SYNTHETIC VISION EFIS

CHELTON
FLIGHT SYSTEMS

FLIGHTLOGIC

# Pilot's Guide & Reference

Software Version 4.0J

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# FlightLogic EFIS
## Synthetic Vision Flight Display

# Pilot's Operating Guide and Reference

Document 150-045240, Rev D.

**EFIS Software Version J Only**

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# Section 1
# Introduction

## Welcome

Congratulations on your acquisition of a Chelton Flight Systems FlightLogic EFIS (Electronic Flight Instrument System).

In the last two decades, aviation has become more and more complex; as a result, cockpit resources have followed the commercial carriers' trend toward **"automation-centered"** systems. These sophisticated systems minimize pilot involvement and automate control of the aircraft and its systems to the greatest extent possible, thereby relegating the pilot to the role of manager and emergency backup. Examples are Flight Directors and Fly-By-Wire systems.

Your Chelton EFIS, on the other hand, was conceived and designed as a **"pilot-centered"** system. This type of system, common in military tactical applications, presents the pilot with information necessary to make decisions about the flight and take the appropriate actions. Contrary to the popular idea of overloading the pilot with information and options, Chelton Flight Systems EFIS products clearly and concisely present ONLY necessary information. This reduces pilot workload, decreases task complexity, and minimizes confusion. The result is safer flying.

Chelton Flight Systems' goal is **IFR-VFR equivalence** and the basic concept of your Chelton EFIS is proven HUD symbology overlaying a real-time 3-D virtual reality view of the outside world. The resulting **"synthetic vision"** provides the pilot in IMC with the same simple visual clues for navigation and aircraft control as those used in VFR conditions. This **"virtual**

**VFR"** eliminates the need to scan multiple instruments for aircraft control or mentally interpret complicated enroute and approach procedures. As you gain experience with your Chelton EFIS, you will fly with more precision, awareness, and comfort than you ever thought possible.

# Before You Fly

While the EFIS is extraordinarily easy to operate, it does rely heavily on advanced display concepts, so you will likely be exposed to some new terminology and ideas in the following pages.

It is recommended that, prior to flying with your FlightLogic EFIS, you read this document from start to finish. After you have read through this manual, complete the "Quick Start" tutorial while sitting in your aircraft.

We recommend flying the system for 10 hours and completing at least 5 full instrument approach procedures (including the missed approach) in VFR conditions before use in actual instrument conditions. Professional instruction and recurrent training are highly recommended.

If you ever have any questions about the use of your FlightLogic EFIS, please do not hesitate to contact your Chelton FlightLogic dealer for assistance.

# About this Guide

This document describes the operation of the Chelton Flight Systems FlightLogic EFIS with the software version specified in the footer at the bottom of the page and is divided into eight sections, each indicated by tabs as follows: Introduction, System Overview, Display Symbology, Menu Functions, Step-by-Step Procedures, Quick Start Tutorial, IFR Operations, and Appendix.

## System Overview

The **System Overview** provides a basic system description and block diagram, operational warnings, acronyms and abbreviations, coloring conventions, and a detailed description of the EFIS hardware.

*Use this section . . .*
to gain a basic understanding of the system.

## Display Symbology

The **Display Symbology** section provides identification of each screen element of the flight display. For each software screen, every element of the symbology is identified on a sample screen. Immediately following the sample screens, all elements for that screen are listed in alphabetical order. This section also covers failure modes.

*Use this section . . .*
to identify and understand the elements you see on the screen.

## Menu Functions

The **Menu Functions** section shows a flow diagram and selection options for each menu.

*Use this section . . .*
when you want to determine the function of a specific button or menu.

## Step-by-Step Procedures

The **Step-by-Step Procedures** section will guide you through each system function.

*Use this section . . .*
when you want to perform a specific task like creating a flight plan or selecting an approach.

## Quick Start Tutorial

The **Quick Start Tutorial** will give you the basics you need to go flying with the system. In a few simple steps, you will learn to enter a waypoint and control the view on the display.

*Use this section . . .*
before you fly for the first time and for a quick refresher when needed.

## IFR Operations

The **IFR Operations** section provides detailed information about selecting and flying instrument approaches, arrivals, and departures.

*Use this section . . .*
to familiarize yourself with instrument procedure conventions.

## Appendix

The **Appendix** section contains support material and other useful information about system operation including detailed discussions of TAWS functions.

*Use this section . . .*
to review operational tips, specifications, or other reference material.

## Joe Pilot

***"Hi, I'm Joe Pilot.***
*I have about a thousand hours flying this system and I'll share some tips with you as you read through the manual. Due to the advanced nature of this thing, you may come across stuff you've never even thought about before. I'll explain, in plain language, the important concepts that you need to know to use the system safely. Being a pilot, you probably hate to read instructions but, please, at least flip through the manual and listen to what I have to say."*

# Revision History

| Document Version | Software Version | Changes |
|---|---|---|
| Rev. A | 4.0C | Original |
| Rev. B | 4.0F | 1. Added notice about lack of skyway terrain clearance<br>2. Miscellaneous edits |
| Rev. C | 4.0H | 1. Replaced “warble tone” with “chime”<br>2. Added hover vector symbology<br>3. Added note regarding repeating alarms<br>4. Added tadpole ILS symbology<br>5. Added marker beacon symbology<br>6. Added RMI/ADF symbology<br>7. Added flight director symbology<br>8. Updated menu structure diagrams<br>9. Added detail regarding Zoom function<br>10. Added detail regarding Lat/Lon function<br>11. Deleted “pulled to ground” references in TAWS description<br>12. Changed knob rotation direction for map scale<br>13. Added note to altimeter setting instructions regarding flight path marker behavior above 50’ AGL while on ground<br>14. Added note regarding paper charts vs. NavData<br>15. Added reference to Terrain NOTAM on website<br>16. Added details regarding GPS failure modes and dead-reckoning limitations<br>17. Added Part 27/29 airspeed tape<br>18. Updated component failure mode matrix<br>19. Added discussion of wind calculation errors<br>20. Added description of discontinuity<br>21. Rewrote IFR Procedures section<br>22. Added additional NOS charts to IFR Procedures section<br>23. Updated TAWS system description in Appendix<br>24. Updated menu diagrams and added descriptions<br>25. Added holding pattern course reversals<br>26. Created new cover artwork<br>27. Added software version to revision history<br>28. Added software version number to cover<br>29. Miscellaneous edits |
| Rev. D. | 4.0J | 1. Updated software version to 4.0J |

Chelton Flight Systems is committed to producing the highest quality product possible; we welcome comments and suggestions concerning this manual. Please e-mail them to support@cheltonflightsystems.com.

Should you encounter problems with the operation of your FlightLogic EFIS, please complete and return the Service Difficulty Report in the **Appendix** section directly to:

Chelton Flight Systems Inc.
1109 Main St., Suite 560
Boise, ID  83702
OR
Fax (208) 389-9961

# Section 2

# System Overview

## General Description

The FlightLogic synthetic vision EFIS is a complete flight/navigation instrumentation system that intuitively provides information to a pilot via computer generated screens shown on panel-mounted hardware.

The panel-mounted hardware consists of an integrated display unit (IDU) that can be either a Primary Flight Display (that only shows the PFD screen) or a multifunction display (MFD) capable of showing a variety of screens. The MFD can be configured by the pilot as a reversionary PFD or navigation display (ND) at the touch of a button. The ND can be further configured as a moving map, electronic HSI, a dedicated traffic display, or a dedicated weather display.

PFD

MFD

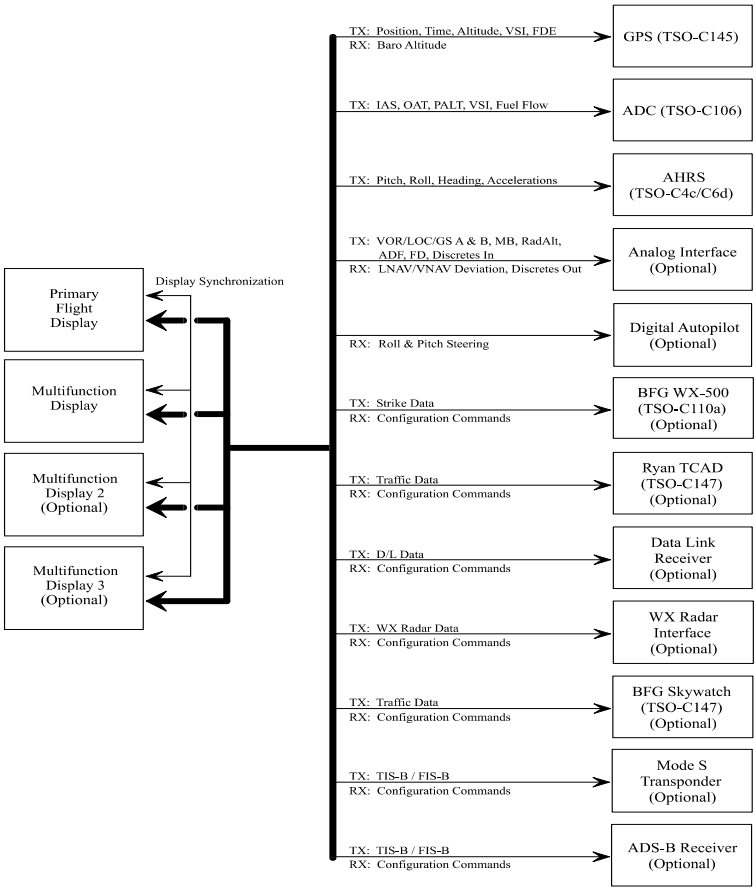
The displays are comprised of a high-brightness backlit LCD screen, eight buttons, two control knobs, and an optional slip indicator. The buttons and slip indicator are also backlit and their brightness can be adjusted independently of the screen.

Remote-mounted equipment consists of an AHRS (Attitude/ Heading Reference System), an ADC (Air Data Computer), and a GPS WAAS receiver.

The Chelton FlightLogic EFIS includes integral Class C TAWS (Terrain Awareness Warning System) or, optionally, may include Class B or Class A TAWS. For a detailed description of TAWS functions, refer to the TAWS section in the appendix.

# System Configuration

Each display is driven by its own internal processor. A complete system consists of at least one MFD, one AHRS, one ADC, and one GPS receiver. All displays communicate with (but do not rely upon) each other and all sensors are connected to the displays in parallel, so each display is independent from all others and, except for the PFD, can show any page at any time. The data transfer between components, along with the additional equipment that can be interfaced with the EFIS are indicated in the following block diagram.



The systems may be configured with a backup battery on an essential bus to provide power in the event of an electrical system failure.

In addition, various component failure modes are automatically handled by the software and annunciated to the pilot both visibly and audibly.

# Operational Warnings

**DO NOT FLY WITH YOUR FLIGHTLOGIC EFIS IF YOU DO NOT FULLY UNDERSTAND EACH WARNING LISTED BELOW:**

***WARNING!***
***DO NOT USE THIS SYSTEM FOR TERRAIN-FOLLOWING FLIGHT. DO NOT ATTEMPT TO NAVIGATE USING THE TERRAIN DEPICTION. ALWAYS ADHERE TO PUBLISHED INSTRUMENT APPROACH PROCEDURES IN INSTRUMENT CONDITIONS.***

***WARNING!***
***SKYWAY SYMBOLOGY DOES NOT PROVIDE PRECISION APPROACH GUIDANCE NOR DOES IT GUARANTEE TERRAIN SEPARATION. IT REMAINS THE PILOT'S RESPONSIBILITY TO PROVIDE SELF SEPARATION FROM TERRAIN DURING NON-PUBLISHED PROCEDURES***

***WARNING!***
***DO NOT CONTINUE AN INSTRUMENT APPROACH BEYOND THE DECISION HEIGHT OR BELOW THE MINIMUM DESCENT ALTITUDE UNLESS THE LANDING ENVIRONMENT IS VISIBLE ACCORDING TO THE FEDERAL AVIATION REGULATIONS.***

***WARNING!***
***DO NOT ENGAGE IN INSTRUMENT FLIGHT UNLESS YOU ARE INSTRUMENT RATED AND CURRENT AND YOUR AIRCRAFT MEETS THE IFR REQUIREMENTS SPECIFIED IN FAR 91.205.***

# Acronyms and Abbreviations

The following abbreviations and acronyms may be used this manual and in the system's user interface.

ACTV - Active
ADC - Air Data Computer
ADS-B - Automatic Dependent Surveillance-Broadcast
AFM - Aircraft Flight Manual
AGL - Above Ground Level
AHRS - Attitude Heading Reference System
AMLCD - Active Matrix Liquid Crystal Display
APPR - Approach
APV - Approach with Vertical Guidance
ARINC - Aeronautical Radio, Inc.
ATC - Air Traffic Control
CDI - Course Deviation Indicator
CDTI - Cockpit Display of Traffic Information
CFS - Chelton Flight Systems
CRC - Cyclic Redundancy Check
CWA - Caution/Warning/Advisory
DA - Decision Altitude
DEM - Digital Elevation Model
DH - Decision Height
DL - Data Link
DME - Distance Measuring Equipment
DO - RTCA Document
DOD - Department of Defense
DOF - Digital Obstruction File
DP - Departure Procedure
DR - Dead Reckoning
EFIS - Electronic Flight Instrument System
EGPWS - Enhanced Ground Proximity Warning System
ETA - Estimated Time of Arrival
ETE - Estimated Time Enroute
FAA - Federal Aviation Administration
FAF - Final Approach Fix
FAR - Federal Aviation Regulation
FAWP - Final Approach Waypoint - same as FAF
FDE - Fault Detection and Exclusion
FIS - Flight Information Service
FIS-B - Flight Information Service-Broadcast
FL - Flight Level
FLTA - Forward Looking Terrain Awareness
FMS - Flight Management System
FPM - Feet per Minute
GPH - Gallons per Hour

GPS - Global Positioning System
GPWS - Ground Proximity Warning System
HAL - Horizontal Alert Limit
HAT - Height Above Threshold
HFOM - Horizontal Figure of Merit
HPL - Horizontal Protection Level
HSI - Horizontal Situation Indicator
HTAWS - Helicopter Terrain Awareness and Warning System
HUL - Horizontal Uncertainty Limit
IAP - Instrument Approach Procedure, also Initial Approach Point
IAWP - Initial Approach Waypoint - same as IAP
IDU - Integrated Display Unit
IFR - Instrument Flight Rules
ILS - Instrument Landing System
IM - Inner Marker
IO - Input/Output
IPV - Instrument Procedure with Vertical Guidance
KIAS - Knots Indicated Airspeed
KT - Knot - Nautical Mile per Hour
KTAS - Knots True Airspeed
LDA - Localizer-type Directional Aid
LNAV - Lateral Navigation
LOC - Localizer
LRU - Line Replaceable Unit
MAHP - Missed Approach Holding Point
MAHWP - Missed Approach Holding Waypoint - same as MAHP
MAP - Missed Approach Point
MAWP - Missed Approach Waypoint - same as MAP
MDA - Minimum Descent Altitude
MFD - Multifunction Display (an IDU with software for showing multiple display screens)
MM - Middle Marker
MSL - Mean Sea Level
MTBF - Mean Time Between Failures
ND - Navigation Display
NDB - Nondirectional Beacon
NM - Nautical Mile
NPA - Non-Precision Approach
OBS - Omnibearing Selector
OM - Outer Marker
OT - Other Traffic (Traffic Function)
PA - Proximate Advisory (Traffic Function)
PDA - Premature Descent Alert
PFD - Primary Flight Display (the display screen showing primary instrumentation -- can also refer to the primary IDU with software that only shows primary instrumentation)
PFDE - Predicted Fault Detection and Exclusion
PLI - Pitch Limit Indicator

RA - Resolution Advisory (Traffic Function)
RMI - Radio Magnetic Indicator
RNAV - Area Navigation
RNP - Required Navigation Performance
SA - Selective Availability
STAR - Standard Terminal Arrival Routes
STC - Supplemental Type Certificate
SUA - Special Use Airspace
TA - Traffic Advisory (Traffic Function)
TAS - Traffic Advisory System
TAWS - Terrain Awareness and Warning System
TCAD - Traffic Collision Alert Device
TCAS - Traffic Collision Alert System
TERPS - Terminal Procedures
TCH - Threshold Crossing Height
TD - Traffic Display
TIS - Traffic Information Service
TIS-B - Traffic information Service-Broadcast
TSO - Technical Standard Order
UAR - Unusual Attitude Recovery
USGS - United States Geological Survey
UTC - Universal Time Coordinated
VAL - Vertical Alert Limit
VFOM - Vertical Figure of Merit
VFR - Visual Flight Rules
VHF - Very High Frequency
VNAV - Vertical Navigation
VOR - VHF Omnidirectional Radio
VPL - Vertical Protection Level
VSI - Vertical Speed Indicator
VTF - Vectors to Final
VUL - Vertical Uncertainty Limit
WAAS - Wide Area Augmentation System

# Coloring Conventions

A consistent set of colors is used for displaying information on FlightLogic EFIS. These colors are detailed as follows:

WHITE is used for scales and associated labels and figures, pilot action, or data entry. Examples:

- Scales markings (airspeed, altitude, heading, VSI, pitch, map ranges, etc.)
- Pilot-selected values (airspeed, heading, altitude)
- Secondary flight data (TAS, wind, OAT, timers, etc.)

CYAN is used for IFR navigation database items (airports with instrument approaches, VORs, intersections).
CYAN is also used to indicate power-off glide area on the moving map.

MAGENTA is used to indicate electronically calculated or derived data and certain navigation database items. Examples:

- Active waypoint related symbols
- Course data (desired track, CDI)
- VFR airports, NDBs
- HSI

GRAY is used as a figure background for airspeed and altitude readout and for conformal runway depiction (light gray for usable portion of the active runway, dark gray for other runway surfaces.

GREEN is used to indicate normal or valid operation (airspeed, altitude tape coloring, status indication, etc.). Examples:

- Aircraft ground track
- Skyway symbology
- Advisories

DARK GREEN is used in terrain indication on the moving map

AMBER is used to identify conditions that require immediate pilot awareness and subsequent pilot action. Examples:

- Caution indications
- Altitude or heading alert
- Component failure indication
- Pitch limit indicator (low-speed awareness)
- Minimum altitude

BROWN is used in a variety of shades to indicate earth/terrain on the primary flight display, altitude tape (ground level and below), and moving map.

BLUE is used in a variety of shades to indicate the sky portion of the primary flight display and bodies of water on the moving map.

RED is used to indicate aircraft limitations or conditions which require immediate pilot action. Examples:

- Warnings (airframe operation limits, terrain awareness)
- Pitch limit indicator (low speed awareness)

Black is used as a background for the moving map, for figures on a gray background, and for outlining certain figures/ elements on backgrounds where contrast is minimal

# Caution/Warning/Advisory System

The Chelton FlightLogic EFIS includes an integrated auditory caution/warning/advisory (CWA) system that monitors a wide variety of parameters and provides auditory annunciations for conditions that demand pilot awareness. Auditory annunciations take the form of either a voice warning or a chime.

Annunciations are grouped into three categories: warning, caution, and advisory. Warnings are accompanied by a red flag and repeat until acknowledged by the pilot (by pushing the MUTE button on yoke or panel) or the condition is corrected. Cautions are accompanied by an amber flag and are annunciated once. Advisories are accompanied by a green flag or no flag, depending on condition, and are indicated by either a voice annunciation or a chime.

***NOTE**:*
*Voice annunciations are programmed in duplicate ("stall, stall" or "altitude, altitude") and cannot be silenced while playing; pressing the MUTE button just keeps a warning from repeating.*

CWA Flags are stacked in reverse chronology with warnings displayed on top, followed by cautions and then advisories.

*The CWA flags in the following list are prioritized top to bottom according to severity and only the most critical one is invoked.*
(Background color indicates flag color. White indicates no flag.)

| Condition | Category | Annunciation | Flag |
|---|---|---|---|
| Excessive rate of descent | Warning | "Pull Up. Pull Up." | PULL UP |
| TAWS forward-looking terrain warning | Warning | "Terrain. Terrain. Pull Up. Pull Up." | PULL UP |
| Airspeed is below the higher of $V_{S1}$ or $V_{S1}$ corrected for G-loading (not enabled if aircraft has factory stall warning) | Warning | "Stall" | STALL |
| Airspeed above $V_{NE}$/$V_{MO}$/$M_{MO}$* | Warning | "Overspeed" | OVERSPEED |

| Condition | Category | Annunciation | Flag |
|---|---|---|---|
| Aircraft below selected minimum altitude | Caution | "Altitude" | ALTITUDE |
| TAWS forward-looking terrain caution | Caution | "Caution, Terrain." | TERRAIN |
| Premature descent | Caution | "Too Low. Terrain." | TOO LOW |
| 500 ft. callout on descent (must climb through 1,000 ft. to enable this function)* | Advisory | "Five Hundred" | No flag |
| Altitude loss after takeoff or on first leg of missed approach | Caution | "Sink Rate" | SINK RATE |
| Aircraft is descending below 500' and below $V_{FE}$ and any landing gear is not down (enabled only when system is configured for retractable gear aircraft) | Caution | "Check Gear" | CHECK GEAR |
| Traffic alert (enabled above 400' AGL and only if system is interfaced with traffic detection system) | Caution | "Traffic" | TRAFFIC |
| Fuel quantity in warning range | Warning | "Fuel Low" | LOW FUEL |
| EFIS core temperature over 90°C | Caution | "EFIS cooling" | EFIS COOLING |
| Fuel quantity in caution range | Caution | "Fuel low" | LOW FUEL |
| 150' deviation from target altitude | Caution | "Altitude" | ALTITUDE |
| Deviation more than 10° from heading bug | Caution | "Heading" | HEADING |
| Deviation of 10 kts. from target airspeed | Caution | "Airspeed" | AIRSPEED |
| Fuel range less than dest. + 100 miles (not activated in climb) | Caution | "Check range" | CHECK RANGE |
| Altimeter not set to 29.92 above FL180 (not enable if set to millibars or hecto pascals) | Caution | "Check altimeter" | ALTIMETER |
| Within 10% of VSI of target altitude (only when vertical speed is greater than 1,000 fpm) | Advisory | "Level off." | LEVEL OFF |
| Expiration of countdown timer | Advisory | Chime | No flag |

| Condition | Category | Annunciation | Flag |
|---|---|---|---|

*The flags and annunciations in the following list are NOT prioritized and are invoked simultaneously as applicable in addition to the above.*

| | | | |
|---|---|---|---|
| GPS/WAAS loss of navigation | Caution | "GPS failure" | NO GPS |
| Dead Reckoning | Caution | Chime | DR ##:## (##:## is the time since GPS loss) |
| GPS/WAAS loss of integrity | Caution | "GPS integrity" | GPS LOI |
| No air data | Caution | "Air data failure" | NO AIR DATA |
| No attitude | Caution | "Attitude failure" | NO ATTITUDE |
| Failure of auxiliary sensor (traffic, weather, etc.) | Caution | "Auxiliary sensor failure" | AUX SENSOR |
| ADC not at full accuracy during warm-up | Advisory | Chime | ADC INIT |
| Automatic waypoint sequencing suspended | Advisory | Chime | SUSPEND |
| GPS/WAAS Parallel offset track selected (## is nautical miles left or right) | Advisory | Chime | PTK = L(R) ##NM |
| GPS WAAS in IFR approach mode | Advisory | Chime | IFR APPR |
| GPS/WAAS in VFR approach mode | Advisory | Chime | VFR APPR |
| GPS/WAAS in terminal mode | Advisory | Chime | TERMINAL |
| GPS/WAAS vectors to final IFR approach mode | Advisory | Chime | VTF IFR APPR |
| WX-500 in self-test | Advisory | Chime | WX-500 TEST |
| HSI and autopilot navigation source | Advisory | None | HSI:X (X = GPS, NAV1, OR NAV2) |

*** Not applicable to rotorcraft**

***AUDIBLE ANNUNCIATION***
Throughout this document, auditory annunciations are identified with this speaker icon.

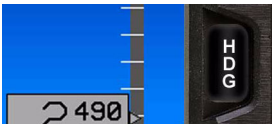
# Displays

## Controls

Each display incorporates eight peripheral buttons (each labeled for a dedicated function) a brightness knob (left side), a menu control knob (right side), and an optional slip indicator. The peripheral buttons and slip indicator are backlit. The buttons are separated by machined “prongs” that isolate the buttons to prevent inadvertent actuation.

There are two kinds of functions: button functions and menu functions. Button functions are activated by pushing a button labeled accordingly. Menu functions are activated by pushing a button adjacent to the desired menu on the screen.

The brightness knob turns clockwise to increase screen brightness and counterclockwise to decrease screen brightness. Pushing the brightness knob while turning adjusts the button and slip indicator brightness in the same manner.




To activate a button function, push the corresponding button.

For example, pushing this button activates the Heading Bug function.

To activate a menu function, push the button that corresponds with the menu. To display menus, push the Menu button.

For example, pushing this button now activates the BUGS menu.

When a menu appears in the lower right corner of the screen (see photo on previous page), it is controlled with the right-hand knob. Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

If there are no menus shown on the PFD screen, turning the control knob sets the barometric pressure for the altimeter. Pushing it has no function on a dedicated PFD.

Likewise, turning the control knob on the MFD when there are no menus shown sets the scale of the display. Pushing the knob on the MFD instantly brings up a reversionary PFD screen; pushing it again returns to the navigation display.

Once inside the menu structure, the top left button (adjacent to the BACK menu) always takes you back one step in the menu structure. The top right button (adjacent to the EXIT menu) always takes you completely out of the menus.

## Mechanical Considerations

The displays slide into trays that connect to the aircraft's electrical system and protect the displays from EMI, RFI, HIRF, and over/under/reversed supply current. The display's internal power supply filters and converts input supply current to usable and stable voltages at appropriate power levels for internal use. The internal power supply also stores sufficient energy to supply uninterrupted power during momentary power interruptions.

The displays are identical in form, fit, and function. Function is determined by a configuration card ("SCC Card") mounted in the tray. Therefore, the displays are interchangeable. The optional slip indicator may be interchanged with a blank plug without disassembling the display by removing two screws on the bottom of the device.

Installation and removal of the display is accomplished using a 3/32" hex driver inserted into a hole immediately to the left of the data card slot. The hex driver turns a jack screw that ensures positive engagement or disengagement of the display with the connectors in the tray. This requires about 14 revolutions of the jack screw.

A cooling fan is mounted in a cavity on the back of the back of the display and can be accessed by sliding the display out of the tray and removing the fan cover plate. The fan is serviceable without further disassembly. The fan draws cooling air through slots in the cover plate and through an optional open-cell foam air filter. This filter protects the internal circuitry in dusty environments and can easily be removed, rinsed, dried, and replaced.

The AMLCD (active matrix liquid crystal display) screen is illuminated by a combination of cold-cathode fluorescent tubes arranged in two pairs with each pair driven by its own independent power supply. Typical bulb life is approximately 25,000 hours. The fluorescent bulbs are augmented by LEDs for cold operation, redundancy, and nighttime dimming capability.

The AMLCD is easily damaged. Avoid rubbing with a hard or sharp object. Wipe water off immediately. Long contact with water may cause discoloration or spots. Clean a soiled screen with an absorbent soft cotton cloth.

# Database and Software Updates

## Navigation and Obstruction Databases

The EFIS uses Jeppesen NavData for the navigation database and government sources for the obstruction database.

A SmartMedia data card is used to update these databases. A thin horizontal slot centered in the lower portion of the bezel provides access to the display's data card reader. When the system is powered up with the data card inserted, it enters the ground maintenance mode which provides for system updates.

When inserted, a portion of the data card remains exposed and the card can be removed by pulling on the exposed portion. There is no eject button. A red LED, mounted immediately to the left of the data card slot, provides an indication of when the data card is being accessed.

***IMPORTANT: Do not remove the data card when the red LED is illuminated or damage to the data card may result, although it will not cause any damage the EFIS display (it will simply cause the system to restart and enter flight mode). It is good practice to only insert or remove the data card with the system powered OFF.***

To update the system:

1. If you received your update in the mail, go immediately to Step 2. If not . . .
   Using the SmartMedia data card (supplied with your system or available anywhere cameras are sold) log onto the Chelton Flight Systems website (www.cheltonflightsystems.com) and download the current databases by following the instructions in the DOWNLOADS area (user name and password required; call 208-389-9959).

2. With the power OFF, insert the data card containing the databases into the primary flight display (gold side up) and connect a keyboard to the keyboard port on the panel.

3. Power the system ON and select the UPDATE DATA-BASE option using the keyboard when prompted.
4. Power the system OFF and remove the data card
5. Repeat 2 through 4 for each additional display.
6. Upon power up, verify that update was successful by noting the new NavData cycle and expiration dates before acknowledging the startup screen.

The data itself is verified by a CRC-32 self test at every step of the process, thereby ensuring that the data you installed onto the system has not been corrupted at any point along the way.

***NOTE**:*
*The system cannot enter flight mode while the data card is in the slot. Inserting the data card in flight has no effect.*

## Terrain Database Updates

The terrain database is stored on an internal solid-state flash drive. Updating the terrain database requires replacing this drive, which can be done without opening the display enclosure. However, since the display must be removed from its tray to gain access to the drive slot, the terrain database can only be updated by your Chelton FlightLogic dealer.

## System Software updates

System software is updated in the same manner as the NavData.

1. Power the system on and make a note of the software version number before acknowledging the startup screen.
2. Power the system OFF, insert the data card containing the software update into the primary flight display (gold side up) and connect a keyboard to the keyboard port on the panel.
3. Power the system ON and select the UPDATE SOFTWARE option using the keyboard when prompted.

4. Power the system OFF and remove the data card
5. Repeat 2 through 4 for each additional display.
6. Upon power up, verify that update was successful by noting the new software version number before acknowledging the startup screen.

As with the databases, the system software itself is verified by a CRC-32 self test at every step of the process, thereby ensuring that the software you installed onto the system has not been corrupted at any point along the way.

# Attitude/Heading Reference System

The AHRS is a high performance, solid-state attitude and heading reference system (AHRS). This high reliability, strap-down inertial system provides attitude and heading measurement using MEMS (micro-electromechanical sensor) gyros and accelerometers. The information provided by the AHRS is used to drive the Attitude Indicator (Artificial Horizon) and Directional Gyro (slaved) indicator. Thus the AHRS provides the same functions traditionally provided by these two spinning gyros and slaved magnetometer.

An internally computed level platform in the AHRS eliminates all precession errors and gyro tumble conditions. All calibration information is stored internally and used by the internal computer to compensate sensor operation.

The AHRS achieves its excellent performance by employing proprietary Kalman filter algorithms to determine stabilized roll, pitch, and heading angles in static and dynamic conditions. The Kalman filter implementation results in a continuous on-line gyro bias calibration, and an adaptive attitude and heading measurement that is stabilized by the long-term gravity and magnetic north references. No external aiding is required; the AHRS functions without requiring air-data or GPS input which greatly increases safety and reliability. The AHRS transmits attitude and heading information to the EFIS on a digital data bus.

The AHRS is remote mounted and designed to meet FAA requirements. A sophisticated suspension system ensures full performance in aircraft vibration environments. A sealed enclosure ensures full performance over full altitude and temperature range without risk of moisture contamination. A comprehensive Built-In Test (BIT) monitors all sensors and internal electronics continuously during operation and sends a system status update to the EFIS 20 times per second.

The maximum roll and pitch rate for the AHRS is 200° per second. On startup, the AHRS performs an extensive self-test

and sensor initialization for 90 seconds. The aircraft must remain stationary during the self-test and alignment initialization (wind gusts and movement within the aircraft will not affect initialization). The EFIS will not display attitude until the AHRS has successfully initialized. The AHRS can also be initialized in flight. To accomplish this, steady, non-accelerating flight should be maintained throughout the initialization period.

# Air Data Computer (ADC)

The Airdata Computer is connected to the aircraft pitot, static ports, OAT probe, and fuel system to measure indicated airspeed, pressure altitude, outside air temperature, and fuel flow. From these raw data, true airspeed and density altitude are calculated for display on the system. These data are also used to calculate the mach number, winds aloft, fuel endurance, and range.

***NOTE**:*
*A green ADC INIT flag may be present after the EFIS starts operating. This flag will be removed once the ADC has completed its warm-up period. ADC information (airspeed and altitude) may not meet TSO accuracies until this flag is no longer displayed.*

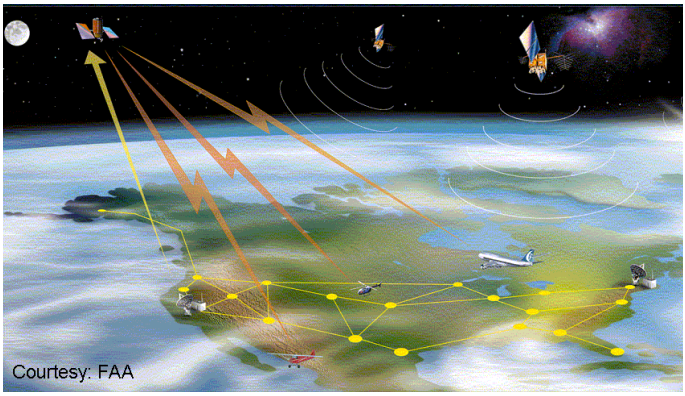
***NOTE**:*
*Leaks in the pitot-static system can cause erroneous airspeed, altitude, and winds aloft information.*

# GPS/WAAS Receiver

The Global Positioning System (GPS) is a space-based radio-navigation system. It consists of 24 satellites, which orbit the Earth at an altitude of approximately 11,000 miles, and ground stations. GPS provides users with accurate information on position, velocity, and time anywhere in the world and in all weather conditions

WAAS (Wide Area Augmentation System) is a GPS-based navigation and landing system that will provide precision guidance to aircraft at thousands of airports and airstrips where there is currently no precision landing capability. Systems such as WAAS are known as satellite-based augmentation systems (SBAS). WAAS is designed to improve the accuracy and ensure the integrity of information coming from GPS satellites.

The WAAS is based on a network of approximately 25 ground reference stations. These precisely surveyed ground stations receive signals from GPS satellites and any errors in the signals are identified by comparing GPS-indicated position with the known surveyed position. Each station in the network then relays the error data to one of two wide area master stations where correctional information for specific geographical areas is computed.


Courtesy: FAA

A correction message is prepared and uplinked to a geostationary communications satellite. This message is then

broadcast on the same frequency as the GPS signal to the GPS WAAS receiver in your FlightLogic EFIS. The WAAS improves basic GPS accuracy to approximately 7 meters vertically and horizontally and provides important integrity information about the entire GPS constellation.

The Chelton FlightLogic EFIS obtains position information from a TSO-C145 GPS WAAS receiver. The GPS sends position and integrity data to the displays which, in turn, present it as useful position, navigation, and wind information on the PFD and moving map displays. GPS position is also used for terrain awareness alerting (TAWS) functions. GPS status is monitored continuously by the EFIS.

If a GPS-related caution flag is displayed, refer to the **FAULTS** menu on the MFD (see **FORMAT or RMI ON / RMI OFF: On screens other than the HSI screen, displays the appropriate screen format menu option. On HSI screen with optional VHF navigation, toggles showing of radio magnetic indicator. RMI ON appears when the current mode is radio magnetic indicator off. RMI OFF appears when the current mode is radio magnetic indicator on., page 4-24** in the **Menu Functions** section). GPS faults are designated as follows:

1. GPS/WAAS loss of navigation due to absence of power ("GPS PWR").
2. GPS/WAAS loss of navigation due to probable equipment failure ("GPS EQPMNT").
3. GPS/WAAS loss of navigation due to inadequate satellites to compute a position solution ("GPS SATLT").
4. GPS/WAAS loss of navigation due to a position failure that cannot be excluded within the time to alert ("GPS FDE").
5. GPS/WAAS loss of horizontal integrity monitoring and loss of navigation due to loss of horizontal integrity monitoring ("GPS HLOI").
6. GPS/WAAS loss of navigation due to no valid WAAS message received for 4 seconds or more ("WAAS MSG").

7. GPS/WAAS loss of navigation due to insufficient number of WAAS HEALTHY satellites ("WAAS HLTH").

For more information about GPS failure modes, see **GPS Failure, page 3-110.**

# Component Failure Modes

The EFIS continuously monitors attached sensors for receipt of valid data strings and for status information. Should a valid data string not be received within certain time periods, or if the sensor status information indicates a failure, then the associated sensor is considered to be in a failed condition.

Failure of a weather receiver, datalink receiver, TCAS/TCAD receiver, or AIU-1 (Analog Interface Unit) results in the EFIS issuing an amber caution flag and voice annunciation. None of these receivers or devices significantly impact the navigational or display capabilities of the EFIS.

Failure of the GPS, the AHRS or the ADC, singly or in combination, adversely impacts the EFIS capabilities. These failures are annunciated with amber caution flags on the MFD and corresponding voice warnings. In addition, the software provides degraded displays to show as much useful and accurate information as possible in the failure condition. These degraded displays are described in detail under **Failure Modes, page 3-107**.

# Section 3

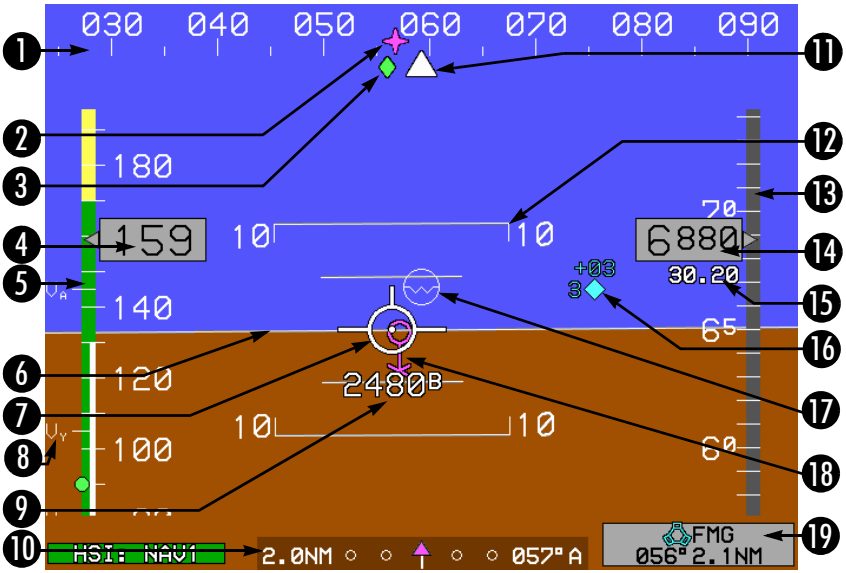
# Display Symbology

The following pages detail the symbology used on the various screens. Each screen is mapped with identifiers for each element and the element descriptions follow alphabetically immediately thereafter.

# PFD Symbology

The PFD combines analog and digital pitot-static information, heading, attitude, 3-D navigation data, and more overlaid on a "virtual" background of the outside world. Objects shown in the virtual background, including terrain, towers, approaches, and runways, are presented conformally (proper scale and perspective according to the aircraft's position, altitude, and heading). What is shown on the screen is a replica of a day VFR view out the front window of the aircraft.

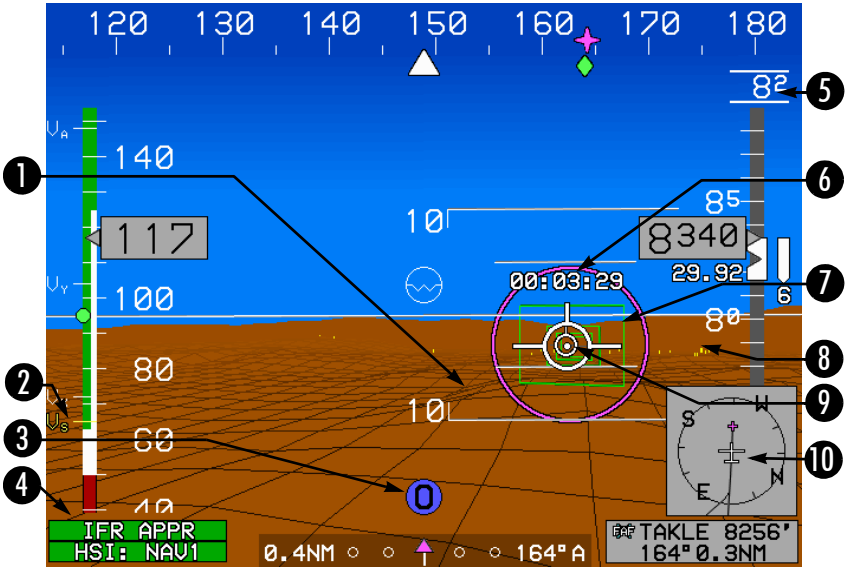
# Basic PFD




1. Directional scale
2. Bearing to waypoint
3. Ground track
4. Indicated airspeed readout
5. Indicated airspeed tape
6. Horizon
7. Flight path marker
8. V-speeds
9. Altitude above ground
10. GPS/WAAS CDI
11. Heading indicator
12. Pitch scale
13. Altitude tape
14. Altitude readout
15. Altimeter setting
16. Traffic
17. Waterline
18. Active waypoint symbol
19. Active waypoint information

Not shown: G-force indicator
Not shown: Flight director
Not shown: HSI

# PFD on Approach (Terrain On)

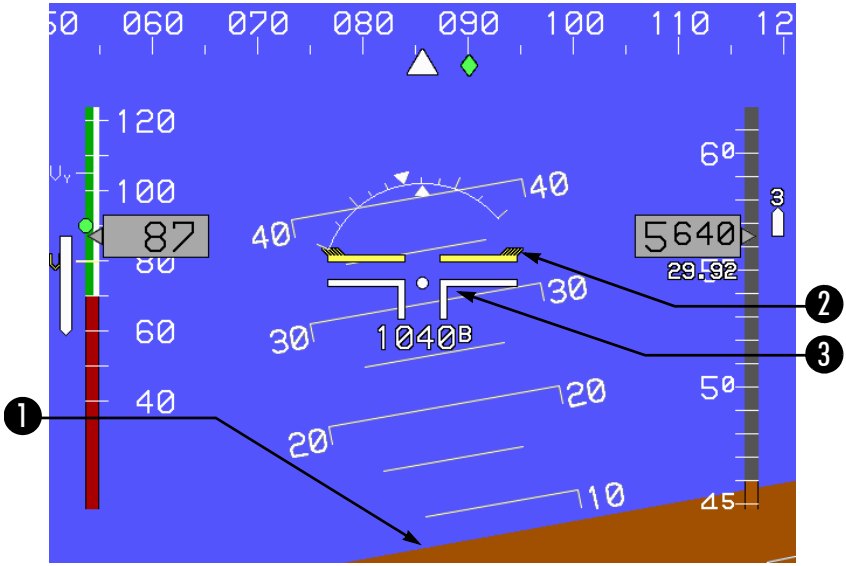



1. Terrain
2. Dynamic stall speed
3. Marker beacon
4. CWA flags
5. Target altitude
6. Timer
7. Skyway
8. Obstruction
9. Tadpole (ILS)
10. MiniMap

# PFD on Approach (Terrain Off)

1. Heading bug
2. Target airspeed
3. Best glide speed
4. Target airspeed bug
5. Speed trend indicator
6. Pitch limit indicator
7. Ghost flight path marker
8. Waypoint direction pointer
9. Minimum altitude setting
10. VSI
11. Target altitude bug
12. Minimum altitude bug
13. Caged flight path marker

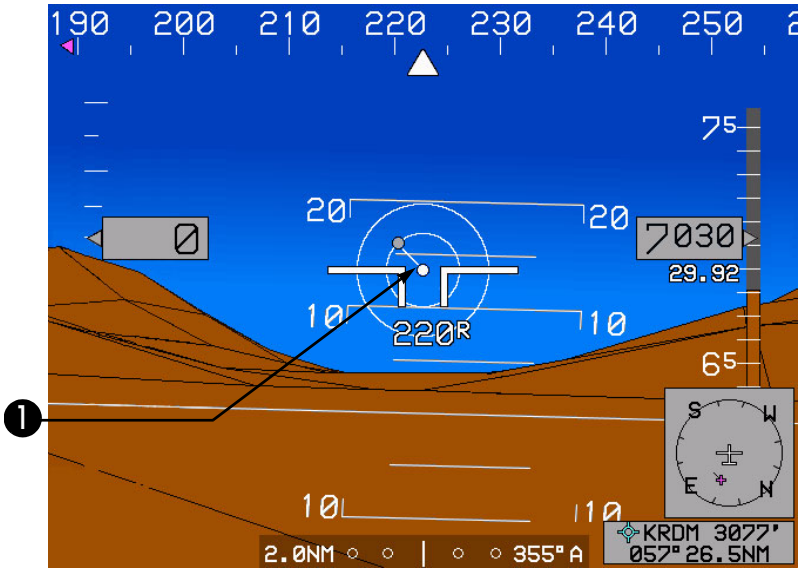
# Unusual Attitude Recovery Mode




1. Horizon Cue
2. Pitch limit indicator
3. Expanded waterline

When pitch exceeds +/-25°, the PFD automatically displays the unusual attitude recovery (UAR) mode. In UAR mode, all navigation, terrain, and obstruction symbology are removed. The flight path marker is removed and the waterline is expanded. The pitch limit indicator is retained to provide enhanced low speed awareness, and a horizon cue (a sliver of blue or brown) is always shown to indicate the closest direction to return to straight-and-level flight. The display returns to normal at +/-5° of pitch.

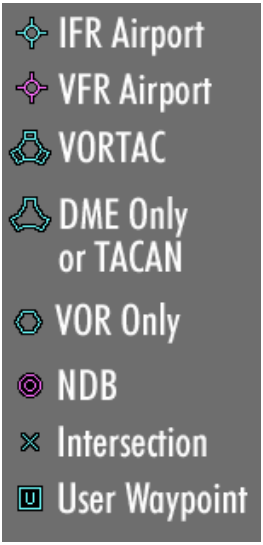
# Helicopter PFD




1. Hover Vector

## Active Waypoint Information

Information for the active waypoint is shown in the lower right corner of the display. Waypoint information includes waypoint type and identifier, elevation or crossing altitude, bearing, and distance.

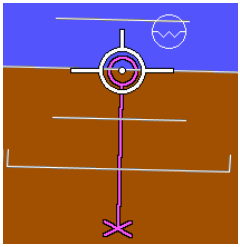



Navigation waypoint symbol conventions

***NOTE**:*
*See **Jeppesen NavData Chart Compatibility** in the **Appendix** for additional information on waypoint naming conventions.*

## Active Waypoint Symbol

Waypoints (including destination airport) and fixes are displayed as a magenta "tethered balloon." The **"X"** on the ground at the bottom of the symbol indicates the waypoint's conformal (correct perspective) position on the surface of the earth, and the 200 ft. radius hoop at the top indicates the aircraft altitude or target altitude (if target altitude is set). In other words, fly the flight path marker through the hoop and the aircraft will be over the fix at the desired altitude.



The hoop is displayed at the current target altitude and must be set by the pilot. When no target altitude is specified, the hoop is displayed at the aircraft's current altitude. See **Skyway Vertical Navigation (VNAV), page 3-40**, for more information.

If you take off from Seattle and your active waypoint is San Diego, you will see the hoop over San Diego on the horizon. Only the active waypoint is shown on the screen. Subsequent waypoints in a route are displayed sequentially as the active waypoint is passed. Obstruction of the waypoint symbol by terrain means that there is terrain between the aircraft and the obstructed portion of the waypoint symbol.

With terrain turned off, the active waypoint will always be visible regardless of distance.

If the waypoint is beyond the lateral limits of the screen, the magenta waypoint direction pointer on the directional scale will indicate the shortest direction of turn to the waypoint.

If the waypoint is just a hoop hanging in space, that waypoint is a fix not directly associated with a navaid on the ground (such as a VOR, airport or NDB).

***"Get the most out of the waypoint symbol:***

1. *If the waypoint hoop is above the artificial horizon, you must climb to go through it; if it is below the horizon, you must descend.*
2. *Use the waypoint hoop and pitch scale to determine the climb or descent angle required to cross the waypoint at the target altitude. If the hoop is 4° above the artificial horizon, you will have to climb at 4° to go through it.*
3. *Use the* **X** *on the ground to do your descent planning. Maintain altitude until the* **X** *is 2.5° to 3.0° below the horizon (as measured by the pitch scale), then put the flight path marker on the* **X**. *You'll enter the traffic pattern at the correct altitude."*
4. *If the waypoint* **X** *disappears behind terrain on the screen, there is terrain in your flight path between you and the airport."*

## Waypoint Sequencing

The system defines the desired flight path based upon the active flight plan. The active flight plan can be recalled from a list of stored flight plans or generated using the Nearest function (**NRST**) or **Direct-To** function, then adding and deleting waypoints en route.

In most cases, the system will auto-sequence from one waypoint to the next, in accordance with the flight plan. Waypoint auto-sequencing will be suspended in the following cases:

1. A manual GPS/WAAS OBS is set ("SUSPEND" flag shown).
2. The aircraft is on the final approach segment of an instrument approach and the missed approach procedure has not

been armed by pressing the MISSED button ("SUSPEND" flag shown).

3. The aircraft is in a published holding pattern and the pilot has not chosen to continue out of the holding pattern by pressing the CONTINUE ("SUSPEND" flag shown).

4. The active waypoint is the last waypoint of the active flight plan ("SUSPEND" flag not shown).

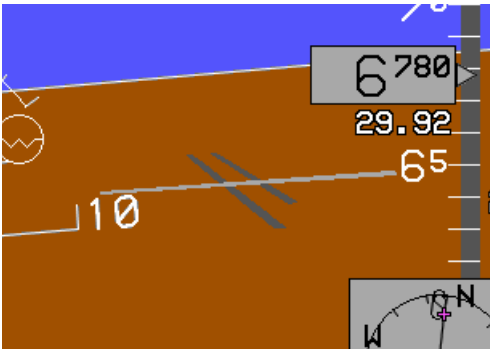
Where automatic waypoint sequencing is suspended, the system automatically switches from TO operation to FROM operation when crossing the waypoint.

***AUDIBLE ANNUNCIATION***
Suspension of automatic waypoint sequencing is annunciated by an auditory chime and an advisory SUSPEND flag.

SUSPEND

## Airport

On system startup, all runways at the current airport are displayed conformally on the PFD to increase situational awareness. When an IFR approach or STAR is selected at the destination, the runways at that airport are displayed. The usable portion of the active runway is shown in light gray while other runways and unusable portions of the active runway are shown in dark gray.



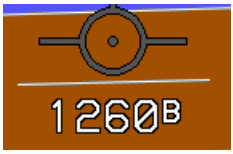
## Altitude Above Ground (AGL)

The estimated altitude above ground level is displayed directly below the flight path marker or expanded waterline any time the indication is 2,500 feet or less. AGL altitude is driven by the AGL altitude source being used for TAWS. A source indication appears after the figure to designate the source as follows:

1. **R** = radar altitude.
2. **G** = GPS/WAAS geodetic height less database ground elevation.
3. **B** = barometric altitude less database ground elevation.

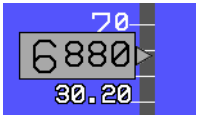
AGL altitude is not displayed when it is greater than 2,500' and is not displayed when it is invalid.

***NOTE:***
*AGL using barometric altitude can only be as accurate as the current barometric pressure setting and is subject to non-standard-day errors.*




## Altitude Readout

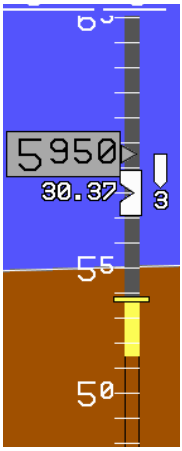
The altitude readout, located approximately two-thirds of the way up the altitude tape, digitally shows barometric altitude in feet MSL. Altitude is displayed in ten-foot increments.



## Altitude Tape

The altitude tape, located on the right side of the display, shows barometric altitude in feet MSL with high numbers toward the top. The portion of the altitude tape that is at and below ground level is colored brown.

The tape is graduated in hundred-foot increments with labels every 500 feet and at least two labels will be visible at all times.




## Altimeter Setting (Barometric Pressure)

Current barometric pressure is set using the right-hand control knob and is displayed on the PFD in inches of mercury or millibars.

## Bank Angle Scale

A bank angle scale is centered on the flight path marker (or expanded waterline in UAR mode) to display aircraft bank angle. The bank angle scale is shown anytime the aircraft's bank angle is 2.8 degrees or greater. Scale markings conform to conventional artificial horizon standards with graduations at 10, 20, 30, 45, and 60 degrees. A solid white triangle pointed up directly above the flight path marker points to current bank angle. A solid white triangle pointed down is located on the scale at 0°.

## Bearing to Waypoint

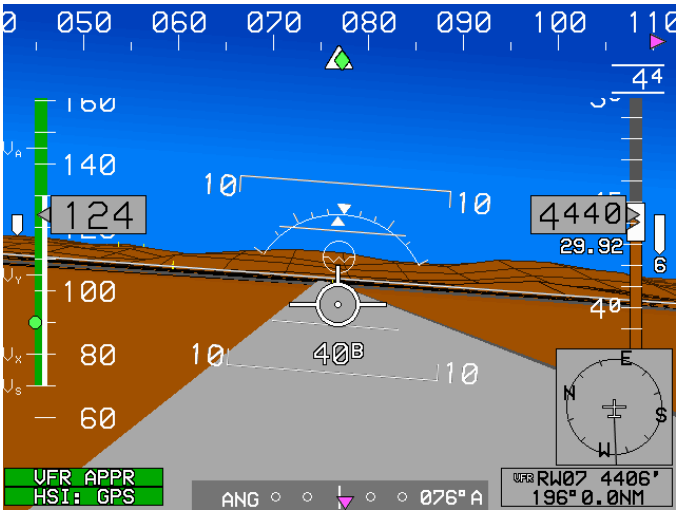
Bearing to waypoint is shown as a magenta star (waypoint symbol) on the directional scale located directly above the active waypoint.

