FlightLogic EFIS
Synthetic Vision Flight Display

Pilot's Operating Guide and Reference

Document 150-045240, Rev N

EFIS Software Version 6.0B or Later

Manual Part Number:
150-045240
09/02/08.ug6.0Bfm

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FLIGHT SYSTEMS

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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 where the pilot is removed from the information loop.

Your Chelton EFIS, on the other hand, was conceived and designed as a **"pilot-centered"** system. While still highly automated, 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. A good example is the Highway-In-The-Sky (HITS). HITS allows for highly automated approaches, but its predictive nature gives the pilot unprecedented awareness of upcoming maneuvers. 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 the FlightLogic 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 confidence 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.

FOR SAFETY OF FLIGHT, IT IS ESSENTIAL THAT YOU STUDY THIS ENTIRE MANUAL PRIOR TO FLYING WITH THE EFIS.

Using the Demonstration Application built into the EFIS, you can fly anywhere and perform any procedure (except takeoff and landing) that you can do in your aircraft. To use this feature:

1. With the power **OFF**, insert the data card into a display (gold side up).

2. Power the system **ON** and select the **RUN DEMONSTRATON/TRAINING APPLICATION** option using the control knob (turn to scroll, push enter).

Chelton Flight Systems Ground and Maintenance Functions:

```
Run Demonstrator/Training Program
Update Databases and Application
Download Log Files
Fuel Tank Calibration (Pilot-Side CPU#0/#1 Only)
View bitlog.dat
WX-500 Maintenance Utility (CPU#0/#1 Only)
TCAD Maintenance Utility (CPU#0/#1 Only)
Terrain Data Verification
Display Internal Temperature
Download Routes and User Waypoints
Upload Routes and User Waypoints
Delete Routes
Edit System Limits
Delete LOG Files
COM Port Inspector
ADAHRS Maintenance Utility (Pilot-Side CPU#0/#1 Only)
```

3. The demonstrator will begin flying over Reno, Nevada. Heading may be changed with the HDG button. Altitudes may be changed by setting a target altitude. Push Menu, then Bugs, then target altitude, then set the value with the control knob. Push to enter. Airspeed will remain relatively constant. The simulated aircraft may be positioned anywhere in the NAV database. By creating and activating a flight plan in training mode, any published procedure can

be practiced prior to flight. Switching back and forth from PFD to MFD is done by pushing the control knob. All appropriate NAV signals will be simulated, allowing for non-precision and precision approaches to be practiced. Localizer signals will normally be found on VLOC1 and VOR signals will be found on VLOC2. Very little power is consumed by one EFIS screen. This allows for training to be accomplished at any time in the aircraft prior to startup.

We recommend flying with a flight instructor prior to using the system. Professional instruction and recurrent training are highly recommended. Chelton Flight Systems utilizes a FITS (FAA, Industry Training Standards) accepted training curriculum and syllabus that comprises a minimum of 10.5 flight hours of dual instruction in addition to ground school. Copies of this syllabus may be obtained from the Chelton Flight Systems web site at no charge.

For a list of Chelton authorized flight instructors, please visit our website at www.cheltonflightsystems.com.

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

About this Guide

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

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.

Rotorcraft Display Symbology

The **Rotorcraft 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.

Button/Menu Functions

The **Button/Menu Functions** section shows a flow diagram and selection options for each button and 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 for a VFR familiarization flight 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 . . .
in conjunction with the Approved Flight Manual Supplement before you fly for the first time and for a quick refresher when needed.

IFR Procedures

The **IFR Procedures** 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 a complete Flight Manual Supplement and detailed discussions of TAWS functions.

Use this section . . .
to review normal and emergency procedures, operational tips, specifications, or other reference material.

Index

The **Index** section provides an alphabetical listing of terms used in the guide with corresponding page numbers.

Use this section . . .
for reference material.

Joe Pilot

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

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

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

Cobham Avionics
One S-TEC Way
Municipal Airport
Mineral Wells, Texas 76067
OR
Fax (940) 325-3904

Section 2

System Overview

General Description

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

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

| PFD | MFD |

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

their brightness can be adjusted independently of the screen. All lighting is night-vision goggle compatible.

Remote-mounted equipment consists of an AHRS (Attitude/ Heading Reference System), an ADC (Air Data Computer), a GPS WAAS receiver, and an optional AIU (Analog Interface Unit). In some installations, the ADC and AHRS may be combined in a single unit called an ADAHRS (Air Data / Attitude Heading Reference Unit).

The fixed-wing 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.

Rotorcraft systems include Class B rotorcraft TAWS. Class A rotorcraft TAWS is available as an option.

The EFIS complies with Advisory Circular AC 90-100A based on compliance with TSO-C146a Stand-Alone Airborne Navigation Equipment Using the Global Positioning System (GPS) Augmented by the Wide Area Augmentation System (WAAS).

System Configuration

Each display is driven by its own internal processor. A complete system consists of at least one display, a GPS receiver, an ADC, and an AHRS. 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.
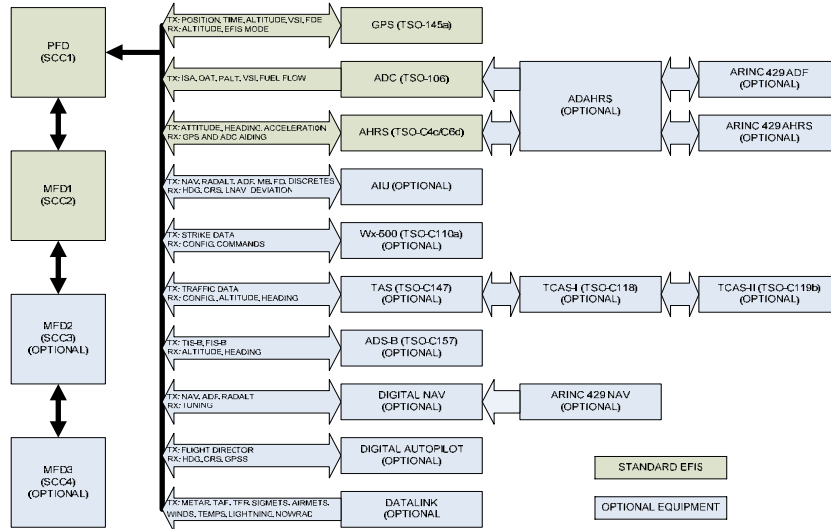
The systems may be configured with a backup battery on an essentials bus to provide power in the event of an electrical system failure.

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

Cold Soak Startup Instructions

When the internal temperature of the display units is below 0 degrees Celsius, the central processor unit is held in a reset condition and internal heaters are activated. These heaters remain on until the core temperature climbs above the cold start threshold. During this time the red light next to the Smart Media slot on the lower face of the display is lit. Heating times will range from seconds to several minutes depending on ambient temperature. If the aircraft has been idle for a period of time, the following is recommended:

• Preheat the aircraft flight compartment before applying power.

OR

• Allow the system to complete the warm up with internal heaters. Do not attempt to speed up the process by cycling power. Doing so will delay the process and add to the warm up time.

Operational Warnings

DO NOT FLY WITH YOUR CHELTON 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.

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!
WAAS OR FAULT DETECTION AND EXCLUSION (FDE) MUST BE AVAILABLE AT THE FINAL APPROACH FIX TO CONTINUE AN APPROACH.

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.

WARNING!
THERE ARE MANY TOWERS, ANTENNAS, AND
OBSTRUCTIONS THAT ARE NOT IN THE DATABASE.

WARNING!
THE VFR APPROACH FUNCTION DOES NOT PROVIDE
TERRAIN OR OBSTRUCTION CLEARANCE. EXTREME
CARE SHOULD BE TAKEN WHEN USING THE VFR
APPROACH FUNCTION AT NIGHT OR IN MARGINAL
VFR CONDITIONS

Acronyms and Abbreviations

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

AC	Advisory Circular
ACTV	Active
AD	Airworthiness Directive
ADAHRS	Air Data Attitude Heading Reference System
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADS-B	Automatic Dependent Surveillance-Broadcast
AFM	Aircraft Flight Manual
AFMS	Aircraft Flight Manual Supplement
AGL	Above Ground Level
AHRS	Attitude Heading Reference System
AIP	Aeronautical Information Publication
AIRMET	Airmen's Meteorological Information
AIU	Analog Input Unit
AMET-IFR	AirMET - IFR Conditions
AMET-ICE	AirMET - Icing Conditions
AMET-TURB	AirMET - Turbulence
AMLCD	Active Matrix Liquid Crystal Display
ANG	Angle
APPR	Approach
APV	Approach with Vertical Guidance
ARM	Arm (as in Arm an Instrument Approach)
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
BARO	Barometric
BIT	Built-In Test
BUG	Bug (settings)
CCFL	Cold Cathode Fluorescent Lamp
CDA	Climb and Descent Angle
CDI	Course Deviation Indicator
CDTI	Cockpit Display of Traffic Information
CELL	Cell, as in Thunderstorm Cell
CFS	Chelton Flight Systems
CLMB ANG	Climb Angle
CNX	Cancel
COM	Communication
COM1	Communication Radio #1
COM2	Communication Radio #2
CONT	Continue
CONV-SMET	Convective SigMET
CPM	Company Project Manager
CPU	Central Processing Unit

CRC	Cyclic Redundancy Check
CRS	Course
DA	Density Altitude or Decision Altitude (depending on context)
DCLTR	Declutter
DCND ANG	Decent Angle
DEC HT	Decision Height
DESIG	Designate
DEST	Destination
DH	Decision Height
DISCONT	Discontinuity
DIST	Distance
DL	Data Link
DME	Distance Measuring Equipment
DN	Down
DOD	Department of Defense
DOF	Digital Obstruction File
DP	Departure Procedure
DR	Dead Reckoning or Defect Report
DSP	Digital Signal Processing
ECHO-TOPS	Radar Echo Tops
EFIS	Electronic Flight Instrument System
EGPWS	Enhanced Ground Proximity Warning System
END	End
EQPMNT	Equipment
ETA	Estimated Time of Arrival
ETE	Estimated Time Enroute
FAF	Final Approach Fix
FAR	Federal Aviation Regulation
FAWP	Final Approach Waypoint – same as FAF
FDE	Fault Detection and Exclusion
FG	Fixed Gear
FIR	Flight Information Region
FIS	Flight Information Service
FIS-B	Flight Information Service-Broadcast
FITS	FAA, Industry Training Standards
FL	Flight Level
FLTA	Forward Looking Terrain Awareness
FMEA	Fault Mode and Effects Analysis
FMS	Flight Management System
FNCT	Function
FPL	Flight Plan
FPM	Feet per Minute
FSD	Full Scale Deflection
FT/NM	Feet per Nautical Mile
FTE	Flight Technical Error
G METAR	Graphical METAR
GLS	GNSS Landing System
GNSS	Global Navigation Satellite System

GPH	Gallons per Hour
GPS	Global Positioning System
GPSS	GPS Steering
GPWS	Ground Proximity Warning System
GS	Glide Slope or Ground Speed (depending on context)
GS1	Glide Slope #1
GS2	Glide Slope #2
HAL	HAL Horizontal Alert Limit
HAT	Height Above Threshold
HDG	Heading
HDG UP	Heading Up
HFOM	Horizontal Figure of Merit
HG	Pressure in Inches of Mercury
HIRF	High Intensity Radio Frequency
HITS	Highway in the Sky
HLOI	Horizontal Loss of Integrity
HLTH	Health
HPL	Horizontal Protection Level
HSI	Horizontal Situation Indicator
HTAWS	Helicopter Terrain Advisory and Warning System
HUD	Head Up Display
HUL	Horizontal Uncertainty Limit
IAP	Instrument Approach Procedure, *also* Initial Approach Point
IAS	Indicated Airspeed
IAWP	Initial Approach Waypoint – same as IAP
IC	Integrated Circuit
ICAO	International Civil Aviation Organization
ID	Identity or Identification
IDU	Integrated Display Unit
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IAP	Instrument Approach Procedure
IM	Inner Marker
IMC	Instrument Meteorological Conditions
IN	Inches
INFO	Information
INHBT	Inhibit
INIT	Initialization
ISA	Instrumentation Systems and Automation Society
ISR	Interrupt Service Routine
K	Kilo=1000
KB	Kilobyte
KIAS	Knots Indicated Airspeed
KT Knot	Knot – Nautical Mile per Hour
KTAS	Knots True Airspeed
LAT/LON	Latitude / Longitude
LDA	Localizer-type Directional Aid
LED	Light Emitting Diode

LNAV	Lateral Navigation
LOC	Localizer
LOI	Loss of Integrity
LPV	Instrument Procedure with Vertical Guidance
LRU	Line Replaceable Unit
LTNG	Lightning
M	Meter
MAINS	Main Landing Gear
MAP	Missed Approach Point
MASPS	Minimum Aviation System Performance Standard
MAWP	Missed Approach Waypoint – same as MAP
MB	Megabyte
MBAR	Millibars
MDA	Minimum Descent Altitude
MEMS	Micro Electro-Mechanical System
METAR	Routine Aviation Weather Report
MFD	Multifunction Display
MIN	Minimum
MIN ALT	Minimum Altitude
MISCOMP	Miscompare
MISS	Missed Approach
MM	Middle Marker
M_{mo}	Maximum Operating Mach Number
MOPS	Minimum Operational Performance Standard
MSL	Mean Sea Level
MSU	Magnetic Sensor Unit
MTBF	Mean Time Between Failures
N UP	North Up
NACO	National Aeronautical Charting Office
NAS	U.S. National Airspace System
NAV	Navigation
NAVAID	Navigational Aid
ND	Navigation Display
NDB	Nondirectional Beacon
NED	National Elevation Dataset
NEXRAD	Next Generation Radar
NM	Nautical Mile
NOTAM	Notices To Airmen
NPA	Non-Precision Approach
NRST	Nearest
OAT	Outside Air Temperature
OBS	Omnibearing Selector
OM	Outer Marker
OT	Other Traffic (Traffic Function)
PA	Proximate Advisory (Traffic Function)
PDA	Premature Descent Alert
PDR	Preliminary Design Review

PFD	Primary Flight Display (the display screen showing primary instrumentation)
PLI	Pitch Limit Indicator
PTK	Parallel Track
PTR	Pointer
PWR	Power
QFE	Altimeter setting that provides height above reference point
QM	Quality Management
QNE	Altimeter setting that provides pressure altitude readout
QNH	Altimeter setting that provides MSL altitude at a reporting point
RA	Resolution Advisory (Traffic Function)
RAM	Random Access Memory
RBP	Remote Bug Panel
RG	Retractable Gear
RMI	Radio Magnetic Indicator
RNAV	Area Navigation
RNG	Range
RNP	Required Navigation Performance
RTC	Required Terrain Clearance
RTCA	Radio Telephone Commission for Aeronautics
Rx	Receive
SA	Selective Availability
SATLT	Satellite
SBAS	Satellite Based Augmentation System
SCC	System Configuration Card
SIGMET	Significant Meteorological Advisory
SMA	Sub-Miniature version A connector
SN	Serial Number
SNI	Serial Number Information
SPD SEL	Speed Select
SRTM	Shuttle Radar Topographical Mission
STAR	Standard Terminal Arrival Routes
STD	Standard
STRK	Strike, as in lightning strike
STRKS	Strikes
SUA	Special Use Airspace
SYMB	Symbol
SYNC	Synchronize
SYRD	System Requirements Document
TA	Traffic Advisory (Traffic Function)
TACAN	Tactical Air Navigation
TAFs	Terminal Aerodrome Forecasts
TAS	True Airspeed or Traffic Advisory System (depending on context)
TAS	Traffic Advisory System
TAWS	Terrain Awareness and Warning System
TCAD	Traffic Collision Alert Device
TCAS	Traffic and Collision Avoidance System

TCH	Threshold Crossing Height
TD	Traffic Display
TERPS	Terminal Instrument Procedures
TFR	Temporary Flight Restriction
TIS	Traffic Information Service
TIS-B	Traffic Information Service Broadcast
TO	To
TSO	Technical Standard Order
Tx	Transmit
UIR	Upper Flight Information Region
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
VLOC	VHF Omnidirectional Radio/Localizer
VNAV	Vertical Navigation
V_{nepo}	Power-off Airspeed Limit for Rotorcraft often referenced as VNE (autorotation)
VOR	Very High Frequency Omnirange
VOR	VHF Omnidirectional Radio
VORDME	Very High Frequency Omnirange Distance Measuring Equipment
VORTAC	Very High Frequency Omnirange / TACAN
VPL	Vertical Protection Level
V_1	Minimum Speed For Takeoff
V_2	Takeoff Safety Speed
V_a	Design Maneuvering Speed at gross weight
V_{app}	Approach Speed
V_{fe}	Maximum Flap Extended Speed
V_{gl}	The aircraft's best glide speed at gross weight with gear and flaps retracted. This value, if established in the limits settings during installation of the IDU, defines the location of the "green dot" best glide speed marker on the airspeed scale.
V_{mc}	Minimum Control Speed with the critical engine inoperative.
V_{mfe}	Maximum speed for partial flap extension
V_{min}	Defines the lower limit of the safe operating range area of the IDU airspeed indicator scale (for rotorcraft)
V_{mo}	Maximum Operating Limit Speed
V_{ne}	Never Exceed Speed
V_{no}	Maximum structural cruising speed defined as the maximum speed for operation in turbulence. This value defines the top of the "green arc" and the bottom of the "yellow arc" areas of the IDU airspeed indicator scale (small aircraft and rotorcraft).
V_{proc}	Normal speed for flying instrument approaches (DPs, IAPs, and STARs)
V_r	Rotation Speed

V_{ref}	Reference Landing Approach Speed
V_{s0}	Stalling speed at gross weight with gear and flaps extended
V_{s1}	Stalling speed at gross weight with gear and flaps retracted
V_x	Speed for Best Angle of Climb, gear and flaps retracted
V_y	Speed for Best Rate of Climb, gear and flaps retracted
V_{yse}	Best Rate of Climb Single Engine, gear and flaps retracted
VSI	Vertical Speed Indicator
VTF	Vectors to Final
VUL	Vertical Uncertainty Limit
WAAS	Wide Area Augmentation System
WGS84	World Geodetic System 1984
WNDS-TMPS	Winds and Temperatures
WPT	Waypoint
WX LEGEND	Weather Legend
XFILL	Crossfill

Coloring Conventions

A consistent set of colors is used for displaying information on the Chelton 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, VOR's, 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
- VNAV Altitudes

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

YELLOW is used to identify conditions that require immediate pilot awareness and subsequent pilot action. Examples:
- Caution indications
- Altitude or heading alert
- Component failure indication
- Pitch limit indicator (low-speed awareness)
- Minimum altitude
- CDI needles at full-scale deflection

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.
- Advisories

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

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

Annunciation volume is based on level of threat and audio is silenced immediately upon pressing the EFIS MUTE button. Overall volume can be adjusted during installation.

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

Pilot Actions:

Red: Immediate Pilot Action Required
Yellow: Pilot Attention Required
Blue: Advisory Only

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.)

Annunciation	Category	Flag	Aural Annun.	Condition
GPWS Mode 1 Warning	Warning	PULL UP	"Pull Up, Pull Up"	Within GPWS Mode 1 warning envelope.
GPWS Mode 2 Warning	Warning	PULL UP	"Terrain, Terrain, Pull Up, Pull Up"	Within GPWS Mode 2 warning envelope.

Annunciation	Category	Flag	Aural Annun.	Condition
TAWS FLTA Warning	Warning	PULL UP	"Terrain, Terrain, Pull Up, Pull Up"	Terrain cell within TAWS FLTA warning envelope.
Obstruction Warning	Warning	OBSTRUCTION	"Obstruction"	Obstruction within TAWS FLTA warning envelope.
Stall	Warning	STALL	"STALL"	Activated above 100' AGL if indicated airspeed is below the higher of V_{S1} or V_{S1} corrected for G-load + 5 KIAS. Deactivated if stall-warning flag is set to 0.
Overspeed	Warning	OVERSPEED	"Overspeed"	Indicated airspeed exceeds redline (V_{NE}/V_{MO}/M_{MO} as appropriate). Not used for rotorcraft due to possible confusion with rotor speed alarms
Decision Height	Caution	MINIMUMS	"Minimums"	Deviation from above to below decision height bug. Causes decision height readout to turn yellow and flash.
Minimum Altitude	Caution	MINIMUMS	"Minimums"	Deviation from above to below minimum altitude bug. Causes minimum altitude readout to turn yellow and flash.
TAWS FLTA Caution	Caution	TERRAIN	"Caution, Terrain"	Terrain cell within TAWS FLTA caution envelope.
Obstruction Caution	Caution	OBSTRUCTION	"Obstruction"	Obstruction within TAWS FLTA caution envelope.
GPWS Mode 4-1	Caution	TOO LOW	"Too Low Terrain"	Within GPWS Mode 4 "Too Low Terrain" envelope.
TAWS PDA	Caution	TOO LOW	"Too Low Terrain"	Within TAWS PDA envelope.
GPWS Mode 6	Advisory	—	"Five Hundred"	Descending through 500' AGL advisory. Armed upon climbing through deadband value above 500' AGL.
GPWS Mode 4-2	Caution	TOO LOW	"Too Low Gear"	Within GPWS Mode 4 "Too Low Gear" envelope.

Annunciation	Category	Flag	Aural Annun.	Condition
GPWS Mode 4-3	Caution	TOO LOW	"Too Low Flaps"	Within GPWS Mode 4 "Too Low Flaps" envelope.
GPWS Mode 1 Caution	Caution	SINK RATE	"Sink Rate"	Within GPWS Mode 1 caution envelope.
GPWS Mode 2 Caution	Caution	TERRAIN	"Caution, Terrain"	Within GPWS Mode 1 caution envelope.
GPWS Mode 3	Caution	TOO LOW	"Too Low, Terrain"	Within GPWS Mode 3 caution envelope.
GPWS Mode 5 Warning	Warning	GLIDE SLOPE	"Glide Slope"	Within GPWS Mode 5 warning envelope.
GPWS Mode 5 Caution	Caution	GLIDE SLOPE	"Glide Slope"	Within GPWS Mode 5 caution envelope.
Check Gear	Caution	CHECK GEAR	"Check Gear"	Activated if RG flag is set to 1, aircraft is below 500' AGL, aircraft is descending, aircraft is below V_{FE}, and any landing gear is not down.
Traffic Warning	Warning	TRAFFIC	"Traffic"	Resolution Advisory. Not given if own aircraft below 400' AGL. Not given if target is below 200' AGL (ground target). Audio not generated with TCAS-II system.
Traffic Caution	Caution	TRAFFIC	"Traffic"	Traffic Advisory. Not given if own aircraft below 400' AGL. Not given if target is below 200' AGL (ground target). Audio not generated with TCAS-II system.
Low Fuel Warning	Warning	LOW FUEL	"Fuel Low"	Calculated fuel quantity is below low fuel warning threshold.
IDU Overtemp	Caution	EFIS COOL	"EFIS Cooling"	IDU core temperature greater than 95°C.
Low Fuel Caution	Caution	LOW FUEL	"Fuel Low"	Calculated fuel quantity is below low fuel caution threshold.

Annunciation	Category	Flag	Aural Annun.	Condition
Selected Altitude Deviation	Caution	ALTITUDE	"Altitude"	Deviation greater than 150' from selected altitude after capture. Altitude capture defined as being within 100' of altitude.
Check Range	Caution	CHECK RANGE	"Check Range"	Less than 100NM buffer between calculated range and distance to destination. Not activated in climbing flight.
Radar Altimeter	Caution	RADALT FAIL	Alert Tone	Radar altimeter is installed, aircraft is in flight below 2000 feet AGL and radar altitude is invalid.
ADC #1 Failure	Caution	ADC1 FAIL	Alert Tone	Only active in dual-ADC installation. Indicates no valid indicated airspeed, pressure altitude, or VSI received from ADC #1 for more than 1 second.
ADC #2 Failure	Caution	ADC2 FAIL	Alert Tone	Only active in dual-ADC installation. Indicates no valid indicated airspeed, pressure altitude or VSI received from ADC #2 for more than 1 second.
AHRS #1 Failure	Caution	AHRS1 FAIL	Alert Tone	Only active in dual-AHRS installation. Indicates no valid bank, pitch or heading received from AHRS #1 for more than 1 second.
AHRS #2 Failure	Caution	AHRS2 FAIL	Alert Tone	Only active in dual-AHRS installation. Indicates no valid bank, pitch or heading received from AHRS #2 for more than 1 second.

Annunciation	Category	Flag	Aural Annun.	Condition
Radar Altimeter #1 Failure	Caution	RADALT1 FAIL	Alert Tone	Only active in dual-Radar Altimeter installation. Indicates no radar altimeter reading received from Radar Altimeter #1 for more than 1 second. Inhibited on ground and above 2000'AGL (areas where it is normal for radar altimeter to report no data).
Radar Altimeter #2 Failure	Caution	RADALT2 FAIL	Alert Tone	Only active in dual-Radar Altimeter installation. Indicates no radar altimeter reading received from Radar Altimeter #2 for more than 1 second. Inhibited on ground and above 2000'AGL (areas where it is normal for radar altimeter to report no data).
Air Data Failure	Caution	NO AIR DATA	"Air Data Failure"	No valid indicated airspeed, pressure altitude or VSI received from selected ADC for more than 1 second.
VNAV Altitude Deviation	Caution	ALTITUDE	"Altitude"	If not on a descending VNAV profile, deviation greater than 150' from altitude of the current or prior VNAV waypoint after capture. Altitude capture defined as being within 100' of altitude.
AHRS Failure	Caution	NO ATTITUDE	"Attitude Failure"	No valid bank, pitch or heading received from selected AHRS for more than 1 second.

Annunciation	Category	Flag	Aural Annun.	Condition
Auxiliary Sensor	Caution	AUX SENSOR	"Auxiliary Sensor Failure"	No valid message received from installed optional sensors. Sensor status displayed in FAULTS menu. This message applies to the following optional sensors: 1. RS-232 TAS System 2. ADS-B System 3. WSI Datalink System 4. WX-500 Lightning System 5. Analog Interface Unit
GPS/WAAS Dead Reckoning Mode	Caution	DR ##:##	None	GPS/WAAS in dead reckoning mode with valid ADC and AHRS data. Timer shows time since loss of navigation to indicate quality of DR solution.
GPS/WAAS Failure	Caution	NO GPS	"GPS Failure"	No valid message received from selected GPS/WAAS for more than 5 seconds.
GPS/WAAS Loss of Integrity	Caution	GPS LOI	Alert Tone	GPS/WAAS loss of integrity caution.
GPS/WAAS Loss of Navigation	Caution	GPS LON	Alert Tone	GPS/WAAS loss of navigation caution.
GPS/WAAS #1 Failure	Caution	GPS1 FAIL	Alert Tone	Only active in dual-GPS/WAAS installation. Indicates no valid message received from GPS/WAAS #1 for more than 5 seconds.
GPS/WAAS #2 Failure	Caution	GPS2 FAIL	Alert Tone	Only active in dual-GPS/WAAS installation. Indicates no valid message received from GPS/WAAS #2 for more than 5 seconds.

Annunciation	Category	Flag	Aural Annun.	Condition
Altitude Miscompare	Caution	ALT MISCOMP	Alert Tone	Only active in dual-ADC installation with neither ADC in failure condition. Indicates that pressure altitude difference between ADC's is beyond limits. Limits are as follows: 　>= 40K'　　Δ250' 　30 – 40K'　Δ200' 　20 – 30K'　Δ100' 　10 – 20K'　Δ70' 　< 10K'　　Δ50'
Attitude Miscompare	Caution	ATT MISCOMP	Alert Tone	Only active in dual-AHRS installation with neither AHRS in failure condition. Indicates that pitch or roll difference between AHRS is beyond limits (6°).
GPS/WAAS Miscompare	Caution	GPS MISCOMP	Alert Tone	Only active in dual-GPS/WAAS installation with neither GPS/WAAS in failure condition. Indicates that position, track or groundspeed difference between GPS/WAAS units is beyond limits. Limits are as follows: Position: 　Enroute Mode　4NM 　Terminal Mode　2NM 　Departure Mode　.6NM 　IFR Approach Mode　.6NM 　VFR Approach Mode　.6NM Track: 　If groundspeed is greater than 30 kts, miscompare if difference is more than 4°. Groundspeed: 　10 kts.

Annunciation	Category	Flag	Aural Annun.	Condition
Glideslope Miscompare	Caution	GS MISCOMP	Alert Tone	Only active when two valid glideslopes are being received. Indicates that difference between glideslope signals is beyond limits (0.25 Dots).
Heading Miscompare	Caution	HDG MISCOMP	Alert Tone	Only active in dual-AHRS installation with neither AHRS in failure condition. Indicates that heading difference between AHRS is beyond limits (6°).
Airspeed Miscompare	Caution	IAS MISCOMP	Alert Tone	Only active in dual-ADC installation with neither ADC in failure condition. Indicates that indicated airspeed difference between ADC's is beyond limits. Limits are as follows: >= 100KIAS　Δ4KIAS < 100KIAS　　Δ10KIAS
Localizer Miscompare	Caution	LOC MISCOMP	Alert Tone	Only active when two valid localizers are being received. Indicates that difference between localizer signals is beyond limits (0.25 Dots).
Radar Altitude Miscompare	Caution	RALT MISCOMP	Alert Tone	Only active in dual-radar altimeter installation with neither radar altimeter in failure condition. Indicates that radar altitude difference between radar altimeters is beyond limits. Limits are as follows: >= 500'AGL　　Δ14% 100 – 500'AGL　Δ10% < 100'AGL　　　Δ10'

Annunciation	Category	Flag	Aural Annun.	Condition
TAWS FLTA Function Inoperative	Caution	NO TAWS	Alert Tone	Indicates that aircraft is currently beyond extent of terrain database or a failure condition exists that prevents the TAWS FLTA function from operating.
OAT Sensor Failed	Caution	OAT SENSOR	Alert Tone	Indicates that OAT sensor has failed.
Same ADC Source	Caution	SAME ADC	Alert Tone	Only active in dual-System (Pilot and Co-pilot), dual-ADC installation with good inter-System communications and neither ADC in failure condition. Indicates that both Systems are operating from same ADC source.
Same AHRS Source	Caution	SAME AHRS	Alert Tone	Only active in dual-System (Pilot and Co-pilot), dual-AHRS installation with good inter-System communications and neither AHRS in failure condition. Indicates that both Systems are operating from same AHRS source.
Same GPS/WAAS Source	Caution	SAME GPS	Alert Tone	Only active in dual-System (Pilot and Co-pilot), dual-GPS/WAAS installation with good inter-System communications and neither GPS/WAAS in failure condition. Indicates that both Systems are operating from same GPS/WAAS source.

Annunciation	Category	Flag	Aural Annun.	Condition
Same NAV Source	Caution	SAME NAV	Alert Tone	Only active in dual-System (Pilot and Co-pilot) with good inter-System communications. Indicates that both Systems are operating from same navigation source. Alert inhibited if both Systems are operating from GPS/ WAAS in a single-GPS/ WAAS installation.
Same Radar Altimeter Source	Caution	SAME RADALT	Alert Tone	Only active in dual-System (Pilot and Co-pilot), dual-radar altimeter installation with good inter-System communications and neither radar altimeter in failure condition. Indicates that both Systems are operating from same radar altimeter source.
SCC Card Failed	Caution	SCC FAIL	Alert Tone	Indicates that SCC card could not be read upon power-up. This means that limits internal to the IDU are being used by the System.
TAWS Autorotation Mode	Caution	TAWS AUTOROT	Alert Tone	TAWS autorotation mode activated through use of discrete input.
Crossfill Failed	Caution	XFILL FAIL	Alert Tone	Only active in dual-System (Pilot and Co-pilot). Indicates lack of inter-System communications.
TCAS Failed	Caution	TCAS FAIL	Alert Tone	Only active with ARINC735A-1 TCAS-II, TCAS-I or TAS system. Indicates lack of communications with system or failure indication from system.
Air Data Initializing	Advisory	ADC INIT	Chime	ADC not at full accuracy during warm-up.

Annunciation	Category	Flag	Aural Annun.	Condition
Check Barometric Setting	Advisory	CHK BARO	Chime	Ascending through transition level: Altimeter not set to 29.92in. Hg or 1013mB. Descending through transition level: Altimeter set to 29.92in. Hg or 1013mB. Descent warning times out in 10 seconds. Disabled during QFE operation.
Flight Path Marker Inhibit	Advisory	FPM INHBT	Chime	Flight path marker inhibit function activated through use of momentary discrete input.
GPS/WAAS IFR Approach Mode	Advisory	IFR APPR	Chime	GPS/WAAS in NPA mode.
Automatic Waypoint Sequencing Suspended	Advisory	SUSPEND	Chime	GPS/WAAS automatic waypoint sequencing is suspended. Caused by being on final approach segment prior to arming missed approach, selecting manual GPS/WAAS OBS, or being in holding prior to activating the "CONTINUE" tile.
GPS/WAAS Terminal Mode	Advisory	TERMINAL	Chime	GPS/WAAS in Terminal mode.
GPS/WAAS VFR Approach Mode	Advisory	VFR APPR	Chime	GPS/WAAS in VFR approach mode (active waypoint is part of VFR approach runway and within 6NM of runway).
GPS/WAAS Vectors to Final IFR Approach Mode	Advisory	VTF IFR APPR	Chime	GPS/WAAS in Vectors to Final NPA mode.

Annunciation	Category	Flag	Aural Annun.	Condition
Barometric Setting Miscompare	Advisory	BARO MISCOMP	Chime	Only active in dual-System (Pilot and Co-pilot) installation. Indicates mismatch of altimeter settings or altimeter modes between systems.
Menu Locked	Advisory	MENU LOCK	None	Menu system being used on another IDU.
Parallel Offset	Advisory	PTK = ##	Chime	GPS/WAAS Parallel Offset path advisory. ## is nautical miles left ("L") or right ("R") of main path.
TAWS Inhibit	Advisory	TAWS INHBT	Chime	TAWS inhibited through use of discrete input.
TAWS Low Altitude Mode	Advisory	TAWS LOW ALT	Chime	TAWS low altitude mode activated through use of discrete input.
TAWS Glideslope Cancel	Advisory	TAWS GS CNX	Chime	TAWS glideslope cancel (GPWS Mode 5) activated through use of discrete input.
Crossfill Armed	Advisory	XFILL ARM	Chime	Only active in dual-System (Pilot and Co-pilot) with good inter-System communications and crossfill not inhibited. Indicates that Systems are not synchronized and synchronization function is available.
Crossfill Inhibited	Advisory	XFILL INHBT	Chime	Only active in dual-System (Pilot and Co-pilot) with good inter-System communications. Indicates that crossfill is manually inhibited through use of discrete input.
TCAS Standby	Advisory	TCAS STBY	Chime	Only active with TCAS-II system. Indicates that system is either: (1) in standby; or (2) executing functional test in flight.

Annunciation	Category	Flag	Aural Annun.	Condition
TCAS TA Only Mode	Advisory	TA ONLY	Chime	Only active with TCAS-II system. Indicates that TCAS-II system is unable to display resolution advisories.
TCAS Test Mode	Advisory	TCAS TEST	Chime	Only active with TCAS-II system. Indicates that system is in functional test on ground.
Countdown Timer Chime	Advisory	—	Chime	Sounds chime when countdown timer reaches 00:00:00.
Level-off	Advisory	—	Altitude Alert Tone	Tone given when within the greater of 1000' or 50% of VSI from uncaptured selected or VNAV waypoint altitude. Inhibited in approach procedures.

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

"Practice makes perfect.

To listen to audio samples of all alerts and learn what to do when you hear them in flight, please study the Master Caution System training aid available on our website:

www.cheltonflightsystems.com in the Downloads area."

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.

Button

Menu Tile

Use right-hand control knob for this menu

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 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 page 2-29), it is controlled with the right-hand knob. Turn the knob to scroll to the desired menu item, letter, or number, then push to select.

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

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

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

MENU LOCK

Button and menu input can only be made on one display at a time. When an action is taking place on one screen, the others will display a MENU LOCK flag and the buttons and knobs will not function.

Database and Software Updates

Navigation and Obstruction Databases

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

IFR enroute, terminal, and instrument approach navigation predicated upon the EFIS is prohibited unless the pilot verifies the currency of the database *or* verifies each selected waypoint for accuracy by reference to current published charts.

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

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

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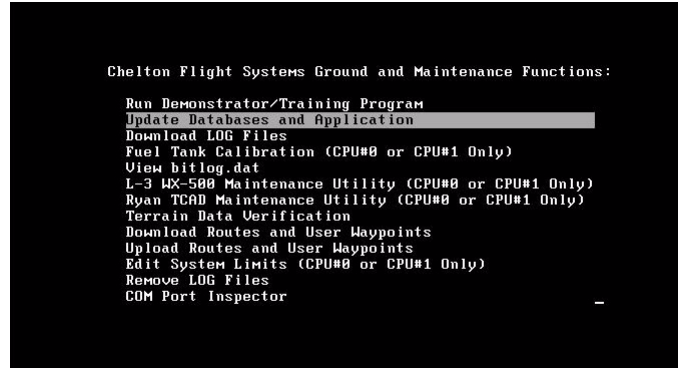

To update the system:

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

2. With the power OFF, insert the data card containing the databases into the primary flight display (gold side up).

3. Power the system ON and select the
    UPDATE DATABASES AND APPLICATION option
    using the control knob (turn to scroll, push to enter).


```
Chelton Flight Systems Ground and Maintenance Functions:

Run Demonstrator/Training Program
Update Databases and Application
Download LOG Files
Fuel Tank Calibration (CPU#0 or CPU#1 Only)
View bitlog.dat
L-3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
Terrain Data Verification
Download Routes and User Waypoints
Upload Routes and User Waypoints
Edit System Limits (CPU#0 or CPU#1 Only)
Remove LOG Files
COM Port Inspector                              _
```

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 not-
    ing the new NavData cycle and expiration dates before
    acknowledging the startup screen.

The data itself is verified by a CRC 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 during the process.

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 or A&P Mechanic.
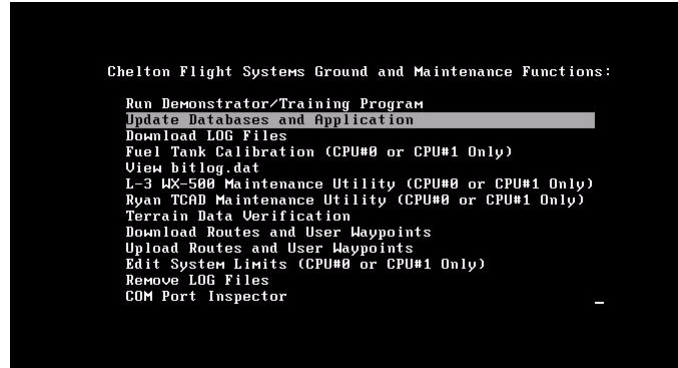
Please see the Terrain NOTAM at www.cheltonflightsystems.com (Certified Downloads section) which is posted whenever a new terrain database is compiled. This NOTAM identifies airports in mountainous regions of the United States near which terrain database errors in excess of 100 ft. have been detected due to exceptionally rugged geography. Pilots operating near those airports should use extra vigilance.

System Software Updates

System software must be updated by an authorized repair station in the following manner:

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).

3. Power the system ON and select the
   UPDATE DATABASES, AND APPLICATION
   option using the control knob (turn to scroll, push to enter).

```
Chelton Flight Systems Ground and Maintenance Functions:

Run Demonstrator/Training Program
Update Databases and Application
Download LOG Files
Fuel Tank Calibration (CPU#0 or CPU#1 Only)
View bitlog.dat
L-3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
Terrain Data Verification
Download Routes and User Waypoints
Upload Routes and User Waypoints
Edit System Limits (CPU#0 or CPU#1 Only)
Remove LOG Files
COM Port Inspector                                    _
```

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 not-
   ing the new software version number before acknowledg-
   ing the startup screen.

As with the navigation database, 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 during the process.

Mechanical Considerations

The displays slide into trays that connect to the aircraft's electrical system and protect the displays from electromagnetic interference, radio frequency interference, high-intensity radiated fields (HIRF), and over/under/reversed supply current. The display's internal power supply filters and converts input supply current to usable and stable voltages at appropriate power levels for internal use. The internal power supply also stores sufficient energy to supply uninterrupted power during momentary power interruptions.

The displays are identical in form, fit, and function. Function is determined by a configuration card ("SCC") 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. (Do not over tighten!)

A cooling fan is mounted in a cavity on 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 AMLCD (active matrix liquid crystal display) screen is illuminated by a combination of cold-cathode fluorescent (CCFL) 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 LED's for cold-start operation, redundancy, and nighttime dimming capability.

As the screen is dimmed, a flicker and a slight shift in color are normal as the CCFL backlight turns off and the screen is backlit by LED's only. When operated in this range (LED's only), the screens are compatible with night vision goggles.

Although quite rugged, the AMLCD can be damaged. Avoid touching with a hard or sharp object. Wipe water off immediately. Long contact with water may cause discoloration or spots. Clean a soiled screen with an absorbent soft cotton cloth or a "screen prep" pad available at electronics stores.

Air Data and Attitude Heading Reference Systems

ADC, AHRS, and ADAHRS

A variety of ADC (Air Data Computer), AHRS (Attitude Heading Reference System), and ADAHRS (Air Data Atitude Heading Reference System) are supported by the EFIS. Refer to the Installation Manual for model numbers.

The information provided by the AHRS (or AHRS portion of an ADAHRS) is used to drive the Attitude Indicator and Heading Indicator. Thus the AHRS provides the same functions traditionally provided by these two spinning gyros and slaved magnetometer.

The ADC (or ADC portion of an ADAHRS) is connected to the aircraft pitot and static ports, and OAT probe to measure indicated airspeed, pressure altitude, and outside air temperature. From these raw data, true airspeed, and density altitude are calculated for display on the system. These data are also used to calculate the Mach number, winds aloft, fuel endurance, and range. Fuel totalizer functions may not be available on some installations.

GPS/WAAS Receiver

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

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

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

Courtesy: FAA
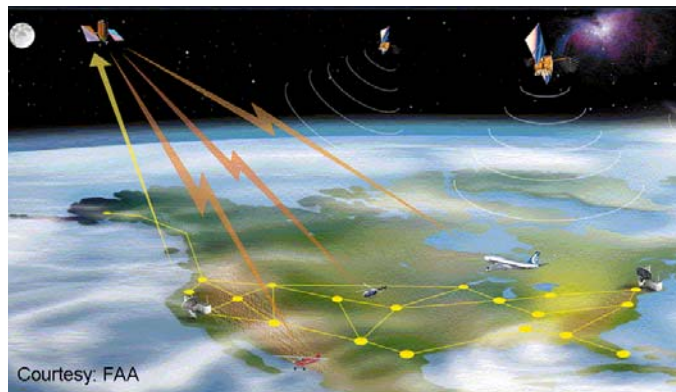
A correction message is prepared and uplinked to a geostationary communications satellite. This message is then broadcast on the same frequency as the GPS signal to the GPS WAAS receiver in your FlightLogic EFIS. The WAAS improves basic GPS accuracy to approximately 7 meters vertically and horizontally and provides important integrity information about the entire GPS constellation.

The EFIS obtains position information from a TSO-C145a Class Beta 1, TSO-C145c Class Beta 1, or a TSO-C145c Class Beta 3 GPS/WAAS receiver. The receiver sends position, velocity, time, and integrity data to the displays which, in turn, present it as useful position, navigation, and wind information on the PFD and moving map displays. GPS position is also used for terrain awareness alerting (TAWS) functions. GPS status is monitored continuously by the EFIS.

> *WARNING!*
> *WAAS OR FAULT DETECTION AND EXCLUSION (FDE) MUST BE AVAILABLE AT THE FINAL APPROACH FIX TO CONTINUE AN APPROACH.*

If a GPS-related caution flag is displayed, refer to the **FAULTS** menu on the MFD (see **MFD Fault Display (FAULTS) Menu, page 5-35**). 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").

NOTE:
*GPS loss of integrity (**GPS LOI** flag) is not uncommon and does not indicate a malfunction of the GPS/WAAS receiver or the EFIS. It simply means that the GPS signal from the satellite constellation is not providing a position that is reliable enough to meet FAA standards for sole-source, stand-alone navigation. This is a condition that can cannot be detected by non-WAAS GPS receivers.*

For more information about GPS failure modes, see **GPS Failure, page 3-146.**

Analog Interface Unit (AIU)

The Chelton Flight Systems AIU provides a data conversion function for the EFIS. The system receives inputs from navigation receivers and radar altimeters and translates them to digital data that is sent to the EFIS. It also translates digital autopilot commands to lateral analog steering signals to allow the EFIS system to command an autopilot system.

Through the AIU, the EFIS provides lateral commands to an analog autopilot to fly DPs, enroute legs, STARs, approaches (including DME arcs, procedure turns, and holding pattern course reversals), and even missed approaches (including the holding patterns and correct entries) automatically. For precision approaches, in order to provide vertical coupling, the pilot must switch the autopilot from the HEADING mode to NAV or APPROACH mode just prior to the final approach fix. The EFIS and AIU permit all approach procedures to be performed "hands-off." See **IFR Procedures, page 8-1** for more information.

The AIU has no effect on autopilot pitch or altitude performance.

Input Signals

The following signals are received from various equipment:

- Composite VOR radial/Localizer deviation inputs for two Nav Receivers

- ILS Energize inputs for two Nav Receivers

- DC Glideslope deviation for two Nav Receivers

- Glideslope validity flag for two Nav Receivers

- ADF bearing input for one ADF Receiver in Sin/Cos or ARINC 407 format.

- Marker Beacon inputs for Blue, Yellow and White indications

- Radar Altimeter altitude signal

- Radar Altimeter validity flag

- Flight director vertical deviation

- Flight director horizontal deviation

Autopilot Output Signals

The AIU provides autopilots with:

- Analog Vertical Steering (glideslope)

- Analog Horizontal Steering (course datum, heading datum, course error).

See **Analog Autopilot Interface, page 6-106** for step-by-step procedures for autopilot usage.

Remote Bugs Panel

The optional Remote Bugs Panel (RBP) provides dedicated controls for frequently needed bugs, as well as additional controls for selecting and setting IDU parameters.
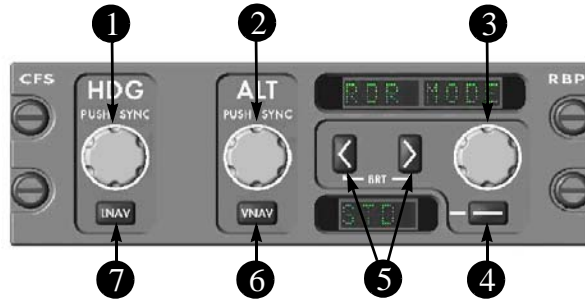
Intened use of the RBP buttons and knobs are described below:

Button/ Knob	Function	Turn	Press
1. Heading Knob	Heading Bug	Increment or decrement the heading bug.	Synchronize the heading bug to current heading.
2. Altitude Knob	Altitude Bug	Increment or decrement the target altitude bug.	Synchronize the target altitude bug to current altitude.
3. Set Knob	GPS Course	Increment or decrement the GPS Course setting.	Synchronize the GPS Course to current bearing to the active waypoint.
3. Set Knob	VOR1 Course	Increment or decrement the VOR1 Course setting.	Synchronize the VOR1 Course to the current bearing to the station.
3. Set Knob	VOR2 Course	Increment or decrement the VOR2 Course setting.	Synchronize the VOR2 Course to the current bearing to the station.
3. Set Knob	Airspeed Bug	Increment or decrement the Airspeed Bug setting.	Synchronize the Airspeed Bug to current airspeed.
3. Set Knob	Vertical Speed Bug	Increment or decrement the Vertical Speed Bug setting.	Synchronize the Vertical Speed Bug to current VSI.
3. Set Knob	Climb Angle Set	Increment or decrement the Climb Angle setting.	Set the Climb Angle Setting to 3 degrees.
3. Set Knob	Descent Angle Set	Increment or decrement the Descent Angle setting.	Set the Descent Angle Setting to 3 degrees.

Button/ Knob	Function	Turn	Press
3. Set Knob	Decision Height Bug	Increment or decrement the Decision Height Bug.	Set the Decision Height Bug to 200' AGL.
3. Set Knob	Minimum Altitude Bug	Increment or decrement the Minimum Altitude Bug.	Set the Minimum Altitude to current altitude.
4. Set "---" Button	GPS Course	n/a	Change OBS mode (Manual or Automatic)
4. Set "---" Button	VOR1 Course	n/a	No Function.
4. Set "---" Button	VOR2 Course	n/a	No Function.
4. Set "---" Button	Airspeed Bug	n/a	Toggle Airspeed Bug (ON or OFF).
4. Set "---" Button	Vertical Speed Bug	n/a	Toggle Vertical Speed Bug (ON or OFF)
4. Set "---" Button	Climb Angle Setting	n/a	No Function.
4. Set "---" Button	Descent Angle Setting	n/a	No Function.
4. Set "---" Button	Decision Height Bug	n/a	Toggle Decision Height Bug (ON or OFF).
4. Set "---" Button	Minimum Altitude Bug	n/a	Toggle Minimum Altitude Bug (ON or OFF).
5. Arrow Buttons	Function Scroll	n/a	Scroll through possible functions for the "Set" rotaray knob. Pressing both arrow buttons simultaneously places the RBP into dimming mode. In this mode, the main display will show "BRT." Use the "Set" knob to set panel display brightness.
6. VNAV Button	VNAV	n/a	Switch the EFIS autopilot pitch steering and commanded VSI between VNAV sub-mode and target altitude sub-mode.
7. LNAV Button	LNAV	n/a	Switch the EFIS autopilot roll steering between LNAV sub-mode and heading sub-mode.

Component Failure Modes

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

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

Failure of the GPS, the AHRS or the ADC, singly or in combination, adversely impacts the EFIS capabilities. These failures are annunciated with yellow caution flags on the MFD and corresponding voice warnings. In addition, the software provides degraded displays to show as much useful and accurate information as possible in the failure condition. These degraded displays are described in detail under **Failure Modes, page 3-142.**

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 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
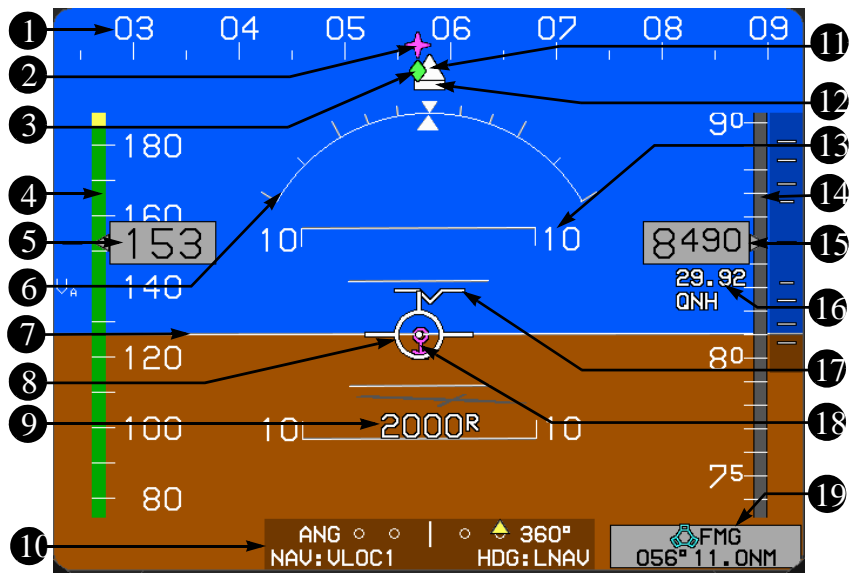
1. Directional scale	11. Heading indicator
2. Bearing to waypoint	12. Slip Indicator
3. Ground Track	13. Pitch scale
4. Indicated airspeed tape	14. Altitude tape
5. Indicated airspeed readout	15. Altitude readout
6. Bank Angle scale	16. Altimeter setting
7. Horizon line	17. Waterline
8. Flight path marker	18. Active waypoint symbol
9. Altitude above ground	19. Active waypoint information
10. CDI/Annunciator	

PFD on Instrument Approach
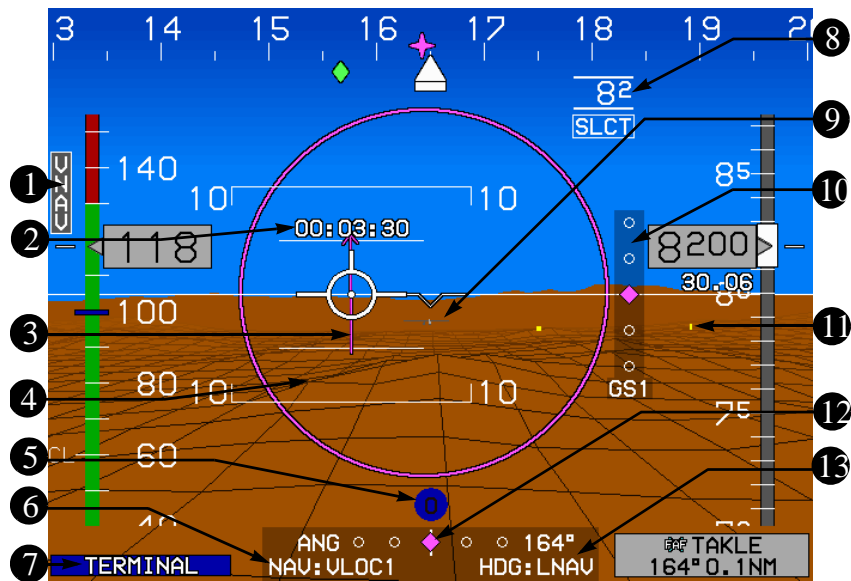
1. Vertical Navigation Arming Tile
2. Timer
3. HSI (Localizer 1)
4. Terrain
5. Marker Beacon
6. Nav Source
7. Advisory Flag
8. Target Altitude Submode
9. Runway
10. VNAV Indicator (Glide Slope 1)
11. Obstruction
12. Localizer CDI
13. Heading Source

PFD on Instrument Approach (cont.)
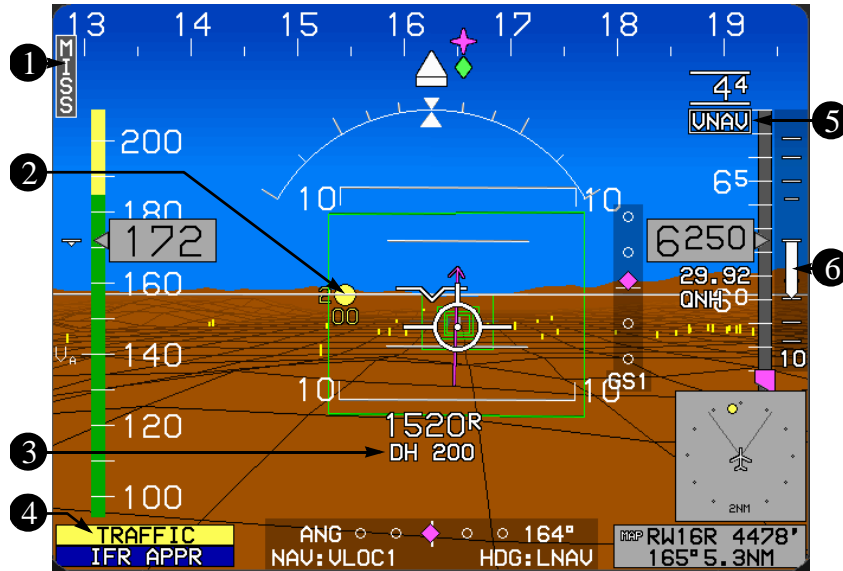
1. Missed Approach Tile (go around)
2. Traffic Location
3. Decision Height
4. Traffic Warning
5. VNAV Altitude
6. Vertical Speed

Unusual Attitude Recovery Mode
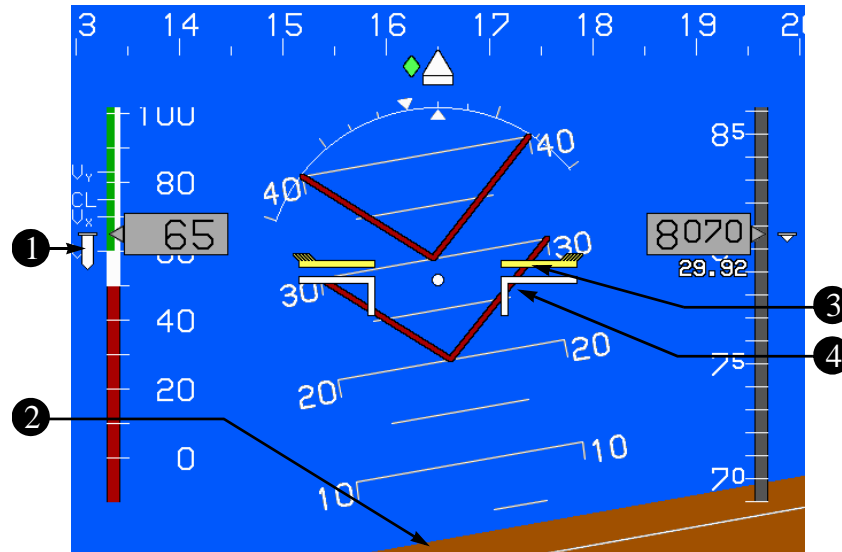
1. Speed trend worm   3. Pitch limit indicator
2. Horizon cue   4. Expanded waterline

When pitch exceeds +/-25° or roll exceeds +/-60° in an airplane (+/-45° in a rotorcraft), 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. Large red chevrons point to the horizon. The display returns to normal when pitch and roll are within +/-5°.

Active Waypoint Information

Information for the active waypoint is shown in the lower right corner of the display. Waypoint information includes waypoint type and identifier, elevation or crossing altitude, bearing, and distance. A datalink weather symbol for the destination airport may be shown optionally.

Navigation waypoint
symbol conventions

 IFR Airport

 VFR Airport

 VORTAC

 DME Only or
TACAN

 VOR Only

 NDB

 Fix

 User Waypoint

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

Active Waypoint Symbol

Waypoints (including destination airport) and fixes are displayed as magenta "tethered balloons." 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.
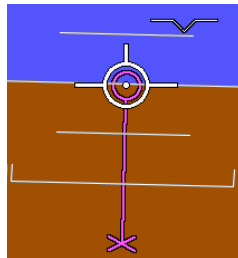
The hoop is displayed at the current target altitude and must be set by the pilot. When no target altitude is specified, the hoop is displayed at the aircraft's current altitude. See **Skyway Vertical Navigation, page 3-52**, for more information.

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.

NOTE:
Obstruction of the waypoint symbol by terrain means that there is terrain between the aircraft and the obstructed portion of the waypoint symbol.

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

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

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

"Get the most out of the waypoint symbol:

1. *If the waypoint hoop is above the artificial horizon, you must climb to go through it; if it is below the horizon, you must descend.*

2. *Use the waypoint hoop and pitch scale to determine the climb or descent angle required to cross the waypoint at the target altitude. If the hoop is 4° above the artificial horizon, you will have to climb at 4° to go through it.*

3. *Use the* **X** *on the ground to do your descent planning. Maintain altitude until the* **X** *is 2.5° to 3.0° below the horizon (as measured by the pitch scale), then put the flight path marker on the* **X**. *You'll enter the traffic pattern at the correct altitude."*

4. ***This is very important: 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 loaded from a list of stored flight plans or generated using the Nearest function (**NRST**) or **Direct-To** function, then adding and deleting waypoints en route.

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

1. A manual GPS/WAAS OBS is set ("SUSPEND" flag shown).

---

2. The aircraft is on the final approach segment of an instrument approach and the missed approach procedure has not been armed by pressing the **ARM** 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 **CONT** button("SUSPEND" flag shown).

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

Where automatic waypoint sequencing is suspended, the GPS/ WAAS CDI automatically switches from TO operation to FROM operation when crossing the waypoint.

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

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. See page 6-1 for more information.
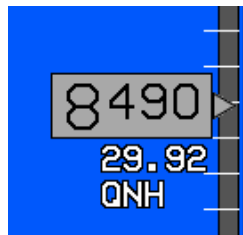
Altitude Above Ground (AGL)

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

1. **R** = radar altitude (used when a valid radar altimeter signal is present).

2. **G** = GPS/WAAS geodetic height less database ground elevation (Used when a valid radar altimeter signal is not present and GPS WAAS altitude is accurate within 75 ft).

3. **B** = barometric altitude less database ground elevation (Used when neither of the above are valid).

AGL altitude is not displayed when it is greater than 2,500 ft., less than 20 ft., or is invalid. In rotorcraft installations, barometric derived AGL altitude will be invalid at low airspeeds due to rotorwash effects.

NOTE:

AGL using barometric altitude can only be as accurate as the current barometric pressure setting and is subject to non-standard-day errors. Also, remember that ATIS altimeter setting values are based on the barometric pressure at one particular location on the airport and may be up to one hour old.

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.
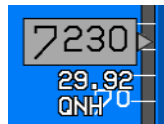
Altitude Tape

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.
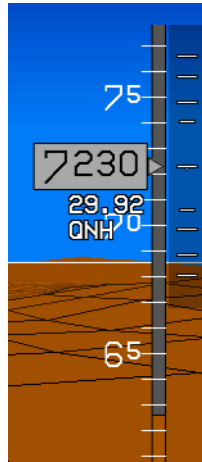
Bank Angle Scale

When bank angle scale decluttering is selected, a bank angle
scale and roll pointer will be displayed when the magnitude of
bank angle exceeds 2.8°. With decluttering selected,
appearance of the bank angle scale and roll pointer will be
dampened based upon magnitude and time to prevent nuisance
appearances. When decluttering is not selected, the bank angle
scale and roll pointer will appear full time. The bank angle
scale and roll pointer will be centered upon the waterline
(airplanes - normal mode) or Large Aircraft Symbol Reference
Marks (rotorcraft, Basic Mode or Unusual Attitude Mode). It is
possible to select either roll-pointer or sky-pointer style bank
angle scales as an aircraft limits setting. In Basic Mode, the
bank angle scale will always be the sky-pointer type and, if the

slip indicator flag is enabled, the roll pointer will incorporate an integral slip indicator.
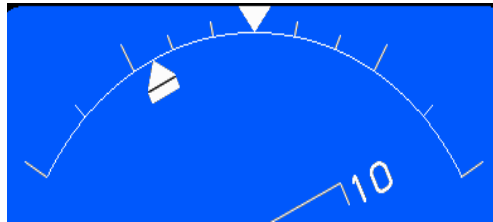
Bearing to Waypoint

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

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

NOTE:
The bearing to waypoint symbol does not indicate the safest way to turn; just the shortest. The pilot must evaluate terrain, traffic, and obstructions before beginning any turn.

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. In addition, the runways at three nearest airports are shown at all times.

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.

Since only runways are shown and they will be very apparent on the PFD when approached (as seen below), this feature is especially useful for avoiding accidental runway incursion during taxi operations.
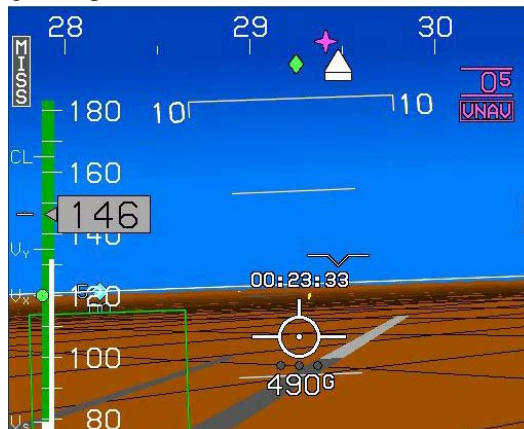
The illustration above depicts final approach on the ILS Runway 30R at Bakersfield, CA. Note the expanded 35° scale when the PFD zoom mode has been activated. This optional mode enlarges the view of the runways on the PFD. The displaced threshold and desired touchdown point are shown where the landing runway changes to light gray. On approach, the pilot should place the flight path marker on the desired point of touchdown and adjust pitch and sink rate to maintain this point. A stabilized approach from the final

approach fix to touchdown becomes a low workload task with the EFIS.

Course Deviation Indicator

A CDI and annunciator are centered at the bottom of the display. The CDI is the primary reference for WAAS GPS navigation. The currently selected navigation source is annunciated immediately below the CDI as follows:

1. NAV: GPS1 or, if a second GPS/WAAS receiver is not installed, NAV: GPS.

2. NAV: GPS2 (only available if a second GPS/WAAS receiver is installed).

3. NAV: VLOC1.

4. NAV: VLOC2.

The selected navigation source may be changed by pressing OBS and then the appropriate HSI source tile. The heading/ roll-steering sub-mode is also shown. (This is what the autopilot will track). Choices are:

1. HDG: LVL (Wing-Leveling Sub-Mode Guidance)

2. HDG: LNAV (LNAV Sub-Mode Guidance)

3. HDG: BUG (Heading Bug Sub-Mode Guidance)

4. HDG: --- (Failure Sub-Mode)

A magenta triangle pointing UP is a TO indication. A magenta triangle pointing DOWN is a FROM indication.

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 30NM from destination) – 2NM scale
Terminal (within 30NM of destination) – 1NM scale
Approach (within 2NM of final approach fix) – 0.3NM scale

Final (inside FAF) – Angular (like a localizer)

NOTE:
In order to maximize display readability, the 2.0NM CDI scale is the only annunciation that the system is in the Enroute Mode. Other modes are indicated by a flag (see the Caution/Warning/ Advisory System section).

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 a yellow flag. Flagged advisories are indicated by a blue flag.

Flags are stacked with warnings on top, followed by cautions, and then advisories. Flags are shown in reverse chronology. For a complete list of flags and annunciations, as well as order of prioritization, see **Caution/Warning/Advisory System, page 2-16**.

AUDIBLE ANNUNCIATION
CWA flags are accompanied by an auditory annunciation.

Directional Scale

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

For example, an object outside the aircraft that is 10° left of the nose will appear on the display under the heading scale 10° left of the heading pointer. In standard mode, the directional scale

is 70° wide and is depicted with graduations at 5° increments and figures at 10° increments. In zoom mode, the directional scale is 35° wide with graduations still at 5° increments (although much more widely spaced).

Dynamic Stall Speed

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

Vs is defined as clean stall at gross weight.

