



Trimble

TNL 2100T

GPS Navigator

Pilot Guide

SOFTWARE 0235

February 23, 1996

Trimble
2105 Donley Drive
Austin, TX 78758
(512) 432-0400

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B The GPS System: How It Works

C Flying with the Autopilot

D Operational Summary

Introduction

Congratulations! With your purchase of the Trimble TNL 2100T GPS Navigator, your aircraft is equipped for navigation position accuracies better than 15 meters; ANYWHERE, ANYTIME and in ANY WEATHER. Your new Navigator is the ultimate in radio navigation. It has a low susceptibility to jamming and interference, and since your Trimble GPS receiver is an integral part of the future ATC system, its growth potential is unlimited.

The Trimble TNL 2100T GPS Navigator calculates your position in three dimensions: Latitude, Longitude and Altitude. It uses Global Positioning System (GPS) satellites, is completely automatic and requires *no* initialization.

Your TNL 2100T GPS Navigator uses a state-of-the art, DZUS rail-mounted design, and features:

- A six-channel GPS receiver which calculates position and monitor signal integrity.
- Direct access to worldwide data on airports, VORs, NDBs, intersections, and special use airspaces in the Jeppesen database card used by the Navigator. This information can be accessed using either the standard identifier (for example, LAX), the ICAO identifier (for example, CYYZ) or the city or object name.

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- Its push-button and knob-select functions are simple and consistent, making them easy to learn and remember. Its annunciator lights clearly show your unit's mode of operation and any messages it issues. Also, you never have to specify beforehand which waypoints you will be using—all waypoint information in the Jeppesen database is quickly and easily accessible.

The Navigator Functions

The TNL 2100T GPS Navigator performs a wide variety of navigation functions:

<i>Direct Navigation</i>	Designate a destination and fly directly to it from any position.
<i>Flight Plan Navigation</i>	Define a flight plan with up to 19 legs or 20 waypoints and be guided automatically along the proper route.
<i>Position Finding</i>	Determine current position in terms of latitude and longitude or bearing and distance from any point.
<i>ETA/Fuel Consumption</i>	Monitor a flight's progression and determine accurately the time of arrival and fuel consumption.
<i>Emergency Navigation</i>	Determine the nearest Airport, VOR, NDB or Agency with the press of one button.
<i>Controlled Airspace</i>	Receive immediate notification if the aircraft is approaching a controlled airspace, or if a flight plan leg being selected enters a controlled airspace.

Preflight Planning

Determine the distance and bearing to destination, distance and bearing of any leg, total flight plan distance, and other useful information before departure.

Navigator Functions

Access information or perform calculations including Waypoint data (such as airport communication frequencies; runway lengths, and approach type); Estimated time enroute and time of arrival; Ground track and ground speed; Minimum safe altitude; Minimum enroute safe altitude; Desired and actual tracks; Vertical navigation; Winds aloft; Fuel range; True air speed; Density altitude calculation.

Safety First

Although Trimble Navigation Ltd. has designed and built the TNL 2100T GPS Navigator with all possible care, many factors can affect aircraft safety. Please observe the following precautions:

Follow the fundamental rule of aircraft navigation: NEVER RELY ON A SINGLE NAVIGATION SYSTEM! Errors or malfunctions are always possible in any system, and double-checking navigation information should be a standard procedure.

The TNL 2100T GPS Navigator and other equipment must be properly maintained in order to perform according to specifications.

The Jeppesen database card must be updated regularly in order to ensure that its information is current. Jeppesen issues an update approximately every 28 days. See the Jeppesen subscription packet enclosed with the TNL 2100T GPS Navigator or refer to the subscription form in this manual for information on subscribing to this update service.

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While the TNL 2100T is a powerful navigation tool, don't be tempted to violate IFR regulations because of the accuracy of the GPS receiver. Before flying IFR, make sure that the TNL 2100T is operating in IFR mode. (The IFR annunciator is lit when the unit is in IFR mode.)

Although the TNL 2100T GPS Navigator has a wealth of features and information, remember that "SEE AND BE SEEN" is the most important rule for flight.

Other Things You Should Know

Warranty Information

Be sure to fill out and return the Registration and Warranty Card as soon as you purchase your unit. The tear-out card is located at the front of this guide. When you return this card, we will send you a complimentary copy of Trimble's *GPS: A Guide to the Next Utility*.

Service Information

Authorized service for your TNL 2100T GPS Navigator is available by returning the unit to Trimble or a Trimble-authorized repair center. Any customizing of the unit will be erased during system servicing (i.e., Serial Setups, Flight Plans, User Waypoints, Personal Messages). If you have purchased the optional flight planning and configuration software, be sure to save your customized settings so they can be restored when the unit is returned to you. To return the unit directly to Trimble, send it to:

Trimble - Austin
2105 Donley Drive
Austin, Texas 78758
Attn: Service Department
Phone: (512) 432-0400
FAX: (512) 836-9413

Quick Reference Card

A separate Reference Card is included with this guide. The card summarizes the steps required to perform frequently used Navigator functions. Once you become familiar with the operation of your TNL 2100T GPS Navigator, this card will be a helpful reminder.

Installation Manual

Installation information for your TNL 2100T GPS Navigator is contained in a separate Installation Manual that came with the unit. The person who installs your Navigator—probably your dealer—will use this manual to install the unit in your aircraft.

Jeppesen Database - General Use

The navigation database used with the Navigator is produced by Jeppesen NavData Services. The International database card provides access to data on Airports, VORs, NDBs, Intersections, and Airspace Boundaries. The North American database card also includes MSAs. Both the North American and International database cards are required for complete worldwide information. Although this database information is quite reliable, about 120 NDB and Intersection identifiers are repeated anywhere from 2 to 5 times in the Jeppesen database, so it is recommended that you double-check waypoint information. Instructions for selecting between similar identifiers are located in Section 4.4.2.

Greater resolution for latitude and longitude was added to the database card. The new GPS IFR TNL 2100T **MUST BE OPERATED** with the compatible GPS IFR database card (cycle 9308 or later). Using older datacards will result in "DATABASE FAIL" and "DATABASE MISSING" messages.

Another important note regards the insertion or removal of the database card. **NEVER** insert or remove this card from the Navigator while the power is on. The system automatically resets when the card is removed, and there is also a risk of data corruption and other system errors.

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Users finding incorrect information in the database are encouraged to call Jeppesen NavData Services at (303) 799-9090 and ask to report a Trimble database problem.

Instructions regarding these and other database characteristics are included in this guide as those topics are introduced.

Jeppesen Database - International Use

Database coverage for International airspaces is limited. For example, there are no UNI frequencies available in the International database. Also, information on Restricted Airspaces and MSAs is not currently available for International airspaces. We recommend that you contact Jeppesen NavData Services for complete information on International coverage.

Altitude Sources

Barometric altitude is the Navigator's standard source of altitude information when a digital barometric input is supplied. The Navigator uses this altitude to aid in GPS positioning when in 2-D navigation (3 satellites).

Air and Fuel Data Computer

The ADC-200 Air and Fuel Data Computer, produced by Shadin Co., Inc., can be used to supply the following data to the Navigator:

- Fuel Flow
- Pressure Altitude
- Outside Air Temperature
- Indicated Air Speed
- Heading

The Navigator receives the data via its serial port and uses it for automatic calculation of fuel remaining, flight time remaining, fuel to destination, fuel efficiency, fuel consumed, density altitude, true airspeed, wind direction and speed, and crosswinds.

How To Use This Guide

This guide is designed to get you up to speed as quickly as possible using the TNL 2100T GPS Navigator.

Chapter 1, *Getting Started*, gives a solid introduction to the TNL 2100T GPS Navigator, including physical descriptions of components and their uses and functions.

Chapter 2, *Using the Navigator*, will be the most frequently used chapter in this guide. Following the step-by-step instructions and accompanying graphics, you will quickly learn to use the TNL 2100T GPS Navigator. It is intended as a quick overview rather than a detailed description, and as such provides a handy pilot's reference.

Chapters 3-8 will primarily be used for reference. They include detailed information on the TNL 2100T GPS Navigator modes, displays and functions. In-depth information on the topics covered in Chapter 2 is also located in these chapters.

The *Appendices* include detailed information about GPS technology, and are followed by a glossary and index.

You may also wish to use the TNL 2100T GPS Navigator's Demo capability, which lets you try out many of the unit's functions while on the ground. Instructions for using the Demo feature are located in Chapter 7.

THE TRIMBLE NAVIGATOR

GPS Satellite Navigation Information

GPS is a three-dimensional (3-D) precision location and navigation system. The high order of accuracy that can be obtained from the GPS satellite constellation requires four or more satellites in view. LAT/LON can be computed from only three satellites, making position accuracy dependent upon an automatic or manual altitude input.

The Navigator operates in 3-D mode whenever four or more satellites are available. In a 3-D solution, altitude is part of the solution. When only three satellites are available, the Navigator automatically defaults to a two-dimensional (2-D) operating mode. The GPS indicator light will flash to advise the pilot that the unit is operating in 2-D mode. The Navigator then relies on an external altitude input to calculate accurate position information.

External altitude information may be provided through an external altitude encoder or altitude serializer, or entered manually. An automatic altimeter input will provide full 3-D operation automatically. If an external source is not available, the pilot should enter altitude information manually. When altitude is entered manually, the LAT/LON error may be as much as twice the altitude error. For example, a one mile altitude error could yield as much as a two mile position error.

The flashing GPS indicator light reminds the user that the Navigator is operating in 2-D mode.

Chapter 1

Getting Started

The TNL 2100T GPS Navigator is a powerful tool designed for simple operation. Its wide range of capabilities is easily accessible. Chapter 1 introduces the user to the primary components and the major functions of the TNL 2100T GPS Navigator.

This chapter covers the following topics:

- Information Displays
- Mode Keys
- Function Keys
- Selector Knobs
- Annunciator Lights

THE TRIMBLE NAVIGATOR

1.1 The Navigator Components

The front panel of the TNL 2100T GPS Navigator includes six components:

- Jeppesen database credit-card slot
- A power switch
- The LED display
- The operation keys
- Two selector knobs
- Annunciator lights

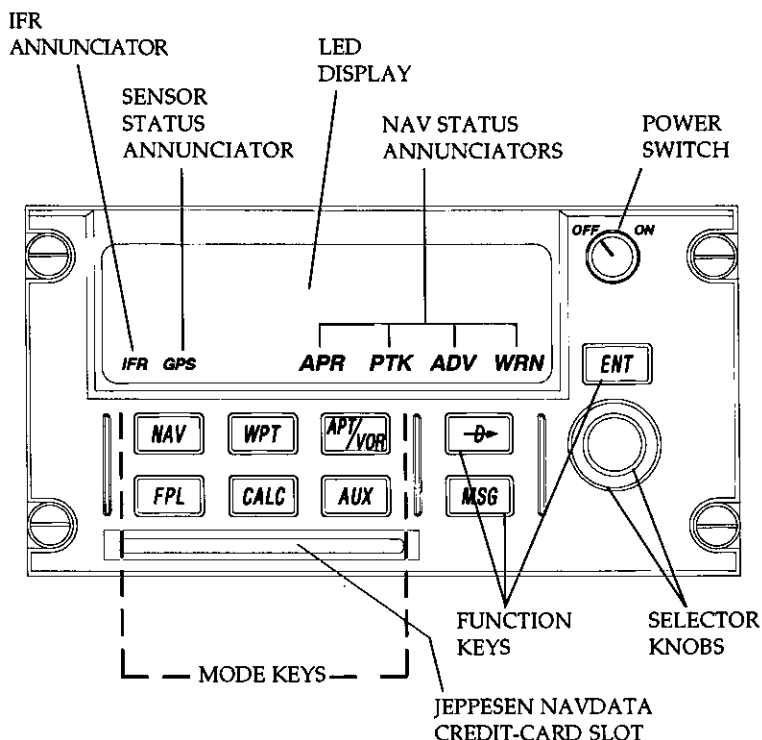


Figure 1-1: Primary Navigator Components

1.2 The Jeppesen Navigation Database

The Navigation Database for the Navigator Series is produced by Jeppesen NavData Services. This electronic database system is a sophisticated product, providing access to reliable, worldwide data on Airports, VORs, NDBs, Intersections, and Airspace Boundaries. Both the North American and International database cards are required for complete worldwide information.

A current NavData Database Card is supplied with the Navigator. Since this database information is updated every 28 days, it is important to monitor the database expiration date. Once the card is expired, the Navigator system provides an Advisory message which must be acknowledged by the operator. Although the system will continue to operate normally, the warning message will be repeated on each power-up to remind the user that the database is out of date. To eliminate this warning, and ensure data integrity, Jeppesen provides a NavData update Subscription Service.

To receive database updates every 28 days, complete the subscription form enclosed with the system or use the form located in the front of this guide. The NavData Database Card contains the following information (see exceptions below on the International Database Card):

Reported Public Use Airports and Military Bases with Runways of 2000 Feet or Greater

- Identifier, City Name, State/Country, Facility Name
- Runway Number, Length, Width and Surface Type (Hard or Soft), Traffic Direction
- Field Elevation and Beacon Availability
- Lighting Availability on at Least One Runway
- Fuel Availability (100LL)
- ATIS, Approach, Tower, Ground, CTAF and Unicom Frequencies (when multiple frequencies exist, only one is given)
- Latitude and Longitude

THE TRIMBLE NAVIGATOR

VOR's and NDB's

- Identifier, City Name, State/Country, Facility Name
- Frequency (range of 180 to 713 KHz for NDB's; range of 108 to 137 MHz for Com and VOR frequencies) and Morse Code for identifier
- Latitude and Longitude

Intersections

- Name and Region
- Latitude and Longitude

Minimum Safe Altitudes

Controlled Airspace Advisories and Frequencies

- Nearest Controlling Agency and Frequency (when multiple frequencies exist, only one is given)

Note that the International NavData Database Card does not contain Unicom frequency information, nor Minimum Safe Altitudes.

NOTE:

Information provided is as reported by governing agencies and Jeppesen. The database information is provided as a reference and is not to be solely depended upon for navigation communication, takeoff, landing or guidance. Depending on the reporting agency, some information may be missing or inaccurate. Also, the International Database may be missing certain classes of data and does not contain minimum safe altitudes. Always check local agency documents for full and correct information.

The Jeppesen NavData system is easy to use. Simply insert the Database Card into the slot located on the front of the Navigator.

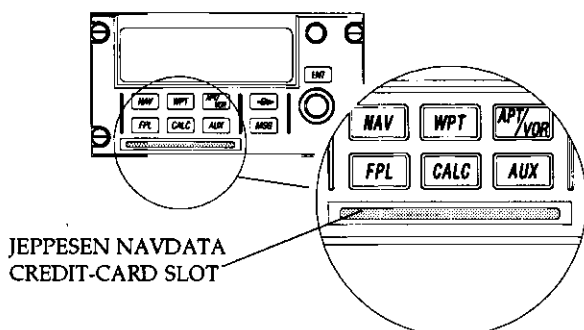


Figure 1-2: The Jeppesen Database Card Slot

WARNING:

Do not remove the NavData card from the system when the power is on. To prevent corrupted data and random system errors, the system will automatically RESET if the card is removed.

THE TRIMBLE NAVIGATOR

1.3 The Power Switch

The Navigator has one power switch, located at the top right of the unit. To activate the unit, turn the power switch to the ON position.

When the power is turned on, the system goes through a series of self-diagnostic tests. When these tests are successfully completed the Fuel on Board message appears. The process of determining the aircraft's current position is also initiated. Refer to Section 2.1 for information on completing initialization.

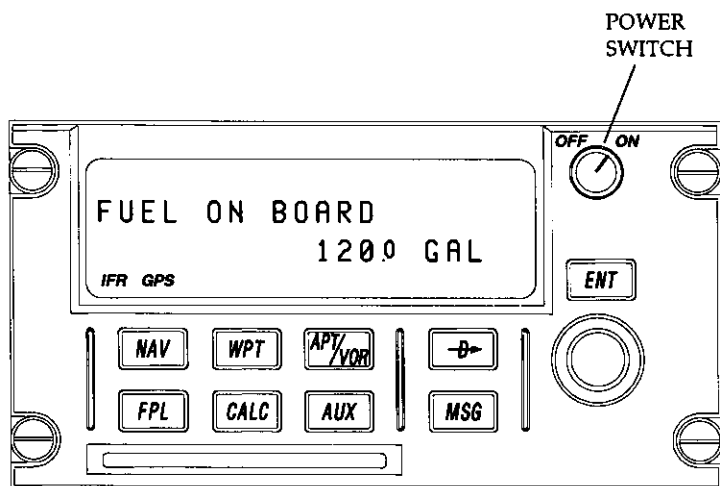


Figure 1-3: The Power Switch

1.4 The LED Display

The Navigator displays information on a two line LED screen. The information displayed on these two lines changes depending upon which mode is currently in use. Several different sets of information are displayed in each mode.

For example, when working in the Navigation (NAV) mode the primary display in Figure 1-4 appears. The top line of this display provides the bearing, distance and estimated time enroute (ETE) for the current identifier and destination. The bottom line displays the course deviation indicator (CDI), current ground track and ground speed.

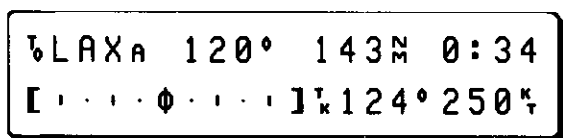


Figure 1-4: Primary NAV Mode Display

The top line of the display in Figure 1-4 indicates that to the Los Angeles Airport, bearing is 120°; distance is 143 nautical miles; estimated time enroute is 34 minutes. The bottom line indicates that the CDI is centered; current track is 124°; current ground speed is 250 knots.

NOTE:

This LED screen features automatic dimming. The screen intensity is automatically adjusted based on the ambient or surrounding light. The brightness level range may be manually adjusted (refer to Chapter 7 in this guide).

THE TRIMBLE NAVIGATOR

1.5 Operation Overview

The pilot controls the operation of the Navigator with the **MODE KEYS**, the **FUNCTION KEYS**, and the **SELECTOR KNOBS**. **ANNUNCIATOR LIGHTS** alert the pilot of system messages, current navigation mode, and parallel track selection.

The Mode keys select a major function category. For example, the **WPT** mode key selects the Waypoint Database. See Section 1.5.1.

The Function keys provide specific operations. For example, the **MSG** function key displays all current system messages. See Section 1.5.2.

The Selector knobs are used to control the display and modification of information. See Section 1.5.3.

- **Modes, Functions and Data Pages**

The Navigator's operation is organized into **MODES**, **FUNCTIONS**, and **DATA PAGES**.

A **MODE** is a logical grouping of one or more function categories. The six modes are

NAV	(Navigation Information)
WPT	(Waypoint Database)
FPL	(Flight Planning)
CALC	(E6B calculations, present position store)
AUX	(Auxiliary Functions)
APT/VOR	(Nearest Airports and VORs)

A mode may have one or more **FUNCTIONS**. The Navigator displays function names bracketed by asterisks. For example, the System Status function of the AUX mode is displayed as ***SYSTEM STATUS*** on the Navigator.

In this manual, references to a function have the format "AUX-SYSTEM STATUS".

A function may have one or more DATA PAGES. Data pages may display status information about the Navigator, or contain data fields that may be edited. For example, the Present Position data page of AUX-SYSTEM STATUS displays the present position of the receiver. The ETA Display Time data page of the AUX-INSTALL function may be edited to select local or Zulu (GMT) time.

A data page may also have additional information displayed either on a secondary data page or on the upper or lower line of the current page. For example, the GPS Status page of AUX-SENSOR Status has secondary status pages that display information on individual GPS satellites.

- **Selecting Modes, Functions, and Data Pages**

A mode is selected by pressing one of the Navigator's six Mode keys. When a Mode key is pressed, the key lights to indicate this is the active mode, and one of the functions of that mode is displayed. Pressing the Mode key again displays the next function, and so on. When the last function is reached, pressing the Mode key again will select the first function in a cyclical manner.

If the displayed function contains data pages, then rotating the SMALL, INNER SELECTOR KNOB sequences through the data pages. If a data page has additional information related to the current data page, this may be displayed by turning the LARGE, OUTER SELECTOR KNOB. The additional information may be a secondary data page, or another line of data on the current data page.

When the last data page is reached, rotating the small, inner selector knob in the opposite direction sequences back through the data page, or to another line of data on the current data page.

THE TRIMBLE NAVIGATOR

- **Entering Information**

Some data pages contain fields that are editable. The SELECTOR KNOBS and ENT function key are used to enter or change information on a data page. To do this:

- Rotate the SMALL, INNER SELECTOR KNOB to select the desired data page of the active function.
- Press the  key to initiate editing.
- Rotate the LARGE, OUTER SELECTOR KNOB to move to the data field to be changed.
- Rotate the SMALL, INNER SELECTOR KNOB to edit information in the data field.
- Press the  key to complete the data entry.

Appendix D provides an operational summary of the Navigator's functions.

1.5.1 The Mode Keys

The six Mode keys are located in a row at the bottom of the front panel and are used to select the Navigator's mode of operation. When a key is pressed, it lights to confirm selection of that mode. The following is a brief description of each Mode key and its function:

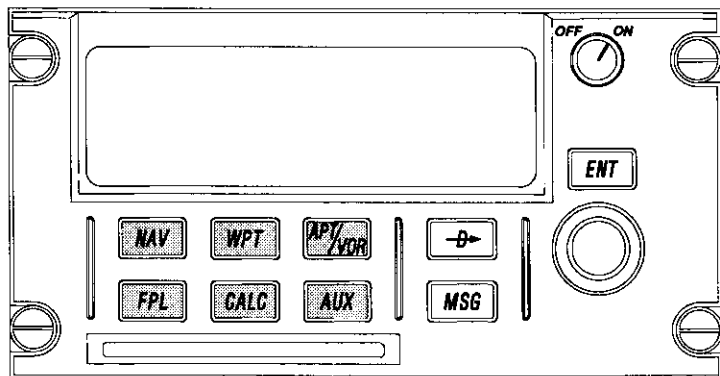


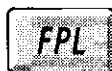
Figure 1-5: The Mode Keys



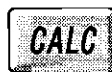
The Navigation mode is used to access navigation information. This includes the aircraft's current ground speed, direction, destination, estimated time enroute and more.



The Waypoint mode provides access to database information. Complete information is available on airports, VORs, NDBs, enroute and terminal Intersections and User waypoints. Destination selection is also a function of this mode.



The Flight Plan mode is used to plan the route of a flight. Flight plans may be created, edited, reversed or erased. They are used to navigate to a chosen destination. The Navigator can store up to 20 different flight plans.



The Calculator mode performs many common E6B computer functions. This mode is used to save present position and calculate VNAV profiles, wind speed and direction, fuel ranges, flight plan summaries and more.



The Auxiliary mode provides access to less commonly used functions. The mode is divided into five categories: Checklists, System Status Information, Sensor Status Information, System Setup, and Installation.



The Airport/VOR mode provides information on the 20 nearest airports, VORs, NDBs, Intersections and User waypoints, and also the nearest Agency or Agencies.

THE TRIMBLE NAVIGATOR

1.5.2 The Function Keys

The three function keys are located near the lower right corner of the LED display. Each function key has a unique set of applications. The following paragraphs contain a brief description of each Function key:

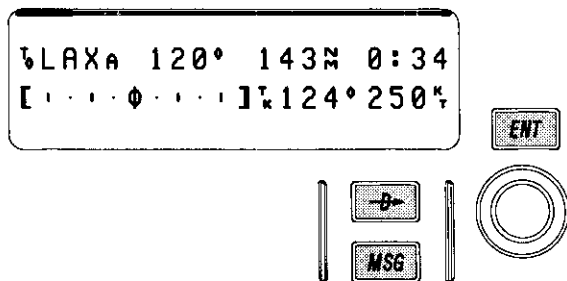
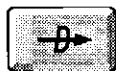


Figure 1-6: The Function Keys



The function of the Direct key is to select the current destination or a new destination. It may also be used to select a direct track, re-center the CDI and activate a flight plan.



The Message key is used to view messages on the LED display. Annunciator lights indicate that a message is present. When the Warning (WRN) or Advisory (ADV) annunciator lights are on, simply press the Message key to display the message.



The Enter key is used to enter, select or change the information currently displayed on the LED screen. This key is generally used in conjunction with the selector knobs.

1.5.3 The Selector Knobs

The Navigator has two selector knobs which control the display of information on the LED screen.

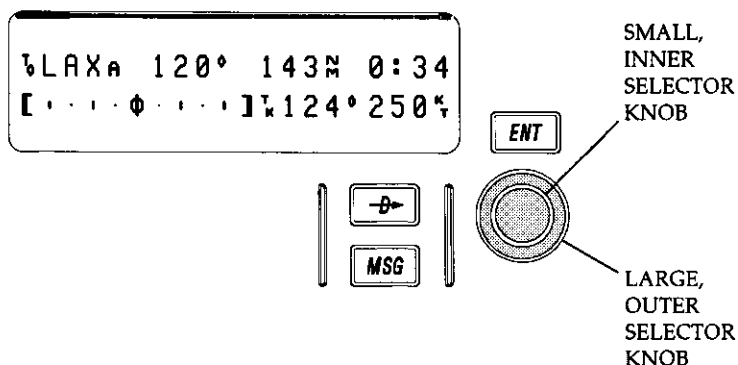


Figure 1-7: The Selector Knobs

For NAV functions, the small, inner selector knob changes the information in the top line of the LED display. The large, outer selector knob changes the information in the bottom line of the LED display.

There are usually several lines of information available in each mode of operation. A clockwise turn of either knob moves the user forward through the information, while a counterclockwise turn moves the user backward.

The selector knobs also control the change of information on these lines and are used for data entry. When data is being entered, the small, inner selector knob is used to select a data item such as a letter in the alphabet. The large, outer selector knob is used to move from one character field to the next.

THE TRIMBLE NAVIGATOR

1.5.4 The Annunciator Lights

The Annunciator Lights are located below the LED display. They are not visible unless lit.

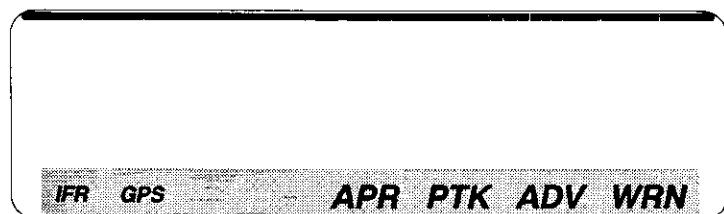


Figure 1-8: The Annunciator Lights

The following paragraphs contain a brief description of each annunciator light:

IFR

The IFR annunciator light confirms that the unit is operating in IFR mode. When RAIM is active for GPS, the IFR annunciator is lit. See Section 7.3.2 (GPS Status Display) for an explanation of RAIM.

GPS

The GPS annunciator light confirms that the Navigator is operating in GPS mode. A constant GPS annunciator light indicates 3-D operation mode. A flashing GPS annunciator light indicates 2-D operation mode.

WRN

The WRN annunciator light alerts the pilot that a warning message is waiting. Warning messages relate to the accuracy of the position shown or to possible problems with the Navigator. Press the MSG key to display the message. The WRN annunciator light will flash until the MSG key is pressed to read all warning messages. The WRN light is displayed in red.

ADV

The ADV annunciator light alerts the user that an advisory message is waiting. Advisory messages require the pilot's attention or action. Press the **MSG** key to display the message.

PTK

The Parallel Track annunciator light alerts the user that a track parallel to the direct course has been selected. To display the selected track, press the **MSG** key.

APR

Reserved for future use.

Chapter 2

Using the Navigator

This chapter covers the most frequently used features of the TNL 2100T GPS Navigator. Explanations and step-by-step instructions are provided for the primary TNL 2100T GPS Navigator functions. All users, including those experienced with other long-range navigation systems, will benefit from reviewing this chapter.

After completing this chapter you will be able to :

- Select a Direct Destination
- Access flight information in Navigation mode
- View destination waypoint information from the Navigation mode
- Access complete information on waypoints (Airports, VORs, NDBs, Intersections and User)
- Use the APT/VOR mode to access the 20 nearest waypoints
- Navigate to the nearest Airport, VOR, NDB or Intersection
- Access information in the CALC and AUX modes
- Enter Vertical Navigation Profiles
- Access Warning and Advisory Messages

THE TRIMBLE NAVIGATOR

2.1 The Navigator Power-up

To activate the TNL 2100T GPS Navigator, rotate the power switch located at the upper-right portion of the unit. In a few seconds the power-up sequence is completed.

NOTE:

In the event a datum other than WGS-84 has been selected in AUX-INSTALL-User Units, a message indicating "DATUM IN USE" will be displayed for approximately 5 seconds, following the standard initialization message.

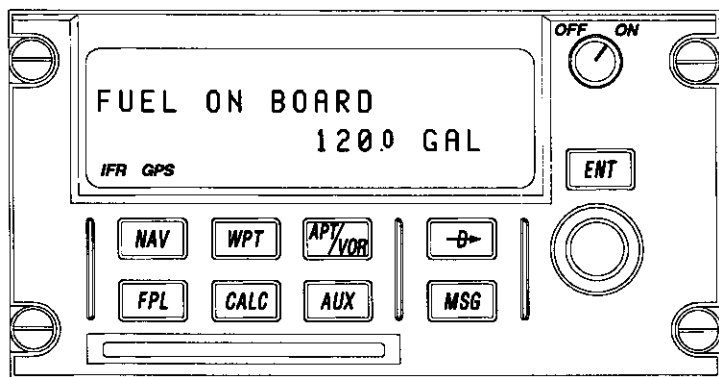
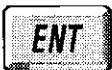


Figure 2-1: Fuel Initialization Page

After system messages, the fuel level (in gallons, pounds, etc., as selected under AUX-INSTALL-User Units) is displayed. This is required to initialize the fuel management capabilities.

- Rotate the small, inner selector knob to change the displayed digit.
- Press the  key to complete the selection.

NOTE:

If Fuel on Board is set to zero, the Navigator's fuel management functions will be disabled.

When the System Ready message appears, press any mode key to begin navigating.

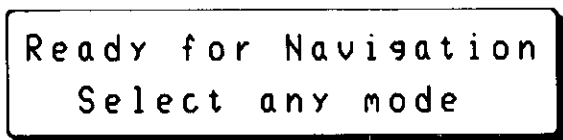


Figure 2-2: System Ready Display

TIP:

Once the Navigator's diagnostic procedure has begun, the user may press any of the Mode keys to bypass the fuel input process and remaining system messages and begin navigating.

THE TRIMBLE NAVIGATOR

2.2 Waypoint Information

The Navigator series uses the Jeppesen NavData Database Card to provide direct access to worldwide data on Airports, VORs, NDBs, and Intersections. Both the North American and International database cards are required for complete worldwide information. The system also stores up to 250 User waypoints. The small letter after a waypoint identifier denotes the waypoint category.

The following database information may be accessed from the Waypoint mode:

Airports (A) or (M)

Identifier, city name, airport name, communications frequencies, field elevation, runway information, lighting, approach information, services, and latitude/longitude. The (M) denotes a military operation.

VORs (V)

Identifier, city name, VOR name, navigation frequency, Morse code for identifier, and latitude/longitude.

NDBs (N)

Identifier, city name, NDB name, navigation frequency, Morse code for identifier, and latitude/longitude.

Intersections (I)

Identifier, region name, and latitude/longitude.

User Waypoint (U)

User identifier and latitude/longitude.

All Categories

- Bearing to waypoint
- Distance to waypoint
- Radial from waypoint

WARNING:

Do not remove the NavData card from the system when the power is on. To prevent corrupted data and random system errors, the system will automatically RESET if the card is removed.

2.2.1 Accessing Waypoint Information

Waypoint information is stored in the Waypoint mode. To access the Waypoint mode, press the **WPT** key. Each time the key is pressed, a different waypoint category becomes active.

- Press the **WPT** key to select the Waypoint mode.

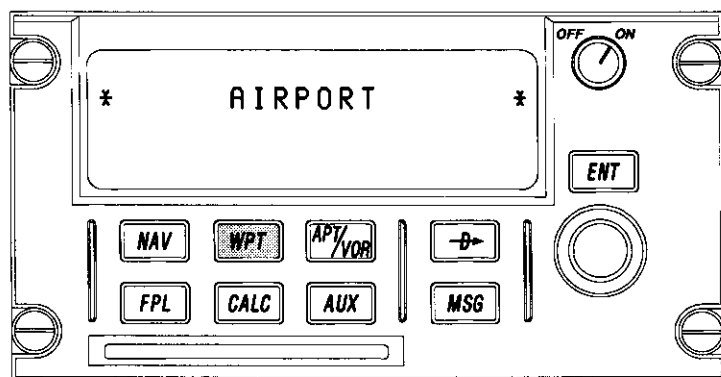


Figure 2-3: The Waypoint Mode

When the **WPT** key is pressed, the last selected waypoint category (Airport, VOR, NDB, Intersection, User) flashes on the screen followed by the identifier for the last selected waypoint.