If the symbol is displaced beyond the range of the heading scale, a magenta pointer on the directional scale indicates the shortest direction of turn to the waypoint bearing.

## Conformal Runway

Runways are displayed conformally – correct location, scale, and perspective with respect to the aircraft's position, heading, and altitude. Runways at the departure airport are shown automatically. When an IFR approach or STAR is selected, all runways at the destination airport are displayed for added situational awareness.

The usable portion of the selected runway is shown in light gray while other runways and unusable portions of the landing runway (displaced threshold) are shown in dark gray.



## CWA Flags

The CWA (**Caution/Warning/Advisory**) flags alert the pilot to situations that require pilot awareness. Warnings are indicated by a red flag. Cautions are indicated by an amber flag. Flagged advisories are indicated by a green flag.

Flags are stacked with warnings on top, followed by cautions, and then advisories. Flags are shown in reverse chronology. For a complete list of flags and annunciations, as well as order of prioritization, see **Caution/Warning/Advisory System, page 2-11**.

***AUDIBLE ANNUNCIATION***
CWA flags are accompanied by an auditory annunciation.

## Directional Scale

A stabilized directional scale is presented across the top of the display. The scale is conformal with the virtual display elements (terrain, waypoints, obstructions, etc.).

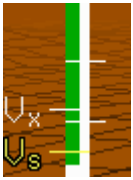
For example, an object outside the aircraft that is 10° left of the nose will appear on the display under the heading scale 10° left of the heading pointer. In standard mode, the directional scale is 70° wide and is depicted with graduations at 5° increments and figures at 10° increments. In zoom mode, the directional scale is 35° wide with graduations still at 5° increments (although much more widely spaced).

## Dynamic Stall Speed

The stall speed of the aircraft, based on Vs and corrected for normal acceleration (G-load) when greater than one G, is displayed as a dynamic label (**Vs**) that moves up the airspeed tape to indicate the actual stall speed.

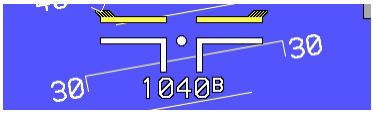
**Vs** is defined as clean stall at gross weight.

Any time the stall speed is greater than the unaccelerated stall speed, the **Vs** is displayed in amber.




## Expanded Waterline

In the unusual attitude recovery mode, the waterline symbol is expanded to provide instant, simple cues for pitch and bank.



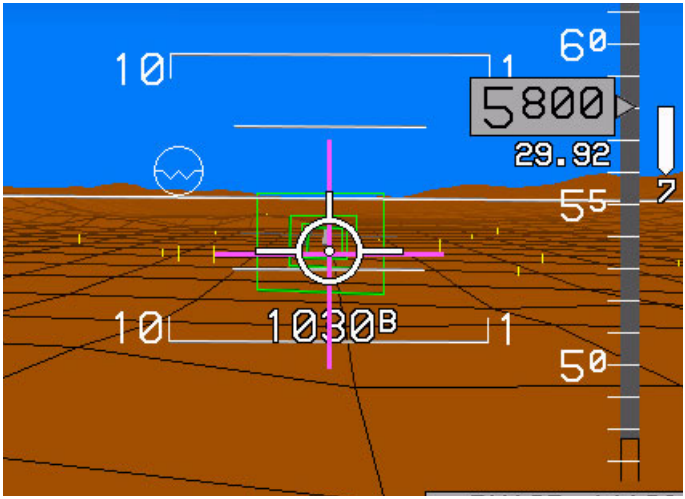
## Flight Director

Conventional dual-cue flight director symbology is available when the EFIS is connected, through the optional AIU-1-1 analog interface device, with an autopilot computer that transmits flight director commands.

The vertical bar moves laterally and the horizontal bar moves vertically to provide bank and pitch cues generated by the autopilot's flight director computer.

Flight director and HSI symbology on the PFD are mutually exclusive although the flight director and skyway can be shown simultaneously.

Refer to your autopilot/flight director documentation for more information on flight director functions.



## Flight Path Marker

The flight path marker appears conformally on the PFD (coinciding with the aircraft's actual flight path as projected upon the outside world). Thus, the flight path marker is displaced laterally from the waterline to account for the difference between aircraft track and heading (crab angle), and vertically from the horizon to account for aircraft glide path or climb angle.

*"This is really very simple. The flight path marker is where the aircraft is going, regardless of where it is pointed."*

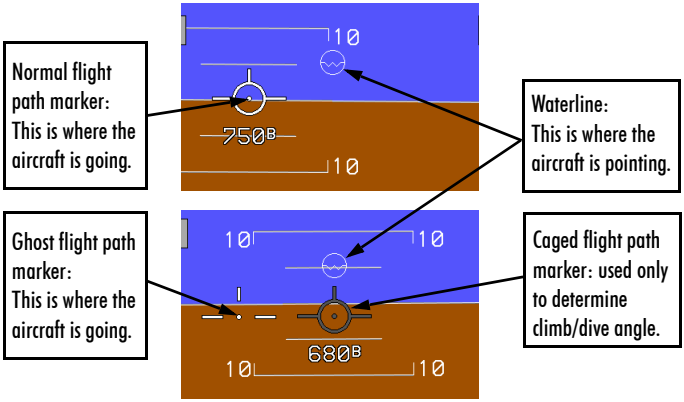
If the flight path marker is superimposed on terrain or an obstruction, the aircraft's current path through the air will result in a collision with that object. Likewise, if the flight path marker is well above terrain in climb, the aircraft will clear the terrain. Placing the flight path marker on a waypoint symbol will result in the aircraft flying directly to the waypoint.

Normally, the flight path marker and pitch scale drift around the screen as a single element. When the flight path marker drifts to the edge of the screen due to a crab angle greater than 15° (7.5° in zoom mode), the flight path marker and pitch scale will automatically cage (return to the center of the screen), and a "ghost" flight path marker, represented by three white bars (two horizontal, one vertical), will remain in its place to indicate flight path. The caged flight path marker is grayed out to indicated that it is in the caged position. When the crab angle drops below 13° (6.5° in normal mode), the pitch scale uncages and realigns with the flight path marker.

Caging of the pitch scale and flight path marker is done to preclude clutter and overlapping of other symbols near the edges of the display.

When the flight path marker is displaced beyond the threshold of the viewing area, the ghost symbol will change color to amber. This will indicate a large crosswind and low groundspeed or an erroneous heading or ground track.

Below: Normal pitch scale and flight path marker. Note lateral position of flight path marker relative to waterline, indicating a crab angle less than 15°.




Above: Caged pitch scale and flight path marker. Note lateral position of ghost flight path marker relative to waterline, indicating crab angle greater than 15°. Nose position to the right of the flight path marker indicates wind from the right.

***"To fly the flight path marker:***
*Simply position it on the symbol you want to fly to.*

*If the flight path marker is above the horizon, you are climbing. If it is below the horizon you are descending.*

*If you want to hit the mountain, put the flight path marker on the mountain. If you want to miss the mountain, put it somewhere else. If the flight path marker cages, use the ghost for getting to the waypoint and use the caged symbol for climb and descent angle.*

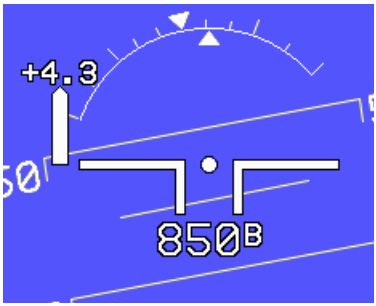
*Beware of the YELLOW ghost, indicating displacement beyond the bounds of the screen."*

## G-Force Indicator

The G-force indicator is presented as a dynamic pointer that grows out of a fixed datum in correspondence with the amount of Gs subjected to the aircraft.

The pointer grows upward from the datum with positive Gs and downward with negative Gs. The actual G loading is shown digitally at the end of the pointer (example: +4.3 Gs).

The G-force indicator is disabled when the difference between G-force and 1-G is less than 0.3 Gs. Appearance of the G-force indicator is damped based upon magnitude and time to prevent nuisance appearances.



## GPS/WAAS CDI

A CDI is centered at the bottom of the display. The CDI scale and mode are shown immediately to the left and the OBS value and mode are shown to the right.

An arrow pointing UP is a TO indication.

An arrow pointing DOWN is a FROM indication.

The CDI scale is adjusted according to phase of flight:
**Enroute** (more than 30NM from destination) – 2NM scale
**Terminal** (within 30NM of destination) – 1NM scale
**Approach** (within 2NM of final approach fix) – 0.3NM scale
**Final** (inside FAF) – Angular (like a localizer)

The OBS value is followed by an "**A**" for automatic or an "**M**" for manual. In automatic mode, the OBS displays the course of the active route segment (the magenta line on the moving map).

In manual mode, the OBS displays the pilot-selected course to the active waypoint.

## Ground Track

The aircraft's track over the ground is indicated on the directional scale by a green diamond. Ground track is based on GPS-measurement.

If the ground track is beyond the limits of the directional scale, it will be displayed at the limit of the scale and highlighted in amber. This situation would be unusual as it would indicate a crab angle greater than 35°.

The ground track symbol is removed below 30 kts.

## Heading Bug

The heading bug is a notched, white rectangle (consistent with target altitude and airspeed bugs) displayed on the directional scale.

When the heading bug is displaced beyond the range of the directional scale, the heading bug value is displayed in a box at the limit of the scale.

In this example, the heading bug is set to 210°.

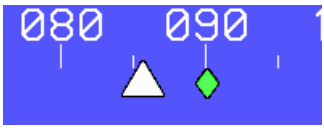
***AUDIBLE ANNUNCIATION***
When the heading bug has been set and captured, a deviation more than 10° from the heading bug will result in an amber caution flag and an auditory chime.

**HEADING**

***NOTE**:*
*If coupled with an autopilot via ARINC-429 roll steering or via the AIU-1 in heading mode, the EFIS will command the autopilot to maintain the selected heading. If the autopilot is flying a flight plan, invoking the heading bug will override the flight plan in favor of the selected heading.*

## Heading Indicator

The heading indicator is a solid white triangle below the directional scale, pointing upward to the current aircraft heading (where the nose is pointed).



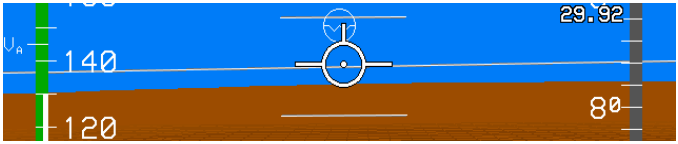

In this example, heading 086°.

## Horizon

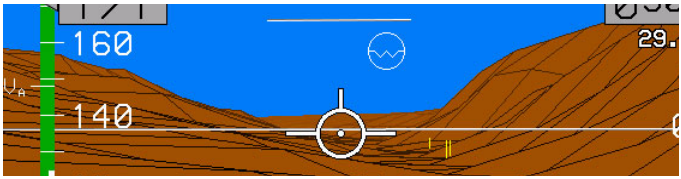
The horizon extends the entire width of the display for enhanced attitude awareness and moves in conjunction with the earth's horizon according to aircraft roll and pitch. There are two components of the horizon symbology, the **artificial horizon** and the **actual horizon**.

The artificial horizon is a thin (thick on helicopters) white line that represents the aircraft's level flight path (or current altitude) projected into infinity. The artificial horizon is used for attitude control and climb/descent angle determination. Objects (waypoint hoops, terrain, traffic, etc.,) that appear above the artificial horizon are above the aircraft's current altitude, while those appearing below the artificial horizon are below the aircraft's altitude. Placing the flight path marker on the artificial horizon will result in level flight.

The actual horizon, as in the real world, is the borderline between ground and sky and can be above or below the artificial horizon. On the PFD, the actual horizon is depicted 40 miles away.



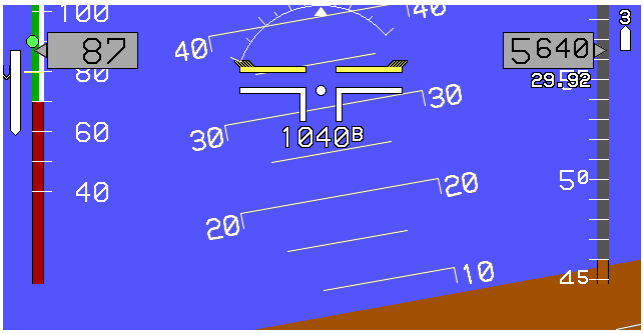

This example shows the artificial horizon and actual horizon over relatively featureless terrain.




This example shows the artificial horizon and actual horizon in mountainous terrain.

## Horizon Cue

In the unusual attitude recovery mode, a small strip of blue or brown is left (no matter how extreme the pitch angle) so as to indicate the closest direction to recovery.



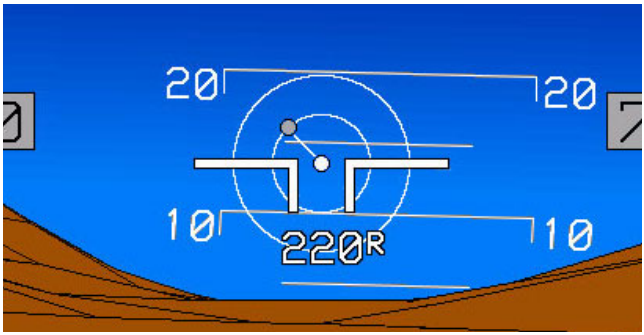
## Hover Vector

Whenever the airspeed is below 30 kts., the flight path marker and waterline are replaced with the conventional attitude bars and the hover vector. The hover vector is centered on the attitude bars and is used to indicated direction and groundspeed of drift at low airspeeds.

The inner concentric ring indicates 15 kts. and the outer concentric ring indicates 30 kts. The white dot indicates a still hover. The gray dot indicates the direction of drift, as viewed from above (straight up, the 12:00 position, equates to forward flight while straight down, the 6:00 position, equates to rearward flight). Groundspeed is determined by the location of the gray dot over the concentric rings.

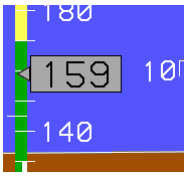
The example below indicates the helicopter drifting forward and to the left (10:00 position) at 15 kts.

AGL altitude is only displayed in conjunction with the hover vector when a high-quality GPS WAAS or radar altimeter signal is present.



## Indicated Airspeed Readout

Indicated airspeed is displayed digitally in a gray box overlaying the airspeed tape. Measured in knots with 1 kt. resolution.

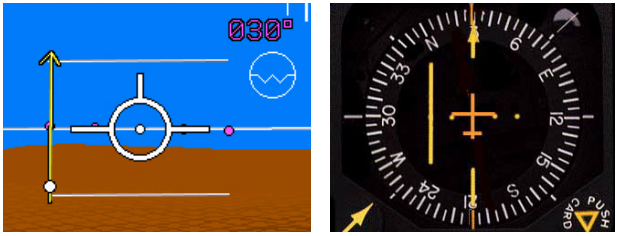



## HSI

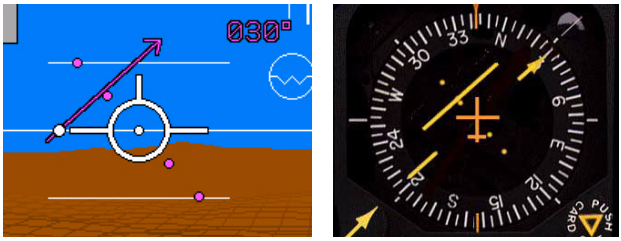
A conventional HSI can be overlaid on the PFD, centered on the flight path marker. The HSI can be driven by Nav 1, Nav 2, or GPS (see **OBS (Omnibearing selector) Function, page 4-13 or HSI Source Selection, page 5-56**) and the source is identified as an advisory flag in the lower left corner of the screen.

The selected course is displayed in magenta above and to the right of the symbol. The white dot on the courseline arrow provides the TO/FROM indication. The deviation dots are automatically decluttered when the deviation is less than one dot.

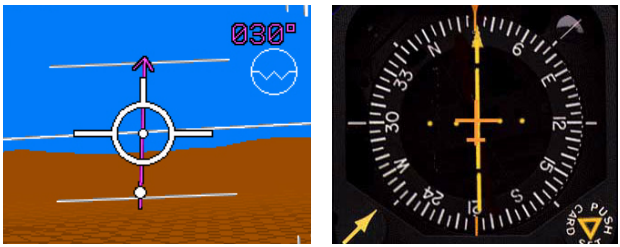
The HSI and flight director symbology are mutually exclusive.




**With a selected course of 030°, the needle is at full-scale deflection to the left (indicated on the EFIS by yellow coloration) and the aircraft is on a parallel outbound course.**




**The needle is alive (indicated on the EFIS by magenta coloration) and the aircraft is on a heading to intercept the 030° course.**



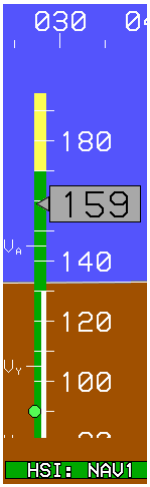

**In this frame, the aircraft is centered on the 030° course FROM the station (indicated by the white dot on the tail of the courseline arrow).**

## Indicated Airspeed Tape

### Fixed Wing (Part 23 aircraft)

The airspeed tape has graduations every 10 knots with labels every 20 knots and high numbers are at the at top. Airspeed indication begins at 30 knots.

The airspeed tape is colored as follows:




1. A red low-speed awareness area from 0 to $V_{S0}$
2. A white area from $V_{S0}$ to $V_{FE}$
3. For aircraft without a $V_{MO}/M_{MO}$, a green area from $V_{S1}$ to No
4. For aircraft without a $V_{MO}/M_{MO}$, a yellow area from $V_{NO}$ to $V_{NE}$
5. For aircraft without a $V_{MO}/M_{MO}$, a red high-speed awareness area from $V_{NE}$ to the top of the scale
6. For aircraft with a $V_{MO}/M_{MO}$, a red high-speed awareness area from the lower of $V_{MO}$ or $M_{MO}$ to the top of the scale
7. For reciprocating multiengine-powered aircraft of 6,000 pounds or less, a red line at $V_{MC}$
8. For reciprocating multiengine-powered aircraft of 6,000 pounds or less, a blue line at $V_{YSE}$
9. A white $V_S$ marking at the aircraft's 1-G $V_{S1}$ or a yellow $V_S$ marking at $V_{S1}$ corrected for G-loading, whichever is higher
10. If enabled, a "green dot" best glide speed marker at $V_{GL}$
11. If enabled, a $V_X$ marking at $V_X$
12. If enabled, a $V_Y$ marking at $V_Y$
13. If enabled, a $V_A$ marking at $V_A$

### Rotorcraft (Part 27 and Part 29 aircraft)

The airspeed tape has graduations every 10 knots with labels every 20 knots and high numbers are at the at top. Airspeed indication begins at 30 knots. Below 30 knots, groundspeed is displayed using the Hover Vector, see **Hover Vector, page 3-27**

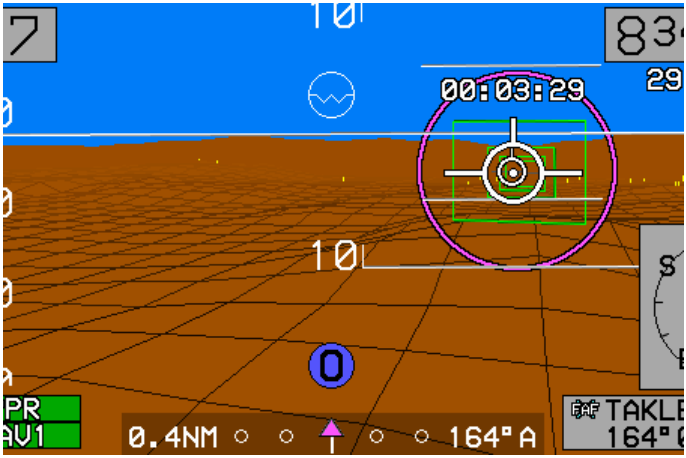
The airspeed tape is colored as follows:

1. A green safe operating range area from $V_{s0}$ to $V_{no}$.
2. A yellow caution range area from $V_{no}$ to $V_{ne}$ (power-on)
3. A red high-speed awareness area from $V_{ne}$ to the top of the scale
4. A red cross-hatched line at $V_{ne}$ (power-off)

## Marker Beacon

Conventional marker beacon indicators are shown centered in the lower portion of the PFD, just above the CDI.

Marker beacons will only be shown when a marker beacon receiver is connected to the EFIS through the optional AIU-1-1 analog interface device.

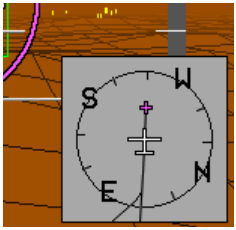


## MiniMap

The MiniMap graphically shows the aircraft's position relative to the active waypoint and route segment in a heading-up orientation.

The MiniMap has no specific scale; it is used for general situational awareness, presenting a simplified, miniature view of what is shown on the navigation display.

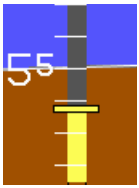
The MiniMap's compass rose has graduations at 30° increments and labels for north, south, east, and west. The active waypoint is shown as a magenta "+" symbol. The line through the waypoint symbol represents the selected course leg. If an instrument approach is selected, the MiniMap displays the entire approach procedure up to the missed approach point. When a missed approach is activated, the MiniMap depicts the entire missed approach procedure.




The MiniMap is only displayed when there is an active waypoint.

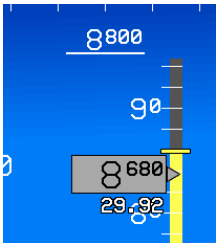
## Minimum Altitude Bug

When a minimum altitude is selected, a bug in the form of a bold amber bar is displayed in the appropriate position on the altitude tape, and the tape below the tick is colored amber. Minimum altitudes can be set in 10-foot increments.




## Minimum Altitude Setting

When a minimum altitude is selected, the setting is indicated above the altitude tape. A minimum altitude value is identified by a line immediately below it. Minimum altitudes can be set in 10-foot increments.




This example shows a Minimum Altitude Setting of 8,800 ft.

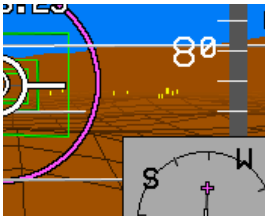
***AUDIBLE ANNUNCIATION***
When a minimum altitude is set, descending below it causes an annunciation of "Altitude"
**ALTITUDE**

## Obstructions

Towers, antennas, and other obstructions are shown on the PFD as vertical amber lines.

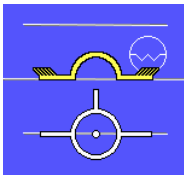
Obstructions are conformal in both location and size (a tower shown 10° left of heading and below the horizon line on the screen will be seen outside 10° left of the aircraft's nose and below the current altitude).

Obstructions are only shown in conjunction with terrain and regardless of aircraft altitude.

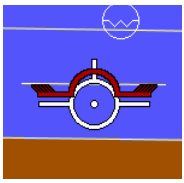


## Pitch Limit Indicator

The pitch limit indicator (PLI) is a winged symbol that appears above the flight path marker and moves downward as the aircraft approaches stall speed. The PLI enhances low speed awareness. The PLI is based on $V_{S1}$ (clean stall, gross weight) and is G-load compensated above one G.

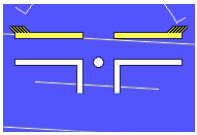


The PLI first appears in amber at 20 knots above G-corrected $V_S$ and moves downward as airspeed decreases.

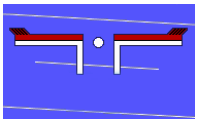


The PLI turns red at 5 knots above G-corrected $V_S$ and activates the STALL voice warning if enabled.

In unusual attitudes (beyond ±25° pitch), the flight path marker is removed and the waterline is expanded. The PLI is displayed relative to the expanded waterline.



Unusual attitude PLI appears in amber at 20 knots above G-corrected $V_S$ and moves downward as airspeed decreases.

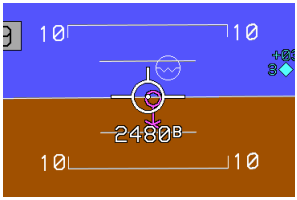


Unusual attitude PLI turns red 5 knots above G-corrected $V_S$ and activates the STALL voice warning if enabled.

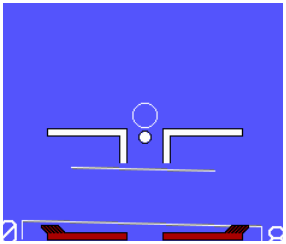
***"To use the pitch limit indicator:***
*Think of it as a low-speed awareness cue; don't let it settle on the flight path marker or attitude bars and you won't stall the aircraft. But remember, since it is based on the clean stall configuration, it is not a stall warning and will turn yellow or red during a normal landing as the speed decays."*

## Pitch Scale

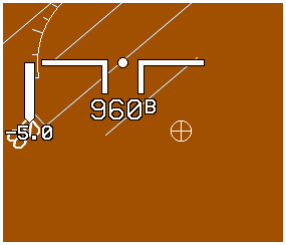
The pitch scale rotates in conjunction with the horizon according to the aircraft's roll angle. The graduations on the pitch scale are spaced to conform with the background.




The pitch scale is truncated, only showing 10° beyond the flight path marker or waterline, whichever is further from the artificial horizon. The pitch scale has graduations every 5° and labels every 10°. Tick marks at the ends of each numbered pitch scale graduation indicate the direction to the horizon.



The pitch scale terminates with a zenith symbol (hollow circle) at 90° up.




The pitch scale terminates with a nadir symbol (circle with cross) at 90° down:

## Skyway

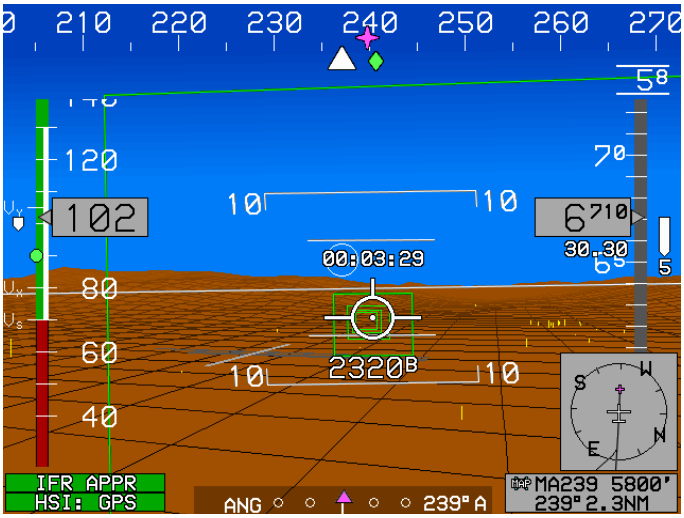
The PFD displays the active navigation route or manual OBS course in a three-dimensional manner using a series of skyway boxes (commonly referred to as HITS or Highway-In-The-Sky). The skyway boxes overlay the flight plan route at a desired altitude providing lateral and vertical guidance.

The skyway is displayed whenever a waypoint, runway, or any approach/departure procedure is selected. The skyway shows the course that you have selected but it is not guidance in the traditional sense (like a flight director) because it does not command you to turn left or turn right or fly up or down. It merely indicates the 3-D course (or procedure) through the air that you have chosen.

The skyway boxes are centered on the active leg of the route. When the active leg of the route is within the field of view on the PFD, five boxes are shown. If the active leg of the route is not in PFD's field of view, the skyway will not be visible.

The boxes are spaced 2,000 feet apart and always measure 320 feet high by 400 feet wide. For comparison, an ILS localizer is 700 feet wide at the runway threshold.

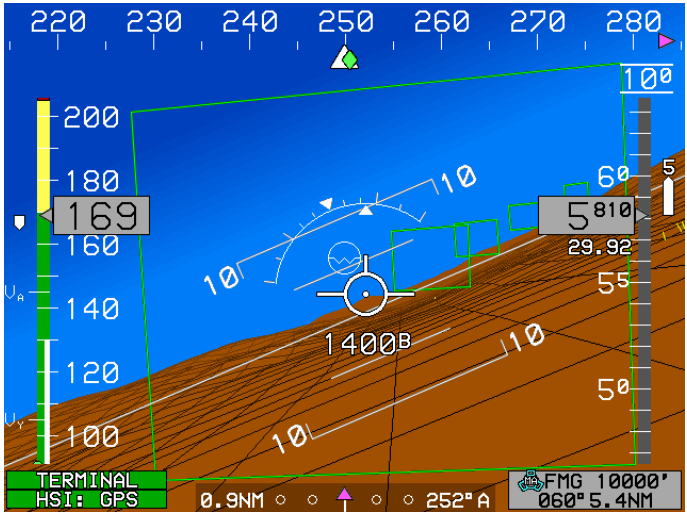
The skyway boxes are drawn using a hidden surface removal techniques such that a skyway box behind terrain will appear to be so. The skyway boxes may be removed from the screen using the **Declutter** menu.




Skyway as seen on final approach (circle-to-land; active runway is light gray).

## Skyway Lateral Navigation (LNAV)

The skyway starts at the beginning of a route or flight plan and terminates at the destination or, if an instrument approach is selected, at the missed approach point. Arming the missed approach procedure (simply pushing the MISSED menu button) causes the skyway to follow the missed approach procedure. It will automatically calculate the entry to the hold and then hold at the missed approach holding fix.




Skyway as seen while executing a missed approach (climbing right turn).

Skyway turns requiring more than 5° bank angle are indicated by boxes banked 15° in the direction of the turn, while turns requiring less than 5° bank angle are unbanked.

For example, a holding pattern or procedure turn will have banked boxes indicating the turn, while a 15-mile DME arc will have unbanked boxes because it is a very gradual turn along the arc.

The system is configured with a $\mathbf{V_{PROC}}$ or preprogrammed speed to determine the radius of the skyway turns in a procedure. $\mathbf{V_{PROC}}$ is used on:

1. the first two waypoints in a DP,

2. STAR waypoints within 30NM of the destination,

3. IFR approaches.

Otherwise, turn skyway turn radius is based on a 15° bank at the higher of the preprogrammed $\mathbf{V_{PROC}}$ or current speed. Therefore, in zero-wind conditions, the angle of the flight path

marker will match the angle of the boxes. However, wind will cause the actual bank angle required to stay within the skyway to vary.

Due to the fact that five boxes are shown ahead of the aircraft, upcoming turns are apparent well before turn input is required, thus they become an anticipatory cue for the pilot. The pilot always has a clear understanding of what will happen next along the course.

***"To fly skyway turns:***
*Wait until you fly through the last level box on a straight course segment before initiating your turn. If you overshoot the next box, just increase your bank angle slightly. If you undershoot the next box, shallow your bank angle a bit. You can check your progress through a turn by looking at the projected path on the moving map; just make it match the curve of your courseline."*

***NOTE**:*
*The boxes do not indicate a target bank angle because of the effects of wind. The bank of the boxes is just to indicate a turn.*

## Skyway Vertical Navigation (VNAV)

Skyway altitude is controlled by target altitude, aircraft altitude, and climb/descent angle setting. If no target altitude is set, then the skyway boxes are shown at aircraft's current altitude.

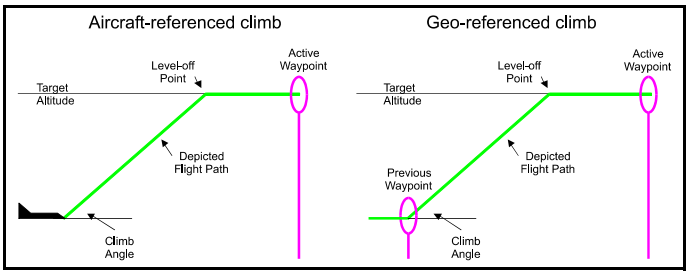
When a target altitude is entered by the pilot (using the BUGS menu), or automatically from the approach database, skyway boxes climb or descend then maintain the target altitude.

Climb and descent angles (VNAV) for enroute and approach procedures are entered manually by the pilot, see **Bug Set Function, page 4-19**, until inside the final approach fix, at which point the descent angle is generated from the navigation database.

When the active waypoint is part of a procedure, the system expects the altitude constraint for that waypoint to be provided by the navigation database. Where a procedure altitude

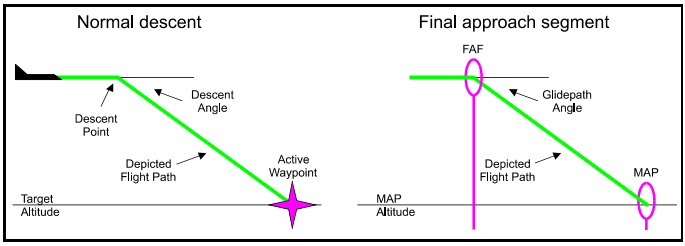
constraint exists, the system automatically updates the target altitude to match the altitude constraint. Where a procedure altitude constraint does not exist, the system searches further waypoints in the procedure for additional altitude constraints (it looks ahead). If a further altitude constraint is found and it is above current aircraft altitude (a climb is necessary), then a target altitude is calculated for the active waypoint based upon an immediate climb to the altitude constraint at the current VNAV climb angle setting. If a further altitude constraint is found and it is below current aircraft altitude (a descent is necessary), then a target altitude is calculated for the active waypoint based upon a descent to reach the altitude constraint at the waypoint using the current descent angle setting. Remember, VNAV climb and descent angles are entered manually by the pilot. It is always possible for the pilot to override the procedure altitude constraint or calculated altitude constraint by manually setting the target altitude bug.

When the aircraft is below the target altitude (a climb is desired), the skyway boxes are drawn at a vertical position that is the higher of: (a) the climb angle beginning from the aircraft's current position (aircraft-referenced); or (b) the climb angle beginning from the previous waypoint altitude (geo-referenced). Once the boxes intercept the target altitude, further boxes are a shown leveling off, followed by a level flight segment. The climb angle is based on the current VNAV climb angle. Due to the fact that five boxes are shown, the level-off depiction becomes an anticipatory cue for the pilot. Climb guidance is depicted below:



**Descents**

When aircraft altitude is above the target altitude (a descent is desired), the skyway boxes continue level until reaching a descent point. Beyond the descent point, the boxes are shown descending at an angle corresponding to the VNAV descent angle setting. The descent point is defined by the intercept of a line emanating upward from the active waypoint at the VNAV descent angle setting, and a line representing level flight at the aircraft's current altitude. On the final approach segment of an IFR or VFR approach procedure, the descent point is the Final Approach Fix and the descent angle is the angle that creates a stabilized approach to the Missed Approach Point location and altitude as stored in the navigation database. Due to the fact that five boxes are shown, the descent point depiction becomes an anticipatory cue for the pilot. Descent guidance is depicted below:




When the pilot of this aircraft at 15,000 ft. sets a target altitude of 10,000 ft. and a VNAV-Descent angle of -3°, the skyway will remain at the current altitude until a 3° descent will cross the waypoint at 10,000 ft. The target altitude will then remain at 10,000 ft. until the pilot changes it or it is changed automatically from the database as part of a procedure. On final approach, the skyway follows the angle between the final approach fix and the missed approach point.

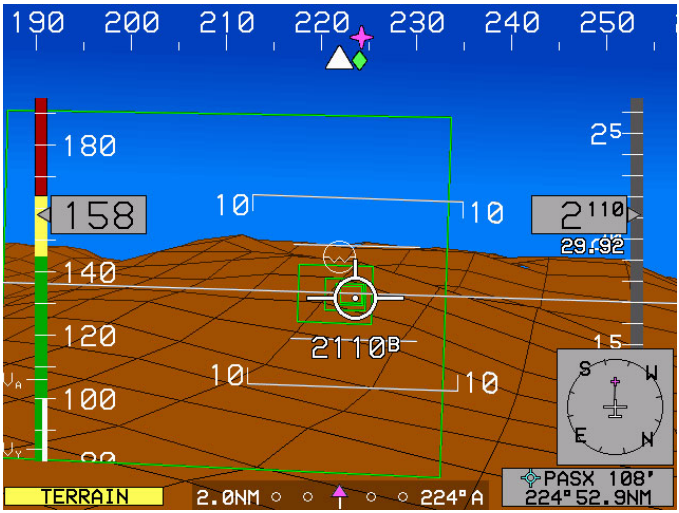
If the aircraft descends to the lower target altitude before the descent point, as in an expedited descent, the skyway will recenter on the new altitude once it is reached.

***NOTE**:*
*VNAV-Climb and VNAV-Descent angles will retain their last setting until changed by the pilot. The factory default for both values is 3°. Be sure to verify the descent angle when initiating a VFR approach using the skyway.*

**Flying the skyway**

Because of its visually oriented 3-D nature, flying the skyway is easy, like driving down the road (you don't need needles or command bars to tell you how to stay in the center of your lane). The boxes indicate the path through the air you want to take and the flight path marker indicates the path through the air you are actually flying. Simply fly the flight path marker through the boxes; wind is accounted for automatically. If you find yourself drifting out of the boxes, simply drift back to the center, like you would on the road in your car. Also, just like in your car, don't make large corrections or you will S-turn along the course. Most pilots master the skyway in less than 15 minutes.

It is important to recognize that the skyway does not provide precision vertical instrument approach guidance, nor does it guarantee terrain separation. As with any navigation device, it is possible, using the **Direct-To** function for example, to generate a course that will impact terrain as shown below.




In this circumstance, however, the compelling nature of the forward-looking terrain display combined with the advance TAWS capabilities will provide the pilot with the situational awareness to recognize the hazard and take the appropriate corrective action.

***"The key to successfully flying the skyway is:***

1. *When flying straight and level, don't try to steer through the nearest box. Aim for the smallest box you can see and make small corrections, like you are flying an ILS.* ***Rule of thumb: If you see the bank angle scale come on, you are using too much bank.***

2. *When turning, if you find yourself turning inside or outside the turn radius indicated by the skyway, relax and simply increase or decrease your bank angle slightly. If you look down at the CDI, it will probably be nearly centered (unlike a VOR/LOC the CDI provides course deviation indication throughout turning maneuvers, as well as for straight courselines). Remember, the skyway is only half the width of the localizer at the inner marker making it very precise, so if you are a bit inside or outside, you are still flying with extreme precision.*

3. *When joining the skyway at an angle, think of it as merging onto the freeway using an on-ramp. Join up gradually and make small adjustments.*

4. *If you are given an expedited descent before the skyway begins its descent, just manually descend below the boxes to the target altitude; the skyway will join you down there at the new altitude when you level off.*

5. *If you ever lose track of the skyway, simply look at the moving map and locate the active (magenta) leg of your course. The skyway will be located along that courseline. If you are on the magenta line and the skyway is not visible, it is probably above or below you based on your target altitude setting.*

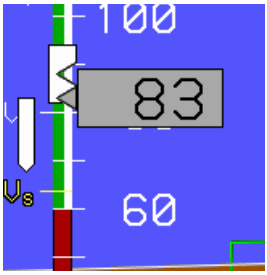
6. *Pay attention to where the skyway is taking you; if you don't like the looks of it, don't go there."*

## Speed Trend Indicator

The Speed Trend Indicator is presented as a dynamic pointer that grows out of a fixed datum in correspondence with changes in horizontal velocity.

The pointer grows upward from the datum when accelerating and downward when decelerating.

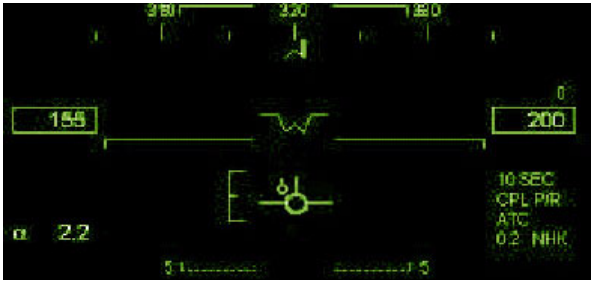
The pointer tells the pilot what the aircraft's velocity will be in five seconds.




The above example shows that the aircraft will be at approximately 68 KTAS in five seconds.

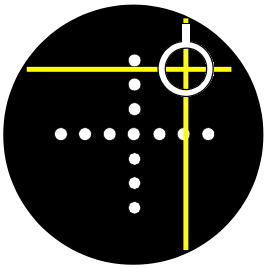
## Tadpole (ILS)

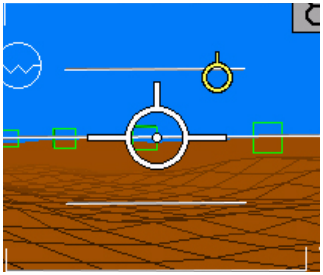
Originally developed for the F/A-18 ACLS (Automatic Carrier Landing System), the tadpole provides raw data from the localizer and glideslope as a small circle with a short line extending upward from the 12:00 position, centered about the flight path marker.




The tadpole symbol is visible on this F/A-18 HUD near the center of the display, just left of and above the flight path marker.

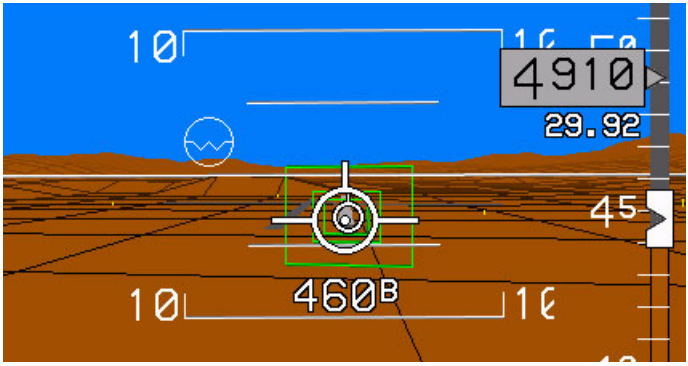
The tadpole comes on automatically with valid localizer and glideslope signals and indicates the intersection of the localizer and glideslope needles as shown below. The center dot on the flight path marker represents zero deviation. At full-scale deflection, the tadpole will be outside the flight path marker about the length of the horizontal “wing” and will flash yellow.





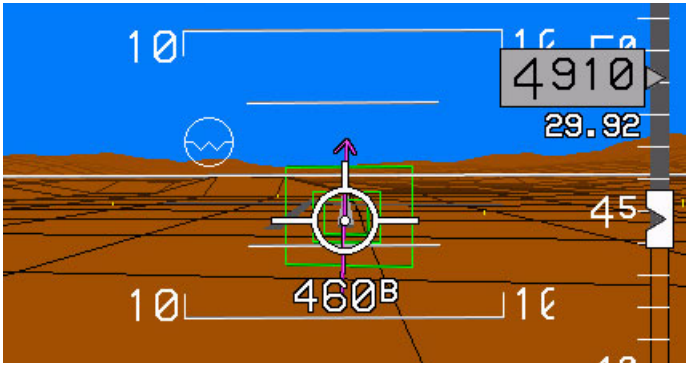
So, if the tadpole is high and to the right, like above, just make a slight heading change to the right and fly level until intercepting the glideslope.

Once the tadpole is inside the flight path marker (which is easy to do using the skyway), you are within one dot of deviation. The manner in which the tadpole circles the center dot of the flight path marker makes tiny deviations readily apparent -- just keep it centered.



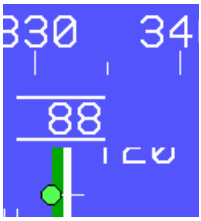

**Remember, the skyway is always driven by GPS (lateral) and barometric altitude (vertical) while the tadpole is always driven by the ILS so you have a continuous cross-check of independent sources centered in your scan.**

For localizer-only (no glideslope) display, the tadpole is replaced by a magenta course needle just like on the HSI but without the TO/FROM indication (no white dot). The HITS will continue to provide vertical navigation to the missed approach point.



## Target Airspeed

The current target airspeed is displayed in conjunction with the target airspeed bug immediately above the airspeed tape. The value is bracketed by lines above and below.

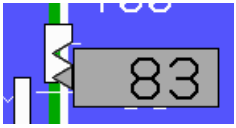



In this example, the target airspeed is set to 88 kts.

***AUDIBLE ANNUNCIATION***
When a target airspeed is set and has been reached, deviation of more than 10 kts. will result in an amber flag and a voice warning of "Airspeed. Airspeed."
**AIRSPEED**

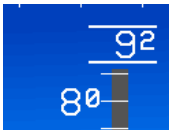
## Target Airspeed Bug

A bug marking the target airspeed is displayed on the airspeed tape. The bug moves up and down the tape as the control knob is rotated.



## Target Altitude

The target altitude is displayed above the altimeter tape and is bracketed by a line above and below. Target altitude is settable with a resolution of 100 ft. enroute and in terminal mode, and 10 ft. in approach mode.



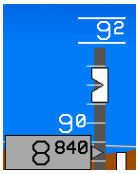

In this example, target altitude is set to 9,200 ft.

***AUDIBLE ANNUNCIATION***
When a target altitude is set and has been reached, deviation of more than 150 feet will result in a single annunciation of "Altitude. Altitude."

**ALTITUDE**

## Target Altitude Bug

A bug marking the target altitude is displayed on the altitude tape. The bug moves up and down the tape as the control knob is rotated. Target altitudes are also set automatically for waypoints during procedures.



## Terrain

The terrain ahead of the aircraft is shown conformally with the artificial horizon and in the correct scale and perspective for the aircraft's current position and altitude.

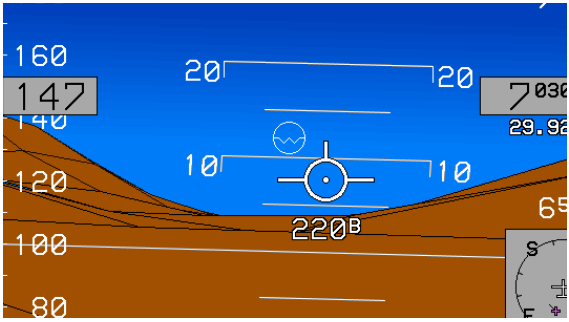
Terrain is currently shown with a resolution of 24 arc seconds, which represents about 2,400 feet.

Terrain is displayed 14 miles ahead of the aircraft using a grid and simulates "atmospheric perspective," meaning that the terrain lines fade into the background "ground" color as they recede into the distance. This enhances the three-dimensional effect, improves distance judging, and minimizes foreground occlusion (objects in the foreground that cannot be seen against a similar background). Furthermore, a 40NM actual horizon is depicted.

A blended-tone sky is displayed in conjunction with terrain. The sky fades from light blue at the horizon to dark blue at the top of the display to simulate atmospheric perspective and enhance the 3-D presentation. Additionally, the blended sky increases contrast of the directional scale, emphasizes the horizon, and provides a compelling visual cue to a nose-high attitude.

If a runway or the "**x**" at the bottom of the waypoint symbol is obscured, then there is terrain between the aircraft and the runway or waypoint at ground level.

**This is an important point; if the aircraft is descending and the active waypoint becomes obscured or partially obscured, the aircraft could impact terrain.**




Terrain in this example is approximately 15° above the horizon on both sides of the flight path. Position of flight path marker indicates that terrain will be cleared if the current climb angle is maintained.

Terrain display is dependent on geodetic altitude, if high-quality GPS is available, otherwise, barometric altitude setting is used and, therefore, can only be as accurate as the current setting. Furthermore, while the grid uses the highest points for terrain depiction, terrain between datapoints is not displayed. This results in a “simplification” of the terrain that will be most noticeable near ground level in areas of rugged terrain.

The FlightLogic EFIS includes integral Class C TAWS (Terrain Awareness Warning System) and, optionally, may include Class B or Class A TAWS. For a detailed description of TAWS functions, refer to the TAWS section in the appendix.

While the Chelton EFIS uses the same terrain source as the enhanced ground proximity warning systems in airliners and is quite accurate, certain areas exhibit greater errors than others.

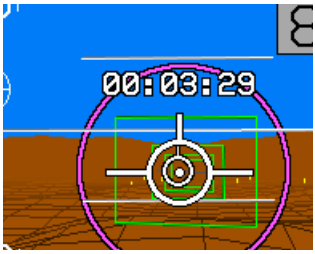
**Please see the Terrain NOTAM at www.cheltonflightsystems.com (DOWNLOADS section) which is posted whenever a new terrain database is compiled.**

***"How to use the terrain display:***

1. *Unless you want to be involved in an accident, don't use the terrain depiction in instrument conditions for operating below minimums or without regard to published procedures.*
2. *When climbing out of a valley, climb in a circle above the airport until the flight path marker is well above the terrain (factor in anticipated climb deterioration).*
3. *The terrain shown on the PFD and moving map will often give you a clear understanding of why the published instrument procedures are making you do what you are doing.*
4. *If you have selected a course and altitude that will impact terrain, ignore the course and avoid the terrain visually on the PFD.*
5. *If you encounter inadvertent VFR flight into instrument conditions,*
   a. *Remain calm and immediately set the heading bug to the reciprocal of your course.*
   b. *Using the PFD, level the wings and ensure the flight path marker is not overlaying terrain; if it is, turn gently toward lower terrain and initiate a climb if necessary to position the flight path marker in the blue.*
   c. *Look at the moving map to determine the direction to turn away from terrain, and turn to your heading bug.*
   d. *If you get a terrain alert, identify the threatening terrain on the moving map and maneuver to avoid it."*

## Timer

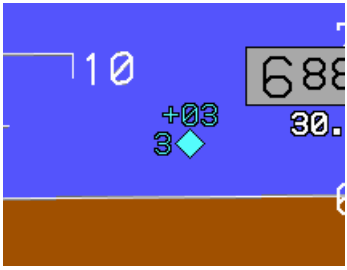
A timer showing **hours:minutes:seconds** is displayed at the pilot's option, immediately above the flight path marker. Timer can be set to count up indefinitely or count down from a pilot-specified value. Elapsed time since power-up can also be shown without affecting an active timer. When selected, elapsed time is shown for 10 seconds in the lower right corner of the screen.




***AUDIBLE ANNUNCIATION***
A chime annunciates the expiration of a count-down timer.

## Traffic

When interfaced with a suitable traffic receiver, airborne traffic is displayed on the PFD as symbols that are based on the level of threat. Since the artificial horizon represents ownship altitude, traffic displayed above the horizon is above your altitude, and traffic below the artificial horizon is below your altitude.




This traffic is above your altitude (300 ft.), 3 miles away.

The relative altitude is shown above (**+**) the symbol when the traffic is above or below (**-**) the symbol when the traffic is below your altitude. Traffic distance is shown to the left of the symbol. A vertical direction arrow to the right of the symbol indicates a climb or descent greater than 500 fpm.

| | |
|---|---|
| ● | **Traffic Alert - Traffic within immediate vicinity based upon flight parameters.** |
| ◆ | **Proximate Advisory - Traffic within 6NM and 1,200 ft. of ownship altitude.** |
| ◇ | **Other Traffic - Traffic detected beyond 6NM and 1,200 ft.** |

When the ownship AGL indication is less than 400 ft., traffic is shown but alerts are not given. Traffic within 200 ft. of ground level is not shown or annunciated.

***AUDIBLE ANNUNCIATION***
Traffic alerts will result in an amber flag and a single voice warning of “Traffic. Traffic.”

**TRAFFIC**

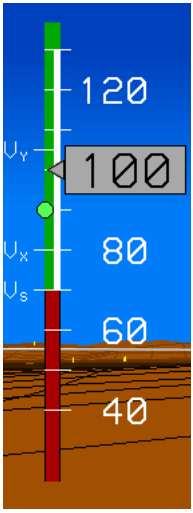
## V-Speeds

Significant aircraft speeds that are not indicated by airspeed tape coloration ($V_X$, $V_Y$, $V_A$, etc.) are shown on the outboard side of the airspeed tape.

See **Indicated Airspeed Tape, page 3-30** for more information.

**Vs** (clean stall, gross weight — the bottom of the green range) is displayed dynamically and corrected for G-force in turns and turbulence.

See **Dynamic Stall Speed, page 3-18** for more information.




***NOTE**:*
*No V-speeds are shown on rotorcraft airspeed scale.*

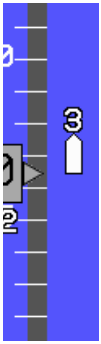
## VSI

The vertical speed indicator is presented as a dynamic pointer that grows out of a fixed datum in correspondence with the vertical velocity.

The pointer grows upward from the datum in a climb and downward in a descent.

The actual vertical speed is shown digitally at the end of the pointer and is graduated in hundreds of feet per minute (example: 5 = 500 ft./min.).

VSI showing a 300 ft./min. descent.

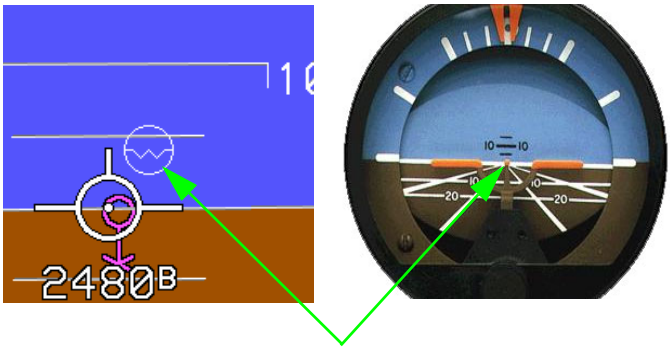



VSI showing a 300 ft./min. climb.

The VSI is only shown when there is a vertical velocity.

## Waterline

Fixed in the center of the primary flight display, so as to align with the longitudinal axis of the aircraft, is a waterline symbol (a **"W"** in a circle). Rotation of the horizon and pitch scale occurs relative to the waterline symbol, indicating aircraft attitude. The waterline is analogous to the orange or white dot in the center of a mechanical attitude gyro; it is where the nose is pointed.




This is essentially the same thing although the waterline will typically indicate a few degrees up for the angle of incidence and is not adjustable.

