Synthetic Vision EFIS

CHELTON
FLIGHT SYSTEMS

FLIGHTLOGIC

Pilot's Guide

FlightLogic

EFIS-SV

Synthetic Vision Flight Display

Pilot's Operating Guide and Reference

Document 150-045240, Rev B.

EFIS Software Version F Only

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1109 Main St., Suite 560, Boise, ID 83702 • Phone: (208) 389-9959 • Fax: (208) 389-9961

www.cheltonflightsystems.com

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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 **software version 4.0C** 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 what I have to say."

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 software screens consist of:
a primary flight display (PFD)
a navigation display (ND)

The panel-mounted hardware consists of one Primary Flight Display (that only shows the PFD screen) and one or more multifunction displays (MFD). The MFD can be configured by the pilot as a reversionary PFD or 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

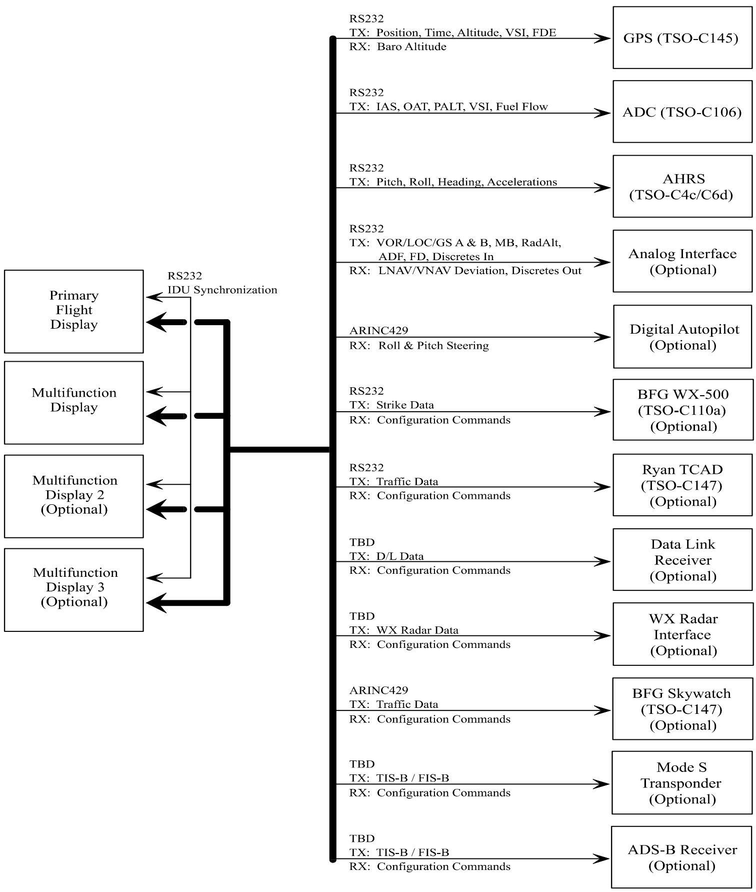
The displays are comprised of a high-brightness backlit LCD screen, eight buttons, two control knobs, and an optional slip indicator. The buttons and slip indicator are also backlit and their brightness can be adjusted independently of the screen.

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 PFD, 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 this case, the system will continue to operate even if it is accidentally turned off by the pilot in flight.

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
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
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 Instrument 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

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

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 descent 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 high/low alert tone.

Annunciations are grouped into three categories: warning, caution, and advisory. Warnings are accompanied by a red flag and repeat until acknowledged by the pilot or the condition is corrected. Cautions are accompanied by an amber flag and are only annunciated once. Advisories are accompanied by a green flag or no flag, depending on condition, and are indicated by either a voice annunciation or alert tone.

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

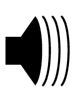
The CWA flags in the following list are prioritized top to bottom according to severity and only the most critical one is invoked.

(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 G-compensated V_{S1}+5kts. and aircraft is above 100' AGL (not enabled if aircraft has factory stall warning)	Warning	"Stall"	STALL
Airspeed above VNE/VMO/MMO	Warning	"Overspeed"	OVERSPEED
Aircraft below selected minimum altitude	Caution	"Altitude"	ALTITUDE
TAWS forward-looking terrain caution	Caution	"Caution, Terrain."	TERRAIN

Condition	Category	Annunciation	Flag
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 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 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	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	Alert tone	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 (##:## is the time since loss)	**Caution**	**"GPS failure"**	**NO GPS ##:##**
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**	**Alert tone**	**ADC INIT**
Automatic waypoint sequencing suspended	**Advisory**	**Alert tone**	**SUSPEND**
GPS/WAAS Parallel offset track selected (## is nautical miles left or right)	**Advisory**	**Alert tone**	**PTK = L(R) ##NM**
IFR approach enabled & within 30 NM of runway	**Advisory**	**Alert tone**	**IFR APPR**
GPS/WAAS in VFR approach mode	**Advisory**	**Alert tone**	**VFR APPR**
GPS/WAAS in terminal mode	**Advisory**	**Alert tone**	**TERMINAL**
GPS/WAAS vectors to final IFR approach mode	**Advisory**	**Alert tone**	**VTF IFR APPR**
WX-500 in self-test	**Advisory**	**Alert tone**	**WX-500 TEST**



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.

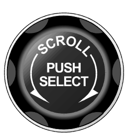
The brightness knob turns clockwise to increase screen brightness and counterclockwise to decrease screen brightness. Pushing the brightness knob while turning adjusts the button and slip indicator brightness in the same manner.

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.

Likewise, turning the control knob on the MFD when there are no menus shown sets the scale of the map. 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 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.

A master dimming circuit is provided to allow dimming of the displays in concert with existing instrument panel lighting.

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 slot in the bezel immediately below the slip indicator 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.

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).

To update the system:

1. 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.
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 DATABASE option 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 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 a 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 AHRS notifies the EFIS through the data bus when the initialization and self-test routine has been completed successfully.

Air Data Computer (ADC)

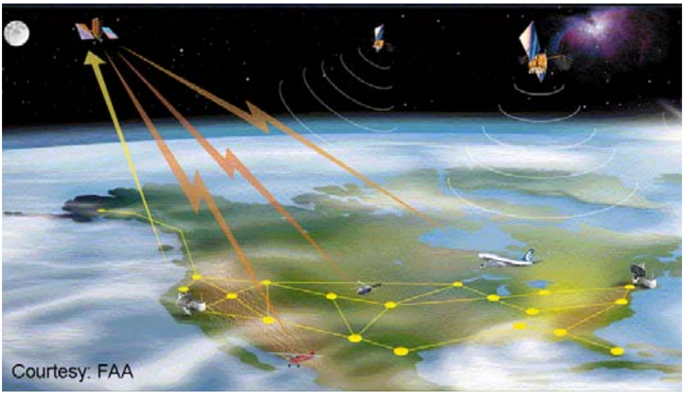
The Airdata Computer is connected to the aircraft pitot, static ports, OAT probe, and fuel system to measure indicated airspeed, pressure altitude, outside air temperature, and fuel flow. From these raw data, TAS, true air temperature and outside air temperature are calculated for display on the system.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

GPS 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.



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 will improve basic GPS accuracy to approximately 7 meters vertically and horizontally and provide 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.

WAAS functions include FDE (Fault Detection/Exclusion) and automatic predictive RAIM (Remote Autonomous Integrity Monitoring).

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 Faults Function, page 20 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").

Component Failure Modes

Chelton Flight Systems EFIS acquire data through a variety of sensors. The EFIS monitors each sensor using two methods:

1. Validating data integrity
2. Timing to ensure that each sensor is on line and communicating.

The fundamental requirement for a sensor to be considered in normal condition is the receipt of a valid data string within the previous 2 seconds. If this requirement is not satisfied, then the associated sensor is considered to be in a failed condition.

Failure of a weather receiver, datalink receiver, TCAS/TCAD receiver, or autopilot interface 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 EAU, 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 in the Display Symbology section, page 98.

Section 3

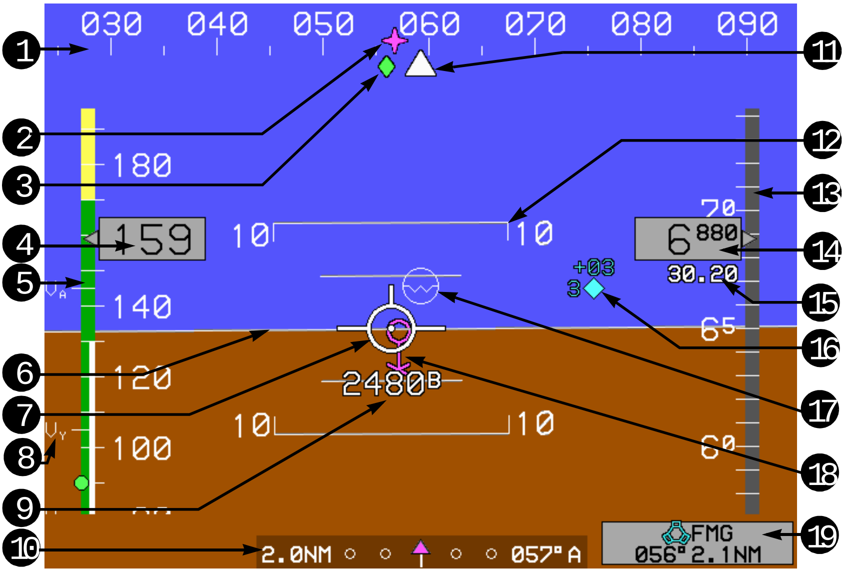
Display Symbology

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.

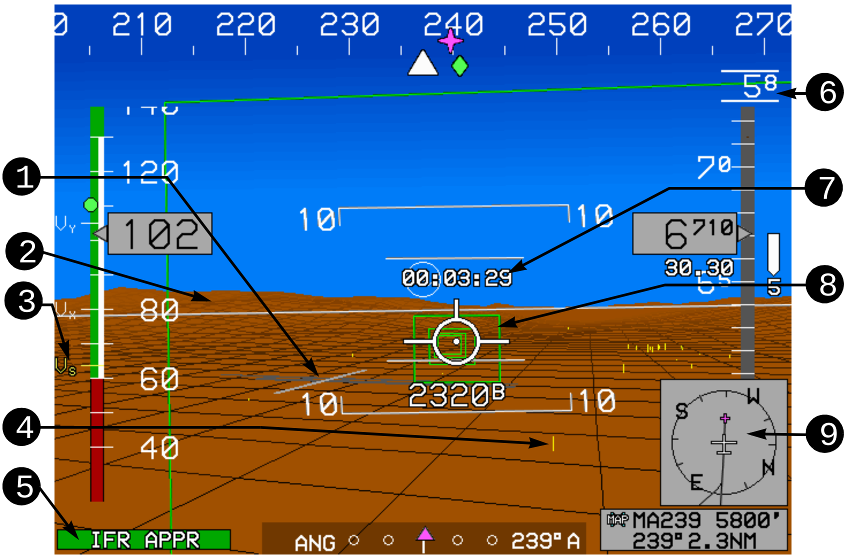
Basic PFD



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. Course deviation indicator
11. Heading indicator
12. Pitch scale
13. Altitude tape
14. Altitude readout
15. Altimeter setting
16. Traffic
17. Waterline
18. Waypoint symbol
19. Waypoint information

Not shown: G-force indicator

PFD on Approach (Terrain On)

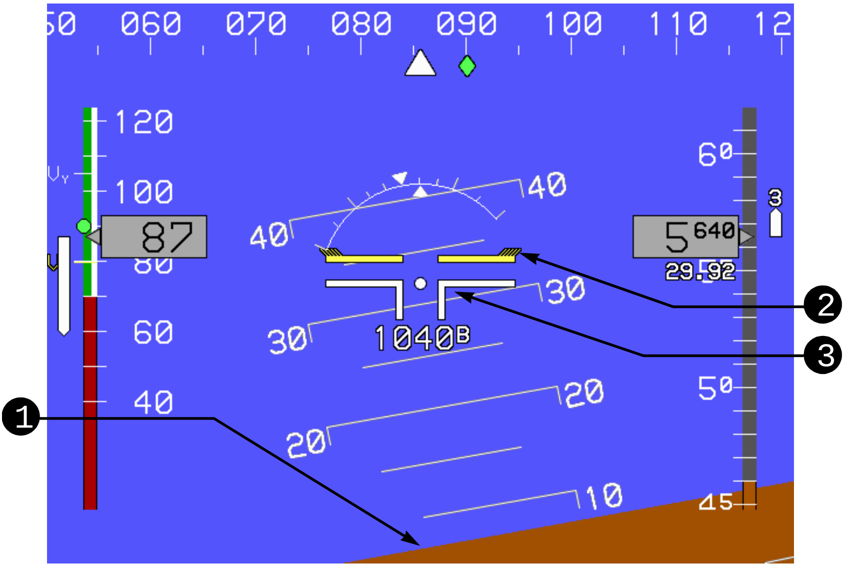


1. Conformal Runways
2. Terrain
3. Dynamic stall speed
4. Obstruction
5. CWA flags
6. Target altitude
7. Timer
8. Skyway
9. MiniMap

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. Waterline
13. Minimum altitude bug

Unusual Attitude Recovery Mode

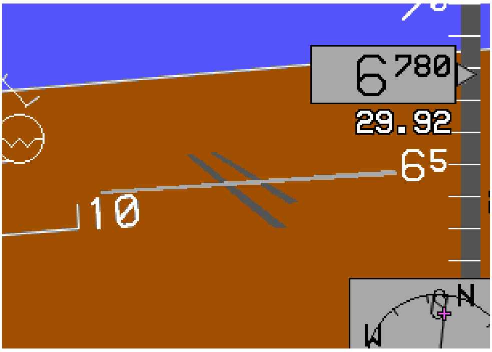


1. Horizon Cue
2. Pitch limit indicator
3. Expanded waterline

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.

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 (if this is done before takeoff, the runways at the departure airport will be removed). 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.



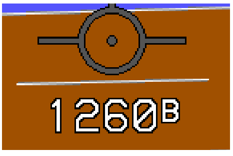
Altitude Above Ground (AGL)

The estimated altitude above ground level is displayed directly below the flight path marker 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.

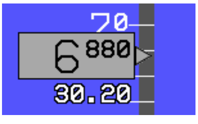
AGL altitude is not displayed when it is greater than 2,500' and is not displayed when it is invalid.

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

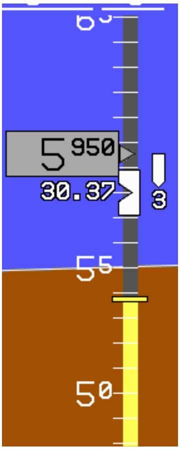
The altitude readout, located approximately two-thirds of the way up the altitude tape, digitally shows barometric altitude in feet MSL. Altitude is displayed in ten-foot increments.



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

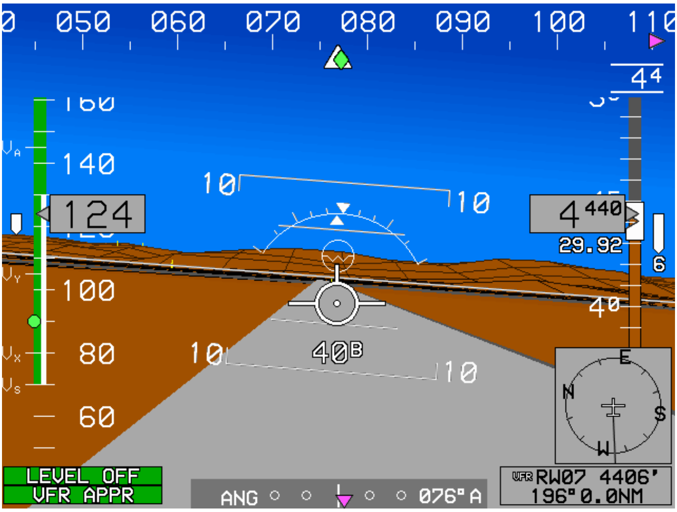
Bearing to waypoint is shown as a magenta star (waypoint symbol) on the directional scale located directly above the active waypoint.

If the symbol is displaced beyond the range of the heading scale, a magenta pointer on the directional scale indicates the direction of displacement.

Conformal Runway

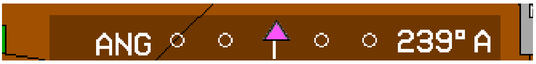
Runways are displayed conformally – correct location, scale, and perspective with respect to the aircraft's position, heading, and altitude. Runways at the departure airport are shown automatically. When an IFR approach or STAR is selected, all runways at the destination airport are displayed for added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



Course Deviation Indicator

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.



The CDI scale is adjusted according to phase of flight:
Enroute (more than 30 NM from destination) – 5 NM scale
Terminal (within 30 NM of destination) – 1 NM scale
Approach (within 2 NM of final approach fix) – 0.3 NM 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.

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.

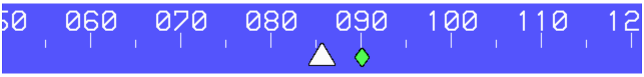
Flags are stacked with warnings on top, followed by cautions, and then advisories. For a complete list of flags and annunciations, as well as order of prioritization, see Caution/Warning/Advisory System, page 11 in the System Overview section.

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), 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 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.

Quite simply, the flight path marker is where the aircraft is going, regardless of where the aircraft is pointed.

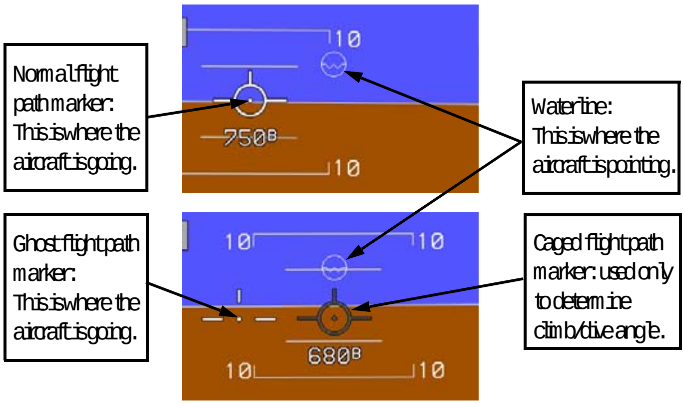
If the flight path marker is superimposed on terrain or an obstruction, the aircraft's current path through the air will result in a collision with that object. Likewise, if the flight path marker is well above terrain in climb, the aircraft will clear the terrain. Placing the flight path marker on a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

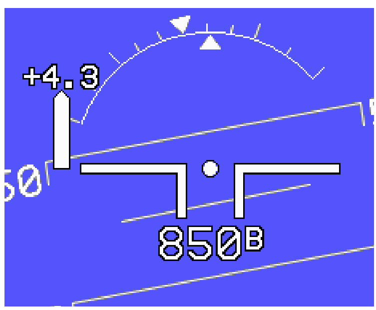
If you want to hit the mountain, put the flight path marker on the mountain. If you want to miss the mountain, put it somewhere else. If the flight path marker cages, ignore the grayed out symbol and continue flying with the ghost."

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 dampened damped based upon magnitude and time to prevent nuisance appearances.



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.

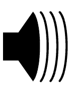
If the ground track is beyond the limits of the directional scale, it will be displayed at the limit of the scale and highlighted in amber. This situation would be unusual as it would indicate a crab angle greater than 35°.

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°.

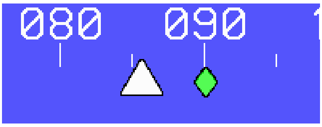


AUDIBLE ANNUNCIATION
When the heading bug has been set and captured, a deviation more than 10° from the heading bug will result in an amber caution flag and an auditory warble.
HEADING

NOTE
If coupled with an autopilot, 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).



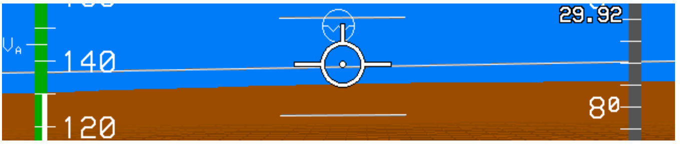
In this example, heading 086°.

Horizon

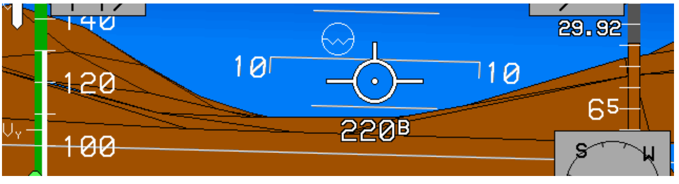
The horizon extends the entire width of the display for enhanced attitude awareness and moves in conjunction with the earth's horizon according to aircraft roll and pitch. There are two components of the horizon symbology, the **artificial horizon** and the **actual horizon**.

The artificial horizon is a thin 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.



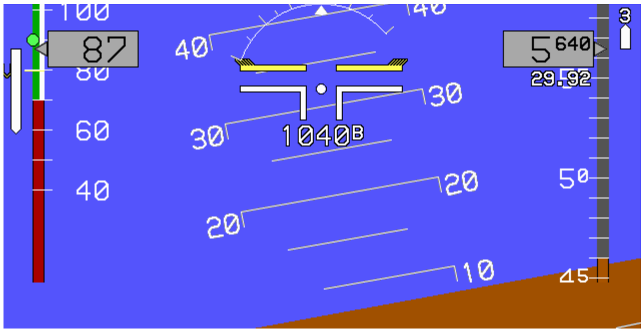
This example shows the artificial horizon and actual horizon over relatively featureless terrain.



This example shows the artificial horizon and actual horizon near ground level in mountainous terrain. Note that the 8° climb will clear terrain but level flight would not.

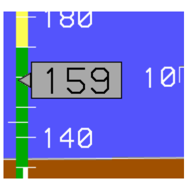
Horizon Cue

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.



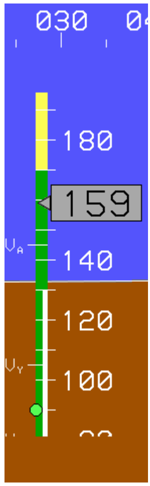
Indicated Airspeed Readout

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



Indicated Airspeed Tape

Indicated airspeed is also displayed in an analog format using an airspeed tape. The airspeed tape has graduations every 10 knots with labels every 20 knots and high numbers are at the at top.



The airspeed tape is colored as follows:

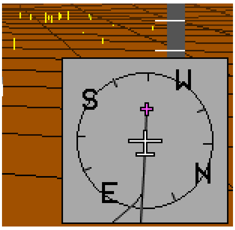
1. A red low-speed awareness area from 0 to V_{S0}
2. A white area from V_{S0} to V_{FE}
3. For aircraft without a V_{MO}/M_{MO}, a green area from V_{S1} to No
4. For aircraft without a V_{MO}/M_{MO}, a yellow area from V_{NO} to V_{NE}
5. For aircraft without a V_{MO}/M_{MO}, a red high-speed awareness 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.

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.

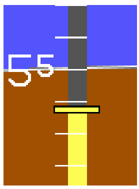
The MiniMap's compass rose has graduations at 30° increments and labels for north, south, east, and west. The active waypoint is shown as a magenta "+" symbol. The line through the waypoint symbol represents the selected course leg. If an instrument approach is selected, the MiniMap displays the entire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

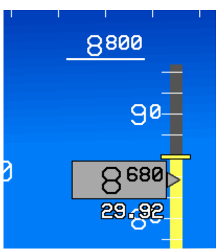
Minimum Altitude Bug

When a minimum altitude is selected, a bug in the form of a bold amber tick mark 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.

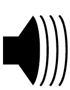


Minimum Altitude Setting

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 continuous annunciation of "Altitude"

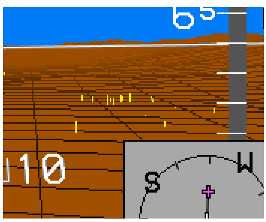
ALTITUDE

Obstructions

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

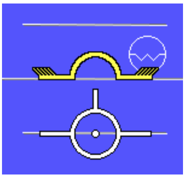
Obstructions are conformal in both location and size (a tower shown 10° left of heading and below the horizon line on the screen will be seen outside 10° left of the aircraft's nose and below the current altitude).

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

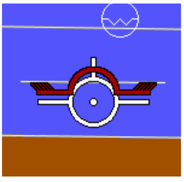


Pitch Limit Indicator

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 $\mathbf{V_S}$ (clean stall, gross weight) and is G-load compensated.

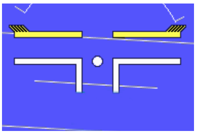


The PLI first appears in amber at 20 knots above G-corrected V_S and moves downward as airspeed decreases.

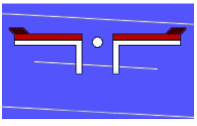


The PLI turns red at 5 knots above G-corrected V_S and activates the STALL voice warning if enabled.

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.

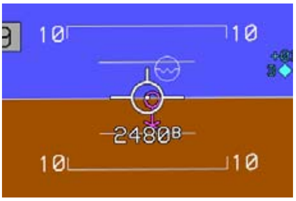


Unusual attitude PLI turns red 5 knots above G-corrected $V_S$and activates the STALL voice warning if enabled.

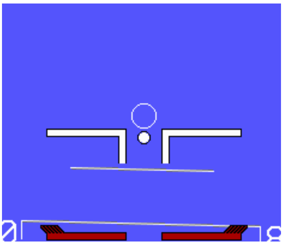
"To use the pitch limit indicator:
Think of it as a low-speed awareness cue; don't let it settle on the flight path marker or attitude bars and you won't stall the aircraft. But remember, since it is based on the clean stall configuration, it is not a stall warning and will turn yellow or red during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

Pitch Scale

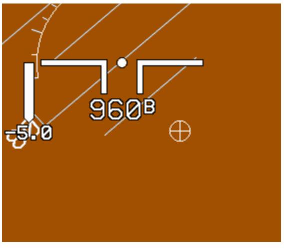
The pitch scale rotates in conjunction with the horizon according to the aircraft's roll angle. The graduations on the pitch scale are spaced to conform with the background.



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

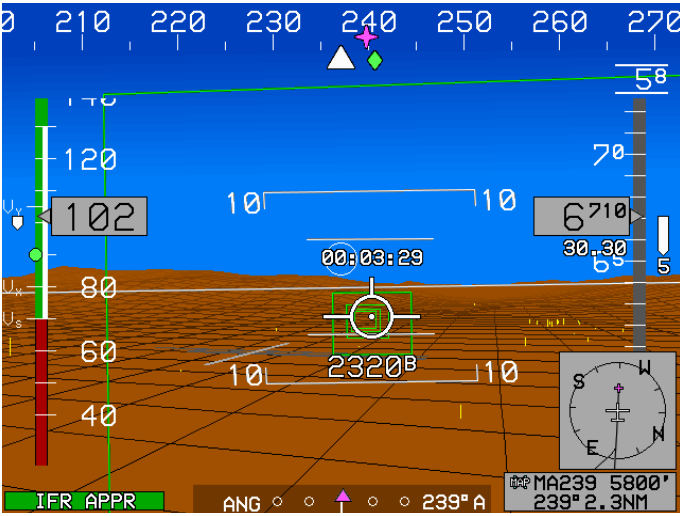
The PFD displays the active navigation route or manual OBS course in a three-dimensional manner using a series of skyway boxes (commonly referred to as HITS or Highway-In-The-Sky. The skyway boxes overlay the flight plan route at a desired altitude providing lateral and vertical guidance.

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.

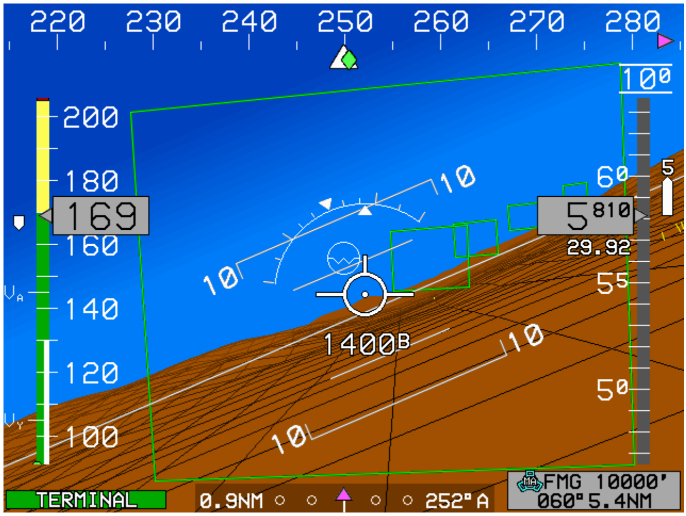
The skyway boxes are drawn using a hidden surface removal techniques such that a skyway box behind terrain will appear to be so. The skyway boxes may be removed from the screen using the Declutter menu.