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

Expanded Waterline

In the unusual attitude recovery mode, the waterline symbol is expanded to provide instant, simple cues for pitch and bank.
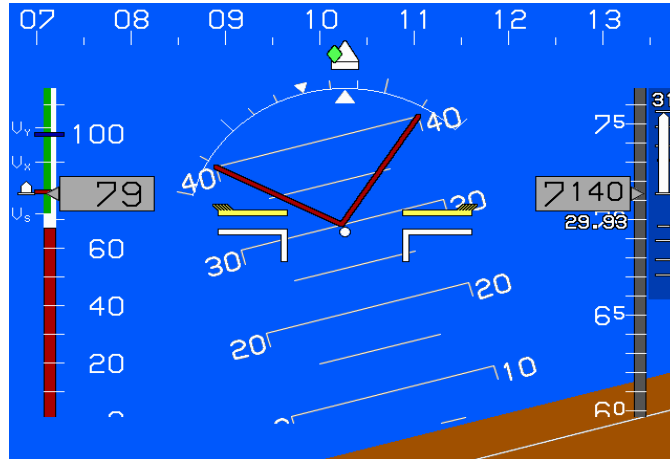
Flight Director
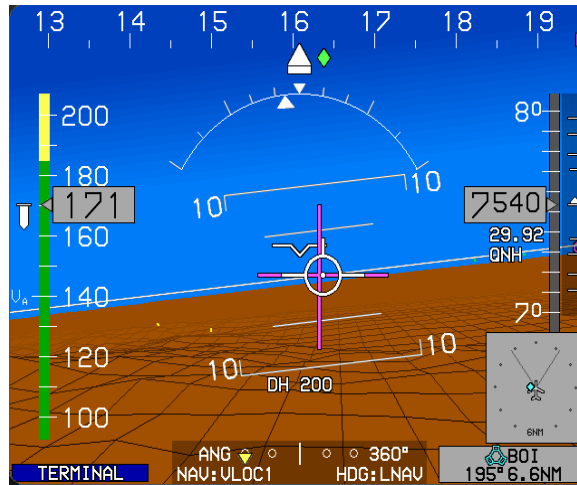
Conventional dual-cue flight director symbology is available when the EFIS is connected to an autopilot that transmits flight

director commands. It supports all flight director modes including Take-Off and Go Around.

The vertical bar moves laterally and the horizontal bar moves vertically to provide bank and pitch cues generated by the autopilot's flight director computer. When flown manually, the pilot should apply pitch and bank input to center the needles on the flight path marker. When both needles are centered, the current pitch and bank should be maintained until the needles command a change. For example, if the horizontal needle is displaced above the center dot of the flight path marker, the pilot should pitch up until the needle is centered, then hold that pitch angle until commanded to change.

Flight Director symbology is pilot-selectable, however it is mutually exclusive to the PFD HSI Symbology. In other words, it will not be possible to show PFD HSI symbology and Flight Director symbology simultaneously. In Basic Mode, the pilot may select either dual cue or single cue Flight Director.
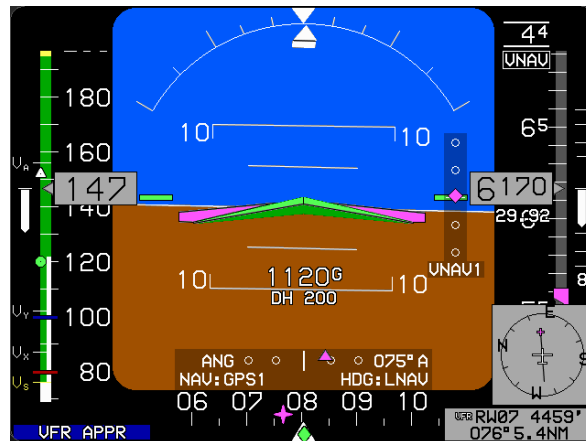
Flight director symbology will disappear in Unusual Attitude Mode. Refer to your autopilot/flight director documentation for more information on flight director functions.

Flight Path Marker

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

> *"This is really very simple.*
>
> *The flight path marker is where the aircraft is <u>going</u>, regardless of where it is <u>pointed</u>."*
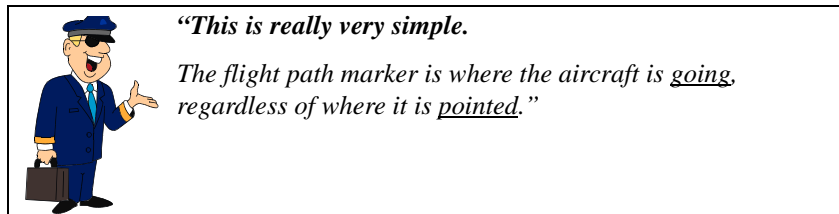
If the flight path marker is superimposed on terrain or an obstruction, the aircraft's current path through the air will result in a collision with that object. Likewise, if the flight path marker is well above terrain in climb, the aircraft will clear the terrain if the current climb angle is maintained. Placing the flight path marker on a waypoint symbol will result in the aircraft flying directly to the waypoint.

In an airplane installation, the flight path marker and pitch scale drift around the screen as a single element. See **Rotorcraft PFD, page 4-2** for rotorcraft flight path marker behavior. When the flight path marker drifts to the edge of the screen due to a crab angle greater than 15° (7.5° in zoom mode), the flight path marker and pitch scale will automatically cage (return to the center of the screen), and a "ghost" flight path marker, represented by three white bars (two horizontal, one vertical), will remain in its place to indicate flight path. The caged flight path marker is grayed out to indicated that it is in the caged position. When the crab angle drops below 13° (6.5° in zoom mode), the pitch scale uncages and realigns with the flight path marker.

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

When the flight path marker is displaced beyond the threshold of the viewing area, the ghost symbol will change color to yellow. This will indicate a large crosswind (15° of crab angle) and low ground speed. It could also indicate erroneous heading from the AHRS or erroneous ground track from the GPS.

NOTE:
Do not use a yellow flight path marker for navigation.

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°.

Normal flight path marker: This is where the aircraft is going.

Waterline: This is where the aircraft is pointing.

Ghost flight path marker: This is where the aircraft is going.

Caged flight path marker: used only to determine climb/dive angle.
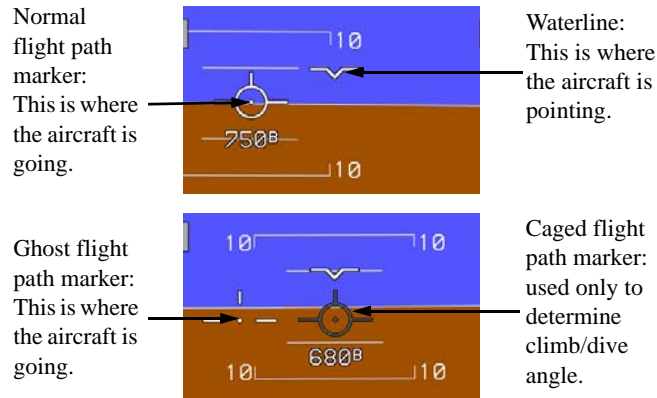
Above: Caged pitch scale and flight path marker. Note lateral position of ghost flight path marker relative to waterline, indicating crab angle greater than 15°. Nose position to the right of the flight path marker indicates wind from the right. Loss of GPS affects the accuracy of the flight path marker. While the vertical component of the flight path marker is unaffected by a loss of GPS, the lateral component is based on GPS track and GPS ground speed. Track and ground speed use the last known wind as part of the computations. However, unlike the dead reckoning position solution, the effects of loss of GPS on the accuracy of the flight path marker lateral component are not cumulative. Also, the flight path marker remains an accurate tool for maintaining level flight during a GPS failure. The flight path marker is grayed to indicate degraded performance after 1 minute of continuous GPS outage.

> *"To fly the flight path marker:*
> *Simply position it on the symbol you want to fly to.*
>
> *If the flight path marker is above the horizon, you are climbing. If it is below the horizon you are descending.*
>
> *If you want to hit the mountain, put the flight path marker on the mountain. If you want to miss the mountain, put it somewhere else. If the flight path marker cages, use the ghost for getting to the waypoint and use the caged symbol for climb and descent angle.*
>
> *Beware of the **YELLOW** ghost, indicating displacement beyond the bounds of the screen. If you see this, crosscheck winds, heading, and ground track."*

G-Force and Fast/Slow Indicator
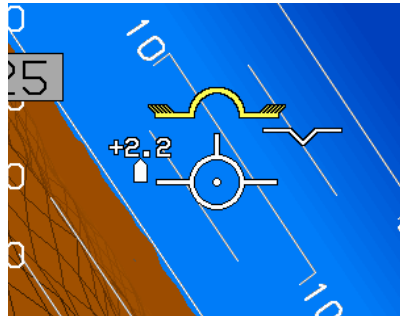
A G-Force indicator is located to the left of the Fight Path Marker (normal mode) or Large Aircraft Symbol Reference Marks (Basic Mode or Unusual Attitude Mode). The G-Force indicator has a "worm" format and will give an analog and digital representation of G-Force in gravitational acceleration units. The G-Force indicator is decluttered when the difference between G-Force and 1-G is less than 0.3 Gs. Appearance of the G-Force indicator is dampened based upon magnitude and time to prevent nuisance appearances.

When the landing gear is down, the G-Force indicator is replaced by a Fast/Slow indicator (if enabled). The Fast/Slow indicator is decluttered when the aircraft is on the ground. The

Fast/Slow indicator has a "worm" format and will give an analog representation of deviations from a target angle of attack. The background of the Fast/Slow indicator has an "F" at the top and an "S" at the bottom . The Fast/Slow indicator worm will grow in the "F" direction with angle of attacks lower than target and in the "S" direction with angle of attacks higher than target.

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 yellow. This situation would be unusual as it would indicate a crab angle greater than 35°. The ground track symbol is removed at low speeds to prevent jumpiness.

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°.

NOTE:
*If coupled with an autopilot in **HEADING** mode, the EFIS will command the autopilot to maintain the selected heading. If the autopilot is flying a flight plan and coupled to the EFIS*

*using GPSS mode, **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 262°.

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 an edge-to-edge white line that represents the aircraft's level flight path (or current altitude) projected into infinity. It can also be called a zero pitch line. The artificial horizon is used for attitude control and climb/ descent angle reference. 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.

NOTE:
Placing the waterline on the artificial horizon will result in zero pitch. 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 at a distance determined by aircraft altitude.
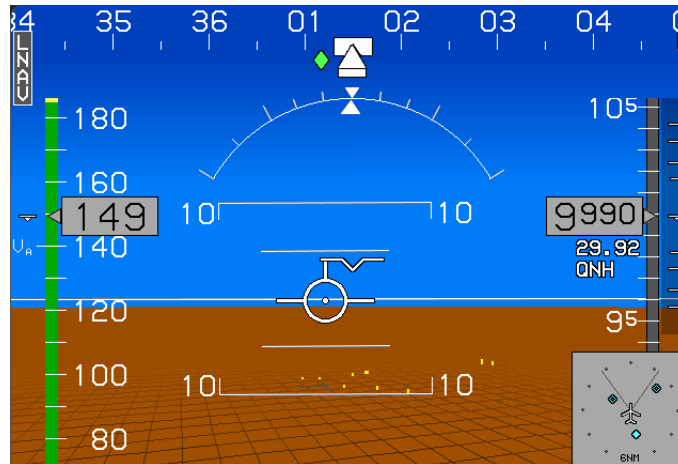
This example shows the artificial horizon and actual horizon over featureless terrain.
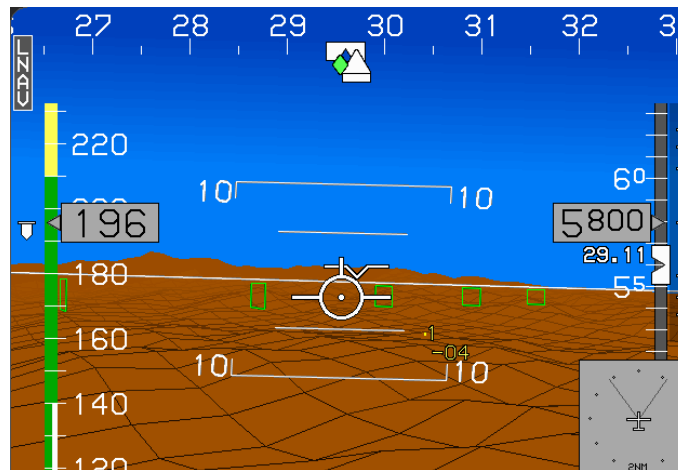
This example shows the artificial horizon and actual horizon in mountainous terrain.

Horizon Cue

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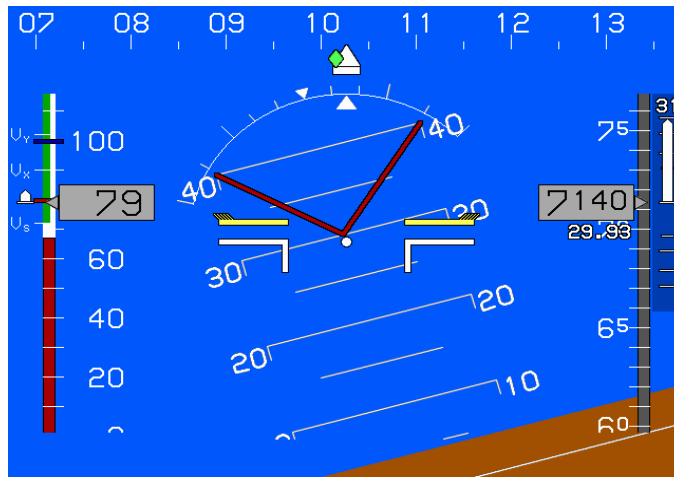
HSI (on PFD)

A PFD HSI can be overlaid on the PFD, centered on the flight path marker. The PFD HSI can be driven by VLOC1, VLOC2, or GPS (see **Omnibearing Selector (OBS) Menu, page 5-20** or **HSI and CDI/ANNUNCIATOR Source Selection, page 6-59**).

The white dot on the courseline arrow provides the **TO/FROM** indication:

> A white dot on the arrow side indicates **TO**.
> A white dot on the tail indicates **FROM**.
> Think of the white dot as the VOR station.

The deviation dots are automatically decluttered when the deviation is less than one dot.

The PFD HSI symbology is pilot-selectable, however it is mutually exclusive to the Flight Director Symbology. In other words, it will not be possible to show PFD HSI symbology and Flight Director symbology simultaneously.
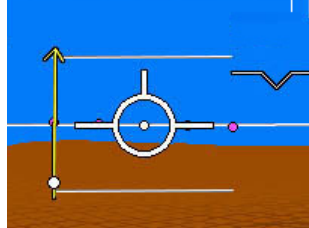
With a selected course of 030°, the needle is at full-scale deflection to the left (indicated on the EFIS by yellow coloration) and the aircraft is on a parallel outbound course.
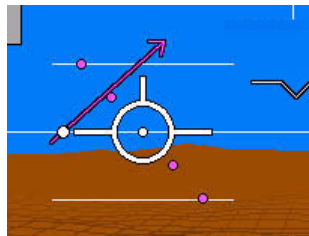
The needle is alive (indicated on the EFIS by magenta coloration) and the aircraft is on a heading to intercept the 030° course.
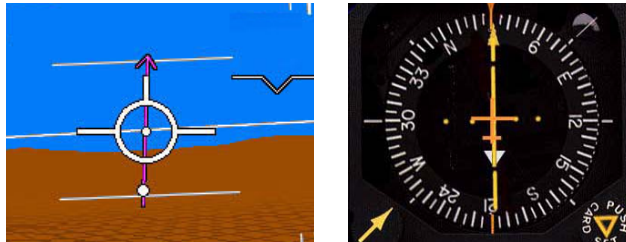
In this frame, the aircraft is centered on the 030° course FROM the station (indicated by the white dot on the tail of the courseline arrow).

Indicated Airspeed Display
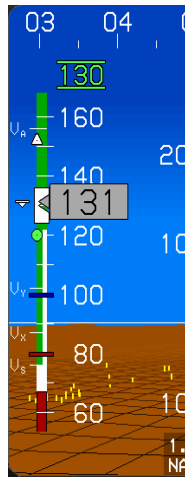
The PFD has an airspeed box and airspeed scale on the left side of the display. The airspeed box will digitally display indicated airspeed in knots or miles per hour depending upon the setting of the "Speed Units" system limit. In the case of airplanes, the airspeed scale has graduations every 10 measurement units with labels every 20 measurement units.

The airspeed scale background for small airplanes has colored regions as follows:

1. A gray background.

2. A red low-speed awareness area from 0 to V_{s0}.

3. If a valid Vfe exists, a white flap-operating area from V_{s0} to V_{fe}.

4. For aircraft without a V_{mo}/M_{mo}:

    a. A green safe-operating area from V_{s1} to V_{no}.

    b. A yellow caution area from V_{no} to V_{ne}.

    c. A red high-speed awareness area from V_{ne} to the top of the scale.

5. For aircraft with a Vmo/Mmo, a red high-speed awareness area from the lower of V_{mo} or M_{mo} to the top of the scale.

This is depicted below:
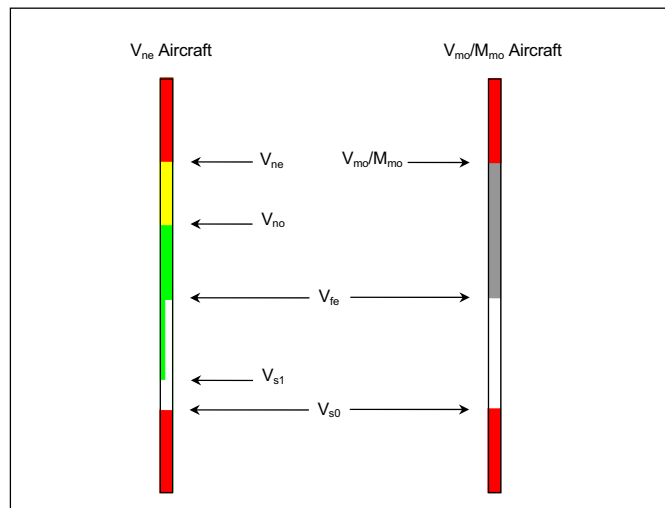
The airspeed scale for small airplanes has additional specific airspeed markings as follows:

1. For reciprocating multiengine-powered aircraft of 6,000 pounds or less, a red line at V_{mc}.

2. For reciprocating multiengine-powered aircraft of 6,000 pounds or less, a blue line at V_{yse}.

3. 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.

4. If enabled (V_{gl} not 0), a "green dot" best glide speed marker at V_{gl}.

5. If enabled (V_x not 0), a V_x marking at V_x.

6. If enabled (V_y not 0), a V_y marking at V_y.

7. If enabled (V_a not 0), a V_a marking at V_a.

8. If enabled (V_{mfe} not 0), a "white triangle" maximum flap extension speed marker at V_{mfe}.

The airspeed scale background for Part 25 airplanes has markings as follows:

1. A gray background.

2. A red low-speed awareness area from 0 to G-compensated 1.1 x V_{s0}. Note that V_{s0} is calculated by dividing the pilot-input V_{REF} by 1.23. The red low-speed awareness area is not shown unless a valid V_{REF} value exists.

3. A yellow low-speed awareness area from G-compensated 1.1 x V_{s0} to G-compensated 1.2 x V_{s0}. Note that V_{s0} is calculated by dividing the pilot-input V_{REF} by 1.23. The yellow low-speed awareness area is not shown unless a valid V_{REF} value exists.

4. If a valid V_{fe} exists, a white flap-operating area from 0 to V_{fe}. Note that when a pilot-input V_{REF} exists, the white flap-operating area extends from the top of the yellow low-speed awareness area to V_{fe}.

5. A red high-speed awareness area from the lower of V_{mo} or M_{mo} to the top of the scale.

This is depicted below:
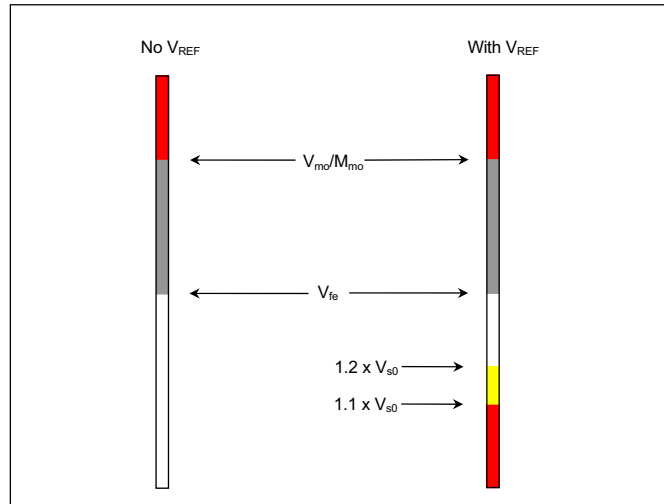
The airspeed scale for Part 25 airplanes has additional specific airspeed markings as follows:

1. If pilot-input V_{REF} is valid, a white V_s marking at the aircraft's 1-G V_{s0} or a yellow V_s marking at V_{s0} corrected for G-loading, whichever is higher. Note that V_{s0} is calculated by dividing the pilot-input V_{REF} by 1.23

2. If enabled (V_{gl} not 0), a "green dot" best glide speed marker at V_{gl}.

3. If enabled (V_x not 0), a V_x marking at V_x.

4. If enabled (V_y not 0), a V_y marking at V_y.

5. If enabled (V_a not 0), a V_a marking at V_a.

6. If enabled (V_{mfe} not 0), a "white triangle" maximum flap extension speed marker at V_{mfe}.

The airspeed scale has a user-settable airspeed bug that geometrically interacts with the airspeed box pointer. The airspeed bug setting is annunciated above the airspeed scale with a resolution of 1 knot indicated airspeed. The airspeed bug can be used either as a visual reference or, when vertically

integrated with an autopilot, as a control parameter for climbs or descents. It is mutually exclusive with the vertical speed bug. When vertically integrated with an autopilot, the airspeed bug setting annunciation is colored green and the airspeed bug is a filled-white when in airspeed climb or descent mode. Otherwise, the airspeed bug setting annunciation will be colored white and the airspeed bug will be hollow-white. When not vertically integrated with an autopilot, the airspeed bug setting annunciation will be colored white and the airspeed bug will be a filled-white at all times.

An airspeed trend vector will located to the left of the airspeed box.

In airplanes, V_1, V_R, V_2, V_{REF} and V_{APP} will also be shown on the airspeed scale when set. The V_1, V_R and V_2 symbols will automatically declutter when the respective value is exceeded by 40 knots or when above 2000 feet AGL.

Localizer/Glideslope (ILS)

Localizer and glideslope are displayed on the PFD using the CDI, VDI, and PFD HSI.
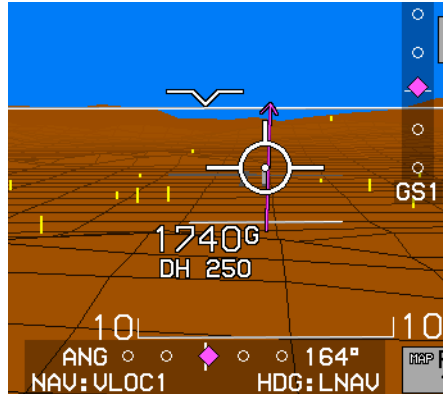
The localizer may be automatically set to the final approach course by pressing the **CRS SYNC** button in the nearest ILS function.

For localizer-only (no glideslope) display, only the localizer symbology is displayed. The HITS will continue to provide barometric vertical navigation to the missed approach point. When flying a localizer backcourse, the glideslope symbology is automatically removed to prevent display of false glideslope activity.

CHELTON

FLIGHT SYSTEMS

Section 3 — Display Symbology
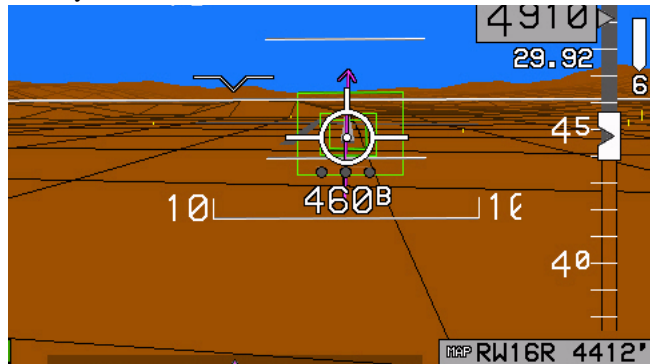
*"Remember, the skyway is always driven by GPS for lateral
and barometric altitude for vertical while the localizer and
glideslope are always driven by the ILS so you have a
continuous cross-check of independent sources centered in
your scan. The conformal runway presentation is a powerful
aid when flying an ILS; keeping the flight path marker on the
near end of the runway will result in very precise ILS
tracking."*

Mach Indicator

The Mach number is shown as an installation option above the
airspeed tape on the airspeed indicator. It is automatically
removed below Mach 0.35.
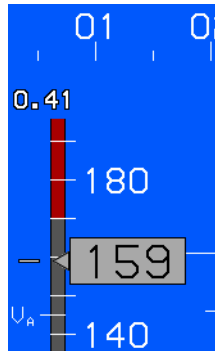
Marker Beacon

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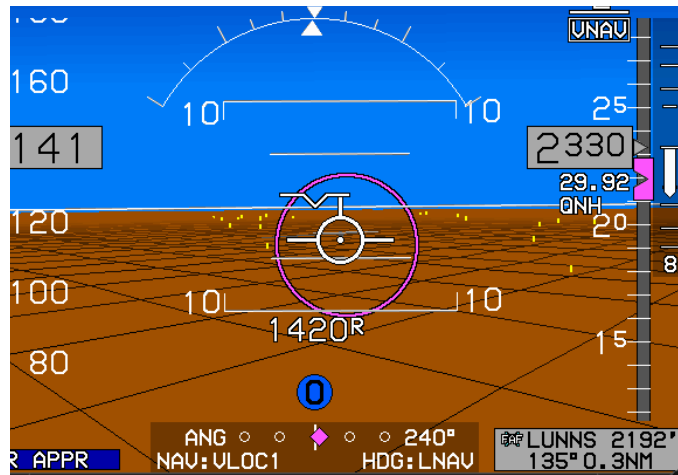
MiniMap

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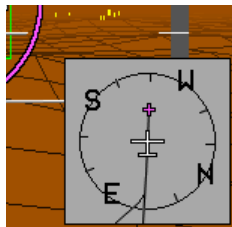
The MiniMap is only displayed when there is an active waypoint.

NOTE:
The MiniMap will not be shown when the traffic thumbnail display is selected either manually or by automatic pop-up. MiniMap and Traffic thumbnail are mutually exclusive. See **Traffic, page 3-69**

Minimum Altitude

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

The altitude 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. In addition to setting minimum altitudes for non-precision approaches, a decision height may be chosen. See Section 5, Step by Step Procedures.
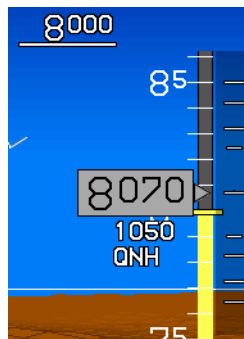
This example shows a Minimum Altitude Setting of 8,000 ft.

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

MINIMUMS

Obstructions

Towers, antennas, and other obstructions are shown on the PFD as vertical yellow 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. Obstructions that represent a collision hazard are annunciated aurally and with a caution or warning flag. A ground maintenance function utility is available to import custom obstructions from a SmartMedia card into the existing obstruction database.
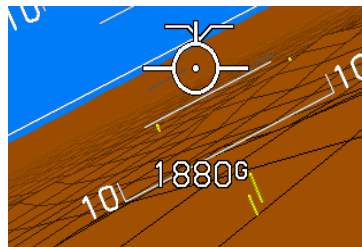
WARNING!
THERE ARE MANY TOWERS, ANTENNAS, AND
OBSTRUCTIONS THAT ARE NOT IN THE DATABASE.

NOTE:
The obstruction data is provided by Jeppesen Sanderson on a 28 day cycle.

AUDIBLE ANNUNCIATION
Towers, antennas, and obstructions that represent a collision hazard cause an annunciation of "Obstruction."

OBSTRUCTION

PFD Basic Mode
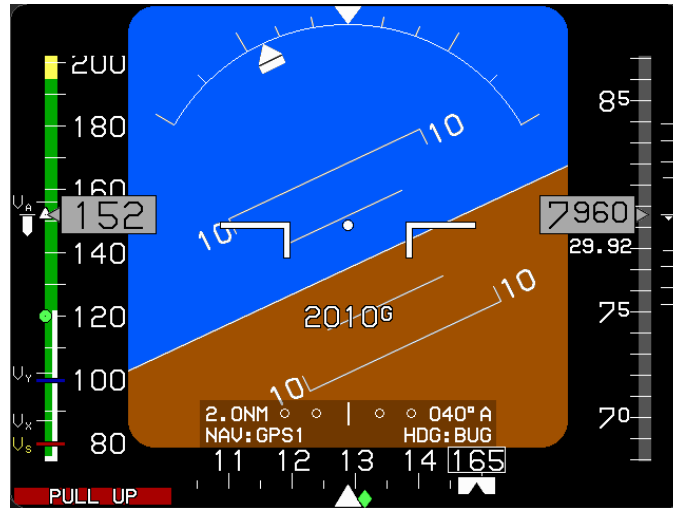
The PFD has a Basic Mode. Basic Mode is enabled by pushing MENU, then DCLTR, then choosing BASIC from the list. Scroll to DONE and press enter. Basic Mode uses a traditional attitude display with the airspeed, altitude and heading scales appearing in blacked-out areas in a "Basic-T" arrangement. In Basic Mode, the bank angle scale will always be the sky pointer type. The slip skid indicator will be at the bottom of the sky pointer. The flight path marker will not be shown in Basic Mode. Basic Mode is disabled while Unusual Attitude Mode is active. Two types of Flight Directors may be displayed while in Basic Mode. The first is a traditional command bar. The second is the cross pointer type of flight director. They are mutually exclusive. Both types are shown below.
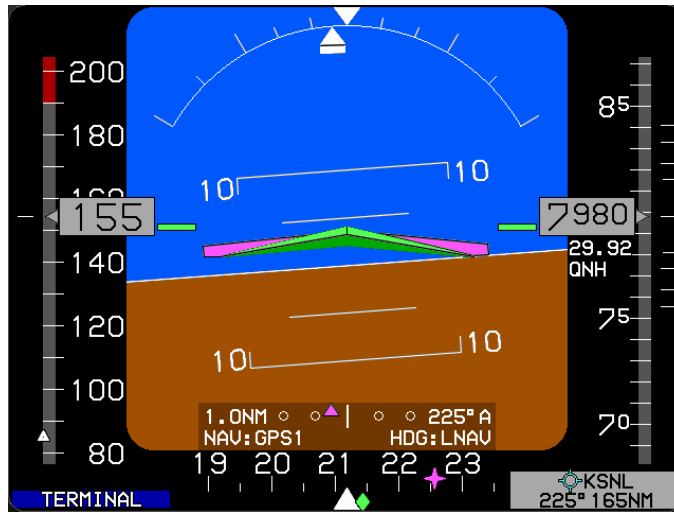
Basic PFD display with conventional flight director command bar.
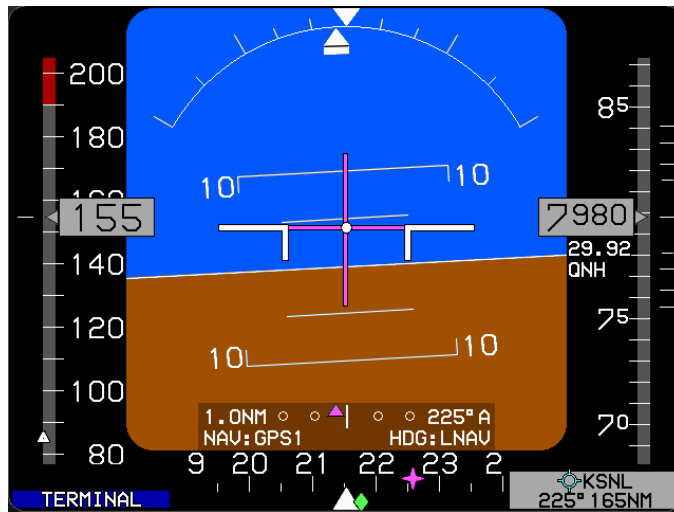
Basic PFD display with cross pointer flight director.

Pitch Limit Indicator
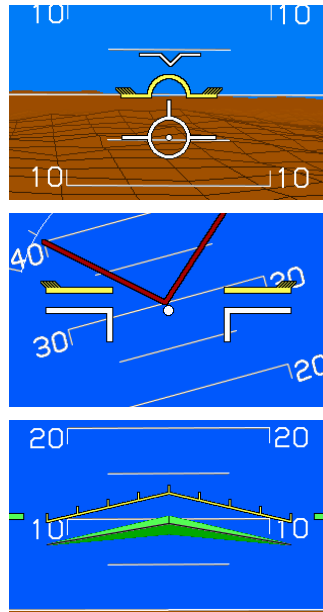
If enabled, a yellow pitch limit indicator will appear at 20 knots indicated airspeed above stall speed. Stall speed is defined as:

1. For small airplanes, the higher of the aircraft's 1-G V_{s1} or V_{s1} corrected for G-loading; or

2. For transport category airplanes, if pilot-input V_{REF} is valid, the higher of the aircraft's 1-G V_{s0} or V_{s0} corrected for G-loading where Vs0 is calculated by dividing the pilot-input V_{REF} by 1.23 .

The pitch limit indicator is a "feathered" symbol modified to work with either the Flight Path Marker or the Large Aircraft Symbol Reference Marks (Basic Mode or Unusual Attitude Mode). At 5 knots indicated airspeed above stall speed, the pitch limit indicator will become red. The pitch limit indicator will merge with the applicable reference symbol at stall speed and will continue moving downward as indicated airspeed further decreases.

Pitch Scale

The PFD has a white pitch scale and horizon line that rotate in conjunction with the background according to the aircraft's roll angle. For aircraft, the horizon line will be single width. For rotorcraft, the horizon line will be double width. The pitch scale has increments every 5° with major increments and pitch scale labels every 10°. Pointer bars at the ends of each major increment will indicate the direction to the horizon.
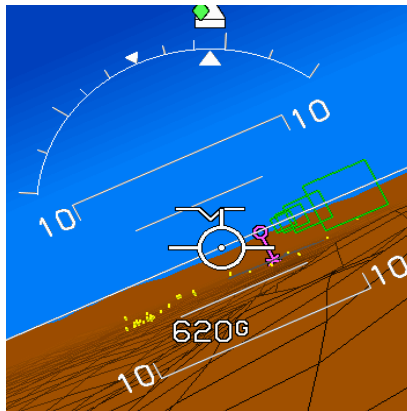
Runways

The PFD displays airport runways in a three-dimensional manner. Immediately upon a system startup on the ground, the runways for the nearest three airports will be displayed. Upon activation of a DP, VFR approach, IFR approach, or STAR procedure, the runways for the airport associated with the procedure will be displayed. In addition, the runways associated with the three nearest airports will be displayed. Runways will be shown in dark gray according to characteristics contained in the navigation database, including elevation, position, orientation, length and width. The landing portion of the selected runway will be shown in light gray.
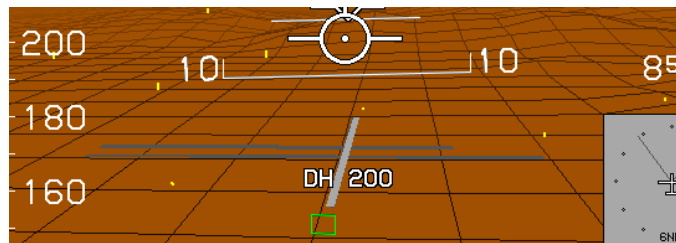
Selected Altitude/Selected Altitude Bug

The selected altitude is displayed above the altimeter tape and is bracketed by a line above and below. A bug marking the selected altitude is displayed on the altitude tape.

When a selected altitude and bug are set by the VNAV function, they are shown in magenta and the readout includes "VNAV". When the selected altitude and bug are set using the Target Altitude Bug function, they are shown in white and the readout includes "SLCT".
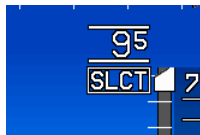
In this example, target altitude is set to 9,500 ft.

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

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 depiction of the desired flight path.

The Skyway is based solely on GPS. It **NEVER** represents any other navigation source such as VOR or ILS.

The skyway is displayed whenever a waypoint, runway, or any approach/departure procedure is selected. The skyway shows the course that you have selected and can be thought of as a predictive flight director because it indicates upcoming maneuvers.

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.

NOTE:
The skyway boxes are drawn using a hidden surface removal technique, such that a skyway box behind terrain will appear to be so.

The skyway boxes may be removed from the screen using the **DCLTR . .** menu.
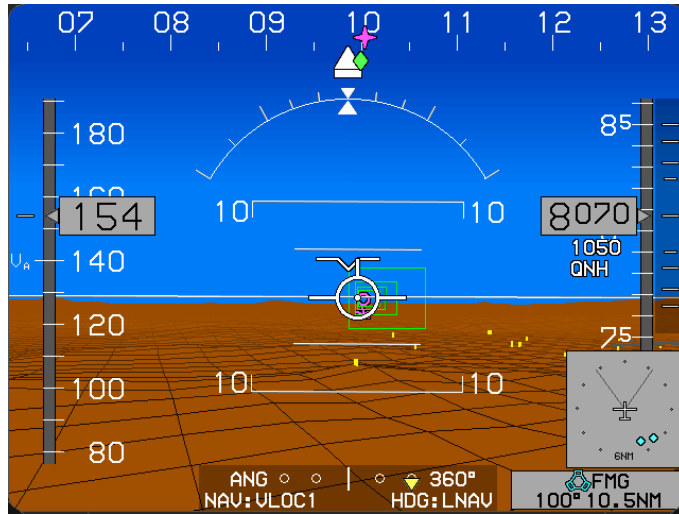
Skyway Lateral Navigation (LNAV)

The skyway starts at the beginning of a route or flight plan and terminates at the destination. Complex procedures, such as procedure turns, arcs and holding patterns (including entries) are automatically calculated and displayed.
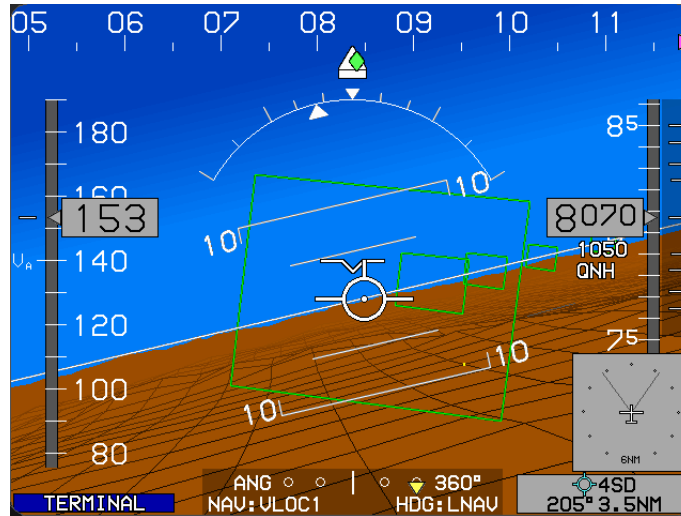
Skyway turns requiring more than 5° of bank angle are indicated by boxes banked in the direction of the turn, while turns requiring less than 5° of bank angle are unbanked.

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

The system is configured with a **V$_{PROC}$** or preprogrammed speed to determine the radius of the skyway turns in a procedure. **V$_{PROC}$** is the approximate speed that approach procedures are typically flown in a particular aircraft. Skyway turns will result in 15° banks at that speed. **V$_{PROC}$** is used on:

1. the first two waypoints in a DP,

2. STAR waypoints within 30NM of the destination,

3. IFR approach and missed approach procedures.

Otherwise, skyway turn radius is based on a 15° bank at the higher of the preprogrammed **V$_{PROC}$** or current speed. Therefore, in zero-wind conditions, the angle of the flight path marker will match the angle of the boxes. However, wind will

cause the actual bank angle required to stay within the skyway to vary.

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


"To fly skyway turns:
Wait until you fly through the last level box on a straight course segment before initiating your turn. If you overshoot the next box, just increase your bank angle slightly. If you undershoot the next box, shallow your bank angle a bit. You can check your progress through a turn by looking at the projected path on the moving map; just make it match the curve of your courseline. And remember, the boxes just indicate a turn, not a target bank angle - because of the effects of wind."

Skyway Vertical Navigation

Skyway box altitude is controlled by the selected altitude (target or VNAV), aircraft altitude, aircraft climb performance, and climb/descent angle setting.

Selected altitude is set by the target altitude bug (shown in white) or a VNAV altitude (shown in magenta).
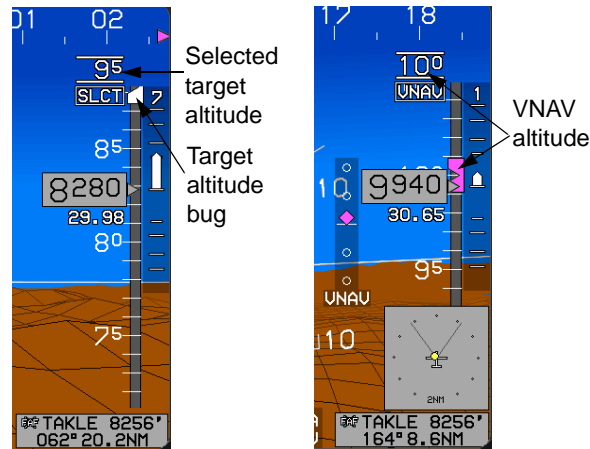
If no selected altitude is set, then the skyway boxes describe the desired lateral navigation path at the aircraft's current altitude (they just go up and down with the aircraft's altitude).

The VNAV function provides preprogrammed altitudes for all waypoints in the active route which are set manually by the pilot, loaded from the Jeppesen NavData for procedures, or calculated by the EFIS. When one waypoint in the active route is assigned a VNAV altitude by the pilot or the NavData, the EFIS automatically fills in altitudes for the rest of the waypoints.

The target altitude bug overrides the VNAV altitudes and makes the skyway go up or down immediately.

Climb and descent angle settings are controlled individually with a resolution of 0.1° using the **VNAV CDA** function in the **BUGS . .** menu, see **PFD Bug (BUGS) Menu, page 5-28**.

VNAV Climbs

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 altitude for the waypoint is set automatically in the VNAV function. Where a procedure altitude constraint does not exist, the system looks ahead in the procedure for additional altitude constraints. If a further altitude constraint is found and it is above current aircraft altitude (a climb is necessary), the desired altitude is continuously calculated for the active waypoint in the VNAV function based upon an immediate climb to the altitude constraint at the higher of

   1) the aircraft's actual climb angle or

   2) the climb angle setting. This means you won't outclimb the skyway.

If a further altitude constraint is found and it is below current aircraft altitude (a descent is necessary), then a target altitude is automatically set for the active waypoint in the VNAV function based upon a descent to reach the target altitude at the waypoint using the descent angle setting.

At any time, the pilot may override the VNAV target altitude by setting the target altitude bug or manually setting a different waypoint crossing altitude in the VNAV function. Note that waypoint crossing altitudes in instrument approach procedures cannot be overriden.

When the aircraft is below the target altitude (a climb is desired), the boxes are drawn at a vertical position that is the higher of
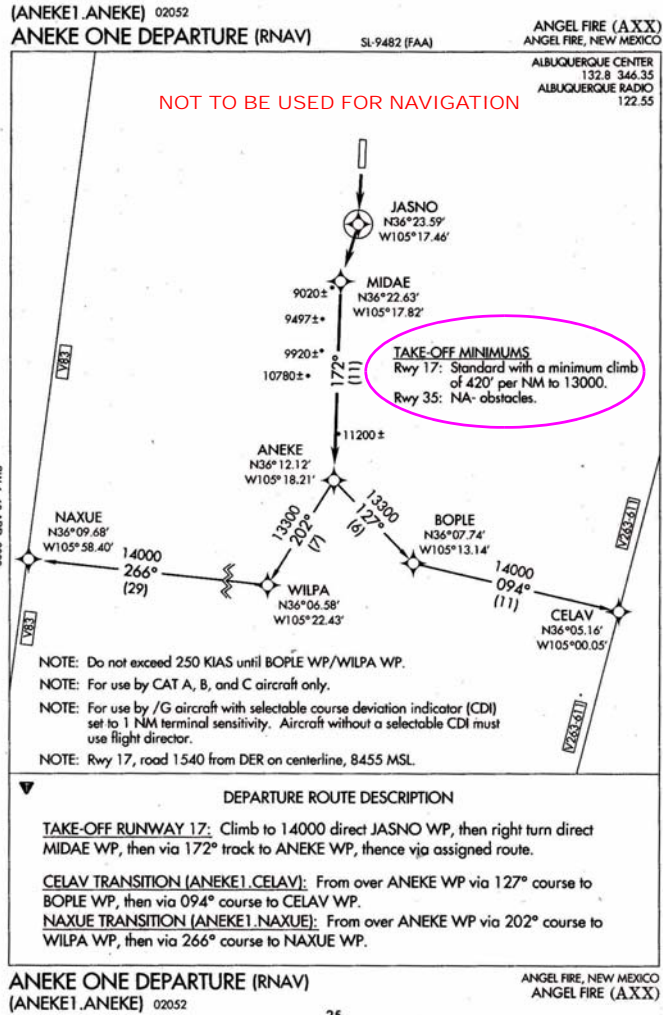
   1) the dynamic climb angle emanating from the aircraft's present position (aircraft-referenced),

   2) the dynamic climb angle emanating from the next waypoint altitude (geo-referenced forward),

   3) the climb angle setting emanating from the previous waypoint altitude (geo-referenced backward).

The geo-referenced backward method is only considered when the current leg is part of a procedure and is designed to provide pilot awareness if a specified climb gradient is not being met (a

missed approach in a mountainous area, for example). Once the boxes intercept the target altitude, further boxes are drawn with a zero angle to indicate a level-off. Due to the fact that five boxes are shown, the level-off depiction becomes an anticipatory cue for the pilot.
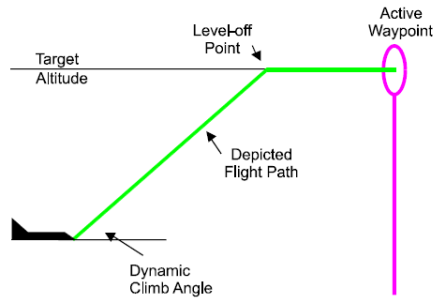
NOTE:
*Be sure to set the climb angle (**ft./NM**) required for a departure procedure (from the DP plate as shown below) using the VNAV climb angle setting under the* **BUGS . .** *menu.*

(ANEKE1.ANEKE) 02052
ANEKE ONE DEPARTURE (RNAV) SL-9482 (FAA) ANGEL FIRE (AXX) ANGEL FIRE, NEW MEXICO

ALBUQUERQUE CENTER 132.8 346.35
ALBUQUERQUE RADIO 122.55

NOT TO BE USED FOR NAVIGATION

JASNO
N36°23.59'
W105°17.46'

MIDAE
N36°22.63'
W105°17.82'
9020±
9497±

9920±
10780±

172°
(11)

TAKE-OFF MINIMUMS
Rwy 17: Standard with a minimum climb
of 420' per NM to 13000.
Rwy 35: NA- obstacles.

11200±

ANEKE
N36°12.12'
W105°18.21'

13300
202°
(7)

13300
127°
(6)

BOPLE
N36°07.74'
W105°13.14'

NAXUE
N36°09.68'
W105°58.40'

14000
266°
(29)

14000
094°
(11)

WILPA
N36°06.58'
W105°22.43'

CELAV
N36°05.16'
W105°00.05'

SW-1, 18 APR 2002

NOTE: Do not exceed 250 KIAS until BOPLE WP/WILPA WP.
NOTE: For use by CAT A, B, and C aircraft only.
NOTE: For use by /G aircraft with selectable course deviation indicator (CDI)
set to 1 NM terminal sensitivity. Aircraft without a selectable CDI must
use flight director.
NOTE: Rwy 17, road 1540 from DER on centerline, 8455 MSL.

▼   DEPARTURE ROUTE DESCRIPTION

TAKE-OFF RUNWAY 17: Climb to 14000 direct JASNO WP, then right turn direct
MIDAE WP, then via 172° track to ANEKE WP, thence via assigned route.

CELAV TRANSITION (ANEKE1.CELAV): From over ANEKE WP via 127° course to
BOPLE WP, then via 094° course to CELAV WP.
NAXUE TRANSITION (ANEKE1.NAXUE): From over ANEKE WP via 202° course to
WILPA WP, then via 266° course to NAXUE WP.

ANEKE ONE DEPARTURE (RNAV)
(ANEKE1.ANEKE) 02052   ANGEL FIRE, NEW MEXICO
ANGEL FIRE (AXX)

25

Climb guidance is depicted as follows:

Aircraft-Referenced Climb

Geo-Referenced Forward Climb
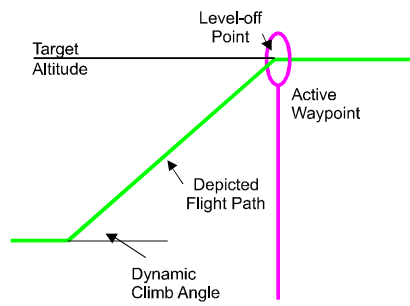
Geo-Referenced Backward Climb
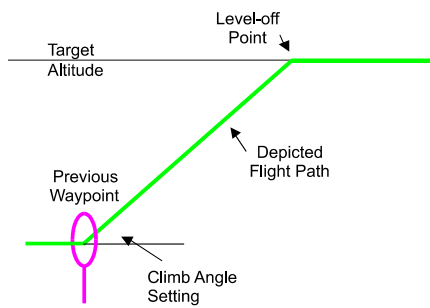
VNAV Descents

When aircraft altitude is above the altitude constraint (a descent is desired), the boxes are drawn with a zero angle until reaching a descent point. Further boxes are then drawn downward at an angle corresponding to the descent angle setting to cross the active waypoint at the target altitude.

Normal descent
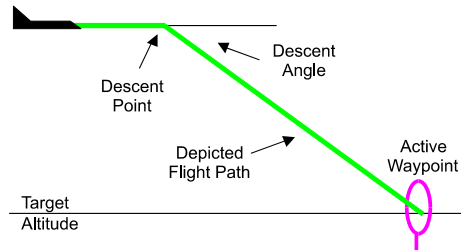
On the final approach segment of an IFR or VFR approach procedure, the descent point is the Final Approach Fix and the descent angle creates a stabilized approach to the Missed Approach Point location and altitude as stored in the navigation database. Due to the fact that five boxes are shown, the descent point depiction becomes an anticipatory cue for the pilot.

Final approach segment
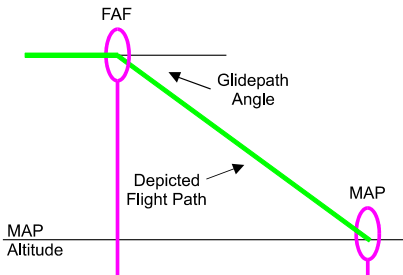
During an early descent, if the aircraft descends below the boxes, they will rejoin the aircraft upon reaching the target altitude.

"VNAV in a nutshell:

VNAV altitudes can be set for all waypoints in a route. They can be set automatically from the Jeppesen NavData (for procedures) or manually by the pilot. These 'hard' altitudes are shown in white. The EFIS calculates a target altitude for any waypoint that is not assigned a 'hard' altitude. These are shown in magenta and are based on the VNAV Climb/Descent angles.

Setting a target altitude bug overrides the VNAV function and provides immediate climb or descent guidance, sort of like a traditional altitude preselector.

Be sure to turn the target altitude bug **OFF** *for proper VNAV altitude sequencing during published procedures.*

If you are using an autopilot preselector:
1. Enter the magenta VNAV altitudes provided by the EFIS into the preselector.
2. Entering a manual target altitude bug on the EFIS is unnecessary extra workload.

Note that this will cause you to climb and descend out of the boxes but they will rejoin you when you arrive at the target altitude."

Flying the skyway

Because of its visual 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; for straight segments, bank angles greater than 3° are
excessive.

**It is important to recognize that the skyway does not
provide approved precision vertical instrument approach
guidance, nor does it guarantee terrain separation. As with
any navigation device, including VOR's, it is possible to
generate course guidance that will impact terrain as shown
in the following example:**
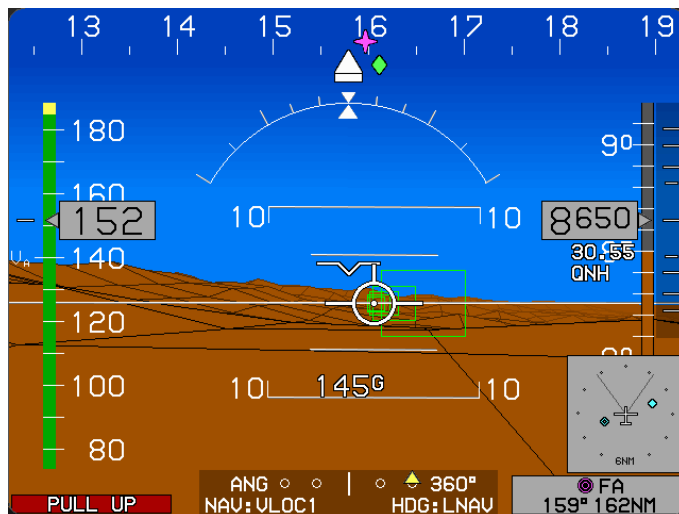
In this circumstance, however, the compelling nature of the
forward-looking terrain display combined with the advanced
TAWS capabilities will provide the pilot with the situational
awareness to recognize the hazard and take the appropriate
corrective action.

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.***

"The key to successfully flying the skyway is:

1. *When flying straight and level, don't try to steer through
the nearest box. Aim for the smallest box you can see and
make tiny corrections, like you are flying an ILS.*
Remember, 3° of bank is too much bank.

2. *Don't overcontrol; once established in the skyway and
trimmed correctly, your aircraft will fly a long way in the
boxes without any "help" from you.*

3. *When turning, if you find yourself turning inside or out-
side the turn radius indicated by the skyway, relax and
simply increase or decrease your bank angle slightly. If
you look down at the CDI, it will probably be nearly cen-
tered (unlike a VOR/LOC the CDI provides course devia-
tion indication throughout turning maneuvers, as well as
for straight segments). Remember, the skyway is only
half the width of the localizer at the inner marker making
it very precise, so if you are a bit inside or outside, you
are still flying with extreme precision. Do not fixate on
flying through the center of the boxes prior to the final
approach fix.*

4. *When joining the skyway at an angle, think of it as merg-
ing onto the freeway using an on-ramp. Join up gradu-
ally and make small adjustments.*

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

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

Slip Indicator

An electronic slip indicator is provided and may replace the mechanical slip indicator mounted in the bezel.

The slip indicator is a rectangle just below the heading pointer that moves left and right to indicate the lateral acceleration sensed by the AHRS in the same manner as the ball in a mechanical slip indicator.

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 ten seconds.
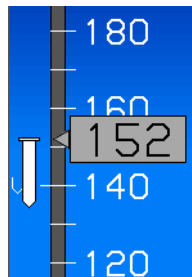
The above example shows that the aircraft will be at approximately 135 KTAS in ten seconds.

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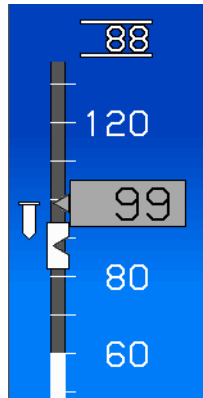
In this example, the target airspeed is set to 88 kts.

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.

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.

Worldwide terrain coverage is provided and is grouped into regions as follows:
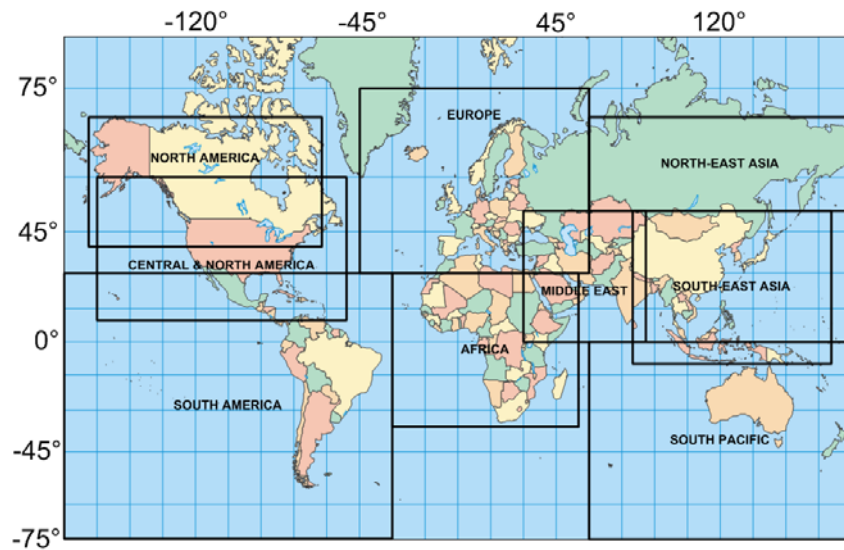
Each of the above regions is stored on a single terrain data card, which is installed in each display. Each system comes loaded with one terrain region. Terrain cards may be changed in minutes by your Chelton FlightLogic dealer or A&P Mechanic.

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

Terrain is displayed 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, an actual horizon is

depicted based on aircraft altitude, like the real horizon. Distance varies to create a realistic depiction of the horizon.

Threatening terrain will cause a "pop-up" condition on the PFD and MFDs in a system meaning that, even if it has been manually decluttered by the pilot, terrain will automatically be shown on the displays when it becomes threatening.

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

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

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

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.
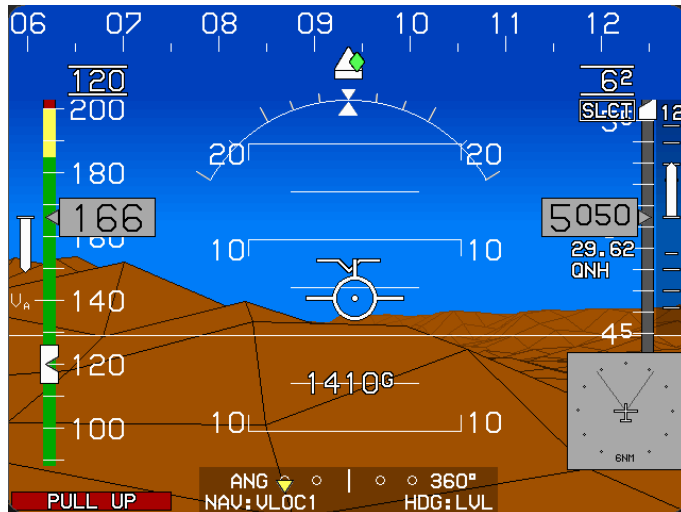
Terrain in this example is approximately 10° above the horizon. Position of flight path marker indicates that terrain will be cleared if the current climb angle is maintained.

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 for airplanes includes integral Class C TAWS (Terrain Awareness Warning System) and, optionally, may include Class B or Class A TAWS. Rotorcraft systems include Class B HTAWS or, optionally, Class A HTAWS. For a detailed description of TAWS functions, refer to **TAWS (Terrain Awareness and Warning System) Functions, page 9-12**).

While the Chelton EFIS uses the same terrain source as the enhanced ground proximity warning systems in airliners and is quite accurate, certain geographic areas exhibit greater errors than others.
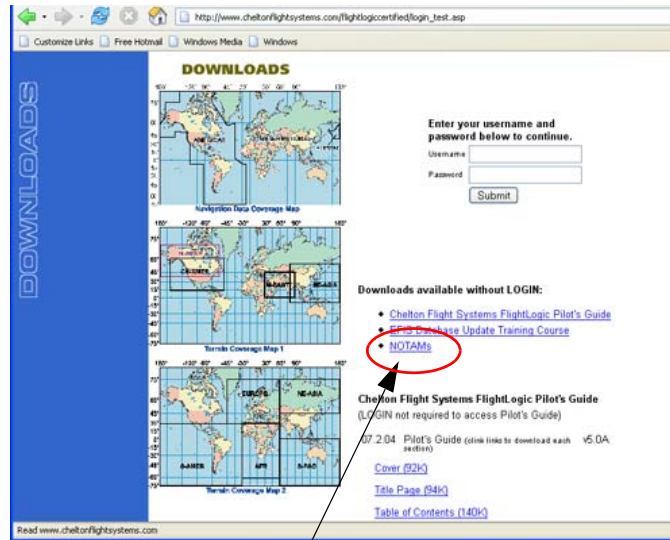
Please see the Terrain NOTAM at www.cheltonflightsystems.com (Certified Downloads section) which is posted whenever a new terrain database is compiled. This NOTAM identifies airports in mountainous regions of the United States near which terrain database errors in excess of 100 ft. have been detected due to exceptionally rugged geography. Pilots operating near these airports should use extra vigilance.

NOTE:

*To avoid unwanted alerts, the Terrain Awareness System must be inhibited by pushing the **TAWS INHIBIT** switch (located near the display) when approaching or departing a landing site that is not included in the airport database, or when a user waypoint approach has not been selected.*

"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 (be sure to account for anticipated climb deterioration).*

3. *The terrain shown on the PFD and moving map will often give you a clear understanding of why the published instrument procedures are making you do what you are doing.*

4. *If you have selected a course and altitude that will impact terrain, ignore the course and avoid the terrain visually on the PFD and moving map.*

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 take-off 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 or until a button is pressed.

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

Traffic
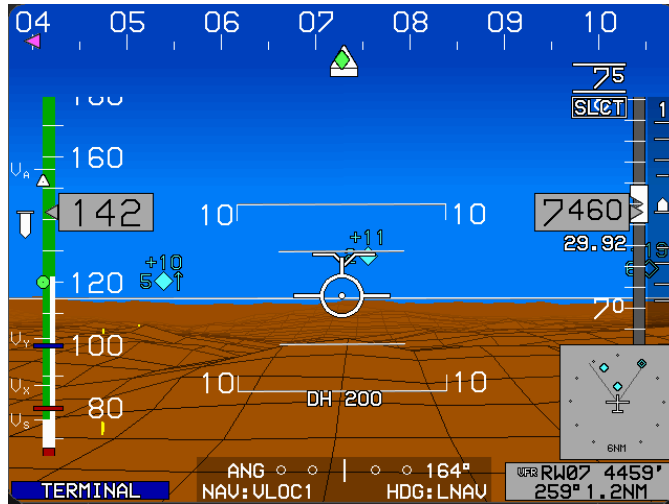
The normal mode PFD will display traffic in a three-dimensional manner. PFD traffic will use standard traffic symbols as defined on page 3-70.

PFD traffic will include a range indication in nautical miles immediately to the left of the symbol. The relative altitude will be displayed in hundreds of feet below the traffic symbol if the traffic is below own aircraft. The relative altitude will be displayed in hundreds of feet above the traffic symbol if the traffic is above own aircraft. The arrow to the right of the traffic symbol indicates if the traffic is climbing or descending at a rate greater than 500 feet per minute. PFD traffic will not be rendered in Basic Mode or Unusual Attitude Mode.

AUDIBLE ANNUNCIATION
Traffic alerts will result in a yellow flag and a single voice warning of "Traffic. Traffic."

TRAFFIC

Traffic Thumbnail

A traffic thumbnail is displayed in the lower right corner of the PFD above the active waypoint identifier. The traffic thumbnail has clock face markings and is normally fixed at 6NM scale. It will be possible for the pilot to declutter the traffic thumbnail. In the event of a traffic warning (TA or RA), the traffic thumbnail will automatically be enabled while the traffic warning is active and the traffic thumbnail scale will automatically adjust, in multiples of 2NM (2NM, 4NM or 6NM), to optimally display the traffic. The traffic thumbnail will disappear in Unusual Attitude Mode. Display of the mini-map and the traffic thumbnail will be mutually exclusive with the traffic thumbnail taking precedence during a traffic warning (TA or RA). The traffic thumbnail will use standard traffic symbols as follows:
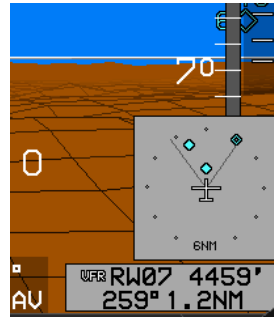
TCAS-I, TCAS-II, TAS and TIS-A

Other Traffic　　Proximite Advisory　　Traffic Advisory　　Resolution Advisory (Flashing)

ADS-B and TIS-B

High-Integrity Traffic with Track Information

Other
Traffic

Proximite
Advisory

Traffic
Advisory
(Flashing)

High-Integrity Traffic without Track Information

Other
Traffic

Proximitye
Advisory

Traffic
Advisory
(Flashing)

Degraded Position Traffic without Track Information

Other
Traffic

Proximite
Advisory

Traffic
Advisory
(Flashing)

Degraded Position Traffic without Track Information

Other
Traffic

Proximite
Advisory

Traffic
Advisory
(Flashing)

Vertical Deviation Indicator
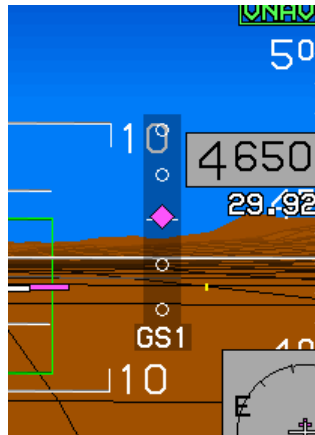
The PFD has a vertical deviation indicator on the right side of the display. The vertical deviation indicator will display vertical deviation for the currently selected vertical navigation source. When the selected vertical navigation source is VNAV, the vertical deviation indicator will conform to the vertical deviation display requirements of TSO-C146a. The vertical deviation indicator will only appear when the source of vertical navigation is valid. When the source of vertical navigation is VNAV, the source will be valid in VNAV mode (i.e., not in selected altitude sub-mode), on level or descending legs, and when within 2NM or twice the full scale deflection for the GPS/WAAS mode of flight (whichever is greater) of the lateral navigation route. When the source of vertical navigation is glideslope, the source will be valid when a valid glideslope signal is received. The currently selected vertical navigation source will be annunciated immediately below the vertical deviation indicator as follows:

1. VNAV1 or, if a second GPS/WAAS receiver is not installed, VNAV.

2. VNAV2 (only available if a second GPS/WAAS receiver is installed).

3. GS1.

4. GS2.

5. When vertically integrated with an autopilot in conventional GS or APPR modes, the selected vertical navigation source will be annunciated in green to indicate that the autopilot is vertically coupled to the selected vertical navigation source. Otherwise, the selected vertical navigation source will be annunciated in white.

The vertical deviation indicator will disappear in Unusual Attitude Mode.

Vertical Speed Indicator
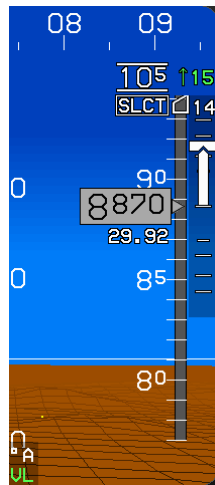
The vertical speed indicator is presented as a dynamic pointer that grows out of a fixed datum in correspondence with the vertical velocity. The pointer grows upward from the datum in a climb and downward in a descent.

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.). The digital display is rounded to the nearest number (example: 349 ft./min. = 3) but the analog portion behaves as an analog needle. The VSI is only shown when there is a vertical velocity. Maximum VSI value is 9,999 ft./min.

When TCAS II is installed in the aircraft, the VSI display limits are ±6,000 feet per minute and the background of the VSI will function as an RA display with green and red colored regions to provide RA maneuver guidance.

The VSI indication has a user-settable vertical speed bug that geometrically interacts with the VSI pointer. The vertical speed bug setting is annunciated above the VSI scale with a resolution of 100 feet per minute. The vertical speed bug can be used either as a visual reference or, when vertically integrated with an autopilot, as a control parameter for climbs or descents. It is mutually exclusive with the airspeed bug. When vertically integrated with an autopilot, the vertical speed bug setting annunciation will be colored green and the vertical speed bug will be a filled-white when in VSI climb or descent mode. Otherwise, the vertical speed bug setting annunciation will be colored white and the vertical speed bug will be hollow-white. When not vertically integrated with an autopilot, the vertical speed bug setting annunciation will be colored white and the vertical speed bug will be filled-white at all times.