- Press the **WPT** key until the desired waypoint category is selected.

TIP:

*To return to the Airport display at any time, press and hold the **WPT** key for at least one second.*

THE TRIMBLE NAVIGATOR

2.2.2 The Waypoint Displays

The Waypoint mode includes several different information displays or pages for each identifier. These pages are controlled by the large, outer selector knob and appear in the bottom line of the display.

Figure 2-4 provides examples of the waypoint displays for the Airport category:

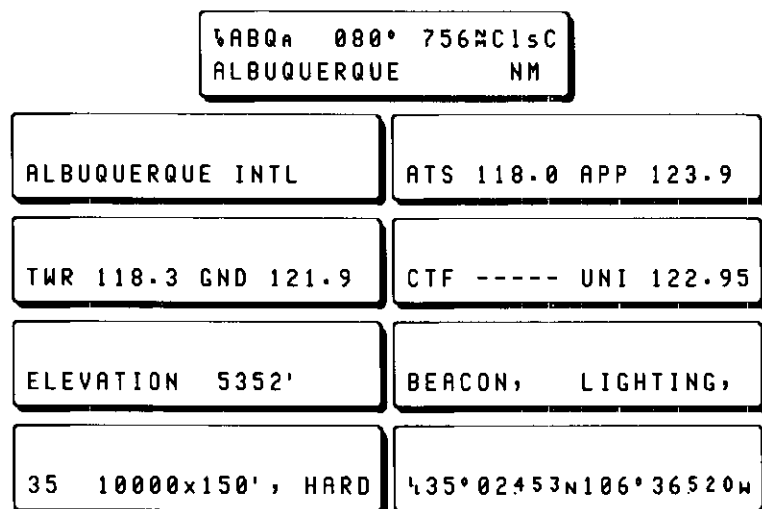


Figure 2-4: The Airport Displays: Bottom Line

To access these displays:

- Press the **WPT** key until the Airport category is selected.
- Rotate the large, outer selector knob clockwise to view the different displays.

TIP:

Each time the large, outer selector knob is rotated, the next information page for the current waypoint is displayed in the bottom line.

2.2.3 Selecting Waypoints

Once a waypoint category is chosen, a waypoint may be selected. There are four methods for selecting waypoints:

- Scan the identifiers in the database
- Enter the waypoint identifier
- Enter the waypoint city name
- Enter the waypoint name

This chapter describes the first two methods for selecting waypoints. For instructions on selecting waypoints by name or city, refer to Chapter 4.

2.2.3.1 Scanning the Database Identifiers

The identifiers in each waypoint category are organized alphanumerically. To locate a specific waypoint, rotate the small inner selector knob. A clockwise rotation of the knob scrolls forward through the information, while a counter-clockwise rotation scrolls backward.

For example, follow the steps listed below to scan the database and select the identifier for the San Francisco Airport (SFO):

- Press the  key until the Airport category is selected.
- Rotate the small, inner selector knob, in either direction, until the WPT identifier for the San Francisco Airport (SFO) is displayed.

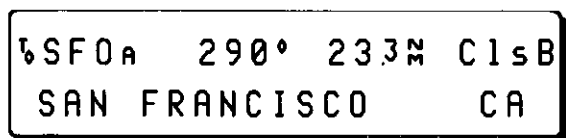


Figure 2-5: SFO Identifier

Each rotation of the knob brings up the next available airport identifier in alphanumerical order. The bottom line continues to display the same field information for each new waypoint.

THE TRIMBLE NAVIGATOR

2.2.3.2 Selecting Waypoints by Identifier

Any waypoint may be accessed by entering the identifier.

To select a waypoint by the identifier, perform the following steps:

- Press the  key until the desired category is selected.

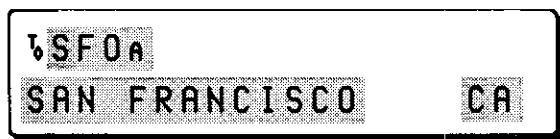


Figure 2-6: Database Fields

- Press the  key.

The  key and the first letter of the waypoint identifier begin to flash.

- Rotate the small, inner selector knob, in either direction, until the desired letter is displayed.

When the small, inner selector knob is rotated, only the letters that spell a valid identifier appear. A nonexistent identifier cannot be entered.

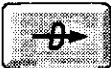
- Rotate the large, outer selector knob clockwise to select the next field to edit.
- Repeat the previous three steps until the desired waypoint identifier is displayed.
- Press the  key to complete the selection.

Once the desired identifier is selected, additional waypoint information may be viewed in the bottom line of the display.

- Rotate the large, outer selector knob to view additional waypoint information on the bottom line of the screen.

2.3 Activating a Direct Destination

Any waypoint, in any waypoint category, may be selected as a direct destination. A destination is selected one of three ways:

- From the WPT mode using the  key (see below)
- From the APT/VOR mode, selecting the nearest waypoint (refer to Section 2.4.1)
- By activating a Flight Plan (refer to Section 2.9)

2.3.1 Selecting a Destination Waypoint from the WPT Mode

To select a destination waypoint from the WPT mode, perform the following steps:

- Select a waypoint as described in Section 2.2.3.
- Press the  key twice to select the waypoint as the destination.

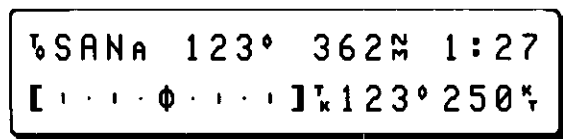


Figure 2-7: Primary NAV Mode Display

The NAV mode becomes active. The aircraft is now navigating towards the destination shown above and the CDI is automatically centered.

TIP:

From the NAV mode, the CDI may be re-centered at any time by pressing the  key twice.

THE TRIMBLE NAVIGATOR

2.4 Nearest Waypoints and Agencies

2.4.1 Identifying Nearest Waypoints

The APT/VOR mode provides the user with immediate access for up to 20 of the nearest Airports, VORs, NDBs, Intersections and User-created waypoints within a 200 nm radius. Waypoints are displayed in order of their distance from the aircraft's current position.

The APT/VOR mode also displays the nearest agency or agencies depending upon the current location of the Navigator.

The waypoint data available in the APT/VOR mode is the same information that is accessed from the WPT mode. The APT/VOR displays are also controlled by the selector knobs.

To locate the waypoint that is closest to the aircraft's current position:

- Press the  key until the desired waypoint category is opened.

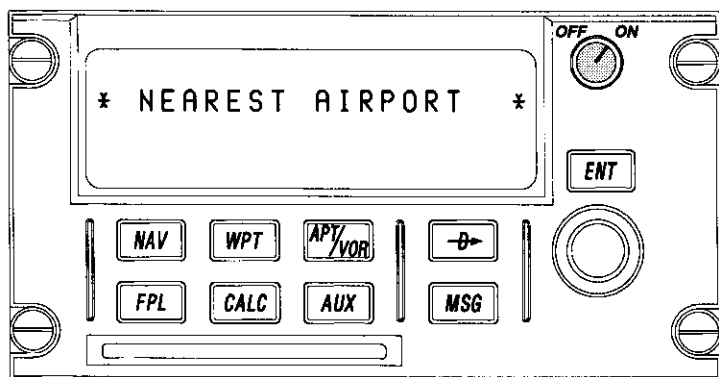


Figure 2-8: The Airport Category Message

The selected category flashes on the screen followed by information on the nearest waypoint.

- Rotate the small, inner selector knob clockwise to rotate through the 20 nearest waypoints.

Each rotation of the knob brings up the next waypoint, in order of proximity to the aircraft's current position.

To access additional information on the displayed waypoint:

- Rotate the large, outer selector knob.

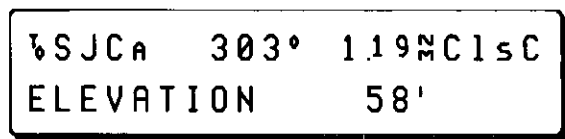
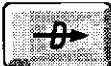
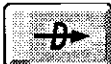


Figure 2-9: Nearest Waypoint Information

To select the displayed waypoint as a destination:

- Press the  key once to select this waypoint as the desired destination.
- Press the  key a second time to confirm this selection and begin navigating.

The NAV mode becomes active. The aircraft is now navigating towards the destination shown above and the CDI is automatically centered.

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2.4.2 Identifying Agencies

The AGENCY information in the APT/VOR mode displays controlling agency name and radio contact frequency whenever the Navigator is within the appropriate airspace. Class C (ClsC) or Class B (ClsB) information is displayed first, followed by center information. (All points in the United States are within an area controlled by a contact center.) Figures 2-10 and 2-11 give examples.



Figure 2-10: Controlling Class C

The Navigator is within the San Jose, California, Class C. The contact name is "Bay Approach"; the contact frequency is 120.1 MHz.



Figure 2-11: Controlling Center

The Navigator is also within the area controlled by the Oakland, California, center. The contact frequency is 125.45 MHz.

2.5 The Navigation Mode

Once a destination has been selected, the Navigation (NAV) mode becomes active. The primary function of this mode is to provide information required by the pilot to navigate the aircraft.

The top line of the Primary NAV Mode page displays the current destination. The CDI and current track are displayed in the bottom line.

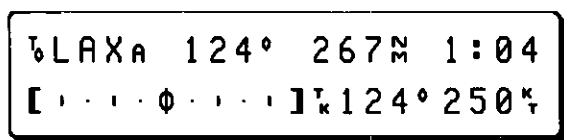


Figure 2-12: The Primary NAV Mode Display

TIP:

*To quickly return to the primary Navigation display at any time, press and hold the **NAV** key for at least one second.*

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2.5.1 The Navigation Displays

Navigation information appears within a series of displays or pages. The top and bottom line display options allow the user to create display combinations according to personal preference.

Figures 2-13 and 2-14 illustrate the different NAV Mode displays on a standard unit for the top and bottom lines respectively, corresponding to the order in which they appear (clockwise).

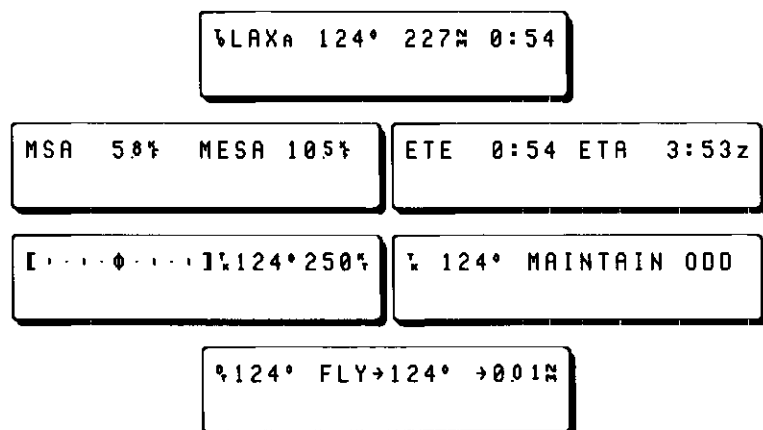


Figure 2-13: Top Line NAV Mode Displays

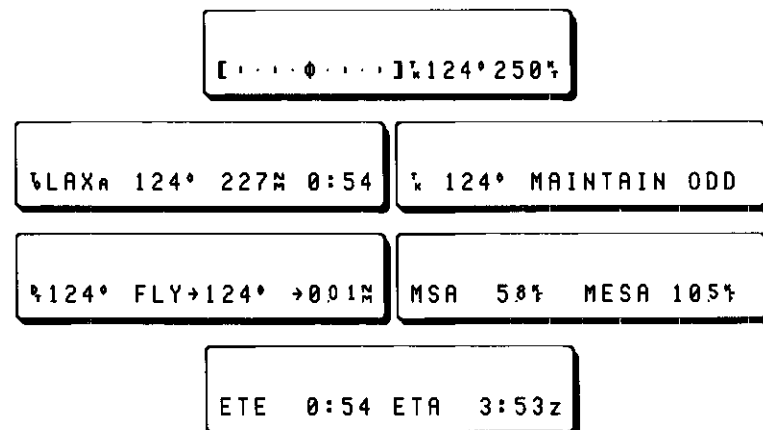
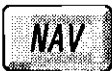


Figure 2-14: Bottom Line NAV Mode Displays

2.5.2 Accessing the Navigation Displays

When the NAV mode is active, the user may create display combinations according to personal preference. The small, inner selector knob controls the display of information on the top line. The large, outer selector knob controls the display of information on the bottom line.

To change the NAV mode display:

- Press the  key to select the NAV mode.
- Rotate the small, inner selector knob until the desired top line display is shown.
- Rotate the large, outer selector knob until the desired bottom line display is shown.

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2.5.3 Destination Waypoint Information

To view destination waypoint information (or information for any waypoint listed in an Active Flight Plan) while in the NAV mode:

- Press the  key to access the destination waypoint information.

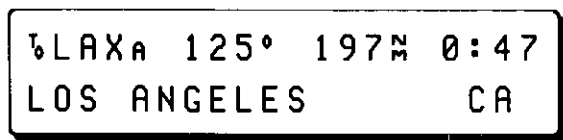


Figure 2-15: Destination Waypoint Display

The "Destination Waypoint" message flashes on the screen.

- If a Flight Plan is Active, rotate the small, inner selector knob to display the desired waypoint.
- Rotate the large, outer selector knob to display additional information.

Each time the large, outer selector knob is rotated, additional waypoint information is displayed on the bottom line. When a Flight Plan is Active, the small, inner knob allows viewing of information for any waypoint listed in the plan. This is the same information and logic that is available in the WPT mode.

To return to the NAV mode displays:

- Press the  key.

2.5.4 Alternate Waypoint Information

The Alternate Waypoint display allows the user to review bearing and distance to any selected waypoint, simultaneously with the selected destination.

The Alternate Waypoint feature is linked to the WPT and APT/VOR modes, providing real-time navigation information on the last selected waypoint in either mode. This information is only available on the bottom line of the NAV mode display.

To access Alternate Waypoint information from the NAV mode:

- Select an alternate waypoint using the WPT or APT/VOR modes.
- When the desired waypoint is displayed, press the  key to return to the NAV mode.
- Rotate the large, outer selector knob to display alternate waypoint information on the bottom line.

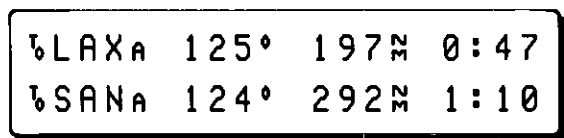


Figure 2-16: Alternate Waypoint Display

Bearing, distance and time to the requested identifier are now available on the bottom line of the display.

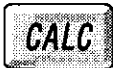
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2.6 The Calculator Mode

The Calculator (CALC) mode allows the user to perform many common E6B computer functions and calculate the following information:

- VNAV Profiles
- Time, Distance and Speed
- Fuel Management
- Winds Aloft
- Pressure Altitude
- Density Altitude
- True Airspeed
- Crosswind and Headwind
- Save Present Position

The CALC mode is accessed by pressing the CALC key. When this key is pressed, it lights to confirm the mode selection and remains lit until another mode is chosen.

- Press the  key.

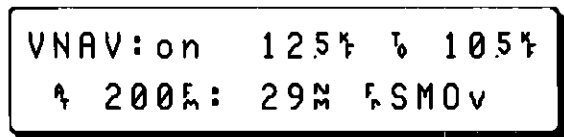


Figure 2-17: The Primary CALC Mode Display

The CALC mode is now active. The first page in this mode is the VNAV display. This display indicates that the aircraft will descend from 12,500 feet to 10,500 feet at 200 feet per minute, ending 29 nautical miles from the Santa Monica VOR.

2.6.1 Vertical Navigation Profiles

One of the most common uses of the CALC mode is to calculate Vertical Navigation Profiles (VNAV) for aircraft descent.

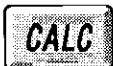
VNAV Profiles are calculated based on the aircraft's current speed. When entering VNAV data, altitudes are set in 100 foot increments and vertical speed is set in 10 foot per minute or 0.1° increments.

To create a VNAV Profile, the pilot must enter the starting altitude, ending altitude, the desired rate of descent or ascent, the desired distance from the destination for ending altitude and the destination identifier. See Section 6.3.2 for more information.

NOTE:

The Navigator will provide a series of Advisory messages to indicate when the level-off point has been reached. Advisory messages are indicated by the ADV annunciator light. When this light is on, press the  key to display the message.

To enter a VNAV profile:

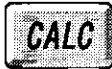
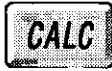
- Press the  key to access the CALC mode, and then the VNAV page.
- Press the  key.
- Rotate the large, outer selector knob to the right to move to the desired field.
- Rotate the small, inner selector knob to change the number in a field.
- Repeat the steps above until all VNAV information is entered.
- Press the  key a second time to complete the entries.

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2.6.2 Saving Present Position

The CALC mode may also be used to save the aircraft's present position. The Navigator provides 10 locations (alpha - julet) for temporary storage of these positions. Once these 10 locations are filled, rename any positions that should be saved. The Navigator automatically writes over the existing positions when the temporary locations are filled.

To save a present position:

- Press the  key to activate the CALC mode.
- Press the  key to save the present position.
- Press the  key a third time to return to the CALC mode.

The present position is saved to a temporary location. The position may be renamed from the WPT mode.

2.7 The Auxiliary Mode

The Auxiliary (AUX) mode allows the user to control and monitor information from the Navigator.

The AUX mode is divided into five functions:

- Checklists
- System Status
- Sensor Status
- System Setup
- Install

Each time the AUX key is pressed, a different function becomes active.

2.7.1 Checklist Function

The checklist function allows the user to create up to 10 custom checklists with up to 26 entries each. The checklist mode may be used to create an emergency checklist. This will provide the pilot with immediate access to critical information, should it ever be needed.

2.7.2 System Status Function

The Status function provides quick access to system status information including:

- Time Display
- Present Position Altitude Information
- Voltage and Temperature Display
- Database Revision Information
- Software Revision Information
- Software Code Display

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2.7.3 The Sensor Status Function

The Sensor Status function provides access to system diagnostic information as well as the system navigation mode.

2.7.4 The System Setup Function

The System Setup function allows quick access to frequently used setup features including Database Search Regions.

- **Database Search Regions**

This page allows the user to select the states and regions that a database search covers. Narrowing down the search parameters reduces the number of objects that are scanned to locate a specific object.

2.7.5 The Install Function

The Install function is used for installation purposes, Selectable User Units, Load/Save functions via RAM (Memory) Card or Serial Port, Pop-up Level Enable/Disable, etc.

2.8 Interpreting Messages

The Navigator uses three different annunciator lights to communicate special messages to the user:

- WRN (Warning Light)
- ADV (Advisory Light)
- PTK (Parallel Track)

New Warning messages (WRN) or Advisory messages (ADV) are indicated by the flashing indicators WRN and ADV. Old messages which are still relevant cause the message indicators to stay lit.

Messages are displayed in order of priority. New Warning messages have highest priority, followed by new Advisory messages.

To display messages, press the MSG key.

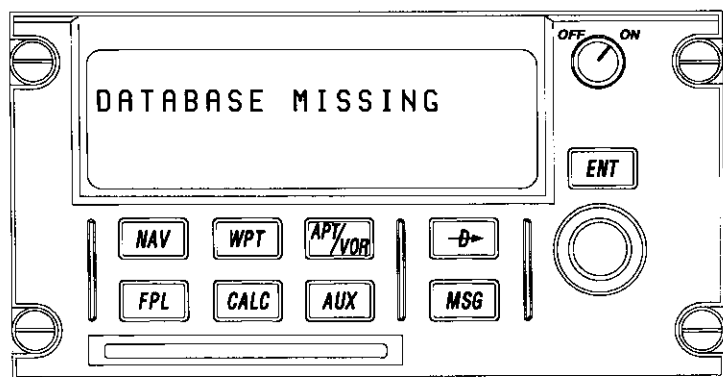


Figure 2-18: Message Display

*If more than one message is waiting, the **MSG** key will remain lit. Continue to press the **MSG** key to read through all waiting messages. The annunciator lights remain flashing until all advisories have been viewed.*

If a message continues to be relevant, the appropriate annunciator remains lit. The message may be viewed again by pressing the MSG key.

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2.9 Flight Planning

The Navigator provides a variety of flight planning functions including:

- Defining a Flight Plan
- Activating a Flight Plan
- Executing Direct To within a Flight Plan
- Modifying a Flight Plan
- Defining and Executing Holding Patterns

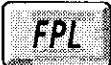
The following sections describe the steps to follow to execute the Navigator Flight Planning Functions.

2.9.1 Define a Flight Plan

This flight plan originates at the San Marcos Airport and ends at Love Field Airport in Dallas. Follow the steps listed below to create this sample flight plan.

	Waypoint	Type
1	T98	Airport
2	AUS	VOR
3	EDDEE	Intersection
4	ACT	VOR
5	DFW	VOR
6	DAL	Airport

To create the flight plan:

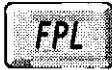
- Press the  key to access the Primary Flight Plan Display.
- Rotate the large, outer selector knob until the "EDIT NEW FLIGHT PLAN" message is displayed.

The "end" message alternates with the "<- Add" message. The  key begins to flash.

- Press the  key to add the first waypoint.

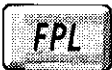
The display changes to the Waypoint mode; the last selected waypoint is displayed; the  key is lit; the  key begins to flicker. Waypoints may now be added to this flight plan.

To add waypoints or legs to a flight plan use the standard methods for selecting waypoints (Refer to Section 4.4):

- Press the  key to select the Airport waypoint category.
- Press the  key to open the identifier field for input.
- Rotate the small, inner selector knob to select "T" as the first character.
- Rotate the large, outer selector knob one click clockwise to address the second character.
- Repeat the two steps above to select "T98" as the waypoint identifier, then press the  key.
- Press the  key to complete the selection of this waypoint.

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The  key remains lit. The  key begins to flash.

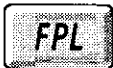
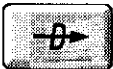
- Press the  key to begin entering the next waypoint.
- Repeat the steps above to enter each waypoint.
- When the last desired waypoint is entered, press the  key to finalize the plan.

TIP:

The  key can be used instead of the  key to select nearby waypoints.

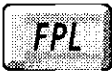
2.9.2 Activating a Flight Plan

The following outlines the steps to Activate the flight plan.

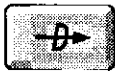
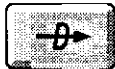
- Press the  key to access the Primary Flight Plan page.
- Rotate the small, inner selector knob to display the desired flight plan.
- Rotate the large, outer selector knob until the desired leg (usually Leg 1) is displayed in the bottom line.
- Press  key twice to activate the flight plan.

2.9.3 Fly Direct to a Waypoint in the Active Flight Plan

In the following example, the pilot is on Leg 1 (T98 to AUS), and chooses to fly **DIRECT TO** the EDDEE Intersection and pick up the flight plan at that waypoint.

- Press and hold the  key to display the active "T98A -> DALA" flight plan.
- Rotate the large, outer selector knob until the AUSv -> EDDEEi leg is displayed.
- Press the  key.

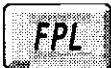
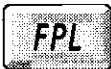
"Join Leg AUS to EDDEE" is displayed.

- Press the  key.
- Rotate the large, outer selector knob clockwise to display "FLY COURSE DIRECT TO EDDEE".
- Press the  key again to select the **DIRECT TO** leg.

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2.9.4 *Modifying an Active Flight Plan*

The following example shows how to replace DFWv with SCYv within the Active Flight Plan.

- Press and hold the  key.
- Rotate the large, outer selector knob to "EDIT".
- Press the  key.
- Rotate the large, outer selector knob to select "DFWv" (flashing).
- Rotate the small, inner selector knob to "DELETE".
- Press the  key followed by the  key to confirm the deletion.
- Press the  key.
- Use the  key, the  key and the selector knobs to select the SCY VOR.

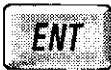
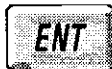
Note that waypoints are added to the left (i.e., before) the selected waypoint, and that the display is ready to Add a waypoint before DALA.

- Press the  key twice.
- Press the  key to select "SETUP" page.
- Rotate the small, inner selector knob until the Parallel Offset option is displayed.
- Press the  key to activate the cursor.

2.9.5 Holding Patterns

The following section describes the procedure to define and execute a holding pattern. The example describes how to:

HOLD southwest of the 20 degree radial, 25 DME fix off the Scurry (SCY) VOR.

- Press the  key until "USER" is displayed.
- Rotate the large, outer selector knob to display "Add Waypoint? (ENT)".
- Press the  key to confirm this selection.
- Rotate the selector knobs to name the user waypoint (e.g., "HOLD").
- Press the  key.
- Rotate the large, outer selector knob until "WPT + RNG&BRG?" is displayed and press the  key.
- Press the  key until VOR is displayed and use the  key and the selector knobs to select the SCY VOR, then press the  key.
- Use the selector knobs to enter a 020° radial and a distance of 25 NM.
- Press the  key.

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The new "HOLD" user waypoint is displayed.

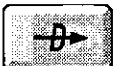
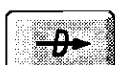
- Press the  key to display:



Figure 2-19: Hold User Waypoint Display

- Rotate the small, inner selector knob to select a COURSE of 020°.
- Press the  key again.

The active plan is suspended, and the Navigator is ready to navigate to SCYv and execute the holding pattern.

Chapter 3

The Navigation Mode

The Navigation mode provides the user with extensive information on the current destination or current leg of a flight plan.

After reading this chapter you will be able to :

- Interpret NAV mode displays
- Access "FROM" radial information
- Select a Direct Course to a Destination
- Select a desired Course To/From a Destination
- Select a desired Track from Present Position
- Correct cross-track errors
- Track bearing distance to two waypoints simultaneously
- Access Alternate Waypoint information
- Access Destination Waypoint information
- Access information for any Waypoint listed in an Active Plan.

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3.1 Navigation Mode Summary

Navigation information appears within a series of six displays or pages:

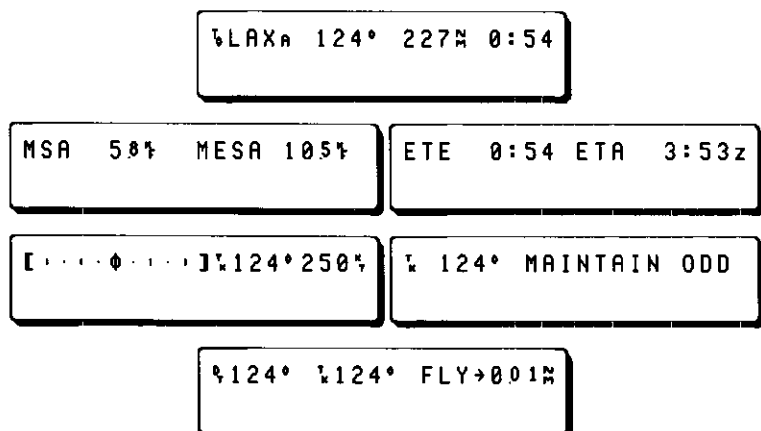


Figure 3-1: Top Line NAV Mode Displays

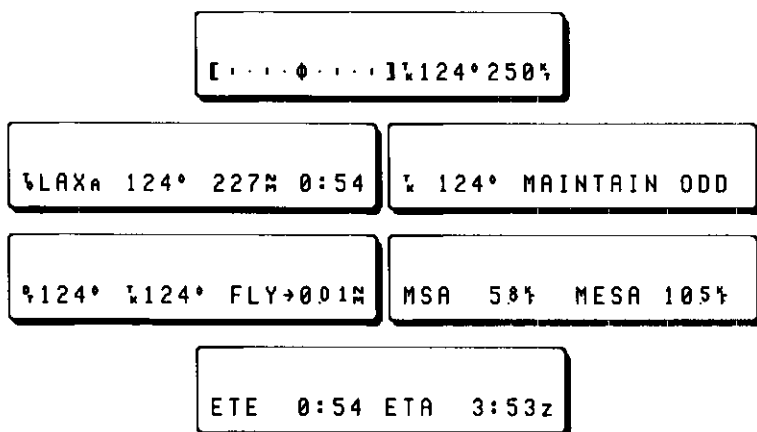


Figure 3-2: Bottom Line NAV Mode Displays

The Navigation mode displays always contain two lines of information. The small, inner selector knob controls the display of information on the top line. The large, outer selector knob controls the display of information on the bottom line. Since each line operates independently, the user may create display combinations according to personal preference.

The following abbreviations are used in the NAV mode displays:

3.3 The Primary Navigation Display

N	Nautical miles
K	Kilometers
S	Statute miles
K	Knots
K	Kilometers per Hour
M	Miles per Hour (Statute Miles)
K	Kilofeet (thousands of feet)
F	Feet per minute
F	From (radial)
T	TO
A	Current expected altitude
T	Ground track
D	Desired track

NOTE:

User selectable units are provided under AUX-INSTALL-User Units. "Distance" is available in Nautical Miles, Statute Miles, and Kilometers; "Speed" is available in Knots, Miles per Hour, and Kilometers per Hour; "Altitude" is available in Feet or Meters (typically displayed as kilometers); "Fuel" is available in Gallons, Pounds, Liters, and Imperial Gallons. When modified by the User, all displayed units in all modes conform to the selected convention.

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3.2 Accessing the Navigation Mode

To access the Navigation (NAV) mode, press the NAV key. When the NAV key is pressed, it lights to confirm selection and remains lit until another mode is chosen.

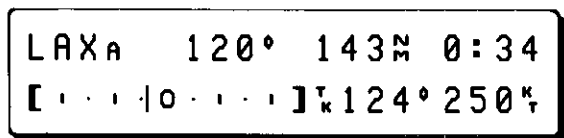


Figure 3-3: The Primary NAV Mode Display

The Primary NAV Mode display in Figure 3-3 is the most frequently used display in this mode. Destination information is located in the top line; the course deviation indicator (CDI) and current track are in the bottom line.

To select a different display:

- Rotate the small, inner selector knob in either direction until the desired display appears in the top line.
- Rotate the large, outer selector knob in either direction until the desired display appears in the bottom line.

NOTE:

The last display selected before leaving the NAV mode is retained. When the user returns to this mode, the navigation display that was last selected will appear.

When a destination is selected, the Navigator automatically returns to the Primary NAV Mode display. The Destination page is displayed on the top line and the CDI page is displayed on the bottom line.

The top line of the display in Figure 3-4 indicates that the current destination is the Los Angeles International Airport;

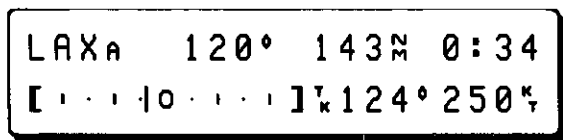


Figure 3-4: Primary NAV Mode Display

bearing is 120°; distance is 143 nautical miles; ETE is 34 minutes. (Time can be shown in hours and minutes or in minutes and seconds.)

The bottom line in the Primary NAV Mode display is the CDI page. The display in Figure 3-4 indicates that the CDI is centered; ground track is 124°; ground speed is 250 knots.

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3.4 Navigation Mode Displays

3.4.1 Waypoint Displays

The two waypoint displays are the Destination and the Alternate. Both displays contain information on the bearing and distance to the waypoint and the Estimated Time Enroute (ETE) at the current ground speed.

The "To" that precedes the LAX identifier indicates that the bearing shown is *to* the waypoint. A small capital letter "A" identifies this waypoint as an airport.

Waypoints are always identified as one of the following:

- A : Airport
- M : Military airport
- V : VOR
- N : NDB
- I : Intersection
- U : User waypoint

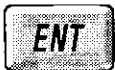
3.4.1.1 Destination Display

The Destination Display is always shown on the top line of the display. The destination is either the current destination selected from the WPT or APT/VOR mode or the destination waypoint of the current leg of an Active Flight Plan.

- **The "from" Radial Display**

The Destination and Alternate displays show great circle bearing *to* all waypoints.

To view the radial *from* Airports, VORs, NDBs, Intersections, and User Waypoints:

- Press and hold the  key for at least one second.

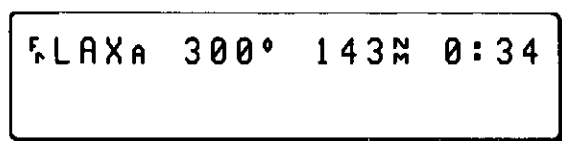


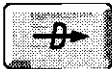
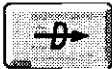
Figure 3-5: "from" Radial Display

The "F_r" that now precedes the LAX identifier indicates that from the destination, the Los Angeles International Airport, the radial is 300°; distance is 143 nautical miles; ETE is 34 minutes.

When the  key is released, the original display is returned.

3.4.1.2 Course to Destination or Track from Present Position

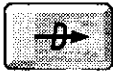
Choice of Direct Course inbound to, or selectable Course To/From, a Destination waypoint is provided for the NAV, WPT, and APT/VOR modes. Track from present position (no specific destination) is also provided.