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 20° 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.

When an instrument approach procedure (procedure turn, holding pattern, etc.,) or DP is selected, the skyway's turn radius is based on a 20° zero-wind bank angle at the aircraft's V_{PROC} or preprogrammed approach 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)

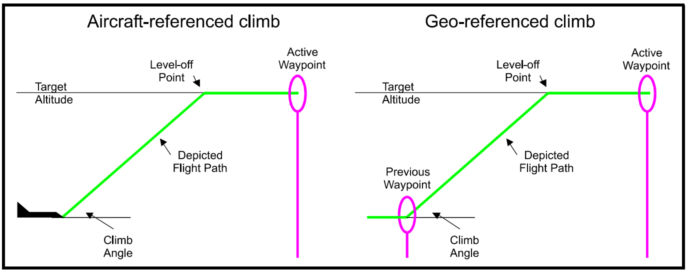
Skyway altitude is controlled by target altitude, aircraft altitude, and climb/descent angle setting. If no target altitude is set, then the skyway boxes are shown at aircraft's current altitude.

When a target altitude is entered by the pilot (using the BUGS menu), or automatically from the approach database, skyway boxes are centered on the desired altitude.

Climb and descent angles (VNAV) for enroute and approach procedures are entered manually by the pilot (using the BUGS menu) until inside the final approach fix, at which point the descent angle is generated from the navigation database.

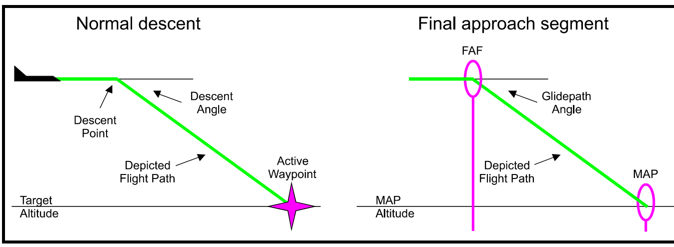
When the active waypoint is part of a procedure, the system expects the altitude constraint for that waypoint to be provided by the navigation database. Where a procedure altitude constraint exists, the system automatically updates the target altitude to match the altitude constraint. Where a procedure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

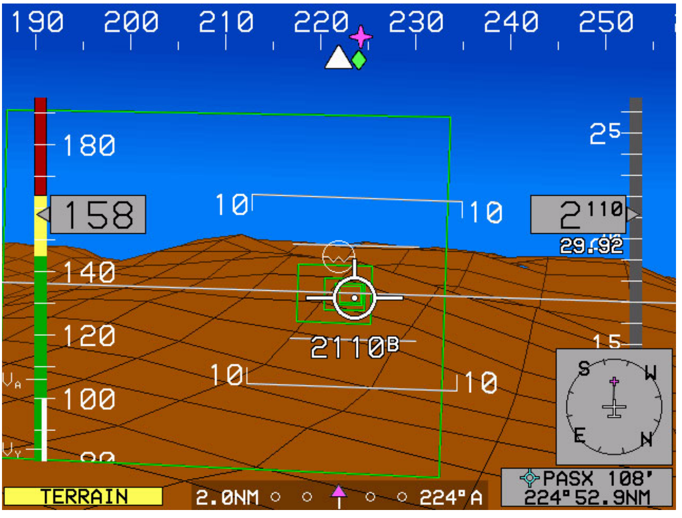
If the aircraft descends to the lower target altitude before the descent point, the skyway will recenter on the new altitude once it is reached.

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°.

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. It is possible, using the Direct-To function for example, to generate a skyway 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:

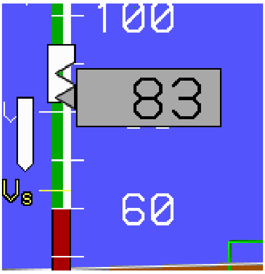
1. *Whether you are turning or flying straight and level, make small corrections, like you are flying an ILS. If you see the bank angle scale come on, you are using too much bank.*
2. *When flying straight and level, don’t try to steer through the nearest box. Aim for the smallest box you can see.*
3. *When turning, if you find yourself turning inside or outside the turn radius indicated by the skyway, relax and simply increase or 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 runway threshold making it is very precise, so if you are a bit inside or outside, you are still flying with extreme precision.*
4. *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.*
5. *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.

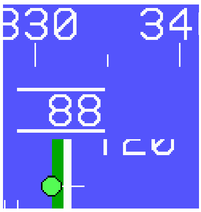
The pointer tells the pilot what the aircraft’s velocity will be in five seconds.



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

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.



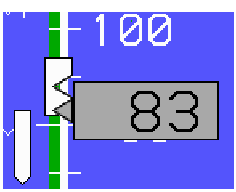
In this example, the target airspeed is set to 88 kts.

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 an annunciation warble

AIRSPEED

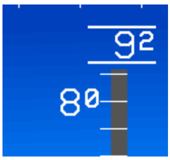
Target Airspeed Bug

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.

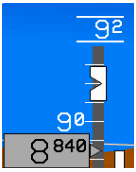
AUDIBLE ANNUNCIATION
When a target altitude is set and has been reached, deviation of more than 150 feet will result in a single annunciation of "Altitude. Altitude."

ALTITUDE

NOTE
If coupled with an autopilot, the EFIS will command the autopilot to climb or descend according to the skyway's VNAV guidance to and maintain the target altitude. If you want the autopilot to descend before the skyway does, use the autopilot's manual descent mode.

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 fixes during procedures.



Terrain

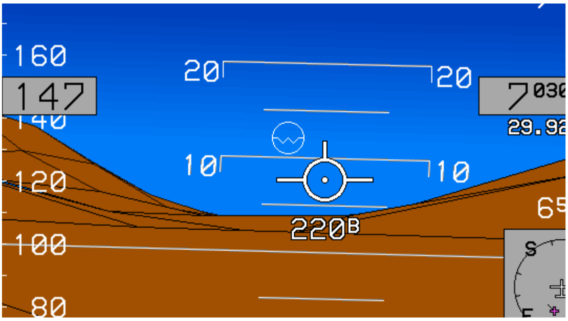
The terrain ahead of the aircraft is shown conformally with the artificial horizon and in the correct scale and perspective for the aircraft's current position and altitude.

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 40 NM 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 waypoint is within 14 miles and the 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 at current climb angle.

Terrain display is dependent on GPS altitude, if a suitable figure is available, otherwise, barometric pressure 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.

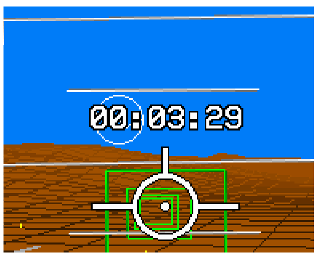
The FlightLogic EFIS includes integral Class C TAWS (Terrain Awareness Warning System) and, optionally, may include Class B or Class A TAWS. For a detailed description of TAWS functions, refer to the TAWS section in the appendix.

"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.*
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 do.*
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

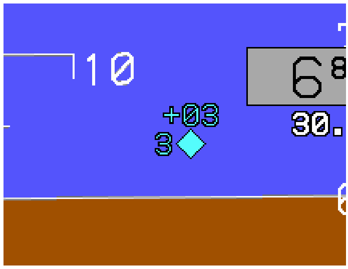
A timer showing **hours:minutes:seconds** is displayed at the pilot's option, immediately above the flight path marker. Timer can be set to count up indefinitely or count down from a pilot-specified value. Elapsed time since power-up can also be shown without affecting an active timer. When selected,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



AUDIBLE ANNUNCIATION
A warble tone annunciates the expiration of a count-down timer.

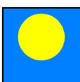
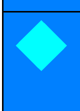
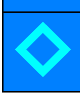
Traffic

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 6 NM and 1,200 ft. of ownship altitude.**
	**Other Traffic -** **Traffic detected beyond 6 NM 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

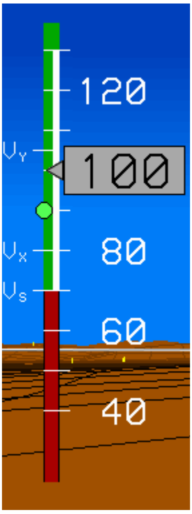
Traffic alerts will result in an amber flag and a single voice warning.

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 22, 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 14, for more information.

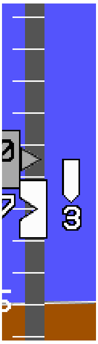


VSI

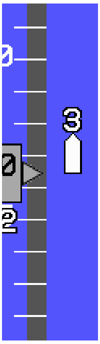
The vertical speed indicator is presented as a dynamic pointer that grows out of a fixed datum in correspondence with the vertical velocity.

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.

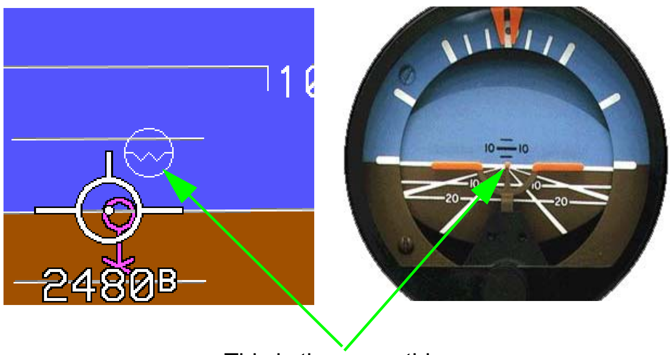


VSI showing a 300 ft./min. climb.

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

Waterline

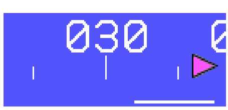
Fixed in the center of the primary flight display, so as to align with the longitudinal axis of the aircraft, is a waterline symbol (a **"W"** in a circle). Rotation of the horizon and pitch scale occurs relative to the waterline symbol, indicating aircraft attitude. The waterline is analogous to the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



This is the same thing

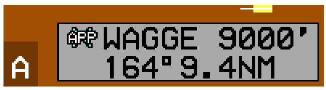
Waypoint Direction Pointer

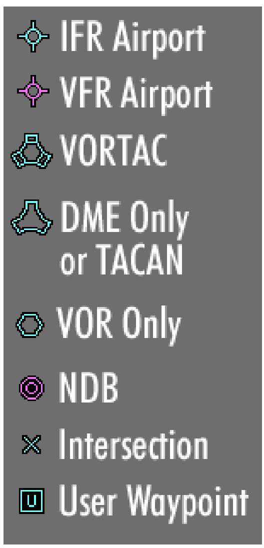
When the waypoint symbol is beyond the range of the directional scale, a magenta pointer indicates the shortest direction of turn to the active waypoint.



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.





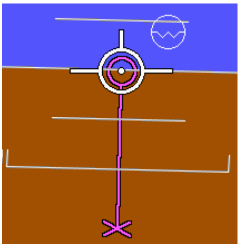
Navigation waypoint symbol conventions

NOTE

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

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 31, 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 this 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 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 shall [SYS_GPS_004] 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 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.

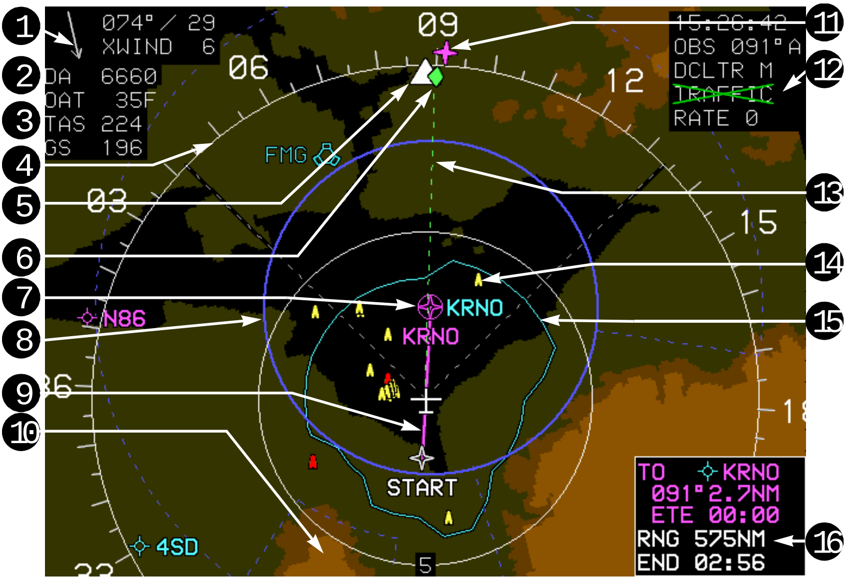
AUDIBLE ANNUNCIATION
Suspension of automatic waypoint sequencing is annunciated by an auditory warble and an advisory SUSPEND flag.

SUSPEND

Navigation Display Symbology

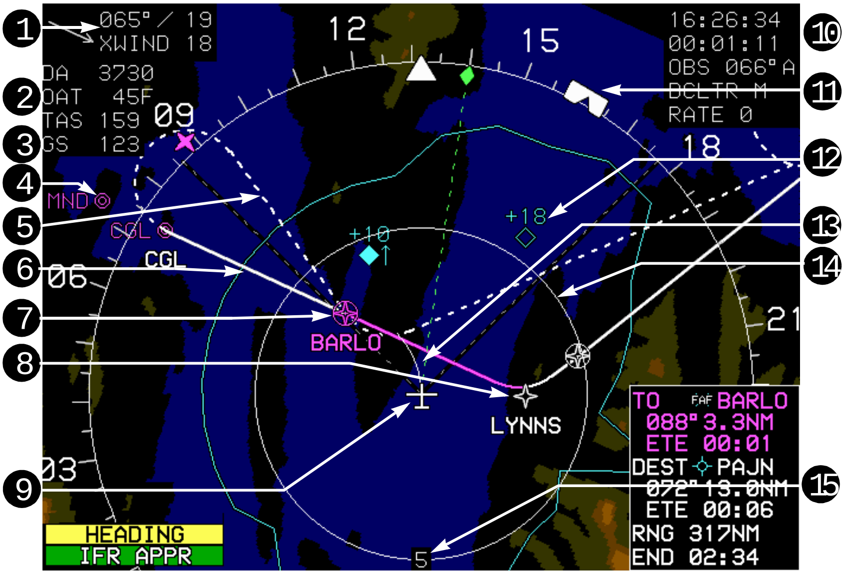
The navigation display can be presented in a variety of formats including moving map (arc or centered) in heading-up or north-up orientation, conventional HSI, dedicated traffic display, or dedicated weather display. The moving map is vector-based and uses Jeppesen NavData and other databases to display 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



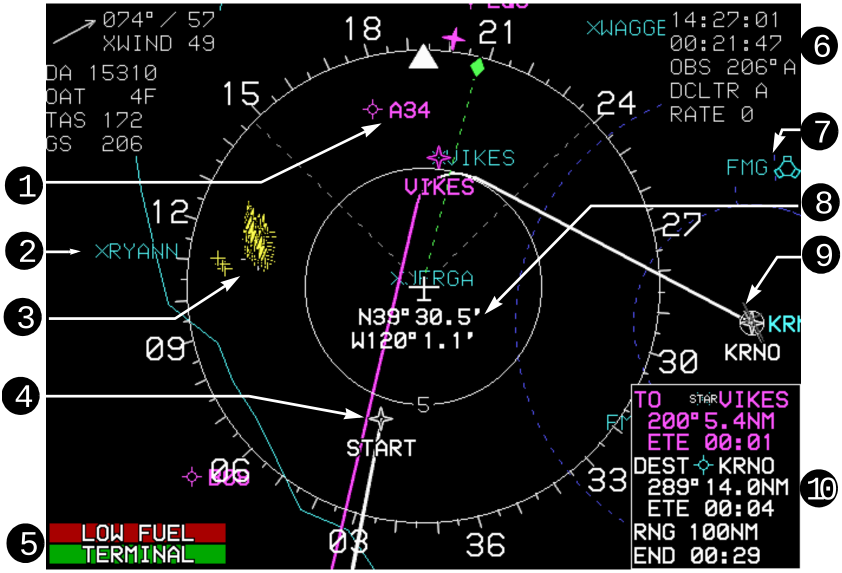
1. Wind vector
2. Density altitude
3. True airspeed
4. Directional scale
5. Heading indicator
6. Ground track
7. Waypoint
8. Airspace
9. Courseline
10. Terrain
11. Bearing to waypoint
12. Mode annunciators
13. Ground track lubber line
14. Obstruction
15. Dead-stick glide area
16. Fuel totalizer

Moving Map with Instrument Approach



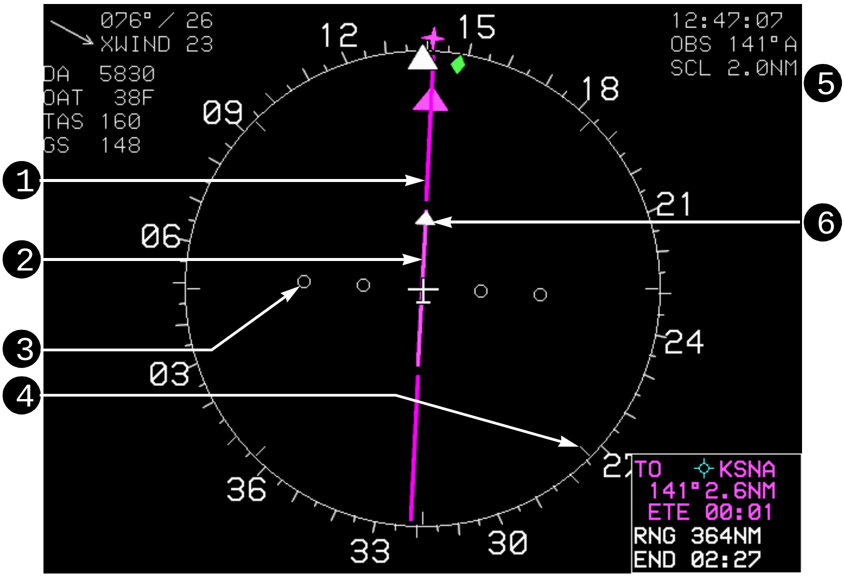
1. Wind data
2. Outside air temperature
3. Groundspeed
4. NDB
5. Missed approach course
6. Instrument approach course
7. Waypoint (fly-through)
8. Waypoint (fly-by)
9. Aircraft position
10. Zulu clock and timer
11. Heading bug
12. Traffic
13. Projected path
14. Range ring
15. Range ring scale

Moving Map with STAR



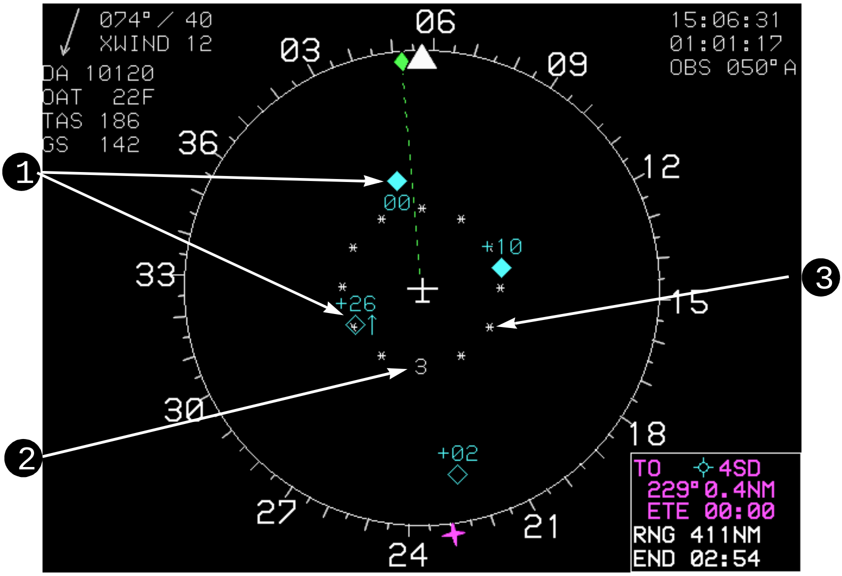
1. VFR Airport
2. Intersection
3. Lightning strikes
4. Start Waypoint
5. CWA flags
6. Timer
7. VORTAC
8. Latitude longitude
9. Airport runway diagram
10. Navigation log

Conventional HSI Format



1. Courseline arrow
2. CDI needle
3. Displacement marks
4. 45° marks
5. CDI scale and OBS setting
6. To-From indicator

Traffic Display

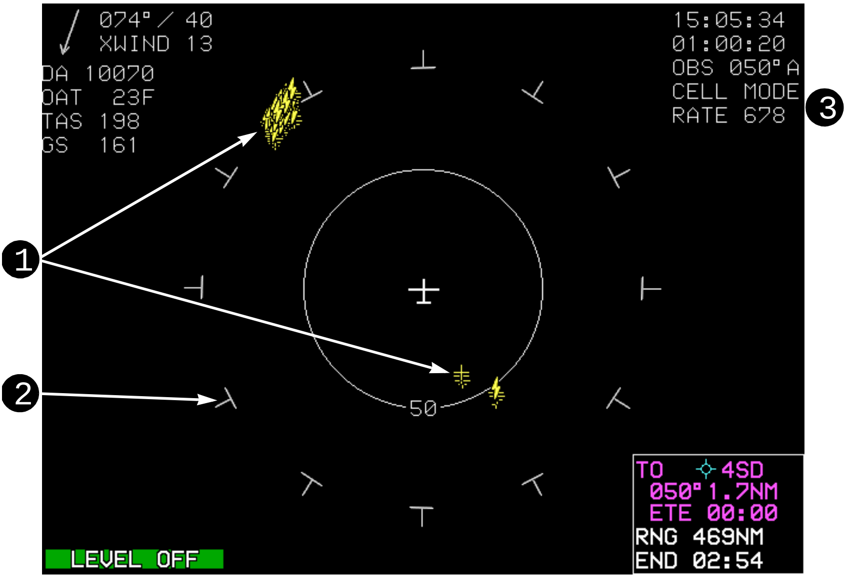


1. Traffic
2. Traffic position reference
3. Traffic position scale

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

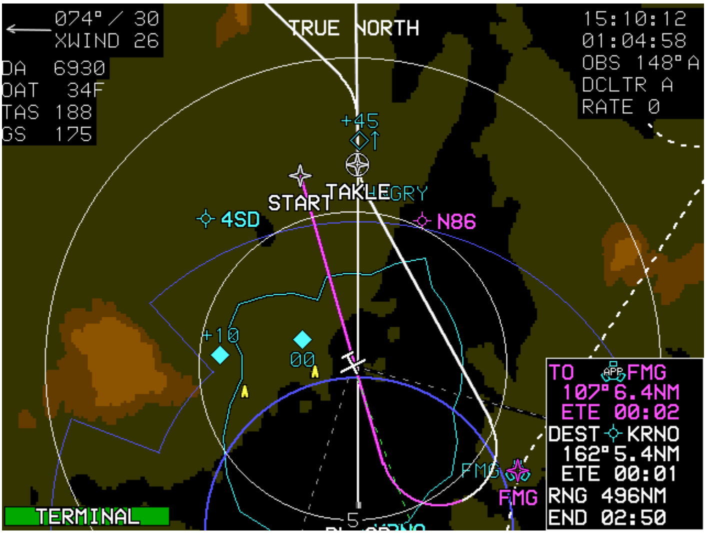


1. Lightning strikes
2. Strike position reference
3. Mode and rate indicators

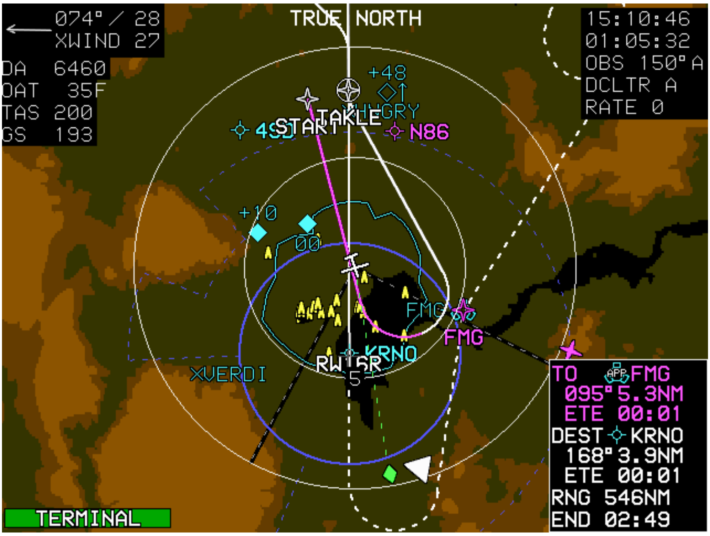
The route and waypoints may be overlaid on this display at the pilot's discretion.

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

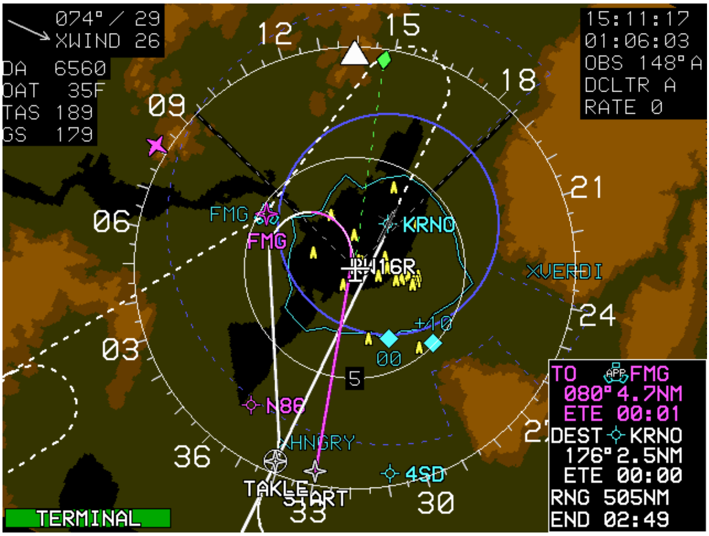
North-Up Arc Mode



North-Up Centered Mode

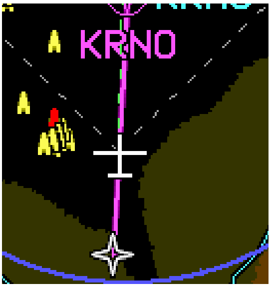


Heading-Up Centered Mode



Aircraft Position

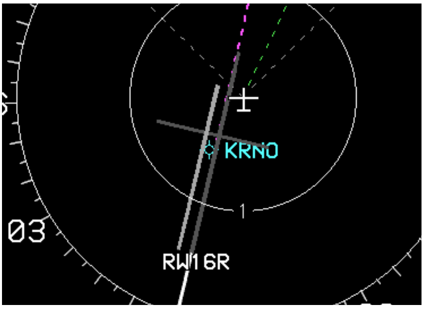
The aircraft symbol indicates ownship position relative to the map elements. The aircraft is always located at the center of the concentric range rings.



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.

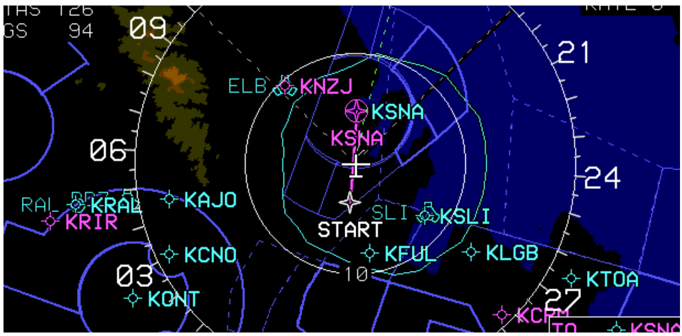
Airport Runway Diagram

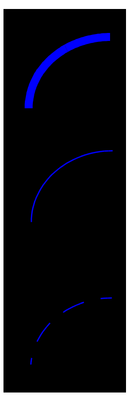
On system power up, all runways at the current airport are shown for enhanced situational awareness and to minimize runway incursion. When an instrument approach is selected, all runways at the destination airport are shown in correct scale with the usable portion of the selected landing runway displayed 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 CDI needle moves laterally over CDI displacement marks.

