GENESYS AEROSYSTEMS

3D SYNTHETIC VISION EFIS

HIGHWAY-IN-THE-SKY NAVIGATION

GRAPHICAL FLIGHT MANAGEMENT SYSTEM

COMPLETE FLIGHT AND NAVIGATION INSTRUMENTATION SYSTEM

EFIS Version 7.0E Pilot Guide

Pilot Operating Guide and Reference

Document 64-000054-070E

Software Version 7.0E

Record of Revisions	Retain this record in front of manual. Upon receipt of a revision, insert changes and complete table below.	
Revision Number	**Revision Date**	**Insertion Date/Initials**
1st Ed	Nov, 2010	
Rev A		

7.0E Rev A Differences

1) Entire document revised with higher resolution images.
2) Removed the majority of Rotorcraft images from section 3 and 5 and relocated in section 4.
3) Completed Appendix section 9 with more thorough Finmeccanica (Agusta) AW-109SP symbology description.
4) Removed partial descriptions of TAWS and HTAWS from throughout the document and created HTAWS section at the end of section 4 and Fixed Wing TAWS description at the end of section 8.
5) Changed format of section 7 for description of Instrument procedures with new layout.
6) Reformatted the Warnings, Cautions, and Advisories table for clarity and reduction in actual columns.
7) Added new name for the EFIS Training Tool and provided instructions for loading and operating in section 8.
8) Relocated Highway in the Sky description from section 3 to section 7.
9) Revised table of contents for each section and master Index provisioned for fully interactive and searchable secure PDF.
10) Changed company name to Genesys Aerosystems.
11) Relocated IDU Initialization description to new location in section 2.
12) Added Routes and Waypoints description for VFR Waypoints example in section 8.
13) Added AHRS Modes for Heading Source description in section 7.

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Section 1 Introduction

Revision Record

Rev	Notes	Date	Author
A	Rev A includes new images and some reformatting with HTAWS described in detail in Section 4. The PDF is fully hyperlinked and interactive. There are no change bars due to the entire pilot guide being changed and or updated. There have been no IDU software changes associated with this Rev A document.		G Schmidt

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1.1. Introduction

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.

The Genesys Aerosystems EFIS (Electronic Flight Instrument System) installed in this aircraft was conceived and designed as a "pilot-centered" system. While still highly automated, this type of system, common in other 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 allow for highly automated approaches, but its predictive nature provides the pilot unprecedented awareness of upcoming maneuvers. Contrary to the traditional idea of overloading the pilot with information and options, this Genesys Aerosystems EFIS clearly and concisely presents only necessary information which reduces pilot workload while greatly decreasing task complexity as it minimizes confusion. The result is safer flying with less stress and fatigue.

The Genesys Aerosystems EFIS Flight Logic 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 experience is gained with this advanced integrated system, pilots will fly with more precision, awareness, and confidence.

1.2. Before You Fly

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

WARNING:

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

Using the Demonstration Application built into the EFIS, pilots may fly anywhere and perform any procedure (except takeoff and landing) that may be done in the aircraft. To use this feature:

1) With the power off, insert memory card gold side up (IDU-III) or lift the USB Memory Flash door and insert a USB Flash Memory Storage Device into the display (IDU-450).

Figure 1-1: Memory Data Card (IDU-III)

Figure 1-2: USB Memory Flash Door (IDU-450)

2) Power the system on and select the **RUN DEMONSTRATION/TRAININGAPPLICATION** option using the right-hand encoder ❶ (turn to scroll, push to enter).

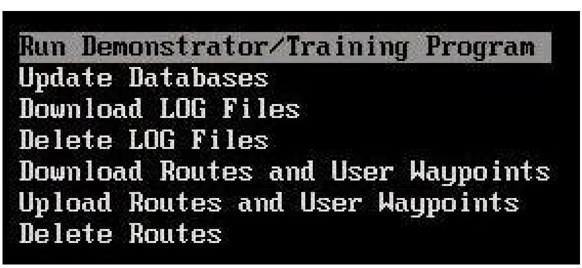

Figure 1-3: Run Demonstrator/Training Application

3) The demonstrator begins flying over Reno, Nevada. Heading maybe changed with the encoder on the PFD. Altitudes may be changed by setting a target altitude via the bugs menu, see

Section 5.55 PFD Bug (BUGS) Menu. Airspeed remains relatively constant. The simulated aircraft may be positioned anywhere in the navigation database. By creating and activating a flight plan in training mode, any published procedure may be practiced prior to flight. Push the encoder to switch back and forth from PFD to MFD. All appropriate nav signals are simulated, allowing for non-precision and precision approaches to be practiced. Localizer signals are normally found on VLOC1, and VOR signals are 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.

Flying with a flight instructor prior to using the system is recommended. Professional instruction and recurrent training are also highly recommended. Genesys Aerosystems utilizes a FITS (FAA Industry Training Standards) accepted training curriculum and syllabus comprising of a minimum of 10.5 flight hours of dual instruction in addition to ground school.

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

1.3. EFIS Training Tool

The EFIS Training Tool (ETT) is an application entirely based on the EFIS code and is compatible with 32- or 64-bit versions of Microsoft Windows®. It serves as a multi-purpose tool for training pilots and provides features to record and capture images. This tool may be used to create routes and user waypoints for saving and uploading into the aircraft mounted IDUs. The ETT has a bezel with simulated buttons and encoders responsive to mouse and external keyboard messages. Bezel graphics are derived from actual bezel design data, and the ETT presents an active display with 1:1 pixel correspondence to an actual IDU display. The audio output capability for the ETT matches with the audio functionality in the actual IDU. This Training Tool simulates the functionalities of the IDU-3 and IDU-450, which begins flight in Reno Nevada at approximately 7900' MSL. An alternate method of Training Tool initialization is available at any altitude, speed, and wind conditions anywhere in the world through a simulate.ini program loaded into the computer root directory. See Section 8 Appendix in for further details.

Flight plans may be created (on the MFD only), stored, and activated in the exact same manner as done on the EFIS displays installed in the aircraft. This allows moving the start point to anywhere in the world where loaded Nav data is present for practicing published procedures. All applicable Nav signals are simulated with Localizer signals found on VLOC1 and VOR signals found on VLOC2. Once the start position has been moved from Reno, Nevada, the aircraft begins flying at approximately 7900’ MSL intercepting the first leg at a 45° angle.

1.4. About This Guide

This document describes the operation of the Genesys Aerosystems EFIS with the software version specified in the footer at the bottom of the page and is divided into nine sections as follows:

TABLE OF CONTENTS

Use this section to locate areas by topic…

INTRODUCTION (Section 1)

Use this section to gain basic understanding of how this pilot guide is constructed and where to begin…

SYSTEM OVERVIEW (Section 2)

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

Use this section to gain better understanding of the system and learn terminology, abbreviations, acronyms, and what the warnings, cautions, and advisories mean for rotorcraft and airplanes. This is where a basic description of all encoder and button functions and coloring conventions are introduced with menu tile definitions, as well as, database updating procedures which are described and how the IDU behaves during initialization…

DISPLAY SYMBOLOGY (Section 3)

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

Use this section to gain familiarity and understand what symbology to anticipate and define after viewing for every possible PFD and ND presentation…

ROTORCRAFT DISPLAY SYMBOLOGY (Section 4)

The Rotorcraft Display Symbology section provides identification of each screen element of the flight display specifically for rotorcraft which differs from the airplane symbology. For each software screen, every element of the symbology is identified on a sample screen. Immediately following the sample screens, all elements for are listed. This section also covers failure modes and TSO C-194 Enhanced and HTAWS descriptions. (See Section 9 Finmeccanica [Agusta] AW-109SP Appendix)

Use this section to identify and understand the elements seen on the screen for rotorcraft. Pilots will have to review the entire pilot guide for airplane and rotorcraft common menus for an understanding of the complete system...

MENU FUNCTIONS/STEP-BY-STEP PROCEDURES (Section 5)

This section shows a flow diagram and selection options with step-by-step procedures for each configuration possibility with this EFIS system.

Use this section for understanding the menu structure of each feature and how to go step-by-step during operation of each specific task…

QUICK START TUTORIAL (Section 6)

This section provides the basics necessary for flying a familiarization flight with this system. With a few simple steps, an active waypoint may be created, and the view may be controlled to manage the displays for the existing flight conditions.

Use this section to quickly gain familiarity with where to locate controls to manipulate the system for each operation and understanding the menu flow for PFD an MFD applicability.

IFR PROCEDURES (Section 7)

This section provides detailed information and instruction about selecting and flying instrument procedures found within the Jeppesen Navigation database.

Use this section to gain familiarity with selection of departure procedures, published instrument approach procedures, and standard terminal arrival procedures. This section describes how ATC clearances may often change, and how the active flight plan quickly reflects these changes. Additionally, this section defines every example of the most popular of all published procedures with views of referenced published procedures. (This section only shows airplane configuration views.)

APPENDICES (Section 8 and Section 9)

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 for airplanes.

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

The Finmeccanica (Agusta) AW-109SP (Section 9) Appendix section provides detailed information about customized symbology and functionality for the AW-109SP helicopter.

Use this section along with the rest of this manual to understand the Finmeccanica (Agusta) AW-109SP EFIS.

INDEX

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

Use this section to lookup key words and locate where at least one or more instances are used in the text.

Genesys Aerosystems is committed to producing the highest quality product possible and welcomes comments and suggestions concerning this publication. Please e-mail comments and suggestions to:

genesys-support@genesys-aerosystems.com

or

genesys-support@s-tec.com

If you encounter problems with the operation of your Genesys Aerosystems EFIS, please complete and return the Service Difficulty Report in the Appendix section directly to:

Genesys Aerosystems

One S-Tec Way

Mineral Wells Municipal Airport

Mineral Wells, Texas 76067 or Fax: (940) 325-3904

Section 2 System Overview

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List of Figures and Tables

2.1. Abbreviations and Acronyms

AC	Advisory Circular
AD	Airworthiness Directive
ADF	Automatic Direction Finder
A-D	Analog to Digital (converter)
ADAHRS	Air Data Attitude Heading Reference System
ADC	Air Data Computer
ADS-B	Automatic Dependent Surveillance-Broadcast
AFM	Aircraft Flight Manual
AFCS	Automatic Flight Control System
AGL	Above Ground Level
AHRS	Attitude Heading Reference System
AIRAC	Aeronautical Information Regulation and Control
AIRMET	Airmen’s Meteorological Information
ALTA	Equal to “Selected Altitude Submode” (AW- 109SP)
AMLCD	Active Matrix Liquid Crystal Display
ANSI	American National Standards Institute
APV	Approach with Vertical Guidance
ARINC	Aeronautical Radio, Inc.
ARP	SAE Aerospace Recommended Practice
AS	SAE Aerospace Standard
ASEL	Aircraft Selected Altitude
ATA	AT Attachment (hard disk storage interface)
ATC	Air Traffic Control
CA	Course to Altitude
CD	Course to DME Distance

CDI	Course Deviation Indicator
CDTI	Cockpit Display of Traffic Information
CDR	Critical Design Review
CM	Configuration Management
COM	Communication
CPM	Company Project Manager
CPM	Computer Processor Module
CPU	Central Processing Unit
CR	Change Request
CR	Course to Radial Termination
CRC	Cyclic Redundancy Check
CSA	Conflict Situation Awareness (ADS-B)
DA	Decision Altitude
D-A	Digital to Analog (converter)
DAICD	Digital Aeronautical Information CD
DAR	Designated Airworthiness Representative
DCN	Document Change Notice
DEM	Digital Elevation Model
DER	Designated Engineer Representative
DH	Decision Height
DL	Data Link
DME	Distance Measuring Equipment
DMG	Digital Map Generator (AW-109SP)
DMIR	Designated Manufacturing Inspection Representative
DO	RTCA Document
DOD	Department of Defense

DOF	Digital Obstruction File
DP	Departure Procedure
DR	Dead Reckoning or Defect Report
DSP	Digital Signal Processing
EFIS	Electronic Flight Instrument System
EGNOS	European Geostationary Navigation Overlay Service
EGPWS	Enhanced Ground Proximity Warning System
EIA	Electronics Industry Association
EICAS	Engine Indicating and Crew Alerting System
ETA	Estimated Time of Arrival
ETE	Estimated Time Enroute
ETT	EFIS Training Tool
FA	Course from a Fix to Altitude
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FAR	Federal Aviation Regulation
FAWP	Final Approach Waypoint (same as FAF)
FD	Course from a Fix to DME Distance
FDE	Fault Detection and Exclusion
FHA	Functional Hazard Analysis
FIFO	"First in, First out"
FIS	Flight Information Service
FIS-B	Flight Information Service-Broadcast
FL	Flight Level
FLTA	Forward Looking Terrain Awareness
FMEA	Fault Mode and Effects Analysis

FMS	Flight Management System
FPE	Floating Point Emulation
FPM	Feet per Minute
FPM	Flight Path Marker
FSD	Full Scale Deflection
FTE	Flight Technical Error
FTP	Fictitious Threshold Point
GAGAN	India's GPS and GEO-Augmented navigation System
GBAS	Australia's Ground Based Augmentation System
GPIP	Glide Path Intercept Point
GLS	GNSS Landing System
GMF	Ground Maintenance Function
GLONASS	Russian Global Navigation Satellite System
GND	Ground (potential)
GNSS	Global Navigation Satellite System
GPH	Gallons Per Hour
GPI	Glidepath Intercept
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
HAL	Horizontal Alert Limit
HAT	Height above Threshold
HFOM	Horizontal Figure of Merit
hPa	Hectopascal
HPL	Horizontal Protection Level
HSI	Horizontal Situation Indicator
HUL	Horizontal Uncertainty Limit

IAP	Instrument Approach Procedure; Initial Approach Point
IAS	Indicated Airspeed
IAWP	Initial Approach Waypoint (same as IAP)
IC	Integrated Circuit
ICAO	International Civil Aviation Organization
ICD	Interface Control Document
ID	Identity or Identification
IDS	Integrated Display System (AW-109SP)
IDU	Integrated Display Unit
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IM	Inner Marker
IO	Input/Output
IPV	Instrument Procedure with Vertical Guidance
IVSI	Instantaneous Vertical Speed Indicator
ISR	Interrupt Service Routine
JAD	Jeppesen Aviation Database
JTAG	Joint Test Action Group (IEEE 1149.1 Standard)
K	Kilo=1000
KB	Kilobyte
KIAS	Knots Indicated Airspeed
KT	Knot - Nautical Mile per Hour
KTAS	Knots True Airspeed
LDA	Localizer-type Directional Aid
LED	Light Emitting Diode
LNAV	Lateral Navigation

LOC	Localizer
LOI	Loss of Integrity
LON	Loss of Navigation
LP	Localizer Performance
LPV	Localizer Performance with Vertical Guidance
LRU	Line Replaceable Unit
LSB	Least Significant Bit or Byte
LTP	Landing Threshold Point
MAHP	Missed Approach Holding Point
MAHWP	Missed Approach Holding Waypoint (same as MAHP)
MAP	Missed Approach Point
MASPS	Minimum Aviation System Performance Standard
MAWP	Missed Approach Waypoint (same as MAP)
MB	Megabyte
MDA	Minimum Descent Altitude
MEMS	Micro Electro Mechanical System
MFD	Multifunction Display (IDU with software for showing multiple display screens)
MM	Middle Marker
MOPS	Minimum Operational Performance Standard
MOT	Mark on Target
MSAS	Japan's MTSAT-based Satellite Augmentation System
MSB	Most Significant Bit or Byte
MSL	Mean Sea Level
MSU	Magnetic Sensor Unit
MTBF	Mean Time between Failures

NACO	National Aeronautical Charting Office
NAS	U.S. National Airspace System
NASA	National Aeronautics and Space Administration
NED	National Elevation Dataset
NIMA	National Imagery and Mapping Agency
ND	Navigation Display
NDB	Nondirectional Beacon
NI	Navigational Information
NM	Nautical Mile
NPA	Non-Precision Approach
OASIS	Open Architecture Systems Integration Symbology
OAT	Outside Air Temperature
OBS	Omnibearing Selector
ODP	Obstacle Departure Procedure
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 (display screen showing primary instrumentation -- also refers to the primary IDU with software that only shows primary instrumentation)
PFDE	Predictive Fault Detection and Exclusion
PFI	Primary Flight Information
PIC	Peripheral Interface Controller
PLI	Pitch Limit Indicator
PM	Personality Module

PN	Part Number
PRAIM	Predictive Receiver Autonomous Integrity Monitoring
PSAC	Plan for Software Aspects of Certification
PSCP	Project Specific Certification Plan
PSP	Partnership for Safety Plan
PTN	Problem Tracking Number
QA	Quality Assurance
QFE	Altimeter setting provides height above reference point
QM	Quality Management
QNE	Altimeter setting provides pressure altitude readout
QNH	Altimeter setting provides MSL altitude at a reporting point
RA	Resolution Advisory (Traffic Function)
RAIM	Receiver Autonomous Integrity Monitoring
RAM	Random Access Memory
RCP	Radar Control Panel
RBP	Remote Bug Panel
RHT	Radar Height
RMI	Radio Magnetic Indicator
RNAV	Area Navigation
RNP	Required Navigation Performance
RS	EIA Recommended Standard
RTC	Real Time Computing
RTCA	Radio Telephone Commission for Aeronautics
RTD	Resistive Thermal Detector
RTL	Run Time Library

Rx	Receive
SA	Selective Availability
SAE	Society of Automotive Engineers
SAS	Software Accomplishment Summary
SBAS	Satellite Based Augmentation System
SCI	Software Configuration Index
SCMP	Software Configuration Management Plan
SCR	Software Conformity Review
SCS	Software Coding Standards
SDCM	System of Differential Correction and Monitoring
SDD	Software Design Document
SDP	Software Development Plan
SDS	Software Design Standards
SECI	Software Environment Configuration Index
SIGMET	Significant Meteorological Advisory
SMA	Sub-Miniature version A connector
SN	Serial Number
SNI	Serial Number Information
SOI	Stage of Involvement (FAA software audit)
SPR	Software Problem Report
SQA	Software Quality Assurance
SQAP	Software Quality Assurance Plan
SQAR	Software Quality Assurance Representative
SRD	Software Requirements Document
SRS	Software Requirements Standards
SRTM	Shuttle Radar Topographical Mission

SSA	System Safety Assessment
SSM	Sign Status Matrix
STAR	Standard Terminal Arrival Routes
STC	Supplemental Type Certificate
STP	Software Test Protocol
STS	Software Test Specification
SUA	Special Use Airspace
SV	Service Vehicle
SVCP	Software Verification Cases and Procedures
SVP	Software Verification Plan
SVR	Software Verification Results
SVS	Synthetic Vision System
SYRD	System Requirements Document
TA	Traffic Advisory (Traffic Function)
TACAN	Ultra-high frequency tactical air navigational aid
TAFs	Terminal Aerodrome Forecasts
TAS	Traffic Advisory System
TAS	True Airspeed
TAWS	Terrain Awareness and Warning System
TCAD	Traffic Collision Alert Device
TCAS	Traffic Collision Alert System
TERPS	Terminal Instrument Procedures
TCH	Threshold Crossing Height
TD	Traffic Display
TFR	Temporary Flight Restriction
TIS	Traffic Information Service

TIS-B	Traffic information Service-Broadcast
TMS	Texas Instruments family of DSP processors
TQP	Tool Qualification Plan
TSO	Technical Standard Order
TTA	Time to Alert
Tx	Transmit
UART	Universal Asynchronous Receiver-Transmitter
UIM	User Interface Module
USGS	United States Geological Survey
UTC	Universal Time Coordinated
VA	Heading to Altitude
VAL	Vertical Alert Limit
VD	Heading to DME Distance
VFOM	Vertical Figure of Merit
VFR	Visual Flight Rules
VHF	Very High Frequency
VNAV	Vertical Navigation
VOR	VHF Omnidirectional Radio
VORTAC	Collocated VOR and TACAN
VPL	Vertical Protection Level
VR	Heading to Radial Termination
VSI	Vertical Speed Indicator
VTF	Vectors to Final
VUL	Vertical Uncertainty Limit
WAAS	Wide Area Augmentation System
WGS84	World Geodetic System 1984

2.2. 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 may be either a Primary Flight Display (only shows the PFD screen), or a multifunction display (MFD) capable of showing a variety of screens. At the touch of a button, the pilot may configure the MFD as a reversionary PFD or navigation display (ND). The ND may be further configured as a moving map, electronic HSI, dedicated traffic display, or dedicated weather display.

IDU-III PFD

IDU-III MFD

IDU-450 PFD

IDU-450 MFD

Figure 2-1: IDU-III and IDU-450 Displays

The displays are comprised of a high-brightness backlit LCD screen, eight buttons, two encoders, and an optional slip indicator. The buttons and slip indicator are also backlit, and their brightness may be adjusted independently of the screen. All lighting is night-vision goggle compatible.

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

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 HTAWS. Class A rotorcraft EHTAWS is available as an option.

The EFIS complies with Advisory Circular AC 90-100A, based on compliance with TSO-C146c Stand-Alone Airborne Navigation Equipment, using the Global Positioning System (GPS) augmented by the Satellite Based Augmentation System (SBAS).

The IDU supports required navigation performance by means of:

Manually entered RNP values; or

RNP values automatically retrieved from the navigation database associated with airways or procedures (DPs, STARs, or IAPs).

The order of precedence for system operation is:

1) If a manually entered RNP value exists, the manually entered RNP value is annunciated along with the actual navigation performance in the pilot's primary field of view. The navigation mode is RNP, and the manually entered RNP value is used to determine CDI FSD, LON alerting, and LOI alerting.

2) If a manually entered RNP value does not exist, but an automatic RNP value retrieved from the navigation database does exist, the automatically retrieved RNP value is annunciated along with the actual navigation performance ANP in the pilot's primary field of view. The navigation mode is RNP, and the automatically retrieved RNP value is used to determine CDI FSD, LON alerting, and LOI alerting.

3) If neither a manually entered nor automatic RNP value exists, system operation defaults to GPS/SBAS operation as specified in TSO-C146.

2.3. System Configuration

Its own internal processor drives each display. A complete system consists of at least one display, a GPS/SBAS 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. Therefore, each display is independent from all others and, except for the PFD, may show any page at any time. The data transfer between components, along with the additional equipment that may be interfaced with the EFIS, is indicated in the following block diagram.

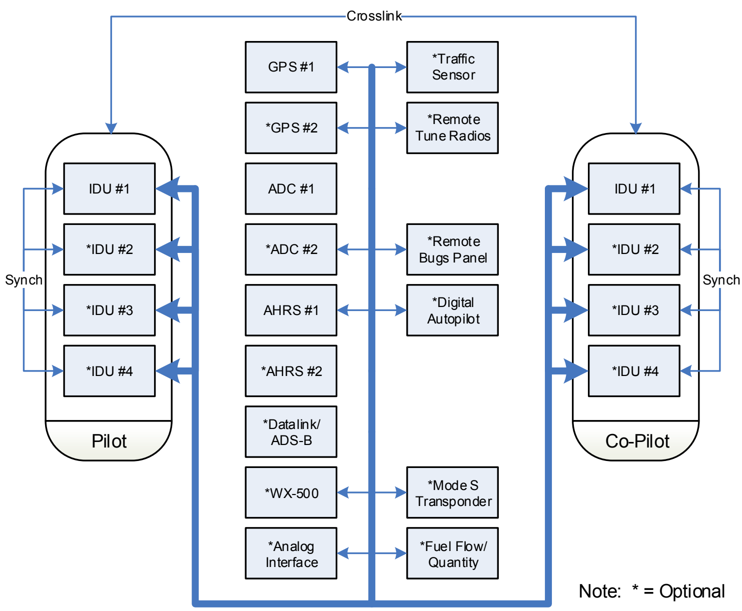


Figure 2-2: System Diagram

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

2.4. Cold Soak Startup Instructions

When the IDU-450 internal temperature of the display unit is below 0° Celsius during a startup, the central processor unit activates the internal heaters, as well as an external indium oxide heater on the display glass. These heaters remain on until the core temperature climbs above the cold start threshold, 2° Celsius. Once the threshold temperature has been reached, the system resets and boots up. Heating times 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:

1) Preheat the aircraft flight compartment before applying power.

OR

2) Allow the system to complete the warm up with internal heaters. Do not attempt to speed up the process by cycling power. It delays the process and adds to the warm up time.

2.4.1. IDU-III

When the internal temperature of the display units is below 0° 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 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:

1) Preheat the aircraft flight compartment before applying power.

OR

2) Allow the system to complete the warm up with internal heaters. Do not attempt to speed up the process by cycling power. It delays the process and adds to the warm up time.

2.5. Operational Warnings

WARNING:

DO NOT FLY WITH THE GENESYS AEROSYSTEMS EFIS WITHOUT FULLY UNDERSTANDING EACH WARNING LISTED BELOW.

DO NOT USE THIS SYSTEM FOR TERRAIN-FOLLOWING FLIGHT. DO NOT ATTEMPT TO NAVIGATE USING THE TERRAIN DEPICTION. ALWAYS ADHERE TO PUBUSHED INSTRUMENT APPROACH PROCEDURESIN INSTRUMENT CONDITIONS.

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.

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.

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

DO NOT ENGAGE IN INSTRUMENT FLIGHT UNLESS INSTRUMENT RATED, CURRENT, AND THE AIRCRAFT MEETS THE IFR REQUIREMENTS SPECIFIED IN FAR 91.205.

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

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.

2.6. Initialization Requirements

The hardware, including file system, IO, and graphics, are initialized. Immediately after graphics initialization, a logo screen with the text "INITIALIZING" appears. The logo screen includes the Genesys Aerosystems logo and software version number. The software version number delineates: (1) major revision number (e.g., 7.0) and (2) minor revision letter (e.g., E). The software version number is shown as follows:

Table 2-1: IDU Initialization Software Version and Part Numbers

Build Type	Version Number
IDU-450 CERT	Rev 7.0E
IDU-III CERT	Rev 7.0E

Aircraft limitations are initially read from flash drive storage. This provides the IDUs with a default limitations setup in the event of PM (IDU-450) or System Configuration Card (SCC) (IDU-III) failure. The Pilot System #0 or #1 IDU reads aircraft limitation from its Personality Module (PM) (IDU-450) or SCC card (IDU-III) and, in the case of a multi-screen installation with a #1 IDU, transmit these limitations to other IDUs, including all Co-Pilot System IDUs. Upon reception of the limitations transmission from the Pilot System #0 or #1 IDU, the other IDUs save the transmitted limitations to flash drive storage.

Aircraft parameters (latitude, longitude, altitude) as they existed prior to the last system shutdown are read to initialize the system. This allows for a good initialization, even if system sensors are failed or not yet initialized. Upon an application update (i.e., updating software version 6.0B to 7.0E), all aircraft settings re-initialize to default values. Otherwise, aircraft settings as they existed prior to the last system shutdown are used to initialize the system with the exception of the following default values:

1) Active flight plan structure and associated are cleared.

2) Timers are turned off.

3) Minimum altitude setting is turned off.

4) FMS OBS setting is set to automatic.

5) VOR I LOC 1 OBS setting is set to 360°.

6) VOR I LOC 2 OBS setting is set to 360°.

7) Parallel offset is set to 0 NM.

8) Airspeed bug is turned off.

9) Target altitude bug is turned off.

10) Vertical speed bug is turned off.

11) HSI navigation source is set to FMS.

12) Heading bug is set to 360° (HeliSAS enabled) or turned off (HeliSAS disabled).

13) Datalink and map panning modes are set to off.

14) PFD zoom mode is set to off.

15) Manual RNP is set to off.

16) PFD skyway is set to on.

17) V-speeds are cleared.

18) RDR-2000/2100 scale is initialized to 80NM

19) Crosslink is initialized to on.

Based upon the air/ground mode parameter value from the last system shutdown, the IDU decides whether it is booting on the ground or in flight. If booting on the ground, the following actions happen:

1) A logo screen with the words "TESTING" is displayed.

2) CRC-32 values for application executable, limitations files, NavData files, obstruction files, and terrain header files are checked.

3) If the CRC-32 check fails, the program exits with an error message and creates a bit result file indicating failure.

4) If the CRC-32 check passes, the program continues to initialize and creates a bit result file indicating passage.

5) The application searches for the nearest airport and activate its run ways for display.

6) The application auto-sets the altimeter based upon the terrain elevation at the startup point.

7) A logo screen displaying database versions and validity dates is displayed with the message "PRESS ANY KEY TO CONTINUE".

8) If all critical sensors (GPS, ADC, and AHRS) are in normal condition, the display screens are shown immediately. The #1 IDU initializes to the PFD screen. Other IDUs initialize to the ND.

9) If any critical sensor is not in normal condition, a logo screen with a two-minute countdown timer appears. The display screen is shown at the earliest of: (1) when two minutes have elapsed; (2) when the pilot presses any button to escape the startup countdown; or (3) when all critical sensors are in normal condition. The #1 IDU initializes to the PFD screen. Other IDUs initialize to the ND.

10) On the #0 or #2 IDU with fuel totalizer functions enabled, the fuel set menu activates to remind the pilot to set the fuel totalizer quantity.

If booting in the air, the following actions happen:

1) A logo screen with the words "QUICK START" appears.

2) The bit result file created during the last ground boot is checked. If the bit result file indicates a failure, the program exits with an error message. If the bit result file indicates passage, the program continues.

3) The display screens are shown immediately. The #1 IDU initializes to the PFD screen. Other IDUs initialize to the ND.

2.7. Color Conventions

The Genesys Aerosystems EFIS uses a consistent set of colors for displaying information on display. Any color representation may not be exactly identical as it appears on the IDU. These colors are detailed as follows:

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

- Scales markings (airspeed, altitude, heading, VSI, pitch, map ranges, etc.).

- Pilot-selected values (airspeed, heading, altitude).
- Secondary flight data (TAS, wind, OAT, timers, etc.).

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

On the AW-109SP, cyan is used for pre-selected bugs, values, navigation pointers, etc.).

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

On the AW-109SP, magenta is used for currently selected datum bugs, values, navigation pointers, etc.

GRAY is used as a figure background for airspeed and altitude readout, and conformal runway depiction (light gray for usable portion of the active runway, dark gray for other runway surfaces). Terrain is colored shades of gray when more than 2000 feet below aircraft altitude. The slope between adjacent terrain pixels in an increasing longitude direction determines the shade.

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 for the terrain indication on the moving map.

AMBER (YELLOW) is used to identify conditions requiring immediate pilot awareness, and may require subsequent pilot action. Examples:

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

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

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

BLUE is used in a variety of shades to indicate the sky portion of the PFD and bodies of water on the moving map. On the MFD, deep blue denotes areas of water and takes precedence over other colors.

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 for the field of view angle lines on the moving map, for figures on a gray background, and for outlining borders and certain figures/elements on backgrounds where contrast is minimal, e.g., airspeed, altitude, and menu tiles on the PFD/MFD.

2.8. Warning/Caution/Advisory System

The IDU's integrated audio/visual warning system monitors a wide variety of parameters and provides annunciations for conditions that demand pilot awareness. There are three categories of annunciations: WARNINGS, CAUTIONS, and ADVISORIES. Warnings are displayed with red flags and an aural annunciation that repeats until the condition goes away or is acknowledged by the pilot. Cautions are displayed with amber (yellow) flags and a single aural annunciation. Advisories are displayed with blue flags and a single aural annunciation. Where a time delay is referenced, it is the programmed delay in seconds prior to the annunciation appearing. The following table lists the annunciations that are provided by the IDU.

Pilot Actions:

WARNING	Red: Immediate Pilot Action Required
CAUTION	Amber (Yellow): Pilot Attention Required
ADVISORY	Blue: Advisory Only

Table 2-2: Warnings, Cautions, and Advisories

Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
COOLING FAN	Alert Tone	Triggered when external cooling fan is commanded on by the cooling fan discrete output and the cooling fan status discrete input indicates the cooling fan is not rotating. 1 minute time delay.
GLIDESLOPE	"Glideslope, Glideslope"	Within GPWS Mode 5 warning envelope. Half second time delay.

Table 2-2: Warnings, Cautions, and Advisories

Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
LOW FUEL	"Fuel Low, Fuel Low"	One of the following conditions is true: 1) One of the Low Fuel Warning discrete inputs is active 2) One of the sensed fuel tank quantities is below its low fuel warning threshold 3) Total aircraft fuel is below the pilot-set emergency fuel threshold. 1 minute time delay.
OBSTRUCTION	"Warning Obstruction, Warning Obstruction"	Obstruction within TAWS FLTA warning envelope. Half second time delay.
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. No time delay.
PULL UP	"Pull Up, Pull Up"	Within GPWS Mode 1 warning envelope. Half second time delay.
		Within GPWS Mode 2 warning envelope. Half second time delay.
	"Terrain, Terrain, Pull Up, Pull Up"	Terrain cell within TAWS FLTA warning envelope. Half second time delay.

Table 2-2: Warnings, Cautions, and Advisories		
Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
HTAWS: TERRAIN	"Warning Terrain, Warning Terrain"	Terrain cell within TAWS FLTA warning envelope. Half second time delay.
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 is set to 0. No time delay.
TRAFFIC	"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. No time delay.
CAUTIONS		
ADC1 FAIL	Alert Tone	Only active in dual-ADC installation. Indicates no valid indicated airspeed, pressure altitude, or V_{SI} received from ADC #1 for more than 1 second. No time delay.
ADC2 FAIL	Alert Tone	Only active in dual-ADC installation. Indicates no valid indicated airspeed, pressure altitude, or V_{SI} received from ADC #2 for more than 1 second. No time delay.

Table 2-2: Warnings, Cautions, and Advisories

Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
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. No time delay.
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. No time delay.
ALT MISCOMP	Alert Tone	Only active in dual-ADC installation with neither ADC in failure condition. Indicates pressure altitude difference between ADCs is beyond limits. 10 second time delay. Inhibit for 10 minutes after startup. Limits are as follows: > = 40K' Δ 250' 30 - 40K' Δ 200' 20 - 30K' Δ 100' 10 - 20K' Δ 70' < 10K' Δ 50'
ALTITUDE	"Altitude, Altitude"	Deviation greater than 150' from selected altitude after capture. Altitude capture defined as being within 100' of altitude. 2 second time delay.
		If not on a descending VNAV profile, deviation

Table 2-2: Warnings, Cautions, and Advisories

Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
		greater than 150' from altitude of the current or prior VNAV waypoint after capture. Altitude capture defined as being within 100' of altitude. 2 second time delay.
ATT MISCOMP	Alert Tone	Only active in dual-AHRS installation with neither AHRS in failure condition. Indicates pitch or roll difference between AHRS is beyond limits (6°). 10 second time delay. Inhibit for 10 minutes after startup.
AUX SENSOR	"Auxiliary Sensor Failure, Auxiliary Sensor Failure"	No valid message or bad status received from installed optional sensors. Sensor status displayed in FAULTS menu. 5 second time delay. 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 System 6) Weather Radar 7) Weather Radar Control Panel

Table 2-2: Warnings, Cautions, and Advisories

Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
CHECK GEAR	"Check Gear, Check Gear"	Activated if RG flag is set to 1, aircraft is 500' AGL (airplanes) or 150' AGL (rotorcraft), aircraft is below V_{FE}, and any landing gear is not down. 2 second time delay.
CHECK IDU 1 CHECK IDU 2 CHECK IDU 3 CHECK IDU 4	Alert Tone	When armed (i.e., at least one intra-system monitor message has been received from the transmitting display), checks intra-system monitor messages. Indicates either: 1) screen counter value has not changed in the last 1 second ± 0.1 seconds; or 2) intra-system monitor message is not fresh (i.e., no message received for longer than 1 second ± 0.1 second). The "#" parameter indicates which IDU is failing the check, either IDU1 (COM 17), IDU2 (COM18), IDU3 (COM19), or IDU4 (COM19). No time delay.

Table 2-2: Warnings, Cautions, and Advisories

Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
CHECK RANGE	"Check Range, Check Range"	Less than 30 minutes buffer (at current groundspeed) between calculated range and distance to: 1) The last waypoint if it is active; or 2) The airport if on a missed approach; or 3) Along-route distance to destination. Not activated in climbing flight. Not activated if below 60 knots groundspeed. 5 minute time delay.
DEC HT	"Decision Height"	Deviation from above to below decision height bug. Causes decision height readout to turn amber (yellow) and flash. No time delay. Not applicable for AW-109SP.
DR ##.##	None	GPS/SBAS in dead reckoning mode with valid ADC and AHRS data. Timer shows time since loss of position to indicate quality of DR solution. No time delay.
EFIS COOL	"EFIS Cooling"	IDU core temperature greater than 95°C. 2 second time delay.

Table 2-2: Warnings, Cautions, and Advisories

Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
GLIDESLOPE	"Glideslope, Glideslope"	Within GPWS Mode 5 caution envelope. Half second time delay.
GPS LOI	Alert Tone	GPS/SBAS loss of integrity caution. No time delay.
GPS LON	Alert Tone	GPS/SBAS loss of navigation caution. No time delay.
GPS MISCOMP	Alert Tone	Only active in dual-GPS/SBAS installation with neither GPS/SBAS in failure condition. Indicates position, track, or ground-speed difference between GPS/SBAS units is beyond limits. 10 second time delay. 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**: If difference between GPS#1 and GPS#2

Table 2-2: Warnings, Cautions, and Advisories		
Display Flag “--“ indicates no flag	**Aural Annunciation**	**Condition**
		miscompare if difference is more than 10 kts.
GPS1 FAIL	Alert Tone	Only active in dual-GPS/SBAS installation. Indicates no valid message received from GPS/SBAS #1 for more than 5 seconds. No time delay.
GPS2 FAIL	Alert Tone	Only active in dual-GPS/SBAS installation. Indicates no valid message received from GPS/SBAS #2 for more than 5 seconds. No time delay.
GS MISCOMP	Alert Tone	Only active when two valid glideslopes are received. Indicates at least one glideslope is receiving a signal within 1 dot of center and difference between glideslope signals is beyond limits (0.25 dots). 10 second time delay.
HDG MISCOMP	Alert Tone	Only active in dual-AHRS installation with neither AHRS in failure condition. Indicates heading difference between AHRS is beyond limits (6°). 1 minute time delay. Inhibit for 10 minutes after startup.

Table 2-2: Warnings, Cautions, and Advisories

Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
IAS MISCOMP	Alert Tone	Only active in dual-ADC installation with neither ADC in failure condition. Indicates indicated airspeed difference between ADCs is beyond limits. 10 second time delay. Inhibit for 10 minutes after startup. Limits are as follows: >= 100KIAS Δ4KIAS < 100KIAS Δ10KIAS
IDU MISCOMP	Alert Tone	Only active when fresh intra-system monitor messages are being received. Indicates a critical parameter being used by another display exceeds the miscompare thresholds when compared to the monitoring display. Compares the following critical parameters: • Attitude (Pitch and Roll) (use Attitude Miscompare logic) • Heading (use Heading Miscompare logic) • Pressure Altitude (use Altitude Miscompare logic) • Indicated Airspeed (use Airspeed Miscompare logic)

Table 2-2: Warnings, Cautions, and Advisories

Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
		• Localizer (both inputs) (use Localizer Miscompare logic) • Glideslope (both inputs) (use Glideslope Mis-compare logic) • Radar Altitude (use Radar Altitude Miscompare logic) • Latitude (Use GPS/SBAS Mis-compare logic) • Longitude (Use GPS/SBAS Mis-compare logic) • Track (Use GPS/SBAS Mis-compare logic) • Groundspeed (Use GPS/SBAS Mis-compare logic) One second time delay.
IDU POWER	Alert Tone	Indicates one of the dual redundant power supplies within an IDU is not functioning correctly. Only active on IDU-450. 1 minute time delay.

Table 2-2: Warnings, Cautions, and Advisories		
Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
LOC MISCOMP	Alert Tone	Only active when two valid localizers are received. Indicates at least one localizer is receiving a signal within 1 dot of center and difference between localizer signals is beyond limits (0.25 Dots). 10 second time delay.
LOW FUEL	"Fuel Low, Fuel Low"	Calculated fuel quantity is below low fuel warning threshold. 1 minute time delay.
MINIMUMS	"Minimums, Minimums"	Deviation from above to below minimum altitude bug. Causes minimum altitude readout to turn amber (yellow) and flash. No time delay.
NO GPS	"GPS Failure"	No valid message received from GPS/SBAS for more than 5 seconds. No time delay.
NO HEADING	Alert Tone	No valid heading received from selected AHRS for more than 1 second. No time delay. Disabled if MFD-only operation.
NO TAWS	Alert Tone	Indicates aircraft is currently beyond extent of terrain database or a failure condition exists preventing the TAWS FLTA function from operating. Half second time delay.

Table 2-2: Warnings, Cautions, and Advisories

Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
OAT SENSOR	Alert Tone	Indicates OAT sensor has failed. Half second time delay.
OBSTRUCTION	"Caution Obstruction, Caution Obstruction"	Obstruction within TAWS FLTA caution envelope. Half second time delay.
RADALT	Alert Tone	Radar altimeter is installed, and radar altitude is invalid. This annunciation is displayed in ground mode also. For dual system, dual radar altimeter installations, pilot side uses radar altimeter #2 and co-pilot side uses radar altimeter # 1. Inhibited when radar altimeter value received from ARINC 429, except when SSM of radar altimeter message indicates failure warning. 5 second time delay.
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. Annunciation also displayed in Ground Mode. Inhibited when Radar Altimeter value received from ARINC 429, except when SSM of Radar Altimeter message

Table 2-2: Warnings, Cautions, and Advisories		
Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
		indicates Failure Warning. No time delay.
RADALT2 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. Annunciation also displayed in Ground Mode. Inhibited when Radar Altimeter value received from ARINC 429, except when SSM of Radar Altimeter message indicates Failure Warning. No time delay.
RALT MISCOMP	Alert Tone	Only active in dual-radar altimeter installation with neither radar altimeter in failure condition. Indicates radar altitude difference between radar altimeters is beyond limits. 10 second time delay. Limits are as follows: >= 500'AGL Δ14% 100 – 500'AGL Δ10% < 100'AGL Δ10'

Table 2-2: Warnings, Cautions, and Advisories		
Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
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 both systems are operating from same ADC source. No time delay.
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 both systems are operating from same AHRS source. No time delay.
SAME GPS	Alert Tone	Only active in dual-system (pilot and co-pilot), dual-GPS/SBAS installation with good inter-system communications, and neither GPS/SBAS in failure condition. Indicates both systems are operating from same GPS/SBAS source. No time delay.
SAME NAV	Alert Tone	Only active in dual-system (pilot and co-pilot) with good inter-System communications. Indicates both systems are operating from same navigation source. Alert

Table 2-2: Warnings, Cautions, and Advisories		
Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
		inhibited if both Systems are operating from GPS/SBAS in a single-GPS/SBAS installation. No time delay.
SAME RADALT	Alert Tone	Only active dual-system (pilot and co-pilot), dual-radar altimeter installation with good inter-system communications, and neither radar altimeter in failure condition. Indicates both systems are operating from same radar altimeter source. No time delay.
SCC FAIL	Alert Tone	Indicates SCC card could not be read upon power-up. Means limits internal to the IDU are being used by the system.
SINK RATE	"Sink Rate, Sink Rate"	Within GPWS Mode 1 caution envelope. Half second time delay.
TAWS AUTOROT	Alert Tone	TAWS autorotation mode activated through use of discrete input. No time delay.
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. No time delay.

Table 2-2: Warnings, Cautions, and Advisories

Display Flag “--“ indicates no flag	**Aural Annunciation**	**Condition**
TERRAIN	“Caution Terrain, Caution Terrain”	Terrain cell within TAWS FLTA caution envelope. Half second time delay.
		Within GPWS Mode 2 caution envelope. Half second time delay.
TOO LOW	“Too Low Terrain, Too Low Terrain”	Within GPWS Mode 4 “Too Low Terrain” envelope. Half second time delay.
		Within TAWS PDA. Half second time delay.
		Within GPWS Mode 3 caution envelope. Half second time delay.
	“Too Low Gear, Too Low Gear”	Within GPWS Mode 4 “Too Low Gear” envelope. Half second time delay.
	“Too Low Flaps, Too Low Flaps”	Within GPWS Mode 4 “Too Low Flaps” envelope. Half second time delay.
TRAFFIC	“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. No time delay.
VERT LON	Alert Tone	GPS/SBAS loss of vertical navigation caution. No time delay.
XFILL FAIL	Alert Tone	Only active in dual-system (pilot and co-pilot). Indicates lack of inter-system communications. 2 second time delay. Inhibit for 30 seconds after startup.

Table 2-2: Warnings, Cautions, and Advisories		
Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
ADVISORIES		
ADC INIT	Chime	ADC not at full accuracy during warm-up. No time delay.
AHRS DG	Chime	Activated DG mode if available.
ANP: 0.01 ANP: 15.0	Chime	GPS/SBAS Actual Navigation Performance based upon current GPS/SBAS HPL.
BARO MISCOMP	Chime	Only active in dual-system (pilot and co-pilot) installation. Indicates mismatch of altimeter settings or altimeter modes between systems. 10 second time delay.
CHK BARO	Chime	Ascending through transition level: Altimeter not set to 29.92 inHg or 1013mbar. Descending through transition level: Altimeter set to 29.92 inHg or 1013mbar. Descent warning times out in 10 seconds. 2 second time delay. Disabled during QFE operation.

Table 2-2: Warnings, Cautions, and Advisories		
Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
FLTA INHBT	Chime	Shown when the FLTA function is automatically inhibited during normal operation. "NO TAWS" caution and "TAWS INHBT" advisory have priority over this message. No time delay.
FPM INHBT	Chime	Flight path marker inhibit function activated through use of momentary discrete input. No time delay.
LNAV APPR	Chime	GPS/SBAS in LNAV Approach Mode. No time delay.
LNV/VNV APPR	Chime	GPS/SBAS in LNAV/VNAV Approach Mode. No time delay.
LP APPR	Chime	GPS/SBAS in LP Approach Mode. No time delay.
LPV APPR	Chime	GPS/SBAS in LPV Approach Mode. No time delay.
MENU LOCK	None	Menu system being used on another IDU. No time delay.
PTK = L 1NM PTK = L 20NM PTK = R 1NM PTK = R 20NM	Chime	GPS/SBAS Parallel Offset path advisory. ## is nautical miles left "L" or right "R" of main path. No time delay.
RNP: 0.10A RNP: 15.0A	Chime	GPS/SBAS Automatic Required Navigation Performance as acquired from navigation database.

Table 2-2: Warnings, Cautions, and Advisories		
Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
RNP: 0.10M RNP: 15.0M	Chime	GPS/SBAS Manual Required Navigation Performance as set by pilot.
SUSPEND	Chime	GPS/SBAS automatic waypoint sequencing is suspended. Caused by being on final approach segment prior to arming missed approach, selecting manual GPS/SBAS OBS, or being in holding prior to activating the **CONTINUE** tile. No time delay.
TA ONLY	Chime	Only active with TCAS-II system. Indicates TCAS-II system is unable to display resolution advisories. No time delay.
TAS INHBT	Chime	TAS aural inhibited through activation of TCAS/TAS Audio Inhibit discrete input. No time delay.
TAWS GS CNX	Chime	TAWS glideslope cancel (GPWS Mode 5) activated through use of discrete input. No time delay. The GS Cancel annunciation feature is for Enhanced HTAWS only.
TAWS INHBT	Chime	TAWS inhibited (audio only) through use of discrete input. No time delay.

Table 2-2: Warnings, Cautions, and Advisories		
Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
TAWS LOW ALT	Chime	TAWS low altitude mode activated through use of discrete input. No time delay.
TCAS STBY	Chime	Only active with TCAS-II system. Indicates system is either: (1) in standby or (2) executing functional test in flight. No time delay.
TCAS TEST	Chime	Only active with TCAS-II system. Indicates system is in functional test on ground. No time delay.
TERMINAL	Chime	GPS/SBAS in Terminal mode. No time delay. N/A for AW-109SP when in MOT mode.
TRUE NORTH	Chime	True North mode input discrete is asserted and system is operating in True North mode. No time delay.
VECTORS	Chime	GPS/SBAS in Vectors to Final Approach mode prior to sequencing FAWP. No time delay.
VFR APPR	Chime	GPS/SBAS in VFR approach mode. No time delay.