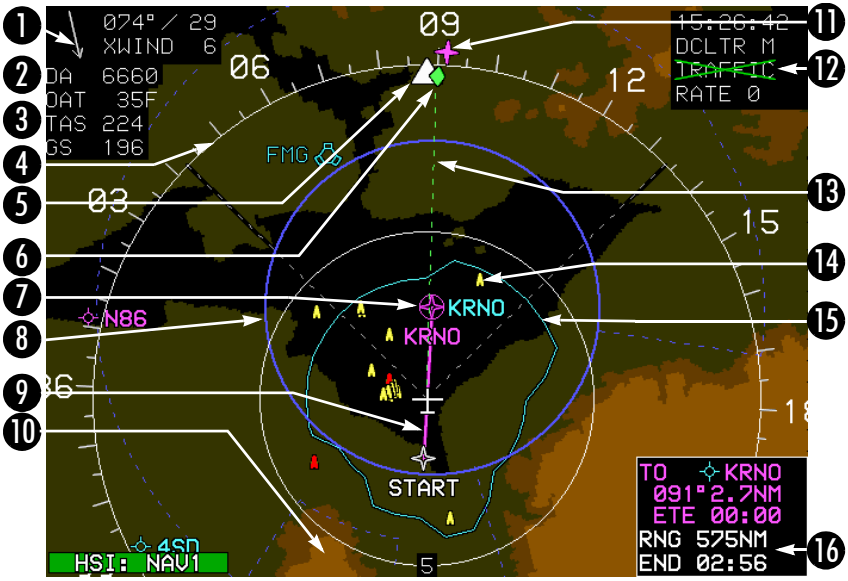
## Waypoint Direction Pointer

When the waypoint symbol is beyond the range of the directional scale, a magenta pointer indicates the shortest direction of turn to the active waypoint.

# Navigation Display Symbology

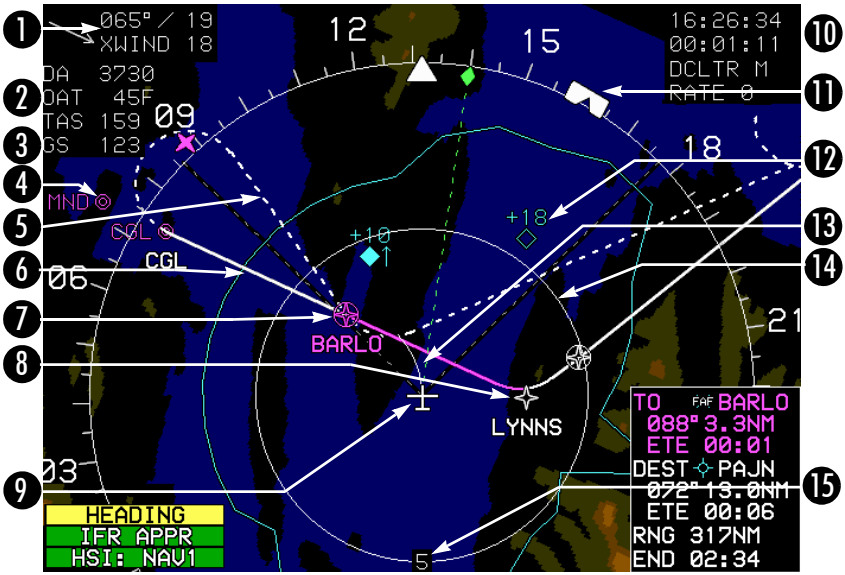
The navigation display can be presented in a variety of formats including moving map (arc or centered) in heading-up or north-up orientation, conventional HSI, dedicated traffic display, or dedicated weather display. The moving map is vector-based and uses Jeppesen NavData and other databases to display airports, navigation aids, airspace, winds, terrain, obstructions, and more. When the EFIS is integrated with the appropriate external devices, the map will display weather and traffic.

# Basic Moving Map



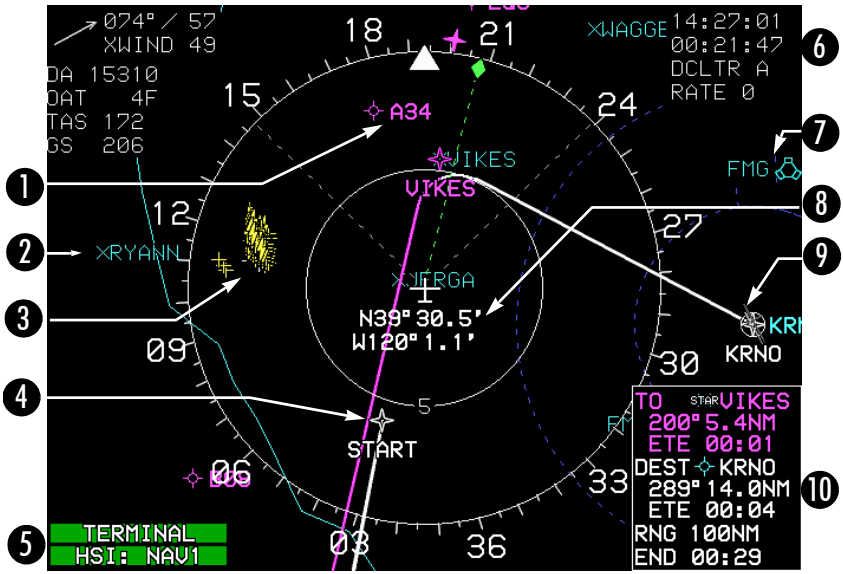

1. Wind vector
2. Density altitude
3. True airspeed
4. Directional scale
5. Heading indicator
6. Ground track
7. Waypoint
8. Airspace
9. Courseline
10. Terrain
11. Bearing to waypoint
12. Mode annunciators
13. Ground track lubber line
14. Obstruction
15. Dead-stick glide area
16. Fuel totalizer

# Moving Map with Instrument Approach



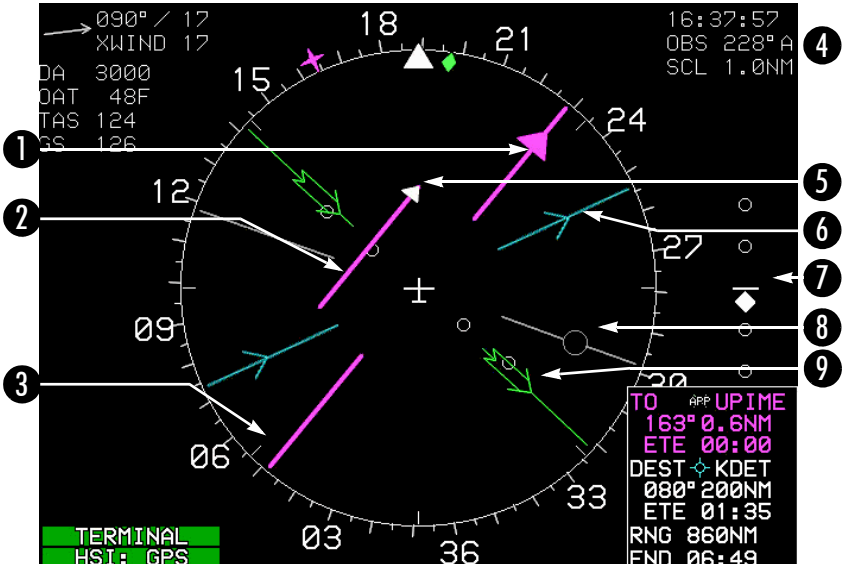

1. Wind data
2. Outside air temperature
3. Groundspeed
4. NDB
5. Missed approach course
6. Instrument approach course
7. Waypoint (fly-over)
8. Waypoint (fly-by)
9. Aircraft position
10. Zulu clock and timer
11. Heading bug
12. Traffic
13. Projected path
14. Range ring
15. Range ring scale

# Moving Map with STAR




1. VFR Airport
2. Intersection
3. Lightning strikes
4. Start Waypoint
5. CWA flags
6. Timer
7. VORTAC
8. Latitude longitude
9. Airport runway diagram
10. Navigation log

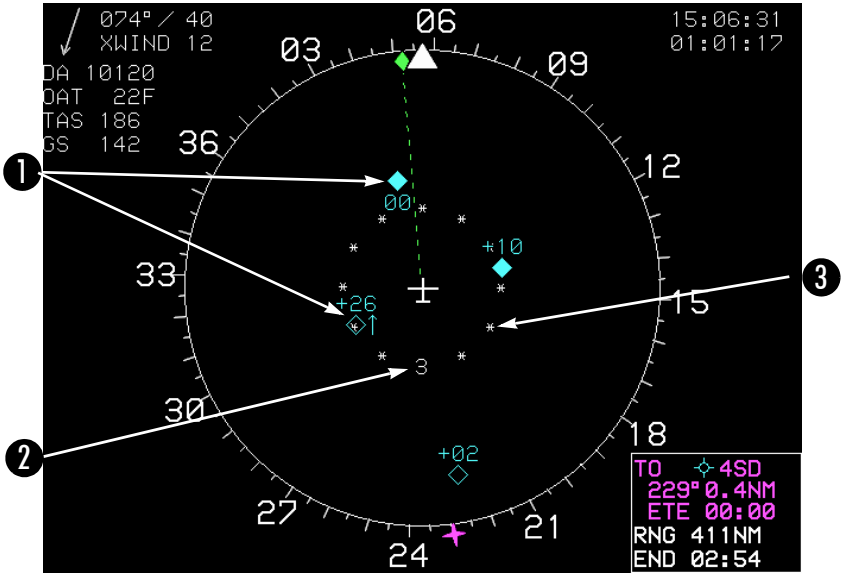
# Conventional HSI/RMI Format




1. Courseline arrow
2. CDI needle
3. 45° marks
4. CDI scale and OBS setting
5. To-From indicator
6. RMI needle (Nav 1)
7. Glide slope indicator
8. ADF needle
9. RMI needle (Nav 2)

***NOTE**:*
*RMI/ADF symbology is only available when the EFIS is interfaced with the appropriate external receivers.*

# Traffic Display

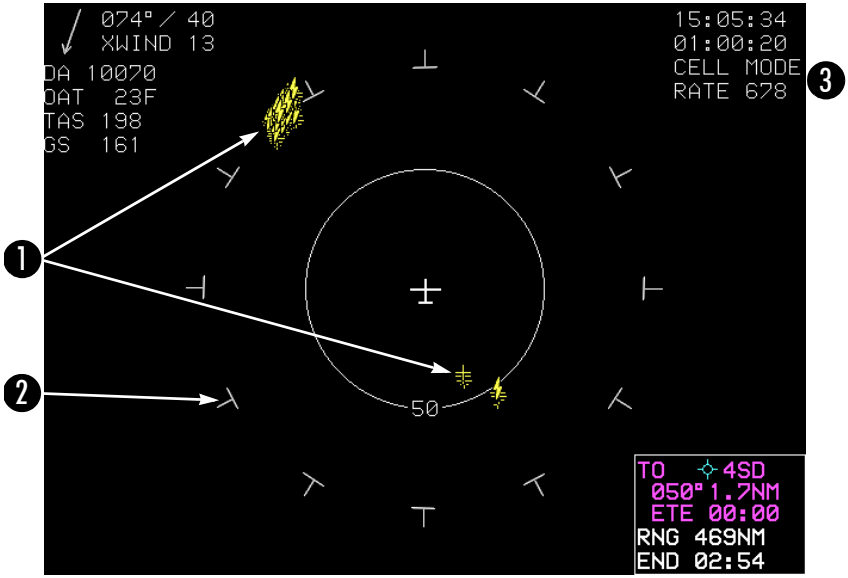



1. Traffic
2. Traffic position scale
3. Traffic position reference

The route and waypoints may be overlaid on this display at the pilot's discretion.

***NOTE**:*
*This display page is only available when the EFIS is interfaced with a suitable traffic sensor.*

# Lightning Display

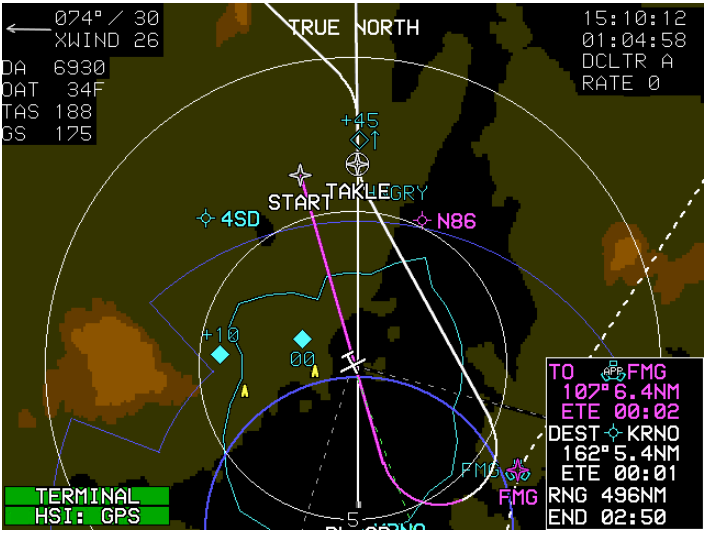



1. Lightning strikes
2. Strike position reference
3. Mode and rate indicators

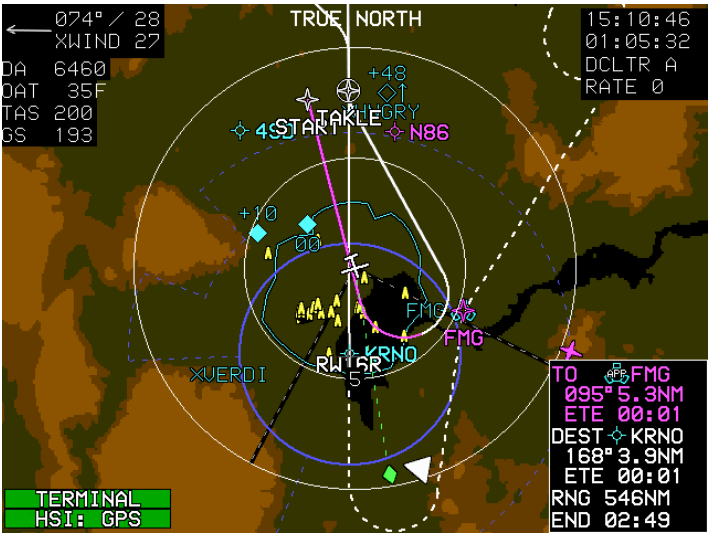
The route and waypoints may be overlaid on this display at the pilot's discretion.

***NOTE**:*
*This display page is only available when the EFIS is interfaced with a WX-500 Stormscope.*

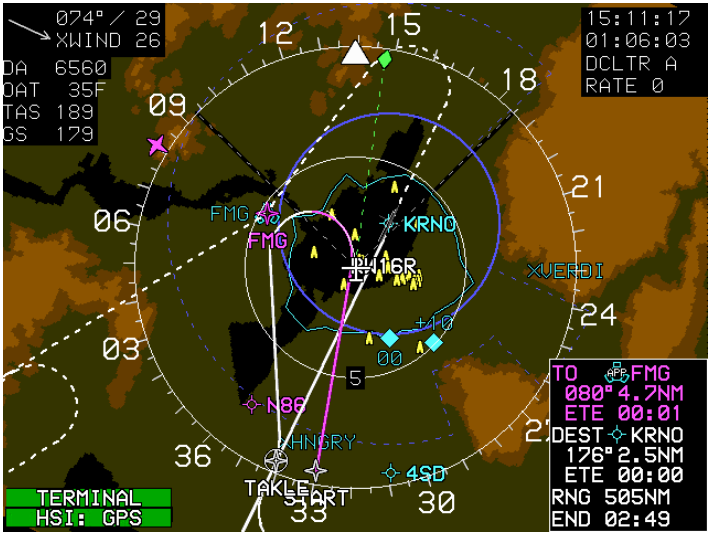
# North-Up Arc Mode




# North-Up Centered Mode



# Heading-Up Centered Mode



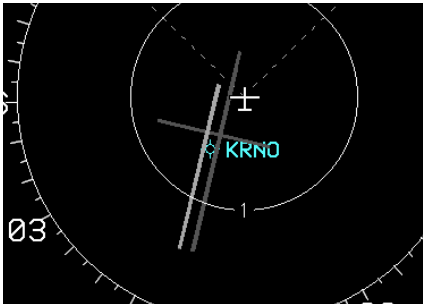
## Aircraft Position

The aircraft symbol indicates ownship position relative to the map elements. The aircraft is always located at the center of the concentric range rings.

The aircraft position may be viewed in arc mode, showing approximately 240° of directional scale ahead and to the sides of the aircraft, or centered with the directional scale forming a full 360° compass rose around the aircraft.

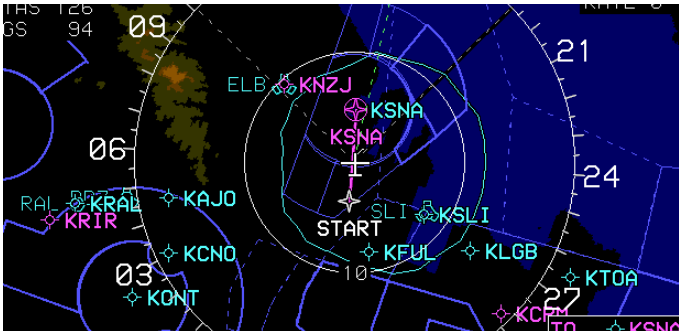
## Airport Runway Diagram

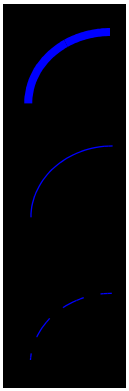
On system power up, all runways at the current airport are shown for enhanced situational awareness and to minimize runway incursion. When an instrument approach is selected, all runways at the destination airport are shown in correct scale with the usable portion of the selected landing runway displayed in a lighter shade of gray.



## Airspace Markings

Special-use and controlled airspace boundaries are indicated with blue lines of varying styles.



Heavy, solid blue airspace lines **CANNOT** be crossed without communication or clearance at the current altitude.

Thin, solid blue airspace lines **CAN** be crossed at the current altitude, but the aircraft is within 500 ft. vertically of the airspace's floor or ceiling.

Thin, dashed blue airspace lines **CAN** be crossed at current altitude and the aircraft is more than 500 ft. vertically from the airspace floor or ceiling.

***"Don't bust airspace!***
*If you are VFR, crossing only thin airspace lines will keep you out of trouble. If you are IFR, airspace is irrelevant so turning it off keeps screen clutter to a minimum."*

## Bearing to Waypoint

The bearing to the waypoint is indicated on the directional scale by a magenta star, which is the same symbol used for waypoints on the moving map and on the PFD directional scale.

## CDI Needle / CDI Displacement Marks (HSI Format)

A CDI is centered in the middle of the conventional HSI display and shows direction and magnitude of deviation from the course when read against the courseline arrow and aircraft position symbol. The CDI needle rotates around the aircraft position symbol such that it remains parallel with the courseline arrow. The CDI needle rotates independently of the directional scale when the courseline is being set by the pilot (Manual OBS).

The HSI may be driven by Nav 1, Nav 2, or GPS and the current source is always indicated by an HSI SOURCE advisory flag.

HSI source may be changed using the OBS button (see **OBS (Omnibearing selector) Function, page 4-13** and **HSI Source Selection, page 5-56**).

The CDI needle moves laterally over CDI displacement marks.

During GPS/WAAS operations, the CDI scale is adjusted automatically according to phase of flight:

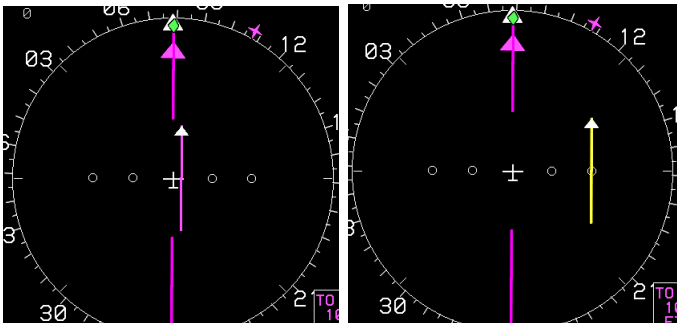
**Enroute** (more than 30NM from destination) – 2NM
**Terminal** (within 30NM of destination) – 1NM
**Approach** (within 2NM of final approach fix) – 0.3NM

CDI Scale is measured from the center line to the second displacement mark.

In **automatic** mode, the OBS displays the course of the current route segment.

In **manual** mode, the OBS displays the pilot-entered course to the active waypoint.

Once the course is set (Manual or Automatic OBS), the CDI remains fixed relative to, and rotates with, the directional scale. The CDI displacement marks always remain perpendicular to the courseline and the CDI needle moves laterally within the limits of the scale to indicate deviation from the selected course. At full deflection, the CDI needle is displayed in amber.



***"Mind your OBS.***
*If your skyway or courseline doesn't seem to be working, check the OBS mode setting (Manual or Automatic is annunciated) in the upper right corner of the ND. Set the OBS using the OBS button function."*

## CDI Scale and OBS Setting (HSI Format)

CDI scale value, mode, and OBS setting are annunciated in the upper right corner of the display.

The OBS value is followed by an "**A**" for automatic mode or an "**M**" for manual mode.

In automatic mode, the OBS displays the course of the current route segment.

In manual mode, the OBS displays the pilot-entered course to the active waypoint.

***NOTE**:*
*Only the OBS bearing is shown when HSI source is Nav 1 or Nav 2 (no scale or mode indication).*

## Courseline

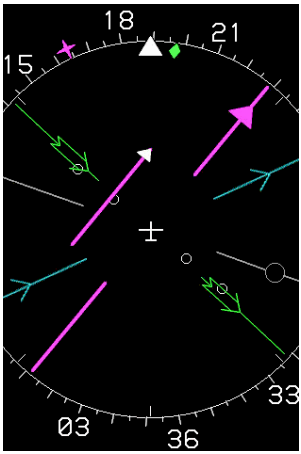
The courseline connects the waypoints of the route for both flight plans and direct navigation and is only shown when a flight plan or waypoint is activated. Turns are drawn actual size based on the speed of the aircraft or **$V_{PROC}$** (see page 3-39).

The courseline is shown in white except for the active leg, which is shown in magenta. The second waypoint is automatically activated upon selection of a flight plan. The active (magenta) leg is automatically sequenced upon waypoint passage. Any leg of the flight plan may be selected by the pilot as the active leg using the **ACTV** menu.

*"If you ever lose track of the skyway, simply look at the moving map and locate the active (magenta) leg of your course. The skyway will be located along that courseline. If you still don't see it, it is probably above or below you based on target altitude."*

## Courseline Arrow (HSI Format)

The courseline arrow indicates the selected course (Manual or Automatic OBS) and consists of a head and tail displayed within the boundaries of the directional scale. The head and tail are always aligned with each other (allowing space for the CDI needle); the head points to the selected course and the tail points to the reciprocal of the selected course when read against the directional scale. The courseline arrow rotates independently of the directional scale when the courseline is being set by the pilot (Manual OBS or VOR OBS).




Once a course is set, the courseline arrow remains fixed relative to, and rotates with, the directional scale.

## CWA Flags

The CWA (**Caution/Warning/Advisory**) flags alert the pilot to situations that require pilot awareness. Warnings are indicated by a red flag. Cautions are indicated by an amber flag. Flagged advisories are indicated by a green flag.

Flags are stacked with warnings on top, followed by cautions, and then advisories. Flags are shown in reverse chronology. For a complete list of flags and annunciations, as well as order of prioritization, see **Caution/Warning/Advisory System, page 2-11**.

***AUDIBLE ANNUNCIATION***
CWA flags are accompanied by an auditory annunciation.

## Dead-Stick Glide Area

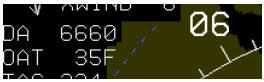
The area in which a power-off landing can be made from the current altitude is shown as an irregular light blue line encircling the aircraft position symbol. This is a dynamic calculation and changes constantly during flight.

The glide area, as presented, is based on the aircraft's best-glide speed (the green dot on the airspeed tape). The glide area is

adjusted for turns, wind, terrain, airspeed, pilot reaction time, and stored energy, and indicates the point at which the aircraft will be at approximately 200 feet above the ground during the glide.

## Density Altitude

The density altitude display corrects pressure altitude for nonstandard temperatures. Measurement is in feet MSL.(mean sea level)

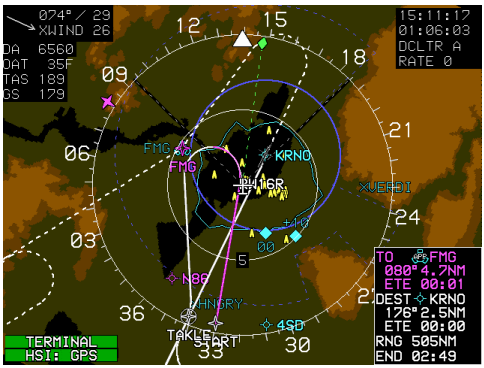



Density altitude is shown in amber any time conditions are above standard day.

## Directional Scale

A stabilized directional scale is presented as the outermost range ring on the navigation display. Directional scale may be viewed in an arc or centered format.

Directional scale in arc




Directional scale in centered format

## Fuel Totalizer

Fuel range (**RNG**) and endurance (**END**), based on fuel totalizer calculations, are displayed in nautical miles and hours:minutes respectively. Totalizer data is displayed at the bottom of the waypoint navigation log for quick comparison with flight plan data.

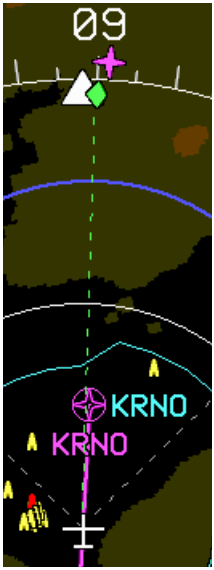
***AUDIBLE ANNUNCIATION***
A fuel range less than the distance to the destination + 100 miles will result in an annunciation chime and an amber "CHECK RANGE" flag. To eliminate nuisance alarms, range checking is suppressed when on the ground or in a climb.
**CHECK RANGE**

## Groundspeed

The aircraft's speed over the ground, in nautical miles per hour is displayed in the upper left corner below the true airspeed. Groundspeed is based on GPS data.

## Ground Track / Ground Track Lubber Line

The aircraft's straight-and-level track over the ground is indicated on the directional scale by a green diamond. Ground track is based on GPS signal. The ground track symbol is connected to the aircraft symbol by a dashed green "lubber" line.



***"The lubber line is handy.***
*Use it to ensure your current ground track will clear terrain or airspace. Also, you can use it to cross a specific fix or waypoint that is not in your active flight plan."*

## Heading Bug

The heading bug is a white “bow tie” symbol affixed to the directional scale. The heading bug is only visible when activated.

***AUDIBLE ANNUNCIATION***
When the heading bug has been set and captured, a deviation more than 10° from the heading bug will result in an amber caution flag and an auditory chime.

**HEADING**

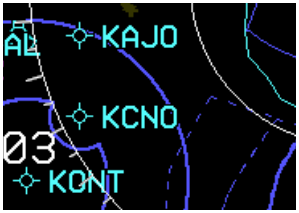
***NOTE**:*
*If coupled with an autopilot via ARINC-429 roll steering or via the AIU-1 in heading mode, the EFIS will command the autopilot to maintain the selected heading. If the autopilot is flying a flight plan, invoking the heading bug will override the flight plan in favor of the selected heading.*

## Heading Pointer

The heading pointer is a white triangle indicating the current aircraft heading (where the nose is pointed).

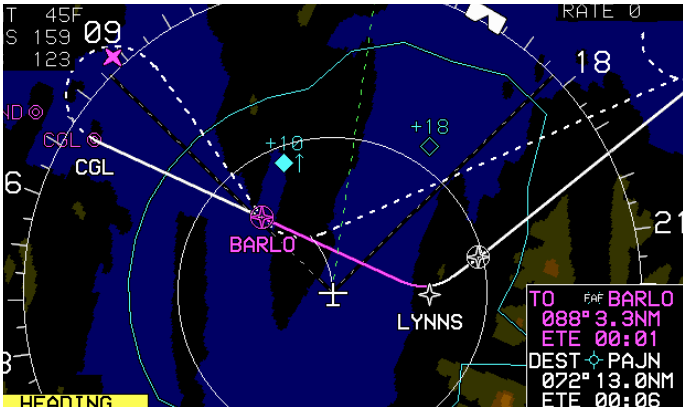
## IFR Airport

IFR airports are depicted as a blue circle with a pronounced tick mark every 90°. IFR airports have published IFR approaches.



## Instrument Approach Course

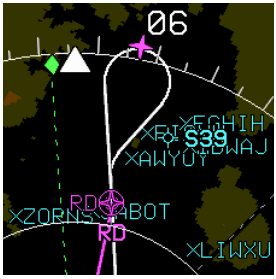
Instrument approach procedures are depicted as white courselines except the active leg, which displayed in magenta. Active legs of an approach are automatically sequenced. Alternately, the pilot can select any leg as the active leg by using the **ACTV** button function. The missed approach course is depicted as a dashed white line with the active leg displayed in magenta.




Approach symbology includes approach fixes (both fly-over and fly-by), procedure turns, missed approaches, holding patterns, and holding pattern entries.

BARLO is an example of a fly-over fix. They have a circle around the waypoint star symbol.

LYNNS is an example of a fly-by fix. They are a waypoint star symbol without a circle.




Procedure turn at fix RD (an NDB).

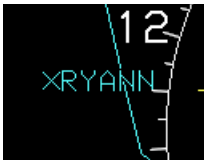
Entry to missed approach holding pattern at DSD (here, the aircraft has left the holding pattern and is flying the approach again from DSD).

See Waypoint Sequencing, page 102, for information on waypoints and waypoint sequencing.

***NOTE**:*
*See **Jeppesen NavData Chart Compatibility** in the Appendix for information on approach waypoint nomenclature.*

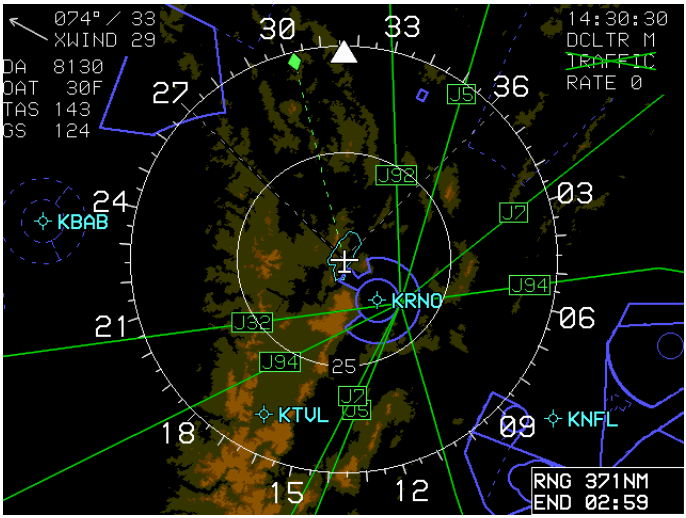
## Intersection

Airway intersections are depicted as a cyan **X** with cyan labels.




## Jet Routes

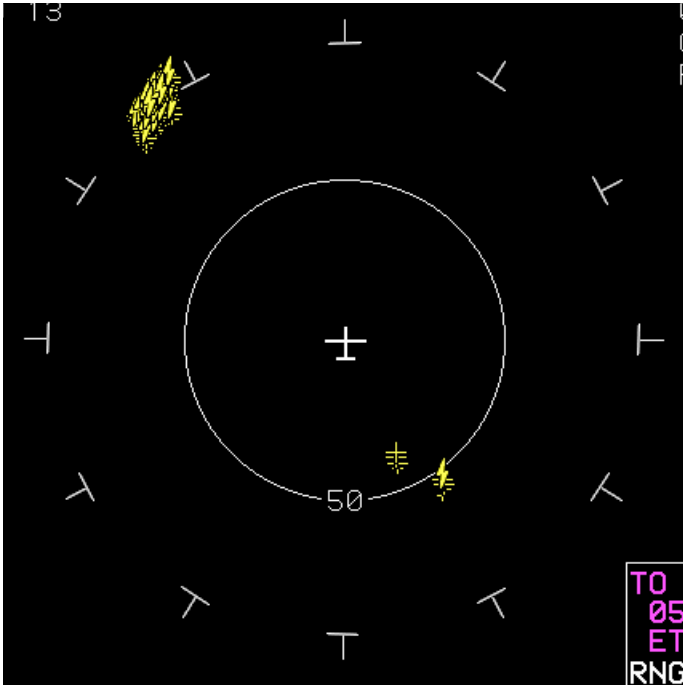
Jet routes, or high-altitude airways, are shown in green, along with their labels. To minimize clutter, jet routes are not shown by default; they may be shown at any time by the pilot using the **MENU . .** then **FORMAT . .** then **DCLTR . .** then **NAV SYMB . .** menu.




***NOTE**:*
*Jet route labels only show the first label. Refer to printed charts for routes that have more than one label.*

## Lightning Strikes

Lightning strikes from an attached WX-500 Stormscope are initially displayed as yellow lightning bolts. After 20 seconds, the lightning bolt changes to a large yellow + sign. After two minutes, it is reduced to a small yellow + sign. After three minutes, the symbol is removed from the display.




Lightning strikes may be shown on the moving map or on a dedicated Lightning display screen (with or without route overlay).

Lightning may be displayed in one of two modes: cell mode or strike mode. Strike mode shows every strike detected. In cell mode, the WX-500 filters the strike data to display storm cells. The moving map only shows cell mode.

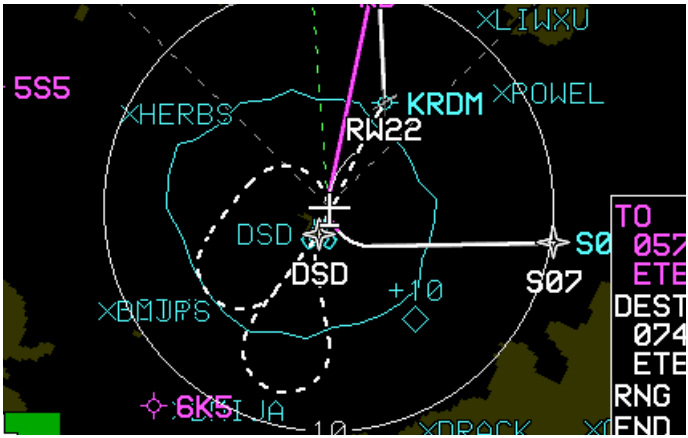
A new strike rate value, based upon the strikes within the selected range, will be calculated every 5 seconds during

normal operation. The number of fresh strikes (strikes less than 20 seconds old) is used to generate a strike rate that represents strikes per minute. Strike rate increases are shown immediately upon calculation while decreases in strike rate are dampened.

Activating the Clear Strikes function resets the strike rate to zero.

## Missed Approach Course

The missed approach course is shown as a dashed white line beginning at the missed approach point, with the active leg being shown in magenta. See **Waypoint Sequencing, page 3-102**, for information on waypoints and waypoint sequencing during missed approach procedures.




## Mode Annunciators

### Omnibearing Selector Mode (OBS)

Selected omnibearing radial is shown in magenta along with the current mode (**M** for Manual or **A** for Automatic). Automatic mode simply displays the active flight plan segment course

while manual mode allows the pilot to specify a radial or to the active waypoint.

**Terrain Mode - Map only**

If terrain is OFF, an annunciator in the upper right corner will read **TERRAIN** with an **X** through it. The **X** will be green if the pilot manually turns terrain off and red if terrain is disabled automatically due to a sensor failure. See example below.

Terrain mode is always the same for both the PFD and moving map screens on the MFD. For example, turning terrain OFF on the moving map turns it OFF on the reversionary PFD simultaneously. However, terrain mode is not transmitted between displays, so it is possible to run one screen with terrain and another without.

Manually turning the terrain off does not affect TAWS alerting functions. See the TAWS section of the appendix for more information.

**Declutter Mode (DCLTR) - Map only**

The current declutter (**M** for Manual or **A** for Automatic) is annunciated in white in the upper right corner of the display.

**Traffic Mode - Map and Traffic display only**

If equipped with a Ryan TCAD receiver, an annunciator in the upper right corner will read **TRAFFIC** with an **X** through it when it is disabled. The **X** will be green if the pilot manually turns traffic display off and red if it is disabled automatically due to a sensor failure. See example below.

Manually turning the traffic off does not affect traffic alerting functions. See the Traffic section of the appendix for more information

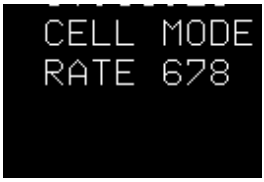
**Lightning mode (STRKS) - Map and WX display only**

If equipped with a Goodrich WX-500 Stormscope, an annunciator in the upper right corner will read **STRIKES** with an **X** through it when it is disabled. The **X** will be green if the pilot manually turns traffic display off and red if it is disabled automatically due to a sensor failure. See example below.

**Dedicated Lightning Display**
If equipped with Goodrich WX-500 Stormscope, the display mode (**CELL** or **STRK**) and strike rate will be displayed in the upper right corner of the dedicated lightning display. Strike mode shows every strike detected. In cell mode, the WX-500 filters the strike data to display storm cells.

A new strike rate value, based upon the strikes within the selected range, will be calculated every 5 seconds during normal operation. The number of fresh strikes (strikes less than 20 seconds old) is used to generate a strike rate that represents strikes per minute. Strike rate increases shown immediately upon calculation while decreases in strike rate are dampened.

Activating the Clear Strikes function resets the strike rate to zero.



## Navigation Log

Waypoint navigation information is displayed in the navigation log box located in the lower right corner of the display. The navigation log is only displayed when there is an active waypoint.

The navigation log shows the range, bearing, and estimated time enroute to the active "**TO**" waypoint and the destination "**DEST**" waypoint. Only the "**TO**" waypoint is shown if the "**TO**" and "**DEST**" waypoints are the same.

Fuel totalizer (range and endurance) is shown immediately below the navigation log for easy comparison.

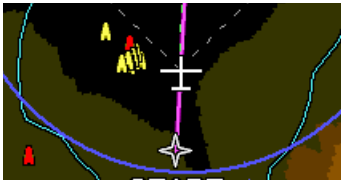
## NDB

NDBs are depicted as two small, concentric magenta circles with the identifier adjacent.

## Obstruction

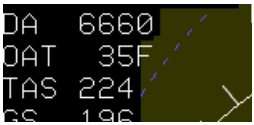
Antennas, towers, and obstructions are displayed only in conjunction with the terrain. Obstruction symbols /\ are depicted using color to show relationship to aircraft altitude as follows:

1. Obstructions beyond 6NM in any cardinal direction are not depicted.
2. Obstructions whose tops are lower than 2,000 feet below aircraft altitude are not depicted.
3. Obstructions whose tops are within 2,000 feet but more than 500 feet below aircraft altitude are depicted in amber.
4. Obstructions whose tops are within 500 feet but below aircraft altitude are depicted in light red.
5. Obstructions whose tops are at or above aircraft altitude are depicted in deep red.



## Outside Air Temperature

Outside air temperature (**OAT**) is displayed in the upper-left corner of the navigation display, between density altitude (**DA**) and true airspeed (**TAS**). OAT is measured in °F or °C, depending on system installation settings.



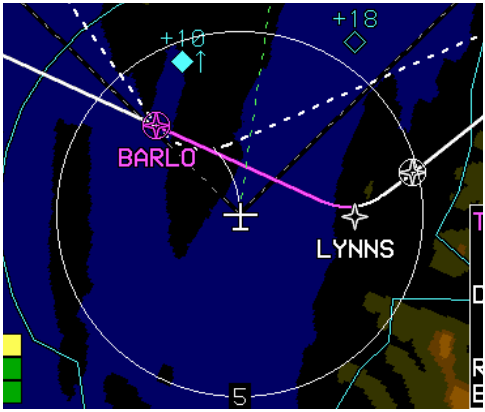

## Projected Path

The curving white line extending from the nose of the aircraft symbol indicates the horizontal flight path of the aircraft projected one minute into the future or 180°, whichever comes first. The projected path is corrected for bank angle and groundspeed and is only displayed when the aircraft is in a turn .

***"No-sweat course interception.***
*Use the projected path to intercept courses perfectly from any angle. Roll in an estimated bank angle and see where that puts your projected path. Make small bank adjustments as necessary to keep the projected path tangent to the desired courseline. Roll out centered on course. If interception will require an uncomfortable bank angle, you'll know you have to overshoot and come back in from the other side. It's great for when ATC gives you a late turn onto the localizer."*

## Range Ring

The range ring is a white circle (centered on the aircraft's position) used to quickly estimate distances. Distance (in nautical miles) from the aircraft to the ring is shown as a white figure overlaying the six o'clock position of the ring. The range ring is half the distance to the directional scale. Consequently, when the range ring shows a distance of 5NM, the directional scale is at 10NM. Overall map scale ranges can be set to 1, 2, 5, 10, 20, 50, 100, and 200 nautical miles.

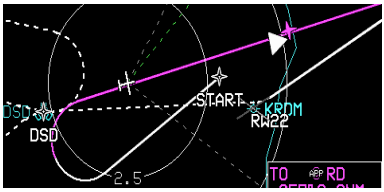



## Range Ring Scale

Distance (in nautical miles) from the aircraft to the ring is shown as a white figure overlaying the six o'clock position of the ring. The intermediate range ring is half the distance to the outer range ring. So, when the intermediate range ring shows a distance of 5NM, the outer ring is at 10NM.

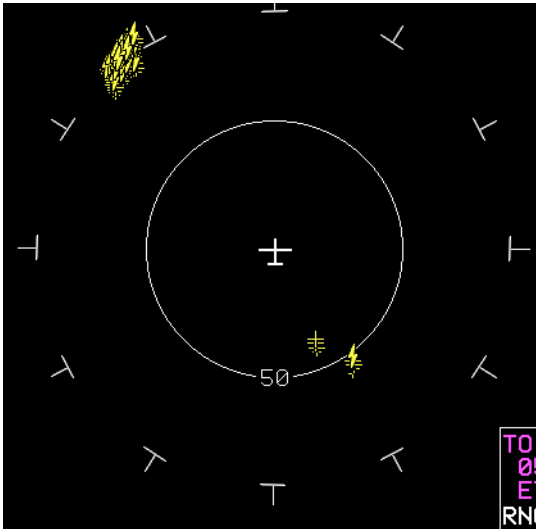
## Start Point

Activation of the **NRST** or **Direct-To** functions creates and activates a flight plan from the current aircraft position to the selected waypoint. A waypoint named START is placed at the current aircraft location when the flight plan is created.



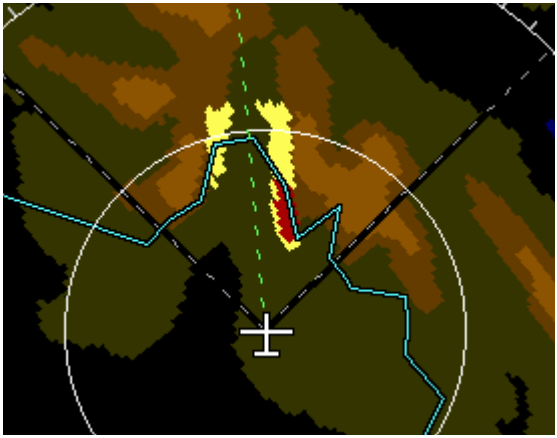

## Strike Position Reference (Dedicated Lightning Display)

**T**-shaped tick marks are shown around the perimeter of the dedicated lightning display corresponding to positions of the clock to aid in avoiding and reporting strikes relative to aircraft position.



## Terrain

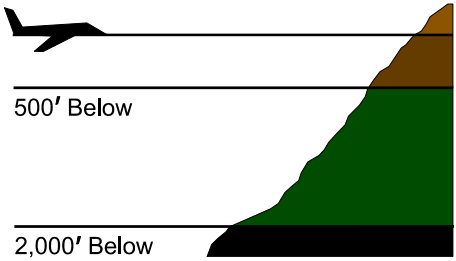
Terrain is displayed around the aircraft and is color-coded as **threatening** and **non-threatening** terrain.



### Non-Threatening Terrain

Terrain areas are colored black when more than 2,000 feet below aircraft altitude; dark olive when within 2,000 feet but more than 500 feet below aircraft altitude; dark brown when within 500 feet but below aircraft altitude; and light brown when at or above aircraft altitude.

Deep blue denotes areas of water and takes precedence over other colors.




Non-threatening terrain coloration.

**Threatening Terrain**

Threatening terrain, as determined by the requirements for TAWS, is colored in red and yellow.

Threatening terrain will cause a “pop-up” condition on both the PFD and ND meaning, even if it has been manually decluttered by the pilot, terrain will automatically be shown on the displays. On the moving map, the scale will be set automatically to highlight the threatening terrain. The pilot is then free to reconfigure the displays as desired.

The FlightLogic EFIS features integrated Class C TAWS or, optionally, Class B TAWS or Class B Helicopter TAWS (HTAWS).

Class C and B TAWS provide the following terrain alerting functions:

1. Forward Looking Terrain Awareness ("FLTA"): A warning function that uses a terrain database to alert the pilot to hazardous terrain in front of the aircraft, automatically adjusting for climbs, descents, and turns.
2. Premature Descent Alert ("PDA"): A warning function that alerts the pilot when descending well below a normal approach glide path on the final approach segment of an instrument approach procedure.

3. Excessive Rate of Descent: A warning function that alerts the pilot when the rate of descent is hazardously high as compared to height above terrain (i.e., descending into terrain).
4. Sink Rate after Takeoff or Missed Approach: A warning function that alerts the pilot when a sink rate is detected immediately after takeoff or during initiation of a missed approach.
5. 500 foot Wake-up Call: A single voice callout when descending through 500 feet AGL.

Each of the above TAWS alerts is accompanied by a voice annunciation and, except for the 500 foot callout, a CWA flag color-coded amber for caution and red for warning.

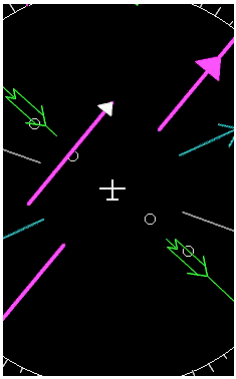
See **Caution/Warning/Advisory System, page 2-11** of System Overview section for details of the auditory annunciations associated with terrain.

***"The bottom line on terrain and TAWS:***
*If you see red or yellow on the moving map, accompanied by a voice alert, take action immediately. Use extreme caution and be suspect of yellow terrain. Add power, climb, and turn away from red terrain. You have two very effective terrain displays, the moving map and primary flight display; use them both to your advantage."*

For detailed information on the TAWS class in your aircraft, see the TAWS section in the appendix.

## To-From Indicator (HSI Format)

The to-from indicator is a white triangle placed at the end of the CDI needle on the conventional HSI display, between the aircraft position symbol and the courseline arrow. The arrow is ahead of the aircraft symbol and points toward the courseline arrowhead when showing a “to” indication and behind the aircraft symbol and pointing toward the tail of the courseline arrow when showing a “from” indication.



Once a course is selected (Automatic or Manual), the to-from indicator rotates with the directional scale. The indicator will flip from one end of the CDI needle to the other upon waypoint or navigation station passage.

The HSI may be driven by Nav 1, Nav 2, or GPS and the current source is always indicated by an HSI SOURCE advisory flag.

HSI source may be changed using the OBS button, see **OBS (Omnibearing selector) Function, page 4-13** and **HSI Source Selection, page 5-56**.

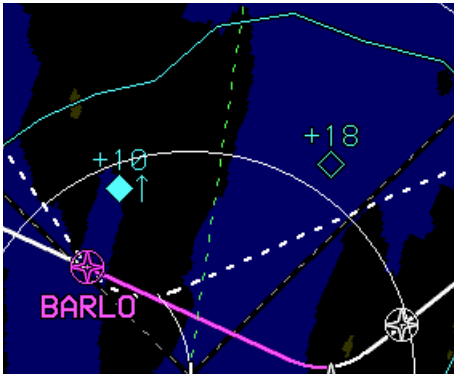
## Timer

A timer showing **hours:minutes:seconds** is displayed at the pilot's option in the upper right corner of the display, just below the clock. The timer can be set to count up indefinitely or count down from a pilot-specified value. Elapsed time since power-up can also be shown without affecting an active timer. When selected, elapsed time is shown for 10 seconds in the lower right corner of the screen.

***AUDIBLE ANNUNCIATION***
A chime annunciates the expiration of a count-down timer.

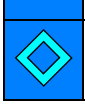
## Traffic

When interfaced with a suitable traffic sensor, airborne traffic is displayed on the moving map as symbols that are based on the level of threat.




The relative altitude is shown above (**+**) the symbol when the traffic is above or below (**-**) the symbol when the traffic is

below ownship altitude. A direction arrow to the right of the symbol indicates a climb or descent greater than 500 fpm.

| | |
|---|---|
| | **Traffic Alert - Traffic within immediate vicinity based upon flight parameters.** |
| | **Proximate Advisory - Traffic within 6NM and 1,200 ft. of ownship altitude.** |
|  | **Other Traffic - Traffic detected beyond 6NM and 1,200 ft.** |

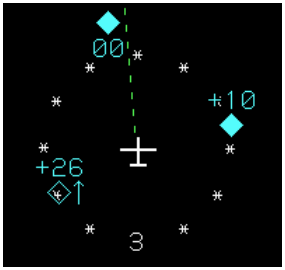
When the ownship AGL indication is less than 400 ft., traffic is shown but alerts are not given. Traffic within 200 ft. of ground level is not shown or annunciated.

***AUDIBLE ANNUNCIATION***
Traffic advisories will result in an amber flag and a single voice warning of “Traffic. Traffic.”

**TRAFFIC**

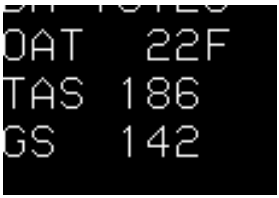
## Traffic Position Reference (Dedicated Traffic Display)

Asterisks are shown around the ownship aircraft symbol on the dedicated traffic display corresponding to positions of the clock to aid in identifying traffic relative to aircraft position. The scale of the reference ring is shown at the six o'clock position.



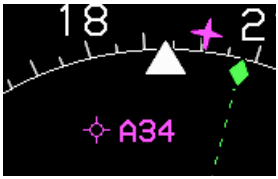

## True Airspeed

True airspeed, (**TAS**) airspeed is displayed in the upper left corner of the display, between outside air temperature (**OAT**) and groundspeed (**GS**). True airspeed is measured in knots and is corrected for altitude, temperature, and compressibility due to aerodynamic heating.



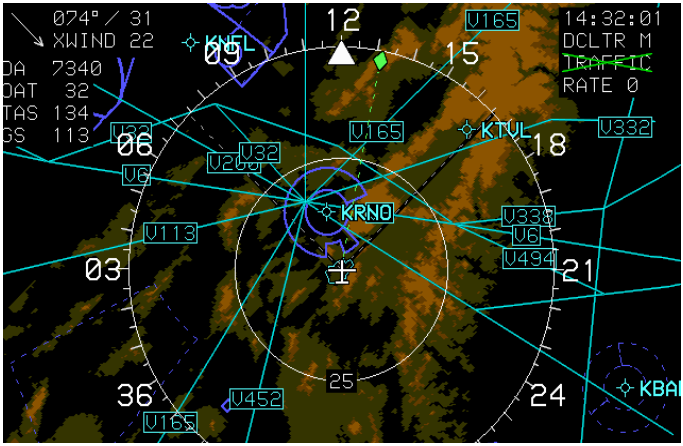
## VFR Airport

VFR airports (airports having no published instrument procedures) are displayed in magenta, along with the identifier.




## Victor Airways

Victor, or low-altitude airways are displayed as cyan lines along with their identifiers. To minimize clutter, Victor airways are not shown by default; they may be shown at the pilot's discretion using **MENU** button, then **FORMAT . .** then **DCLTR . .** then **the NAV SYMB . .** menu.




*NOTE:*
*Jet route labels only show the first label. Refer to printed charts for routes that have more than one label.*

## VORTAC/VOR-DME, TACAN, VOR, DME

VHF navaids are displayed in cyan with the following symbols:

## Waypoint

Route waypoints are displayed as four-point stars. The active waypoint is displayed in magenta; prior and subsequent waypoints in the route are white. Fly-over waypoints are enclosed in a circle, while fly-by waypoints are not.

The identifier associated with each waypoint is shown below the star in the same color.

**BARLO is an example of a fly-over waypoint.**

**LYNNS is an example of a fly-by waypoint.**

### Waypoint Sequencing

The system defines the desired flight path based upon the active flight plan. The active flight plan can be recalled from a list of stored flight plans or generated using the Nearest function

(NRST) or **Direct-To** function, then adding and deleting waypoints en route.

In most cases, the system will auto-sequence from one waypoint to the next, in accordance with the flight plan. Waypoint auto-sequencing will be suspended in the following cases:

1. A manual GPS/WAAS OBS is set ("SUSPEND" flag shown).
2. The aircraft is on the final approach segment of an instrument approach and the missed approach procedure has not been armed by pressing the **MISSED** button ("SUSPEND" flag shown).
3. The aircraft is in a published holding pattern and the pilot has not chosen to continue out of the holding pattern by pressing **CONTINUE** ("SUSPEND" flag shown).
4. The active waypoint is the last waypoint of the active flight plan ("SUSPEND" flag not shown).

Where automatic waypoint sequencing is suspended due to manual GPS/WAAS OBS, being on the final approach segment without arming the missed approach procedure, or being on the last leg of the active flight plan, the system automatically switch from TO operation to FROM operation when appropriate.When an IFR approach is selected and the next waypoint is the missed approach point, automatic waypoint sequencing is suspended. Automatic waypoint sequencing is also suspended when the active waypoint is a holding point or when the pilot has selected Manual OBS mode.

***AUDIBLE ANNUNCIATION***
Suspension of automatic waypoint sequencing is annunciated by an auditory chime and an advisory SUSPEND flag.