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

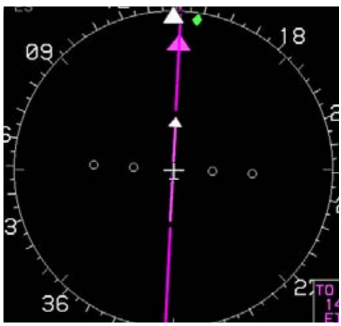
Enroute (more than 30 NM from destination) – 5 NM
Terminal (within 30 NM of destination) – 1 NM
Approach (within 2 NM of final approach fix) – 0.3 NM

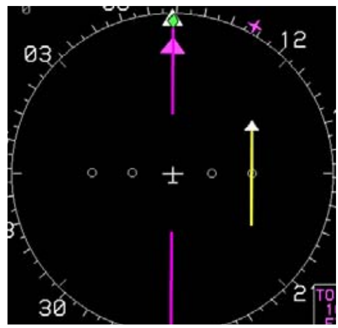
CDI Scale is measured from the center line to the second displacement mark.

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 or an “**M**” for manual.

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.

Courseline

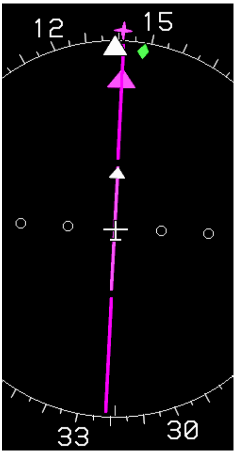
The courseline connects the waypoints of the route for both flight plans and direct navigation and is only shown when a flight plan or waypoint is activated.

The courseline is shown in white except for the active leg, which is shown in magenta. The most logical leg 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."

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).



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. For more information, see Section 2, System Overview.

AUDIBLE ANNUNCIATION
CWA flags are accompanied by an auditory annunciation.

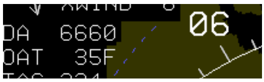
Dead-Stick Glide Area

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)

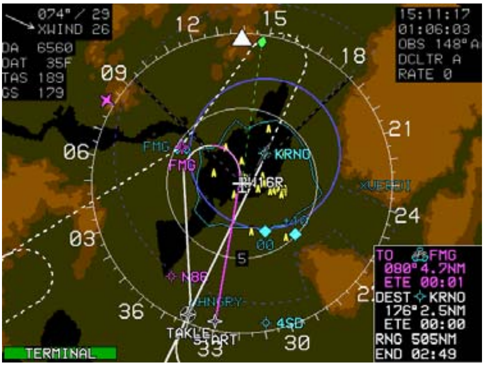


Density altitude is shown in amber any time conditions are above standard day.

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.

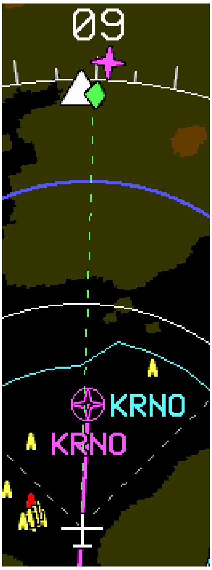
AUDIBLE ANNUNCIATION
A fuel range less than the distance to the destination + 100 miles will result in an annunciation warble and an amber "CHECK RANGE" flag. To eliminate nuisance alarms, range checking is suppressed when on the ground or in a climb.
CHECK RANGE

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.

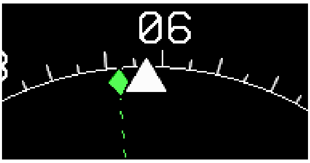
AUDIBLE ANNUNCIATION
When the heading bug has been set and captured, a deviation more than 10° from the heading bug will result in an amber caution flag and an auditory warble.

HEADING

NOTE:
If coupled with an autopilot, the EFIS will command the autopilot to maintain the selected heading. If the autopilot is flying a flight plan, setting the heading bug will override the flight plan in favor of the selected heading.

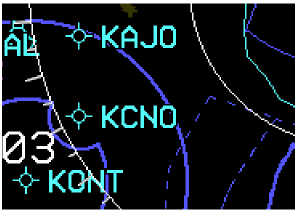
Heading Pointer

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



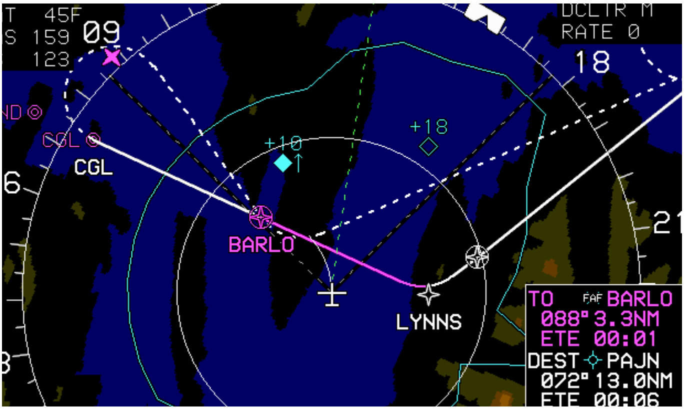
IFR Airport

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



Instrument Approach Course

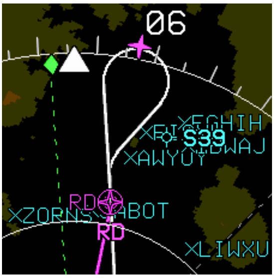
Instrument approach procedures are depicted as white courselines with the active leg displayed in magenta. Active legs of an approach are automatically sequenced. Alternately, the pilot can select any leg as the active leg by using the **ACTV** button function. The missed approach course is depicted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



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

BARLO is an example of a fly-through 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 94, for information on waypoints and waypoint sequencing.

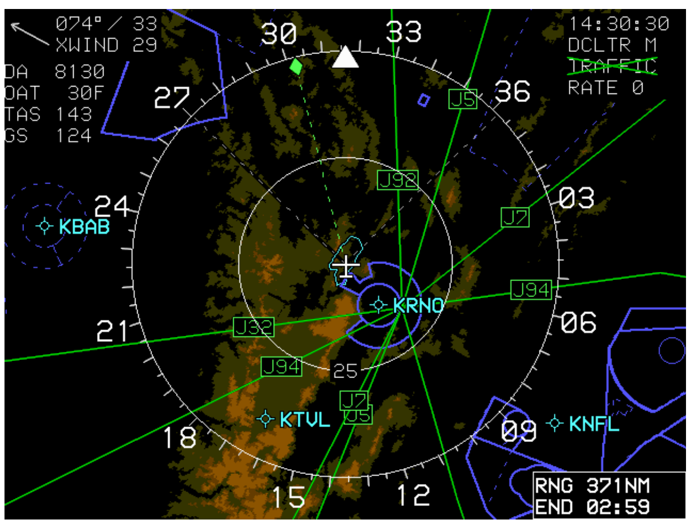
NOTE:
*See **Jeppesen NavData Chart Compatibility** in the Appendix for information on approach waypoint nomenclature.*

Intersection

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

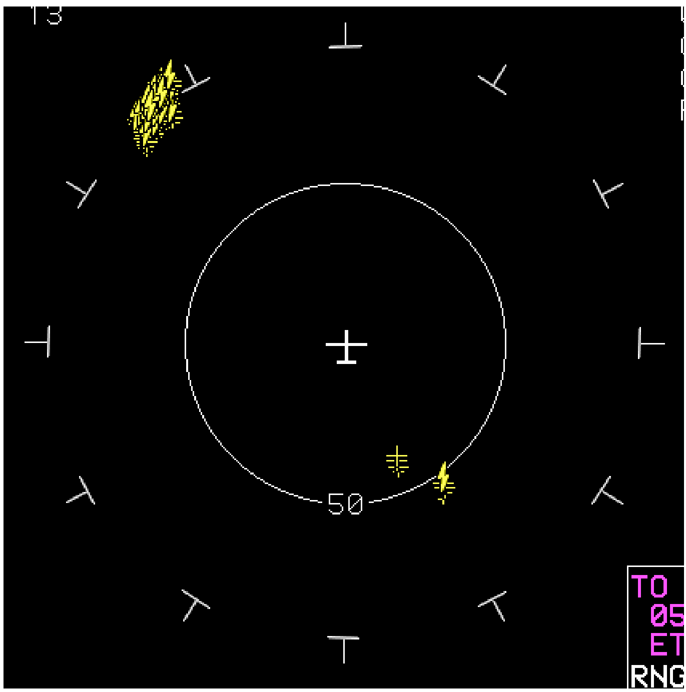
Jet Routes

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.



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.

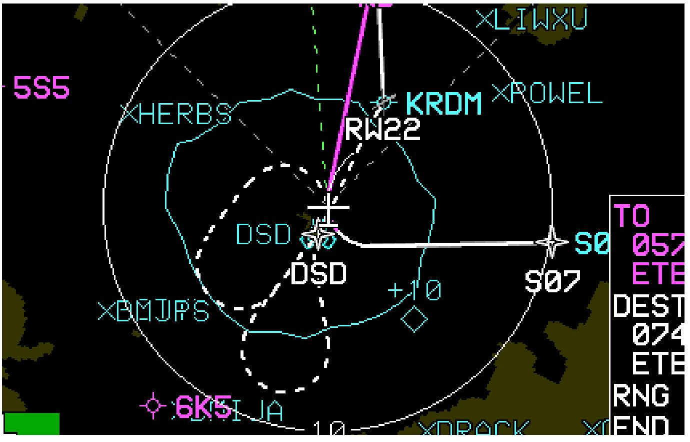
A new strike rate value, based upon the strikes within the selected range, will be calculated every 5 seconds during normal operation. The number of fresh strikes (strikes less than 20 seconds old) is used to generate a strike rate that represents strikes per minute. Strike rate increases shown immediately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

Activating the Clear Strikes function or changing the scale of the ND resets the strike rate to zero.

Please refer to WX-500 documentation for additional information.

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 94, 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

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 display, so it is possible to run one screen with terrain and the other 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)

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

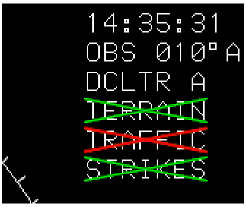
Traffic Mode

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)

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.

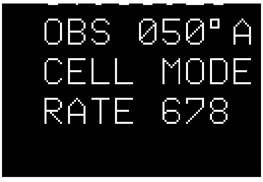


Dedicated Lightning Display
If equipped with Goodrich WX-500 Stormscope, the display mode (**CELL** or **STRK**) and strike rate will be displayed in the upper right corner of the dedicated lightning display. Strike mode shows every strike detected. In cell mode, the WX-500 filters the strike data to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

Please refer to WX-500 documentation for additional information.



Navigation Log

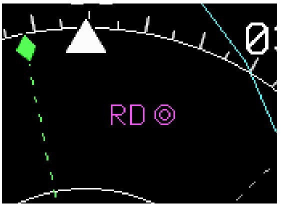
Waypoint navigation information is displayed in the navigation log box located in the lower right corner of the display. The navigation log is only displayed when there is an active waypoint.

The navigation log shows the range, bearing, and estimated time enroute to the active "**TO**" waypoint and the destination "**DEST**" waypoint.

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

NDB

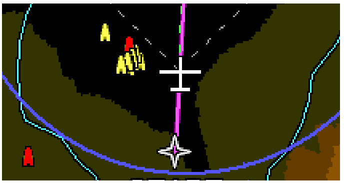
NDBs are depicted as two small, concentric magenta circles with the identifier and frequency adjacent.



Obstruction

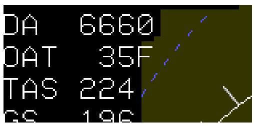
Antennas, towers, and obstructions are displayed only in conjunction with the terrain. Obstruction symbols /\ are depicted using color to show relationship to aircraft altitude as follows:

1. Obstructions beyond 4.25NM 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

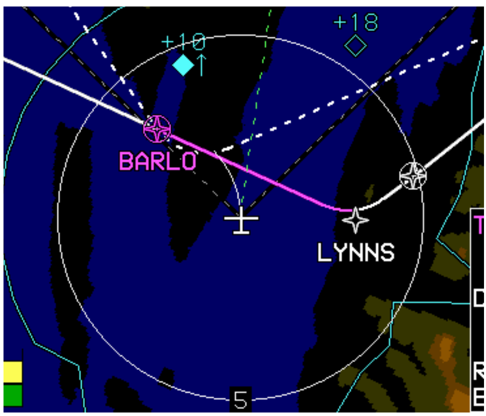
The curving white line extending from the nose of the aircraft symbol indicates the horizontal flight path of the aircraft projected one minute into the future or 180°, whichever comes first. The projected path is corrected for bank angle, groundspeed, and winds aloft and is only displayed when the aircraft 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 to overshoot and come back in from the other side. It's great for when ATC gives you a late turn onto the localizer."

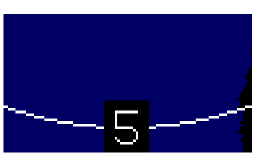
Range Ring

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 5 NM, the directional scale is at 10 NM. Overall map scale ranges from 0.5 to 200 nautical miles.



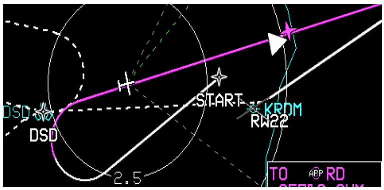
Range Ring Scale

Scale of the map is shown as a distance from the aircraft's position to the range ring. 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 5 NM, the outer ring is at 10 NM.



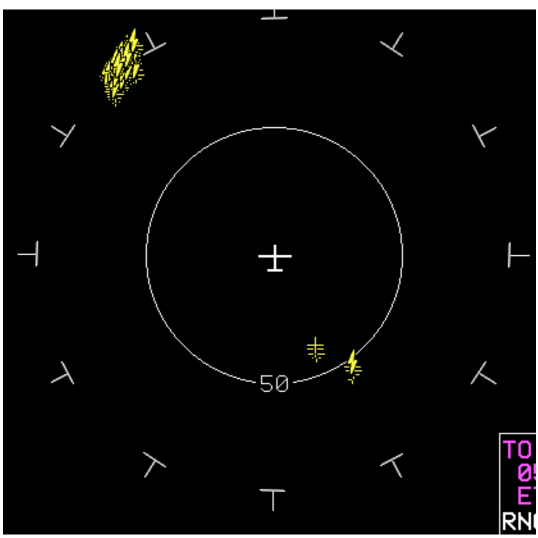
Start Point

Activation of the Nearest 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.



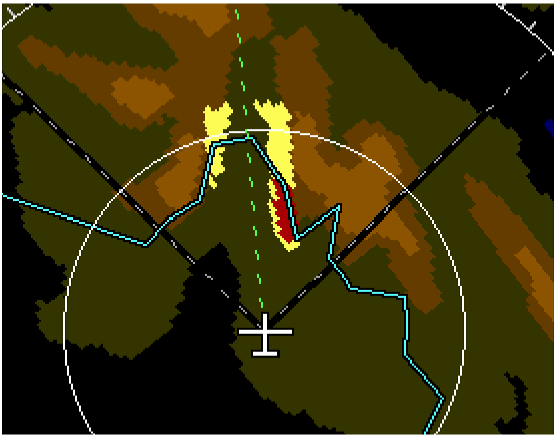
Strike Position Reference (Dedicated Lightning Display)

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.

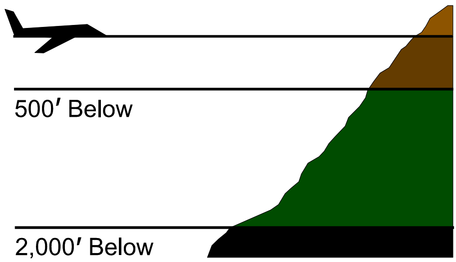


Non-Threatening Terrain

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.

Black areas are more than 2,000 ft. below the aircraft's current altitude.



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 or Class A TAWS.

Class C TAWS provides 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.

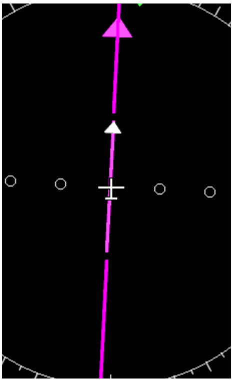
See Caution/Warning/Advisory System, page 11 of System Overview section for details of the auditory annunciations associated with terrain.

"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)

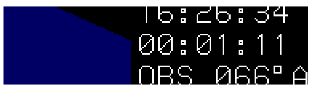
The to-from indicator is a white triangle placed at the end of the CDI needle on the conventional HSI display, between the aircraft position symbol and the courseline arrow. The arrow is ahead of the aircraft symbol and points toward the courseline arrowhead when showing a "to" indication and behind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

Timer

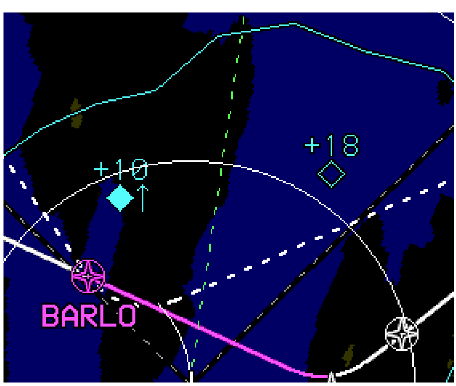
A timer showing **hours:minutes:seconds** is displayed at the pilot's option in the upper right corner of the display, just below the clock. The timer can be set to count up indefinitely or count down from a pilot-specified value. Elapsed time since power-up can also be shown without affecting an active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



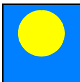
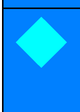
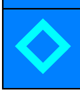
AUDIBLE ANNUNCIATION
A warble tone annunciates the expiration of a count-down timer.

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. Traffic distance is shown to the left of the symbol. 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 6 NM and 1,200 ft. of ownship altitude.**
	**Other Traffic -** **Traffic detected beyond 6 NM and 1,200 ft.**

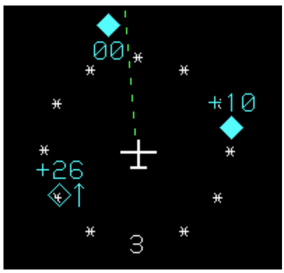
When the ownship AGL indication is less than 400 ft., traffic is shown but alerts are not given. Traffic within 200 ft. of ground level is not shown or annunciated.

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

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

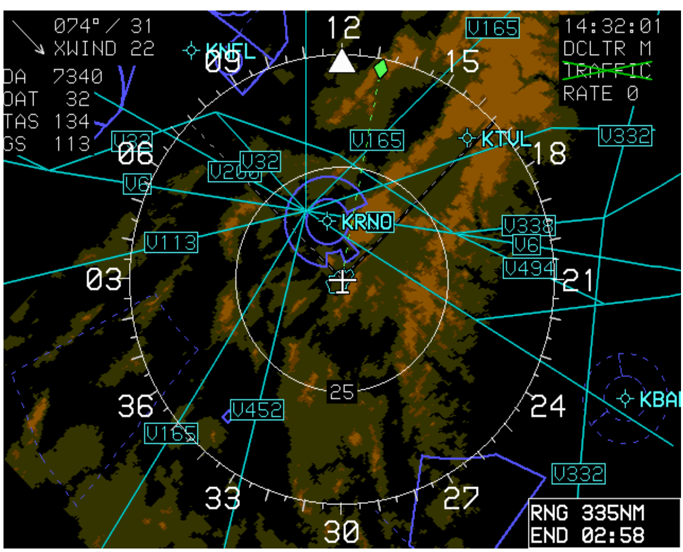
True airspeed, (**TAS**) airspeed is displayed in the upper left corner of the display, between outside air temperature (**OAT**) and groundspeed (**GS**). True airspeed is measured in knots and is corrected for altitude, temperature, aerodynamic heating, and compressibility.

VFR Airport

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

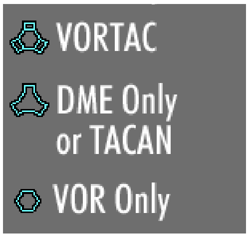
Victor Airways

Victor, or low-altitude airways are displayed as white 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.



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 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 shall [SYS_GPS_004] be suspended in the following cases:

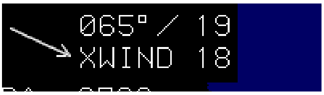
1. A manual GPS/WAAS OBS is set ("SUSPEND" flag shown).
2. The aircraft is on the final approach segment of an instrument approach and the missed approach procedure has not been armed by pressing the MISSED button ("SUSPEND" flag shown).
3. The aircraft is in a published holding pattern and the pilot 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 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 warble and an advisory SUSPEND flag.
SUSPEND

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.



NOTE
Wind data is only updated when in coordinated straight-and-level flight.

Wind Vector

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

NOTE
Wind vector is only updated when in coordinated straight-and-level flight.

Zulu Time

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

Failure Modes

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

Failure of the GPS, the AHRS or the EAU, 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	-	-	-	-	-	-
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	-	-	-	-	-	-
Terrain / Obstructions	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	OK	-	OK	-	7	-
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 and range are presented.
Note 13:	Large attitude bars presented and crossed out with bold red "X"

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 and continues to provide navigational position, groundspeed and ground track information based upon the last known wind and current air data and heading. A "NO GPS" caution flag and timer are displayed. The primary flight and navigation displays are affected as follows:

PFD page during GPS failure

ND page during 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

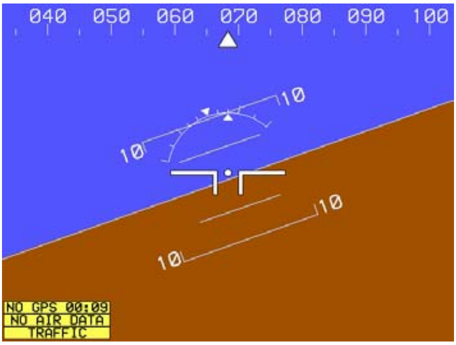
Failure of the AHRS results in loss of attitude, magnetic heading and, G-force information. This failure causes the "NO ATTITUDE" caution flag to be displayed. The primary flight and navigation displays are affected as follows:

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

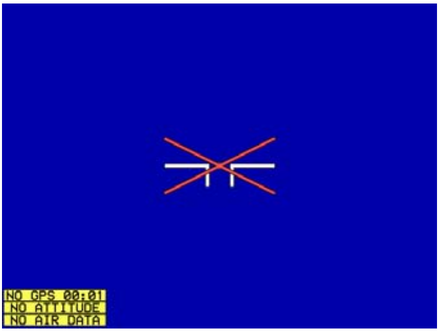
With a GPS and AHRS failure, the EFIS loses its navigational, three-dimensional, attitude, and heading presentation capabilities. With this failure, the PFD presents air data only. The navigation display is only selectable for the purposes of showing passive lightning detection and traffic information. 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. The moving map also retains its 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 menus on the screen.

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

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

In this example, pressing the NRST button 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 . .**).

Submenus adjacent to buttons are activated by pressing the associated button. When the submenu appears in the lower-right corner of the screen, it is controlled by the right-hand control knob.

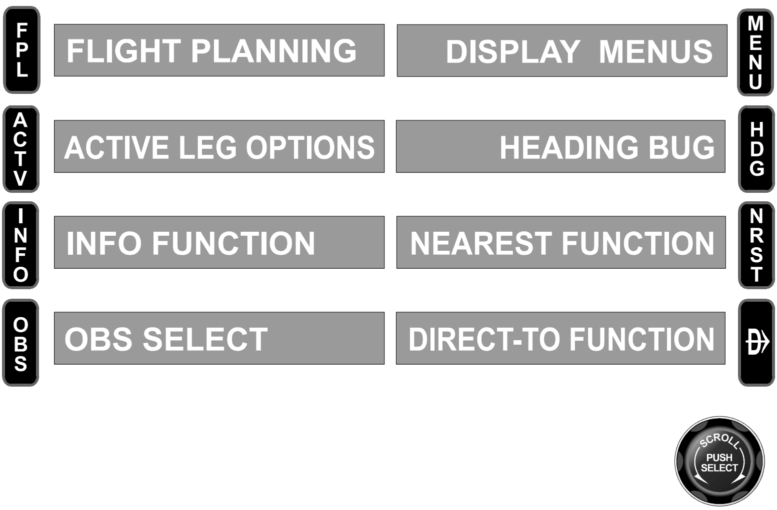
Turning the control knob steps through the submenu and the current selection is displayed as an indentation. When the desired submenu is highlighted (indented), pushing the control knob enters the selection, which may activate a function or display yet another submenu.

When within the menu structure, an **EXIT** menu will always appear in the upper right corner and a **BACK** menu will appear in the upper left corner when appropriate, indicating that a single step back to the prior menu position is possible. Use the Exit menu to get completely out of the menu structure from any level. Use the Back menu 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 screens associated with each menu are identified.

Button Functions

PFD and ND



Control Knob (Right)

No Menus Displayed:

Push - toggle PFD/ND screens (Except on No. 1 PFD)

Turn -
PFD: set altimeter (Note: when setting altimeter, an STD menu provides one-touch setting to 29.92)
ND - set scale

With menus Displayed:

Turn - scroll

Push - enter

PFD Top Level Menus

PFD Only

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

FPL

EXIT
Clears menu from screen.

MENU

ACTV

BUGS . .
See BUGS. . Function

HDG

INFO

DESIG
Creates a User Waypoint at the present position.*

ZOOM ON
OR
ZOOM OFF
Toggles between 35° and 70° (default) field of view.

NRST

OBS

TIMER . .
See TIMER . . Function.

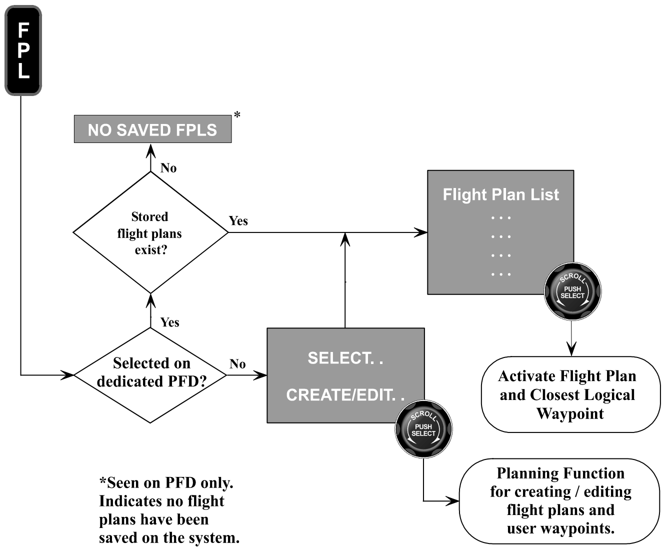
DCLTR . .
See DCLTR function.

