Honeywell

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HT1000 GNSS
Navigation Management System Pilot's Guide

To all holders of the HT1000 GNSS Pilot's Guide:

This is to inform HT1000 customers currently on distribution for the HT1000 Pilot's Guide that the current revision (Rev 3) supersedes all previous revisions. Revision 3 contains all changes to date and is compatible with NPU Operating Software Load 6.0

Revision 3 8/99

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HT1000 GNSS
Navigation Management System
Pilot's Guide

This Pilot's Guide contains information developed by Honeywell/ Trimble to provide the operational procedures for the HT1000 GNSS Navigation Management System. The Supplemental Type Certificate (STC) holder is solely responsible for the requirements for use and revision status of this manual.

Pilots using the avionics system described in this document are required to maintain Lateral and Vertical Situational Awareness at all times through the use of current and approved en route, sectional, and other navigational charts. The avionics system herein described is designed to provide pilots with a TSO C-129 (A1) navigation capability. However, pilots are advised to use all available flight-following techniques appropriate for the phase of flight to ensure that a valid mental picture of the desired route is maintained at all times.

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Helping You Control Your World

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List of Revised Pages

PAGE NO.	REV	STATUS
Title Page	Rev 3	8/99
Proprietary Notice	—	5/96
Table of Contents		
i	Rev 3	8/99
ii	Rev 3	8/99
iii	Rev 3	8/99
iv	Rev 3	8/99

SECTION 1

PAGE NO.	REV	STATUS
1-1	Rev 3	8/99

SECTION 2

PAGE NO.	REV	STATUS
2-i	Rev 3	8/99
2-1	Rev 3	8/99
2-2	Rev 3	6/96
2-3	Rev 3	8/99
2-4	Rev 3	6/96
2-5	Rev 3	8/99
2-6	Rev 3	8/99
2-7	Rev 3	8/99
2-8	Rev 3	8/99
2-9	Rev 3	6/96
2-10	Rev 3	8/99
2-11	Rev 3	8/99
2-12	Rev 3	8/99
2-13	Rev 3	8/99
2-14	Rev 3	8/99
2-15	Rev 3	8/99
2-16	Rev 3	8/99
2-17	Rev 3	8/99

SECTION 3

PAGE NO.	REV	STATUS
3-i	Rev 3	8/99
3-ii	Rev 3	8/99
3-iii	Rev 3	8/99
3-iv	Rev 3	8/99
3-1	Rev 3	8/99
3-2	Rev 3	8/99
3-3/4	Rev 3	8/99

SECTION 3.1

PAGE NO.	REV	STATUS
3.1-i	Rev 3	8/99
3.1-1	Rev 3	8/99
3.1-2	Rev 3	8/99
3.1-3	Rev 3	8/99
3.1-4	Rev 3	8/99
3.1-5	Rev 3	8/99
3.1-6	Rev 3	8/99
3.1-7	Rev 3	8/99
3.1-8	Rev 3	8/99
3.1-9	Rev 3	8/99
3.1-10	Rev 3	8/99
3.1-11	Rev 3	8/99
3.1-12	Rev 3	8/99
3.1-13	Rev 3	8/99
3.1-14	Rev 3	8/99
3.1-15	Rev 3	8/99
3.1-16	Rev 3	8/99
3.1-17	Rev 3	8/99
3.1-18	Rev 3	8/99
3.1-19	Rev 3	8/99
3.1-20	Rev 3	8/99
3.1-21	Rev 3	8/99
3.1-22	Rev 3	8/99
3.1-23	Rev 3	8/99
3.1-24	Rev 3	8/99
3.1-25	Rev 3	8/99
3.1-26	Rev 3	8/99
3.1-27	Rev 3	8/99
3.1-28	Rev 3	8/99
3.1-29	Rev 3	8/99
3.1-30	Rev 3	8/99
3.1-31	Rev 3	8/99
3.1-32	Rev 3	8/99
3.1-33	Rev 3	8/99
3.1-34	Rev 3	8/99
3.1-35	Rev 3	8/99

PAGE NO.	REV	STATUS
3.1-36	Rev 3	8/99
3.1-37	Rev 3	8/99
3.1-38	Rev 3	8/99
3.1-39	Rev 3	8/99

SECTION 3.2

3.2-i	Rev 3	8/99
3.2-1	Rev 3	8/99
3.2-2	Rev 3	8/99
3.2-3	Rev 3	8/99
3.2-4	Rev 3	8/99
3.2-5	Rev 3	8/99
3.2-6	Rev 3	8/99

SECTION 3.3

3.3-i	Rev 3	8/99
3.3-1	Rev 3	8/99
3.3-2	Rev 3	8/99
3.3-3	Rev 3	8/99
3.3-4	Rev 3	8/99
3.3-5	Rev 3	8/99
3.3-6	Rev 3	8/99
3.3-7	Rev 3	8/99
3.3-8	Rev 3	8/99
3.3-9	Rev 3	8/99
3.3-10	Rev 3	8/99
3.3-11	Rev 3	8/99
3.3-12	Rev 3	8/99
3.3-13	Rev 3	8/99
3.3-14	Rev 3	8/99
3.3-15	Rev 3	8/99
3.3-16	Rev 3	8/99
3.3-17	Rev 3	8/99
3.3-18	Rev 3	8/99
3.3-19	Rev 3	8/99
3.3-20	Rev 3	8/99
3.3-21	Rev 3	8/99
3.3-22	Rev 3	8/99
3.3-23	Rev 3	8/99
3.3-24	Rev 3	8/99
3.3-25	Rev 3	8/99

PAGE NO.	REV	STATUS
3.3-26	Rev 3	8/99
3.3-27	Rev 3	8/99
3.3-28	Rev 3	8/99
3.3-29	Rev 3	8/99
3.3-30	Rev 3	8/99
3.3-31	Rev 3	8/99

SECTION 3.4

3.4-i	Rev 3	8/99
3.4-1	Rev 3	8/99
3.4-2	Rev 3	8/99
3.4-3	Rev 3	8/99
3.4-4	Rev 3	8/99
3.4-5	Rev 3	8/99
3.4-6	Rev 3	8/99
3.4-7	Rev 3	8/99
3.4-8	Rev 3	8/99
3.4-9	Rev 3	8/99
3.4-10	Rev 3	8/99
3.4-11	Rev 3	8/99
3.4-12	Rev 3	8/99
3.4-13	Rev 3	8/99
3.4-14	Rev 3	8/99
3.4-15	Rev 3	8/99
3.4-16	Rev 3	8/99
3.4-17	Rev 3	8/99

SECTION 3.5

3.5-i	Rev 3	8/99
3.5-1	Rev 3	8/99
3.5-2	Rev 3	8/99
3.5-3	Rev 3	8/99
3.5-4	Rev 3	8/99
3.5-5	Rev 3	8/99
3.5-6	Rev 3	8/99
3.5-7	Rev 3	8/99
3.5-8	Rev 3	8/99
3.5-9	Rev 3	8/99
3.5-10	Rev 3	8/99
3.5-11	Rev 3	8/99
3.5-12	Rev 3	8/99
3.5-13	Rev 3	8/99

PAGE NO.	REV	STATUS
3.5-14	Rev 3	8/99
3.5-15	Rev 3	8/99
3.5-16	Rev 3	8/99
3.5-17	Rev 3	8/99
3.5-18	Rev 3	8/99
3.5-19	Rev 3	8/99
3.5-20	Rev 3	8/99
3.5-21	Rev 3	8/99
3.5-22	Rev 3	8/99
3.5-23	Rev 3	8/99
3.5-24	Rev 3	8/99
3.5-25	Rev 3	8/99
3.5-26	Rev 3	8/99
3.5-27	Rev 3	8/99

SECTION 3.6

PAGE NO.	REV	STATUS
3.6-i	Rev 3	8/99
3.6-1	Rev 3	8/99
3.6-2	Rev 3	8/99
3.6-3	Rev 3	8/99
3.6-4	Rev 3	8/99
3.6-5	Rev 3	8/99
3.6-6	Rev 3	8/99
3.6-7	Rev 3	8/99
3.6-8	Rev 3	8/99
3.6-9	Rev 3	8/99
3.6-10	Rev 3	8/99
3.6-11	Rev 3	8/99
3.6-12	Rev 3	8/99
3.6-13	Rev 3	8/99
3.6-14	Rev 3	8/99
3.6-15	Rev 3	8/99
3.6-16	Rev 3	8/99
3.6-17	Rev 3	8/99
3.6-18	Rev 3	8/99
3.6-19	Rev 3	8/99
3.6-20	Rev 3	8/99
3.6-21	Rev 3	8/99
3.6-22	Rev 3	8/99
3.6-23	Rev 3	8/99
3.6-24	Rev 3	8/99
3.6-25	Rev 3	8/99
3.6-26	Rev 3	8/99
3.6-27	Rev 3	8/99
3.6-28	Rev 3	8/99
3.6-29	Rev 3	8/99
3.6-30	Rev 3	8/99
3.6-31	Rev 3	8/99
3.6-32	Rev 3	8/99
3.6-33	Rev 3	8/99
3.6-34	Rev 3	8/99
3.6-35	Rev 3	8/99
3.6-36	Rev 3	8/99
3.6-37	Rev 3	8/99
3.6-38	Rev 3	8/99
3.6-39	Rev 3	8/99
3.6-40	Rev 3	8/99
3.6-41	Rev 3	8/99
3.6-42	Rev 3	8/99
3.6-43	Rev 3	8/99
3.6-44	Rev 3	8/99
3.6-45	Rev 3	8/99
3.6-46	Rev 3	8/99
3.6-47	Rev 3	8/99
3.6-48	Rev 3	8/99
3.6-49	Rev 3	8/99

APPENDIX A

PAGE NO.	REV	STATUS
A-1	Rev 3	8/99
A-2	Rev 3	8/99
A-3	Rev 3	8/99
A-4	Rev 3	8/99
A-5	Rev 3	8/99
A-5	Rev 3	8/99
A-6	Rev 3	8/99
A-7	Rev 3	8/99
A-8	Rev 3	8/99
A-9	Rev 3	8/99
A-10	Rev 3	8/99

PAGE NO.	REV	STATUS
APPENDIX B		
B-1	Rev 3	8/99
B-2	Rev 3	8/99
B-3	Rev 3	8/99
B-4	Rev 3	8/99
B-5	Rev 3	8/99
APPENDIX C		
C-1	Rev 3	8/99
C-2	Rev 3	8/99
C-3	Rev 3	8/99
C-4	Rev 3	8/99
C-5	Rev 3	8/99
C-6	Rev 3	8/99
C-7	Rev 3	8/99
C-8	Rev 3	8/99
C-9	Rev 3	8/99
C-10	Rev 3	8/99
C-11	Rev 3	8/99
APPENDIX D		
D-1	Rev 3	8/99
D-2	Rev 3	8/99
D-3	Rev 3	8/99
APPENDIX E		
E-1	Rev 3	8/99
E-2	Rev 3	8/99
E-3	Rev 3	8/99
E-4	Rev 3	8/99
E-5	Rev 3	8/99
E-6	Rev 3	8/99
E-7	Rev 3	8/99
E-8	Rev 3	8/99
E-9	Rev 3	8/99
E-10	Rev 3	8/99

PAGE NO.	REV	STATUS
APPENDIX F		
F-1	Rev 3	8/99
F-2	Rev 3	8/99
F-3	Rev 3	8/99
F-4	Rev 3	8/99
F-5	Rev 3	8/99
F-6	Rev 3	8/99
F-7	Rev 3	8/99

TABLE OF CONTENTS

Section 1 PILOT OVERVIEW

INTRODUCTION

The HT1000 Global Navigation Management System is a lightweight, state-of-the-art navigation system that receives and processes Global Positioning System (GPS) signals to provide worldwide navigation capability. The HT1000 meets or exceeds the en route, terminal, and instrument approach navigation standards set forth by TSO C129, AC 20-129, AC 20-138, and AC 20-130. The system also meets the requirements for primary means of navigation in Oceanic/Remote operation set forth in FAA Notice N8110.60. When interfaced to a frequency-agile DME transceiver or inertial system, the HT1000 meets the requirements of TSO C115b.

The Honeywell/Trimble HT1000 Global Navigation Management System Pilot's Guide provides the information necessary to operate the HT1000. It provides guidance in flight plan management, navigation and information display. The pilot's guide contains details sufficient to answer the majority of operational questions that arise during system use.

This guide is organized to:

- Provide a general overview.
- Step through system operation as it may be used in airline operations.
- Provide information about system functions.

Appendices provide reference information useful in understanding this guide and the Honeywell/Trimble Global Navigation Management System.

Every effort has been made to ensure the accuracy of published information. Questions about aircrew related questions, problems, or comments should be directed to Honeywell Flight Operations at (602) 436-1446.

This manual is intended as a guide and does not supersede Honeywell/Trimble, any certifying authority, or any airline approved procedures. It is for system familiarization only.

TABLE OF CONTENTS

The HT1000 Global Navigation Management System is a full flight regime navigation system that performs navigation and route flight planning. It reduces the work load in route planning, navigation, aircraft guidance, and monitoring of flight progress. The pilot defines the route from the origin to the destination airport by data entry into the Multifunction Control Display Unit (MCDU). The system provides automatic aircraft guidance along the defined path while computing and displaying current and predicted progress along the route.

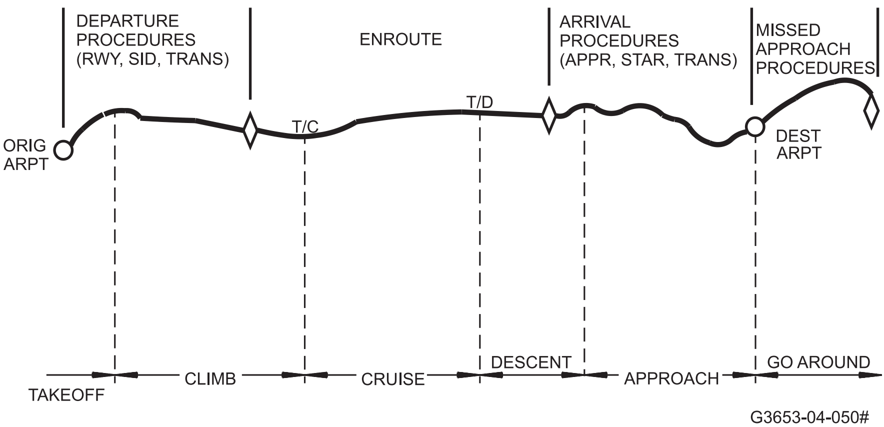


Figure 2-1
Flight Profile

The HT1000 system provides en route and terminal area guidance, autopilot coupling, roll steering and vertical deviation (non-coupled), along defined lateral procedures, including Standard Instrument Departures (SIDs), Standard Terminal Arrival Routes (STARs), approaches, and holding patterns. It can fly lateral offsets to the defined path. In addition, the HT1000 computes predicted arrival times at waypoints along the route. It also predicts arrival time at the flight's destination. The HT1000 also provides vertical navigation guidance (no autopilot coupling) from the top-of-descent down to the end-of-descent point (for example, a runway or missed approach point).

NOTE: The user must verify the legality of system certification for flying GPS Approaches with individual aircraft types.

2.1 SYSTEM DESCRIPTION

This section examines the following HT1000 components, which are pictured in Figure 2-2:

- Navigation Processor Unit
- GPS Antenna
- Multifunction Control Display (MCDU)

Figure 2-2
HT1000 System Components

2.1.1 Navigation Processor Unit (NPU)

The NPU is the processing unit of the HT1000 system. It contains the GPS receiver, computers, navigation data base, and the required external system interfaces. The NPU receives and processes the GNS/FMS signal data from the GPS Antenna and other aircraft systems, for example the Air Data Computer, to compute position and course information. It transmits data to the MCDU for display and to other aircraft systems such as the autopilot, HSI, and CDI.

A nonvolatile, Honeywell-supplied regional data base is stored in the NPU. The HT1000 navigation data base includes the information the pilot would normally determine by referring to navigational charts and maps. This information is displayed on the Multifunction Control Display Unit (MCDU).

2.1.2 GPS Antenna

The omnidirectional GPS Antenna receives, amplifies, and conditions signals from orbiting satellites. The Antenna transmits these signals to the GPS receiver in the NPU.

2.1.3 Multifunction Control Display Unit (MCDU)

The Multifunction Control Display Unit (MCDU) is the interface between the pilot and the HT1000. It is used to enter, monitor, and revise routes; to display information; and to select operational modes. It provides readout capability along with verification of data entered into memory. Route and advisory data are continuously available for display on the MCDU. The system is capable of handling seven 739 protocol subsystems.

The MCDU provides a full alphanumeric keyboard plus function and line-select keys (LSKs). The keyboard assembly contains advisory annunciators and a display brightness control. The MCDU is shown in Figure 2-3.

Figure 2-3
HT1000 Multifunction Control Display Unit

NOTE: A fold-out page illustrating the MCDU is located at the back of this Guide for your convenience.

2.2 SYSTEM INTERFACES

Figure 2-4, Functional Block Diagram, shows the relationship of the HT1000 components, plus existing aircraft components that interface with the NPU; for example, HSI, ADC, Compass, and Oleo (air/ground logic). Correct aircraft, engine, and data base configuration may be confirmed on the MCDU Identification (IDENT) page on aircraft power-up.

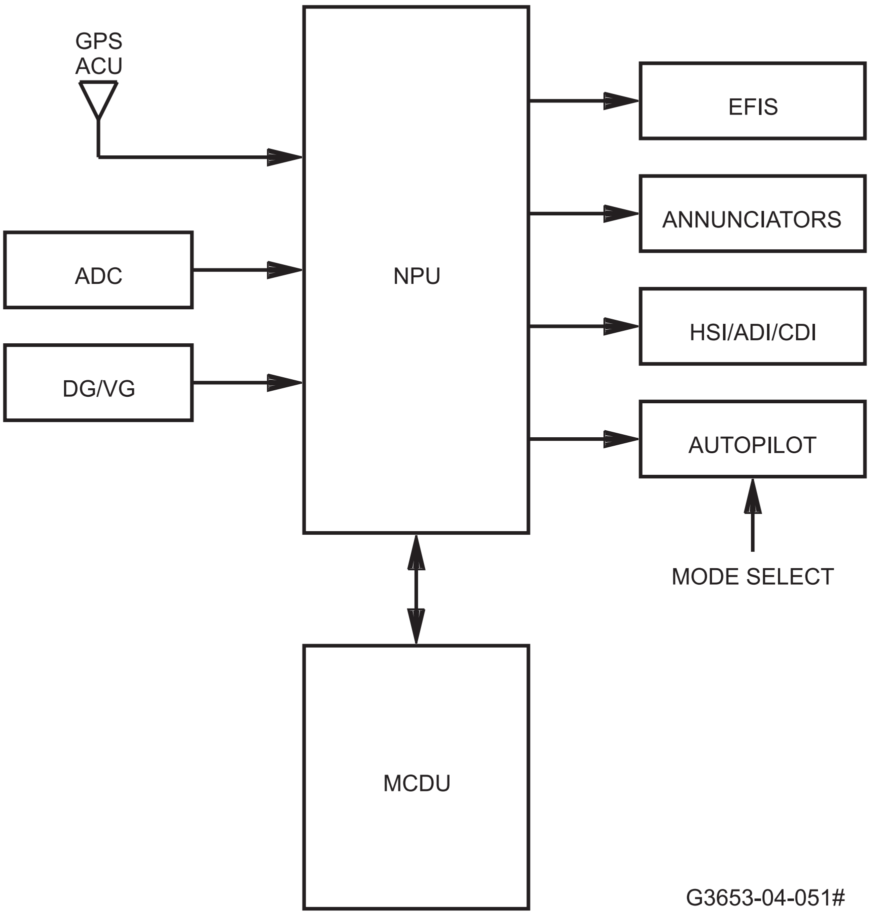


Figure 2-4
Functional Block Diagram

2.3 SYSTEM FUNCTIONS

The HT1000 processes pilot-entries from the Multifunction Control Display Unit (MCDU). It provides navigation and guidance information to the autopilot through lateral steering commands to the flight control systems.

2.3.1 Guidance

The HT1000 provides guidance when a route has been entered and activated. The system automatically sequences and updates route legs. The guidance function compares the aircraft's actual position with the desired flight path and generates lateral steering commands to the autopilot. Direct guidance from the aircraft's present position to any NAV data base waypoint is possible.

2.3.2 Navigation Data Base

The HT1000 navigation data base includes information the pilot would normally determine by referring to navigational charts and maps. This information can be displayed on the Multifunction Control Display Unit (MCDU). The data base contains en route data, including waypoints and airways; terminal data such as airports, runways, marker beacons, and terminal waypoints; SIDs, STARs and approaches; and supplemental data including the names of facilities and countries.

Navigation-based standard data is updated on a 28-day cycle that corresponds to the normal revision cycle for navigation charts. The HT1000 NPU can store two complete cycles of the navigation data base, and provides a window of time in which to load the new data base.

The data base part number (which identifies the customer, data cycle, and revision number) and the effective date periods are displayed on the MCDU IDENT page.

> NOTE: The HT1000 is supplied with a non-volatile Honeywell regional data base stored in the NPU.

2.4 MULTIFUNCTION CONTROL DISPLAY UNIT

The MCDU is the pilot interface for operation and data entry of the HT1000 and also displays routes and advisory data on a color 5.5" liquid crystal display. The display has 14 lines of data with 24 characters per line. The MCDU keyboard provides for data input and display selection and control. Refer to the MCDU as shown in Figure 2-5 for the following explanations.

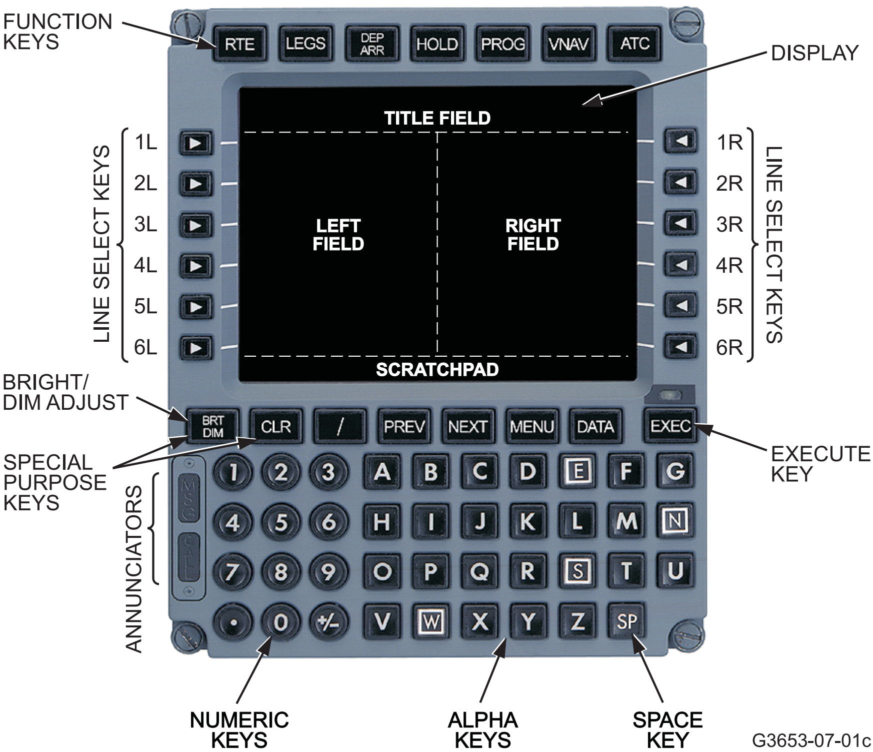


Figure 2-5
HT1000 Multifunction Control Display Unit

NOTE: A fold-out page showing the MCDU is located at the back of this Guide for your convenience.

2.4.1 MCDU Display Conventions

A display title appears on the top line of every display screen. The number of the currently displayed screen appears in the upper right corner. A slash separates the display screen number from the number of pages of related data (for example, page 1 of 3 is displayed 1/3). If more than one page of data is available, the PREV and NEXT keys are used to change pages. Labels are shown in SMALL font except for the page title. The colors are assigned as follows:

Data is generally WHITE Waypoints, Courses, Distance, and ETAs.

- The current active flight leg is displayed in MAGENTA on the LEGS page, the RTE DATA page, and the PROG page. The active vertical waypoint on the descent page is also displayed in magenta.
- Caution warnings are YELLOW. Entry error and advisory messages are WHITE .
- Page TITLES, page numbers (1/3-2/3 etc.), altitudes (pilot-entered) and label lines are CYAN.
- Action line-select keys such as <ACTIVATE, RTE DATA> and <POS REPORT are GREEN.

2.4.2 MCDU Functional Areas

The functional areas of the MCDU are the liquid crystal display (LCD), line-select keys (LSK), brightness control, keyboard, and annunciators.

2.4.2.1 Display Screen

The LCD screen has 14 lines with 24 characters per line. The page is partitioned into five areas:

TITLE FIELD – This field is the top line of the display area. It identifies the subject or title of the data displayed on the page in view. It also identifies page number and the number of pages in series, that is, 1/2 identifies a page as first in a series of two pages.

LEFT FIELD – This field contains 6 pairs of lines having 11 characters per line. The pilot has access to one line of each pair through a LSK (line-select key) on the left side of the MCDU. A line pair is made up of a label line and a data line.

RIGHT FIELD – This field is similar to the left field. Pilot access is available by a LSK on the right side.

CENTER FIELD – This field in the middle of the display is used on the DEP/ARR INDEX page and PERF INIT page to show system-generated information.

SCRATCHPAD – The scratchpad (SP) is the bottom line of the MCDU display. This line displays HT1000-generated messages, keyboard entries, and data being moved from the display field into the scratchpad. Scratchpad messages allow for easy identification of Alert, Advisory, or Entry error anomalies.

2.4.2.2 Line-Select Keys (LSKs)

There are six line-select keys on each side of the LCD screen. For clarity, this manual refers to the line-select keys (from top down) on the left side of the display as 1L through 6L and the right side as 1R through 6R.

A momentary push of an LSK affects the adjacent line for data entry, selection, or deletion. The transfer of data from the scratchpad to the data line is accomplished by pushing the LSK.

Line-select keys may have an adjacent prompt and a chevron. For example, the <ACTIVATE or LEGS> prompts indicate that if the LSK adjacent to the prompt is pressed a corresponding page of data will be displayed or an action will take place within the NPU.

2.4.2.3 Annunciators

There are two annunciators located on the lower left side of the MCDU. These annunciators display the following:

MSG – The WHITE MSG display light illuminates when a CDU message is pending.

CALL – The AMBER CALL light will be used in the future for uplinks. Presently, it is inoperative.

2.4.3 Keyboard

There are 66 keys: 7 function keys, 8 special character keys, 12 line-select keys (LSK) (6 on the left and 6 on the right), and 39 alphanumeric keys.

2.4.3.1 Function Keys

The function keys access the pages for display on the LCD. Once the desired page is displayed, the pilot can find information and enter or retrieve data. A brief description of these function keys follows.

RTE

RTE Key – The RTE key provides access to the Route pages. It is used for selection, entry, and modification of routes.

LEGS

LEGS Key – The LEGS key provides access to LEGs pages where details, such as course and distance, of each leg of the route are displayed. Modification of individual legs can be accomplished on the LEGs pages.

DEP ARR

DEP/ARR Key – The DEP ARR key provides access to departure and arrival information for selected airports.

HOLD

HOLD Key – The HOLD key allows for the definition and execution of holding patterns.

PROG

PROG Key – The PROG key provides access to flight progress data on the current leg of the flight.

VNAV

VNAV Key – The VNAV key provides access to the PERF INIT and DESCENT pages. The PERF INIT page allows entry of fuel, gross weight, and cruise altitude. The descent VNAV page allows selection of VNAV path data for display (if configured for VNAV).

ATC

ATC Key – The ATC key is presently inoperative. Future software revisions will allow for ATC communication.

2.4.3.2 Special Purpose Keys

The special purpose keys consist of the following:

BRT DIM

BRT/DIM Key – Pressing the BRT DIM key alternately increases and decreases the brightness of the display. The key must be released for approximately one second before initiating another press to reverse the brightness level. Brightness level of the keyboard is controlled by a separate rheostat.

CLR

CLR Key – This key clears the scratchpad and data fields. A single press clears one character and holding it down clears the entire scratchpad. If the CLR key is pressed with nothing in the SP the word DELETE appears. Then by pressing an appropriate left or right LSK the data entered on the LSK line may be removed.

/

Slash Key – The / key is included as one of the special purpose keys and is used to separate pairs of entries in the same field. For example, airspeed and Mach (280/.72), wind direction and velocity (240/75), bearing and distance (180/20), or airspeed and altitude (250/10000). The trailing entry of an entry pair must be preceded by the slash if it alone is entered.

PREV

PREV Key – The PREV key moves the display backwards to the previous page (if a previous page is available).

NEXT

NEXT Key – The NEXT key moves the display forward to the next page (if a next page is available).

MENU

MENU Key – The MENU key calls up a menu of the connected A739 subsystems. GPS/NAV or any A739 subsystem displayed may be selected. The HT1000 can be selected by pressing GPS/NAV prompt.

DATA

DATA Key – The DATA key provides access to a menu of advisory data displays.

EXEC

EXEC Key – The EXEC key executes modifications to the active route. A green bar-light above the key indicates when the EXEC key is armed.

2.4.3.3 Alpha Numeric Keys

The alpha numeric keys enable the pilot to enter letters and numbers, including ⊙, +/-, and the SP key. Alpha and numeric keys may be entered together as required.

The Plus/Minus Key – The +/- key enters numeric characters into the scratchpad. The first momentary press of the +/- key inserts a minus sign. A second press of the +/- inserts a plus sign.

The Space Key - The SP key is used to insert a space between characters. It is available for ATC downlink text messages in the future.

2.4.4 Page Formats and Data Labels

HT1000 formats and data labels are displayed on the MCDU pages selected by the function keys. Two sizes of font (LARGE and SMALL) are used on the display pages. LARGE font indicates either primary flight data OR data entered by the pilot. Typical page format and data labels are illustrated in Figure 2-6.

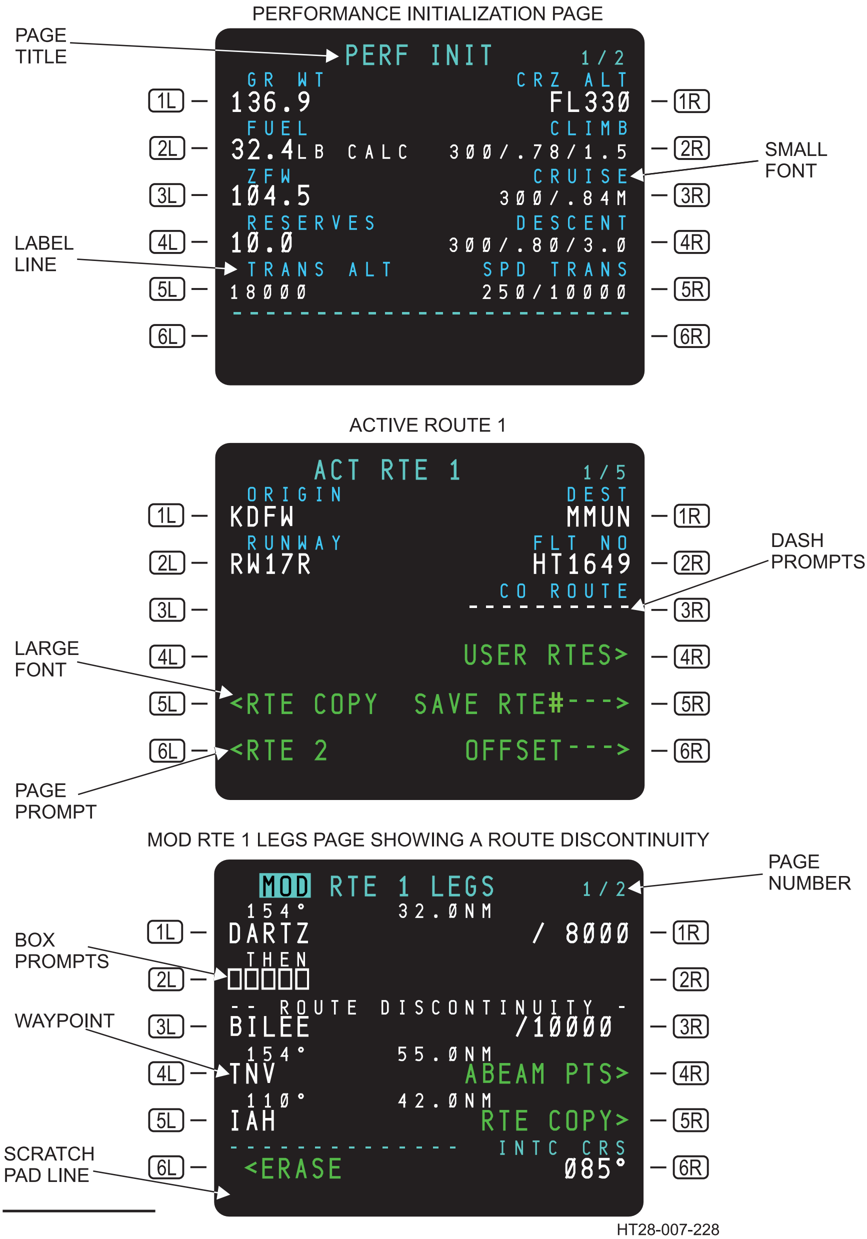


Figure 2-6
MCDU Page Formats

The following are explanations for the data labels and page formats illustrated in Figure 2-6.

Page Title (LARGE font) – The page title is at the top of the display. It indicates the subject or title of the page displayed on the MCDU. If a route is displayed, ACT or MOD will be displayed to indicate that the route displayed is Active or Modified.

Scratchpad Line (SP) – This is the bottom line of the display. This line displays HT1000-generated messages, keyboard entries, and data that is being moved from one line to another. All data entry is displayed on this line and then "line selected" to the appropriate location by pressing a LSK to the right or left of the display. Data can be entered into the SP with the alphanumeric keys, the LSK, or by the HT1000.

System-generated messages are displayed in the scratchpad. Alert messages take precedence. System-generated messages appear only when pilot-entry is not in progress. When the system sends a message to the MCDU, the WHITE MSG annunciator light on the left side of the MCDU illuminates. Press the CLR key once to remove a message from the scratchpad. If more than one message is waiting, the HT1000 displays the next new message when the CLR key is pressed. The MSG annunciator is illuminated until all new messages have been cleared. Data entry to the scratchpad can be made while a system message is displayed. (MCDU Messages are summarized in Appendix B, MCDU Messages.)

Scratchpad entries are independent of page selection and remain in view until cleared, even when page changes occur.

LARGE Font – Indicates crew-entered data or crew-verified information. LARGE font may also represent certain navigational data base entries.

SMALL Font – Represents predicted, default, or HT1000-calculated values. When adjacent to a LSK, the data may be changed in some instances by crew entry, which changes the SMALL font to LARGE font. SMALL font also is used on the label line to identify the data that appears on the data line. (See Label Line below.)

Label Line – Identifies the data displayed on line(s) below it. The line label is displayed in SMALL font.

Data Line – Contains box prompts, dashes, computer generated data (SMALL font), or crew entered data (LARGE font).

Box Prompts (□□□□□) – Indicate that crew-entered data is required for minimum HT1000 operation. Data entry is performed by the crew entering alphanumeric data in the scratchpad and pressing the corresponding LSK. Entries into a box-prompt data line are displayed in LARGE font.

Dash Prompts (– – – –) – Indicate that data entry is optional. (Optional data is that data which is not required for the HT1000 to perform navigation tasks.) The crew may enter the optional data in the scratchpad followed by a press of the LSK adjacent to the dash prompts.

Page Number – Displays that have more than one page of data include a page number, which is located in the top right corner of the display screen. The first digit indicates the page number that is currently displayed and the second digit indicates total number of related pages. For example, 1/2 identifies a page as the first in a series of two pages. This data is in SMALL font.

Page or Action Prompts (< or >) – Indicates access to related page displays or actions.

Waypoint – Waypoint identifiers are displayed in LARGE font.

2.4.5 Data Entry

Data is entered into the scratchpad using the alphanumeric keys. As a rule, the display field or data field acts as an example format that, when followed, results in successful data entry. After scratchpad entry and confirmation of correct data, pressing a LSK transfers data from the scratchpad to the data field. Data entry formats that are not obvious are explained.

For specific formats, it is possible to transfer information from a data field into the scratchpad by pressing the LSK when the scratchpad is empty. The data subsequently can be transferred to another data field by an appropriate keyboard procedure, or it can be cleared from the scratchpad using the CLR key.

2.5 TERMINOLOGY

The following information defines the terminology used to describe the flight crew interaction with the HT1000 MCDU.

Active – Refers to route information currently being used to calculate lateral navigation guidance commands. The active waypoint is the point the system is currently navigating toward. ACT is displayed on the respective page titles.

Activate – Designating one of two routes as active. It is a two-step process. First, press the ACTIVATE> LSK, then press the illuminated EXEC key.

Enter – Entering data into the system by typing or line-selecting alphanumeric characters into the MCDU scratchpad and then line-selecting the information to the desired location.

Erase – Removes a modified flight path from the system by pressing the line-select key adjacent to the word ERASE. The prompt is present in 6L anytime MOD Route is in progress.

Execute – Refers to making pilot-entered information part of the active route by pressing the illuminated EXEC key.

Inactive – Refers to route information currently not being used to calculate navigation commands.

Initialize – Entering required information into the MCDU to make the HT1000 operative.

Message – Refers to information that the HT1000 automatically writes in the scratchpad to inform the flight crew of conditions.

Modify – Modification of data in the active route. When a modification is made to the active route, MOD is displayed in the page title, ERASE appears next to 6L, and the EXEC key illuminates. Pressing the ERASE LSK removes the modification. Pushing the EXEC key makes the modified route active.

Prompt – A symbol displayed on the MCDU page to prompt the crew for information. It may be boxes (□□□□□) or dashes (– – – –). A boxed prompt indicates a required entry. A dashed prompt is an optional entry.

Select – Pressing a key to obtain the desired information or action.

Waypoint – A point in the route. It may be a fixed point, such as latitude and longitude, a VOR or NDB station, or an intersection on an airway.

TABLE OF CONTENTS

This section describes the HT1000 operations used on a typical flight, in this case, a flight from Dallas-Fort Worth to Cancun (that is, KDFW to MMUN). It begins with system initialization prior to takeoff at Dallas-Fort Worth and continues to engine shutdown at the destination, Cancun. Not all system functions are described; however, those frequently used as part of the normal operations are covered.

Table 3-1
FLIGHT DATA - DALLAS TO CANCUN

Flight Number	HT1649
Departure Airport	Dallas-Fort Worth International
Destination Airport	Cancun International
Alternate Airport	Cozumel International
B727 Aircraft	
Cruise Level	FL330
Route as filed:	
KDFW	
RO455F330 JPOOL2 BILEE TNV J87IAH SBI A766 FIR38	
UA766 EDGAR MMUNO206	

Symbols commonly used throughout this guide to illustrate the HT1000 functions include:

SP	Abbreviation for Scratchpad.
☞ RTE	Press MCDU function or character key.
☞ 2L	Press MCDU line-select key.

Also, review the special purpose keys in Section 2.4.3.2 and data entry in 2.4.5.

NOTES and CAUTIONS for this guide use the following standard definitions:

> NOTE: Calls attention to methods that make the task easier or to pertinent information for the flight crew.

CAUTION

Calls attention to methods and procedures that must be followed to avoid damage to data or equipment.

This page will be replaced by the flight plan map.

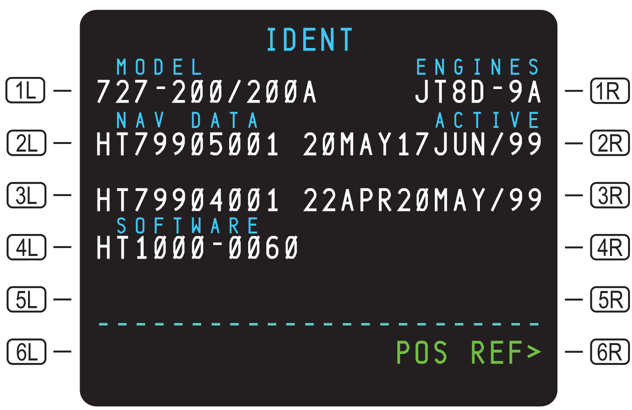
TABLE OF CONTENTS

3.1 PREFLIGHT

During preflight the pilot verifies the HT1000 status, initializes the system, enters or modifies the route, and configures the HT1000 for flight.

3.1.1 Identification Page

When aircraft power is supplied, the HT1000 is powered up. It does not have a power on/off switch. The first screen the HT1000 displays is the IDENT page. The IDENT page allows the pilot to review the aircraft type, engine type, and navigational database. All data on the aircraft IDENT page should be reviewed for accuracy and applicability. The only data that can be changed on the IDENT page is the active navigational database. Any MCDU message can be cleared from the scratchpad using the CLR key. (MCDU message explanations are in Appendix A.)



HT28-007-229

Figure 3.1-1
IDENT Page

Explanations of the LSKs and the adjacent data in Figure 3.1-1 begin on the next page.

1L **MODEL** – Displays the aircraft model stored in the configuration module.

2L **NAV DATA** – Displays the identifier of the navigational database stored in the NPU. The first two digits of the database part number designate the airline or generic HT. The third digit designates the airline's database number. The fourth and fifth digits designate the year the database was produced. The sixth and seventh digits designate the database cycle number. There are 13 database cycles in one year, so sometimes the database cycle number coincides with the month it is effective, and sometimes it does not. The eighth, ninth, and tenth digits designate the sequence number. The sequence number will display the number of revisions incurred within a database cycle.

NOTE: The NAV database identifier will be displayed in yellow if the NAV database is corrupted or not yet validated. If it is corrupted, a NAV DATA CORRUPT message will be displayed in the SP. If this occurs on the ground, the NAV databases should be reloaded or the alternate database should be selected. If the failure occurs in flight, the current active route remains good, however, any attempt to use data from that database will result in the error message NOT IN DATABASE being displayed in the scratchpad. However, LAT/LON waypoints may still be created.

After the navigation database has been loaded, it is normal for the NAV database identifier to be displayed in yellow while the validity checks are being run. Once the validity checks are complete and no problems are found, the navigation database identifier will turn white.

4L **SOFTWARE** – Displays the operating program's identifier part number. This is the operating system of the HT1000.

1R **ENGINES** – Displays the engine model number contained in the configuration module.

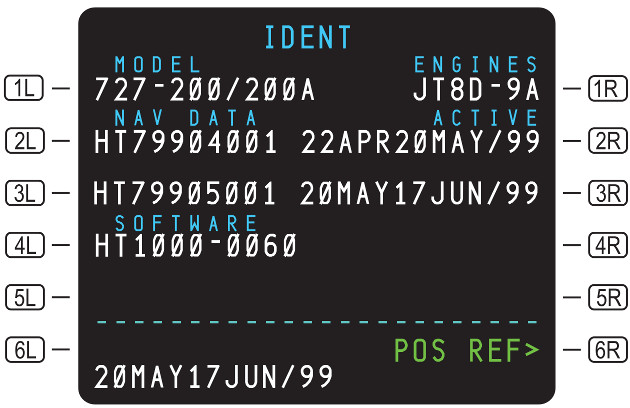
2R **ACTIVE** – Displays the active navigational database effective dates in the HT1000. The INACTIVE navigational database effective dates are displayed next to LSK **3R**.

To change the ACTIVE database, carry out steps A and B.

STEPS:

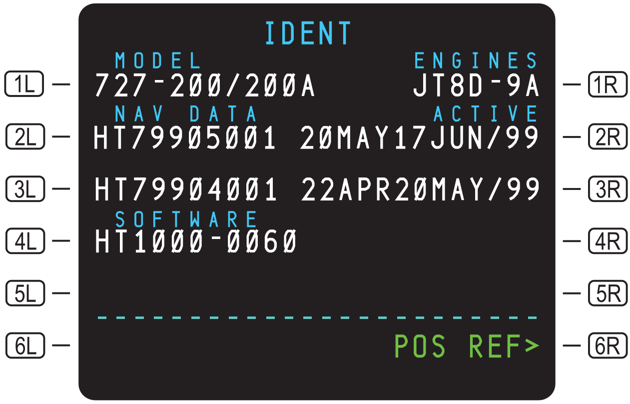
A. **3R** to copy the inactive database identifier to the scratchpad (see Figure 3.1-2).