SUSPEND

### Discontinuity

Where the system is unable to construct a smooth, continuous flight path due to active flight plan waypoint spacing (i.e., spacing too close for turn radius), a discontinuity will be placed between the waypoints. This is indicated in the ACTV menu by **-DISCONT-** between the waypoints.

When a discontinuity exists, no path or skyway is drawn between the waypoints and auto-sequencing past the waypoint leading into the discontinuity shall will not occur. It is not be possible to activate the phantom waypoint after the discontinuity as it is not possible to provide path guidance to this waypoint. Attempting to activate the phantom waypoint after the discontinuity will result in activation of the next waypoint or, if there is no next waypoint (i.e., end of active flight plan) activation of the waypoint leading into the discontinuity.

In addition to the above, selecting a vectors-to-final IFR approach, a VFR approach, or re-centering on your route using **Direct-To** will result in a discontinuity.

## Wind Data

Wind data is presented in the upper-left corner of the Navigation Display. Wind velocity (measured in knots) and direction are displayed based on GPS, heading, and airdata calculations.

During normal system operation, wind is calculated during periods of relatively wings-level flight (bank < 6°). The wind calculation considers TAS, heading, GS and track. Factors that affect these parameters can cause inaccuracies in the calculated wind. The pilot should be cognizant of the following potential error sources:

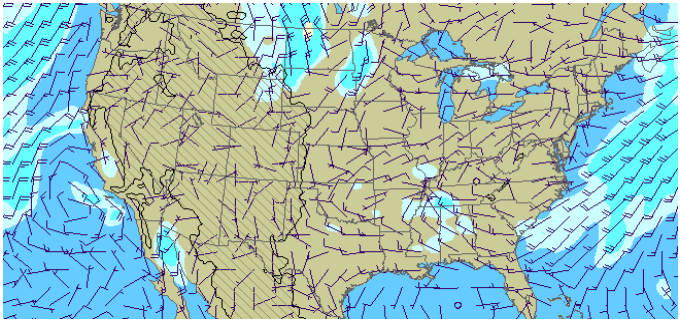
**TAS:** True airspeed errors can be caused by airframe induced pitot-static inaccuracies, pitot-static system leaks or blockages, and inaccurate outside air temperature readings.

**Heading:** Heading errors can be caused by poor AHRS calibration, carrying iron-bearing materials in proximity to the AHRS, and operation of electric motors or other magnetic field inducing equipment. In addition, for the wind calculation to be accurate, heading must match the vector direction of TAS. As a rule of thumb, if the aircraft is being flown out of balance, the wind calculation should be considered suspect.

**Groundspeed:** Poor satellite geometry can cause variations in the ground speed reading. Although this parameter is generally reliable, it should be considered suspect when a GPS “Loss of Integrity” exists.

**Track:** Poor satellite geometry can cause variations in the track reading. Although this parameter is generally reliable, it should be considered suspect when a GPS “Loss of Integrity” exists.

**Atmospheric wind changes:** As seen in this FAA graphic, actual wind is rarely constant.



The pilot should expect large wind changes with changes in altitude or in the presence of significant weather. The pilot should also consider the effect of surrounding terrain upon wind.

## Wind Vector

The wind vector is a graphical depiction of current winds aloft displayed relative to aircraft symbol regardless of map display mode (see **Wind Data** illustration above).

***NOTE**:*
*See discussion of wind calculation errors under **Wind Data** above.*

## Zulu Time

Current Zulu time, based on GPS clock, is displayed in the upper-right corner of display.

# Failure Modes

Failure of a weather receiver, datalink receiver, TCAS/TCAD receiver, or AIU-1 results in the EFIS issuing an amber caution flag and auditory chime. None of these receivers or devices significantly impact the navigational or display capabilities of the EFIS.

Failure of the GPS, the AHRS or the ADC, singly or in combination, adversely impacts the EFIS capabilities. These failures are annunciated with amber caution flags on the MFD and corresponding voice warnings. In addition, the software provides degraded displays to show as much useful and accurate information as possible in the failure condition. These degraded displays are described in detail as follows.

The equipment has 8 operating modes depending upon the status of the attached sensors. The modes are:

Mode 0: GPS, ADC, and AHRS normal.

Mode 1: GPS failed, ADC and AHRS normal.

Mode 2: ADC failed, GPS and AHRS normal.

Mode 3: AHRS failed, GPS and ADC normal.

Mode 4: GPS and ADC failed, AHRS normal.

Mode 5: GPS and AHRS failed, ADC normal.

Mode 6: ADC and AHRS failed, GPS normal.

Mode 7: GPS, ADC and AHRS failed.

System operation in the above modes is detailed on the following chart (legend and example screens follows chart):

| PFD Functions: | Mode 0 | Mode 1 | Mode 2 | Mode 3 | Mode 4 | Mode 5 | Mode 6 | Mode 7 |
|---|---|---|---|---|---|---|---|---|
| Airspeed | OK | OK | - | OK | - | OK | - | - |
| Altimeter | OK | OK | - | OK | - | OK | - | - |
| Altimeter Set | OK | OK | - | OK | - | OK | - | - |
| Bank Scale | OK | OK | OK | - | OK | - | - | - |
| CDI | OK | 1 | OK | OK | - | - | OK | - |
| Runway | OK | 1 | - | - | - | - | - | - |
| Waypoint Pointer | OK | 1 | OK | 7 | - | - | 7 | - |
| Heading Scale | OK | OK | OK | 7 | OK | - | 7 | - |
| AGL Ind. | OK | 2 | 4 | OK | 11 | 11 | 4 | - |
| Flight Path Marker | OK | 1 + 14 | - | - | - | - | - | - |
| G-meter | OK | OK | OK | - | OK | - | - | - |
| Ground Track | OK | 1 | OK | 7 | - | - | 7 | - |
| Heading Indicator | OK | OK | OK | - | OK | - | - | - |
| Horizon | OK | OK | OK | - | OK | - | - | - |
| Mini-Map | OK | 1 | OK | 7 | - | - | 7 | - |
| Pitch Limit Indicator | OK | OK | - | 8 | - | 8 | - | - |
| Pitch Scale | OK | OK | OK | - | OK | - | - | - |
| Highway in the Sky | OK | 1 + 15 | - | - | - | - | - | - |
| Terrain / Obstruct | OK | - | - | - | - | - | - | - |
| Clock Functions | OK | OK | OK | OK | OK | OK | OK | OK |
| VSI | OK | OK | - | OK | - | OK | - | - |
| Waterline Symbol | OK | OK | 5 | 13 | 5 | 13 | 13 | 13 |
| Waypoint Symbol | OK | 1 | - | - | - | - | - | - |
| Waypoint Brg / Dist | OK | 1 | OK | OK | - | - | OK | - |
| Traffic | OK | OK | - | - | - | - | - | - |
| Speed Trend | OK | OK | - | - | - | - | - | - |
| Dynamic Stall Speed | OK | OK | - | 8 | - | 8 | - | - |
| **ND Functions:** | | | | | | | | |
| Aircraft Position | OK | 1 | OK | OK | - | - | OK | - |
| Special Use Airspace | OK | 1 | 6 | 9 | - | - | 6 + 9 | - |
| Waypoint Pointer | OK | 1 | OK | 9 | - | - | 9 | - |
| Active Flight Plan Path | OK | 1 | OK | 9 | - | - | 9 | - |
| Glide Range | OK | 1 | - | 10 | - | - | - | - |
| Groundspeed | OK | 1 | OK | OK | - | - | OK | - |
| Ground Track | OK | 1 | OK | 9 | - | - | 9 | - |
| Heading Indicator | OK | OK | OK | - | OK | - | - | - |
| Navigation Symbols | OK | 1 | OK | 9 | - | - | 9 | - |
| Outside Air Temperature | OK | OK | - | OK | - | OK | - | - |
| Projected Path | OK | 1 | OK | - | - | - | - | - |
| Traffic | OK | OK | OK | OK | OK | OK | OK | OK |
| Terrain / Obstructions | OK | - | - | OK | - | - | - | - |
| Clock Functions | OK | OK | OK | OK | OK | OK | OK | OK |
| Waypoint Brg. / Dist. | OK | 1 | OK | OK | - | - | OK | - |
| Wind | OK | 3 | - | - | - | - | - | - |
| WX-500 Data | OK | OK | OK | OK | OK | OK | OK | OK |
| Compass Rose | OK | OK | OK | 9 | OK | - | 9 | - |
| Fuel Totalizer Functions | OK | 1 | - | OK | - | 12 | - | - |
| True Airspeed | OK | OK | - | OK | - | OK | - | - |
| Density Altitude | OK | OK | - | OK | - | OK | - | - |

Note 1: Presented using inertial dead-reckoning based on last known wind information.

Note 2: Either radar altitude or barometric altitude less database elevation based upon inertial dead reckoning.

Note 3: Last known wind is saved during GPS/WAAS failure.

Note 4: Either radar altitude or geodetic altitude less database elevation.

Note 5: Waterline symbol expanded to large attitude bars.

Note 6: Special use airspace boundaries are drawn with bold lines due to lack of aircraft altitude data.

Note 7: Display aligned with aircraft track.

Note 8: Based upon 1G stall speed.

Note 9: Aligned with aircraft track in heading up mode.

Note 10: Presenting using last-known wind information and aligned with aircraft track in heading up mode.

Note 11: Only radar altitude presented when available.

Note 12: Only endurance is presented.

Note 13: Large attitude bars presented and X'd out.

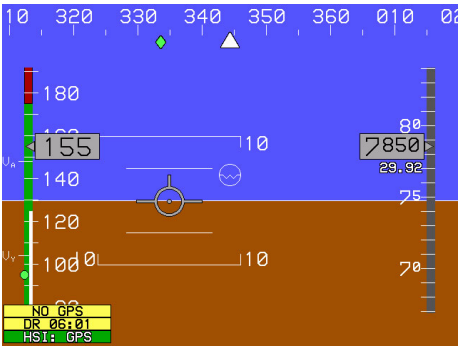
Note 14: Flight Path Marker grayed after 1 minute to indicate degraded operation.

Note 15: Highway in the Sky removed after 1 minute.

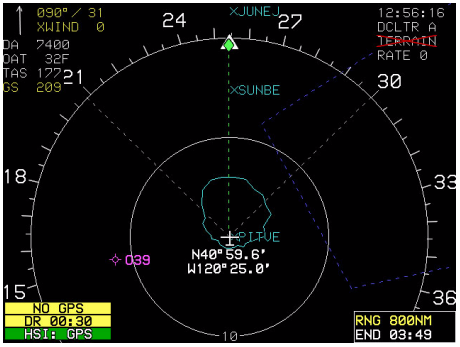
***AUDIBLE ANNUNCIATION***
Component failures will result in amber caution flags and a single voice annunciation identifying each failed component.

## GPS Failure

GPS failure causes the EFIS to lose updating of aircraft position, groundspeed, and ground track and the ability to calculate wind information. In this condition, the EFIS operates in “dead reckoning” mode, indicated by DR ##:## caution flag with a timer and a “NO GPS” caution flag, and continues to provide navigational position, groundspeed and ground track information based upon the last known wind and current air data and heading. Terrain is removed immediately. The flight path marker is grayed out and the skyway is removed after one minute. The primary flight and navigation displays are affected as follows:




PFD page during GPS failure




ND page during GPS failure

**CAUTION: In the event of loss of GPS, transition to other navigation sources as soon as possible. Following system dead reckoning guidance can lead to large position errors.**

The accuracy of the dead reckoning solution depends upon how closely the actual wind matches the last known wind. It is important for the pilot to realize that, in the event of a wind mismatch, position errors will grow over time and can become large. Because of this, the dead reckoning solution is considered a short-term aid to position awareness in event of a GPS failure, and should not be used for continued navigation. The following factors should be considered in assessing the validity of the dead reckoning solution:

1. The length of time during which the EFIS has been dead reckoning. The longer the time, the greater the position error can be. As an example, with a 10 knot wind mismatch, the dead reckoning solution will be in error by 10NM after one hour.

2. Accuracy of the last known wind computation. During normal system operation, wind is calculated during periods of relatively wings-level flight (bank < 6°). The wind calculation considers TAS, heading, GS and track. Factors that affect these parameters can cause inaccuracies in the calculated wind. The pilot should be aware of the following potential error sources:

   - TAS: True airspeed errors can be caused by airframe induced pitot-static inaccuracies, pitot-static system leaks or blockages, and inaccurate outside air temperature readings.

   - Heading: Heading errors can be caused by poor AHRS calibration, carrying iron-bearing materials in proximity to the AHRS, and operation of electric motors or other magnetic field inducing equipment. In addition, for the wind calculation to be accurate, heading must match the vector direction of TAS. As a rule of thumb, if the aircraft is being flown out of balance, the wind calculation should be considered suspect.

   - GS: Poor satellite geometry can cause variations in the ground speed reading. Although this parameter is

generally reliable, it should be considered suspect when a GPS “Loss of Integrity” exists.

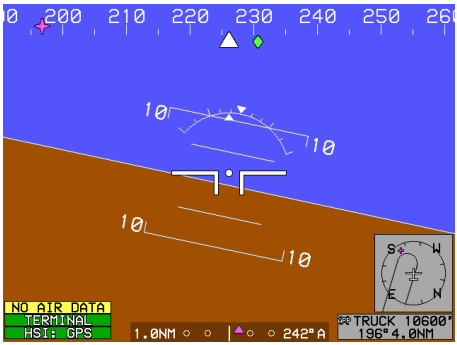
- Track: Poor satellite geometry can cause variations in the track reading. Although this parameter is generally reliable, it should be considered suspect when a GPS “Loss of Integrity” exists.

3. Atmospheric wind changes. Actual wind is rarely constant. The pilot should expect large wind changes with changes in altitude or in the presence of significant weather. The pilot should also consider the effect of surrounding terrain upon wind.

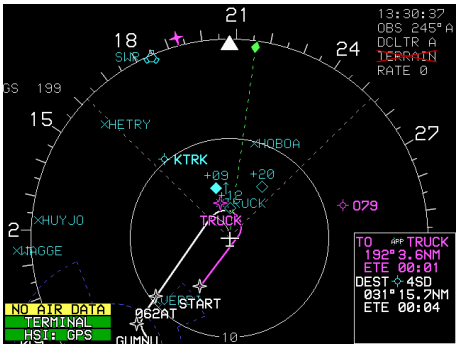
Loss of GPS also affects the accuracy of the Flight Path Marker. While the vertical component of the Flight Path Marker is unaffected by a loss of GPS, the lateral component, based upon track and GS, uses the last known wind and can be inaccurate. Unlike the dead reckoning position solution, the effects of loss of GPS on the accuracy of the Flight Path Marker are not cumulative. The Flight Path Marker remains an accurate tool for maintaining level flight during a GPS failure.

# ADC Failure

Failure of the ADC causes the loss of air data. This failure causes "NO AIR DATA" caution flag to be displayed. The primary flight and navigation displays are affected as follows:




PFD page during ADC failure

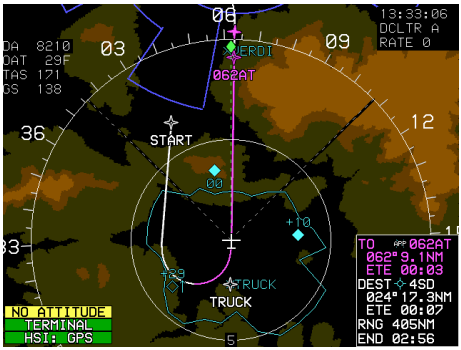



ND page during ADC failure

# AHRS Failure

Failure of the AHRS results in loss of attitude, magnetic heading and, G-force information. This failure causes the “NO ATTITUDE” caution flag to be displayed. The primary flight and navigation displays are affected as follows:

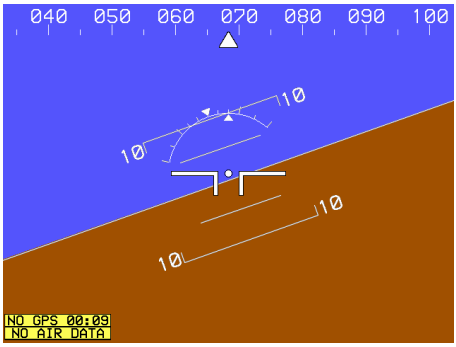
PFD page during AHRS failure



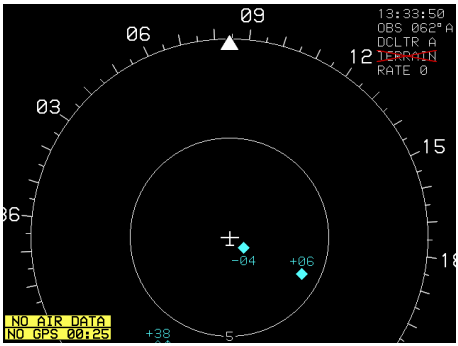

ND page during AHRS failure

# ADC and GPS Failure

When the GPS fails in conjunction with the ADC, the EFIS loses its navigational and three-dimensional presentation capabilities. In this condition, the PFD reverts to operation as a conventional ADI. The moving map page is selectable only for the purpose of showing third-party weather and TCAS/TCAD information. This failure causes "NO GPS" and "NO AIR DATA" caution flags to be displayed. The primary flight and navigation displays are affected as follows:




PFD page during GPS and ADC failure

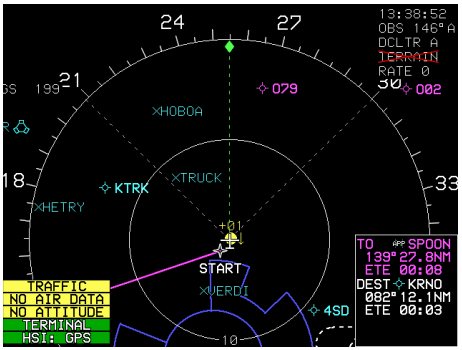



ND page during GPS and ADC

# ADC and AHRS Failure

ADC and AHRS failure causes the loss of air data, magnetic heading data, and attitude data. This failure causes “NO AIR DATA” and “NO ATTITUDE” caution flags to be displayed. The primary flight and navigation displays are affected as follows:

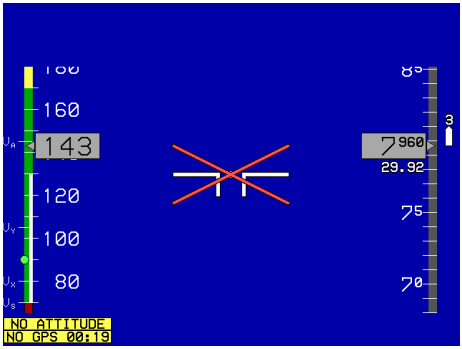
PFD page during ADC and AHRS failure




ND page during ADC and AHRS

# GPS and AHRS Failure

With a GPS and AHRS failure, the EFIS loses its navigational, three-dimensional, attitude, and heading presentation capabilities. With this failure, the PFD presents air data only. The navigation display is only selectable for the purposes of showing passive lightning detection and traffic information. This failure causes the “NO GPS” caution flag and timer, and “NO ATTITUDE” caution flag to be displayed. The primary flight and navigation displays are affected as follows:

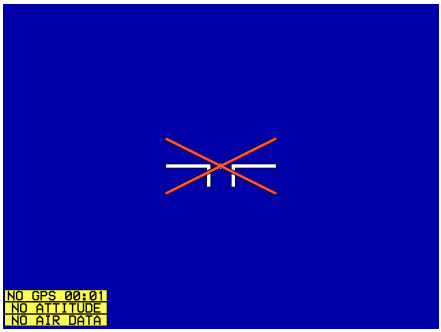



PFD page during GPS and AHRS failure

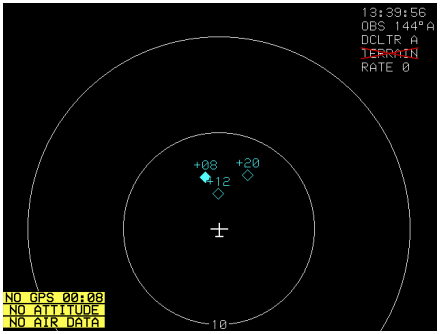
ND page during GPS and AHRS failure

# GPS, ADC, and AHRS Failure

With a failure of all primary sensors, the only display page that retains a function is the moving map page for the display of third party weather, datalink, and TCAS/TCAD information. Both displays retain timer functions.




PFD during GPS, ADC, and AHRS failure



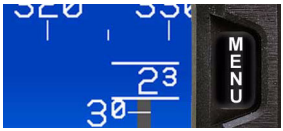

ND during GPS, ADC, and AHRS failure

# Section 4

# Menu Functions

## Overview

Pressing any of the peripheral buttons performs the function indicated by the button label. Some of these activate a function immediately, others display menu tiles on the screen.




In this example, pressing the MENU button displays the menus on the screen.

If the menu tiles are shown, pressing the button adjacent to the menu tile activates that menu.

In this example, pressing the NRST button (ZOOM ON menu tile) turns the PFD zoom function on.

Some menus generate an immediate response, in which case the main menu disappears. Other menus display further "submenus" (indicated by a dot-dot after the menu name, example: **BUGS . .** ).

When the menu appears in the lower-right corner of the screen, it is controlled by the right-hand control knob.

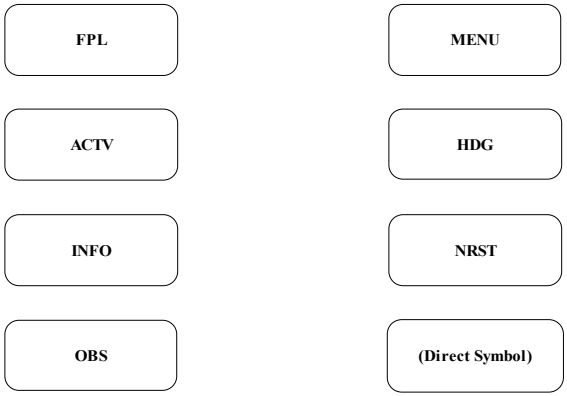
Turning the control knob steps through the scrolling menu (or alphanumeric characters) and the current selection is highlighted (as **WAYPOINT** above). When the desired selection is highlighted, pushing the control knob enters the selection, which may activate a function or display yet another menu. When making alphanumeric entries, push the knob to advance to advance to the next character.

When within the menu structure, **EXIT** will always appear in the upper right corner and **BACK** will appear in the upper left corner when appropriate, indicating that a single step back to the prior menu position is possible. Use **EXIT** to get completely out of the menu structure from any level. Use **BACK** to step back one level to correct a mistake.

Many menu functions are the same on both the PFD and the ND, however there are some differences. In the following pages, the various menu functions are diagramed.

# Button Functions

## PFD and ND




**PFD Page:**
1. **Press -- Switch to MFD (N/A to IDU#1)**
2. **Rt. Turn -- Increase Altimeter Setting**
3. **Lt. Turn -- Decrease Altimeter Setting**

**Note: Altimeter setting menu includes "STD" quick option for setting 29.92 or 1013.**

**MFD Page:**
1. **Press -- Switch to PFD**
2. **Rt. Turn -- Increase Range (If Applicable)**
3. **Lt. Turn -- Decrease Range (If Applicable)**

**FPL** button: displays the flight plan menu.

**ACTV** button: displays the active flight plan menu.

**INFO** button: displays the information menu.

**OBS** button: displays the omnibearing selector menu.

**MENU** button: displays the first menu level associated with the current display screen. The first menu level automatically times out after 10 seconds if there are no subsequent user actions.

**HDG** button: displays the heading bug set menu.

**NRST** button: displays the “nearest” menu.

**Direct-To** button: displays the direct-to menu option.

**Encoder knob**: Function depends upon screen. On the PFD screen, rotating the encoder changes the altimeter setting. On all MFD screens other than the HSI (i.e., moving map, Strike or Traffic), rotating the encoder changes the display scale (clockwise = increase scale, counterclockwise = decrease scale). Pressing the encoder toggles between the PFD and MFD screens on IDUs running MFD software (i.e., not IDU#1).

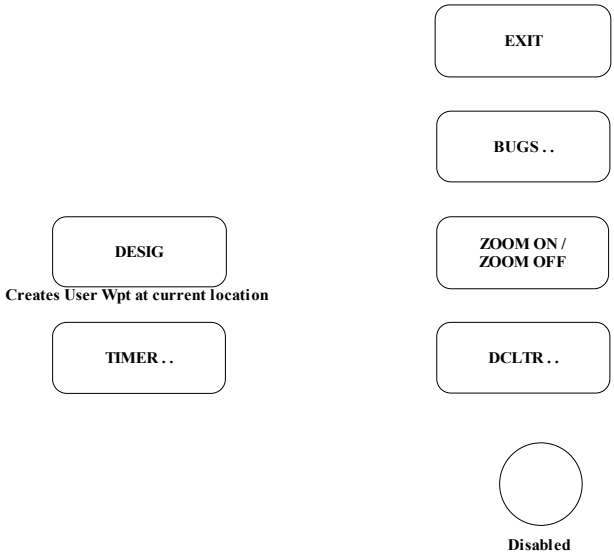
A **MISSED** tile will appear adjacent to the top left pushbutton upon transitioning the Final Approach Fix. When the **MISSED** tile is pressed, the missed approach procedure will be armed (if pressed prior to missed approach point) or activated (if pressed after missed approach point).

A **CONTINUE** tile will appear adjacent to the top left pushbutton when in a holding pattern with further active flight plan legs after the holding pattern. When the **CONTINUE** tile is pressed, automatic waypoint sequencing will be re-enabled to allow normal sequencing to the leg after the holding pattern.

# PFD Top Level Menus

**PFD Only**

(Shown by pressing the **MENU** button when on the PFD screen)




**DESIG:** creates a user waypoint at the current aircraft location. User waypoint will automatically be named "OF###" where ### is the next available overfly user waypoint number.

**TIMER:** displays the timer menu.

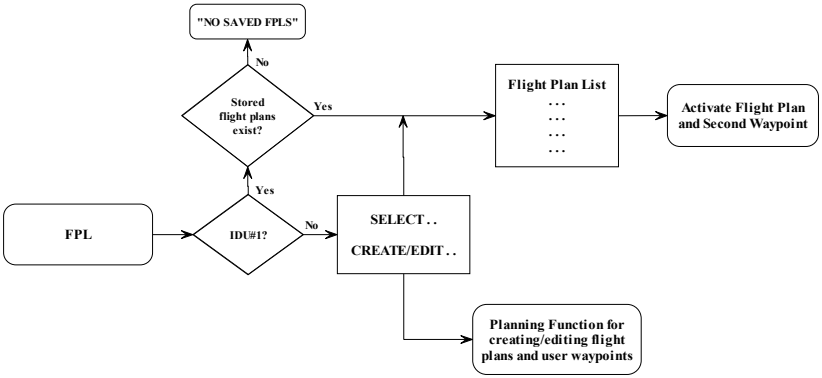
**BUGS:** displays the PFD bug set menu.

**ZOOM ON / ZOOM OFF:** toggles between wide and narrow field of view modes. **ZOOM ON** appears when the current mode is wide. **ZOOM OFF** appears when the current mode is narrow.

**DCLTR:** displays the PFD declutter menu.

# Flight Plan Function

## PFD and ND




**PFD:**
Upon activation of the flight plan function, the system will check for the existence of saved flight plans. If there are no saved flight plans, a **NO SAVED FPLS** menu will be displayed. Otherwise, a scrolling menu of saved flight plans will be presented.

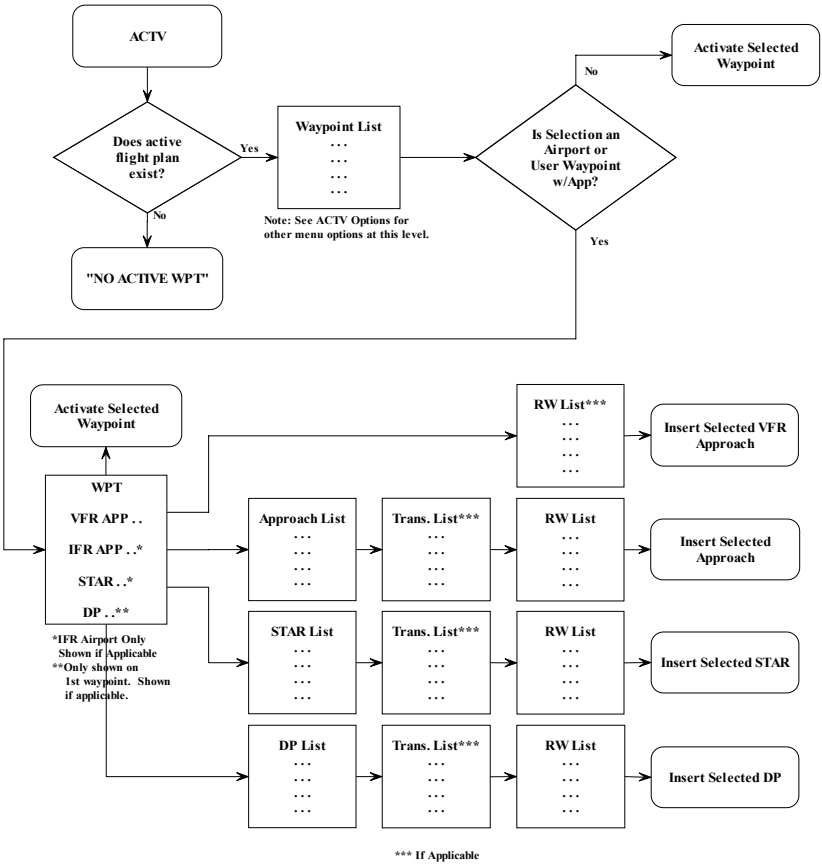
**MFD:**
Upon activation of the flight plan function, the system will check for the existence of saved flight plans. If there are no saved flight plans, then the flight planning function will be activated. Otherwise, a menu will be presented allowing the user to either select a saved flight plan or enter the flight planning function. Selecting the saved flight plan menu option will lead to a list of saved flight plans.

Upon selection of a saved flight plan, the second waypoint in the flight plan will be activated (it assumes you are departing from the first waypoint in the flight plan). For example, when activating a flight plan from Teterboro to Manasas to Charlotte, Manasas will be automatically set as the active flight plan. If a flight plan is activated enroute, the most logical waypoint is automatically set as the active waypoint.

# ACTV (Active) Function

## PFD and ND

(Shown by pressing the **ACTV** button. Only shown when a waypoint or flight plan has been selected.)




When the **ACTV** button is pushed, the system will check for the existence of an active waypoint. If there is no active waypoint, a "NO ACTV WPT" advisory will be issued. Otherwise, a list waypoints in the active flight plan will be presented. The list will show each waypoint identifier, a symbol designating

waypoint type and what type of procedure (if any) the waypoint is associated with, and information related to the flight plan path between each waypoint. The current active waypoint will be designated by an asterisk. Any suppressed waypoint will be designated by brackets.

A suppressed waypoint is an airport associated with an approach procedure. After an approach procedure is activated, the associated airport is no longer part of the active flight plan for guidance purposes. However, the associated airport is still shown in the waypoint list so that it can be highlighted for information or to activate other procedures at the airport. Since there can only be one approach active at any given time, there can only be one suppressed waypoint at any given time.

It is possible to scroll through each waypoint of the active flight plan and it is also possible to scroll one position past the end of the active flight plan for the purpose of adding a waypoint to the end of the active flight plan.

Upon selection of a waypoint from the selection list, the system will check to see whether the selected waypoint is an airport or user waypoint with an approach bearing. If not, the system will make the selected waypoint active. Otherwise, an option list will be presented as follows:

**WPT:** makes the selected waypoint the active waypoint.

**VFR APPR:** If the selected waypoint is a user waypoint with an approach bearing, then a VFR approach to the user waypoint based upon the approach bearing will be created and the user waypoint will be suppressed. If the selected waypoint is an airport, then the user will be presented with a selection list of runways. After selecting a runway, a VFR approach to the runway will be created and the airport will be suppressed. Activating a VFR approach will automatically delete any pre-existing IFR or VFR approaches.

**IFR APPR:** If the selected waypoint is an airport with an IFR approach, then this option will be available. Upon selecting this option, a list of available approaches will be presented (if there are more than one), followed by a list of available transitions (if there are more than one), and a list of runways. After selecting

a runway, the appropriate IFR approach to the runway will be created and the airport will be suppressed. Activating an IFR approach will automatically delete any pre-existing IFR or VFR approaches. If there is a pre-existing STAR to the airport, then the IFR approach waypoints will be inserted after the STAR waypoints.

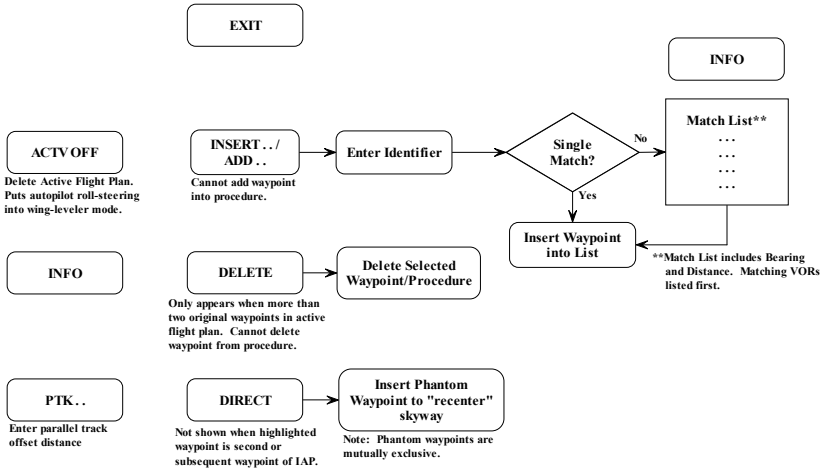
**STAR:** If the selected waypoint is an airport with a STAR, then this option will be available. Upon selecting this option, a list of available STARs will be presented (if there are more than one), followed by a list of available transitions (if there are more than one), and a list of runways. After selecting a runway, the appropriate STAR to the runway will be created. Activating a STAR approach will automatically delete any pre-existing STAR. If there is a pre-existing approach (IFR or VFR) to the airport, then the STAR waypoints will be inserted prior to the approach waypoints.

**DP:** If the selected waypoint is the first waypoint of the active flight plan and is an airport with a DP, then this option will be available. Upon selecting this option, the user will be presented with a selection list of DPs (if there are more than one), followed by a selection list of available transitions (if there are more than one), and a selection list of runways. After selecting a runway, the appropriate DP from the runway will be created. Activating a DP will automatically delete any pre-existing DPs.

# ACTV (Active) Options

## PFD and ND

(Shown by pressing the **ACTV** button. Only shown when a waypoint or flight plan has been selected.)




Various options appear at the same menu level as the waypoint list. These options allow various modifications to be made to the active flight plan as follows:

**ACTV OFF:** deletes the active flight plan. The user will be prompted to confirm deletion prior to completion of the operation.

**INFO:** activates the information menu option for the highlighted waypoint.

**PTK:** specifies a parallel offset distance for non-procedure segments of the active flight plan. The range of parallel offsets is from 20NM left of track to 20NM right of track in 1NM increments.

**INSERT / ADD:** inserts or adds a waypoint into the active flight plan. If the highlighted position is one position past the end of the active flight plan, the menu tile will read **ADD**,

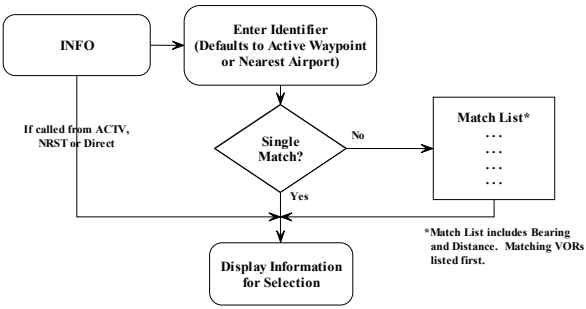
otherwise it will read **INSERT**. When the highlighted waypoint is the second or subsequent waypoint of a procedure, the tile not appear. The tile also will not appear when the highlighted waypoint is suppressed. When activated, the user will be prompted to enter an identifier. If there is a single match from the search, that result will be inserted ahead of the selected waypoint or added to the end of the active flight plan. If there is no result from the search, the user will be re-prompted to enter an identifier. If there are multiple results from the search, a list with matching identifiers will be presented and, upon selection, the selected waypoint be inserted or added to the active flight plan. An **INFO** menu tile giving access to the information function for the highlighted result will appear at this level to aid in selection.

**DELETE:** If the highlighted waypoint is a non-procedure waypoint, then the function will delete the highlighted waypoint from the active flight plan. If the highlighted waypoint is part of a procedure, then the function will delete the entire procedure from the active flight plan. The user will be prompted to confirm deletion prior to completion of the operation. This tile will not appear if the highlighted waypoint is a non-procedure waypoint and there are fewer than three non-procedure waypoints in the active flight plan. This is because an active flight plan must always have at least two non-procedure waypoints. The tile also will not appear when the highlighted waypoint is suppressed or when the highlighted position is one position past the end of the active flight plan.

**Direct-To:** will insert a phantom waypoint at the current aircraft location and re-center the aircraft on a direct route to the waypoint active. This tile will not appear when the highlighted waypoint is suppressed, when the highlighted position is one position past the end of the active flight plan, or when the highlighted waypoint is the second or subsequent waypoint of a procedure.

# INFO Function

**PFD and ND**



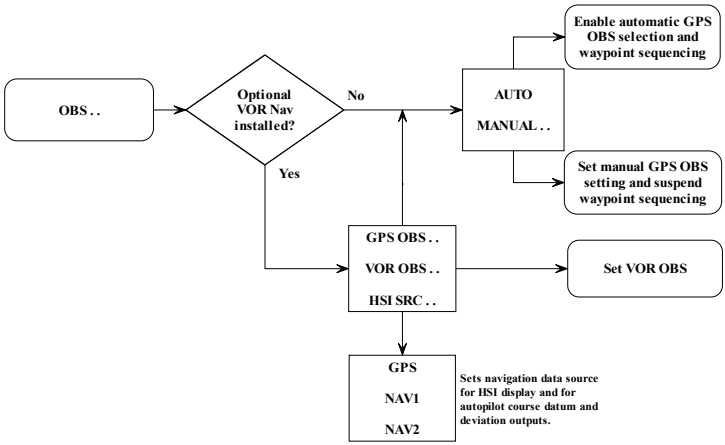

If the **INFO** tile is activated from within the **ACTV**, **NRST** or **Direct-To** menus, then information on the highlighted waypoint from the applicable selection list will be shown directly. Otherwise, the system will check for a current active waypoint. If there is an active waypoint, then it will be the default entry. If there is no active waypoint, then the nearest airport be the default entry. If the default entry is accepted by the user, then its information will be shown. If the user rejects the default entry by entering identifier characters, then a search for matching identifiers will be performed. If there is a single result from the search, information for that result will be shown. If there is no result from the search, the user will be re-prompted to enter an identifier. If there are multiple results from the search, a selection list with matching identifiers will be presented to allow the user to select the desired identifier.

The amount and type of information presented depends upon the type of waypoint. For all types of waypoints, waypoint identifier, waypoint type, long name, bearing and distance, and latitude/longitude are presented. For navigation aids, navigation aid frequency will also be presented. For airports, communication frequencies and airport runway data will also be presented.

The information window is closed by pushing the control knob.

# OBS (Omnibearing selector) Function

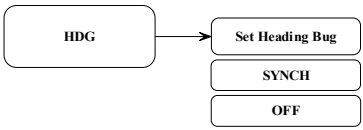
**PFD and ND**




The **OBS** function allows the user to control the setting of the omnibearing selector for purposes of showing course deviations. The OBS for GPS/WAAS allows the user to specify either a manual OBS setting, or an automatic OBS setting in which the current active OBS is controlled by the GPS/WAAS flight plan. The OBS for VOR allows the user to specify the active OBS setting for the VHF navigation function. Manual GPS/WAAS OBS setting and VOR OBS setting is settable in increments of 1°. With optional VHF navigation, the OBS function also permits the user to select either GPS, NAV1, or NAV2 as the HSI source. The HSI source determines which navigation source is used to generate HSI guidance symbology. HSI source also determines which navigation source is used for autopilot lateral navigation signals.

# HDG (Heading) Function

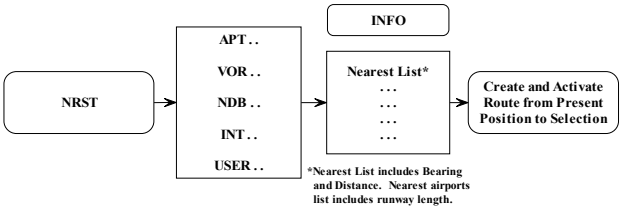
**PFD and ND**




The heading bug function allows the user to the heading bug in increments of 1°, synchronize the heading bug to current heading, or turn the heading bug off.

# NRST (Nearest) Function

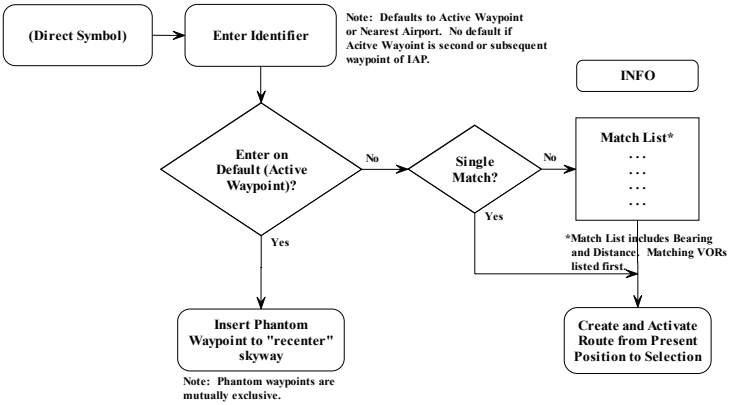
**PFD and ND**




Upon activating the Nearest function, an option list appear to allow the user to select from a list of the nearest airports, nearest VORs, nearest NDBs, nearest intersection, or (if user waypoints exist) nearest user waypoints. Upon selecting a waypoint category from the option list, a list of waypoints matching the waypoint category will be displayed. The list will include the identifier along with bearing and distance to the waypoint. The list for airports also contains an indication of the longest runway length at the airport. An **INFO** tile will also be available to activate the information function and provide further information on the highlighted waypoint prior to activation. Upon selecting a waypoint, a new active flight plan will be created from present aircraft position to the selected waypoint.

# Direct-To Function

## PFD and ND




Upon pressing the **Direct-To** button, the system will check for a current active waypoint. If there is an active waypoint and the waypoint is not the second or subsequent waypoint of an IFR approach procedure, then the active waypoint will be the default entry. If there is no active waypoint, then the nearest airport will be the default entry.

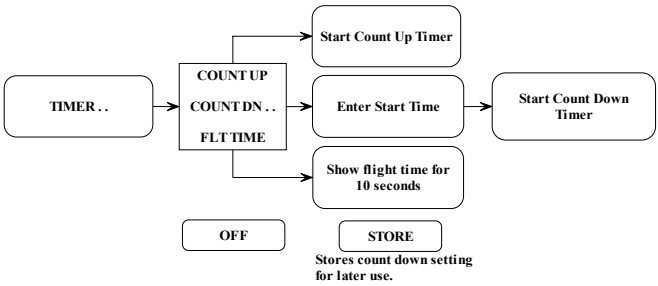
If the default entry is the active waypoint and is accepted by the user, then a phantom waypoint will be inserted at the current aircraft location and the skyway will be “re-centered” to provide guidance directly to the new active waypoint. The rest of the active flight plan will remain unchanged. If the default entry is not the active waypoint and is accepted by the user, then a new active flight plan will be created from present aircraft position to the selected waypoint.

If the user rejects the default entry by entering identifier characters, then a search for matching identifiers will be performed. If there is a single result from the search, then a new active flight plan is created from present aircraft position to the result. If there is no result from the search, the user will be re-prompted to enter an identifier. If there are multiple results from the search, a list with matching identifiers will be

presented and, upon selection, a new active flight plan will be created from present aircraft position to the selected waypoint. An **INFO** tile giving access to the information function for the highlighted result will appear at this level to aid in selection.

# Timer Function

**PFD and ND**

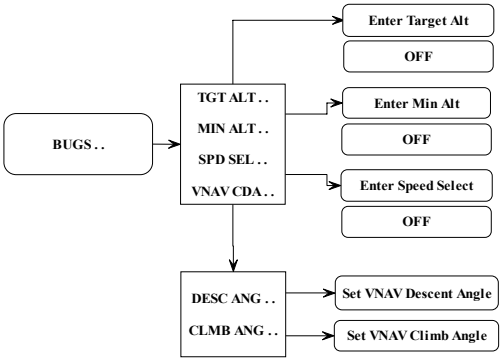



Upon selecting the timer function, a menu will appear to let the user choose the count up timer, the count down timer, or the flight time display. An **OFF** tile will also appear at this level to allow the user to turn off any active timer functions. If the user selects the count up timer, the count up timer will be activated immediately.

If the user selects the count down timer, the user will be prompted to enter a start time from which the count down begins. After entering a start time, the user will be able to either start the count down timer or select the **STORE** tile to store the start time for later use. If the user selects the flight time display option, the current elapsed time since system power up will be displayed for 10 seconds or until any key is pressed.

# Bug Set Function

**PFD Only**




Upon selecting the PFD bugs function, the user will be presented a menu to choose either setting a target altitude, setting a minimum altitude, setting an airspeed bug, or setting the VNAV climb or descent angle. Selecting the target altitude option will allow the user to either turn the target altitude off or to set the target altitude in increments of 100 feet (enroute and terminal mode) or 10 feet (approach mode).

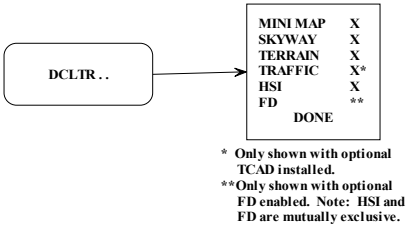
Selecting the minimum altitude option will allow the user to either turn the minimum altitude off or to set the minimum altitude in increments of 10 feet.

Selecting the airspeed bug option will allow the user to either turn the airspeed bug off or to set the airspeed bug in increments of 1 knot indicated airspeed.

Selecting the VNAV climb or descent angle option will bring up a further option list for setting either climb angle or descent angle. At this further level, selecting either option will allow the user to set the climb angle or the descent angle (as appropriate) in increments of 0.1°.

# PFD Declutter Function

**PFD Only**



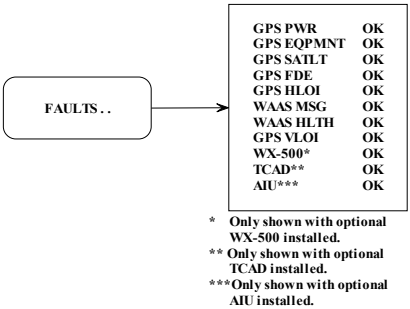

Upon activating the PFD declutter function, an list of declutter items will be shown. It is possible to select or deselect the following items:

1. PFD mini-map.
2. Skyway guidance symbology.
3. Perspective terrain and obstacle depiction.
4. Perspective traffic depiction.
5. HSI symbology.
6. Flight director symbology (only shown with optional flight director symbology option and mutually exclusive with HSI symbology).

# Faults Function

**ND Only**

(See System Overview, GPS/WAAS Receiver, page 25, for information on GPS Faults.)




Upon selecting the MFD faults function, the status of the following system parameters will be displayed:

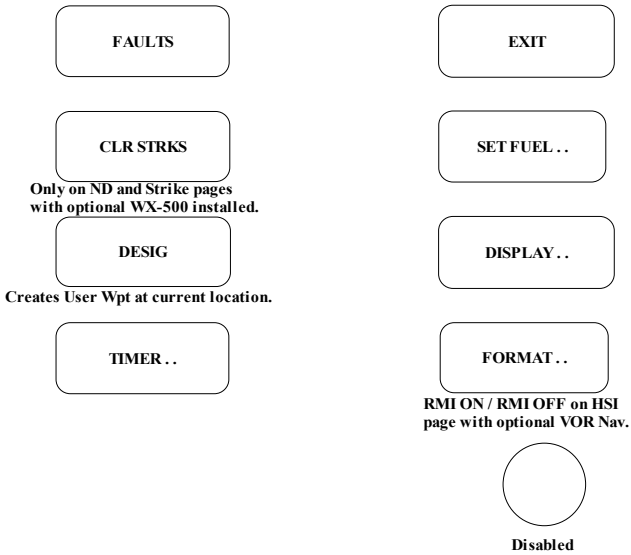
1. GPS/WAAS loss of navigation due to absence of power (**GPS PWR**).
2. GPS/WAAS loss of navigation due to probable equipment failure (**GPS EQPMNT**).
3. GPS/WAAS loss of navigation due to inadequate satellites to compute a position solution (**GPS SATLT**).
4. GPS/WAAS loss of navigation due to a position failure that cannot be excluded within the time to alert (**GPS FDE**).
5. GPS/WAAS loss of horizontal integrity monitoring and loss of navigation due to loss of horizontal integrity monitoring (**GPS HLOI**).
6. GPS/WAAS loss of navigation due to no valid WAAS message received for 4 seconds or more (**WAAS MSG**).
7. GPS/WAAS loss of navigation due to insufficient number of WAAS HEALTHY satellites (**WAAS HLTH**).

8. GPS/WAAS loss of vertical navigation due to loss of vertical integrity monitoring (**GPS VLOI**).
9. If the WX-500 option is enabled, loss of communications with the WX-500 (**WX-500**).
10. If the TCAD option is enabled, loss of communications with the TCAD (**TCAD**).
11. If the analog interface option is enabled, loss of communications with the analog interface (**AIU**).

# Navigation Display Top Level Menus

**ND Only**

(Shown by pressing the **MENU** button when on the MFD screen)




**FAULTS:** displays the fault display menu.

**CLR STRKS:** displays the strike clear option for the Goodrich WX-500. This menu option will only appear on the ND screen and Strike screen when the WX-500 option is enabled.

**DESIG:** Same function as PFD Top Level Menu.

**TIMER:** Same function as PFD Top Level Menu.

**SET FUEL:** displays the fuel totalizer set menu.

**DISPLAY:** displays the MFD screen display select menu.

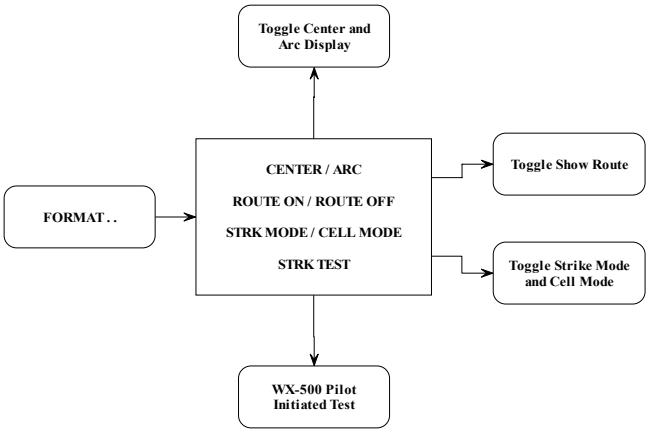
**FORMAT** or **RMI ON / RMI OFF**: On screens other than the HSI screen, displays the appropriate screen format menu

option. On HSI screen with optional VHF navigation, toggles showing of radio magnetic indicator. **RMI ON** appears when the current mode is radio magnetic indicator off.
**RMI OFF** appears when the current mode is radio magnetic indicator on.

# Strike Format Function

**ND Only**

(Only shown with optional WX-500 installed).




Upon selecting the MFD format function when in the Strike screen, a menu appears with the following options:

**CENTER / ARC:** toggles between centered and arc lightning strike screen display format.

**ROUTE ON / ROUTE OFF:** toggles showing/not showing the active flight plan route on the lightning strike screen.

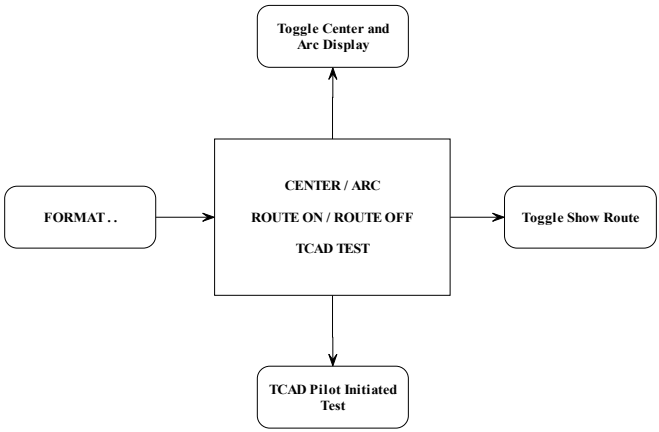
**STRK MODE / CELL MODE:** toggles between strike mode/ strikes and cell mode on the lightning strike screen.

**STRK TEST:** activates the WX-500 pilot initiated test function.

# Traffic Format Function

**ND Only**

(Only shown with optional TCAD installed.)




Upon selecting the MFD format function when in the Traffic screen, a menu will appear with the following options:

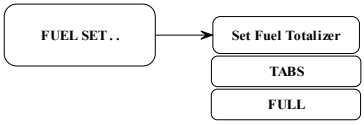
**CENTER / ARC:** toggles between a centered and arc traffic screen display format.

**ROUTE ON / ROUTE OFF:** toggles showing/not showing the active flight plan route on the traffic screen.

**TCAD TEST:** activates the TCAD pilot initiated test function.

# Fuel Set Function

**ND Only**



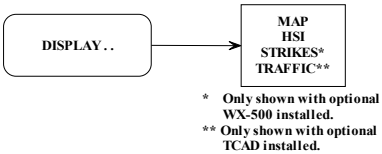

The fuel totalizer quantity setting function allows the user to set the fuel totalizer quantity in increments of volume units (volume units depends upon the aircraft-specific configuration of the system, i.e. pounds, gallons, etc.).