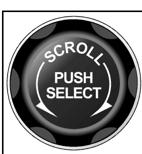
***Waypoint is automatically named OF###, where ### is the next available user waypoint number. OF stands for overfly.**

Disabled

Flight Plan Function

PFD and MFD



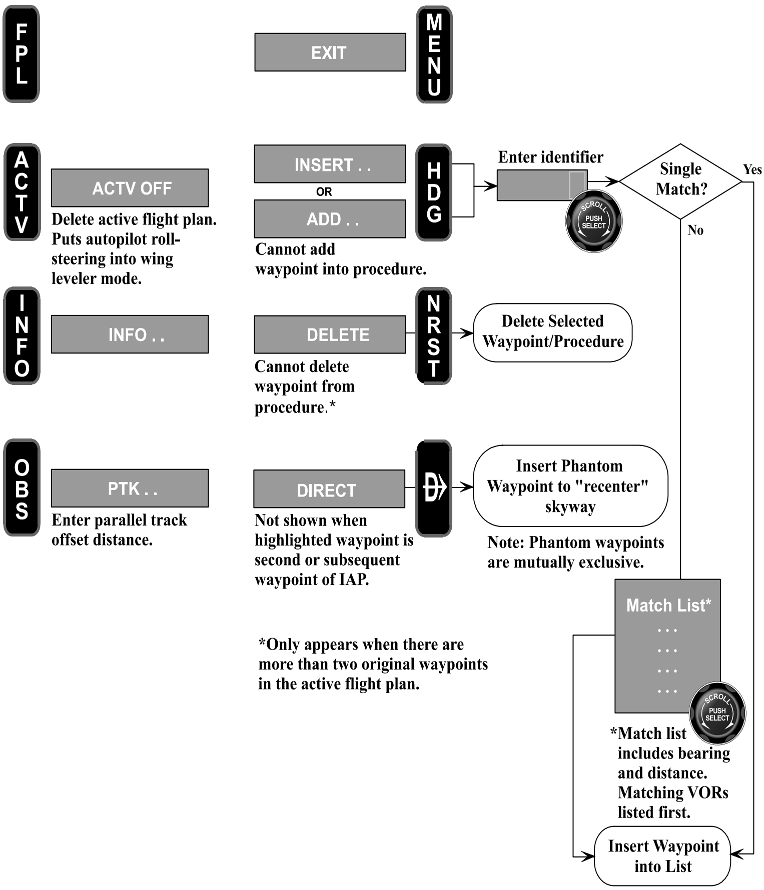


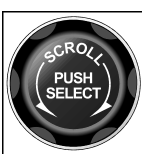
Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

ACTV (Active) Menu Options

PFD and MFD

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

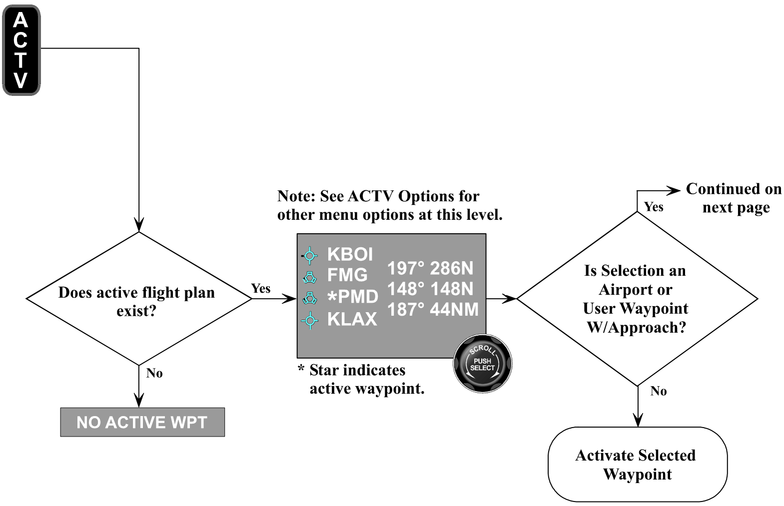




Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

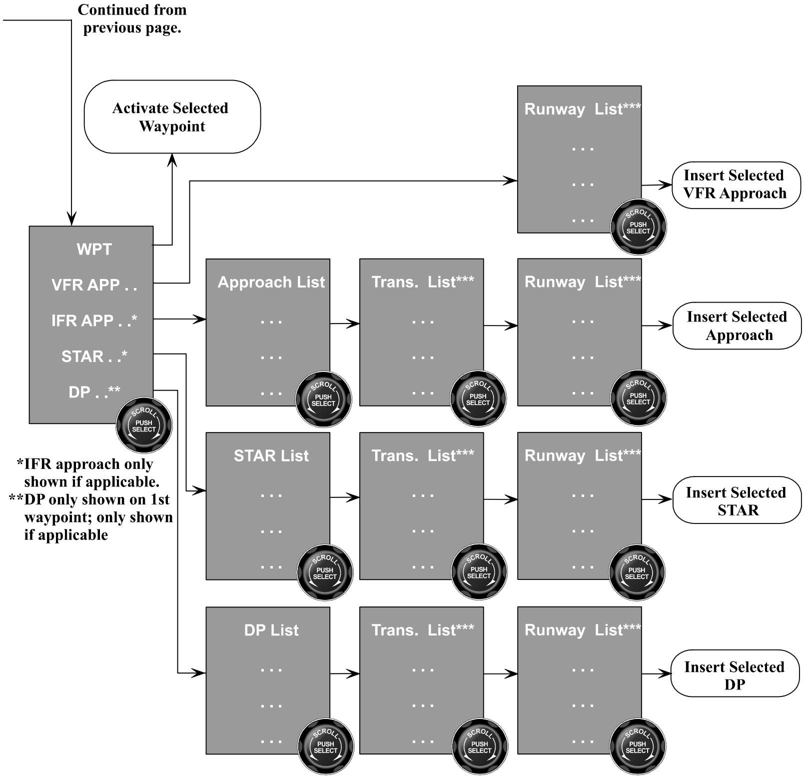
ACTV Function

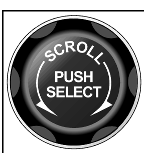
PFD and MFD



Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

ACTV Function (continued)

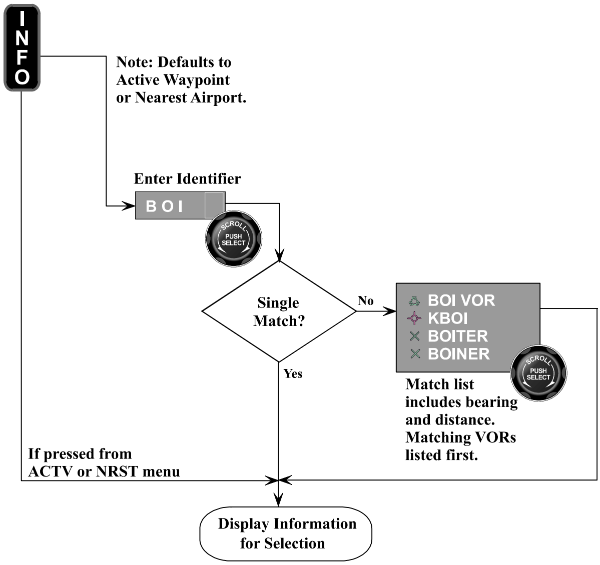


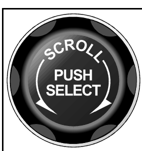


Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

INFO Function

PFD and MFD

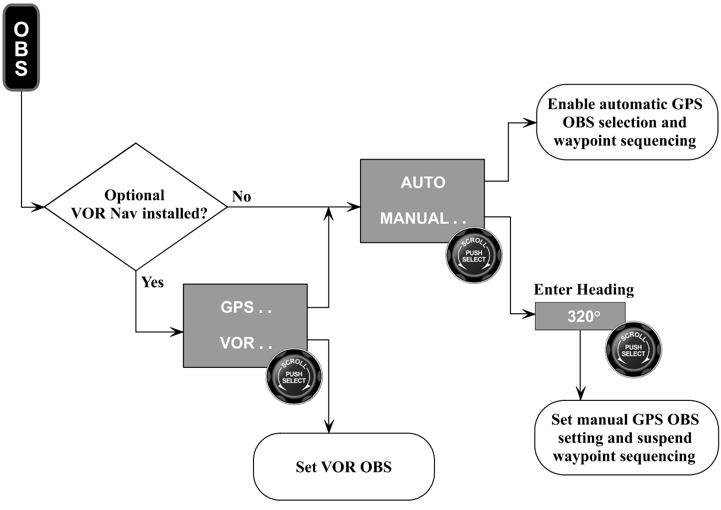


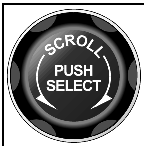


Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

OBS (Omnibearing selector) Function

PFD and MFD

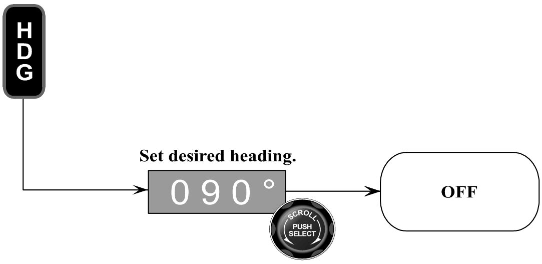


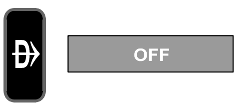


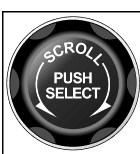
Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

HDG (Heading) Function

PFD and MFD



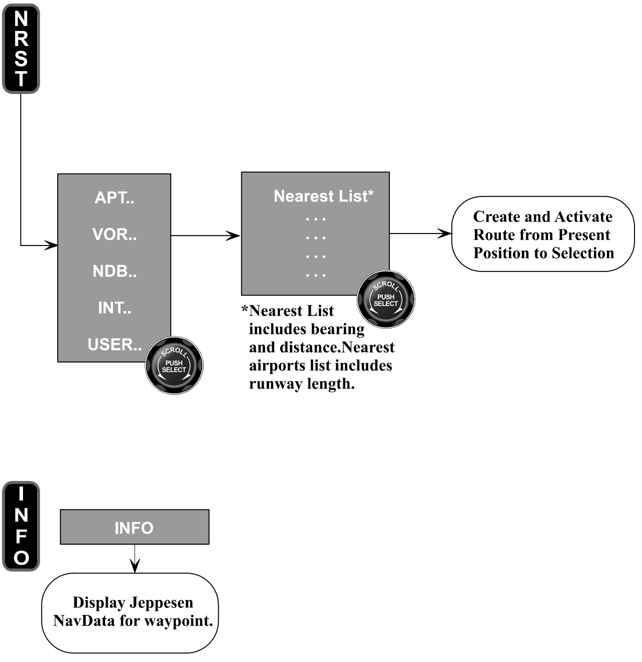


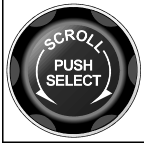


Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

NRST (Nearest) Function

PFD and MFD

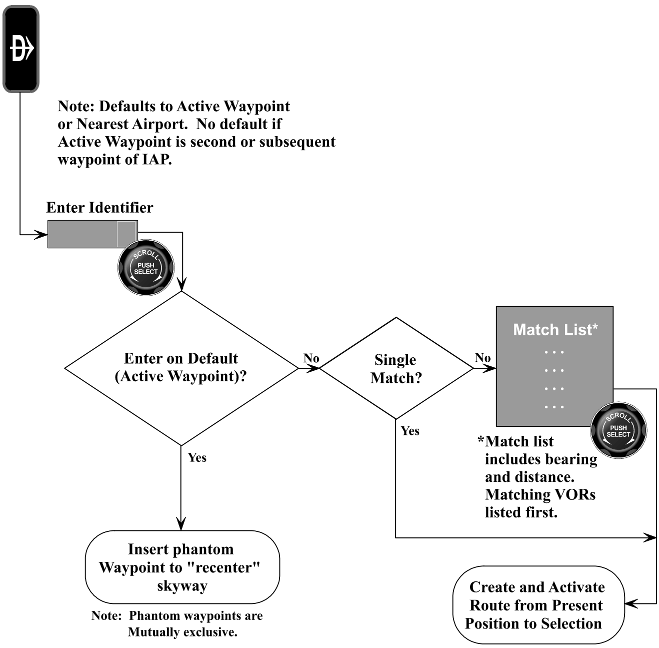


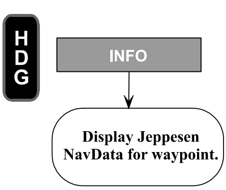


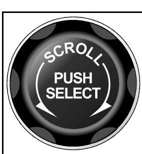
Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

Direct Function

PFD and MFD



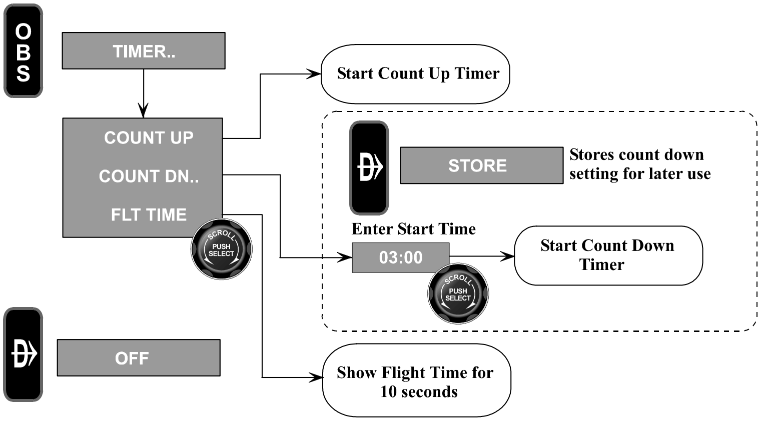


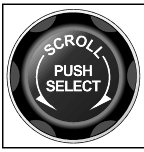


Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

Timer Function

PFD and MFD

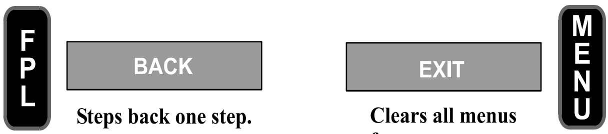




Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

Back and Exit Functions

PFD and MFD

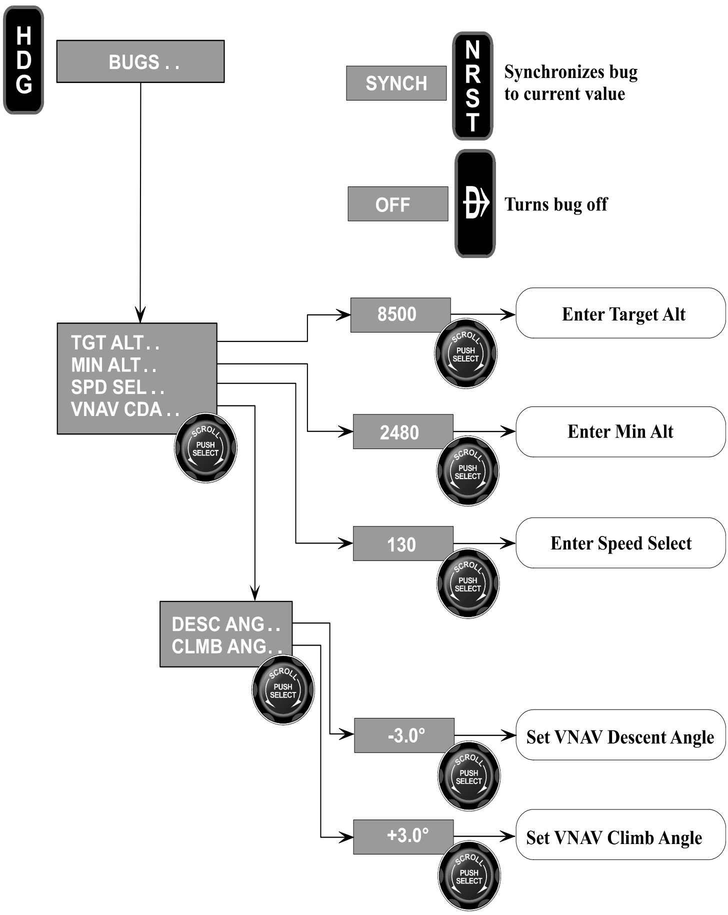


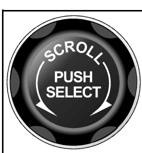
Steps back one step.

Clears all menus from screen.

Bug Set Function

PFD Only





Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

ZOOM Function

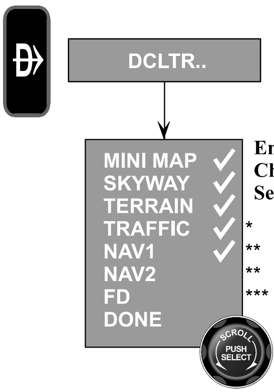
PFD Only

N
R
S
T

ZOOM ON	**35° Field of View**
OR	
ZOOM OFF	**70° Field of View (default)**

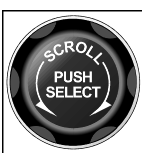
PFD Declutter Function

PFD Only



Enable or disable elements.
Check indicates element enabled.
Select DONE to exit.

***Only shown with optional TCAD installed.**
****Only shown with optional VHF nav interface.**
***** Only shown with optional Flight Director (FD).**
Note: NAV1, NAV2, and FD are mutually exclusive.



Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

Navigation Display Top Level Menus

FPL

FAULTS..

Only shown when a GPS or auxiliary sensor fault exists.

EXIT

Clears menu from screen.

MENU

ACTV

CLR STRKS

Only on Moving Map, Strike and Datalink pages with optional WX-500 installed.

SET FUEL..

HDG

INFO

DESIG

Creates user waypoint at current location.

DISPL..

NRST

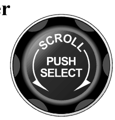
OBS

TIMER . .

See TIMER . . Function.

FORMAT...

Only shown on HSI page with optional VOR Nav. Always shown on other pages.

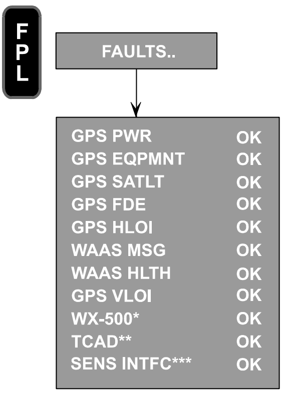


Disabled

Faults Function

ND Only

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

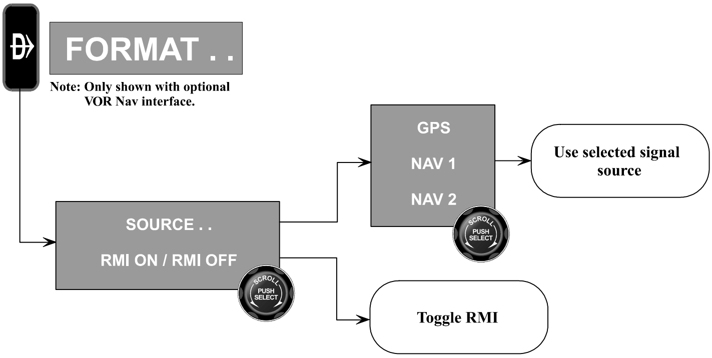


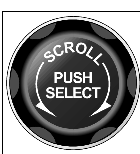
***Only shown with optional WX-500 installed.**
****Only shown with optional TCAC installed.**
*****Only shown with optional analog sensor interface installed**

HSI Format Function

ND Only

(Only shown with optional VHF nav interface installed).



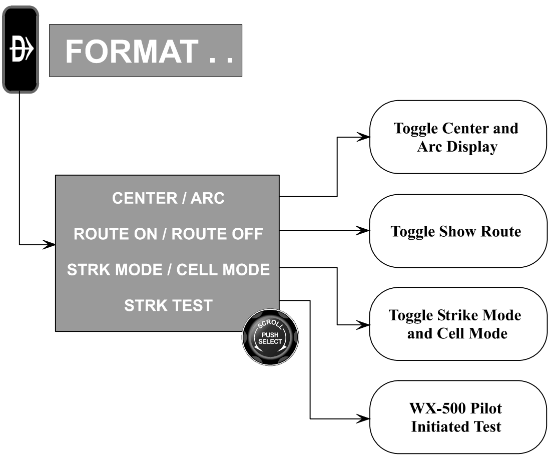


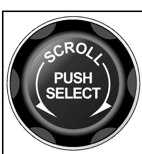
Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

Strike Format Function

ND Only

(Only shown with optional WX-500 installed).



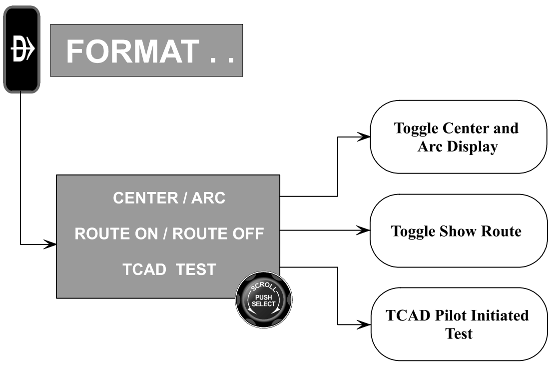


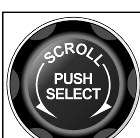
Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

Traffic Format Function

ND Only

(Only shown with optional TCAD installed.)





Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

DESIG (Designate) Function

PFD and ND

INFO

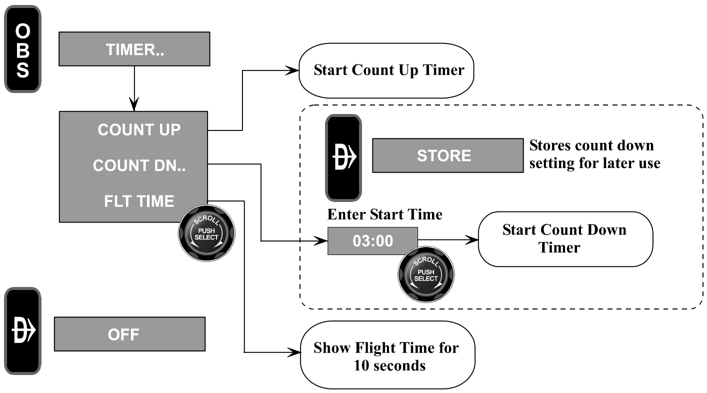
DESIG

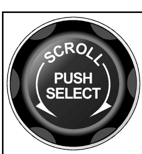
Creates user waypoint at current location.

User can change waypoint name at a later date from FPL function.

Timer Function

PFD and ND

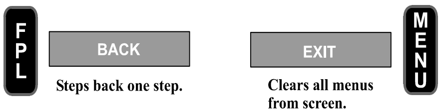




Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

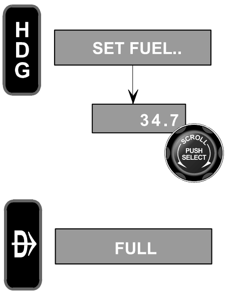
EXIT Function

PFD and ND

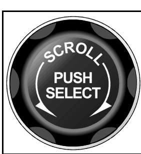


Fuel Set Function

ND Only



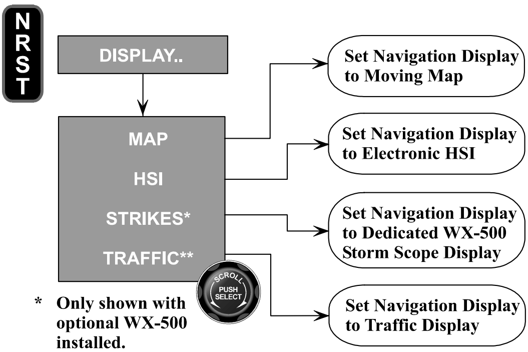
Enter total fuel on board.



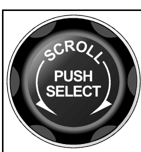
Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

MFD Display Function

ND Only



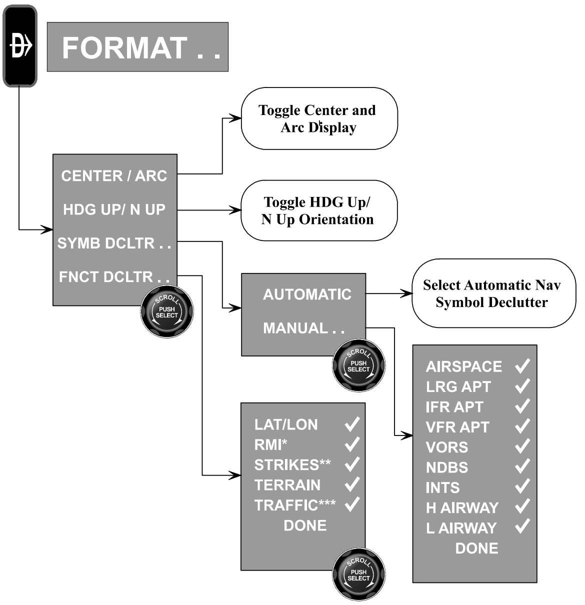
* Only shown with optional WX-500 installed.
** Only shown with optional TCAD installed



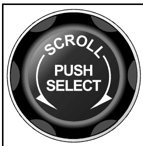
Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

Moving Map Format Function

ND Only



*Only shown with optional VOR nav interface installed.
**Only shown with optional WX-500 installed.
***Only shown with optional TCAD installed.



Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

Section 5

Step-by-Step Procedures

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 either the PFD page or the ND page on any display in the system, and they are automatically crossfilled to other displays. 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.

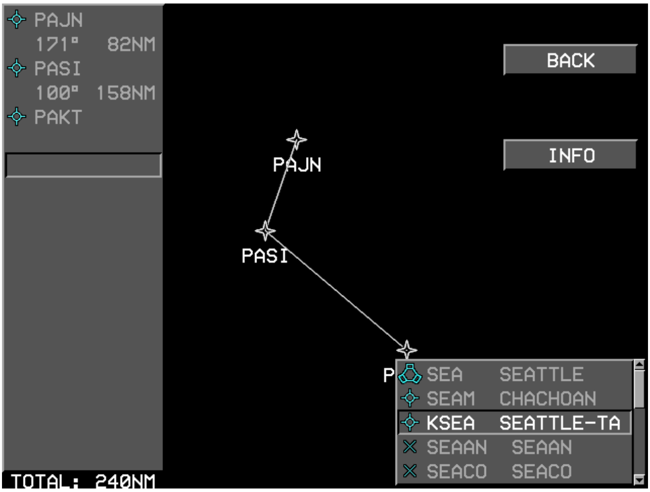
Create a Flight Plan

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.

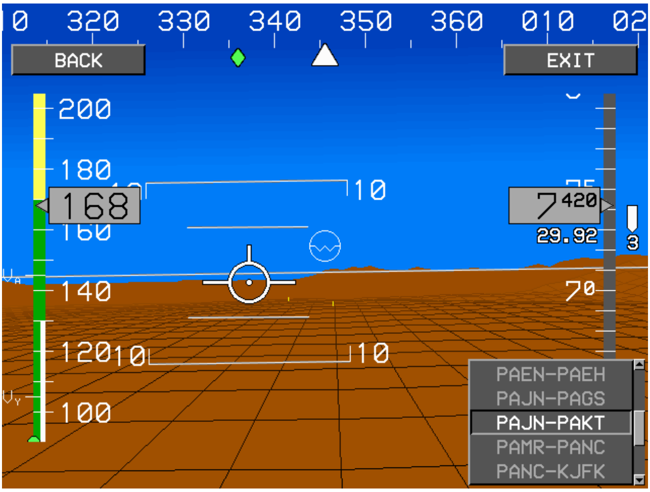


If there is no exact match, turn the control knob to select desired waypoint, and push to enter.
An exact match will be accepted and entered immediately.

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 added to the flight plan list.

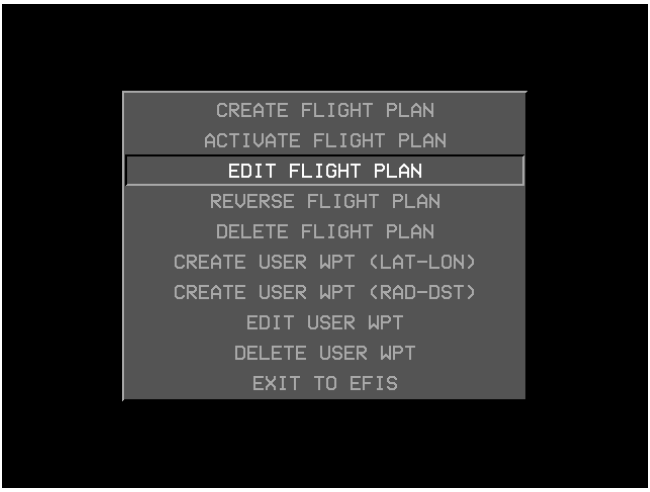
Use a Flight Plan

1. Select the **FPL . .** menu.
2. **SELECT** will be highlighted..., push to enter. A list of flight plans in the EFIS will be displayed. Rotate the selector knob through the flight plans. When the desired flight plan is highlighted, push the selector knob to enter.