B. **2R** to make the INACTIVE database ACTIVE. The HT1000 moves the new date up to **2R** (see Figure 3.1-3).



HT28-007-230

Figure 3.1-2
Change Active Database



HT28-007-231

Figure 3.1-3
New Active Navigation Database

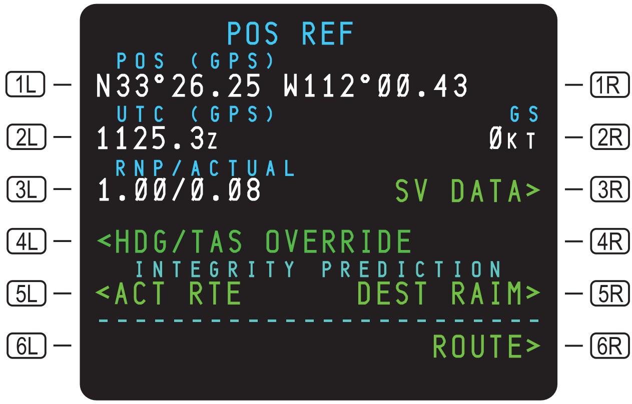
NOTES:
1. The ACTIVE navigation database can be changed only while the aircraft is on the ground.
2. Changing the ACTIVE navigation database erases any flight plan information previously entered.
3. Following the prompts at LSK **6R** will guide the pilot through the preflight initialization entries.

6R **POS REF** – Pressing the LSK **6R** provides access to the POS REF page.

3.1.1.1 Position Reference Page

Pressing **6R** on the IDENT page or **2L** on the data index page provides access to the Position Reference (POS REF) page. The POS REF page displays present position, time, ground speed, RNP, and actual navigation performance.

STEP: 6R from the IDENT page.



HT28-007-121

Figure 3.1-4
POS REF Page

1L **POS (GPS)** – Displays the present HT1000-calculated position and source of position. Position source is identified by either (GPS), (DR), (DME), or (INS) on the display.

2L **UTC (GPS)** – Universal Coordinated Time. UTC time is provided by the GPS signal. In the event GPS is lost, time will be replaced with the HT1000's own internal clock. RTC (Real Time Clock) will then be displayed adjacent to UTC time. When the system again acquires a GPS signal, the UTC time will be updated.

3L **RNP/ACTUAL** – Displays Required Navigation Performance (RNP) and Actual Navigation Performance values.

The displayed RNP value is based on the aircraft's phase-of-flight. For oceanic/remote operations the RNP default is 12 NM. For en route operations the default RNP is 2.0 NM. For terminal operations it is 1.0 NM, and for approach operations the default RNP is 0.3 NM. The RNP value will automatically default to these values as the aircraft flies through the different phases of flight. These default values can be overridden by the pilot by typing in a value and Line-selecting the value to 3L. However, this will prevent the system from automatically defaulting to the next phase-of-flight RNP. To return to the automatic default logic, press the CLR key and line-select DELETE to 3L.

The Actual navigation performance number is a measure of the navigation accuracy of the system. It computes the actual navigation performance number based on the known satellite geometry and the known inherent system errors (such as receiver noise, multi-path and atmospheric effects). If the ANP value exceeds the RNP value, the system will generate an UNABLE RNP message or annunciation.

4L **<HDG/TAS OVERRIDE** – Accesses the HDG/TAS OVERRIDE page for entering and displaying data (HDG, TAS, GS, TK, WIND). If the system is in Dead Reckoning mode, <DR appears at 4L.

<DR – Accesses the Dead Reckoning page for entering and displaying data (HDG, TAS, GS, TK, WIND). <DR is displayed at 4L instead of <HDG/TAS OVERRIDE whenever the HT1000 goes into dead reckoning mode with a loss of the GPS signal.

5L **<ACT RTE** – Accesses the Active Route Integrity Prediction page. Available only when there is an active route (see Section 3.6.3.2) and the aircraft is on the ground.

2R **GS** – Displays the ground speed of the aircraft in knots as computed by the HT1000.

3R **SV DATA>** – SV data is displayed if no other sensors are configured. If the system is configured to use DME or INS, SV data is not displayed on this page, but it can be accessed on page 3/3. When the SV DATA> prompt is present, pressing 3R will display a page of satellite data (azimuth, elevation, and signal quality.)

5R **DEST RAIM>** – Accesses the Destination RAIM Prediction page. The Destination RAIM Prediction requires an active route and can be run in the air or on the ground.

6R **ROUTE>** – Displays the RTE page, which is used to continue the preflight initialization sequence.

3.1.1.2 POS REF Page 2/2 (Available If DME or INS Is Installed)

> ***NOTICE***
>
> ***The following pages 3.1-7 to 3.1-17 are for use only with GPS aircraft that have Inertial Systems installed, and in which the HT1000 is configured to interface with the INS system. If you do not have Inertial equipment installed, continue to page 3.1-18 (Section 3.1.3, Flight Planning).***

The POS REF page displays the different navigation solutions that have been calculated, and provides a means to access supplemental navigation data for each of the solutions. Figures 3.1-5, 3.1-6, and 3.1-7 show examples of POS REF pages when either DME or INS equipment is installed.

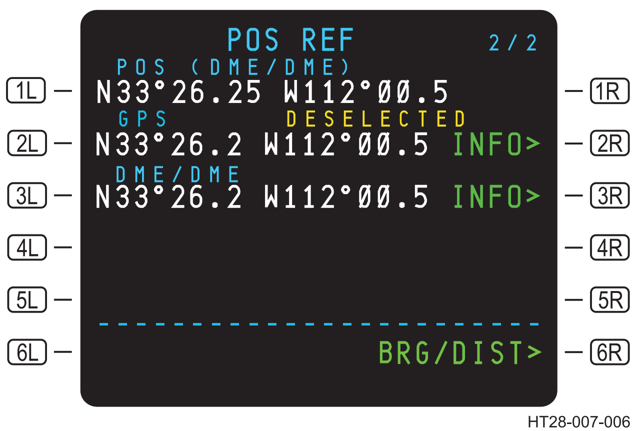
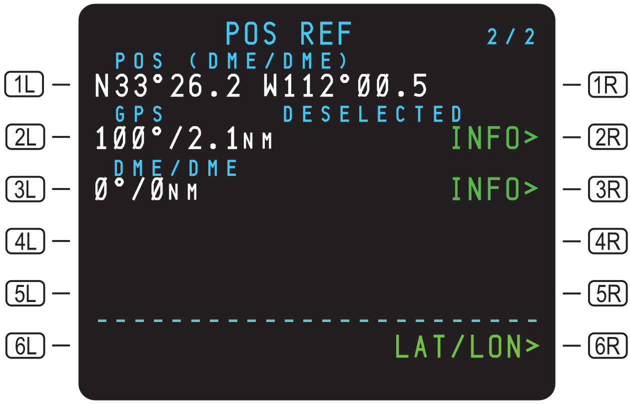


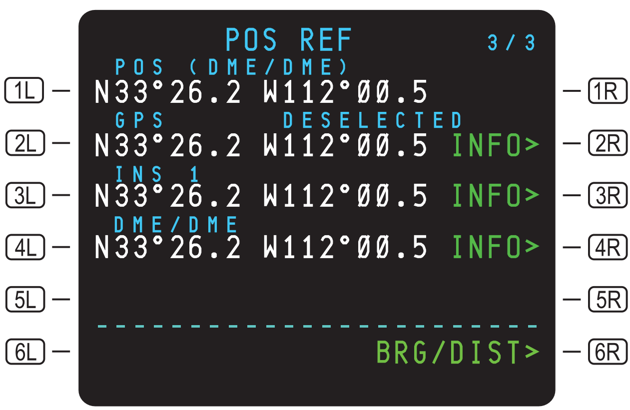
Figure 3.1-5
Sample POS REF Page
DME-Equipped Aircraft in LAT/LON

Pressing **6R** BRG/DIST> displays GPS at **2L** and DME at **3L** as a bearing distance from the position in line 1. (See Figure 3.1-6.) The HT1000-calculated position at **1L** will always be displayed in LAT/LON.



HT28-007-232

Figure 3.1-6
Sample POS REF Page – BRG/DIST Selected



HT28-007-233

Figure 3.1-7
Sample POS REF Page - INS and DME Installed in Addition to GPS

If the BRG/DIST> prompt at **6R** is not selected, all positions on the POS REF page 2/2 are displayed in latitude/longitude format. The BRG/DIST> prompt at **6R** selects the bearing/distance mode. In this mode, the **2L** through **4L** data fields display the bearing and distance from the computed position displayed in field **1L**.

Any displayed sensor may be deselected by selecting DELETE from the scratchpad and placing it on top of the position for the selected sensor. This will result in DESELECTED being displayed in YELLOW in the label line adjacent to the sensor type. (See Figure 3.1-8.) Selecting DELETE on a sensor already deselected will reselect that sensor.

1L **POS (DME/DME)** – This line remains in latitude/longitude format at all times. Line-selecting 1L will downselect the LAT/LON to the SP.

2L **GPS** – The 2L label line field displays GPS position. The data source is determined by the configuration module. If the GPS position is invalid or unavailable, the 2L label line and data fields are blank. Line-selecting 2L will downselect the LAT/LON to the SP.

3L **INS** – On INS-equipped aircraft, line-selecting 3L will downselect the LAT/LON to the SP. (See Section 3.1.2 Inertial Systems Interface.)

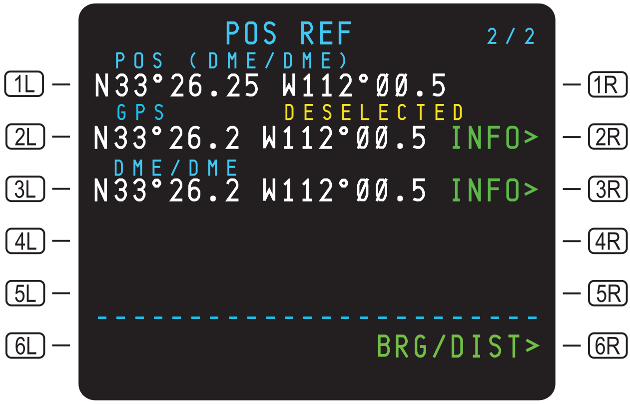
If the INS position input is valid, data field 3L displays the position in either latitude/longitude format or bearing/distance format. If INS is invalid, the 3L label and data fields are blank.

4L **DME/DME** – For DME-equipped aircraft the 4L label line displays DME/DME. If the DME position is valid, data field 4L displays the position in either latitude/longitude format or bearing/distance format. If the DME position is invalid, the 4L data field is blank.

2R **GPS, INS, DME, GPS INFO>** – Selection of 2R while INFO> is displayed results in the display of the appropriate INFO page for the GPS, INS, or DME source. (See INFO prompts at 3R and 4R in Figure 3.1.7.) For example, Figure 3.1-9 shows the results of selecting the INFO> prompt for DME 4R.

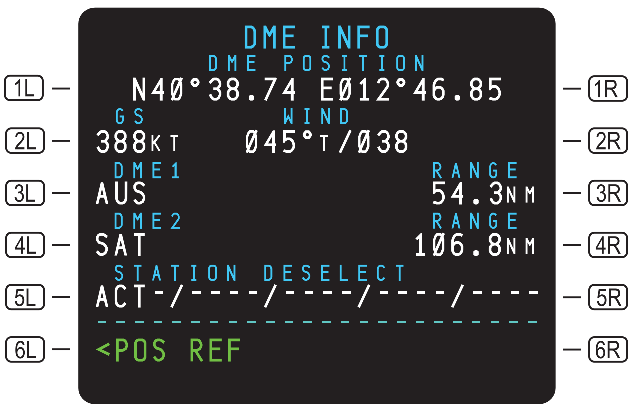
3.1.1.3 POS REF INFO Page

Pressing the INFO> prompt at 3R (Figure 3.1-8) brings up the DME INFO page, which displays pertinent information on the DME/DME-derived position. (See Figure 3.1-9.)



HT28-007-006

Figure 3.1-8
Sample POS REF Page



HT28-007-009

Figure 3.1-9
Sample DME INFO Page

(1L) **DME** – Displays DME/DME position calculated by the HT1000.

(2L) **GS** – Displays current groundspeed. If GS is less than 100 KT, the GS field is blank.

(3L) **DME 1** – Shows identification of DME tuned for DME 1.

4L **DME 2** – Shows identification of DME tuned for DME 2.

5L **Station Deselect** – The station deselect is used to deselect navaids from being used in the navigation solution. The station identification is typed into the scratchpad and line-selected to 5L. The CLR key is used to remove the stations by line-selecting DELETE to 5L. This will clear all deselected navaids from line 5L.

2C **WIND** – Displays real time winds.

3R **RANGE** – Shows distance to AUS.

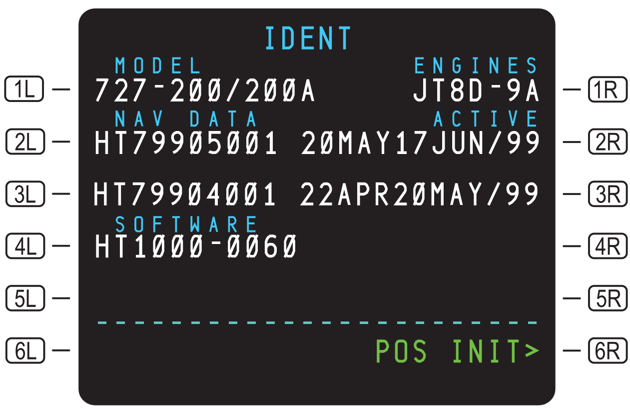
4R **RANGE** – Shows distance to SAT.

3.1.2 Inertial Systems Interface

NOTICE

Section 3.1.2, Inertial Systems Interface, is for use only with GPS aircraft that have Inertial Systems installed and in which the HT1000 is configured to interface with the INS system. If you do not have Inertial equipment installed, continue to Section 3.1.3, Flight Planning.

When Inertial Systems are installed, the IDENT of the HT1000 changes slightly. The **6R** prompt displays POS INIT> instead of POS REF>. Pressing **6R** brings up the POS INIT page, from which the INS can be initialized.



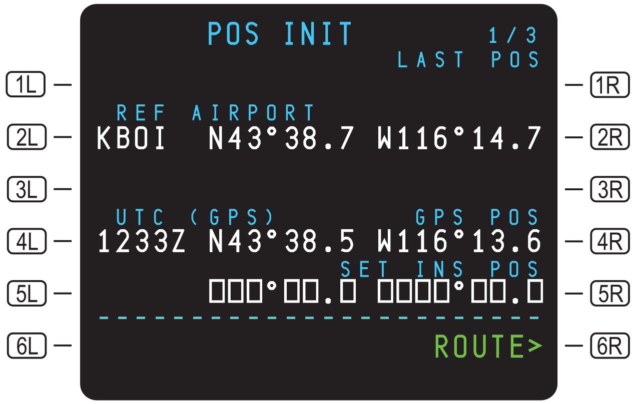
HT28-007-234

Figure 3.1-10
IDENT Page when Inertial Systems are Installed

3.1.2.1 POS INIT Page

The POS INIT page is displayed only if the aircraft is equipped with an Inertial System and the HT1000 is configured for the INS interface. It is accessible only when the aircraft is on the ground.

STEP: ☞ **6R** POS INIT on the IDENT page. (See Figure 3.1-10.)



HT28-007-010

Figure 3.1-11
POS INIT Page 1/3

The POS INIT page provides a means of initializing the Inertial System to full alignment on the ground. It displays on line 2 the position of the HT1000 at last shut down (in certain conditions) and Universal Time Coordinated (UTC) at 4L.

2L **REF AIRPORT** – This field provides for entry of the departure airport four-letter ICAO identifier. Upon entry the system Navigation Database (NDB) displays the LAT/LON coordinates of the Airport Reference Point (ARP) in 2R.

4L **UTC (GPS)** – Universal Time Coordinated (UTC) as provided by the GPS from the satellites is displayed in 4L. If GPS time is invalid, real time clock (RTC), the NPU's internal clock time, will be displayed. The label line will show GPS or RTC as appropriate.

1R **LAST POS** – Displays the last position at which the HT1000 was shut down. Will be blank if the present HT1000 position is valid.

2R LAT/LON of the Airport Reference Point (ARP) based on the ICAO identifier entered in 2L.

4R **GPS POS** – The present position coordinates as determined by the GPS.

5R **SET INS POS** – The label SET INS POS is displayed if an Inertial source is valid and in align mode. Boxes in 5R allow entry of the GPS position coordinates from 4R by downselecting to the SP and entering into 5R. The entered LAT/LON is then sent to the Inertial systems to start the initialization countdown.

NOTE: If a GPS position is not valid, coordinates from 1R or 2R may be downselected or a LAT/LON can be typed into the SP for Line-selection to 5R.

6R Pressing the ROUTE> prompt at 6R results in the display of the RTE 1 page.

Pressing the NEXT key displays the POS REF page 2/3.

STEP: ☞ NEXT key.

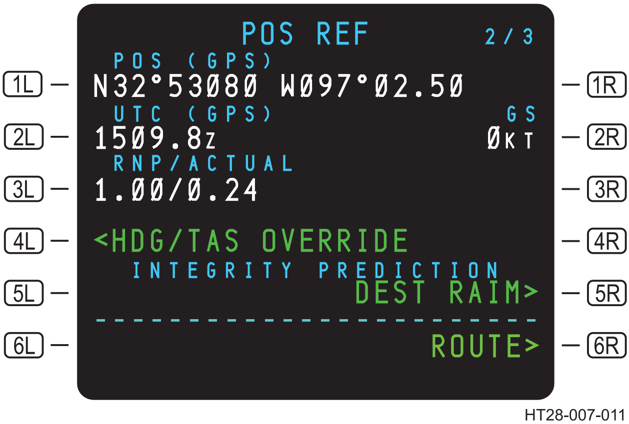


Figure 3.1-12
POS REF Page 2/3

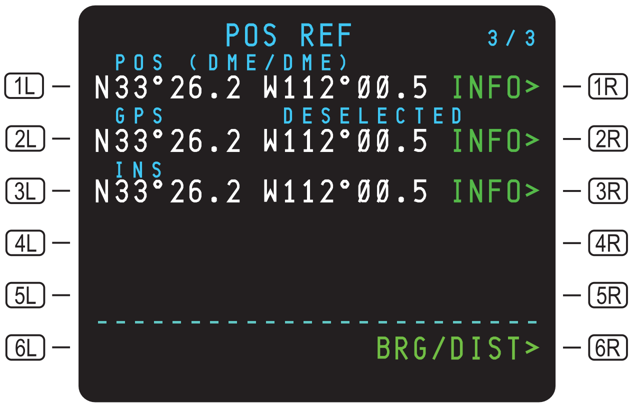
In Figure 3.1-12, the position shown at 1L may be derived from INS, DME, or DR (based on the navigation solution hierarchy) if GPS happens to be inoperative, invalid, or deselected. The label line at 1L will reflect the change.

1L **POS** – Displays the present position coordinates that are derived from either GPS, INS, DME, or DR as indicated in the label line.

2L **UTC** – Universal Time Coordinated or Real Time Clock (RTC) if GPS time is not valid.

The NEXT key accesses POS REF page 3/3.

STEP: NEXT key.



HT28-007-235

Figure 3.1-13
POS REF Page 3/3

1L **POS (DME/DME)** – Displays present position coordinates as determined by the HT1000, using either GPS, INS, DME, or DR as the NAV source.

2L **GPS** – Displays the present coordinates as determined by the GPS.

3L **INS** – Displays the onside Inertial System LAT/LON on the left cockpit MCDU.

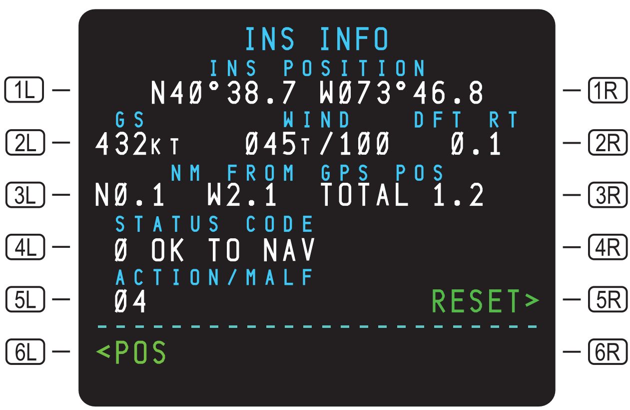
3R **INFO>** – Provides access to the INS 1 Information page. (See Figure 3.1-14.)

6R **BRG/DIST>** – Pressing 6R alternately changes the coordinate readout in 1L and 2L and 3L to Bearing and Distance or LAT/LON.

STEP: 3R INFO> prompt.

HT28-007-143

Figure 3.1-14
INS INFO Page During Alignment



HT28-007-144

Figure 3.1-15
INS INFO Page After Alignment

1L **INS POSITION** – The label INS POSITION displays the position of the on-side INS after alignment. (See Figure 3.1-15.)

2L **IN ALIGN MODE** – Displays time to NAV in minutes remaining to full inertial alignment. (See Figure 3.1-14.)

2L **GS WIND DFT RT** – This label line changes to GS, WIND, and DFT RT after alignment is complete, with display of appropriate data. (See Figure 3.1-15.)

3L **NM FROM GPS POS** – This line displays the position difference between the INS and the HT1000 GPS POS in terms of direction North or South and East or West, and the distance. TOTAL direct distance is shown at the right. This field is blank during INS alignment. (See Figure. 3.1-15.)

4L **STATUS CODE** – During alignment, a status code is displayed in 4L to indicate degree of alignment completion, with a description of the status to the right.

Code Number	Description	Remaining time to align
9	WARM UP	5 minutes to go
8	HORIZINIT	3 minutes to go
7	ENTER ALIGN POS	1 minute to go
6	ALIGNING	10 minutes to go
0-5	OK TO NAV	

Table 3.1-1 – Status Codes

5L **ACTION/MALF** – Should malfunctions occur within the INS during alignment or in full operation, the unit may display an Action/Malfunction code. The action code may appear for a very brief period followed by the malfunction code number. These code numbers are listed in a table defining each numeric set. The table is maintained by the user airline to aid in detection and correction of inertial system malfunctions.

5R **RESET>** – If INS alignment is incomplete or discontinues, a RESET> prompt may appear in 5R of the INS INFO page. It allows a reset of the alignment sequence. When the reset command begins to transmit, SENDING is displayed at 5R.

3.1.3 Flight Planning

3.1.3.1 Route Page 1

From the POS REF page, pressing LSK 6R, the ROUTE prompt, provides access to the RTE pages. This permits the pilot to enter and activate flight plan routes. Departure and destination ICAO identifiers are entered in 1L and 1R. The intervening waypoints and airways are entered on subsequent pages. The following steps illustrate entry and activation of the route from Dallas-Fort Worth (KDFW) to Cancun (MMUN).

Figures 3.1-16 and 3.1-17 illustrate entry of the origin and destination airports and the departure runway and flight number for an inactive route.

NOTES:

1. Two system routes may be stored in the HT1000, although only one can be active at any given time.
2. LSK 6L on the RTE pages allows the pilot to select, view, and activate the other route (RTE 1 or RTE 2).
3. The active route clears after flight completion (landing time plus five minutes).

1L **ORIGIN** – Box prompts in 1L allow entry of the origin airport using ICAO identifiers stored in the navigation database. An entry clears any previous route and allows entry of departure or arrival procedures.

2L **RUNWAY** – Valid entries are runway numbers contained in the navigation database for the airport entered into the origin. The entry may be through keyboard action or Line-selection from the Departure/Arrival page.

5L **<RTE COPY** – Copies RTE 1 to RTE 2 (or, if RTE 2 is displayed, vice versa). RTE COPY COMPLETE is displayed in LARGE font when copying is complete. This prompt appears only after a route has been activated.

6L **<RTE 2** – Displays RTE 2 page 1/X. It allows access to an inactive route for creation and modification, or activation. Modification to an inactive route does not alter an active route. The prompt at 6L changes to RTE 1 when RTE 2 is displayed. If the route is modified active or pending activation, <ERASE is displayed in LARGE font at 6L. Pressing 6L erases the pending modification.

1R **DEST** – Allows for entry of the destination airport ICAO identifier.

2R **FLT NO** – Displays the pilot-entered flight number. The entry is optional for activation of the route. Dash prompts indicate an optional entry and the system's readiness to accept a valid entry. The flight number propagates to the PROGRESS and REPORT pages.

3R **CO ROUTE** – Displays the pilot-entered company route. This entry retrieves the company route from the NDB. Dash prompts indicate the system's readiness to accept a valid entry. Company routes are a custom NAV database procedure and must be requested from the airline's NAV data base supplier.

6R **PERF INIT>** – If the required entries (indicated by box prompts) have not been made on the PERF INIT page, 6R displays PERF INIT (See Section 3.1.4).

ACTIVATE> – Activates the displayed route and arms the EXEC key. (ACTIVATE is displayed at 6R if the route is defined and has not yet been activated.) The EXEC key press is required to complete the activation.

OFFSET – Displayed on all ACT RTE pages when parallel offset track is available. (Only available in flight. See Section 3.3.1.8, Offset.)

STEP: 6R ROUTE> on POS REF Page.

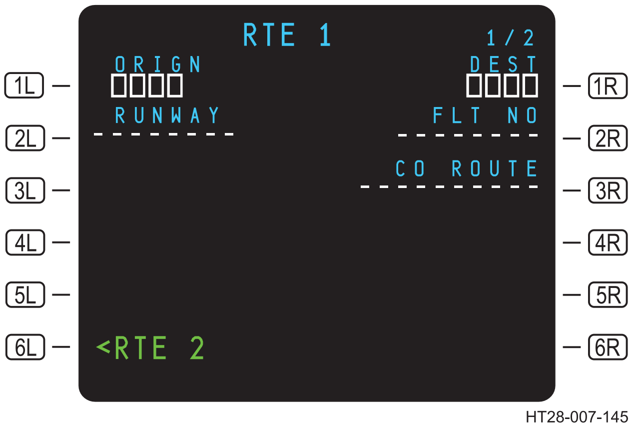


Figure 3.1-16
RTE 1 – Page 1

STEPS:

A. Type KDFW in SP.
B. 1L
C. Type MMUN in SP.
D. 1R
E. Type 17R in SP.
F. 2L
G. Type HT5269 in SP.
H. 2R

NOTE: KDFW is the identifier for Dallas-Fort. Worth. MMUN is the identifier for Cancun.

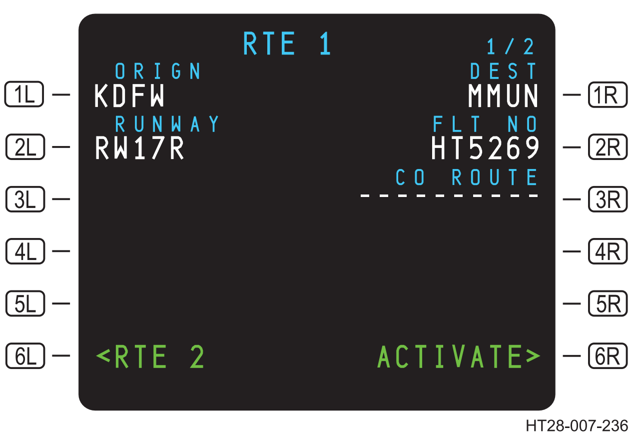


Figure 3.1-17
RTE 1 – Page 1 Complete

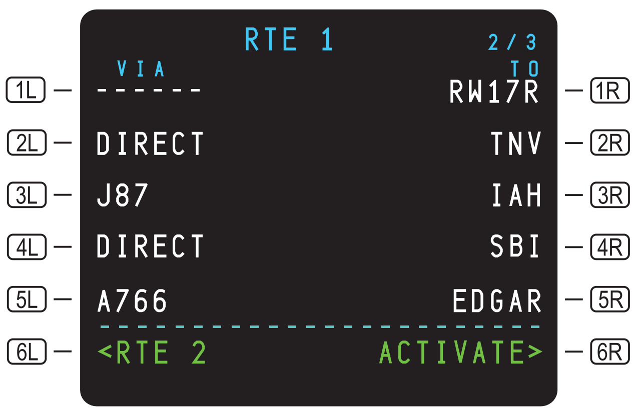
3.1.3.2 Route Page 2

The route from DFW to CUN (Airport identifiers KDFW and MMUN), shown in Table 3-1 (Section 3, Flight Operations), can be entered on the Route 1 pages 2/X. Figure 3.1-18 illustrates the route entry.

STEPS:

NEXT to go to page 2/2, then:

A. Type TNV in SP.
B. 2R
C. Type J87 in SP.
D. 3L
E. Type IAH in SP.
F. 3R
G. Type SBI into SP.
H. 4R
I. Type A766 in SP.
J. 5L
K. Type EDGAR into SP.
L. 5R



HT28-007-237

Figure 3.1-18
RTE 1 – Page 2/2

1L Allows entry of airway identifiers of 1 to 5 characters (only on page 2).

2L Allows entry of airway identifiers of 1 to 5 characters.

3L Allows entry of airway identifiers of 1 to 5 characters.

4L Allows entry of airway identifiers of 1 to 5 characters.

5L Allows entry of airway identifiers of 1 to 5 characters.

6L **<u><RTE 2</u>** – Allows access to RTE 2 page for entry of an optional secondary route.

1R – **5R** Allows entry of waypoint identifiers or route segment termination points.

6R May display one of the three prompts described below:

<u>PERF INIT></u> – Provides access to PERF INIT page and is displayed if box entries on the PERF INIT page are not complete.

<u>ACTIVATE></u> – Activates the route when followed by the EXEC key.

<u>OFFSET</u> – Allows entry of an offset under certain conditions. OFFSET may be L or R, and between 1 and 99 NM. (See Section 3.3.1.8 OFFSET.)

Route leg information and all intermediate waypoints can always be viewed and checked on the RTE LEGS pages.

Figure 3.1-19a shows the RTE LEGS page and waypoints in the route plus bearing and distance between waypoints.

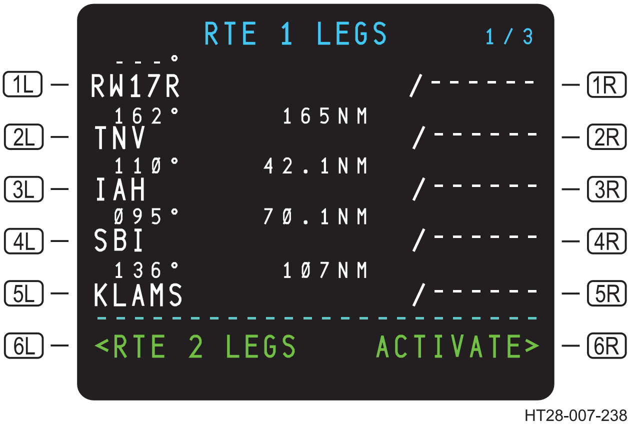


Figure 3.1-19a
RTE 1 – Completed Page 1/3

Bearing can be either magnetic or TRUE depending on the cockpit switch position (if installed on the aircraft). If selected to TRUE, a small "T" will appear after the degree symbol of the displayed course. (See Figure 3.1-19b.)

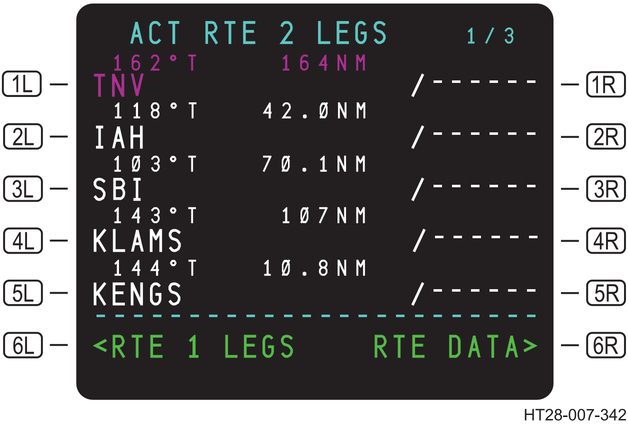


Figure 3.1-19b
RTE LEGS Page - True Bearing

3.1.3.3 Departure Selection

The DEP/ARR INDEX (Figure 3.1-20) gives access to departures and arrivals for the origin and destination airports. Departures and arrivals for RTE 1 and RTE 2 are listed if the two routes have been entered.

The departure and arrival pages can be accessed at any time by pressing the DEP ARR key on the MCDU. The departure and arrival index page (DEP/ARR INDEX) is used to select the departure and arrival pages for the origin and destination airports for each route. The DEP/ARR INDEX page also allows the pilot to browse departure or arrival information for any other airport in the navigation database.

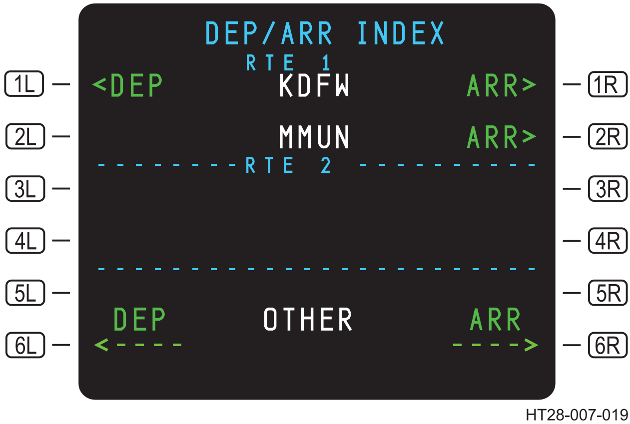


Figure 3.1-20
DEP/ARR INDEX Page – KDFW Departures

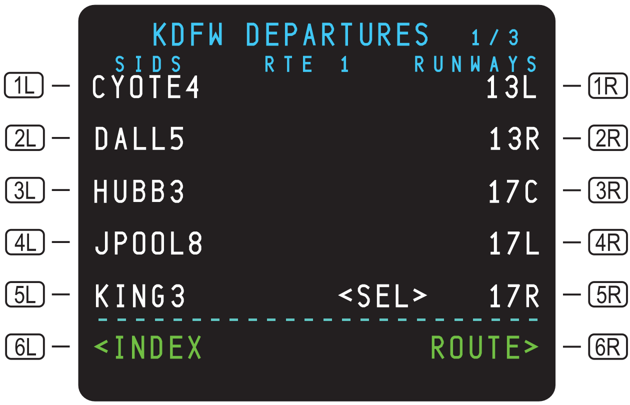
RTE 1 and RTE 2 appear in the center field as line labels above the first and third data fields respectively. The originating airports are displayed in the center of the first and third lines (assuming two routes have been defined). The destination airports appear in the center of the second and fourth lines (assuming two routes have been defined).

NOTES:
1. If a route has been activated, ACT is displayed next to the RTE 1 or RTE 2 line.
2. If RTE 1 and/or RTE 2 have not been defined, the data fields below the respective line titles are blank.

The <DEP prompts in **1L** and **3L** allow access to SIDs and runways of the defined departure airport(s). The ARR> prompts in **1R** through **4R** allow access to STARS, approaches, and runways of the defined arrival and departure airports.

The DEP/ARR INDEX also allows the pilot to access departure and arrival information of airports not defined in one of the two routes. The title OTHER appears in the center of the sixth line. The pilot may review departures of an airport not defined in RTE 1 or RTE 2 by entering the airport's identifier in the SP and pressing **6L**. Likewise, an airport's arrivals may be reviewed by entering its identifier in the SP and pressing **6R**. Entries must be four-character ICAO identifiers that are stored in the navigation database for departures or arrivals to be displayed. These departures and arrivals can be viewed only by procedure name and may not be appended to a flight plan.

SID and Departure Runway. Departure runways and SIDs are selected on the DEPARTURES page. To access the DEPARTURES page, press 1L on the DEP/ARR INDEX page. On the KDFW DEPARTURES page (Figure 3.1-21), the left data fields display the available SIDs and the right data fields display the available departure runways. Notice that there are three pages of SIDs and runways.



HT28-007-239

Figure 3.1-21
KDFW DEPARTURES – Page 1/3

NOTE: If a runway was defined on the RTE 1 page, an <ACT> (or <SEL> if the route has not been activated) legend is displayed next to that runway.

After selecting a SID, transition, or runway; the selections move to the top and all other choices are blanked out as in Figure 3.1-22.

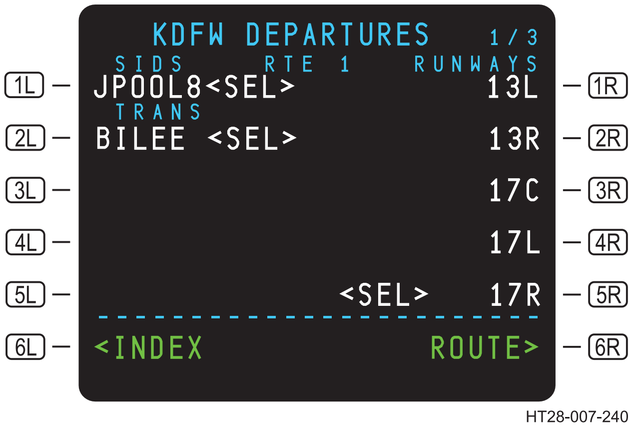


Figure 3.1-22
KDFW Departures Page – Completed

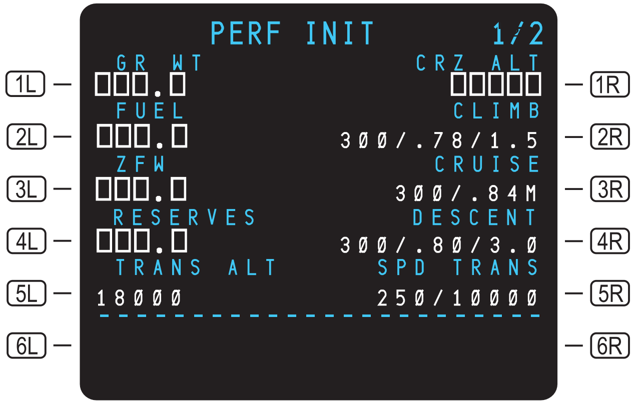
NOTES:
1. The procedure and transition selected can be reviewed on the RTE page.
2. Returning to the departure index and reselecting a procedure will load a new procedure or transition and will reset the previously selected procedure or transition. The reselected DEP/ARR will be indicated by <SEL>. (See Figure 3.1-22.)

3.1.4 Performance Initialization

Press VNAV to access the PERF INIT page and to initialize entries. After initial power up, route entry, activation, and execution; the PERF INIT prompt is displayed at **6R** on the RTE page. Once the data is entered on the PERF INIT page, the prompt at **6R** on the RTE page will not be displayed again until the next power-up initialization of the HT1000.

NOTE: The PERF INIT page will be cleared with flight complete logic (after landing plus five minutes). Figure 3.1-23 illustrates the PERF INIT page as it will appear when not initialized.

STEP: VNAV



HT28-007-248

Figure 3.1-23
PERF INIT Page

1L **GR WT** – The Gross Weight (GR WT) is displayed in thousands of pounds or metric tons. It automatically displays the calculated weight if zero fuel weight and fuel are entered first. In installations where the HT1000 is interfaced with fuel flow sensors, the GR WT will decrease as fuel is burned off.

The gross weight is always the sum of the Zero Fuel Weight (ZFW) at 3L and the fuel weight (<FUEL) at 2L .

Valid entries for gross weight are three-digit values, optionally followed by an decimal point and tenths. Given any two entries of either GR WT, FUEL, or ZFW; the system will calculate the third entry.

NOTE: Display of metric tons or pounds is set up by maintenance personnel on the maintenance configuration pages.

2L **FUEL** – This line normally displays the HT1000-calculated fuel quantity (CALC – in center field) or a pilot-entered value. Prior to engine start, the HT1000-calculated fuel quantity should be set equal to the total fuel. During flight the fuel quantity decreases due to fuel flow indications.

NOTES:
1. Only manual entries can be deleted.
2. Box prompts indicate that crew entry is required.
3. Auto fuel sensing is not available on all aircraft. If not, 1L and 2L may be blank.

3L **ZFW** – Displays Zero Fuel Weight (ZFW) in thousands of pounds or metric tons. Box prompts are displayed until a valid zero fuel weight is entered. If the crew enters a gross weight at 1L and a fuel weight at 3L, a valid zero fuel weight will also be calculated.

4L **RESERVES** – Displays the fuel reserves weight in thousands of pounds. The reserve fuel weight is used in determining an insufficient fuel condition. An insufficient fuel condition will trigger the message CHECK FUEL - VNAV (if the HT1000 system is interfaced with aircraft fuel flow sensors.)

Valid reserve entries are one- to three-digit weights that optionally may be followed by tenths.

5L **TRANS ALT** – Displays the altitude above which the HT1000 will display altitudes in a flight level format (for example: FL 290). Default transition altitudes are set by maintenance personnel on the maintenance configuration pages. Pilots can override the default altitude on this page when flying in regions requiring a different transition altitude by typing the new altitude into the scratchpad and line-selecting to 5L.

1R **CRZ ALT** – The desired Cruise Altitude (CRZ ALT). Valid entries for Cruise Altitude are standard altitude entries. This entry is required for VNAV and ETAs. This altitude entry will not automatically change as the aircraft climbs or descends to a new cruise altitude. The crew must manually change the altitude.

2R **CLIMB, CRUISE, DESCENT** – Indicates speeds/mach numbers and angle of the climb or descent segments.

3R 4R These are used by the HT1000 to determine top-of-climb, ETAs, and the top of descent points. They normally are not changed by the crew; however, crew entries can be made on this page and will override the default values. To return to the default values, line-select DELETE to the proper field. Default values are set by maintenance in the maintenance configuration pages.

5R **SPD TRANS** – Displays the speed restriction of 250 knots below 10,000 feet. This field can be modified by the crew.

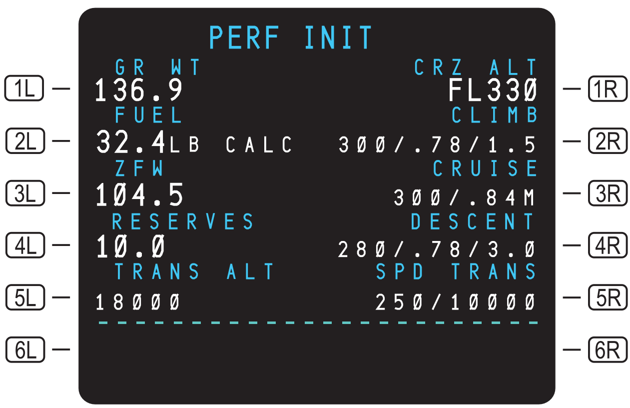
NOTE: Any pilot-entered changes at 1R through 5R cause the EXEC light to come on. These are changes to the vertical path and require execution by the crew. Any changes made on the left side LSKs, 1L through 5L, autotransfer to the other unit and do not require execution by the crew.

Figure 3.1-24 illustrates how to complete a PERF INIT page for the flight.

STEPS:

Enter the flight data into the SP and press the appropriate LSKs.

A. Type 104.5 in SP.
B. ☞ 3L.
C. Type 32.4 in SP.
D. ☞ 2L.
E. Type 10.0 in SP.
F. ☞ 4L.
G. Type 330 in SP.
H. ☞ 1R.



HT28-007-023

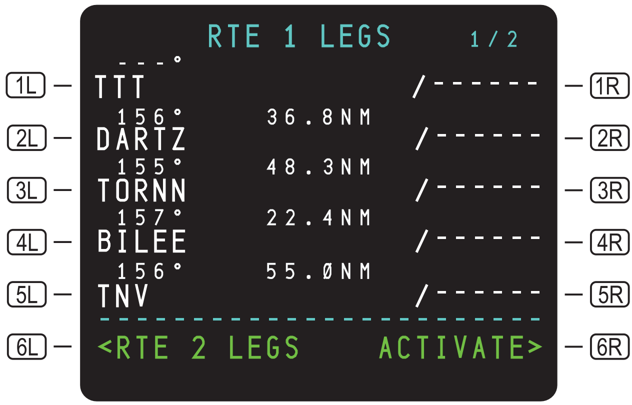
Figure 3.1-24
PERF INIT Page – Complete

NOTE: If the system is configured for VNAV (see the maintenance configuration option), the PERF INIT page will provide access to the DESCENT page by pressing PREV or NEXT. (See Section 3.4.)