The **TABS** menu tile sets the quantity to the “fuel tabs” fuel capacity (partial tanks or mains only, for example).

The **FULL** menu tile sets the quantity to the total aircraft fuel capacity (full tanks or mains plus tips, for example).

# MFD Display Function

**ND Only**




The Display function allows the user to select which MFD screen to display. Options include:

**MAP:** shows the moving map screen.

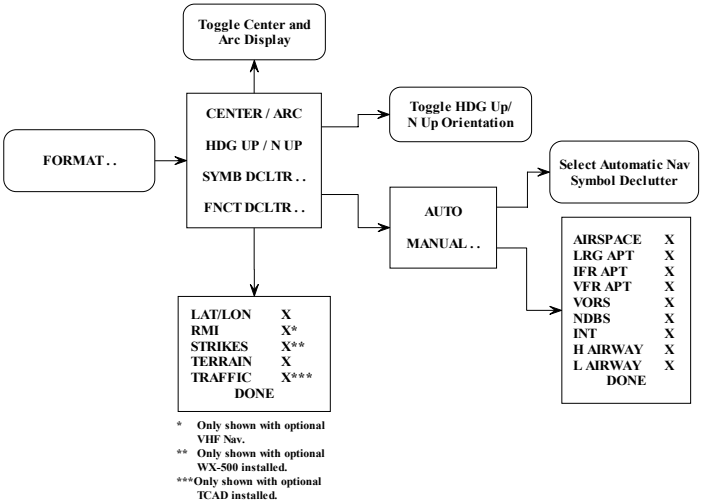
**HSI:** shows the HSI screen.

**STRIKES:** shows the lightning strike screen. This option is only available if the WX-500 option is enabled.

**TRAFFIC:** shows the traffic screen. This option is only available if the TCAD option is enabled.

# Moving Map Format Function

**ND Only**




Upon selecting the MFD format function when on the moving map screen, an menu appears with the following options:

**CENTER / ARC:** toggles between centered and arc display format.

**HDG UP / N UP:** toggles between a heading up and a True North up display format.

**SYMB DCLTR:** activates an menu that allows the user to choose either automatic navigation symbol declutter or manual navigation symbol declutter. If the user chooses manual navigation symbol declutter, a further menu appears to allow the user to individually toggle airspace, large airports (IFR and longest runway > 8100'), IFR airports, VFR airports, VORs, NDBs, intersections, high altitude airways, or low altitude airways. Turning on VFR airports also turns on large airports and IFR airports. Turning on IFR airports also turns on large airports. Turning off large airports also turns off IFR airports

and VFR airports. Turning off IFR airports also turns off VFR airports.

**FNCT DCLTR:** activates a menu that allows the user to individually toggle display of current latitude and longitude, display of RMI needles (if VHF navigation option is enabled), display of lightning strikes (if WX-500 option is enabled), display of terrain, and display of traffic (if TCAD option is enabled).

# Section 5

# Step-by-Step Procedures

## Setting Altimeter

**PFD and reversionary PFD Only**

The altimeter is set automatically on startup based on the touchdown zone elevation of the nearest runway.

To change the altimeter, turn the control knob to enter the desired setting an push to enter.

***NOTE**:*
*In the event the altimeter setting results in an AGL altitude indication of more than 50 ft., the PFD enters the unusual attitude mode. To correct this, set the altimeter to produce an AGL altitude less than 50 ft.*

## Setting Fuel Quantity

**ND Only**

1. Press the **MENU** button.
2. Select the **SET FUEL . .** menu, then push to enter.
3. Turn control knob to set fuel quantity on board or press **FULL** menu button to set to total usable value or press **TABS** to enter a preset partial amount.
4. Push control knob to enter.

# Flight Plans

Flight plans are stored routes that can be used over and over without having to re-enter the waypoints each time. A flight plan consists of at least two waypoints (a start and an end) and can have up to 40 waypoints.

All flight planning is done using a built-in graphical interface. Flight plans can be created, edited, or reversed on the MFD only, and they are automatically crossfilled to other displays. They can be activated from either the PFD or MFD. Once activated, a flight plan can be edited en route without affecting the stored flight plan. A total of 50 flight plans can be stored in the system.

# Create and Store a Flight Plan

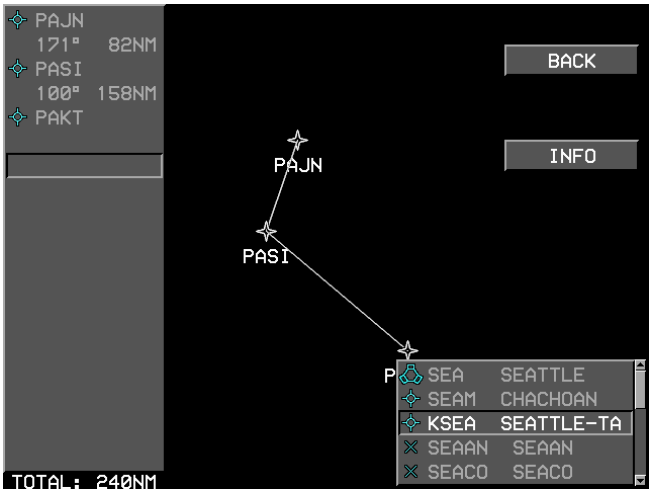
**MFD Only**

1. Select the **FPL . .** menu.
2. Turn control knob to highlight **CREATE - EDIT . .** , then push to enter.
3. **CREATE FLIGHT PLAN** will be highlighted. Push to enter.

4. The graphical flight planner will be displayed. Press **ADD** and the waypoint entry boxes will appear in the lower right corner of the display. Enter the first waypoint of your flight plan - turn the control knob to select an alphanumeric character and push enter to advance to the next character. Begin the waypoint selection with a K if a U.S. airport is

the starting point. This will save time by shortening the list of possible matches.

5. Enter at least one character. Advance through any remaining blank character spaces by simply pushing the control knob. A list of possible matching waypoints will be displayed.



If there is no exact match, turn the control knob to select desired waypoint, and push to enter.
An exact match will be accepted and entered immediately.

The **INFO** button may be used to get Jeppesen NavData information about waypoints as they are added.

6. Repeat for all waypoints in route.
7. Press **BACK** at any point to back up during selection of alphanumeric characters.
8. Press **SAVE-EXIT** when finished to save and return to previous screen.
9. The flight plan will be automatically named with the first and last waypoint and added to the flight plan list.

# Activate a Stored Flight Plan

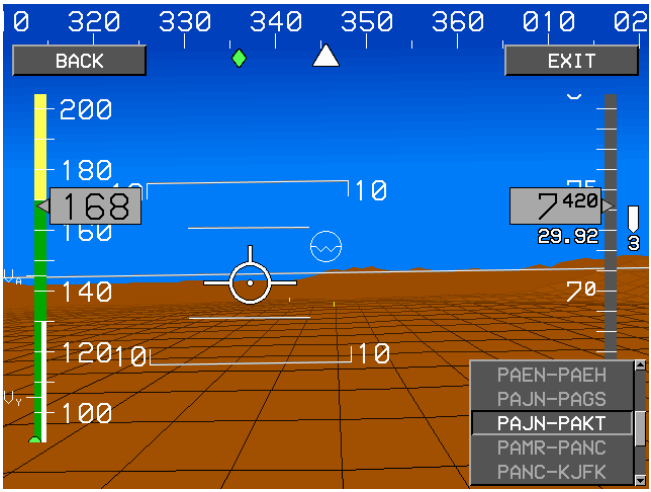
**PFD and ND**

1. Select the **FPL . .** menu.

   On the PFD, a list of flight plans stored in the EFIS will be displayed.

   On the MFD, **SELECT** will be highlighted...
   Push the control knob to display a list of flight plans stored in the EFIS.

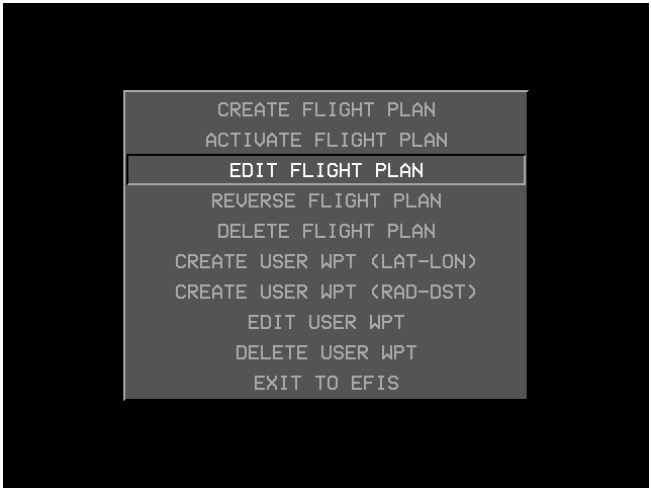
2. Rotate the control knob through the flight plans. When the desired flight plan is highlighted, push the control knob to enter.



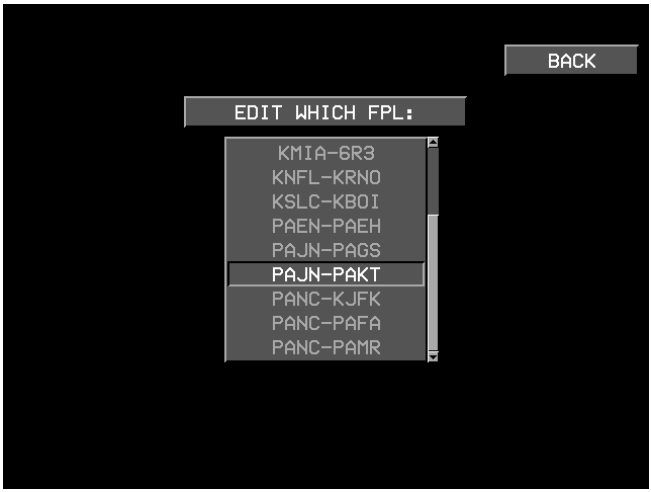

*NOTE:*
**NO SAVED FPLS** *will be displayed if no flight plans have been created and stored.*

# Edit a Stored Flight Plan

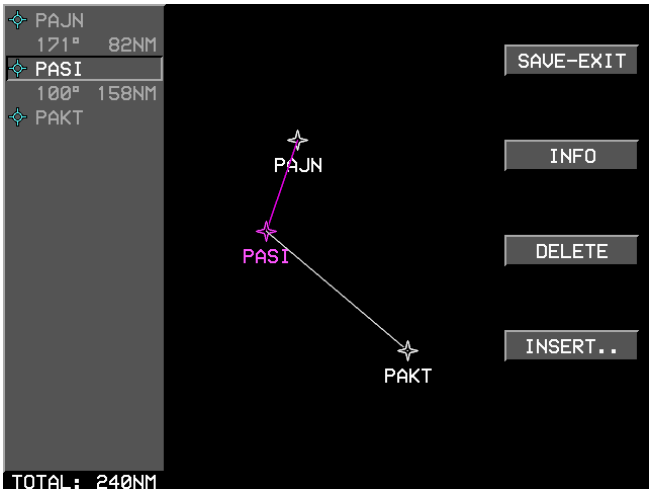
1. Select the **FPL . .** menu.
2. Turn control knob to highlight **CREATE - EDIT . .** , then push to enter.
3. Turn control knob to highlight **EDIT FLIGHT PLAN**, then push to enter.



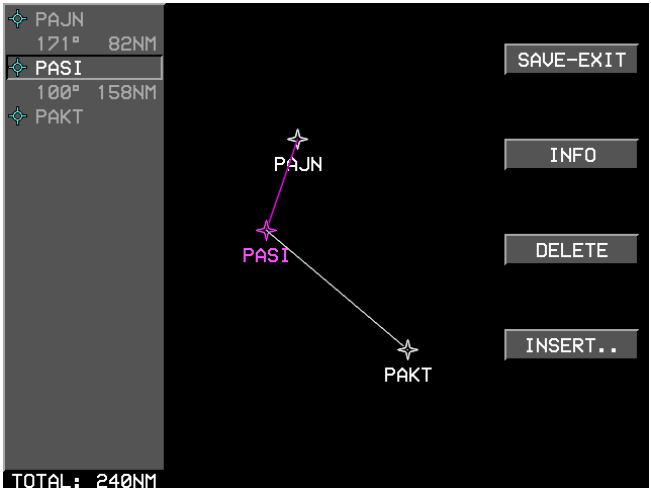
4. Turn control knob to highlight the flight plan you wish to edit, then push to enter.



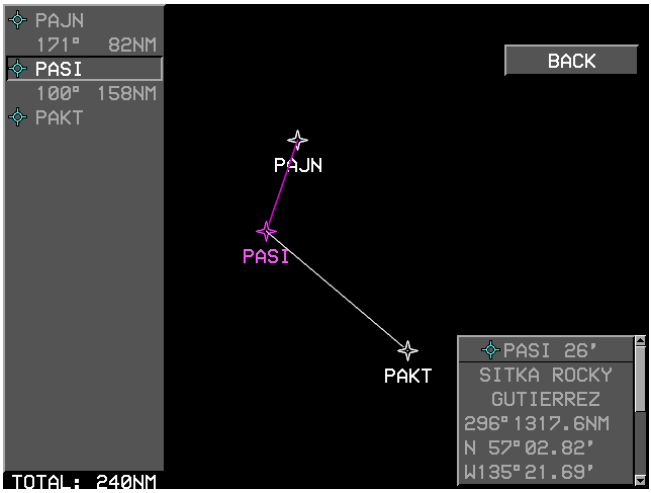

5. Turn control knob to highlight the waypoint you wish to edit, then push to enter.



6. Select **INSERT . .** to add a new waypoint before the highlighted waypoint. Highlighted waypoints may be changed by turning the control knob.
   Or:
   Select **DELETE** to delete the highlighted waypoint.



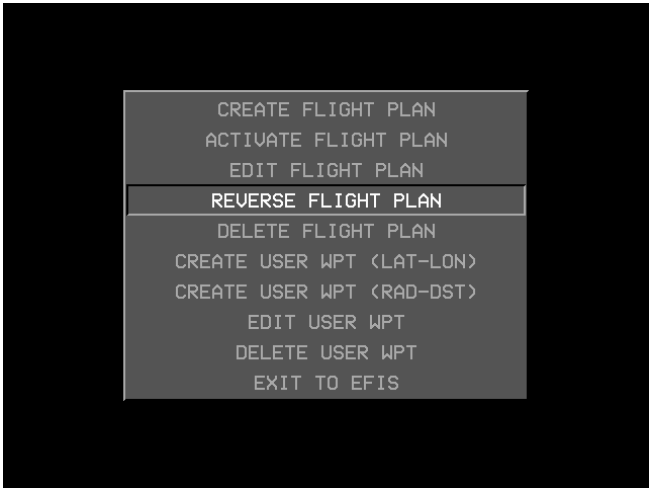

   Select **INFO** to display additional information about the highlighted waypoint.



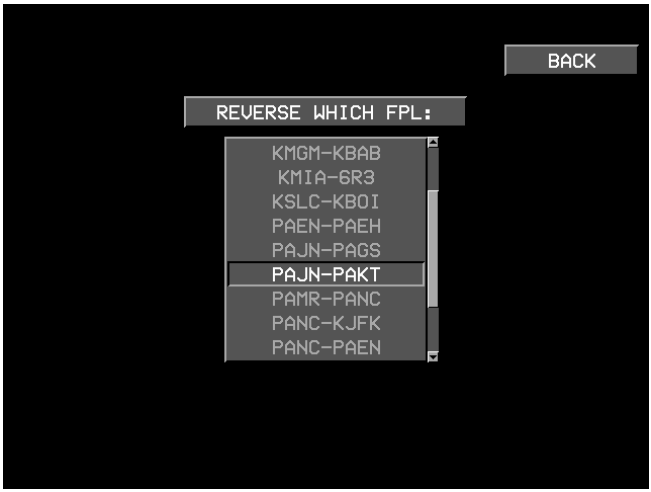
7. Scroll to the end and press **ADD . .** to add waypoints to the end of the route.
8. Press **BACK** to return to **EDIT** page.
9. Press **SAVE-EXIT** when finished to save and return to previous screen.

# Reverse a Stored Flight Plan

1. Select the **FPL . .** menu.
2. Turn control knob to highlight **CREATE - EDIT . .** , then push to enter.
3. Turn control knob to highlight **REVERSE FLIGHT PLAN**, then push to enter.



4. Turn control knob to highlight flight plan to be reversed, then push to enter.

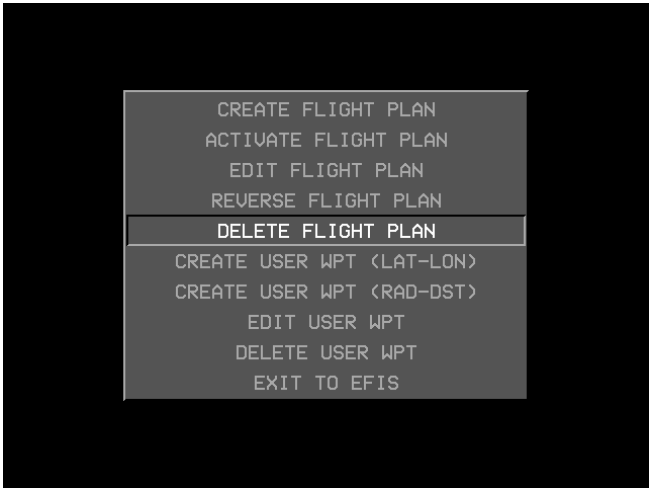



Reversed flight plan will be added to flight plan list. It may then be selected for active use in the normal manner.

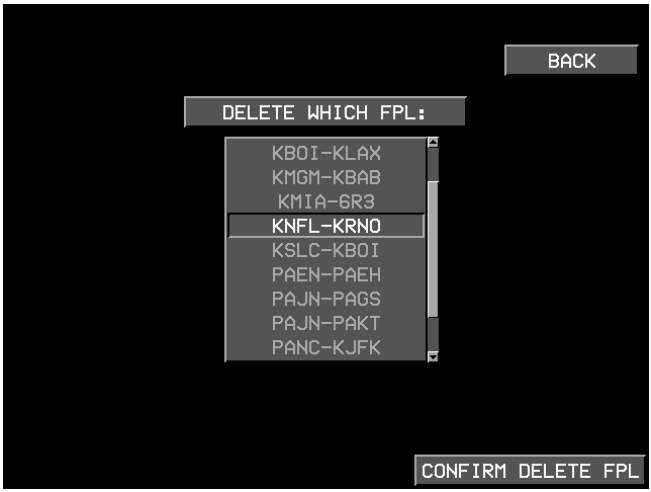
5. Press **BACK** to return to previous screen.

# Delete a Stored Flight Plan

1. Select the **FPL . .** menu.
2. Turn control knob to highlight **CREATE - BACK . .** , then push to enter.
3. Turn control knob to highlight **DELETE FLIGHT PLAN**, then push to enter.



4. Turn control knob to highlight flight plan to be deleted, then push to enter.



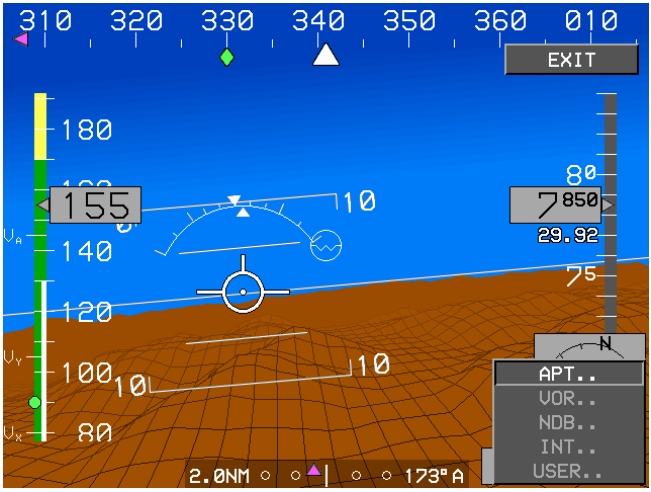

You will be asked for confirmation to delete the highlighted flight plane. Push enter to confirm or push **BACK** to return to the previous menu.

5. Press **BACK** to return to previous screen.

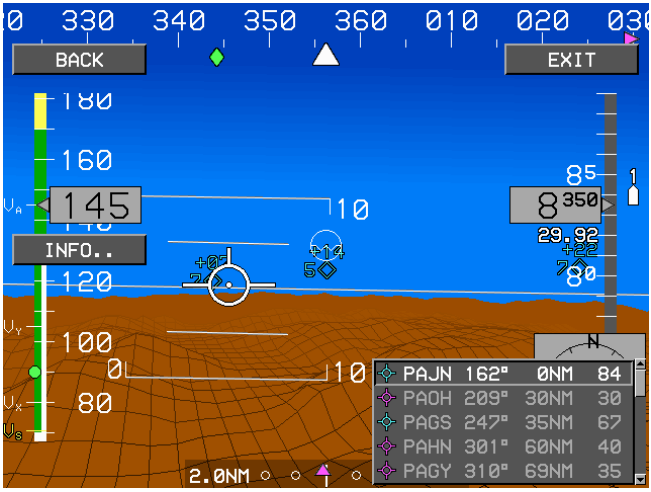
# Waypoints

## Direct to Nearest Waypoint

1. Press the **NRST** dedicated button.
2. Turn control knob to highlight nearest airport, VOR, NDB, intersection, or user waypoint, then push to enter.



3. A list of waypoints will be displayed, each with bearing and distance (and longest runway for airports). Turn control knob to highlight desired choice, then push to enter.




Direct course to selected waypoint will be displayed with distance in NM.

***NOTE**:*
*Using **NRST** or entering a new destination waypoint using **Direct-To** will override an existing flight plan or waypoint.*

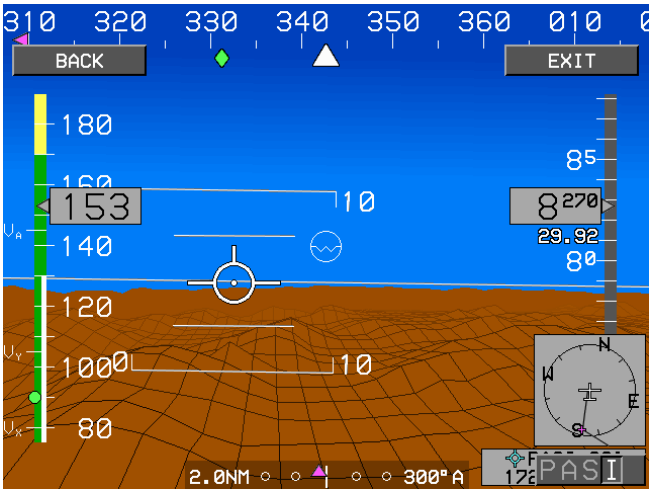
# Direct to Any Waypoint

1. Press the **D→** dedicated button.

2. If an active waypoint exists, it will be entered as the default. Pushing the control knob will create a phantom waypoint at the current aircraft location and recenter the skyway and CDI directly from the present position to the waypoint. The leg prior to the phantom waypoint is designated a discontinuity, see **Discontinuity, page 3-104**.

   If there is no active waypoint, the nearest airport will be the default entry.

3. If desired, enter the identifier of another waypoint – turn the control knob to select an alphanumeric character and push to enter and advance to the next character. Press **BACK** if you need to back up. Entering at least one character and advancing through the remaining blank character spaces will display a list of potential waypoints if there is no exact match.



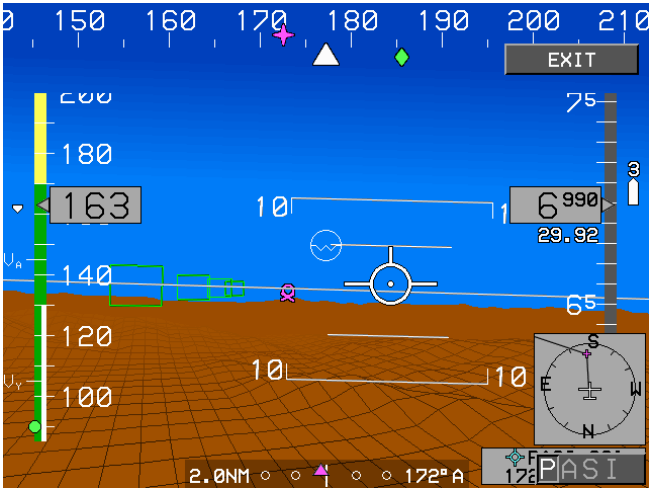

4. The **INFO** button may be used to get Jeppesen NavData information about a waypoint before it is activated.

5. Turn control knob to highlight desired waypoint, push to enter. Direct course to selected waypoint will be displayed with distance in NM.

***NOTE:***
*Unless the default (current active waypoint) is accepted, using* ***Direct-To*** *will override an existing flight plan or waypoint. To go directly to another waypoint within the active flight plan, press the ACTV button, scroll to the desired waypoint, then push the D→ button.*

# Recenter on Route

1. Press the Ð→ dedicated button.
2. The active waypoint identifier will be displayed in the character spaces.



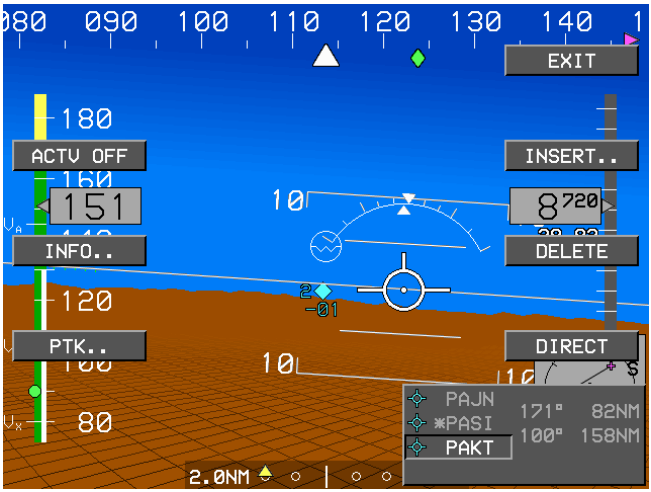

3. To fly direct from present position (re-center the skyway/ courseline), push control knob to enter.
   Direct course to selected waypoint will be displayed from aircraft's current position with distance in NM.

***NOTE:***
***Using Direct-To and entering another waypoint identifier (other than the default) will override an existing flight plan or waypoint. To go directly to another waypoint within the active flight plan, press the ACTV button, scroll to the desired waypoint, then push the Ð→ button.***

# Activating a Waypoint Within a Route

1. Press the **ACTV** Button. A list of waypoints in the current flight plan will be displayed. An asterisk indicates the active waypoint.

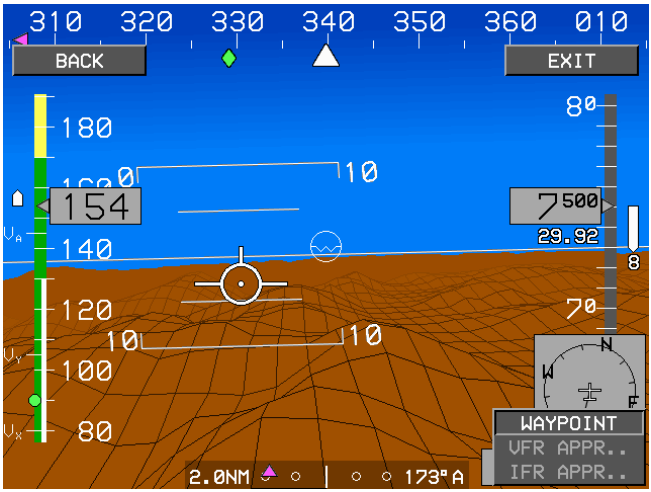
2. Turn control knob to highlight desired waypoint, then push to enter.




3. If waypoint **is not an airport or user waypoint,** waypoint is activated immediately and a direct course to selected waypoint will be displayed.

   If waypoint **is an airport**, a list with the airport reference

point (**WPT**), **VFR** and **IFR** approaches, **DP's**, and **STAR's** will be displayed.



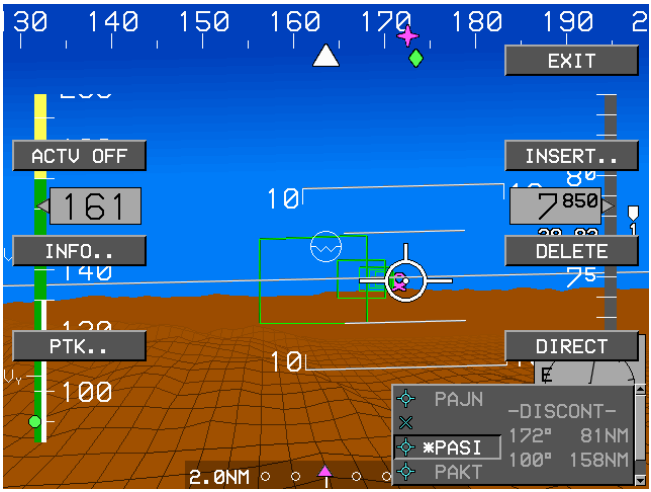

4. If waypoint is airport, turn control knob to highlight **WPT**, and push to enter. Selected airport will be activated as a waypoint and the courseline to the waypoint will be displayed in magenta.

***NOTE:***
***This will not take you directly from the present position to the active waypoint, it just specifies a new active waypoint without altering the route. To go directly from the present position to a different waypoint within an active flight plan, press the ACTV button, select the desired waypoint, then press the D→ button.***

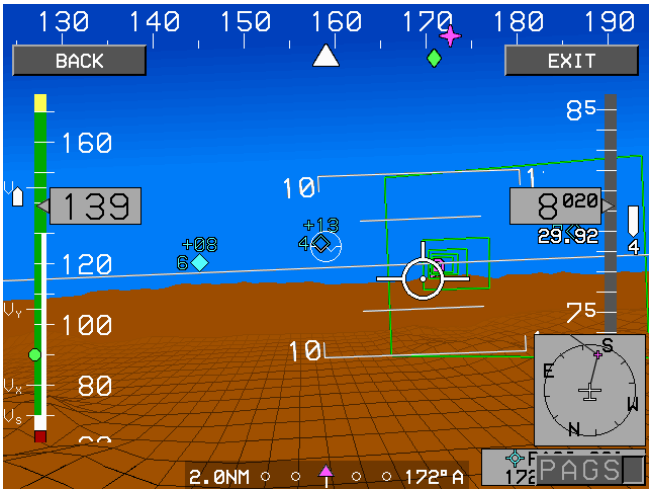
# Add a Waypoint to an Active Route

1. Press the **ACTV** button.
   A list of waypoints in the current flight plan will be displayed.

2. Turn control knob to highlight the waypoint *before which* you wish to add a new waypoint.



3. Select the **INSERT . .** menu.




4. Enter the identifier of the desired waypoint - turn the control knob to select an alphanumeric character and push to enter and advance to the next character. Press **BACK** at any point to back up. Entering at least one character and advancing through the remaining blank character spaces will display a list of waypoints if there is no exact match. An exact match will be accepted and entered immediately.

5. The **INFO** button may be used to get Jeppesen NavData information about a waypoint before it is activated.

6. Turn control knob to highlight desired waypoint, push to enter. Waypoint will be added to current flight plan.

---

***NOTE**:*
*For more detailed information on inserting, adding, and deleting waypoints, see* ***ACTV (Active) Options, page 4-10***

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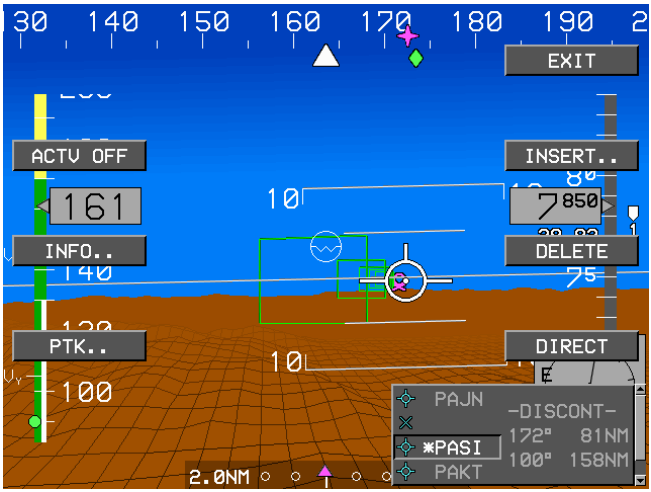
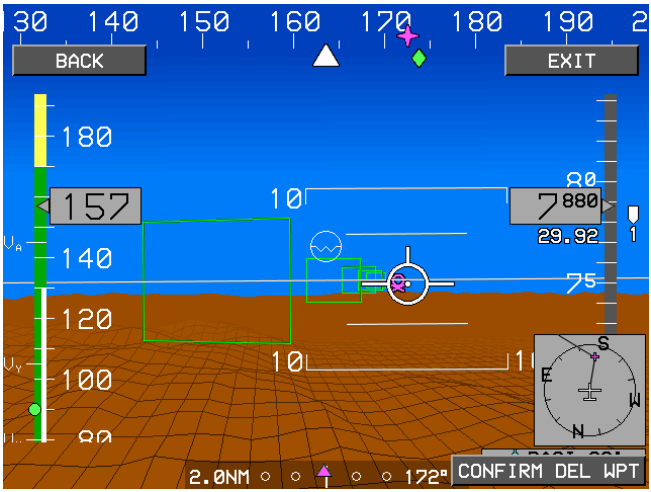
# Delete a Waypoint From an Active Route

1. Press the **ACTV** button
   A list of waypoints in the current flight plan will be displayed.

2. Turn control knob to highlight the waypoint you wish to delete.



3. Select the **DELETE . .** menu.




Confirmation for delete will be requested. Push control knob to confirm. Waypoint will be deleted from current flight plan.

***NOTE**:*
*For more detailed information on inserting, adding, and deleting waypoints, see* ***ACTV (Active) Options, page 4-10***

# Create a User Waypoint

User waypoints may be created in three ways:

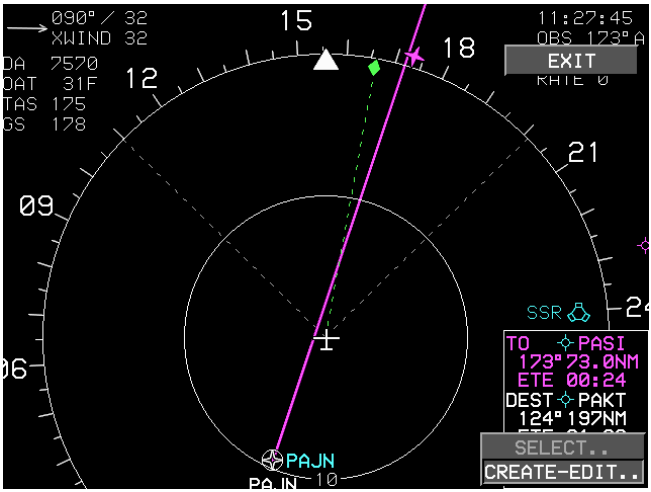
**A. Latitude & Longitude**

**B. Radial & Distance**

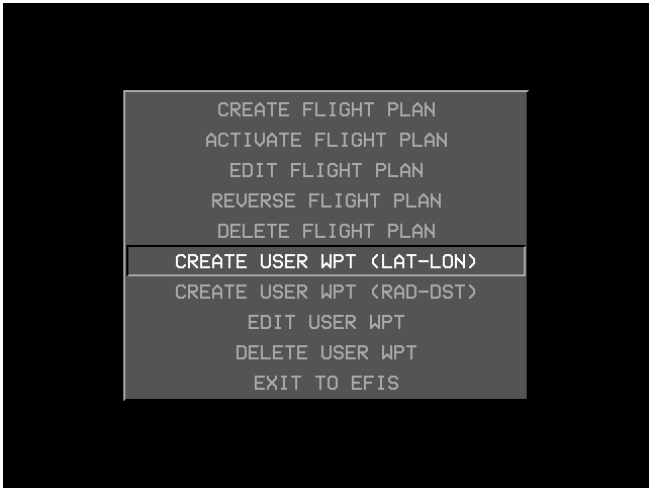
**C. Overfly**

**A. To create a user waypoint using Latitude & Longitude:**

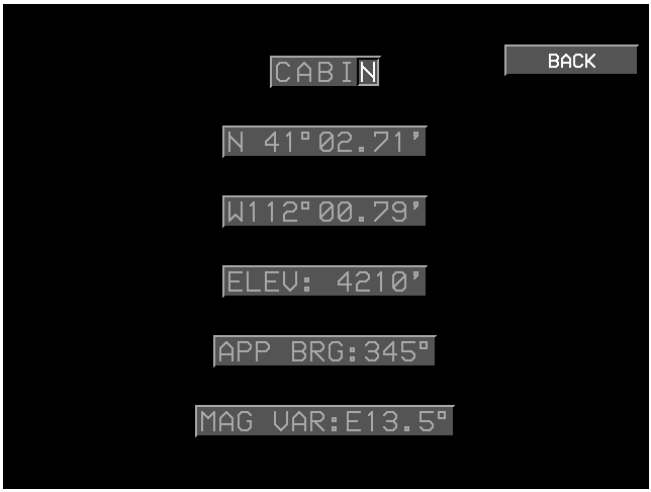
1. Press the **FPL . .** menu.
2. Turn control knob to highlight **CREATE - EDIT . .** , then push to enter.



3. Turn control knob to highlight **CREATE USER WPT (LAT-LON)**, in the Function Select screen, then push to enter.




Using the control knob to enter alphanumeric characters, follow on-screen prompts to edit information.




**a) Identifier:** The top line allows the user to specify a five

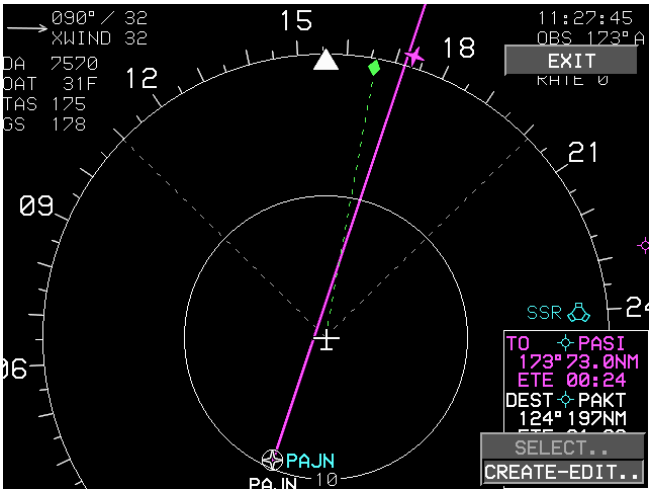
character identifier for the waypoint
**b) Latitude:** The second line allows the user to specify latitude for the waypoint in increments of hundredths of minutes.
**c) Longitude:** The third line allows the user to specify a longitude for the waypoint in increments of hundredths of minutes.
**d) Elevation:** The fourth line allows the user to specify an elevation for the waypoint in feet. (This value may be used for VFR approaches.)
**e) Approach Bearing:** The fifth line allows the user to specify an approach bearing to the user waypoint in degrees. Valid values are 1°-360° and "OFF." A value of "OFF" will disable VFR approaches to the user waypoint. (This value may be used for defining user waypoint VFR approaches.)
**f) Magnetic Variation:** The sixth line allows the user to specify a magnetic variation at the waypoint in tenths of a degree.

After all fields have been entered, push the control knob to save and return to the editing screen.

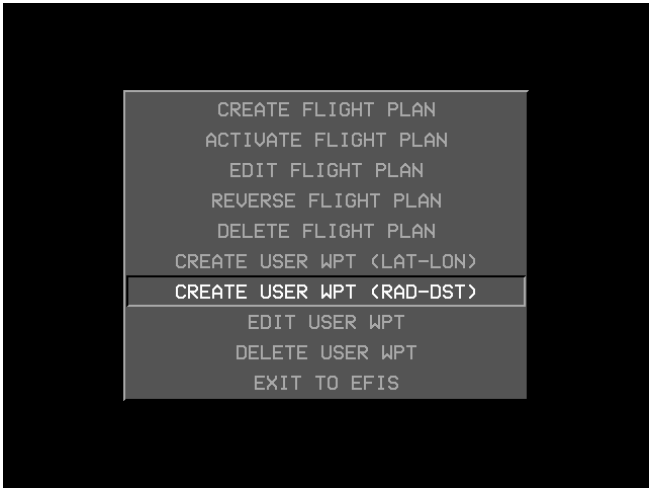
**B. To create a user waypoint using Radial & Distance:**

1. Press the **FPL . .** menu.

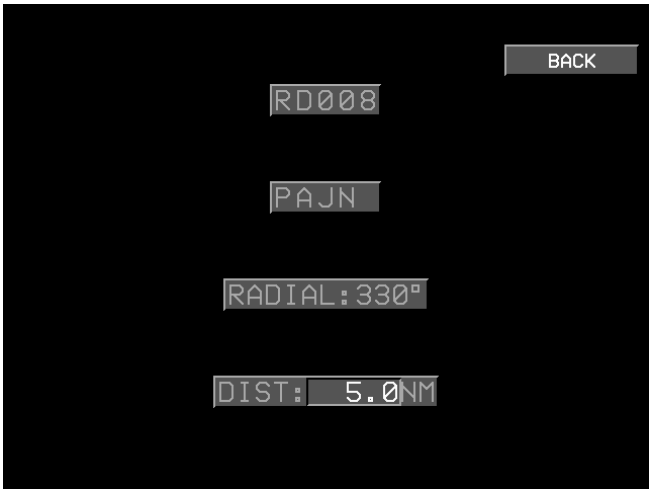
2. Turn control knob to highlight **CREATE - EDIT . .** , then push to enter.




3. Turn control knob to highlight **CREATE USER WPT (RAD-DST)**, then push to enter. This will display the editing screen:.



4. Using control knob to enter alphanumeric characters, follow on-screen prompts to edit information.




The radial-distance user waypoint creation screen allows the user to create a waypoint by reference to radial and distance from another waypoint.
The screen has various data entry boxes as follows:
**a) Identifier:** The first line will annunciate the automatic name applied to the new user waypoint. New user waypoint will automatically be named "RD###," where ### is the next available radial-distance waypoint number.
**b) Reference Waypoint:** The second line will be prompted to enter an identifier for the reference waypoint. The reference waypoint will be entered in the same manner as a waypoint is entered for a flight plan using the control knob. If there is a single result from the search, the user will be advanced to the radial entry box. If there is no result from the search, the user will be re-prompted to enter an identifier. If there are multiple results from the search, a selection list with matching identifiers will be displayed and, upon selection, the user will be advanced to the radial entry box. An **INFO** menu giving access to information for the highlighted result will appear at this level to aid in selection.

**c) Radial Entry:** The third line will allow the user to specify a radial from the reference waypoint in increments of degrees.
**d) Distance Entry:** The forth line will allow the user to specify a distance from the reference in increments of tenths of nautical miles.
After all fields have been entered, push the control knob to save and return to the editing screen.

**C. To create an Overfly user waypoint:**

When directly over the intended waypoint, press **MENU** then **DESIG**.

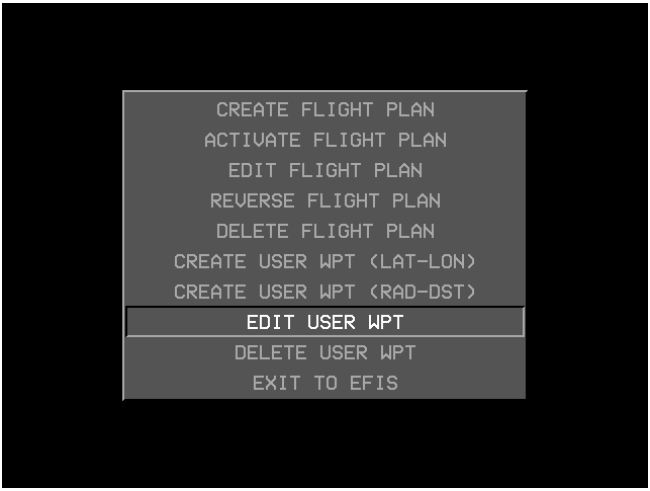
A user waypoint will be created at the present position and automatically be named "OF###" where ### is the next available overfly user waypoint number.

The waypoint name may be changed using the **EDIT USER WPT** function, see **Edit a User Waypoint, page 5-32**.

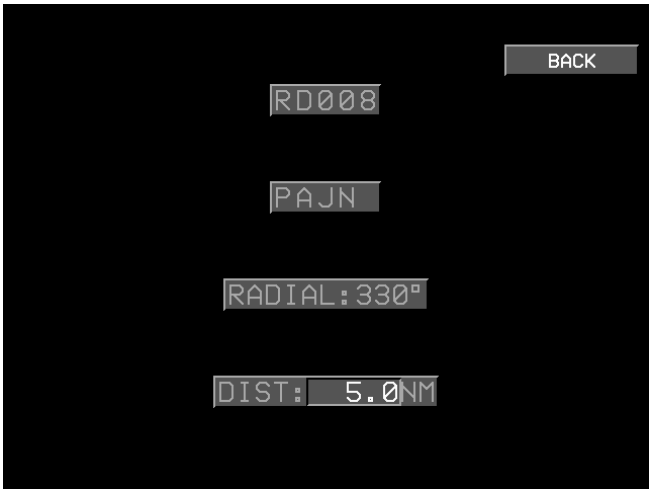
***NOTE**:*
*A maximum of 100 user waypoints may be created and stored.*

# Edit a User Waypoint

1. Select the **FPL . .** menu.
2. Turn control knob to highlight **CREATE - EDIT . .** , then push to enter.
3. Turn control knob to highlight **EDIT USER WPT**, then push to enter.



4. Turn control knob to highlight user waypoint to be edited, then push to enter.

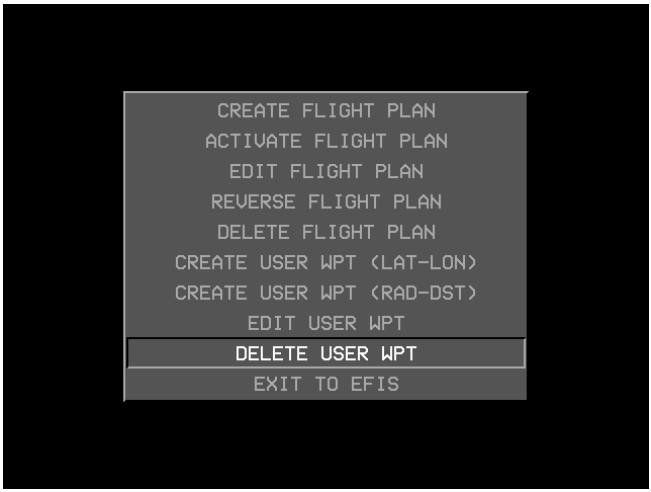



5. Using the control knob to enter alphanumeric characters, follow on-screen prompts to edit information. Step through the characters by pushing the control knob. Back up by pressing **BACK.**

# Delete a User Waypoint

1. Select the **FPL . .** menu.
2. Turn control knob to highlight **CREATE - EDIT . .** , then push to enter.

3. Turn control knob to highlight **DELETE USER WPT**, then push to enter.




4. Turn control knob to highlight user waypoint to be deleted, then push to enter. The selected user waypoint will be deleted from the system.

# Approaches, DPs, and STARs

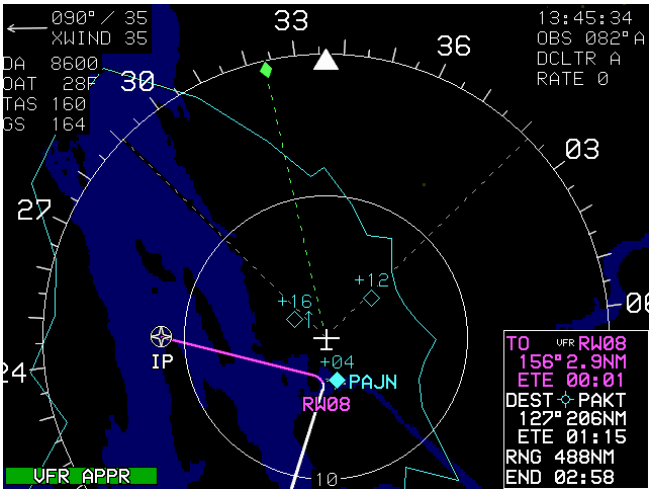
## Select a VFR Approach

1. Press the **ACTV** button.
   A list of waypoints in the current flight plan will be displayed.
2. Turn control knob to highlight landing airport or user waypoint, then push to enter.
3. Turn control knob to highlight **VFR APPR . .** and push to enter.

A list of runways at the destination airport will be displayed (no runways are displayed for user waypoints).

4. Turn control knob to highlight desired runway and push to enter.

   The VFR approach will be entered and displayed as a courseline on the moving map.



The VFR Skyway approach symbology will be displayed on the PFD. The skyway boxes will guide the pilot to an extended centerline for the chosen runway. An initial point (labeled IP, followed by the runway number) will be automatically created. It will be placed 15NM from the runway. If a more direct approach is desired, change the active waypoint to the destination airport. Skyway boxes will then lead directly to the center of the airport.

***AUDIBLE ANNUNCIATION***

The TERMINAL flag will be displayed when within 30NM of the airport and will be accompanied by an auditory chime.

**TERMINAL**

VFR APPR flag will be displayed along with an auditory chime when established on the approach course.

**VFR APPR**

# Select an IFR Approach

1. Press the **ACTV** button.
   A list of waypoints in the current flight plan will be displayed.
2. Turn control knob to highlight landing airport, then push to enter.
3. Turn control knob to highlight **IFR APPR . .** and push to enter. A list of the published instrument approaches will be displayed.

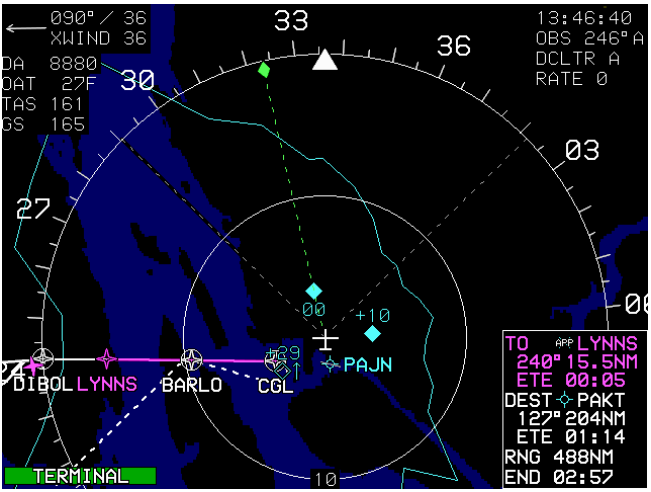
4. Turn control knob to highlight desired approach and push to enter. A list of available transitions will be displayed if applicable.

5. Turn control knob to highlight desired transition and push to enter. A list of runways will be displayed.

6. Turn control knob to highlight desired runway and push to enter.

   The approach will be entered and displayed as a white courseline on the moving map, except the active leg, which will be magenta.

   The approach waypoints will be displayed on the PFD and automatically sequenced so that only the active waypoint is shown (magenta).




   A crossing altitude for each waypoint will be displayed in the waypoint information box (lower right corner of PFD) and the target altitude will automatically be updated.

   Minimum descent altitude or decision height can be entered by setting **MIN ALT . .** from the Bugs menu. The CDI scale will gradually adjust according to the phase of flight and will be indicating 0.3 nautical miles when 2 nautical miles from the final approach fix. Inside the final approach fix, the CDI will be angular like a localizer.

***AUDIBLE ANNUNCIATION***

The TERMINAL flag will be displayed when within 30NM of the airport and will be accompanied by an auditory chime.

**TERMINAL**

VFR APPR flag will be displayed along with an auditory chime when established on the approach course.

**IFR APPR**

# Select a DP or STAR

Selecting a DP or STAR involves essentially the same steps, just substitute **STAR** for **DP** in the following instructions.

1. Press the **ACTV** button.
   A list of waypoints in the current flight plan will be displayed.
2. Turn control knob to highlight appropriate airport, then push to enter.
3. Turn control knob to highlight **SELECT . .** , then push to enter
4. Turn control knob to highlight **DP . .** and push to enter. A list of published procedures will be displayed.

*NOTE:*
*DPs are only displayed for the first waypoint in a stored* ***flight plan****. You cannot activate a DP from the departure airport when using* ***Direct-To*** *or* ***Nearest*** *functions for navigation.*

5. Turn control knob to highlight desired procedure and push to enter. A list of available transitions will be displayed if applicable.

6. Turn control knob to highlight desired transition and push to enter. A list of runways will be displayed.

7. Turn control knob to highlight appropriate runway and push to enter. The DP will be entered and displayed as a white courseline on the moving map, except the active leg, which will be magenta.

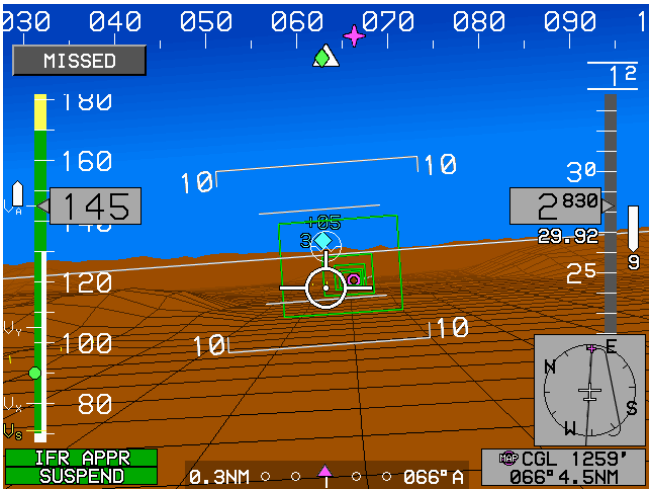
The approach waypoints will be displayed on the PFD and automatically sequenced so that **only** the active waypoint is shown (magenta).