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 Display, page 3-31** for more information.

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

See **Dynamic Stall Speed, page 3-18** for more information.
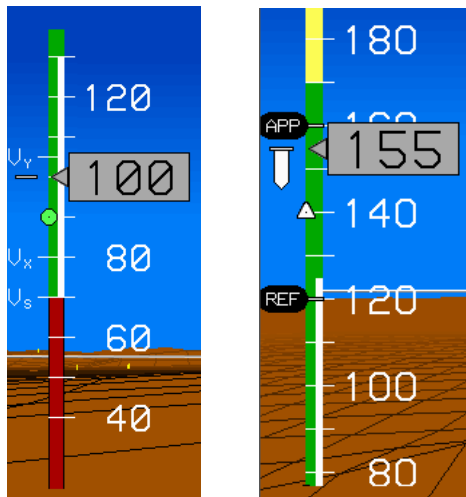
Takeoff and approach V speeds may be selected with the bugs menu.

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 small "**v**" with wings). Rotation of the horizon and pitch scale occurs relative to the waterline symbol, indicating aircraft attitude. The waterline is analogous to the dot in the center of a mechanical attitude gyro; it is where the nose is pointed.
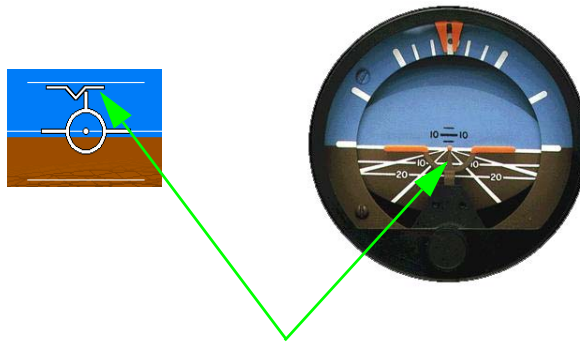
This is essentially the same thing although the waterline will typically indicate a few degrees up for the angle of incidence and is not adjustable.

Navigation Display Symbology

The navigation display can be presented in a variety of formats including:

- Moving Map

- Conventional HSI

- Navigation Log

- Lightning Display

- Traffic Display

- Datalink 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
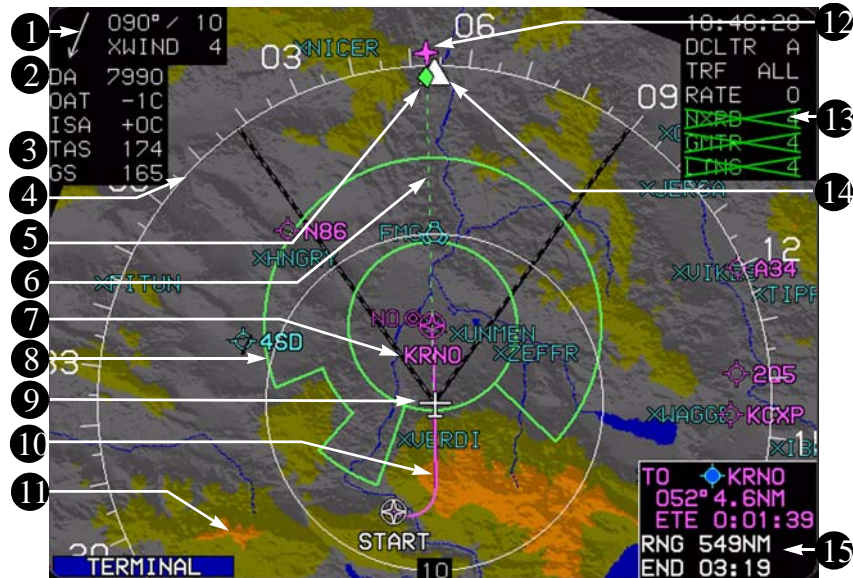
1. Wind vector
2. Density altitude
3. True airspeed
4. Directional scale
5. Ground track
6. Ground track lubber line
7. Waypoint
8. Airspace boundary
9. Aircraft Position
10. Courseline
11. Terrain
12. Bearing to waypoint
13. Datalink Weather Status
14. Heading indicator
15. Fuel totalizer

Moving Map with Instrument Approach

1. Wind data
2. Outside air temperature
3. ISA temperature
4. Groundspeed
5. Missed approach course
6. Instrument approach course
7. Heading bug
8. Waypoint (fly-by)
9. Waypoint (fly-over)
10. Traffic
11. Range ring scale

NOTE:
Destination distances for example PAJN (Juneau) 51.1NM include all the legs of the approach. Actual distance to the airport is much closer.

Moving Map with STAR
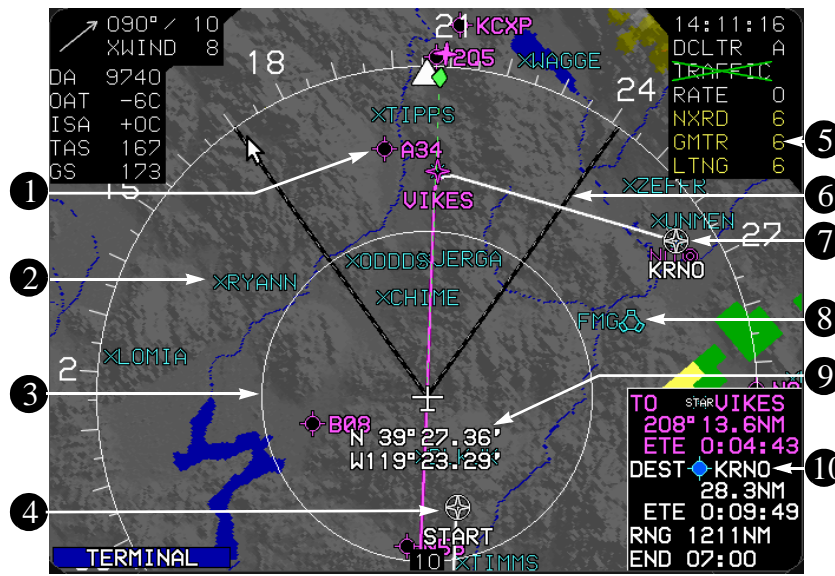
1. VFR Airport
2. Fix or Intersection
3. Range Ring
4. Start Waypoint
5. Datalink Weather Status

6. Field of View on PFD
7. Destination Airport
8. VORTAC
9. Latitude Longitude (pilot selectable)
10. Destination

North-Up Arc Mode
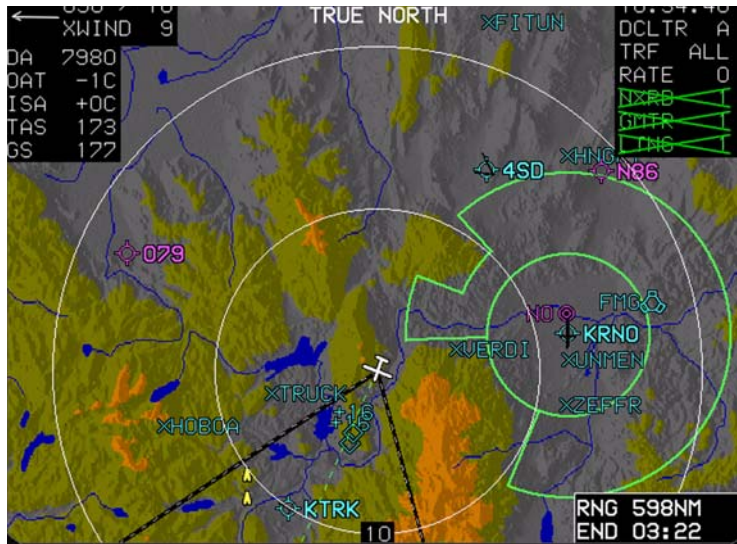
North-Up Centered Mode
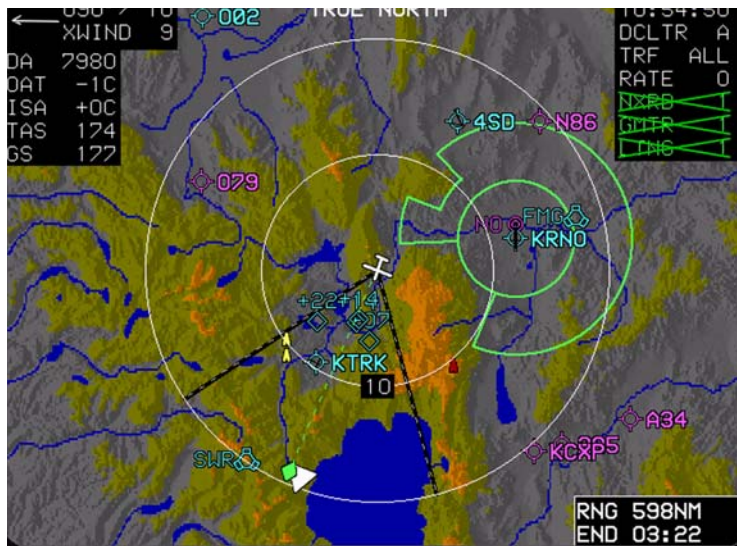
Heading-Up Centered Mode
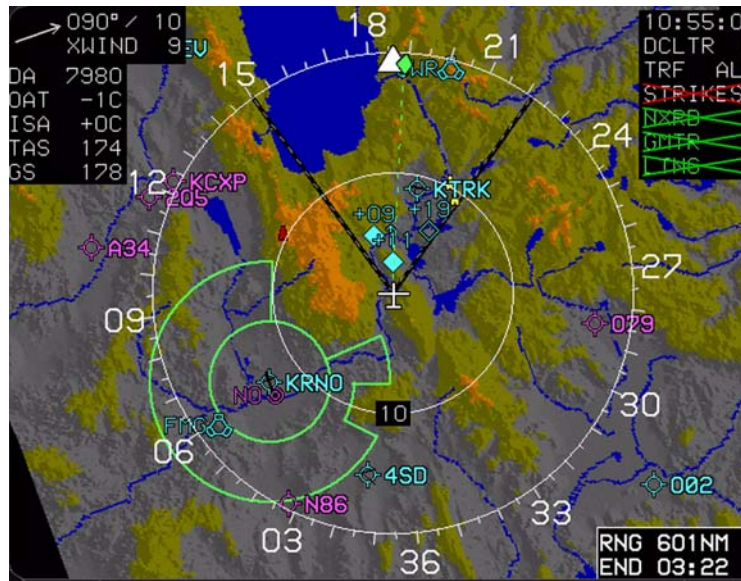
Conventional HSI/PTR Format
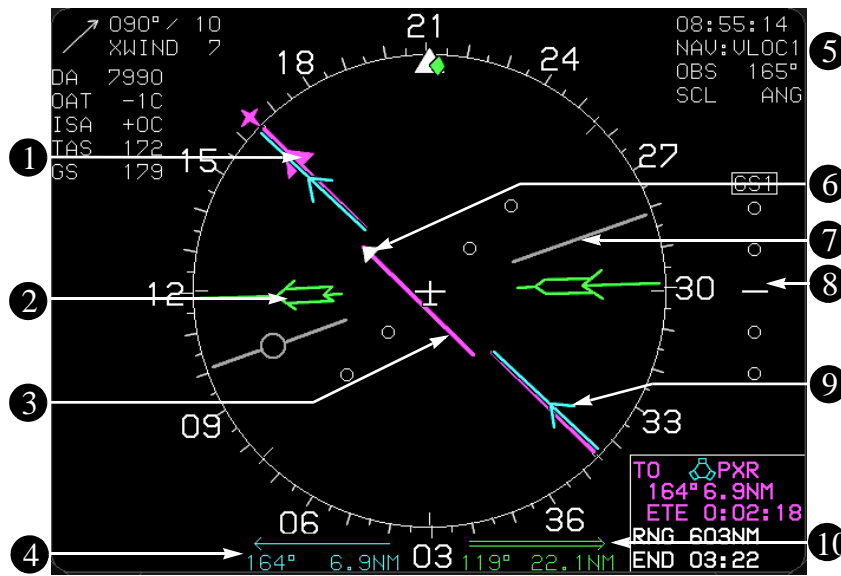
1. Selected Course Pointer	6. To-From indicator
2. PTR (VLOC2)	7. ADF needle
3. Selected Course Needle	8. Glide slope indicator
4. DME/TACAN 1	9. PTR (VLOC1)
5. CDI scale and OBS setting	10. DME/TACAN 2

NOTE:
VOR and ADF symbology is only available when the EFIS is interfaced with the appropriate external receivers.

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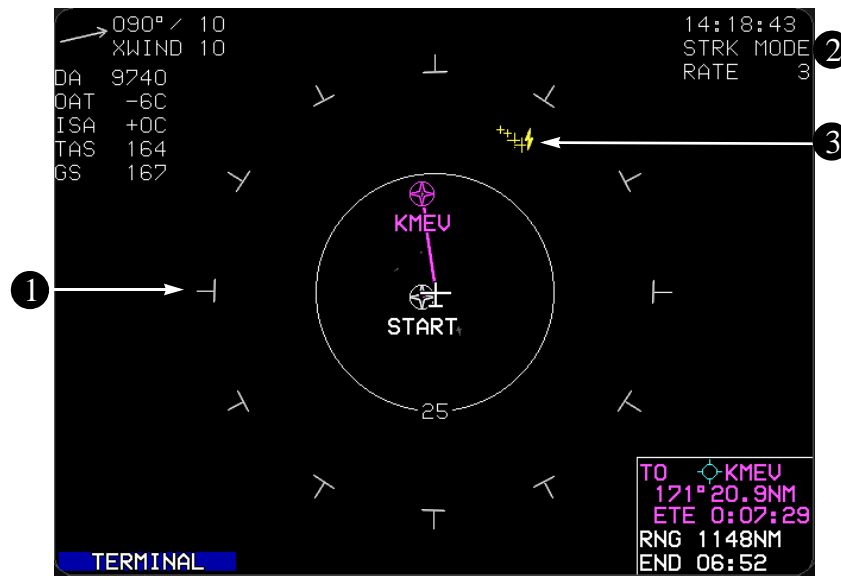
1. Strike position reference
2. Mode and rate indicators
3. Lightning strikes

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

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

Navigation Log Display

1. Zulu Time
2. Ground Speed
3. Active Waypoint
4. VNAV Altitude and Offset
5. Geodetic Path between Waypoints
6. Fuel Remaining
7. Fuel Flow
8. Fuel Remaining at Waypoint
9. Estimated Time of Arrival
10. Estimated Time Enroute
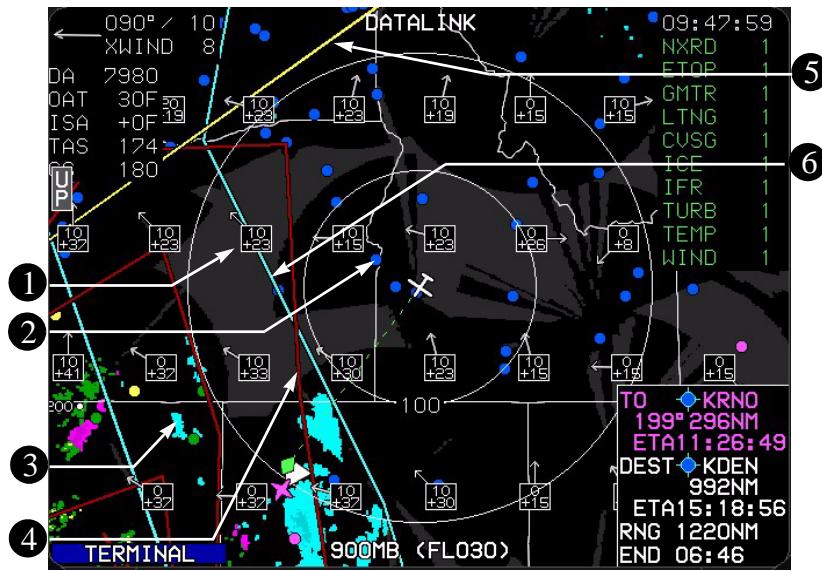11. Distance between Waypoints

CHELTON
FLIGHT SYSTEMS
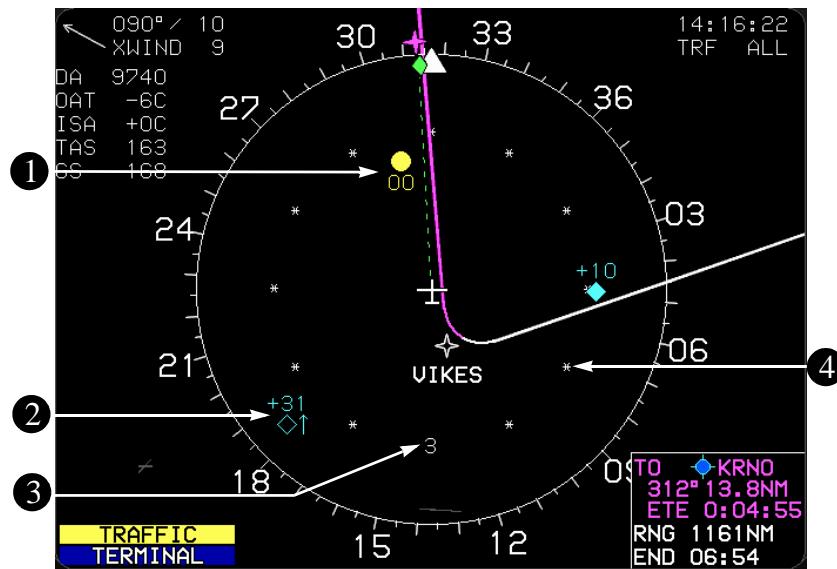
Traffic Display

1. Traffic warning
2. Traffic
3. Traffic position scale

4. Traffic position reference

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

_____

NOTE:

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

_____

Datalink Display

1. Winds and Temperatures
2. G METAR
3. Nexrad
4. AMET-IFR
5. AMET-TURB
6. AMET-ICE

Altitude Capture Predictor

When a selected altitude is specified on the PFD, the point at which that altitude will be captured is shown as a green arc located ahead of the aircraft along the lubber (ground track) line. The arc marks the bottom-of-descent or top-of-climb point.

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. One of the following symbols will be used depending on the installation.
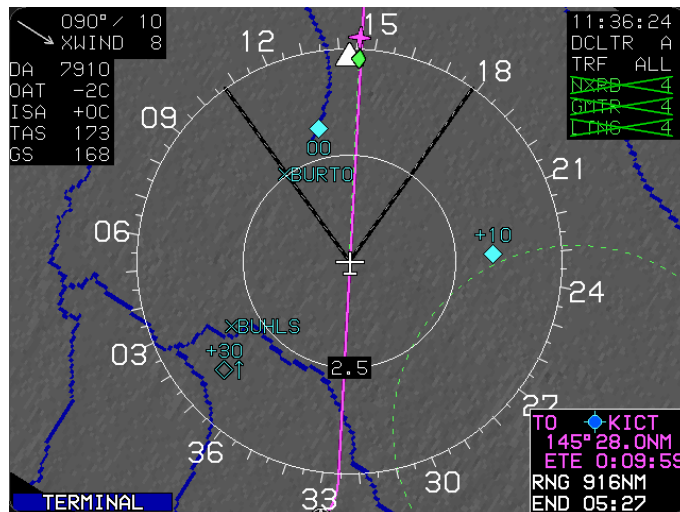
Ownship symbols:

Rotorcraft	Airplane with M_{MO}	Airplane without M_{MO}

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. When an approach is selected, all runways at the destination airport are shown with the usable portion of the selected landing runway displayed in a lighter shade of gray. In North-Up format, this makes a useful taxi aid that can prevent runway incursion. In addition, all runways at the three nearest airports are shown at all times.
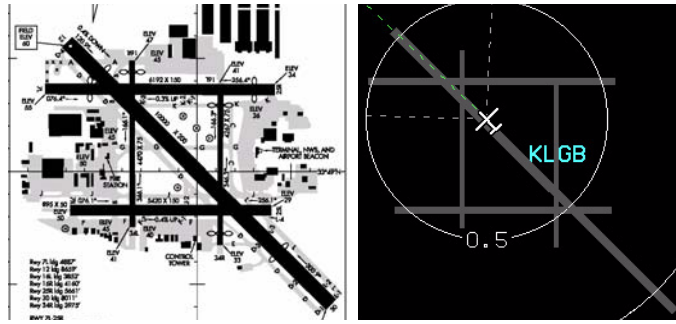
Airspace Markings

Special-use and controlled airspace boundaries are indicated with lines of varying styles. Color indicates type and line style indicates relative altitude.

Red represents **Restricted** and **Prohibited Areas**

Yellow represents **MOA's** and **Warning Areas**

Green represents **Class C and D** airspace

Blue represents **Class B** airspace
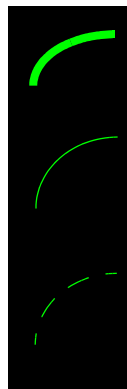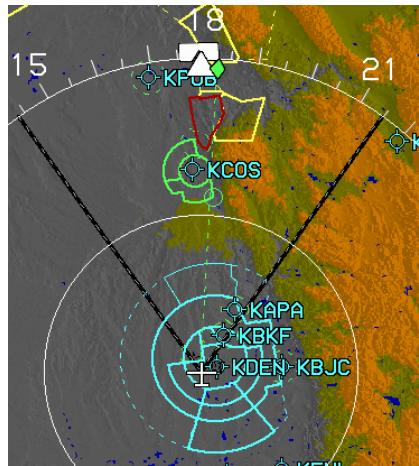
Heavy, solid airspace lines indicate that the airspace will be penetrated at the current altitude.

Thin, solid airspace lines indicate that the airspace will be cleared at the current altitude, but the aircraft is **within** 500 ft. vertically of the airspace floor or ceiling.

Thin, dashed airspace lines indicate that the airspace will be cleared at the 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 or dashed 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."*

NOTE:
A ground maintenance function utility is available to import
custom Special Use Airspace data. It is imported using a
SmartMedia card and the custom data is incorporated into
existing airspace data.

Airways

High-altitude airways may be displayed in green. Low-altitude airways may be displayed in cyan. To minimize clutter airways are not shown by default. To show either type of airway, see **MFD ND Screen Format (FORMAT) Menu, page 5-39**.

Interception of an airway when a clearance is issued can be as simple as displaying the airway on the map and navigating to an intercept with the heading bug and autopilot in heading mode. This allows time to then go to the ACTV (active waypoint list) and make appropriate changes to the programmed route. Airways may be inserted in a flightplan following a waypoint that is part of the airway.
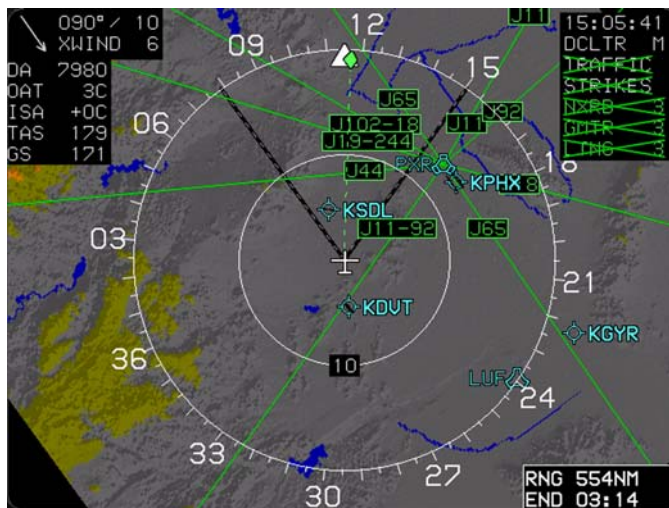
Analog Navigation

The HSI page has the ability to display analog (VOR1, VOR2, and ADF) navigation symbology. The pointers for each navigation source are visuall distinct. VOR1 is depicted by the single lined cyan pointer. VOR2 is depicted by the double lined green pointer. ADF is depicted by the single lined gray pointer. These pointers may be enabled/disabled.   see **MFD HSI Pointer (POINTERS) Menu, page 5-42**.
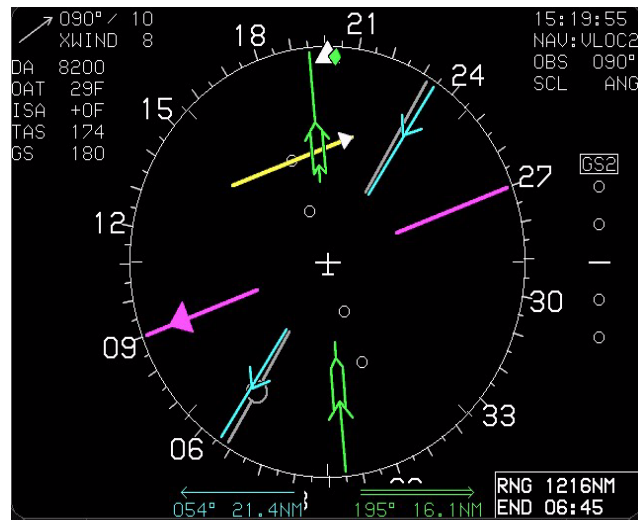
When VOR1 or VOR2 pointers are selected for display, the corresponding bearing and distance are shown at the bottom of the HSI display. The VOR1 distance readout is cyan and the VOR2 distance readout is green. If a DME channel is in hold mode, the associated distance readout is displayed in yellow and the letter "H" is shown above the distance readout.

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.
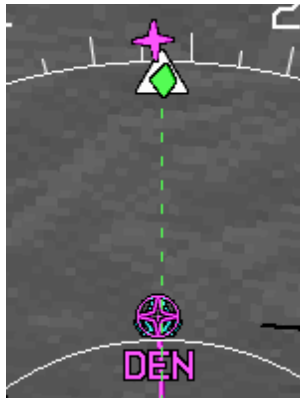
Courseline

The courseline connects the waypoints of the route for both flight plans and direct navigation and is only shown when a flight plan or waypoint is activated. Turns are drawn actual size based on the speed of the aircraft or V_{PROC} (see page 3-50).
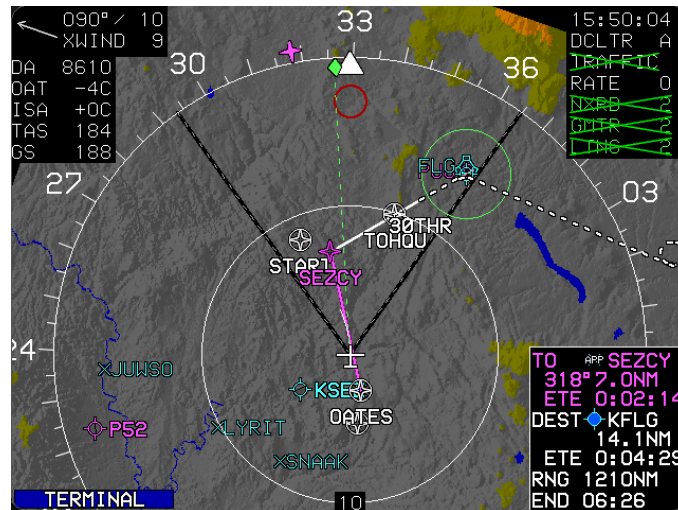
The courseline is shown in white except for the active leg, which is shown in magenta. The second waypoint is automatically activated upon selection of a flight plan. The active (magenta) leg is automatically sequenced upon waypoint passage. Any leg of the flight plan may be selected by the pilot as the active leg using the **ACTV** menu. The dotted line indicates the missed approach procedure, just like on a chart.

"Can't Find the Skyway?

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

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 a yellow flag. Flagged
advisories are indicated by a blue flag.

Flags are stacked with warnings on top, followed by cautions,
and then advisories. Flags are shown in reverse chronology. For
a complete list of flags and annunciations, as well as order of
prioritization, see **Caution/Warning/Advisory System, page
2-16**.

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.
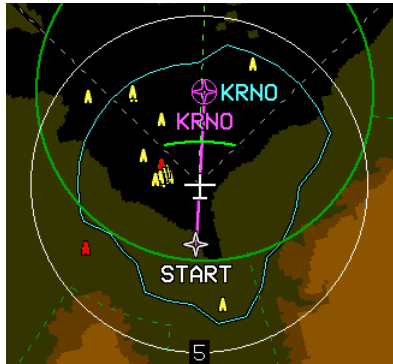
The glide area, as presented, is based on the aircraft's best-glide
speed (the green dot on the airspeed tape). The glide area is
adjusted for turns, wind, terrain, airspeed, pilot reaction time,
and stored energy, and indicates the point at which the aircraft

will be at approximately 200 ft. above the ground during the glide. Dead-stick glide area depiction can be decluttered if desired.

Density Altitude

The density altitude display corrects pressure altitude for nonstandard temperatures. Measurement is in feet MSL (mean sea level). The example below shows a density altitude of 7980 ft.

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.
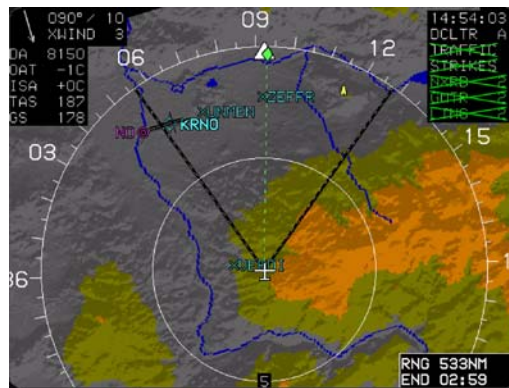
Directional scale in arc format

Directional scale in centered format

Fix

Airway fixes or intersections are depicted as a cyan **X** with cyan labels. Terminal fixes are not shown by default. They may be shown using the symbology select function.

Fuel Totalizer

Fuel range (**RNG**) and endurance (**END**), based on fuel totalizer calculations, are displayed in nautical miles and hours:minutes respectively. Totalizer information is displayed at the bottom of the waypoint navigation log for quick comparison with flight plan information. Totalizer data is not available in all installations.

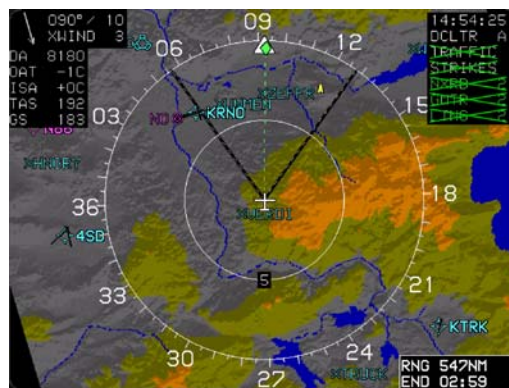*AUDIBLE ANNUNCIATION*
A fuel range less than the distance (along the route) to the destination plus 100 miles will result in an annunciation chime and a yellow "CHECK RANGE" flag. To eliminate nuisance alarms, range checking is suppressed when on the ground or in a climb.

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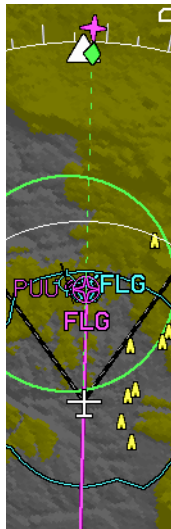
"The lubber line is handy.
Use it to ensure your current ground track will clear terrain or airspace. Also, you can use it to cross a specific fix or waypoint that is not in your active flight plan."

Heading Bug

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

NOTE:

If coupled with an autopilot using **HEADING** *mode GPS steering, 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. When the heading bug is turned off, the EFIS will command the autopilot to rejoin the active flight plan.*

Heading Pointer

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

IFR Airport

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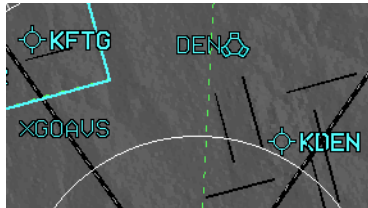
Instrument Approach Course

Instrument approach procedures are depicted as white courselines except the active leg, which displayed in magenta. Active legs of an approach are automatically sequenced. Alternately, the pilot can select any leg as the active leg by using the **ACTV** button function. The missed approach course is depicted as a dashed white line with the active leg displayed in magenta.
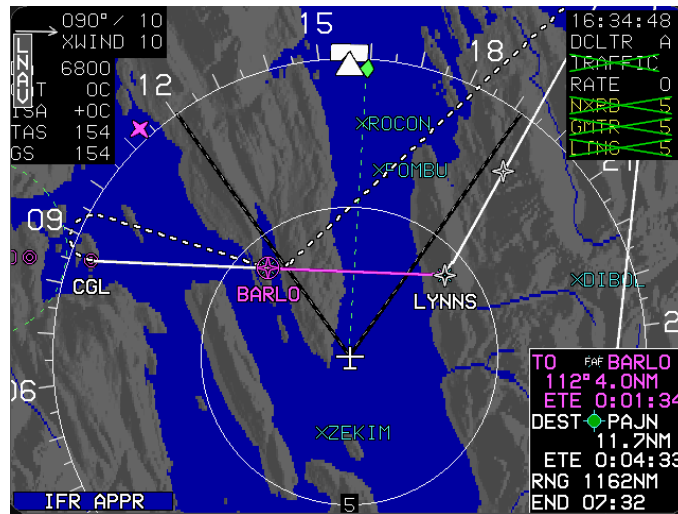
Approach symbology includes approach fixes (both fly-over and fly-by), procedure turns, missed approaches, holding patterns, and holding pattern entries.

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

LYNNS is an example of a fly-by fix. They are a waypoint star symbol without a circle.
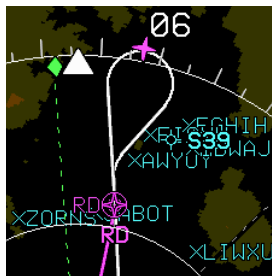
Procedure turn at fix RD (an NDB).
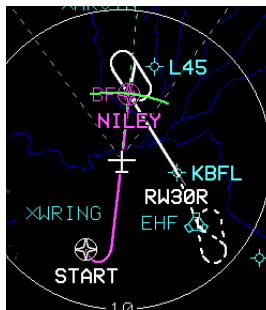
Hold entry to Bakersfield.

See **Waypoint Sequencing, page 3-137**, for information on waypoints and waypoint sequencing.

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

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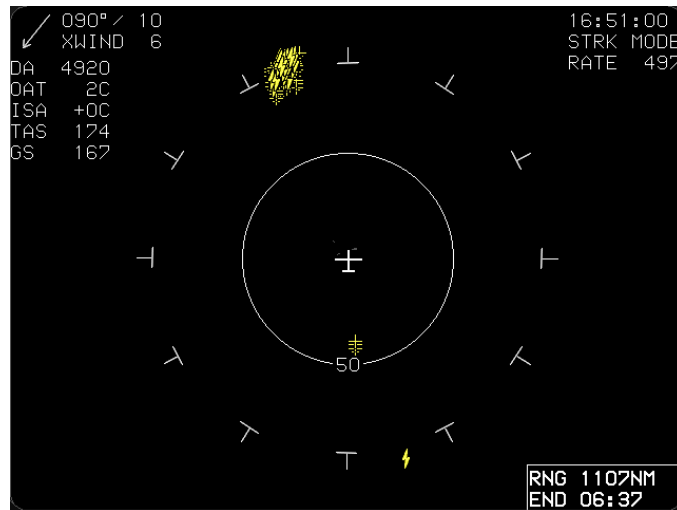
Lightning strikes may be shown on the moving map or on a dedicated Lightning display screen (with or without route overlay).

Missed Approach Course

The missed approach course is shown as a dashed white line beginning at the missed approach point, with the active leg being shown in magenta. See **Waypoint Sequencing, page 3-137**, for information on waypoints and waypoint sequencing during missed approach procedures.

Mode Annunciators - Moving Map

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.

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.

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

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

Traffic Mode

Traffic mode is annunciated on the Moving Map page. See **Mode Annunciators - Traffic Display, page 3-110**, for details.

Lightning mode (STRKS)

Lightning mode is annunciated on the Moving Map page. See **Mode Annunciators - Lightning Display, page 3-110**, for details.

Datalink Mode
If equipped with an optional WSI Inflight datalink receiver and the Temporary Flight Restriction Data has not been completely downlinked, it will be annunciated with the "TFR" with an X through it.

If equipped with an optional datalink or ADS-B reciever, the status of NEXRAD radar (NXRD), graphical METARs (GMTR) and lightining ground strike data (LTNG) are displayed. See **Mode Annunciators - Datalink Display, page 3-111**, for details.

Mode Annunciators - HSI

HSI NAV Source
The source of the HSI symbology is pilot selectable and will be annunciated in the upper right portion of the HSI page. The HSI source may be VLOC1, VLOC2, or GPS.
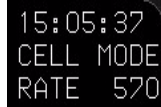
Omnibearing Selector Mode (OBS)
Selected omnibearing radial is shown along with the current mode (**M** for Manual or **A** for Automatic). Automatic mode simply displays the active flight plan segment course while manual mode allows the pilot to specify a radial or to the active waypoint.

CDI Scale
The current CDI scale is displayed in the upper right portion of the HSI page. The CDI scale indication matches the CDI scale shown on the PFD course deviation indicator.

Mode Annunciators - Lightning Display

```
15:05:37
CELL MODE
RATE   570
```

If equipped with a WX-500 Stormscope, the following annunciations may be displayed. When the WX-500 is disabled, an annunciator in the upper right corner will read **STRIKES** with an **X** through it. 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. If the WX-500 sensor is enabled and functioning normally, the strike rate value is displayed next to the **RATE** annunciation in the upper right corner. The strike rate value, based upon the strikes within the selected range, will be calculated every 5 seconds during normal operation. The number of fresh strikes (strikes less than 20 seconds old) is used to generate a strike rate that represents strikes per minute. Strike rate increases shown immediately upon calculation while decreases in strike rate are dampened.

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

Mode Annunciators - Traffic Display

```
15:05:44
TRF   ALL
```

If equipped with a 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.

Manually turning the traffic off does not affect traffic alerting functions.

Mode Annunciators - Datalink Display

```
15:06:11
NXRD    2
ETOP    2
GMTR    2
LTNG    2
CVSG    2
ICE     2
IFR     2
TURB    2
TEMP    2
WIND    2
```

If equipped with an optional WSI Inflight datalink receiver and the Temporary Flight Restriction Data has not been completely downlinked, it will be annunciated with the "TFR" with an X through it.

If equipped with an optional datalink or ADS-B reciever, the status of NEXRAD radar (NXRD), Echo Tops (ETOP), graphical METARs (GMTR), lightining ground strike data (LTNG), Convective SIGMET (CVSG), Icing AIRMET/ SIGMET (ICE), IFR AIRMET/SIGMET (IFR), Turbulence AIRMET/SIGMET (TURB), Temperatures Aloft (TEMP) and Winds Aloft (WIND) are displayed as follows:

• If the data never completely downlinked, no annunciation is displayed.

• If the data downlinked is fresh, the annunciation and the age in minutes are displayed in green. If the data is deselected from display, the annunciation is displayed in green overlaid with a green "X".

• If the data downlinked is stale, the annunciation and age in minutes are displayed in yellow. If the data deselected from display, the annunciation is displayed in yellow overlaid with a green "X".

• If the data downlinked is really stale, the annunciation and age in minutes are displayed in red. If the data is deselected from display, the annunciation is overlaid with a green "X".

- If the data timed-out, the annuncation will be displayed in red with "XX" instead of age in minutes and overlaid with a red "X".

NXRD, ETOP, GMTR, LTNG, CVSG, ICE, IFR and TURB are green when data has been downlinked in last 5 minutes, yellow between 5 and 10 minutes, red between 10 and 75 minutes, and timed-out over 75 minutes.

TEMP and WIND are green when data has been downlinked in last 30 minutes, yellow between 30 and 60 minutes, red between 60 and 75 minutes, and timed-out over 75 minutes.

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 (along the route). Only the "**TO**" waypoint is shown if the "**TO**" and "**DEST**" waypoints are the same.

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

NDB

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

Obstructions

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

1. Obstructions beyond 6NM in any cardinal direction are not depicted.

2. Obstructions whose tops are lower than 2,000 feet below aircraft altitude are not depicted.

3. Obstructions whose tops are within 2,000 feet but more than 500 feet below aircraft altitude are depicted in yellow.

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 bright red.

Obstructions are included in the TAWS search envelopes and will generate a caution or alarm if they represent a collision hazard. Obstructions generating a caution are highlighted. Obstructions generating a warning are highlighted and flashing. In areas with many obstructions, this enables easy identification of those causing the alerts.

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. ISA temperature is indicated below OAT.

Projected Path

The curving white line extending from the nose of the aircraft symbol indicates the horizontal flight path of the aircraft projected one minute into the future or 180°, whichever comes first. The projected path is corrected for bank angle and groundspeed and is only displayed when the aircraft is in a turn.
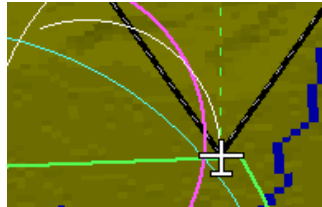
"No-sweat course interception.
Use the projected path to intercept courses perfectly from any angle. Roll in an estimated bank angle and see where that puts your projected path. Make small bank adjustments as necessary to keep the projected path tangent to the desired courseline. Roll out centered on course. If interception will require an uncomfortable bank angle, you'll know you have to overshoot and come back in from the other side. It's great for when ATC gives you a late turn onto the localizer."

Range Ring

The range ring is a white circle (centered on the aircraft's position) used to quickly estimate distances. Distance (in nautical miles) from the aircraft to the ring is shown as a white figure overlaying the six o'clock position of the ring. The range ring is half the distance to the directional scale. Consequently, when the range ring shows a distance of 5NM, the directional scale is at 10NM. Overall map scale ranges can be set to 1, 2, 5, 10, 20, 50, 100, 200, and 400 nautical miles.


Range Ring Scale

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

Selected Course Pointer

The HSI page displays a selected course needle which indicates the direction and magnitude of deviation from the course when read against the courseline arrow and aircraft position symbol. The course deviation indicator needle rotates around the aircraft position symbol such that it remains parallel with the courseline arrow. At full deflection, the selected course needle turns yellow.

The to-from indicators is a white triangle placed at the end of the selected course needle, 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 selected course needle to the other upon waypoint or navigation station passage. HSI source may be changed using the OBS button (see **Omnibearing Selector (OBS) Menu, page 5-20**.
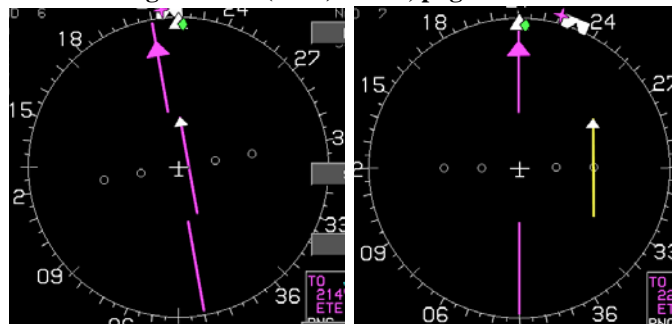
> *"Mind your OBS.*
> *If your skyway or courseline doesn't seem to be working, check the OBS mode setting (Manual or Automatic is annunciated) in the upper right corner of the ND. Set the OBS using the OBS button function."*

Start Point

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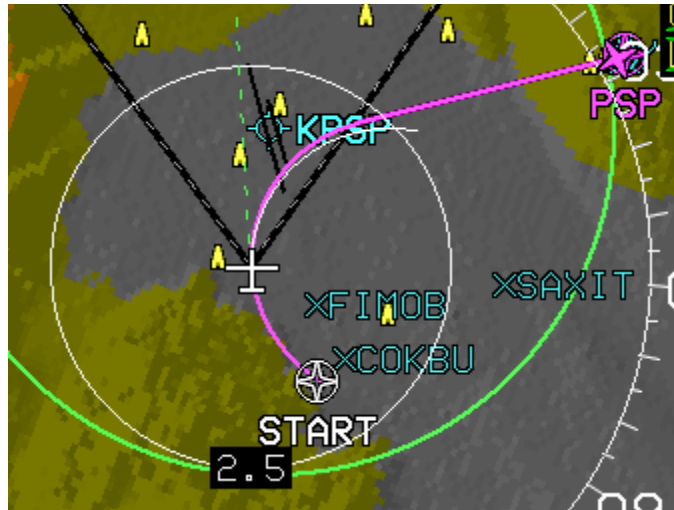
Strike Position Reference (Dedicated Lightning Display)

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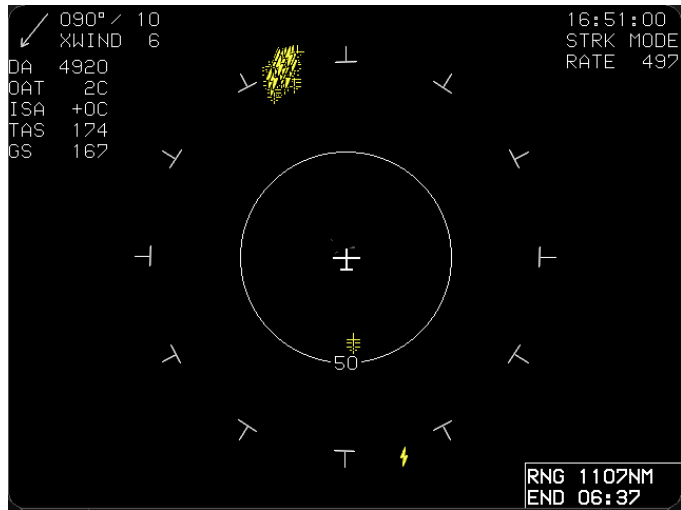
Terrain

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

Terrain alert MFD
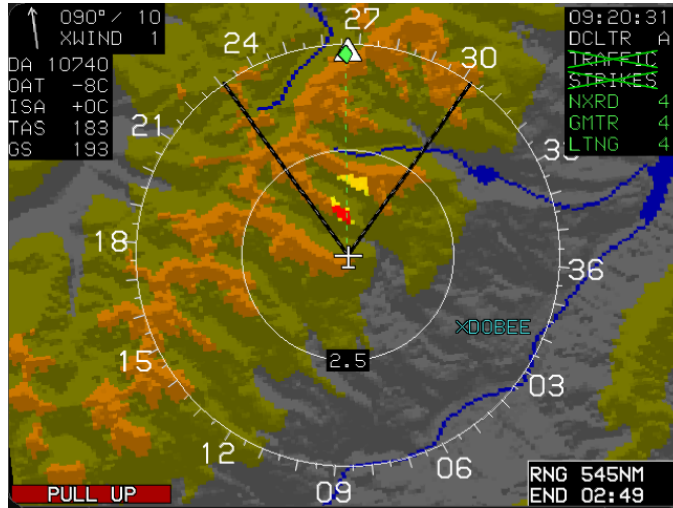
Non-Threatening Terrain

Terrain is displayed on the MFD in its correct relationship to the ownship symbol. Terrain is be shown using color to show relationship to aircraft altitude as follows:

1.   Terrain is colored shades of gray when more than 2000 feet below aircraft altitude. The shade used is determined by the slope between adjacent terrain pixels in an increasing longitude direction.

2.   Terrain is colored shades of olive when within 2000 feet but below aircraft altitude. The shade used is determined by the slope between adjacent terrain pixels in an increasing longitude direction.

3.   Terrain is colored shades of brown when at or above aircraft altitude. The shade used is determined by the slope between adjacent terrain pixels in an increasing longitude direction.

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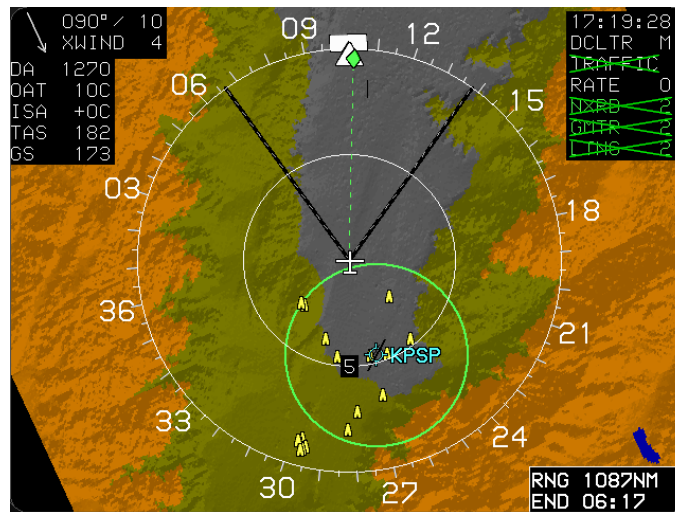
Threatening Terrain

Threatening terrain, as determined by the requirements for
TAWS, is colored in red and yellow. The red and yellow colors
are shown with a "transparency" that allows the underlying
contours to be distinguished to aid a terrain avoidance
maneuver.

Threatening terrain will cause a "pop-up" condition on both the
PFD and first MFD in a system 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. A **RESET**
menu botton will appear in the upper left corner of the MFD for
20 seconds to return to the previous scale.

TAWS

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

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

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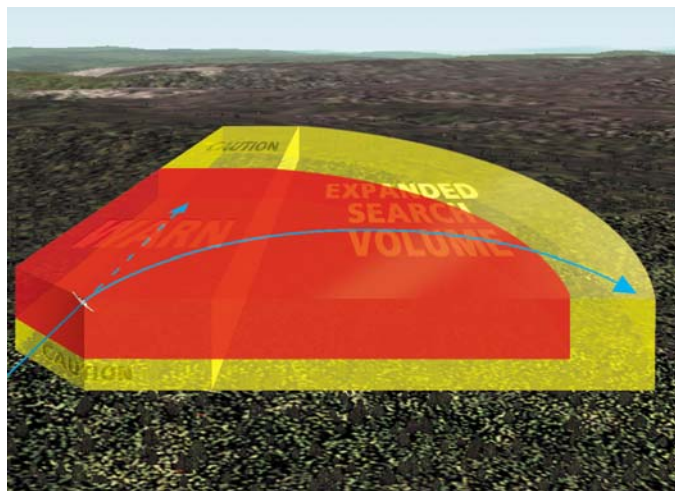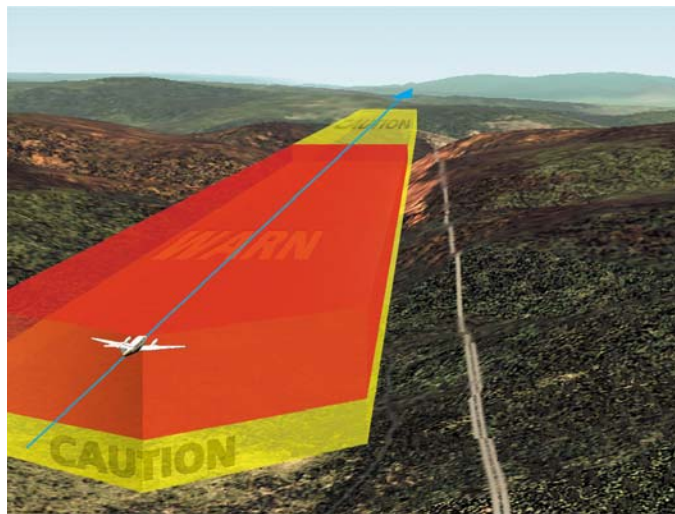
2. Premature Descent Alert ("PDA"): A warning function that alerts the pilot when descending well below a normal approach glide path on the final approach segment of an instrument approach procedure.

3. Excessive Rate of Descent (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).
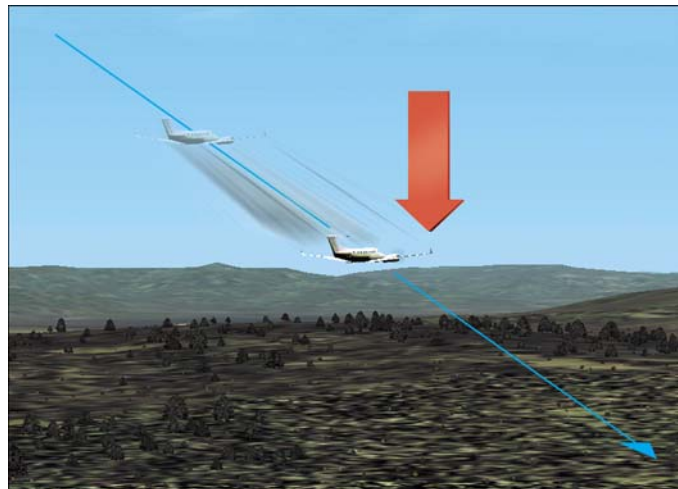
4. Sink Rate after Takeoff or Missed Approach (GPWS Mode 3): A warning function that alerts the pilot when a sink rate is detected immediately after takeoff or during initiation of a missed approach.
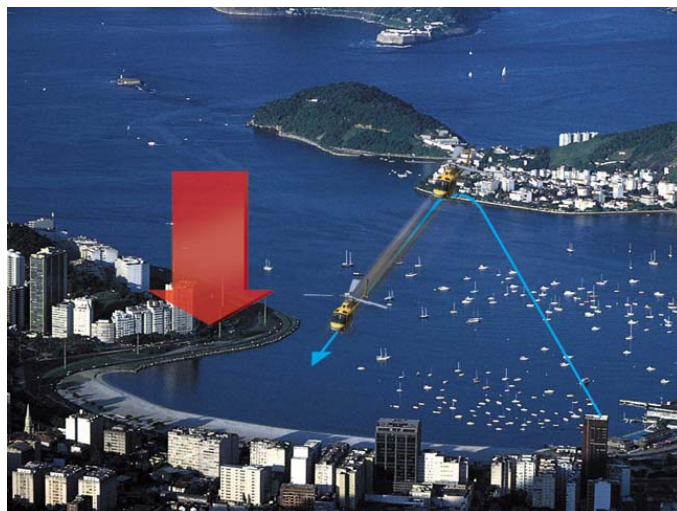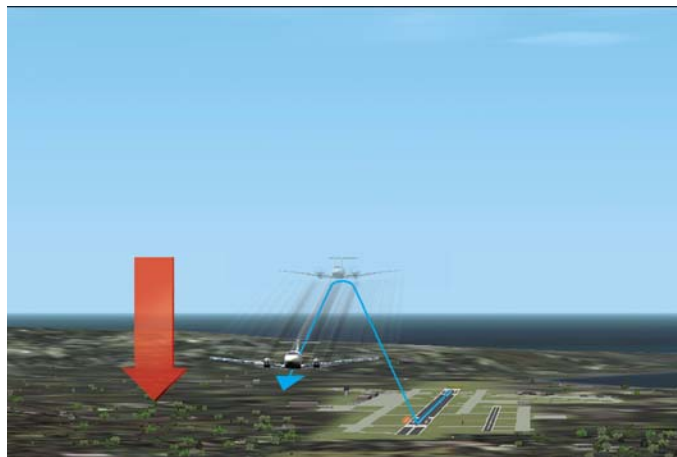
5. 500 foot Wake-up Call: A single voice callout when descending through 500 feet AGL.
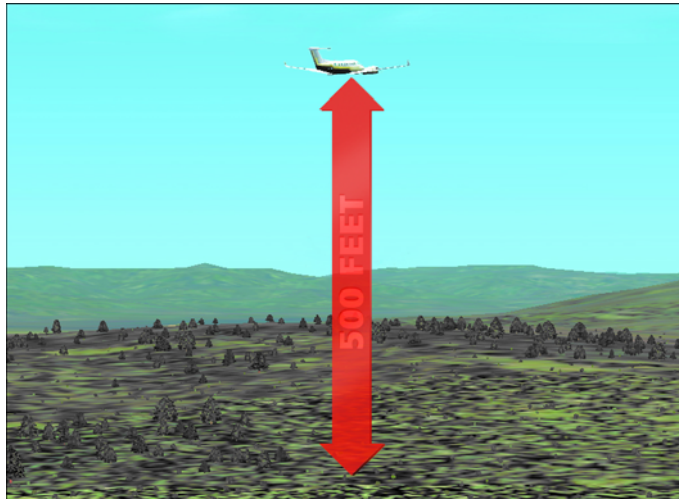
Class A TAWS incorporates gear and flap position, radar altitude, and ILS signal and adds the following functions:

1. Excessive Closure Rate to Terrain (GPWS Mode 2): This function uses AGL rate of change 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).
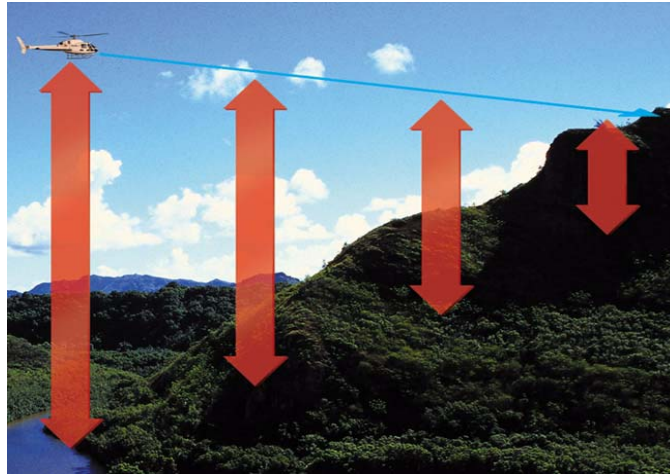
2. Flight into Terrain when not in Landing Configuration (GPWS Mode 4): This function uses aircraft speed and AGL altitude to alert the pilot when descending into terrain without properly configuring the aircraft for landing.
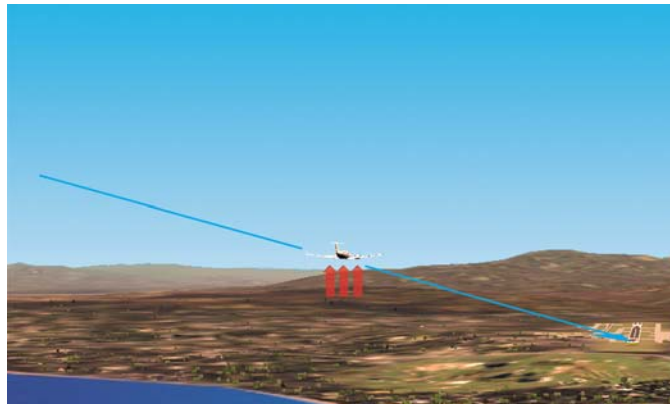
3. Excessive Downward Deviation from an ILS Glideslope (GPWS Mode 5): This function uses ILS glideslope deviation information and AGL altitude to alert the pilot when an excessive downward glideslope deviation is detected on the final approach segment of an ILS approach.
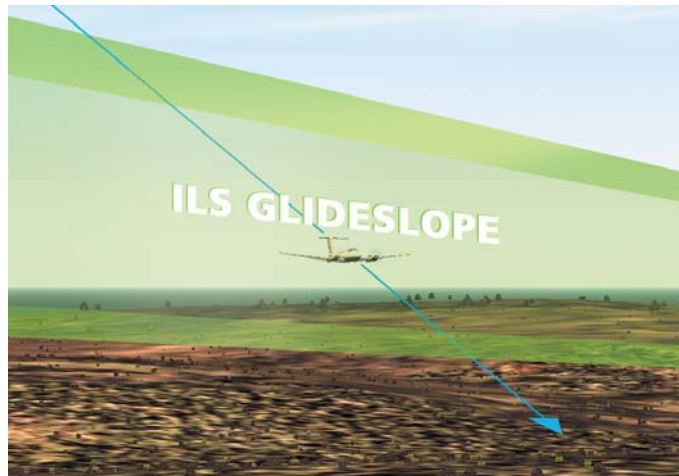
Each of the above TAWS conditions is accompanied by a voice annunciation and, except for the 500 foot callout, a CWA flag color-coded yellow for caution and red for warning.

A TAWS INHIBIT switch near the PFD mutes the voice warning and removes the caution and warning flags but the terrain is still colored for caution and warning conditions.

HELICOPTER TAWS

When installed in rotorcraft, the EFIS provides Class A or B Helicopter TAWS (HTAWS) functions which allow for operation closer to the ground without generating nuisance alerts.

Rotorcraft Class B includes only FLTA and altitude loss on climb-out functions (GPWS Mode-3).

Rotorcraft Class A includes all TAWS functions except premature descent alert (PDA) and the 500-foot callout.

Refer to the preceding TAWS section for explanation of these functions.

A low-altitude mode desensitizes the system to allow for very-low altitude operations. The low altitude mode is activated with a switch that reduces the terrain clearance requirements in the protection envelopes provided. See the extended TAWS description in the Appendix for more information.

See **Caution/Warning/Advisory System, page 2-16** 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."

NOTE: Please see the Terrain NOTAM at www.cheltonflightsystems.com (Certified Downloads section) which is posted whenever a new terrain database is compiled. This NOTAM identifies airports in mountainous regions of the United States near which terrain database errors in excess of 100 ft. have been detected due to exceptionally rugged geography. Pilots operating near these airports should use extra vigilance.

NOTE:
In order to be considered valid for use by the TAWS, the horizontal figure of merit must be less than or equal to the greater of 0.3NM or the horizontal alert limit ("HAL") for the mode of flight.
In order for GPS/WAAS geodetic height to be considered valid for use as MSL altitude, the vertical figure of merit must be less than or equal to 75 feet. The secondary source of MSL altitude will be barometric altitude from an air data computer

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 take-off
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 or until a button is pressed.

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

To-From Indicator (HSI Function)

The to-from indicator is a white triangle placed at the end of the CDI needle on the conventional HSI display, between the aircraft position symbol and the courseline arrow. The arrow is ahead of the aircraft symbol and points toward the courseline arrowhead when showing a "to" indication and behind the aircraft symbol and pointing toward the tail of the courseline arrow when showing a "from" indication.
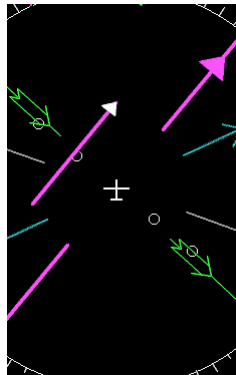
Once a course is selected (Automatic or Manual), the to-from indicator rotates with the directional scale. The indicator will flip from one end of the CDI needle to the other upon waypoint or navigation station passage.

The HSI may be driven by VLOC1, VLOC2, or GPS and the current source is always indicated by an HSI SOURCE advisory flag.

HSI source may be changed using the OBS button, see **Omnibearing Selector (OBS) Menu, page 5-20** and **HSI and CDI/ANNUNCIATOR Source Selection, page 6-59**.

Traffic

When interfaced with a suitable traffic sensor, airborne traffic is displayed on the moving map as symbols that are based on the level of threat.
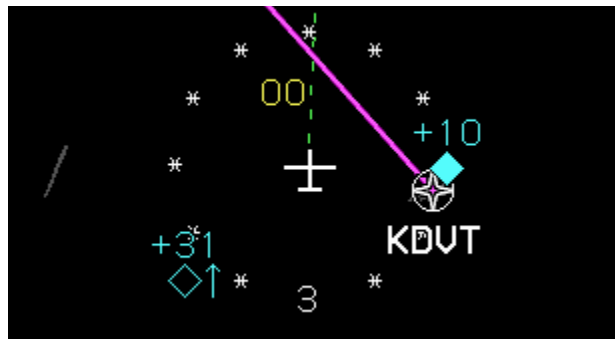
The relative altitude is shown above (**+**) the symbol when the traffic is above or below (**-**) the symbol when the traffic is below ownship altitude. A direction arrow to the right of the symbol indicates a climb or descent greater than 500 fpm.

> *AUDIBLE ANNUNCIATION*
> Traffic advisories will result in a yellow flag and a voice warning of "Traffic. Traffic."
> **TRAFFIC**

TCAS-I, TCAS-II, TAS and TIS-A
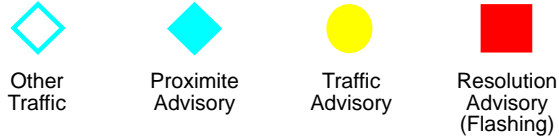
◇	◆	●	■
Other Traffic	Proximite Advisory	Traffic Advisory	Resolution Advisory (Flashing)

ADS-B and TIS-B

High-Integrity Traffic with Track Information

Other Traffic	Proximite Advisory	Traffic Advisory (Flashing)

High-Integrity Traffic without Track Information

Other Traffic	Proximitye Advisory	Traffic Advisory (Flashing)

Degraded Position Traffic without Track Information

Other Traffic	Proximite Advisory	Traffic Advisory (Flashing)

Degraded Position Traffic without Track Information

Other Traffic	Proximite Advisory	Traffic Advisory (Flashing)

Traffic Position Reference (Dedicated Traffic Display)

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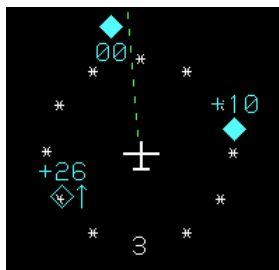
True Airspeed

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

VFR Airport

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

VORTAC/VOR-DME, TACAN, VOR, DME

VHF navaids are displayed in cyan with the following symbols:

Waypoint

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

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

BARLO is an example of a fly-over waypoint.

LYNNS is an example of a fly-by waypoint.

Waypoint Sequencing

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

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

1. A manual GPS/WAAS OBS is set ("SUSPEND" flag shown).

2. The aircraft is on the final Approach segment of an instrument approach and the missed approach procedure has not been armed by pressing the **ARM** 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 **CONT** ("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 switches from TO operation to FROM operation when appropriate.When an IFR approach is selected and the next waypoint is the missed approach point, automatic waypoint sequencing is suspended. Automatic waypoint sequencing is also suspended when the active waypoint is a holding point or when the pilot has selected Manual OBS mode

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

Discontinuity

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

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

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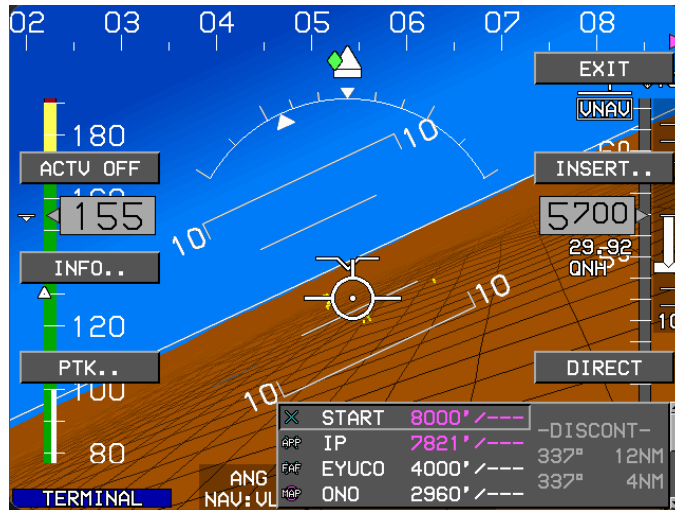
Wind Data

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

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

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

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

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

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

Atmospheric wind changes: As seen in this FAA graphic, actual wind is rarely constant and the direction and velocity can change in a few minutes.
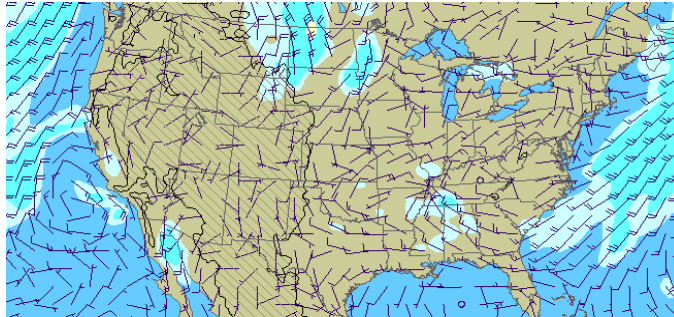
The pilot should expect large wind changes with changes in altitude or in the presence of significant weather. The pilot should also consider the effect of surrounding terrain upon wind.

