

operator's guide

FMS-6100 **Flight Management System** **for the Gulfstream G150**

Rockwell
Collins

operator's guide

FMS-6100 Flight Management System for the Gulfstream G150

Notice

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INTRODUCTION

The FMS-6100 Flight Management System includes the Flight Management Computer (FMC), Control Display Unit (CDU), and Global Positioning System (GPS). The system is used to control the electronic flight displays, FMS, radio tuning, and other aircraft functions. This operator's guide provides operating information for this system. It is not a training manual. It is a guide to understand the operation of the FMS-6100 Flight Management System designed by Rockwell Collins, Inc.

Basic operating procedures for the FMS-6100 are described and arranged approximately in the order of their use in the various phases of flight, from preflight through missed approach. Additional functions of the FMS-6100 such as radio tuning, database loading, and other operating information are also described.

Not all display elements and/or annunciations shown in the figures and described in this operator's guide show on every system installation. Other equipment installed in the aircraft, the FMS options installed, the interconnect wiring on the aircraft, and the phase of flight determines some of the information shown. Also, some display elements and/or annunciations will not show on the displays at the same time as other elements and/or annunciations. In some instances, the data shown on a specific CDU page can, depending on variations in installations, show on a previous or following display page. The colors of the some of display elements can also vary. Refer to the appropriate aircraft flight manuals for information related to the installed options and variations.

In some cases, there is more than one way to accomplish a task related to flight planning, changing a flight plan, or other FMS functions. In general, this guide describes only one method for accomplishing any specific task.

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SAFETY SUMMARY

CAUTION



Some aircraft operators can have special procedures that are different from those given in this operator's guide. Refer to the applicable aircraft flight manual for instructions specified for your aircraft.

CAUTION



Be careful if you wear sunglasses with lenses that cause you not to see some colors. These types of lenses can have an unwanted effect on how some colors show on the EFIS displays. You cannot see some items on the display when you wear these types of sunglasses. Also, the color of some items can change. For example, some blue lenses can cause a magenta display item to show as red. If the displays are read incorrectly, possible damage to the equipment could occur.

CAUTION



Monitor all instruments to identify if an FMS malfunction occurs. The FMS-6100 and related components operate as a system and usually give the pilot an indication when a malfunction occurs. But the pilot must also know that it is not possible to monitor the system for all possible malfunctions. Also, incorrect operation could occur without an indication of a malfunction.

NOTICES



NOTE

The FMS-6100 can hold a large database of navigation aids, waypoints, and airport data to help the pilot with navigation. But the pilot must have and use the applicable charts, terminal procedures, and facility directories necessary for the flight. Applicable federal regulations give instructions about the requirement to have the applicable documents available.



NOTE

Defects that you can see on the display surface of the AFD-5220 are permitted. But these defects must not cause a distraction or make the pilot read the display incorrectly. Also, defects you cannot see in an operational format from a minimum view distance are permitted.

Defective ON or defective OFF rows or columns can make servicing of the AFD-5220 necessary. Groups (three or more adjacent elements) of defective ON elements are not permitted. Defective OFF elements are permitted if they do not make the pilot read the display incorrectly or cause distraction.

The number of defective ON elements that are permitted include no more than: 6 red, 6 green, 10 blue, or 5 sets of two adjacent defects. The number of defective OFF elements that are permitted include no more than: 5 sets of two adjacent defects, 1 set of three adjacent defects, or 30 defective OFF elements.

LIST OF ACRONYMS AND ABBREVIATIONS

ACT	Active
ADC	Air Data Computer
ADV	Advance
AFMS	Aircraft Flight Manual Supplement
AGL	Above Ground Level
AHS	Attitude Heading System
AIR DIST	Air Distance
ALT	Altitude
ALTN	Alternate
APPR	Approach
APTS	Airports
ARP	Airport Reference Point
ARR	Arrival
ATA	Actual Time of Arrival
ATC	Air Traffic Control
AV PASS WT	Average Passenger Weight
AVAIL	Available
AVG TAS/GS	Average True Airspeed/Groundspeed
BOC	Bottom of Climb
BOW	Basic Operating Weight
BRG	Bearing
C/F	Celsius or Fahrenheit
CAP	Capture
CCP	Cursor Control Panel
CDU	Control Display Unit
CHK	Check
CLB	Climb
CLR DEL	Clear/Delete
CMD	Commanded
COM	Communication
COND	Condition
CPL	Couple
CPN	Collins Part Number
CRS	Course
CRZ	Cruise
CRZ ALT	Cruise Altitude
CTR	Center
CTRL	Control
DB	Data Base
DBU	Data Base Unit

DCP	Display Control Panel
DEMO	Demonstrated
DEP	Departure
DES	Descent
DEST	Destination
DEV	Deviation
DG	Directional Gyro
DH	Decision Height
DIR	Direction
DISC	Discontinuity
DISP	Display
DIST	Distance
DME	Distance Measuring Equipment
DMU	Data Management Unit
DP	Departure Procedure
DR	Dead Reckoning
DTK	Desired Track
EFC	Expect Further Clearance
EFD	Electronic Flight Display
EFIS	Electronic Flight Instrument System
ELEV	Elevation
ET	Elapsed Time
ETA	Estimated Time of Arrival
ETE	Estimated Time Enroute
EXEC	Execute
F/M	Feet or Meters
FAC	Final Approach Course
FACF	Final Approach Course Fix
FD	Flight Director
FGC	Flight Guidance Computer
FGP	Flight Guidance Panel
FGS	Flight Guidance System
FIX ETA	ETA at the Fix
FL	Flight Level
FLT	Flight
FMC	Flight Management Computer
FMS	Flight Management System
FPLN	Flight Plan
GA	Go Around
GND SPD	Groundspeed
GPS	Global Positioning System

GS	(1) Glideslope (2) Groundspeed
GWT	Gross Weight
HDG	Heading
HF	High Frequency
HFDR	HF Data Radio
HI NAVAIDS	High Altitude Navaids
HSI	Horizontal Situation Indicator
I/H	Inches or Hectopascals
IAPS	Integrated Avionics Processor System
IAS	Indicated Airspeed
ID	Identifier
IDENT	Identifier
IDX	Index
ILS	Instrument Landing System
in.hg.	Inches of mercury
INBD CRS	Inbound Course
INDEP	Independent
INHB	Inhibit
INIT	Initialize
INTC	Intercept
INTERS	Intersections
IRS	Inertial Reference System
ISA	International Standard Atmosphere
ISA DEV	Deviation from ISA
KIAS	Knots, Indicated Airspeed
KT	Knots
LAT	Latitude
LDG	Landing
LMT	Limit
LO NAVAIDS	Low Altitude Navaids
LOC	Localizer
LON	Longitude
LRU	Line Replaceable Unit
LSK	Line Select Key
MAG VAR	Magnetic Variation
MAN	Manual
MAP	Missed Approach Point
mb	Millibars
MCDU	Multifunction Control Display Unit
MDA	Minimum Descent Altitude

MFD	Multifunction Display
MGMT	Management
MLW	Maximum Landing Weight
MOD	Modify
MSG	Message
MTOW	Maximum Takeoff Weight
NAV	Navigation
NAVAID	Navigational Aid
NM	Nautical Mile
OAT	Outside Air Temperature
OFFSET	Offset Track Distance
OFST	Offset
OP	Operation
OPS	Options
ORIG	Origin
ORIG RWY	Departure Runway
P ALT	Pressure Altitude
PASS/WT	Passenger Weight
PERF	Performance
PFD	Primary Flight Display
POS	Position
POS DIFF	Position Differences
POS INIT	Position Initialization
PPOS	Present Position
PRESS ALT	Pressure Altitude
PREV	Previous
RA	(1) Radio Altimeter (2) Resolution Advisory
RAIM	Receiver Autonomous Integrity Monitoring
REF	Reference
REF CRS	Reference Course
REQ	Request
RESV	Reserve
RNG TO RESV	Range to Reserves
RNP	Required Navigation Performance
RSS	Radio Sensor System
RTES	Routes
RTU	Radio Tuning Unit
RWY	Runway
SAT	(1) Static Air Temperature (2) Satellite

SDU	Satellite Data Radio
SEC FPLN	Secondary Flight Plan
SEL	Select
SEQ	Sequence
SID	Standard Instrument Departure
SP RNG	Specific Range for the Current Fuel Burn
SPD/ALT LIMIT	Speed/Altitude Limit
STAR	Standard Terminal Arrival Route
STBY	Standby
SYNC	Synchronize
TAE	Track Angle Error
TAS	True Airspeed
TAT	(1) Total Air Temperature (2) True Air Temperature
TCAS	Traffic Collision Avoidance System
TERM	Terminal
TERM WPTS	Terminal Waypoints
TERR	Terrain
TFC	Traffic
TGT	Target
TGT SPEED	Target Speed
TIME TO RESV	Time to Reserves
T/O	Takeoff
TOC	Top of Climb
TOD	Top of Descent
TRANS	Transition
TRANS ALT	Transition Altitude
TRANS FL	Transition Flight Level
TRK	Track
TTG	Time To Go
TXT	Text
U/D	Up/Down
UTC	Coordinated Universal Time
VDR	VHF Data Radio
VHF	Very High Frequency
VIR	VOR/ILS Receiver
VOR	VHF Omnidirectional Range
VPA	Vertical Path Angle
VS	Vertical Speed
VSR	Vertical Speed Required
VTA	Vertical Track Alert

WPT(S)	Waypoint(s)
WT	Weight
WX	Weather
XMIT	Transmit
XSIDE	Cross Side
XTALK	Cross Talk
XTD	Cross Track Deviation
XTK	Cross Track
YD	Yaw Damper
ZFW	Zero Fuel Weight

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OVERVIEW

INTRODUCTION

The FMS-6100 supplies the capability of en route, terminal, and non-precision approach navigation. The system contains an advanced Global Positioning System (GPS) receiver and processes the transmissions from multiple GPS satellites simultaneously to calculate navigation solutions based on information from all satellites in view. A minimum of four satellites with acceptable geometry, or three satellites plus calibrated barometric altitude, are required to calculate a navigation solution. With additional satellites, the system can improve the fault tolerance and accuracy of the navigation solution and supply Receiver Autonomous Integrity Monitoring (RAIM) to detect satellite failures. The system also supplies predictive RAIM, which is used to determine whether the satellite geometry at the destination airport will be sufficient to support approach at the planned time of arrival. The computed GPS position, velocity and time are input to the Flight Management function, which integrates this data into the flight plan based navigation solution. The FMS also receives data from the AHS, ADC, DME and VOR. The FMS supplies necessary controls for all input sensors, when appropriate.

The FMS can be initialized, waypoints chosen, and destination selected by a variety of pilot friendly means. SIDs, STARs, and airways are accommodated. A great circle route is calculated between waypoints for en route lateral navigation, and roll steering is supplied to the Flight Guidance System (FGS). A sophisticated interface with the FGS allows the FMS VNAV function to select various FGS vertical modes of navigation. The FMS also supplies vertical steering when appropriate. Additionally, the FMS interfaces with the electronic flight displays to supply conventional navigation information and state-of-the-art map presentation.

A typical FMS-6100 system as installed on the Gulfstream G150 consists of the following components:

- Two CDU-6200 Control Display Units
- Two FMC-6000 Flight Management Computers
- Two GPS-4000A Global Positioning System Sensors

- Either of the following data loaders:
 - One DBU-4100 Data Base Unit
 - One PCD-3000 PC Database Unit or CPAS-3000 Data Loader.

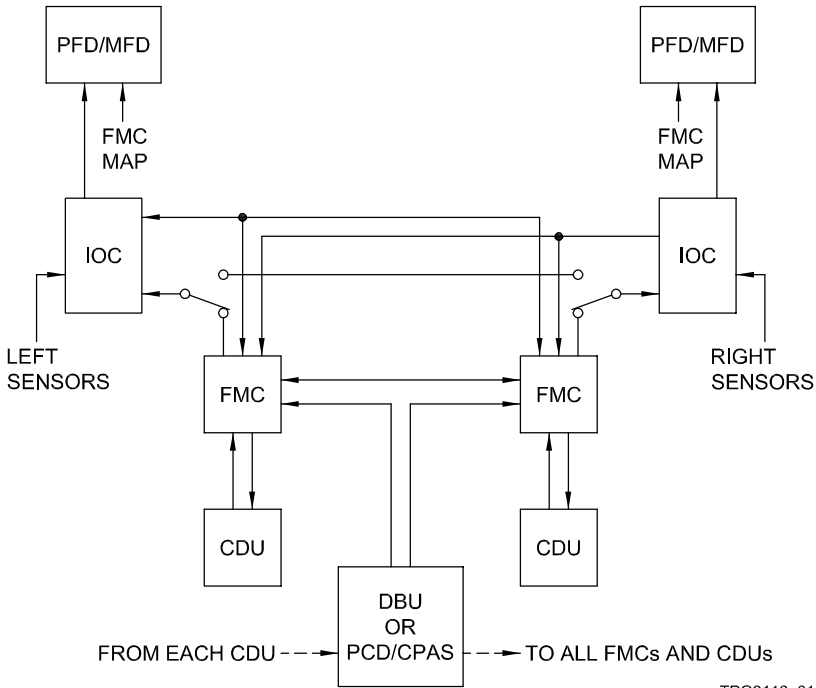
SYSTEM DESCRIPTION

The Flight Management System (FMS) is usually installed as a dual system. Either a Data Base Unit (DBU) or a PC-based data loader (a PCD-3000 or CPAS-3000) is used to load navigation and performance data bases, as well as store and load pilot-defined routes and pilot-defined waypoints from a disk. Each FMC is a single Line Replaceable Unit (LRU) that receives data from both the left and right avionics systems. An FMC requires a single Control Display Unit (CDU) for operator control.

KEY OPERATING FEATURES

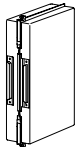
- The CDU is the primary interface with the pilot:
 - Function keys supply quick access to frequently used CDU pages.
 - Full alphanumeric keypad allows pilot input.
 - Line select keys supply additional control of FMS functions.
- Full color electronic flight displays supply additional FMS information and both map and text page capability.
- The DBU, PCD, or CPAS supplies disk reading and database loading capability.

Figure 2-1 FMS System Schematic Diagram



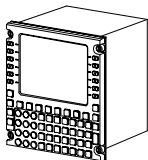
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COMPONENTS



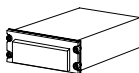
Flight Management Computer

The FMC accepts data from multiple navigation sensors and computes a position estimate. The data from each sensor is weighted according to its error characteristics so that the position estimate is the best possible. The FMC will supply navigation in the en route, terminal, and approach phases of flight. The FMC will determine that it is in the terminal phase of flight when an origin or arrival airport has been entered in the flight plan and the location of the aircraft is within 30 NM of the origin or arrival airport. The FMC will determine that it is in the approach phase of flight upon passage of 2 NM inbound to FAF and non-precision approach when the approach has been activated.



Control Display Unit

The CDU communicates with the FMC and other subsystems using the ARINC 739 protocol. This supplies the capability for the CDU to act as a Multifunction Control Display Unit (MCDU) and communicate with other compatible subsystems, such as the Collins AFIS™ Adaptor. The available subsystems are selectable from the INDEX (or MCDU MENU) page at all times.



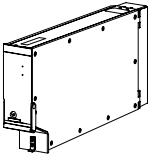
Data Base Unit

The DBU-4100 supplies data loading capability for the FMS-6100 and other aircraft systems. Based on the installation, it can be mounted in the aircraft in an avionics bay, in the cockpit, or it can be a remote portable unit that plugs into a connector located in an avionics bay or the cockpit. The DBU accepts both 750 kb and 1.44 mb 3.5-inch diskettes.



PC Database Unit/CPAS

Either the PCD-3000 or the CPAS-3000 supplies external data loading capability of FMS and MDC databases for the FMS-6100 and other aircraft systems. The PCD-3000/CPAS-3000 Data Loader is a software application that supplies external media upload and download capabilities. If a Collins File Server Unit is installed, the CPAS-3000 is the data loader. The FSU supplies the capability to allow uploads and downloads of databases to and from the FMC and other systems. A separate, customer-supplied PC or laptop computer is required to run the PCD-3000/CPAS-3000. Refer to the Collins PCD-3000 Data Loader User's Guide (CPN 523-0780041) for information on how to install and operate the PCD-3000 Data Loader. Refer to the Collins CPAS-3000 Data Loader Operator's Guide (CPN 523-0790386) for information on how to install and operate the CPAS-3000 Data Loader.



Global Positioning System Sensor

The GPS-4000A Global Positioning System processes the GPS signals received from the antenna to supply various navigation data (three dimensional position, three dimensional velocity and time) to the onside IAPS data concentrators. The active GPS antenna acquires, actively filters, and amplifies the GPS signals from up to 12 satellites and sends them to the GPS receiver. The GPS satellite signals supply all data needed to calculate the position, velocity and time.

KEY PERFORMANCE FEATURES

- System performance predictions are available for the active flight plan, the modified flight plan, and the second flight plan (second flight plan performance predictions are only supplied for system configurations that support a performance data base).
- Navigation is based on using all the available navigation sensors on the aircraft to fly from waypoint to waypoint along a flight plan route. With the navigation and other sensor data available to it, the FMS determines its present position relative to the flight plan route and computes steering commands for use by the flight guidance system to fly the aircraft along the route.
- Selectable independent and synchronized modes of operation are supplied (optional dual system). In the synchronized mode, certain initialization operations and selections performed on one FMC are communicated to the other FMC. This includes selection of active database, deselection of nav aids, enabling/disabling of VOR/DME from the navigation solution, and performance mode selection and fuel flow and ground speed values entered on the FUEL MGMT page.

KEY TROUBLESHOOTING FEATURES

Messages on the CDU and electronic flight displays supply indications of malfunctions, incorrect operations, or data entry or pilot operation errors.

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PREFLIGHT

INTRODUCTION

Typical FMS preflight procedures include:

- Using the STATUS page to verify/select the navigation and performance databases installed in the FMS.
- Checking and setting the current date and time on the STATUS page.
- Checking and setting the initial position on the POS INIT page.
- Enabling/disabling VOR USAGE and DME USAGE on the VOR/DME CONTROL page, or individually inhibit the use of any VOR/DME navaids that NOTAMs indicate are out of service.
- Enabling GPS sensor(s) on the GPS CONTROL page.
- Checking and setting the synchronized (SYNC) or independent (INDEP) operating mode on the FMS CONTROL page for systems with optional dual FMS installation.
- Setting display mode options for the MAP display on the MFD MAP DISPLAY MENU page.

Optional equipment and functions installed in an aircraft and operational variations can delete or add additional preflight functions for the FMS. Refer to the appropriate aircraft flight manuals for specific FMS preflight procedures for the aircraft.

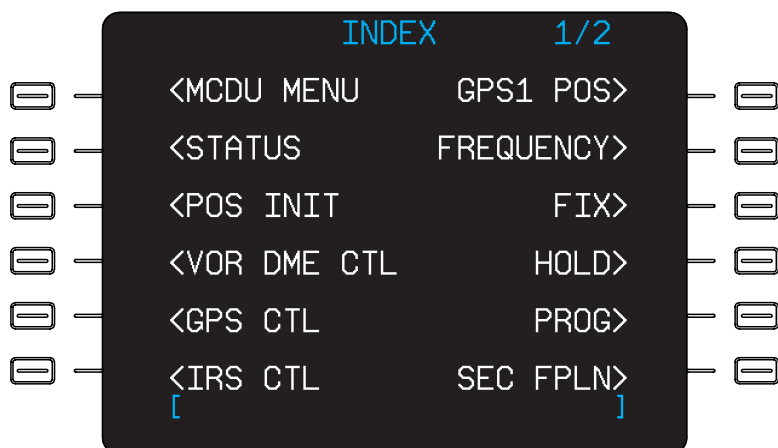
INDEX PAGE OPERATIONS

RATIONALE:

The INDEX pages give access to FMS functions that do not have direct access through the CDU function keys.

SUMMARY:

The INDEX pages are used to select available functions that are not directly selectable with the function keys. Some of the options available on the INDEX pages include access to the system DEFAULTS pages, VOR and GPS CONTROL pages, the HOLD function, the SEC FPLN function, the ROUTE MENU, and others.



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▼ CHECKLIST:

- 1 Push the IDX function key to show the INDEX 1/2 page.
- 2 Push the PREV or NEXT function key to show the INDEX 2/2 page as necessary.
- 3 Push the line select key for the appropriate function to show the desired page.

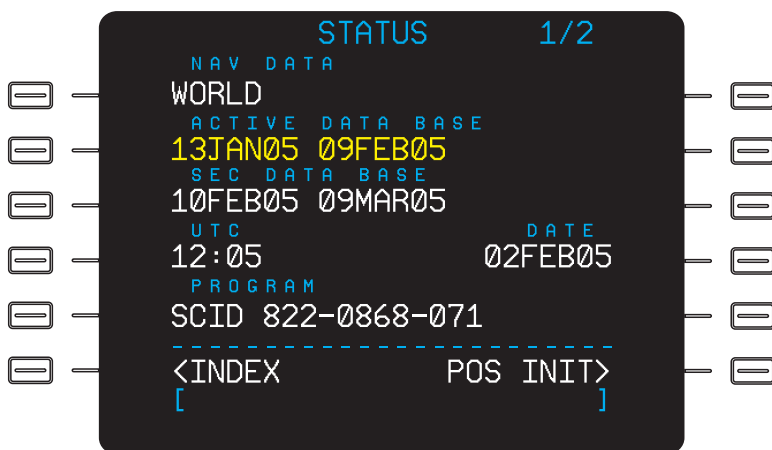
STATUS PAGE OPERATIONS

RATIONALE:

The STATUS page check allows the operator to determine if a current database is installed in the FMC and to set the date and time if necessary.

SUMMARY:

The STATUS page is used to verify/select the navigation and performance databases installed in the FMS, and to check or set the current date and time.



TPH8455_01

PRECONDITIONS:

The STATUS page can show on the CDU display at initial power-up, or when selected from the INDEX 1/2 page.



NOTE

The FMS STATUS page can show on the CDU display at initial power-up. In SATCOM-equipped aircraft, the SATCOM menu page can show on the CDU display at initial power-up. To access the FMS STATUS page in these cases, push the IDX function key to show the INDEX 1/2 page, then push the STATUS line select key to show the STATUS page.

▼ **CHECKLIST:**

1	Push the IDX function key on the CDU to show the INDEX 1/2 page.
2	Push the STATUS line select key to show the STATUS page.



DATABASE CHECK/CHANGE

RULES:

The aircraft must be on the ground to change the navigation database.

▼ CHECKLIST:

1	Push the SEC DATA BASE line select key to enter the effective dates for the secondary database dates into the scratchpad.
2	Push the ACTIVE DATA BASE line select key to move the secondary database date from the scratchpad to the active database line. The previous effective date of the active database automatically moves to the secondary database line.



NOTE

Changing the navigation database clears the ACT and SEC FPLNs.

SET TIME

SUMMARY:

When there is a valid system clock, the current time as received from the clock shows on the Coordinated Universal Time (UTC) data line. Normally, the left system clock is the time source. If the left system clock is inoperative or the data is invalid, the right clock is used. If neither system clock is available or valid, dashes show on the UTC data line to indicate time can be entered.

RULES:

In installations with GPS sensors enabled for use by the FMS, the FMS time and date are automatically updated with GPS time and date; manual updates are not allowed. Also, some FMS installations automatically get time and date from the aircraft clock; manual updates are not allowed. Refer to the appropriate aircraft flight manuals to set the aircraft clock.

▼ **CHECKLIST:**

1	Enter the desired time into the scratchpad.
2	Push the UTC line select key to transfer the scratchpad time entry to the UTC data line.



SET DATE

SUMMARY:

When there is a valid system clock, the current date as received from the clock shows on the UTC data line. Normally, the left system clock is the date source. If the left system clock is inoperative or the data is invalid, the right clock is used. If neither system clock is available or valid, dashes show on the DATE data line to indicate a date can be entered.

RULES:

In installations with GPS sensors enabled for use by the FMS, the FMS time and date are automatically updated with GPS time and date; manual updates are not allowed. Also, some FMS installations automatically get time and date from the aircraft clock; manual updates are not allowed. Refer to the appropriate aircraft flight manuals to set the aircraft clock.

▼ **CHECKLIST:**

1	Enter the desired date into the scratchpad.
2	Push the DATE line select key to transfer the scratchpad date entry to the DATE data line.



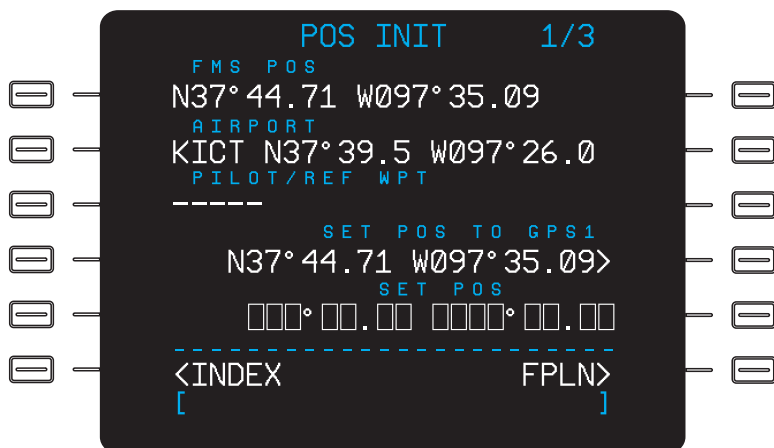
POSITION INITIALIZATION

RATIONALE:

The FMS requires a Position Initialization (POS INIT) to be fully operational.

SUMMARY:

The FMS position is initialized on the POS INIT 1/3 page. When the aircraft is on the ground, the AIRPORT or PILOT/REF WPT data line is normally filled with the destination airport from the last flight (if one was defined for that flight). The AIRPORT, PILOT/REF WPT, GNSS, IRS, or FMS latitude and longitude position data can be used to initialize position. Use the most accurate position data available when initializing the position.



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▼ CHECKLIST:

1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the POS INIT line select key to show the POS INIT 1/3 page.



NOTE

If IRS is not installed on the aircraft, the page label will be POS INIT 1/2.

- 3 Push the line select key adjacent to the desired position (for example, AIRPORT) to copy the latitude and longitude, shown to the right of the position identifier, into the scratchpad.

- 4 Push the SET POS line select key to move the latitude and longitude from the scratchpad to the SET POS display line.



NOTE

The message RESET INITIAL POS shows on the message line if the initialized position is greater than 40 NM from the last known FMS position. This situation can occur if a maintenance action replaced the FMS since the last flight. If the position is correct, the message is cleared when the SET POS line select key is pushed two more times to enter the position. If the position is not correct, the correct position must be entered into the SET POS field.



NOTE

The message RE-ENTER SET POS shows on the message line if the IRS requires confirmation of the new position. This can occur if the pilot entered a position that differs significantly from the IRS position at the time the IRS was turned off. If the position is correct, the message can be cleared by pushing the SET POS line select key two more times to enter the position. If the position is not correct, the correct position must be entered into the SET POS field. IRS is an option and will not be available in every installation.

5



NOTE

In aircraft with an IRS installed that is capable and configured for remote initialization, initializing the FMS position also initializes the IRS position. Refer to the appropriate flight manuals for specific information related to initializing the IRS on your aircraft.

Push the SET POS TO GPS1 to initialize the FMS position to the available GPS with a single key stroke.

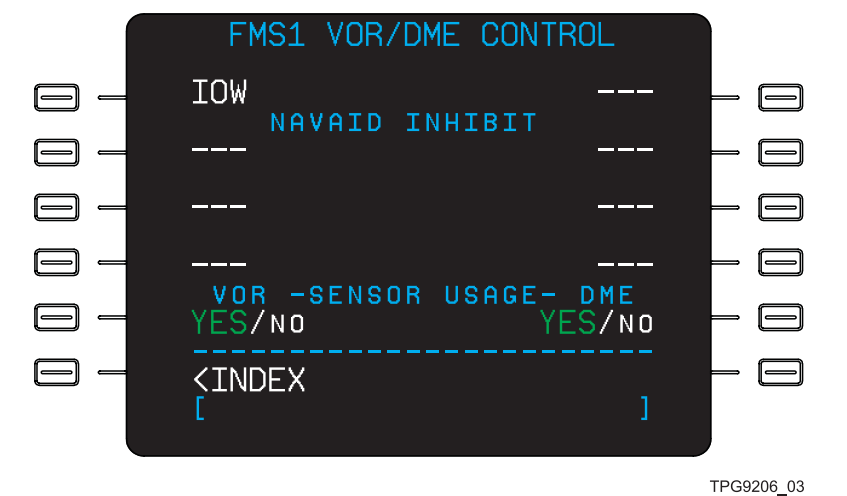
VOR/DME NAVAID INHIBIT

RATIONALE:

When a specified VOR is known to be invalid, it can be inhibited to keep it out of the FMS position solution. Additionally, all VOR/DME sensor data can disabled for use by the FMS when it determines the position.

SUMMARY:

The FMS VOR/DME CONTROL page is used to inhibit up to eight individual VORs. This page is also used to separately enable or disable VOR and/or DME SENSOR USAGE by the FMS when it calculates the position solution.



▼ CHECKLIST:

1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the VOR DME CTL line select key to show the VOR/DME CONTROL page.
3	Enter the VOR identifier into the scratchpad.

- 4 Push a line select key for the right or left side of the NAVAID INHIBIT display line. This moves the VOR identifier from the scratchpad to the right or left NAVAID INHIBIT prompt.



NOTE

A disabled navaid is re-enabled only when it is deleted from the NAVAID INHIBIT data line, or when the active navigation database is changed on the STATUS page. A navaid is removed from the NAVAID INHIBIT data lines in one of two ways: 1) The identifier for a different navaid that is to be inhibited must be entered. 2) The CLR DEL function key is used to enter DELETE into the scratchpad, then the DELETE entry is moved to the applicable NAVAID INHIBIT data line.

- 5 To enable or disable VOR SENSOR USAGE by the FMS, push the YES/NO line select key to select or deselect VOR SENSOR USAGE. The selected mode shows in green.

- 6 To enable or disable DME SENSOR USAGE by the FMS, push the YES/NO line select key to select or deselect DME SENSOR USAGE. The selected mode shows in green.

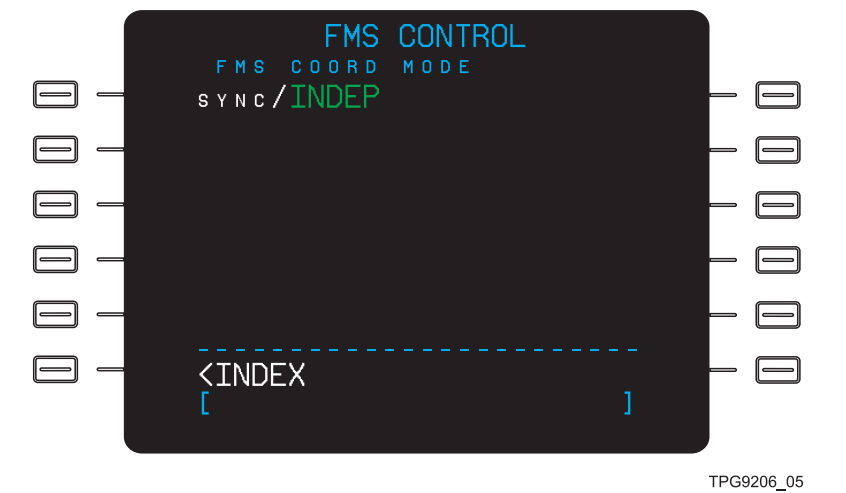
FMS CONTROL MODE SELECTION

RATIONALE:

The FMS CONTROL MODE allows the two FMCs to operate in a synchronized (SYNC) or independent (INDEP) mode, based on the needs of the operator.

SUMMARY:

In the synchronized mode, flight plan changes and most FMS operations are automatically synchronized between both FMSs. Changes made to an active flight plan on one FMS are synchronized with the other FMS when the EXEC function key on the CDU is pushed to execute the flight plan. Changes made to the second flight plan on one FMS are synchronized immediately with the other FMS. In the independent mode, none of the mode selections or flight planning data from one FMS are shared with the other FMS.



▼ CHECKLIST:

1	Push the IDX function key on the CDU to show the INDEX 1/2 page.
2	Push the FMS CTL line select key to show the FMS CONTROL page.

3 Push the SYNC/INDEP line select key to change the mode.

4 When switching from INDEP to SYNC, the prompt SELECT SYNC MASTER shows on the page. Push the FMS1 or FMS2 line select key to select the FMS that is to be the synchronization master.



NOTE

When selecting SYNC mode, specify which FMS is the MASTER. The flight plans in the FMS selected as the MASTER are transferred to the other FMS, thereby replacing any previously existing flight plans in that FMS. This can influence the decision on which FMS to select as the MASTER. Once SYNC mode is selected, flight plan changes made on either FMS are automatically made to the other FMS regardless of which one was initially selected as the MASTER.

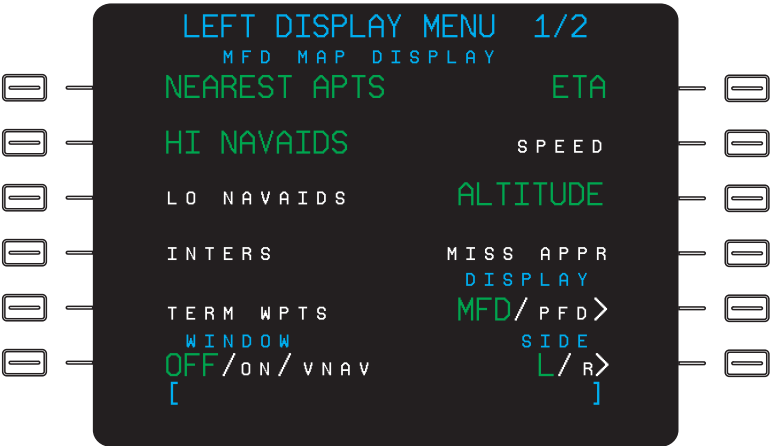
MFD DATA WINDOW SELECTION

RATIONALE:

A four-line data window on the MFD can be selected for display. The display provides navigation information only, or a combination of navigation and VNAV information.

SUMMARY:

The MFD Data Window shows at the top of the MFD when the MFD is set to the PPOS MAP or PLAN MAP display modes. The MFD Data Window is a four-line text display of navigation progress data. When the WINDOW is selected ON, the data window shows navigation information only. When the WINDOW is selected VNAV, VNAV information is added to the display. The MFD Data Window is controlled from the MAP DISPLAY page.



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▼ CHECKLIST:

1	Push the MFD MENU function key on the CDU to show the DISPLAY MENU page.
2	Push the MFD DATA function key if necessary to change the TEXT DISPLAY page to the MAP DISPLAY page.

3

Push the WINDOW line select key to turn the navigation data display window OFF or ON or to select VNAV data to show in the MFD display window.



NOTE

Each push of the WINDOW line select key selects the next mode in the sequence (OFF, ON, VNAV).

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FLIGHT PLANNING

INTRODUCTION

The procedures in this chapter apply to creating an active flight plan (ACT/MOD FPLN) and a second flight plan (SEC FPLN). The FMS uses the ACT FPLN to generate steering commands for use by the aircraft flight guidance system. A SEC FPLN can be saved and recalled from FMS memory, but cannot be used to generate steering commands. Creating a flight plan on the SEC FPLN pages is identical to creating an ACT FPLN, except for the selection of SEC FPLN page.

TIP



When creating a flight plan from scratch, push the EXEC function to save MOD FPLN in its current state at any time. Save, as each task is entered in a flight plan allows for correcting errors without rewriting the flight plan. The CANCEL MOD line select key will delete all changes made since the EXEC function key was last pushed. Remember to verify the flight plan before executing it with the EXEC function key.

TIP



All flight plans should be verified before they are executed. Make sure a flight plan is correct by reviewing it on the MOD LEGS pages on the CDU and on the MFD in the PLAN MAP display mode. The PLAN MAP shows a North-up pictorial presentation of the flight plan route that can be scrolled from waypoint to waypoint along the route to review the flight plan.

NOTE



The plain English routing name will be shown for the identifier.

CREATE A FLIGHT PLAN

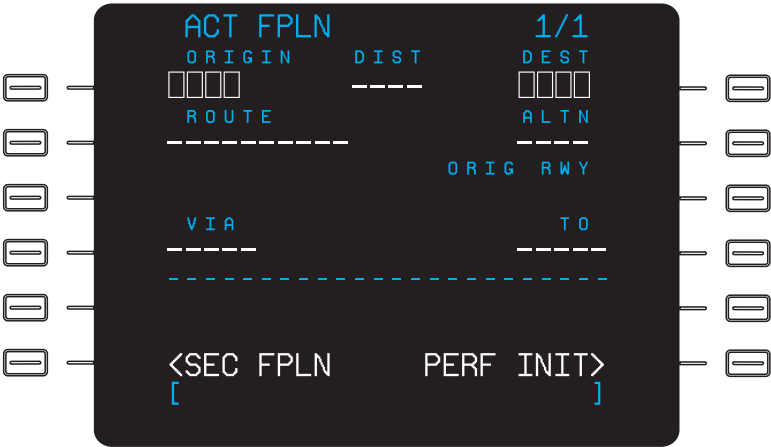
RATIONALE:

The flight plan function allows the pilot to create a flight plan that is customized for each particular route of flight. Changes or additions to the flight plan can be made at any point, either during the creation process or as required inflight.

SUMMARY:

The basic steps to creating a flight plan from scratch include:

- 1. Entering the origin, destination and alternate airports.
- 2. Selecting a departure runway or a SID with a departure runway.
- 3. Entering a route from the departure to the arrival.
- 4. Selecting a STAR with or without a transition and an approach.



TPG9206_07

RULES:

The following guidelines apply to creating a flight plan.

- Navigation facilities and procedures that can be entered and selected for a flight plan include, but are not limited to:
 - Airports
 - Airways
 - STARs
 - Nav aids (VOR/DME, NDB, TACAN, etc.)
 - Intersections
 - Holds
 - SIDs
 - Approaches.
- At least one waypoint must be entered into a flight plan, whether or not an ORIGIN or DEST airport is entered, for the FMS to show a route on the MFD maps.
- When entering airport identifiers, use the ICAO standard identifiers that include the country code for the airport.

▼ CHECKLIST:

1	Push the FPLN function key to show the ACT FPLN page.
2	Enter the ORIGIN airport.
2.1	Enter the origin airport identifier in the scratchpad.
2.2	Push the ORIGIN line select key to move the scratchpad entry to the ORIGIN prompt.
3	Enter the DEST airport.
3.1	Enter the destination airport identifier in the scratchpad.

3.2 Push the DEST line select key to move the scratchpad entry to the DEST prompt.

4 Enter the ALTN (alternate) airport.



NOTE

An alternate (ALTN) airport is an optional entry.

4.1 Enter alternate airport identifier into the scratchpad.

4.2 Push the ALTN line select key.

5 Enter the ROUTE name (optional).



NOTE

When the name of a route that is stored in the PILOT ROUTE LIST or DISK LIST is entered, the FMS automatically loads that route directly into the MOD FPLN. When creating a new route to store in the PILOT ROUTE LIST, enter a unique name for that route.

5.1 Enter name of route into the scratchpad.

5.2 Push the ROUTE line select key to move the route name from the scratchpad to the ROUTE prompt.

6 Select the ORIG RWY for departure.



TECH DETAIL

When the Origin Runway is selected, the flight plan begins at the runway threshold versus the airport reference point (only if the ORIGIN airport is entered). However, without an ORIG RWY, the FMS cannot perform a RUNWAY UPDATE at the runway threshold.

6.1

Push the DEP ARR function key to show the DEPART page for the ORIGIN airport.



NOTE

When the DEP ARR function key is pushed, one of three pages shows: the DEPART, ARRIVAL, or DEP/ARR INDEX page. If the aircraft is on the ground, or airborne but less than either 50 NM from the origin airport or halfway to the destination airport, the DEPART page for the origin airport shows.

If the aircraft is airborne and more than halfway to the destination airport, or more than 50 NM from the origin airport, the ARRIVAL page for the destination airport shows. If no active flight plan exists, or no origin or destination airport is specified, the DEP/ARR INDEX page shows.

To view a page other than the one currently showing, push the line select key for the DEP/ARR INDEX page, or push the DEP ARR function key a second time to show the DEP/ARR INDEX page, then select the desired page for the appropriate airport.

6.2

Push the line select key next to the desired runway in the RWYS column.



NOTE

For some airports, the runway list fills more than one page. Push the NEXT or PREV function key as necessary to show the desired runway, then push the line select key for that runway.

6.3

Push the FPLN line select key or the FPLN function key to return to the MOD FPLN page.

7

Select a SID (if necessary) for the ORIGIN airport.



TECH DETAIL

Only the approved combinations of transition routes and runways are shown for each SID. Therefore, if the first selection is the departure runway, only transition routes and SID for that runway show in the SIDS and TRANS columns on the DEPART page. Likewise, if the first selection is the SID, only transition routes and runways for that departure show under the TRANS and RWYS columns.

7.1

Push the DEP ARR function key to show the DEPART page for the ORIGIN airport.



NOTE

One of three pages shows when the DEP ARR function key is pushed: the DEPART, ARRIVAL, or DEP/ARR INDEX page. If a page other than the DEPART page is showing, push the line select key for the DEP/ARR INDEX page, or push the DEP ARR function key a second time to show the DEP/ARR INDEX page, then select the DEPART page for the appropriate airport.

7.2

Push the line select key next to the desired SID in the SIDS column.

7.3

Push the line select key next to the desired transition route (TRANS).

7.4

Push the line select key next to the desired departure runway (RWYS).

7.5

Push the FLPN line select key or the FLPN function key to return to the MOD FLPN page.

8

Enter the flight plan legs.



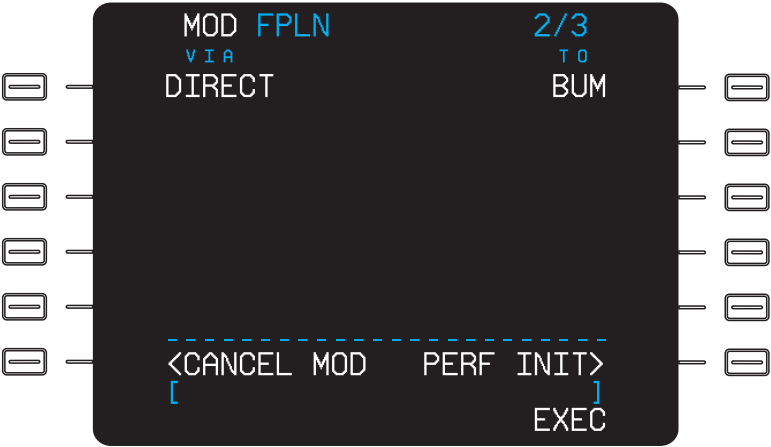
NOTE

Flight plan legs can include direct legs and airway legs in any combination or order.

DIRECT LEGS

SUMMARY:

Direct legs of a flight plan are defined by entering each waypoint in the TO column on the right side of the appropriate flight plan page. When a waypoint is entered, DIRECT shows in the VIA column on the left side of the page.



TPG9206_08

PRECONDITIONS:

This procedure starts from the ACT/MOD FPLN page.

▼ CHECKLIST:

1	Enter the desired waypoint into the scratchpad.  NOTE It is possible that the current ACT/MOD FPLN page will not have a prompt showing in the TO column. Push the NEXT or PREV function key as necessary to show the desired page.
2	Push the TO column line select key to move the waypoint from the scratchpad to the TO prompt.



NOTE

Occasionally a waypoint identifier (such as BLH) can be used more than once in the navigation database. In such instances, the SELECT WPT page shows when the TO line select key is pushed in the previous step. On the SELECT WPT page, identically named waypoints are arranged from closest to the waypoint before the insertion point to the farthest from the insertion point. If there is no preceding waypoint in the flight plan, then they are arranged from the waypoint closest to the current FMS position to the waypoint farthest from that position. Select the waypoint by pushing the line select key adjacent to the desired waypoint.



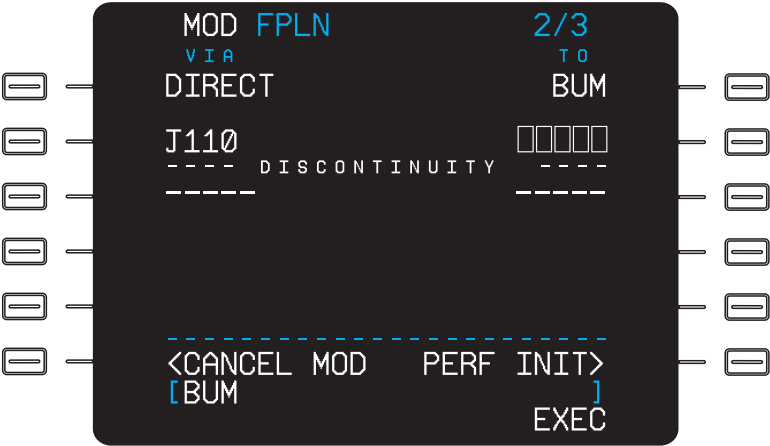
NOTE

If a wrong waypoint is entered, or requires a change or deletion after executing the FPLN with the EXEC function key, refer to the CHANGE/CORRECT A FLIGHT PLAN section in this chapter.

AIRWAY LEGS

SUMMARY:

Enter airway identifiers as shown on the navigation charts (for example, V29 or J65) into the VIA column on the left side of the ACT/MOD FPLN pages. Enter entry and exit waypoints into the TO column on the right side of these pages. When an airway is entered in the flight plan, all intermediate waypoints along the airway are automatically entered as well. These waypoints show on the ACT/MOD LEGS pages on the CDU, and in the FMS MAP and PLAN MAP display modes on the MFD. Any combination of airways and direct legs as required for the flight plan can be entered as long as the entry and exit waypoint requirements are followed.



TPG9206_09

PRECONDITIONS:

This procedure starts from the ACT/MOD FPLN page.

RULES:

The following guidelines apply to entering an airway leg into the flight plan.

- Both the entry waypoint that precedes the airway in the flight plan, and the exit waypoint of the airway itself must be on that airway.
- Trying to enter either an entry or an exit waypoint that is not on the airway causes the FMS to generate the message NOT ON AIRWAY.

- Two airways that cross without a defined crossing intersection cannot be entered.

▼ CHECKLIST:

1	Enter the entry waypoint of the airway into the scratchpad.  NOTE If the entry waypoint is already in the flight plan, Steps 1 and 2 can be ignored.
2	Push the TO column line select key to move the waypoint from the scratchpad to the TO prompt.
3	Enter the airway identifier into the scratchpad.
4	Push the VIA column line select key to move the airway identifier from the scratchpad to the VIA prompt.  NOTE When the VIA line select key is pushed, the FMS generates a DISCONTINUITY in the flight plan. The DISCONTINUITY is cleared when the airway exit waypoint is entered.
5	Enter the airway exit waypoint into the scratchpad.
6	Push the TO column line select key to move the waypoint from the scratchpad to the DISCONTINUITY prompts to clear the discontinuity.
7	Repeat Steps 3 through 6 to continue adding airways to the flight plan.

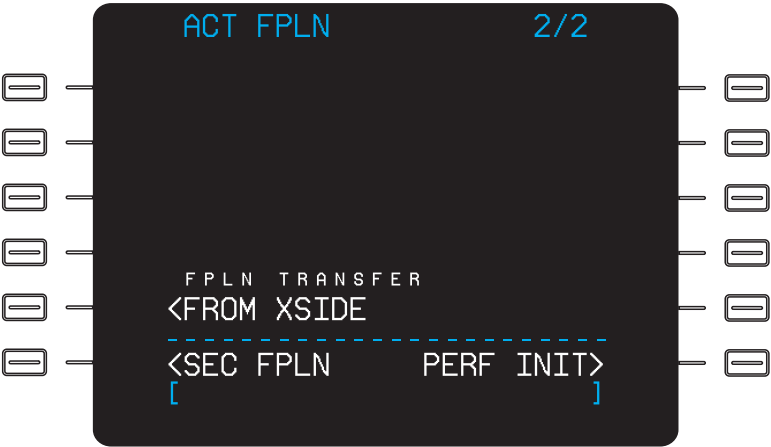
TRANSFER A FLIGHT PLAN

RATIONALE:

The transfer function allows the pilot to copy a flight plan from one FMS to the other.

SUMMARY:

When the FMS-6100 is operating in the INDEP mode, flight plans entered into one FMS are not automatically transferred to the other. The cross-side transfer function allows the pilot to transfer the ACT FPLN and SEC FPLN from the cross-side FMS to the same-side FMS. The procedure for transferring a SEC FPLN is identical to transferring an ACT FPLN.



TPG9206_10

▼ CHECKLIST:

1	On the same-side FMS, push the FPLN function key to show the ACT FPLN page.
2	Push the NEXT or PREV function key as necessary to show the last ACT FPLN page with the FPLN TRANSFER FROM XSIDE prompt.

- 3 Push the FPLN TRANSFER FROM XSIDE line select key to transfer the cross-side ACT FPLN to the same-side FMS. The CDU annunciates FPLN TRANSFER IN PROGRESS. When the transfer is complete, the CDU changes back to the MOD FPLN page.
- 4 Make sure the correct FPLN is entered, and then push EXEC to execute the flight plan.



CAUTION

When dual FMSs are in INDEP mode, using the above procedure allows the pilot to transfer flight plans from one FMS to the other. However, if a MOD FPLN exists on the cross-side FMS, the MOD FPLN will be transferred to the same-side FMS, but the unexecuted edits/changes will not. Therefore, it is possible to have two different flight plans in the two FMSs following a flight plan transfer. As a precaution, any changes to the flight plan should be executed by pushing the EXEC function key before initiating a FPLN transfer.

VERIFY A FLIGHT PLAN

RATIONALE:

A flight plan should be verified before takeoff to make sure the planned route of flight is correct and matches the flight plan that was filed.

SUMMARY:

All flight plans should be verified before they are executed. They can be checked for accuracy by reviewing the flight plan route on the MFD, when it is set to the PLAN MAP display mode, and on the appropriate LEGS pages on the CDU.

▼ CHECKLIST:

1	Make sure the flight plan has been entered into the FMS.
2	Make sure the route of flight is correct by either MFD plan map scrolling or checking the FPLN or LEGS pages on the CDU.



MFD PLAN MAP SCROLLING

SUMMARY:

The MFD plan map can be scrolled from waypoint to waypoint along a flight plan route using the MFD ADVANCE page. Push the MFD ADV function key on the CDU to show the MFD ADVANCE page.



TPG9206_11

▼ CHECKLIST:

1	Set the MFD to the PLAN MAP display mode and select the desired display range.
2	Push the MFD ADV function key to show the MFD ADVANCE page.
3	Use one of the following methods to scroll the flight plan route on the MFD. • Push the PREV WPT or NEXT WPT line select key to move the display center point to the previous or next waypoint along the flight plan route. • Push the TO WPT line select key to place the current TO waypoint in the center of the display.

- Enter a waypoint identifier in the scratchpad, then push the CTR WPT line select key to center the display on that waypoint.



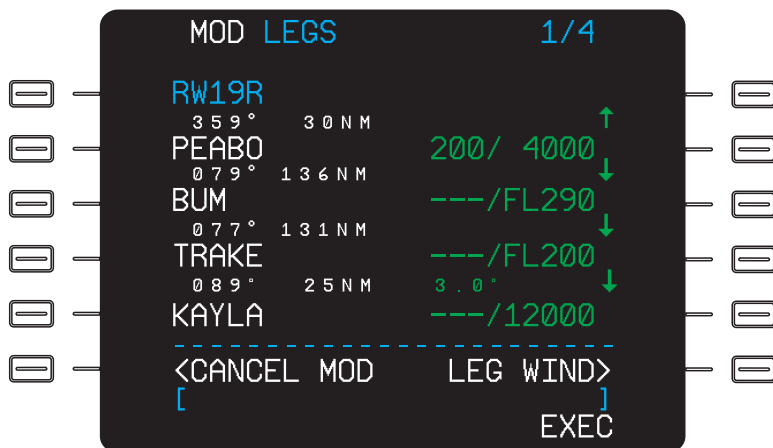
NOTE

Changing the display center point using this method does not change the center point reference for PREV WPT or NEXT WPT. Pushing the PREV WPT or NEXT WPT line select key after performing the above operation moves the display center point to the previous waypoint or next waypoint from the display center point before the above operation was performed.

CDU SCROLLING

SUMMARY:

Use the ACT/MOD FPLN or ACT/MOD LEGS pages to make sure the route is accurate. The FPLN pages show filed flight plan routing (but not each individual waypoint on the route). On the LEGS pages, each waypoint used to define the flight plan route can be viewed, including those conditional waypoints used in SIDs, STARs, and approaches.



TPG9206_12

▼ CHECKLIST:

- 1 Push the FPLN function key to show the ACT/MOD FPLN pages or the LEGS function key to show the ACT/MOD LEGS pages.
- 2 Push the NEXT and PREV function keys as necessary to move from page to page to review the entire flight plan.

CHANGE/CORRECT A FLIGHT PLAN (FPLN PAGES)

RATIONALE:

Changes to the flight plan route or corrections to the flight plan can be made on the ACT/MOD FPLN pages.

SUMMARY:

The procedures in this section apply to changing or correcting the Flight Plan on ACT/MOD FPLN pages. They will also work for the SEC FPLN pages when these pages are selected. Changes to the flight plan will not take effect until the EXEC function key on the CDU is pushed.

▼ CHECKLIST:

1	Push the FPLN function key to show the ACT/MOD FPLN page.
2	Push the NEXT or PREV function key to show the page where the change/correction is required.
3	Make the correction/change to the flight plan. Changes/corrections that can be made on the FPLN pages include: • Delete an airway • Insert/add an airway • Delete a direct waypoint • Insert a direct waypoint • Change SID and/or departure runway • Delete a discontinuity.
4	Push the EXEC function key to execute the changes and update the flight plan.

DELETE AN AIRWAY

PRECONDITIONS:

This procedure starts from the ACT/MOD FPLN page.

▼ CHECKLIST:

1	Push the CLR DEL function key to enter DELETE in the scratchpad.
2	Push the VIA column line select key adjacent to the airway to be deleted.



NOTE

The first line of the FPLN page cannot be deleted while the aircraft is airborne. However, any line on the LEGS pages can be deleted.



NOTE

When the VIA line select key is pushed in Step 2 above, DIRECT now appears in the VIA column and will be the new routing for the selected flight plan leg.

INSERT/ADD AN AIRWAY

PRECONDITIONS:

This procedure starts from the ACT/MOD FPLN page.

RULES:

An airway must be preceded in the flight plan by the entry waypoint, and each airway must have an exit waypoint.

▼ CHECKLIST:

1	Make sure the entry point of the airway is in the flight plan.

- 2 Enter the airway identifier into the scratchpad.
- 3 Push the VIA column line select key below the airway entry waypoint to transfer the airway to the flight plan.

**NOTE**

If the exit point of the airway is already in the flight plan, Steps 4 and 5 can be ignored.

- 4 Enter the exit waypoint identifier into the scratchpad.
- 5 Push the line select key next to the DISCONTINUITY prompts to move the waypoint to the TO column and remove the discontinuity.

DELETE A DIRECT WAYPOINT**PRECONDITIONS:**

This procedure starts from the ACT/MOD FPLN page.

▼ CHECKLIST:

- 1 Push the CLR DEL function key to enter DELETE into the scratchpad.
- 2 Push the TO column line select key adjacent to the DIRECT waypoint to be deleted.

INSERT/ADD A DIRECT WAYPOINT**PRECONDITIONS:**

This procedure starts from the ACT/MOD FPLN page.

▼ **CHECKLIST:**

1	Enter the waypoint identifier in the scratchpad.
2	Push the TO column line at the position where the waypoint is to be entered to transfer it to the flight plan.

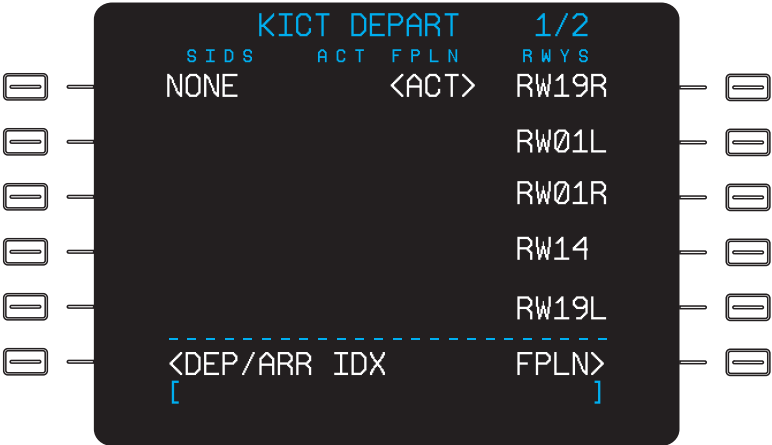


CHANGE SID AND/OR DEPARTURE RUNWAY

SUMMARY:

Changes that can be made to a selected SID include selection of:

- A different SID
- A different transition route for the existing SID
- A different departure runway for the existing SID
- Any available combination of transition routes and runways for the existing SID.



TPG9206_13

▼ CHECKLIST:

1	Push the DEP ARR function key to show the DEPART page.



NOTE

One of three pages shows when the DEP ARR function key is pushed: the DEPART, ARRIVAL, or DEP/ARR INDEX page. If a page other than the DEPART page is showing, pushing the line select key for the DEP/ARR INDEX page, or pushing the DEP ARR function key a second time will show the DEP/ARR INDEX page. The DEPART page for the appropriate airport can then be selected.

2

Push the line select key for the desired SID or runway (RWYS).

3

Push the line select key for the desired transition route if one is available.



NOTE

After selecting a SID and transition, the only way to display the entire TRANS list again is to reselect the SID.

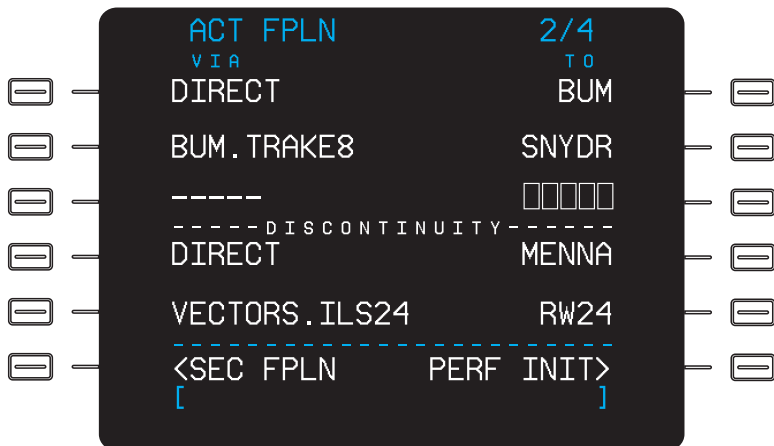
4

Push the FPLN line select key or the FPLN function key to return to the MOD FPLN pages.

DELETE A DISCONTINUITY

SUMMARY:

Discontinuities are used to indicate a break in a flight plan sequence. They are used, for example, to separate the approach segment from the arrival segment. They are also used to segregate a changed portion of a flight plan from an unchanged portion during certain flight plan edits or changes. They can be deleted with a CLR DEL function key entry (DELETE) from the scratchpad, or by entering the next desired waypoint at the discontinuity prompts. When a discontinuity is deleted, a direct-to course is created to the next waypoint in the flight plan. Also, once a discontinuity is deleted, additional changes to the flight plan can be required or desired, depending on the resulting construction of the flight plan.



TPG9206_14

PRECONDITIONS:

Some discontinuities cannot be deleted with the CLR DEL function key, such as an entry preceding an approach with an initial leg that is radar vectored leg, or one at the end of an airway where the next waypoint is not on that airway. In these cases, enter the next desired waypoint at the discontinuity prompts.

This procedure starts from the ACT/MOD FPLN page.

▼ **CHECKLIST:**

1

Do either of the two steps listed below to bypass the discontinuity.

- Push the CLR DEL function key to enter DELETE into the scratchpad.
- Push the line select key for the next desired waypoint to enter that waypoint identifier into the scratchpad.

2

Push the line select key next to the prompt boxes above the DISCONTINUITY to transfer the scratchpad entry.



CHANGE/CORRECT A FLIGHT PLAN (LEGS PAGES)

RATIONALE:

Changes to the flight plan route or corrections to the flight plan can be made on the ACT/MOD LEGS pages.

SUMMARY:

The procedures in this section apply to changing or correcting the Flight Plan on the ACT/MOD LEGS pages. They will also work for the SEC LEGS pages when these pages are selected. Changes to the flight plan will not take effect until the EXEC function key on the CDU is pushed.

▼ CHECKLIST:

1	Push the LEGS function key to show the ACT/MOD LEGS page.
2	Push the NEXT or PREV function key to show the page where the change/correction is required.
3	Make the correction/change to the flight plan. Changes/corrections that can be made on the LEGS pages include: • Delete a waypoint • Insert a waypoint • Create/Delete a flyover waypoint • Enter/Change VNAV data • Delete a discontinuity • Enter/Change ISA Deviation and winds aloft.
4	Push the EXEC function key to execute the changes and update the flight plan.



DELETE A WAYPOINT

PRECONDITIONS:

This procedure starts from the ACT/MOD LEGS page.

▼ CHECKLIST:

1	Push the CLR DEL function key to enter DELETE into the scratchpad.
2	Push the line select key of the waypoint that is to be deleted to transfer the scratchpad entry.



INSERT A WAYPOINT

PRECONDITIONS:

This procedure starts from the ACT/MOD LEGS page.

▼ CHECKLIST:

1	Enter the new waypoint identifier into the scratchpad.
2	Push the line select key at the entry point for the new waypoint to transfer the entry from the scratchpad.



CREATE A FLYOVER WAYPOINT

RATIONALE:

Waypoints can be designated as flyover waypoints, which require the aircraft to fly over the waypoint before initiating a turn.

SUMMARY:

It is possible to transform a non-flyover waypoint into a flyover waypoint. On the MFD Plan Map, when the flyover attribute is added, the flight plan route is drawn as a line through the flyover waypoint. An arrowhead that points toward the waypoint that follows the flyover waypoint indicates an offset from the next course because of the flyover.

ACT LEGS

1/4

SEQUENCE

AUTO/INHIBIT

RW19R

359° 30NM

PEABO

079° 136NM

BUM

077° 131NM

TRAKE

089° 25NM

KAYLA

FL290

FL200

3.0°

12000

<RWY UPDATE

LEG WIND>

[PEABO/0]

]

TPG9206_15

PRECONDITIONS:

This procedure starts from the ACT/MOD LEGS page.

CHECKLIST:

1	Push the PREV or NEXT function key to locate the page with waypoint to be designated a flyover waypoint.
2	If the scratchpad is not empty, use the CLR DEL function key to clear the scratchpad.

3	Push the line select key next to the desired waypoint to copy the waypoint identifier to the scratchpad.
4	With the keypad, add a /0 (slash - zero) suffix to the waypoint identifier to enable the flyover attribute.
5	Push the line select key for the waypoint identifier to transfer the modified waypoint identifier from the scratchpad.



NOTE

When the modified waypoint has been inserted into the flight plan, the waypoint identifier is appended with an @ designation to indicate this is a flyover waypoint.

DELETE A FLYOVER WAYPOINT

SUMMARY:

Waypoints that have been user-defined as flyover waypoints can have the flyover attribute removed if the flyover requirement no longer exists. When the flyover attribute is removed from the waypoint, the course is drawn on the MFD Plan Map from point to point as usual (with no course offset) for non-flyover waypoints.

PRECONDITIONS:

This procedure starts from the ACT/MOD LEGS page.

▼ CHECKLIST:

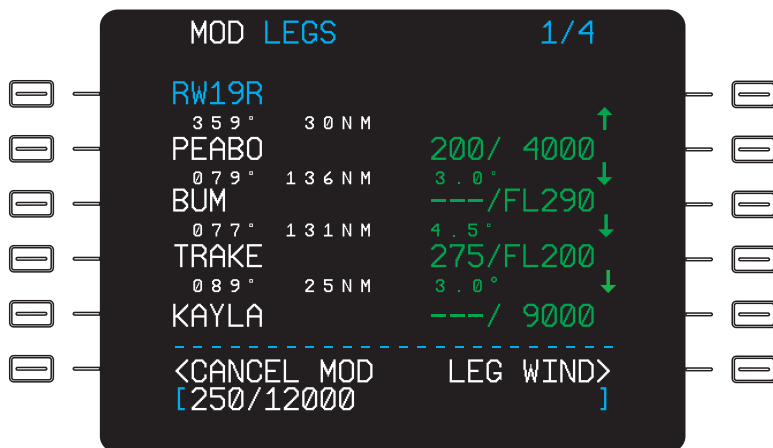
1	Push the PREV or NEXT function key to locate the page with the waypoint that is designated a flyover waypoint indicated by the @ suffixed to the waypoint identifier.
2	If the scratchpad is not empty, use the CLR DEL function key to clear the scratchpad.

- 
- 3 Push the line select key next to the flyover waypoint to copy the waypoint identifier to the scratchpad.
 - 4 With the keypad, add a /0 (slash - zero) suffix to the waypoint identifier to disable the flyover attribute.
 - 5 Push the line select key for the waypoint identifier to transfer the modified waypoint identifier from the scratchpad.

ENTER/CHANGE VNAV DATA

SUMMARY:

VNAV entries include altitude constraints, speeds (IAS or Mach), and Vertical Path Angles (VPA) for descents. They can be entered singly, or as combined entry speeds and altitude only. For specific information regarding VNAV entries, see the VNAV OPERATIONS chapter of this operator's guide.



TPG9206_16

PRECONDITIONS:

This procedure starts from the ACT/MOD LEGS page.

RULES:

The following guidelines apply to VNAV entries.

- For speeds, enter a three digit number (IAS) from 100 to 499, or a two digit Mach setting from .10 to .99 (with the decimal point prefix).
- For VPA, entry range is from 1.0 to the maximum VPA (usually 6.0) specified for the aircraft.

- For altitude, entries can be barometric pressure altitudes or flight levels. When entering a barometric pressure altitude that is less than 500 feet, prefix the altitude with a / (slash) to prevent the FMS from misidentifying the altitude as a speed or VPA.
- Altitude entry range is from -1300 feet to 65,000 feet, and FL000 to FL650. Flight level entries are prefixed with **F** or **FL**.
- Altitudes can be suffixed with the letter A (at or above) or B (at or below).
- For between altitudes, enter the lower altitude suffixed with an A, immediately followed by the upper altitude suffixed with a B (for example, 6000A8000B).
- Enter C only to change a descent to a climb, or D to change a climb to a descent.
- Speeds and altitude entries can be combined if separated by a / (slash) mark (for example, 250/10000, .78/F290).

▼ CHECKLIST:

1	Enter the VNAV data in the scratchpad.
2	Push the line select key for the appropriate waypoint to transfer the information from the scratchpad. TIP When the same information is entered into several waypoints, copy the VNAV information can be copied to the scratchpad by pushing the appropriate right side line select key (instead of manually entering the data), then transferring the data to another waypoint.

DELETE A DISCONTINUITY

PRECONDITIONS:

This procedure starts from the ACT/MOD LEGS page.



TPG9206_17

RULES:

Some discontinuities cannot be deleted with the CLR DEL function key, such as an entry preceding an approach with an initial leg that is the radar vectored leg, or one at the end of an airway where the next waypoint is not on that airway. In these cases, enter the next desired waypoint at the discontinuity prompts.

▼ CHECKLIST:

1

- Do either of the two steps listed below to bypass the discontinuity.
- Push the CLR DEL function key to enter DELETE into the scratchpad.
 - Push the line select key for the next desired waypoint to enter that waypoint identifier into the scratchpad.

2

Push the line select key next to the prompt boxes above the DISCONTINUITY to transfer the scratchpad entry.

**TIP**

To skip a leg or legs following a discontinuity, select the desired downtrack waypoint, then enter it into the THEN prompt of the discontinuity. The downtrack waypoint will replace the discontinuity. All intermediate waypoints between the discontinuity and the selected waypoint will be deleted from the flight plan.

ENTER/CHANGE ISA DEVIATION AND WINDS ALOFT

SUMMARY:

ISA Deviation (ISA DEV) and winds aloft for each leg of the flight plan are entered through the LEG WIND page, which is accessed from the LEGS page. The FMS uses winds and ISA deviation in its performance calculations such as fuel consumption, leg times, and ETAs. Each LEG WIND page correlates with a LEGS page. For instance, pushing the LEG WIND line select key on ACT/MOD LEGS 3/6 page shows ACT/MOD LEG WIND 3/6 page.

ACT	LEG	WIND	1/3
ISA	DEV	FTZ	WIND
+2° C		0 : 0 1	250T/ 20
		C O O R S	
+2° C		0 : 0 2	250T/ 20
		S N Y D R	
+2° C		0 : 0 3	250T/ 20
		M E N N A	
+2° C		0 : 0 1	250T/ 20
		Z U M A Y	
+2° C		0 : 0 1	250T /20
<LEGS		LEG DATA>	
[		]	

TPG9206_18

PRECONDITIONS:

This procedure starts from the ACT/MOD LEGS page.

RULES:

Winds can be entered in any one of the following formats:

- Direction and speed (280/25)
- Headwind or tailwind (H32 or T85)
- Plus wind or minus wind (P102 or M50). Plus is a tailwind.

▼ CHECKLIST:

1	Push the LEG WIND line select key to show the correlating ACT/MOD LEG WIND page.
2	On the appropriate ACT/MOD LEG WIND page, enter the ISA deviation and/or wind data in the scratchpad for the individual leg.  NOTE ISA DEV and winds aloft data can be entered independently of each other. ISA DEV, or winds, or both for each leg can be entered.
3	Push the appropriate line select key for the leg where the data is to be entered to transfer it from the scratchpad.

STORE A FLIGHT PLAN

RATIONALE:

Both the ACT FPLN and the SEC FPLN can be stored directly to FMS memory for future use.

SUMMARY:

The ACT STORE and SEC STORE functions allow active and secondary flight plans to be written to FMS memory to be used again. Once the ACT FPLN or SEC FPLN has been created, the ACT STORE and SEC STORE line key selections on the PILOT ROUTE LIST page allows the operator to store the flight plan in FMS memory. The ability to store flight plans in the FMS memory is an optional item and will not be available in all installations. If the ACT STORE/SEC STORE option is not available, the PILOT ROUTE LIST selection will not appear on the ROUTE MENU page.



TPG9206_19

▼ CHECKLIST:

- 1 Push the FPLN function key to show the ACT/MOD FPLN page.
- 2 Push the SEC FPLN line select key on the ACT/MOD FPLN page to show the SEC FPLN page.

- 3 Push the ROUTE MENU line select key on the SEC FPLN page to show the ROUTE MENU page.



NOTE

The ROUTE MENU page can also be accessed from the INDEX page. Push the INDEX function key to show the INDEX page, then push the ROUTE MENU line select key to show the ROUTE MENU page.

- 4 Push the PILOT ROUTE LIST line select key to show the PILOT ROUTE LIST page.

- 5 Push the ACT STORE line select key to save the active flight plan with the route name shown.



NOTE

PILOT ROUTE LIST names are defined by the individual user.



NOTE

A SEC FPLN is stored in the same manner. In Step 5, push the SEC STORE line select key to store SEC FPLN as a route.

- 6 If a route with the same name is already stored in memory, the CDU shows OVERWRITE ROUTE? with YES and NO line key selections. Do one of the steps that follow:

- 6.1 To overwrite the existing route with the new route, push the YES line select key.

- 6.2 To keep the old route, push the NO line select key.

- 6.3 To store the route with a new name, do the steps that follow:

6.3.1

Enter the new name into the scratchpad.

6.3.2

Push the ACT STORE line select key again to save the ACT FPLN with the new name.



ACTIVATE AND EXECUTE A SEC FPLN

RATIONALE:

A SEC FPLN can be made into an ACT FPLN when necessary.

SUMMARY:

A SEC FPLN is created in the same manner as an ACT FPLN, but is not used by the FMS to generate steering commands. The SEC FPLN must be activated and executed before use.



TPG9206_20

PRECONDITIONS:

A flight plan should be verified by reviewing the route on the MFD Plan Map and/or CDU LEGS before it is activated and executed. Refer to the VERIFY A FLIGHT PLAN procedure in this chapter.

▼ CHECKLIST:

1	Push the FPLN function key to show the ACT/MOD FPLN page.
2	Push the SEC FPLN line select key on the ACT/MOD FPLN page to show the SEC FPLN page.



NOTE

The SEC FPLN page can also be accessed from the INDEX page by pushing the INDEX function key to show the INDEX page, then pushing the SEC FPLN line select key.

3

Push the ACTIVATE line select key to activate the flight plan and show the MOD FPLN page.

4

Push the EXEC function key to execute the flight plan and show the ACT FPLN page.



NOTE

When a SEC FPLN is activated and executed, the ACT FPLN and SEC FPLN exchange places. This prevents the previous flight plan from being lost, and allows it to be recalled if necessary.

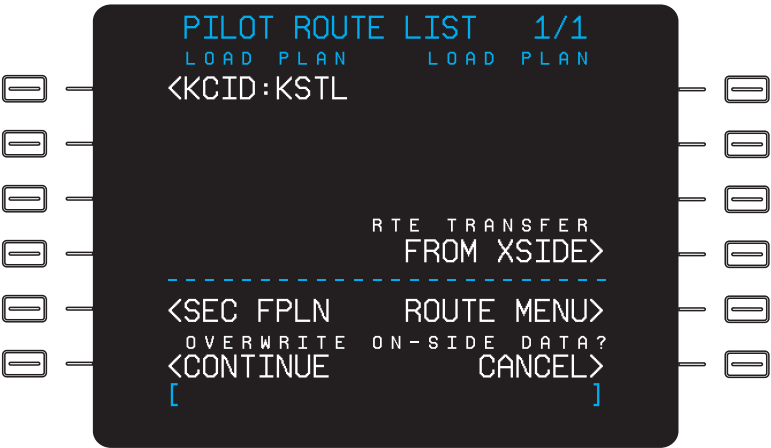
PILOT ROUTE LIST TRANSFER

RATIONALE:

A PILOT ROUTE LIST that is contained in one FMS can be transferred to the cross-side FMS. This is useful if an FMC has been replaced.

SUMMARY:

The PILOT ROUTE LIST transfer allows the pilot routes stored in one FMS to be transferred/copied to the other FMS. If the RTE TRANSFER FROM XSIDE option is not available, the PILOT ROUTE LIST selection will not appear on the ROUTE MENU page.



TPG9206_21

RULES:

Cross-side PILOT ROUTE LIST transfers are only allowed when the aircraft is on the ground.

▼ CHECKLIST:

1	Push the INDEX function key to show the INDEX 1/2 page.
2	Push the NEXT function key to show the INDEX 2/2 page.

- 3 Push the ROUTE MENU line select key to show the ROUTE MENU page.



NOTE

The PILOT ROUTE LIST can also be accessed through the SEC FPLN function. Push the ROUTE MENU line select key on the SEC FPLN page to show the PILOT ROUTE LIST.

- 4 Push the PILOT ROUTE LIST line select key to show the PILOT ROUTE LIST page.

- 5 Push the RTE TRANSFER FROM XSIDE line select key on the last page of the PILOT ROUTE LIST pages to copy the cross-side FMS routes to the same-side FMS.



NOTE

Pilot routes are automatically stored in both FMSs if they are in SYNC mode. The PILOT ROUTE LIST can differ on the two FMSs if routes were stored while the FMS was in INDEP mode or one of the FMCs was replaced after routes were stored.

- 6 When the RTE TRANSFER FROM XSIDE line select key is pushed, if the same-side FMS already contains routes in the PILOT ROUTE LIST, the FMS prompt OVERWRITE ON-SIDE DATA? shows. Do one of the two steps that follow:

- 6.1 Push the CONTINUE line select key to complete the transfer.

- 6.2 Push the CANCEL line select key to cancel the transfer and end the procedure.

LOAD AND EXECUTE A STORED PILOT ROUTE

RATIONALE:

A stored pilot route can be selected for use as an ACT FPLN.

SUMMARY:

A route stored in the PILOT ROUTE LIST can be activated for use as an active flight plan. A stored route is entered into the SEC FPLN pages, activated to become a MOD FPLN, then executed to become an ACT FPLN. A pilot route can consist of any combination of the elements that make up a flight plan route. It can be used as is, or modified and stored as a new route or as a replacement of the existing route. Refer to the CHANGE/CORRECT A FLIGHT PLAN procedure for instructions on modifying a flight plan route. The ability to store flight plans in the FMS memory is an optional item and will not be available in all installations. If the ACT STORE option is not available, the PILOT ROUTE LIST selection will not appear on the ROUTE MENU page.



TPG9206_22

▼ CHECKLIST:

1	Push the INDEX function key to show the INDEX 1/2 page.

2 Push the NEXT function key to show the INDEX 2/2 page.

3 Push the ROUTE MENU line select key to show the ROUTE MENU page.



NOTE

The ROUTE MENU page can also be accessed through the SEC FPLN function. Push the ROUTE MENU line select key on the SEC FPLN page to show the PILOT ROUTE LIST.

4 Push the PILOT ROUTE LIST line select key to show the PILOT ROUTE LIST page.

5 Push the line select key adjacent to the desired flight plan.

6 Verify the flight plan on the CDU and on the MFD PLAN MAP, then push the ACTIVATE line select key to activate the route as a MOD FPLN.



NOTE

With the MOD FPLN function the flight plan can be modified or corrected before executing it for use as an ACT FPLN.

7 Push the EXEC function key to execute the MOD FPLN.



NOTE

If the name of a specified route that exists in the PILOT ROUTE LIST is known, enter that name directly in the scratchpad and transfer it to the ROUTE data line on the ACT/MOD FPLN or SEC FPLN pages. The FMS automatically finds the route in the PILOT ROUTE LIST and loads it into the flight plan.

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PERFORMANCE

INTRODUCTION

A variety of performance functions and information is available to the pilot from the FMS-6100. The basic functions are selected from the PERF MENU page. The selections on the PERF MENU page can include:

- **PERF INIT** — Up to three pages for setting or reviewing various attributes used to initialize the performance functions.
- **VNAV SETUP** — Three pages for setting/showing target speeds, altitude limits, and vertical path angle, as well as other attributes in the climb, cruise, and descent phases of flight.
- **TAKEOFF** — Five TAKEOFF REF pages to show departure runway information, the ambient meteorological conditions, and aircraft configurations used to determine Takeoff Vsports. This information is also used to determine Maximum Takeoff Weight (MTOW) and Takeoff Field Length (TOFL). Maximum weight limits are also computed. Refer to the TAKEOFF & LANDING PERFORMANCE (VSPEEDS) chapter for information on the Takeoff function.
- **FUEL MGMT** — Up to three pages for setting/showing the various elements for fuel management, selecting the performance operating mode, monitoring fuel flow and fuel used, and a trip planning function/calculator.
- **FLT LOG** — The FLIGHT LOG page keeps track of the takeoff (T/O), en route (EN ROUTE), and landing (LDG) times as well as the FUEL USED, average true airspeed/groundspeed (AVG TAS/GS), air distance (AIR DIST), and ground distance (GND DIST).
- **APPROACH** — Five APPROACH REF pages to show approach runway information, meteorological conditions, and aircraft configurations used to determine Approach Vsports. This information is also used to determine Maximum Landing Weight (MLW), and Landing Field Length (LFL) or Actual Landing Distance (ALD). Maximum weight limits are also computed. Refer to the TAKEOFF & LANDING PERFORMANCE (VSPEEDS) chapter for information on the Approach function.
- **ADVISORY VNAV** — Enables and disables advisory VNAV features including the required vertical speed, vertical deviation scale, and constraint altitudes for display on the Primary Flight Display (PFD).

- VNAV PLAN SPD — Shows the speed bug setting the FMS is using or uses when VNAV PLAN SPD is active or resumed.

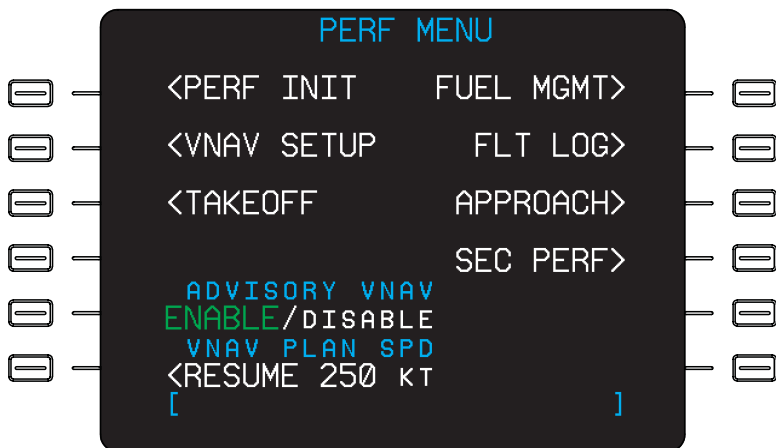
Some elements of the performance functions have default values that can be changed as necessary on the DEFAULTS pages. For additional flexibility, some of the defaults can be changed on the performance pages for an individual flight.



NOTE

Procedures for entering or changing performance information for a SEC FPLN are similar to those for the ACT/MOD FPLN. However, on the SEC PERF pages, a fuel quantity entry is not required. Instead, the FMS calculates the fuel required if it is not entered on the SEC PERF pages. The SEC PERF pages are accessed through the SEC FPLN pages.

The VNAV PLAN SPD display indicates the VNAV planned reference speed for the current position in the flight plan. The VNAV value is dashed when VNAV is invalid.



TPH8456_01

DATABASE LIMITATIONS FOR THE G150 PERFORMANCE DATABASE

Use of the FMS predictive time and fuel performance function with the G150 Performance Database, CPN 815-8809-XXX, must be within the limitations shown in the tables that follow.

Performance Database Limitations

	MINIMUM	MAXIMUM
Aircraft Weight	15,000 lbs	26,100 lbs
ISA Deviation	-20°C	+20°C
Origin/Departure Airport Altitude	0 ft	14,000 ft
Cruise Altitude	0 ft	45,000 ft

Performance Database Speed Limitations by Phase of Flight

FLIGHT PHASE	MINIMUM	MAXIMUM
Takeoff/Climb – KCAS	160 knots	330 knots
Climb — Mach	0.50 Mach	0.85 Mach
Cruise — Mach/KCAS	the greater of 0.30 Mach or 160 knots	the lesser of 0.85 Mach or 330 knots
Descent Flight Path Angle	0.50 degrees	5.5 degrees
Descent — KCAS	150 knots	330 knots
Descent — Mach	0.55 Mach	0.85 Mach

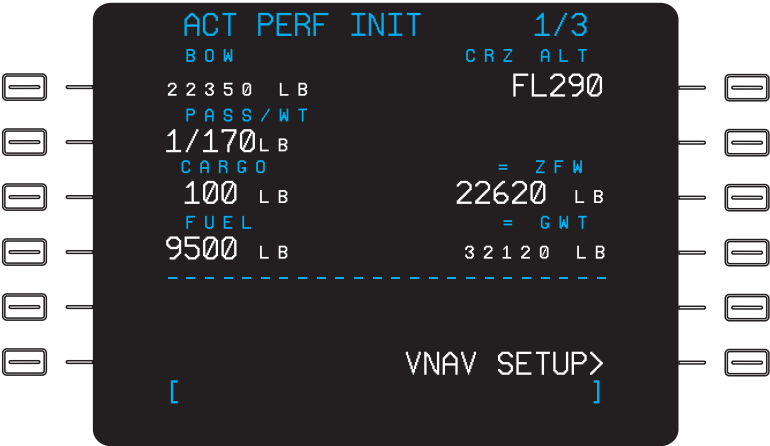
PERF INIT

RATIONALE:

A Performance Initialization (PERF INIT) must be performed before each flight for all of the FMS performance features to function correctly and provide performance-related information to the operator.

SUMMARY:

The PERF INIT 1/3 page on the CDU is accessible by pushing the appropriate line select key on the ACT/MOD FPLN, PERF MENU, and VNAV SETUP pages. Prompt boxes () for FUEL and CRZ ALT, on the PERF INIT 1/3 page, identify the required entries to activate the performance functions. Initializing the performance functions can be simple or detailed, based on the needs of the pilots. The procedures for both a simple and detailed performance initialization follow.



TPH8457_01

▼ CHECKLIST:

1	Push the PERF function key to show the PERF MENU page.
2	Push the PERF INIT line select key to show the PERF INIT 1/3 page.

3

Do either the SIMPLE PERF INIT or DETAILED PERF INIT checklist.

SIMPLE PERF INIT

SUMMARY:

When using the simplified performance initialization, the Basic Operating Weight (BOW), Passenger Weight (PASS/WT), and Zero Fuel Weight (ZFW) entries are available from the default values. The fields for number of passengers and CARGO weight initially show dashes. For a simple performance initialization, the only items that are required are:

- Total FUEL weight
- Cruise altitude (CRZ ALT).

▼ CHECKLIST:

1

Enter the total FUEL weight into the scratchpad.

2

Push the FUEL line select key to transfer the entry to the FUEL data line.



NOTE

A manual FUEL entry on the PERF INIT 1/3 page updates the fuel weight for the current flight plan. After initialization by the pilot, FUEL is computed by subtracting the fuel consumed as measured by the fuel flow sensors. Creating a new flight plan, or deleting the current flight plan, does not change the FUEL value on the PERF INIT 1/3 page.



NOTE

Entering DELETE in the scratchpad, then pushing the FUEL line select key to delete the fuel weight will replace the current FUEL weight with the quantity indicated on the MFD. The FMS will resume calculation from that value.

3	Enter the planned cruise altitude into the scratchpad.
4	Push the CRZ ALT line select key to transfer the entry to the CRZ ALT data line. NOTE Manual CRZ ALT entries on the PERF INIT 1/3 page update the cruise altitude for the current flight plan. However, the entry applies only to the current flight plan and the default value (prompt boxes) are restored when a new flight plan is created.
5	Verify the flight plan change on the CDU, then push the EXEC function key to execute the modified flight plan. NOTE The CRZ ALT value can be reset to the default value by using the CLR DEL function key to enter DELETE into the scratchpad, then pushing the CRZ ALT line select key.

DETAILED PERF INIT

▼ CHECKLIST:

1	Verify the correct Basic Operating Weight (BOW) for the aircraft shows on the PERF INIT 1/3 page.
2	Enter the number of passengers.
3	Enter the CARGO weight.
4	Enter the FUEL (total) weight.
5	Enter the CRZ ALT for the flight.

6	Enter the Zero Fuel Weight (ZFW) if desired.
7	Enter the aircraft GWT if desired.
8	Push the NEXT function key to show the PERF INIT 2/3 page.
9	Enter ISA DEV and winds aloft for the flight if desired.
10	Push the NEXT function key to show the PERF INIT 3/3 page.
11	Enter the ETD if desired.
12	Verify all entries are correct, then push the EXEC function key to execute the modified flight plan.



BOW

SUMMARY:

The Basic Operating Weight (BOW) that shows on the PERF INIT 1/3 page can only be modified on the DEFAULTS 1/5 page. Manual BOW entries for BOW on the DEFAULTS 1/5 page automatically update the BOW on the PERF INIT 1/3 page, and are applied to the current flight plan. Deleting a manual entry for BOW on the DEFAULTS 1/5 page restores the BOW to the default value defined in the database for the aircraft. This value also updates the BOW value that shows on the PERF INIT 1/3 page for the current flight plan.

▼ CHECKLIST:

1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the NEXT function key to show the INDEX 2/2 page.

- 
- 3 Push the DEFAULTS line select key to show the DEFAULTS 1/5 page.
 - 4 Enter the BOW value into the scratchpad.
 - 5 Push the BOW line select key to transfer the entry from the scratchpad.

PASS/WT

SUMMARY:

Manual PASS/WT entries on the PERF INIT 1/3 page update the number of passengers and/or average passenger weight for the current flight plan **only**. This value is restored to the default values (zero passengers, default average passenger weight) when a new flight plan is created. Deleting the PASS/WT value on the PERF INIT 1/3 page restores PASS/WT to zero passengers and the default average passenger weight from the DEFAULTS 1/5 page (0/170 LB). The default value (170 LB) for Average Passenger Weight (AV PASS WT) is defined by the performance database or can be entered manually on the DEFAULTS 1/5 page.

RULES:

The following guidelines apply for AV PASS WT manual entries on the DEFAULTS 1/5 page.

- Manual AV PASS WT entries on the DEFAULTS 1/5 page do **not** automatically update the average passenger weight (PASS/WT) on the PERF INIT 1/3 page for the current flight plan. However, manual entries update the average passenger weight value on the PERF INIT 1/3 page when the next flight plan is created, and become the default AV PASS WT value for subsequent flight plans.
- When AV PASS WT has been entered manually on the DEFAULTS 1/5 page, deleting the manual entry restores AV PASS WT to the default value (170 LB) defined by the performance database. The new value does **not** automatically update the average passenger weight on the PERF INIT 1/3 page for the current flight plan. It updates the PERF INIT 1/3 page the next time a flight plan is created and becomes the default value thereafter.

▼ **CHECKLIST:**

1	On the PERF INIT 1/3 page, enter either of the following values:
	• The number of passengers only • The number of passengers and a new weight per passenger.
2	Push the PASS/WT line select key to transfer the entry from the scratchpad.



CARGO

SUMMARY:

Manual CARGO entries on the PERF INIT 1/3 page updates the cargo weight for the current flight plan. This value applies to the current flight plan ONLY and is restored to the default value (zero LBS) when a new flight plan is created. Deleting a manual CARGO entry on the PERF INIT 1/3 page restores the default value for cargo weight.

▼ **CHECKLIST:**

1	On the PERF INIT 1/3 page enter the cargo weight into the scratchpad.
2	Push the CARGO line select key to transfer the scratchpad entry to the CARGO line.



FUEL (TOTAL WEIGHT)

SUMMARY:

Manual fuel entries on the PERF INIT 1/3 page update the fuel weight for the current flight plan. After initialization by the pilot, FUEL is computed by subtracting the fuel consumed as measured by the fuel

flow sensors. Creating a new flight plan or deleting the current flight plan does not change the FUEL value on the PERF INIT 1/3 page.

▼ CHECKLIST:

1	On the PERF INIT 1/3 page, enter the fuel weight into the scratchpad.
2	Push the FUEL line select key to transfer the scratchpad entry to the FUEL line. NOTE Entering DELETE in the scratchpad, then pushing the FUEL line select key to delete the fuel weight will replace the current FUEL weight with the quantity indicated on the MFD. The FMS will resume calculation from that value. NOTE Changes to the FUEL weight can be made without executing the flight plan.

CRZ ALT

▼ CHECKLIST:

1	On the PERF INIT 1/3 page, enter the planned cruise altitude into the scratchpad.
2	Push the CRZ ALT line select key to transfer the scratchpad entry to the CRZ ALT line.



NOTE

A manual Cruise Altitude (CRZ ALT) entry on the PERF INIT 1/3 page updates the cruise altitude for the current flight plan. However, the entry applies **only** to the current flight plan, and the default value (prompt boxes) is restored when a new flight plan is created.

ZFW

SUMMARY:

Zero Fuel Weight (ZFW) shows on the PERF INIT 1/3 page. The zero fuel weight is computed using basic operating weight, total passenger weight, and cargo weight. However, ZFW can also be entered manually.

▼ CHECKLIST:

- 1 On the PERF INIT 1/3 page, enter the zero fuel weight in the scratchpad.
- 2 Push the ZFW line select key to transfer the scratchpad entry to the ZFW line.



NOTE

A manual ZFW entry on PERF INIT page replaces BOW, PASS/WT, and CARGO values with dashes. Also, if a FUEL weight has been entered, the FMS computes Gross Weight (GWT) as the sum of ZFW and the FUEL weight. It must also be executed to update the current flight plan.



NOTE

When a manual ZFW entry on PERF INIT page is deleted, BOW, PASS/WT, and CARGO values are restored. The FMS computes ZFW as the sum of BOW, PASS/WT, and CARGO weight. If FUEL weight is specified, GWT is computed as the sum of ZFW and FUEL weight. It must be executed to update the flight plan.

GWT

SUMMARY:

The FMS computes Gross Weight (GWT) if data for BOW, PASS/WT, CARGO, FUEL, and ZFW are available on the PERF INIT 1/3 page. However, GWT can also be entered manually.

▼ CHECKLIST:

- 1
- On the PERF INIT 1/3 page, enter the gross weight of the aircraft into the scratchpad.
- 2
- Push the GWT line select key to transfer the scratchpad entry to the GWT line.



NOTE

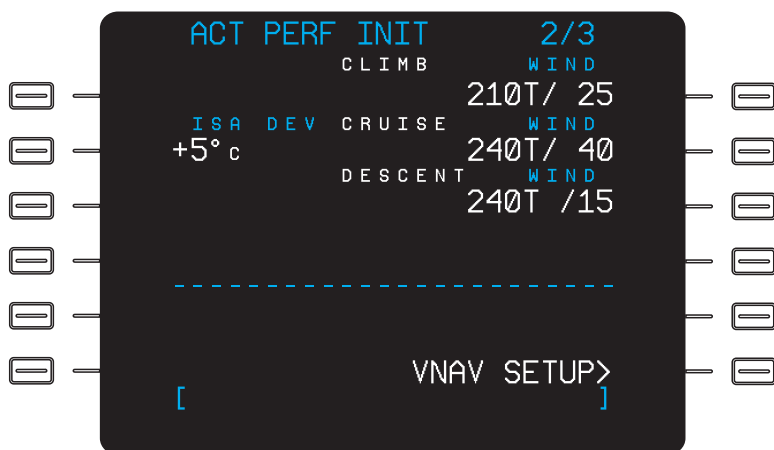
A manual GWT entry on the PERF INIT 1/3 page replaces BOW, PASS/WT, and CARGO values with dashes. Also, if a FUEL weight has been entered, the FMS computes Zero Fuel Weight (ZFW) as the difference between GWT and the FUEL weight. It must also be executed to update the current flight plan.

WINDS ALOFT & ISA DEVIATION

SUMMARY:

Winds aloft for the climb, cruise, and descent phases of a flight are entered on the PERF INIT 2/3 page. The FMS uses the average winds in the climb, cruise, and descent, as well as wind on individual cruise legs, in its performance predictions of fuel consumption, flight plan legs, etc. The FMS also uses ISA Deviation (ISA DEV) inputs for both individual flight plan cruise legs and average cruise ISA DEV in its performance calculations. It also uses ISA DEV inputs, along with airspeed, altitude, and winds, to maintain a holding pattern within its protected airspace. Setting ISA DEV on the PERF INIT 2/3 page loads ISA DEV for the flight plan into the ACT LEG WIND pages (refer to the FLIGHT PLANNING chapter). Winds can be entered in any of the formats listed below:

- Direction and speed (280/25)
- Headwind or tailwind (H32 or T85)
- Plus wind or minus wind (P102 or M50). Plus is a tailwind.



TPG9206_25

▼ CHECKLIST:

1

Push the NEXT or PREV function key to show the PERF INIT 2/3 page.

3	Push the ISA DEV line select key to transfer the entry from the scratchpad.



The ISA DEV value entered will be used by the FMS for the entire flight, not a single phase, such as climb or cruise. The ISA DEV can be changed at any point during the flight if necessary.



ISA DEV on the PERF INIT page is used to calculate performance predictions of fuel consumption. It is not related to the TEMP COMP function that uses ISA DEV to compensate for altimeter errors on approaches to a specific airport.

5	Push the line select key for the appropriate phase of flight to transfer the entry from the scratchpad.

6	Repeat Steps 4 and 5 as necessary to enter winds for each phase of flight.

The information that follows describes the wind and ISA Deviation blending feature.



TECH DETAIL

The wind blending feature is used within the FMS predicted performance function to enhance the time and fuel prediction accuracy by accounting for the actual winds encountered during the flight. The actual winds are blended with the pilot specified forecast wind data in the FMS. The blending algorithm emphasizes the actual winds for portions of the flight plan that are close to the aircraft present position, and emphasizes the forecast wind data for regions of the flight plan that are further downtrack.

A similar algorithm is used for predicting the atmospheric temperature along the flight plan route in the form of deviation from ISA temperature (ISA DEV). The ISA DEV temperature blending is another part of the wind blending feature in the FMS.

Both the wind blending and temperature blending use the same algorithm. Each one blends 100% actual conditions and 0% forecast conditions at the aircraft present position. The actual conditions are linearly tapered down (decreasing effect), and the forecast conditions are linearly tapered up (increasing effect) over the next 400 NM distance downtrack along the flight plan route. Beyond 400 NM downtrack, the wind blending and temperature blending algorithms use 100% forecast conditions.

The 400 NM wind integration segment applies only to the cruise phase. In the climb and descent phase, the wind integration segment is for each 10,000 feet of vertical (altitude) change (100% actual and 0% forecast at current aircraft altitude decreasing linearly over the next 10,000 feet of vertical change).

ETD/ATD, ETE, AND FUEL REMAINING

SUMMARY:

The PERF INIT 3/3 page shows the default FUEL remaining for RESERVES and TAXI FUEL, along with ETE, ETA, and FUEL requirements to the DEST and ALTN airports. Manual entries for RESERVES and TAXI FUEL are allowed. An Estimated Time of Departure (ETD) can be entered in the ETD field. The ETD changes to the Actual Time of Departure (ATD) when the aircraft lifts off the ground.

ACT PERF INIT		3/3	
RESERVES		TAXI FUEL	
2000 LB		140 LB	
ETD		FUEL FLOW CORR	
12:30		(0.0)%	
ETE		ETA	FUEL
DEST 0:56	13:26	7420 LB	
ALTN 1:04	13:33	7200 LB	

VNAV SETUP>			
[			

TPG9206_26

▼ CHECKLIST:

- 1 Push the NEXT or PREV function key if necessary to show the PERF INIT 3/3 page.
- 2 Enter the ETD time, RESERVES fuel value, or TAXI FUEL value into the scratchpad.
- 3 Push the appropriate line select key to transfer the scratchpad entry.

4



Repeat Steps 2 and 3 as necessary to enter all desired changes.

VNAV SETUP

RATIONALE:

The VNAV SETUP pages allow the operator to specify or change a speed and/or altitude limit, a target speed, and the transition altitude.

SUMMARY:

ACT/MOD VNAV CLIMB, CRUISE, and DESCENT pages show default IAS and Mach TGT SPEED. On each page, the IAS and Mach speeds are independent from each other, allowing an individual speed setting for each. Default speed/altitude limits are also shown on the ACT/MOD VNAV CLIMB and DESCENT pages. The ACT/MOD VNAV DESCENT page has an additional default for a vertical path angle (VPA). Each of these default values can be changed on the DEFAULTS 2/5 page, or for a single flight, on the appropriate VNAV SETUP pages. In addition, on the CLIMB and DESCENT pages, a speed/altitude limit can be added to the existing defaults.

▼ CHECKLIST:

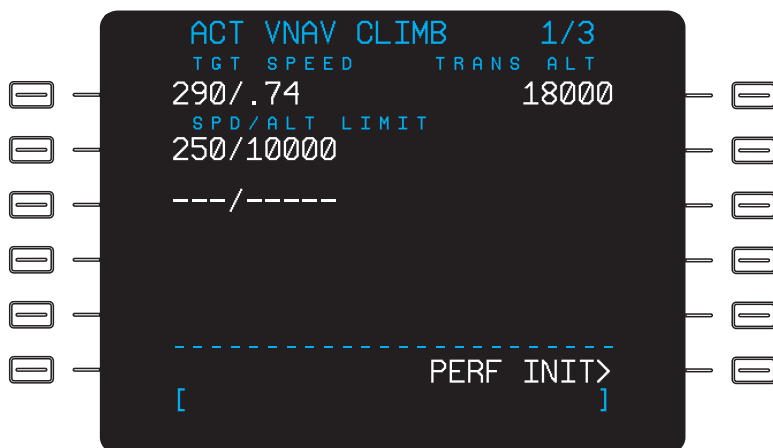
1	Push the PERF function key on the CDU to show the PERF MENU page.
2	Push the VNAV SETUP line select key to show the ACT/MOD VNAV CLIMB, CRUISE, or DESCENT page.
	 NOTE The PERF INIT page also has a VNAV SETUP line key selection for access to the ACT/MOD VNAV CLIMB, CRUISE, and DESCENT pages.

VNAV CLIMB

SUMMARY:

The ACT/MOD VNAV CLIMB page shows the default settings for the items listed below. Change any of these parameters as necessary and add an additional SPD/ALT LIMIT if more than one is necessary.

- Target Speed in IAS/Mach (TGT SPEED)
- Transition Altitude (TRANS ALT)
- Speed/Altitude Limit (SPD/ALT LIMIT).



TPG9206_27

RULES:

The following guidelines apply to making changes on the VNAV CLIMB page.

- The default SPD/ALT LIMIT can be deleted if it does not apply to the aircraft.
- TRANS ALT on the VNAV CLIMB page and TRANS FL on the VNAV DESCENT page are interconnected. Changing either one results in a concurrent change to the other.

▼ CHECKLIST:

1

Enter the desired change into the scratchpad.

2

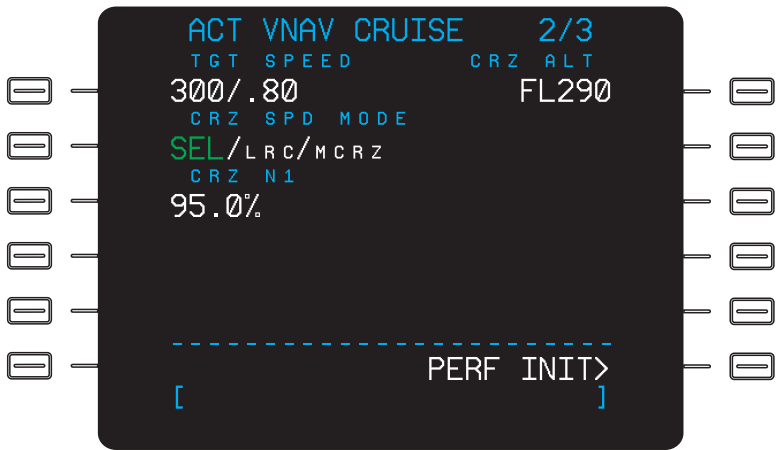


Push the line select key for the appropriate data line to transfer the scratchpad entry to that data line.

VNAV CRUISE

SUMMARY:

The ACT/MOD VNAV CRUISE page shows the default setting for TGT SPEED and the selected cruise altitude (CRZ ALT). Selection of the Cruise Speed Mode (CRZ SPD MODE) is also available, as well as a target N1 setting for the cruise (CRZ N1). Change any of these parameters as necessary.



TPH8744_01

RULES:

The CRZ ALT is the same altitude that is entered on the PERF INIT page. Changes to the CRZ ALT on the VNAV CRUISE page will also change the CRZ ALT on the PERF INIT page.

▼ CHECKLIST:

1	Push the PREV or NEXT function key on the CDU as necessary to show the ACT/MOD VNAV CRUISE page.
2	Enter the desired change into the scratchpad.
3	Push the line select key for the appropriate data line to transfer the scratchpad entry to that data line.

4



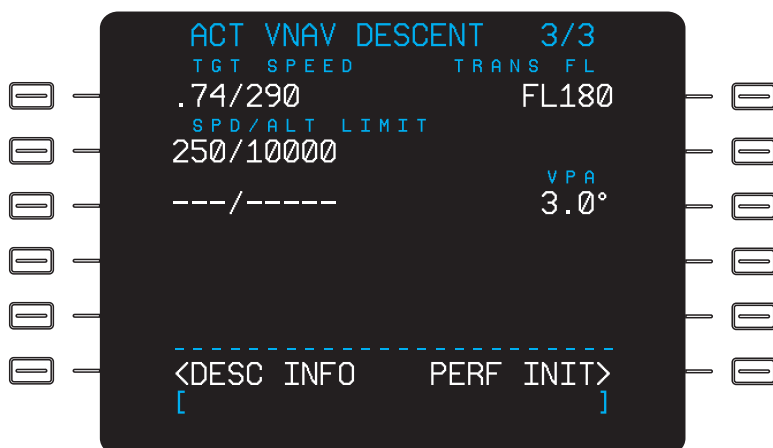
To select the cruise speed mode, push the CRZ SPD MODE line select key. Each push of the CRZ SPD MODE line select key selects the next available option (SEL, LRC, or MCRZ).

VNAV DESCENT

SUMMARY:

The ACT/MOD VNAV DESCENT page shows the default settings for the items listed below. Change any of these parameters as necessary and add an additional SPD/ALT LIMIT if more than one is necessary.

- Target Speed in IAS/Mach (TGT SPEED)
- Transition Flight Level (TRANS FL)
- Speed/Altitude Limit (SPD/ALT LIMIT)
- Vertical Path Angle (VPA).



TPG9206_29

RULES:

The following guidelines apply to making changes on the VNAV DESCENT page.

- The default SPD/ALT LIMIT can be deleted if it does not apply to the aircraft.
- TRANS ALT on the VNAV CLIMB page and TRANS FL on the VNAV DESCENT page are interconnected. Changing either one results in a concurrent change to the other.

▼ **CHECKLIST:**

1	Push the PREV or NEXT function key on the CDU as necessary to show the ACT/MOD VNAV DESCENT page.
2	Enter the desired change into the scratchpad.
3	Push the line select key for the appropriate data line to transfer the scratchpad entry to that data line.



VPA

SUMMARY:

Changing the Vertical Path Angle (VPA) on the ACT/MOD VNAV DESCENT page changes the VPA data for all descents in the flight plan that are not smoothed or specified otherwise in the flight plan. However, on the LEGS page, the VPA for any individual descent can be specified thereby overriding the settings on the ACT/MOD VNAV DESCENT page.

▼ **CHECKLIST:**

1	Enter the desired descent path angle into the scratchpad.
2	Push the VPA line select key to transfer the scratchpad entry to the VPA data line.



DESC INFO

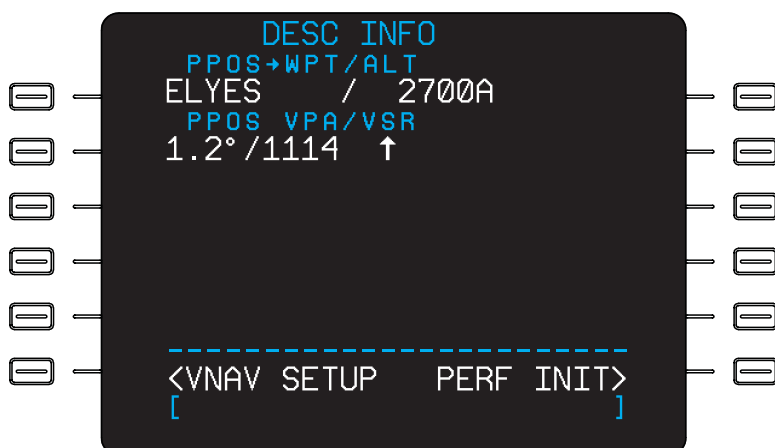
RATIONALE:

The intent of the DESC INFO page is to provide vertical situational awareness to the pilot by showing the next descent constraint along

with the VPA and Vertical Speed Required (VSR) to reach the constraint from the present position and altitude of the aircraft.

SUMMARY:

The DESC INFO page shows vertical information from the aircraft present position and altitude Direct-To the displayed waypoint altitude. The waypoint value defaults to the next waypoint in the active flight plan that has a descent constraint. The pilot can overwrite the default waypoint with any waypoint in the flight plan that has a descent altitude constraint. Also, the pilot can enter any runway that is associated with the destination airport. The intent of these fields is to supply vertical situational awareness to the pilot.



TPH6176_03

▼ CHECKLIST:

- 1 Push the DESC INFO line select key on the VNAV DESCENT page to show the DESC INFO page.
- 2 If the desired waypoint is not showing under PPOS field, enter the applicable waypoint identifier into the scratchpad.
- 3 Push the PPOS line select key to transfer the waypoint entry from the scratchpad.

- 
- 4 If the waypoint that shows under the PPOS label is the destination airport, enter the identifier (for example, RW27L) of a runway associated with that airport.
- 5 Push the PPOS line select key to transfer the runway entry from the scratchpad.

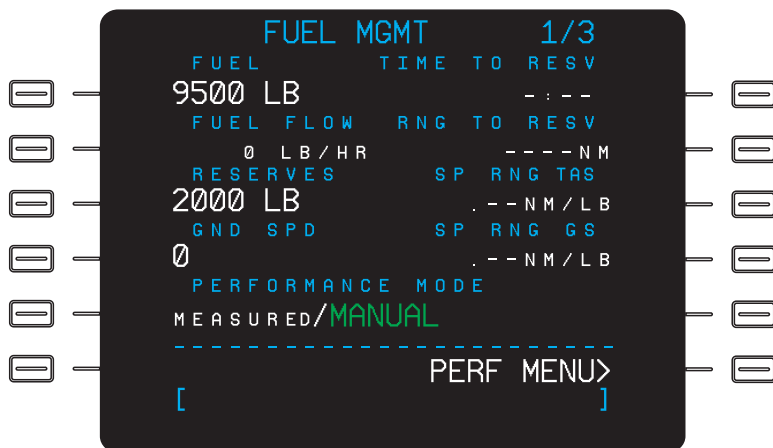
FUEL MANAGEMENT (FUEL MGMT)

RATIONALE:

The Fuel Management function gives information on fuel consumption to allow for precise trip planning and inflight fuel management.

SUMMARY:

The Fuel Management (FUEL MGMT) function provides information to the pilots on fuel usage, time and range to reserves, and specific range based on True Airspeed (TAS) and Groundspeed (GS). FUEL MGMT also provides a trip calculator that allows the pilot to do “what if” fuel and time calculations to determine fuel requirements. The default values shown for each of the parameters on the FUEL MGMT pages are the current measured values for each parameter. The total quantity of FUEL is the same as the fuel remaining on the PERF INIT 1/3 page and cannot be changed on the FUEL MGMT page. However, the FUEL FLOW, RESERVES, and/or GND SPD can be changed to see the affect the change has on each of the other values shown on the FUEL MGMT page. To return to the measured values, use the CLR DEL function key to delete all the changes made.



TPG9206_30

RULES:

The FUEL quantity can only be changed on the PERF INIT 1/3 page. FUEL quantity on the FUEL MGMT page is for display only.

▼ **CHECKLIST:**

1	Push the PERF function key to show the PERF MENU page.
2	Push the FUEL MGMT line select key to show the FUEL MGMT 1/3 page.



PERFORMANCE MODE SELECTION

SUMMARY:

The FMS calculates performance data in either a PREDICTED or MEASURED/MANUAL mode. The mode selected affects:

- Altitude predictions shown on the ACT LEGS pages
- ETA, ETE and FUEL shown on the PERF INIT 1/3 page
- ETE and FUEL shown on the PROGRESS pages
- ETA and FUEL shown on the ACT FPLN PROGRESS pages on the MFD.