A crossing altitude for each waypoint will be displayed in the waypoint information box (lower right corner) and automatically entered as the target altitude.

# Missed Approach Arming Procedure

1. The **MISSED** menu tile will be displayed automatically upon passing the final approach fix (FAF) of a published instrument approach.

2. To arm the missed approach procedure, press the **MISSED** menu any time. The missed approach procedure will be automatically activated upon passing the missed approach point (MAP).




The appropriate missed approach procedure is alway displayed as a white dashed courseline on the moving map, except the active leg (when appropriate), which will be magenta.

After passing the MAP, the missed-approach procedure waypoints will be displayed on the PFD and automatically sequenced so that **only** the active waypoint is shown (magenta hoop).

If the **MISSED** menu is ***not*** pressed after FAF passage, navigation guidance will continue along the extended centerline of the runway and automatic waypoint

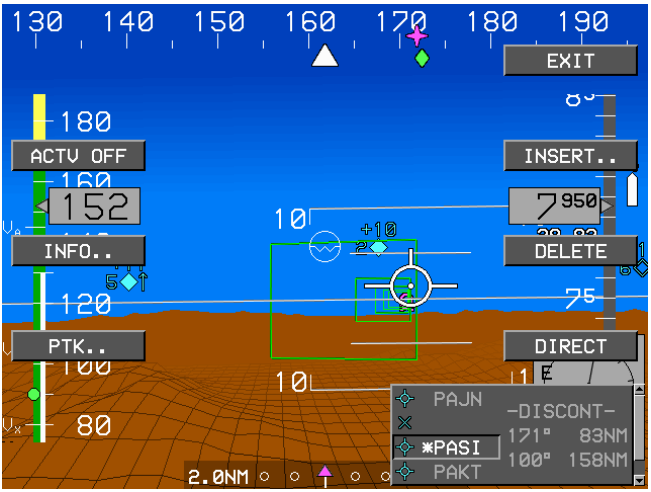
sequencing will be suspended; the missed approach procedure can be activated at any time.

The missed approach procedure can be activated prior to the final approach fix by selecting the first waypoint of the missed procedure from the **ACTV** menu, see **Activating a Waypoint Within a Route, page 5-20**

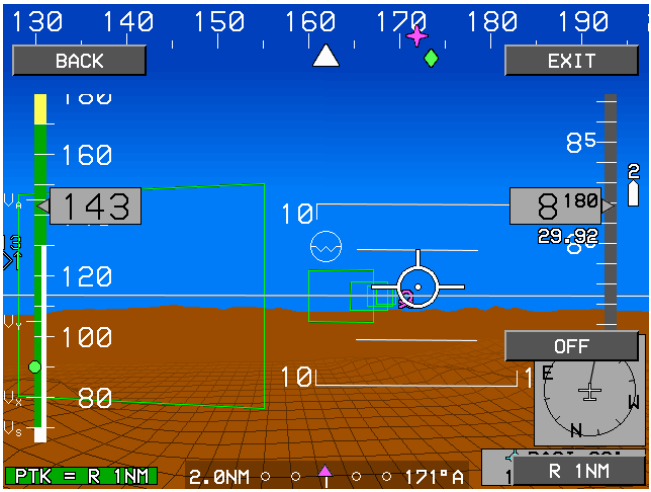
# Parallel Track Function

## Set a Parallel Track

1. Press the **ACTV** button.
2. Select the **PTK . .** menu.



3. Turn control knob left or right to select offset distance in one NM increments, then push to enter.




Waypoints will automatically be sequenced as the flight progresses.

***AUDIBLE ANNUNCIATION***
The parallel track function will be annunciated by a green advisory flag indicating the direction (left or right) and the distance (NM) of offset and will be accompanied by an auditory chime.

**PTK = (L)RXXNM**

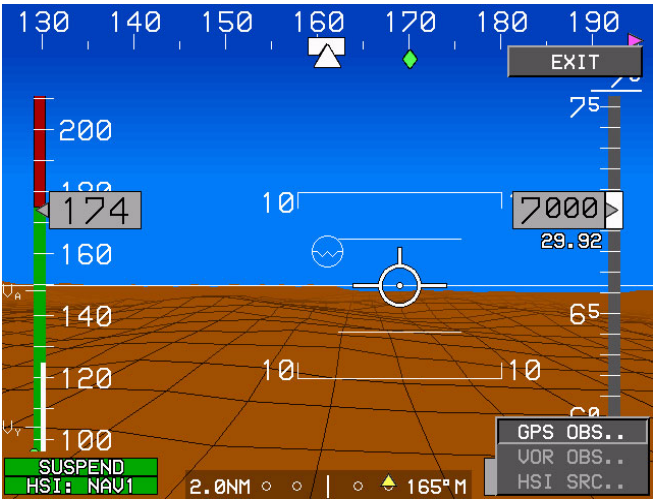
## Turn Parallel Track Off

1. Press the **ACTV** button.
2. Select the **PTK . .** menu.
3. Select the **OFF** menu.

# Omnibearing Selector Function

## Automatic OBS -- GPS

1. Press the **OBS** button.
2. Turn the control knob to highlight **GPS OBS . .**



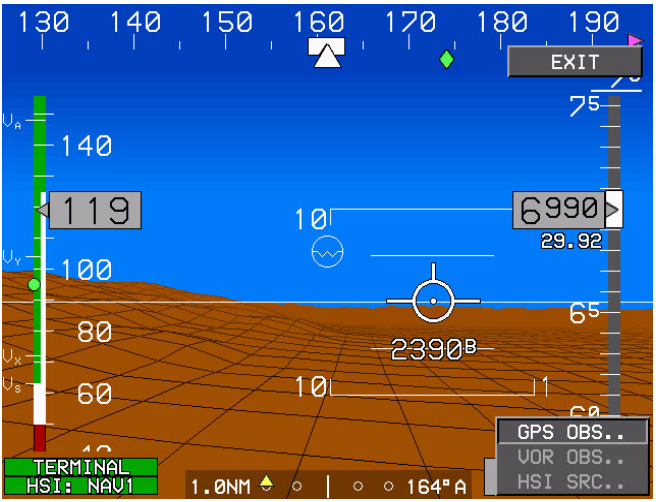
3. **AUTO** will be highlighted. Push to enter.

The OBS setting will automatically adjust to reflect the current flight plan segment.
Waypoints will automatically be sequenced as the flight progresses.

***NOTE**:*
*Automatic OBS is the system default.*

# Manual OBS - GPS

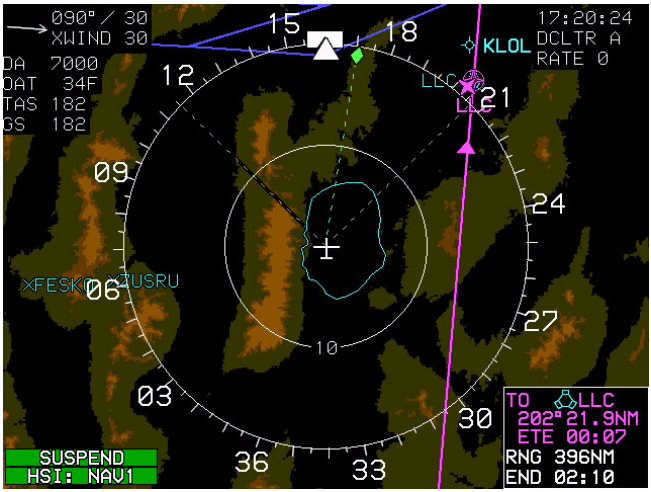
1. Press the **OBS** button.
2. Turn the control knob to highlight **GPS OBS . .**




3. Turn control knob to highlight **MANUAL . .** , then push to enter.

4. Turn the control knob to select desired OBS course and push to enter.

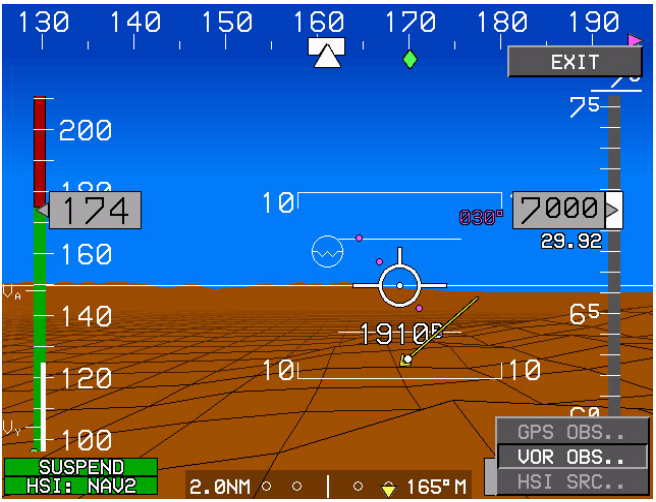
The courseline will be displayed through the active waypoint. Automatic waypoint sequencing will be suspended.



# VOR OBS - HSI

This will set the OBS course of the selected VOR (Nav 1 or Nav 2, see **HSI Source Selection, page 5-56**). VOR course information is displayed on either the PFD or on the ND as a conventional HSI. To display HSI on PFD, use the **Declutter** function.

1. Press the **OBS** button.
2. Turn the control knob to highlight **VOR OBS . .**




At full-scale deflection, the courseline arrow will be yellow as shown above.

3. Turn control knob to select desired OBS course, then push to enter.

# HSI Source Selection

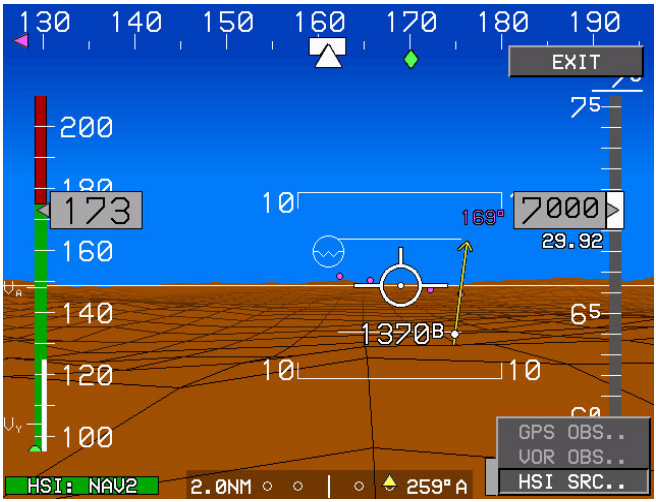
The source of the HSI that is displayed on the PFD or ND can be set to GPS, Nav 1, or Nav 2. The selected source will be annunciated with a green flag in the lower left corner of the display.

The HSI on the PFD may be turned on and off using the **Declutter** function and will only be shown if there is a valid VOR nav signal. If the EFIS detects a localizer and glideslope, the HSI on the PFD will automatically be replaced with the ILS tadpole symbol, **see Tadpole (ILS), page 47**.

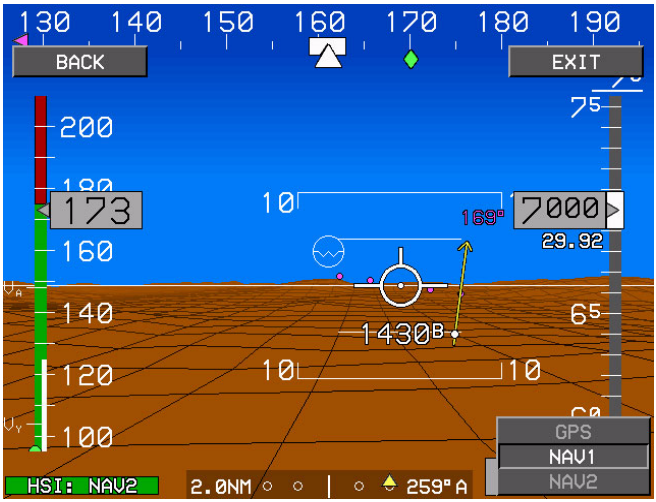
The MFD can be configured to show a conventional HSI using the Display function.

***NOTE**:*
*The skyway on the PFD and magenta courseline on the moving map are always GPS-based. The HSI (both PFD and ND) can be GPS- or VOR-based. The selected HSI source also determines the analog course and deviation signals sent from the EFIS to the autopilot (HSI source does not affect GPS roll steering or analog heading signals sent to the autopilot). This allows you to fly a coupled ILS and still see both the ILS and the skyway on the PFD.*

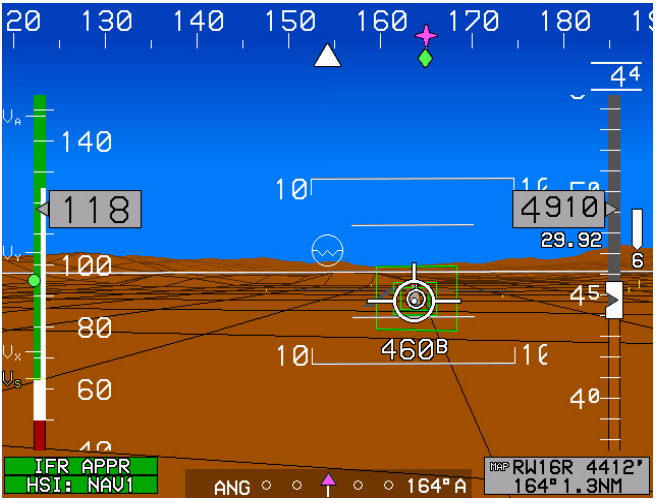
1. To select a nav source, press the **OBS** button (note the current HSI source as Nav 2).




2. Turn the control knob to highlight the desired HSI source, then push to enter. The selected source will now be controlling the HSI symbology on the PFD and ND and will control the autopilot in nav or approach modes.



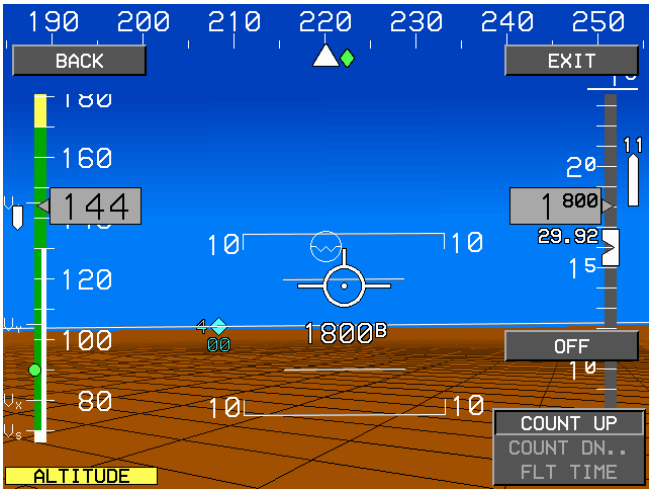
If the selected nav source is a valid localizer and glideslope, the HSI will be replaced with the tadpole ILS symbol, see **Tadpole (ILS), page 3-47**.



# Timer Functions

## Count Up

1. Press the **MENU** button.
2. Select the **TIMER . .** menu
3. Turn control knob to highlight **COUNT UP**, then push to enter.

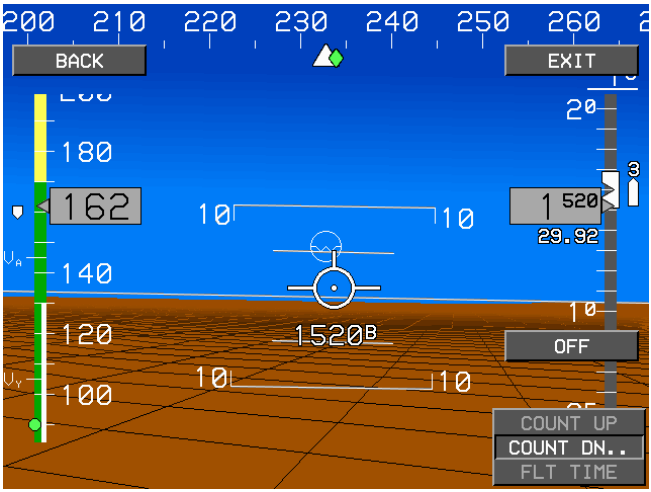



A count-up timer will be centered above the flight path marker on the PFD and below the zulu clock on the moving map.

## Count Down

1. Press the **MENU** button.
2. Select the **TIMER . .** menu

3. Turn control knob to highlight **COUNT DN . .** , then push to enter.




4. Enter the desired time period by turning the control knob to select numeric character and pushing to enter and advance to the next character (press **BACK** at any point to back up). The count-down time can be stored for later use by pressing **STORE**. Once stored, this value will be the default for the count down timer.

   A count-down timer will be centered above the flight path marker on the PFD and below the zulu clock on the moving map.

# Flight Timer

1. Press the **MENU** button.
2. Select the **TIMER . .** menu.
3. Press to enter.

The flight time will be displayed in the bottom right corner of the primary flight display for 10 seconds or until another button is pushed.

# Turning the Timer Off

(Count up and count down timers only)

1. Press the **MENU** button.
2. Select the **TIMER . .** menu.
3. Press the **OFF** menu button.

# BUG Functions (Heading, Altitudes, Airspeed, VNAV)

## Set the Heading Bug

1. Press the **HDG** button.
2. Turn control knob to select the desired heading. Heading selection is in 1° increments and the number will change faster if you turn the control knob faster.

   Press the SYNCH button to instantly set the heading bug on the current heading.

   If coupled with an autopilot in GPS roll steering or heading mode, the EFIS will command the autopilot to maintain the selected heading. If the autopilot is flying a flight plan, invoking the heading bug will override the flight plan course in favor of the selected heading.

***AUDIBLE ANNUNCIATION***
Deviation more than 10° from the heading bug will result in an amber caution flag and an auditory chime.
**HEADING**

## Turn Heading Bug Off

1. Press the **HDG** button.
2. Press the **OFF** menu button.

# Specify a Target Altitude

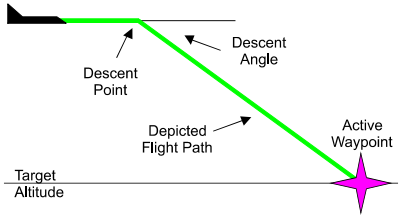
1. Press the **MENU** button while on the PFD display page.
2. Press the **BUGS . .** menu.
3. **TGT ALT . .** will be highlighted, push to enter.
   Current altitude, rounded to the nearest 10 foot increment in the approach phase and nearest 100 foot increment in the enroute and terminal areas will be displayed.
4. Turn control knob to select the desired target altitude and push to enter.
   A bow-tie shaped bug will be located on the altimeter tape, centered on the target altitude.

   Press **SYNCH** to instantly set the target altitude to the current altitude.

   The target altitude value will be displayed between two horizontal white bars immediately above the altimeter tape.

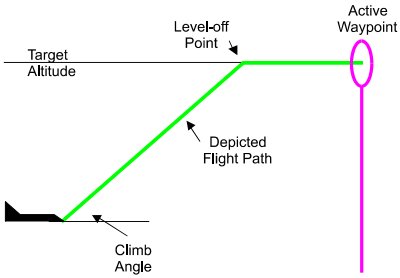
If a lower target altitude is selected, the skyway will maintain the current altitude until the preprogrammed VNAV descent angle will take the aircraft over the next waypoint at the target altitude:

Normal descent



If a higher target altitude is selected, the skyway will immediately climb to the target altitude at the preprogrammed VNAV climb angle and level off:

Aircraft-referenced climb



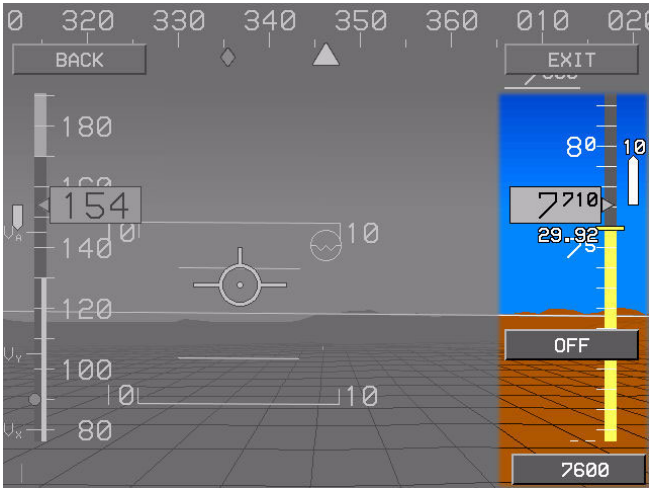

If the aircraft reaches the target altitude before the skyway does, the skyway will automatically reset at the target altitude.

***AUDIBLE ANNUNCIATION***
Deviation more than 150 feet from target altitude will result in an amber caution flag and a single voice warning of "Altitude. Altitude."

**ALTITUDE**

# Specify a Minimum Altitude

1. Press the **MENU** button while on the PFD display page.
2. Select the **BUGS . .** menu.
3. Turn control knob to highlight **MIN ALT . .** , then push to enter.
   Current altitude, rounded to the nearest 10 foot increment, will be displayed.
4. Turn control knob to select desired minimum altitude and push to enter.




The altimeter tape will be displayed in yellow below the minimum altitude. The minimum altitude value will be displayed above a single horizontal white bar immediately above the yellow altimeter tape.

# Specify a Target Airspeed

1. Press the **MENU** button while on the PFD display page.
2. Select the **BUGS . .** menu.
3. Turn control knob to highlight **SPD SEL . .** , then push to enter.
   Current airspeed will be displayed.
4. Turn control knob to select desired target airspeed and push to enter.

   Press **SYNCH** to instantly set the airspeed bug on the current airspeed.

   A bow-tie shaped bug will be located on the airspeed tape, centered on the target airspeed.
   Selected airspeed value will be displayed immediately above the airspeed tape.

***AUDIBLE ANNUNCIATION***
Deviating from the selected airspeed by 10 knots will result in an amber caution flag and an auditory chime.
**AIRSPEED**

# Turning Bugs Off

1. Press the **MENU** button while on the PFD display page.
2. Select the **BUGS . .** menu.
3. Turn control knob to highlight **TGT ALT . .** , **MIN ALT . .** or **SPD SEL . .** then push to enter.
4. Press the **OFF** menu button.

# Changing VNAV Angles

1. Press the **MENU** button while on the PFD display page.
2. Select the **BUGS . .** menu.
3. Turn control knob to highlight **VNAV CDA . .** then push to enter.
4. Turn control knob to highlight **CLIMB ANG . .** or **DESC ANG . .** and push to enter.

Using the control knob, turn to select the desired vertical navigation climb or descent angle value and push to enter. To cancel, push **EXIT**.

# Controlling The Displays

## Changing MFD Display Pages

Push the control knob to advance to the next display. The order is PFD followed by the Navigation Display, then the engine page (if equipped).

## Show/Hide Terrain (Moving Map)

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to select the **FNCT DCLTR . .** and push to enter.
4. Turn the control knob to select **TERRAIN**.
5. Push control knob to turn terrain on or off (a check mark indicates terrain ON). Select **DONE** and push to enter when finished.

   Note: Terrain and obstructions are controlled simultaneously.

# Show/Hide LAT/LON (Moving Map)

Current latitude and longitude can be shown on the navigation display.

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to select the **FNCT DCLTR . .** and push to enter.
4. Turn the control knob to select **LAT/LON**.
5. Push control knob to turn LAT/LON on or off (a check mark indicates terrain ON). Select **DONE** and push to enter when finished.

# Show/Hide RMI/ADF (Moving Map)

A dual RMI and ADF can be overlaid on the moving map.

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to select the **FNCT DCLTR . .** and push to enter.
4. Turn the control knob to select **RMI**.
5. Push control knob to turn RMI/ADF on or off (a check mark indicates terrain ON). Select **DONE** and push to enter when finished.

***NOTE**:*
*This option is only available with the optional nav interface. RMI/ADF will only be shown if a valid nav signal is present.*

# Show/Hide RMI/ADF (HSI)

A dual RMI and ADF can be displayed on the conventional HSI.

1. Press the **MENU** button.
2. Select **RMI ON** or **RMI OFF** as appropriate.

# Show/Hide Strikes (Moving Map)

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to select the **FNCT DCLTR . .** and push to enter.
4. Turn the control knob to select **STRIKES**.
5. Push control knob to turn STRIKES on or off (a check mark indicates terrain ON). Select **DONE** and push to enter when finished.

# Scale the Moving Map

Turn the control knob clockwise to increase scale and counterclockwise to decrease scale. Map scales available are 1, 2, 5, 10, 20, 50, 100, and 200 nautical miles.

# Change Moving Map Format

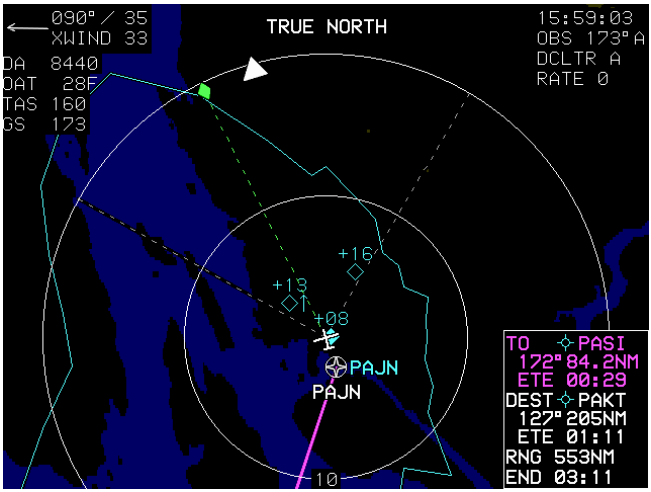
The Navigation Display can be viewed in a variety of formats including position-centered (full compass rose), arc (position offset), heading up, and north up.

## Centered or Arc Format

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **CENTER** or **ARC**, then push to enter.

## Heading-Up or North-Up Format

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **HDG UP** or **N UP**, then push to enter.




## Change Moving Map Function

In addition to the moving map, the MFD can display an HSI, a dedicated lightning display, and a dedicated traffic display.

1. Press the **MENU** button.
2. Select the **DISPLAY . .** menu.
3. Turn control knob to highlight desired function, (MAP, HSI, STRIKES, or TRAFFIC) then push to enter.

# Declutter the Moving Map

The moving map can be decluttered in two ways: removing navigation symbology, and removing display functions (i.e. terrain, traffic, lightning).

## Manual Declutter Navigation Symbology:

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **SYMB DCLTR . .** , then push to enter.
4. Select **MANUAL . .** . Auto settings are optimized factory defaults.
5. Turn control knob to highlight desired elements and push to enable or disable. A check mark after an element indicates ON.
6. Turn the control knob to select **DONE** and push to enter.

## Declutter Display Functions

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **FNCT DCLTR . .** , then push to enter.
4. Turn control knob to highlight functions and push to enable or disable. A check mark after a function indicates ON.
5. Turn the control knob to select **DONE** and push to enter. Declutter settings are saved upon system shutdown.

# Auto Declutter Navigation Symbology

To set the system for automatic decluttering:

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **SYMB DCLTR . .** , then push to enter.
4. Turn control knob to highlight **AUTO**, the push to enter.

# Declutter The PFD

1. Press the **MENU** button.
2. Select the **DCLTR . .** menu. A menu containing Mini Map, Skyway, Terrain, HSI, and conventional autopilot FD (flight director) will be displayed.

3. Turn control knob to highlight elements and push to enable or disable elements. A check mark indicates enabled. Select **DONE** when you are finished. Declutter settings will be saved upon system shutdown.

***NOTE:***
*The HSI and flight director are mutually exclusive.*

# Zoom the PFD

The PFD can be set to two different fields of view: 35° and 70°.

The 70° field of view is the default and resembles a wide-angle lens on a camera. Since aircraft operate primarily in the lateral plane, this field of view is most useful.

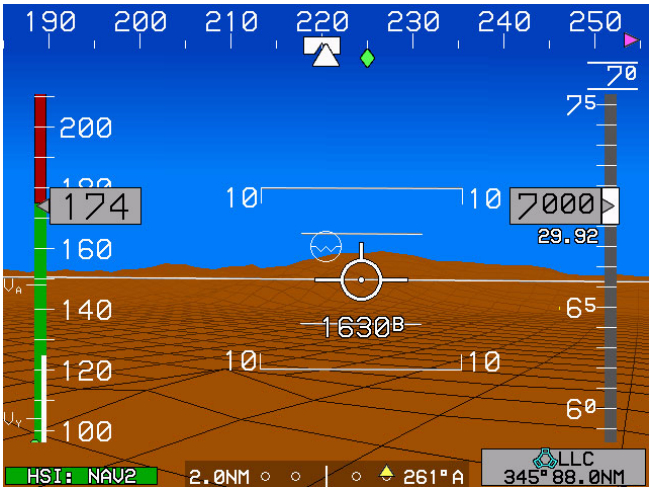
However, if you want to see terrain displayed so that it more closely resembles what you see out the window, select the zoom (35° field of view). This magnified view more closely matches the human eye and will give a very realistic depiction of terrain but since the heading and pitch scales are magnified as well, the display will be very sensitive to every movement of the aircraft.

To set the zoom mode:

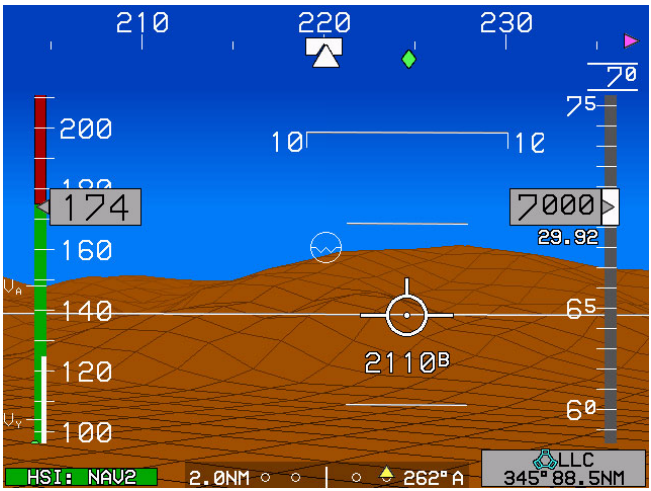
1. Press the **MENU** button.
2. Select the **ZOOM ON** or **ZOOM OFF** menu.

***NOTE****:*
*Field of view is indicated on the moving map by two dashed lines that form a "pie" shape extending forward from the aircraft. Only objects within the pie shape on the moving map will appear on the PFD.*

Zoom OFF (70° field of view)




Zoom ON (35° field of view)



# Controlling the Stormscope Display

These procedures refer only to the dedicated WX-500 Stormscope display function and are available only when a WX-500 Stormscope is connected to the system.

## Centered or Arc Format

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **CENTER** or **ARC**, then push to enter.

## Route On or Route Off

To show or hide the active route while in the dedicated Stormscope display function:

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **ROUTE ON** or **ROUTE OFF**, then push to enter.

## Strike or Cell Mode

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **STRK MODE** or **CELL MODE**, then push to enter.

See the WX-500 documentation for more information.

## Clear Strikes

To clear residual strike symbols from the display:

1. Press the **MENU** button.

2. Select the **CLR STRKS . .** menu. Strikes will be cleared from screen.

See the WX-500 documentation for more information.

# Strike Test

To perform a pilot-initiated test of the WX-500 system:

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **STRK TEST**, then push to enter.

See the WX-500 documentation for more information.

# Controlling the Traffic Display

These procedures refer only to the dedicated Ryan International TCAD display function and are available only when a Ryan 9900B or 9900BX TCAD is connected to the system.

## Centered or Arc Format

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **CENTER** or **ARC**, then push to enter.

## Route On or Route Off

To show or hide the active route while in the dedicated traffic display function:

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **ROUTE ON** or **ROUTE OFF**, then push to enter.

## TCAD Test

To perform a pilot-initiated test of the TCAD system:

1. Press the **MENU** button.
2. Select the **FORMAT . .** menu.
3. Turn control knob to highlight **TCAD TEST**, then push to enter.

See the Ryan International TCAD documentation for more information.

# Section 6

# Quick Start Tutorial

1. Begin by powering up the EFIS. The system will perform a self-test routine and then display a screen identifying the database coverage. Press any button to acknowledge and the system will begin a two-minute countdown while awaiting sensor initialization (for the purposes of flight planning, etc., this countdown can be overridden by pressing the control knob).

***NOTE:***
*Allow the system to initialize for 90 seconds before taxiing to ensure proper initialization of the AHRS.*

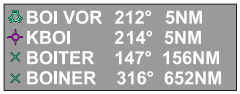
RIGHT

2. Note that the altimeter is adjusted automatically on startup based on the touchdown zone elevation of the nearest runway. If necessary, adjust the setting by turning the right-hand control knob on the display. The altimeter setting will be displayed immediately below the altitude readout on the PFD. Push the knob to enter the setting.

3. Press the **Direct-To** button to enter a destination.

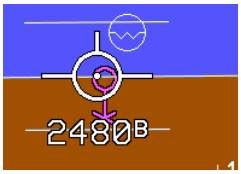
4. Use the control knob (turn to select, push to enter), to enter the desired waypoint.

For example: To enter the Boise airport, turn to select "**B**" then push to enter; turn to select "**O**" then enter; turn to select "**I**" then enter. Push two more times to step through the last two character spaces (the leading "K" identifier may be entered but is not required).




If there is no exact match, a list of potential matches will be displayed. In this example, there are five waypoints beginning with "BOI."

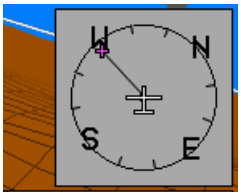
5. Turn control knob to select the desired waypoint, then push to enter. An exact match will be accepted and entered automatically.




6. A route to the selected waypoint will be activated. The active waypoint will be shown as a tethered balloon on the PFD screen.

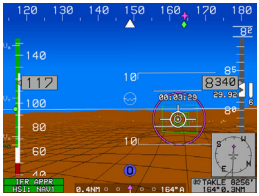
A magenta bearing to waypoint symbol will be displayed on the desired track on the directional scale.

If the bearing to the waypoint is beyond the limits of the directional scale, a magenta arrow on the scale will indicate the closest direction to turn.




The MiniMap, showing aircraft position relative to the waypoint, will be displayed in the lower right corner of the screen.

The waypoint information, indicating waypoint type and identifier, elevation or crossing altitude, and bearing and distance, will be displayed immediately below the MiniMap.



Airspeed is on the left, altitude is on the right, heading is across the top, and a GPS/WAAS CDI is at the bottom.

PUSH

7. Push the control knob to step through the screens on the MFD as follows:

   ND → reversionary PFD → engine display (if available) → ND

   (Note: the PFD cannot be changed)

TURN

8. When on the moving map page, turn the control knob clockwise to increase scale and counter-clockwise to decrease scale (range is from 1 to 200 miles).

Now you should be familiar enough with the basic operation of your Chelton Flight Systems EFIS to navigate from point to point and change from one display page to another. Please study the **Symbology, Menu Functions** and **Step-by-Step Procedures** sections to gain a detailed understanding of all system features.

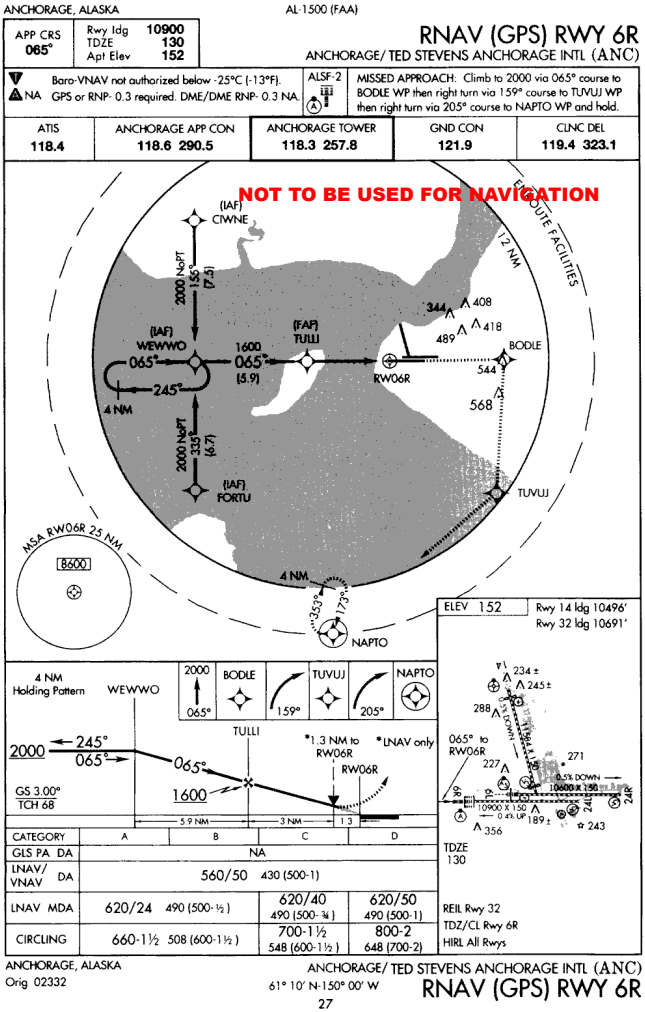
# SECTION 7
# IFR Procedures

## Overview of Approaches

Your Chelton EFIS provides three-dimensional GPS non-precision instrument approach procedures using an integral GPS receiver. The Chelton GPS complies with TSO-C145a/146a and may be used for stand-alone, sole-source enroute procedures and GPS and "GPS overlay" approaches. Approaches designed specifically for GPS are often very simple and don't require overflying a VOR or NDB. Currently, many non-precision approaches have GPS overlays to let you fly an existing procedure (VOR, VOR/DME, NDB, RNAV, etc.) more accurately using GPS, although many of these approaches are complex (compared with GPS-only approaches). Using the skyway guidance offered by the FlightLogic EFIS, however, makes all approaches equally simple.

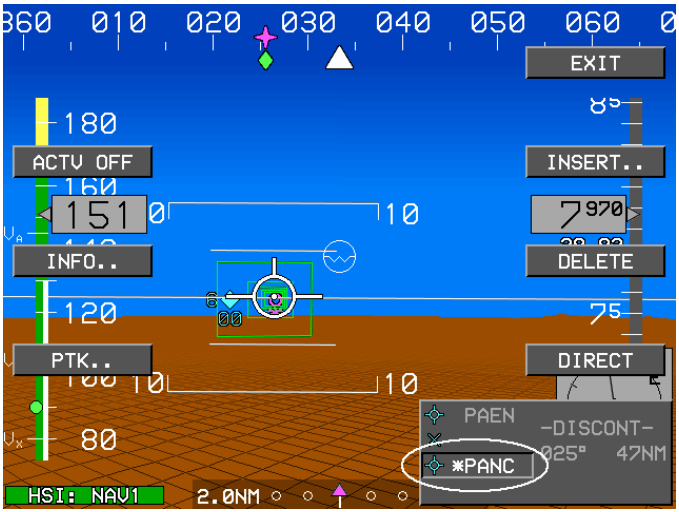
The Chelton EFIS PFD and moving map guide you through every step of the approach using extremely precise 3-D skyway symbology. The system automatically sequences through each leg, up to the missed approach point (MAP), and through the complete missed approach procedure including holds. Approaches may be flown "as published" with the full transition, using any published route or initial approach fix (IAF), or with a vector-to-final (VTF) transition.

# Basic Instrument Approach Operation

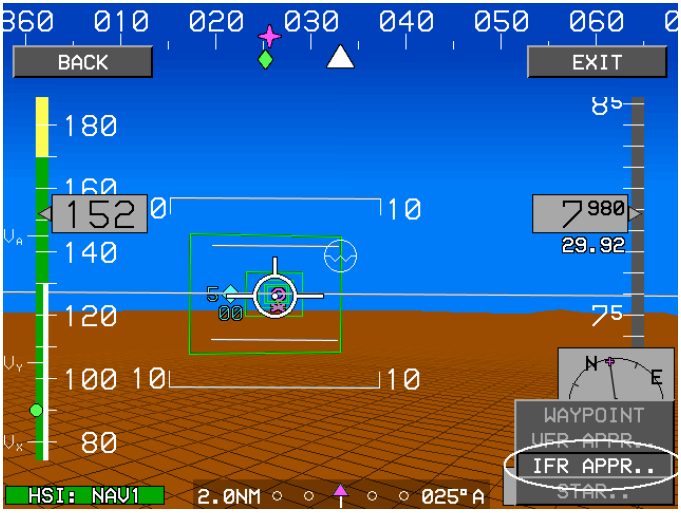


All approach operations will typically begin with the same basic steps (This example selects the GPS approach to runway 6 at Anchorage):

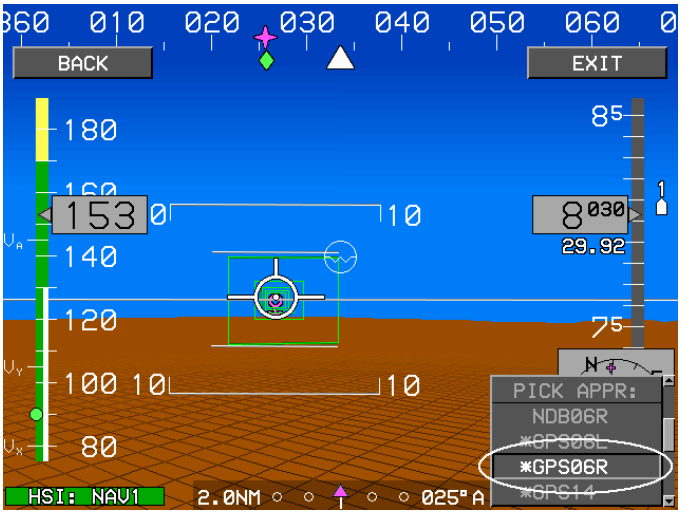
1. You must have an active waypoint (either selected from an active flight plan **or** entered using **Direct-To** or **Nearest**).
2. Press the **ACTV** button.
3. Turn the control knob to select the desired airport and press to enter.



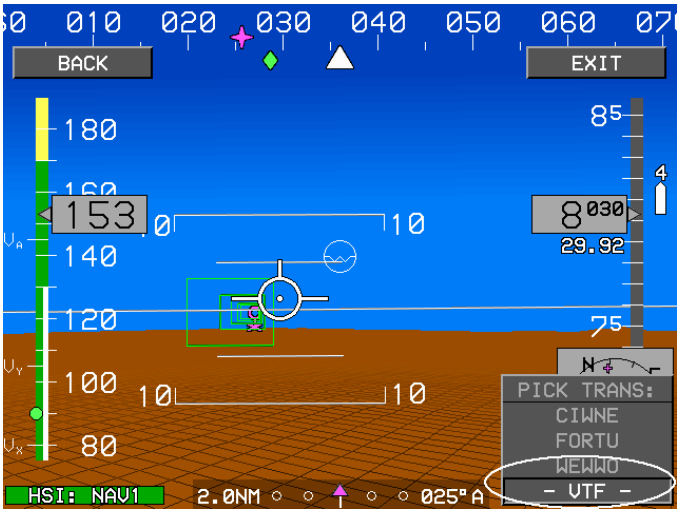
4. Choose **IFR APPR . .**



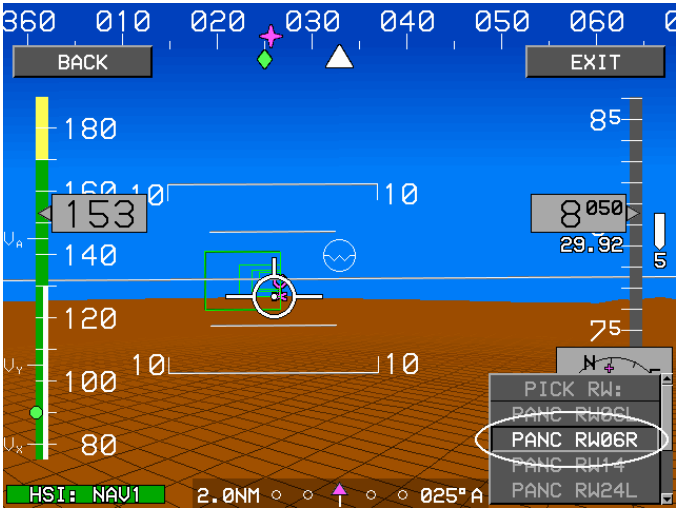

5. Choose the desired **approach (APPR)**.



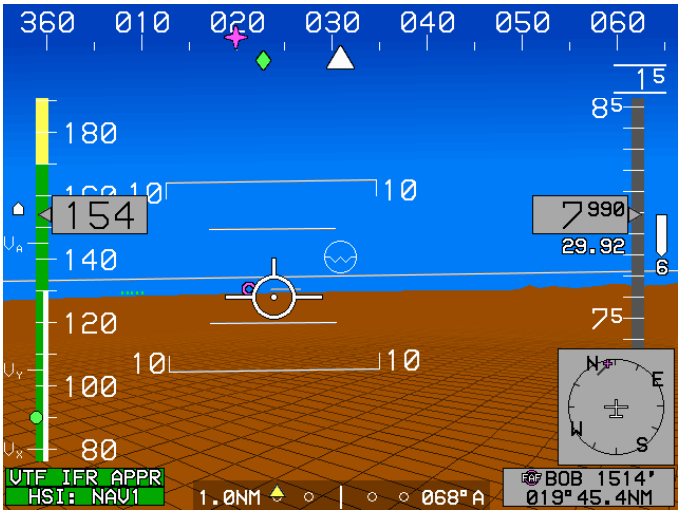
6. Choose the desired **transition (TRANS)** or **vectors to final ( - VTF - )**.




7. Choose the desired **runway (RW)**.



The approach is now enabled. The PFD will now show that an IFR approach is active.

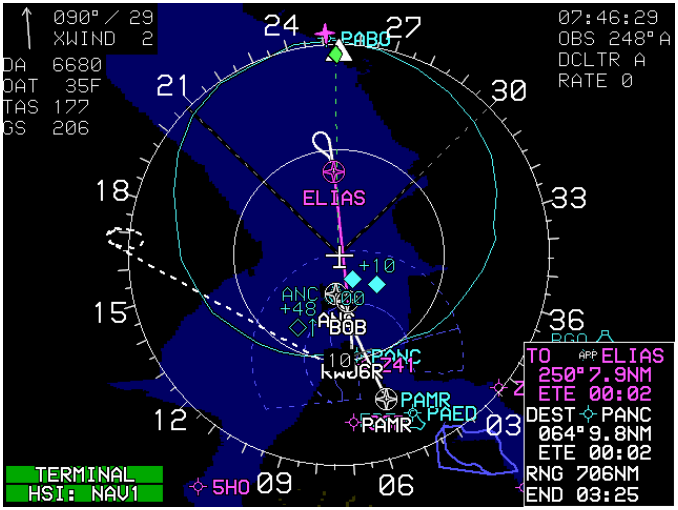


***"Where'd the boxes go?***
*In this example, we chose vectors to final so the skyway boxes are no longer drawn from the last waypoint to the destination; they are drawn along the final approach course to the runway. They are visible just below the artificial horizon about 20° left of the nose position. Notice the MiniMap shows a small line extending down to the 7 o'clock position from the waypoint; that is the final approach course and the boxes are lined up along it. The runway is visible inside the flight path marker."*

Within 30NM of the destination airport, a "TERMINAL" flag appears to annunciate that the EFIS is in terminal mode and automatic CDI scaling gradually transitions from 2.0NM (enroute) to 1.0NM (terminal).

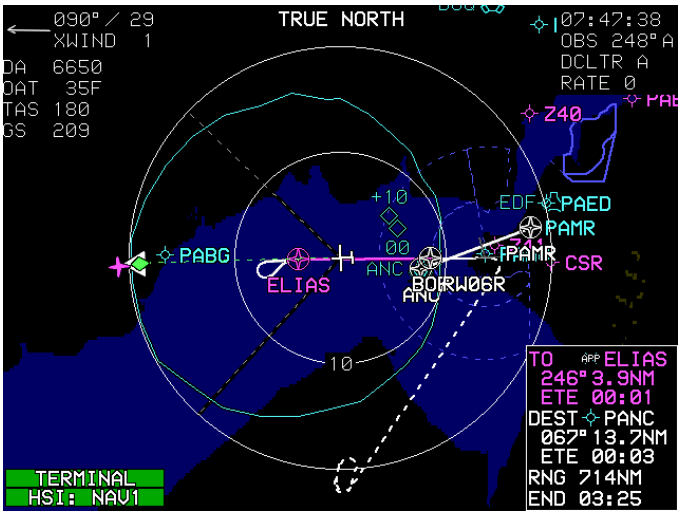
The first waypoint will be displayed conformally on the Primary Flight Display (PFD) and the crossing altitude will be automatically entered as the target altitude. The fix, distance, bearing, and crossing altitude will be displayed in the waypoint information box in the lower-right corner of the PFD.

The EFIS will automatically sequence through approach waypoints as the approach is flown. The approach procedure will appear on the moving map as solid white lines, except the active leg, which is displayed in magenta. The missed approach procedure will appear on the navigation display as dashed lines. The navigation display will also show procedure turns, arcs and holding patterns as appropriate.

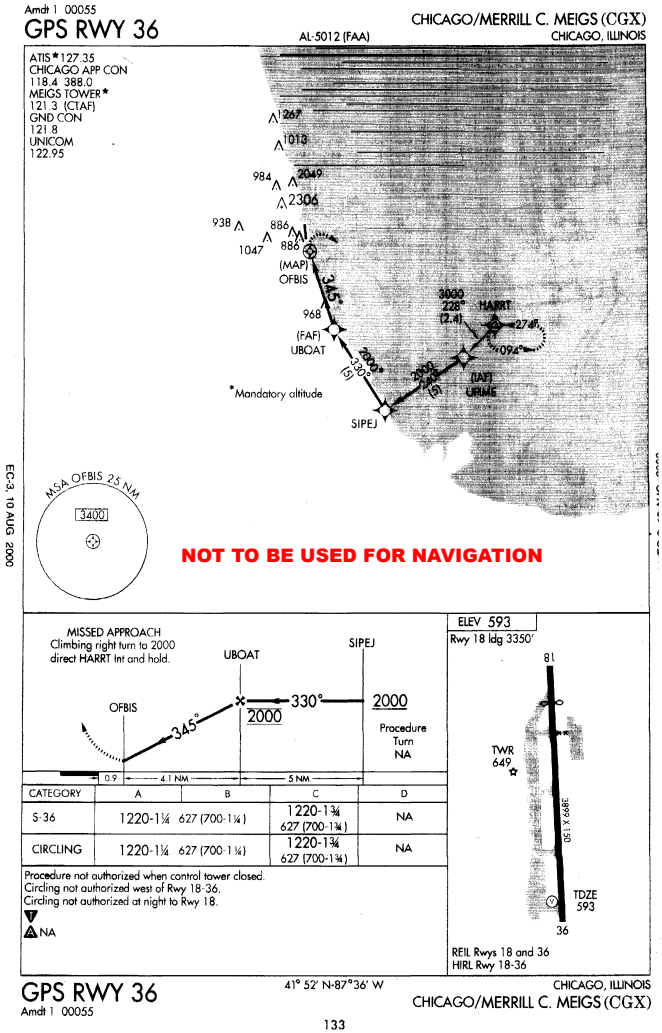


***"Just follow the magenta line:***
*Here, we are outbound toward ELIAS intersection for a procedure turn. Remember, the skyway boxes will always be positioned along the magenta line so if you lose them on the PFD, just look for the magenta line on the moving map (remember, they could be above you or below you based on the target altitude, or you could have a discontinuity, see* ***Discontinuity, page 3-104****). Also, remember that all turns in a procedure are actual size based on a 15° bank (zero wind) at the preprogrammed* $V_{PROC}$*, or procedure speed for your aircraft. If you are going faster or slower, you will need more or less bank angle, respectively, to stay in the boxes."*

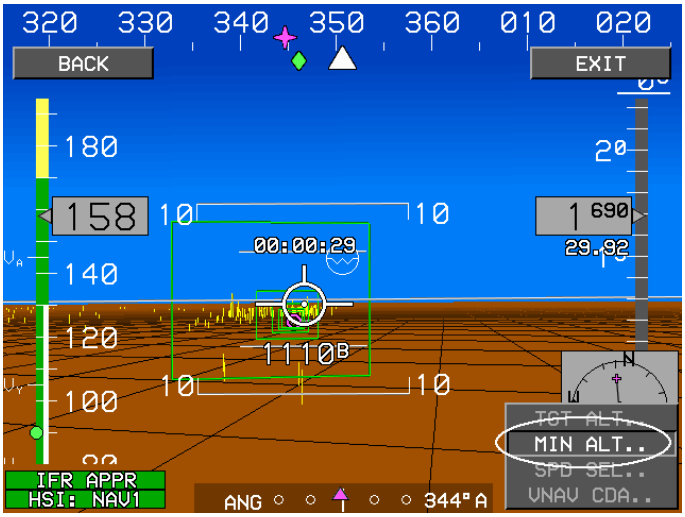
Changing the format of the navigation display to North-Up (by using the **Format** menu) will make the display match an approach chart. Use the navigation display approach procedure depiction and the primary flight display CDI and Skyway for course guidance and turn anticipation.