Wind Vector

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

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

Zulu Time

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

Failure Modes

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

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

Failure of the GPS, the AHRS or the ADC, singly or in combination, adversely impacts the EFIS capabilities. These failures are annunciated with yellow 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 EAU 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 Display	OK	OK	-	OK	-	OK	-	-
Bank Scale	OK	OK	OK	-	OK	-	-	-
CDI	OK	1	OK	OK	-	-	OK	-
Runway	OK	1	-	-	-	-	-	-
Waypoint Pointer	OK	1	OK	7	-	-	7	-
Heading Scale	OK	OK	OK	7	OK	-	7	-
AGL Ind.	OK	2	4	OK	11	11	4	-
Flight Path Marker	OK	1 + 14	-	-	-	-	-	-
Hover Vector	OK	-	-	-	-	-	-	-
G-meter	OK	OK	OK	-	OK	-	-	-
Ground Track	OK	1	OK	7	-	-	7	-
Heading Indicator	OK	OK	OK	-	OK	-	-	-
Horizon	OK	OK	OK	-	OK	-	-	-
Mini-Map	OK	1	OK	7	-	-	7	-
Pitch Limit Indicator	OK	OK	-	8	-	8	-	-
Pitch Scale	OK	OK	OK	-	OK	-	-	-
Highway in the Sky	OK	1 + 15	-	-	-	-	-	-
Terrain / Obstruct	OK	-	-	-	-	-	-	-
Clock Functions	OK	OK	OK	OK	OK	OK	OK	OK
VSI	OK	OK	-	OK	-	OK	-	-
Waterline Symbol	OK	OK	5	13	5	13	13	13
Waypoint Symbol	OK	1	-	-	-	-	-	-
Waypoint Brg / Dist	OK	1	OK	OK	-	-	OK	-
Traffic	OK	OK	-	-	-	-	-	-
Traffic Thumbnail	OK	OK	OK	OK	OK	OK	OK	OK
Speed Trend	OK	OK	-	-	-	-	-	-
Dynamic Stall Speed	OK	OK	-	8	-	8	-	-

ND Functions:	Mode 0	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7
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 Temp.	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	-	-
OAT / ISA Display	OK	OK	-	OK	-	OK	-	-

Output Functions:	Mode 0	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7
Air/Ground Output	16	16	17	16	17	16	17	17
Autopilot EFIS Valid	16	16	16	-	-	-	-	-
TAWS Alarm Output	16	16	16	16	16	16	16	16
TCAS-II RA Display Valid	16	16	-	16	-	16	-	-
TCAS-II TA Display Valid	16	16	16	16	16	16	16	16
Transmit Enabled	16	16	16	16	16	16	16	16
Warning Light Output	16	16	16	16	16	16	16	16
Caution Light Output	16	16	16	16	16	16	16	16
Mstr. Caut. Light Output	16	16	16	16	16	16	16	16
MDA/DH Output	16	16	18	16	18	16	18	18
Altitude Capture Output	16	16	-	16	-	16	-	-
IAS Switch Output	16	16	-	16	-	16	-	-
A429 Tx Groups	See IDU Communication Requirements (Doc. No. 01-000028)							

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

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

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

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

Note 5: Waterline symbol expanded to large attitude bars.

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

Note 7: Display aligned with aircraft track.

Note 8: Based upon 1G stall speed.

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

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

Note 11: Only radar altitude presented when available.

Note 12: Only endurance is presented.

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

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

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

Note 16: See IDU SCC Card and Limits Requirements (Doc. No. 01-000029) for activation requirements.

Note 17: Defaults to AIR unless Weight on Wheel/Weight on Ground discrete input is active.

Note 18: Only DH function (with valid AGL altitude) in this mode.

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

GPS Failure

GPS can degrade or fail as a result of loss of satellite information or GPS equipment failure. GPS degradation is annunciated with a "GPS LOI" caution flag and an aural tone to indicate GPS loss of integrity. In this mode, the GPS data loses the WAAS accuracy but remains as accurate as traditional GPS.

Further GPS degradation causes the EFIS to lose GPS updating of aircraft position, ground speed and ground track, and the ability to calculate wind information. A "GPS LON" caution flag is displayed to indicate GPS loss of navigation along with a "GPS failure, GPS failure" voice annunciation.

GPS failure results in the EFIS operating in "dead reckoning" mode. The EFIS continues to provide navigational position, groundspeed, and ground track information based upon the last known wind and current air data and heading. Terrain is removed immediately. The flight path marker is grayed out and the skyway is removed after one minute. In addition, a "DR ##:##" caution flag is displayed to show the pilot the length of time during which the EFIS has been dead reckoning.

NOTE:

WAAS or Fault Detection and Exclusion (FDE) must be available at the Final Approach Fix to continue an approach.

In the event of loss of GPS during an IFR approach procedure at or after the final approach fix and still IMC - Initiate the missed approach procedure.

The primary flight and navigation displays are affected as follows:

PFD page during
GPS Failure

ND page during
GPS Failure

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

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

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

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

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

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

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

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

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

Loss of GPS also affects the Flight PathMarker. While the vertical component of the Flight Path Marker is unaffected by a loss of GPS, the lateral component, based upon track is removed so the Flight Path Marker cages in the center of the screen. Unlike the dead reckoning position solution, the effects of loss of GPS on the accuracy of the Flight Path Marker are not cumulative. The Flight Path Marker remains an accurate tool for maintaining level flight during a GPS failure.

ADC Failure

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

PFD page during ADC failure
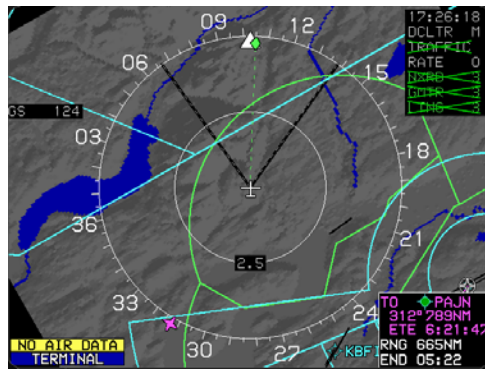
ND page during ADC failure

NOTE:

*Failure of the ADC **outside air temperature probe only** will result in disabled TAS, OAT, ISA, DA, and wind displays and an **OAT SENSOR** caution flag. It will not affect other air data parameters.*

In the event of an ADC failure, revert to the standby altimeter and airspeed indicator.

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
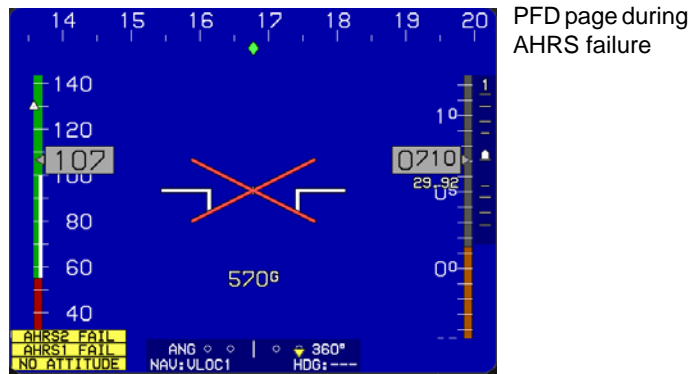
In the event of an AHRS failure, revert to the standby attitude indicator for attitude and the standby directional gyro or compass for direction.

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 ADC and GPS failure

ND page during ADC and GPS failure

In the event of an ADC and GPS failure, revert to the standby airspeed indicator and altimeter and use other navigation sources.

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
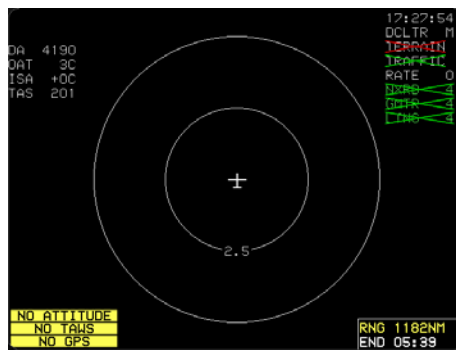

ND page during ADC and AHRS failure

In the event of an ADC and AHRS failure, revert to the standby attitude indicator, airspeed indicator, and altimeter.

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:

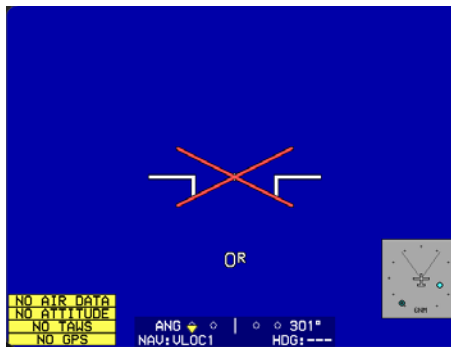PFD page during GPS and AHRS failure

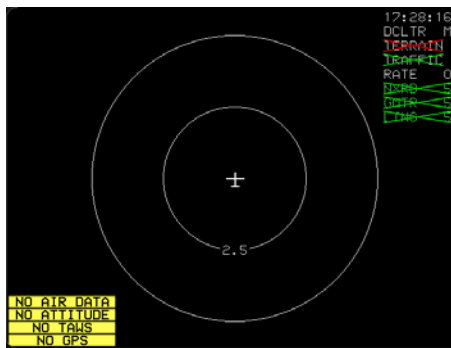ND page during GPS and AHRS failure

In the event of a GPS and AHRS failure, revert to the standby attitude indicator and directional gyro or wet compass and use other navigation sources.

GPS, ADC, and AHRS Failure

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

PFD during GPS, ADC, and AHRS failure

ND during GPS, ADC, and AHRS failure

In the event of a GPS and ADC and AHRS failure, revert to all standby instruments and use other sources for navigation.

Section 4

Rotorcraft Display Symbology

The following pages detail the symbology specific to rotorcraft installations. Each screen is mapped with identifiers for each element and the element descriptions follow immediately thereafter.

Rotorcraft PFD

In systems installed in rotorcraft, the pitch scale is caged in the center of the screen. The flight path marker continues to move and indicate direction of travel. A full-time expanded waterline aids in situational awareness. Because the flight path marker is used in conjunction with a 3-dimensional background, the flight path marker utility normally associated with a HUD is achieved.

PFD In Flight
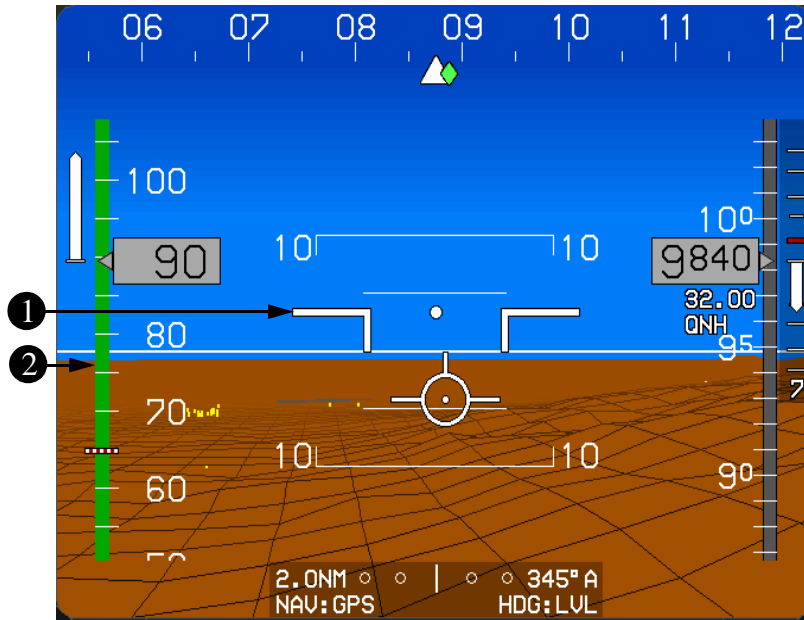
1. Expanded Waterline
2. Airspeed Scale

PFD Hover
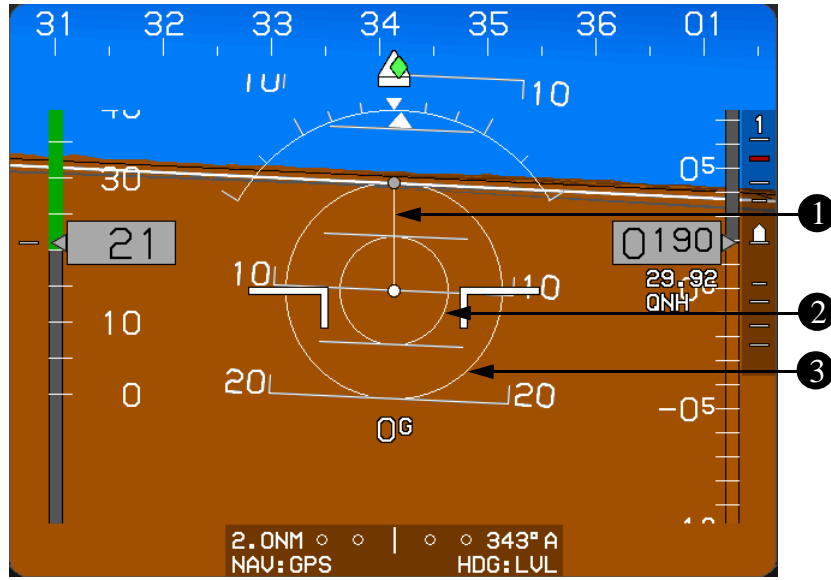
1. Hover Vector
2. 10 Knot Ring
3. 20 Knot Ring

Airspeed Scale
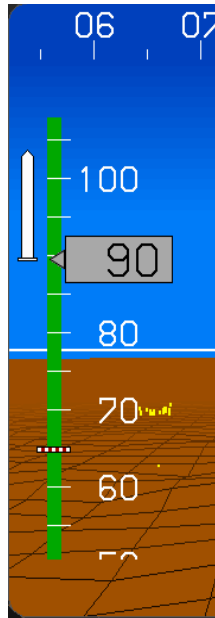
The Part 27 and 29 rotorcraft airspeed scale has graduations every 5 measurement units with labels every 10 measurement units and has markings as follows:

1. A gray background.

2. A green safe operating range area from V_{min} to V_{no}. V_{min} refers to the minimum speed for effective airspeed.

3. A yellow caution range area from V_{no} to V_{ne} (power-on)

4. A red high-speed awareness area from V_{ne} (power-on) to the top of the scale

This is depicted below:
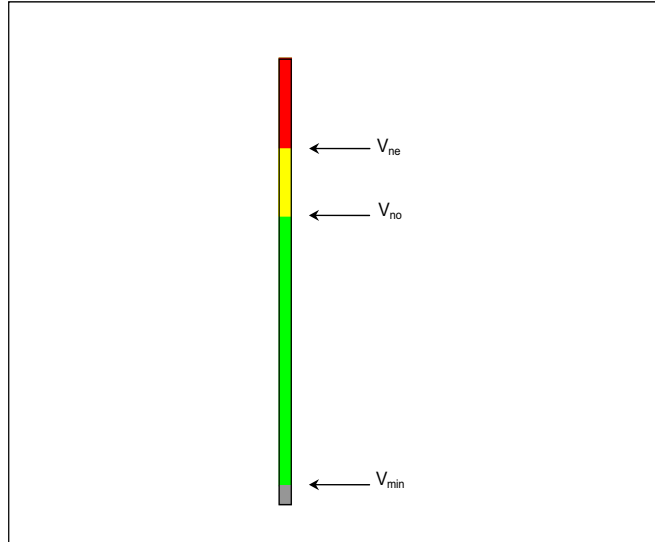
The airspeed scale for rotorcraft has markings to indicate V_{NE} power off, commonly referred to as a "Barber Pole", and also for translational lift reference if enabled. The V_{NE} marking will be a red cross-hatched line on the airspeed indicator. This will normally indicate the power off recommended autorotation airspeed. If enabled, the translational lift marking will be a white triangle on the airspeed indicator.

Hover Vector and Rings
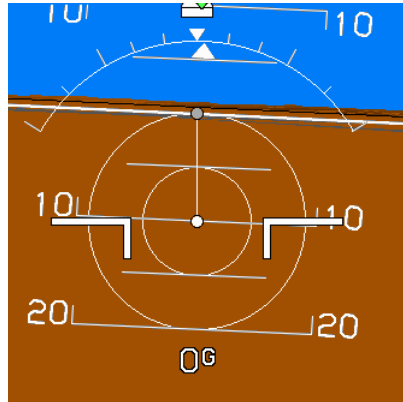
The hover vector appears when groundspeed drops below 30 knots. Velocity and direction of travel are then determined by the vector symbol. Deviation of the dot in a straight up direction (12 o'clock position) indicates forward flight while straight down (6 o'clock position) indicates rearward flight. Deviation of the dot laterally indicates lateral drift. The movement of the dot is constrained to less than 5 knots per second to prevent jumpiness. The inner ring indicates 10 knots and the outer ring indicates 20 knots.

Rotorcraft MFD

On MFD systems installed in rotorcraft, the MFD Map page shows the ownship symbol as a helicopter. A Hover Page is also available which displays the hover vector, projected path, and AGL Indication.

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Rotorcraft MFD Map Page
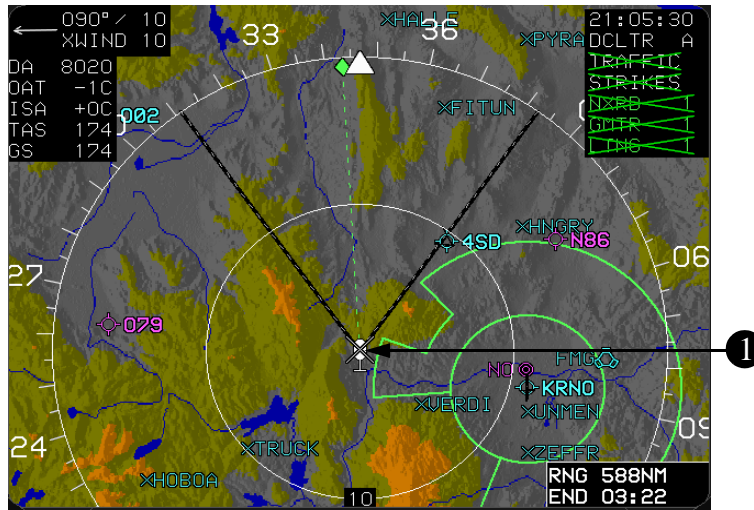
1. Rotorcraft Ownship

Rotorcraft MFD Hover Page
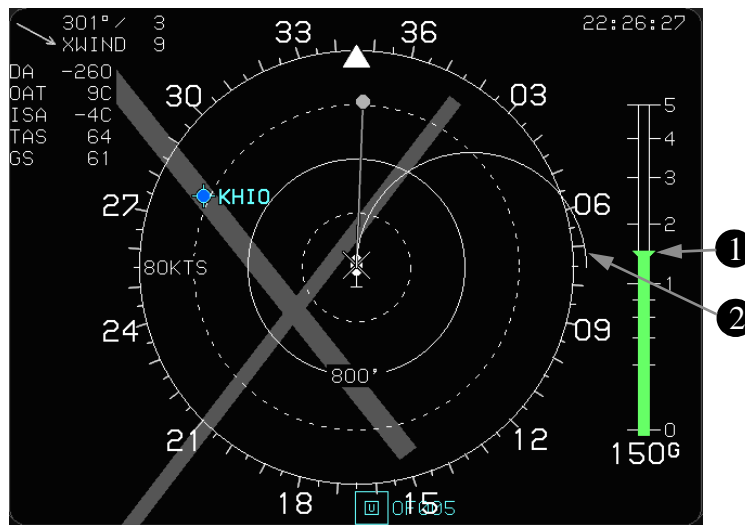
1. AGL Indicator
2. Projected Path

The solid ring indicates the distance from the ownship symbol. The possible distance ranges are 200', 400', 800', 0.25NM, 0.5NM, 1NM, and 2.5NM. The range may be changed using the lower right scroll knob. The dashed ring indicates speed range which changes automatically based upon current groundspeed. Possible speed ranges are 20KTS, 40KTS, and 80KTS.

AGL Indicator
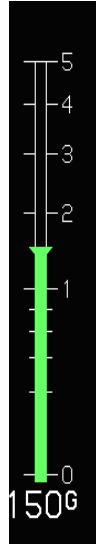
An AGL Indicator is displayed on the right side of the hover page. The top of the scale indicates 500 feet AGL. The scale is logarithmic to show finer resolutions at lower altitudes. A digital readout of the AGL value is displayed below the scale. The AGL altitude is driven by one of the following:

"R" = Radar Altitude

"G" = GPS/WAAS Geodetic Height less ground elevation

"B" = Barometric Altitude less ground elevation

Projected Path
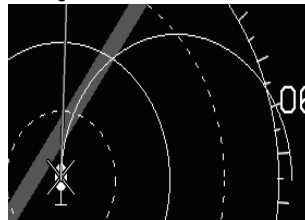
A projected path symbol is displayed on the hover page to aid in visualizing the radius of turns. See page 3-116.

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Section 5

Button/Menu Functions

Overview

Pressing any of the peripheral buttons activates the function indicated by the button label. These are button functions.

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

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

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

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

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

Turning the control knob steps through the scrolling menu (or alphanumeric characters) and the current selection is highlighted (as **WAYPOINT** JNU2 is above). When the desired selection is highlighted, pushing the control knob enters the selection, which may activate a function or display yet another menu. When making alphanumeric entries, push the knob to advance to the next character.

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

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

Top Level Menu

General

IDU menu functions are navigated using the peripheral buttons and the right hand rotary encoder. There are two types of menu functions, top-level menu functions corresponding to the IDU key hard labels, and soft menu functions annunciated by menu tiles that appear on the screen. Functions associated with soft menu function tiles take precedence over functions associated with IDU key hard labels. Soft menu function tiles include an indication of further menu levels with a two-dot trailer at the end of the word. Soft menu function tiles appear next to the appropriate IDU key or in the lower right corner when use of the encoder is appropriate (i.e., selection lists and option lists). Selection lists that are too long to be presented in the space available provide an indication of location within the list. Whenever a soft menu is active, an "EXIT" tile appears adjacent to the top right pushbutton to provide one touch escape from the soft menu system. Whenever a soft menu level is deeper than the first soft menu level, a "BACK" tile appears adjacent to the top left pushbutton to provide a method of regressing through the soft menu system by one level.

The IDU menus are described in the following flow charts.

Top Level Menu
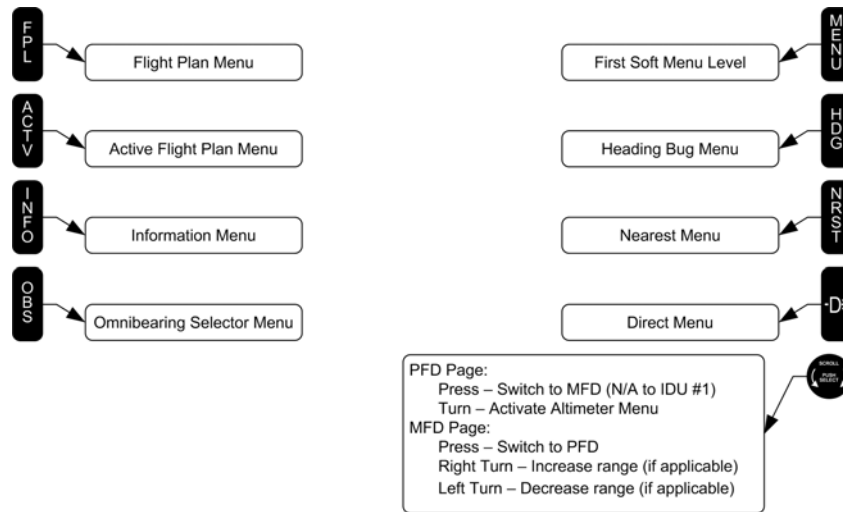
The top-level menu corresponds to the permanent labeling of the IDU pushbuttons. Top-level menus are active any time that no soft menu options appear on screen. Top-level menu options are as follows:

1. **FPL** (top left pushbutton): Activates the flight plan menu option.

2. **ACTV** (second left pushbutton): Activates the active flight plan menu option.

3. **INFO** (third left pushbutton): Activates the information menu option.

4. **OBS** (bottom left pushbutton): Activates the omnibearing selector menu option.

5. **MENU** (top right pushbutton): Activates the first soft menu level associated with the current display screen. The first soft menu level automatically times out after 10 seconds if there are no subsequent pilot actions.

6. **HDG** (second right pushbutton): Activates the heading bug set menu option.

7. **NRST** (third right pushbutton): Activates the nearest menu option.

8. **Direct** (bottom right pushbutton): Activates the direct menu option.

9. **Right Knob** (encoder): Function depends upon screen. On the PFD screen, rotating the encoder activates the altimeter menu option. On all MFD screens other than the HSI or navigation log screens (i.e., ND, Strike, Traffic, Datalink or Hover), rotating the encoder changes the display scale (clockwise = Increase Scale, counterclockwise = Decrease Scale). Pressing the encoder swaps between the PFD and MFD screens on IDUs running MFD software (i.e., not IDU#1).

Under certain conditions, soft menu tiles automatically appear at the top level to provide the pilot with single-touch access to needed functions. As these menu tiles may be shown for a significant period of time, they have a reduced form factor. The following soft menu tiles appear under the specified conditions:

1. When a terrain popup occurs on an MFD during a TAWS FLTA alert, a "RESET" tile appears adjacent to the top left pushbutton.

2. An "LNAV" tile appears adjacent to the top left pushbutton of the primary PFD when there is an active flight plan and the heading bug is active. When the "LNAV" tile is pressed, the heading bug is deactivated and guidance to the active flight plan path resumes. The "RESET" tile has precedence over the "LNAV" tile.

3. A "MISS" tile appears adjacent to the top left pushbutton of the primary PFD upon transitioning the Final Approach Fix. When the "MISS" tile is pressed, the missed approach procedure is activated. The "RESET" and "LNAV" tiles have precedence over the "MISS" tile.

4. A "CONT" tile appears adjacent to the top left pushbutton of the primary PFD when in a holding pattern with further active flight plan legs after the holding pattern. When the "CONT" tile is pressed, automatic waypoint sequencing is

re-enabled to allow normal sequencing to the leg after the holding pattern. The "RESET," "LNAV" and "MISS" tiles have precedence over the "CONT" tile.

5. On an MFD showing the Datalink Screen with Winds and Temperatures Aloft enabled, an "UP" tile appears adjacent to the second left pushbutton. When the "UP" tile is pressed, the Winds and Temperatures Aloft grid level are increased. The "UP" tile does not appear when the highest grid level is being displayed.

6. A "VNAV" tile appears adjacent to the top left pushbutton of the primary PFD when VNAV guidance is valid and the selected altitude sub-mode is active. When the "VNAV" tile is pressed, the selected altitude is deactivated and guidance to the VNAV path resumes. The "UP" tile has precedence over the "VNAV" tile.

7. An "ARM" tile appears adjacent to the second left pushbutton of the primary PFD when on the Final Approach Segment (between the Final Approach Fix and Missed Approach Point). When the "ARM" tile is pressed, the missed approach procedure is armed to automatically activate upon sequencing the Missed Approach Point. The "UP" and "VNAV" tiles have precedence over the "ARM" tile.

8. On an MFD showing the Datalink Screen with Winds and Temperatures Aloft enabled, a "DOWN" tile appears adjacent to the second right pushbutton. When the "DOWN" tile is pressed, the Winds and Temperatures Aloft grid level are decreased. The "DOWN" tile does not appear when the lowest grid level is being displayed.

9. On an MFD showing the Datalink Screen with Pan Mode is enabled, a "NORTH" tile appears adjacent to the third left pushbutton, a "SOUTH" tile appears adjacent to the bottom left pushbutton, an "EAST" tile appears adjacent to the third right pushbutton, and a "WEST" tile appears adjacent to the bottom right pushbutton. When pressed, these buttons cause the center of the Pan Mode Datalink Screen to shift in the specified direction.
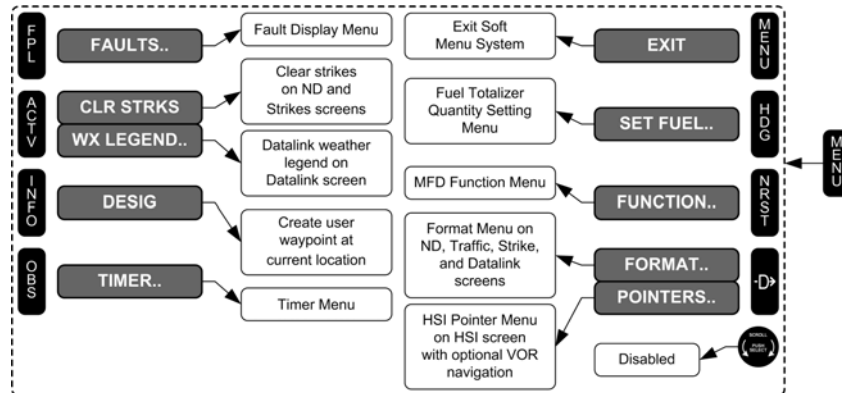
PFD Screen First Soft Menu Level
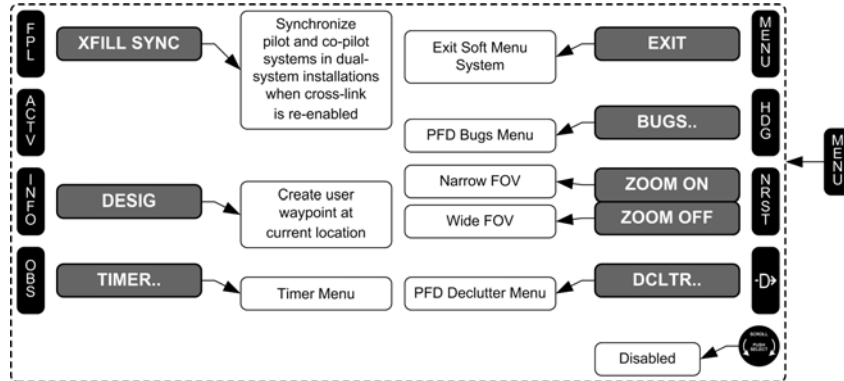
PFD screen first soft menu level options are as follows:

1. **XFILL SYNC** (top left pushbutton): appears in dual-system installations where the pilot and co-pilot systems are not synchronized but crosslink is enabled. When pressed, it synchronizes the pilot and co-pilot active flight plan and system settings. In dual-system installations, XFILL SYNC allows synchronization of pilot and co-pilot systems when cross-link is re-enabled.

2. **DESIG** (third left pushbutton): creates a user waypoint at the current aircraft location. User waypoint automatically is named "OF###," where ### is the next available over-fly user waypoint number.

3. **TIMER** (bottom left pushbutton): Activates the timer menu option.

4. **BUGS** (second right pushbutton): Activates the PFD bug set menu option.

5. **ZOOM ON / ZOOM OFF** (third right pushbutton): toggles between wide FOV mode and narrow FOV mode. "ZOOM ON" appears when the current mode is wide FOV. "ZOOM OFF" appears when the current mode is narrow FOV.

6. **DCLTR** (bottom right pushbutton): Activates the PFD declutter menu option.

MFD Screen First Soft Menu Level

MFD screen first soft menu level options are as follows:

1. **FAULTS** (top left pushbutton): Activates the fault display menu option.

2. **CLR STRKS** or **WX LEGEND** (second left pushbutton): On ND screen or Strike screen with WX-500 option enabled, "CLR STRKS" activates the strike clear option for the WX-500. On Datalink screen, "WX LEGEND" activates the datalink weather legend.

3. **DESIG** (third left pushbutton): Same function as PFD Screen First Soft Menu Level, i.e. Creates a user waypoint at the current location.

4. **TIMER** (bottom left pushbutton): Same function as PFD Screen First Soft Menu Level.

5. **SET FUEL** (second right pushbutton): Activates the fuel totalizer set menu option.

6. **FUNCTION** (third right pushbutton): Activates the MFD display screen select menu option.

7. **FORMAT . . / POINTERS . .** (bottom right pushbutton): On the ND, Traffic, Strike and Datalink screens, "FORMAT" activates the appropriate screen format menu option. On HSI screen with optional VHF (VOR) navigation, "POINTERS" activates HSI RMI pointer menu option.

8. EXIT takes the system out of the Soft Menu level.

Flight Plan (FPL) Menu
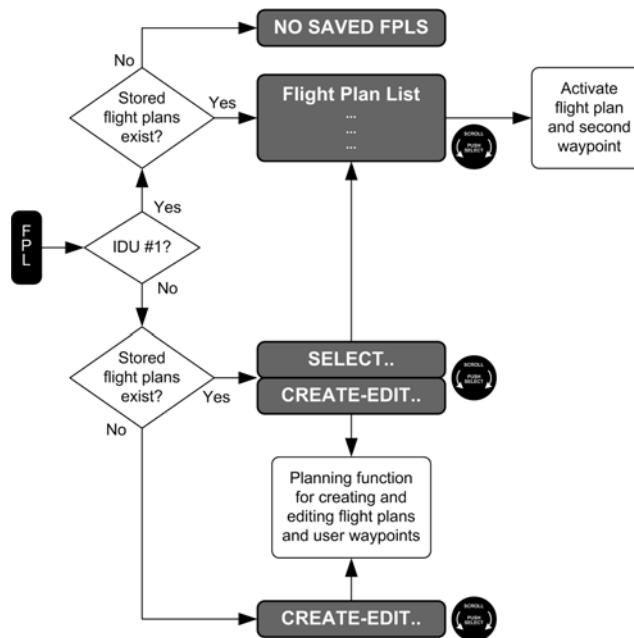
PFD Application (IDU#1)

Upon activation of the flight plan menu, the application is
checked for the existence of saved flight plans. If there are no
saved flight plans, a "NO SAVED FPLS" advisory is issued.
Otherwise, a selection list of saved flight plans is presented.
Upon selection of a saved flight plan, the second waypoint in
the flight plan is activated.

MFD Application (Not IDU#1)

Upon activation of the flight plan menu, the application checks
for the existence of saved flight plans. If there are no saved
flight plans, then the flight planning function is activated.
Otherwise, an option list is presented allowing the pilot to either
select a saved flight plan or enter the flight planning function.
Selecting the saved flight plan select option leads to a list of
saved flight plans. Upon selection of a saved flight plan, the
second waypoint in the flight plan is activated.

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F L I G H T   S Y S T E M S

Active Flight Plan (ACTV) Menu

Main Menu

* Shown if applicable
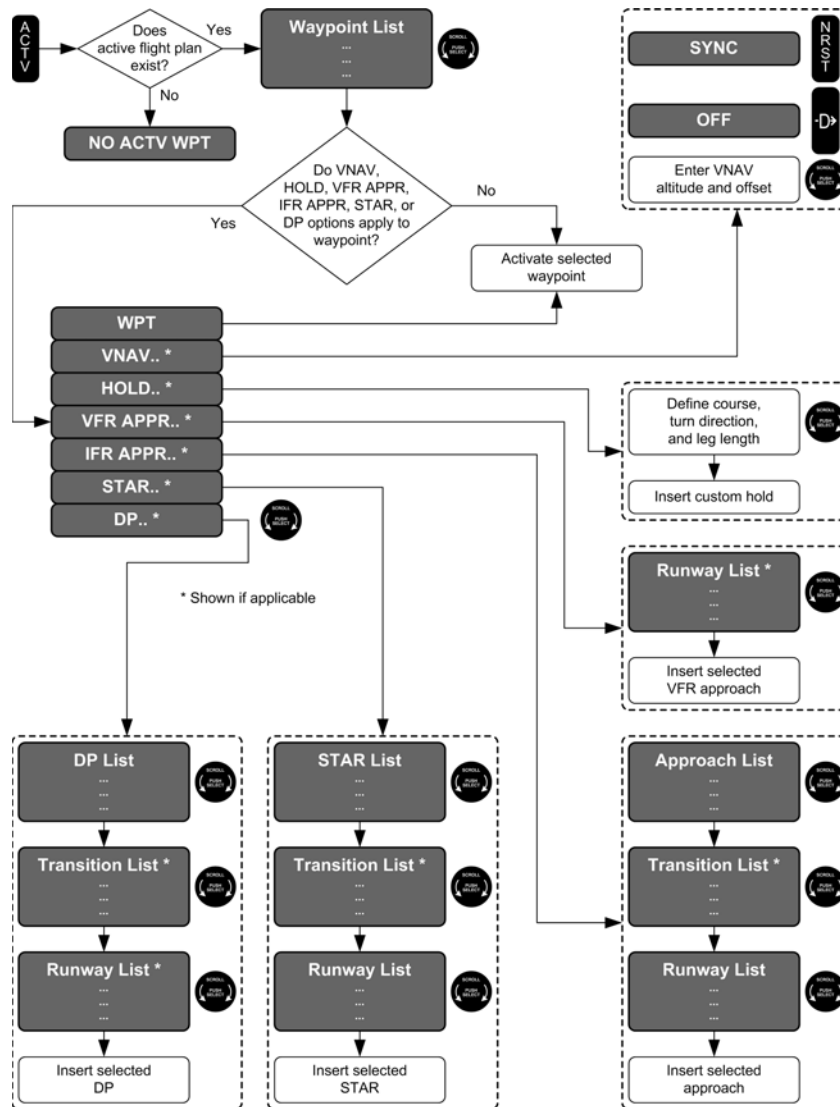
Upon activation of the active flight plan menu, the application checks for the existence of an active waypoint. If there is no active waypoint, a "NO ACTV WPT" advisory is issued. Otherwise, a selection list in the form of a log of waypoints in the active flight plan is presented. The log shows each waypoint identifier, a symbol designating waypoint type and what type of procedure (if any) the waypoint is associated with, VNAV altitudes and offsets associated with each waypoint, and information related to the flight plan path between each waypoint. VNAV altitudes and offsets that come from the navigation database are shown in white. VNAV and offsets altitudes that are computed automatically are shown in magenta. The current active waypoint is designated by an asterisk. Any suppressed waypoint is designated by brackets.

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

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

Upon selection of a waypoint from the selection list, the application checks to see whether the selected waypoint meets the criteria for manual VNAV parameter entry, custom holding pattern entry, VFR approach entry, IFR approach entry, STAR entry or DP entry. If not, the application makes the selected waypoint active. Otherwise, an option list is presented as follows:

1. **WAYPOINT**: makes the selected waypoint the active waypoint.

2. **VNAV**: If the selected waypoint is neither a suppressed waypoint, part of an IFR approach nor part of a VFR

approach, it is possible for the pilot to enter a manual VNAV altitude and offset for the selected waypoint with this option. This level includes tiles for synchronizing the VNAV altitude to current altitude and for removing the manual VNAV altitude and offset entry. VNAV altitudes are settable in increments of 100 feet. VNAV offsets are settable in increments of 1NM.

3. **HOLD**: If the selected waypoint is neither a suppressed waypoint, part of an IFR approach, part of a VFR approach, a holding waypoint, a DP anchor waypoint nor a manual leg, it is possible for the pilot to enter a manual holding pattern at the selected waypoint with this option. The pilot is able to define the course, turn direction (left or right), and leg length (expressed as either distance or time) for the manual holding pattern. Holding pattern course is settable in increments of 1°. Holding pattern leg length is settable in increments of 1NM or a tenth of a minute.

4. **VFR APP**: If the selected waypoint is a user waypoint with an approach bearing, then a VFR approach to the user waypoint based upon the approach bearing is created and the user waypoint is suppressed. If the selected waypoint is an airport, then the pilot is presented with a selection list of runways. After selecting a runway, a VFR approach to the runway is created and the airport waypoint is suppressed. Activating a VFR approach automatically deletes any pre-existing IFR or VFR approaches. If a heading bug is not already active, activating a VFR approach automatically activates the heading bug on current aircraft heading. The heading bug can then be used to define the course intercept angle.

5. **IFR APP**: If the selected waypoint is an airport with an IFR approach, then this option is available. Upon selecting this option, the pilot is presented with a selection list of available approaches, followed by a selection list of available transitions (if there are more than one), and a selection list of runways. After selecting a runway, the appropriate IFR approach to the runway is created and the airport waypoint is suppressed. Activating an IFR approach automati-

cally deletes any pre-existing IFR or VFR approaches. If there is a pre-existing STAR to the airport, then the IFR approach waypoints are inserted after the STAR waypoints. If a heading bug is not already active, and the activated transition is "Vectors to Final," activating an IFR approach automatically activates the heading bug on current aircraft heading. The heading bug can then be used to define the course intercept angle.

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

7. **DP**: When the selected waypoint is an airport with a DP, then this option is available. Upon selecting this option, the pilot is presented with a selection list of DPs, followed by a selection list of available transitions (if there are more than one), and a selection list of runways (if more than one runway is authorized for the DP). After selecting a runway, the appropriate DP from the runway is created. Activating a DP automatically deletes any pre-existing DPs.

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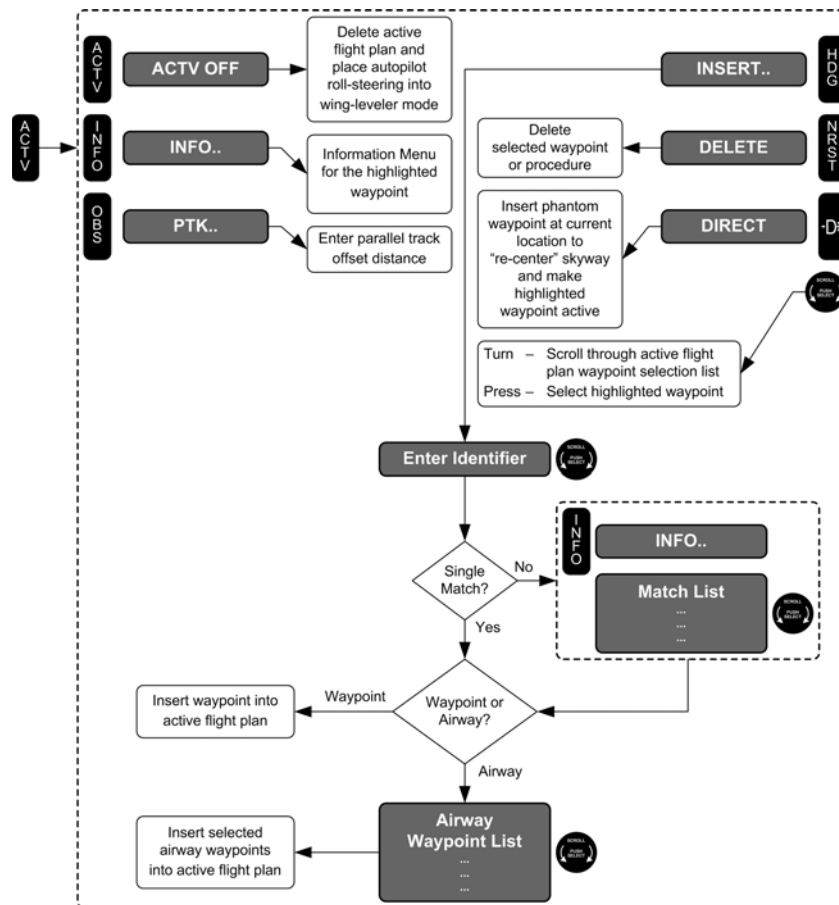
Various options appear at the same menu level as the log selection list. These options allow various modifications to be made to the active flight plan as follows:

1. **ACTV OFF** (second left pushbutton): deletes the active flight plan. The pilot is prompted to confirm deletion prior to completion of the operation.

2. **INFO** (third left pushbutton): activates the information menu option for the highlighted waypoint.

3. **PTK** (bottom left pushbutton): allows the pilot to specify a parallel offset distance for non-procedure segments of the active flight plan. The range of parallel offsets is from 20NM left of track to 20NM right of track in 1NM increments.

4. **INSERT. . / ADD. .** (second right pushbutton): allows the pilot to insert or add a waypoint or airway into the active flight plan. If the highlighted position is one position past the end of the active flight plan, the tile reads "ADD," otherwise the tile reads "INSERT." When the highlighted waypoint is the second or subsequent waypoint of a procedure, the tile does not appear. This prevents corruption of IFR approaches, STARs and DPs. When activated, the pilot is prompted to enter an identifier. Performing a search for waypoints requires the entry of at least two characters. If only one character is entered, only airways are searched.

   For waypoints, if there is a single result from the search, that result is inserted or added to the active flight plan. If there is no result from the search, the pilot is re-prompted to enter an identifier. If there are multiple results from the search, a selection list with matching identifiers is presented and, upon selection, the selected waypoint is inserted or added to the active flight plan. An "INFO" tile giving access to the information function for the highlighted result appears at this level to aid in selection.

   For airways, a search is performed for all airways that go through the highlighted waypoint and match the entered identifier (i.e., to get a list of all Victor airways that go through the highlighted waypoint, enter an identifier string of "V"). If there is a single result from the search, then a list of airway waypoints is shown so that the pilot can select the desired exit point. If there is no result from the search, the pilot is re-prompted to enter an identifier. If there are multiple results from the search, a selection list with matching airway identifiers is presented and, upon selection, a list of airway waypoints is shown so that the pilot can select the desired exit point. Upon selecting the

desired exit point, the necessary airway waypoints from the previous waypoint to the desired exit point is inserted or added to the active flight plan. Necessary airway waypoints are the airway entry waypoint, the airway exit waypoint, turn waypoints, and VORs.

5. **DELETE** (third right pushbutton): If the highlighted way-point is a non-procedure waypoint, then the function deletes the highlighted waypoint from the active flight plan. If the highlighted waypoint is part of a procedure, then the function deletes the entire procedure from the active flight plan. The pilot is prompted to confirm dele-tion prior to completion of the operation. This tile does not appear if the highlighted waypoint is a non-procedure way-point and there are fewer than three non-procedure way-points in the active flight plan. This is because an active flight plan must always have at least two non-procedure waypoints. The tile also does not appear when the high-lighted waypoint is suppressed or when the highlighted position is one position past the end of the active flight plan.

6. **Direct** (bottom right pushbutton): inserts a phantom way-point at the current aircraft location and makes the high-lighted waypoint active. The phantom waypoint is a fly-over defined entry waypoint and the leg prior to the phan-tom waypoint is designated a discontinuity. This assures that the skyway is "re-centered" to provide guidance to the new active waypoint. This tile does not appear when the highlighted waypoint is suppressed or when the highlighted position is one position past the end of the active flight plan.

Information (INFO) Menu
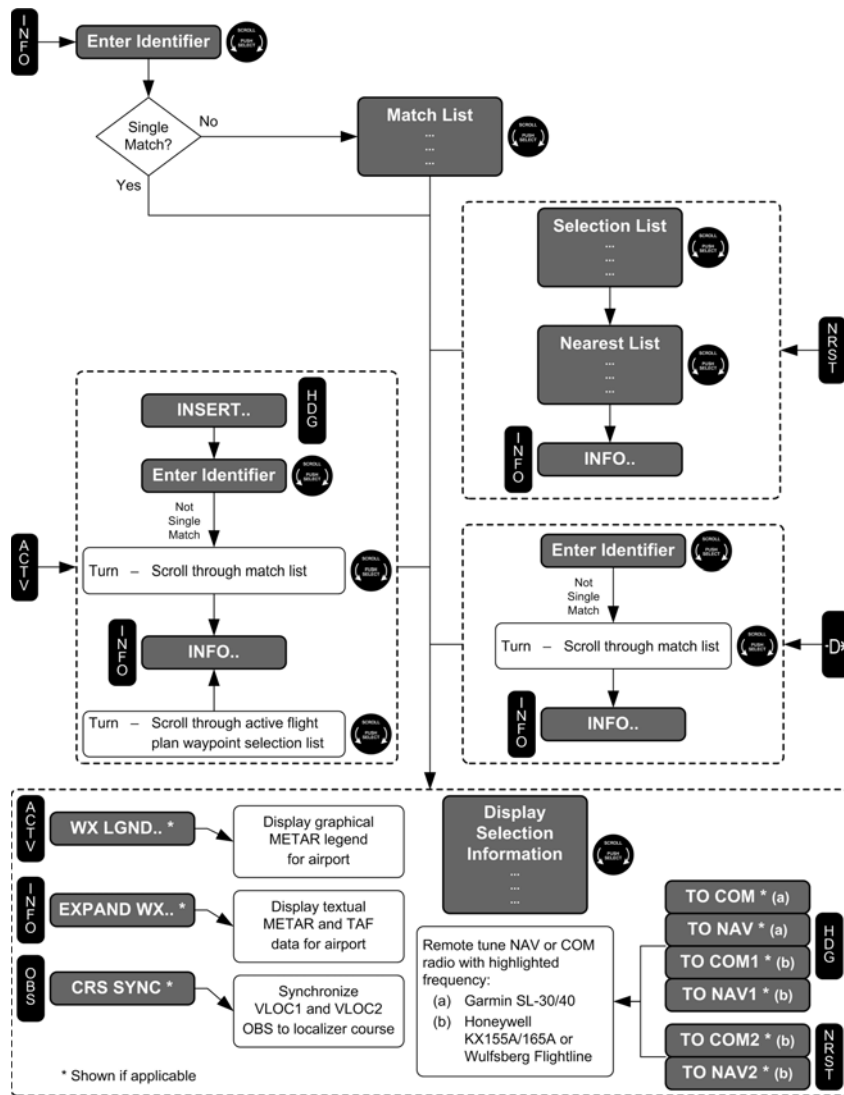
If the INFO tile is activated from within the ACTV, NRST or Direct menus, then information on the highlighted waypoint from the applicable selection list is shown directly. Otherwise,

the function checks for a current active waypoint. If there is an active waypoint, then the active waypoint becomes the default entry. If there is no active waypoint, then the nearest airport becomes the default entry. If the default entry is accepted, then information for the default entry is shown. If the pilot rejects the default entry by entering identifier characters, then a search for matching identifiers is performed. If there is a single result from the search, information for that result is shown. If there is no result from the search, the pilot is re-prompted to enter an identifier. If there are multiple results from the search, a selection list with matching identifiers is presented to allow the pilot to select the desired identifier.

The amount and type of information presented depends upon the type of waypoint. For all types of waypoints, waypoint identifier, waypoint type, waypoint elevation (if it exists), long name, bearing and distance, and latitude/longitude are presented. For navigation aids, navigation aid frequency is presented. For airports, communication frequencies and airport runway data are also presented. In addition, on an MFD screen with datalink enabled, airport graphical METAR, current altimeter setting and current wind conditions ar presented.
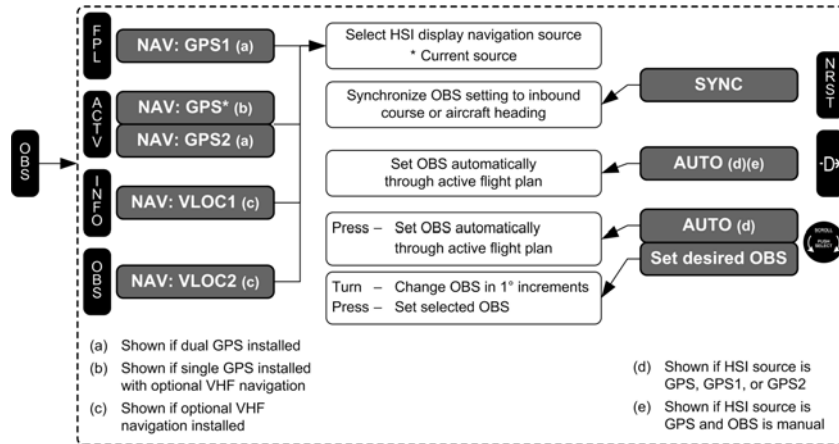
If remote tuning is enabled and a single frequency is associated with the waypoint, tiles are shown to allow transmission of the frequency to remote NAV or COM radios. If more than one frequency is associated with the waypoint (i.e., airport waypoint), tiles are shown to allow transmission of a frequency to remote NAV or COM radios when a frequency is highlighted in the INFO block. If the frequency is less than 118MHz, the tiles read "TO NAV#" and the transmission is addressed to NAV radios. If the frequency is greater than or equal to 118MHz, the tiles read "TO COM#" and the transmission is addressed to COM radios. Where remote tuning is enabled for Garmin SL-30/40 radios, only a single "TO COM" or "TO NAV" tile is shown in the second right pushbutton position because transmissions to the SL-30/40 radios are not directed to a particular radio number. Where remote tuning is enabled for Honeywell KX155A/165A and Wulfsberg FlightLine, a "TO COM1" or "TO NAV1" tile is shown in the second right

pushbutton position, while a "TO COM2" or "TO NAV2" tile is shown in the third right pushbutton position.

When airport weather information is presented in the information block, a "WX LEGEND" tile in the second left pushbutton position is shown to allow the display of an airport graphical METAR legend. In addition, an "EXPAND WX" tile in the third left pushbutton position is shown to allow the display of textual METAR and TAF data for the airport.

When the information is being presented for an ILS or localizer waypoint and the current VLOC1 or VLOC2 omnibearing selectors are not synchronized with the localizer course, a "CRS SYNC" tile is shown to allow one-touch synchronization of the VLOC1 and VLOC2 omnibearing selectors to the localizer course.

Omnibearing Selector (OBS) Menu

(a) Shown if dual GPS installed
(b) Shown if single GPS installed with optional VHF navigation
(c) Shown if optional VHF navigation installed
(d) Shown if HSI source is GPS, GPS1, or GPS2
(e) Shown if HSI source is GPS and OBS is manual

The OBS menu allows the pilot to control the setting of the omnibearing selector for purposes of showing course deviations. The OBS for GPS/WAAS allows the pilot to specify either a manual OBS setting, or an automatic OBS setting in which the current active OBS is controlled by the active flight plan. The OBS for VLOC1 allows the pilot to specify the active OBS setting for the VLOC1 navigation function. The OBS for VLOC2 allows the pilot to specify the active OBS setting for the VLOC2 navigation function. Manual GPS/WAAS, VLOC1 and VLOC2 OBS settings are settable in increments of 1°. A "SYNC" tile is available to synchronize the Manual GPS/WAAS, VLOC1 or VLOC2 OBS settings (depending upon HSI source) to the inbound course or, if the inbound course cannot be determined, to aircraft heading. When HSI source is GPS, GPS1 or GPS2 and a manual GPS/ WAAS OBS exists, an "AUTO" tile is available to enable quick access to the automatic OBS setting.

With optional VHF navigation or dual GPS installation, the OBS function permits the pilot to select either GPS (single GPS), GPS1 (dual GPS), GPS2 (dual GPS), VLOC1 (optional VHF navigation) or VLOC2 (optional VHF navigation) as the

HSI source. The HSI source selects the navigation source used to generate HSI guidance symbology, autopilot course datum and course deviation signals.

Heading Bug (HDG) Menu
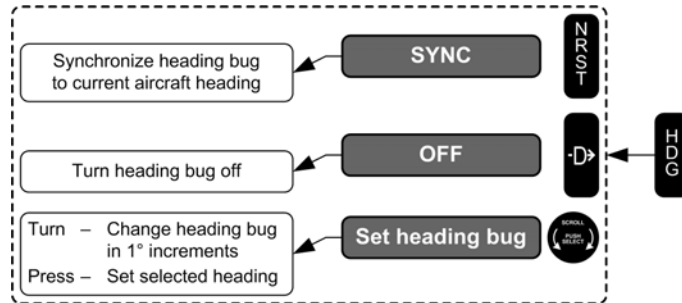
The heading bug menu allows the pilot to set the heading bug in increments of 1°, synchronize the heading bug to current heading, or turn the heading bug off.

"Remember, when a heading bug is selected it will be annunciated at the bottom of the PFD with HDG:BUG.. An LNAV arming tile will appear in the upper left corner as well. To resume LNAV (lateral navigation or roll steering on an autopilot) either push the LNAV tile, or push the HDG button and then OFF, to turn off the heading bug. As long as the bug is activated, the autopilot will follow it. Magenta course lines will be not be tracked by the autopilot until LNAV is resumed."

Nearest (NRST) Menu
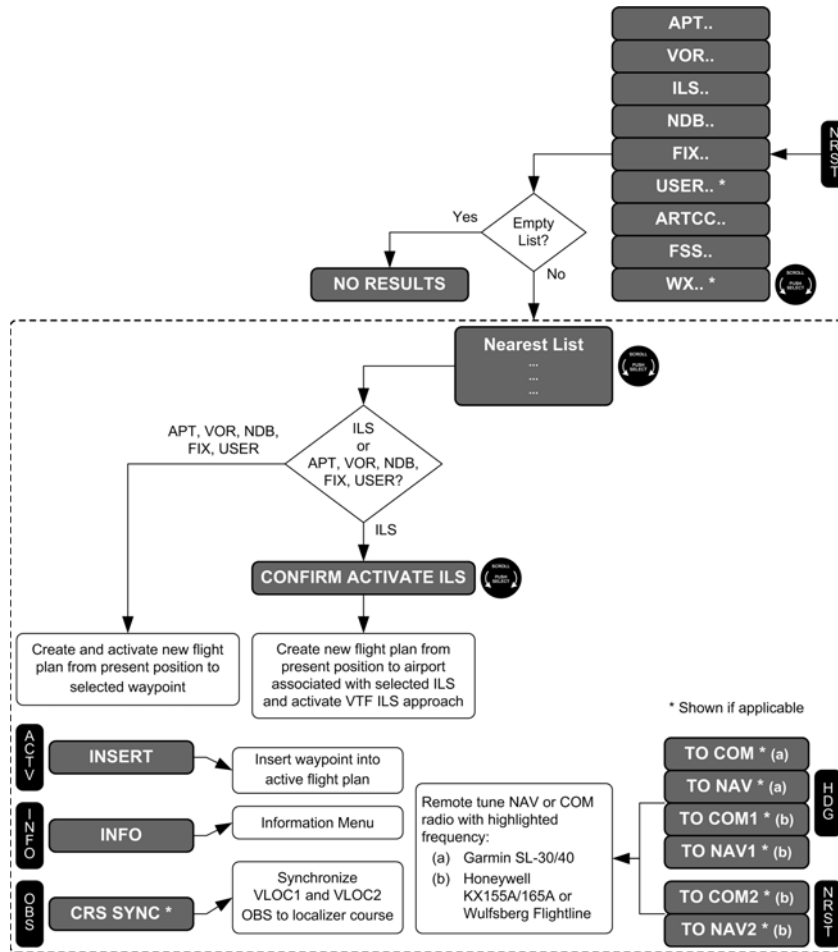
Upon activating the nearest menu, an option list appears to allow the pilot to select from a list of the nearest airports, nearest VORs, nearest ILSs, nearest NDBs, nearest fixes, nearest user waypoints (if user waypoints exist), nearest ARTCC frequencies, nearest FSS frequencies, or nearest METAR and TAF weather reports (MFD application with datalink option enabled and METARs available). Upon selecting a category from the option list, a selection list of up to

20 items within 240NM matching the category appears. If the list is empty (i.e., no items within 240NM), a "NO RESULTS" message button is displayed. The selection list includes identifier, bearing and distance to the item. The selection list for airports also contains an indication of the longest runway length at the airport.

The selection list for airports, VORs, ILSs, NDBs, ARTCCs and FSSs includes an associated frequency (CTAF in the case of airports). If remote tuning is enabled, tiles are shown to allow transmission of the associated frequency to remote NAV or COM radios. If the frequency is less than 118MHz, the tiles read "TO NAV#" and the transmission is addressed to NAV radios. If the frequency is greater than or equal to 118MHz, the tiles are read "TO COM#" and the transmission is addressed to COM radios. Where remote tuning is enabled for Garmin SL-30/40 radios, only a single "TO COM" or "TO NAV" tile is shown in the second right pushbutton position because transmissions to the SL-30/40 radios cannot be directed to a particular radio number. Where remote tuning is enabled for Honeywell KX155A/165A and Wulfsberg FlightLine, a "TO COM1" or "TO NAV1" tile is shown in the second right pushbutton position, while a "TO COM2" or "TO NAV2" tile is shown in the third right pushbutton position.

When the results for airports, VORs, NDBs, fixes and user waypoints are displayed, an "INSERT" tile is provided to allow the pilot to quickly insert a waypoint into the active flight plan at the current active waypoint position. This feature is intended to facilitate rapid clearance changes from air traffic control. The "INSERT" tile does not appear if the current active waypoint is within a procedure. This prevents corruption of IFR approaches, STARs and DPs.

When the results for airports, VORs, ILSs, NDBs, fixes, user waypoints and weather are displayed, an "INFO" tile is available to activate the information function and provide further information on the highlighted item.

In the case of "NRST ILS" where the current VLOC1 or VLOC2 OBS does not match the localizer course, a "CRS

SYNC" tile is presented to synchronize VLOC1 and VLOC2 OBS to the localizer course.

Upon selecting a waypoint of a type such as airport, VOR, NDB, fix or user waypoint, a new active flight plan is created from present aircraft position to the selected waypoint. Upon selecting an ILS waypoint type, a "CONFIRM ACTIVATE ILS" tile is displayed. When the pilot confirms the ILS activations, the following actions occur:

1. A direct flight plan to the airport associated with the ILS is created;

2. A vectors-to-final ILS approach to the ILS is activated;

3. The VLOC1 and VLOC2 OBS settings are set to the associated localizer course;

4. HSI source is switched as follows:
   – aircraft pilot side switched to VLOC1
   – aircraft co-pilot side switched to VLOC2
   – rotorcraft pilot side switched to VLOC2
   – rotorcraft co-pilot side switched to VLOC1

5. Connected NAV radios are remotely tuned to the ILS frequency.

Direct Menu
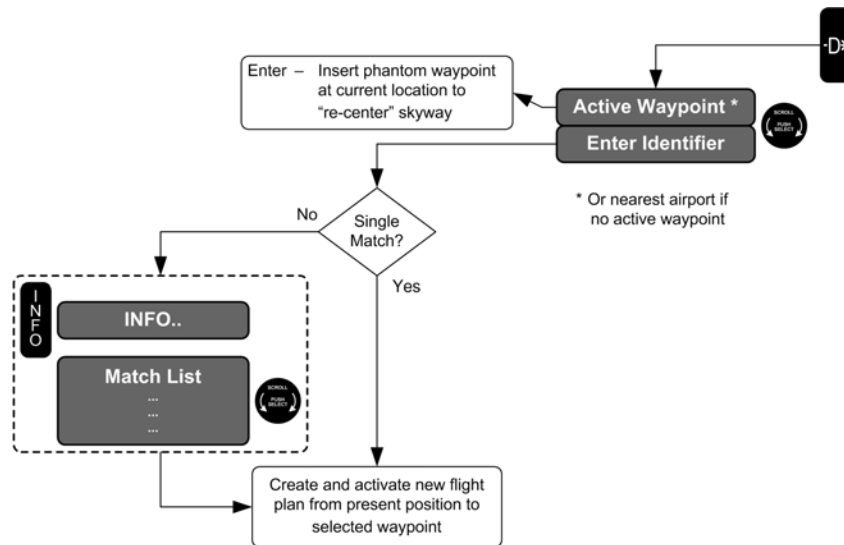
Upon activating the direct menu from the top-level menu, the function checks for a current active waypoint. If there is an active waypoint, then the active waypoint becomes the default entry. If there is no active waypoint, then the nearest airport becomes the default entry.

If the default entry is the active waypoint and is accepted by the pilot, then a phantom waypoint is inserted at the current aircraft location. The phantom waypoint is a fly-over defined entry waypoint and the leg prior to the phantom waypoint is designated a discontinuity. This assures that the skyway is "re-centered" to provide guidance to the new active waypoint. The rest of the active flight plan will remain unchanged.

If the default entry is not the active waypoint and is accepted by the pilot, then the resulting action depends upon whether the aircraft is in the air or on the ground. If in the air, a new active flight plan is created from present aircraft position to the selected waypoint. If on the ground, a search is conducted for a database airport within 6NM. If an airport is found, a new active flight plan is created from the found airport to the

selected waypoint. Otherwise, a new active flight plan is created from present aircraft position to the selected waypoint.

If the pilot rejects the default entry by entering identifier characters, then a search for matching identifiers is performed. If there is a single result from the search, then the resulting action depends upon whether the aircraft is in the air or on the ground. If in the air, a new active flight plan is created from present aircraft position to the selected waypoint. If on the ground, a search is conducted for a database airport within 6NM. If an airport is found, a new active flight plan is created from the found airport to the selected waypoint. Otherwise, a new active flight plan is created from present aircraft position to the selected waypoint.

If there is no result from the search, the pilot is re-prompted to enter an identifier.

If there are multiple results from the search, a selection list with matching identifiers is presented. Upon selection, the resulting action depends upon whether the aircraft is in the air or on the ground. If in the air, a new active flight plan is created from present aircraft position to the selected waypoint. If on the ground, a search is conducted for a database airport within 6NM. If an airport is found, a new active flight plan is created from the found airport to the selected waypoint. Otherwise, a new active flight plan is created from present aircraft position to the selected waypoint. An "INFO" tile giving access to the information function for the highlighted result appears at this level to aid in selection.

Timer (TIMER) Menu
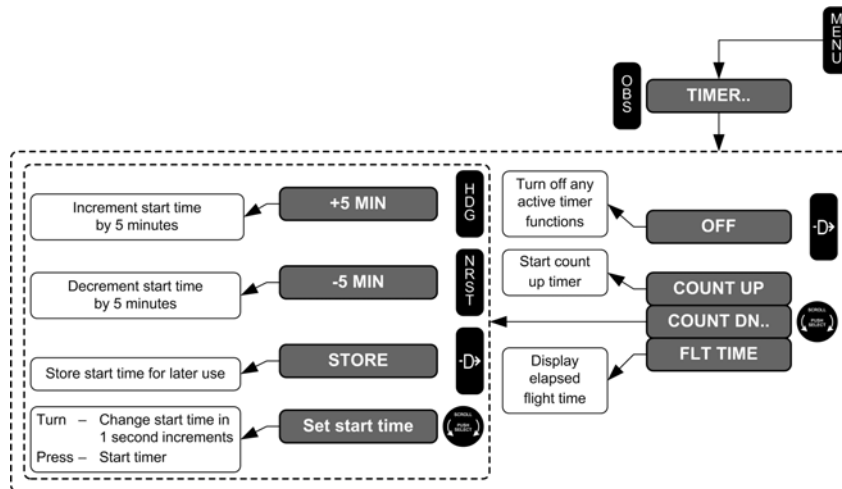
Upon selecting the timer menu, an option list appears to let the pilot choose the count up timer, the count down timer, or the flight time display. An "OFF" tile also appears at this level to allow the pilot to turn off any active timer functions.

If the pilot selects the count up timer, the count up timer is activated.

If the pilot selects the count down timer, the pilot is prompted to enter a start time from which the count down begins. Shortcut keys to quickly add or decrement by 5 minute increments is provided at this level. After entering a start time, the pilot is able to either start the count down timer or select the "STORE" tile to store the start time for later use.