- To select a direct course to a Destination waypoint:
 - Press the  key to select/re-select the destination.
 - Press the  key again to confirm the selection.

The NAV mode becomes active. The CDI is automatically centered and providing direct steering to the selected destination. If on an Active Flight Plan, steering is provided direct to the selected waypoint.

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- To select a desired course To or From a Destination waypoint:

- Press the  key to select/re-select the destination.
- Rotate the small, inner selector knob to select the desired Course inbound to the destination ($\pm 90^\circ$ left or right of the direct course from present position).

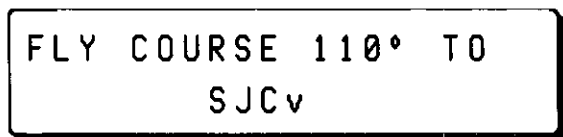


Figure 3-6: Selected Course To SJC

- To select a desired course outbound from the destination, rotate the small, inner selector knob greater than $\pm 90^\circ$ from the direct course to destination.

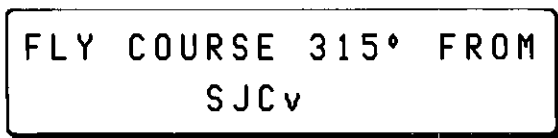
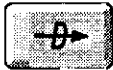


Figure 3-7: Selected Course From SJC

- Press the  key again to confirm the selection.

The NAV mode becomes active. The CDI is automatically placed left or right to indicate position of desired inbound/outbound course. If an outbound course from a destination is selected, the NAV display will indicate *From...*

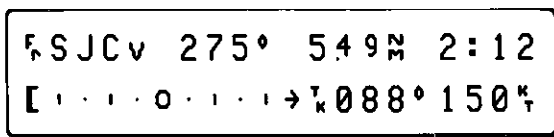


Figure 3-8: Fly to 315° Outbound SJC

NOTE:

In the event an inbound course is desired that is more than ± 90 degrees from the direct course to the waypoint from present position (or an outbound course is desired that is less than ± 90 degrees from the direct course), the pilot must first maneuver the aircraft so as to position it properly from the referenced waypoint. For example, if the desired inbound course is 135° off the direct course to the waypoint from present position, the aircraft must be flown to a new position that is located less than 90 degrees from the desired inbound course.

ARGUS NOTE:

For Trimble Navigators integrated to the ARGUS Map, the track outbound from a waypoint may now be displayed on the Map. This function is enabled by selecting ARGUS instead of K0 in the appropriate serial output port, as described in Section 7.5.9.2. Display of the outbound track is fully automatic for both waypoint fly-over, and selection of desired course from a waypoint is as described above.

CAUTION:

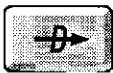
Presentation of the outbound track on the ARGUS results in reverse sensing of the ARGUS CDI and Track Angle Error (TE) displays (similar to reverse sensing experienced with a VOR when the OBS is set 180° from actual track). Reverse sensing is obvious since the displayed TE will be approximately 180° left or right. The Navigator Internal and External CDIs function normally.

TIP:

To quickly select a course or track significantly distant from that displayed ($\rightarrow 100^\circ$ away), spin the small, inner selector knob left or right as appropriate.

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- To select a desired track from Present Position:

- Press the  key to select/re-select the destination.
- Rotate the large, outer selector knob clockwise.

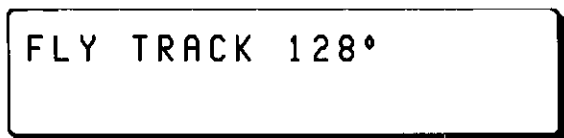
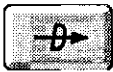


Figure 3-9: Flying a Direct Track

NOTE:

The "FLY TRACK" initially displayed corresponds to the present track of the aircraft, not the direct course to the displayed waypoint. If a different track is desired (e.g., 078°), use the small, inner selector knob as described below.

- Press the  key again to confirm the selection.

The NAV mode becomes active. The CDI is automatically centered and providing direct steering on the selected track from Present Position.

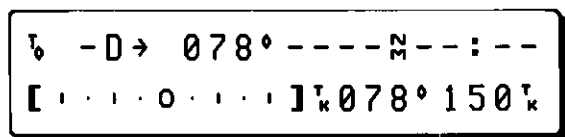


Figure 3-10: Fly Selected Track 078°

- When selecting other than direct Course while on an Active Flight Plan:

When on an Active Flight Plan, any attempt to select other than a direct Course to a waypoint listed in the plan, will result in the Flight Plan being canceled. Once the -D> key is pressed the first time, if the small, inner selector knob is rotated, a warning of impending cancellation will appear, such as:

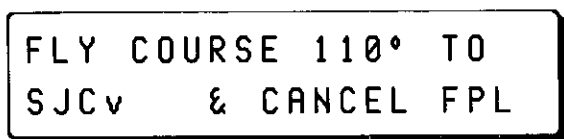


Figure 3-11: Non-Direct Cancels FPL

TIP:

To deselect a non-direct Course or Track, rotate the large, outer selector knob clockwise, then counter-clockwise. This action will reinstate display of the direct Course to the destination, which may be selected by pressing the  key. To cancel any action, simply select the  key (or any other key), returning the display to its former status.

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3.4.1.3 The Alternate Waypoint Display

The Alternate Waypoint display allows the user to review bearing and distance to any selected waypoint, simultaneously with the selected destination. This feature is linked to the WPT and APT/VOR modes, providing real-time navigation information to the last selected waypoint in the database or the APT/VOR mode.

Alternate Waypoint information is only available in the bottom line of the NAV mode display.

To select the Alternate Waypoint display:

- Press the  key or the  key until the desired waypoint category is selected.
- Rotate the small, inner selector knob to select the identifier or, in the WPT mode, use the  key and selector knobs to enter the identifier.
- When the desired information is displayed, press the  key to return to the navigation displays.
- Rotate the large, outer selector knob to display bearing and distance to the alternate waypoint.

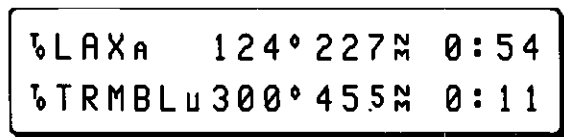


Figure 3-12: Alternate Waypoint Display

3.4.2 The Time Display

The Time page provides information on the Estimated Time Enroute and Estimated Time of Arrival to the next waypoint.

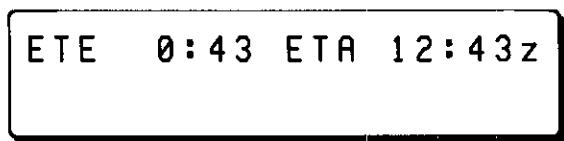


Figure 3-13: The Time Display

The display in Figure 3-13 indicates that the ETE to the next waypoint is 0 hours, 43 minutes; ETA to the next waypoint is 12:43 Zulu (refer to Chapter 7, The Auxiliary Mode, for instructions for setting local time).

The Navigator determines the ETE by dividing the distance to the next destination by the current ground speed. The ETA is determined by adding the ETE to the current time (local or Zulu).

In Figure 3-14, plane A is travelling along the desired track. The computed ETE is 45 min. Plane B has the same ground speed and distance to destination as plane A, but with a different track. The computed ETE is also 45 min. If both planes continue along their same course, the ETE for plane A will decrease faster than that of plane B.

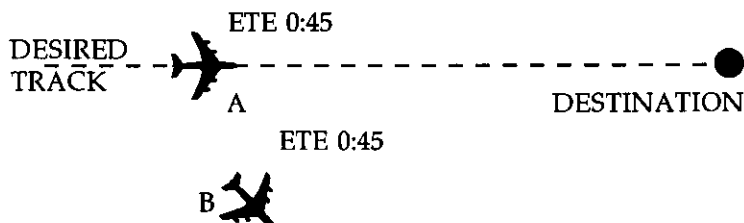


Figure 3-14: ETE/ETA Calculation

TIP:

If a flight plan is active, the ETE and ETA for the final destination can be determined in CALC mode.

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3.4.3 The Vertical Navigation Display

The Vertical Navigation display (VNAV) provides the pilot with descent/climb information.

If the descent/climb starting point has not yet been reached (if the aircraft is not descending or climbing) or VNAV instructions have not been entered in the CALC mode, a display similar to Figure 3-15 will appear:



Figure 3-15: Vertical Navigation Display

This display indicates that the current track is 124°; maintain ODD altitude based on VFR/IFR altitude rules.

The current ground track (shown as "TK") is displayed in degrees.

The desired altitude is given as ODD or EVEN depending on the course over ground.

If VNAV instructions have been given in the CALC mode (as described in Section 6.3.2), the ODD/EVEN display is replaced with the current desired altitude after the descent/climb profile is active.

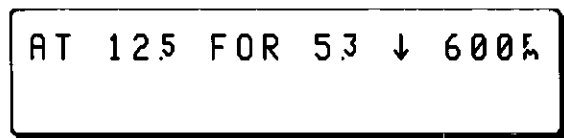


Figure 3-16: VNAV Calculation Display

The display in Figure 3-16 indicates that the current altitude should be 12,500 feet; destination altitude will be 5,300 feet; descent should be made at 600 feet per minute.

3.4.4 Ground Track Displays

The Ground Track pages in NAV mode provide information on the Desired Track (DT), the ground track (TK), and distance off-track, in both graphic and numeric format.

The following diagram illustrates an aircraft off-track and the corresponding track relationships.

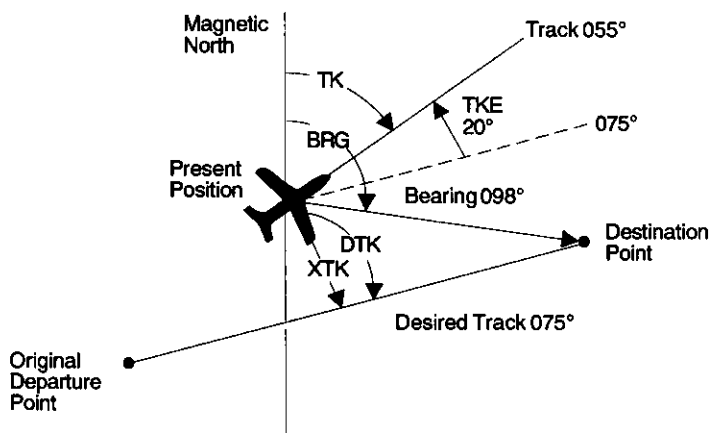


Figure 3-17: Track Relationships

3.4.4.1 Track Angle Error Graphic Display

The Track Angle Error (TKE) Display is provided in graphic form on the first line of the primary NAV display (press the NAV button for approximately one second until display defaults to primary NAV mode). To access the graphic TKE from the primary NAV display:

- Rotate the small, inner selector knob counterclockwise one click until the display in Figure 3-18 appears.



Figure 3-18: Track Angle Error Display

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The scale on the top line provides TKE graphic information aircraft nose position relative to desired track. The moving symbol is not a fly-to symbol, but rather an indication of current nose position. The waypoint ID and distance to go are also displayed on the top line. The CDI located on the lower line is a fly-to symbol, and provides course deviation left/right of desired track, per standard operations.

CDI sensitivity is selected by the pilot in the AUX-SETUP-INTERNAL CDI ADJUST page per procedures described in Section 7.4.4.1. TKE sensitivity is automatically provided dependent on the selected CDI scale:

CDI Sensitivity

1/32 to 1/8 NM
1/4 to 1 NM

TKE Sensitivity

5° per Dot
10° per Dot

When 1/32 through 1/8 NM is selected on the CDI, short TKE tick marks are provided to show the 5° intervals. When 1/4 to 1 NM is selected on the CDI, all TKE tick marks are long, representing 10° each.

NOTE:

To smoothly intercept the desired track represented by the location of the CDI indicator, turn the aircraft toward the CDI fly-to symbol until the TKE symbol is located directly above the CDI symbol. Maintaining this relationship throughout the intercept will result in a smooth shallowing of the intercept angle. To increase the rate of intercept, merely oversteer the TKE symbol relative to the CDI indicator.

3.4.4.2 Track Angle Error Numeric Display

The Ground Track page provides information on the Desired Track, degrees off-track, and distance off-track (in nautical miles (NM), kilometers (KM), or statute miles (MI), as selected under AUX-INSTALL-User Units.

The display in Figure 3-19 indicates that the desired track is 075°; track angle error is 20° left (current track is 055°, therefore turn right 20° to get back on desired track); fly 1.48 NM to the right to reach the commanded course line.

The Navigator usually selects the desired track as the direct course line from the present position to the selected destination. If a Flight Plan is active, the desired track is selected as the direct course line to the destination of the next leg of the Flight Plan.

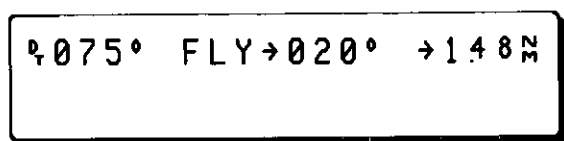


Figure 3-19: Ground Track Display

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3.4.5 CDI Display

3.4.5.1 Cross-Track Errors - Ground Track

The CDI in Figure 3-20 simulates a mechanical course deviation indicator. When the flashing vertical bar is centered on the O, the aircraft is on course. If the flashing bar is to the left or right of the O, a cross-track error is occurring. To correct the error, fly towards the "needle" as in conventional VOR navigation. If the cross-track error is greater than the display allows, the left or right bracket will change to a flashing arrow. Steer in the direction of the arrow to center the CDI.

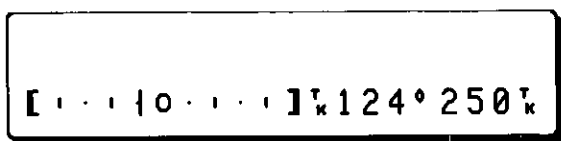


Figure 3-20: CDI Display

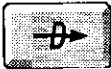
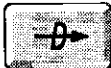
3.4.5.2 CDI Scale

Each mark on the CDI (O, vertical bar, or dot) corresponds to one dot on a standard analog CDI. CDI sensitivity is set at one half mile per dot when the system is delivered from the factory. Full scale deflection represents five nautical miles of cross-track error. CDI sensitivity may be adjusted for individual preference and stored in memory.

3.4.5.3 Re-Centering the CDI

To save time and eliminate large cross-track errors on the CDI, simply re-enter the current destination. The system will automatically compute present position, direct navigation information and display a centered CDI.

To re-center the CDI:

- Press the  key to re-select the destination.
- Press the  key again to confirm the selection.

3.4.6 The Minimum Safe Altitude Display

Information on minimum safe altitude is provided in the Jeppesen NavData credit-card database. MSAs provide a reference for safe reference point clearance during off-airway navigation. The Navigator determines and displays the MSA for the block of airspace within which the aircraft is operating. MSAs are provided for blocks of airspace measuring one-half degree of latitude by one-half degree of longitude in CAN, MEX, USA and Hawaii or approximately 30 nm by 30 nm blocks.

NOTE:

MSA information is not available outside CAN, MEX, USA and HAWAII.

3.4.6.1 Minimum Safe Altitude (MSA)

MSA is displayed in thousands of feet (kilofeet, shown as "KF"). MSA is calculated based on the highest reference point in the block of airspace within which the aircraft is operating.

3.4.6.2 Minimum Enroute Safe Altitude (MESA)

MESA is displayed in thousands of feet (kilofeet, shown as "KF"). MESA is calculated based on the highest reference point in all blocks of airspace through which the aircraft will pass enroute to its final destination.

MSA or MESA values clear all reference points by 1000 feet in areas where the highest reference points are 5000 feet MSL or lower. MSA or MESA values clear all reference points by 2000 feet in areas where the highest reference points are 5001 feet MSL or higher.

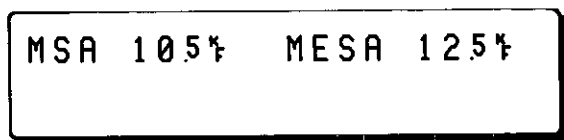


Figure 3-21: Track Relationships

The display in Figure 3-21 indicates that the minimum safe altitude at the current location is 10,500 feet; minimum enroute safe altitude is 12,500 feet.

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3.4.6.3 Altitude Accuracy

Altitude accuracy is essential to flight safety. Use caution and observe all safety precautions.

- Never rely on a single navigation system.
- Maintain the Trimble Navigator and other navigation equipment properly.
- Keep the Jeppesen database up to date.
- Observe VFR regulations when using navigation equipment that does not have IFR approval.
- Don't forget to see and be seen.

NOTE:

Refer to Section 7.2.2.1 for additional altitude information.

3.5 The Destination Waypoint Display

The NAV mode provides quick access to waypoint information for the current destination or any waypoint listed in an Active Flight Plan. To access destination waypoint information (or information for any waypoint listed in a plan) while in the NAV mode:

- Press the  key from any display within the NAV mode.
- If a flight plan is Active, rotate the small, inner selector knob to display the desired waypoint.
- Rotate the large, outer selector knob to view the destination (or Flight Plan) waypoint information in the bottom line of the display.

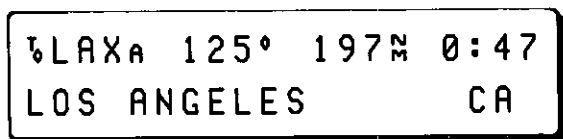


Figure 3-22: The Destination Waypoint Display

Each time the large, outer selector knob is rotated, additional waypoint information is displayed on the bottom line. When a Flight Plan is Active, the small, inner selector knob allows viewing of information for any waypoint listed in the plan. This is the same information and logic that is available in the WPT mode.

When on an Active Flight Plan, direct steering may be initiated to any future waypoint in the flight plan using the following steps:

- Rotate the small, inner selector knob to display the desired waypoint.
- Press the  key to select the desired waypoint.
- Press the  key again to confirm the selection.

The Flight Plan remains Active, the CDI is automatically centered and providing steering from present position to the selected waypoint. The Flight Plan continues from the selected waypoint to the final destination, as programmed.

To return to the NAV mode displays:

- Press the  Key.

Chapter 4

The Waypoint Mode

The Waypoint mode provides access to comprehensive, reliable information on Airports, VORs, NDBs, Intersections and User-created waypoints.

After reading this chapter you will be able to:

- Select waypoint categories and identifiers
- Access extensive information on each waypoint in the NavData database
- Interpret waypoint mode displays
- Select waypoint bearing/radial
- Select any direct destination
- Create User waypoints
- Edit User waypoints
- Erase User waypoints

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4.1 The Jeppesen Navigation Database

Waypoint information is stored in the Jeppesen NavData Database Card. A current Database Card is supplied with the Navigator. The information stored on this Database Card is updated every 28 days. The expiration date is listed on the back of the card.

To receive an updated Database Card every 28 days, complete the Jeppesen subscription form in the Introductory section of this manual, or refer to the Jeppesen information packet enclosed with the Navigator.

A list of the States, Provinces, and Countries included in the Database Card is located in Appendix A. User waypoints are not stored on the Database Card and are not erased by updating the database.

NOTE:

The pilot should use the most current NavData Database Card. To receive an updated NavData Database Card on a regular basis, complete the subscription form in the Introductory section of this guide.

WARNING:

Do not remove the NavData Database Card from the system when the power is on. To prevent corrupted data and random system errors, the system will automatically RESET if the card is removed.

Most waypoints in the database have a unique identifier. These identifiers are assigned based on the waypoint type (Airport, VOR, NDB, Intersection, User) and location. The following information pertains to airport identifiers only:

Continental U.S.

Waypoint identifiers in the continental U.S. are shown with FAA-standard designations. For example, the identifier for the San Francisco International Airport is SFO.

Alaska and Hawaii

Identifiers for some waypoints in Alaska and Hawaii use ICAO identifiers. For example, the identifier for the Anchorage airport is PANC.

International

For waypoints outside the U.S., standard ICAO identifiers are used. Refer to Appendix A for a complete list of state, province and country codes.

4.2 Waypoint Categories

Waypoint information is divided into five categories:

- Airports
- VORs
- NDBs
- Intersections
- User waypoints

Each waypoint category provides a different set of information:

All categories contain:

- Bearing to waypoint
- Bearing from waypoint
- Distance to waypoint

Airports

Identifier, city, state or country name, airport name, communications frequencies, field elevation, runway information, lighting, approach information, services and latitude/longitude.

VORs

Identifier, city, state or country name, VOR name, navigation frequency, Morse code for identifier, and latitude/longitude.

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NDBs

Identifier, city, state or country name, NDB name, navigation frequency, Morse code for identifier, and latitude/longitude.

Intersections

Identifier, region name, and latitude/longitude.

User Waypoints

User identifier and latitude/longitude.

The **WPT** key is used to select a specific waypoint category. Each time this key is pressed, the next waypoint category flashes on the screen.

Waypoint categories appear in the following order. Once the last category in this list appears, the cycle begins again.

1. Airport
2. VOR
3. NDB
4. Intersection
5. User

TIP:

*To return directly to the Airport display from any other waypoint category, just press and hold the **WPT** key for at least one second.*

4.3 Accessing the Waypoint Mode

To access the Waypoint (WPT) mode, press the WPT key. When this key is pressed, it lights to confirm the mode selection and remains lit until another mode is chosen.

When the WPT mode is selected after system power-up, the Airport category flashes on the screen.



Figure 4-1: Airport Category Display

Then the last waypoint selected in the Airport category is displayed. The primary airport display in Figure 4-2 indicates that the bearing to San Francisco Airport from present position is 313°; distance is 243 nautical miles; the SFO Airport has Class B.

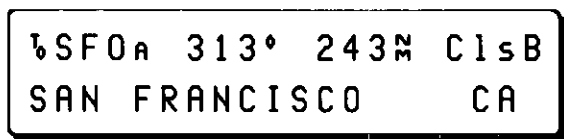


Figure 4-2: The Primary Airport Display

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4.4 Selecting Waypoints

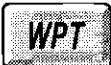
The Navigator provides the following four methods for selecting waypoints:

- Scan the identifiers in the database
- Enter the waypoint identifier
- Enter the waypoint city
- Enter the waypoint name

4.4.1 *Scanning the Identifiers in the Database*

The identifiers in each waypoint category are organized alphanumerically, with numbers 0-9 following Z. To scan the database and select a specific waypoint, rotate the small, inner selector knob. A clockwise rotation of the knob scrolls forward through the information, while a counterclockwise rotation scrolls backward.

For example, to scan the database and select the identifier for the San Francisco Airport, SFO:

- Press the  key until the Airport category is selected.
- Rotate the small, inner selector knob, in either direction, until the desired waypoint identifier is displayed.

Each time this knob is rotated, a new identifier is displayed in the top line of the screen, except at either end of the list of waypoints in the given category.

4.4.2 *Selecting Waypoints by Identifier*

Any waypoint may be selected by entering the waypoint identifier into the appropriate database fields.

The ENT key and the selector knobs are used to enter field information. The small, inner selector knob changes a letter, number or character in a field. The large, outer selector knob is used to move from one field to the next.

For example, to select the identifier for the Los Angeles International Airport, LAX, follow these steps:

- Press the **WPT** key until the Airport category is selected.
- Press the **ENT** key once.

The **ENT** key and the first letter of the Airport identifier begin to flash.

- Rotate the small, inner selector knob in the appropriate direction until the first letter of the Airport identifier changes to "L".
- Rotate the large, outer selector knob clockwise to move to the next field.
- Repeat the previous two steps until the "LAX" identifier is displayed.
- Press the **ENT** key to complete the selection.

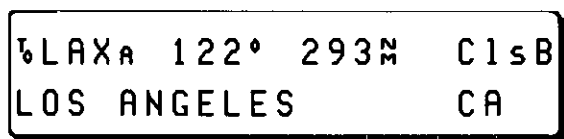


Figure 4-3: Los Angeles Airport Identifier

The waypoint identifier for the Los Angeles International Airport is now displayed.

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- **Selecting Between Similar Identifiers**

Not all waypoints in the Jeppesen database have unique identifiers. To confirm that the correct waypoint has been selected, check the waypoint city or latitude and longitude.

- Press  key to select the desired waypoint category and identifier.
- Once the identifier is displayed in the top line, rotate the large, outer selector knob to display the latitude and longitude or city in the bottom line.

Similar identifiers are listed in sequence. If the selected identifier is not correct:

- Rotate the small, inner selector knob to select the next similar identifier.

NOTE:

Although there are some occurrences of duplicate identifiers in the U.S. database, most similarities occur in the International database.

4.4.3 *Selecting Waypoints by City or Name*

Waypoints may also be selected by entering their city or name. To enter a city or name, the correct bottom line display must first be selected.

To select the bottom line displays:

- Press the  key to access the Waypoint mode.
- Rotate the large, outer selector knob until the desired category (city or name) for the current waypoint is displayed in the bottom line.

Once the correct bottom line display is selected, the city or name may be entered. The same steps that are used for entering waypoint identifiers may be used to enter this information.

For example, to select a San Diego Airport by city:

- Press the **WPT** key to access the Waypoint mode and select the Airport category.
- Rotate the large, outer selector knob to display the city name for the current waypoint.
- Press the **ENT** key.
- Rotate the large, outer selector knob until the cursor is displayed in the city line.
- Rotate the small, inner selector knob, in either direction, until the first letter of the city reads "S".
- Rotate the large, outer selector knob clockwise to move to the next field.
- Rotate the small, inner selector knob to change the selected field.
- Repeat the previous two steps until the airport city reads, "SAN DIEGO".
- Press the **ENT** key to complete the selection.

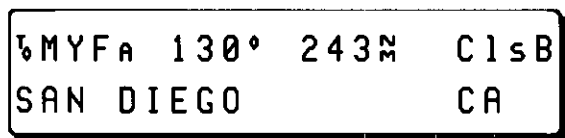


Figure 4-4: Waypoint Display

NOTE:

If the state or province code displayed does not match the desired city, follow the procedures for "Selecting Waypoints by City with Multiple Airports."

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- **Selecting Waypoints by City with Multiple Airports**

Enter the city name as described in the previous paragraph, "Selecting Waypoints by City or Name." Proceed as follows:

- Place the cursor under the last letter of the city.
- Rotate the small, inner selector knob to select other waypoints located in that city (or in other cities of that name in other states or provinces).

4.5 Selecting Waypoint Displays

Each waypoint in the database has a series of two-line information displays. The top line usually displays the identifier for the selected waypoint and the bearing and distance *TO* the waypoint from the current location. The bottom line displays additional information for the current waypoint.

To access the additional information on the bottom line:

- Select a waypoint (refer to Section 4.4).
- Rotate the large, outer selector knob.

Each time the large, outer selector knob is rotated, a new page of information is displayed. An example in Figure 4-5 includes the displays for the Albuquerque Airport. Descriptions of these displays are included in the following sections.

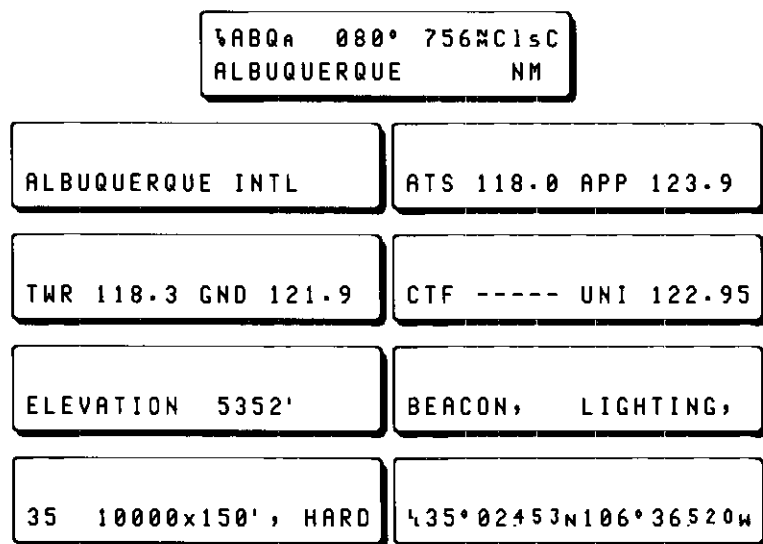


Figure 4-5: Airport Bottom Line Displays

TIP:

The last display that is selected before leaving the WPT mode is retained. The next time the WPT mode is accessed, that display will be shown.

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4.5.1 The Airport Displays

The Primary Airport display appears after the Airport category is selected from the Waypoint mode.

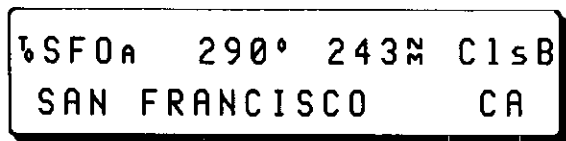


Figure 4-6: The Primary Airport Display

The top line of the Primary Airport display includes the airport identifier followed by a small letter "A" to indicate airport; the bearing to the airport; the distance to the airport in nautical miles; and the control area for the airport (ClsB and ClsC) if one exists. The bearing and distance information in this page continuously updates for real time display of relative position.

The bottom line of the Primary Airport display includes the airport name and the city where the airport is located. The following pages of information may also be displayed in this line:

- Airport name
- City and state where the airport is located
- Communication frequencies
- Field elevation
- Lights, approach and service information
- Runway information
- Latitude and longitude

To select these pages, rotate the large, outer selector knob. Each time this knob is rotated, the next page appears in the bottom line of the display.

4.5.1.1 The Communication Frequencies Page

Communication Frequencies are displayed in a series of three pages. The following frequencies and abbreviations appear in these pages:

ATIS	ATS
Approach	APP
Tower	TWR
Ground	GND
UNICOM	UNI
CTAF	CTF

To access the Frequencies pages:

- Press the  key to access the Airport category in the WPT mode.
- Rotate the large, outer selector knob until the frequencies pages appear in the bottom line of the display.

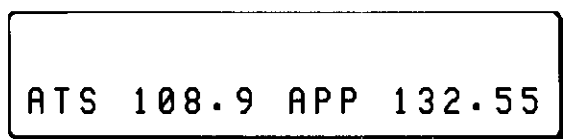


Figure 4-7: The Frequency Page

The display in Figure 4-7 indicates that ATIS frequency is 108.9; the approach frequency is 132.55.

NOTE:

If a frequency is not displayed, a series of dashes (- - -) appears in its place. If no frequencies exist, the message "NO COM FREQUENCIES" appears.

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4.5.1.2 The Lights, Approach and Service Page

The Lights, Approach and Services page displays messages concerning the lights, approach and services for the current airport. These messages scroll horizontally across the screen, from right to left.

To access this page:

- Press the  key to access the Airport category in the Waypoint mode.
- Rotate the large, outer selector knob until the Lights, Approach and Service page appears in the bottom line of the display.

The following messages and abbreviations appear in these pages:

Beacon Messages

no BEACON	No Beacon available
BEACON	Beacon at airport

Lighting Messages

no LIGHT	No lighting available
??	Lighting availability unknown
LIGHTING	Lighting available
pc LIGHT	Pilot-controlled lighting

Approach Messages

no APCH	No IFR approach
IFR APCH	IFR approach available

Service Messages

no SERVICE	No services available
SERVICES	Services available

NOTE:

An airport is considered to have services if it sells 100LL fuel.

4.5.1.3 The Runway Information Page

To access the Runway Information page:

- Press the  key to access the Airport category in the Waypoint mode.
- Rotate the large, outer selector knob until the Runway Information page appears in the bottom line of the display.

When the Airport Runway page is selected, the longest runway is displayed first. If there are other runways at least 2000 feet in length, they may be displayed by turning the large, outer selector knob to the right.

The following information and abbreviations appear in these pages:

Runway Designations

L	Left
R	Right
M	Middle
-	No parallel runways

Runway Surfaces

HARD	Hard Surface
TURF	Turf Surface
GRVL	Gravel Surface
DIRT	Dirt Surface

Pattern Traffic Directions

LEFT
RIGHT
UNKNOWN

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4.5.2 VOR and NDB Displays

The VOR and NDB displays appear after their respective categories are selected from the WPT mode.

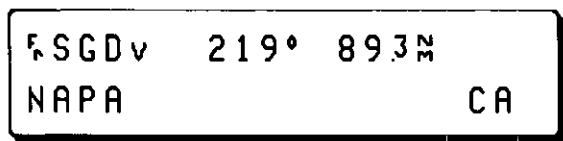


Figure 4-8: The Primary VOR Display

The top line of the VOR and NDB displays includes the identifier for the last selected waypoint, followed by a small sized letter "V" to indicate VOR or "N" to indicate NDB; the radial from the waypoint for VORs or the bearing to the waypoint for NDBs; and the distance to the waypoint in nautical miles.

The bottom line of these displays may include any one of the following pages:

- City and state, province or country code
- Waypoint name
- Navigation frequency
- Morse code identifier
- Latitude and longitude

To select these pages, rotate the large, outer selector knob. Each time this knob is rotated, the next page appears in the bottom line of the display.