3.1.5 Route Legs

3.1.5.1 Flight Plan Route Activation

Access the RTE 1 LEGS page by pressing the LEGS key.



HT28-007-249

Figure 3.1-25
RTE 1 LEGS Page – Route Activation

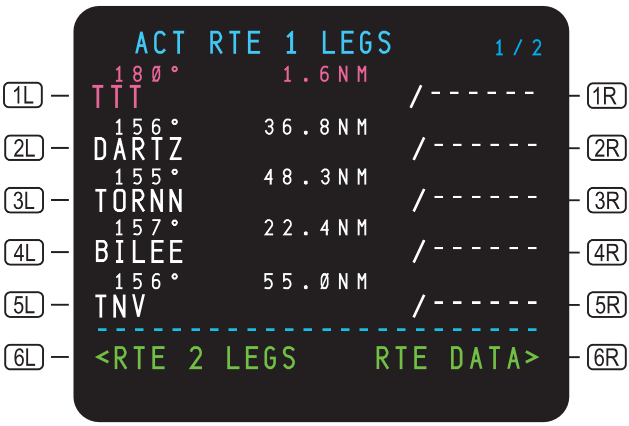
Once the LEGS information has been entered, the pilot can activate the route. The waypoint in 1L is displayed in MAGENTA if it is the active waypoint. Lateral steering commands and the CDI/HSI information is valid. If the waypoint is inactive, it will be displayed in WHITE. Lateral steering commands and CDI/HSI information are not valid.

NOTE: There are cases where a course to the next waypoint is undefined (such as flying through a discontinuity or when a flight plan has been entered and no runway or procedure has been selected). In such a case, the next waypoint will be displayed in WHITE and the system will not provide navigation data until the course to the waypoint is defined, which may be done by performing a direct-to. An example of this is the symbology _ _ _ ° prior to TTT in Figure 3.1-25. To have the system compute a course to TTT, perform a direct-to to TTT, and execute. Once this is done, the system will compute a course to TTT and turn TTT to MAGENTA, indicating that it is now the active waypoint.

STEPS:

A. 6R ACTIVATE.

B. EXEC and the page title changes to ACT RTE 1 LEGS.



HT28-007-250

Figure 3.1-26
Active RTE 1 LEGS Page

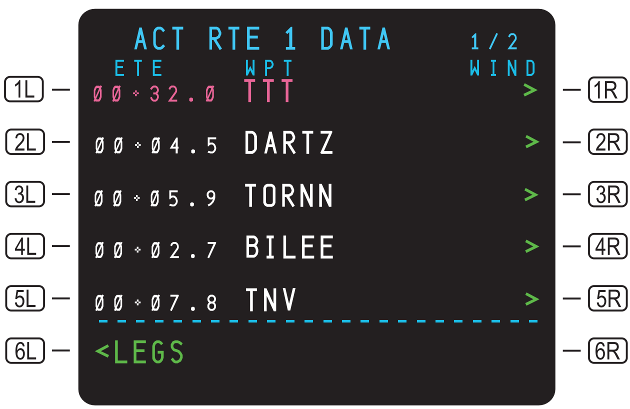
NOTE: See Appendix B for LEGS Page definitions and display characteristics.

3.1.6 Route Data Page

The Route Data page is accessed via **6R** on the Active Legs page. The Route Data page displays the flight plan waypoints in the same sequence as the legs page. The ETE column shows estimated time en route between waypoints before take off, and estimated time of arrival (ETA) when airborne. Each waypoint on the Route Data page has an associated wind page. The wind pages for each waypoint are accessed by pressing LSKs **1R** through **5R**.

3.1.7 Wind Input

STEP: ☞ **6R** RTE DATA> from the ACT RTE 1 LEGS page.

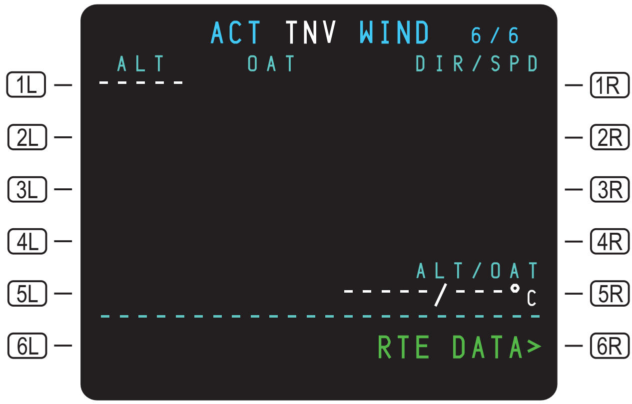


HT28-007-251

Figure 3.1-27
ACTIVE RTE 1 DATA Page

Wind Page. As illustrated in Figure 3.1-28, this page provides entry and display of forecast winds and temperatures at specified altitudes for specific waypoints.

STEP: ☞ 5R TNV (Figure 3.1-27).



HT28-007-252

Figure 3.1-28
Active TNV Wind Entry Page

A maximum of four wind altitudes may be entered and displayed. Enter the desired altitude in the SP and press 1L. This will display a prompt on the right hand side where wind direction and velocity can be entered. (See Figure 3.1-29) Wind direction and velocity are then entered in the SP and line-selected to the appropriate data line. Altitudes may be entered in any order. The HT1000 sorts and displays them in ascending order. Initial cruise altitude and temperature may be entered in 5R, which allows the system to calculate temperatures for the remaining altitudes.

STEP: Type each altitude 250, 290, and 330 in SP and enter in 1L.

Wind direction and velocity are typed in the SP and entered at 1R to 4R as appropriate.

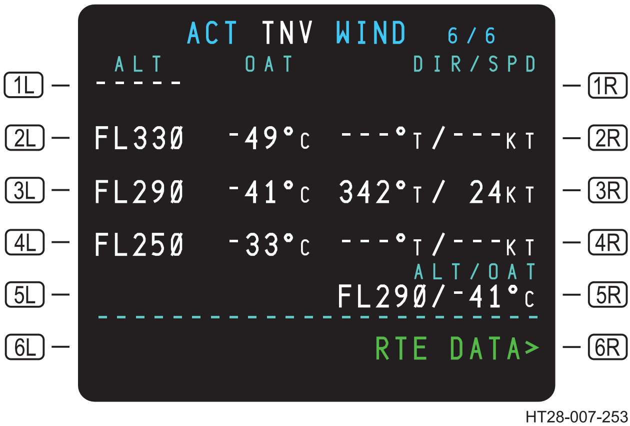


Figure 3.1-29
ACT TNV WIND Page

The entered winds will propagate forward and backward along the entire route if there are no pilot-entered winds. Winds entered at the next waypoint will propagate forward only. (See Figure 3.1-30.)

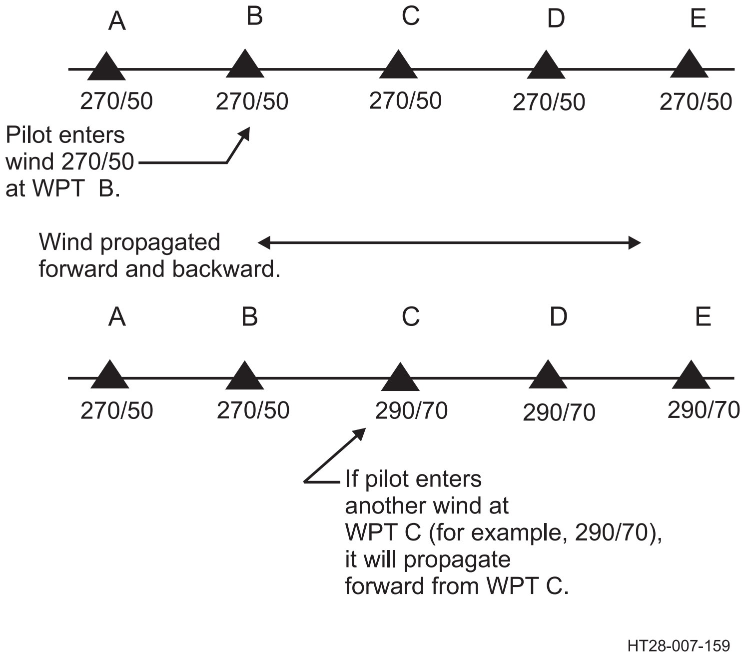


Figure 3.1-30
Propagated Winds

NOTES:

1. As winds for each waypoint are entered, the NEXT or PREV keys may be used to step through the flight plan waypoints to the next point where wind entry is desired. There is no need to return to the RTE 1 DATA page to select the next waypoint position for wind entry.
2. Entered winds will be in LARGE font, propagated winds are in SMALL font. Wind entries can be overwritten to change the direction and velocity.

3.1.8 Automatic Flight Plan Transfer

In a dual installation, the AUTOMATIC FLIGHT PLAN TRANSFER function provides an automatic transfer of the active flight plan to the second system. The function requires that:

- There is a dual NPU installation
- Both have the same software, and
- The active NAV databases are identical.

When the flight plan has been entered, activated, and the EXEC key has been pressed, the flight plan is automatically transferred to the other system. During transfer, the message RTE X UPDATING appears in the receiving unit's scratchpad. If the system is unable to transfer the flight plan, TRANSFER UNABLE will be displayed in the scratch pad. The flight plan must be executed on the receiving system to accept the transfer.

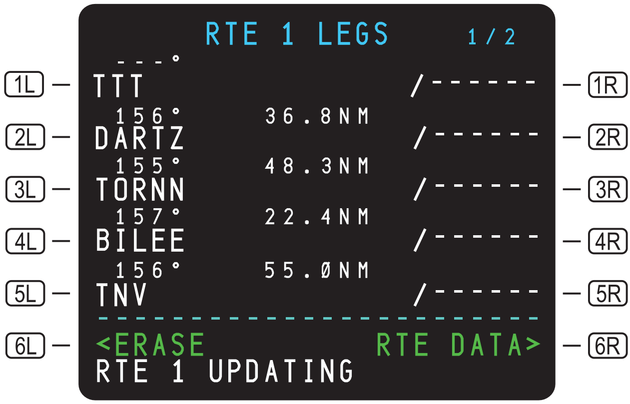
NOTE: Flight plan data on the two HT1000 systems will be compared every 10 seconds. In the event that flight plan data are in disagreement for more than 60 seconds, the advisory message FLIGHT PLAN DISAGREE is displayed in the SP.

STEPS:

A. 6R ACTIVATE from the RTE LEGS page.

B. EXEC.

The receiving MCDU will switch to the RTE LEGS page and the EXEC key will illuminate.



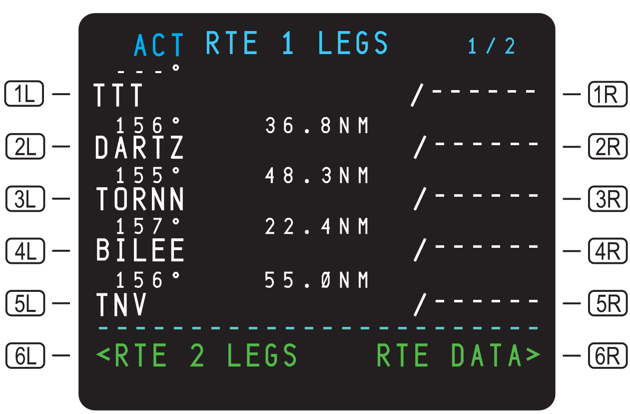
HT28-007-254

Figure 3.1-31
Receiving MCDU – Route 1 Updating

6L **<u><ERASE</u>** – Cancels flight plan transfer.

<u>STEP:</u>

EXEC on receiving MCDU to accept the transferred flight plan.



HT28-007-255

Figure 3.1-32
RTE 1 LEGS Page – Receiving MCDU

When the crew modifies speed transition, cruise altitude, climb, cruise, or descent profile data, the HT1000 creates a modified route and illuminates the EXEC light. The modified route information is transferred to the other system when the crew presses EXEC. On the receiving system, the EXEC light illuminates and EXEC must be pressed to accept the modified route.

The HT1000 automatically transfers the following flight plan data without any action from the crew:

- Origin, destination airport, origin runway.
- Flight number and company route identifier.
- Lateral routing including SIDs, STARs, procedures.
- Wind information.
- Offset.
- LEGS Page descent data including FPA and altitude constraints.
- Descent path information.
- PERF INIT data including gross weight, fuel weight, zero fuel weight, reserves, transition altitude, speed transition, cruise altitude, climb, cruise, descent profile data.
- RNP value from the POS REF page.

NOTES:
1. At the time of transfer, any existing MOD on the receiving unit will be cleared.
2. In a triple HT1000 installation, only two units can be in communication at the same time. The third unit can be switched in to communicate with Unit 1 or Unit 2.

TABLE OF CONTENTS

Page

3.2 TAKEOFF/CLIMB

3.2.1 DIRECT-TO

DIRECT-TO route entries allow the pilot to fly direct to a particular fix. The fix may be part of the active route or it may be an off-path waypoint as used in this example.

To perform a DIRECT-TO, enter the desired fix from the SP into 1L on the first ACT RTE LEGS page. The following are allowable entries into 1L:

- Any navigation database-defined waypoint, airport, NAVAID, or NDB.
- Any fix defined in the active or modified active route.
- Any along-track waypoint.
- A valid PBD waypoint.
- A valid PB/PB waypoint.
- A LAT/LON waypoint.
- Any LAT/LON crossing waypoint.

Once an entry has been made in 1L, a modification is created and the title becomes MOD RTE LEGS. After verifying the modified path, the pilot has the option to execute or erase the Direct-To operation.

Using the flight scenario to MMUN, fly direct to LOA (LEONA).

STEPS:

A. Type LOA in the SP.

B. ☞ 1L.

C. ☞ EXEC.

HT28-007-256

Figure 3.2-1
MOD RTE 1 LEGS Page

1L **LOA** – Displays the pilot-entered Direct-To waypoint and also the desired track to the waypoint.

6L **ERASE** – Is displayed only on the MOD pages and pressing the prompt displays the previous unmodified page.

NOTES:
1. If the waypoint you are going DIRECT-TO is part of your route, such as BILEE or TNV, merely downselect it to the SP and then to 1L and EXEC.
2. A discontinuity appears when a waypoint is entered that is not already part of the route.
3. ABEAM PTS> and RTE COPY> are discussed in Section 3.3.1.5.

The DIRECT-TO may now be executed or the pilot may choose to continue and specify an Intercept Course as described in the next section.

3.2.2 Intercept Course

An intercept course to a particular fix is similar to the direct-to procedure. A fix is entered into **1L** on the first ACT RTE LEGS page. This will result in a MOD RTE LEGS page being displayed. The pilot then enters the desired intercept course into box prompts in **6R** or overwrites an already entered value on the MOD RTE LEGS page.

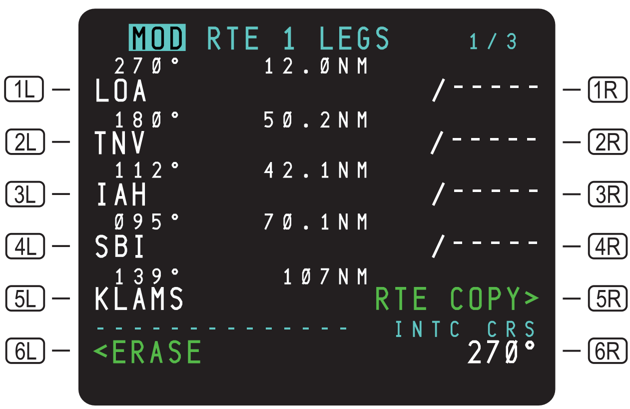
If the Direct-To-Fix was line-selected from the active route, the original course to the fix is displayed in **6R**. If an off-route fix is typed into the SP and line-selected to **1L**, empty box prompts are displayed in **6R**.

STEPS:

A. Type LOA in the SP.

B. ☞ **1L**.

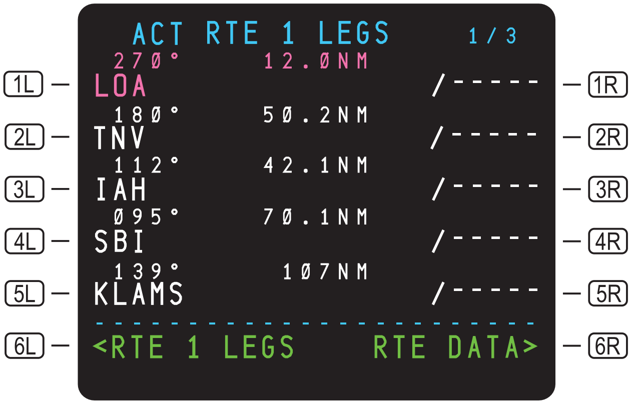
C. Type 270 in SP and enter in **6R**.



HT28-007-257

Figure 3.2-2
MOD RTE 1 LEGS Page – INTC CRS

STEP: EXEC.



HT28-007-258

Figure 3.2-3
ACT RTE 1 LEGS Page

After pressing EXEC, the following occurs. The MOD RTE 1 LEGS page is replaced with the ACT RTE 1 LEGS page. (See Figure 3.2-3.) The HT1000 creates two legs. One leg is the inbound course to the active waypoint. (In Figure 3.2-2 it is 270° to LOA.) Crosstrack deviation indications on the HSI or EFIS map will be provided to this leg (see Figures 3.2-4b and 3.2-5).

The HT1000 creates a second leg called the intercept leg. This leg is constantly calculated from the aircraft's present position to the point where the aircraft track intercepts the 270° inbound leg to LOA. This intercept leg will not be shown on the MCDU legs page. However lateral steering will be provided on this leg, allowing autopilot coupling. (See Figure 3.2-4 for illustration.) A waypoint will not be displayed at the intersection of the current aircraft track with inbound leg to the active waypoint; however, the waypoint alert will be generated as if there were a waypoint at this intersection.

If the current track of the airplane does not cross the inbound course to the active waypoint, NOT ON INTERCEPT HEADING is displayed in the SP and the EXEC key light bar is extinguished. When the aircraft turns to a heading that will intercept the inbound course prior to the active waypoint, the EXEC light bar will illuminate and the EXEC key will be armed for execution.

Distance-to-go (DTG) to LOA is from present position direct, not along the flight path. (See Figures 3.2-4a and 3.2-4b.)

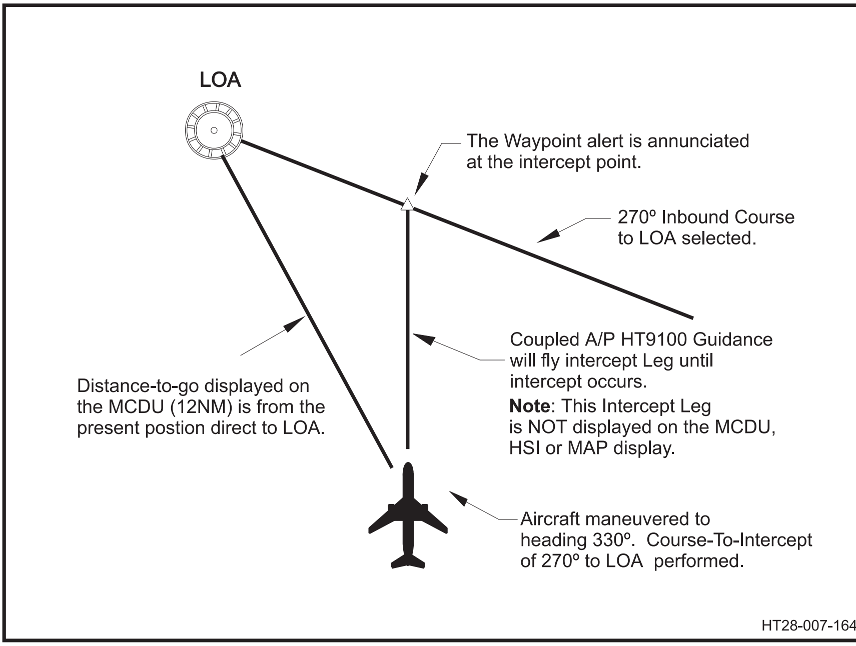
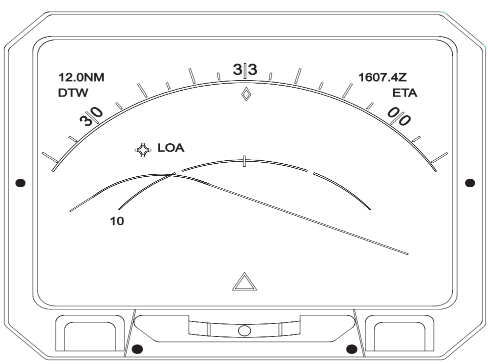


Figure 3.2-4a
Course-To-Intercept



HT28-007--165

Figure 3.2-4b
EFIS Course-To-Intercept Presentation

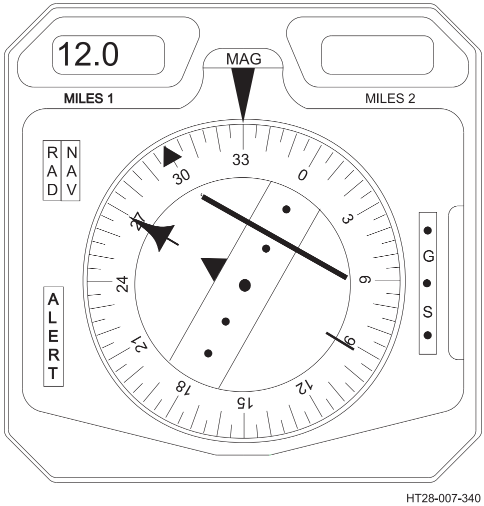


Figure 3.2-5
HSI Course-To-Intercept Presentation

Figure 3.2-5 shows crosstrack deviation indications provided to the 270º inbound course to LOA.

TABLE OF CONTENTS

3.3 CRUISE

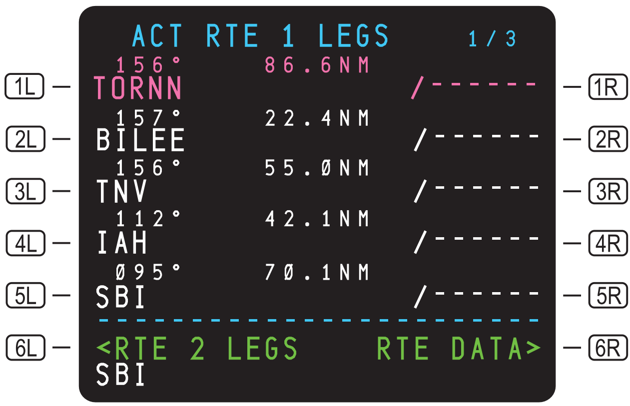
3.3.1 Route Modification

Route modification using Direct-To or Intercept Course functions are explained in Section 3.2.

3.3.1.1 Erasing an ACT RTE Leg

To remove a leg in an active route, downselect the waypoint below the unwanted leg or legs to the SP.

STEP: 5L. SBI drops to the SP.



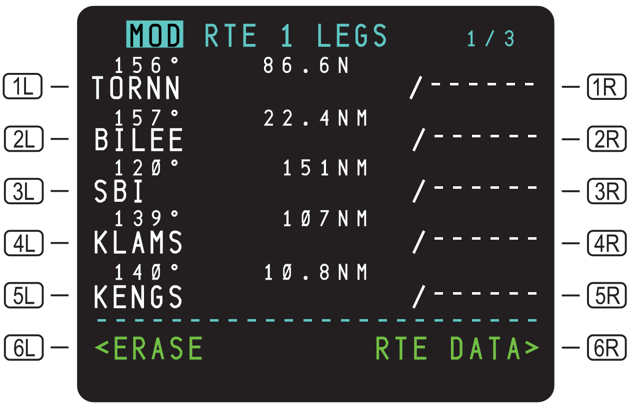
HT28-007-259

Figure 3.3-1
ACT RTE 1 LEGS Page – Erasing a Route Leg

STEPS:

A. 3L SBI replaces TNV and IAH.

B. EXEC to execute the modification.



HT28-007-260

Figure 3.3-2
MOD RTE 1 LEGS Page – Erasing a Route Leg

3.3.1.2 Route Discontinuity

A route discontinuity is created whenever there is no defined path between successive waypoints in a flight plan. Discontinuities may be created by waypoint deletion, addition, or procedure stringing.

The HT9100 does not automatically bridge discontinuities. Whenever the aircraft gets to a route discontinuity, the message DISCONTINUITY is displayed in the SP. If the autopilot is coupled to the HT9100, the aircraft will revert to HDG hold.

Discontinuities can be cleared by downselecting the next waypoint after the DISCONTINUITY into the SP. Then press the LSK next to the discontinuity (where box prompts are displayed), followed by the EXEC key, thus clearing the ROUTE DISCONTINUITY.

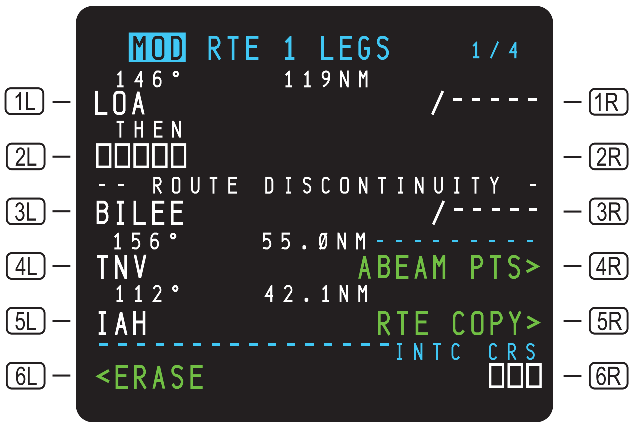
In the route to Cancun, a discontinuity is shown after the LOA waypoint. (See Figure 3.3-3.) Close the discontinuity by moving BILEE from 3L to 2L.

STEPS:

A. 3L BILEE drops to the SP.

B. 2L the discontinuity is eliminated.

C. Execute EXEC.



HT28-007-261

Figure 3.3-3
Route Discontinuity

3.3.1.3 Select Desired Waypoint Page

The SELECT DESIRED WPT page is automatically displayed when a waypoint is entered that exists at a number of different locations in the Navigation Data Base. The SELECT DESIRED WPT page is displayed to allow the pilot to select the desired navigation database fix. (See Figure 3.3-5.)

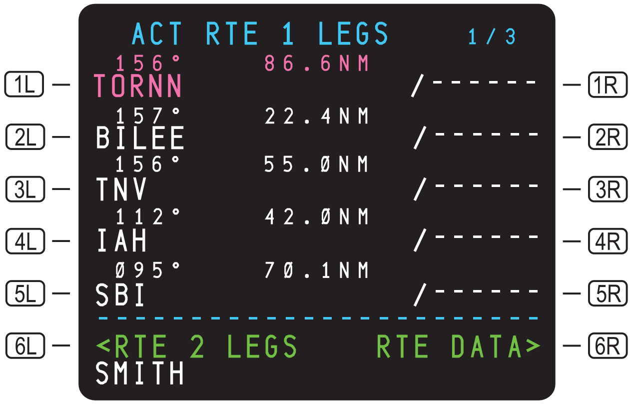
CAUTION

Care should be exercised before selecting the proper NAVAID from the SELECT DESIRED WPT page or list. The pilot should review the NAVAID type, LAT/LON, frequency, and country code and compare this data to the chart and the desired route to ensure proper waypoint selection.

STEPS:

A. Type SMITH into the SP.

B. ☞ 5L.



HT28-007-262

Figure 3.3-4
ACT RTE 1 LEGS Page – Insert a FIX in Line 5L

There are duplicate SMITH waypoints in the database. The SELECT DESIRED WAYPOINT page, described below, allows the pilot to choose the correct one (See Figure 3.3-5).

STEP: ☞ 1L to choose the correct fix.

HT28-007-263

Figure 3.3-5
SELECT DESIRED WPT Page

Displayed fixes are listed by increasing distance from the aircraft. Press the adjacent left or right line-select key to select the correct fix.

If more than six non-unique identifiers exist, the remaining fixes may be displayed using the NEXT key. Leaving the SELECT DESIRED WPT page before selecting a fix cancels the fix entry.

Identifier/Fix Type. The fix identifier, fix type, and location are all displayed in the title lines. Fix types may be any of the following:

APRT ADF DME VOR VORDME WPT

Frequency. 1L through 6L display frequencies for navaids.

Lines 1R through 6R display the positions of the fixes in LAT/LON.

When the pilot has chosen the correct fix, press the corresponding LSK. The display returns to ACT RTE 1 LEGS.

If a discontinuity exists, remove the discontinuity as described in Section 3.3.1.2 Route Discontinuity. (See Figure 3.3-3.)

3.3.1.4 Pilot-Defined Waypoints

Waypoints are specified as navigation database waypoints or pilot-defined waypoints. All pilot-defined waypoints are created and entered on the LEGS page.

Pilot-defined waypoints include the following:

- Place Bearing/Distance (PBD)
- Place Bearing/Place Bearing (PB/PB)
- Latitude/Longitude
- Along Track
- LAT/Long Crossing

Generally, waypoints are entered in the SP and moved to the desired location by pressing the appropriate LSK. If a waypoint entry is typed into the scratchpad with an invalid syntax and then line selected, the INVALID ENTRY message is displayed. If a waypoint entry identifier that is not in the navigation data base is line-selected, the message NOT IN DATABASE is displayed.

PBD and PB/PB. Waypoints entered as Place Bearing/Distance (PBD) are identified on the LEGS page by the first three characters of the entry followed by a two-digit sequence number. The sequence numbers define how many pilot-defined waypoints have been created since power up. The latitude and longitude of PBD waypoints can be identified by downselecting the waypoint into the SP, going to the REF NAV DATA page and line-selecting the waypoint to 1L.

The format for entering a PBD into the scratchpad is to define the reference waypoint, RADIAL (or bearing from), and distance.

Example: **PBD** SEA330/10 becomes SEA01

The format for entering PB/PB is to define the fix identifier for the first fix followed by the bearing from the fix. A slash is entered followed by the next fix identifier for the next fix followed by the bearing from that fix.

Example: **PB/PB** SEA330/OLM020 becomes SEA02

NOTE: PB/PB identifiers must be within 700 NM and the bearing from the fix may be entered to a tenth of a degree, if desired.

Latitude/Longitude. Waypoints entered as a latitude/longitude are displayed in a seven-character format. Latitude and longitude waypoints are entered with no space or slash between latitude and longitude. Leading zeroes for longitude must be entered (for example W095°). Latitude and longitude may be entered with resolution up to 0.01 minutes (one one-hundredth of a minute).

Example 1:

- N47° W008° would be entered as N47W008 and displayed as N47W008.

Example 2:

- N47°15.4" W008°3.4" would be entered as N4715.4W00803.4 and displayed as N47W008.

NOTE: For some EFIS configurations, latitude and longitude waypoints on the MCDU page are displayed as *LL01, *LL02, etc. on RTE 1 and *LL51, *LL52, etc. on RTE 2.

Along Track. Along-track waypoints are entered using the waypoint name followed by a slash (/) and minus (-) sign or no sign (no sign assumes a plus (+), or positive, distance ahead of the waypoint), then the mileage offset for the newly-defined waypoint. The created waypoint is then inserted over the original waypoint and will automatically be placed ahead of or behind the waypoint. Latitude and longitude waypoints cannot be used to create along-track waypoints. The leg length must be longer than the distance used for the along-track waypoint.

Example:

- ELN/25 would be 25 miles **after** ELN on the present route.
- ELN/-30 would be 30 miles **before** ELN on the present route.

NOTES:

1. On the LEGS page, these along-track waypoints would be inserted on top of ELN.
2. The naming convention of along-track waypoints is the same as PBD waypoints.
3. Downselecting an along-track waypoint into the scratchpad will display the place, bearing, and distance of the created along-track waypoint.

LAT/LON Crossing Points. LAT/LON crossing points are entered on the LEGS page, using the latitude or longitude in whole degrees. Longitude crossing point entries must be four characters and latitude crossing point entries must be three characters. A series of crossing points can be entered by adding a dash after the latitude or longitude followed by the increment chosen for the multiple waypoints. This entry must be made on the line prior to the first desired crossing point. If the crossing point is prior to the next fix, then entry should be made to line 1. Crossing points are entered on the existing flight plan route and do not add to or change the existing path.

Examples:

- N50 creates a fix named N50.
- N50-2 creates a series of fixes at two degree intervals named N50, N48... (if southbound towards destination) or N50, N52... (if northbound towards destination). Interval range for specifying number of degrees between fixes is 1-20.
- W070 creates a fix named W070.
- W070-2 creates a series of fixes at two-degree intervals named W070, W072 (if westbound towards destination) or W070, W068 (if eastbound towards destination). The interval range for specifying the number of degrees between fixes is 1-20.

NOTE: If a leading zero is left out of a LON fix (for example, W70) then the system will search the Navigation Data Base for a waypoint named W70. If it is not found, the message NOT IN DATABASE is displayed in the SP.

Entry of LAT/LON crossing points is allowed only in fields 1L through 5L on the RTE LEGS pages and in the TO fields on the RTE pages that contain a fix.

3.3.1.5 ABEAM PTS> and RTE COPY> Prompts

With an active route, any time a Direct-To is initiated on the RTE LEGS page an ABEAM PTS> and a RTE COPY> prompt will be displayed in 4R and 5R, respectively.

The Abeam Points function allows the pilot to retain reference points along a direct-to path. Flight plan waypoints on the active flight plan that are downpath of the aircraft and prior to the direct-to waypoint are projected onto the direct-to path abeam the original position. If the Abeam location is less than 100 NM of the original location, entered wind information is retained. However, any altitude or speed constraints are not retained for the created abeam points. Abeam waypoints are not generated if the abeam distance exceeds 700 NM (See Figure 3.3-6).

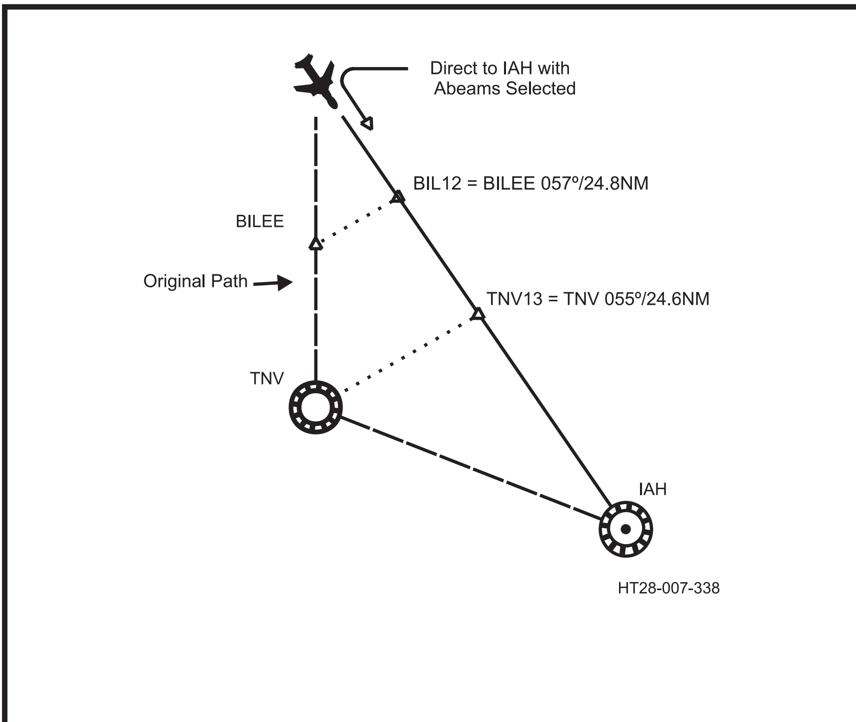


Figure 3.3-6
Abeam Points

Abeam points are inserted into the flight plan as follows:

- If the original fix is a database waypoint, NAVAID, NDB, or airport, a Place Bearing Distance naming convention (that is, DFW01) is used to name the abeam waypoint on the new direct-to path.
- If the original fix is a LAT/LON waypoint, then a LAT/LON naming convention is used (for example, N40W095) to name the abeam waypoint on the new direct-to path.
- If the original fix is a PBD, a PBD naming convention is used to name the abeam waypoint on the new direct-to path.
- If the original fix was a LAT/LON crossing point, the LAT/LON crossing point is recomputed so that it accurately marks the crossing of the LAT/LON. Therefore, LAT/LON crossing waypoints will not be brought over as abeam but rather readjusted on the new path to the actual LAT/LON crossing point.

Abeam waypoints cannot be generated under the following conventions:

- They cannot be generated from procedural waypoints (that is, waypoints that make up runways, departures, arrivals, approaches, and transitions).

  NOTE: There are two exceptions to this rule. Abeam points can be created from a fix terminating the last leg of any departure procedure in the route and from a fix terminating the leg immediately preceding the first leg of an arrival procedure in the route.

- Abeam points cannot be generated if it will cause a course reversal in the generated flight plan.
- Abeam points cannot be generated from waypoints on the original track that do not have a defined latitude/longitude position (for example, conditional waypoints and legs that terminate with an INTC).

In the illustrations, the clearance is via TORNN direct to IAH. (See Figure 3.3-6.) The pilot decides to retain BILEE and TNV, the two waypoints in between.

STEPS:

A. Select IAH from the ACT RTE 1 LEGS page to the 1L position.

B. ☞ 4R, the ABEAM PTS> prompt (it changes to ABEAM POINTS SELECTED).

C. ☞ the EXEC key.

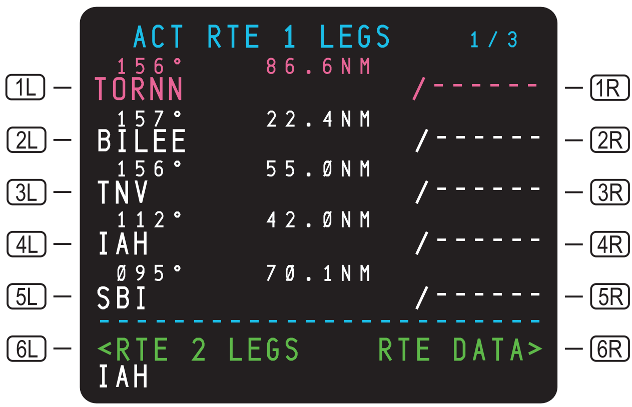
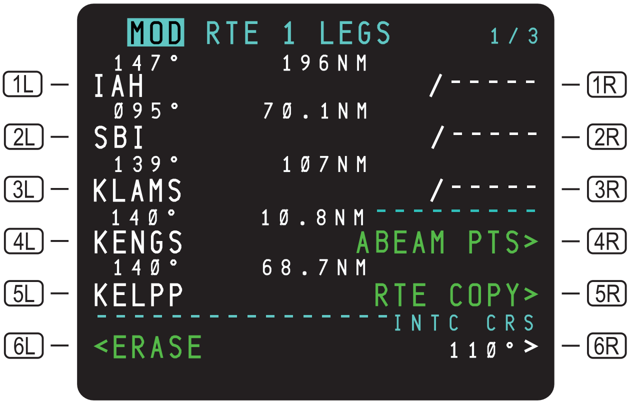


Figure 3.3-7
ACT RTE 1 LEGS Page

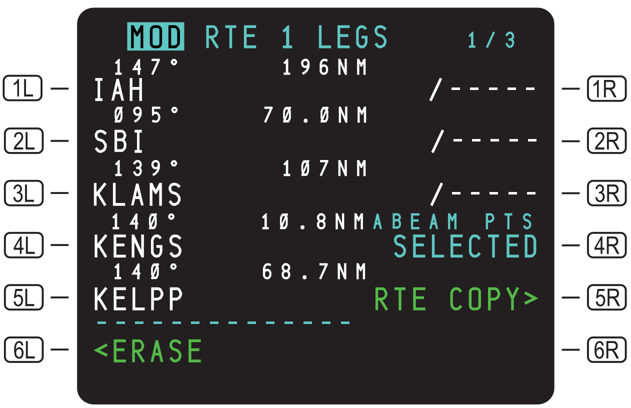
The figures show the sequence of page displays as the Direct -To with ABEAM PTS selected. Any winds entered at the original waypoint positions will be carried along when the new "on course" points are constructed, as long as the lateral distance moved is not greater than 100 miles.

NOTE: If an intercept course (6R INTC CRS) is entered after setting up a Direct-To, the ABEAM PTS> prompt will be blanked out.



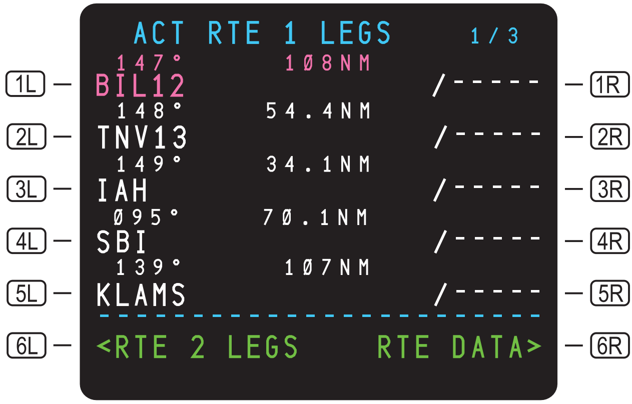
HT28-007-269

Figure 3.3-8
RTE MOD LEGS Page – ABEAM Points and RTE Copy Prompts



HT28-007-270

Figure 3.3-9
MOD RTE LEGS Page – ABEAM Points Selected



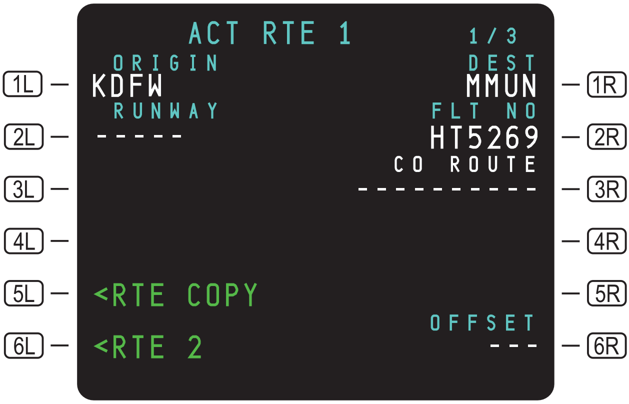
HT28-007-271

Figure 3.3-10
New ABEAM Points
(BIL12 and TNV13 in 1L and 2L)

If the RTE COPY> prompt is selected prior to pressing the ABEAM PTS> prompt, the original route (as it was before abeam selection) is retained in the secondary (RTE 2) route. It is then available for recall should it become necessary. The RTE COPY> prompt should be selected prior to activation and execution of a Direct-To. RTE COPY saves the original route (as it was before performing the Direct-To) and retains it in the inactive route.

3.3.1.6 OFFSET

The pilot may establish a parallel lateral path offset to the left or right of the original flight path. The activation of a lateral offset can be accomplished only on the active leg. Valid offsets are distances of 1 to 99 NM left or right of course. Entries are made at the OFFSET prompt located at **6R** on any ACT RTE page when the aircraft is airborne (See Figure 3.3-11).



HT28-007-272

Figure 3.3-11
OFFSET Function - ACT RTE 1 Page

The pilot may initiate, change, or cancel the offset using the offset function on the ACT RTE page. When offset is executed and becomes the active path, the aircraft leaves the original path and captures the offset route.

Offset entry is allowed only when the aircraft is airborne and not active in the selected SID procedure or SID transition. The offset entry propagates through the remaining route up to the end of the route waypoint, a discontinuity, the start of a published STAR or approach transition or approach procedure, a DME arc, a heading leg, a holding pattern, or a course change of 45 degrees or greater. Thirty seconds before an offset is automatically cancelled, END OF OFFSET will be displayed. The aircraft then will turn to intercept the initial route with a 45° course and will resume the initial flight plan 45 seconds prior to sequencing the end of that leg.