Table 2-2: Warnings, Cautions, and Advisories

Display Flag "--" indicates no flag	**Aural Annunciation**	**Condition**
XFILL ARM	Chime	Only active in dual-system (pilot and co-pilot) with good inter-system communications and crossfill not inhibited. Indicates systems are not synchronized and synchronization function is available. No time delay.
XFILL INHBT	Chime	Only active in dual-system (pilot and co-pilot) with good inter-system communications. Indicates crossfill is manually inhibited through use of discrete input. No time delay.
--	Chime	Sounds chime when countdown timer reaches 00:00:00. No time delay.
--	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. No time delay.
--	"Five Hundred"	GPWS Mode 6. Descending through 500' AGL advisory. Armed upon climbing through deadband value above 500' AGL. Half second time delay.

The volume of aural annunciations is adjusted according to severity as follows:

WARNING = Full Volume set into aircraft limits

CAUTION = 80% of volume set into aircraft limits

ADVISORY = 60% of volume set into aircraft limits

Press the audio mute switch to mute the active aural annunciation.

Flags are visually prioritized with active warning flags displayed above active caution flags, which are displayed above active advisory flags. Within categories, active flags are stacked in chronological order with the most recent annunciation appearing on top. Warning flags flash at 2Hz until acknowledged by pressing the audio mute switch. Caution flags flash at 1 Hz until acknowledged by pressing the audio mute switch. Only the highest priority (in criticality and recency), unacknowledged aural annunciation is played at any given time. In addition, to further minimize cockpit confusion, the above annunciations are grouped and prioritized so only one annunciation is active. Annunciations prioritized in this manner are as follows (higher in list = higher priority):

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

2.9. Display Controls

Each display incorporates eight peripheral buttons (each labeled for a dedicated function), a brightness encoder (left side), a menu encoder (right side), and an optional slip indicator. The right encoder is also referred to as ❶.The peripheral buttons and slip indicator are backlit. Machined “prongs” to prevent inadvertent actuation separate the buttons.

There are two kinds of functions: button functions and menu functions. To activate button functions, push the button labeled accordingly. To activate menu functions, push the button adjacent to the desired menu on the screen.

Figure 2-3: IDU-III

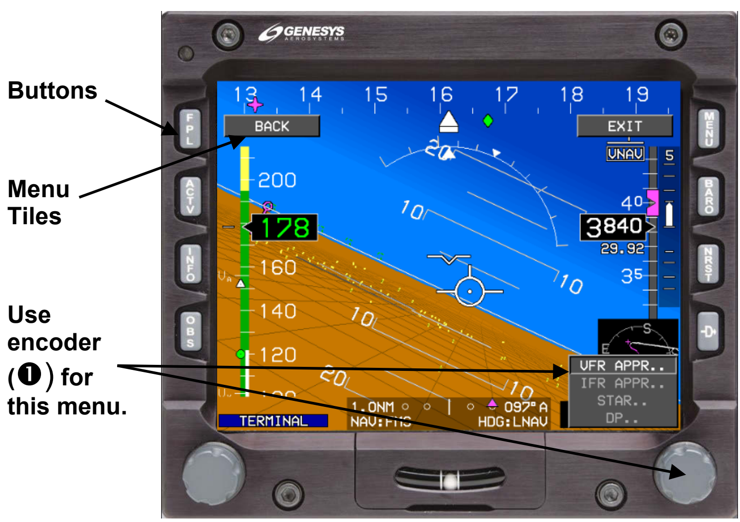
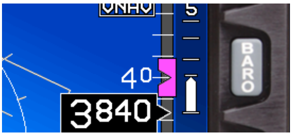


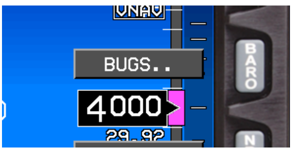
Figure 2-4: IDU-450

Scroll the brightness encoder on the lower left of the EFIS clockwise to increase screen brightness and counter-clockwise to decrease screen brightness. Push the brightness encoder while scrolling to adjust the bezel (button, encoders, and slip indicator) brightness in the same manner.



To activate a function, push the button. For example, push this button to activate the Altimeter function (IDU-450 only).

Figure 2-5: IDU-450 Button Function



To activate a menu function, push the button corresponding with the menu. To display menus, push the Menu **(R1)**. For example, push this button to activate the BUGS menu.

Figure 2-6: Menu Function

When a menu appears in the lower right corner of the screen, control it with the ❶ encoder. Scroll the encoder to the desired menu item, letter, or number, then push to select.

If there are no menus shown on the PFD screen, scroll the encoder to set the heading bug. Likewise, scroll the encoder on the MFD when there are no menus shown to set the scale of the display. Push the encoder on the MFD instantly to bring up a reversionary PFD screen; push it again to return to the navigation display.

Once inside the menu structure, the top left button (adjacent to the BACK menu) always backs up one step in the menu structure. The top right button (adjacent to the EXIT menu) always exits completely out of the menus and resets previous values.

MENU LOCK button and menu input may only be made on one display at a time. When an action is taking place on one screen, the others display MENU LOCK, and the buttons and encoders do not function.

2.10. Database and Software Updates

2.10.1. Navigation, Obstruction, and Terrain Databases

The EFIS uses Jeppesen NavData® for the navigation database and Jeppesen data for the obstruction database. These databases should be acquired directly from Jeppesen.

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

To update these databases on the IDU-450, use a USB flash memory storage device via a USB port in the lower center portion of the bezel. When the system is powered up on ground, it enters the ground maintenance mode which provides for system updates.

To update these databases on the IDU-III, use a smart media card.

NOTE:

Only insert or remove the memory storage device with the systems powered OFF.

To update the system:

1) Download the navigation and obstruction databases from Jeppesen (www.jeppesen.com) and store them on a USB flash memory storage device.

2) With the power OFF, insert the USB flash memory storage device containing the databases into the primary flight display.

3) Power the system ON, and select the UPDATE DATABASES option using the encoder (rotate to scroll, push to enter).

Figure 2-7: Ground Maintenance Page

4) Power the system OFF, and remove the memory storage device.

5) Repeat 2 through 4 for each additional display and close the USB door on each display.

6) Upon power up, verify the update was successful by noting the new NavData cycle and expiration dates before acknowledging the startup screen.

A Cyclic Redundancy Check (CRC) self-test at every step of the process verifies the data, thereby ensuring the data installed into the system was not corrupted during the process.

The IDU provides an updateable navigation database containing at least the following location and path information, referenced to WGS-84, with a resolution of 0.01 minute (latitude/longitude) and 0.1° (for course information) or better at all of the following for the area(s) in which IFR operations are intended:

1) Airports

2) VORs, DMEs (including DMEs collocated with localizers), collocated VOR/DMEs, VORTACs, and NDBs (including NDBs used as locator outer marker);

3) All named waypoints and intersections shown on enroute and terminal area charts;

4) All airways shown on enroute charts, including all waypoints, intersections, and associated RNP values (if applicable). Airways are retrievable as a group of waypoints (select the airway by name to load the appropriate waypoints and legs between the desired entry and exit points into the flight plan).

5) RNAV DPs and STARs, including all waypoints, intersections, and associated RNP values (if applicable). DPs and STARs are retrievable as a procedure (select the procedure by name to load the appropriate waypoints and legs into the flight plan).

6) LNAV approach procedures in the area(s) in which IFR operation is intended consist of:

   a) Runway number and label (required for approach identification);

   b) Initial approach waypoint (IAWP);

c) Intermediate approach waypoint(s) (IWP) (when applicable);

d) Final approach waypoint (FAWP);

e) Missed approach waypoint (MAWP);

f) Additional missed approach waypoints (when applicable); and

g) Missed approach holding waypoint (MAHWP).

The complete sequence of waypoints and associated RNP values (if applicable), in the correct order for each approach, is retrievable as a procedure (select the procedure by name to load the appropriate waypoints and legs into the flight plan). Waypoints utilized as a final approach waypoint (FAWP) or missed approach waypoint (MAWP) in an LNAV approach procedure are uniquely identified as such (when appropriate) to provide proper approach mode operation.

7) LNAV/VNAV procedures in the area(s) where IFR operation is intended. LPV, LP, and/or LNAV/VNAV published procedures are available.

Select a procedure by name to load the appropriate waypoints and legs into the active flight plan. Waypoints used as a Final Approach Waypoint (FAWP) and LTP/FTP/MAWP in an LNAV/VNAV procedure are uniquely identified as such to provide proper approach mode operation.

2.10.2. 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, and insert the USB Flash memory storage device (IDU-450) or smart media card (IDU-III) containing the software update into the IDU.

3) Power the system ON, and select the UPDATE DATABASES option using the encoder (rotate to scroll, push to enter).

Figure 2-8: Update Databases on Ground Maintenance Page

4) Power the system OFF, and remove the memory storage device.

5) Repeat 2 through 4 for each additional display and close the USB door on each display (IDU-450 only).

6) Upon power up, verify the update was successful by noting the new software version number before acknowledging the startup screen.

As with the navigation database, the system software is verified by a CRC-32 self-test at every step of the process, thereby ensuring the software installed onto the system has not been corrupted at any point during the process.

2.11. Mechanical Considerations

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 for the display to provide uninterrupted power during momentary power loss.

All IDU-450 Integrated Display Units are identical in form, fit, and function. The Personality Module (PM) inside the J-1 Connector determines the function and performs as a systems configuration card (SCC). A failure of PM is annunciated as an SCC Fail. Therefore, the displays are interchangeable. The optional slip indicator may be interchanged with a blank plug without disassembling the display.

The IDU-III Integrated Display Units are also identical in form, fit, and function. A systems configuration card mounted in the associated tray determines the function and serves the same purpose as described for the personality module.

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 LEDs 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 LEDs only. When operated in this range (LEDs only), the screens are compatible with night vision goggles.

Although quite rugged, the AMLCD may 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. Avoid the use of abrasive cleaning compounds or pads to prevent damage to the anti-reflective coating on the screen.

2.12. Air Data and Attitude Heading Reference Systems

2.12.1. ADC, AHRS, and ADAHRS

A variety of ADC (Air Data Computer), AHRS (Attitude Heading Reference System), and ADAHRS (Air Data Attitude 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) drives 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, static ports, and OAT probe to measure indicated airspeed, pressure altitude, and outside air temperature. True airspeed and density altitude are calculated from these raw data. These data also calculate the Mach number, winds aloft, fuel endurance, and range. Fuel totalizer functions may not be available on some installations.

2.13. GPS/SBAS Receiver

The Global Positioning System (GPS) is a space-based radio-navigation system. It consists of 32 satellites, which orbit the Earth at an altitude of approximately 11,000 miles. GPS provides accurate information on position, velocity, and time, anywhere in the world and in all weather conditions.

SBAS (Wide Area Augmentation System) is a GPS-based navigation and landing system providing precision guidance to aircraft at thousands of airports and airstrips where there is 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 SBAS is based on a network of 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 relays the error data to one of two wide area master stations where correctional information for specific geographical areas is computed.

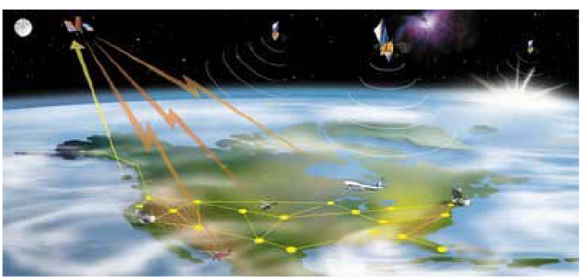


Figure 2-9: Global Positioning System (GPS) (FAA Image)

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

The EFIS obtains position information from a TSO-C145c Class Beta 3 GPS/SBAS 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 required for terrain display and awareness alerting (TAWS) functions. GPS status is monitored continuously by the EFIS.

WARNING:

SBAS OR FAULT DETECTION AND EXCLUSION (FOE) 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, Section 5.69). GPS faults are designated as follows:

1) GPS/SBAS loss of navigation: Absence of power (GPS PWR).
2) GPS/SBAS loss of navigation due to probable equipment failure (GPS EQPMNT).
3) GPS/SBAS loss of navigation: Inadequate satellites to compute a position solution (GPS SATLT).
4) GPS/SBAS loss of navigation: Unable to exclude position failure.
5) GPS/SBAS loss integrity monitoring, and loss of navigation due to loss of horizontal integrity monitoring (GPS HLOI).
6) GPS/SBAS horizontal protection level in nautical miles (GPS/SBAS).
7) GPS/SBAS vertical protection level in meters (GPS VPL).
8) GPS/SBAS horizontal figure of merit (95% accuracy) in nautical miles.
9) GPS/SBAS vertical protection level in meters.
10) GPS/SBAS almanac validity (GPS ALMANAC).
11) GPS/SBAS loss of navigation: no valid SBAS message.
12) GPS/SBAS loss of navigation: Insufficient healthy satellites (SBAS HLT).

2.14. Analog Interface Unit (AIU)

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

Through the AIU, the EFIS automatically provides the commands to an analog autopilot:

1) Departure Procedures
2) Enroute Legs
3) STARS
4) Approaches
5) DME ARCs
6) Procedure Turns
7) Holding Patterns Course Reversals
8) Missed Approach Procedures

For precision approaches, refer to autopilot supplemental documentation.

The EFIS and AIU permit all approach procedures to be performed "hands-off". See Section 7.0 IFR Procedures for additional information.

2.15. Input Signals

The following signals are received from various equipment:

1) Composite VOR radial/Localizer deviation inputs for two nav receivers
2) ILS Energize inputs for two nav receivers
3) DC Glideslope deviation for two glideslope receivers
4) Glideslope validity flag for two glideslope receivers

5) ADF bearing input for one ADF receiver in Sin/Cos or ARNIC 407 format or two bearing inputs from ADF with ARNIC 429 format (AIU-2 ONLY)

6) Marker Beacon inputs for blue, amber (yellow), and white indications

7) Radar Altimeter altitude signal

8) Radar Altimeter validity flag

9) Flight director vertical deviation

10) Flight director horizontal deviation

2.16. Analog Output Signals

The AIU provides autopilots with:

1) Analog Vertical Steering (Glideslope) + pseudo Glideslope (AIU-2 ONLY)

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

Section 3 Display Symbology

Table of Contents

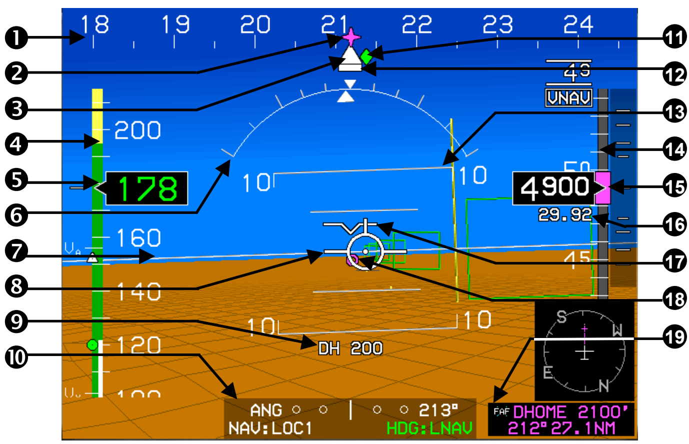
List of Figures and Tables

3.1. Introduction

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

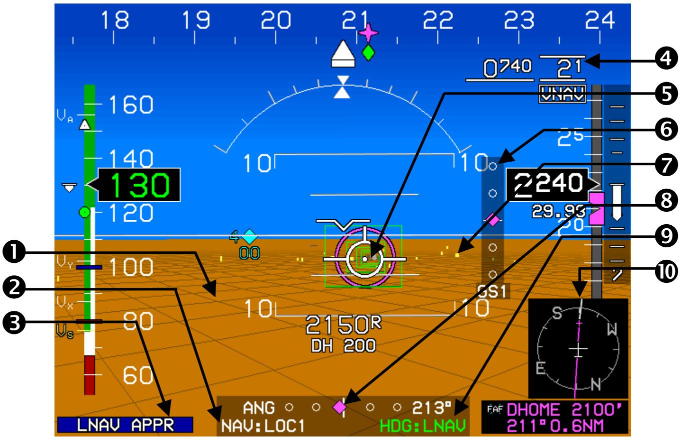
3.2. PFD Symbology

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). A replica of a day VFR view out the front window of the aircraft is shown on the screen.



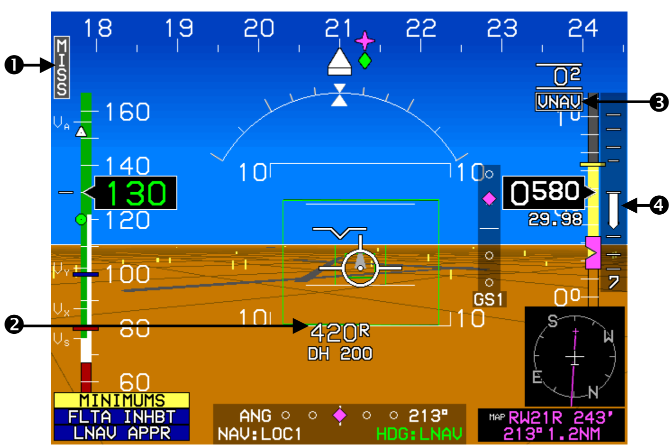
1) Directional Scale
2) Bearing to Waypoint
3) Heading Indicator
4) Indicated Airspeed Tape
5) Indicated Airspeed Readout
6) Bank Angle Scale
7) Horizon Line
8) Flight Path Marker
9) Decision Height
10) CDI Annunciator
11) Ground Track
12) Slip Indicator
13) Pitch Scale
14) Altitude Tape
15) Altitude Readout
16) Altimeter Setting
17) Waterline
18) Active Waypoint Symbol
19) Active Waypoint Information

Figure 3-1: Basic PFD



1) Terrain
2) Navigation Source
3) Mode Flag
4) Target Altitude Submode
5) Runway
6) Vertical Deviation Indicator
7) Obstruction
8) Course Deviation Indicator
9) Heading Submode
10) Mini-Map

Figure 3-2: PFD on Instrument Approach

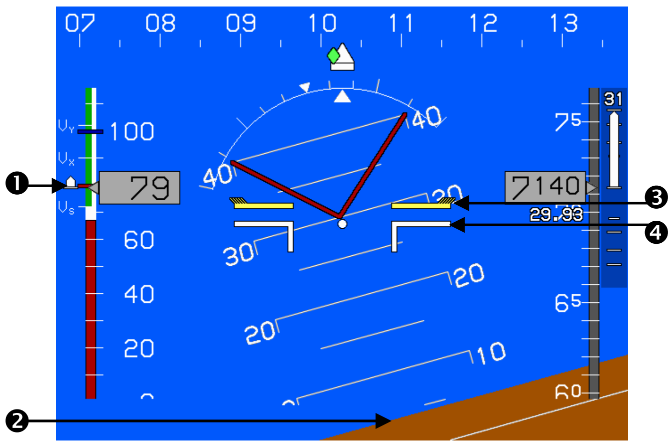


1) Missed Approach Tile
2) Altitude Above Ground
3) Vertical Navigation Sub Mode (VNAV or ASEL)
4) Vertical Speed

Figure 3-3: PFD on Instrument Approach (Continued)

3.3. Unusual Attitude Recovery (UAR) Mode

When pitch exceeds ±30° or roll exceeds ±65°, 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 (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°.



1) Speed Trend Worm
2) Horizon Cue
3) Pitch Limit Indicator
4) Expanded Waterline

Figure 3-4: Unusual Attitude Recovery Mode

3.4. Active Waypoint Information

Information for the active way point 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.

IFR Airport

VFR Airport

VORTAC

DME only or TACAN

VOR only

NDB

FIX

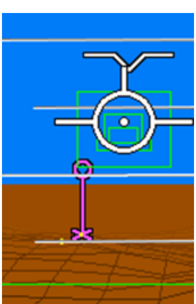
User Waypoint

Figure 3-5: Waypoint Information

NOTE:

See Jeppesen NavData Chart Compatibility in Section 8 Appendix, for additional information on waypoint naming conventions.

3.5. 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 is over the fix at the desired altitude.

Figure 3-6: Active Waypoint Symbol

The active waypoint symbol is drawn using the hidden surface removal techniques of the terrain and obstruction rendering so an active waypoint behind terrain appears to be so. The active waypoint symbol disappears in Unusual Attitude Mode and turns amber (yellow) in the event of a Loss of Navigation caution event.

If taking off from Seattle and the active way point is San Diego, a hoop over San Diego appears the on the horizon. Only the active waypoint is shown on the screen. Subsequent waypoints in a route appear sequentially as the active waypoint is passed.

NOTE:

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

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

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

If the waypoint is just a hoop hanging in space, the 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, climb to go through it; if it is below the horizon, 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, climb at 4° to go through it.

3) Use the “X” on the ground for 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. 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 the flight path between the aircraft and the airport.

3.6. Waypoint Sequencing

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

1) In most cases, the system auto-sequences from one waypoint to the next in accordance with the flight plan. Waypoint auto-sequencing is suspended in the following cases: A manual GPS/SBAS OBS is set (SUSPEND).

2) The aircraft is on the final approach segment of an instrument approach, and **ARM** (SUSPEND) has not been pressed to arm the missed approach procedure.

3) The aircraft is in a published holding pattern with another waypoint entered after the holding waypoint In the Active Flight Plan, and the pilot has not pressed **CONT** (SUSPEND) to continue out of the holding pattern.

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 reasons 1, 2, or 4 above, the IDU automatically switches from TO operation to FROM operation when appropriate. If not suspended, automatic waypoint sequencing occurs upon the following conditions:

AUDIBLE ANNUNCIATION

An auditory chime and the SUSPEND advisory flag annunciate suspension of automatic waypoint sequencing.

Where automatic waypoint sequencing is suspended due to manual GPSI 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.

The desired flight path shall be created from a sequence of straight, left turning, and right turning leg segments designed to provide smooth skyway, GPS/SBAS CDI and lateral autopilot guidance. Each leg between waypoints is composed of up to nine segments.

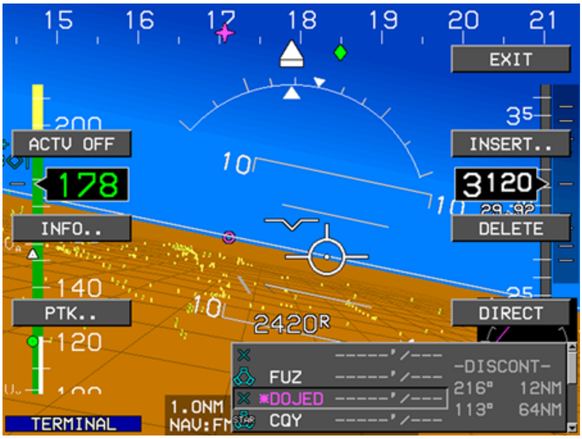


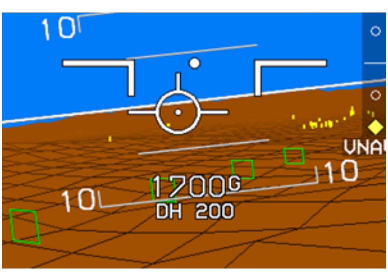
Figure 3-7: Waypoint Sequencing and Discontinuity

3.7. Selecting BARO

To enter the BARO mode, press **BARO (R2)** (IDU-450) on either the PFD or MFD to display the barometric pressure on the PFD in inches of mercury or millibars. For the IDU-III, scroll ➊ to enter the **BARO** mode on the PFD only.

Figure 3-8: Selecting BARO

3.8. Altitude above Ground (AGL)



The altitude above ground level is displayed directly below the flight path marker or expanded waterline any time the indication is below the maximum height configured during system installation. AGL altitude is driven by the AGL altitude source being used for TAWS.

Figure 3-9: Altitude above Ground (AGL)

A source indication appears after the figure to designate the source. In order of precedence, the sources are as follows:

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

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

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 the maximum height configured during system installation.

NOTE:

AGL using barometric altitude is only as accurate as the current barometric pressure setting and is subject to non-standard-day errors. Remember 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.

3.9. Altitude Readout

The altitude readout, located approximately two-thirds of the way up the altitude tape, digitally shows barometric altitude in feet MSL or on final descent during an LPV approach procedure, altitude is derived from GNSS and displayed in ten-foot increments.

The target altitude bug setting is limited to -1000 feet at the low end and 50,000' at the high end. The target altitude bug setting is annunciated above the altitude scale with a resolution of 100 feet. The target altitude bug setting annunciation includes a legend with the abbreviation "ASEL" to indicate the setting for the selected altitude sub-mode. The target altitude bug may be used either as a visual reference or, when vertically integrated with an autopilot (either fully integrated i.e., HeliSAS-E) or partially integrated through use of the vertical mode discrete input, as a control parameter for climbs or descents. When vertically integrated with an autopilot:

1) The target altitude bug setting annunciation is colored green, and the target altitude bug is a filled-white when in altitude hold mode.

2) The target altitude bug setting annunciation is colored white, and the target altitude bug is hollow-white when in a climb or descent mode.

3) The target altitude bug setting annunciation is colored green and flashes while the target altitude bug is a filled-white during altitude hold capture.

When not vertically integrated with an autopilot, the target altitude bug setting annunciation is colored white, and the target altitude bug is a filled-white at all times.

AUDIBLE ANNUNCIATION

When a target altitude is set and has been reached, deviation of more than 150 feet results in a single annunciation of “Altitude” (ALTITUDE).

When in VNAV sub-mode, the altitude scale shows the active waypoint VNAV altitude (if it exists) with a bug symbol geometrically interacting with the altitude box pointer. The VNAV altitude bug setting is annunciated above the altitude scale with a resolution of 100 feet. The VNAV altitude bug setting annunciation includes a legend with the abbreviation “VNAV” to indicate it is the setting for the VNAV altitude sub-mode. The VNAV altitude bug may be used either as a visual reference or, when vertically integrated with an autopilot (either fully integrated) or partially integrated through use of the vertical mode discrete input, as a control parameter for climbs or descents. When vertically integrated with an autopilot:

1) The VNAV altitude bug setting annunciation is colored green, and the VNAV altitude bug is filled-magenta when in altitude hold mode.

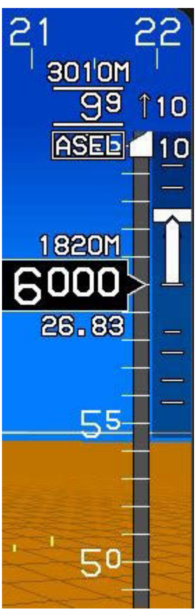
2) The VNAV altitude bug setting annunciation is colored white, and the VNAV altitude bug is hollow-magenta when in a climb or descent mode.

3) The VNAV attitude bug setting annunciation is colored green and flashes while the VNAV altitude bug is filled-magenta during altitude hold capture.

When not vertically integrated with an autopilot, the VNAV altitude bug setting annunciation is colored white, and the VNAV altitude bug is filled-magenta at all times.

When the VNAV altitude or target altitude differs from aircraft altitude to the extent the associated bug would be off-scale, the associated bug appears to be “parked” in the direction of the difference with half of the associated bug visible.

The altitude scale has a pilot-settable minimum altitude bug consisting of a bold amber (yellow) line on the altitude scale and an amber (yellow) region on the altitude scale background from the minimum altitude bug position to the ground level position. The minimum altitude bug setting is annunciated above the altitude scale with a resolution of one foot. It is possible to use both of the target altitude/VNAV altitude bug and the minimum altitude bug simultaneously with no interference of respective annunciations. The minimum altitude annunciation turns amber (yellow) and begins to flash when the aircraft descends below the minimum altitude setting from above. This is accompanied by MINIMUMS and an aural annunciation.



Altitude values may be presented in metric units. The metric display of barometric altitude has a resolution of 10 meters. Likewise, the metric display of the target altitude bug setting has a resolution of 10 meters. The metric display of barometric altitude and target altitude bug settings appears above the normal values and is colored white followed by a white “M.” The metric display of barometric altitude and target altitude bug setting is pilot-selectable to allow the pilot to declutter the display.

Figure 3-10: Altitude Values

The altimeter setting is displayed immediately below the altitude box. The altimeter setting digitally displays the altimeter setting in either inches of mercury (inHg) or millibars (mbar) according to the pilot-selected units. Immediately below the altimeter setting, the altimeter setting mode is annunciated QFE operations. Otherwise, no mode is annunciated. Definitions are as follows:

QFE: Barometric setting results in the altimeter displaying height above a reference elevation (e.g., airport or runway threshold).

QNE: Standard barometric setting (29.92 inHg or 1013 mbar) used to display pressure attitude for flight above the transition attitude.

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

When on the final approach VNAV descent segment in modes that perform GPS altitude integrity monitoring (e.g., LPV, or LNAV/VNAV) using GPS VNAV modes, the altimeter setting display shows the legend "GNSS" instead of the altimeter setting value. The intent is to make the pilot aware of the altitude source value on the display.

3.10. Minimum Altitude

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

The altitude setting is indicated above the altitude tape. A line immediately below it identifies a minimum altitude value. Minimum altitudes may be set in 10-foot increments. In addition to setting minimum altitudes for non-precision approaches, a decision height may be chosen. This example shows a Minimum Altitude Setting of 1,800 ft. See Section 5 Menu Functions and Step-by-Step Procedures.

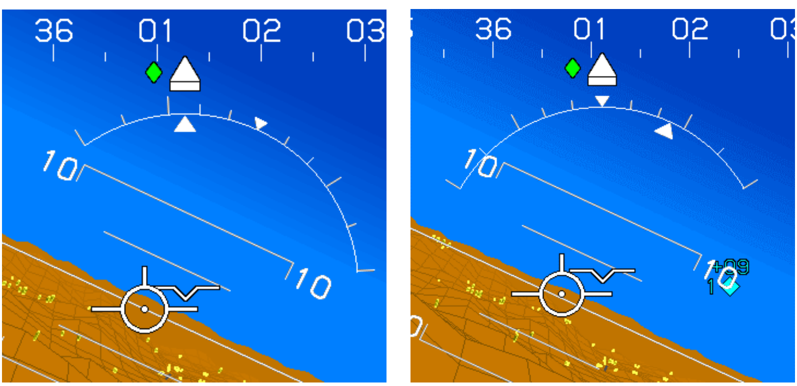
Figure 3-11: Minimum Altitude Setting

AUDIBLE ANNUNCIATION

When a minimum altitude is set, descending below it causes an annunciation of “Minimums” (
).

3.11. Bank Angle Scale

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



Roll Pointer **Sky Pointer**

Figure 3-12: Roll Pointer and Sky Pointer

3.12. Bearing to Waypoint

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

Figure 3-13: Bearing to Waypoint Symbol

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.

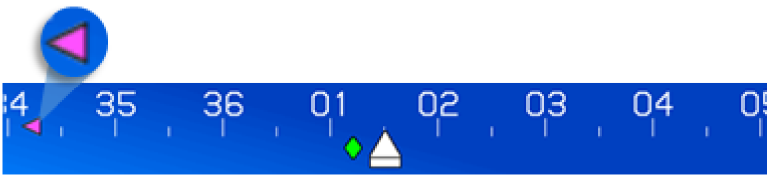


Figure 3-14: Displaced Bearing to Waypoint Symbol

NOTE:

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

3.13. 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 automatically shown in a three-dimensional manner. During start-up, on the ground, the runways for the nearest three airports are displayed. 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 the 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, they is very apparent on the PFD when approached (as seen below). This feature is especially useful for avoiding accidental runway incursion during taxi operations.

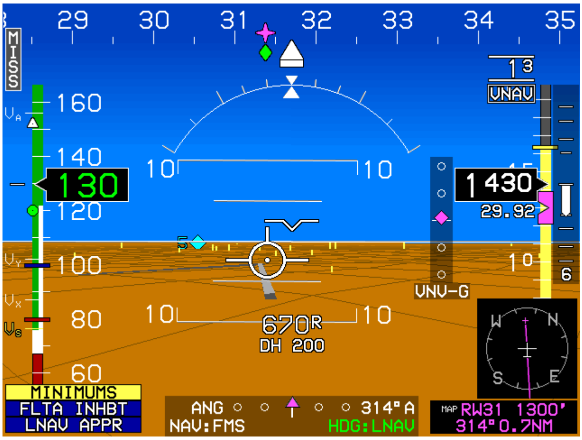


Figure 3-15: Runways

The illustration above depicts final approach on Runway 31 at Mineral Wells, TX. The aircraft offset from the runway, 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.

3.14. Course Deviation Indicator

A CDI and annunciator are centered at the bottom of the display. The CDI is the primary reference for GPS/SBAS navigation.

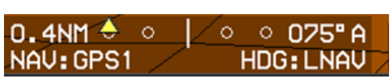


Figure 3-16: Course Deviation Indicator

The OBS annunciation includes either a degree (°) symbol (used if navigation source is not FMS or if not in True North mode) or a stylized True North (ᵀ) symbol (used if navigation source is FMS and in True North mode).

The currently selected navigation source is annunciated immediately below the CDI as follows:

1) NAV: FMS1 or, if a second GPS/SBAS receiver is not installed, NAV: FMS.
2) NAV: FMS2 (only available if a second GPS/SBAS receiver is installed).
3) NAV: VOR1 or LOC1.
4) NAV: VOR2 or LOC2.

Press OBS then the appropriate HSI source tile to change the selected navigation source. When VLOC is chosen, VOR or LOC is automatically selected, depending on which is available. The heading/roll-steering sub-mode is also shown (this is what the autopilot tracks). 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 indicator flashes when it is at full scale deflection. The CDI scale is adjusted according to phase of flight

1) Enroute (more than 30NM from destination) - 2NM scale
2) Terminal (within 30NM of destination) - 1NM scale
3) Approach (within 2NM of final approach fix) - 0.3NM scale
4) Final (inside FAF) - Angular (like a localizer)
5) Manual RNP (0.3NM - 4.0NM Scale)

NOTE:

In order to maximize display readability, the 2.0NM CDI scale is the only annunciation the system in the Enroute Mode. Other modes are indicated by a flag (see § 2.8 Warning/Caution/Advisory System).

"A" for automatic or an "M" for manual follows the OBS value. 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.

3.15. CWA Flags

The CWA (Caution/Warning/Advisory) flags alert the pilot to situations requiring pilot awareness. A red flag indicates warnings. An amber (yellow) flag indicates cautions. A blue flag indicates advisories.

Flags are stacked with warnings on top, followed by cautions, then advisories. For a complete list of flags and annunciations, as well as order of prioritization, see § 2.8 Warning/Caution/Advisory System.

AUDIBLE ANNUNCIATION

CWA flags are accompanied by an auditory annunciation.

3.16. Directional Scale

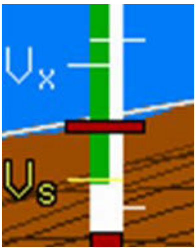
A stabilized directional scale is presented across the top of the display. The scale is conformal with the virtual display elements (terrain, waypoints, obstructions, etc.).

For example, an object outside the aircraft 100 left of the nose appears on the display under the heading scale, 100 left of the heading pointer. In standard mode, the directional scale is 70° wide, and is depicted with graduations at 50 increments and figures at 100 increments. In zoom mode, the directional scale is 35° wide, with graduations still at 50 increments (although more widely spaced).

Figure 3-17: Directional Scale

3.17. Dynamic Stall Speed

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



V_S is defined as clean stall at gross weight. Any time the stall speed is greater than the un-accelerated stall speed, the **V_S** is displayed in amber (yellow).

Figure 3-18: Dynamic Stall Speed

3.18. Expanded Waterline

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

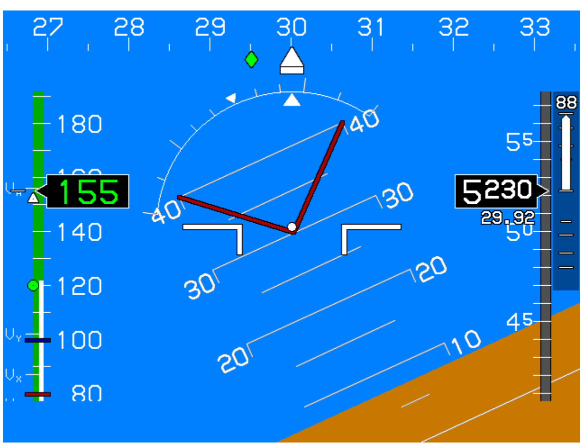


Figure 3-19: Expanded Waterline

3.19. Flight Director

Conventional dual-cue flight director symbology is available when the EFIS is connected to an autopilot transmitting flight director commands. It supports all flight director modes including take-off and go around.

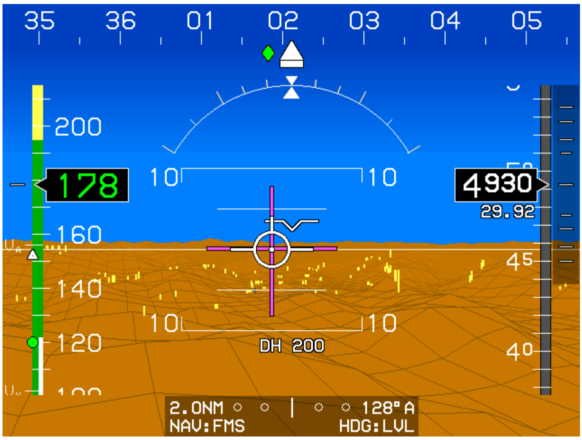


Figure 3-20: Flight Director Symbology

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, pitch up until the needle is centered, hold the 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 is not 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.

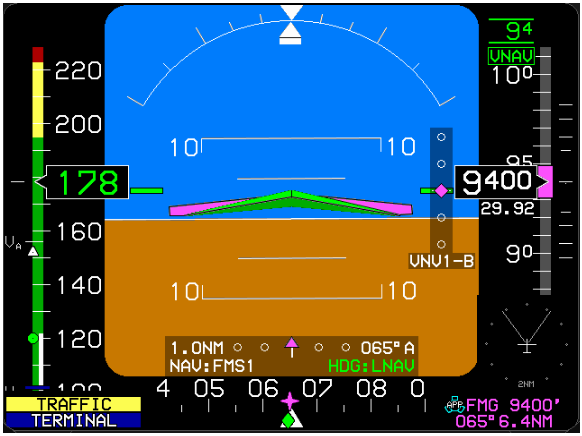


Figure 3-21: Flight Director Symbology

Flight Director symbology disappears in Unusual Attitude Mode. Refer to the autopilot/flight director documentation, for more information on flight director functions.

3.20. 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.

NOTE:

The flight path marker is where the aircraft is going, regardless of where it is pointed.

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

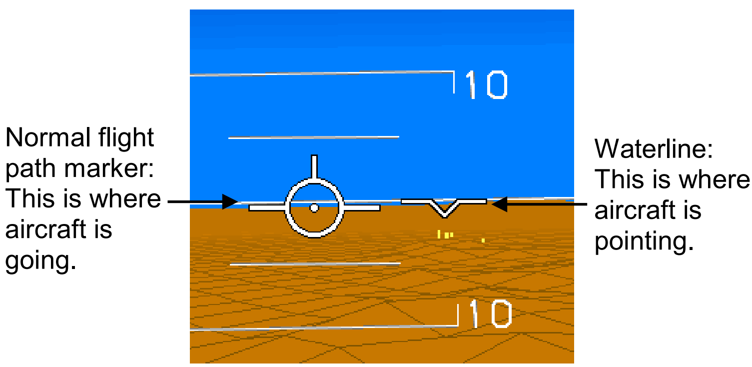
In an airplane installation, the flight path marker and pitch scale drift around the screen as a single element. When the flight path marker drifts to the edge of the screen due to a crab angle greater than 15° (7.5° in zoom mode), the flight path marker and pitch scale automatically cage (return to the center of the screen), and a “ghost” flight path marker, represented by three white bars (two horizontal, one vertical), remain in its place to indicate flight path. The caged flight path marker is grayed out to indicate 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 changes color to amber (yellow). This indicates 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:

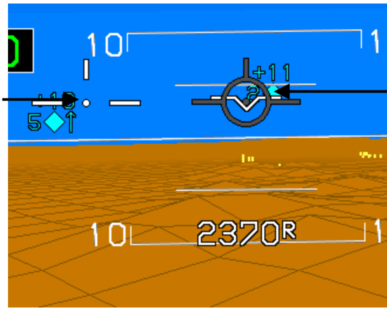
Do not use an amber (yellow) flight path marker for navigation.



Normal pitch scale and flight path marker. Lateral position of flight path marker relative to waterline indicating a crab angle less than 15°.

Figure 3-22: Normal Pitch Scale and Flight Path Marker

Ghost flight path marker: Where aircraft is going.



Caged flight path marker: Used only to determine climb/dive angle.

Figure 3-23: Caged Pitch Scale and Flight Path Marker

Caged pitch scale and flight path marker. 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. The flight path marker also remains an accurate tool for maintaining level flight during a GPS failure. The flight path marker is grayed to indicate degraded performance after one minute of continuous GPS outage.

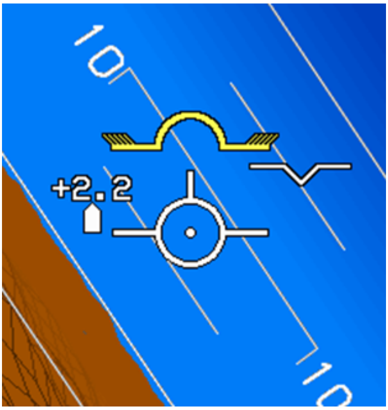
NOTE:

To fly the flight path marker: Simply position it on the desired symbol to fly. If the flight path marker is above the horizon, the aircraft is climbing. If it is below the horizon, the aircraft is descending. If the flight path marker cages, use the ghost for getting to the waypoint, and use the caged symbol for climb and descent angle.

CAUTION:

Beware of the amber (yellow) ghost indicating displacement beyond the bounds of the screen. If this is shown, crosscheck winds, heading, and ground track.

3.21. G-Force 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 gives 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.

Figure 3-24: G-Force Indicator

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 gives 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 grows in the “F” direction with angle of attacks lower than target and in the “S” direction with angle of attacks higher than target.

3.22. 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.

Figure 3-25: Ground Track on Directional Scale

If the ground track is beyond the limits of the directional scale, it is displayed at the limit of the scale and highlighted in amber (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.

3.23. Heading Bug

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

Figure 3-26: Heading Bug

When the heading bug is displaced beyond the range of the directional scale, the heading bug is halved, and the value is displayed in a box at the limit of the scale. In this example, the heading bug is set to 230°.

Figure 3-27: Displaced Heading Bug

NOTE:

If coupled with an autopilot using HEADING mode GPS steering, the EFIS commands the autopilot to maintain the selected heading. If the autopilot flies a flight plan and is coupled to the EFIS using GPSS mode, invoke the heading bug to override the flight plan in favor of the selected heading.

3.24. 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 313°.

Figure 3-28: Heading Indicator

3.25. 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 actual horizon.

The artificial horizon is an edge-to-edge white line representing the aircraft's level flight path (or current altitude) projected into infinity. It may 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.) 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 results in zero pitch. Placing the flight path marker on the artificial horizon results in level flight.

The actual horizon, as in the real world, is the borderline between ground and sky and may be above or below the artificial horizon. On the PFD, the actual horizon is depicted at a distance determined by aircraft altitude.

This following examples show the artificial horizon and actual horizon over featureless terrain and in mountainous terrain.

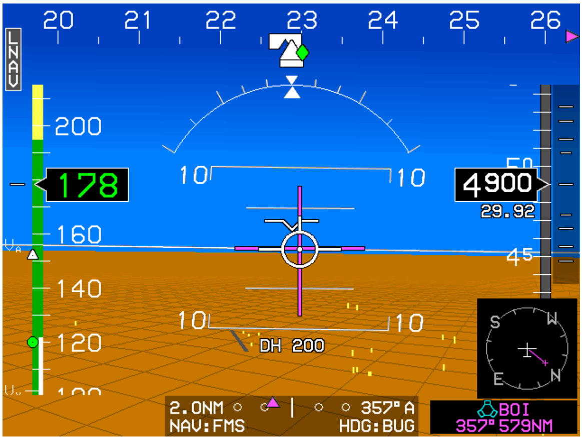


Figure 3-29: Artificial Horizon and Actual Horizon, over Featureless Terrain

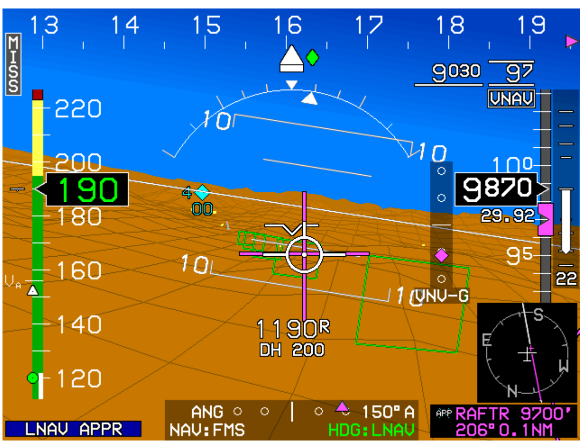


Figure 3-30: Artificial Horizon and Actual Horizon, in Mountainous Terrain

3.26. Horizon Cue

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

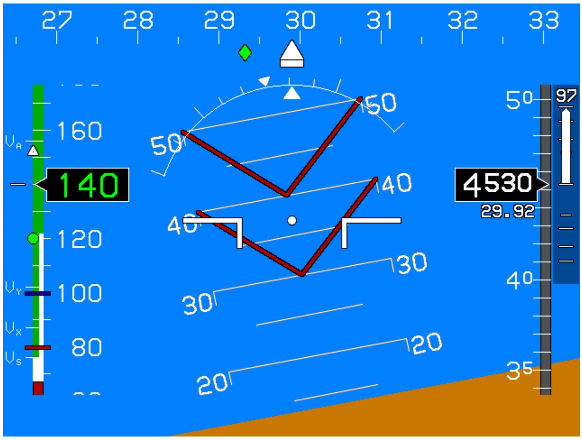


Figure 3-31: Horizon Cue

3.27. HSI (on PFD)

An HSI may be overlaid on the PFD, centered on the flight path marker. The PFD HSI is driven by VOR1, VOR2, LOC1, LOC2, GPS1, or GPS2 (see § 5.42 Omnibearing Selector (OBS) Menu , or § 5.43 Omnibearing Selector Function HSI and CDI/Annunciator Source Selection).

The white dot on the course-line arrow provides the TO/FROM indication:

1) A white dot on the arrow side indicates TO.

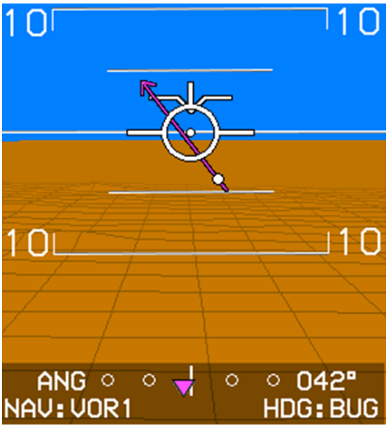
2) A white dot on the tail indicates FROM.

3) Think of the white dot as the VOR station.

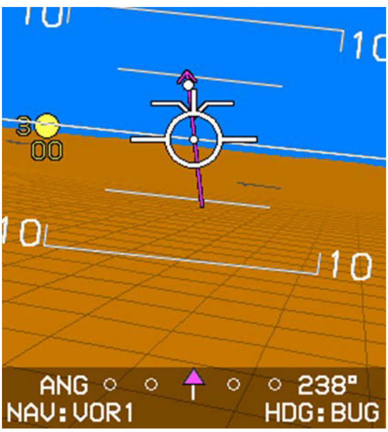
The deviation dots are automatically decluttered when the deviation is less than one dot.