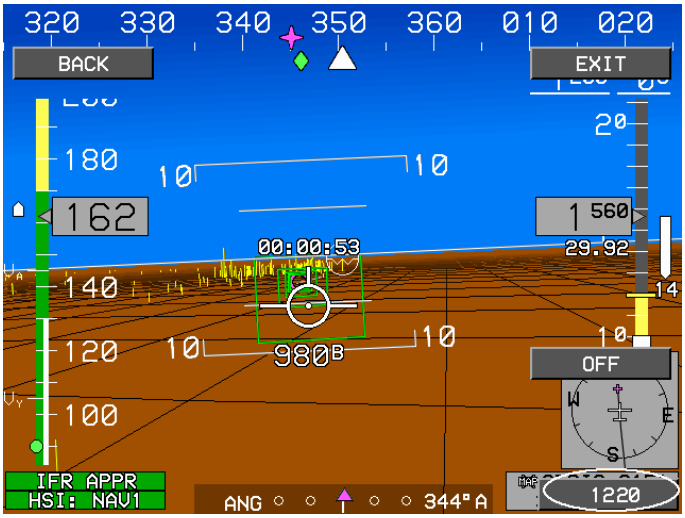



You will notice differences from time to time between the Jeppesen NavData on the EFIS and the published paper charts. Due to the complexities of converting paper charts to a navigation database, errors and omissions occasionally occur. These differences are usually limited to minor inconsistencies among crossing altitudes and waypoint locations and do not impose a threat to flight safety. However, always verify the legs of an approach using a paper chart before performing the approach. This can quickly be done by using the **ACTV** menu to review the legs, bearings, and crossing altitudes while you are nearing the initial approach fix.



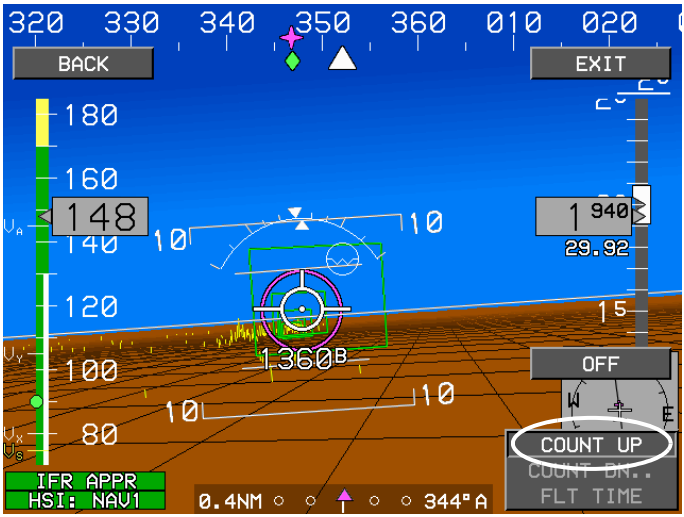

This example uses the GPS approach to 36 at Chicago's Meigs Field. As the approach is flown, target altitudes will be automatically updated. However, the minimum altitude bug must be set manually according to the MDA or DH as specified on the published instrument approach plate.


320 330 340 350 360 010 020
BACK
EXIT
180
158
140
120
100
20
1 690
29.92
00:00:29
1110B
IFR APPR
HSI: NAV1
ANG
344° A
TGT ALT..
MIN ALT..
SPD SEL..
VNAV CDA..


320 330 340 350 360 010 020
BACK
EXIT
180
162
140
120
100
20
1 560
29.92
00:00:53
980B
OFF
IFR APPR
HSI: NAV1
ANG
344° A
1220

Within 2.0NM of the Final Approach Fix (FAF), automatic CDI scaling gradually transitions from 1.0NM (terminal) to 2° angular (approach) like a localizer.

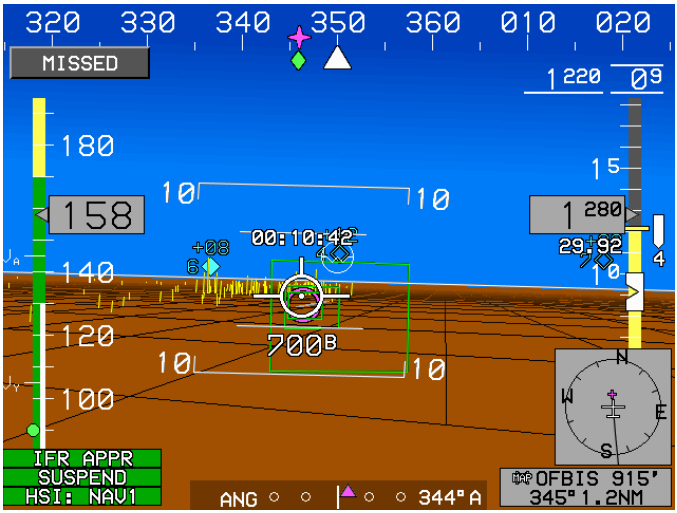
Use the **TIMER . .** function (count up or count down) for approaches that require timing from the Final Approach Fix to the Missed Approach Point.



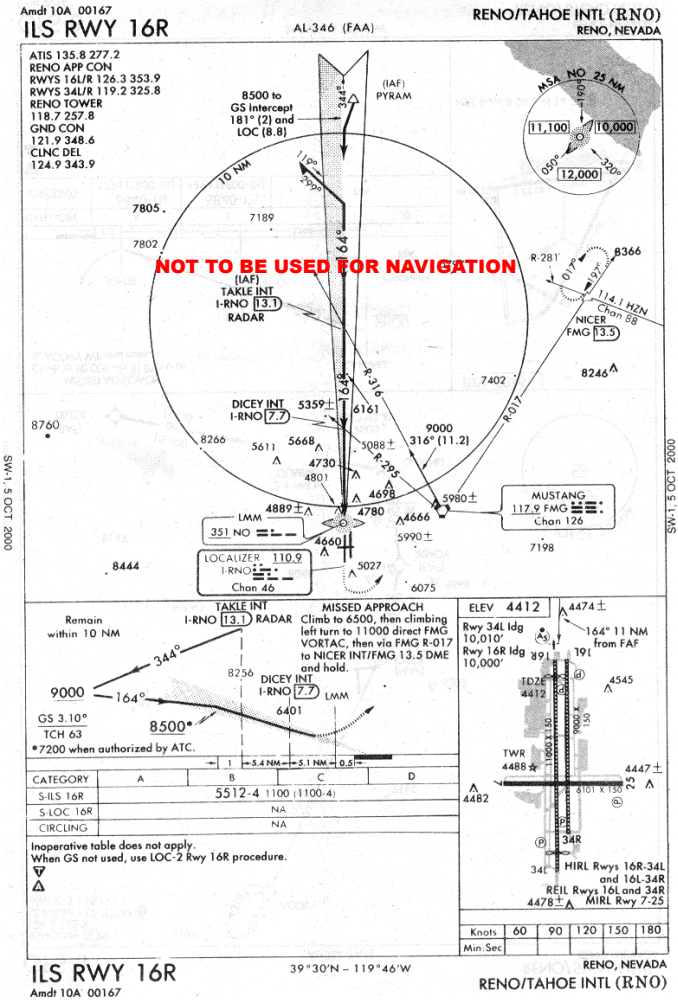

Once past the FAF, waypoint sequencing automatically suspends so as to provide CDI guidance along the extended final approach course past the MAP. “SUSPEND” is annunciated with a green advisory flag and the **MISSED** menu appears in the upper left corner. Press **MISSED** to arm the missed approach procedure (the SUSPEND flag will disappear); the missed approach procedure will be automatically activated upon passing the missed approach point.

The runway depiction, with associated skyway, aids in visualizing the runway environment, especially in situations where the final approach course and the runway are not aligned.

Neither the MAP waypoint symbol (magenta tethered balloon) nor an associated target altitude are shown so that the depicted runway can be seen more clearly. Refer to the minimum altitude bar for MDA and DH guidance.



# Approaches with Course Reversals



An approach may contain a course reversal, commonly in the form of a procedure and less commonly in the form of a holding pattern.

- The procedure turn portion of an approach is stored as one of the legs of the approach. For this reason, there are no special operations required of the pilot, other than flying the procedure turn itself when appropriate.
- The holding pattern is composed of two legs, the entry and the hold itself. When the active leg automatically sequences from the entry to the holding pattern, the entry leg will be removed from the moving map, the **CONTINUE** menu will be displayed, and automatic waypoint sequencing will be suspended (annunciated by a "SUSPEND" flag). To continue the approach beyond the hold, the pilot need only press the **CONTINUE** button.

**Approaches with Procedure Turns:**
This example of a procedure turn uses the ILS Runway 16 approach for Reno (Nevada) Regional Airport, KRNO. The steps required to set up and fly the approach are detailed below:

1. You must have the airport entered as a waypoint (using **NRST**, **Direct-To**, or as part of an active flight plan).
2. While enroute to KRNO, approximately 40NM away, select the proper frequency to obtain airport conditions and runway usage. Frequency information is available for the destination airport by selecting the **INFO . .** menu, see **INFO Function, page 4-12**. From ATIS or ATC, you learn that runway 16R is in use and plan your approach accordingly.
3. Press the **ACTV** button, and select **IFR APPR . .** then the airport (**KRNO**) then **ILS16R** then the desired transition **FMG** (Mustang VOR) and finally the desired runway (**RW16R**). The approach will now be entered and displayed as a white courseline on the moving map, except the active leg, which will be magenta.

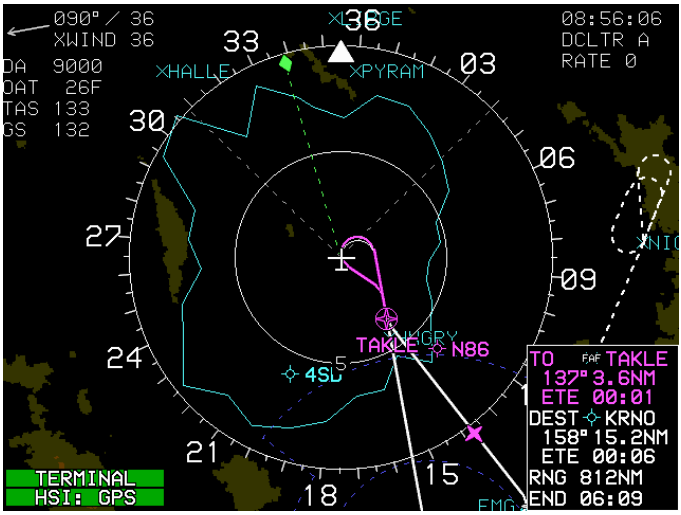
Within 30 nautical miles of the destination airport, the system will transition from "enroute" mode to "terminal" mode. The

change to terminal mode is accompanied by a gradual CDI scale transition from 2.0 to 1.0NM.

You may review the approach sequence at any time by pressing the **ACTV** button. Turn the control knob to review each segment of the approach. Bearing and distance information will be displayed for each waypoint. Press **INFO** to review crossing altitudes. When finished, press **EXIT** to remove menus from the screen.

As you approach the IAF (FMG), the active waypoint will be displayed as a "tethered balloon" shown on the PFD. The active leg will be displayed on the moving map. Distance, bearing and ETE will appear in the bottom right corner of the moving map. Waypoints will sequence automatically as the flight progresses. Skyway boxes will connect the waypoints to guide you through the entire procedure. No further pilot action is required.

As you pass over the procedure turn waypoint, the procedure turn segment becomes active and is displayed in magenta on the moving map. Skyway boxes continue to guide you through the turn back to the final approach fix.



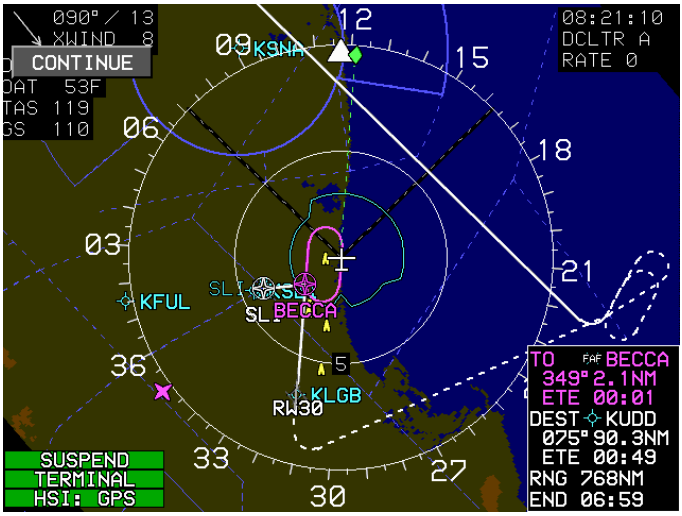
Within 2.0NM of the final approach fix, the display will switch from “terminal” mode to “approach mode.” The switch to terminal mode is accompanied by a gradual CDI scale transition from 1.0 to 0.3NM. Skyway boxes display appropriate descent points and altitudes for the approach.

As you cross the FAF, the destination sequences to the MAP (RW16R in this example) and the CDI scale becomes angular like a localizer. Continue flying through the skyway toward the MAP. The **MISSED** menu button will be shown in the upper left corner of the screens and automatic waypoint sequencing will be suspended upon crossing the FAF. Pressing the **MISSED** menu button at this point arms the missed approach procedure and re-enables automatic waypoint sequencing. Even though **waypoint crossing altitudes are automatically entered** from the Jeppesen database, decision height or minimum descent altitude are **NOT** in the Jeppesen NavData and **MUST** be determined using the approved instrument approach charts. These may be entered as a minimum altitude bug.

If the **MISSED** was armed, the first waypoint of the missed approach procedure becomes active upon passing the MAP.

**Approaches with Holding Patterns:**
Select the approach in the same manner as described above.

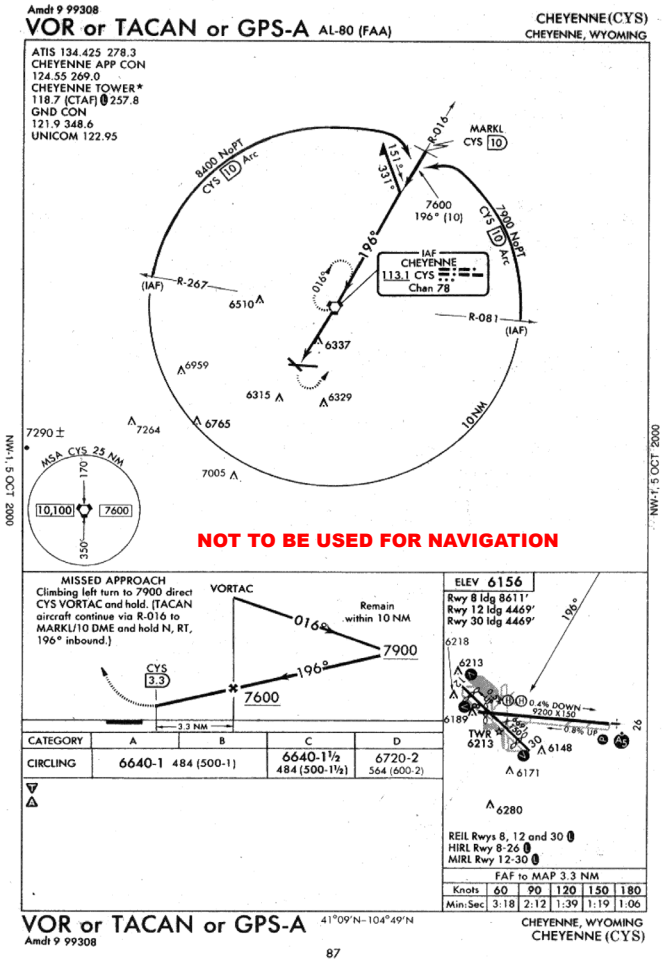
The courseline on the moving map and the skyway on the PFD will provide guidance and turn anticipation throughout the procedure, including the entry to the hold (parallel, teardrop, or direct, which will be automatically calculated).




Automatic waypoint sequencing will be suspended once you are established in the holding pattern and the entry leg will be removed (as shown in the example above).

To continue the approach from the holding pattern and re-enable automatic waypoint sequencing, just press **CONTINUE**. In this example, the MAP (runway 30) will then become the active waypoint upon passing BECCA.

# Approaches with DME Arcs



The GPS overlay for a DME arc approach uses additional Jeppesen waypoints to define the arc. These waypoints are indicated by "D" as the first letter in the waypoint name. This is followed by three numbers which indicate the radial the waypoint lies on. The last letter indicates the radius of the arc.

For example:

"D258G" indicates a DME waypoint ("D") on the 258 degree radial at 7 DME ("G", the seventh letter of the alphabet.)

***NOTE***
*For additional information on waypoint names, see* ***Navdata Name Conventions: Waypoint Identifiers, page 8-37****.*

When you are cleared for the approach, you may do either of the following to establish yourself on the approach:

- Use the IAF waypoint, defined by a specific radial along the arc.
- Follow ATC vectors which allow you to intercept the arc at any point along the arc.

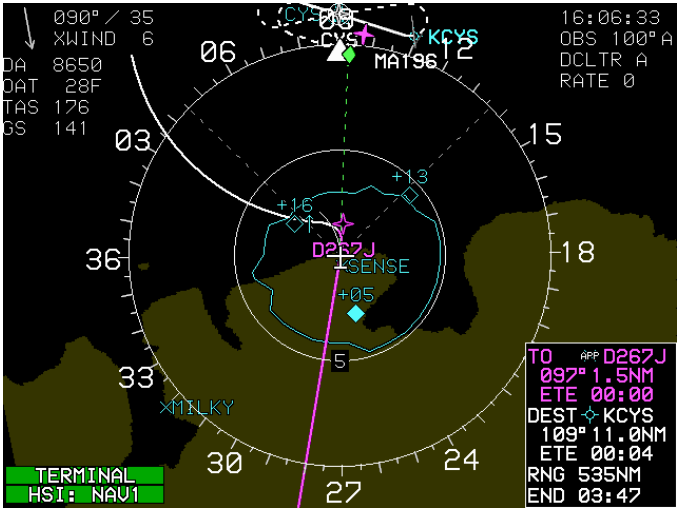
1. You must have the airport entered as a waypoint (using **NRST**, **Direct-To**, or as part of an active flight plan).
2. While enroute to KCYS, approximately 40 nautical miles away, select the ATIS frequency to monitor airport conditions and runway usage. Frequency information is available for the destination airport by selecting the **INFO . .** menu, see **INFO Function, page 4-12**. From ATIS or ATC, you learn that runway 8 is in use and plan your approach accordingly.
3. Press the **ACTV** button, and select **IFR APPR . .** then the airport (**KCYS**) then **VOR A** then the desired transition **D267J** (10-mile DME arc at the 267° radial) and finally the desired runway (**RW08**). The approach will now be entered and displayed as a white courseline on the moving map, except the active leg, which will be magenta.

Within 30 nautical miles of the destination airport, the system will transition from "enroute" mode to "terminal" mode. The

change to terminal mode is accompanied by a gradual CDI scale transition from 2.0 to 1.0NM.

You may review the approach sequence at any time by pressing the **ACTV** button. Turn the control knob to review each segment of the approach. Bearing and distance information will be displayed for each waypoint. Press **INFO** to review crossing altitudes. When finished, press **EXIT** to remove menus from the screen.

As you approach the IAF (D267J), the active waypoint will be displayed as a "tethered balloon" shown on the PFD. The active leg will be displayed on the moving map. Distance, bearing and ETE will appear in the bottom right corner of the ND. Waypoints will sequence automatically as the flight progresses. Skyway boxes will connect the waypoints to guide you through the entire procedure. No further pilot action is required.




The skyway and CDI will provide you with continuous guidance throughout the arc, including the inbound turn from the arc to the final approach course, along with turn anticipation. Simply steer the flight path marker through the

boxes and you will make a smooth transition from the arc to the final approach course.

Within 2.0NM of the final approach fix, the display will switch from “terminal” mode to “approach mode.” The switch to terminal mode is accompanied by a gradual CDI scale transition from 1.0 to 0.3NM. Skyway boxes display appropriate descent points and altitudes for the approach.

As you cross the FAF, the destination sequences to the MAP (CYS 3.3 DME in this example) and the CDI scale becomes angular like a localizer. Continue flying through the skyway toward the MAP. The **MISSED** menu button will be shown in the upper left corner of the screens and automatic waypoint sequencing will be suspended upon crossing the FAF. Pressing the **MISSED** menu button at this point arms the missed approach procedure and re-enables automatic waypoint sequencing. Even though **waypoint crossing altitudes are automatically entered** from the Jeppesen database, decision height or minimum descent altitude are **NOT** in the Jeppesen NavData and **MUST** be determined using the approved instrument approach charts. These may be entered as a minimum altitude bug.

If the **MISSED** was armed, the first waypoint of the missed approach procedure becomes active upon passing the MAP.

# Vectors to Final (VTF)

When a VTF IFR approach is selected, the system will create an "IP" (Initial Point) waypoint on the extended final approach course. The IP will be designated a fly-over waypoint, and the leg prior to the IP be a discontinuity, see **Discontinuity, page 3-104**. Until the FAF has been passed, the system will display an advisory flag indicating that a VTF IFR approach has been selected. This is to advise the pilot that guidance is not relative to a published approach path and that **procedure clearances are not assured**.

1. You must have the airport entered as a waypoint (using **NRST**, **Direct-To**, or as part of an active flight plan).

2. While enroute to KAAT (in the example above), approximately 40 nautical miles away, select the appropriate frequency to determine airport conditions and runway usage. Frequency information is available for the destination airport by selecting the **INFO . .** menu, see **INFO Function, page 4-12**. From ATIS or ATC, you learn that runway 31 is in use and plan your approach accordingly.

3. Press the **ACTV** button, and select **IFR APPR . .** then the airport (**KAAT**) then ***GPS31** (the asterisk indicates the

approach is approved for GPS), then the vectors-to-final transition **- VTF -**, and finally the desired runway (**RW31**). The approach will be shown as a solid magenta line beginning at the IP and terminating at the MAP.

Within 30 nautical miles of the destination airport, the system will transition from “enroute” mode to “terminal” mode. The change to terminal mode is accompanied by a gradual CDI scale transition from 2.0 to 1.0NM.

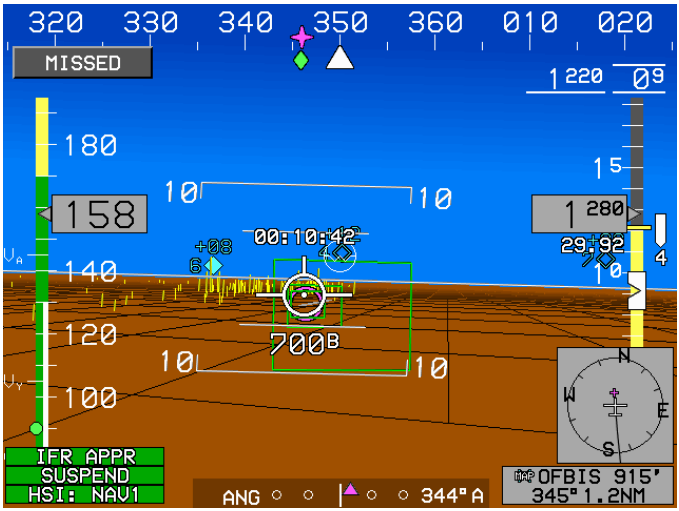
Within 2.0NM of the final approach fix, the display will switch from “terminal” mode to “approach mode.” The switch to terminal mode is accompanied by a gradual CDI scale transition from 1.0 to 0.3NM. Skyway boxes display appropriate descent points and altitudes for the approach.

As you cross the FAF (TEFAN in this example), the destination sequences to the MAP (runway 31) and the CDI scale becomes angular like a localizer. Continue flying down the skyway toward the MAP. The **MISSED** menu button will be shown in the upper left corner of the screens and automatic waypoint sequencing will be suspended upon crossing the FAF. Pressing the **MISSED** menu button at this point arms the missed approach procedure and re-enables automatic waypoint sequencing. Even though **waypoint crossing altitudes are automatically entered** from the Jeppesen database, decision height or minimum descent altitude are **NOT** in the Jeppesen NavData and **MUST** be determined using the approved instrument approach charts. These may be entered as a minimum altitude bug.

If the **MISSED** was armed, the first waypoint of the missed approach procedure becomes active upon passing the MAP.

# Missed Approaches

Upon passing the FAF, **MISSED** appears in the upper left hand corner.

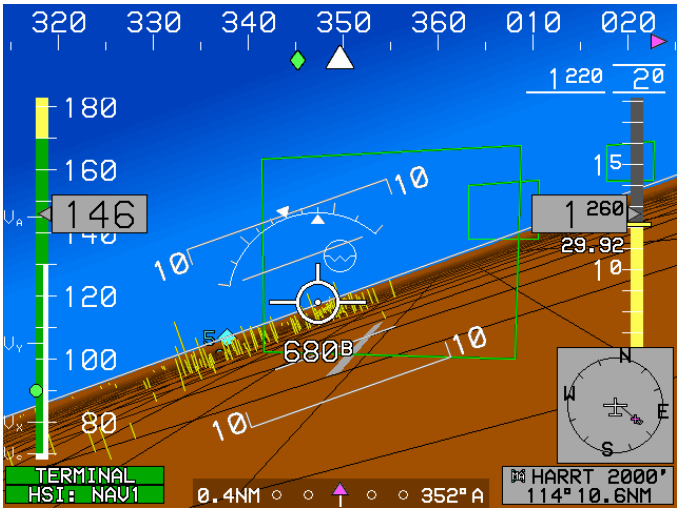


Pressing the **MISSED** menu arms the missed approach. Navigation continues until passage of the Missed Approach Point (MAP). Upon passing the MAP navigation sequences to the first waypoint of the missed approach procedure and the system returns to “terminal” mode.

Auto sequencing is re-enabled upon arming the missed.

If the missed approach is not armed, navigation guidance continues along the extended final approach course. **MISSED** may be pressed at any time.

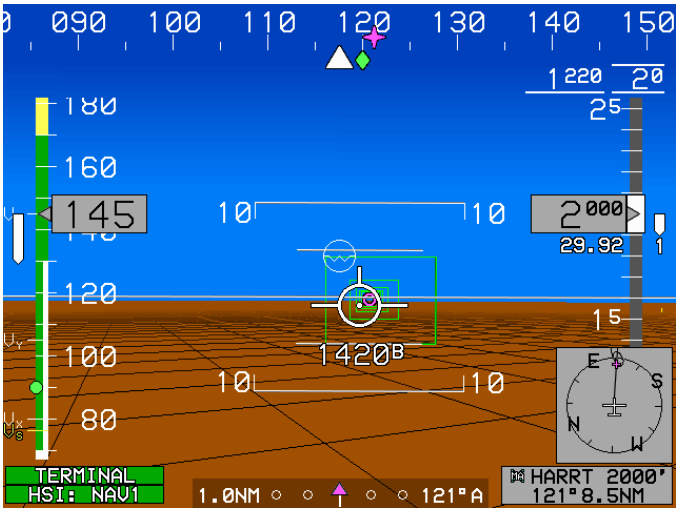
Most missed approaches end with a holding pattern, in which case automatic waypoint sequencing is suspended and must be re-enabled by manually by pressing **CONTINUE** (if there is a subsequent waypoint in the active flight plan) or activating another waypoint using the **ACTV** menu.




***NOTE**:*
*Not all missed approaches end in a holding pattern. Some just end with a straight course segment.*

***NOTE**: Any time prior to the Missed Approach Point, it is possible to **activate the missed approach** by manually selecting the first waypoint of the missed approach procedure using the **ACTV** menu.*

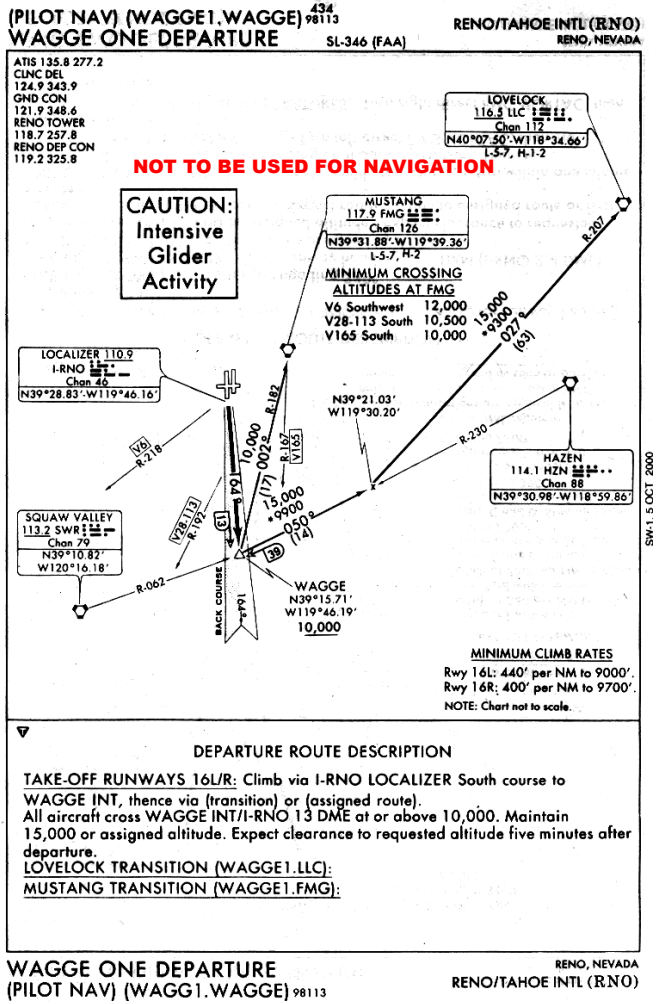
1. Press the **MISSED** menu button as soon as it appears. The active waypoint will automatically sequence to the first waypoint of the missed approach procedure upon passing the missed approach point. This first waypoint may be a phantom waypoint as in "fly runway heading to 6,500 feet, then right turn and direct to the VOR," where different aircraft will reach 6,500 feet at different places. The phantom waypoint's position is based on YOUR aircraft. The skyway boxes will lead from the missed approach point to the end of the procedure (usually a holding pattern). No further pilot action is required.




2. The skyway boxes will provide guidance for the holding pattern entry (parallel, teardrop, or direct) and the pattern will be sized according to the procedure speed ($V_{PROC}$) of YOUR aircraft. Continuation of the hold is at the pilot's discretion. A menu prompt **CONTINUE** will appear if there are additional waypoints further along in the route (such as an alternate). Pressing **CONTINUE** will enable guidance from the holding waypoint to the next waypoint.

3. When leaving the holding pattern to re-fly the same approach, press the **ACTV** button and select the IAF waypoint. To fly another approach at the same airport, press **ACTV**, select the airport, and choose a new approach. Alternately, press the **FPL . .** menu, **NRST** (nearest) button, or **Ð>** (direct-to) button to enter another destination.

# Departure Procedures (DP)

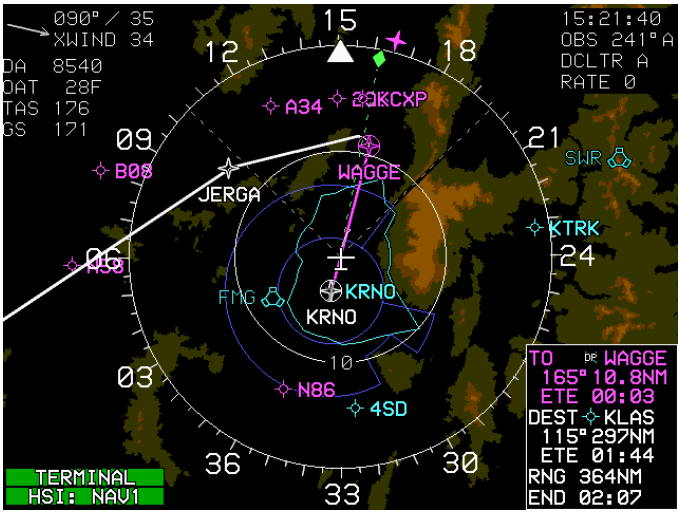


A DP is a coded departure route established at busier airports to facilitate clearance delivery procedures. There are two types of DPs: **Pilot Navigation** and **Vector**.

- **Pilot Navigation** – The pilot is primarily responsible for navigation along this kind of route. Terrain and safety-related factors usually call for pilot navigation DPs. These may contain vector instructions that pilots are expected to comply with until resuming normal navigation on the filed route.
- **Vector** – ATC provides radar navigation guidance to a filed route or to a fixed point depicted on the vector DP charts. Since Vector DPs are based on vectors from ATC, they are not included in the Jeppesen database.

1. Unlike other procedures, you must have an active **flight plan** (not just a destination waypoint entered using **Nearest** or **Direct-To**). The **first** waypoint in the flight plan **must** be the departure airport.
2. Press the **ACTV** button and use the control knob to select the departure **airport**.
3. Using the control knob, choose **DP . .** (if **DP . .** is not shown, no pilot nav departure exists for that airport). Using the control knob, select the desired DP, the appropriate transition (if available), and the departure runway.
4. Before departing, review the DP sequence (by pressing the **ACTV** button) and compare it with the printed plate. Turn the control knob to review each segment of the procedure. Bearing and distance information will be displayed for each waypoint. Press **INFO** to review crossing altitudes. When finished, press **EXIT** to remove menus from the screen.

The departure procedure, transition, and runway will be displayed on the PFD and on the moving map. The active leg will be displayed in magenta.



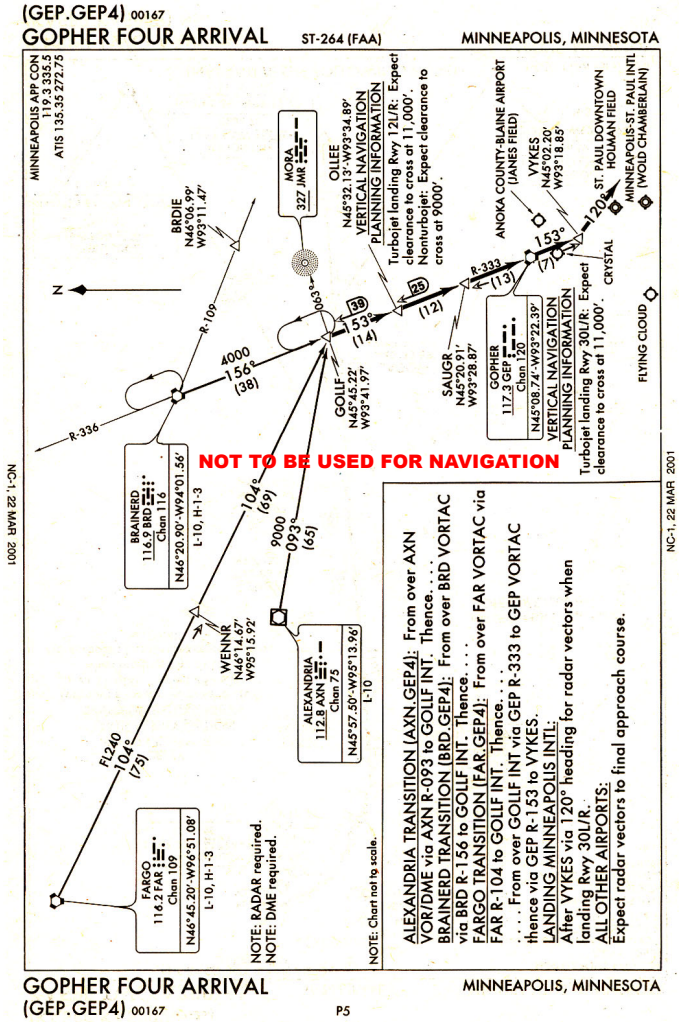

Course guidance and turn anticipation will be provided on the PFD with skyway boxes and CDI. Skyway boxes will connect waypoints throughout the procedure. The CDI will automatically transition from 0.3NM for the first straight leg to 1.0NM for the duration of the DP, finally transitioning to 2.0NM for enroute mode.

Fly to the active waypoint on the PFD by guiding the flight path marker though the skyway boxes, thereby keeping the CDI needle centered. You may monitor your position along the courseline on the moving map. The active waypoint will automatically sequence to the next waypoint as the active waypoint is crossed.

DPs normally terminate at an enroute waypoint. As the DP limit is reached, the active waypoint will sequence to the continuation of the active flight plan.

Compare the above screen with the DP plate (WAGGE ONE, Lovelock Transition) on page 7-28. The departure is made to the south to WAGGE intersection, then a left turn to JERGA intersection (shown as a lat/lon and intersecting radials on the plate), the direct to the Lovelock VOR.

# Standard Terminal Arrival Routes (STARs)

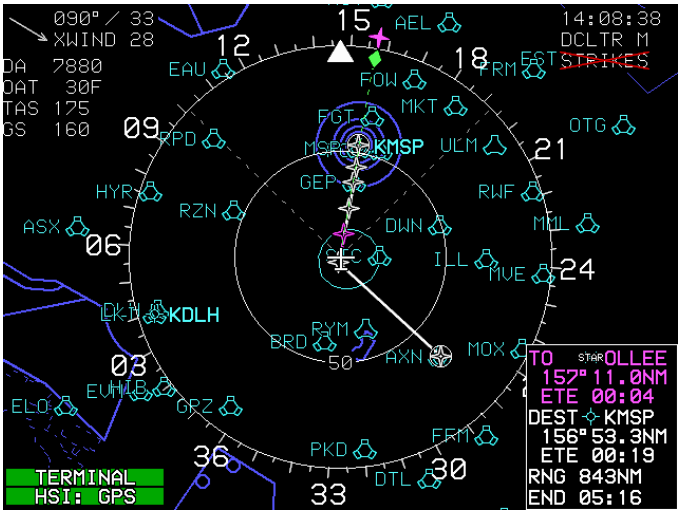


STARs are ATC coded IFR arrival routes established at busier airports to facilitate arrival and approach procedures. To select and display a STAR:

1. You must have the arrival airport entered as a waypoint (using **NRST**, **Direct-To**, or as part of an active flight plan).
2. Press the **ACTV** button and use the control knob to select the arrival **airport**.
3. Using the control knob, choose **STAR . .** (if **STAR . .** is not shown, no arrival procedure exists for that airport). Using the control knob, select the desired STAR, the appropriate transition (if available), and the anticipated arrival runway.
4. Review the arrival sequence (by pressing the **ACTV** button) and compare it with the printed plate. Turn the control knob to review each segment of the procedure. Bearing and distance information will be displayed for each waypoint. Press **INFO** to review crossing altitudes. When finished, press **EXIT** to remove menus from the screen.

The entire arrival route along with the runway will be displayed on the screens. The active leg will be displayed in magenta on the moving map.

Course guidance and turn anticipation will be provided on the PFD with skyway boxes and CDI. Skyway boxes will connect waypoints throughout the procedure.




Fly to the active waypoint on the PFD by guiding the flight path marker though the skyway boxes, thereby keeping the CDI needle centered. You may monitor your position along the courseline on the moving map. The active waypoint will automatically sequence to the next waypoint as the active waypoint is crossed.

Thirty miles from the destination, course guidance will switch from the enroute mode to the terminal mode and the CDI scale will transition from 2.0 to 1.0NM.

Compare the above screen with the STAR plate (GOPHER FOUR, Alexandria Transition) on page 7-31. The arrival is made to the east from the Alexandria VOR (AXN), then southeast through a series of fixes to the Minneapolis-St. Paul International Airport.

STARs normally terminate at a fix near the airport, then a radar vector or feeder route is used for transition to the approach phase. If you activate an IFR approach during the STAR, the approach waypoints will be inserted into the STAR.

# Section 8

# Appendix

The appendix of this document contains a variety of useful information not covered elsewhere in the manual. In this section you will find operating tips, system specifications, a detailed description of TAWS functions, warranty information, feedback forms, and more.

## Operating Tips

After thousands of hours of flying the system, Chelton Flight Systems test pilots have compiled some tips, tricks, and suggestions to help you get the most out of your EFIS.

### Descent Planning

Instead of doing time/speed/distance/descent-rate calculations, use the waypoint symbol for descent planning. Simply maintain your cruise altitude until the "X" at the bottom of the waypoint symbol is 2-3 degrees below the horizon (as indicated by the pitch scale), then begin a 2-3 degree descent. Maintain the correct descent angle by keeping the flight path marker positioned on the waypoint "X" symbol. If you use the skway boxes and set your VNAV descent angle accordingly, this will happen automatically.

### Terrain Clearance

Use the flight path marker to evaluate climb performance in regards to terrain clearance. If you are climbing at best angle to clear terrain and the flight path marker on the PFD is overlaying the terrain you are trying to clear, your climb is insufficient and

circling will be required. If your flight path marker is well clear of terrain (overlaying blue) your climb is sufficient, but remember that climb performance deteriorates with altitude and monitor your situation closely.

# Departure airport information

On startup, all the information for the departure airport is readily available; just think "nearest airport info."

Push the **NRST** button, push the control knob to choose **AIRPORT** (the current airport will be highlighted), then push the **INFO** button. All frequencies and runway data will be displayed.

# Pattern Entry

Locating an unfamiliar airport and entering the correct traffic pattern under visual conditions at an unfamiliar airport can be a source of anxiety for any pilot. The FlightLogic EFIS can make it effortless and foolproof. First, tune into ATIS/ASOS, or obtain an airport advisory 20-30 miles out. Select the runway in use from the **ACTV . .** (select the airport) then **VFR APPR . .** menu. The selected runway will appear light gray on the display with a skyway indicating the final approach path. The runway and touchdown zone elevation will be displayed below the minimap on the PFD.

# Your Instrument Scan

As you become familiar with the system, remember why the Primary Flight Display is called that; it should be used as your primary reference during flight. The PFD page is designed so that your complete instrument scan is a circle with a radius of less than one inch (illustrated below). Combine this "microscan" with an occasional glance at the moving map and you will always be on altitude and on course.

CHELTON
FPL
ACTV
INFO
OBS
MENU
HDG
NRST
148
690B
IFR APPR
ANG
164° A
RW16R 4412'
164° 2.1NM
SCROLL
PUSH
SELECT

# TAWS Functions

**General Description:**
The FlightLogic EFIS provides TSO-C151b TAWS functionality. Depending upon aircraft configuration settings and external sensors/switches, the system can be configured as a Class A, B, or C TAWS, or a Class A or B HTAWS. Functions provided by TAWS are:

1. Terrain Display: Display of terrain and obstacles on the PFD and ND.
2. Forward Looking Terrain Awareness (FLTA): A warning function that uses a terrain database to alert the pilot to hazardous terrain in front of the aircraft.
3. Premature Descent Alert (PDA): A warning function that alerts the pilot when descending well below a normal approach glidepath on the final approach segment of an instrument approach procedure.
4. Excessive Rate of Descent (GPWS Mode 1): A warning function that alerts the pilot when the rate of descent is hazardously high as compared to height above terrain (i.e., descending into terrain).
5. Excessive Closure Rate to Terrain (GPWS Mode 2): A warning function that alerts the pilot when the rate of change of height above terrain is hazardously high as compared to height above terrain (i.e., flying level over rising terrain).
6. Sink Rate after Takeoff or Missed Approach (GPWS Mode 3): A warning function that alerts the pilot when a sink rate is detected immediately after takeoff or initiation of a missed approach.
7. Flight into Terrain when not in Landing Configuration (GPWS Mode 4): A warning function that alerts the pilot when descending into terrain without properly configuring the aircraft for landing.

8. 8.Excessive Downward Deviation from an ILS Glideslope (GPWS Mode 5): A warning function that alerts the pilot when an excessive downward glideslope deviation is detected on the final approach segment of an ILS approach.

9. 9.500 foot Wake-up Call: A single voice callout when descending through 500 feet AGL.

TAWS functions provided by the EFIS as compared to TAWS/ HTAWS class and aircraft type are as follows:

| Aircraft Type | TAWS Class | Terrain Display | FLTA | PDA | GPWS Mode 1 | GPWS Mode 2 | GPWS Mode 3 | GPWS Mode 4 | GPWS Mode 5 | 500' Call |
|---|---|---|---|---|---|---|---|---|---|---|
| Airplane RG + F | A | X | X | X | X | X | X | X | X | X |
| Airplane RG | A | X | X | X | X | X | X | X | X | X |
| Airplane FG + F | A | X | X | X | X | X | X | X | X | X |
| Airplane FG | A | X | X | X | X | X | X | | X | X |
| Rotorcraft RG | A | X | X | | X | X | X | X | X | |
| Rotorcraft FG | A | X | X | | X | X | X | | X | |
| Airplane | B or C | X | X | X | X | | X | | | X |
| Rotorcraft | B | X | X | | | | X | | | |

Notes:RG + F = Retractable Gear with Defined Landing Flaps Position
RG= Retractable Gear
FG + F= Fixed Gear with Defined Landing Flaps Position
FG= Fixed Gear

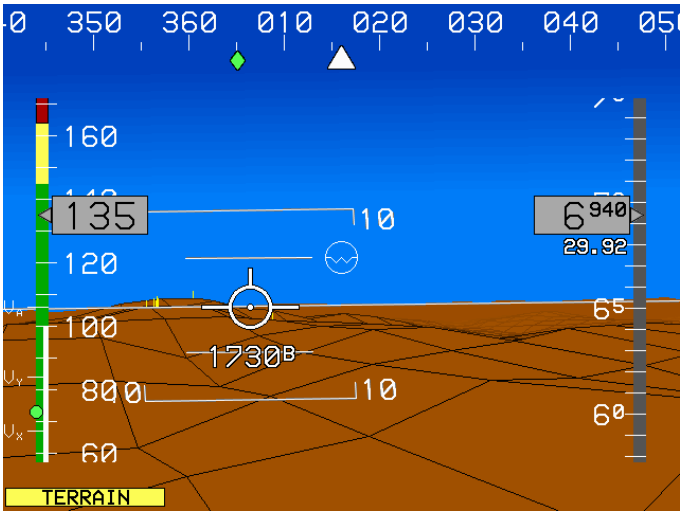
Detailed operations of the TAWS functions are described in the following sections.

**Terrain Display:**

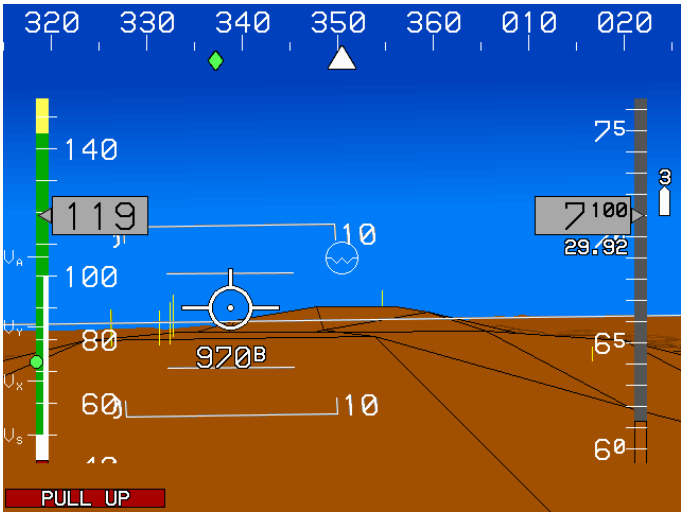
This function is present in all systems. The Terrain Display function uses a terrain database, aircraft position, aircraft heading or track, aircraft attitude, and aircraft altitude to render a display of surrounding terrain and obstacles on the primary flight display and navigation display.

Terrain is displayed on the primary flight display using a perspective fishnet style rendering. Terrain color is brown with the fishnet color fading from black to brown to impart atmospheric perspective. In addition, the sky color changes from a light blue at the horizon to a darker blue above the horizon for additional atmospheric perspective effect. The relative elevation of terrain

with respect to aircraft altitude and performance is naturally observed by reference to the primary flight display pitch ladder and flight path marker. Obstacles are shown on the primary flight display as simple yellow lines, and look very much like radio towers. The following screen captures show terrain and obstacles on the primary flight display:



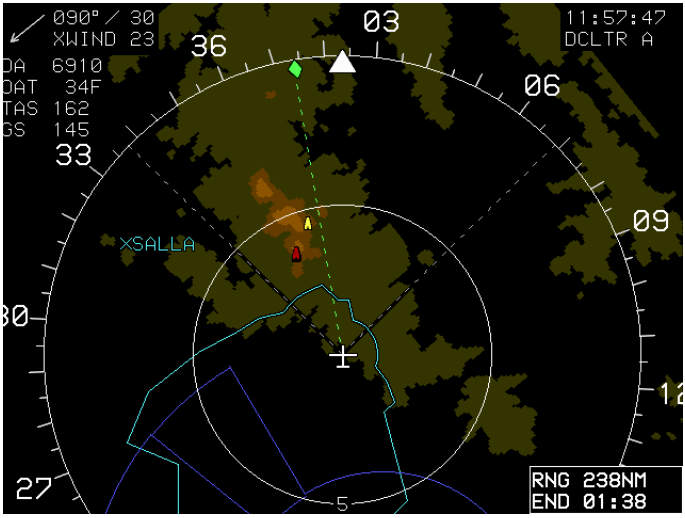

Above: TAWS Caution on PFD.



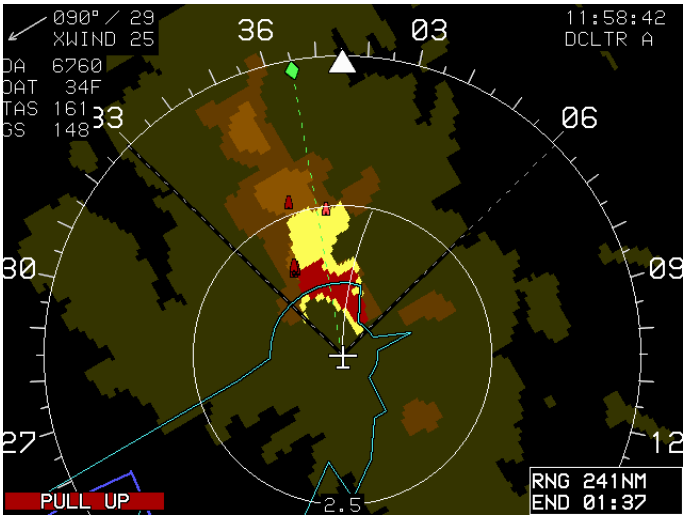

Above: TAWS warning on PFD.

Terrain and obstacles are displayed on the navigation display using colors to show relationship to aircraft altitude. Terrain areas are colored black when more than 2000 feet below aircraft altitude; dark olive when within 2000 feet but more than 500 feet below aircraft altitude; dark brown when within 500 feet but below aircraft altitude; and light brown when at or above aircraft altitude. Deep blue denotes areas of water and takes precedence over other colors. Obstruction symbols are colored yellow when within 2000 feet but more than 500 feet below aircraft altitude; light red when within 500 feet but below aircraft altitude; and deep red when at or above aircraft altitude. The colors green, amber and red are not used for normal display of terrain because: (1) such usage would conflict with the meanings attributed to these colors by the FARs; and (2) these are customarily used on electronic displays to show weather and could lead to pilot confusion when both terrain and weather are shown on the naviga-

tion display. Amber and red are used to show terrain areas causing an FLTA alert as further described in the FLTA section below. Such coloration complies with the requirement that terrain elements causing an FLTA alert be distinguishable from those that do not. The following screen capture shows terrain and obstructions on the navigation display:




Above: Obstructions and non-threatening terrain on the moving map; no TAWS warning.




Above: Threatening terrain on the moving map generating a TAWS warning.

The Terrain Display function can be manually inhibited by the pilot for decluttering. In addition, under certain failure conditions, the Terrain Display function is automatically inhibited. When the Terrain Display function is inhibited, the primary flight display background changes to a solid blue over brown presentation without a fishnet or atmospheric perspective. This makes it clear to the pilot that terrain is not being displayed and obviates the need for an annunciation on the primary flight display. On the navigation display, the word TERRAIN with an X over the top is displayed in the upper right hand corner. If the Terrain Display function is manually disabled, the X will be green. If the Terrain Display function is automatically disabled due to an abnormal condition, the X will be red.

**Forward Looking Terrain Alert Function:**
The EFIS FLTA mode is either slaved to the GPS/WAAS navigation mode or set automatically based upon default mode logic. Mode selection is described as follows:

*GPS/WAAS Navigation Mode Slaving*

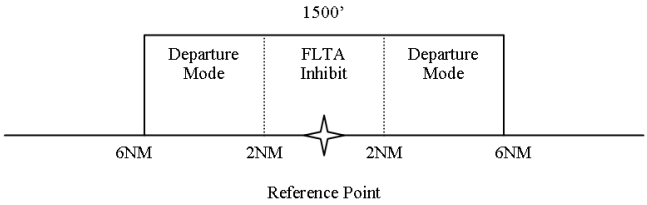
The EFIS performs TSO-C146a GPS/WAAS system functions in addition to the TAWS functions. As a result, GPS/WAAS navigation mode is available as an input to the TAWS. In accordance with RTCA/DO-229C, the user can select an IFR procedure (Approach, DP, or STAR) that automatically changes the GPS/WAAS navigation mode to Enroute, Terminal, Departure, or IFR Approach as appropriate. In addition, the EFIS allows the user to select a VFR approach to any runway or user waypoint with a defined approach path. Selection of a VFR approach causes automatic GPS/WAAS navigation mode changes to Enroute, Terminal or VFR Approach as appropriate. If the GPS/WAAS navigation mode is higher in precedence than the default FLTA mode, the FLTA mode is slaved to the GPS/WAAS navigation mode. The order of precedence is: (1) Departure Mode; (2) Approach Mode (IFR or VFR); (3) Terminal Mode; and (4) Enroute Mode. When slaved, the GPS/WAAS active runway threshold or user waypoint will be the reference point for automatic FLTA inhibiting. The advantage of this methodology is that the GPS/WAAS navigation modes are a direct indication to the FLTA function of pilot intent. Thus, it provides a mechanism for helicopter or bush pilots to desensitize the TAWS when conducting normal off-runway operations.

*Default FLTA Mode*

If the default FLTA navigation mode is higher in precedence than the GPS/WAAS navigation mode, the FLTA mode will be slaved to the default FLTA navigation mode. The order of precedence is: (1) Departure Mode; (2) Approach Mode; (3) Terminal Mode; and (4) Enroute Mode. These modes are as follows:

1. Departure Mode. This mode is enabled when on the ground (defined as indicated airspeed less than or equal to Vs AND AGL altitude less than 75 feet). The reference point for automatic FLTA inhibiting and mode envelope definition is the last point at which the ground

definition was satisfied (this will be near the liftoff point). The Departure Mode will end upon climbing through 1,500 feet above or traveling more than 6NM from the reference point.