4.5.3 Intersection Display

The Jeppesen NavData Database Card contains both enroute and terminal intersections. The Primary Intersection page appears after the Intersection category is selected from the WPT mode.

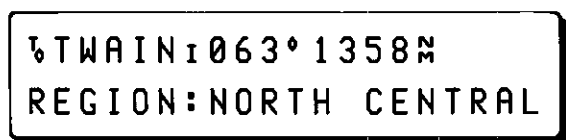


Figure 4-9: The Primary Intersection Display

The top line of the Intersection display includes the identifier for the last intersection selected, followed by a small letter "I" to indicate Intersection, the bearing to the intersection, and the distance in nautical miles.

The bottom line of this display may include either of the following pages:

- Intersection region
- Latitude and longitude

These pages are selected from the Waypoint mode. Each time the large, outer selector knob is rotated, the next page appears in the bottom line of the display.

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4.5.4 User Waypoint Display

The User Waypoint display appears after the User category is selected from the WPT mode.

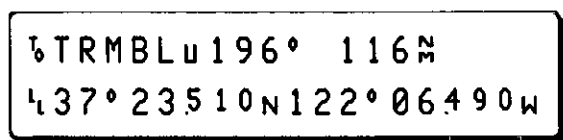


Figure 4-10: The Primary User Waypoint Display

The top line of this display includes the identifier for the last User waypoint selected, followed by a small capital letter "U" to indicate User waypoint; the bearing to the User waypoint; and the distance in nautical miles.

The bottom line of this display includes the waypoint latitude and longitude displayed in degrees, minutes, and thousandths of minutes.

4.6 Selecting Waypoint Bearing/Radial

Airports, NDBs and Intersections are normally displayed with the great circle bearing "to" information. The VOR pages display great circle radial "from" information.

These pages can be changed to display either radial or bearing information by pressing and holding the ENT key for at least one second.

For example, in Figure 4-11 the "T" that precedes the SFO identifier indicates that this is the bearing information to the San Francisco International Airport.



Figure 4-11: Bearing "to" Display

To display the radial "from" this identifier:

- Select the desired Waypoint category and identifier.
- While viewing the desired waypoint, press and hold the  key for at least one second.

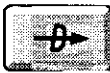


Figure 4-12: Radial "from" Display

The radial "from" information is displayed as long as the  key is pressed. The "T" that preceded the SFO identifier in Figure 4-11 changes to "F". The display in Figure 4-12 indicates that the radial "from" the San Francisco Airport to present position is 130°.

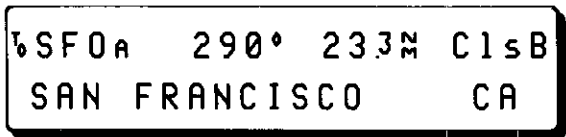
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4.7 Selecting a Destination

A direct destination is usually selected from the WPT mode. Any waypoint (Airport, VOR, NDB, Intersection, User) may be selected as a destination. The  key is used to confirm the selection and begin navigating.

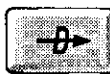
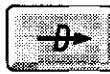
For example, suppose the destination for this flight is the San Francisco International Airport:

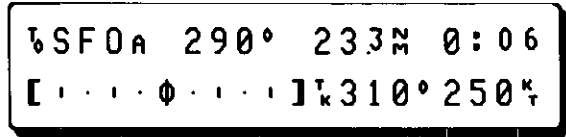
- Press the  key.
- Select the SFO identifier from the Airport category. (Refer to Section 4.4)



WPT Mode display showing the selected destination: SFO, 290°, 23.3M, C15B, SAN FRANCISCO, CA.

Figure 4-13: SFO Identifier WPT Mode

- Press the  key once to select this identifier as the desired destination.
- Press the  key a second time to confirm this selection and begin navigating.



NAV Mode display showing the destination: SFO, 290°, 23.3M, 0:06, [. . .] 310° 250M.

Figure 4-14: Destination Display NAV Mode

The display returns to the NAV mode. The aircraft is assumed to be navigating towards this destination and the CDI is automatically centered.

4.8 User Waypoint Information

Up to 250 User waypoints may be created and stored in the Navigator's database.

When creating User waypoints, name the waypoint first and then define the waypoint position (refer to Section 4.8.1).

A User waypoint name can be up to 5 characters long and may include any combination of letters and numbers. To eliminate confusion, do not use a name that matches the name of any existing Airport, VOR, NDB, or Intersection in the database.

The position of a User waypoint may be defined by the current position of the aircraft, latitude and longitude or range and bearing from any stored waypoint.

User phonetic waypoints, "alpha" to "julet" (lowercase), already exist as user waypoints and are used to capture the pilot's present position. This is accomplished by pressing the CALC key twice at that position.

The pilot must change the name to uppercase to edit the phonetic waypoint as follows:

- Rotate the large, outer selector knob in either direction until the "EDIT" message appears.
- Press the  key. The waypoint name changes to uppercase.
- The waypoint may now be edited.
- Press the  key to complete the edit.

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4.8.1 Creating User Waypoints

User waypoint names are entered just like other waypoint information, using a combination of the ENT key and the selector knobs.

For example, to create a User waypoint called TRMBL:

- Press the  key to access the WPT mode and the User category.
- Rotate the large, outer selector knob until the display reads, "Add Waypoint? (ENT)".
- Press the  key.

The flashing letter "A" appears as the first letter of the waypoint.

- Rotate the small, inner selector knob to select the first letter of the waypoint name.
- Rotate the large, outer selector knob to move to the next field.
- Repeat the previous two steps until the waypoint name "TRMBL" is entered.

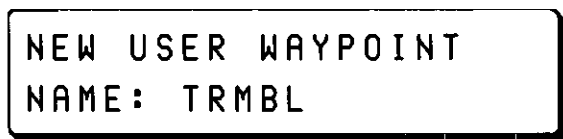


Figure 4-15: User Waypoint Name Display

- Press the  key to accept the waypoint name.

The User waypoint is now named. The waypoint position may now be defined.

NOTE:

If a name already exists, a message will be displayed that tells the user to enter a different name. The name must be changed before continuing.

Once a User waypoint is named, it must be defined by one of the following:

- Present position
- Latitude and longitude
- Range and bearing from another waypoint

These options are selected from the User waypoint pages.

4.8.1.1 Defining a User Waypoint by Present Position

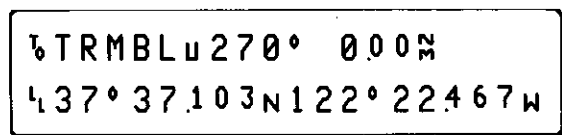
After a User waypoint is named, the display prompts the user to save the present position as the location for the waypoint.



TRMBL SAVE USING
THIS POSITION? (ENT)

Figure 4-16: Current Position Display

- Press the  key once to define this waypoint by the current aircraft position.



b TRMBL u 270° 000M
4 37° 37.103N 122° 22.467W

Figure 4-17: Current Position Defined

The display briefly indicates that the waypoint has been saved and the new User waypoint appears.

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4.8.1.2 Defining a Waypoint by Latitude and Longitude

To define a User waypoint by latitude and longitude, follow these steps:

- Enter the User waypoint name.
- Press the  key to save the new name.
- Rotate the large, outer selector knob until the display in Figure 4-18 appears.

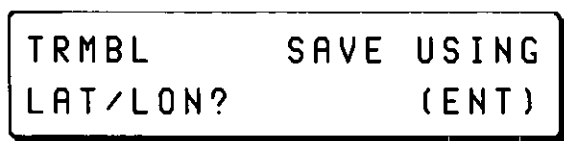


Figure 4-18: Saving Via Latitude and Longitude

- Press the  key.

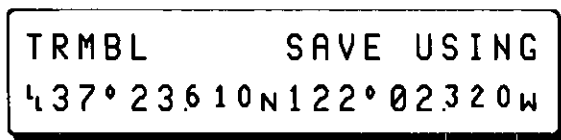


Figure 4-19: Latitude and Longitude Display

The display changes to include the latitude and longitude of the present or last known aircraft position. The first digit of the latitude is flashing.

- Use the selector knobs to enter the latitude and longitude for the new waypoint.
- If a change to a cardinal direction is required, the designator will begin flashing. Rotate the small, inner selector knob to select "N", "E", "S", or "W".
- When the latitude and longitude entry is completed, press the  key to save the information.

4.8.1.3 Defining a User Waypoint by Range and Bearing from Another Waypoint

A User waypoint may also be defined as a range and bearing from an existing waypoint. The first step is to name the waypoint.

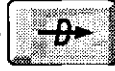
- Press the  key to access the User category.
- Enter the User waypoint name.
- Rotate the large, outer selector knob until the display in Figure 4-20 appears.



Figure 4-20: Range and Bearing Display

- Press the  key.

The  key begins to flicker. The WPT mode is now active.

- Press the  or  key to select the desired waypoint category.
- Use the inner and outer selector knobs to locate the reference waypoint.
- Press the  key to select the waypoint.

Once the reference waypoint is selected, the Navigator automatically prompts the user to enter the bearing and distance.

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Use the selector knobs to select a bearing between 0 and 359°.

- Rotate the small, inner selector knob to enter each digit.
- Rotate the large, outer selector knob to move between fields.

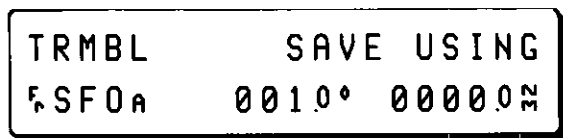


Figure 4-21: Entering Bearing

The bearing is now entered.

Next, enter the desired distance:

- Rotate the large, outer selector knob clockwise, one click to the right, or until the desired digit of the distance field begins flashing.
- Rotate the small, inner selector knob until the correct digit appears; repeat for other positions until the desired distance (in nautical miles) appears.

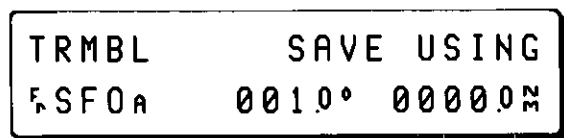


Figure 4-22: Entering Distance

- Press the  key.

The waypoint is now saved.

4.8.2 Editing User Waypoints

Once a User waypoint is created, the User waypoint name and its latitude and longitude may be changed or edited.

4.8.2.1 Editing a User Waypoint Name

To edit a User waypoint name, follow these steps:

- Press the  key to access the User category.
- Rotate the small, inner selector knob to select the waypoint.
- Rotate the large, outer selector knob until the display in Figure 4-23 appears.

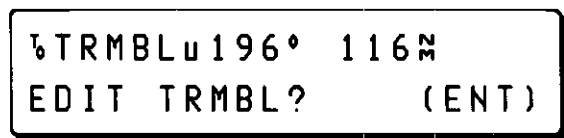


Figure 4-23: Edit Display

- Press the  key.

The first letter of the identifier begins flashing.

- Use the selector knobs to enter the new User waypoint name.
- Press the  key to complete the entry.

TIP:

If a waypoint name already exists, the display will prompt the user to enter a different name.

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4.8.2.2 Editing User Waypoint Latitude and Longitude

To edit the latitude and longitude of a User waypoint, follow these steps:

- Press the  key to access the User category.
- Rotate the large, outer selector knob until the Edit display appears.
- Press the  key.

The first letter of the identifier begins to flash.

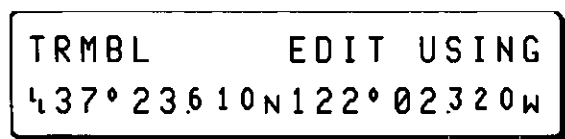


Figure 4-24: Entering Latitude and Longitude

- Use the inner and outer selector knobs to move to the latitude and longitude fields and enter the new data.
- If a cardinal heading (N, S, E, W) is flashing, turn the inner selector knob to select "N" or "S" for the latitude, or "E" or "W" for the longitude.
- Press the  key to complete the entry.

4.8.3 Erasing User Waypoints

When a User waypoint is erased, it is permanently removed from the Navigator's database.

To erase a User waypoint:

- Press the  key to select the User category.
- Rotate the small, inner selector knob to locate the desired User waypoint.
- Rotate the large, outer selector knob until the erase display in Figure 4-25 appears:

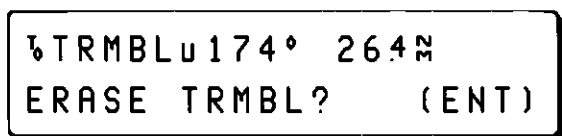


Figure 4-25: Erasing a User Waypoint

- Press the  key.



Figure 4-26: Erased Message Display

The  key begins to flash.

- Press the  key.

A message confirming erasure appears briefly and the next User waypoint in the database is now displayed.

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NOTE:

If your unit has the Moving Waypoint Option, please see the Options section in the back of this manual for information on creating and using Moving Waypoints.

Chapter 5

The Flight Plan Mode

The Flight Plan mode is used to plan the route of a flight. The Navigator can store up to 20 different flight plans, each consisting of multiple waypoints.

After reading this Chapter you will be able to:

- Create a Flight Plan
- Activate a Flight Plan
- Reverse a Flight Plan
- Edit a Flight Plan (including an Active plan)
- Delete a Flight Plan
- Cancel a Flight Plan

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5.1 Accessing the Flight Plan Mode

The Navigator can store up to 20 different flight plans, each consisting of multiple waypoints. These waypoints may be Airports, VORs, NDBs, Intersections or User waypoints.

To access the Flight Plan mode (FPL), press the FPL key. When this key is pressed, it lights to confirm the mode selection and remains lit until another mode is chosen.

When the FPL mode is accessed, the last selected flight plan is displayed (Figure 5-1). If a flight plan has not been created yet, the "NO DEFINED FLIGHT PLANS" message will appear.



Figure 5-1: FPL Mode Display

The Flight Plan page in Figure 5-1 indicates that the flight plan is from the Los Angeles Airport to the Phoenix Airport; the total distance is 335 nautical miles; the second leg of the flight plan is from the Paradise VOR to the Palm Springs Airport.

Flight plans are arranged in alphabetical order by destination waypoints.

To access the different flight plans:

- Rotate the small, inner selector knob in either direction.

To display the individual legs of a flight plan:

- Rotate the large, outer selector knob.

TIP:

*To quickly return to the active flight plan at any time, press and hold the **FPL** key for at least one second.*

5.2 The Primary Flight Plan Display

The Primary Flight Plan page appears whenever the FPL mode is selected after the Navigator is initially turned on.

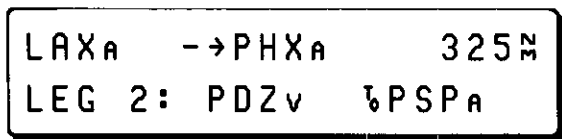


Figure 5-2: Primary Flight Plan Display

The top line of the Primary Flight Plan page displays the origin and destination of the last selected flight plan and the distance between them in nautical miles. The arrow points to the destination.

The bottom line displays the last selected leg of the flight plan and the origin and destination for that leg.

When a flight plan is not active, the legs are displayed as leg numbers (see Figure 5-2). When a flight plan is active, the legs are displayed relative to the leg that is currently being flown (see Figures 5-3 and 5-4).

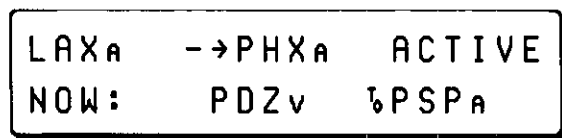


Figure 5-3: Active Leg Display

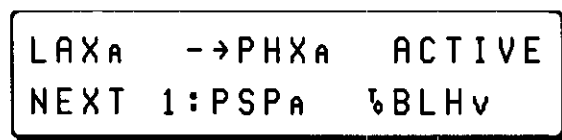


Figure 5-4: Next Leg Display



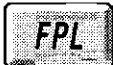
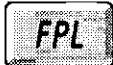
If a plan is active, the distance field is replaced with the "Active" message. If a plan is reversed, the arrow points from right to left.

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5.3 The Secondary Flight Plan Display

The Secondary Flight Plan page displays detailed information about a selected leg, including the origin, destination, bearing, distance and ETE.

To access the Secondary display:

- Press the  key to access the FPL mode and display the Primary Flight Plan page.
- Press the  key a second time to access the Secondary Flight Plan page.
- Rotate the small, inner selector knob to display information on subsequent legs.

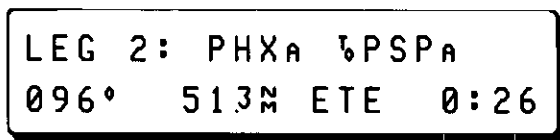


Figure 5-5: Secondary Flight Plan Display

The display in Figure 5-5 indicates that the second leg of this flight plan is from the Paradise VOR to the Palm Springs Airport; the leg bearing is 96°; leg distance is 51.3 nautical miles; ETE, using the current ground speed (120 knots) is 26 minutes.

5.4 Flight Plan Leg Sequencing

When a flight plan is active, the Navigator will automatically sequence between legs.

5.5 Creating a Flight Plan

Flight plans are created in the FPL mode. The legs or way-points for a flight plan are selected just like the identifiers in the WPT mode.

To create a flight plan:

- Press the  key to access the Primary Flight Plan Display.
- Rotate the large, outer selector knob until the "EDIT NEW FLIGHT PLAN" message is displayed.

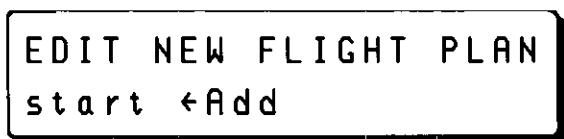


Figure 5-6: Edit Message Display

The "-end" message alternates with the "<- Add" message. The

 key begins to flash.

- Press the  key to add the first waypoint.

The display changes to the Waypoint mode; the last selected waypoint is displayed; the  key is lit; the  key begins to flicker. Waypoints may now be added to this flight plan.

To add waypoints or legs to a flight plan use the standard methods for selecting waypoints (Refer to Section 4.4):

- Press the  key to select the desired waypoint category.
- Rotate the small, inner selector knob to locate the desired identifier, or use the  key and the selector knobs to enter the identifier or city name.
- Press the  key to complete the selection of this waypoint.

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The **FPL** key remains lit. The **ENT** key begins to flash.

- Press the **ENT** key to begin entering the next waypoint.
- Repeat the steps above to enter the next waypoint.
- When the last desired waypoint is entered, press the **FPL** key to finalize the plan.

TIP:

The **APV/VOR** key can be used instead of the **WPT** key to select nearby waypoints.

5.5.1 Creating a Sample Flight Plan

This flight plan originates at the Los Angeles Airport. The destination is the Phoenix, Arizona Airport. Follow the steps listed above to create this sample flight plan.

Leg	From	To	
1	LAX Airport	PDZ VOR	(Paradise)
2	PDZ VOR	PSP Airport	(Palm Springs)
3	PSP Airport	BLH VOR	(Blythe)
4	BLH VOR	BXK VOR	(Buckeye)
5	BXK VOR	PXR VOR	(Phoenix)
6	PXR VOR	PHX Airport	(Phoenix)

5.6 Activating a Flight Plan

A flight plan may be activated on any of its legs. The previous legs will be shown as having been completed.

When activating a flight plan, the pilot is given two options: 1) Joining the displayed leg; or 2) Flying direct to either waypoint in the leg. In the latter case, the Navigator adds an additional leg by inserting the current location as a waypoint (shown as the -D> symbol) before the waypoint chosen.

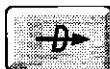
5.6.1 Joining a Displayed Leg

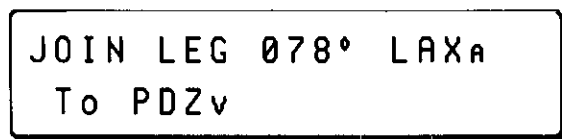
- Press the  key to access the Primary Flight Plan page.
- Rotate the small, inner selector knob to display the desired flight plan.
- Rotate the large, outer selector knob until the desired leg is displayed in the bottom line.



LAX A -> PHX A 325 M
LEG 1: LAX A > PDZ v

Figure 5-7: The Selected Flight Plan Leg

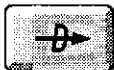
- Press the  key to activate the JOIN LEG option.



JOIN LEG 078° LAX A
To PDZ v

Figure 5-8: Track Between Waypoints

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- Press  to complete the selection.

```
LAXA -> PHXA ACTIVE
NOW: LAXA 1 PDZV
```

Figure 5-9: The Active Flight Plan Leg

NOTE:

The top line of this display indicates a track between the two waypoints displayed. In NAV mode, the display will show the actual bearing from the aircraft's position to the current destination (the second of the two waypoints in the flight plan leg), and the CDI will indicate the cross-track error as the deviation from the desired track between the two waypoints. With this information, the pilot may fly direct and center the CDI by pressing  twice in NAV mode. The figure and display below illustrate joining a leg 2 nm from the desired track:

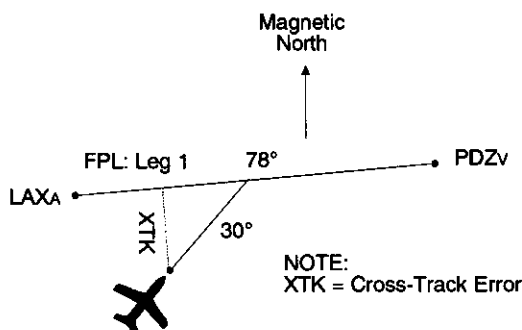


Figure 5-10: Course to Second Waypoint
Cross-Track Error

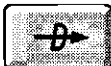
```
1 PDZV 75° 41.9M 0:34
[ 1 . . . 0 . . . ] 1030° 120M
```

Figure 5-11: NAV Mode

5.6.2 Flying to Either Waypoint in a Leg

The other option is to activate a plan to fly to either waypoint in a leg. In the previous flight plan, for example, the pilot may be several miles from LAXA and want to begin the plan at the current location instead of at LAXA. This option adds the current location as a waypoint to create an additional leg before picking up the flight plan at the selected waypoint.

In the example, the pilot chooses to fly direct to PDZv and pick up the flight plan at that waypoint.

- Press the  key and rotate the small, inner selector knob to display the LAXA -> PHXA flight plan.
- Rotate the large, outer selector knob until the first leg is displayed (Figure 5-7).
- Press the  key to activate the join leg option (Figure 5-8).
- Rotate the large, outer selector knob clockwise and the display will change to the FLY COURSE option for the second waypoint (PDZv).

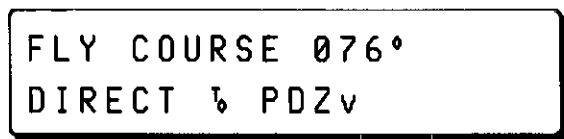
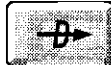
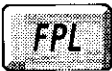


Figure 5-12: Direct Course to Waypoint

- Press the  key again to confirm the waypoint selection and the flight plan is activated (Figure 5-9).

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The following example is identical in function to the previous example. The only difference is that the second leg (PDZV -> PSPA) is displayed when the FLY COURSE option is chosen.

- Press the  key and rotate the small, inner selector knob to display the LAXA -> PHXA flight plan.
- Rotate the large, outer selector knob until the second leg is displayed.

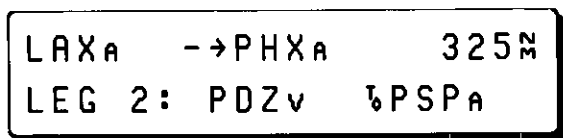
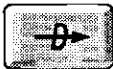


Figure 5-13: The Selected Flight Plan Leg (2)

- Press the  key to activate the join leg option.

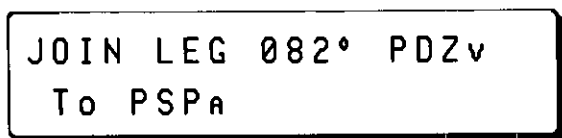
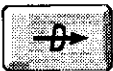


Figure 5-14: Track Between Waypoints (2)

- Rotate the large, outer selector knob counter-clockwise and the display will change to the FLY COURSE option for the first waypoint (PDZV) of that leg, refer to Figure 5-12.
- Press the  key again to confirm the waypoint selection and the flight plan is activated (Figure 5-15).

LAX _A	-→PHX _A	ACTIVE
NOW:	PDZ _V	↳PSP _A

Figure 5-15: The Active Flight Plan

When a flight plan is active, its route distance is replaced with the “ACTIVE” message. The remaining plan distance, ETE and ETA may be located on the Flight Plan page in the CALC mode or the Primary NAV mode page.

NOTE:

When a new flight plan is activated, the previously active flight plan is cancelled.

NOTE:

The following sections may only be performed on non-active flight plans:

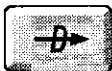
Reversing FPL (Section 5.8)

Deleting FPLs (Section 5.10)

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5.7 Cancelling an Active Flight Plan

There are three ways to cancel a flight plan:

- Use the "CANCEL" selection.
- Activate a different flight plan.
- Select a new destination with the  key.

To cancel a flight plan displayed as "ACTIVE":

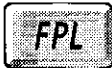
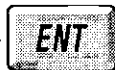
- Press the  key to display the Active Flight Plan.
- Rotate the large, outer selector knob until the "CANCEL" message is displayed.



Figure 5-16: Cancel Message

The "ACTIVE" message is replaced by the flashing "CANCEL" message, and the  key begins to flash.

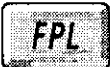
- Press the  key to cancel the flight plan.

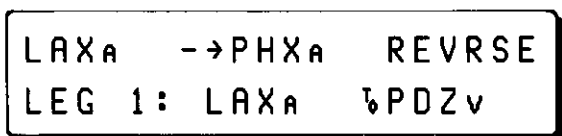
When a flight plan is cancelled, the Navigator continues navigating to the current destination until a new destination is selected.

5.8 Reversing a Flight Plan

Return flight plans may be created by reversing the direction of an existing flight plan. The reversed flight plan replaces the original flight plan. To restore the original plan, reverse the flight plan a second time.

To reverse a flight plan follow these steps:

- Press the  key to select the desired flight plan.
- Rotate the large, outer selector knob until the "REVRSE" message is displayed.

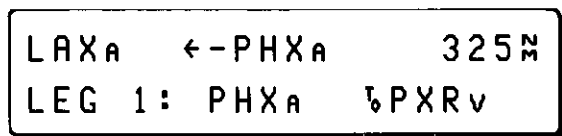


A rectangular display box showing two lines of text. The top line reads "LAXA ->PHXA REVRSE". The bottom line reads "LEG 1: LAXA 16PDZV".

Figure 5-17: Reverse Message

The distance on the display is replaced with the flashing "REVRSE" message, and the  key begins to flash.

- Press the  key to reverse the flight plan.



A rectangular display box showing two lines of text. The top line reads "LAXA <-PHXA 325M". The bottom line reads "LEG 1: PHXA 16PXR V".

Figure 5-18: Reversed Flight Plan

The arrow in the top line now points to the left indicating that the flight plan is reversed.

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5.9 Editing a Flight Plan

The edit feature allows the user to accomplish the following:

- Add waypoints to a flight plan
- Delete waypoints from a flight plan
- Edit an Active Flight Plan

5.9.1 Selecting the Edit Mode

To edit a flight plan, (both Active and Inactive):

- Press the  key to select the desired flight plan.
- Rotate the large, outer selector knob until the "EDIT" message is displayed.



Figure 5-19: Edit Display

- Press the  key to begin editing the displayed flight plan.

The "EDIT FLIGHT PLAN" message appears in the top line, and up to three waypoints in the plan appear in the bottom line.

To display other waypoints in the current plan:

- Rotate the large, outer selector knob to scroll through the waypoints of the flight plan.

5.9.2 Adding Waypoints to an Existing Flight Plan

To add a waypoint to a flight plan (both Active and Inactive):

- Select the Edit mode, as described in Section 5.9.1.
- Rotate the large, outer selector knob until the waypoint that will follow the new waypoint is centered in the bottom line.



Figure 5-20: Add Waypoint Display

NOTE:

When editing an Active Flight Plan via rotation of the large, outer selector knob in either direction, the "ADD" initially flashes to place a new waypoint on the current flight plan leg. When editing an Inactive Flight Plan via rotation of the large, outer selector knob, the "ADD" initially flashes at the beginning or end of the flight plan, depending on clockwise or counter-clockwise selection of "EDIT" mode.

WARNING:

When editing the current waypoint of the Flight Plan (by deleting the waypoint or adding a new waypoint on the current leg), the CDI will display a direct track from the present position to the new waypoint. If interfaced to a moving map such as an ARGUS, a direct track from the previous waypoint on the current leg to the new waypoint will be displayed. If the autopilot is coupled to the Navigator during this process, a rotation to the left or right will begin to intercept the new track (this may require setting the heading bug, etc., depending on the autopilot). To properly display the track to the new waypoint on the moving map, press the  key to display the flight plan; rotate the small, inner selector knob to deselect, then re-select the new waypoint; press   to re-select the new waypoint. The current track will now be properly displayed. See Section 3.5 for complete information on selecting a waypoint in the Destination Waypoint Display.

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The centered waypoint alternates with the “-<-Add” message. The arrow indicates that the new waypoint will be inserted before this waypoint. The **ENT** key begins to flash.

- Press the **ENT** key to select the new waypoint.

The display changes to the WPT mode, showing the last waypoint selected. The **WPT** key lights and the **FPL** key begins to flicker.

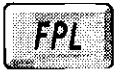
- Press the **WPT** key to select the desired waypoint category.
- Use the standard method for selecting waypoints to select the new waypoint.
- Press the **FPL** key to add this waypoint to the flight plan and return to the FPL mode.
- Repeat the last five steps to add other waypoints.
- When editing is completed, press the **FPL** key to exit the Edit mode.
- Repeat the last four steps to delete other waypoints.
- Press the **FPL** key a second time to exit the Edit mode and return to the flight plan.

TIP:

The **APV/VOR** key can be used instead of the **WPT** key to select nearby waypoints.

5.9.3 Quick Flight Plan Edit

Quick Flight Plan Edit allows modification of both Active and Inactive Flight Plans, by merely selecting the  key while displaying the primary flight plan page of the leg to be edited.

- Press the  key to select the Flight Plan mode.
- Rotate the small, inner selector knob until the desired Flight Plan is displayed.
- Rotate the large, outer selector knob until the desired leg is displayed.

Verify that a Primary Flight Plan page (Figure 5-2) is displayed, not a Secondary (Figure 5-5).

- Press the  key.

The “<--Add” message begins to flash over the second way-point on the page.

- Press the  key again.

Edit the flight plan as described in Sections 5.9.1 and 5.9.2 above, or, if desired,

- Rotate the large, outer selector knob until the flight plan leg to be edited is displayed.
- Press the  key and edit the flight plan.

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5.9.4 Deleting Waypoints from a Flight Plan

To delete a waypoint from a flight plan (both Active and Inactive):

- Select the Edit mode, as described in Section 5.9.1.
- Rotate the large, outer selector knob until the waypoint to be deleted is centered in the bottom line of the display.

NOTE:

See the "Warning" and "Note" in Section 5.9.2.

The center waypoint alternates in the display with the "-<-Add" message.

- Rotate the small, inner selector knob in either direction to display the "-Delete" message.

The center waypoint alternates with the "-Delete" message and the  key begins to flash.

- Press the  key to delete the waypoint.

A confirmation message will be displayed.



Figure 5-21: Erasing Waypoint Display

- Press the  key a second time to exit the Edit mode and return to the flight plan.

NOTE:

If all of the waypoints in a plan are deleted, the plan will be erased and the Navigator will leave the Edit mode.

5.10 Deleting a Flight Plan

When a flight plan is deleted, it is permanently removed from the database.

To delete a flight plan:

- Press the  key to select the desired flight plan.
- Rotate the large, outer selector knob until the "ERASE" message is displayed.



Figure 5-22: Deleting a Flight Plan

The flight plan distance is replaced by the flashing "ERASE" message and the  key begins to flash.

- Press the  key.

The "ERASE FLIGHT PLAN" message is displayed and the  key begins to flash.

- Press the  key to delete the plan.

The current flight plan is deleted and the next flight plan is displayed.

Chapter 6

The Calculator Mode

The CALC mode allows the user to perform many common E6B computer functions and other calculations.

After reading this chapter you will be able to :

- Save the Present Position
- Create Grid Pattern Profiles
- Create VNAV Profiles
- Calculate Time, Distance and Speed
- Perform Fuel Management Calculations
- Calculate Winds Aloft
- Determine Pressure Altitude
- Determine Density Altitude
- Calculate True Airspeed
- Determine Crosswind and Headwind

NOTE:

User selectable units are provided under AUX-INSTALL-User Units. "Distance" is available in Nautical Miles, Statute Miles, and Kilometers; "Speed" is available in Knots, Miles per Hour, and Kilometers per Hour; "Altitude" is available in Feet or Meters (typically displayed as kilometers); "Fuel" is available in Gallons, Pounds, Liters, and Imperial Gallons. When modified by the User, all displayed units in all modes conform to the selected convention.