The PFD HSI symbology is pilot-selectable, however it is mutually exclusive to the Flight Director Symbology. The HSI only appears when VOR/VLOC is selected.

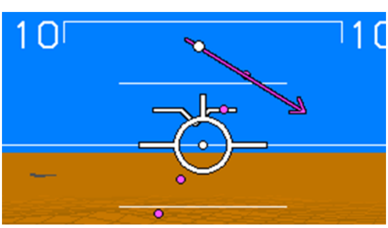
When HSI symbology is selected and the HSI source is valid and active, an HSI display centered upon the flight path marker (normal mode in airplanes). The HSI display color is magenta. When the HSI is slaved to VOR 1 or VOR 2 the course is indicated as shown below:



VOR1 is selected and the 042º radial is being crossed proceeding outbound.



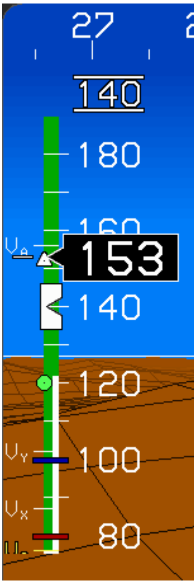
VOR1 is selected while on the 058º radial inbound.



The CDI flashes when at full scale.

Figure 3-32: PFD HSI Symbology

3.28. Indicated Airspeed Display



The PFD has an airspeed box and airspeed scale on the left side of the display. The airspeed box digitally displays indicated airspeed in knots, miles per hour, or kilometers per hour, depending upon the setting of the “Speed Units” system limit. The color of the airspeed value within the airspeed box matches the background of the airspeed scale. In the case of airplanes, the airspeed scale has graduations every 10 measurement units, with labels every 20 measurement units. The color of the digital display of indicated airspeed coordinates with the color of the current region of the scale.

Figure 3-33: Indicated Airspeed Display

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 $\mathbf{V_{S0}}$.

3) If a valid $\mathbf{V_{FE}}$ exists, a white flap-operating area from $\mathbf{V_{S0}}$ to $\mathbf{V_{FE}}$.

4) For aircraft without a $\mathbf{V_{MO}/M_{MO}}$:

   a) A green safe-operating area from $\mathbf{V_{S1}}$ to $\mathbf{V_{NO}}$.

   b) An amber (yellow) caution area from $\mathbf{V_{NO}}$ to $\mathbf{V_{NE}}$.

   c) A red high-speed awareness area from $\mathbf{V_{NE}}$ to the top of the scale.

5) For aircraft with a $\mathbf{V_{MO}/M_{MO}}$, a red high-speed awareness area from the lower of $\mathbf{V_{MO}}$ or $\mathbf{M_{MO}}$ to the top of the scale.

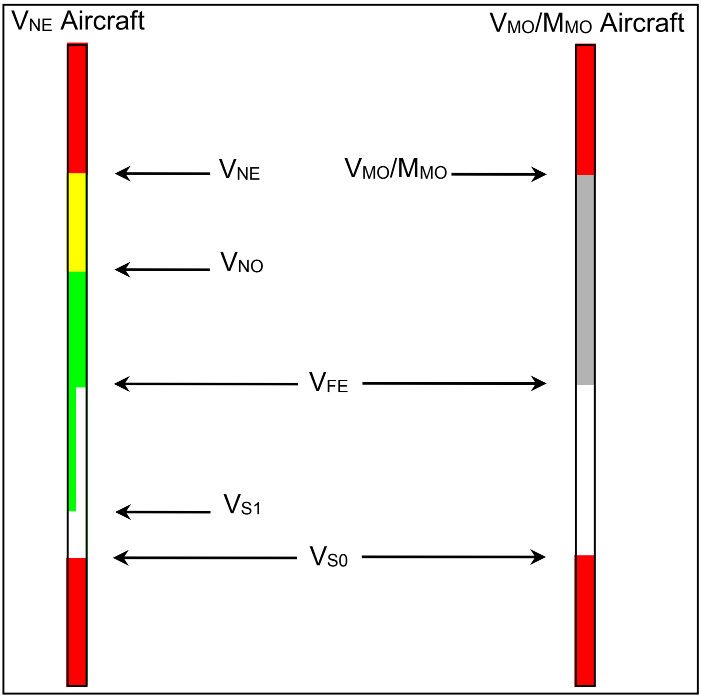


Figure 3-34: Airspeed Scale Background

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 $\mathbf{V_{ME}}$.

2) For reciprocating multiengine-powered aircraft of 6,000 pounds or less, a blue line at $\mathbf{V_{YSE}}$.

3) A white $\mathbf{V_S}$ marking at the aircraft's 1-G $\mathbf{V_{S1}}$, or an amber (yellow) $\mathbf{V_S}$ marking at $\mathbf{V_{S1}}$ corrected for G-loading, whichever is higher.

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

5) If enabled ($\mathbf{V_X}$ not 0), a $\mathbf{V_X}$ marking at $\mathbf{V_X}$.

6) If enabled ($\mathbf{V_Y}$ not 0), a $\mathbf{V_Y}$ marking at $\mathbf{V_Y}$.

7) If enabled ($\mathbf{V_A}$ not 0), a $\mathbf{V_A}$ marking at $\mathbf{V_A}$.

8) If enabled (**V_{MFE}** not 0), a "white triangle" maximum flap extension speed marker al **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}. 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) An amber (yellow) low-speed awareness area from G-compensated 1.1 x **V_{S0}** to G-compensated 1.2 x **V_{S0}. V_{S0}** is calculated by dividing the pilot-input **V_{REF}** by 1.23. The amber (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}.** When a pilot-input **V_{REF}** exists, the white flap-operating area extends from the top of the amber (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:

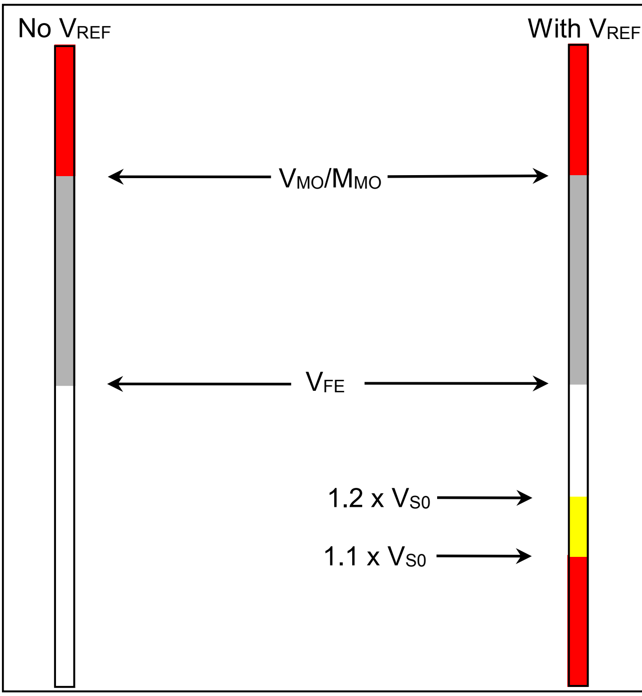


Figure 3-35: Airspeed Scale Background for Part 25

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

1) If pilot-input $\mathbf{V_{REF}}$ is valid, a white $\mathbf{V_S}$ marking at the aircraft's 1-G $\mathbf{V_{S0}}$ or an amber (yellow) $\mathbf{V_S}$ marking at $\mathbf{V_{S0}}$ corrected for G-loading, whichever is higher. $\mathbf{V_{S0}}$ is calculated by dividing the pilot-input $\mathbf{V_{REF}}$ by 1.23.

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

3) If enabled ($\mathbf{V_X}$ not 0), a $\mathbf{V_X}$ marking at $\mathbf{V_X}$.

4) If enabled ($\mathbf{V_Y}$ not 0), a $\mathbf{V_Y}$ marking at $\mathbf{V_Y}$.

5) If enabled ($\mathbf{V_A}$ not 0), a $\mathbf{V_A}$ marking at $\mathbf{V_A}$.

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

The airspeed scale has a pilot-settable airspeed bug geometrically interacting with the airspeed box pointer. The airspeed bug setting is annunciated above the airspeed scale, with a resolution of one knot indicated airspeed. The airspeed bug may 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 is colored white, and the airspeed bug is hollow-white. When not vertically integrated with an autopilot, the airspeed bug setting annunciation is colored white, and the airspeed bug is a filled-white at all times.

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

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

3.29. Localizer/Glideslope (ILS)

Localizer and glideslope are displayed on the PFD using the CDI, VDI, and PFD HSI.

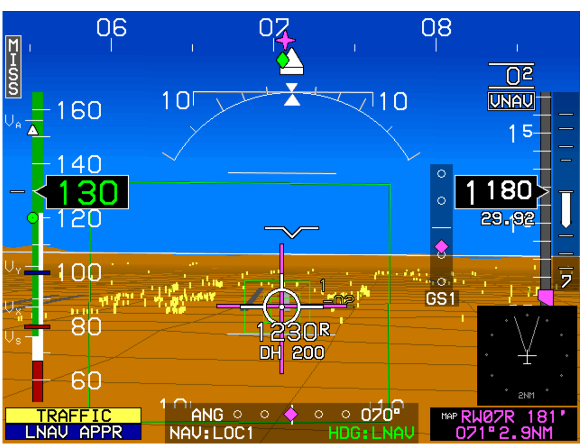


Figure 3-36: Localizer/Glideslope (ILS)

Press the **CRS SYNC** button in the nearest ILS function to automatically set localizer to the final approach course.

For localizer-only (no glideslope) display, only the localizer symbology is displayed. The HITS continues to provide barometric vertical navigation to the missed approach point based on GPS only.

When flying a localizer back course, the glideslope symbology is automatically removed to prevent display of false glideslope activity.

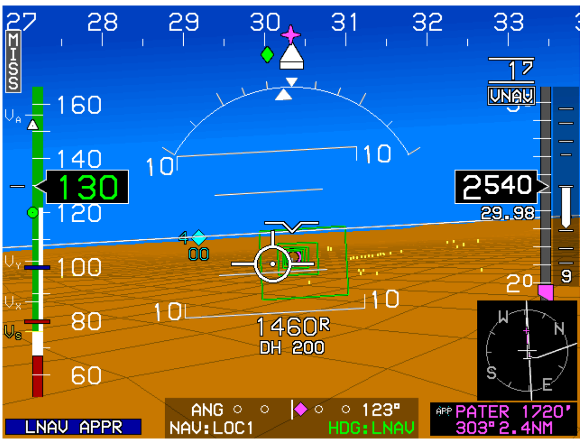
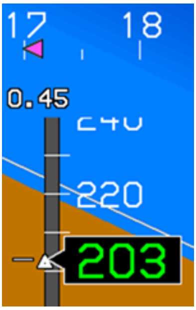


Figure 3-37: Flying a Localizer Back Course

NOTE:

Remember, the skyway is always driven by GPS for lateral and barometric altitude for vertical, while the ILS always drives the localizer and glideslope, so there is a continuous cross-check of independent sources centered in the scan. The conformal runway presentation is a powerful aid when flying an ILS, keep the flight path marker on the near end of the runway to result in very precise ILS tracking.

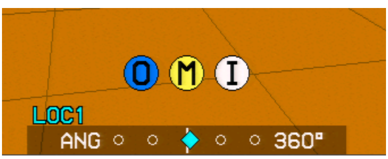
3.30. Mach Number



The Mach number is shown as an installation option above the airspeed tape on the airspeed indicator. It is automatically removed below Mach 0.45.

Figure 3-38: Mach Number

3.31. Marker Beacon



Conventional marker beacon indicators are shown centered in the lower portion of the PFD just above the CDI. During a built-in test more than one marker beacon may be active. In this mode, all active Marker Beacons (Inner, Middle, and Outer) is displayed side-by-side.

Figure 3-39: Marker Beacon

3.32. Mini Map

The identifier of the active waypoint along with the bearing and distance to the waypoint is displayed in magenta in the lower right corner of the PFD. Bearing to the active waypoint is displayed referenced to either magnetic or True North depending upon the status of the True North mode discrete input. If referenced to magnetic North, the bearing display uses the degree (°) symbol. Otherwise, a stylized True North (^{T}) symbol is used. If a target altitude is not set and the active waypoint has a VNAV altitude associated with it, the identifier includes a display of VNAV altitude. The CDI and active waypoint identifier disappear in Unusual Attitude Mode. The identifier of the active waypoint along with the bearing and distance to the waypoint turns amber (yellow) in the event of GPS Loss of Navigation caution.

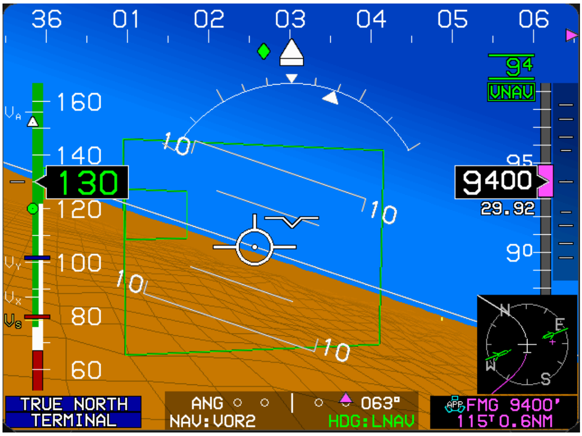


Figure 3-40: Mini Map

A miniature-moving map (mini-map) is displayed in the lower right corner of the PFD above the active waypoint identifier with a compass rose and displays the active navigation route and active waypoint. The color of the active leg in the flight plan path is magenta. The color of the active leg turns amber (yellow) in the event of GPS loss of navigation caution. VOR pointers are displayed on the miniature moving map corresponding to selected Navigational Source. The VOR1 pointer is blue. The VOR2 pointer is green. The associated pointer is only shown when the signal is valid. The pilot may declutter the mini-map. The mini-map disappears in Unusual Attitude Mode. The mini-map is mutually exclusive with the traffic thumbnail. See § 3.43.1.

If an instrument approach is selected, the Mini Map displays the entire approach procedure up to the missed approach point. When activated, the Mini Map depicts the entire missed approach procedure.

Figure 3-41: Mini Map Only Displayed with Active Waypoint

NOTE:

The Mini Map is not shown when the traffic thumbnail display is selected, either manually or by automatic pop-up. Mini Map and Traffic thumbnail are mutually exclusive. See § 3.43.1.

3.33. Obstructions

Towers, antennas, and other obstructions are shown on the PFD as vertical amber (yellow) lines. Obstructions are conformal in both location and size (a tower shown 100 left of heading and below the horizon line on the screen is seen outside 100 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 representing 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 USB Flash Memory Storage Device (IDU-450) or Smart Media Card (IDU-III) into the existing obstruction database.

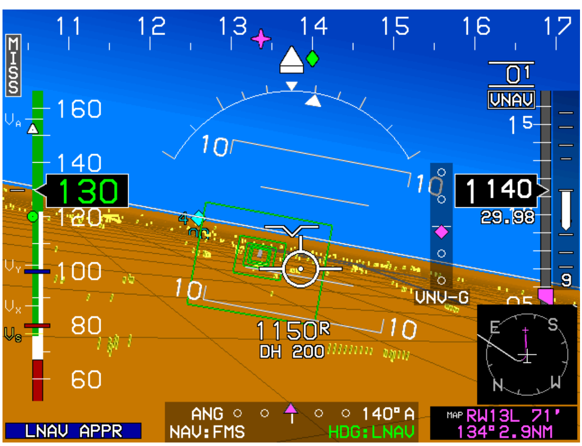


Figure 3-42: Obstructions

WARNING:

MANY TOWERS, ANTENNAS, AND, OBSTRUCTIONS ARE NOT IN THE DATABASE.

NOTE:

Jeppesen provides the obstruction data on a 28-day cycle.

AUDIBLE ANNUNCIATION

Towers, antennas, and obstructions representing a collision hazard cause an annunciation of OBSTRUCTION and aural annunciation of "Caution Obstruction".

3.34. PFD Basic Mode

The PFD has a Basic Mode. See § 5.66 PFD Declutter (DCLTR) Menu for enabling/disabling Basic Mode. 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 is always the sky pointer type. The slip/skid indicator is at the bottom of the sky pointer. The flight path marker is not shown in Basic Mode. Basic Mode is disabled while Unusual Attitude Mode is active.

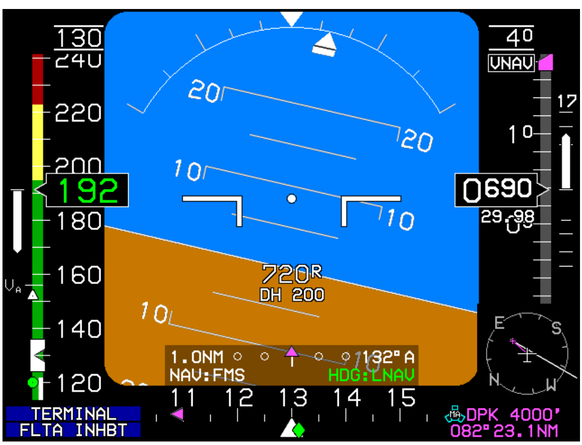


Figure 3-43: PFD Basic Mode

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.

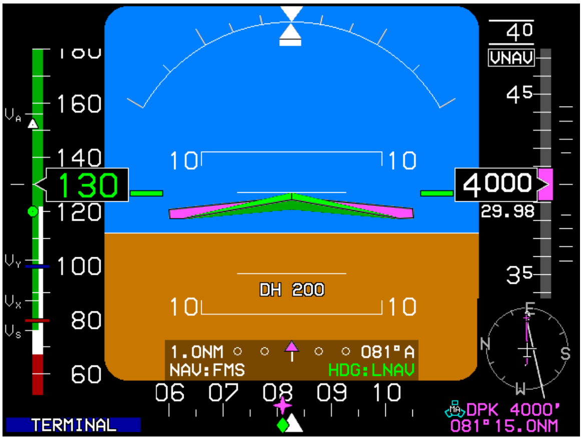


Figure 3-44: Basic PFD Display with Conventional Flight Director Command Bar

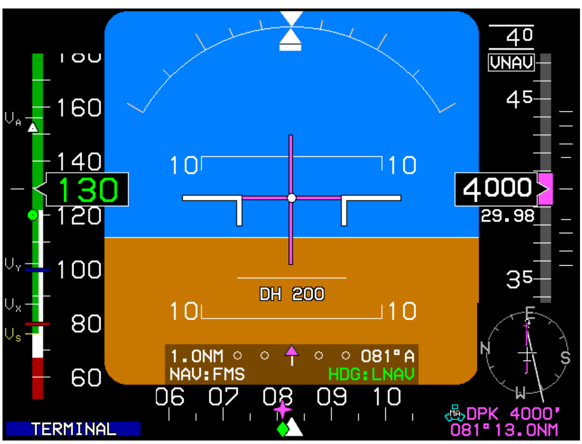


Figure 3-45: Basic PFD Display With Cross Pointer Flight Director

3.35. Pitch Limit Indicator

If enabled, an amber (yellow) pitch limit indicator appears 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 $\mathbf{V_{S1}}$ or $\mathbf{V_{S1}}$ corrected for G-loading; or

2) For transport category airplanes, if pilot-input $\mathbf{V_{REF}}$ is valid, the higher of the aircraft's 1-G $\mathbf{V_{S0}}$ or $\mathbf{V_{S0}}$ corrected for G-loading where $\mathbf{V_{S0}}$ is calculated by dividing the pilot-input $\mathbf{V_{REF}}$ 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 five knots indicated airspeed above stall speed, the pitch limit indicator becomes red. The pitch limit indicator merges with the applicable reference symbol at stall speed and continue moving downward as indicated airspeed further decreases.

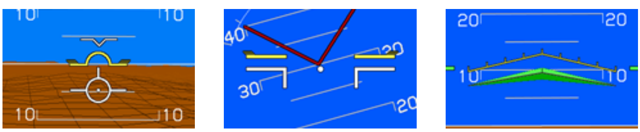
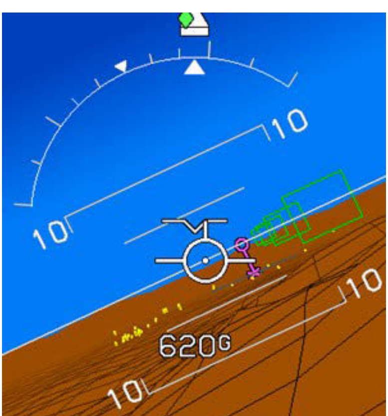


Figure 3-46: Pitch Limit Indicator

3.36. Pitch Scale



The PFD has a single width white pitch scale and horizon line that rotate in conjunction with the background according to the aircraft's roll angle. 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 indicate the direction to the horizon.

Figure 3-47: Pitch Scale

3.37. 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.

NOTE:

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 selected course and may 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 is not visible.

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

The Skyway boxes are drawn using the hidden surface removal techniques of the terrain and obstruction rendering, so a skyway box behind terrain appears to be so. The pilot may declutter skyway box depiction. The skyway boxes disappear In Basic and Unusual Attitude Modes. In Reversionary Mode 1 (GPS Failure), the skyway boxes disappear after one minute to indicate degraded navigation performance.

Dashed or solid lines are used to indicate whether the autopilot is coupled to the skyway as follows:

1) Fully integrated autopilot:

   a) Dashed-Autopilot not coupled to skyway.

   b) Solid-Autopilot coupled to skyway.

2) Partially integrated autopilot through use of the HDG mode and/or NAV/APR mode discrete inputs:

a) Dashed-Autopilot not coupled to skyway.

b) Solid-Autopilot coupled to skyway. Either autopilot is in HDG mode with LNAV heading/roll-steering sub-mode engaged or autopilot is in NAV/APR mode with the FMS, FMS1, or FMS2 as the currently selected navigation source.

3) Unintegrated autopilot:

a) Always solid.

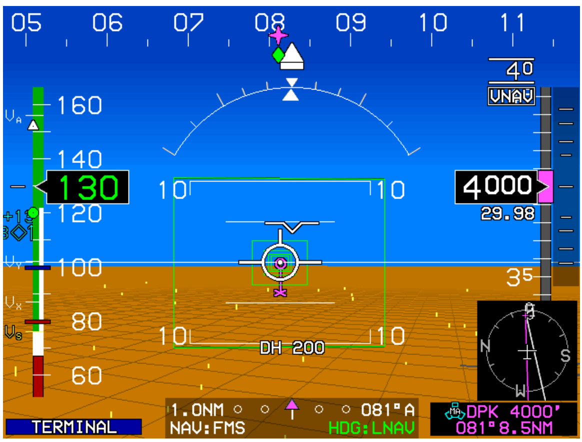


Figure 3-48: Skyway

See § 5.66 PFD Declutter (DCLTR) Menu for disabling skyway boxes.

3.37.1. 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.

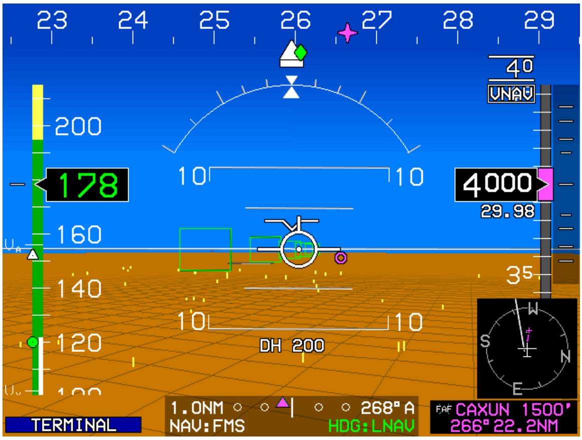


Figure 3-49: Skyway Lateral Navigation (LNAV)

The top and bottom sides of the boxes are parallel to the horizon on straight leg segments, and dynamically tilt with respect to the horizon on turning leg segments based upon leg segment turn radius and groundspeed.

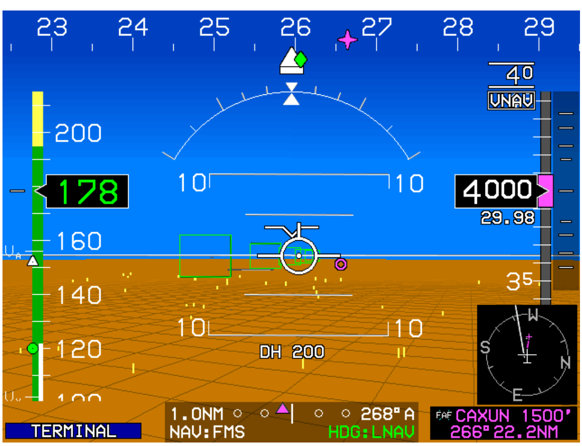


Figure 3-50: V_{PROC} or Pre-Programmed Speed

The system is configured with a $\mathbf{V_{PROC}}$ or pre-programmed speed to determine the radius of the skyway turns in a procedure. $\mathbf{V_{PROC}}$ is the approximate speed approach procedures are typically flown in a particular aircraft. Skyway turns result dynamically tilted boxes with respect to the horizon on turning leg segments based upon leg segment turn radius and groundspeed. $\mathbf{V_{PROC}}$ 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

Therefore in zero-wind conditions, the angle of the flight path marker matches the angle of the boxes. However, wind causes the actual bank angle required to stay within the skyway to vary.

Since 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 happens next along the course.

NOTE:

To fly skyway turns, wait until flying through the last level box on a straight course segment before initiating the turn. If the next box is overshot, increase the bank angle slightly. If the next box is undershot, slightly shallow the bank angle. Check the progress through a turn by looking at the projected path on the moving map; make it match the curve of the course line. Remember, the boxes indicate a turn not a target bank angle, because of the effects of wind.

3.37.2. Skyway Vertical Navigation (VNAV)

Skyway box altitude is controlled by target altitude, VNAV altitude, aircraft altitude, aircraft climb performance, and climb/descent angle setting. If no target altitude or VNAV altitude is set, the skyway boxes describe the desired lateral flight path of the aircraft at the aircraft's current altitude. With a target altitude or VNAV altitude set, the boxes provide both lateral and vertical guidance. Climb and descent angle settings are controlled individually with a resolution of 0.1°.

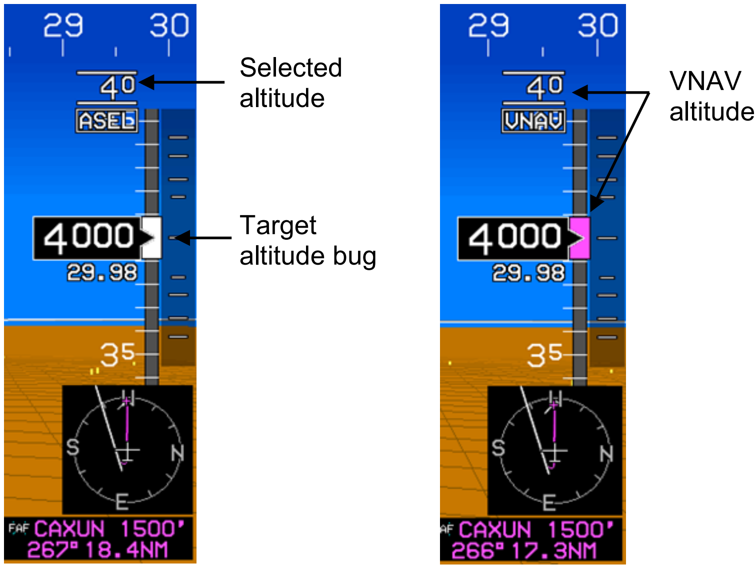


Figure 3-51: Skyway Vertical Navigation (VNAV)

When a target altitude is set, the boxes emanate from the current aircraft altitude at the climb or descent angle setting, as appropriate, until reaching the target altitude. The purpose of this symbology is to emulate an altitude pre-selector and give guidance to climb or descend "right now" as if being given an assigned altitude from an air traffic controller. Most operations are performed in this "altitude pre-selector" mode.

When no target altitude is set and at least one VNAV altitude associated with a waypoint exists, VNAV is guided by VNAV waypoints determined by VNAV altitude and VNAV offset from flight plan waypoints.

There are two sources for VNAV altitudes, the navigation database and manual input through the ACTV menu. VNAV altitudes for waypoints without a navigation database or manually input VNAV altitude is automatically computed by the system using "look-ahead" rules. When "look-ahead" finds a further VNAV altitude constraint above the previous VNAV altitude constraint (i.e., climb commanded), an automatic VNAV altitude is continuously calculated for the waypoint based upon an immediate climb to the altitude constraint at the higher of actual climb angle or the climb angle setting (dynamic climb angle). When “look-ahead” finds a further VNAV altitude constraint below the previous VNAV altitude constraint (i.e., descent commanded), an automatic VNAV altitude is calculated for the way point based upon a descent to reach the VNAV altitude constraint at the associated waypoint using the descent angle setting. If no further VNAV altitude constraints are found, the automatic VNAV altitude is set to the last valid VNAV altitude constraint.

When a VNAV climb is desired, the boxes are drawn at a vertical position the higher of: (a) the dynamic climb angle emanating from the aircraft's present position (aircraft-referenced); (b) the dynamic climb angle emanating from the next waypoint VNAV altitude (geo-referenced forward); or (c) the climb angle setting emanating from the previous waypoint VNAV altitude (geo-referenced backward). The geo-referenced backward calculation 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. Once the boxes intercept the VNAV altitude, further boxes are drawn with a zero angle to show a level off followed by a level flight segment.

3.38. 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.

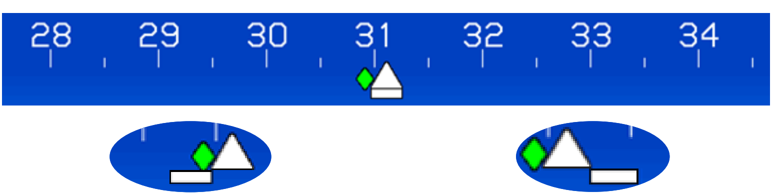
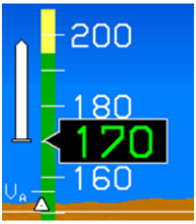


Figure 3-52: Slip/Skid Indicator

3.39. Speed Trend Indicator



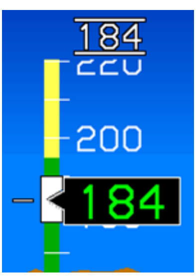
The Speed Trend Indicator is presented as a dynamic pointer that grows out of a fixed datum in correspondence with changes in horizontal velocity.

Figure 3-53: Speed Trend Indicator

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

The pointer tells the pilot what the aircraft's velocity is in ten seconds. This example shows the aircraft will be at approximately 198 KTAS in ten seconds.

3.40. Target Airspeed



The current target airspeed is displayed in conjunction with the target airspeed bug, immediately above the airspeed tape. Lines above and below bracket the value. In this example, the target airspeed is set to 184 Kts.

Figure 3-54: Target Airspeed

A bug marking the target airspeed is displayed on the airspeed tape. Scroll the encoder to move the bug up and down the tape.

3.41. 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. 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 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 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 causes a "pop-up" condition on the PFD and MFD. Even if it has been manually decluttered by the pilot, terrain is automatically 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, there is terrain between the aircraft and the runway or waypoint at ground level.

CAUTION:

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 5° above the horizon. Position of flight path marker indicates the terrain is not cleared if the current climb angle and track are maintained.

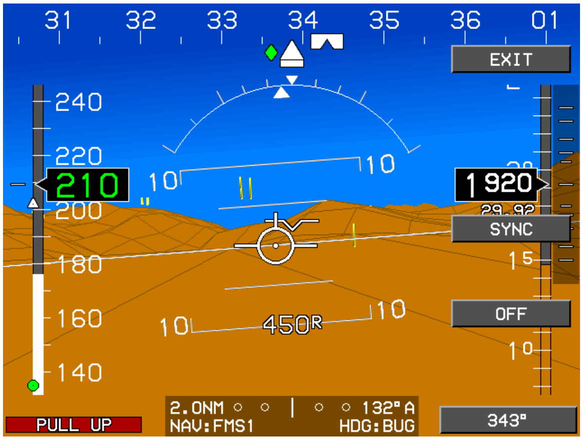


Figure 3-55: Position of Flight Path Marker

While the grid uses the highest points for terrain depiction, terrain between data points is not displayed. This results in a “simplification” of the terrain that is most noticeable near ground level in areas of rugged terrain.

While the Genesys Aerosystems 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.

CAUTION:

Do not use terrain depiction in instrument conditions for operating below minimums or without regard to published procedures.

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).

The terrain shown on the PFD and moving map often gives a clear understanding of why the published instrument procedures are making the pilot make certain maneuvers.

If the selected course and altitude impact terrain, ignore the course and avoid the terrain visually on the PFD and moving map.

If in VMC flight the pilot encounters inadvertent IMC, immediately set the heading bug to the reciprocal of the course. 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. Use the moving map to determine the direction to turn away from terrain and turn to the heading bug. If there is a terrain alert, identify the threatening terrain on the moving map and maneuver to avoid the threatening terrain.

3.42. Timer

At the pilot's option, a timer (hours: minutes: seconds) is displayed immediately above the flight path marker. Timer may be set to count up indefinitely or count down from a pilot-specified value. Elapsed time since take-off may also be shown without affecting an active timer. When selected, elapsed time is shown for ten seconds in the lower right corner of the screen or until a button is pressed.

Figure 3-56: Timer

AUDIBLE ANNUNCIATION

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

3.43. Traffic

The normal mode PFD displays traffic in a three-dimensional manner. PFD traffic uses standard traffic symbols as defined in § 3.43.1.

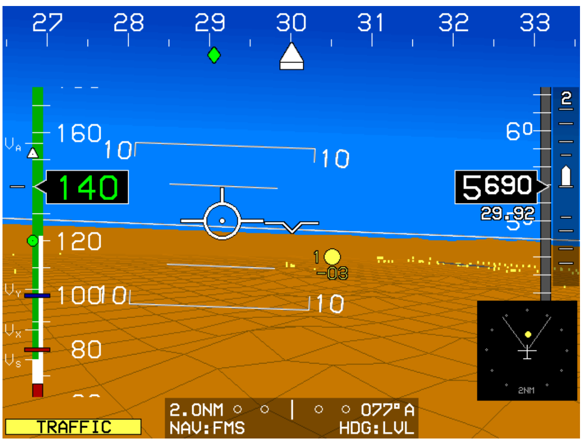


Figure 3-57: Traffic

Immediately to the left of the symbol, PFD traffic includes a range indication in nautical miles. The relative altitude in hundreds of feet is displayed below the traffic symbol, if the traffic is below own aircraft. The relative altitude in hundreds of feet is displayed 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 is not rendered in Basic Mode or Unusual Attitude Mode.

AUDIBLE ANNUNCIATION

Traffic alerts result in a 

flag and a single aural warning of “Traffic”.

A Resolution Advisory results in a 

flag and a single aural warning of “Traffic.

3.43.1. Traffic Thumbnail

A traffic thumbnail is displayed in the lower right corner of the PFD above the active way point identifier.

Figure 3-58: Traffic Thumbnail

The traffic thumbnail has clock face markings and is normally fixed at 6NM scale. The pilot may declutter the traffic thumbnail however; the event of a traffic warning (TA or RA), the traffic thumbnail is automatically enabled while the traffic warning is active, and the traffic thumbnail scale automatically adjusts in multiples of 2NM (2NM, 4NM, or 6NM) to optimally display the traffic. The traffic thumbnail disappears in Unusual Attitude Mode. Display of the mini-map and traffic thumbnail is mutually exclusive with the traffic thumbnail taking precedence during a traffic warning (TA or RA). The traffic thumbnail uses standard traffic symbols as follows:

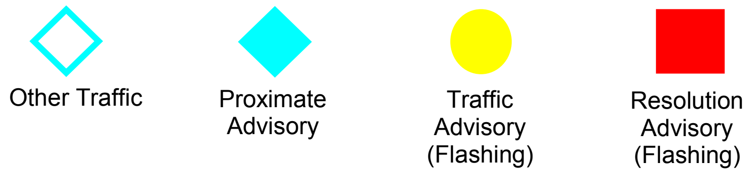


Figure 3-59: TCAS-I, TCAS-II, TAS, and TIS-A Traffic Symbols

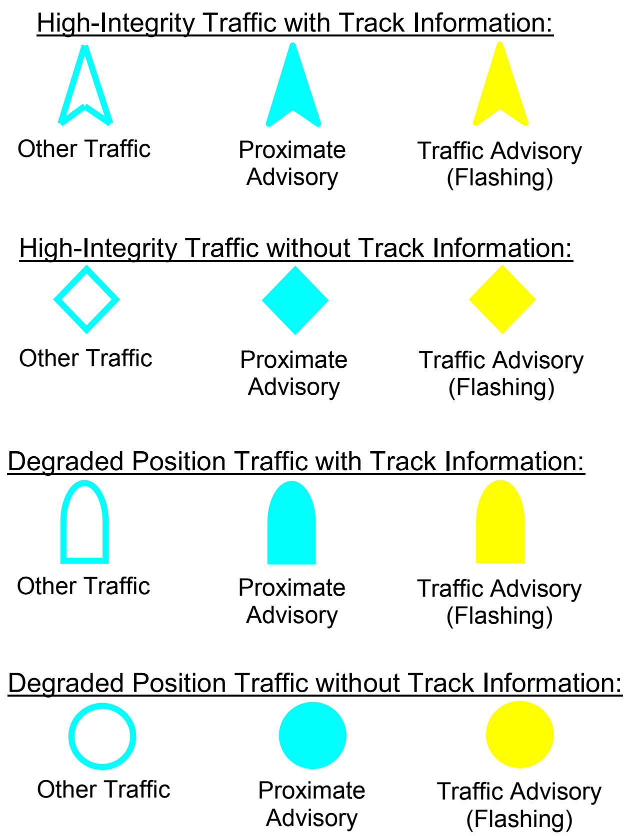


Figure 3-60: ADS-B and TIS-B Traffic Symbols

3.44. Vertical Deviation Indicator

The PFD has a vertical deviation indicator on the right side of the display which displays vertical deviation for the currently selected vertical navigation source. When the selected vertical navigation source is FMS, the vertical deviation indicator conforms to the vertical deviation display requirements of TSO-C146c.

Figure 3-61: Vertical Deviation Indicator

The vertical deviation indicator only appears when the source of vertical navigation is valid. When the source of vertical navigation is FMS (either LPV or VNAV modes), the source is valid:

1) On VNAV descent segments; OR

2) If the vertical deviations on VNAV level segments option is enabled on VNAV level segments; OR

3) If the vertical deviations on VNAV level segments option is disabled when approaching the Top of Descent point so as to provide descent anticipation;

As long as:

1) The aircraft is within 2NM or twice the full scale deflection for the mode of flight (whichever is greater) of the lateral navigation route; AND

2) The aircraft is in TO operation relative to the active VNAV waypoint (i.e., taking into account VNAV offsets); AND

3) If on the final approach segment, the aircraft is within a 35° lateral wedge of the azimuth reference point (either the GARP or MAWPT + 10,000 ft.)

4) When the source of vertical navigation is glideslope, the source is valid when a valid glideslope signal is received.

The currently selected vertical navigation source is annunciated immediately below the vertical deviation indicator as follows:

1) **LPV1** or, if a second GPS/SBAS receiver is not installed, LPV. Annunciation is made when descending on the final approach segment in LPV mode.

2) **LPV2** (only if a second GPS/SBAS receiver is installed). Annunciation is made when descending on the final approach segment in LPV mode.

3) **VNV1-G** or, if a second GPS/SBAS receiver is not installed, **VNV-G**. Annunciation is made when descending on the final approach segment in LP, LNAV/VNAV, LNAV, or RNP modes when using GPS VNAV.

4) **VNV2-G** (only if a second GPS/SBAS receiver is installed). Annunciation is made when descending on the final approach segment in LP, LNAV/VNAV, LNAV, or RNP modes when using GPS VNAV.

5) **VNV1-B** or, if a second GPS/SBAS receiver is not installed, **VNV-B**. This is the default FMS barometric VNAV mode.

6) **VNV2-8** (only if a second GPS/SBAS receiver is installed). This is the default FMS barometric VNAV mode.

7) **GSI** (only if a NAV receiver is installed).

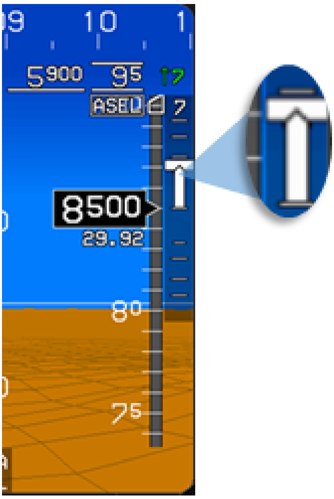
8) **GS2** (only if a second NAV receiver is installed).

When vertically integrated with an autopilot (either fully integrated or partially integrated) through use of the glideslope mode discrete input with the glideslope mode engaged, the selected vertical navigation source is annunciated in green to indicate the autopilot is vertically coupled to the selected vertical navigation source. Otherwise, the selected vertical navigation source is annunciated in white. When the source of vertical navigation is LPV, LPV1, LPV2, VNV-G, VNV1-G, or VNV2-G and there is a GPS Loss of Navigation or GPS Vertical Loss of Navigation condition, the selected vertical navigation source is annunciated in amber (yellow) (this takes precedence over the green and white annunciations described above).

NOTE:

The vertical deviation indicator disappears in Unusual Attitude Mode.

3.45. Vertical Speed Indicator



A vertical speed indicator (VSI) is located to the right of the altitude box. The VSI has a "worm" format and gives an analog and digital representation of VSI in feet per minute. This example of 700 FPM climb is set as a VSI bug and the actual rate of climb is 700 FPM.

Figure 3-62: Vertical Speed Indicator

The scale of the VSI is ±6,000 feet per minute in applications where TCAS-II is enabled. Otherwise, the scale of the VSI is ±3,000 feet per minute. The VSI worm grows in proportion to the square root of the vertical speed so a change near 0 feet per minute displaces the worm to a much greater degree than an equivalent change at a larger feet per minute value. The ±3,000 feet per minute VSI indication includes an integral scale with graduations at ±500, ±1,000, ±2,000, and ±3,000 feet per minute. The ±6,000 feet per minute VSI indication includes an integral scale with graduations at ±500, ±1,000, ±2,000, ±4,000, and ±6,000 feet per minute. Readouts of vertical speed rounded to the nearest 100 feet per minute appears above the VSI scale (for climbs) or below the VSI scale (for descents).

When TCAS-II is enabled, the background of the VSI functions as an RA display with green and red colored regions to provide RA maneuver guidance. The VSI indication has a pilot-settable vertical speed bug geometrically interacting with the VSI pointer. The vertical speed bug setting is limited ±3,000 feet per minute (airplanes). The vertical speed bug setting is annunciated above the VSI scale with a resolution of 100 feet per minute. The vertical speed bug may be used either as a visual reference or, when vertically integrated with an autopilot or partially integrated through use of the vertical mode discrete input, 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 is colored green and the vertical speed bug is a filled-white when in VSI climb or descent mode. Otherwise, the vertical speed bug setting annunciation is colored white, and the vertical speed bug is hollow-white. When not vertically integrated with an autopilot, the vertical speed bug setting annunciation is colored white, and the vertical speed bug is a filled-white at all times.

3.46. V-Speeds

Significant aircraft speeds not indicated by airspeed tape coloration (**V**$_X$, **V**$_Y$, **V**$_A$, etc.) are shown on the outboard side of the airspeed tape.

V$_S$ (clean stall, gross weight - the bottom of the green range) is displayed dynamically and corrected for G-force in turns and turbulence. See § 3.17 for more information.

Approach speeds are shown here with **V**$_{ENR}$, **V**$_{APP}$, and **V**$_{REF}$ speeds selected.

Figure 3-63: V-Speeds

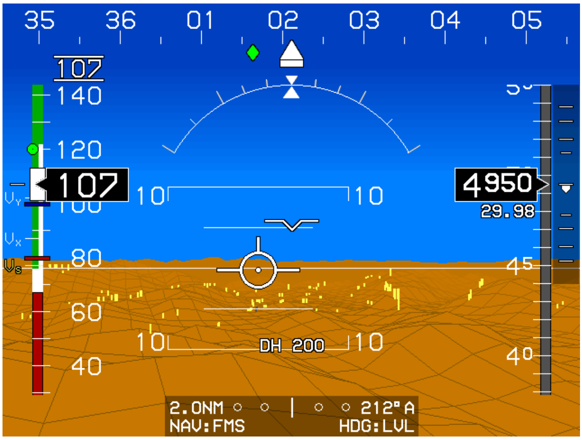


Figure 3-64: V_1, V_R, and V_2 Selected with Bugs Menu

3.47. Waterline

The waterline symbol (a small “v” with wings) is fixed in the center of the primary flight display to align with the longitudinal axis of the aircraft. The horizon and pitch scale rotates relative to the waterline symbol and indicates aircraft attitude. The waterline is analogous to the dot in the center of a mechanical attitude gyro; it is where the nose is pointed.

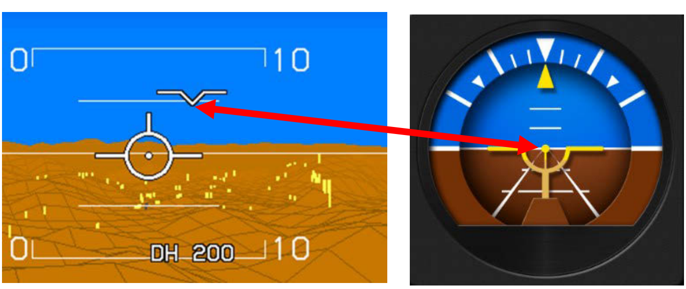


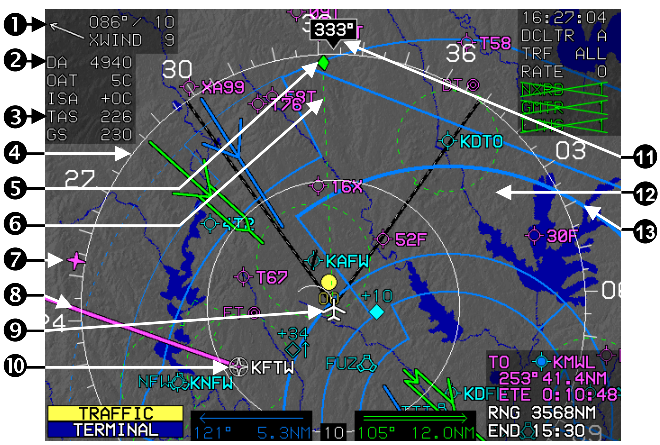
Figure 3-65: Two Views of the Waterline; Aircraft is Pointed and Not Adjustable

3.48. Navigation Display Symbology

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

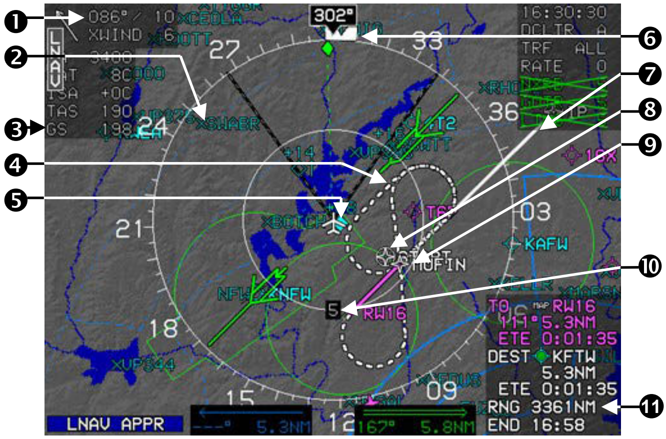
1) Moving Map
2) Conventional HSI
3) Navigation Log
4) Lightning Display
5) Traffic Display
6) Datalink Display

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 displays weather and traffic.