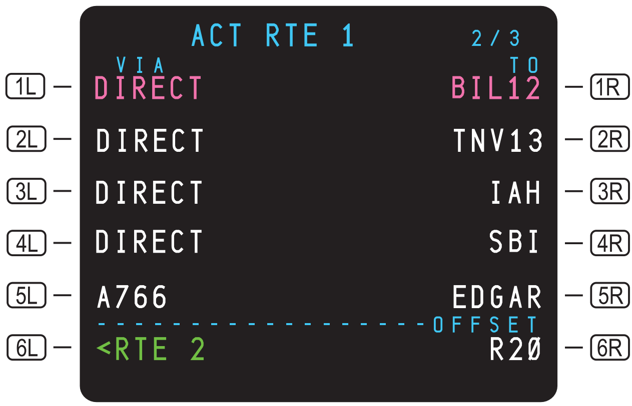
A valid entry first includes the direction, either left (L) or right (R) of the active route, followed by the NM offset. The flight scenario illustrates an offset of 20 NM to the right of the original path in Figure 3.3-12.

STEPS:

A. Type R20 in SP.

B. 6R at OFFSET.

C. EXEC.



HT28-007-273

Figure 3.3-12
ACT RTE 1 Page OFFSET – R20

An active offset is cancelled by selecting DELETE to 6R.

STEPS:

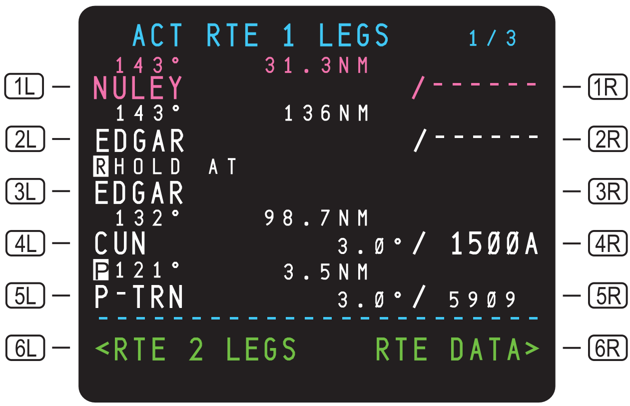
A. CLR.

B. 6R.

C. EXEC.

3.3.2 ACTIVE RTE LEGS Pages

The RTE LEGS pages display a consecutive listing of flight plan waypoints and pertinent information about each waypoint on the route. The active waypoint is colored MAGENTA. The ACT RTE LEGS page is displayed when the LEGS key is pressed and an active route exists.



HT28-007-274

Figure 3.3-13
ACT RTE 1 LEGS Page

The active waypoint displayed in Figure 3.3-13 is NULEY. The computed Distance-To-Go (DTG) to NULEY is displayed in the center field and indicates 31.3 NM. Distance-To-Go is dynamic and will countdown as the aircraft moves towards the waypoint. The DTG to each waypoint is displayed in whole numbers when it is 100 NM or greater and it shows tenths of a mile below 100 NM.

As the aircraft sequences NULEY, the ACT RTE LEGS display-set moves upward, deleting the waypoint that has been passed (NULEY), and displays the next active waypoint (EDGAR) in magenta at the top of the page.

On the LEGS pages, the calculated path for the aircraft precedes each waypoint that is listed. For instance, preceding EDGAR is the course 143°, indicating the course direction (path) for the aircraft.

NOTE: See Appendix B for LEGS Page definitions and display characteristics.

The following refer to Figure 3.3-13.

1L **NULEY** – This is the waypoint toward which the HT9100 is providing navigation guidance (ACTIVE WPT).

3L L or R – If the flight plan leg is part of a terminal area procedure (SID/STAR or approach) or holding pattern and the procedure calls for a turn, the turn direction at the waypoint is specified. If a turn procedure is not specified, no turn direction is displayed.

NOTE: In case of a pilot-defined holding pattern, the L - R symbology will reflect the turn direction as entered by the crew, regardless of the turn direction specified on the chart. (The default setting is a right turn.)

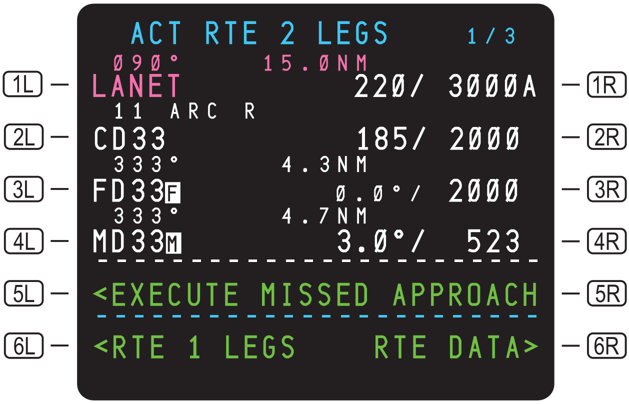
6L **<RTE 2 LEGS** – Returns the display to the LEGS page of the inactive route 2.

2R Indicates that no vertical flight path or constraint is associated with waypoint EDGAR.

4R **VERTICAL FLIGHT PATH ANGLE/ALTITUDE, CONSTRAINT** Displays the vertical flight path angle of 3.0 degrees and a data base-coded constraint (LARGE font in white) of 1500A, which indicates cross waypoint CUN at or above 1500 feet.

5R **VERTICAL FLIGHT PATH ANGLE/PREDICTED CROSSING ALTITUDE** – Displays the vertical flight path angle of 3.0 degrees and a system-computed crossing altitude (SMALL font displayed in white) of 5909 feet for the procedure turn leg. This indicates that the aircraft will cross the procedure turn leg at 5909 feet.

6R **RTE DATA>** – Displays the RTE DATA page.



HT28-007-275

Figure 3.3-14
ACT RTE 2 LEGS

(1R) **SPEED CONSTRAINT/ALTITUDE CONSTRAINT** – Displays a speed constraint to cross waypoint LANET at 220 KTs CAS at or above 3000 feet. LARGE font in white for both of these constraints indicates that they are derived from a data base procedure.

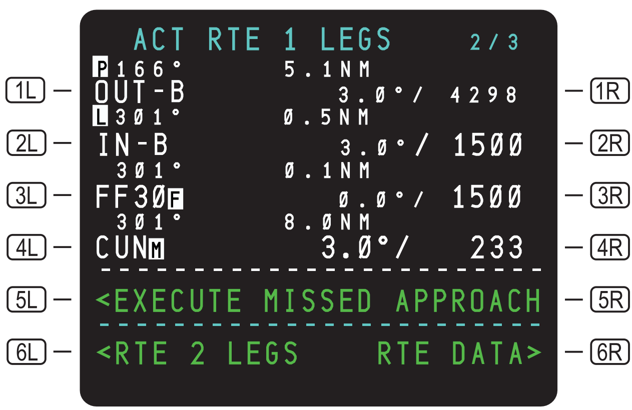
Altitude constraints on the LEGS page are either AT or ABOVE, AT or BELOW, AT, or WINDOW constraint altitudes. If the altitude constraints are pilot-entered, they are displayed in LARGE font in CYAN. If the altitude constraints are supplied by the navigation data base procedure, the altitudes are displayed in LARGE font in WHITE. System predicted altitudes are displayed in SMALL font in WHITE. These calculated altitudes can be overridden by the pilot and defined as ABOVE, AT or BELOW, or WINDOW constraint altitudes.

If the altitude is an AT or ABOVE altitude then it is displayed as 14000A. If the altitude is an AT or BELOW constraint then it is displayed as 14000B. If it is a WINDOW constraint then it is displayed as 13000B 10000A. Above the transition altitude FL will precede the altitude values.

Flight path angles are generated by the system or extracted from the NDB and are a function of the geometric descent path that is drawn to meet the altitude constraints. FPA angles in LARGE font are NAV database angles.

NOTES:
1. If an altitude entry has been modified by the pilot (adding, deleting, or changing an entry) and the entry is different from the initial flight plan entry, the value will be displayed in CYAN.
2. If a NAV data base flight path angle must be increased to adhere with a procedure specified altitude constraint, the changed FPA angle will be displayed in SMALL font CYAN.

When an approach procedure is appended to the route, the final approach fix (FAF) and the missed approach point (MAP) will be positively identified on the LEGS page. A F will be displayed adjacent to the waypoint identifying the final approach fix. Likewise, an M will be displayed adjacent to the waypoint identifying the missed approach point. Both the F and the M will be shown in reverse video and in the same color as the waypoint. See Figure 3.3-15.



HT28-007-276

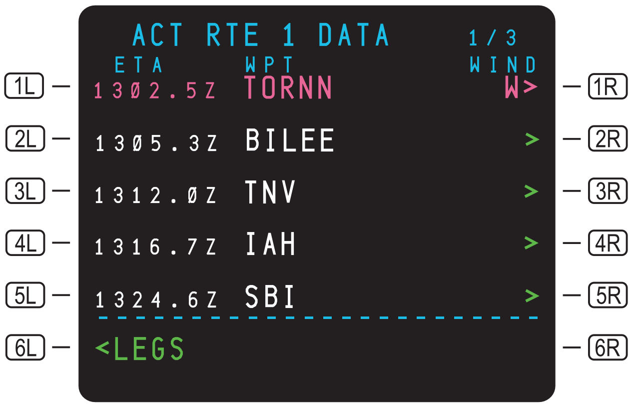
Figure 3.3-15
Missed Approach Point and Final Approach Fix Identified

3.3.2.1 RTE DATA

The ACT RTE DATA page can be selected through the RTE DATA> prompt on line (6R) of any ACT LEGS page. (Figure 3.3-15.) The ROUTE DATA page displays data for each waypoint on the ACT RTE 1 LEGS page.

The RTE DATA page displays Estimated Time of Arrival (ETA) when airborne or Estimated Time En route (ETE) on the ground and provides access to each waypoint WIND page. Data entry on the RTE DATA page is not possible.

STEP: ☞ (6R) (RTE DATA) on ACT RTE 1 LEGS Page.



HT28-007-277

Figure 3.3-16
ACT RTE 1 DATA Page

(1L) **ETA** – Displays the HT9100-calculated waypoint ETA. When on the ground, this changes to ETE.

(6L) **<LEGS** – This LSK, when pressed, returns to the ACT RTE 1 LEGS page.

1C **WPT** – Displays the identifier for the waypoint from the LEGS page. Waypoints are listed in the same sequence as found on the LEGS page.

1R **W>** – Displays the WIND page for the selected waypoint. W indicates that wind data has been entered for the waypoint. A chevron (>) without a W indicates that no wind data is entered for that waypoint or that winds have been carried forward to that waypoint by propagation.

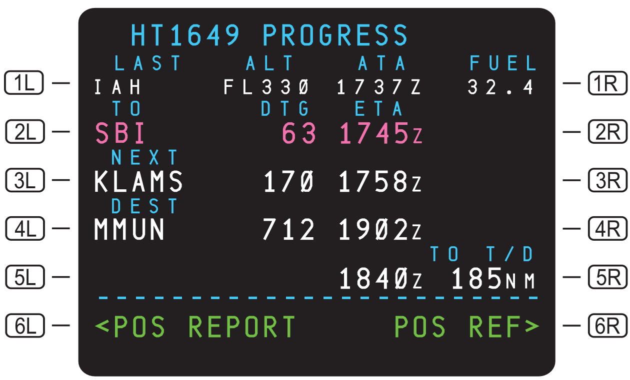
For wind input procedures, refer to Section 3.1.7 WIND INPUT.

3.3.3 PROGRESS Pages

PROGRESS pages 1/2 and 2/2 display information relative to the progress of the flight. The pages are accessed by the PROG function key.

3.3.3.1 Progress Page 1/2

STEP: PROG.



HT28-007-046

Figure 3.3-17
PROGRESS Page 1/2

1L Displays the last waypoint crossed, altitude, time, and fuel at that point.

2L **TO** – Displays the active waypoint identifier (in MAGENTA), distance-to-go (DTG), and ETA at the active waypoint. The DTG is the direct distance from the aircraft current position to the active waypoint.

3L **NEXT** – Displays the waypoint identifier, distance-to-go, and ETA. The DTG is the distance along the flight path from the aircraft to the next waypoint.

4L **DEST** – Displays the destination ICAO identifier. DTG and ETA are measured along the flight plan route. If another waypoint, NAVAID or airport is inserted into this field the distance and ETA are measured directly to that point. If a flight plan waypoint is entered into 4L, ENROUTE WPT is displayed in the label line above 4L. If the waypoint is not in the flight plan, the DIR TO ALTERNATE is displayed in the label line above 4L. To return the destination to the original destination, line-select delete up to 4L.

6L **<POS REPORT** – Displays the POS REPORT page. (See Figure 3.3-19.)

5R **TO T/C (Top-of-climb)** – Top-of-climb is calculated based on the PERF INIT cruise altitude and the climb angle on the ground. In the air, T/C is based on current ground speed and vertical speed as the aircraft flies toward its cruise altitude. (This feature is available only in software version -005F and later.)

5R **TO T/D (Top-of-descent)** – If the system is configured for VNAV and the flight plan contains a valid descent path (see Section 3.4), the T/D is based on the first AT constraint in front of the aircraft. If not, T/D is based on cruise altitude, the descent angle, and the end-of-descent point. In this case, T/D will be adjusted for head and tail winds. The T/D is displayed within 200 NM of the destination.

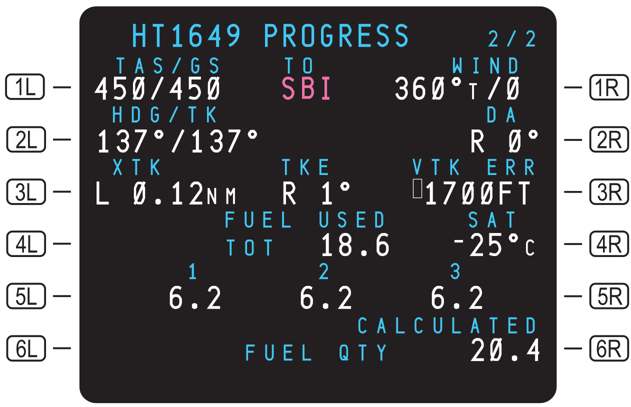
Top-of-climb and Top-of-descent are used to compute ETAs.

6R **POS REF>** – Displays the POS REF page.

3.3.3.2 Progress Page 2/2

PROGRESS Page 2/2 contains measured wind information, lateral and vertical tracking errors, TAS, GS, static air temperature, and fuel information.

STEP: ☞ NEXT from PROG page 1/2.



HT28-007-128

Figure 3.3-18
PROGRESS Page 2/2

1L **TAS/GS** – Current True Air Speed/Ground Speed are displayed in **1L**. TAS is MAGENTA if manually keyed and is YELLOW if failed.

1C **TO** – Displays active waypoint in MAGENTA.

1R **WIND** – Displays the current measured wind direction in degrees TRUE, and the velocity in knots.

2L **HDG/TK** – Heading and Track are displayed in **2L**. HDG is MAGENTA if manually keyed and is YELLOW if failed.

2R **DA** (Drift Angle) – The angle between the aircraft heading and the intended track.

3L **XTK** – Crosstrack Error – The distance in nautical miles the aircraft is left or right of the intended track.

3C **TKE** – Track Angle Error – The angle the aircraft is either diverging from or converging toward the intended track.

(3R) **VTK ERR** – This information is displayed if the system is configured for VNAV and the aircraft is past the T/D of a valid VNAV descent. The VTK Error displays in feet the distance the aircraft is above or below the vertical path. The display is active in the descent phase only. Above path deviations are indicated with a "+" (plus) sign and below path deviations are indicated with a "-" (minus) sign.

(4L) **FUEL USED** – The total fuel used by all engines in operation.

(4R) **SAT** – Static Air Temperature in degrees centigrade (if available).

(5L) **FUEL USED** – Total fuel used by each operating

(5R) engine numbered from left to right across the aircraft.

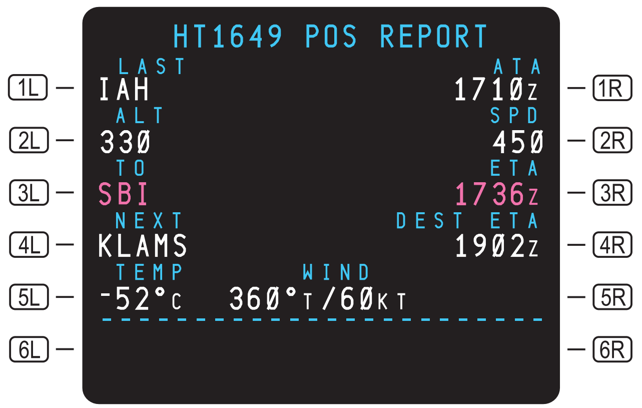
(6R) **CALCULATED FUEL QTY** – The fuel as calculated from takeoff minus fuel used to that point in the flight.

3.3.4 Position Report

This page displays speed, altitude, and ATA for the LAST position (displayed in 1L) and ETAs for the TO and the destination. Current temperature, measured winds and the next waypoint are also displayed.

Access to the POS REPORT page is from PROGRESS page 1.

STEP: 6L on PROGRESS page 1.



HT28-007-048

Figure 3.3-19
POS REPORT Page

Other flight plan waypoints from the active route can be entered at 4L to display their ETAs at 4R. To return 4L to its default waypoint, line-select delete to 4L.

3.3.5 Holding Patterns

This section describes holding pattern creation, modification, and guidance.

3.3.5.1 ACT RTE 1 – HOLD Page

The ACT RTE 1 – HOLD page provides a means of initiating a holding pattern contained in the route, at the aircraft's current position or any other desired point. To access this page, press the HOLD function key. Figure 3.3-21 will be displayed. When the HOLD key is pressed and the desired hold waypoint is downselected and entered in the boxes at 6L, a page allowing definition of the hold is displayed. (See Figure 3.3-20.) The following steps indicate how to define a holding pattern.

STEP: ☞ HOLD and downselect the desired holding waypoint into the boxes at 6L.

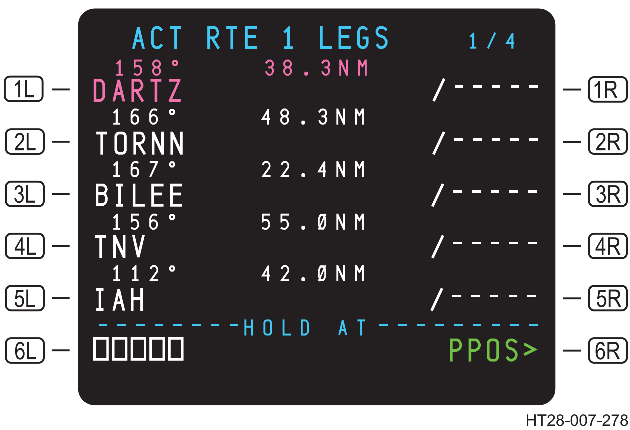


Figure 3.3-20
ACT RTE 1 LEGS Page – HOLD AT

6L **HOLD AT** – The HOLD AT line permits entry of a flight plan, waypoint or any other Navigation Data Base or pilot-defined holding fix. The waypoints displayed in Figure 3.3-20 can be downselected to the SP, then entered at 6L. For example: TNV (Figure 3.3-21) has been selected as the desired holding fix.

An off-route waypoint IDENT that is not in the flight plan may be entered in the scratchpad. Since the system does not know where to insert the hold in this case, HOLD AT XXX appears in the scratchpad.

The pilot then selects the insertion point in the flight plan by pressing the appropriate line-select key on the LEGS page.

6R **PPOS>** – Selecting the Present Position (PPOS) prompt creates a holding pattern at the time EXEC is pressed.

NOTES:
1. Selecting the PPOS HOLD while on an offset path deletes the offset path. The crew must define a path back to the original route.
2. A PPOS hold will create a discontinuity.

The RTE HOLD page (Figure 3.3-21) is used to review and change data associated with the holding patterns contained in the route. The pilot can display and change the holding pattern or exit from an active holding pattern.

1L **FIX** – Displays the holding fix.

2L **QUAD/RADIAL** – Displays the Quadrant and Radial (QUAD/ RADIAL) and permits entry of an assigned holding radial that causes 3L to reflect the reciprocal Inbound Course.

3L **INBD CRS/DIR** – Displays the Inbound Course and Turn Direction (INBD CRS/DIR). The INBD CRS/DIR are entered through the keyboard. Valid entries for the course are three-digit bearings optionally followed by L for left turn and R for right turn. L or R will also be displayed next to the hold fix on the ACT LEGS page.

NOTE: Default value in 3L is the present Inbound Course to the holding fix with standard right turns.

4L **LEG TIME** – The length of the inbound leg of the pattern defaults to elapsed time instead of leg distance. It displays 1.0 minute at or below 14,000 feet and 1.5 minutes above 14,000 feet. This time can be changed by pilot-entry.

5L **LEG DIST** – Displays dashes unless the pilot makes a keyboard entry for leg distance, in which case LEG TIME 4L is deleted.

6L **<u><ERASE</u>** – <ERASE is displayed only on the MOD RTE HOLD page. Selecting it deletes any pending modifications, and returns the display to the RTE LEGS page if the holding fix is deleted as a consequence.

1R **<u>FIX BRG/DIST</u>** – Displays the continuously updated bearing and distance from the aircraft to the hold Fix.

2R **<u>FIX ETA</u>** – The FIX ETA line displays the estimated time to the holding pattern fix point. This information is updated each time the fix point is crossed.

3R **<u>EFC TIME</u>** – The Expect Further Clearance (EFC) Time allows a pilot to enter the time further clearance can be expected. It is for reference only and has no effect on hold parameters.

5R **<u>ENTRY</u>** – Displays the type of entry the system will use during entry to the hold.

<u>STEP</u>: EXEC.

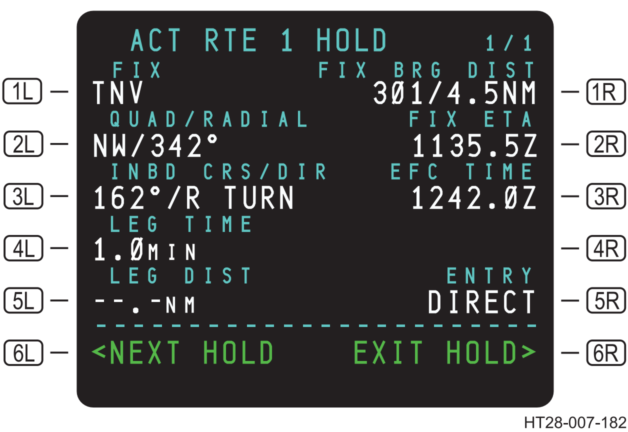


Figure 3.3-21
ACT RTE 1 HOLD Page

Figure 3.3-21 displays the ACT RTE 1 HOLD for TNV in the flight scenario.

6L **<NEXT HOLD** – Selecting the <NEXT HOLD prompt displays another ACT RTE 1 LEGS – HOLD page where an additional downpath hold can be programmed.

6R **EXIT HOLD>** – Displayed if the hold leg is the active leg.

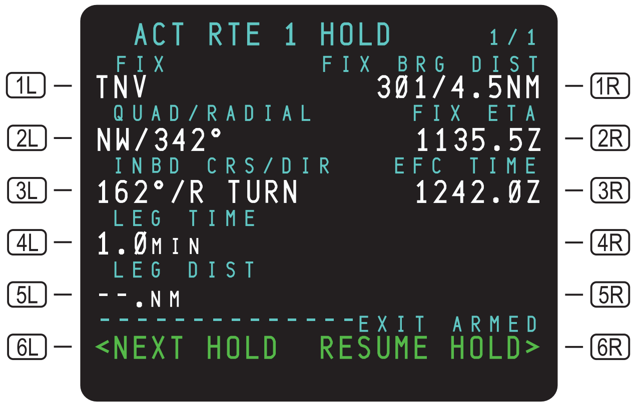
Selection of the EXIT HOLD> at 6R causes EXIT ARMED to be displayed as shown in Figure 3.3-22. When the EXEC key is pressed, the aircraft will continue in the holding pattern until it next reaches the holding fix; then it will exit the hold. A scratchpad message EXIT HOLD ARMED will be issued one minute prior to reaching the hold fix. RESUME (hold) may be selected at any time to cancel exit armed. An exit armed in 6R will be replaced with NO EXIT DISCONTINUITY when Exit Armed is not available. Exit Hold will not arm if a route discontinuity exists directly after the hold on the flight plan route. To arm the Exit Hold the crew must remove the discontinuity, or perform a DIRECT TO to the next waypoint on the flight plan.

NOTES:
1. If an NDB procedure adds a holding pattern as part of the approach procedure, the hold may be exited automatically. A message EXIT HOLD ARMED will be displayed in the scratchpad one minute prior to exiting the hold fix, in all cases. The pilot may select the HOLD page and select the RESUME HOLD> prompt if required to proceed for another circuit.
2. Some departures will have a hold-to-altitude built into the SID. Once the aircraft reaches the predefined altitude, it will automatically exit the hold. Therefore, the crew should monitor the exit status on the RTE HOLD page.
3. If there is a discontinuity after the hold, the EXIT HOLD> prompt will be replaced by a NO-EXIT - DISCONTINUITY indication until the discontinuity is removed.
4. When a hold is executed, it creates a hold fix on the LEGS page. The hold fix on the LEGS page can be deleted without creating a discontinuity.

STEPS:

A. 6R.

B. EXEC.



HT28-007-051

Figure 3.3-22
ACT RTE 1 HOLD Page – EXIT ARMED

6R **RESUME HOLD >** – Displayed if EXIT ARMED> has been selected.

Selecting RESUME HOLD >at 6R before crossing the hold fix causes the aircraft to continue in the previously selected holding pattern.

CAUTION

Ensure that the holding pattern conforms to ATC requirements. The HT9100 does not automatically generate holding patterns as published on the navigation chart unless the holding pattern is part of an approach or missed approach procedure.

3.3.5.2 Holding Pattern Guidance

When the holding pattern is created by the pilot, the system builds the geometry of the hold using the current aircraft groundspeed with the configured autopilot bank limits. If the geometry of the hold exceeds the holding airspace requirements, the system will restrict the size of the hold and annunciate the HIGH HOLDING SPEED message approaching the hold fix (indicating that the system will not be able to fly the restricted holding pattern due to the configuration roll limits and current aircraft speed). The size of the holding pattern is frozen while the aircraft is in the holding pattern and is not adjusted until the aircraft is next flown over the hold fix. When the aircraft next crosses the holding fix, another snapshot of the aircraft's groundspeed is taken and the holding pattern is resized if necessary.

NOTE: Pilots must adhere to the maximum allowable holding speed or less for holding patterns, since the HT9100 computes pattern size based on the speed at the initial crossing of the hold fix.

3.3.5.3 MOD HOLD PENDING

A MOD HOLD PENDING message will be displayed in the scratchpad to alert the crew that a pending modification has not been executed prior to reaching the hold fix point.

The message will be displayed in the following situations:

1. Prior to entering a hold, a MOD HOLD is created but not executed and the aircraft is approaching the hold fix point.
2. After a hold has been entered, and a MOD HOLD has been executed, a second MOD HOLD has been created but not executed, and the aircraft is approaching the hold fix point.

If the MOD HOLD is not executed, the aircraft will continue to fly the currently defined route or hold. If the MOD HOLD is executed prior to the fix point, the aircraft will transition to the new hold at the fix point. If the MOD HOLD is executed after the fix point, the aircraft will transition to the new hold after again passing the fix point.

CAUTION

If the MOD is to be executed after the hold fix point, the crew should ensure that the aircraft will stay in the holding airspace prior to executing the MOD or the pilot should erase the MOD and redefine the hold.

TABLE OF CONTENTS

3.4 DESCENT

The HT1000 VNAV descent function displays descent path deviation to the crew in the descent phase-of-flight. The VNAV function does not provide autopilot coupling via pitch steering commands.

The VNAV function creates a fixed geometric path that is independent of winds and aircraft performance. The path construction begins at the End-of-Descent (E/D) and builds backward to the Top-of-Descent (T/D) point. As the path builds backward towards the T/D from the E/D point, the path will comply with all altitude constraints. There is no minimum or maximum slope for the descent path. The crew can use the DESCENT page to evaluate the ability of the aircraft to maintain descent path. More detail on path construction is provided in Section 3.4.1.

VNAV data and path deviation indications are provided to the crew on the DESCENT page, LEGS page, and PROGRESS 2/2 page. Depending on aircraft installation, analog path deviations also can be shown on the HSI and ADI.

3.4.1 Descent Path Construction

In order for the HT1000 to build a descent path the following conditions must be met:

1. The system must be enabled for VNAV on the configuration pages.
2. The flight plan must contain a destination airport.
3. The flight plan must contain at least one AT constraint in the descent phase.
4. A cruise altitude must be entered on the PERF INIT page.

The HT1000 builds the descent path backward from the end-of-descent point (E/D) to the top-of-descent (T/D). (See Figure 3.4-1.)

The system will comply with all constraints. If it cannot, the descent path will be set invalid.

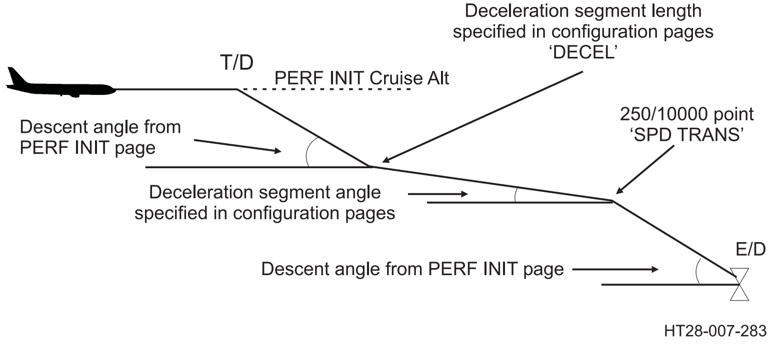


Figure 3.4-1
Descent Path with Deceleration Segment

3.4.1.1 Deceleration Segment

The HT1000 constructs a deceleration segment (see Figure 3.4-2) to the Speed Transition point (250/10000 in the US), using data entered on the PERF INIT page. The range of settings for building a deceleration segment distance is 0 - 50 NM. Entering zero eliminates a deceleration segment from the flight plan. If the crew enters an altitude constraint above the deceleration segment, the deceleration segment will be deleted from the vertical path. The angle and distance for the deceleration segment are defined in the configuration pages. The slope of the descent segment ranges from 0° to 9°. This range is set by the airline and is not to be set by the flight crew.

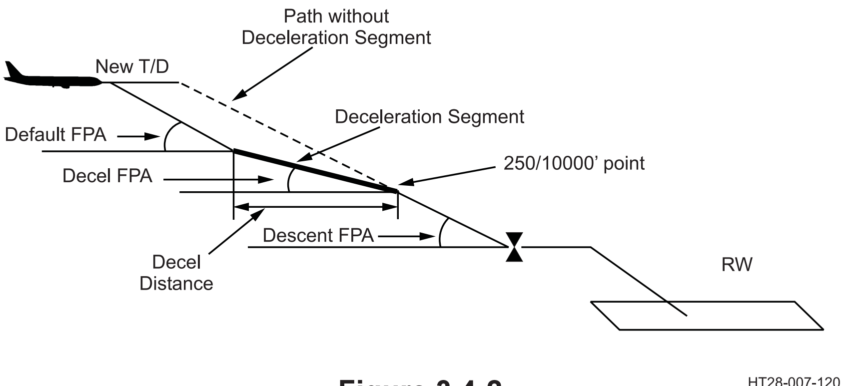


Figure 3.4-2
Descent Path and Deceleration Segment

3.4.1.2 Descent Path Construction

Flight Plan Discontinuities – As the aircraft sequences into the discontinuity, Vertical Deviation indications are blanked and set invalid.

Procedure Turns –When a procedure turn is inserted into the flight plan, the distance around the procedure turn is used in the descent path calculation.

Lateral Offset – Vertical Deviation is blank when lateral offset is entered.

Holding Patterns

Manual (Pilot-Entered) Holds — The distance around the holding pattern is not counted in the descent path (it is not used to calculate DTG). Vertical Deviation from the descent path is blanked.

NAV Database Holds — When a holding pattern is part of a NAV data base procedure, the distance around the holding pattern is used in the descent path calculation, and Vertical Deviation is displayed.

3.4.2 Display of VNAV Data (Summary)

LEGS PAGE – Displays descent path angles, waypoint crossing altitudes and speed constraints from the NDB.

PROGRESS Page 1 (See Figure 3.4-4) – This page displays T/D, DTG, and ETA.

PROGRESS Page 2 (See Figure 3.4-5) – This page displays the numerical vertical deviation data and T/D DTG/ETA.

DESCENT page (See Figure 3.4-6) – includes:

- Active vertical constraint
- Next vertical constraint
- End-of-Descent constraint
- T/D Information and DTG to T/D
- Aircraft Current Flight Path Angle
- Vertical bearing to the active vertical constraint
- Aircraft current Vertical Speed
- Required Vertical Speed to fly the descent path
- Long/short path distance information
- Numerical vertical deviation from descent path

VNAV scratchpad messages (See Section 3.4.6) – These include: VERTICAL TRACK CHANGE ALERT, DESCENT PATH DELETED, END-OF-DESCENT, ACT DESCENT PATH INVALID, CONFIGS DIFFER - NO VNAV, and VNAV PATH NOT RECEIVED.

DESCENT PATH DEVIATION DISPLAY – Depending on aircraft installation, this can be displayed on glideslope scale on the electromechanical HSI and/or ADI or drawn as a vertical scale in an EFIS-equipped aircraft. The scale becomes active when the aircraft is 30 seconds from T/D.

> NOTE: Vertical deviation will be invalid when flying through a discontinuity, flying an offset route, or flying a pilot-entered holding pattern. Vertical deviation is also invalid when flying past the FAF of a selected precision approach.

VERTICAL DEVIATION SCALING — The en route scaling of the vertical deviation indicator can be modified by maintenance personnel. The range can be modified from 500 to 4000 feet. Full scale deflection varies, depending upon the phase-of-flight. In en route RNP (2 NM), full scale deflection represents 500 feet. In terminal RNP (1 NM), full scale deflection represents 500 feet. In approach RNP (0.3 NM), full scale deflection represents 150 feet.

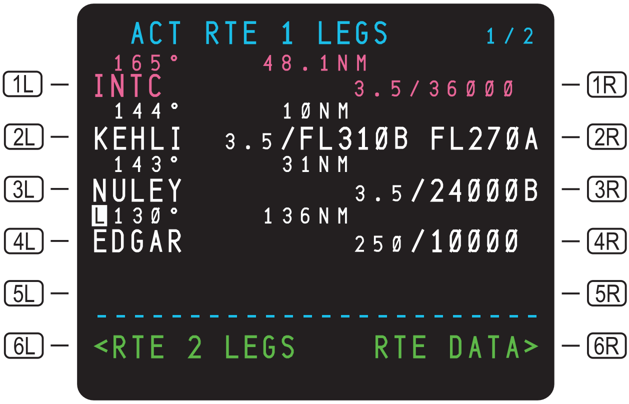
NOTES:

1. The HT1000 will output Vertical Deviation if:
   a. The VDEV ON/OFF prompt at 6R on the DESCENT page is ON. (See Figure 3.4-6a.) ON is the default setting.
   b. CRZ ALT is set on the PERF INIT page.
   c. One constraint is in the descent flight plan.
   d. There is a valid BARO ALT set.
2. When VDEV is selected to OFF (line-select key 6R on DESCENT page), VNAV descent path deviation data outputs will be set invalid. The flight complete logic will reset VDEV to ON.
3. Display of vertical deviation is invalid when flying through a discontinuity, flying an offset route, or flying a pilot-entered holding pattern. Vertical deviation is also invalid when flying past the MAP of an approach.

FLAGS – A flag on the vertical deviation scale will be displayed when indicating a failure. This can occur with a BARO ALT FAIL or UNABLE RNP message.

FLIGHT DIRECTOR — The HT1000 provides no information to the flight director in the vertical axis.

3.4.3 ACT RTE LEGS Page (VNAV Information)



HT28-007-281

Figure 3.4-3
Altitude Constraints and Descent Path Angles

VNAV information is presented on the LEGS pages. The displayed altitude may be either an altitude constraint (AT, AT or ABOVE, AT or BELOW or a window constraint) or a predicted altitude computed by the system along the descent profile at the waypoint. Altitude constraints are displayed in LARGE font. Predicted altitudes along the descent profile computed by the system are displayed in SMALL font (see Figure 3.4-3, LSKs 1R to 4R). The LEGS page also displays the descent path angle for the descent profile of each descent leg.

ALTITUDES

An altitude constraint may come from the navigation data base as part of a selected procedure or it may have been entered by the crew. Pilot entries will override a navigation data base constraint; pilot entries are not allowed on FAFs and MAPs. Altitude constraints can be modified by the crew except for the FAF/MAP and any waypoint in between. When an altitude is entered by the crew, the value is displayed in CYAN.

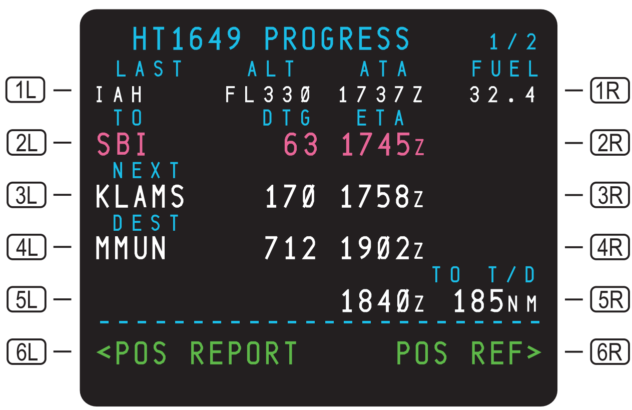
If the altitude is an AT or ABOVE altitude then it is displayed as 14000A. If the altitude is an AT or BELOW constraint then it is displayed as 14000B. If it is a WINDOW constraint then it is displayed as 13000B/10000A. If the altitude is an "at" constraint, it will be displayed as 14000. Above the transition altitude, information will be presented as flight levels.

ANGLE OR SPEED

The system displays speed constraint information or a descent path angle if a speed constraint is from the data base. The descent path angle normally is displayed and is the descent angle computed between two vertical constraints, the default path angle is specified by the navigation data base. When the descent angle is specified by a procedure (MAP, FAF, FACF), the value will be displayed in LARGE font, otherwise it will be displayed in SMALL font. If a procedure-specified angle must be changed by the system to meet an altitude constraint, it is presented in CYAN, otherwise it is presented in WHITE. A speed constraint is displayed when it is a part of a selected procedure. Speed constraint information is advisory and does not affect descent path construction.

3.4.4 PROGRESS Page (VNAV Information)

The PROGRESS page displays two fields relevant to VNAV operations. These are T/D and Vertical Track Error (VTK ERR).



HT28-007-046

Figure 3.4-4
PROGRESS Page 1/2

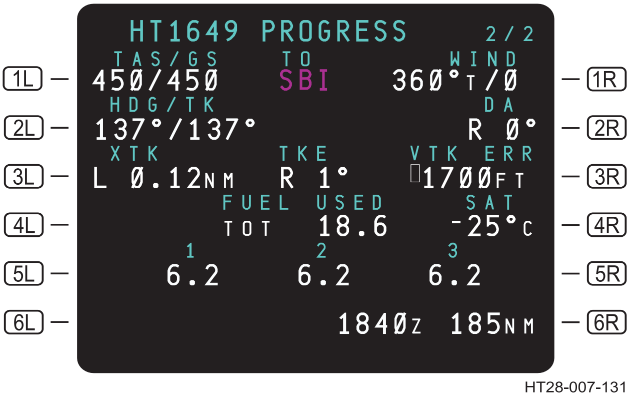


Figure 3.4-5
PROGRESS Page 2/2

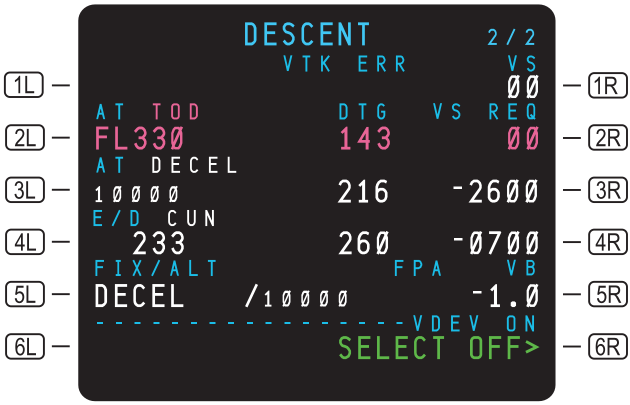
3R **VTK ERR** – On PROGRESS Page 2/2, vertical track error is reported. Vertical error is reported in feet with a "+" (plus) sign to indicate above path or a "-" (minus) sign to indicate below path. The vertical track error is displayed whenever the aircraft is in the active descent mode. (See Figure 3.4-5.)

TO T/D– If the system is configured for VNAV and the flight plan contains a valid descent path, the T/D is based on that descent path and shown on PROGRESS Page 1/2.

If the system is not configured for VNAV, the T/D is based on the cruise altitude, the descent angle (on the PERF INIT page), and the end-of-descent point. The T/D will be adjusted for tail and head wind (up to a maximum of 50 NM). In this case, the T/D is displayed within 200 NM of the destination.

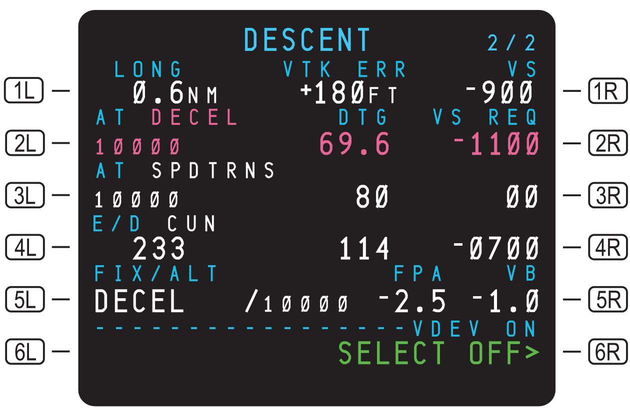
3.4.5 DESCENT Page

The HT1000 displays the DESCENT page if VNAV has been enabled on the configuration pages. Press VNAV to bring up the DESCENT page when the aircraft is airborne. If the aircraft is not airborne, the page is accessed by first pressing VNAV, then PREV or NEXT.



HT28-007-279

Figure 3.4-6a
DESCENT Page - Before Top-of-Descent and Before VTA



HT28-007-280

Figure 3.4-6b
Descent Page - After Top-of-Descent

1L **SHORT or LONG** – This field displays the horizontal distance of the aircraft from the descent path. If the aircraft is short of or below the horizontal projection to the descent path, the field will display SHORT and the horizontal distance the aircraft must travel to regain the descent path. If the aircraft is above the descent path, the field will display LONG and the horizontal distance from the descent path. Distance is displayed in NM expressed to one decimal place. (See Figure 3.4-6 and Figure 3.4-8.)

1C **VTK ERR** – Vertical track error is reported in feet with a "+" (plus) to indicate above path or a "-" (minus) to indicate below path. The vertical track error is displayed whenever the aircraft is in the active descent mode. Vertical track error is rounded to the nearest 10 feet.

1R **VS** – Vertical Speed (VS) displays actual vertical speed of aircraft. Vertical speed will be rounded to the nearest 100 feet.

2L **AT XXXX** – Displays the distance relative to the active vertical waypoint. Prior to reaching the DECEL point (Figure 3.4-1), the information relative to the DECEL point is presented.

2C **DTG** – Displays the Distance To Go (DTG) to the active vertical waypoint displayed in 2L.

2R **VS REQ** – Displays the VS required to cross the active vertical waypoint at the required altitude constraint, which is shown in 2L. When the designated waypoint is not the active vertical waypoint or before reaching the T/D, this value is the predicted rate-of-descent to follow the descent path.

3R Displays the vertical speed required if the aircraft were "on path".

4R Displays the vertical speed required if the aircraft were "on path".

3L **AT XXXXX** – This field displays the next vertical constraint. In this example, the next vertical constraint is the end of the deceleration segment. (See Section 3.4.1.1 for details on deceleration segments.)

4L **E/D XXXXX** – This field displays the E/D waypoint, which is the last waypoint in the descent that has an AT altitude constraint associated with it.

5L **FIX/ALT** – The FIX/ALT field allows the pilot to enter any waypoint and altitude to display the vertical bearing from the aircraft to the entered waypoint and altitude. The default value is the active vertical waypoint of the profile (same waypoint as displayed in 2L once past T/D).

5C **FPA** – Displays the current aircraft inertial flight path angle (FPA) in degrees relative to the ground.