If the pilot selects the flight time display option, the current elapsed time since the aircraft transitioned from ground to air mode is displayed for 10 seconds or until any key is pressed. If the aircraft has not yet transitioned from ground to air mode, upon selecting the flight time display option, the elapsed time is displayed as "FLT TM: 00:00:00".

PFD Bug (BUGS) Menu
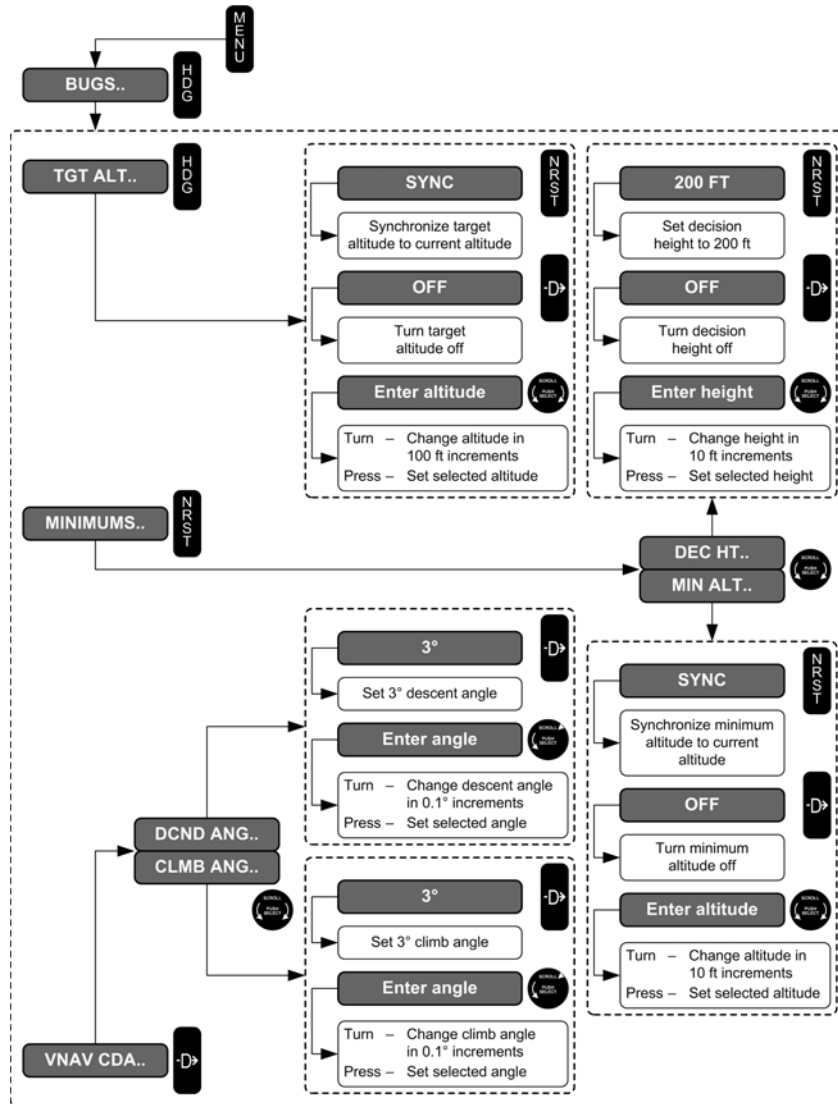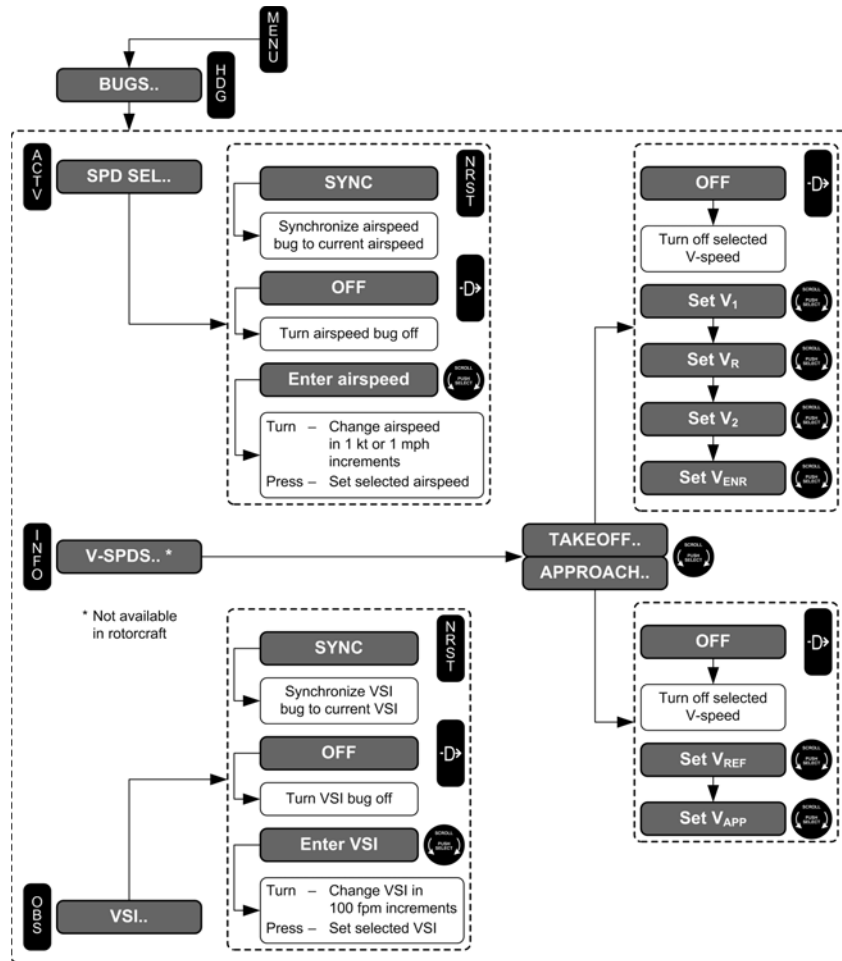
Upon selecting the PFD bugs menu, the pilot is presented with tiles to choose either setting a target altitude, setting minimums, setting an airspeed bug, setting the VNAV climb or descent angle, setting V-speeds or setting vertical speed.

Selecting the target altitude option allows the pilot to either synchronize the target altitude to current altitude, turn the target altitude off or set the target altitude in increments of 100 feet.

Selecting the minimums option brings up a further option list for setting either decision height or minimum altitude. Selecting the minimum altitude option allows the pilot to either synchronize the minimum altitude to current altitude, turn the minimum altitude off or set the minimum altitude in increments of 10 feet. Selecting the decision height option allows the pilot to either set the decision height to a default height of 200 feet, turn the decision height off or set the decision height in increments of 10 feet.

Selecting the airspeed bug option allows the pilot to either synchronize the airspeed bug to current airspeed, turn the airspeed bug off or set the airspeed bug in increments of 1 knot indicated airspeed. On the low end, airspeed bug settings are limited to the highest of $(1.2 \text{ x } V_{s1})$, $(1.2 \text{ x } V_{REF})$ or 60KIAS. On the high end, airspeed bug settings are limited to the aircraft redline.

Selecting the VNAV climb or descent angle option brings up a further option list for setting either climb angle or descent angle. At this further level, selecting either option allows the pilot to set the climb angle or the descent angle (as appropriate) in increments of $0.1°$ (note: a value of 0 is not allowed). Corresponding feet per nautical mile are shown adjacent to the climb or descent angle setting. In addition, a shortcut tile is available to set the climb or descent angle to $3°$.

Selecting the V-speed option brings up a further option list for setting either takeoff V-speed (V_1, V_R, V_2 and V_{ENR}) or approach V-speeds (V_{REF} and V_{APP}). Selecting the takeoff V-speed option allows the pilot to set takeoff V-speeds (V_1, V_R, V_2 and V_{ENR}) in sequence. Selecting the approach V-speed option allows the pilot to set approach V-speeds (V_{REF} and V_{APP}) in sequence. The V-speed option is not available in rotorcraft installations.

Selecting the VSI bug option allows the pilot to either synchronize the VSI bug to the current VSI, turn the VSI bug off or set the VSI bug in increments of 100 feet per minute.

Note that the airspeed bug and VSI bug are mutually exclusive and therefore selecting one turns off the other.

PFD Declutter (DCLTR) Menu
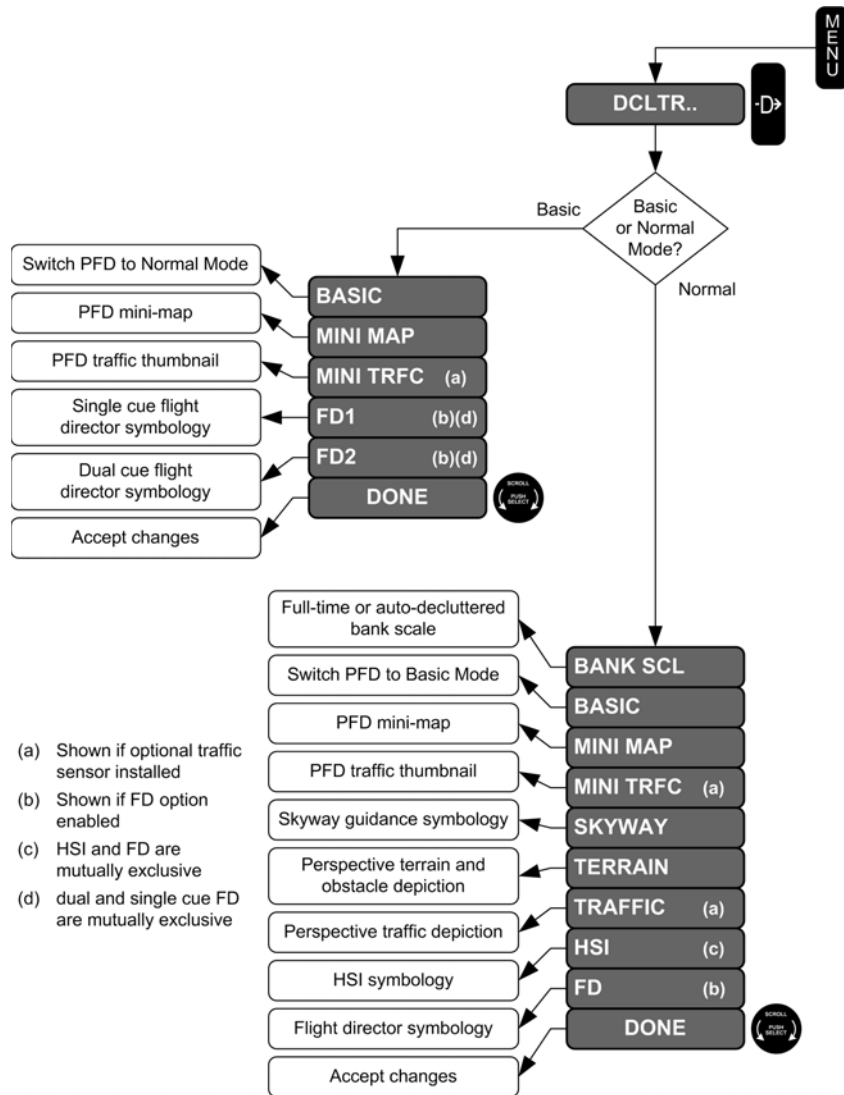
Upon activating the PFD declutter menu, an option list of declutter items are shown. In Normal Mode, it is possible to select or deselect the following items:

1. Full-time or auto-decluttered bank scale display;

2. Basic Mode (switches the PFD to Basic Mode);

3. PFD mini-map;

4. PFD traffic thumbnail;

5. Skyway guidance symbology;

6. Perspective terrain and obstacle depiction;

7. Perspective traffic depiction;

8. HSI symbology (mutually exclusive with Flight Director symbology); and

9. Flight Director symbology (only shown with optional Flight Director symbology option and mutually exclusive with HSI symbology).

In Basic Mode, it is possible to select or deselect the following items:

1. Basic Mode (switches PFD back to Normal Mode);

2. PFD mini-map;

3. PFD traffic thumbnail;

4. Single Cue Flight Director symbology (only shown with optional Flight Director symbology option and mutually exclusive with Dual Cue Flight Director symbology); and

5. Dual Cue Flight Director symbology (only shown with optional Flight Director symbology option and mutually exclusive with Single Cue Flight Director symbology).

PFD Altimeter Menu
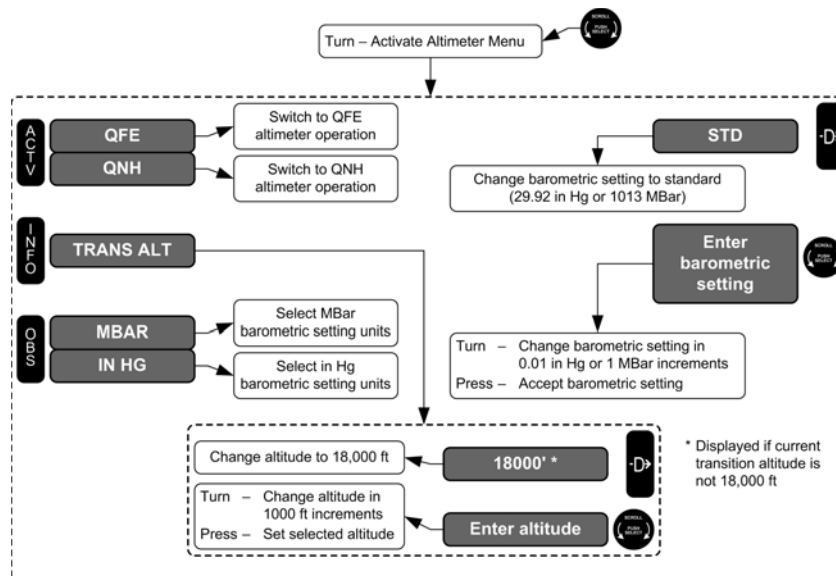
Upon turning the rotary encoder on the PFD screen, the altimeter menu is activated. In the altimeter menu, turning the rotary encoder increments (clockwise rotation) or decrements (counter-clockwise rotation) the barometric setting. Pressing the rotary encoder accepts the new barometric setting. In addition, the following options are available in the altimeter menu:

1. **QNH/QFE** (second left pushbutton): toggles between QNH altimeter operation and QFE altimeter operation. This setting is used by the TAWS system to determine whether barometric altitude can be used for TAWS functions. When in QNH mode, QNE operation is automatically selected when above the transition altitude with a standard altimeter setting. Note the following definitions:
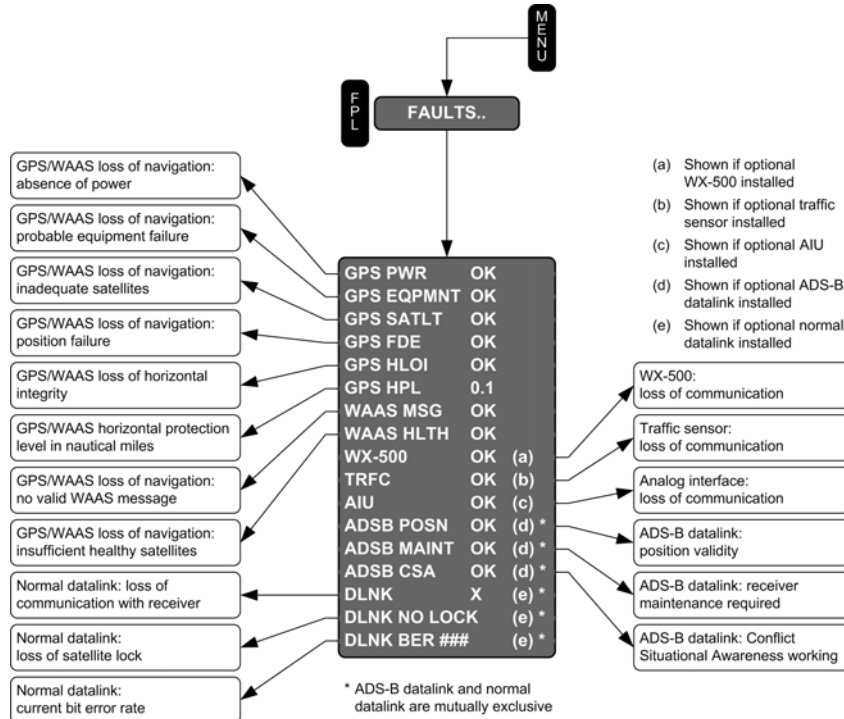
    QFE: Barometric setting that results in the altimeter displaying height above a reference elevation (i.e., airport or runway threshold).

QNE: Standard barometric setting (29.92 in. Hg. or 1013 MBar) used to display pressure altitude for flight above the transition altitude.

QNH: Barometric setting that results in the altimeter displaying altitude above mean sea level at the reporting station.

2. **TRANS ALT** (third left pushbutton): allows the pilot to change the transition altitude used by the system in units of 1000 feet. Transition altitude is used to generate barometric setting warnings and to determine QNE/QNH operation. If the current transition altitude is not 18,000 feet, an "18000'" tile is available to quickly set 18,000 feet as the transition altitude.

3. **MBAR/IN HG** (bottom left pushbutton: allows the pilot to select the barometric setting units (In. Hg. or Mbar).

4. **STD** (bottom right pushbutton): sets the barometric setting to standard (29.92 in. Hg. or 1013 MBar).

MFD Fault Display (FAULTS) Menu

GPS/WAAS loss of navigation: absence of power

GPS/WAAS loss of navigation: probable equipment failure

GPS/WAAS loss of navigation: inadequate satellites

GPS/WAAS loss of navigation: position failure

GPS/WAAS loss of horizontal integrity

GPS/WAAS horizontal protection level in nautical miles

GPS/WAAS loss of navigation: no valid WAAS message

GPS/WAAS loss of navigation: insufficient healthy satellites

Normal datalink: loss of communication with receiver

Normal datalink: loss of satellite lock

Normal datalink: current bit error rate

(a) Shown if optional WX-500 installed

(b) Shown if optional traffic sensor installed

(c) Shown if optional AIU installed

(d) Shown if optional ADS-B datalink installed

(e) Shown if optional normal datalink installed

GPS PWR	OK	
GPS EQPMNT	OK	
GPS SATLT	OK	
GPS FDE	OK	
GPS HLOI	OK	
GPS HPL	0.1	
WAAS MSG	OK	
WAAS HLTH	OK	
WX-500	OK	(a)
TRFC	OK	(b)
AIU	OK	(c)
ADSB POSN	OK	(d) *
ADSB MAINT	OK	(d) *
ADSB CSA	OK	(d) *
DLNK	X	(e) *
DLNK NO LOCK		(e) *
DLNK BER ###		(e) *

WX-500: loss of communication

Traffic sensor: loss of communication

Analog interface: loss of communication

ADS-B datalink: position validity

ADS-B datalink: receiver maintenance required

ADS-B datalink: Conflict Situational Awareness working

* ADS-B datalink and normal datalink are mutually exclusive

Upon selecting the MFD faults menu, the statuses of the following system parameters are displayed:

1. GPS/WAAS loss of navigation due to absence of power ("GPS PWR").

2. GPS/WAAS loss of navigation due to probable equipment failure ("GPS EQPMNT").

3. GPS/WAAS loss of navigation due to inadequate satellites to compute a position solution ("GPS SATLT").

4. GPS/WAAS loss of navigation due to a position failure that cannot be excluded within the time to alert ("GPS FDE").
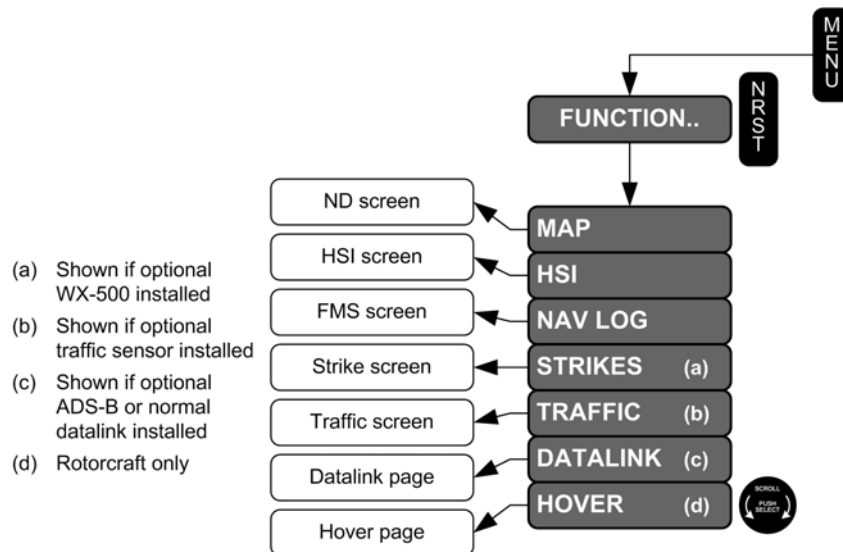
5. GPS/WAAS loss of horizontal integrity monitoring and loss of navigation due to loss of horizontal integrity monitoring ("GPS HLOI").

6. A readout of the current GPS/WAAS horizontal protection level ("GPS HPL") in nautical miles. This value can be used as the display of navigational uncertainty required in RNP airspace.

7. GPS/WAAS loss of navigation due to no valid WAAS message received for 4 seconds or more ("WAAS MSG").

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

9. If the WX-500 option is enabled, loss of communications with the WX-500 ("WX-500").

10. If the traffic option is enabled, loss of communications with the traffic sensor ("TRFC").

11. If the analog interface option is enabled, loss of communications with the Analog Interface Unit ("AIU").

12. If normal datalink is enabled, the datalink item indicates either loss of communications with the datalink receiver ("DLNK X"), loss of satellite lock ("DLNK NO LOCK"), or the current bit error rate or the datalink ("DLNK BER ###"). Normal datalink is mutually exclusive with ADS-B datalink.

13. If ADS-B datalink is enabled, an indication of ADS-B position validity ("ADSB POSN"), an indication of whether maintenance of the ADS-B receiver is required ("ADSB MAINT") and an indication of whether the Conflict Situational Awareness algorithm is working ("ADSB CSA"). ADS-B datalink is mutually exclusive with normal datalink.

MFD Fuel Totalizer Quantity Setting (SET FUEL) Menu
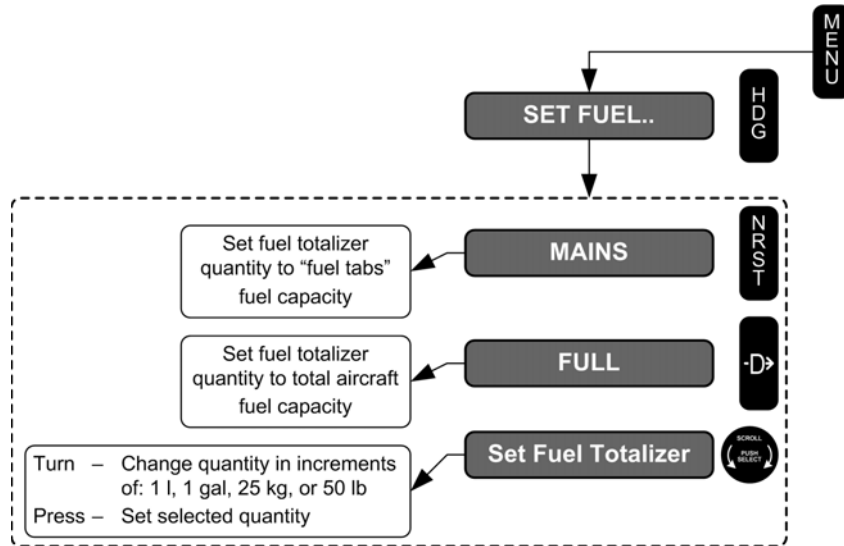
The fuel totalizer quantity setting menu allows the pilot to set the fuel totalizer quantity in increments of volume units (volume units depends upon the setting of the volume units flag). A "MAINS" tile is available to quickly set the quantity to the "fuel tabs" fuel capacity. A "FULL" tile is available to quickly set the quantity to the total aircraft fuel capacity. Units of measure are shown in the quantity window. Current fuel flow is also shown in the quantity window.

MFD Function (FUNCTION) Menu

(a) Shown if optional WX-500 installed

(b) Shown if optional traffic sensor installed

(c) Shown if optional ADS-B or normal datalink installed

(d) Rotorcraft only

The "FUNCTION" menu allows the pilot to select which MFD screen to display. Options are:

1. **MAP**: shows the ND screen.

2. **HSI**: shows the HSI screen.

3. **NAV LOG**: Shows the FMS screen.

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

5. **TRAFFIC**: shows the Traffic screen. This option is only available if a traffic option is enabled.

6. **DATALINK**: shows the Datalink page. This option is only available if datalink (normal or ADS-B) is enabled.

7. **HOVER**: shows the Hover page. This option is only available in rotorcraft.

MFD ND Screen Format (FORMAT) Menu
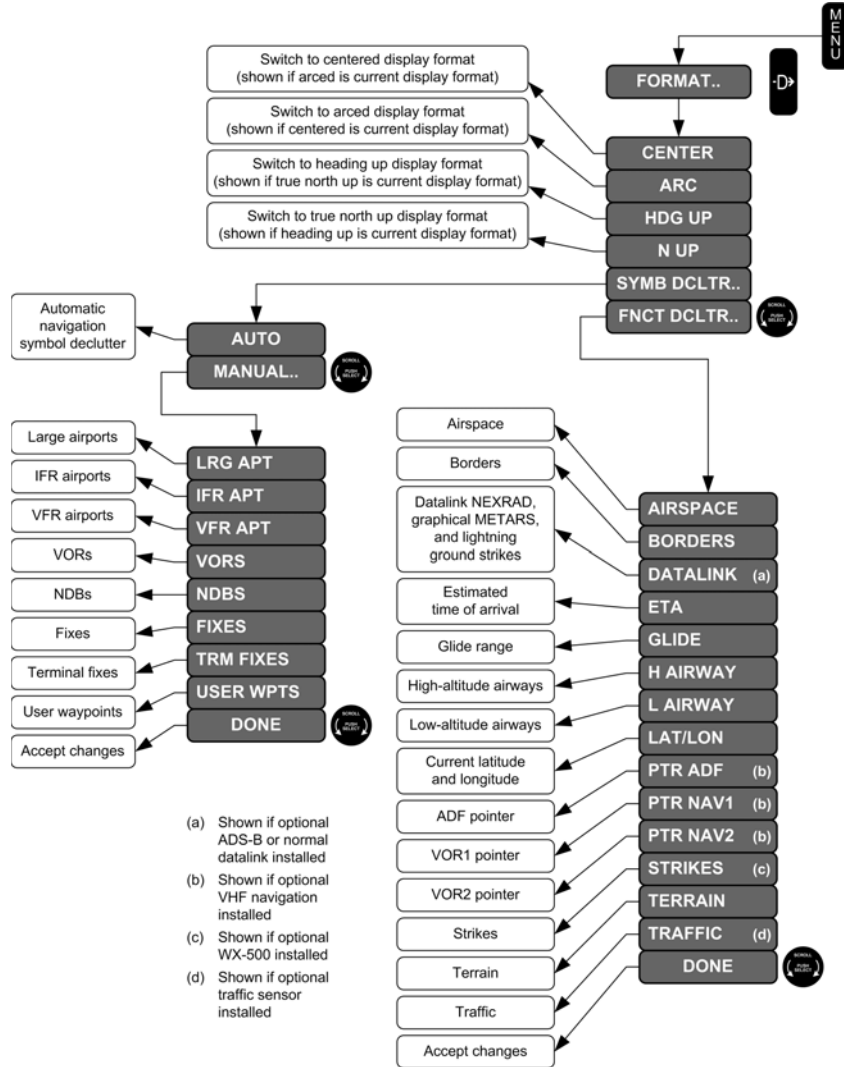
Upon selecting the MFD format menu when in the ND screen, an option appears with the following options:

1. **CENTER / ARC**: Selecting this option toggles between a centered and arced ND display format.

2. **HDG UP / N UP**: Selecting this option toggles between a heading up and a True North up ND display format.

3. **SYMB DCLTR**: Selecting this option activates an option list that allows the pilot to choose either automatic navigation symbol declutter or manual navigation symbol declutter. If the pilot chooses manual navigation symbol declutter, a further option list appears to allow the pilot to individually select:
   – large airports;
   – IFR airports;
   – VFR airports;
   – VORs;
   – NDBs;
   – fixes;
   – terminal fixes; and
   – user waypoints.

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

4. **FNCT DCLTR:** Selecting this option activates an option list that allows the pilot to individually toggle display of:
   – airspace;
   – borders;
   – datalinked NEXRAD, graphical METARs and lightning ground strikes (if datalink or ADS-B option is enabled);
   – estimated time of arrival ("ETA");
   – glide range;
   – high-altitude airways;
   – low-altitude airways;
   – current latitude and longitude
   – display of ADF pointer (if VHF navigation option is enabled);

– display of VOR1 pointer (if VHF navigation option is enabled);
– display of VOR2 pointer (if VHF navigation option is enabled);
– display of strikes (if WX-500 option is enabled);
– display of terrain; and
– display of traffic (if traffic option is enabled).

MFD HSI Pointer (POINTERS) Menu
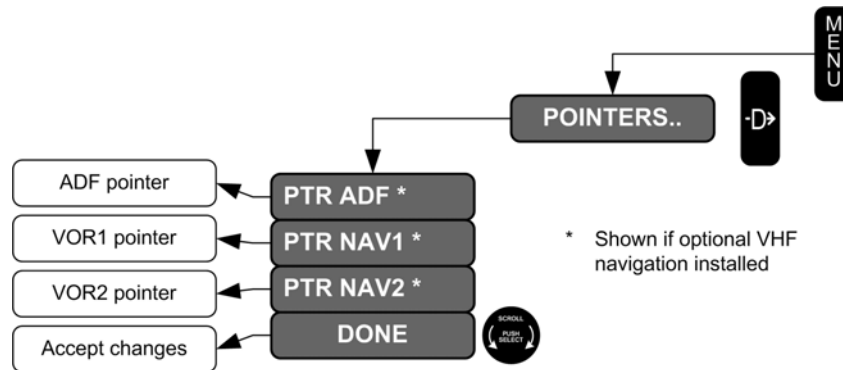
Upon selecting the HSI pointers menu when in the HSI screen, an option list appears to allow the pilot to individually select:

- display of ADF pointer (if VHF navigation option is enabled);

- display of VOR1 pointer (if VHF navigation option is enabled); and

- display of VOR2 pointer (if VHF navigation option is enabled).

MFD Strike Format (FORMAT) Menu
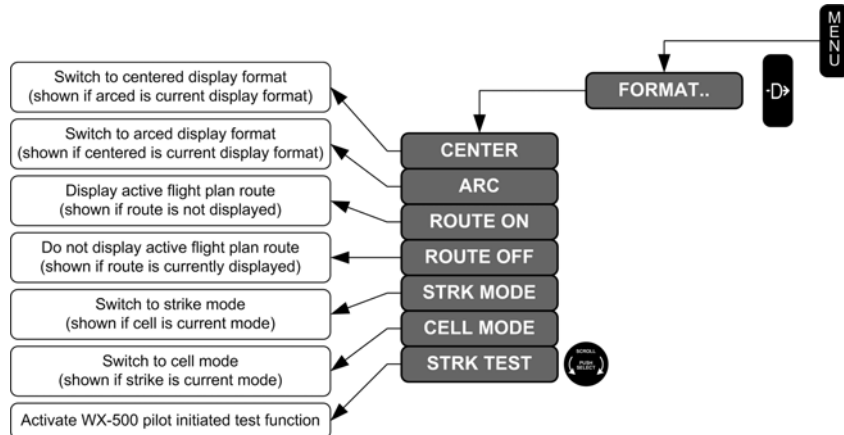
Upon selecting the MFD format menu when in the Strike screen, an option list appears with the following options:

1. **CENTER / ARC**: Selecting this option toggles between a centered and arced Strike screen display format.

2. **ROUTE ON / ROUTE OFF**: Selecting this option toggles showing the active flight plan route on the Strike screen.

3. **STRK MODE / CELL MODE**: Selecting this option toggles between strike mode strikes and cell mode strikes on the Strike screen.

4. **STRK TEST**: Selecting this option activates the WX-500 pilot initiated test function.

MFD Traffic Format (FORMAT) Menu
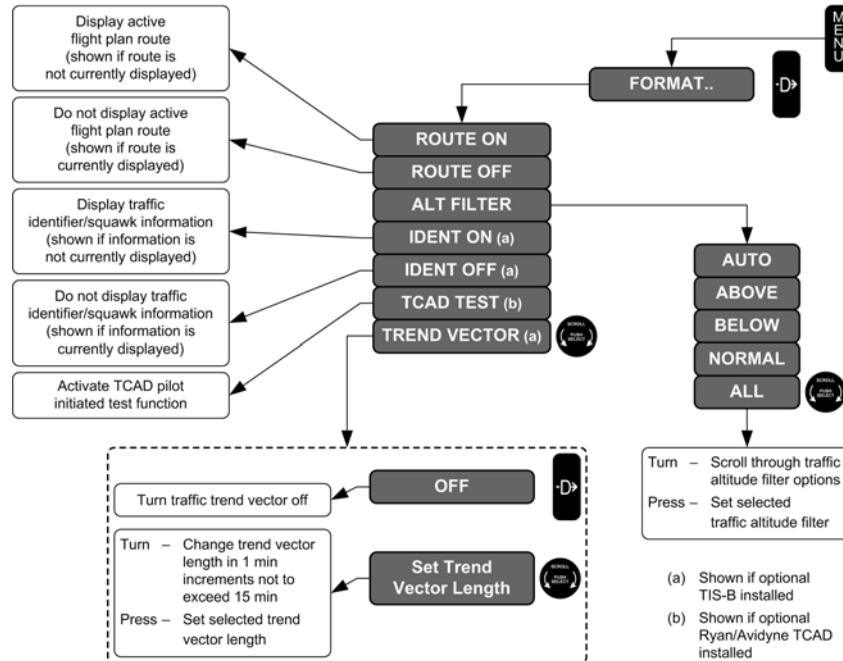
Upon selecting the MFD format menu when in the Traffic screen, an option list appears with the following options:

1. **ROUTE ON / ROUTE OFF**: Selecting this option toggles showing the active flight plan route on the Traffic screen.
2. **IDENT OFF / IDENT ON**: When the TCAS flag is TIS-B, selecting this option toggles showing traffic identifier/squawk information.
3. **ALT FILTER**: Selecting this option allows the pilot to set the traffic altitude filter to either AUTO, ABOVE, BELOW, NORMAL or ALL.
4. **TCAD TEST**: When the TCAS flag is Ryan/Avidyne TCAD, selecting this option activates the TCAD pilot initiated test function.

5. **TREND VECTOR**: When the TCAS flag is TIS-B, selecting this option allows the pilot to select the traffic trend vector length in minutes (the trend vector is a line extending from an ADS-B target indicating the predicted position of the target). An "OFF" pushbutton appears at this level to allow the pilot to quickly turn off the traffic trend vector.

MFD Datalink Format (FORMAT) Menu
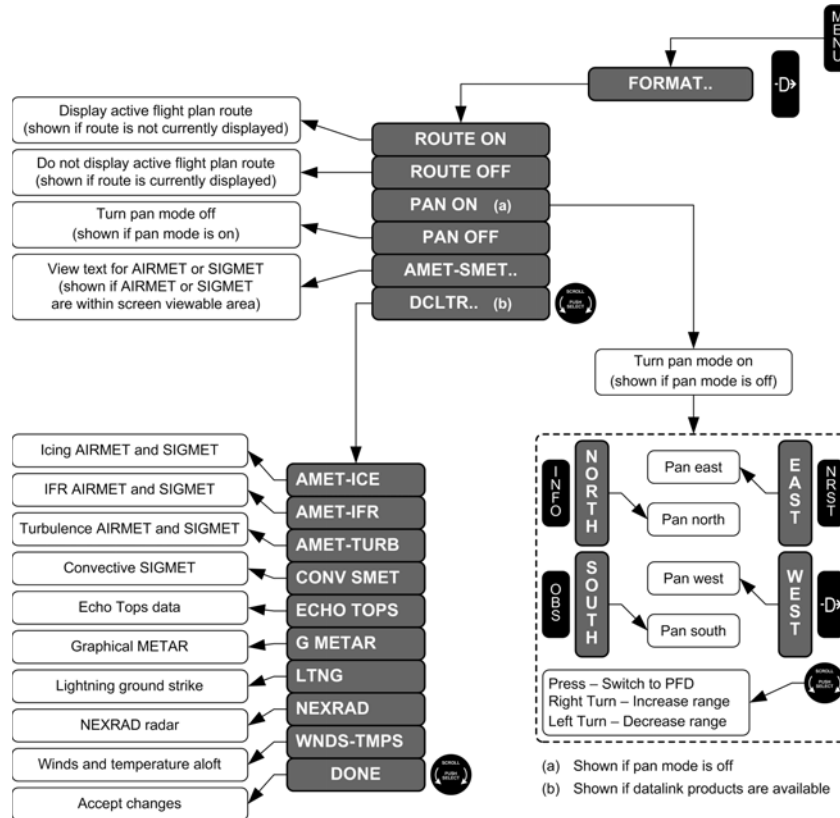
Upon selecting the MFD format menu when in the Datalink screen, an option list appears with the following options:

1. **ROUTE ON / ROUTE OFF**: Selecting this option toggles showing the active flight plan route on the Datalink screen.

2. **PAN ON / PAN OFF**: Selecting this option toggles Datalink screen Pan mode.

3. **AMET-SMET**: This option is only available when an AIRMET or SIGMET is within the Datalink screen viewable area. Selecting this option allows the pilot to view the text for the displayed AIRMETs and SIGMETs. While viewing the text for a particular AIRMET or SIGMENT, the border associated with the AIRMET or SIGMET flashes on the screen.

4. **DCLTR**: This option is only available when datalink weather products are available for display. Selecting this option allows the pilot select individual datalink weather products for display. Note that only those datalink weather products that are available for display appears in the selection box.

NOTE:
Manual declutter settings will be retained upon power down.

When dual Systems (Pilot and Co-pilot) are installed, a function called Crossfill permits inter-system communications and synchronization of data from one pilot side to the other. Normally crossfill is automatic. A discrete switch can inhibit crossfill in order to permit more operational flexibility.

When crossfill is inhibited by a discrete switch, a pilot may build a flight plan, routes, or waypoints without altering the navigation currently in use in-flight (a **CROSSFILL INHIBITED** advisory will be displayed). After confirming data such as range, distance, and ETE in a proposed flight plan, the pilot can then restore the external switch and crosslink the data to the second system. The new plan can then be activated and flown as desired. A **CROSSFILL ARMED** advisory indicates that the Crossfill synchronization function is available. To synchronize systems, push **MENU** on the PFD, then push **XFILL SYNC**.

If there is no intersystem communication, **XFILL FAIL** is annunciated, accompanied by a chime.

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Section 6

Step-by-Step Procedures

Setting Altimeter

PFD and Reversionary PFD Only

The altimeter is set automatically on startup based on the airport elevation.

To change the altimeter setting, turn the control knob to enter the desired barometric pressure and push to enter. See **PFD Altimeter Menu, page 5-33.**

Setting Fuel Quantity

MFD Only

1. Upon startup, the #1 MFD will prompt for adding fuel; otherwise, press the **MENU** button and select the **SET FUEL . .** menu, then push to enter. The amount displayed in the lower-right corner is the amount remaining.
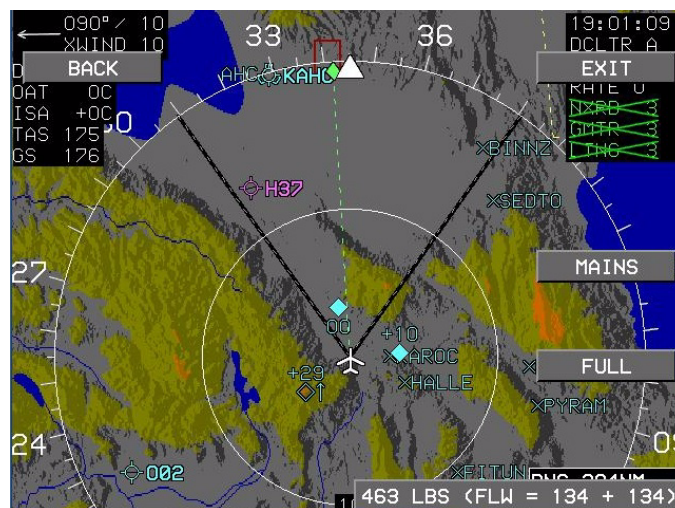
2. Turn control knob to set fuel quantity on board or press **FULL** menu button to set to total usable value or press **MAINS** to enter a preset partial amount (configured at installation). Current fuel flow for each engine is indicated in parenthesis if equipped with a fuel flow transducer.

3. Push control knob to enter.

Flight Plans

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

All flight planning is done using a built-in graphical interface. Flight plans can be created, edited, or reversed on the MFD only, and they are automatically cross filled to other displays. They can be activated from either the PFD or MFD. Once activated, a flight plan can be edited enroute without affecting the stored flight plan. A total of 100 flight plans can be stored in the system.

Create and Store a Flight Plan

MFD Only

1. Press the **FPL** button.

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

3. **CREATE FLIGHT PLAN** will be highlighted. Push to enter.

```
              CREATE FLIGHT PLAN
             ACTIVATE FLIGHT PLAN
               EDIT FLIGHT PLAN
              REVERSE FLIGHT PLAN
              DELETE FLIGHT PLAN
          CREATE USER WPT (LAT-LON)
          CREATE USER WPT (RAD-DST)
               EDIT USER WPT
              DELETE USER WPT
               EXIT TO EFIS
```

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 to enter and advance to the next character. Begin the waypoint entry with the ICAO identifier for airport region (K for continental U.S., PA for Alaska, etc.) if

entering an airport. This not necessary but may save time by shortening the list of possible matches.
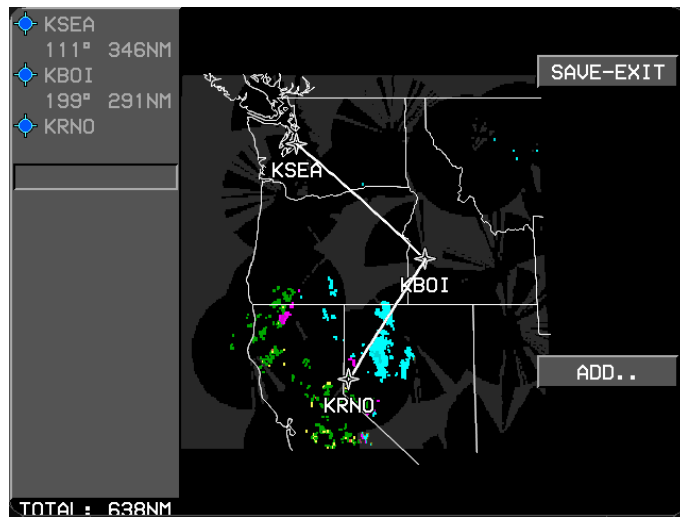
5. Enter at least one character. Advance through any remaining blank character spaces by repeatedly pushing the control knob. A list of matching waypoints will be displayed.
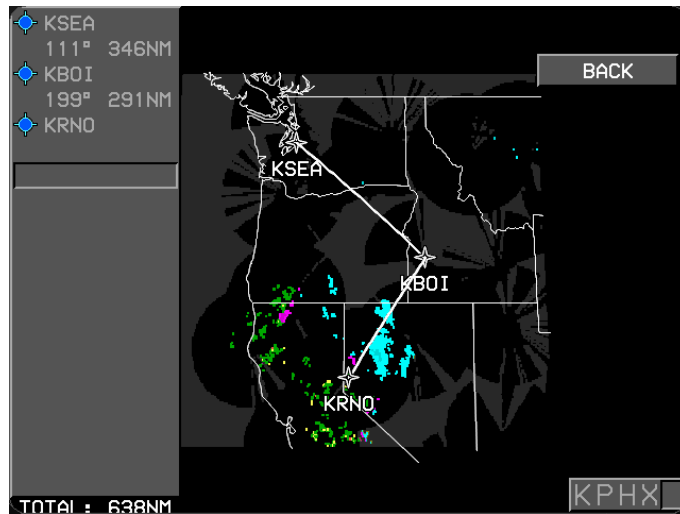
6.   Enter Victor Airways and Jet Routes by their identifier (J54, V254, etc.) or some portion thereof. When flight planning using airways or routes, you will be prompted for the fix from which you will be departing the airway. For more information, see **Using Airways, page 6-41.**

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

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

8. Repeat for all waypoints in route.

9. Press **BACK** at any point to back up during selection of alphanumeric characters.

10. Press **SAVE-EXIT** when finished to save and return to previous screen.

   The flight plan will be automatically named with the first and last waypoint and added to the flight plan list.

   Multiple flight plans between the same airport pairs are named sequentially by appending the name with a (1), (2), (3), etc. for each additional flight plan.

Activate a Stored Flight Plan

PFD and MFD

1. Press the **FPL** button.

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

2. Rotate the control knob through the flight plans. When the desired flight plan is highlighted, push the control knob to select it as the active flight plan.

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

Edit a Stored Flight Plan

MFD Only

1. Press the **FPL** button.

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.

```
            CREATE FLIGHT PLAN
           ACTIVATE FLIGHT PLAN
            EDIT FLIGHT PLAN
           REVERSE FLIGHT PLAN
           DELETE FLIGHT PLAN
       CREATE USER WPT (LAT-LON)
       CREATE USER WPT (RAD-DST)
             EDIT USER WPT
            DELETE USER WPT
             EXIT TO EFIS
```

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.

7. Select **INFO** to display additional information about the highlighted waypoint.
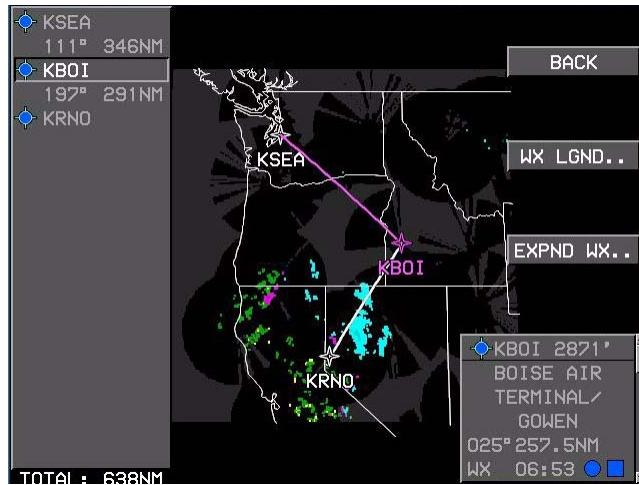
8. Scroll to the end and press **ADD . .** to add waypoints to the end of the route.

9. Press **BACK** to return to **EDIT** page.

10. Press **SAVE-EXIT** when finished to save and return to previous screen.

Reverse a Stored Flight Plan

MFD Only

1. Press the **FPL** button.

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.

```
            CREATE FLIGHT PLAN
            ACTIVATE FLIGHT PLAN
            EDIT FLIGHT PLAN
            REVERSE FLIGHT PLAN
            DELETE FLIGHT PLAN
        CREATE USER WPT (LAT-LON)
        CREATE USER WPT (RAD-DST)
            EDIT USER WPT
            DELETE USER WPT
            EXIT TO EFIS
```
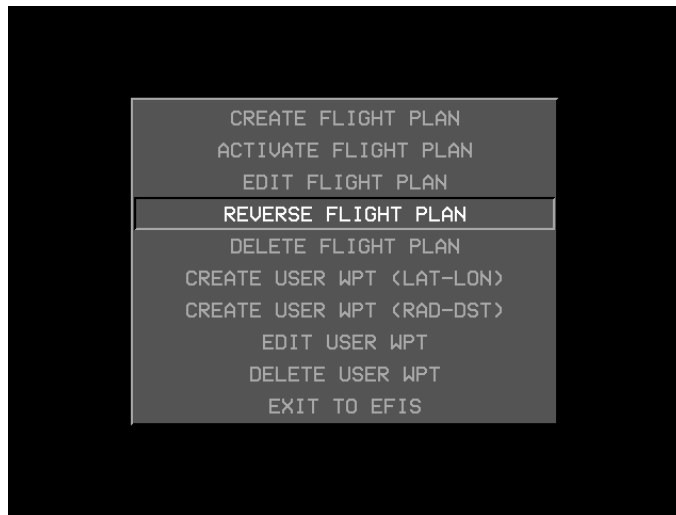
4. Turn control knob to highlight flight plan to be reversed, then push to enter.

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

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

Delete a Stored Flight Plan

MFD Only

1. Press the **FPL** button.

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

3. Turn control knob to highlight **DELETE FLIGHT PLAN**, then push to enter.

```
            CREATE FLIGHT PLAN
           ACTIVATE FLIGHT PLAN
             EDIT FLIGHT PLAN
            REVERSE FLIGHT PLAN
            DELETE FLIGHT PLAN
        CREATE USER WPT (LAT-LON)
        CREATE USER WPT (RAD-DST)
              EDIT USER WPT
             DELETE USER WPT
               EXIT TO EFIS
```
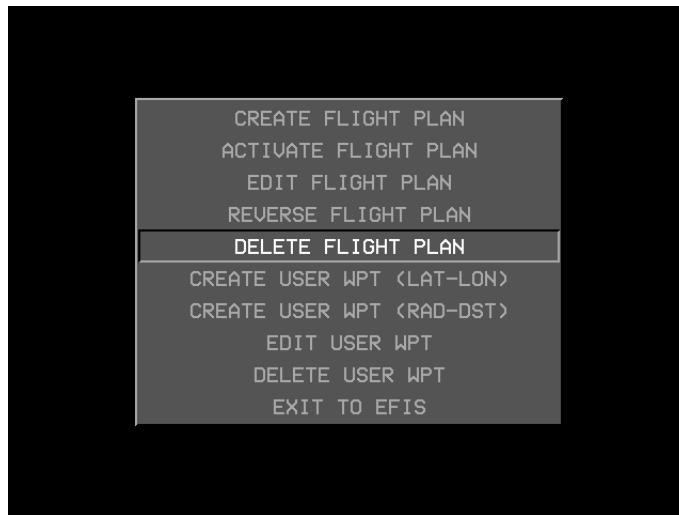
4. Turn control knob to highlight flight plan to be deleted, then push to enter. You will be asked for confirmation to delete the highlighted flight plan. Push enter to confirm or push **BACK** to return to the previous menu.

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

Transfer Flight Plans Between Aircraft

There may be times when it is necessary to transfer the flight plans stored on one system to a system in another aircraft. This is done using the Ground and Maintenance Utility.

1. With the power OFF, insert a data card into the primary flight display (gold side up).

2. Power the system ON and select the **DOWNLOAD ROUTES AND USER WAYPOINTS** option using the control knob (turn to scroll, push to enter).

```
Chelton Flight Systems Ground and Maintenance Functions:

   Run Demonstrator/Training Program
   Update Databases and Application
   Download LOG Files
   Fuel Tank Calibration (CPU#0 or CPU#1 Only)
   View bitlog.dat
   L-3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
   Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
   Terrain Data Verification
   Download Routes and User Waypoints
   Upload Routes and User Waypoints
   Edit System Limits (CPU#0 or CPU#1 Only)
   Remove LOG Files
   COM Port Inspector                                    _
```

3. When the red light goes out, power the system OFF and remove the data card.

4. With the power OFF, nsert a data card into the primary flight display *in the other aircraft* (gold side up).

5. Power the system ON and select the
    UPLOAD ROUTES AND USER WAYPOINTS option
    using the control knob (turn to scroll, push to enter).


```
Chelton Flight Systems Ground and Maintenance Functions:

    Run Demonstrator/Training Program
    Update Databases and Application
    Download LOG Files
    Fuel Tank Calibration (CPU#0 or CPU#1 Only)
    View bitlog.dat
    L-3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
    Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
    Terrain Data Verification
    Download Routes and User Waypoints
    Upload Routes and User Waypoints
    Edit System Limits (CPU#0 or CPU#1 Only)
    Remove LOG Files
    COM Port Inspector                                  _
```
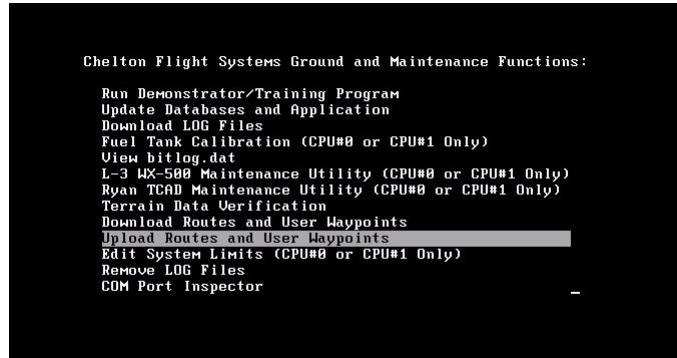
6. Power the system OFF and remove the data card.

NOTE:
*The system cannot enter flight mode while the data card is in
the slot. Saved route packs exported from JEPPESEN FliteStar
IFR may be uploaded as flight plans.*

Waypoints

Nearest Waypoint

1. Press the **NRST** button.

2. Turn control knob to highlight nearest airport, VOR, ILS, NDB, fix, user waypoint, then push to enter. Nearest ARTCC, and FSS are shown as well but may not be selected for navigation.

3. A list of waypoints will be displayed, each with bearing, distance, longest runway, and frequency as applicable. Turn control knob to highlight desired choice, then push to enter.
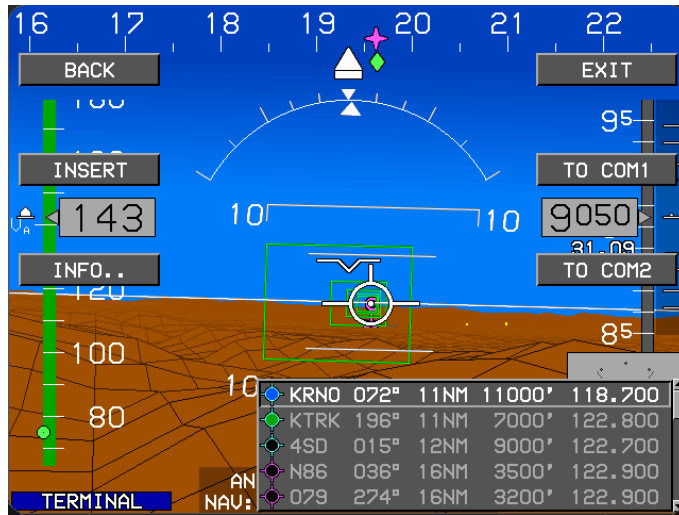
If a frequency is displayed in this step, it may be high-lighted and sent to a radio. See **Tuning Radios using the EFIS, page 6-105** for more information.

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

Direct to Any Waypoint

1. Press the Ð⮕ dedicated button.

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

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

3. If desired, enter the identifier of another waypoint – turn the control knob to select an alphanumeric character and push to enter and advance to the next character. Press **BACK** if you need to back up. Entering at least one character and advancing through the remaining blank character spaces will display a list of potential waypoints if there is no exact match.
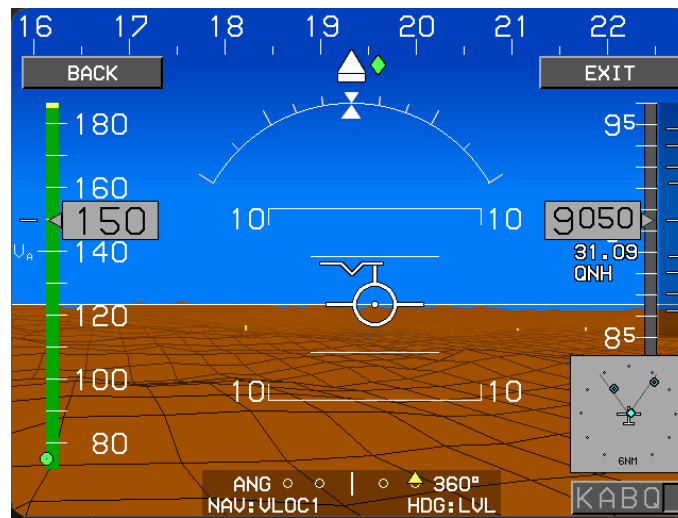
4. The **INFO** button may be used to get \ NavData information about a waypoint before it is activated.

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

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

Recenter on Route

1. Press the **Đ** dedicated button.

2. The active waypoint identifier will be displayed in the character spaces (do not change it).
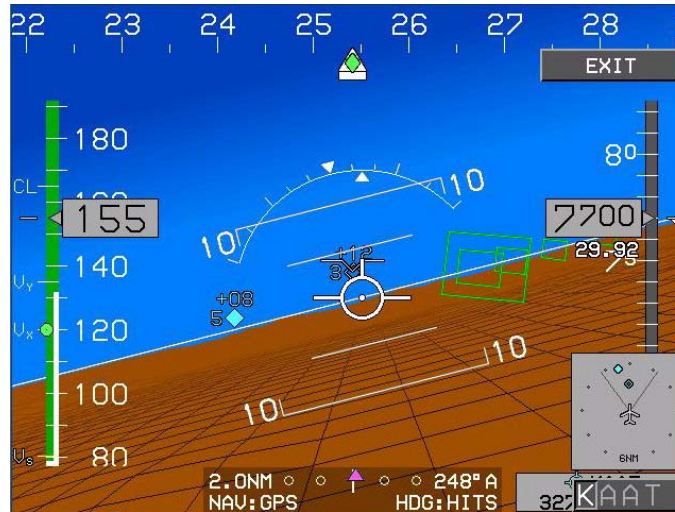
3. To fly direct from present position (re-center the skyway/courseline), push control knob to enter.

   Direct course to selected waypoint will be displayed from aircraft's current position.

NOTE:
*Using **Direct-to** and entering another waypoint identifier (other than the default) will override an existing flight plan or waypoint.*

Activate a Waypoint within an Active 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.
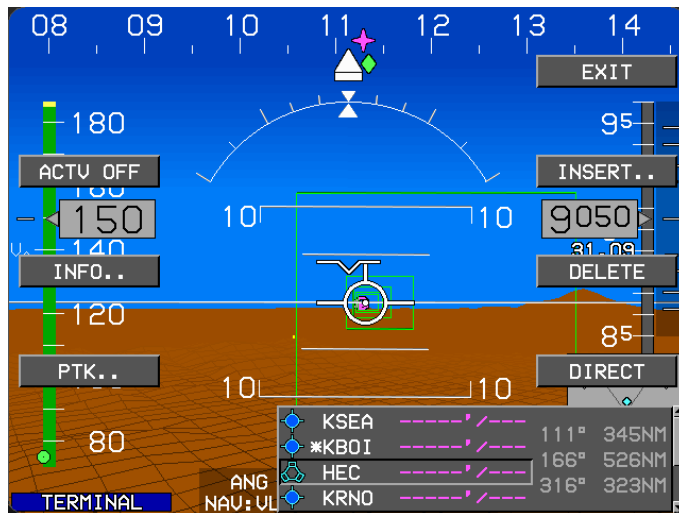
3. Turn the control knob to highlight **WAYPOINT**, and push to enter. The selected waypoint will become the active waypoint and the courseline to the waypoint will be displayed in magenta. See **Active Flight Plan (ACTV) Menu, page 5-10.**
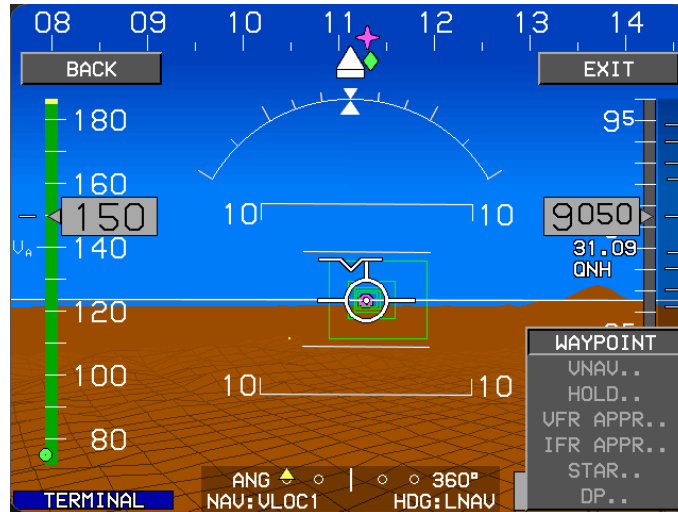
> *"This will not redraw the route on the map from the present position to the active waypoint:*
>
> **...**It just specifies a new active waypoint without altering the route. To go directly from the present position to a different waypoint within an active flight plan, press the ACTV button, select the desired waypoint, then press the Đ button. Choosing a new active waypoint will, however, command the autopilot to intercept the courseline to the new active waypoint."

Add a Waypoint or Airway 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 insert a new waypoint or airway (an airway can only be added after a waypoint that is part of that airway).
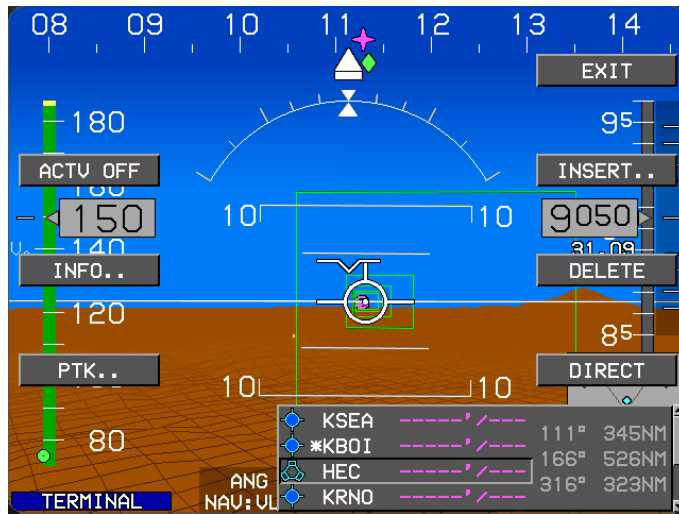
3.   Select the **INSERT . .** menu.
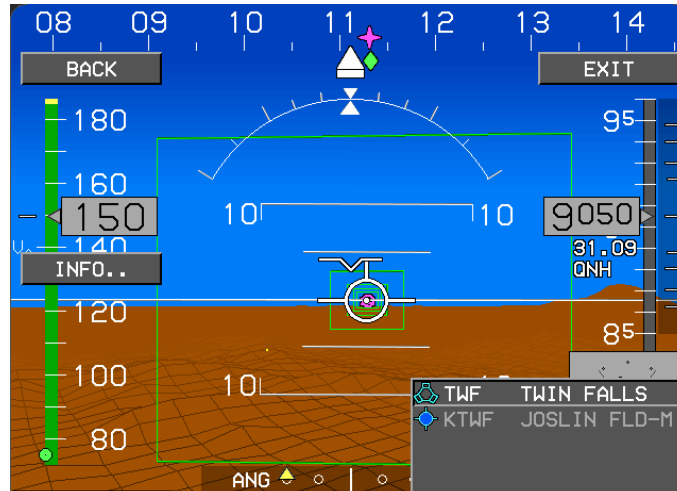
4.   Enter the identifier of the desired waypoint – turn the control knob to select an alphanumeric character and push to enter and advance to the next character. Press **BACK** at any point to back up. Enter Victor Airways and Jet Routes using their identifier (V254, J54), or portion thereof, and then selecting the transition fix when prompted (see **Using Airways, page 6-41**).

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

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

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

Add as many waypoints as necessary, then scroll to the desired active waypoint and push to enter.

See **Options, page 5-14** for more information.

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.
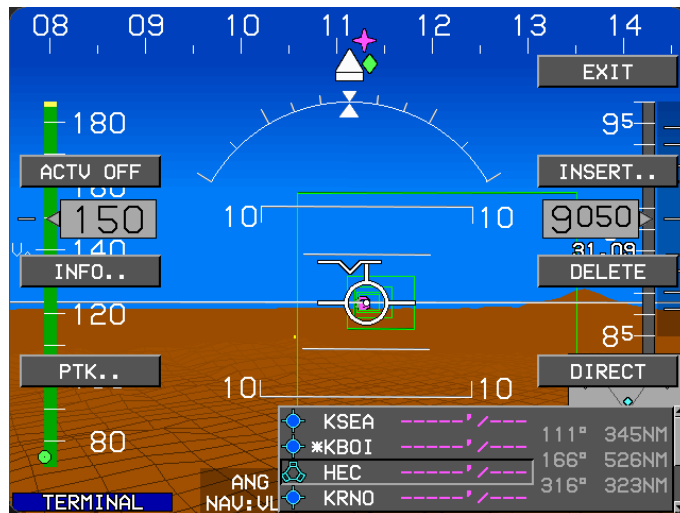
3. Select the **DELETE . .** menu.
    Confirmation for delete will be requested. Push control knob to confirm. Waypoint will be deleted from current flight plan.

See **Options, page 5-14** for more information.

Creating a Non-Published Holding Pattern

If ATC assigns a holding pattern at a fix or waypoint that is not published in the Jeppesen data, simply highlight the fix or waypoint in the active waypoint list.

Push to enter and then scroll down to HOLD in the list presented. Push to enter. Course, turn direction, leg length or leg timing are presented. After creating the holding pattern, it will be displayed on the MFD. Skyway boxes will also be created on the PFD to guide the pilot. Hold entries will be computed automatically just as they are for published holding patterns. Waypoint sequencing will be suspended after entering the hold. (A SUSPEND flag will be displayed) Pushing the CONT (Continue) menu tile will remove the suspend flag and normal sequencing of the flight plan waypoints will occur. Steps required to create a hold with right turns at PXR Vortac are shown. 4 mile leg lengths have been assigned by ATC.
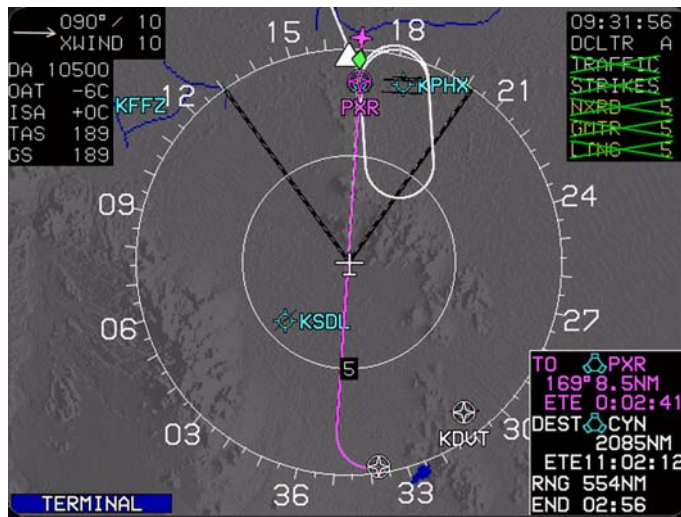
Create a User Waypoint

User waypoints may be created in three ways:

A.   Latitude & Longitude

B.   Radial & Distance

C.   Overfly (Designate)

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

MFD Only

1.   Press the **FPL** button.

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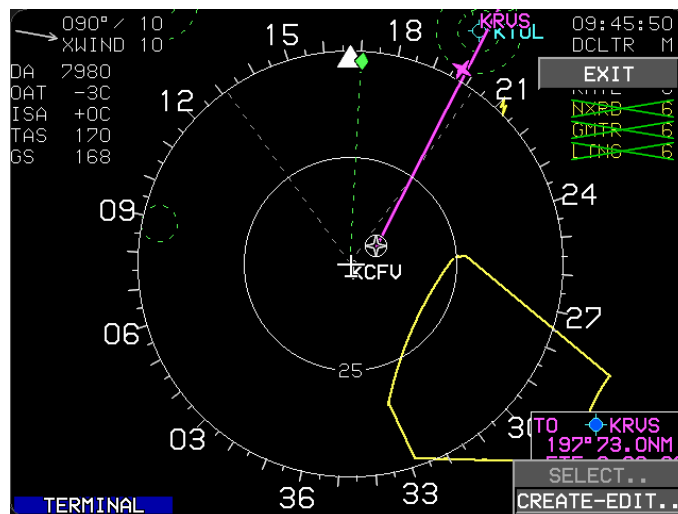
3. Turn control knob to highlight **CREATE USER WPT (LAT-LON)**, in the Function Select screen, then push to enter.