1) Wind Vector
2) Density Attitude
3) True Airspeed
4) Directional Scale
5) Ground Track
6) Ground Track Lubber Line
7) Bearing to Waypoint
8) Course Line
9) Aircraft Position
10) Waypoint
11) Heading Indicator Directional Scale
12) Terrain
13) Airspace Boundary

Figure 3-66: Basic Moving Map in Arc Mode

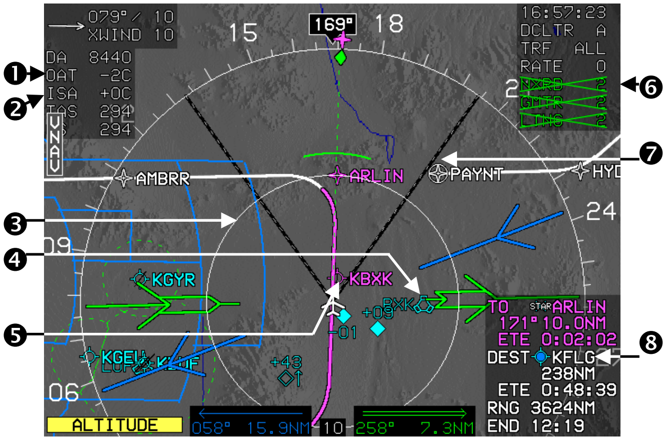


1) Wind Data
2) Fix or Intersection
3) Groundspeed
4) Missed Approach Course
5) Traffic
6) Heading Bug
7) Instrument Approach Course
8) Waypoint (fly-over)
9) Waypoint (fly-by)
10) Range Ring Scale
11) Fuel Totalizer

Figure 3-67: Moving Map with Instrument Approach

NOTE:

Destination distances, for example KFTW 5.3NM, include all the legs of the approach. Actual distance to the airport is much closer.



1) Outside Air Temperature
2) ISA Temperature
3) Range Ring
4) VORTAC
5) VFR Airport
6) Datalink Weather Status
7) Field of View on PFD
8) Destination

Figure 3-68: Moving Map with STAR

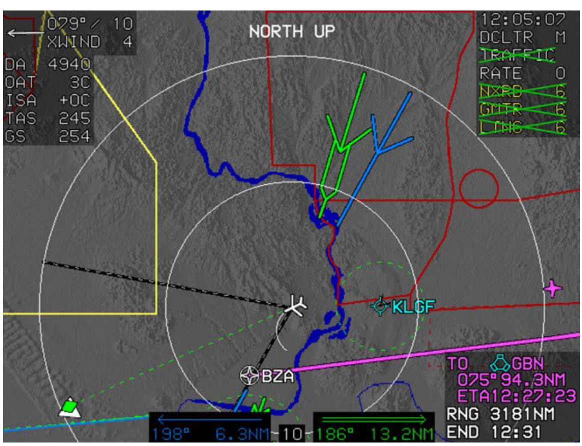


Figure 3-69: North-Up Arc Mode

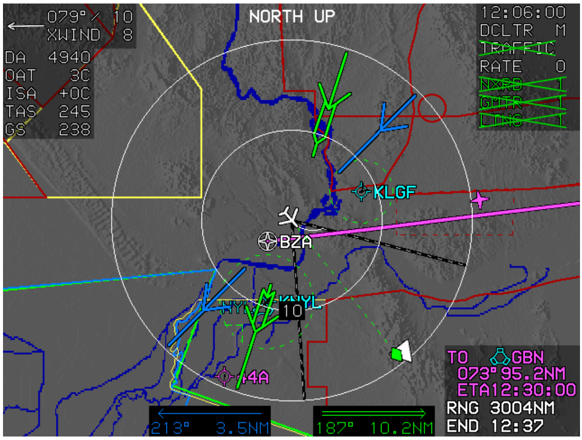


Figure 3-70: North-Up Centered Mode

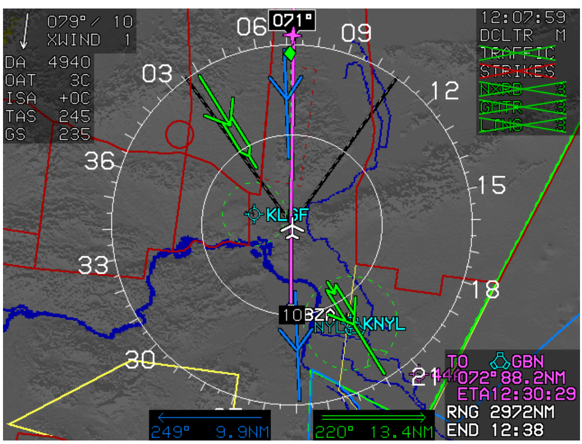
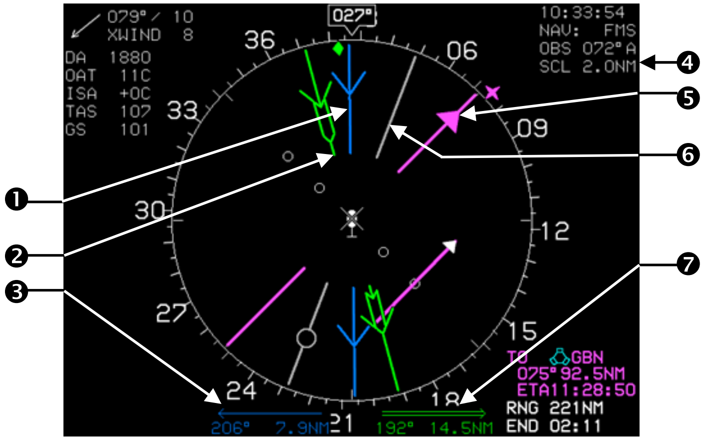


Figure 3-71: Heading-Up Centered Mode

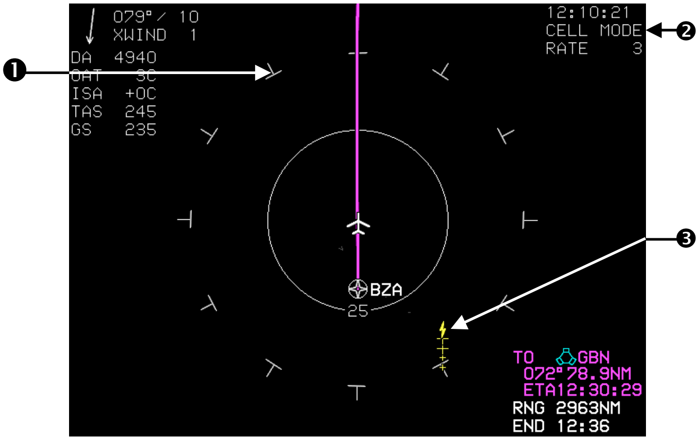


1) VOR1 Pointer
2) VOR2 Pointer
3) VOR1 Bearing and Distance
4) CDI Scale and OBS Setting
5) Selected Course Pointer
6) ADF1 Pointer
7) VOR2 Bearing and Distance

Figure 3-72: Conventional HSI/PTR Format

NOTE:

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



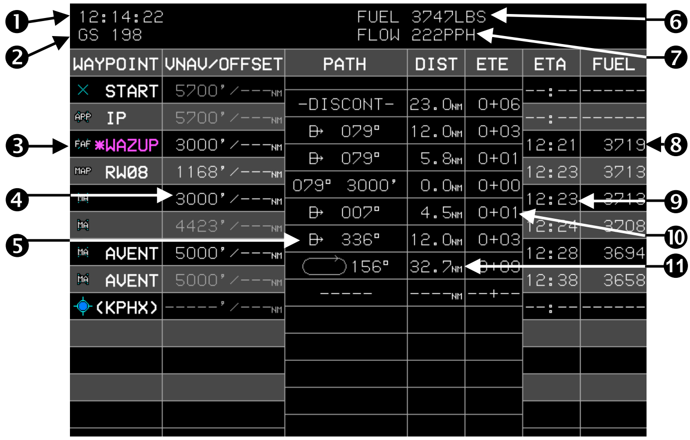
1) Strike Position Reference
2) Mode and Rate Indicators
3) Lightning Strikes

Figure 3-73: Lightning Display

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

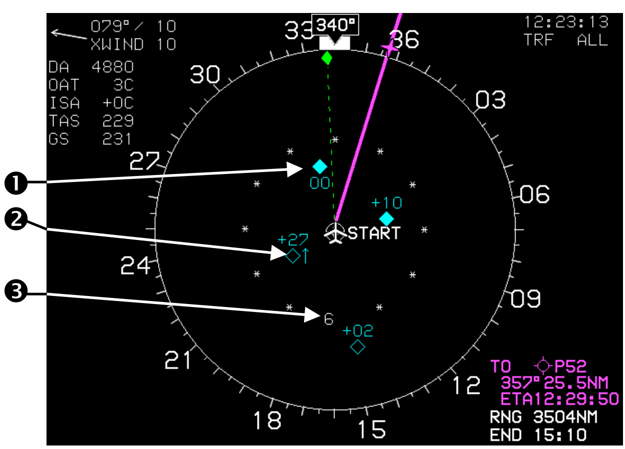
NOTE:

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



1) Zulu Time
2) Groundspeed
3) Active Waypoint
4) VNAV Altitudes Offset
5) 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

Figure 3-74: Navigation Log Display



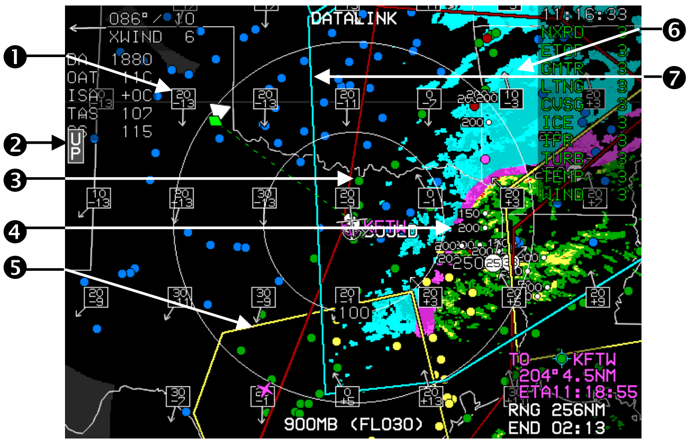
1) Traffic
2) Traffic Position Reference
3) Traffic Position Scale

Figure 3-75: Traffic Display

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.



1) Winds and Temperatures
2) UP control for Winds and Temps
3) AMET-TURB
4) Echo Tops
5) AMET-IFR
6) Nexrad
7) AMET-ICE

Figure 3-76: Datalink Display

3.49. Altitude Capture Predictor

When a selected altitude or VNAV is specified on the PFD, the point at which the altitude is 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.

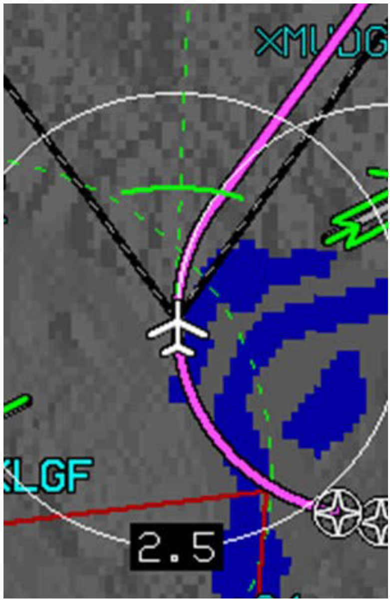


Figure 3-77: Altitude Capture Predictor

3.50. 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 is used, depending on the installation.

Airplane with $\mathbf{M_{MO}}$ Airplane w/o $\mathbf{M_{MO}}$

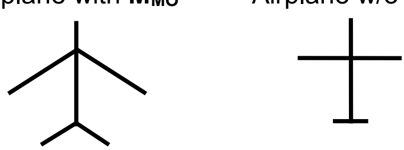


Figure 3-78: Ownship Symbols

3.51. 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, a useful taxi aid may prevent runway incursion. In addition, all runways at the three nearest airports are shown at all times.

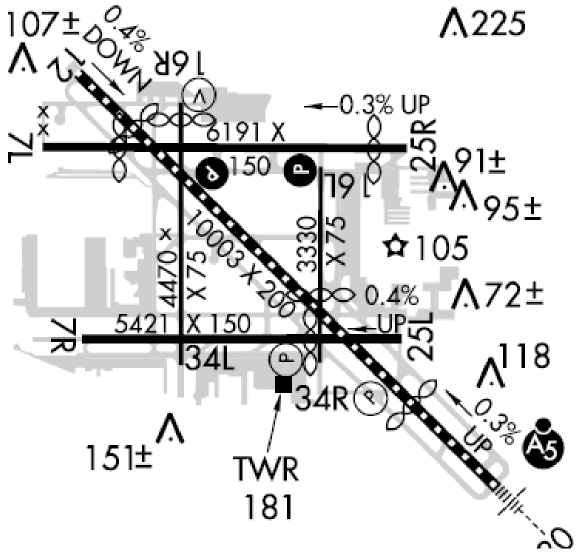


Figure 3-79: Airport Runway Diagram

Figure 3-80: Selected Landing Runway Displayed

3.52. Airspace Markings

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

Table 3-1: Airspace Markings	
	Red represents Restricted, Prohibited Areas, and TFR (Temporary Flight Restrictions) when Datalink is enabled.
	Amber (Yellow) represents MOAs and Warning Areas
	Green represents Class C and Class D Airspace
	Blue represents Class 8 Airspace

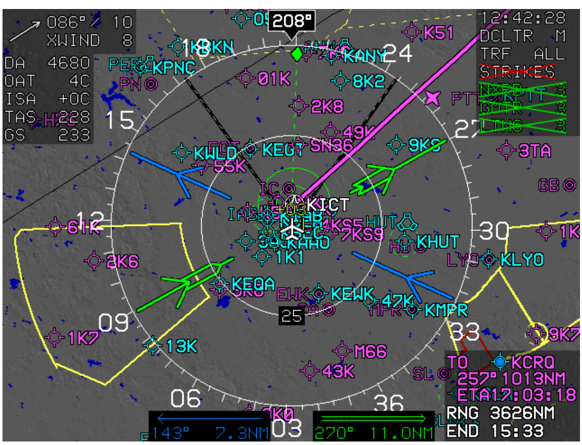
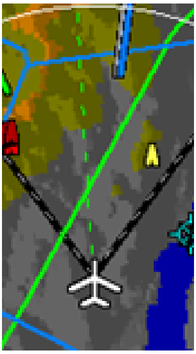
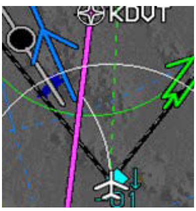


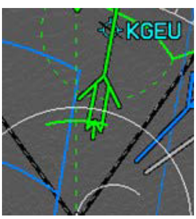
Figure 3-81: Airspace Markings



Heavy (double pixel), solid airspace lines indicate the airspace is penetrated at the current altitude.



Thin (single pixel), solid airspace lines indicate the airspace is cleared at the current altitude, but the aircraft is within 500 ft. vertical of the airspace floor or ceiling.



Thin (single pixel), dashed airspace lines indicate the airspace is cleared at the current altitude, and the aircraft is more than 500 ft. vertical from the airspace floor or ceiling.

Figure 3-82: Airspace Markings

NOTE:

Do not violate airspace. If in VFR conditions, cross only thin or dashed airspace lines to keep out of trouble. If IFR, airspace maybe irrelevant, turning it off to keep screen clutter to a minimum is an option.

NOTE:

A ground maintenance function utility is available to import custom special use airspace data.

3.53. Airways

High-altitude airways are green. Low-altitude airways are cyan. To minimize clutter, airways are not shown by default. To show either type of airway, see § 5.80 MFD ND Screen Format (FORMAT) Menu.

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

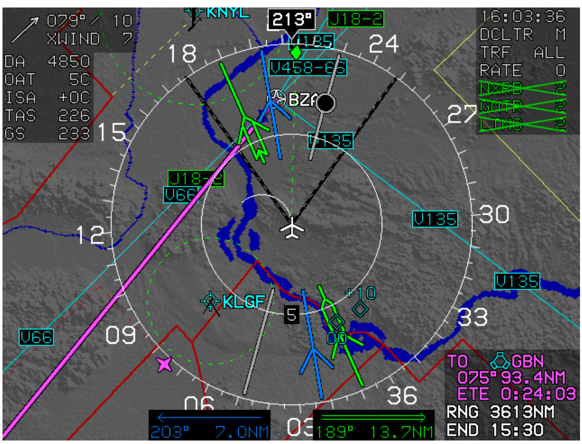


Figure 3-83: Airways

3.54. Analog Navigation

The HSI and Moving Map pages may display analog (VOR1, VOR2, ADF1, and ADF2) navigation symbology. The pointers for each navigation source are visually distinct. The single lined blue pointer depicts VOR1. The double lined green pointer depicts VOR2. The single lined gray pointer depicts ADF1. The double lined gray pointer depicts ADF2. These pointers may be enabled/disabled. See § 5.90 MFD HSI Pointer (POINTERS) Menu.

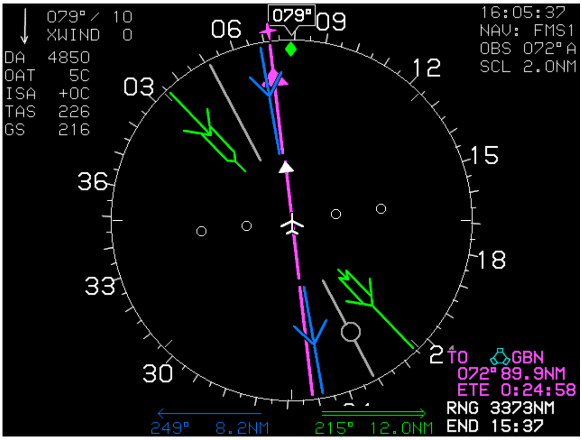
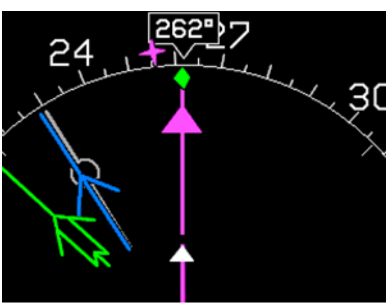


Figure 3-84: Analog Navigation

When the 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 blue, and the VOR2 distance readout is green. If a DME channel is in hold mode, the associated distance readout is amber (yellow), and the letter “H” is shown above the distance readout.

3.55. 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 PFD directional scale.

Figure 3-85: Bearing to Waypoint

3.56. Course Line

The course line connects the waypoints of the route for 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**$_{\mathbf{PROC}}$.

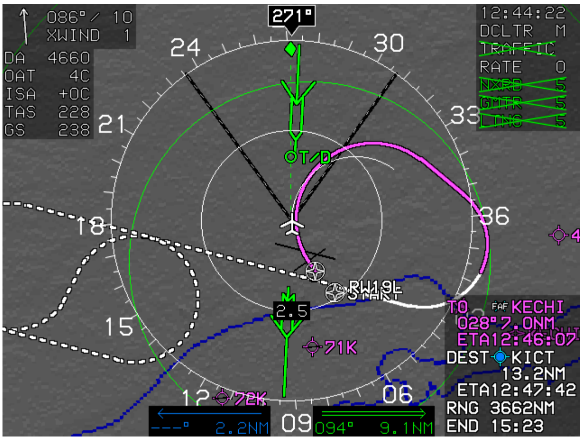


Figure 3-86: Course Line

The course line is white except for the active leg which is magenta. The second waypoint automatically activates upon selection of a flight plan. The active (magenta) leg automatically sequences upon waypoint passage. The pilot may select any leg of the flight plan as the active leg using the ACTV menu, see § 5.31 Active Flight Plan (ACTV) Menu. The dotted (dashed) line indicates the missed approach procedure, just like on a chart.

NOTE:

If the skyway is ever lost, look at the moving map and locate the active (magenta) leg of the course. The skyway is located along the course line. It may above or below the aircraft based on selected altitude.

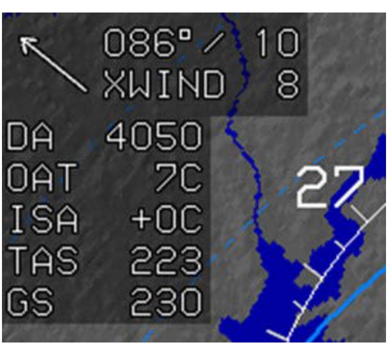
3.57. Dead-Stick Glide Area

The area in which a power-off landing may 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.

Figure 3-87: Glide Area

The glide area, as presented, is based on the aircraft's best-glide speed (the green dot on the airspeed tape). The glide area may be adjusted for turns, wind, terrain, airspeed, pilot reaction time, and stored energy, and indicates the point at which the aircraft is at approximately 100 ft. above the ground during the glide. Dead-stick glide area depiction may be decluttered if desired.

3.58. Density Altitude



The density altitude display corrects pressure altitude for nonstandard temperatures. Measurement is in feet MSL (mean sea level). The example shows a density altitude of 4050 ft.

Figure 3-88: Density Altitude

3.59. 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.

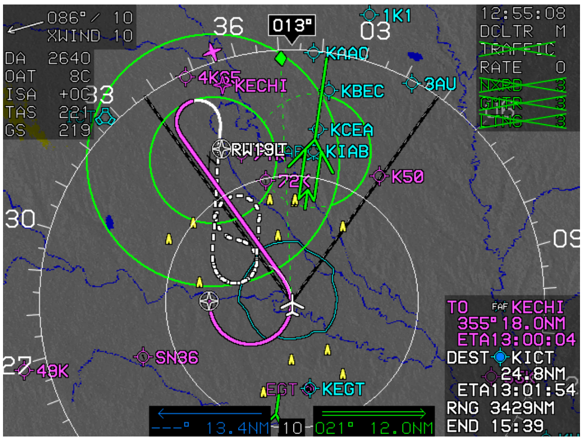


Figure 3-89: Directional Scale in Arc Format

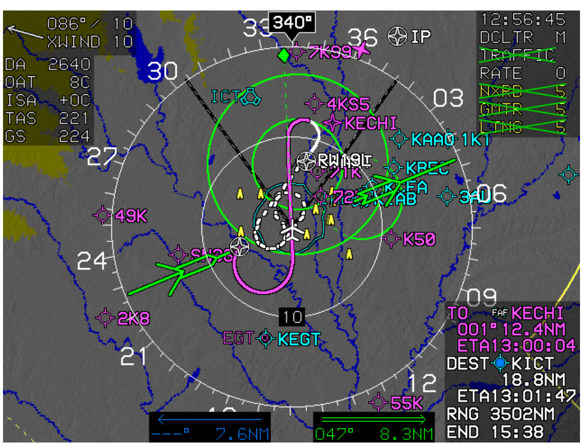


Figure 3-90: Directional Scale in Centered Format

3.60. Fix

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

Figure 3-91: Airway Fixes

3.61. Fuel Totalizer

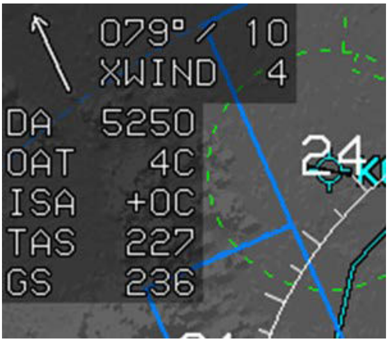
Fuel range (RNG) and endurance (END), based on fuel totalizer calculations, are displayed in nautical miles and hours: minutes, respectively. Totalizer information is displayed at the bottom of the waypoint navigation log for quick comparison with flight plan information. Totalizer data is not available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

Figure 3-92: Fuel Totalizer

AUDIBLE ANNUNCIATION

A fuel range less than the time to the destination (along the route) plus thirty minutes results in an annunciation chime and a CHECK RANGE flag. To eliminate nuisance alarms, range checking is suppressed when on ground or in a climb.

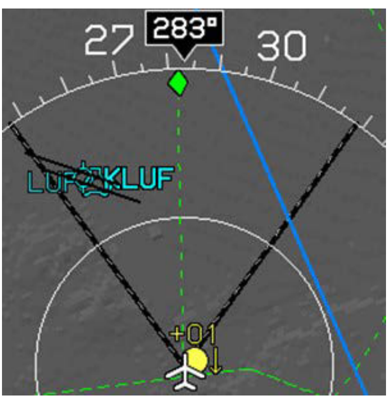
3.62. Groundspeed



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.

Figure 3-93: Groundspeed

3.63. 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.

Figure 3-94: Lubber Line

The lubber line is convenient, use it to ensure current ground track clears terrain or airspace. It may also be used to cross a specific fix or waypoint that is not in active flight plan.

3.64. Heading Bug

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

Figure 3-95: Heading Bug

NOTE:

If coupled with an autopilot using HEADING mode GPS steering, the EFIS commands the autopilot to maintain the selected heading. If the autopilot is flying a flight plan, invoke the heading bug to override the flight plan in favor of the selected heading. When the heading bug is turned off, the EFIS commands the autopilot to rejoin the active flight plan.

3.65. Heading Readout

The heading readout provides a digital readout of the current aircraft heading (where the nose is pointed) and points to the current heading on the directional scale.

Figure 3-96: Heading Readout

The IDU supports a True North mode based upon one of the configurable discrete inputs. True North mode addresses pilot requirements during high latitude operations and should be used when the AHRS has been set to free-gyro mode. In True North mode, directions are referenced and labeled with a small (^{T}) symbol instead of “ON” and a continuous “True North” flag appears.

3.66. VFR Airport

VFR airports (airports without published instrument procedures) are displayed in magenta along with the identifier.

Figure 3-97: VFR Airport

3.67. IFR Airport

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

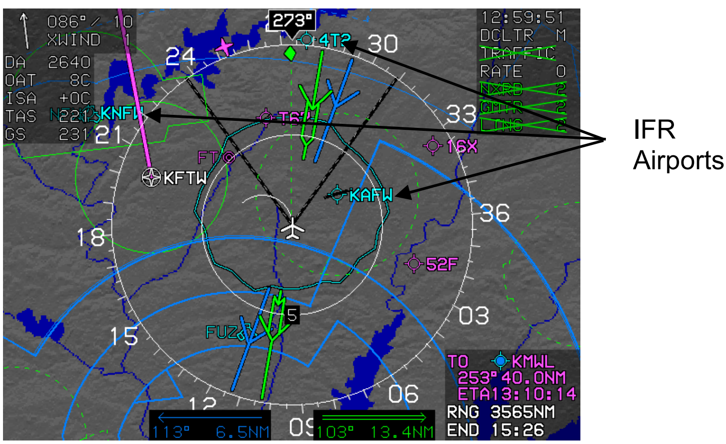


Figure 3-98: IFR Airport

3.68. Instrument Approach Course

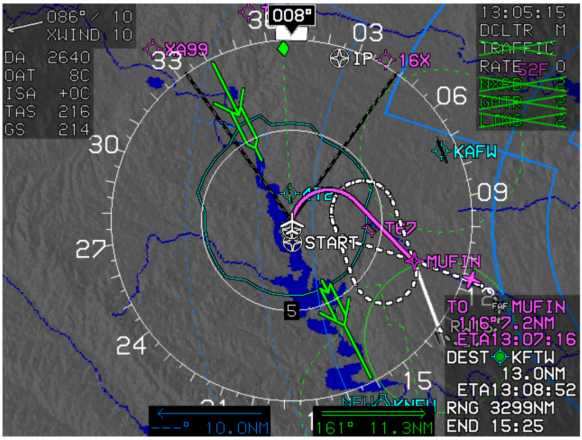


Figure 3-99: Instrument Approach Course

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

DOJED is an example of a fly-over fix, which has a wide circle around the waypoint star symbol.

Figure 3-100: Fly-Over Fix

53LOC is an example of a fly-by fix. These are a waypoint star symbol without a circle.

Figure 3-101: Fly-By Fix

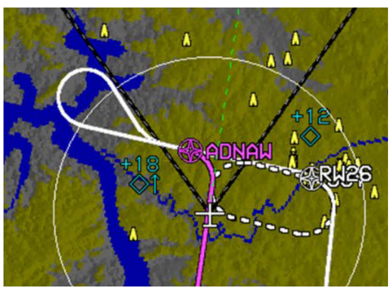


Figure 3-102: Procedure Turn at Fix ADNAW

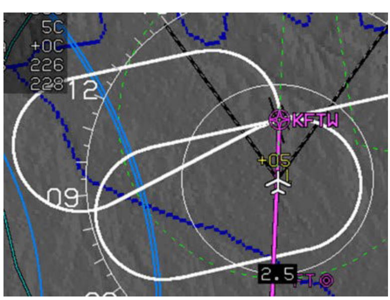


Figure 3-103: Hold Entry to KFTW

See § 3.6 for information on waypoints and waypoint sequencing.

NOTE:

See Jeppesen NavData Chart Compatibility in Section 8 Appendix for information on approach way point nomenclature.

3.69. Lightning Strikes

Lightning strikes from an attached WX-500 Stormscope are initially displayed as amber (yellow) lightning bolts. After 20 seconds, the lightning bolt changes to a large amber (yellow) “+” sign. After two minutes, it is reduced to a small amber (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).

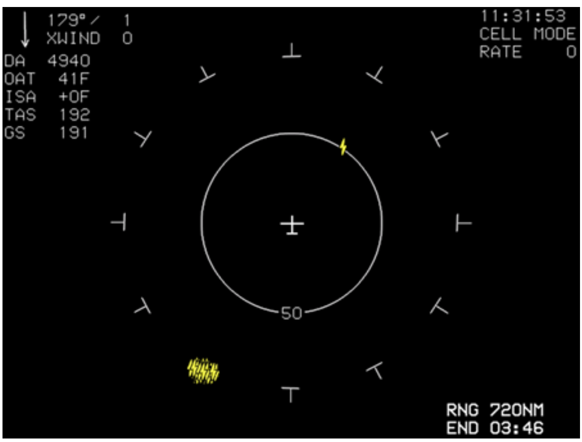


Figure 3-104: Lightning Strikes

3.70. Mode Annunciators - Moving Map

Figure 3-105: Mode Annunciators

3.70.1. Declutter Mode for Navigational Data (DCLTR)

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

3.70.2. Terrain Mode

If terrain is OFF, an annunciator in the upper right corner reads TERRAIN with an "X" through it. The "X" is green if the pilot manually turns terrain off and red if terrain is disabled automatically due to a sensor failure.

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

Manually turning the terrain off does not affect TAWS alerting functions. See TAWS in Section 8 Appendix for more information.

3.70.3. Traffic Mode

Traffic mode is annunciated on the Moving Map page. See § 3.85 for details.

3.70.4. Lightning Mode (STRIKES)

Lightning mode is annunciated on the Moving Map page. See § 3.72 for details.

3.71. Mode Annunciators - HSI

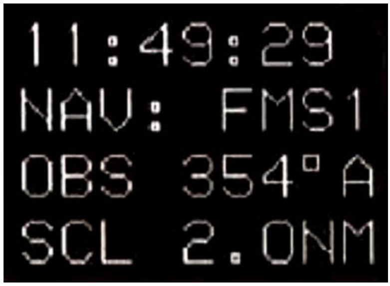


Figure 3-106: Mode Annunciators - HSI

3.71.1. HSI Nav Source

The source of the HSI symbology is pilot-selectable and is annunciated in the upper right portion of the HSI page. The HSI source may be VOR1, VOR2, LOC1, LOC2, FMS, FMS1, or FMS2.

3.71.2. 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 course to the active waypoint.

3.71.3. 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.

3.72. Mode Annunciators - Lightning Display

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 reads STRIKES with an “X” through it. The “X” is 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, is calculated every five seconds during normal operation. The number of fresh strikes (strikes less than 20 seconds old) is used to generate a strike rate representing 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.

Figure 3-107: Mode Annunciators - Lightning Display

3.73. Mode Annunciators - Traffic Display

If equipped with either a TAS, TCAS-I, TCAS-II, or ADS-B receiver, an annunciator in the upper right corner reads TRAFFIC with an "X" through it when it is disabled. The "X" is 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.

Figure 3-108: Mode Annunciators - Traffic Display

3.73.1. Datalink Mode

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

NOTE:

Up to 300 Temporary Flight Restrictions may be displayed.

If equipped with an optional Datalink receiver, the status of NEXRAD radar (NXRD), Graphical METARS (GMTR), and lightning ground strike data (LTNG) are displayed. See § 3.74 for details. If equipped with an optional ADS-B receiver only, NEXRAD radar (NXRD), Graphical METARs (GMTR) and traffic are displayed.

3.74. Mode Annunciators - Datalink Display

Figure 3-109: Mode Annunciators - Datalink Display

If equipped with an optional datalink or ADS-B receiver the status of NEXRAD radar (NXRD), Echo Tops (ETOP), graphical METARs (GMTR), lightning 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:

1) If the data never completely downlinked, no annunciation displayed.

2) If the data downlinked is fresh, the annunciation and age in minutes are green. If the data is deselected from display, the annunciation is green and overlaid with a green “X”.

3) If the data downlinked is stale, the annunciation and age in minutes are amber (yellow). If the data deselected from display, the annunciation is amber (yellow) and overlaid with a green “X”.

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

5) If the data timed-out, the annunciation is displayed in red with "XX" instead of age in minutes and overlaid with a red "X".

Table 3-2: NXRD/ETOP/GMTR/LTNG/CVSG/ICE/IFR/TURB	
Green	Last 5 minutes
Amber (Yellow)	Between 5-10 minutes
Red	Between 10-75 minutes
Timed-out	Over 75 minutes

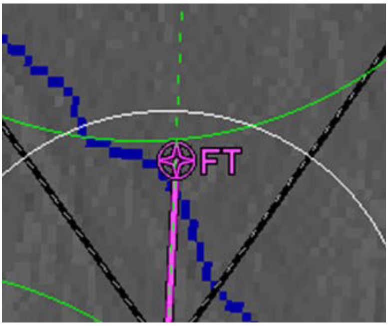
Table 3-3: Temp and Wind	
Green	Last 30 minutes
Amber (Yellow)	Between 30-60 minutes
Red	Between 60-75 minutes
Timed-out	Over 75 minutes

3.75. 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 way point. The navigation 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" way points are the same.

Figure 3-110: Navigation Log Box

3.76. NDB



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

Figure 3-111: NDB

3.77. 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 the greater of 8.5NM, or the current TAWS FLTA range 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 amber.
4) Obstructions whose tops are within 500 feet, but below aircraft altitude, are light red.
5) Obstructions whose tops are at or above aircraft altitude are deep red.
6) A minimum obstacle height may be configured, which inhibits the display of obstacles with heights that fall below the minimum.

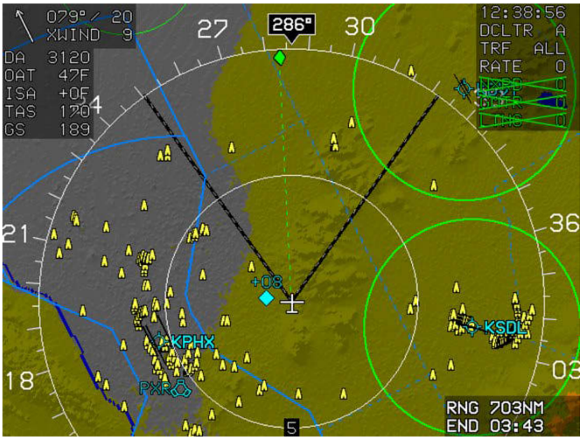


Figure 3-112: Obstructions

Obstructions are included in the TAWS search envelopes and 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.

3.78. Outside Air Temperature

Outside air temperature (OAT) is displayed in the upper left corner of the navigation display, between density altitude (DA) and International Standard Atmosphere (ISA) temperature. OAT is measured in °F or °C, depending on system installation settings. True airspeed (TAS) is indicated below ISA.

Figure 3-113: Outside Air Temperature

3.79. 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.

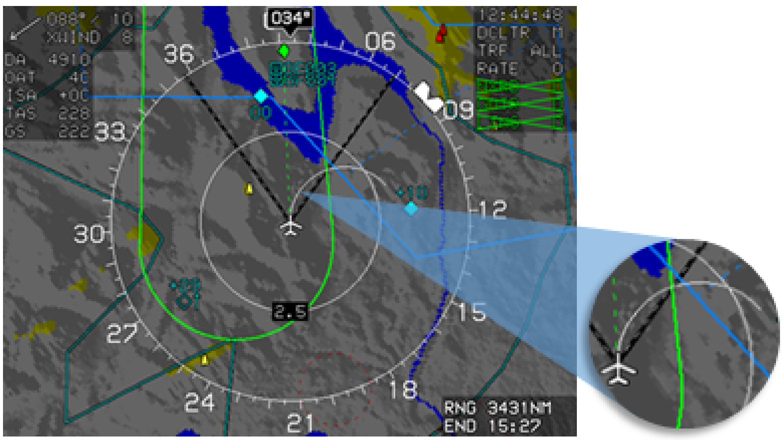
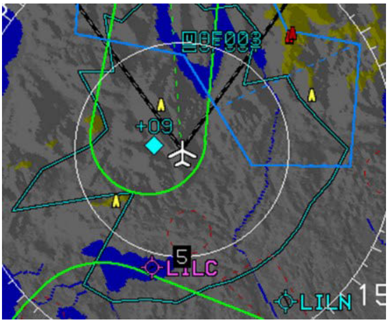


Figure 3-114: Projected Path

NOTE:

Use the projected path to intercept courses perfectly from any angle. Roll in an estimated bank angle and see where that puts the projected path. Make small bank adjustments as necessary to keep the projected path tangent to the desired course line. Roll out centered on course. If interception requires an uncomfortable bank angle, overshoot and come back in from the other side. It's great for when ATC gives a late turn onto the localizer.

3.80. 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 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 SNM, the directional scale is at 10NM. Overall map scale ranges may be set to 1, 2, 5, 10, 20, 50, 100, 200, and 400 nautical miles.

Figure 3-115: Range Ring

3.81. 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 course line arrow and aircraft position symbol. The course deviation indicator needle rotates around the aircraft position symbol so it remains parallel with the course line arrow. At full deflection, the CDI needle flashes.

The to-from indicator is a white triangle placed at the end of the CDI needle, between the aircraft position symbol and course line arrow. The arrow is ahead of the aircraft symbol and points toward the course line arrowhead when showing a “to” indication and behind the aircraft symbol and pointing toward the tail of the course line 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 flips from one end of the CDI needle to the other upon waypoint or navigation station passage.

HSI source may be changed using the OBS button (see § 5.42 Omnibearing Selector (OBS) Menu).

NOTE:

If the skyway or course line does not seem to be working, check the OBS mode setting (manual or automatic is annunciated) in the upper right corner of the ND when in the HSI mode. Press the OBS button to set the OBS.

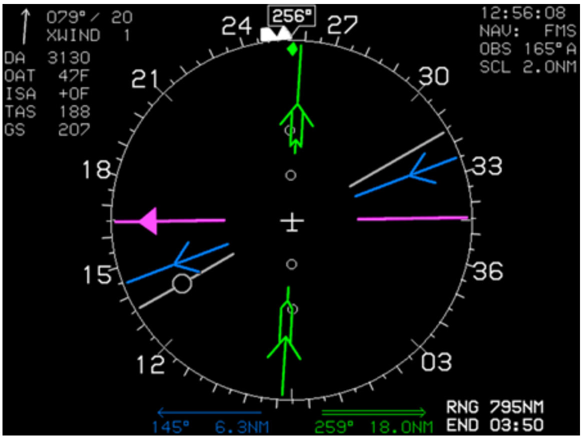


Figure 3-116: HSI Course Pointer

3.82. 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.

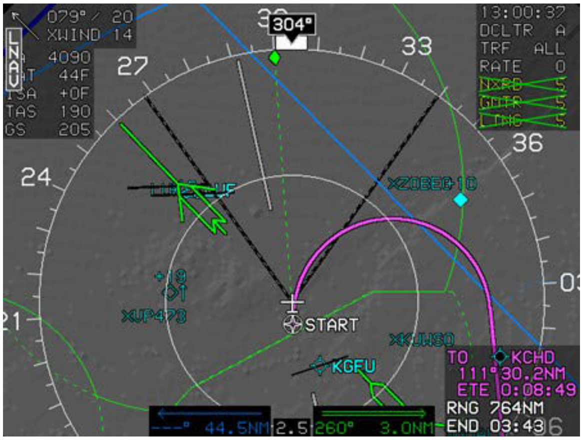


Figure 3-117: Start Point

3.83. 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.

Figure 3-118: Strike Position Reference

3.84. Terrain

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

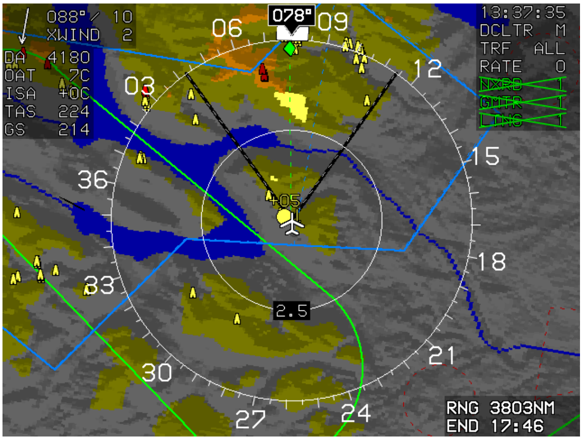


Figure 3-119: Terrain Alert MFD

3.84.1. Non-Threatening Terrain

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

1) Terrain is colored shades of gray when more than 2,000 feet below aircraft altitude. The slope between adjacent terrain pixels in an increasing longitude direction determines the shade.

2) Terrain is colored shades of olive when within 2,000 feet, but below aircraft altitude. The slope between adjacent terrain pixels in an increasing longitude direction determines the shade used.

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

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

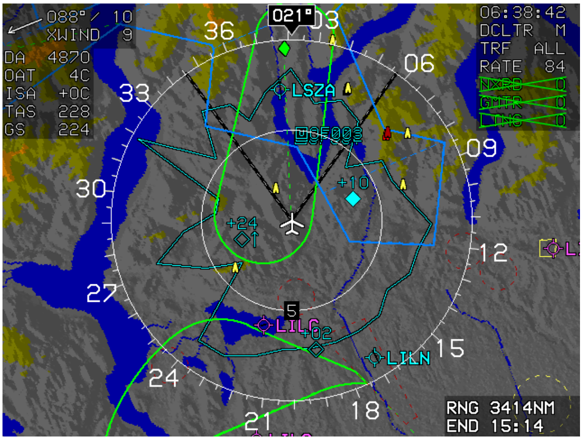


Figure 3-120: Non-Threatening Terrain

3.84.2. Threatening Terrain

Threatening terrain, as determined by the requirements for TAWS, is red and amber (yellow). The red and amber (yellow) colors are shown with a "'transparency" to allow the underlying contours to be distinguished to aid a terrain avoidance maneuver.

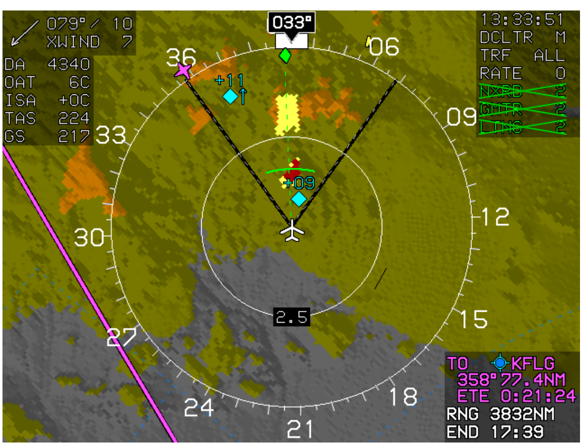


Figure 3-121: Threatening Terrain

When terrain or obstructions fall within the FLTA search envelope, an FLTA warning is generated. For all TAWS classes, terrain rendering is enabled when an FLTA warning is initiated or upgraded. In addition, for class A TAWS, when an FLTA warning is initiated or upgraded, an automatic popup mode is engaged as follows:

Display switched to navigation display.

1) Display switched to aircraft centered and heading up.

2) Navigation display panning mode disabled.

3) Scale set to 10NM (groundspeed > 200 knots) or scale set to 5 NM (groundspeed < 200 knots and groundspeed > 100 knots) or 2NM (groundspeed < 100 knots).

After the popup mode is engaged, the pilot may manually change any setting automatically changed by the popup mode. In addition, **RESET** appears for 20 seconds to allow the pilot to reset the previous screen configuration with one button press. Popups only occur on CPU #0 or CPU #2 and do not occur if the IDU is displaying the PFD or if TAWS inhibit is enabled. The following screen capture shows an example of the ND in popup mode.

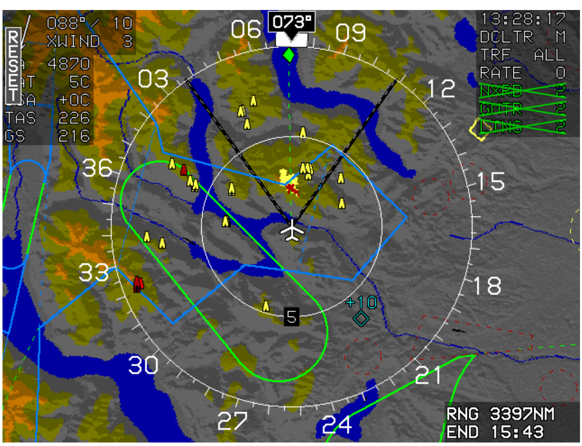


Figure 3-122: ND in Popup Mode

NOTE:

To avoid unwanted alerts, inhibit the Terrain Awareness System by pushing the TAWS INHIBIT switch (located near the display) when approaching or departing a landing site not included in the airport database, when a user waypoint approach has not been selected, or when a user waypoint approach has been selected without an assigned approach bearing.

3.85. Traffic

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

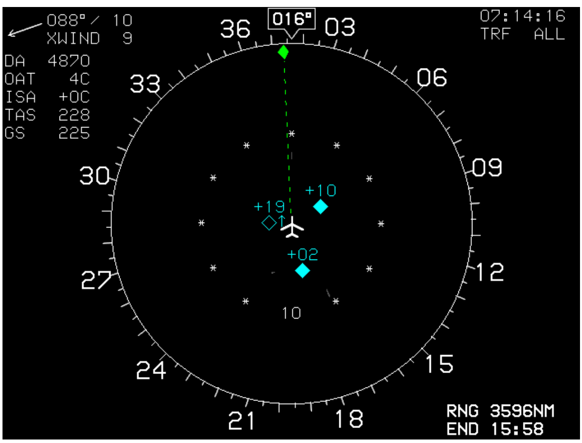


Figure 3-123: Airborne Traffic Displayed on Traffic Page

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 alerts result in a TRAFFIC flag and an aural warning of “Traffic”.