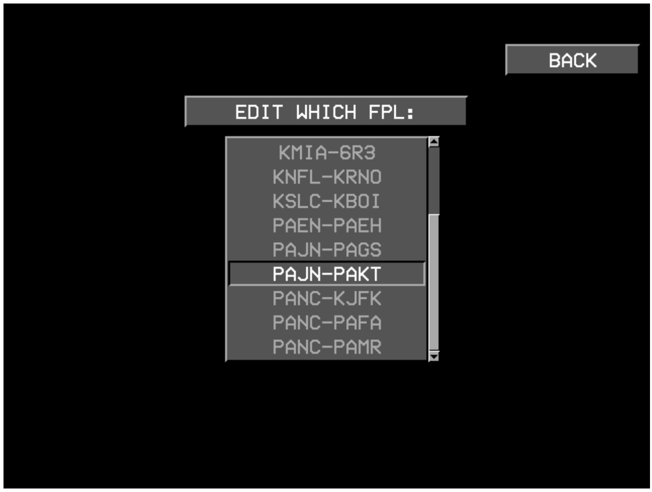


Edit an Existing Flight Plan

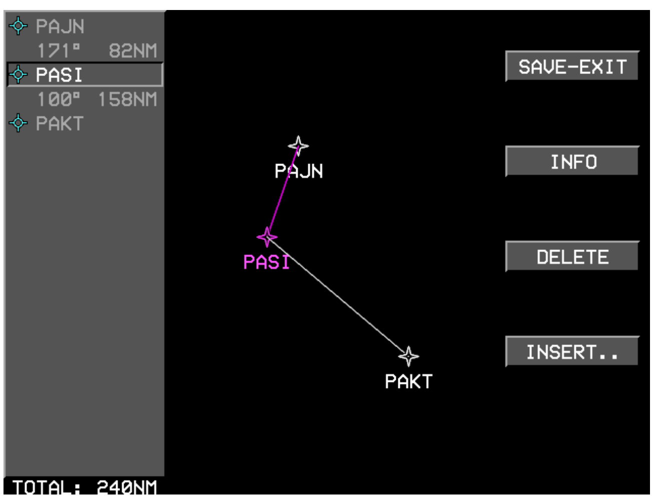
1. Select the **FPL . .** menu.
2. Turn control knob to highlight **CREATE - EDIT . .** , then push to enter.
3. Turn control knob to highlight **EDIT FLIGHT PLAN**, then push to enter.



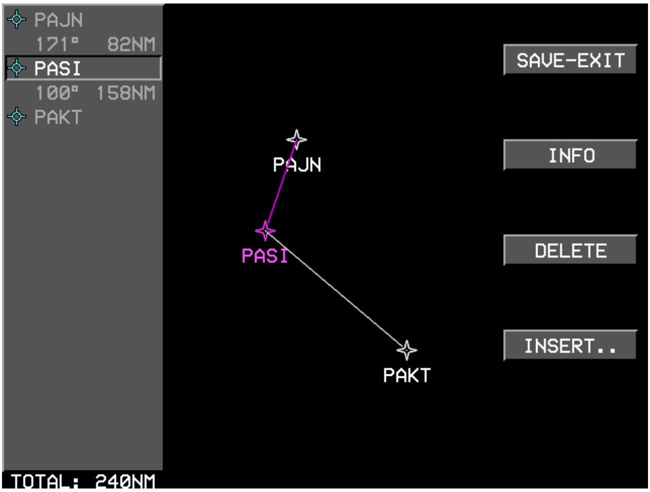
4. Turn control knob to highlight the flight plan you wish to edit, then push to enter.



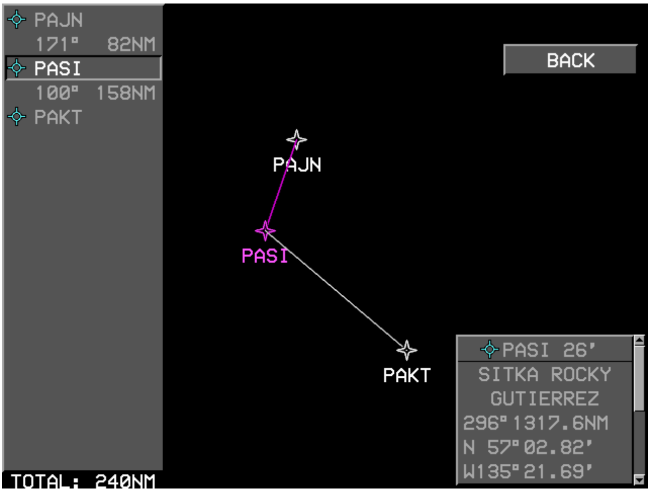
5. Turn control knob to highlight the waypoint you wish to edit, then push to enter.



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.



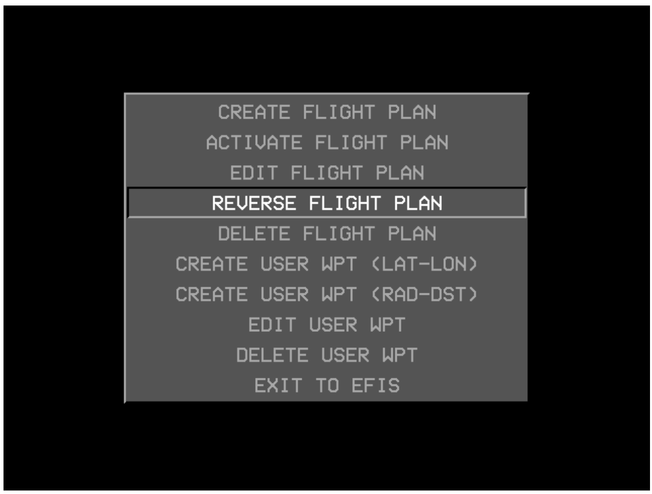
Select **INFO** to display additional information about the highlighted waypoint.



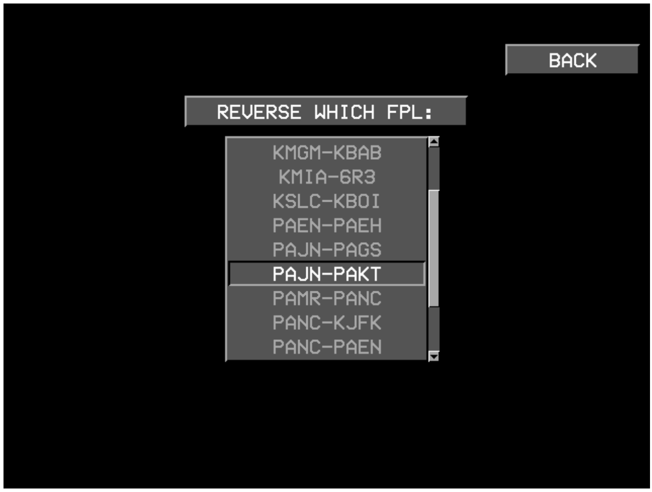
7. Press **BACK** to return to **EDIT** page.
8. Press **SAVE-EXIT** when finished to save and return to previous screen.

Reverse a 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.

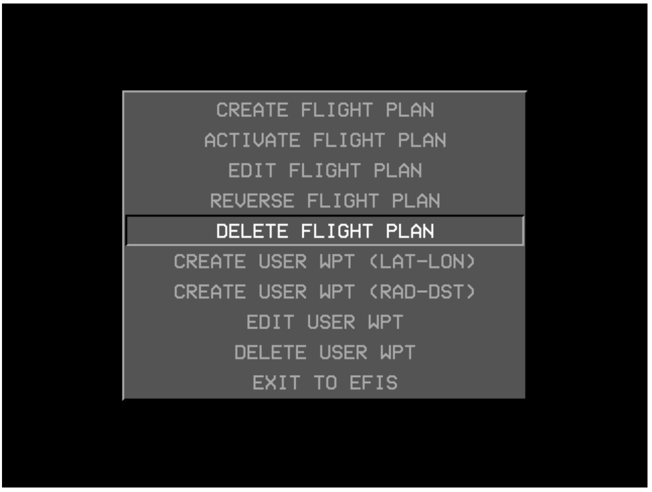


Reversed flight plan will be added to flight plan list. It may then be selected for active use in the normal manner.

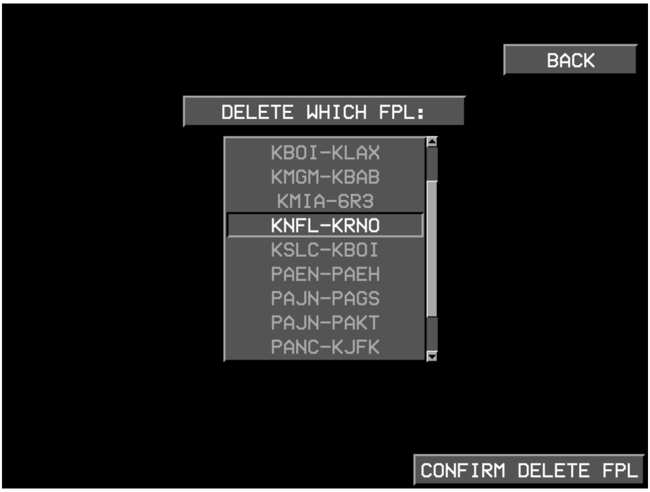
5. Press **BACK** to return to previous screen.

Delete a 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.



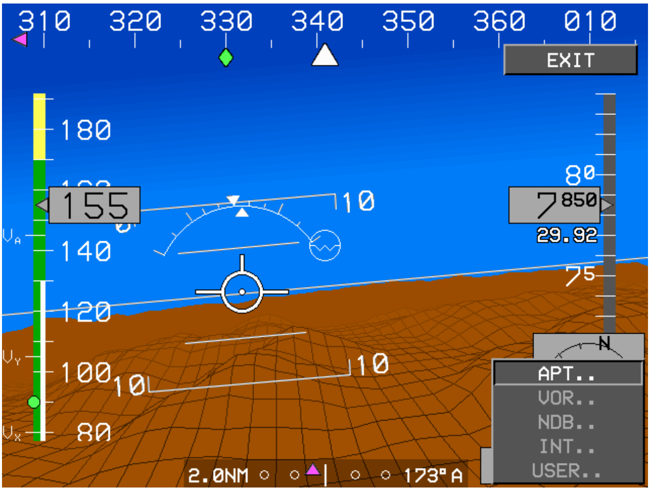
You will be asked for confirmation to delete the highlighted flight plane. Push enter to confirm or push **BACK** to return to the previous menu.

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

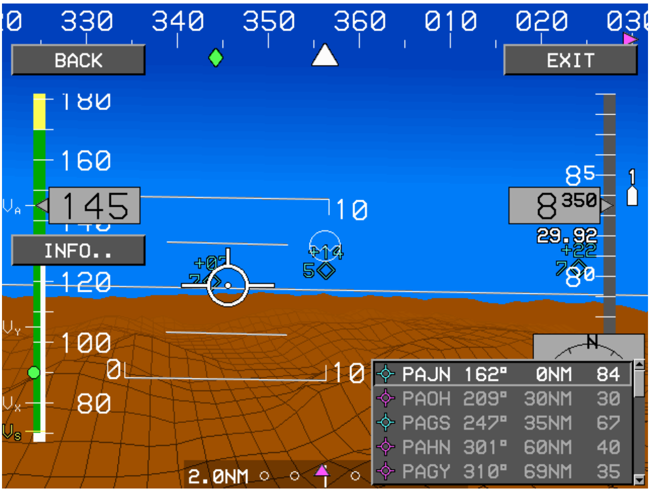
Waypoints

Direct to Nearest Navaid

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. Turn control knob to highlight desired choice, then push to enter.

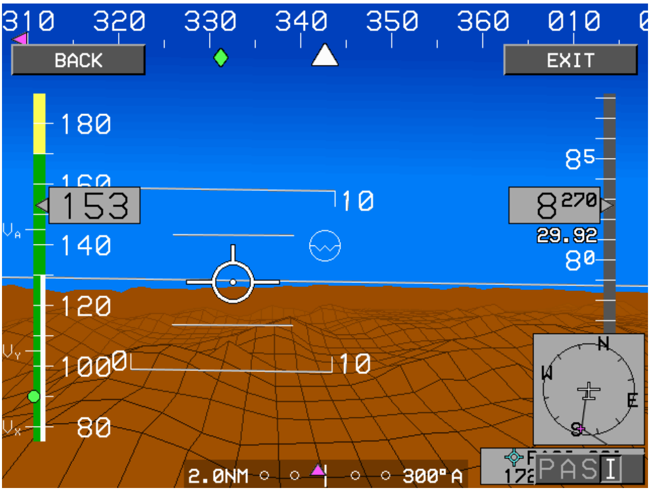


Direct course to selected waypoint will be displayed with distance in NM.

Direct to Waypoint

1. Press the D> dedicated button.
2. 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. 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.

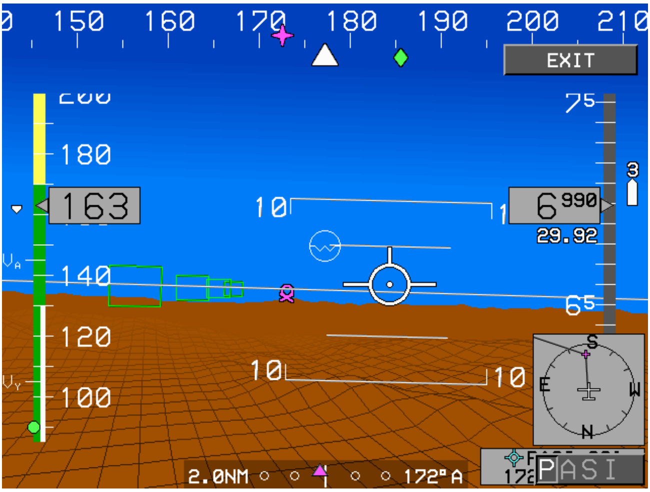


3. Press **BACK** at any point to back up.
4. Turn control knob to highlight desired waypoint, push to enter.
   An exact match will be accepted and activated immediately. Direct course to selected waypoint will be displayed with distance in NM.

Recenter on Direct Route

1. Press the **D→** dedicated button.

2. The active waypoint identifier will be displayed in the character spaces.

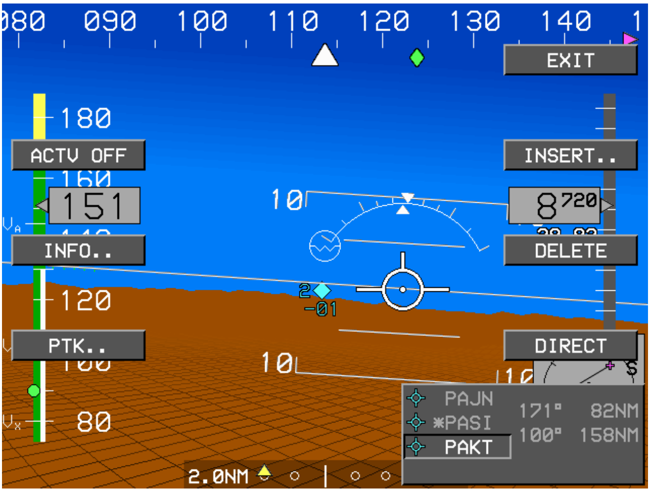


3. To fly direct from present position, push control knob to enter.
   Direct course to selected waypoint will be displayed from aircraft's current position with distance in NM.

Select a Waypoint Within a Route

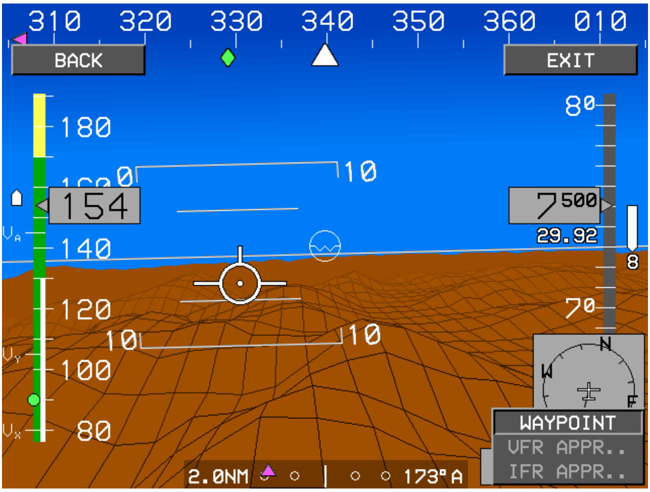
1. Press the **ACTV** Button. A list of waypoints in the current flight plan will be displayed. An asterisk indicates the active waypoint.

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.

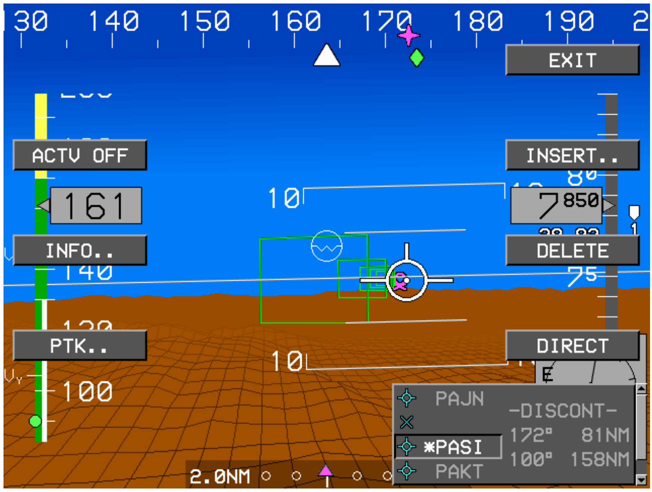


4. If waypoint is airport, turn control knob to highlight **WPT**, and push to enter. Selected airport will be activated as a waypoint and the courseline to the waypoint will be displayed.

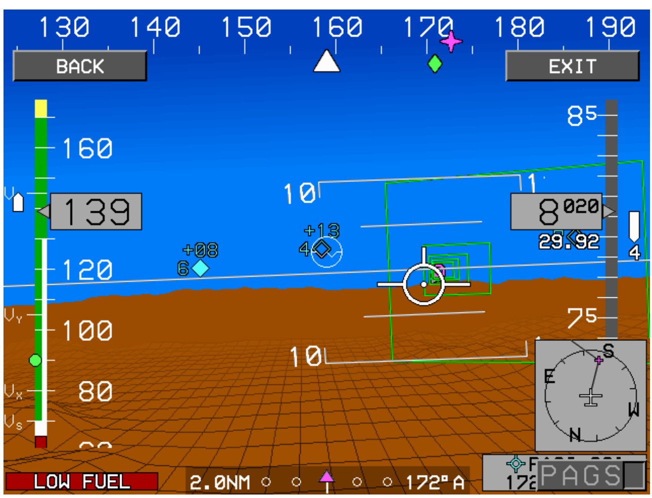
Add a Waypoint to an Active Route

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

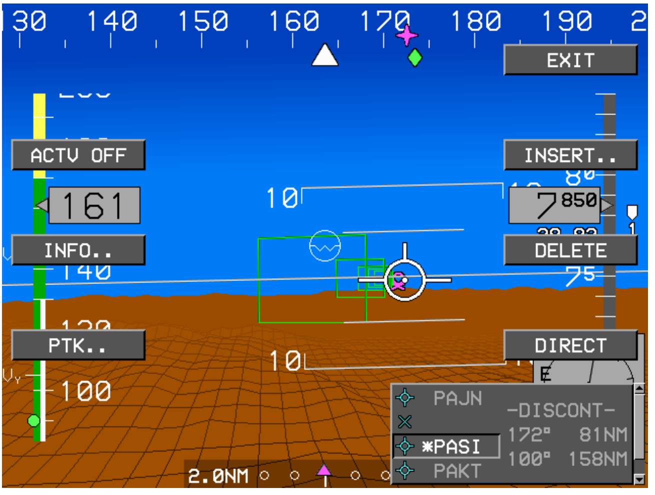
any point to back up. Entering at least one character and advancing through the remaining blank character spaces will display a list of waypoints if there is no exact match. An exact match will be accepted and entered immediately.

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

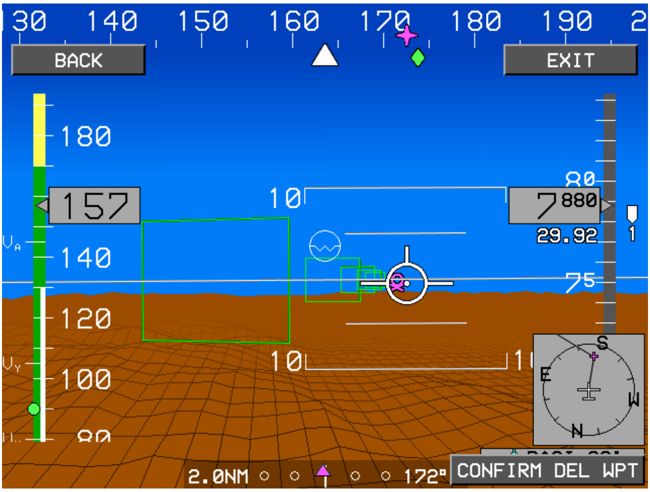
Delete a Waypoint From an Active Route

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.

Create a User Waypoint

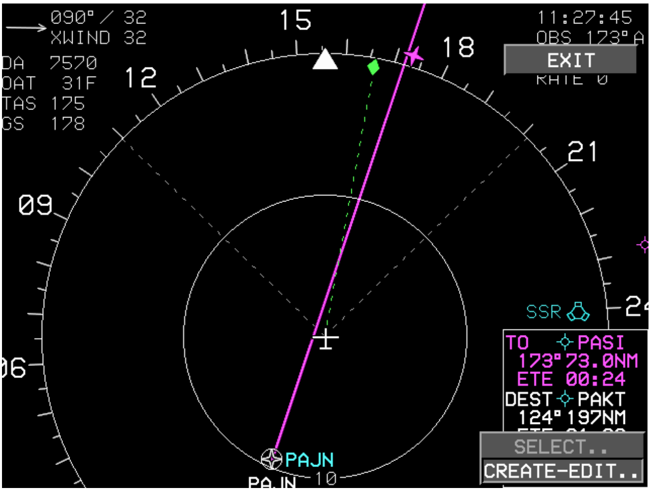
User waypoints may be created in two ways:

A. Latitude & Longitude

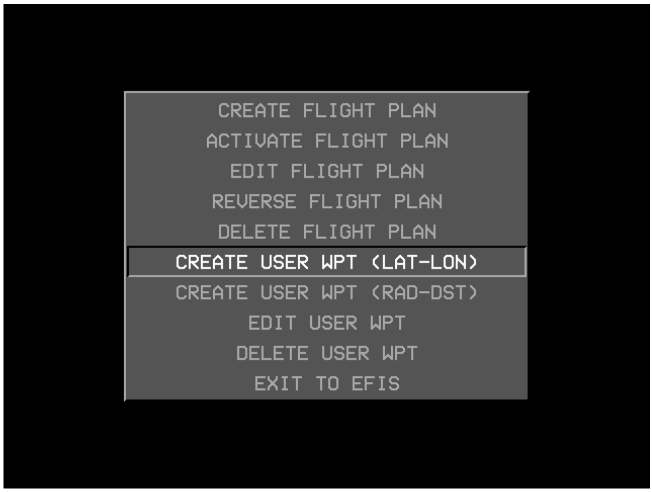
B. Radial & Distance

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

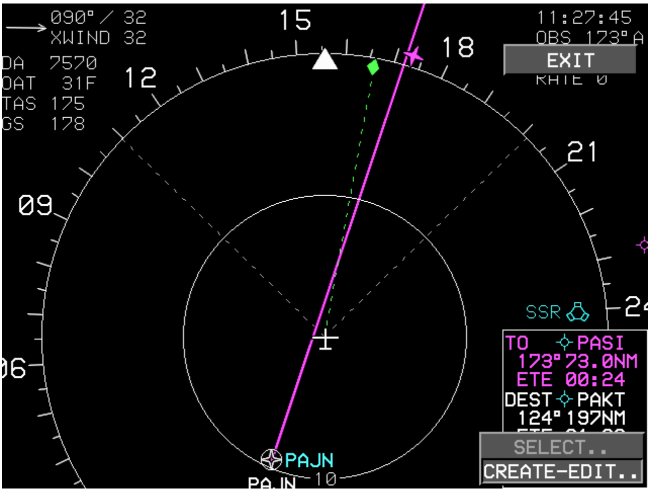
a) Identifier: The top line allows the user to specify a five

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 forth 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.
Note: A maximum of 100 user waypoints may be created and stored.

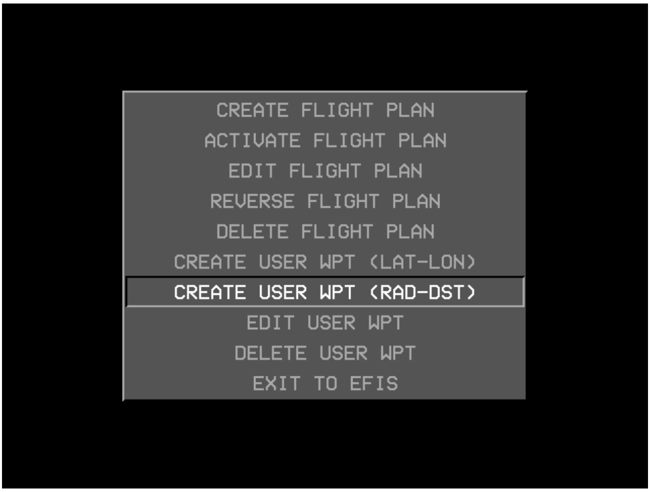
B. To create a user waypoint using Radial & Distance:

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

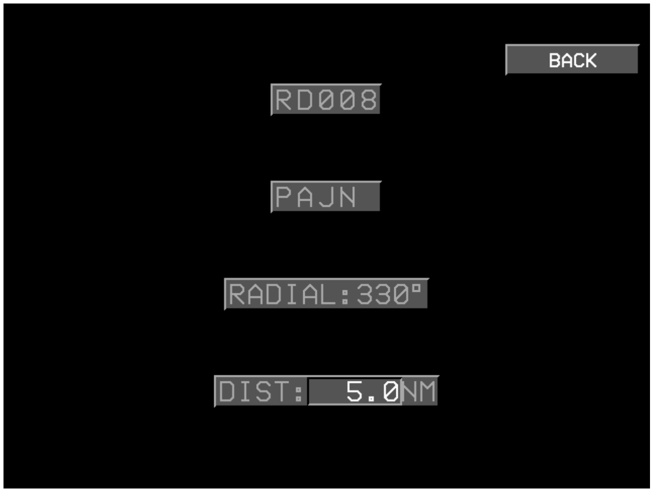
2. Turn control knob to highlight **CREATE - EDIT . .** , then push to enter.



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.

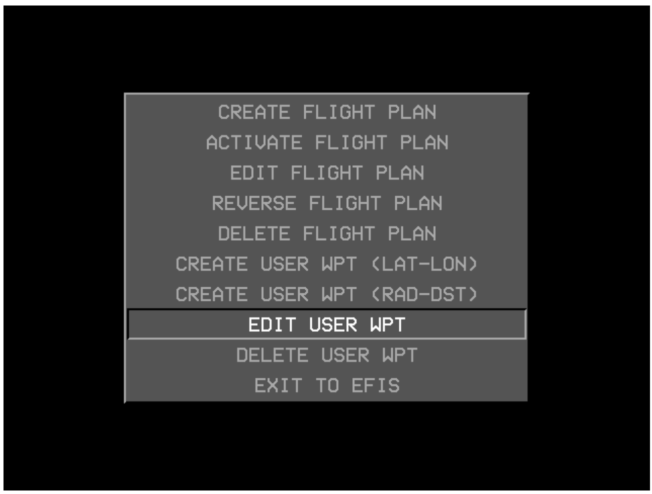
Note: A maximum of 100 user waypoints may be created and stored.

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.