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

a) Identifier: The top line allows the user to specify a five character identifier for the waypoint

b) Latitude: The second line allows the user to specify latitude for the waypoint in increments of hundredths of minutes.

c) Longitude: The third line allows the user to specify a longitude for the waypoint in increments of hundredths of minutes.

d) Elevation: The fourth line allows the user to specify an elevation for the waypoint in feet. (This value may be used for VFR approaches.)

e) Approach Bearing: The fifth line allows the user to specify an approach bearing to the user waypoint in degrees. Valid values are 1°-360° and "OFF." A value of "OFF" will disable VFR approaches to the user waypoint. (This value may be used for defining user waypoint VFR approaches.)

f) Magnetic Variation: The sixth line allows the user to specify a magnetic variation at the waypoint in tenths of a degree.

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

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

MFD Only

1. Press the **FPL** button.

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.

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

The radial-distance user waypoint creation screen allows the user to create a waypoint by reference to radial and distance from another waypoint.

The screen has various data entry boxes as follows:

a) Identifier: The first line will annunciate the automatic name applied to the new user waypoint. New user waypoint will automatically be named "RD###," where ### is the next available radial-distance waypoint number.

b) Reference Waypoint: The second line will be prompted to enter an identifier for the reference waypoint. The reference waypoint will be entered in the same manner as a waypoint is entered for a flight plan using the control knob. If there is a single result from the search, the user will be advanced to the radial entry box. If there is no result from the search, the user will be re-prompted to enter an identifier. If there are multiple results from the search, a selection list with matching identifiers will be displayed and, upon selection, the user will be advanced to the radial entry box. An **INFO** menu giving access to information for the highlighted result will appear at this level to aid in selection.

c) Radial Entry: The third line will allow the user to specify a radial from the reference waypoint in increments of degrees.

d) Distance Entry: The forth line will allow the user to specify a distance from the reference in increments of tenths of nautical miles.

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

C. To create an Overfly user waypoint:

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

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

The waypoint name may be changed using the **EDIT USER WPT** function, see **Edit a User Waypoint, page 6-34**.

NOTE:
A maximum of 500 user waypoints may be created and stored.

Edit a User Waypoint

MFD Only

1. Press the **FPL** button.

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.
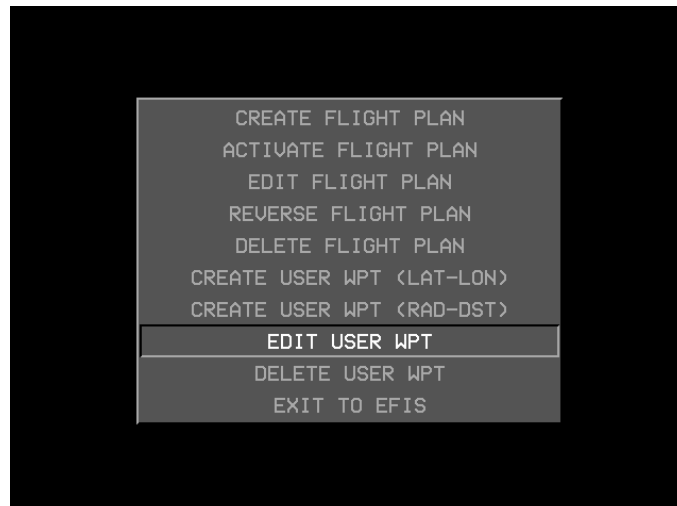
```
          CREATE FLIGHT PLAN
          ACTIVATE FLIGHT PLAN
           EDIT FLIGHT PLAN
          REVERSE FLIGHT PLAN
          DELETE FLIGHT PLAN
       CREATE USER WPT (LAT-LON)
       CREATE USER WPT (RAD-DST)
           EDIT USER WPT
           DELETE USER WPT
            EXIT TO EFIS
```

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

VNAV

For ATC assigned crossing altitudes, the VNAV functions are available. To select a VNAV assignment, push the ACTV button. Scroll to the desired waypoint and push enter. Select VNAV. The crossing altitude and an offset in nautical miles may be assigned. Negative numbers indicate an offset prior to the waypoint.

Delete a User Waypoint

MFD Only

1. Press the **FPL** button.

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.

```
            CREATE FLIGHT PLAN
           ACTIVATE FLIGHT PLAN
             EDIT FLIGHT PLAN
            REVERSE FLIGHT PLAN
            DELETE FLIGHT PLAN
        CREATE USER WPT (LAT-LON)
        CREATE USER WPT (RAD-DST)
             EDIT USER WPT
             DELETE USER WPT
              EXIT TO EFIS
```

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.

NOTE:

Pilot alterations of user waypoint parameters while inflight will not automatically be updated to an active flight plan.

When changes are made to a user waypoint and those changes are desired in existing flight plans that use the waypoint, it must be deleted and replaced in the flight plans following these steps:

1. **EDIT** the user waypoint as described above

2. **Open** a flight plan that uses the user waypoint

3. **Delete** the existing user waypoint from the flight plan

4. **Add** the edited user waypoint to the flight plan

5. **Save** and Exit

6. **Reload** the flight plan if it was in use.

Waypoint Information (NavData and DataLink Weather)

A large amount of information regarding each waypoint can be retrieved such as lat/lon bearing/distance, elevation or altitude, nav and com frequencies, runway lengths, METARs and TAFs.

This information can be accessed in a variety of ways: From the active route using **ACTV**, or for nearby waypoints using **NRST** and then pressing the **INFO** button, or by pressing **INFO** after startup for departure airport information.

Nearby Waypoints

1. Press the **NRST** button.
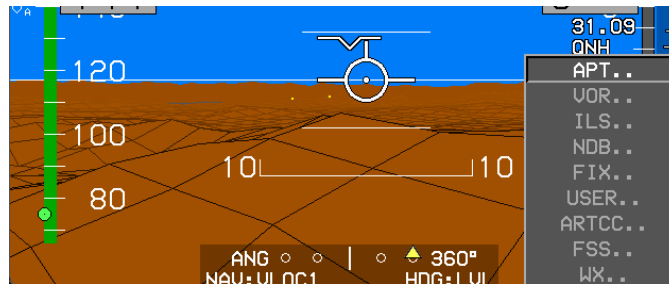
2. Turn control knob to highlight Airport, VOR, ILS, NDB, fix, user waypoint, air traffic control center, or Flight Service Station as desired, then push to enter.

3. Turn control knob to highlight desired waypoint or facility and press the **INFO** button.

4. Turn the control knob to scroll through the information.

5. Push the control knob or press **BACK** to return to the **ACTV** menu or press **EXIT** to clear the screen.

Distant Waypoints not in Active Route

1. Press the **ACTV** button, then choose **INSERT**.

2. Use the control knob to enter the alphanumeric identifier and press enter.

3. Scroll to the waypoint of interest and press the **INFO** button.

4. Turn the control knob to scroll through the information.

5. Push the control knob or press **BACK** to return to the **ACTV** menu or press **EXIT** to clear the screen.

Waypoints within Active Route

1. Press the **ACTV** button.
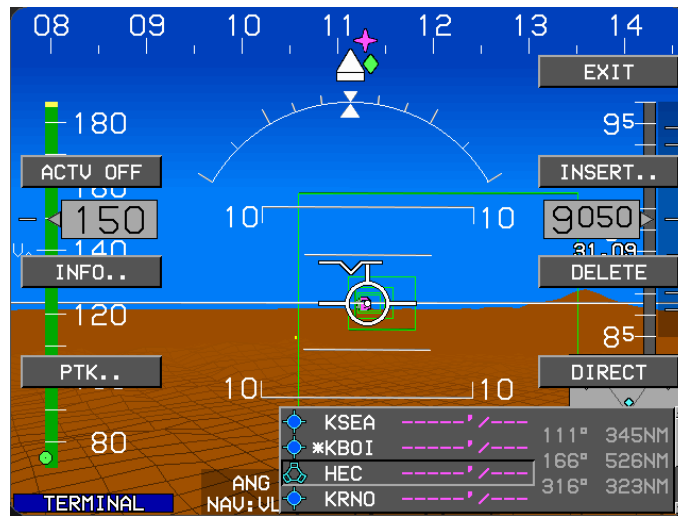
2. Turn control knob to highlight the desired waypoint, then press the **INFO** button.

3. Turn the control knob to scroll through the information. If a frequency is displayed in this step, it may be highlighted and sent to a radio. See **Tuning Radios using the EFIS, page 6-105** for more information.

4. Push the control knob or press **BACK** to return to the **ACTV** menu or press **EXIT** to clear the screen.

Transfer User Waypoints Between Aircraft

There may be times when it is necessary to transfer user waypoints created on one system to a system in another aircraft. This is done using the Ground and Maintenance Utility.

1. With the power **OFF**, insert a data card into the primary flight display (gold side up).

2. Power the system ON and select the
   DOWNLOAD ROUTES AND USER WAYPOINTS
   option using the control knob (turn to scroll, push to enter).

```
Chelton Flight Systems Ground and Maintenance Functions:

   Run Demonstrator/Training Program
   Update Databases and Application
   Download LOG Files
   Fuel Tank Calibration (CPU#0 or CPU#1 Only)
   View bitlog.dat
   L-3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
   Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
   Terrain Data Verification
   Download Routes and User Waypoints
   Upload Routes and User Waypoints
   Edit System Limits (CPU#0 or CPU#1 Only)
   Remove LOG Files
   COM Port Inspector                            _
```

3. Power the system **OFF** and remove the data card.

4. With the power **OFF**, insert the data card into the primary
   flight display in the other aircraft (gold side up).

5. Power the system **ON** and select the
   UPLOAD ROUTES AND USER WAYPOINTS option
   using the control knob (turn to scroll, push to enter).

```
Chelton Flight Systems Ground and Maintenance Functions:

   Run Demonstrator/Training Program
   Update Databases and Application
   Download LOG Files
   Fuel Tank Calibration (CPU#0 or CPU#1 Only)
   View bitlog.dat
   L-3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
   Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
   Terrain Data Verification
   Download Routes and User Waypoints
   Upload Routes and User Waypoints
   Edit System Limits (CPU#0 or CPU#1 Only)
   Remove LOG Files
   COM Port Inspector                            _
```

6. Power the system **OFF** and remove the data card.

NOTE:
*The system cannot enter flight mode while the data card is in
the slot.*

Using Airways

Airways, including low-altitude Victor Airways and high-altitude Jet Routes, are extremely easy to enter into the EFIS and can be included in a stored flight plan or added to an active flight plan or route "on the fly."

To enter an airway into a route, it must be preceded with a fix (VOR, intersection) that is located on the airway (an airway cannot be added between the START waypoint and the next waypoint, for example).

Airways are identified using their name (**V113**, **J254**) and are entered into the system in the same format in which they are received from controllers or in a clearance. They may be entered using their full name but only the first letter must be entered (in which case a list will be presented).

For example, on a flight from Boise, where there is a VOR on the field, to Salt Lake City, the following clearance is received:

"ATC clears N1234 to Salt Lake City via radar vectors to join V253 to Twin Falls, V142 to SHEAR, V101 to Ogden, direct."

1. Using the **NRST** button, choose **BOI** (the Boise VOR — the nearest fix on V253. Remember, airways must be preceded by an airway fix).

2. Press **ACTV**, scroll to the blank space after **BOI**, press **ADD . .** or **INSERT . .** and enter **V253**. You may also just enter a **V** in the first box and advance through the remaining boxes, leaving them empty; a list of all Victor Airways passing through BOI will be shown.

3. Scroll to select the desired airway, **V253** in this case, and push to enter.
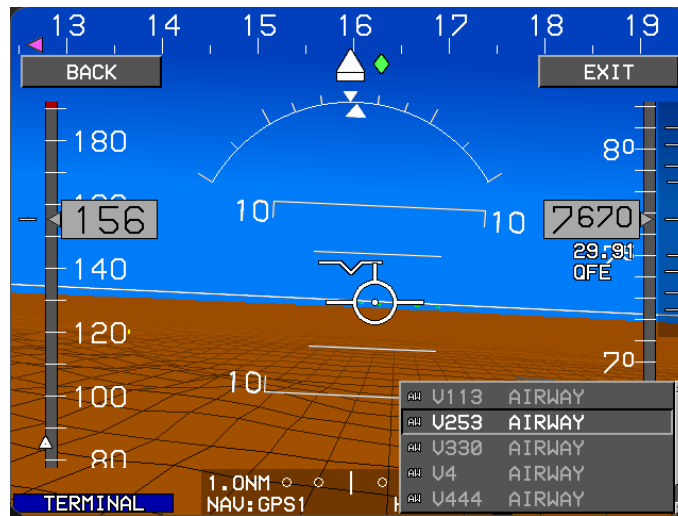
A list of fixes along the airway will be shown.

4. Scroll up or down (Jeppesen determines the order) to the desired end point on that airway (Twin Falls — **TWF**) and push to enter.

5. Repeat steps 3 and 4 for each leg until you reach Ogden VOR as an end point for V101.

6. Repeat the procedure again and enter **KSLC** for Salt Lake City instead of an airway.

   All of the appropriate fixes along the airway will be added to the route. Review the entire route by pressing the **ACTV** button.
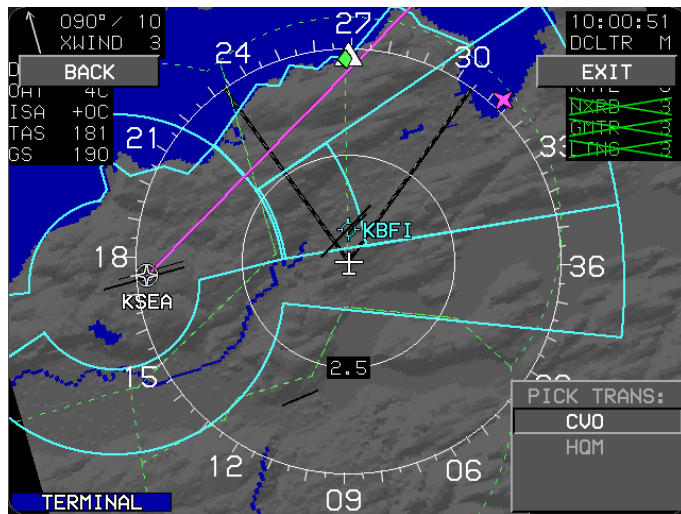
Approaches, DPs, and STARs

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 way-point, then push to enter.

3. Turn control knob to highlight **VFR APPR . .** and push to enter.
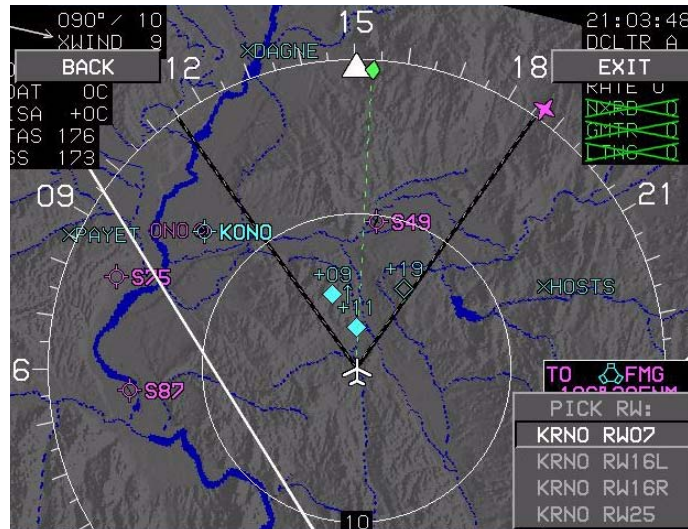
A list of runways at the destination airport will be displayed (no runways are displayed for user waypoints).

4. Turn control knob to highlight desired runway and push to enter. The VFR approach will be entered and displayed as a courseline on the moving map.
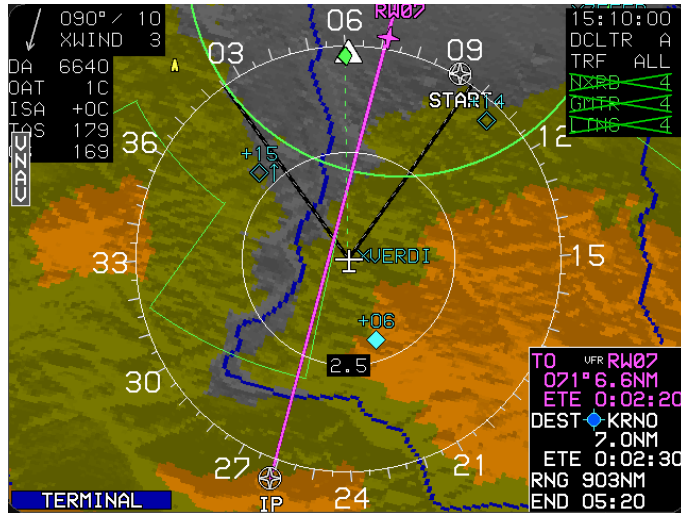
The VFR Skyway approach symbology will be displayed on the PFD. The skyway boxes will guide the pilot to an extended centerline for the chosen runway.

An initial point will be automatically created. It will be placed 15NM from the runway and it will be preceded by a discontinuity.
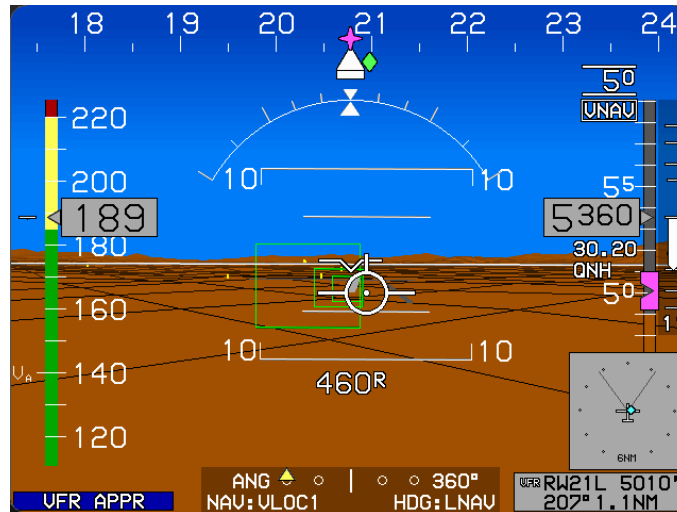
This screen shows a VFR approach to runway 21L at KPRC. The elevation at the end of the runway is 5010 ft. Add 50 feet to the altitude indicated in the waypoint box at the lower right corner of the PFD. In this example, the skyway will guide you through a stabilized approach to 5060 feet. The angle of the approach is determined by the VNAV CDA (climb and descent angles) as described in section five.

WARNING!
THE VFR APPROACH FUNCTION DOES NOT PROVIDE TERRAIN OR OBSTRUCTION CLEARANCE. EXTREME CARE SHOULD BE TAKEN WHEN USING THE VFR APPROACH FUNCTION AT NIGHT OR IN MARGINAL VFR CONDITIONS.

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

TERMINAL

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

VFR APPR

Select an IFR Approach

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

2. Turn control knob to highlight landing airport, then push to enter.

3. Turn control knob to highlight **IFR APPR . .** and push to enter. A list of the published instrument approaches will be displayed.
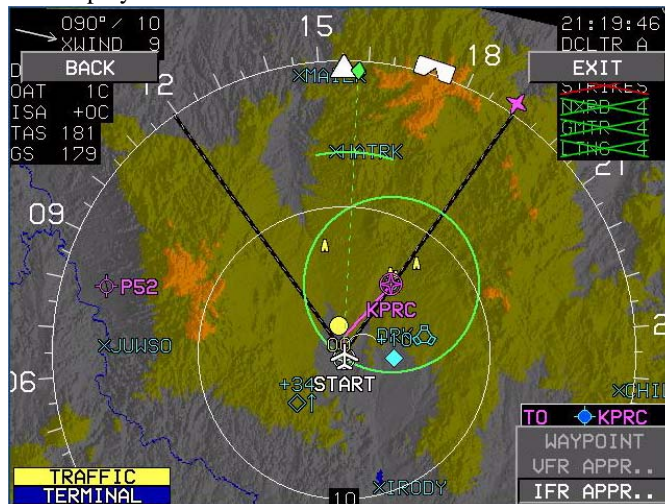
4. Turn control knob to highlight desired approach and push to enter. A list of available transitions will be displayed if applicable.
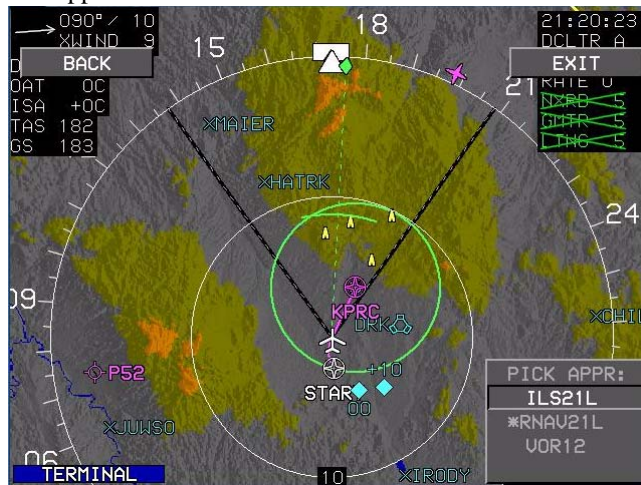
5. Turn control knob to highlight desired transition and push to enter. A list of runways will be displayed.

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

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

The approach waypoints will be displayed on the PFD and automatically sequenced so that only the active waypoint is shown (magenta).
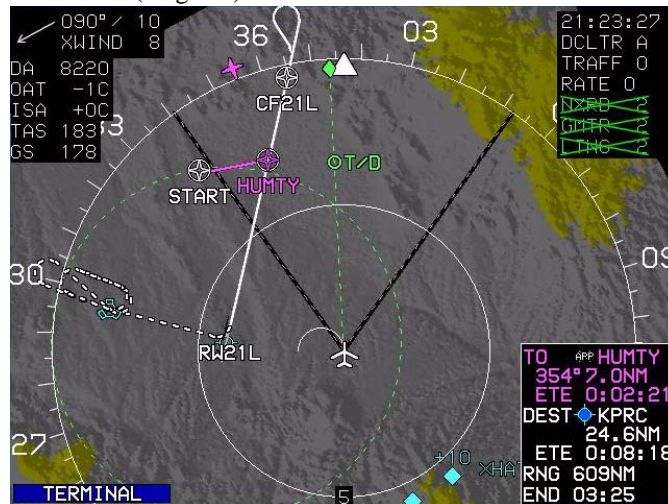
A crossing altitude for each waypoint will be displayed in the waypoint information box (lower right corner of PFD).

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

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

TERMINAL

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

IFR APPR

Select a DP or STAR

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

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

2. Turn control knob to highlight appropriate airport, then push to enter.

3. Turn control knob to highlight **DP . .** and push to enter.
   A list of published procedures will be displayed.
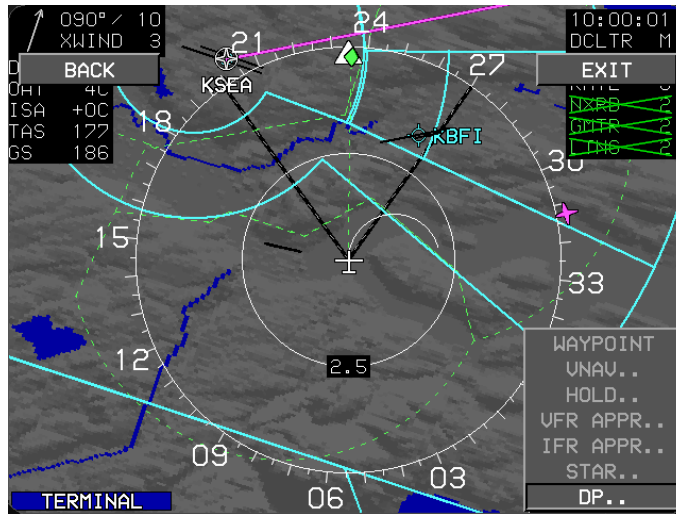
4. Turn control knob to highlight desired procedure and push to enter. A list of available transitions will be displayed if applicable.
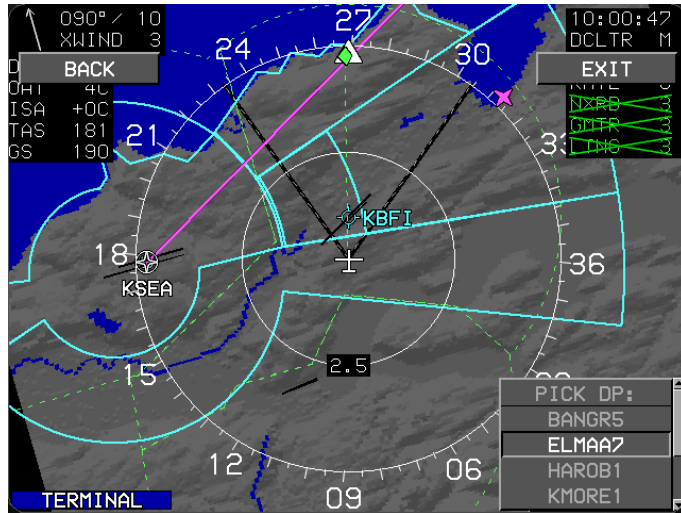
5. Turn control knob to highlight desired transition and push to enter. A list of runways will be displayed.

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

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

Missed Approach Arming Procedure

1. The **MISS** and **ARM** menu tiles will be displayed automatically upon passing the final approach fix (FAF) of a published instrument approach.

2. To arm the missed approach procedure, press the **ARM** menu any time. The missed approach procedure will then be automatically activated upon passing the missed approach point. Press **MISS** at any time to immediately activate missed approach. (MAP).

The appropriate missed approach procedure is always displayed as a dashed courseline on the moving map.

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 **MISS** or **ARM** menu is *not* pressed after FAF passage, navigation guidance will continue along the extended centerline of the runway and automatic waypoint sequencing will be suspended (indicated by a SUSPEND

flag). The missed approach procedure can be activated at any time.

The missed approach procedure can be activated prior to the final approach fix by selecting the first waypoint of the missed procedure from the **ACTV** menu, see **Activate a Waypoint within an Active Route, page 6-21.**

Parallel Track Function

Set a Parallel Track

1. Push the **ACTV** button.

2. Choose the **PTK . .** button.

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

Waypoints will automatically be sequenced as the flight progresses.

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

PTK = (L)RXXNM

Turn Parallel Track Off

1. Push the **ACTV** button.

2. Choose the **PTK . .** button

3. Choose the **OFF** button.

Omnibearing Selector Function

HSI and CDI/ANNUNCIATOR Source Selection

The source of the navigation information that is indicated on the ANNUNCIATOR at the bottom of the PFD and also displayed on the HSI needle can be set to GPS, VLOC1, or VLOC2. This is done by pressing the OBS button on the PFD and then selecting the source next to one of the HSI menu tiles. CDI deviations will always reflect the selected source of navigation information. Display of the overlay **HSI needle** on the PFD may be turned on and off using the **Declutter** function and will only display a needle when the navigation radio delivers a valid signal to the EFIS. If the valid signal is from a localizer glideslope combination, the ILS needle and a vertical deviation indicator will be displayed and no to/from dot will appear at the end of the needle.
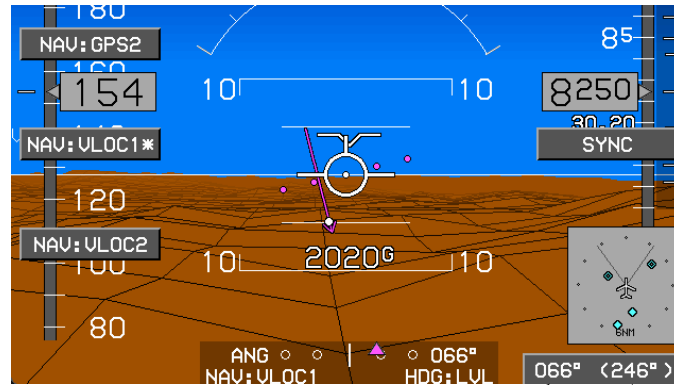
OBS COURSE   OBS RECIPROCAL

NOTE:
*The skyway boxes on the PFD and the magenta courseline on the MFD are **always** GPS based. The CDI/Annunciator at the bottom of the PFD can reflect a source of GPS or VLOC1 or VLOC2. The selected source also determines the analog course and deviation signals sent from the EFIS to the autopilot. The HSI needle, when selected can also reflect a source of GPS or VLOC1 or VLOC2. The annunciator will indicate what source of navigation information is being delivered to the autopilot. The aircraft will track either signal, depending on whether HEADING mode is selected or NAV/APPROACH mode is selected on the autopilot mode selector. The vertical deviation indicator will indicate either VNAV or GS1 or GS2 (glideslope 1 or 2) respectively as the pilot chooses either GPS as a source or VLOC1 or VLOC2.*

Automatic OBS – GPS

1. Push the **OBS** button.

2. Choose a HSI/CDI source of GPS1 or GPS2 (in a dual GPS installation) by pressing the soft key next to the desired choice. An asterisk will appear by the currently selected source.

3. Push to enter.

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

NOTE:
Automatic OBS is the system default.

Manual OBS – GPS

1. Push the **OBS** button.

2. If it is not already selected, push **NAV: GPS**, then turn the control knob to set desired OBS course, then push to enter.

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

VOR OBS – HSI

When interfaced with a VHF nav radio, this will set the OBS course of the selected VOR (VLOC1 or VLOC2). VOR course information is displayed on either the PFD or on the ND as a conventional HSI. To display HSI on PFD, use the **DCLTR . .** function.

1.   Push the **OBS** button.

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

Selected course is shown in the **CDI/ANNUNCIATOR** at the bottom of the PFD. A white dot on the HSI needle provides TO/FROM indication. At full-scale deflection, the courseline arrow will be yellow. The deviation dots are automatically decluttered when needle deflection is less than one dot.

The selected HSI source (VLOC1 or VLOC2) will drive the autopilot when it is placed in NAV or APPROACH mode.

Timer Functions

Count Up

1. Push 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. Push the **MENU** button.

2. Choose the **TIMER . .** menu

3. Turn control knob to highlight **COUNT DN . .** , then push to enter.
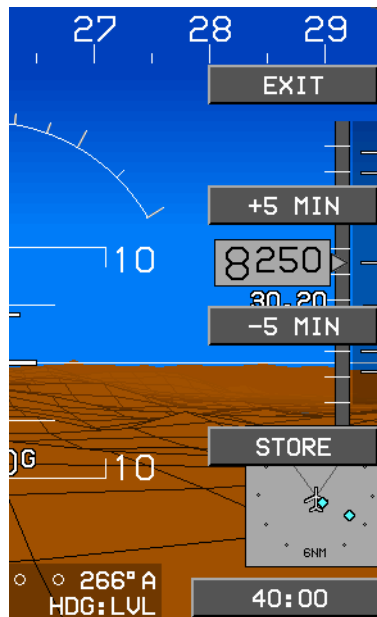
4. Enter the desired time period by turning the control knob to increment or decrement seconds (press **BACK** at any point to back up). Push **+5 MIN** or **-5 MIN** to quickly add or subtract time in five-minute increments.

   The count-down time can be stored for later use by pushing **STORE**. Once stored, this value will be the default for the count down timer.

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

Flight Timer

1. Push the **MENU** button.

2. Choose the **TIMER . .** menu.

3. Turn the control knob to highlight **FLT TIME**, then push to enter.

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

Turn the Timer Off

(Count up and count down timers only)

1. Push the **MENU** button.

2. Choose the **TIMER . .** menu.

3. Push the **OFF** menu button.

BUG Functions (Heading, Altitudes, Airspeed, V-Speeds)

Set the Heading Bug

1. Push the **HDG** button.

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

   Push **SYNC** to instantly set the heading bug on the current heading.

   If coupled with an autopilot using **HEADING** mode GPS steering, 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. The EFIS is in selected heading submode. To exit the selected heading submode, push the LNAV soft key. The EFIS will resume lateral tracking of the flight planned course (EFIS coupled mode).

The heading bug may also be turned off by the following steps.

1. Push the **HDG** button.

2. Push the **OFF** menu button.

   If coupled with an autopilot in **HEADING** mode, turning the heading bug off will result in the autopilot reintercepting the active leg of the route, if one is selected.

Resume
LNAV

Selected heading
mode annunciation
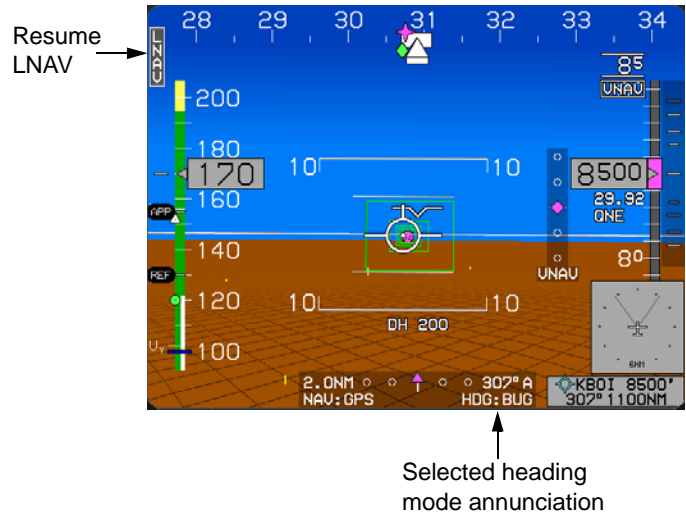
The selected heading mode annunciator will indicate LNAV
after the heading bug is turned off.

Specify a Target Altitude Bug

(Selected Altitude Submode)

1. Push the **MENU** button while on the PFD display page.

2. Push the **BUGS . .** menu button.

3. Push **TGT ALT . .**
    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 set the desired target altitude and push to enter.

    A white bow-tie shaped bug will be located on the altimeter tape, centered on the target altitude. The bug will be hollow for pre-selected altitudes, and will be filled for captured altitudes.

    Push **SYNC** to instantly set the target altitude to the current altitude.

    The target altitude value will be displayed in white between two horizontal white bars immediately above the altimeter tape. It will flash during altitude capture. **SLCT** for selected altitude submode will be shown below the value.

    This manually set target altitude bug will override the magenta VNAV target altitude bug. To de-activate the selected altitude submode, push the **VNAV** soft key. The VNAV or level flight submode will be entered.

If a lower target altitude is selected, the skyway will descend immediately and a green arc showing altitude capture point will appear on the courseline on the MFD. The intent is to climb or descend "right now" as if being given an assigned altitude from ATC. This is analogous to the heading bug submode. The system uses descent logic. This will be either a manually-selected vertical speed (VSI bug) or airspeed (airspeed bug). If neither is selected, a default descent of 1000 fpm will be used.

If a higher target altitude is selected, the skyway will follow either a manually-selected vertical speed or a manually-selected airspeed. These are mutually exclusive. If neither is chosen, the default climb airspeed programmed in limits will be used. The control logic for climbs in VNAV submode is identical to selected altitude submode. Climbs are performance based. They do not follow a geographic profile. Hence, no vertical deviation indicator will be shown.

Descents in VNAV submode are based on defined vertical angles eminating from a point. These angles are pilot-defined on all legs with the exception of the final approach segment. The VNAV submode is active when an active flight plan includes at least one VNAV altitude and the pilot has not manually selected an altitude. VNAV altitudes are imported from Jeppesen data for IAP's, DP's and STAR's. All database and manually set VNAV altitudes are depicted in white. System calculated VNAV altitudes will be depicted in magenta. When the system is capable of performing vertical navigation but the pilot has manually selected an altitude, a VNAV soft key tile appears on the PFD. Once engaged, **SLCT** changes to **VNAV** and the bug goes from white to magenta.

NOTE:
On DP's, set an angle resulting in a minimum performance measured in FPNM (feet per nautical mile). Then while flying the procedure, note the relative position of the skyway to determine if aircraft performance is satisfactory to meet requirements.

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

ALTITUDE

Specify a Minimum Altitude

1. Push the **MENU** button while on the PFD display page.

2. Push the **BUGS . .** menu button.

3. Push **MINIMUMS . .** menu button.
   Current altitude, rounded to the nearest 10 foot increment, will be displayed.

4. Select **MIN ALT . .** and push to enter. The **MIN ALT . .** value will be displayed above a single horizontal white bar.

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.

AUDIBLE ANNUNCIATION
Descending below the minimum altitude will result in a yellow caution flag and an annunciation of "Altitude. Altitude."

ALTITUDE

NOTE:
After consulting the approach plate, you man enter a minimum altitude.

Specify a Decision Height

1. Push the **MENU** button while on the PFD display page.

2. Push the **BUGS . .** menu button.

3. Push **MINIMUMS** menu button.
   Current altitude, rounded to the nearest 10 foot increment, will be displayed.

4. Push **DEC HT**. A default value of 200 ft. will be shown. Turn the control knob to select desired decision height and push to enter. Selected value will be displayed under the AGL readout on the PFD. An annunciation **MINIMUMS** will be displayed when passing below decision height.
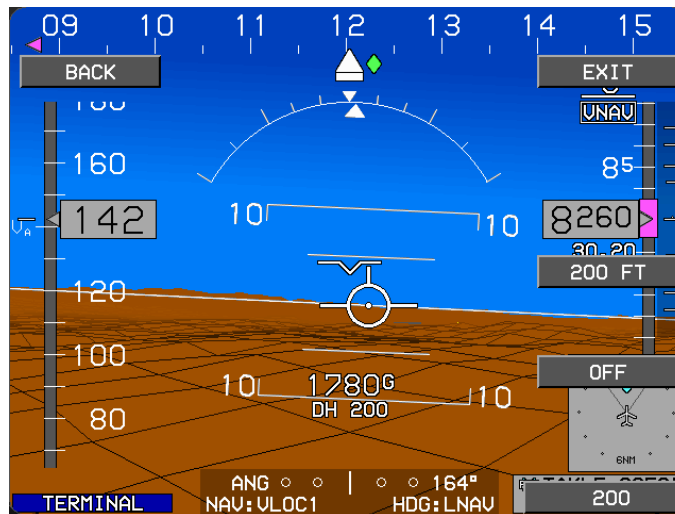
AUDIBLE ANNUNCIATION
Descending below the decision height will result in a yellow caution flag and an annunciation of "Minimums."

MINIMUMS

NOTE:
Approach data from the EFIS will not include DH or MDA. Consult the approach plate to determine decision height.

Specify a Target Airspeed

1.   Push the **MENU** button while on the PFD display page.

2.   Push the **BUGS . .** menu button.

3.   Push the **SPD SEL . .** menu button. Current airspeed will be displayed.

4.   Turn control knob to select desired target airspeed and push to enter.

Push **SYNC** to instantly set the airspeed bug to the current airspeed.

When vertically integrated with an autopilot, the airspeed bug setting annunciation will be colored green and the airspeed bug will be a filled-white when in airspeed climb or descent mode. Otherwise, the airspeed bug setting annunciation will be colored white and the airspeed bug will be hollow-white. When not vertically integrated with an autopilot, the airspeed bug setting annunciation will be colored white and the airspeed bug will be a filled-white.

Specify a Vertical Speed

1.   Push the **MENU** button while on the PFD display page.

2.   Push the **BUGS . .** menu button.

3.   Push the **VSI** menu button.

4.   Turn the control knob to select the desired vertical speed. Selections are in 100 ft. increments and can be negative (descent) or positive (climb). Push to enter.

When vertically integrated with an autopilot, the vertical speed bug setting annunciation will be colored green and the vertical speed bug will be a filled-white when in VSI climb or descent mode. Otherwise, the vertical speed bug setting annunciation will be colored white and the vertical speed bug will be hollow-white. When not vertically integrated with an autopilot, the vertical speed bug setting annunciation will be colored white and the vertical speed bug will be a filled-white at all times.

The VSI indication for Part 27 and Part 29 rotorcraft will optionally include a red line at the rotorcraft's VSI limit.

When TCAS-II is enabled as the TCAS flag, the background of the VSI will function as an RA display with green and red colored regions to provide RA maneuver guidance.

Turn Bugs Off

1. Push the **MENU** button while on the PFD display page.

2. Push the **BUGS . .** menu button.

3. Push **TGT ALT . .** , **MINIMUMS . .** and/or **SPD SEL . .**

4. Push the **OFF** menu button.

Set V-Speeds

1. Push the **MENU** button while on the PFD display page.

2. Push the **BUGS . .** menu button.

3. Push **V-SPDS . .** menu button.

4. Turn the control knob to highlight **TAKEOFF . .** or **APPROACH . .** and push to enter.

5. Follow prompts to enter **V1 . .** , **VR . .** , **V2 . .** , **VREF . .** , **VAPP . .** , and **VENR . .** Use the control knob to set the speed. Push to enter.

To minimize clutter, V_1, V_R, and V_2 are reset to zero at each power cycle and are disabled when exceeded by 40 KIAS or when the aircraft climbs above 2,000 ft. AGL.
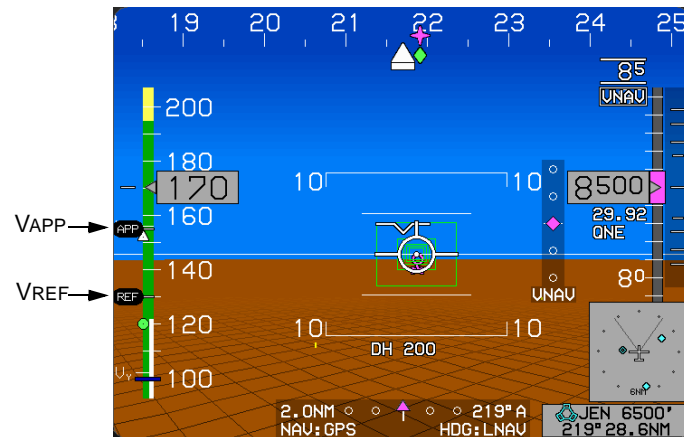
Vertical Navigation (VNAV)

The FlightLogic EFIS provides advanced vertical navigation capability known as VNAV. The skyway provides VNAV guidance for all procedures including DPs, STARs, approaches, and missed approaches. All VNAV functions are based on climb and descent angles which, except for the final approach segment, are set by the pilot using the VNAV CDA (climb/descent angles) see *Change VNAV Angles, page 6-76*.

During final approach the descent angles are derived from the Jeppesen NavData.

Change VNAV Angles

1. Push the **MENU** button on the PFD.

2. Push the **BUGS . .** menu button.

3. Push **VNAV CDA . .** menu button.

4. Turn control knob to highlight **CLIMB ANG . .** or **DCND ANG . .** and push to enter.

Rotate the control knob to select the desired angle or rate in feet per nautical mile and push to enter. To cancel, push **EXIT**.

VNAV Altitudes

VNAV refers to preprogrammed altitudes for all the waypoints in a route. VNAV altitudes are set three ways:

1. Automatically from the Jeppesen NavData for procedure waypoints (shown in white in the ACTV waypoint list);

2. Manually by the pilot for any waypoint in the route (shown in white in the ACTV waypoint list);

    These can be thought of as "hard" altitudes.

3. If a "hard" altitude is not set for a waypoint, it is calculated by the EFIS based on the VNAV climb/descent angles (shown in magenta in the ACTV waypoint list).

To set a manual VNAV altitude, follow these steps.

1. Push **ACTV. .**

2. Turn the control knob to highlight the desired waypoint in the active list.

3. Select **VNAV. .**
    A crossing altitude and offset distance may be selected.

4. Turn the control knob to change the value.

5. Push to enter.

This may be repeated for any of the waypoints in an active flight plan or published procedure.

The following screens illustrate an arrival procedure.
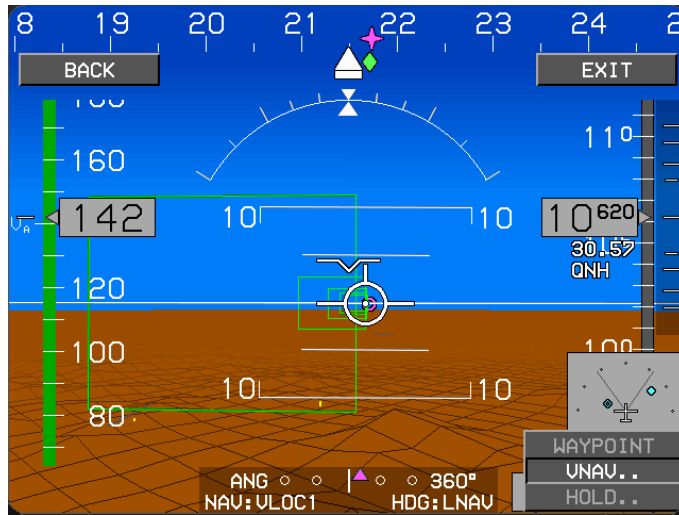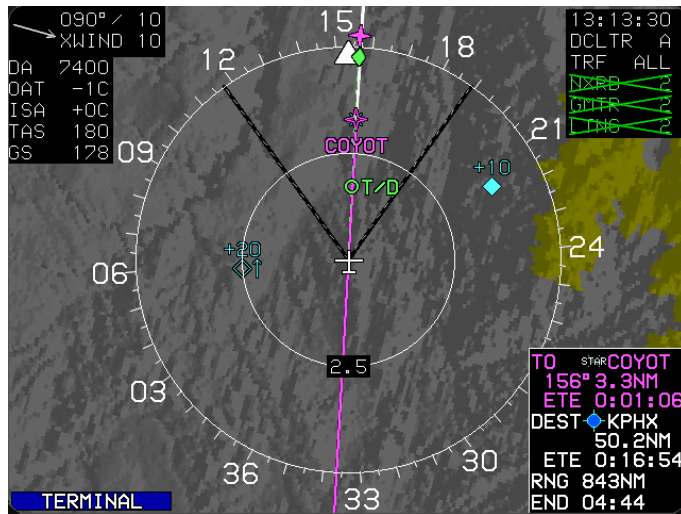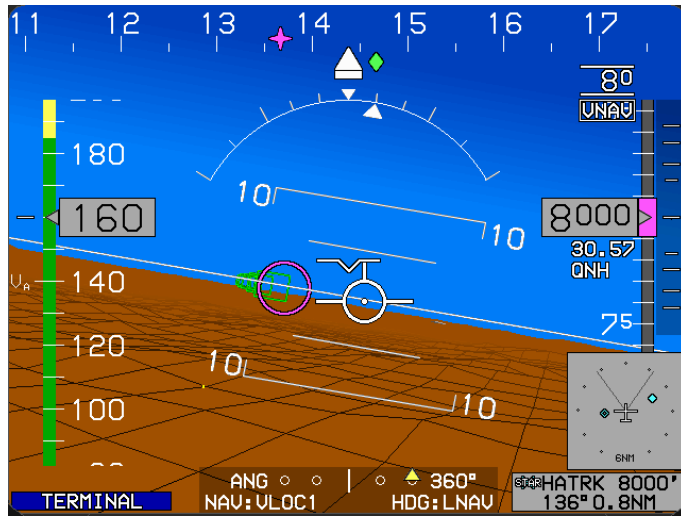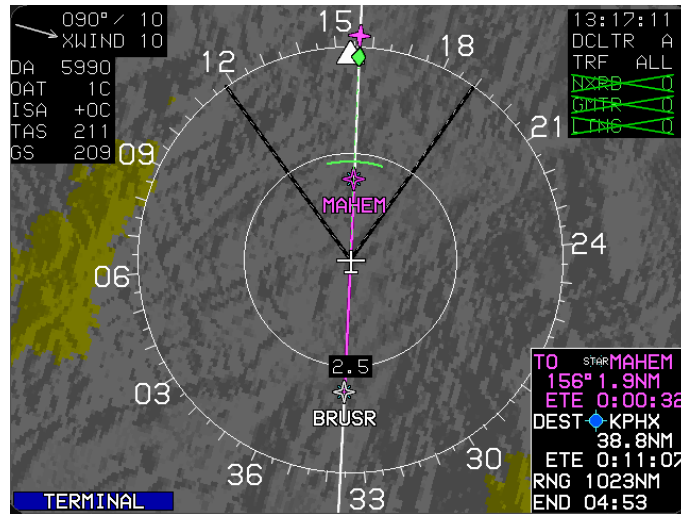
NOTE:
An altitude alert tone will sound 1000 ft. or 50% of VSI, if greater, from uncaptured VNAV waypoint altitudes.

Controlling The Displays

Change MFD Display Pages

Push the control knob to advance to the next display. The order is PFD followed by the Navigation Display, the engine page (if equipped), then back to the PFD.

NOTE:
The primary PFD display in the aircraft cannot be changed to MFD.

Show/Hide Terrain (Moving Map)

1. Push the **MENU** button.

2. Push the **FORMAT** .. menu button.

3. Turn the control knob to select the **FNCT DCLTR** ..(function declutter) and push to enter.

4. Turn the control knob to select **TERRAIN** .

5. Push control knob to turn terrain on or off (a check mark indicates terrain ON). Select **DONE** and push to enter when finished.

NOTE:
Terrain and obstructions are controlled simultaneously. If hidden, terrain and obstructions will turn on automatically if a threat is detected.

Show/Hide LAT/LON (Moving Map)

Current latitude and longitude can be shown on the navigation display.

1. Push the **MENU** button.

2. Push the **FORMAT . .** menu button.

3. Turn control knob to select **FNCT DCLTR . .** and push to enter.

4. Turn the control knob to select **LAT/LON**.

5. Push control knob to toggle LAT/LON on or off (a check mark indicates terrain ON). Select **DONE** and push to enter when finished.

Show/Hide VOR and ADF Pointers (Moving Map)

A dual Pointer (similar to RMI) for VOR and single Pointer for ADF can be overlaid on the moving map.

1. Push the **MENU** button.

2. Push the **FORMAT** .. menu button.

3. Turn the control knob to select the **FNCT DCLTR** ..(function declutter) and push to enter.

4. Scroll through the list and push the control knob to toggle pointers on or off. **PTR ADF, PTR VLOC1** and **PTR VLOC2** can be selected individually (a check mark indicates ON).

5. Select **DONE** and push to enter when finished.
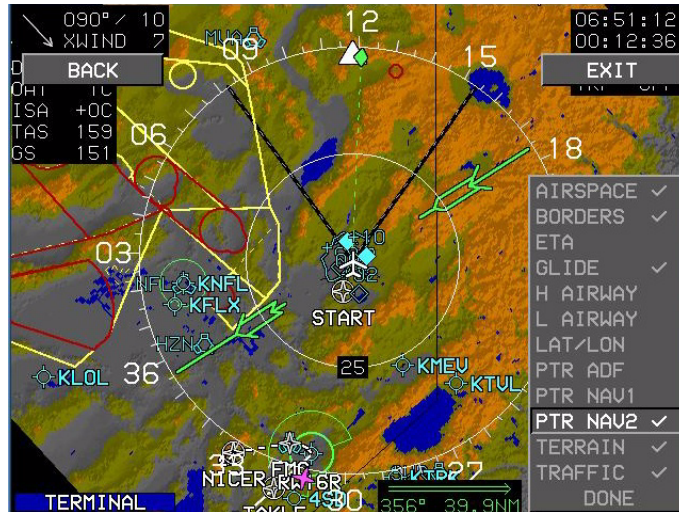
NOTE:

This option is only available with the optional nav interface. Pointers will only be shown if a valid nav signal is present or the ADF is computing a bearing.

Show/Hide VOR and ADF Pointers on Conventional HSI

A dual Pointer (similar to RMI) can be displayed on the conventional HSI.

1. When the MFD function has been changed to HSI as described in section 3, push the **MENU** button.

2. Push the **POINTERS** menu button.

3. Scroll through the list and select from **PTR ADF, PTR VLOC1 or PTR VLOC2**.

4. Push control knob to toggle on or off. (a check mark indicates ON).

5. Select **DONE** and push to enter when finished.
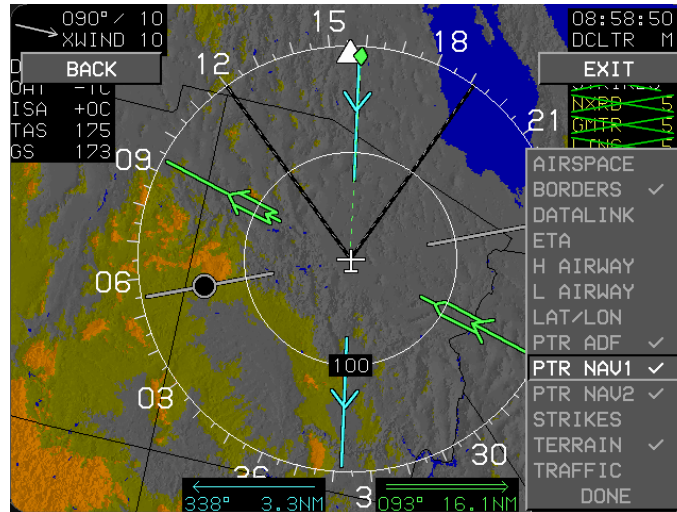
Show/Hide Strikes (Moving Map)

1. Press the **MENU** button.

2. Select the **FORMAT . .** menu.

3. Turn control knob to select **FNCT DCLTR . .** and push to enter.

4. Turn the control knob to select **STRIKES**.

5. Push the control knob to turn STRIKES on or off (a check mark indicates terrain ON). Select **DONE** and push to enter when finished.

Scale the Moving Map

Turn the control knob clockwise to increase scale and counterclockwise to decrease scale. Map scales available are 0.5, 1, 2.5, 5, 10, 25, 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. Push the **MENU** button.

2. Push the **FORMAT . .** menu button.

3. Turn control knob to highlight **CENTER** or **ARC**, then push to enter.
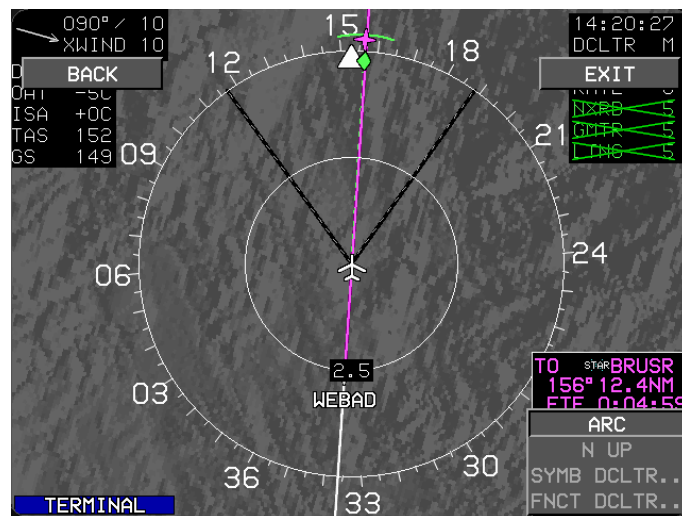
The dedicated traffic display can only be shown in centered mode.

Heading-Up or North-Up Format

1. Push the **MENU** button.

2. Push the **FORMAT . .** menu button.

3. Turn control knob to highlight **HDG UP** or **N UP**, then push to enter.
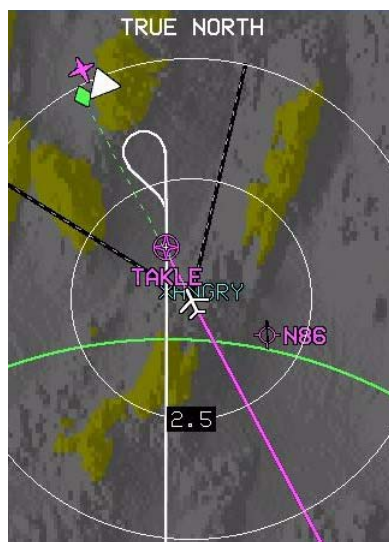
Change Moving Map Function

In addition to the moving map, the MFD can display an HSI, a navigation log, a dedicated lightning display, a dedicated traffic display, and a dedicated datalink display.

1. Push the **MENU** button.

2. Push the **FUNCTION . .** menu button.

3. Turn the control knob to highlight desired function, (MAP, HSI, NAV LOG, STRIKES, TRAFFIC, DATALINK) then push to enter.
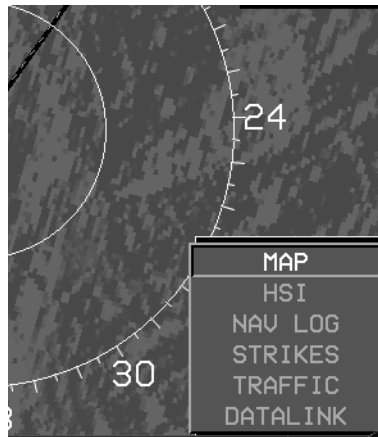
NOTE:
When HSI is selected, a traffic thumbnail view will appear on the PFD and replace the mini map in aircraft equipped with traffic sensors.

Declutter the Moving Map

The moving map can be decluttered in two ways: removing navigation symbology, and removing display functions (i.e. terrain, traffic, lightning).

Manual Declutter Navigation Symbology:

1. Push the **MENU** button.

2. Push the **FORMAT . .** menu button.

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

4. Select **MANUAL . .** Auto settings are optimized factory defaults.

5. Turn control knob to highlight desired elements and push to enable or disable. A check mark after an element indicates ON.

6. Turn the control knob to select **DONE** and push to enter.

Declutter Display Functions

1. Push the **MENU** button.

2. Push the **FORMAT . .** menu button.

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.

NOTE:
Settings will be retained when powered down.

Auto Declutter Navigation Symbology

To set the system for automatic decluttering:

1. Press the **MENU** button.

2. Select the **FORMAT . .** menu.

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

4. Turn control knob to highlight **AUTO**, the push to enter.

Declutter The PFD

1. Push the **MENU** button.

2. Push the **DCLTR . .** menu button. A menu containing Bank Scale, Basic Display, Mini Map, Mini Traffic, Skyway, Terrain, Traffic, HSI, and conventional autopilot FD (flight director) will be displayed.
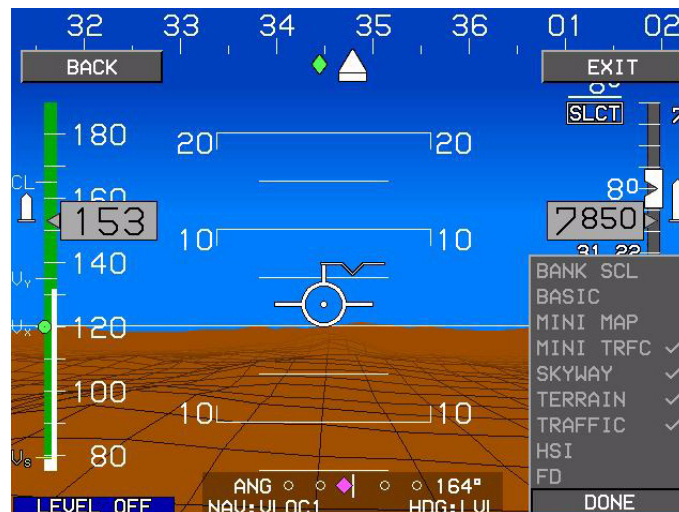
3. Turn control knob to highlight elements and push to enable or disable them. A check mark indicates enabled. Select

DONE and push to enter when you are finished. Declutter settings will be saved upon system shutdown.

NOTE:
The HSI and flight director are mutually exclusive.

Zoom the PFD

The PFD can be set to two different fields of view: 35° and 70°.

The 70° field of view is the default and resembles a wide-angle lens on a camera. Since aircraft operate primarily in the lateral plane, this field of view is most useful.

However, if you want to see terrain displayed so that it more closely resembles what you see out the window, select the zoom (35° field of view). This magnified view more closely matches the human eye and will give a very realistic depiction of terrain but since the heading and pitch scales are magnified as well, the display will be very sensitive to every movement of the aircraft.

To set the zoom mode:

1. Push the **MENU** button.

2. Push the **ZOOM ON** or **ZOOM OFF** menu button.

NOTE:
Field of view is indicated on the moving map by two dashed lines that form a "pie" shape extending forward from the aircraft. Only objects within the pie shape on the moving map will appear on the PFD.

Zoom OFF (70° field of view)
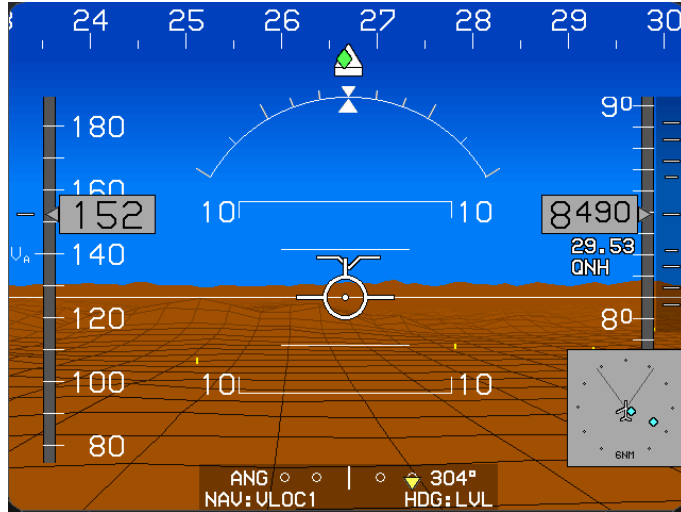
Zoom ON (35° field of view)
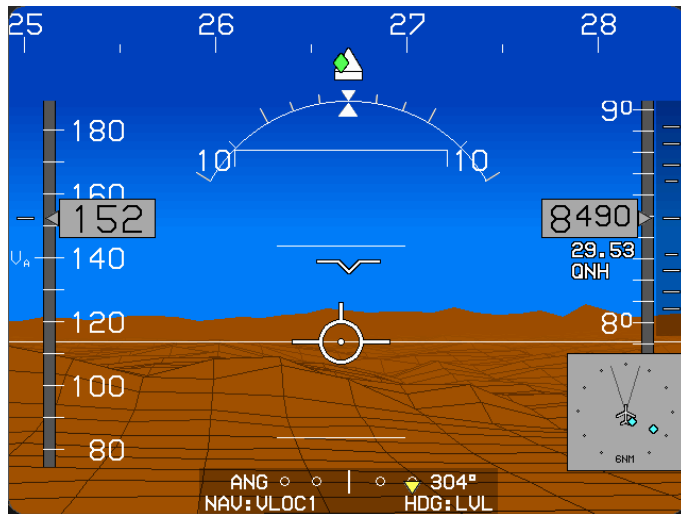
Controlling the Stormscope Display

These procedures refer only to the dedicated WX-500 Stormscope display function and are available only when a WX-500 Stormscope is connected to the system.

Centered or Arc Format

1. Push the **MENU** button.

2. Push the **FORMAT ..** menu button.

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. Push the **MENU** button.

2. Push the **FORMAT ..** menu button.

3. Turn control knob to highlight **ROUTE ON** or **ROUTE OFF**, then push to enter.

Strike or Cell Mode

1. Push the **MENU** button.

2. Push the **FORMAT ..** menu button.

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. Push the **MENU** button.

2. Push the **CLR STRKS . .** menu button. 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. Push the **MENU** button.

2. Push the **FORMAT . .** menu button.

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

See the WX-500 documentation for more information.

Controlling the NAV Log Display

To view the NAV LOG display page, press MENU and then
FUNCTION. Turn the control knob to highlight NAV LOG and
push to enter. The NAV LOG page will be displayed. Standard
flight log data is available in addition to VNAV crossing
altitudes and offsets. Offsets are useful when ATC clears an
aircraft to cross a fix at a specified altitude and distance prior to
a fix or waypoint. Ground speed and fuel flows are available on
the NAV LOG display as well. To return to the MAP display,
push MENU and then FUNCTION. Turn the control knob to
highlight MAP and push to enter.

WAYPOINT	VNAV/OFFSET	PATH	DIST	ETE	ETA	FUEL
◆ KSEA	-----°/---NM				--:--	------
◆✳KBOI	-----°/---NM	↦ 111°	345NM	1+57	11:49	930
◆ KRNO	-----°/---NM	↦ 199°	290NM	1+38	13:27	475
◆ KPHX	-----°/---NM	↦ 116°	521NM	2+56	16:24	-338

09:52:51 FUEL = 1466LBS
GS 177 FLOW = 277PPH

Controlling the Traffic Display

These procedures refer only to the dedicated traffic display function and are available when any traffic device is installed (TAS, TCAS-I, TCAS-II, TIS, ADS-B, TIS-B).

Route On or Route Off

To show or hide the active route while in the dedicated traffic display function:

1. Push the **MENU** button.

2. Push the **FORMAT . .** menu button.

3. Turn control knob to highlight **ROUTE ON** or **ROUTE OFF**, then push to enter.

Traffic Test

If the traffic device is a TCAD, a pilot-initiated test of the TCAD system may be performed:

1. Push the **MENU** button.

2. Push the **FORMAT . .** menu button.

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

See the TCAD documentation for more information.

NOTE:
See Traffic, page 3-69.

Optional ADS-B Datalink and Traffic

Some systems will be equipped with optional ADS-B traffic displays.

The screens below show sample traffic displayed along with format options on the MFD.

Please refer to your vendor-supplied documentation for further details.
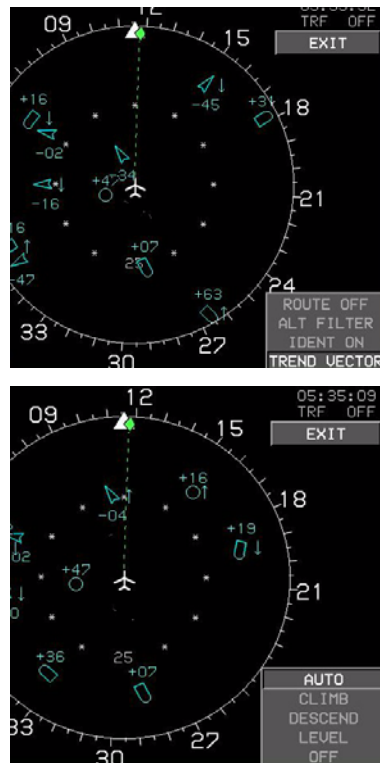
NOTE:
Weather products received via ADS-B may include automatic text to symbology conversion. This will aid pilots in decoding and utilizing METAR and TAF information from ADS-B sources inflight.