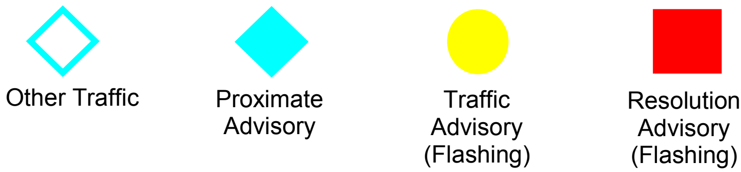


Figure 3-124: TCAS-I, TCAS-II, TAS, and TIS-A (Ref: SAE ARP4102-7 App. B Symbols 72-75)

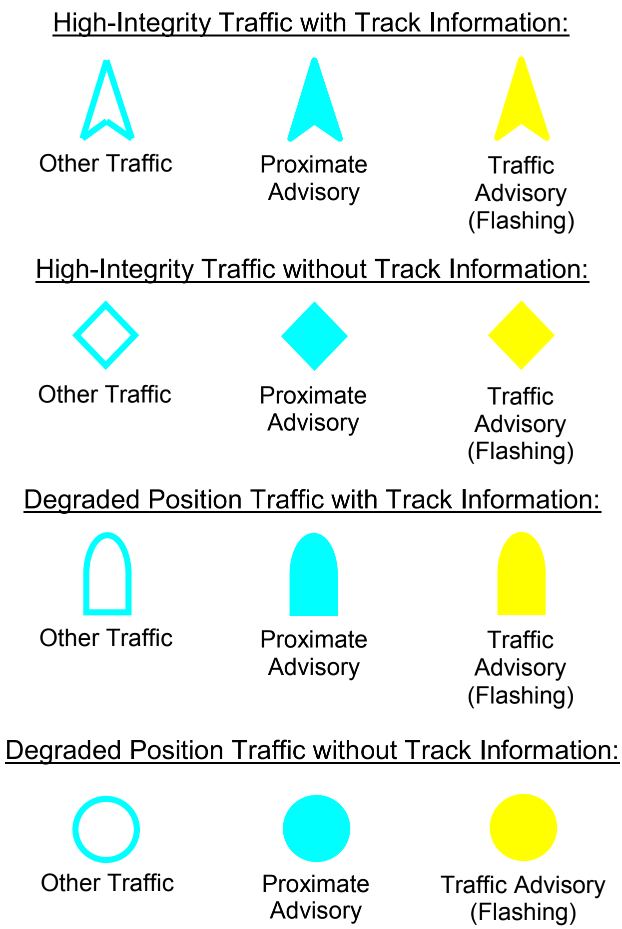


Figure 3-125: ADS-B and TIS-B Symbols

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).

Altitude filtering available as follows:

AUTO = Senses ownship VSI and automatically selects CLMB, DCND, or LVL parameters.

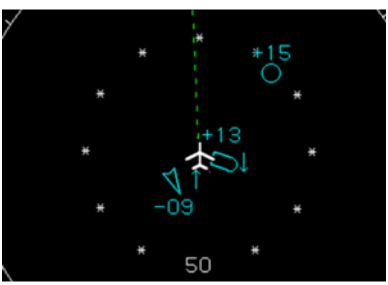
CLMB = Shows traffic from 2700' below to 9900' above.

DCND = Shows traffic from 9900' below to 2700' above.

LVL = Shows traffic from 2700' below to 2700' above.

OFF = Shows all available traffic.

3.85.1. 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.

Figure 3-126: Traffic Position Reference (ADS-B)

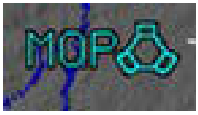
3.86. True Airspeed

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

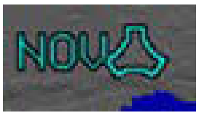
Figure 3-127: True Airspeed

3.87. VORTAC/VOR-DME, TACAN, VOR, DME

VHF NAVAIDs are displayed in cyan with the following symbols:



VORTAC

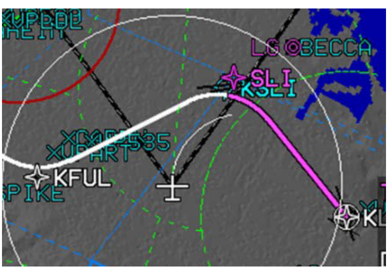


DME only or TACAN

VOR only

Figure 3-128: VHF NAVAIDs

3.88. Waypoint



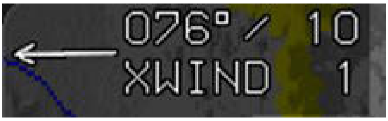
Route waypoints are displayed as four-point stars. The active waypoint is magenta; prior and subsequent waypoints in the route are white. Fly-over waypoints are enclosed in a circle, while fly-by waypoints are not. The identifier associated with each waypoint is shown next to the star in the same color. SLI is an example of a fly-by waypoint.

Figure 3-129: Fly-By Waypoint

KIWA is an example of a fly-over waypoint.

Figure 3-130: Fly-Over Waypoint

3.89. 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 air data calculations.

Figure 3-131: Wind Data

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 affecting these parameters may cause inaccuracies in the calculated wind. The pilot should be cognizant of the following potential error sources:

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

Heading: Heading errors may 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 may 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 may 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 may change significantly with altitude.

Figure 3-132: Atmospheric Wind Changes

3.89.1. Wind Vector

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

NOTE:

See discussion of wind calculation errors under wind data above.

3.90. Zulu Time

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

Figure 3-133: Zulu Time

Section 4 Rotorcraft Display Symbology

Table of Contents

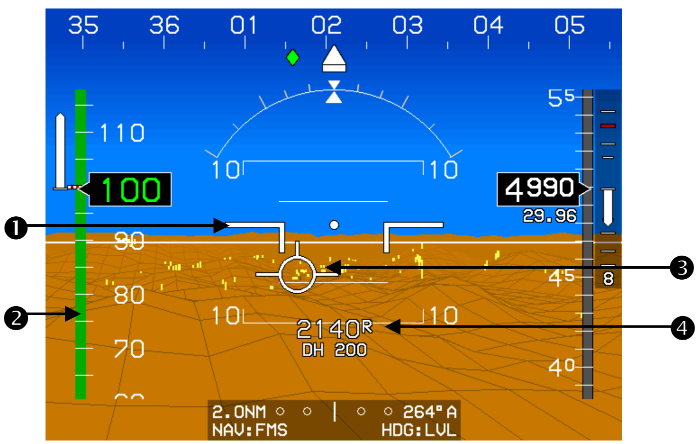
List of Figures and Tables

4.1. Rotorcraft Symbology

The symbology described for airplanes in Section 3 Display Symbology is identical except where described as different for rotorcraft as follows. Rotorcraft pilots must read the entire pilot guide to learn the symbology and operation of menus for rotorcraft.

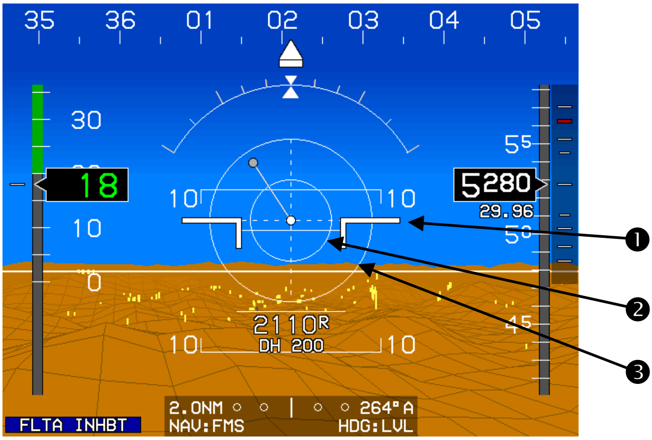
4.2. Rotorcraft PFD

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 attitude and pitch awareness.



1) Expanded Waterline
2) Airspeed Scale
3) Flight Path Marker
4) Radar Altimeter

Figure 4-1: PFD in Flight

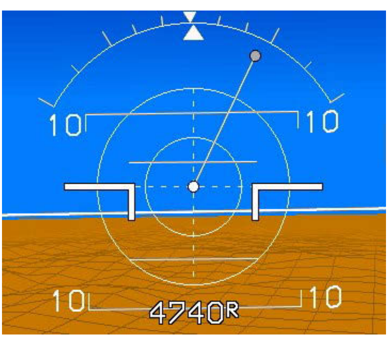


1) Hover Vector 2) 10 Knot Ring 3) 20 Knot Ring

Figure 4-2: PFD in Hover

In this view the helicopter is below 30 knots groundspeed in a forward hover to the left at about 18 knots.

4.2.1. Hover Vector and Rings



The hover vector is used to indicate direction and groundspeed of drift and appears at low groundspeeds of 30 Kts or less. The hover vector consists of Large Aircraft Symbol Reference Marks, an inner concentric ring indicating 10 knots groundspeed, an outer concentric ring indicating 20 knots groundspeed, and a vertical and horizontal dashed line passing through the center extending to the outer ring.

Figure 4-3: Hover Vector and Rings

The white dot of the Large Aircraft Symbol Reference Marks indicates 0 knots groundspeed and is the center for the concentric rings. A dot equal in size to the white dot and connected to the white dot by a white line floats over the concentric ring area to indicate direction and magnitude of drift in a gods-eye view. 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 dot is colored gray. The movement of the dot is constrained to less than five knots per second to prevent jumpiness. The example above shows drift to the right (3 O'clock position) at over 20 knots groundspeed.

4.2.2. Altitude above Ground (AGL)

The altitude above ground level is displayed directly below the flight path marker or expanded waterline any time the indication is below the maximum height configured during system installation. 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).

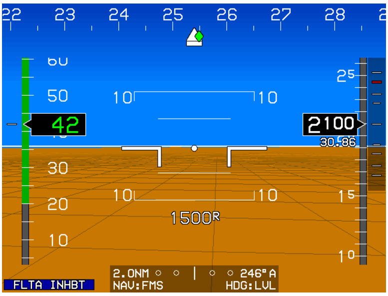
2) G = GPS/SBAS geodetic height less database ground elevation (used when a valid radar altimeter signal is not present and GPS SBAS altitude is accurate within 75 ft.).

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

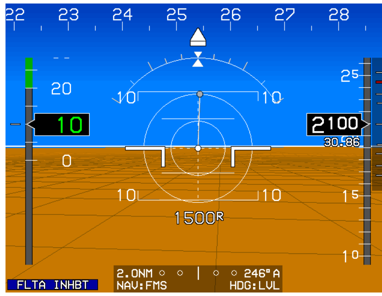
AGL altitude is not displayed when it is greater than the maximum height configured during system installation. In rotorcraft installations, barometric derived AGL altitude is invalid at low airspeeds due to rotorwash effects.

4.3. Bank Angle Scale

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



Bank angle scale decluttered from view in level flight above 30 Kts groundspeed.



Bank angle scale automatically reappears below 30Kts groundspeed in hover vector mode.

Figure 4-4: Bank Angle Scale

4.4. NRST ILS

In the case of **NRST ILS** where the current VLOC1 or VLOC2 OBS does not match the localizer course, **CRS SYNC (L4)** 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-ta-final I LS approach to the ILS is activated;

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

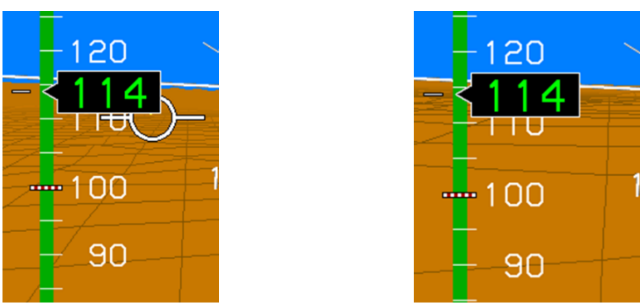
4) HSI source is switched as follows:

   a) For rotorcraft: If the ILS was selected from the pilot side, the pilot side switches to VLOC2 and the co-pilot side does not change. If the ILS was selected from the co-pilot side, the co-pilot side switches to VLOC1 and the pilot side does not change.

5) Connected nav radios are remotely tuned to the ILS frequency in the standby position.

4.5. Flight Path Marker

The flight path marker appears at a location on the background to coincide with the aircraft's actual flight path as projected upon the outside world and is referenced to the Large Aircraft Symbol Reference Marks. The Reference Marks are centered on the display and laterally displaced parallel to the horizon with respect to the center of the display to account for the difference between aircraft track and heading and are vertically displaced perpendicular to the horizon to account for aircraft climb or descent angle. Because the flight path marker is used in conjunction with a three-dimensional background, the flight path marker utility normally associated with a HUD is achieved. When the location of the flight path marker is displaced to the extent it would interfere with heading, altitude, or airspeed indications, it is removed from the display as seen in Figure 4-5 with increasing crosswind from the right side.



Flight Path Marker nearing Airspeed tape due to strong crosswind

Flight Path Marker removed due to excessive crosswinds from the right

Figure 4-5: Flight Path Marker Disappearing

NOTE:

The flight marker is where the aircraft is going, regardless of where the aircraft is pointed.

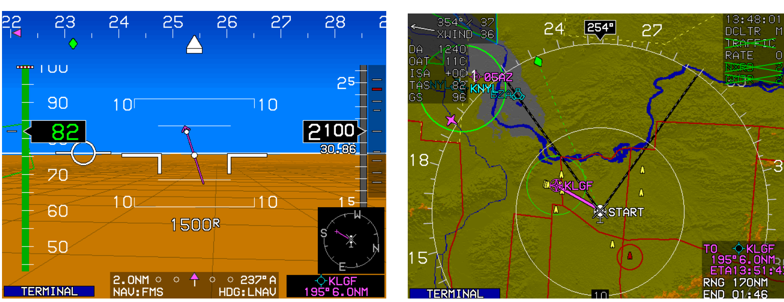
If the flight path marker is superimposed on terrain or an obstruction, the aircraft's current path through the air results in a collision with the object. Likewise, if the flight path marker is well above terrain in climb, the aircraft clears the terrain if the current climb angle is maintained. Placing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

The flight path marker and pitch scale drift around the screen as a single element. When the flight path marker drifts to the edge of the screen due to a crab angle greater than 15° (7.5° in zoom mode), the flight path marker is removed from the display. When the crab angle drops below 13° (6.5° in zoom mode), the flight path marker reappears in its appropriate position inside of the airspeed tape and altitude tape.

At low speed, the flight path marker is removed and replaced with hover vector symbology.

NOTE:

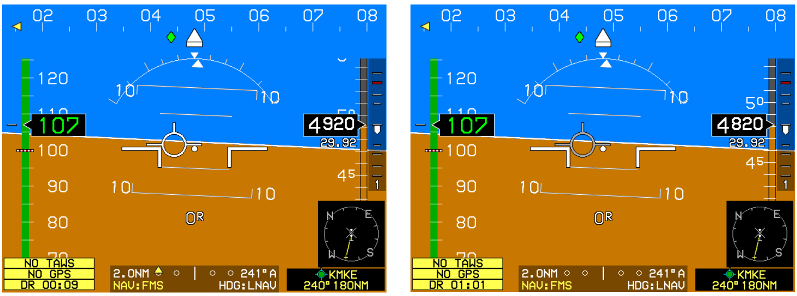
Flight path marker movement is dampened by reference to aircraft pitch and heading so as not to deviate from pitch or heading at a rate greater than 1°/sec.



The Flight Path Marker is nearing the airspeed tape due to the excessive 36 knot crosswind from the right.

Figure 4-6: Flight Path Marker Behavior

In reversionary mode 1 (GPS failure), the flight path marker changes to a light gray color after one minute to indicate degraded performance as seen below.

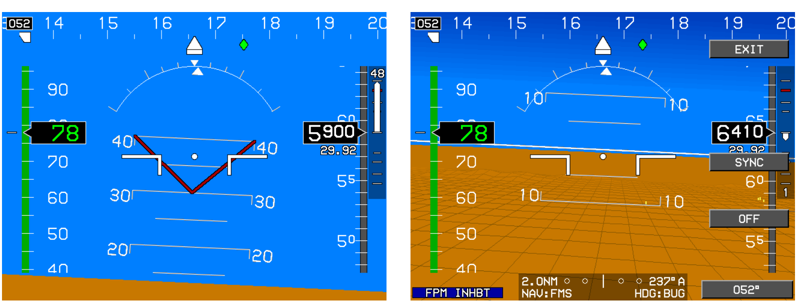


For the first minute after a GPS failure the FPM remains unchanged.

After one minute of dead reckoning following a GPS changes to a light gray color to indicate degraded performance.

Figure 4-7: Flight Path Marker during GPS Failure

In Unusual Attitude Mode, the flight path marker disappears to allow the pilot to concentrate on the Large Aircraft Symbol Reference Marks for unusual attitude recovery.



The FPM is automatically removed during the UAR mode and when inhibited if that feature is enabled.

Figure 4-8: Flight Path Marker Removal

4.6. Pitch Scale

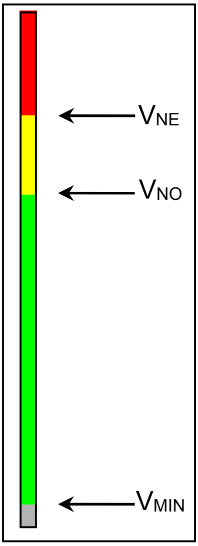
The PFD has a white pitch scale and double width horizon line that rotate in conjunction with the background according to the aircraft's roll angle. The pitch scale has increments every 5° with major increments and pitch scale labels every 10°. Pointer bars at the ends of each major increment indicate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

Figure 4-9: Pitch Scale

4.7. Altitude Readout

The altitude readout, located approximately two-thirds of the way up the altitude tape, digitally shows barometric altitude in feet MSL or on final descent during an LPV approach procedure, altitude is derived from GNSS and displayed in ten-foot increments.

The target altitude bug setting is limited to -1000 feet at the low end and 20,000' (rotorcraft) at the high end. The target altitude bug setting is annunciated above the altitude scale with a resolution of 100 feet. The target altitude bug setting annunciation includes a legend with the abbreviation “ASEL” to indicate the setting for the selected altitude sub-mode. The target altitude bug may be used either as a visual reference or, when vertically integrated with an autopilot (either fully integrated i.e., HeliSAS-E) or partially integrated through use of the vertical mode discrete input, as a control parameter for climbs or descents. When vertically integrated with an autopilot:



The airspeed scale background for Part 27 and 29 rotorcraft (Part 27 or 29 Airspeed Scale Type) has colored regions conforming to FAR § 27.1545 and FAR § 29.1545 as follows:

1) A gray background.

2) A green safe operating range area from $\mathbf{V_{MIN}}$ to $\mathbf{V_{NO}}$. $\mathbf{V_{MIN}}$ refers to the minimum speed for effective airspeed indication (usually 20KIAS – depending upon the connected Air Data Computer)

3) A yellow caution range area from $\mathbf{V_{NO}}$ to $\mathbf{V_{NE}}$ (power-on).

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

Figure 4-10: Airspeed Readout

The airspeed scale for Part 27 and Part 29 rotorcraft has additional specific airspeed markings as follows:

1) A red cross-hatched line at $\mathbf{V_{NE}}$ (power-off).

2) If enabled ("White Triangle" not 0), a "white triangle" translational lift reference speed marker.

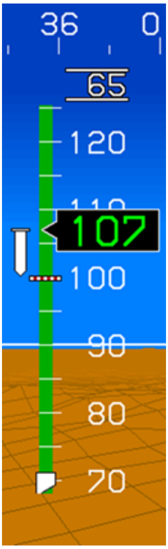
See Section 3 Display Symbology for altimeter scale and description.

4.8. Vertical Speed Indicator

The vertical speed indicator (VSI) is the same as described in Section 3 Display Symbology with the exception of being limited to ±2,000 feet per minute.

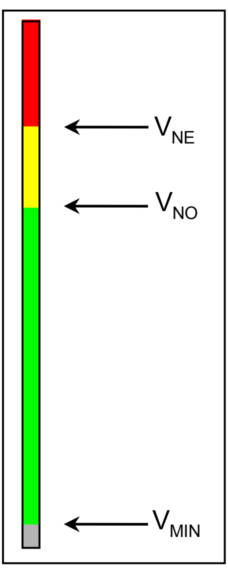
4.8.1. Airspeed Scale

The rotorcraft airspeed scale has graduations every five measurement units, with labels every ten measurement units, and has markings as follows:



1) A gray background.
2) A green safe operating range area **V$_{MIN}$** to **V$_{NO}$**. **V$_{MIN}$** refers to the minimum speed for effective airspeed.
3) An amber (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, as depicted here.
5) Airspeed trend vector in worm format providing analog representation of airspeed achieved in five seconds.

Figure 4-11: Rotorcraft Airspeed Scale

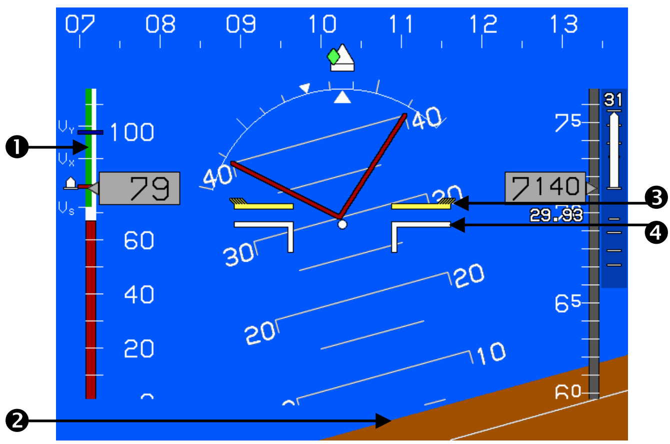


The airspeed scale for rotorcraft has markings to indicate **V$_{NE}$** (power off), commonly referred to as a "Barber pole", and also for translational lift reference if enabled. The **V$_{NE}$** marking is a red cross-hatched line on the airspeed Indicator. This normally indicates the power off recommended autorotation airspeed. If enabled, the translational lift marking is a white triangle on the airspeed indicator.

Figure 4-12: Airspeed Scale for Rotorcraft

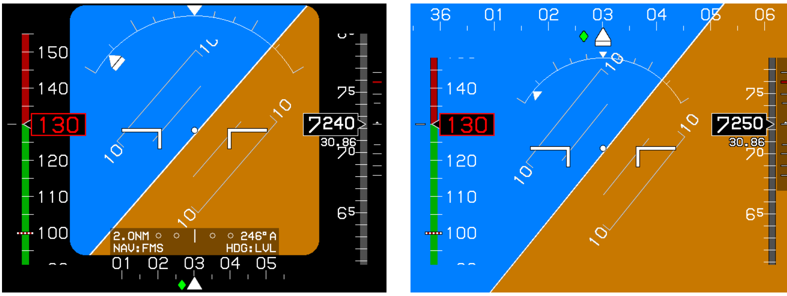
4.9. Unusual Attitude Recovery (UAR) Mode

When pitch exceeds ±30° or roll exceeds ±50°, 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 (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°.

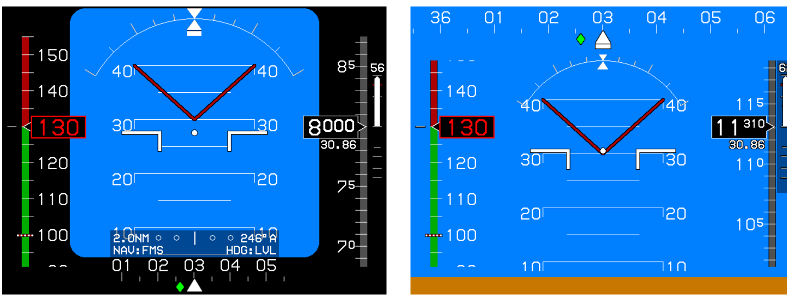


1) Speed Trend Worm
2) Horizon Cue
3) Pitch Limit Indicator
4) Expanded Waterline

Figure 4-13: Rotorcraft UAR Mode



Rotorcraft in Basic mode rolling past ±50° the SVS mode reappears for best attitude recovery to level flight.

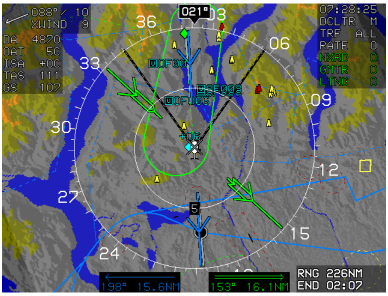


Rotorcraft in Basic mode pitching past ±30°, the SVS mode reappears for best attitude recovery to level flight.

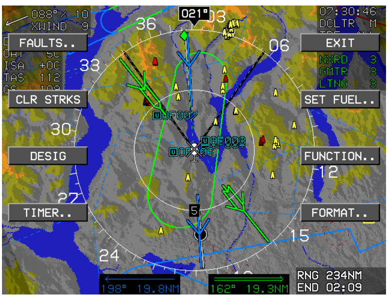
Figure 4-14: Rotorcraft Basic Mode UAR

4.10. Rotorcraft MFD

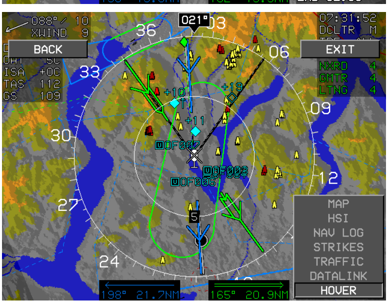
On MFD systems installed, the MFD Map page shows the ownship symbol as a helicopter. A Hover Page is also available which displays the hover vector, projected path, and AGL Indication.



1) Press **MENU (R1).**

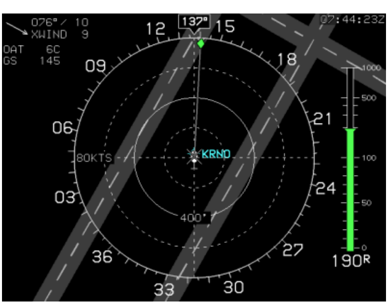


2) Press **FUNCTION (R3).**



3) Scroll ❶ to **HOVER** and push to enter.

Figure 4-15: Rotorcraft MFD Map Page



1) The hover page appears RADALT AGL indication on right side.

2) Scroll ❶ to alter range scale.

Figure 4-16: Rotorcraft MFD Hover Page

The following selectable hover screen ranges are available (all distances represent the distance from the ownship symbol to the compass rose): 400’, 800’, 1,600’, 0.5NM, 1NM, 2NM, and 5NM. Two range rings (one at half the radius of the compass rose) centered upon the ownship symbol aid the pilot to judge range to displayed symbols. A range indication corresponding to the radius of the range ring is presented on the range ring (200’, 400’, 800’, 0.25NM, 0.5NM, 1NM, and 2.5NM).

The hover vector is used to indicate flight direction and groundspeed and re-uses the compass rose and range ring as speed scales. In addition, two intermediate speed scales (the first between the ownship symbol and the range ring, the second between the range ring and the compass rose) are drawn using dashed lines. The speed range for the hover vector indication automatically changes based upon current groundspeed. Available speed ranges are (all speeds represent the speed indicated at the compass rose): 20KTS, 40KTS, and 80KTS with the currently selected speed range textually displayed adjacent to the compass rose. Changes in speed range employ a deadband to prevent flicker at speed range boundaries.

The ownship symbol indicates 0 knots groundspeed and a dot connected to the ownship symbol by a gray colored line floats over the hover screen to indicate flight direction and groundspeed. 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 five knots per second to prevent jumpiness. The hover vector line and dot are limited and cropped at the outer circle of the hover screen.

4.10.1. Compass Rose Symbols

Figure 4-17: ND (Hover Vector Compass Rose)

A digital magnetic heading readout and pointer aligned with the longitudinal axis of the ownship symbol appears on the compass rose boundary circle. A green diamond-shaped track pointer aligned with the aircraft’s track across the earth appears on the compass rose when groundspeed is greater than or equal to 30 knots. A pilot-settable heading bug geometrically interacting with the heading pointer appears on the compass rose. A magenta, star-shaped waypoint pointer is displayed on the heading scale at a point corresponding with the active waypoint which turns amber (yellow) in the event of GPS Loss of Navigation caution.

4.10.2. Active Flight Plan Path/Manual Course

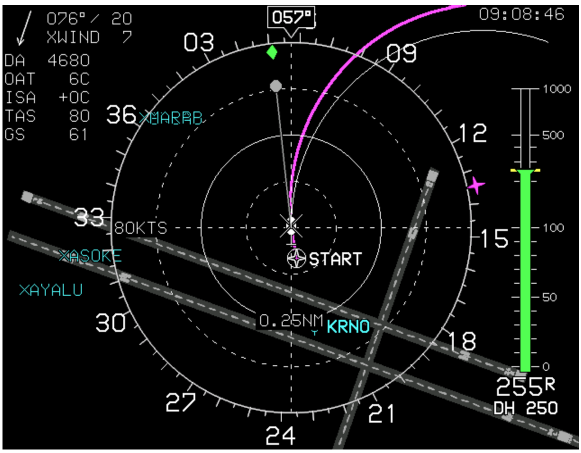


Figure 4-18: Hover Vector Screen - ND (Hover Vector Active Flight Plan Path/Manual Course)

When there is an active flight plan and the GPS/SBAS OBS setting is automatic, the flight plan path is shown on the hover screen in its correct relationship to the ownship symbol. The active flight plan path meets all the requirements of GPS/SBAS path definition and matches the lateral navigation guidance given on the PFD (GPS/SBAS CDI in automatic OBS mode, skyway boxes, and mini-map). Active flight plan path waypoints are shown as Fly-over or Fly-by waypoints with the Fly-over waypoint consisting of a waypoint symbol within a circle. The Fly-by waypoint consists of a waypoint symbol without the circle.

When there is a parallel offset, the active flight plan path depicts the parallel offset path, and the original flight plan path is be shown with haloed gray lines.

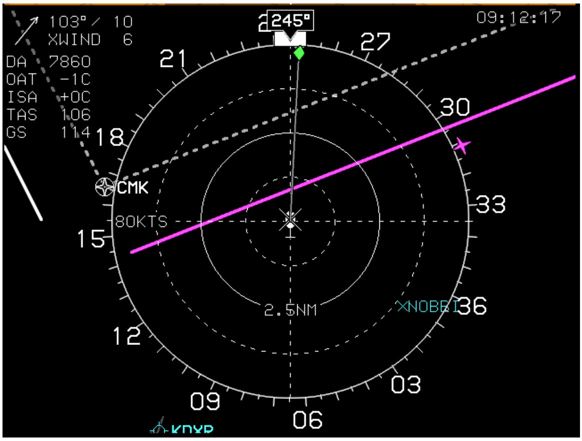


Figure 4-19: Hover Vector Parallel Track - ND (Hover Vector Active Flight Plan Path/Parallel Course)

When there is an active waypoint and the GPS/SBAS OBS setting is manual, the manual course through the waypoint is shown as a pointer centered on the waypoint. The pointer matches the lateral navigation guidance given on the PFD (GPS/SBAS CDI in manual OBS mode, skyway boxes, and mini-map).

The active flight plan path's active leg/manual course and active waypoint are normally colored magenta and turn amber (yellow) in the event of a GPS Loss of Navigation caution.

4.10.3. Navigation Data

The hover screen displays navigation data in its correct relationship to the ownship symbol. Navigation data symbols include airport symbols, VORs, NDBs, Fixes, and user waypoints. The user waypoint symbol on the hover screen includes an outlining box sized so it cannot be obscured by the ownship symbol. The intent of this requirement is to allow the pilot to hover by reference to a user waypoint. These symbols cannot be decluttered from the Hover Vector screen.

The hover screen displays airport runways in their correct relationship and scale to the ownship symbol. Immediately upon a system startup on the ground, the runways for the nearest airport are displayed. Upon activation of a DP, VFR approach, IFR approach, or STAR procedure, the runways for the airport associated with the procedure are displayed. In addition, the runways associated with the three nearest airports are also displayed. Runways are shown in dark gray according to characteristics contained in the navigation database, including position, orientation, length, and width. The landing portion of the selected runway, taking into account displaced threshold data, are shown in light gray.

4.10.4. Projected Path

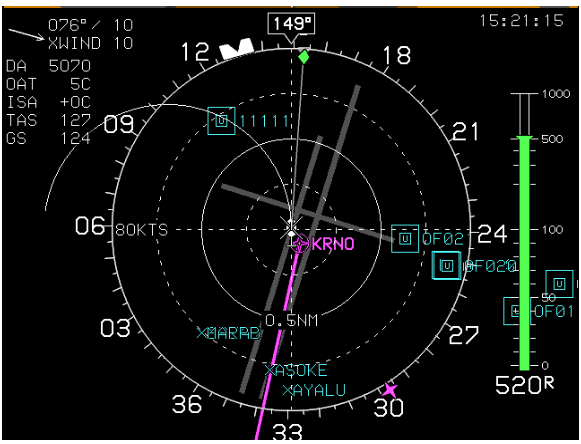


Figure 4-20: ND (Hover Vector Projected Path)

A projected path symbol is displayed on the hover page to aid in visualizing the radius of tums. When the aircraft is in a bank angle, a projected path emanates from the ownship symbol. The projected path is based upon aircraft bank angle and groundspeed and projects one minute into the future up to a maximum of 180° of turn. Air data and groundspeed is displayed in the upper left corner.

4.10.5. Air Data and Groundspeed

Air data and groundspeed are displayed in the upper left corner of the hover screen as specified in Figure 4-20.

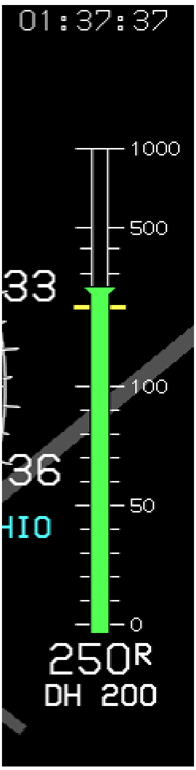
4.10.6. Clock and Timer

The following data items are displayed in the upper right corner of the hover screen:

Zulu Time: Zulu time is shown in hours: minutes: seconds format and synchronized with the GPS/SBAS constellation.

Timer: A countdown timer or count-up timer is displayed when selected by the pilot and match the timer shown on the PFD.

4.10.7. AGL Indication



AGL altitude is displayed as an analog indication and digital readout on the right side of the hover screen, which is driven by whatever AGL altitude source being used as follows:.

R = radar altitude.

G = GPS/SBAS geodetic height less database ground elevation.

B = barometric altitude less database ground elevation.

The digital readout of AGL altitude is not displayed when it is greater than the radar altimeter maximum valid altitude and not displayed when it is invalid. The digital readout of AGL altitude is not displayed when its source is barometric and indicated airspeed is in the noise range (less than 20 KIAS) due to rotor wash effects. When AGL altitude source is radar altitude, the digital readout of AGL indication is smoothed to avoid jumpiness.

Figure 4-21: ND (Hover Vector AGL Indication)

Table 4-1: AGL Indication Designed Behavior to Avoid Jumpiness

Altitude	**300 Feet**	**≥100Feet < 300Feet**	**<100 Feet**
AGL Indication resolution	10 Feet	5 Feet	1 Foot

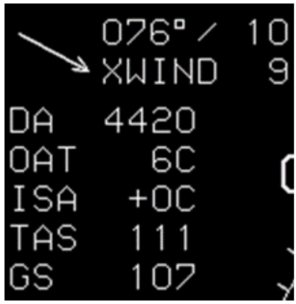


Figure 4-22: Air Data and Groundspeed

Figure 4-23: Clock and Timer

The following data items are displayed in the upper right corner of the hover screen:

1) Zulu Time: Zulu time is shown in hours: minutes: seconds format and synchronized with the GPS/SBAS constellation.

2) Timer: A countdown timer or count-up timer is displayed when selected by the pilot. The timer matches the timer on the PFD.

Figure 4-24: Hover Page Clock and Timer

Table 4-2: Top-Level Menu Automatic Function Descriptions Precedence, Tile Legend, and Action

(FPL) (L1)	1) When a terrain popup occurs during a TAWS FLTA alert, **RESET** tile appears. (ENHANCED HTAWS only) 2) When showing the Datalink Page with Pan Mode enabled, **PN OFF** tile appears. Press to disable Pan Mode. The **RESET** tile has precedence over the **PN OFF** tile. 3) When showing ND Page with Pan Mode enabled, **PN OFF** tile appears. Press to disable Pan Mode. The **RESET** tile has precedence over the **PN OFF** tile. 4) When the display is "transmit enabled", **LNAV** tile appears. When there is an active flight plan, heading bug sub-mode is active, and the system is integrated with an analog autopilot. Press **LNAV** tile to deactivate heading bug sub-mode and resume guidance to the active flight plan path. The **RESET** and **PN OFF** tiles have precedence over the **LNAV** tile. The LNAV tile does not appear on the AW-109SP. The pilot must use the RBP LNAV button. 5) When the display is "transmit enabled", **MISS** tile appears upon transitioning the Final Approach Fix. Press to activate the missed approach procedure. The **RESET**, **PN OFF**, and **LNAV** tiles have precedence over the **MISS** tile. 6) When the display is "transmit enabled", **CONT** tile appears when in a holding pattern with further active flight plan legs after the holding pattern. Press to re-enable automatic waypoint sequencing to allow normal sequencing to the leg after the holding pattern. The **RESET**, **PN OFF**, **LNAV**, and **MISS** tiles have precedence over the **CONT** tile.

Table 4-2: Top-Level Menu Automatic Function Descriptions Precedence, Tile Legend, and Action

(**ACTV**) **(L2)**	1) When showing Datalink Page with Winds and Temperatures Aloft enabled, **UP** tile appears. Press to increase the Winds and Temperatures Aloft grid. Does not appear when the highest grid level is being displayed. 2) When showing Video Input Page with pan mode enabled, **UP** tile appears. Press to move up the section of the video image displayed in the full video image. 3) When showing Datalink Page with: (a) pan mode enabled; (b) information for the nearest highlighted waypoint being shown; and (c) airport weather information present in the information block; **WX** tile appears to allow the display of textual METAR and TAF data for the airport. The **UP** tile has precedence over the **WX** tile. 4) When showing ND Page with: (a) pan mode enabled; (b) information for the nearest highlighted waypoint being shown; and (c) airport weather information present in the information block; **WX** tile appears to allow the display of textual METAR and TAF data for the airport. 5) When the display is “transmit enabled”, **VNAV** tile appears when VNAV guidance is valid, the selected altitude sub-mode is active, and the system is integrated with an analog autopilot or HeliSAS-E. Press to deactivate the selected altitude sub-mode and resume guidance to the VNAV path. The **UP** and **WX** tiles have precedence over the **VNAV** tile. When the display is “transmit enabled”, **ARM** tile appears when on the Final Approach Segment (between the Final Approach Fix and Missed Approach Point). Press to arm the missed approach procedure to automatically activate upon

Table 4-2: Top-Level Menu Automatic Function Descriptions Precedence, Tile Legend, and Action

	sequencing the Missed Approach Point. The **UP**, **WX**, and **VNAV** tiles have precedence over the **ARM** tile. The VNAV tile does not appear on the AW-109SP. The pilot must use the RBP VNAV button. 6) When the display is "transmit enabled", **ARM** tile appears when on the Final Approach Segment (between the Final Approach Fix and Missed Approach Point). Press to arm the missed approach procedure to automatically activate upon sequencing the Missed Approach Point. The **UP**, **WX**, and **VNAV** tiles have precedence over the **ARM** tile. (See #5 for AW-109SP)
INFO (L3)	1) When showing Datalink Page with Pan Mode enabled, **NORTH** tile appears. Press to shift the center of the Pan Mode Datalink Page in the specified direction. 2) When showing ND Page with Pan Mode enabled, **NORTH** tile appears. Press to shift the center of the Pan Mode ND Page in the specified direction. 3) When showing Video Input Page with pan mode enabled, **DOWN** tile appears. Press to move down the section of the video image displayed in the full video image.
(OBS) (L4)	1) When showing Datalink Page with Pan Mode enabled, **SOUTH** tile appears. Press to shift the center of the Pan Mode Datalink Page in the specified direction. 2) When showing ND Page with Pan Mode enabled, **SOUTH** tile appears. Press to shift the center of the Pan Mode ND Page in the specified direction.

Table 4-2: Top-Level Menu Automatic Function Descriptions Precedence, Tile Legend, and Action	
(BARO) (R2) (IDU-450) **(HDG) (R2) (IDU-III)**	1) When showing Datalink Page with Winds and Temperatures Aloft enabled, **DOWN** tile appears. Press to decrease the Winds and Temperatures Aloft grid level. Not shown when the lowest grid level is being displayed. 2) When showing Video Input Page with pan mode enabled, **LEFT** tile appears. Press to move left the section of the video image displayed in the full video image. 3) When showing Datalink Page with Pan Mode enabled, **INFO** or **HIDE** tile appears. Press to toggle the display of information for the nearest highlighted waypoint. Refer to the **INFO** Menu requirements for the amount and type of information presented. The **DOWN** tile has precedence over the **INFO**/**HIDE** tile. 4) When showing ND Page with Pan Mode enabled, **INFO** or **HIDE** tile appears. Press to toggle the display of information for the nearest highlighted waypoint.
(**NRST**) **(R3)**	1) When showing Datalink Page with Pan Mode enabled, **EAST** tile appears. Press to shift the center of the Pan Mode Datalink Page to shift in the specified direction. 2) When showing ND Page with Pan Mode enabled, **EAST** tile appears. Press to shift the center of the Pan Mode ND Page in the specified direction. 3) When showing Video Input Page with pan mode enabled, **RIGHT** tile appears. Press to move right the section of the video image displayed in the full video image.

Table 4-2: Top-Level Menu Automatic Function Descriptions Precedence, Tile Legend, and Action	
(Direct-To Symbol)  **(R4)**	1) When showing Datalink Page with Pan Mode enabled, **WEST** tile appears. Press to shift the center of the Pan Mode Datalink Page in the specified direction. 2) When showing ND Page with Pan Mode enabled, **WEST** tile appears. Press to shift the center of the Pan Mode ND Page in the specified direction.

4.11. HELISAS-E Integrated Autopilot Interface Symbology

Mode = SAS, CDI NAV Source = FMS

Figure 4-25: Active LNAV Route Engaged

Mode = SAS, CDI NAV Source = FMS

Figure 4-26: No Active LNAV Route Engaged

Heading bug pre-selected hollow white.

Figure 4-27: HDG Mode Not Engaged

Heading bug solid white.

Figure 4-28: HDG Mode Engaged

Engaged Mode = HDG, CDI NAV Source = FMS

Figure 4-29: Active LNAV Route

Engaged Mode = HDG, CDI NAV Source = FMS

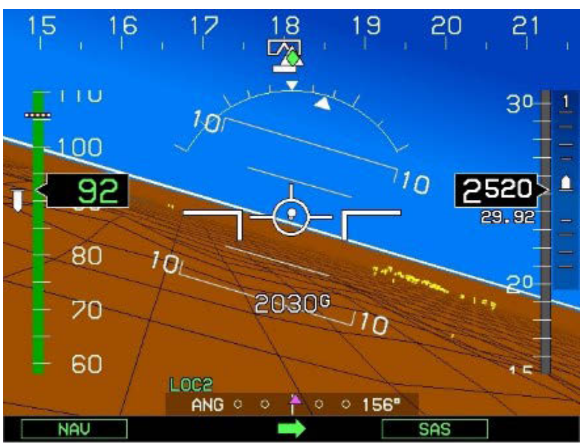
Figure 4-30: No Active LNAV Route

Engaged Mode = NAV, CDI NAV Source = FMS

Figure 4-31: Active LNAV Route

Engaged Mode = NAV, CDI NAV Source = LOC1

Figure 4-32: Active LNAV Route



Engaged Mode = NAV, CDT NAV Source = LOC2

Figure 4-33: No Active LNAV Route

Engaged Mode = BC, CDI NAV Source = LOC1
“GS ARM” Menu Tile

Figure 4-34: Active LNAV Route

Engaged Mode = BC, CDI NAV Source = LOC1

Figure 4-35: No Active LNAV Route

VNAV Path = No, Selected Altitude = No, Selected VSI or IAS = No

Figure 4-36: Display before SAS Engaged

VNAV Path = No, Selected Altitude = Yes, Selected VSI or IAS = No

Figure 4-37: Display after SAS Engaged

VNAV Path = No, Selected Altitude = No, Selected VSI or IAS = No

Figure 4-38: Display before ALT Engaged

VNAV Path = No, Selected Attitude = No, Selected VSI or IAS = No

Figure 4-39: Display after ALT Engaged

VNAV Path = No, Selected Altitude = No, Selected VSI or IAS = No

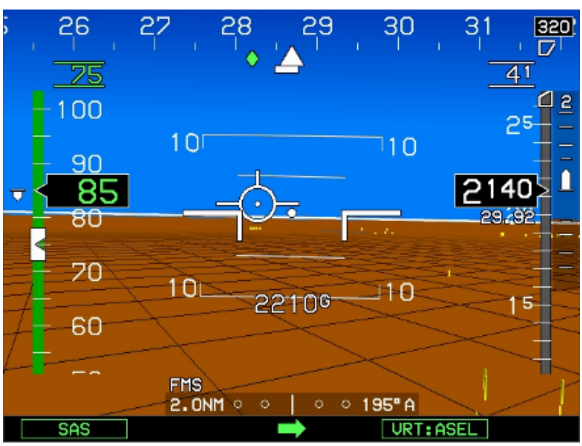
Figure 4-40: Display before VRT Mode Engaged

VNAV Path = No, Selected Altitude = No, Selected VSI or IAS = No
Selected altitude automatically created at current altitude.

Figure 4-41: Display after VRT Mode Engaged

VNAV Path = No, Selected Altitude = Yes (4100'), Selected VSI or IAS = No

Figure 4-42: Display before VRT Mode Engaged



VNAV Path = No, Selected Altitude = Yes (4100'), Selected VSI or IAS = No
Hollow white altitude bug at selected altitude and white readout.
Filled white airspeed bug at default climb airspeed and green airspeed bug readout.

Figure 4-43: Display after VRT Mode Engaged Prior to Level-Off

VNAV Path = No, Selected Altitude = Yes (4100'), Selected VSI or IAS = No
Filled white altitude bug at selected attitude and flashing green altitude bug readout. Airspeed bug and readout disappear.

Figure 4-44: Display with VRT:ASEL Engaged During Level-Off

VNAV Path = Yes (3300'), Selected Altitude = Yes (2300'), Selected VSI or IAS = No
Hollow white altitude bug at selected altitude and white altitude bug readout. **VNAV** menu tile.

Figure 4-45: Display before VRT Mode Engaged

VNAV Path = Yes (3300'), Selected Altitude = Yes (2300'), Selected VSI or IAS = No

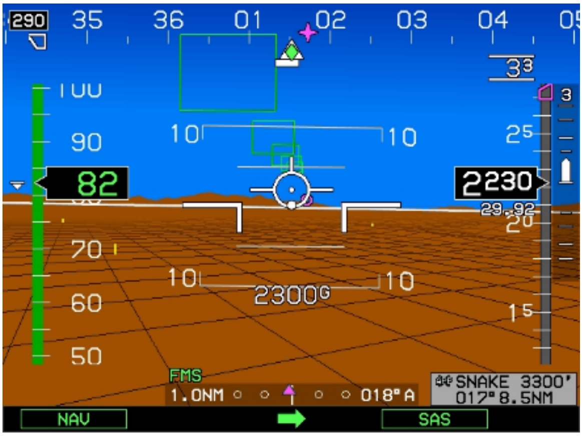
Hollow white altitude bug at selected altitude and white altitude bug readout. Filled white vertical speed bug at default vertical speed and green vertical speed bug readout. **VNAV** menu tile.

Figure 4-46: Display after VRT Mode Engaged Prior to Level-Off

VNAV Path = Yes (3300'), Selected Altitude = Yes (2300'), Selected VSI or IAS = No

Filled white altitude bug at selected altitude and flashing green altitude bug readout. Vertical speed bug and vertical speed bug readout disappear. **VNAV** menu tile.

Figure 4-47: Display with VRT: ASEL Engaged During Level-Off



VNAV Path = Yes, Selected Altitude = No, Selected VSI or IAS = No
Hollow magenta altitude bug and white readout. No VSI or IAS bug and readout.

Figure 4-48: Display before VRT Mode Engaged

VNAV Path = Yes, Selected Altitude = No, Selected VSI or IAS = No
Vertical deviation indication displayed during VNAV descent. The selected vertical navigation source annunciated with green “VNAV.”

Figure 4-49: Display during VNAV Descent

VNAV Path = No, Selected Altitude =Yes (2700'), Selected VSI or IAS = No
Filled white altitude bug at selected altitude and green altitude bug readout. VRT:GS mode is armed with white “GS” in FCC display area.