PRECONDITIONS:

The following procedure begins on FUEL MGMT 1/3 page.

▼ **CHECKLIST:**

1	Push the PERFORMANCE line select key to select the PREDICTED or MEASURED for the performance mode.



FUEL MGMT CALCULATIONS

SUMMARY:

FUEL MGMT calculations are made on FUEL MGMT 1/3 page. TIME TO RESV, RNG TO RESV, SP RNG TAS, and SP RNG GS are calculated from the fuel, flow, reserves, along with groundspeed and true airspeed data. Changes cannot be made directly to TIME TO RESV, RNG TO RESV, and SP RNG. To make TIME TO RESV calculations, the FMS requires fuel, fuel flow, and reserves data. To make RNG TO RESV, SP RNG TAS, and SP RNG GS calculations, the FMS requires the addition of true airspeed and groundspeed data.

PRECONDITIONS:

The following procedure begins on FUEL MGMT 1/3 page.

▼ CHECKLIST:

1	Enter the desired change in the scratchpad.
2	Push the line select key for the appropriate data line to transfer the scratchpad entry to that line.



NOTE

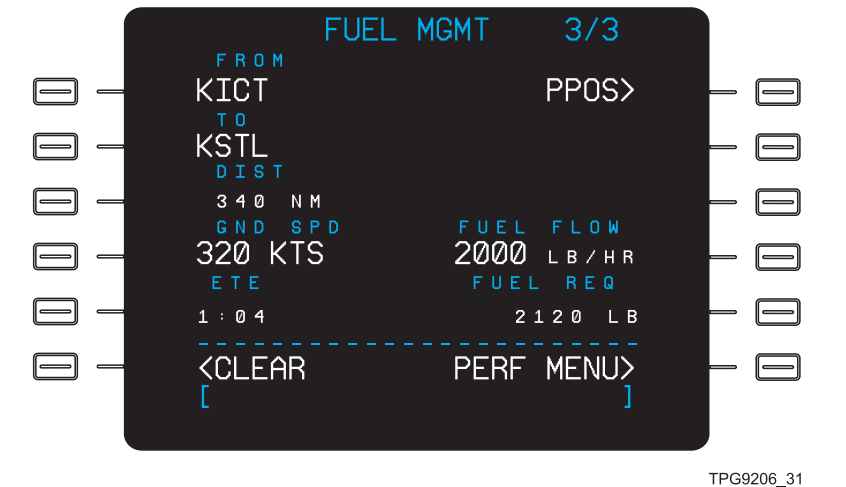
Sensor-measured data (MEASURED mode) shows in small font characters; pilot entries (MANUAL mode) show in large font characters. Delete all manual entries to return to MEASURED mode after making MANUAL entries. To delete a manual entry, enter DELETE in the scratchpad with the CLR DEL key, then push the line select key for the data to be deleted. When a manual entry is deleted, it is automatically replaced with a measured or default value.

3	Repeat Steps 1 and 2 as necessary to make changes to the FUEL, FUEL FLOW, RESERVES, and GND SPD.

TRIP CALCULATOR OPERATION

SUMMARY:

FUEL MGMT 3/3 page is a trip performance calculator. This page shows the TOTAL FUEL FLOW, FUEL REQ, ETE, and GND SPD. On this page, fuel calculations can be made from the present position (PPOS) of the aircraft to a specified waypoint, a specified distance or from one specific waypoint to another. Also, fuel flow and ground speed can be modified to determine fuel requirements and/or time to the specified point or distance.



TPG9206_31

PRECONDITIONS:

The following procedure begins on FUEL MGMT 1/3 page.

▼ CHECKLIST:

1	Push the NEXT function key to show the FUEL MGMT 3/3 page.
2	Use the scratchpad to enter either FROM or TO waypoints, or push the PPOS line select key to enter the aircraft present position as the FROM waypoint (shown as a latitude and longitude position), and enter a TO waypoint or distance.

3 Push the line select keys to transfer the entries to the appropriate data lines in the calculator.

4 Repeat Steps 2 and 3 as necessary to enter additional information, such as fuel flow and ground speed, or push the CLEAR line select key to reset the page.



VNAV PLAN SPD

RATIONALE:

VNAV PLAN SPD function reminds the pilot of speed restrictions for the various phases of flight.

SUMMARY:

VNAV PLAN SPD can be placed on the PFD reference airspeed bug with the RESUME line select key. On the PERF MENU page, the VNAV PLAN SPD shows the more restrictive of any one of the speeds listed below.

- A climb or descent speed constraint set on the ACT LEGS page
- A SPD/ALT LIMIT set on the VNAV CLIMB or VNAV DESCENT pages
- A TGT SPEED for the current phase of flight as specified on the VNAV CLIMB, VNAV CRUISE, or VNAV DESCENT pages
- A decelerating speed when approaching a lower speed limit
- V_{MO}/M_{MO} .

▼ CHECKLIST:

1	Push the PERF function key on the CDU to show the PERF MENU page.
2	Push the VNAV PLAN SPD RESUME line select key to set the speed bug to the value shown on the data line.
	 NOTE The RESUME selection is only available when VNAV is selected on the Flight Guidance Panel (FGP).

POST CONDITIONS:

The PFD reference airspeed bug can be returned to the manual setting by turning the reference airspeed knob located on the FGP.

Climb speed limits are indicated with up (↑) arrows and descent speed limits are indicated with down (↓) arrows on the ACT LEGS pages.

Climb speed limits on waypoints apply before passing the waypoint. If the climb speed limit is no longer appropriate, it can be deleted on the ACT/MOD LEGS page. Speed limits on holding patterns apply to only the holding pattern legs.

Descent speed limits on waypoints on the ACT LEGS pages apply after passing the waypoints. If the descent speed limit is no longer appropriate after the waypoint has been sequenced, it can be deleted on the ACT/MOD LEGS page.

REVIEW FLIGHT LOG

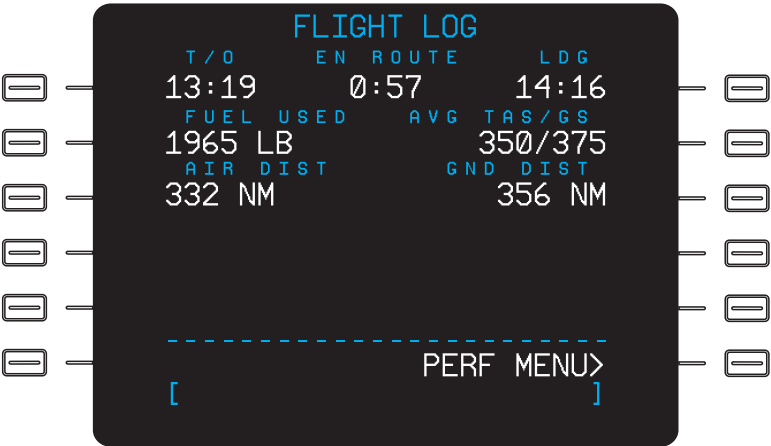
RATIONALE:

The FLIGHT LOG page allows the pilot to review en route performance.

SUMMARY:

The FLIGHT LOG page shows the items listed below. Information on the FLIGHT LOG page is for display only, with the exception of FUEL USED.

- Takeoff time (T/O)
- En route time (EN ROUTE)
- Landing time (LDG)
- Total amount of fuel used (FUEL USED)
- Average true airspeed and ground speed (AVG TAS/GS)
- Total air distance (AIR DIST)
- Total ground distance (GND DIST).



TPG9206_32

▼ CHECKLIST:

1	Push the PERF function key to show the PERF MENU page.

- 2 Push the FLT LOG line select key to show the FLIGHT LOG page.
- 3 The FUEL USED field can be reset by the crew. This is useful if the crew wants to reset the FUEL USED and the avionics are not powered off long enough for a cold start during a refueling stop.



NOTE

The FUEL USED reset function can only be done on the FLIGHT LOG page.

To reset the FUEL USED value, do either of the steps that follow.

- Enter a value of zero into the scratchpad, then push the FUEL USED line select key.
- Use the CLR DEL key to enter DELETE into the scratchpad, then push the FUEL USED line select key.

POST CONDITIONS:

If the FLIGHT LOG ON LDG option on the DEFAULTS 3/5 page is set to YES before takeoff, the FLIGHT LOG page is automatically displayed on the CDU 15 seconds after landing (weight on wheels) if the CDU is not showing a non-FMS-sourced page at the time.



NOTE

Non-FMS functions that can show pages on the CDU include the RTU, DATALINK, SATCOM, and AFIS functions.

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DEPARTURE

INTRODUCTION

This chapter includes some of the functions likely to be used during the departure phase of flight. With the exception of RWY UPDATE, these functions can also be used in other phases of flight as well.

Configuring the aircraft to use the FMS as the navigation source for a departure reduces the workload on the pilot during a critical phase of flight. Based on the equipment installed in the aircraft, updating the position of the FMS to the runway threshold before departure gives the flight crew the most accurate navigation data during and after takeoff. To use the FMS steering commands that are provided to the flight director, the pilot must select FMS as the NAV source (as indicated on the PFD) and select the NAV mode on the Flight Guidance Panel (FGP).

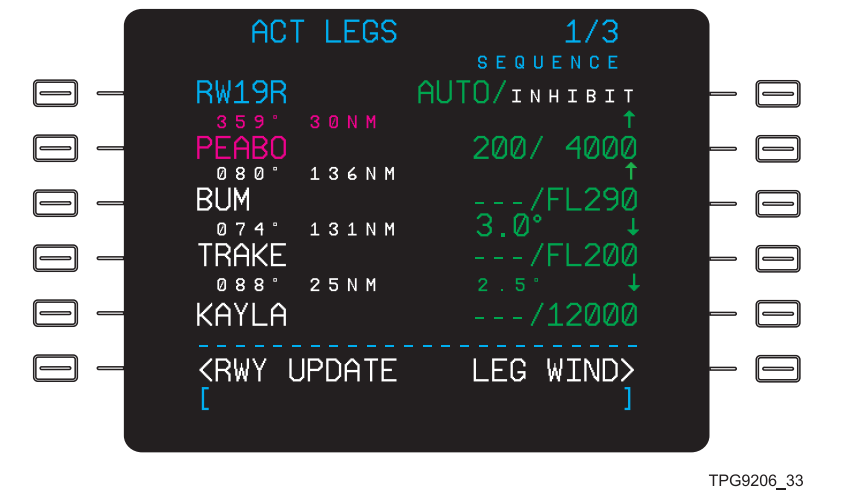
RUNWAY UPDATE

RATIONALE:

A RWY UPDATE updates the FMS position to the runway threshold coordinates. Depending on the accuracy of the data used for position initialization, the RWY UPDATE increases the navigational accuracy of the FMS.

SUMMARY:

The RWY UPDATE prompt shows on the ACT LEGS page when a departure runway is included in the flight plan and the aircraft is on the ground. Push the LEGS function key on the CDU to show the ACT LEGS page. Depending on which source is used for initializing the position, the FMS provides greater navigation accuracy during takeoff and climbout when the position is updated at the runway threshold just before takeoff.



▼ CHECKLIST:

- 1 Push the LEGS function key to show the ACT LEGS page.
- 2 Push the RWY UPDATE line select key to update the FMS with the departure runway threshold-coordinates.

POST CONDITIONS:

When the position update is complete, the annunciation COMPLETED shows above RWY UPDATE on the CDU that issued the runway update request.

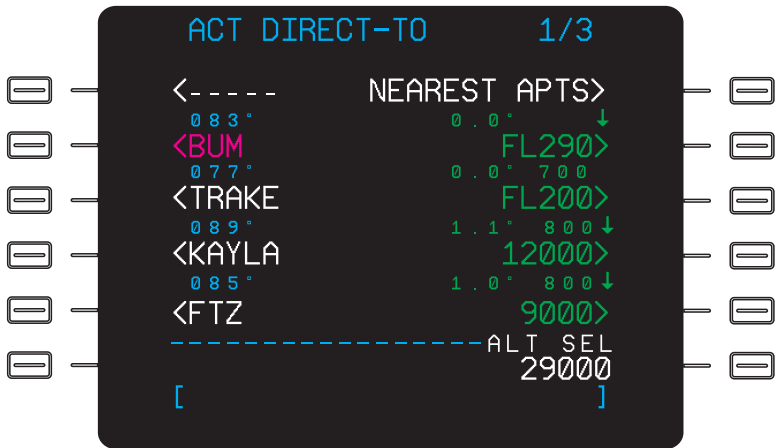
DIRECT TO WAYPOINT (DIR KEY)

RATIONALE:

The Direct-To waypoint function, when selected, sends FMS steering commands to the flight guidance system to fly directly to the selected waypoint.

SUMMARY:

Pushing the DIR function key shows the ACT DIRECT-TO page. The ACT DIRECT-TO page can consist of several pages. To find a waypoint that is part of the active flight plan, but not shown on the current page, push the NEXT or PREV function key as necessary to show the desired waypoint. The annunciation HISTORY shows at the top of the page just below the title line when a DIRECT-TO HISTORY page shows on the CDU.



TPG9206_34

▼ CHECKLIST:

1	Push the DIR function key to show the ACT DIRECT-TO page.
2	Push the line select key next to the identifier of the waypoint to fly Direct-To.



NOTE

Many SIDs and STARs contain conditional waypoints that have no fixed geographical location, such as a heading to an altitude leg or a vector leg. Although these types of waypoints show on the ACT DIRECT-TO page, they cannot be selected for Direct-To navigation.

3



TIP

To intercept and fly a specific course to the Direct-To waypoint, enter the course into the scratchpad, then transfer it to the INTC CRS line on the MOD LEGS page before executing the modified flight plan.

Make sure that the flight plan change on the MFD and CDU, then push the EXEC function key to execute the modified flight plan.

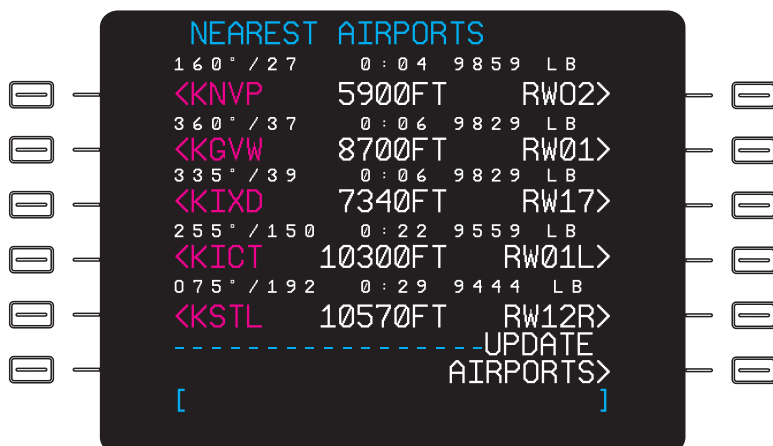
DIRECT TO NEAREST AIRPORTS

RATIONALE:

The NEAREST AIRPORTS feature shows airports nearest to the aircraft position in the event an emergency landing or diversion is necessary. In the same manner as the Direct-To waypoint function, the FMS calculates a course direct-to the selected airport and sends steering commands to the flight guidance system to fly directly to the selected airport.

SUMMARY:

The NEAREST APTS prompt shows on the ACT DIRECT-TO page. Pushing the line select key next to the NEAREST APTS selection shows the NEAREST AIRPORTS page on the CDU. The NEAREST AIRPORTS page shows a list of five airports that normally includes the origin and destination airports, as well as the three nearest airports. The airports are listed by the ICAO identification code, and are arranged by distance from the present position of the aircraft. The pilot can select a course either direct to the airport reference point, or to the longest runway at the selected airport. The NEAREST AIRPORTS page has a page refresh feature (UPDATE AIRPORTS) that updates the page using the current position of the aircraft.



TPG9206_35

▼ CHECKLIST:

1	Push the DIR function key to show the ACT DIRECT-TO page.
2	Push the NEAREST APTS line select key to show the NEAREST AIRPORTS page.
3	Push a line key for the desired airport. • Pushing the airport ICAO line select key causes the FMS to compute a course direct to the airport reference point. • Pushing the runway line select key causes the FMS to compute a course direct to the longest runway at the airport for a visual approach.
4	The FMS shows the MOD LEGS page with the course and distance to the selected airport. • If the airport reference point was selected, the MOD LEGS page shows the course and distance to the airport reference point. • If the longest runway was selected, the MOD LEGS page shows the course and distance to the runway extension point, along with the VNAV constraint associated with the visual approach point, followed by the selected runway as a visual approach procedure. TIP To intercept and fly a specific course to the airport reference point or runway extension point, enter the course into the scratchpad, then transfer it to the INTC CRS line on the MOD LEGS page before executing the modified flight plan.

5

Make sure that the flight plan changed on the MFD and CDU, then push the EXEC function key to execute the modified flight plan.



NOTE

If the Direct-To course is to the airport reference point, no STAR or runway associated with the selected airport shows in the new flight plan. There are also no VNAV constraints associated with the selected Direct-To airport in the new flight plan.



NOTE

The NEAREST AIRPORTS function replaces all the waypoints remaining in the active flight plan with only the selected nearest airport or visual approach for the selected nearest airport. After a DIRECT-TO the nearest airport is executed with the EXEC function key, all of the replaced waypoints are permanently deleted from the active flight plan.

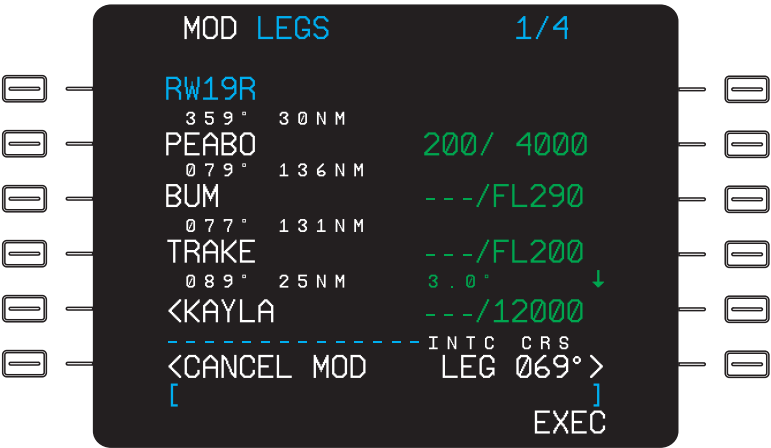
DIRECT TO WAYPOINT (ACT LEGS PAGE)

RATIONALE:

The ACT LEGS pages also provide a Direct-To function. The Direct-To function, when selected, sends FMS steering commands to the flight guidance system to fly directly to the selected waypoint.

SUMMARY:

To create a Direct-To on the ACT LEGS page, change the current TO waypoint to the specified go-direct waypoint. The Direct-To waypoint can be an existing down-track waypoint in the current flight plan or any other valid waypoint.



TPG9206_36

▼ CHECKLIST:

- 1
- Push the LEGS function key on the CDU to show the ACT/MOD LEGS page.



NOTE

The ACT LEGS page can consist of several pages. To find a waypoint that is part of the active flight plan, but not shown on the current page, push the NEXT or PREV function key as necessary to show the desired waypoint.

2

Enter a waypoint in the scratchpad by pushing the line select key next to the identifier of the specified direct-to waypoint, or by manually entering the waypoint identifier with the keypad.



NOTE

Selecting a down-track waypoint as the Direct-To waypoint deletes any waypoints on the flight plan between the current waypoint. The selected waypoint is deleted when the Direct-To waypoint is transferred from the scratchpad to the TO waypoint line. However, the FMS stores the intermediate waypoints in the DIRECT-TO history and the intermediate waypoints are still available for use if the pilot accesses the DIRECT-TO history pages.

3

Push the line select key next to the current TO waypoint (shown in magenta on the ACT/MOD LEGS 1/X page) to move the waypoint from the scratchpad to the TO waypoint display line.



TIP

To intercept and fly a specific course to the Direct-To waypoint, enter the course in the scratchpad, then transfer it to the INTC CRS line on the MOD LEGS page before executing the modified flight plan.

4

Make sure that the flight plan changed on the MFD and CDU, then push the EXEC function key to execute the modified flight plan.

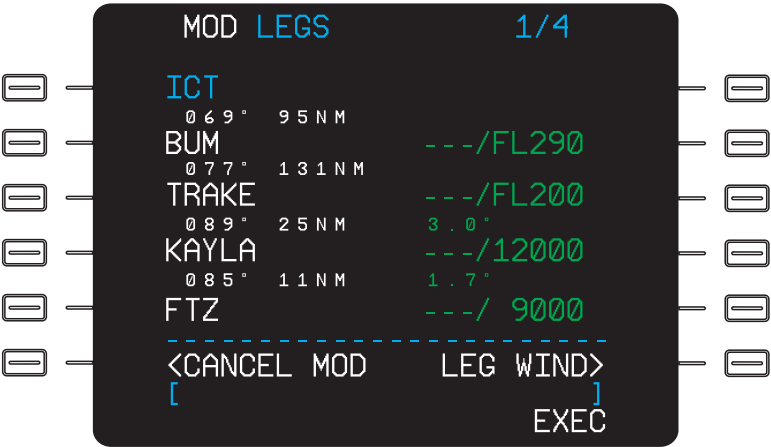
FROM WAYPOINT EDIT

RATIONALE:

By changing the FROM waypoint (shown on the LEGS page above the TO waypoint), the leg from that waypoint to the next waypoint as the active leg can be established. The FROM waypoint edit allows the pilot to set a radar vector and heading leg to intercept a specified flight plan leg. The FMS will then arm to intercept the route and fly the new course to the TO waypoint.

SUMMARY:

A FROM waypoint edit is done from the LEGS page. Pushing the LEGS function key on the CDU shows the ACT/MOD LEGS page.



TPG9206_37

▼ CHECKLIST:

1	Push the LEGS function key to show the LEGS page.
2	Enter the new FROM waypoint into the scratchpad.
	 NOTE The top waypoint in cyan on ACT/MOD LEGS 1/X page is the FROM waypoint.

- 3 Push the FROM waypoint line select key to transfer the waypoint from the scratchpad to the FROM waypoint data field.
- 4 Make sure that the flight plan changed on the CDU and MFD, then push the EXEC function key to execute the modified flight plan.



NOTE

Selecting a down-track waypoint as the new FROM waypoint deletes any waypoints on the flight plan between the current FROM waypoint. The selected waypoint will also be deleted when the Direct-From waypoint is transferred from the scratchpad to the FROM waypoint line.

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EN ROUTE

HOLD AT FLIGHT PLAN WAYPOINT

RATIONALE:

A HOLD can be set up at any waypoint in the flight plan. The HOLD function reduces the workload on the pilot by automatically loading the hold pattern at the designated hold point into the flight plan.

SUMMARY:

The HOLD function is accessed through the INDEX 1/2 page. A flight plan can have up to six holds. A hold can be defined with an inbound course and turn direction, or a quadrant and a radial, from a navaid, or from the point on which the hold is defined.



TPG9206_38

RULES:

When the HOLD line select key on the INDEX 1/2 page is pushed, one of three pages appears, depending on the number of holds in the flight plan. If no holds exist, the ACT LEGS page with the HOLD AT prompt appears. If the flight plan contains one hold that is not in the missed approach or alternate flight, the ACT FPLN HOLD page for that hold shows. If the flight plan contains more than one hold, or at least one hold in the missed approach or alternate flight plan, the ACT HOLD

LIST page shows. This page shows all holds currently in the flight plan. Missed approach and alternate flight plan holds are identified as such on the ACT HOLD LIST page.

▼ CHECKLIST:

1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the HOLD line select key.
3	If the ACT FPLN HOLD or the ACT HOLD LIST page shows, push the NEW HOLD line select key to show the ACT LEGS page with the HOLD AT prompt.
4	Push the line select key next to the waypoint for the hold to copy the waypoint identifier to the scratchpad.
5	Push the line select key for prompt boxes under the HOLD AT field to transfer the scratchpad entry.
	NOTE When the waypoint identifier is transferred to the HOLD AT prompt boxes, the page changes from the ACT LEGS page to the MOD FPLN HOLD page.
6	Make sure that the flight plan changed on the MFD and on the CDU, then push the EXEC function key to execute the modified flight plan.
7	Push the LEGS function key to return to the LEGS page and make sure the hold shows on the LEGS page.



NOTE

The ACT LEGS can consist of several pages. The NEXT and PREV function keys can be used as necessary to show the desired waypoint on the CDU.

▼ **CHECKLIST:**

- 1 Push the IDX function key to show the INDEX 1/2 page.
- 2 Push the HOLD line select key.
- 3 If the ACT FPLN HOLD or the ACT HOLD LIST page shows, push the NEW HOLD line select key to show the ACT LEGS page with the HOLD AT prompt.
- 4 Enter the identifier of the desired holding fix into the scratchpad.
- 5 Push the line select key for prompt boxes under the HOLD AT field to transfer the scratchpad entry.
- 6 Push the line select key of the waypoint that the HOLD is to precede.
- 7 Make sure that the flight plan changed on the MFD and on the CDU, then push the EXEC function key to execute the modified flight plan.
- 8 Push the LEGS function key to return to the LEGS page and make sure the hold shows on the LEGS page.



NOTE

When the new waypoint is transferred to the HOLD AT prompt boxes, HOLD AT IDENT shows in the scratchpad.



NOTE

The ACT LEGS can consist of several pages. The NEXT and PREV function keys can be used as necessary to show the desired waypoint on the CDU.

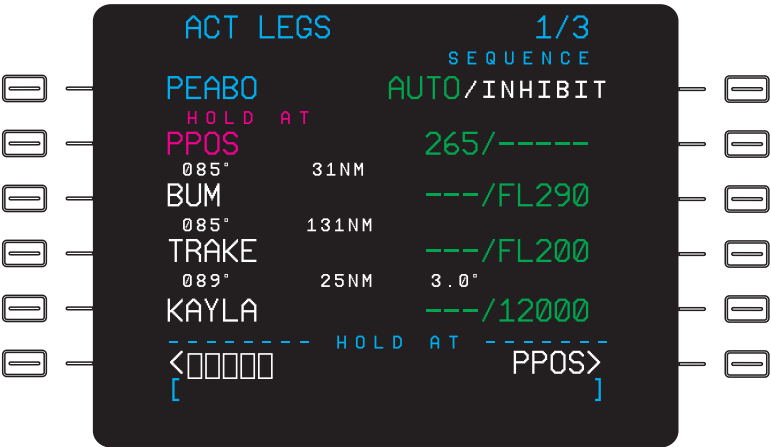
HOLD AT PRESENT POSITION

RATIONALE:

A HOLD can be set up at the Present Position (PPOS) of the aircraft. The HOLD function reduces the workload on the pilot by automatically loading the present position holding pattern into the flight plan.

SUMMARY:

The HOLD function is accessed through the INDEX 1/2 page. A flight plan can have up to six holds. A hold can be defined with an inbound course and turn direction, or a quadrant and a radial, from a navaid, or from the point on which the hold is defined.



TPG9206_40

RULES:

When the HOLD line select key on the INDEX 1/2 page is pushed, one of three pages appears, depending on the number of holds in the flight plan. If no holds exist, the ACT LEGS page with the HOLD AT prompt appears. If the flight plan contains one hold that is not in the missed approach or alternate flight, the ACT FPLN HOLD page for that hold shows. If the flight plan contains more than one hold, or at least one hold in the missed approach or alternate flight plan, the ACT HOLD LIST page shows. This page shows all holds currently in the flight plan. Missed approach and alternate flight plan holds are identified as such on the ACT HOLD LIST page.

▼ CHECKLIST:

- 1 Push the IDX function key to show the INDEX 1/2 page.
- 2 Push the HOLD line select key.
- 3 If the ACT FPLN HOLD or the ACT HOLD LIST page shows, push the NEW HOLD line select key to show the ACT LEGS page with the HOLD AT prompt.
- 4 Push the PPOS line select key to show the HOLD page with the aircraft present position as the holding fix.



NOTE

Present position holds are inbound on the current course with right hand turns and leg lengths of 1.0 or 1.5 minutes, depending on altitude and aircraft specifications. The pilot can make changes to both the leg length and turn direction of a present position hold if necessary.

- 5 Make sure that the flight plan changed on the MFD and on the CDU, then push the EXEC function key to execute the modified flight plan.
- 6 Push the LEGS function key to return to the LEGS page and make sure the hold shows on the LEGS page.



NOTE

The ACT LEGS can consist of several pages. The NEXT and PREV function keys can be used as necessary to show the desired waypoint on the CDU.

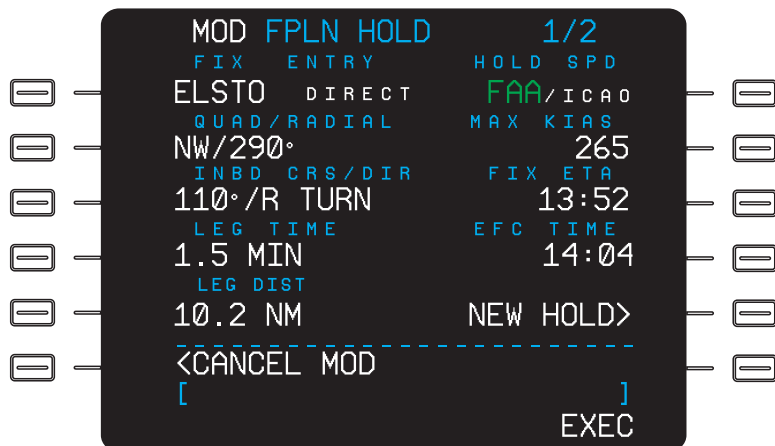
MODIFY A HOLDING PATTERN

RATIONALE:

A holding pattern can be changed as necessary.

SUMMARY:

If the flight plan contains one hold that is not in the missed approach or alternate flight, the ACT FPLN HOLD page for that hold shows when the HOLD line select key is pushed. If the flight plan contains more than one hold or at least one hold in the missed approach or alternate flight plan, the ACT HOLD LIST page shows when the HOLD line select key is pushed. The following procedure modifies the various elements of an existing hold. A hold can be modified when created and before executing the flight plan change



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▼ CHECKLIST:

- 1 Push the IDX function key to show the INDEX 1/2 page.
- 2 Push the HOLD line select key to show the ACT FPLN HOLD or the ACT HOLD LIST page.



NOTE

The ACT HOLD LIST shows all holds currently in the flight plan. Missed approach procedure holds and holds in the alternate flight plan are identified as such on the ACT HOLD LIST page.

3

If the ACT HOLD LIST page is showing, push the line select key for the desired hold to be modified to show the ACT FPLN HOLD page.

4

To change the inbound course and direction of turn of a hold, or quadrant and radial, enter the appropriate information into the scratchpad.



NOTE

Use the QUAD/RADIAL only if cleared to hold in a particular cardinal direction (quadrant) from a specified fix defined off a VOR radial. When QUAD/RADIAL is entered, the FMS automatically computes the inbound course for the hold. Depending on the direction of the hold off the fix, the resulting inbound course can be a reciprocal of the radial. The QUAD/RADIAL entry never determines the direction of turn of the hold itself. Standard holding pattern turns are to the right. The controlling authority issues all nonstandard holding instructions.



NOTE

The inbound course of a hold in progress cannot be manually changed.

5

Push the appropriate line select key to enter the information from the scratchpad.

6

To change a time-based leg to a distance-based leg, enter the distance into the scratchpad.



NOTE

A leg time or leg distance modified from the defaults provided by the FMS shows in large font.

7 Push the LEG DIST line select key to move the leg distance from the scratchpad to the LEG DIST data field.

8 To enter or change the Expect Further Clearance (EFC) time, enter the time into the scratchpad.



NOTE

Entering EFC time is optional. The modified hold can be executed without the EFC time.

9 Push the EFC TIME line select key to move the time from the scratchpad to the EFC TIME entry line.

10 Make sure that the flight plan changed on the MFD and CDU, then push the EXEC function key to execute the modified flight plan.



NOTE

The MAX KIAS or MACH speed setting is the default speed limit for the hold. It also shows on the LEGS page as a speed constraint for the holding waypoint, unless a SID, STAR, or approach procedure specified a speed limit for the hold. A change to the speed can be entered on the LEGS page, but not on the HOLD page. The speed setting allows the FMS to generate a CHECK SPEED message 1 minute before reaching the holding fix if the airspeed of the aircraft is above the prescribed limit. The size of the holding pattern is based on bank angle limit, current winds, and the true airspeed of the aircraft or MAX KIAS, whichever is lower, when the aircraft crosses the holding fix.

11

To modify or view the hold data for another existing hold from the ACT/MOD FPLN HOLD page, push the PREV or NEXT function key to show the ACT FPLN HOLD page for that hold. This bypasses the ACT HOLD LIST page when modifying or viewing more than one existing hold.



EXIT HOLDING

RATIONALE:

The FMS will automatically exit the holding pattern and continue on the flight plan path when exit conditions are met.

SUMMARY:

A hold exit can be initiated from the ACT LEGS page or the ACT FPLN HOLD page. The FMS-calculated exit path shows on the MFD map. The FMS steers the aircraft to exit the hold in one of three ways:

- If the aircraft is already on the inbound turn or inbound leg of the hold, the FMS steers the aircraft along the existing holding track to exit the hold.
- If the aircraft is on the outbound turn, the FMS continues the turn through the outbound leg heading and back to the holding fix.
- If the aircraft is on the outbound leg of the hold before the inbound turn, the FMS starts an immediate turn to the inbound leg to exit the hold.

▼ CHECKLIST:

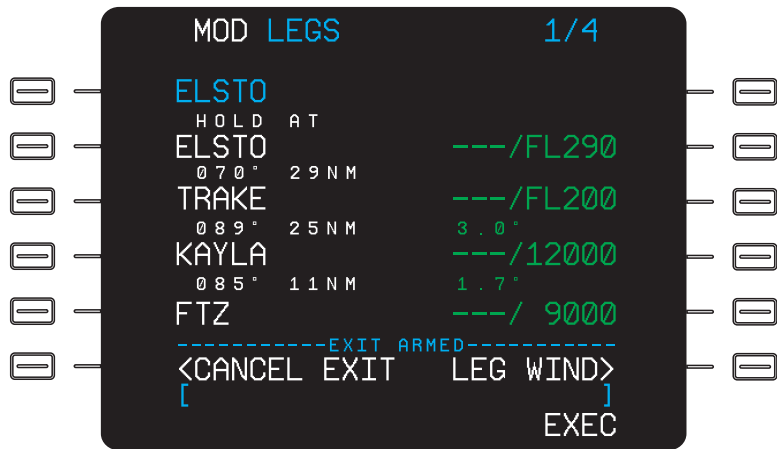
1	Arm the FMS for exit either through the ACT LEGS page or the ACT FPLN HOLD page.
2	Execute the flight plan change.



VIA ACT LEGS PAGE

SUMMARY:

A hold can be exited from the ACT LEGS page. To exit the hold, arm the FMS for the exit, then execute the flight plan change.



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▼ CHECKLIST:

- 1

Push the LEGS function key to show the ACT LEGS page.
- 2

Push the EXIT HOLD line select key.
- 3

Push the EXEC function key to execute the change and exit the holding pattern.

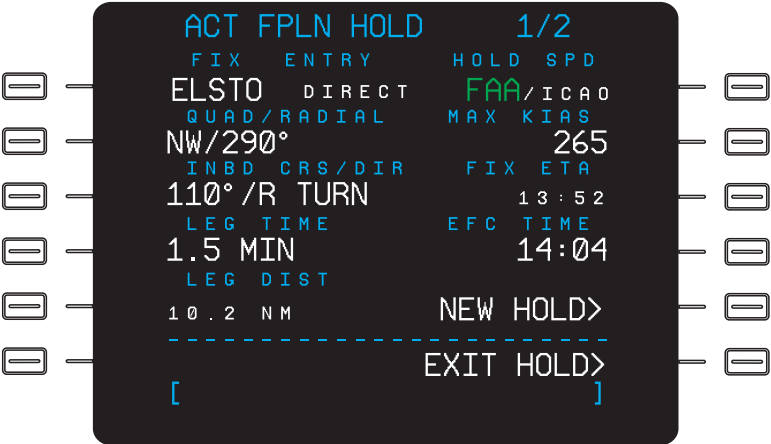
**NOTE**

Course reversal holds that commonly appear in approach transitions automatically arm for exit once the aircraft has established the hold. However, the pilot can cancel the exit before reaching the final course intercept point.

VIA ACT FPLN HOLD PAGE

SUMMARY:

A hold can be exited from the ACT FPLN HOLD page. To exit the hold, arm the FMS for the exit, then execute the flight plan change.



TPG9206_43

▼ CHECKLIST:

- 1 Push the IDX function key to show the INDEX 1/2 page.
- 2 Push the HOLD line select key to show the ACT FPLN HOLD page.
- 3 Push the EXIT HOLD line select key.
- 4 Push the EXEC function key to execute the change and exit the holding pattern.



NOTE

Course reversal holds that commonly appear in approach transitions automatically arm for exit once the aircraft has established the hold. However, the pilot can cancel the exit before reaching the final course intercept point.

CANCEL HOLDING EXIT

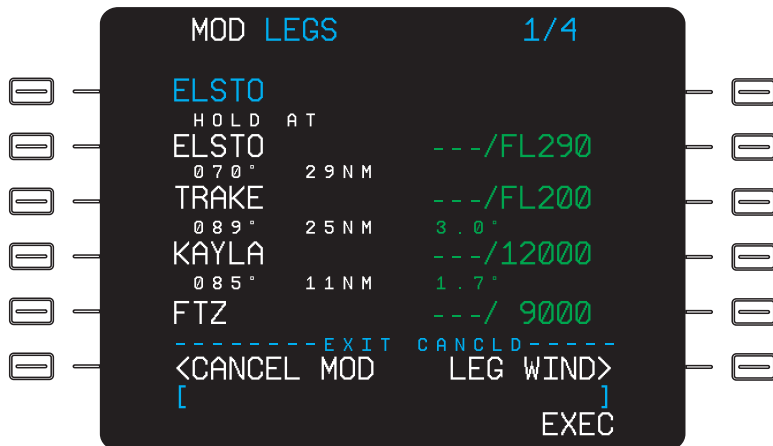
RATIONALE:

A hold exit can be cancelled at any time while the aircraft is still in the holding pattern if necessary.

SUMMARY:

The pilot can cancel a hold exit at any time or at any point around the holding pattern before crossing the holding fix for the exit. However, the pilot must cancel the exit from course reversal holds, used in instrument approach procedures, before sequencing to the inbound course INTC waypoint. The FMS steers the aircraft to continue the hold in one of three ways:

- If an outbound turn is in progress, the FMS will complete the turn to the outbound leg and continue the hold.
- If an inbound turn is in progress, the FMS will complete the turn to the inbound leg and continue the hold.
- If the aircraft is on the inbound leg, the FMS will continue the hold as if the exit was never selected.



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▼ **CHECKLIST:**

1	Push the LEGS function key on the CDU to show the ACT LEGS page.
2	Push the CANCEL EXIT line select key to cancel the hold exit.
3	Push the EXEC function key to execute the change and remain in the hold.



CREATE PILOT-DEFINED WAYPOINTS

RATIONALE:

The pilot can create unique pilot-defined waypoints for use in a flight plan.

SUMMARY:

Pilot-defined waypoints can be created on the ACT FPLN, ACT LEGS, or DEFINE PILOT WPT page where they can also be stored/saved for recall from the PILOT WPT LIST page. Pilot-defined waypoints can be stored with or without a name given to them. A pilot-defined named waypoint on the ACT/MOD FPLN or LEGS page is stored in the PILOT WPT LIST. If the waypoint name already exists in the PILOT WPT LIST, the prompt WPT ALREADY EXISTS appears. along with the prompts REPLACE and CANCEL. Selecting the REPLACE option causes the new waypoint definition to replace the old one in the PILOT WPT LIST. Selecting CANCEL, or not making a choice, keeps the original definition in the PILOT WPT LIST and does not update the flight plan. There are five ways to define a waypoint:

- Along-Track Offset — A waypoint that is offset at a specified distance that either precedes or follows a specified existing waypoint on the flight plan route.
- PLACE BRG/DIST — A waypoint that is defined as a bearing and distance from another waypoint.
- PLACE BRG/PLACE BRG — A waypoint that is defined as the intersection created by bearings from two different waypoints.
- LATITUDE and LONGITUDE — A waypoint that is defined by latitude and longitude.
- Shorthand LATITUDE and LONGITUDE — A waypoint that is defined by shorthand (hemispheric) latitude and longitude.

RULES:

Up to 100 pilot-defined waypoints can be stored in the FMS, but no more than 50 can be used in any one flight plan.

▼ CHECKLIST:

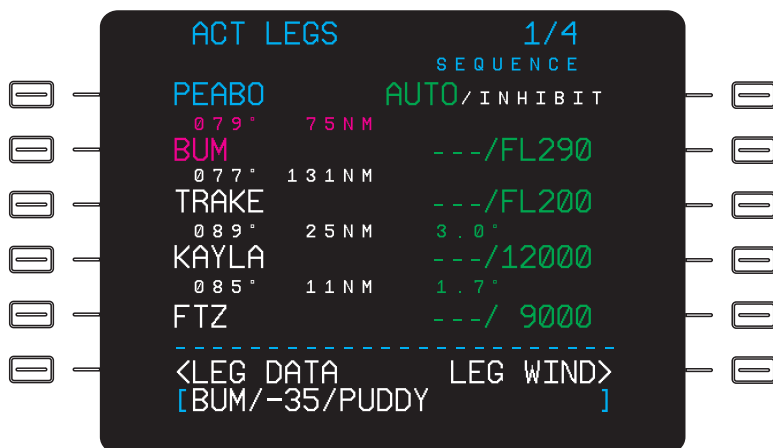
1	Select the desired entry page (ACT LEGS or ACT FPLN).

- 
- 2 Enter the waypoint definition into the scratchpad.
 - 3 Push the line select key at the location in the flight plan where the aircraft will enter the waypoint.
 - 4 Make sure the flight plan changed on the CDU and MFD, then push the EXEC function key to execute the flight plan change.

ALONG-TRACK OFFSET

SUMMARY:

An existing waypoint (base waypoint) in the flight plan defines an along-track-offset waypoint. The waypoint must be along the route of flight and not off-track. The entry format is IDENT/DIST/NAME. IDENT is the name of the waypoint on which the offset waypoint is based. DIST is the distance from the base waypoint. NAME is an optional entry. The NAME can be a pilot-defined name for the new waypoint. If no NAME is specified, the FMS names the point based on the IDENT.



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RULES:

The following guidelines apply to creating an along-track offset waypoint.

- A positive value for distance inserts the along-track offset waypoint down-track from the base waypoint in the flight plan. A negative distance value inserts it before the base waypoint in the flight plan.
- The entered positive distance value must be less than the length of the leg immediately following the base waypoint in the flight plan.
- For the active leg, a negative distance value must be less than the distance from the present position of the aircraft to the TO waypoint.
- Only if the flight plan specifies a track-to-fix leg immediately before the base waypoint is a negative offset value permitted. In this case, the negative offset value must be less than the length of the leg immediately before the waypoint.

▼ **CHECKLIST:**

- 1 Enter the name of the flight plan waypoint (IDENT), followed by a slash (/) and the distance from the waypoint (DIST). A name (NAME) for the waypoint can also be entered using the format IDENT/DIST/NAME.



NOTE

The FMS automatically stores the named waypoint in the PILOT WPT LIST.

- 2 Push the line select key for the base waypoint to transfer the waypoint to the flight plan.

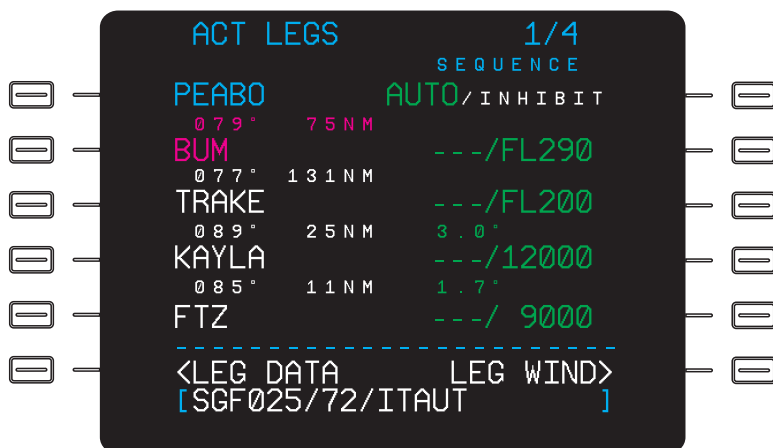


PLACE BRG/DIST

SUMMARY:

A PLACE BRG/DIST waypoint is based on any valid geographically-fixed point. The scratchpad entry format is IDENT/BRG/DIST with the base waypoint identifier for IDENT, a numeric value for BRG, a slash, and a numeric value for DIST (for example, CME025/7, TCS360/105, TAGGS275.3T/15.5). The items listed below can be used as the IDENT for the base waypoint.

- Nav aids
- En route intersections
- Non-directional beacons
- Airports
- Reference points
- Runway threshold of the origin, destination or alternate airport
- Terminal waypoints of the origin, destination or alternate airport
- Other pilot-defined waypoints (except those defined with shorthand latitude/longitude).



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RULES:

The following guidelines describe the specific requirements for a BRG entry.

- The bearing must be either a three-digit number or a four-digit number with a decimal point for tenths of a degree.
- All leading zeros must be entered (for example, 005, 040, 007.1, 055.2T).
- 000 or 360 can be entered for North. The FMS always shows North as 360.
- Distance entries must be between 0.1 and 199.9 NM. Use a leading zero for a distance of less than 1 NM.

▼ CHECKLIST:

1

Enter the base waypoint identifier (IDENT) and bearing (BRG), followed by a slash (/) and the DIST from the base waypoint. A name can be added if desired (NAME) using the format IDENT BRG/DIST/NAME.

**NOTE**

To force the bearing reference to True north, add the letter T as a suffix to the BRG.

**NOTE**

If a name is not specified, the FMS uses the base waypoint identifier with a number added as a suffix to give it a unique name in the flight plan.

2

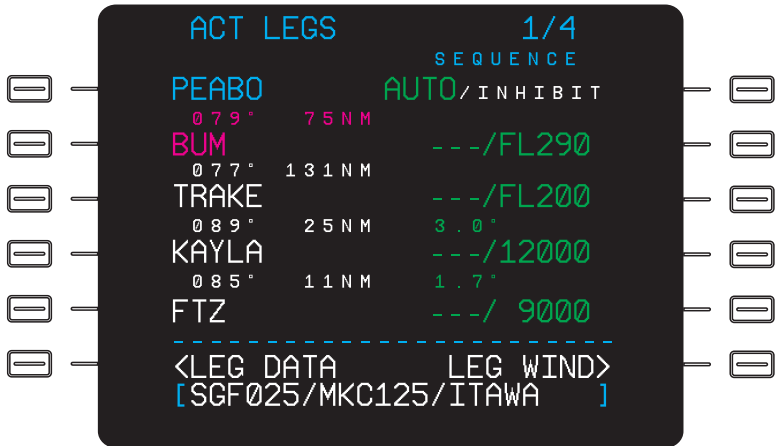
Push the line select key where the pilot-defined waypoint is to be added to transfer the waypoint to the flight plan.



PLACE BRG/PLACE BRG

SUMMARY:

A PLACE BRG/PLACE BRG waypoint is defined using the same criteria that is used to define other waypoints, with the addition of runway extension for the destination airport. The scratchpad entry format is (IDENT)(BRG)/(IDENT)(BRG), with the waypoint identifier as the IDENT and a numeric value for BRG. Bearing entry format and references are the same as those previously described for PLACE BRG/DIST waypoints. For PLACE BRG/PLACE BRG waypoints, the FMS uses the first waypoint and bearing entry as the base waypoint. The second waypoint and bearing determine the intersection point of the specified bearings. The FMS then converts the intersection into a PLACE BRG/DIST waypoint based on the first waypoint. This can be seen by copying the waypoint from the flight plan (once entered it in the flight plan) back into the scratchpad.



TPG9206_47

▼ CHECKLIST:

- 1
- Enter the first base waypoint IDENT and BRG, followed by a slash (/), then the second base waypoint IDENT and BRG. A name can be added if desired using the format (IDENT)(BRG)/(IDENT)(BRG)/NAME.

2

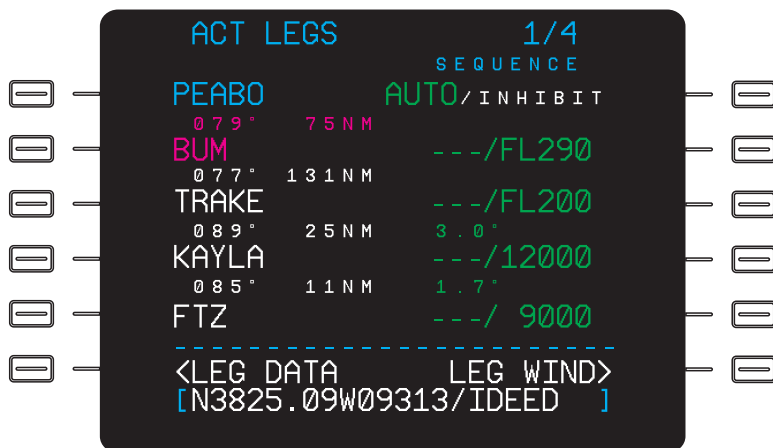


Push the line select key where the pilot-defined waypoint is to be added to transfer the waypoint to the flight plan.

LATITUDE AND LONGITUDE

SUMMARY:

A waypoint can be specified using latitude and longitude with the following scratchpad entry format: (N or S)DDMM.MM(W or E)DDMM.MM. The hemispheric designation (N/S, E/W) must always precede the coordinates. Enter the coordinates with the standard of four-digits for latitude and five-digits for longitude.



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RULES:

The following guidelines apply to latitude and longitude entries.

- If waypoint coordinates are in whole degrees of latitude, longitude or both, the minutes do not have to be entered (such as N40, S09, W030, and E042).
- Always enter degrees of longitude in three digits.
- When entering minutes, use two numbers before the decimal point.
- When using a decimal point, enter at least one number after it.
- The minutes entry range is from 00.00 to 59.99.

▼ **CHECKLIST:**

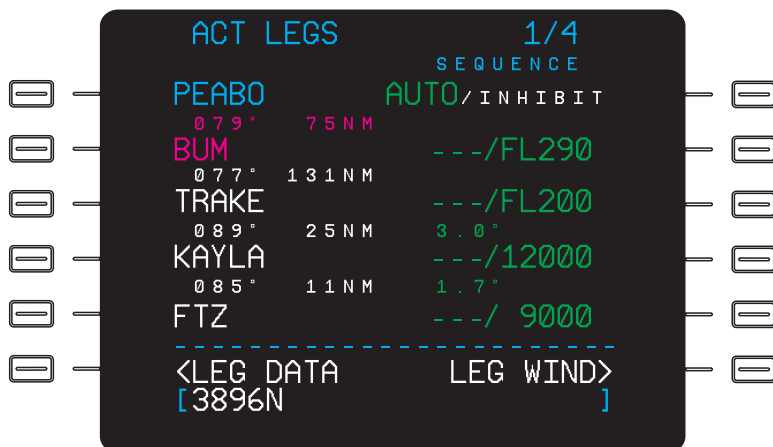
1	Enter the latitude followed by the longitude of the waypoint. A name can be entered if desired using the format (N or S)DDMM.MM(W or E)DDDMM.MM]/NAME.
2	Push the line select key where the pilot-defined waypoint is to be added to transfer the waypoint to the flight plan.



SHORTHAND LATITUDE/LONGITUDE

SUMMARY:

Shorthand latitude and longitude entries differ from regular latitude/longitude entries in that shorthand entries are resolved to only 1 degree of both latitude and longitude. Shorthand entries cannot be named, and the entry must have five characters.



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RULES:

The rules that follow define shorthand latitude and longitude.

- The letters N or E identify positions in the Northern Hemisphere. The letter N indicates North latitude and West longitude. The letter E indicates North latitude and East longitude.
- The letters S and W identify positions in the Southern Hemisphere. The letter S indicates South latitude and East longitude. The letter W indicates South latitude and West longitude.
- The two-digit latitude **always** precedes longitude. The placement of the letter indicates the value of the longitude hundreds digit. If longitude is 100 degrees or greater, the letter is in the third character position, which allows it to function as the 100 digit in the longitude. If the longitude is less than 100 degrees, the letter is last of the five characters.

▼ **CHECKLIST:**

1	Enter the latitude, letter designator, and longitude following the rules listed above.
2	Push the line select key where the pilot-defined waypoint is to be added to transfer the waypoint to the flight plan.



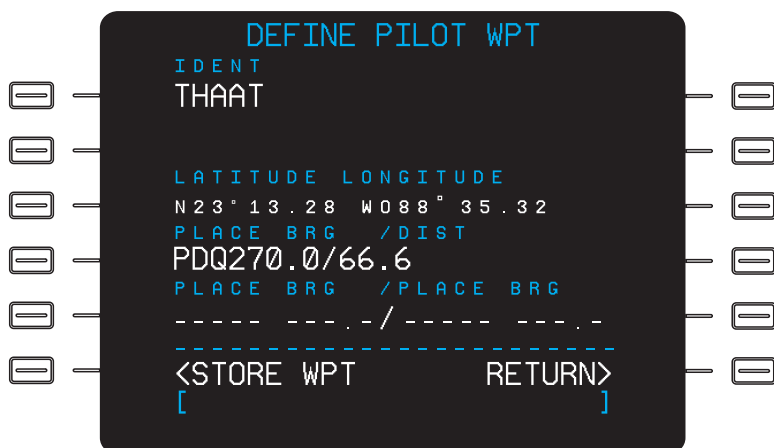
DEFINE AND STORE PILOT WAYPOINTS

RATIONALE:

Pilot-defined waypoints can be defined and stored in the DEFINE PILOT WPT page for future use.

SUMMARY:

Waypoints can also be defined and stored on the DEFINE PILOT WPT page. Pilot-defined waypoints stored from the DEFINE PILOT WPT page remain in the FMS in the PILOT WPT LIST until they are manually deleted.



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▼ CHECKLIST:

1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the NEXT function key to show the INDEX 2/2 page.
3	Push the DATA BASE line select key to show the DATA BASE page.

4 Push the DEFINE WPT line select key to show the DEFINE PILOT WPT page.

5 Enter a name (IDENT) for the waypoint into the scratchpad.

6 Push the IDENT line select key to transfer the scratchpad entry to the IDENT data field.

7 Enter LATITUDE and LONGITUDE, a PLACE BRG/DIST, or a PLACE BRG/PLACE BRG into the scratchpad.

**NOTE**

Shorthand latitude/longitude entries cannot be defined on the DEFINE PILOT WPT page nor stored in the PILOT WPT LIST.

8 Push the line select key for the type of waypoint to enter.

9 Push the STORE WPT line select key to store the waypoint in the FMS database with the name assigned it.



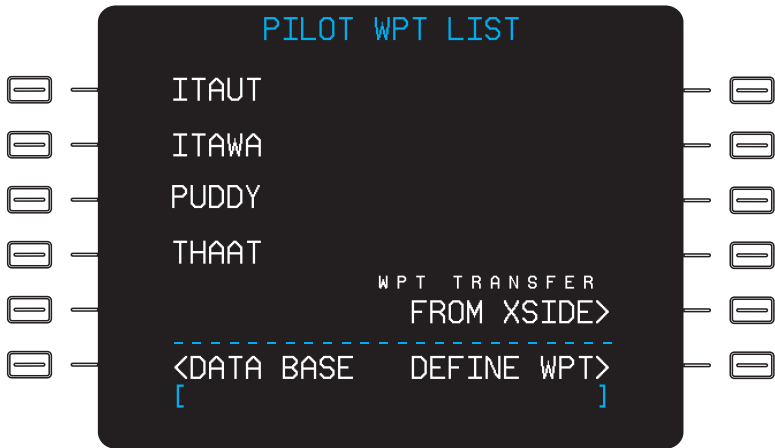
SELECT PILOT-DEFINED WAYPOINTS

RATIONALE:

Pilot-defined waypoints that have been stored in the PILOT WPT LIST can be selected for use in a flight plan.

SUMMARY:

A stored waypoint is retrieved from the PILOT WPT LIST page for use in the flight plan. If the name of the waypoint is already known, the waypoint can be entered directly on the ACT/MOD FPLN or ACT/MOD LEGS pages. The FMS will retrieve the waypoint from the PILOT WPT LIST and insert it into the flight plan.



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▼ CHECKLIST:

1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the NEXT function key to show the INDEX 2/2 page.
3	Push the DATA BASE line select key to show the DATA BASE page.

- 4 Push the PILOT WPT LIST line select key to show the PILOT WPT LIST page.



NOTE

The PILOT WPT LIST can require several pages to show the entire list. Push the NEXT or PREV function key as necessary to show the desired waypoint on the display.

- 5 Push the line select key for the desired waypoint to copy it to the scratchpad.
- 6 Push the LEGS or FPLN function key to show the LEGS or FPLN page.
- 7 Push the NEXT or PREV function key as necessary to show the desired location to insert the waypoint.
- 8 Push the desired line select key to transfer the waypoint data from the scratchpad to the flight plan.
- 9 Make sure that the flight plan changed on the CDU and MFD, then push the EXEC function key to execute the flight plan.

FIX INFO ENTRIES

RATIONALE:

The FIX INFO function allow the pilot to enter a fix that can be used as a reference point.

SUMMARY:

Fix entries are made on the FIX INFO pages. Each FIX INFO page (up to five pages) shows a reference waypoint and the fix data based on that waypoint. Each reference fix shows on an individual FIX INFO page. The FIX INFO page can be used to get a direct-to course, distance (DIST), Estimated Time En Route (ETE), and FUEL to a reference waypoint. FIX INFO color on the MFD is cyan for the optional 3D Map. There are four types of fixes that can be entered on a FIX INFO page:

- Abeam
- Radial Crossing
- Distance Crossing
- Latitude or Longitude Crossing.

▼ CHECKLIST:

1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the FIX INFO line select key to show the FIX INFO page(s).



NOTE

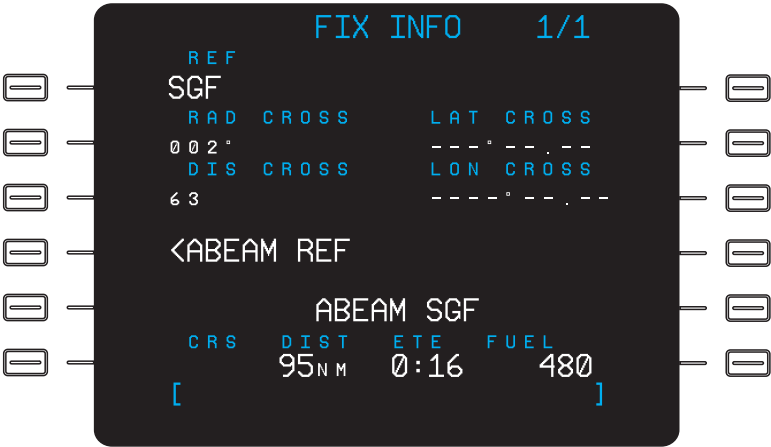
Push the NEXT function key as necessary to find the next blank FIX INFO page to enter a new fix.

3	Enter the data for the type of fix (abeam, radial crossing, distance crossing, latitude or longitude crossing).

ABEAM FIX

SUMMARY:

An abeam fix is the point on the flight plan where the reference waypoint is perpendicular to the flight plan leg. The abeam fix shows on the MFD as a small cyan circle around the fix reference. A dashed cyan line also shows leading from the cyan circle to a small white circle on the course line at the fix point.



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▼ CHECKLIST:

1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the FIX line select key to show the FIX INFO page. NOTE Push the NEXT function key as necessary to find the next blank FIX INFO page to enter a new fix.
3	Enter a reference waypoint into the scratchpad.

4

Push the REF line select key to transfer the waypoint to the REF data field.

5

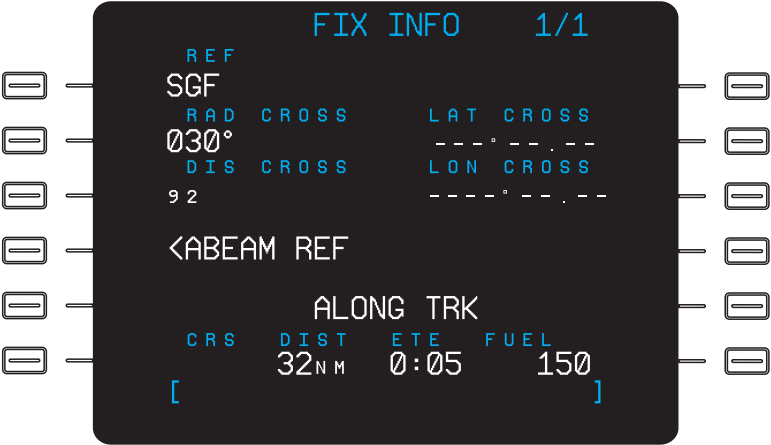
Push the ABEAM line select key to show the abeam fix.



RADIAL CROSSING FIX

SUMMARY:

A radial crossing fix is the point at which a specific radial that originates from the reference waypoint intersects the flight plan. The radial crossing fix shows on the MFD as a small cyan circle around the fix reference. A dashed cyan line also shows leading from the cyan circle to a small white circle on the course line at the fix point.



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▼ CHECKLIST:

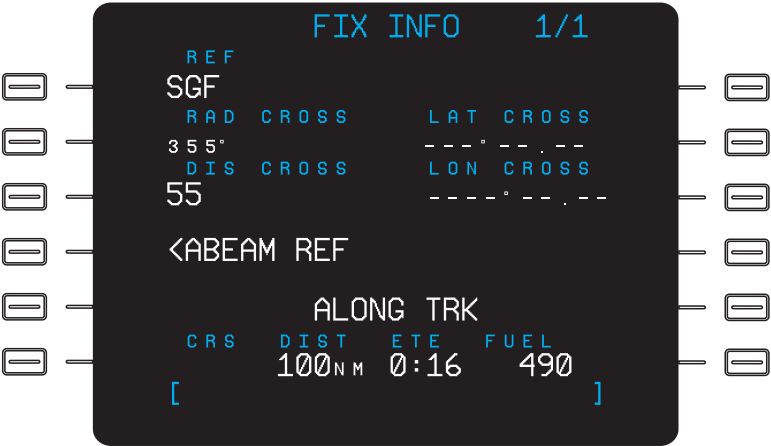
1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the FIX line select key to show the FIX INFO page(s). NOTE Push the NEXT function key as necessary to find the next blank FIX INFO page to enter a new fix.
3	Enter a reference waypoint identifier into the scratchpad.

- 
- 4 Push the REF line select key to move the waypoint from the scratchpad to the REF entry line.
 - 5 Enter the desired radial into the scratchpad.
 - 6 Push the RAD CROSS line select key to move the radial from the scratchpad to the RAD CROSS line.

DISTANCE CROSSING FIX

SUMMARY:

A distance crossing fix is the point at which a specific distance measured from the reference waypoint intersects the flight plan. A distance crossing fix shows as a large cyan circle (or partial circle) centered over the fix reference. The radius of the circle is equal to the specified distance from the fix reference, and a small white circle shows at the point where the large circle intersects the course line.



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▼ CHECKLIST:

1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the FIX line select key to show the FIX INFO page(s).
 NOTE Push the NEXT function key as necessary to find the next blank FIX INFO page to enter a new fix.	

- 3 Enter a reference waypoint identifier into the scratchpad.
- 4 Push the REF line select key to move the waypoint from the scratchpad to the REF entry line.
- 5 Enter the desired distance into the scratchpad.



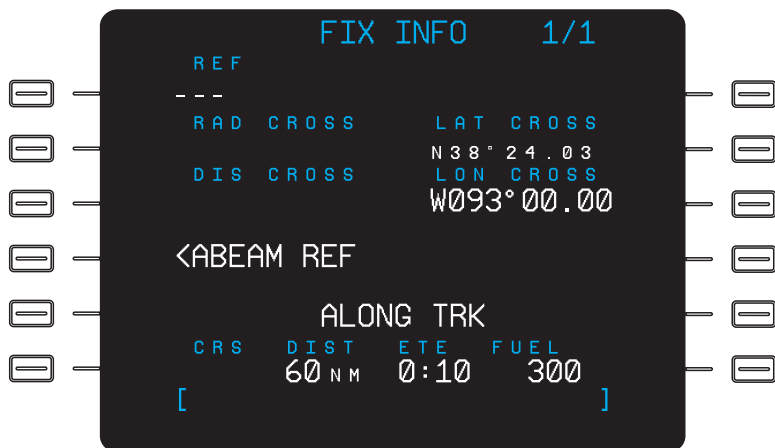
NOTE

The DIS CROSS field on the FIX INFO page accepts any positive whole number that is less than or equal to 500 NM as a valid distance entry. If the DIS CROSS value is greater than 500 NM, or the resulting RAD CROSS radial does not intersect the flight plan within 500 NM, the message NO INTERSECTION appears.
- 6 Push the DIS CROSS line select key to move the distance from the scratchpad to the DIS CROSS line.



SUMMARY:

A latitude or longitude crossing fix is the point where the specified latitude and longitude intersects the flight plan. A latitude or longitude crossing point fixes show as a white circle at the point on the flight plan where the specified latitude or longitude intersects the flight plan. Latitude or longitude crossing point fixes do not use reference waypoints. A reference waypoint cannot be entered. Enter a latitude or longitude, but not both. The fix coordinates must intersect the flight plan, or the message NO INTERSECTION shows in the scratchpad. When a correct latitude or longitude entry is made, it shows in large font text, and the corresponding latitude or longitude for the intersecting point shows in small font text.



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▼ CHECKLIST:

1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the FIX line select key to show the FIX INFO page(s).



NOTE

Push the NEXT function key as necessary to find the next blank FIX INFO page to enter a new fix.

3

Enter a latitude or longitude coordinate that the flight path crosses.

4

Push the LAT CROSS or LON CROSS line select key to transfer the coordinate to the LAT CROSS or LON CROSS line.



NOTE

When the appropriate latitude or longitude-crossing coordinate is loaded into the LAT CROSS or LON CROSS line, the FMS automatically loads the corresponding longitude or latitude. Direct entry coordinates appear in large font text. FMS-calculated coordinates appear as small font text.

CHANGE A FIX INFO ENTRY TO A WAYPOINT

RATIONALE:

A fix on any of the FIX INFO pages can be changed into a waypoint for use in the flight plan.

SUMMARY:

Any of the four types of fixes on the FIX INFO pages can be made into a waypoint for use in the flight plan.

▼ CHECKLIST:

1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the FIX line select key to show the FIX INFO page(s).
	 NOTE Use the NEXT or PREV function key as necessary to show the appropriate FIX INFO page that contains the applicable fix information.
3	Push the REF line select key to enter the fix into the scratchpad (shows as a PLACE BRG/DIST fix).
4	Push the LEGS function key to show the ACT LEGS page.
5	Push the appropriate line select key to enter the waypoint into the flight plan.
6	Push the EXEC function key to execute the change. The FMS assigns a name to the new waypoint using one of the two criteria that follow: • If the fix has a reference waypoint (abeam, distance crossing, or radial crossing), the name is based on the reference waypoint.



- If the fix is a LAT CROSS or LONG CROSS, the name assigned is LL##]. The numbers ##] are generated by the FMS based on the number of similar type fixes in the database.

DELETE FIX INFO ENTRIES

RATIONALE:

A FIX INFO entry can be deleted when it is no longer necessary.

SUMMARY:

A FIX INFO entry is deleted by deleting the REF waypoint, RAD CROSS, DIS CROSS, LAT CROSS or LON CROSS on the FIX INFO page.

▼ CHECKLIST:

1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the FIX line select key to show the FIX INFO page(s).
	 NOTE Use the NEXT or PREV function key as necessary to show the appropriate FIX INFO page from which the fix is to be deleted.
3	Push the CLR DEL function key to enter DELETE into the scratchpad.
4	Push the line select key to delete the REF waypoint, or RAD CROSS, DIS CROSS, LAT CROSS, or LON CROSS fix.

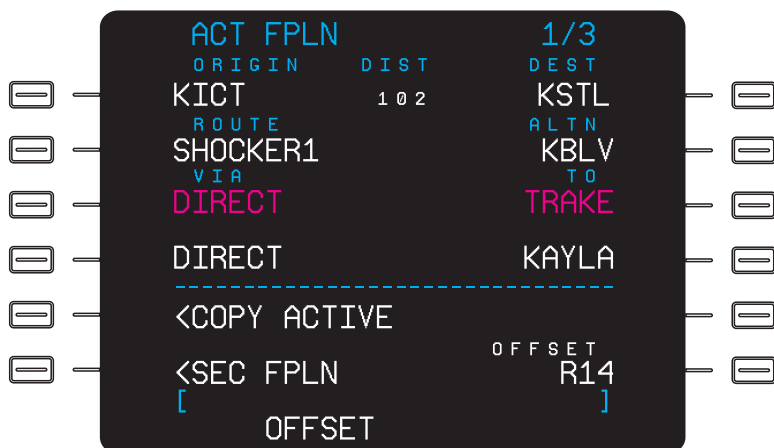
FLY OFFSET PARALLEL COURSE

RATIONALE:

The FMS can be configured to fly a course offset from the planned flight path.

SUMMARY:

Offset parallel courses are entered on the ACT/MOD FPLN page. Parallel offset entries must be in whole numbers from 1 to 99 NM, preceded or followed by L for left of the course, or R for right of the course (for example, L2, 5L, R28, 17R). To change an entered offset parallel course, enter a new course, only numbers, or only letters. Entering an offset shows the message OFFSET on the message line of the CDU, and the annunciation OFST on the PFD. The MFD shows a dashed magenta line parallel to the course line for the active offset track. Enter an offset only when the active leg is a fixed-track leg that terminates at a geographically fixed waypoint.



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RULES:

The following rules apply to flying an offset parallel course.

- Offsets terminate at flight plan discontinuities, DME arc legs, holding patterns, approach legs, and any other leg type that does not terminate at a geographically fixed waypoint.

- Offsets terminate at waypoints with course changes greater than 100 degrees.
- OFFSET WILL END shows on the message line approximately 2 minutes before arriving at the termination waypoint. The message OFFSET TERMINATED shows on the message line when the offset terminates. Both messages are disabled for offsets that terminate at the last waypoint in a flight plan.

▼ **CHECKLIST:**

1	Push the FPLN function key to show the ACT/MOD FPLN page.
2	Enter the necessary offset into the scratchpad.
3	Push the OFFSET line select key to transfer the offset from the scratchpad to the OFFSET display line.
4	Make sure that the flight plan changed on the CDU and MFD, then push the EXEC function key to execute the flight plan.



CANCEL OFFSET PARALLEL COURSE

RATIONALE:

An offset parallel course can be manually cancelled at any time.

SUMMARY:

Cancel an offset manually by entering either a zero distance or DELETE with the CLR DEL function key into the OFFSET data line, or by completing a Direct-To edit on the flight plan. When manually terminating or deleting an offset, no messages show on the message line. When the offset is cancelled, the FMS steers a course direct to the TO waypoint.

▼ CHECKLIST:

1	Push the FPLN function key to show the ACT/MOD FPLN page.
2	Do either of the following two actions. • Push the CLR DEL function key to enter a DELETE command into the scratchpad. • Enter a distance of 0 into the scratchpad.
3	Push the OFFSET line select key to delete the offset.
4	Make sure that the flight plan changed on the CDU and MFD, then push the EXEC function key to execute the flight plan.



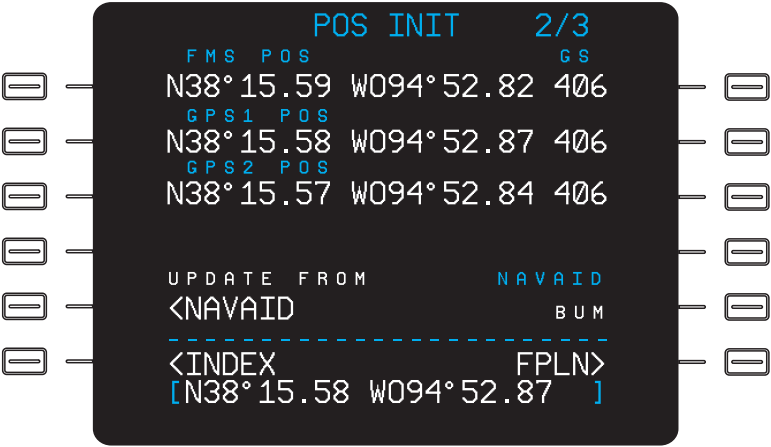
POSITION UPDATE

RATIONALE:

The FMS position can be updated to increase navigation accuracy.

SUMMARY:

The FMS position update function allows the pilot to update the FMS to increase navigation accuracy. The FMS position can be updated from a GPS sensor or from a selected navaid en route.



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▼ CHECKLIST:

1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the POS INIT line select key to show the POS INIT 1/3 page.
3	Push the NEXT function key to show the POS INIT 2/3 page.
4	Do the position update using either a GPS sensor or a navaid.

VIA GPS

PRECONDITIONS:

The following procedure begins on the POS INIT 2/3 page.

▼ CHECKLIST:

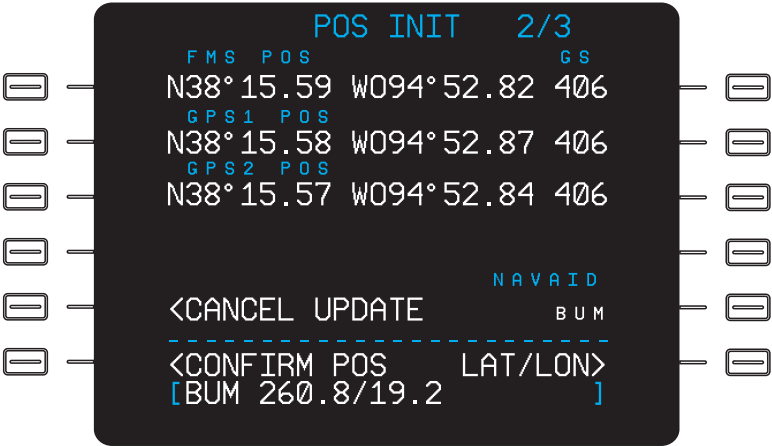
1	Push the left side line select key to copy the latitude or longitude data from the desired GPS sensor to the scratchpad.
2	Push the PREV or NEXT function key as necessary to show the POS INIT 1/3 page with the SET POS prompt.
3	Push the SET POS line select key to transfer the scratchpad entry to the SET POS line and update the FMS position.



VIA NAVAID

SUMMARY:

The UPDATE FROM NAVAID feature allow the pilot to update the FMS position with position data from a navaid. When updating from a navaid, the FMS prompts the pilot to confirm the position update. The position shows on the scratchpad entry line as a radial and distance from the selected NAVAID. A LAT/LON line select key allows the position data to be changed to latitude and longitude if desired.



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PRECONDITIONS:

The following procedure begins on the POS INIT 2/3 page.

▼ CHECKLIST:

1	Make sure that the POS INIT 2/3 page with the UPDATE FROM NAVAID line select key shows on the CDU.



NOTE

A navaid identifier must show in the NAVAID display data field on the lower right side of POS INIT 2/3 page to perform a navaid position update. If the NAVAID line shows dashes, or a desired navaid other than the one showing, enter the identifier of an appropriate, receivable navaid into the scratchpad and transfer it to the NAVAID line. Continue with the following steps.

2

Push the UPDATE FROM NAVAID line select key.

3

Push the CONFIRM POS line select key to update the position.



NOTE

The UPDATE FROM NAVAID function is available only when the aircraft is airborne.

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ARRIVAL AND APPROACH

INTRODUCTION

Preparation for arrival and approach to an airport can include selecting an arrival procedure with an associated transition route, and an approach procedure. Not all items have to be selected. Selection options are as follows:

- A STAR and transition
- An approach and transition.

The DEP/ARR INDEX page can be accessed from any display page on the CDU by pushing the DEP ARR function key.

To show the ARRIVAL page from any other CDU page:

1. Push the DEP ARR function key on the CDU to show the DEP/ARR INDEX page.
2. Push the line select key adjacent to ARR prompt. The ARRIVAL page for the entered airport identifier shows.

If an ORIGIN (departure), destination (DEST) and alternate (ALTN) airport are entered on the MOD/ACT FPLN page, pushing the DEP/ARR function key shows the departure page for the ORIGIN airport.

To show the ARRIVAL page from the MOD/ACT FPLN page:

1. Push the DEP ARR function key on the CDU to show the DEPART page for the origin airport.
2. Push the line select key adjacent to DEP/ARR IDX to show the DEP/ARR INDEX page.
3. Push the line select key adjacent to ARR to show the ARRIVAL page for the selected airport.

NOTE



If the aircraft is on the ground, or airborne but less than 50 NM from the origin airport or less than halfway to the destination airport, the DEPART page for the origin airport shows. If the aircraft is airborne and more than halfway to the destination airport, the ARRIVAL page for the destination airport shows. If no active flight plan exists, or no origin or destination airport was specified, the DEP/ARR INDEX page shows.

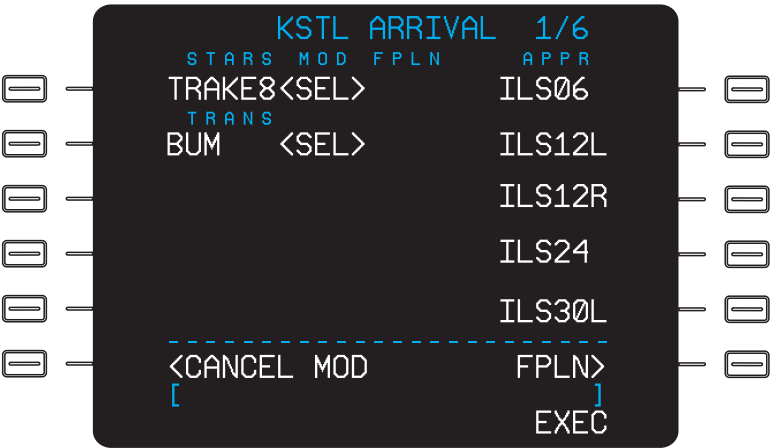
SELECT/CHANGE A STAR

RATIONALE:

Selecting a STAR and any associated transition on the ARRIVAL page loads the published procedure into the flight plan, easing the workload on the pilot.

SUMMARY:

When a STAR and an associated transition are selected on the ARRIVAL page, the FMS loads the waypoints and altitudes of the published procedure into the active flight plan. The pilot has the option of checking the change to the flight plan before executing the change.



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RULES:

The following rules apply to selecting a STAR and transition.

- When a STAR is selected or changed, if the STAR is not associated with a previously selected approach or runway, the runway or approach selection on the ARRIVAL page is removed.
- If a STAR is reselected, and a leg of that STAR happens to be active, that leg remains in the flight plan as the active leg, and the legs of the new STAR, which are preceded by a DISCONTINUITY, follow the active leg.

- Changing the selection of the STAR removes the old STAR from the flight plan. The new STAR is inserted in place of the old STAR, unless a leg of the old STAR happens to be active. In that case, the new STAR is inserted following the active waypoint.
- If a previously selected runway is not associated with the newly selected STAR, the runway is removed from the flight plan.

▼ CHECKLIST:

1

Push the line select key next to the applicable procedure in the list of STARS to select it as the active STAR. The selected STAR identifier followed by <SEL> shows, and the transition list for that STAR shows below the TRANS legend.



NOTE

For some airports, the lists shown on the ARRIVAL page are large enough to fill several display pages. Push the NEXT or PREV function key as necessary to show the desired STAR or transition route, then push the line key for the desired item.

2

Push the line select key next to the applicable transition to select it as the active transition. The selected transition is followed by <SEL>.

3

Verify the flight plan change on the CDU and MFD, then push the EXEC function key on the CDU to execute the flight plan.



NOTE

If the destination airport is the last waypoint in the flight plan when an arrival or approach is selected, the destination airport IDENT is replaced with the selected arrival/approach procedure unless the destination airport is the active (TO) waypoint. If the destination airport is the active waypoint when the procedure is selected, the destination airport remains the active waypoint to prevent the current aircraft course from being unexpectedly changed when the MOD FPLN is executed.

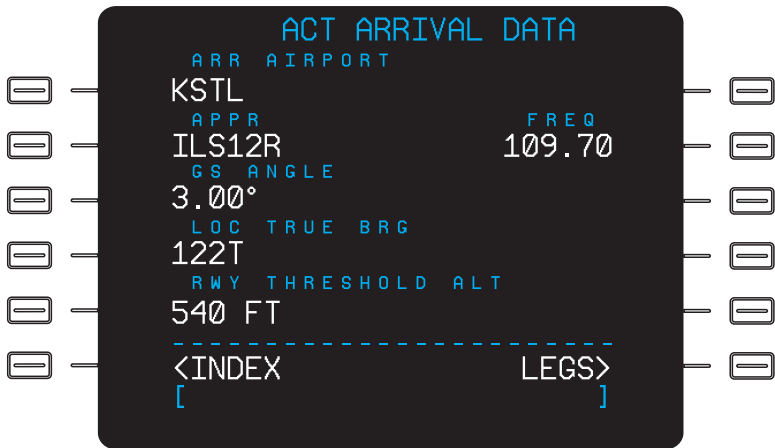
VIEW ARRIVAL DATA

RATIONALE:

The ARRIVAL DATA function allows the pilot to view information on the destination airfield and approach.

SUMMARY:

Information on the destination airfield and approach, if specified, shows on the ACT ARRIVAL DATA page, which is accessed through the INDEX page. If no approach is selected, only the airport ICAO identifier shows. If an approach is selected, the approach, runway, and runway threshold altitude show. If an ILS approach is selected, the glideslope angle, localizer true bearing, and localizer frequency show.



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▼ CHECKLIST:

1	Push the IDX function key on the CDU to show the INDEX 1/2 page.
2	Push the NEXT function key to show INDEX 2/2 page.

3



Push the line select key adjacent ARR DATA to show the ACT ARRIVAL DATA page.

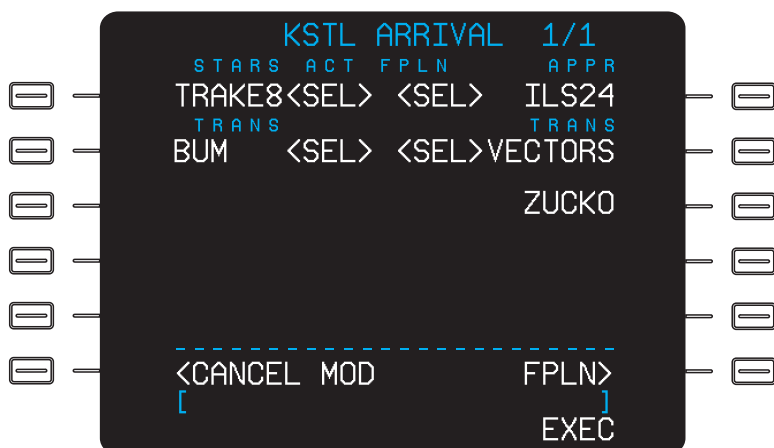
SELECT/CHANGE AN APPROACH

RATIONALE:

Selecting an approach and the associated transition on the ARRIVAL page loads the published procedure into the flight plan, easing the workload on the pilot.

SUMMARY:

When an approach and its associated transition are selected on the ARRIVAL page, the FMS loads the waypoints and altitudes of the published procedure into the active flight plan. The pilot has the option of checking the change to the flight plan before executing the change. Approaches are selected from the ARRIVAL page. Select the ARRIVAL page with the DEP ARR function key, or with the appropriate ARR line select key on the DEP/ARR INDEX page. Both visual and instrument approaches can be selected from the ARRIVAL page.



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PRECONDITIONS:

Either an ORIGIN or a Destination (DEST) airport must be specified in the flight plan for approach selections to be available on the ARRIVAL page.

▼ **CHECKLIST:**

1 Push the DEP ARR function key on the CDU to show the DEP/ARR INDEX page.

2 Push the line select key adjacent to ARR to select the approach for the desired airport.



NOTE

When the DEP ARR function key is pushed, one of three pages shows: the DEPART, ARRIVAL, or DEP/ARR INDEX page. If the aircraft is on the ground, or airborne but less than 50 NM from the origin airport or less than halfway to the destination airport, the DEPART page for the origin airport shows. If the aircraft is airborne and more than halfway to the destination airport, the ARRIVAL page for the destination airport shows. If no active flight plan exists, or no origin or destination airport was specified, the DEP/ARR INDEX page shows. To select a page other than the one showing, push the DEP ARR line select key, or press the DEP ARR function key a second time, then push the appropriate line select key on the DEP/ARR INDEX page.

3 Push the line select key next to the desired approach under the APPR list. The selected approach shows <SEL> beside the selected runway and TRANS <SEL> VECTORS shows under the selected runway.



NOTE

For some airports, the APPR and VISUAL lists are large enough to fill several display pages. Push the NEXT or PREV function key as necessary to show the desired approach on the page, then push the line select key for that approach.

- 4 Push the line select key for the desired STARS approach. The selected approach shows SEL beside the selected STARS and TRANS shows below the selected STARS.
- 5 Push the LEGS function key on the CDU to show the ACT/MOD LEGS page.



NOTE

When an approach is added to the flight plan resulting from selections made on the ARRIVAL page, it causes a discontinuity immediately preceding the approach procedure to be added to the flight plan. The pilot must decide whether to keep the discontinuity or remove it.

- 6 Verify the flight plan change on the CDU and MFD, then push the EXEC function key to execute the flight plan. When the flight plan accepts the change the <SEL> changes to <ACT>.



NOTE

If the destination airport is the last waypoint in the flight plan when an arrival or approach is selected, the destination airport IDENT is replaced with the selected arrival/approach procedure unless the destination airport is the active (TO) waypoint. If the destination airport is the active waypoint when the procedure is selected, the destination airport will remain the active waypoint to prevent the current aircraft course from being unexpectedly changed when the MOD FPLN is executed.

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MISSED APPROACH

INTRODUCTION

Missed approach procedures are automatically inserted into the flight plan following the missed approach point or runway threshold when an approach is selected. For the FMS to sequence beyond the missed approach point to the missed approach procedure, disable the approach, or fly to the Missed Approach Point (MAP) waypoint with AUTO SEQUENCE selected.

To prevent clutter on the MFD map display, the missed approach legs are generally inhibited from display before entering the missed approach procedure.

The pilot can select a preview display of the missed approach procedure (shown in cyan) on the MFD MAP by selecting the MISSED APPROACH line select key option on the MAP DISPLAY page. Pushing the MFD MENU function key while the MFD MAP is showing causes the MAP DISPLAY page to show.

The missed approach procedure shows on the MFD MAP as part of the normal flight plan route if the flight plan approach is disabled and the Missed Approach Point (MAP) is the active waypoint. The procedure also shows if the FMS has sequenced the flight plan to the missed approach procedure. The missed approach procedure, including any procedural holds, shows on the CDU, PFD, and MFD as a normal flight plan. Any legs in the flight plan following the missed approach will show in the same format as an alternate flight plan.

An approach can be disabled (thereby enabling the missed approach procedure) in a number of different ways as follows:

1. While flying the approach procedure, push the TOGA button.
This allows the flight plan to sequence into the missed approach procedure.
2. Select AUTO sequencing (AUTO SEQUENCE) when at the missed approach point. This changes the sequencing from INHIBIT to AUTO.
3. Push the APPR ENABLED line select key on the ARRIVAL page to select NO.
4. Delete the FAF or MAP waypoint.

5. Edit the flight plan to make a point in the missed approach procedure the active waypoint.



NOTE

The APPR ENABLED line key selection on the ARRIVAL page is available only for non-precision approaches.

MISSED APPROACH FROM LOCALIZER-BASED APPROACH

RATIONALE:

Using the FMS to fly the missed approach procedure reduces the workload on the pilot.

SUMMARY:

The missed approach procedure shows in the flight plan and on the MFD to assist the pilot in flying the missed approach.

RULES:

▼ CHECKLIST:

1	Select Go Around (GA).
2	Set power and configuration as needed.
3	Make sure AUTO sequence is selected (ACT LEGS page).
4	Make sure the first waypoint of the missed approach is the TO waypoint.
5	Set FMS as NAV SOURCE.
6	Set the appropriate lateral and vertical flight director modes (NAV or VNAV).
7	Engage the autopilot (if desired).



MISSED APPROACH FROM FMS-BASED APPROACH

RATIONALE:

Using the FMS to fly the missed approach procedure reduces the workload on the pilot.

SUMMARY:

The missed approach procedure shows in the flight plan and on the MFD to assist the pilot in flying the missed approach.

▼ CHECKLIST:

1	Select Go Around (GA).
2	Set power and configuration as needed.
3	Make sure AUTO sequence is selected (ACT LEGS page).
4	Make sure the first waypoint of the missed approach is the TO waypoint.
5	Set the appropriate lateral and vertical flight director modes (NAV or VNAV).
6	Engage the autopilot (if desired).

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DATABASE OPERATIONS

INTRODUCTION

The Rockwell Collins, Inc. FMS-6100 Navigation Database Service provides the navigation data for the FMS-6100 Flight Management System. This service allows the selection of a navigation database that matches the operational requirements of individual flight operations.

Speak to an FMS Database Support representative by telephone at 319-295-5000 for information on database subscriptions as well as other questions about databases for the FMS-6100.

Push the DB DISK OPS line select key on the INDEX page to show the DATA BASE DISK OPS page. From the DATA BASE DISK OPS page, a database can be loaded into the FMS through the READ DISK function. With the WRITE RTEs and WRITE WPTS functions, any custom Pilot Routes and Pilot Waypoints entered in the FMS can be copied to a disk.



NOTE

Database operations can be performed only when the aircraft is on the ground.



NOTE

For aircraft equipped with a file server unit, the PCD-3000 or CPAS-3000 Data Loader is used to remotely initiate a database read or write. Refer to the Collins PCD-3000 Data Loader User's Guide (CPN 523-0780041) for information on how to install and operate the PCD-3000 Data Loader. Refer to the Collins CPAS-3000 Data Loader Operator's Guide (CPN 523-0790386) for information on how to install and operate the CPAS-3000 Data Loader.

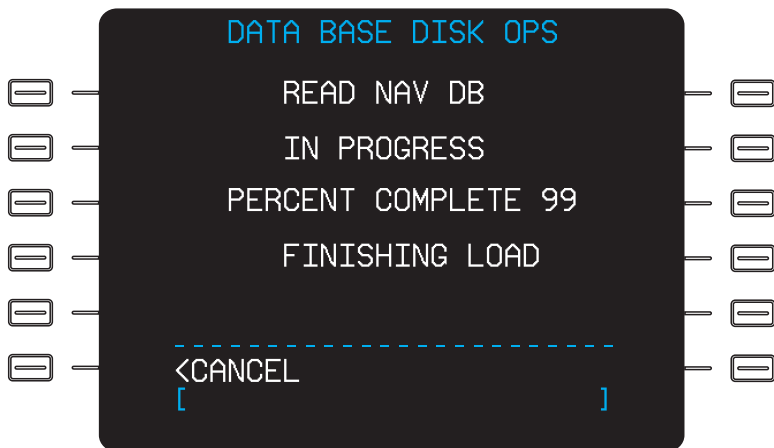
LOAD A DATABASE

RATIONALE:

The FMS requires a current navigation database be loaded in to the FMC to provide full functionality.

SUMMARY:

The DATA BASE DISK OPS page provides the controls for a database load. Pushing the DB DISK OPS line select key on the INDEX 2/2 page causes the DATA BASE DISK OPS page to show. To load a database, the operator inserts the database disk into the data loader and pushes the READ DISK line select key. It can be necessary to use more than one disk for a complete database (navigation, performance, or Vspeeds) load. In such cases, the operator is prompted to insert additional disks when necessary. Once the read or write function is selected, the CDU function keys will not operate until the load is complete or the process is cancelled. The CDU shows various status pages while a database load is in process. When a database has finished the load process, the display indicates that the load is complete, then shows the STATUS 1/2 page.



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RULES:

For the optional dual FMS configuration, database loads cannot be cross-talked by the FMSs. A separate database load must be performed for each FMC installed on the aircraft.

▼ **CHECKLIST:**

1	Push the IDX function key to show the INDEX 1/2 page.
2	Push the NEXT function key to show the INDEX 2/2 page.
3	Push the DB DISK OPS line select key to show the DATA BASE DISK OPS page.
4	Insert the diskette with the database into the data loader.
5	Push the READ DISK line select key.
6	Push the line select key for the database that is to be loaded.
7	Follow the instructions on the CDU display. The display shows the status of each step in the database loading process. The display also annunciates when the loading is complete, then shows the STATUS page.

POST CONDITIONS:

The ACTIVE DATA BASE and SEC DATA BASE fields on the STATUS 1/2 page show the effective dates of the active and secondary databases that are loaded in the FMC. To find which version of the performance or Vs speeds database is loaded into the FMC, look at the STATUS 2/2 page. The PERF DATA BASE field shows the version of the performance database that is installed. The VSPD DATA BASE field shows the version of the Vs speeds database that is installed

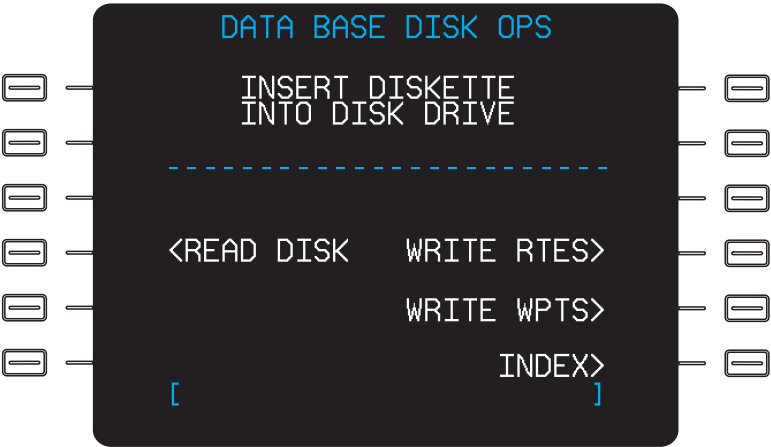
COPY ROUTES/WAYPOINTS TO A DISK

RATIONALE:

Pilot-created routes or waypoints can be copied from the FMS to a disk. This allows commonly used routes and waypoints to be stored on a removable disk to be used again.

SUMMARY:

The WRITE function of the DATA BASE DISK OPS page provides the ability to download pilot-created routes or waypoint to a disk. To copy routes or waypoints to a disk, the operator inserts a disk into the data loader, then pushes either the WRITE RTES line select key to download the routes, or the WRITE WPTS line select key to download waypoints.



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▼ CHECKLIST:

1	Push the IDX function key on the CDU to show the INDEX 1/2 page.
2	Push the NEXT function key to show the INDEX 2/2 page.
3	Push the DB DISK OPS line select key to show the DATA BASE DISK OPS page.

- 4
 - 5
- 
- Insert a diskette into the data loader.
- Push the WRITE RTES or WRITE WPTS line select key and then follow the instructions on the display. The display indicates when copying is complete.

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RADIO OPERATIONS

INTRODUCTION

Control of communication and navigation radio equipment is done through the CDU TUN function. The NAV CONTROL page allows for the selection of the automatic tuning mode through which the FMS automatically tunes the paired VOR/DME channel frequencies of the NAV receivers. Manual (MAN) is the default mode. However, automatic (AUTO) is the recommended operating mode for the navigation receivers.

The FMS does not control ADF BFO, ADF antennas, DME holds, or the transponder operating modes.

The radios are tuned in several different ways. COM, NAV, and ADF radios can be tuned directly using the scratchpad entry method or by selecting a preset frequency. Communication frequencies are differentiated by three digits following the decimal point to accommodate 8.33 kHz tuning. Navigation receivers can be tuned using the station frequency, manually or through preset channels, or by entering the station three-letter identifier. Navigation receivers can also be set for automatic tuning by the FMS. ADF receivers must be tuned directly using the appropriate frequency.

Colors are used as follows:

- The TUNE title line shows in cyan.
- Radio names show in white.
- Active frequencies show in yellow.
- Active navigation tuning modes AUTO/MAN and the transponder STAND BY annunciation show in cyan.

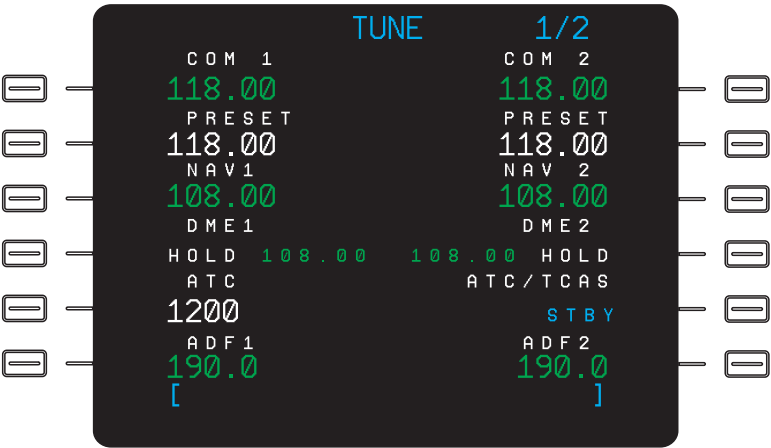
MANUAL TUNING (ALL RADIO TYPES)

RATIONALE:

All radios can be manually tuned as needed.

SUMMARY:

The CDU provides manual tuning control of both the onside and cross-side radios. Data entry to the CDU is made through the scratchpad and the line select keys. Information is entered on the scratchpad, then transferred to the appropriate location with the adjacent line select key. Warning messages show if the information entered is not appropriate for the data field.



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RULES:

The FMS supports 8.33 kHz frequency separation in the VHF frequency range of 118.000 to 136.990 in systems with compatible communication radios. Navaid frequencies, ADF frequencies, and transponder codes are not affected by the 8.33 kHz separation. In the 8.33 kHz tuning configuration, the TUNE pages show six digits for COM channel names (frequencies). The naming convention for frequencies is shown in the table below. The actual tuning frequency is not entered in the scratchpad in the 8.33 kHz mode. Trying to enter an invalid channel name in any of the COM channels causes the message INVALID ENTRY to show in the scratchpad. Trailing zeros and decimal points

are not required to be entered as part of the channel name, but show once the channel name has been entered.

FREQUENCY (MHZ)	CHANNEL SPACING (kHz)	CHANNEL NAME
118.0000	25	118.000
118.0000	8.33	118.005
118.0083	8.33	118.010
118.0167	8.33	118.015
118.0250	25	118.025
118.0250	8.33	118.030
118.0333	8.33	118.035
118.0417	8.33	118.040
118.0500	25	118.050
118.0500	8.33	118.055
118.0583	8.33	118.060
118.0667	8.33	118.065
118.0750	25	118.075
118.0750	8.33	118.080
ETC	ETC	ETC

▼ CHECKLIST:

1	Push the TUN function key to show the TUNE 1/2 page.
2	To tune a radio (COM, NAV, ADF) directly, do one of the following steps: • Enter the frequency into the scratchpad, then push the line select key for the appropriate radio.

- Enter a preset channel number (1 through 20) into the scratchpad, then push the line select key for the appropriate radio.
- NAV radios only: Enter the three letter identifier for the NAVAID, then push the line select key for the appropriate radio (NAV 1 or NAV 2).
- To select the HF operation mode (lower sideband voice, upper sideband voice, amplitude modulation) for an HF frequency, enter the appropriate letters (LV, UV, AM) into the scratchpad, then push the HF line select key.

3 For HF tuning, push the NEXT function key to show the TUNE 2/2 page.

4 To tune the HF radio, do any of the following steps:

- To enter an HF frequency, enter the frequency in the scratchpad, then push the HF line select key.
- To select the operation mode (lower sideband voice, upper sideband voice, or amplitude modulation) for an HF frequency, enter the appropriate letters (LV, UV, AM) into the scratchpad, then push the HF line select key.
- To enter an HF preset channel, enter the preset channel number into the scratchpad, then push the HF line select key.

4.1 Push the HF line select key to show the HF CONTROL page.

4.2 Push the MODE line select key to select the EMER or MAR modes.

4.3



Enter the EMER or MAR channel number (for example, 1, 2, 3, etc.) into the scratchpad, then push the HF line select key.

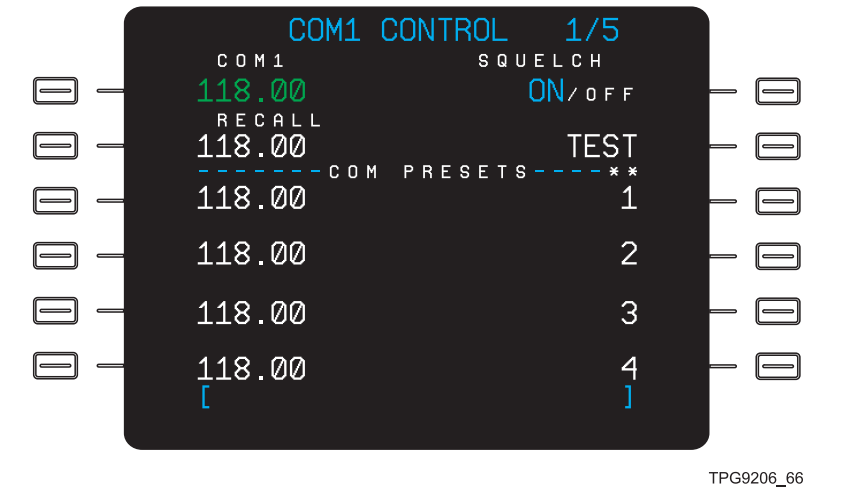
PRESETTING FREQUENCIES

RATIONALE:

The PRESETS function allows the operator to set frequently used COM, NAV, and ADF radio frequencies into preset channels.

SUMMARY:

The PRESETS feature allows the operator to set up to 20 preset frequencies for each installed radio. The PRESETS channels for each radio are accessed through the CONTROL pages for that radio.



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▼ CHECKLIST:

1	Push the TUN function key to show the TUNE 1/2 page.
2	Push the line select key for the appropriate radio to show the CONTROL page (COM CONTROL, NAV CONTROL, ADF CONTROL, HF CONTROL) for that radio.

3



NOTE

The HF radio has a separate page for setting the HF PRESETS. Pushing the HF PRESETS line select key on the HF CONTROL page shows the HF PRESETS page.

Enter the COM, NAV, ADF, or HF frequency or channel number into the scratchpad.



NOTE

NAV radio PRESETS can be filled by entering only the three-letter station identifier in the preset channels. The FMS enters the appropriate frequency using the information in the database.



NOTE

For HF frequencies, the frequency mode (LV, UV, or AM) can be entered at the same time as the frequency. Entry format is the frequency followed by a space, then the operating mode letters (for example, 5.250 LV). The default mode is UV.

4

Push a frequency (left side) line select key to transfer the entry from the scratchpad to the preset channel.



NOTE

Up to 20 preset frequencies can be set for each installed radio. The PREV or NEXT function page can be used to show all the CONTROL pages to view all preset frequencies for a radio.

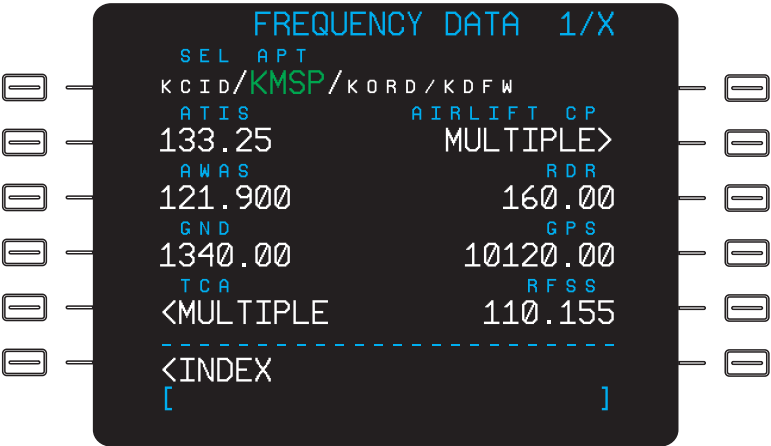
FREQUENCY LOOKUP

RATIONALE:

The FREQUENCY DATA pages show communication frequencies associated with airports, which lets the pilot quickly find and tune a desired frequency.

SUMMARY:

The FMS supplies the capability to lookup and show communication frequencies associated with airports, select a particular frequency, and tune the radio to that frequency via the FREQUENCY DATA page. The FREQUENCY DATA page lists the departure (origin), destination, and alternate airports contained in the active flight plan, along with space for a pilot-entered airport. When an airport is selected on the FREQUENCY DATA page, the communication types, such as ATIS, clearance delivery, and flight service stations, show along with the available frequencies. The pilot can select a frequency and tune the radio to that frequency with the CDU scratchpad.



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▼ CHECKLIST:

1	Push the IDX function key to show the INDEX 1/2 page with the FREQUENCY selection.

- 2 Push the FREQUENCY line select key to show the FREQUENCY DATA page.
- 3 The currently selected airport shows in large green font. To change the airport selection, push the SEL APT line select key until the desired airport identifier is selected.
- 4 To enter an airport that is not in the active flight plan, or to change the pilot-entered airport:
 - 4.1 Enter the four-letter ICAO identifier of the airport into the scratchpad.
 - 4.2 Push the SEL APT line select key to transfer the airport identifier to the prompt boxes.
- 5 To tune the radio to the desired frequency, do the steps that follow:



NOTE

If no pilot-entered airport currently exists, four prompt boxes show in the pilot-entered airport field.



NOTE

Based on the number of frequencies available for the selected airport, there can be up to nine FREQUENCY DATA pages. The NEXT or PREV function key can be used as necessary to show the page with the desired communication type.



NOTE

Some communication types have multiple frequencies available. The MULTIPLE line select key for that communication type can be used to show the list of frequencies. A page with the communication type as the title (such as TCA) shows with the list of frequencies. Based on the number of frequencies available for that communication type, there may be up to nine additional pages. The PREV or NEXT function key can be used to show any additional pages.

- 5.1 Push the line select key adjacent to the desired frequency to copy the frequency to the scratchpad.
- 5.2 Push the TUN function key to show the TUNE 1/2 page.
- 6 Push the line select key for the applicable radio to transfer the frequency from the scratchpad and tune the radio to that frequency.

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VNAV OPERATIONS

INTRODUCTION

The FMS provides multiple Vertical Navigation waypoints for each phase of flight. Vertical Navigation helps the pilot to comply with the following:

- Altitude and speed constraints at waypoints
- Speed limits at altitudes
- The vertical flight profile as specified by the pilot.

Vertical Navigation (VNAV) mode automatically commands the autopilot to sequence modes and set target speeds and altitudes to ensure the flight plan requirements are followed within the constraints of the preselect altitude setting. By integrating VNAV data with the autopilot, pilots have full command of the normal autopilot modes (Pitch, Flight Level Change, Vertical Speed, and Altitude Hold) while VNAV mode is active. If the aircraft is commanded to violate a VNAV constraint, appropriate warning annunciations are given to the pilots by the VNAV functions.

During the various phases of flight, VNAV follows the flight plan. It captures an altitude to level the aircraft at the flight plan altitude constraints, and begins descent at a planned location. Step climbs can be initiated with the altitude preselector and selection of the desired climb mode.

During descent, VNAV computes a geographical path to each waypoint with an altitude constraint, and provides guidance relative to that path. If there are multiple altitude constraints at various waypoints along the flight plan, the FMS automatically adjusts the descent path for a smooth stabilized descent while ensuring that the altitude constraints are honored.

**NOTE**

The FMS vertical speed advisory pointer that shows on the PFD vertical speed scale gives the flight crew the awareness of the climb/descent rate that is necessary for the aircraft to achieve the next altitude constraint. Display of the vertical speed advisory pointer on the PFD vertical speed scale will be allowed in cases where FMS performance calculations indicate that the requirements to achieve flight plan altitude constraints fall outside the boundaries of expected aircraft operation. The vertical speed advisory pointer position on the VSI scale is a reflection of the FMS calculation of required climb/descent rates associated with the flight plan. It does not imply that the aircraft is capable of meeting the required rate of climb/descent.

In a flight plan, each waypoint can show some or all of the VNAV data that follows. With some exceptions, each of these can be changed.

- An altitude constraint
- Climb or descent applicability (↑ for climb, ↓ for descent)
- A vertical path angle
- A speed constraint.

When a flight plan is created, the FMS automatically makes the first half of the waypoints in the flight plan climbs (↑), and the last half waypoints descends (↓). SID waypoints are automatically assigned as climbs, and STAR and approach waypoints as descents. Flight plan climb or descent constraints can be changed using the entry formats described in the procedure that follows.

An altitude constraint that shows in yellow indicates any one of the conditions that follow.

- The aircraft currently not flying in a manner required to meet the specified flight plan altitude constraints, or will not be able to do so.
- All climb altitude constraints do not precede all descent altitude constraints (except for the missed approach procedure).
- A climb altitude constraint is lower than the preceding climb altitude constraint.
- A descent altitude constraint is higher than the preceding descent altitude constraint.
- An altitude constraint is higher than the cruise altitude (CRZ ALT) that was defined on the PERF INIT page.

An altitude constraint that shows in yellow is not necessarily an incorrect entry. Examine any altitude constraint that shows in yellow to confirm why it shows in yellow.

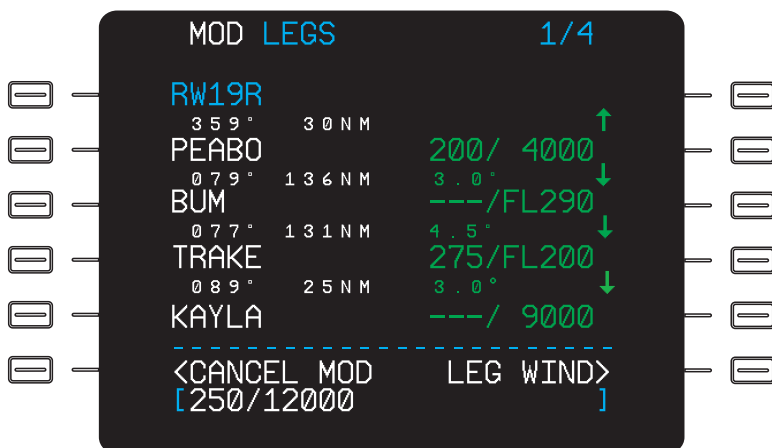
ENTER/CHANGE VNAV DATA

RATIONALE:

Entering or updated VNAV data for the active flight plan allows the operator to take advantage of the VNAV capability.