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6.1 Accessing the Calculator Mode

To access the Calculator (CALC) mode, press the CALC key. When the key is pressed, it lights to confirm the mode selection and remains lit until another mode is chosen.

- Press the  key.

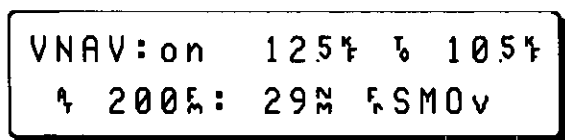


Figure 6-1: CALC Mode Display: VNAV Page

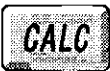
The CALC mode is now active. The first page in this mode displays VNAV information. The display in Figure 6-1 indicates a descent from 12,500 feet to 10,500 feet at 200 feet per minute, ending 29 nautical miles from the Santa Monica VOR.

NOTE:

When the user returns to the CALC mode, the last selected sub-mode is displayed.

6.2 Entering Data in the CALC Mode

To enter information and perform calculations in the CALC mode, follow the steps below:

- Press the  key to access the CALC mode.
- Rotate the small, inner selector knob to move to the desired CALC page.
- Press the  key.
- Rotate the large, outer selector knob to move to the desired field.
- Rotate the small, inner selector knob to change information in a field.

When this knob is turned quickly, the information in the selected field changes rapidly.

- Continue this procedure until all information is entered.
- Press the  key to complete the entry.

When one field is updated, all pages containing that field reflect the current information.

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6.3 Calculator Mode Functions

6.3.1 Saving the Present Position

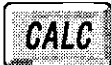
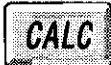
In addition to the calculator functions, the CALC mode may also be used to save the aircraft's present position. The Navigator conveniently provides ten locations (alpha - julet) for temporary storage of these positions.

NOTE:

Once the temporary locations are filled, the user should rename the positions to be saved, since the Navigator automatically writes over the existing temporary positions when the ten locations are full. Temporary positions must also be saved after a power cycle, since any subsequent saved position will be placed in storage beginning at location "alpha".

Once a position is saved, the location may be reviewed, edited or renamed from the User waypoint mode.

To save a present position:

- Press the  key to activate the CALC mode.
- Press the  key to save the present position to a temporary location.

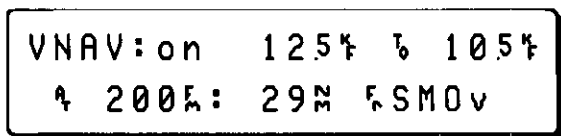
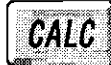


Figure 6-2: Present Position Display

- Press the  key a third time to return to the CALC mode.

The present position is saved to a temporary location. The position may be renamed from the WPT mode.

NOTE:

Once the present position is saved, any mode may be selected by pressing the appropriate mode key.

NOTE:

If your unit has the Search Air Rescue Option, please see the Options section in the back of this manual for accessing Search Air Rescue patterns through the CALC mode.

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6.3.2 Vertical Navigation Profiles

Vertical Navigation Profiles (VNAV) are created in the CALC mode. VNAV Profiles are calculated based on the aircraft's current ground speed. To create a VNAV profile, the pilot must enter the starting altitude, ending altitude, the desired rate (or angle) of descent or climb, the desired distance from the destination for ending altitude and the destination identifier.

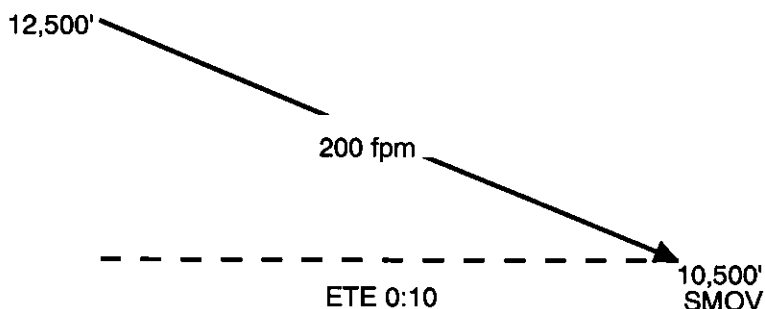


Figure 6-3: VNAV Calculation

The illustration in Figure 6-3 indicates that the aircraft descent is from 12,500 feet to 10,500 feet, at a rate of 200 feet per minute; the destination is the Santa Monica VOR at 10,500 feet. Based on this information, the Navigator will automatically calculate the VNAV descent starting point and the altitude the aircraft must maintain to follow the descent profile. VNAV can be used for climb profiles as well as descent profiles.

NOTE:

*The Navigator will provide a series of Advisory messages to indicate when the level-off point has been reached. Advisory messages are indicated by the ADV annunciator light. When this annunciator light is lit, press the **MSB** key to display the message.*

To enter VNAV profile information, follow the steps below:

- Press the **CALC** key to access the CALC mode.
- If required, rotate the small, inner selector knob counterclockwise to display the VNAV page.

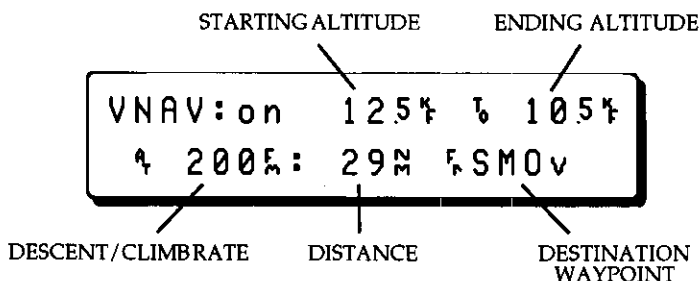


Figure 6-4: VNAV Profile Display

- Press the **ENT** key.

The "o" of "off"(or "on") begins to flash.

- Rotate the small, inner selector knob clockwise to turn VNAV on (or counterclockwise to turn VNAV off).
- Rotate the large, outer selector knob to move to the next field.
- Rotate the small, inner selector knob to select the correct digit or character for this field.
- Rotate the large, outer selector knob to move to the next field.

NOTE:

Descent/climb rate may be entered as an angle by positioning the cursor over F_M and rotating the small, inner selector knob to read degrees "°". The subsequent rate of descent (or climb) will be calculated and displayed in NAV Mode.

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TIP:

When entering VNAV information, altitudes are set in 100 foot increments and vertical speed is set in 10 foot increments (or degrees/tenths of degrees). Modifying any field on the VNAV page will automatically change an "off" indication to "on".

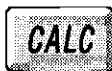
- Repeat the previous two steps until the desired information has been entered into each VNAV field.
- Press the  key when all entries are completed.

Once a VNAV profile has been started, the profile information may be viewed from the NAV mode.

6.4 Flight Plan Calculations

Flight plan calculations are accessed in the Fuel Management and Time, Distance, and Speed pages. These pages reflect current flight data and information when available. They may also be used as a flight planning calculator.

To access these displays:

- Press the  key.
- Rotate the small, inner selector knob clockwise.

If the pilot is flying an Active Flight Plan, these pages utilize the current ground speed and external fuel computer or user-entered rate of fuel consumption to compute the following:

- Estimated Time Enroute (ETE)
- Estimated Time of Arrival (ETA)
- Flight Plan Distance (DIST)
- Miles Per Gallon (MPG)

The Fuel Management and Time, Distance, and Speed pages also estimate the amount of fuel required to arrive at the current destination. If flying a multi-leg flight plan, the data reflects calculations from present position through the final destination.

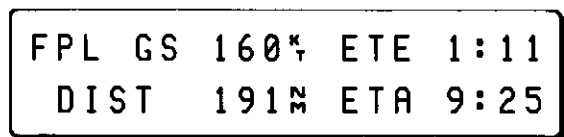


Figure 6-5: Flight Plan Calculation Display

6.4.1 Time, Distance and Speed Calculations

The Time, Distance and Speed page shown in Figure 6-6 utilizes a sample flight plan from LAXA (Los Angeles Airport) to KICA (King City Airport):

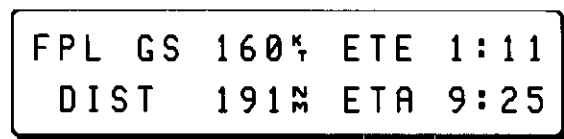


Figure 6-6: Time, Distance, Speed Display

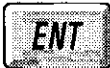
The Time, Distance, and Speed page shown in Figure 6-6 indicates the flight plan ground speed is 160 knots; flight plan distance is 191 nautical miles; the flight plan time (ETE) is 1 hour and 11 minutes; the estimated time of arrival (ETA) is 9:25 LOCAL time.

The fields (except ETA) displayed in Figure 6-6 may be edited at any time for different flight plan calculations.

For example, the user may wish to determine trip time at an accelerated ground speed:

- Press the  key. The first digit in the FPL GS field begins to blink.

Follow the standard data entry techniques explained on page 6-3 to enter a new ground speed (200 kts).

- Press the  key.

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The ETE and ETA change as shown in Figure 6-7 below:

FPL	GS	200%	ETE	0:57
DIST	191M		ETA	9:11

Figure 6-7: Time, Distance, Speed Display

Distance, ground speed, and ETE may be manually edited to view different flight plan data. The following chart shows how each changed field initiates new calculations:

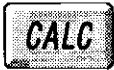
<u>Changed Field</u>	<u>Calculation Effected</u>
ETE	Distance, ETA
Distance	ETE, ETA
Ground Speed	ETE, ETA

NOTE:

All the CALC mode displays (except Pressure Altitude page) use data provided by the Navigator or external sensors. When manually editing data, returning to NAV mode erases the changes. Press the  key to return to the NAV mode and view the current flight data.

6.4.2 Fuel Management Calculations

To access the Fuel Management page:

- Press the  key.
- Rotate the small, inner selector knob clockwise.

The Fuel Management page shown in Figure 6-8 utilizes a sample flight plan from LAXA (Los Angeles Airport) to KICA (King City Airport):

FUEL	14.5 GAL	12.3 GH
DIST	190 N	13.0 MPG

Figure 6-8: Fuel Management Display

The Fuel Management page in Figure 6-8 indicates that the estimated fuel required to reach the destination is 14.5 gallons; fuel consumption rate is 12.3 gallons per hour; the remaining distance is 190 nautical miles; fuel efficiency is 13.0 nautical miles per gallon. The fuel consumption rate is taken from the Air and Fuel Data Computer input, if available, or from user input.

The fuel, current fuel consumption rate, and remaining distance may be entered. The fuel efficiency is always computed by using the ground speed from the Time, Distance, and Speed page. This is the aircraft's current ground speed unless a new value has been entered.

For flight planning, the user can determine the maximum remaining flight range and fuel efficiency. Enter the remaining usable fuel and current fuel consumption rate as follows:

- Press the  key. The first digit in the FUEL field begins to blink.

To enter the remaining fuel (20 gallons), follow the standard data entry techniques explained on page 6-3.

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- Press the  key.

The DIST field changes, showing the maximum remaining flight range of 260 nautical miles as shown in the following display:

FUEL	200 GAL	123 GH
DIST	260 N	13.1 MPG

Figure 6-9: Fuel Management Display

Editing the fuel, rate of consumption, or distance field results in changed values as shown below:

<u>Changed Field</u>	<u>Calculation Effected</u>
Fuel	Distance
Rate	Distance, MPG
Distance	Fuel

Distance is used on the Time, Distance, and Speed page. Changing or computing a value on one page automatically results in the new value being passed onto the other page, but does not affect current flight data.

NOTE:

Fuel management calculations are based on the information that the user enters and the aircraft's current ground speed. The user is responsible for monitoring fuel reserves, changes in fuel consumption rates and changing wind conditions.

NOTE:

The RS-422 output from the Navigator has been configured for use with some digital fuel flow instruments.

6.4.2.1 Fuel Remaining Page

To access the Fuel Remaining page:

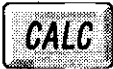
- Press the  key.
- Rotate the small, inner selector knob clockwise to access the Fuel Management page.
- Rotate the large, outer selector knob clockwise.



Figure 6-10: Fuel Remaining Display

The Fuel Remaining page provides the following information:

- Fuel Remaining
- Flight Time Remaining
- Range

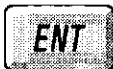
Fuel Remaining is measured in gallons, liters, pounds, etc., as selected under AUX-INSTALL-User Units; Initial Fuel minus Fuel Used.

Flight Time Remaining is measured in hours and minutes; Fuel Remaining divided by Fuel Consumption Rate.

Range is measured in nautical miles, statute miles, etc., as selected under AUX-INSTALL-User Units; Flight Time Remaining times Ground Speed.

The initial fuel on board is entered during the power-up sequence (see Section 2.1). The Navigator keeps track of Fuel Remaining, based on fuel rate information from the Air and Fuel Data Computer, if one is used, or from user input.

The user may edit the Fuel Remaining field at any time to show fuel on board, using the standard data entry techniques explained on page 6-3.

- Press the  key to begin data entry.

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6.4.2.2 Fuel At Arrival Page

To access the Fuel At Arrival page:

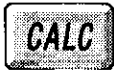
- Press the  key.
- Rotate the small, inner selector knob clockwise to access the Fuel Management page.
- Rotate the large, outer selector knob clockwise until the display shown in Figure 6-11 appears.



Figure 6-11: Fuel At Arrival Display

The Fuel At Arrival page provides the following information:

- Fuel At Arrival
- Flight Time Reserve
- Reserve

Fuel At Arrival is measured in gallons, liters, pounds, etc., as selected under AUX-INSTALL-User Units; Fuel Remaining minus Fuel Used.

Flight Time Reserve is measured in hours and minutes; Fuel At Arrival divided by Fuel Consumption Rate.

Reserve is measured in nautical miles, statute miles, etc., as selected under AUX-INSTALL-User Units; Flight Time Reserve times Ground Speed.

The Navigator calculates the amount of fuel which will be available on board when the aircraft reaches its final destination. This display provides the pilot with the necessary information to evaluate the reserve fuel situation early enough to take necessary action. See Section 6.4.2.1 for the sources of Fuel Remaining.

The distance and flight time remaining will be recomputed using the new Fuel Remaining.

6.4.2.3 Total Fuel Used Page

To access the Total Fuel Used page:

- Press the  key.
- Rotate the small, inner selector knob clockwise to access the Fuel Management page.
- Rotate the large, outer selector knob clockwise until the display shown in Figure 6-12 appears.

TOTAL USED	412
LEFT 198 RIGHT	214

Figure 6-12: Total Fuel Used Display

The Total Fuel Used page provides the following information (in gallons, liters, pounds, etc., as selected under AUX-IN-STALL-User Units):

- Total Fuel Used
- Total Used by Left Engine
- Total Used by Right Engine

The Navigator keeps track of the fuel used since the last fuel entry. When installed in a single engine aircraft, or without an Air and Fuel Data Computer, the second line (Left and Right Engine usage) is not displayed.

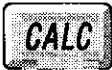
NOTE:

After powering off the Navigator, the Fuel Used is reset to zero. The Fuel Remaining is not reset. This feature is useful for multi-stop flights where the fuel used for each leg may be monitored while keeping track of the total fuel remaining.

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6.4.2.4 Engine Fuel Flow Page

To access the Engine Fuel Flow page (not available on single engine aircraft):

- Press the  key.
- Rotate the small, inner selector knob clockwise to access the Fuel Management page.
- Rotate the large, outer selector knob clockwise until the display shown in Figure 6-13 appears.

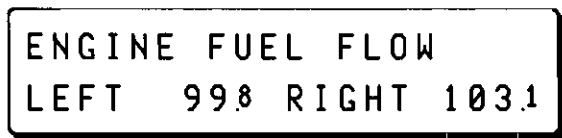


Figure 6-13: Engine Fuel Flow Display

The Navigator provides a digital readout of the engine fuel flow quantity to a tenth of a gallon per hour, liter per hour or pound per hour, as selected under AUX-INSTALL-User Units. This page is not displayed when the Navigator is installed in a single engine aircraft or when there is no Air and Fuel Data Computer. (Total fuel flow information is available on the main Fuel Management page; see Section 6.4.2).

6.4.3 Pressure Altitude Calculations

The Pressure Altitude page provides the following information:

- Pressure Altitude
- Barometric Pressure Setting
- Indicated Altitude

Pressure Altitude and Indicated Altitude are measured in thousands of feet or thousands of meters, as selected under AUX-INSTALL-User Units.

Barometric Pressure Setting is measured in inches of mercury, from 28.00 in. to 31.00 in. or in millibars, from 948 mb to 1050 mb as selected under AUX-INSTALL-User Units.



Figure 6-14: Pressure Altitude Display

The Pressure Altitude page in Figure 6-14 indicates that the pressure altitude is 12,800 feet; barometric pressure setting is 28.61 inches of mercury; indicated altitude is 11,600 feet.

To enter the information required for pressure altitude calculations, follow the standard data entry techniques explained on page 6-3.

- Press the  key to begin data entry.

A change in barometric setting or indicated altitude initiates new calculations in related fields, according to the chart below:

<u>Changed Field</u>	<u>Calculation Effected</u>
Barometric Setting	Pressure Altitude
Indicated Altitude	Pressure Altitude

NOTE:

Changes made for pressure altitude will be reflected in the Density Altitude and TAS displays.

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6.4.4 Density Altitude Calculations

The Density Altitude page provides the following information:

- Density Altitude (in thousands of feet or thousands of meters, as selected under AUX-INSTALL-User Units)
- Ram Air Temperature (degrees Celsius) - the Total Air Temperature as indicated on an uncorrected temperature probe (typically labeled OAT in light aircraft and RAT in corporate/commercial aircraft; see Section 6.4.5 on True Airspeed Calculations for complete definition)
- Pressure Altitude (in thousands of feet or thousands of meters, as selected under AUX-INSTALL-User Units)



Figure 6-15: Density Altitude Display

The Density Altitude page in Figure 6-15 indicates that density altitude is 13,700 feet; the Ram Air Temperature (Total Air Temperature) is 19° Celsius; pressure altitude is 10,500 feet.

To enter the information required for density altitude calculations, follow the standard data entry techniques explained on page 6-3.

- Press the  key to begin data entry.

A change in either RAT or pressure altitude initiates new calculations in related fields, according to the chart below:

<u>Changed Field</u>	<u>Calculation Effected</u>
RAT	Density Altitude
Pressure Altitude	Density Altitude
Density Altitude	RAT

NOTE:

When the user returns to the CALC mode, the last selected sub-mode is displayed.

6.4.5 True Airspeed (TAS) Calculations

The True Airspeed page provides the following information:

- True Airspeed (in knots, statute miles per hour, or kilometers per hour, as selected under AUX-INSTALL-User Units)
- Outside Air Temperature (OAT, degrees Celsius) - the True Air Temperature of the ambient corrected for temperature rise, compressibility, etc)
- Mach Number (non-dimensional; True Airspeed divided by Speed of Sound at current Pressure Altitude)
- Indicated Airspeed (in knots, statute miles per hour, or kilometers per hour, as selected under AUX-INSTALL-User Units)
- Ram Air Temperature (RAT, degrees Celsius) - the Total Air Temperature as indicated on an uncorrected temperature probe (typically labeled OAT in light aircraft and RAT in corporate/commercial aircraft)



Figure 6-16: True Airspeed Display

For an Indicated Airspeed of 321 knots, Ram Air Temperature of +14° C, and a Pressure Altitude of 20,000 feet (not displayed on this page), the True Airspeed page in Figure 6-16 indicates that the True Airspeed is 427 knots, true Outside Air Temperature is -10° C, and Mach number is .68.

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NOTE:

OAT and TAS presented on the CALC-TAS page are dependent on the "K" Factor entered on the AUX-INSTALL-OAT "K" Factor page. This "K" Factor only applies to the standard Ram Air Temperature gauge located on the instrument panel (typically labeled OAT in light aircraft and RAT in corporate/commercial aircraft), and is only used to determine the true Outside Air Temperature (OAT) for manual TAS calculations as described below. When an Air Data Computer (such as the Shadin ADC 200) is installed in the aircraft, displayed ADC parameters generally are based on a "K" Factor of 1.0. See Section 7.5.14 for detailed information on the "K" Factor, and how to determine the factor if unknown.

To enter the information required for true airspeed calculations, follow the standard data entry techniques explained in Section 6.2. For manual calculations, ensure that the desired Pressure Altitude has been entered on the previous CALC page.

- Press the  key to begin data entry.

A change in IAS, RAT, TAS, OAT, or Mach initiates new calculations in related fields, according to the chart below:

<u>Changed Field</u>	<u>Calculation Effected</u>
IAS	TAS, OAT, Mach
RAT	TAS, OAT
TAS	OAT, Mach, IAS
OAT	TAS, RAT
Mach	TAS, OAT, IAS

NOTE:

Changes made in TAS calculations will be reflected in the Winds Aloft calculations.

6.4.6 Winds Aloft Calculations

The Winds Aloft page provides the following information:

- Wind Direction and Speed
- True Airspeed and Heading

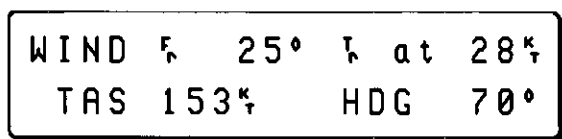


Figure 6-17: Winds Aloft Display

The Winds Aloft page in Figure 6-17 indicates that the wind is from 25° true at 28 knots, given a true airspeed of 153 knots and a heading of 070°. Wind direction is given in degrees TRUE, not degrees magnetic.

This page is used primarily to determine the winds aloft based on (1) the current track and ground speed from the NAV page, (2) the current magnetic variation from the AUX-SETUP mode, (3) the TAS from the TAS page, and, (4) the manually-entered HDG, or HDG from the Air and Fuel Data Computer.

- Press the  key to begin data entry.

A change in either the TAS or heading fields initiates new calculations in related fields, according to the chart below:

<u>Changed Field</u>	<u>Calculation Effected</u>
TAS	Wind Speed, Wind Direction
Heading	Wind Speed, Wind Direction

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6.4.7 Crosswind and Headwind Calculations

The Crosswind and Headwind page provides the following information:

- Crosswind
- Headwind
- Runway Direction
- Wind Direction (magnetic) and Speed

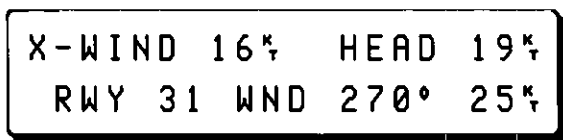


Figure 6-18: Crosswind and Headwind Display

The Crosswind and Headwind page in Figure 6-18 indicates that the crosswind component is 16 knots; the Headwind component is 19 knots for runway 31, when the wind is from 270° magnetic at 25 knots.

To enter the information required for crosswind and headwind calculations, follow the standard data entry techniques explained on page 6-3.

- Press the  key to begin data entry.

A change in either the runway number, wind direction or wind speed initiates new calculations in related fields, according to the chart below:

<u>Changed Field</u>	<u>Calculation Effected</u>
Runway Number	Crosswind, Headwind
Wind Direction	Crosswind, Headwind
Wind Speed	Crosswind, Headwind

Chapter 7

The Auxiliary Mode

The Auxiliary mode is used to control and monitor information from the TNL 2100T GPS Navigation system.

After reading this chapter, you will be able to:

- Create customized checklists
- Set the Date, Time and Zulu Time
- View the Present Position and Altitude
- Obtain current status information on the GPS
- Access information on GPS Satellite availability
- Specify Database Search Regions
- Enable AIRWATCH™ for selected airspaces
- Enable Dead Reckoning
- Set CDI Sensitivity and Calibration
- Enable the Navigator's security feature
- Create Personal Messages and Personal Access Codes
- Check Receiver Autonomous Integrity Monitor (RAIM) Status
- Save and Load User Configuration, Waypoints, Flight Plans, Checklists, etc., through RAM Card or Serial Port
- Enable/Disable Pop-up Messages
- Customize User Units for NAV Coordinate System, Datum, Distance, Speed, Altitude, Baro Setting, and Fuel

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NOTE:

User-selectable units are provided under AUX-INSTALL-User Units. "Distance" is available in Nautical Miles, Statute Miles, and Kilometers; "Speed" is available in Knots, Miles per Hour, and Kilometers per Hour; "Altitude" is available in Feet or Meters (typically displayed as kilometers); "Fuel" is available in Gallons, Pounds, Liters, and Imperial Gallons. When modified by the User, all displayed units in all modes, conform to the selected convention.

Accessing the Auxiliary Mode

To access the Auxiliary (AUX) mode, press the AUX key. When this key is pressed, it lights to confirm the mode selection, and remains lit until another mode is chosen.

Selecting Functions

The AUX mode is divided into five functional areas:

- Checklist
- System Status Information
- Sensor Status Information
- Setup
- Installation

Selecting the Function Displays

Once the desired function is selected, rotate the small, inner and large, outer selector knobs to access additional information displays.

TIP:

To quickly return to the first function in the AUX mode, press and hold the  key for at least one second.

7.1 The Checklist Function

The customized checklist function allows the user to create a customized checklist. Up to ten checklists (0 to 9) can be retained with up to 26 entries each (A to Z). A maximum of 150 entries may be entered.

7.1.1 Creating and Naming Checklists

To create and name a customized checklist:

- Press the  key to access the Checklist function.

The checklist message flashes on the screen and then the title for the last selected checklist is displayed. If no checklists have been created, the display in Figure 7-1 appears.



Figure 7-1: Checklist Display

- Rotate the large, outer selector knob until the display in Figure 7-2 appears.



Figure 7-2: Checklist Name Display

- Press the  key.

The  key and (ENT) on the display will begin to flash.

- Rotate the inner and outer selector knobs to enter the name for this checklist.

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- Press the  key when the entry is complete.

The checklist number is listed on the top line of the display shown in Figure 7-3. The first item in the list, A, is listed on the bottom line.

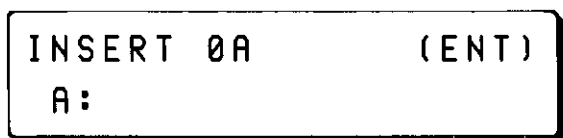


Figure 7-3: Checklist Number and First List Item Entry Display

- Rotate the inner and outer selector knobs to enter the first item in the list.
- Press the  key to complete the entry.

The first item is entered into the list. The message in the display tells the user that the second item in the list, B, is currently the location to insert new checklist items.

- Press the  key to enter a second item to the list.
- Rotate the inner and outer selector knobs to enter the second item to the list.
- Press the  key to complete the entry.



Figure 7-4: Checklist Number and Additional List Items Entry Display

The user can repeat the previous three steps until all desired items have been entered into the checklist.

TIP:

Although the Navigator stores up to 26 items in a list, a list may be created with as few as zero items.

- Press the **AUX** key to store the checklist to memory.

To enter another checklist at the end, proceed as follows:

- Rotate large, outer selector knob until the bottom line of the display in Figure 7-2 appears.

NOTE:

*If the **ENT** key is pressed at this point, the checklist stored in 0 is moved to 1 and a new checklist, 0, is created.*

- Rotate small, inner selector knob until the display in Figure 7-5 appears.



1: INSERT AT END
INSERT LIST 1 (END)

Figure 7-5: Checklist Name Display

- Press the **ENT** key to enter a new checklist 1 and proceed as before.

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7.1.2 Utilizing a Checklist

Once a checklist is created, it may be utilized at any time during a flight.

To activate a checklist:

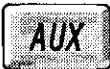
- Press the  key to access the Checklist function.
- Rotate the small, inner selector knob to select the desired list.



Figure 7-6: Activate List Display

To check off the first item in the list:

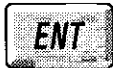
- Press the  key.



Figure 7-7: Item Checkoff Display

Each time the  key is pressed, a check-mark appears next to the item. The item that was checked scrolls off the screen and the next item in the checklist is displayed.

When the last item in the list is checked off, the first display (Figure 7-6) is repeated, with a checkmark next to the list.

- Rotate the small, inner selector knob to go to another checklist.

TIP:

The user may leave the Checklist function at any time by pressing a different mode key (, , etc.). When the user returns to this function, the Navigator returns to the same checklist display. The user may proceed with checking off items as though there had been no interruption. The checkmarks will remain next to the list checked off until the unit is powered down.

7.1.3 Editing a Checklist

Once a checklist is created, the checklist name or items may be changed.

To edit an entry in a checklist, follow these steps:

- Press the  key to enter the Checklist function.
- Rotate the small, inner selector knob to select the list to be edited.
- Rotate the large, outer selector knob until the "EDIT LIST" message shown in Figure 7-8 is displayed.

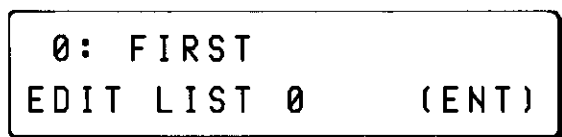


Figure 7-8: Edit List Display

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- Press the  key.
- Rotate the large, outer selector knob to select the item in the checklist to be edited, including the checklist title.
- Press the  key to begin the editing process.



Figure 7-9: Edit Checklist Display

The  key, the (ENT) indicator on the display, and the first letter of the item to be edited all begin to flash.

- Rotate the selector knobs to edit the selected item.
- Press the  key to conclude the editing process of the selected checklist.
- Press the  key to exit the Edit function.

7.1.4 Inserting and Deleting Checklist Items

Once a checklist is created, the user may add or delete items.

To insert a new item into a checklist:

- Press the  key to enter the Checklist function.
- Rotate the small, inner selector knob to select the list to be edited.
- Rotate the large, outer selector knob until the "EDIT LIST" message shown in Figure 7-10 is displayed.



Figure 7-10: Insert Checklist Item Display

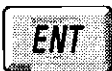
- Press the  key.
- Rotate the small, inner selector knob until Figure 7-11 appears on the display.

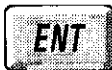
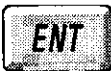


Figure 7-11: Insert New Item Display

- Rotate the large, outer selector knob to select the position in the checklist in which to insert the new item.



Figure 7-12: Select Item Position Display

- Press the  key to begin the insertion of a new item.
- Rotate the small, inner and large, outer selector knobs to enter the new item.
- Press the  key to conclude the insertion.
- Edit more items or press the  key to exit the Edit function.

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The new item is inserted into the checklist as the new item B. The former item B and all the following items move down one position.

To delete an item from the checklist:

- Press the  key to enter the Checklist function.
- Rotate the small, inner selector knob to select the list to be edited.
- Rotate the large, outer selector knob until the "EDIT LIST" message in Figure 7-13 is displayed.

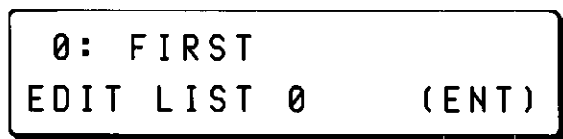


Figure 7-13: Select Checklist Item To Delete

- Press the  key.
- Rotate the large, outer selector knob to select the item in the checklist to delete.
- Rotate the small, inner selector knob until Figure 7-14 appears on the display.



Figure 7-14: Select Checklist Item To Delete

- Press the  key to begin the deletion.



Figure 7-15: Confirm Checklist Item Delete Display

The  key and the AUX indicator on the display begin to flash.

- Press the  key to delete item C from the checklist. (Press any one of the other mode keys to abort the deletion process.)

When an item is deleted from a checklist, all of the remaining checklist items move up one position.

7.1.5 Deleting a Checklist

Once a checklist is created, the checklist may be deleted.

To delete a checklist, follow these steps:

- Press the  key to access the Checklist function.
- Rotate the small, inner selector knob to select the list to be deleted.
- Rotate the large, outer selector knob until the "DELETE LIST" message is displayed.



Figure 7-16: Delete Checklist Display

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- Press the  key.

The Navigator requests confirmation from the user before it deletes the list.



Figure 7-17: Confirm Delete Display

The  key flashes.

- Press the  key to delete the list, or
- Press any one of the other mode keys to cancel the deletion. In this case, press the  key to return to the AUX function.

When a checklist is deleted, all the lists that follow move up one position.

7.2 The System Status Function

The System Status function provides quick access to system status information. The six status pages include the following:

- Time Display
- Present Position / Altitude Information
- Voltage and Temperature Display
- Database Revision Information
- Software Revision Information
- Software Code Display

7.2.1 The Time Display

The first page in the System Status function displays the local date, local time, time zone and Zulu (UTC) time.

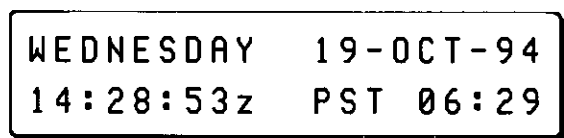


Figure 7-18: Time Display

The Time page in Figure 7-18 indicates that the current date is October 19, 1994; the day is Wednesday; the time is 6:29, the time zone is Pacific Standard Time; the current Zulu time is 14:28:53.

NOTE:

When GPS Satellites are available, the time and date are set automatically.