Figure 4-50: VRT:GS Armed (VRT:ASEL Engaged)

VNAV Path = No, Selected Altitude = Yes (2700’), Selected VSI or IAS = No
Hollow white altitude bug and white readout. Green selected vertical navigation source annunciation (GS1).

Figure 4-51: Display after VRT:GS Engaged

VNAV Path =Yes (2202’), Selected Altitude =No, Selected VSI or IAS = No
Filled magenta altitude bug at VNAV altitude and green altitude bug readout. VRT:GS mode is armed with white “GS” in FCC display area.

Figure 4-52: VRT:GS Armed (VRT:VNAV Engaged)

VNAV Path = Yes (2202’), Selected Altitude = No, Selected VSI or IAS = No
Hollow magenta altitude bug and white readout. Green selected vertical navigation source annunciation (GS1).

Figure 4-53: Display after VRT:GS Engaged

4.12. Reversionary Modes

4.13. Failure Modes

AUDIBLE ANNUNCIATION

CWA flags are accompanied by an auditory annunciation.

Failure of a weather receiver, datalink receiver, TCAS/TCAD receiver, AIU, and Weather Radar results in the EFIS issuing an amber (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, AHRS, or ADC, singly or in combination, adversely impacts the EFIS capabilities. 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 eight operating modes, depending upon the status of the attached sensors. The modes are:

Mode 0: GPS, ADC, and AHRS normal.

Mode 1: GPS failed, ADC and AHRS normal.

Mode 2: ADC failed, GPS and AHRS normal.

Mode 3: AHRS failed, GPS and ADC normal.

Mode 4: GPS and ADC failed, AHRS normal.

Mode 5: GPS and AHRS failed, ADC normal.

Mode 6: ADC and AHRS failed, GPS normal.

Mode 7: GPS, ADC and AHRS failed.

System operation in the above modes is detailed on the following chart.

Table 4-3: PFD Functions

PFD Function	Mode							
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Airspeed	OK	OK	19	OK	19	OK	19	19
Altimeter	OK	OK	19	OK	19	OK	19	19
Altimeter Set Display	OK	OK	-	OK	-	OK	-	-
Bank Scale	OK	OK	OK	-	OK	-	-	-
CDI	OK	1 + 20	OK	OK	20	20	OK	20
Runway	OK	1	-	-	-	-	-	-
Waypoint Pointer	7	1	7	7	-	-	7	-
Heading Scale	7	7	7	7	7	-	7	-
AGL Ind.	OK	2	4	OK	11	11	4	-
Flight Path Marker	OK	1 + 14	-	-	-	-	-	-
G-meter	OK	OK	OK	-	OK	-	-	-
Ground Track	7	1	7	7	-	-	7	-
Heading Indicator	7	7	7	-	7	-	-	-
Horizon	OK	OK	OK	-	OK	-	-	-
Mini-Map	7	1	7	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	22	22	5	13	5	13	13	13
Waypoint Symbol	OK	1	-	-	-	-	-	-
Waypoint Brg./Dist.	OK	1	OK	OK	-	-	OK	-
Traffic	OK	OK	OK	-	-	-	-	-
Traffic Thumbnail	OK	OK	OK	OK	OK	OK	OK	OK
Speed Trend	OK	OK	-	-	-	-	-	-
Dynamic Stall Speed	OK	OK	-	8	-	8	-	-

Table 4-4: ND Functions

ND Functions	Mode							
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Aircraft Position	OK	1	OK	OK	-	-	OK	-
Special Use Airspace	9	1	6	9	-	-	6 + 9	-
Waypoint Pointer	9	1	9	9	-	-	9	-
Active Flight Plan Path	9	1	9	9	-	-	9	-
Glide Range	9	1	-	10	-	-	-	-
Groundspeed	OK	1	OK	OK	-	-	OK	-
Ground Track	9	1	9	9	-	-	9	-
Heading Indicator	9	9	9	-	9	-	-	-
Navigation Symbols	9	1	9	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	21	3	-	-	-	-	-	-
Compass Rose	9	9	9	9	9	-	9	-
Fuel Totalizer Functions	23	24	23	23	12	12	12	12
True Airspeed	OK	OK	-	OK	-	OK	-	-
Density Altitude	OK	OK	-	OK	-	OK	-	-
OAT / ISA Display	OK	OK	-	OK	-	OK	-	-

Table 4-5: Output Functions

Output Functions	Mode							
	0	**1**	**2**	**3**	**4**	**5**	**6**	**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
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	-	-

Note 1: Presented using inertial dead-reckoning based on last known wind information. If unable to dead-reckon (e.g., heading is failed or true airspeed cannot be calculated), function is disabled.

Note 2: Only radar altitude presented when available.

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. The rotorcraft versions use full-time large attitude bars and do not show the waterline symbol.

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

Note 7: In heading-only failure mode or AHRS failure mode, heading scale aligned with aircraft track and heading indication is removed. In heading-only failure mode or AHRS failure mode combined with GPS failure, heading scale is replaced with a Red-X.

Note 8: Based upon 1G stall speed.

Note 9: In heading-only failure mode or AHRS failure mode, compass rose aligned with aircraft track and heading indication is removed when in heading up mode. In heading-only failure mode or AHRS failure mode combined with GPS failure, compass rose is removed.

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: Assuming valid fuel flow information, endurance is presented.

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

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

Note 15: Highway in the Sky removed after one minute,

Note 16: See IDU IV Personality Module and Limits Requirements 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.

Note 19: Red “X” in place of scale.

Note 20: VLOC CDI always available if optional VOR symbology enabled.

Note 21: Function removed during heading-only failure mode,

Note 22: Rotorcraft versions use full-time large attitude bars and do not show the waterline symbol.

Note 23: Assuming valid fuel flow information both range and endurance are presented, Note 24: Assuming valid fuel flow information, both range and endurance are presented using inertial dead-reckoning based on last known wind information. If unable to dead-reckon (e.g., heading is failed or true airspeed cannot be calculated), only endurance is presented.

AUDIBLE ANNUNCIATION

Component failures result in amber (yellow) caution flags and a single aural annunciation identifying each failed component.

4.14. GPS Failure

GPS degrades or fails as a result of loss of satellite information, or GPS equipment failure. When the integrity is provided by SBAS, the IDU provides a LOI (Loss of Integrity) monitoring caution within two seconds if the current HPL (Horizontal Protection Level) exceeds the HAL (Horizontal Alert Level). This LOI caution appears when there is not integrity monitoring and disappears when integrity monitoring is restored.

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.

The LON (Loss of Navigation) is displayed within one second of the onset of the following:

1) The absence of power
2) Equipment malfunction or failure
3) The presence of a condition lasting five seconds or more where there are an inadequate number of satellites to compute position solution.
4) Fault detects a position failure that cannot be excluded within time-to-alert when integrity is provided by FDE.

When in LNAV, the fault detection function detects positioning failures within ten seconds after the onset of the positioning failure.

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 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 ##.## flag is displayed to show the pilot the length of time during which the EFIS has been dead reckoning.

NOTE:

SBAS 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 a GPS-Based approach procedure at or after the FAF and still IMC (no TAWS available), initiate the Missed Approach Procedure.

In the event of a loss of GPS during an ILS, LOC, VOR, or NDB approach procedure (no TAWS available) and still IMC, continuation of approach procedure may only be based upon raw data navigational information.

The primary flight and navigation displays are affected as follows:

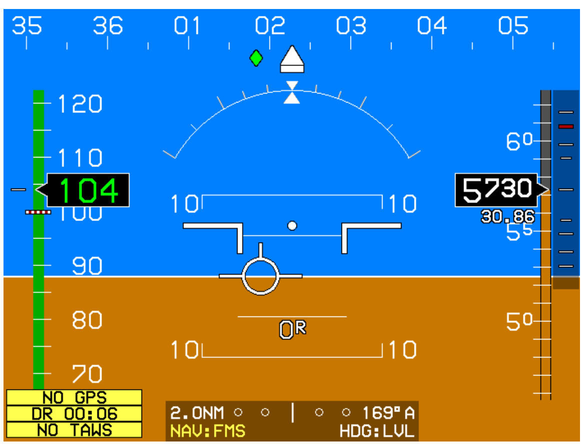


Figure 4-54: PFD Page during GPS Failure

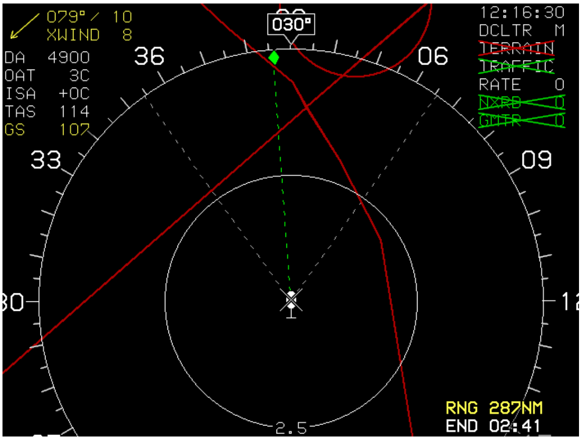


Figure 4-55: ND Page during GPS Failure

CAUTION:

In the event of loss of GPS, transition to other navigation sources as soon as possible. Following system dead reckoning guidance may 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, in the event of a wind mismatch, position errors grow over time and may 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 may be. As an example, with a ten knot wind mismatch, the dead reckoning solution is 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 affecting these parameters may cause inaccuracies in the calculated wind. The pilot should be aware of the following potential error sources:

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

b) Heading: Heading errors may be caused by poor AHRS alignment, carrying iron-bearing materials in proximity to the magnetic sensor, 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.

c) GS: Poor satellite geometry may 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.

d) Track: Poor satellite geometry may 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 Path Marker. 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.

4.15. ADC Failure

Failure of the ADC causes the loss of air data. This failure is annunciated by loss of air data information and a red "X" over the airspeed and altimeter. The primary flight and navigation displays are affected as follows:

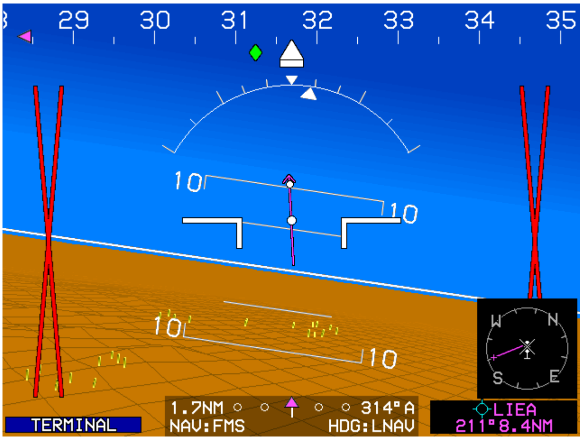


Figure 4-56: PFD Page during ADC Failure

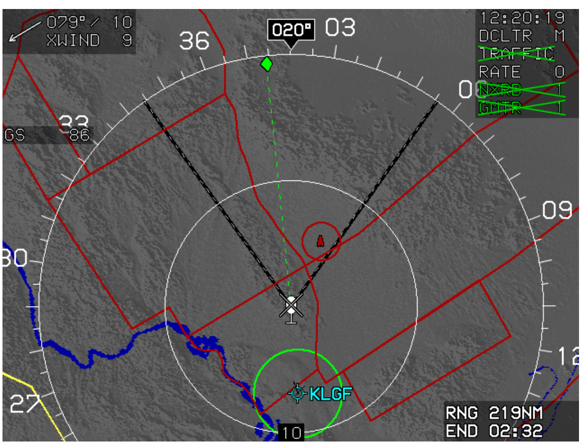


Figure 4-57: ND Page during ADC Failure

NOTE:

Failure of the ADC outside air temperature probe only results in disabled TAS, OAT, ISA, DA, and wind displays and causes OAT SENSOR caution with an alert tone. It does not affect other air data parameters.

In the event of an ADC failure, revert to the standby altimeter and airspeed indicator and switch to the other ADC if so equipped.

4.16. AHRS Failure

Failure of the AHRS results in loss of attitude, magnetic heading, and G-force information. This failure causes the AHRS1 FAIL caution flag to be displayed. The engine display is not affected, and continues normal operation. The primary flight and navigation displays are affected as follows:

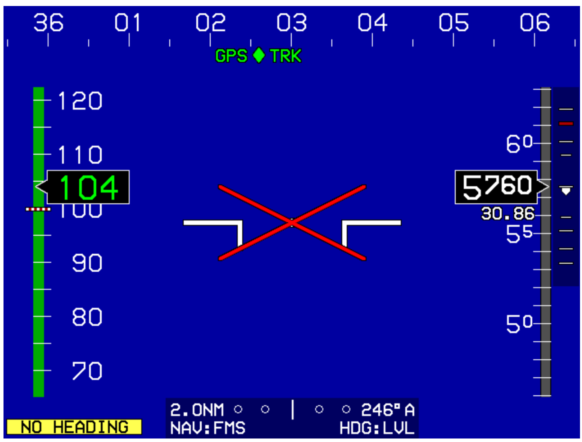


Figure 4-58: PFD Page during AHRS Failure

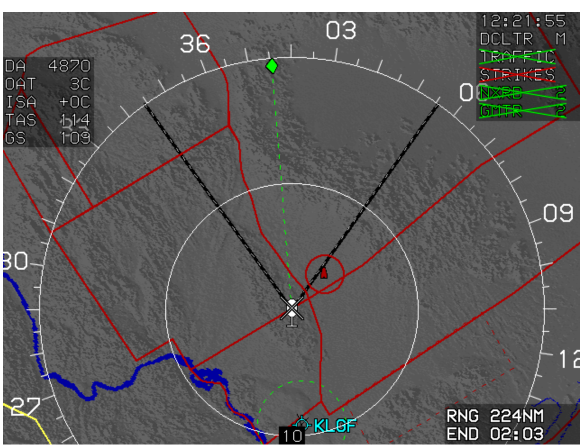


Figure 4-59: ND Page during AHRS Failure

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

4.17. 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 TCASI TCAD information. This failure causes NO GPS and NO TAWS caution flags to be displayed. The primary flight and navigation displays are affected as follows:

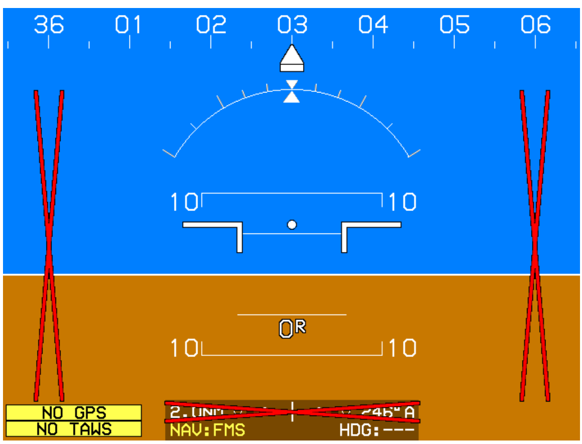


Figure 4-60: PFD Page during ADC and GPS Failure

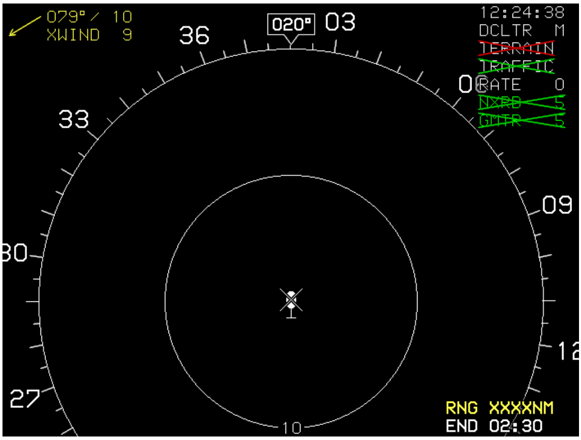


Figure 4-61: ND Page during ADC and GPS Failure

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

4.18. ADC and AHRS Failure

ADC and AHRS failure causes the loss of air data, magnetic heading data, and attitude data. This failure causes NO HEADING and AHRS1 FAIL caution flags to be displayed. The primary flight and navigation displays are affected as follows:

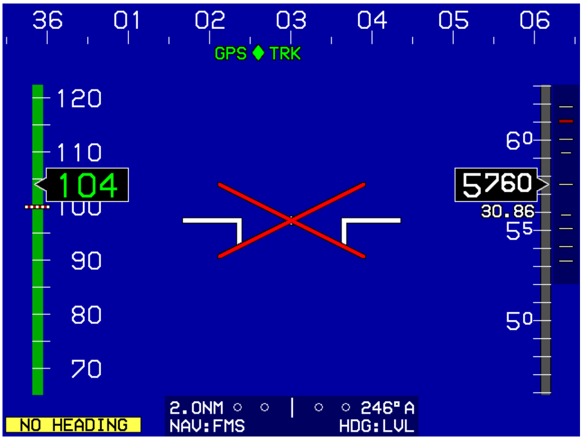


Figure 4-62: PFD Page during ADC and AHRS Failure

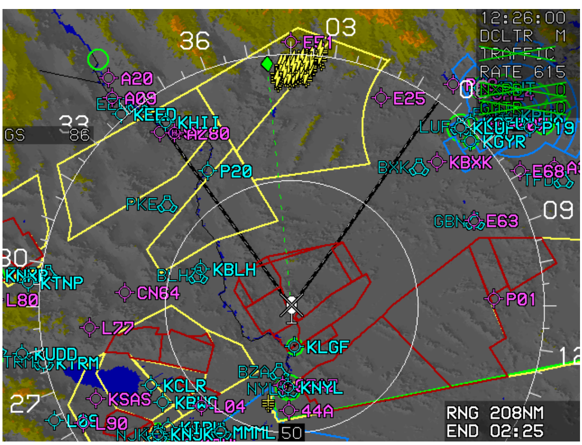


Figure 4-63: ND page during ADC and AHRS Failure

In the event of an ADC and AHRS failure, revert to the standby attitude indicator, airspeed indicator, and altimeter and switch to the other ADC and AHRS if so equipped.

4.19. 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 navigational display is only selectable for the purposes of showing passive lightning detection and traffic information. This failure causes NO TAWS, NO GPS, and NO HEADING flags to be displayed and timer started. The primary flight and navigation displays are affected as follows:

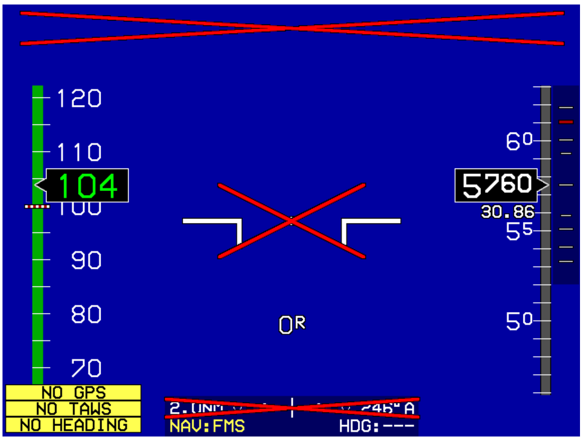


Figure 4-64: PFD Page during GPS and AHRS Failure

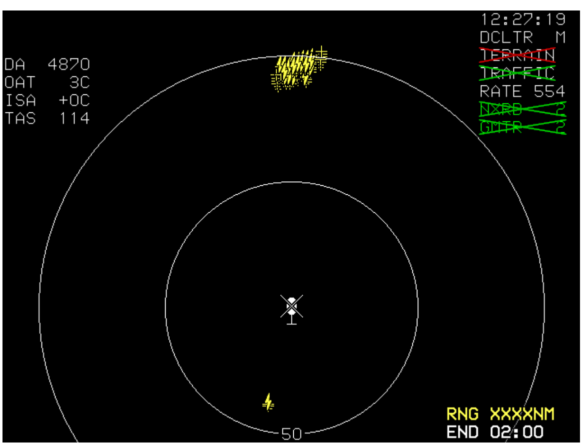


Figure 4-65: ND Page during GPS and AHRS Failure

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 source and switch to other GPS and AHRS If so equipped.

4.20. GPS, ADC, and AHRS Failures

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

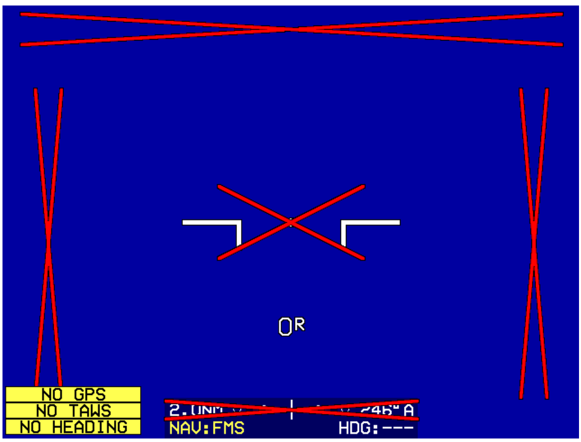


Figure 4-66: PFD Page during GPS, ADC, and AHRS Failure

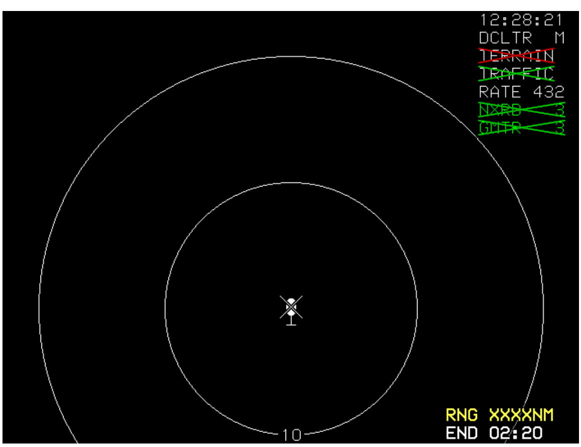


Figure 4-67: ND Page during GPS, ADC, and AHRS Failure

In the event of a GPS, ADC, and AHRS failure, revert to all standby instruments, and use other sources for navigation. In installations where dual GPS, ADC, and AHRS are installed and only one of each has failed, switch to the other sensor as applicable if so equipped.

4.21. Enhanced and HTAWS

4.21.1. Enhanced HTAWS and HTAWS (Terrain Awareness and Warning System) Functions

The IDU provides TSO-C194 HTAWS functionality. Depending on aircraft configuration and external sensors/switches, the system is configurable as an Enhanced HTAWS or HTAWS. Functions provided by HTAWS are:

Terrain Display: Display of terrain and obstacles on the PFD and ND.

Forward Looking Terrain Awareness (**FLTA**): A warning function using a terrain database and an obstruction database to alert the pilot to hazardous terrain or obstructions in front of the aircraft.

Excessive Rate of Descent (**GPWS Mode 1**): A warning function alerting the pilot when the rate of descent is hazardously high as compared to height above terrain (i.e., descending into terrain).

Excessive Closure Rate to Terrain (**GPWS Mode 2**): A warning function alerting 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).

Sink Rate after Takeoff or Missed Approach (**GPWS Mode 3**): A warning function alerting the pilot when a sink rate is detected immediately after takeoff or initiation of a missed approach.

Flight into Terrain when not in Landing Configuration (**GPWS Mode 4**): A warning function alerting the pilot when descending into terrain without properly configuring the aircraft for landing.

Excessive Downward Deviation from an ILS Glideslope (**GPWS Mode 5**): A warning function alerting the pilot when an excessive downward glideslope deviation is detected on the final approach segment of an ILS approach.

Table 4-6: TAWS Functions Provided by the EFIS

Aircraft Type	TAWS Class	Terrain Display	FLTA	GPWS Mode				
				1	2	3	4	5
Rotorcraft RG	Enhanced	✓	✓	✓	✓	✓	✓	✓
Rotorcraft FG	Enhanced	✓	✓	✓	✓	✓		✓
Rotorcraft	Normal	✓	✓			✓		

RG = Retractable Gear; FG = Fixed Gear

4.21.2. Terrain Display

The display of terrain on the PFD and MFD are described in Section 3 Display Symbology and Section 5 Menu Functions and Step-By-Step Procedures of this pilot guide where applicable.

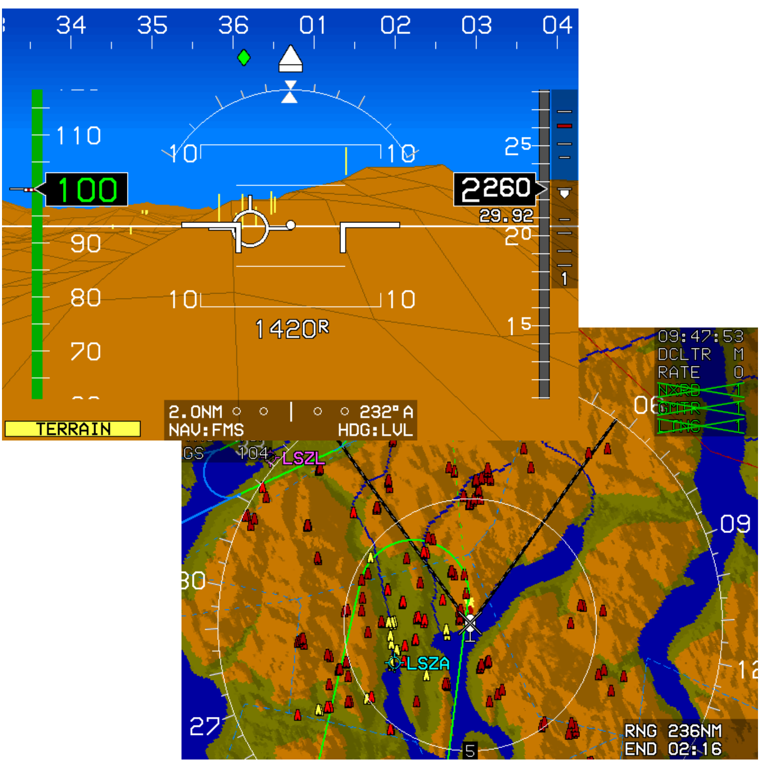


Figure 4-68: PFD and MFD Terrain Display

4.22. Forward Looking Terrain Alert Function

The FLTA function uses the following information to alert the pilot to hazardous terrain or obstructions within a search envelope in front of the aircraft:

1) Terrain database
2) Obstruction database
3) Airport and runway database
4) Aircraft position
5) Aircraft track
6) Aircraft groundspeed
7) Aircraft bank angle
8) Aircraft altitude
9) Aircraft vertical speed

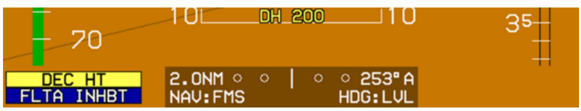


Figure 4-69: FLTA INHBT

4.22.1. FLTA Modes

The EFIS FLTA mode is either slaved to the GPS/SBAS navigation mode or set automatically based upon default mode logic.

4.22.2. GPS/SBAS Navigation Mode Slaving

The EFIS performs TSO-C146c GPS/SBAS system functions in addition to the TAWS functions. As a result, GPS/SBAS navigation mode is available as an input to the TAWS. The pilot may select an IFR procedure (Approach, DP, or STAR) which automatically changes the GPS/SBAS navigation mode to Enroute, Terminal, Departure, or IFR Approach as appropriate. In addition, the EFIS allows the pilot to select a VFR approach to any runway or user waypoint with a defined approach path. Selection of a VFR approach causes automatic GPS/SBAS navigation mode changes to Enroute, Terminal, or VFR Approach as appropriate.

When slaved, the GPS/SBAS active runway threshold or user waypoint is the reference point for automatic FLTA inhibiting. The advantage is the GPS/SBAS navigation modes are a direct indication to the FLTA function of pilot intent.

4.22.3. Default FLTA Mode

If the default FLTA navigation mode is higher in precedence than the GPS/SBAS navigation mode, the FLTA mode is slaved to the default FLTA navigation mode.

These modes, in order of precedence, are as follows:

1) Departure Mode. This mode is enabled when in Ground Mode. The reference point for automatic FLTA inhibiting and mode envelope definition is the last point at which the ground definition was satisfied (this is near the liftoff point). The Departure Mode ends upon climbing through 1500 feet above or traveling more than 6NM from the reference point.

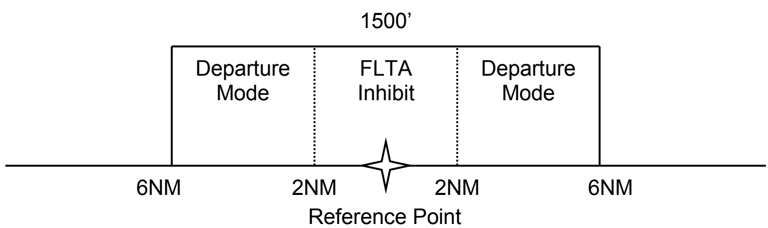


Figure 4-70: Default FLTA INHBT

2) Other Modes. For other default FLTA modes, the reference point for automatic FLTA inhibiting and mode envelope is the nearest runway threshold or the nearest user waypoint with a defined approach bearing. The TAWS system continuously searches all runway thresholds at the nearest three airports to determine the nearest runway threshold. The TAWS system performs a search for the nearest three airports and nearest user waypoints with a defined approach bearing every 3NM of distance traveled. Modes are as follows:

   a) Approach Mode. Exists when within 1900 feet and 5NM of the reference point.

   b) Terminal Mode. Exists from 5NM to 15NM from the reference point when below an altitude that varies from 1900 feet (at 5NM) to 3500 feet (at 15NM) above the reference point.

   c) Enroute Mode. Exists when not in any other mode.

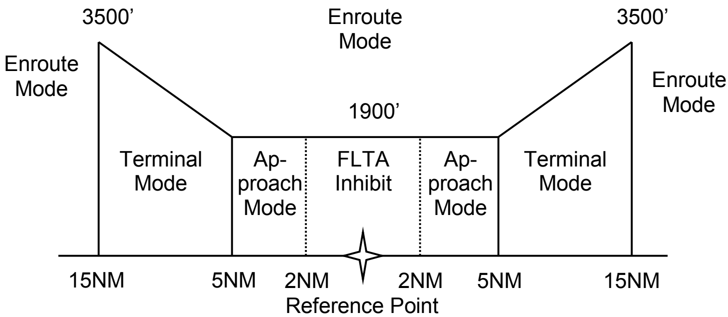


Figure 4-71: FLTA INHBT Mode Areas

4.23. FLTA Search Envelope

The FLTA search envelope is an area in front of and below the aircraft. If terrain or obstructions are found within the FLTA search envelope, a caution or warning is given to the pilot. The dimensions of the search envelope depend upon TAWS type, FLTA mode (described above), aircraft groundspeed, aircraft bank angle, and vertical speed. Basic envelope parameters are as follows:

TAWS Type: The TAWS type determines the value of several parameters used to calculate the search envelope. These parameters are described below:

Table 4-7: FLTA Search Envelope for HTAWS

Envelope	**Parameter**	**Notes**
Level-Off Rule:	10% of vertical speed	Used for level off leading
Range:	36 seconds of the forward range search envelope	Reduced to 24 seconds when Low Altitude Mode is engaged. GPS/SBAS HFOM is added to range.
Enroute Mode Level/Climbing Flight RTC:	150 feet	Reduced to 100 feet when Low Altitude Mode is engaged
Terminal Mode Level/Climbing Flight RTC:	150 feet	Reduced to 100 feet when Low Altitude Mode is engaged

Table 4-7: FLTA Search Envelope for HTAWS

Envelope	Parameter	Notes
Approach Mode Level/Climbing Flight RTC:	150 feet	Reduced to 100 feet when Low Altitude Mode is engaged
Departure Mode Level/Climbing Flight RTC:	100 feet	
Enroute Mode Descending RTC:	100 feet	
Terminal Mode Descending RTC:	100 feet	
Approach Mode Descending RTC:	100 feet	
Departure Mode Descending RTC:	100 feet	

1) Aircraft Track: The terrain search envelope is aligned with aircraft track.

2) 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 0.5NM 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.

After calculating search volume width as described above, the GPS/SBAS HFOM is added to search volume width.

1) Aircraft Bank Angle: Aircraft bank angle is used to expand the search volume in the direction of a turn and require at least 10° of bank. In addition, search volume expansion is delayed so at 10° of bank, the bank angle must be continuously held for 3.25 seconds. The amount of delay is reduced linearly with increased bank angle so at 30° of bank there is no delay time. Delaying is intended to reduce nuisance search volume expansions when experiencing bank angle excursions due to turbulence.

2) Aircraft Vertical Speed: Aircraft vertical speed is used to determine which RTC values should be used. At vertical speeds above -500 fpm, level and climbing flight RTC values are used. At vertical speeds less than or equal to -500 fpm, 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 three-second pilot reaction time and VSI leading according to the level-off rule parameter.

4.23.1. FLTA Search Volume

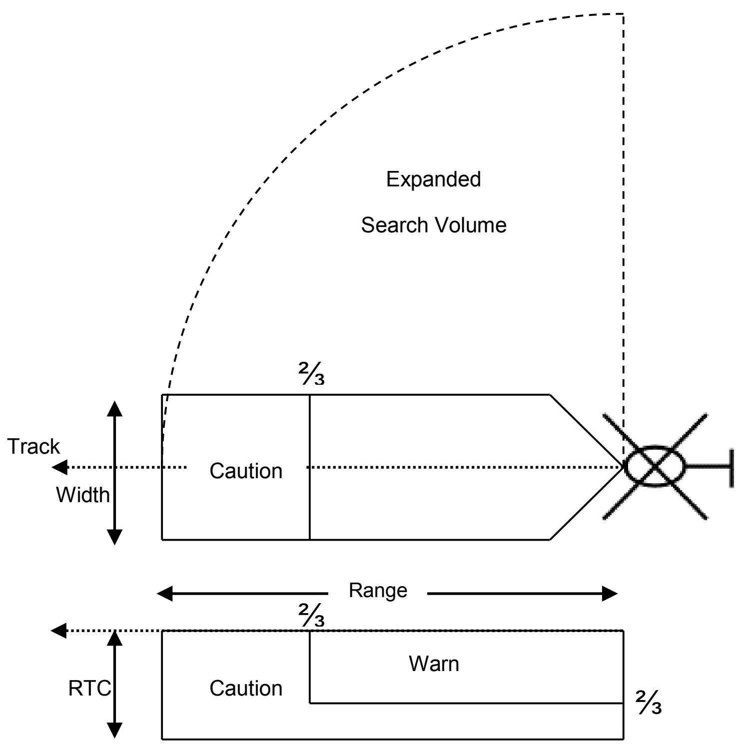


Figure 4-72: FLTA Search Volume

4.23.2. FLTA Alerts and Automatic Popup

When terrain or obstructions fall within the FLTA search envelope, a FLTA warning is generated. Terrain rendering is enabled when a FLTA warning is initiated or upgraded as follows:

1) On PFD screen, terrain rendering is enabled;

2) On navigation display screen, terrain rendering is enabled only if TAWS Inhibit is not enabled (i.e., TAWS Inhibit prevents terrain from being automatically enabled on the navigation display).

In addition, when an FLTA warning is initiated or upgraded, an automatic popup mode is engaged as follows:

1) Display switched to navigation display.

2) Display switched to aircraft centered and heading up.

3) Display panning disabled.

4) Display scale set to:

   a) 10NM (groundspeed > 200 knots);

   b) 5 NM (groundspeed < = 200 knots and groundspeed > 100 knots); or

   c) 2NM (groundspeed < = 100 knots).

After the popup mode is engaged, the pilot is able to manually change any setting automatically changed by the popup mode. In addition, **RESET** appears for 20 seconds to allow the pilot to reset the previous screen configuration with one button press. Popups only occur on CPU #0 or CPU #2 (with Enhanced HTAWS enabled) and do not occur if TAWS Inhibit is enabled,

NOTE:

This function is present in rotorcraft Enhanced HTAWS systems only.

The following screen capture shows an example of the PFD in popup mode.

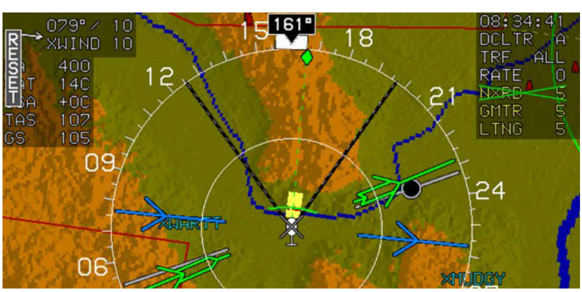


Figure 4-73: Popup Mode Excessive Rate of Descent (GPWS Mode 1)

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 and a warning threshold. When below the thresholds, a GPWS Mode 1 warning is generated.

The curve is shown below:

Table 4-8: HTAWS GPWS Mode 1 Envelope

Sink Rate (fpm)	AGL Altitude (ft.)	
	"Sink Rate" Caution Threshold	"Pull Up" Warning Threshold
< 1000	$62.5\% \times (\text{Sink Rate} - 600)$	$66\% \times \left(\begin{array}{c}\text{Caution}\\\text{Threshold}\end{array}\right)$
1000 to 3000	Lesser of: 750, or, $25\% \times (\text{Sink Rate})$	

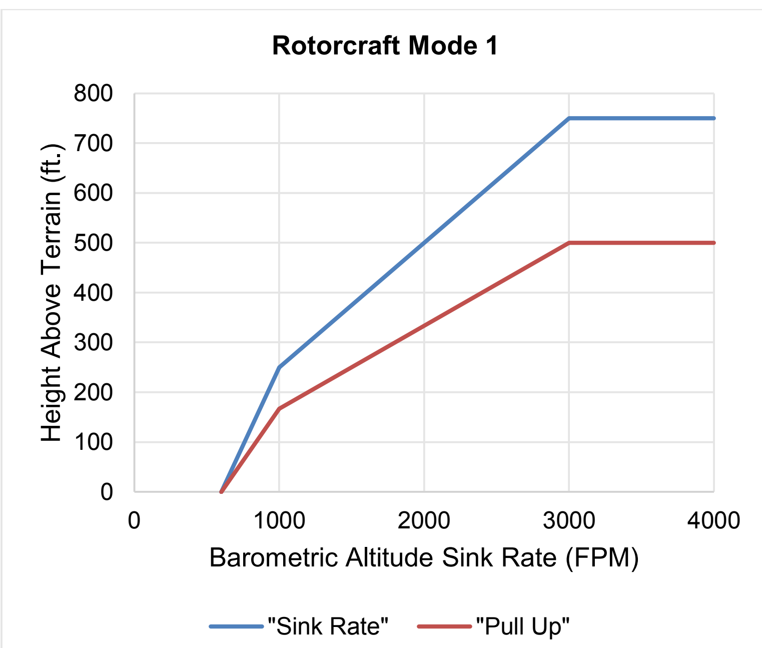


Figure 4-74: Rotorcraft GPWS Mode 1

4.24. Excessive Closure Rate to Terrain (GPWS Mode 2)

This function is present in Enhanced HTAWS system only. 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 10-second sampling time.

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:

Table 4-9: HTAWS GPWS Mode 2 Envelopes

Landing Gear	Mode 2A	Mode 2B
Retractable	Landing Gear Up	Landing Gear Down
Fixed	$\text{AGL Altitude} > 200\text{ ft}$ or $\text{Airspeed} > 80\text{ KIAS}$	$\text{AGL Altitude} \le 200\text{ ft}$ and $\text{Airspeed} \le 80\text{ KIAS}$

When the GPWS Mode 2 envelope is pierced, a GPWS Mode 2 warning is generated.

Table 4-10: HTAWS GPWS Mode 2A Envelopes (NOT in Landing Configuration)

<table>
<tr><th rowspan="2">AGL Rate (fpm)</th><th colspan="2">AGL Altitude (ft.)</th></tr>
<tr><th>“Caution, Terrain” Caution Threshold</th><th>“Pull Up” Warning Threshold</th></tr>
<tr><td>< 1905</td><td>$125\% \times (\text{AGL Rate} - 1600)$</td><td rowspan="2">$66\% \times \left(\begin{matrix}\text{Caution}\\ \text{Threshold}\end{matrix}\right)$</td></tr>
<tr><td>> 1905</td><td>20% of the lesser of:
<table>
<tr><th>Airspeed (KIAS)</th><th>AGL Rate (fpm)</th></tr>
<tr><td>< 90</td><td>3120</td></tr>
<tr><td>90 to 130</td><td>$3120 + 72 \times (\text{Airspeed} - 90)$</td></tr>
<tr><td>> 130</td><td>6000</td></tr>
</table>
or
AGL Rate</td></tr>
</table>

Table 4-11: HTAWS GPWS Mode 2B Envelopes (Landing Configuration)	
AGL Altitude (ft.)	
"Caution, Terrain" Caution Threshold	**"Pull Up" Warning Threshold**
Lesser of: 300, or, $20\% \times (\text{AGL Rate} - 2000)$	$66\% \times (\text{Caution Threshold})$

Envelope Depictions Mode 2 envelopes are shown below:

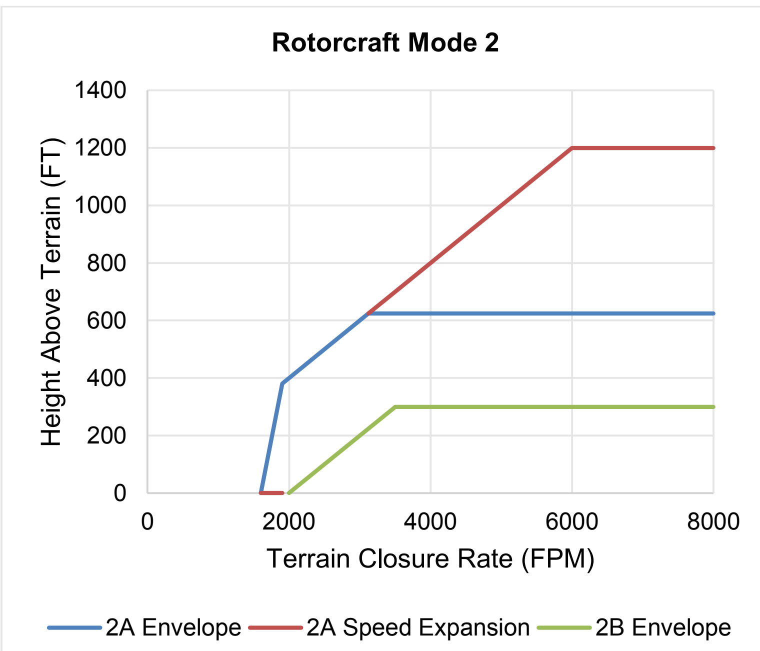


Figure 4-75: Rotorcraft GPWS Mode 2

4.25. Sink Rate after Takeoff or Missed Approach (GPWS Mode 3)

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 in ground mode or by being on the first leg of a missed approach procedure (as determined by the GPS/SBAS) with distance to the active runway threshold increasing. GPWS Mode 3 is disarmed upon climbing through 700 feet AGL traveling more than 6 NM from the last point at which the ground definition was satisfied (this is 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 defined below:

“**Don’t Sink**” AGL = 140 % of sink rate

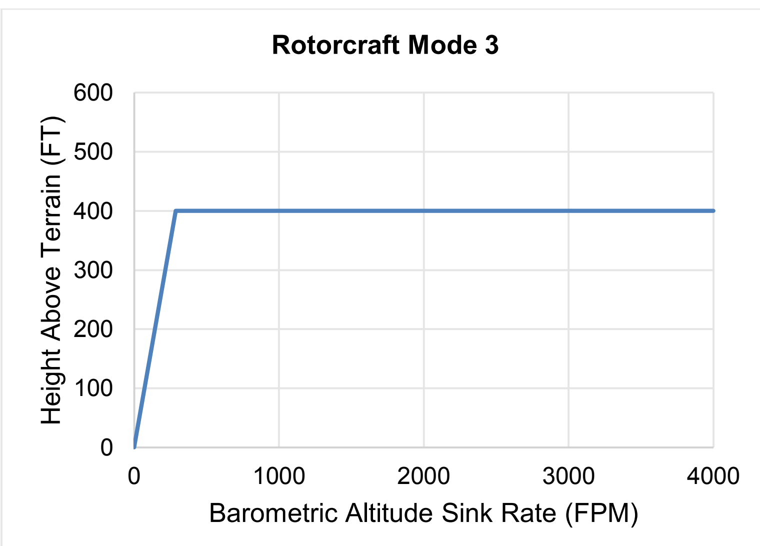


Figure 4-76: Rotorcraft GPWS Mode 3

4.26. Flight into Terrain when not in Landing Configuration (GPWS Mode 4)

This function is present in Enhanced HTAWS systems. The GPWS Mode 4 function uses aircraft speed information and AGL altitude to alert the pilot when descending into terrain without properly configuring the aircraft for landing. There are two Mode 4 envelopes: Mode 4A, which gives cautions when landing gear is in other than landing configuration, and Mode 4B, which gives cautions when landing gear or flaps are in other than landing configuration. Applicability of Mode 4 envelopes to aircraft types are as follows:

Table 4-12: HTAWS GPWS Mode 4 Envelopes

Landing Gear	Mode 4A	Mode 4B
Retractable	Landing Gear Up	Not Applicable
Fixed	Not Applicable	Not Applicable

The rotorcraft Mode 4 envelope consists of a low-speed region and a high-speed region. In the low-speed region, TOO LOW appears in conjunction with a single "Too Low Gear" aural alert. In the high-speed region, TOO LOW appears in conjunction with a single "Too Low Terrain" aural alert. In addition, the rotorcraft Mode 4 has autorotation expansion and, when engaged, the aural alert is "Too Low Gear" regardless of speed.

Mode 4 alerting criteria require the Mode 4 envelope to be entered from above so changing aircraft configuration while within a Mode 4 envelope does not generate an alert.

Table 4-13: HTAWS GPWS Mode 4A Envelopes

Segment	Speed (KIAS)	AGL Altitude (ft.)
4A Low-Speed	< 100	150 (400 in autorotation)
4A High-Speed	≥ 100	

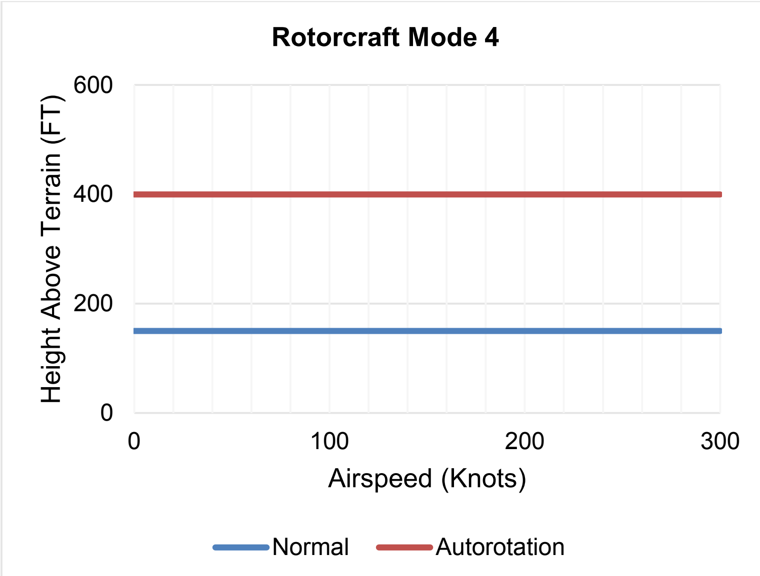


Figure 4-77: Rotorcraft GPWS Mode 4

4.27. Excessive Downward Deviation from an ILS Glideslope (GPWS Mode 5)

This function is present in Enhanced HTAWS systems only. 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 is below 1000’ AGL.