SUMMARY:

VNAV information shows on the ACT LEGS pages. When any VNAV entry or change is made, the FMS handles them by creating a MOD FLPN in the same manner as a lateral change. For the changes to be included in the ACT FLPN, push the EXEC function key on the CDU to execute the flight plan.



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RULES:

The following rules apply to the format and range for VNAV data entries.

- For speeds, enter a three digit number (IAS) from 100 to 499, or a two digit Mach setting from .10 to .99 (with the decimal point prefix).
- For VPA, entry range is from 1.0 to the maximum VPA specified for the aircraft.

- For altitude, entries can be barometric pressure altitudes or flight levels. Altitude entry range is from -1300 feet to 65000 feet, and FL000 to FL650. Flight level entries are prefixed with F or FL.
- Altitudes can be suffixed with the letter A (at or above) or B (at or below).
- For between altitudes, enter the lower altitude suffixed with an A, immediately followed by the upper altitude suffixed with a B (for example, 6000A8000B)
- Enter C to change a descent to a climb, or D to change a climb to a descent.
- Speed and altitude entries can be combined if separated by a / (slash) mark (for example, 250/10000, .78/F290).

▼ CHECKLIST:

1	Push the LEGS function key on the CDU to show the ACT LEGS page.
2	Enter the desired data in the scratchpad.  NOTE The letters C and D do not show on the altitude constraints once they are transferred from the scratchpad to the flight plan. The flight plan indicates an up arrow for climb altitude constraints and a down arrow for descent altitude constraints.  NOTE When entering barometric pressure altitudes, if the altitude is less than 500 feet, prefix the altitude with a / (slash) to prevent the FMS from misidentifying the altitude as a speed or VPA.
3	Push the line select key for the appropriate waypoint to transfer the information from the scratchpad.

4



TIP

If several waypoints use the same VNAV information, such as altitude, copy the VNAV information to the scratchpad by pushing the appropriate right line select key (instead of manually entering the data), then transferring the data to another waypoint.

Make sure that the data is correct, then push the EXEC function key to execute the MOD FPLN.

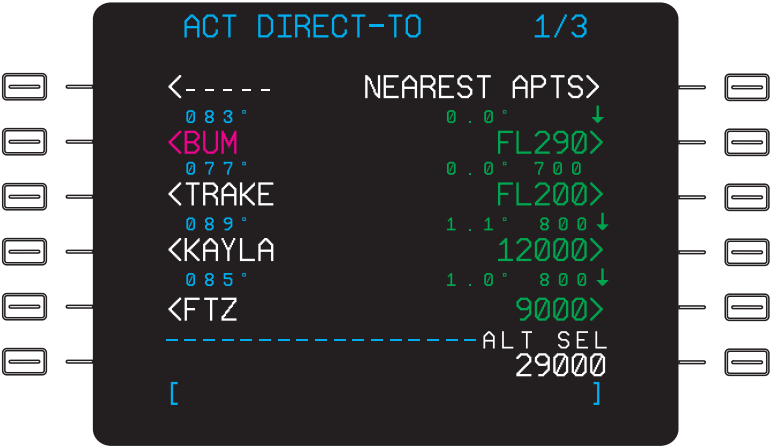
VERTICAL DIRECT-TO

RATIONALE:

The Vertical Direct-To function allows the operator to create an FMS descent path to a down-track waypoint.

SUMMARY:

The operator can enter a Direct-To descent to an altitude at a down-track waypoint. In response, the FMS will calculate a Vertical Path Angle (VPA) and provide pitch steering commands to vertically fly Direct-To the selected altitude. The waypoint for the Direct-To altitude does not have to be the active lateral waypoint; it can be any down-track waypoint. When creating a Vertical Direct-To, if there are other altitude constraints between the aircraft present position and the waypoint selected as the Vertical Direct-To, the intermediate constraints are automatically deleted when the Vertical Direct-To is executed.



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RULES:

- The Direct-To waypoint cannot be a waypoint beyond a discontinuity or a vectors leg.
- A Vertical Direct-To cannot be created when the active waypoint is a holding pattern.
- A Vertical Direct-To is limited to descents only, and cannot exceed the maximum VPA specified for the aircraft.

▼ **CHECKLIST:**

1	Push the DIR function key to show the ACT DIRECT-TO page.  NOTE If the desired altitude is already displayed on the target waypoint, Step 2 can be skipped.
2	Enter the desired altitude in the scratchpad, or push the ALT SEL line select key to enter the preselector altitude in the scratchpad.
3	Push the line select key adjacent to the associated waypoint to transfer the altitude value entered in the scratchpad to the desired waypoint.  NOTE The waypoint list can be large enough to fill several CDU display pages. The NEXT or PREV function key can be used as necessary to show the desired waypoint on the display.
4	Push the line select key to the left of the desired waypoint to command a vertical Direct-To.
5	Make sure that the flight plan changed on the CDU, then push the EXEC function key to execute the flight plan.

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CONTROLS AND INDICATORS

INTRODUCTION

Primary control of the FMS is through the Control Display Unit (CDU). The CDU acts as the single control point for FMS operations and functions. The electronic flight displays (PFD and MFD) provide additional display capability for FMS information and functions.

The CDU is the pilot's interface with the various functions of the FMS-6100. It has a color display to show the FMS-related information and function modes. The line select keys around the display select modes and copy or transfer displayed information. The CDU function keys are used to directly select many of the FMS functions and display modes. It also has a full alphanumeric keypad for entering data.

All operations that entail entering data for FMS operating functions are done through the use of a scratchpad entry system. Flight plan data, performance data, or data for other FMS operations, is entered directly into the scratchpad with the keypad, or by pushing a line select key to copy data shown on a display line to the scratchpad. From the scratchpad, data is transferred to the appropriate data line by pushing the line select key for the entry position.

FMS operating modes are selected directly by pushing the appropriate function key, or by pushing a line select key adjacent to an item in a menu shown on the display. Some functions are alternately switched on and off with sequential pushes of the associated line select key or a function key.

The Primary Flight Display (PFD) shows the information related to FMS operations, including NAV source annunciation, course/deviation bar, a navigation data readout, Vertical Navigation (VNAV) information, and FMS messages.

The Multifunction Display (MFD) shows both FMS Map and Text displays. Map displays show the various navigation facilities in and progress along the flight plan. A text window that shows navigation and VNAV information above the MFD map display can be enabled. Text displays show information on navigation and aircraft performance in text-only formats.

CONTROL DISPLAY UNIT (CDU) DISPLAYS



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The top line of the CDU display shows a title/mode, and the current page number and total number of pages as applicable for that display mode. Below the title/mode line, there are six data lines and six label lines to show data for a given display page. The two bottom lines on the display are used for the scratchpad and message lines. Many of

the display pages are configured to show two columns of information, which allows the use of the line select keys on both sides of the display to select, copy, or transfer displayed data. Refer to the MENUS AND DISPLAYS chapter of this operator's guide for detailed information on a specific display page.

▼ **CALLOUTS:**

Text Lines	The display shows up to 15 lines of 24 characters of text in five colors. Text shows in a large or small font depending on its use. Generally, display page titles, data lines with a mode selection or data entry capability, manual or default override entries, and active mode selections show in the large font. Label lines, FMS-calculated data values, and unselected mode functions show in the small font.
Title/Mode Line	The top line of the CDU display always shows the display page title or mode, and the current page and total number of pages when applicable.
Data Lines	Data lines align with the line select keys. Data lines show specific information related to the selected display page. On many of the display pages, the line select keys can copy the associated data line information into the scratchpad to use on another data line on the same page, or on another display page.

□ □ □ □ □
Prompts

Prompts show on data lines as small square boxes. A prompt indicates required input of data to perform the function related to the prompt description on the label line. If no data is entered for a specific prompt, it is possible that the FMS will not be able to perform the related function, or it can have degraded performance. To enter data to replace a prompt, it must be entered into the scratchpad, then transferred to the prompt.

Dashes

Dashes show on data lines where data can be entered. The dashed data lines are for optional information and do not require input. However, a specific format can be required for the data that is entered on a dashed data line. To enter data into a dashed data line, the data must be entered into the scratchpad, then transferred to the data line with its associated line select key.

Label Lines

Label lines show above each data line. They describe the information in a data line or provide additional information related to the data.

Function Lines

Many of the display pages use the two bottom line select keys for additional function selections. To separate function selection lines from the data lines, the display page shows a dashed line across the display on the label line above the bottom two line select keys. For some functions, in addition to the dashed line, there can also be a label on the line that describes the operations of one or both of the bottom line select keys.

Scratchpad

The scratchpad display line shows just below the bottom line select keys with brackets [] at each end of the line. Unless specified otherwise, all data entered, changes made to a flight plan, or other FMS-controlled functions, must be done through the scratchpad. When the scratchpad is empty (no text or messages showing between the brackets), enter data into it using the alphanumeric keypad, or copy data directly from the display by pushing the appropriate line select key. Once data is in the scratchpad, transfer it to the desired data line on the appropriate display page by pushing the line select key for that data position.

Messages show momentarily on the scratchpad line for data entry errors and other scratchpad operating errors. Scratchpad messages are described in detail in the MESSAGES AND ANNUNCIATORS chapter of this operator's guide.

Message Line

Below the scratchpad on the bottom line of the display is the message line. Various messages show on the message line to inform or alert the operator of the various functional operations. Each message is described in detail in the MESSAGES AND ANNUNCIATORS chapter of this operator's guide.

Display Colors

Five colors (cyan, yellow, magenta, white, and green) are used to show text on the various CDU display pages.

Cyan is generally used for secondary information. Cyan is specifically used for:

- Display page titles and page numbers
- Label line text (except on the TUNE page)
- FROM waypoint on the ACT/MOD LEGS page
- Scratchpad brackets.

Green is generally used for active mode selections, and same-side data. Green is specifically used for:

- VNAV data
- Active mode selection (except on the TUNE page when it is used for frequencies and transponder codes).

White is generally used for:

- Line select key functions
- Scratchpad entries and error messages
- Selected messages on the message line and MESSAGES page
- Data lines except for those with mode selections and the TO waypoint
- Unselected modes
- The word MOD on the modified FPLN and LEGS display page titles
- TO waypoint on the MOD FPLN and MOD LEGS display pages
- ACT LEGS and TUNE page label lines
- MSG, EXEC, and OFFSET annunciations on the message line.



Yellow is generally used for selected messages on the message line and MESSAGES page, cross-side data, and for an expired active database.

Magenta is used for the TO waypoint on the CDU and electronic flight displays (PFD and MFD).

CDU CONTROLS



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▼ **CALLOUTS:**

Line Select Keys

The line select keys are placed on either side of the display. Push a line select key to copy or transfer its associated display data to or from the scratchpad, or to select an associated operating mode or function shown on a display page.

MSG

Message Key

Push the MSG function key on the CDU to show the MESSAGES page. Refer to the figure on page 14-143. Push the MSG function key while the MESSAGES page is showing to return to the CDU display mode that was showing before the MESSAGES display mode was selected. Refer to the MESSAGES AND ANNUNCIATIONS chapter for detailed descriptions of the messages that show on the MESSAGES page and message line.

DIR

Direct Function Key

Push the DIR function key on the CDU to show the ACT DIRECT-TO pages. The ACT DIRECT-TO pages can consist of several pages and show a list of waypoints in the active flight plan. The pilot can select a DIRECT-TO waypoint from the list, or enter any valid waypoint into the top (dashed) waypoint line as a DIRECT-TO waypoint. The pilot can also enter an altitude for a vertical DIRECT-TO. The ACT DIRECT-TO pages also show a selection for NEAREST AIRPORTS. Refer to the figure on page 14-124.

FPLN

Flight Plan Function
Key

Push the FPLN function key on the CDU to show either the ACT FPLN or MOD FPLN page. Each page shows the same information. Refer to the figure on page 14-79.

LEGS

Legs Function Key

Push the LEGS function key to show either the ACT LEGS or MOD LEGS page. Each of these pages shows the same information. Refer to the figure on page 14-81.

DEP ARR

Departure/Arrival
Function Key

Push the DEP ARR function key on the CDU key to show the DEPART page for the origin airport , the ARRIVAL page for the destination airport, or the DEP/ARR INDEX page. If the DEPART or ARRIVAL page is showing, a second push of the DEP ARR function key shows the DEP/ARR INDEX page. Refer to the figure on page 14-117, the figure on page 14-119, and the figure on page 14-121.

PERF

Performance Func-
tion Key

Push the PERF function key on the CDU to show the PERF MENU page. The PERF MENU page shows a menu of the available performance functions, allows the pilot to enable the VNAV advisory function, and displays/enables the VNAV PLAN SPD. Refer to the figure on page 14-84.

MFD MENU

MFD Display Menu
Function Key

Push the MFD MENU function key on the CDU to show the DISPLAY MENU page. When the MFD MENU function key is pushed, either the MAP DISPLAY page or the TEXT DISPLAY page shows. The MFD DATA function key controls whether the MAP DISPLAY or TEXT DISPLAY menu shows. The DISPLAY MENU page is used to select the display of airports, navigation facilities, and other navigation-related display elements, modes or options for the PPOS MAP, PLAN MAP, and TEXT PG display modes of the MFDs. Refer to the figure on page 14-147 and the figure on page 14-152.

MFD ADV

MFD Advance
Function Key

Push the MFD ADV function key on the CDU to show the DISPLAY ADVANCE page. Use this page to move through the MFD text pages, or to move the center waypoint on the MFD PLAN MAP. This page shows either a TEXT DISPLAY menu or a PLAN MAP CENTER menu, depending on whether the MFD is in a Map mode or the Text mode. The MFD DATA function key whether the TEXT DISPLAY or the PLAN MAP CENTER menu shows. Refer to the figure on page 14-155 and the figure on page 14-157.

MFD DATA

MFD Data Function
Key

Push the MFD DATA function key on the CDU to alternately switch display modes between MAP and TEXT modes for the same-side MFD. When MAP mode is selected, the MFD is in MAP mode. On the CDU, the MAP DISPLAY menu shows when the MFD MENU function key is pushed, and the PLAN MAP CENTER page shows when the MFD ADV key is pushed. When TEXT mode is selected, the MFD is in TEXT mode. On the CDU, the TEXT DISPLAY menu shows when the MFD MENU function key is pushed, and the TEXT DISPLAY menu shows when the MFD ADV key is pushed.

PREV

Previous Page
Function Key

Many CDU display modes, such as ACT LEGS and ACT FPLN, can require several pages to show all their information. Page numbers in the upper right corner show the current page and total number of pages of the display mode. Push the PREV function key to go back to a previous page of a selected display mode. When the first page of display mode is showing, push the PREV function key to go directly to the last page of that display mode.

NEXT

Next Page Function
Key

Many CDU display modes, such as ACT LEGS and ACT FPLN, can require several pages to show all their information. Page numbers in the upper right corner show the current page and total number of pages of the display mode. Push the NEXT function key to advance to the next page of the selected display mode. When the last page of a display mode is showing, push the NEXT function key to return to the first page of that display mode.

EXEC

Execute Function
Key

Push the EXEC function key to execute a flight plan and change the MOD LEGS to the ACT LEGS or MOD FPLN to the ACT FPLN page. Pushing the EXEC function key allows the FMS to use the flight plan to generate steering commands for the flight guidance systems if any of the following apply:

- A new flight plan is entered on the FPLN or LEGS pages
- A modification is made to an active flight plan on the ACT FPLN or ACT LEGS pages
- Selected entries or changes are made on the PERF INIT pages.

This method of flight plan activation allows the operator to enter, change, and review a flight plan before it is activated for use as a steering source by the FMS.

IDX

Index Function Key

Push the IDX function key to show the INDEX pages. The INDEX pages shows a menu of additional FMS functions available, that do not have direct access function keys. Refer to the figure on page 14-3 and the figure on page 14-6.

TUN

Radio Tuning Function Key

Push the TUN function key on the CDU to show the TUNE page. Refer to the figure on page 14-128.



NOTE

The equipment installed in the aircraft, the interconnect wiring in the aircraft, and the FMS options installed determine what radio controls are available on the TUNE page.

CLR DEL

Clear/Delete Function Key

The CLR DEL key performs two functions, depending on whether or not there is data in the scratchpad.

- When there is data in the scratchpad, push and release the CLR DEL key to backspace one character at a time (right to left), or push and hold the key for more than 1/2 second to clear the entire scratchpad at once.
- When there is no data in the scratchpad, push the CLR DEL key to enter the word DELETE into the scratchpad. This can then be transferred to various functions or data fields on the CDU pages to delete the data currently entered/showing for that function or field.

Keypad

The keypad includes the 26 letters of the alphabet, the numbers 0 through 9, a decimal point, a +/- key, a space (SP) key, and a slash (/) key. Push the letter keys to enter letter characters into the scratchpad. Push the number keys to enter numbers into the scratchpad.

BRT DIM

Bright/Dim Button

The BRT DIM button adjusts the brightness of the CDU display. Push the BRT edge of the button to increase brightness. Push the DIM edge of the button to decrease brightness.

CURSOR CONTROL PANEL (CCP)



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The Cursor Control Panel provides control for the MFD display format.



NOTE

Only the controls that apply to FMS-sourced displays will be described in this section.

▼ CALLOUTS:

L/R
L/R Toggle Switch

The L/R toggle switch selects which MFD the CCP is controlling. When the displays are not reverted, the L position selects the left MFD, and the R position selects the right MFD.

Joystick

The joystick provides control to position the FMS PPOS map pilot-created waypoint. With the FMS PPOS map showing, move the joystick to position the cursor at a desired point on the map. When the ENTER button is pushed, the geographic coordinates show in the CDU scratchpad.

FRMT

Format Button

The FRMT button shows the Format menu on the MFD and selects the next available MFD format.

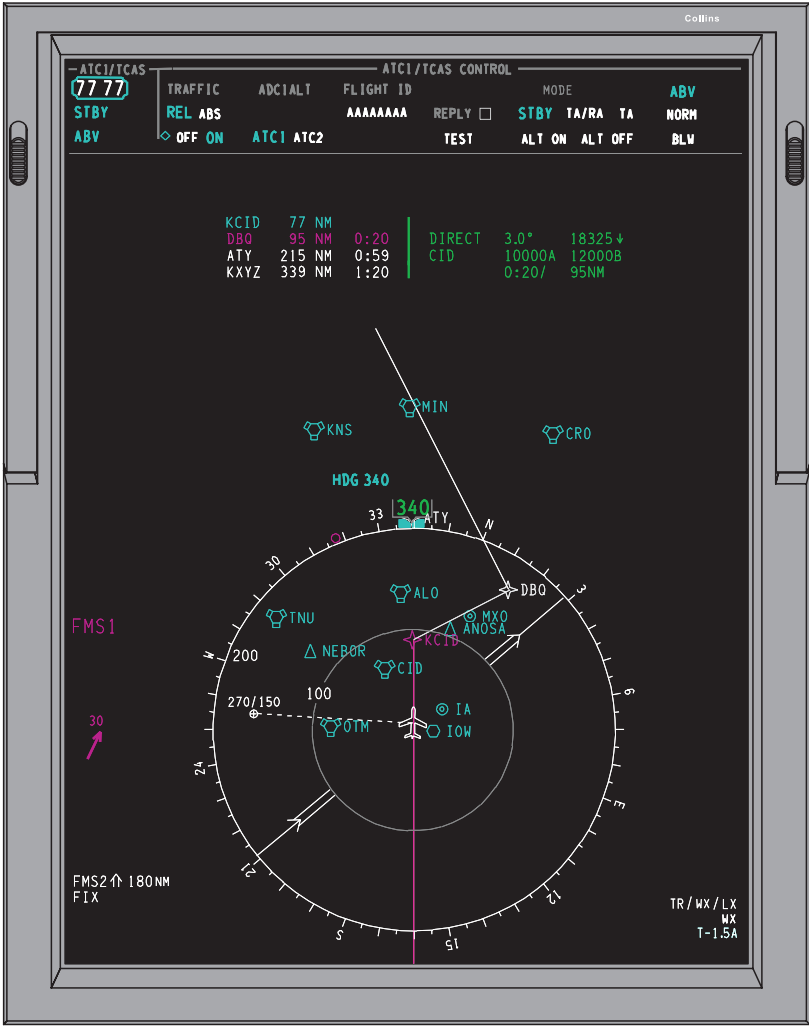
ENTER

Enter Button

The ENTER button works in conjunction with the joystick. When the FMS PPOS map shows, pushing the ENTER button enters the geographical coordinates of the cursor position, which is controlled by the joystick.



MULTIFUNCTION DISPLAY (MFD)



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The MFD shows both FMS Map and Text displays. In the Map display modes, symbols are used to identify and show the various navigation facilities in relation to the current position of the aircraft or a selected waypoint along the flight plan. The MFD also has a five-line text

window that can be enabled to show selected navigation and VNAV information above the MFD map display. Text displays show information related to the flight plan progress, current position of the aircraft, status of navigation sensors (VOR/DME and GPS), takeoff and landing performance data (Vs speeds), fuel management, and other functions. Controls for the MFD are provided primarily through the Display Control Panel (DCP) and the CDU.

PRIMARY FLIGHT DISPLAY (PFD)

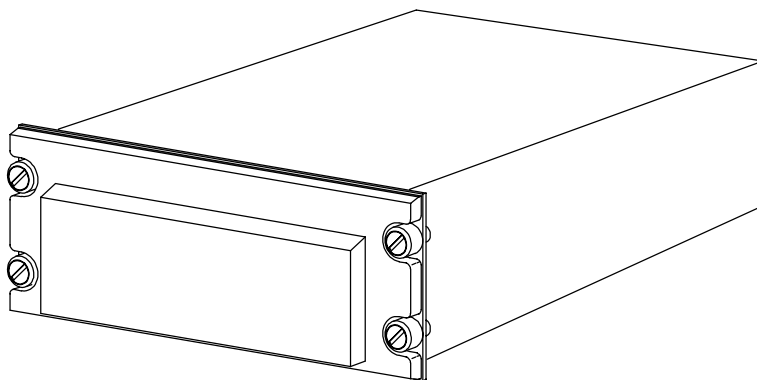


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The PFD shows the information related to FMS operations, including NAV source annunciation, course/deviation bar, a navigation data readout, Vertical Navigation (VNAV) information, and FMS messages. The Display Control Panel (DCP) and Flight Guidance Panel (FGP)

provide the controls for displaying information on the PFD. Specifically, the DCP selects the NAV modes, and the FGP selects the autopilot and flight director modes that are annunciated on the PFD. Controls for other sensors, such as those for air data and attitude, also control the information shown on the PFD.

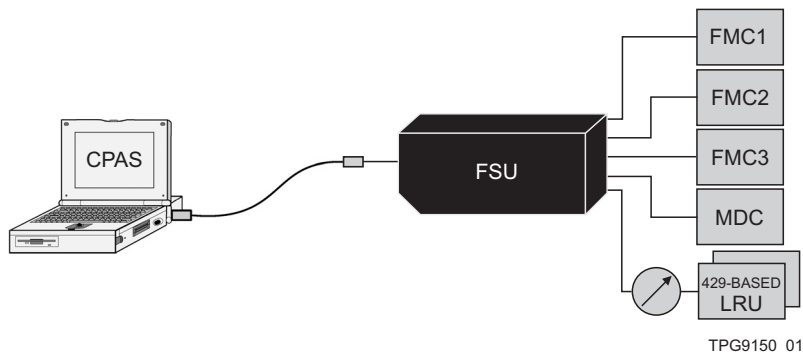
DATABASE UNIT (DBU)



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The DBU-4100 is a data loader for the FMS-6100 and other aircraft systems. Based on the installation, it can be mounted in the aircraft in an avionics bay, in the cockpit, or it can be a remote portable unit that plugs into a connector located in an avionics bay or the cockpit. The DBU-4100 accepts both the 750 kb and 1.44 mb 3.5-inch diskettes.

PCD-3000/CPAS-3000



Either the PCD-3000 or the CPAS-3000 supplies external data loading capability of FMS and MDC databases for the FMS-6100 and other aircraft systems. The PCD-3000/CPAS-3000 Data Loader is a software application that supplies external media upload and download capabilities. If a Collins File Server Unit is installed, the CPAS-3000 is the data loader. The FSU supplies the capability to allow uploads and downloads of databases to and from the FMC and other systems. A separate, customer-supplied PC or laptop computer is required to run the PCD-3000/CPAS-3000. Refer to the Collins PCD-3000 Data Loader User's Guide (CPN 523-0780041) for information on how to install and operate the PCD-3000 Data Loader. Refer to the Collins CPAS-3000 Data Loader Operator's Guide (CPN 523-0790386) for information on how to install and operate the CPAS-3000 Data Loader.

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MENUS AND DISPLAYS

INTRODUCTION

This chapter describes the display elements and pages related to FMS-6100 operations. It includes descriptions of the CDU display pages, and the PFD and the MFD display elements related to FMS operations.

CDU DISPLAYS

Figure 14-1 CDU Display Page



TPG9218_01

IDX

Path:

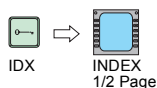
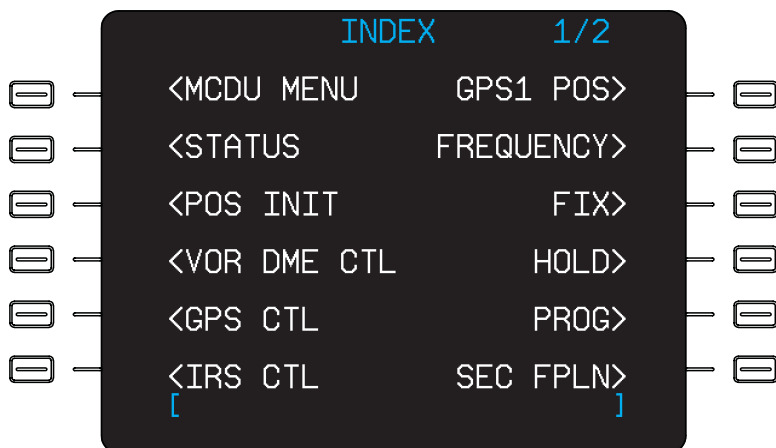


Figure 14-2 INDEX 1/2 Page



TPH8458_01

The INDEX pages show a menu of additional available FMS functions that do not have direct access from function keys. The menus include identifiers for the associated sensor side when applicable for FMS control pages (for example, FMS1 VOR CONTROL, FMS2 GPS CONTROL).



NOTE

The functions available from the INDEX pages can be different based on the equipment installed in the aircraft, the interconnect wiring on the aircraft, and the options installed in the FMS.



NOTE

For aircraft equipped with the Datalink option, a DATALINK line key selection will be available on the INDEX pages. Refer to the Collins Corporate Datalink System CMU-4000/RIU-40X0 Operator's Guide, CPN 523-0790499, for information on the operation of the Datalink function.

▼ **SELECTIONS:**

MCDU MENU	Selection supplies access to the MCDU MENU page. Refer to the figure on page 14-8.
STATUS	Selection supplies access to the STATUS page. Refer to the figure on page 14-10.
POS INIT	Selection supplies access to the POS INIT pages. Refer to the figure on page 14-13.
VOR DME CTL	Selection supplies access to the VOR/DME CONTROL page. Refer to the figure on page 14-18.
IRS CTL	Selection supplies access to the IRS CONTROL page. Refer to the figure on page 14-20.
GPS CTL	Selection supplies access to the GPS CONTROL page. Refer to the figure on page 14-21.
GPS1 POS	Selection supplies access to the GPS page. Refer to the figure on page 14-23.
FREQUENCY	Selection supplies access to the FREQUENCY DATA page. Refer to the figure on page 14-24.
FIX	Selection supplies access to the FIX INFO page(s). Refer to the figure on page 14-29.

HOLD

Selection supplies access to the FPLN HOLD page, the HOLD LIST page, or the ACT LEGS page with the HOLD AT prompt. Refer to the figure on page 14-33, the figure on page 14-39, and the figure on page 14-35.

PROG

Selection supplies access to the PROGRESS pages. Refer to the figure on page 14-40.

SEC FPLN

Selection supplies access to the SEC FPLN page(s). Refer to the figure on page 14-44.

Path:

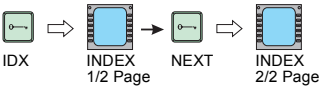
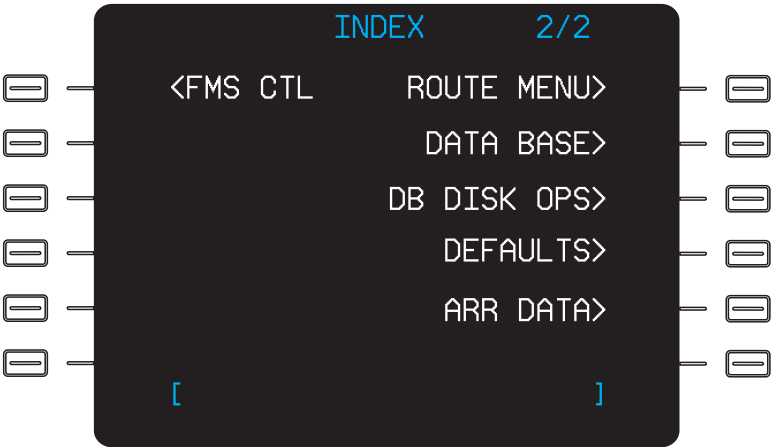


Figure 14-3 INDEX 2/2 Page



TPG9206_99

▼ SELECTIONS:

FMS CTL	Selection supplies access to the FMS CONTROL page. Refer to the figure on page 14-46.
ROUTE MENU	Selection supplies access to the ROUTE MENU page. Refer to the figure on page 14-47.
DATA BASE	Selection supplies access to the DATA BASE page. Refer to the figure on page 14-52.
DB DISK OPS	Selection supplies access to the DATA BASE DISK OPS page. Refer to the figure on page 14-63.

DEFAULTS

Selection supplies access to the DEFAULTS pages. Refer to the figure on page 14-65.

ARR DATA

Selection supplies access to the ARRIVAL DATA page for the destination airport. Refer to the figure on page 14-70.



MCDU MENU

Path:

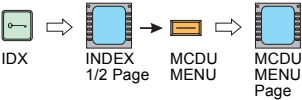
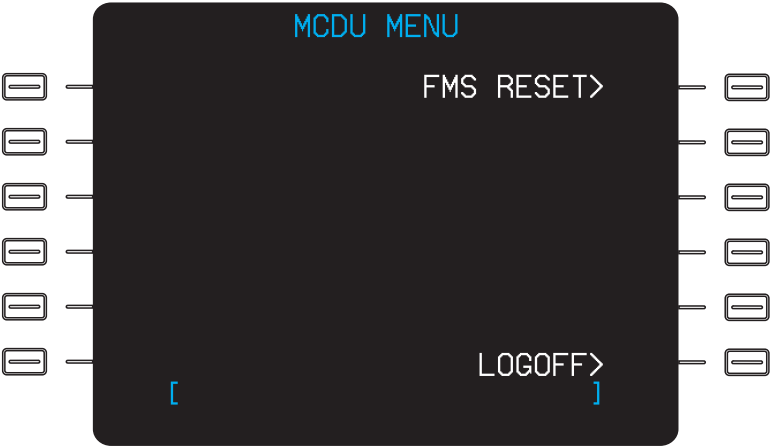


Figure 14-4 MCDU MENU Page



TPG9209_01

The MCDU MENU page provides access to the FMS reset function. The FMS reset function allows the operator to reset the CDU in the event the FMS has stopped responding or is locked up. If the FMS is locked up, the CDU will show the MCDU MENU page with the FMS RESET prompt.

▼ SELECTIONS:

FMS RESET

Selection supplies access to the RESET CONTROL page. Refer to the figure on page 14-9.

RESET CONTROL

Path:

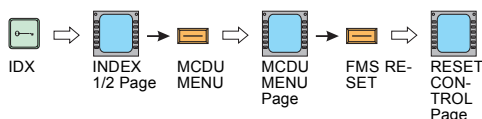


Figure 14-5 RESET CONTROL Page



TPG9209_02

The RESET CONTROL page provides the control to reset the CDU. When FMS RESET is selected on the MCDU MENU page, the RESET CONTROL page shows with a warning of the possible loss of data if the reset function is performed. If the operator still wants to perform the reset function, push the RESET line select key. The CDU sends the reset command to FMS. Once the FMS has been reset, it can be necessary for the operator to re-enter previously entered data, such as the flight plan and pilot-waypoints.

To exit the RESET CONTROL page without continuing with the reset function, push the CANCEL line select key to return to the MCDU MENU page.

STATUS

Path:

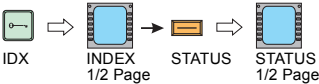
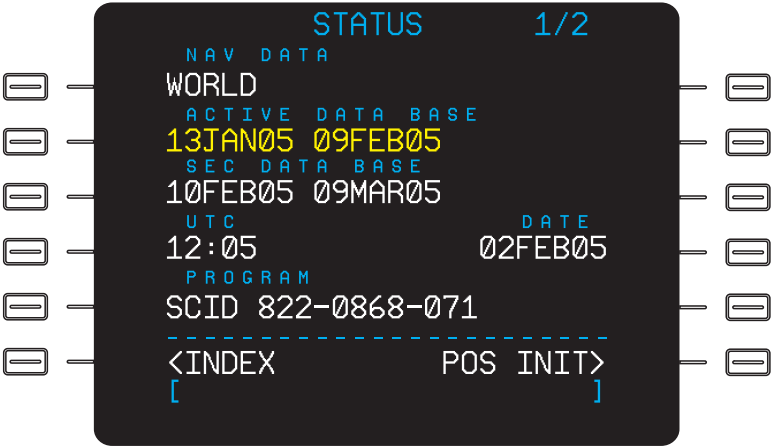


Figure 14-6 STATUS 1/2 Page



TPH8455_01

The STATUS 1/2 page can show on the CDU display at initial power-up, or when selected from the INDEX 1/2 page.

NOTE

The FMS STATUS 1/2 page can show on the CDU display at initial power-up. In SATCOM-equipped aircraft, the SATCOM menu page can show on the CDU display at initial power-up. To access the FMS STATUS page in these cases, push the IDX function key to show the INDEX 1/2 page, then push the STATUS line select key to show the STATUS 1/2 page.

The STATUS 1/2 page shows the following items:

- A NAV DATA identifier for the installed navigation databases
- The ACTIVE DATA BASE and SEC DATA BASE effective dates
- UTC time and DATE currently set for the FMS
- A PROGRAM identification code for the operating software installed in the FMS

- Line key selections for returning to the INDEX 1/2 page, or for going on to the position initialization (POS INIT) page.

An out-of-date ACTIVE DATA BASE shows in yellow, and a corrupted database (either the ACTIVE or SEC) shows dashed lines in place of the effective dates. If a database is not loaded, the effective dates are blank.

▼ **SELECTIONS:**

INDEX

Selection supplies access to the INDEX pages. Refer to the figure on page 14-3.

POS INIT

Selection supplies access to the POS INIT pages. Refer to the figure on page 14-13.

Path:

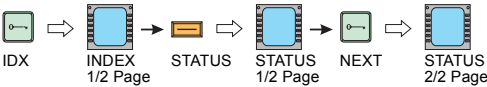
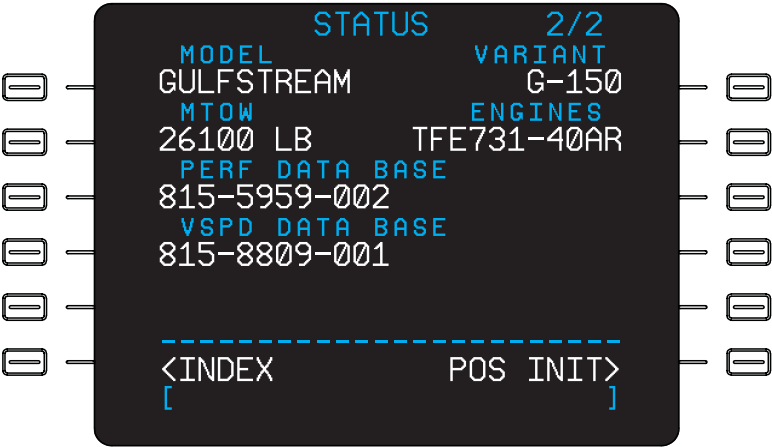


Figure 14-7 STATUS 2/2 Page



TPG9209_24

The STATUS 2/2 page shows the following items:

- The aircraft MODEL.
- The aircraft VARIANT.
- Maximum Takeoff Weight (MTOW).
- The ENGINES type name and number.
- The PERF DATA BASE identifier for the performance database installed in the FMS.
- The VSPD DATA BASE identifier for the Vspeeds performance database installed in the FMS.

POS INIT

Path:

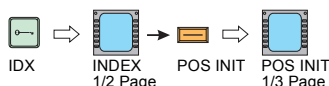
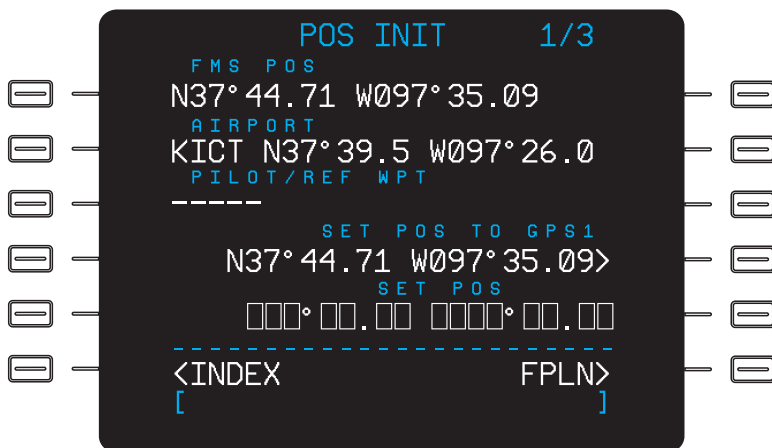


Figure 14-8 POS INIT 1/3 Page



TPG9206_02

The POS INIT line select key on the INDEX 1/2 page supplies access to the POS INIT pages. These pages are used to show and update the position data for the FMS and compatible IRS systems if installed. Based on the equipment installed in the aircraft, there can be several POS INIT pages. POS INIT 1/3 page always shows:

- The current FMS Position (FMS POS).
- An AIRPORT and its position (when on the ground).
- A PILOT/REF WPT and its position (for entering a specific waypoint to use for a position update or initialization).
- SET POS with a latitude and longitude position, prompt boxes or dashes. The prompt boxes show when the FMS needs a position update. Otherwise, a position or dashes shows.
- SET POS TO GPS1 with a latitude and longitude position of the available GPS, or dashes. The dashes show when no GPS is available for position initialization.

When an appropriate identifier is entered into the AIRPORT or PILOT/REF WPT data line, the associated latitude and longitude position shows adjacent to the identifier. Use any of the latitude and longitude positions shown on the page as a SET POS entry.

When the aircraft is on the ground, the AIRPORT or PILOT/REF WPT data line is normally filled with the destination airport from the last flight (if one was defined for that flight). Regardless of the data, enter the ICAO identifier of any airport in the navigation database. When an airport identifier is entered into the AIRPORT data line, the airport reference point latitude/longitude position shows adjacent to the identifier. Use of an AIRPORT entry to set the FMS position is possible only when the aircraft is on the ground. Display of the AIRPORT identifier and its location is cleared at takeoff.

The PILOT/REF WPT line is filled with a waypoint identifier when there is a Pilot Defined Waypoint within 3 NM of the current FMS position. Any Pilot Defined Waypoint, or any waypoint in the navigation database, can be used in the PILOT/REF WPT line. Use the PILOT/REF WPT entry to set the FMS position only when the aircraft is on the ground. The PILOT/REF WPT and its location are removed at takeoff.

The SET POS line shows prompt boxes to indicate that the FMS requires a position initialization or update. Entering a position into the SET POS line from the scratchpad updates the FMS to that position. If the position entered is more than 40 NM from the last known position, the message RESET INITIAL POS shows on the message line. Push the SET POS line select key two more times to re-enter or reset the position.

The SET POS line shows dashes 2 minutes after an entry is made if the aircraft is airborne, or 2 minutes after the aircraft becomes airborne if the entry is made when the aircraft is on the ground.

The SET POS TO GPS1 data fields are filled with data as soon as GPS1 or GPS2 is available (if the system has a third GPS installed, then GPS3 would also be annunciated). The data field position will be updated with the GPS position. Push the SET POS TO GPS1 line select key to update the FMS position to the GPS. If the aircraft position is greater than 40 NM from the nearest GPS position when the line select key is pushed, position reconfirmation is required. Push the SET POS TO GPS1 line select key a second time to re-enter or reset the position.

Path:

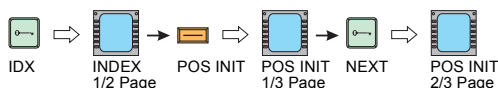
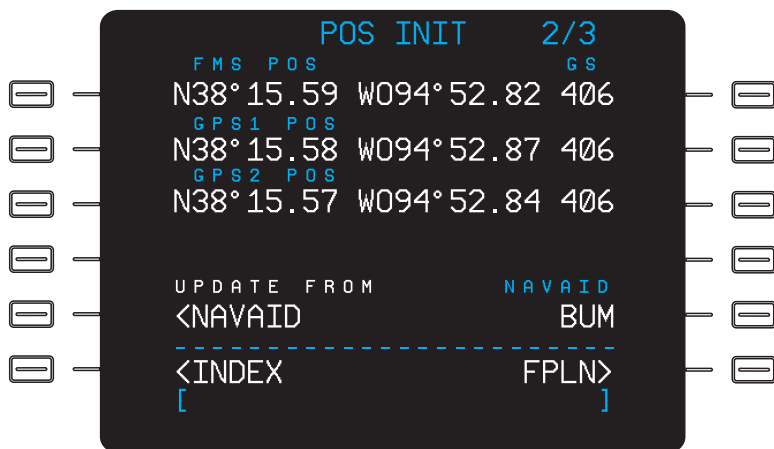


Figure 14-9 POS INIT 2/3 Page



TPG9209_25

Additional POS INIT pages show position information from other sensors available for use by the FMS, as well as the UPDATE FROM NAVAID function. Use the position information from any of the available sensors to initialize or update the FMS position. The UPDATE FROM NAVAID function is available only when the aircraft is airborne.

The UPDATE FROM NAVAID line is prefilled with the identifier of a navaid that meets the conditions that follow:

- The navaid is not disabled for use on the VOR CONTROL page.
- The navaid has collocated VOR and DME components (VOR/DME or VORTAC).
- Both same-side VOR and DME frequencies are tuned to the navaid.
- Both same-side VOR and DME data are valid.
- The current position based on the VOR/DME signals is within 30 NM of the FMS position.
- The DME distance measures less than 100 NM.
- If a DME identifier is received, it must match the navaid identifier.

If no navaid satisfies the above conditions, the NAVAID entry shows dashes.

An identifier can be manually entered to replace the dashes or to select another navaid instead of the one currently showing. A manually entered navaid shows in large font characters and remains on the NAVAID line until another identifier is entered, the NAV radio frequency changes, or the DME identifier differs.

Manual entry of a navaid identifier is accepted by the FMS provided the entry collocates the VOR and DME components. Entering a navaid identifier tunes the same-side VOR radio to the navaid frequency, and sets the tuning mode of that radio to MAN on the TUNE page. When an identifier is entered, which is not in the database, or is an unacceptable navaid, the appropriate scratchpad message shows on the CDU message line as follows:

- NOT IN DATA BASE
- NOT A COLOCATED NAVAID
- NOT A VOR/DME
- NAVAID INHIBITED.

If the VOR or DME components of a manually selected navaid are not received within 5 seconds after the selection, the identifier field changes to dashes and the scratchpad shows the message NAVAID NOT RECEIVED.

The navaid position initially shows as a radial and distance from the navaid. Push the LAT/LON line select key to see the position as a latitude/longitude. The position is updated regularly using the signals received from the specified navaid. Push the CONFIRM POS line select key to update the FMS position. If the position update from the navaid causes the message RESET INITIAL POS to show, a second UPDATE FROM NAVAID is required and must be accomplished within 5 NM of the first NAVAID update.

Path:

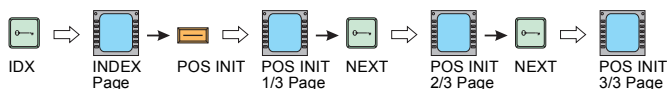
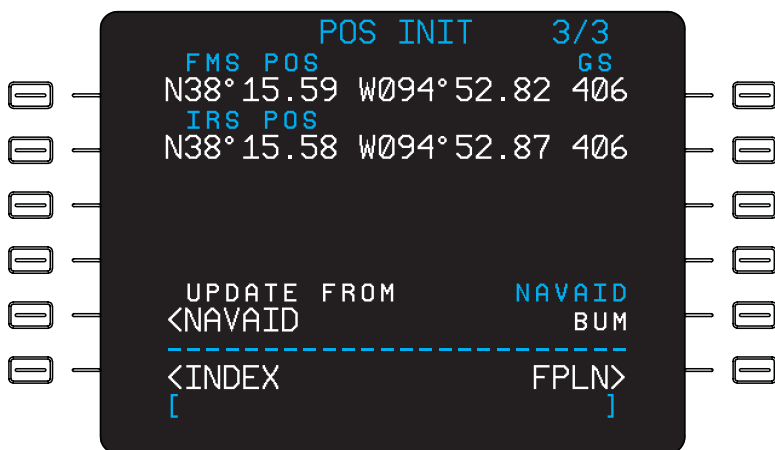


Figure 14-10 POS INIT 3/3 Page



TPG9209_98

VOR/DME CONTROL

Path:

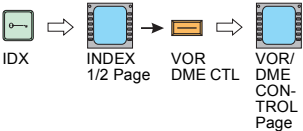
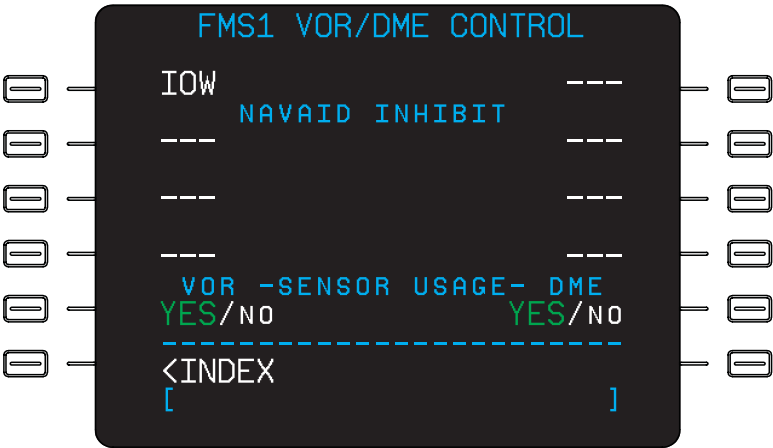


Figure 14-11 VOR/DME CONTROL Page



TPG9206_03

The VOR/DME CONTROL page is used to individually disable or enable the use of all VOR or all DME sensor data by the FMS in its calculations to determine position. It is also used to inhibit up to eight specific navigation aids from use by the FMS.

Push the YES/NO line select key for either VOR or DME to alternately enable and disable SENSOR USAGE of VOR data and DME data. When VOR usage is disabled, the message VOR DISABLED shows on the MESSAGE page. When DME usage is disabled, the message DME DISABLED shows on the MESSAGE page.

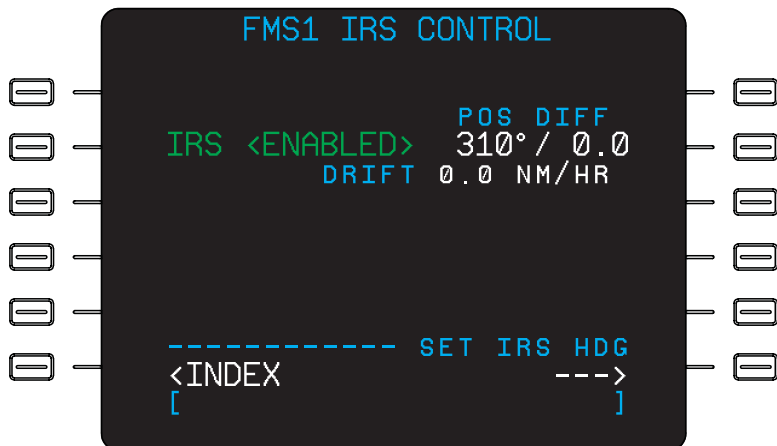
In either the SYNC or INDEP mode, if there is a change to the VOR or DME USAGE selection on one FMS, only that FMS is affected. The selection of VOR or DME SENSOR USAGE on the cross-side FMS will not be affected.

The selected SENSOR USAGE setting is reset to the VOR usage value and the DME usage value on the DEFAULTS 3/5 page when a new flight plan is created or one is selected from the PILOT ROUTES LIST.

To disable use of an individual VOR, enter the IDENT into the scratchpad, then transfer it to one of the NAVAID INHIBIT data lines. Up to eight navigation aids can be inhibited from use by the FMS. Individually inhibited navigation aids remain inhibited until they are deleted from the data lines, or until a new navigation database is selected.

IRS CONTROL

Figure 14-12 IRS CONTROL Page



TPG9209_99

The use of one or more IRS sensors data by the FMS is ENABLED or DISABLED on the IRS CONTROL page. It is also used to set the IRS heading when an IRS is in ATT mode.

The IRS CONTROL page shows position differences (POS DIFF) between each IRS sensor's position and the position calculated by the FMS. Both direction and distance (up to 99.9 NM) are given for a POS DIFF, as well as the current DRIFT rate (in NM/hr) if the IRS is set to the NAV mode. Any POS DIFF greater than 99.9 NM shows as 99.9 NM. Dashes show for the POS DIFF and DRIFT if insufficient data is available for their determination. Dashes also show for DRIFT if IRS is NOT set to the NAV mode or for 30 minutes after an initialization.

In some installations, remote switches in the cockpit are used to select the IRS sensors available for use by the FMS. If only one sensor is available to the FMS, the POS DIFF and DRIFT data lines of the other sensors are dashed.

Push the left side line select key of a sensor to alternately ENABLE or DISABLE use of that sensor by the FMS. An IRS sensor remains DISABLED until it is manually ENABLED by the pilot.

If an IRS is in ATTITUDE mode and needs a heading entry, the IRS CONTROL page shows the SET IRS HDG prompt. Enter the necessary

heading into the scratchpad and transfer it to the prompt. The entered heading value is dashed after the heading update is transmitted. The SET IRS HDG prompt with dashes ONLY shows if an IRS is set to ATT.



NOTE

The FMS does not use IRS data in the calculations to determine position when the IRS is ALIGNING in the NAV mode or is set to ATTITUDE mode.

GPS CONTROL

Path:

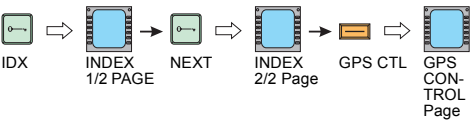
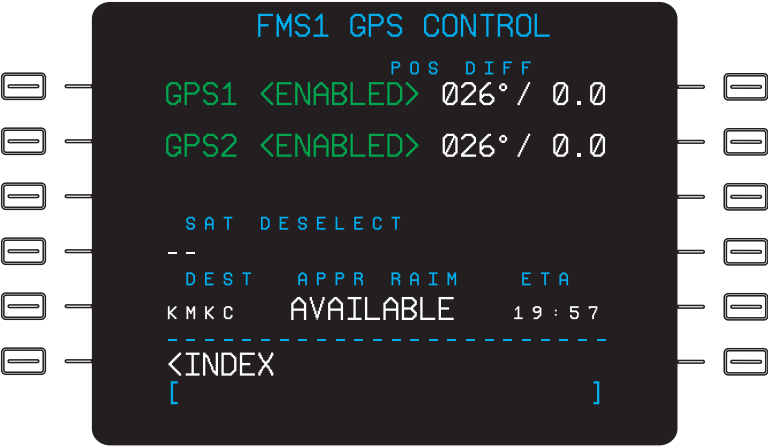


Figure 14-13 GPS CONTROL Page



TPG9209_26

The GPS CONTROL page shows position differences (POS DIFF) between each GPS sensor position and the position calculated by the FMS. Both direction and distance (up to 99.9 NM) show. A position difference greater than 99.9 NM shows as 99.9 NM. Dashes show for the POS DIFF if there is insufficient data to calculate a difference.

The line select key for each installed GPS sensor enables or disables the use of the sensor by the FMS. If a GPS sensor has been DISABLED, it remains disabled until the pilot manually enables it.

SAT DESELECT is used to deselect up to eight satellites that are scheduled to be out of service as identified in NOTAMs. Deselected satellites (SAT DESELECT) are not included in the predicted RAIM computations. Enter the satellite numbers one at a time. Enable all deselected satellites at once with the CLR/DEL function key, or enable individual satellites from the list by reentering the satellite number.

The DEST and ETA entries, by default, are those of the active flight plan. Changes can be manually entered to see if RAIM is available for other destinations and/or arrival times. APPR RAIM indicates if approach RAIM will be available at the ETA that shows.

GPS POS

Path:

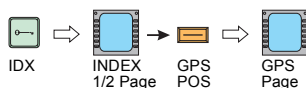
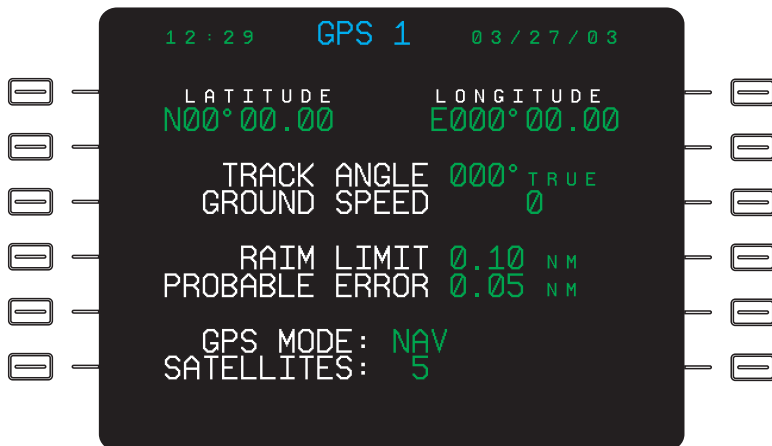


Figure 14-14 GPS Page



TPG9209_92

The GPS page is used to show the current GPS position and related GPS information. The information on the GPS page is for display only and cannot be edited. The GPS page shows:

- The current time and date
- Latitude and longitude coordinates of the GPS position
- Track angle and ground speed
- RAIM LIMIT in nautical miles
- PROBABLE ERROR in nautical miles
- The current GPS MODE
- The number of satellites the GPS is currently tracking.

FREQUENCY

Condition(s):

If there are airport frequencies stored in the navigation database, the FREQUENCY DATA page shows.

Path:

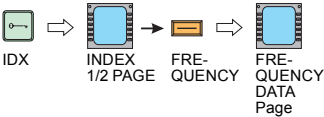
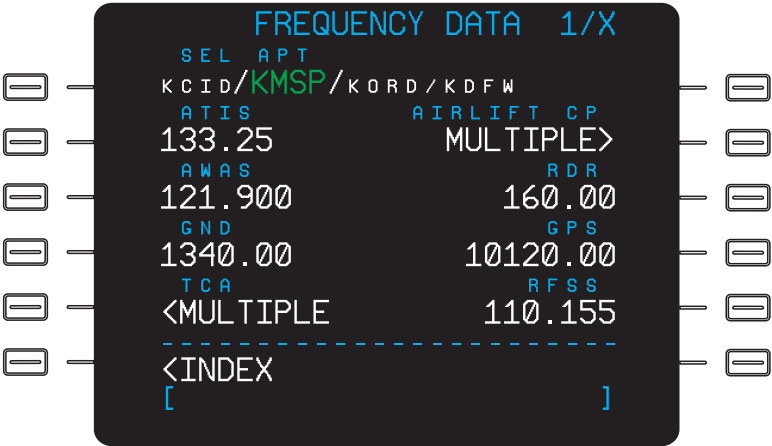


Figure 14-15 FREQUENCY DATA Page



TPH8808_01

The FREQUENCY DATA pages show communication frequencies associated with airports.

The FREQUENCY DATA page lists the origin, destination, and alternate airports along with a space for a pilot-entered airport.

If a pilot-entered airport identifier is associated with more than one airport stored in the navigation database, the SELECT APT page shows that lists the identifier, ICAO country code, and the latitude and longitude for each airport. Refer to the figure on page 14-78.

If there are no frequencies stored in the database, the FREQUENCY DATA page with the message NO DATA AVAILABLE page shows. Refer to the figure on page 14-26.

The FREQUENCY DATA page shows up to eight communication types per page, four on each side of the page. If more than eight frequencies are available for an airport, up to nine pages are available to show the frequencies. Push the PREV and NEXT function keys to show any additional pages.

▼ **SELECTIONS:**

SEL APT

The SEL APT field lists airport identifiers that are in the active flight plan. The order of the display is departure (origin), arrival, alternate, and a pilot-entered airport. If no airport is in the flight plan, four dashes show for the airport. The SEL APT line select key is used to select the airports for which frequency data is desired. Each push of the line select key selects the next airport in the list. Changes made to the origin, destination or alternate airport results in the selection of that airport and a return to page 1 of the FREQUENCY DATA page.

Communication
Types

For communication types with more than one frequency available for a particular airport, a line select key is labeled with that frequency type and a MULTIPLE selection. Push the MULTIPLE line select key to show the Communication Type page for the selected airport. Refer to the figure on page 14-27.

INDEX

Selection returns the display to the INDEX 1/2 page. Refer to the figure on page 14-3.

Condition(s):

If there are no airport frequencies stored in the navigation database, the FREQUENCY DATA page shows with the message NO DATA AVAILABLE.

Path:

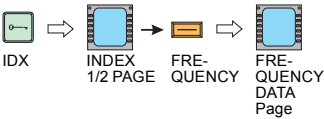
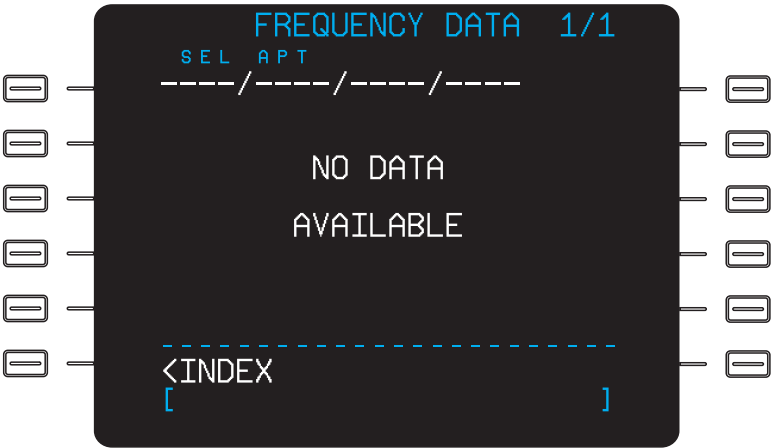


Figure 14-16 FREQUENCY DATA Page – No Data Available



TPG9209_40

Selecting the INDEX line select key returns the display to the INDEX 1/2 page. Refer to the figure on page 14-3.

COMMUNICATION TYPE

Path:

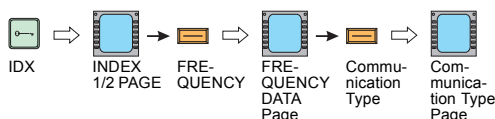
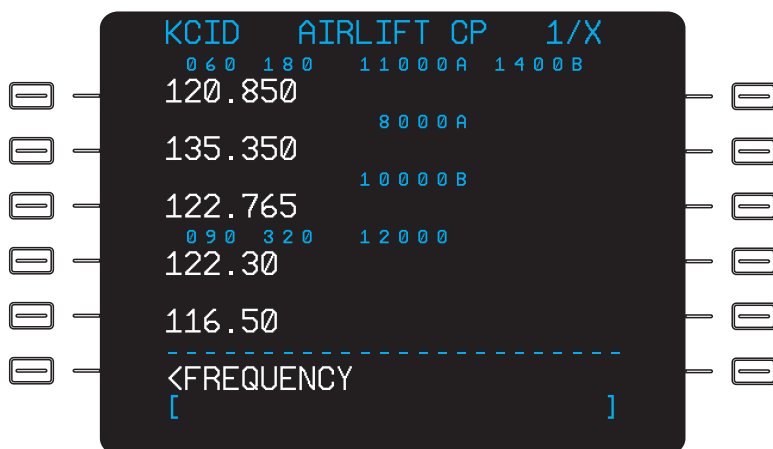


Figure 14-17 Communication Type Page



TPG9209_41

Frequencies listed next to the left side line select keys are ordered as follows: VHF 8.33, VHF, HF, and UHF. The COMMUNICATION TYPE page shows up to five frequencies per page for up to nine pages. Push the PREV and NEXT function keys to show any additional pages.

Sector and altitude limitations (as available) are listed above the frequencies. The sector limitation consists of two three-digit fields separated by a blank space. Altitude limitations show in feet. There are four types of altitude limitations:

- At or above altitude limits, which are followed by an A
- At or below altitude limits, which are followed by a B
- Between altitude limits, which show as at or above and at or below altitudes separated by a blank space
- At limits.

If the scratchpad is empty, pushing a line select key next to a frequency copies the frequency to the scratchpad.

▼ SELECTIONS:

FREQUENCY

Selection returns the display to the first FREQUENCY DATA page. Refer to the figure on page 14-24.



FIX

Path:

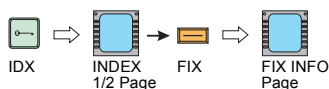
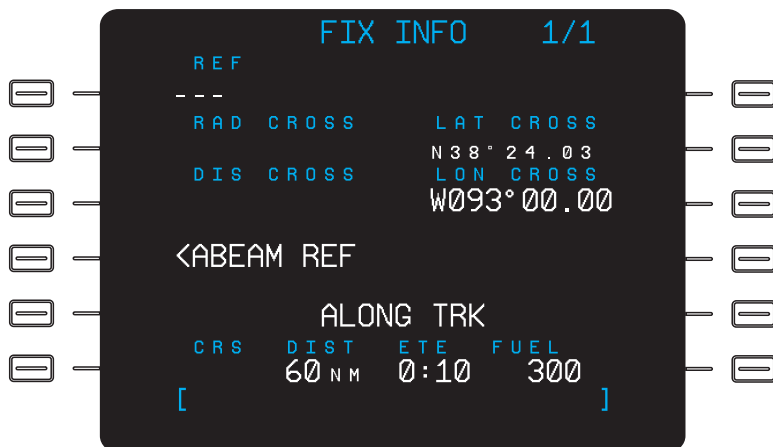


Figure 14-18 FIX INFO Page



TPG9206_55

Each FIX INFO page is used to create pilot-defined waypoints based on a reference waypoint, a latitude crossing, or a longitude crossing. A flight plan can have up to five fix waypoints. Each reference fix shows on an individual FIX INFO page. There are up to five FIX INFO pages available. There are four types of fixes that can be entered on a FIX INFO page: abeam, radial, distance, and latitude or longitude crossing point.



NOTE

Fixes can be converted to waypoints for use in a flight plan. Refer to the EN ROUTE chapter of this operator's guide for instructions on how to convert a fix to a waypoint.

An abeam fix is the point on the flight plan where the reference waypoint is perpendicular to a flight plan leg. A radial fix is the point where a specific radial from the reference waypoint intersects the flight plan. A distance fix is the point where a specific distance from the reference waypoint intersects the flight plan. A latitude or longitude crossing point

fix is the point where the specified latitude or longitude entry intersects the flight plan.

On the MFD, a radial fix or abeam fix shows as a small green circle around the fix reference, with a dashed green line from the circle to a small white circle on the course line at the fix point. A distance fix shows as a large green circle (or partial circle) centered over the fix reference, with a radius equal to the specified distance from the fix reference, and a small white circle at the point where the large circle intersects the course line. The latitude or longitude crossing fix shows as a small white circle at the point on the flight plan where the specified latitude or longitude intersects the flight plan.

▼ SELECTIONS:

REF	Used to enter the identifier of a reference waypoint for a fix. A fix reference can be a waypoint, navaid, or airport. Once a fix reference is entered into the REF prompt from the scratchpad, the FIX INFO page shows the course (CRS), distance (DIST), Estimated Time En Route (ETE), and estimated FUEL remaining from the fix reference to the present position of the aircraft under the DATA TITLE. NOTE Runway threshold waypoints cannot be used as fix references.
RAD CROSS	Used to enter a specific radial from the reference waypoint that intersects the flight plan. A REF waypoint must be entered for a RAD CROSS fix.
DIS CROSS	Used to enter a specific distance from the reference waypoint that intersects the flight plan. A REF waypoint must be entered for a DIS CROSS fix.



NOTE

The DIS CROSS field on the FIX INFO page accepts any positive whole number that is less than or equal to 500 NM as a valid distance entry. If the DIS CROSS value is greater than 500 NM, or the resulting RAD CROSS radial does not intersect the flight plan within 500 NM, the message NO INTERSECTION appears.

LAT CROSS

Used to enter a specified latitude coordinate that intersects the flight plan. LAT CROSS fixes do not use reference waypoints. If a reference waypoint was entered, LAT CROSS and LON CROSS show dashes. The fix coordinates must intersect the flight plan or the message NO INTERSECTION shows in the scratchpad. When a correct LAT entry is made, it shows in large font text and the corresponding LON for the intersecting point shows in small font text.

LON CROSS

Used to enter a specified longitude coordinate that intersects the flight plan. LON CROSS fixes do not use reference waypoints. If a reference waypoint was entered, LAT CROSS and LON CROSS show dashes. The fix coordinates must intersect the flight plan or the message NO INTERSECTION shows in the scratchpad. When a correct LON entry is made, it shows in large font text and the corresponding LAT for the intersecting point shows in small font text.

ABEAM REF

Used to select a fix abeam the entered REF waypoint. An abeam fix is the point on the flight plan where the reference waypoint is perpendicular to a flight plan leg.

DATA TITLE

The default data title that shows above the CRS, DIST, ETE, FUEL readout is DIRECT TO.

- Once the REF waypoint is entered, the REF identifier is added to DIRECT TO (for example, DIRECT TO ABQ).
- If the fix intersects the flight plan, ALONG TRK shows as the data title.
- If the fix is an abeam fix, ABEAM shows as the data title with the REF waypoint identifier (for example, ABEAM ABQ).



HOLD

Condition(s):

When the HOLD line select key on the INDEX 1/2 page is pushed and no holds currently exist in the flight plan, the ACT LEGS page with the HOLD AT prompt shows on the CDU.

Path:

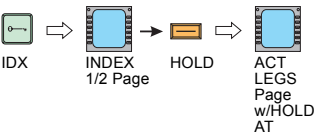


Figure 14-19 ACT LEGS Page with HOLD AT Prompt



TPG9206_38

On the ACT LEGS page, a hold can be entered at a flight plan waypoint, at a waypoint not in the flight plan, or at the present position of the aircraft. A hold is entered by entering the designated hold at point in the scratchpad, then transferring it to the HOLD AT prompt. Refer to the EN ROUTE chapter of this operator's guide for instructions on entering a hold.

▼ SELECTIONS:

HOLD AT

□ □ □ □ □

Prompt boxes are used to enter the identifier of the waypoint for the hold. Up to five characters can be entered. When the hold waypoint is entered into the prompts, the page changes to the MOD FPLN HOLD page with the hold point as the FIX.

PPOS

Used to select the present position of the aircraft as the holding point. When PPOS is selected, the page changes to the MOD FPLN HOLD page with PPOS as the holding FIX.

Condition(s):

When the HOLD line select key on the INDEX 1/2 page is pushed and one hold already exists in the flight plan, the ACT FPLN HOLD page shows on the CDU.

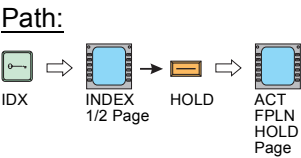
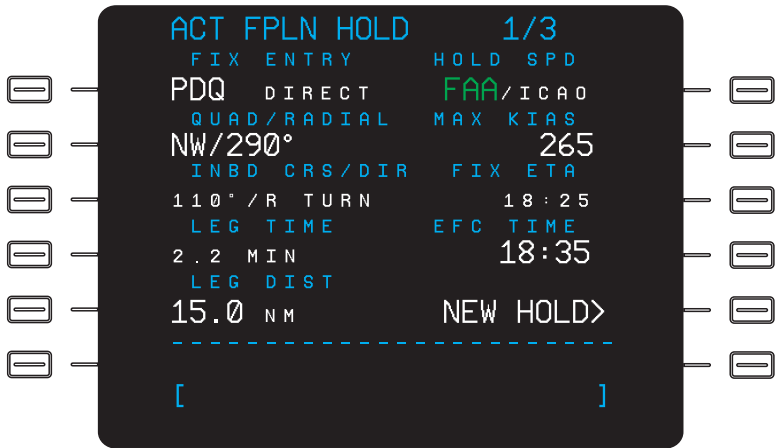


Figure 14-20 ACT FPLN HOLD Page



TPG9209_27

The ACT FPLN HOLD page shows the holding fix, the type of entry into holding (direct, teardrop, or parallel), the holding pattern, and speeds for the existing hold. The pilot can modify the hold or enter a new hold with the NEW HOLD selection. Refer to the EN ROUTE chapter of this operator’s guide for instructions on how to modify a hold.

▼ **SELECTIONS:**

FIX ENTRY	Identifies the holding pattern FIX and the type of ENTRY into the holding pattern (DIRECT, TEARDP, PARALL).

HOLD SPD

Selects the display of FAA or ICAO recommended holding speed (HOLD SPD) values. The default selection is FAA. The selected mode shows in large green text, and the unselected mode shows in small white text.

QUAD/RADIAL

Used to show/enter the quadrant and radial on which the holding pattern is based. The QUAD/RADIAL is used only if cleared to hold in a particular cardinal direction (quadrant) from a specified fix defined off a VOR radial. When QUAD/RADIAL is entered, the FMS automatically computes the inbound course for the hold. Based on the radial, the resulting inbound course can be a reciprocal heading of the radial. The QUAD/RADIAL entry **never** determines the direction of turn of the hold itself. Standard hold pattern turns are to the right. The controlling authority issues non-standard holding instructions (left turns). The following examples show valid QUAD/RADIAL entries:

- S/185
- NE/017
- SW/245.

MAX KIAS

Shows the maximum recommended holding speed in knots IAS (KIAS).

INBD CRS/DIR

Shows the inbound course (INBD CRS) and direction of turns (DIR) for the holding pattern. The pilot can modify the inbound course and direction if necessary. The following examples show valid INBD CRS/DIR entries:

- 275/R

- 318/L
- 182T/L.



NOTE

A T can be added to the course to create a true north reference.

FIX ETA

Shows the Estimated Time of Arrival (ETA) at the holding fix. The time is based on the distance around the holding pattern. The ETA is computed by the FMS and cannot be manually changed.

LEG TIME

Shows the duration of the pattern leg in minutes. LEG TIME can be manually changed if necessary. If LEG TIME is manually entered, the FMS recomputes the LEG DIST using ground speed and leg time.

EFC TIME

Shows the Expect Further Clearance (EFC) time. EFC TIME is an optional pilot entry. Entry format for EFC TIME is HHMM or HMM (for example, 1345 or 020). Entering EFC TIME does not create a MOD FPLN, and EFC TIME can be edited at any time during a hold. When the specified EFC TIME arrives, and the aircraft has not exited the hold, the message HOLD EFC EXPIRED shows.

LEG DIST

Shows the length of the pattern leg in nautical miles. LEG DIST can be manually changed if necessary. If LEG DIST is manually entered, the FMS recomputes the LEG TIME using ground speed and leg length.

NEW HOLD



Selection supplies access to the ACT LEGS page with the HOLD AT prompt to enter a new holding fix. Refer to the figure on page 14-33.

Condition(s):

When the HOLD line select key on the INDEX 1/2 page is pushed and two or more holds currently exist in the flight plan, the HOLD LIST page shows on the CDU.

Path:

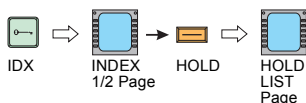


Figure 14-21 HOLD LIST Page



TPG9209_28

The HOLD LIST page shows all holds currently in the flight plan. Holds that are part of an approach or a missed approach procedure are identified as such on the HOLD LIST page. The NEW HOLD line key selection supplies access to the LEGS page with the HOLD AT prompt to enter a new hold into the flight plan. To show the FPLN HOLD page for an existing hold, push the line select key next to the holding fix.

PROGRESS

Path:

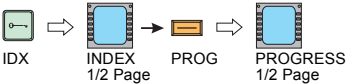
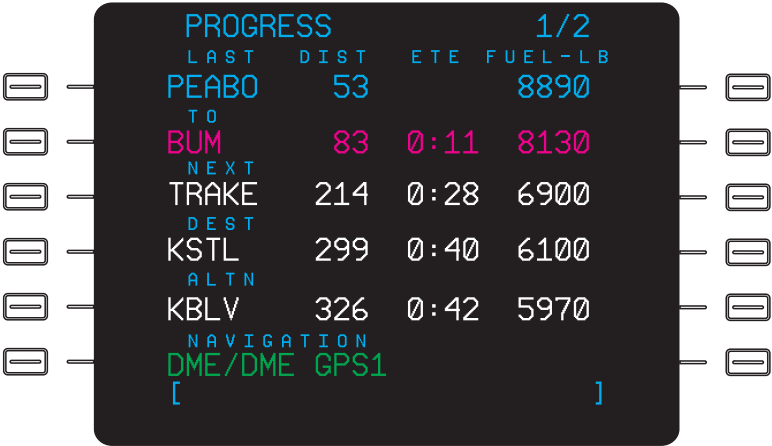


Figure 14-22 PROGRESS 1/2 Page



TPG9209_29

The PROGRESS 1/2 page shows flight plan and performance data. The data is based on the measured fuel flow and ground speed. In the MANUAL performance mode, the data is based on the pilot-entered fuel flow and/or ground speed on the FUEL MGMT page. The page title changes to MANUAL PROGRESS when the MANUAL mode on the FUEL MGMT page is active.

The LAST waypoint is the last waypoint passed in the flight plan. The distance (DIST) that shows for the last waypoint is the distance from that waypoint. FUEL-LB is the fuel remaining at that waypoint.

The TO waypoint is the active waypoint. Dashes show for the TO waypoint if there is no active waypoint due to a discontinuity, or after passing the last waypoint at the end of the flight plan. DIST is the distance to the TO waypoint. For a holding fix, the TO waypoint DIST is the distance from the current position of the aircraft around the holding pattern to the fix. ETE is the estimated time en route to the TO waypoint. FUEL-LB is the current remaining fuel.

The NEXT waypoint is the waypoint following the TO waypoint in the flight plan, except when the TO waypoint is a holding fix. If the leg following the TO waypoint is a hold, the NEXT waypoint is the waypoint that follows the holding fix. DIST for the NEXT waypoint is the distance from the current position of the aircraft to the NEXT waypoint. ETE for the NEXT waypoint is the estimated time en route to the NEXT waypoint. FUEL-LB is the projected remaining fuel upon reaching the NEXT waypoint.

The DEST waypoint is the same as the DEST airport on the ACT FPLN page. If no destination airport is entered, dashes show for the DEST waypoint. DIST, ETE, and FUEL-LB are projected for the DEST airport, or runway threshold if an arrival runway has been selected, and are calculated from the current position of the aircraft along the flight plan route.

The ALTN waypoint is the same as the ALTN airport of the ACT FPLN page. If no alternate is entered, then dashes show for the ALTN. DIST, ETE, and FUEL-LB are projected for the ALTN airport and are calculated from the current position of the aircraft to the ALTN airport.

The FMS annunciates the navigation sensors that are in use under the NAVIGATION title. The annunciations are based on the equipment installed in the aircraft. The following list shows the available annunciations.

- DME/DME – (indicates two or more DMEs are being used)
- VOR/DME1 – (indicates that DME/DME is not being used and that the VOR and DME pair tuned on the NAV1 radio are being used)
- VOR/DME2 – (indicates that DME/DME is not being used and that the VOR and DME pair turned on the NAV2 radio are being used)
- IRS
- GPS1
- GPS2.



NOTE

When both VOR and DME sensor pairs are being used to determine position, the pair tuned to the closest navaid is annunciated.

Path:

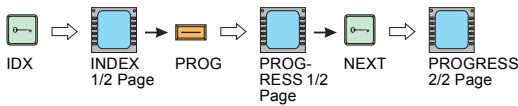
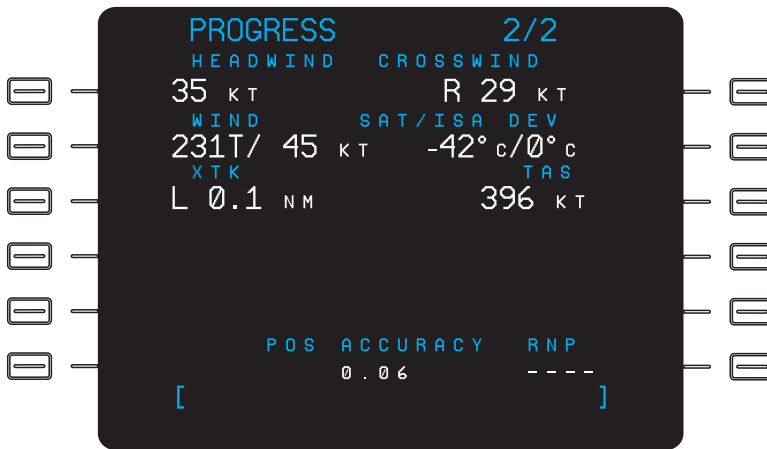


Figure 14-23 PROGRESS 2/2 Page



TPG9209_30

The PROGRESS 2/2 page shows the wind and temperature effects on the aircraft. The data is based on the measured fuel flow and ground speed. In the MANUAL performance mode, the data is based on the pilot-entered fuel flow and/or ground speed on the FUEL MGMT page. The page title changes to MANUAL PROGRESS when the MANUAL mode on the FUEL MGMT page is active. PROGRESS 2/2 page shows:

- HEADWIND or TAILWIND and CROSSWIND components
- WIND direction and speed
- Static Air Temperature (SAT) and ISA temperature deviation (DEV)
- Cross track (XTK) direction and distance in nautical miles
- True airspeed (TAS)
- Expected POS ACCURACY in nautical miles
- Required Navigation Performance (RNP) in nautical miles. Refer to the Required Navigation Performance section of the PRINCIPLES OF NAVIGATION chapter for an explanation of RNP and POS ACCURACY.



NOTE

The RNP value is an optional pilot entry. Dashes show for the following: no value has been entered, an on-ground cold start, or entering a new origin airport has cleared the flight plan.



NOTE

Wind direction is always referenced to true north on the PROGRESS pages.

SEC FPLN

Path:

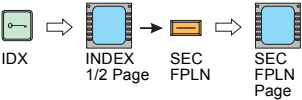


Figure 14-24 SEC FPLN Page



TPG9206_20

The SEC FPLN pages show the same type of information as the ACT FPLN pages. Like the active/modified flight plan, the secondary flight plan is complete when it includes both the lateral and vertical segments, plus the expected flight conditions required for time and fuel calculations. Unlike the ACT/MOD FPLN, the SEC FPLN does not use sensor data to estimate time, fuel, and weight calculations (estimates are based on the performance database of the aircraft). Manual changes affect the secondary flight plan performance calculations.

▼ SELECTIONS:

ROUTE MENU	Selection supplies access to the ROUTE MENU page. Refer to the figure on page 14-47.

ACTIVATE

Activates the SEC FPLN for use as the ACT FPLN. Refer to the FLIGHT PLANNING chapter for information on activating a SEC FPLN.

SEC LEGS

Selection supplies access to the SEC LEGS pages. SEC LEGS pages show the same type of information as the ACT LEGS pages.



FMS CONTROL

Path:

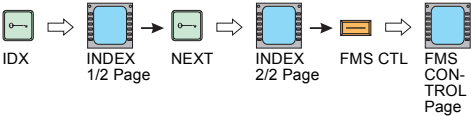
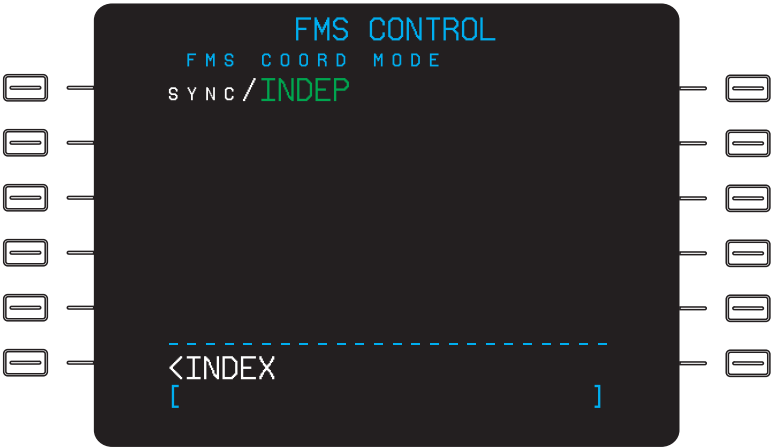


Figure 14-25 FMS CONTROL Page



TPG9206_05

If the MFD DATA function key selection is changed while a text page shows on an MFD, the system causes the same page to show on the newly selected MFD, and the previously selected MFD will revert to a non-text display.

ROUTE MENU

Path:

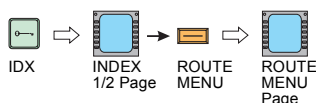
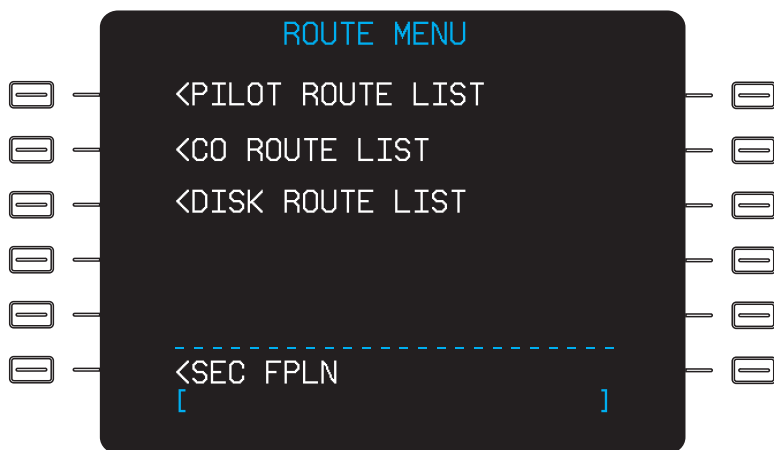


Figure 14-26 ROUTE MENU Page



TPG9209_31

The ROUTE MENU page shows an index of the route lists available from which to select preplanned flight plan routes. The available route lists include the PILOT ROUTE LIST and the DISK ROUTE LIST. In addition to the routes already loaded into the FMS in the PILOT ROUTE LIST, the DISK ROUTE LIST feature provides the ability to load a flight plan from a disk.

▼ SELECTIONS:

PILOT ROUTE LIST

Selection supplies access to the PILOT ROUTE LIST page. Refer to the figure on page 14-49.

DISK ROUTE LIST

Selection supplies access to the DISK ROUTE LIST page. Refer to the figure on page 14-51.

SEC FPLN



Selection supplies access to the SEC FPLN page. Refer to the figure on page 14-44.

PILOT ROUTE LIST

Path:

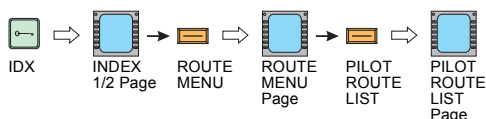


Figure 14-27 PILOT ROUTE LIST Page



TPG9206_22

The PILOT ROUTE LIST page shows a list of the routes stored in the FMS. Select a route from the list by pushing the line select key adjacent to the desired route.

▼ SELECTIONS:

RTE TRANSFER
FROM XSIDE

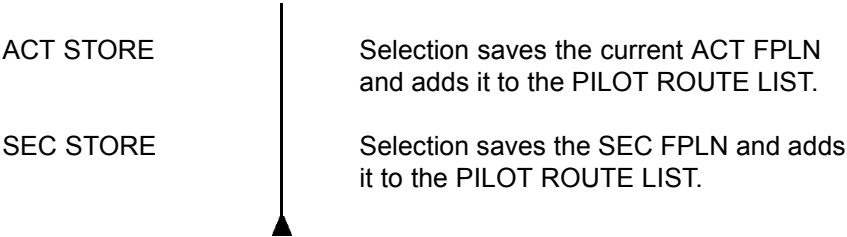
Initiates a transfer of pilot routes contained in the cross-side FMS to the same-side (requesting) FMS.

SEC FPLN

Selection supplies access to the SEC FPLN page.

ROUTE MENU

Selection supplies access to the ROUTE MENU.



CO ROUTE LIST

Path:

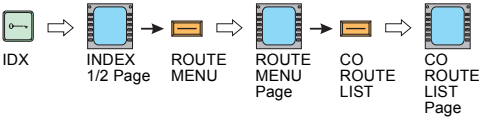


Figure 14-28 CO ROUTE LIST Page



TPG9209_32

The CO ROUTE LIST page shows a list of the company routes stored in the FMS. Select a route from the list by pushing the line select key adjacent to the desired route.

DISK ROUTE LIST

Path:

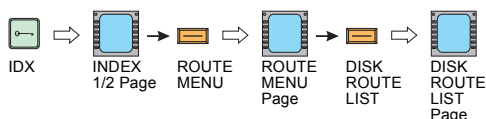
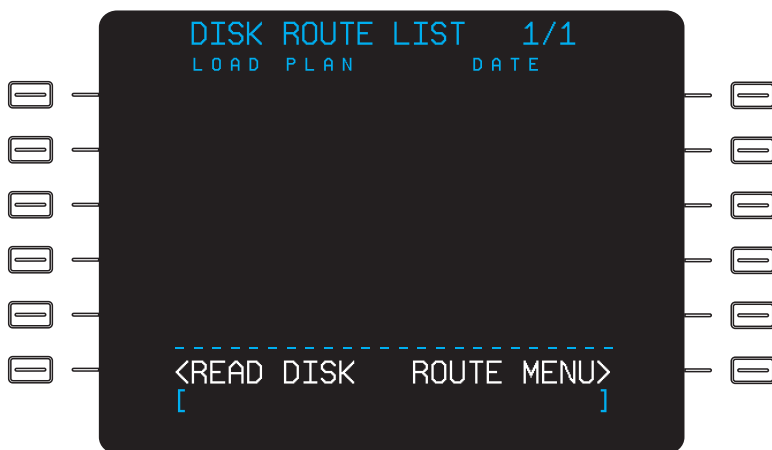


Figure 14-29 DISK ROUTE LIST Page



TPG9209_33

The DISK ROUTE LIST page is used to load a route from a computer disk. Pushing the READ DISK line select key causes the data loader to read an inserted disk that contains the desired routes. The CDU then shows a list of flight plan routes on the disk. Pushing the line select key adjacent to the desired route loads that route into the SEC FPLN, which can then be activated and executed.

DATA BASE

Condition(s):
If the IDENT field is empty when the DATA BASE line select key is pushed, the DATA BASE page shows with the IDENT prompts.

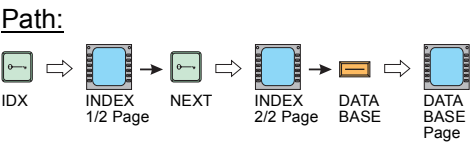
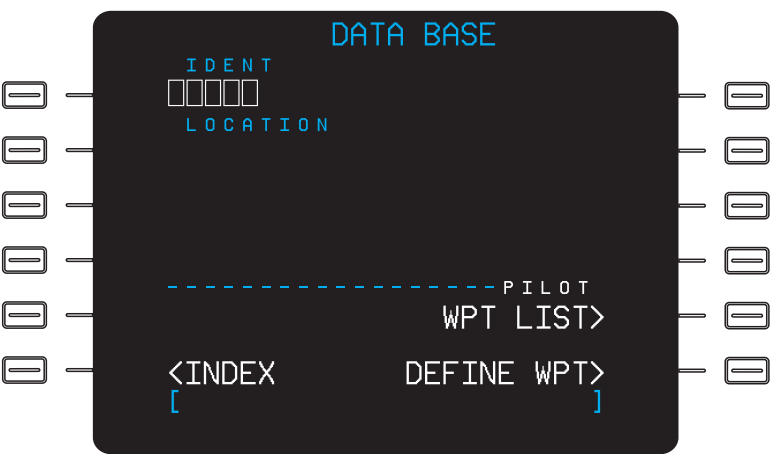


Figure 14-30 DATA BASE Page



TPG9209_42

The DATA BASE page is used to show information about a specific airport, navaid, intersection, or PILOT WPT LIST waypoint. To show the desired information, enter the identifier into the IDENT prompts.

If a waypoint identifier that is associated with more than one waypoint stored in the navigation database is entered, a SELECT WPT page is presented that shows the waypoint type, latitudes, longitudes, and ICAO country codes, which assists in the selection of the desired waypoint. Duplicate waypoint types and their associated pages are listed as follows. Refer to the SELECT WPT section of this chapter for information about each page type.

- Duplicate Airport/Navaid — Refer to the figure on page 14-71.
- Duplicate Airport Runway — Refer to the figure on page 14-72.

- Duplicate Airport Terminal/En Route Intersection — Refer to the figure on page 14-73.
- Duplicate Pilot Defined/En Route Intersection — Refer to the figure on page 14-74.
- Duplicate VOR/DME Nav aids — Refer to the figure on page 14-75.
- Duplicate ILS Station — Refer to the figure on page 14-77.

If an airport identifier that is associated with more than one airport stored in the navigation data base is entered, the SELECT APT page shows. Refer to the figure on page 14-78.

▼ SELECTIONS:

IDENT

□ □ □ □ □

The IDENT prompts are used to enter the identifier of an airport, navaid, waypoint in the FMS database, or waypoint in the PILOT WPT LIST.

PILOT WPT LIST

Selection supplies access to the PILOT WPT LIST page. Refer to the figure on page 14-49.

INDEX

Selection supplies access to the INDEX 1/2 page.

DEFINE WPT

Selection supplies access to the DEFINE PILOT WPT page. Refer to the figure on page 14-59.

Condition(s):

When an airport identifier is entered into the IDENT prompts, the DATA BASE page shows with the airport information.

Path:

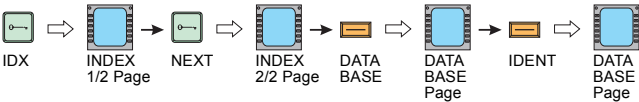
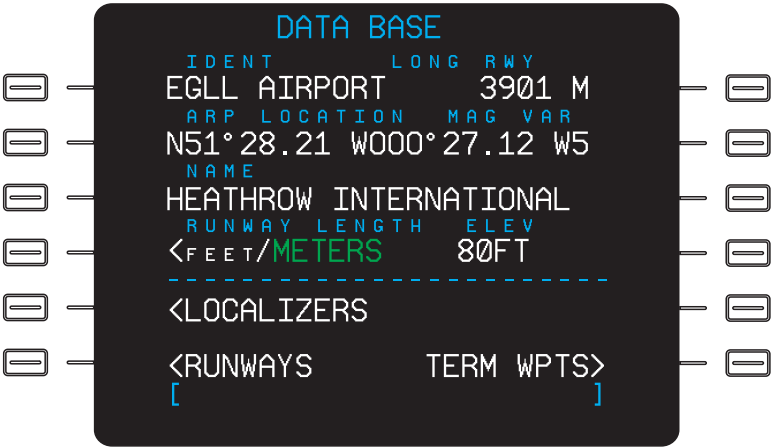


Figure 14-31 DATA BASE Page with Airport Information



TPG9209_43

For airports, the DATA BASE page shows:

- Airport identification code (IDENT)
- Longest operational hard surface runway (LONG RWY)
- RUNWAY LENGTH in FEET or METERS
- Latitude and Longitude position of the geographical center of the airport (ARP)
- Magnetic variation (MAG VAR)
- NAME of the airport
- Airport elevation (ELEV) in feet
- LOCALIZERS select function
- RUNWAYS select function
- TERM WPTS select function.

Condition(s):

When a navaid identifier is entered into the IDENT prompts, the DATA BASE page shows with the navaid information.

Path:

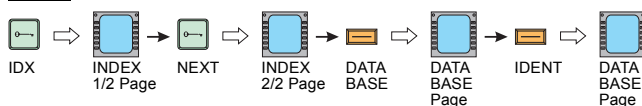
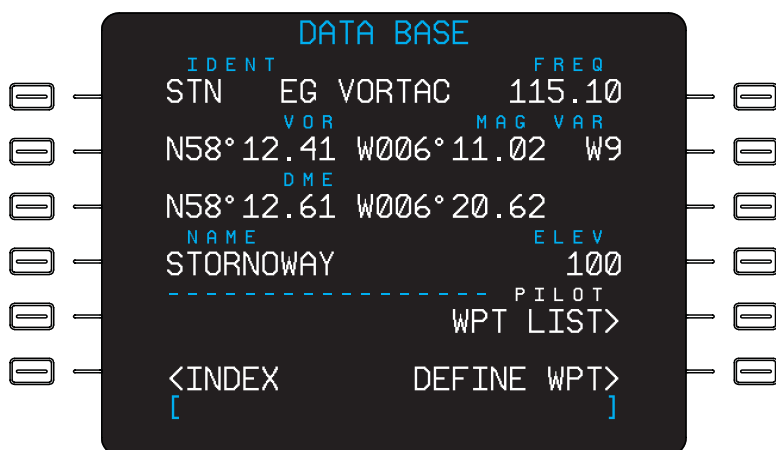


Figure 14-32 DATA BASE Page with Navaid Information



TPG9209_95

For VOR, VOR/DME, DME, VORTAC, and TACAN navaids, the DATA BASE page shows:

- Identifier of navaid and type of equipment (VOR, VOR/DME, VORTAC, or TACAN)
- Transmitter frequency
- LAT/LON for VOR and DME facilities, as appropriate
- MAG VAR (for facilities that include VOR equipment)
- NAME of the navaid
- ELEV in feet.

Condition(s):

When a waypoint identifier is entered into the IDENT prompts, the DATA BASE page shows with the waypoint information.

Path:

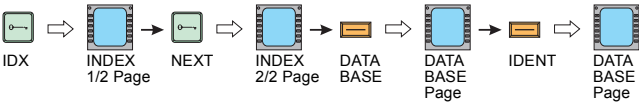
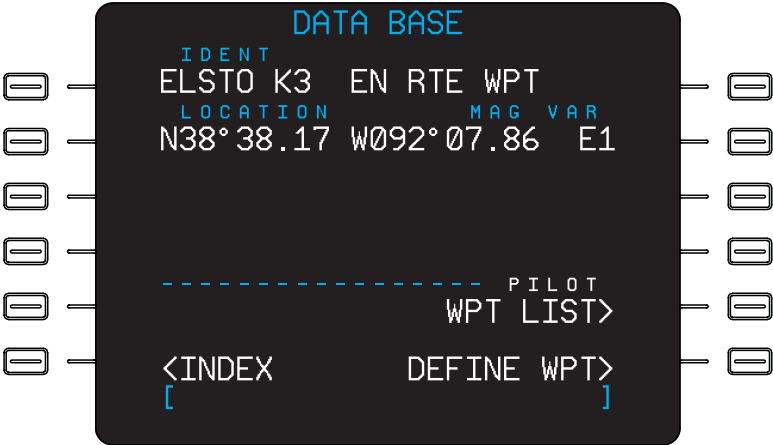


Figure 14-33 DATA BASE Page with Waypoint Information



TPG9209_44

For waypoints in the PILOT WPT LIST, the DATA BASE page shows the latitude, longitude, and MAG VAR, and the basis for the definition of the waypoint.

For waypoints in the FMS database, the DATA BASE page shows the waypoint name, the latitude and longitude, the ICAO country code and location, the type of waypoint, and the MAG VAR.

PILOT WPT LIST

Path:

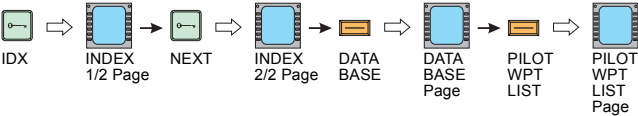
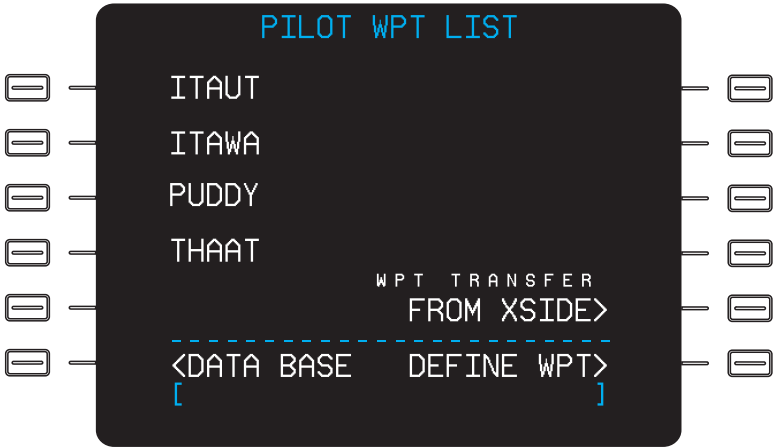


Figure 14-34 PILOT WPT LIST Page



TPG9206_51

The PILOT WPT LIST page shows a list of all pilot-defined waypoints in the FMS database. Up to 100 waypoints can be stored in the database. Each PILOT WPT LIST page shows up to 10 pilot-defined waypoints. Push the NEXT and PREV functions keys to show all PILOT WPT LIST pages.

▼ SELECTIONS:

WPT TRANSFER
FROM XSIDE

Selection initiates a transfer of the PILOT WPT LIST in the cross-side FMS to the same-side (requesting) FMS.

DATA BASE

Selection supplies access to the DATA BASE page.

DEFINE WPT



Selection supplies access to the DEFINE PILOT WPT page. Refer to the figure on page 14-59.

DEFINE PILOT WPT

Path:

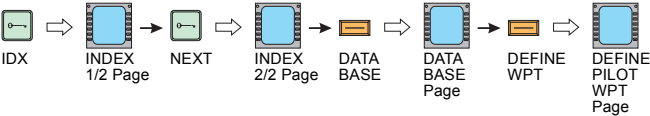
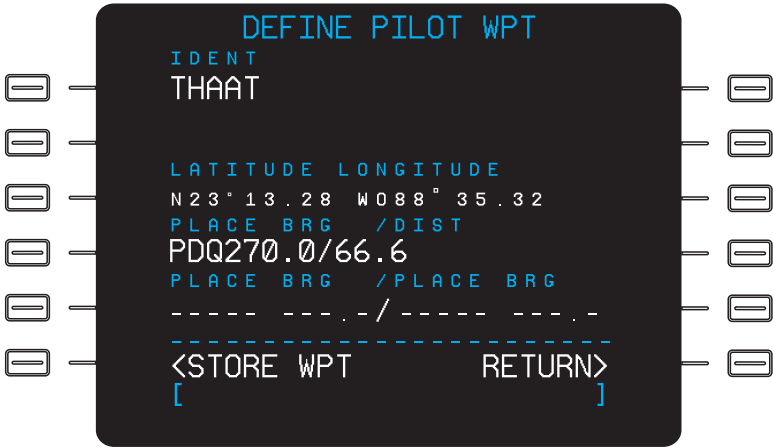


Figure 14-35 DEFINE PILOT WPT Page



TPG9206_50

The DEFINE PILOT WPT page is used to create and name pilot-defined waypoints. The waypoints can then be stored in the PILOT WPT LIST. Up to 100 pilot defined waypoints can be stored in the database.

▼ SELECTIONS:

IDENT

Used to enter a unique name for the pilot-defined waypoint. Up to five characters (letters and numbers) can be entered.

LATITUDE
LONGITUDE

Used to define a waypoint by latitude and longitude coordinates. The format for latitude and longitude data entry is (N or S) DDMM.MM (W or E) DDDMM.MM where D represent degrees and M represents minutes. The following guidelines apply to entering coordinates.

- If the coordinates are in whole degrees of latitude or longitude, the minute entries are not required.
- If minutes are entered, use two digits before a decimal point.
- If a decimal point is used, use at least one number after it.
- The acceptable range for entering minutes is 00.00 to 59.99.
- Optional spaces can be placed between the degrees and minutes fields, and between the latitude and longitude fields.

PLACE BRG/DIST

Used to define a waypoint by a bearing and distance from a base waypoint. The format for a PLACE BRG/DIST entry is a base waypoint identifier followed by a bearing in degrees, a slash, and a distance value (for example, CID005.3/23.5). The following rules apply to PLACE BRG/DIST entries.

- Base waypoint identifiers must be valid navigation aids, en route intersections, non-directional beacons, airport reference points, or pilot-defined waypoints.

- Bearings can be specified in tenths of degrees if desired (for example, 034.5). Bearings must be specified with three numbers for the whole degree part, with leading zeros where necessary (for example, 005).
- North bearings can be entered as 000 or as 360. The FMS always shows North as 360.
- Distance entries are limited to 199.9 NM. Zero distance values are not accepted.



TECH DETAIL

Bearing references vary based on the type of a base waypoint. If the base waypoint has a VOR component, then the bearing is referenced to the VOR radial of zero degrees. If the base waypoint is an airport reference point or a runway threshold, bearing is referenced to the North Datum of the airport. For other base waypoints, bearing is referenced to either magnetic north or true north, based upon the latitude of the base waypoint. For base waypoints between the latitudes of 73 degrees north and 60 degrees south, the entered azimuth data is referenced to magnetic north using a computed value for the magnetic variation. Otherwise, the entered azimuth is referenced to true north. Suffixing the bearing with the letter T for true north overrides the logic mentioned above and fixes the reference to true north (for example, CID034T/15).

PLACE BRG/
PLACE BRG

Used to define a waypoint by the intersection of bearings from two different base waypoints.

STORE WPT

Selection stores the new waypoint in the
PILOT WPT LIST.

RETURN

Selection returns the display to the
previous display page.



DB DISK OPS

Path:

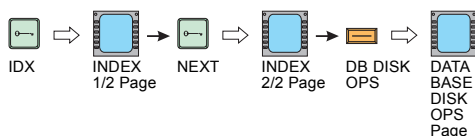


Figure 14-36 DATA BASE DISK OPS Page



TPG9206_68

The DATA BASE DISK OPS page is used to update the FMS databases, or to copy routes and waypoints to a disk. Load a diskette into the data loader, then push the appropriate line select key on the page. Once the read or write function is selected, the CDU function keys will not operate until the load is complete or the process is canceled.



NOTE

A database load or write routes or waypoints to a disk operation can be done only when the aircraft is on the ground.

▼ SELECTIONS:

READ DISK	Used to load a database into the FMS. More than one disk can be required for a complete navigation database load. In such cases, the operator is prompted to insert additional disks when necessary. The CDU shows various status pages during the database load. When a database load has finished, the display indicates that the load is complete, then shows the STATUS page.
WRITE RTES	Used to copy routes in the database to the disk in the data loader.
WRITE WPTS	Used to copy waypoints in the PILOT WPT LIST to the disk in the data loader.
INDEX	Selection supplies access to the INDEX 1/2 page. Refer to the figure on page 14-3.

DEFAULTS

Path:

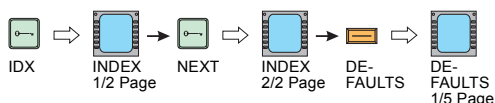
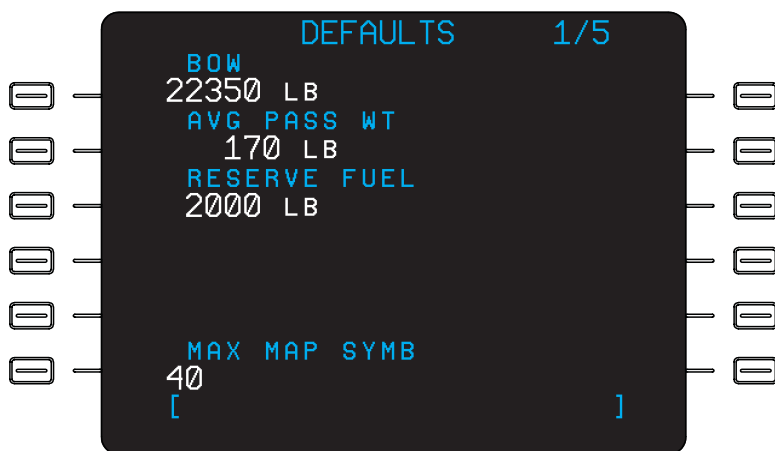


Figure 14-37 DEFAULTS 1/5 Page



TPH8459_01

The DEFAULTS 1/5 page shows default values for the performance values that show on the PERF INIT pages. The DEFAULTS 1/5 page is used to set or change the default values/settings for:

- Basic Operating Weight (BOW)
- Average Passenger Weight (AVG PASS WT)
- TAXI FUEL Weight
- RESERVE FUEL Weight
- MAX MAP SYMBOLS.

The settings on the DEFAULTS pages remain in effect until they are changed. However, for any individual flight plan, any of the defaults on the appropriate display page of a flight plan can be overridden. Overriding the default setting from within a flight plan does not change the settings on the DEFAULTS page. Also, when changes are made to the settings on the DEFAULTS page, they do not affect the ACT/MOD FPLN or SEC FPLN.

Changes made on the DEFAULTS pages are applied only when a new flight plan is created, or one is selected from the PILOT ROUTES LIST. BOW and FUEL FLOW CORRECTION are exceptions to this rule. These values are applied to the ACT/MOD/SEC FPLN as soon as they are entered/changed on the DEFAULTS page.

MAX MAP SYMB determines the maximum number of all types of map symbols that can show on the MFD MAP. A detailed description of how symbols are prioritized for display can be found in the MFD section of this chapter.

Path:

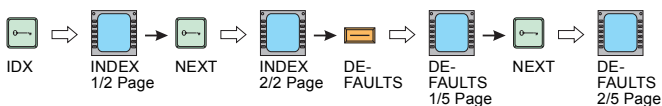
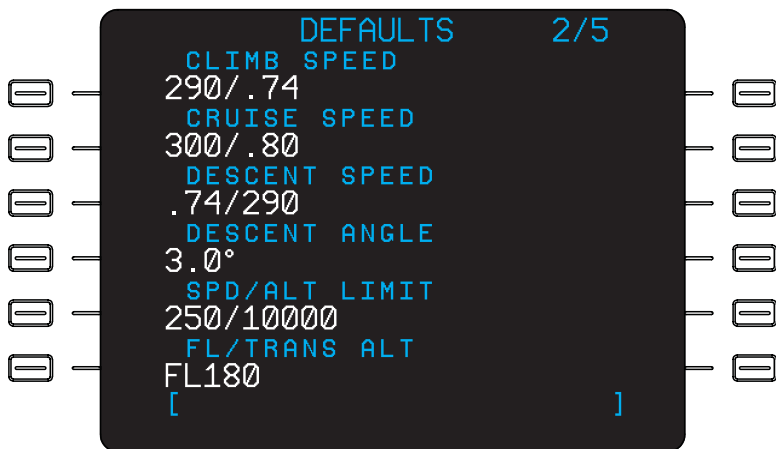


Figure 14-38 DEFAULTS 2/5 Page



TPH8460_01

The DEFAULTS 2/5 page is used to set or change the default values/settings for:

- CLIMB SPEED
- CRUISE SPEED
- DESCENT SPEED
- DESCENT ANGLE
- SPD/ALT LIMIT

- FL/TRANS ALT.

Path:

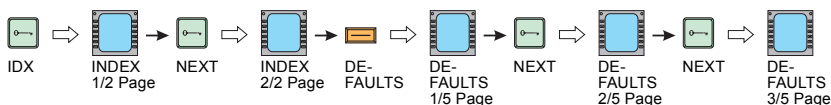
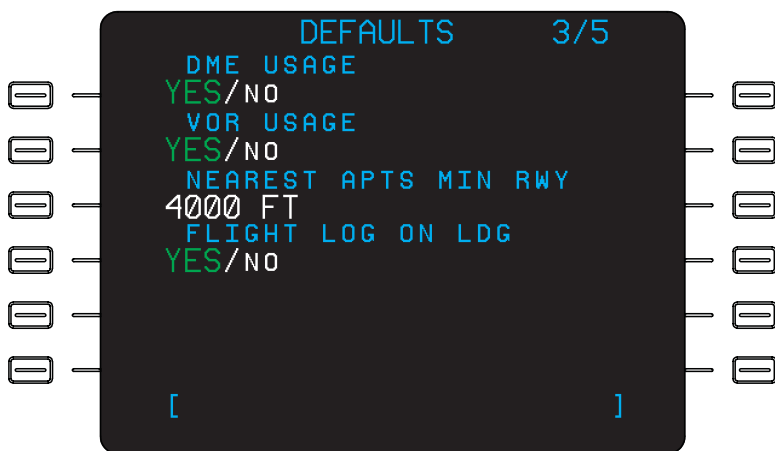


Figure 14-39 DEFAULTS 3/5 Page



TPH8463_01

The DEFAULTS 3/5 page shows default settings for VOR and DME sensor usage by the FMS when it is calculating the position. Use the DEFAULTS 3/5 page to change the individual default settings for:

- DME USAGE
- VOR USAGE.

The selected setting on the DEFAULTS 3/5 page affects the setting on the VOR/DME CONTROL page.

The DEFAULTS 3/5 page is also used to set the minimum runway length for the NEAREST APTS page. The NEAREST APTS page will list the nearest airports that have runways that meet or exceed the length of the minimum runway length value designated in the NEAREST APT MIN RWY field on the DEFAULTS 3/5 page.

The DEFAULTS 3/5 page also shows default settings for display of the FLIGHT LOG page after landing (FLIGHT LOG ON LDG). Use the

DEFAULTS 3/5 page to change the individual settings for automatic display of the FLIGHT LOG page.