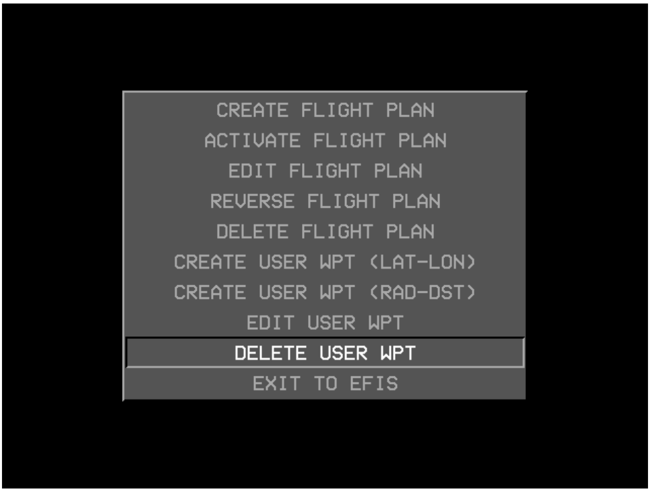
5. Using control knob to enter alphanumeric characters, follow on-screen prompts to edit information. Step through the characters by pushing the control knob. Back up by pressing **BACK.**

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.

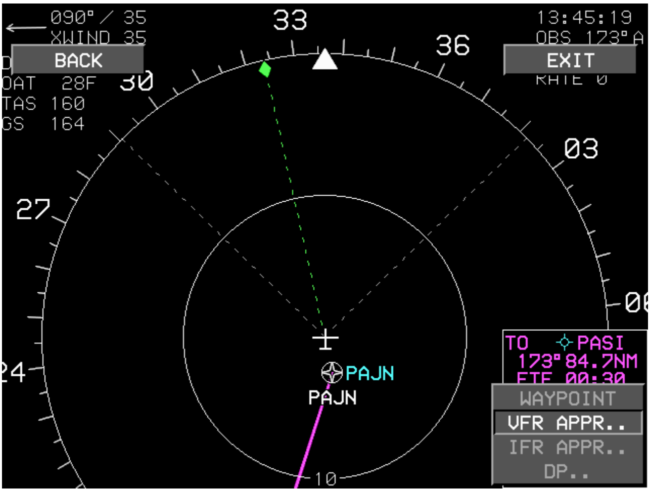


4. Turn control knob to highlight user waypoint to be deleted, then push to enter. The selected user waypoint will be deleted from the system.

Approaches, DPs, and STARs

Select a VFR Approach

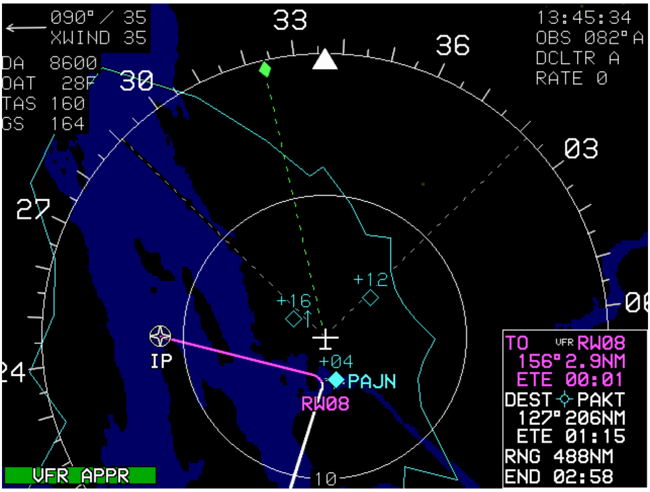
1. Press the **ACTV** button.
   A list of waypoints in the current flight plan will be displayed.
2. Turn control knob to highlight landing airport or user waypoint, then push to enter.
3. Turn control knob to highlight **VFR APPR . .** and push to enter.



A list of runways at the destination airport will be displayed.

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 15 NM from the runway. If a more direct approach is desired, change the active waypoint to the destination airport. Skyway boxes will then lead direct to the center of the airport

AUDIBLE ANNUNCIATION

VFR approach selection and within 30 NM of destination will result in an advisory flag and auditory warble.

VFR APP

5. The CDI scale, if set to "**A**" for automatic, will gradually adjust according to the phase of flight and will be indicating 0.3 NM when 6 nautical miles from the destination.

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.

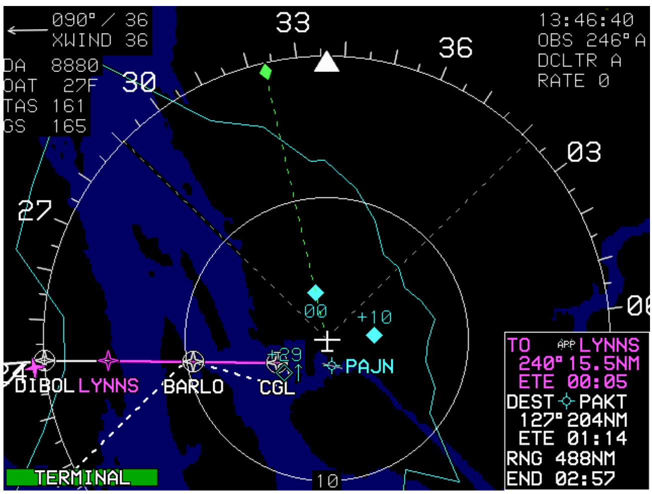
4. Turn control knob to highlight desired approach and push to enter. A list of available transitions will be displayed if applicable.

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; the active leg 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, if set to "**A**", for automatic, 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.

> ***AUDIBLE ANNUNCIATION***
> IFR approach selection and within 30 NM of destination will result in an advisory flag and auditory warble.
> **IFR APP**

Select a DP

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.

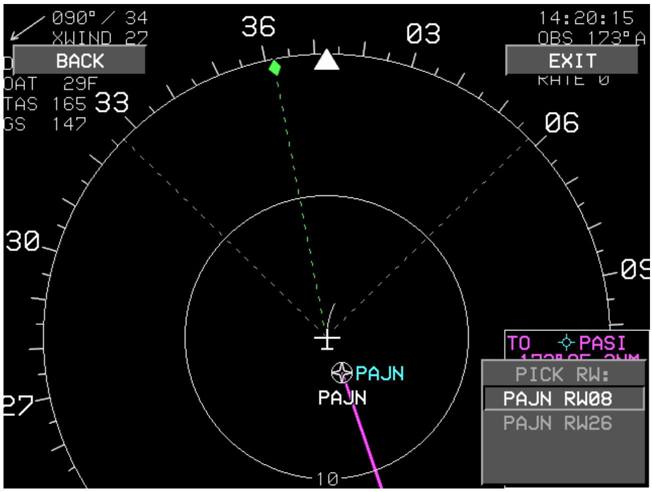
3. Turn control knob to highlight **SELECT . . .** , then push to enter

4. Turn control knob to highlight **DP . .** and push to enter. A list of published procedures will be displayed.

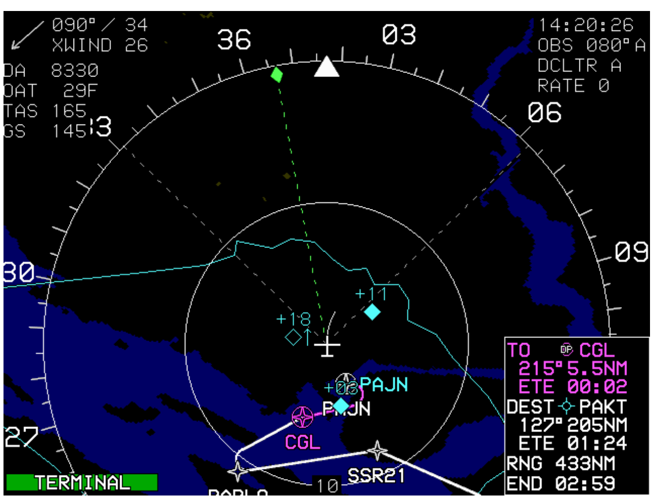
5. Turn control knob to highlight desired procedure and push to enter. A list of available transitions will be displayed if applicable.

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; the active leg will be magenta.



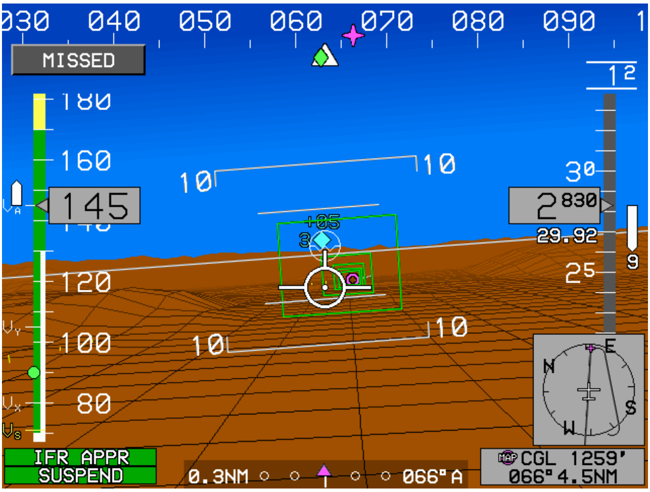
The approach waypoints will be displayed on the PFD and automatically sequenced so that **only** the active waypoint is shown (magenta).



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. Select the **MISSED** menu displayed in upper left corner upon passage of final approach fix (FAF). The missed approach procedure will be entered into the active flight plan.



The appropriate missed approach procedure will then be displayed as a white courseline on the moving map. Missed approach navigation will not commence until MAP passage.

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 will return to last waypoint (runway).

Change Runway During Approach

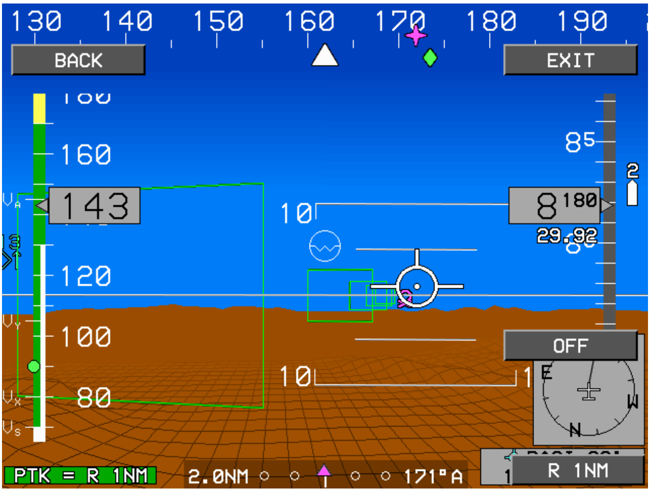
1. Press the **ACTV** button. A list of waypoints in the current flight plan will be displayed.
2. Turn control knob to select landing airport, then push to enter.
3. Turn control knob to highlight **IFR APPR . .** and push to enter. A list of the published instrument approaches will be displayed
4. Turn control knob to highlight current approach and push to enter. A list of available transitions will be displayed if applicable.
5. Turn control knob to highlight current 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 symbology will be changed to reflect new runway selection.

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.



The OBS setting will automatically adjust to reflect the requested parallel track.
Waypoints will automatically be sequenced as the flight progresses.

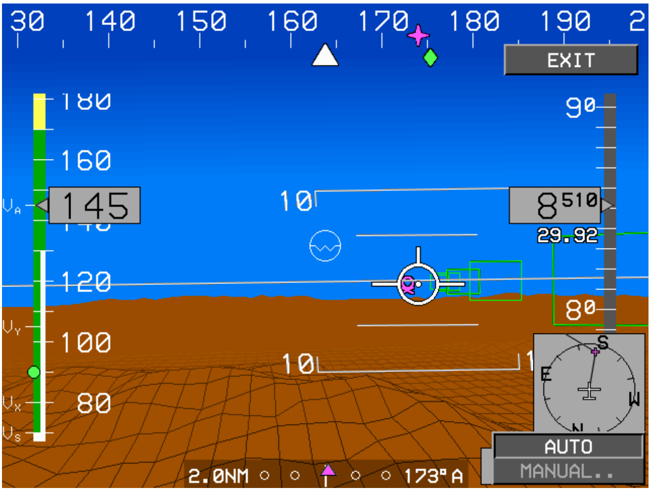
Turn Parallel Track Off

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

Omnibearing Selector Function

Automatic OBS

1. Press the **OBS** button.
2. **AUTO** will be highlighted. Push to enter.

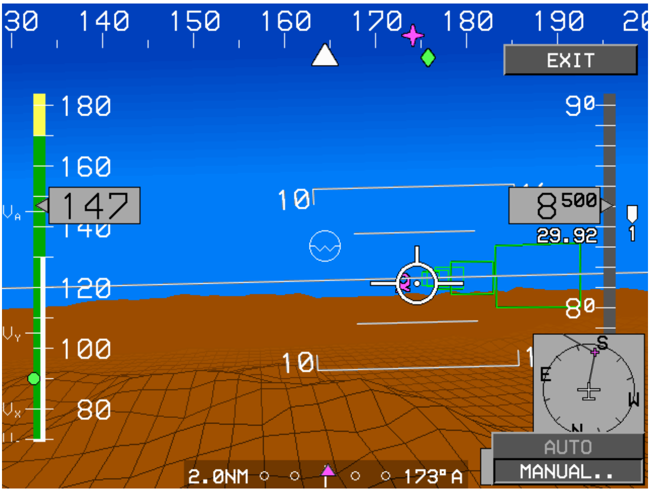


The OBS setting will automatically adjust to reflect the current flight plan segment.
Waypoints will automatically be sequenced as the flight progresses.

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

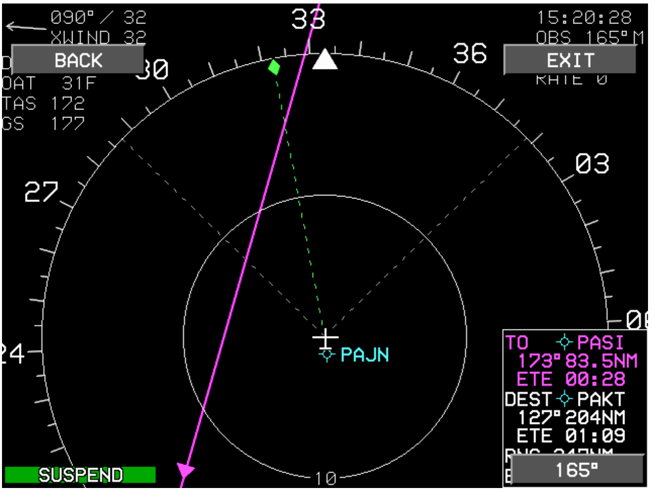
Manual OBS

1. Press the **OBS** button.
2. Turn control knob to highlight **MANUAL . . ,** then push to enter.



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

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

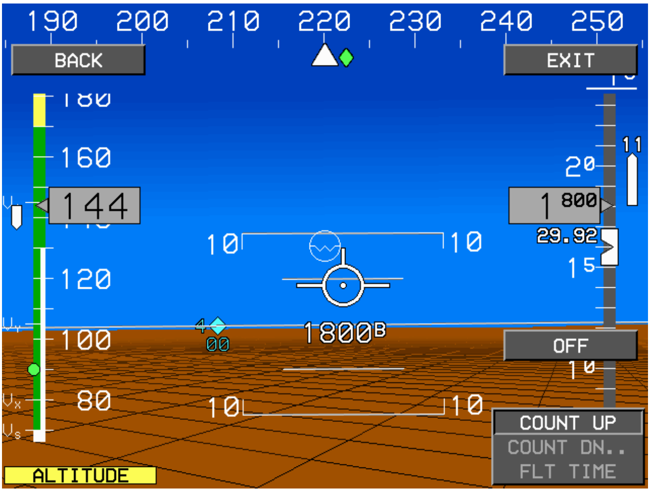


5. **To change the CDI scale manually,** select the **OBS . .** menu

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.

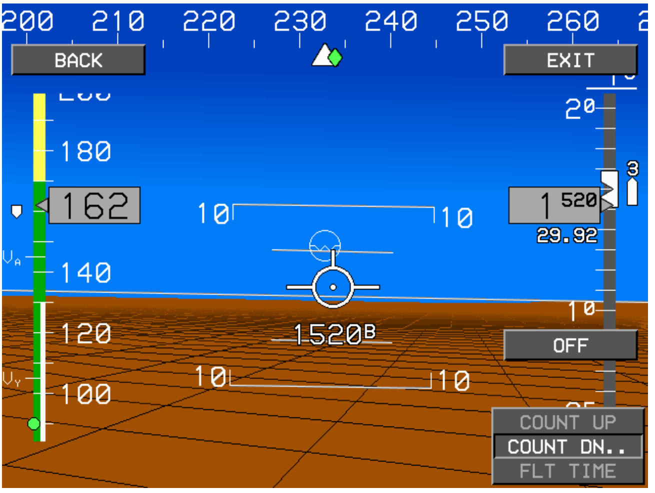


A count-up timer will be centered above the flight path marker on the PFD and below the zulu clock on the moving map.

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). 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.

Turning the Timer Off

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, 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 warble.
HEADING

Turn Heading Bug Off

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

Specify a Target Altitude

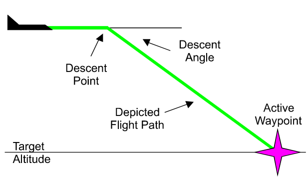
1. Press the **MENU** button while on the PFD display page.
2. Press the **BUGS . .** menu.
3. **TGT ALT . .** will be highlighted, push to enter.
   Current altitude, rounded to the nearest 10 foot increment in the approach phase and nearest 100 foot increment in the enroute and terminal areas will 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 the SYNCH button 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.

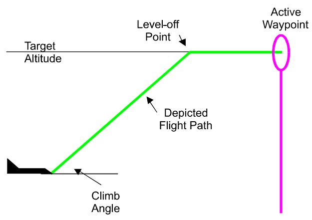
If a lower target altitude is selected, the skyway will maintain the current altitude until the preprogrammed VNAV descent angle will take the aircraft over the next waypoint at the target altitude:

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.

If coupled with the Chelton Flight Systems autopilot, the EFIS will command the autopilot to climb/descend to or maintain the target altitude.

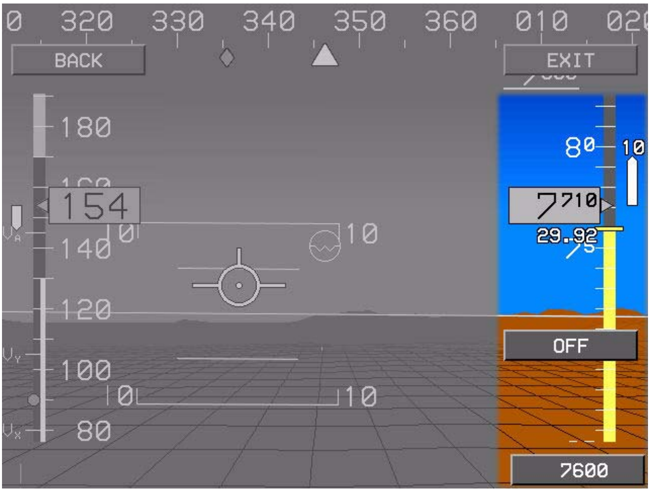
AUDIBLE ANNUNCIATION
Deviation more than 150 feet from target altitude will result in an amber caution flag and a single voice warning of "Altitude. Altitude."

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.

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 the SYNCH button 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 warble.
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

1. Push the control knob to advance to the next display. The order is PFD followed by the Navigation Display.

Show/Hide Terrain (PFD)

1. Press the **MENU** button.
2. Select the **DCLTR . .** menu.
3. Turn the control knob to select **TERRAIN**.
4. Push control knob to turn terrain on or off (a check mark indicates terrain ON)
5. Turn the control knob to select **DONE** and push to enter.

   Note: Terrain and obstructions are controlled simultaneously.

Show/Hide Terrain (ND)

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 **TRAFFIC** and push to enter.
5. Turn the control knob to select **TERRAIN**.
6. Push control knob to turn terrain on or off (a check mark indicates terrain ON)
7. Turn the control knob to select **DONE** and push to enter.

   Note: Terrain and obstructions are controlled simultaneously.

Scale the Moving Map

1. Turn the control knob clockwise to zoom in and counterclockwise to zoom out. Map scales available are 0.5, 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.

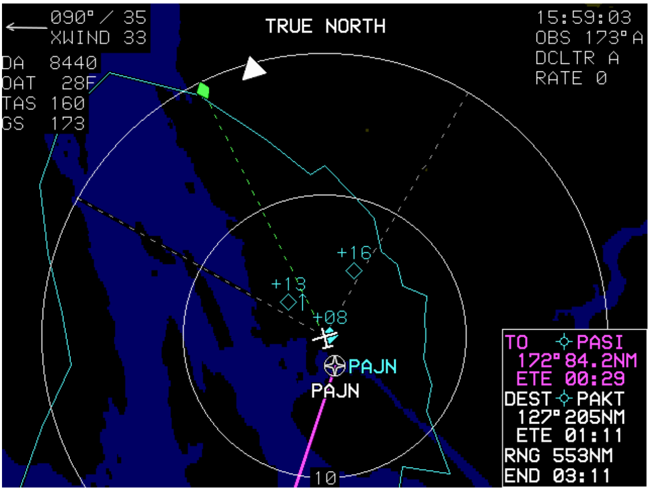
Centered or Arc Format

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).

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 **AUTO** or **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.

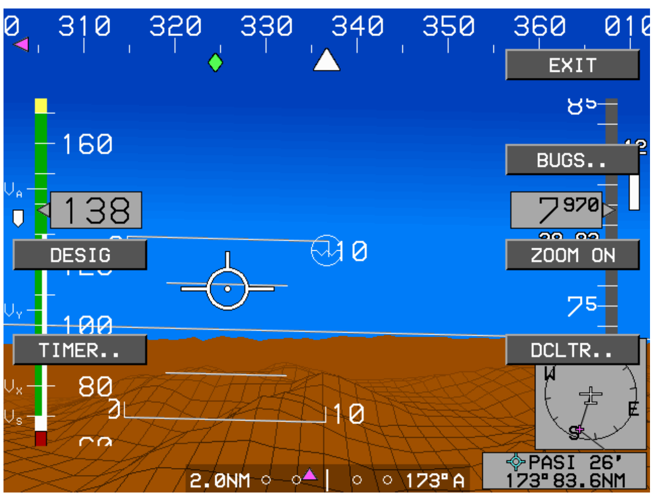
Auto Declutter (moving map)

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 list of PFD elements will be displayed.



3. Turn control knob to highlight elements and push to enable or disable elements.

A check mark after an element indicates it is enabled.

Note: Declutter settings will be saved upon system shut-down.

Setting Fuel Quantity

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.
4. Push control knob to enter.

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

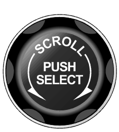
1. Begin by powering up the EFIS. The system will perform a self-test routine (approximately 45 seconds) and then display the PFD (Primary Flight Display).

   ***Note:** Allow the system to initialize for 90 seconds before taxiing to ensure proper initialization of the AHRS.*

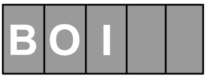
RIGHT

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.

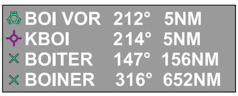
3. Press the Direct-To button to enter a destination.



4. Use the control knob (turn to select, push to enter), to enter the desired waypoint.

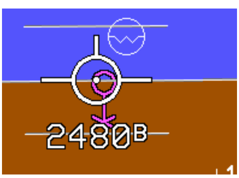


For example: To enter the Boise airport, turn to select “**B**” then push to enter; turn to select “**O**” then enter; turn to select “**I**” then enter. Push two more times to step through the last two character spaces.



If there is no exact match, a list of potential matches will be displayed. In this example, there are five navaids beginning with “BOI.”

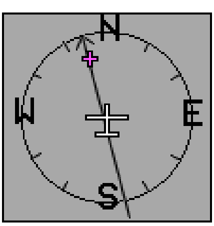
5. Turn control knob to select the desired waypoint, then push to enter. An exact match will be accepted and entered automatically.



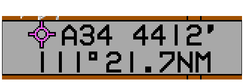
6. The selected navaid will be entered as your waypoint and identified as a tethered balloon on the PFD screen.

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.

PUSH

7. Push the control knob to step through the screens on the MFD as follows:

   PFD → moving map → engine monitor → PFD

   (Note: the PFD cannot be changed)

TURN

8. When on the moving map page, turn the control knob clockwise to zoom in and counterclockwise to zoom out (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 refer to the **Menu Functions** and **Step-by-Step Procedures** sections for details 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-C145/146 and may be used for 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).

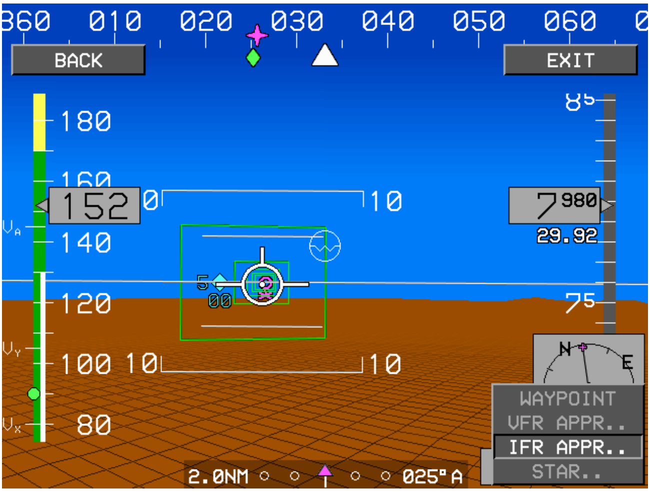
The Chelton EFIS PFD (primary flight display) and ND (navigation display) guide you through every step of the approach using extremely precise 3-D skyway symbology. The system automatically sequences through each leg, up to the missed approach point (MAP), and through the complete missed approach procedure if necessary 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

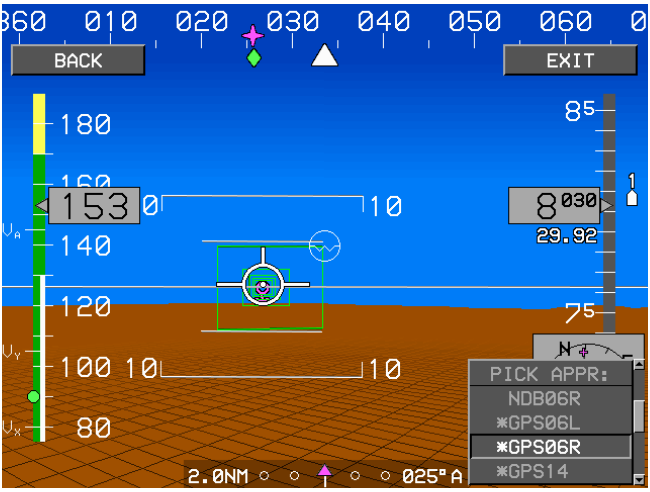
All approach operations will typically begin with the same basic steps:

1. You must have an active waypoint (either selected from a flight plan **or** entered using Direct-To or Nearest).
2. Press the **ACTV** button.
3. Turn the control knob to select the desired waypoint and press to enter.