GPWS Mode 5 has a caution and a warning threshold. When below a threshold, a GPWS Mode 5 warning is generated. The curve compares glideslope deviation to AGL altitude as shown below:

Table 4-14: HTAWS GPWS Mode 5 Envelopes

Caution Threshold	Warning Threshold
Greater of: $\begin{bmatrix} 1.3 + 1.4\% \times \\ (150 - \text{AGL Altitude}) \end{bmatrix}$ Dots or 1.3 Dots	Greater of: $\begin{bmatrix} 2 + 1\% \times \\ (150 - \text{AGL Altitude}) \end{bmatrix}$ Dots or 2 Dots

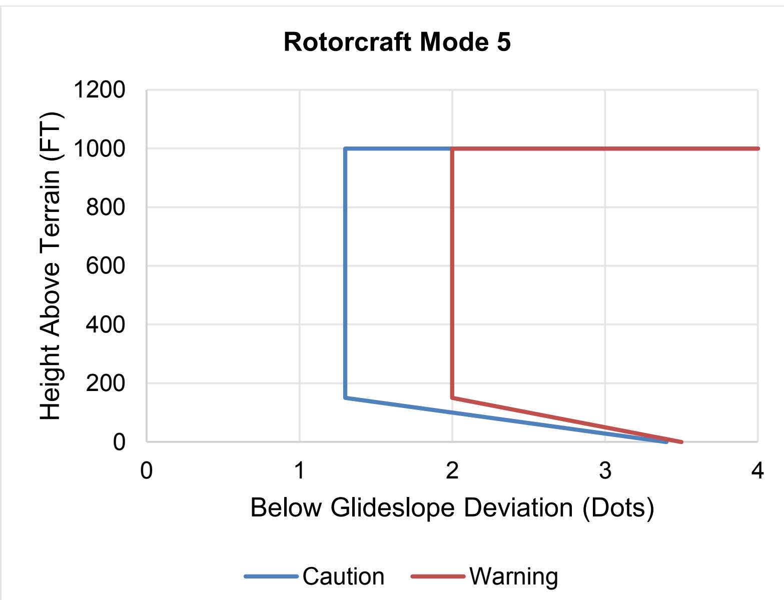


Figure 4-78: Rotorcraft GPWS Mode 5

4.28. 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 as follows:

1) GPS/SBAS Receiver. The GPS/SBAS receiver is the source of aircraft position, geodetic height, horizontal figure of merit (HFOM), vertical figure of merit (VFOM), loss of integrity (LOI), and loss of navigation (LON) inputs for the TAWS. The GPS/SBAS receiver connects directly to the EFIS IDU.

2) Air Data Computer (ADC). The air data computer is the source of barometric altitude, outside air temperature, and vertical speed for the TAWS and connects directly to the EFIS IDU.

3) ILS Receiver. A glideslope receiver is the source of glideslope deviation for the TAWS.

4) Radar Altimeter (RA). A radar altimeter is the source for radar altitude for the TAWS.

5) Gear Position Sensors. Landing gear position discretes, as configured in the system limits, are the source of landing gear position for the TAWS.

6) Flap Position Sensor. A flap position discrete, as configured in the system limits is the source of flap position for the TAWS.

7) TAWS Inhibit Switch. A TAWS Inhibit Switch, as configured in the system limits, 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 (e.g., toggle/rocker or pushbutton with indicator light and TAWS INHBT on the lower left corner of the PFD).

8) Low Altitude Mode Switch. A Low Altitude Mode Switch, as configured in the system limits, 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 (e.g., toggle/rocker or pushbutton with indicator light and TAWS LOW ALT on the lower left corner of the PFD).

9) Audio Mute Switch. An Audio Mute Switch is used for silencing active aural alerts. The Audio Mute Switch is of the momentary type and is connected directly to the EFIS IDU. The Audio Mute Switch is momentarily activated when silencing of active aural alerts is desired.

10) Glideslope Deactivate Switch. A Glideslope Deactivate Switch, as configured in the system limits, is used for inhibiting the

GPWS Mode 5 function. The Glideslope Deactivate Switch is of the momentary type and is momentarily activated when inhibition of the GPWS Mode 5 function is desired.

Applicability of external sensors and switches for the applicable TAWS system is as follows:

Table 4-15: External Sensors and Switches (Applicable TAWS System)

Aircraft Type	**Rotorcraft RG**	**Rotorcraft FG**	**Rotorcraft**
HTAWS Class	Enhanced	Enhanced	Normal
GPS/SBAS	✓	✓	✓
ADC	✓	✓	✓
Gear Position Sensor	✓		
TAWS Inhibit Switch	✓	✓	✓
Audio Cancel Switch	✓	✓	✓
Low Altitude Mode Switch	✓	✓	✓

Table 4-16: External Sensors and Switches (Applicable TAWS System)

Aircraft Type	**Rotorcraft RG**	**Rotorcraft FG**	**Rotorcraft**
HTAWS/Class	Enhanced	Enhanced	Normal
Low Torque Sensor	✓	✓	
ILS	✓	✓	
Radar Altimeter	✓	✓	
Glideslope Deactivate Switch	✓	✓	

RG = Retractable Gear; FG = Fixed Gear

4.29. TAWS System Basic Parameter Determination

The fundamental parameters used for TAWS system functions are:

Table 4-17: HTAWS Basic Parameters Determination

Parameter	**Source**	**Notes**
Aircraft position, groundspeed, and track	GPS/SBAS	The HFOM must be less than or equal to the greater of 0.3 NM or the Horizontal alert limit (HAL) for the mode of flight
MSL Altitude	GPS/SBAS	Geodetic Height converted to MSL with the current EGM (Earth Gravity Model) database. In order for this to be considered valid for use as MSL altitude, the VFOM must be less than or equal to 106 feet. The secondary source of MSL altitude is barometric altitude from an air data computer. Barometric altitude is determined based upon a barometric setting in the following order of preference: 1) If either the pilot or co-pilot system is operating in QNH mode, then the QNH barometric setting is used (on-side barometric setting preferred); or 2) If GPS/SBAS geodetic height has been valid within the last 30 minutes, a barometric setting derived from the

Table 4-17: HTAWS Basic Parameters Determination		
Parameter	**Source**	**Notes**
		GPS/SBAS geodetic height is used. If neither of the above conditions is met, MSL altitude is marked as invalid. When a reporting station elevation is determined and outside air temperature is valid, a temperature correction is applied. The TAWS system uses the lower of the barometric altitude or the temperature-corrected altitude. In the case of QNH-mode barometric setting, reporting station elevation is derived from waypoint or active runway elevations in the active flight plan using the following logic: 1) If the aircraft is in **TERMINAL, DEPARTURE**, **IFR APPROACH**, or **VFR APPROACH** mode and an active runway exists, reporting station elevation is the elevation of the active runway threshold. 2) Otherwise, if the aircraft is in **TERMINAL** mode, reporting station elevation is the

Table 4-17: HTAWS Basic Parameters Determination

Parameter	Source	Notes
		elevation of the airport causing **TERMINAL** mode. 3) In **ENROUTE** mode, no reporting station elevation can be determined. In the case of GPS/SBAS geodetic height-based barometric setting, reporting station elevation is the GPS MSL altitude reported at the time the barometric setting was determined. Note the following definitions: **QFE**: Barometric setting resulting in the altimeter displaying height above a reference elevation (e.g., airport or runway threshold). **QNE**: Standard barometric setting (29.92 inHg or 1013 mbar) used to display pressure altitude for flight above the transition altitude. **QNH**: Barometric setting resulting in the altimeter displaying altitude above mean sea level at the reporting station.

Table 4-17: HTAWS Basic Parameters Determination

Parameter	**Source**	**Notes**
Terrain Data	Terrain Database	In order for terrain data to be considered valid for use by the TAWS, the following conditions must be met: 1) Aircraft position is valid; 2) Aircraft position is within the boundaries of the terrain database; and 3) The terrain database is not corrupt as determined by CRC-32 checks at system initialization and during runtime.
Obstacle Data	Obstacle Database	In order for obstacle data to be considered valid for use by the TAWS, the following conditions must be met: 1) Aircraft position is valid; 2) Aircraft position is within the boundaries of the obstacle database; and 3) The obstacle database is not corrupt as determined by CRC-32 checks at system initialization.
AGL Altitude	Radar Altitude	The secondary source for AGL Altitude is MSL altitude less terrain altitude.
Vertical Speed	Instantaneous vertical speed	IVSI values come from barometric vertical speed from an ADC “quickened” with vertical acceleration from an AHRS. The

Table 4-17: HTAWS Basic Parameters Determination

Parameter	Source	Notes
		secondary source for vertical speed is barometric vertical speed from an ADC. The tertiary source for vertical speed is GPS/SBAS vertical speed providing the VFOM is less than or equal to 106 feet.
Terrain Closure Rate	The smoothed first derivative of AGL Altitude	Due to the multiple sources for altitude, there are multiple sources for terrain closure rate.
Runway/Reference point location	EFIS navigation database	In order to be considered valid for use, the following conditions must apply: 1) Aircraft position is valid; 2) Aircraft position is within the boundaries of the navigation database; and 3) The navigation database is not corrupt as determined by a CRC-32 check at system initialization.

4.30. TAWS Automatic Inhibit Functions (Normal Operation)

The following automatic inhibit functions occur during normal TAWS operation to prevent nuisance warnings:

The FLTA function is automatically inhibited when in the Terminal, Departure, IFR Approach, or VFR Approach Modes and within 2 NM and 1900’ of the reference point.

GPWS Modes 1 through 4 are automatically inhibited when below 50 feet AGL (radar altimeter AGL altitude) or below 100 feet AGL (terrain database AGL altitude).

GPWS Mode 4 is inhibited while Mode 3 is armed.

GPWS Mode 5 is inhibited below 200’ AGL. This form of automatic inhibit remains active until the aircraft climbs above 1000’ AGL. The purpose of this form of inhibiting is to prevent nuisance alarms on missed approach when glideslope sidelobes are detected by the glideslope receiver.

The FLTA function is automatically inhibited when airspeed or groundspeed is below the HTAWS FLTA Inhibit Speed.

4.30.1. TAWS Automatic Inhibit Functions (Abnormal Operation)

The following automatic inhibit functions occur during the specified abnormal operations:

1) Autorotation detection. When the low torque sensor is active, an Enhanced HTAWS system enters Autorotation Mode. In this mode:

    a) FLTA is inhibited;

    b) GPWS Mode 1 is inhibited;

    c) GPWS Mode 2 is inhibited; and

    d) 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:

Table 4-18: TAWS Automatic Inhibit Functions

Sensor	Parameters Lost	Terrain Displaced	FLTA	GPWS Mode 1	GPWS Mode 2	GPWS Mode 3	GPWS Mode 4	GPWS Mode 5
GPS/SBAS (H)	AC Position	Inhibit	Inhibit					
TD	Terrain Elev.	Inhibit	Inhibit					
ILS	Glide-slope Dev.							Inhibit
MSL	MSL Altitude	Inhibit	Inhibit					
GPS/SBAS (H) + RADLT	AC Position, AGL Altitude	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit
GPS/SBAS (V) + ADC	MSL Altitude, VSI	Inhibit	Inhibit	Inhibit		Inhibit		
TD + RADLT	Terrain Elev. AGL Altitude	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit

Table 4-18: TAWS Automatic Inhibit Functions

Sensor	Parameters Lost	Terrain Displaced	FLTA	GPWS Mode				
				1	2	3	4	5
MSL + RADLT	MSL Altitude, AGL Altitude	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit
GPS/SBAS (V) + ADC + RADLT	MSL Altitude, VSI, AGL ALT	Inhibit	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/SBAS (H) = HFOM > max (0.3NM, HAL). Indication is loss of terrain display on PFD and ND.

3) GPS/SBAS (V) = VFOM > 106’.

4) GPS/SBAS = GPS/SBAS (H) + GPS/SBAS (V). Indication is loss of terrain display on PFD and ND.

5) TD = Terrain Data invalid. This would be due to being beyond the database boundaries or database corruption.

6) ADC = Air Data Computer. Indication is ADC1 FAIL or ADC2 FAIL flags or Red Xs over Airspeed and Altitude tapes.

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.

9) MSL=MSL Altitude Invalid. Indication is NO TAWS in the absence of other failures.

4.30.2. TAWS Manual Inhibit Functions

The pilot may select one of the following manual inhibit functions:

1) The Terrain Display function may be inhibited using an EFIS soft menu declutter control.

2) All TAWS alerting functions (including popup functionality) are manually inhibited by actuation of the external TAWS Inhibit Switch. The Terrain Display function, including display of FLTA alarm (red) and caution (amber [yellow]) cells on the ND, is not affected by the TAWS Inhibit Switch.

3) GPWS Mode 5 is manually inhibited by actuation of the momentary Glideslope Cancel Switch when below 1000' AGL. GPWS Mode 5 manual inhibit automatically resets by ascending above 1000' AGL.

4.31. TAWS Selections on PFD

The PFD Declutter menu includes three option possibilities for TAWS as follows:

1) TERRAIN

2) No TERRAIN

The figures below show all possible scenarios including "None" where the aircraft pierces the TAWS FLTA Terrain envelope, and SVS TAWS automatically becomes enabled for the safest possible warning alert condition.

Figure 4-79: PFD TERRAIN Option

Figure 4-80: PFD No TERRAIN Option

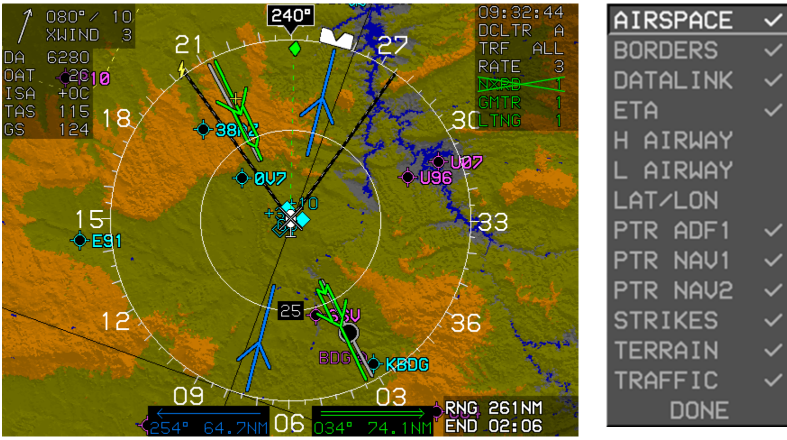


Figure 4-81: MFD TERRAIN Option

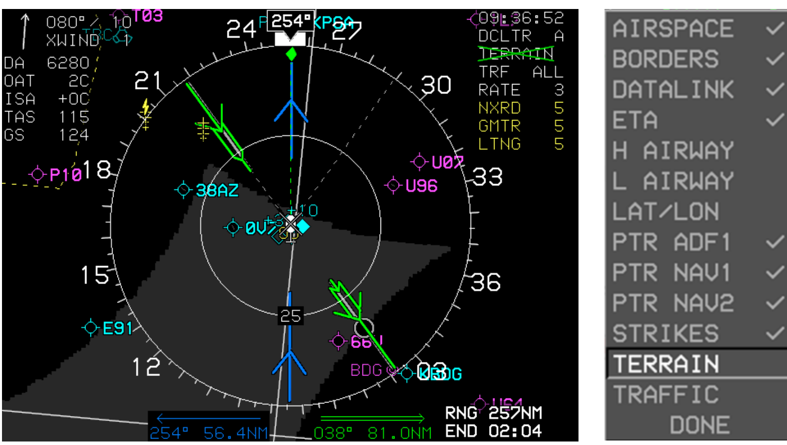
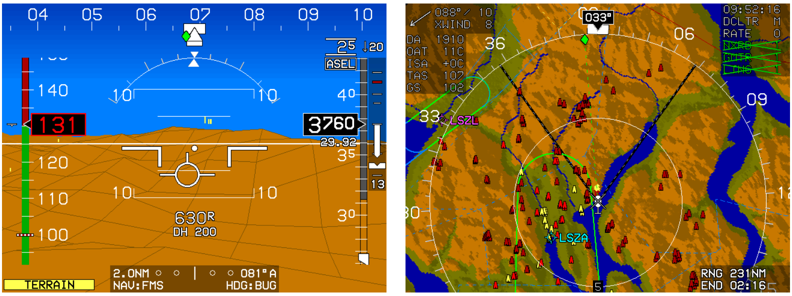
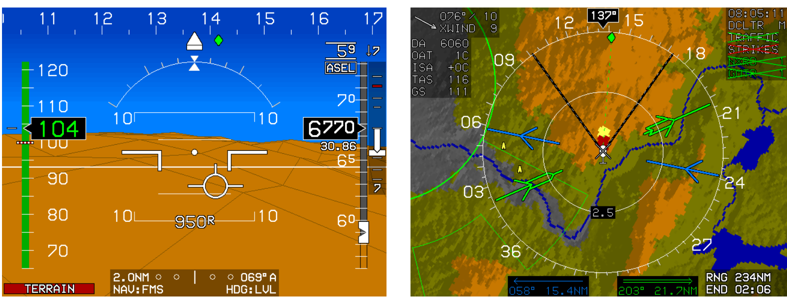


Figure 4-82: MFD No TERRAIN Option



TAWS FLTA Caution Terrain: Amber (Yellow)

Figure 4-83: PFD and MFD TERRAIN Caution



TAWS FLTA Caution Warning: Red

Figure 4-84: PFD and MFD TERRAIN Warning

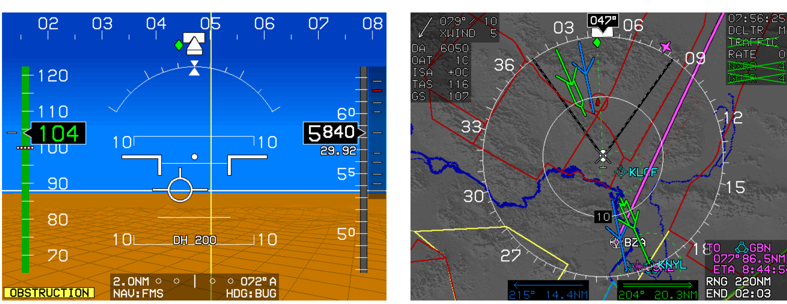


Figure 4-85: PFD and MFD Obstruction Caution

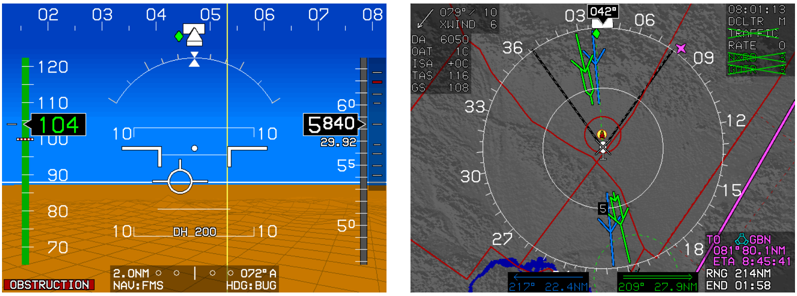


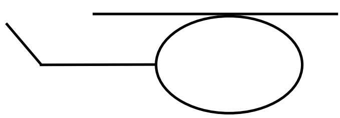
Figure 4-86: PFD and MFD Obstruction Warning

4.31.1. Ownship Symbol

The ownship symbol is displayed on the weather radar page as follows:

1) Horizontal depiction as specified above;

2) Profile Depiction:



Rotorcraft

Figure 4-87: Ownship Symbol

4.31.2. Weather Screen Format

In a horizontal depiction, the weather screen uses an arced format with the ownship symbol centered in the bottom of the display with the weather area depicted as an arc ahead of the ownship symbol.

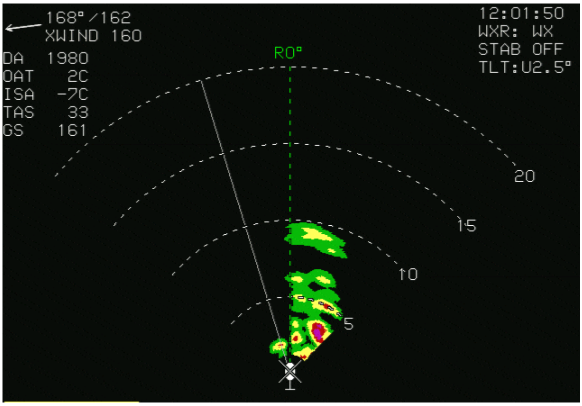


Figure 4-88: Weather Area Depicted as an Arc ahead of the Ownship Symbol

In a profile depiction (only available with RDR-2000 or RDR-2100 weather radar types), the weather screen uses an arced format with the ownship symbol centered on the left side of the display with the weather area depicted as an arc to the right of the ownship symbol.

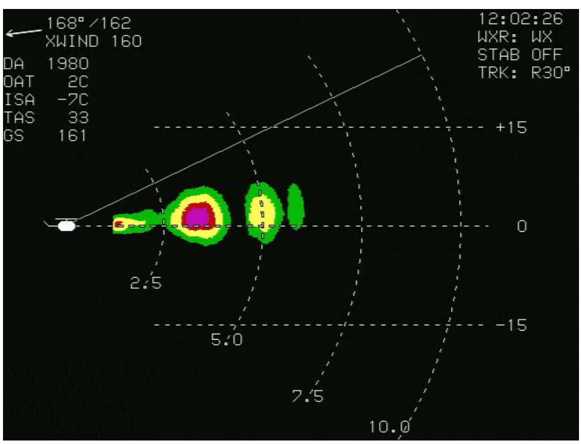


Figure 4-89: Profile Weather Depiction

Pilot selection of the profile depiction is performed using a separate Weather Radar Control Panel. The IDU ensures at least one weather radar-enabled screen is showing the weather radar page prior to entering into the profile depiction. The IDU also automatically disables profile depiction if the pilot sets up the screens so no weather radar page is shown on any weather radar-enabled screen. The purpose of this is to maximize the availability of weather radar information on the moving map. The moving map only shows a horizontal depiction. The IDU automatically disables profile depiction if the weather radar mode is set to off or standby via Radar Control Panel.

4.32. Weather Screen Range

Weather screen range is pilot-selectable. Selection is made through either ❶ (RDR-2000 and RDR-2100 weather radar types) or a control panel directly attached to the weather radar receiver-transmitter. Weather screen range is displayed as a series of equidistant dashed arcs centered upon the ownship symbol to help the pilot judge range to the displayed weather radar returns. For most screen ranges, there are four equidistant dashed arcs. When in 2.SNM range, there are five equidistant dashed arcs. Each arc is labeled with distance in nautical miles at its right-most point (horizontal depiction) or bottom-most point (profile depiction). In the profile depiction mode, there are also be three horizontal altitude lines drawn relative to the aircraft's altitude to help the pilot judge the vertical distance to the displayed weather radar returns. The center line is level with the ownship symbol to represent the aircraft's altitude. The other two lines is equally spaced above and below the center line to represent altitude differences above and below the aircraft. The number of feet above and below the aircraft varies with the selected range to compensate for the radar scan width at the different ranges.

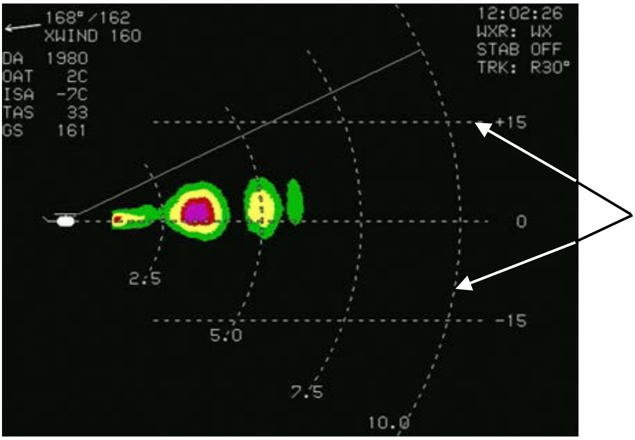


Figure 4-90: Weather Screen Range

Control of screen ranges is dependent on weather radar Installed. The RDR-2000 and RDR-2100 weather radar units internally control screen range from the ownship as follows:

1) SNM (RDR-2100 Only)

2) 10NM, 20NM, 40NM, 80NM, 160NM, 240NM, and 320NM (RDR-2100).

4.33. Track Line (RDR-2000/2100 Only)

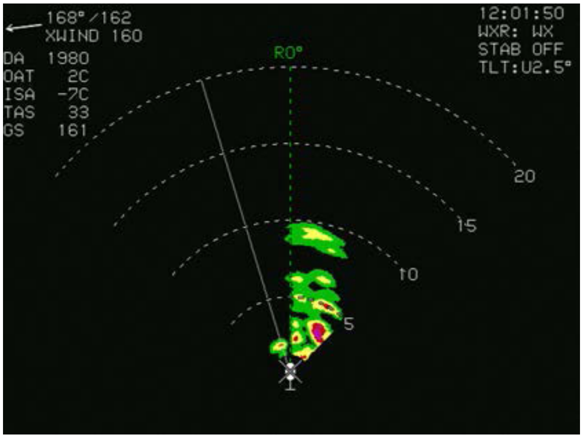


Figure 4-91: Track Line (RDR-2000/2100 Only)

When the weather radar type is RDR-2000 or RDR-2100 and the horizontal depiction is being shown, a dashed track line appears emanating from the ownship symbol to the outer dashed arc. The value of the track line in whole degrees left or right of aircraft heading is displayed adjacent to the outer end of the track line.

4.34. Active Flight Plan Path/Manual Course/Runways

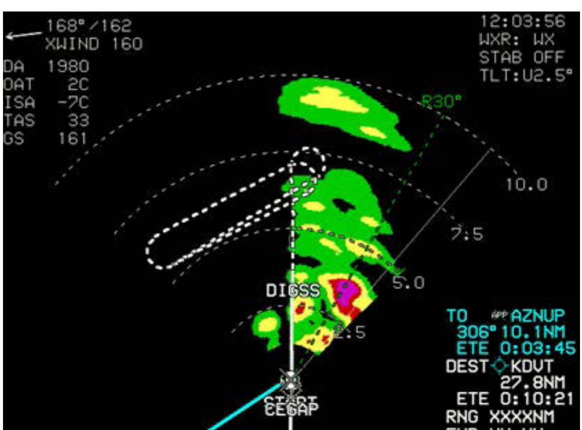


Figure 4-92: Active Flight Plan Path/Manual Course/Runways

The active flight plan path, waypoints, and manual course appear when the weather radar screen is showing horizontal depiction.

The weather radar screen displays airport runways when the weather radar screen is showing horizontal depiction.

Depicting the flight plan paths, manual course, and runways on the weather radar screen showing horizontal orientation is pilot-selectable.

4.35. Weather Radar Return Data

Weather radar return data is displayed on the weather radar screen in its correct relationship to the ownship symbol.

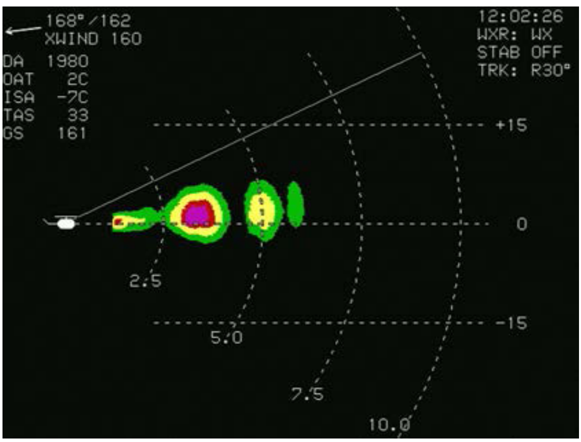


Figure 4-93: Weather Radar Return Data

NOTE:

See Section 5 Menu Functions and Step-By-Step Procedures Table 5-2 for Weather Radar Return Data.

Section 5 Menu Functions and Step-By-Step Procedures

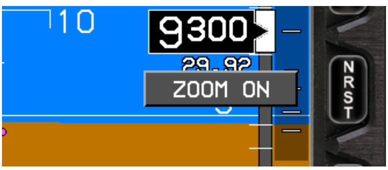
Table of Contents

List of Figures and Tables

5.1. Overview

Press any of the peripheral buttons to activate the function indicated by the button label. In this example of button functions, press the **MENU** button to display the menus on the screen.

Figure 5-1: Menu Button



If menu tiles are shown, press the button adjacent to the menu tile to activate the menu. In this example of menu functions, press the **NRST** button (ZOOM ON menu tile) to turn on the PFD zoom function.

Figure 5-2: PFD Zoom Function On

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

The right-hand encoder controls the menu when it appears in the lower right-hand corner of the screen. The encoder is numbered #1 from the right side as noted by ❶.

Figure 5-3: Right Encoder (❶)

Scroll the encoder to step through the menu (or alphanumeric characters), and the current selection is highlighted (as VOR BOI is above). When the desired selection is highlighted, push the encoder to enter the selection to activate a function or display another menu. When making alphanumeric entries, push the encoder to advance to the next character.

When within the menu structure, **EXIT** always appears in the upper right corner, and **BACK** appears in the upper left corner when appropriate, indicating a single step back to the prior menu position is possible. Use **EXIT** to completely leave the menu structure from any level, but this erases all recent entries. Use **BACK** to step back one level to correct a mistake or make a different selection.

Figure 5-4: EXIT and BACK Tiles

NOTE:

BARO bezel button is applicable to IDU-450 only and replaced with HDG bezel button on the IDU-III.

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.

5.2. Top-Level Menu

Use the peripheral buttons and ➊ to navigate the IDU menu functions. There are two types of menu functions, top-level menu functions, corresponding to the IDU labeled pushbuttons and soft menu functions annunciated by menu tiles on the screen. Functions associated with soft menu function tiles take precedence over functions associated with IDU pushbuttons.

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 pushbutton or in the lower right corner when use of the encoder is appropriate (e.g., selection lists and option lists). Selection lists 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 MENU 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 FPL to provide a method of regressing through the soft menu system by one level.

The top-level menu corresponds to the permanent labeling of the IDU-450 pushbuttons. Top-level menus are active any time no soft menu options appear on screen. The IDU menus are described in the following flow charts.

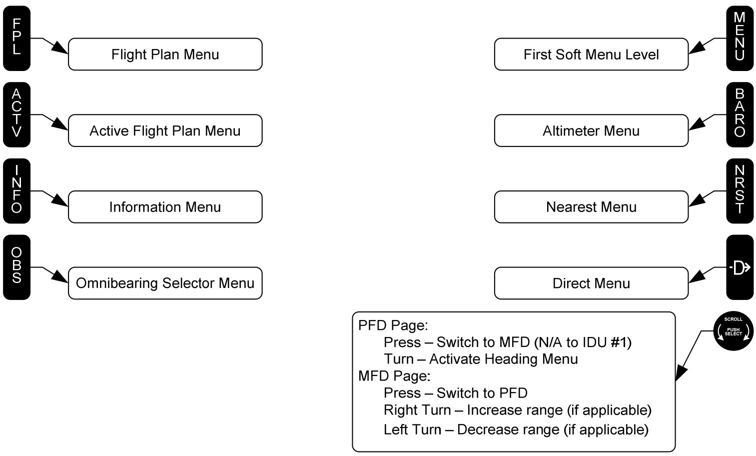


Figure 5-5: IDU-450 Flowchart, Top Level Menu

Top-level menu options are as follows:

1) **FPL (L1)**: Activates the flight plan menu option.

2) **ACTV (L2)**: Activates the active flight plan menu option.

3) **INFO (L3)**: Activates the information menu option.

4) **OBS (L4)**: Activates the omnibearing selector menu option.

5) **MENU (R1)**: 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) **BARO (R2)**: Activates the altimeter menu option.

7) **NRST (R3)**: Activates the nearest menu option.

8) **Direct** **(R4)**: Activates the direct menu option.

9) **Encoder** ❶: Function depends upon screen. On the IDU-450 PFD screen, scroll the encoder to activate the heading menu option. On most MFD screens, other than the HSI, navigation log or weather radar screens (e.g., ND, Strike, Traffic, Datalink, or Hover), scroll the encoder to change the display scale (clockwise Increase Scale, counterclockwise = Decrease Scale). The exceptions are:

   a) HSI screen (scale not applicable);

   b) Navigation Log screen (scale not applicable);

   c) Weather Radar screen when the weather radar type is ARINC 708-6, Collins 800/840, or Honeywell Primus. For these radar types, an external weather radar control panel controls display scale. For weather radar type Honeywell RDR-2000 or Honeywell RDR-2100, the IDU controls display scale.

Press ❶ to swap between the PFD and MFD (Only on IDUs 0, 2, 3, and 4).

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:

The top-level menu corresponds to the permanent labeling of the IDU-III pushbuttons. Top-level menus are active any time no soft menu options appear on screen.

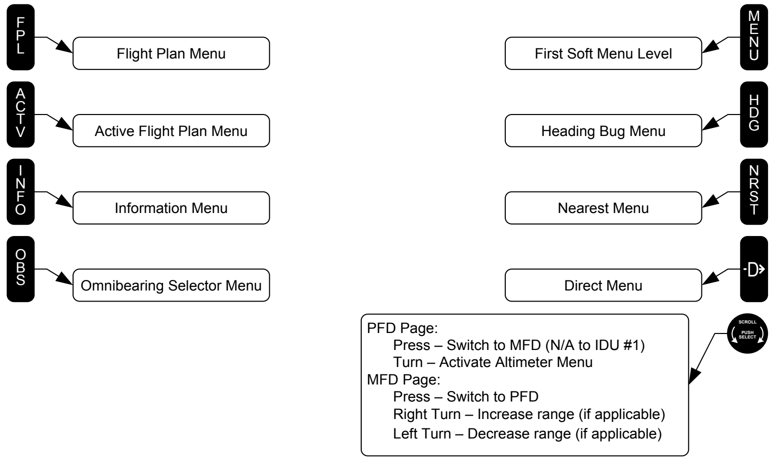


Figure 5-6: IDU-III Flowchart, Top-Level Menu

Top-level menu options are as follows:

1) **FPL (L1)**: Activates the flight plan menu option.

2) **ACTV (L2)**: Activates the active flight plan menu option.

3) **INFO (L3)**: Activates the Information menu option.

4) **OBS (L4)**: Activates the omnibearing selector menu option.

5) **MENU (R1)**: 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 (R2)**: Activates the heading bug set menu option.

7) **NRST (R3)**: Activates the nearest menu option.

8) **DIRECT**  **(R4)**: Activates the direct menu option.

5.3. Waypoint Information (NavData and DataLink Weather)

A large amount of information regarding each waypoint may be retrieved such as LAT/LON bearing/distance, elevation or altitude, nav and com frequencies, runway lengths, METARs, and TAFs.

This information may be accessed in a variety of ways: From the active route use **ACTV (L2)**, or for nearby waypoints press **NRST (R3)** then **INFO (L3)** or press **INFO (L3)** after startup for departure airport information.

5.3.1. Nearby Waypoints

1) Press **NRST**.

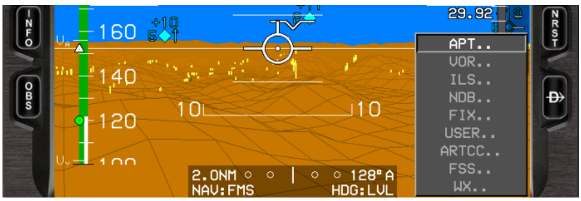


Figure 5-7: NRST Menu

2) Scroll ❶ to highlight Airport, VOR, ILS, NDB, fix, user waypoint, air traffic control center, or flight service station as desired then push to enter.

3) Scroll ❶ to highlight desired waypoint or facility and press **INFO (L3)**.

4) Scroll ❶ through the information.

5) Push ❶ or press **BACK (L1)** to return to the **ACTV** menu or press **EXIT (R1)** to clear the screen.

5.3.2. Far-Away Waypoints not in Active Route

1) Press **ACTV (L2)** and press **INSERT (R2)**.

2) Scroll ❶ to enter the alphanumeric identifier and press enter.

3) Scroll to the waypoint of interest and press **INFO (L3)**.

4) Scroll ❶ through the information.

5) Push ❶ or press **BACK (L1)** to return to the **ACTV** menu or press **EXIT (R1)** to clear the screen.

5.4. Waypoints within Active Route

1) Press **ACTV (L2)**.

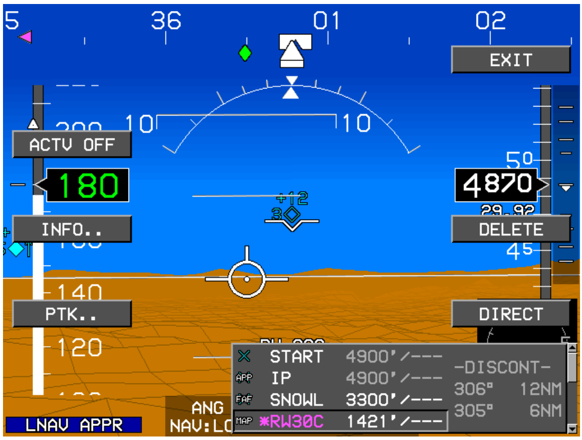


Figure 5-8: Waypoints within Active Route, ACTV Menu

2) Scroll ❶ to highlight the desired waypoint and press **INFO**.

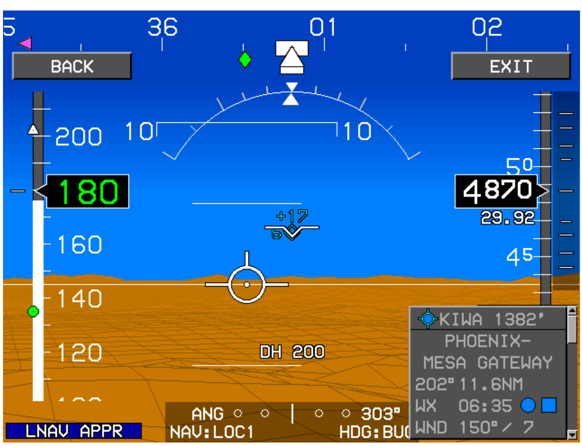


Figure 5-9: Waypoints within Active Route, INFO Menu

3) Scroll ➊ through the information. If a frequency is displayed in this step, it may be highlighted and sent to a radio. See § 5.41 for more information.

4) Push ➊ or press **BACK** to return to the **ACTV** menu or press **EXIT** to clear the screen.

Table 5-1: Top-Level Menu Automatic Function Descriptions Precedence, Tile Legend, and Action	
(FPL) (L1)	1) When a terrain popup occurs during a TAWS FLTA alert, **RESET** tile appears. 2) When showing the Datalink Page with Pan Mode enabled, **PN OFF** tile appears. Press to disable Pan Mode. The **RESET** tile has precedence over the **PN OFF** tile. 3) When showing ND Page with Pan Mode enabled, **PN OFF** tile appears. Press to disable Pan Mode. The **RESET** tile has precedence over the **PN OFF** tile. 4) When the display is “transmit enabled”, **LNAV** tile appears. When there is an active flight plan, heading bug sub-mode is active, and the system is integrated with an analog autopilot. Press **LNAV** tile to deactivate heading bug sub-mode and resume guidance to the active flight plan path. The **RESET** and **PN OFF** tiles have precedence over the **LNAV** tile. 5) When the display is “transmit enabled”, **MISS** tile appears upon transitioning the Final Approach Fix. Press to activate the missed approach procedure. The **RESET**, **PN OFF**, and **LNAV** tiles have precedence over the **MISS** tile. 6) When the display is “transmit enabled”, **CONT** tile appears when in a holding pattern with further active flight plan legs after the holding pattern. Press to re-enable automatic waypoint sequencing to allow normal sequencing to the leg after the holding pattern. The **RESET**, **PN**

Table 5-1: Top-Level Menu Automatic Function Descriptions Precedence, Tile Legend, and Action	
	OFF, **LNAV**, and **MISS** tiles have precedence over the **CONT** tile.
(**ACTV**) **(L2)**	1) When showing Datalink Page with Winds and Temperatures Aloft enabled, **UP** tile appears. Press to increase the Winds and Temperatures Aloft grid. Does not appear when the highest grid level is being displayed. 2) When showing Video Input Page with pan mode enabled, **UP** tile appears. Press to move up the section of the video image displayed in the full video image. 3) When showing Datalink Page with: (a) pan mode enabled; (b) information for the nearest highlighted waypoint being shown; and (c) airport weather information present in the information block; **WX** tile appears to allow the display of textual METAR and TAF data for the airport. The **UP** tile has precedence over the **WX** tile. 4) When showing ND Page with: (a) pan mode enabled; (b) information for the nearest highlighted waypoint being shown; and (c) airport weather information present in the information block; **WX** tile appears to allow the display of textual METAR and TAF data for the airport. 5) When the display is “transmit enabled”, **VNAV** tile appears when VNAV guidance is valid, the selected altitude sub-mode is active, and the system is integrated with an analog autopilot or HeliSAS-E. Press to deactivate the selected altitude sub-mode and resume guidance to the VNAV path. The **UP** and **WX** tiles have precedence over the **VNAV** tile. When the display is “transmit enabled”, **ARM** tile appears when on the Final Approach Segment (between

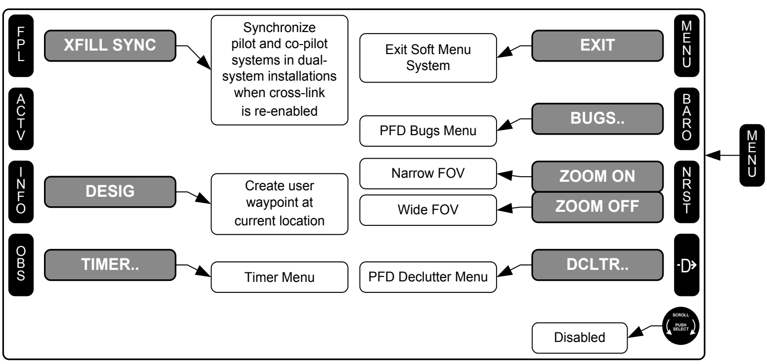
Table 5-1: Top-Level Menu Automatic Function Descriptions Precedence, Tile Legend, and Action	
	the Final Approach Fix and Missed Approach Point). Press to arm the missed approach procedure to automatically activate upon sequencing the Missed Approach Point. The **UP**, **WX**, and **VNAV** tiles have precedence over the **ARM** tile.
INFO (L3)	1) When showing Datalink Page with Pan Mode enabled, **NORTH** tile appears. Press to shift the center of the Pan Mode Datalink Page in the specified direction. 2) When showing ND Page with Pan Mode enabled, **NORTH** tile appears. Press to shift the center of the Pan Mode ND Page in the specified direction. 3) When showing Video Input Page with pan mode enabled, **DOWN** tile appears. Press to move down the section of the video image displayed in the full video image.
(OBS) (L4)	1) When showing Datalink Page with Pan Mode enabled, **SOUTH** tile appears. Press to shift the center of the Pan Mode Datalink Page in the specified direction. 2) When showing ND Page with Pan Mode enabled, **SOUTH** tile appears. Press to shift the center of the Pan Mode ND Page in the specified direction.

Table 5-1: Top-Level Menu Automatic Function Descriptions Precedence, Tile Legend, and Action

(BARO) (R2) (IDU-450) **(HDG) (R2) (IDU-III)**	1) When showing Datalink Page with Winds and Temperatures Aloft enabled, **DOWN** tile appears. Press to decrease the Winds and Temperatures Aloft grid level. Not shown when the lowest grid level is being displayed. 2) When showing Video Input Page with pan mode enabled, **LEFT** tile appears. Press to move left the section of the video image displayed in the full video image. 3) When showing Datalink Page with Pan Mode enabled, **INFO** or **HIDE** tile appears. Press to toggle the display of information for the nearest highlighted waypoint. Refer to the **INFO** Menu requirements for the amount and type of information presented. The **DOWN** tile has precedence over the **INFO**/**HIDE** tile. 4) When showing ND Page with Pan Mode enabled, **INFO** or **HIDE** tile appears. Press to toggle the display of information for the nearest highlighted waypoint.
(**NRST**) **(R3)**	1) When showing Datalink Page with Pan Mode enabled, **EAST** tile appears. Press to shift the center of the Pan Mode Datalink Page to shift in the specified direction. 2) When showing ND Page with Pan Mode enabled, **EAST** tile appears. Press to shift the center of the Pan Mode ND Page in the specified direction. 3) When showing Video Input Page with pan mode enabled, **RIGHT** tile appears. Press to move right the section of the video image displayed in the full video image.

Table 5-1: Top-Level Menu Automatic Function Descriptions Precedence, Tile Legend, and Action	
(Direct-To Symbol)  **(R4)**	1) When showing Datalink Page with Pan Mode enabled, **WEST** tile appears. Press to shift the center of the Pan Mode Datalink Page in the specified direction. 2) When showing ND Page with Pan Mode enabled, **WEST** tile appears. Press to shift the center of the Pan Mode ND Page in the specified direction.

5.5. PFD Screen First Soft Menu Level



* BARO bezel button is applicable to IDU-IV only. It is replaced with HDG bezel button on IDU-III.

Figure 5-10: Flowchart, PFD Screen First Soft Menu Level

PFD screen first soft menu level options are as follows:

1) **XFILL SYNC (L1)**: appears in dual-system installations where the pilot and co-pilot systems are not synchronized but crosslink is enabled. Press to synchronize the pilot and co-pilot active flight plan parameters to the system where the button press occurred.

2) **DESIG (L3)**: 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 (L4)**: Activates the timer menu option.

4) **BUGS (R2)**: Activates the PFD bug set menu option.

5) **ZOOM ON/ZOOM OFF (R3)**: 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 (R4)**: Activates the PFD declutter menu option.

NOTE:

Manual declutter settings are 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 inhibits 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 XFILL INHBT advisory is displayed. After confirming data such as range, distance, and ETE in a proposed flight plan, the pilot may restore the external switch and crosslink the data to the second system. The new plan may be activated and flown as desired. A XFILL ARM advisory indicates the Crossfill synchronization function is available. To synchronize systems, press **MENU (R1)** on the PFD and press **XFILL SYNC (L1)**.

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

5.6. Timer Functions-Count Up

1) Press **MENU (R1)**.

2) Select **TIMER.. (L4).**

3) Scroll ❶ to highlight **COUNT UP** and push to enter.

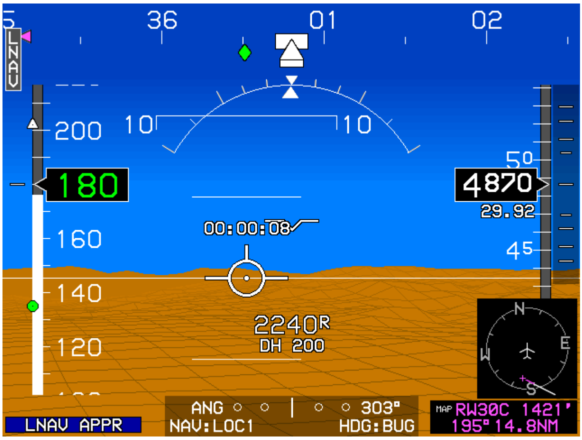


Figure 5-11: Count-Up Timer

A count-up timer is centered above the flight plan marker on the PFD and below the Zulu clock on the moving map.

5.7. Count Down

1) Press **MENU (R1).**

2) Select **TIMER.. (L4).**

3) Scroll ❶ to highlight **COUNT DN** and push to enter.

Figure 5-12: Count-Down Timer

4) Scroll ❶ to enter the desired time period by increment or decrement seconds (press **BACK (L1)** at any point to backup). Press +5 MIN **(R2)** or-5 MIN **(R3)** to quickly add or subtract time in five-minute increments.

Press **STORE (R4)** to store the count-down time for later use. Once stored, this value is the default for the countdown timer.

A count-down timer is centered above the flight path marker on the PFD and below the Zulu clock on the moving map.

5.8. Flight Timer

1) Press **MENU (R1)**.

2) Select **TIMER.. (L4).**

3) Scroll ❶ to highlight **FLT TIME** and push to enter.

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

5.9. Turn Off the Count-Up and Countdown Timers Only

1) Press **MENU (R1)**.

2) Choose **TIMER.. (L4).**

3) Press **OFF (R4)**.