Path:

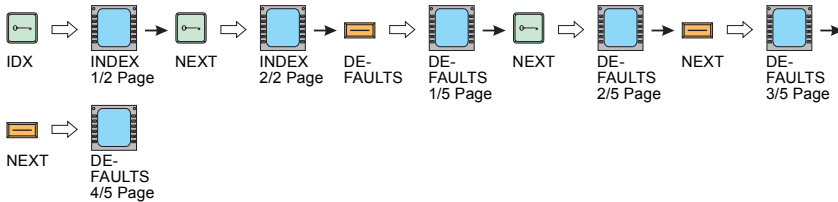
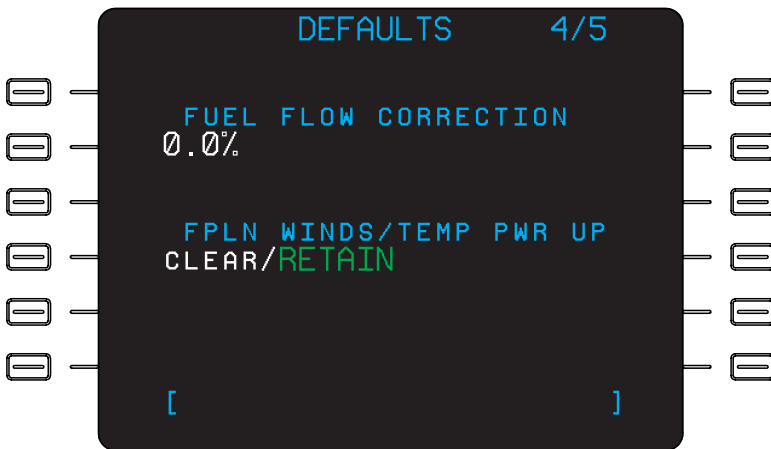


Figure 14-40 DEFAULTS 4/5 Page



TPH8461_01

The DEFAULTS 4/5 page is used to change default values and settings for performance-related information. The DEFAULTS 4/5 page shows:

- FUEL FLOW CORRECTION
- FPLN WINDS/TEMP PWR UP — Controls the option at system power up to CLEAR or RETAIN wind and temperature data previously entered into a flight plan.

Path:

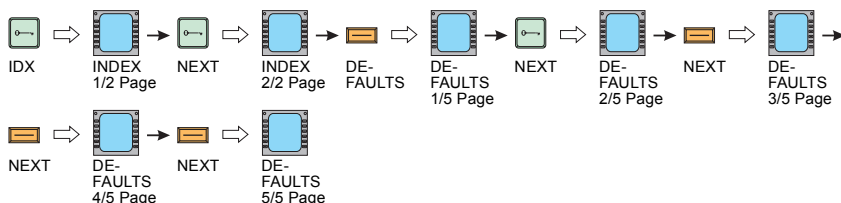
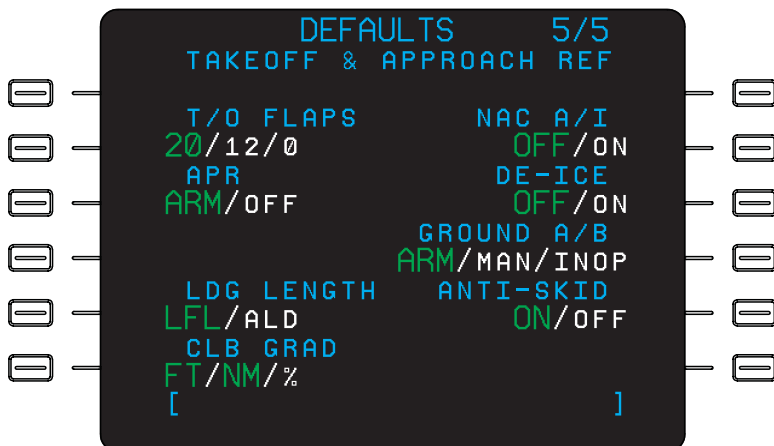


Figure 14-41 DEFAULTS 5/5 Page



TPH8809_01

The DEFAULTS 5/5 page shows default values and settings for the Vspeeds values that show on the TAKEOFF REF and APPROACH REF pages. Use the DEFAULTS 5/5 page to change the default values/settings for:

- Takeoff Flaps (T/O FLAPS) configuration
- Engine Bleed (ENG BLEED) configuration
- Landing Length (LDG LENGTH) display format as either Landing Field Length (LFL) or Actual Landing Distance (ALD)
- Climb Gradient (CLB GRAD) display format as either Feet per Nautical Mile (FT/NM) or as a percentage (%).

Fields on the TAKEOFF REF and APPROACH REF pages are also set to their selected default settings after an FMC cold start.

ARR DATA

Path:

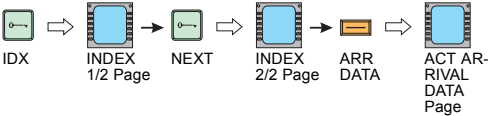
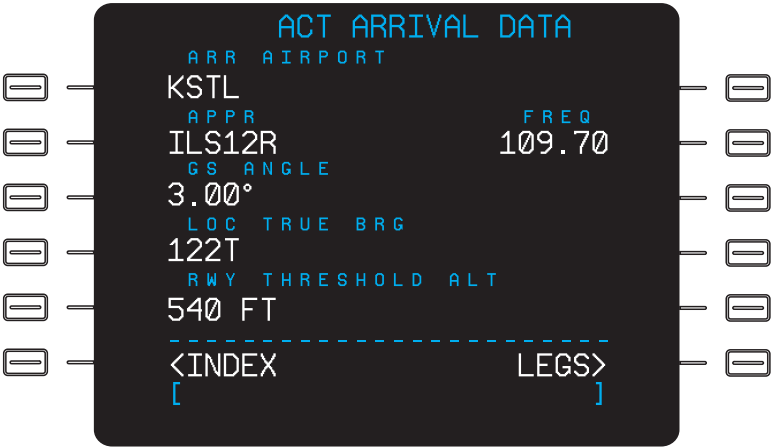


Figure 14-42 ACT ARRIVAL DATA Page



TPG9206_60

The ACT ARRIVAL DATA page shows information on the destination airfield. If no destination airport has been entered, all display fields are blank. If no approach is selected, only the four-letter airport ICAO identifier shows. If a non-precision approach has been selected, the approach designation and runway, and runway threshold altitude also show. If an ILS approach is selected, the glide slope angle, localizer true bearing, and localizer frequency show in addition to the information already described. The information presented on the ARRIVAL DATA page is for display only. To change the display, select a new approach at the destination airport through the ARRIVAL page.

SELECT WPT

Condition(s):

If an airport identifier that is associated with both a navaid and an airport stored in the navigation data base is entered, the SELECT WPT page shows with airport and navaid information.

Path:

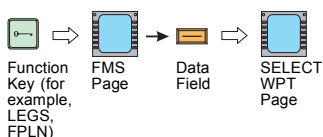


Figure 14-43 SELECT WPT Page – Airport/Navaid



TPG9209_45

Each entry shows the airport or navaid identifier, latitude, longitude, and ICAO country code. The duplicate identifier waypoints are ordered by increasing distance from the FMS position if the entry is on the TUNE page or POS INIT page, or if the entry involves the active waypoint. If the entry is on the FPLN or LEGS pages, the duplicate identifier waypoints are ordered by distance from the previous waypoint if one exists. Otherwise, for the FPLN and LEGS pages, the duplicate identifier waypoints are ordered by distance from the FMS position.

Pushing the left or right line select key next to one of the duplicate identifiers transfers the waypoint identifier into the data line of the page

that was shown before the SELECT WPT page and returns the display to the previous page.

If a selection on the SELECT WPT page is not made before leaving the page (by pushing another function key), the requested edit is cancelled and the scratchpad is cleared.

Condition(s):

If an airport runway waypoint identifier that is associated with more than one airport stored in the navigation data base is entered, the SELECT WPT page shows with airport runway information.

Path:

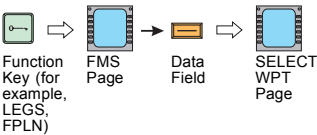
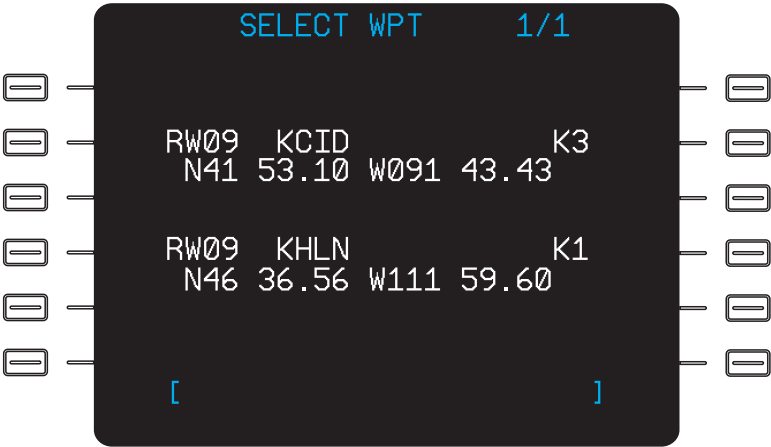


Figure 14-44 SELECT WPT Page – Airport Runway



TPG9209_46

Each entry shows the runway, airport identifier, latitude, longitude, and ICAO country code. The duplicate identifier waypoints are ordered by increasing distance from the FMS position if the entry is on the TUNE page or POS INIT page, or if the entry involves the active waypoint. If the entry is on the FPLN or LEGS pages, the duplicate identifier waypoints are ordered by distance from the previous waypoint if one

exists. Otherwise, for the FPLN and LEGS pages, the duplicate identifier waypoints are ordered by distance from the FMS position.

Condition(s):

If an airport terminal waypoint identifier that is associated with an airport and an en route intersection stored in the navigation data base is entered, the SELECT WPT page shows with airport terminal and en route intersection information.

Path:

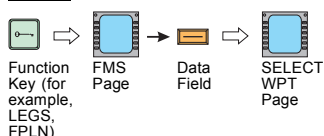


Figure 14-45 SELECT WPT Page – Airport Terminal & En Route Intersection



TPG9209_47

Each entry shows the waypoint identifier, type designation (terminal or en route), latitude, longitude, and ICAO country code. The duplicate identifier waypoints are ordered by increasing distance from the FMS position if the entry is on the TUNE page or POS INIT page, or if the entry involves the active waypoint. If the entry is on the FPLN or LEGS pages, the duplicate identifier waypoints are ordered by distance from the previous waypoint if one exists. Otherwise, for the FPLN and LEGS

pages, the duplicate identifier waypoints are ordered by distance from the FMS position.

Condition(s):

If a pilot-defined waypoint identifier that is associated with an en route intersection stored in the navigation data base is entered, the SELECT WPT page shows with pilot-defined waypoint and en route intersection information.

Path:

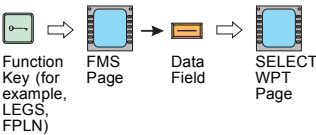
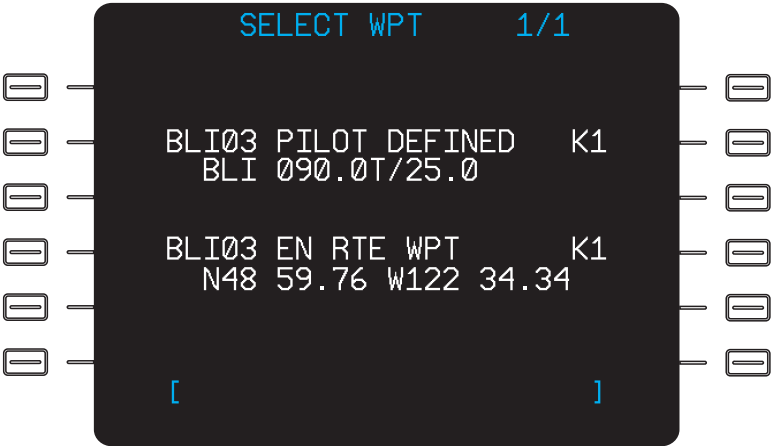


Figure 14-46 SELECT WPT Page – Pilot Defined & En Route Intersection



TPG9209_48

Each entry shows the waypoint identifier, type designation (pilot-defined or en route), latitude, longitude, and ICAO country code. The duplicate identifier waypoints are ordered by increasing distance from the FMS position if the entry is on the TUNE page or POS INIT page, or if the entry involves the active waypoint. If the entry is on the FPLN or LEGS pages, the duplicate identifier waypoints are ordered by distance from the previous waypoint if one exists. Otherwise, for the FPLN and LEGS

pages, the duplicate identifier waypoints are ordered by distance from the FMS position.

Condition(s):

If a waypoint identifier that is associated with duplicate nav aids (VOR and DME) stored in the navigation data base is entered, the SELECT WPT page shows with VOR and DME information.

Path:

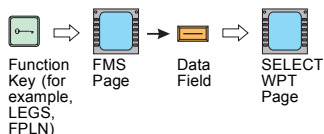
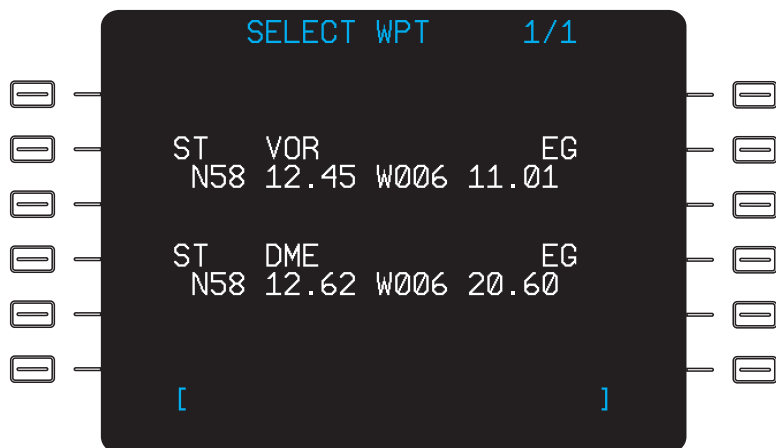


Figure 14-47 SELECT WPT Page – VOR/DME Navaid Pages



TPG9209_49



TPG9209_50

Each entry shows the waypoint identifier, type of navaid, the frequency as applicable, latitude, longitude, and ICAO country code. The duplicate identifier waypoints are ordered by increasing distance from the FMS position if the entry is on the TUNE page or POS INIT page, or if the entry involves the active waypoint. If the entry is on the FPLN or LEGS pages, the duplicate identifier waypoints are ordered by distance from the previous waypoint if one exists. Otherwise, for the FPLN and LEGS pages, the duplicate identifier waypoints are ordered by distance from the FMS position.

Condition(s):

If a waypoint identifier that is associated with duplicate ILS waypoints stored in the navigation data base is entered, the SELECT WPT page shows with ILS information.

Path:

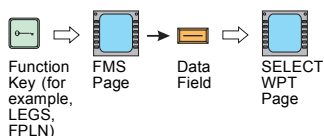
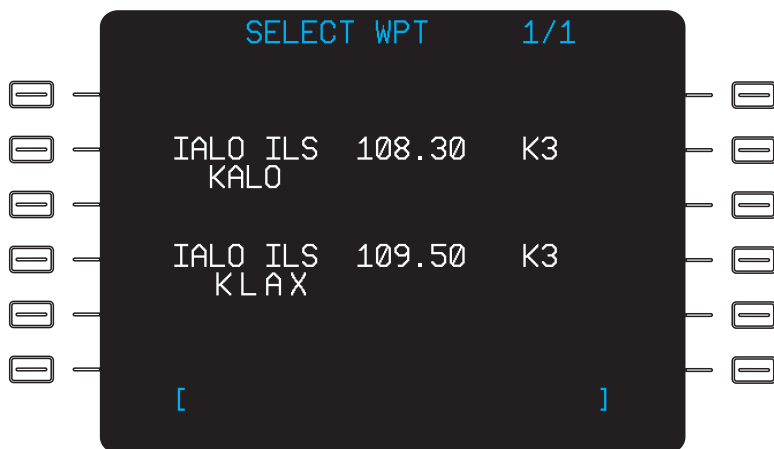


Figure 14-48 SELECT WPT Page – ILS Station



TPG9209_51

Each entry shows the waypoint identifier, type of navaid, frequency, associated airport, and ICAO country code. The duplicate identifier waypoints are ordered by increasing distance from the FMS position if the entry is on the TUNE page or POS INIT page, or if the entry involves the active waypoint. If the entry is on the FPLN or LEGS pages, the duplicate identifier waypoints are ordered by distance from the previous waypoint if one exists. Otherwise, for the FPLN and LEGS pages, the duplicate identifier waypoints are ordered by distance from the FMS position.

SELECT APT

Path:

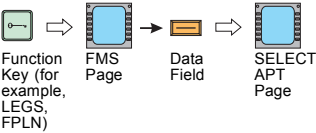


Figure 14-49 SELECT APT Page



TPG9209_52

If the pilot enters an airport identifier that is associated with more than one airport stored in the navigation data base, the SELECT APT page shows.

Each entry shows the airport identifier, latitude, longitude, and ICAO country code. The duplicate airports are ordered by increasing distance from the FMS position.

Pushing the left or right line select key next to one of the duplicate identifiers transfers the airport identifier into the data line of the page that was shown before the SELECT APT page and returns the display to the previous page.

If a selection on the SELECT APT page is not made before leaving the page (by pushing another function key), the requested edit is cancelled and the scratchpad is cleared.

FPLN

Condition(s):

When the FPLN function key on the CDU is pushed, the ACT FPLN or MOD FPLN page shows. Each page shows the same information.

- If no flight plan exists, or an unmodified active flight plan is being used, the ACT FPLN page shows.
- If a flight plan modification is in progress, the MOD FPLN page shows.

Path:

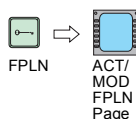
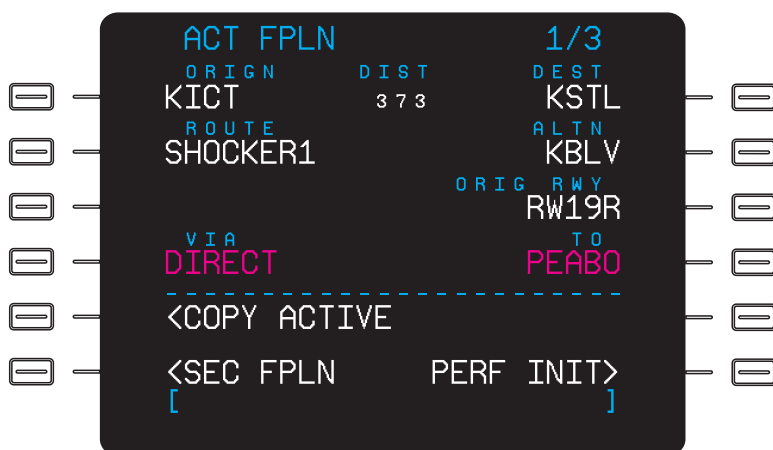


Figure 14-50 ACT FPLN Page



TPG9209_93

Information shown on the ACT FPLN pages varies with the equipment and options installed in the aircraft. Items that show on the ACT/MOD FPLN pages can include:

- ORIGIN, DEST and ALTN airports
- Distance to the destination airport (DIST)
- ROUTE identifier
- Departure runway (ORIG RWY)

- The beginning of the flight plan route (VIA and TO)
- Offset track distance (OFFSET).

All subsequent ACT or MOD FPLN pages show up to five lines of flight plan routing data, and line key selections for the SEC FPLN and PERF INIT pages. The active route shows in green. All other route data shows in white.

▼ SELECTIONS:

COPY ACTIVE

Selection copies the ACT FPLN and loads it into the SEC FPLN.

SEC FPLN

Selection supplies access to the SEC FPLN page. Refer to the figure on page 14-44.

PERF INIT

Selection supplies access to the PERF INIT pages. Refer to the figure on page 14-86.



LEGS

Condition(s):

When the LEGS function key on the CDU is pushed, the ACT LEGS or MOD LEGS page shows. Each page shows the same information.

- If an unmodified active flight plan is being used, the ACT LEGS page shows.
- If a flight plan modification is in progress, the MOD LEGS page shows.

Path:

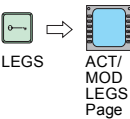
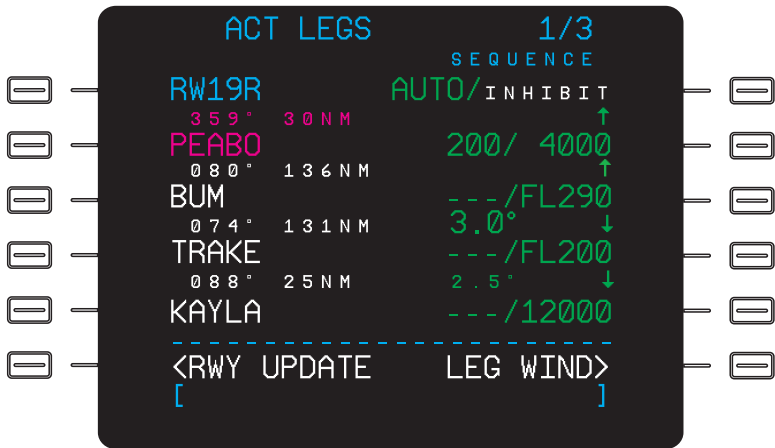


Figure 14-51 LEGS Page



TPG9206_33

The ACT LEGS and MOD LEGS pages show a list of all of the leg segments that make up a flight plan route. The TO leg shows in magenta, the last waypoint passed (FROM waypoint) shows in cyan, and all other leg waypoints show in white. Various types of flight plan legs are identified by the information shown in the left column of the display page. The list that follows describes the information shown for each leg type.

- For a magnetic or true course leg that terminates at a database or pilot-defined waypoint, the course direction and waypoint identifier show.
- For a magnetic or true heading leg with an altitude termination point, the heading and terminating altitude show.
- For a DME ARC leg, the distance and direction of the turn show along with a unique identifier.
- For a distance terminated leg, the course and waypoint with the terminating distance show.
- For a radial terminated leg, the course and waypoint with the terminating radial show.
- For an intercept leg that terminates when it intercepts the next leg, a course and the identifier (INTC) show.
- For a leg that is terminated manually when vectored from it, a course and the identifier (VECT) show.
- For a hold, HOLD AT and the holding fix identifier show.
- For a hold-to-an-inbound-course set of legs (for example, some approach transitions use a course reversal holding pattern to establish the course into the final approach), HOLD TO, the intercept identifier (INTC) and INBD CRS (to identify the inbound waypoint) show. A course reversal hold terminates when the holding intercepts the course into the final approach.
- For a procedure turn set of legs, P-TURN and the intercept identifier (INTC) show.

In addition to the leg type and course, a leg display also shows:

- The distance from the current position of the aircraft to the waypoint.
- Vertical navigation information for the waypoint to include any of the following.
 - Descent angle to the altitude constraint.
 - A SID, STAR, approach, or pilot-entered reference airspeed at a waypoint.
 - A SID, STAR, approach, or pilot-entered constraint altitude or flight level at a waypoint.

LEG WIND

Path:

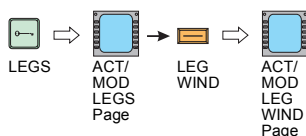
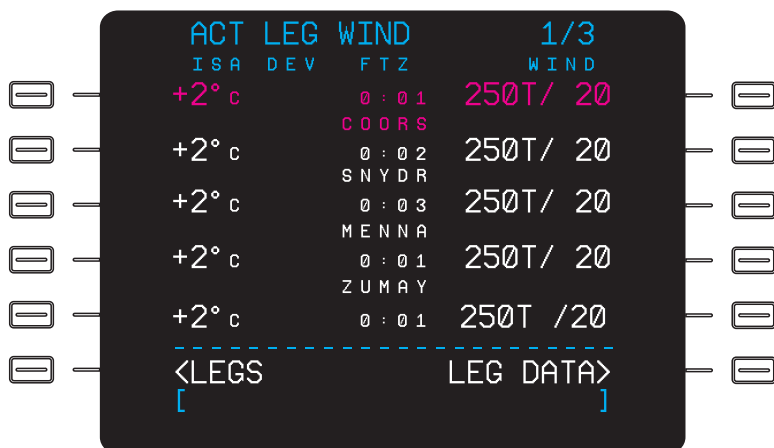


Figure 14-52 LEG WIND Page



TPG9206_18

The same color conventions for the TO waypoint, active leg, and FROM waypoint that are used on the LEGS page are also used on the LEG WIND page. Refer to the FLIGHT PLANNING chapter for information on entering winds and ISA deviation on the LEG WIND pages.

PERF

Path:

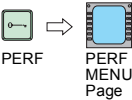
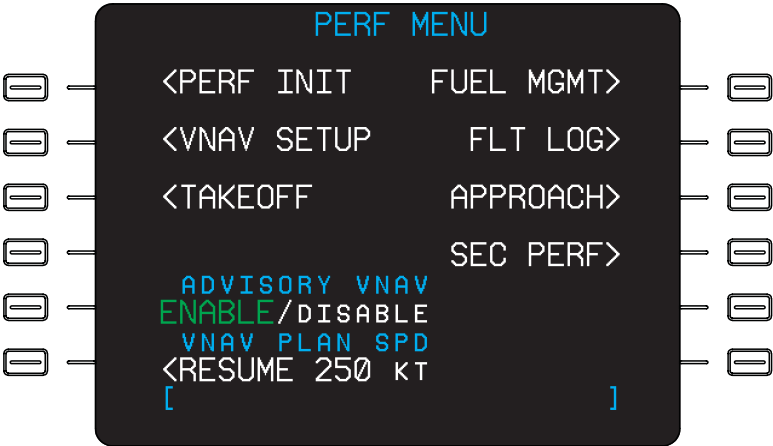


Figure 14-53 PERF MENU Page



TPH8456_01

The PERF MENU page shows a menu of the available performance functions, allows the pilot to enable the VNAV advisory function, and shows/enables the VNAV PLAN SPD.

▼ SELECTIONS:

PERF INIT	Selection supplies access to the PERF INIT pages. Refer to the figure on page 14-86.
VNAV SETUP	Selection supplies access to the VNAV setup pages (VNAV CLIMB, VNAV CRUISE, VNAV DESCENT). Refer to the figure on page 14-90, the figure on page 14-92, and the figure on page 14-94.

TAKEOFF	Selection supplies access to the TAKEOFF REF pages. Refer to the figure on page 14-98.
FUEL MGMT	Selection supplies access to the FUEL MGMT pages. Refer to the figure on page 14-103.
FLT LOG	Selection supplies access to the FLIGHT LOG page. Refer to the figure on page 14-107.
APPROACH	Selection supplies access to the APPROACH REF pages. Refer to the figure on page 14-109.
SEC PERF	Selection supplies access to the SEC PERF pages. Refer to the figure on page 14-114.
ADVISORY VNAV	Selection enables and disables advisory VNAV features including the required vertical speed, vertical deviation scale, and constraint altitudes for display on the Primary Flight Display (PFD).
VNAV PLAN SPD	VNAV PLAN SPD, shown at the bottom left of the PERF MENU page, shows the VNAV speed for the current flight phase that is specified on the VNAV SETUP pages, or a flight plan speed restriction, whichever is the most restrictive. The RESUME text shows when VNAV PLAN SPD is not selected. Refer to the PERFORMANCE chapter for a more detailed description of VNAV PLAN SPD.

PERF INIT

Path:

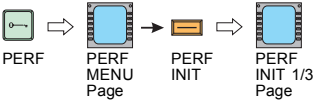
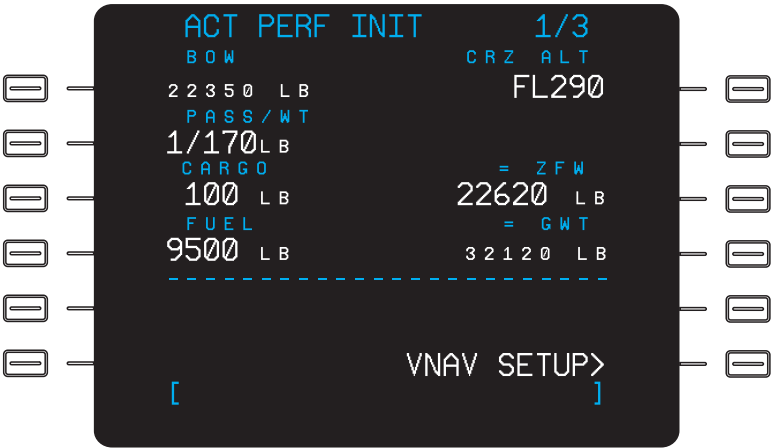


Figure 14-54 PERF INIT 1/3 Page



TPH8457_01

The PERF INIT 1/3 page is used for setting or reviewing various attributes used to initialize the performance functions. Prompt boxes (□ □ □ □ □ □) for FUEL and CRZ ALT, on the PERF INIT 1/3 page, identify the entries required to activate the performance functions. Initializing the PERF functions can be very simple or very detailed, based on the needs of the pilots. Refer to the PERFORMANCE chapter for a more detailed description of PERF INIT.

Path:

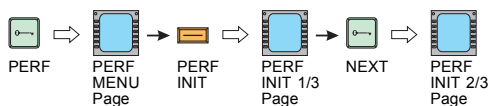
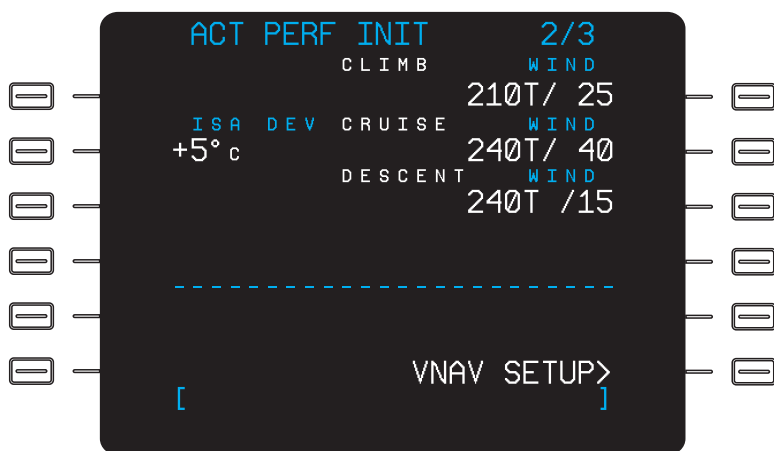


Figure 14-55 PERF INIT 2/3 Page



TPG9206_25

The PERF INIT 2/3 page allows the pilot to enter the expected winds and air temperature deviation (ISA DEV) for a flight. The FMS uses the average winds in the climb, cruise, and descent, as well as winds on individual cruise legs, in its performance predictions of fuel consumption, and flight plan leg times. The FMS also uses ISA DEV inputs for both individual flight plan cruise legs, and average cruise ISA DEV, in its performance calculations. Additionally, the FMS uses ISA DEV inputs, along with airspeed, altitude, and winds, to maintain a holding pattern within its protected airspace.

The wind blending feature is used within the FMS predicted performance function to enhance the time and fuel prediction accuracy by accounting for the actual winds encountered during the flight. The actual winds are blended with the pilot specified forecast wind data in the FMS. The blending algorithm emphasizes the actual winds for portions of the flight plan that are close to the aircraft present position, and emphasizes the forecast wind data for regions of the flight plan that are further downtrack.

A similar algorithm is used for predicting the atmospheric temperature along the flight plan route in the form of deviation from ISA temperature (ISA DEV). The ISA DEV temperature blending is another part of the wind blending feature in the FMS.

Both the wind blending and temperature blending use the same algorithm. Each one blends 100% actual conditions and 0% forecast conditions at the aircraft present position. The actual conditions are linearly tapered down (decreasing effect), and the forecast conditions are linearly tapered up (increasing effect) over the next 400 NM distance downtrack along the flight plan route. Beyond 400 NM downtrack, the wind blending and temperature blending algorithms use 100% forecast conditions.

The 400 NM wind integration segment applies only to the cruise phase. In the climb and descent phase, the wind integration segment is for each 10,000 feet of vertical (altitude) change (100% actual and 0% forecast at current aircraft altitude decreasing linearly over the next 10,000 feet of vertical change).

Path:

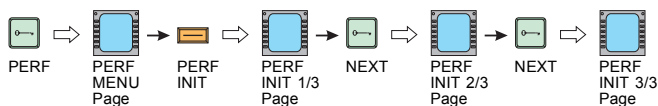
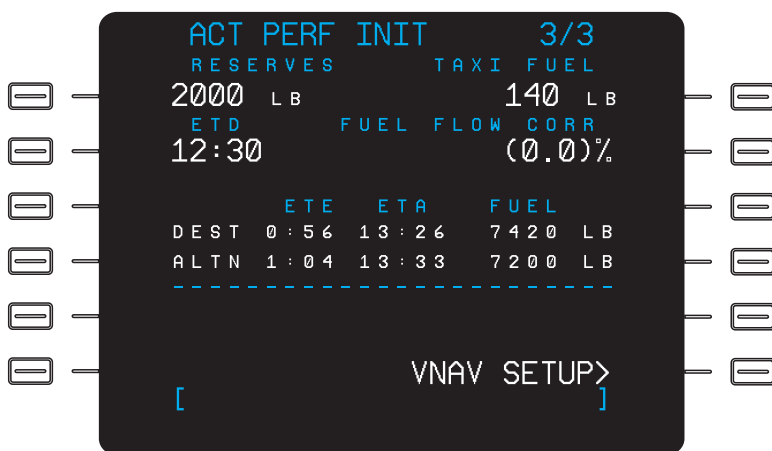


Figure 14-56 PERF INIT 3/3 Page



TPG9206_26

The PERF INIT 3/3 page allows the pilot to set an ETD, and shows the ETA, default RESERVES and TAXI FUEL, and the fuel remaining estimates at the destination and alternate airports.

VNAV SETUP

Condition(s):
When the VNAV SETUP line select key is pushed and the aircraft is on the ground or in the climb phase, the VNAV CLIMB page shows.

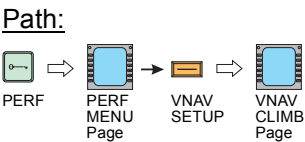
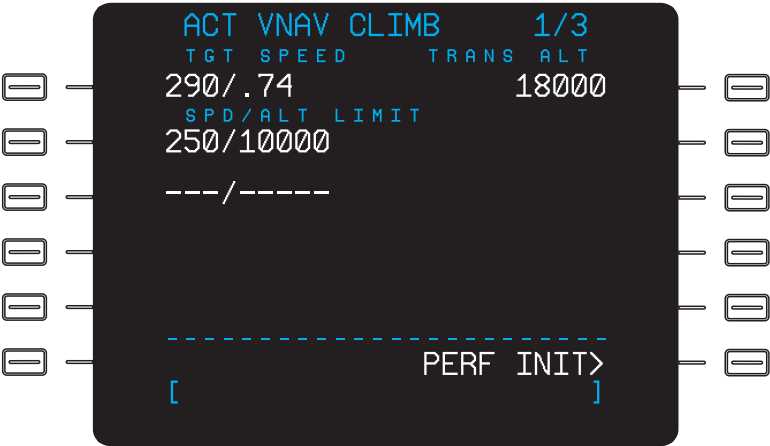


Figure 14-57 VNAV CLIMB Page



TPG9206_27

The VNAV CLIMB page shows the default setting for TGT SPEED and speed/altitude limit (SPD/ALT LIMIT) for the climb phase, along with the TRANS ALT. The IAS and Mach speeds that show on each page are independent so that individual speeds for each phase of flight can be set. The speed/altitude limits are also independent on each page. Additional SPD/ALT LIMIT entries can be added to the default setting.

▼ SELECTIONS:

TGT SPEED	Shows the default target speed for the climb in IAS/Mach. TGT SPEED can be changed as necessary.

TRANS ALT

Shows the transition altitude. The value is retrieved from the FL/TRANS ALT setting on DEFAULTS 2/5 page every time a new flight plan is created. This value can be changed without affecting the value on DEFAULTS 2/5 page.



NOTE

TRANS ALT on the CLIMB page and TRANS FL on the DESCENT page are interconnected. Changing either one results in a concurrent change in the other.

SPD ALT/LIMIT

Shows the default speed/altitude limit, which can be changed as necessary or an additional SPD/ALT LIMIT added.

PERF INIT

Selection supplies access to the PERF INIT page.

Condition(s):

When the VNAV SETUP line select key is pushed and the aircraft is in the cruise phase, the VNAV CRUISE page shows.

Path:

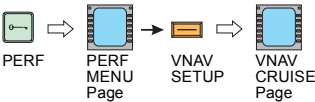
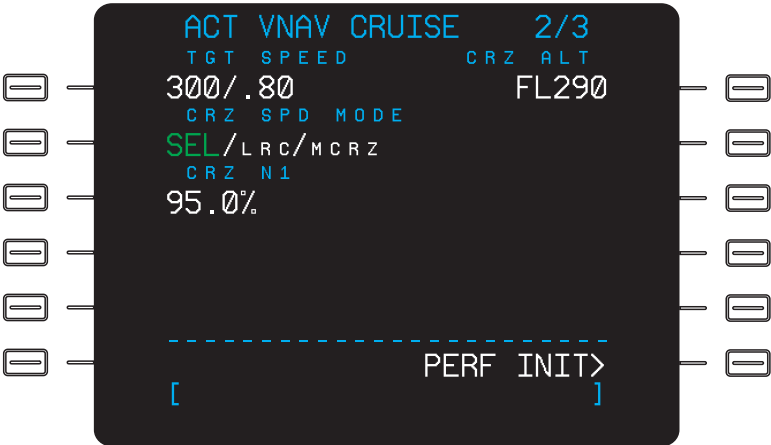


Figure 14-58 VNAV CRUISE Page



TPH8744_01

The VNAV CRUISE page shows the default setting for TGT SPEED and the selected CRZ ALT. The IAS and Mach speeds that show on each page are independent so that individual speeds for each phase of flight can be set. The speed/altitude limits are also independent on each page. All of the default values on each page can be changed on the DEFAULTS 2/5 page, or for a single flight, on the VNAV SETUP pages. However, changes made on the DEFAULTS 2/5 page do not take affect for the current flight plan.

SELECTIONS:

TGT SPEED	Shows the default target speed for the cruise in IAS/Mach. TGT SPEED can be changed as necessary.

CRZ SPD MODE

Used to select the cruise speed schedule. Available settings are standard cruise schedule (SEL), Long Range Cruise (LRC), and Maximum Cruise (MCRZ). Each push of the CRZ SPD MODE line select key sequentially selects the next option.

- The standard cruise schedule (SEL) supplies a constant target speed for cruise, regardless of the weight of the aircraft.
- The Long Range Cruise (LRC) speed supplies a cruise schedule that lets the aircraft fly the longest range. In the LRC mode, the target speed is a function of aircraft weight, which causes the target speed to continually change as the aircraft burns fuel.
- The Maximum Cruise (MCRZ) speed supplies the maximum cruise speed schedule at which the aircraft can be operated. MCRZ minimizes the time en route. MCRZ is defined as the lowest speed obtained at either Maximum Continuous Thrust (MCT) or V_{MO}/M_{MO} .

CRZ N1

Used to enter a target N1 setting for the cruise.

CRZ ALT

Shows the planned cruise altitude for the flight.



NOTE

The CRZ ALT is the same altitude that is entered on the PERF INIT page. Changing the CRZ ALT on the VNAV CRUISE page also changes it on the PERF INIT pages.

Condition(s):

When the VNAV SETUP line select key is pushed and the aircraft is in the descent phase, the VNAV DESCENT page shows.

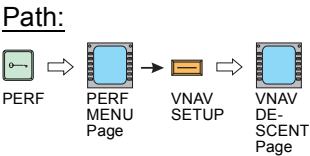
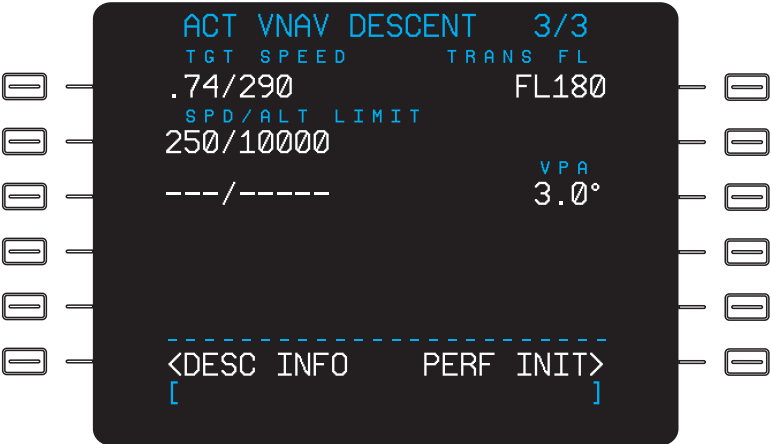


Figure 14-59 VNAV DESCENT Page



TPG9206_29

The VNAV DESCENT page shows the default setting for TGT SPEED and speed/altitude limit (SPD/ALT LIMIT) for the descent phase, along with the TRANS FL. The VNAV DESCENT page also shows a default setting for Vertical Path Angle (VPA) for the descent. The IAS and Mach speeds that show on each page are independent so that individual speeds for each phase of flight can be set. The speed/altitude limits are also independent on each page. All of the default values on each page can be changed on the DEFAULTS 2/5 page, or for a single flight, on the VNAV SETUP pages. However, changes made on the DEFAULTS 2/5 page do not take affect for the current flight plan.

▼ SELECTIONS:

TGT SPEED

Shows the default target speed for the cruise in IAS/Mach. TGT SPEED can be changed as necessary.

TRANS FL

Shows the transition flight level. The value is retrieved from the FL/TRANS ALT setting on DEFAULTS 2/5 page every time a new flight plan is created. This value can be changed without affecting the value on DEFAULTS 2/5 page.



NOTE

TRANS ALT on the CLIMB page and TRANS FL on the DESCENT page are interconnected. Changing either one results in a concurrent change in the other.

SPD ALT/LIMIT

Shows the default speed/altitude limit, which can be changed as necessary or an additional SPD/ALT LIMIT added.

VPA

Shows the default setting for vertical path angle. The default value can be changed as necessary. Changing the VPA on the VNAV DESCENT page changes the VPA for all descents in the flight plan. However, on the LEGS page, the VPA can be changed for any individual descent. Refer to the VNAV OPERATIONS chapter for information on setting the VPA for individual descent.

DESC INFO

Selection provides access to the DESC INFO page. Refer to the figure on page 14-96.

DESC INFO

Path:

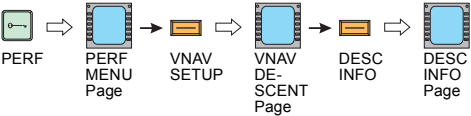
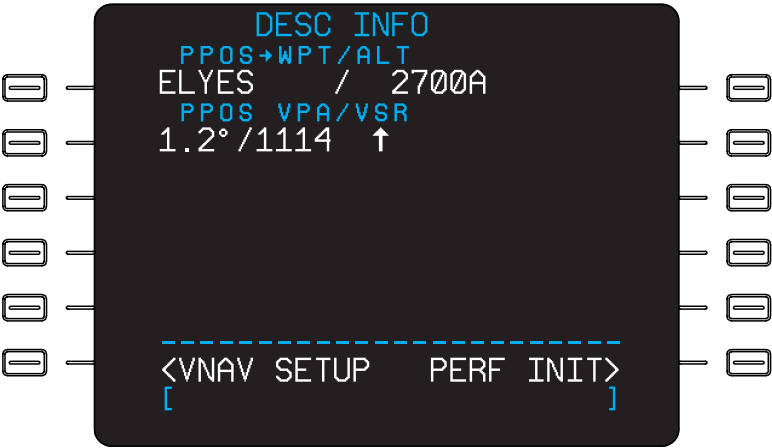


Figure 14-60 DESC INFO Page



TPH6176_03

The DESC INFO page shows vertical information from the aircraft present position and altitude Direct-To the displayed waypoint altitude. The waypoint value defaults to the next waypoint in the active flight plan that has a descent constraint. The pilot can overwrite the default waypoint with any waypoint in the flight plan that has a descent altitude constraint. Also, the pilot can enter any runway that is associated with the destination airport. The intent of these fields is to supply vertical situational awareness to the pilot.

SELECTIONS:

PPOS→WPT ALT	Shows the waypoint identifier and the associated descent constraint.

PPOS VPA/VSR



Shows the Vertical Path Angle in degrees to the descent constraint and the Vertical Speed Required to reach the descent constraint. The VSR is computed based on vertical distance to the constraint, ground distance to the waypoint, and the current groundspeed. The VPA is computed based on the PPOS VSR divided by the current groundspeed, multiplied by a constant of 57.3 deg/rad.

TAKEOFF REF

Path:

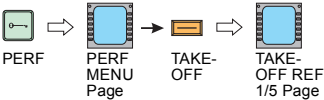


Figure 14-61 TAKEOFF REF 1/5 Page



TPH8745_01

The TAKEOFF REF 1/5 page shows the runway information and the ambient metrological conditions used for determining Vs speeds, Maximum Takeoff Weight (MTOW) and Takeoff Field Length (TOFL). The information provided on the TAKEOFF REF pages is defined with respect to the active flight plan only.

Path:

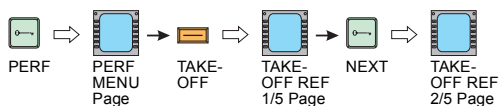
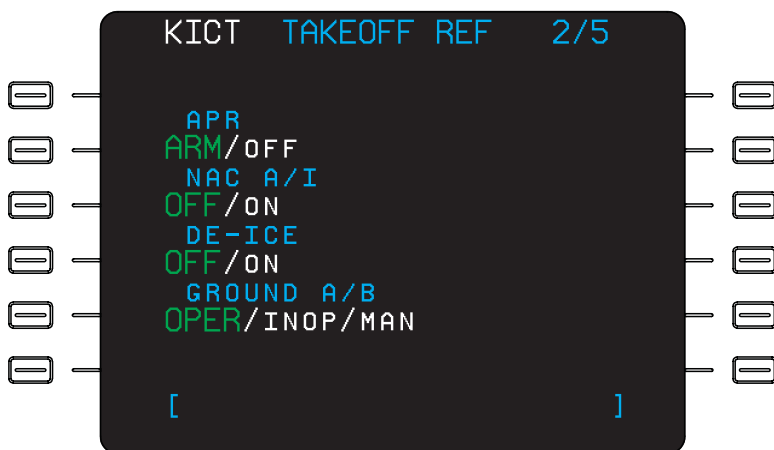


Figure 14-62 TAKEOFF REF 2/5 Page



TPH8746_01

The TAKEOFF REF 2/5 page supplies fields to enter planned aircraft configuration settings for takeoff. The aircraft configurations that can be set include Automatic Power Reserve, nacelle anti-ice, surface de-ice, and ground air brake.

Path:

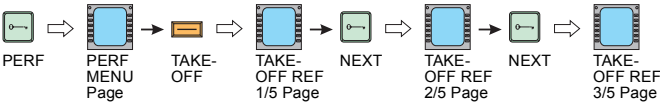
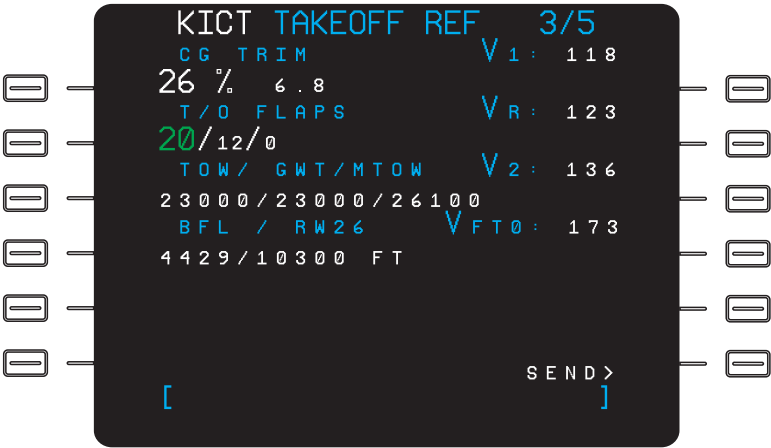


Figure 14-63 TAKEOFF REF 3/5 Page



TPH8747_01

The TAKEOFF REF 3/5 page provides data entry and display fields for takeoff speeds, takeoff weight data, takeoff runway length data and aircraft configuration settings. For systems which have integrated Vs speeds, it also lets the pilot select the computed Takeoff Vs speeds for display on the PFD airspeed scale.

Path:

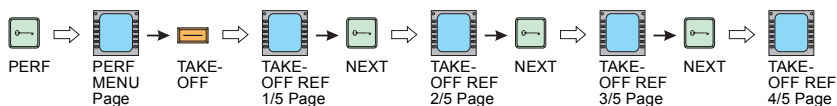
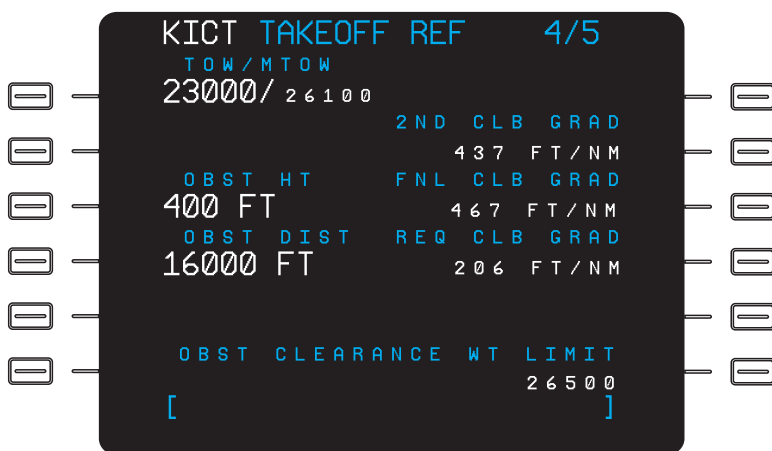


Figure 14-64 TAKEOFF REF 4/5 Page



TPH8748_01

The TAKEOFF REF 4/5 page shows takeoff weight information, climb gradient performance data and provides an obstacle clearance/climb performance calculator function, as well as display of the obstacle clearance weight limit.

Path:

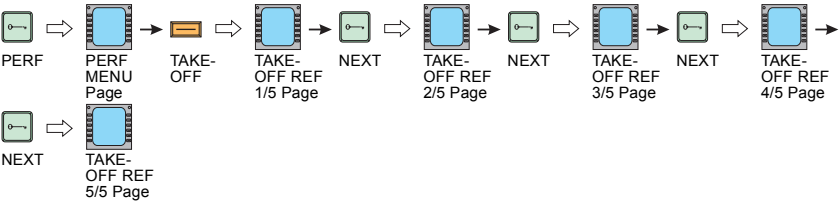


Figure 14-65 TAKEOFF REF 5/5 Page



TPH8749_01

The TAKEOFF REF 5/5 page supplies takeoff weight and maximum takeoff weight values and supplies data on the structural, climb performance, runway length, and brake energy weight limits.

FUEL MGMT

Path:

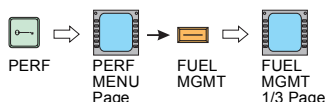
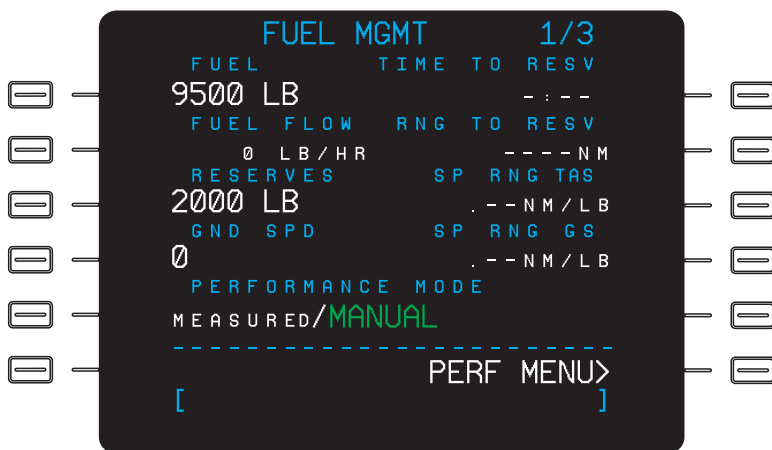


Figure 14-66 FUEL MGMT Page 1/3



TPG9206_30

The FUEL MGMT 1/3 page shows:

- Total quantity of FUEL
- Total FUEL FLOW
- Total RESERVES
- Groundspeed (GND SPD)
- Time To Reserves (TIME TO RESV)
- Range To Reserves (RNG TO RESV)
- Current fuel burn for a Specific Range based on the True Airspeed (SP RNG TAS)
- Current fuel burn for a Specific Range based on the Groundspeed (SP RNG GS).



NOTE

The FUEL quantity can only be changed on the PERF INIT 1/3 page. FUEL quantity on the FUEL MGMT pages is for display only.

The FMS can calculate performance data in one of two modes: PREDICTED or MEASURED/MANUAL.

On the CDU, the performance mode selected affects:

- Altitude predictions shown on the LEGS pages
- ETA, ETE and FUEL shown on the PERF INIT 3/3 page
- ETE and FUEL-LB/KG shown on the PROGRESS pages.

On the MFD, the mode selected affects the ETA and FUEL shown on the ACT FPLN PROGRESS pages.

In PREDICTED mode, the data shown is based on the performance tables for the aircraft as they relate to the flight plan route and profile for the entire planned flight. In MEASURED/MANUAL mode, the data shown is based on the current sensor-measured data for FUEL FLOW and GND SPD (MEASURED mode), or pilot-entered FUEL FLOW and GND SPD (MANUAL mode). In MEASURED mode, it is possible to see wide variations in the performance data during climb and descent phases of flight. Also, the altitude predictions shown on the LEGS pages are not available in the MEASURED/MANUAL mode.



NOTE

To help differentiate sensor-measured FUEL FLOW and GND SPD from pilot entries, sensor-measured data shows in small font characters and pilot entries show in large font characters. To return the FMS to MEASURED mode after you have made manual entries, which automatically selects the MANUAL mode, you must delete all of the manual entries you made. Use the CLR DEL key to enter DELETE into the scratchpad and transfer it to the entry to be deleted. When a manual entry is deleted, the current sensor measured value shows.

Path:

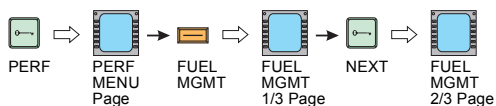
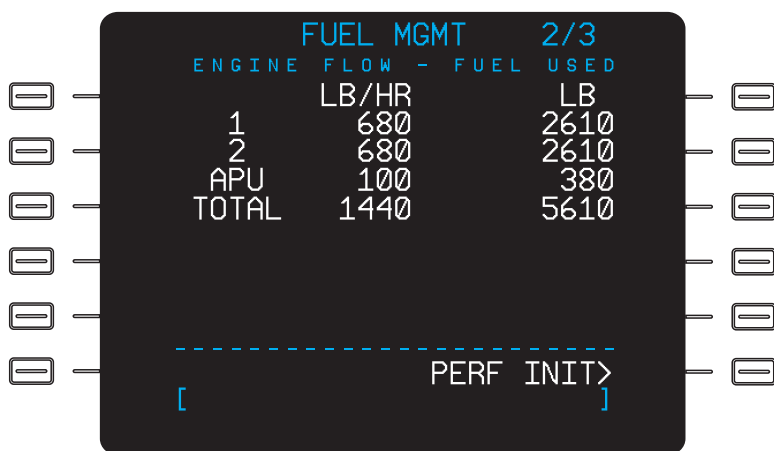


Figure 14-67 FUEL MGMT 2/3 Page



TPG9209_62

The FUEL MGMT 2/3 page shows the ENGINE FUEL-FLOW-USED, which is the fuel flow rate and fuel used for each engine individually and the TOTAL for both. Values shown are for display only.

Path:

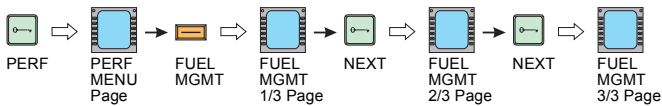
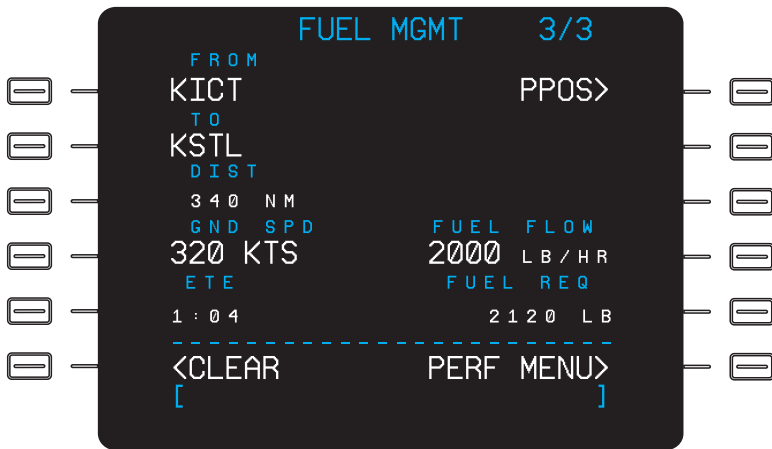


Figure 14-68 FUEL MGMT 3/3 Page



TPG9206_31

The FUEL MGMT 3/3 page is a trip calculator. This page shows the following:

- FROM
- TO
- DIST
- GND SPD
- ETE
- PPOS
- FUEL FLOW (LB/HR)
- FUEL REQ (LB).

The FUEL MGMT 3/3 page is used to calculate ETE and the fuel required (FUEL REQ) based on DIST, GND SPD, and FUEL FLOW inputs. The inputs can be calculated by the FMS or entered manually by the pilot. Distance can be specified either FROM a specific waypoint, or from the present position (PPOS) to a specific waypoint (TO) or a specified distance (DIST).

FLIGHT LOG

Path:

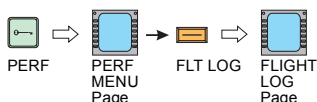
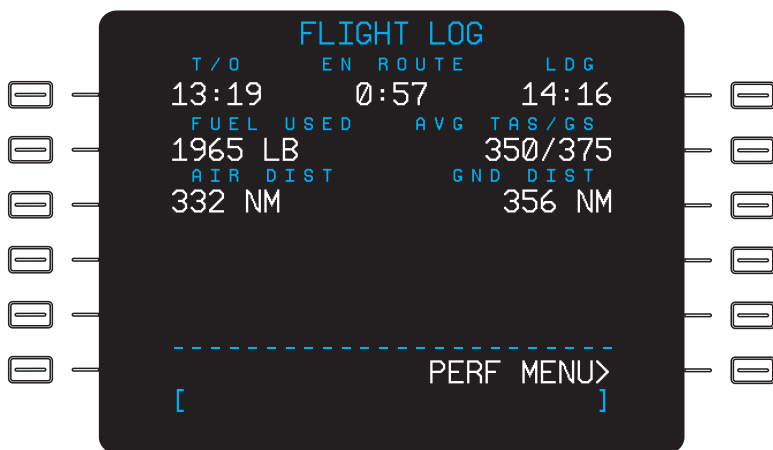


Figure 14-69 FLIGHT LOG Page



TPG9206_32

The FLIGHT LOG page shows:

- Takeoff time (T/O)
- EN ROUTE time
- Landing time (LDG)
- FUEL USED
- Average true airspeed and ground speed (AVG TAS/GS)
- AIR DIST
- GND DIST
- A line key selection to return to the PERF MENU page.

If the FLIGHT LOG ON LDG option on the DEFAULTS 3/5 page is set to YES before takeoff, the FLIGHT LOG page is automatically displayed on the CDU 15 seconds after landing (weight on wheels) if the CDU is not showing a non-FMS-sourced page at the time.



NOTE

Non-FMS functions that can show pages on the CDU include the RTU, DATALINK, SATCOM, and AFIS functions.

APPROACH REF

Path:

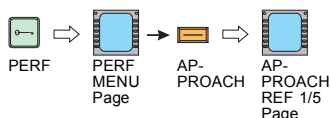
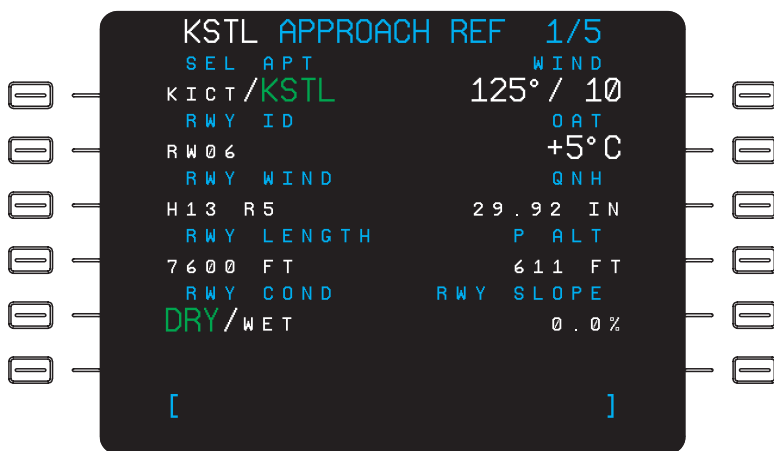


Figure 14-70 APPROACH REF 1/5 Page



TPH8750_01

The APPROACH REF 1/5 page shows the approach runway information and the ambient meteorological conditions used for determining approach Vspeeds. This information is also used to determine Maximum Landing Weight (MLW), and Landing Field Length (LFL) or Actual Landing Distance (ALD). The information provided on the APPROACH REF pages is defined with respect to the active flight plan only.

Path:

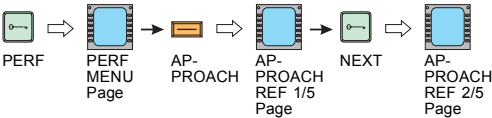
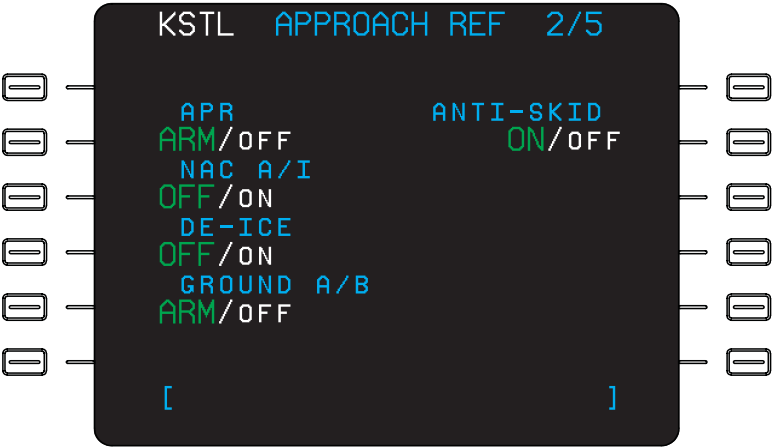


Figure 14-71 APPROACH REF 2/5 Page



TPH8810_01

The APPROACH REF 2/5 page supplies fields to enter planned aircraft configuration settings for the approach and landing. The aircraft configurations that can be set include Automatic Power Reserve, nacelle anti-ice, surface de-ice, ground air brake, and anti-skid.

Path:

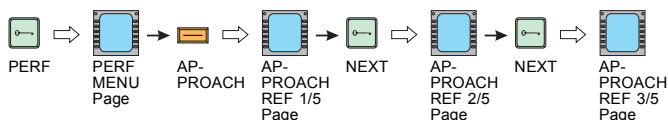
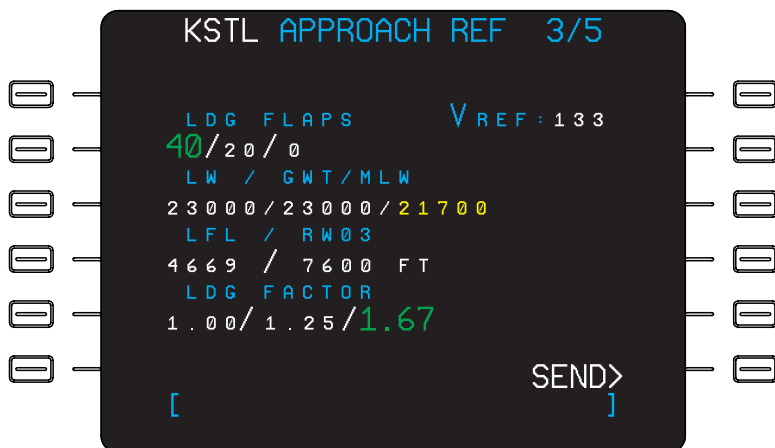


Figure 14-72 APPROACH REF 3/5 Page



TPH8752_01

The APPROACH REF 3/5 page shows data fields for approach speeds, landing weight data, landing runway length data and aircraft configuration settings. This page allows for selection of the approach Vspeed to be sent for display on the PFD airspeed scale.

Path:

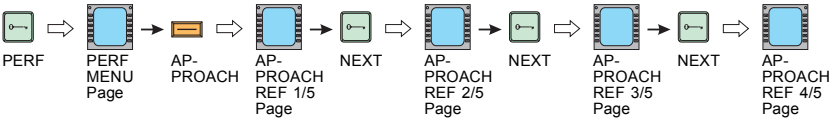
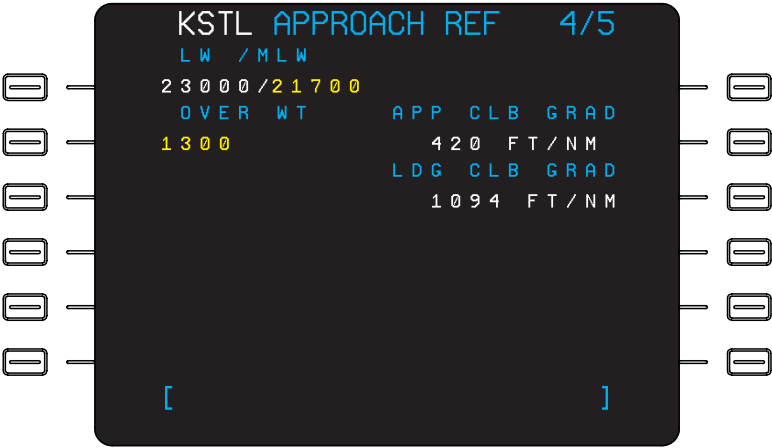


Figure 14-73 APPROACH REF 4/5 Page



TPH8753_01

The APPROACH REF 4/5 page shows landing weight information and climb gradient performance data.

Path:

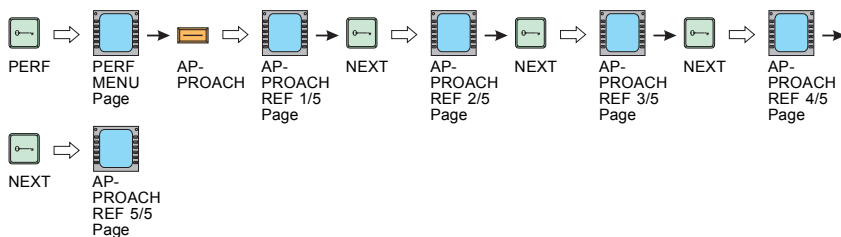
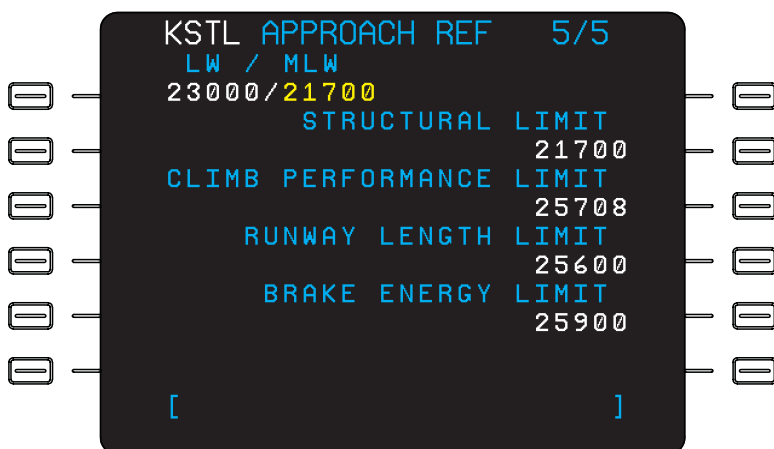
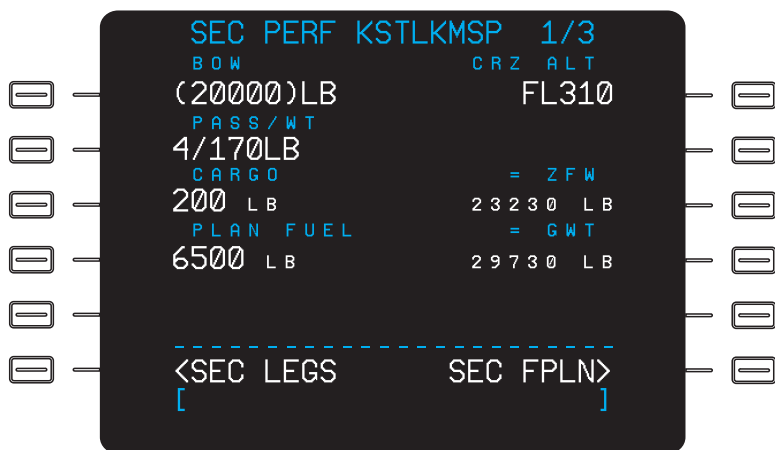
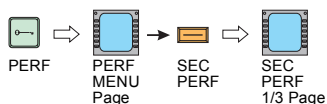


Figure 14-74 APPROACH REF 5/5 Page



TPH8754_01

The APPROACH REF 5/5 page supplies landing weight information and data on the structural, climb performance, runway length, and brake energy weight limits.



The SEC PERF 1/3 page uses the same format as the PERF INIT 1/3 page. Refer to the figure on page 14-86.

Path:

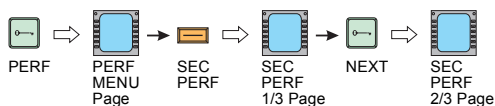
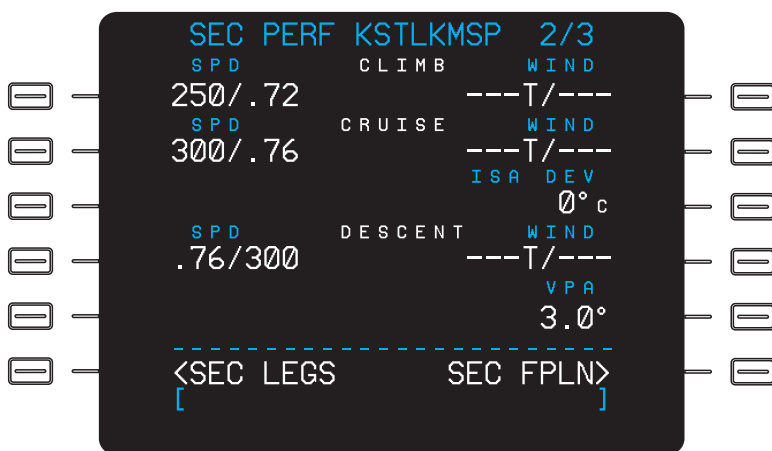


Figure 14-76 SEC PERF 2/3 Page



TPG9209_68

The SEC PERF 2/3 page shows VNAV SETUP information and WIND/ISA DEV for the CLIMB, CRUISE, and DESCENT phases of the SEC FPLN.

Path:

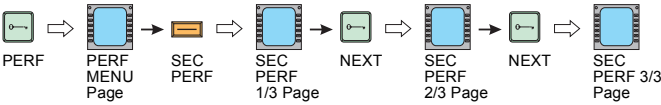
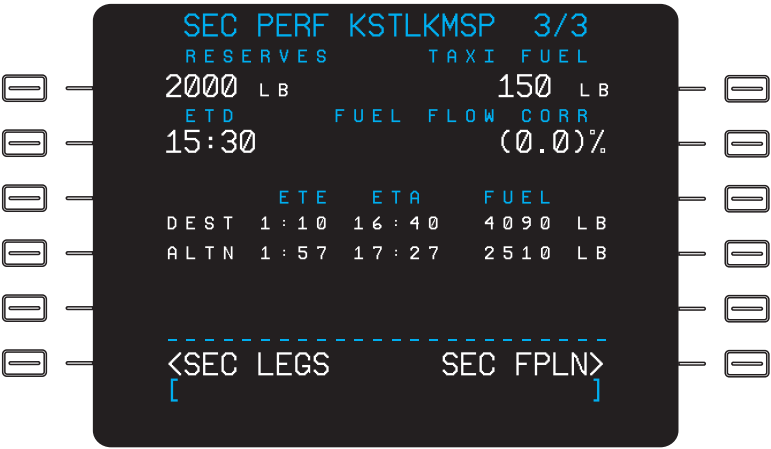


Figure 14-77 SEC PERF 3/3 Page



TPG9209_69

The SEC PERF 3/3 page allows the pilot to set an ETD, and shows the ETA, default RESERVES and TAXI FUEL, and the fuel remaining estimates at the destination and alternate airports for the SEC FPLN.

DEP ARR

Condition(s):

The DEP/ARR INDEX page shows if one of the following is true when the DEP ARR function key is pushed:

- Neither an active or modified flight plan exists.
- The SEC FPLN page or SEC LEGS page is showing.
- The origin or destination airport is not specified.

Path:

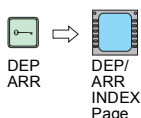
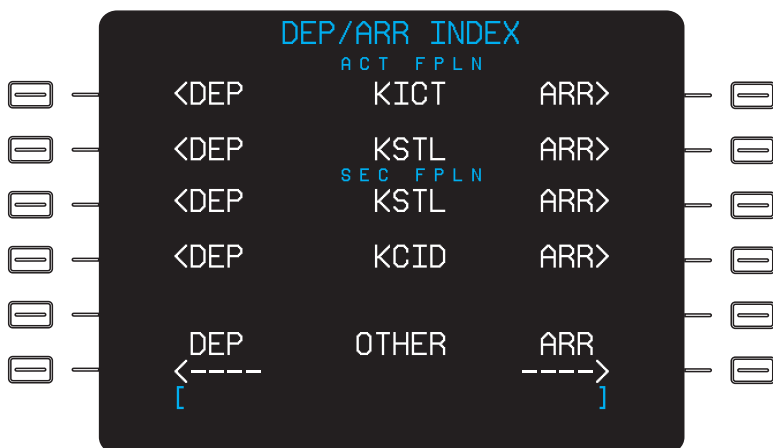


Figure 14-78 DEP/ARR INDEX Page



TPG9209_70

The DEP/ARR INDEX page shows the identifiers for the origin and destination airports for the ACT FPLN and the SEC FPLN if the airports have been entered on the respective flight plan pages. An entry line labeled OTHER is used to show departures and arrivals for an airport that is not associated with either flight plan.

When an airport identifier is entered into the scratchpad, and the DEP line select key adjacent to the OTHER legend is pushed, the CDU page changes to a DEPART page that shows SIDS and RWYS for the

selected airport. These departures cannot be directly incorporated into a flight plan as they are for display only.

When an airport identifier is entered into the scratchpad and the ARR line select key adjacent to the OTHER legend is pushed, the CDU page changes to an ARRIVAL page that shows STARS and APPR, including any visual approaches, for the selected airport. These arrivals cannot be directly incorporated into a flight plan as they are for display only.

Condition(s):

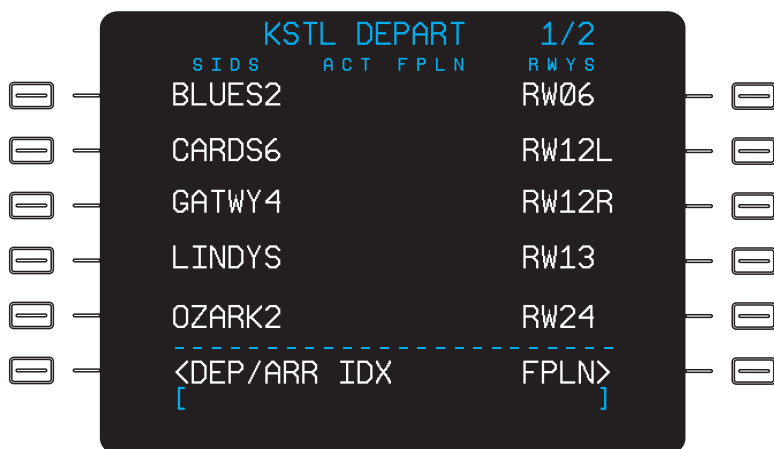
The DEPART page for the origin airport shows if all of the following are true when the DEP ARR function key is pushed:

- An active or modified flight plan exists.
- Neither the SEC FPLN page nor the SEC LEGS page is showing.
- The aircraft is on the ground.

Path:



Figure 14-79 DEPART Page



TPG9209_71

The DEPART page shows a list of runways and a list of SIDS, arranged in alphabetical and numerical order. From these lists, a runway and a SID can be selected. Pushing a line select key to select a runway on the DEPART page clears all other runways from the display, and the list of SIDS is restricted to those applicable to the selected runway. If, on the other hand, a SID is selected, all other SIDS are cleared from the list and only applicable runways show on the runway list.

Until the EXEC function key on the CDU is pushed, the CANCEL MOD line select key can be used to clear the pending changes. With selection of a runway or a SID, the EXEC annunciation shows to indicate the EXEC function key executes the pending flight plan changes.

After selecting either a runway or a SID, make a selection from the items remaining in the other list. After a SID has been selected, a list of en route transitions (if available) shows below the selected SID. Use the NEXT and PREV function keys on the CDU as necessary to show all the DEPART pages.

If the DEPART page is selected to show when either runway or SID has been previously selected, the DEPART page shows the selected items along with the unselected items. Selected items show at the top of the lists and the remaining items are arranged in alphabetical and numerical order.

If a selected item is incompatible with a previous selection, the previous selection is removed. For example, if a new SID is selected, but it is not associated with the previously selected runway, the runway selection is removed. If a SID is reselected, and a leg of that SID happens to be active, that leg remains in the flight plan as the active leg, with the new SID, which is preceded by a discontinuity, following the active leg.

After the departure selections are made, pushing the line select key adjacent to FPLN shows the ACT/MOD FPLN page with the selections of runway, SID, and en route transition, as appropriate. If the flight plan contains waypoints when the SID is selected and the first waypoint is not the SID exit point, a discontinuity is inserted after the SID procedure. After passing the first waypoint, the departure runway display on the first ACT/MOD FPLN page is removed and another VIA data line is added.

Condition(s):

The ARRIVAL page for the ORIGIN airport shows if all of the following are true when the DEP ARR function key is pushed:

- An active or modified flight plan exists.
- Neither the SEC FPLN page nor the SEC LEGS page is showing.
- The aircraft is airborne and less than 50 NM from the origin airport or less than halfway to the destination airport.

The ARRIVAL page for the DEST airport shows if all of the following are true when the DEP ARR function key is pushed:

- An active or modified flight plan exists.
- Neither the SEC FPLN page nor the SEC LEGS page is showing.
- The aircraft is airborne and more than 50 NM from the origin airport or more than halfway to the destination airport.

Path:

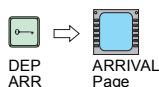
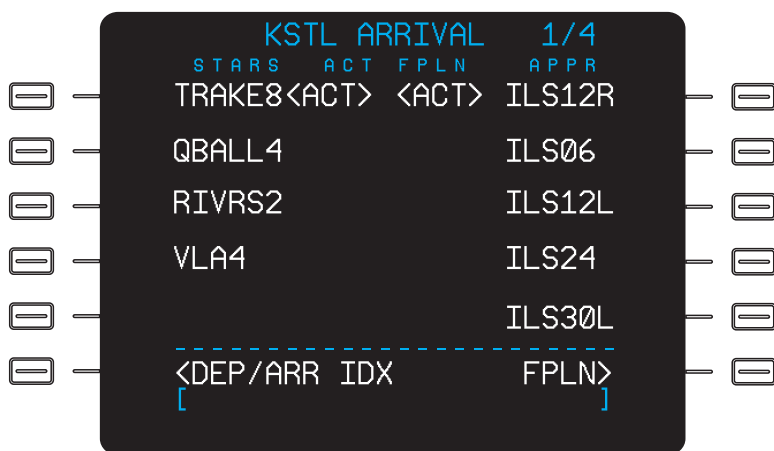


Figure 14-80 ARRIVAL Page



TPG9209_72

The ARRIVAL page shows a list of approaches and runways, along with a list of STARs. From these lists select an approach, runway, and/or a STAR. Use the NEXT or PREV function key on the CDU as necessary to sequence through the ARRIVAL pages.

Pushing a line select key to select an approach or runway on the ARRIVAL page clears all other approaches and runways from the display, and the list of STARs shows only the STARs associated with the selected approach or runway. If a STAR is selected, it clears all other STARs from the list and only applicable runways and approaches show on the approach and runway list. After a STAR is selected, the available transitions for the chosen STAR show.

Until the EXEC function key on the CDU is pushed, use the CANCEL MOD line select key to clear the pending changes. Once the runway or SID is selected, the EXEC annunciation shows to indicate that pushing the EXEC function key executes the pending flight plan changes.

If the ARRIVAL page is selected to show when an approach, runway, or STARs has been previously selected, the ARRIVAL page shows the

selected items along with the unselected items. Selected items show at the top of the lists and the remaining items show in normal order.

Select the approach, runway, and/or the STAR. If a newly selected item is incompatible with a previous selection, the previous selection is removed. For example, when a new STAR is selected, but is not associated with the previously selected approach or runway, the approach or runway selection is removed. If a STAR is reselected, and a leg of that STAR happens to be active, that leg remains in the flight plan as the active leg, with the new STAR, which is preceded by a discontinuity, following the active leg.

Changing the selection of the STAR removes the previous STAR from the flight plan. The new STAR is inserted in place of the old STAR, unless a leg of the previous STAR happens to be active. In that case, the new STAR is inserted after the active waypoint. Additionally, if the selected runway is not associated with the newly selected STAR, the runway is removed from the flight plan.

After the arrival selections are made, the associated FPLN page shows the selections of STAR, en route transition, approach procedure, runway, and runway extension, as appropriate.

The table below cross-references TERMINAL PROCEDURE DESIGNATION names to those shown on the CDU. For simplicity, the table lists only the root designations without the various suffix designations that define specific runways or procedure types. The CDU does show the appropriate suffix with the designations listed in the table (for example, VORA or ILS21R). Also, some circling approaches have unique names that do not follow the conventions described in the table, but they show correctly on the CDU.

TERMINAL PROCEDURE DESIGNATION	CDU DESIGNATION
ILS	ILS
LOC	LOC
B/C	B/C
LDA	LDA
SDF	SDF
GPS	GPS

TERMINAL PROCEDURE DESIGNATION	CDU DESIGNATION
LORAN	LRN
VOR or GPS	GVOR
VOR DME or GPS	GVOR
VOR	VOR
VOR DME	VOR
NDB or GPS	GNDB
NDB DME OR GPS	GNDB
NDB	NDB
NDB DME	NDB
IGS	IGS
TACAN	TCN
RNAV or GPS	GRNV
RNAV	RNV
VISUAL Approaches To A Runway	RW

DIR

Path:

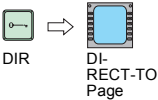
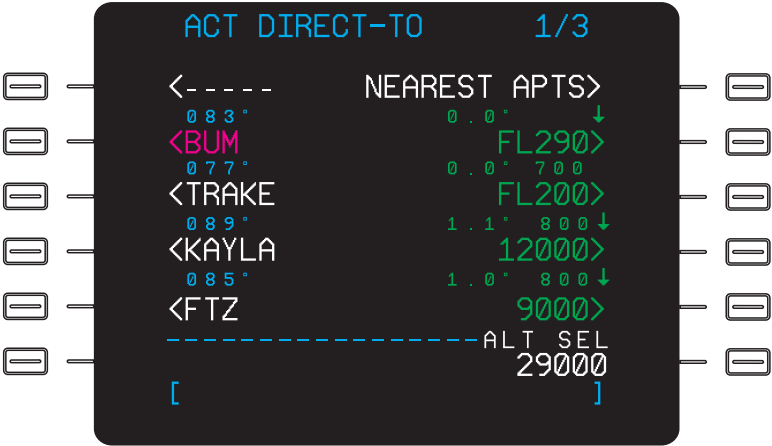


Figure 14-81 DIRECT-TO Page



TPG9206_34

The DIRECT-TO pages show a list of waypoints in the active flight plan and can consist of several pages. The pilot can select a DIRECT-TO waypoint from the list, or enter any valid waypoint into the top (dashed) waypoint line as a DIRECT-TO waypoint.

 **NOTE**

Many SIDS and STARS contain conditional waypoints that have no fixed geographical location, such as a heading to an altitude leg or a vectors leg. Although these types of waypoints show on the DIRECT-TO pages, they cannot be selected for DIRECT-TO navigation.

On the right side of the DIRECT-TO pages, the pilot can enter an altitude for the waypoints shown in the list. The current preselector altitude shows in white in the lower right corner of the display.

On the DIRECT-TO page, the pilot can page forward through the list of waypoints from the current TO waypoint to the last waypoint in the

active flight plan, or page backward through a HISTORY list of the waypoints already passed in the flight plan. Use the NEXT function key on the CDU to page forward and the PREV function key to show the HISTORY pages.

When selecting a DIRECT-TO waypoint, the FMS changes to the MOD FPLN page with the selected waypoint in the TO waypoint position. A line key selection for an INTC CRS to the TO waypoint also shows. If desired, change the intercept course before executing the modified flight plan.

▼ SELECTIONS:

NEAREST APTS

Selection shows the NEAREST AIRPORTS page. Refer to the figure on page 14-126.



NEAREST AIRPORTS

Path:

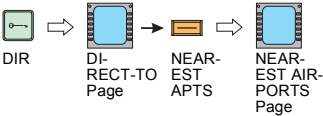
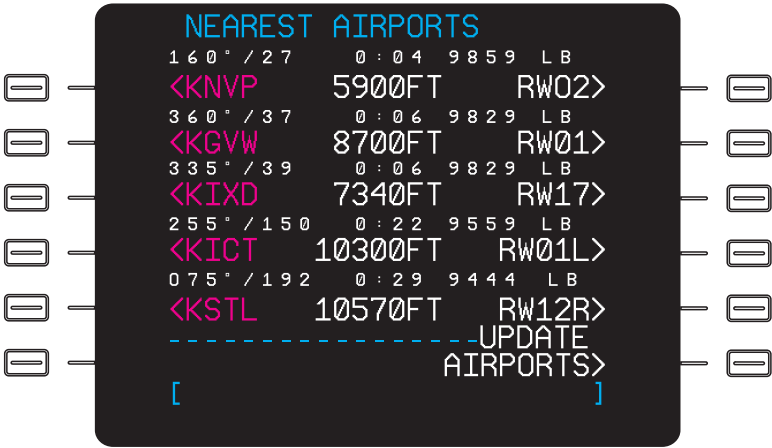


Figure 14-82 NEAREST AIRPORTS Page



TPG9206_35

The NEAREST AIRPORTS page shows a list of five airports that includes the departure (ORIGIN) and arrival (DEST) airports, as well as three other airports that are closest to the present position of the aircraft. If the origin and destination airports are the same, the list shows the four closest airports along with the ORIGIN/DEST airport. If no ORIGIN or DEST airport is defined in the active flight plan, the list shows the five closest airports.

The closest airports are listed by the ICAO airport identification code, and are arranged in order of increasing distance from the present position of the aircraft. If two or more airports are equidistant from the aircraft, the airports are listed in order of increasing course change required to proceed to the airport (the airport that requires the lesser course change is listed first).

For each airport, the NEAREST AIRPORTS page shows the bearing and distance from the present position of the aircraft to the airport

reference point, the Estimated Time En Route (ETE), the fuel remaining at the destination, the designation of the longest runway (for example, RWY23, RWY03L), and the length of the longest runway. If more than one runway is the longest at the airport (same length), the runway is chosen by alphabetical order.

The pilot can select between setting a direct course to the Airport Reference Point (ARP) or the runway extension point of the longest runway for a visual approach. If the pilot chooses the airport reference point, the FMS calculates the course and distance to the ARP for the modified flight plan. The FMS does not include any STARs or runways associated with the airport, nor does it include any VNAV constraints associated with the airport.

If the pilot selects the longest runway for the direct-to course, the FMS calculates the course and distance to the runway extension point for a visual approach, and includes the VNAV constraint associated with the visual approach in the modified flight plan. The FMS also inserts the selected runway for a RWY type approach.

The NEAREST AIRPORTS page shows the airports closest to the present position of the aircraft when the page is first shown. The FMS does not automatically update the page based on the current position of the aircraft while the NEAREST AIRPORTS page shows. To have the FMS recalculate the closest airports for the new position, push the line select key next to the UPDATE AIRPORTS prompt on the NEAREST AIRPORTS page.

TUN

Path:

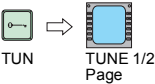
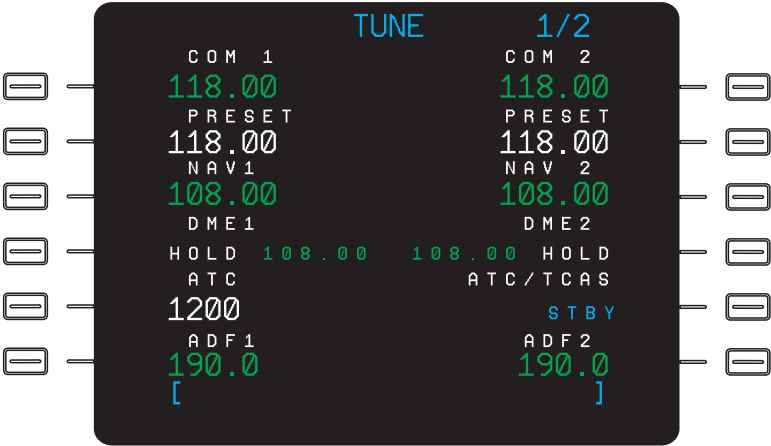


Figure 14-83 TUNE 1/2 Page



TPG9206_65

The TUNE 1/2 page shows:

- Currently selected frequencies for the COM, NAV, and ADF radios
- NAV radio tuning mode (AUTO/MAN)
- Current and available TCAS modes
- Current ATC beacon code
- STANDBY annunciation for the active transponder when it is set to the STANDBY mode.

SELECTIONS:

COMx	The COMx (COM1, COM2) line select key provides access to the appropriate COM CONTROL page when there is no data in the scratchpad. Refer to the figure on page 14-132.

NAVx

The NAVx (NAV1, NAV2) line select key provides access to the appropriate NAV CONTROL page when there is no data in the scratchpad. Refer to the figure on page 14-133.

DMEx

The DMEx (DME1, DME2) line select key selects the DME HOLD function on and off. When HOLD is on, the annunciation HOLD shows in larger cyan text. When HOLD is deselected, the HOLD annunciation shows in smaller white text.

ATC

The ATC line select key provides access to the ATC CONTROL page when there is no data in the scratchpad. Refer to the figure on page 14-135.

TCAS MODE

The TCAS line select key selects the TCAS operation mode. The current selected mode shows in large cyan text. Unselected modes show in small white text. The available selections are TA, RA, STBY, REL, and ABS.

Path:

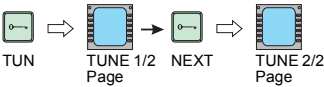
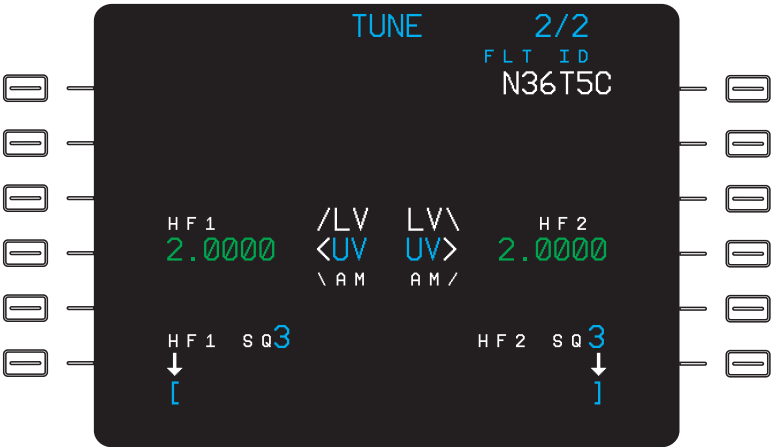


Figure 14-84 TUNE 2/2 Page



TPG9209_73

The TUNE 2/2 page shows the current ADF and HF frequencies, and is used to set the FLIGHT ID code.

SELECTIONS:

FLIGHT ID

The FLIGHT ID line select key is used to enter the Flight Identification code. Up to 8 characters can be entered for the FLIGHT ID code. The FLIGHT ID code can also be entered/changed on the ATC CONTROL page.

ADFx

The ADFx (ADF1, ADF2) line select key provides access to the ADF CONTROL page when there is no data in the scratchpad. Refer to the figure on page 14-138.

**ADDENDUM 2
TO
FMS-6100 Flight Management System for the Gulfstream G150
OPERATOR'S GUIDE**

Part Number 523-0807226-003117, 3rd Edition Dated 10 Oct 06

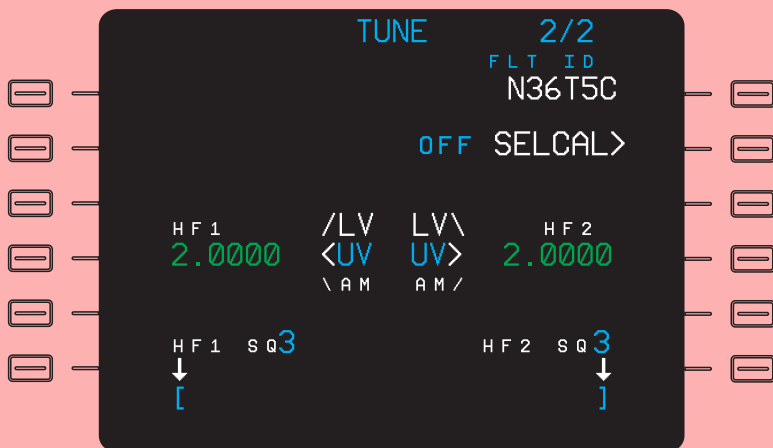
NOTICE

INFORMATION SUBJECT TO EXPORT CONTROL LAWS

The technical data in this document (or file) is controlled for export under the Export Administration Regulations (EAR), 15 CFR Parts 730-774. Violations of these laws may be subject to fines and penalties under the Export Administration Act.

Insert this addendum sheet facing page 14-130.

Replace the Figure 14-84 TUNE 2/2 page with the following illustration.



Add the following text after the sentence below the figure.

The optional Selective Calling (SELCAL) feature will show just below the Flight ID. The title SELCAL shows if the option is installed.

**ADDENDUM 2
TO
FMS-6100 Flight Management System for the Gulfstream G150
OPERATOR’S GUIDE**

Part Number 523-0807226-003117, 3rd Edition Dated 10 Oct 06

Add the following after HFx SQ on page 14-131.

▼SELECTIONS:

SELCAL	The SELCAL line select key selects the SELECTIVE CALLING menu page. This page allows the operator to set the SELCAL code and turn the SELCAL DETECTION function ON or OFF. When the system detection is turned OFF, then OFF will display on the TUNE 2/2 page next to SELCAL. Normal operations with the DETECTION function set to ON, SELCAL shows on the TUNE 2/2 page. The flight crew is notified by an aural SELCAL chime and CAS message when the radio detects the preset aircraft SELCAL code.

HFx

The HFx (HF1, HF2) line select key provides access to the appropriate HF CONTROL page when there is no data in the scratchpad. Refer to the figure on page 14-140.

HFx SQ

The line select keys above and below the HFx SQ annunciation select the squelch level for the appropriate HF radio. Each push of a line select key selects the next available setting for the radio squelch. The current squelch setting shows in cyan next to the SQ label. Refer to the HF CONTROL section that follows.

COM CONTROL

Path:

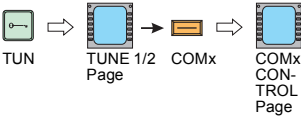
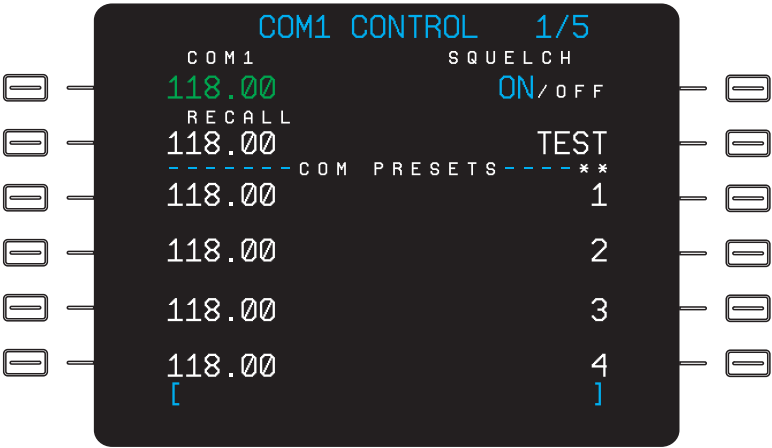


Figure 14-85 COM CONTROL Page



TPG9206_66

The COM CONTROL page is used to preset frequencies for the appropriate COM radio. Preset frequencies can be set for each installed radio. The RECALL function causes the active COM frequency and the RECALL frequency to change places. The SQUELCH line select key turns the radio squelch ON or OFF.

NOTE
Each installed COM radio has its own CONTROL page.

NAV CONTROL

Path:

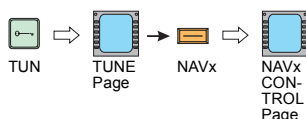
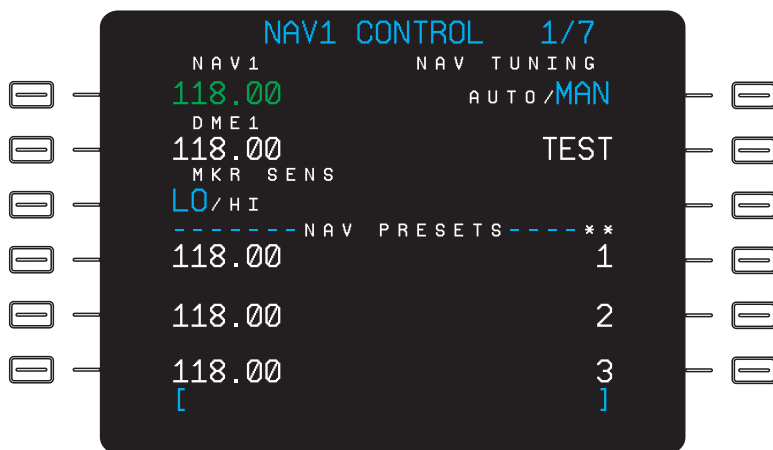


Figure 14-86 NAV CONTROL Page



TPG9209_74

The NAV CONTROL page is used to preset frequencies for the NAV radios and select the NAV TUNING mode. Preset frequencies can be set for each installed radio by using the radio frequency or the three-letter station identifier. If the three-letter station identifier is entered, the FMS retrieves the station frequency from the database to tune the NAV radio.

▼ SELECTIONS:

NAV

The NAV line select key is used to enter the radio frequency when the frequency is in the scratchpad. When there is no data in the scratchpad, pushing the NAV line select key returns the display to the TUNE 1/2 page.

DME	The DME line select key selects the DME HOLD function on and off. When HOLD is on, the annunciation HOLD shows in larger cyan text. When HOLD is deselected, the HOLD annunciation shows in smaller white text.
MKR SENS	The MKR SENS selects the sensitivity status of the marker beacon. Available selections are LO (low) and HI (high). The selected option shows in large cyan text. The unselected option shows in smaller white text.
NAV TUNING	The NAV TUNING line select key selects the navigation tuning mode. Available selections are AUTO (automatic) and MAN (manual). The selected mode shows in large cyan text. The unselected mode shows in smaller white text. The recommended mode is AUTO.
TEST	The TEST line select key initiates a self-test of the NAV and DME radio. The TEST legend shows in large cyan text when the test is active. The TEST legend shows in smaller white text when the test function is not active.
NAV PRESETS	Up to 20 preset frequencies can be set for each NAV radio. Refer to the RADIO TUNING chapter for information on how to enter data into the preset channels.

ATC CONTROL

Path:

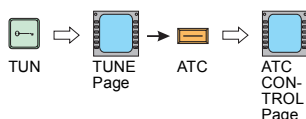


Figure 14-87 ATC CONTROL Page



TPG9209_75

▼ SELECTIONS:

ATC

The ATC field is used to set the transponder beacon code when the beacon frequency is in the scratchpad. When there is no data in the scratchpad, pushing the ATC line select key returns the display to the TUNE 1/2 page.

IDENT

The IDENT line select key is used to send a beacon identification flash.

FLIGHT ID

The FLIGHT ID line select key is used to enter the Flight Identification code. The FLIGHT ID code can also be entered/changed on the TUNE 2/2 page. When there is no data in the scratchpad, pushing the FLIGHT ID line select key returns the display to the TUNE 1/2 page.

ALT REPORT

The ALT REPORT line select key is used to select the altitude reporting mode. The available options are ON and OFF. The selected mode shows in large cyan text. The unselected mode shows in small white text.

MODE

The MODE line select key is used to select the TCAS mode. Each push of the line select key selects the next option. Selecting TA sets the Traffic Advisory mode, RA sets the Resolution Advisory mode, and STBY sets the standby mode. The selected mode shows in large cyan text. The unselected modes show in small white text.

◇TRAFFIC

The ◇TRAFFIC line select key is used to select the traffic display mode ON or OFF. The selected mode shows in large cyan text. The unselected mode shows in small white text.

ALT TAG

The ALT TAG line select key is used to select the altitude tag mode. The available options are REL (relative) and ABS (absolute). The selected mode shows in large cyan text. The unselected mode shows in small white text.

TEST

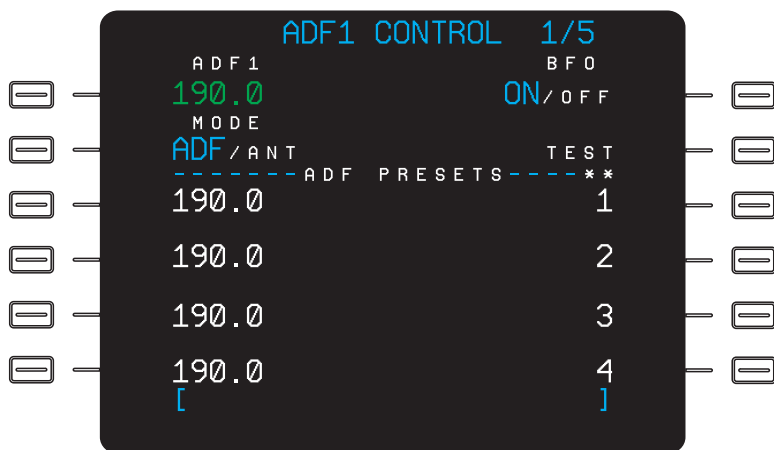
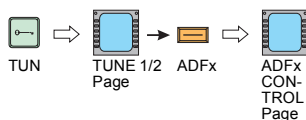
Pushing the TEST line select key initiates a test of the TCAS system. The TEST legend shows in large cyan text while the test function is active. The TEST legend shows in small white text when the test function is not active.

EXT TEST

Pushing the EXT TEST line select key initiates an extended test of the TCAS system. The EXT TEST legend shows in large cyan text while the extended test function is active. The EXT TEST legend shows in small white text when the extended test function is not active.

ALT LIMITS

The ALT LIMITS selection set the altitude window limits. The available selections are ABOVE, NORM (normal), and BELOW. ABOVE and BELOW can both be selected. When NORM is selected, ABOVE and BELOW are deselected if either was previously selected. The selected mode(s) shows in large cyan text. The unselected modes show in small white text.



ADF	The ADF line select key is used to enter the radio frequency when the frequency is in the scratchpad. When there is no data in the scratchpad, pushing the ADF line select key returns the display to the TUNE 1/2 page.
MODE	The MODE line select key is used to select the ADF operation mode. Available selections are ADF and ANT. The selected mode shows in large cyan text. The unselected mode shows in small white text.

BFO

The BFO line select key is used to select the Beat Frequency Oscillation (BFO) mode ON or OFF. The selected mode shows in large cyan text. The unselected mode shows in small white text.

TEST

The TEST line select key initiates a test of the ADF radio. The TEST legend shows in large cyan text while the test function is active. The TEST legend shows in small white text when the test function is not active.

ADF PRESETS

Up to 20 preset frequencies can be set for each ADF radio. Refer to the RADIO TUNING chapter for more information on how to enter data into the preset channels.

HF CONTROL

Path:

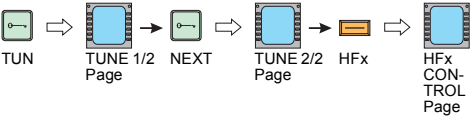


Figure 14-89 HF CONTROL Page



TPG9209_77

SELECTIONS:

HFx	The HFx (HF1, HF2) line select key is used to enter a frequency or channel to tune the HF when the frequency or channel number is in the scratchpad. When there is no data in the scratchpad, pushing the HFx line select key returns the display to the TUNE 2/2 page.

SQ

The line select keys above and below the SQ annunciation select the squelch level for the appropriate HF radio. Each push of a line select key selects the next available setting for the radio squelch. The current squelch setting shows in cyan next to the SQ label.

- If an up arrow is showing, each push of the line select key above the SQ legend increases the squelch setting to the maximum setting (3).
- If a down arrow is showing, each push of the line select key below the SQ legend decreases the squelch setting to the minimum setting (0).
- If both up and down arrows are showing, the squelch level can be increased or decreased as desired.

MODE

The HF MODE line select key selects the HF frequency mode. Each push of the MODE line select key selects the next option in the sequence. The available selections are **FREQ** (frequency) mode, **EMER** (emergency) channel mode, or **MAR** (maritime) channel mode.

PRESETS

The PRESETS line select key provides access to the HF PRESETS page. Refer to the figure on page 14-142.

POWER

The POWER line select key selects the HF power mode. Each push of the line select key selects the next option in the sequence. The available selections are **LO** (low), **MED** (medium), and **HI** (high).

TEST

The TEST line select key initiates a test of the HF radio. The TEST legend turns cyan while the test mode is active.

HF PRESETS

Path:

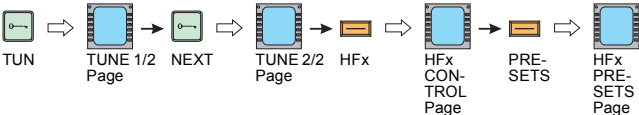
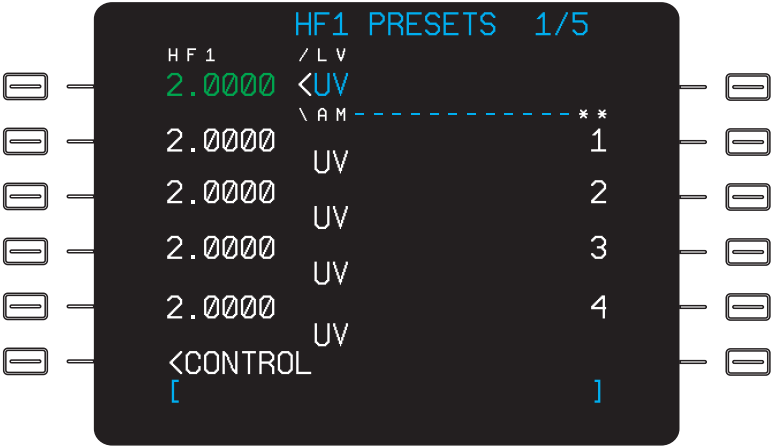


Figure 14-90 HF PRESETS Page



TPG9209_78

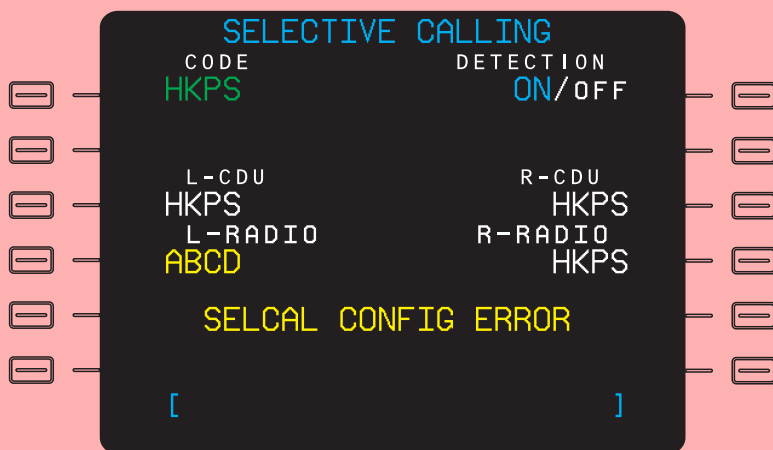
The HF PRESETS page allows the operator to set up to 20 preset frequencies and/or channels for the HF radio. The letters for the frequency operating mode can be appended to the frequency to set the operating mode simultaneously with the frequency. The default mode is UV.

**ADDENDUM 2
TO
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Part Number 523-0807226-003117, 3rd Edition Dated 10 Oct 06

Insert this addendum page facing page 14-142.

SELCAL



TPI5169_01

Push the SELCAL line select key on the TUNE 2/2 page to show the SELECTIVE CALLING menu page. This page allows the operator to set the SELCAL code and turn the DETECTION function ON or OFF. If a code of AAAA is set, the SELCAL system is disabled and the DETECTION is set to OFF.

The SELCAL CONFIG ERROR message appears in yellow when the system detects an error. The radio or CDU that did not set the correct SELCAL code will show the incorrect code in yellow.

When the aircraft SELCAL code is detected, the flight crew is notified with a SELCAL chime and CAS message. Keying the radio that SELCAL was detected on will cancel the CAS message.

MSG

Path:

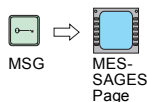
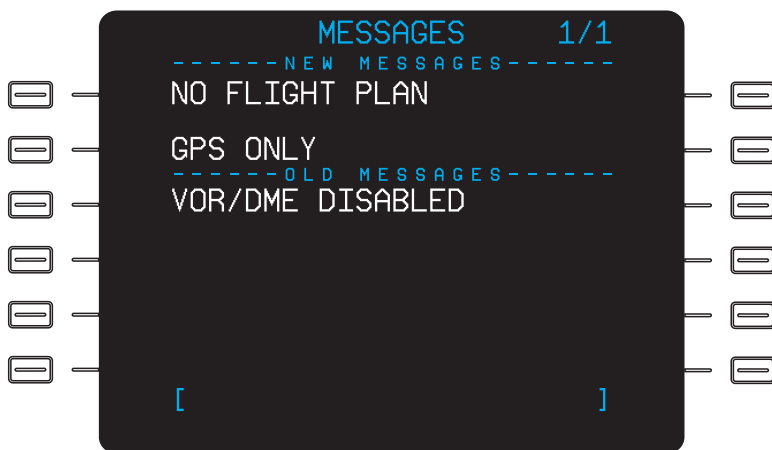


Figure 14-91 MESSAGES Page



TPG9209_79

The MESSAGES page shows new and old FMS messages. Push the MSG function key while the MESSAGES page is showing to return to the CDU display mode that was showing before the MESSAGES display mode was selected. Refer to the MESSAGES AND ANNUNCIATORS chapter for detailed descriptions of the messages that show on the MESSAGES page and message line.