5R **VB** – Vertical Bearing (VB) displays the angle from the aircraft to the waypoint and altitude displayed in 5L. This provides an indication of the descent flight path angle (FPA) required to reach the waypoint at the altitude displayed in the FIX/ALT field. Flying the aircraft with a descent flight path angle (FPA) steeper than the displayed vertical bearing (VB) ensures that the aircraft will reach the altitude displayed in the FIX/ALT field prior to the designated waypoint. (See Figure 3.4-7.)

6R **VDEV ON or VDEV OFF** - When selected ON, the HT1000 provides vertical deviation information (to the forward panel displays - ADI/HSI, EFIS). Pressing 6R, VDEV SELECT OFF>, turns off the vertical deviation outputs.

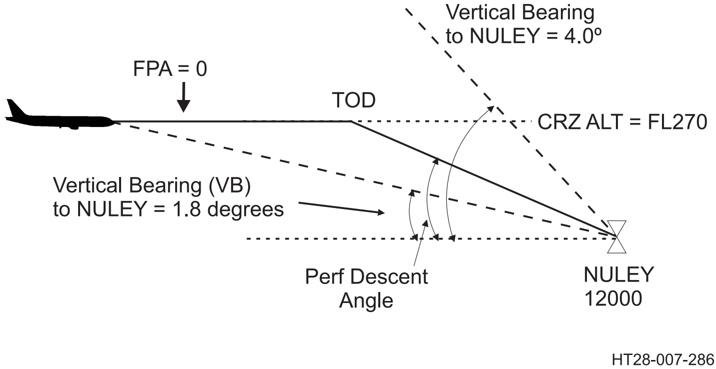


Figure 3.4-7
Vertical Bearing to Active Constraint

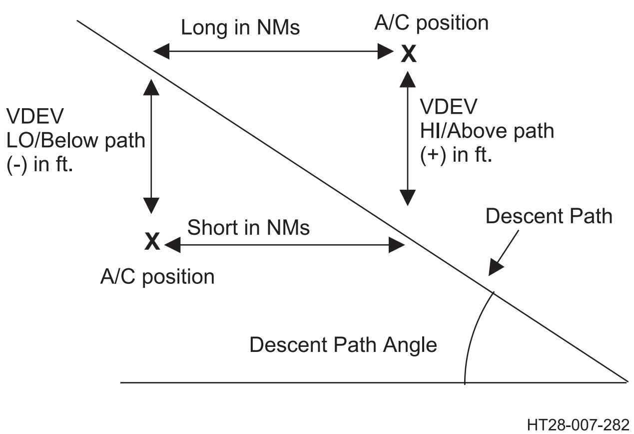


Figure 3.4-8
Descent Before T/D

3.4.6 VNAV Messages

DESCENT PATH DELETED

This message is displayed if the pending route modification will result in no descent path.

VERTICAL TRACK CHANGE ALERT

This message and annunciator is displayed at 2 minutes prior to a vertical track change when RNP=Oceanic/Remote (typically 12 NM), 30 seconds prior to a vertical track change when RNP = En route (2 NM), and 10 seconds prior to a vertical track change when RNP = Terminal (1 NM) or Approach (0.3 NM). The vertical track change alert is given at every altitude constraint including the two deceleration points if they are present in the descent path.

END OF DESCENT

This message appears whenever the aircraft is 2 minutes, 30 seconds, or 10 seconds from the last altitude constraint on the descent path. (This depends upon RNP. See VERTICAL TRACK CHANGE ALERT above.)

ACT DESCENT PATH INVALID

This message appears when the system detects a climb in the descent path. VNAV is set invalid when this message is displayed.

CONFIGS DIFFER - NO VNAV

This message appears when the default (configured) performance data in a dual or triple installation do not match. VNAV is not allowed when this occurs since descent paths would be different.

VNAV PATH NOT RECEIVED

VNAV Path information was not received by the receiving unit. Message may be the result of a temporary interruption to the transfer process. Any flight plan MOD will remedy this situation.

3.4.7 Scenarios

This section presents two examples of VNAV descents, one in which the aircraft is below the descent path and one in which it is above the descent path as it begins its descent.

VNAV Descent Scenario One

The aircraft is cruising at FL270 and is 20 NM from T/D. (See Figure 3.4-9.) The vertical deviation indicator is showing the aircraft below descent path. As the aircraft approaches the descent path, the pointer on the vertical deviation scale starts to move downward toward the center of the scale. The first altitude constraint is CCC (AT constraint). Since a constraint was entered above the deceleration altitude, the deceleration segment is not included. (See Section 3.4.1.1.) BBB does not have an altitude constraint; waypoint XXX has a window constraint; and waypoint AAA is an AT constraint.

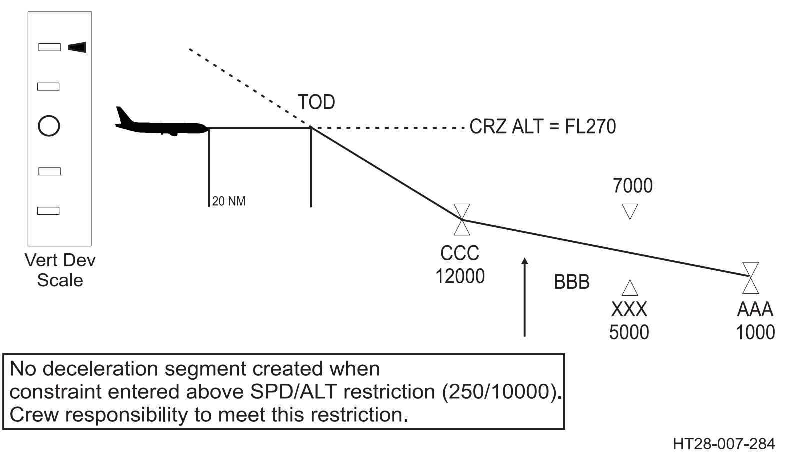


Figure 3.4-9
Scenario One - At Cruise Altitude Prior to T/D

On the LEGS page, the active waypoint is CCC, the aircraft has 65 NM to go to CCC, with a path that has 3º of slope to meet the AT constraint of 12,000 feet. (See Figure 3.4-10.) Waypoint BBB does not have an altitude constraint. The altitude shown (9700) is a prediction of the altitude where the path will cross BBB.

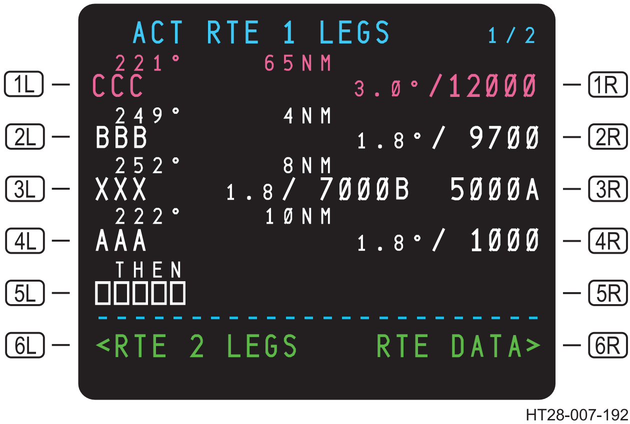


Figure 3.4-10
ACT RTE LEGS Page - Scenario 1

The DESCENT page (Figure 3.4-11) is showing T/D as the first active vertical constraint. Distance to go is 20. Current VS is 00 since the aircraft is in level flight. The next altitude constraint is CCC at 12000 feet and 65 NM. When flying the path towards CCC, the required VS target will be 2000 FPM. This target VS is required to meet the constraint. Target VS will not be generated to indicate how to acquire the descent path. The next waypoint line shows the E/D point (AAA). Line 5 provides angular information relative to waypoint CCC. Vertical Bearing from current aircraft position to the CCC waypoint. FPA (current aircraft inertial flight path angle) is presented.

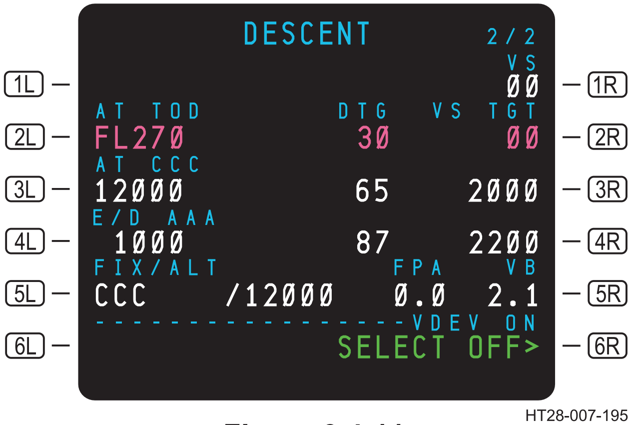


Figure 3.4-11
VNAV DESCENT Page

VNAV Descent — Scenario Two

In Scenario Two, the aircraft has flown past the T/D point and is above path. (See Figure 3.4-12.) The vertical deviation indicator is at the bottom of the scale. As the aircraft descends to reacquire the path, the deviation pointer moves upward toward the center of the scale. Notice on the profile that CCC is an AT constraint at 12000, as is waypoint BBB. This will create a level segment between CCC and BBB. Waypoint XXX is a window constraint. (See Figure 3.4-13.) Waypoint AAA is an AT constraint and is also the E/D point.

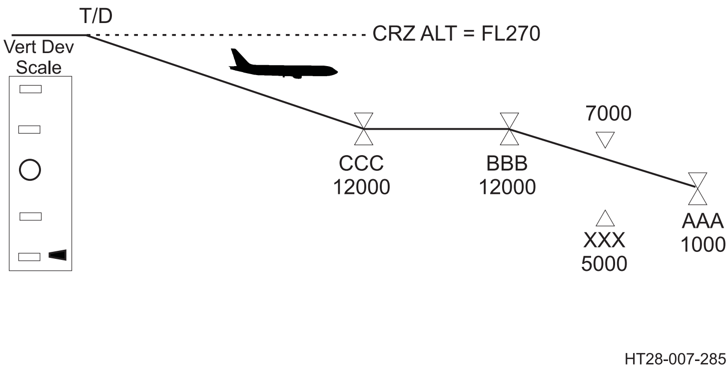
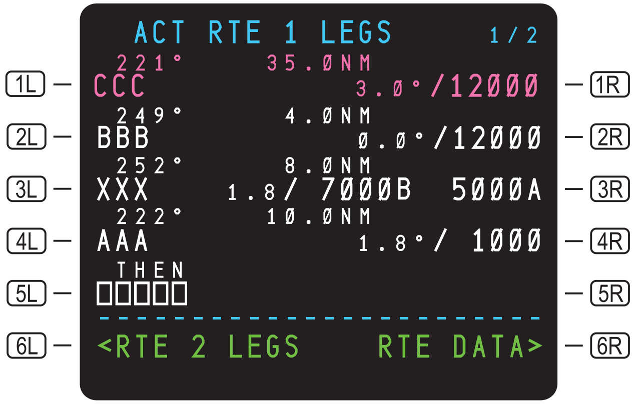


Figure 3.4-12
Scenario 2 — Above Path in Descent

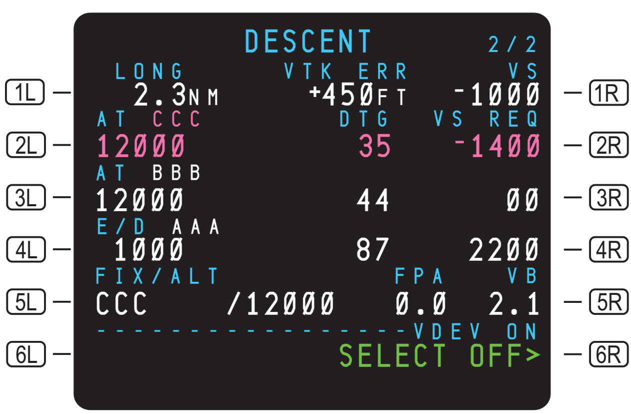
The LEGS page (Figure 3.4-13) displays CCC as the active waypoint with an altitude constraint of 12000 feet. The descent path angle to CCC is 3.0º. The next altitude constrained waypoint is BBB. Notice that the descent path angle to BBB is 0º. Since they both have AT altitudes of 12000 feet, the path was constructed as a level segment. The path from BBB to AAA passes through a window constraint at XXX and defines a descent path of 1.8º.



HT28-007-193

Figure 3.4-13
ACT RTE LEGS page - Scenario 2

The DESCENT page (Figure 3.4-14) shows that the aircraft is long by a distance of 2.3 NM and that it is currently +450 feet high. The vertical bearing of the aircraft to the next altitude constraint (CCC) is 2.1º, however, the aircraft's FPA is 0.0º. To meet CCC's altitude constraint of 12000, increase the rate-of-descent until the current aircraft FPA is greater than the vertical bearing (remember the VB points to the active altitude constraint). The crew must monitor vertical track error (VTK ERR) and current VS REQ to reacquire the descent path. The VS REQ will also provide guidance to meet the altitude constraint at CCC.



HT28-007-195

Figure 3.4-14
DESCENT Page - Scenario 2

TABLE OF CONTENTS

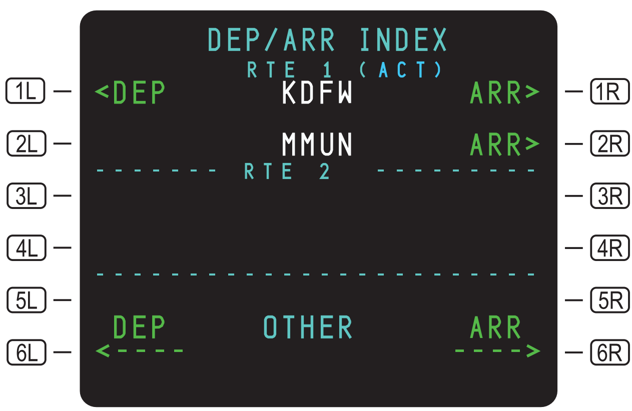
3.5 ARRIVAL/APPROACH

3.5.1 Arrival Selection

The DEP/ARR INDEX (Figure 3.5-1) gives access to arrivals for the destination airports.

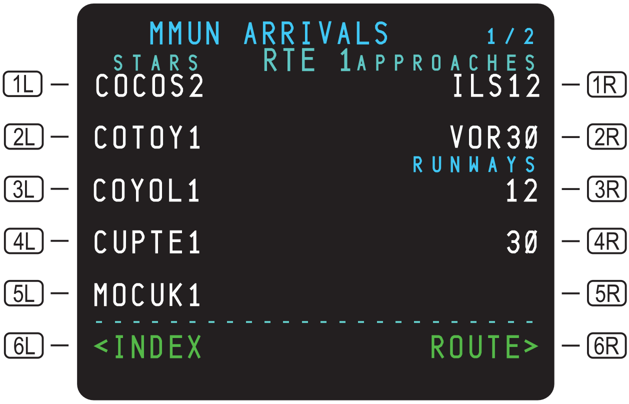
The departure and arrival pages can be accessed at any time by pressing the DEP ARR key on the MCDU. When the DEP ARR key is pressed, it will display ARR> prompts for both the departure (KDFW) and destination (MMUN) airports. (See Figure 3.5.1.) Arrivals for the departure airport can be accessed in the event a return to the departure airfield is required.

The destination airport (MMUN) appears in the center of the second line under ACT RTE 1. The ARR> prompt in 2R allows access to STARS, STAR transition, approaches, approach transitions, and runways for the arrival airport. When this page is accessed the page will show all the arrivals on the left side and all approaches and runways on the right side. (See Figure 3.5-2.)



HT28-007-289

Figure 3.5-1
DEP/ARR INDEX – KDFW Departures



HT28-007-290

Figure 3.5-2
MMUN Arrivals Page 1/2

When the pilot selects the appropriate STAR, STAR transition, Approach, and approach transition, the screen will blank all other STARS and approaches and show only the pilot selections. (See Figure 3.5-3.) SEL (SELECTED) will be shown next to the selection until the route is activated and executed. When the route is activated and executed, SEL will change to ACT (ACTIVE).

STEPS:

A. ☞ DEP ARR key (Figure 3.5.1 will appear on the display).
B. Select **2R** on the DEP/ARR INDEX page (Figure 3.5.2 will appear on display).
C. ☞ **1L** to select COCOS2 STAR.
D. ☞ **1R** to select approach ILS12.
E. ☞ **2R** to select AVSAR TRANS.

NOTE: Transitions for the approach will appear after the approach is selected.

After all selections are made, the display will look like Figure 3.5.4.

Figure 3.5-3
MMUN Arrivals Page 1/1

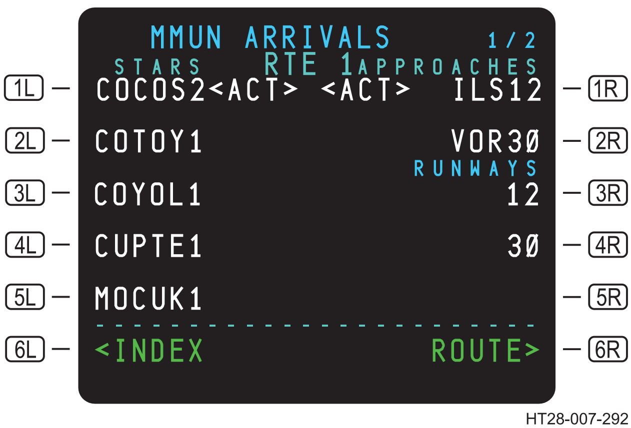


Figure 3.5-4
MMUN Arrivals Page 1/2

NOTES:

1. If a route has been activated, the label line is changed to ACT RTE 1 (or ACT RTE 2) on the DEP/ARV index page.
2. If RTE 1 and/or RTE 2 have not been defined, the data fields below the respective title lines will not show departures or arrivals airports.
3. Be sure that when selecting arrivals for a destination airport that you are selecting from the active route. Look for the ACT in front of RTE 1 or RTE 2 on the DEP/ARR INDEX page.

4. The name of the procedure and transition selected can be reviewed on the RTE page.
5. Returning to the arrival index and reselecting a procedure will initiate a new procedure/transition selection process and will delete the previously selected procedure/transition.

CAUTION

After selecting an approach, there may be a short delay before the corresponding transitions appear. **Do not** press the EXEC key before reviewing appropriate transitions.

The DEP/ARR INDEX (Figure 3.5-1) also allows the pilot to access departure and arrival information of airports not defined in the route. The title OTHER appears in the center of line 6L. The pilot may review departures of an airport not defined in RTE 1 or RTE 2 by entering its identifier via the SP and LSK 6L. Likewise, arrivals of an airport may be reviewed by entering its identifier in the SP and pressing LSK 6R. Entries must be four-character ICAO identifiers stored in the navigation data base for departures or arrivals to be displayed. These departures and arrivals can be reviewed **only**; they cannot be appended to the flight plan.

3.5.2 Approach Terminology Used In This Guide

The HT1000 provides the following types of approaches:

1. Non-Precision Approaches include GPS stand-alone, or GPS overlays of VOR, VOR-DME, NDB, etc., that are flown to the MAP. LNAV roll steering is provided on these approaches and presented on the HSI or EFIS Map display. The autopilot can be coupled laterally.

2. VNAV approaches are GPS overlay or stand-alone approaches that are flown down to the MDA or DA(H) with lateral and vertical deviation guidance (pending POI or ops spec approval). LNAV roll steering is provided on the approaches allowing autopilot coupling. Lateral path deviation is presented on the HSI or EFIS Map display. Vertical deviation from the VNAV path is displayed on the EFIS Map and HSI/ADI.

3. A SCAT 1 approach uses differential GPS to provide precision approach capability down to CAT I minimums. The SCAT 1 approach allows autopilot coupling to both the final approach course and glideslope.

3.5.3 Non-Precision Approaches (Lateral Guidance Only)

3.5.3.1 Selecting a Non-Precision Approach

Non-Precision approaches to the destination airport are accessed from the DEP/ARR page. (This page is accessed by pressing the DEP ARR key.) To select an approach, press the line-select key next to the destination airport <ARR prompt on the DEP/ARR page. All approaches for the destination airport will be listed along the right side of the page. If there is more than one page (as indicated by 1/2 or 1/3 in the upper right hand corner), use the NEXT key to navigate to subsequent pages.

Find the desired approach and press the adjacent line-select key. This will append the approach segments to the flight plan, including the missed approach if provided.

After an approach has been selected, the transitions to the approach will appear on the same page. After an approach has been selected, it may take a few seconds for the transitions selections to appear. If desired, a transition segment to the approach can be selected.

> NOTE: After selecting the approach and any approach transitions, the crew should review the procedure on the LEGS page for any discontinuities, incorrect bearings or distances. The approach as represented on the LEGS page should conform to the approach plate. In the event of any disparities, the approach plate is the final authority.

The missed approach procedure also will be appended to the flight plan but must be manually connected to the missed approach point on the LEGS page when it is desired to fly the missed approach procedure. This is done at the prompt labeled <EXECUTE MISSED APPROACH. Pressing the line-select key next to this prompt will tie the missed approach procedure to the missed approach point and will no longer allow HT1000 into approach mode.

3.5.3.2 Course Deviation Indications

As the aircraft flies towards the approach, the CDI sensitivity increases corresponding to changes in RNP. En route RNP is 2.0 NM and occurs outside of 30 NM from the airport. Within 30 NM of the airport the RNP changes to Terminal RNP (1.0 NM) and just outside the FAF the RNP changes to 0.3 RNP. With each change in RNP the CDI indicator sensitivity increases. During final approach the full scale deflection of the CDI represents 0.3 NM. See reference chart below.

The HT1000 has the following default RNP/CDI settings:

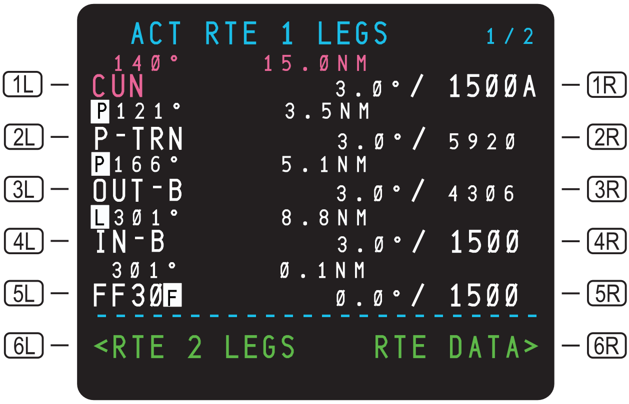
Flight Mode	Default RNP	HSI Scaling
Approach	0.3 NM	0.3 NM
Terminal	1.0 NM	1.0 NM
En Route	2.0 NM	4.0 NM

3.5.3.3 Flight Director Indications

The HT1000 will provide roll steering commands to the autopilot and flight director.

3.5.3.4 Indications on the LEGS Page

The FAF is identified on the LEGS page by a F displayed in inverse video adjacent to the FAF waypoint. The Missed Approach Point (MAP) is identified with an M displayed in inverse video adjacent to the MAP waypoint. If there is a procedure turn in the approach transition, the waypoint where the aircraft will begin its procedure turn entry is identified as P-TRN. The waypoint where the aircraft will begin its turn inbound to the FAF is identified as OUT-B. The waypoint where the inbound procedure turn intersects the final approach course will be identified as IN-B. (See Figures 3.5-5, 3.5-6 and 3.5-7.)



HT28-007-293

Figure 3.5-5
Procedure Turn Symbology

3.5.3.5 Approach Scratchpad Annunciations

CHECK GPS STATUS-POS REF – At 30 NM from the destination, this message will be generated if the system is not using GPS for navigation.

UNABLE APPROACH – If there is a loss of RAIM or if the GPS accuracy does not meet approach requirements during the approach mode, this message will appear in the scratchpad.

UNABLE RNP – This message will be displayed if the GPS accuracy or integrity does not meet a phase-of-flight RNP requirement.

NO TRANSITION SELECTED – This message is displayed if an approach has been selected without a transition at the time of execution. It is advisory only, since a transition to the approach may not be desired.

CHECK DEST RAIM-POS REF - Upon entering the terminal area, the HT1000 predicts that the approach RNP will not be available to support the approach procedure.

3.5.4 Example Non-Precision Approach (Lateral Guidance Only)

3.5.4.1 En Route and Terminal Area

The crew should select and appended the appropriate STAR, approach and transitions to the flight plan before approaching the terminal area. When the navigation source is GPS, the CDI on the HSI display will display lateral deviations from the lateral track on the LEGS page. The sensitivity of the CDI in the terminal area will be 1.0 NM full scale. Engaging the NAV mode results in the autopilot capturing and tracking the lateral path. Lateral path guidance will be displayed by the flight director.

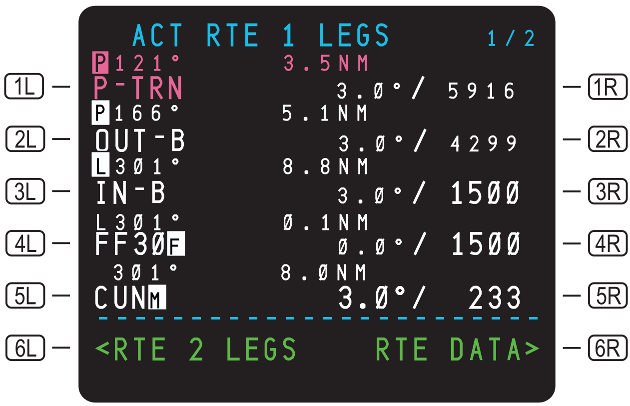
If desired, the crew can run a DEST RAIM check to view approach GPS accuracy predictions. However, at 30 NM to the destination, the system will perform its own RAIM prediction test. If the system passes the RAIM prediction test, nothing occurs. If the RAIM prediction test fails, the following annunciations occur:

1. The MSG annunciator turns on (flashing WHITE).
2. The scratchpad message CHECK DEST RAIM-POS REF is displayed in the scratchpad.

NOTE: See Section 3.5.5.2.2 on HT1000 Status Annunciations.

3.5.4.2 Transition to the Approach from a Procedure Turn

If approach transition procedure contains a procedure turn, the procedure turn point and the outbound leg will be identified on the LEGS page. (See Figure 3.5-6.)



HT28-007-294

Figure 3.5-6
Approach from a P-Turn

In Figure 3.5-7 the aircraft is outbound on the 121° radial from CUN and is 3.5 NM from the procedure turn point identified on the LEGS page as P-TRN. At the P-TRN point on the procedure calls for a 45° turn to the right to a heading of 166 degrees. The aircraft will fly outbound on the procedure turn entry until flying over the OUT-B waypoint. At this point the aircraft will begin a left turn to join the 301° inbound course to IN-B which defines the end of the procedure turn.

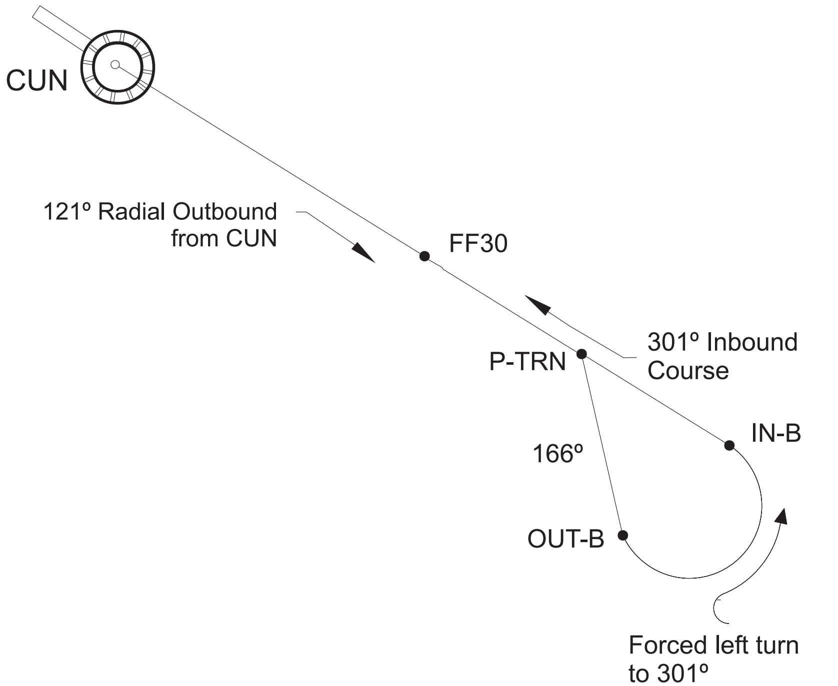


Figure 3.5-7
Transition to the Approach from a Procedure Turn

3.5.4.3 Aircraft Inbound to the Final Approach Course

After the procedure turn has been completed, the aircraft will be inbound to FF30 (FAF). The sensitivity of the CDI will be 1.0 NM until 2 NM outside the FAF. At this point the system transitions from terminal to approach RNP and the CDI sensitivity will be increased so that full-scale deflection is now 0.3 NM. With GPS as the selected source and the NAV mode engaged, the autopilot will capture and track the lateral path. Lateral flight director roll steering guidance will be displayed.

When the HT1000 enters the approach mode at 2 NM from the FAF, the APPRoach annunciator will illuminate if the HT1000 meets the RNP requirements for the approach (both predictive RAIM and current RAIM must pass integrity/accuracy checks). If the crew observes that the GREEN APPRoach light is illuminated, then all sensors selected for the approach have passed their integrity/accuracy checks.

If the HT1000 does not pass the approach integrity/accuracy checks, the following status annunciations will occur:

1. The RNP ALERT annunciator is turned ON (steady AMBER).
2. The GREEN APPRoach light does not turn ON.
3. The MSG annunciator turns ON (flashing WHITE).
4. The scratchpad message UNABLE APPROACH is displayed on the MCDU.

Should this occur, the flight crew must use other means of navigation or abandon the approach. (See section 3.5.7.2.2 on HT1000 status annunciations)

3.5.4.4 Final Approach Fix Inbound

Upon crossing the FAF, the flight crew begins the descent to the Minimum Descent Altitude (MDA) using vertical speed. The approach continues until the Missed Approach Point (MAP) is crossed. At the MAP the crew will decide to continue to landing or declare a missed approach.

If the GPS can not meet RNP requirements during the final approach segment between the FAF and MAP, the following annunciations occur:

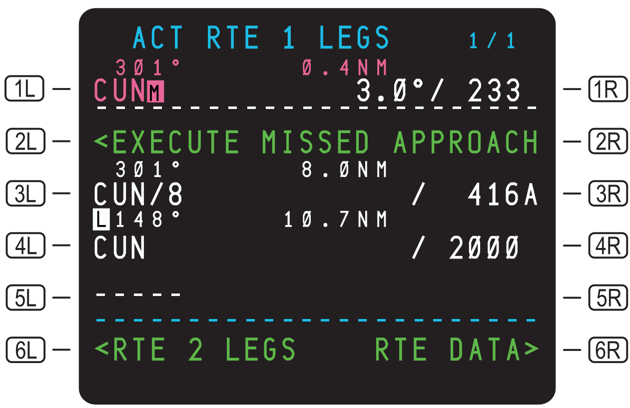
1. The APPRoach annunciator is turned OFF.
2. The RNP ALERT annunciator is turned ON (steady AMBER)
3. The MSG annunciator turns ON (flashingWHITE).
4. The scratchpad message UNABLE APPROACH is displayed on the MCDU.

Should this occur, the flight crew must use other means of navigation or abandon the approach.

NOTE: The altitude displayed next to the MAP waypoint on the LEGS page is a calculated altitude based on the intersection of a 3° glidepath with the MAP waypoint. (See Figure 3.5-9.) The MDA displayed on the paper approach chart is the final authority for non-precision approach minimums.

3.5.4.5 Missed Approach

Should a missed approach be necessary, the EXECUTE MISSED APPROACH function appends the missed-approach legs to the active route. (See Figure 3.5-8.)



HT28-007-295

Figure 3.5-8
ACT RTE 1 LEGS Page

STEPS: On the ACT RTE 1 LEGS page:

A. 2L to engage the missed approach function.

B. EXEC.

Figure 3.5-9 shows the ACT RTE 1 LEGS after the missed approach function has been appended.

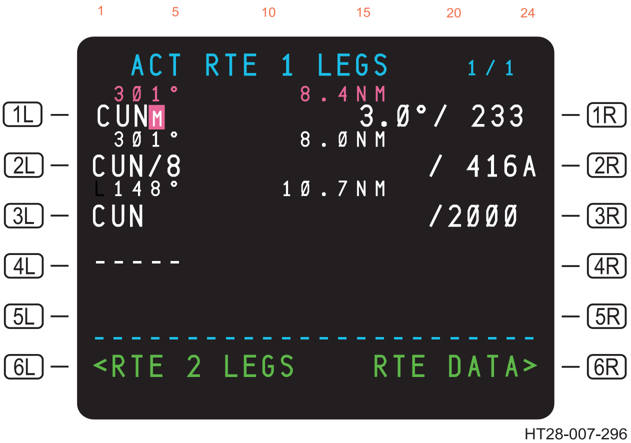


Figure 3.5-9
ACT RTE 1 LEGS Page

Auto Go-Around Function . Appending the missed approach procedure to the route may be accomplished automatically by pressing the TOGA or Go Around button (not available on all aircraft installations). When the TOGA button is pressed, the missed approach procedure will be appended to the route, activated, and executed. Once the MAP procedure is appended, the RNP returns to 1.0 NM.

3.5.5 SCAT 1 Precision Approaches

NOTICE

The following description is of a typical Differential Global Position System (DGPS) precision approach. Additional specialized equipment must be installed for an aircraft to be capable of DGPS precision approaches.

Differential GPS (DGPS) Tuning is displayed only if the Configuration Module indicates the aircraft is equipped with DGPS airborne equipment.

3.5.5.1 Differential GPS System Overview

Differential GPS (DGPS) systems consist of a ground portion and an airborne portion as illustrated in Figure 3.5-10. Together the two components allow an aircraft to perform precision approaches equivalent to ILS Special Category 1 Approach (SCAT 1). The SCAT 1 approach allows autopilot coupling to both the final approach course and glideslope.

The ground portion consists of a ground station with multiple GPS receivers installed near it. The GPS receivers are installed at a known latitude and longitude position. The GPS receivers receive data from the GPS satellite constellation and compute a GPS position. The ground station computes the difference between the GPS receivers' known position and the instantaneous position the receiver is computing from the GPS constellation. The position difference is known as the differential correction. By applying the differential corrections, airborne receivers improve navigation accuracy to within 1.5 meters vertically and 1 meter horizontally. Using a VHF data link, the ground station transmits differential corrections and additional information to the aircraft's GPS receivers to create an ILS-look-alike or co-located glide path. The onboard GPS receiver computes the aircraft deviation from the final approach path. By using the accurate differential position, the receiver computes the lateral and vertical error of the aircraft from the final approach path transmitted by the ground station. The GPS receiver then outputs these deviations to the Horizontal Situation Indicator (HSI) for display to the flight crew. In addition, the outputs are sent to the Digital Flight Guidance Computer (DFGC) so the flight director and autopilot may be coupled for the approach. Deviations from the GPS receiver are designed to emulate an ILS beam.

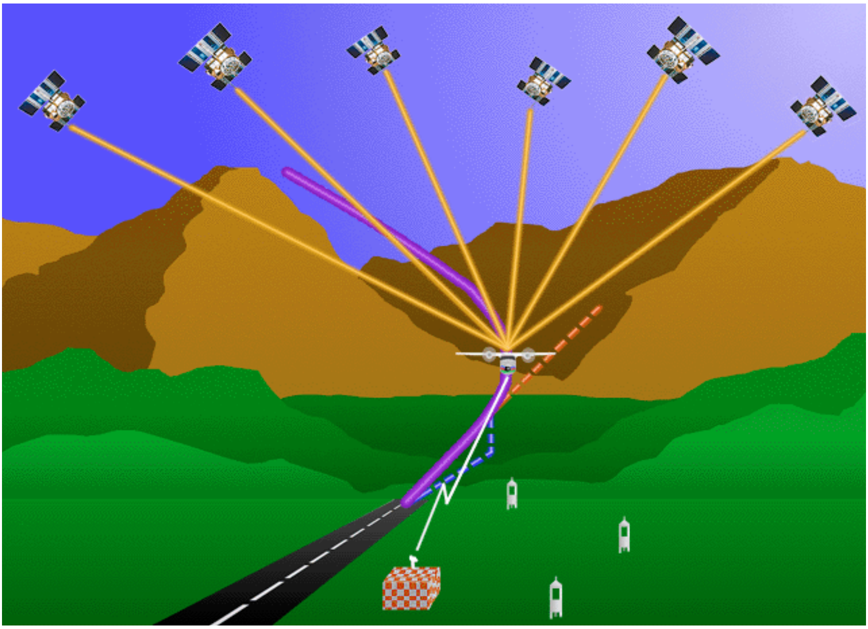


Figure 3.5-10
Differential Global Positioning System

3.5.5.2 DGPS Airborne Equipment

The system consists of dual Honeywell/Trimble HT1000 Navigation Management Systems, a single Honeywell VHF Data Link receiver (VL-500), dual Honeywell Global Navigation System Units (GNSSU), and dual Navigation Selection Panels (NSP).

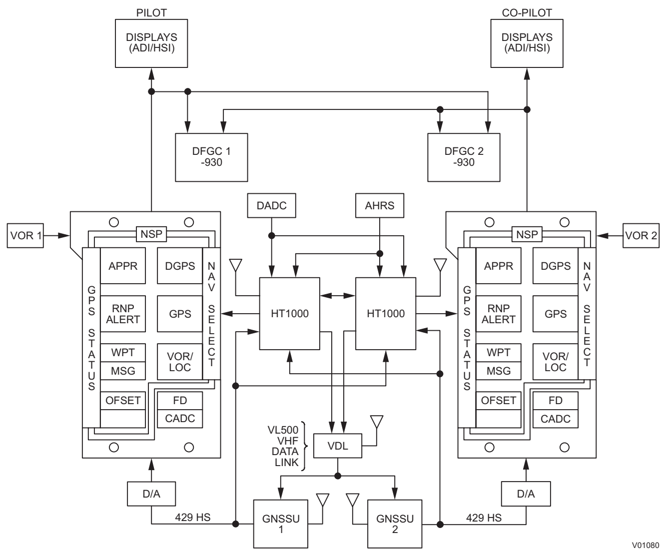


Figure 3.5-11
MD-83 DGPS Airborne Complement

The HT1000, using pilot-entered data, tunes the VL-500 to the ground station VHF frequency. The ground station transmits differential corrections to the aircraft using a VHF data link. Differential GPS data from the ground station is received by the VL-500 and passed to the GNSSUs, which apply the differential corrections. The VL-500 also receives and passes to the GNSSUs the vertical and lateral path of the final approach segment. The GNSSUs compute a differential GPS position and compute the lateral and vertical deviations of the present aircraft position from the desired path being transmitted by the ground station. After the flight crew has selected DGPS on the Navigation Selection Panel (NSP), the deviations are displayed to the pilot and transmitted to the DFGC to provide for coupled approaches.

3.5.5.2.1 Navigation Select Panel

The NAV SELECT panel consists of three push-buttons for selecting the navigation source to be displayed on the HSI and transmitted to the DFGC. The push-buttons are located in the Capt's and F/O's primary field of view. The possible selections are DGPS, GPS, and VOR/LOC. Only one source may be active at any time. The lights turn GREEN when selected by the flight crew and indicate the active navigational source.

NOTE: A typical Navigation Select Panel (NSP) is shown below. Installation may vary with the type of aircraft. Location of switches and indicators may be different.

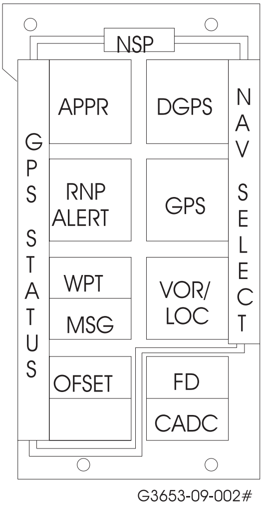


Figure 3.5-12
Navigation Selection Panel

For SCAT 1 approaches, the DGPS must be selected to provide navigation information to the displays and DFGC.

3.5.5.2.2 GPS STATUS Annunciators

STATUS Annunciators

The status annunciators are on the left side of the NSP and are labeled GPS STATUS. The HT1000 status annunciators are active **only** when GPS is selected as the navigational source. These GPS annunciators are usually located on the front panel in the pilot's primary field of view.

APPR Annunciator

Used during precision and non-precision approaches, the APPR annunciator turns ON to indicate that the HT1000 is operating in the approach mode. When the APPR annunciator is illuminated, it is a "go" annunciator for the approach. Two APPR annunciators are installed on the flight deck, one in front of each crew member. The annunciator does not flash.

The APPR and RNP ALERT annunciators are mutually exclusive (only one annunciator can be ON) during an approach being flown by the HT1000.

UNABLE RNP

The annunciator turns ON to indicate to the flight crew the HT1000 does not meet accuracy and/or integrity requirements for the current phase-of-flight. During approaches using the HT1000, the annunciator is a "no-go" annunciator. Should it turn ON during an approach, the flight crew must use other means for navigation or abandon the approach.

WPT

The WPT annunciator is the lateral track change annunciator. It turns ON 30 seconds prior to the aircraft sequencing the TO waypoint during the en route phase-of-flight. The time is 10 seconds for terminal and RNP approach phases of flight. The annunciator does not flash. The WPT annunciator lights two minutes prior to sequencing in oceanic phase. The color is typically WHITE, but it may vary with aircraft installation.

MSG

This annunciator turns ON to inform the flight crew a message is being displayed on the HT1000. The annunciator flashes until the message is cleared from the scratchpad.

OFSET

The OFSET annunciator illuminates to indicate the pilot has entered an offset. The OFSET annunciator turns OFF when the offset is canceled.

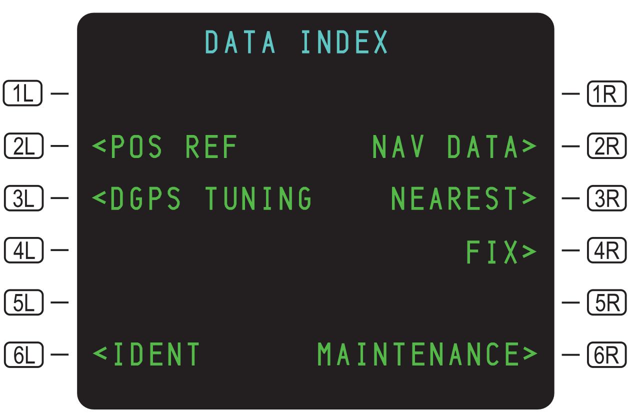
3.5.6 SCAT 1 Example Approach

The following sections describe a DGPS approach from the en route to approach phase-of-flight. The DGPS 11 approach at KEWR is used in this example.

3.5.6.1 Aircraft Outside Terminal Area

In the en route phase, the aircraft is beyond reception (30NM radius) of the ground station. At this stage, the VDL may be tuned by the flight crew. The DGPS Tuning page is accessed from the DATA INDEX page.

STEP: 3L to access the DGPS TUNING page.



HT28-007-304

Figure 3.5-13
Accessing DGPS Tuning Page

1L **TUNE** – The channel number and a time slot designator (alphabetic characters A – H).

2L **AIRPORT** – Airport identifier.

3L **RUNWAY** – Runway identifier.

4L **FAS** – Final Approach Segment identifier (alphabetic characters A – Z). (For future growth only. Not presently available.)

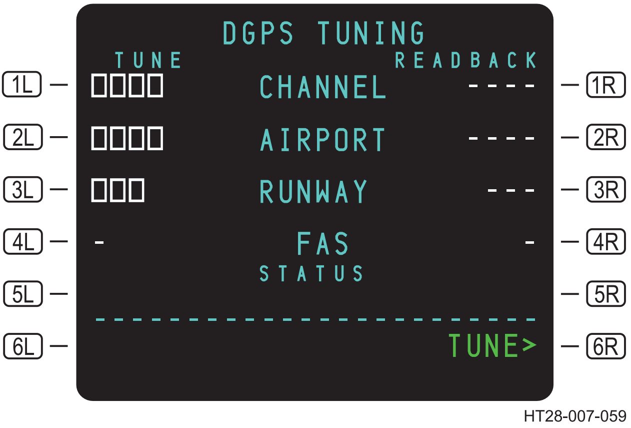


Figure 3.5-14
DGPS Tuning Page

Once the DGPS TUNING page has been accessed, enter the tuning data into the SP and line-select to the appropriate position. The parameters used here are found in the upper portion of the selected approach plate.