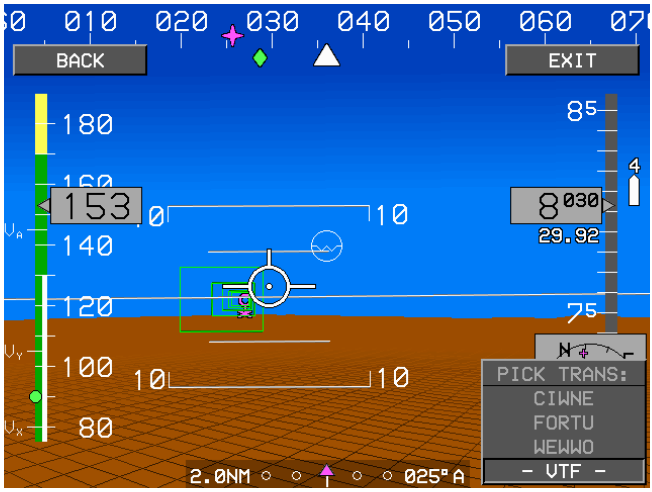
4. Choose **IFR APPR . .**



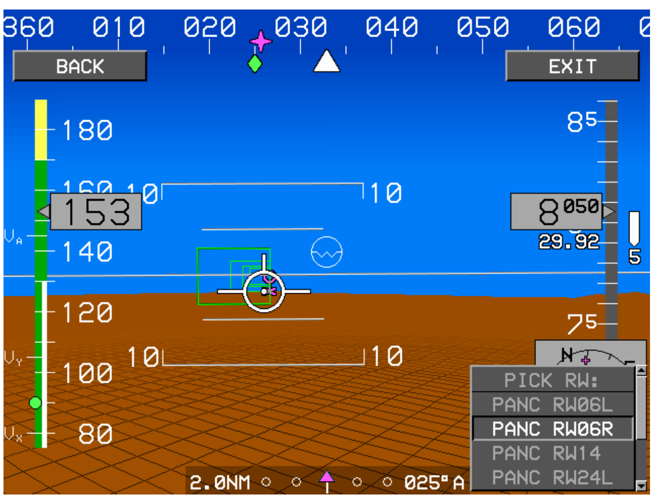
5. Choose the desired **approach (APPR)**.



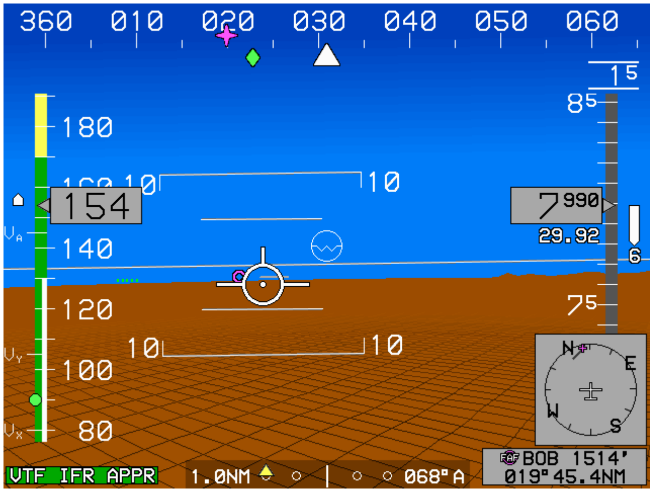
6. Choose the desired **transition (TRANS)** or **vectors to final (VTF)**.



7. Choose the desired **runway (RW)**.



The approach is now enabled. The PFD will now show that an IFR approach is active.



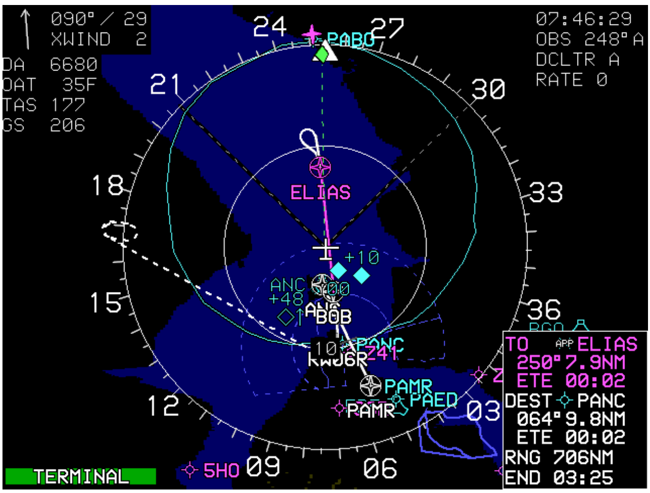
"Where'd the boxes go?

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 extended runway centerline. 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, an "IFR APPR" flag appears to annunciate that the EFIS is in terminal mode and automatic CDI scaling gradually transitions from 5 NM (enroute) to 1 NM (terminal).

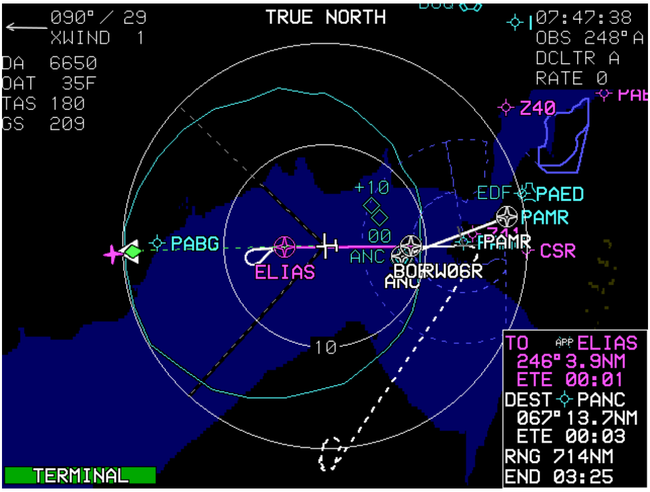
The first waypoint will be displayed conformally on the Primary Flight Display (PFD) and the crossing altitude will be automatically entered as the target altitude. The fix, distance, bearing, and crossing altitude will be displayed in the waypoint information box in the lower-right corner of the PFD.

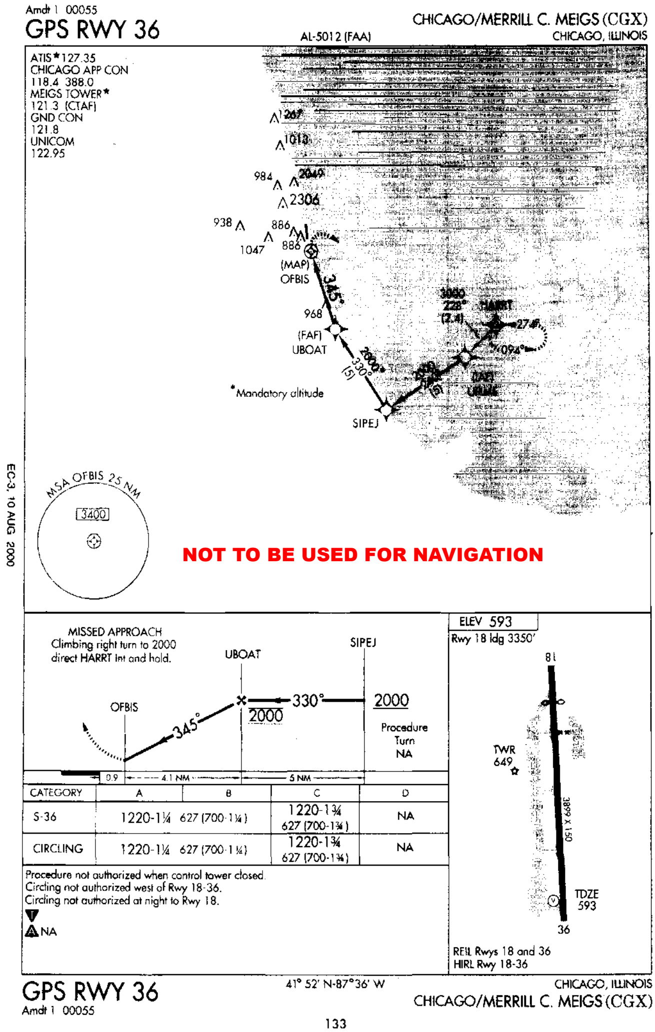
The EFIS will automatically sequence through approach waypoints as the approach is flown. The approach procedure will appear on the navigation display as solid white lines, with the active leg displayed in magenta. The missed approach procedure will appear on the navigation display as dashed lines. The 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 loose them from the PFD, just look for the magenta line on the moving map. Also, remember that the all turns in a procedure are actual size based on a 20° 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 turn guidance.

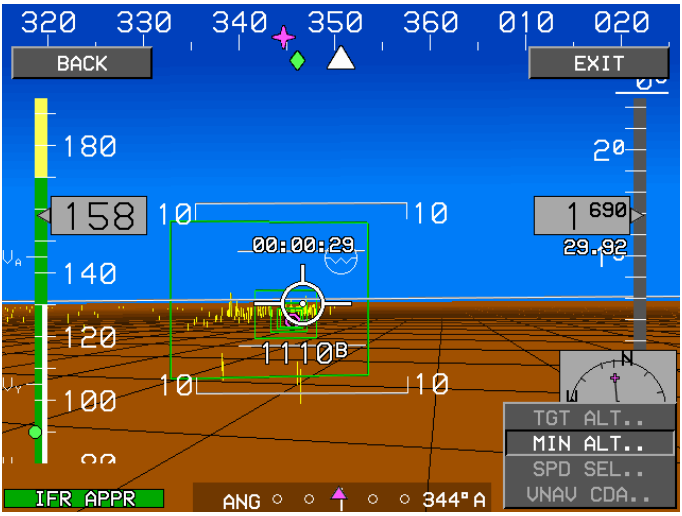


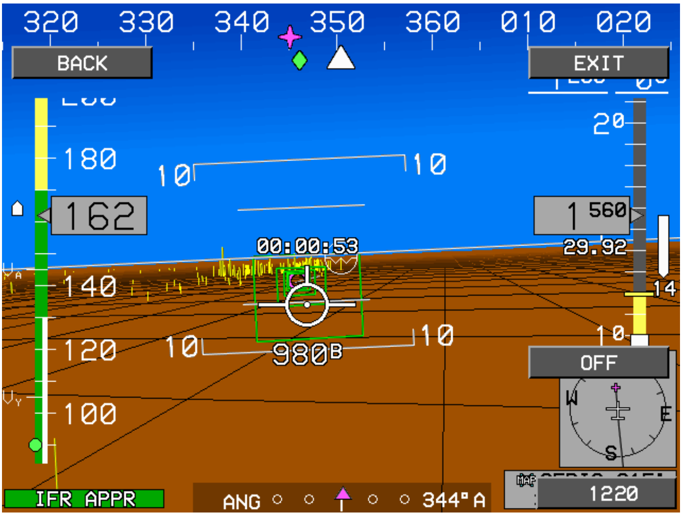


Chicago Meigs Field approach plate

(Refer to this plate as you read the next few pages.)

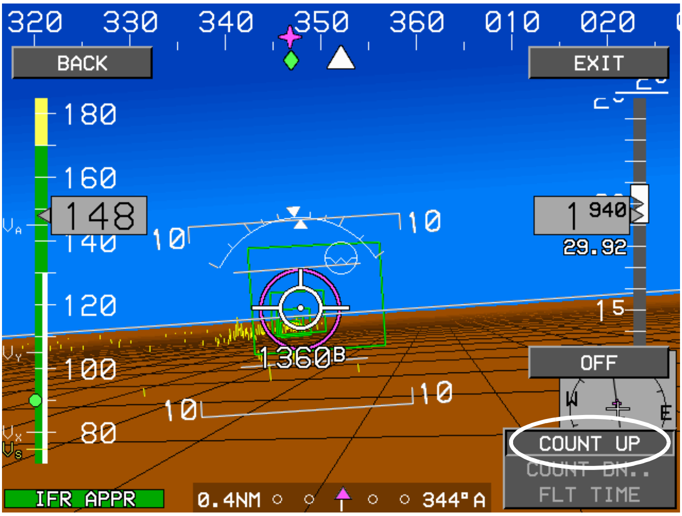
As the approach is flown, target altitudes will be automatically updated. However, the minimum altitude bug must be set manually according to the MDA or DH as specified on the published instrument approach plate.





Within 2 NM of the Final Approach Fix, automatic CDI scaling gradually transitions from 1 NM (terminal) to 0.3 NM (approach).

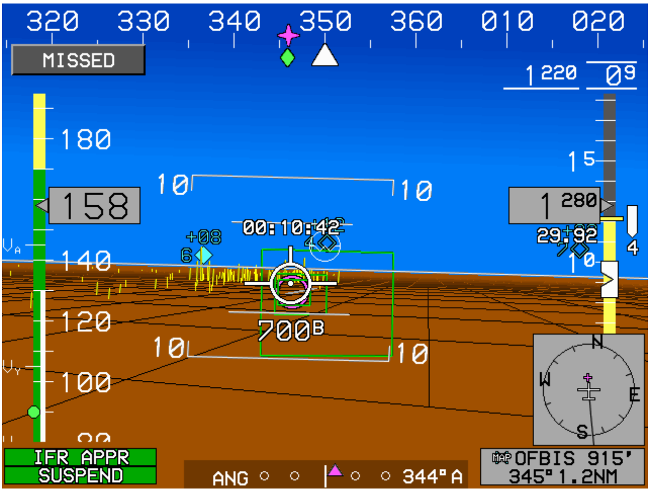
Use the **TIMER . .** function (count up or count down) for approaches that require timing from the Final Approach Fix to the Missed Approach Point.



Once past the Final Approach Fix, waypoint sequencing automatically suspends so as to provide CDI guidance along the extended final approach course past the Missed Approach Point. Suspend is annunciated with a green advisory flag.

The runway depiction, with associated skyway, aids in visualizing the runway environment, especially in situations where the final approach course is at some angle from the runway heading.

Neither the Missed Approach Point waypoint symbol (magenta tethered balloon) nor an associated target altitude is shown so that the depicted runway can be seen more clearly. Refer to the minimum altitude bar for MDA and DH guidance.



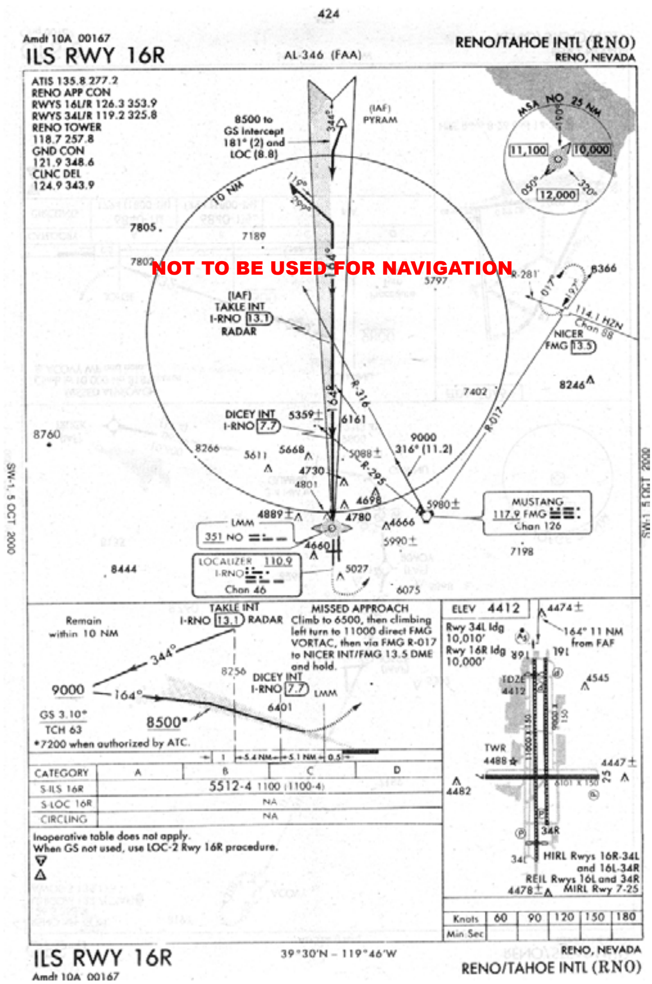
Approaches with Procedure Turns

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.

This example 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. Prior to arrival, the destination is selected using the **DIRECT or NRST** button or by creating a flight plan with Reno Regional as waypoint in the route.
2. While enroute to KRNO, 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. The active waypoint will be displayed; press the control knob to enter and view airport information. If the destination airport is not the active waypoint, simply enter the airport identifier and continue. Turn the menu control knob to view the desired information. Press the control knob to exit the airport information box (it can be left open without hindering the display).
3. From ATIS, you learn that runway 16R is in use and plan your approach accordingly.
    a. Press the **ACTV** button, turn the control knob to highlight **KRNO** and push to enter the selection.
    b. Turn the control knob to highlight **IFR APP . .** and push to enter the selection.
    c. Turn the control knob to highlight **ILS 16R** and push to enter the selection.
    d. Turn the control knob to highlight the desired transition **FMG** (Fallon Mustang VOR) and push to enter the selection.

e. Turn the control knob to highlight the desired runway (**KRNO RW16R**) and push to enter the selection. The approach will now be entered and displayed as a white courseline on the moving map; the active leg will be magenta.



Reno/Tahoe Intl — ILS Rwy 16R

Flying the Procedure Turn

1. With the KRNO ILS 16R approach selected using the FMG transition, within 30 nautical miles of the destination airport, the display will switch from “enroute” mode to “terminal” mode. The switch to terminal mode is accompanied by a gradual Course Deviation Indicator (CDI) scale transition from 5.0 to 1.0 NM, full scale deflection shown on the PFD or on the HSI format.

2. 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. When finished, press **EXIT** to remove menus from the screen.

3. 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 ND moving map. Distance, bearing and ETE will appear in the bottom right corner Nav Log. Waypoints will sequence automatically as the flight progresses. Skyway boxes will connect the way-points to guide you through the entire procedure.

4. As you approach the procedure turn and pass over the way-point, the procedure turn segment becomes active and is displayed in magenta on the ND. Skyway boxes continue to guide you through the turn back to the final approach fix.

5. Within 2NM 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 Course Deviation Indicator (CDI) scale transition from 1.0 to 0.3 NM, full scale deflection shown on the PFD or on the HSI format. Skyway boxes display appropriate descent and altitudes for the approach.

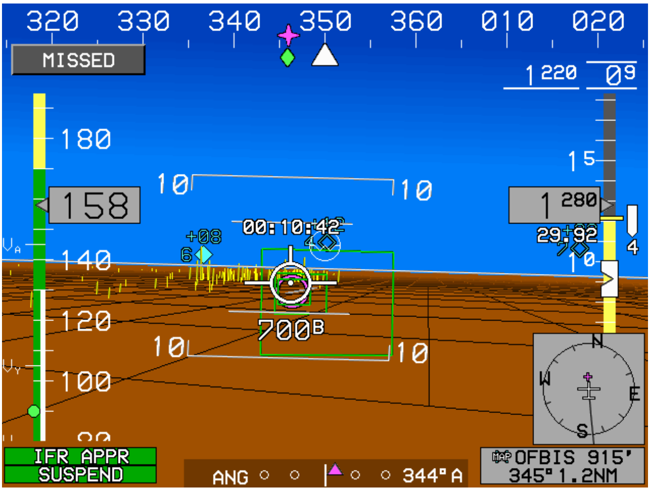
6. As you cross the FAF, the destination sequences to the MAP (missed approach point; RW16R in this example). Continue flying through the skyway toward the MAP. The **MISSED** menu button will be shown in the upper left corner of the PFD and the ND after crossing the FAF.

Pressing the **MISSED** menu button arms the missed approach procedure. Even though **waypoint crossing altitudes are automatically entered** from the Jeppesen database, always observe the altitude minimums dictated by the approach plate. **Decision height or minimum descent altitude MUST** be **determined** using the approved instrument approach charts and **entered as a minimum altitude bug.**

7. If the **MISSED** was armed, automatic waypoint sequencing is continued after crossing the FAF with the first waypoint of the missed approach procedure becoming active.

Missed Approaches

Upon passing the Final Approach Fix, **MISSED** appears in the upper left hand corner.



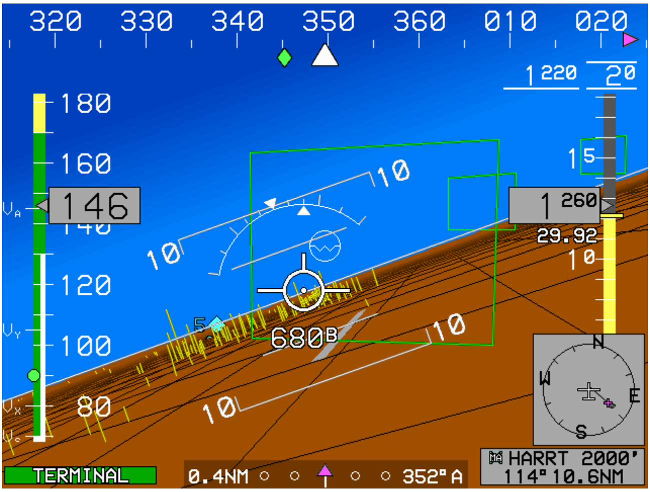
Pressing the **MISSED** menu arms the missed approach.

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 exits the approach mode, changing automatic CDI scaling from 0.3 NM to 1 NM.

Auto sequencing is re-enabled.

Most missed approaches end with a holding pattern. As with any holding pattern, waypoint sequencing is suspended and must be re-enabled by manually sequencing to another waypoint using the **ACTV** menu.



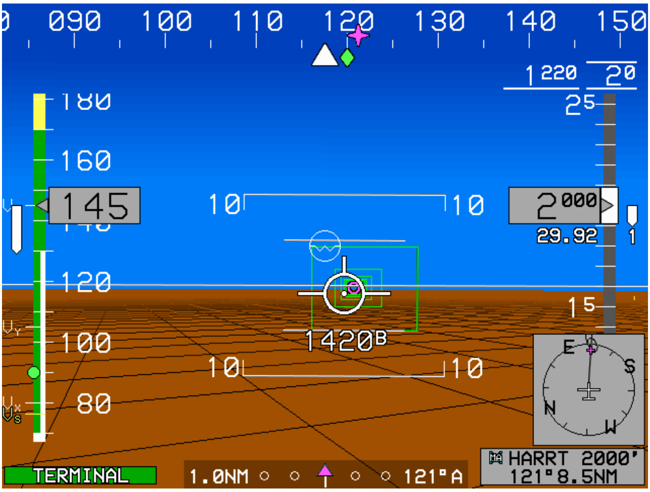
NOTE: Any time prior to the Missed Approach Point, it is possible to ***activate the missed approach*** *by manually selecting the first waypoint of the missed approach procedure using the* **ACTV** *menu.*

Flying A Missed Approach

As you pass the MAP (missed approach point) the EFIS continues to give guidance along the extension of the final course segment. If the runway environment is not in sight and you execute a missed approach, you manually initiate the missed approach procedure by pressing the missed menu button. (It will appear in the upper right corner of the display)

The **MISSED** button is used to initiate the missed approach as follows:

1. Press the **MISSED** menu button. The active waypoint is now automatically sequenced to the first waypoint of the missed approach procedure and will be displayed on the primary flight display. The active leg will be displayed on the ND moving map with distance, bearing and ETE (estimated time enroute) appearing in the bottom right corner Nav Log. Waypoints will sequence to the next segment as the flight progresses. 3-D skyway boxes will lead from the missed approach point to the end of the procedure (usually a holding pattern). The appropriate holding pattern entry will be depicted.



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 the 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 approach (or another approach) press the **ACTV** button to select the approach or press the **FPL . .** menu, **NRST** (nearest) button, or **D→** (direct-to) button to select another destination.

Instrument Departure Procedures (DP)

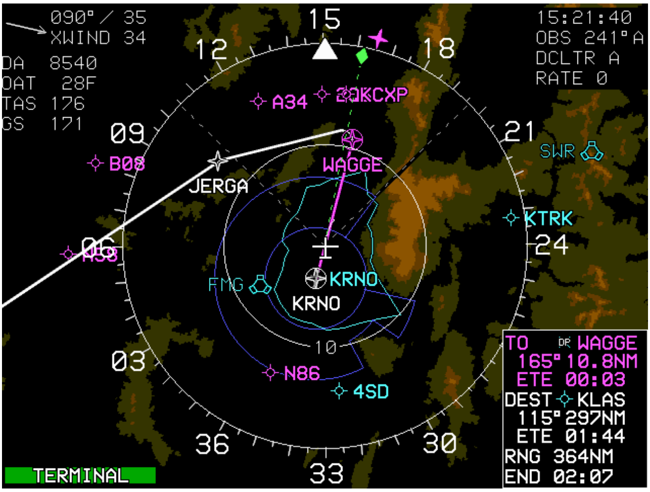
A DP is a coded departure route established at busier airports to facilitate clearance delivery procedures. There are two types of DPs: Pilot Navigation and Vector.

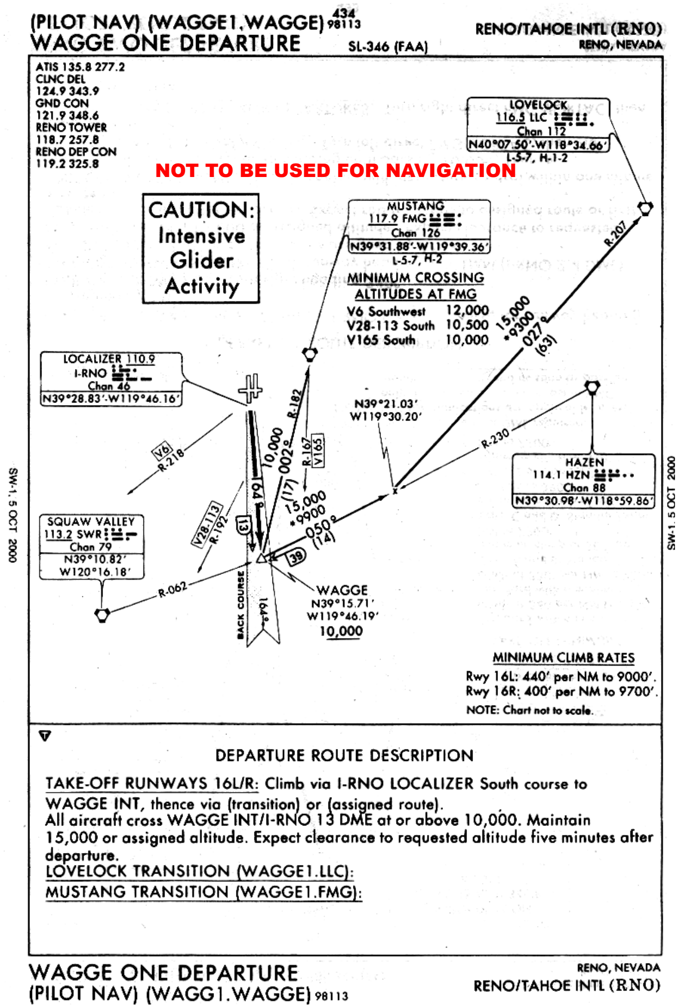
- **Pilot Navigation** – The pilot is primarily responsible for navigation along this kind of route. Terrain and safety-related factors usually call for pilot navigation DPs. These may contain vector instructions, that pilots are expected to comply with, until instructions are given for resuming normal 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 EFIS database.

To select and display a DP

1. 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.
3. Turn the control knob to highlight the departure **airport**, then push to enter the selection.
4. Choose **DP . .**, then push to enter the selection (if **DP . .** is not shown, no pilot nav departure exists for that airport).
5. Choose the desired **DP** from the list, then push to enter the selection.
6. Choose the desired **transition (**if applicable) from the list, then push to enter the selection.
7. Choose the desired **runway** from the list, then push to enter the selection.

The departure procedure transitions and runway will be displayed on the PFD and on the ND. The following is an example of a departure procedure and transition shown on the ND.





Reno/Tahoe Intl. — DP

To fly the DP

Prior to departure, select **DP . .** from the **ACTV** menu as described above. Activate the **Wagge One Departure**.

The DP will now be entered and displayed as a white courseline on the moving map. The active leg will be displayed in magenta.

Course guidance will be provided on the PFD as a 3-D skyway and waypoint symbol depicting the course and active waypoint, with CDI reference displayed on the bottom of the display. 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 ND. The active waypoint will automatically sequence to the next waypoint as the active waypoint is crossed.

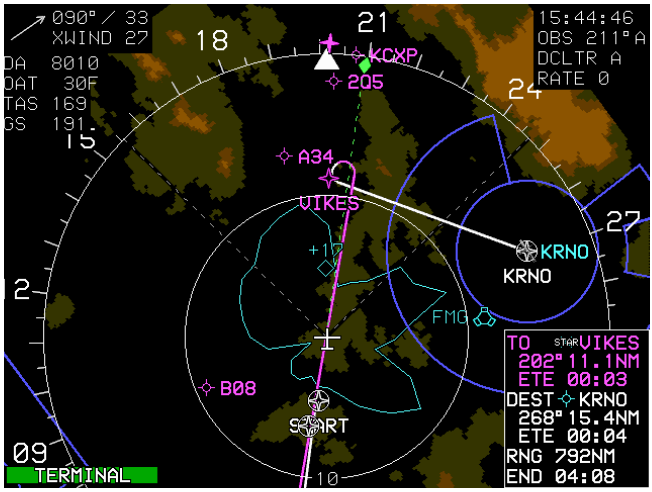
DPs normally terminate at an enroute waypoint. As the DP limit is reached, the active waypoint will sequence to the continuation of the active flight plan.