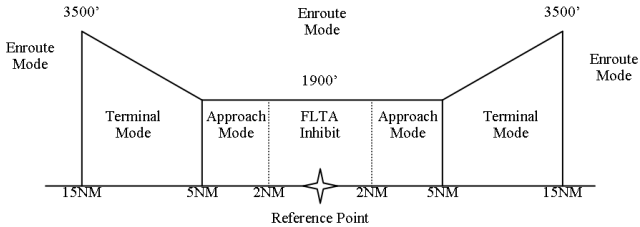



2. Other Modes. For other default FLTA modes, the reference point for automatic FLTA inhibiting and mode envelope definition will be the nearest runway threshold. The TAWS continuously searches all runway thresholds at the nearest airport to determine the nearest runway. The TAWS performs a search for the nearest airport every 3NM of distance traveled. Modes are as follows:

a. Approach Mode. This mode exists when within 1,900 feet and 5.0NM of the reference point.

b. Terminal Mode. This mode exists from 5NM to 15NM from the reference point when below an altitude that-varies from 1,900 feet (at 5NM) to 3,500 feet (at 15NM) above the reference point.

c. Enroute Mode. This mode exists when not in any other mode.




FLTA Search Envelope:

The FLTA search envelope is an area in front of and below the aircraft. If terrain is found within the FLTA search envelope, a caution or warning is given to the pilot. The dimensions of the search envelope depend TAWS type, FLTA mode (described above), aircraft groundspeed, aircraft bank angle and aircraft vertical speed. Basic envelope parameters are as follows:

1. TAWS Type: The TAWS type determines the value of several parameters used to calculate the search envelope. These parameters are described below:
    a. Level-Off Rule: This parameter is the value, in percent of vertical speed, used to determine level-off leading for the descending flight Reduced Required Terrain Clearance (RTC) calculation. For airplanes, this value is set to 20% for Class A and B TAWS, and 10% for Class C TAWS. For rotorcraft, this value is set to 10%.
    b. Range: This parameter is the forward range of the search envelope in seconds. For airplanes, this value is set to 60 seconds. For rotorcraft, this value is set to 30 seconds and is reduced to 20 seconds when Low Altitude Mode is engaged.

c. Enroute Mode Level / Climbing Flight RTC: This parameter is the Enroute Mode level or climbing flight RTC in feet. For airplanes, this value is set to 700 feet for Class A and B TAWS, and 250 feet for Class C TAWS. For rotorcraft, this value is set to 150 feet and is reduced to 100 feet when Low Altitude Mode is engaged.

d. Terminal Mode Level / Climbing Flight RTC: This parameter is the Terminal Mode level or climbing flight RTC in feet. For airplanes, this value is set to 350 feet for Class A and B TAWS, and 250 feet for Class C TAWS. For rotorcraft, this value is set to 150 feet and is reduced to 100 feet when Low Altitude Mode is engaged.

e. Approach Mode Level / Climbing Flight RTC: This parameter is the Approach Mode level or climbing flight RTC in feet. For airplanes, this value is set to 150 feet. For rotorcraft, this value is set to 150 feet and is reduced to 100 feet when Low Altitude Mode is engaged.

f. Departure Mode Level / Climbing Flight RTC: This parameter is the Departure Mode level or climbing flight RTC in feet. This value is set to 100 feet for all TAWS classes for both airplanes and rotorcraft.

g. Enroute Mode Descending RTC: This parameter is the Enroute Mode descending flight RTC in feet. For airplanes, this value is set to 500 feet for Class A and B TAWS, and 200 feet for Class C TAWS. For rotorcraft, this

value is set to 100 feet.

h. Terminal Mode Descending RTC: This parameter is the Terminal Mode descending flight RTC in feet. For airplanes, this value is set to 300 feet for Class A and B TAWS, and 200 feet for Class C TAWS. For rotorcraft, this value is set to 100 feet.

i. Approach Mode Descending RTC: This parameter is the Approach Mode descending flight RTC in feet. This value is set to 100 feet for all TAWS classes for both airplanes and rotorcraft.

j. Departure Mode Descending RTC: This parameter is the Departure Mode descending flight RTC in feet. This value is set to 100 feet for all TAWS classes for both airplanes and rotorcraft.

TAWS type parameters are summarized in the following table:

| Aircraft Type | TAWS Class | Level-Off Rule | Range | Level RTC | | | | Descending RTC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Enroute | Terminal | Approach | Departure | Enroute | Terminal | Approach | Departure |
| Airplane | A & B | 20% | 60sec | 700' | 350' | 150' | 100' | 500' | 300' | 100' | 100' |
| | C | 10% | | 250' | 250' | | | 200' | 200' | | |
| Rotorcraft | A & B | 10% | 30sec | 150' | 150' | 150' | 100' | 100' | 100' | 100' | 100' |
| Rotorcraft (Low Alt) | A & B | 10% | 20sec | 100' | 100' | 100' | 100' | 100' | 100' | 100' | 100' |

2. Aircraft Track: The terrain search envelope is aligned with aircraft track.

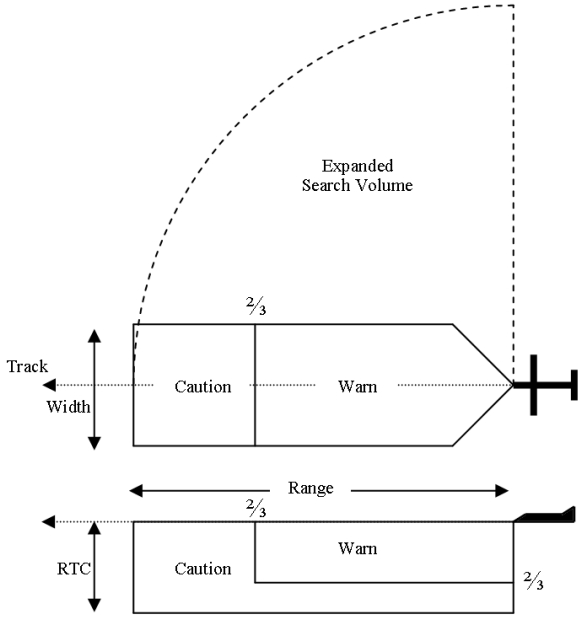
3. Aircraft Groundspeed: Aircraft groundspeed is used in conjunction with the range parameter to determine the look-ahead distance. In addition, aircraft groundspeed is used in conjunction with FLTA mode to determine the search volume width as follows:

a. Enroute Mode: Search volume width is based upon a 30° change in track followed by 30 seconds of flight at aircraft groundspeed. Maximum width is 0.5NM either side of track.
b. Terminal Mode: Search volume width is based upon a 15° change in track followed by 30 seconds of flight at aircraft groundspeed. Maximum width is 0.4NM either side of track.
c. Approach Mode: Search volume width is based upon a 10° change in track followed by 30 seconds of flight at aircraft groundspeed. Maximum width is 0.3NM either side of track.
d. Departure Mode: Search volume width is based upon a 10° change in track followed by 30 seconds of flight at aircraft groundspeed. Maximum width is 0.3NM either side of track.

4. Aircraft Bank Angle: Aircraft bank angle is used to expand the search volume in the direction of a turn. Search volume expansion requires at least 10 of bank. In addition, search volume expansion is debounced such that at 10° of bank, the bank angle must be continuously held for 3.25 seconds. The amount of debouncing is reduced linearly with increased bank angle such that at 30° of bank, there is no debounce time. Debouncing is intended to reduce nuisance search volume expansions when experiencing bank angle excursions due to turbulence.
5. Aircraft Vertical Speed: Aircraft vertical speed is used to determine which RTC values should be used. At vertical speeds above -500fpm, level and climbing flight RTC values are used. At vertical speeds less than or equal to -500fpm, descending flight RTC values are

used. In addition, vertical speed is used to increase the descending flight RTC value used by the system. The increase in descending flight RTC is based upon a 3 second pilot reaction time and VSI leading according to the level-off rule parameter.

FLTA search volume is depicted below:



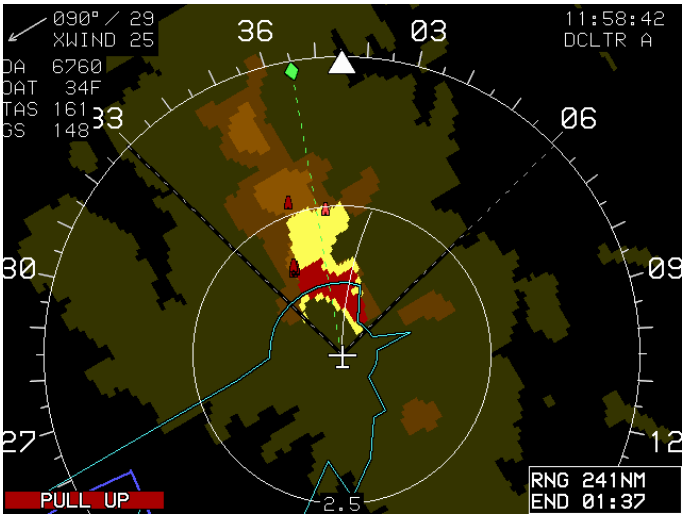

FLTA Alerts and Automatic Popup:

When terrain falls within the FLTA search envelope an FLTA warning is generated as described in **Caution/Warning/Advisory System, page 2-11**. In addition, an automatic popup mode will be engaged as follows:

| Primary Flight Display | Multi-Function Display |
|---|---|
| Terrain rendering enabled. | 1. Display switched to navigation display.<br>2. Terrain rendering enabled.<br>3. Display switched to aircraft centered and heading up.<br>4. Scale set to 5NM (groundspeed < 200 knots) or 10NM (groundspeed > 200 knots).<br>5. Terrain elements generating cautions are colored amber.<br>6. Terrain elements generating warnings are colored red. |

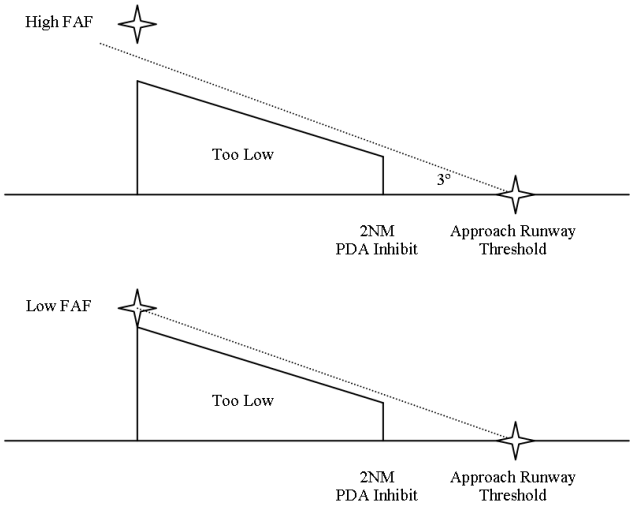
After the popup mode is engaged, the pilot can manually change any setting that was automatically changed by the popup mode.

The following screen capture shows the multi-function display in popup mode:



**Premature Descent Alert Function:**
This function applies to airplane TAWS systems. The PDA function uses the GPS/WAAS navigation database, GPS/WAAS navigation mode, aircraft position, and aircraft altitude to alert the pilot when descending well below a normal approach glide path on the final approach segment of an instrument approach procedure.

The PDA function is armed when on the final approach segment of an IFR approach procedure and below the FAF crossing altitude. The alerting threshold for the PDA function is 0.5° less than the lower of: (1) a straight line from the FAF to the approach runway threshold; or (2) 3°. When the aircraft descends below the threshold, an amber TOO LOW caution flag is presented in conjunction with a single Too Low Terrain voice alert. The PDA alert threshold is depicted below:



**Excessive Rate of Descent (GPWS Mode 1):**
This function is present in all airplane TAWS systems and rotorcraft Class A HTAWS. The GPWS Mode 1 function uses aircraft vertical speed information and AGL altitude to alert the pilot when the rate of descent is hazardously high as compared to height above terrain.

GPWS Mode 1 has a caution threshold and a warning threshold. When below the warning threshold, a red PULL UP warning flag is presented in conjunction with a repeating Pull Up, Pull Up voice alert. When above the warning threshold but below the caution threshold, an amber SINK RATE caution flag is presented in conjunction with a single Sink Rate voice alert. The system uses RTCA/DO-161A Mode 1, Envelope 1 for TAWS systems, and a similar curve modified for helicopter operations for HTAWS systems.

**Excessive Closure Rate to Terrain (GPWS Mode 2):**
This function is present in Class A TAWS and HTAWS systems. The GPWS Mode 2 function uses filtered AGL rate and AGL altitude to alert the pilot when the rate of change of height above terrain is hazardously high as compared to height above terrain (i.e., flying level over rising terrain). AGL rate filtering is based upon a sampling distance that varies with AGL altitude. Sampling distance varies from 0.5NM at 0'AGL to 0.2NM at 2,500'AGL.

There are two Mode 2 envelopes: Mode 2A which is active when not in landing configuration; and Mode 2B which is active when in landing configuration. Envelope selection is determined as follows:

| Aircraft Type | Mode 2A | Mode 2B |
|---|---|---|
| Airplane RG + F | Flaps NOT in landing configuration. | Flaps in landing configuration. |
| Airplane RG | Landing Gear UP | Landing Gear DOWN |
| Airplane FG + F | Flaps NOT in landing configuration | Flaps in landing configuration |
| Airplane FG | AGL Altitude > 500' OR IAS > Note 1 | AGL Altitude < 500' AND IAS < Note 1 |
| Rotorcraft RG | Landing Gear UP | Landing Gear DOWN |
| Rotorcraft FG | AGL Altitude > 200' OR IAS > 80KIAS | AGL Altitude < 200' AND IAS < 80KIAS |

Notes: RG + F = Retractable Gear with Defined Landing Flaps Position
RG = Retractable Gear
FG + F = Fixed Gear with Defined Landing Flaps Position
FG = Fixed Gear
1. Normal Landing Pattern Speed + 15KIAS

When the GPWS Mode 2 envelope is pierced, a GPWS Mode 2 warning is generated as described in **Caution/Warning/Advisory System, page 2-11**. Envelopes are defined below:

<u>Mode 2A (NOT in Landing Configuration):</u>

The system uses the RTCA/DO-161A Mode 2A envelope for TAWS systems, and a similar curve modified for helicopter operations for HTAWS. The upper limit of the curves includes an airspeed expansion function.

Mode 2B (Landing Configuration):
The system uses the RTCA/DO-161A Mode 2B envelope for TAWS systems, and a similar curve modified for helicopter operations for HTAWS systems.

**Sink Rate after Takeoff or Missed Approach (GPWS Mode 3):**
This function is present in all TAWS and HTAWS classes. The GPWS Mode 3 function uses aircraft vertical speed information and AGL altitude to alert the pilot when a sink rate is detected immediately after takeoff or initiation of a missed approach.

GPWS Mode 3 is armed by either being on the ground (defined as indicated airspeed less than $V_S$ (airplanes) / 40KIAS (rotorcraft) AND AGL altitude less than 75 feet) or by being on the first leg of a missed approach procedure (as determined by the EFIS FMS) with distance to the active runway threshold increasing. GPWS Mode 3 is disarmed upon climbing through 700 feet AGL, traveling more than 6NM from the last point at which the ground definition was satisfied (this will be near the liftoff point), or transitioning to the second leg of a missed approach procedure. GPWS Mode 3 has a caution threshold based upon height above terrain and vertical speed. When below the caution threshold, a GPWS Mode 3 warning is generated as described in **Caution/Warning/Advisory System, page 2-11**

**Flight into Terrain when not in Landing Configuration (GPWS Mode 4):**
This function is present in Class A TAWS and HTAWS. The GPWS Mode 4 function uses aircraft speed information and AGL altitude to alert the pilot when descending into terrain without properly configuring the aircraft for landing. There are two Mode 4 envelopes: Mode 4A which gives cautions when landing gear is in other than landing configuration; and Mode 4B

which gives cautions when landing gear or flaps are in other than landing configuration. Applicability of Mode 4 envelopes to aircraft types is as follows:

| Aircraft Type | Mode 4A | Mode 4B |
|---|---|---|
| Airplane RG + F | Landing Gear UP | Landing Gear UP OR Flaps not in landing configuration. |
| Airplane RG | Landing Gear UP | Landing Gear UP |
| Airplane FG + F | Not Applicable | Flaps not in landing configuration |
| Airplane FG | Not Applicable | Not Applicable |
| Rotorcraft RG | Landing Gear UP | Not Applicable |
| Rotorcraft FG | Not Applicable | Not Applicable |

Notes: RG + F = Retractable Gear with Defined Landing Flaps Position
RG = Retractable Gear
FG + F = Fixed Gear with Defined Landing Flaps Position
FG = Fixed Gear

Mode 4 alerting criteria require that the Mode 4 envelope be entered from above. Changing aircraft configuration while within a Mode 4 envelope will not generate an alert.

Airplane Mode 4 envelopes consist of a low-speed region and a high-speed region. When Mode 4A alerting criteria is met in the low-speed region, an amber TOO LOW caution flag is presented in conjunction with a single Too Low Gear voice alert. When Mode 4B alerting criteria is met in the low-speed region, an amber TOO LOW caution flag is presented in conjunction with either a single Too Low Gear voice alert (if landing gear is UP) or a single Too Low Flaps voice alert (if landing gear is DOWN). When either Mode 4 alerting criteria is met in the high-speed region, an amber TOO LOW caution flag is presented in conjunction with a single Too Low Terrain voice alert.

The rotorcraft Mode 4 envelope also consists of a low-speed region and a high-speed region. In the low-speed region, an amber TOO LOW caution flag is presented in conjunction with a single Too Low Gear voice alert. In the high-speed region, an amber

TOO LOW caution flag is presented in conjunction with a single Too Low Terrain voice alert. In addition, the rotorcraft Mode 4 features autorotation expansion. When autorotation expansion is engaged, the voice alert is Too Low Gear regardless of speed.

The system uses RTCA/DO-161A Mode 4 Envelope 3 for TAWS systems, and a similar curve modified for helicopter operations for HTAWS systems.

**Excessive Downward Deviation from an ILS Glideslope (GPWS Mode 5):**
This function is present in Class A TAWS and HTAWS systems. The GPWS Mode 5 function uses ILS glideslope deviation information and AGL altitude to alert the pilot when an excessive downward glideslope deviation is detected on the final approach segment of an ILS approach. GPWS Mode 5 is armed when a valid glideslope signal is being received AND the aircraft's 5 second filtered descending glide path is greater than 1° AND the aircraft is below 1,000' AGL.

GPWS Mode 5 has a caution threshold and a warning threshold. When below the warning threshold, a red GLIDESLOPE warning flag is presented in conjunction with a repeating Glide Slope voice alert. When above the warning threshold but below the caution threshold, an amber GLIDESLOPE caution flag is presented in conjunction with a single Glideslope voice alert. The system uses RTCA/DO-161A Mode 5 for TAWS and HTAWS.

**500-Foot Wake-Up Call:**
This function is present in all TAWS classes. The 500-foot function includes an arming deadband of 500 feet to prevent nuisance warnings during low altitude operations. Thus, the aircraft must climb above 1,000 feet AGL to arm the 500-foot function. Once

armed, the 500-foot function works by simply issuing a “Five Hundred” voice alert when descending through 500 feet AGL.

**External Sensors and Switches:**
The EFIS TAWS system requires a variety of inputs from external sensors and switches to perform its functions. These inputs are summarized below:

1. GPS/WAAS receiver. The GPS/WAAS receiver is the source of aircraft position, geodetic height, horizontal figure of merit, vertical figure of merit, loss of integrity and loss of navigation inputs for the TAWS. The GPS/WAAS receiver connects directly to the EFIS IDU.
2. Air Data Computer. The air data computer is the source of barometric altitude, outside air temperature, and vertical speed for the TAWS. The air data computer connects directly to the EFIS IDU.
3. ILS Receiver. An ILS receiver is the source of glideslope deviation for the TAWS. The glideslope receiver connects to an external signal conversion box that communicates digitally with the EFIS IDU.
4. Radar Altimeter. A radar altimeter is the source for radar altitude for the TAWS. The radar altimeter connects to an external signal conversion box that communicates digitally with the EFIS IDU.
5. Gear Position Sensors. Three individual landing gear position discretes are the source of landing gear position for the TAWS. The landing gear position discretes are of the pull-to-ground type and connect directly to the EFIS IDU. Each discrete is grounded when the landing gear to which it is connected is down and locked.
6. Flap Position Sensor. A flap position discrete is the

source of flap position for the TAWS. The flap position discrete is of the pull-to-ground type and connects to an external signal conversion box that communicates digitally with the EFIS IDU. The flap position discrete is grounded when the flaps are in the landing configuration.

7. TAWS Inhibit Switch. A TAWS Inhibit Switch is used for manual inhibiting of TAWS alerting functions. The TAWS Inhibit Switch is of the latching type and gives an obvious indication of actuation (i.e., toggle / rocker or pushbutton with indicator light). The TAWS Inhibit Switch is connected directly to the EFIS IDU. The TAWS Inhibit Switch is activated when manual inhibiting of TAWS alerting functions is desired.
8. Low Altitude Mode Switch. A Low Altitude Mode Switch is used for inhibiting and modifying HTAWS alerting functions to allow normal operation at low altitudes. The Low Altitude Mode Switch is of the latching type and gives an obvious indication of actuation (i.e., toggle / rocker or pushbutton with indicator light). The Low Altitude Mode Switch is connected directly to the EFIS IDU. The Low Altitude Mode Switch is activated when operation in Low Altitude Mode is desired.
9. Audio Cancel Switch. An Audio Cancel Switch is used for silencing active voice alerts. The Audio Cancel Switch is of the momentary type. The Audio Cancel Switch is connected directly to the EFIS IDU. The Audio Cancel Switch is momentarily depressed when silencing of active voice alerts is desired.
10. Glideslope Deactivate Switch. A Glideslope Deactivate Switch is used for inhibiting the GPWS Mode 5 function. The Glideslope Deactivate Switch is of the

momentary type. The Glideslope Deactivate Switch connects to an external signal conversion box that communicates digitally with the EFIS IDU. The Glideslope Deactivate Switch is momentarily depressed when inhibition of the GPWS Mode 5 function is desired.

11. Low Torque Sensor. A low torque discrete is used for inhibiting and modifying HTAWS alerting functions during an autorotation. The low torque discrete is of the pull-to-ground type and connects to an external signal conversion box that communicates digitally with the EFIS IDU. The low torque discrete detects when engine torque is less than 7.5%.

The following tables list the applicability of external sensors and switches for various aircraft and TAWS system types:

| Sensors/Switches Connected Directly to IDU | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Aircraft Type** | **TAWS/ HTAWS Class** | **GPS/WAAS** | **ADC** | **Gear Position Sensor** | **TAWS Inhibit Switch** | **Audio Cancel Switch** | **Low Altitude Mode Switch** |
| Airplane RG + F | A | X | X | X | X | X | |
| Airplane RG | A | X | X | X | X | X | |
| Airplane FG + F | A | X | X | | X | X | |
| Airplane FG | A | X | X | | X | X | |
| Rotorcraft RG | A | X | X | X | X | X | X |
| Rotorcraft FG | A | X | X | | X | X | X |
| Airplane | B or C | X | X | | X | X | |
| Rotorcraft | B | X | X | | X | X | X |

| Sensors/Switches Connected to External Signal Conversion Box | | | | | | |
|---|---|---|---|---|---|---|
| **Aircraft Type** | **TAWS/ HTAWS Class** | **ILS** | **Radar Altimeter** | **Flap Position Sensor** | **Glideslope Deactivate Switch** | **Low Torque Sensor** |
| Airplane RG + F | A | X | X | X | X | |
| Airplane RG | A | X | X | | X | |
| Airplane FG + F | A | X | X | X | X | |
| Airplane FG | A | X | X | | X | |
| Rotorcraft RG | A | X | X | | X | X |
| Rotorcraft FG | A | X | X | | X | X |
| Airplane | B or C | | | | | |
| Rotorcraft | B | | | | | |

Notes: RG + F = Retractable Gear with Defined Landing Flaps Position
RG = Retractable Gear
FG + F = Fixed Gear with Defined Landing Flaps Position
FG = Fixed Gear

**TAWS Basic Parameter Determination:**

The fundamental parameters used for TAWS system functions are: (a) aircraft position, groundspeed, and track; (b) MSL altitude; (c) terrain data; (d) obstacle data; (e) AGL altitude; (f) vertical speed; (g) terrain closure rate; and (h) runway/reference point location. There are redundant sources for some of these parameters. These parameters are acquired for use by the EFIS as follows:

1. Aircraft position, groundspeed and track. Aircraft position, groundspeed and track come solely from the GPS/WAAS. In order to be considered valid for use by the TAWS, the following conditions must be met:
    a. There is no GPS/WAAS loss of integrity caution;
    b. There is no GPS/WAAS loss of navigation caution; and
    c. GPS/WAAS horizontal figure of merit (HFOM) is less than or equal to 0.3NM.
2. MSL altitude. The primary source for MSL altitude is GPS/WAAS geodetic height. In order for GPS/WAAS geodetic height to be considered valid for use as MSL altitude, the following conditions must be met:
    a. There is no GPS/WAAS loss of integrity caution;
    b. There is no GPS/WAAS loss of navigation caution; and
    c. GPS/WAAS vertical figure of merit (VFOM) is less than or equal to 75 feet.

    The secondary source of MSL altitude is temperature corrected barometric altitude from an air data computer.
3. Terrain data. The sole source for terrain data is a terrain

database. In order for terrain data to be considered valid for use by the TAWS, the following conditions must be met:

a. Aircraft position is valid;
b. Aircraft position is within the boundaries of the terrain database; and
c. The terrain database is not corrupt as determined by a CRC-32 check at system initialization.

4. Obstacle data. The sole source for obstacle data is an obstacle database. In order for obstacle data to be considered valid for use by the TAWS, the following conditions must be met:

a. Aircraft position is valid;
b. Aircraft position is within the boundaries of the obstacle database; and
c. The obstacle database is not corrupt as determined by a CRC-32 check at system initialization.

Note that obstacle data is only used for depicting obstacles. It is not used for warning functions.

5. AGL altitude. The primary source for AGL altitude is radar altitude. The secondary source for AGL altitude is MSL altitude less terrain altitude.
6. Vertical speed. The primary source for vertical speed is barometric vertical speed from an air data computer. The secondary source for vertical speed is GPS/WAAS vertical speed. In order for GPS/WAAS vertical speed to be considered valid, the following conditions must be met:

a. There is no GPS/WAAS loss of integrity caution;

b. There is no GPS/WAAS loss of navigation caution; and
c. GPS/WAAS vertical figure of merit is less than or equal to 75 feet.

7. Terrain closure rate. The source for terrain closure rate is the smoothed first derivative of AGL altitude. As there are multiple sources for AGL altitude, there are multiple sources for terrain closure rate. The smoothing algorithm is described in the GPWS Mode 2 section.
8. Runway/reference point location. The runway or reference point location used by the TAWS algorithms is determined from the EFIS navigation database. In order to be considered valid for use, the following conditions must be met:
    a. Aircraft position is valid;
    b. Aircraft position is within the boundaries of the navigation database; and
    c. The navigation database is not corrupt as determined by a CRC-32 check at system initialization.

**TAWS Automatic Inhibit Functions (Normal Operation):**

The following automatic inhibit functions occur during normal TAWS operation to prevent nuisance warnings:

1. The FLTA function is automatically inhibited when in the Terminal, Departure, IFR Approach or VFR Approach Modes and within 2NM of the reference point.
2. The PDA function is automatically inhibited when within 2NM of the approach runway threshold.
3. GPWS Modes 1 through 5 are automatically inhibited when below 50 feet AGL (radar altimeter AGL alti-

tude) or below 100 feet AGL (terrain database AGL altitude).

4. GPWS Mode 4 is inhibited while Mode 3 is armed.

As these inhibit modes are part of normal TAWS operation, no annunciation is given when they are engaged.

**TAWS Automatic Inhibit Functions (Abnormal Operation):** The following automatic inhibit functions occur during the specified abnormal operations:

1. Autorotation detection. When engine torque drops below 7.5%, a Class A HTAWS system enters Autorotation Mode. In this mode:
    a. GPWS Mode 1 is inhibited;
    b. GPWS Mode 2 is inhibited; and
    c. GPWS Mode 4 uses a modified envelope (see GPWS Mode 4 description above).
2. System Sensor/Database Failures. System sensor failures, non-installation of optional sensors, database failures and combinations thereof affect the TAWS system as follows:

| Sensor | Parameters Lost | Terr. Displ. | FLTA | PDA | GPWS Mode 1 | GPWS Mode 2 | GPWS Mode 3 | GPWS Mode 4 | GPWS Mode 5 | 500' Wake-Up |
|---|---|---|---|---|---|---|---|---|---|---|
| GPS (H) | AC Position | Inhibit | Inhibit | Inhibit | | | | | | |
| TD | Terrain Elevation | Inhibit | Inhibit | | | | | | | |
| ILS | Glideslope Deviation | | | | | | | | Inhibit | |
| GPS (H) + Radalt | AC Position, AGL Altitude | Inhibit | Inhibit | Inhibit | Inhibit | Inhibit | Inhibit | Inhibit | Inhibit | Inhibit |
| GPS (V) + ADC | MSL Altitude, VSI | Inhibit | Inhibit | Inhibit | Inhibit | | Inhibit | | | |
| TD + Radalt | Terrain Elevation, AGL Altitude | Inhibit | Inhibit | | Inhibit | Inhibit | Inhibit | Inhibit | Inhibit | Inhibit |
| GPS (V) + ADC + Radalt | MSL Altitude, VSI, AGL Altitude | Inhibit | Inhibit | Inhibit | Inhibit | Inhibit | Inhibit | Inhibit | Inhibit | Inhibit |
| GPS (V) + ADC + ILS | MSL Altitude, VSI, Glideslope Deviation | Inhibit | Inhibit | Inhibit | Inhibit | | Inhibit | | Inhibit | |

Notes:

1. The combinations listed give the minimum combinations with the worst consequences. Many other combinations are possible, but their effects are subsumed within the combinations listed.
2. GPS (H) = HFOM > 0.3NM or loss of integrity or loss of navigation. Indication is "NO GPS" flag for loss of integrity or loss of navigation.
3. GPS (V) = VFOM > 75' or loss of integrity or loss of navigation. Indication is "NO GPS" flag for loss of integrity or loss of navigation.
4. GPS = GPS (H) + GPS (V). Indication is "NO GPS" flag for loss of integrity or loss of navigation.
5. TD = Terrain Data invalid. This would be due to being beyond the database boundaries, as the system will not initialize if database errors are detected on system start.
6. ADC = Air Data Computer. Indication is "NO AIR DATA" flag.
7. Radalt = Radar Altimeter. Indication is lack of radar altimeter source indication on radar altimeter display.
8. ILS = ILS Glideslope Deviation. Indication is lack of glideslope needles.

## TAWS Manual Inhibit Functions:

The following manual inhibit functions can be selected by the pilot:

1. The Terrain Display function can be manually inhibited using the EFIS declutter menu.
2. All TAWS alerting functions can be manually inhibited by actuation of the external TAWS Inhibit Switch. The Terrain Display function is not affected by the TAWS Inhibit Switch.
3. In HTAWS systems, a Low Altitude Mode Switch can be actuated to inhibit or modify parameters for alerting functions. The purpose of this switch is to desensitize the HTAWS when purposefully flying VFR at low alti-

tudes. Low Altitude Mode has the following effects:

a. If source terrain data has a resolution lower than 6 arc-seconds, the FLTA function is inhibited. If source terrain data resolution is equal to or better than 6 arc-seconds, FLTA parameters are modified.
b. GPWS Mode 1 is inhibited.
c. GPWS Mode 2 in inhibited.
d. GPWS Mode 3 is inhibited.

4. GPWS Mode 5 can be manually inhibited by actuation of the momentary Glideslope Cancel Switch when below 2000’ AGL. GPWS Mode 5 manual inhibit is automatically reset by ascending above 2000’AGL or descending below the automatic inhibit altitude (50 feet AGL with radar altimeter AGL source or 100 feet AGL with terrain database AGL source).

# Jeppesen NavData Chart Compatibility

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## Aeronautical Information Compatibility

Jeppesen Airway Manual Charts are the same publications which Jeppesen has provided to the aviation community for many years. Jeppesen NavData has not been around for quite as long, but has established and maintained the same reputation for accuracy, reliability, and dependability with those customers who use computerized navigational systems and other computer navigation data bases from Jeppesen. For those who subscribe to both services, slight differences may occasionally be noted between what is seen on the chart and what is generated from the navigation data base. These differences may be caused by any or all of the following:

1. **Differences in Publication Criteria.**
   Jeppesen computerized NavData is updated and issued every 28 days. This is a relatively quick and simple operation for the user, since all of the changes are included on the updated media which is loaded into the aircraft navigation system or a main-frame computer system. The charts are quite a different story, as each chart must be individually updated and published. The new charts are then collated and mailed, and once received by the customer, must be filed individually in the Airway Manual. Variations, such as differences in information cut-off dates and lead time requirements, may bring about distribution in one medium before the other. These differences are generally resolved in the Jeppesen NavData NOTAMs and the Jeppesen Chart NOTAMs. The NOTAMs provide a weekly or bi-weekly update to the NavData and Chart services. A review of the Jeppesen NOTAM pages prior to using either service will help to ensure that you have the most current information.

2. **Differences in the Method Used to Determine Bearing and Distance Values on Charts and in Computerized Navigational Systems.**
   Bearings and distances on airways, approach transitions, and instrument approaches are published in a country's Aeronautical Information Publication (AIP). Almost exclusively, these values are taken from the AIP and published on Jeppesen charts. In contrast, the navigation database contains exact locations of the navaids used to form tracks of airways, approach transitions, and instrument approaches. System software computes geodetic route bearings and distances based on the most current navaid information on the desired route, and presents this data on the system display. Slight differences in bearing and distance may not be changed in the AIP, and therefore, may not change on the Jeppesen charts. But if navaid information has changed even minutely, differences may show up because the bearings and distances displayed are computed by the navigation system or computer flight planning software each time a particular track is called up.

3. **Differences in Waypoint Names and Coordinates.**
   Waypoint names published on Jeppesen charts are taken directly from official government sources. In some countries, there are no restrictions on the number of characters used in the name. Computerized navigation system software limits waypoint names to a maximum of five characters. Therefore, waypoint names with more than five characters will be abbreviated for entry into the navigation data base. Note that the basic structure of the name is retained, and it should be relatively easy to tie that abbreviation generated by the data base to the complete name of the waypoint on the chart. In addition, there are unnamed turning points and intersections depicted on charts which must be included in the navigation data base. Therefore, certain names may appear in a computerized system which do not appear on a chart. The method used to identify these turning points and intersections is also included in "NavData Name Conventions".

**For Jeppesen Charts Dated 14 OCT 94 and Later**
On standard Enroute and Area charts, for unnamed, or named

with name other than five characters and no State assigned identifier, fixes/reporting points/mileage breaks

- and -

For entry points on STAR charts and exit points on SID charts:

The NavData identifier is published, adjacent to the point involved, within square brackets, and in italic type. Example: *[ABC73]*. Should changes occur to a charted NavData identifier prior to the re issue of the chart, the change will be announced in a special section of the Jeppesen Chart NOTAMs titled "NavData Identifiers". ***NavData identifiers are Jeppesen derived only, and should not be used for ATC flight plan filing or used in ATC communications.*** Coordinates on Jeppesen charts may also differ slightly from those generated by a computer. As stated in paragraph 1 above, the navigation data base is updated completely every 28 days. The charts, on the other hand, may accumulate small changes over a longer period of time. Because of these differences in publication schedules, there may be very slight differences between the charts and the NavData generated information.

**4. Incompatibility of Some Routes and Instrument Approaches with Computerized Navigation System Software.**

By nature of their design, some routes and instrument approach procedures are not usable by certain computerized navigation systems. For example, consider an approach transition from the enroute structure to an instrument approach. In most cases these are named and defined as STARs, or they are tied into particular instrument approach procedures. To be compatible with computerized navigation system software, one of the above prerequisites must be present, that is, the transitions must be either named STARs, or connected to instrument approach procedures. But occasionally a procedure will define an approach transition which is not a named STAR and which is not connected to an instrument approach procedure. When neither of the conditions is met, approach transitions of this type may not

be entered into the navigation data base. Certain approaches are also incompatible with system software, and may not be entered into the navigation data base. In most cases, these restrictions do not apply to publication of Jeppesen charts. All types of routes and approaches may be published on Jeppesen charts, but depending on the capabilities of the computerized navigation system, they may not appear in the system data base, and therefore you may not be able to call them up on your system display.

**SUMMARY**

Any or all of the above may cause slight differences between charts and information generated from the navigation data base. The Jeppesen NavData NOTAMs and Chart NOTAMs should be reviewed prior to using either Jeppesen service. As a final note, be sure to obtain a preflight briefing to ensure that you have knowledge of any last minute changes affecting your flight.

# Navdata Name Conventions: Waypoint Identifiers

Waypoint names entered into the navigation data base are limited to a maximum of five characters. Official waypoint names assigned by a country's aviation information authority often have other than five characters. For compatibility with the navigation data base, waypoint identifiers are assigned to all waypoints in accordance with the ground rules set forth as follows:

**A. VOR, VORDME, VORTAC, TACAN and Non-Directional Beacons (NDB).**

Waypoints located at any of the above types of facilities will take on the official 1-, 2-, 3-, or 4-character identifier of the facility in question.

Examples:
Los Angeles VORTAC LAX
Tyndall TACAN PAM

Ft. Nelson NDB YE
Newark NDB EWR

**B. NDB**

NDB as Waypoint Concept

For systems employing the "NDB as Waypoint" concept, waypoints located at NDB's will be identified by the use of the station identifier followed by the alpha characters "NB".

Examples:
Ft. Nelson NDB YENB
Newark NDB EWRNB

**C. Named RNAV Waypoints, Intersections and Reporting Points.**

In many countries, these waypoints are assigned unique 5-character names, with the identifier the same as the name. For waypoints not so named, identifiers are developed using the following rules sequentially until 5 or fewer character groups emerge.

**1. One-Word Names**

a. Use the full name if five characters or less are involved.

Examples:
ACRA, LOGAN, PIKE, DOT

b. Eliminate double letters.

Examples:
KIMMEL becomes KIMEL
COTTON becomes COTON
RABBITT becomes RABIT

c. Keep first letter, first vowel and last letter. Drop other vowels starting from right to left.

Examples:
ADOLPH becomes ADLPH

BAILEY becomes BAILY
BURWELL becomes BURWL

d. Drop consonants, starting from right to left.

Examples:
ANDREWS becomes ANDRS
BRIDGEPORT becomes BRIDT

**2. Multiple Word Names**

Use the first letter of the first word and abbreviate the last word using the above rules for one-word names to reduce it to four characters.

Examples:
CLEAR LAKE becomes CLAKE
ROUGH AND READY becomes RREDY

**3. Phonetic Letter Names.**

a. When an ICAO phonetic alpha character is used as a waypoint name (Alpha, Bravo, Charlie, etc.), use the rules established in paragraph C.1 above. When more than one waypoint in a country has the same phonetic name, obtain uniqueness by applying rule E below.

Examples:
Waypoint November becomes NOVMR
Waypoint Charlie becomes CHARE
Waypoint Alpha remains ALPHA

b. When a double phonetic, such as Tango India, is used as the waypoint name, use the rules established in paragraph C.2 above.

c. When a phonetic alpha character followed by a numeric and/or other alpha characters (A1, A1N, B2, etc.), is used as the waypoint name, it will appear the same in the data base as shown on aeronautical charts.

**D. Unnamed Waypoints**

**1. Unnamed Turn Points, Intersections and Bearing/ Distance Waypoints**

(For bearing/distance waypoints on terminal area procedures, see paragraph F.2)

a. If an unnamed turn point, intersection or bearing/ distance waypoint is collocated with a named waypoint or NAVAID station on a different route structure (e.g., low level or approach), the name or identifier of the collocated waypoint is used.

Example:

Unnamed turn point on J2 between Lake Charles (LCH) and New Orleans (MSY) VORTACs is coincidental with the Lafayette (LFT) low level VORTAC. LFT is used as the identifier code for the turn point.

b. Identifier codes for unnamed turn points, intersections or bearing/ distance way-points that are not coincidental with named waypoints should be constructed by taking the identifier code of the reference NAVAID for the turn point/ intersection/ (bearing/distance waypoint) (expected to be the nearest NAVAID serving the airway structure in which it is located) and the distance from this NAVAID to the turn point/intersection/(bearing/ distance waypoint). If the distance is 99 nautical miles or less, the NAVAID identifier is placed first, followed by the distance. If the distance is 100 nautical miles or more, the last two digits only are used and placed ahead of the NAVAID identifier.

Examples:

| NAVAID | DISTANCE | CODE |
|---|---|---|
| INW | 18 | INW18 |
| CSN | 106 | 06CSN |

**2. FIR, UIR and Controlled Airspace Reporting Positions**

In cases where the government authority does not provide unique 5-letter or less waypoint names, and in cases where the government supplied name cannot be converted to a unique 5-letter identifier using rules C.1,

C.2, and C.3, the following rules are applied in developing an identifier for such waypoints.

a. FIR - use the three characters "FIR" plus a numeric from 02 to 99. An identifier so developed is unique within the geographical area code.

Example: FIR09

b. UIR - use the three characters "UIR" plus a numeric from 02 to 99. An identifier so developed is unique within the geographical area code.

Example: UIR39

c. FIR/UIR - Use "FIR" and a numeric as indicated above.

Example: FIR69

d. Controlled Airspace - use the 3-letter characters for the type of controlled airspace plus a numeric from 02 to 99. These are Terminal Waypoints and as such are unique within the Terminal Area. Examples of controlled airspace types are:

TMA Terminal Control Area
CTA Control Area
CTR Control Zone
TIZ Traffic Information Zone
ATZ Aerodrome Traffic Zone

Examples:
CTR03
TIZ15

**3. Reporting Positions Defined by Coordinates**

Entry/Exit positions to Oceanic Control Areas are often defined by waypoints which are "undesignated," made available in source documentation as geographical coordinates (Latitude/ Longitude) expressed in full degrees. In cases where such positions are to be entered into the data base, the following rules are applied:

a. Positions in the northern hemisphere use the letters "N" and "E", the southern hemisphere use the letters "S" and "W" and numerics for latitude and longitude as follows:

(1) Latitude, use values provided by source. Latitude will always precede longitude.

(2) Longitude, use only the last two values of the three digit longitude value. Placement of the letter designator in the five character set indicates what the first digit is published as. The letter designator will be the last character if the longitude is less than 100 degrees and will be the third character if the longitude is 100 degrees or greater.

(3) The letter "N" is used for north latitude and west longitude. The letter "E" is used for north latitude and east longitude. The letter "S" is used for south latitude and east longitude. The letter "W" is used for south latitude and west longitude.

b. Examples:

N latitude/W longitude
N52 00/W075 00 = 5275N
N50 00/W040 00 = 5040N
N07 00/W008 00 = 0708N
N75 00/W170 00 = 75N70
N07 00/W120 00 = 07N20

N latitude/E longitude
N50 00/E020 00 = 5020E
N75 00/E050 00 = 7550E
N06 00/E008 00 = 0608E
N75 00/E150 00 = 75E50
N06 00/E110 00 = 06E10

S latitude/W longitude
S52 00/W075 00 = 5275W
S50 00/W040 00 = 5040W
S07 00/W008 00 = 0708W

S75 00/W170 00 = 75W70
S07 00/W120 00 = 07W20

S latitude/E longitude
S50 00/E020 00 = 5020S
S75 00/E050 00 = 7550S
S06 00/E008 00 = 0608S
S75 00/E150 00 = 75S50
S06 00/E110 00 = 06S10

**E. Duplicate Identifiers**

1. **Should application of these rules result in more than one waypoint having the same identifier, a new identifier is generated for each waypoint by developing a four (or less) character identifier and adding a suffix number or letter.**

   Examples:
   SHAWNEE (COLO) SHAE1
   SHAWNEE (CAL) SHAE2

2. **If the suffix number reaches 10, start over with one and place the suffix in the fourth- character position.** The original fourth character is placed in the fifth-character position.

   Example: SHAWNEE (OKLA) SHA1E

**F. Terminal Waypoints.**

The following rules are applied in developing identifiers for waypoints used solely in terminal area procedures. Such waypoint identifiers will be unique only for the airport specified. A way-point identifier used in a terminal area cannot be repeated in that terminal area but can be used in an enroute area encompassed by the same geographical area code. Terminal way-point identifiers can be repeated in areas covered by different geographical codes. These identifier developing rules are only applied when the waypoints in question have not been assigned official names/identifiers by the government authority.

1. **Airport-Related Waypoints** (Single Approach Procedure for given runway coded) Single Approach Procedure for given runway coded and Waypoints common to more than one approach: The following two-character codes are to be added to the runway identifier to create an airport-related waypoint identifier when no named waypoint has been established by the government source for the fix type:

   FF = Final Approach Fix
   AF = Initial Approach Fix
   IF = Intermediate Approach Fix
   CF = Final Approach Course Fix
   MA = Missed Approach Point Fix
   SD = Step-Down Fix

   Note: if multiple step-down fix waypoints need to be created, replace "D" with another character, retain the "S".

   RC = Runway Centerline Fix
   RW = Runway Fix
   *OM = Outer Marker Fix
   *MM = Middle Marker Fix
   *IM = Inner Marker Fix
   *BM = Backcourse Marker Fix
   TD = Touchdown point inboard of runway threshold

   *See also rule G

   Examples:
   FF36
   MA09L

2. **Airport-Related Waypoints** (Multiple Approach Procedure for given runway coded.)

   Multiple approach Procedures for a given runway coded for which common waypoints cannot be established: The following two-character codes are to be added to the runway identifier to create an airport-related waypoint identifier when no named waypoint has been established by the government source for the fix type:

Fx = Final Approach Fix, where "x" equals the Type of procedure in question

Ax = Initial Approach Fix, where "x" equals the Type of procedure in question

Ix = Intermediate Approach Fix, where "x" equals the Type of procedure in question

Cx = Final Approach Course Fix, where "x" equals the Type of procedure in question

Mx = Missed Approach Point Fix, where "x" equals the Type of procedure in question

Sx = Step-Down Fix Note: if multiple step-down fix waypoints need to be created, replace "D" with another character, retain the "S".

Rx = Runway Centerline Fix, where "x" equals the Type of procedure in question

Tx = Touchdown Fix inboard of runway threshold, where "x" equals the Type of procedure in question

These procedure type characters do not appear on the Jeppesen Approach Charts.

**3. Bearing/Distance Waypoints**

Identifiers are developed by the application of the following rules:

a. The first character is "D".

b. Characters 2 through 4 signify the VHF NAVAID radial on which the waypoint lies.

c. The last character is the DME arc radius defining the position of the waypoint on the radial. This radius is expressed as the equivalent letter of the alphabet, i.e.,A =1NM,G = 7NM, P = 16NM, etc.

Examples:
D185J
D250P

d. If distance is greater than 26NM, use the convention in paragraph D or E.

e. If the arc radius is provided in official government source as nautical miles and tenths of nautical miles, the letter of the alphabet will reflect values rounded to full nautical miles, i.e., 10.5nm = 11nm or K, 10.4nm = 10nm or J. All values between 0.1 and 1.4 will be character "A".

**G. Approach Marker Identification Priority Convention**

1. If the approach marker is named, use its name.

   Example: PIKKE OM Runway 26 will be PIKKE

2. If it is unnamed but an NDB, use the NDB ident followed by the letters NB.

   Example: Ft. Nelson LOM will be YENB

3. If it is unnamed and not an NDB, use letters OM followed by the runway number.

   Example:
   Outer Marker for Runway 26 becomes OM26

**BOTTOM LINE:**
**ALWAYS VERIFY NAVDATA APPROACH DETAILS WITH PRINTED INSTRUMENT APPROACH PROCEDURES, FLY THE SKYWAY, AND NEVER DESCEND BELOW THE MINIMUM DESCENT ALTITUDE OR DECISION HEIGHT UNLESS THE RUNWAY IS IN SIGHT.**

**REPORT ANY MAJOR NAVDATA INCONSISTENCIES TO CHELTON FLIGHT SYSTEMS IMMEDIATELY USING THE SERVICE DIFFICULTY REPORT IN THIS APPENDIX.**

# Data Logging and Retrieval

## Overview

Chelton Flight Systems EFIS log all data associated with a flight, including all flight instrument and navigation data. These data can be downloaded for review after a flight.

Data from the last 5 flights are logged at a one-second interval. There is no reasonable limit to the lengths of the flights. On system initialization, each log file is a comma delimited ASCII file. The file contains a date stamp and each line contains a time stamp (Zulu time).

To access the data, with the power off, connect a keyboard to the system, insert a data card, and power up the system. Follow the on-screen instructions for downloading the log files. These log files (*.dat) can be opened and manipulated (charting, graphing, etc.) in Microsoft Excel or other spreadsheet applications that support comma-delimited data format or using Chelton's FlightMetrics flight analysis software.

## Data Format

There are two lines per time stamp; the first line contains navigation and airdata parameters and the second line contains engine parameters. The parameters, listed in spreadsheet column order, are as follows:

Navigation/Airdata line:

1. Time Stamp
2. Aircraft Latitude in Degrees
3. Aircraft Longitude in Degrees
4. Aircraft Altitude in Feet
5. Aircraft Pitch in Degrees
6. Aircraft Bank in Degrees
7. Aircraft Heading in Degrees True
8. Aircraft Track in Degrees True

9. Aircraft Indicated Airspeed in Knots
10. Aircraft True Airspeed in Knots
11. Aircraft Groundspeed in Knots
12. Aircraft VSI in Feet per Minute
13. Aircraft Glide path in Degrees
14. Aircraft Computed AOA in Degrees
15. Aircraft G-force
16. Computed Wind Speed in Knots
17. Computed Wind Direction in Degrees True
18. Outside Air Temperature in Degrees Fahrenheit
19. Density Altitude in Feet

# Service Difficulty Report

**Photocopy, complete, then fax to 208-389-9961.**

| | |
|---|---|
| Name: | Phone: |
| Flight No. | Date: |
| Aircraft: | N#: |
| Software Version: | Error Code: |
| Route: | Duration of flight: |
| Conditions: | |
| Remarks: (Include time, altimeter setting, OAT, ALT, IAS, TAS, GS, heading, track, position, flight segment, pilot action, system response, is problem repeatable.) | |

# Warranty

Chelton Flight Systems, Inc. warrants this instrument and system components to be free from defects in materials and workmanship for a period of one year from the user invoice date. Chelton Flight Systems, Inc. will repair or replace any item under the terms of this Warranty provided the item is return to the factory prepaid.

1. This Warranty shall not apply to any product that has been repaired or altered by any person other than Chelton Flight Systems, Inc., or that has been subjected to misuse, accident, incorrect wiring, negligence, improper or unprofessional assembly or improper installation by any person. This warranty does not cover any reimbursement for any person's time for installation, removal, assembly, or repair. Chelton Flight Systems, Inc. retains the right to determine the reason or cause for warranty repair.
2. This warranty does not extend to any machine, vehicle, boat, aircraft or any other device to which the Chelton Flight Systems, Inc. product may be connected, attached, interconnected or used in conjunction with in any way.
3. The Obligation assumed by Chelton Flight Systems, Inc. under this warranty is limited to repair, replacement or refund of the product, at the sole discretion of Chelton Flight Systems, Inc..
4. Chelton Flight Systems, Inc. is not responsible for shipping charges or damages incurred under this Warranty.
5. No representative is authorized to assume any other liability for Chelton Flight Systems, Inc. in connection with the sale of Chelton Flight Systems, Inc. products.
6. Installation times may be affected by the installer's experience, the type of aircraft, engine type and many other factors. Chelton Flight Systems, Inc., at the request of a customer, dealer or installer, may elect to modify any

instrument, component(s) or feature(s) for a specific situation which may also affect installation time. In no event is Chelton Flight Systems, Inc. responsible for installation, troubleshooting, research or development or any other costs incurred by the customer, dealer installer, repair person, mechanic, technician, etc.

7. If you do no agree to and accept the terms of this warranty, you may return the product in new condition, with receipt, within thirty (30) days for a refund.

This warranty is made only to the original user.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES OR OBLIGATIONS: EXPRESS OR IMPLIED. MANUFACTURER EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. PURCHASER AGREES THAT IN NO EVENT SHALL MANUFACTURER BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS OR LOSS OF USE OR OTHER ECONOMIC LOSS. EXCEPT AS EXPRESSLY PROVIDED HEREIN, MANUFACTURER DISCLAIMS ALL OTHER LIABILITY TO PURCHASER OR ANY OTHER PERSON IN CONNECTION WITH THE USE OR PERFORMANCE OR MANUFACTURER'S PRODUCTS, INCLUDING SPECIFICALLY LIABILITY IN TORT.

# NOTES

# NOTES

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# Quick Reference

## PFD Symbology

| | |
|---|---|
| | Heading |
| | Bearing to Waypoint |
| | Groundtrack |
| | Heading Bug |
| | Direction to Waypoint |
| | Flight Path Marker |
| | Pitch Limit Indicator |
| | Waypoint Symbol |
| | Waterline (Nose Position) |

## Moving Map Symbology

| | |
|---|---|
| | VOR |
| | IFR Airport |
| | VFR Airport |
| | NDB |
| | Intersection |
| | User Waypoint |
| | Active Fly-Through Waypoint |
| | Other Fly-Through Waypoint |
| | Active Fly-By Waypoint |
| | Other Fly-By Waypoint |

## Airspace Symbology

| | |
|---|---|
| | Airspace more than 500' from current altitude |
| | Airspace within 500' of current altitude |
| | Airspace at current altitude |