STEPS:

A. Type 263A in SP.
B. 1L.
C. Type KEWR in SP.
D. 2L.
E. Type 11 in SP.
F. 3L.

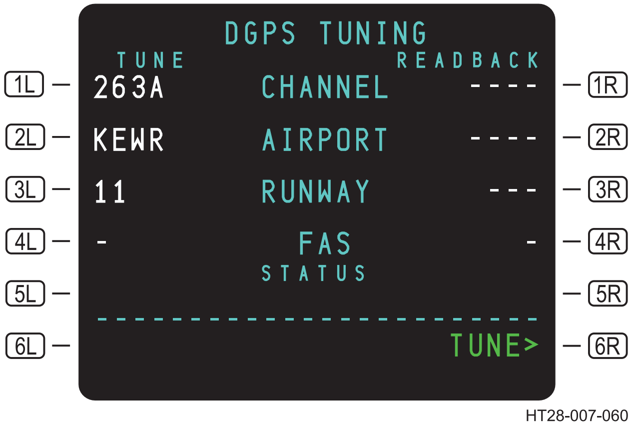


Figure 3.5-15
Pilot-Entry of DGPS Approach at KEWR

Press TUNE at 6R to initiate the tuning sequence. When 6R is pressed, the status message WAITING FOR DATA is displayed as in Figure 3.5-16. The message will be displayed until corrections are received from the ground station.

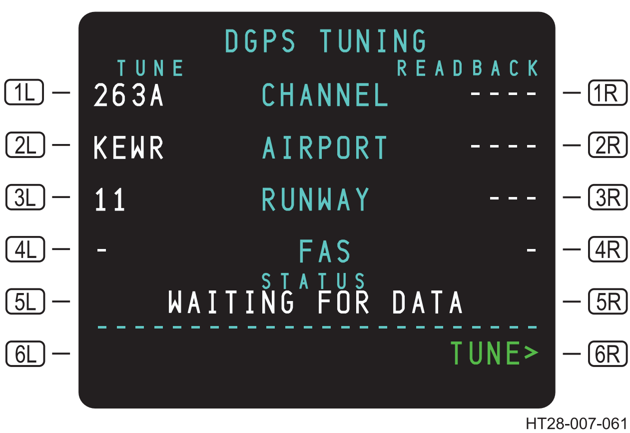


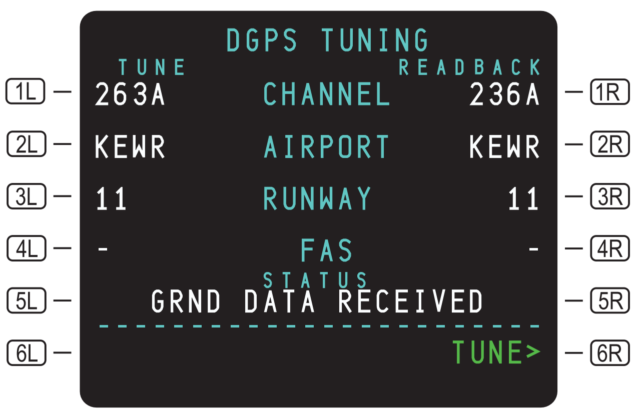
Figure 3.5-16
VDL TUNING Following Tuning Command

While the aircraft is outside the terminal area, the approach procedure may be selected and activated on the MCDU, using the DEP ARR key and normal procedures described in the HT1000 Pilot's Guide.

> NOTE: DGPS approaches are not presently stored in the navigation database of the HT1000. If the DGPS approaches are overlays of existing ILS approaches, the flight crew could select and activate the underlying ILS to view the approach procedure on the MCDU LEGS page.

3.5.6.2 Aircraft in Terminal Area

Upon entering the terminal area, the HT1000 receives corrections from the ground station. Figure 3.5-17 displays GRND DATA RECEIVED on the status line of the DGPS TUNING page, indicating ground station data is being received from the VDL. The right side of the display shows the READBACK from the GNSSU. Dashes in any of these fields indicate the received data is not valid or the received status is not confirmed.



HT28-007-062

Figure 3.5-17
DGPS TUNING Page – Aircraft In Terminal Area

The GNSSU looks for the approach the pilot requested on the HT1000 in the data being received from the ground. The GNSSU informs the HT1000 the approach has been selected and the HT1000 confirms it is the correct approach. At this point, the approach is displayed on the right side of the DGPS TUNING page. The confirmation process is automatic and requires a maximum of 22 seconds from the time the aircraft enters ground station reception. The airborne equipment is now ready to fly the DGPS approach.

To display DGPS data on the HSI and couple the autopilot to track DGPS, perform the following steps:

1. Confirm that the status message GRND DATA RECEIVED is displayed on the DGPS tuning page to verify that the ground station has been tuned and that data is being received. (See Figure 3.5-17.)
2. Select DGPS on the NAV SELECT panel. (See Figure 3.5-12)
3. Select ILS on FGCP to couple the DGPS to the flight director.

3.5.6.3 Final Approach Fix Inbound

As the aircraft approaches the FAF, the glideslope is captured and tracked. At 1500' RA, TRK is the active FMA mode for localizer and glideslope. If problems occur during the final approach segment (between the FAF and MAP) and the GNSSU cannot compute the lateral and/or vertical deviation, onside localizer and/or glideslope flags are displayed. This is the indication to go-around. ILS remains in the FMA during DGPS approaches **even** if the lateral and vertical deviations become invalid.

3.5.7 Accuracy and Integrity Requirements

3.5.7.1 RAIM at Destination

The DEST RAIM page provides access to the DESTINATION RAIM PREDICTION for the active route destination airport. The RAIM prediction looks at a 30 minute window around the aircraft's ETA for the arrival airport and determines whether there will be enough satellites in the proper geometry to ensure that required navigation performance is met.

NOTE: DEST RAIM provides a prediction only. This prediction provides the crew with a "look ahead" to see if there will be enough satellites in the proper geometry at the time of their ETA. Keep in mind that real time RAIM is always provided throughout flight including the descent and approach flight phases. Should RAIM become invalid during any portion of the flight phase it will be annunciated in the scratchpad as UNABLE RNP.

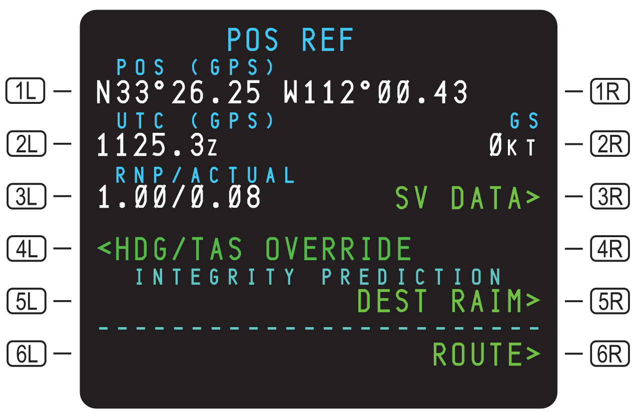
The crew may check PREDICTIVE RAIM at any time (on the ground or in the air) by using the steps described below. Figure 3.5-18 below shows a typical result on the DEST RAIM page. Destination RAIM can be accessed on the POS REF page at 5R.

STEPS:

A. DATA key.

B. 2L POS REF.

C. 5R DEST RAIM.



HT28-007-005

Figure 3.5-18
DEST RAIM Page

At 30 NM to the destination the system performs its own RAIM prediction test. (See Figure 3.5-18.) If the RAIM prediction test fails the following annunciations occur:

1. The MSG annunciator turns on (flashing white).
2. The scratchpad message CHECK DEST RAIM-POS REF is displayed in the scratchpad.

At 2 NM outside the FAF, the HT1000 performs another accuracy/ integrity check. The APPRoach annunciator will be illuminated if the HT1000 meets the RNP requirements for the approach being performed (both predictive RAIM and current RAIM must pass accuracy/ integrity checks). If it does not, the following annunciations will occur:

1. The RNP ALERT annunciator is turned on (steady AMBER).
2. The GREEN APPRoach light does not illuminate.
3. The MSG annunciator turns on (flashing WHITE).
4. The scratchpad message UNABLE APPROACH is displayed in the scratchpad.

NOTE: See section 3.5.5.2.2 for HT1000 Status Annunciations.

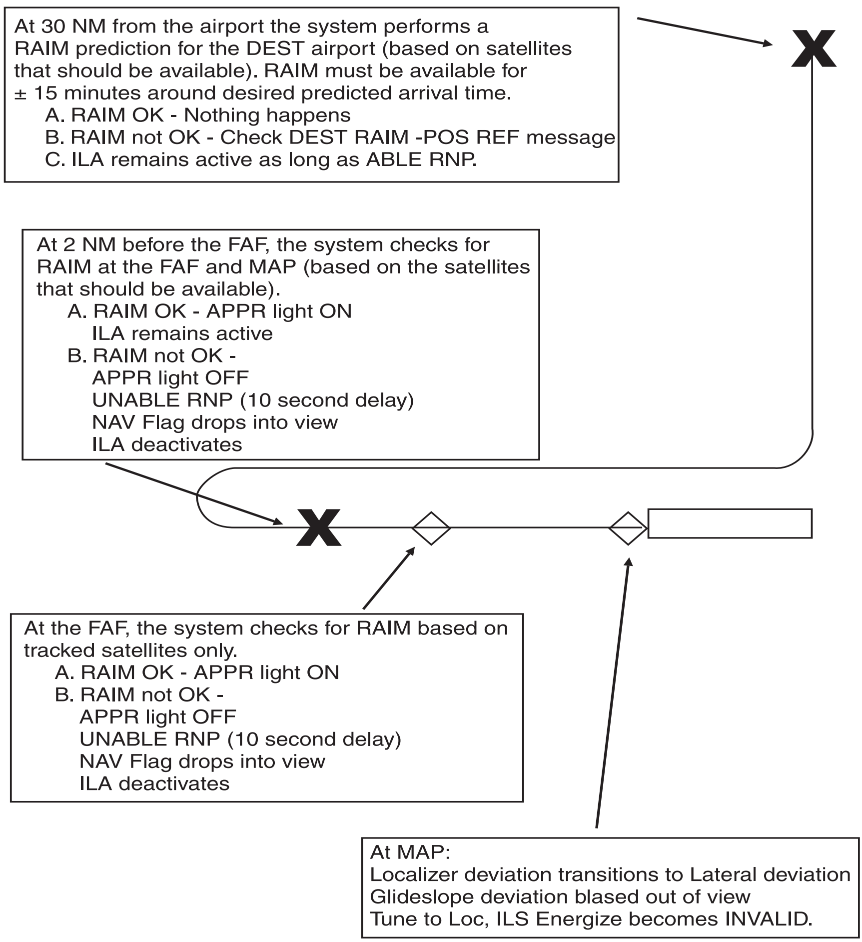


Figure 3.5-19
System RAIM Checks in Approach Mode

TABLE OF CONTENTS

3.6 MISCELLANEOUS

3.6.1 REF NAV Data

The Reference Navigation Data (REF NAV DATA) Page provides information for waypoints, navaids, and airports in the navigation data base. It is accessed by selecting the NAV DATA> prompt at [2R] on the DATA INDEX page. Remember, the DATA INDEX page is accessed by pressing the [DATA] function key.

STEPS:

A. [DATA] to access DATA INDEX page.
B. [2R] on the DATA INDEX page.

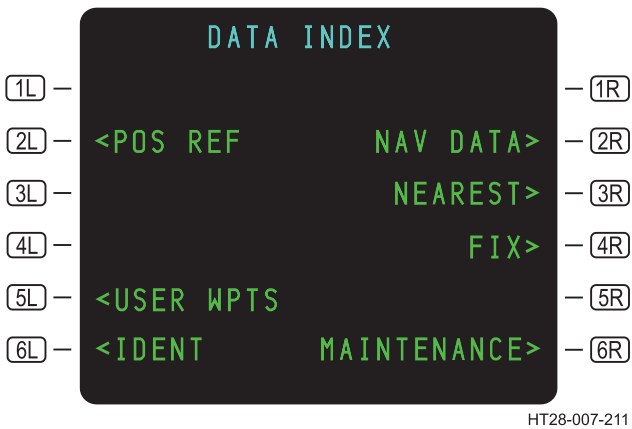


Figure 3.6-1
DATA INDEX Page

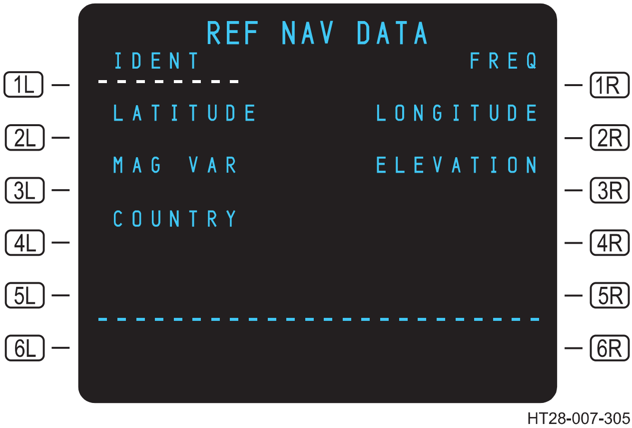


Figure 3.6-2
REF NAV DATA Page

Enter an IDENT in 1L as explained below.

1L **IDENT** – A valid entry is the identifier for any waypoint, navaid, airport, or destination runway in the navigation data base.

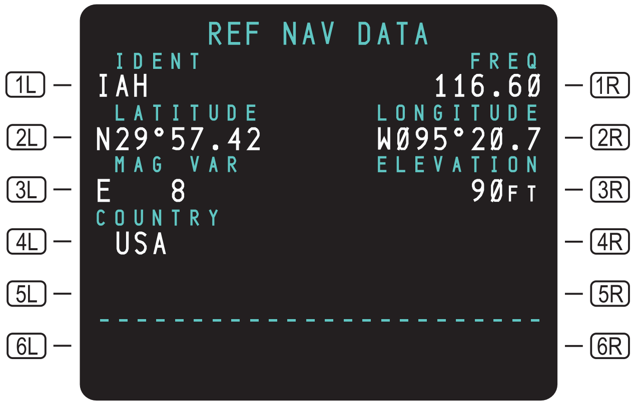
Changing the page causes the waypoint to be replaced with dashes and associated data is removed. Deletion of a 1L entry is not permitted.

On the flight from KDFW to MMUN for example, the pilot is interested in the reference navigation data for the IAH navaid.

STEPS:

A. Type IAH in SP.

B. ☞ 1L.



HT28-007-306

Figure 3.6-3
REF NAV DATA Page – IAH

1R **FREQ** – If the identifier displayed in **1L** represents a navaid, then the field in **1R** displays the navaid Frequency (FREQ). In this example, the frequency for IAH is 116.60.

2L **LATITUDE** – This field displays the latitude of the fix entered in **1L**.

2R **LONGITUDE** – Displays the longitude of the fix entered in **1L**.

3L **MAG VAR** – The title line displays Magnetic Variation (MAG VAR) from true North when the identifier is a navaid. The magnetic variation is for the navaid.

4L Displays country in which the waypoint is located.

NOTE: A list of country codes is in Appendix D.

3R **ELEVATION** – This field displays the elevation of the navaid, airport (reference point), or runway threshold entered in **1L**. Waypoint entries in **1L** cause the data field and title line at **3R** to remain blank.

3.6.2 FIX INFO

3.6.2.1 Fix Info Page

The Fix Information (FIX INFO) page displays bearing and distance from a selected waypoint to present position. The bearing data is magnetic or true depending on the position of the Heading Reference Switch (depending on aircraft installation).

STEP: On the DATA INDEX page, ☞ 4R.

Figure 3.6-4
FIX INFO Page

1L **FIX BRG/DIS FR** – Valid entries into the box prompts at 1L are airports, navaids, nondirectional radio beacons, or waypoint identifiers contained in the navigation data base. Entry is through keyboard action or line selection from another page.

6L **<ERASE FIX** – Selection of 6L removes all FIX data from that page.

3.6.3 ACTIVE PLAN PREDICTION

3.6.3.1 Required Navigation Performance (RNP)

RNP – On the POS REF page, this field displays the default RNP in SMALL font if a manual entry has not been made. See Figures 3.6-5 and 3.6-6.

- Default values of RNP are based on stored values determined by flight phase.
- Manual entries of RNP are displayed in LARGE font.
- Manual entry of RNP will automatically transfer to other unit.
- Manual entries will override the automatic display of RNP values per phase of flight.
- Deletion of a manual entry results in display of the default RNP.
- Attempted deletion of the default RNP results in an INVALID DELETE message.
- A valid manual entry is from 0.01 to 99.9. Refer to Appendix A Messages:

    VERIFY RNP

    VERIFY RNP ENTRY

ACTUAL – Actual Navigation Performance (ANP) – This value displays the computed estimate of FMC POS accuracy in SMALL font.

- ANP values are based on the position update mode (GPS, DME, or Inertial).

3.6.3.2 Active Route Integrity Prediction

Before oceanic operations, it is necessary to predict the availability of the HT1000 satellite exclusion function. This is known as Fault Detection and Exclusion (FDE) as explained in Appendix C, pages 5 and 6. This is normally accomplished by the airline dispatcher, but it also can be run on the HT1000. The HT1000 performs the prediction for the anticipated departure and arrival times (or average ground speed) and the displayed RNP value. Running the FDE Prediction from the HT1000 is a time consuming task and is allowed only when the aircraft is on the ground.

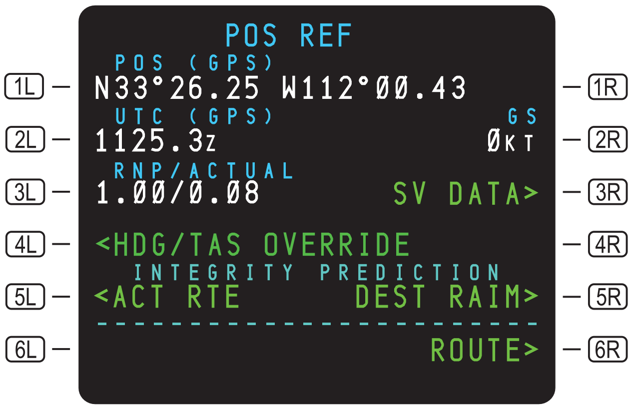
Access to the ACT RTE INTEGRITY PRED page is from the POS REF page. (See Figure 3.6-5.) Follow the steps to perform the prediction for the route to Cancun (MMUN).

STEPS:

A. PROG.

B. 6R POS REF.

C. 5L ACT RTE.



HT28-007-121

Figure 3.6-5
Integrity Prediction

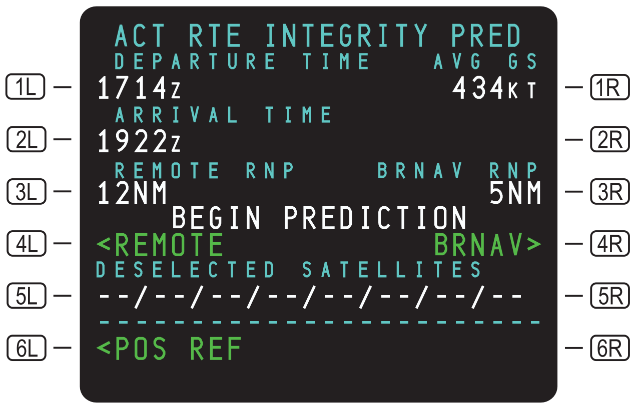
<u>STEPS</u>:

A. Enter 1714.

B. ☞ 1L.

C. Enter 1922.

D. ☞ 2L.



HT28-007-308

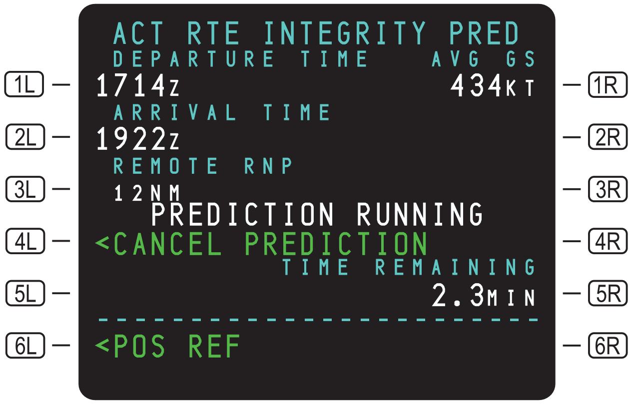
Figure 3.6-6
Active Route RNP Prediction

Two FDE prediction programs are available, one for oceanic/remote (displayed at 3L in Figure 3.6-6) and one for BRNAV airspace (displayed at 3R in Figure 3.6-6). The RNP requirement for oceanic airspace is generally 12 NM while the RNP requirement for BRNAV airspace is 5 NM. These RNP restrictions are taken into account when the prediction is run.

The pilot can enter a departure time and arrival time and the HT1000 will compute the average ground speed. Alternatively the departure time and ground speed can be entered, in which case the HT1000 will compute the arrival time.

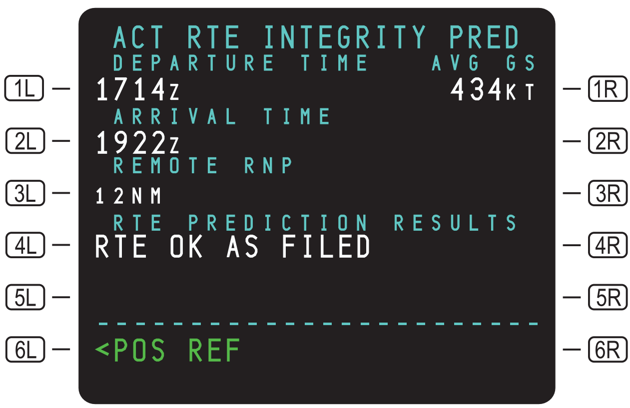
Satellites that are known to be out-of-service (for example, as disseminated through the NOTAM Service) **must** be excluded from the prediction program. Satellites' PRN numbers must be used for deselection. Do **not** use SVN numbers for this. Out-of-service SVs must be entered into 5L by typing the PRN number into the SP. Then press 5L. This will delete all SV PRN entries.

STEP: ☞ (3L) to begin prediction.



HT28-007-309

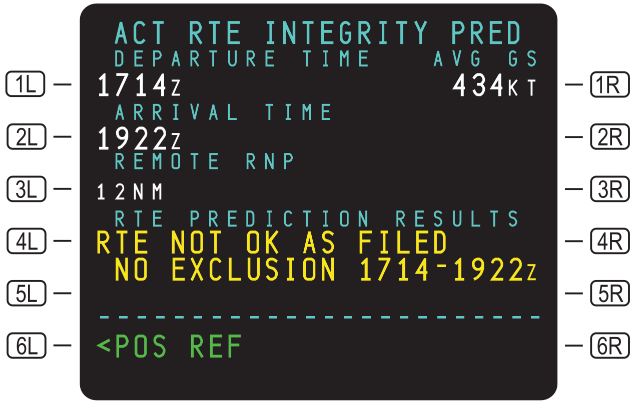
Figure 3.6-7
Prediction Running



HT28-007-310

Figure 3.6-8
Results of RNP Prediction

If the program issues a NOT OK AS FILED (Figure 3.6-9), the route has failed the FDE check. There are not enough good satellites in the proper geometry for the oceanic/remote crossing. Changing departure time and/or ground speed may alleviate this condition.



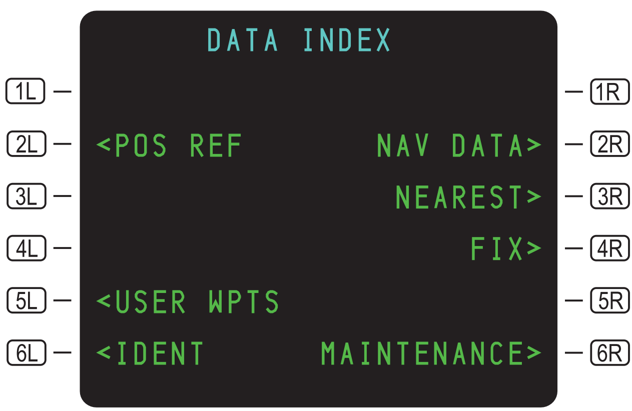
HT28-007-311

Figure 3.6-9
Integrity Prediction – RTE NOT OK AS FILED

3.6.4 DATA INDEX and NEAREST Pages

The DATA INDEX page provides access to the NEAREST pages. The four NEAREST pages include nearest airports, VOR/DMEs, ADFs, and waypoints.

STEP: DATA to display the DATA INDEX page.



HT28-007-215

Figure 3.6-10
NEAREST Page

STEP: ☞ 3R to display the NEAREST INDEX page. (See Figure 3.6-10.)

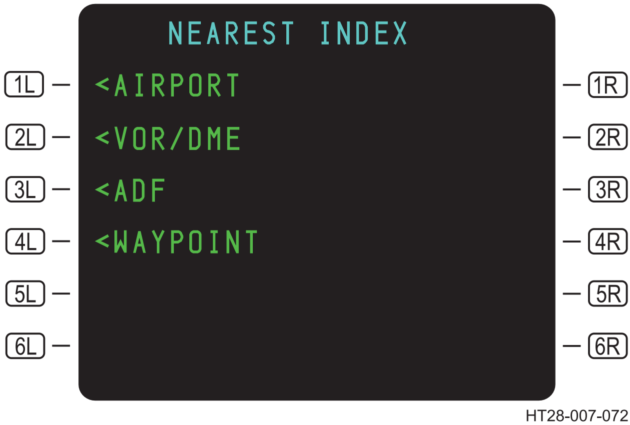


Figure 3.6-11
NEAREST INDEX

Pressing the adjacent LSK displays a page listing the nearest airports, VOR/DMEs, ADFs, or waypoints. Each listing will display up to four pages of airports, VOR/DMEs, ADFs or waypoints in increasing distance from the current aircraft position. The bearing and distance to each airport, VOR/DME, ADF, or waypoint is provided.

STEP: ☞ 1L to display the nearest airports.

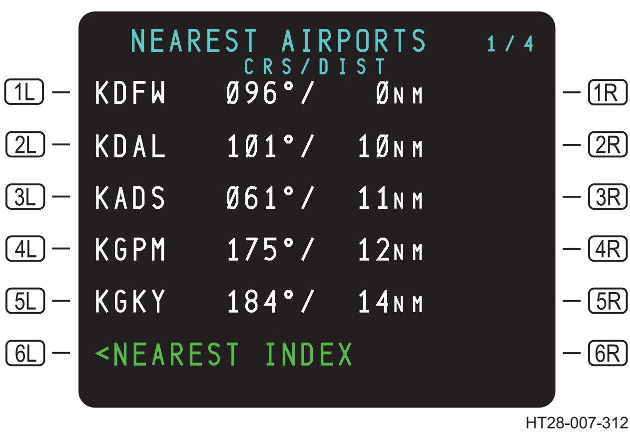


Figure 3.6-12
NEAREST AIRPORTS

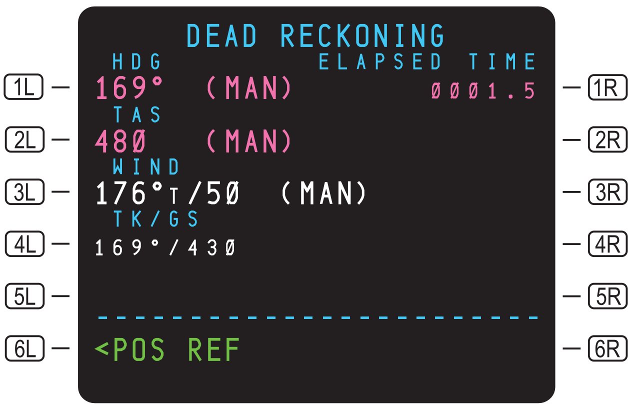
3.6.5 Dead Reckoning and HDG/TAS OVERRIDE

If the system enters Dead Reckoning mode, <DR will be displayed on the POS REF page at 4L and DEAD RECKONING will be displayed in the SP. Press 4L to access the Dead Reckoning page. The DR page enables entry of Heading, TAS, and Wind. Track (TK) and Ground Speed (GS) will result from the manual inputs into 1L, 2L, and 3L. If DR occurs because of a loss of only GPS, but the aircraft is still providing heading and TAS, all that is required to compute the track is to insert wind manually for each leg of the flight plan. Steering commands will still be provided to the autopilot in DR mode. Elapsed time in 1R is the total time in DR mode.

STEPS:

A. 4L.

B. Enter HDG, TAS, and WIND as required.



HT28-007-313

Figure 3.6-13
DEAD RECKONING

When not in Dead Reckoning mode, HDG/TAS OVERRIDE is displayed at 4L on the POS REF page. Pressing 4L provides access to the same page, but it is now titled HDG/TAS OVERRIDE. In HDG/TAS OVERRIDE mode, ELAPSED TIME is not displayed. The HDG/TAS OVERRIDE page allows the crew to manually enter HDG/TAS in the event there is a HDG or TAS fault.

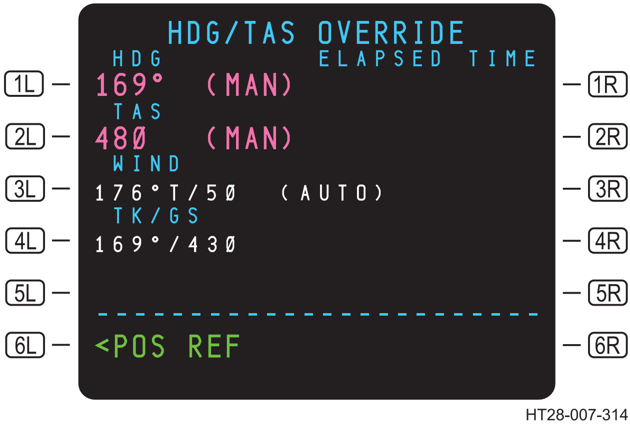
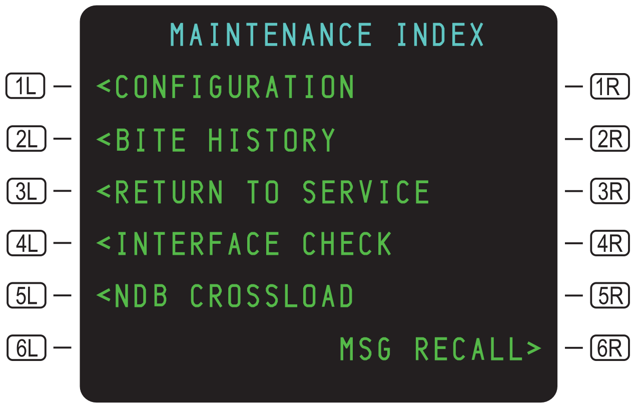


Figure 3.6-14
HDG/TAS OVERRIDE Page

3.6.6 NAV Data Base (NDB) Crossload

The NDB crossload function is accessed through the Maintenance Index page.



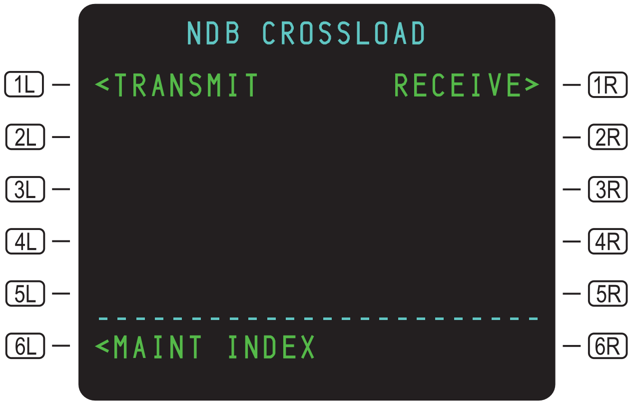
HT28-007-076

Figure 3.6-15
MAINTENANCE INDEX Page

Line-select keys 3L, 4L, and 5L are displayed only when the aircraft is on the ground.

Accessing the NDB CROSSLOAD page causes the connected systems to transmit data about their NDBs (identifiers, expiration dates, and sizes). Only those data bases with a valid CRC are transmitted. If either data base processor has not completed its CRC checks, the message UNABLE NDB INVALID will be displayed. (See Figure 3.6-17.)

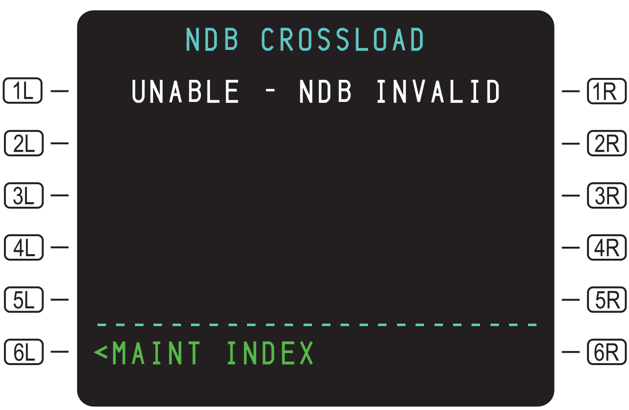
If both systems have valid NDBs (at least one each), Figure 3.6-16 is displayed with prompts for TRANSMIT and RECEIVE. If only one side has a valid NDB, then only one of the prompts appears.



HT28-007-077

Figure 3.6-16
NDB CROSSLOAD

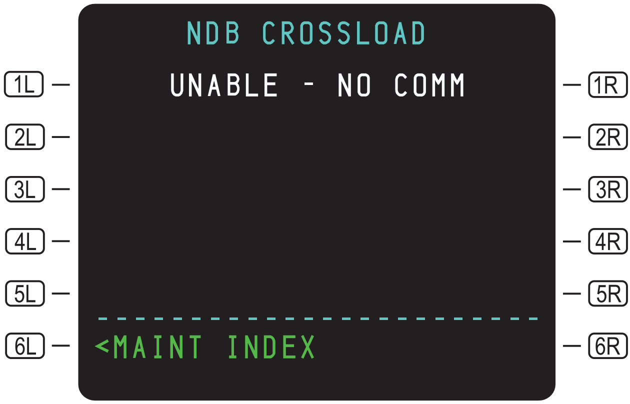
If neither side has a valid NDB, the NDB crossload function is not available because no NDBs are defined. (See Figue 3.6-17.)



HT28-007-078

Figure 3.6-17
Invalid NDB

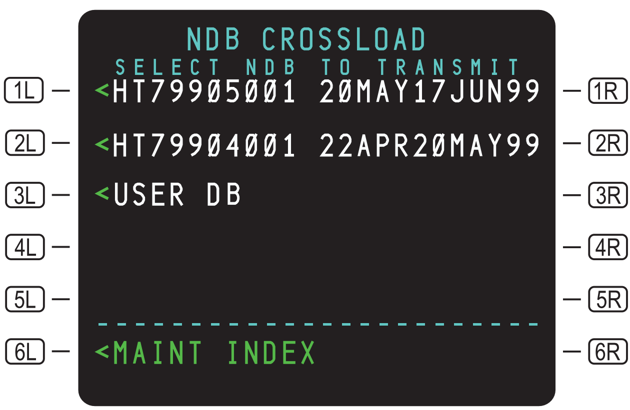
If the units are unable to communicate their NDB status to each other, Figure 3.6-18 appears.



HT28-007-079

Figure 3.6-18
NDB Communication Failure

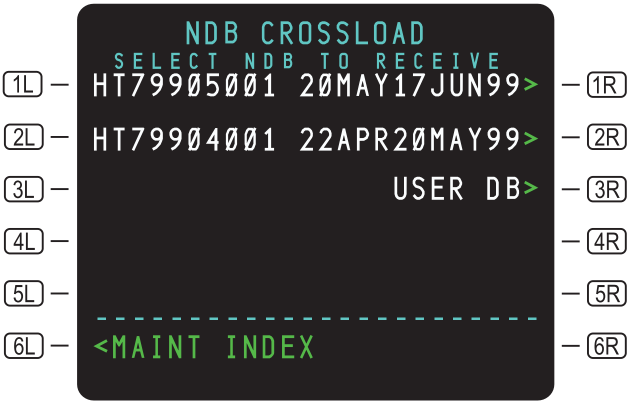
When the crew selects the TRANSMIT prompt at 1L (Figure 3.6-16), Figure 3.6-19 is displayed, listing the two NDBs available and the user data base in the onside system.



HT28-007-315

Figure 3.6-19
NDB Transmit

If RECEIVE at 1R (Figure 3.6-16) is selected, the NDB CROSSLOAD page (Figure 3.6-20) is displayed, listing the offside NDBs.



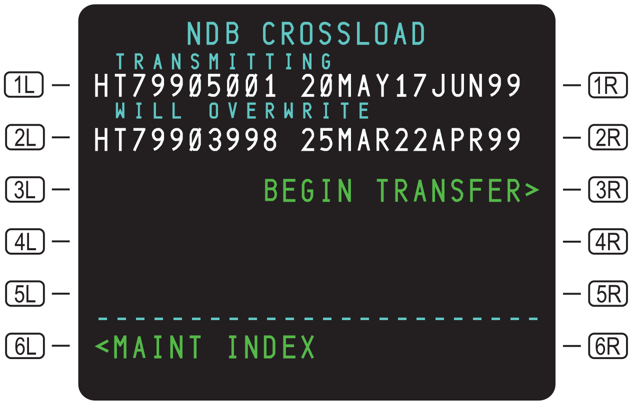
HT28-007-316

Figure 3.6-20
NDB Receive

After selection of the NDB to be transmitted (or received), NDB CROSSLAOD (Figure 3.6-20) is displayed. (If RECEIVE was selected, RECEIVING is displayed rather than TRANSMITTING.)

The receiving system will always overwrite its inactive data base. The identifier (and effectivity dates) are displayed at 2L. If no inactive data base exists (or if it fails validation), the word NOTHING is displayed at 2L.

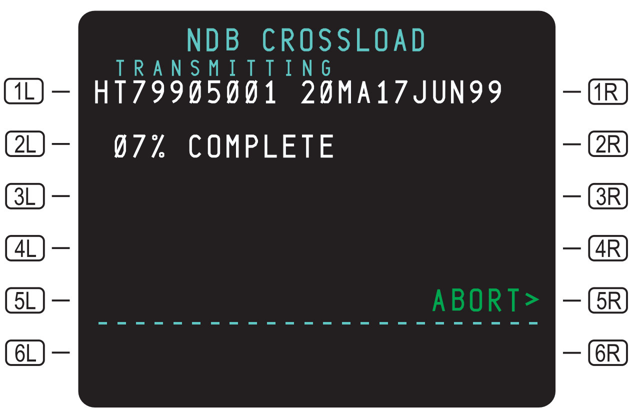
If only one NDB is available in the transmitting system, NDB CROSSLOAD (Figure 3.6-21) is displayed.



HT28-007-317

Figure 3.6-21
Single NDB Transmission

When **3R** BEGIN TRANSFER is selected, the transfer begins and Figure 3.6-22 is displayed. RECEIVING replaces TRANSMITTING as appropriate.



HT28-007-318

Figure 3.6-22
NDB Data Transfer

The displays of each system are independent (that is, the pilot and copilot may independently select different NDB crossload functions) until a transfer is begun. After BEGIN TRANSFER is selected, one side will display TRANSMITTING while the other side displays RECEIVING.

Figure 3.6-23 will be displayed when either the onside or offside data base processors has not completed its validation checks. This occurs if the crossload function is accessed shortly after a power interrupt. If a data base that has just been transferred fails its validation, NAV DATA CORRUPT appears in the scratchpad of the receiving unit.

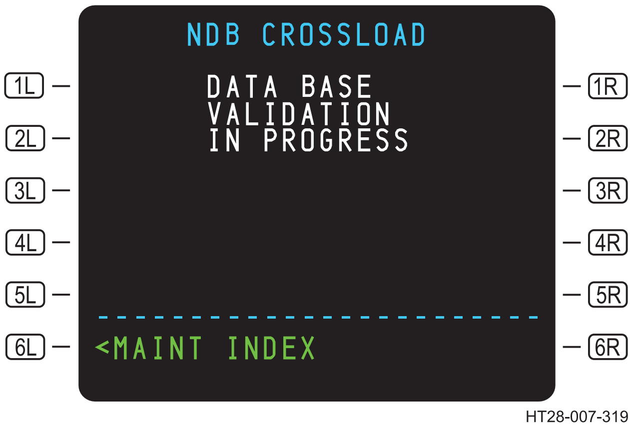


Figure 3.6-23
NDB CROSSLOAD – Validation in Progress

Figure 3.6-24 will be displayed under two conditions:

1. If a communication failure occurs during a crossload.
2. If ABORT is selected at 5R (Figure 3.6-22), COMM FAIL is not displayed.

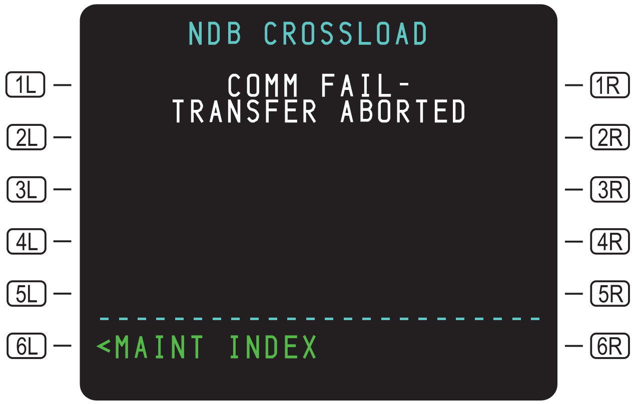


Figure 3.6-24
COMM Failure/Transfer Aborted

3.6.7 Transfer of USER DATA BASES

The system allows the manual transfer of all user-defined routes and waypoints from one unit to another. Press the DATA key to access the MAINTENANCE INDEX page. (See Figure 3.6-25).

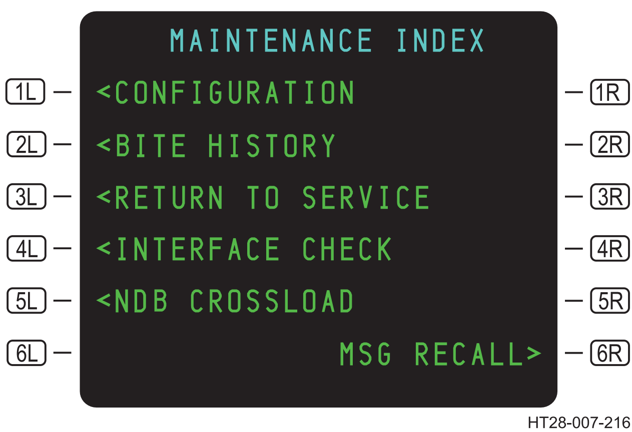
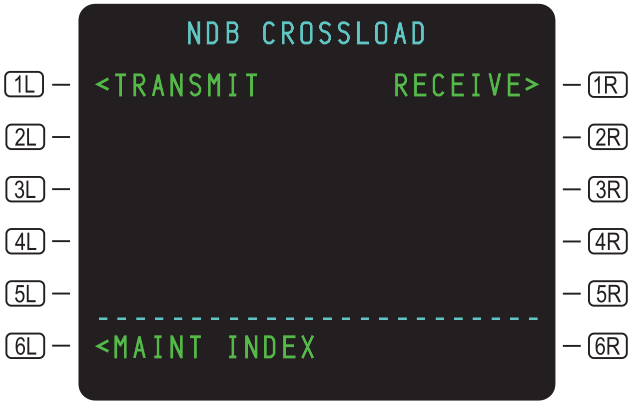


Figure 3.6-25
MAINTENANCE INDEX

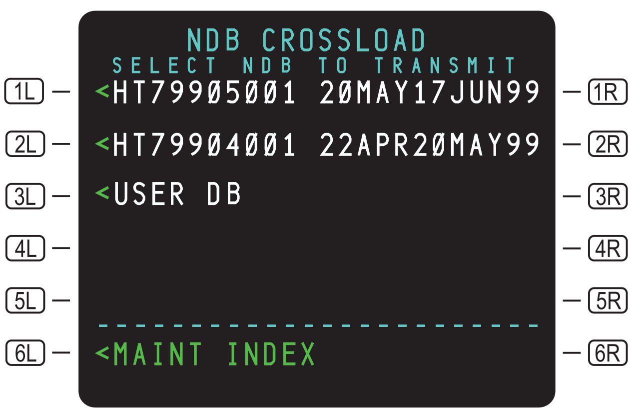
Pressing **5L** on the MAINTENANCE INDEX page will bring up theNDB CROSSLOAD TRANSMIT AND RECEIVE page. Pressing **1R** RECEIVE will transfer the data from the offside unit to the onside unit. (See Figure 3.6-26.) Pressing **1L** TRANSMIT will send the data from the onside unit to the offside unit.