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Time zones are selected from the following list:

PST	Pacific Standard Time
PDT	Pacific Daylight Savings Time
MST	Mountain Standard Time
MDT	Mountain Daylight Savings Time
CST	Central Standard Time
CDT	Central Daylight Savings Time
EST	Eastern Standard Time
EDT	Eastern Daylight Savings Time
AST	Atlantic Standard Time
ADT	Atlantic Daylight Savings Time

Each time zone has a corresponding time offset. For example, the time offset for Pacific Standard Time is -8. Pre-programmed time zones are not available for International use. For operation outside of North America, enter the time offset from UTC. For example, the time offset for Melbourne, Australia would be UTC + 10.

To select a time zone or time offset:

- Press the  key to access the System Status function.
- Press the  key.
- Rotate the large, outer selector knob to the right, until the first character in the time zone/offset field begins to flash.
- Rotate the small, inner selector knob to select the desired time zone or time offset.

Time zones are listed before time offsets. After the last time zone appears, continue rotating the small, inner selector knob to the right to select time offsets.

- Press the  key to confirm the selection.

7.2.2 The Present Position Display

The Present Position page displays the aircraft's current position in terms of latitude and longitude, UTM, or MGRS. (See Section 7.5.2 for selecting display units.)

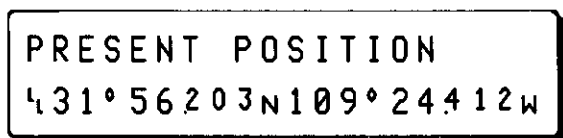


Figure 7-19: Present Position Display

The Present Position page in Figure 7-19 indicates a present position of latitude, 31° and 56.203 minutes north; longitude, 109° and 24.412 minutes west.

NOTE:

The starting position for Dead Reckoning is set under Setup mode on the Dead Reckoning page.

7.2.2.1 The Altitude Display

The Altitude page follows the Present Position page in the database, and displays the current altitude source and altitude.

To access the Altitude page:

- Press the  key to access the System Status function.
- Rotate the small, inner selector knob to display the Present Position page.
- Rotate the large, outer selector knob to display the Altitude page.

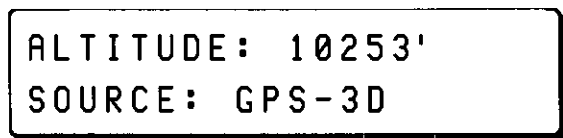


Figure 7-20: The Altitude Page

The Altitude page in Figure 7-20 indicates that the current altitude is 10,253 feet. The altitude source is GPS-3D.

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Altitude Sources and Information

The Navigator relies on different sources of altitude information depending on the current operating mode.

Barometric

The altitude is determined on an external barometric input. If a barometric altitude input is supplied, this source is automatically selected and may not be changed.

The Barometric altitude source may be displayed in one of three ways on this page to provide additional information:

BARO/GPS-3D: GPS altitude is available as a back-up in case of loss of barometric altitude.

BARO/GPS-2D: GPS position is available, but in 2-D mode. The barometric altitude is used to aid the GPS position solution.

BARO ONLY: The altitude source is barometric; no GPS position is available.

GPS 3-D (GPS-3D)

If the receiver is currently in GPS 3-D mode, using 4 satellites, and the barometric input is absent, GPS is automatically selected as the altitude source. When the Navigator is operating in 3-D mode, the GPS indicator light remains lit. GPS altitude may differ from barometric altitude by as much as 1,000 feet.

Held GPS (HELD/GPS-2D)

If the Navigator is using just 3 satellites, it will depend on an altitude input to supply the additional dimension for the GPS position solution. If an external barometric altitude is available, that source is automatically used.

When no barometric altitude is available and the Navigator initially transitions from 3-D to 2-D mode, there is a 60 second period in which the Navigator will hold the last GPS altitude before prompting for manual input. If a fourth satellite does not become usable by the end of the period, or manual altitude is not entered, the GPS indicator light will flash and the Navigator will display the following message for a few seconds:



Figure 7-21: Altitude Confirmation

The Navigator will then be placed in the Edit mode on the Altitude page to allow a change to the altitude (if required) before confirming with ENT (see Section 7.2.2.2).

Manual (MANUAL/GPS-2D)

If an altitude has been entered or confirmed and the Navigator is in 2-D mode, the GPS indicator light will flash and the altitude displayed will be used to aid the GPS position solution. A new altitude may be entered.

Old (OLD)

If there is no barometric input and the receiver is not generating a position solution, the altitude source will be OLD. The last altitude in use will be displayed, and a manual altitude may be entered by the user.

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7.2.2.2 Entering the Altitude

When the Navigator is using just three satellites for position solutions (2-D), position accuracy is tied to an external altitude input. If an external altitude encoder or altitude serializer is not being used, altitude may be entered manually.

Sixty seconds after the Navigator enters 2-D mode operation, the GPS indicator begins to flash and the WRN annunciator lights.

To display the Warning message:

- Press the  key.

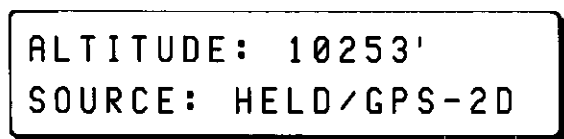


Figure 7-22: Held Altitude Display

The message in Figure 7-21 (previous page) is displayed, followed by the last GPS 3-D altitude. The  key begins to flash.

To enter the current aircraft altitude:

- Press the  key.
- Rotate the large, outer selector knob to move to the first digit in the altitude field.
- Rotate the small, inner selector knob to select the current altitude.
- Press the  key to confirm this entry.

The display changes to reflect the manually entered altitude:

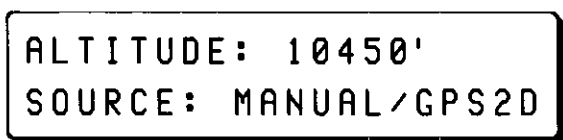


Figure 7-23: Manual Altitude

The Warning message is now downgraded to an Advisory message. The ADV annunciator light remains lit to remind the pilot to periodically update this altitude information. To update the altitude input, press the MSG key and follow the steps above to enter the current aircraft altitude.

7.2.2.3 Pressure Altitude and GPS Altitude

- Rotate the large, outer selector knob to the right to view the current pressure and GPS altitudes.

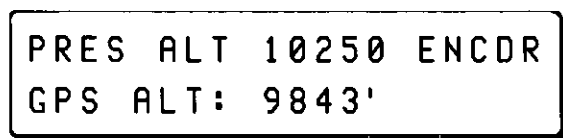


Figure 7-24: Current Pressure and GPS Altitudes

The display in Figure 7-24 indicates that the current pressure altitude is 10,250 feet. The source is barometric encoder input. GPS altitude is 9843 feet. Altitude displays may include the following sources:

- ENCDR (Encoder)

The receiver is receiving the pressure altitude from an external barometric encoder.

- None

The altitude source is not available and altitude will be displayed as dashes (for either pressure or GPS altitude).

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7.2.3 *The Voltage and Temperature Display*

The Voltage and Temperature page in Figure 7-25 indicates that the input voltage is 14.2 volts; temperature inside the unit is 33° Celsius.

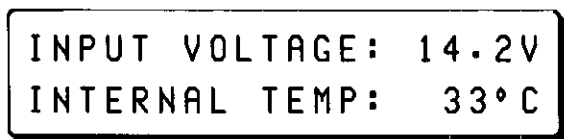


Figure 7-25: Voltage and Temperature Display

7.2.3.1 *The Crystal Offset Display*

The Crystal Offset page in Figure 7-26 indicates that the crystal frequency offset is 13 Hz out of 16.368 MHz. This page is primarily accessed when the Navigator is being serviced.



Figure 7-26: Crystal Frequency Display

- Rotate the large, outer selector knob while viewing the Voltage and Temperature page to access this display.

7.2.3.2 The GPS Antenna Display

The GPS Antenna page display shown below indicates that the voltage across the antenna leads is currently 4.36 volts and the current is 85 milliamps.

- Rotate the large, outer selector knob while viewing the Voltage and Temperature page or the Crystal Offset page to access this display.



Figure 7-27: GPS Antenna Display

7.2.4 The Database Expiration Display

The Database Expiration page provides the expiration date for the current NavData credit-card database.

The Database Expiration page in Figure 7-28 indicates that the current database expires on February 3, 1994.

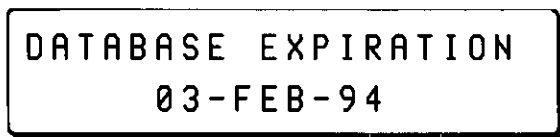


Figure 7-28: Database Expiration Display

WARNING:

Do not remove the NavData card from the system when the power is on. To prevent corrupted data and random system errors, the system will automatically RESET if the card is removed.

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7.2.5 The Software Revisions Display

The TNL 2100T GPS Navigator requires two different computer software programs for navigation:

- Navigation
- GPS

The Software Revisions page in Figure 7-29 provides information on the two versions of software that are currently being used by the TNL 2100T GPS Navigator.

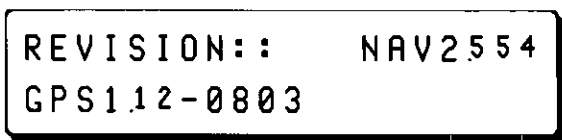


Figure 7-29: Software Revisions Display

NOTE:

The version numbers shown are for illustration only and do not necessarily indicate the version numbers for the unit.

7.2.6 The Software Code Display

The software code is displayed on the Software Code page.

The Software Code page in Figure 7-30 indicates that this unit's software code is 20000.

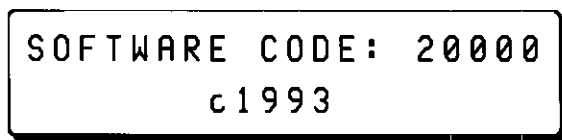


Figure 7-30: Software Code Display

NOTE:

The software code is for illustration only and does not necessarily indicate the software code for the unit.

7.3 The Sensor Status Function

The Sensor Status function allows quick access to sensor diagnostic information as well as the system navigation mode. The sensor status pages include the following:

- GPS Status
- Estimated Accuracy
- GPS Satellite Status
- GPS Sensor Reset
- GPS Satellite Availability

7.3.1 GPS Sensor Status

GPS status and satellite data are available in the Sensor Status pages of the AUX mode. The first display under Sensor Status is the GPS Status page.

The GPS Status page displays current GPS information, Receiver Autonomous Integrity Monitor (RAIM) status, and Position Dilution of Precision (PDOP). RAIM provides a verification that GPS accuracy is sufficient for use as a supplemental means of navigation during IFR Enroute and Terminal operations. In the event "RAIM" status reverts to "NO RAIM", use of GPS for primary navigation must be terminated during IFR operations (subsequent IFR navigation to be conducted using VOR, DME, etc.). PDOP is a measurement of the geometry of the satellites. The smaller the number, the greater the precision. A list of GPS Status Messages is located in Appendix A.

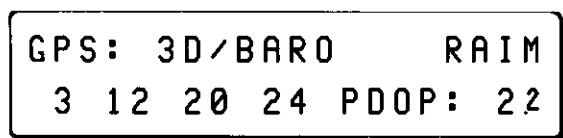


Figure 7-31: GPS Status Display

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The GPS Status page in Figure 7-31 indicates that the GPS receiver is currently using 4 satellites for its position solution; the receiver is computing position in three dimensions; RAIM is active, therefore GPS may be used for IFR navigation; the Position Dilution of Precision is 2.2. The satellites being used for a position fix are numbers 3, 12, 20, and 24.

- Rotate the large, outer selector knob clockwise to view all the satellites being tracked by the GPS receiver.
- Rotate the large, outer selector knob counterclockwise to view the GPS estimated accuracy page.

RAIM status codes include:

<u>Code</u>	<u>Meaning</u>
RAIM	Receiver Autonomous Integrity Monitor is active; GPS may be used for IFR navigation
NO RAIM	Receiver Autonomous Integrity Monitor is not active; under new FAA guidelines, GPS may be used for IFR navigation if current position is cross-tracked with a different means of Navigation (e.g., VOR) at least once every 15 minutes.
RAIM/P	Receiver Autonomous Integrity Monitor is active and using pressure altitude aiding; GPS may be used for IFR navigation

7.3.2 Estimated Accuracy

Based on the accuracy of the signals and the geometry of the GPS Satellites, the Navigator computes an estimate of the worst case error on position. This is shown on the Estimated Accuracy page. While viewing the GPS Sensor Status page, turn the large, outer selector knob clockwise.

The display in Figure 7-32 indicates that the estimated accuracy of the GPS sensor is .06 nautical miles. Therefore, the estimated accuracy of the receiver is .06 nautical miles.

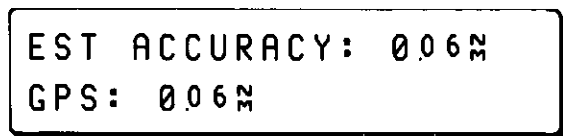


Figure 7-32: Estimated Accuracy

7.3.2.1 GPS Satellites Tracked Display

The GPS Satellites Tracked page displays the numbers of all the satellites being tracked by the GPS receiver.

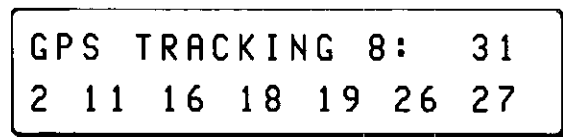


Figure 7-33: GPS Satellites Being Tracked

The GPS Satellites Tracked page in Figure 7-33 indicates that the GPS receiver is currently tracking 8 satellites. The satellites being tracked are numbers 2, 11, 16, 18, 19, 26, 27, and 31. Up to 9 tracked satellites may be displayed.

- Rotate the large, outer selector knob clockwise to view individual satellite information (see Section 7.3.2.2).

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7.3.2.2 GPS Satellite Status Display

The GPS Satellite Status page displays information on each satellite: elevation, azimuth, and signal level.

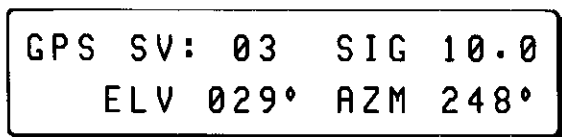


Figure 7-34: GPS Satellite Status Display

The GPS Satellite Status page in Figure 7-34 indicates that satellite (SV for Space Vehicle) number 3 is being received with a signal to noise ratio of 10.0; it is currently at an elevation of 29° and an azimuth of 248°.

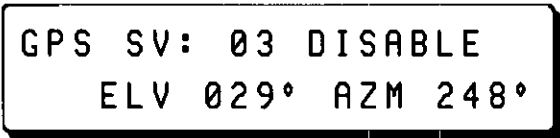
If a negative elevation appears in this page, it is an indicator that the satellite is below the horizon and cannot be used to obtain a position fix.

To access information on each satellite:

- Rotate the large, outer selector knob to the right. The status of all satellites can be displayed, whether or not they are currently being tracked.

The Navigator allows the user to manually disable the GPS receiver from using any satellite in the 24 satellite constellation. To activate this procedure, access the display shown in Figure 7-35.

- Press the  key and rotate the small, inner selector knob. The top line shows "DISABLE" blinking.
- Press the  key and the receiver no longer uses that satellite for its position solution:



GPS SV: 03 DISABLE
ELV 029° AZM 248°

Figure 7-35: GPS Satellite Deselection

- Rotate the large, outer selector knob to the right to repeat the above procedure for the rest of the satellites. If the Navigator is turned off and on, any satellites which have been manually deselected are re-enabled.

7.3.2.3 GPS Sensor Reset

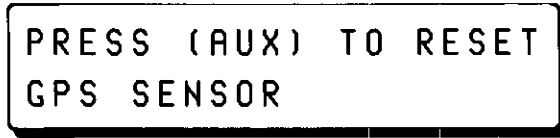
From the Satellite Status pages, rotate the large, outer selector knob clockwise. The user will access the GPS Sensor Reset display shown in Figure 7-36:



RESET GPS SENSOR?
(ENT)

Figure 7-36: GPS Sensor Reset Display

- Press the  key. The display shown in Figure 7-37 will ask the user to confirm the reset.



PRESS (AUX) TO RESET
GPS SENSOR

Figure 7-37: GPS Sensor Reset Confirmation Display

Sensor reset causes the GPS receiver to go through its power-on and satellite acquisition sequence as if the unit had been turned off and on. This function is not needed during normal operation of the Navigator.

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7.3.3 GPS Satellite Availability

- Rotate the small, inner selector knob clockwise to view the display shown in Figure 7-38.

The Satellite Availability page shown in Figure 7-38 indicates that GPS three dimensional positioning is available 24 hours at the current location on October 19, 1994.

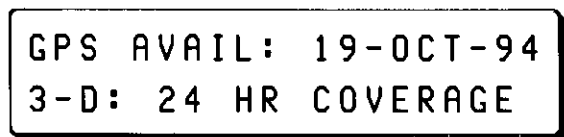


Figure 7-38: GPS Satellite Availability Display

To access information on the next available satellite navigation period, rotate the large, outer selector knob to the right. To enter a specific date or to select between visibility computation for two or three-dimensional positioning, press the ENT key. This information may be entered using the standard data entry techniques.

The position used for satellite visibility computations is the last computed fixed position. If the Dead Reckoning mode has been set, the visibility will be computed for the present DR position (Refer to Section 7.4.6).

7.4 The Setup Function

The Setup function is used to establish parameters for the following:

- Database Search Regions
- Restricted Airspaces
- Parallel Offset
- CDI Sensitivity
- Magnetic Variation
- Dead Reckoning

7.4.1 Database Search Regions

A user may select the specific states and regions that a database search covers. These search parameters can include up to 6 regions, states, provinces or countries. This will reduce the number of objects the user will have to view when trying to locate the area of interest. "ALL" is the factory default setting for this page.

A database search can also be restricted by specifying the following regions in the United States:

nw	North West
sw	South West
nc	North Central
sc	South Central
ec	East Central
ne	North East
se	South East

These U.S. Regions correspond to the ARINC regions. Their boundaries are different from those used in government publications. Refer to Appendix A for regional maps, and a list of state, province and country codes.

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Figure 7-39: International Search Regions Display

The display in Figure 7-39 indicates that database searches will be made for the individual countries of France, Germany and Italy.



Figure 7-40: Domestic Search Regions Display

The display in Figure 7-40 indicates that database searches will be made for the northeast region, California, Nevada, Arizona, Utah, and Colorado.

To establish Database Search Regions, follow these steps:

- Press the  key until the Setup function is selected.
- Press the  key.

The first character in the region field begins to flash.

- Rotate the small, inner selector knob to select the desired region, state, province, or country code.
- Rotate the large, outer selector knob to move to the next field.
- Continue using the inner and outer selector knobs to enter up to 6 search parameters.
- Press the  key to complete the selection.

NOTE:

Defining a search region will not restrict searches in the APT/VOR mode, or restrict searches for restricted airspaces.

7.4.2 AIRWATCH™ - The Airspace Alert System

The Airspace Alert page allows the user to enable or disable specific Special Use airspaces from the AIRWATCH search feature. When the Navigator is initially installed, the AIRWATCH feature is turned off.

For Special Use airspaces in the United States, the Navigator monitors aircraft position in relation to the boundaries of these areas and provides a warning of impending airspace penetration. AIRWATCH does not take into consideration hours of operation or vertical boundaries associated with controlled airspaces.



Figure 7-41: AIRWATCH Alert Display

The message in Figure 7-41 indicates that AIRWATCH is currently ON; and ALL airspaces are being monitored. If individual airspaces have been enabled or disabled, the word "SELECTED" will appear instead of "ON" in this display.

The subsequent pages display AIRWATCH information for all MOAs, and individually for Class B and Class C.

To turn AIRWATCH ON/OFF or to designate SELECTED airspaces, follow these steps:

- Press the  key to access the System Setup submode.
- Rotate the small, inner selector knob to access the AIRWATCH page.

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- Press the  key to confirm the selection.
- If SELECTED is chosen, rotate the large, outer selector knob to display optional airspaces.
- Press the  key and rotate the small, inner selector knob to enable or disable each SELECTED airspace.
- Press the  key to confirm each selection.

7.4.3 *Selecting a Parallel Offset*

Parallel Offsets from 99.99 nm LEFT to 99.99 nm RIGHT may be selected.

- Press the  key to access the Setup function.
- Rotate the small, inner selector knob to the right until the Parallel Offset page is displayed.

When this page is first displayed, the current offset setting is shown:



Figure 7-42: Parallel Offset Setting

The display in Figure 7-42 indicates a parallel offset of 10 nautical miles to the right of the designated track has been set.

- Press the  key to display a flashing cursor in the first digit field.

- Press the  key to start AIRWATCH selections.
- Rotate the small, inner selector knob to select the ON, OFF, or SELECTED position.
- Rotate the large, outer selector knob to the right to select the digit field or to move to the LEFT/RIGHT field.
- Rotate the small, inner selector knob to change the digit field or LEFT/RIGHT field.
- Press the  key to select the new offset.

If a parallel offset other than 0.00 nm is selected, the parallel offset (PTK) annunciator is lit. The parallel offset can also be viewed by pressing the MSG key.

The parallel offset feature does not affect the course or distance to the destination waypoint. Parallel offset changes the cross-track error distance and the CDI, and the turn computations if a flight plan is active.

Parallel offset is cancelled automatically when the course to the destination waypoint differs from the desired track by 45 degrees or more, or when the one minute to arrival message is displayed. If flying a flight plan, destination refers only to the last waypoint on the final leg of the plan.

Parallel offset is also automatically cancelled when the Direct function is used.

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7.4.4 The CDI Sensitivity Display

7.4.4.1 Internal CDI Sensitivity

Internal electronic CDI sensitivity may be set by the user. The factory default setting is 1/2 nautical mile per dot; the CDI sensitivity may be changed to 1, 1/2, 1/4, 1/8, 1/16, or 1/32 nautical mile per dot. Internal CDI sensitivity may also be displayed in statute miles or kilometers, as selected under AUX-INSTALL-User Units. The same fractional dimensions listed for nautical miles may be selected for statute miles and kilometers.

The Navigator's electronic CDI is extremely sensitive. At 1/32 mile per dot, the minimum visible cross-track distance, one pixel width, is just 37.5 feet.

- Press the  key to select the Setup function.
- Rotate the small, inner selector knob to access the CDI sensitivity display.

When the CDI page is first displayed, the current setting is shown:

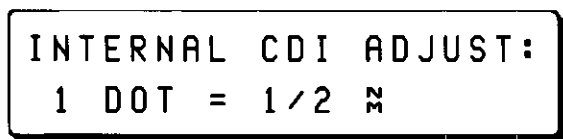


Figure 7-43: Internal CDI Sensitivity Setting

To select previous or subsequent settings:

- Press the  key.
- Rotate the small, inner selector knob.

The new setting is displayed along with the flashing (ENT) message.

The  key begins to flash.

- Press the  key to confirm the new setting.

7.4.4.2 External CDI Sensitivity

The Navigator is capable of driving external CDIs and providing left/right information to an autopilot. The sensitivity scale for an external CDI is limited to two settings: 1 nautical mile and 1/4 nautical mile per dot (factory default is 1 nm). For optimal autopilot tracking performance, 1/4 nm per dot is recommended.

NOTE:

User-selectable units are provided for the Internal CDI only, as described in the previous section. The External CDI is only displayed in nautical miles per the above paragraph, to meet FAA requirements.

For convenience, the following table lists the conversions for full scale deflection of the External CDI for both 1 and 1/4 nautical mile per dot settings:

	CDI set at 1/4 NM per dot	CDI set at 1 NM per dot
Nautical Miles	± 1.25 NM	± 5 NM
Statute Miles	± 1.44 MI	± 5.75 MI
Kilometers	± 2.32 KM	± 9.27 KM

To set external CDI sensitivity:

- Press the **AUX** key to access the Setup function.
- Rotate the small, inner selector knob to access:

EXTERNAL CDI ADJUST:
1 DOT = 1/1 N

Figure 7-44: External CDI Sensitivity Setting

For further discussion on flying the Navigator with an autopilot, see Appendix C.

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7.4.5 The Magnetic Variation Display

Magnetic Variation may be set to AUTO or any value between 180° West and 180° East. AUTO is the factory default setting.

When this page is first displayed, the current setting is shown.

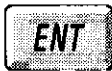
The display in Figure 7-45 indicates that the Magnetic Variation at the current position is 15° East.



Figure 7-45: Magnetic Variation Setting

To select previous or subsequent settings, rotate the small, inner selector knob. A clockwise rotation of this knob increases the variation to the East; a counterclockwise rotation of the knob increases the variation to the West. The AUTO setting is located in the middle of the East and West settings.

For example, to select a setting of 5° East:

- Press the  key to access the Setup function.
- Rotate the small, inner selector knob to select the Magnetic Variation display.
- Press the  key.
- Rotate the small, inner selector knob until a variation of 5° East is displayed.

The new setting is displayed and the (ENT) message flashes.

- Press the  key to confirm the new selection.

NOTE:

To operate in true degrees, enter 0° magnetic variation.

7.4.6 The Dead Reckoning Display - Demo Mode

The Dead Reckoning (DR) feature allows the user to navigate in areas where GPS signal coverage is not available. It may only be activated if the Navigator is not receiving signals sufficient for a position fix. This mode may also be used outside the aircraft, to demonstrate the Navigator features.

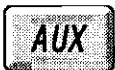
When Dead Reckoning is activated, the WRN annunciator is lit. This warning message may be viewed by pressing the MSG key.

When the Dead Reckoning page is first displayed, the current ON/OFF setting is shown. If the OFF setting is selected, only the top line in Figure 7-46 is displayed.

To select the starting position for DR or Demo mode operation:



Figure 7-46: Dead Reckoning Display

- Press the  key to select the Setup function.
- Rotate the small, inner selector knob to select the Dead Reckoning display.
- Press the  key to select Dead Reckoning.

The Starting Position display flashes on the screen. The Waypoint mode becomes active and the  key begins to flicker.



Figure 7-47: Starting Position Display

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To set the starting point:

- Use the standard method of selecting a waypoint from the WPT or APT/VOR mode.
- Press the  key.

To set the destination, activate a flight plan or navigate directly to a waypoint.

To activate a ground speed from the starting position:

- Press the  key to return to the Primary NAV Mode display.
- Press the  key.

The first digit in a ground track field begins to flash.

- Rotate the inner and outer selector knobs to set the ground track field.
- Rotate the large, outer selector knob to move to the ground speed field.
- Rotate the inner and outer selector knobs to set the ground speed field.
- Press the  key.

The entry is now complete and the Dead Reckoning/Demo mode is enabled. You may now use the DR mode for navigation or the Demo mode to demonstrate the Navigator features.

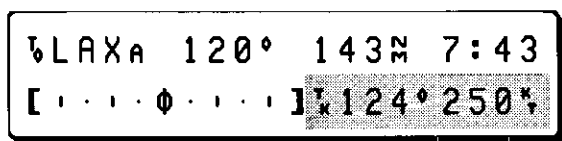


Figure 7-48: Ground Track/Speed Entry Display

7.5 The Install Function

The Install function provides quick access to system installation information. These pages are normally set by the installer, but may be accessed by the user.

From the Install function, the user may modify the following features:

- Select User Units
- Personal Messages
- ETA Display Time
- Display Intensity
- Audio Level
- CDI Calibration
- RAM Card Save/Load
- Serial I/O Save/Load
- Serial I/O Setup
- GPS Antenna Height/OAT "K" Factor
- Pop-Up Messages
- Display Diagnostic

7.5.1 Select User Units

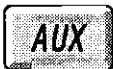
- Press the  key to access the Install mode.
- Rotate the small, inner selector knob until the display in Figure 7-49 appears.



Figure 7-49: Select User Units

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7.5.1.1 *Select Position Coordinate System*

The following coordinate systems are available in the Navigator:

- LAT/LON – Latitude/Longitude
- MGRS – Military Grid Reference System
- UTM – Universal Transverse Mercator
- UPS – Universal Polar Stereographic
- OSGB – Ordnance Survey of Great Britain
- ING – Irish National Grid

The UPS coordinate system is not directly selectable by the User. When MGRS or UTM coordinates are selected, both automatically revert to UPS when above 84°N latitude or below 80°S latitude.

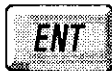
- Rotate the large, outer selector knob clockwise until Figure 7-50 appears.



Figure 7-50: Select Position Coordinates

- Press the  key.

The  key and the ENT indicator on the display begin to flash.

- Rotate the small, inner selector knob to select LAT/LON, MGRS, UTM, OSGB, or ING.
- Press the  key to conclude the selection.

7.5.1.2 Select Position Datum

- Rotate the large, outer selector knob clockwise until Figure 7-51 appears.



Figure 7-51: Select Position Datum

- Press the  key.

The  key and the ENT indicator on the display begin to flash.

- Rotate the small, inner selector knob to select the desired Datum (listed alphabetically).
- Press the  key to conclude the selection.

NOTE:

In the event a datum other than WGS-84 has been selected in AUX-INSTALL-User Units, a message indicating "DATUM IN USE" will be displayed for approximately 5 seconds, following the standard initialization message.

7.5.1.3 Select Distance Units

- Rotate the large, outer selector knob clockwise until Figure 7-52 appears.



Figure 7-52: Select Distance Units

- Press the  key.

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The  key and the ENT indicator on the display begin to flash.

- Rotate the small, inner selector knob to select Nautical Miles, Kilometers, or Statute Miles.
- Press the  key to conclude the selection.

7.5.1.4 Select Speed Units

- Rotate the large, outer selector knob clockwise until Figure 7-53 appears.



Figure 7-53: Select Speed Units

- Press the  key.

The  key and the ENT indicator on the display begin to flash.

- Rotate the small, inner selector knob to select Knots, Kilometers per Hour, or Miles per Hour.
- Press the  key to conclude the selection.

7.5.1.5 Select Altitude Units

- Rotate the large, outer selector knob clockwise until Figure 7-54 appears.



Figure 7-54: Select Altitude Units

- Press the  key.

The  key and the ENT indicator on the display begin to flash.

- Rotate the small, inner selector knob to select Feet, or Meters.
- Press the  key to conclude the selection.

7.5.1.6 Select Barometric Setting Units

- Rotate the large, outer selector knob clockwise until Figure 7-55 appears.



Figure 7-55: Select Baro Set Units

- Press the  key.

The  key and the ENT indicator on the display begin to flash.

- Rotate the small, inner selector knob to select Inches of Hg or Millibars.
- Press the  key to conclude the selection.

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7.5.1.7 Select Fuel Computation Units

- Rotate the large, outer selector knob clockwise until Figure 7-56 appears.



Figure 7-56: Fuel Computation Units

- Press the  key.

The  key and the ENT indicator on the display begin to flash.

- Rotate the small, inner selector knob to select Avgas, Jet-A or JP-4 in Gallons, Imperial Gallons, Kilograms, Liters or Pounds.
- Press the  key to conclude the selection.

7.5.2 Creating Personal Messages

Personal messages are displayed when the Navigator is initially turned on.

To enter a personal message:

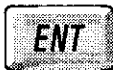
- Press the  key until the Install function is selected.
- Rotate the small, inner selector knob to access the “New Personal Message” display.
- Press the  key.



Figure 7-57: Personal Message Display

The top line of the message is entered first.

To enter or modify information in a line, use the inner and outer selector knobs.

- Use the  key and the selector knobs to enter the desired message.
- Press the  key a second time, when the entry is completed.

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7.5.3 Estimated Time of Arrival (ETA) Display

The user may select the time zone with which to display ETA and GPS availability.

- Press the  key to access the Install mode.
- Rotate the small, inner selector knob until the display in Figure 7-58 appears.



Figure 7-58: ETA Time Zone Selection

- Press the  key.

The  key begins to flash.

- Rotate the small, inner selector knob to select either Local or Zulu time.
- Press the  key to conclude the selection.

7.5.4 Setting the Display Light Intensity

The Display Intensity page enables the user to set the backlight and night intensity levels on the display.

To set the backlight and night intensity levels:

- Press the  key to access the Install mode.
- Rotate the small, inner selector knob until the display in Figure 7-59 appears.



Figure 7-59: Set Display Light Level

- Press the  key.

The display in Figure 7-60 appears indicating that the small, inner selector knob may be used to set the backlight and the large, outer selector knob may be used to set the night level.



Figure 7-60: Set Backlight and Night Level

- Rotate the small, inner selector knob to set the backlighting for push-button keys.

Rotating the knob to the right increases the intensity level.

- Rotate the large, outer selector knob to set the brightness of the display.

Rotating the knob to the right increases the intensity.

- Press the  key to complete the calibration.

NOTE:

Calibration of light intensity should be done in the dark.

7.5.5 Setting the Audio Level

The Set Audio page enables the user to set and test the Navigator's audio level and frequency.

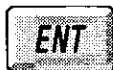
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To set the audio level and frequency:

- Press the  key to access the Install mode.
- Rotate the small, inner selector knob until the display in Figure 7-61 appears.



Figure 7-61: Set Audio Level Page

- Press the  key.