MFD MENU

Condition(s):

When the MFD MENU function key is pushed (and the CDU is in map display mode as set by the MFD DATA function key) and PFD is selected on the MAP DISPLAY page, the PFD MAP DISPLAY version of the DISPLAY MENU page shows.

Path:

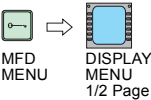
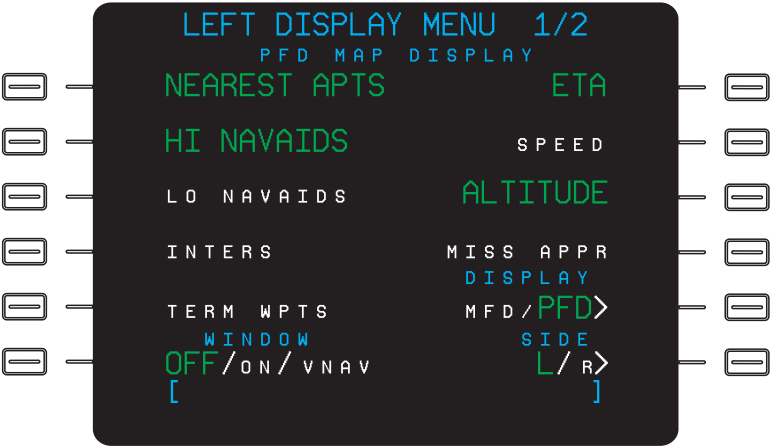


Figure 14-92 MAP DISPLAY 1/2 Page



TPG9209_80

The PFD MAP DISPLAY menu pages are used to control the display of airports, navigation facilities, and other navigation-related display elements on the PFD. Any number or combination of items in the menu can show on the PFD (up to the limit specified for MAX MAP SYMB on the DEFAULTS 1/5 page). Selected items show in large green font, unselected items show in small white font.

▼ **SELECTIONS:**

NEAREST APTS	Shows the origin and destination airports, and the three airports closest to the present position of the aircraft. The data is continuously updated. However, if the CDU is showing the NEAREST AIRPORTS page, the five airports shown on the PFD match the five airports listed on the CDU page.
HI NAVAIDS	Shows the high altitude navaids.
LO NAVAIDS	Shows the low altitude navaids.
INTERS	Shows intersections.
TERM WPTS	Shows terminal waypoints.
ETA	Selection shows the ETA adjacent to waypoints, intersections, or navaids.
SPEED	Selection shows the current speed adjacent to waypoints, intersections, or navaids.
ALTITUDE	Selection shows reference altitude data adjacent to waypoints, intersections, or navaids.
MISS APPR	Selection shows the plan path for the published missed approach procedure (based upon the approach selected on the ARRIVAL page).
SIDE	Selection determines which PFD (left side or right side) the CDU is controlling.

Path:

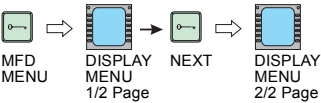


Figure 14-93 MAP DISPLAY 2/2 Page



TPG9209_81

SELECTIONS:

APTS	Selection shows airports.
NDBS	Selection shows non-directional beacons.
RNG: ALT SEL	Selection shows the arc symbols for range to altitude along the flight path to indicate where the aircraft will reach the altitude preselector altitude.
LRN POS	Selection shows the LRN sensor position symbol.

ALTN FPLN

Selection shows the alternate flight plan route on the PFD MAP.

Condition(s):

When the MFD MENU function key is pushed (and the CDU is in map display mode as set by the MFD DATA function key) and MFD is selected on the MAP DISPLAY page, the MFD MAP DISPLAY version of the DISPLAY MENU page shows.

Path:

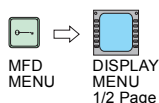


Figure 14-94 MAP DISPLAY 1/2 Page



TPG9206_06

The MAP DISPLAY menu pages are used to control the display of airports, navigation facilities, and other navigation-related display elements on the MFD. Any number or combination of items in the menu can show on the MFD (up to the limit specified for MAX MAP SYMB on the DEFAULTS 1/5 page). Selected items show in large green font, unselected items show in small white font.

▼ SELECTIONS:

NEAREST APTS	Shows the origin and destination airports, and the three airports closest to the present position of the aircraft. The data is continuously updated. However, if the CDU is showing the NEAREST AIRPORTS page, the five airports shown on the MFD match the five airports listed on the CDU page.
HI NAVAIDS	Shows the high altitude navaids.
LO NAVAIDS	Shows the low altitude navaids.
INTERS	Shows intersections.
TERM WPTS	Shows terminal waypoints.
WINDOW	When ON or VNAV is selected, a four-line text display of navigation progress data shows at the top of the MFD when the MFD is set to the PPOS MAP or PLAN MAP display modes. Selecting OFF returns the display to a windowless format. Each push of the line select key selects the next option (OFF, ON, VNAV) in order.
ETA	Selection shows the ETA adjacent to waypoints, intersections, or navaids.
SPEED	Selection shows the current speed adjacent to waypoints, intersections, or navaids.
ALTITUDE	Selection shows reference altitude data adjacent to waypoints, intersections, or navaids.

MISS APPR

Selection shows the plan path for the published missed approach procedure (based upon the approach selected on the ARRIVAL page).

SIDE

Selection determines which MFD (left side or right side) the CDU is controlling.



Path:

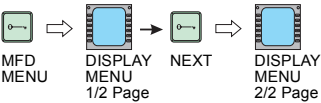


Figure 14-95 MAP DISPLAY 2/2 Page



TPG9209_82

SELECTIONS:

APTS	Selection shows airports.
NDBS	Selection shows non-directional beacons.
RNG: ALT SEL	Selection shows the arc symbols for range to altitude along the flight path to indicate where the aircraft will reach the altitude preselector altitude.
LRN POS	Selection shows the LRN sensor position symbol.

ALTN FPLN



Selection shows the alternate flight plan route on the MFD PLAN MAP.

Condition(s):

When the MFD MENU function key is pushed and the MFD is in text display mode (as set by the MFD DATA function key), the TEXT DISPLAY version of the DISPLAY MENU page shows.

Path:

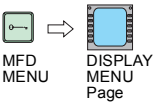
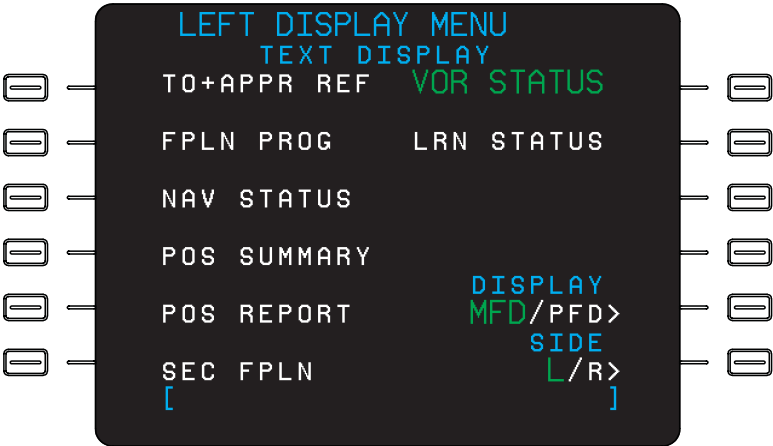


Figure 14-96 TEXT DISPLAY Page



TPH8462_01

The TEXT DISPLAY menu shows a list of text page display modes for the MFD. Text pages show on the MFD when the text mode is selected with the MFD DATA function key. The MFD can show only one text page at a time. Therefore, only one menu item can be selected at any time for the MFD. Selected menu items show in large green font, unselected menu items show in small white font.

 **NOTE**

FMS Text pages cannot show on the MFD while the PFD is in MAP mode.

▼ **SELECTIONS:**

TO+APPR REF

Selects the TAKEOFF REFERENCE and APPROACH REFERENCE pages for display. These pages show Takeoff and Approach performance data for the origin and destination airports to include weights, reference Vsports, climb gradients, and aircraft configuration. Refer to the figure on page 14-173 and the figure on page 14-175.

FPLN PROG

Selects the FPLN PROGRESS page for display. The FPLN PROGRESS page shows DIST, ETA, and FUEL information for the waypoints in the flight plan. Refer to the figure on page 14-177.

NAV STATUS

Selects the NAV STATUS page for display. The NAV STATUS page shows navigation information for the TO waypoint. Refer to the figure on page 14-181.

POS SUMMARY

Selects the POSITION SUMMARY page for display. The POSITION SUMMARY page shows the navigation sensors in use and their position differences relative to the FMS current position. Refer to the figure on page 14-183.

POS REPORT

Selects the POSITION REPORT page for display. The POSITION REPORT page shows all information needed for making position reports, including waypoints, times, fuel and weather information. Refer to the figure on page 14-185.

SEC FPLN	Selects the SEC FPLN page for display. The SEC FPLN page shows DIST, ETA, and FUEL for the second flight plan. Refer to the figure on page 14-187.
VOR STATUS	Selects the VOR STATUS page for display. The VOR STATUS page shows VOR/DME navigation information to include the identifier, frequency, and bearing and distance data. Refer to the figure on page 14-189.
LRN STATUS	Selects the LRN STATUS pages for display. The LRN STATUS pages show status information for the long-range navigation sensors. Refer to the figure on page 14-191.
SIDE	Selection determines which MFD (left side or right side) the CDU is controlling.

MFD ADV

Condition(s):

When MFD ADV function key is pushed and the MFD is in map display mode (as set by the MFD DATA function key), the PLAN MAP CENTER version of the DISPLAY ADVANCE page shows.

Path:

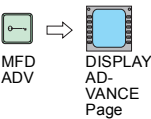
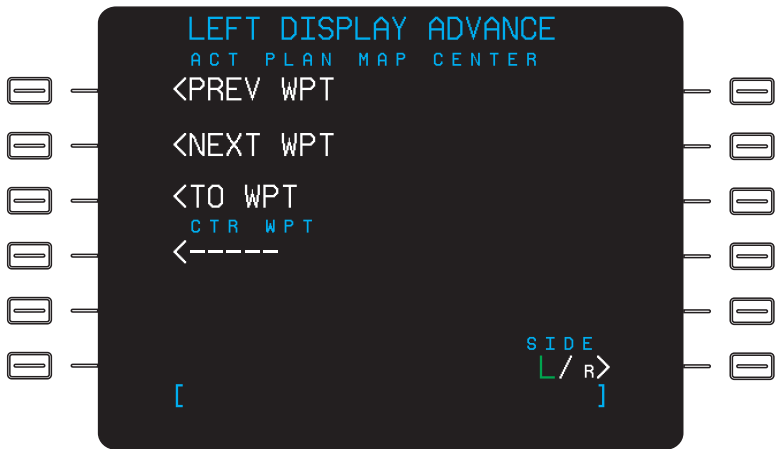


Figure 14-97 PLAN MAP CENTER Page



TPG9206_11

The PLAN MAP CENTER version of the DISPLAY ADVANCE page is used to move the center waypoint on the MFD PLAN MAP.

▼ SELECTIONS:

PREV WPT

Selects the previous waypoint (PREV WPT) in the flight plan as the center point of the MFD PLAN MAP.

NEXT WPT

Selects the next waypoint (NEXT WPT) in the flight plan as the center point of the MFD PLAN MAP.

TO WPT

Select the current TO waypoint in the flight plan as the center point of the MFD PLAN MAP.

CTR WPT

Used to enter any valid waypoint as the center of the MFD PLAN MAP. The waypoint does not have to be a waypoint in the flight plan.



Condition(s):

When MFD ADV function key is pushed and the MFD is in text display mode (as set by the MFD DATA function key), the TEXT DISPLAY version of the DISPLAY ADVANCE page shows.

Path:

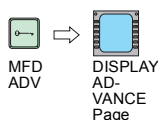
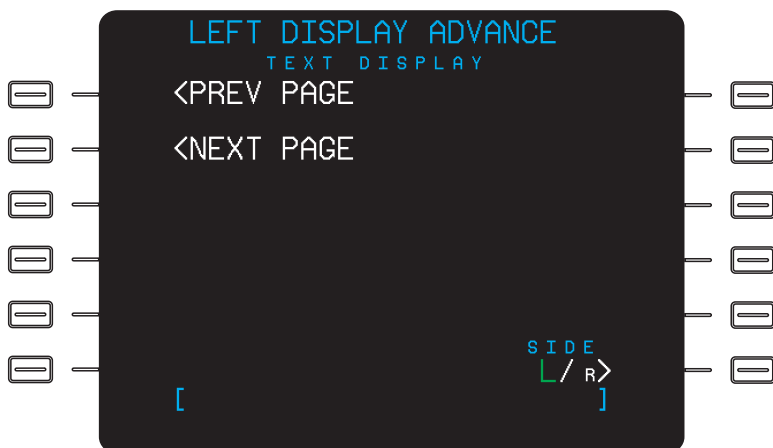


Figure 14-98 TEXT DISPLAY Page



TPG9209_84

The TEXT DISPLAY version of the DISPLAY ADVANCE page is used to change the text page shown on the MFD. The TEXT DISPLAY selections can only change the pages within the selected text page. If another type of text page is desired, push the MFD MENU function key to show the MFD MENU page, then select the desired text display. The MFD DISPLAY ADVANCE menus affect the text pages of the left MFD or right MFD according to the selection of the SIDE L/R selection.

▼ SELECTIONS:

PREV PAGE

Selects the previous page (PREV PAGE) of the selected text display.

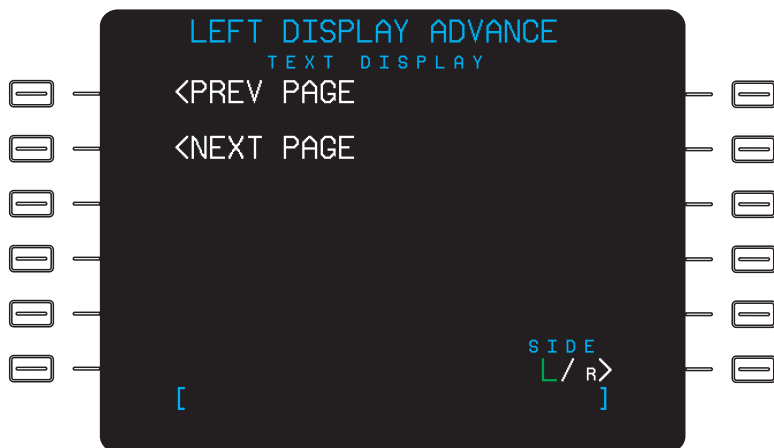
NEXT PAGE



Selects the next page of the selected text display.

MFD DATA

Figure 14-99 TEXT DISPLAY Page



TPG9209_84

An MFD DATA function key push on either CDU causes the FMC to direct a toggle between a map display or a text display, provided the MFD is capable at that time of displaying remote text. The text page that shows is chosen from the DISPLAY MENU page (refer to the figure on page 14-152), which is accessed via the MFD MENU function key. A second push of the MFD DATA function key causes the MFD to return to the format that was active before the MFD DATA function key was pushed.

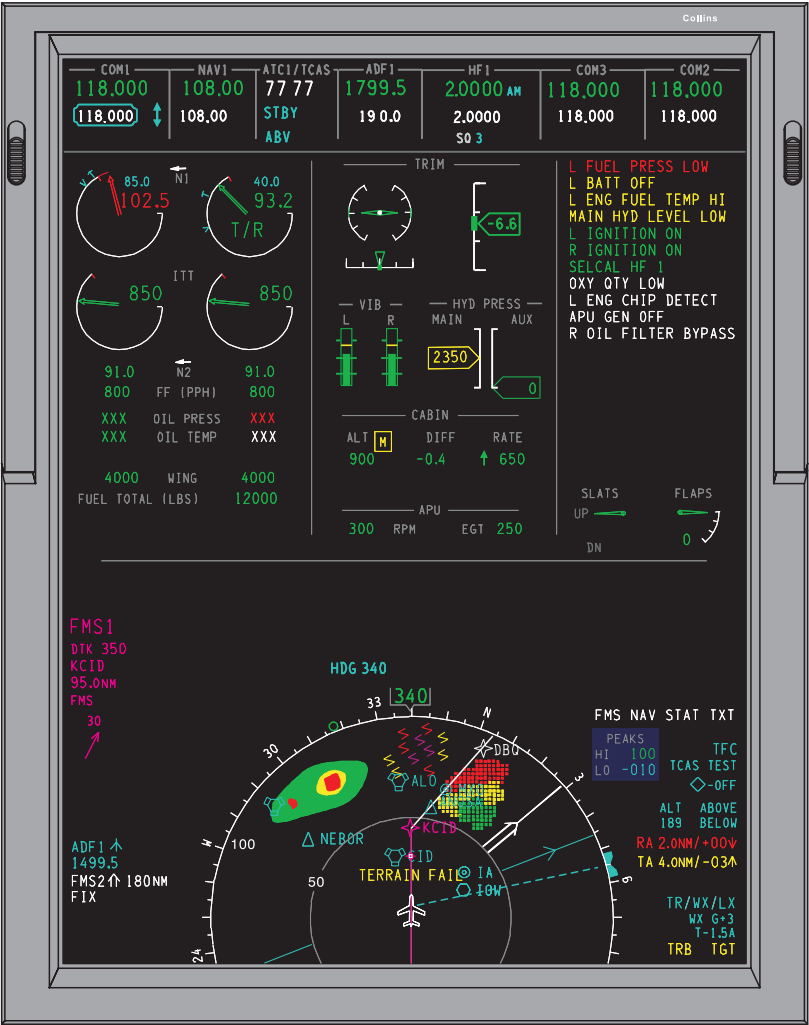


NOTE

FMS Text pages cannot show on the MFD while the PFD is in MAP mode.

MFD DISPLAYS

Figure 14-100 Typical MFD Display



TPG9218_04

This section describes only the display elements of MFD that show information related to or generated by the FMS.

MFD MAP DISPLAYS

Condition(s):

The MFD DATA function key is used to alternately switch display modes between the MAP DISPLAY and TEXT DISPLAY on the MFD and CDU when the MFD MENU page is selected.

Figure 14-101 Map Symbols

	VOR		ENERGY MANAGEMENT FIX OR SELECTED REFERENCE POINT
	VOR/DME		ALTITUDE REFERENCE POINT OR CONDITIONAL WAYPOINT
	VOR/DME AND VORTAC		LONG RANGE NAV SENSOR
	DME		VOR/DME SIGNAL POSITION (EFIS 4077)
	DME AND TACAN		JOY STICK CURSOR
	NDB		TURN ARROW
	AIRWAY INTERSECTIONS AND TERMINAL WAYPOINTS		MODIFIED HOLDING PATTERN (AS SYMBOL)
	ARRIVAL RUNWAY (MAP RANGE GREATER THAN 50 NM)		MODIFIED PROCEDURE TURN
	ARRIVAL RUNWAY (MAP RANGE LESS THAN OR EQUAL TO 50 NM)		RANGE TO ALTITUDE (OPTION)
	HOLDING PATTERN (AS SYMBOL)		MODIFIED FLIGHT PLAN (WHITE)
	PROCEDURE TURN (AS SYMBOL)		OFFSET FLIGHT PLAN (MAGENTA)
	FLIGHT PLAN WAYPOINT		
	AIRPORT		
	ACTIVE FLIGHT PLAN (WHITE) ACTIVE LEG = MAGENTA		
	SECONDARY FLIGHT PLAN (CYAN)		

TPG9149_01

For FMS functions, the MFD shows the PPOS MAP, PLAN MAP, and TEXT PG display modes. In the PPOS MAP and PLAN MAP display

modes, symbols are used to identify and show the various navigation facilities in relation to the current position of the aircraft (PPOS MAP) or a selected waypoint along the flight plan (PLAN MAP). Other items that show in these display modes are:

- Track for the active flight plan (shows as a solid white line)
- Track for a modified flight plan (shows as a dashed white line)
- Track for the second flight plan (shows as a solid cyan line)
- Track for the active flight plan leg (shows as a solid magenta line)
- Track for the missed approach preview (shows in cyan)
- Any parallel offset track (shows as a dashed magenta line)
- The TO waypoint (shows in magenta)
- Runways (shows by two different symbols that depend on the selected display range)
- Holding patterns (show as racetracks that change size relative to the speed of the aircraft and the distance or time base for the hold)
- Special turns from a SID or STAR
- A cyan circle around a selected fix reference point
- A conditional waypoint, which shows in white, created from a reference fix
- Speed, altitude and ETA waypoint data (shows next to each flight plan waypoint)
- A VOR/DME signal position indicator for a currently tuned navaid (only shows in the PPOS MAP display mode)
- Five-pointed star symbols to show the position determination of each LRN sensor relative to the FMS position, which is the aircraft symbol, and each other (only shows in the PPOS MAP display mode).



NOTE

Some of the symbols described previously will not show on the MFD in all installations, based on the equipment installed in the aircraft and the aircraft wiring.

The symbols that show on the MFD in the PPOS MAP and PLAN MAP modes are selected from the MFD DISPLAY MENU on the CDU. In both the PPOS MAP and PLAN MAP display modes, the number of symbols that show on the MFD is limited to 40 of all types. The number of map symbols selected for display is set on the DEFAULTS 1/5 page. The

figure on page 14-161 shows the map symbols that show on the PPOS MAP and PLAN MAP display modes. Map symbols are selected for display based on the following priorities:

- High altitude nav aids (HI NAVAIDS)
- Low altitude nav aids (LO NAVAIDS)
- Intersections (INTERS)
- Non-Directional Beacons (NDBS)
- Airports (APTS)
- Terminal Waypoints (TERM WPTS).

Map symbols selected on the DISPLAY MENU show approximately in order of distance from the reference point of the map. The prioritization of symbols causes the selected highest priority items that are closest to the map reference point to show first, for example, HI NAVAIDS take priority over INTERS if both are selected for display. The selection continues at expanding ranges until either the total count has been reached, or all highest priority selected items within the map range have been included. If the total number of display symbols has not yet been reached, the FMS continues to show items based on priorities until the maximum count is attained, or all available data has been included for the map. The FMS fills the map display using the MAX MAP SYMBOLS setting on the DEFAULTS 1/5 page, the display hierarchy described previously, and the range selected for the map display.

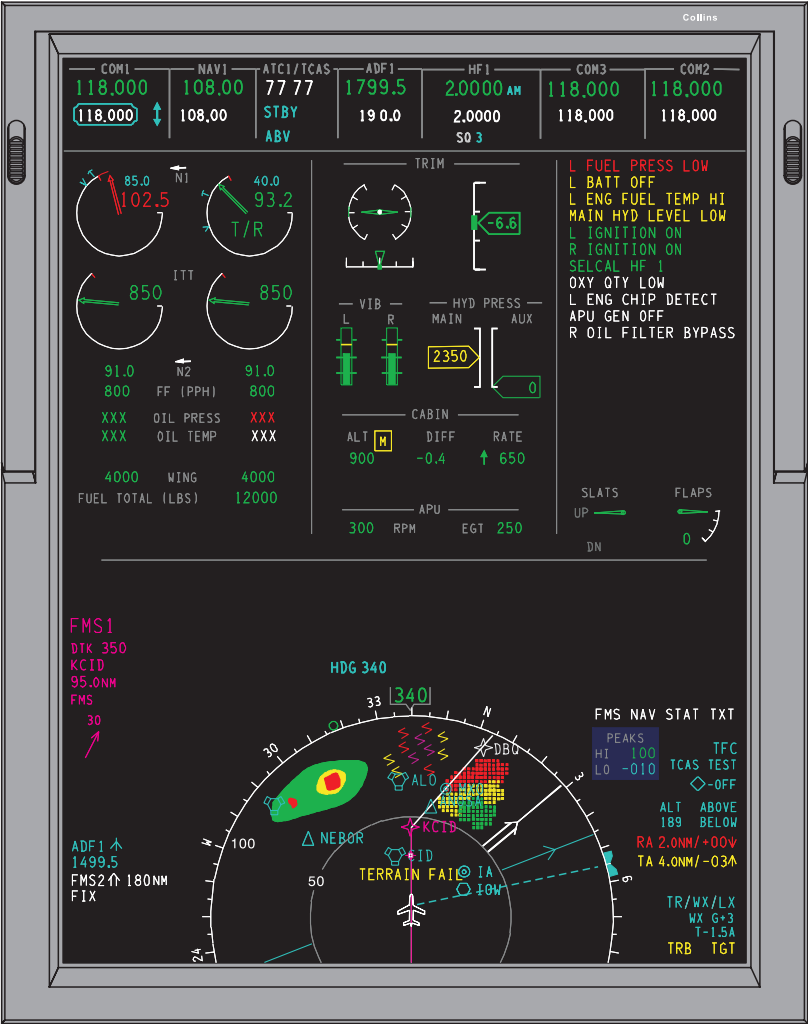
Even when selected for display, not all symbols show for all display ranges. The following is a list of the symbols and the ranges at which they show on the MFD:

- HI NAVAIDS — Show at all display ranges.
- LO NAVAIDS — Show at all display ranges.
- INTERS — Show at ranges of 50 NM or less.
- NDBS — Show at ranges of 50 NM or less.
- APTS — Show at all display ranges.
- TERM WPTS — Show at map ranges of 25 NM or less.

MFD PRESENT POSITION (PPOS) MAP

Condition(s):
The PPOS MAP display mode is selected with the FRMT button on the Cursor Control Panel (CCP).

Figure 14-102 MFD PPOS Map



TPG9218_04

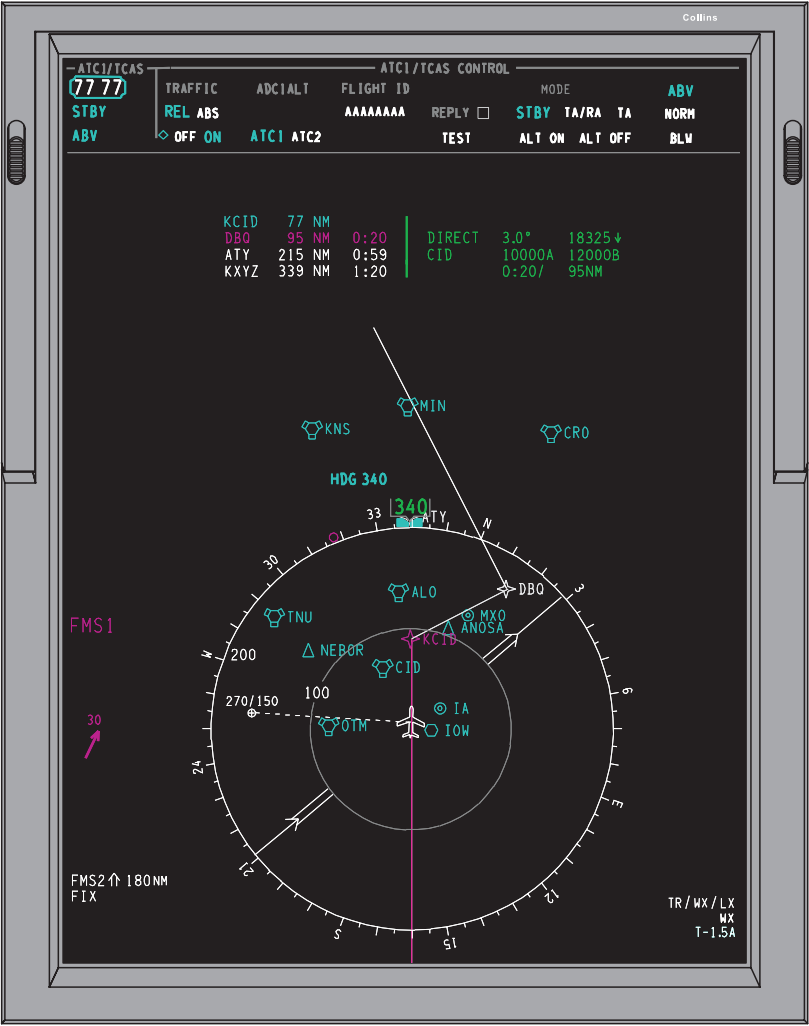
The PPOS MAP display mode is a heading up display page with the aircraft symbol located just below the middle of the display. Two range rings are centered on the aircraft symbol.

Based on the installation and mode selections, the PPOS MAP display mode shows in one of four ways: without a navigation progress data window, with a navigation progress data window, with VNAV or Advisory VNAV data included in the progress window, or a compass rose map display with no text window. The WINDOW line select key on the DISPLAY MENU page on the CDU selects what shows on the PPOS MAP.

The navigation data progress window at the top of the MFD in the PPOS MAP display mode shows, when activated:

- LAST waypoint passed, including the distance from the last waypoint and the time of passage.
- TO waypoint, including the distance and time-to-go to the waypoint, and the ETA at the waypoint.
- NEXT waypoint after the TO waypoint, including the distance and time-to-go to the waypoint, and the ETA at the waypoint.
- DEST (destination) airport, including the distance and time-to-go to the destination, and the ETA at the destination.
- FUEL available at the destination airport.
- GW of the aircraft at the destination airport.
- If the FMS is set to MEASURED fuel flow and ground speed for the performance calculations, the annunciation MEASURED shows.
- If the FMS is set to MANUAL fuel flow and ground speed for the performance calculations, the annunciation MANUAL shows.

Figure 14-103 MFD PPOS Map with NAV Window



TPG9218_05

When the VNAV display option is selected, VNAV window data shows above the present position and plan maps. Selecting VNAV clears destination airport fuel and gross weight information, and the ETA column from the display. Vertical data relating to the next VNAV climb or descent in the flight plan replaces fuel, GW, and ETA data, separated from the progress data by a vertical dotted line.

When VNAV display option is selected, the next altitude constraint in the flight plan shows. If the next constraint is a climb, the VNAV window shows CLIMB, the constraint altitude, the waypoint name, and time and distance to the constraint waypoint. If there are no down track climb constraints and the aircraft is not close to a Top Of Descent (TOD), the VNAV window is blank.

The TOD line shows when the distance to TOD is less than 50 NM or 20% of the total flight plan distance, whichever is less, but not less than 20 NM. The next descent altitude constraint and time and distance to that point also show along with the TOD line. If the aircraft begins an early descent before the TOD would normally show, the next altitude constraint information shows, but the TOD line does not because it is no longer relevant.

For descents, the VNAV window gives vertical Direct-To information when the required minimum descent rate exceeds 100 feet per minute. The descent window shows the vertical speed required and VPA to fly directly to the next altitude constraint while following the flight plan, as well as the waypoint information previously described.

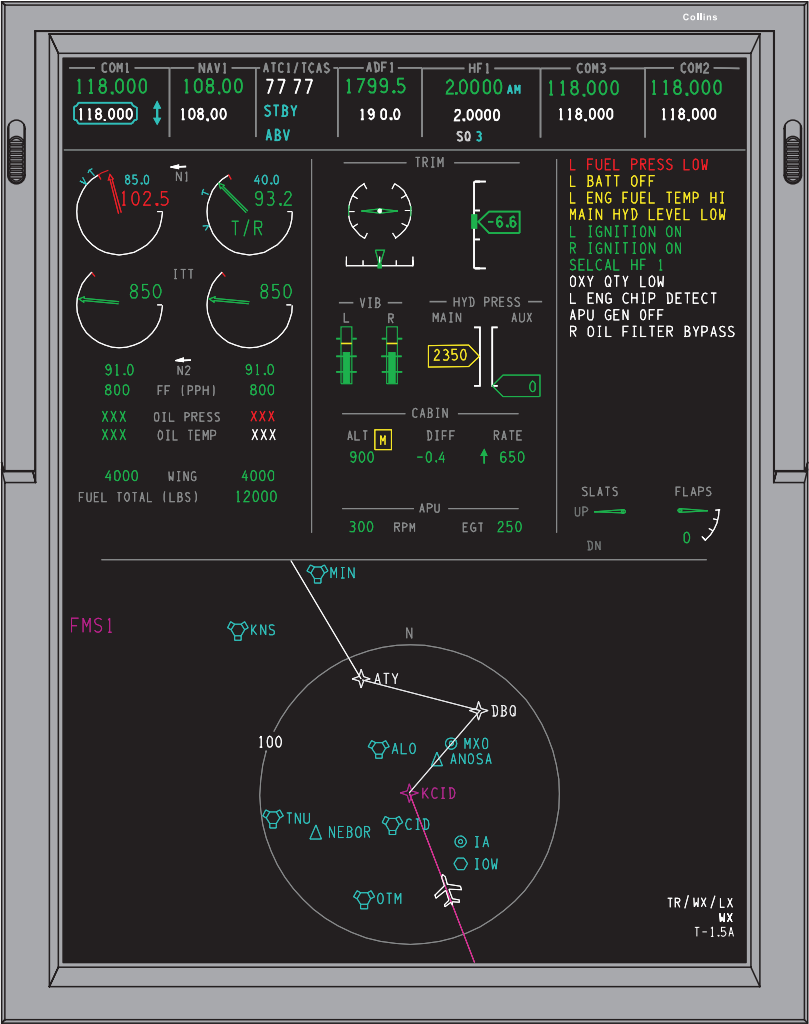
If there are no further altitude constraints, the VNAV data window is blank. However, if the aircraft has not begun descent to the destination airport, DES ADVISORY with a time and distance to a recommended descent point appears in the window. This point is based on following a descent profile that has the aircraft arriving at 1500 FT AGL not later than 10 NM from the destination airport.

MFD PLAN MAP

Condition(s):

The PLAN MAP display mode is selected with the FRMT button on the Cursor Control Panel (CCP).

Figure 14-104 MFD PLAN Map



TPG9218_08

The PLAN MAP display shows a north up map centered on a selected waypoint. If there is no active flight plan, the map center is aircraft present position. If the flight plan that shows on the CDU is the active or second flight plan, the first waypoint of the respective flight plan is the center waypoint, unless otherwise selected on the CDU. Use the CDU DISPLAY ADVANCE page to move the center waypoint on the MFD.

MFD 3D MAP (OPTION)

Condition(s):

If the 3D MAP option is not installed, the 3D MAP will not be available.

Figure 14-105 MFD 3D Map



TPG9218_02

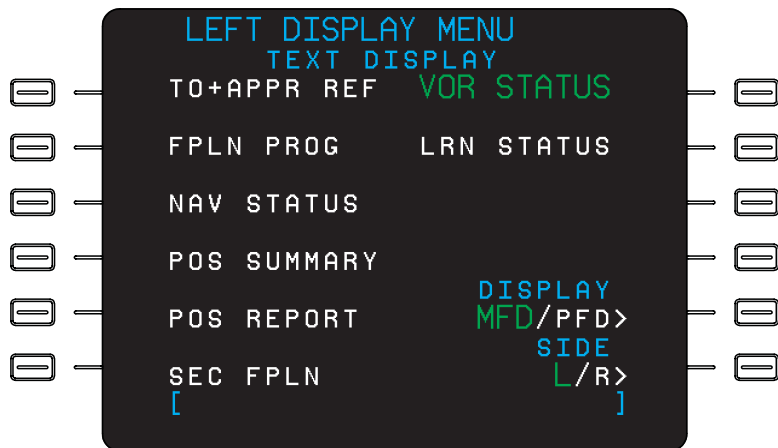
The 3D MAP display shows a three-dimensional view of lateral, vertical, and performance-predicted flight plan information. The map is a combination of what would typically show as two separate map formats: a vertical profile and a plan map. The 3D MAP is based on the PLAN MAP format, but has an adjustable lateral viewing angle. The MFD Lower Main Menu and the CCP provide the controls for the 3D MAP mode on the MFD. Refer to the 3D MAP (OPTION) chapter of this operator's guide for detailed information on the 3D map display and operation.

MFD TEXT DISPLAYS

Condition(s):

The MFD DATA function key is used to switch display modes between the MAP DISPLAY and TEXT DISPLAY on the MFD, and on the CDU when the MFD MENU page is selected.

Figure 14-106 TEXT DISPLAY (DISPLAY MENU) Page



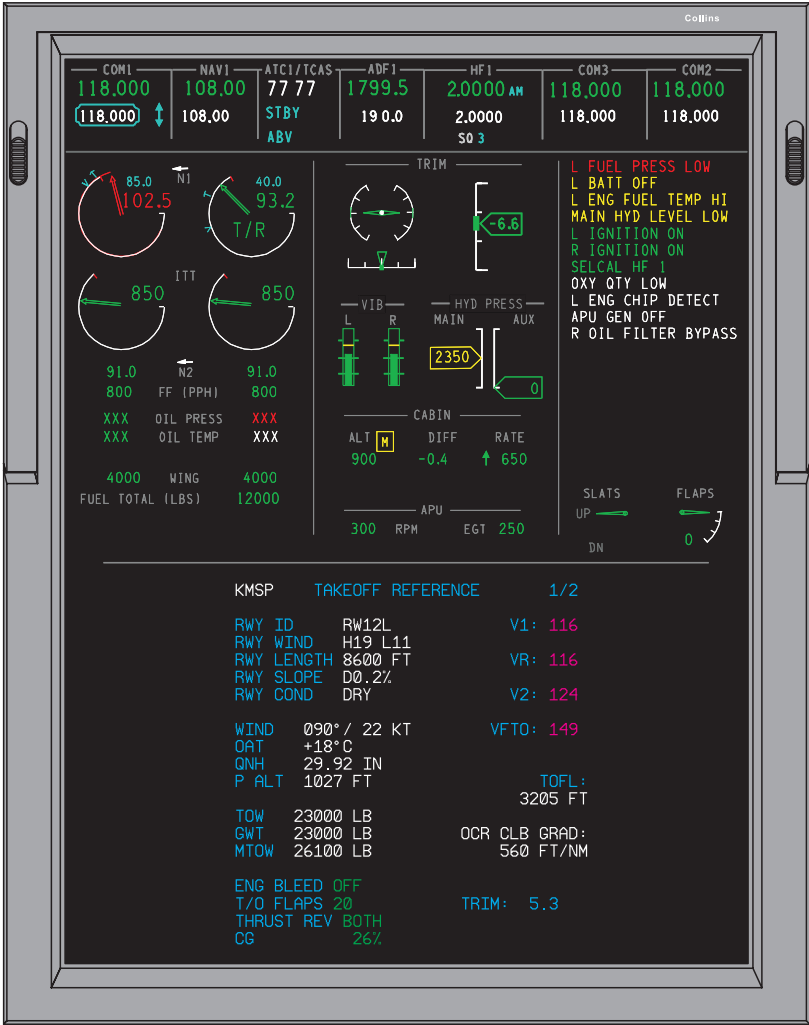
TPH8462_01

The TEXT DISPLAY mode shows various pages of text related to FMS functions. The TEXT DISPLAY selections and the corresponding MFD display page include:

- TO+APPR REF — TAKEOFF REFERENCE and APPROACH REFERENCE
- FPLN PROG — FMS ACT PROGRESS
- NAV STATUS — FMS NAV STATUS
- POS SUMMARY — FMS POSITION SUMMARY
- POS REPORT — FMS ACT POS REPORT
- SEC FPLN — FMS SEC FPLN
- VOR STATUS — VOR/DME STATUS
- LRN STATUS — LRN STATUS.

TAKEOFF/APPROACH REFERENCE

Figure 14-107 TAKEOFF REFERENCE Page



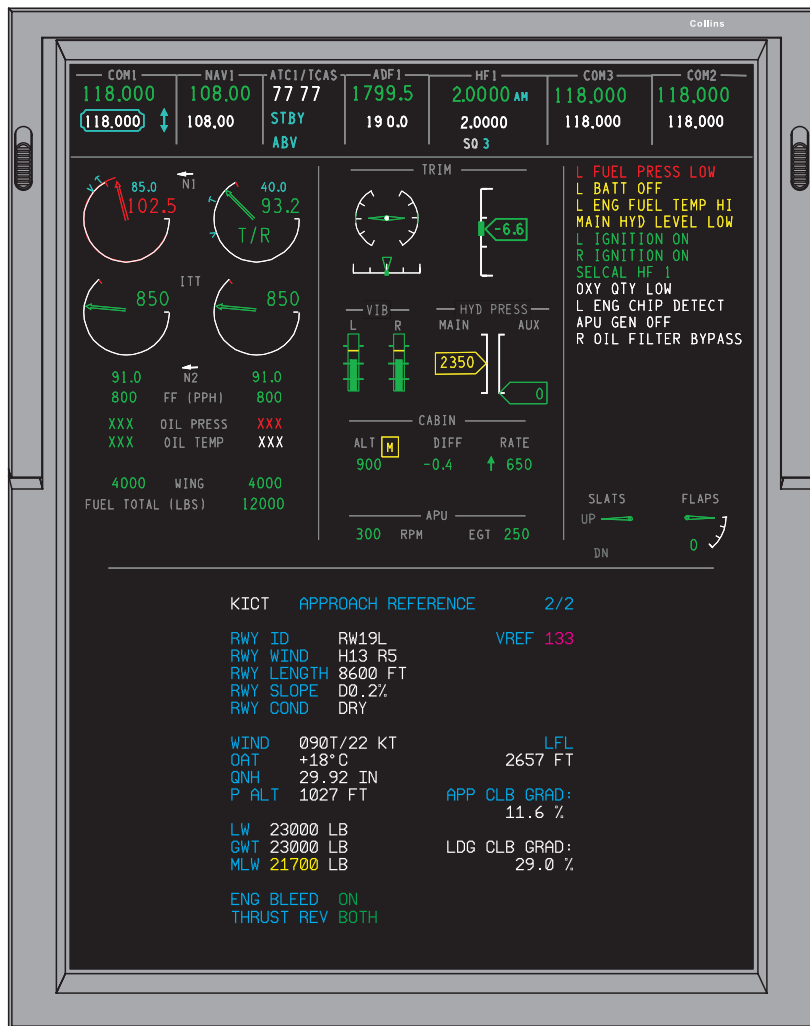
TPG9218_06

The TAKEOFF REFERENCE page shows:

- Origin airport identifier

- Runway Identifier (RWY ID), RWY WIND (headwind/tailwind and crosswind component), RWY LENGTH, RWY SLOPE and RWY CONDition
- WIND, OAT, QNH, and Pressure Altitude (P ALT) for the airport
- Takeoff weight (TOW), Gross Weight (GWT), and Maximum Takeoff Weight (MTOW)
- Engine Bleed (ENG BLEED), Automatic Power Reserve (APR), Thrust Reverser (THRUST REV) and Center of Gravity (CG) settings
- V_1 , V_R , V_2 , and V_{FTO} Vspeeds for the takeoff
- Takeoff Field Length (TOFL)
- Obstacle Clearance Required Climb Gradient (OCR CLB GRAD)
- TRIM and N1 Percentage settings.

Figure 14-108 APPROACH REFERENCE Page



TPG9218_07

The APPROACH REFERENCE page shows:

- Approach airport identifier
- RWY ID, RWY WIND (headwind/tailwind and crosswind component), RWY LENGTH, and RWY COND
- WIND, OAT, QNH, and P ALT for the airport

- Landing Weight (LW), GWT, and Maximum Landing Weight (MLW)
- ENG BLEED and THRUST REV settings
- LDG FLAPS
- V_{REF} Vspeed for the planned approach
- Landing Field Length (LFL) or Actual Landing Distance (ALD)
- Approach Climb Gradient (APP CLB GRAD) and Landing Climb Gradient (LDG CLB GRAD) for the planned approach.

Figure 14-109 FMS ACT FPLN PROGRESS Page

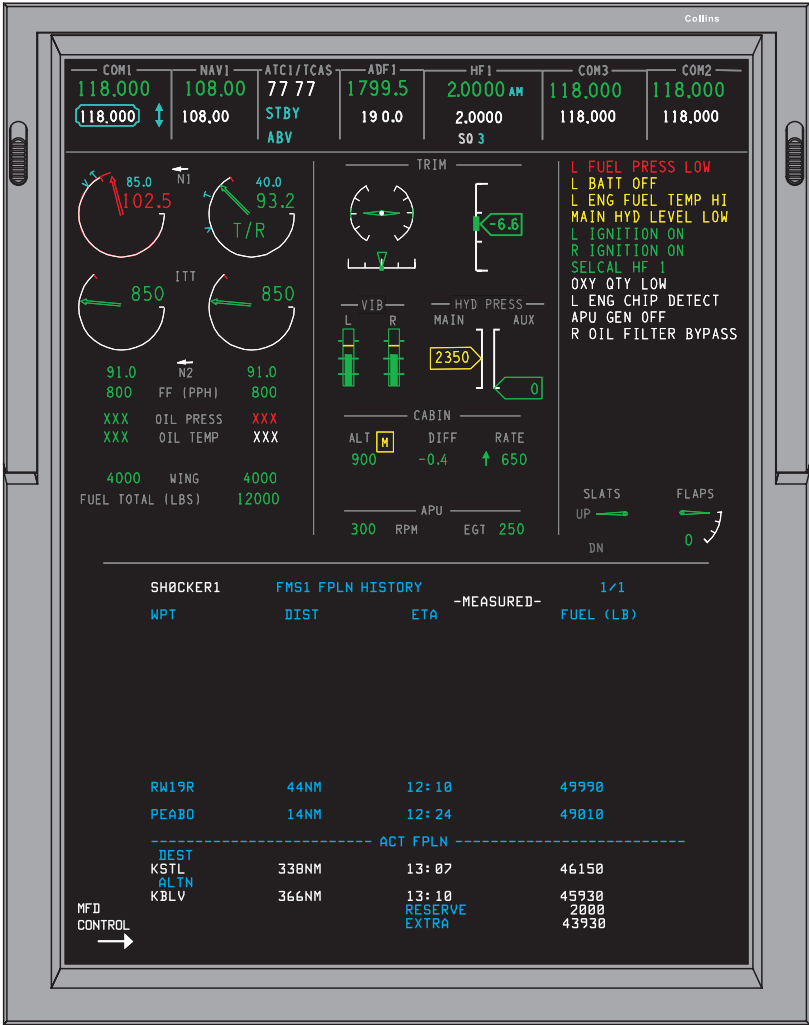


The FMS ACT FPLN PROGRESS text page on the MFD shows:

- Last waypoint passed
- Active TO waypoint

- A sequence of waypoints following the TO waypoint
- Destination (DEST) airport
- Alternate (ALTN) airport
- RESERVE FUEL
- EXTRA FUEL.

Figure 14-110 FMS ACT FPLN HISTORY Page



TPG9218_10

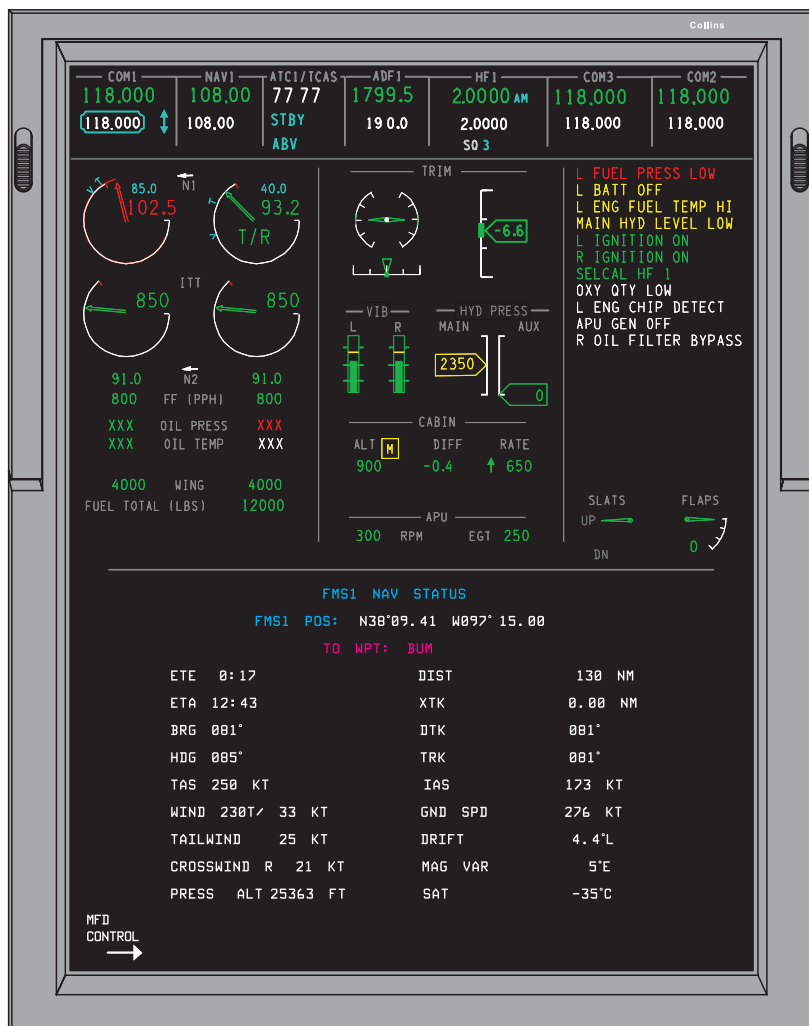
The FMS ACT FPLN HISTORY page shows the waypoints that have been passed as well as:

- Distance (DIST) in nautical miles from the waypoint
- Actual Time of Arrival (ATA) for the waypoints
- Predicted remaining FUEL at the waypoints.

The FMS ACT FPLN HISTORY page also shows DEST, ALTN, RESERVE FUEL, and EXTRA FUEL.

FMS NAV STATUS

Figure 14-111 FMS NAV STATUS Page



TPG9218_11

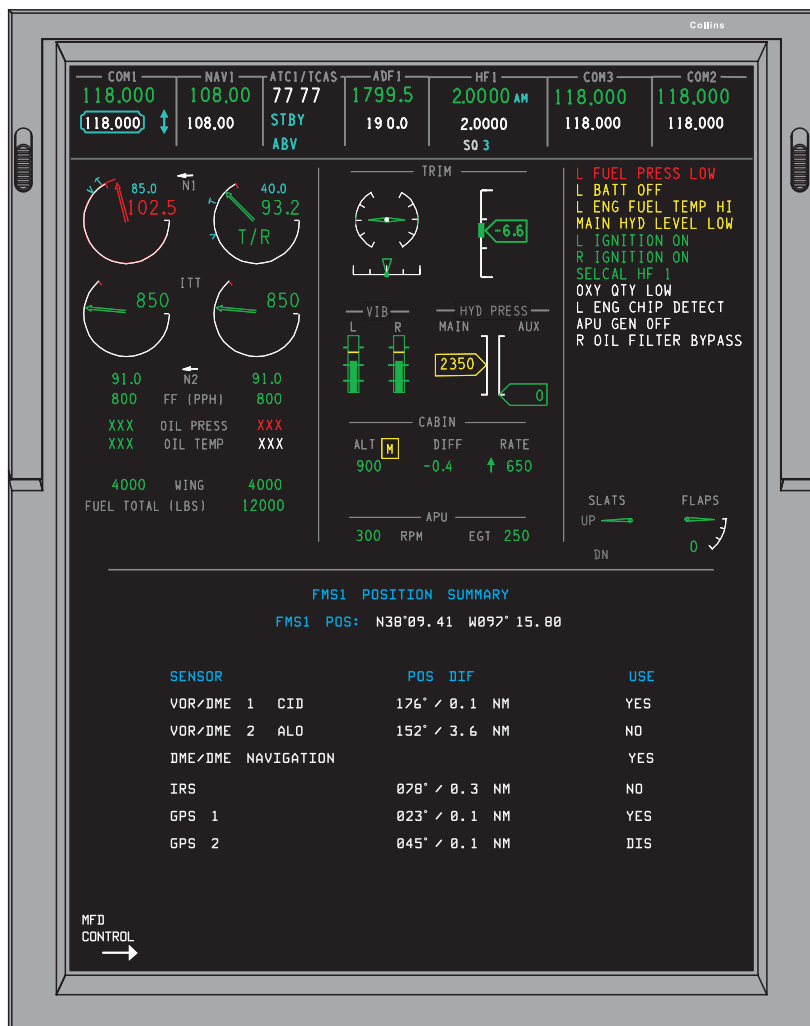
The FMS NAV STATUS text page on the MFD shows:

- FMS current latitude/longitude position
- TO waypoint

- ETE (estimated time en route)
- DIST (distance to go)
- ETA (estimated time of arrival)
- XTK (cross track position (L or R) and distance)
- BRG (bearing)
- CRS (course)
- HDG (heading)
- TRK (track)
- TAS (true airspeed)
- IAS (indicated air speed)
- WIND direction and speed
- GND SPD (ground speed)
- HEADWIND/TAILWIND speed
- DRIFT in degrees and direction (L or R)
- CROSSWIND direction (L or R) and speed
- MAG VAR (magnetic variation)
- PRESS ALT (pressure altitude)
- SAT (static air temperature).

FMS POSITION SUMMARY

Figure 14-112 FMS POSITION SUMMARY Page



TPG9218_12

The FMS POSITION SUMMARY text page on the MFD shows:

- FMS latitude and longitude position (POS)
- Each of the navigation sensors installed in the aircraft (SENSOR)

- Position difference (POS DIFF) as bearing and distance for each sensor as appropriate
- USE of each sensor in the navigation solution — YES, NO, or DIS (disabled).

The POS DIFF is in radial and distance format, and is measured from the FMS position to the sensor position. The USE indicates the current status of the sensors in use by the FMS to determine position. YES indicates a sensor is in use, NO indicates it is not in use, and DIS indicates the sensor is disabled for use by the FMS.



NOTE

The FMS POSITION SUMMARY page includes a list of navigation sensors (or combination of sensors) that can be used by the FMS to determine position. One of the columns on the page is labeled USE. For aircraft equipped with an IRS, the IRS is not part of the FMS navigation solution when any other sensors are being used (GPS/DME/VOR). NO will show in the USE column to indicate the IRS is not being used by the FMS. When position fixing sensors are used, the IRS position errors are determined and stored. Once the FMS is not able to use position fixing sensors, it attempts to use the IRS position data if IRS is selected for use by the crew (in other words, ENABLED on the IRS CONTROL page.) The IRS position is then corrected using the stored IRS position errors. YES will show in the USE column when IRS is being used by the FMS for the position solution.

FMS ACT POS REPORT

Figure 14-113 FMS ACT POS REPORT Page



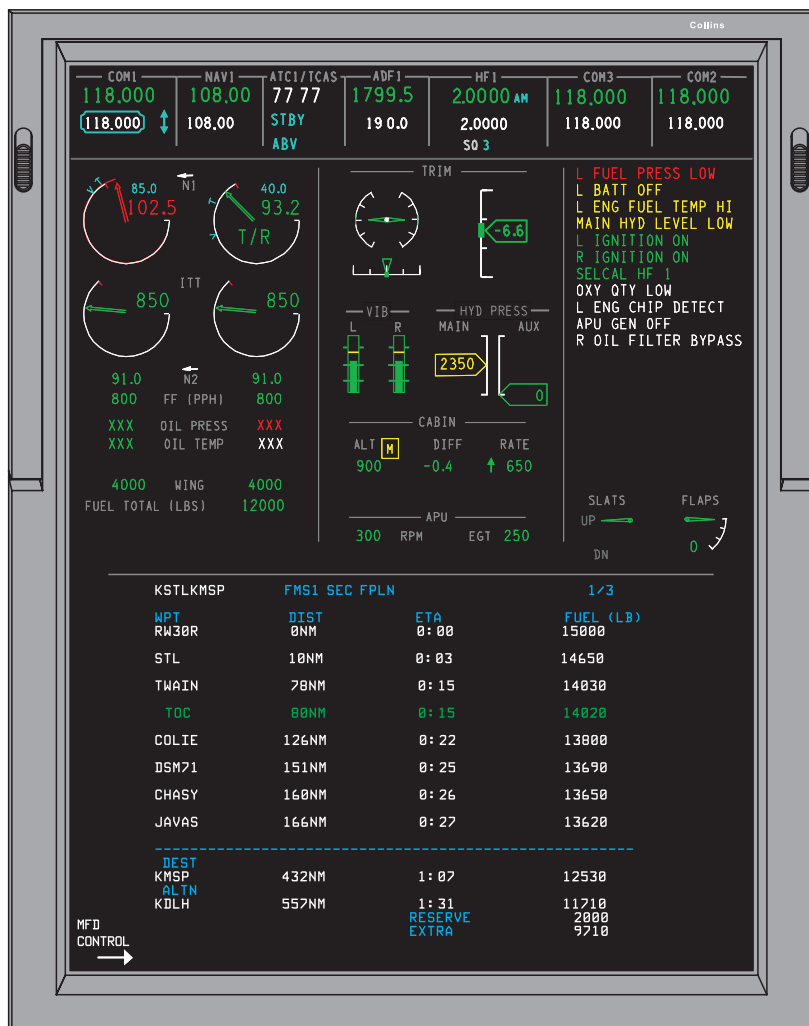
TPG9218_13

The FMS ACT POS REPORT page shows the information, including waypoints, times, fuel, and weather information, needed to make position reports:

- FROM waypoint, including latitude and longitude coordinates, Actual Time of Arrival (ATA), Altitude at crossing (ALT), distance (DIST) from that point, and FUEL at the point
- TO waypoint, including coordinates, Estimated Time of Arrival (ETA), DIST to the point, estimated FUEL, leg time in minutes (LEG T), and course (CRS)
- NEXT waypoint with coordinates, ETA, DIST, FUEL, LEG T, CRS, and leg distance (LEG D)
- Meteorological report information giving temperature and winds aloft information for the FROM waypoint just passed, and the temperature and winds aloft for the midpoint between the previous waypoint and the FROM waypoint
- Fuel remaining (FUEL REM)
- Estimated Time En Route to the destination (ETE DEST)
- Distance to go (DIST TO GO)
- FUEL USED
- TIME ALOFT
- DIST FLOWN.

FMS SEC FPLN

Figure 14-114 FMS SEC FPLN Page



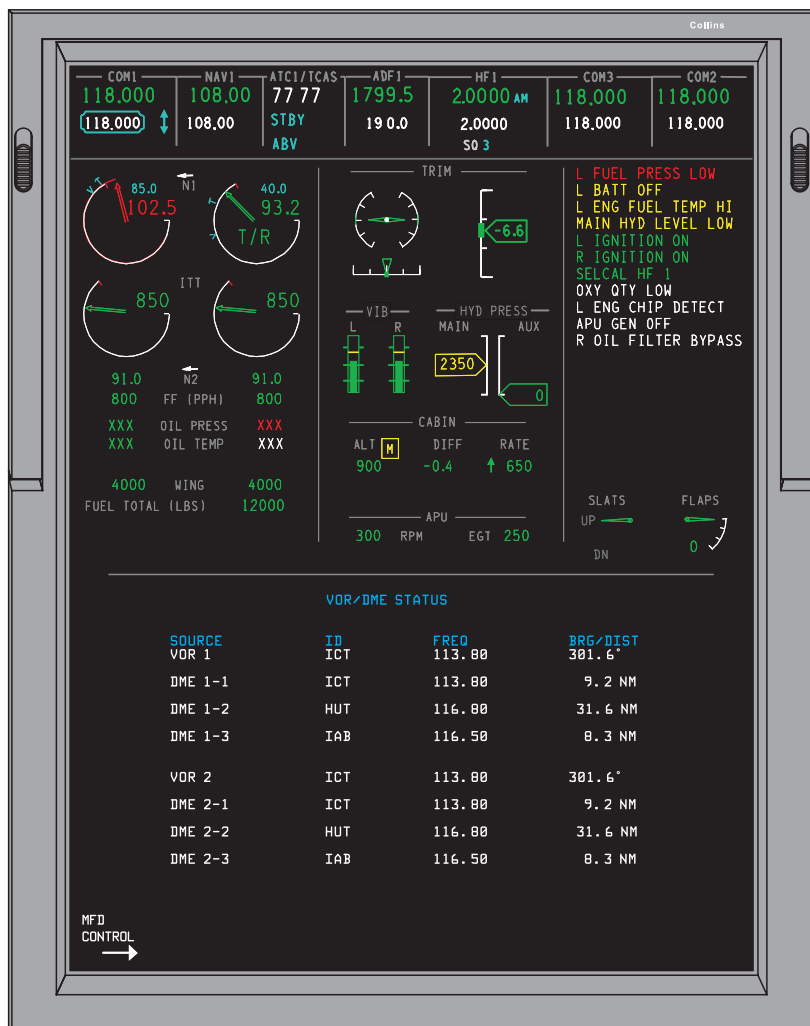
TPG9218_14

The FMS SEC FPLN page shows WPT, DIST (distance to the next waypoint), ETE, and FUEL at each waypoint for the SEC FPLN. The ETE and fuel remaining fields remain blank until the SEC FPLN is activated. Distance to the destination airport and any specified alternate

for the SEC FPLN shows at the bottom of the page, with ETE and fuel information remaining blank until the SEC FPLN is activated.

VOR/DME STATUS

Figure 14-115 VOR STATUS Page



TPG9218_15

The VOR/DME STATUS text page on the MFD shows:

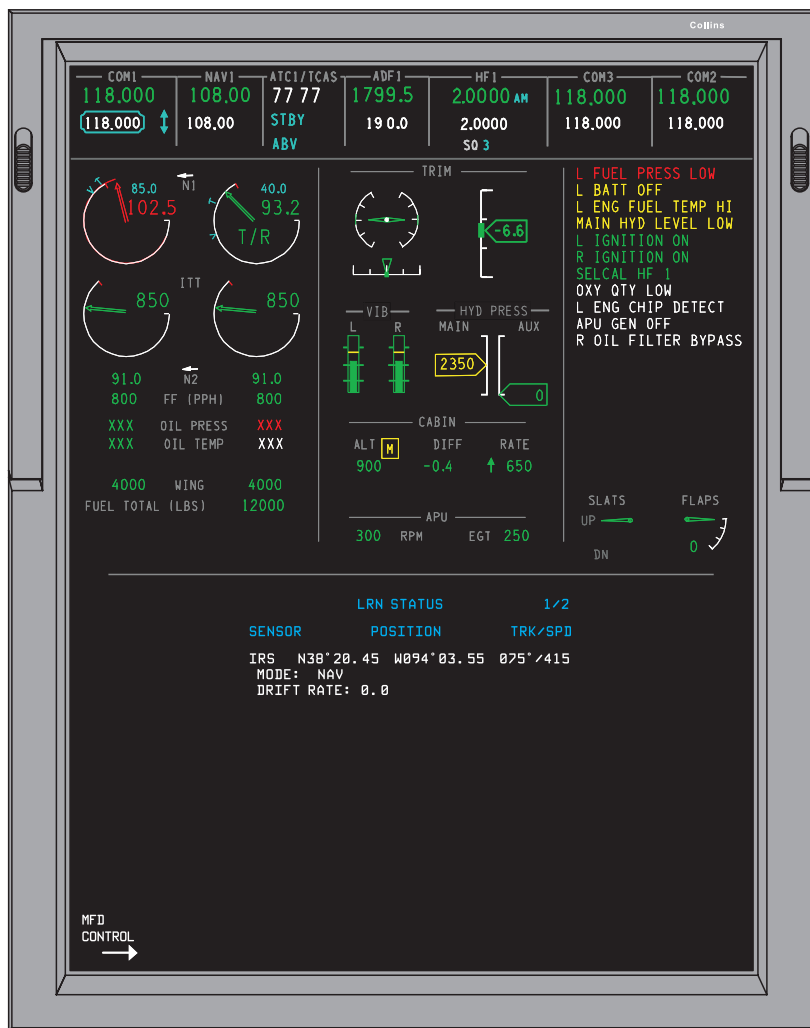
- A list of the installed VOR/DME NAV sensors (SOURCE)

- Identification (ID) of the source from which the sensor is receiving a valid signal
- Frequency of the current NAV facility (FREQ)
- Bearing/distance to the NAV facility (BRG/DIST).

An H identifies a DME sensor that is set to DME HOLD. Dashes indicate the sensor data is invalid or unavailable.

LRN STATUS

Figure 14-116 LRN STATUS 1/2 Page



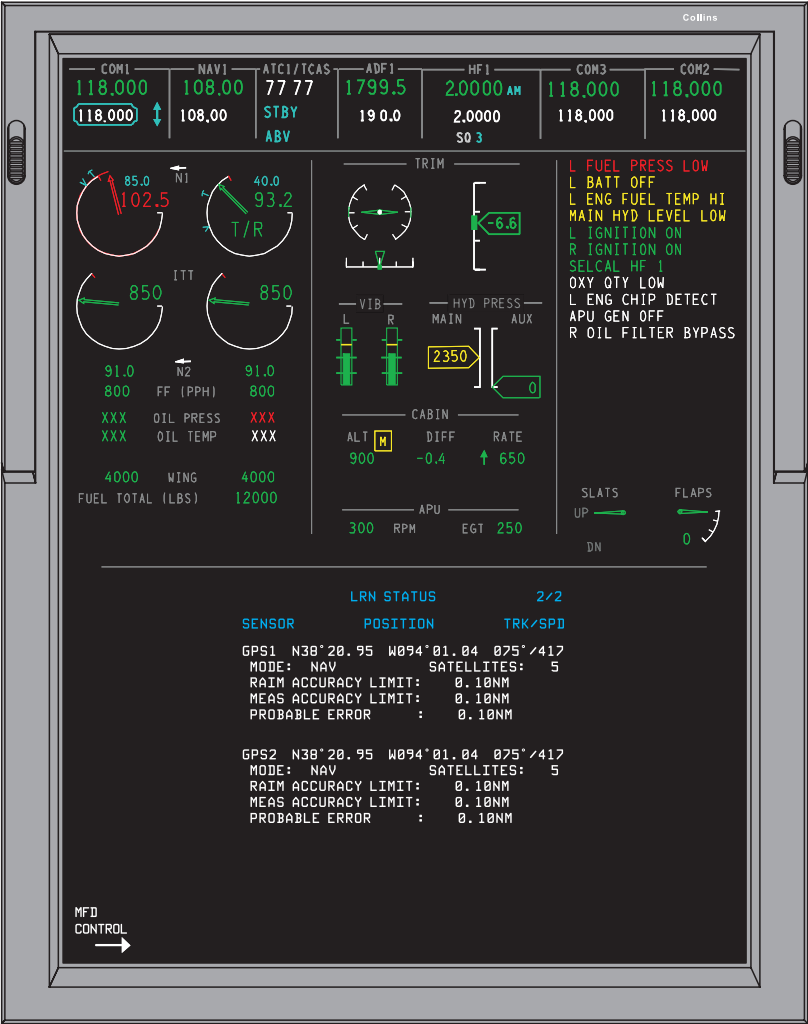
TPG9218_18

The LRN STATUS 1/2 page shows:

- The installed IRS (SENSOR)
- The current latitude and longitude POSITION of the IRS sensor

- The current tracking direction and speed (TRK/SPD) of the IRS sensor
- The current operating MODE of the IRS sensor
- The DRIFT RATE of the IRS sensor.

Figure 14-117 LRN STATUS 2/2 Page



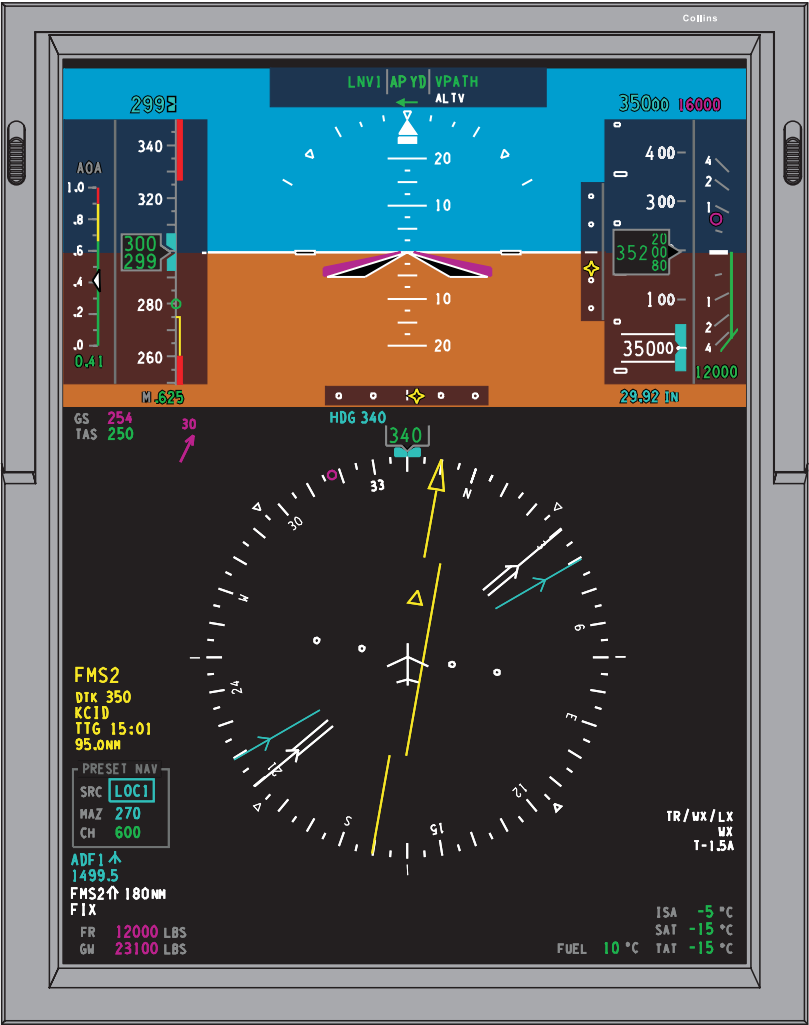
TPG9218_16

The LRN STATUS 2/2 page shows:

- Each installed GPS (SENSOR)
- The current latitude and longitude POSITION of each sensor
- The current tracking direction and speed (TRK/SPD) of each sensor
- The current operating MODE of sensor
- The number of SATELLITES in use by each sensor
- The RAIM ACCURACY LIMIT of each sensor
- The MEAS ACCURACY LIMIT of each sensor
- The PROBABLE ERROR of each sensor.

PFD DISPLAYS

Figure 14-118 Typical PFD Displays



TPG9218_03

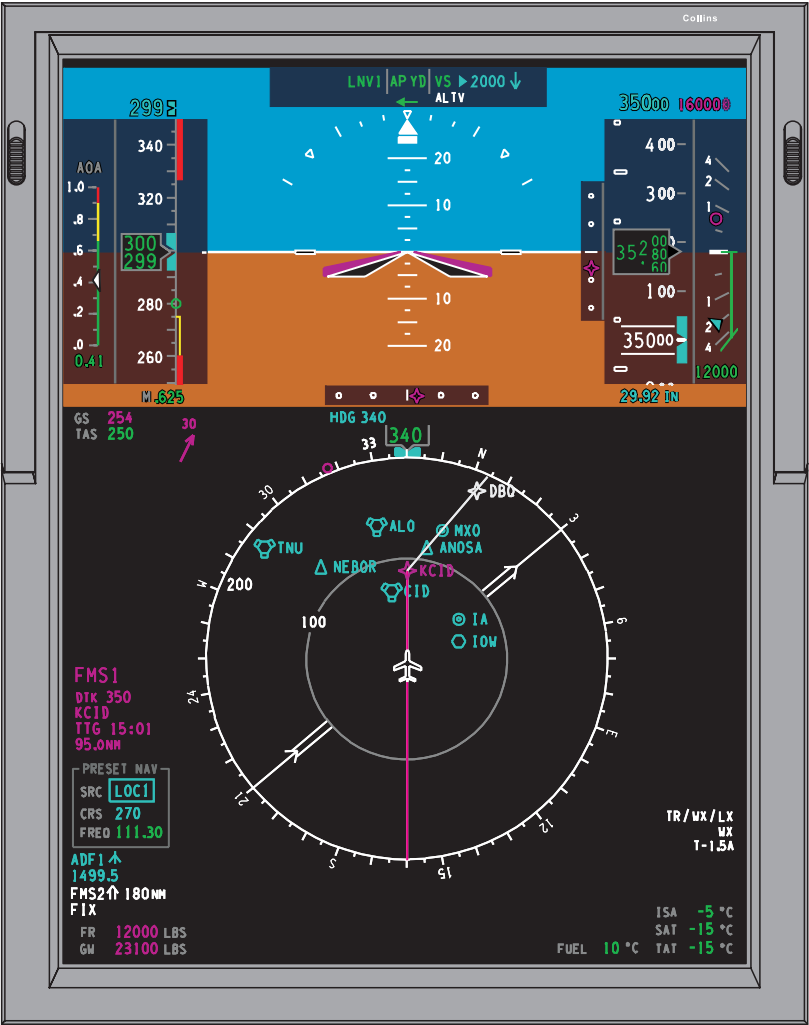
This section describes only the generic elements of the PFD that are related to or generated by the FMS.

A PFD display shows the following information related to FMS operations:

- NAV source annunciation.
- TO waypoint identifier annunciation.
- Course/deviation bar.
- Distance to the TO waypoint in nautical miles.
- Course to the TO waypoint.
- NAV to NAV Capture Preview function.
- VNAV altitude mode and constraint annunciations, along with vertical deviation and vertical speed advisories. Refer to the PRINCIPLES OF VNAV chapter for further information on VNAV functions.
- Two message lines for FMS annunciations and messages.

PFD PRESENT POSITION (PPOS) MAP

Figure 14-119 PFD PPOS Map



TPG9218_09

The PFD can have a moving map display of FMS-supplied navigation aids that are in the area surrounding the aircraft. This Present Position Map (PPOS) shows in the lower portion of the PFD, surrounding the aircraft symbol and below the heading readout. This mode is selected

for display with the FRMT button on the Display Control Panel (DCP). The list of formats can be Rose, PPOS and Summary. Summary is only included in the list when a same-side display is reverted. The map is a heading-up map showing the radius around the aircraft selected with the RANGE knob. If there is a flight plan in the FMS, the flight plan legs show with solid lines connecting the waypoints.

The active NAV source, FMS1 or FMS2, remains annunciated on the left side of the map to identify the source of the map. MFD features such as Plan Map, Text shows and extended present position MAP display are not available on the PFD Map Display.

With the PPOS Map showing on the PFD, if any navigation source other than FMS1 or FMS2 is selected from the NAV SOURCE menu, or if an automatic transition of PRESELECT CRS to active course occurs during a NAV to NAV Capture, the FMS Flight Plan symbology will be removed and replaced by the Course/Deviation display.

Refer to the MFD MAP DISPLAYS section of this chapter for detailed information on FMS map symbology.

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MESSAGES AND ANNUNCIATORS

INTRODUCTION

The FMS-6100 Flight Management System shows various messages and annunciations on the CDU, PFD, and MFD displays. This chapter gives a brief description of each message, annunciation and the action that can be taken, if applicable, when it shows on the display.

There are two display lines on the CDU that show messages. One is the bottom display line called the message line; the other is the scratchpad line.

Messages that show on the CDU scratchpad line are generally related to using the DBU and maintenance operations; these messages show in white on the display for approximately 1 second, then the previous scratchpad entry returns for correction or deletion. The PFD and MFD do not show annunciations for scratchpad messages. Also, scratchpad messages do not show on the MESSAGES page.

Messages that show on the message line are generally related to the system operation. Most of these messages also show on the CDU MESSAGES page. For many of these messages, the FMS generates an annunciation on the PFD and/or MFD at the same time. Some conditions can cause two annunciations to show on the PFD.

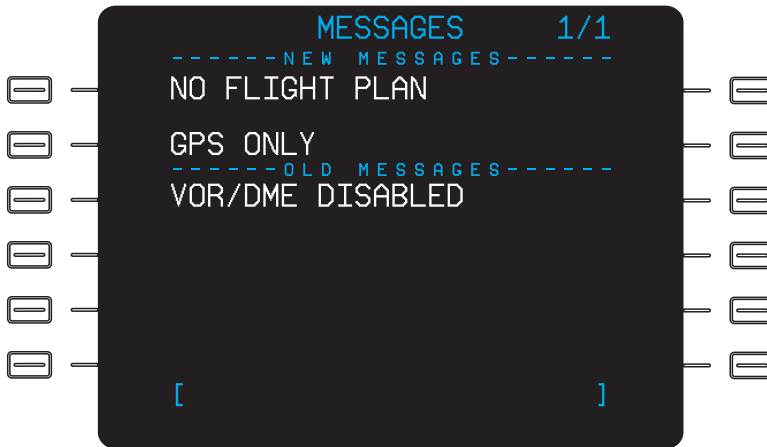
On the message line, a new message overwrites any existing message except for the execute message. When multiple messages occur, they are prioritized and the most important or most recent message is the one that shows. The MESSAGES page stores all the current active messages that were generated for the message line.

To review all messages stored on the MESSAGES page:



NOTE

The MESSAGES page can require more than one page to show all messages. Push the NEXT or PREV function key as necessary to review all messages.



TPG9209_79

1. Push the MSG function key on the CDU to show the MESSAGES page.
2. Push the MSG function key a second time to return to the display page shown before selection of the MESSAGES page, or push any other function key to show that function display page.

FMS annunciations on the PFD and MFD alert the operator to some specific operating conditions. These messages stay on while the condition causing them exists, or for a minimum of 5 seconds. The PFD annunciation lines are below the NAV sensor annunciations; the PFD message line is in the middle of the HSI display. The MFD message line is at the bottom of the MFD display.

VISUAL ANNUNCIATIONS

CREW AWARENESS MESSAGES

▼ CDU Message Line/MESSAGES Page:

APPR FOR REF
ONLY

(White)

PFD

MSG(White)

Shows when the aircraft is within 30 NM of the FAF for the selected approach, and the approach is not qualified for use by the FMS as primary approach guidance.



▼ CDU Message Line/MESSAGES Page:

CHECK ALT SEL

(White)

PFD

MSG(White)

VNAV is active and either of the conditions that follow is true.

- (Climb) The preselected altitude is not higher than the current barometric altitude of the aircraft, and the aircraft is within 45 seconds of a Bottom Of Climb.
- (Descent) The preselect altitude is not lower than the current barometric altitude of the aircraft, and the aircraft is within 45 seconds of a Top Of Descent and approach condition is not active.



▼ **CDU Message Line/MESSAGES Page:**

CHECK APPROACH
PERF

(Yellow)

PFD

MSG(Yellow)

⇒ Review the APPROACH REF pages to determine the limiting value.

Shows when APPROACH REF pages are first accessed on either FMC in a synchronized mode or the same-side FMS in independent mode while the aircraft is in the air and one of the following is true:

- One of the FMS-computed approach performance values does not meet the specified limit.
- The computed landing field length exceeds the available runway length.
- The approach climb and/or landing climb gradient are less than the required minimum value(s).

▼ **CDU Message Line/MESSAGES Page:**

CHECK CRZ SPD
MODE

(White)

⇒ Review input ISA, cruise altitude, or aircraft gross weight.

This message indicates that one or more points/legs along the FMS-computed path for the cruise phase contains a predicted cruise speed that is limited to the LRC or MCRZ table boundaries for the input aircraft flight plan conditions (ISA DEV, ALTITUDE, GROSS WEIGHT).

This message shows when either of the following conditions are true:

- Performance mode is set to predicted.

- 
- LRC/MCRZ selections are available and either LRC or MCRZ is selected to ACTIVE on the VNAV CRUISE page.

▼ **CDU Message Line/MESSAGES Page:**

CHECK FPLN ALT
(White)

PFD
MSG(White)



Shows when there is an error in an altitude constraint because it results in a reversal of a climb or descent altitude, or the aircraft has exceeded a down-track altitude constraint.

▼ **CDU Message Line/MESSAGES Page:**

CHECK FUEL AT
DEST
(Yellow)

PFD
MSG(Yellow)



Informs the pilot that the computed fuel for the active flight plan destination airport is less than the specified reserve fuel.

▼ **CDU Message Line/MESSAGES Page:**

CHECK FUEL AT
ALTN
(Yellow)

PFD
MSG(Yellow)



Informs the pilot that the computed fuel for the active flight plan alternate airport is less than the specified reserve fuel. If the condition for CHECK FUEL AT DEST exists, this message will be suppressed.

▼ **CDU Message Line/MESSAGES Page:**

CHECK LOC TUNING

(White)

PFD

MSG(White)

⇒ Manually tune the correct localizer frequency if necessary before making the approach.

Shows when the aircraft is at or within 30 NM of the destination airport, a localizer-based approach is selected, and the navigation frequency does not match the tuned value of the FMS.

▼ **CDU Message Line/MESSAGES Page:**

CHECK LRN STATUS

(White)

PFD

MSG(White)

Shows when at least one GPS sensor is installed on the aircraft, the GPS sensor is enabled, and GPS measurements are not available for use in the FMS solution as follows:

- In the oceanic/remote environment, the aircraft is airborne and GPS is not available for 60 seconds.
- In the en route or terminal environment, the aircraft is either airborne or on the ground and GPS is not available for 30 seconds.
- In the approach environment, the aircraft is airborne and GPS is not available for 10 seconds.

▼ **CDU Message Line/MESSAGES Page:**

CHECK NAV
SOURCE

(White)

PFD

MSG(White)

⇒ Set the navigation source to FMS or LOC.

Shows when VNAV is selected and the navigation source is not FMS or LOC after the FMS initiated ILS capture.



▼ **CDU Message Line/MESSAGES Page:**

CHECK NAV TUNING

(White)

PFD

MSG(White)

⇒ Select the correct VOR/DME for the approach.

⇒ Select the AUTO tuning mode when able.

Shows when the aircraft is at or within 30 NM of the destination airport, approach mode is selected, an RNAV approach is selected, and the FMS could not tune the referenced navaid. If the correct VOR/DME is not available, the approach is not authorized.



▼ **CDU Message Line/MESSAGES Page:**

CHECK SPEED

(Yellow)

PFD

MSG(Yellow)

PFD

SPD(Yellow)

⇒ Reduce aircraft speed.

Shows when either condition that follows is true:

- The current airspeed is 20 knots or 0.03 Mach greater than a VNAV speed restriction and VNAV is selected.

- 
- The aircraft is within 2 minutes of a hold and the current indicated airspeed is 20 knots or 0.03 Mach greater than the maximum recommended holding airspeed.

▼ **CDU Message Line/MESSAGES Page:**

CHECK TAKEOFF
PERF
(Yellow)

PFD
MSG(Yellow)

⇒ Review the TAKEOFF REF pages to determine the limiting value.

Shows when the aircraft is on the ground and one of the conditions that follow is true:

- One of the FMS-computed takeoff performance values does not meet the specified limit.
- The computed takeoff field length exceeds the available runway length.
- The computed second segment and/or final segment climb gradient does not meet the required minimum value.

▼ **CDU Message Line/MESSAGES Page:**

CHECK VPA ENTRY
(White)

PFD
MSG(White)

⇒ Correct the VPA entry if necessary.

Shows when a descent angle entered by the user is greater than the VPA limit but still less than or equal the maximum VPA allowed for the aircraft.

▼ **CDU Message Line/MESSAGES Page:**

CHK DATABASE
DATES

(White)

PFD

MSG(White)

⇒ Go to the STATUS page and select the appropriate database on each CDU.

To operate dual FMS installations in the coordinated mode, the active databases on both systems must have the same effective dates. Shows when they are not the same.



▼ **CDU Message Line/MESSAGES Page:**

CHK POS

(Yellow)

PFD

CHK POS(Yellow)

PFD

MSG(Yellow)

⇒ Do a position update of the FMS.

⇒ If a failed sensor caused the problem, disable the failed sensor.

Shows when the FMS has determined that a navigation sensor is not meeting the accuracy requirements for the current phase of flight. This message is usually followed by another message showing the affected sensor, such as FMS-FMS DISAGREE, GPS-FMS DISAGREE, or VOR/DME DIST>75NM.



▼ **CDU Message Line/MESSAGES Page:**

CRS REVERSAL IN
FPLN

(Yellow)

PFD

MSG(Yellow)

⇒ Edit the flight plan to eliminate the course reversal.

⇒ Ignore the message if the flight plan course reversal is intentional.

Shows when the flight plan route contains a course reversal of more than 160 degrees at the TO waypoint. Its purpose is to identify a possible error in a flight plan.

▼ **CDU Message Line/MESSAGES Page:**

DB MEMORY FAULT

(White)

PFD

MSG(White)

Shows when there is a fault in the Data Base Memory.

▼ **CDU Message Line/MESSAGES Page:**

DECELERATE

(White)

PFD

MSG(White)

⇒ Reduce aircraft speed.

Shows when the current airspeed is faster than planned decelerating reference speed computed by VNAV when VNAV is selected.

▼ **CDU Message Line/MESSAGES Page:**

DL FPLN LOADED

(White)

⇒ Go to the SEC FPLN pages to view the flight plan and clear the message.

Shows when the Datalink flight plan that was requested by the pilot has been loaded and not yet viewed.

▼ **CDU Message Line/MESSAGES Page:**

DL FPLN REJECTED
(White)

⇒ Review the flight plan for errors.
Resubmit the flight plan if necessary.

Shows when the Datalink flight plan that was requested by the pilot has been rejected. The rejection can be caused by one or more of the conditions that follow:

- A flight plan recall uplink is received from the Information Provider with the last FMS generated flight plan recall request number and a rejected message is present.
- The FMS failed to send a valid flight plan update request.
- The FMS failed to load a valid flight plan update.
- The CRC check did not pass.
- An uplinked airport identifier is not recognized by the FMS.

▼ **CDU Message Line/MESSAGES Page:**

DL WINDS UPDATED
(White)

⇒ Go to the LEG WIND page to view the winds.

⇒ Cancel the MOD FPLN if desired/necessary.

The Datalink flight plan wind update that the pilot requested has been loaded into the active flight plan, creating a MOD FPLN that has not yet been viewed.

▼ **CDU Message Line/MESSAGES Page:**

DL WINDS RE-
JECTED
(White)

⇒ Send a new FPLN WIND UPDATE request if desired/necessary.

Shows when a flight plan winds update uplink is received from the Information Provider with the last FMS-generated flight plan winds update request number and a rejected message is received. The rejection can be caused by one or more of the conditions that follow:

- The flight plan wind update that was requested has been rejected by the information provider.
- The FMS failed to send a valid wind update request.
- The FMS failed to load a valid wind update.

▼ **CDU Message Line/MESSAGES Page:**

DME DISABLED
(White)

⇒ Enable the DME sensors on the VOR/DME CONTROL page.

Shows when the DME navigation sensors are deselected for use by the FMS on the VOR/DME CONTROL page. This can degrade FMS navigation capability.

This message will appear on the MESSAGES page without an accompanying MSG indication on the CDU Message Line.

▼ **CDU Message Line/MESSAGES Page:**

DME-FMS DIS-
AGREE

(Yellow)

PFD

MSG(Yellow)

⇒ Do a position update of the FMS.

⇒ Determine if one of the NAV sensors is in error. Disable that sensor if necessary.

⇒ Determine if a DME station is in error. Disable that DME station if necessary.

Shows when one or more DMEs are inconsistent with the current FMS position estimate. This message is annunciated when the difference is 2.0 NM in the en route environment, 1.0 NM in the terminal environment, and 0.5 NM in the approach environment.

▼ **CDU Message Line/MESSAGES Page:**

DR EXCEED 5 MIN

(Yellow)

PFD

MSG(Yellow)

⇒ Make sure navigation sensors are enabled. Enable them if they are not.

⇒ Do a position update of the FMS with data from a known good sensor.

The FMS has been in DR mode for more than 5 minutes while the aircraft is airborne.

▼ **CDU Message Line/MESSAGES Page:**

EXCESS IRS MO-
TION

(White)

PFD

MSG(White)

⇒ Make sure that the aircraft is not in motion and restart IRS alignment.

The IRS has detected excessive motion during alignment. This message occurs usually because the aircraft is taxied or towed during alignment.

▼ **CDU Message Line/MESSAGES Page:**

EXEC FPLN MOD

(Yellow)

PFD

MSG(Yellow)

⇒ Do any of actions that follow to remove the message:

- Continue the modification.
- Verify the current change and push the EXEC function key on the CDU to execute the flight plan.
- Push the CANCEL MOD line key to cancel the modification in progress.

Shows for a modified flight plan that has not been updated or executed for more than 1 minute (approximate).

▼ **CDU Message Line/MESSAGES Page:**

FMS DR

(White)

PFD

FMS DR(White)

PFD

MSG(White)

⇒ Make sure VOR/DME and GPS sensors are enabled. Enable them if they are not.

⇒ Determine if AUTO tuning mode is selected on the TUNE page. Select AUTO if it is not.

⇒ Determine if any VOR/DME stations are being received. If airborne, climb higher to receive more stations.

⇒ Do a position update of the FMS with data from a known good sensor.

Shows when the aircraft is on the ground or has been airborne for less than 2 minutes and the FMS has been in dead reckoning mode for between 10 to 30 seconds. Another reason for this message could be that the FMS position was not properly initialized.

▼ **CDU Message Line/MESSAGES Page:**

FMS DR
(Yellow)

PFD
MSG(Yellow)

⇒ Make sure navigation sensors are enabled. Enable them if they are not.

⇒ Do a position update of the FMS with data from a known good sensor.

Shows when the FMS has been in DR mode for at least 2 minutes. Another reason for this message could be that the FMS position was not properly initialized.

▼ **CDU Message Line/MESSAGES Page:**

FMS-FMS DIS-
AGREE
(Yellow)

PFD
MSG(Yellow)

⇒ Review the sensor position summary page on both sides to determine the best FMS position.

⇒ Do one of the actions that follow:

- Do a position update for the suspected incorrect side.
- Change to INDEP operation and use the known good FMS.

Shows when the cross-side FMS position data is significantly different from that of the same-side FMS.

▼ **CDU Message Line/MESSAGES Page:**

FMS INDEPENDENT
OP
(White)

⇒ If the communications failure was due to a power fluctuation, resync the FMSs.

PFD
NO DISCON(White)

⇒ If the CHK DATABASE DATES message also shows, correct the dates to allow SYNC operation.

PFD
MSG(White)

Shows when in a dual FMS installation, a communications failure between the FMSs has occurred, the selected databases are different, or the software programs in the FMS are different and the FMS cannot operate in the SYNC mode.

▼ **CDU Message Line/MESSAGES Page:**

FMS NAV INVALID
(Yellow)

⇒ Check the NAV sensors to be sure they are enabled.

PFD
MSG(Yellow)

⇒ Check for a heading sensor failure.

Shows when the FMS does not have a valid source for sensor and heading data while airborne.

▼ **CDU Message Line/MESSAGES Page:**

FMS NAV INVALID
(White)

PFD
MSG(White)

⇒ Check the NAV sensors to be sure they are enabled.

⇒ Check for a heading sensor failure.

Shows when the FMS does not have a valid source for sensor and heading data while on the ground.



▼ **CDU Message Line/MESSAGES Page:**

FPLN DISCONTINUITY
(Yellow)

PFD
MSG(Yellow)

⇒ Modify the flight plan as required.

Shows when the flight plan has sequenced past, or is within 2 minutes of sequencing past, the last waypoint before a flight plan discontinuity.



▼ **CDU Message Line/MESSAGES Page:**

FUEL FLOW NOT
AVAIL
(White)

PFD
MSG(White)

Shows when fuel flow data has been invalid for at least 2 minutes.



▼ **CDU Message Line/MESSAGES Page:**

GPS DISABLED

(White)

PFD

MSG(White)

⇒ If the GPS sensors are valid, enable the GPS sensors on the GPS CONTROL page.

Shows when the GPS sensors are disabled for use by the FMS on the GPS CONTROL page. This can degrade FMS navigation performance.



▼ **CDU Message Line/MESSAGES Page:**

GPS-FMS DIS-
AGREE

(Yellow)

PFD

MSG(Yellow)

⇒ Do a position update of the FMS with data from a known good sensor.

⇒ Determine if a GPS sensor is failed or invalid. Disable the sensor if necessary.

The GPS position estimate is different from that of the FMS. Shows when the difference is:

- 2.0 NM or greater in the oceanic, remote, or en route environment
- 1.0 NM or greater in the terminal environment
- 0.3 NM or greater in the approach environment.



▼ **CDU Message Line/MESSAGES Page:**

GPS NOT AVAIL-
ABLE

(Yellow)

PFD

MSG(Yellow)

Shows when the FMS is not using GPS position data as part of its calculations to determine position. Shows if the GPS has been unavailable for at least 2 minutes in the terminal environment of the destination airport, or at least 30 seconds in the approach environment of the destination airport, and the GPS sensors are enabled.

▼ **CDU Message Line/MESSAGES Page:**

GPS NOT AVAIL-
ABLE

(White)

PFD

MSG(White)

Shows when the FMS is not using GPS position data as part of its calculations to determine position. Shows when the GPS has been unavailable for at least 5 minutes in the oceanic, remote or en route environment.

▼ **CDU Message Line/MESSAGES Page:**

GPS ONLY

(White)

PFD

GPS ONLY(White)

PFD

MSG(White)

⇒ Determine if other navigation sensors are valid. Enable the navigation sensors if disabled.

Shows when the FMS is using position data from the GPS sensor only. Shows only if all of the other sensors are disabled, invalid, or failed. This message can be inhibited in some aircraft installations.

▼ **CDU Message Line/MESSAGES Page:**

GPS REVERTED

(White)

PFD

MSG(White)

Shows when the FMS is using the cross-side GPS sensor, instead of the same-side sensor, while the same-side sensor is enabled. This could be the result of invalid data from the same-side GPS sensor or a failed same-side sensor.

▼ **CDU Message Line/MESSAGES Page:**

HALF-BANK SE-
LECTED

(Yellow)

PFD

MSG(Yellow)

⇒ Deselect HALF-BANK mode.

Shows when the aircraft is within 1 minute or less of arriving at holding fix or procedure turn, or the active leg is an approach leg, and HALF-BANK mode is selected on the FGP. An overshoot of the desired path can occur when HALF-BANK mode is selected.

▼ **CDU Message Line/MESSAGES Page:**

HOLD EFC EXPIRED

(White)

PFD

MSG(White)

⇒ Enter new EFC time on HOLD page or obtain clearance to exit the hold.

Shows when the Expect Further Clearance (EFC) time has expired and the aircraft has not exited the hold.

▼ **CDU Message Line/MESSAGES Page:**

INITIALIZE POSI-
TION

(Yellow)

PFD

MSG(Yellow)

⇒ Initialize the FMS from the POS INIT page on the CDU.

Shows when the FMS and IRS sensors have not been initialized.



▼ **CDU Message Line/MESSAGES Page:**

INVALID PERF DB

(White)

PFD

MSG(White)

⇒ Contact maintenance personnel.

Shows when the aircraft is configured to support predicted performance mode and the FMS performance database version does not match the aircraft type or the database is incomplete.



▼ **CDU Message Line/MESSAGES Page:**

INVALID VSPEED DB

(White)

PFD

MSG(White)

⇒ Contact maintenance personnel.

Shows when the system is configured to support the Vspeed feature and the loaded FMS Vspeed Database (VDB) version does not match the aircraft type or the VDB is incomplete.



▼ **CDU Message Line/MESSAGES Page:**

IRS DISABLED

(White)

⇒ Re-enable the IRS sensor unless there is a problem with the sensor.

The IRS navigation sensor is disabled for use by the FMS on the IRS CONTROL page. This can degrade FMS navigation capability.

▼ **CDU Message Line/MESSAGES Page:**

IRS-FMS DISAGREE
(Yellow)

PFD
MSG(Yellow)

⇒ Determine if a position update can correct the problem, or if the IRS sensor should be disabled.

The IRS position determination is different from that of the FMS. This message shows when the difference is either:

- 5 NM or greater within the first half of flight
- Greater than 2.5 NM multiplied by the duration of flight (T), plus 3.75 NM, up to a limit of 25 NM $[(2.5 \times T) + 3.75 = X \text{ and } X \leq 25 \text{ NM}]$ after the first half hour of flight.

However, if the FMS position has not been initialized, or if the IRS was initialized in the air, it is annunciated only if the FMS and IRS positions differ by more than 25.0 NM.

▼ **CDU Message Line/MESSAGES Page:**

IRS ONLY
(White)

PFD
IRS ONLY(White)

The IRS is the only sensor being used by the FMS and one of the following is true:

- In the en route environment, it has been more than 20 minutes since a position update was available from a GPS or other navaid, and it has been more than 2 hours since IRS alignment and takeoff.
- In the terminal environment, it has been more than 10 minutes since a position update was available from a GPS or other navaid, and it has been more than 1 hour since IRS alignment and takeoff.
- In the North Atlantic region, it has been more than 20 minutes since a position update was available from a GPS or other navaid, and it has been more than 6 hours since IRS alignment and takeoff.

▼ **CDU Message Line/MESSAGES Page:**

LAST WAYPOINT
(Yellow)

PFD
MSG(Yellow)

⇒ Insert the next waypoint into the flight plan if the aircraft has not reached the destination.

⇒ Select an arrival and/or approach on the DEP/ARR INDEX page for the destination airport if not already accomplished.

Shows when the aircraft has passed, or is within 2 minutes of passing, the last waypoint in the flight plan.

▼ **CDU Message Line/MESSAGES Page:**

LOC WILL BE TUNED
(White)

PFD
MSG(White)

⇒ Select AUTO tuning mode if necessary.

Shows when the FMS is within 30 seconds of automatically tuning the localizer and the radio tuning mode is set to MANUAL.



▼ **CDU Message Line/MESSAGES Page:**

LOW POS ACCU-
RACY
(Yellow)

PFD
MSG(Yellow)

Shows when the estimated position accuracy value is greater than the Required Navigation Performance (RNP) value that shows on the PROGRESS 2/2 page.



▼ **CDU Message Line/MESSAGES Page:**

MAX VPA EX-
CEEDED
(White)

PFD
MSG(White)

⇒ Select another approach or obtain amended approach clearance.

Shows a descent angle specified in the selected approach exceeds the maximum VPA for the aircraft.



▼ **CDU Message Line/MESSAGES Page:**

NO APPR GPS RAIM
(White)

PFD
MSG(White)

⇒ Select a non-GPS approach if possible.

Shows when a GPS or GPS-only approach is specified in the flight plan, and RAIM is predicted to be unavailable to the GPS sensor for the approach.



▼ **CDU Message Line/MESSAGES Page:**

NO APPR REVER-
SION

(White)

PFD

NO APPR(White)

Shows when either DCP is in reversion mode while the aircraft is within 30 NM of the airport, a localizer-based approach is in the active flight plan, and FMS-to-localizer NAV-to-NAV capture is enabled. NAV-to-NAV capture does not occur with the DCP in reversion.

▼ **CDU Message Line/MESSAGES Page:**

NO FLIGHT PLAN

(White)

PFD

NO FLIGHT PLAN(White)

⇒ Create and execute a new flight plan, or activate and execute an existing flight plan.

Shows when the FMS does not have an active flight plan.

▼ **CDU Message Line/MESSAGES Page:**

NO GPS RAIM

(White)

PFD

MSG(White)

Shows when the FMS is using GPS in its calculations to determine position in the en route, terminal, or approach phase of flight, and RAIM is not available at the required accuracy to the GPS sensor.

▼ **CDU Message Line/MESSAGES Page:**

NO NAV DATA BASE

(White)

PFD

MSG(White)

⇒ Load a database into the FMS system.

Shows when the FMS has no navigation database.

▼ **CDU Message Line/MESSAGES Page:**

NO PERF DATA
BASE

(White)

PFD

MSG(White)

⇒ Load a performance database into the FMS.

Shows when the system is configured to support predicted performance mode and there is no performance database stored in the FMS.

▼ **CDU Message Line/MESSAGES Page:**

NO VPATH CONDI-
TION

(White)

PFD

MSG(White)

⇒ Changing the autopilot to a mode other than VPITCH or passing the last altitude constraint on the descent path clears this message.

Shows when VPATH mode automatically reverts to VPITCH mode. This occurs because either the aircraft crossed a vertical discontinuity in the descent path, or a flight plan edit occurred that caused the active descent path to move.

▼ **CDU Message Line/MESSAGES Page:**

NO VPATH-PILOT
CMD

(White)

PFD

MSG(White)

⇒ Turn VNAV off, then back on.

Shows when a vertical autopilot mode is selected while flying VPATH. VPATH automatically recaptures only after vertical deviation exceeds 1 dot, and the aircraft is maneuvered back to the VNAV path.

▼ **CDU Message Line/MESSAGES Page:**

NO VPATH THIS LEG
(White)

PFD
MSG(White)

⇒ Change the autopilot to a mode other than VPITCH.

⇒ Change to a leg that is not a holding pattern.

Shows when the flight plan sequences to a new leg that is a holding pattern. When this occurs, VPATH automatically changes to VPITCH.



▼ **CDU Message Line/MESSAGES Page:**

NO VPATH-TAE
(White)

PFD
MSG(White)

⇒ Turn the aircraft to fly parallel to the FMS course line.

⇒ Change the autopilot to a mode other than VPITCH.

Shows when VPATH mode has automatically reverted to VPITCH mode because the track-angle error has exceeded the specified limits.



▼ **CDU Message Line/MESSAGES Page:**

NO VPATH-VECTORS
(White)

PFD
MSG(White)

⇒ Change the autopilot to a mode other than VPITCH.

Shows when VPATH mode has automatically reverted to VPITCH mode because there is a heading leg in the FMS flight plan. The message also clears after the aircraft passes the heading leg.



▼ **CDU Message Line/MESSAGES Page:**

NO VPATH-XTD
(White)

PFD
MSG(White)

⇒ Reduce the cross-track distance to within the specified limit.

⇒ Change the autopilot to a mode other than VPITCH.

Shows when VPATH mode has automatically reverted to VPITCH mode because the cross-track deviation has exceeded the specified limits.

▼ **CDU Message Line/MESSAGES Page:**

NO VSPD DATABASE
(White)

PFD
MSG(White)

⇒ Load a Vspeed database into the FMS.

Shows when the system is configured to support the Vspeed feature and there is no Vspeed database stored in the FMS.

▼ **CDU Message Line/MESSAGES Page:**

NOT ON INTERCEPT
TRACK
(Yellow)

PFD
MSG(Yellow)

⇒ Turn the aircraft to intercept the FMS track.

⇒ If the FMS is steering the aircraft, this condition is corrected automatically. Assess the possibility of airspace violations during the maneuver.

Shows when the FMS is steering the aircraft back to the active leg, or it is armed for capture, but the current flight path does not intercept the active flight plan leg.

▼ **CDU Message Line/MESSAGES Page:**

OFFSET TERMINATED
(White)

PFD
MSG(White)

Shows when the aircraft has reached the end of a parallel offset leg of the flight plan.



▼ **CDU Message Line/MESSAGES Page:**

OFFSET WILL END
(White)

PFD
MSG(White)

Shows when the aircraft is within 2 minutes of the end of an offset track.



▼ **CDU Message Line/MESSAGES Page:**

PATH BELOW A/C
(White)

PFD
MSG(White)

Shows when the current descent path is below the aircraft, the aircraft is in a holding pattern, and the current vertical path will not intercept the descent path unless the aircraft descends.



▼ **CDU Message Line/MESSAGES Page:**

PROGRAM DIFFER
(White)

PFD
MSG(White)

⇒ See a maintenance technician to correct this problem.

Shows when the two FMS software programs are incompatible. Also shows when an incorrect FMC or CDU is installed in the aircraft.



▼ **CDU Message Line/MESSAGES Page:**

RE-ENTER SET POS
(Yellow)

PFD
MSG(Yellow)

This message shows when an IRS
(or other LRN) did not properly
receive a position update or requires
reconfirmation of the update.



▼ **CDU Message Line/MESSAGES Page:**

RESET INITIAL POS
(Yellow)

PFD
MSG(Yellow)

⇒ Perform the FMS position initialization
again on the POS INIT page on the
CDU.

Shows when the position entered during
position initialization is greater than 40
NM from the last known FMS position.
Because of this, the FMS is requesting
that the initial position be reentered for
verification.



▼ **CDU Message Line/MESSAGES Page:**

SET IRS HDG
(Yellow)

PFD
MSG(Yellow)

⇒ Go to the IRS CONTROL page and
enter a heading value into the SET
IRS HDG field.

IRS requires a heading value to continue
to supply heading in the attitude mode.



▼ **CDU Message Line/MESSAGES Page:**

SUPPLEMENTAL
DATA
(White)

PFD
MSG(White)

Takeoff or Approach performance data is derived from the SUPPLEMENTAL portion of the AFM.



▼ **CDU Message Line/MESSAGES Page:**

UNABLE CRZ ALT
(White)

PFD
MSG(White)

⇒ Correct the vertical profile to clear the message.

Shows when the FMS performance predictions indicate the aircraft cannot reach the cruise altitude because of climb or cruise ceiling limitations, or because the climb and descent profiles overlap.



▼ **CDU Message Line/MESSAGES Page:**

UNABLE CRZ SPD
MODE
(White)

PFD
MSG(White)

⇒ Refer to the PERF INIT page to make sure CRZ ALT and/or GWT is entered.

Shows when the selected cruise speed mode on the VNAV CRUISE setup page is an FMS-computed cruise speed schedule and the cruise speed readout is dashed due to either of the following:

- The MOD/ACT FPLN cruise altitude is not specified.
- Gross weight (GWT) is not available.



▼ **CDU Message Line/MESSAGES Page:**

UNABLE FPLN ALT
(Yellow)

PFD
MSG(Yellow)

⇒ Correct the vertical profile of the climb or descent to clear this message.

Shows when the FMS performance predictions indicate an altitude constraint cannot be met at the specified waypoint.

▼ **CDU Message Line/MESSAGES Page:**

UNABLE NEXT ALT
(Yellow)

PFD
MSG(Yellow)

⇒ Correct the flight plan altitude constraint.

⇒ Change the climb or descent profile to comply with the current constraint.

Shows when the next altitude constraint cannot be cleared in the flight plan at the present rate of climb or descent. This message shows when the climb or descent is insufficient for at least 1 minute or more. Also shows that an automatic vertical direct-to has been attempted, and it cannot be performed because the required descent path exceeds the maximum VPA for the aircraft. This message does not show when the FMS is in an altitude hold mode.

▼ **CDU Message Line/MESSAGES Page:**

UNABLE TO SEQ
FPLN

(White)

PFD

MSG(White)

⇒ Change the flight plan to eliminate the conditions listed below.

Shows when any of the conditions that follow occur:

- A SID, STAR, or approach specifies that the active leg be terminated at a specified distance from a DME station, and the current flight path of the aircraft does not intercept the specified DME station.
- A SID, STAR, or approach specifies that the active leg is a heading leg, which terminates either at a specified VOR radial or when it intercepts the next leg, and the termination point is more than 50 NM from the present position of the aircraft.
- An altitude-terminated procedure leg is active and either barometric altitude is invalid, or vertical speed has been negative for at least 1 minute.



▼ **CDU Message Line/MESSAGES Page:**

VNAV SENSOR FAIL

(White)

PFD

MSG(White)

⇒ Determine which is the invalid or failed sensor, and select a reversion mode to provide valid data to the FMS.

Shows when the sensor data for VNAV functions is not available or is invalid.



▼ **CDU Message Line/MESSAGES Page:**

VNAV WARN-TAE
(White)

PFD
MSG(White)

Shows when the aircraft track angle error is greater than:

- 80% of the TAE threshold for oceanic/remote, en route, or terminal environment
- 50% of the TAE threshold for approach
- VNAV is deactivated at threshold crossing.

This message only appears if the aircraft is configured to drop VNAV in this situation.

▼ **CDU Message Line/MESSAGES Page:**

VNAV WARN-XTD
(White)

PFD
MSG(White)

Shows when the aircraft cross-track distance is greater than:

- 80% of the XTD threshold for oceanic/remote, en route, or terminal environment
- 50% of the XTD threshold for approach
- VNAV is deactivated at threshold crossing.

This message only shows if the aircraft is configured to drop VNAV in this situation.

▼ **CDU Message Line/MESSAGES Page:**

VOR DISABLED
(White)

⇒ Enable the VOR sensors on the VOR/DME CONTROL page.



Shows when the VOR navigation sensors are deselected for use by the FMS on the VOR/DME CONTROL page. This can degrade FMS navigation capability.

This message will appear on the MESSAGES page without an accompanying MSG indication on the CDU Message Line.

▼ CDU Message Line/MESSAGES Page:

VOR/DME DIS-
TANCE>40 NM
(Yellow)

PFD
MSG(Yellow)



Shows when the FMS is navigating within a terminal environment using a single collocated VOR/DME for determining position and location of the navaid is more than 40 NM from the present position.

▼ CDU Scratchpad:

VOR/DME ONLY
(White)

PFD
V/D ONLY(White)



Shows when the FMS is using a single collocated VOR/DME for determining position and the location of the navaid is less than or equal to 40 NM from the present position

▼ CDU Message Line/MESSAGES Page:

VOR/FMS DIS-
AGREE
(Yellow)

PFD
MSG(Yellow)



- ⇒ Do a position update of the FMS with data from a known good sensor.
- ⇒ Disable individual VOR/DME navaids.
- ⇒ Disable the use of all VOR/DME navaids.



Shows when the VOR/DME position estimate is different from that of the FMS. This message shows when the difference is greater than 10 NM in the en route environment, and greater than 5 NM in the terminal and approach environment. The pilot should determine whether the FMS position or the VOR signal is incorrect and determine the appropriate action, if any.

▼ **CDU Message Line/MESSAGES Page:**

VSPEEDS DESELECTED
(Yellow)

⇒ Push the SEND line select key to transmit the Vspeed values to the PFD.

PFD
MSG(Yellow)

Shows when the FMS Vspeed bugs have been removed from the PFD airspeed tape due to either of the following:

- The FMS has recomputed the corresponding takeoff or approach reference values due to a change in a required input parameter.
- The SEND line select key is pushed while the IN PROGRESS or COMPLETED message is showing.

This message is cleared automatically after 5 seconds.

▼ **CDU Message Line/MESSAGES Page:**

VSPEEDS DIS-
AGREE
(Yellow)

PFD
MSG(Yellow)

⇒ Verify the performance information on both FMSs and correct any input values that differ.

Shows when a miscompare of one or more computed Vspeed values exists and has been detected between the FMSs.



▼ **CDU Message Line/MESSAGES Page:**

VSPDS OUT OF
RANGE
(Yellow)

PFD
MSG(Yellow)

⇒ Verify the performance information on both FMSs and correct any input values that might be incorrect. If all values are correct, the FMS will not be able to calculate one or more Vspeed values.

Shows when the FMS is unable to compute at least one of the Vspeed values because one or more of the input parameters was outside of the range supported by the Vspeed database or the computed RWY WIND exceeds the maximum limit for the aircraft.



▼ **CDU Message Line/MESSAGES Page:**

XTALK FAIL
(White)

PFD
MSG(White)

Shows in a dual FMS installation when the two systems have had a communications failure and cannot operate in the SYNC mode.



CDU ANNUNCIATIONS

▼ CDU Annunciation Line:

EXEC
(White)

⇒ Verify the flight plan change, then push the EXEC function key on the CDU to execute the flight plan.

Shows at the right side of the message line anytime an active flight plan is modified, or when a new flight plan is activated. Does not show on the MESSAGES page.

▼ CDU Annunciation Line:

MSG
(White or Yellow)

PFD
MSG(White or Yellow)

⇒ Push the MSG function key to acknowledge the message and remove the MSG annunciation from the PFD.