Description of ADS-B Traffic Symbology

1. God's-eye View High-Integrity ADS-B Target with Track Information:

2. God's-eye View Low-Integrity ADS-B Target with Track Information:

3. God's-eye View High-Integrity ADS-B Target without Track Information / Perspective View High-Integrity ADS-B Target:

4. God's-eye View Low-Integrity ADS-B Target without Track Information / Perspective View Low-Integrity ADS-B Target:

Notes:

TA = Traffic Alert (Based upon GDL-90 internal UAT (Universal Access Transceiver)). Symbol flashes. Accompanied by "TRAFFIC, TRAFFIC" aural when above 400' AGL.

PA = Proximate Advisory (within 1200' AND 6NM).

OT = Other Traffic (beyond 1200' OR 6NM).

1. Altitude filtering available as follows:

AUTO = Senses ownship VSI and automatically selects CLMB, DCND or LVL parameters.

CLMB = Shows traffic from 2700' below to 9900' above.

DCND = Shows traffic from 9900' below to 2700' above.

LVL = Shows traffic from 2700' below to 2700' above.

OFF = Shows all available traffic.

Optional TCAS I or TCAS II

The Chelton EFIS System is capable of displaying TCAS Resolution Advisories when the system is installed with compatible TCAS equipment. TCAS requires flight crew training and aircraft-specific operational data. Consult the Aircraft Flight Manual or Flight Manual Supplement for TCAS operation. Optional TCAS systems use the following symbology:

TCAS-I, TCAS-II, TAS and TIS-A

| Other Traffic | Proximate Advisory | Traffic Advisory (Flashing) | Resolution Advisory (Flashing) |
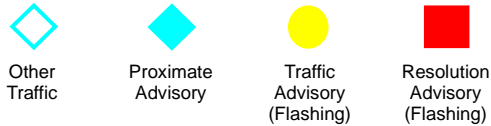
Display of Other Traffic and Proximate Advisories is altitude-filtered in accordance with pilot-selected filters as follows:

a. AUTO: If aircraft VSI is less -500FPM, traffic that is within +2,700 and -9,900 feet of aircraft altitude is displayed. If aircraft VSI is more than +500FPM, traffic that is within -2,700 and +9,900 feet of aircraft altitude is displayed. Otherwise, traffic that is within -2,700 and +2,700 feet of aircraft altitude is displayed.

b. ABOVE: Traffic that is within -2,700 and +9,900 feet of aircraft altitude is displayed.

c. BELOW: Traffic that is within +2,700 and -9,900 feet of aircraft altitude is displayed.

d. NORMAL: Traffic that is within -2,700 and +2,700 feet of aircraft altitude is displayed.

e. ALL: All received traffic is displayed, no altitude filtering is performed.

TCAS rendering rules dictate that TA and RA traffic that are off-scale are displayed with half symbols. TA and RA traffic

that are no bearing are displayed with text. OT and PA traffic that are off scale or no bearing are not displayed. When equipped with a TCAS-1, TCAS-2, TAS or TIS-A sensor, all traffic within 200 feet of the ground is not displayed. ADS-B and TIS-B ground traffic is displayed.

Controlling the Datalink Display

Customers with the optional WSI datalink installed may receive subscription weather products.

Activate Datalink

To activate the datalink features from the MFD:

1. Push the **MENU** and then the **FUNCTION** button.

2. Turn the control knob to highlight **DATALINK** and push to enter.

The main datalink page will be displayed. Range scale may be varied by turning the control knob.

Turn On/Off Datalink Products

To selected products on or off:

1. Push the **MENU** and then the **FORMAT** button.

2. Turn the control knob to highlight **DCLTR** (declutter).

3. Select the products to be turned on or off. A checkmark next to the product name indicates it is turned on. The following products may be available.

    - AMET-ICE (Airmets for icing)

    - AMET-IFR (Airmets for IFR flight conditions)

    - AMET-TURB (Airmets for turbulence)

    - CONV-SMET (Convective Sigmets)

    - ECHO-TOPS (Echo tops of convective buildups)

    - G METAR (Graphical Metars)

    - LTNG (Lightning Strikes)

    - NEXRAD (Nexrad radar returns)

- WNDS-TMPS (Winds and temperatures aloft)
  Altitude selectable

4. Select **DONE** when finished and push to enter.

Route On/Off and Pan On/Off

Additional **FUNCTION** choices are ROUTE ON or OFF, and PAN ON or OFF. When PAN is turned on, North, South, East and West tiles appear on the perimeter of the map. Holding one of these direction buttons down will scroll smoothly across the map. When WNDS-TMPS (winds and temperatures) is selected, Tiles for UP, DOWN will appear on the perimeter of the display. These can be used to select the desired altitude. Selected altitude will be annunciated at the bottom of the screen and will indicate millibars and Flight Level.

Changing Range

Turn the control knob to change range on the map. Maximum range is 1600NM.

Displaying Weather Text

To view text for AIRMET/SIGMET:

1. Push the **MENU** and then the **FORMAT** button.

2. Turn the control knob to scroll to **AMET-SMET** and push to enter.

To view text for TAF and METAR:

1. Push the **ACTV** and then the **INFO** button.

2. Push the button next to the **EXPAND WX** soft tile.

Text data will be displayed at the bottom of the screen. The associated area of coverage will be shown on the map with a colored border and will flash. Turn the control knob to scroll through selected areas of coverage. Each in turn will flash to

indicate which area the text refers to. Elapsed time indicating the age in minutes of each weather product will be shown to the right of the map.

To return to the map display without text, press the **EXIT** tile at the top right corner of the MFD.

To view a legend of weather symbols, press **MENU**, and then press **WX LEGEND**. A box containing symbols and color coding will appear in the lower right corner of the MFD.

To return to the map display, press **EXIT**.

Airport Weather Information

To view selected airport weather information:

1. Push **NRST** and then **WX**.

2. Scroll through the available list of airports to highlight your choice.

3. Push the **INFO** button.

4. An **EXPND WX** (Expanded Weather Depiction Data) menu tile will appear on the left side of the MFD. Additional weather details may be obtained with this function.

5. Press **WX LEGEND** to view a legend of weather symbology.

In a class A TAWS installation, datalink weather on the MFD will be inhibited during a popup forward looking terrain alert. This allows the alerting terrain to be seen more clearly.

After a TAWS popup alert, the pilot may reset the previous screen configuration by pressing **RESET**. During a TAWS popup alert, the display is changed to heading up mode.

NOTE:
To activate WSI weather datalink the first time, locate the aircraft in an open area with a clear view of the sky in all directions. Run WSI InFlight for a minimum of 10 minutes. After running the system for 10 to 15 minutes, reboot the system. When datalink weather is again received, allow the

system to run for another 10 minutes. This completes the activation process.
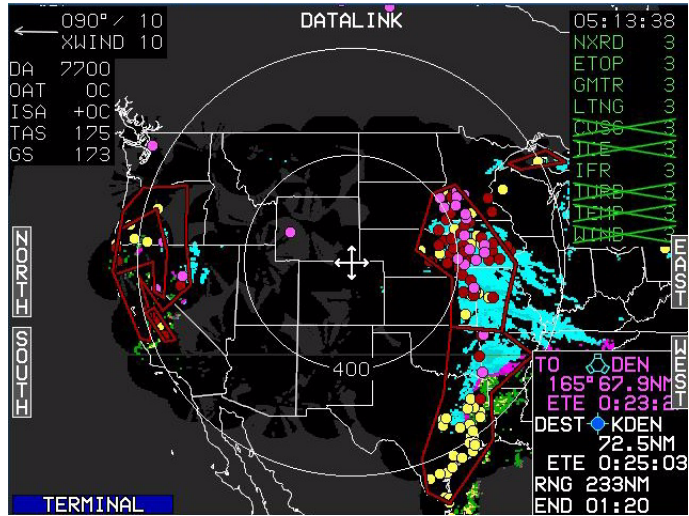
WX Depictions
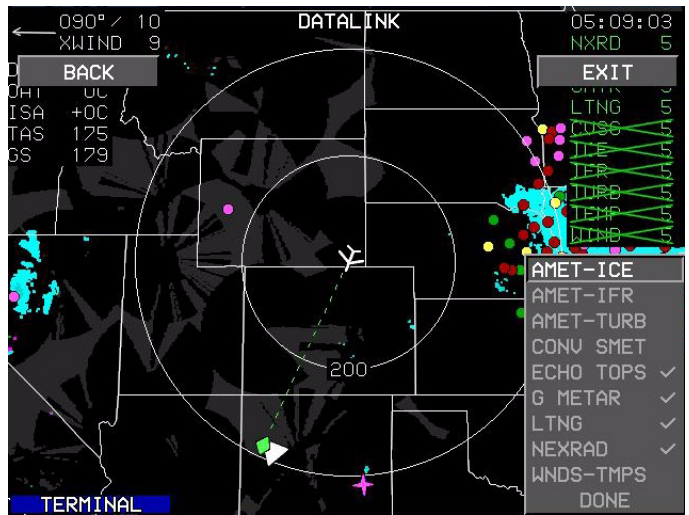
Datalink Selections
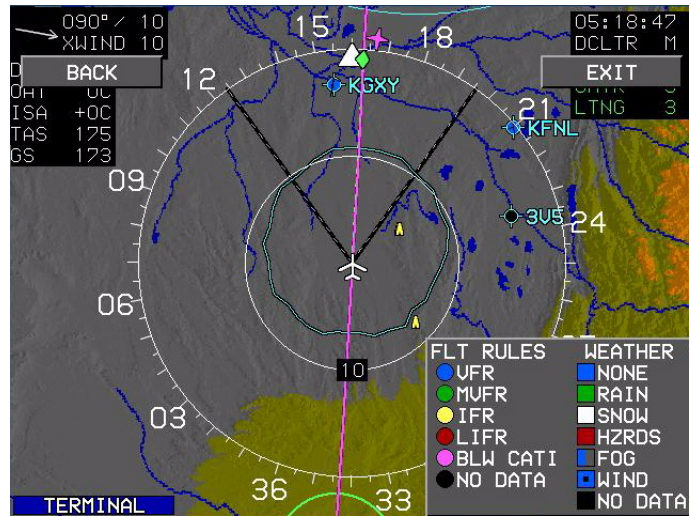
Legend of Symbols
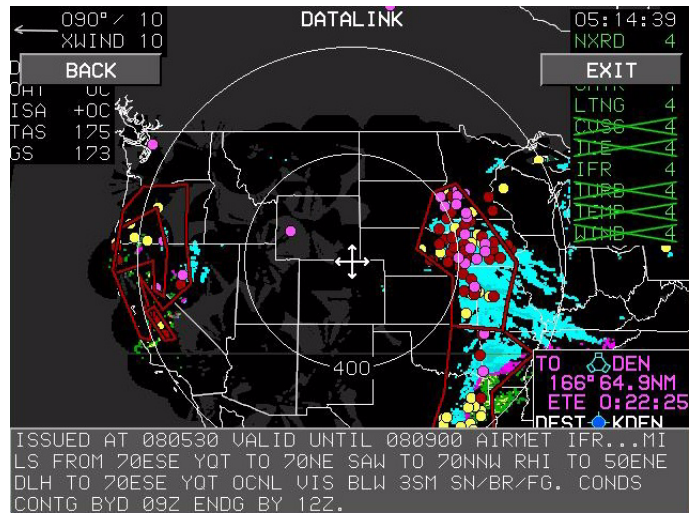
Expanded Weather Depiction Data

Tuning Radios using the EFIS

When the FlightLogic EFIS is connected to a Bendix/King KX-155A or KX-165A, Wulfsberg Fliteline, or a UPS/GarminAT SL-30 or SL-40, frequencies may be sent to the standby position on the radio directly from the EFIS, if wired to do so during installation.
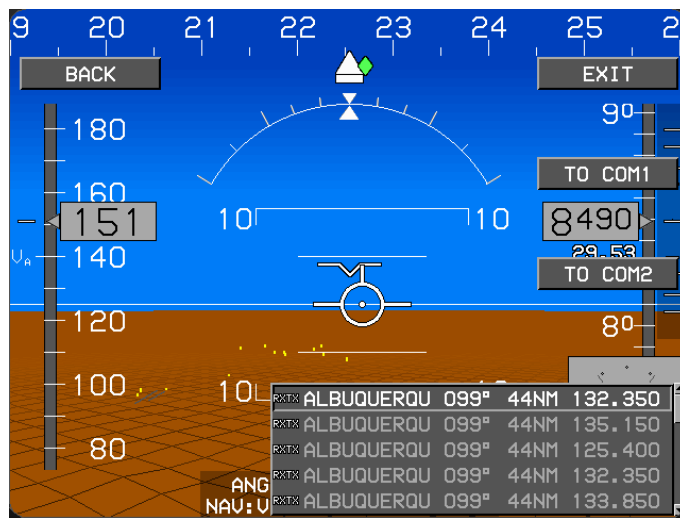
1. Display the information for the facility (see **Waypoint Information (NavData and DataLink Weather), page 6-37**).

2. Turn the control knob to highlight the desired frequency. Menu functions will appear as appropriate to send the frequency to the com or nav radios.

3. Push **TO COM1** or **TO COM2** (or **TO VLOC1** or **TO VLOC2**) to send the frequency to the standby position of the com (or nav) radio.

    Push **BACK** or **EXIT** when finished.

Analog Autopilot Interface

Most autopilots are analog and interface with the EFIS using the optional AIU. See **Analog Interface Unit (AIU), page 2-42.** Operation of your analog autopilot when interfaced with the FlightLogic EFIS becomes extremely simple.

Departure, Enroute, and Arrival Procedures

1. Set your autopilot in **HEADING** mode.

2. Activate a waypoint, flight plan, DP, STAR, heading bug, or manual GPS OBS.

The autopilot will fly through the skyway and trace the courseline on the moving map using analog roll steering.

When your autopilot is in **HEADING** mode, setting a **HEADING BUG** or manual GPS OBS, **OVERRIDES** the course shown on the EFIS. When the heading bug is turned off and the GPS OBS set to **AUTO**, the autopilot will automatically reintercept the course. If no course or heading bug exists, the autopilot will function as a wing leveler.

Non-precision approaches

1.   Set your autopilot in **HEADING** mode.

2.   Activate an approach or missed approach procedure.

The autopilot will fly through the skyway and trace the courseline on the moving map using analog roll steering.

Vertical navigation cues will be provided by the EFIS (the skyway will indicate a descent) **but you must manipulate the throttles and altitude function of the autopilot to control the descent.**

NOTE:
You must not have a target altitude selected in order for the skyway to indicate a descent. Target altitudes OVERRIDE descent profiles.

Precision approaches

Follow steps 1 and 2 above, then:

3.   Before the initial approach fix, set the HSI Source to the nav receiver that is tuned to the localizer frequency (push **OBS**, then **NAV:VLOC1** or **NAV:VLOC2** as appropriate) and, using the control knob, set the OBS to the final approach course (use **OBS** button or **NRST**, **ILS**, **SYNC**). Push the control knob to enter.

4.   On the inbound course, prior to the final approach fix, put the autopilot in **APPR** mode (or **NAV** mode if you do not have an **APPR** mode). The autopilot will then use the analog ILS signals to fly the coupled approach.

NOTE:
If the angle between the heading and inbound final approach course is within 135 degrees and the heading bug is turned off or LNAV is armed, present heading will be maintained until intercept occurs on the localizer.

Some autopilots must be in ALTITUDE HOLD or

GLIDESLOPE mode to enable glideslope capture. See your autopilot flight manual supplement for more information.

Vectors to final

Follow the steps above but use the heading bug on the EFIS to follow the controller's instructions to intercept the final approach course. Just prior to the final approach fix, set the autopilot to **APPR** (or **NAV**) mode and turn the EFIS heading bug **OFF**.

Missed approaches

1. Ensure the EFIS heading bug is **OFF** and push the **ARM** menu button on the EFIS after you pass the final approach fix.

2. Set the autopilot back in **HDG** mode at the missed approach point and execute a climb.

Example of a typical approach sequence:

Autopilot is already in **HDG** mode (analog roll steering) from enroute legs.
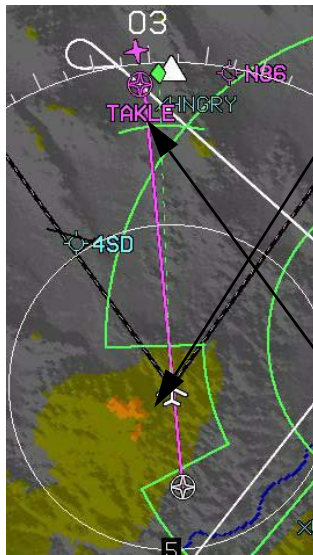
❶ 20-30 miles out, get ATIS, set the altimeter, enter the approach or select nearest ILS, and set minimum or decision height. Confirm that target altitudes are turned off.

❷ Tune the localizer frequency on your VLOC1 receiver, set the NAV source and CDI/Annunciator to VLOC1 on the PFD. Do this by pushing **OBS**, then select the source, then push enter. (Note: VLOC2 may be used for the localizer if desired.) Confirm the source selection on the CDI/ Annunciator.

❸ Leave the autopilot in **HDG** (heading) mode to deliver analog roll steering commands to the autopilot throughout any procedure turns, arcs, course reversals or holds.

❹ Select the **NAV** or **APPR** (approach) mode on the autopilot before passing the final approach fix inbound. Glideslope arming annunciations may be shown depending on the model of autopilot. (most autopilots intercept below the glideslope in order to capture the signal). The autopilot will track the localizer and glideslope for the completion of the approach. The missed approach may be armed by pressing **ARM** on the PFD inside the final approach fix.

If a missed is initiated, **select HEADING mode on the autopilot again. Climb must be initiated in the normal manner with the throttles and autopilot pitch controls.**

*"**Which mode when?***

*When your autopilot is in **HEADING** mode, it will follow the **heading bug** or **skyway** displayed on the EFIS. Following the skyway, it will fly DPs, STARs, approaches with procedure turns or holding pattern course reversals or DME arcs, and even complete missed approach procedures including the holding pattern and the correct entry completely hands off. Unlike a conventional autopilot flight director, the skyway will provide you with turn anticipation so you will know what your autopilot is **going** to do, long before it actually makes a turn. **You will, however, have to control the vertical navigation manually as you have always done.***

*When your autopilot is in **NAV** or **APPR** mode, it will follow the **navigation signal** from whichever nav source is displayed on the **CDI/ANNUNCIATOR**. Normally this will either be **VLOC1** or **VLOC2**. When flying a coupled precision approach, use the **APPR** (approach) mode on the autopilot to allow glideslope coupling. Some autopilots only have **NAV** mode and will adjust automatically."*

Digital Autopilot Interface

Some autopilots have a digital roll steering interface. The EFIS will send digital roll steering (lateral navigation) commands directly to the autopilot which will enable the autopilot to fly the depicted courseline when it is in roll steering mode. Refer to your autopilot flight manual supplement for appropriate procedures.

NOTE:
Digital roll steering (ARINC429 Label 121) is **ONLY** *sent when HSI Source is set to* **GPS***.*

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Section 7

Quick Start Tutorial

1. Begin by reading the Chelton EFIS Supplement in your aircraft's Flight Manual. Pay special attention to the Emergency, Abnormal, and Normal Procedures sections (which are included in the Appendix of this guide for reference).

2. Power up the EFIS. The system will perform a built-in test routine. If all tests are passed, the system will display a screen identifying the database coverage. Press any button to acknowledge and the system will begin a two-minute countdown while awaiting sensor initialization (for the purposes of flight planning, etc., this countdown can be overridden by pressing any button).

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

RIGHT

3. Note that the altimeter setting 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 is displayed immediately below the altitude readout on the PFD. Push the knob to enter the setting.

4. Push the **Direct-To** button to enter a destination.

5. Use the control knob (turn to scroll to the desired character, push to confirm and advance to the next position), to enter the desired waypoint.
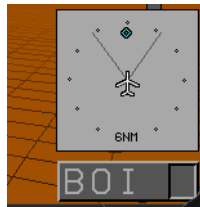
    For example: To enter the Boise airport, turn to select "**B**" then push to enter; turn to select "**O**" then enter; turn to select "**I**" then enter. **Push two more times to step through the last two character spaces** (the leading "K" identifier may be entered but is not required). An exact match will be accepted and entered automatically.
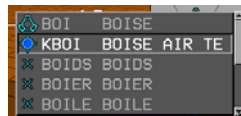
    If there is no exact match, a list of potential matches will be displayed.

6. Turn control knob to highlight the desired waypoint, then push to enter.
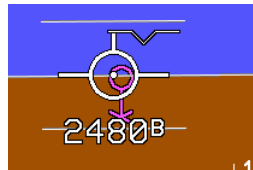
7. A route to the selected waypoint will be activated. The active waypoint will be shown as a tethered balloon on the PFD screen.
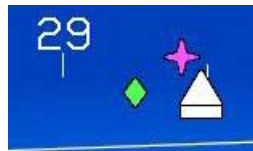
A magenta bearing to waypoint symbol will be displayed on the directional scale. If the bearing to the waypoint is beyond the limits of the directional scale, a magenta arrow on the scale will indicate the closest direction to turn.
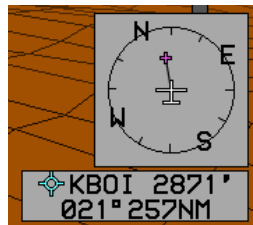
The waypoint information, indicating waypoint type and identifier, elevation or crossing altitude, and bearing and distance, will be displayed immediately below the MiniMap.

Airspeed is on the left, altitude is on the right, heading is across the top, and a GPS/WAAS CDI is at the bottom. VSI is to the right of the altitude tape.

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

   ND → reversionary PFD → engine display (if available) → ND

   (Note: the PFD cannot be changed)

PUSH

9. When on the moving map page, turn the control knob clockwise to increase scale and counter-clockwise to decrease scale (range is from 1 to 400 miles).

TURN

Now you should be familiar enough with the basic operation of your Chelton Flight Systems EFIS to navigate from point to point in VFR conditions and change from one display page to another. Please read this entire manual and fly with a Chelton Recommended Instructor to gain a detailed understanding of all system features.

Section 8

IFR Procedures

Overview of Approaches

Your Chelton EFIS provides three-dimensional GPS non-precision instrument approach guidance using an integral GPS receiver. 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, etc.) more accurately using GPS, although many of these approaches are complex (compared with GPS-only approaches). New RNAV approaches are being published which offer LNAV-VNAV minimums. The vertical deviation indicator will guide the pilot to follow a stabilized approach path.

NOTE:
WAAS or Fault Detection and Exclusion (FDE) must be available at the Final Approach Fix to continue an approach.

The Chelton EFIS PFD and moving map guide you through every step of the approach using extremely precise 3-D skyway symbology. The system automatically sequences through each leg, up to the missed approach point (MAP), and through the complete missed approach procedure including holds. Approaches may be flown "as published" with the full transition, using any published route or initial approach fix (IAF), or with a vectors-to-final (VTF) transition.

When coupled to your autopilot, the EFIS will fly complete procedures with little or no pilot interaction.

Basic Instrument Approach Operation

All approach operations will typically begin with the same basic steps. (This example selects the GPS approach to runway 28R at San Diego):

1. You must have the intended landing airport as the active waypoint (either selected from an active flight plan using **ACTV or** entered using **Direct-To** or **NRST**).

2. Push the **ACTV** button.

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

4.   Choose **IFR APPR. .**

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

6.   Choose the desired **transition** (**TRANS**) or **vectors to final** (**- VTF -**).
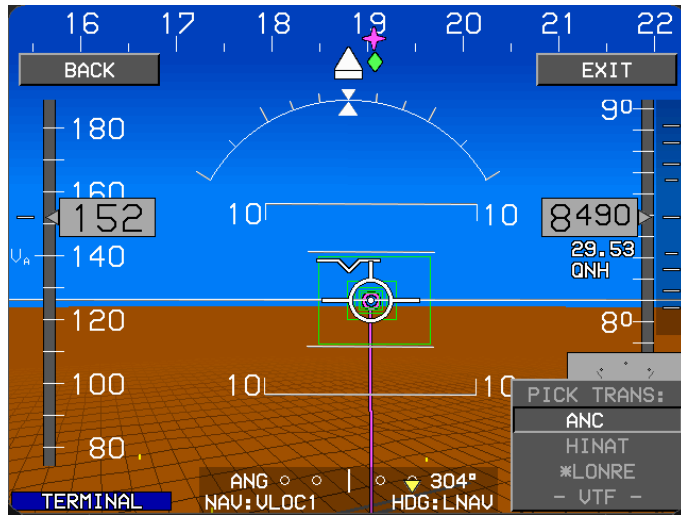
7.   Choose the desired **runway** (**RW**).

Within 30NM of the destination airport, a "TERMINAL" flag appears to annunciate that the EFIS is in terminal mode and automatic CDI scaling gradually transitions from 2.0NM (enroute) to 1.0NM (terminal). On the final approach segment, the flag will read IFR APPR and CDI scaling will transition from 1.0NM to 0.3NM. Inside the final approach fix the CDI scaling becomes angular like a localizer.

The first waypoint will be displayed conformally on the PFD and the crossing altitude will be automatically entered. It will be magenta, to indicate that it's source is from the Jeppesen data. Remember to frequently access the active list of waypoints by pushing the **ACTV** button. This allows reviews of planned waypoints and crossing altitudes.The fix, distance, bearing, and crossing altitude will be displayed in the waypoint information box in the lower-right corner of the PFD.

Regardless of the type of approach, a stabilized descent is good practice. In the past, it was common to "dive and drive" on step down approaches to allow for more time at the minimum descent altitude to find the runway. With skyway guidance and a conformal runway depiction, that is no longer necessary. Likewise, needle chasing on the ILS is common, especially for pilots who don't fly them regularly. Once established on the ILS, use the skyway, runway, and flightpath marker to stabilize your approach. The result will be fewer control movements, superior speed control, and extremely precise ILS tracking. If you keep the flight path marker in the smallest green box or on the runway as shown on the ILS below, the needles will hardly move.
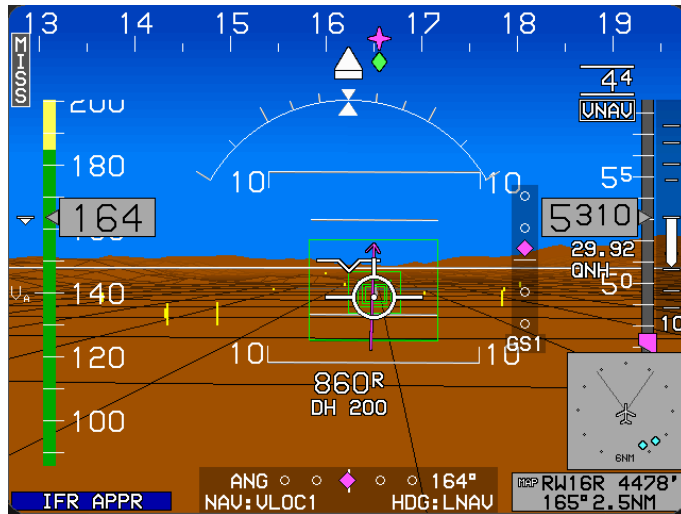
The EFIS will automatically sequence through approach waypoints as the approach is flown. The approach procedure will appear on the moving map as solid white lines, except for the active leg, which is displayed in magenta. The missed approach procedure will appear on the navigation display as dashed lines. The navigation display will also show procedure turns, arcs and holding patterns as appropriate.

> *"Just follow the magenta line:*
>
> *Here, we are inbound toward the final approach course. Remember, the skyway boxes will always be positioned along the magenta line so if you lose them on the PFD, just look for the magenta line on the moving map (remember, they could be above you or below you based on the target altitude, or you could have a discontinuity, see* **Discontinuity, page 3-139***). Also, remember that all turns in a procedure are actual size based on a 15° bank (zero wind) at the preprogrammed V_{PROC}, or procedure speed for your aircraft. If you are going faster or slower, you will need more or less bank angle, respectively, to stay in the boxes."*

NOTE:
During a Non-Precision Approach, the primary instruments are the Course Deviation Indicator (CDI) and the Altimeter. The Skyway provides reference to the approach path and a stabilized approach path from the Final Approach Fix (FAF) altitude to the Missed Approach Point (MAP) reference altitude. The Skyway may descend below the Minimum Descent Altitude. The Altimeter must be used to maintain the appropriate altitudes during the approach procedure.

Changing the format of the navigation display to North-Up (by using the **FORMAT** menu) will make the display match an approach chart. Use the navigation display approach procedure depiction and the primary flight display CDI and Skyway for course guidance and turn anticipation.
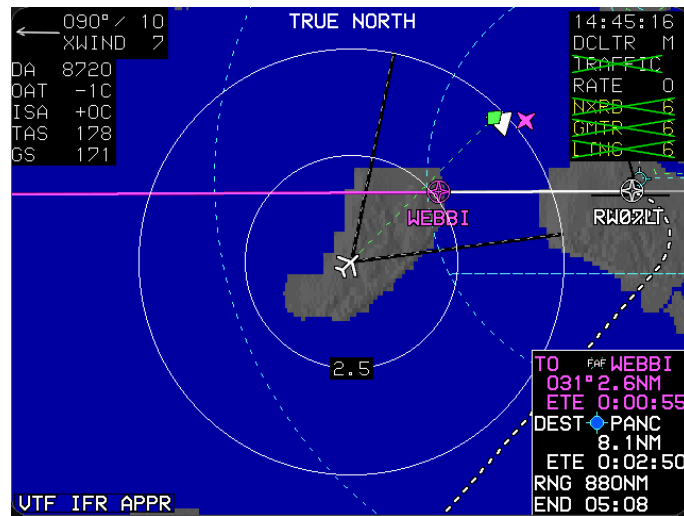
You may review the bearing, distance, procedure type, and crossing altitude for each waypoint in the approach by scrolling to each waypoint in the **ACTV** menu and pressing **INFO**.

You will notice differences from time to time between the Jeppesen NavData on the EFIS and the published paper charts. Due to the complexities of converting paper charts to a navigation database, errors and omissions occasionally occur.

These differences are usually limited to minor inconsistencies among crossing altitudes and waypoint locations and do not impose a threat to flight safety. However, always verify the legs of an approach using a paper chart before performing the approach. The paper chart is the legal and approved data so it takes precedence over the Jeppesen NavData stored in the system.

This example uses the RNAV approach to 07R at Phoenix's Deer Valley Airport. As the approach is flown, VNAV altitudes will be automatically displayed. However, the minimum

RNAV (GPS) RWY 7R
PHOENIX DEER VALLEY (DVT)

APP CRS 074°	Rwy ldg 7311 TDZE 1460 Apt Elev 1478		

DME/DME RNP-0.3 NA.
Circling not authorized north of Rwy 7R-25L at night.
When VGSI inoperative, circling to Rwy 25R not authorized at night.

MISSED APPROACH: Climb to 5000 direct MIKSY and via 070° track to AVENT and hold, continue climb-in-hold to 5000.

ATIS 126.5	PHOENIX APP CON 120.7 239.0	DEER VALLEY TOWER* 118.4 (CTAF) (Rwy 7R-25L) 120.2 (Rwy 7L-25R)	GND CON 121.8	CLNC DEL 123.9

NOT TOBE USED FOR NAVIGATION

ELEV 1478
Rwy 7R ldg 7311'
Rwy 25L ldg 7278'

MSA DIGSS 25 NM 7800

CATEGORY	A	B	C	D
LNAV MDA	2060-1	600 (600-1)	2060-1½ 600 (600-1½)	2060-1¾ 600 (600-1¾)
CIRCLING	2400-1¼ 922 (1000-1¼)	2420-1¼ 942 (1000-1¼)	2420-2¾ 942 (1000-2¾)	2420-3 942 (1000-3)

MIRL Rwys 7L-25R and 7R-25L
REIL Rwys 7L, 7R, 25L, and 25R

PHOENIX, ARIZONA
Orig 05160

33°41'N-112°05'W

PHOENIX DEER VALLEY (DVT)
RNAV (GPS) RWY 7R

altitude bug must be set manually according to the MDA as specified on the published instrument approach plate. By pressing the soft key **MINIMUMS..**, two options are offered.

The first is MIN ALT for non-precision approaches, the second is DH for decision height on a precision approach. Select the value and push to enter..
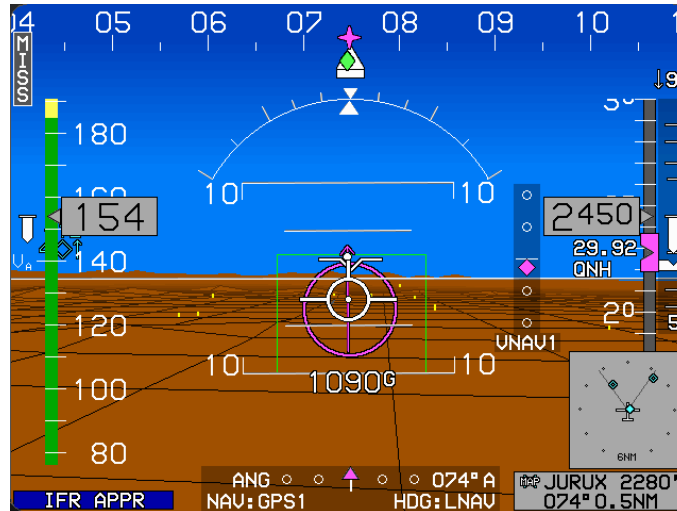
Within 30NM of the airport, terminal mode will be announced. A blue advisory flag will appear in the lower left corner of the PFD and a chime will be heard. Automatic CDI scaling will gradually transition through 1.0NM (terminal), 0.4NM, 0.3NM and then ANG. is angular like a localizer.

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

Once past the FAF, waypoint sequencing automatically suspends so as to provide CDI guidance along the extended final approach course past the MAP. "SUSPEND" is annunciated with a blue advisory flag and the MISSED menus appear in the upper left corner. The MISSED menus consist of two tiles, MISS and ARM.

When armed, the missed approach procedure will be automatically activated upon passing the missed approach

point. For more information on the SUSPEND mode, see
Waypoint Sequencing, page 3-9.

NOTE:

*The PFD has a vertical deviation indicator on the right side of
the display. The vertical deviation indicator displays vertical
deviation for the currently selected vertical navigation source.
When the selected vertical navigation source is VNAV, the
vertical deviation indicator conforms to the vertical deviation
display requirements of TSO-C146a. The vertical deviation
indicator only appears when the source of vertical navigation is
valid. When the source of vertical navigation is VNAV, the
source is valid in VNAV mode (i.e., not in target altitude sub-
mode), on level or descending legs, and when within 2NM or
twice the full scale deflection for the GPS/WAAS mode of flight
(whichever is greater) of the lateral navigation route. When the
source of vertical navigation is glideslope, the source is valid
when valid localizer and glideslope signals are received. The
currently selected vertical navigation source is annunciated
immediately below the vertical deviation indicator.*

The runway depiction, with associated skyway, aids in visualizing the runway environment, especially in situations where the final approach course and the runway are not aligned.
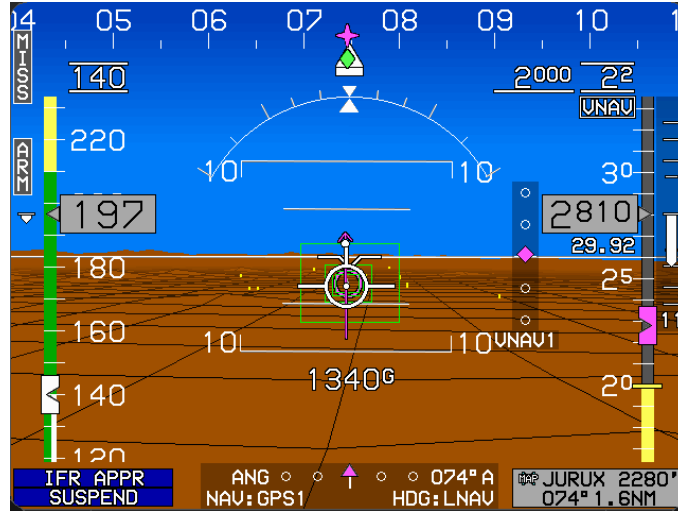
"On this runway 07R approach into Deer Valley, we see that waypoint sequencing has been suspended. The option to ARM the missed approach is presented. The annunciator at the bottom shows we are using GPS1 to navigate the approach and that the autopilot will be driven by LNAV or roll steering commands if in the HEADING mode."

Approaches with Course Reversals

NOT TO BE USED FOR NAVIGATION
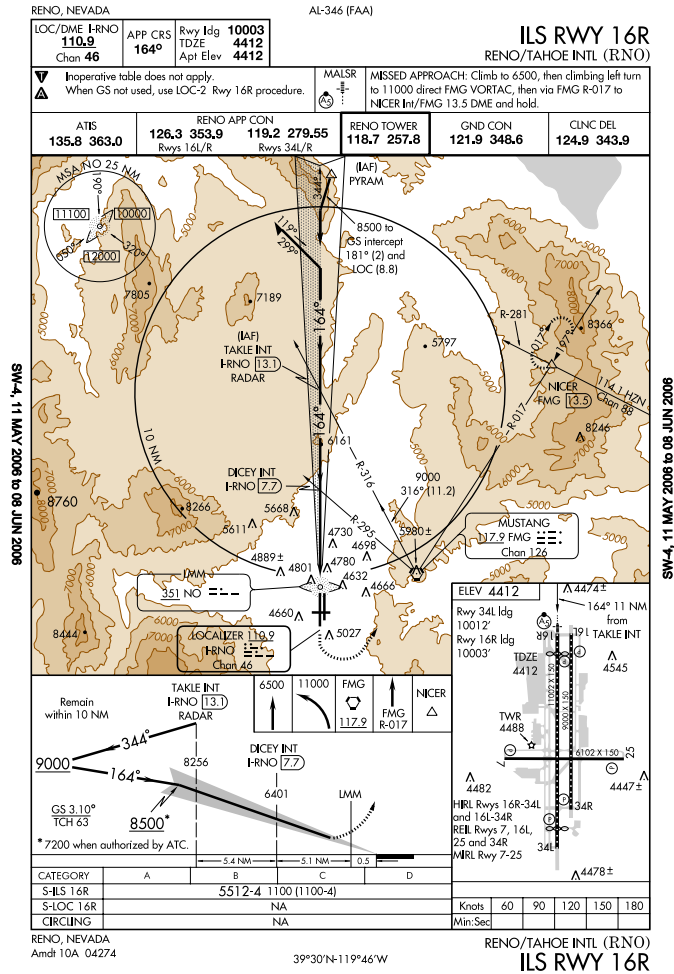
An approach may contain a course reversal, commonly in the form of a procedure turn and less commonly in the form of a holding pattern or teardrop.

• The procedure turn portion of an approach is stored as one of the legs of the approach. For this reason, there are no special operations required of the pilot, other than flying the procedure turn itself when appropriate.

• The holding pattern is composed of two legs, the entry and the hold itself. When the active leg automatically sequences from the entry to the holding pattern, the entry leg will be removed from the moving map, the **CONT (continue)** menu will be displayed, and automatic waypoint sequencing will be suspended (annunciated by a "SUSPEND" flag). Push **CONT** to continue.
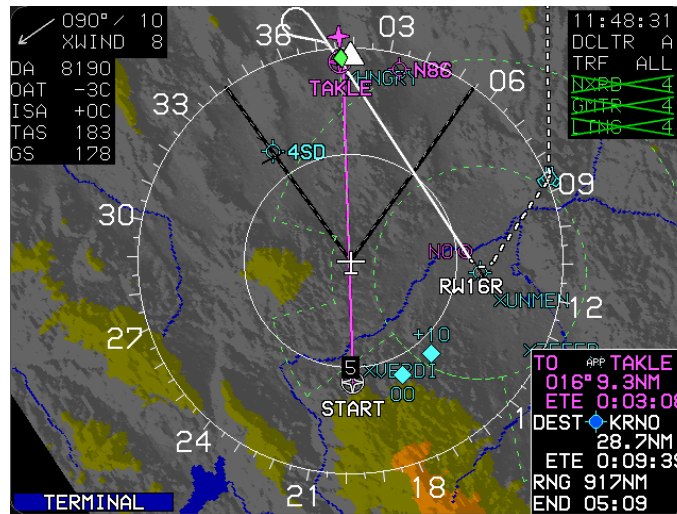
Approaches with Procedure Turns:
This example of a procedure turn uses the ILS Runway 16R approach for Reno (Nevada) Regional Airport, KRNO. The steps required to set up and fly the approach are detailed below:

1. You must have the airport entered as a waypoint (using **NRST**, **Direct-To**, or as part of an active flight plan).

2. While enroute to KRNO, approximately 40NM away, select the proper frequency to obtain airport conditions and runway usage. Frequency information is available for the destination airport by selecting the **INFO . .** menu, see **Waypoint Information (NavData and DataLink Weather), page 6-37**. From ATIS or ATC, you learn that runway 16R is in use and plan your approach accordingly.

3. Push the **ACTV** button, and select **IFR APPR . .** then the airport (**KRNO)** then **ILS16R** then the desired transition **FMG** (Mustang VOR) and finally the desired runway (**RW16R**). The approach will now be entered and displayed as a white courseline on the moving map, except the active leg, which will be magenta.

Within 30 nautical miles of the destination airport, the system will transition from "enroute" mode to "terminal" mode. The change to terminal mode is accompanied by a gradual CDI scale transition from 2.0 to 1.0NM.

During a system calculated descent, a small circle labeled T/D, that stands for top of descent, will appear along the green ground track line on the MFD. This will indicate where the pilot should begin a stabilized descent to the next VNAV published crossing altitude.
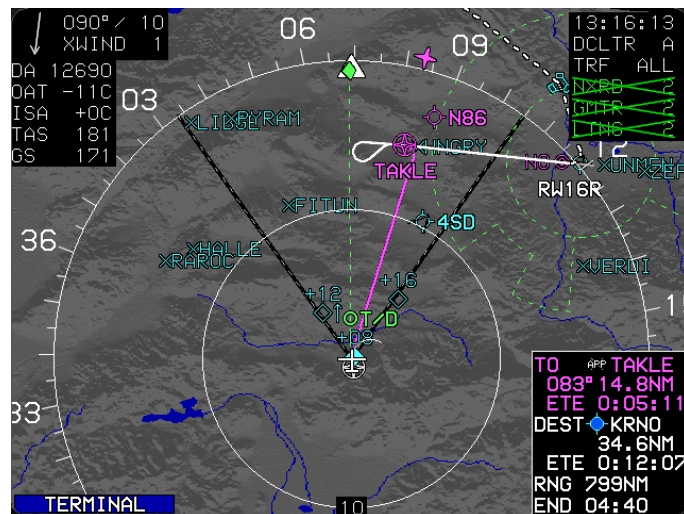
You may review the approach sequence at any time by pressing the **ACTV** button. Turn the control knob to review each segment of the approach. Bearing and distance information will be displayed for each waypoint.

For ATC assigned crossing altitudes, the VNAV functions are available. To select a VNAV assignment, push the **ACTV** button. Scroll to the desired waypoint and push enter. Select VNAV. The crossing altitude and an offset in nautical miles may be assigned. Minus numbers will be assigned prior to the waypoint.

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

As you approach the IAF (FMG), the active waypoint will be displayed as a "tethered balloon" shown on the PFD. The active leg will be displayed on the moving map. Distance, bearing and ETE will appear in the bottom right corner of the moving map. Waypoints will sequence automatically as the flight progresses. Skyway boxes will connect the waypoints to guide you through the entire procedure. No further pilot action is required.

As you pass over the procedure turn waypoint, the procedure turn segment becomes active and is displayed in magenta on the moving map. Skyway boxes continue to guide you through the turn back to the final approach fix. A small circle with T/D that stands for top of descent will appear along the green ground track line. This will indicate where the pilot should begin a stabilized descent to the next VNAV published crossing altitude.

Within 2.0NM of the final approach fix, the display will switch from "terminal" mode to "approach mode." The switch to terminal mode is accompanied by a gradual CDI scale transition from 1.0 to 0.3NM. Skyway boxes display appropriate descent points and altitudes for the approach.

As you cross the FAF, the active waypoint sequences to the MAP (RW16R in this example) and the CDI scale becomes angular like a localizer. Continue flying through the skyway toward the MAP. The **MISS** and **ARM** menu buttons will be shown in the upper left corner of the PFD only and automatic

waypoint sequencing will be suspended upon crossing the FAF. Pushing the **MISS** button at this point causes the skyway boxes to immediately depict the published missed approach. This is similar to a go around button. Pushing the **ARM** button arms the missed approach procedure and re-enables automatic waypoint sequencing. Even though **waypoint crossing altitudes are automatically entered** from the Jeppesen database, decision height or minimum descent altitude are **NOT** in the Jeppesen NavData and **MUST** be determined using the published instrument approach charts. These may be entered as a minimum altitude bug.

If the missed was armed, the first waypoint of the missed approach procedure becomes active upon passing the MAP. If not, guidance continues straight ahead along the extended runway centerline.
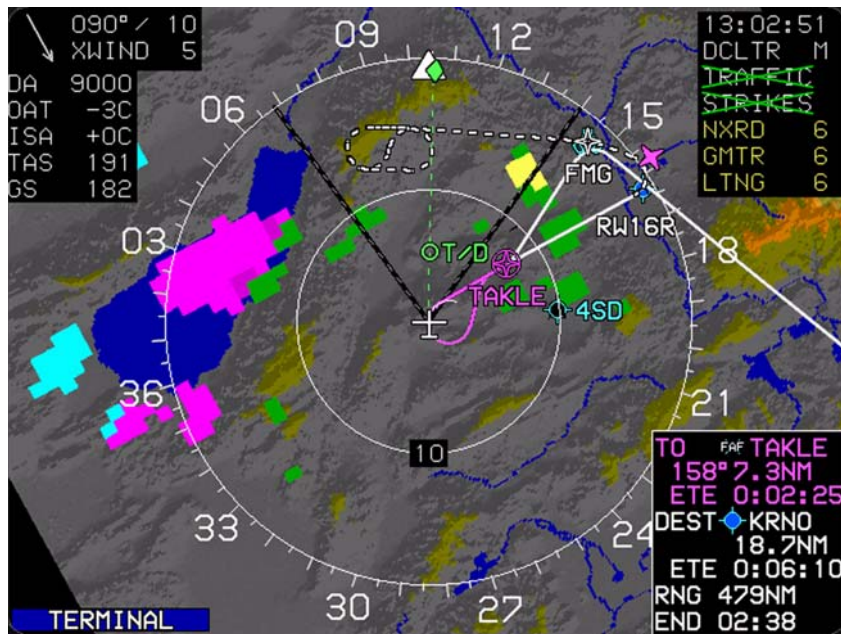
Approaches with Holding Patterns:
Select the approach in the same manner as described above.

The courseline on the moving map and the skyway on the PFD
will provide guidance and turn anticipation throughout the
procedure, including the entry to the hold (parallel, teardrop, or
direct, which will be automatically calculated).

Automatic waypoint sequencing will be suspended once you
are established in the holding pattern and the entry leg will be
removed (as shown in the example above).

To continue the approach from the holding pattern and re-
enable automatic waypoint sequencing, just push **CONT**. In
this example, the MAP (runway 30) will then become the active
waypoint upon passing BECCA.

Approaches with DME Arcs
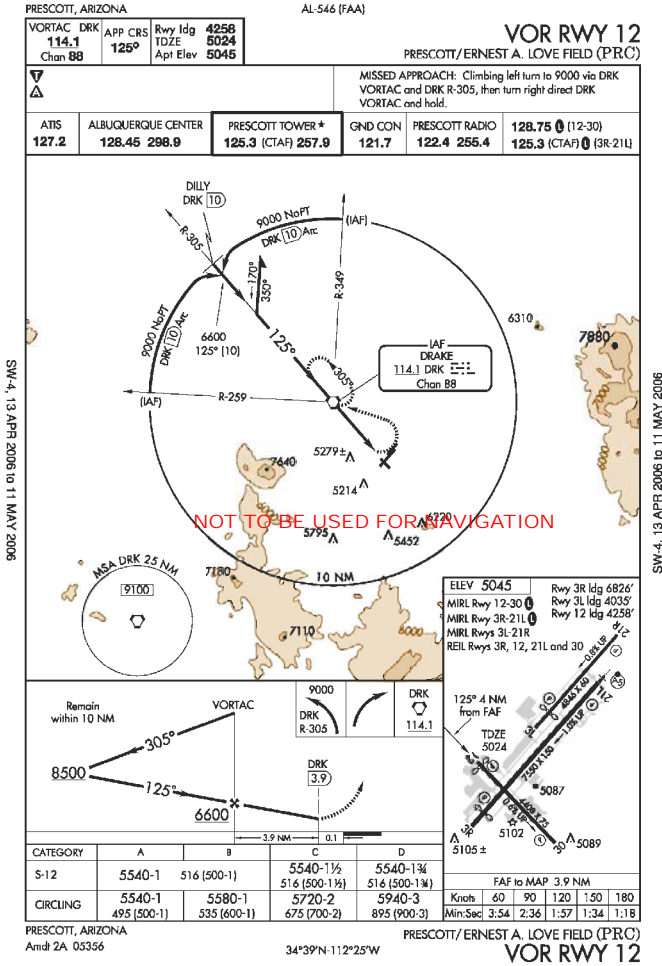
The GPS overlay for a DME arc approach uses additional Jeppesen waypoints to define the arc. These waypoints are indicated by "D" as the first letter in the waypoint name. This is followed by three numbers which indicate the radial the waypoint lies on. The last letter indicates the radius of the arc.

For example:

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

NOTE:
*For additional information on waypoint names, see **Navdata Name Conventions: Waypoint Identifiers, page 9-41**.*

When you are cleared for the approach, you may do either of the following to establish yourself on the approach:

• Use the IAF waypoint, defined by a specific radial along the arc.

• Follow ATC vectors which allow you to intercept the arc at any point along the arc.

1. You must have the airport entered as a waypoint (using **NRST**, **Direct-To**, or as part of an active flight plan).

2. While enroute to KPRC, approximately 40 nautical miles away, select the ATIS frequency to monitor airport conditions and runway usage. Frequency information is available for the destination airport by selecting the **INFO . .** menu, see **Waypoint Information (NavData and DataLink Weather), page 6-37**. From ATIS or ATC, you learn that runway 12 is in use and plan your approach accordingly.

3. Press the **ACTV** button, and scroll to KPRC. Push to Enter. Select **IFR APPR.** Then VOR **12** then the desired transition **D259J** (10-mile DME arc at the 259° radial) and finally the desired runway (**RW12**). The approach will now be entered and displayed as a white courseline on the moving map, except the active leg, which will be magenta.

Within 30 nautical miles of the destination airport, the system will transition from "enroute" mode to "terminal" mode. The change to terminal mode is accompanied by a gradual CDI scale transition from 2.0 to 1.0NM.

You may review the approach sequence at any time by pushing the **ACTV** button. Turn the control knob to review each segment of the approach. Bearing and distance information will be displayed for each waypoint. Push **INFO** to review crossing altitudes. When finished, press **EXIT** to remove menus from the screen.

As you approach the IAF (D259J), the active waypoint will be displayed as a "tethered balloon" shown on the PFD. The active leg will be displayed on the moving map. Distance, bearing and ETE will appear in the bottom right corner of the ND. Waypoints will sequence automatically as the flight progresses. Skyway boxes will connect the waypoints to guide you through the entire procedure. No further pilot action is required.
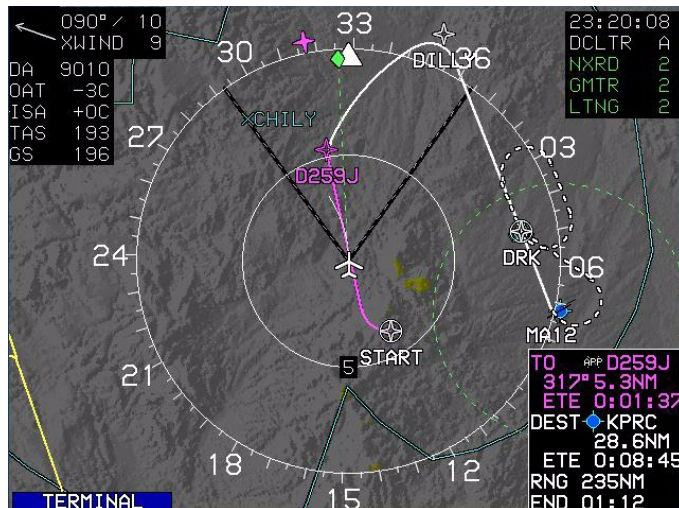
The skyway and CDI/Annunciator will provide you with continuous guidance throughout the arc, including the inbound turn from the arc to the final approach course, along with turn anticipation. Simply steer the flight path marker through the

boxes and you will make a smooth transition from the arc to the final approach course.

Within 2.0NM of the final approach fix, the display will switch from "terminal" mode to "approach mode." The switch to terminal mode is accompanied by a gradual CDI scale transition from 1.0 to 0.3NM. Skyway boxes display appropriate descent points and altitudes for the approach.

As you cross the FAF, the destination sequences to the MAP (MA12 in this example) and the CDI scale becomes angular like a localizer. Continue flying through the skyway toward the MAP. The **ARM** menu button will be shown in the upper left corner of the screens and automatic waypoint sequencing will be suspended upon crossing the FAF. Pressing the **ARM** menu button at this point arms the missed approach procedure and re-enables automatic waypoint sequencing. Even though **waypoint crossing altitudes are automatically entered** from the Jeppesen database, decision height or minimum descent altitude are **NOT** in the Jeppesen NavData and **MUST** be determined using the published instrument approach charts. These may be entered as a minimum altitude bug.

If the missed was armed, the first waypoint of the missed approach procedure becomes active upon passing the MAP. If not, course guidance is provided straight ahead along the extended final approach course.

NOTE:
To fly a DME arc without the skyway, use the VOR pointer on the moving map or the HSI; keeping it perpendicular to the longitudinal axis of the aircraft symbol will greatly simplify the arc procedure.

Vectors to Final (VTF)

When a VTF IFR approach is selected, the system will create an "IP" (Initial Point) waypoint on the extended final approach course. This is designed to allow intercept anywhere along the final approach course. **Use the heading bug to follow ATC vectors to join the final approach course**. You may arm LNAV at any time by pressing LNAV in the upper left corner of the PFD. The heading bug will be turned off and ARM will show on the annunciator. The autopilot will intercept the final approach course automatically.

The IP will be designated a fly-over waypoint, and the leg prior to the IP be a discontinuity, see **Discontinuity, page 3-139**.

Until the FAF has been passed, the system will display an advisory flag indicating that a VTF IFR approach has been selected. This is to advise the pilot that guidance is not relative to a published approach path and that **procedure clearances are not assured**.
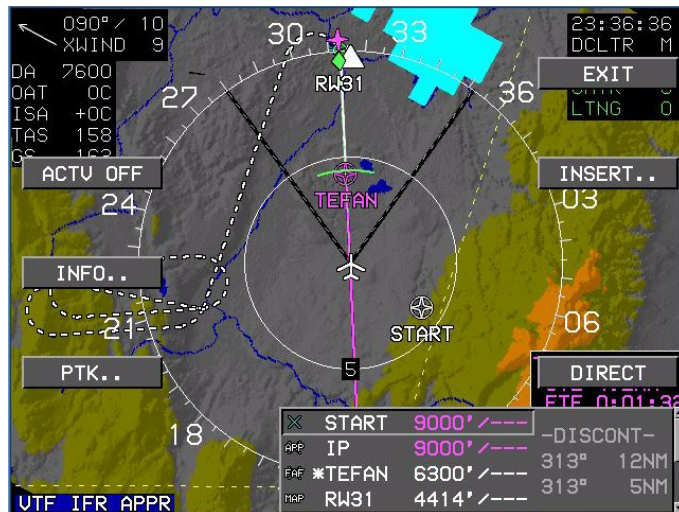
1. You must have the airport entered as a waypoint (using **NRST**, **Direct-To**, or as part of an active flight plan).

2. While enroute to KAAT (in the example above), approximately 40 nautical miles away, select the appropriate frequency to determine airport conditions and runway usage. Frequency information is available for the destination airport by selecting the **INFO . .** menu, see **Waypoint Information (NavData and DataLink Weather), page 6-37**. From ATIS or ATC, you learn that runway 31 is in use and plan your approach accordingly.

3. Push the **ACTV** button, and select **IFR APPR . .** then the airport (**KAAT**) then ***GPS31** (the asterisk indicates the approach is approved for sole source GPS approaches), then the vectors-to-final transition **- VTF -**, and finally the desired runway (**RW31**). The approach will be shown as a 15nm line beginning at the IP (initial point) and terminating at the missed approach point. The final approach fix will be shown along the course. Crossing altitude at the FAF may be checked by pushing the **ACTV** button.

Within 30 nautical miles of the destination airport, the system will transition from "enroute" mode to "terminal" mode. The change to terminal mode is accompanied by a gradual CDI scale transition from 2.0 to 1.0NM.

Using the heading bug, follow ATC vectors to join the final approach course.

Within 2.0NM of the final approach fix, the display will switch from "terminal" mode to "approach mode." The switch to terminal mode is accompanied by a gradual CDI scale transition from 1.0 to 0.3NM. Skyway boxes display appropriate descent points and altitudes for the approach.

As you cross the FAF (TEFAN in this example), the active waypoint sequences to the MAP (runway 31) and the CDI scale becomes angular like a localizer. Continue flying down the skyway toward the MAP. The **MISS** and **ARM** menu buttons will be shown in the upper left corner of the screens and automatic waypoint sequencing will be suspended upon crossing the FAF. Pressing the **ARM** menu button at this point arms the missed approach procedure and re-enables automatic waypoint sequencing. Even though **waypoint crossing**

altitudes are automatically entered from the Jeppesen database, decision height or minimum descent altitude are **NOT** in the Jeppesen NavData and **MUST** be determined using the published instrument approach charts. These may be entered as a minimum altitude bug.

If the missed was armed, the first waypoint of the missed approach procedure becomes active upon passing the MAP. If not, continued guidance is provided straight ahead along the extended runway centerline.

ILS Approaches

ILS approaches are set up and are flown in the same manner as all other approaches except they rely on the ground-based localizer and glideslope transmitters for lateral and vertical navigation.

The skyway will continue to provide both lateral and vertical guidance for the entire approach. However, unlike non-precision approaches, **the raw data from the localizer and glideslope must be used as the primary reference during the approach.**

The following steps should be added to the previously described approach procedures when flying an ILS:

1. When the heading bug is activated, an **LNAV** menu button will appear on the upper left corner of the PFD. Pushing the **LNAV** menu button will **turn off** the heading bug and arm the **LNAV mode**. The autopilot will be commanded to intercept and track the magenta courseline. The CDI/ Annunciator will indicate one of the following three possible **HDG modes**. 1. **LVL** (level) 2. **BUG** 3. **LNAV**. The mode LNAV may be overlayed with the word ARM, when the EFIS is flying an intercept angle to a magenta courseline. Note: The EFIS heading bug acts as an OVERRIDE to the selected magenta courseline. As long as there is a HEADING BUG selected, the autopilot will be commanded to fly that heading. If there is no active waypoint or flightplan, and the autopilot is engaged in

heading mode, HDG: LVL will be annunciated and the autopilot will act as a simple wing leveler.

2. Push the **OBS** button and set the HSI source to the appropriate nav source (**NAV: VLOC1** or **NAV: VLOC2**). This is done by pushing the menu button next to the source desired.

3. Push the control knob to enter.
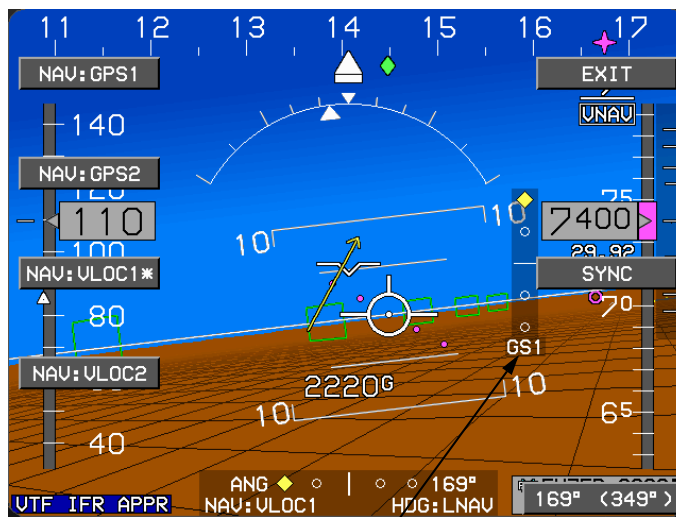
HSI and glideslope source annunciation

The HSI needle will not be displayed until a valid nav signal is received. The Asterisk indicates the selected source and the CDI/Annunciator will indicate one of the following NAV sources: **NAV:GPS, NAV:VLOC1, NAV:VLOC2** (VOR or Localizer). When an autopilot is installed and in the **NAV or Approach mode**, the EFIS will command it to follow one of the above NAV sources. NAV:GPS provides roll steering commands to the autopilot and the aircraft intercepts or remains on the magenta courseline. **NAV:VLOC1 or NAV:VLOC2** selections will provide guidance to the autopilot based on the selected NAV received frequency and OBS setting. The CDI at the bot-

tom of the PFD will provide guidance from the selected source at all times. The **HSI needle** may be selected in the PFD declutter menu. When selected, it will overlay the flight path marker. An HSI needle deflected more than two dots from center will turn from magenta to yellow. A to/from dot will appear at one end of the needle (except when receiving an ILS localizer signal). The needle may be rotated by pressing OBS and then turning the control knob. Push to enter. The selected course and the reciprocal (in parentheses) will be shown in the lower right corner of the PFD.

4. For an ILS in a normal ATC Radar environment, the **NRST ILS** function may be used. To do this, push NRST, then ILS, then scroll to the desired approach. Push to enter. A confirmation warning will appear in the lower right corner of the PFD. Push to confirm. This will activate a VTF (vectors to final) ILS approach to the selected runway, send a localizer/glideslope frequency to an appropriately equipped NAV receiver and set the HSI needle to the inbound course. A blue advisory flag **VTF IFR APPR** will appear in the lower left corner of the PFD. In addition to activating the VTF approach, the heading bug will be activated and an LNAV arming menu button will appear in the upper left corner of the PFD. The heading bug may be used to comply with the vectors supplied by ATC. When cleared to intercept the localizer, the LNAV menu button may be pushed. The autopilot will be commanded to inter-cept the final approach course. This "all angle" intercept may be accomplished up to 135 degrees off from the final approach course. When established on the localizer, the NAV or APPROACH mode on the autopilot may be cho-sen. This will allow coupling to the localizer and glideslope signals. Monitoring both the skyway boxes and the VLOC and Glideslope course deviation indicators will provide increased situational awareness on ILS approaches.

The following examples show selection of the nearest ILS approach at Reno.

Missed Approaches

Upon passing the FAF, **MISS** and **ARM** appear in the upper left hand corner and automatic waypoint sequencing is suspended (see **Waypoint Sequencing, page 3-9** for more information).
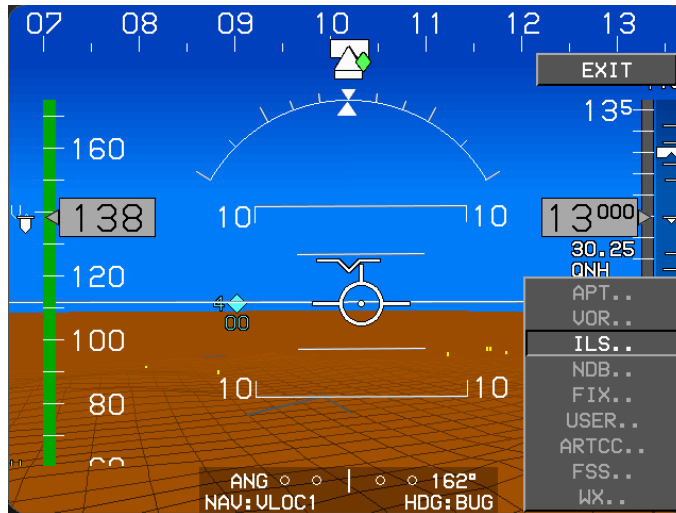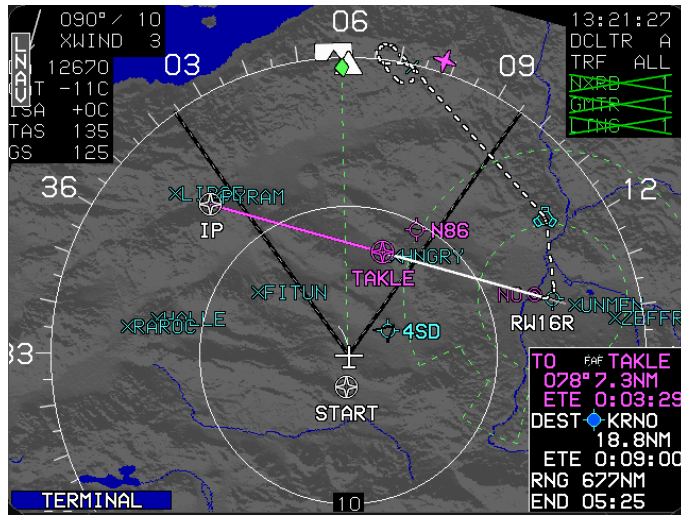
1. If desired, push the **ARM** menu button as soon as it appears. The active waypoint will automatically sequence to the first waypoint of the missed approach procedure upon passing the missed approach point. If an immediate missed approach is needed, prior to the missed approach point, push the **MISS** menu button. If autopilot guidance is required, change the autopilot mode selection back to **HEADING** at this point, from **NAV** or **APPROACH** mode. The autopilot will be commanded to follow the skyway boxes through the entire published missed approach including the proper entry to the hold.

2. On a depicted missed approach, the first waypoint shown may be a phantom waypoint as in "fly runway heading to 6,500 feet, then turn right and proceed direct to the **DRK VOR.**" Different aircraft will reach 6,500 feet at different points. The phantom waypoint's position is based on YOUR aircraft and will not have a tether anchoring it to the ground at any particular place. When reaching the published altitude for the next turn in a missed procedure, the skyway boxes will depict the upcoming direction of bank and course. After entering the hold, as published, the entry track will disappear and only the race track will be shown. The pattern will be sized according to the procedure speed (Vproc) of YOUR aircraft. If an alternate airport has been included in the active flight plan, the menu tile **CONT** will appear in the upper left corner of the PFD. Arming this function will cause waypoint sequencing to resume upon passage of the holding fix. Remember that all missed procedures are depicted by dashed lines instead of solid lines.

3. When leaving a holding pattern to re-fly the same approach again, push the ACTV button and select the IAF waypoint. To fly a different approach at the same airport, push ACTV, select the airport name in the active list, and choose another approach. The NRST ILS function as outlined this section may be used at any time as well. To reduce clutter from the screen, the pilot may push ACTV and then ACTV again. A confirmation of DELETE ACTIVE PROCEDURE is shown. If confirmed, all active waypoints will be immediately removed from both the PFD and MFD.