The display in Figure 7-62 appears, indicating that the small, inner selector knob may be used to set the volume and the large, outer selector knob may be used to set the frequency.

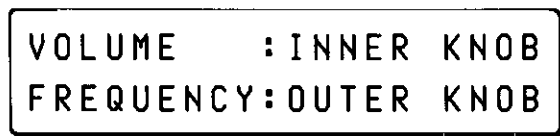


Figure 7-62: Setting Audio and Frequency Page

The Navigator will generate a test beep on an external speaker.

- Rotate the small, inner selector knob to set the desired audio level.

Rotating the knob to the right increases the audio level.

- Rotate the large, outer selector knob to set the desired audio frequency.

Rotating the knob to the right increases the frequency.

- Press the  key to complete the calibration.

NOTE:

The frequency may be adjusted between 100 and 1000 Hz.

7.5.6 The CDI Calibration Feature

The CDI Calibration feature allows the user to set or check the following:

- CDI indicator position
- Flag or External Annunciator

To set or check these indicator positions and the External Annunciator(s), follow these steps:

- Press the  key until the Install function is displayed.
- Rotate the small, inner selector knob to select the CDI Calibration and Annunciator page.
- Press the  key.



Figure 7-63: CDI Calibration Display

The CDI test page in Figure 7-63 indicates that the user is testing the external analog CDI for no deflection of the indicator.

- Rotate the inner or outer selector knobs until the CDI meter is centered.
- Press the  key.

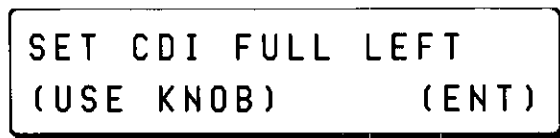


Figure 7-64: CDI Calibration Test Page

The CDI test page in Figure 7-64 indicates that the user is testing the external analog CDI for full-scale deflection to the left.

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- Rotate the inner or outer selector knob counter-clockwise until the CDI indicator is positioned at the left-most position.
- Press the  key.

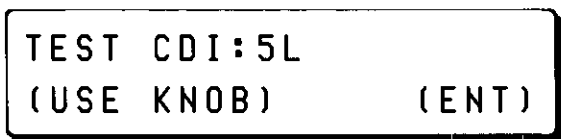


Figure 7-65: CDI Calibration Test Page

The CDI test page in Figure 7-65 indicates that the external analog CDI indicator should display a full-scale deflection to the left.

- Rotate the small, inner selector knob one click clockwise.

The external CDI display indicator should move right one dot. The display in Figure 7-65 will now indicate "4L".

- Rotate the small, inner selector knob one click clockwise.

The external CDI display indicator should move right one more dot. The display in Figure 7-65 will now indicate "3L".

- Continue rotating the small, inner selector knob one click at a time, clockwise, until the Navigator display indicates "5R", meaning that the CDI display indicator should be at the right-most position.
- Press the  key.

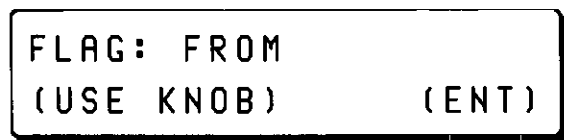


Figure 7-66: CDI "FROM" Flag Display

The external CDI display displays the "FROM" flag.

- Rotate the small, inner selector knob clockwise one click.

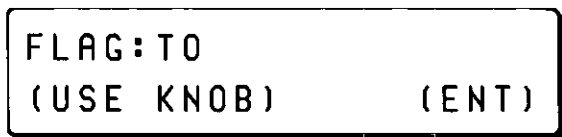


Figure 7-67: CDI "TO" Flag Display

The external CDI display displays the "TO" flag.

- Rotate the small, inner selector knob clockwise one additional click.

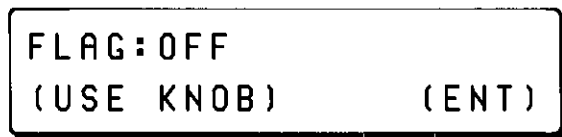


Figure 7-68: CDI Flag "OFF" Display

The external CDI display "FROM" and "TO" flags are not visible.

- Continue rotating the small, inner selector knob clockwise, one click at a time, while testing the appearance of the following on the external CDI display or the external annunciators:
 - NAV flag no longer displayed
 - GS flag no longer displayed
 - WPT annunciator lit
 - ADV annunciator lit
 - WARN annunciator lit
 - APCH annunciator lit
- Rotate the small, inner selector knob counterclockwise at any time to repeat any of these tests.
- Press the  key to end CDI calibration testing.

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7.5.7 *Loading and Saving Configuration with the Memory Card*

The Memory Card (also called the RAM Card) is a memory storage device that fits in the slot on the front of the Navigator normally used by the Jeppesen NavData Database Card.

The Memory Card may be used to load or save the Navigator configuration. The data on the card may be updated using the optional Trimble Flight Planning and Configuration software (NavPak).

WARNING:

Always TURN OFF the Navigator before inserting or removing either the Memory Card or the NavData Database Card from the system. To prevent corrupted data and random system errors, the system will automatically RESET if the card is removed.

WARNING:

Do not load or save configuration data during navigation. Data should be loaded or saved immediately following the Navigator's power-on procedure.

7.5.7.1 Storing Configuration on the Memory Card

To save the current Navigator configuration onto the Memory Card:

- Press the  key until the Install function is selected.
- Rotate the small, inner selector knob until the "LOAD/SAVE RAM CARD" message is displayed.
- Rotate the large, outer selector knob to select "SAVE CONFIGURATION".
- Press the  key. The Navigator will then display the status of the Memory Card and ask confirmation to write to the card.
- Press the  key to start data transfer to the Memory Card.

During the data transfer, the display will indicate the amount of data transferred by showing the percentage of transfer in the upper right-hand corner. When the transfer is completed, the display will show 100%.

During the SAVE process, the Navigator can detect some problems with the Memory Card. If an error occurs, the user can exit the SAVE process by pressing any of the Navigator Mode Keys.

To return the Navigator to normal operation:

- Turn the Navigator off.
- Replace the RAM Card with the Database Card.
- Turn the Navigator on.

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7.5.7.2 Loading Configuration from the Memory Card

To load the Navigator configuration from the Memory Card:

- Press the  key until the Install function is selected.
- Rotate the small, inner selector knob until the "LOAD/SAVE RAM CARD" message is displayed.
- Rotate the large, outer selector knob to select "LOAD CONFIGURATION".
- Press the  key to select this function.

The display will now read: CLEAR BEFORE LOAD? The user has two options:

- Press the  key to clear the existing configuration and load the new one.

OR

- Rotate the small, inner selector knob to display "APPEND CARD DATA", then press the  key to add the configuration from the Memory Card to the existing configuration.

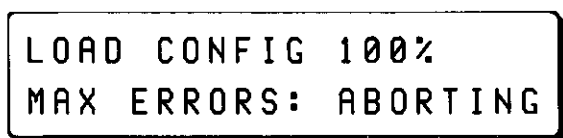
During the data transfer, the display will indicate the amount of data transferred by showing the percentage of transfer in the upper right-hand corner. When the transfer is completed, the display will show 100%. It is not possible to stop the data transfer once it is started (other than by turning off Navigator power).

If an error is detected before the transfer begins, the transfer will not start. In this case, an advisory message appears and the ADV indicator on the Navigator starts to flash. The advisory message directs the user to make the necessary corrections.

During the LOAD process, if a record error is detected, an advisory message is displayed on the bottom line. If an error is found in a record, that record is not transferred to the Navigator, but the load operation continues.

During a LOAD process for which the user has selected the APPEND option, the data being loaded is automatically checked for compatibility with the existing data. If an incompatibility is found in a record, that record is not transferred to the Navigator, but the load operation continues.

If there are more than 10 errors or incompatibilities detected, the data transfer is aborted. The error message shown in Figure 7-69 is displayed:



```
LOAD CONFIG 100%
MAX ERRORS: ABORTING
```

Figure 7-69: Memory Card Load Error Display

When any errors are reported, the Navigator contains a partial (and probably corrupted) data set. The configuration process should be repeated.

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7.5.8 *Loading and Saving Configuration via Serial Port*

It is possible to store the current Navigator configuration onto an IBM PC compatible, or to load a configuration into the Navigator from an IBM PC compatible.

The PC must contain Trimble's Flight Planning and Configuration software (NavPak), and appropriate cabling must be provided between the Navigator rear connector and the PC.

WARNING:

Do not load or save configuration data during navigation. Data should be loaded or saved immediately following the Navigator's power-on procedure.

7.5.8.1 Storing Configuration via Serial Port

To save the current Navigator configuration onto an IBM PC compatible:

- Press the  key until the Install function is selected.
- Rotate the small, inner selector knob until the "LOAD/SAVE VIA SERIAL" message is displayed.
- Rotate the large, outer selector knob to select "SAVE CONFIGURATION".
- Press the  key.
- Prepare the PC to receive navigation data and write it into a file.

During the data transfer, the display will indicate the amount of data transferred by showing the percentage of transfer in the upper right-hand corner. When the transfer is completed, the display will show 100%.

During the SAVE process, the Navigator can detect some processing problems. If an error occurs, the user can exit the SAVE process by pressing any of the Navigator Mode Keys.

NOTE:

To ensure proper Navigator operation, turn the Navigator off and then back on after the Save operation.

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7.5.8.2 Loading Configuration via Serial Port

To load the Navigator configuration from an IBM PC compatible:

- Press the  key until the Install function is selected.
- Rotate the small, inner selector knob until the "LOAD/SAVE VIA SERIAL" message is displayed.
- Rotate the large, outer selector knob to select "LOAD CONFIGURATION".
- Press the  key to select this function.

The display will now read: CLEAR BEFORE LOAD? The user has two options:

- Press the  key to clear the existing configuration and load the new one.

OR

- Rotate the small, inner selector knob to display "APPEND CARD DATA", then press the 
 key to add the configuration from the serial port to the existing configuration.

Finally, for either option:

- Prepare the PC to send the data file to the Navigator.

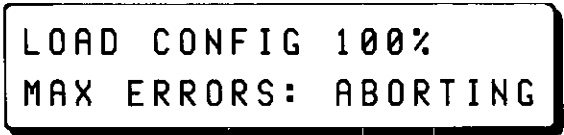
During the data transfer, the display will indicate the amount of data transferred by showing the percentage of transfer in the upper right-hand corner. When the transfer is completed, the display will show 100%. It is not possible to stop the data transfer once it is started (other than by turning off Navigator power).

If an error is detected before the transfer begins, the transfer will not start. In this case, an advisory message appears and the **ADV** indicator on the Navigator starts to flash. The advisory message directs the user to make the necessary corrections.

During the **LOAD** process, if a record error is detected, an advisory message is displayed on the bottom line. If an error is found in a record, that record is not transferred to the Navigator, but the load operation continues.

During a **LOAD** process for which the user has selected the **APPEND** option, the data being loaded is automatically checked for compatibility with the existing data. If errors are detected, the **ADV** indicator begins to flash. The number of the bad record and the number of the character within the record are displayed on the second line. If an incompatibility is found in a record, that record is not transferred to the Navigator, but the load operation continues.

If there are more than 50 errors or incompatibilities detected, the data transfer is aborted. The following error message is displayed:



```
LOAD CONFIG 100%  
MAX ERRORS: ABORTING
```

Figure 7-70: Serial Port Load Error Display

When any errors are reported, the Navigator contains a partial (and probably corrupted) data set. The configuration process should be repeated.

NOTE:

To ensure proper Navigator operation, turn the Navigator off and then back on after the Load operation.

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7.5.9 *Setting the Serial Port and Protocol*

The Serial Port and Protocol feature allows the user to set input/output, the serial port and baud rate, the data update rate and the data protocol.

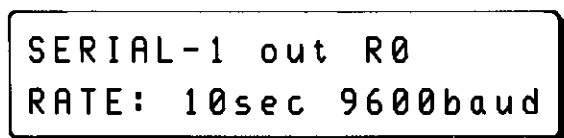


Figure 7-71: Serial Port and Protocol Display

The display in Figure 7-71 indicates that the serial channel number 1 output port is programmed for RNAV output mode 0; data will be output every 10 seconds at a rate of 9600 bits per second.

7.5.9.1 *The Serial Port Channels*

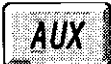
The Navigator features four independent serial data channels. Two of these channels are dedicated to input, and two are dedicated to output. Depending on the application, these channels may be used independently or in combination with one another. There are six possible input and output channel choices:

I/O Channels	Default Mode Settings
Serial - 1 in:	ENCODER (9600 baud, no rate)
Serial - 1 out:	K0 (9600 baud, 1 sec.)
Serial - 1 I/O:	None (no baud or rate, factory test mode)
Serial - 2 in:	None
Serial - 2 out:	None
Serial - 2 I/O:	None (no baud or rate, factory test mode)

The following are possible configurations of the serial channels:

I/O Channel	Possible Settings
Serial - 1 in:	none, ENCODER (9600 baud only), RMI (1200 baud only)
Serial - 1 out:	none, K0, K1, R0, R1, X0, X1, ARGUS (1 sec, 9600 baud default)
Serial - 1 I/O	none (factory use only)
Serial - 2 in:	none, ENCODER (9600 baud only), RMI (1200 baud only)
Serial - 2 out:	none, K0, K1, R0, R1, X0, X1, ARGUS (1 sec, 9600 baud default)
Serial - 2 I/O	none (factory use only)

To select the settings for a serial channel:

- Press the  key to access the Install mode.
- Rotate the small, inner selector knob until the first serial port page is displayed.

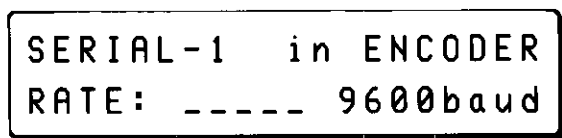


Figure 7-72: Serial Port Page Display

- Rotate the large, outer selector knob until the serial port to be configured is displayed.
- Press the  key to enable configuration changes.

The  key and the first letter of the port's current serial protocol setting begin to flash.

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- Rotate the small, inner selector knob until the desired protocol is displayed.
- Rotate the large, outer selector knob to adjust the data update rate and the baud rate setting.
- Press the  key when serial port configuration is complete.

7.5.9.2 Data Protocol

When a data protocol is selected, the matching input/output port will automatically default to that mode. The following input and output modes may be selected:

Output Mode Selections

none	NONE
R0	RNAV unformatted mode with carriage returns
R1	RNAV unformatted mode with carriage returns and line feeds
K0	King unformatted mode with carriage returns
K1	King unformatted mode with carriage returns and line feeds
X0	Extended K0 format
X1	Extended K1 format
ARGUS	K0 mode modified to display out-bound Track Line (see Section 3.4.1.2 for detailed explanation)

Input Mode Selections

none	NONE
ENCODER	Either ICARUS or Rosetta serial encoder or Shadin air and fuel data input
RMI	Rocky Mountain Instrument air data input

7.5.9.3 Baud Rates

The serial port may be programmed for the following baud rates:

1200	1200 bits per second (R0/R1 only)
2400	2400 bits per second (R0/R1 only)
4800	4800 bits per second (R0/R1 only)
9600	9600 bits per second
38.4(K)	38400 bits per second

When an input channel is selected, the baud rate is not displayed. If a mode of "none" is selected, the baud rate and input rates will appear as a series of dashes (---).

To select a baud rate:

- Press the  key.
- Use the selector knobs to enter the desired rate.
- Press the  key when done.

7.5.9.4 The Data Update Rate

The data update rate may be set between 1 and 999 seconds. For some protocols, this rate is ignored.

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7.5.10 GPS Antenna Height Setup & OAT "K" Factor

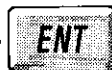
- **GPS Antenna Height Setup**

Unlike LORAN, GPS is a three-dimensional positioning system. To "fine-tune" the altitude component of GPS position, the Navigator allows specification of how high the GPS antenna is above a reference point. When GPS altitude is displayed, the value will have been reduced by the antenna height offset.

- **Outside Air Temperature Probe (OAT) "K" Factor**

True Airspeed determination is dependent on knowing the Outside Air Temperature (OAT) of the ambient. Since the OAT probe reading (typically labeled OAT in light aircraft and RAT in corporate/commercial aircraft) is affected by installation, airspeed, etc., a Temperature Recovery Coefficient, known as the "K" Factor, must be considered to accurately account for temperature rise at the probe. Values for the "K" Factor are generally around 1.0 for modern aircraft, but could be as low as 0.6 for older installations. If the "K" Factor is unknown and accurate True Airspeed is available from another source, start with a "K" Factor of 1.0 and modify as necessary to achieve accurate OAT and TAS on the TAS CALC page.

To change the GPS antenna height offset:

- Press the  key to access the Install mode.
- Rotate the small, inner selector knob until the display in Figure 7-73 appears.
- Press the  key to edit the displayed height.
- Enter a height from 0 to 99 feet. Use the large, outer selector knob to select the position to change; use the small, inner selector knob to dial in the appropriate digit.
- Press the  key to confirm the new value.



GPS ANT HEIGHT: 5'
OAT "K" FACTOR: 1.0

Figure 7-73: GPS Antenna & OAT "K" FACTOR

To edit the OAT "K" Factor:

- Press the  key to edit the "K" Factor.
- Enter the "K" Factor for the installed OAT Probe (typically 1.0, although could be as low as 0.6).
- Press the  key again to save the entry.

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7.5.11 Pop-Up Messages

Advisory messages may be automatically displayed as they occur, or stored in a queue to be read at the convenience of the pilot (see Section 8.2).

To select Enable/Disable Pop-up Messages:

- Press the  key to access the Install mode.
- Rotate the small, inner selector knob clockwise until Figure 7-74 appears (may be either DISABLED or ENABLED, depending on last setup).



Figure 7-74: Pop-up Messages Disable

- Press the  key.

The  key and the first letter on the second line of the display begin to flash.

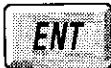
- Rotate the small, inner selector knob to select the desired Message Pop-up mode.
- Press the  key to conclude the selection.



Figure 7-75: Pop-up Messages Enabled

7.5.12 The Display Test Page

The Display Test page enables the user to check that the display lights and functions are in working order.

To access the Display Test page:

- Press the  key to access the Install mode.
- Rotate the small, inner selector knob until the display in Figure 7-76 appears.

The "DISPLAY DIAGNOSTIC" message appears briefly. Then a horizontal bar appears across the characters in both lines of the display and sequences through each character. The annunciator lights and push-button keys light in sequence to assure that they are also in good working order.



Figure 7-76: The Display Test Page

Chapter 8

The Message Function

The Navigator keeps the pilot apprised of all critical information that relates to the current flight.

After reading this Chapter you will be able to:

- Understand the use of flashing and non-flashing indicators
- Display messages
- Enable or Disable Pop-up Messages
- Understand message priority
- Interpret Warning, Parallel Track and Advisory messages

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8.1 Accessing Messages

The Navigator uses three different annunciator lights to communicate special messages to the user:

WRN	(Warning Light)
ADV	(Advisory Light)
PTK	(Parallel Track)

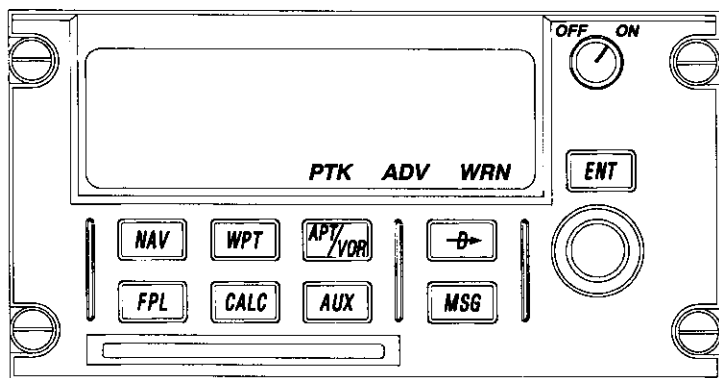


Figure 8-1: Annunciator Lights

New Warning messages (WRN) or Advisory messages (ADV) are indicated by the flashing indicators WRN and ADV. Old messages which are still relevant cause the message indicators to stay lit.

Messages are displayed in order of priority. New Warning messages have highest priority:

- New Warnings
- New Advisories
- Old Warnings
- Old Advisories
- Parallel Track Offset

If a message is waiting, the MSG key is lit. To access messages:

- Press the  key.

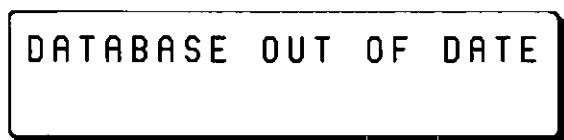


Figure 8-2: Message Display

The first message appears on the screen. If more than one message is waiting, the  key will remain lit. If this is the case, continue to press the  key and read through all waiting messages.

The message in Figure 8-2 is an Advisory message indicating that the current Jeppesen NavData Database Card is out of date.

When the MSG key is no longer lit, all messages have been viewed and the Navigator is returned to the previous mode in use.

If a message continues to be relevant, the appropriate annunciator remains lit. The message can be viewed again by pressing the MSG key.

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8.2 Message Pop-up Mode

Advisory messages may be automatically displayed as they occur, or stored in a queue to be read at the convenience of the pilot.

- *Pop-Up Messages Enabled*

Automatic Pop-up of Advisory messages is provided when "POP-UP MESSAGES:" is "ENABLED" on the applicable page in AUX-INSTALL (see Section 7.5.11). Whenever appropriate, Advisory messages will be automatically displayed, and will remain on the display until cleared by the pilot by depressing the MSG key, or replaced by a subsequent message depending on the message). If multiple messages are active, remaining messages may be retrieved by continuing to depress the MSG key.

- *Pop-up Messages Disabled*

Pop-up messages may be disabled by selecting "DISABLED" on the applicable page in AUX-INSTALL (see Section 7.5.11). When Advisory messages occur, they will be stored in a queue and the Advisory Light will begin to flash along with the MSG key. Messages will remain in the queue and accumulate, until selected for display by the pilot by depressing the MSG key.

8.3 Warning Messages

New warning messages are given highest priority and are always displayed first.

The following is a list of Warning messages and an explanation for each:

BATTERY BACK-UP FAIL

The internal battery has failed. As a result, all stored way-points and flight plans were erased. The battery should be replaced immediately.

DATABASE MISSING

The database card is missing or is not installed properly.

EXTERNAL ALTIMETER
LOST COMMUNICATION

The communication link to the altimeter has failed.

EXTERNAL ALTIMETER
IS IN ERROR

Bad data was received from the altimeter.

GPS: ANTENNA FAULT

The GPS antenna is not connected or is not functioning. Check GPS antenna voltage and current on AUX system status display.

GPS: RECEIVER FAIL

The GPS receiver is not functioning properly and requires service.

LOW VOLTAGE
INPUT VOLTAGE: 10.6V

The input voltage is below 11V or in a range between 18V and 22V.

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NO USABLE POSITION
DEAD RECKONING ON

The receivers have not located enough satellites to make a position fix. The message may also be an indication of a poor antenna connection. This Warning message is always issued when the Navigator is first turned on. If very poor signal conditions exist, the message will remain.

UNIT RESET DUE TO
LOW INPUT VOLTAGE

The input voltage was below the minimum for the Navigator to operate.

GPS: NO FIX NO
 IFR

The GPS receiver does not have a position fix; IFR operations using GPS must be terminated.

GPS: 3D/BARO NO
 IFR

The GPS receiver has lost RAIM; IFR operations using GPS must be terminated.

GPS: SATELLITE FAIL

RAIM has detected a Satellite Failure that has not been reported as Unhealthy by the satellite.

8.4 Advisory Messages

Advisory messages provide the pilot with information on a variety of topics. The following is a list of Advisory messages and an explanation for each:

8.4.1 Database Advisory Message

DATABASE OUT OF DATE

The database card contains data which may not be current.

8.4.2 Vertical Navigation Advisory Messages

BEGIN VNAV DESCENT
500 $\pm$ in 59 SECONDS

VNAV has been enabled. The pilot will receive a 60 second warning before reaching the point at which the altitude change should begin.

BEGIN VNAV DESCENT
to 20 $\pm$ at 500 $\pm$ NOW

VNAV has been enabled and the aircraft *should* be at the point to begin the altitude change.

PREPARE TO LEVEL
OFF in 29 SECONDS

VNAV is nearing completion. The pilot will receive a 30 second warning before reaching the point at which VNAV should end.

VNAV COMPLETED
LEVEL OFF AT 20 $\pm$

The final VNAV advisory. The final altitude point has been reached. This is an indication that the aircraft should have reached the desired altitude by this point. It does not indicate the aircraft has actually reached the desired altitude.

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8.4.3 *Flight Plan Advisory Messages*

TURN TO 320°
in 0:59

The Turn Anticipation display will continuously update to keep the pilot apprised of the approaching turn. Once this message is displayed, the ADV annunciator light remains lit until display timer reaches zero.

MAKE 2-MINUTE TURN
TO 320° NOW

If the turn angle is less than 90°, the ADV light will begin to

flash. Press the **MSG** key to view this display which will direct the pilot to make the turn.

MAKE IMMEDIATE TURN
TO 320°

If the turn angle is greater than 90°, the ADV light will begin to

flash. Press the **MSG** key to view this display which will direct the pilot to make the turn.

ARRIVAL AT PA00n
WITHIN 59 SECONDS

When approaching final destination, the pilot receives a 60 second countdown advisory.

8.4.4 Parallel Track Advisory Messages

PARALLEL TRACK (PTK)

If a parallel track offset has been set and is still in effect, the PTK indicator will remain lit.

PARALLEL OFFSET
1000M RIGHT

If a parallel offset has been previously set and is still in effect, the PTK indicator remains lit. Press the  key to display the offset that has been selected.

PARALLEL OFFSET
CANCELED

Parallel offset is canceled when the course to destination differs from the desired track by 45° or more, or when the one minute to arrival message is displayed.

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8.4.5 Fuel Management Advisory Messages

When the fuel on board is not zero, the following messages may appear.

CAUTION: USING FUEL
RESERVE TO PROA

If the amount of time remaining at current fuel flow rate is less than the time to reach the destination plus 45 minutes, this advisory will appear. Once this message is displayed, it will remain until the Fuel Remaining is zero or the time remaining exceeds the time to destination plus 59 minutes.

CAUTION: NOT ENOUGH
FUEL TO REACH PROA

The calculated fuel to reach the destination on the Fuel Management Page is more than the fuel remaining on the Fuel Remaining Page. Once this message is displayed, it will remain until the Fuel Remaining is zero or the time remaining on the Fuel at Arrival page exceeds 15 minutes.

CAUTION: EXHAUSTED
FUEL WITHIN 0:29

The flight time remaining on the Fuel Remaining page is less than 30 minutes. Once displayed, the message will remain and will count down time to fuel exhaustion until the Fuel Remaining is zero or the time to fuel exhaustion exceeds 59 minutes, due to reduced power setting.

8.4.6 AIRWATCH™ Advisory Messages

When AIRWATCH is enabled, the Navigator generates three different advisories regarding controlled and restricted airspace. Examples of each are shown below:

INSIDE
SAN FRANCISCO C15B

The pilot is within the San Francisco Class B.

CONTACT BAY APP
ON 120.9

Contact Bay approach on frequency 120.9.

CLOSE
R 2533 RESTRICTED

The pilot is within 10 nautical miles of the R 2533 restricted airspace. There is no contact agency or frequency.

IN PATH
SANTA BARBARA C15C

The pilot will enter the Santa Barbara Class C in approximately 10 minutes on present track and speed.

CONTACT SANTA BARBAR
ON 125.4

Contact Santa Barbara approach on frequency 125.4.

Appendix A

Reference

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A.1 State and Province Codes

The following codes are used to identify States and Provinces in the Jeppesen North American NavData database listed in alphabetical order by identifier.

State or Province	Code	State or Province	Code
ALBERTA	AB	JAMAICA	JAM
ANGUILLA	AIA	JOHNSTON IS	JTN
ALABAMA	AL	ST KITTS	KNA
ALASKA	AK	KANSAS	KS
ARUBA	ANT	KENTUCKY	KY
ARKANSAS	AR	LOUISIANA	LA
ANTIGUA	ATG	ST LUCIA	LCA
ARIZONA	AZ	MASSACHUSETTS	MA
BRITISH COLUMBIA	BC	MANITOBA	MB
BAHAMAS	BHS	MARYLAND	MD
BELIZE	BLZ	MAINE	ME
BERMUDA	BMU	MEXICO	MEX
BARBADOS	BRB	MICHIGAN	MI
CALIFORNIA	CA	MINNESOTA	MN
CANADA	CAN	MISSOURI	MO
COLORADO	CO	MISSISSIPPI	MS
COLOMBIA	COL	MONTSERRAT IS	MSR
COSTA RICA	CRI	MONTANA	MT
CONNECTICUT	CT	MARTINIQUE	MTQ
CUBA	CUB	NEW BRUNSWICK	NB
CAYMAN ISLANDS	CYN	NORTH CAROLINA	NC
DISTRICT OF COLUMBIA	DC	NORTH DAKOTA	ND
DELAWARE	DE	NEBRASKA	NE
DOMINICA	DMA	NEWFOUNDLAND	NF
DOMINICAN REPUBLIC	DOM	NEW HAMPSHIRE	NH
FLORIDA	FL	NICARAGUA	NIC
GEORGIA	GA	NEW JERSEY	NJ
GUADELOUPE	GLP	NEW MEXICO	NM
GRENADA	GRD	NOVA SCOTIA	NS
GUATEMALA	GTM	NEVADA	NV
HAWAII	HI	NORTHWEST TERRITORIES	NW
HONDURAS	HND	NEW YORK	NY
HAITI	HTI	OHIO	OH
IOWA	IA	OKLAHOMA	OK
IDAHO	ID	ONTARIO	ON
ILLINOIS	IL	OREGON	OR
INDIANA	IN	PENNSYLVANIA	PA

State or Province	Code
PANAMA	PAN
PRINCE EDWARD IS	PE
QUEBEC	PQ
PUERTO RICO	PRI
RHODE ISLAND	RI
RUSSIA	RUS
SOUTH CAROLINA	SC
SOUTH DAKOTA	SD
EL SALVADOR	SLV
SASKATCHEWAN	SK
MIQUELON IS	SPM
CAICOS IS	TCA
TURKS IS	TCA
TENNESSEE	TN
TOBAGO	TTO
TEXAS	TX
UNITED STATES	USA
UTAH	UT
VIRGINIA	VA
ST VINCENT	VCA
BRITISH VIRGIN IS	VGB
VIRGIN IS	VIR
VERMONT	VT
WASHINGTON	WA
WISCONSIN	WI
WEST VIRGINIA	WV
WYOMING	WY
YUKON TERRITORY	YK

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A.2 Country Codes

The following codes are used to identify Countries in the Jeppesen International NavData database.