Shows when the CDU message page contains a new or old message. Also shows on the PFD for each new message. The MSG annunciation shows on the CDU as long as there is a message on the MESSAGES page. Does not show on the MESSAGES page.

▼ CDU Annunciation Line:

OFFSET
(White)

PFD
MSG(White)

Shows when a parallel offset is in use. The message clears when the offset is terminated. Does not show on the MESSAGES page.

PILOT OPERATIONS MESSAGES

▼ CDU Scratchpad:

ALONG TRACK WPT
N/A
(White)

⇒ Check for a possible scratchpad entry error.

⇒ Make sure that the entry complies with the entry rules for pilot-entered waypoints.

Shows when an attempt to enter a place/along-track offset or place/along-track offset/name waypoint in the flight plan failed.

▼ CDU Scratchpad:

CHK SELECTED
DATA BASE
(White)

⇒ Go to the STATUS page on each CDU and make sure that the navigation database name and effective dates are the same. A new database must be loaded in one or both FMSs.

Shows in a dual installation when the effective date and active database is not the same on each FMS.

▼ CDU Scratchpad:

DATE ENTRY N/A
(White)

⇒ Refer to the appropriate aircraft flight manuals to set the DATE.

Shows when an attempt to enter a date value in the DATE location on the STATUS page failed because current conditions do not allow the clock to be reset.

▼ **CDU Scratchpad:**

DATA MISSING
(White)

⇒ Make sure all required fields for the type of search pattern are filled.

Shows when an attempt to enter an incomplete search pattern into the flight plan was made.

▼ **CDU Scratchpad:**

DISTANCE TOO
LARGE
(White)

⇒ Make sure that the correct reference waypoint and the correct distance were used.

Shows when an attempt is made to enter an along-track waypoint offset that is too large for the flight plan leg.

▼ **CDU Scratchpad:**

DME IN HOLD
(White)

⇒ Clear the HOLD mode, and then set the navigation radio to the AUTO mode.

Shows when an attempt to set the navigation radio-tuning mode to AUTO failed because the affected radio has a DME in the HOLD mode.

▼ **CDU Scratchpad:**

FMS FAULT
(White)

⇒ Report this problem to the maintenance personnel.



Shows when the FMS has detected an internal fault that prevents it from storing the database.

▼ **CDU Scratchpad:**

FPLN EDIT IN
PROGRESS
(White)

⇒ Execute the modified flight plan on the cross-side FMS, then try again.

Shows when an attempt is made to select the SYNC mode while one FMS has a flight plan edit in progress (MOD FPLN).

▼ **CDU Scratchpad:**

FPLN FULL
(White)

⇒ Delete extra waypoints/legs, or wait until there are fewer than 100 legs in the flight plan.

Shows when an attempt is made to add waypoints to a flight plan failed because the flight plan already has the maximum number (100) of legs allowed. The flight plan leg count includes legs in the DIRECT-TO HISTORY and the alternate flight plan.

▼ **CDU Scratchpad:**

INBD CRS ENTRY
N/A
(White)

Shows when an attempt is made to edit the inbound course of an active hold.

▼ **CDU Scratchpad:**

INTERSECTION>400
NM
(White)

⇒ Correct the waypoint entry and try again.

Shows when a waypoint specified by the intersection of radials from two nav aids is more than 400 NM from either of the nav aids.

▼ **CDU Scratchpad:**

INVALID DELETE
(White)

⇒ This message clears itself.

Shows when an attempt is made to delete data that cannot be deleted with the DELETE function.

▼ **CDU Scratchpad:**

INVALID DIRECT-TO
(White)

⇒ Modify the flight plan as necessary to correct the problem.

Shows when a Direct-To request cannot be complied with because any of the conditions below are true.

- The selected Direct-To waypoint is not a geographical waypoint.
- The vertical Direct-To was requested to an altitude that is above the barometric altitude of the aircraft or requires a descent path that exceeds the maximum VPA.
- There is a VECTORS leg or discontinuity between the current aircraft position and the target waypoint.

▼ **CDU Scratchpad:**

INVALID ENTRY
(White)

⇒ Correct the entry and try again.

Shows when the data entry is invalid (such as invalid format, value out of range, etc.) for the attempted data entry field.

▼ **CDU Scratchpad:**

INVALID ROUTE
(White)

⇒ Enter waypoints into a route before attempting to store the route.

Shows when an attempt is made to store a route that does not have any waypoints.

▼ **CDU Scratchpad:**

KEY NOT ACTIVE
(White)

⇒ The message clears itself.

Shows when an inactive line key or function key is pushed.

▼ **CDU Scratchpad:**

LIST FULL
(White)

⇒ Enable a GPS satellite before attempting to disable another one.

Shows when eight GPS satellites are disabled on the GPS CONTROL page and an attempt was made to disable another one. Only eight satellites can be disabled at one time.

▼ **CDU Scratchpad:**

MAG N/A
(White)

⇒ The message clears itself.

Shows when an attempt to select the MAG display mode on the FMS CONTROL page failed because of operation at extreme latitudes, either north of 73 degrees north latitude or south of 60 degrees south latitude.

▼ **CDU Scratchpad:**

N/A IN POLAR RE-
GION
(White)

⇒ The message clears itself.

Shows when an attempt to perform a disallowed edit in the polar regions of the flight plan failed. None of the items listed below that are located in a polar region can be entered:

- A hold either at a fix or at PPOS
- A reference fix (FIX INFO page)
- A reference fix for a place bearing/distance
- A place bearing/place bearing fix
- An along-track fix
- A course edit to fix
- A FROM waypoint.

▼ **CDU Scratchpad:**

NAVAID INHIBITED
(White)

⇒ Select a different navaid for the position update or enable the inhibited navaid on the VOR CONTROL page.



Shows when an attempt to specify a navaid for position update on the POS INIT page failed because the navaid is inhibited on the VOR CONTROL page.

▼ **CDU Scratchpad:**

NAVAID NOT RECEIVED
(White)

⇒ Select a different navaid for the position update.

Shows when an attempt to update position from a navaid on the POS INIT page failed because the navaid signal is invalid.

▼ **CDU Scratchpad:**

NO ENTRY ALLOWED
(White)

⇒ Select a valid entry field for the data in the scratchpad.

Shows when a line select key adjacent to a data field, is pushed, that does not allow entry of data.

▼ **CDU Scratchpad:**

NO INTERSECTION
(White)

⇒ Correct the radial entries and try again.

⇒ If the message is for an airway entry, modify the flight plan if necessary and try again.



Shows when the waypoint specified by the intersection of radials from two nav aids does not exist because the radials do not intersect, or the radial or distance does not intercept a flight plan leg. This message also shows when trying to enter an airway for which there is neither an entry or exit waypoint already in the flight plan.

▼ **CDU Scratchpad:**

NO XSIDE DATA
(White)



Shows when an attempt is made to transfer a cross-side waypoint list and there is no data in the cross-side FMS.

▼ **CDU Scratchpad:**

NO XSIDE FPLN
(White)



Shows when an attempt to transfer an empty flight plan from the cross-side FMS is made.

▼ **CDU Scratchpad:**

NOT A NAVAID
(White)



⇒ Select another VOR/DME or another sensor type to initialize or update the position.

Shows when a non-collocated VOR/DME is used to initialize position or update from a nav aid.

▼ **CDU Scratchpad:**

NOT A VOR/DME
(White)

⇒ Select another VOR/DME or another sensor type to initialize or update the position.

Shows when the station identifier entered corresponds to a navaid that is not a paired VOR/DME, which is unacceptable for initializing or updating the position.

▼ **CDU Scratchpad:**

NOT IN DATA BASE
(White)

⇒ The message clears itself.

Shows when the identifier entered in the scratchpad is not in the navigation database.

▼ **CDU Scratchpad:**

NOT ON AIRWAY
(White)

⇒ Select a waypoint that is located on the airway and try again.

Shows when an attempt to enter an exit waypoint for an airway failed because the waypoint is not part of the airway.

▼ **CDU Scratchpad:**

NOT ON GROUND
(White)

⇒ The message clears itself.

Shows when the FMS has determined that the aircraft is not on the ground and the pilot has attempted to perform one of actions that follow:

- Select an active database

- 
- Load a database from disk
 - Transfer a pilot route
 - Specify an origin airport in the active flight plan.

The above actions are not permitted while the aircraft is airborne.

▼ **CDU Scratchpad:**

PILOT WPT LIST
FULL
(White)

⇒ To enter another pilot-defined waypoint, first delete one from the current flight plan or the pilot waypoint database.

Shows when an attempt is made to enter a pilot-defined waypoint into the flight plan and there are already 50 pilot-defined waypoints in the flight plan. This message also shows when trying to store a waypoint in the pilot waypoint database, and the total number of waypoints in the database is at the limit of 100 waypoints.

▼ **CDU Scratchpad:**

QUAD/RADIAL EN-
TRY N/A
(White)

⇒ The message clears itself.

Cannot edit the QUAD/RADIAL of an active hold.

▼ **CDU Scratchpad:**

RADIO IS NAV
SOURCE
(White)

⇒ Set the navigation source to FMS and try again.

Shows when an attempt is made to set the navigation radio tuning mode to AUTO when the affected radio is the navigation source.

▼ **CDU Scratchpad:**

ROUTE LIST FULL
(White)

⇒ Delete a route to make room for the new route and try again to store it.

Shows when 100 routes have been stored in the FMS route database, or there is not enough memory to store this route.

▼ **CDU Scratchpad:**

SEND N/A – NOT IN
SYNC
(White)

⇒ Go to the FMS CONTROL page and select SYNC mode, then reselect the SEND command.

Shows when the crew has attempted to send Vs speeds to the PFD when the FMS is in the INDEP mode and current conditions will allow the FMS to be put into SYNC mode.

▼ **CDU Scratchpad:**

SYNC N/A
(White)

⇒ On the STATUS page, make sure that the PROGRAM names in both FMSs are the same. If they are not the same, then the appropriate programs must be installed in the FMSs. If they are the same, there is a cross talk communications failure between the FMSs.

Shows when an attempt to select the SYNC mode failed because the two software programs in the FMSs are different, or cross-talk communication between the two FMSs is unavailable.

▼ **CDU Scratchpad:**

SYSTEM NOT AVAIL-
ABLE
(White)

⇒ The message clears itself.

Shows when an attempt is made to select an MCDU function and the associated system is not available to the FMS.

▼ **CDU Scratchpad:**

TIME ENTRY N/A
(White)

⇒ Refer to the appropriate aircraft flight manuals to set the TIME for the aircraft clock.

Shows when an attempt to change the UTC time on the STATUS page failed because an external clock source is in use.

▼ **CDU Scratchpad:**

TOO MANY HOLDS
(White)

⇒ Delete a previous hold from the flight plan to make room to add a new one.

Shows when an attempt to enter a hold into a flight plan failed because the flight plan already has the maximum number of holds allowed. Only six holds are allowed in a flight plan, which includes the Direct-To history.

▼ **CDU Scratchpad:**

TUNING NOT AVAIL
(White)

⇒ Set the reversion modes so that this FMS is not in stand-alone mode and try again.

Shows in a triple FMS installation when the FMS being used is in stand-alone operating mode (reverted out), and an attempt is made to tune a radio from the TUNE page.

▼ **CDU Scratchpad:**

WPT NOT MATCHED
(White)

⇒ Correct the scratchpad entry and try again.

Shows when an attempt to enter a place/along-track offset waypoint at a location in the flight plan failed because the waypoint identifiers in the flight plan and scratchpad did not match.

▼ CDU Scratchpad:

XSIDE EDIT IN
PROGRESS
(White)

⇒ Cancel or execute the modification on the other CDU to allow edits from this CDU.

Shows when an attempt to edit an active flight plan failed, because the other CDU is already in the MOD mode. Only one CDU at a time is allowed to edit the active flight plan when either FMS is set to the SYNC mode.

▼ CDU Scratchpad:

XSIDE STORE FAIL
(White)

Show when an attempt is made to store a waypoint on the same-side FMS while in the SYNC mode, and the cross-side FMS could not store the data. This can occur if the database on the cross-side FMS is full, but the same-side FMS database is not, or when the cross-side database contains an identically named item that is not in the same-side database.

▼ CDU Scratchpad:

XTALK BUS FAILURE
(White)

Shows when the cross-talk bus is invalid and an attempt is made to change the cross-side navigation radio tuning mode from manual to automatic.

DBU AND MAINTENANCE OPERATIONS MESSAGES

▼ CDU Scratchpad:

DBU NOT RE-
SPONDING
(White)

⇒ Cancel the operation.

Shows when the DBU is not responding to commands from the FMS.

▼ CDU Scratchpad:

DISK CHANGED
DURING REQ
(White)

⇒ Cancel the operation or reinsert the previous disk.

Shows when the disk is changed before the last command is completed.

▼ CDU Scratchpad:

DISK DRIVE COLD
(White)

⇒ Wait until the disk drive warms up above 0 °F and try again.

Shows when the disk drive indicates it is too cold to operate. The drive must be above 0 °F to operate.

▼ CDU Scratchpad:

DISK DRIVE NOT
READY
(White)

⇒ Insert the disk and try the procedure again.

Shows when no diskette is inserted in the disk drive.

▼ **CDU Scratchpad:**

DISK ERROR
(White)

⇒ Try the procedure again.

Shows when the disk drive detected an error while reading or writing to the disk.

▼ **CDU Scratchpad:**

DISK UNFORMAT-
TED
(White)

⇒ Format the disk and try again.

Shows when the disk inserted in the DBU is not formatted.

▼ **CDU Scratchpad:**

DISK WRITE PRO-
TECTED
(White)

⇒ Set the tab on the disk to the unprotected position and try again.

Shows when an attempt is made to write data to the disk in the DBU and the write protection tab on the disk is set to the protect position.

▼ **CDU Scratchpad:**

FILE NOT
DELETABLE
(White)

Shows when an attempt is made to delete a file that cannot be deleted.

▼ **CDU Scratchpad:**

FILE NOT FOUND
(White)

⇒ Cancel the operation or make sure the correct disk is inserted and try again.



Shows when the disk in the DBU does not contain the file requested by the FMS.

▼ **CDU Scratchpad:**

FILE TRANSFER
ERROR
(White)

⇒ Cancel the operation or try again.

Shows when an error occurred while transferring data between the FMS and the DBU.

▼ **CDU Scratchpad:**

FMS LOAD ERROR
(White)

⇒ Cancel the operation and try again.

Shows when the FMS has detected an error in storing the disk data.

▼ **CDU Scratchpad:**

FMS NOT RE-
SPONDING
(White)

⇒ Cancel the operation and try again.

Shows when the FMS is not responding to the DBU.

▼ **CDU Scratchpad:**

FMS MEMORY FULL
(White)

⇒ Cancel the operation.

Shows when the FMS does not have enough memory to load the requested data from the disk.

▼ **CDU Scratchpad:**

INSUFFICIENT DISK
SPACE
(White)

⇒ Try a new or larger capacity disk, or
cancel the operation.

Shows when the memory available
on the disk does not meet the amount
needed to write the complete list of
routes or waypoints to the disk.

▼ **CDU Scratchpad:**

NO LOADABLE
FILES
(White)

⇒ Insert the correct disk and try again.

Shows when the diskette in the DBU
does not contain any loadable files.

▼ **CDU Scratchpad:**

NO SAVABLE FILES
(White)

Shows when a request is made for
the FMS to store data to a diskette.
However, there is no data available for
storage.

▼ **CDU Scratchpad:**

OTHER LRU USING
DBU
(White)

⇒ Discontinue the use of the other
device and try again.

Show when the DBU is in use by another
device.

▼ **CDU Scratchpad:**

POWER INTERRUPT
DETECTED
(White)

⇒ Cancel or continue the operation as necessary.

Shows when a momentary loss of power has been detected during DBU operations.

▼ **CDU Scratchpad:**

WRONG DISK
(White)

⇒ Insert the correct disk and continue the database load.

Shows when a diskette that is different from the requested disk was inserted in the DBU while loading a navigation database.

PFD MESSAGES

▼ PFD Top Annunciation Line:

APPR
(Green)

Shows when the lateral and vertical deviation shown on the PFD is set to the approach sensitivity level and RNAV approach is active.

▼ PFD Top Annunciation Line:

CHK POS
(Yellow)

Shows the calculated FMS position does not meet the accuracy requirements for the current phase of flight.

▼ PFD Top Annunciation Line:

FMS DR
(White)

Shows when the FMS is in dead reckoning mode with the aircraft on the ground or airborne for less than 2 minutes.

▼ PFD Top Annunciation Line:

FMS DR
(Yellow)

Shows when the FMS is in dead reckoning mode with the aircraft airborne for more than 2 minutes.

▼ PFD Top Annunciation Line:

GPS APPR
(Green)

Shows when the lateral and vertical deviation is set to the approach sensitivity level and a GPS approach is active.

▼ PFD Top Annunciation Line:

GPS ONLY
(White)

Shows when the FMS position is determined from GPS sensor data only.

▼ PFD Top Annunciation Line:

NO APPR
(White)

Shows when the FMS guidance for the approach is not approved or the approach had been disabled. When this annunciation shows on the display, the lateral deviation scaling reverts to the terminal environment sensitivity level.

▼ PFD Top Annunciation Line:

NO APPR
(Yellow)

Shows during final approach, when the required navigation accuracy to complete the approach is lost.

▼ PFD Top Annunciation Line:

SEQ INHB
(White)

Shows when the SEQUENCE mode is set to INHIBIT on the LEGS page and the aircraft is on the FROM side of the active waypoint. Setting SEQUENCE to AUTO on the LEGS page removes this annunciation.

▼ PFD Top Annunciation Line:

TERM
(White)

Shows when the lateral and vertical deviations are set to the terminal sensitivity levels.

▼ PFD Bottom Annunciation Line:

ALT (Yellow)	Shows when the rate of climb or descent is less than what is required to make the next altitude constraint specified in the flight plan.

▼ PFD Bottom Annunciation Line:

BOC (White)	Shows when the aircraft is within 1 minute of a bottom of climb altitude change. When the aircraft is within 5 seconds of the change, the annunciation begins to flash. The annunciation turns off after the aircraft passes the BOC point.

▼ PFD Bottom Annunciation Line:

HOLD (White)	Shows when a holding pattern is active.

▼ PFD Bottom Annunciation Line:

MSG (White)	Shows when there is a white message on the CDU MESSAGES page.

▼ PFD Bottom Annunciation Line:

MSG (Yellow)	Shows when there is a yellow message on the CDU MESSAGES page.

▼ **PFD Bottom Annunciation Line:**

OFST
(White)

Shows when a flight plan parallel offset is in effect.



▼ **PFD Bottom Annunciation Line:**

SPD
(Yellow)

Shows when the current aircraft speed is 20 knots or greater than the target speed and VNAV is selected. It also shows when the aircraft is within 2 minutes of reaching a hold and the aircraft speed is 10 knots or greater than the recommended maximum holding speed and VNAV is not selected or not available.



▼ **PFD Bottom Annunciation Line:**

TOD
(White)

Shows when the aircraft is within 1 minute of a top of descent altitude change. When the aircraft is within 5 seconds of the change, the annunciation begins to flash. The annunciation turns off after the aircraft passes the TOD point.



▼ **PFD Message Line:**

DISCONTINUITY
(White)

- ⇒ Delete the discontinuity.
- ⇒ Sequence past the discontinuity if it cannot be deleted.

Shows in the middle of the HSI displays when the active leg of the flight plan is a discontinuity.

▼ PFD Message Line:

NO FLIGHT PLAN
(White)

⇒ Enter and execute a flight plan.

⇒ Select a navigation source other than FMS.

Shows in the middle of the HSI display when FMS is selected as the navigation source and there is no flight plan entered into the FMS.

MFD MESSAGES

▼ MFD Message Line:

CHK POS
(Yellow)

⇒ Verify all sensors are enabled for use by the FMS.

⇒ Perform a position update if an accurate position can be determined by one of the navigation sensors.

Shows when the FMS position estimate does not meet the accuracy required for the current phase of flight.

▼ MFD Message Line:

FMS NAV INVALID
(Yellow)

⇒ Check the NAV sensors to be sure they are enabled.

⇒ Check for an attitude sensor failure.

Shows when the aircraft is airborne and the FMS does not have a valid airspeed or heading.

▼ MFD Message Line:

FMS NAV INVALID
(White)

⇒ Check the NAV sensors to be sure they are enabled.

⇒ Check for an attitude sensor failure.

Shows when the aircraft is on the ground and the FMS does not have a valid source for heading.

▼ **MFD Message Line:**

FMS DR
(White)

- ⇒ Make sure VOR/DME and GPS sensors are enabled.
 - ⇒ Make sure AUTO tuning mode is selected on the TUNING page.
 - ⇒ Do a position update of the FMS with data from a known good sensor.
- Shows when the FMS is in dead reckoning mode with the aircraft on the ground or airborne for less than 2 minutes.

▼ **MFD Message Line:**

FMS DR
(Yellow)

- ⇒ Make sure navigation sensors are enabled.
 - ⇒ Do a position update of the FMS with data from a known good sensor.
- Shows when the FMS is in dead reckoning mode and the aircraft has been airborne for longer than 2 minutes.

▼ **MFD Message Line:**

DR EXCEEDS 5 MIN
(Yellow)

Shows when the FMS has been in DR mode for 5 minutes or longer.

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TAKEOFF & APPROACH PERFORMANCE (VSPEEDS)

INTRODUCTION

The takeoff and approach performance function provides an electronic search capability and display of Vs speeds, weight limits, and runway length requirements, all based on data from the Original Equipment Manufacturer (OEM) airframe design. The FMS not only provides the information in a format similar to the printed data in the aircraft manual, but also automates the process of referencing the appropriate tables, interpolating the data, and applying correction factors.

The FMS bases the performance computations for Takeoff and Approach Reference Vs speeds upon performance data extracted from the Aircraft Flight Manual (AFM). In some instances, there are more combinations of aircraft configurations available than are covered by published AFM performance charts. In addition, AFM performance charts that depict Takeoff and Approach Reference Vs speed performance data are designed over defined ranges of input variables. Inputs outside of those defined ranges can result in failure of the FMS to calculate some or all the Vs speeds.

When the FMS is unable to calculate a Takeoff or Approach Reference Vs speed performance value due to an unsupported aircraft system configuration or an out-of-range input variable, a yellow question mark shows in place of the numerical value. Once the conflicting aircraft system or out-of-range input variable has been corrected, the associated computed output performance parameter returns to normal color, and the numeric value replaces the yellow question mark.

The takeoff and approach performance function is divided into two sets of CDU and MFD pages: one set for takeoff references (TAKEOFF REF) and one set for approach and landing references (APPROACH REF). The format for display of the information is essentially the same for both sets of pages, with common variables (for example, gross weight), shown in the same location.

To get access to the takeoff and approach performance pages, push the PERF function key on the CDU to show the PERF MENU page. The available takeoff and approach performance functions include:

- **TAKEOFF** — Five pages to show and set the inputs for calculation of takeoff data. Inputs include airport information, runway and meteorological conditions, aircraft configuration data and weight, and weight limits.
- **APPROACH** — Five pages to show and set the inputs for calculation of approach and landing data. Inputs include airport selection and information, runway and meteorological conditions, aircraft configuration data and weight, and weight limits.

**NOTE**

After a long power interrupt (longer than 2 minutes), the Vspeed feature will clear the OAT and WIND values. As a result, the Vspeed numbers will go away since OAT is necessary for them to be calculated. The RWY WIND (headwind/tailwind and crosswind component) will also go away since WIND is required for its calculation. For short power interrupts (less than or equal to 2 minutes), the Vspeed feature will retain the previous values for OAT and WIND, and the Vspeed calculations will remain unchanged.

TAKEOFF REFERENCE DISPLAYS

Push the TAKEOFF line select key on the PERF MENU (or the PERF INIT) page to show the TAKEOFF REF pages. It can require multiple pushes of the PERF function key to show the PERF MENU page. Push the TAKEOFF line select key to display one of five TAKEOFF REF pages, then push the NEXT and PREV function keys as necessary to select other pages. The TAKEOFF REF pages show:

- Origin airport
- Runway (RWY) ID, RWY WIND (headwind/tailwind and crosswind component), RWY LENGTH, RWY SLOPE, and RWY CONDitions
- WIND, Outside Air Temperature (OAT), Barometric correction (QNH), and Pressure Altitude (P ALT)
- Automatic Power Reserve (APR), Nacelle Anti-Ice (NAC A/I), Surface De-Ice (DE-ICE), Ground Air Brake (GROUND A/B) configurations
- Center of Gravity (CG) and TRIM, Takeoff Flaps (T/O FLAPS), Takeoff Weight (TOW), Gross Weight (GWT), and Maximum Takeoff Weight (MTOW)
- Balanced Field Length (BFL) and Runway length

- Takeoff Vspeeds: V_1 — Decision Speed, V_R — Rotation Speed, V_2 — Takeoff Safety Speed, and V_{FTO} — Final Takeoff Climb Speed
- A line key selection to transmit Takeoff Reference Vspeeds to the PFD (SEND)
- Obstacle height (OBST HT) and distance (OBST DIST) as part of the climb performance calculator
- Second Climb Gradient (2ND CLB GRAD), Final Climb Gradient (FNL CLB GRAD), and Required Climb Gradient (REQ CLB GRAD) values
- Obstacle Clearance Weight Limit (OBST CLEARANCE WT LIMIT)
- Structural, climb performance, runway length, and brake energy weight limits.

The ORIGIN airport cannot be changed on the TAKEOFF REF pages since it is defined in the flight plan. If a runway was defined on the DEPART page, RWY ID and RWY LENGTH data is prefilled on the TAKEOFF REF 1/5 page for the designated runway. If the RWY ID field contains an entry when wind data is entered, the FMS computes and shows the RWY WIND. RWY LENGTH accepts manual entry on the TAKEOFF REF 1/5 page. But manual entry of RWY LENGTH deletes a prefilled RWY ID and removes RWY WIND and RWY SLOPE values.

The list that follows shows which inputs can be entered manually and their acceptable formats. For any data field with a designator (for example, F/M (Feet or Meters), I/H (Inches or Hectopascals), U/D (Up or Down), C/F (Celsius or Fahrenheit)), the designator can precede or follow the numerical entry.

NOTE



For some data entry fields on the TAKEOFF REF pages, if nothing is entered into dashed data fields, the FMS uses a zero correction factor. The applicable data fields are: RWY WIND (headwind/tailwind and crosswind component), RWY SLOPE, and WIND (direction/velocity).

- RWY ID — RW09, RW19R, RW02L, RW13C (RWY ID is usually pre-filled with identifier of the flight plan departure runway, but it also accepts manual entry for any runway associated with the flight plan Origin airport.)

**NOTE**

Manual entry of RWY ID on the TAKEOFF REF pages applies to the TAKEOFF REF pages only. It does not alter the departure runway on the Active Flight Plan (ACT FPLN) or the RWY ID on the APPROACH REF pages when the ORIGIN airport is selected for the approach.

- RWY WIND — (Headwind: H or +, Tailwind: T or -) H12, 9H, +10, T8, 6T, -10
- RWY LENGTH — Feet (F – default) or Meters (M)
- RWY SLOPE —.5, 1.2U, U1.0, .5D, -1.2, D1.0 (Up: U, Down: D or –)
- WIND — 090/12, 050M/08, 035T/12 (MAG – default)
- OAT — 11, -05, C10, 25C, 25F, F-13 (C - default)
- QNH — Inches (I – default) or Hectopascals (H)
- P ALT — Feet
- CG — Two digits
- TOW — Five digits (for example, 26,100) in pounds or KG (for example, 11,838)
- RW length — Feet (F) or Meters (M)
- OBST HT and DIST — Feet (F - default) or Meters (M) (OBST HT and DIST are measured from reference zero)
- REQ CLB GRAD — FT/NM or %, with units defined on the DEFAULTS 5/5 page.

In the event BFL exceeds the available runway length, the available runway length shows in yellow on the TAKEOFF REF pages, and the message CHECK TAKEOFF PERF shows on the CDU. In addition, the RWY ID shows in yellow on the TAKEOFF REF 1/5 page.

In the event that the FMS computed Required Climb Gradient (REQ CLB GRAD) value (or a manually entered REQ CLB GRAD value) exceeds the Final Climb Gradient value, the FNL CLB GRAD value shows in yellow and the message CHECK TAKEOFF PERF is annunciated in yellow.

In the event TOW exceeds MTOW, MTOW shows in yellow, and the message CHECK TAKEOFF PERF is annunciated on the CDU.



NOTE

On the TAKEOFF REF 4/5 page, if MTOW is exceeded, the page displays OVER and a numeric value that represents the difference between TOW and MTOW to indicate the amount the aircraft is over weight.



NOTE

Aircraft configuration settings (APR, NAC A/I, DE-ICE, and GROUND A/B) on the TAKEOFF REF 2/5 page represent the planned settings for the takeoff and do not represent the actual/sensed aircraft configuration.

There is a minimum set of inputs, if entered and available, that are sufficient for the Takeoff Reference Vspeed values to be computed and shown as V_1 , V_R , V_2 , and V_{FTO} . The minimum set of inputs necessary for Takeoff Reference Vspeed computations to be performed are:

- RWY LENGTH
- OAT (outside air temperature)
- P ALT (airport pressure altitude)
- TOW (takeoff weight).

Once these four required input parameters have been specified on the TAKEOFF REF pages, Takeoff Reference Vspeed values will be computed and shown as V_1 , V_R , V_2 , and V_{FTO} . (This assumes that valid QNH barometric correction is available from the avionics system if airport P ALT is provided by the FMS database rather than manually entered by the pilot).

In addition, for the computed TAKEOFF REF Vsports to be accurate and correct for the operating conditions, the flight crew must also enter:

- Airport WIND (magnitude/direction) or RWY WIND component
- RWY SLOPE
- RWY COND
- T/O FLAPS (20/12/0)
- APR (ARM/OFF) Condition
- NAC A/I (OFF/ON) Condition
- DE-ICE (OFF/ON) Condition
- GROUND A/B (ARM/INOP/MAN) Condition

- Appropriate Obstacle Clearance data (OBST HT and OBST DIST or REQ CLB GRAD).

Once the required inputs have been entered, the FMS calculates and shows the takeoff speeds.

The Takeoff Reference Vspeed performance computations are based upon performance data extracted from the aircraft AFM. In some instances, there are more combinations of aircraft configurations available than are covered by published AFM performance charts. In addition, AFM performance charts depicting TAKEOFF REF Vspeed performance data are prescribed over defined ranges of input variables.

In the event the FMS is unable to calculate a Takeoff Reference Vspeeds performance value due to an unsupported aircraft system configuration or an out-of-range input variable, the computed output performance parameter will be identified with a yellow question mark in place of a numerical value and the message VSPD OUT OF RANGE is annunciated on the CDU. Once the conflicting aircraft system or (out of range) input variable has been corrected, the associated computed output performance parameter will return to normal color, and the numeric value will replace the yellow question mark.

The FMS is required to be on the ground and operating in SYNC mode to transmit Takeoff Reference Vspeeds to the PFD (not applicable to single FMS systems, except when the system is strapped for single FMS and in INDEP mode). Pushing the SEND line select key on the TAKEOFF REF 3/5 page in a system that is operating in the INDEPENDENT mode causes the Takeoff Reference Vspeeds to not be sent to the PFD, and the message SEND N/A – NOT IN SYNC shows on the CDU. If the FMS is operating in INDEPENDENT mode, it is necessary to select SYNC mode on the FMS CONTROL page and select an FMS Sync Master.

Pushing the SEND line select key on the TAKEOFF REF 3/5 page sends the FMS-computed Takeoff Reference Vspeeds to the PFD airspeed display. The FMS must be operating in SYNC mode for the FMS-computed Vspeeds to be posted on the PFD. If no status message shows on the line immediately above the SEND line select option when the key is pushed, the FMS transmits the Vspeeds to the avionics system to show on the PFD. The message IN PROGRESS shows above the SEND selection while the FMS sends the Takeoff Reference Vspeeds to the PFD.

After the FMS has transmitted the Takeoff Reference Vspeeds to the PFD, the FMS performs an echo test of each value to verify the information sent to the PFD matches the values that show on the TAKEOFF REF 3/5 page. If each value matches, the message COMPLETE shows above the SEND line select option. If any one value fails the echo test, the message FAILED shows in yellow.

Once Takeoff Reference Vspeeds are selected for display on the PFD, all values are latched. While the aircraft remains on the ground, a change to any of the inputs used to determine Takeoff Reference Vspeeds (for example, TOW) removes the FMS-sourced takeoff Vspeeds from view on the PFD, and generates the CDU message VSPEEDS DESELECTED in yellow.

The table that follows shows which inputs can be directly changed on the TAKEOFF REF pages, and which inputs cause the VSPEEDS DESELECTED message to show on the CDU if they are changed after FMS-computed Takeoff Vspeeds have been posted on the PFD.

DATA INPUT	MSG SHOWS	DATA INPUT	MSG SHOWS
RWY ID	YES	NAC A/I	YES
RWY WIND	YES	DE-ICE	YES
RWY LENGTH	YES	GROUND A/B	YES
RWY SLOPE	YES	CG/TRIM	YES
RWY COND	YES	T/O FLAPS	YES
WIND	YES	TOW	YES
OAT	YES	OBST HT	YES
QNH	YES	OBST DIST	YES
P ALT	YES	REQ CLB GRAD	YES
APR	YES		

**NOTE**

Performing an FMS SYNC operation causes the VSPEEDS DESELECTED message to momentarily show as a CDU message, regardless of whether Takeoff Reference or Approach Reference Vspeeds have been posted on the PFD.

Takeoff Weight (TOW) is synchronized on the TAKEOFF REF pages, and can be modified as needed. Maximum Takeoff Weight (MTOW) is based upon the structural limits of the aircraft, climb performance limit, runway length limit, and brake energy limit.

Aircraft configuration settings and display unit formats can be changed on the DEFAULTS 5/5 page. Aircraft configuration settings changed on the DEFAULTS 5/5 page take effect as default selections the next time a flight plan is created.

The default selections do not change an existing flight plan. Format changes made on DEFAULTS page, cause an immediate change in the corresponding selections on the TAKEOFF REF and APPROACH REF pages. Selected items/options show in large green font, and the non-selected items/options show in small white font.

**NOTE**

FMS TAKEOFF REF Vsports input values need to be reconfirmed by the pilot following any FMS SYNC operation or FMS cold start.

TAKEOFF REFERENCE OPERATION

Push the PERF function key on the CDU to show the PERF MENU page. Push the TAKEOFF line select key to show one of five TAKEOFF REF pages, then push the NEXT and PREV function keys as necessary to select other pages. The TAKEOFF REF pages can also be accessed through the TAKEOFF line key selection on the PERF INIT 1/3 page.

Information provided on the TAKEOFF REF pages is based on the ACT FPLN only. The ORIGIN airport and departure runway should be entered in the ACT FPLN to get access to all the functions available on the TAKEOFF REF pages. The ORIGIN airport identifier shows in white at the top left side of each of the pages. If the ORIGIN airport is changed, any data entered manually into the available data fields is cleared, any selections made manually are returned to their default selections, and the TAKEOFF REF pages are reset to their default values and default settings.

If the departure runway to the ORIGIN airport has not been entered in the ACT FPLN, the TAKEOFF REF pages is not initially prefilled with RWY ID, RWY WIND, and RWY LENGTH values. Data can be entered manually on the TAKEOFF REF pages for the RWY ID, RWY WIND, and RWY LENGTH. RWY SLOPE can be entered on the TAKEOFF REF pages, and is always specified through manual entry. When manually entering RWY ID into the TAKEOFF REF 1/5 page, only runway identifiers associated with the flight plan ORIGIN airport are accepted.

Information provided on the TAKEOFF REF pages uses aircraft gross weight. Gross weight must be initialized and available on the PERF INIT 1/3 page to accommodate the operation of the Takeoff Reference functions.

On all TAKEOFF REF pages, FMS-computed values in the data fields show in small white font. Manual entries show in large white font. Must-enter boxes (□ □ □) in a data field indicate a required entry.

The DEFAULTS 5/5 page provides the Vspeed Takeoff Reference default settings for aircraft configuration at takeoff. Available configuration takeoff configuration settings include: T/O FLAPS, APR, NAC A/I, DE-ICE, GROUND A/B, and ANTI-SKID. When these selections are changed on the DEFAULTS 5/5 page, they take effect as initial conditions the next time the flight plan is built. Selections for display of Landing Length (LDG LENGTH) and Climb Gradient (CLB GRAD) are also available. CLB GRAD represents a scaling selection for output computations on the Takeoff Reference pages. When CLB

GRAD selection is changed on the DEFAULTS 5/5 page, the change takes place immediately on the Takeoff Reference pages.

**NOTE**

Settings for aircraft configuration on the DEFAULTS and TAKEOFF REF pages represent the planned aircraft configuration for takeoff and do not reflect the actual/sensed status of these aircraft systems.

TAKEOFF REF 1/5 PAGE

The TAKEOFF REF 1/5 page shows the departure runway information and the ambient weather conditions used for determining Vs speeds (V_1 , V_R , V_2 , V_{FTO}). This information is also used to determine Maximum Takeoff Weight (MTOW) and Balanced Field Length (BFL). The information provided on the TAKEOFF REF pages is defined with respect to the ACT FPLN only.

Figure 16-1 TAKEOFF REF 1/5 Page



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TAKEOFF AIRPORT

The ORIGIN airport identifier of the ACT FPLN shows on the title line on each TAKEOFF REF page. If the ACT FPLN does not have an ORIGIN airport specified, the takeoff airport identifier data field is blank on the TAKEOFF REF pages. Manual entry of the Takeoff airport identifier is

not supported on the TAKEOFF REF pages, but must be defined on the ACT FPLN page ORIGIN airport data field. All TAKEOFF REF pages return to the default data information whenever the ORIGIN airport is changed in the ACT FPLN.

RWY ID

The Runway Identifier (RWY ID) data field shows the selected departure runway, when a departure runway has been entered into the ACT FPLN. The runway identifier field can be entered manually on the TAKEOFF REF 1/5 page. Manually entered runway identifiers are only accepted if they correspond to runways that are associated with the flight plan ORIGIN airport. Dashes show for the runway identifier on the TAKEOFF REF pages if no departure runway identifier has been entered.

When manually entering a runway identifier, the formats used to successfully retrieve runway data from the FMS database are restrictive. The suggested format is RW##Y as follows:

- RW is a required two letter identifier that indicates runway information.
- ## is a two digit runway number in the range 01 to 36.
- Y is the location character L, C, or R (representing left, center, or right runway) when more than one runway with the same number is available (for example, RW19R and RW19L).

Entry of other runway identifier formats, for example, RW### with a three-digit runway number (RW018) or RW#Y with a single digit runway number (RW3R), should not be expected to successfully retrieve runway data from the FMS database.

The FMS format checks the entry for runway identifier. If the initial two characters of an entered runway identifier are not RW, the entry is rejected. If the third character of a runway identifier is not a number, the entry is rejected. If the final character of a runway identifier is an alphabetical character, the character must be L, C, or R. Otherwise, the runway identifier is rejected. If the entered runway identifier fails any of the format checks described, it is rejected and the message INVALID ENTRY shows.

The entry of a runway identifier must also be a runway in the database for the airport specified, stored under the same identifier format. If it is not in the database, the entry is rejected and the message NOT IN DATA BASE shows.

Deleting a manually entered RWY ID causes the RWY ID to revert to the flight plan runway (if one is specified), or dashes if the departure runway is unspecified in the flight plan. If the RWY ID has been prefilled from the flight plan departure runway, an attempt to delete a RWY ID on the TAKEOFF REF 1/5 page causes the message INVALID DELETE to show.

RWY WIND

The Runway Wind (RWY WIND) data field shows the headwind/tailwind and crosswind components used to calculate the takeoff performance. When a departure runway has been identified, the headwind/tailwind and crosswind components are computed and shown at the time the wind direction and velocity are entered on the TAKEOFF REF 1/5 page.

Dashes show as the default value in the RWY WIND field after initialization. The dashes identify the RWY WIND data field as an optional pilot entry, and are interpreted as a zero wind correction factor in the takeoff performance calculations.

Manual entry or overwrite capability of the headwind or tailwind component is also provided on the TAKEOFF REF 1/5 page. When entered manually a positive wind (or headwind) entry can be preceded by a plus sign (+), preceded or followed by an H, or have no direction indication. A negative wind (or tailwind) entry must be preceded by a minus sign (–), or preceded or followed by a T.

The crosswind component cannot be entered manually. The crosswind component display is removed whenever a headwind or tailwind value is entered manually. An FMS-computed headwind/tailwind and crosswind does not overwrite a manually entered headwind or tailwind. The manually entered wind values show in large font. FMS-computed wind values show in small font.

If the RWY ID is the same on the TAKEOFF REF 1/5 page and APPROACH REF 1/5 page for the ORIGIN airport, a manual update to RWY WIND on the TAKEOFF REF 1/5 page updates the RWY WIND on the APPROACH REF 1/5 page. This includes cases where the RWY ID is not specified and dashes show on both TAKEOFF REF and APPROACH REF pages.

Similarly, under these conditions, deletion of a manually entered RWY WIND on the TAKEOFF REF 1/5 page causes a corresponding deletion of RWY WIND on the APPROACH REF 1/5 page and vice versa. No

synchronization occurs between the manual entry of RWY WIND on the TAKEOFF REF 1/5 page and APPROACH REF 1/5 page if the RWY ID on the two pages differ. No synchronization occurs between the manual entry of RWY WIND on the TAKEOFF REF 1/5 page and the RWY WIND that shows on the APPROACH REF 1/5 page for the Destination (DEST) airport.

Headwind values greater than 20 knots can be entered/calculated on TAKEOFF REF 1/5 page. In the case of a headwind component greater than 20 knots, it must be noted that a value of 20 knots is used for the Takeoff Vspeed calculations per the AFM.

If a manually entered headwind or tailwind component is deleted, the manual wind value is replaced with the FMS-computed headwind/tailwind and crosswind components, when available. If the computed wind components are not available (WIND direction/velocity or Takeoff runway is unspecified), deleting the manual headwind or tailwind causes the RWY WIND data field to show dashes. If either FMS-computed headwind/tailwind and crosswind components or dashes show for RWY WIND, attempting a DELETE command on the RWY WIND line causes the scratchpad message INVALID DELETE to show.

If either FMS-computed headwind/tailwind and crosswind components or dashes show for runway wind, attempting to perform a DELETE command on the RWY WIND line causes the scratchpad message INVALID DELETE to show.

The RWY WIND data (either computed or manually entered) is removed if a manual RWY LENGTH is entered.

If the computed crosswind component exceeds the maximum demonstrated crosswind component for the aircraft, as specified in the Vspeeds database, the CDU message CHECK TAKEOFF PERF shows in amber and the computed crosswind component shows in amber.

Manual entry of a RWY WIND component (headwind or tailwind) does not remove the value of airport WIND (direction/velocity) that shows.

Computation of Takeoff Reference Vspeeds is based on the RWY WIND that shows on the TAKEOFF REF 1/5 page, whether the RWY WIND value has been computed by the FMS based on the WIND (direction/velocity) entry or if the value has been manually entered directly into the RWY WIND field as a headwind or tail component.

RWY LENGTH

The Runway Length (RWY LENGTH) data field shows the runway length used in takeoff performance calculations. When the ACT FPLN specifies a departure runway, the value that shows is the runway length retrieved from the navigation database. If the departure runway is not specified in the ACT FPLN, must-enter boxes show in the RWY LENGTH data field to indicate a required pilot entry. Manual entry of RWY LENGTH can be done on the TAKEOFF REF 1/5 page. In addition, the prefilled departure RWY LENGTH can be overwritten to allow the pilot to enter an adjusted value. A manually entered RWY LENGTH value shows in large white font while a database value shows in small white font.

The RWY LENGTH can show as default in feet or optional meters. A numerical entry preceded or followed with an F or M, or without units is an allowable entry. A numerical entry without units is interpreted as the same units that currently show. Deletion of an entered value returns the RWY LENGTH display to the default setting or database value, whichever is applicable.

RWY SLOPE

Runway Slope (RWY SLOPE) is used in the takeoff performance calculations. A Runway Slope value must be manually entered for the FMS to use a RWY SLOPE correction. Otherwise, the FMS will use a zero correction factor for RWY SLOPE. Dashes show as the default value in this field after initialization. Dashes represent an optional pilot entry for RWY SLOPE and are interpreted as a zero slope correction factor in the takeoff performance calculations. A positive slope or UP entry can be preceded or followed by a U. A negative or DOWN entry requires a D preceded or followed by the numerical value or a minus sign followed by the numerical value.

RWY COND

The Runway Condition (RWY COND) data field represents the Runway Condition selected for use in takeoff performance computations. The selected Runway Condition shows in large green font, while the other options show in small white font. Alternate runway conditions can be selected by pushing the RWY COND line select key, and cycling through the available options (DRY/WET).

The default state for RWY COND on the TAKEOFF REF page is DRY. When manual selection of RWY COND is performed on the TAKEOFF REF page from the available menu, the selection applies to the current flight plan. An FMS cold start or creation of a new flight plan causes the RWY COND selection to return to the default selection.

WIND

The WIND data field shows wind direction and velocity. Dashes show as the default value in this field after initialization. Dashes represent an optional pilot entry for WIND (direction/velocity) and are interpreted as a zero wind. The wind direction can be referenced to either magnetic (M), the default, or true (T) north.

If the manually entered WIND direction is not within the range 000 to 360, the scratchpad message INVALID ENTRY shows. Likewise, if the WIND velocity is not within the range specified by the Vspeed data base, the message INVALID ENTRY shows.

WIND direction and velocity can be entered together (for example, 200/25) or individually (for example, 200 or /25). WIND direction can be referenced to either magnetic (M) or true (T) north by preceding or following the wind direction with the corresponding letter. The default direction reference is magnetic. A wind direction entry without units is interpreted to be in the same units that are currently shown.

When WIND direction and velocity are entered and the departure runway is defined, the FMS computes and shows the corresponding headwind/tailwind and crosswind components.

If the origin airport is selected on the APPROACH REF page (via the airport selection field), the WIND value that shows on the Takeoff Reference is the same value on the APPROACH REF page. A change to the TAKEOFF REF page WIND value shall also change the APPROACH REF page WIND value under these conditions and vice versa.

OAT

The Outside Air Temperature (OAT) data field defines the temperature used in takeoff performance calculations. When OAT is not specified, must-enter boxes show in the OAT data field to indicate this is a required pilot entry item. The OAT can be entered in degrees Celsius

(the default) or degrees Fahrenheit by entering the numerical value preceded or followed by the letter C or F.

If the OAT entered is not within the range specified by the Vspeed database, the scratchpad message INVALID ENTRY shows.

If the ORIGIN airport is selected (via the airport selection field) on the APPROACH REF 1/5 page, the OAT data value that shows on the TAKEOFF REF is the same value on the APPROACH REF 1/5 page. Under these conditions, a change to the OAT on the TAKEOFF REF 1/5 page causes a corresponding change in OAT on the APPROACH REF 1/5 page and vice versa.

QNH

The barometric pressure correction (QNH) data field is a required input parameter for the computation of takeoff performance data. Normally, QNH is available to the FMS from the avionics system. Barometric pressure correction for the TAKEOFF REF pages is taken from the autopilot transfer side of the aircraft while both air data sources are valid and the ADC reversion switch is in the normal position. Barometric pressure correction for the TAKEOFF REF pages can be set on the Display Control Panel (DCP) that is associated with the autopilot transfer side of the aircraft.

If QNH is not available from the avionics system, must-enter boxes show on the TAKEOFF REF 1/5 page to indicate a required pilot entry. A manual entry/overwrite of the QNH is supported on the TAKEOFF REF 1/5 page. QNH is entered in inches of mercury (default) or Hectopascals by entering the numerical value preceded or followed by the letter I or H.

A manually entered QNH value shows in large white font while a QNH value from the avionics system shows in small white font.

If the ORIGIN airport is selected on the APPROACH REF 1/5 page (via the airport selection field), the QNH value that shows on the TAKEOFF REF is the same value on the APPROACH REF 1/5 page. Changing the QNH on the TAKEOFF REF 1/5 page causes a corresponding change to the QNH on the APPROACH REF 1/5 page and vice versa.

P ALT

The Pressure Altitude (P ALT) data field indicates airport field elevation for the departure airport, corrected for ambient barometric pressure.

If the ORIGIN airport is specified in the flight plan, the airport field elevation is retrieved by the FMS from the navigation database, and the QNH specified on the TAKEOFF REF 1/5 page is applied for barometric correction.

When Pressure Altitude data is unspecified, the P ALT data field shows must-enter boxes to indicate a pilot entry is required. A manual entry/overwrite of P ALT is provided on the TAKEOFF REF 1/5 page. The unit of measure for P ALT is always feet. Deletion of an entered value returns the P ALT display to the computed value or must-enter boxes, whichever is applicable. A manually entered P ALT value shows in large white font while a computed value shows in small white font.

Manual entry of P ALT on the TAKEOFF REF 1/5 page causes a corresponding change to P ALT on the APPROACH REF 1/5 page for the ORIGIN airport and vice versa. Similarly, deletion of a manually entered P ALT value on the TAKEOFF REF 1/5 page causes a corresponding deletion for P ALT on the APPROACH REF 1/5 page and vice versa. No synchronization occurs between the manual entry of P ALT on the TAKEOFF REF 1/5 page and the P ALT that shows on the APPROACH REF 1/5 page for the DEST airport.

TAKEOFF REF 2/5 PAGE

The TAKEOFF REF 2/5 page shows data fields for aircraft configuration, which includes the Automatic Power Reserve state, nacelle anti-ice setting, surface de-ice setting, and ground air brake setting for takeoff.

Figure 16-2 TAKEOFF REF 2/5 Page



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APR

The APR data field represents the planned Automatic Power Reserve configuration for the takeoff conditions. It does not represent the actual/sensed APR setting. The selected APR setting on the TAKEOFF REF 2/5 page shows in large green font, while the alternate APR setting shows in small white font. Alternate planned automatic power reserve conditions can be selected by pushing the APR line select key on the TAKEOFF REF 2/5 page to cycle through the available options (ARM/OFF).

NAC A/I

The NAC A/I data field represents the expected nacelle bleed configuration for the takeoff conditions. The selected NAC A/I condition shows in large green font, while the other option shows in small white font. Push the line select key adjacent to NAC A/I to cycle between the available conditions (OFF/ON) on the TAKEOFF REF 2/5 page.

DE-ICE

The DE-ICE data field represents the expected Surface De-Ice configuration for the takeoff conditions. The selected DE-ICE condition shows in large green font, while the other option shows in small white font. Push the line select key adjacent to DE-ICE to cycle between the available conditions (OFF/ON) on the TAKEOFF REF 2/5 page.

GROUND A/B

The GROUND A/B data field represents the expected Ground Air Brake configuration for the takeoff conditions. The selected GROUND A/B condition shows in large green font, while the other options show in small white font. Push the line select key adjacent to GROUND A/B to cycle between the available Ground Air Brake conditions (ARM/INOP/MAN) on the TAKEOFF REF 2/5 page.

TAKEOFF REF 3/5 PAGE

The TAKEOFF REF 3/5 page provides data entry fields and data display fields for takeoff speeds, takeoff weight data and takeoff runway length data. For systems that have integrated Vsports, it also allows the pilot to send the computed Takeoff Vsports to the PFD for display on airspeed scale.

Figure 16-3 TAKEOFF REF 3/5 Page



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CG TRIM

The Center of Gravity (CG) data field allows for manual pilot entry of Center of Gravity information. When valid CG data has been specified, Stabilizer Trim Setting shows in the TRIM data field.

T/O FLAPS

The Takeoff Flaps (T/O FLAPS) data field represents the planned flaps configuration for the takeoff conditions. It does not represent the actual/sensed flap positions. The takeoff flaps selection on the TAKEOFF REF page shows in large green font, while the alternate flap settings show in small white font. Alternate planned takeoff flap conditions can be selected by pushing the T/O FLAPS line select key on the TAKEOFF REF page to cycle through the available options (20/12/0).

TOW

Takeoff Weight (TOW) is a required input parameter for computing of takeoff performance data. TOW is prefilled to the current gross-weight at the time the TAKEOFF REF pages are accessed (from a non-TAKEOFF REF page). Once prefilled, the TOW value is not updated again while the TAKEOFF REF pages show.

A manual entry/overwrite of the TOW is supported on the TAKEOFF REF 3/5 page that allows the pilot to enter an adjusted weight (to account for engine start, taxi fuel consumption, etc.) A manually entered Takeoff Weight value should not be overwritten by a prefilled TOW, without additional pilot action. A manually entered takeoff weight value shows in large white font while a prefilled TOW value shows in small white font.

If the Gross Weight (GWT) is not specified in the ACT FPLN, the TOW data field shows must-enter boxes to indicate a required pilot entry for Takeoff Weight.

Takeoff Weight (TOW) values are synchronized on the TAKEOFF REF pages.



NOTE

Takeoff Weight (TOW) is not continuously updated to current Gross Weight (GWT) while the TAKEOFF REF 2/5 page shows. An update of TOW to the current aircraft gross weight can be accomplished by using the DELETE command to update the TOW that shows.

GWT

Gross Weight (GWT) is specified on the flight plan PERF INIT 1/3 page. GWT on the TAKEOFF REF 3/5 page is prefilled to the current gross weight at the time the TAKEOFF REF pages are accessed from a non-TAKEOFF REF page. Gross weight is periodically updated to the GWT value on the PERF INIT 1/3 page if the flight plan GWT has been specified.

Once the TAKEOFF REF Vspeed values are correctly sent to the PFD for display, a pilot-entered change to the gross weight on the PERF INIT 1/3 page causes the following to occur:

1. The GWT value on the TAKEOFF REF 3/5 page is updated to the new value.
2. The TOW on the TAKEOFF REF 3/5 page is updated to the new GWT value.
3. The FMS-sourced Takeoff Vsports are removed from the PFD display.
4. The message VSPEEDS DESELECTED shows on the CDU.

If Gross Weight is unspecified, the GWT data field on the TAKEOFF REF 3/5 page is blank.

MTOW

Maximum Takeoff Weight (MTOW) is determined by the most restrictive of the following weight limits: structural, climb performance, runway length, and brake energy. In cases where Maximum Takeoff Weight is unable to be computed, the MTOW data field is blank.

In the event that Takeoff Weight (TOW) exceeds Maximum Takeoff Weight, the MTOW data field shows in yellow and the message CHECK TAKEOFF PERF shows on the CDU.

Maximum Takeoff Weight values are synchronized on the TAKEOFF REF pages.

BFL/RWY LENGTH

The Balanced Field Length (BFL) data field shows an FMS-computed value for the runway length required. Adjacent to it on the TAKEOFF REF 3/5 page is the departure RWY LENGTH (runway length available). When the ACT FPLN specifies the departure runway, value that shows for the RWY LENGTH available is the runway length retrieved from the navigation database. If unspecified, must-enter boxes show to indicate a required pilot entry for the RWY LENGTH available.

The value for BFL shows in small white font, except in cases where BFL is unable to be computed, in which case BFL is blank. A manual entry/overwrite of the RWY LENGTH available is supported to allow the pilot to enter an adjusted value. A manually entered RWY LENGTH available value shows in large white font. Deletion of an entered value returns the RWY LENGTH available display to the default setting value or database value, whichever is applicable.

Both the BFL and RWY LENGTH available show in either feet (default) or meters. A numerical entry preceded or followed with an F or M, or without units, would be an allowable entry. A numerical entry without units is interpreted as the same units that currently show.

If the BFL is longer than the departure RWY LENGTH, the departure RWY LENGTH shows in yellow on the TAKEOFF REF 1/5 page and TAKEOFF REF 2/5 page. The runway identifier shows in yellow on the TAKEOFF REF 1/5 page, and the message CHECK TAKEOFF PERF shows.

V₁, V_R, V₂, V_{FTO}

The TAKEOFF REF page shows the computed values for the Takeoff Vspeeds:

- V₁ (Decision Speed)
- V_R (Rotation Speed)
- V₂ (Takeoff Safety Speed)
- V_{FTO} (Final Takeoff Climb Speed).

SEND

The SEND line select key on the TAKEOFF REF 3/5 page is used to transmit the Takeoff Vsports to the PFD for display. When the SEND command is initiated, the status message IN PROGRESS shows above the SEND line select key. When the Vspeed values are correctly transferred to the PFD, COMPLETE shows as the status message. If the Vspeed transfer is not performed correctly to the PFD, the status message is replaced with a FAILED status message.

All TAKEOFF REF Vsports must be valid, and TOW must be less than MTOW, before any are sent to the PFD for display. If any of the TAKEOFF REF Vspeed values are not valid, then selection of the SEND function causes the scratchpad message KEY NOT ACTIVE to show.

Pushing the SEND line select key in a system that is operating in the INDEP mode causes the Takeoff Vsports to not be sent to the PFD, and the scratchpad message SEND N/A – NOT IN SYNC shows on the CDU.

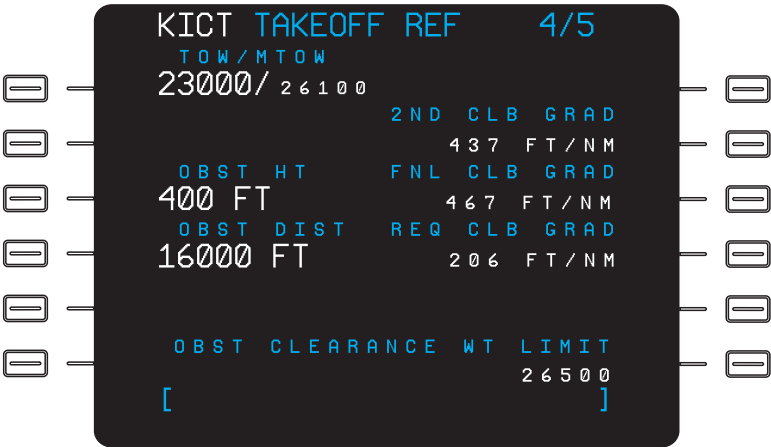
At the time the FMS Takeoff Vsports are sent to the PFD for display, all of the Takeoff Vspeed input and output parameters are latched. Once the Takeoff Vspeed parameters are correctly sent to the PFD for display, a change to the state or value of any parameter used to determine the FMS Takeoff Vsports removes the FMS-sourced Takeoff Vsports from the PFD display. The message VSPEEDS DESELECTED shows.

Performing an FMS SYNC operation causes the VSPEEDS DESELECTED message to show on the CDU momentarily, regardless of whether TAKEOFF REF Vsports or APPROACH REF Vsports have been posted on the PFD.

TAKEOFF REF 4/5 PAGE

The TAKEOFF REF 4/5 page provides takeoff weight and maximum takeoff weight values, an aircraft overweight indication when applicable, obstacle height and distance data, required climb gradient as part of the obstacle clearance calculator, as well as the second and final climb gradients. The obstacle clearance weight limit also shows on the TAKEOFF REF 4/5 page.

Figure 16-4 TAKEOFF REF 4/5 Page



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TOW/MTOW

TOW and MTOW values are synchronized on the TAKEOFF REF pages.

OVER

When the expected TOW exceeds the MTOW, the TAKEOFF REF 4/5 page shows the legend OVER WT (in cyan) and the numerical value by which the aircraft is overweight (in yellow).

OBST HT

The Obstacle Height (OBST HT) data entry field on the TAKEOFF REF 4/5 page is part of the obstacle clearance calculator.

The obstacle clearance calculator takes values from the Obstacle Height and Obstacle Distance inputs to compute the Required Climb Gradient.

The default setting for the OBST HT data field is dashes. This indicates the obstacle height is an optional pilot entry data field.

Obstacle height can be entered in either feet or meters. An entry can be either preceded or followed by an F (for feet) or M (for meters), or be entered without units. To be valid, an entry for OBST HT must be within the range specified in the Vspeed database for obstacle height.

Deletion of a manually entered OBST HT value restores the default setting of dashes.

OBST DIST

The Obstacle Distance (OBST DIST) data field is used to enter obstacle distance from reference zero.

The default setting for the OBST DIST data field is dashes. This indicates the obstacle distance is an optional pilot entry data field.

Obstacle distance can be entered in either feet or meters. An entry can be either preceded or followed by an F (for feet) or M (for meters), or be entered without units. To be valid, an entry for OBST DIST must be within the range specified in the Vspeed database for obstacle distance.

Deletion of a manually entered OBST DIST value restores the default setting of dashes.

2ND CLB GRAD

Second Climb Gradient (2ND CLB GRAD) is the climb gradient used for the segment of climb from the point the wheels are up to flap retraction. The 2ND CLB GRAD is computed based on T/O FLAPS, P ALT, OAT, TOW, WIND, NAC A/I and APR settings.

In the event that the FMS computed Required Climb Gradient value (or a manually entered Required Climb Gradient value) exceeds the 2ND CLB GRAD value, the 2ND CLB GRAD value shows in yellow and the message CHECK TAKEOFF PERF is annunciated in yellow.

FNL CLB GRAD

Final Climb Gradient (FNL CLB GRAD) is the climb gradient used for the segment of climb from the point the flaps are retracted to the point

the aircraft levels off. The FNL CLB GRAD is computed based on P ALT, OAT, TOW, WIND, and NAC A/I settings.

In the event that the FMS computed Required Climb Gradient value (or a manually entered Required Climb Gradient value) exceeds the FNL CLB GRAD value, the FNL CLB GRAD value shows in yellow and the message CHECK TAKEOFF PERF is annunciated in yellow.

REQ CLB GRAD

Required Climb Gradient (REQ CLB GRAD) is calculated by the obstacle clearance calculator using the input values from OBST HT and OBST DIST. Required Climb Gradient represents the climb gradient that must be achieved to provide clearance for obstacles of known height (OBST HT) and known location (OBST DIST) in the takeoff profile.

The FMS also supports the ability to manually enter a REQ CLB GRAD. If an attempt is made to enter a REQ CLB GRAD that is not within the range specified by the Vs speeds database, the scratchpad message INVALID ENTRY shows. A manually entered REQ CLB GRAD will override a REQ CLB GRAD computed by the FMS.

The manual entry of REQ CLB GRAD is in units of FT/NM or %. Unit selection is controlled via the DEFAULTS 5/5 page.

If the current value for REQ CLB GRAD is a manually entered value and a DELETE command is entered, dashes show for REQ CLB GRAD.

When either a manually entered or FMS-computed REQ CLB GRAD value exceeds either the 2ND CLB GRAD value or the FNL CLB GRAD, the 2ND CLB GRAD value or the FNL CLB GRAD shows in yellow on the TAKEOFF REF 4/5 page, and a yellow CHECK TAKEOFF PERF message shows on the CDU.

OBST CLEARANCE WT LIMIT

The Obstacle Clearance Weight Limit (OBST CLEARANCE WT LIMIT) data field shows the FMS-computed value for Maximum Takeoff Weight limited by obstacle clearance. These weight limit values show in small font and can not be modified.

TAKEOFF REF 5/5 PAGE

The TAKEOFF REF 5/5 page provides takeoff weight and maximum takeoff weight values and provides data on the structural, climb performance, runway length, and brake energy weight limits.

Figure 16-5 TAKEOFF REF 5/5 Page



TOW/MTOW

Takeoff Weight (TOW) values and Maximum Takeoff Weight (MTOW) values are synchronized on the TAKEOFF REF pages.

STRUCTURAL LIMIT

The STRUCTURAL LIMIT data field shows the FMS-computed value for maximum takeoff weight limited by structural restrictions. This weight limit value shows in small font and cannot be modified.

CLIMB PERFORMANCE LIMIT

The CLIMB PERFORMANCE LIMIT data field shows the FMS-computed value for maximum takeoff weight limited by the climb performance. This weight limit value shows in small font and cannot be modified.

RUNWAY LENGTH LIMIT

The RUNWAY LENGTH LIMIT data field shows the FMS-computed value for maximum takeoff weight limited by the runway length. This weight limit value shows in small font and cannot be modified.

BRAKE ENERGY LIMIT

The BRAKE ENERGY LIMIT data field shows the FMS-computed value for maximum takeoff weight limited by brake energy restrictions. This weight limit value shows in small font and cannot be modified.

TAKEOFF REFERENCE TEXT PAGE ON THE MFD

The TAKEOFF REFERENCE MFD text page is a summary of the corresponding Takeoff Reference pages on the CDU. The selection of the TAKEOFF REFERENCE MFD text page is described in the MENUS AND DISPLAYS chapter. The details of the TAKEOFF REFERENCE MFD text page layout are described further in the MENUS AND DISPLAYS chapter.

COMPUTE TAKEOFF REFERENCE VSPEEDS

To have the FMS compute Takeoff Reference Vspeeds data, do the steps that follow:



NOTE

The takeoff reference example that follows uses all controlling factors (winds, runway slope, obstacles, etc.) that affect Takeoff Vspeeds and the climbout profile. Not every situation requires entering all the controlling factors.



NOTE

For some data entry fields on the TAKEOFF REF pages, if nothing is entered into dashed data fields, the FMS uses a zero correction factor. The list of applicable data entry fields includes RWY WIND, RWY SLOPE, and WIND.

SET UP THE FMS FOR TAKEOFF REFERENCE VSPEEDS

1. Create a flight plan. (Refer to the FLIGHT PLANNING chapter for details on creating a flight plan).



NOTE

The FMS is required to be on the ground and operating in SYNC mode to transmit Takeoff Vs speeds to the PFD. If the FMS is operating in INDEP mode, it is necessary to select SYNC mode on the FMS CONTROL page and select an FMS SYNC Master.

When creating the flight plan, make sure to:

- Enter an ORIGIN airport. This becomes the Takeoff airport on the TAKEOFF REF pages.
- Enter a Destination (DEST) airport. This becomes the DEST airport in the SEL APT pair for the APPROACH REF pages.
- Select a Departure Runway or a SID with a Departure Runway. This becomes the Takeoff Runway on the TAKEOFF REF pages.
- When appropriate, define a STAR Transition and Approach using the DEP/ARR INDEX and ARRIVAL pages.
- Make sure that the flight plan is correct, and push the EXEC function key on the CDU to execute the flight plan.

2. Initialize Performance on the PERF INIT pages. (Refer to the PERFORMANCE chapter for details on Performance Initialization).

Make sure that all of the required inputs have been made to allow the FMS to compute and show Gross Weight (GWT) on the PERF INIT 1/3 page. Execute the Performance Initialization entries.

3. Push the PERF function key on the CDU to show the PERF MENU page.

4. Push the TAKEOFF line select key on the PERF MENU page to show the TAKEOFF REF 1/5 page.

TAKEOFF REF 1/5

5. Make sure that the Takeoff airport is identified on the TAKEOFF REF 1/5 page title line.

Figure 16-6 TAKEOFF REF 1/5 Page



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NOTE

If the Takeoff airport identifier field is blank on the title line of the TAKEOFF REF 1/5 page, it indicates the flight plan has not been entered and the ORIGIN airport has not been defined.

NOTE

Manual entry of the Takeoff airport identifier is NOT supported on the TAKEOFF REF pages. The airport identifier must be entered on the FPLN page using the ORIGIN and DEST airport data fields.

6. Make sure that the runway identifier for the departure runway has been prefilled and shows in the RWY ID field on the TAKEOFF REF 1/5 page.



NOTE

If the RWY ID field on the TAKEOFF REF 1/5 page shows dashes, it indicates the departure runway has not been entered into the ACT FPLN. The flight crew can manually enter the departure runway data in the flight plan using the DEP ARR function key, the DEP/ARR INDEX page, and the DEPART page. This allows the RWY ID field on the TAKEOFF REF 1/5 page to be prefilled from the ACT FPLN-data for the departure runway. The RWY ID field on the TAKEOFF REF 1/5 page also accepts manual entry of runway selection, but only accepts runways associated with the flight plan ORIGIN airport as valid entries. In addition, manual entry of the runway identifier on the TAKEOFF REF 1/5 page applies solely to the TAKEOFF REF 1/5 page, and does not cause an update to departure runway selection on the ACT FPLN.



NOTE

Manual entry of RWY ID on the TAKEOFF REF 1/5 page removes some previously entered manual data entries on the TAKEOFF REF 1/5 page. The data must be entered again for correlation to the new runway alignment. Manual entry of RWY ID on the TAKEOFF REF 1/5 page causes removal of manually entered RWY WIND headwind or tailwind and causes an update to be performed for FMS-computed RWY WIND (headwind/tailwind and crosswind components). It also removes the manually entered RWY LENGTH, updates RWY LENGTH from the navigation database, and removes the manually entered Runway Slope. The flight crew must reenter new appropriate values for these parameters.

7. Make sure that the runway length for the departure runway has been prefilled and shows in the RWY LENGTH field on the TAKEOFF REF 1/5 page.



NOTE

If the RWY LENGTH field shows must-enter boxes on the TAKEOFF REF 1/5 page, it indicates the departure runway has not been entered into the ACT FPLN. The flight crew can choose to enter the departure runway in the flight plan using the DEP ARR function key, the DEP/ARR INDEX page, and the DEPART page. This allows the RWY LENGTH field on the TAKEOFF REF 1/5 page to be prefilled from the ACT FPLN-data for the departure runway.

**NOTE**

The Runway Length (RWY LENGTH) data field on the TAKEOFF REF 1/5 page accepts manual entry of RWY LENGTH in cases where the RWY LENGTH data field is either must-enter boxes or prefilled with RWY LENGTH data associated with the departure runway. Manually entering a RWY LENGTH on the TAKEOFF REF 1/5 page overwrites a prefilled database value for RWY LENGTH.

8. Manually enter RUNWAY SLOPE in scratchpad.
9. Push the RWY SLOPE line select key on the TAKEOFF REF 1/5 page to transfer the slope entry from the scratchpad.

**NOTE**

After the RWY SLOPE is entered, manual entry of a new RWY ID on the TAKEOFF REF 1/5 page removes the RWY SLOPE value. It also returns the RWY SLOPE data field to dashes (interpreted as zero slope for TAKEOFF REF Vs speeds computations).

**NOTE**

If RWY SLOPE is manually entered while RWY ID is a manually defined identifier, deletion of the RWY ID on the TAKEOFF REF 1/5 page also removes the RWY SLOPE value, and return the RWY SLOPE data field to dashes.

**NOTE**

If the RWY SLOPE is manually entered while RWY LENGTH is a manually defined value, deletion of the RWY LENGTH on the TAKEOFF REF 1/5 page also remove the RWY SLOPE value. This returns the RWY SLOPE data field to dashes.

10. Select Runway Condition (RWY COND) from the menu on the TAKEOFF REF 1/5 page. Push the RWY COND line select key as many times as necessary to select the appropriate runway condition (each key push sequentially selects the next RWY COND option).

**NOTE**

The Runway Condition that shows on the TAKEOFF REF 1/5 page is the condition that is applied to TAKEOFF REF Vs speeds calculations.



NOTE

The default state for RWY COND on the TAKEOFF REF 1/5 page is DRY. When RWY COND is manually selected on the TAKEOFF REF 1/5 page from the available menu, the selection applies to the current flight plan. FMS cold start or creation of a new flight plan returns the RWY COND to the default selection.

11. Enter WIND data direction and velocity in the scratchpad.
12. Push the WIND line select key on the TAKEOFF REF 1/5 page to transfer the WIND data from the scratchpad.



NOTE

The TAKEOFF REF 1/5 page contains two types of wind data fields: WIND (direction/velocity), and RWY WIND (headwind/tailwind, and crosswind components). When WIND data has been entered, the FMS computes RWY WIND automatically when a RWY ID has been defined. As an alternative, manual entry of runway headwind or tailwind component can be defined in the RWY WIND data field, but this data field does not allow manual entry of crosswind component value.



NOTE

Manual entry of a RWY WIND component (headwind or tailwind) does not remove the value of airport WIND (magnitude/direction) that shows. Computations of Takeoff Reference Vsports are performed based upon the RWY WIND that shows, or from manually entered values directly entered into the RWY WIND data field as headwind/tailwind components.



NOTE

Headwind values greater than 20 knots can be entered/calculated on TAKEOFF REF 1/5 page. In the case of a headwind component greater than 20 knots, it must be noted that a value of 20 knots is used for the Takeoff Vspeed calculations as per the AFM.



NOTE

If the computed crosswind component equals or exceeds the maximum demonstrated crosswind component for the aircraft (24 knots), as specified in the AFM, the CDU message MAX DEMO CROSSWIND shows in white.

**NOTE**

If the ORIGIN airport is selected on the APPROACH REF 1/5 page (via the airport selection field), the WIND value that shows on the TAKEOFF REF 1/5 page is the same value on the APPROACH REF 1/5 page. A change to the TAKEOFF REF 1/5 page WIND value shall also change the APPROACH REF 1/5 page WIND value under these conditions and vice versa.

13. Enter Outside Air Temperature (OAT) in the scratchpad.
14. Push the OAT line select key on the TAKEOFF REF 1/5 page to enter the scratchpad data.

**NOTE**

If the flight plan ORIGIN airport is selected on the APPROACH REF 1/5 page as the selected airport, OAT entries on the APPROACH REF 1/5 page are synchronized to the OAT value of the TAKEOFF REF 1/5 page.

15. Set the Barometric Correction (QNH) on the ARP control panel for the departure airport, and confirm that the QNH value for the departure airport shows correctly on the TAKEOFF REF 1/5 page.

**NOTE**

Barometric pressure correction for the Takeoff Reference pages can be set on the ARP control panel associated with the autopilot transfer side of the aircraft (when both ADC sources are valid and the ADC reversionary switch is set to NORMAL).

**NOTE**

Once the SEND command has been used on the TAKEOFF REF 3/5 page to send Takeoff Vspeed values to the PFD for display, the value for QNH that shows on the TAKEOFF REF 1/5 page becomes latched and will no longer be updated by changes in the barometric correction on the ARP control panel until the FMS-computed Takeoff Vspseds have been deselected from the PFD display.

If QNH is not available from the avionics system, must-enter boxes show on the TAKEOFF REF 1/5 page to indicate a required pilot entry.

16. Make sure that pressure altitude for the departure airport has been pre-filled and shows in the Pressure Altitude (P ALT) data field on the TAKEOFF REF 1/5 page.



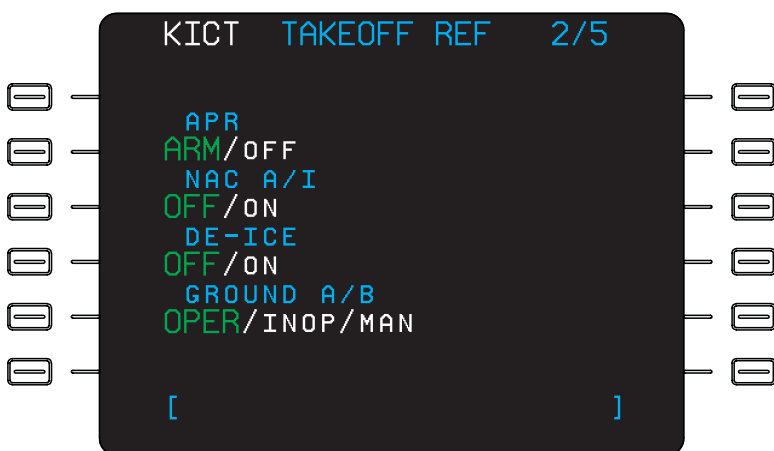
NOTE

If the ORIGIN airport is specified in the flight plan, the airport field elevation is retrieved by the FMS from the navigation database, and the QNH specified on the TAKEOFF REF 1/5 page is applied for barometric correction. When pressure altitude data is unspecified, the P ALT data field shows must-enter boxes to indicate a pilot entry is required. In addition, a manual entry/overwrite of Pressure Altitude is provided on the TAKEOFF REF 1/5 page. P ALT always shows in feet.

TAKEOFF REF 2/5

17. Push the NEXT function key on the CDU to show the TAKEOFF REF 2/5 page.

Figure 16-7 TAKEOFF REF 2/5 Page



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18. Push the APR line select key to select the Automatic Power Reserve setting (ARM or OFF) that is appropriate for the anticipated takeoff configuration.

19. Push the NAC A/I line select key to choose a nacelle anti-ice configuration (OFF or ON) that matches the anticipated takeoff configuration.
20. Push the DE-ICE line select key to choose a Surface De-Ice configuration (OFF or ON) that matches the anticipated takeoff configuration.
21. Push the GROUND A/B line select key to choose the Ground Air Brake configuration (ARM, MAN, or INOP) that matches the anticipated takeoff configuration.

**NOTE**

Settings for aircraft configuration on the TAKEOFF REF 3/5 page represent the planned aircraft configuration for takeoff and do not reflect the actual/sensed status of these aircraft systems.

TAKEOFF REF 3/5

22. Push the NEXT function key on the CDU to show the TAKEOFF REF 3/5 page.

Figure 16-8 TAKEOFF REF 3/5 Page



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23. Enter the aircraft Center of Gravity (CG) into the scratchpad.

24. Push the CG TRIM line select key to transfer the CG entry from the scratchpad.



NOTE

When the aircraft CG value is entered or changed, the FMS will automatically calculate the necessary trim setting for takeoff.

25. Push the T/O FLAPS line select key to select the planned flaps setting for takeoff. Push the T/O FLAPS line select key to cycle through the menu selections on the TAKEOFF REF page.

26. Review the Maximum Takeoff Weight (MTOW) from the TOW/GWT/MTOW data entry fields.



NOTE

Maximum Takeoff Weight (MTOW) is determined by the most restrictive of the following weight limits: structural, climb performance, runway length, and brake energy. In cases where Maximum Takeoff Weight cannot be computed, the MTOW data field is blank.

27. Examine Gross Weight (GWT) from the TOW/GWT/MTOW data fields.



NOTE

Gross Weight is specified on the flight plan PERF INIT 1/3 page. Gross Weight (GWT) on the TAKEOFF REF 3/5 page is prefilled to the current gross-weight at the time the TAKEOFF REF pages are accessed (from a non-TAKEOFF REF page). Gross weight is periodically updated to the GWT value on the PERF INIT 1/3 page if the flight plan GWT has been specified.



NOTE

If Gross Weight is unspecified, the GWT data field on the TAKEOFF REF 3/5 page is blank.

**NOTE**

Once the TAKEOFF REF Vspeed values are sent to the PFD for display, a pilot-entered change to gross weight on the PERF INIT 1/3 page causes a corresponding update to the GWT value on the TAKEOFF REF 3/5 page, updates TOW to the new GWT value, removes the FMS-sourced Takeoff Vspeeds from the PFD display, and causes the VSPEEDS DESELECTED message to show on the CDU.

28. Enter the planned Takeoff Weight (TOW), if different from the TOW that shows, into the scratchpad.

29. Push the TOW/GWT/MTOW line select key to transfer the TOW entry from the scratchpad.

**NOTE**

The Takeoff Weight is preset to the gross weight value, unless a manual entry for Takeoff Weight has been performed. A manual entry/overwrite of the TOW is supported on the TAKEOFF REF 3/5 page that allows the pilot to enter an adjusted weight (to account for engine start, taxi fuel consumption, etc.). A manually entered Takeoff Weight value should not be overwritten by a prefilled TOW, without additional pilot action. A manually entered Takeoff Weight value shows in large white font while a prefilled TOW value shows in small white font.

**NOTE**

If any input value is changed (for example, TOW), the Vspeed data fields goes blank momentarily while the FMS is computing the Vspeeds based upon the new data. The FMS then shows the new Vspeeds.

30. Make sure that the takeoff runway identifier and RWY LENGTH are correctly indicated.

**NOTE**

When the ACT FPLN specifies the departure runway, the RWY LENGTH available value that shows is the runway length retrieved from the navigation database. If unspecified, must-enter boxes show to indicate a required pilot entry for RWY LENGTH available. The pilot can choose to either add the departure runway to the ACT FPLN or manually enter the RWY LENGTH data on the TAKEOFF REF 1/5 page.



NOTE

A manual entry/overwrite of the RWY LENGTH available is supported to allow the pilot to enter an adjusted value. A manually entered RWY LENGTH available value shows in large white font. Runway length available shows in either feet (default) or meters. A numerical entry preceded or followed with an F or M, or without units would be an allowable entry. The FMS interprets a numerical entry without units to be the same as what currently shows. Deletion of an entered value returns the runway-length-available display to the database value.

31. Examine the computed Balanced Field Length (BFL) to determine if the computed BFL runway length required is within the departure runway length available.



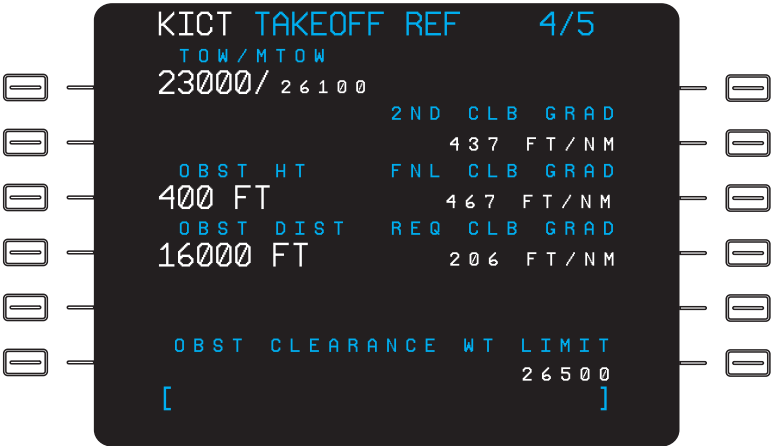
NOTE

If the Balanced Field Length (BFL) is longer than the departure RWY LENGTH, the departure RWY LENGTH shows in yellow on the TAKEOFF REF 1/5 and TAKEOFF REF 2/5 pages. The runway identifier shows in yellow on the TAKEOFF REF 1/5 page, and the CDU message CHECK TAKEOFF PERF shows.

TAKEOFF REF 4/5

32. Push the NEXT function key on the CDU to view the TAKEOFF REF 4/5 page.

Figure 16-9 TAKEOFF REF 4/5 Page



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 **NOTE**
If TOW exceeds MTOW, the annunciation OVER and the amount overweight shows under the TOW/MTOW values.

The MTOW that shows on the TAKEOFF REF pages is the most restrictive of the following maximum weights limits: structural climb performance, runway length, and brake energy.

33. Enter the controlling obstacle height into the scratchpad.

 **NOTE**
Obstacle height must be entered as obstacle height above the runway.

34. Push the OBST HT line select key to transfer the data from the scratchpad.

35. Enter the obstacle distance from the runway into the scratchpad.



NOTE

Obstacle distance must be entered as obstacle distance from reference zero.

36. Push the Obstacle Distance (OBST DIST) line select key to transfer the data from the scratchpad.

When Obstacle Height and Obstacle Distance are entered, the FMS computes the Required Climb Gradient (REQ CLB GRAD). The FMS also calculates Obstacle Clearance Weight Limit (OBST CLEARANCE WT LIMIT).



NOTE

The FMS also supports the ability to manually enter a REQ CLB GRAD. If an attempt is made to enter a REQ CLB GRAD that is not within the range specified by the Vs speeds database, the scratchpad message INVALID ENTRY shows. A manually entered REQ CLB GRAD will override a REQ CLB GRAD computed by the FMS.



NOTE

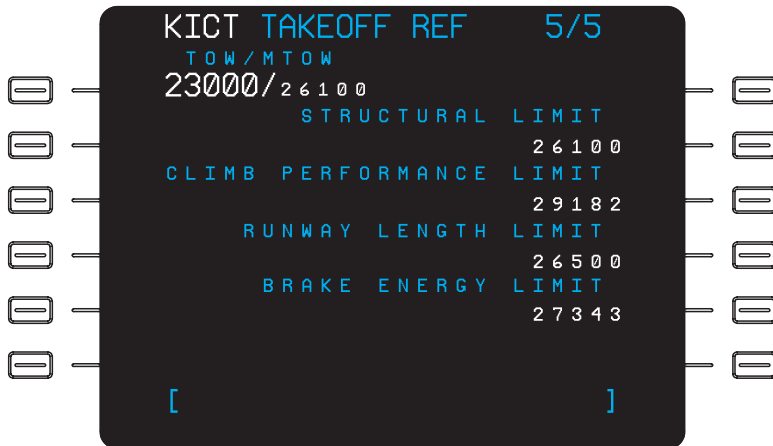
The manual entry of REQ CLB GRAD is in units of FT/NM or %. Unit selection is controlled via the DEFAULTS 5/5 page. If the value that currently shows for REQ CLB GRAD is a manually entered value and a DELETE command is entered, the REQ CLB GRAD field will show dashes.

37. Examine the data fields for Required Climb Gradient (REQ CLB GRAD) and Second Climb Gradient (2ND CLB GRAD), and Final Climb Gradient (FNL CLB GRAD). Make sure that the REQ CLB GRAD does not exceed the 2ND CLB GRAD or the FNL CLB GRAD. If the REQ CLB GRAD value exceeds either the 2ND CLB GRAD value or the FNL CLB GRAD, the 2ND CLB GRAD value or the FNL CLB GRAD shows in yellow on the TAKEOFF REF 4/5 page, and a yellow CHECK TAKEOFF PERF message shows on the CDU.

TAKEOFF REF 5/5

38. Push the NEXT function key to view the weights and limits on the TAKEOFF REF 5/5 page. Examine the weight values that show for STRUCTURAL LIMIT, CLIMB PERFORMANCE LIMIT, RUNWAY LENGTH LIMIT, and BRAKE ENERGY LIMIT. Inspect the value that shows for MTOW.

Figure 16-10 TAKEOFF REF 5/5 Page



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**NOTE**

The MTOW that shows on the TAKEOFF REF pages is the most restrictive of the maximum weights determined as the structural limit, climb performance limit, runway length limit, and brake energy limit.

TRANSMIT TAKEOFF VSPEEDS TO PFD

To transmit Takeoff Vs speeds to the PFD, do the steps that follow:

1. Push the NEXT or PREV function keys as necessary to show TAKEOFF REF 3/5 page.
2. Examine the Takeoff Vs speed values that show on TAKEOFF REF 3/5 page. Make sure that values have been computed by the FMS and show for the following:
 - V_1 (Decision Speed)
 - V_R (Rotation Speed)
 - V_2 (Takeoff Safety Speed)
 - V_{FTO} (Final Takeoff Climb Speed).



NOTE

In order to send Vspeed data to the PFDs, both CDUs must be showing FMS pages. If both CDUs are not showing FMS pages, it is possible that the CDU message VSPEEDS DISAGREE will show.

3. If no status message shows above the SEND prompt, push the line select key adjacent to SEND.



NOTE

The line select key adjacent to SEND on the TAKEOFF REF 3/5 page is used to transmit Takeoff Vsports for display on the PFD. After the SEND line select key is pushed, the annunciation IN PROGRESS shows first above the SEND prompt. The FMS performs an echo test on each of the values to verify the information has been correctly received by the PFD. If any one value fails, the annunciation FAILED shows above the SEND prompt. If the values match, the Takeoff Vsports change to magenta and the annunciation COMPLETE shows above the SEND prompt.



NOTE

All TAKEOFF REF Vsports must be valid, and TOW must be less than MTOW, before any are allowed to be sent to the PFD for display. If any of the TAKEOFF REF Vspeed values are not valid, then selection of the SEND function causes the scratchpad message KEY NOT ACTIVE to show.



NOTE

To send the Takeoff Vsports to the PFD, the aircraft must be on the ground and the FMS operating in SYNC mode. Pushing the SEND line select key while in a system that is operating in the INDEP mode causes the Takeoff Reference Vsports to not be sent to the PFD, and the CDU message SEND N/A – NOT IN SYNC shows. If the FMS is operating in INDEP mode, it is necessary to select SYNC mode on the FMS CONTROL page and select an FMS Sync Master.

**NOTE**

When the FMS sends the Takeoff Reference Vs speeds to show on the PFD, all of the Takeoff V speed input parameters and output values are latched. Once the Takeoff V speed values are correctly sent to show on the PFD, a change to the state or value of any parameter used to determine the FMS Takeoff Vs speeds removes the FMS-sourced Takeoff Vs speeds from the PFD display. The CDU message VSPEEDS DESELECTED shows.

**NOTE**

In cases where the aircraft takeoff has been aborted, the TAKEOFF REF parameters should be reentered, and must be resent to the PFD to clear the old Takeoff Reference V speed target values that show on the airspeed scale.

**NOTE**

Performing an FMS SYNC operation causes the VSPEEDS DESELECTED message to momentarily show, regardless of whether Takeoff Reference Vs speeds or Approach Reference Vs speeds have been posted on the PFD.

**NOTE**

FMS TAKEOFF REF V speed input values need to be reconfirmed by the pilot following any FMS SYNC operation.

Figure 16-11 Vspeeds Sent to PFD (TAKEOFF REF 3/5)

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TAKEOFF VSPEEDS: MANUALLY-ENTERED AND FMS-COMPUTED

Values for the Takeoff Vspeeds (V_1 , V_R , V_2 , and V_{FTO}) entered manually with the ARP panel show on the PFD in cyan.

FMS-computed Takeoff Reference Vspeeds (V_1 , V_R , V_2 , and V_{FTO}) show in white on the TAKEOFF REF 2/5 page before they are sent to the PFD.

FMS-computed Takeoff Reference Vspeeds (V_1 , V_R , V_2 , and V_{FTO}) show on the TAKEOFF REF 2/5 page in magenta when the SEND status message COMPLETE shows after the entry of a SEND command. FMS-computed Takeoff Reference Vspeeds (V_1 , V_R , V_2 , and V_{FTO}) show on the PFD in magenta.

When FMS-computed TAKEOFF REF Vspeeds show on the PFD, subsequent changes made on the ARP control panel cause all pilot-specified Takeoff Reference Vspeeds to become manually selected values controlled by the DCP and show on the PFD in cyan.

To manually enter adjustments to the Takeoff Vspped values after posting FMS-computed Takeoff Reference Vspeeds on the PFD, use the controls on the ARP as follows:

1. Set the SPEED REFS switch on the ARP to the VSPDS position.

2. Push the SEL key to select V_1 , V_R , V_2 , then turn the SPEED REFS knob to enter new Vs speeds data values.

As an alternative, the SPEED REFS switch on the ARP can be switched to TGT. The SPEED REF knob is then used to enter a target VT value.

When manually entered Takeoff V speed values have been entered on the ARP, they show on the PFD in cyan. If FMS-computed TAKEOFF REF V speeds are subsequently sent to the PFD using the SEND command on the TAKEOFF REF 3/5 page, the FMS-computed values for V_1 , V_R , V_2 , and V_{FTO} replace the manually entered values, and the Takeoff V speeds shows the values on the PFD in magenta.

APPROACH REFERENCE DISPLAYS

Push the PERF function key on the CDU to show the PERF MENU page. Push the APPROACH line select key to show the first of five APPROACH REF pages, then push the NEXT and PREV function keys as necessary to select other pages.

The APPROACH pages show:

- Select Airport (SEL APT) prompt with the ORIGIN and DEST airports
- Runway (RWY) ID, RWY WIND (headwind/tailwind and crosswind component), RWY LENGTH, and RWY condition (RWY COND)
- WIND, Outside Air Temperature (OAT), barometric correction (QNH), and Pressure Altitude (P ALT)
- Automatic Power Reserve (APR), Nacelle Anti-Ice (NAC A/I), Surface DE-ICE, Ground Air Brake (GROUND A/B) and ANTI-SKID configurations
- Landing Flaps (LDG FLAPS) setting
- Landing Weight/Gross Weight/Maximum Landing Weight (LW/GWT/MLW)
- Landing Field Length (LFL) or Actual Landing Distance (ALD) and runway designator and length
- Landing Factor (LDG FACTOR) setting
- Approach and landing V speed: V_{REF} — Reference Speed
- Approach Climb Gradient (APP CLB GRAD) and Landing Climb Gradient (LDG CLB GRAD)
- A line key selection to transmit approach V speeds to the PFD

- Landing Weight/Maximum Landing Weight (LW/MLW)
- Structural, climb performance, runway length, and brake energy weight limits.

There is a minimum set of inputs, if entered and available, that are sufficient for the Approach Reference Vspeed value to be computed and shown as V_{REF} . The minimum set of inputs necessary for Approach Reference Vspeed computations to be performed are:

- RWY LENGTH
- OAT (outside air temperature)
- P ALT (airport pressure altitude)
- LW (landing weight).

Once these four required input parameters have been specified on the APPROACH REF pages, the Approach Reference Vspeed values will be computed and shown as V_{REF} , V_{GA} , and V_{FTO} . This assumes that valid QNH correction is available from the avionics system.

In addition, for the computed Approach Reference Vspeeds to be accurate and correct for the operating conditions, the flight crew must also enter the following items:

- Airport WIND (magnitude/direction) or RWY WIND component
- RWY COND (runway condition)
- APR (ARM/OFF) Condition
- NAC A/I (OFF/ON) Condition
- DE-ICE (OFF/ON) Condition
- GROUND A/B (ARM/MAN/INOP) Condition
- LDG FLAPS (40/20/0).

The SEL APT field determines the airport (either the ORIGIN or DEST) for which the FMS will calculate and display approach data. The ORIGIN airport is the default when the aircraft is either:

- Within 50 NM of the airport
- Less than halfway along the flight plan route, whichever is the lesser distance.

The airport selection is made at the time the APPROACH REF pages initially show, and is not automatically updated while the page is viewed on either the CDU or the MFD.

Once the aircraft has passed outside the criteria, the DEST airport becomes the default selection and applies the next time the APPROACH REF pages are selected from another CDU page.

The line select key for SEL APT is used to manually change the approach data for the desired airport. However, once the DEST airport has been selected manually, the default selection function is no longer active, unless the pages are reset with an ACT FPLN airport change, or the ORIGIN airport is manually reselected on the APPROACH REF 1/5 page. The selected airport shows in large green font, while the other airport shows in small white font.

The list that follows identifies inputs that can be entered manually on the APPROACH REF pages and their acceptable formats. For any data field with a designator (for example, F/M (Feet or Meters), I/H (Inches or Hectopascals), U/D (Up or Down), C/F (Celsius or Fahrenheit)), the designator can precede or follow the numerical entry.

- RWY ID — RW09, RW19R, RW02L, RW13C (RWY ID is usually prefilled with the identifier of the flight plan departure runway (for ORIGIN airport selection), or flight plan approach runway (for DEST airport selection). Manual entries for specific runways are also allowed.
- RWY WIND — (Headwind: H or +, Tailwind: T or -)
- RWY LENGTH — Feet (F - default) or Meters (M)
- WIND — 090/12, 050M/08, 035T/12 (MAG default) (Mag = M or True = T)
- OAT — 11, -05, C10, 25C, 25F, F-13 (Celsius: C (default) or Fahrenheit: F)
- QNH — Inches of Mercury (I-default) or Hectopascals (H)
- P ALT — Feet
- LW — Three digits with decimal (for example, 26.0) for thousands of pounds or KG.

NOTE

For some data entry fields on the APPROACH REF pages, if nothing is entered into dashed data fields, the FMS uses a zero correction factor. The applicable data fields for data entry are RWY WIND, and WIND.



NOTE

Manual entry of RWY ID on the APPROACH REF pages applies to the APPROACH REF pages only.

If a runway was defined in the flight plan, RWY ID and RWY LENGTH are prefilled on the APPROACH REF 1/5 page for the designated runway. If the RWY ID field contains an entry when WIND data is entered, the FMS computes and shows the RWY WIND. RWY LENGTH accepts manual entry on the APPROACH REF 1/5 page. However, manual entry of RWY LENGTH deletes a prefilled RWY ID and removes RWY WIND.

If the approach is to the ORIGIN airport, data input fields are prefilled with information from the TAKEOFF REF pages. Changes to any of the inputs result in a concurrent change on the TAKEOFF REF pages. If the approach is to the DEST airport, changes/inputs on the APPROACH REF pages do not affect information on the TAKEOFF REF pages.



NOTE

Aircraft configuration settings (APR, NAC A/I, DE-ICE, GROUND A/B, and ANTI-SKID) on the APPROACH REF 2/5 page represent the planned settings for the takeoff and do not represent the actual/sensed aircraft configuration.

Once the required inputs are entered, the FMS calculates and shows the approach reference value.

The Approach Reference Vspeed performance computations are based upon performance data extracted from the aircraft AFM. In some instances, there are more combinations of aircraft configurations available than are covered by published AFM performance charts. In addition, AFM performance charts depicting Approach Reference Vspeeds performance data are prescribed over defined ranges of input variables.

In the event the FMS is unable to calculate the Approach Reference Vspeed performance value due to an unsupported aircraft system configuration or an out-of-range input variable, the computed output performance parameter will be identified with a yellow question mark in place of a numerical value. Once the conflicting aircraft system or (out of range) input variable has been corrected, the associated computed

output performance parameter will return to normal color, and the numeric value will replace the yellow question mark.

The computed Landing Field Length (LFL) value is derived from the actual landing distance and includes factors for operational rules that require the use of 60% of the available runway (landing field length required).

If the LFL/ALD exceeds the available RWY LENGTH, the available RWY LENGTH shows in yellow on the APPROACH REF 1/5 page, and on the APPROACH REF 3/5 page, the message CHECK APPROACH PERF shows in yellow. In addition, the runway identifier shows in yellow on the APPROACH REF 1/5 page.

If the LW exceeds the MLW, MLW shows in yellow, and the CDU message CHECK APPROACH PERF shows in yellow.

Values less than 2.1% for APP CLB GRAD or 3.2% for LDG CLB GRAD show in yellow. If either of these conditions occur, the CDU message CHECK APPROACH PERF shows in yellow.

The SEND line key selection on the APPROACH REF 3/5 page allows the pilot to transmit Approach Vs speeds for display on the PFD. When the SEND prompt is pushed, the FMS transmits the Approach Vs speeds to the PFD. The annunciation IN PROGRESS shows first above the SEND prompt.

The FMS performs an echo test on each of the values to verify the information has been correctly received by the PFD. If any one value fails, the annunciation FAILED shows above the SEND prompt. If the values match, the Approach Vs speeds change to cyan and the annunciation COMPLETE shows above the SEND prompt.

To transmit Approach Vs speeds to the PFD, the FMS should be in the air and operating and operating in SYNC mode. Approach Reference Vs speeds will not be sent to the PFD when the SEND line select key is pushed while operating in the INDEP mode and the CDU message SEND N/A – NOT IN SYNC shows. If the FMS is operating in INDEP mode, it is necessary to select SYNC mode on the FMS CONTROL page and select an FMS Sync Master.

When the FMS sends Approach Vs speeds to the PFD for display, all of the Approach Vs speeds input parameters and output values are latched. While the aircraft remains in the air, a change to the state or value of any parameter used to determine the FMS Approach Vs speeds (for

example, LW), removes the FMS-sourced Approach Vsports from the PFD display, and generates the message VSPEEDS DESELECTED on the CDU.

Landing Weight (LW) is synchronized on the APPROACH REF pages and can be modified as needed. Maximum Landing Weight (MLW) is based upon the structural limits of the aircraft, climb performance limit, runway length, and brake energy limits. MLW will be the most restrictive of these contributing factors.

Aircraft configuration settings and display unit formats can be changed on DEFAULTS 5/5 page. Aircraft configuration settings that are changed on the DEFAULTS 5/5 page take effect as default selections the next time a flight plan is created. The default selections do not change an existing flight plan.

NOTE



FMS APPROACH REF Vspeed input values need to be reconfirmed by the pilot following any FMS SYNC operation or FMS cold start.

APPROACH REFERENCE OPERATION

Push the PERF function key to show the PERF MENU page. Push the APPROACH line select key to show one of five APPROACH REF pages, then push the NEXT and PREV function keys as necessary to select another page.

NOTE



For some data fields on the APPROACH REF pages, the FMS uses a zero correction factor if nothing is entered into those fields. The applicable fields include: RWY WIND, WIND and RWY SLOPE.

Information provided on the APPROACH REF pages is based upon the ACT FPLN only. The information that shows can be for either the ORIGIN or DEST airport. If the approach is to the ORIGIN airport, data input fields are prefilled with information from the TAKEOFF REF pages. Changes to any of the inputs cause a concurrent change on the TAKEOFF REF pages. If the approach is to the DEST airport, changes/inputs on the APPROACH REF pages do not affect information on the TAKEOFF REF pages.

A change to the ORIGIN airport in the ACT FPLN affects the TAKEOFF REF and APPROACH REF pages for the ORIGIN and the DEST airport. A change to the ORIGIN airport causes any data entered manually into the available data fields to be cleared on the TAKEOFF REF and APPROACH REF pages for both the ORIGIN and DEST airport. It also causes the TAKEOFF REF and APPROACH REF pages for both the ORIGIN and DEST airport to be reset to the default values and default settings for aircraft configuration.

A change to the DEST airport in the ACT FPLN affects only the APPROACH REF pages for the DEST airport. If the DEST airport is changed in the ACT FPLN, the data entered manually in the APPROACH REF pages for the DEST airport is cleared. The DEST APPROACH REF pages are reset to the default values and settings for aircraft configuration.

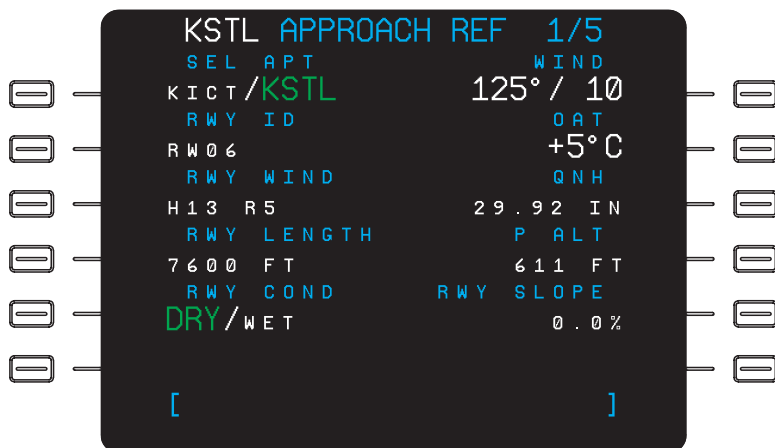
On all APPROACH REF pages, FMS-computed values in the data fields show in small white font. Manual entries show in large white font. Must-enter boxes (□ □ □) in a data field indicate a required entry.

**NOTE**

Settings on the DEFAULTS and APPROACH REF pages represent the planned aircraft configuration for landing and do not reflect the actual/sensed status of these aircraft systems.

APPROACH REF 1/5 PAGE

The APPROACH REF 1/5 page shows the approach runway information and the ambient meteorological conditions used to calculate determining the approach Vspeed (V_{REF}). This information is also used to determine Maximum Landing Weight (MLW) and landing distance (LFL or ALD). The information provided on the APPROACH REF pages is defined with respect to the ACT FPLN only.

Figure 16-12 APPROACH REF 1/5 Page

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APPROACH AIRPORT

The landing airport that is selected in the SEL APT data field on the APPROACH REF 1/5 page shows in the title line. If no airport is specified in the ACT FPLN, the landing airport data-field in the title line of the APPROACH REF 1/5 page is blank.

SEL APT

Approach data for either the flight plan ORIGIN or DEST airport is identified as the landing airport data by the SEL APT field. The default airport selection (of either the ORIGIN or the DEST airport) for the APPROACH REF pages is determined at the time the APPROACH REF page on the CDU and APPROACH REF text pages on the MFD are accessed, and remains the same as long as the page continues to show (in other words, the selected airport does not automatically change while an APPROACH REFERENCE page shows on either the CDU or MFD). The default selection is based on the aircraft position, and favors the closer airport between the ORIGIN and DEST options.

Approach data for the desired airport can also be selected manually by pushing the line select key adjacent to SEL APT. This command causes alternation between the airports in the SEL APT field. The selected

airport shows in large green font, while the deselected airport shows in small white font.

RWY ID

The Runway Identifier (RWY ID) data field shows the runway identification of the arrival airport. The RWY ID field shows dashes if the corresponding runway or airport has not been specified in the ACT FPLN.

Manual entry of the runway identification is supported, but the manually entered RWY ID must be one that is associated with the SEL APT on the APPROACH REF 1/5 page. An attempt to enter a RWY ID that is not in the database for the airport specified causes the entry to be rejected and the message NOT IN DATA BASE to show on the CDU.

When manually entering a runway identifier, the formats used to successfully retrieve runway data from the FMS database are restrictive. The suggested format is RW##Y as follows:

- RW is a required two letter identifier that indicates runway information
- ## is a two digit runway number in the range 01 to 36
- Y is the location character L, C, or R (representing left, center, or right runway) when more than one runway with the same number is available (for example, RW19R and RW19L).

Entry of other runway identifier formats, for example, RW### with a 3 digit runway number (RW018) or RW#Y with a single digit runway number (RW3R), should not be expected to successfully retrieve runway data from the FMS database.

The FMS supplies the entry format checks for runway identifiers. If the initial two characters of an entered runway identifier are not RW, the entry is rejected. If the third character of a runway identifier is not a number, the entry is rejected. If the final character of a runway identifier is an alphabetical character, the character must be L, C, or R. Otherwise, the runway identifier is rejected. If the entered runway identifier fails any of the format checks described, it is rejected and the message INVALID ENTRY shows on the CDU.

The entry of runway identifier must also be a runway in the database for the airport specified, stored under the same identifier format. If it is not in the database, the entry is rejected and the message NOT IN DATA BASE shows on the CDU.

If the RWY ID is manually entered, deleting it causes the RWY ID to revert to the flight plan runway if one exists, or to dashes if the flight plan runway is not specified. An attempt to delete a RWY ID causes the message INVALID DELETE to show if the runway identifier has been prefilled from the flight plan.

RWY WIND

The Runway Wind (RWY WIND) data field shows the headwind/tailwind, and crosswind components used to calculate the approach performance. The headwind/tailwind and crosswind components are computed by the FMS and shown at the time the WIND direction and velocity are entered on the APPROACH REF 1/5 page, when an approach runway has been identified.

If the approach data is for the ORIGIN airport, the RWY WIND data on the APPROACH REF 1/5 page is prefilled to the values that show on the TAKEOFF REF 1/5 page.

Dashes show as the RWY WIND default value after initialization. The dashes identify the RWY WIND data field as an optional pilot entry, and are interpreted as a zero wind correction factor in the approach performance calculations.

Manual entry or overwrite of the headwind or tailwind data can be completed on the APPROACH REF 1/5 page. When manually entering a positive wind (or headwind), the entry can be preceded by a positive sign (+), preceded/followed by an H, or have no direction indication. A negative wind (or tailwind) entry must be preceded by a minus sign (-), or preceded or followed by a T.

The crosswind component cannot be entered manually. The crosswind component display is removed whenever a headwind/tailwind value is entered manually. An FMS-computed headwind/tailwind does not overwrite a manually entered headwind/tailwind. manually entered wind values show in large font. FMS-computed wind values show in small font.

If RWY ID is the same for the TAKEOFF REF 1/5 page and ORIGIN APPROACH REF 1/5 page (including the case where RWY ID is not specified and dashes show on both TAKEOFF REF 1/5 page and ORIGIN APPROACH REF 1/5 page), a manual entry to RWY WIND on the TAKEOFF REF 1/5 page causes a corresponding update to the RWY WIND on the ORIGIN APPROACH REF 1/5 page and vice

versa. Similarly, under these conditions, deletion of a manually entered RWY WIND on the TAKEOFF REF 1/5 page causes a corresponding deletion of RWY WIND on the ORIGIN APPROACH REF 1/5 page and vice versa. No synchronization occurs between the manual entry of RWY WIND on the TAKEOFF REF 1/5 page and ORIGIN APPROACH REF 1/5 page if the RWY ID on the two pages is not the same. No synchronization occurs between the manual entry of RWY WIND on the TAKEOFF REF 1/5 page and the RWY WIND that shows on the Destination APPROACH REF 1/5 page.

Headwind values greater than 30 knots can be entered/calculated on the APPROACH REF 1/5 page. In the case of a headwind component greater than 30 knots, it must be noted that a value of 30 knots is used for the Approach Vspeeds calculations as per the AFM.

If a manually entered headwind or tailwind component is deleted, the manual wind value is replaced with the FMS-computed headwind or tailwind and crosswind components, when available. If the computed wind components are not available (WIND direction/velocity or Approach runway is unspecified), deletion of the manual headwind/tailwind causes the RWY WIND data field to show dashes.

If FMS-computed headwind/tailwind and crosswind components, or dashes show for RWY WIND, attempting to perform a DELETE command on the RWY WIND line causes the scratchpad message INVALID DELETE to show.

Manual entry of a RWY WIND component (headwind or tailwind) does not remove the value of airport WIND (direction/velocity) that shows.

Computation of the Approach Reference Vspeed is based on the RWY WIND that shows on APPROACH REF 1/5 page, whether the RWY WIND value has been computed by the FMS based on the WIND (direction/velocity) entry or if the value has been manually entered directly into the RWY WIND field as a headwind or tail component.

RWY LENGTH

The Runway Length (RWY LENGTH) data field shows the runway length used in approach performance calculations. When the ACT FPLN specifies a runway for the selected airport, the RWY LENGTH data that shows on the APPROACH REF 1/5 page that is retrieved from the navigation database. If the runway for the selected airport is not specified in the ACT FPLN, must-enter boxes show in the RWY

LENGTH data field to indicate a required pilot entry. Manual entry of RWY LENGTH is available on the APPROACH REF 1/5 page. In addition, overwriting the prefilled flight plan RWY LENGTH is provided to allow the pilot to enter an adjusted value. A manually entered RWY LENGTH value shows in large white font while a database value shows in small white font.

The RWY LENGTH can show in either feet (the default) or meters. A numerical entry preceded/followed with an F or M, or without units, is an allowable entry. The FMS interprets a numerical entry without units to be the same units that currently show. Deletion of an entered value returns the runway-length display to the default setting or database value, whichever is applicable.

The FMS compares the values of the available landing runway length and the computed landing field length. If the landing field length exceeds available landing runway length, the RWY LENGTH and RWY ID data show in yellow. In addition, the CDU message CHECK APPROACH PERF shows in yellow when the aircraft is airborne.

RWY COND

The Runway Condition (RWY COND) data field represents the Runway Condition selected for use in approach performance computations. The selected RWY COND shows in large green font, while the other options show in small white font. Alternate runway conditions can be selected by pushing the RWY COND line select key, and cycling through the available options.

WIND

The WIND data field shows wind direction and velocity. Dashes are the default value that shows in this field after initialization. Dashes are used to represent an optional pilot entry for WIND (direction/velocity) and are interpreted as a zero wind. The wind direction can be referenced to magnetic (M), the default, or true north (T).

If the manually entered WIND direction is not within the range 000 to 360, the message INVALID ENTRY shows. Likewise, if the WIND velocity is not within the range specified by the Vspeed database, the scratchpad message INVALID ENTRY shows.