HT28-007-217

Figure 3.6-26
NDB CROSSLOAD

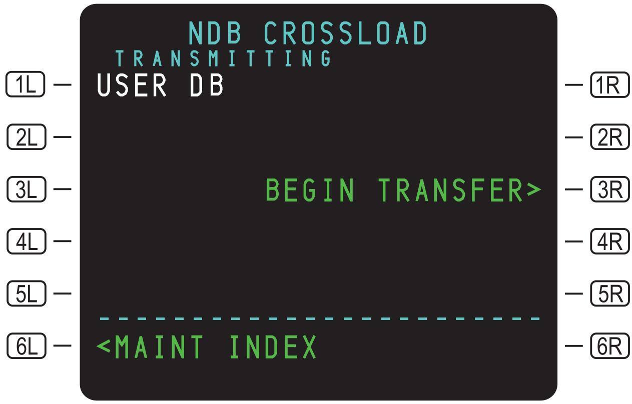
When either 1L TRANSMIT or 1R RECEIVE is pressed, the NDB CROSSLAOD page is displayed, listing the data bases that can be transferred. In Figure 3.6-27 there are two prompts, one is for the NDB and the other is for the USER DATA BASE.



HT28-007-321

Figure 3.6-27
USER DB Prompt

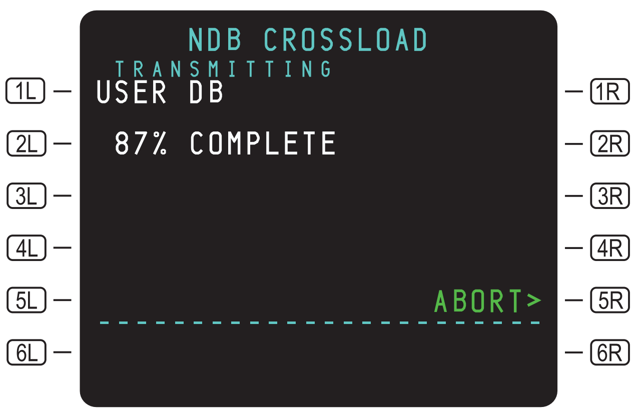
When 3L USER DB is pressed (Figure 3.6-27), the NDB CROSSLOAD page changes to show a BEGIN TRANSFER prompt at 3R. (See Figure 3.6-28.) Pressing 3R initiates the transfer.



HT28-007-322

Figure 3.6-28
BEGIN TRANSFER Prompt

When the BEGIN TRANSFER prompt **3R** (Figure 3.6-28) is pressed, the page changes to indicate that the USER DB is being transmitted and it displays the percentage complete. (See Figure 3.6-29.)



HT28-007-323

Figure 3.6-29
User Data Base Transmitting

Notice that on the NDB CROSSLOAD page there is an ABORT prompt at **5R** . When **5R** is pressed, the transfer is aborted and a TRANSFER ABORTED message is displayed. (See Figure 3.6-30.)

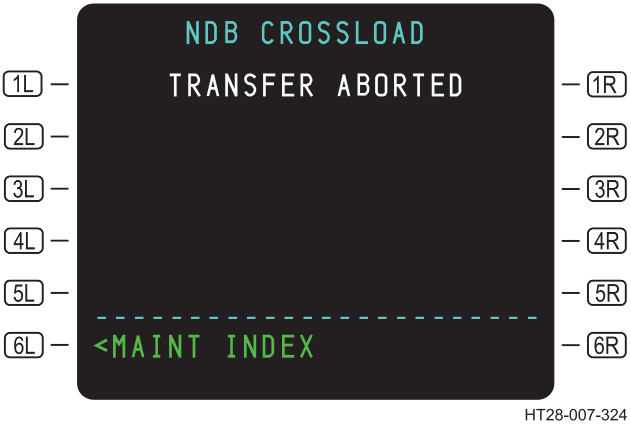


Figure 3.6-30
User Data Base TRANSFER ABORTED

NOTE: At any time on any NDB CROSSLOAD page, the pilot can return to the main MAINTENANCE INDEX page by selecting **6L**.

Figure 3.6-31 will be displayed if one of these two conditions occurs:
1. If a communication failure occurs during a crossload.
2. If ABORT is selected, COMM FAIL is not displayed.

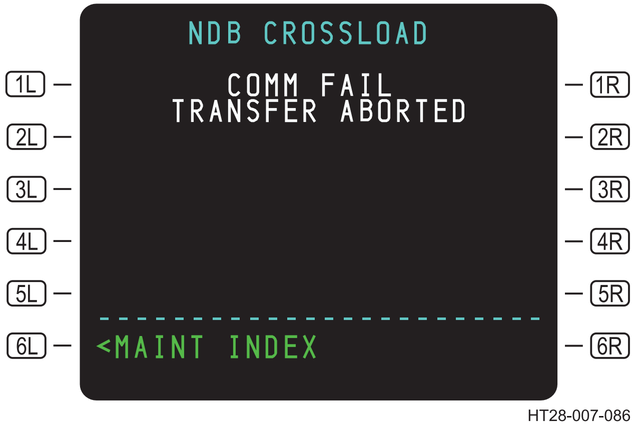


Figure 3.6-31
User Data Base TRANSFER ABORTED

3.6.8 SV Data Page

When GPS is the only navigation sensor available, the SV DATA> prompt is displayed at **3R** on POS REF Page 1.

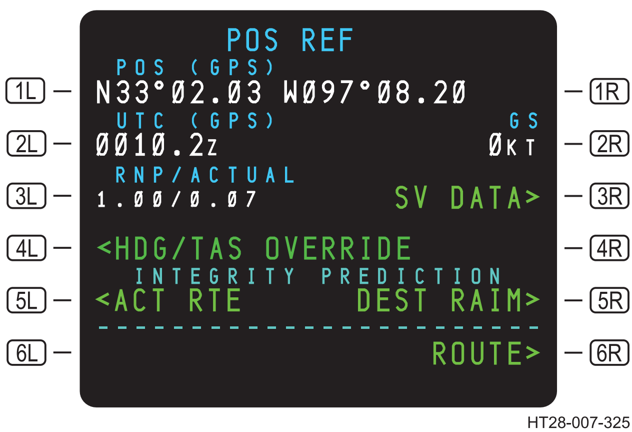
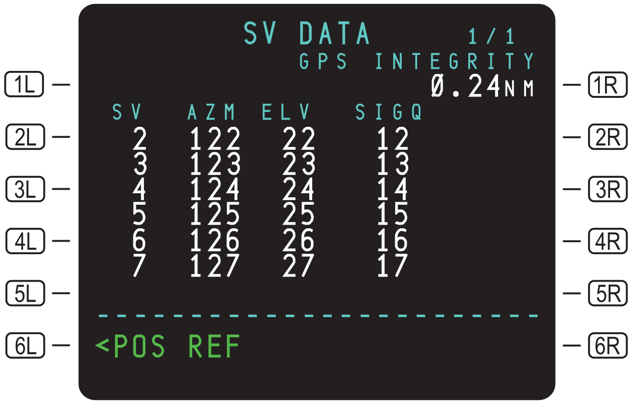


Figure 3.6-32
POS REF Page – SV DATA Prompt

STEP: ☞ 3R on the POS REF Page to view SV DATA.



HT28-007-326

Figure 3.6-33
SV DATA Page

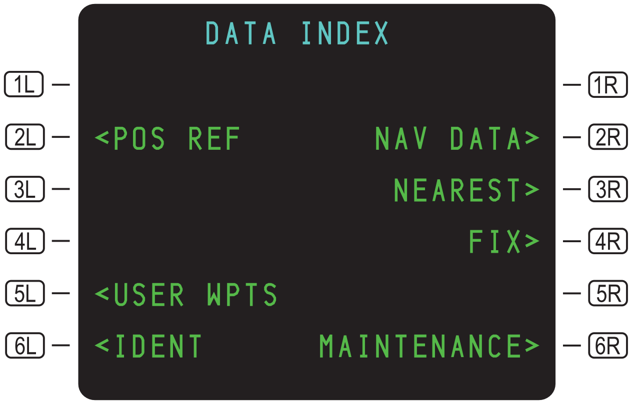
The SV DATA page shows information for all satellites currently being tracked. The information provided on this page includes azimuth (measured in degrees from the aircraft's antenna), elevation (that is, the elevation of the satellite in degrees above the horizon), and signal quality (Signal quality is a measure of the GPS signal strength. A minimum value of six is normally required.) Information for satellites that have been deselected is displayed in yellow. Satellites can be deselected manually on the ACT RTE PREDICTION page or by the system.

The GPS INTEGRITY at 1R (Figure 3.6-33) indicates the confidence level of the system regarding the aircraft's position. In Figure 3.6-33 the system is indicating it is 99% certain that the aircraft position is within 0.24 NM of the position displayed on the POS REF page.

3.6.9 Message Recall

Messages that have been displayed in the SP and cleared by the crew can be reviewed on the MESSAGE RECALL page. On the MAINTENANCE INDEX page, press DATA to access the DATA INDEX page.

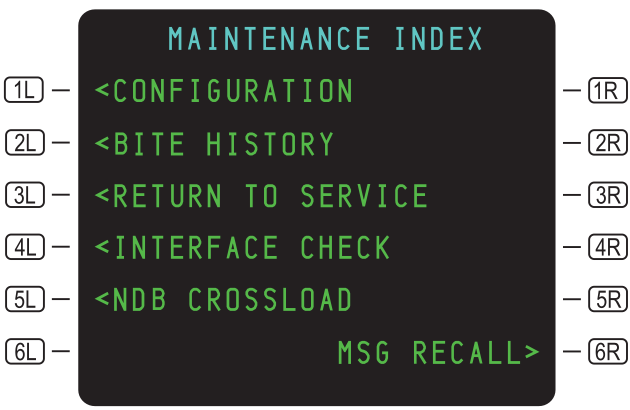
STEP: DATA.



HT28-007-222

Figure 3.6-34
DATA INDEX Page

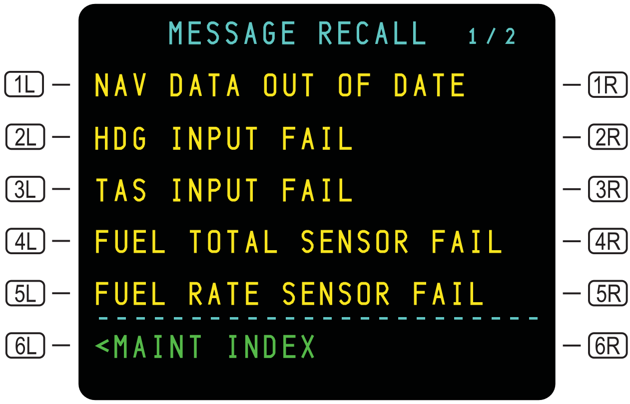
STEP: 6R on the DATA INDEX page to see MAINT INDEX page.



HT28-007-111

Figure 3.6-35
MAINTENANCE INDEX Page

STEP: ☞ 6R on the MAINTENANCE INDEX page to dispaly the MESSAGE RECALL page and review all of the messages. (See Figure 3.6-36.)



HT28-007-327

Figure 3.6-36
MESSAGE RECALL

The MESSAGE RECALL page displays all of the messages generated by the HT1000 since it was last powered up. Messages are displayed in order of importance. Alerting messages, displayed in YELLOW , appear first in the list. Advisory messages are displayed after the alerting messages.

3.6.10 User Routes

The HT1000 can store up to 127 user-defined flight plans with up to 150 legs per flight plan. These flight plans can be recalled and loaded into one of the two system routes (RTE 1 or RTE 2). The USER RTES> prompt is displayed on page 1 of RTE 1 or RTE 2 as shown in Figure 3.6-37. The USER ROUTES feature has to be enabled in the configuration pages in order for the prompt to be displayed.

HT28-007-241

Figure 3.6-37
User Routes Prompt

3.6.10.1 Create and Save User Routes

To create a new user route, insert a new origin and destination and at least one waypoint in either RTE 1 or RTE 2. If the route does not contain a discontinuity, the SAVE USER RTE #– – – – – –> prompt will be displayed at **5R**. (See Figure 3.6-38.) (If the route contains a discontinuity, no prompt will be displayed at **5R** until the route is properly defined.) The crew may assign a number to the route by entering the number into the SP and line-selecting it to **5R**. If a crew-entered number has already been assigned to a route with the same origin and destination, the message RTE # ALREADY EXISTS will be displayed. If the crew presses **5R** without entering a number (leaving the spaces blank), the system will assign a number . Whethe crew presses **5R** SAVE USER RTE#– – – – – –>, the system will save the user route. Upon saving, the prompt at **5R** will display ORGN/DEST – # SAVED (for example, KDFW/MMUN – 01 SAVED).

HT28-007-148

Figure 3.6-38
RTE 1 Page with User Routes Prompt

NOTES:

1. The system will save all waypoints except runways, SIDs, STARs, approach procedures, holding patterns, altitude constraints, along track waypoints, LAT/LON crossing waypoints or intercept legs of the defined route.
2. A route may contain a user-stored waypoint if that waypoint is part of the user data base.
3. If the user data base is full (127 user routes), an UNABLE SAVE message will be displayed in the scratchpad when attempting to save another route.

<u>STEPS:</u>

A. Enter a new route in RTE 1 or RTE 2.
B. ☞ PREV if necessary to go back to RTE page 1.
C. ☞ 5R (See Figure 3.6-40.)

When 5R is pressed, KDFW/MMUN - 01 is saved and then stored in the user route index. (See Figure 3.6-39.)

Figure 3.6-39
RTE 1 Page – User Route Saved

NOTES:
1. User routes created and saved on one HT1000 in a dual system will not automatically crossload to the other side. However, once the user route is called up, activated, and executed, the HT1000 system will automatically transfer the route to the other HT1000.
2. **All** stored user routes can be transferred to the other HT1000 system(s) by accessing the user route transfer prompt on the NDB crossload page (Section 3.6.6). The NDB page is accessible only while the aircraft is on the ground.

STEPS: To access to the NDB CROSSLOAD page.

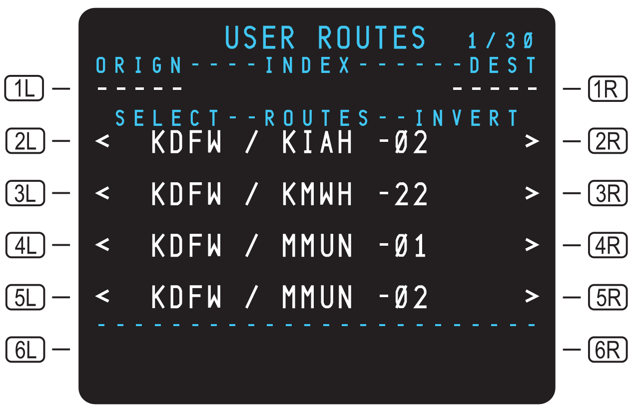
A. ☞ DATA.
B. ☞ 6R.
C. ☞ 5L.

3.6.10.2 Search the Data Base for a User Route

The USER ROUTE index lists all the stored user routes. From this page, the crew can search for a particular route by entering the ICAO identifier for the origin, destination, or both.

STEP: 4R on RTE page 1. (See Figure 3.6-37.)

Page 1 of the USER ROUTE index (Figure 3.6-40) is displayed.



HT28-007-150

Figure 3.6-40
USER ROUTES Index Page

1L **ORIGIN** - Allows for entry of the origin identifier in order to search the data base for a specific route. Once the origin identifier is entered, the system will search for and display all routes with that origin identifier.

1R **DEST** - Allows for entry of the destination identifier in order to search the data base for a specific route. Once the destination identifier is entered, the system will search for and display all routes with that destination identifier.

Line-select keys 2L, 3L, 4L, and 5L allow the pilot to select the User Route to load into the system, either route 1 or 2.

Line-select keys 2R, 3R, 4R, and 5R allow the pilot to select and invert the User Route to load into system route 1 or 2.

The pilot can search for a specific route by typing the route's origin or destination ICAO identifier into 1L or 1R.

STEPS:

A. Type KAUS in the SP on the USER ROUTES page.

B. ☞ 1L.

Typing KAUS into the scratchpad on the USER ROUTES page (Figure 3.6-40) and line-selecting to 1L brought up all routes with KAUS as an originating airport. (See Figure 3.6-41.)

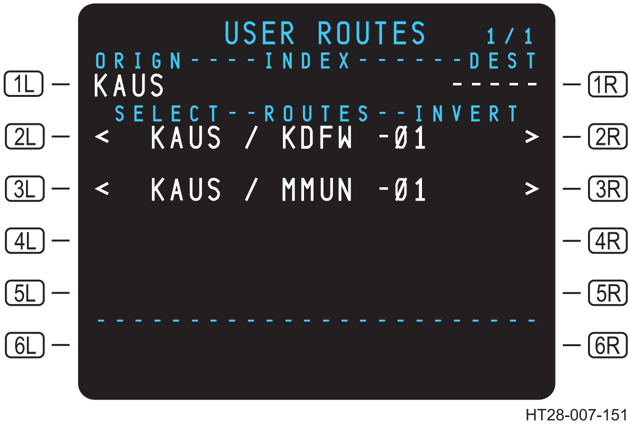
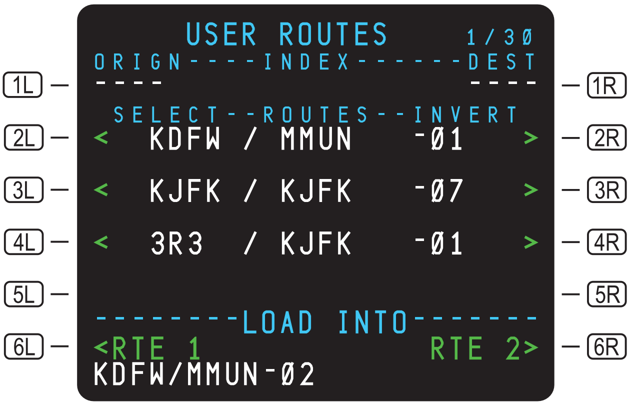


Figure 3.6-41
Search Results for Origin Identifier KAUS

3.6.10.3 Load a User Route

After the desired User Route is located in the data base, it can be loaded into one of the system routes (RTE 1 or RTE 2).

STEP: ☞ 5L to downselect KDFW/MMUN - 02 to the SP.



HT28-007-243

Figure 3.6-42
Load a USER ROUTE

6L **<RTE 1** – Pressing 6L will load the selected User Route into system Route 1. The screen will then display LOADING. (See Figure 3.6-43.) When the route is finished loading, the screen will display page 1 of RTE 1.

6R **RTE 2>** – Pressing 6R will load the selected User Route into system Route 2. The screen will display LOADING. (See Figure 3.6-43.) When the route is finished loading, the screen will display page 1 of RTE 2.

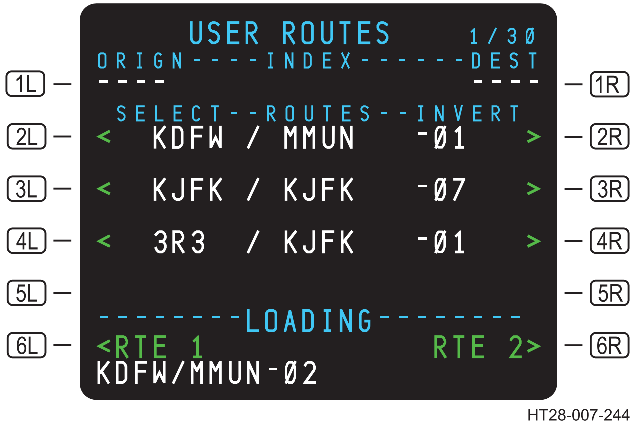


Figure 3.6-43
Page 1 of USER RTE 2

The system will only load into an inactive route page. Therefore, the pilot will see only RTE 1 at **6L** or RTE 2 at **6R** if they are inactive. For example, if RTE 1 is active, only RTE 2 will be displayed at **6R**.

The inverse route can be selected by pressing the **2R** to **5R** LSKs. In such a case, a ORGN/DEST - # (INVERT) message will be displayed in the scratchpad. The route then will be inverted and loaded into either the RTE 1 or RTE 2 page as selected by the pilot. (See Figure 3.6-44.)

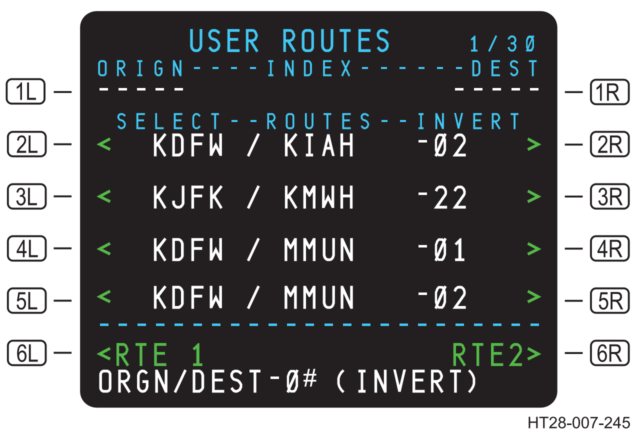
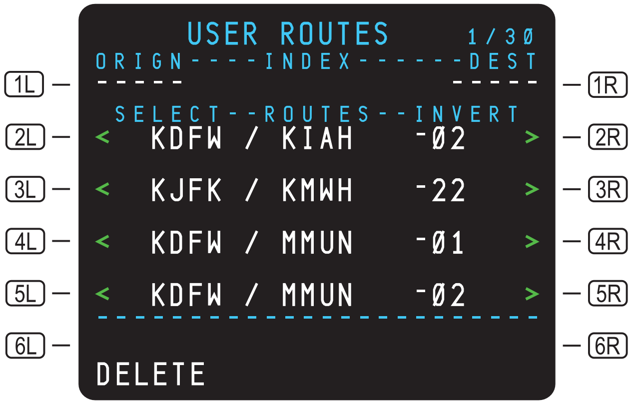


Figure 3.6-44
USER ROUTES - Inverted

3.6.10.4 Delete User Routes

Stored User Routes can be deleted if they are no longer needed or to make room for new routes.

STEP: CLR until DELETE appears in the SP.

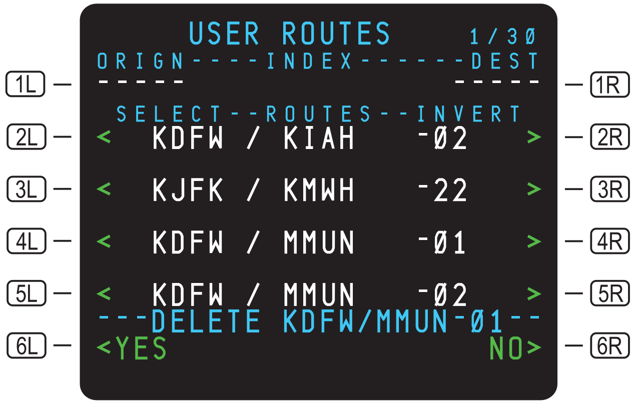


HT28-007-246

Figure 3.6-45
Delete USER ROUTES

STEP: **4L** to line select DELETE to the **4L** field.

After DELETE is entered into **4L**, KDFW/MMUN-01 appears in the SP and <YES and NO> prompts are displayed in **6L** and **6R** respectively. (See Figure 3.6-46.) Press **6L** <YES to delete the route or **6R** NO>to cancel deletion of the route.



HT28-007-247

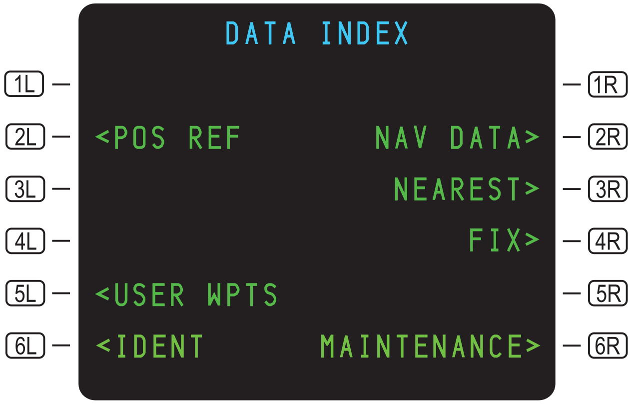
Figure 3.6-46
USER ROUTES Page - Confirm Delete

3.6.11 User Waypoints Storage and Retrieval

The HT1000 allows the pilot to define a waypoint using PB/PB, PB/D or by LAT/LON if the system has been configured for this feature. The waypoint can be named using any combination of alphanumeric characters (not to exceed five characters), and stored away for future retrieval. When retrieved, the waypoint can be inserted into the flight plan according to the same rules used for other waypoints. The HT1000 system is capable of storing up to 256 customized user waypoints.

If the system is configured for the USER WPTS function, follow the steps below to access the USER WPTS page.

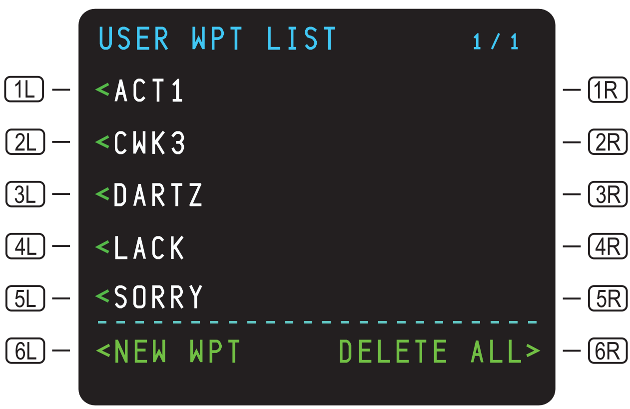
STEPS:
1. DATA.
2. Select the USER WPTS prompt at 5L.



HT28-007-170

Figure 3.6-47
DATA INDEX Page

Selecting the USER WPTS prompt at 5L displays the USER WPT LIST page (Figure 3.6-48). This page lists all user-defined waypoints.



HT28-007-264

Figure 3.6-48
USER WPT LIST Page

On the USER WPT page (Figure 3.6-49), the pilot can define the waypoint using several methods, such as LAT/LON, PB/D or PB/PB. In Figure 3.6-49, the waypoint has been named A5BC7. (Any combination of letters and numbers can be used, not to exceed five characters in length.) The new waypoint has been defined using the PBD technique (PXR180/20). When this PBD is inserted into 4L, the HT1000 automatically computes the LAT/LON in 3L.

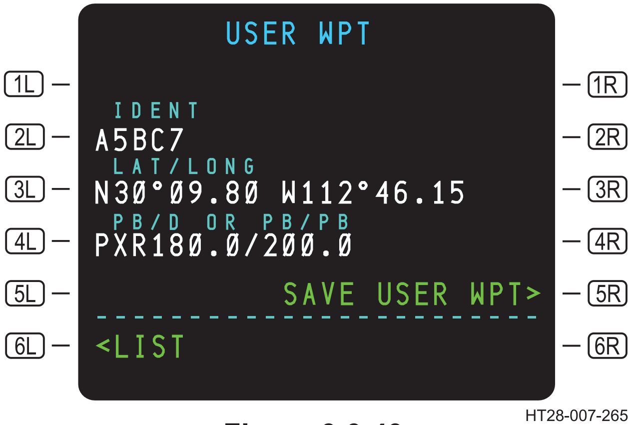


Figure 3.6-49
SAVE USER WPT

Notice that after a waypoint has been defined, SAVE USER WPT appears at **5R** allowing the crew to save the new waypoint. (See Figure 3.6-49.) When **5R** is pressed, the display will show USER WPT SAVE COMPLETE. (See Figure 3.6-50.)

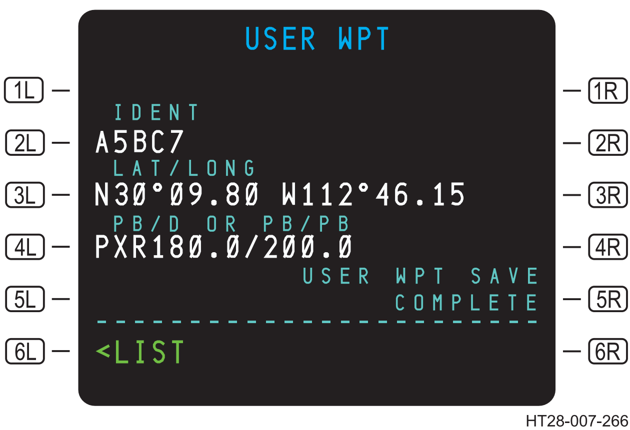


Figure 3.6-50
USER WPT SAVE COMPLETE

3.6.11.1 User Waypoint Retrieval

Notice the LIST prompt at 6L in Figure 3.6-50. Pressing 6L will access the USER WPT LIST page(s) (Figure 3.6-51) that contain all of the stored, customized waypoints. There may be several pages as the system can store up to 256 customized waypoints.

HT28-007-267

Figure 3.6-51
USER WPT LIST Page

Pressing the LSK adjacent to a waypoint on the list will bring up the waypoint page for that waypoint. (See Figure 3.6-49). After confirming the selection, the pilot can drop the waypoint name into the scratchpad and transfer the waypoint into the flight plan via the LEGS page. Pressing 6L NEW WPT will access a blank USER WPT page so that a new customized waypoint can be defined and stored, if desired.

3.6.11.2 Delete User Waypoint

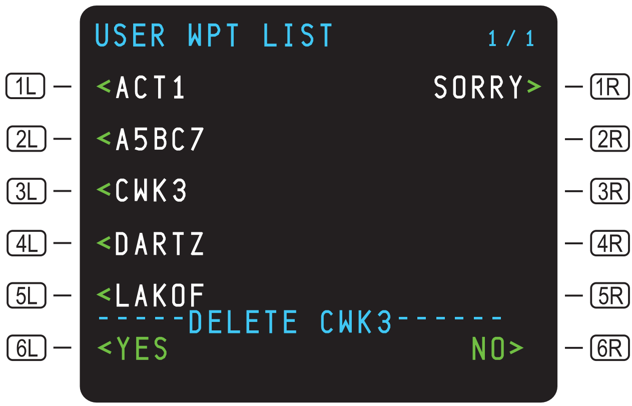
Pressing 6R DELETE ALL> (Figure 3.6-51) will erase **all** user-defined waypoints that are in storage.

To delete one user waypoint, follow these steps:

STEPS:

A. ☞ CLR and DELETE appears in the SP.

B. ☞ 3L to delete user waypoint CWK3.



HT28-007-343

Figure 3.6-52
Deleting a User Waypoint

Then choose <YES at 6L or NO> at 6R to complete the change.

3.6.12 HT1000 Page Tree

The following pages provide a quick reference to MCDU page access by means of a "tree" structure. The function key "trees" covered include the following.

Function	Figure Number
VNAV	3.6-53
RTE	3.6-53
LEGS	3.6-54
DEP ARR	3.6-55
HOLD	3.6-56
PROG	3.6-57
DATA	3.6-58

This page to be substituted by a foldout, Figure 3.6-53

This page to be substituted by a foldout, Figure 3.6-53

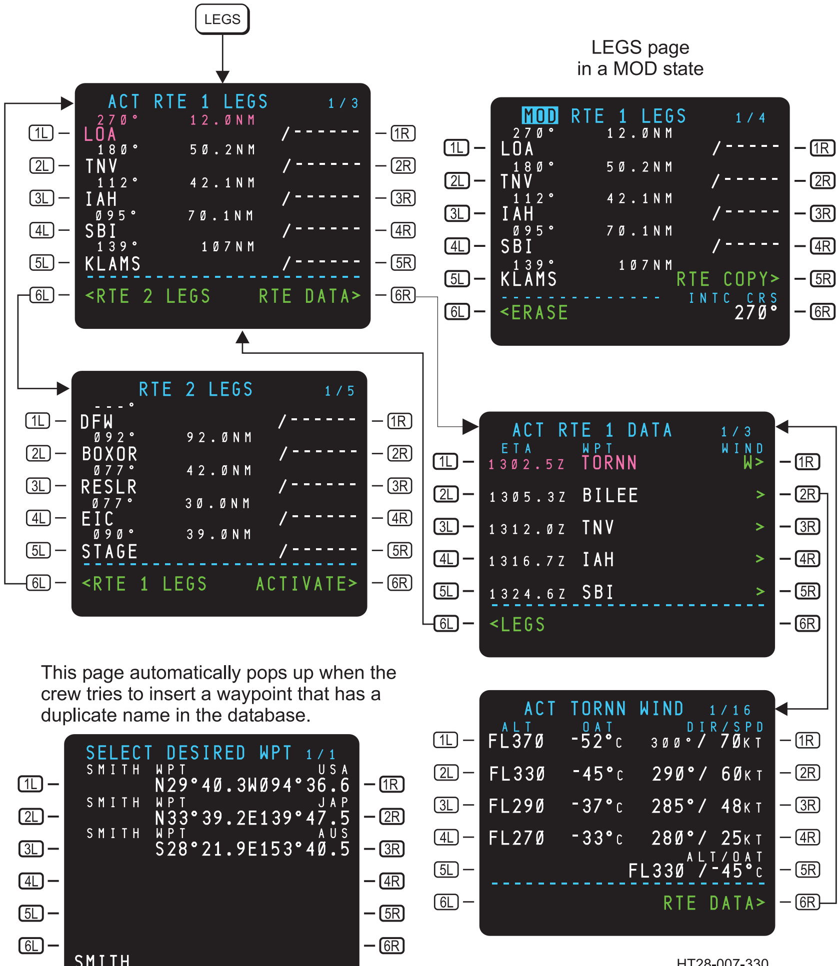


Figure 3.6-54
LEGS Page Tree

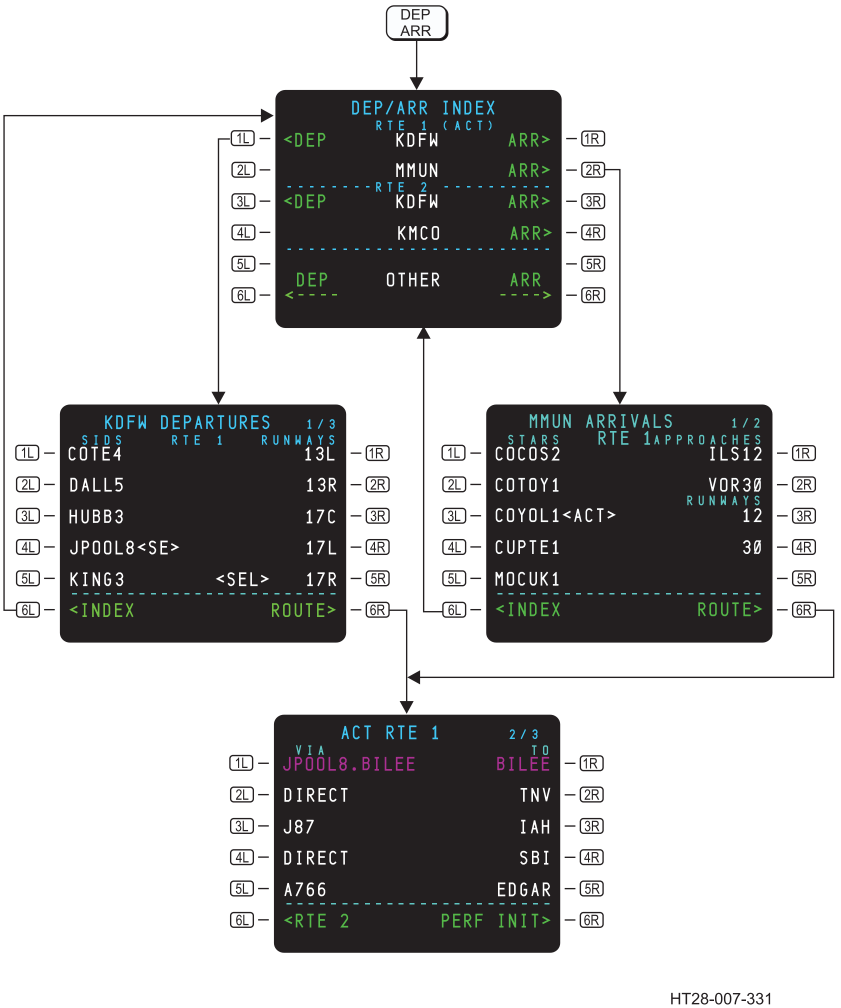


Figure 3.6-55
DEP/ARR Page Tree

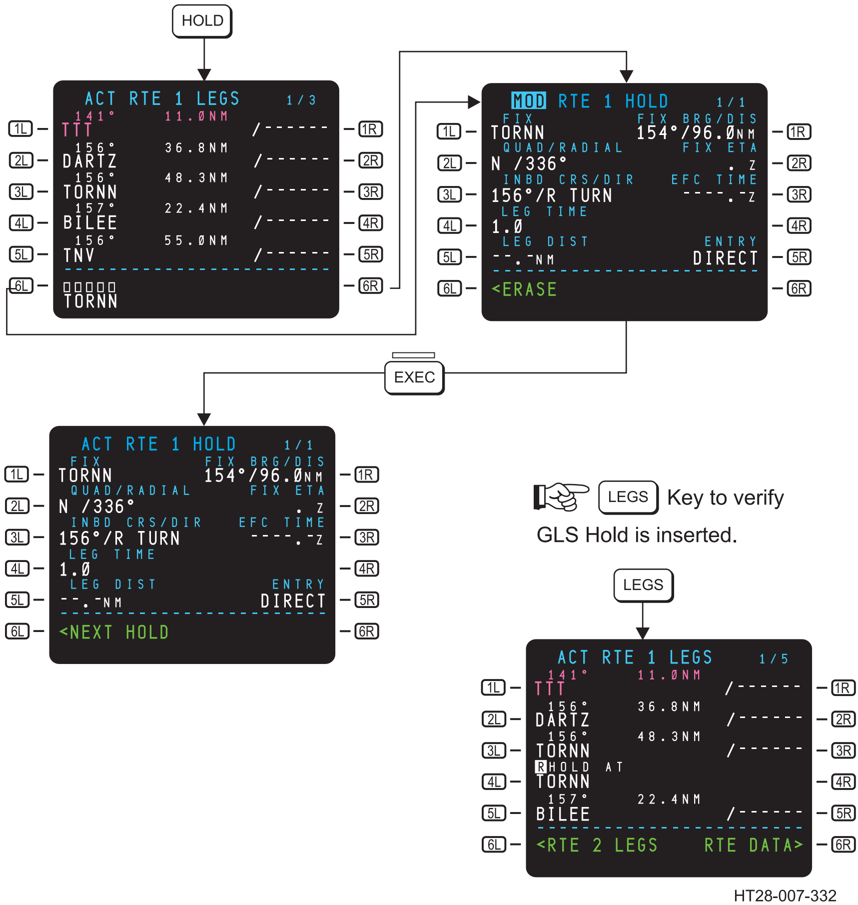


Figure 3.6-56
HOLD Page Tree

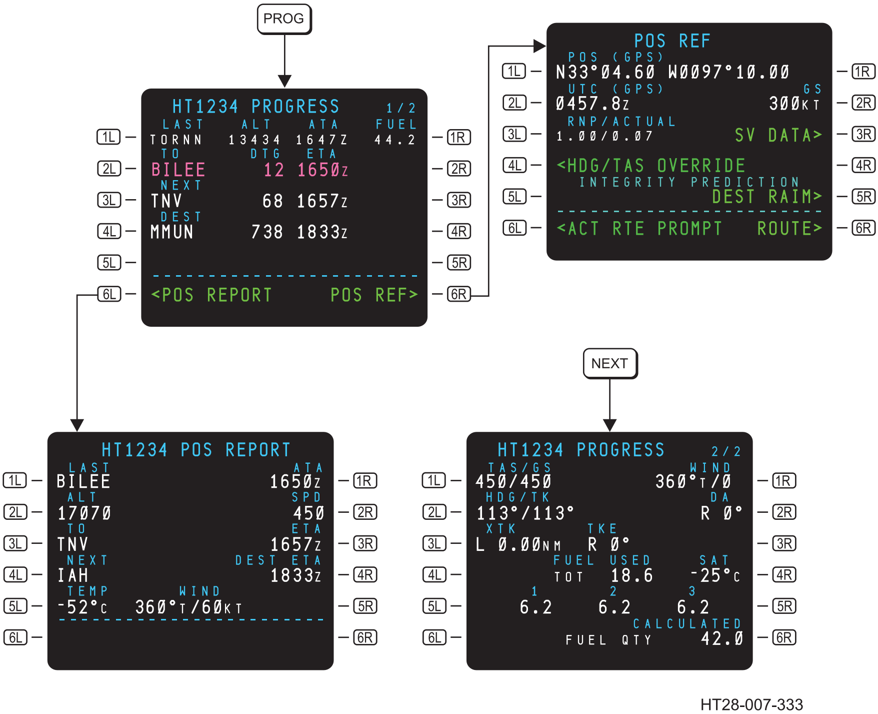


Figure 3.6-57
PROGRESS Page Tree

This page to be substituted by a foldout, Figure 3.6-58, This page to be substituted by a foldout, Figure 3.6-58,

Figure 3.6-59
DATA (MAINTENANCE) Page Tree

TABLE OF CONTENTS

Alerting and Advisory messages illuminate the MCDU message (MSG) light. Clearing the message or correcting the condition cancels the message. Once the message is cleared, it will not reappear even if the condition triggering the message is still current. To review messages once they have been cleared to the message log, follow these steps:

1. ☞ DATA
2. ☞ 6R on the DATA INDEX page
3. ☞ 6R on the MAINTENANCE INDEX page

A.1 ALERTING MESSAGES

HT1000 alerting messages are displayed on the MCDU scratchpad in YELLOW, and they illuminate the MCDU message light (MSG).

Use the CLR key or correct the condition responsible for the message to remove the message permanently. The message is pushed to the background when data is manually entered into the SP. The message returns to the SP when the data is removed.

HT1000 MESSAGE	CONDITION	PILOT ACTION
ACT DESCENT PATH INVALID	System detects a rise within the descent path.	Recheck the descent path and modify if necessary.
ALTITUDE INPUT FAIL	The system has no source for Altitude data. VNAV is disabled. There will be no TOC or TOD computed.	Crew awareness. Top of Climb and Top of Descent computations are inop. VNAV is inop. Altitude legs in procedures will require manual sequencing.
CHECK GPS STATUS-POS REF	At 30 NM from the destination, message will be generated if the system is not using GPS for navigation.	Crew must use altenate means of navigation for the arrival and approach.
DEAD RECKONING	Insufficient satellites ar avaialable to support GPS navigation.	Go to 4L on the DR page. Manually insert forecast winds for current leg.
DME INPUT FAIL	No DME data has bee received from DME 1 or DME 2 for 10 seconds.	Monitor HT1000 position using alternate external sensors as available.
GNSSU 1 FAIL or GNSSU 2 FAIL	BITE has detected a failure in one of the Global Navigation Satellite Sensor Units in a dual installation.	ON SIDE lateral and vertical path deviations for the approach are invalid. 1. Verify that OFFSIDE unit is operable. 2. If OFFSIDE unit is inoperable, suitable supplemental navigation is required for the approach.
GNSSU FAIL	BITE has detected a failure i the GNSSU.	Lateral and vertical path devistions for the approach are invalid. Suitable supplemental navigation is required for the approach.
GPS ANTENNA FAIL	BITE has detected a GPS antenna failure.	Monitor HT1000 position using external sensors as available.