Country	Code	Country	Code
AFGANISTAN	AFG	ALGERIA	DZA
ANGOLA	AGO	ECUADOR	ECU
ALBANIA	ALB	EGYPT	EGY
UNTD ARAB EMIRATES	ARE	CANARY IS	ESP
ARGENTINA	ARG	MELILLA	ESP
ARMENIA	ARM	SPAIN	ESP
AMERICAN SAMOA	ASM	ESTONIA	EST
ANTARCTICA	AUS	ETHIOPIA	ETH
AUSTRALIA	AUS	FINLAND	FIN
AUSTRIA	AUT	FIJI IS	FJI
AZERBAIJAN	AZE	FALKLAND IS	FLK
BURUNDI	BDI	FRANCE	FRA
BELGIUM	BEL	FAERO IS	FRO
BENIN	BEN	CAROLINE IS	FSM
BURKINA FASO	BFA	MICRONESIA	FSM
BANGLADESH	BGD	PALAU	FSM
BULGARIA	BGR	GABON	GAB
BAHRAIN	BHR	UNITED KINGDOM	GBR
BELORUSSIA	BLR	GEORGIA	GEO
BOLIVIA	BOL	GHANA	GHA
BRAZIL	BRA	GIBRALTAR	GIB
BRUNEI	BRN	GUINEA REP	GIN
BHUTAN	BTN	GAMBIA	GMB
BOTSWANA	BWA	GUINEA-BISSAU	GNB
CENTRAL AFRICAN REP	CAF	EQUATORIAL GUINEA	GNQ
SWITZERLAND	CHE	GREECE	GRC
CHILE	CHL	GREENLAND	GRL
CHINA, PR OF	CHN	FRENCH GUIANA	GUF
IVORY COAST	CIV	GUAM	GUM
CAMEROON	CMR	MARIANA IS	GUM
CONGO	COG	HAWAII	HI
COOK IS	COK	HONG KONG	HKG
COLOMBIA	COL	CROATIA	HRV
COMOROS	COM	HUNGARY	HUN
CAPE VERDE	CPV	INDONESIA	IDN
CYPRUS	CYP	INDIA	IND
CZECH	CZE	CHAGOS ARCH	IOT
GERMANY	DEU	IRELAND	IRL
DJIBOUTI	DJI	IRAN	IRN
DENMARK	DNK	IRAQ	IRQ
FAROE IS	DNK	ICELAND	ISL

Country Codes

Country	Code	Country	Code
ISRAEL	ISR	NAURU	NRU
ITALY	ITA	NEW ZEALAND	NZL
JORDAN	JOR	OMAN	OMN
JAPAN	JPN	PAKISTAN	PAK
JOHNSTON I	JTN	PERU	PER
KAZAKHSTAN	KAZ	PHILLIPINES	PHL
KENYA	KEN	PAPUA NEW GUINEA	PNG
KYRGYZSTAN	KGZ	POLAND	POL
KAMPUCHEA	KHM	KOREA, DPR OF	PRK
KIRIBATI	KIR	PORTUGAL	PRT
KOREA	KOR	PARAGUAY	PRY
KUWAIT	KWT	FRENCH POLYNESIA	PYF
LAOS	LAO	QATAR	QAT
LEBANON	LBN	REUNION	REU
LIBERIA	LBR	ROMANIA	ROM
LIBYA, SPA JAMAH.	LBY	RUSSIA	RUS
SRI LANKA	LKA	RWANDA	RWA
LESOTHO	LSO	SAUDI ARABIA	SAU
LITHUANIA	LTU	SUDAN	SDN
LUXEMBOURG	LUX	SENEGAL	SEN
LATVIA	LVA	SINGAPORE	SGP
MOROCCO	MAR	ASCENSION	SHN
MOLDOVA	MDA	ST HELENA	SHN
MALDIVES	MDV	SOLOMON IS	SLB
MARSHALL IS	MHL	SIERRA LEONE	SLE
MIDWAY I	MID	SOMALIA	SOM
MALI	MLI	SAO TOME & PRINCIPE	STP
MALTA	MLT	SURINAME	SUR
UNION OF MYANMAR	MMR	SLOVAKIA	SVK
MONGOLIA	MNG	SLOVENIA	SVN
MARIANA IS	MNP	SWAZILAND	SWZ
MOZAMBIQUE	MOZ	SWEDEN	SWE
MAURITANIA	MRT	SEYCHELLES	SYC
MAURITIUS	MUS	SYRIA	SYR
MALAWI	MWI	CHAD	TCD
MALAYSIA	MYS	TOGO	TGO
MAYOTTE	MYT	THAILAND	THA
NEW CALEDONIA	NCL	TAJIKISTAN	TJK
NIGER	NER	TURKMENISTAN	TKM
NIGERIA	NGA	TONGA	TON
NIUE	NIU	TUNISIA	TUN
NETHERLANDS	NLD	TURKEY	TUR
NORWAY	NOR	TUVALU	TUV
NEPAL	NPL	TAIWAN	TWN
		TANZANIA	TZA

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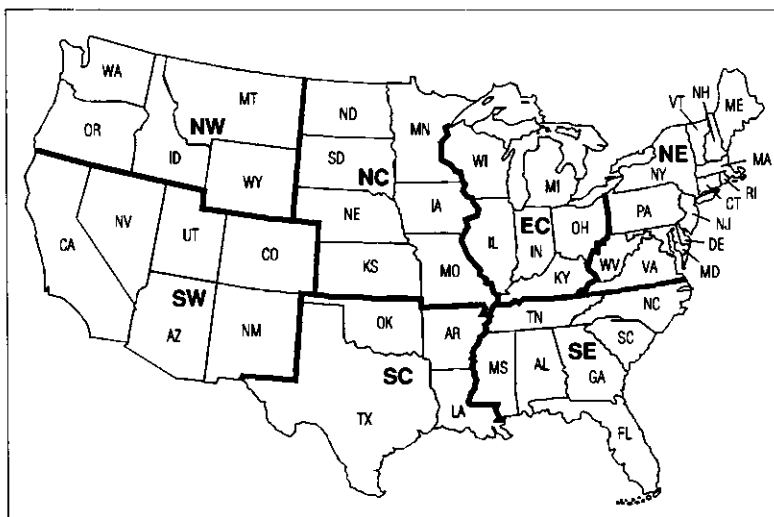
Country Codes

Country	Code
UGANDA	UGA
UKRAINE	UKR
URUGUAY	URY
UNITED STATES	USA
UZBEKISTAN	UZB
VENEZUELA	VEN
VIETNAM	VNM
VANUATU	VUT
FUTUNA IS	WLF
WESTERN SAMOA	WSM
ARMENIA	XJA
KYRGYZSTAN	XJI
AZERBAIJAN	XJJ
KAZAKHSTAN	XJK
MOLDOVA	XJO
RUSSIA	XJR
TAJIKISTAN	XJT
WAKE I	XJW
YEMEN ARAB REP	YEM
YUGOSLAVIA	YUG
BOPHUTHATSWANA	ZAF
CISKEI	ZAF
NAMIBIA	ZAF
SOUTH AFRICAN REP	ZAF
SOUTHWEST AFRICA	ZAF
TRANSKEI	ZAF
VENDA	ZAF
ZAIRE	ZAR
ZAMBIA	ZMB
ZIMBABWE	ZWE

A.3 ARINC Maps

A.3.1 United States

5.0 RNAV DATA - FIELD DEFINITIONS
7 SUBDIVISIONS FOR UNITED STATES



REVISED: January 31, 1986

Figure A-1: ARINC Map (United States)

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A.3.2 Standard ARINC Geographic Coverages

Refer to Figure A-2 for the standard ARINC geographic coverages.

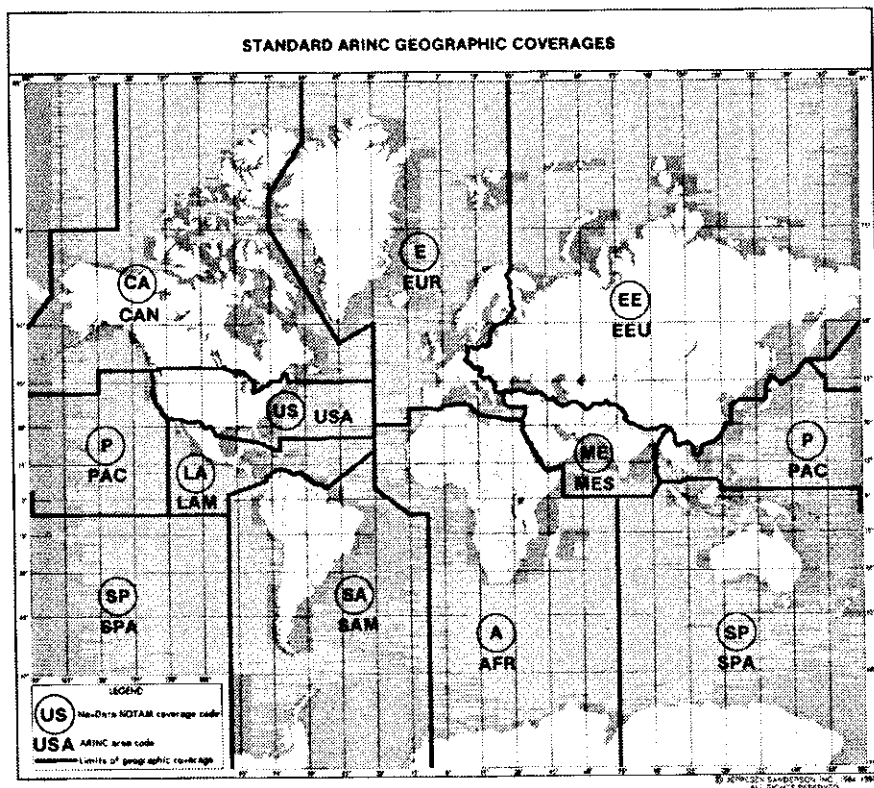


Figure A-2: Standard ARINC Geographic Coverages

A.4 GPS Status Messages

GPS Status Messages include the following:

- GPS: ANTENNA FAULT
The GPS antenna is not connected or is not operating properly.
- GPS: NO GPS TIME
Satellite signal levels are too low to receive.
- GPS: NO SV AVAILABLE
No satellites are in view at this time.
- GPS: NO USABLE SVs
Tracking at least one SV. Time is being obtained.
- GPS: NOT AVAILABLE
GPS sensor has failed.
- GPS: ONLY *n* USABLE SV
Tracking 1 or 2 SVs. Need 3 for position fix.
- GPS: PDOP TOO HIGH
Tracking at least three SVs, but geometry is bad.
- GPS: RECEIVER FAIL
The GPS receiver is not functioning correctly and requires service.
- GPS: USING *n* SV 2-D
Tracking 3 or more SVs. Computing a 2-D position.
- GPS: USING 4 SV 3-D
Tracking 4 or more SVs. Computing a 3-D position.

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A.5 Changing NavData Cards During Flight

It is possible to change the NavData card during flight without disturbing the active flight plan.

It is necessary to accomplish this if flying between international boundaries.

Perform the following steps to change the NavData card:

1. Power down the Navigator.
2. Remove the NavData card currently being used.
3. Insert the desired NavData card.
4. Power up the Navigator.

The Navigator resumes executing the active flight plan after being powered back on.

The Domestic and International NavData cards have few overlapping waypoints (except Hawaii). When crossing international boundaries, we recommend making two separate flight plans, one for each card. Fly the flight plan of the card currently being used. When it becomes necessary to change cards, activate the second flight plan to continue on the next leg.

NOTES

NOTES

Appendix B

The GPS System: How It Works

GPS (Global Positioning System) is a navigation system based on a constellation of 24 satellites orbiting the earth at very high altitude. This system was established and is maintained by the U.S. 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 that 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.

If we also know that 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 B-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.

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

$$\text{Distance} = \text{Velocity} \times \text{Time}$$

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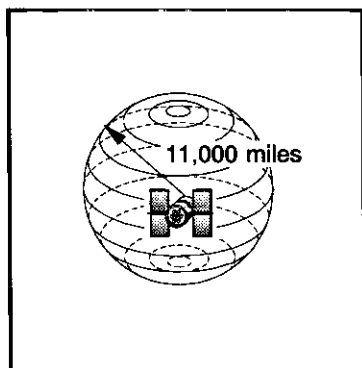


Figure B-1

Figure B-2

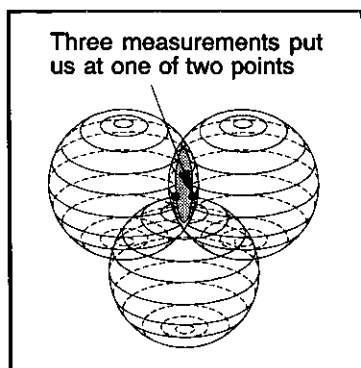
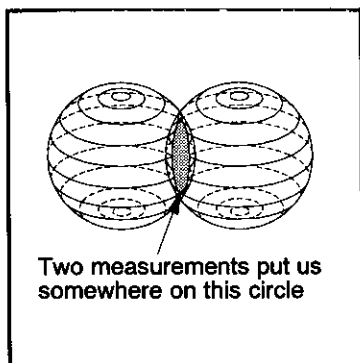


Figure B-3

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 is in fact, carefully determined. Since the code appears to be random, it is often referred to as “pseudo-random 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.

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Consider the example in Figure B-4. Suppose our receiver's clock is consistent, but is 1 second slow. And, let's say that 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.

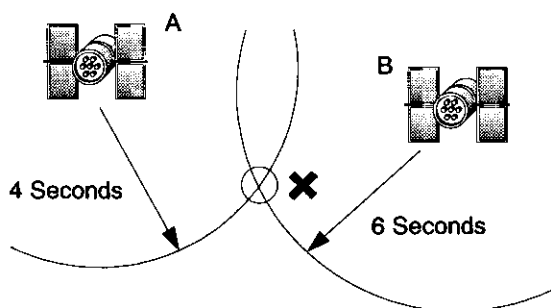


Figure B-4

But, our imperfect receiver would think the signal from satellite A took 5 seconds to reach us, and that 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 B-5 we can see that the three solid lines intersect at our true location.

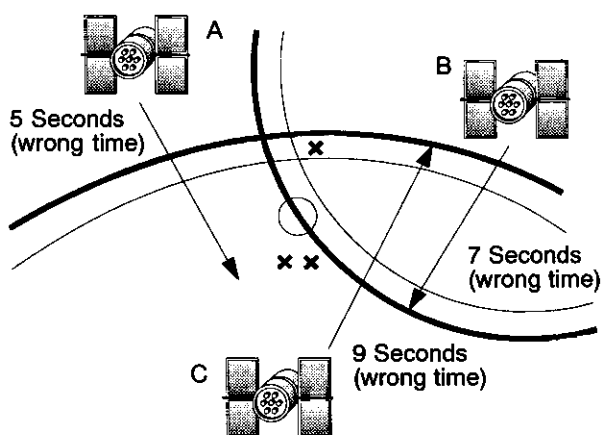


Figure B-5

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 that 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. Until all 24 satellites are in place, there may be times when fewer than four satellites are available overhead. During these times, altitude from an encoder 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, 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 that the 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 (30m); in a worst case, no more than 200 feet (70m).

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

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

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A sophisticated form of GPS, differential GPS, allows precise measurements down to a centimeter ($1'' = 2.54 \text{ cm}$). Such ultra-precise measurements are based on at least fifteen 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.

Here is a quick summary of the types of GPS receivers available:

Single-channel receivers

These collect satellite data through a single channel, which moves from one satellite to the next. Their power consumption and price are the lowest of any type of GPS receiver. Some are battery-powered and portable. The process of sequencing, or moving between satellites, can interrupt positioning and will limit overall accuracy. They are not designed for aircraft navigation. Fast-multiplexing single-channel receivers move very quickly between satellites and can function continuously, but cost as much as a two-channel receiver.

Multi-Channel Sequencing Receivers

These use one channel to continuously monitor position data and the other channels to track and lock onto the next satellites. These systems can provide continuous navigation functions and have much better signal-to-noise ratio than single-channel systems. They usually cost more and use more power than single-channel systems.

Continuous receivers

These come in configurations of from four to twelve channels. They can give instantaneous position and velocity readings and can eliminate the GDOP problem by tracking more than four satellites. They are used in applications that are highly dynamic or require high accuracy, such as surveying and scientific work. Their size, cost, and power consumption are the highest of any GPS System. A six channel GPS receiver is used in the Navigator.

B.1 GPS Information Center

Precise Worldwide Position, Velocity, and Time

GPS is providing over 22 hours of highly accurate data daily. When fully operational, GPS will enable 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 will ultimately contain 21 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 U.S. and allied military forces, the unprecedented accuracies 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 sizeable margin.

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Civil GPS Information Center

In order to accommodate the needs of the large worldwide civil GPS user community, the U.S. Government has established GPS Information Center (GPSIC). Operated and maintained by the United States Coast Guard for the Department of Transportation, the primary functions 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 addition 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.

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

Commanding Officer
U.S. Coast Guard ONSCEN
7323 Telegraph Road
Alexandria, Va 22310-3998
(703) 866-3806

Other Information Sources

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

- WWV/WWVH HF 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 is 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 U.S. 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 TRIMBLE NAVIGATOR

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

U.S. Department of Transportation
Research and Special Programs Administration
400 7th Street, S.W., Room 9402
Washington, DC 20590-0001
Phone: (202) 366-4355
Fax: (202) 366-3272

Commandant (G-NRN)
U.S. Coast Guard
2100 Second Street, S.W.
Washington, DC 20593-0001
Phone: (202) 267-0283
Fax: (202) 267-4427

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

Appendix C

Flying with the Autopilot

C.1 Considerations for Autopilot Interfacing

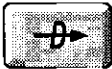
All of the common autopilots installed in the general aviation fleet were designed to be coupled to VOR CDIs. One of the problems that autopilot manufacturers have been faced with is how to track a VOR radial (which is your desired course) when the CDI sensitivity changes as a function of distance to the VOR station. Common problems with autopilots coupled to VORs include sluggish tracking (drifting off course), or zig-zagging across the desired course, often referred to as “scalloping”. Most autopilots are designed to provide optimal tracking performance about 15 miles from a VOR, which is equivalent to CDI sensitivity of 1/4 nm per dot. The sensitivity increases as you approach the station and decreases as you leave the station.

One of the benefits of long range navigation equipment, such as the Navigator, is that CDI sensitivity remains fixed, regardless of your distance from a waypoint. With the external CDI sensitivity (setup mode) set for 1/4 nm per dot, the Navigator is providing optimal CDI inputs to your autopilot.

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C.2 Suggested Autopilot Flying Technique

By following this procedure, the pilot establishes the aircraft on the desired course prior to engaging the autopilot, and will provide satisfactory autopilot tracking performance with most general aviation autopilots.

1. On the Navigator, select the desired waypoint. Note the bearing to the waypoint, which immediately follows the waypoint identifier. Turn the OBS on the external CDI or HSI that is coupled to the Navigator to the bearing to waypoint.
2. Turn the aircraft to a heading that corresponds to the bearing to waypoint.
3. Once the aircraft is established on the proper heading, press the  key twice to enter the NAV mode. The Navigator is now providing cross-track corrections for the desired waypoint.
4. Couple the autopilot to the Navigator, using the proper procedures as established by the autopilot manufacturer.

NOTE:

If you are flying a multi-leg flight plan with heading changes in excess of 15 degrees, it is recommended that the autopilot be disengaged and "hand-flown" through the heading changes. Once the aircraft is established on the new heading, the autopilot can be re-engaged.

Appendix D

Operational Summary

The Operation Summary depicts the major functions and data pages of the Navigator and how to access them.

The Operation Summary organizes the Navigator's functions in the form of a chart that indicates which steps to take to activate a particular function or display a particular data page.

Each function category is listed under its appropriate Mode key symbol. Functions and data pages belonging to that category are listed under that category name. If a mode has more than one function category, then the Mode key appears more than once.

For example, the AUX mode has several function categories (such as * SETUP * and * INSTALL *), so the AUX Mode key symbol appears several times.

Functions and data pages may have sub-functions or secondary data pages; these are indented on the chart under the related primary function or data page.

For example, to set the Position Display to Lat/Long, do the following:

- Press the  key until the * AUX-INSTALL * function category is displayed.
- Rotate the small, inner selector knob until the "Select User Units" function is displayed.
- Rotate the large, outer selector knob until the "Position Display" sub-function is displayed.

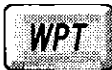
THE TRIMBLE NAVIGATOR

- Press the  key to begin editing.
- Rotate the small, inner selector knob to choose "Lat/Long".
- Press the  key to complete the input.

The Operation Summary uses the following symbols:

- ⊙ = Small, inner selector knob
- = Large, outer selector knob

Shaded text portions within the chart indicate LORAN-only operations.

 <i>(Top line display)</i> ⊙ WPT Course & Distance ⊙ ETE & ETA ⊙ TRK & Maintain Odd or Even ⊙ DTK, TRK & Distance ⊙ Internal CDI ⊙ MSA & MESA <i>(Bottom line display)</i> ● Internal CDI ● TRK & Maintain Odd or Even ● MSA & MESA ● ETE & ETA ● DTK, TRK & Distance ● WPT Course & Distance  <i>Destination Waypoint is displayed.</i> ⊙ Scan Waypoints of Active Flight Plans ● WPT Information	 <i>* AIRPORT *</i> ⊙ Scan Airports ● Airport Information  <i>* VOR *</i> ⊙ Scan VORs ● VOR Information  <i>* NDB *</i> ⊙ Scan NDBs ● NDB Information  <i>* INTERSECTION *</i> ⊙ Scan Intersections ● Intersection Information
--	--

WPT * USER * ● Scan User ● Edit User ● Erase User ● Add WPT ● Name WPT ● Save Using Latitude/Longitude ● Save Using WPT plus RNG & BRG ENT User WPT saved	CALC (Top line display) Vertical NAV OFF/ON with Descent (Bottom line display) Rate & Distance from WPT ● FPL, GS, ETE, Distance & ETA ● Fuel - QTY, Flow & Economy ● Fuel Remaining & Range ● Fuel at Arrival & Reserve ● Total Fuel Used ● Pressure ALT, Barometer & Indicated ALT ● Density ALT, OAT & Pressure ALT ● TAS, TAT, IAS & OAT ● Wind - Direction, SPD, TAS & HDG ● Crosswind, Headwind, Runway Wind Info
FPL Primary Flight Plan Page ● Select Flight Plan → ← To Activate ● Display Leg(s) Waypoints ● Cancel Active Flight Plan ● Reverse Flight Plan (Inactive only) ● Edit Flight Plan (Active or Inactive) ● Select Edit Point ● Select Add or Delete ADD: WPT , ● To Select Waypoint FPL DELETE: FPL ● Erase Flight Plan (Active or Inactive) ● Edit New Flight Plan (See "Edit Flight Plan") FPL Secondary Flight Plan Page ● Display Leg BRG, Range, & ETE	APT/VOR (Nearest 20 Airports) * NEAREST AIRPORT * ● Airport Information ● View Next Nearest Airport APT/VOR (Nearest 20 VORs) * NEAREST VOR * ● VOR Information ● View Next Nearest VOR APT/VOR * NEAREST AGENCY * ● View Next Nearest Agency APT/VOR * NEAREST NDB * ● NDB Information ● View Next Nearest NDB

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* NEAREST INTERSECTION * - Intersection Information - View Next Nearest Intersection * NEAREST USER * - User WPT Information - View Next Nearest User	DELETE: Current List   Confirm Delete EDIT: Current List - Edit List Title - Select Item - Edit, Delete, Insert Item * SYSTEM STATUS * Date & Time
<i>(Indicates Course & Direct To WPT) (Can also be selected from WPT or APT/VOR Database)</i> - Changes Course - View - Fly Course/Track - Changes Track <i>(Activates the Direct To function)</i>	- Present Position - Altitude & Source - Pressure ALT & GPS ALT - Input Voltage & Internal Temp - Crystal Offset - GPS Antenna - Current & Voltage - Database Card Expiration - Software Revision Release Codes - Software Code
<i>(Views all Messages & Advisories)</i>	
* CHECKLIST * - Select List (if any) - Select EDIT, DELETE, INSERT, Display Items of Current List ( to check off) INSERT: New List before Current List or - INSERT: New List at end - Name New List - Name New Items (any Mode key to end)	* SENSOR STATUS * <i>(Top/Bottom line display)</i> GPS: (Status) & AUTO (Sensor Select Mode) <i>(Bottom/Top line display)</i> LORAN: (Status)  - Auto or Manual - Select LORAN - Manual - Select GPS - Auto - Manual or Auto - Est Accuracy GPS & LORAN - GPS & LORAN Difference - GPS SVs in use with PDOP - GPS SVs Currently Tracking - View all GPS SVs with Signal Quality - Reset GPS Sensor

AUX*** SENSOR STATUS ****(continued)*

- LORAN: (Status), Noise & GDOP
 - View LORAN Chains & Status
 - Reset LORAN Sensor
- LORAN Mode Select
 - ENT** ● Select Cross-Chain or Specific LORAN Chain
- GPS Availability & Coverage

AUX*** SETUP *****Search Regions**

- ENT** ● To Select Region or State
- AIRWATCH™
 - ENT** ● OFF, ON or Select
- Parallel Offset
 - ENT** ● nm LEFT or RIGHT
- Internal CDI Adjust
 - ENT** ● 1 Dot = 1, 1/2, 1/4, 1/8, 1/16 or 1/32 nm
- External CDI Adjust
 - ENT** ● 1 Dot = 1 or 1/4 nm
- Magnetic Variation
 - ENT** ● Auto or Manual Select
- Dead Reckoning - OFF or ON
 - ENT** For Demo Mode (GPS & LORAN Antennas must be disconnected)

AUX*** INSTALL ***

SAFEGUARD™ & Status [applies only to TNL 2000T & TNL 3000T systems]

- ENT** ● Enable or Disable (Guard must indicate OK)
- Select User Units
 - Position Display
 - ENT** ● Lat/Long, MGRS or UTM
 - Position Datum
 - ENT** ● Select 1 of 130
 - Distance Display
 - ENT** ● Kilometers, NM or Statute miles
 - Speed Display
 - ENT** ● KPH, Knots or MPH
 - Altitude Display
 - ENT** ● Feet or Meters
 - Barometric Set in
 - ENT** ● Inches or Millibars
 - Fuel Computations
 - ENT** ● Gals, Imperial Gals, Kilograms [AV-Gas, Jet-A or JP-4], Liters, Pounds [AV-Gas, Jet-A or JP-4]
- New Personal Message
 - Input current code
 - Changes top, bottom lines
- Personal Access Code [applies only to TNL 2000T & TNL 3000T systems]
 - ENT** ● Input old code
 - ENT** ● Input new code
- ETA Display Time
 - ENT** ● Local or Zulu
- Set Display Intensity
 - ENT** ● For Backlight
 - For Night Level

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AUX

* INSTALL *

(Continued)

● Set Audio Level

ENT

- For Volume
- For Frequency

● Check CDI Annunciators

ENT

- Set CDI Centered

ENT

- Set CDI Full Left

ENT

- Test CDI: 5L to 5R

ENT

- From Flag
- To Flag
- OFF
- NAV not Visible
- GS not Visible
- WPT Annunciator
- ADV Annunciator
- WRN Annunciator
- APR Annunciator

● Load/Save RAM Card

- Save Configuration
- Load Configuration

● Load/Save Via Serial

- Save Configuration
- Load Configuration

● Serial-1 In

ENT

- None
- Encoder
- RMI

● Serial-1 Out

ENT

- None
- K0 & Rate
- K1 & Rate
- R0 & Rate
- R1 & Rate
- X0 & Rate
- X1 & Rate
- ARGUS & Rate

● Serial-1 I/O

● Serial-2 In

ENT

- None
- Encoder
- RMI

● Serial-2 Out

ENT

- None
- K0 & Rate
- K1 & Rate
- R0 & Rate
- R1 & Rate
- X0 & Rate
- X1 & Rate
- ARGUS & Rate

● Serial-2 I/O

● LORAN Antenna: (Mount) (Antenna Type)

ENT

- Top or Bottom Mount
- Moves cursor to bottom line
- Straight Whip, Bent Whip or Blade Antenna

● LORAN OFFSETS: AUTO (have LORAN IFR) or MANUAL

ENT

- Select AUTO or MANUAL
- Moves cursor to bottom line
- ECD 9.9 to -9.9 & GAIN 99 to -99

● GPS Antenna Height/ OAT "K" Factor

ENT

- GPS Antenna Height 0-99 (Top)
- OAT "K" Factor 0-9.9 (Bottom)

● Pop-up Messages

ENT

- Enable or Disable

● Display Diagnostic (Self-test - LEDs & Panel Lights)

Glossary of Terms

absolute altitude

Actual altitude above the surface of the earth.

auto fix

The ability of a GPS receiver to start position calculations without being given an approximate location and approximate time.

AUX (auxiliary mode)

AUX mode contains the functions not used directly for navigation, but as a supplementary to navigation functions.

barometric altitude

Altitude above the surface of the earth as measured by barometric pressure; a relative measure of altitude.

bandwidth

The range of consecutive frequencies comprising a signal.

C/A code

The standard (Clear / Acquisition) GPS code: a sequence of 1023 pseudo-random, binary, biphasic modulations on the GPS carrier at a chip rate of 1.023 MHz. Also known as the "civilian code."

carrier-aided tracking

A signal processing strategy that uses the GPS carrier signal to aid the code loop tracking.

carrier frequency

The frequency of the unmodulated fundamental output of a radio transmitter.

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CDI

Course Deviation Indicator; a visual display of distance offset from the desired course.

channel

A channel of a GPS receiver, consisting of the circuitry necessary to track the signal from a single GPS satellite.

clock bias

The difference between the clock's indicated time and true universal time.

continuous receiver

A GPS receiver which has from five to twelve channels used in environments that are highly dynamic or require high accuracy.

control segment

A worldwide network of GPS monitoring and control stations that ensure the accuracy of satellite positions and their clocks.

cross-track error

A measure of the distance of an aircraft from its desired track; usually in nautical miles.

data message

A 1500-bit message included in the GPS signal that reports the satellite's location, clock corrections, and condition. Included is rough information on the other satellites in the constellation.

datum

A mathematical model (ellipsoid or spheroid) which best represents all or one area of the Earth's surface.

desired track

The desired track between current position and the selected destination. Aircraft HSI's OBS (OMNI bearing selector) or HDG bug should be set to match the desired track.

differential positioning

Precise measurement of the relative positions of two receivers tracking the same GPS signals.

Dilution of Precision

The multiplicative factor that modifies range error. It is caused solely by the geometry between the user and the set of satellites used. Known as DOP, GDOP or PDOP.

Doppler-aided

A signal processing strategy that uses a measured Doppler shift to help the receiver smoothly track the GPS signal. Allows more precise velocity and position measurement.

Doppler shift

The apparent change in the frequency of a signal caused by the relative motion of the transmitter and receiver. Doppler shift measurements provide extremely accurate velocity measurements.

ephemeris data

Predictions of current satellite positions that are transmitted to the user in the data message.

field

A part of the Navigator's LED display that contains one discrete piece of information; for example, one letter of an identifier, or the bearing to a waypoint.

frequency band

A particular range of frequencies.

frequency spectrum

The distribution of signal amplitudes as a function of frequency.

function keys

The Navigator's -D> (DIRECT), ENT, and MSG keys.

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geometric dilution of precision

See Dilution of Precision.

GPS

Global Positioning System; a satellite-based navigation system.

great circle

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

ICAO

International Civil Aviation Organization; assigns identifiers to waypoints throughout the world. The Trimble Navigation System uses these identifiers for international waypoints; it uses FAA identifiers for waypoints in the continental U.S.

identifier

The FAA code or ICAO code that identifies an Airport, VOR, NDB, or Intersection.

ING

Irish National Grid

intersection

The crossing of two VOR radials or victor airways.

ionosphere

The band of charged particles 80-120 miles above the earth's surface.

ionospheric refraction

The change in the propagation speed of a signal as it passes through the ionosphere.

L-band

The group of radio frequencies extending from 390 MHz to 1550 MHz. The GPS carrier frequencies (1227.6 MHz and 1575.42 MHz) are in the L-band and/or UHF frequency band.

LAT/LON

Latitude/Longitude

LED

Light Emitting Diode, used in the Navigator's display.

LSEA

Lowest Safe Enroute Altitude.

MEA

Minimum Enroute Altitude.

MESA

Minimum Enroute Safe Altitude to destination waypoint, allowing 1000 feet of clearance over the highest terrain.

MGRS

Military Grid Reference System

mode keys

The NAV, WPT, FPL, CALC, AUX, and APT/VOR keys on the Navigator, which determine the mode in which it is operating.

MSA

Minimum Safe Altitude calculated for present position, allowing 1000 feet over highest terrain and obstacles in current geographic sector.

multi-channel receiver

A GPS receiver that can simultaneously track more than one satellite signal.

multiplexing channel

A channel of a GPS receiver that can quickly sequence through a number of satellite signals.

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NDB

Non-Directional Beacon.

OSGB

Ordnance Survey of Great Britain.

P-code

The Precise or Protected code. A very long sequence of pseudo-random binary biphasic modulations on the GPS carrier at a chip rate of 10.23 MHz, which repeats about every 267 days. Each one-week segment of this code is unique to one GPS satellite and is reset each week.

PDOP

See Dilution of Precision (DOP).

pseudo-random code

A signal with random-noise-like properties. It is a very complicated, repeating pattern of 1s and 0s.

pseudo-range

A distance measurement based on the correlation of a satellite-transmitted code and the local receiver's reference code, not corrected for errors in synchronization between the transmitter's clock and the receiver's clock.

RAIM

RAIM Receiver Autonomous Integrity Monitoring.

satellite constellation

The arrangement in space of a set of satellites. The GPS constellation consists of 24 satellites in 6 orbital planes.

scroll

To move (characters) to the left across the LED display in order to show more information.

sequencing receiver

A receiver of less than four channels that collects GPS data by switching from one satellite to the next in sequence.

space segment

The part of the whole GPS system that is in space (i.e., the satellites).

spread spectrum

A system in which the transmitted signal is spread over a frequency band much wider than the minimum bandwidth needed to transmit the information. This is done by modulating with a pseudo-random code (for GPS).

static positioning

Location determination when the receiver's antenna is presumed to be stationary in the earth. This allows the use of various averaging techniques that improve accuracy by factors of over 1000.

TK

Track, the actual magnetic course.

true altitude

Altitude above mean sea level.

UPS

Universal Polar Stereographic.

user interface

The way a receiver conveys information to the person using it; the controls and displays.

user segment

The part of the whole GPS system that includes the receivers of GPS signals.

UTC

Coordinated Universal Time.

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UTM

Universal Transverse Mercator.

VNAV

Vertical Navigation; the ability to establish a vertical descent profile. The Navigator provides for a VNAV calculation and provides vertical guidance information to the pilot.

VOR

Very High-Frequency Omnidirectional Range transmitter used for aircraft navigation.

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