WIND direction and velocity can be entered together (for example, 200/25) or individually (for example, 200 or /25). The wind direction can

be referenced to either magnetic (M) or true (T) north by preceding or following the wind direction with the corresponding letter. The default direction reference is magnetic. A wind direction entry without units is interpreted as the same units currently that shows.

When the wind direction and velocity are entered, the FMS computes and shows the corresponding headwind/tailwind and crosswind components in the RWY WIND field if the selected runway is defined.

If the ORIGIN airport is selected on the APPROACH REF 1/5 page (via the airport selection field), the WIND value that shows on the APPROACH REF 1/5 page is the same value on the TAKEOFF REF 1/5 page. A change to the APPROACH REF 1/5 page WIND value also changes the TAKEOFF REF 1/5 page WIND value under these conditions and vice versa.

OAT

The Outside Air Temperature (OAT) data field defines the temperature used in approach performance calculations. When OAT is not specified, must-enter boxes show in the OAT data field to indicate this is a required pilot entry item. OAT can be entered in either degrees Celsius (the default) or degrees Fahrenheit by entering the numerical value preceded/followed by the letter C or F. The FMS interprets a temperature entry without units to be in the same units that currently show.

If the OAT entered is not within the range specified by the Vspeed database, the scratchpad message INVALID ENTRY shows.

If the ORIGIN airport is selected on the APPROACH REF 1/5 page (via the airport selection field), the OAT value that shows on the TAKEOFF REF 1/5 page is the same value on the APPROACH REF 1/5 page. Under these conditions, a change to the OAT on the TAKEOFF REF 1/5 page causes a corresponding change to OAT on the APPROACH REF 1/5 page and vice versa.

QNH

The barometric pressure correction (QNH) data field is a required input parameter for the computation of approach performance data. Normally, barometric pressure correction is available to the FMS from the avionics system. Barometric pressure correction for the APPROACH REF pages is taken from the autopilot transfer side of the aircraft (when both ADC sources are valid and the ADC reversion switch is set to Normal). Under

these conditions, barometric pressure correction for the APPROACH REF pages can be set on the ARP control panel associated with the autopilot transfer side of the aircraft.

If QNH is not available from the avionics system, must-enter boxes show on the APPROACH REF 1/5 page to indicate a required pilot entry. A manual entry/overwrite of the QNH is supported on the APPROACH REF 1/5 page. The manually entered QNH value shows in large white font while a QNH value from the avionics system shows in small white font. QNH can show in either inches mercury (default) or Hectopascals by entering the numerical value preceded/followed by the letter H or I.

If the ORIGIN airport is selected on the APPROACH REF 1/5 page (via the airport selection field), the QNH value that shows on the APPROACH REF 1/5 page is the same value on the TAKEOFF REF 1/5 page. Changing the QNH on the APPROACH REF 1/5 page causes a corresponding change to the QNH on the TAKEOFF REF 1/5 page and vice versa.

A manually entered value of QNH has priority over a QNH value whose source is the avionics system. The QNH value from the avionics system does not overwrite the manual QNH entry.

P ALT

The Pressure Altitude (P ALT) data field indicates the airport field elevation for the selected airport, corrected for ambient barometric pressure. If the selected airport is specified in the flight plan, the airport field elevation is retrieved from the navigation database, and the QNH specified on the APPROACH REF 1/5 page is applied for barometric correction.

When pressure altitude data is unspecified, the P ALT data field shows must-enter boxes to indicate a pilot entry is required. A manual entry or overwrite of Pressure Altitude is provided on the APPROACH REF 1/5 page. P ALT units are always feet. Deletion of manually entered value returns the P ALT display to the computed value or must-enter boxes, whichever is applicable. A manually entered P ALT value shows in large white font while a computed value shows in small white font.

Manual entry of P ALT on the TAKEOFF REF 1/5 page causes a corresponding update to P ALT on the APPROACH REF 1/5 page for the ORIGIN airport and vice versa. Manual entry of P ALT on the

TAKEOFF REF 1/5 page does not synchronize with the P ALT on the APPROACH REF 1/5 page for the DEST airport.

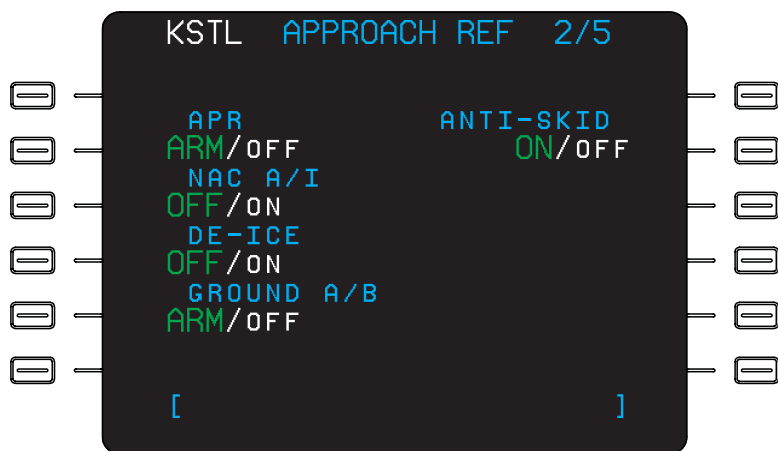
RWY SLOPE

Runway Slope (RWY SLOPE) is used in the approach performance calculations. Runway slope values are only made available through manual entry. Dashes show as the default value in this field after initialization. Dashes represent an optional pilot entry for Runway Slope and are interpreted as a zero slope correction factor in the approach performance calculations. A positive slope entry (or UP entry) can be preceded or followed by a U (the U is optional). A negative entry (or DOWN entry) requires a D, or minus sign, preceded or followed by the numerical value.

APPROACH REF 2/5 PAGE

The APPROACH REF 2/5 page shows data fields for aircraft configuration to include the Automatic Power Reserve (APR) state, nacelle anti-ice, surface de-ice, ground air brake, and anti-skid status.

Figure 16-13 APPROACH REF 2/5 Page



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APR

The APR data field represents the planned Automatic Power Reserve configuration for the approach conditions. It does not represent the actual/sensed APR setting. The selected APR setting on the APPROACH REF 2/5 page shows in large green font, while the alternate APR setting shows in small white font. Alternate planned automatic power reserve conditions can be selected by pushing the APR line select key on the APPROACH REF 2/5 page to cycle through the available options (ARM/OFF).

NAC A/I

The NAC A/I data field represents the expected nacelle bleed (anti-ice) configuration for the approach conditions. The selected NAC A/I condition shows in large green font, while the other option shows in small white font. Push the line select key adjacent to NAC A/I to cycle between the available conditions (OFF/ON) on the APPROACH REF 2/5 page.

DE-ICE

The DE-ICE data field represents the expected Surface De-Ice configuration for the approach conditions. The selected DE-ICE condition shows in large green font, while the other option shows in small white font. Push the line select key adjacent to DE-ICE to cycle between the available conditions (OFF/ON) on the APPROACH REF 2/5 page.

GROUND A/B

The GROUND A/B data field represents the expected Ground Air Brake configuration for the approach conditions. The selected GROUND A/B condition shows in large green font, while the other options show in small white font. Push the line select key adjacent to GROUND A/B to cycle between the available Ground Air Brake conditions (ARM/MAN/INOP) on the APPROACH REF 2/5 page.

ANTI-SKID

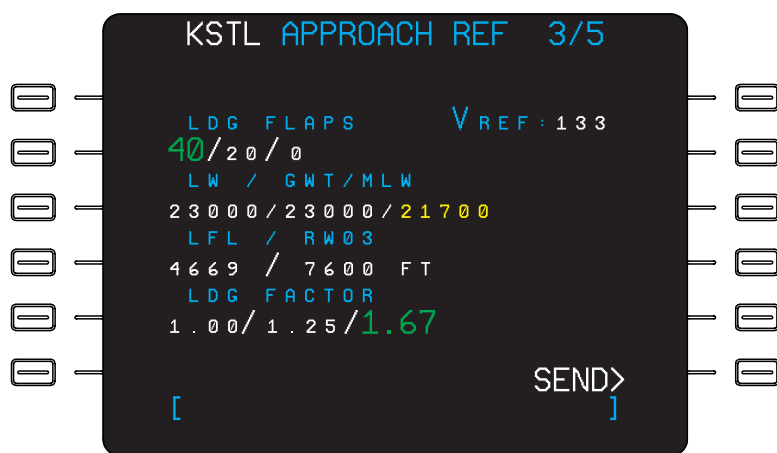
The ANTI-SKID data field represents the expected anti-skid configuration for the approach conditions. The selected ANTI-SKID condition shows in large green font, while the other option shows in

small white font. Push the line select key adjacent to ANTI-SKID to cycle between the available conditions (ON/OFF) on the APPROACH REF 2/5 page.

APPROACH REF 3/5 PAGE

The APPROACH REF 3/5 page shows data fields for the approach Vspeed, landing weight data, landing runway length data, and landing factor to be applied to approach computations. It also allows the computed Approach Vspeed to be sent for display on the PFD airspeed scale.

Figure 16-14 APPROACH REF 3/5 Page



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LDG FLAPS

The Landing Flaps (LDG FLAPS) configuration data field represents the expected landing flaps configuration for aircraft approach conditions. The selected LDG FLAPS setting shows in large green font, while the other LDG FLAPS options show in small white font. Alternate LDG FLAPS settings can be selected by pushing the LDG FLAPS line select key on the APPROACH REF 3/5 page and cycling through the available options (40/20/0).

LW

Landing Weight (LW) is a required input parameter for the computation of approach performance data. Landing weight is prefilled to the aircraft Gross Weight (GWT) at the time the APPROACH REF pages are accessed (from a non-APPROACH REF page). Once prefilled, the LW value is not updated again while the APPROACH REF pages show.

A manual entry/overwrite of the landing weight is supported on the APPROACH REF 3/5 page that allows the pilot to enter an adjusted weight. A manually entered landing weight value should not be overwritten by a prefilled landing weight, without additional pilot action. If the pilot attempts to enter a landing weight that is not within the weight range specified by the Vs speeds database, the scratchpad message INVALID ENTRY shows. A manually entered landing weight value shows in large white font while a prefilled LW value shows in small white font.

When the ORIGIN airport is selected (via the airport selection field) and Takeoff Weight (TOW) has been manually entered on the TAKEOFF REF 3/5 page, the LW on the APPROACH REF 3/5 page is prefilled with the TOW.

When an FMS-computed landing weight shows on the APPROACH REF 3/5 page and the approach Vs speeds show on the PFD, the FMS system freezes the landing weight that shows. The freeze remains until the approach Vs speeds are deselected and the pilot accesses the APPROACH REF pages from a non-APPROACH REF page.

The LW values are synchronized on the APPROACH REF pages.

NOTE



Landing Weight (LW) is not continuously updated to current Gross Weight (GWT) while the APPROACH REF 2/5 page is showing. An update of LW to the current aircraft GWT can be accomplished by using the DELETE command to update the LW that shows.

If the ACT FPLN gross weight is not specified, the LW data field shows must-enter boxes to indicate a required pilot entry for landing weight.

When the landing weight is entered manually and a DELETE command is performed, the landing weight reverts to the current gross weight, if the gross weight is available and within the range for landing weight specified by the Vspeed database. If the gross weight is not available, must-enter boxes shows for the landing weight value.

If the Landing Weight that currently shows is an FMS-computed value, or must-enter boxes show and a DELETE command is performed, the scratchpad message INVALID DELETE shows.

GWT

The GWT that shows on the APPROACH REF 3/5 page is specified on the flight plan PERF INIT 1/3 page. If the gross weight is unspecified, the GWT data field on the APPROACH REF 3/5 page is blank.

The system initializes the gross weight to the value on the PERF INIT 1/3 page any time the APPROACH REF pages are accessed from a non-approach reference page. The GWT is periodically updated to the gross weight value on the PERF INIT 1/3 page if the flight plan GWT has been specified.

Once the approach Vspeed values are correctly sent to the PFD for display, a pilot-entered change to aircraft gross weight on the PERF INIT 1/3 page causes the following to occur:

- A corresponding update to the GWT value on the TAKEOFF REF 3/5 page
- An update of the TOW on the TAKEOFF REF 3/5 page to the new GWT value
- Removal of the FMS-sourced approach Vspseds from the PFD display
- Display of the message VSPEEDS DESELECTED on the CDU.

MLW

Maximum Landing Weight (MLW) is determined by the most restrictive of the following weight limits: structural, climb performance, runway length, and brake energy. In cases where Maximum Landing Weight is unable to be computed, the MLW data field is blank.

When LW is greater than MLW, the maximum landing weight shows in yellow. In addition, the CDU message CHECK APPROACH PERF shows under these conditions.

MLW values are synchronized on the APPROACH REF pages.

ALD OR LFL/RWY LENGTH

The pilot can choose between Actual Landing Distance (ALD) and Landing Field Length (LFL) as the desired display format for the required runway length on the APPROACH REF page. Actual landing distance is the distance for landing and is computed from a 50 foot height above the runway at VREF with flaps at 45 degrees to a full stop. Entering an A or a D into the CDU scratchpad and pushing the line select key adjacent to the landing length data selects ALD for display. Entering an L into the CDU scratchpad and pushing the line select key adjacent to the landing length data selects Landing Field Length (LFL) for display. Landing length display can also be changed on DEFAULTS 5/5 page to show ALD instead of LFL.



NOTE

Selection of LFL or of ALD on the APPROACH REF 3/5 page is synchronized with the default setting that shows on the DEFAULTS 5/5 page. A change to the display format selection on the APPROACH REF 3/5 page results in a change to the default setting on the DEFAULTS 5/5 page.

The ALD or LFL data field shows a computed value for the runway length required. Adjacent to it on the APPROACH REF 3/5 page is the selected approach RWY LENGTH (runway length available). When the ACT FPLN specifies the selected runway, the RWY LENGTH available value that shows is the runway length retrieved from the navigation database. If unspecified, must-enter boxes show to indicate a required pilot entry for the RWY LENGTH available. The value for ALD/LFL shows in small white font, except when ALD/LFL is unable to be computed, then ALD/LFL is blank. A manual entry/overwrite of the RWY LENGTH available is supported to allow the pilot to enter an adjusted value. A manually entered RWY LENGTH available value shows in large white font. Deletion of an entered value returns the RWY LENGTH available display to the default setting value or database value, whichever is applicable.

The ALD/LFL will show in the same units as the RWY LENGTH. Both the ALD/LFL and RWY LENGTH available can show in either feet (which is the default) or meters. A numerical entry preceded/followed with an F or M, or without units, would be an allowable entry. A numerical entry without units is interpreted as the same units as what currently shows.

If the ALD/LFL is larger than the approach RWY LENGTH, the approach RWY LENGTH readout shows in yellow on the APPROACH REF 1/5 and APPROACH REF 3/5 pages and the runway identifier shows in yellow on APPROACH REF 1/5 page. In addition, the CDU message CHECK APPROACH PERF shows.

LDG FACTOR

The Landing Factor (LDG FACTOR) field is used to select the landing factor that is to be applied to approach performance calculations. The selected LDG FACTOR (1.00, 1.25, or 1.67) is applied to the LFL value. A LDG FACTOR of 1.00 equals the actual landing distance. The selected LDG FACTOR shows in large green font, while the other LDG FACTOR options show in small white font. Alternate LDG FACTOR settings can be selected by pushing the LDG FACTOR line select key on the APPROACH REF 3/5 page and cycling through the available options.

V_{REF}

The APPROACH REF page shows the computed value for the Approach Vspeed: V_{REF} (Reference Speed).

The FMS-computed values for APPROACH REF Vspeed shows in white on the CDU and MFD when the approach reference Vspeed has not been selected to show on the PFD. The FMS-computed value for approach Vspeed shows in cyan on the CDU and MFD when it has been successfully selected to show on the PFD.

SEND

The SEND line select key on the APPROACH REF 3/5 page is used to transmit the Approach Vspeed to show on the PFD. When the SEND command is initiated, the status message IN PROGRESS shows above the SEND line select key. COMPLETE shows when the Vspeed value is correctly transferred to the PFD. If the Vspeed transfer to the PFD fails, the FAILED status message shows.

The Approach Reference Vspeed must be valid before it is sent to show on the PFD. If the APPROACH REF Vspeed value is not valid, then selection of the SEND function causes the scratchpad message KEY NOT ACTIVE to show.

The line select key adjacent to SEND function is used to initiate the transfer of the Approach Reference Vspeed from the FMS to show on the PFD. This can only be completed if the aircraft is airborne. If the line select key adjacent to SEND on the APPROACH REF 3/5 page is pushed while the aircraft is on the ground, the scratchpad message KEY NOT ACTIVE shows.

Pushing the SEND line select key while the system is operating in the INDEP mode prevents the approach Vspeed from being sent to the PFD. The CDU scratchpad message SEND N/A – NOT IN SYNC shows.

At the time the FMS approach Vspeed is sent to show on the PFD, all of the Approach Vspeed input and output parameters are latched. Once the approach Vspeed value is correctly sent to show on the PFD, a change to the state or value of any parameter used to determine the FMS approach Vspeed removes the FMS-sourced Approach Vspeed from the PFD display. The CDU message VSPEEDS DESELECTED shows.

Performing an FMS SYNC operation causes the VSPEEDS DESELECTED message to flash as a CDU message, regardless of whether Takeoff Reference or Approach Reference Vspseds have been posted on the PFD.

APPROACH REF 4/5 PAGE

The APPROACH REF 4/5 page shows data fields for landing weight information and approach climb gradient performance data.

Figure 16-15 APPROACH REF 4/5 Page



LW/MLW

LW and MLW values are synchronized on the APPROACH REF pages.

OVER

When the expected LW exceeds the MLW, the APPROACH REF 4/5 page will show the legend OVER (in cyan) and the numerical value by which the aircraft is overweight (in yellow).

APP CLB GRAD

The FMS computes and shows Approach Climb Gradient (APP CLB GRAD) based on inputs specified on the APPROACH REF pages. The gradient shows in units of either feet per nautical mile (FT/NM) or percentage (%), based upon the selection from the DEFAULTS 5/5 page.

If the approach climb gradient shows, and the value is below the minimums specified for the APP CLB GRAD (2.1%), the approach

climb gradient field shows in yellow, and the CDU message CHECK APPROACH PERF shows in yellow.

LDG CLB GRAD

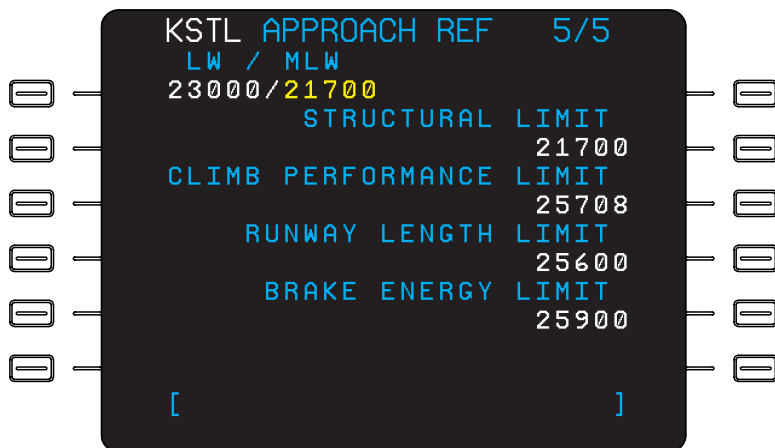
The FMS computes and shows Landing Climb Gradient (LDG CLB GRAD) based on inputs specified on the APPROACH REF pages. The gradient shows in units of either feet per nautical mile (FT/NM) or percentage (%), based upon the selection from the DEFAULTS 4/5 page.

If the landing climb gradient shows and the value is below the minimums specified for the LDG CLB GRAD (3.2%), the landing climb gradient field shows in yellow, and the CDU message CHECK APPROACH PERF shows in yellow.

APPROACH REF 5/5 PAGE

The APPROACH REF 5/5 page provides landing weight information and data on the structural, climb performance, runway length, and brake energy weight limits.

Figure 16-16 APPROACH REF 5/5 Page



TPH8754_01

LW/MLW

Landing Weight (LW) and Maximum Landing Weight (MLW) values are synchronized on the APPROACH REF pages.

STRUCTURAL LIMIT

The STRUCTURAL LIMIT data field shows the FMS-computed value for maximum landing weight limited by structural restrictions. This weight limit value shows in small font and cannot be modified.

CLIMB PERFORMANCE LIMIT

The CLIMB PERFORMANCE LIMIT data field shows the FMS-computed value for maximum takeoff weight limited by the climb performance. This weight limit value shows in small font and cannot be modified.

RUNWAY LENGTH LIMIT

The RUNWAY LENGTH LIMIT data field shows the FMS-computed value for maximum takeoff weight limited by runway length limitations. This weight limit value shows in small font and cannot be modified.

BRAKE ENERGY LIMIT

The BRAKE ENERGY LIMIT data field shows the FMS-computed value for maximum takeoff weight limited by brake energy restrictions. This weight limit value shows in small font and cannot be modified.

APPROACH REFERENCE TEXT PAGE ON THE MFD

The APPROACH REFERENCE MFD text page is a summary of the corresponding APPROACH REF pages on the CDU. The selection of the APPROACH REFERENCE MFD text page is described in the DISPLAYS AND CONTROLS chapter under MFD MENU. The details of the APPROACH REFERENCE MFD text page layout are described further in the DISPLAYS AND CONTROLS chapter under MFD TEXT DISPLAY for TAKEOFF/APPROACH REFERENCE.

COMPUTE APPROACH REFERENCE VSPEEDS

APPROACH REFERENCE AIRPORT

Approach data for either the ORIGIN or DEST airport is determined by the SEL APT prompt. The ORIGIN airport is the default when the aircraft is either:

- Within 50 NM of the airport
- Less than halfway along the flight plan route, whichever is the lesser distance.

This airport selection is made at the time the APPROACH REF 1/5 page initially shows and it is not automatically updated while the page is viewed on either the CDU or the MFD.

Once the aircraft has passed outside the preceding criteria, the DEST airport becomes the default selection (and applies the next time an APPROACH REF page is accessed from a non-APPROACH REF page).

Approach data for the desired airport can be manually changed by pushing the line select key adjacent to SEL APT. However, once an airport is selected manually, the default selection function is no longer active, unless the pages are reset via an ACT FPLN airport change.

The information that needs to be set up by the pilot on the APPROACH REF pages is for the flight plan ORIGIN airport and a second set of approach information for the DEST airport.

The FMS keeps track of the input and output parameters for each airport. However, it shows only one set of information at a time, based upon the SEL APT between the flight plan ORIGIN airport and DEST airport.

The tables that follow show the input parameters for approach to the ORIGIN or DEST airports that can be defined by the pilot as follows, and the FMS-computed outputs for approach to the ORIGIN or DEST airport.

INPUTS – ORIGIN AIRPORT	INPUTS – DESTINATION AIRPORT
RWY ID	RWY ID
RWY WIND	RWY WIND

INPUTS – ORIGIN AIRPORT	INPUTS – DESTINATION AIRPORT
RWY LENGTH	RWY LENGTH
RWY COND	RWY COND
WIND	WIND
OAT	OAT
QNH	QNH
P ALT	P ALT
RWY SLOPE	RWY SLOPE
APR	APR
NAC A/I	NAC A/I
DE-ICE	DE-ICE
GROUND A/B	GROUND A/B
ANTI-SKID	ANTI-SKID
LDG FLAPS	LDG FLAPS
LW	LW
LDG FACTOR	LDG FACTOR

OUTPUTS - ORIGIN AIRPORT	OUTPUTS - DESTINATION AIRPORT
LFL/ALD	LFL/ALD
GWT	GWT
MLW	MLW
Approach Vspeed: V_{REF}	Approach Vspeed: V_{REF}
APP CLB GRAD	APP CLB GRAD
LDG CLB GRAD	LDG CLB GRAD
STRUCTURAL LIMIT Weight	STRUCTURAL LIMIT Weight
CLIMB PERFORMANCE LIMIT Weight	CLIMB PERFORMANCE LIMIT Weight

OUTPUTS - ORIGIN AIRPORT	OUTPUTS - DESTINATION AIRPORT
RUNWAY LENGTH LIMIT Weight	RUNWAY LENGTH LIMIT Weight
BRAKE ENERGY LIMIT Weight	BRAKE ENERGY LIMIT Weight

For the pilot, this means setting up the inputs on the APPROACH REF pages two times for Approach Vspeeds calculations that can be performed.

- The first calculation uses the ORIGIN airport as the selected arrival airport.
- The second calculation uses the DEST airport as the selected arrival airport.

Thereafter, if the SEL APT is changed on the APPROACH REF 1/5 page, the corresponding values for the selected arrival airport are restored to the APPROACH REF pages for display.

SET UP THE FMS FOR APPROACH REFERENCE VSPEEDS

To set up the FMS to compute Approach Reference Vspeeds data, do the steps that follow:

1. Create a flight plan. (Refer to the FLIGHT PLANNING chapter for details on creating a flight plan).



NOTE

The FMS is required to be in the air and operating in SYNC mode to transmit Approach Vspeeds to the PFD. If the FMS is operating in INDEP mode, it is necessary to select SYNC mode on the FMS CONTROL page and select an FMS Sync Master.

When creating the flight plan, make sure to:

- Enter an ORIGIN airport. This becomes the ORIGIN airport in the SEL APT data field for the APPROACH REF pages.
- Enter a Destination (DEST) airport. This becomes the DEST airport in the SEL APT data field for the APPROACH REF pages.
- Select a Departure Runway or a SID with a Departure Runway. This becomes the Approach Runway on the APPROACH REF pages.

- When appropriate, define a STAR Transition and Approach using the DEP/ARR INDEX and ARRIVAL pages. This defines the arrival airport for the APPROACH REF pages when the DEST airport is selected.
 - Make sure that the flight plan is correct, and push the EXEC function key on the CDU to execute the flight plan.
2. Initialize Performance on the PERF INIT pages. (Refer to the PERFORMANCE chapter for details on Performance Initialization).

Make sure that all of the required inputs have been made to allow the FMS to compute and show Gross Weight (GWT) on the PERF INIT 1/3 page. Execute the PERF INIT entries.

3. Push the PERF function key on the CDU to show the PERF MENU page.

**NOTE**

If Takeoff Reference Vs speeds values have not already been set up on the TAKEOFF REF pages, the Compute Takeoff Reference Vs speeds procedure should be completed first. Refer to the section that begins on page 16-28 for instructions.

4. Push the APPROACH line select key on the PERF MENU page to show the APPROACH REF 1/5 page.
5. Make sure that the airport identified on the APPROACH REF 1/5 page title line corresponds to the highlighted airport in the SEL APT field.

**NOTE**

If the SEL APT data field and the airport identifier field are blank on the title line of the APPROACH REF pages, it indicates that the flight plan has not been entered and the ORIGIN and DEST airports have not been defined.

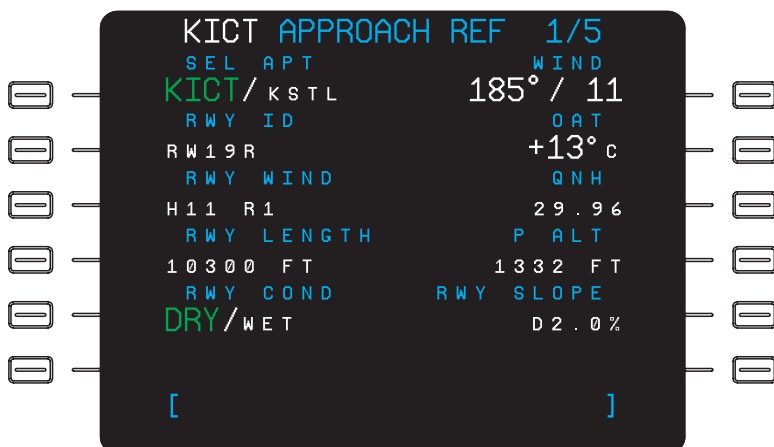
**NOTE**

Manual entry of the airport identifier is NOT supported on the APPROACH REF pages. The airport identifier must be entered on the FPLN page using the ORIGIN and DEST airport data fields.

APPROACH REF 1/5 (ORIGIN AIRPORT)

To compute Approach Reference Vs speeds data for the ORIGIN airport, do the steps that follow:

Figure 16-17 APPROACH REF 1/5 Page (ORIGIN Airport)



TPG9209_86

6. Make the flight plan ORIGIN airport the highlighted selection in the SEL APT data field. Push the SEL APT line select key if necessary to make this selection.
7. Make sure that the runway identifier for the arrival runway associated with the ORIGIN airport has been prefilled and shows in the RWY ID data field on the APPROACH REF 1/5 page.

**NOTE**

If the RWY ID field on the APPROACH REF 1/5 page shows dashes, the arrival runway has not been entered into the ACT FPLN. The flight crew can enter the arrival runway in the flight plan (using the DEP ARR function key, the DEP/ARR INDEX page, and the ARRIVAL page). This allows the APPROACH REF 1/5 page RWY ID to be prefilled from the ACT FPLN identified arrival runway. The APPROACH REF 1/5 page RWY ID field also accepts manual entry of runway selection, but only accepts runways associated with the ORIGIN or DEST airport (based upon the SEL APT entry) in the flight plan as valid entries. In addition, manual entry of the runway identifier on the APPROACH REF 1/5 page applies solely to the APPROACH REF 1/5 page and does not cause an update to arrival runway selection on the ACT FPLN.

**NOTE**

Manual entry of RWY ID on the APPROACH REF 1/5 page causes removal of some previously entered manual data entries on the APPROACH REF 1/5 page. The flight crew must re-enter the data for correlation to the new runway alignment. Manual entry of RWY ID on the APPROACH REF 1/5 page removes the manually entered RWY WIND headwind or tailwind and cause an update to be performed for FMS-computed RWY WIND (headwind/tailwind and crosswind components). It also removes the manually entered RWY LENGTH data field and causes an update to RWY LENGTH from the navigation database. The flight crew is required to re-enter appropriate new values for these parameters.

8. Make sure the arrival runway length at the ORIGIN airport is prefilled, and shows in the RWY LENGTH data field on the APPROACH REF 1/5 page.

**NOTE**

If the RWY LENGTH field shows must-enter boxes on the APPROACH REF 1/5 page, it indicates the arrival runway has not been entered into the ACT FPLN. The flight crew can choose to enter the arrival runway in the flight plan (using the DEP ARR function key, the DEP/ARR INDEX page and the ARRIVAL page). This allows the APPROACH REF 1/5 page RWY LENGTH to be prefilled from the ACT FPLN arrival runway.



NOTE

The RWY LENGTH data field on the APPROACH REF 1/5 page accepts manual entry of RWY LENGTH in cases where the RWY LENGTH data field either shows must-enter boxes or is prefilled with RWY LENGTH data associated with the arrival runway. Manual entry of a RWY LENGTH on the APPROACH REF 1/5 page that overwrites a prefilled database value for RWY LENGTH.

9. Select the Runway Condition for the ORIGIN airport from the RWY COND menu on the APPROACH REF 1/5 page. Push the RWY COND line select key as many times as necessary to select the appropriate runway condition (each key push sequentially selects the next RWY COND option).



NOTE

The RWY COND selected on the APPROACH REF 1/5 page is the condition that is applied to APPROACH REF Vs speeds calculations.



NOTE

The default state for RWY COND on the APPROACH REF 1/5 page is DRY. When manual selection of RWY COND is performed on the APPROACH REF 1/5 page from the available menu, the selection applies to the current flight plan. An FMS cold start or creation of a new flight plan causes the RWY COND selection to return to the default selection.

10. Enter WIND direction and velocity for the ORIGIN airport in the APPROACH REF 1/5 page scratchpad.

11. Push the WIND line select key on the APPROACH REF 1/5 page to transfer the WIND data from the scratchpad.



NOTE

The APPROACH REF 1/5 page contains two types of wind data fields: WIND (direction/velocity) and RWY WIND (headwind/tailwind and crosswind components). When WIND (direction/velocity) data is entered, the FMS computes RWY WIND (headwind/tailwind and crosswind components) automatically when a RWY ID has been defined. As an alternative, manual entry of runway headwind or tailwind component can be defined in the RWY WIND data field, but this data field does not allow manual entry of crosswind component value.

**NOTE**

Manual entry of a RWY WIND component (headwind or tailwind) does not remove the value of airport WIND (direction/velocity) that shows. Computations of Approach Reference Vsports are performed based upon the RWY WIND (headwind/tailwind and crosswind components) that shows, regardless of whether these component values have been computed by the FMS from airport WIND (direction/velocity) or from manually entered values directly entered into the RWY WIND data field as headwind/tailwind components.

**NOTE**

Headwind values greater than 20 knots can be entered/calculated on the APPROACH REF 1/5 page. In the case of a headwind component greater than 20 knots, it must be noted that a value of 20 knots is used for the Approach Vspeed calculations as per the AFM.

**NOTE**

If the ORIGIN airport is selected on the APPROACH REF 1/5 page (via the airport selection field), the WIND value that shows on the TAKEOFF REF 1/5 page is the same value on the APPROACH REF 1/5 page. A change to the TAKEOFF REF 1/5 page WIND value also changes the APPROACH REF 1/5 page WIND value under these conditions and vice versa.

12. Enter Outside Air Temperature (OAT) for the ORIGIN airport in the APPROACH REF 1/5 page scratchpad.

13. Push the OAT line select key to enter the scratchpad data.

**NOTE**

If the flight plan ORIGIN airport is selected on the APPROACH REF 1/5 page as the SEL APT, OAT entries on the APPROACH REF 1/5 page are synchronized to the outside air temperature value of the TAKEOFF REF 1/5 page.

14. Set up Barometric Correction (QNH) for the ORIGIN airport on the ARP control panel for the arrival airport, and make sure that the QNH value is correct on the APPROACH REF 1/5 page.



NOTE

Barometric Correction (QNH) for the APPROACH REF pages on both the left and right CDU is taken from the ARP control panel that is on the aircraft side to which the AP transfer switch is selected.



NOTE

Once the SEND command is used on the APPROACH REF 3/5 page to send Approach Vspeed values to show on the PFD, the QNH that shows on the APPROACH REF 1/5 page becomes latched. It is not updated by changes in the barometric correction on the ARP until the FMS-computed Approach Vsports have been deselected from the PFD display.



NOTE

Normally QNH is pre-filled with the current altimeter setting. If QNH is not available from the avionics system, must-enter boxes show to indicate a required pilot entry.

15. Make sure that pressure altitude for the arrival airport (in this case the ORIGIN airport) is pre-filled and shows in the P ALT data field on the APPROACH REF 1/5 page.



NOTE

If the selected airport (ORIGIN or DEST airport) is specified in the flight plan, the airport field elevation is retrieved from the navigation database and the QNH specified on the APPROACH REF 1/5 page is applied for barometric correction. When pressure altitude data is unspecified, the P ALT data field shows must-enter boxes to indicate a pilot entry is required. In addition, a manual entry/overwrite of P ALT is provided on the APPROACH REF 1/5 page. P ALT units are always feet.



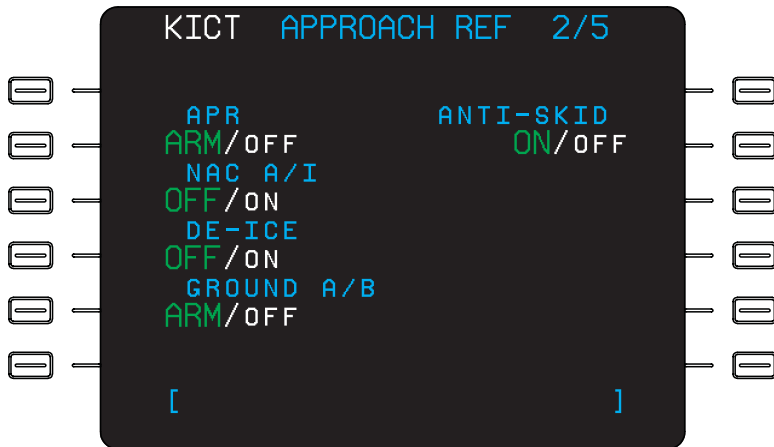
NOTE

Manual entry of P ALT data on the TAKEOFF REF 1/5 page causes a corresponding update to P ALT on the APPROACH REF 1/5 page for the ORIGIN airport and vice versa. Manual entry of P ALT data on the TAKEOFF REF 1/5 page does not synchronize with the P ALT data on the APPROACH REF 1/5 page for the DEST airport.

APPROACH REF 2/5 (ORIGIN AIRPORT)

16. Push the NEXT function key to show the APPROACH REF 2/5 page.

Figure 16-18 APPROACH REF 2/5 Page (ORIGIN Airport)



TPH6176_02

17. Push the APR line select key to select the Automatic Power Reserve setting (ARM or OFF) that is appropriate for the anticipated approach configuration.

18. Push the NAC A/I line select key to choose a nacelle anti-ice configuration (OFF or ON) that matches the anticipated approach configuration.

19. Push the DE-ICE line select key to choose a Surface De-Ice configuration (OFF or ON) that matches the anticipated approach configuration.

20. Push the GROUND A/B line select key to choose the Ground Air Brake configuration (ARM or OFF) that matches the anticipated takeoff configuration.

21. Push the ANTI-SKID line select key to choose the Anti-Skid configuration (ON or OFF) that matches the anticipated approach configuration.



NOTE

Settings for aircraft configuration on the APPROACH REF 3/5 page represent the planned aircraft configuration for approach and landing and do not reflect the actual/sensed status of these aircraft systems.

APPROACH REF 3/5 (ORIGIN AIRPORT)

22. Push the NEXT function key to show the APPROACH REF 3/5 page.

Figure 16-19 APPROACH REF 3/5 Page (ORIGIN Airport)

KICT APPROACH REF 3/5

LDG FLAPS V REF: 133

40/20/0

LW / GWT / MLW

23000 / 23000 / 21700

LFL / RW 19R

4771 / 10300 FT

LDG FACTOR

1.00 / 1.25 / 1.67

SEND>

[]

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23. Push the LDG FLAPS line select key to select the planned flaps setting for the landing. Push the LDG FLAPS line select key as necessary to cycle through the menu selections.

24. Examine Maximum Landing Weight (MLW) from the LW/GWT/MLW data entry fields.



NOTE

Maximum Landing Weight (MLW) is determined by the most restrictive of the following weights: structural limit, climb performance limit, runway length limit and brake energy. In cases where Maximum Landing Weight cannot be computed, the MLW data field is blank.

25. Examine Gross Weight (GWT) from the LW/GWT/MLW data fields.

**NOTE**

Landing Weight (LW) is prefilled to the current Gross Weight (GWT) at the time the APPROACH REF pages are initially accessed. Once prefilled, the LW is not updated again while the APPROACH REF pages show on the CDU or MFD.

**NOTE**

Aircraft Gross Weight is specified on the flight plan PERF INIT 1/3 page. Gross Weight (GWT) on the APPROACH REF 3/5 page is prefilled to the aircraft gross weight at the time the APPROACH REF pages are accessed (from a non-APPROACH REF page). Gross weight is periodically updated to the GWT value on the PERF INIT 1/3 page if the flight plan GWT has been specified.

**NOTE**

If Gross Weight is unspecified, the GWT data field on the APPROACH REF 3/5 page is blank.

**NOTE**

Once the APPROACH REF Vspeed values are sent to the PFD for display, a pilot-entered change to aircraft Gross Weight on the PERF INIT 1/3 page causes a corresponding update to the Gross Weight (GWT) value on the AP page, updates to the Landing Weight to the new GWT value, removes the FMS-sourced Approach Vspeeds from the PFD display, and causes the message VSPEEDS DESELECTED to show on the CDU.

26. Enter the planned Landing Weight (LW) at the ORIGIN airport in the scratchpad, if different from the LW that shows.

27. Push the LW/GWT/MLW line select key to transfer the LW entry from the scratchpad.



NOTE

The Landing Weight is preset to the Gross Weight (GWT) value, unless a manual entry for Landing Weight has been performed. A manual entry/overwrite of the LW is supported on the APPROACH REF 3/5 page that allows the pilot to enter an adjusted weight. A manually entered Landing Weight value should not be overwritten by a prefilled LW, without additional pilot action. A manually entered Landing Weight value shows in large white font while a prefilled LW value shows in small white font.



NOTE

If any input value is changed (for example, LW), the Approach Vspeed data field goes blank momentarily while the FMS is computing the Vspeed based upon the new data. The FMS shows the new Approach Vspeed.

28. Examine RWY ID and RWY LENGTH (for arrival at the ORIGIN airport) on the APPROACH REF 3/5 page.



NOTE

The selected approach RWY LENGTH indicates the runway length available. When the ACT FPLN specifies the selected runway, the RWY LENGTH available value that shows is the runway length retrieved from the navigation database. If unspecified, must-enter boxes show to indicate a required pilot entry for RWY LENGTH available. The pilot can choose to either add the arrival runway to the ACT FPLN or manually enter the RWY LENGTH on the APPROACH REF 1/5 page.



NOTE

A manual entry/overwrite of the RWY LENGTH available is supported to allow the pilot to enter an adjusted value. A manually entered Runway Length available shows in large white font. Runway length available can show in either feet (default) or meters. A numerical entry preceded or followed with an F or M, or without units would be an allowable entry. The FMS interprets a numerical entry without units to be the same units that currently show. Deletion of an entered value returns the RWY LENGTH available display to the database value.

29. Examine the FMS-computed value for LFL on the APPROACH REF 3/5 page to determine whether the computed LFL runway length required is within the arrival runway length.

 **NOTE**

The LFL/ALD data field shows the computed value for the runway length required. The LFL/ALD shows in the same units as the RWY LENGTH. Both can show in either feet (default) or meters.

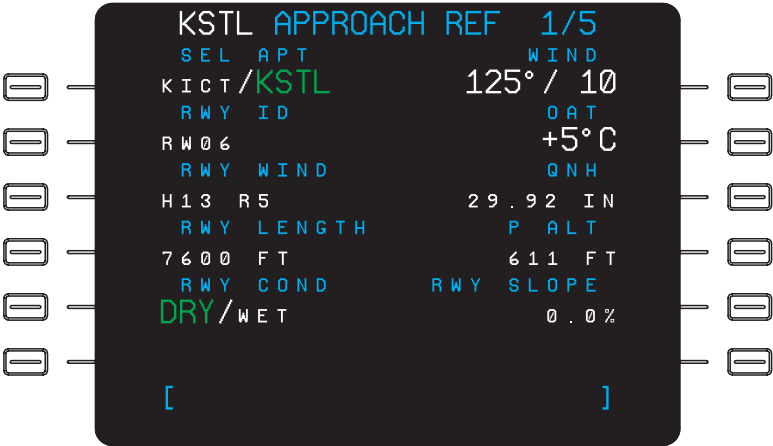
 **NOTE**

If the LFL/ALD is larger than the approach RWY LENGTH, the approach RWY LENGTH shows in yellow on the APPROACH REF 1/5 and APPROACH REF 3/5 pages. The runway identifier shows in yellow on the APPROACH REF 1/5 page. In addition, the message CHECK APPROACH PERF shows on the CDU.

APPROACH REF 1/5 (DEST AIRPORT)

To compute Approach Reference Vsports data for the DEST airport, do the steps that follow:

Figure 16-20 APPROACH REF 1/5 Page (DEST Airport)



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30. Make sure the flight plan DEST airport is the highlighted selection in the SEL APT data field. Push the SEL APT line select key if necessary to make this selection.

31. Make sure that the runway identifier for the arrival runway associated with the DEST airport has been prefilled and shows in the RWY ID field on the APPROACH REF 1/5 page.



NOTE

If the RWY ID field shows dashes on the APPROACH REF 1/5 page, it indicates the arrival runway has not been entered into the ACT FPLN. The flight crew can choose to enter the arrival runway in the flight plan (using the DEP ARR function key, the DEP/ARR INDEX page and the ARRIVAL page). This allows the APPROACH REF 1/5 page RWY ID to be prefilled from the ACT FPLN arrival runway. The APPROACH REF 1/5 page RWY ID field also accepts manual entry of runway selection, but only accepts runways associated with the flight plan ORIGIN or DEST airport (based upon the SEL APT entry) as valid entries. In addition, manual entry of the runway identifier on the APPROACH REF 1/5 page applies solely to the APPROACH REF 1/5 page and does not cause an update to arrival runway selection on the ACT FPLN.



NOTE

Manual entry of RWY ID on the APPROACH REF 1/5 page removes some previously entered manual data entries on the APPROACH REF 1/5 page, and they must be entered again for correlation to the new runway alignment. Manual entry of RWY ID on the APPROACH REF 1/5 page causes removal of manually entered RWY WIND headwind or tailwind, and causes an update to be performed for FMS-computed RWY WIND headwind/tailwind, and crosswind components. It also removes the manually entered Runway Length and causes an update to RWY LENGTH from the navigation database. The flight crew is required to re-enter appropriate new values for these parameters.

32. Make sure the arrival runway length at the DEST airport is prefilled, and shows in the RWY LENGTH data field on the APPROACH REF 1/5 page.

**NOTE**

If the RWY LENGTH field shows must-enter boxes on the APPROACH REF 1/5 page, the arrival runway has not been entered into the ACT FPLN. The flight crew can choose to enter the arrival runway in the flight plan (using the DEP ARR function key, the DEP/ARR INDEX page and the ARRIVAL page). This allows the APPROACH REF 1/5 page RWY LENGTH to be prefilled from the ACT FPLN arrival runway. Alternatively, the crew can choose to manually enter a RWY LENGTH value directly on the APPROACH REF 1/5 page.

**NOTE**

The RWY LENGTH data field on the APPROACH REF 1/5 page accepts manual entry of Runway Length in cases where the RWY LENGTH data field either shows must-enter boxes or is prefilled with RWY LENGTH data associated with the arrival runway. The manual entry of a RWY LENGTH on the APPROACH REF 1/5 page overwrites a prefilled database value for RWY LENGTH.

33. Select the Runway Condition for the ORIGIN airport from the RWY COND menu on the APPROACH REF 1/5 page. Push the RWY COND line select key as many times as necessary to select the appropriate runway condition (each key push sequentially selects the next RWY COND option).

**NOTE**

The RWY COND selected on the APPROACH REF 1/5 page is the condition that is applied to APPROACH REF Vs speeds calculations.

**NOTE**

The default state for RWY COND on the APPROACH REF 1/5 page is DRY. When manual selection of RWY COND is performed on the APPROACH REF 1/5 page from the available menu, the selection applies to the current flight plan. An FMS cold start or creation of a new flight plan causes the RWY COND selection to return to the default selection.

34. Enter WIND data direction and velocity for the DEST airport in the APPROACH REF 1/5 page scratchpad.

35. Push the WIND line select key on the APPROACH REF 1/5 page to transfer the WIND data from the scratchpad.



NOTE

The APPROACH REF 1/5 page contains two types of wind data fields: WIND (direction/velocity) and RWY WIND (headwind/tailwind and crosswind components). When WIND data has been entered, the FMS computes RWY WIND automatically when a RWY ID has been defined. As an alternative, manual entry of runway headwind or tailwind component can be defined in the RWY WIND data field. However, the RWY WIND data field does not allow manual entry of crosswind component value.



NOTE

Manual entry of a RWY WIND component (headwind or tailwind) does not remove the value of the airport WIND (magnitude/direction) that shows. Computations of Approach Reference Vsports are based on the RWY WIND (headwind/tailwind, and crosswind components) that shows.



NOTE

Headwind values greater than 20 knots can be entered/calculated on the APPROACH REF 1/5 page. In the case of a headwind component greater than 20 knots, it must be noted that a value of 20 knots is used for the Approach Vspeed calculations as per the AFM.

36. Enter Outside Air Temperature (OAT) for the DEST airport in the APPROACH REF 1/5 page scratchpad.
37. Push the OAT line select key to enter the scratchpad data.
38. Set Barometric Correction (QNH) for the DEST airport on the ARP control panel for the arrival airport, and confirm that the QNH value is correct on the APPROACH REF 1/5 page.



NOTE

Barometric Correction (QNH) for both the Left and Right CDU APPROACH REF pages is taken from the ARP control panel that is on the aircraft side to which the AP transfer switch is selected.

**NOTE**

Once the SEND command is used on the APPROACH REF 3/5 page to send Approach Vspeed values to show on the PFD, the value that shows for QNH on the APPROACH REF 1/5 page becomes latched. It is no longer updated by changes in the barometric correction on the ARP control panel until the FMS-computed Approach Vspeeds have been deselected from the PFD display.

**NOTE**

Normally QNH is prefilled with the current altimeter setting. If QNH is not available from the avionics system, must-enter boxes show to indicate a required pilot entry.

39. Make sure that pressure altitude for the arrival airport (in this case the DEST airport) has been prefilled and shows in the P ALT data field on the APPROACH REF 1/5 page.

**NOTE**

If the selected airport (ORIGIN or DEST airport) is specified in the flight plan, the airport field elevation is retrieved from the navigation database, and the QNH specified on the APPROACH REF 1/5 page is applied for barometric correction. When pressure altitude data is unspecified, the P ALT data field shows must-enter boxes to indicate a pilot entry is required. In addition, a manual entry/overwrite of Pressure Altitude is provided on the APPROACH REF 1/5 page. P ALT units are always feet.

40. Manually enter Runway Slope on the APPROACH REF page scratchpad.

41. Push the RWY SLOPE line select key on the APPROACH REF page to transfer the slope entry from the scratchpad.

**NOTE**

After RWY SLOPE has been entered, manual entry of a new RWY ID on the APPROACH REF page removes the RWY SLOPE value, and returns the RWY SLOPE data field to dashes (interpreted as zero slope for APPROACH REF Vspeeds computations)



NOTE

After RWY SLOPE has been entered, manual entry of a new RWY LENGTH on the APPROACH REF page removes the RWY SLOPE value, and returns the RWY SLOPE data field to dashes (interpreted as zero slope for APPROACH REF Vspeeds computations).



NOTE

If RWY SLOPE has been manually entered while RWY ID is a manually defined value, deletion of the RWY ID on the APPROACH REF page also removes the RWY SLOPE value, and returns the RWY SLOPE data field to dashes (interpreted as zero slope for the Vspeeds computations)



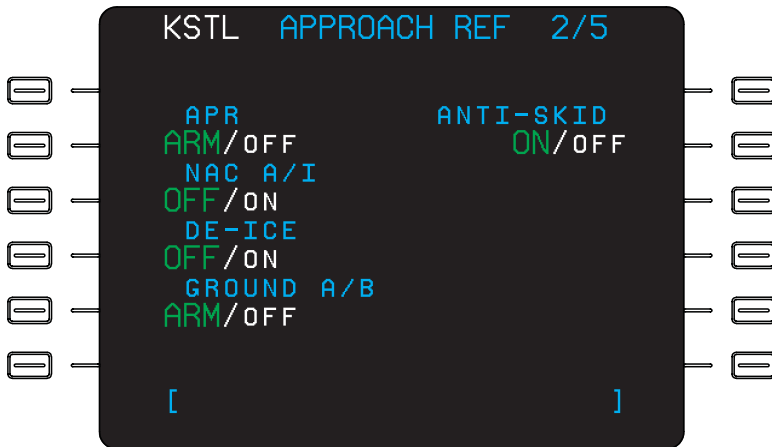
NOTE

If RWY SLOPE has been manually entered while RWY LENGTH is a manually defined value, deletion of the RWY LENGTH on the APPROACH REF page also removes the RWY SLOPE value, and returns the RWY SLOPE data field to dashes (interpreted as zero slope for Approach Vspeeds computations).

APPROACH REF 2/5 (DEST AIRPORT)

42. Push the NEXT function key to show the APPROACH REF 2/5 page.

Figure 16-21 APPROACH REF 2/5 Page (DEST Airport)



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43. Push the APR line select key to select the Automatic Power Reserve setting (ARM or OFF) that is appropriate for the anticipated approach configuration.

44. Push the NAC A/I line select key to choose a nacelle anti-ice configuration (OFF or ON) that matches the anticipated approach configuration.

45. Push the DE-ICE line select key to choose a Surface De-Ice configuration (OFF or ON) that matches the anticipated approach configuration.

46. Push the GROUND A/B line select key to choose the Ground Air Brake configuration (ARM or OFF) that matches the anticipated takeoff configuration.

47. Push the ANTI-SKID line select key to choose the Anti-Skid configuration (ON or OFF) that matches the anticipated approach configuration.



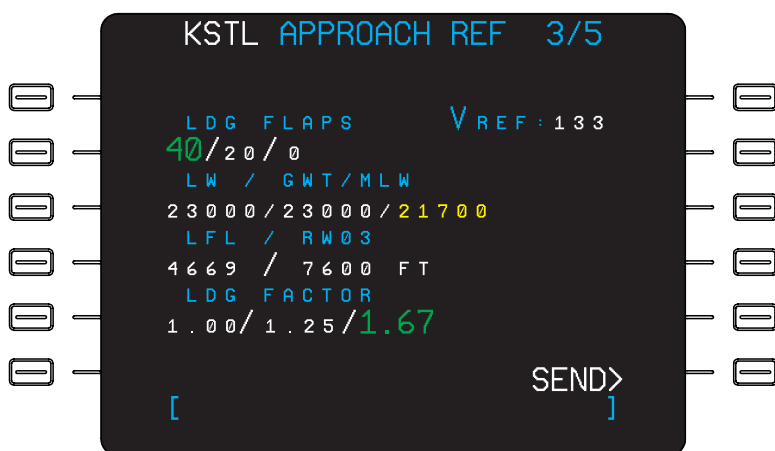
NOTE

Settings for aircraft configuration on the APPROACH REF 3/5 page represent the planned aircraft configuration for approach and landing and do not reflect the actual/sensed status of these aircraft systems.

APPROACH REF 3/5 (DEST AIRPORT)

48. Push the NEXT function key to show the APPROACH REF 3/5 page.

Figure 16-22 APPROACH REF 3/5 Page (DEST Airport)



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49. Push the LDG FLAPS line select key to select the planned flaps setting for the landing. Push the LDG FLAPS line select key as necessary to cycle through the menu selections.

50. Examine Maximum Landing Weight (MLW) from the LW/GWT/MLW data entry fields.

**NOTE**

Maximum Landing Weight (MLW) is determined by the most restrictive of the following weight limits: structural, climb performance, runway length and brake energy. In cases where Maximum Landing Weight cannot be computed, the MLW data field is blank.

51. Examine Gross Weight (GWT) from the LW/GWT/MLW data fields.

**NOTE**

Landing Weight (LW) is prefilled to the current Gross Weight (GWT) at the time the APPROACH REF pages are initially accessed. Once prefilled, the LW is not updated again while the APPROACH REF pages show on the CDU or MFD.

**NOTE**

Aircraft Gross Weight is specified on the flight plan PERF INIT 1/3 page. Gross Weight (GWT) on the APPROACH REF 3/5 page is prefilled to the aircraft gross weight at the time the APPROACH REF pages are accessed (from a non-APPROACH REF page). Gross weight is periodically updated to the GWT value on the PERF INIT 1/3 page if the flight plan GWT has been specified.

**NOTE**

If Gross Weight is unspecified in the ACT FPLN, the GWT data field on the APPROACH REF 3/5 page is blank.

**NOTE**

Once the APPROACH REF Vspeed values are sent to the PFD for display, a pilot-entered change to aircraft Gross Weight on the PERF INIT 1/3 page causes a corresponding update to the Gross Weight (GWT) value on the AP page, updates to the Landing Weight to the new GWT value, removes the FMS-sourced Approach Vspeeds from the PFD display, and causes the message VSPEEDS DESELECTED to show on the CDU.

52. Enter the planned Landing Weight at the DEST airport in the scratchpad, if different from the LW that shows.

53. Push the LW/GWT/MLW line select key to transfer the Landing Weight entry from the scratchpad.



NOTE

The Landing Weight will initially be preset to the Gross Weight (GWT) value, unless a manual entry for Landing Weight has been performed. A manual entry/overwrite of the LW is supported on the APPROACH REF page, which allows the pilot to enter an adjusted weight. A manually entered Landing Weight value should not be overwritten by a pre-filled LW, without additional pilot action. A manually entered Landing Weight value shows in large white font while a pre-filled LW value shows in small white font.



NOTE

If any input value, such as LW, is changed, the Approach Vspeed data fields will go blank momentarily while the FMS is computing the Vs speeds based upon the new data. The FMS will then display the new Approach Vs speeds.

54. Examine RWY ID and RWY LENGTH (for arrival at the DEST airport) on the APPROACH REF 3/5 page.



NOTE

The selected approach RWY LENGTH indicates the runway length available. When the ACT FPLN specifies the selected runway, the RWY LENGTH available value that shows is the runway length retrieved from the navigation database. If unspecified, must-enter boxes show to indicate a required pilot entry for RWY LENGTH available. The pilot can choose to either add the arrival runway to the ACT FPLN or manually enter the RWY LENGTH on the APPROACH REF 1/5 page.



NOTE

A manual entry/overwrite of the RWY LENGTH available is supported to allow the pilot to enter an adjusted value. A manually entered RWY LENGTH shows in large white font. Runway length available can show in either feet (default) or meters. A numerical entry preceded or followed with an F or M, or without units would be an allowable entry. The FMS interprets a numerical entry without units to be the same units that currently show. Deletion of an entered value returns the RWY LENGTH display to the database value.

55. Examine the FMS-computed value for LFL/ALD on the APPROACH REF 2/5 page to determine whether the computed landing distance is within the arrival RWY LENGTH.

**NOTE**

The LFL/ALD data field shows the computed value for the runway length required. The LFL/ALD shows in the same units as the RWY LENGTH. Both can show in either feet (default) or meters.

**NOTE**

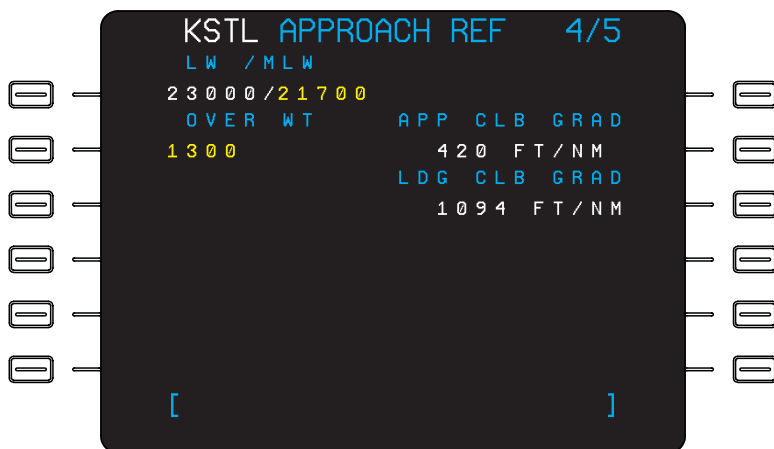
If the LFL/ALD is larger than the approach RWY LENGTH, the approach RWY LENGTH shows in yellow on the APPROACH REF 1/5 and APPROACH REF 2/5 pages. The runway identifier shows in yellow on the APPROACH REF 1/5 page. In addition, the message CHECK APPROACH PERF shows on the CDU.

56. Select the Landing Factor to be applied for the approach conditions as appropriate in the LDG FACTOR selection menu of the APPROACH REF 3/5 page. Push the LDG FACTOR line select key as necessary to cycle through the menu selections (1.00/1.25/1.67).

APPROACH REF 4/5 (ORIGIN OR DEST AIRPORT)

57. Push the NEXT function key to view the APPROACH REF 4/5 page. Examine the approach and landing climb gradients. Review the LW and MLW.

Figure 16-23 APPROACH REF 4/5 Page



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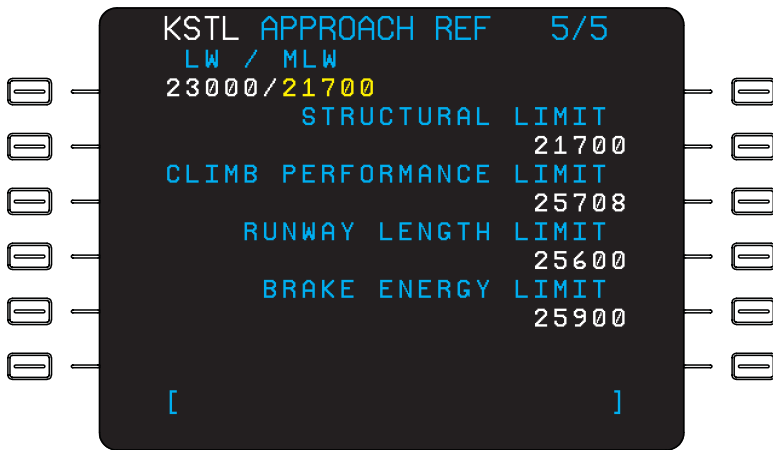
NOTE

If LW exceeds MLW, the annunciation OVER and the amount overweight shows under the LW/MLW values.

APPROACH REF 5/5 (ORIGIN OR DEST AIRPORT)

58. Push the NEXT function key to view the weights and limits on the APPROACH REF 5/5 page. Examine the weight values that show for STRUCTURAL LIMIT, CLIMB PERFORMANCE LIMIT, RUNWAY LENGTH LIMIT, and BRAKE ENERGY LIMIT. Inspect the value that shows for MLW.

Figure 16-24 APPROACH REF 5/5 Page



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**NOTE**

The MLW that shows on the APPROACH REF pages is the most restrictive of the maximum weights determined as the structural limit, climb performance limit, runway length limit, and brake energy limit.

TRANSMIT APPROACH VSPEEDS TO THE PFD

To transmit Approach Vspeeds to the PFD:

1. Push the NEXT or PREV function key on the CDU as necessary to show the APPROACH REF 1/5 page.
2. Push the SEL APT line select key as necessary to select either the ORIGIN airport or the DEST airport as the appropriate arrival airport.

3. Push the NEXT or PREV function key as necessary to show the APPROACH REF 3/5 page.
4. Examine the Approach Vspeed value that shows on the APPROACH REF 3/5 page.
5. Make sure the value has been computed by the FMS and shows for V_{REF} (Reference Speed).

NOTE



In order to send Vspeed data to the PFDs, both CDUs must be showing FMS pages. If both CDUs are not showing FMS pages, it is possible that the CDU message VSPEEDS DISAGREE will show.

6. If no status message shows above the SEND prompt, push the SEND line select key.

NOTE



The SEND line key selection on the APPROACH REF 3/5 page allows the pilot to transmit the Approach Vspeed for display on the PFD. When the SEND prompt is pushed, the FMS transmits the Approach Vspeed to the PFD. The annunciation IN PROGRESS shows first above the SEND prompt. The FMS performs an echo test the value to verify the information has been correctly received by the PFD. If the value fails, the annunciation FAILED shows above the SEND prompt. If the value matches, the Approach Vspeed changes to magenta and the annunciation COMPLETE shows above the SEND prompt.

NOTE



The APPROACH REF Vspeed must be valid before it is allowed to be sent to the PFD for display. If the APPROACH REF Vspeed value is not valid, selection of the SEND function causes the scratchpad message KEY NOT ACTIVE to show.

NOTE



The FMS is required to be in the air and operating in SYNC mode to transmit the Approach Vspeed to the PFD. Pushing the SEND line select key with the FMS operating in the INDEP mode causes the Approach Reference Vspeed not to be sent to the PFD. The CDU shows the message SEND N/A – NOT IN SYNC. If the FMS is operating in INDEP mode, it is necessary to select SYNC mode on the FMS CONTROL page and select an FMS Sync Master.

**NOTE**

When the FMS sends the Approach Vspeed to show on the PFD, all of the Approach Vspeed input and output parameters are latched. While the aircraft is in the air, any change to the state or value of the parameters used to determine the FMS Approach Vspeed removes the FMS-sourced Approach Vspeed from the PFD display. The message VSPEEDS DESELECTED shows on the CDU.

**NOTE**

Performing an FMS SYNC operation causes the VSPEEDS DESELECTED message to momentarily show as a CDU message, regardless of whether Takeoff Reference or Approach Reference Vsports have been posted on the PFD.

**NOTE**

FMS APPROACH REF Vspeed input values need to be reconfirmed by the pilot following any FMS SYNC operation.

Figure 16-25 Approach Vsports Send In Progress



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APPROACH VSPEEDS: MANUALLY-ENTERED AND FMS-COMPUTED

The value for the Approach Vspeed (V_{REF}) entered manually via the ARP panel shows on the PFD in cyan.

The FMS-computed Approach Reference Vspeed (V_{REF}) shows in white on the APPROACH REF 3/5 page before being sent to the PFD for display.

The FMS-computed Approach Reference Vspeed (V_{REF}) shows in magenta on the APPROACH REF 3/5 page when the COMPLETE message shows after the entry of a SEND command, (the APPROACH REF Vspeed has been successfully sent to the PFD for display). FMS-computed Approach Reference Vspeed V_{REF} also shows on the PFD in magenta.

When the FMS-computed APPROACH REF Vspeed has been successfully sent to the PFD for display (and is posted on the PFD in magenta), subsequent manual Approach Vspeed entries made via the ARP cause the Approach Reference Vspeed (V_{REF}) to become a manually selected value controlled by the ARP and shows on the PFD in cyan.

To manually enter adjustments to the Approach Vspeed value after posting the FMS-computed Approach Reference Vspeed on the PFD, use the controls on the ARP as follows:

1. Set the SPEED REFS switch on the ARP to the VSPDS position.
2. Push the SEL key to select V_{RF} , or V_{GA} , then turn the SPEED REFS knob to enter new Vspsds data values.

As an alternative, you can also switch the SPEED REFS switch on the ARP to TGT. Then use the SPEED REF knob to enter target VT value.

When Approach Vspeed value has been entered manually with the ARP, it shows on the PFD in cyan. Sending the FMS-computed APPROACH REF Vspeed to the PFD using the SEND command on the APPROACH REF 2/5 page replaces the manually entered value with the FMS-computed value for V_{REF} . The Approach Vspeed value shows on the PFD in magenta.

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3D MAP (OPTION)

INTRODUCTION

The 3D MAP is an optional, advanced FMS feature that provides lateral, vertical, and performance-predicted flight plan information in a single, combined three-dimensional (3D) format on the MFD. The map data is a combination of what would typically be shown as two separate map formats: a vertical profile and a plan map.

The 3D map has an adjustable viewing orientation that allows the pilot to customize the viewing angle that is desired. In addition to the traditional map controls for range and map center, view controls on the CCP provide for rotation of the map presentation about two axes. The two axes of rotation are:

- A line through the map center that is perpendicular to the vertical plane of the display, which allows various perspectives of vertical views.
- A line through the map center that is perpendicular to the lateral plane of map center, which allows various perspectives of lateral views.

The 3D map allows predicted flight path views that are referenced from the ground (such as a vertical profile view), referenced directly over a map center position (such as a plan map view), or referenced from an intermediate point in between.



NOTE

The PERFORMANCE MODE selection affects the display of the flight plan vertical profile in the 3D MAP format. For the 3D MAP to show the predicted vertical profile, PREDICTED mode must be selected on the FUEL MGMT 1/3 page. Refer to the Fuel Management section of the MENUS AND DISPLAYS chapter of this guide for a description of performance mode.



NOTE

The 3D MAP vertical profile is based upon en route performance data with the aircraft configured for normal operation (all engines on).

Figure 17-1 3D MAP Format



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DISPLAY FORMAT

The 3D map is based on the traditional FMS PLAN MAP format. Unlike the fixed, north-up display of the PLAN MAP, the lateral viewing angle of the 3D map can be adjusted to any value between 0 and 360 degrees. The lateral view angle is independent of the vertical viewing angle. The joystick on the CCP manually controls both the lateral and vertical viewing angles.

There are three vertical viewing modes, PLAN MAP, SIDE VIEW, and 3D MAP, that determine the types of 3D information that show on the MFD. Each viewing mode provides a specific combination of FMS lateral and vertical flight plan information.

With the vertical viewing angle at 0 degrees (the normal PLAN MAP view), all lateral flight plan information and minimal vertical information shows. An inner range ring that supports map ranges from 2.5 NM to 300 NM shows on the display. Also, the four cardinal compass points (N, S, E, and W) show in the inside perimeter of the range ring. As the lateral viewing angle changes, the cardinal compass points move with the display in the corresponding direction.

All lateral flight plan waypoints, map symbols, associated legs, and background data show for the selected map range. Vertical information is limited to Top Of Climb (TOC) and Top Of Descent (TOD) indications, and waypoint speed/altitude constraints along the flight plan route. The aircraft symbol represents the present position of the aircraft.

For vertical viewing angles between 0 and 90 degrees, all lateral and vertical flight plan information shows. The range ring and cardinal directions turn with the vertical viewing angle, and are positioned on a planar grid that represents a flat surface projection of waypoints, airports, and nav aids, on the surface of the earth. The lateral position for any vertical symbol, including the aircraft symbol, is located on the grid by way of a vertical line from the vertical symbol to the grid as shown in the figure on page 17-2. Vertical flight plan information, such as waypoint altitude constraints, shows as triangles at the appropriate altitude above the grid. Performance waypoints such as TOC and TOD indications also show at the appropriate altitudes above the grid. A vertical reference line shows for each altitude constraint and performance waypoint.

A vertical auto scale sets the dimension of the 3D picture based on the highest vertical point above the grid. This could be a point along the

flight path, an altitude constraint, or the present altitude of the aircraft provided the aircraft symbol is in viewing range on the map.

A series of lines that represent the aircraft performance-predicted flight path shows above the grid. The lateral position for each predicted altitude shows along the flight path, which creates a “connect-the-dots” display of the predicted altitudes for the flight plan. A small arrow shows at the halfway point of each path segment to represent the forward direction of the flight plan. A 3D aircraft symbol, which is created by adding a vertical tail to the two-dimensional aircraft symbol, shows in white at the appropriate altitude above the grid. The aircraft symbol is oriented to the present aircraft heading, pitch, roll, and viewing angle. A second aircraft symbol that represents the shadow of the aircraft is shown in cyan directly below on the grid. The shadow aircraft is oriented to the current viewing angle. A vertical reference line connects the cyan aircraft shadow to the white 3D aircraft symbol.



NOTE

On the 3D MAP, while flight plan edits are being made, the 3D MAP vertical flight path could momentarily show intermediate results while the FMS performance function recomputes the path due to flight plan edits that are in progress.

When a flight plan edit is in process, the initial calculation of the path can sometimes result in a predicted path, based upon intermediate FMS calculations, that momentarily shows on the display. This is indicated by dashed green lines that appear disjointed from the intended vertical path for approximately 5 seconds. When this occurs, the next map update shows the results of the final FMS calculations for the modified flight plan.



NOTE

If a flight plan altitude constraint is less than 1500 feet AGL, and is more than 10 NM from the departure runway, predicted flight trajectory for the 3D MAP ignores the altitude constraint. The FMS divides a flight plan into four phases: takeoff, climb, cruise, and descent. The FMS takeoff phase ends and the climb phase begins at 1500 feet AGL. Because of this, the FMS assumes all altitude constraints beyond the takeoff phase are above 1500 feet AGL. An altitude constraint below 1500 feet AGL that is more than 10 NM from the runway would be outside of the takeoff phase for the 3D MAP performance calculations. However, only the 3D MAP graphical depiction of the flight path shows incorrectly. The FMS still correctly honors and flies the flight plan altitude constraint.

As a result, in those cases where a waypoint climb altitude constraint of less than 1500 feet AGL is specified on the CDU during preflight, the 3D MAP display can show contradictory information for predicted path while the aircraft is on the ground.



NOTE

For the 3D MAP, no performance calculations are computed for the destination airport SIDs in the flight plan. As a result, the 3D MAP display does not plot vertical predicted path information for SIDs at the destination airport.

With the vertical viewing angle set to 90 degrees (the profile or SIDE view), all vertical flight plan information and minimal lateral information shows. The grid shows as a horizontal line. The range ring, digital range readout, and cardinal directions are replaced with a distance/direction line directly below the horizontal line. A digital distance readout is centered beneath the distance/direction line. Arrows that point outward are on the ends of the distance/direction line. Next to the arrows are digital readouts in units of degrees that represent two angles that are perpendicular to the current lateral viewing angle. A vertical scale shows on the left side of the display with the bottom of the scale aligned with the horizontal grid line. The digital readouts at the top and bottom represent the maximum and minimum values of the scale.

The display of lateral flight plan information is limited to the waypoint identifiers immediately below the horizontal line. All vertical flight plan information, TOC and TOD waypoints, and the predicted flight path are shown at appropriate altitudes above the horizontal line. Only one aircraft symbol is shown. No aircraft shadow shows.

MAP CONTROLS

The 3D MAP controls provide for manual control of the viewing modes and preset viewing angles. Manual control allows the pilot to set the view to any desired angle within the available limits. Preset views allow the pilot to select fixed viewing modes with minimal workload. An automatic view control maintains the desired viewing angle regardless of the current heading of the aircraft. Controls for the 3D MAP are located on the CCP and on the MFD Lower Menu.

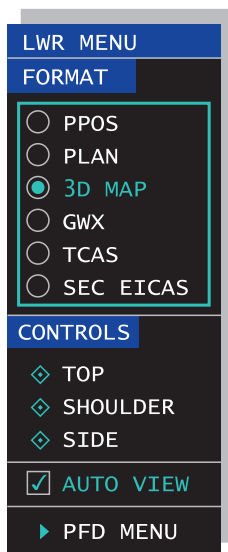
Figure 17-2 Cursor Control Panel (CCP)



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The LWR MENU button on the CCP shows the MFD Lower Menu. When the selected MFD format is 3D MAP, the manual, preset and automatic view controls for the 3D MAP are active. The CCP joystick is used to manually set the lateral and vertical viewing angles. The MENU ADV knob on the CCP is used to move the cursor to the appropriate preset and automatic control (TOP, SHOULDER, SIDE, AUTO VIEW) on the MFD Lower Menu. The PUSH SELECT button on the MENU ADV knob is used to select the desired preset or automatic view.

Figure 17-3 MFD Lower Menu – 3D MAP Format



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MANUAL VIEW

The CCP joystick is used to set the lateral and vertical viewing angle when the selected MFD format is 3D MAP. Both the lateral and vertical viewing angles can be set simultaneously with the joystick. When the joystick is moved out of the detent to the left, the lateral viewing angle decreases from the current setting and the 3D MAP view rotates clockwise. When the joystick is moved to the right, the lateral viewing angle increases and the 3D MAP view rotates counterclockwise.

When the joystick is moved up out of the detent, the vertical viewing angle increases from the top (plan map) view of 0 degrees to the side view of 90 degrees. When the joystick is moved down, the vertical viewing angle decreases from 90 degrees to 0 degrees.

TOP VIEW

The TOP control on the MFD Lower Menu selects the top view, which is the standard plan map “look-down” viewing angle with minimal vertical flight plan information. The PUSH SELECT button on the CCP MENU

ADV knob selects the top view when TOP is highlighted on the MFD Lower Menu.

SHOULDER VIEW

The SHOULDER control on the MFD Lower Menu selects the shoulder view, which displays both lateral and vertical flight plan information. The PUSH SELECT button on the CCP MENU ADV knob selects the shoulder view when SHOULDER is highlighted on the MFD Lower Menu.

Selecting the shoulder view causes the 3D MAP presentation to switch to a lateral viewing angle of 22 degrees and a vertical angle of 75 degrees relative to the inbound course of the map center waypoint at the time of the selection. The 22 degrees lateral angle can be left or right of the inbound course depending on the direction of rotation of view that provides the smallest amount of angular change to the 3D MAP presentation. When the PUSH SELECT button on the CCP MENU ADV knob is pushed multiple times, the view alternates between a left, center, and right display. The left display is 22 degrees left of the inbound course, the center display is centered on the inbound course, and the right display is 22 degrees right of the inbound course.

SIDE VIEW

The SIDE control on the MFD Lower Menu selects the side view, which is the vertical profile display with minimal lateral flight plan information. The PUSH SELECT button on the CCP MENU ADV knob selects the side view when SIDE is highlighted on the MFD Lower Menu.

Selecting the side view changes the 3D MAP presentation to a lateral and vertical viewing angle of 90 degrees relative to the inbound course of the map center waypoint at the time of the selection. The side view provides a full vertical view with a lateral viewing angle that is perpendicular to the inbound course of the map center waypoint. The 90 degrees lateral angle can be left or right of the inbound course, based on the direction of rotation of view that provides the smallest amount of angular change to the 3D MAP presentation. When the PUSH SELECT button on the CCP MENU ADV knob is pushed multiple times, the view alternates between 90 degrees left and right of the inbound course.

AUTO VIEW

The AUTO VIEW function provides a view hold that allows the pilot to keep a desired viewing angle, both laterally and vertically, that is maintained relative to the inbound course of the map center waypoint. The PUSH SELECT button on the CCP MENU ADV knob selects and deselects the auto view mode when AUTO VIEW is highlighted on the MFD Lower Menu.

From the perspective of the pilot, when the auto view mode is on, the selected relative viewing angle does not change as the flight plan sequences from one leg to the next. For example, if the pilot selects a 30 degrees lateral and 70 degrees vertical view, as the flight plan sequences, the display smoothly rotates to maintain the same viewing angle.

The auto view mode remains active until it is deselected. Transitioning to and from auto view does not change the viewing angle. While auto view is active, the 3D MAP shows the annunciation AUTO VIEW in the right side of the MFD. The joystick control and preset view controls can still be used while auto view is active.

When auto view is active and the FMS flight plan TO waypoint is the map center, the inbound course is referenced to the point abeam the aircraft present position instead of the map center waypoint location. This allows the view to automatically rotate to track multiple course changes that occur in FMS radius, arc, holding pattern, and procedure turn leg types.

WAYPOINT LOCK/UNLOCK

A TO waypoint lock/unlock feature in the FMS is provided to allow the 3D MAP center to remain referenced to the leg that is currently being flown, regardless of any edits or pending modifications to the active flight plan. The waypoint lock feature is selected on the CDU DISPLAY ADVANCE page. Push the line select key next to the TO WPT to select and lock the active flight plan waypoint as the map center. The annunciation LOCKED shows to the right of the TO WPT line on the CDU DISPLAY ADVANCE page to indicate the feature is active.

The TO waypoint remains locked until PREV WPT, NEXT WPT, or CTR WPT is selected, at which time the UNLOCKED annunciation replaces LOCKED. The LOCKED annunciation only shows when the active flight plan is shown on the 3D MAP.

Once the TO waypoint is locked, the map center is always the waypoint shown on the TO line of the FMS active flight plan. One exception to this rule occurs when the TO waypoint is a discontinuity (DISCON), in which case the waypoint that immediately follows the DISCON becomes the map center.

While the TO waypoint is unlocked, the 3D MAP shows the annunciation TO WPT UNLOCKED directly above the AUTO VIEW annunciation on the MFD. Locking the TO waypoint or showing the SEC FPLN clears the TO WPT UNLOCKED annunciation from the MFD.

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ADDENDUM 3
TO
FMS-6100 Flight Management System for the Gulfstream G150
OPERATOR'S GUIDE

Part Number 523-0807226-003117, 3rd Edition Dated 10 Oct 06

Notice

INFORMATION SUBJECT TO EXPORT LAWS

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Remove Addendum 1 dated 06 Feb 07.
Insert this addendum sheet before page 18-1

The following information is provided for aircrew awareness and should be accessible to pilots on the flight deck. A choice between two Navigational Databases Vendors is available for Rockwell Collins Flight Management Systems requiring a *Type 4* or *Type 6* navigation database. Two choices exist for Navigation database for the RCI FMS and they are named: **Standard** (Lufthansa Systems Inc.) and **Optional** (Jeppesen Sanderson Inc.).

The status of the FAA AC 20 -153 Type-1 Navigation Database Vendor Letter of Acceptance (LOA) and Rockwell Collins FAA AC 20 -153 Type-2 LOA that ensure compliance of the aeronautical data to the State data sources can be found at the following link. <http://www.rockwellcollins.com/fms/naalerts.asp>

The CDU Status Page delineates which vendor's navigational data is loaded into the FMC by the respective prefix letter "L" (LSY) or "J" (Jeppesen) preceding the identified Nav Data.

Regulatory guidance for preflight planning requires crew members to verify their Flight Plan (route verification check) and accomplish a legs verification check for the complete flight plan route and note or resolve any discrepancies, these observations are offered for consideration by customers electing to change database vendors. These observations are neither totally inclusive nor exclusive and are subject to change with each AIRAC cycle (28 day update cycle). The following LSY observations are general in nature, were noted during one AIRAC cycle and therefore will not be updated

1. When lifting off the runway on takeoff or on a missed approach, an initial altitude constraint not defined by the procedure can be referenced in the navigational database.
 - o LSY usually references 500' AGL
2. "*Expected Altitude*" constraints published in Standard Instrument Departures (SIDs) and Standard Terminal Arrival Routes (STARs) are often included in the LSY database.

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3. Waypoint fixes exist that are not defined as part of a procedural design.
 - o The name and location of aeronautical data representing an undefined fix is at the discretion of the vendor. An example would be the waypoints used to define a turn to final from an arcing approach.
4. STAR/SID Name and Transition:
 - o Waypoints listed as referenced to the PROCEDURAL named fix may not be dependent on runway selection in the LSY database. The BYP5 STAR into Dallas/Ft Worth is an example.
 - a. The LSY database lists the waypoints past BYP prior to runway selection (i.e. all the way to STONZ).
 - o The LSY database lists only the RNAV procedure if more than published procedure exists.
 - a. STAR example at Cairo (HECA): The BALTIM 1A RNAV arrival into Cairo for RWY 05R is listed as BLT1A, not RBLT1A.
5. Approach Transition Name: A database vendor has discretion in approach transition naming. Washington Reagan (KDCA) can be referenced to illustrate.
 - o The GRNV04 approach with the Transition of GTN in the LSY database represents the Georgetown Transition.
6. The LSY database provides Airport Communication Frequency coverage at most Large Volume Airports.

If you have any questions regarding this FMS Pilot's/Operator's Guide Addendum, please contact your local Rockwell Collins Customer Support Engineer or call FMS & Database Support at 319.295.5000.

PRINCIPLES OF FMS NAVIGATION

INTRODUCTION

FMS-6100 navigation is based on using all of the available navigation sensors on the aircraft to fly from waypoint to waypoint along a flight plan route. The waypoints are based on the information contained in the FMS-6100 navigation database and pilot-defined waypoints. A flight plan route is selected from a route list, or created from the database waypoint information and/or pilot-defined waypoints. With the navigation and other sensor data available to it, the FMS determines the present position relative to the flight plan route and computes steering commands for use by the flight control system. These commands are used to fly the aircraft along the route.

FMS DATABASE

The FMS-6100 typically contains two databases: the Active Database, and the Secondary Database. Only the Active Database is used for flight planning and navigation purposes. The Secondary Database allows a new database to be loaded before the effective date so the new database is ready for use when it becomes valid.

A database can include, but is not limited to, information on the following facilities:

- Airports and Runways
- Nav aids – VOR, DME, and TACAN
- GPS
- NDB (All NDB identifiers are suffixed with NB, for example, IOWNB or DBNB)
- Airways
- Intersections
- Pilot-defined waypoints
- SIDs and STARs
- Approach procedures and Missed Approach procedures.

A new, updated database must be installed every 28 days to make sure that it contains the latest available information for the facilities described

previously. Updates are accomplished by loading new data into the Flight Management Computer (FMC) installed on the aircraft.

Navigation database information is used for many purposes. Pilots use the information to create and modify flight plans. The FMS uses the information to do any of the actions that follow:

- Select the VOR/DME nav aids to use in determining the position.
- Show information about the various navigation facilities on the CDU, MFD data pages and MAP displays.
- Automatically insert into a flight plan the waypoints that make up a selected airway, SID, STAR, or approach.

DUAL FMS COORDINATION

Dual FMS installations can operate in a synchronized (SYNC) or independent (INDEP) mode. The mode is selected by the pilot from the CDU on the FMS CONTROL page.

SYNC

In the synchronized mode, the following items are automatically synchronized between both FMSs:

- FMS position initialization
- Database selection
- Disabled VOR/DME nav aids
- Disabled navigation sensors (except for GPS and IRS)
- All mode selections
- FIX INFO entries
- Flight entries or changes (only after the flight plan is executed for active flight plans)
- Second flight plan entries or changes.

In the synchronized mode, changes made to an active flight plan on one FMS are synchronized with the other FMS when the EXEC function key on the CDU is pushed to execute the flight plan. Changes made to the second flight plan on one FMS are synchronized immediately with the other FMS.

Only one FMS can change an active flight plan at any time. If one FMS already has a MOD FPLN in progress, any attempt to edit or change the active flight plan from the other FMS shows the message XSIDE EDIT IN PROGRESS on the CDU scratchpad line. The same is true if an attempt is made to activate a flight plan from the other FMS.

When both FMSs are selected as navigation sources, flight plan leg sequencing is controlled by the FMS that is selected as the active NAV steering source. When only one FMS is selected as the navigation source, it controls the flight plan leg sequencing.

INDEP

In the independent mode, none of the mode selections or flight planning data from one FMS, except for the MAG/TRUE display reference selection, are shared with the other FMS. However, flight plans can still be copied in whole from one FMS to the other through the FPLN TRANSFER function on the last page of the ACT FPLN and SEC FPLN pages. However, if a flight plan transfer is attempted when a flight plan is being edited (MOD FPLN page showing), the flight plan will be transferred without the new information. If a transfer is attempted when no flight plan exists on the other FMS, the message NO XSIDE FPLN shows on the scratchpad. If the database is not the same on both FMSs when a flight plan transfer is attempted, the message CHK SELECTED DATA BASE shows on the scratchpad line. The database must be the same on both FMSs to copy a flight plan from one to the other.



NOTE

Due to variations in each FMS when it determines the position, it is possible that sequencing from one leg of a flight plan to the next will not occur simultaneously on both systems while they are operating in the Independent mode.

POSITION INITIALIZATION

PREFLIGHT

After power is applied to the FMS, a position initialization process is required for the FMS to accurately determine the present position. This is done by entry of a known position, such as the airport, runway threshold, gate, or navaid, into the FMS through the POS INIT page on the CDU. This allows the FMS to use the sensors available to accurately determine and track the present position, direction, and speed. The most accurate way to initialize the FMS position is to enter on the POS INIT page the coordinates, if known, for the location where the aircraft is currently parked.

RUNWAY UPDATES

To further increase the accuracy of the initial position before takeoff, in installations that use an IRS, the ACT LEGS page provides the capability to update the position to the runway threshold. As the aircraft moves into position on the runway, the FMS can be updated to that initial position. It is important that the aircraft be at the threshold before this update is completed. In aircraft with GPS sensors that are available for use by the FMS, it is not necessary to do position updates at the runway threshold.

POSITION UPDATES

FMS position updates are completed in-flight using position data from a GPS sensor, a navaid, an IRS sensor, or the FMS itself (depending on the equipment installed in the aircraft). However, GPS and IRS sensors cannot be position updated from the FMS while the aircraft is airborne.

FLIGHT PLAN

Each FMS-6100 can hold two flight plans. One flight plan is called the active flight plan and the other is called the second flight plan. Active flight plan data shows on the ACT FPLN, MOD FPLN, ACT LEGS, and MOD LEGS display pages. Second flight plan data shows on the SEC FPLN and SEC LEGS display pages. Only the active flight plan is used for navigation, and it is used only when FMS is selected as the navigation source.

A flight plan is made up of waypoints created from a combination of elements that include some or all of the items that follow.

- Airports (origin, destination and alternate)
- Departure runway
- SID and transition
- Direct-to legs
- Airways
- Pilot-defined waypoints
- Holds
- STAR and transition
- Approach procedure, or arrival runway extension, and arrival runway
- Missed approach procedure
- Route to the alternate airport.

A waypoint is any point that is used as a reference for a navigation fix. Waypoints can be either predefined or pilot-defined. Predefined waypoints are stored in the FMS navigation database with the identifiers that are shown on aeronautical charts. These waypoints can be airports, nav aids, or other charted navigation fixes and uncharted fixes used in SIDs, STARs, and approaches. Pilot-defined waypoints are stored within a flight plan and in the pilot-defined waypoint list, but not in the FMS navigation database.

In dual FMS installations set to the synchronized operating mode, flight plan data is shared between both systems. In the independent operating mode, each FMS has separate flight plans. However, the flight plans can be copied, in whole, from one FMS to the other.

In synchronized mode, as the aircraft progresses along the flight plan route, both FMSs are simultaneously sequenced from one waypoint to the next. In the independent mode, when both FMS1 and FMS2 are

selected as navigation sources, each FMS independently sequences through the flight plan as the aircraft progresses along the route.

NAVIGATION SENSORS

To navigate, the FMS-6100 uses sensor data from GPS, VOR/DME nav aids, IRS, and air data systems, along with the active flight plan and the database information. The sensor data is used by the FMS to determine the present position, direction, and speed.

To determine the present position, the FMS uses all of the installed and enabled navigation sensors available. The FMS uses data from each sensor to determine position, as long as the data is valid or the sensor has not been specifically disabled. However, the FMS only uses the IRS in the navigation solution if all other sensors are deselected or otherwise unavailable. By default, all navigation sensors are enabled for use by the FMS at startup. Disabling sensors can degrade the accuracy of the position. Since the FMS weighs the accuracy and validity of each sensor as part of the process to determine position, all sensors should be enabled at all times. Disabling a known invalid or failed sensor, or up to eight specific nav aids that are out of service, would be the only exception to this. By leaving all sensors enabled, the FMS can properly select the most accurate sensors for use in calculating the position.

VOR AND DME

For VOR and DME navigation, the FMS scans approximately every 3 minutes for the best combination of DME stations, according to the database and present position. It takes into account the service volume of the nav aids, the altitude and distance of the aircraft from the nav aids, and the geometric relationship required for accurate positioning data. To make sure that the DME stations received have valid signals and are the stations it expected to receive, the FMS verifies the actual station identifiers it receives with the database information for the expected station and rejects any DME stations with invalid identifiers.

The default FMS operating mode for use of VOR/DME nav aids is DME/DME navigation. In this mode, the FMS automatically tunes DME channels 2 and 3, using the distance data as part of the calculations to determine position. It does this with both NAV receivers, unless they are specifically disabled for use by the FMS on the VOR/DME CONTROL page. When the NAV receiver tuning mode for the FMS is set to AUTO

on the TUNE 1/2 page, the FMS automatically tunes the paired VOR and DME channel 1 frequencies in addition to DME channels 2 and 3. This gives the FMS up to six DME stations to use in determining the position with a high degree of accuracy.

The FMS uses the database to select and tune DME stations. It first looks for stations with a geometry that will give the most accurate position information. If one or more of those stations cannot be received or the signal is invalid, it scans for another station. It continues to do this until it finds valid stations within the required geometric limits for determining the position. As the search expands and the geometric positioning of the stations degrades, the accuracy of the DME position data decreases. However, the FMS takes this into account as it calculates the present position. After the DME scan is complete, any DME channels that did not receive a valid signal are tuned to the navaids closest to the present position of the aircraft. They remain tuned to those navaids until the next scan.



NOTE

When the aircraft is on the ground, the FMS tunes the navigation receivers to the closest navaids so they will be available as soon as possible after takeoff.

When at least two properly positioned DME stations are received and valid, the aircraft present position can be calculated using the distance data from each of those stations. If more valid stations are received, and they are within the required geometric limits, they are also used as part of determining the position and will improve the accuracy. For this reason, the FMS NAV tuning mode should always be set to AUTO to make the additional VOR/DME channels available to the FMS for DME/DME navigation. If the geometry of the received and valid DME stations will not result in an acceptably accurate position determination, the FMS removes the DME/DME navigation data from the calculations to determine position.

When less than two correctly positioned and valid DME stations are available, the FMS can still use VOR radial and DME distance from a collocated VOR/DME pair as part of the calculations to determine position. As with DME/DME, the FMS supplements VOR/DME data with data from the other available navigation sensors, as previously described, to increase the accuracy of the position solution.

When the aircraft is within the cone of confusion of a VOR/DME navaid that is currently in use for VOR/DME navigation, the FMS removes that VOR/DME navigation data from the position calculations. The FMS considers the aircraft to be within the cone of confusion when the elevation angle from the navaid to the aircraft is greater than 45 degrees.

GPS

By default, the FMS uses the same-side GPS sensor data as provided by the sensor.

GPS can be used for primary means of navigation in oceanic and remote areas, provided a qualified GPS sensor is installed in the aircraft. Qualified GPS sensors include a ground-based prediction program that verifies GPS navigation availability over the planned route. Pre-departure verification of GPS availability is required for GPS as primary means of navigation before each flight.

The Collins-supplied GPS is approved for primary means of navigation and as a qualified GPS sensor if used with the Collins ground-based prediction program.

Status and integrity of the GPS position solution shows on the MFD LRN STATUS 2/2 page. GPS Receiver Autonomous Integrity Monitoring (RAIM) is used to assure that the GPS solution meets the required accuracy criteria that follow:

- 4 NM oceanic/remote
- 2 NM en route
- 1 NM terminal
- 0.3 NM final approach with 99.9% confidence.

The current RAIM accuracy limit is displayed on LRN STATUS 2/2 page. The oceanic/remote threshold is used in the North Atlantic region. Other remote areas use the en route threshold.

The measured accuracy limit on LRN STATUS 2/2 page indicates the maximum estimated error based on measurement inconsistency. Unless an error is detected by RAIM, this value is always less than the RAIM accuracy limit.

When an error is detected, it is annunciated on the LRN STATUS 2/2 page. If the detected error cannot be predicted to be less than

the required integrity threshold, GPS is removed from the navigation solution. If no other navigation sensors are available, the FMS navigates by dead reckoning. If no error is detected by RAIM, the probable GPS error is shown. This is a statistical number based on normal satellite error characteristics.

IRS

To compensate for the IRS drift error, IRS position solutions are continuously calibrated by the other long range sensors (GPS, DME/DME, DME/VOR), whenever position data is available from any of those sensors. The FMS uses the IRS position when no other long range sensors are available. In installations with three IRSs and all three are enabled for navigation on the IRS CONTROL page, the position solutions from the three IRSs are blended to reduce the position error drift. The FMS cross compares the three IRS positions. If the position from one IRS deviates substantially from the blended IRS position, the FMS removes data from that IRS from the position calculations.

In installations with two IRSs, or only two of three IRSs are being used because of a substantial deviation, the FMS position is based on only one IRS position when the other long range sensors are not available. The FMS selects the IRS that is to be used based on the priority sequence of: same-side IRS, third IRS, cross-side IRS. After a period of time with no other sensor available, based on the phase of flight (en route or terminal), the message IRS ONLY shows in white on the CDU message line, MESSAGES page, and PFD message line. This indicates FMS is using only IRS data to determine the position and the resultant position error could be too large for the current phase of flight.

IRS sensor data is not used for the position solution when the IRS sensor is set to either attitude or alignment mode. The pilot can view the current position difference relative to the current FMS position and the drift rate for each IRS sensor on the IRS CTL page. The INDEX 1/2 page supplies access to the IRS CTL page.

DEAD RECKONING (DR)

When no navigation sensor data is available for the FMS to use, it begins navigating in the DR mode. In this mode, it estimates the position based only on the last known position, heading, and airspeed. To identify this mode, the message FMS DR shows on the MFD and

PFD if the navigation source is FMS. The same message also shows on the CDU message line and MESSAGES page.

REVERSION MODE

Normally, the FMS uses same-side data from the installed GPS, IRS, and air data sensors. However, if a same-side sensor fails or the data is invalid, the FMS automatically changes to the cross-side sensor as long as that data from that sensor is valid and it has not been manually disabled on the control page for that sensor. Only one of each sensor type is used by the FMS in the calculations to determine position.

If the FMS is using a cross-side sensor while the aircraft is on the ground, it will automatically change back to the same-side sensor if the data from that sensor becomes valid before the aircraft is airborne. When the aircraft is airborne, if the FMS changes to, or is already using, a cross-side sensor, it will not change back to the same-side sensor even if the sensor returns to a valid state. However, if the cross-side sensor becomes invalid while the same-side sensor is valid, it will change back to the same-side sensor. In addition, a sensor that has been manually disabled can be manually enabled on the control page for that sensor on the CDU at any time.

SENSOR MONITORING

The FMS continuously monitors the navigation sensors to make sure that they provide valid position data to the FMS. If position data from a specific sensor varies significantly from the FMS position, the CHK POS message is annunciated on the PFD and MFD. It also shows on the CDU message line and MESSAGES page, where it is followed by a message that identifies the suspect sensor (GPS-FMS DISAGREE, FMS-FMS DISAGREE, IRS-FMS DISAGREE, or DME-FMS DISAGREE). The monitors for each sensor type have different thresholds, based on the phase of flight (en route or terminal), for annunciating a sensor disagreement.

REQUIRED NAVIGATION PERFORMANCE (RNP)

Required Navigation Performance (RNP) is a statement of the navigation accuracy necessary for operation within a defined airspace. The RNP value can be specified by the pilot and entered on the PROGRESS 2/2 page through the CDU. The FMS also computes the expected position accuracy based upon the navigation sensors it is

using. The expected position accuracy also shows on the PROGRESS 2/2 page.

When flying in RNP airspace, the error in the location of the aircraft is required to be less than the RNP value 95% of the time. FMS position error should be less than the expected position accuracy 95% of the time. Therefore, when the expected position accuracy value is greater than the RNP value, the message LOW POSITION ACCURACY shows on the CDU message line.

For example, if the aircraft were operating in an area that requires position accuracy to within 2 NM, the pilot would manually enter 2.0 in the RNP field. If the FMS position accuracy exceeds 2.0, which is the RNP setting, the message LOW POSITION ACCURACY will appear. The pilot should then determine if the FMS is using all available sensors for determining position, and take corrective action, such as enabling sensors or amending clearance if necessary.

FLIGHT PLAN TRACKING

The FMS accomplishes flight plan tracking by determining the present position, direction, and speed, and then computing steering commands for use by the flight control system to steer the aircraft along a flight plan route. Flight plan routes are typically made up of great circle legs from waypoint to waypoint.

WAYPOINTS

In addition to identifying a specific navigation facility, a waypoint can have one or more other unique properties. Some of these properties are as follows: TO waypoints, flyover waypoints, and conditional waypoints.

A TO waypoint is the waypoint to which the FMS is currently tracking on the active leg of the flight plan. The CDU and MFD show the TO waypoint information in magenta, and the TO waypoint identifier is annunciated in magenta on the PFD under the NAV source annunciation.

A flyover waypoint is a waypoint that the aircraft must fly over or abeam before the FMS sequences to the next waypoint of the flight plan. Leg terminating waypoints, such as a waypoint before a discontinuity, a holding fix waypoint, some waypoints in SIDs and STARs, the missed approach (MAP) waypoint, and the last waypoint at the end of a flight plan, are flyover waypoints.

It is possible to transform a non-flyover waypoint into a flyover waypoint, and subsequently remove the flyover attribute from a user-defined flyover waypoint. By adding or removing a /0 (slash zero) to or from a waypoint identifier, the FMS flight plan editor allows the user to add, or remove, the flyover attribute. Refer to the FLIGHT PLANNING chapter of this operator's guide for the procedure for adding or removing the flyover attribute.

Conditional waypoints are waypoints that are part of a SID, STAR, or approach and are not located at a geographically-fixed position. They are shown enclosed in parenthesis. A turn point located at a specified altitude, and the point where a heading leg intersects with a leg defined by a VOR radial are two examples of conditional waypoints. A conditional waypoint cannot be manually entered into a flight plan. They are entered as part of a SID or STAR.

LEG SEQUENCING

Flight plan legs are typically defined by the waypoint located at each end of the leg. As the aircraft approaches the TO waypoint, the FMS gives a waypoint alert by flashing the waypoint identifier on the PFD, and the waypoint identifier and symbol on the MFD maps. Approximately 5 seconds after the waypoint alert the FMS sequences to the next leg of the flight plan and generates steering commands to steer the aircraft toward the new TO waypoint.

When the FMS sequences to a discontinuity in the flight plan, or when the last waypoint in the flight plan is passed, it begins computing steering commands to fly wings level.

MAGNETIC VARIATION EFFECTS ON DISPLAYED DESIRED COURSE

On an HSI, the numeric course and the position of the course pointer arrow for a waypoint or navaid facility often differ slightly from the course value shown by the FMS. The difference is compounded as the distance from that fix increases. The difference exists for the following reasons:

1. As the aircraft travels along the flight path, the FMS constantly calculates the current value of the desired true track, which reflects the changing direction of the curved geodesic route abeam the present position of the aircraft.
2. The FMS corrects the current desired true track to a magnetic reference using the calculated value for magnetic variation at the present position of the aircraft. This value can be somewhat different from the value used to define an arrival or departure course as described above because of the following:
 - The actual magnetic variation varies from place to place as the aircraft travels.
 - The magnetic model used by the FMS to calculate local variation does not exactly match the declination or magnetic variation published in the navigation database for the nav aids and airports.

Another effect caused by the differences in MAG VAR as described above appears when editing a flight plan. The course value shown on the CDU can change when the pilot executes the flight plan. Before executing a flight plan, the course shown to a waypoint is based on the source magnetic variance. After executing the flight plan, the course is based on the MAG VAR at the present position of the aircraft. The

resulting course over the ground is exactly as specified by the pilot using the declination or magnetic variation contained in the database.

DISCONTINUITIES

Discontinuities are inserted automatically during certain edits of a flight plan. Their purpose is to segregate portions of the flight plan that are not naturally connected, such as an approach procedure not connected by an Initial Approach Fix (IAF) to the last en route or arrival waypoint.

A waypoint before a discontinuity is treated as a flyover waypoint. As such, the FMS sequences a flight plan to a discontinuity only as the aircraft passes abeam the waypoint. At that point, the FMS steers the aircraft to wings-level mode. The aircraft will continue to fly wings-level until FMS is deselected as the navigation source or the discontinuity is removed.

Two minutes before reaching a waypoint that is followed by a discontinuity, the message FPLN DISCONTINUITY shows on the CDU message line. The waypoint alert feature flashes the waypoint and the identifier on the CDU and MFD for 5 seconds. The waypoint alert will flash the waypoint and the identifier again 5 seconds before sequencing to the discontinuity.

While the FMS is steering to wings-level flight, no data shows on the displays for the following:

- Time-to-go
- Distance-to-go
- Bearing to waypoint
- Course
- Cross track deviation
- Course arrow
- Course digital readout.

In addition, the LNAV mode annunciation shows in yellow on the PFD.

A discontinuity can be deleted from a flight plan at any time by replacing it with the next waypoint in the flight plan. Some discontinuities can also be deleted directly by entering DELETE in the scratchpad with the CLR DEL function key on the CDU and transferring it to the discontinuity. Either method results in the FMS connecting the last waypoint before the discontinuity with the next waypoint that follows the discontinuity.

Deleting a discontinuity when it is the active leg (the TO waypoint) results in a direct course to the next waypoint unless a specific course is entered and activated in the INTC CRS data line.

Another way to sequence beyond a discontinuity is to select AUTO sequencing with the AUTO/INHIBIT line select key. When the FMS sequences to a discontinuity, the sequencing mode automatically changes to INHIBIT. Push the AUTO/INHIBIT line key to select AUTO, and the FMS will sequence to the next waypoint in the flight plan.

TURNS

The FMS computes a turn using a constant bank angle. For small turns, the amount of bank angle is small. The larger the turn, the greater the bank angle. It also computes when to start a turn based on the type of waypoint, the number of degrees of turn, the true airspeed of the aircraft, the current heading relative to the new heading, and the wind conditions. During a turn, the FMS continuously computes the bank angle to compensate for changes in wind conditions, true airspeed, and the heading of the aircraft relative to the new course.

BANK ANGLE AND ROLL RATE

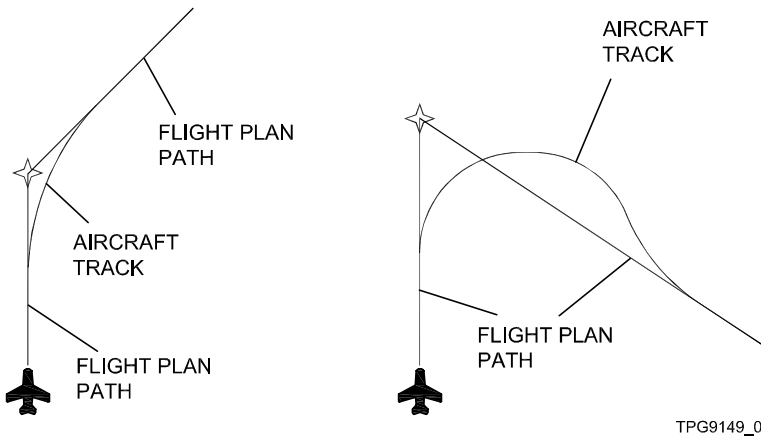
The bank angle and roll rate during a turn is continuously computed by the FMS with consideration for the bank angle limits of the flight control system. With the flight control system set to the normal operation mode (no bank limit selected), the bank angle is limited to approximately 25 degrees. With the flight control system set to the HALF-BANK mode, the bank angle is limited to approximately 12.5 degrees. Roll rate is set at 3 degrees per second for all turns.

ANTICIPATION

As the aircraft approaches a turn at a waypoint, in addition to computing the bank angle for the turn, the FMS computes the point where the turn is to start. This is called turn anticipation. Its purpose is to prevent the aircraft from overshooting the new course during the turn. Essentially, the FMS cuts the corner of the turn to make a smooth transition to the new course.

For flight plan leg turns at true airspeeds of less than 350 knots, the turn initiation point is not further than 7 NM from the waypoint. At true airspeeds of 350 knots or greater, the turn initiation limit is no further than 12 NM from the waypoint. A waypoint alert flashes the active waypoint identifier on the PFD display, and the active waypoint symbol and identifier on the MFD map appear approximately 5 seconds before the FMS initiates the turn to the new course. While turn anticipation prevents most overshoots, very large course changes can still result in some overshoot.

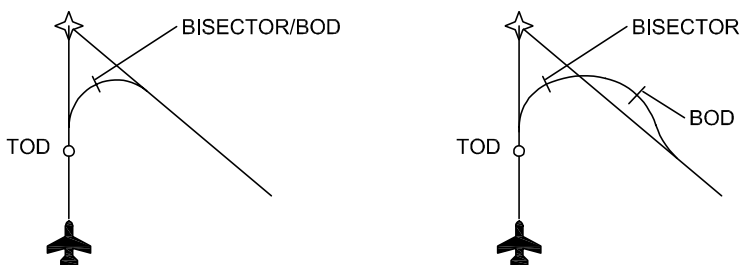
Figure 18-1 Typical Flight Path for Turns



Overshoots can have an effect on how a VNAV descent path is flown. Without an overshoot, the aircraft will begin descent at the TOD, and in most cases, will bottom out at the turn bisector, provided a level-off segment begins at the subject bisector. However, overshoots caused by sharp turns (120 degrees or greater) and/or higher ground speeds can cause the bottoming out (VNAV Bottom of Descent) to occur beyond

the bisector. Under those conditions, the pilot must monitor VNAV to make sure that the altitude constraints are met.

Figure 18-2 Overshoots on VNAV Descent



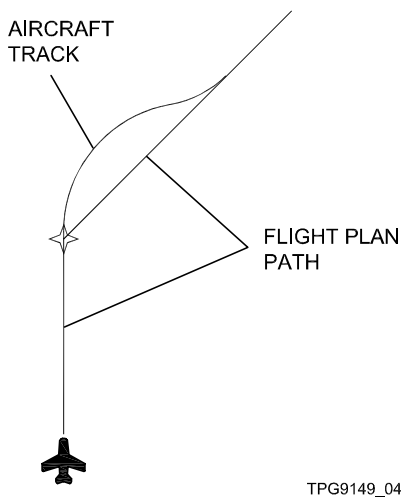
TPG9149_03

FLYOVER WAYPOINTS

Waypoints that are designated as flyover waypoints require the aircraft to fly over the waypoint before a turn is started. Examples of flyover waypoints include leg terminating waypoints such as a waypoint before a discontinuity, holding fix waypoints, and the last waypoint at the end of a flight plan.

It is possible to transform a non-flyover waypoint into a flyover waypoint, and subsequently remove the flyover attribute from a user-defined flyover waypoint. By adding or removing a /0 (slash zero) to or from a waypoint identifier, the FMS flight plan editor allows the user to add, or remove, the flyover attribute. Refer to the FLIGHT PLANNING chapter of this operator's guide for the procedure to add or remove the user-defined flyover attribute.

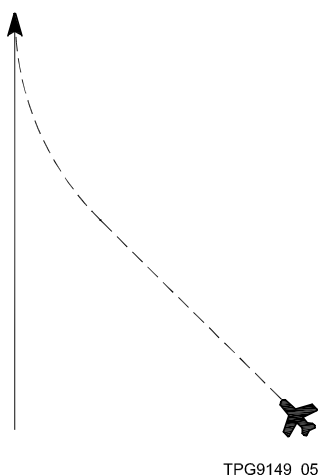
Figure 18-3 Typical Course Change at a Flyover Waypoint



INTERCEPTING A TRACK

The FMS can intercept an active course track at any converging angle. Whenever possible, the intercept is such that the aircraft turns onto the active course without overshoot. However, if the intercept angle is great and the distance to the course is short, an overshoot will occur. If the intercept path is such that the intercept will not occur before the active waypoint, the message NOT ON INTERCEPT TRK shows on the CDU message page.

Figure 18-4 Typical Course Intercept



PARALLEL OFFSET COURSE TRACKING

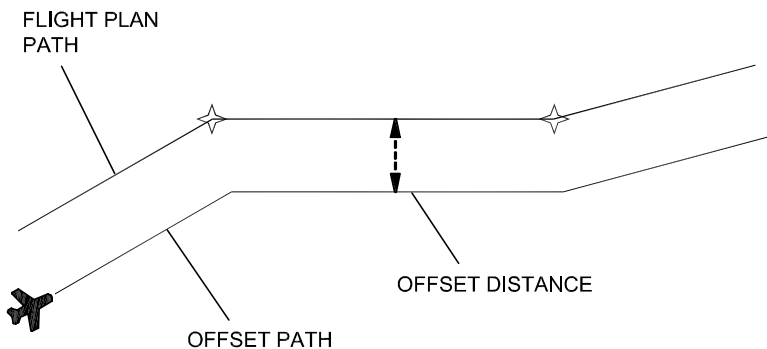
The FMS can track a parallel path that is offset from a flight plan route. While tracking an offset path, course heading and deviation are referenced to the offset path. Also, distance and time-to-go data for the active leg are referenced to the offset path intersections, which effectively treats these intersections as actual waypoints. Turn anticipation and waypoint alerts are also referenced from the offset intersections.

Adding, changing, or deleting an offset to a flight plan path causes the FMS to immediately steer to the new offset, or the original flight plan path if the offset is deleted. For large changes in the offset path, the FMS can steer an intercept of up to 45 degrees to the new path.