HT1000 MESSAGES	CONDITION	PILOT ACTION
HDG INPUT FAIL	The system is not receiving any heading data. Wind data and ETAs may be in error.	If failure persists, manually enter HDG on the HDG/TAS OVERRIDE page.
INS INPUT FAIL	The HT1000 is configured for Inertial Navigation System (INS) interface and the INS reports a failure or stops communicating.	1. If in GPS position updating, no action required. 2. If in INS position updating, verify an alternate navigation update source has been selected.
NAV DATA CORRUPT	The HT1000 navigation data base has been corrupted. Attempts to access Nav Data will result in NOT IN DATA BASE message.	1. Reload Nav Data Base. 2. If reload not possible, select alternate HT1000 data base from IDENT page until reload may be performed.
NAV DATA OUT OF DATE	The HT1000 navigation data base has expired.	Verify navigation/route data using current information.
ONSIDE ALT FAIL	f the system is configured for VNAV this will be an alert message. The onside unit is failing to receive onside altitude data, but is still receiving data from off side unit.	VNAV operations not authorized.
SOFTWARE CONFIG INVALID	The HT1000 contains an invalid or corrupt software configuration. HT1000 MCDU will not leave the IDENT page.	System is INOP.
TAS INPUT FAIL	The system is not receiving any True Airspeed data. Wind data and ETAs may be in error	If failure persists, manually enter TAS on the HDG/TAS OVERRIDE page.
TIME OUT-RESELECT	A communication failure has occurred between the HT1000 NPU and MCDU. This message generally indicates an NPU failure.	1. Select GPS/NAV from MENU if displayed. 2. If message repeats, cycle power on HT1000. 3. If GPS/NAV prompt still does not appear, the NPU or MCDU is failed.

HT1000 MESSAGE	CONDITION	PILOT ACTION
UNABLE APPROACH	Triggered by the system if RAIM prediction fails or if the current RAIM FAILS.	Crew must use an alternate means to navigate the approach or execute a missed approach.
UNABLE RNP	The current HT1000 navigation accuracy or integrity does not meet the current RNP requirements.	Monitor HT1000 position using external sensors as available.
VDL FAIL	BITE had detected a failure in the VHF data link (VDL).	DGPS approach tuning is not available.
VERIFY RNP-POS REF	The system has transitioned to a flight phase (en route, terminal, etc.) for which the Required Navigation Performance (RNP) is more stringent than the pilot input.	On POS REF page, verify that the entered RNP value still applies for the current phase of flight.
HOST PROCESSOR FAIL	The system has detected an internal memory or timing violation.	Cycle power. If message repeats, system is inop.
DBASE PROCESSOR FAIL	The system has detected an internal memory or timing violation.	Cycle power. If message repeats, system is inop.
AIO PROCESSOR FAIL	The system has detected an internal memory or timing violation.	Cycle power. If message repeats, system is inop.
DIO PROCESSOR FAIL	The system has detected an internal memory or timing violation.	Cycle power. If message repeats, system is inop.
MATH COPROCESSOR FAIL	The system has detected an internal memory or timing violation.	Cycle power. If message repeats, system is inop.

A.2 ADVISORY MESSAGES

HT1000 advisory messages are displayed on the MCDU SP in WHITE and they illuminate the MCDU message light (MSG).

HT1000 MESSAGE	CONDITION	PILOT ACTION
CHECK DEST RAIM-POS REF	On entering the terminal area, the HT1000 predicts that approach RNP will not be available to support the approach procedure in the Active Route.	Check DEST RAIM via POS REF page. Be prepared for UNABLE APPROACH alert when approaching FAF.
CHECK FUEL-VNAV	Fuel on board is less than programmed reserve.	On PERF INIT (VNAV)page, verify FUEL and RESERVE quantities.
CONFIGS DIFFER-NO VNAV	Displayed when the default (configured) performance data in the systems in a dual or triple installation do not match. VNAV is not allowed if this occurs	Notify maintenance. Default configuration data in all HT1000 systems will need to be checked.
DESCENT PATH DELETED	The active route had a valid descent path when a mod active route was created that removed the last AT altitude constraint required to define the descent profile.	Crew awareness.
DISCONTINUITY	The Route Discontinuity exists after the current active leg.	Access Route Legs page to resolve Route Discontinuity.
END OF DESCENT	The aircraft is on the last vertically constrained leg that defines the descent profile. The message is displayed at 2 minutes, 30 seconds, or at 10 seconds (based on RNP) prior to the vertical track change.	Crew Awareness
END OF OFFSET	Aircraft is within 2 minutes of the end of offset point.	Crew awareness. The system will cancel the programmed parallel offset at the next leg change(on the original route).
END OF ROUTE	The aircraft has flown beyond the last fix in the active route	Program additional route legs as required.

HT1000 MESSAGE	CONDITION	PILOT ACTION
EXIT HOLD ARMED	Appears one minute prior to aircraft exiting hold.	Crew awareness.
FLIGHT COMPLETE	Five minutes after landing at the destination airport, the IDENT page displays this message.	Crew awareness. The flight complete logic erases the current active flight plan, PERF INIT data (except CRZ ALT) and winds. Inactive route is retained.
FLIGHT PLAN DISAGREE	Displayed when the active routes in a dual or triple installation do not match.	Initiate flight plan tarnsfer by re-entering cruise altitude.
FUEL INPUT FAIL	The system has no source for fuel data.	Crew awareness. Fuel compu- tations on PERF INIT and PROG pages are INOP. Message "CHECK FUEL-VNAV"will not be available.
HIGH HOLDING SPEED	The size of the upcoming hold has been restricted due to airspace limitations. The HT1000 may not be able to maintain the pattern due to aircraft speed and configured bank limits.	Crew awareness. Reduce speed if desired.
MOD HOLD PENDING	The message is displayed when a pending modification has not been executed prior to reaching the hold fix.	Execute or erase modification prior to reaching hold fix.
NOT ON INTERCEPT HDG	Current aircraft heading does not allow execution of programmed course to intercept.	Maneuver aircraft to enable intercept, then execute course to intercept.
NO TRANSITION SELECTED	An approach has been activated without specifying a transition.	If desired, select approach transition on arrival page.
ON SIDE ALT FAIL	Onside unit is failing to receive it's own onside alt data input but is still receiving ALT data from the offside unit. This message will turn yellow and be upgraded to an alert level message.	Crew awareness.

HT1000 MESSAGE	CONDITION	PILOT ACTION
ONSIDE HEADING FAIL	Onside unit is failing to receive onside HDG data from the offside unit.	Crew awareness.
ONSIDE TAS FAIL	Onside unit is failing to receive onside TAS data from the offside unit.	Crew awareness.
RAIM LIMIT EXCEEDS XX NM	The GPS RAIM protection limit exceeds the specified (XX) value.	Monitor HT1000 position using external sensors as available.
REAL TIME CLOCK ERROR	Internal battery on the HT1000 may be bad.	Notify maintenance to schedule service.
RNP AVAILABLE	The HT1000 navigation accuracy and integrity supports the current RNP requirements.	Monitoring of HT1000 position using external sensors is not required.
RTE 1 UPDATING	Route 1 has been or is being modified by the offside system. Onside display will change to the RTE LEGS page when complete and will be in a MOD state. Message will clear automatically when the mod active route is EXECuted.	Crew awareness.
RTE 2 UPDATING	Route 2 has been or is being modified by the offside system. Onside display will change to the RTE LEGS page when complete and will be in a MOD state. Message will clear automatically when the mod active route is EXECuted.	Crew awareness.
TRANSFER UNABLE	Displayed on the system that EXECuted the active route when the route transfer to the offside system fails.	Flight plan must manually be entered into the other MCDUs.
UNABLE CRUISE ALT	The Active Route is too short to achieve the programmed cruise altitude.	Access PERF INIT (VNAV key) page to update cruise altitude as required.

HT1000 MESSAGE	CONDITION	PILOT ACTION
VERT TRACK CHANGE ALERT	Displayed at 2 minutes, 30 seconds, or 10 seconds prior to vertical track change based on RNP for Oceanic/remote, Enroute, or Terminal. the vertical track or change alert will be given at every altitude constraint and the two deceleration points if present.	Crew awareness.
VNAV PATH NOT RECEIVED	VNAV path information was not received by the receiving unit. Message may be the result of a temporary interruption in the transfer process.	Modify flight plan so another automatic transfer can be attempted by the system. If a second failure occurs, notify maintenance.

A.3 ENTRY ERROR MESSAGES

HT1000 entry error messages are displayed in the MCDU SP in WHITE. They must be removed by pressing the CLR key.

HT1000 MESSAGE	CONDITION	PILOT ACTION
INVALID DELETE	The last delete attempt is invalid.	Data in the field cannot be deleted.
INVALID ENTRY	The last entry is invalid.	The data entry syntax is either incorrect, out of range, or it was line-selected to the wrong field.
INVALID ENTRY-CONSTRAINT	Vertical navigation is enabled and a cruise altitude has been entered that is lower than the highest arrival constraint that was contained in the nav data base.	Check cruise altitude compatibility with selected arrival procedures. Reselect cruise altitude or arrival procedures if needed.
INVALID IN APPROACH	The last selection on the DEP/ARR pages is invalid, since the system is currently flying an approach procedure.	Execute Direct-To out of Approach Procedure prior to selecting alternate arrival/approach.
NOT IN DATABASE	The fix entered was not found in the Nav data base.	Verify entered fix identifier is correct.
RECEIVING ROUTE	Flight planning action has been attempted while the unit is receiving a route from the offside unit.	Wait until data transfer is complete before attempting flight plan modification.
ROUTE FULL	The last pilot flight planning operation was not performed because it would have resulted in overflowing the amximum route size of 150 legs.	Use an inactive route to perform additional route planning.
RUNWAY N/A FOR SID	The runway entered on the RTE page is not valid for the selected departure.	Select another SID or select another runway.
STANDBY ONE	The last pilot input is being processed by the system	None required.
UNABLE COPY	An error occurred in the data base processor when a route copy was performed.	Clear the message and retry the route copy. If message reoccurs, notify maintenance.

HT1000 MESSAGE	CONDITION	PILOT ACTION
UNABLE SAVE	An error occurred in the data base proecessor when storing the route or user waypoint.	Clear the message and retry saving the route or waypoint. If message reoccurs, notify maintenance.
VERIFY RNP ENTRY	The manual input of RNP (just performed) is less stringent than the normal RNP for the current flight phase.	Verify that the proper RNP entry was made.

A.4 MCDU ANNUNCIATOR LIGHTS

HT1000 MESSAGE	CAUSE
MSG	An H1000 message is awaiting display or is displayed.
CALL	Presently inoperative.
EXEC Light	EXEC button is armed for execution.

CDU DISPLAY	SYMBOL TYPE	COMMENTS
150° OED	DIRECT TO A FIX OR COURSE TO A FIX	
HOLD AT (8000)	HA (Hold to Altitude) TYPE HOLD	System remains in the hold until reaching a specific altitude. These types of holding patterns are usually associated with some SIDS. Aircraft will climb in the holding pattern until a specific altitude is reached. Holding pattern exit logic will then be valid.
HOLD AT SCARR	HF(Hold to Fix)TYPE HOLD	The aircraft will remain in holding for one complete pattern. After the aircraft crosses the hold fix the exit logic will then become valid. Typically these types are found on approach procedures as part of the alignment procedure. The aircraft will make one turn around the holding pattern and then exit the hold.
HOLD AT SCARR	HM(Manual Hold)	Most common type of hold. The pilot defines the hold on the route of flight. The hold is also exited manually with the pilot selecting the exit hold function.
_ _ _ _ _°	INITIAL FIX	The dashes indicate that the system will not compute course guidance to the first fix on the flight plan. Typically this leg type is shown as the first leg of a SID after departure. The system assumes that the aircraft will be on a heading after takeoff until ATC gives the crew direct-on course. Typically the crew would then do a direct to the first waypoint on their route. The HT1000 would then calculate a course from present position direct to the first waypoint and replace the dotted line with the new course. Guidance to the autopilot would then be available.
030° P-TURN	WAYPOINT NAME THAT DESCRIBES TURN TO INITIAL OUTBOUND HEADING FOR THE PROCEDURE TURN	

CDU DISPLAY	SYMBOL TYPE	COMMENTS
180° OUT-B	POINT WHICH TERMINATES THE OUTBOUND LEG OF THE PROCEDURE TURN	
180° IN-B	POINT AT THE INTERSECTION OF THE PROCEDURE TURN AND THE INBOUND LEG	
167° ALDER	TRACK BETWEEN TWO FIXES	
069° (530)	COURSE FROM A FIX TO AN ALTITUDE	Sometimes referred to as a conditional fix. Instead of the leg terminating at another fix, the leg terminates at an altitude.
055° VECTORS	COURSE FROM A FIX TO A MANUAL TERMINATION	This leg will terminate only when the pilot manually terminates the leg (i.e.performing a direct to)
078° HDG (1530)	HEADING TO AN ALTITUDE	This leg will terminate when the aircraft reaches the altitude (in this case 1520 ft.).
020° HDG PXR/13	HEADING TO A DME DISTANCE	Leg terminates when the aircraft is a specific DME distance from a fix (in this case 13NM from PXR).
300° HDG (INTC)	HEADING TO A COURSE INTERCEPT	Leg terminates when the heading intercepts the inbound leg (the next leg described on the legs page).
085° HDG PXR350	HEADING TO A VOR/DME RADIAL	Leg terminates at a specific DME distance off of a VOR radial.
20 ARC L ABCDE	DME ARC TO A FIX	The CDU shows a left 20NM DME arc that terminates at a waypoint called ABCDE.
20 ARC L D360T	DME ARC TO A FIX	This example shows the ARC ending at a fix defined by a DME distance. The D360T indicates it's a DME fix (D) on the 360 radial at a distance of 20 miles(the alphabet denotes distance with A=1NM, B=2NM...T=20NM, etc.).
085° PXR350	COURSE TO A VOR RADIAL	Leg terminates when course intercepts the 350° radial off of PXR.

CDU DISPLAY	SYMBOL TYPE	COMMENTS
080° ABC/20	COURSE TO A DISTANCE	This leg will terminate at a fixed distance from ABC. Not to be confused with DME distance. This distance is computed and defined by the system.
120° (3000)	COURSE TO AN ALTITUDE	
060° (INTC)	COURSE TO AN INTERCEPT COURSE	
F	FAF	The 'F' identifies the Final Approach Fix for a Non-Precision Approach. The 'F' symbol is displayed next to the waypoint or fix identifying the FAF. The 'F' is displayed in reverse video.
M	MAP	The 'M' identifies the missed approach point on the non-precision approach. The 'M' symbol is displayed next to the waypoint or fix identifying the MAP point. The 'M' is displayed in reverse video.
D136T	DMEFIX	The example shows the nomenclature that identifies a fix as a DME distance on a radial. The 'D' identifies this as a DME fix. The 136 identifies the radial that the DME distance lies on. The 'T'identifies the distance. The alphabet is used to identify DME distance. for example, A=1DME, B=2DME, and so on. T would equal 20 DME.
42.1 NM 170 NM	DTG (Distance to Go)	Distance to go identifies distance as measured along the flight path leg to the next fix. If the distance is less than 99NM then tenths of a mile are displayed. If distance is greater than 99NM, whole miles are displayed.
L OR R	DIRECTION OF TURN	Displayed in reverse video. Indicates direction of turn. When turn direction is associated with a nav database procedure(SID, STAR or Approach), then the turn direction specified by the procedure will be displayed next to the fix at which the turn is initiated

CDU DISPLAY	SYMBOL TYPE	COMMENTS
5000	AT ALTITUDE	Displayed in a large white font if the altitude is an altitude restriction calculated by the nav database. Displayed in large cyan font if the altitude is an altitude restriction inputted by the pilot. Displayed in small white font if the altitude is merely a crossing prediction made by the HT1000.
5000A	AT OR ABOVE ALTITUDE	Indicates a crossing restriction that requires the aircraft to cross the fix at or above 5000 ft. Displayed in large white font if the altitude is an altitude restriction inputted the nav database. Displayed in large cyan font if the altitude is an altitude restriction inputted by the pilot.
5000B	AT OR BELOW ALTITUDE	Indicates a crossing restriction that requires the aircraft to cross the fix at or below 5000 ft. Displayed in large white font if the altitude is an altitude restriction inputted the nav database. Displayed in large cyan font if the altitude is an altitude restriction inputted by the pilot.
5000B 4000A	WINDOW ALTITUDE	Indicates a crossing restriction that requires the aircraft to cross the fix between 5000 and 4000 ft. Displayed in large white font if the altitude is an altitude restriction inputted the nav database. Displayed in large cyan font if the altitude is an altitude restriction inputted by the pilot.
3.0°	FLIGHT PATH ANGLE (FPA)	Flight path angles indicate path angle of the constructed path relative to the ground. the angle is calculated by the HT1000 and is not directly modifiable by the pilot. However, the pilot can modify the FPA by modifying the altitude restrictions. The angle specified between the FAF and MAP fix cannot be modified.
N47W008	LAT/LON FIX	The system truncates the entered LAT/LON. for instance the pilot would enter the full degrees, minutes and tenths of a minute. (N4715.4W00803.5) and when line selected to the legs page would be renamed N47W008. If the pilot desires to see the full LAT/LON just line select it to the scratchpad where it will be displayed as the full value.

CDU DISPLAY	SYMBOL TYPE	COMMENTS
SEA01	PLACE BEARING DISTANCE FIX (PBD)	The pilot defines a PBD by typing (in the scratchpad) the place (navaid or waypoint), the bearing and distance (e.g. SEA180/10). This creates a fix off of the SEA VORTACon the180° radial at 10 NM. When this is line selected to the legs page, the system renames it with the name of the navaid or fix used and then adds a number that represents the number of pilot-defined waypoints that have been created so far. 01 would indicate this is the first pilot defined waypoint.
SEA02	PLACE BEARING PLACE BEARING FIX (PB/PB)	A place/pearing, place/bearing fix is created by naming a fix that is at the intersection of two bearings from two fixes. For instance, typing SEA330/OLM270 would become SEA02. The suffix number (02) merely identifies how many pilot defined waypoints have been created thus far. If the pilot has previously created 4 pilot defined waypoints then this waypoint would be named SEA05.
SEA03	ALONG TRACK FIX	An along track fix is created by naming a fix along the route of flight and then defining a point in front or behind the fix. For example, if you want to create an along track fix that is 10 NM after fix SEA then you would type ABC/10 and the fix would be named SEA03. To define an along track waypoint that is prior to SEA the pilot would type SEA/-10.
SEA04	ABEAM FIX	Abeam point waypoints are created by using the abeam point function that appears on the legs page whenever a DIRECT TO has been initiated.
N48	LAT/LON CROSSING FIX	LAT/LON crossing waypoints are identified by the compass direction (EWNS) and the crossing point in degrees only.

Appendix C HOW THE GPS SYSTEMS WORKS

GPS (Global Positioning System) is a navigation system based on a constellation of 24 satellites orbiting the earth at very high altitudes. This system was established and is maintained by the US Department of Defense. GPS can give three-dimensional position measurements accurate to within 50 feet (15 m).

GPS is based on satellite ranging: calculating a position by measuring the distance to several different satellites. If we know the distance from satellite A is 11,000 miles, then we must be somewhere on an imaginary sphere centered on the satellite and having a radius of 11,000 miles as shown in Figure B-1. If, at the same time, the distance from satellite B is known to be 12,000 miles, then we must be on the circle where the two spheres intersect, as shown in Figure B-2.

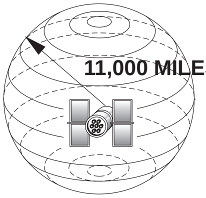


Figure C-1

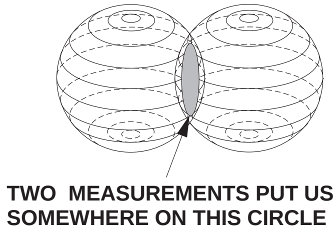


Figure C-2

If we also know we are 13,000 miles from satellite C, our position is further restricted to the two points in space where the three spheres intersect, as shown in Figure C-3. One of these points is usually impossible (for example, far out in space). GPS receivers have various techniques for distinguishing the correct point from the incorrect one. Theoretically, these three measurements are all we need to determine the position of our aircraft.

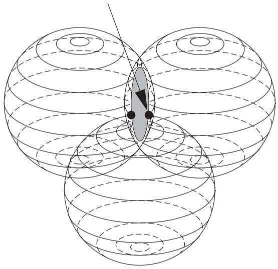


Figure C-3

The basic idea behind measuring the distance to a satellite is the "velocity times travel-time" equation we all learned in school:

Distance = Velocity x Time

The GPS system works by calculating how long a radio signal from a satellite takes to reach us, and then calculating the distance to the satellite based on that time. We know the velocity of light (about 186,000 miles per second). So if we can determine exactly when the GPS satellite started sending its radio signal, and exactly when we received it, we can calculate how long the signal took to reach us. How can the GPS receiver determine exactly when the signal left the satellite? The satellites and receivers are very precisely synchronized to generate the same pattern of radio signals at exactly the same time. This pattern, or code, is a complicated string of pulses that appears to be random, but in fact, is carefully determined. Since the code appears to be random, it is often referred to as "pseudorandom code." When the GPS receiver receives a satellite code, it measures the time that elapsed between when it generated that code and when it received the same satellite code. Plugging this value into the equation above will give us the distance from our aircraft to the satellite. Of course, the measurements must be very precise-down to a nanosecond, or one billionth of a second. The satellites achieve this accuracy by means of atomic clocks that are amazingly precise. GPS receivers are equipped with very precise electronic clocks – but not always precise enough. Fortunately, trigonometry says that if three perfect measurements locate a point in three-dimensional space, then four imperfect measurements can eliminate any clock offset (as long as the offset is consistent). So by making an extra satellite range measurement, we can eliminate clock offset. An example will help explain this. For simplicity (and to eliminate the need for three-dimensional graphics), let's use a two-dimensional example, such as a ship at sea (where altitude is already known). This means that, if our clocks were perfect, we would need only two range measurements to locate ourselves exactly on the surface of the earth. The third range measurement will be our "extra" one.

Consider the example in Figure C-4. Suppose our receiver's clock is consistent, but is 1 second slow. And, let's say the signal from satellite A takes 4 seconds to reach us, while the signal from satellite B takes 6 seconds. So we really are where the two solid lines intersect.

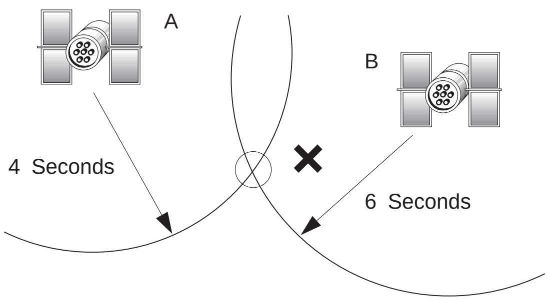


Figure C-4

But, our imperfect receiver would think the signal from satellite A took 5 seconds to reach us, and from satellite B, 7 seconds. So our receiver thinks we are where the two shaded lines intersect-which could be miles from our actual location. Now let's add a third measurement to the calculation. The signal from satellite C takes 8 seconds to reach us, and our receiver thinks it's 9. From Figure C5 we can see the three solid lines intersect at our true location.

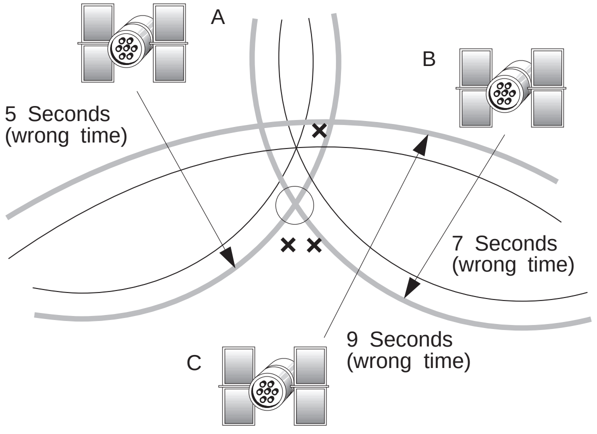


Figure C-5

But, if we add our one-second offset to the drawing, the three shaded lines show three possibilities for our location- the "pseudo-ranges" caused by our slow clock.

The GPS receiver, upon receiving this series of points, assumes its clock is off. It applies algebra to compute where the three points could possibly intersect, and gives this intersection as our true location.

Since an aircraft GPS system operates in three dimensions, it needs four measurements to cancel out any error. This means that it can't determine a truly accurate position unless it has four satellites within range above the horizon. If only 3 satellites are available, altitude from the aircraft altimeter or manual input can permit continued navigation at reduced accuracy.

There are some other sources of minor errors in the GPS system. Tiny variations can occur in the altitude, speed, and position of a satellite. These changes are monitored by the Department of Defense (DOD), and the corrections are sent back to the satellite, where they are broadcast along with the pseudo-codes. Other variations can be caused by ionospheric and atmospheric delays. Another possible source of error is "Geometric Dilution of Precision," which means the

(GDOP) intersection point of two ranges is slightly less accurate when the satellites are close together. In a typical case, the sum of these errors would amount to no more than 100 feet (30 m); in a worst case, no more than 200 feet (70 m).

For military purposes, the Department of Defense can also introduce deliberate errors into the system using an operational mode called "selective availability" or S/A. The stated accuracy with S/A on is as follows:

Better than 100 m, 95% of the time
Better than 300 m, 99% of the time

The other 1% is undetermined; the DOD can set the accuracy reduction much higher!

A sophisticated form of GPS, differential GPS, allows precise measurements down to a centimeter (1" = 2.54 cm). Such ultra-precise measurements are based on at least 15 minutes of GPS data collection at a stationary location and very precise knowledge of a reference point. This form of GPS is used in surveying and is being tested as a precision landing system.

In order to detect GPS position errors, IFR certified navigation systems like the HT1000 implement a function called Receiver Autonomous Integrity Monitoring, or RAIM (also referred to as Fault Detection).

Using redundant measurements (more than 4 satellites, or 4 satellites and an altimeter), the RAIM function can measure the accuracy of the GPS position solution. Depending on the geometry of the available satellite and the protection limit available, the HT1000 can annunciate errors which exceed the accuracy requirements for the current flight mode.

By adding an additional satellite measurement (for a total of six measurements or more), the HT1000 can also detect which satellite has caused a position error, and exclude that satellite from the position calculation function. This function is referred to as Fault Detection and Exclusion, or FDE.

Before conducting oceanic operations, a prediction of the availability of the FDE function for the intended flight must be conducted.

GPS INFORMATION CENTER

Precise Worldwide Position, Velocity, and Time

GPS is providing highly accurate data 24 hours a day. Now fully operational, GPS is enabling land, sea, and airborne users to determine their three-dimensional position, velocity, and time anywhere in the world with unprecedented accuracy. Satellite-based GPS is the most precise radio navigation system available today or in the foreseeable future.

GPS consists of three segments: space, control, and user. The space segment contains 24 operational satellites about 10,900 nautical miles above the earth. The satellites complete an orbit cycle every 12 hours and provide direct line-of-sight radio frequency signals to users worldwide. A ground control network tracks the satellites, determines orbits precisely, and transmits orbit definition data to each satellite. Navigation and position fixing using GPS is accomplished by passive trilateration. Users measure range to and compute the position of four satellites and process the measurements to determine three-dimensional position and time.

Although GPS was originally designed to enhance the war-fighting capability of US and allied military forces, the unprecedented accuracy already available from the system have given rise to a wide variety of civil GPS applications. As the GPS reaches full maturity, applications are anticipated to continue to emerge, and worldwide civil land, sea, and airborne users are expected to out number military users by a sizable margin.

Civil GPS Information Center

In order to accommodate the needs of the large worldwide civil GPS user community, the US Government has established the GPS Information Center (GPSIC). Operated and maintained by the United States Coast Guard for the Department of Transportation, the primary function of the GPSIC are to provide information to and serve as the point of contact for civil GPS users.

Information Available

Information available from the GPSIC is called the Operational Advisory Broadcast, which contains the following general categories of GPS performance data:

- Current constellation status (satellite health data)
- Future status (planned outages of satellites)
- Almanac data (suitable for making GPS coverage and satellite visibility predictions)

Information Media

GPS Operational Advisory Broadcast information is available from the GPSIC in the following forms:

- Computer bulletin boards
- Voice tape recording
- Voice broadcasts
- Facsimile broadcast

All GPSIC services are provided free of charge. Registration for the GPSIC bulletin board is done on-line at the first session.

COMMS PARAMETERS

- Asynchronous - 8 Data Bits
- 1 Start Bit, 1 Stop Bit
- No Parity
- Full Duplex
- XOn/XOff
- Both Bell and CCITT Protocols

The GPSIC computer bulletin board may be accessed by dialing (703) 313-5910 for modem speeds of 300-14,400 bps.

The telephone number for the voice tape recording is (703) 313-5907.

Information Requests

In additional to the prerecorded Operational Advisory Broadcast information available, the GPSIC is prepared to respond to individual user inquiries, comments, or concerns regarding civil access to and use of the GPS. The GPSIC will accept calls of this nature from civil users 24 hours a day. The number is (703) 313-5900.

Written comments, questions, or concerns on the GPS or operation of the GPSIC may be addressed to:

Commanding Officer
US Coast Guard ONSCEN
7323 Telegraph Road
Alexandria, VA 22315
(703) 313-5400
(703) 313-5449 Fax

Other Information Sources

GPS status information may also be obtained from the following sources:

- WWV/WWVHHF radio broadcasts WWV minutes 14 & 15; WWVH minutes 43 & 44)
  – (5, 10, 15, 20 MHz)
- Defense Mapping Agency (DMA) weekly Notices to Mariners
- DMA broadcast warnings (NAVAREA, HYDROLANT, and HYDROPAC)
- DMA NavInfoNet, ANMS
  1200 BAUD - (301) 227-5295
  2400 BAUD - (301) 227-4630
  9600 BAUD - (301) 227-4424
- USCG Broadcast Notices to Mariners
- NAVTEX Data Broadcast
  – (518 kHz)

Users must register off-line before accessing the DMA NavInfoNet. A user ID and information booklet are available by writing the DMA

Hydrographic/Topographic Center (ATTN: MCN/NAV-INFONET) Washington, DC 20315-0030 or calling (301) 227-3296.

GPS Information Center Users' Manual

Detailed information on the GPSIC services and how the services may be obtained is available in a GPS Information Center Users' Manual. The Users' Manual may be obtained by calling (703) 313-5900 or writing the Information Center.

> **NOTE**
>
> Satellite visibility window predictions are not offered by the GPSIC. This information is available from commercial sources or from commercially available software.

Civil GPS Service Steering Committee

In addition to the services provided by the GPSIC, the US Government has established a Civil GPS Service Steering Committee (CGSSC). The purpose of the CGSSC is to address issues and problems that relate to the civil use of the GPS and to provide a forum for discussions between civil GPS users and the DOD.

The CGSSC consists of an Executive Council, General Committee, and five Subcommittees:

- Precise Positioning and Surveying
- Timing
- Reference Station
- International
- Carrier Phase Tracking

The CGSSC is jointly chaired by the US Department of Transportation and the US Coast Guard. Points of contact are:

US Department of Transportation
Research and Special Programs Administration
400 7th Street, SW, Room 9402
Washington, DC 20590-0001
Phone: (202) 366-4433
Fax: (202) 366-7431

Commandant (G-NRN)
US Coast Guard
2100 Second Street, SW
Washington, DC 20593-0001
Phone: (202) 267-2390
Fax: (202) 267-4158

The CGSSC meets about every three months and the General Committee meetings are open to all interested parties.

Appendix D COUNTRY CODES

The following codes are used to identify countries in the Honeywell International Nav Data database.

Code	Country
AFG	AFGANISTAN
AGO	ANGOLA
AIA	ANGUILLA
ALB	ALBANIA
ANT	ARUBA
ARE	UNTD ARAB EMIRATES
ARG	ARGENTINA
ARM	ARMENIA
ASM	AMERICAN SAMOA
ATG	ANTIGUA
AUS	AUSTRALIA
AUT	AUSTRIA
AZE	AZERBAIJAN
BDI	BURUNDI
BEL	BELGIUM
BEN	BENIN
BFA	BURKINA FASO
BGD	BANGLADESH
BGR	BULGARIA
BHR	BAHRAIN
BHS	BAHAMAS
BLR	BELORUSSIA
BLZ	BELIZE
BMU	BERMUDA
BOL	BOLIVIA
BRA	BRAZIL
BRB	BARBADOS
BRN	BRUNEI
BTN	BHUTAN
BWA	BOTSWANA
CAF	CNTRL AFRICAN REP
CAN	CANADA
CHE	SWITZERLAND
CHL	CHILE
CHN	CHINA, PR OF
CIV	IVORY COAST
CMR	CAMEROON
COG	CONGO
COK	COOK IS
COL	COLOMBIA
COM	COMOROS
CPV	CAPE VERDE
CRI	COSTA RICA
CUB	CUBA
CYP	CYPRUS
CYN	CAYMAN ISLANDS
CZE	CZECH REPUBLIC
DEU	GERMANY
DJI	DJIBOUTI
DMA	DOMINICA
DNK	DENMARK
DNK	FAROE IS
DOM	DOMINICAN REPUBLIC
DZA	ALGERIA
ECU	ECUADOR
EGY	EGYPT
ESP	CANARY IS
ESP	MELILLA
ESP	SPAIN
EST	ESTONIA
ETH	ETHIOPIA
FIN	FINLAND
FJI	FIJI IS
FLK	FALKLAND IS
FRA	FRANCE
FRO	FAERO IS
FSM	CAROLINE IS
FSM	MICRONESIA
FSM	PALAU
GAB	GABON
GBR	UNITED KINGDOM
GEO	GEORGIA
GHA	GHANA
GIB	GIBRALTAR
GIN	GUINEA REP
GLP	GUADELOUPE
GMB	GAMBIA
GNB	GUINEA-BISSAU
GNQ	EQUTORIAL GUINEA
GRC	GREECE
GRD	GRENADA
GRL	GREENLAND
GTM	GUATEMALA
GUF	FRENCH GUIANA

Code	Country
GUM	GUAM
GUM	MARIANA IS
HKG	HONG KONG
HND	HONDURAS
HRV	CROATIA
HTI	HAITI
HUN	HUNGARY
IDN	INDONESIA
IND	INDIA
IOT	CHAGOS ARCH
IRL	IRELAND
IRN	IRAN
IRQ	IRAQ
ISL	ICELAND
ISR	ISRAEL
ITA	ITALY
JAM	JAMAICA
JOR	JORDAN
JPN	JAPAN
JTN	JOHNSTON IS
KAZ	KAZAKHSTAN
KEN	KENYA
KGZ	KYRGYZSTAN
KHM	KAMPUCHEA
KIR	KIRIBATI
KNA	ST KITTS
KOR	KOREA
KWT	KUWAIT
LAO	LAOS
LBN	LEBANON
LBR	LIBERIA
LBY	LIBYA, SPA JAMAH.
LCA	ST LUCIA
LKA	SRI LANKA
LSO	LESOTHO
LTU	LITHUANIA
LUX	LUXEMBOURG
LVA	LATVIA
MAR	MOROCCO
MDA	MOLDOVA
MDV	MALDIVES
MEX	MEXICO
MHL	MARSHALL IS
MID	MIDWAY IS
MLI	MALI
MLT	MALTA
MMR	UNION OF MYANMAR
MNG	MONGOLIA
MNP	MARIANA IS
MOZ	MOZAMBIQUE
MRT	MAURITANIA

Code	Country
MSR	MONTSERRAT
MTQ	MARTINIQUE
MUS	MAURITIUS
MWI	MALAWI
MYS	MALAYSIA
MYT	MAYOTTE
NCL	NEW CALEDONIA
NER	NIGER
NGA	NIGERIA
NIC	NICARAGUA
NIU	NIUE
NLD	NETHERLANDS
NOR	NORWAY
NPL	NEPAL
NRU	NAURU
NZL	NEW ZEALAND
OMN	OMAN
PAK	PAKISTAN
PAN	PANAMA
PER	PERU
PHL	PHILLIPINES
PNG	PAPUA NEW GUINEA
POL	POLAND
PRI	PUERTO RICO
PRK	KOREA, DPR OF
PRT	PORTUGAL
PRY	PARAGUAY
PYF	FRENCH POLYNESIA
QAT	QATAR
RUS	RUSSIA
REU	REUNION
ROM	ROMANIA
RUS	RUSSIA
RWA	RWANDA
SAU	SAUDI ARABIA
SDN	SUDAN
SEN	SENEGAL
SGP	SINGAPORE
SHN	ASCENSION
SHN	ST HELENA
SLB	SOLOMON IS
SLE	SIERRA LEONE
SLV	EL SALVADOR
SOM	SOMALIA
SPM	MIQUELON IS
STP	SAO TOME & PRINCIPE
SUR	SURINAME
SVK	SLOVAKIA
SVN	SLOVENIA
SWZ	SWAZILAND
SWE	SWEDEN

Code	Country
SYC	SEYCHELLES
SYR	SYRIA
TCA	CAICOS IS
TCA	TURKS IS
TCD	CHAD
TGO	TOGO
THA	THAILAND
TJK	TAJIKISTAN
TKM	TURKMENISTAN
TON	TONGA
TTO	TOBAGO
TUN	TUNISIA
TUR	TURKEY
TUV	TUVALU
TWN	TAIWAN
TZA	TANZANIA
UGA	UGANDA
UKR	UKRAINE
URY	URUGUAY
USA	UNITED STATES
UZB	UZBEKISTAN
VCA	ST VINCENT
VEN	VENEZUELA
VGB	BRITISH VIRGIN IS
VIR	VIRGIN IS
VNM	VIETNAM
VUT	VANUATU
WLF	FUTUNA IS
WSM	WESTERN SAMOA
XJA	ARMENIA
XJI	KYRGYZSTAN
XJJ	AZERBAIJAN
XJK	KAZAKHSTAN
XJO	MOLDOVA
XJR	RUSSIA
XJT	TAJIKISTAN
XJW	WAKE IS
YEM	YEMEN ARAB REP
YUG	YUGOSLAVIA
ZAF	BOPHUTHATSWANA
ZAF	CISKEI
ZAF	NAMIBIA
ZAF	SOUTH AFRICAN REP
ZAF	SOUTHWEST AFRICA
ZAF	TRANSKEI
ZAF	VENDA
ZAR	ZAIRE
ZMB	ZAMBIA
ZWE	ZIMBABWE

Appendix E GLOSSARY

ACT
Active flight plan or route le

ACT RTE
Active Route

ADC
Air Data Computer

ADF
Automatic Direction Finder

Alphanumeric
A letter and a number

ALT
Altitude, corrected for local barometric pressure

ANP
Actual Navigation Performance

APPR
Approach

APRT
Airport

ARR
Arrival

ATA
Actual Time of Arrival

Bearing
The horizontal direction to a point referenced to north (true, magnetic, or grid)

BITE
Built-In Test Equipment

BRG/DIS
Bearing/Distance

BRT
Bright

C
Centigrade

CALC
An HT1000-calculated value

Capt
Captain

CDI
Course Deviation Indicator

CDU
Control Display Unit

CGSSC
Civil GPS Service Steering Committee

CLR
Clear

CO ROUTE
Company Route, Pilot-entered information

CRC
Cyclical Redundancy Check

Cross Track (XTK)
Distance off course in nautical miles

CRS
Course

CRZ ALT
Cruise Altitude

DA
Drift Angle, The angle between the Heading and the Track

DEP/ARR
Departure and/or Arrival information for selected airports

Desired Track (DTK)
The direction the pilot needs to fly to reach the TO waypoint

DEST
Destination airport

DFGC
Digital Flight Guidance Computer (autopilot)

DFT RT
Drift Right

DGPS
Differential Global Positioning System

Dilution of Precision (DOP)
The multiplicative factor that modifies range error. It is caused solely by the geometry between the user and the set of satellites used. Viewed as PDOP (Position), VDOP (Vertical), and HDOP (Horizontal)

Direct-To
A navigation equipment function that allows the aircraft to proceed directly from present position to a selected waypoint.

DMA
Defense Mapping Agency

DME
Distance Measuring Equipment

DOD
Department of Defense

DR
Dead Reckoning

DTG
Distance-To-Go

EFC
Expect Further Clearance

ETA
Estimated Time of Arrival

ETE
Estimated Time En route

EXEC
Execute, or carry out, a command to the HT1000 system.

FAF
Final Approach Fix

FDE
Fault Detection and Exclusion. Software that provides prediction of GPS satellite coverage to support navigation, fault detection, and satellite exclusion for a selected flight plan. FDE prediction capabilities meet the requirements for using the HT1000 GPS Navigation System as a primary means of navigation for oceanic/remote operations as detailed in N8110.60.

FGCP
Flight Guidance Control Panel

FIX INFO
Fix Information

FL
Flight Level

FMA
Flight Mode Annunciator

FMC
Flight Management Computer

FMS
Flight Management System

F/O
First Officer

FREQ
Frequency

GA
Go-Around

GDOP
Geometric Dilution of Precision

GMT
Greenwich Mean Time, same as UTC and Zulu time

GNSSU
Global Navigation System Sensor Unit

GPS
Global Positioning System, a satellite-based navigation system

GPS Antenna
Flat microstrip antenna that receives GPS Satellite signals

GPSIC
Global Positioning System Information Center

Great Circle Route
The shortest distance between two points on the earth's surface.

GS
Ground Speed, speed of aircraft as measured over the ground

GR WT
Gross Weight

HDG/Heading
Direction in which the longitudinal axis of the aircraft points with respect to north (true, magnetic, or grid).

HDOP
Horizontal Dilution of Precision, See Dilution of Precision.

HSI
Horizontal Situation Indicator

HWIND
Headwind

ICAO
International Civil Aviation Organization

IDENT
Identification

ILS
Instrument Landing System

INBD CRS/DIR
Inbound Course and Turn Direction

INTC CRS
Intercept Course

INS
Inertial Navigation System

Intersection
The crossing of two VOR radials or victor airways.

IRS
Initial Reference System

KT
Speed in knots

LAT
Latitude in degrees, minutes and tenths

LCD
Liquid Crystal Display

LON
Longitude in degrees minutes and tenths

LSK
Line Select Key

MAG VAR
Magnetic Variation The difference between true and magnetic north.

MAP
Missed Approach Point

MCDU
Multifunction Control Display Unit The interface between the pilot and the HT1000.

MDA
Minimum Descent Altitude

MOD
Modification to a flight plan

MSG
Message that the HT1000 system displays on the MCDU

NAVAID
Navigation Aid

NDB
Navigation Data Base

NM
Distance in nautical miles

NPU
Navigation Processor Unit The primary processing unit of the HT1000 system.

NSP
Navigation Selection Panel

OAT
Outside Air Temperature in degrees Celsius

OFFSET
Parallel Offset Track

OFST
Offset

PBD
Place, Bearing, Distance

PDOP
Position Dilution of Precision

PERF INIT
Performance Initialization

POS
Position

POS INIT
Position Initial/Initialize

POS REF
Position Reference

PPOS
Present Position

PREV
Previous Page

PROG
Progress

QUAD/RADIAL
Quadrant and Radial

RA
Radar Altimeter

RAIM
Receiver Autonomous Integrity Monitoring, used to monitor the integrity of the navigation information received from the satellites. Estimates an upper limit on the position accuracy available under the conditions dictated by the satellites. The limit is dependant upon the number of satellites in view and their relative positions in the sky.

REF NAV DATA
Reference Navigation Data, information about waypoints, navaids, airports, and runways that is stored in the data base and is available for display by the HT1000.

RNP
Required Navigation Performance

RTE
Route

S/A
Selective Availability

SAT
Static Air Temperature in degrees Celsius

SID
Standard Instrument Departure

SP
Scratchpad

STAR
Standard Terminal Arrival

SV
Satellite Vehicle

TAS
True Airspeed, speed of aircraft relative to the surrounding air

TOT
Total

Track (TK) (TKE)
The actual direction traveled over the ground referenced to north (true, magnetic, or grid).

TRANS
Transition

TRK
Track

TSO C129
Technical Standard Order used by the FAA for GPS navigation systems.

T/WIND
Tail wind

UTC
Coordinated Universal Time, same as Zulu time and GMT

VDL
VHF Data Link

VDOP
Vertical Dilution of Precision See Dilution of Precision.

VNAV
Vertical Navigation

VOR
VHF (Very High Frequency) Omnidirectional Range transmitter, a ground-based navigation aid

Waypoint (WPT)
A defined location (airport, VOR, etc.) used in a flight plan or as a destination.

WIND
Current wind speed and direction

WT
Weight

XTK
Cross Track, Distance off course in nautical miles

XWIND
Crosswind

ZFW
Zero fuel weight in thousands of pounds

Appendix F INDEX

A

B

C

D

E

F

M

N

O

P

R

S

T

U

V

W

X

Y

Z