CONT will not appear while in a missed approach holding pattern if there is no alternate or subsequent waypoint in the active flightplan.
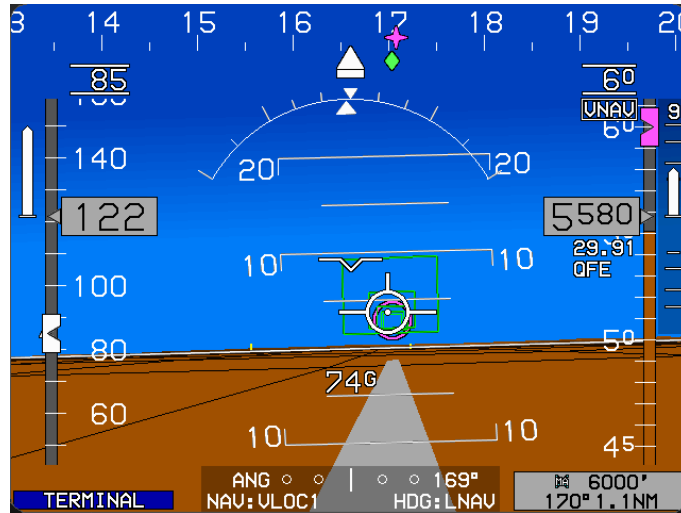
NOTE:

Not all missed approaches end in a holding pattern. Some just end with a straight course segment.

_____

NOTE:
Any time prior to the Missed Approach Point, it is possible to **activate the missed approach** *by pressing MISS.*

_____

Non-Published Holds

To create a non-published holding pattern on the MFD and associated skyway on the PFD, follow these steps.

1. Push **ACTV**.

2. Select an active waypoint from the list. Push enter.

3. Scroll down the list of options to **HOLD**. Push to enter.

4. Using the control knob, scroll through and set up the hold with selected course, direction of turns, leg distance or leg time and then push to enter.

A racetrack holding pattern will be created on the MFD. Skyway boxes will provide course guidance either manually or drive an autopilot with roll steering commands in the hold. While in the hold, a **CONT** (continue) arming button will

appear. Pushing **CONT** will arm the next leg. When the holding fix is passed, the next leg will become active automatically.
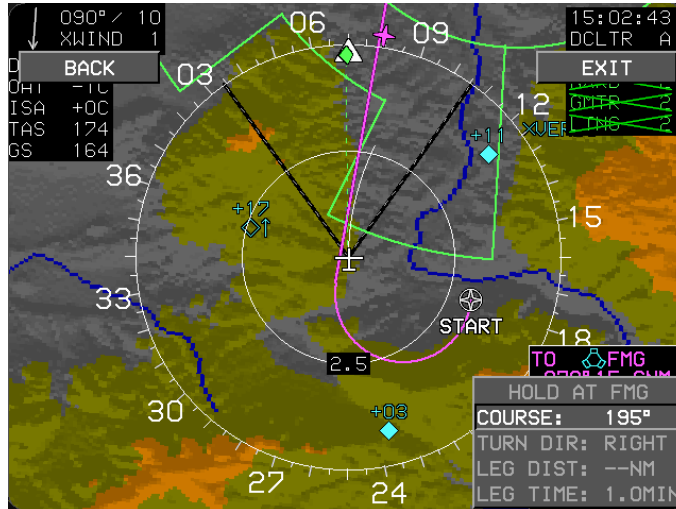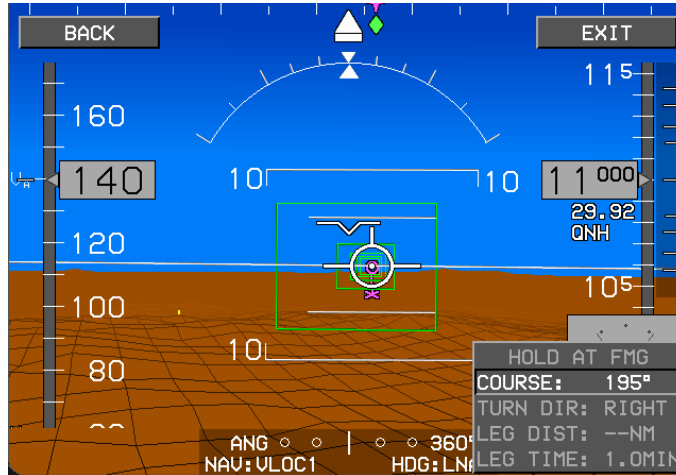
Departure Procedures (DPs)

(PILOT NAV) (WAGGE1.WAGGE) 434 98113
WAGGE ONE DEPARTURE   SL-346 (FAA)

RENO/TAHOE INTL (RNO)
RENO, NEVADA

NOT TO BE USED FOR NAVIGATION

ATIS 135.8 277.2
CLNC DEL 124.9 343.9
GND CON 121.9 348.6
RENO TOWER 118.7 257.8
RENO DEP CON 119.2 325.8

CAUTION: Intensive Glider Activity

LOVELOCK
116.5 LLC Chan 112
N40°07.50'-W118°34.66'
L-5-7, H-1-2

MUSTANG
117.9 FMG Chan 126
N39°31.88'-W119°39.36'
L-5-7, H-2

MINIMUM CROSSING ALTITUDES AT FMG
V6 Southwest   12,000
V28-113 South 10,500
V165 South   10,000

LOCALIZER 110.9
I-RNO Chan 46
N39°28.83'-W119°46.16'

N39°21.03'
W119°30.20'

SQUAW VALLEY
113.2 SWR Chan 79
N39°10.82'
W120°16.18'

HAZEN
114.1 HZN Chan 88
N39°30.98'-W118°59.86'

WAGGE
N39°15.71'
W119°46.19'
10,000

MINIMUM CLIMB RATES
Rwy 16L: 440' per NM to 9000'.
Rwy 16R: 400' per NM to 9700'.
NOTE: Chart not to scale.

DEPARTURE ROUTE DESCRIPTION

TAKE-OFF RUNWAYS 16L/R: Climb via I-RNO LOCALIZER South course to WAGGE INT, thence via (transition) or (assigned route).
All aircraft cross WAGGE INT/I-RNO 13 DME at or above 10,000. Maintain 15,000 or assigned altitude. Expect clearance to requested altitude five minutes after departure.
LOVELOCK TRANSITION (WAGGE1.LLC):
MUSTANG TRANSITION (WAGGE1.FMG):

WAGGE ONE DEPARTURE
(PILOT NAV) (WAGG1.WAGGE) 98113

RENO, NEVADA
RENO/TAHOE INTL (RNO)

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

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

• **Vector** – ATC provides radar navigation guidance to a filed route or to a fixed point depicted on the vector DP charts. Since Vector DPs are based on vectors from ATC, they are not included in the Jeppesen database and are not available in the EFIS.

1. Push the **ACTV** button and use the control knob to select the desired **airport**.

2. Using the control knob, choose **DP . .** (if **DP . .** is not shown, no pilot nav departure exists for that airport). Using the control knob, select the desired DP, the appropriate transition (if available), and the departure runway.

3. Set the minimum climb rate from the approach plate (440' per NM for 16L and 400 for 16R in the example on the previous page) by pushing the **MENU** button, then **BUGS . .**, then **VNAV CDA . .**, then **CLIMB ANG . .**, then turning and pushing the control knob to enter the desire climb angle.

4. Before departing, review the DP sequence (by pushing the
    ACTV button) and compare it with the printed plate. Turn
    the control knob to review each segment of the procedure.
    Bearing and distance information will be displayed for
    each waypoint. Push **INFO** to review crossing altitudes.
    When finished, push **EXIT** to remove menus from the
    screen.

The departure procedure, transition, and runway will be
displayed on the PFD and on the moving map. The active leg
will be displayed in magenta.
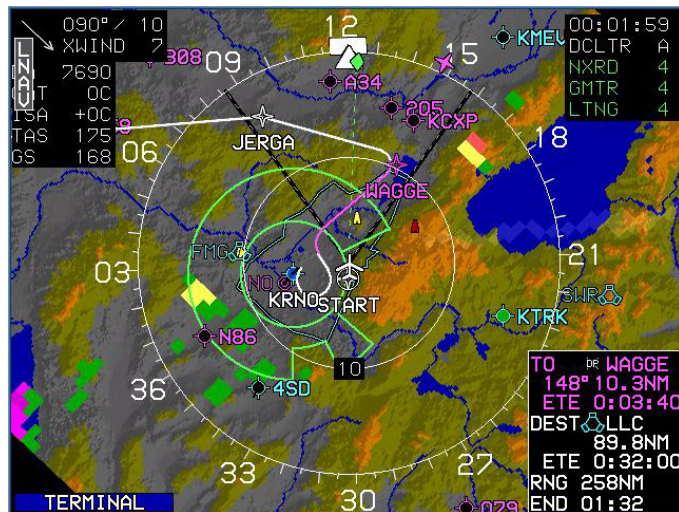
Course guidance and turn anticipation will be provided on the
PFD with skyway boxes and CDI. Skyway boxes will connect
waypoints throughout the procedure and will indicate the
required climb angle. The CDI will automatically transition
from 0.3NM for the first straight leg to 1.0NM for the duration
of the DP, finally transitioning to 2.0NM for enroute mode.

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

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

Compare the above screen with the DP plate (WAGGE ONE, Lovelock Transition) on page 8-37. The departure is made to the south to WAGGE intersection, then a left turn to JERGA intersection (shown as a lat/lon and intersecting radials on the plate), then direct to the Lovelock VOR.

Standard Terminal Arrival Routes (STARs)
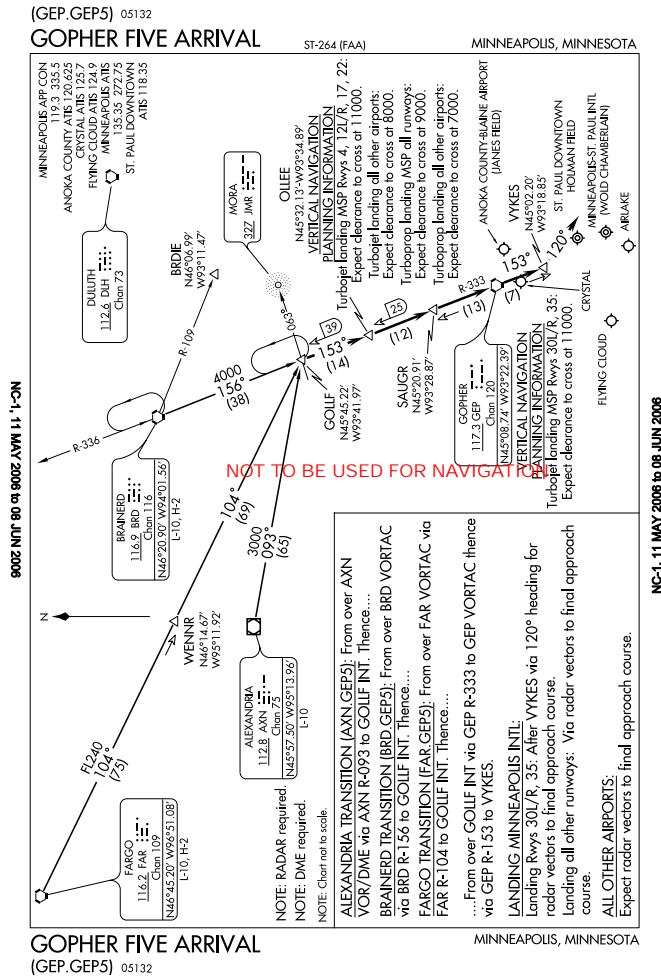
STARs are ATC coded IFR arrival routes established at busier airports to facilitate arrival and approach procedures. To select and display a STAR:

1. You must have the arrival airport entered as a waypoint (using **NRST**, **Direct-To**, or as part of an active flight plan).

2. Push the **ACTV** button and use the control knob to select the arrival **airport**.

3. Using the control knob, choose **STAR . .** (if **STAR . .** is not shown, no arrival procedure exists for that airport). Using the control knob, select the desired STAR, the appropriate transition (if available), and the anticipated arrival runway.

4. Review the arrival sequence (by pushing the **ACTV** button) and compare it with the printed plate. Turn the control knob to review each segment of the procedure. Bearing and distance information will be displayed for each waypoint. Push **INFO** to review crossing altitudes. When finished, push **EXIT** to remove menus from the screen.

The entire arrival route along with the runway will be displayed on the screens. The active leg will be displayed in magenta on the moving map.

Course guidance and turn anticipation will be provided on the PFD with skyway boxes and CDI. Skyway boxes will connect waypoints throughout the procedure.

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

Thirty miles from the destination, course guidance will switch from the enroute mode to the terminal mode and the CDI scale will transition from 2.0 to 1.0NM.

Compare the above screen with the STAR plate (GOPHER FIVE, Alexandria Transition) on **page 8-41**. The arrival is flown to the east from the Alexandria VOR (AXN), then southeast through a series of fixes to the Minneapolis-St. Paul International Airport.

STARs normally terminate at a fix near the airport, then a radar vector or feeder route is used for transition to the approach phase. If you activate an IFR approach during the STAR, the approach waypoints will be inserted after the STAR.

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Section 9

Appendix

The appendix of this document contains a variety of useful information not covered elsewhere in the manual. In this section you will find emergency/abnormal and normal procedures from the Airplane Flight Manual Supplement, operating tips, system specifications, a detailed description of TAWS functions, warranty information, feedback forms, and more.

Emergency/Abnormal Procedures

Emergency Procedures

PFD Failure

In a primary installation, in the event of a failure of the Primary Flight Display (PFD), the Multifunction Display (MFD) or Standby Instrument (whichever is installed) will be utilized to complete the current flight.

OPTIONAL AUTO-SWITCHING TO BATTERY BUS:

In the event of an electrical power failure, the EFIS will be automatically switched to the aircraft battery bus. The "ON BATT" (yellow) annunciator will illuminate indicating that the EFIS is on the aircraft battery.

OPTIONAL DEDICATED BATTERY INSTALLED:

In the event of an electrical power failure, a dedicated battery will automatically supply electrical power to the EFIS. The "BATT ARM" (white) annunciator will extinguisher and the "BATT ON" (yellow) annunciator will illuminate indicating that the EFIS is on the dedicated battery. The dedicated battery will support the pilot's EFIS for a minimum of one hour.

Abnormal Procedures

Failure of the GPS, AHRS or ADC, singly or in combination, adversely impacts the capabilities of the EFIS. Failure of these components is annunciated visually and audibly. In addition, the EFIS software provides reversionary modes to show as much useful and accurate information as possible in light of the failure condition. See **Failure Modes, page 3-142**.

The following sections detail procedures for reversionary modes:

PFD Failure

In a primary installation, in the event of a failure of the Pilot's/ Co-pilot's Primary Flight Display (PFD) – Press the lower right-hand knob on the Multifunction Display (MFD) to display the primary flight instruments on the MFD.

Pilot's Attitude/Heading Failure

In a primary installation, in the event of the loss of attitude and heading information on the Primary Flight Display (PFD) – Refer to the standby Attitude Instrument for airplane attitude information. The EFIS will continue to display all other functions, including ground track, which may be used in lieu of heading.

GPS Failure

GPS can degrade or fail as a result of loss of satellite information or GPS equipment failure. GPS degradation is

annunciated with a "GPS LOI" caution flag and an aural tone to indicate GPS loss of integrity. In this mode, the GPS data loses the WAAS accuracy but remains as accurate as traditional GPS.

Further GPS degradation causes the EFIS to lose GPS updating of aircraft position, ground speed and ground track, and the ability to calculate wind information. A "GPS LON" caution flag is displayed to indicate GPS loss of navigation along with a "GPS failure" voice annunciation.

For more information regarding GPS failure modes, see **GPS Failure, page 3-146**.

Loss of GPS affects the accuracy of the FPM. While the vertical component of the FPM is unaffected by a Loss of GPS, the lateral component is based on GPS track and GPS ground speed. Track and ground speed use the last known wind as part of the computations. However, unlike the dead reckoning position solution, the effects of Loss of GPS on the accuracy of the FPM lateral component are not cumulative. Also, the FPM remains an accurate tool for maintaining level flight during a GPS failure. The flight path marker is grayed to indicate degraded performance after 1 minute of continuous GPS outage, based on Part 27 MEOT feedback.

In the event of the loss of GPS – Immediately revert to navigation based on dead reckoning and transition to other navigation sources as soon as possible.

In the event of loss of GPS during an IFR approach procedure at or after the final approach fix and still IMC – Initiate the missed approach procedure.

Airdata Failure

In a primary installation, in the event of the loss of air data information (Airspeed and Altitude) on the Primary Flight Display (PFD) – Refer to backup Airspeed and Altitude Instruments.

Auxiliary Sensor Failure

In the event of an auxiliary sensor failure (optional AIU, WX-500 or traffic sensor), refer to the **FAULTS** menu to determine which sensor has failed. In a failure condition, associated symbology is automatically removed from the display. No action is required from the pilot.

With an AIU failure in an installation where the AIU is providing analog guidance signals to an autopilot, the analog guidance signals will be nulled and the autopilot will maintain a wings level attitude and will no longer respond to EFIS guidance. With ARINC429-capable autopilots, ARINC429 roll steering guidance from the EFIS continues to function.

Normal Procedures

Power Up and Self Test

Apply power to the system by applying aircraft power and placing the EFIS Master Switch(s) in the ON position.

System will perform an automatic Self-Test. Passing is indicated by a "**Push any Key to Continue**" screen. At this time, verify that the databases are current. Failure is indicated by a "BIOS error," "system not found," blank screen, screen with no image, continual screen resetting (booting) or a "CRC error."

Operation

Normal operating procedures are outlined in **Step-by-Step Procedures, page 6-1** of this document.

Display Annunciation/Messages

Caution / Warning / Advisory System is outlined in **Caution/Warning/Advisory System, page 2-16** of this document.

System Annunciators/Switching

NOTE:
Actual switches installed are dependent on aircraft
configuration

EFIS Master Switch

The optional EFIS Master Switch is a 2-position toggle switch
located on the Pilot's instrument panel. Alternately, the EFIS
may be connected to the Avionics Master Switch.

"ON BATT" Annunciator

With optional auto-switching to battery bus installed, in the
event of an electrical power failure, the EFIS will be
automatically switched to the aircraft battery bus. The "ON
BATT" (yellow) annunciator will illuminate indicating that the
EFIS is on the aircraft battery.

"BATT ON / BATT ARM" Annunciator

With optional dedicated battery installed, in the event of an
electrical power failure, the optional dedicated battery will
automatically supply electrical power to the EFIS. The "BATT
ARM" (white) annunciator will extinguisher and the "BATT
ON" (yellow) annunciator will illuminate indicating that the
EFIS is on the dedicated battery.

TAWS Inhibit Annunciator/Toggle Switch

The "TAWS INHIBIT" (yellow) annunciator switch, when
activated, illuminates and inhibits the visual and audible TAWS
alerting functions. The "TAWS INHIBIT" annunciator switch
is located near the EFIS displays. This switch may be a toggle
switch in which the position of the switch serves as
annunciation of activation.

TAWS Caution/Warning

1. Terrain Awareness CAUTION: When a terrain awareness
CAUTION occurs, take positive corrective action until the alert
ceases. Stop descending or initiate either a climb or a turn, or

both, as necessary, based on analysis of all available instruments and information.

2. Terrain Awareness WARNING: If a terrain awareness WARNING occurs, immediately initiate and continue a climb that will provide maximum terrain clearance, or any similar approved vertical terrain escape maneuver, until all alerts cease. Only vertical maneuvers are recommended, unless either operating in visual meteorological conditions (VMC), or the pilot determines, based on all available information, that turning in addition to the vertical escape maneuver is the safest action, or both.

For more information on TAWS, see **Terrain, page 3-63** and **TAWS (Terrain Awareness and Warning System) Functions, page 9-12**.

EFIS Mute Switch

The EFIS Mute Switch, located on the Pilot's control wheel or on the instrument panel, mutes EFIS active voice alerts.

Sensor Select Annunciator Switches / Toggle Switches (Dual Sensor Installations Only)

A Sensor Select annunciator switch for each dual sensor installation may be located near the pilot's EFIS displays. A separate switch is used for each sensor type (i.e. GPS, ADC, AHRS). In an annunciator switch, the sensor selection is annunciated by illumination of the switch (i.e., GPS 1). This switch may be a toggle switch in which case the up position selects the number 1 sensor and the down position selects the number 2 sensor.

EFIS/AIU Operations with Autopilot Integration

The following discussions relate to using the EFIS to provide guidance signals to the autopilot. All autopilot operations should be performed in accordance with the autopilot user's manual for the system installed in the aircraft.

Heading Mode

There are two methods to operate the EFIS with the autopilot in Heading mode; using the heading bug or using a flight plan following GPS guidance. The Heading Select Sub-mode is a higher priority than the active flight plan. If the Heading Bug is active, the EFIS will provide guidance based on the Heading Bug. If the Heading Bug is deactivated, the EFIS will provide guidance based on the flight plan.

Heading Bug: Select HDG mode on the autopilot. Push the **HDG** (Heading) button to activate the heading bug. Turn the right knob to select the desired heading and push the knob to activate the heading selection.

To deactivate, push the **HDG** button followed by the **OFF** menu.

GPS Guidance: Select **HDG** mode on the autopilot. Activate a flight plan. The EFIS will provide guidance to follow the flight plan using GPS WAAS signals.

Navigation (NAV) Mode

To operate the EFIS with the autopilot in Navigation mode, select the navigation source and the OBS radial. Push the **OBS** button to activate the OBS mode. Press the menu buttons to select the HSI source to be used: **GPS**, **VLOC1**, or **VLOC2**. Turn the right knob to select an OBS radial, or to select "Auto" mode and push the knob to activate the selection.

Approach (APPR) Mode

To operate the EFIS with the autopilot in Approach mode, select an appropriate approach. Push the **ACTV** button and turn the right knob to the type of approach (VFR or IFR). Push the knob to select which approach, transition, and runway will be used. Push the **OBS** button and push the menu buttons to select the HSI source to be used: **GPS**, **VLOC1**, or **VLOC2**. Follow the approach procedure displayed to fly the approach.

An alternate method if receiving vectors to final is to select the appropriate HSI source: **GPS**, **VLOC1**, or **VLOC2**. With the

autopilot's Approach mode armed, set the Heading Bug to provide heading guidance until the airplane is approaching the extended runway centering. Turn off the Heading Bug to allow the autopilot to capture and follow the approach navigation guidance.

NOTE:

*If the angle between the heading and inbound course is within 135° and the heading bug is turned off on the EFIS, present heading will be maintained until intercept occurs on the localizer. Some autopilots must be in **ALTITUDE HOLD** or **GLIDESLOPE** mode to enable glideslope capture. See your autopilot flight manual supplement for more information.*

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 skyway 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 so 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 and push the control knob to select **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 can be a source of anxiety for any pilot. The Chelton 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.

Zoom Mode

Zoom on may be used to view a larger depiction of the runway.

Unique Names for Flight Plans

Multiple routes between the same airport pairs are numbered automatically (KPSP-KPDX [1], KPSP-KPDX [2], etc.). A little ingenuity will work around this and apply easy-to-remember differentiation. Say you regularly fly an eastern and western route from Palm Springs to Portland, depending on weather or MOA activity. Create two user waypoints at Palm Springs named PSPE and PSPW. Then create two flight plans, one starting with PSPE and one starting with PSPW, both having KPSP as the SECOND waypoint (for activating a DP). Add the individual routes and end both at Portland. If you want to fly the western route, choose PSPW - KPDX. For the eastern route, choose PSPE - KPDX.

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 (Terrain Awareness and Warning System) Functions

The IDU provides TSO-C151b TAWS functionality. Depending upon aircraft configuration settings and external sensors/switches, the system is configurable as a Class A, B or C TAWS or a Class A or B HTAWS. Functions provided by TAWS are:

1. Terrain Display: Display of terrain and obstacles on the PFD and ND.

2. Forward Looking Terrain Awareness ("FLTA"): A warning function that uses a terrain database and an obstruction database to alert the pilot to hazardous terrain or obstructions in front of the aircraft.

3. Premature Descent Alert ("PDA"): A warning function that alerts the pilot when descending well below a normal approach glidepath on the final approach segment of an instrument approach procedure.

4. Excessive Rate of Descent (GPWS Mode 1): A warning function that alerts the pilot when the rate of descent is hazardously high as compared to height above terrain (i.e., descending into terrain).

5. Excessive Closure Rate to Terrain (GPWS Mode 2): A warning function that alerts the pilot when the rate of change of height above terrain is hazardously high as compared to height above terrain (i.e., flying level over rising terrain).

6. Sink Rate after Takeoff or Missed Approach (GPWS Mode 3): A warning function that alerts the pilot when a sink rate is detected immediately after takeoff or initiation of a missed approach.

7. Flight into Terrain when not in Landing Configuration (GPWS Mode 4): A warning function that alerts the pilot when descending into terrain without properly configuring the aircraft for landing.

8. 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 is 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:
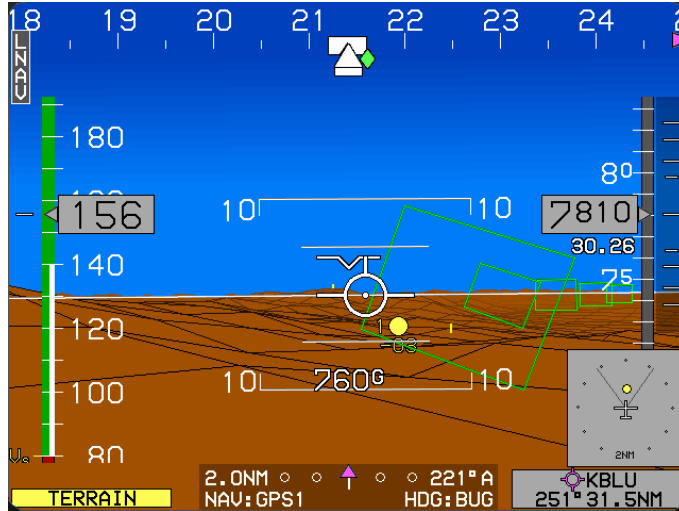
Above: TAWS Caution on PFD.
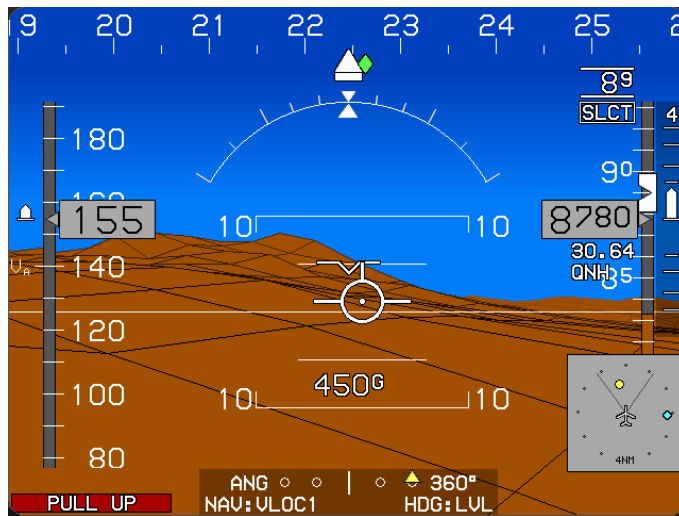
Above: TAWS warning on PFD.

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, yellow 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 FAR's; 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. Yellow and red are used to show terrain areas causing an FLTA alert as further described in the FLTA section below. Such coloration complies with the requirement that terrain elements causing an FLTA alert be distinguishable from those that do not. The following screen capture shows terrain and obstructions on the navigation display:
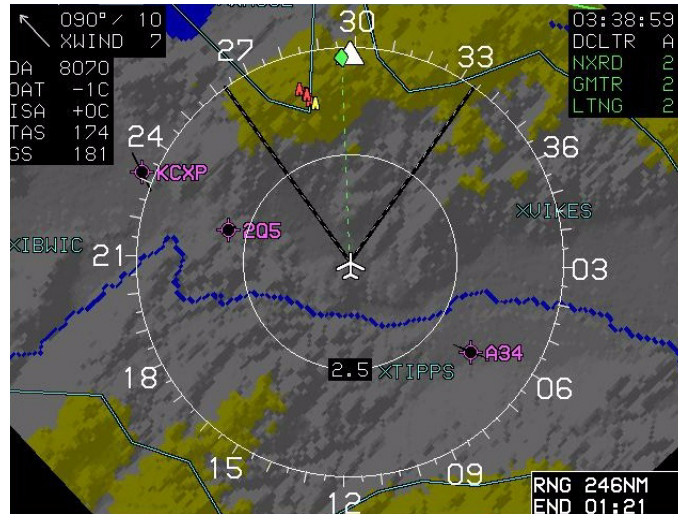
Above: Obstructions and non-threatening terrain on the moving map; no TAWS warning.
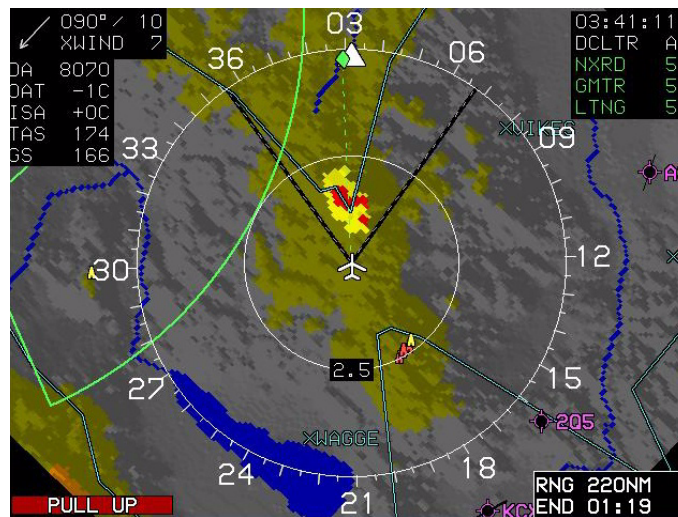
Above: Threatening terrain on the moving map generating a TAWS warning.

The Terrain Display function can be manually inhibited by the pilot for decluttering. In addition, under certain failure conditions, the Terrain Display function is automatically inhibited. When the Terrain Display function is inhibited, the primary flight display background changes to a solid blue over brown presentation without a fishnet or atmospheric perspective. This makes it clear to the pilot that terrain is not being displayed and obviates the need for an annunciation on the primary flight display. On the navigation display, the word TERRAIN with an X over the top is displayed in the upper right hand corner. If the Terrain Display function is manually disabled, the X will be green. If the Terrain Display function is automatically disabled due to an abnormal condition, the X will be red.

Forward Looking Terrain Alert Function:

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

GPS/WAAS Navigation Mode Slaving

The EFIS performs TSO-C146a GPS/WAAS system functions in addition to the TAWS functions. As a result, GPS/WAAS navigation mode is available as an input to the TAWS. In accordance with RTCA/DO-229C, the user can select an IFR procedure (Approach, DP, or STAR) that automatically changes the GPS/WAAS navigation mode to Enroute, Terminal, Departure, or IFR Approach as appropriate. In addition, the EFIS allows the user to select a VFR approach to any runway or user waypoint with a defined approach path. Selection of a VFR approach causes automatic GPS/WAAS navigation mode changes to Enroute, Terminal or VFR Approach as appropriate. If the GPS/WAAS navigation mode is higher in precedence than the default FLTA mode, the FLTA mode is slaved to the GPS/WAAS navigation mode. The order of precedence is: (1) Departure Mode; (2) Approach Mode (IFR or VFR); (3) Terminal Mode; and (4) Enroute Mode. When slaved, the GPS/WAAS active runway threshold or user waypoint will be the reference point for automatic FLTA inhibiting. The

advantage of this methodology is that the GPS/WAAS navigation modes are a direct indication to the FLTA function of pilot intent. Thus, it provides a mechanism for rotorcraft or bush pilots to desensitize the TAWS when conducting normal off-runway operations.

Default FLTA Mode

If the default FLTA navigation mode is higher in precedence than the GPS/WAAS navigation mode, the FLTA mode will be slaved to the default FLTA navigation mode. The order of precedence is: (1) Departure Mode; (2) Approach Mode; (3) Terminal Mode; and (4) Enroute Mode. These modes are as follows:

1. Departure Mode. This mode is enabled when on the ground (defined as indicated airspeed less than or equal to Vs. AND AGL altitude less than 75 feet). The reference point for automatic FLTA inhibiting and mode envelope definition is the last point at which the ground definition was satisfied (this will be near the liftoff point). The Departure Mode will end upon climbing through 1,500 feet above or traveling more than 6NM from the reference point.
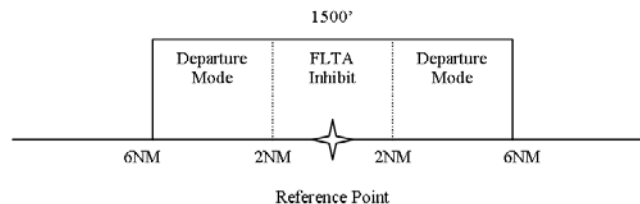
2. Other Modes. For other default FLTA modes, the reference point for automatic FLTA inhibiting and mode envelope definition will be the nearest runway threshold. The TAWS continuously searches all runway thresholds at the nearest airport to determine the nearest runway. The TAWS performs a search for the nearest airport every 3NM of distance traveled. Modes are as follows:

a. Approach Mode. This mode exists when within 1,900 feet and 5.0NM of the reference point.

b. Terminal Mode. This mode exists from 5NM to 15NM from the reference point when below an altitude that varies from 1,900 feet (at 5NM) to 3,500 feet (at 15NM) above the reference point.

c. Enroute Mode. This mode exists when not in any other mode.
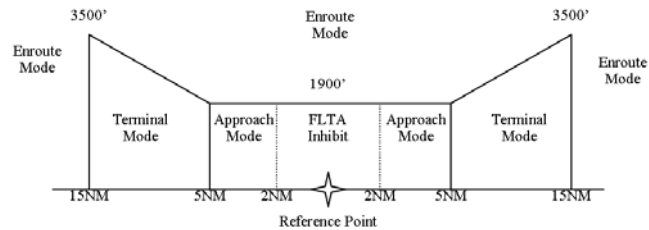
FLTA Search Envelope:

The FLTA search envelope is an area in front of and below the aircraft. If terrain or an obstruction 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 degrees of bank. In addition, search volume expansion is debounced such that at 10° of bank, the bank angle must be continuously held for 3.25 seconds. The amount of debouncing is reduced linearly with increased bank angle such that at 30° of bank, there is no debounce time. Debouncing is intended to reduce nuisance search volume expansions when experiencing bank angle excursions due to turbulence.

5. Aircraft Vertical Speed: Aircraft vertical speed is used to determine which RTC values should be used. At vertical speeds above -500fpm, level and climbing flight RTC values are used. At vertical speeds less than or equal to -500fpm, descending flight RTC values are used. In addition, vertical speed is used to increase the descending flight RTC value used by the system. The increase in descending flight RTC is based upon a 3 second pilot reaction time and VSI leading according to the level-off rule parameter.

FLTA search volume is depicted below:
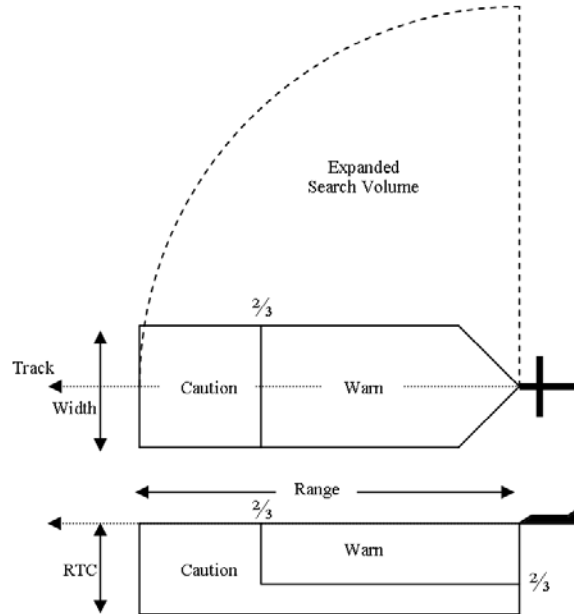
FLTA Alerts and Automatic Popup:

When terrain falls within the FLTA search envelope an FLTA warning is generated as described in **Caution/Warning/ Advisory System, page 2-16**. In addition, an automatic popup mode will be engaged as follows:

Primary Flight Display	Multi-Function Display
Terrain rendering enabled.	1. Display switched to navigation display. 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 is able to manually change any setting that was automatically changed by the popup mode. In addition, a "RESET" button appears for 20 seconds to allow the pilot to reset the previous screen configuration with one button press. The following screen capture shows the ND in popup mode.

Premature Descent Alert Function:

This function applies to airplane TAWS systems. The PDA function uses the GPS/WAAS navigation database, GPS/WAAS navigation mode, aircraft position, and aircraft altitude to alert the pilot when descending well below a normal approach glide path on the final approach segment of an instrument approach procedure.

The PDA function is armed when on the final approach segment of an IFR approach procedure and below the FAF crossing altitude. The alerting threshold for the PDA function is 0.5° less than the lower of: (1) a straight line from the FAF to the approach runway threshold; or (2) 3°. When the aircraft descends below the threshold, a yellow TOO LOW caution flag

is presented in conjunction with a single Too Low Terrain voice alert. The PDA alert threshold is depicted below:
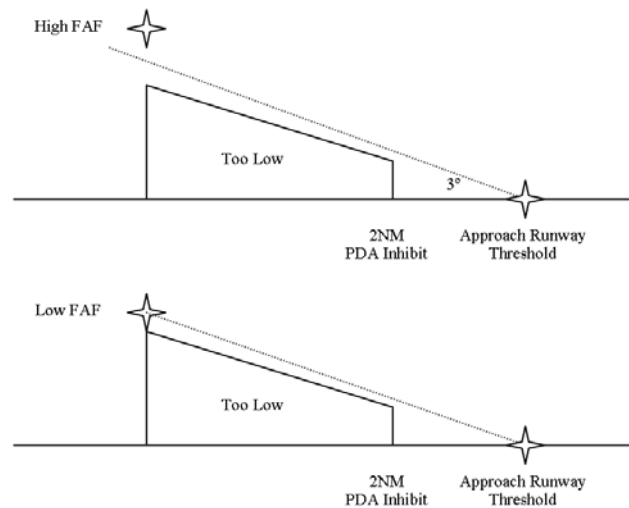
Excessive Rate of Descent (GPWS Mode 1):

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, a yellow 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 rotorcraft operations for HTAWS systems.

Excessive Closure Rate to Terrain (GPWS Mode 2):

This function is present in Class A TAWS and HTAWS systems. The GPWS Mode 2 function uses filtered AGL rate and AGL altitude to alert the pilot when the rate of change of height above terrain is hazardously high as compared to height above terrain (i.e., flying level over rising terrain). AGL rate filtering is based upon a sampling distance that varies with AGL altitude. Sampling distance varies from 0.5NM at 0'AGL to 0.2NM at 2,500'AGL.

There are two Mode 2 envelopes: Mode 2A which is active when not in landing configuration; and Mode 2B which is active when in landing configuration. Envelope selection is determined as follows:

Aircraft Type	Mode 2A	Mode 2B
Airplane RG + F	Flaps NOT in landing configuration.	Flaps in landing configuration.
Airplane RG	Landing Gear UP	Landing Gear DOWN
Airplane FG + F	Flaps NOT in landing configuration	Flaps in landing configuration
Airplane FG	AGL Altitude > 500' OR IAS > Note 1	AGL Altitude < 500' AND IAS < Note 1
Rotorcraft RG	Landing Gear UP	Landing Gear DOWN
Rotorcraft FG	AGL Altitude > 200' OR IAS > 80KIAS	AGL Altitude < 200' AND IAS < 80KIAS

Notes: RG + F = Retractable Gear with Defined Landing Flaps Position
        RG = Retractable Gear
        FG + F = Fixed Gear with Defined Landing Flaps Position
        FG = Fixed Gear
        1. Normal Landing Pattern Speed + 15KIAS

When the GPWS Mode 2 envelope is pierced, a GPWS Mode 2 warning is generated as described in **Caution/Warning/ Advisory System, page 2-16**. Envelopes are defined below:

Mode 2A (NOT in Landing Configuration):
The system uses the RTCA/DO-161A Mode 2A envelope for TAWS systems, and a similar curve modified for rotorcraft operations for HTAWS. The upper limit of the curves includes an airspeed expansion function.

Mode 2B (Landing Configuration):
The system uses the RTCA/DO-161A Mode 2B envelope for TAWS systems, and a similar curve modified for rotorcraft operations for HTAWS systems.

Sink Rate after Takeoff or Missed Approach (GPWS Mode 3):

This function is present in all TAWS and HTAWS classes. The GPWS Mode 3 function uses aircraft vertical speed information and AGL altitude to alert the pilot when a sink rate is detected immediately after takeoff or initiation of a missed approach.

GPWS Mode 3 is armed by either being on the ground (defined as indicated airspeed less than V_s (airplanes) / 40KIAS (rotorcraft) AND AGL altitude less than 75 feet) or by being on the first leg of a missed approach procedure (as determined by the EFIS FMS) with distance to the active runway threshold increasing. GPWS Mode 3 is disarmed upon climbing through 700 feet AGL, traveling more than 6NM from the last point at which the ground definition was satisfied (this will be near the liftoff point), or transitioning to the second leg of a missed approach procedure. GPWS Mode 3 has a caution threshold based upon height above terrain and vertical speed. When below the caution threshold, a GPWS Mode 3 warning is generated as described in **Caution/Warning/Advisory System, page 2-16**

Flight into Terrain when not in Landing Configuration (GPWS Mode 4):

This function is present in Class A TAWS and HTAWS. The GPWS Mode 4 function uses aircraft speed information and AGL altitude to alert the pilot when descending into terrain without properly configuring the aircraft for landing. There are two Mode 4 envelopes: Mode 4A which gives cautions when landing gear is in other than landing configuration; and Mode 4B which gives cautions when landing gear or flaps are in other

than landing configuration. Applicability of Mode 4 envelopes to aircraft types is as follows:

Aircraft Type	Mode 4A	Mode 4B
Airplane RG + F	Landing Gear UP	Landing Gear UP OR Flaps not in landing configuration.
Airplane RG	Landing Gear UP	Landing Gear UP
Airplane FG + F	Not Applicable	Flaps not in landing configuration
Airplane FG	Not Applicable	Not Applicable
Rotorcraft RG	Landing Gear UP	Not Applicable
Rotorcraft FG	Not Applicable	Not Applicable

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

Mode 4 alerting criteria require that the Mode 4 envelope be entered from above. Changing aircraft configuration while within a Mode 4 envelope will not generate an alert.

Airplane Mode 4 envelopes consist of a low-speed region and a high-speed region. When Mode 4A alerting criteria is met in the low-speed region, a yellow 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, a yellow 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, a yellow 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, a yellow TOO LOW caution flag is presented in conjunction with a single Too Low Gear voice alert. In the high-speed region, a yellow 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 rotorcraft operations for HTAWS systems.

Excessive Downward Deviation from an ILS Glideslope (GPWS Mode 5):

This function is present in Class A TAWS and HTAWS systems. The GPWS Mode 5 function uses ILS glideslope deviation information and AGL altitude to alert the pilot when an excessive downward glideslope deviation is detected on the final approach segment of an ILS approach. GPWS Mode 5 is armed when a valid glideslope signal is being received AND the aircraft's 5 second filtered descending glide path is greater than 1° AND the aircraft is below 1,000' AGL.

GPWS Mode 5 has a caution threshold and a warning threshold. When below the warning threshold, a red GLIDESLOPE warning flag is presented in conjunction with a repeating Glideslope voice alert. When above the warning threshold but below the caution threshold, a yellow GLIDESLOPE caution flag is presented in conjunction with a single Glideslope voice alert. The system uses RTCA/DO-161A Mode 5 for TAWS and HTAWS.

500-Foot Wake-Up Call:

This function is present in all TAWS classes. The 500-Foot function includes an arming deadband of 500 feet to prevent nuisance warnings during low altitude operations. Thus, the aircraft must climb above 1,000 feet AGL to arm the 500-Foot function. Once armed, the 500-Foot function works by simply issuing a "Five Hundred" voice alert when descending through 500 feet AGL.

External Sensors and Switches:

The EFIS TAWS system requires a variety of inputs from external sensors and switches to perform its functions. These inputs are summarized below:

1. GPS/WAAS receiver. The GPS/WAAS receiver is the source of aircraft position, geodetic height, horizontal

figure of merit, vertical figure of merit, loss of integrity and loss of navigation inputs for the TAWS. The GPS/WAAS receiver connects directly to the EFIS IDU.

2. Air Data Computer. The air data computer is the source of barometric altitude, outside air temperature, and vertical speed for the TAWS. The air data computer connects directly to the EFIS IDU.

3. ILS Receiver. An ILS receiver is the source of glideslope deviation for the TAWS. The glideslope receiver connects to an external signal conversion box that communicates digitally with the EFIS IDU.

4. Radar Altimeter. A radar altimeter is the source for radar altitude for the TAWS. The radar altimeter connects to an external signal conversion box that communicates digitally with the EFIS IDU.

5. Gear Position Sensors. Three individual landing gear position discretes are the source of landing gear position for the TAWS. The landing gear position discretes are of the pull-to-ground type and connect directly to the EFIS IDU. Each discrete is grounded when the landing gear to which it is connected is down and locked.

6. Flap Position Sensor. A flap position discrete is the source of flap position for the TAWS. The flap position discrete is of the pull-to-ground type and connects to an external signal conversion box that communicates digitally with the EFIS IDU. The flap position discrete is grounded when the flaps are in the landing configuration.

7. TAWS Inhibit Switch. A TAWS Inhibit Switch is used for manual inhibiting of TAWS alerting functions. The TAWS Inhibit Switch is of the latching type and gives an obvious indication of actuation (i.e., toggle / rocker or pushbutton with indicator light). The TAWS Inhibit Switch is connected directly to the EFIS IDU. The TAWS Inhibit Switch is activated when manual inhibiting of TAWS alerting functions is desired.

8. Low Altitude Mode Switch. A Low Altitude Mode Switch is used for inhibiting and modifying HTAWS alerting functions to allow normal operation at low altitudes. The Low Altitude Mode Switch is of the latching type and gives an obvious indication of actuation (i.e., toggle / rocker or pushbutton with indicator light). The Low Altitude Mode Switch is connected directly to the EFIS IDU. The Low Altitude Mode Switch is activated when operation in Low Altitude Mode is desired.

9. Audio Cancel Switch (MUTE button). An Audio Cancel Switch is used for silencing active voice alerts. The Audio Cancel Switch is of the momentary type. The Audio Cancel Switch is connected directly to the EFIS IDU. The Audio Cancel Switch is momentarily depressed when silencing of active voice alerts is desired.

10. Glideslope Deactivate Switch. A Glideslope Deactivate Switch is used for inhibiting the GPWS Mode 5 function. The Glideslope Deactivate Switch is of the momentary type. The Glideslope Deactivate Switch connects to an external signal conversion box that communicates digitally with the EFIS IDU. The Glideslope Deactivate Switch is momentarily depressed when inhibition of the GPWS Mode 5 function is desired.

11. Low Torque Sensor. A low torque discrete is used for inhibiting and modifying HTAWS alerting functions during an autorotation. The low torque discrete is of the pull-to-ground type and connects to an external signal conversion box that communicates digitally with the EFIS IDU. The low torque discrete detects when engine torque is less than 7.5%.

The following tables list the applicability of external sensors and switches for various aircraft and TAWS system types:

Sensors/Switches Connected Directly to IDU							
Aircraft Type	TAWS/ HTAWS Class	GPS/WAAS	ADC	Gear Position Sensor	TAWS Inhibit Switch	Audio Cancel Switch	Low Altitude Mode Switch
Airplane RG + F	A	X	X	X	X	X	
Airplane RG	A	X	X	X	X	X	
Airplane FG + F	A	X	X		X	X	
Airplane FG	A	X	X		X	X	
Rotorcraft RG	A	X	X	X	X	X	X
Rotorcraft FG	A	X	X		X	X	X
Airplane	B or C	X	X		X	X	
Rotorcraft	B	X	X		X	X	X

Sensors/Switches Connected to External Signal Conversion Box						
Aircraft Type	TAWS/ HTAWS Class	ILS	Radar Altimeter	Flap Position Sensor	Glideslope Deactivate Switch	Low Torque Sensor
Airplane RG + F	A	X	X	X	X	
Airplane RG	A	X	X		X	
Airplane FG + F	A	X	X	X	X	
Airplane FG	A	X	X		X	
Rotorcraft RG	A	X	X		X	X
Rotorcraft FG	A	X	X		X	X
Airplane	B or C					
Rotorcraft	B					

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

TAWS Basic Parameter Determination:

The fundamental parameters used for TAWS system functions are: (a) aircraft position, groundspeed, and track; (b) MSL altitude; (c) terrain data; (d) obstacle data; (e) AGL altitude; (f) vertical speed; (g) terrain closure rate; and (h) runway/ reference point location. There are redundant sources for some of these parameters. These parameters are acquired for use by the EFIS as follows:

1. Aircraft position, groundspeed and track. Aircraft position, groundspeed and track come solely from the GPS/WAAS. In order to be considered valid for use by the TAWS, the following conditions must be met:

    a. There is no GPS/WAAS loss of integrity caution;

    b. There is no GPS/WAAS loss of navigation caution; and

   c.   GPS/WAAS horizontal figure of merit (HFOM) is less than or equal to 0.3NM.

2.   MSL altitude. The primary source for MSL altitude is GPS/WAAS geodetic height. In order for GPS/WAAS geodetic height to be considered valid for use as MSL altitude, the following conditions must be met:

   a.   There is no GPS/WAAS loss of integrity caution;

   b.   There is no GPS/WAAS loss of navigation caution; and

   c.   GPS/WAAS vertical figure of merit (VFOM) is less than or equal to 75 feet.

      The secondary source of MSL altitude is temperature corrected barometric altitude from an air data computer.

3.   Terrain data. The sole source for terrain data is a terrain database. In order for terrain data to be considered valid for use by the TAWS, the following conditions must be met:

   a.   Aircraft position is valid;

   b.   Aircraft position is within the boundaries of the terrain database; and

   c.   The terrain database is not corrupt as determined by a CRC 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 check at system initialization.

Note that obstacle data is only used for depicting obstacles.

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 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.

5. The FLTA function is automatically inhibited in HTAWS applications when the airspeed is below 50 knots to prevent spurious warnings when hovering or landing off-airport.

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 Functions:

The following manual inhibit functions can be selected by the pilot:

1. The Terrain Display function can be manually inhibited using the EFIS declutter menu.

2. All TAWS alerting functions can be manually inhibited by actuation of the external TAWS Inhibit Switch. The Terrain Display function is not affected by the TAWS Inhibit Switch.

3. In HTAWS systems, the TAWS Inhibit Switch disables the pop-up function such that the map does not automatically change scaling.

4. 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.

5. GPWS Mode 5 can be manually inhibited by actuation of the momentary Glideslope Cancel Switch when below 2000' AGL. GPWS Mode 5 manual inhibit is automatically reset by ascending above 2000' AGL or descending below the automatic inhibit altitude (50 feet AGL with radar altimeter AGL source or 100 feet AGL with terrain database AGL source).

Jeppesen NavData Chart Compatibility

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Aeronautical Information Compatibility

Jeppesen Airway Manual Charts are the same publications which Jeppesen has provided to the aviation community for many years. Jeppesen NavData has not been around for quite as long, but has established and maintained the same reputation for accuracy, reliability, and dependability with those customers who use computerized navigational systems and other computer navigation data bases from Jeppesen. For those who subscribe to both services, slight differences may occasionally be noted between what is seen on the chart and what is generated from the navigation data base. These differences may be caused by any or all of the following:

1. **Differences in Publication Criteria.**
   Jeppesen computerized NavData is updated and issued every 28 days. This is a relatively quick and simple operation for the user, since all of the changes are included on the updated media which is loaded into the aircraft navigation system or a main-frame computer system. The charts are quite a different story, as each chart must be individually updated and published. The new charts are then collated and mailed, and once received by the customer, must be filed individually in the Airway Manual. Variations, such as differences in information cut-off dates and lead time requirements, may bring about distribution in one medium before the other. These differences are generally resolved in the Jeppesen NavData NOTAMs and the Jeppesen Chart NOTAMs. The NOTAMs provide a weekly or bi-weekly update to the NavData and Chart services. A review of the Jeppesen NOTAM pages prior to using either service will help to ensure that you have the most current information.

2. **Differences in the Method Used to Determine Bearing and Distance Values on Charts and in Computerized Navigational Systems.**
    Bearings and distances on airways, approach transitions, and instrument approaches are published in a country's Aeronautical Information Publication (AIP). Almost exclusively, these values are taken from the AIP and published on Jeppesen charts. In contrast, the navigation database contains exact locations of the navaids used to form tracks of airways, approach transitions, and instrument approaches. System software computes geodetic route bearings and distances based on the most current navaid information on the desired route, and presents this data on the system display. Slight differences in bearing and distance may not be changed in the AIP, and therefore, may not change on the Jeppesen charts. But if navaid information has changed even minutely, differences may show up because the bearings and distances displayed are computed by the navigation system or computer flight planning software each time a particular track is called up.

3. **Differences in Waypoint Names and Coordinates.**
    Waypoint names published on Jeppesen charts are taken directly from official government sources. In some countries, there are no restrictions on the number of characters used in the name. Computerized navigation system software limits waypoint names to a maximum of five characters. Therefore, waypoint names with more than five characters will be abbreviated for entry into the navigation data base. Note that the basic structure of the name is retained, and it should be relatively easy to tie that abbreviation generated by the data base to the complete name of the waypoint on the chart. In addition, there are unnamed turning points and intersections depicted on charts which must be included in the navigation data base. Therefore, certain names may appear in a computerized system which do not appear on a chart. The method used to identify these turning points and intersections is also included in "Nav-Data 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 computer-
   ized navigation systems. For example, consider an
   approach transition from the enroute structure to an instru-
   ment 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 proce-
   dures. But occasionally a procedure will define an
   approach transition which is not a named STAR and which
   is not connected to an instrument approach procedure.

When neither of the conditions is met, approach transitions of this type may not be entered into the navigation data base. Certain approaches are also incompatible with system software, and may not be entered into the navigation data base. In most cases, these restrictions do not apply to publication of Jeppesen charts. All types of routes and approaches may be published on Jeppesen charts, but depending on the capabilities of the computerized navigation system, they may not appear in the system data base, and therefore you may not be able to call them up on your system display.

SUMMARY

Any or all of the above may cause slight differences between charts and information generated from the navigation data base. The Jeppesen NavData NOTAMs and Chart NOTAMs should be reviewed prior to using either Jeppesen service. As a final note, be sure to obtain a preflight briefing to ensure that you have knowledge of any last minute changes affecting your flight.

Navdata Name Conventions: Waypoint Identifiers

Waypoint names entered into the navigation data base are limited to a maximum of five characters. Official waypoint names assigned by a country's aviation information authority often have other than five characters. For compatibility with the navigation data base, waypoint identifiers are assigned to all waypoints in accordance with the ground rules set forth as follows:

A. VOR, VORDME, VORTAC, TACAN and Non-Directional Beacons (NDB).

Waypoints located at any of the above types of facilities will take on the official 1-, 2-, 3-, or 4-character identifier of the facility in question.

Examples:
Los Angeles VORTAC LAX

Tyndall TACAN PAM
Ft. Nelson NDB YE
Newark NDB EWR

B. NDB

NDB as Waypoint Concept

For systems employing the "NDB as Waypoint" concept, waypoints located at NDB's will be identified by the use of the station identifier followed by the alpha characters "NB".

Examples:
Ft. Nelson NDB YENB
Newark NDB EWRNB

C. Named RNAV Waypoints, Intersections and Reporting Points.

In many countries, these waypoints are assigned unique 5-character names, with the identifier the same as the name. For waypoints not so named, identifiers are developed using the following rules sequentially until 5 or fewer character groups emerge.

1. One-Word Names

a. Use the full name if five characters or less are involved.

Examples:
ACRA, LOGAN, PIKE, DOT

b. Eliminate double letters.

Examples:
KIMMEL becomes KIMEL
COTTON becomes COTON
RABBITT becomes RABIT

c. Keep first letter, first vowel and last letter. Drop other vowels starting from right to left.

Examples:
ADOLPH becomes ADLPH

BAILEY becomes BAILY
BURWELL becomes BURWL

d.   Drop consonants, starting from right to left.

Examples:
ANDREWS becomes ANDRS
BRIDGEPORT becomes BRIDT

2.   Multiple Word Names

Use the first letter of the first word and abbreviate the last word using the above rules for one-word names to reduce it to four characters.

Examples:
CLEAR LAKE becomes CLAKE
ROUGH AND READY becomes RREDY

3.   Phonetic Letter Names.

a.   When an ICAO phonetic alpha character is used as a waypoint name (Alpha, Bravo, Charlie, etc.), use the rules established in paragraph C.1 above. When more than one waypoint in a country has the same phonetic name, obtain uniqueness by applying rule E below.

Examples:
Waypoint November becomes NOVMR
Waypoint Charlie becomes CHARE
Waypoint Alpha remains ALPHA

b.   When a double phonetic, such as Tango India, is used as the waypoint name, use the rules established in paragraph C.2 above.

c.   When a phonetic alpha character followed by a numeric and/or other alpha characters (A1, A1N, B2, etc.), is used as the waypoint name, it will appear the same in the data base as shown on aeronautical charts.

D. Unnamed Waypoints

1. Unnamed Turn Points, Intersections and Bearing/ Distance Waypoints

(For bearing/distance waypoints on terminal area procedures, see paragraph F.2)

a. If an unnamed turn point, intersection or bearing/ distance waypoint is collocated with a named waypoint or NAVAID station on a different route structure (e.g., low level or approach), the name or identifier of the collocated waypoint is used.

Example:
Unnamed turn point on J2 between Lake Charles (LCH) and New Orleans (MSY) VORTAC's 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. 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. 3. If it is unnamed and not an NDB, use letters OM followed by the runway number.

   Example:
   Outer Marker for Runway 26 becomes OM26

BOTTOM LINE:

**ALWAYS VERIFY NAVDATA APPROACH DETAILS
WITH PRINTED INSTRUMENT APPROACH
PROCEDURES, FLY THE SKYWAY, AND NEVER
DESCEND BELOW THE MINIMUM DESCENT
ALTITUDE OR DECISION HEIGHT UNLESS THE
RUNWAY IS IN SIGHT.**

**REPORT ANY MAJOR NAVDATA INCONSISTENCIES
TO CHELTON FLIGHT SYSTEMS IMMEDIATELY
USING THE SERVICE DIFFICULTY REPORT IN THIS
APPENDIX.**
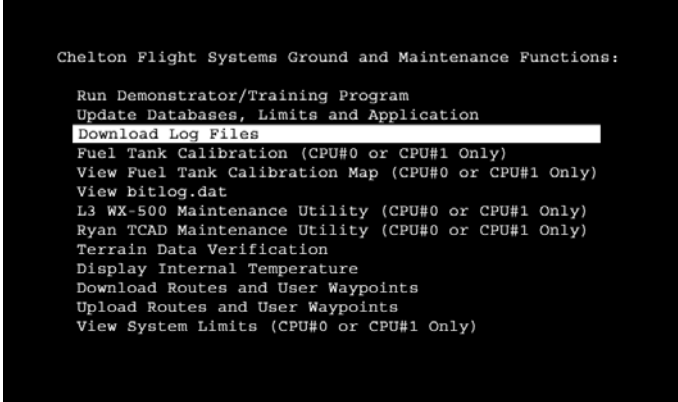
Data Logging and Retrieval

Overview

Chelton Flight Systems EFIS log all data associated with a flight, including all flight instrument and navigation data. These data can be downloaded for review after a flight.

Data from the last 5 flights are logged at a one-second interval. There is no reasonable limit to the lengths of the flights. On system initialization, each log file is a comma delimited ASCII file. The file contains a date stamp and each line contains a time stamp (Zulu time).

To access the data, power the system OFF, insert a data card, and power the system ON. Use the control knob to scroll to "Download Log Files" and push to enter.


```
Chelton Flight Systems Ground and Maintenance Functions:

  Run Demonstrator/Training Program
  Update Databases, Limits and Application
  Download Log Files
  Fuel Tank Calibration (CPU#0 or CPU#1 Only)
  View Fuel Tank Calibration Map (CPU#0 or CPU#1 Only)
  View bitlog.dat
  L3 WX-500 Maintenance Utility (CPU#0 or CPU#1 Only)
  Ryan TCAD Maintenance Utility (CPU#0 or CPU#1 Only)
  Terrain Data Verification
  Display Internal Temperature
  Download Routes and User Waypoints
  Upload Routes and User Waypoints
  View System Limits (CPU#0 or CPU#1 Only)
```

The files will be copied to the data card. Power the system OFF before removing the card.

These log files (*.dat) can be opened and manipulated (charting, graphing, etc.) in Microsoft Excel or other spreadsheet applications that support comma-delimited data format or using Chelton's FlightMetrics flight analysis software.

Data Format

There are two lines per time stamp; the first line contains navigation and airdata parameters and the second line contains engine parameters. The parameters, listed in spreadsheet column order, are as follows:

Navigation/Airdata line:

1. Time Stamp

2. Aircraft Latitude in Degrees

3. Aircraft Longitude in Degrees

4. Aircraft Altitude in Feet

5. Aircraft Pitch in Degrees

6. Aircraft Bank in Degrees

7. Aircraft Heading in Degrees True

8. Aircraft Track in Degrees True

9. Aircraft Indicated Airspeed in Knots

10. Aircraft True Airspeed in Knots

11. Aircraft Groundspeed in Knots

12. Aircraft VSI in Feet per Minute

13. Aircraft Glide path in Degrees

14. Aircraft Computed AOA in Degrees

15. Aircraft G-force

16. Computed Wind Speed in Knots

17. Computed Wind Direction in Degrees True

18. Outside Air Temperature in Degrees Fahrenheit

19. Density Altitude in Feet

Service Difficulty Report

Photocopy, complete, then fax to 208-389-9961.

Name:	Phone:
Flight No.	Date:
Aircraft:	N#:
Software Version:	Error Code:
Route:	Duration of flight:
Conditions:	
Remarks: (Include time, altimeter setting, OAT, ALT, IAS, TAS, GS, heading, track, position, flight segment, pilot action, system response, is problem repeatable.)	

Limited Warranty

"Warrantor" means Chelton Flight Systems Inc.

"Warrantee" means the end user, operator, or aircraft owner.

"Product" means any FlightLogic®, Chelton EFIS® or HeliSAS® equipment manufactured and supplied by Warrantor and includes end items, line replaceable units and components thereof.

"Buyer" means the Warrantor authorized dealer for the relevant Product (an "Authorized Dealer") to whom the Product is first shipped by Warrantor.

"Nonconformance" means having a defect in workmanship or material or a failure to materially conform to Warrantor's Product specifications. Normal wear and tear and the need for periodic maintenance and regular overhaul do not constitute a Nonconformance.

Warrantor warrants that the Product will be free from Nonconformances for the lesser of (i) thirty (30) months from the date of shipment to Buyer or (ii) twenty four (24) months from installation of the Product by an Authorized Dealer in an airframe which the Warrantor recommends as suitable for the Product (the "Warranty Period"). This warranty applies to the Buyer and subsequent legal owners of the Product (the "Warrantee") and is valid subject to the terms and conditions set out below.

Warrantee must complete and return to Warrantor a warranty card and a copy of the completed FAA Form 337 or CAA Installation Approval Form if applicable within [30] days of a change in ownership and/or installation of the Product in an airframe. A copy of the warranty card may be obtained from any Authorized Dealer and is also available on Warrantor's website (www.cheltonflightsystems.com).

Warrantee must notify Warrantor in writing immediately upon discovery of a Nonconformance during the Warranty Period and return the Product to an Authorized Dealer within thirty (30) days after such discovery.

Warrantor's obligation and Warrantee's sole remedy under this warranty is repair or replacement, at Warrantor's sole discretion, by Warrantor of a Product which exhibits a Nonconformance during the Warranty Period (a "Nonconforming Product"). A Product which is repaired or replaced under this warranty is warranted only for the unexpired portion of the original Warranty Period.

For Certified equipment, Warrantor shall bear round trip shipping costs for a Nonconforming Product in an amount not to exceed standard surface shipping charges to and from the nearest Authorized Dealer within the continental United States. Outside the continental United States, the Warrantee or Authorized Dealer shall be responsible for all shipping costs to and from the Warrantor including import/export fees, taxes, duties, customs fees, documentation fees and clearance fees. If the Authorized Dealer elects to use express, overnight or other priority shipping service, Authorized Dealer shall bear any additional costs of such service. The party initiating transport shall bear the cost of insuring the item shipped against loss or damage in transit. If Warrantor determines in its sole judgment after analysis of the returned Product that a Nonconformance does not exist then the Authorized Dealer shall incur all costs relating to the improper return including, but not limited to, analysis and shipping costs. Warrantor shall not be liable for any costs in relation to the removal or re-installation of the Nonconforming Product in an airframe.

For Non-Certified equipment, Warrantor shall bear round trip shipping costs for a Nonconforming Product in an amount not to exceed standard surface shipping charges to and from the Buyer or Warrantee (per Warrantee request) within the continental United States. Outside the continental United States, Warrantee shall be responsible for all shipping costs to and from the Warrantor including import/export fees, taxes, duties, customs fees, documentation fees and clearance fees. If the Warrantee or Buyer elects to use express, overnight or other priority shipping services, the Warrantee or Buyer shall bear any additional costs of such service. The party initiating transport shall bear the cost of insuring the item shipped against loss or damage in transit. If Warrantor determines in its sole

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judgement after analysis of the returned Product that a Nonconformance does not exist then the Warrantee shall incur all costs relating to the improper return including, but not limited to, analysis and shipping costs. Warrantor shall not be liable for any costs in relation to the removal or re-installation of the Nonconforming Product in an airframe.

Warrantor will not be liable under this warranty if the Product has been subjected to, or an alleged Nonconformance arises in conjunction with: (1) operation, use, maintenance, repair, installation, handling, packaging, transportation or storage which is improper or otherwise not in compliance with Warrantor's recommendations; (2) alteration, modification or repair by anyone other than Warrantor or an Authorized Dealer; (3) accident, contamination, foreign object damage, abuse, neglect or negligence after shipment of the Product to Buyer; (4) damage caused by failure of any other hardware or software whether supplied by Warrantor or not; (5) use of counterfeit or replacement parts that are not approved for use in the Product by Warrantor; (6) any product or component not manufactured by Warrantor which carries a separate warranty from its original manufacturer but Seller shall pass through to Warrantee such manufacturer's warranty to the extent permitted; (7) products normally consumed in operation or which have a normal expected life inherently shorter than the Warranty Period including, but not limited to, consumables (e.g. batteries, light bulbs, etc.); (8) damage caused to any other hardware or software as a result of the Nonconformance. This warranty shall be void if the Product is installed in an airframe by anyone other than Warrantor or an Authorized Dealer in accordance with Warrantor's installation instructions or if it is installed in an airframe which is not recommended as suitable for the Product by Warrantor.

Warrantor has no obligation under this warranty unless Buyer and all subsequent Warrantees maintain records that accurately document operating time, maintenance and overhaul performed and the nature of the Nonconformance. Upon Warrantor's request, Warrantee shall give Warrantor access to these records for substantiating warranty claims and analysing the Nonconformance.

Warrantor reserves the right to make changes, additions or improvements in design to its Products but shall not be required under this warranty or otherwise to upgrade a Nonconforming Product for such changes, additions or improvements.

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