Cancel offset tracking manually by entering a zero offset, or deleting it with the DEL function key on the CDU. Offset flight plan tracking is canceled automatically when:

- A Direct-To or other type course change is made to the flight plan.
- The flight plan sequences to a leg that does not support an offset path (holding leg, vectors leg, etc.).
- The flight plan sequences to a discontinuity.
- The flight plan sequences to a leg that requires a course change of greater than 100 degrees.

Figure 18-5 Typical Parallel Offset Course Tracking



TPG9149_06

HOLDING PATTERNS

ENTRY

Just before the aircraft crosses the holding fix, the FMS calculates the size of the holding pattern. The calculation is based on the wind conditions, the true airspeed of the aircraft or the MAX HOLD speed, whichever is lower, and either the leg time or the leg distance of the hold. The size of the holding pattern is set (unless edited on the CDU HOLD page) until the fix is passed again. Just before each subsequent pass of the fix, the FMS recalculates the holding pattern. Thus, each circuit of the holding pattern is the proper size for the existing wind conditions and true airspeed.

In addition, the FMS determines the best entry method based on the direction of approach to the holding fix, and the direction and type (standard or nonstandard) of holding pattern. The entry method is selected in accordance with the rules depicted in the figure on page 18-22.

For parallel entries into a hold, the FMS steers the outbound entry leg to an extended, fixed distance. This is done to make sure that the protected airspace of the holding pattern is not violated when the pattern is flown in excessive wind conditions. If the ground speed is slow, the parallel entry leg can extend well beyond the normal inbound leg turn (as shown below). However, even with the extended entry leg, the FMS maintains the aircraft well within the protected airspace for a holding pattern.

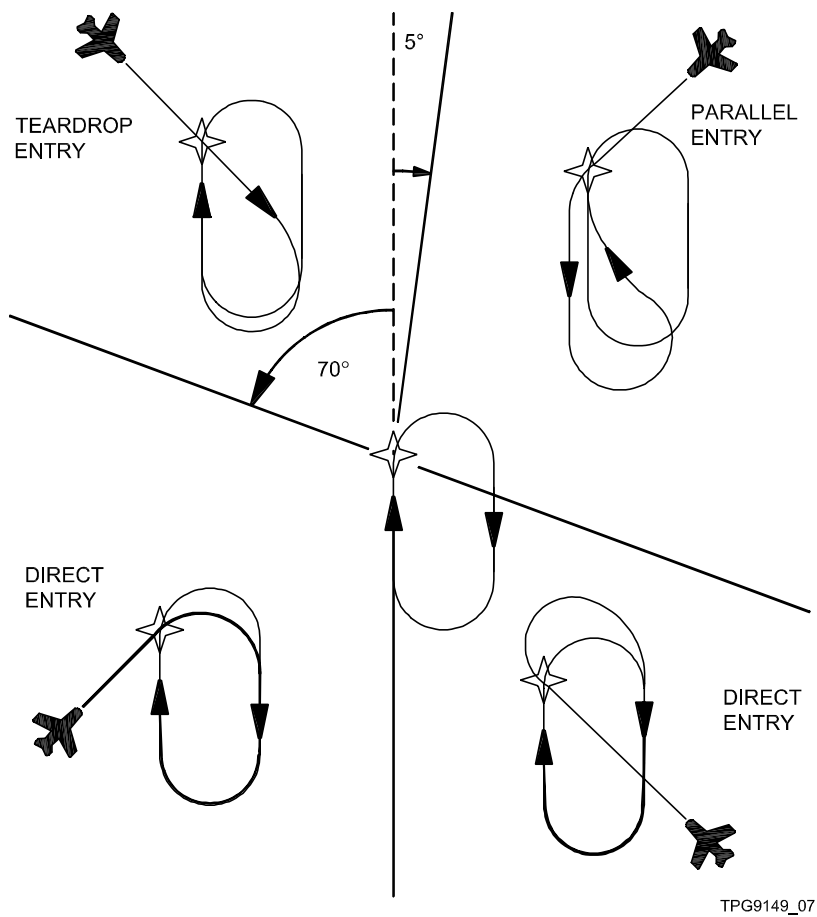
FLYING A HOLD

The FMS provides holding pattern steering data to the flight control system. The FMS calculates to steer the aircraft in the smallest symmetrical racetrack pattern within the selected bank angle limit of the aircraft. The normal bank angle limit is 25 degrees and the HALF-BANK limit is 12.5 degrees. Holding patterns should be flown in normal bank mode unless weight and/or altitude prohibit and ATC approves the use of HALF-BANK.

 **NOTE**

The message HALF-BANK SELECTED shows on the CDU message line when the aircraft is within 1 minute of arriving at the holding pattern fix, and HALF-BANK is selected on the flight control system.

Figure 18-6 Typical Holding Entry Options



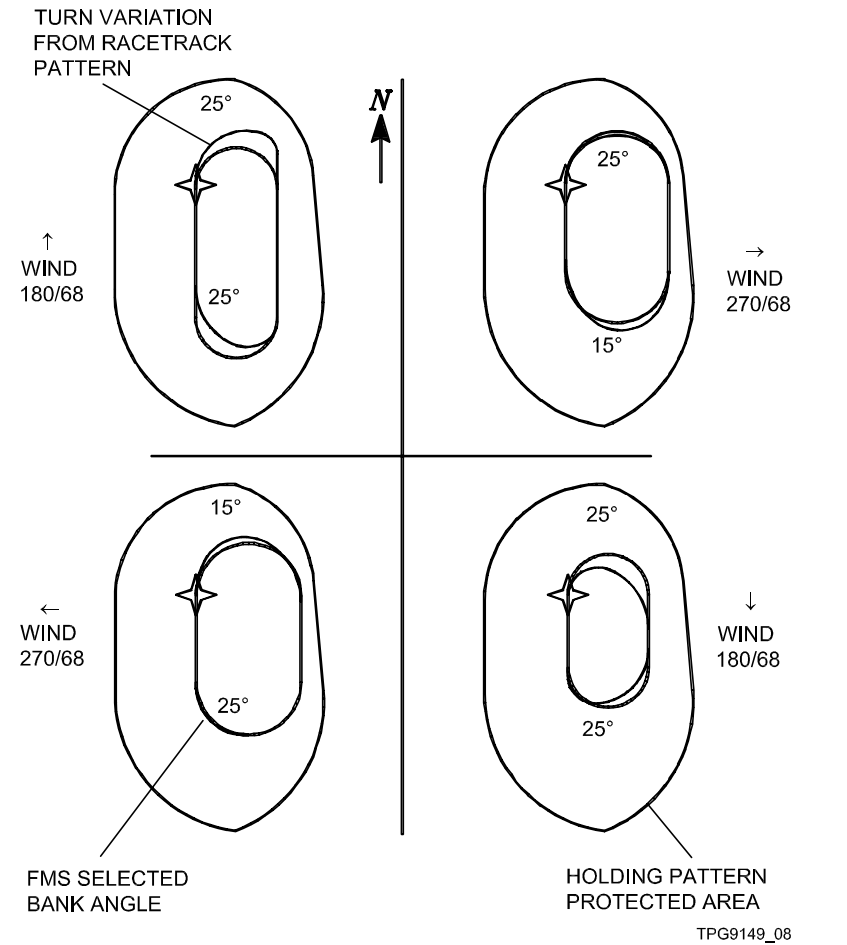


WARNING

Based on the size of the holding pattern and the airspeed of the aircraft, it could be impossible for the FMS to maintain the aircraft within the protected airspace of a holding pattern in strong wind conditions when the flight control system is set to the half bank mode.

The FMS steers the aircraft around the holding pattern using a constant bank angle in the turns. In strong winds, it is possible that the track of the aircraft in the turns of a holding pattern will not be a true semicircular path, as shown in the figure on page 18-24. In addition, the radius of the turns for the holding pattern is size-limited to the MAX KIAS speed for the hold. If the speed is greater than the MAX KIAS for the hold, it is possible that the FMS will not be able to maintain the aircraft within the boundaries of the protected airspace of the holding pattern.

Figure 18-7 Holding Paths in Various Wind Conditions



When flying a hold, approximately 5 seconds before the aircraft reaches the holding fix on each circuit around the holding pattern, the waypoint alert feature flashes the holding fix waypoint to alert the pilot of the fix crossing.

SPEEDS

Both FAA and ICAO recommended maximum holding speeds are programmed into the FMS. They are shown on the HOLD page on the CDU, and also on the LEGS page as the default speed for a hold. The FMS uses the LEGS page speed limits to show a CHECK SPEED message on the message line of the CDU. The CHECK SPEED message shows when the aircraft speed exceeds the calculated deceleration profile for the upcoming speed limit by more than 20 knots. When VNAV is not active, the message is inhibited while the aircraft is more than 1 minute away from the initial arrival at the holding fix.

DISTANCE AND TIME

To help the pilot visualize the current position of the aircraft relative to the fix, distance and time to the holding fix show on the PFD. They are based on the direct distance from the present position of the aircraft to the holding fix. The distance and time to the holding fix that show on MFD displays and on the CDU are based on the distance around the holding pattern to the fix, which gives an exact ETA to the holding fix.

CHANGES

Changing the hold direction, leg time, leg length, or inbound course on the CDU HOLD page, causes the FMS to immediately recalculate the holding pattern. If a change to a holding pattern results in the aircraft being off the holding track, the FMS steers the aircraft onto the new holding pattern track using the smallest course change that is necessary.



NOTE

The direction and inbound course of a hold cannot be changed once the hold is the active leg of the flight plan.

EXIT

Holds can be exited in one of two ways depending on whether or not the hold is part of a course reversal for an approach procedure.

COURSE REVERSALS

When making a direct or teardrop entry into a course reversal hold of an approach, EXIT HOLD is automatically selected as soon as the aircraft enters the hold. When making a parallel entry into a course reversal hold, EXIT HOLD is selected after completing the entry. The pilot can manually select or cancel EXIT HOLD at any time. The aircraft automatically exits a course reversal hold when established on the inbound course at the INTC waypoint as shown on the MFD and the LEGS page of the CDU, rather than at the FIX waypoint.

OTHER HOLDS

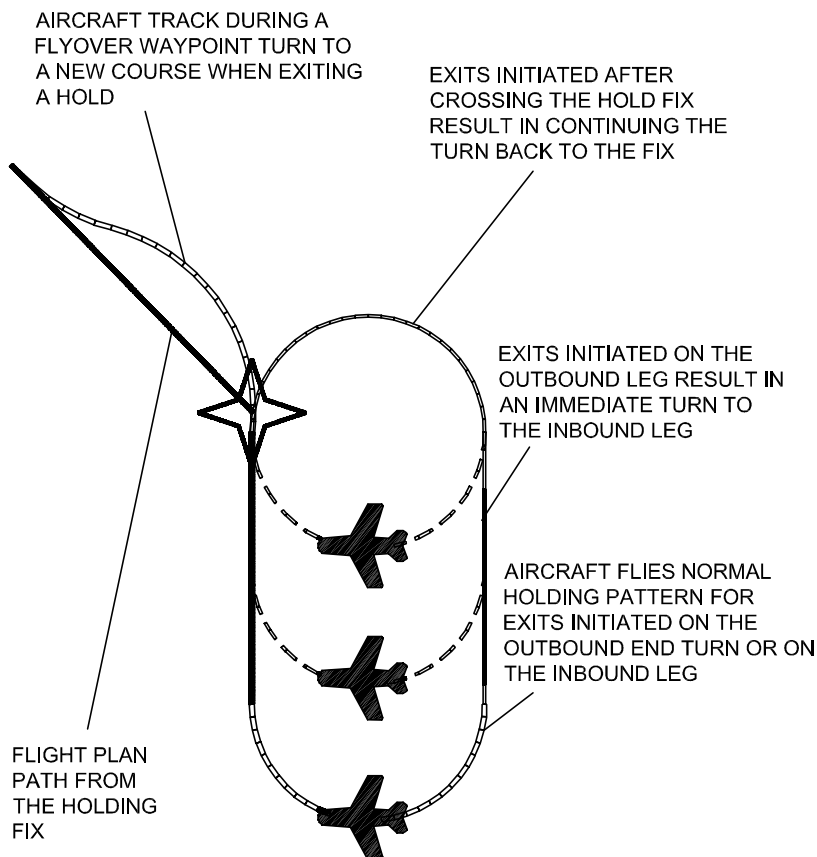
When EXIT HOLD is selected and executed, the EXIT ARMED message shows on the CDU LEGS page, and the FMS steers the aircraft to exit the holding pattern onto the next leg of the flight plan. If the aircraft is on the outbound turn or leg of the holding pattern when EXIT HOLD is selected and executed, the FMS immediately begins to steer the aircraft back to the inbound leg to the fix. If the aircraft is on the inbound turn or leg when EXIT HOLD is selected, the aircraft continues around the holding pattern to the fix in the normal manner. In both cases, the FMS steers the aircraft to fly over the holding fix waypoint and capture the course for the next leg of the flight plan.

CANCEL EXIT

An EXIT HOLD can be canceled at any time. However, if CANCEL EXIT is selected and executed after the FMS has initiated a turn to the inbound leg to exit the hold, it will continue the turn to the inbound leg and return to the fix. After crossing the fix, the FMS follows the complete holding pattern in the normal way.

If the aircraft is on the inbound turn or leg before crossing the fix when CANCEL EXIT is selected and executed, the FMS steers the aircraft around the holding pattern as if EXIT HOLD had not been selected and executed.

Figure 18-8 FMS Steering for a Non Course-Reversal Hold Exit



TPG9149_09

FLIGHT PLAN TERMINATION

Two minutes before reaching the last waypoint of a flight plan, the CDU shows the message LAST WAYPOINT, and the waypoint alert flashes the waypoint for 5 seconds. When the aircraft is within 5 seconds of passing abeam the last waypoint, the waypoint alert flashes the waypoint again. As the aircraft passes abeam the last waypoint, the FMS begins steering to maintain wings-level flight. The FMS continues to steer wings-level until it is deselected as the navigation source, or until a new waypoint is entered into the flight plan. The LEGS page shows the last waypoint until a new one is entered.

While the FMS is steering to wings-level flight, no data shows on the displays for time-to-go, distance-to-go, bearing to waypoint, course, cross track deviation, course arrow, and course digital readout. Also, the LNAV mode annunciation shows in yellow.

HEADING LEGS

For departure and arrival procedures that include legs that must be flown to a specified heading rather than a course, the FMS steers the aircraft to maintain the FMS flight plan heading.

OPERATION IN THE POLAR REGION

DEFINITION

The FMS computes the polar region as the area north of 89 degrees north latitude, inclusive, and the area south of 89 degrees south latitude, inclusive. The FMS navigation and steering is designed to operate normally in the polar region. The flight director and cross-track deviation displayed on the HSI work the same way and are completely unaffected when flying in the polar regions. The main differences observed when operating in or around the polar region have to do with flight plan entry limitations and the affects on cockpit displays.

FLIGHT PLAN ENTRY LIMITATIONS

Waypoints defined by place bearing/distance, place bearing/place bearing, and place along track, can be located in the polar regions. However, a reference fix used for any of these types cannot be located in the polar regions. If a waypoint definition is attempted with a reference fix located in the polar region, the N/A IN POLAR REGION message shows in the scratchpad. This restriction also includes both FMC-named and pilot named waypoints.

A FROM waypoint edit cannot be located within the polar regions. If an attempt is made to enter a FROM waypoint located in the polar regions, the N/A IN POLAR REGION message shows in the scratchpad.

Holding fixes cannot be located in the polar regions. This includes present position holding fixes. An attempt to define a holding pattern with a fix located in the polar regions results in the N/A IN POLAR REGION message to show in the scratchpad.

Course edits to a fix located in the polar regions are not allowed. An attempt to perform a course edit to a fix located in the polar regions results in the N/A IN POLAR REGION message displayed in the scratchpad.

The FIX INFO page is not supported in the polar regions. If an attempt is made to use a reference fix located in the polar regions, the N/A IN POLAR REGION message shows in the scratchpad.

No search patterns are allowed north of 80 degrees north latitude, inclusive, or south of 80 degrees south latitude, inclusive. If any sector of a search pattern lies north of 80 degrees north latitude, inclusive, or

south of 80 degrees south latitude, inclusive then the N/A IN POLAR REGION message will be displayed in the scratchpad.

EFFECTS ON COCKPIT DISPLAYS

Under certain conditions near the pole, the compass card shown on the MFD or PFD can rotate in the opposite direction or at a different rate of angular displacement when compared to the cross-side display of the same information.

The FMS uses a variety of navigational sensors to compute the most accurate position solution possible. Of all the sensor data available, GPS data is the most heavily weighted in the FMS navigation solution. Navigational radio sensor data also has some influence on the FMS position solution but, while operating in the polar regions, navaid availability is so sparse that this usually is not a factor. The only other position fixing instrument onboard is the IRS unit. The FMS does not use the IRS position solution in the navigation solution unless all other sensor data is unavailable or otherwise unusable. The FMS uses the IRS position as a last resort because the position calculated by the IRS sensor can drift from actual position by as much as 3 NM per hour of operation since the last alignment. When the FMS is coupled to the autopilot as the lateral navigation steering source, the FMS will fly a path that is referenced to the navigation position solution.

When the FMS is coupled to the autopilot as the lateral navigation steering source, the FMS flies a path that is referenced to the navigation position solution.

The compass card shown on each Electronic Flight Instrument System (EFIS) display is referenced to aircraft heading. Each EFIS display uses the same-side IRS for heading source under normal conditions. Each IRS position calculation can drift from actual position by as much as 3 NM per hour. This implies that the IRS being used as the heading reference for the displays on one side could be referenced to a position several miles away from the IRS being used as a heading source for the displays on the other side.

As the aircraft FMS flies over the pole using the primarily GPS-based navigation solution, the aircraft heading displayed will be referenced to an IRS. The IRS appears to fly a course parallel to the aircraft track except that it travel either to the left, right, ahead, or behind the aircraft.

Since the heading-up display of the compass card on the EFIS will follow the heading output of the same-side IRS heading, it is possible that the compass card on one side will not match the compass card on the other side. Therefore, when comparing the sensors on the displays on one side to the other, the compass card on one side could swing earlier or later than the other. Also, depending on how each of the IRS sensors have drifted in relation to the FMS position, the compass card on one side could swing clockwise while the other side swings counterclockwise. Again, depending on how each of the IRS sensors have drifted in relation to the FMS position, another possibility would have the compass card on both displays turn the same direction but at different rates of angular displacement.

In any case, whenever the heading shown on one side disagrees with the other side by more than six degrees, the yellow-boxed HDG flag and the yellow EFIS COMP MON message shows on the PFDs.

Another display effect is a possible 5-second period where the aircraft symbol appears to fly backwards on the map. This happens due to a difference in the update rates for the data being sent to the display to show the map. The FMS updates the display data sent to show a map once every 5 seconds. Between map data updates, the display updates the position of the aircraft symbol at a much faster rate. When the aircraft passes directly over a pole, this can cause some interesting effects as the map compass card whips around giving a possible 5 second illusion of the aircraft symbol flying backwards.

Not all of the effects discussed above affect the guidance of the aircraft given by the roll commands from the FMS, the autopilot flight directors, or the cross track deviation as displayed on the HSI.

APPROACHES

The FMS-6100 is designed and authorized to automatically execute non-precision GPS, GPS overlay, multi-sensor RNAV, TACAN (as a GPS overlay), and VOR approaches. The lateral and vertical approach guidance is provided, whether using the course deviation, flight director guidance, or coupled autopilot. The database includes missed approach procedures for all approaches, and the procedures are designed to accommodate ATC radar vectors issued before or during an approach. The FMS can track all leg types stored in the approach database.

The FMS is used when flying ILS, localizer, localizer back course, localizer directional aid (LDA) and simplified directional facility (SDF) approaches. The FMS uses approach data to preset the EFIS, autopilot, and the localizer receiver before beginning an approach with automatic NAV-to-NAV capture. Automatic transition to localizer guidance occurs when the aircraft is in a position to capture the localizer beam. Missed approach procedures for these approaches are also included.

Instrument guidance system (IGS), non-GPS TACAN, non-GPS NDB, and LORAN approaches are included in the database. These are used to generate an FMS MAP for orientation on the MFD, although the approaches are executed using the authorized non-FMS guidance.

Visual approaches are also supported. The FMS MAP mode on the MFD shows the runway threshold and runway extension waypoints.

The FAA has identified certain approaches as Phase Three GPS Approaches. These approaches are identified on the approach charts with “or GPS” in the name of the approach (for example, VOR or GPS Rwy 28). A Phase 3 approach is identified on the CDU approach selection list by prefixing the base name with a G (such as GVOR28), unless the Phase 3 approach is not a GPS-only approach (identified as GPS28). ATC gives clearance for a Phase Three GPS approach using the GPS name (GPS 28) while also giving clearance for the same approach without GPS using the base name (VOR 28). An example clearance would read: “Cleared for GPS approach, VOR 28, report runway in sight.”

VISUAL APPROACHES



WARNING

A visual approach must not be used in Instrument Meteorological Conditions (IMC) as a substitute for an Instrument Flight Rules (IFR) approach.

As discussed here, a visual approach for the FMS is not the same as Instrument Flight Rules (IFR) visual approach clearance issued by ATC. The FMS is not used for a visual approach in Instrument Meteorological Conditions (IMC). FMS visual approaches should only be used in Visual Flight Rules (VFR) conditions.

For a visual approach, the FMS generates lateral and vertical flight paths for an ILS-like approach to a runway. It also gives both lateral and vertical steering commands to the flight control system to capture and follow the generated flight paths of the approach.

Lateral and vertical guidance are shown on the PFD by the lateral deviation bar and scale on the HSI, and the vertical deviation scale and pointer. Lateral deviation sensitivity is ± 1 NM for terminal operation. When the aircraft is within 30 NM of the runway threshold, the message TERM shows on the PFD.

To set up the FMS for a visual approach, simply select an arrival runway for the destination airport on the ARRIVAL page. On selection of the arrival runway, the FMS automatically adds a 5-mile runway extension waypoint. The runway default extension can be changed or deleted.

The FMS also creates a discontinuity from the last en route or STAR waypoint to the runway extension waypoint for the visual approach. The discontinuity can be deleted or initiate a Direct-To the runway extension at the appropriate time. If no other altitude constraints exist at prior waypoints, the VNAV function computes the top of descent (TOD) and en route descent profile to the selected altitude at the runway extension waypoint of the visual approach. The altitude constraints and/or VPA are set on the LEGS page.

A runway extension of 25.0 NM or less is entered into the RWY EXT on the ARRIVAL page. The default is 5 NM. When a RWY EXT is entered, an unnamed pilot-defined waypoint is created. The waypoint is placed at a specified distance from the threshold and along the extension of the runway centerline. The fix is entered into the flight plan with a name consisting of the runway identifier prefixed with RX (example: RX27R).

Changing the selected runway removes the previously selected runway, and associated runway extension fix, from the flight plan. The new selected runway replaces the old selected runway, unless the old selected runway is the active waypoint. In that case, the new selected runway is inserted after the active waypoint. Additionally, if a STAR had been chosen that is not associated with the newly selected runway, the STAR is removed from the flight plan.

Changing a runway extension fix removes any previously selected runway extension fix from the flight plan, unless the old runway extension fix is the active waypoint. In that case, the new runway extension fix is inserted after the active waypoint.

INSTRUMENT APPROACHES

Select an instrument approach and any related elements for that approach on the ARRIVAL page. The ARRIVAL page is selected with the DEP ARR function key on the CDU or with a line select key on the DEP/ARR INDEX page.

The FMS provides vertical and lateral steering commands to the flight control system to fly non-precision approaches, and it provides automatic NAV source transitions from FMS to a ILS sensor (NAV-to-NAV transfer) for localizer-based approaches. All FMS database instrument approaches are either localizer-based or FMS-based. Localizer-based approaches include:

- ILS
- Localizer Only (LOC)
- Simplified Directional Facility (SDF)
- Localizer Directional Aid (LDA)
- Localizer Back Course (B/C).

All other approaches are FMS-based.

TRANSITIONS

Many instrument approaches use transitions to go from the en route or STAR environment to the approach environment. Transitions available for any given approach can include specific charted and named transitions, vectored transitions, or a combination of both. Instrument approach transitions, along with the desired approach, are selected on the ARRIVAL page. Selection of an approach shows the list of

transitions available for that approach under the annunciation TRANS. The default transition for all approaches is VECTORS. If you want a transition other than VECTORS, you must select one from the list of available transitions. If a transition other than VECTORS is desired, one must be selected from the list of available transitions.

Selection of an approach on the ARRIVAL page and execution of the flight plan change automatically inserts a discontinuity in the flight plan. This separates the en route or STAR segment from the approach segment, unless the en route or STAR segment terminates on the initial approach waypoint. When the FMS sequences to that discontinuity, it automatically changes from the AUTO SEQUENCE mode to the INHIBIT SEQUENCE mode.

An easy method to transition to an approach with a named transition (other than VECTORS) is to close the discontinuity before the FMS sequences it to the TO waypoint position. It should be closed with an appropriate waypoint from the approach segment of the flight plan.

For VECTORS transitions, one of the two methods that follow can be used.

Method One:

1. Select the VECTORS transition when vectors to final approach are expected. This transition consists of a course-to-fix leg in the flight plan leading to the final approach course toward the Final Approach Fix (FAF) or toward the Final Approach Course Fix (FACF) fix if present.
2. With this course-to-fix leg established, follow radar vectors manually with the autopilot, or with the flight director.
3. When the aircraft is properly positioned and cleared for the approach, intercept the course-to-fix leg leading to final approach, either manually or using the flight control system.

Method Two:

1. Set the flight control system to the heading mode to follow ATC vectors, then change the flight plan in the FMS to set up for the approach.
2. On the LEGS page, select an appropriate waypoint from the approach segment of the flight plan and make it the TO waypoint.
3. Before executing the flight plan change, push the INTC CRS line key to set the appropriate course to intercept for the approach.

**NOTE**

Manual sequencing to an approach by insertion of an approach segment waypoint in the TO waypoint position causes the FMS to automatically enter an inbound course to that waypoint on the INTC CRS data line. In addition, the FMS automatically inserts the appropriate INTC CRS into the flight plan when AUTO sequence to an approach waypoint from a discontinuity is selected.

To prevent the FAF from sequencing prematurely, regardless of the position of the aircraft, special waypoint passage criteria apply to the FAF. At 2.0 NM radial distance from the FAF, the criteria that follow must be true:

- The aircraft must have less than 1.6 NM cross track deviation.
- The magnitude of intercept (track angle minus outbound course from the FAF) must be less than 90 degrees.
- The aircraft altitude must be less than 3000 feet above the FAF altitude constraint.
- The FAF must be the TO waypoint or next waypoint after the TO waypoint.

LOCALIZER-BASED APPROACHES

The FMS-6100 supports a class of localizer-based approaches that include LOC, B/C, LDA, SDF and full ILS. Although the FMS does not execute the final approach phase of these approaches, it does support initial approach phases leading to lateral navaid capture. Vector transitions to the approach are also supported. Missed approach procedures are included and are flown by re-selecting FMS as the NAV source following a missed approach.

Localizer-based approaches have, as a minimum, an approach entry point called a Final Approach Course Fix, a Final Approach Fix, a runway threshold, and a missed approach procedure. One characteristic of the FACF is that localizer signal reception is assured on the leg from the FACF to the FAF.

The FACF fix can be named and printed on the published approach chart, but not always. However, the FACF is always named in the database. If the database default name applies to an FACF, the first letter C designates the FACF waypoint type. The second letter refers to the approach type, for example, I for ILS, L for localizer, B for back

course localizer, X for LDA, and Z for SDF. For circling approaches, the standard second-letter identifier is F.

The FAF and the portions of the approach that follow the localizer interception are included in the approach flight plan. They are shown on the MFD FMS MAP only as a visual reference aid that depicts the overall navigation situation.

Localizer-based approaches and transitions are selected on the ARRIVAL page. The ARRIVAL page is selected with the DEP ARR function key or with the ARR line select key on the DEP/ARR INDEX page.

For airports with STARS, an available approach can be selected with or without an accompanying STAR.

When the aircraft flies to within 30 NM of the destination airport, the displays, autopilot, and localizer receiver are all automatically preset and tuned by the FMS using the NAV-to-NAV transfer function, once selection of a localizer-based approach is made. It tunes the new LOC frequency, selects it as the preset navigation source, and sets the inbound preset second course.

If the NAV radio is set to manual tuning mode, 30 seconds before the FMS attempts to tune the radio, the CDU shows the message LOC WILL BE TUNED to alert the pilot that the FMS will retune the radio. After the 30 second notice if the FMS was unable to tune the radio, the message CHECK LOC TUNING shows to indicate that it was unable to tune the localizer frequency.

The NAV-to-NAV transfer works only when the same-side FMS is using the same-side navigation sensors, and only when the same-side FMS is selected as the active same-side navigation source.

Because of navigation errors, the actual localizer path can differ from the FMS path from the FACF to the runway. If the localizer capture is at a very small angle, it is possible that the flight path will not converge properly with the localizer, and capture could be uncertain.

The FMS uses the localizer deviation signal to turn the aircraft away from the FMS course toward the localizer course. This assures capture of the beam despite FMS position errors. This steering occurs only if the FACF to FAF leg, or the FAF to runway leg, is active and the localizer signal is valid.

Selecting approach mode on the flight control system arms the flight director for localizer or ILS capture, regardless of the current active flight plan leg. Use discretion in choosing the proper time to arm for the approach, since radar vectors or published approach routes can prematurely approach or cross the localizer.

When the aircraft is in a position to capture the localizer, and cleared for the approach, select the approach mode on the flight control system. The flight control computer automatically changes the NAV source from FMS to the localizer when the aircraft is in a position to receive and capture the localizer signal. Vertical navigation guidance is provided up to the point of glide slope capture for an ILS approach or to the final approach fix for a localizer-only or localizer back course approach.

If the FMS is operating in synchronized mode, all CDU flight-planning actions are cross-linked. Automatic setup of EFIS and radio tuning as described before occurs on both sides of the cockpit, provided the same-side FMS is selected as the active navigation source for EFIS. After the approach is selected on the flight control panel, localizer capture takes place independently on each side. If the cross-side FMS is selected as the active navigation source for EFIS, the pilot must manually tune the localizer and sequence the EFIS source selection to VOR/LOC to capture the localizer on that side.



WARNING

For all types of localizer-based approaches, the pilot must manually set the DH or MDA alerters. It is the responsibility of the pilot to recognize when the aircraft reaches the DH or MDA, and to make a decision on whether or not to continue the approach.

To activate the missed approach, refer to the recommended missed approach checklist in the MISSED APPROACH chapter of this operator's guide.

FMS-BASED APPROACHES

FMS-based approaches and transitions are selected on the ARRIVAL page. The ARRIVAL page is selected with the DEP ARR function key or with the ARR line select key on the DEP/ARR INDEX page.

All FMS-based approaches are non-precision approaches. This includes VISUAL, GPS, RNAV, VOR/DME, VOR, TACAN (as a GPS overlay), and NDB.

The FMS is certified to do both stand-alone GPS and multi-sensor non-precision approaches. GPS sensor data is used predominantly for all FMS-based approaches. However, other available navigation sensors are used as part of the FMS process to determine position.

The FMS also monitors the RAIM to make sure that the required GPS accuracy is maintained for an approach. Visual, RNAV, VOR/DME, TACAN, and VOR approaches can also be executed by the FMS without GPS.

Lateral and vertical guidance is available throughout all FMS-based approaches. On the PFD, the lateral deviation bar and scale on the HSI give the lateral guidance, and the vertical deviation pointer and scale give the vertical guidance. The intent is to fly non-precision FMS-based approaches in a manner similar to that of an ILS. The FMS provides steering commands to fly the aircraft along the flight plan route to a position where it captures an FMS-generated lateral and vertical flight path for the approach. As with all approaches, the pilots must maintain vigilance and verify the aircraft is maintaining the correct lateral course and vertical profile.

CAUTION



When FMS approach operations are done in the INDEP mode for dual installations, make sure that the flight plans on both sides are identical. When the autopilot APPR mode is selected to arm the VGP mode, the autopilot APPR mode uncouples the flight directors, and the flight director on each side is driven by the applicable FMS. If the flight plans are not identical in the two FMSs, the flight director indications will not agree, which is not acceptable during final approach.

FMS approach logic is automatically enabled at 30 NM from the airport reference point (ARP) at the destination, and remains active until after the missed approach point (MAP). The approach logic can be disabled at any time. The approach must be disabled in order to transition to a missed approach procedure.

To disable the approach, do any of the following:

- Push the GA button.
- Make a lateral change to the flight plan between the FAF and MAP.
- Manually sequence through the flight plan past the MAP waypoint.
- Delete the FAF or MAP waypoint.

- Push the APPR ENABLED line key on the ARRIVAL page to select NO.
- If the TO waypoint is the MAP, select AUTO SEQUENCE.



WARNING

For all types of FMS-based and/or non-precision approaches, the pilot must manually set the MDA alerters.

There are two different types of non-precision FMS-based approaches: RWY and V-MDA. In addition to the RWY and V-MDA types of non-precision approaches, specific procedures must be followed to fly DME ARC approaches and special considerations must be observed when holding at the FAF.

RWY APPROACHES



WARNING

It is the responsibility of the pilot to recognize when the aircraft reaches the MDA, and to make a decision on how to continue the approach. In aircraft with coupled VNAV capability, the FMS will not level the aircraft at the MDA for RWY type approaches.



WARNING

With coupled VNAV capability, even though the VPA for a RWY type approach provides compliance with step-down fix altitude restrictions down to the MDA, it is the responsibility of the pilot to monitor for that compliance, and intervene if necessary to prevent a descent through a step-down fix.

Runway approaches are those that terminate at a missed approach point generally located at the runway threshold. The annunciation RWY shows on the ACT LEGS page to identify this type of non-precision approach.

The VPA used by the FMS for a runway approach terminates approximately 50 feet above the runway threshold at the missed approach point. The VPA is specific for a given approach and provides obstacle clearance down to the minimum descent altitude (MDA). The runway waypoint VPA, shown on the LEGS page, cannot be changed or deleted. For this type of approach, the FMS steers the aircraft along a lateral and vertical flight path very similar to that of an ILS. Vertical

flight-path tracking is based on the corrected barometric altimeter of the aircraft.

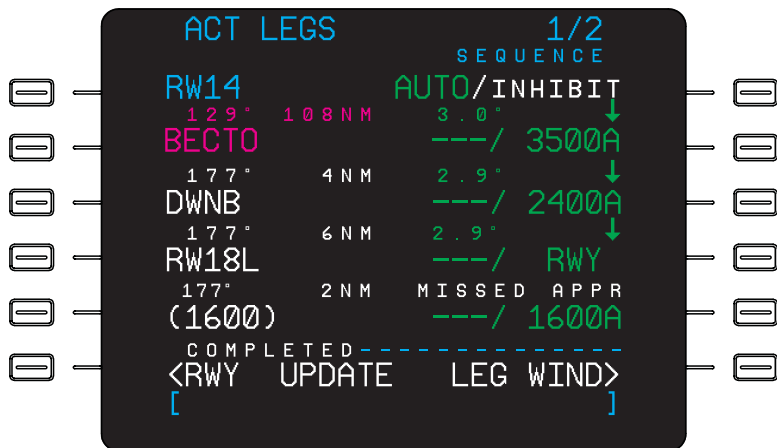
There are two different ways the pilot can choose to fly the runway approach. For some approaches, only authorized operators are permitted use VNAV DA(H) in lieu of MDA(H). If so authorized, the pilot would select the approach mode (APPR) of the autopilot when flying the approach. The approach mode of the autopilot will display VGP to indicate when the aircraft is being steered vertically to a pseudo-glide path very similar to that of an ILS glide slope. When the autopilot is in VGP mode, the aircraft will continue descent through the preselect altitude just as an ILS approach operation. If the operator is not authorized to use VNAV DA(H) in lieu of MDA(H), the pilot would leave the autopilot in NAV mode when flying the approach. The preselect altitude would be set to the MDA for the approach in accordance with the approach category of the aircraft for the approach being flown. When NAV mode remains selected, the VNAV mode will remain VPATH instead of transitioning to VGP during the approach. When in VPATH mode during the entire approach, the aircraft will honor the preselect altitude and capture the MDA altitude (with the preselector set at the MDA altitude).



TIP

The pilot can view the actual altitude the VNAV will fly to for a RWY approach by pushing the line select key next to the RWY annunciation on the ACT LEGS page. This copies the RWY altitude to the scratchpad.

TPG9209 89



V-MDA APPROACHES



WARNING

Refer to the AFM for the limitation for V-MDA approaches. The use of VNAV vertical guidance for a V-MDA type approach between the final approach fix and the missed approach fix is prohibited.



WARNING

Pilots must review the appropriate terminal procedures for an approach and adjust the MDA when appropriate in accordance with the approach category requirements of the aircraft. It is the responsibility of the pilot to recognize when the aircraft reaches the MDA, and to make a decision on how to continue the approach. In installations with coupled VNAV capability, the FMS will capture and track the MDA for V-MDA type approaches.



WARNING

If a given approach has any step-down fixes between the FAF and arrival at MDA, VNAV should not be used for this portion of the approach. The FMS does not recognize step-down fixes between the FAF and the MAP, and will not try to comply with them. It is possible, on some V-MDA approaches, for a selected VPA to result in a vertical flight path that would go below a step-down fix altitude restriction.

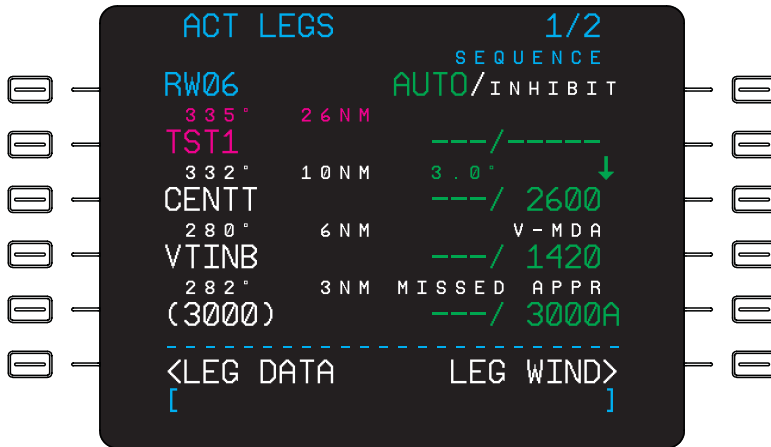
V-MDA approaches are those that terminate at a missed approach point generally located somewhere other than at the runway threshold. The annunciation V-MDA shows on the ACT LEGS page to identify this type of non-precision approach. Examples of V-MDA type approaches are circling approaches or approaches where the missed approach point is a navaid located on the field.

For V-MDA type approaches, the pilot must make sure to set the MDA of the missed approach point in accordance with the approach category of the aircraft for the approach being flown.

The FMS does not provide VNAV guidance between the FAF and the MAP on a V-MDA approach because protection from step-down fix altitude constraints cannot be provided. However, VNAV will protect and capture the V-MDA altitude on the missed approach point waypoint. In other words, between the FAF and the MAP of the V-MDA approach, the FMS will not be able to guide the aircraft vertically using the VGP or VPATH modes of the autopilot. Instead, if the autopilot mode was either

VGP or VPATH before the FAF, the autopilot mode will drop to VPTCH between FAF and the missed approach altitude. In either case, the NO VPATH CONDITION message will appear on the CDU to indicate that FMS VNAV guidance is no longer being provided.

Figure 18-10 ACT LEGS Page with V-MDA Approach



TPG9209_90



NOTE

Based on the approach, if the altitude of a missed approach point waypoint is changed, it also can require changing the altitude of the FAF as well as any intermediate waypoints. It also can require changing the altitude of the initial waypoint of the missed approach procedure. It is possible that the proper temperature compensation will have to be calculated as part of determining these altitudes when operating in extremely cold temperatures.

DME ARC APPROACHES

To intercept a DME arc at a published entry point, no special procedures are required. The FMS will fly to the entry point, turn to intercept the published arc, and fly the approach. Radar-vector DME arc approaches, however, require the pilot to maintain situational awareness to intercept the arc somewhere between the published entry and exit points of the arc.

GPS APPROACHES

To fly a GPS approach, or an RNAV, VOR/DME, VOR, TACAN, or NDB approach as a GPS-overlay approach using the FMS, the approach must be selected and inserted into the flight plan. When the approach is enabled, cross track deviation display sensitivity, enforcement of approach navigation accuracy and integrity, and the display of vertical deviation information during the final approach are activated. If flight director vertical steering guidance is desired, the preselector altitude must remain set below aircraft altitude past the leg into the FAF.



NOTE

GPS and NDB approaches cannot be flown with the FMS if the GPS navigation sensor is not available.

When the FMS sequences from the en route segment to the approach segment, the following events occur.

At 30 NM great circle distance from the airport reference point, the system automatically:

- Transitions to terminal deviation sensitivity (± 1.0 NM)
- Begins monitoring for terminal navigation accuracy (RAIM)
- Shows the TERM message on the PFD.

Between 2 NM from the FAF up to the FAF, if the approach is enabled and FAF waypoint sequencing conditions are met, the system automatically:

- Shows the GPS APPR message on the PFD
- Smoothly transitions to approach deviation sensitivity (± 0.3 NM)
- Begins monitoring for approach navigation accuracy (RAIM).

Between the FAF and the MAP, the system automatically:

- Shows the GPS APPR message on the PFD
- Maintains the deviation sensitivity at ± 0.3 NM
- Continues monitoring of approach navigation accuracy (RAIM).

The integrity of the GPS position solution is monitored by the FMS using more than the minimum number of satellite measurements to determine the position. The FMS also makes sure that the redundant measurements do not produce inconsistent position solutions. This is known as Receiver Autonomous Integrity Monitoring (RAIM).

If the number of satellites cannot support RAIM for the phase of flight (4 NM oceanic/remote, 2 NM en route, 1 NM terminal and 0.3 NM approach), RAIM is not available. The message NO GPS RAIM shows on the CDU. This does not mean that the GPS position is inaccurate. It means that the accuracy of the GPS position cannot be guaranteed. The pilot is responsible for proper monitoring of backup navigation means in the cockpit in accordance with any provisional airworthiness conditions imposed upon GPS approaches.

RAIM status can be examined on the MFD LRN STATUS 2/2 page. RAIM is available if the RAIM ACCURACY LIMIT value is less than that required for the current phase of flight. The LRN STATUS 2/2 page also shows a MEASUREMENT ACCURACY LIMIT based on the current GPS measurements plus the most probable GPS error. If the satellite signals disagree and the source of the disagreement cannot be isolated to one satellite shows the RAIM DETECTED ERROR message on the MFD LRN STATUS 2/2 page.

The FMS does not use the GPS data to determine aircraft position if the RAIM DETECTED ERROR message and the MEASUREMENT ACCURACY LIMIT is greater than what the current phase of flight requires, or the PROBABLE ERROR is too large.

There can be short periods when the required approach accuracy is unavailable. By predicting future satellite positions, GPS is capable of estimating the availability of approach accuracy. This feature is called predictive RAIM.

The GPS CONTROL page on the CDU gives access to the GPS predictive RAIM capability any time the FMS and GPS systems are operational. Normally, the active flight plan contains the required data (destination and ETA) and the estimates are made automatically.

When approach RAIM is unavailable, the message NO APPR GPS RAIM shows on the CDU. This message can show only when the aircraft is within the arrival terminal area and a GPS approach is selected. However, the current RAIM status can be viewed at any time on the GPS CONTROL page.

Flight plan destination and estimated time of arrival are automatically inserted on the GPS CONTROL page. However, before departure the pilot can change them to check alternate destinations and arrival times. Pilot entries show in large font characters and automatic entries from a flight plan show in small font characters.

GPS RAIM status annunciations for the specified DEST and ETA that show on the GPS CONTROL page are:

- AVAILABLE – GPS approach RAIM is available.
- UNAVAILABLE – GPS approach RAIM is not available.
- REQ PENDING – RAIM status is being evaluated.
- INIT GPS – RAIM cannot be evaluated, GPS is not initialized.

Predicted approach RAIM availability at a destination is based on the ETA predicted by the aircraft performance function. If performance predictions are not available because the required data was not entered, ETA for predicted approach RAIM is based on measured ground speed when the aircraft is in the destination terminal area.

The GPS CONTROL page also gives the pilot the ability to manually deselect up to eight satellites identified in NOTAMs as out of service. Deselected satellites are not included in the predicted RAIM computations. Satellite numbers can be entered one at a time. All deselected satellites are deleted simultaneously using the CLR DEL function key on the CDU, or deleted individually from the deselected list by reentering the satellite number.

If approach is enabled and any of the following conditions are true, then NO APPR is shown in yellow on the PFD.

- Approach RAIM is not available at any time while the aircraft is between 2 NM inbound to the FAF and the FAF.
- Approach RAIM is available while the aircraft is between 2 NM inbound to the FAF and the FAF. The missed approach point is more than 5 minutes from the FAF, and approach RAIM is predicted to be unavailable within 5 minutes of predicted arrival time at missed approach point.
- Approach RAIM is not available at 2 NM inbound to the FAF and approach RAIM is predicted to be unavailable within 5 minutes of predicted arrival time at the FAF or missed approach point.
- Approach RAIM is not available for 5 minutes during final approach.
- GPS NOT AVAILABLE, NO APPR GPS RAIM, NO GPS RAIM, or FMS DR message is annunciated after 20 seconds while in final approach.

RNAV APPROACHES

To fly an RNAV, VOR/DME, TACAN, or VOR approach as an RNAV approach with FMS, but without the GPS sensor, the approach must be selected and put in the flight plan. When the approach is enabled, cross track deviation display sensitivity, enforcement of approach navigation accuracy and integrity, and the display of vertical deviation information during the final approach are activated.

When the FMS sequences from the en route segment to the approach segment, the following events occur.

At 30 NM great circle distance from the airport reference point, the system automatically:

- Transitions to terminal deviation sensitivity (± 1.00 NM)
- Begins monitoring for terminal navigation accuracy
- Shows the TERM message on the PFD.

Between 2 NM from the FAF up to the FAF, if the approach is enabled and FAF waypoint sequencing conditions are met, the system automatically:

- Shows the APPR message on the PFD
- Maintains deviation sensitivity of ± 1.00 NM
- Begins monitoring for approach navigation accuracy.

Between the FAF and the MAP, the system automatically:

- Shows the APPR message on the PFD
- Maintains deviation sensitivity of ± 1.00 NM
- Continues monitoring approach navigation accuracy.

Selection of an RNAV approach is the same as the selection of any other approach on the ARRIVAL page. RNAV approaches include a Final Approach Fix (for example, FF31), a missed approach point, and a missed approach procedure. RNAV approaches also include transitions that constitute entry routes for the approach.

For RNAV approaches, the FMS automatically tunes the recommended navaid when the aircraft is 30 NM from the arrival airport. If the radio is not properly tuned because it is in manual tune mode or the radio was re-tuned, the message CHECK LOC TUNING shows on the CDU. If the recommended navaid is not tuned when the aircraft is within 2 NM inbound to the FAF, NO APPR shows in yellow on the PFD.

Although pilot-entered waypoints that define an approach can be included in the flight plan, the FMS does not support important aspects of approach operation for these waypoints. Some of the aspects not supported for pilot-entered approach waypoints include approach deviation scaling, approach accuracy checking, certain leg types commonly used in approaches, and approach mode VNAV operation. Because of these limitations, using pilot-entered approaches with the FMS is approved for reference only. An independent primary source of navigation must be used to conduct the approach.

AUTOMATIC REVERSION

The FMS executes a non-precision approach using the procedures described in the GPS Approaches section if GPS is installed on the aircraft and enabled. Otherwise, the FMS uses the procedures described in the RNAV Approaches section. As a reminder, GPS-only and NDB approaches are not qualified to be flown under the RNAV rules.

The FMS will automatically revert to RNAV approach rules when either of the following is true:

- The pilot elects to fly a non-precision approach under the GPS approach rules and the GPS signal is not available.
- The GPS RAIM does not meet the 0.3 NM requirement.

The automatic reversion will not occur for an GPS-only or NDB approach, or if the aircraft has passed the FAF waypoint. Note that if GPS RAIM meets the 0.3 NM requirement within 2 NM before reaching the FAF waypoint, the approach will be allowed to continue for up to 5 minutes with RAIM larger than 0.3 NM. A GPS receiver failure will cause reversion to the cross-side GPS receiver. If that receiver fails, reversion will be to the RNAV approach, unless the failure occurred inside of the FAF.

COURSE REVERSAL HOLDS IN APPROACH TRANSITIONS

When an approach includes a course reversal hold and the FMS sequences to the waypoint of that hold, the hold is automatically armed for exit. The aircraft will fly the holding pattern, then complete the approach procedure unless a parallel entry is required. On a parallel

entry, the hold will be automatically armed for exit after the entry has been completed. However, the exit can be selected at any time.

If ATC clearance requires a further hold, push the CANCEL EXIT line select key on the LEGS page to cancel the hold exit and continue flying the hold. When cleared to exit the hold, push the EXIT HOLD line select key on the LEGS page to arm the FMS to exit the hold and continue the approach.

Course reversal holds in an approach transition have a waypoint labeled INTC at the point where the holding pattern intercepts the final approach course. Altitude constraints that apply until the aircraft is established on the final approach course also apply to the intercept waypoint.

Not all approaches have a hold in the approach transition. However, many do have a hold in the missed approach procedure. In an approach with these conditions, to enter a hold at the FAF as part of a non-published approach procedure, a new hold at the FAF must be added. When selected, the HOLD page first shows the ACT HOLD LIST with the missed approach hold clearly labeled on the list. Push the NEW HOLD line select key to add a new hold at the FAF waypoint. This will result in what appears to be two holds at the same waypoint. One of the holds is at the FAF and the other hold is part of the missed approach procedure.

MISSED APPROACH

Missed approach procedures are included in the flight plan as part of an approach. The missed approach point waypoint shows on the LEGS page as the waypoint just before the MISSED APPR label. It also shows on the ACT/MOD FPLN page as MISSED APPROACH. The first waypoint after the MISSED APPR annunciation is usually the initial altitude-constraint waypoint for the missed approach. It shows in parentheses and cannot be copied to the scratchpad. However, the waypoint can be deleted. It also shows on the MFD, in parentheses, as the first waypoint of the missed approach.



NOTE

Missed approach procedures do not show on the MFD display until the missed approach is active, or the MISS APR map display option is selected on the MFD MENU page.

For the FMS to sequence beyond the missed approach point to the missed approach procedure, the pilot must disable the approach, or fly to the missed approach point waypoint with AUTO SEQUENCE selected.

An approach can be disabled by any of the methods that follow:

- Push the GA button.
- Make a lateral change to the flight plan between the FAF and missed approach point.
- Manually sequence through the flight plan past the missed approach point waypoint.
- Delete the FAF or missed approach point waypoint.
- Push the APPR ENABLED line key on the ARRIVAL page to select NO.
- Select AUTO sequencing when the missed approach point is reached.



NOTE

The APPR ENABLED line key selection, on the ARRIVAL page, is available only for non-precision approaches.

While on the missed approach, the pilot can edit the flight plan to select a new approach (refer to the ARRIVAL AND APPROACH chapter of this guide), or sequence the FMS to a waypoint on the route to the alternate airport.

Some missed approach procedures can require flying a segment of a SID as part of the procedure. To do this, select the DEP option for the destination airport on the DEP/ARR INDEX page. Once the desired SID is selected, the FMS will insert it in the flight plan, preceded by a discontinuity.



NOTE

To prevent an inadvertent loss of airspeed, VNAV does NOT automatically initiate a climb when the FMS sequences to the missed approach procedure. Pilots must initiate any climbs required for the missed approach procedure. After initiating the climb, with FMS as the navigation source and the VNAV mode selected on the flight control system, the FMS will capture and track the altitude constraint.

The following two simplified checklists, one for each type of approach (localizer-based and FMS-based), should aid in the transition to a missed approach.

To transition to a missed approach procedure from a localizer-based approach:

1. Select Go Around (GA).
2. Set power and configuration as required.
3. Make sure AUTO sequence is selected (LEGS page).
4. Make sure the TO waypoint is the first waypoint of the missed approach.
5. Set FMS as NAV SOURCE.
6. Set the appropriate lateral and vertical flight director modes.
7. Engage the autopilot (if desired).

To transition to a missed approach procedure from an FMS-based approach:

1. Select Go Around (GA).
2. Set power and configuration as required.
3. Make sure AUTO sequence is selected (LEGS page).
4. Make sure the TO waypoint is the first waypoint of the missed approach.
5. Set the desired lateral and vertical flight director modes.
6. Engage the autopilot (if desired).

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PRINCIPLES OF VNAV

INTRODUCTION

The FMS-6100 provides multiple waypoint Vertical Navigation (VNAV) for each phase of flight (climb, cruise and descent). The VNAV feature helps the pilot to comply with altitude and speed constraints at waypoints, and speed limits at altitudes. It also helps in following the vertical flight profile entered in the active flight plan.

Selecting vertical navigation modes on the Flight Guidance Panel (FGP) allows the autopilot to sequence modes and set target speeds and altitudes to maintain the flight plan requirements within the constraints of the preselector altitude setting. The preselector will override any VNAV commands, except glidepath, generated by the FMS. With VNAV integrated with the autopilot, the pilot has command of all autopilot modes (flight level change, vertical speed, pitch, and altitude hold) while VNAV mode is active. Target speeds are set with the airspeed reference knob. The FMS gives the appropriate VNAV warning annunciations to alert the pilot of any violation to flight plan constraints.

During the various phases of flight, VNAV follows the flight plan. It levels the aircraft on capture of the preselect altitude and begins a descent at a planned location. Step climbs can be initiated by setting the preselect altitude and selecting the desired climb mode.

During the descent mode, VNAV computes a geographical path to each waypoint and gives guidance relative to that path to make sure that the descent altitude constraints are honored. As the approach and the corresponding procedure environments are entered, VNAV is fully automated, providing smooth transitions and easing pilot workload. In addition to following a planned vertical profile that is entered in the FMS flight plan, the vertical Direct-To feature allows the pilot to execute a vertical path directly to an altitude at a waypoint.

Vertical navigation information shows on the PFD when VNAV is selected or advisory VNAV is enabled. The information that shows includes:

- The next altitude constraint
- Vertical deviation from the planned descent path
- Vertical speed required to fly directly to the next altitude constraint.

VNAV PLAN SPD shows on the PERF MENU page. Advisory VNAV is enabled and disabled on the PERF MENU page as well.

SETUP

A vertical guidance profile is defined by the active flight plan and the settings on the VNAV SETUP pages. The flight plan defines the altitude and speed constraints on the LEGS page. The VNAV SETUP pages are used to define the cruise altitude, speed targets, altitude-dependent speed limits, and Vertical Path Angle (VPA) for descents. Vertical navigation data is also used in the performance calculations.

There are default values for all VNAV parameters except cruise altitude. When the pilot selects SID, STAR, and approach procedures, the appropriate speed and altitude constraints at waypoints are automatically loaded into the flight plan. The pilot can set up the VNAV default parameters so each flight is automatically initialized in accordance with the way the aircraft is flown. When nonstandard flight conditions arise, the VNAV parameters can be modified for that flight without changing the default values for subsequent flights. No data entry is required on the VNAV SETUP pages to activate VNAV, unless modification to the defaults or addition to a speed or altitude constraint is necessary.

To select the VNAV SETUP pages, push the PERF function key on the CDU to show the PERF MENU page, then push the VNAV SETUP line select key to show the VNAV SETUP pages. If VNAV is in use, the page associated with the current flight phase (climb, cruise, or descent) shows when the VNAV SETUP line select key is pushed. Push the NEXT or PREV function key as necessary to show the other pages.

COUPLED VNAV SELECT AND DESELECT

Push the VNAV key on the flight control panel to select and deselect coupled VNAV. Coupled VNAV is active when it is both valid and selected.

VNAV is valid when the three conditions that follow are met:

- An ACT FPLN with a TO waypoint exists in the FMS.

- The EFIS NAV source is either a valid FMS or localizer. For a localizer, the bearing must be entered into the flight plan and the FMS must have executed a localizer-based capture.
- Preselector altitude, barometric altitude, and airspeed or Mach speed are all valid.

PFD ANNUNCIATIONS AND DISPLAYS

MODES

Captured VNAV modes are annunciated at the top of the PFD where the autopilot vertical modes are annunciated. A captured VNAV mode annunciation shows the letter V in front of the autopilot annunciations. Descent path (VPATH or VGP) and VNAV altitude capture and hold (VALTV CAP and VALTV) are additional unique VNAV modes that are also annunciated on the PFD.

INVALID VNAV

A yellow VNAV annunciation shows in the autopilot mode field when VNAV is selected on the flight control system and VNAV is not valid. If VNAV becomes invalid after it has been an active mode, the V is removed from view, and the yellow VNAV annunciation shows. If VPATH or VGP show when VNAV becomes invalid. The mode annunciation reverts to autopilot pitch. A CDU message identifies the reason that VNAV is invalid after VNAV is selected. One of the CDU messages that follow shows to identify the reason why the VNAV is invalid when VNAV is selected:

- CHECK NAV SOURCE
- VNAV SENSOR FAIL.

FLIGHT PLAN TARGET ALTITUDE

The VNAV data has a flight plan target altitude derived from the altitude constraints in the active flight plan. The flight plan target altitude shows on the PFD near the preselector altitude when VNAV is active or advisory VNAV is selected. Generally, it is the next altitude constraint in the flight plan consistent with the current phase of flight. Therefore, a distant descent altitude constraint is not shown when the aircraft is climbing to cruise altitude. When the flight plan contains a VNAV

altitude-constraint in a down-track waypoint, and the constraint is below the current altitude of the aircraft, the VNAV target altitude for the descent will not show on the PFD. The altitude preselector must be set below the present barometric altitude for the descent VNAV target altitude to show on the PFD.

The target altitude is the next altitude constraint that will be captured by VNAV. Whether or not the altitude is captured depends on the type of altitude constraint and the geometry of adjacent altitude constraints. If VNAV captures the altitude, ALTV shows on the PFD. For step descents, where the aircraft levels at an intermediate constraint altitude, the intermediate altitude remains in view after passing the constraint waypoint so that the autopilot can continue to hold that altitude. The VNAV target altitude is always updated to the next altitude constraint when the 1-minute TOD or BOC annunciation shows on the PFD, unless the autopilot is capturing the VNAV target altitude.

A flight plan target altitude sequences to the next target 60 seconds before the aircraft arrives at the switch point, provided the current target altitude has been captured.

The altitude being captured or tracked (preselector, VNAV target, or pressure) is identified on the PFD by the suffix character in the active mode display field. The final V (instead of an S) indicates the VNAV target altitude (instead of the preselector altitude) is captured. Refer to the tables that follow.

MODE ANNUNCIATION	ALTITUDE TRACKED
VALTS	Preselector
VALTV	VNAV Target
VALT	Pressure

MODE ANNUNCIATION	ALTITUDE ARMED
ALTS	Preselector
ALTV	VNAV Target

DEVIATION SCALE AND POINTERS

A unique FMS deviation pointer shows the vertical deviation from the descent path on the same scale as the glideslope deviation (when in the VPATH or VGP mode, or when the aircraft is close to the planned

descent path). When VNAV is active, the vertical deviation scale and pointer show on the display 60 seconds before the aircraft arrives at the Top Of Descent (TOD). If advisory VNAV is selected, the vertical deviation scale and pointer show when the vertical deviation is within 1000 feet of the descent path.

VERTICAL SPEED

An FMS vertical-speed advisory pointer shows on the vertical speed display to indicate:

- The minimum average vertical speed to climb from present position to the next climb constraint if the rate is at least 100 feet per minute. Vertical speed required to AT OR BELOW constraints is not shown because there is no minimum value.
- The initial vertical speed if a descent were initiated at the present position to the next descent altitude constraint. This is an advisory pointer to assist in determining when it is appropriate to initiate a descent. The vertical speed pointer shows only if the required descent rate is at least 100 feet per minute, and the TOD at current altitude is within 50 NM or vertical deviation is displayed. The pointer shows in all VNAV modes. The vertical speed required for descent shows in the VNAV MFD window as a number. Vertical speed required to AT OR ABOVE constraints is not shown because there is no minimum value.

The vertical speed advisory pointer shows whenever VNAV is active or advisory VNAV is selected and the above display conditions are met.



NOTE

The FMS vertical speed advisory pointer shows on the PFD Vertical Speed Indicator (VSI) to let the flight crew know what climb or descent rate is necessary for the aircraft to reach the next altitude constraint. The vertical speed advisory pointer on the PFD VSI can show even when FMS performance calculations indicate that the climb or descent rate required to reach the flight plan altitude constraint exceeds the capability of the aircraft. The vertical speed advisory pointer position on the VSI scale is only a reflection of the FMS calculation of required climb/descent rates associated with the flight plan. Display of the vertical speed advisory pointer does not imply that the aircraft is capable of meeting the required climb or descent rate.

VNAV ARMED MODES

When coupled VNAV is active, the vertical armed fields on the PFD show the armed mode, if any. There are three armed fields. One field shows the armed holding mode: ALTS for the preselector or ALTV for the VNAV target altitude. A second field shows the armed VNAV vertical mode: Flight Level Change (FLC), VS, or PATH. The third field shows the armed glide mode: GS for an ILS glideslope or GP for a VNAV glidepath. VNAV does not control the ALTS or GS armed modes. VNAV can arm any of the modes that follow:

- ALTV (climb or descent)
- FLC (climb only)
- VS, PATH, GP (descent only).

The general principles for arming the modes are as follows:

- In climb phase, VNAV arms for FLC if the aircraft is holding at a VNAV target altitude, the preselector is above the current aircraft altitude, and there is a down-track climb altitude constraint.
- In cruise or descent phase, VNAV arms for PATH if there is a down-track descent altitude constraint, the preselector is below the aircraft's current altitude, and all other conditions are normal. GP is a special case of PATH. VNAV arms for GP when APPR is selected on the FGP, the final descent path will be captured, and the preselector is set low enough to not intercept the path before the FACP.

The two figures that follow depict various VNAV armed scenarios when the aircraft is following both the lateral and vertical flight plans. Any given mode remains armed until that mode captures or the conditions are changed. Captured modes show above the armed mode.

The figure on page 19-7 shows a climb from 6000 to 8000 feet where FLC is armed when the aircraft approaches BOC, and automatically sequences to VFLC when the aircraft is abeam the waypoint at BOC. The VNAV altitude displayed on the PFD is updated from 6000 to 8000 feet when the aircraft is 1 minute from BOC.

ACTIVE MODE: VALTV
ARM MODE: FLC
VMAV ALTITUDE: 6000

VALT FLC
8000

VFLC
ALTV
8000

1 MINUTE

PRESELECTION ALTITUDE

8000

6000

BOC

WP1

WP2

AIRCRAFT'S VERTICAL TRACK

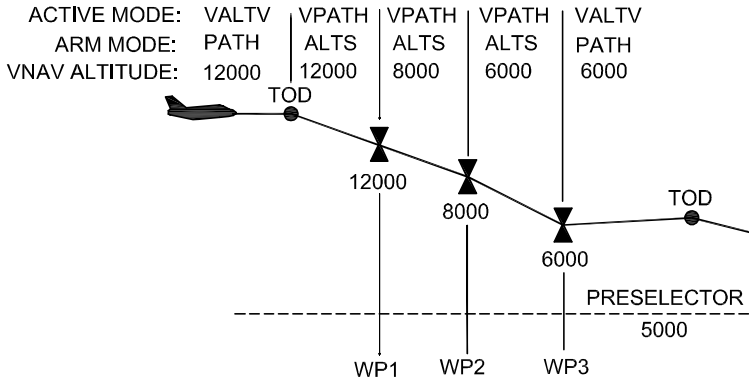
TPG9149 10

When the flight plan descent altitude constraints are aligned so a smoothed path can be flown through the constraints, VNAV will not level at the intermediate altitudes. However, the PFD does show the next altitude constraint. The arm field shows that VNAV will do one of the three things that follow:

- Level at the displayed altitude (ALTV arm)
- Continue to descend when the aircraft crosses the constraint altitude (ALTV arm not shown)
- Capture the preselector altitude when it is reached (ALTS arm).

ALTV indicates the VNAV altitude shown on the PFD is to be captured. The preselector altitude is always armed, except when in VGP mode. Therefore, ALTS arm shows if ALTV arm is not appropriate. An example of the arm mode transitions shows in the figure on page 19-8.

Figure 19-2 Arm Mode Annunciations



TPG9149_11

Listed below are abnormal conditions that can cause the PATH or GP arm to be invalid and the associated CDU message that shows:

- Cross track deviation exceeds the limits for the current environment (en route, terminal, or approach) (NO VPATH – XTD).
- Track angle error exceeds the limits for the current environment (en route, terminal, or approach) (NO VPATH – TAE).
- Another autopilot mode is selected (NO VPATH – PILOT CMD).
- A down track heading leg (VECT) interrupts the vertical path (NO VPATH – VECTORS).
- A holding pattern is active (NO VPATH THIS LEG).
- The aircraft is on the FROM side of a waypoint for which sequencing is inhibited.
- Other conditions as described in the VNAV DESCENTS section exist (NO VPATH CONDITION).

OPERATION

CLIMB

For the climb phase, VNAV provides speed and altitude targets consistent with the climb constraints and speed limits. It also provides automatic mode sequencing using the flight level change mode that is shown as VFLC on the PFD. A VNAV climb is in any of the normal autopilot modes. When an altitude constraint or preselect altitude is encountered during a climb, the altitude is captured and held using an altitude hold mode. The flight level change mode controls pitch to maintain the commanded Indicated Airspeed (IAS) or Mach speed. The altitude hold mode controls pitch to maintain the commanded altitude.

The climb phase is entered whenever preselect altitude is set above the altitude of the aircraft, and the autopilot is in an altitude change mode (flight level change, vertical speed, or pitch).

ALTITUDE CONSTRAINTS

When one or more climb altitude constraints are specified in the flight plan, VNAV allows the aircraft to climb to each constraint altitude and hold that altitude until the constraint is cleared. If the altitude constraint requires the aircraft to cross the waypoint **AT** the specified altitude, or requires the aircraft to cross the waypoint **AT OR BELOW** the specified altitude, the specified altitude is held until the waypoint is reached. If the altitude constraint requires the aircraft to cross the waypoint **BETWEEN** two altitudes, the higher altitude is held. If the altitude constraint requires the aircraft to cross the waypoint **AT OR ABOVE** the specified altitude, then there is no requirement to hold an altitude. While in the climb phase, VNAV honors only climb constraints.

When the aircraft approaches an altitude constraint, the FMS continually updates the predicted Top Of Climb (TOC) location and predicted altitude intercept at the constraint waypoint. If the predicted altitude intercept at the constraint waypoint violates the altitude constraint, the message **UNABLE NEXT ALT** shows in yellow on the CDU, **ALT** shows in yellow and **MSG** shows flashing in yellow on the PFD.

If the aircraft is at a constraint altitude and the preselected altitude is raised, and an altitude change mode (flight level change, vertical speed, or pitch) is selected, VNAV allows the aircraft to leave the constraint altitude. However, if the constraint is an **AT**, **AT OR BELOW**

or BETWEEN altitude, the message CHECK FPLN ALT shows on the CDU. This message also annunciates when the VNAV selection is made while the aircraft is above the next climb constraint altitude.

The vertical speed that is required for the next altitude constraint also shows on the PFD. It shows as an advisory to aid the pilot in judging the climb requirements. During climb for the active flight plan, the average vertical speed shown for the next altitude constraint waypoint is computed from present position to the altitude constraint waypoint. All other vertical speed advisories for altitude constraints farther down-track are computed between the corresponding altitude constraint waypoint and the previous altitude constraint waypoint.

When the aircraft is within capture distance of the constraint altitude, the VNAV mode automatically sequences to VALTS or VALTV, and remains in VALTS, VALTV, or VALT until a climb is resumed. The PFD shows an altitude capture after the mode switch. If the capture altitude is not the same as the preselect altitude, an aural alert is issued when the aircraft is within 1000 feet of the capture.

One minute before the aircraft reaches the altitude constraint waypoint in an altitude hold mode, the annunciation BOC shows on the PFD, and the flight plan target altitude changes to the next altitude constraint. If the preselect altitude is not raised at least 45 seconds before the aircraft reaches the altitude constraint waypoint, the message CHECK PRESELECTOR shows on the CDU message line and on the CDU message page. MSG shows on the PFD to indicate that a new message is on the CDU. At 5 seconds before the bottom of the climb, BOC flashes on the PFD, and the VNAV aural alert sounds.

If the preselect altitude is raised before the aircraft reaches the altitude constraint waypoint, the VNAV mode automatically sequences to VFLC, and resumes the climb after the aircraft crosses the constraint waypoint.

PRESELECT ALTITUDE CAPTURE

If the preselect altitude is not raised to the flight plan target altitude or above, the preselected altitude will be captured, causing the mode to be sequenced to VALTS. When preselect altitude is eventually raised, VNAV will not sequence to climb VFLC until a climb mode selection is made (flight level change, vertical speed, or pitch).

CRUISE ALTITUDE TRACKING

Cruise altitude on the PERF INIT 1/3 page is not a required entry. All VNAV features are available without a cruise altitude entry with two exceptions: TOD from the cruise altitude is not shown and performance predictions are not available.

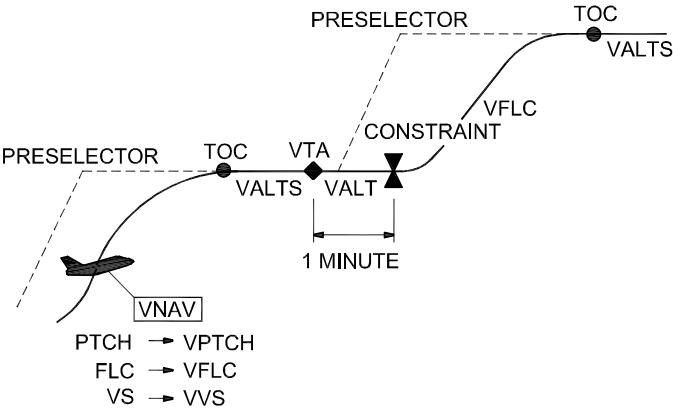
If a cruise altitude is entered, and the aircraft is flying at a higher altitude after capturing the planned cruise altitude, VNAV automatically adjusts the cruise altitude to match the actual flight altitude. This happens when the aircraft initially reaches the cruise altitude that was entered. If the aircraft is climbing from the planned cruise altitude to the preselector setting, then the planned cruise altitude is set to the preselector setting until the aircraft reaches the planned descent path.

If the aircraft never reaches the planned cruise altitude, the climb phase of VNAV operation does not readjust the planned cruise altitude downward. However, when the aircraft is close to the next descent path, the planned TOD point is readjusted to correspond to the actual aircraft altitude.

SCENARIOS

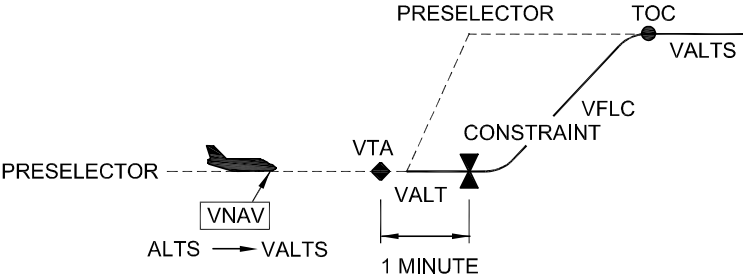
The series of figures that follows shows various scenarios for climbs. In the figures, the track of the aircraft shows as a solid line, preselector settings show as a dashed line, and the FMS flight planned path shows as a thick, solid line. Also, autopilot mode selections show in a box with the associated arm and capture mode annunciations below them. VTA in the figures indicates the vertical track alert that occurs 60 seconds before mode sequencing at the BOC.

Figure 19-3 VNAV Selection During a Climb



TPG9149_12

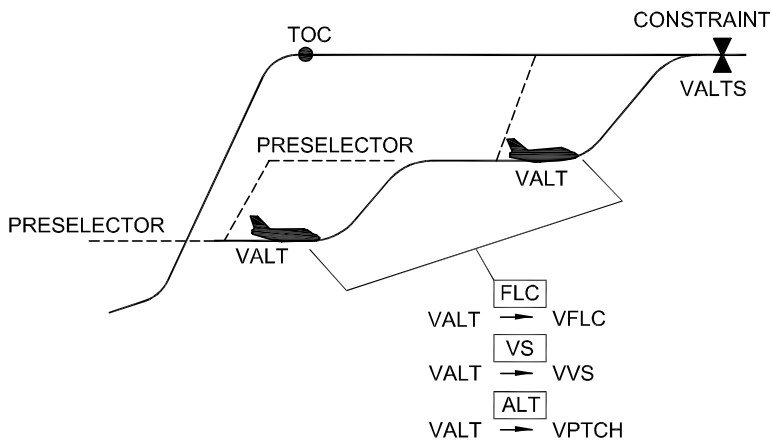
Figure 19-4 VNAV Selection with Autopilot Set to ALT Mode



TPG9149_13

 **NOTE**
Figure 19-4 shows a normal FMS transition to climb.

Figure 19-5 Climb Using the Preselector



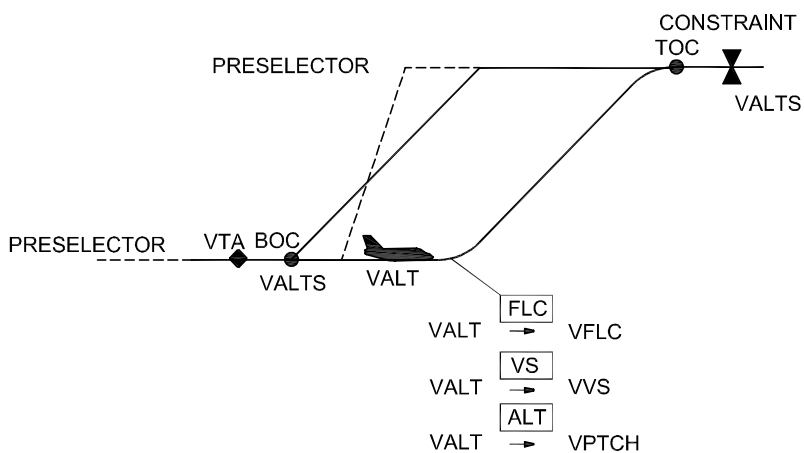
TPG9149_14



NOTE

Figure 19-5 shows using the preselector as an intermediate altitude constraint.

Figure 19-6 Aircraft Crosses BOC before Preselector Is Set



TPG9149_15

Figure 19-7 UNABLE NEXT ALT Condition

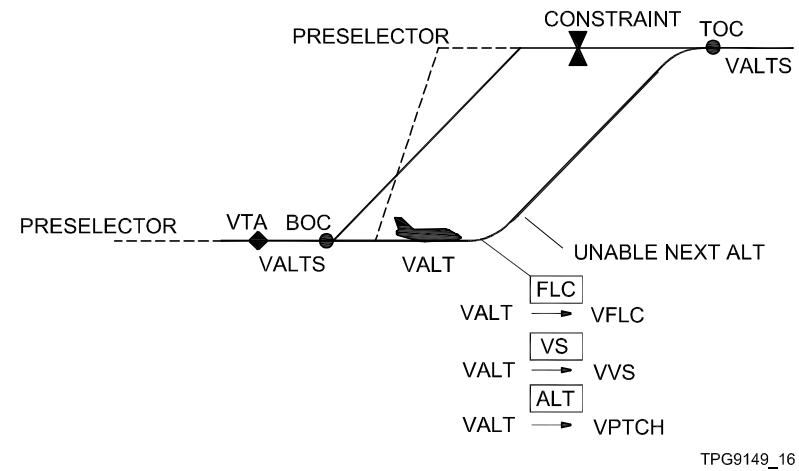
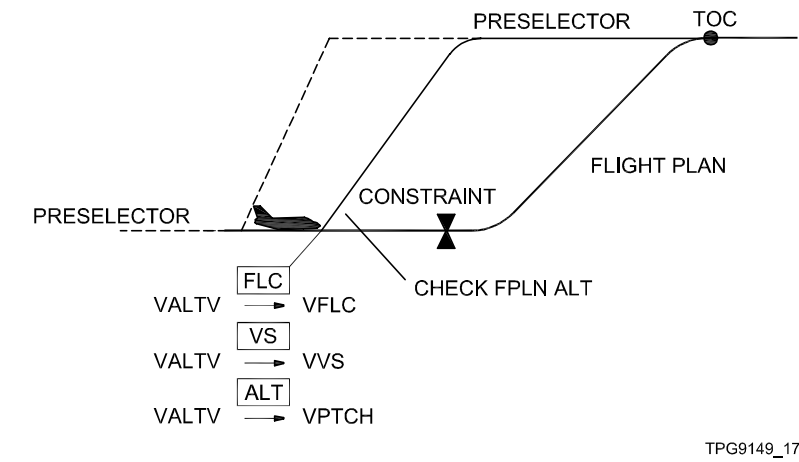


Figure 19-8 CHECK FPLN ALT Condition



NOTE

Figure 19-8 shows that a climb initiated before reaching an altitude constraint waypoint results in a CHECK FPLN ALT condition.

CRUISE

The cruise phase begins when the cruise altitude is captured. Cruise speed command is the Mach or IAS speed target that shows on the cruise VNAV SETUP page. If the cruise altitude is so low that a climb-altitude-dependent speed limit is applicable, then the cruise speed command is limited to that altitude-dependent speed limit.

To execute a step climb, raise the preselect altitude to the desired step climb altitude and select a climb mode. The FMS automatically raises the cruise altitude shown on the VNAV page to the preselect altitude and the step climb will begin. Climb speed targets are used for planned reference speed during a step climb.

DESCENT

Vertical navigation provides path guidance (VPATH or VGP), speed-referenced descent guidance (VFLC), and any other normal descent mode to arrive at a waypoint at a desired altitude. In general, planned and Direct-To VNAV descents are path-based descents, where pitch steering follows a straight-line descent path and speed is controlled by manual thrust management.

The pilot can select any descent mode that does not provide path guidance to an altitude at a waypoint. However, the altitude constraints are annunciated and enforced in all descents. Descent advisory to a destination that has no terminal altitude constraint is not automatically initiated. However, the recommended entry point for the descent advisory shows on the MFD map and on the VNAV display as DES.

The descent phase is entered when the preselected altitude is set below the current altitude of the aircraft and an altitude change mode (flight level change, vertical speed or pitch) is selected on the flight control panel. The descent phase can also include altitude hold segments.

PATH

The descent path is defined by an altitude at a waypoint and a Vertical Path Angle (VPA). The VPA is the angle that defines a straight-line path through the target altitude at the target waypoint. The target altitude and target waypoint comprise the next descent altitude constraint in the flight plan ahead of the present position of the aircraft. The VPA will be one of the items that follow:

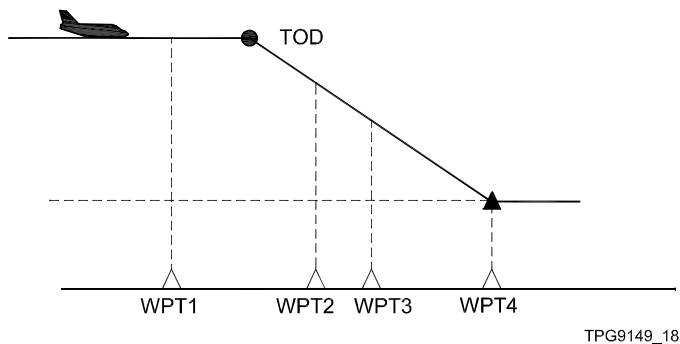
- The angle that appears on the ACT PERF INIT page
- The angle entered by the pilot on the ACT LEGS page
- The angle computed by the FMS to satisfy either descent path smoothing requirements or descend direct requirements of the waypoint
- The angle required for executing a vertical Direct-To.

The LEGS page shows the VPA for the descent path directly above the target altitude for each descent segment. The planned descent path is captured when it is crossed if the preselect altitude is set low enough to allow capture.

VPA

The descent path is defined by the Vertical Path Angle (VPA). The default VPA is initially shown on the VNAV DESCENT page and it is applied to a flight plan when one is created. The default setting can be overwritten on the VNAV DESCENT page and applied to the entire descent portion of a flight plan, or overwritten on the LEGS pages for specific descent segments of a flight plan.

Figure 19-9 VPATH Descent Path



PATH SMOOTHING

When there are two or more altitude constraints in a descent path, the FMS calculates and flies a smooth descent path without intermediate altitude hold segments, as long as each of the descent segments has a VPA greater than the minimum allowable VPA for the aircraft of 1 degree. An altitude hold is inserted before the descent when two altitude constraints are so far apart that a straight-line path connecting the two constraints is shallower than the minimum allowable VPA, or have a specified VPA for that segment.

VPAs on the second and subsequent descent segments are modified to provide the path continuity. The computed VPA shows on the LEGS page. A descent path is always computed to the last descent altitude constraint in a flight plan or before a discontinuity, regardless of the altitude type. If the last descent altitude is BETWEEN, the path defaults to the upper altitude constraint. The descent path is computed through AT OR ABOVE, AT OR BELOW, or BETWEEN descent constraints that are not last in the flight plan or before a discontinuity. This allows the FMS to maintain the selected VPA and perform path smoothing

whenever possible to create a continuous descent path through these constraints. AT OR ABOVE, AT OR BELOW, and BETWEEN constraints are always honored but they do not restrict the path. In the approach phase of flight, VNAV computes a descent path that flies to the first altitude constraint in the approach transition even if it is specified as AT OR ABOVE in the flight plan.

For a smooth descent path, the FMS cannot select a VPA greater than the maximum allowable VPA for the aircraft. If adjacent altitude constraints require a steeper path than the limit for the aircraft, the lower altitude constraint shows in yellow on the LEGS page. The message UNABLE FPLN ALT shows on the message line to alert the pilot to the need to resolve the vertical path ambiguity.

VERTICAL DIRECT-TO

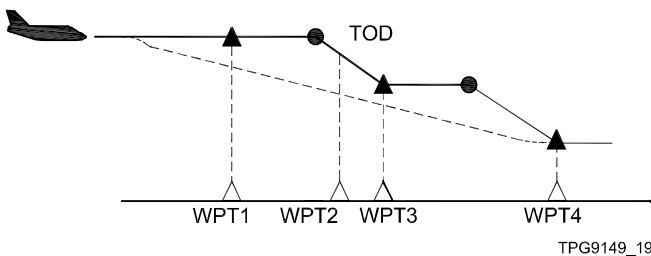
The pilot can specify a descent path from the current position of the aircraft Direct-To a selected altitude at a waypoint, which includes:

- The next altitude constraint waypoint in the flight plan
- Any down-track altitude constraint waypoint in the flight plan
- Any other waypoint in the flight plan, provided a new altitude constraint is specified for the waypoint.

All altitude constraints between the current aircraft altitude and the specified Direct-To target altitude are cleared when a vertical Direct-To is initiated.

The vertical Direct-To path is computed as long as the required VPA is less than the maximum allowable VPA for the aircraft. A descent path can be very shallow, but it cannot be a climb.

Figure 19-10 Vertical Direct-To



FLIGHT LEVEL CHANGE, VERTICAL SPEED, OR PITCH

In flight level change mode, pitch steering holds the descent speed, and thrust controls the vertical speed. In flight level change, vertical speed, or pitch modes, the aircraft descends to the preselector altitude or the next flight plan constraint, whichever occurs first. The vertical situation displays continue to reflect the active flight plan profile. The descent path modes are automatically captured if the aircraft intercepts the VNAV descent path profile again during the descent.

VNAV flight level change, vertical speed or pitch descents are initiated by one of the actions that follow:

- Direct selection of any vertical mode on the flight control panel while VNAV is active. VPATH is not recaptured unless the aircraft deviates at least 1 dot on the vertical deviation scale from the planned descent path, then subsequently satisfies the path capture conditions.
- Automatic VVS selection when the active VPA is modified during a VPATH descent. When the active VPA is edited, the descent path will move and can result in creating a very large vertical deviation, which prevents the path from being recaptured. However, VPATH will be recaptured if the aircraft gets within capture distance of the path.
- Automatic VVS selection during VPATH descent if:
 - The flight plan contains an intermediate discontinuity, heading leg, altitude-terminated leg, or manually terminated leg, except a manually terminated holding pattern between the aircraft and the next altitude constraint.
 - The aircraft track angle error is more than 75 degrees during en route or terminal operations, or 30 degrees during final approach.
 - The cross track deviation is greater than 10 NM during en route operations, or full scale lateral deviation exists during final approach and linear variation is from 10 NM to 1 NM during terminal operations.
- Automatic VVS selection during VPATH descent if the active leg is a holding pattern without an altitude constraint (assuming that any future manually terminated holding patterns in the descent path are canceled before they become active).

To recapture a VPATH or VGP descent after manually selecting a flight level change, vertical speed, or pitch descent mode, the vertical deviation must exceed 1 dot on the PFD vertical deviation scale. The VPATH or VGP mode must be inactive for at least 20 seconds before

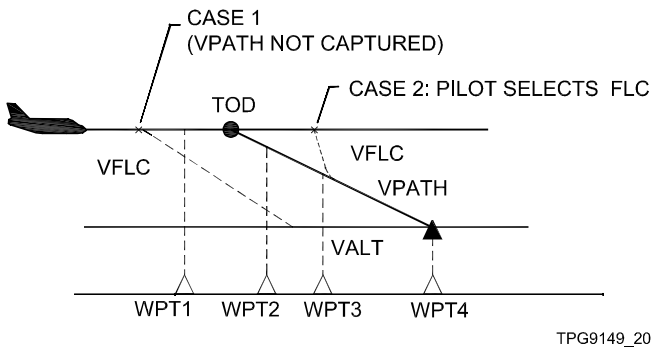
attempting to capture the path again. One dot on the vertical deviation scale equals 250 feet in the en route and terminal environments, and 125 feet in the approach environment.

These capture limitations prevent VNAV from immediately recapturing the path after selection of a flight level, vertical speed, or pitch mode change. If the pilot wants to immediately recapture VPATH or VGP after selection of flight level change, vertical speed, or pitch, the VNAV button on the FCP must be pushed to turn the VNAV mode off, then back on. This procedure defeats the capture limitations.

When the VNAV mode is automatically sequenced from VPATH to VVS, the CDU shows the message NO VPATH THIS LEG if the VPATH or VGP mode is dropped because the active leg is a holding pattern. The CDU shows NO VPATH CONDITION if the active leg is not a holding pattern.

As Figure 19-11 shows, in CASE 1, the altitude preselector is set lower and FLC is selected before VPATH capture at TOD. In CASE 2, the altitude preselector is set lower and FLC selected after passing the TOD.

Figure 19-11 FLC Selection



ALTITUDE CONSTRAINTS

When one or more descent altitude constraints are specified in the flight plan, the FMS plans the VNAV path so the aircraft descends to each constraint altitude. VNAV holds that altitude until the aircraft reaches the planned TOD to the next altitude constraint. This is true unless the descent path allows the path-smoothing feature to create one continuous descent. When smoothing is used to create the descent

path (VPATH or VGP), the path is designed to keep the aircraft as high as possible for as long as possible without violating any altitude constraints.

VNAV captures and holds the preselector altitude when making a flight level change, vertical speed, or pitch descent that does not intersect the planned descent path.

When a flight level change, vertical speed, or pitch descent takes the aircraft down to the altitude constraint of a future waypoint before the waypoint is reached, VNAV holds the specified altitude until arrival at the waypoint. This happens when constraint requires the aircraft to cross the waypoint AT the specified altitude, or AT OR ABOVE the specified altitude.

If the altitude constraint requires the aircraft to cross the waypoint BETWEEN two altitudes, the lower altitude is held. If the altitude constraint requires the aircraft to cross the waypoint AT OR BELOW the specified altitude, no altitude will be held since there is no requirement to hold altitude before the aircraft reaches the waypoint. In the descent phase, VNAV honors only descent constraints.

As the aircraft approaches an altitude constraint, the FMS updates the predicted altitude intercept at the constraint waypoint. If the predicted altitude intercept at the waypoint violates the altitude constraint, the message UNABLE NEXT ALT shows on the CDU. In addition, the PFD shows ALT in yellow and a flashing yellow MSG annunciation. The UNABLE NEXT ALT message also shows when the vertical speed of the aircraft is less than the vertical speed required to reach the constraint.

If the aircraft is approaching an altitude constraint waypoint at the specified altitude and the preselector altitude is lowered, and an altitude change mode is selected, VNAV allows the aircraft to leave the constraint altitude. However, if the constraint is an AT, AT OR ABOVE or BETWEEN altitude, the message CHECK FPLN ALT shows on the CDU. This message also shows the selected VNAV when the aircraft is already below the next descent constraint altitude.

When the aircraft is within the capture distance of a constraint altitude, the VNAV mode automatically sequences to altitude hold and remains in altitude hold until the descent is resumed. The PFD shows an altitude capture annunciation after the mode switch. If the capture altitude is not the same as the preselect altitude, an aural alert is issued when the aircraft is within 1000 feet of the capture altitude.

PRESELECT ALTITUDE CAPTURE

During a descent, VNAV captures the preselected altitude, instead of the planned flight plan target altitude, when the preselected altitude is not set below the flight plan target altitude. When it captures a preselected altitude, it changes the VNAV mode to the VALTS mode.

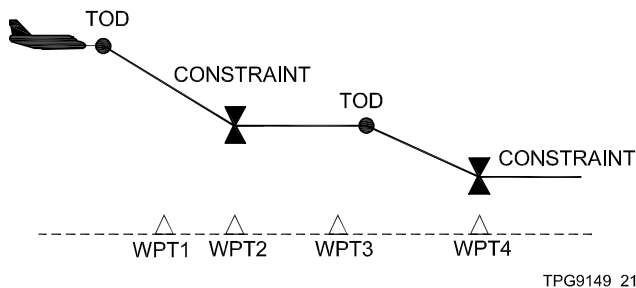
TOP OF DESCENT

The predicted Top Of Descent (TOD) location shows on both the PPOS and PLAN maps on the MFD to help the pilot anticipate an upcoming descent. TOD also shows on the MFD ACT FPLN PROGRESS data page to show the relationship of the TOD location relative to other flight plan waypoints.

The FMS continuously calculates the TOD location. When the aircraft reaches the capture point, the descent path becomes fixed and VNAV begins to track the path. The initial location of the TOD is at the intersection of the planned cruise altitude and the planned descent path. If there is a subsequent planned altitude hold segment that follows an altitude constraint waypoint, TOD also shows at the top of the second descent segment as shown in Figure 19-12.

If the aircraft is close to and approaching the descent path, and is not at a planned altitude that intercepts the path, the FMS recalculates the TOD location based on the intersection of the current altitude and the descent path. The aircraft is considered to be close to the descent path when it is 50 NM or 20% of the distance from origin to the destination, whichever is smaller (but not less than 6 NM).

Figure 19-12 Flight Plan with Two Descent Segments



One minute before the aircraft intercepts the planned descent path, TOD shows on the PFD message line. If the flight plan target altitude

is different from the current preselect altitude, the new target altitude shows on the PFD. The new flight plan target altitude is the next altitude constraint.

Forty-five seconds before the aircraft reaches the TOD, if the preselect altitude has not been lowered, the message CHECK PRESELECTOR shows on the CDU, and MSG shows on the PFD to remind the pilot to lower the preselector altitude.

Five seconds before the aircraft reaches the TOD, the annunciation TOD flashes on the PFD and an aural alert is sounded. If the preselector altitude is set lower than the current altitude of the aircraft before the aircraft reaches the TOD, the VNAV mode automatically sequences to VPATH, and the descent starts when the aircraft reaches the TOD. If the preselector altitude is not set lower than the current altitude of the aircraft before the aircraft reaches the TOD, VNAV continues in the VALT mode.

If the aircraft is about to intersect the planned descent path, VNAV captures the path, even if the altitude at the capture point is not a planned target altitude and the point at which the descent is initiated is not a planned TOD. The altitude alerts and messages described before are provided as appropriate, and the VNAV mode automatically sequences to VPATH mode if the preselector altitude is lowered before the aircraft reaches the descent path intersection.



NOTE

For these cases, the TOD annunciations that show on the PFD can occur before the aircraft reaches the TOD location that is depicted on the PPOS or PLAN Map.

GUIDANCE

The FMS VNAV function provides the pilot with all of the necessary guidance information required to fly the desired path and maintain situational awareness. Whether defined by angle or vertical Direct-To, the FMS displays the same information for all path descents.

VERTICAL DEVIATION

A vertical deviation scale and pointer show on the PFD next to the altitude display when the aircraft is within 1000 feet of the planned vertical path.

DESCENT ANGLE AND VERTICAL SPEED

The VNAV data window on the MFD map shows the descent angle to the next flight plan altitude. It also shows the descent angle and VS from the current position of the aircraft Direct-To the next flight plan altitude constraint waypoint.

FLIGHT DIRECTOR PITCH STEERING

Steering cues show on the PFD to guide the aircraft to capture and track the flight plan VNAV profile. When the vertical path is captured, it is annunciated and pitch steering begins a pitch-over to capture and track the descent path.

SCENARIOS

The series of figures that follows shows various scenarios for descents. The track of the aircraft shows as a solid line, pre-selector settings show as a dashed line, and the FMS flight-planned path shows as a thick solid line. Also, autopilot mode selections show in a box with the associated arm and capture mode annunciations below them. VTA in the figures indicates the vertical track alert that occurs 60 seconds before mode sequencing at the TOD.

Figure 19-13 Normal FMS Transition to a Descent

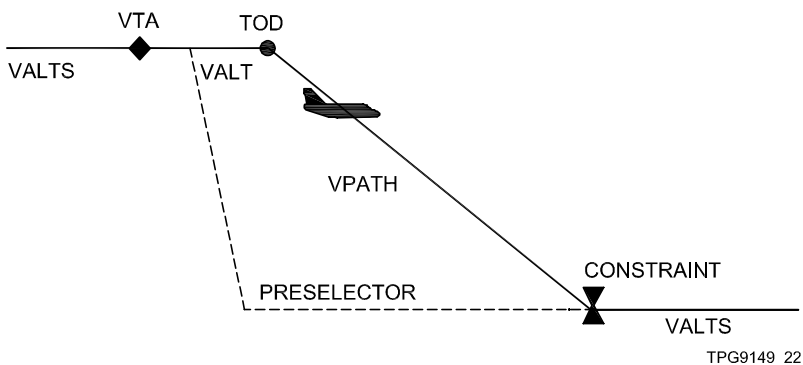
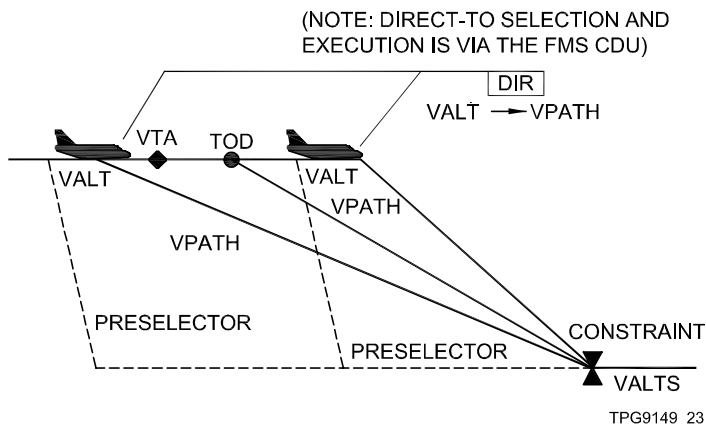


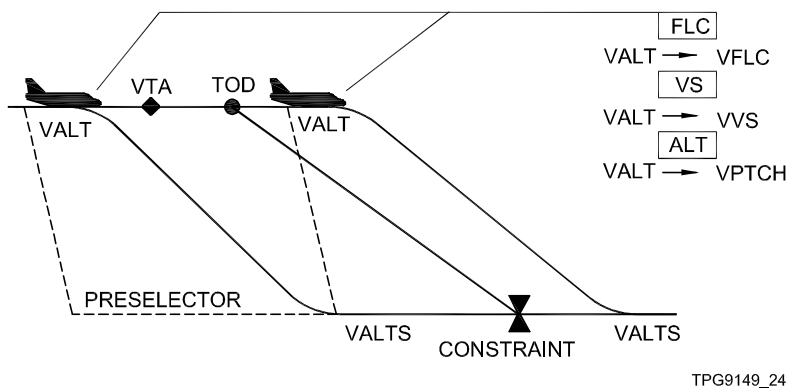
Figure 19-14 Vertical Direct-To Selection



NOTE

Figure 19-14 shows vertical Direct-To selection before and after crossing the TOD.

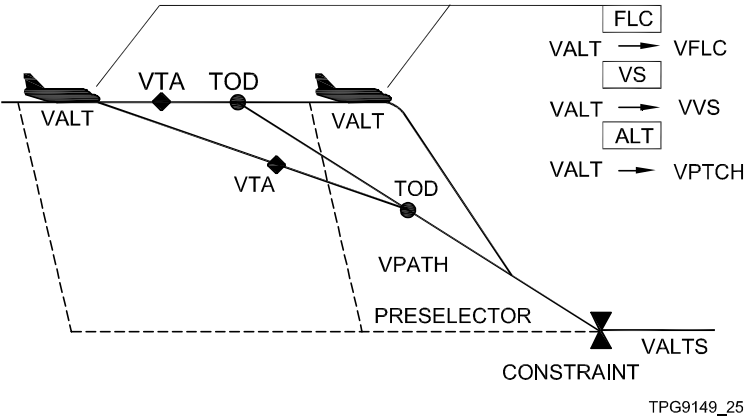
Figure 19-15 Early or Late Descent Selection: Scenario 1



NOTE

Figure 19-15 shows early or late descent selection with **NO** flight plan intercept.

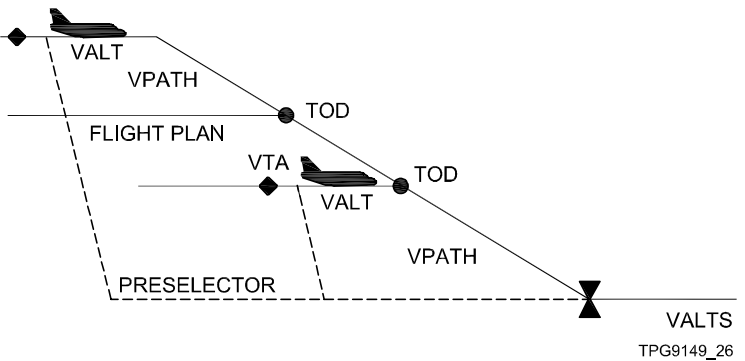
Figure 19-16 Early or Late Descent Selection: Scenario 2



NOTE

Figure 19-16 shows early or late descent selection with a flight plan path intercept.

Figure 19-17 Early or Late Descent Selection: Scenario 3



NOTE

Figure 19-17 shows early or late descent selection with an above or below flight plan altitude.

Figure 19-18 Multiple VPATH Mode Descents

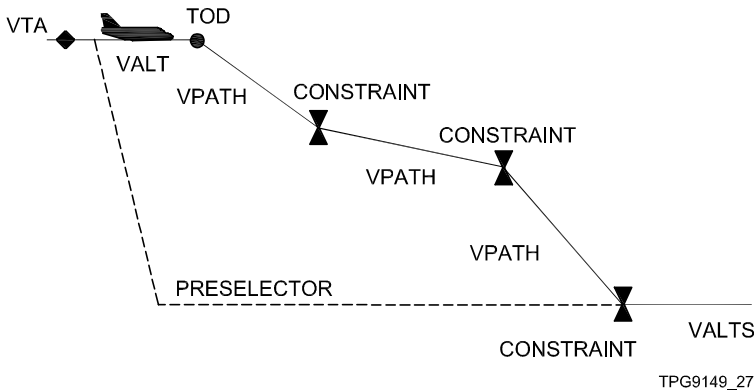
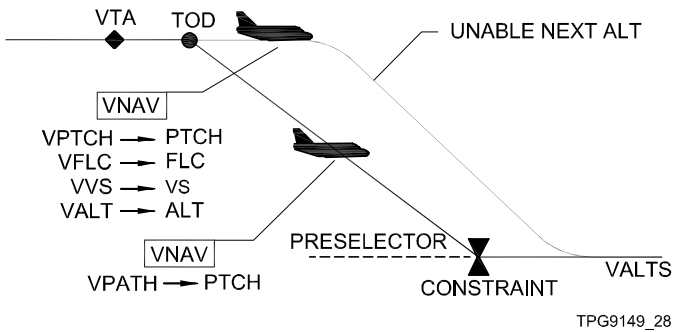


Figure 19-19 VNAV Deselection



OFF FLIGHT PLAN

Basic vertical navigation operation assumes the flight plan is being followed. However, during the course of a flight, it is possible that the aircraft will be required to fly through a flight plan discontinuity, fly ATC vectors, or capture a localizer. In these cases and others, it is likely that the route will be different both laterally and vertically from the flight plan entered into the FMS. This section gives some specifics about VNAV operations when the aircraft is not following the flight plan.

PATH MODES

VPATH automatically reverts to VVS descent when the straight-line geographic descent path to an altitude constraint waypoint becomes ambiguous. This occurs when:

- There is a flight plan discontinuity or a manually terminated leg between the TOD and the altitude constraint waypoint.
- Track angle error exceeds an acceptable threshold.
- Cross track deviation exceeds an acceptable threshold.

However, the pilot can still use flight level change, vertical speed, pitch climb/descent, and altitude hold modes.

Acceptable track angle error and cross track deviation thresholds depend on the airspace environment. In en route and oceanic/remote areas, track angle error must be less than 75 degrees and cross track deviation less than 10 NM.

In the terminal area, track angle error must be less than 75 degrees. The acceptable cross track deviation decreases from 10 NM at the terminal area boundary, or 30 NM from the Airport Reference Point, to 1.1 NM at 5 NM from the Airport Reference Point.

In the approach area, track angle error must be less than 30 degrees and cross track deviation must be less than 110 % of the full scale cross track deviation. During the approach, the cross track deviation scale varies from 1 NM when the aircraft is 2 NM out and inbound to the FAF, to 0.3 NM at the FAF and beyond.

HEADING MODE

When using heading mode to follow ATC vectors, and the active flight plan leg is not a vectors leg, the FMS continues to sequence the flight plan as the aircraft passes abeam the waypoints. VNAV also continues

to fly to the next altitude constraint at the TO waypoint or beyond, and the altitude constraints continue to sequence as the flight plan sequences. Path descents remain active, provided the aircraft is within the course and cross track deviation limits specified above and the active leg has a defined track.

Use flight level change, vertical speed, or pitch descents when a flight plan vectors leg is before the next altitude constraint, as there is no specified track for a vectors leg. However, a DES advisory shows on the MFD if a TOD based on great circle distances occurs before the vectors leg.

DISCONTINUITIES

VNAV remains active when the FMS sequences the ACT/MOD FPLN to a discontinuity. The flight can be continued using the heading mode, or the discontinuity can be removed, which then returns the aircraft to tracking the ACT FPLN.

VNAV honors altitude constraints across a discontinuity and captures that altitude if intercepted. However, it cannot fly a path descent across a discontinuity.

APPROACHES

ILS CAPTURE

When the autopilot captures the localizer of a localizer-based approach to the destination airport selected in the flight plan, VNAV remains active until one of the conditions that follow is true:

- Glideslope is captured.
- There is no glideslope.
- A descent to the runway is initiated.

An altitude constraint is always specified for the Final Approach Course Fix (FACF) waypoint and is usually specified for the Final Approach Fix (FAF) waypoint.

A localizer is normally captured just before arrival at the FACF. Therefore, normal VNAV operation brings the aircraft to the FACF and FAF waypoints at the required altitudes. At the FAF, if there is no glideslope, or the glideslope was not captured, and a manual descent has not been initiated, the VNAV will maintain altitude hold beyond the FAF. This happens because there are no further descent altitude constraints in the flight plan.

For normal operation, the FMS sequences the flight plan to the runway threshold after passing the FAF. For missed approach procedures, VNAV gives climb guidance to the altitude constraints in the missed approach procedure if VNAV is reselected after the aircraft enters the procedure.

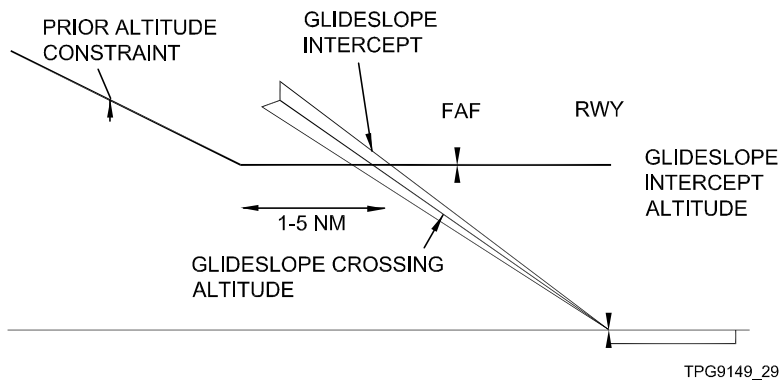
ILS AND LOCALIZER-BASED APPROACHES

The VNAV descent profile on all localizer-based approaches does not descend below the FAF altitude. In the case of an ILS approach, the VNAV can remain active until glideslope capture. The pilot is responsible for descent below the FAF altitude on localizer-only approaches. VNAV remains active after localizer capture.

The FAF waypoint on an ILS approach specifies the glideslope intercept altitude on the LEGS page. As glideslope is intercepted before the aircraft crosses the FAF, the aircraft crosses the FAF waypoint at the glideslope crossing altitude, which is usually lower than the glideslope intercept altitude.

The VNAV descent for an ILS approach is designed to reach the glideslope intercept altitude 1 to 5 NM before the aircraft intercepts the glideslope. This allows the aircraft to establish stabilized level flight to intercept glideslope, as shown in Figure 19-20. The descent path will reach glideslope intercept altitude at least 5 NM before the glideslope intercept, unless the approach geometry is very tight.

Figure 19-20 VNAV Glideslope Intercept



RNAV AND GPS APPROACHES

As long as VNAV remains selected, the FMS flies to the altitude constraints of RNAV and GPS procedures, up to and including the FAF and missed approach point or runway threshold. VPATH or VGP descents are made as long as the aircraft does not exceed a 30-degree track angle error or full-scale deviation. Full-scale deviation equals 1 NM at 2 NM from the FAF, to 0.3 NM at the FAF and beyond.

Vertical deviation guidance to the descent altitude constraint at the missed approach point is also available if approach is enabled in the FMS and the required navigation accuracy is available. Vertical steering guidance to the missed approach point or runway threshold is available in VGP mode. VNAV does not recognize or control the aircraft with respect to the MDA.

To enable the VGP mode, the pilot must select APPR on the FCP. The VGP mode allows the preselector to be set at the missed approach altitude and continue descent to the runway.

If VNAV is still selected when the FMS sequences to the missed approach point, VNAV will give climb guidance to the altitude constraints in the missed approach procedure. VNAV does not initiate a climb in the missed approach procedure, but it does give guidance with respect to the altitude constraints of the procedure.

The figures that follow show different approach path modes. In Figure 19-21, APPR is selected on the FCP and the VGP mode is engaged. In Figure 19-22, although the descent path is followed, VGP mode is never engaged. In Figure 19-23, VNAV is not armed and the FMS will not direct an automatic descent.

Figure 19-21 GP-Armed to VGP-Captured Scenario

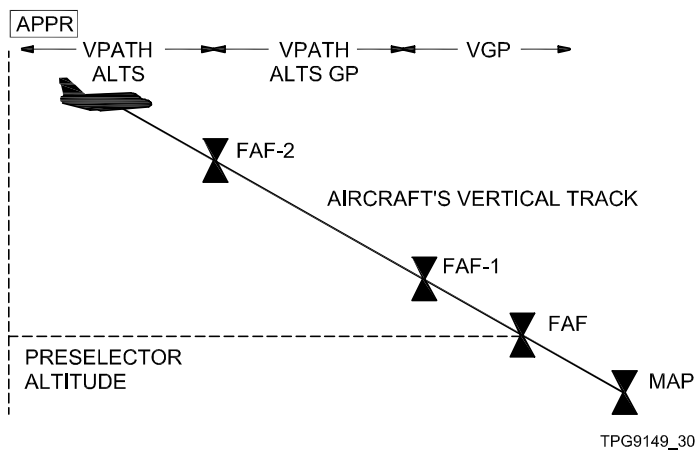
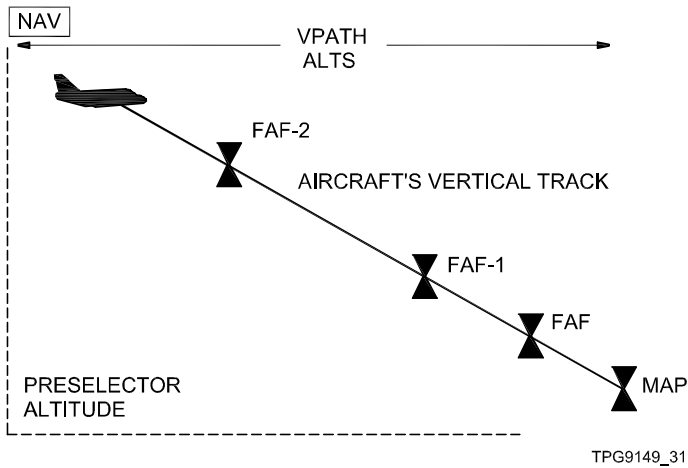


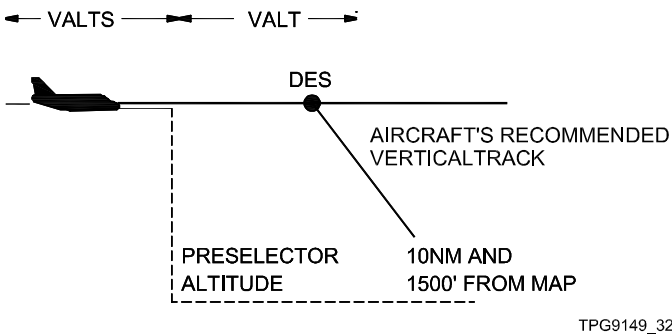
Figure 19-22 VPATH (Not VGP) Approach Scenario



NOTE

Figure 19-22 shows that because APPR is not selected on the FGP, Glide Path (GP) is never armed and VGP is never captured.

Figure 19-23 No VNAV Armed Mode Scenario



VISUAL AND OTHER APPROACHES NOT QUALIFIED FOR FMS

Vertical navigation guidance is available for visual approaches to a runway, and for any other approach that is not executed as an FMS approach (for example, IGS, TCN, or NDB approaches). Vertical deviation and vertical steering guidance to the runway threshold or missed approach point are available in VPATH mode if both of the conditions that follow are met:

- The required approach navigation accuracy is available.
- The preselect altitude remains below aircraft altitude.

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