Standard Terminal Arrival Routes (STARs)

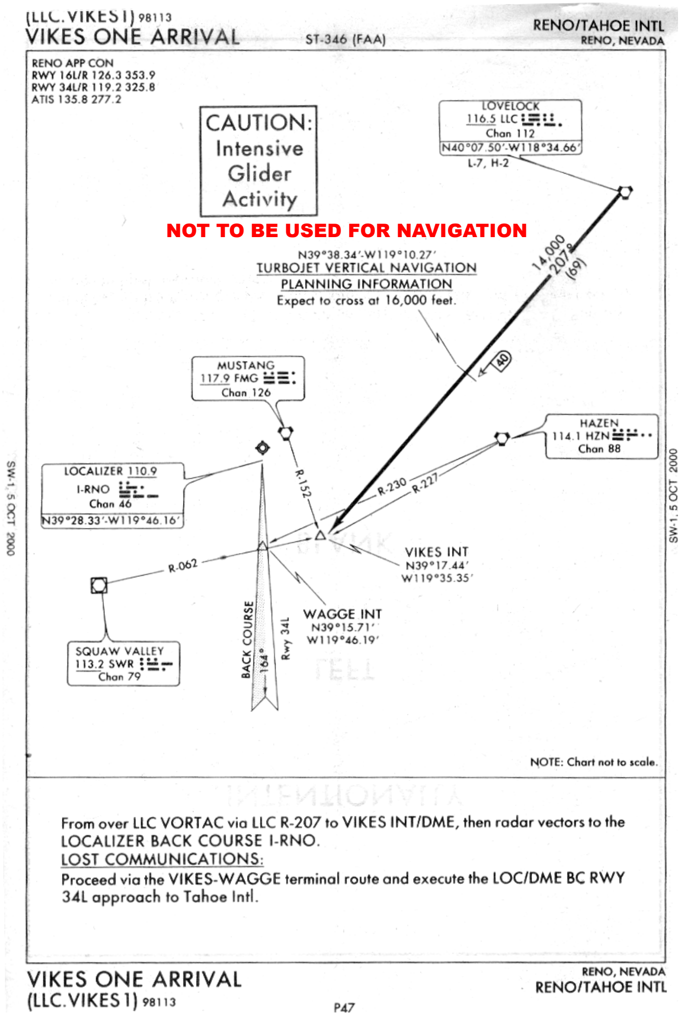
STARs are ATC coded IFR arrival routes established at busier airports to facilitate arrival and approach procedures. To select and display a STAR:

1. You must have an active waypoint (an airport selected from a flight plan or entered using Direct-To or Nearest).
2. Press the **ACTV** button.
3. Turn the control knob to highlight the desired **airport**, then push to enter the selection.
4. Choose **STAR . .** then push to enter the selection.
5. Choose the desired **STAR** from the list, then push to enter the selection.
6. Choose the desired **transition** (if applicable) from the list, then push to enter the selection.
7. Choose the desired **runway** from the list, then push to enter the selection.

8. The STAR will be entered and displayed as a white course-line on the moving map; the active leg will be displayed in magenta.



9. Waypoints in the procedure may be reviewed at any time by pressing the **ACTV** button.



Reno/Tahoe Intl — Vikes One Arrival (LLC.VIKES1)

To fly the STAR

1. Prior to arrival, press the **ACTV** button, turn the control knob to highlight the desired **airport** (**KRNO**), and push to enter the selection.

   - Turn the control knob to highlight **STAR . .** and push to enter the selection.
   - Turn the control knob to highlight the desired **STAR** (**VIKES1**) and push to enter the selection.
   - Turn the control knob to highlight the desired **runway** (**KRNO RW16R**) and push to enter the selection.

   The STAR will now be entered and displayed as a white courseline on the moving map; the active leg will be displayed in magenta.

2. Thirty miles from the destination, course guidance will switch from the enroute mode to the terminal mode with the CDI scale transitioning from 5.0 to 1.0 NM full scale deflection.

3. Course guidance will be provided on the PFD as a 3-D skyway and waypoint symbol depicting the course and active waypoint, with CDI reference displayed on the bottom of the display. The ND will depict the courseline with the active leg displayed in magenta. Skyway boxes will connect waypoints throughout the procedure.

4. Fly to the active waypoint on the PFD by guiding the flight path marker though the skyway boxes, thereby keeping the CDI needle centered. Monitor your position along the courseline on the ND. The active waypoint will automatically sequence to the next waypoint as the active waypoint is crossed.

5. STARs normally terminate at a fix near the airport, then a radar vector or feeder route is used for transition to the approach phase. As the STAR limit is reached, press the **ACTV** button to choose the type of approach desired to complete the flight.

Flying a DME Arc Approach

The GPS overlay for a DME arc approach uses additional Jeppesen-provided 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:

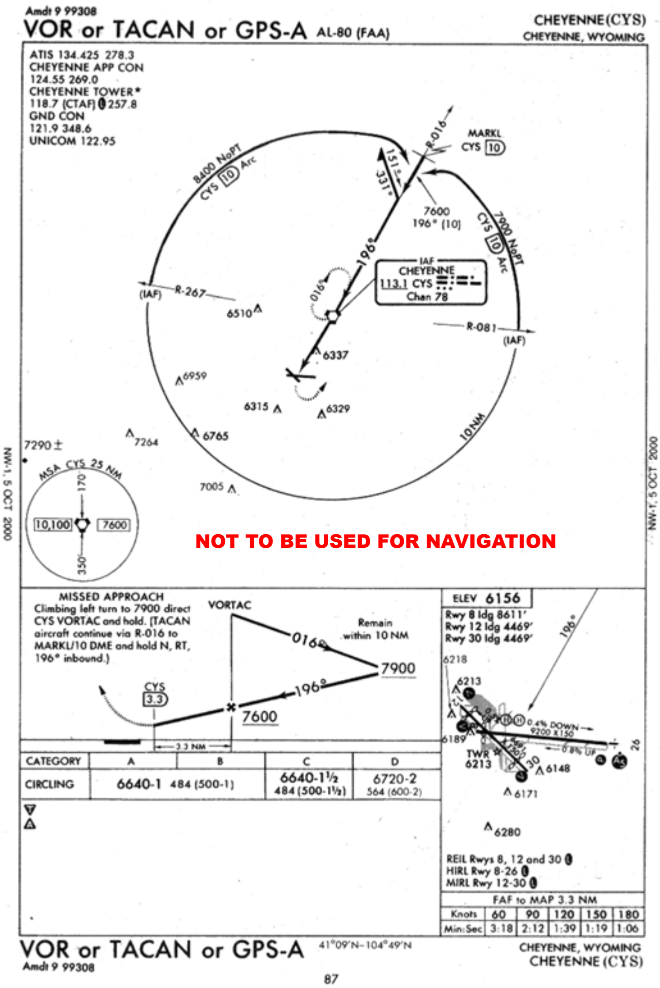
"D258G" indicates a DME waypoint ("D") on the 258 degree radial at 7 DME ("G", the seventh letter of the alphabet.)

NOTE
For additional information on waypoint names, see ***Jeppesen NavData Chart Compatibility*** *in the Appendix.*

When you are cleared for a DME arc approach, you may do either of the following to intercept the arc:

- Follow a specific radial inbound to intercept the IAF.
- Follow ATC vectors which allow you to intercept the arc at any point along the arc.

CHELTON FLIGHT SYSTEMS



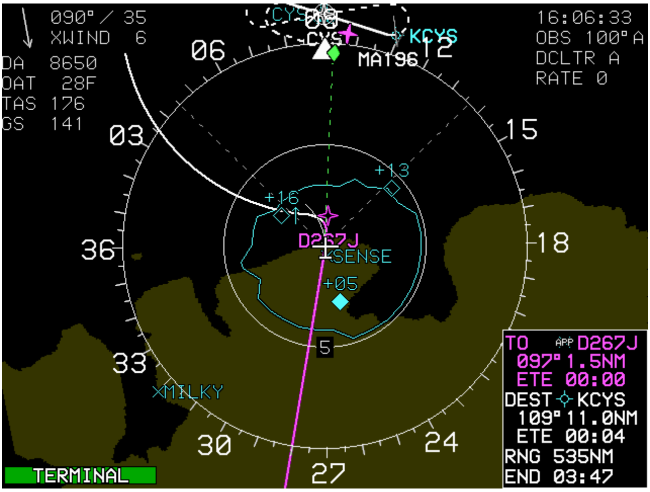
Cheyenne, Wyo — VOR or GPS-A with 10-mile DME arc

Flying the arc

1. Prior to arrival, the destination is selected using the D→ (direct-to) button, **NRST** button, or by creating and activating a flight plan to the destination airport (Cheyenne, Wyoming in this example).

   - Press the **ACTV** button, turn the control knob to highlight the desired airport and push to enter the selection.
   - Turn the control knob to highlight **IFR APP . .** and push to enter the selection.
   - Turn the control knob to highlight **VOR A** and push to enter the selection.
   - Turn the control knob to highlight the desired transition (**D267J**) and push to enter the selection.
   - Turn the control knob to highlight the desired runway (**KCYS RW08**) and push to enter the selection.

   The approach will now be entered and displayed as a white courseline on the moving map; the active leg will be magenta.



2. Within 30 miles of the destination, course guidance will switch from the enroute mode to the terminal mode with the CDI scale transitioning from 5.0 to 1.0 NM full scale deflection.

3. Course guidance will be provided on the PFD as 3-D skyway boxes and a tethered balloon depicting the waypoints around the arc with CDI reference displayed on the bottom of the display. The ND will depict the courseline with the active leg in magenta.

4. Follow the arc by guiding the flight path marker through the skyway boxes, thereby keeping the CDI needle centered.

5. At 2.0 nautical miles from the FAF, the EFIS will switch from terminal mode to approach mode. CDI scaling will be reduced from 1.0 to 0.3 NM, full scale deflection.

6. As you cross the FAF, the skyway provides 3-D guidance to the missed approach point. **Be sure to observe the altitude minimums depicted on the approach plate.**

Vectors to Final

When “vectors to final” (**-VTF-**) is selected, the navigation display will present the entire approach from the FAF, with the active waypoint set as the FAF (final approach fix) and navigation information updated to navigate to that point. Vectors are flown to intercept the final approach course. As the course is intercepted, the active waypoint sequences to the next waypoint, until the missed approach point is reached, and sequencing is suspended.

If the active leg does not automatically sequence upon initial interception, simply activate it from the **ACTV** menu.

If the approach is missed, the **MISSED** menu button (shown in the upper left corner of the PFD and ND after passing the FAF) must be armed to activate course guidance for the missed approach procedure.

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.

TAWS Functions

General Description:
The 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 (helicopter TAWS). Functions provided by TAWS are:

1. Terrain Display: Display of terrain and obstacles on both the PFD and MFD.
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 glide path 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 pi-

lot when descending into terrain without properly configuring the aircraft for landing.

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. 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			

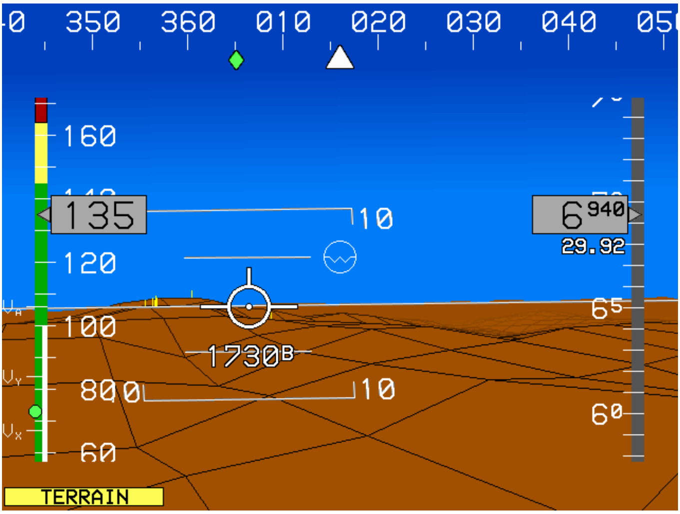
Notes:RG + F = Retractable Gear with Defined Landing Flaps Position
RG= Retractable Gear
FG + F= Fixed Gear with Defined Landing Flaps Position
FG= Fixed Gear

Detailed operations of the TAWS functions are described in the following sections.

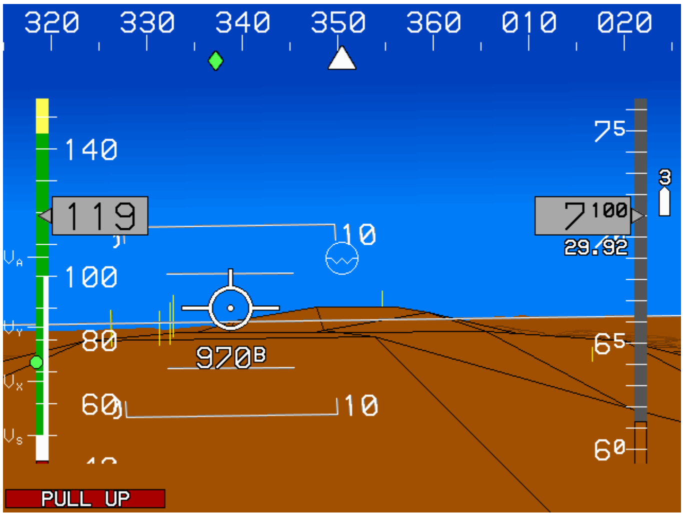
Terrain Display:

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:

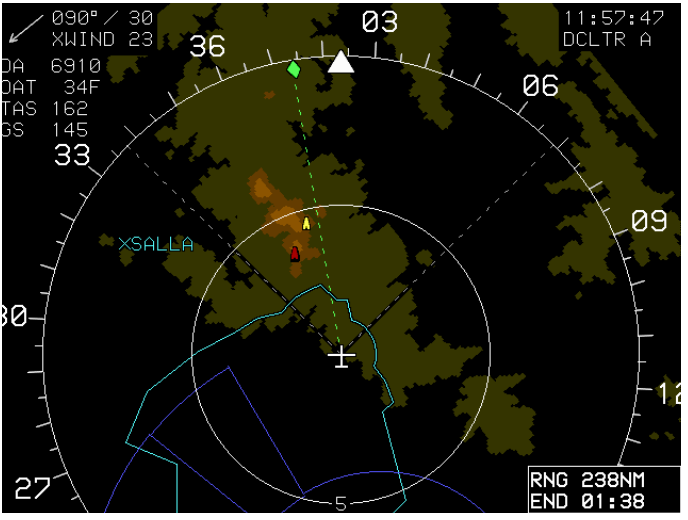


Above: TAWS Caution on PFD.

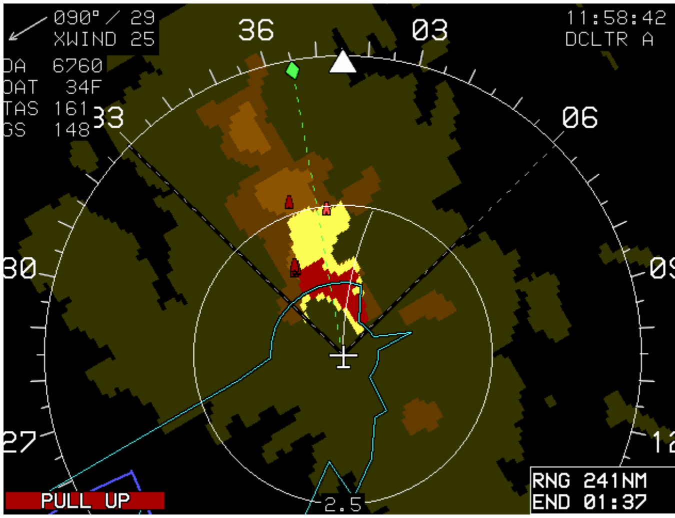


Above: TAWS warning on PFD.

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 navigation 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:
This function is present in all systems. The FLTA function uses a terrain database, an airport and runway database, aircraft posi-

tion, aircraft track, aircraft groundspeed, aircraft bank angle, aircraft altitude and aircraft vertical speed information to alert the pilot to hazardous terrain within a search envelope in front of the aircraft.

FLTA Modes:
The EFIS FLTA mode is either slaved to the GPS/WAAS navigation mode or is set automatically based upon default mode logic. Mode selection is described below:

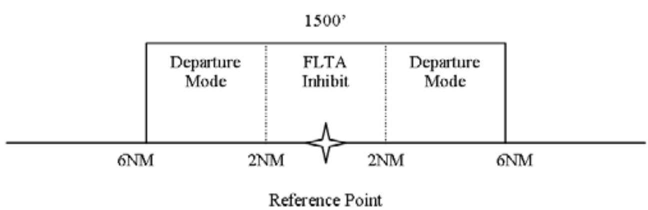
GPS/WAAS Navigation Mode Slaving

The EFIS performs TSO-C146 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 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. When the default FLTA mode is not Departure and the GPS/WAAS navigation mode is Terminal, Departure, IFR Approach or VFR Approach, the FLTA mode is slaved to the GPS/WAAS navigation mode. When slaved, the GPS/WAAS active runway threshold or user waypoint becomes the reference point for automatic FLTA inhibiting. The advantage of this scheme is that the GPS/WAAS navigation modes are a direct indication to the FLTA function of pilot intent. Thus, it prevents inappropriate desensitization when flying near runways that are not the intended landing runway. It also provides a mechanism for helicopter or bush pilots to desensitize the TAWS when conducting normal off-runway operations.

Default FLTA Mode

When not slaved to the GPS/WAAS navigation mode (i.e., GPS/WAAS navigation mode is Enroute or default FLTA mode is Departure), the default FLTA modes are as follows:

1. Departure Mode. This mode is enabled when on the ground (defined as indicated airspeed less than V_S (airplanes) / 40KIAS (rotorcraft) 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 ends upon climbing through 1500 feet above or traveling more than 6NM from the reference point. The Departure Mode takes precedence over any other mode including all GPS/WAAS navigation modes.



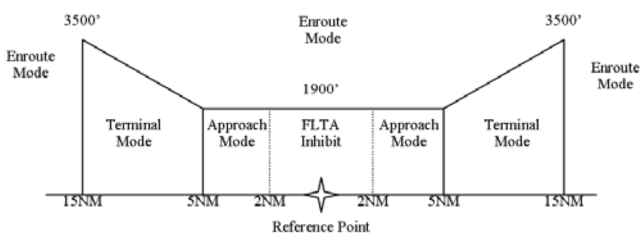
2. Other Modes. The remaining default FLTA modes (Enroute, Terminal and Approach) are automatically set when the GPS/WAAS navigation mode is Enroute. The reference point for automatic FLTA inhibiting and mode envelope definition is the nearest runway threshold. The TAWS system continuously searches all runway thresholds at the nearest airport to determine the nearest runway. The TAWS system performs a search

for the nearest airport every 3NM of distance traveled. Modes are as follows:

a. Approach Mode. This mode exists when within 1900 feet and 5NM 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 1900 feet (at 5NM) to 3500 feet (at 15NM) above the reference point.

c. Enroute Mode. This mode exists when not in any other mode.



<u>FLTA Search Envelope:</u>
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:

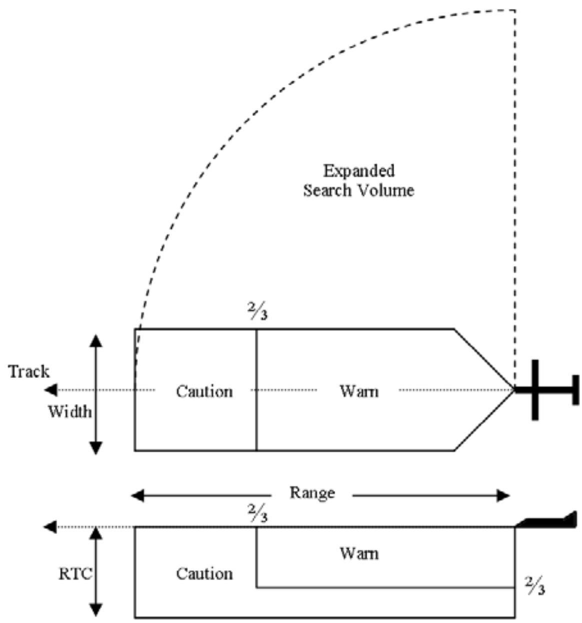
Aircraft Type	TAWS Class	Level-Off Rule	Range	Level RTC				Descending RTC			
				Enroute	Terminal	Approach	Departure	Enroute	Terminal	Approach	Departure
Airplane	A & B	20%	60sec	700'	350'	150'	100'	500'	300'	100'	100'
	C	10%		250'	250'			200'	200'		
Rotorcraft	A & B	10%	30sec	150'	150'	150'	100'	100'	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 2.6 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:

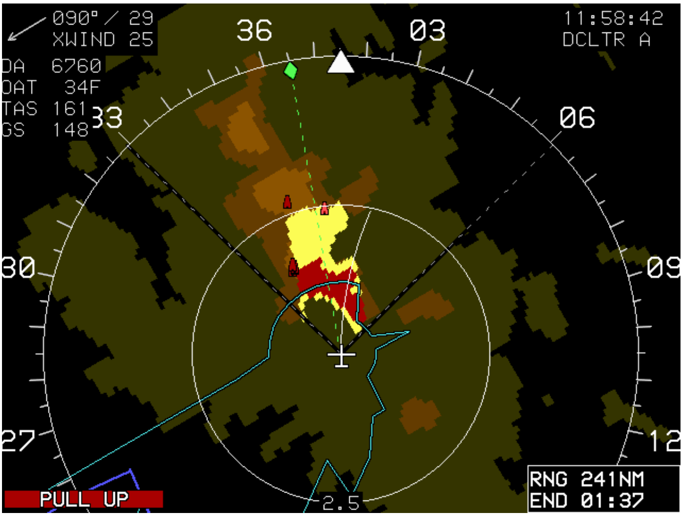


FLTA Alerts and Automatic Popup:

When terrain falls within the FLTA search envelope, either: (1) an amber TERRAIN caution flag in conjunction with a single Caution Terrain; Caution Terrain voice alert; or (2) a red PULL UP warning flag in conjunction with a repeating Terrain, Terrain; Pull Up, Pull Up voice alert is presented, depending upon severity (see areas designated caution vs. warn in search envelope depiction). In addition, an automatic popup mode is engaged as follows:

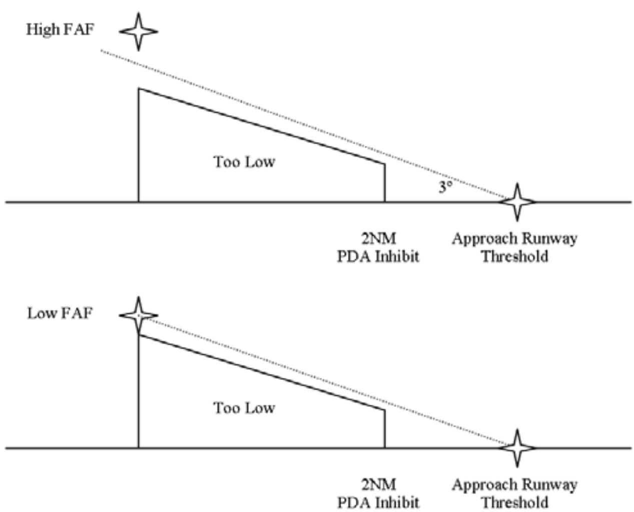
Primary Flight Display	Multi-Function Display
Terrain rendering enabled.	1. Display switched to navigation display. 2. Terrain rendering enabled. 3. Display switched to aircraft centered and heading up. 4. Scale set to 5NM (groundspeed < 200 knots) or 10NM (groundspeed > 200 knots). 5. Terrain elements generating cautions are colored amber. 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. 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 2500'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 initially pierced, an amber TERRAIN caution flag is presented in conjunction with a single Caution, Terrain; Caution, Terrain voice alert. If the aircraft remains within the GPWS Mode 2 envelope for longer than 3 seconds, a red PULL UP warning flag is presented in conjunction with a repeating Pull Up, Pull Up voice alert. 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 systems. 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, an amber TOO LOW caution flag is presented in conjunction with a single Too Low Terrain voice alert.

Flight into Terrain when not in Landing Configuration (GPWS Mode 4):
This function is present in Class A TAWS and HTAWS systems. 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 1000' 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 systems.

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 1000 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-II 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-II 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-II 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-II 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-II IDU. Each discrete is pulled to ground 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-II IDU. The flap position discrete is pulled to ground 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-II IDU. The TAWS Inhibit Switch is pulled to ground 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-II IDU. The Low Altitude Mode Switch is pulled to ground 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-II IDU. The

Audio Cancel Switch is momentarily pulled to ground 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-II IDU. The Glideslope Deactivate Switch is momentarily pulled to ground 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-II IDU. The low torque discrete is pulled to ground 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

Summary of Alerts:
The following table summarizes the cautions, warnings and advisories given by the EFIS TAWS system:

Alert Type	Caution		Warning	
	Visual (1)	Aural (2)	Visual (3)	Aural (4)
FLTA	"TERRAIN"	"Caution, Terrain; Caution, Terrain"	"PULL UP"	"Terrain, Terrain; Pull Up, Pull Up"
PDA	"TOO LOW"	"Too Low Terrain"		
GPWS Mode 1	"SINK RATE"	"Sink Rate"	"PULL UP"	"Pull Up, Pull Up"
GPWS Mode 2	"TERRAIN"	"Caution, Terrain; Caution, Terrain"	"PULL UP"	"Terrain, Terrain; Pull Up, Pull Up"
GPWS Mode 3	"TOO LOW"	"Too Low Terrain"		
GPWS Mode 4	"TOO LOW"	"Too Low Terrain," "Too Low Gear," or "Too Low Flaps"		
GPWS Mode 5	"GLIDE SLOPE"	"Glide Slope"	"GLIDE SLOPE"	"Glide Slope"
500 Foot Wake-Up		"Five Hundred"		

Notes:
1. Cautionary visual alerts are amber in color.
2. Cautionary aural alerts are annunciated once.
3. Warning visual alerts are red in color.
4. Warning aural alerts are repeated until the condition no longer exists or the pilot has manually actuated the Audio Cancel Switch.

Prioritization of TAWS alerts and other EFIS system alerts is covered in the Caution/Warning/Advisory System, page 11 of the System Overview section.

TAWS System 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 altitude) 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 an EFIS soft menu declutter control.
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 altitudes. 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 great circle 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 an AIP 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.

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 airdata, and all navigation. These data can be downloaded for review after a flight.

Data logging files are kept in the **c:\sierrafs\log** directory. Data from the last 21 flights are logged. 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). Data are logged every 5 seconds.

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.

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, LLC 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, LLC 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, LLC, 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, LLC 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, LLC product may be connected, attached, interconnected or used in conjunction with in any way.
3. The Obligation assumed by Chelton Flight Systems, LLC under this warranty is limited to repair, replacement or refund of the product, at the sole discretion of Chelton Flight Systems, LLC.
4. Chelton Flight Systems, LLC 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, LLC in connection with the sale of Chelton Flight Systems, LLC 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, LLC, 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, LLC 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.

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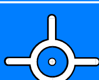
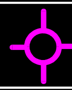
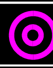
Quick Reference

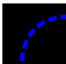
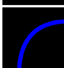
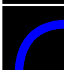
PFD Symbology

	Heading
	Bearing to Waypoint
	Groundtrack
	Heading Bug
	Direction to Waypoint
	Flight Path Marker
	Pitch Limit Indicator
	Waypoint Symbol
	Waterline (Nose Position)

ND 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