Figure 5-13: Turn Off Count-Up/Countdown Timers Only

If the pilot selects the countdown timer, the pilot is prompted to enter a start time from which the countdown begins. Shortcuts to quickly add or decrement by five minute increments are provided at this level. After entering a start time, the pilot is able to either start the countdown timer or select **STORE** 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 button 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.

5.10. Declutter the PFD

1) Press **MENU (R1)**.

2) Press **DCLTR.. (R4)** to display a menu containing Bank Scale, Basic Display, Mini Map, Mini Traffic, Skyway, Terrain, Traffic, HSI, FD, and Meters.

Figure 5-14: Declutter Menu

3) Scroll ❶ to highlight elements and push to enable or disable. A check mark indicates enabled. Select **DONE** and push to enter when finished. Declutter settings is saved upon system shutdown.

5.10.1. Bank SCL

When bank angle scale decluttering is selected, a bank angle scale and roll pointer is displayed when the magnitude of bank angle exceeds 2.8°. With decluttering selected, appearance of the bank angle scale and roll pointer is dampened based upon magnitude and time to prevent nuisance appearances. When decluttering is not selected, the bank angle scale and roll pointer appear full time. The bank angle scale and roll pointer is centered upon the waterline (airplanes-normal mode) or Large Aircraft Symbol Reference Marks (Basic Mode or Unusual Attitude Mode).

5.11. Basic

The PFD has a Basic Mode, which is enabled through a menu selection. Basic Mode uses a traditional attitude display with the airspeed, altitude, and heading scales appearing in blacked-out areas in a “Basic-T” arrangement. Basic Mode is disabled while Unusual Attitude Mode is active.

5.12. Mini Map

A miniature-moving map (mini-map) is displayed in the lower right comer of the PFD above the active waypoint identifier. The mini-map has a compass rose and displays the active navigation route in magenta (amber [yellow] in the event of GPS Loss of Navigation) and active waypoint. VOR pointers are displayed (when a valid signal is received) on the miniature-moving map corresponding to selected Navigational Source. The VOR1 pointer is blue. The VOR2 pointer is green. The mini-map disappears in Unusual Attitude Mode and is mutually exclusive with the traffic thumbnail.

5.13. Mini TRFC

A traffic thumbnail is displayed in the lower right corner of the PFD above the active waypoint identifier, has clock face markings and is normally fixed at 6 NM scale. In the event of a traffic warning (TA or RA), the traffic thumbnail is automatically enabled while the traffic warning is active, and the traffic thumbnail scale automatically adjusts, in multiples of 2 NM (2NM, 4NM or 6NM), to optimally display the traffic. The traffic thumbnail disappears in Unusual Attitude Mode. Display of the mini-map and the traffic thumbnail is mutually exclusive with the traffic thumbnail taking precedence during a traffic warning (TA or RA). The traffic thumbnail uses standard traffic symbols.

5.14. Skyway

The PFD displays the active navigation route or manual OBS course in a three-dimensional manner using a series of skyway boxes. The skyway boxes is a series of perspective objects overlying the flight plan route at a desired altitude providing lateral and vertical guidance.

5.15. Terrain

The PFD displays the terrain if not removed by selecting the declutter function. If decluttered, the terrain is also removed from the MFD.

5.16. HSI

The PFD has pilot selectable HSI, Marker Beacon, and Flight Director symbology. It is possible to show HSI symbology, Flight Director symbology, or neither symbology. It is possible to show HSI symbology and Flight Director symbology simultaneously.

5.17. FD

Flight Director symbology is pilot-selectable. It is possible to show HSI symbology, Flight Director symbology, or neither symbology. It is not possible to show HSI symbology and Flight Director symbology simultaneously.

Flight Director symbology is defined as:

1) Roll Datum Bug
2) Pitch Datum Bug
3) Flight Director Bar (Roll)
4) Flight Director Bar (Pitch)

When Flight Director symbology is selected and valid steering commands are received from the flight director, pitch and roll steering command bars are centered upon the Flight Path Marker (normal mode in airplanes) or large Aircraft Symbol Reference Marks (rotorcraft, Basic Mode or Unusual Attitude Mode) is shown. In Basic Mode, either dual cue or single cue is selectable. Large Aircraft Symbol Reference Marks and steering commands are shown as selected by the pilot.

HSI, marker beacon, and flight director symbology disappear in Unusual Attitude Mode.

5.18. Meters

Altitude values may be presented in metric units with a resolution of 10 meters. Likewise, the metric display of the target altitude bug setting has a resolution of 10 meters. The metric display of barometric altitude and target altitude bug setting appears above the normal values and be colored white followed by a white “M”. The metric display of barometric altitude and target altitude bug setting is pilot-selectable allowing the pilot to declutter the display.

5.19. Zoom the PFD

The PFD may be set to two different fields-of-view: 35° and 70°. The wide 70° field-of-view (FOV) is the default and resembles a wide-angle lens on a camera. Since aircraft operate primarily in the lateral plane, this FOV is most useful.

However, to see terrain displayed so it closely resembles what is seen out the window, select the zoom (narrow) (35° FOV). This magnified view more closely matches the human eye and gives a very realistic depiction of terrain, but since the heading and pitch scales are magnified as well, the display is very sensitive to every movement of the aircraft.

To set the zoom mode:

1) Press **MENU (R1)**.

2) Press **ZOOM ON (R3)** or **ZOOM OFF (R3)**.

NOTE:

FOV is indicated on the moving map, by two dashed lines formed as a "pie" shape extending forward from the aircraft. Only objects within the pie shape on the moving map appear on the PFD.

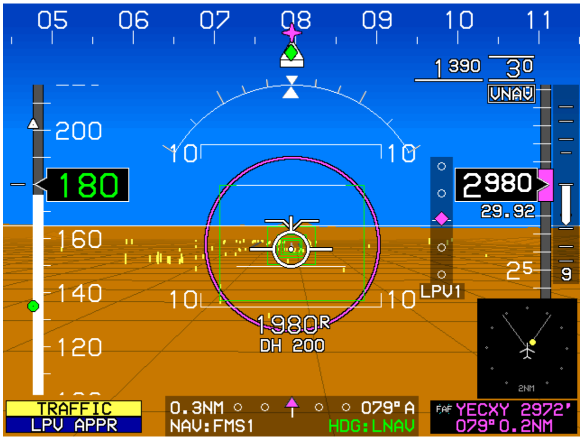


Figure 5-15: Zoom OFF (70° FOV)

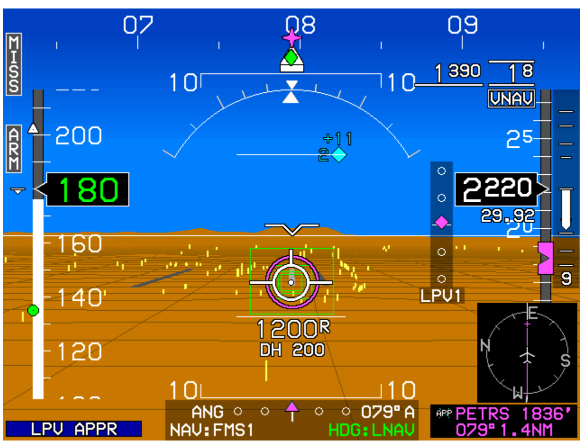
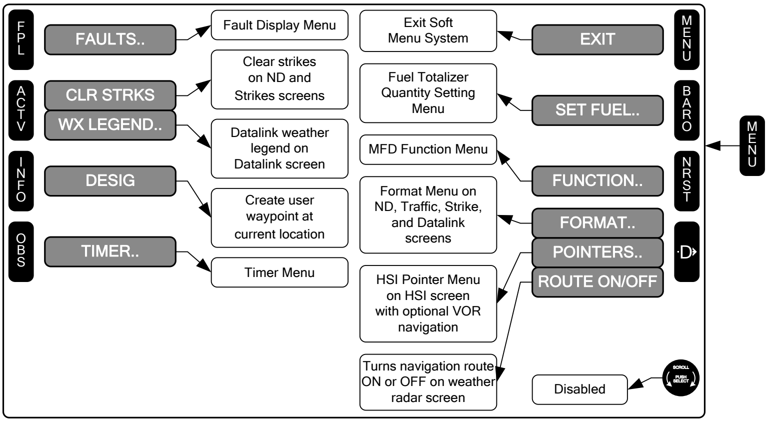


Figure 5-16: Zoom ON (35° FOV)

5.20. MFD Screen First Soft Menu Level



* BARO bezel button is applicable to IDU-IV only. It is replaced with HDG bezel button on IDU-III.

Figure 5-17: Flowchart, MFD Screen First Soft Menu Level

MFD screen first soft menu level options are as follows:

1) **FAULTS (L1)**: Activates the fault display menu option.
2) **CLR STRKS or WX LGND (L2)**: On ND screen or Strike screen with WX-500 option enabled, **CLR STRKS** activates the strike clear option for the Goodrich/L-3 WX-500. On Datalink screen, **WX LGND** activates the datalink weather legend.
3) **DESIG (L3)**: Same function as PFD Screen First Soft Menu Level.
4) **TIMER (L4)**: Same function as PFD Screen First Soft Menu Level.
5) **SET FUEL (R2)**: Activates the fuel totalizer set menu option.
6) **FUNCTION (R3)**: Activates the MFD display screen select menu option.
7) **FORMAT**, **POINTERS** or **ROUTE ON/ROUTE OFF (R4)**: On the ND, Traffic, Strike, and Datalink screens **FORMAT** activates the appropriate screen format menu option. On HSI screen with optional VOR or ADF symbology enabled, **POINTERS** activate HSI RMI pointer menu option. On the

Weather Radar screen, **ROUTE ON/OFF** toggles the display of the active flight plan on the horizontal weather radar display. **ROUTE ON** appears when the display of the active flight plan is disabled. **ROUTE OFF** appears when the display of the active flight plan is enabled.

5.21. Flight Plan (FPL) Menu

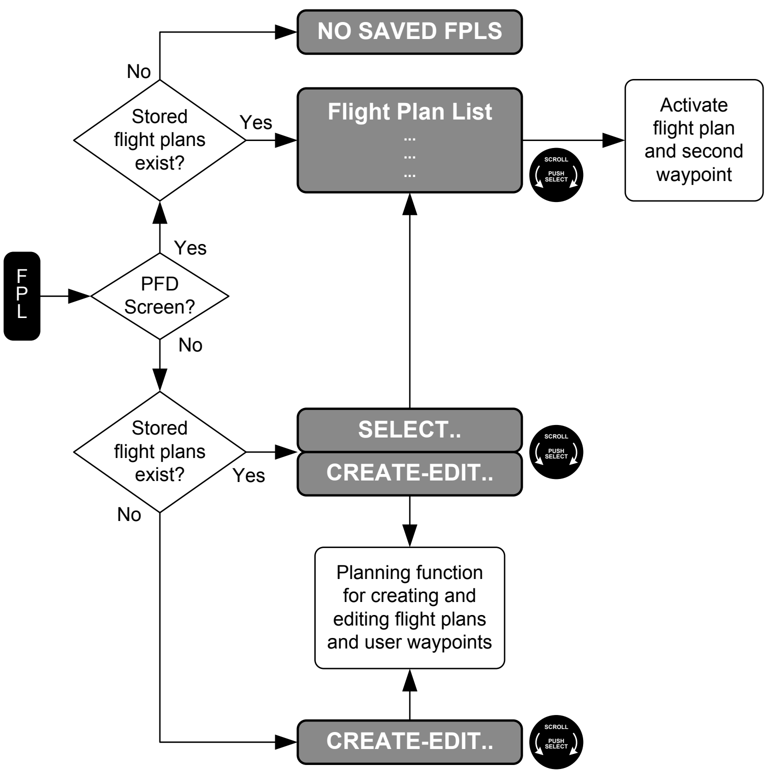


Figure 5-18: Flowchart, Flight Plan (FPL) Menu

NOTE:

RAIM Predictions are found in the **Create-Edit..** menu.

5.21.1. PFD Screen

Upon activation of the flight plan menu, the application checks 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.

5.21.2. MFD Screen

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 and 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.

5.22. Activate a Stored Flight Plan-PFD and MFD

1) Press **FPL (L1)**. **SELECT** is highlighted. Push ➊ to display a list of flight plans stored in the EFIS.

2) Scroll ➊ through the flight plans. When the desired flight plan is highlighted, push ➊ to select it as the active flight plan.

Figure 5-19: Activate a Stored Flight Plan-PFD and MFD

NOTE:

NO SAVED FPLS is displayed if no flight plans have been created and stored.

5.23. Edit a Stored Flight Plan-MFD Only

1) Press **FPL (L1)**.
2) Scroll ❶ to highlight **CREATE-EDIT..** and push to enter.
3) Scroll ❶ to highlight **EDIT FLIGHT PLAN** and push to enter.

Figure 5-20: Edit Flight Plan

4) Scroll ❶ to highlight the desired flight plan to edit and push to enter.

Figure 5-21: Highlighted Flight Plan

5) Scroll ➊ to highlight the desired to edit and push to enter.

6) Select **INSERT..** to add a new waypoint before the highlighted waypoint. Scroll ➊ to change the highlighted waypoints or select **DELETE** to delete the highlighted waypoint.

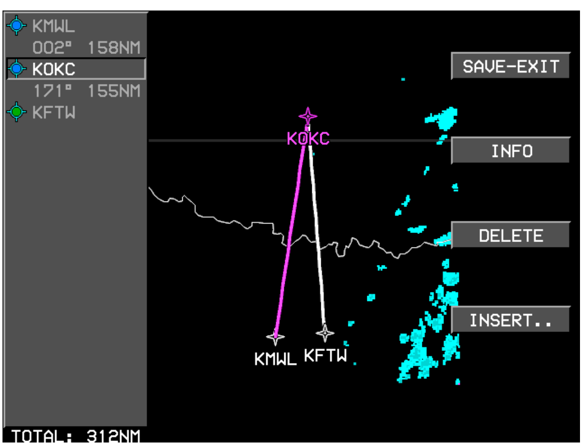


Figure 5-22: Add a New Waypoint

7) Select **INFO (L3)** to display additional information about the highlighted waypoint.

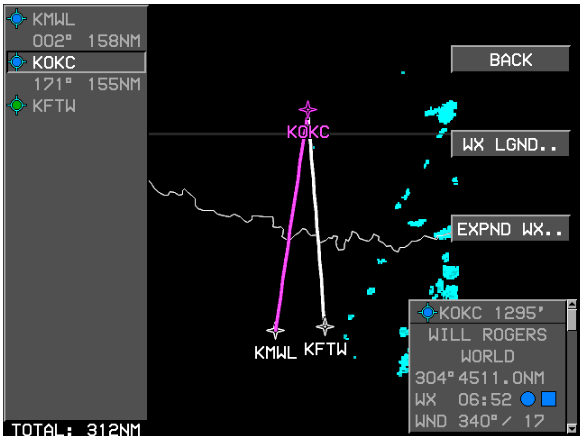


Figure 5-23: Info about Highlighted Waypoint

8) Scroll ❶ to the end and press **ADD.. (R4)** to add waypoints to the end of the route.

9) Press **BACK (L1)** to return to **EDIT** page.

10) Press **SAVE-EXIT (R1)** to save and return to previous screen.

5.24. Reverse a Stored Flight Plan-MFD Only

1) Press **FPL (L1)**.

2) Scroll ❶ to highlight **CREATE-EDIT..** and push to enter.

3) Scroll ❶ to highlight **REVERSE FLIGHT PLAN** and push to enter.

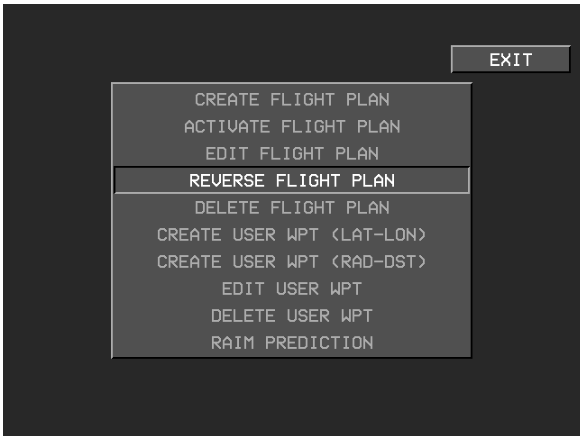


Figure 5-24: Reverse Flight Plan

4) Scroll ❶ to highlight the flight plan to be reversed and push to enter. Reversed flight plan is added to flight plan list and may be selected for active use in the normal manner.

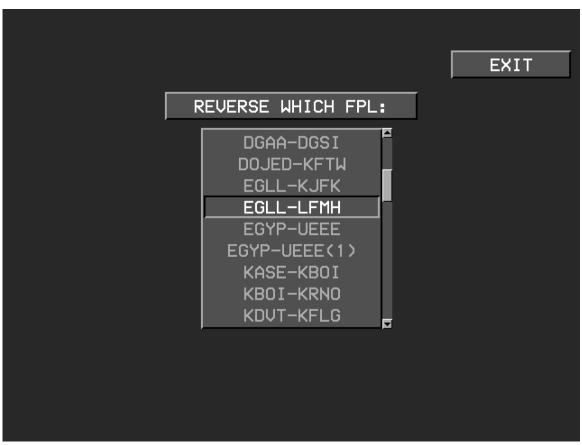


Figure 5-25: Selecting Reversed Flight Plan

5) Press **BACK (L1)** to return to previous screen.

5.25. Delete a Stored Flight Plan-MFD Only

1) Press **FPL (L1)**.

2) Scroll ❶ to highlight **CREATE-EDIT..** and push to enter.

3) Scroll ❶ to highlight **DELETE FLIGHT PLAN** and push to enter.

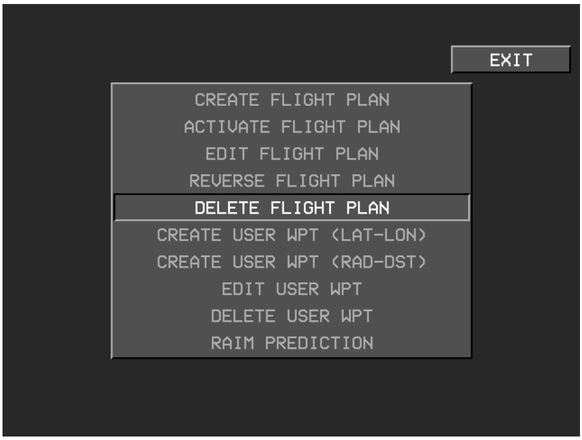


Figure 5-26: Delete Flight Plan

4) Scroll ❶ to highlight the flight plan to be deleted and push to enter. The pilot is asked for confirmation to delete the highlighted flight plan. Push enter to confirm or press **BACK** to return to the previous menu.

5) Press **BACK (L1)** to return to previous screen.

5.26. Create a User Waypoint

Waypoints may be created in three ways:

1) Latitude and Longitude

2) Radial and Distance

3) Overfly (Designate)

5.26.1. Create a User Waypoint using Latitude and Longitude-MFD Only

1) Press **FPL (L1)**.

2) Scroll ❶ to highlight **CREATE-EDIT..** and push to enter.

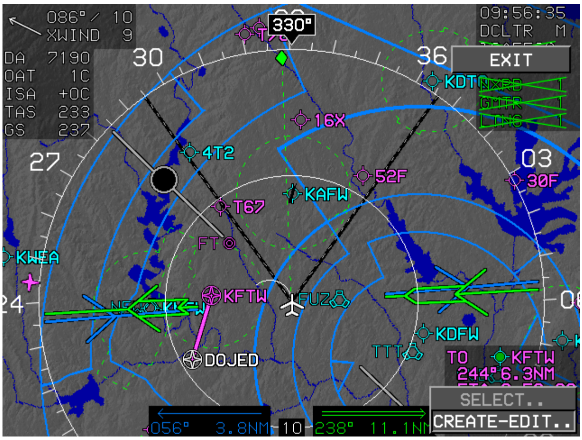


Figure 5-27: Create a User Waypoint Using Latitude and Longitude-MFD Only

3) Scroll ❶ to highlight **CREATE USER WPT (LAT-LON)** in the Function Select screen and push to enter.

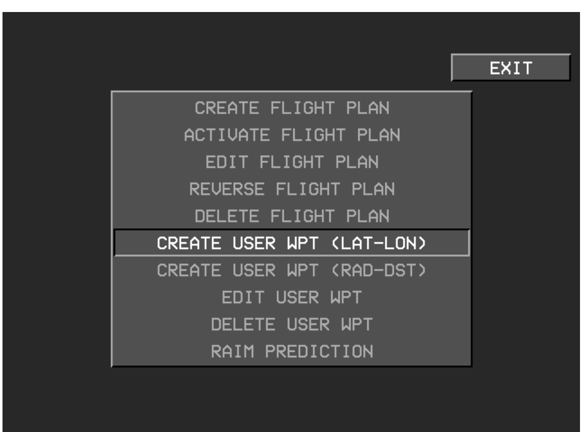


Figure 5-28: Create User WPT (LAT-LON)

4) Scroll ❶ to enter alphanumeric characters and follow on-screen prompts to edit information.

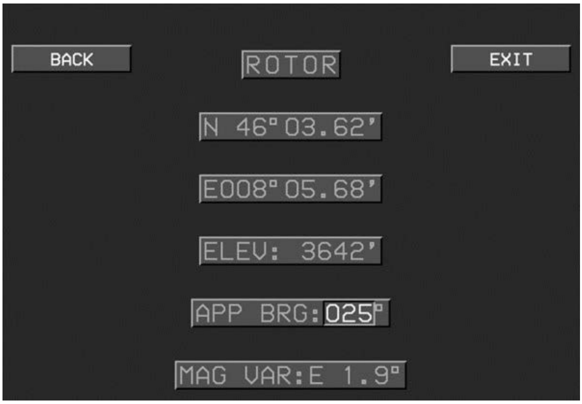


Figure 5-29: Entering Alphanumeric Characters

CREATE USER WPT (LAT-LON): When selected, activates a latitude-longitude user waypoint editing screen so a new user waypoint may be created. The user waypoint editing screen is preloaded with current aircraft parameters. Preloading of the approach bearing parameter is dependent upon mode of flight as follows:

ON GROUND: Preload with current heading;

IN FLIGHT: Preload with OFF value.

1) **Identifier**: Top line allows the pilot to specify a five character identifier for the waypoint.

2) **Latitude**: Second line allows the pilot to specify latitude for the waypoint in increments of hundredths of minutes.

3) **Longitude**: Third line allows the pilot to specify a longitude for the waypoint in increments of hundredths of minutes.

4) **Elevation**: Fourth tine allows the pilot to specify an elevation for the waypoint in feet (this value may be used for VFR approaches.

5) **Approach Bearing**: The fifth line allows the pilot to specify an approach bearing to the user waypoint in degrees. Valid values

are 1°-360° and "OFF". A value of "OFF" disables VFR approaches to the user waypoint (this value may be used for defining user waypoint VFR approaches).

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

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

5.26.2. Create a User Waypoint using Radial and Distance-MFD Only

1) Press **FPL (L1)**.

2) Scroll ❶ to highlight **CREATE-EDIT..** and push to enter.

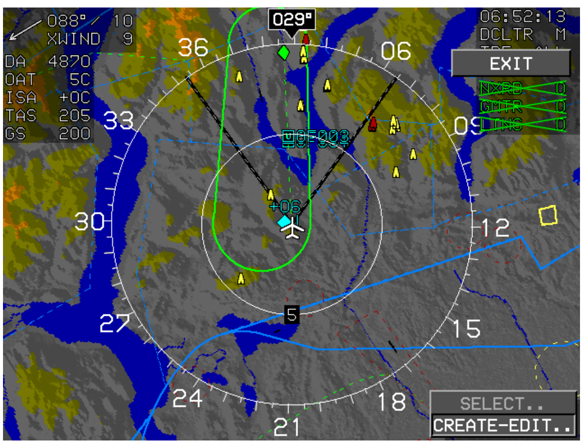


Figure 5-30: Create a User Waypoint using Radial and Distance-MFD Only

3) Scroll ❶ to highlight **CREATE USER WPT (RAD-DST)** and push to enter.

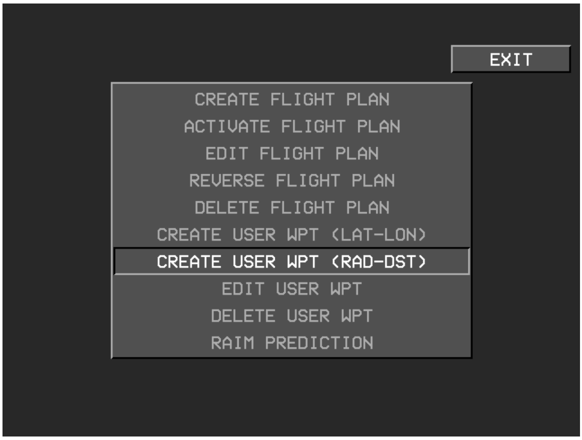


Figure 5-31: Create User WPT (RAD-DST)

4) This displays the editing screen. Scroll ❶ to enter alphanumeric characters, follow on-screen prompts to edit information.

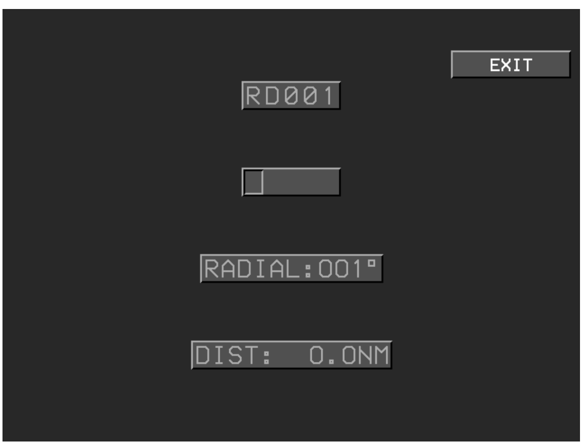


Figure 5-32: Radial-Distance User Waypoint Creation

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

The screen has various data entry boxes as follows:

1) **Identifier**: The first line annunciates the automatic name applied to the new user waypoint new user waypoint is automatically named “RO###”, where ### is the next available radial-distance waypoint number.

2) **Reference Waypoint**: The second line is prompted to enter an identifier for the reference waypoint. The reference waypoint is entered in the same manner as a waypoint is entered for a flight plan using the encoder. If there is a single result from the search, the pilot is advanced to the radial entry box. 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 displayed, and upon selection, the pilot is advanced to the radial entry box. An INFO menu giving access to information for the highlighted result appears at this level to aid in selection.

3) **Radial Entry**: The third line allows the pilot to specify a radial from the reference waypoint in increments of degrees.

4) **Distance Entry**: The fourth line allows the pilot to specify a distance from the reference in increments of tenths of nautical miles.

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

5.26.3. Create an Overfly User Waypoint

When flying over the intended waypoint, press **MENU (R1)** then **DESIG (L3)**.

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

Use the **EDIT USER WPT** function to change the waypoint name, see § 5.27.

NOTE:

A maximum of 500 user waypoints may be created and stored.

5.27. Edit a User Waypoint-MFD Only

1) Press **FPL (L1)**.

2) Scroll ➊ to highlight **CREATE-EDIT..** and push to enter.

3) Scroll ➊ to highlight **EDIT USER WPT..** and push to enter.

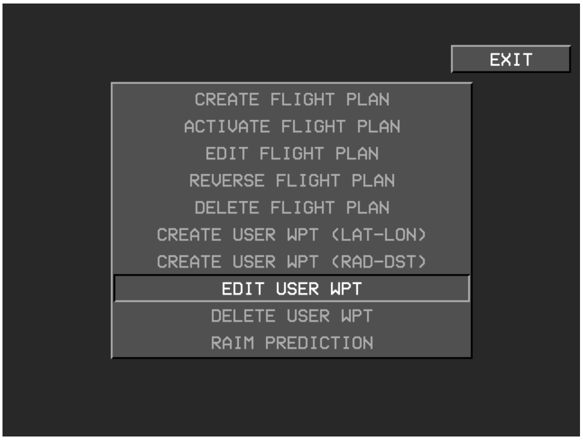


Figure 5-33: Edit a User Waypoint-MFD Only

4) Scroll ➊ to enter alphanumeric characters and follow on-screen prompts to edit information. Push ➊ to step through the characters. Press **BACK** to back-up.

5.27.1. VNAV

For ATC assigned crossing altitudes, the VNAV functions are available. To select a VNAV assignment, press **ACTV**. Scroll ➊ 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.

5.28. Delete a User Waypoint-MFD Only

1) Press **FPL (L1)**.

2) Scroll ➊ to highlight **CREATE-EDIT..** and push to enter.

3) Scroll ➊ to highlight **DELETE USER WPT..** and push to enter.

Figure 5-34: Delete a User Waypoint-MFD Only

4) Scroll ➊ to highlight user waypoint to be deleted and push to enter. The selected user waypoint is deleted from the system.

NOTE:

Pilot alterations of user waypoint parameters while in flight do not automatically update to an active flight plan.

When changes are made to a user waypoint, and those changes are desired in existing flight plans using 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 uses the user waypoint.

3) **Delete** the existing waypoint from the flight plan.

5) **Add** the edited user waypoint to the flight plan.

5) **Save** and Exit.

6) **Reload** the flight plan if it was in use.

5.29. RAIM Prediction

When selected, shows the RAIM Prediction screen. This only option is the GPS/SBAS receiver is capable of performing a RAIM

Prediction. This requires there be no faults along with a current almanac in memory. The FAULTS menu may be monitored to determine if the GPS/SBAS receiver is capable of performing a RAIM prediction.

Exit Menu: When selected, returns to the EAS.

Figure 5-35: Exit Menu

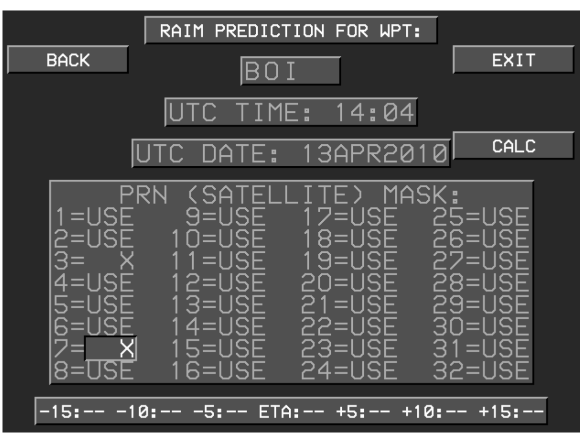


Figure 5-36: RAIM Prediction Screen

The RAIM Prediction screen allows the pilot to perform a RAIM Prediction at a designated waypoint. The screen has various data entry boxes as follows:

1) **Designated Waypoint**: The pilot is prompted to enter an identifier for the designated waypoint. If there is a single result from the search, the pilot is advanced to the UTC time entry box. 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 pilot is advanced to the UTC time entry box. An INFO tile giving access to information for the highlighted results appears at this level to aid in selection.

2) **UTC Time Entry**: Allows entry of the 24-hour UTC estimated time of arrival at the designated waypoint.

3) **UTC Date Entry**: Allows entry of the UTC estimated date of arrival at the designated waypoint.

4) **PRN Mask Entry**: Allows the pilot to specify the PRN number of satellites expected to be unavailable at the destination.

6) **EXIT**: Allows the pilot to exit the RAIM Prediction screen at any time.

7) Once a designated waypoint and UTC estimated time of arrival are entered, **CALC (R2)** appears to allow the pilot to initiate the RAIM Prediction. Press **CALC (R2)** to check the UTC estimated time of arrival is within the current almanac (i.e., < 3.5 days from current date and time). If it is a Predictive FDE Request message requesting **Detection Availability** with a required HAL of 0.3NM is sent to the GPS/SBAS receiver in response, the GPS/SBAS receiver replies with a sequence of Predictive FDE Response messages. These messages are parsed and used to fill in the RAIM Prediction result area at the bottom of the screen. The RAIM Prediction result area shows the RAIM Prediction results as **OK** or **XX** for ETA ±15 minutes in 5 minute increments. Once a prediction is complete, **RESTART (L1)** appears to allow the pilot to perform another prediction without having to exit the RAIM Prediction screen.

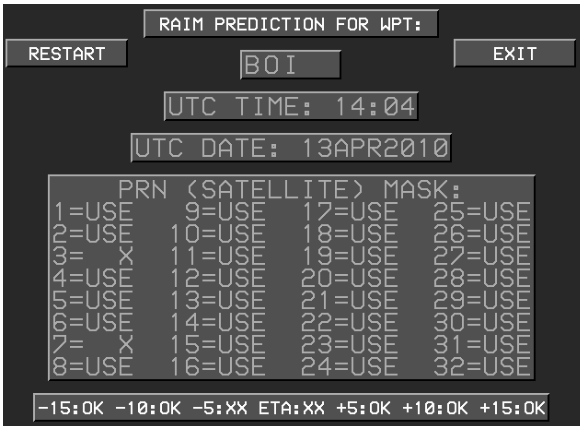


Figure 5-37: RAIM Prediction Result Area

5.30. Transfer Flight Plan 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, which is done using the Ground and Maintenance Utility.

1) With the power OFF, insert a USB Flash Memory Storage Device into the primary flight display's standard USB connector (IDU-450 or Smart media Card IDU-3)

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

Figure 5-38: Download Routes and User Waypoints

3) The application prompts the pilot to “**Press any button to continue**” when the download is complete. Press any button.

4) Once the display has returned to the Ground and Maintenance Functions Menu, power the system OFF and remove the Memory Storage Device.

5) With power OFF, insert the USB Flash Memory Storage Device for IDU-450 or the smart media card for the IDU-III into the primary flight display in the other aircraft.

6) Power the system ON and select the **UPLOADED ROUTES AND USER WAYPOINTS** option using ❶ (scroll and push to enter).

Figure 5-39: Upload Routes and User Waypoints

7) The application prompts the pilot to “**Press any button to continue**”. Press any button.

8) Once the display has returned to the Ground and Maintenance Functions Menu, power the system OFF and remove the USB Flash Memory Storage Device (IDU-450) or smart media card (IDU-III).

NOTE:

The system only recognizes the Memory Storage Device when the aircraft is on the ground. Saved route packs exported from Jeppesen FliteStar IFR may be uploaded as flight plans.

5.31. Active Flight Plan (ACTV) Main Menu

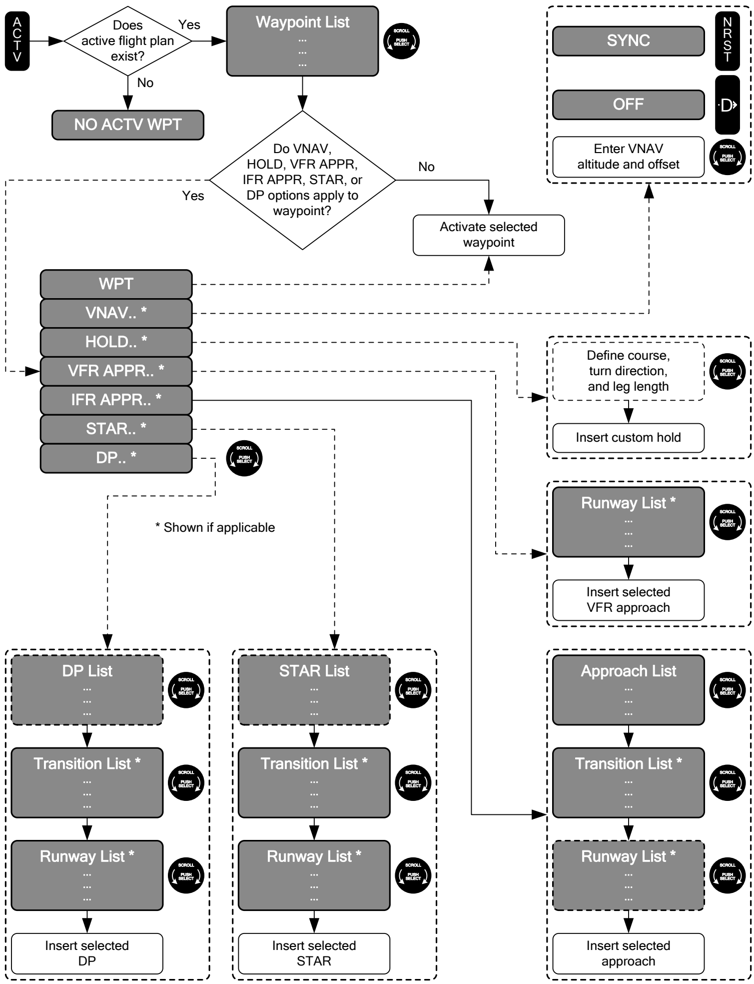


Figure 5-40: Flowchart, Active Flight Plan (ACTV) Main Menu

5.32. Flight Plans

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

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

Upon activation of the active flight plan menu, the application checks for the existence of an active waypoint. If there is no active flight plan, **NO ACTV WPT** advisory is issued. Otherwise, a selection list in the form of a jet log of waypoints in the active flight plan is presented. The jet 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. When courses are presented as part of the path information, they are displayed referenced to either magnetic or True North depending upon the status of the True North mode discrete input. If referenced to magnetic North, the course uses the degree (°) symbol. Otherwise, a stylized True North (^{T}) symbol is used. VNAV altitudes and offsets from the navigation database or have been manually entered are shown in white. VNAV and offsets altitudes automatically computed are shown in gray. The current active waypoint is designated by an asterisk and shown in magenta (amber [yellow] if GPS LON or no GPS condition exits). Brackets designate any suppressed waypoint.

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 jet log so it may be highlighted for information or to activate other procedures to the airport. Since there may only be one approach active at any given time, there may only be one suppressed waypoint at any given time.

The pilot may scroll through each waypoint of the active flight plan. Scroll one position past the end of the active flight plan to add 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, the pilot may 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 is settable in increments of 100 feet. VNAV offsets is settable in increments of 1NM.

3) **HOLD**: If 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, the pilot may 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 ten. 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, 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 a VFR airport or an IFR airport with surveyed runways, 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 to prevent S-turns. The heading bug may be used to define the course intercept angle.

5) **IFR APP**: If the selected waypoint is an airport with an IFR approach, this option is available. Upon selecting this option, the pilot is presented with a selection list of available approaches (including, if applicable, the five-digit channel number), followed by a selection list of available transitions (if there are more than

one), and a selection list of runways (if there are surveyed runways at the airport). After selection, the appropriate IFR approach is created and the airport waypoint is suppressed. Activating an IFR approach automatically deletes any pre-existing JFR or VFR approaches. If there is a pre-existing STAR to the airport, 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 to prevent S-turns. Use the heading bug to define the course intercept angle.

6) **STAR**: If the selected waypoint is an airport with a STAR, 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 (if there are surveyed runways at the airport). After selection, the appropriate STAR is created. Activating a STAR automatically deletes any pre-existing STAR. If there is a pre-existing approach (IFR or VFR) to the airport, the STAR waypoints is inserted prior to the approach waypoints.

7) **DP**: If the selected waypoint is an airport with a DP, 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 there are surveyed runways at the airport and more than one runway is authorized for the DP). After selection, the appropriate DP is created. Activating a DP automatically deletes any pre-existing DPs.

5.33. Create and Store a Flight Plan-MFD Only

1) Press **FPL (L1)**.

2) Scroll ❶ to highlight **CREATE-EDIT..** and push to enter.

3) **CREATE FLIGHT PLAN** is highlighted. Push to enter.

Figure 5-41: Create and Store a Flight Plan-MFD Only

4) The graphical flight planner is displayed. Press **ADD** and the way point entry boxes appears in the lower right comer of the display. Enter the first waypoint of the flight plan. Scroll ❶ 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 is not necessary but may save time by shortening the list of possible matches.

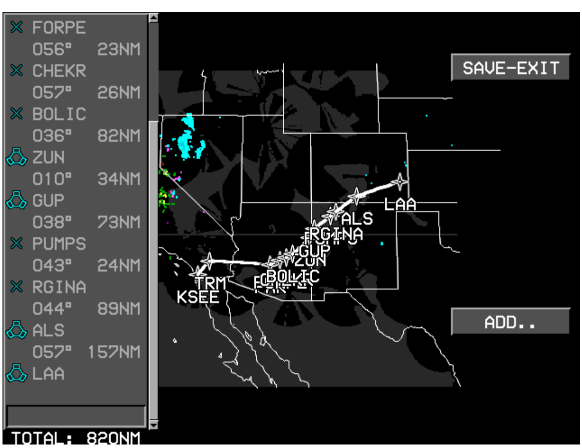


Figure 5-42: Graphical Flight Planner

5) Enter at least one character. Repeatedly push ➊ to advance through any remaining blank character spaces. A list of matching waypoints is displayed.

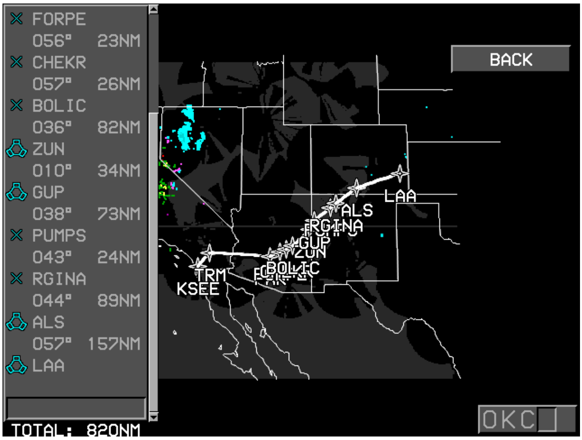


Figure 5-43: Entering Waypoint

6) Enter Victor Airways and Jet Routes by their identifier (J54, V254 etc.) or some portion thereof. When flight planning using airways or routes, the pilot is prompted for the FIX or VOR (which must be on the airway), from which the pilot is departing the airway.

7) If there is no exact match, scroll ➊ to select desired waypoint, and push to enter. An exact match is accepted and entered immediately. **INFO (L3)** may be used to obtain Jeppesen NavData information about waypoints as they are selected.

8) Repeat for all waypoints in route.

9) Press **BACK (L1)** at any point to go back one step during selection of alphanumeric characters.

10) Press **SAVE-EXIT (R1)** when finished to save and return to previous screen.

The flight plan is 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.

5.34. Activate a Waypoint within an Active Route

1) Press **ACTV (L2)**. A list of waypoints in the current flight plan is displayed; an asterisk indicates the active waypoint.

2) Scroll ❶ to highlight desired waypoint and push to enter.

Figure 5-44: Highlight Desired Waypoint

3) Scroll ❶ to highlight **WAYPOINT**, and push to enter. The selected waypoint becomes the active waypoint and the courseline to the waypoint is displayed in magenta.

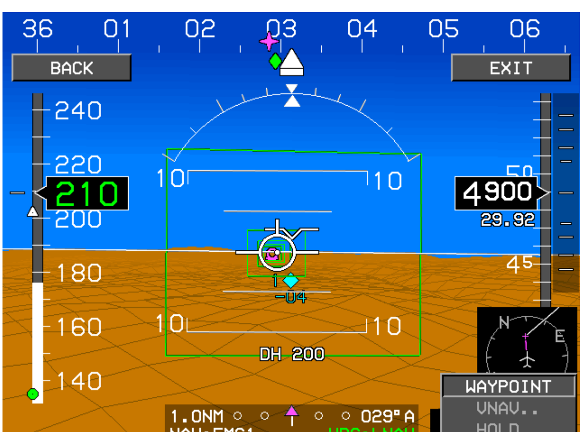


Figure 5-45: Active Waypoint and the Courseline

5.35. Creating a Non-Published Holding Pattern

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

Push to enter and 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 is displayed on the MFD. Skyway boxes are also created on the PFD to guide the pilot. Hold entries is computed automatically, just as they are for published holding patterns. Waypoint sequencing is suspended after entering the hold SUSPEND is displayed. Press the **CONT (L1)** (continue) to remove the SUSPEND flag. Normal sequencing of the flight plan waypoints occurs. Steps required to create a hold with right turns at PXR are shown below.

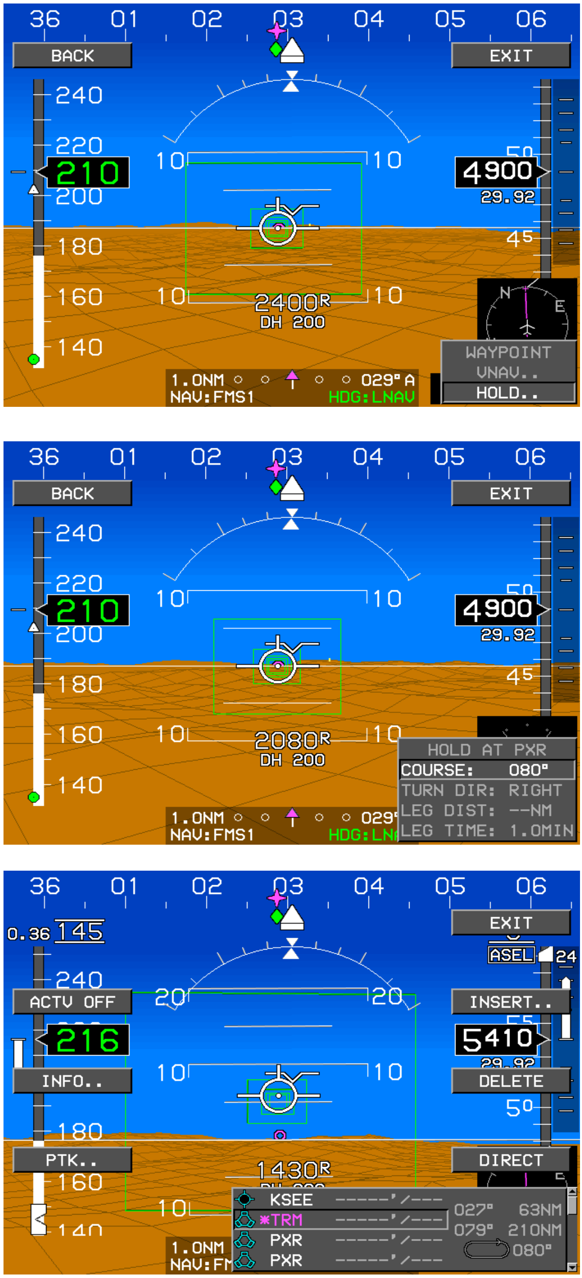


Figure 5-46: Creating a Non-Published Holding Pattern

5.36. Flight Plan Editing Screen

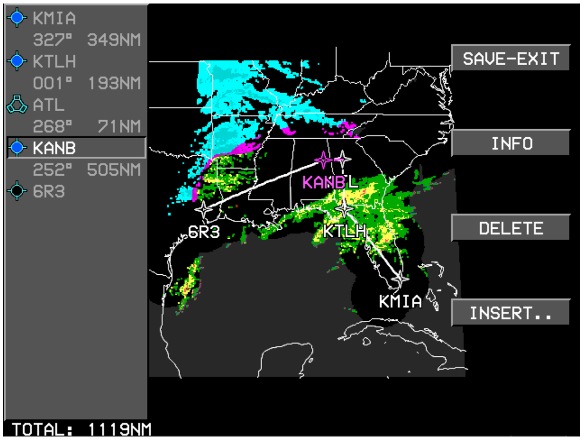


Figure 5-47: Flight Plan Editing Screen

The flight plan editing screen shows the flight plan being edited in the form of a jet log of waypoints. The jet log shows each waypoint Identifier, a symbol designating waypoint type with data linked graphical METAR symbol (if applicable), and bearing distance between flight plan waypoints. Bearings are displayed referenced to either magnetic or True North depending upon the status of the True North mode discrete Input. If referenced to magnetic North, the bearing display uses the degree (°) symbol. Otherwise, a stylized True North (^{T}) symbol is used. Total distance for the flight plan is shown below the jet log. The flight plan editing screen also shows the flight plan in graphical manner along with borders and datalinked NEXRAD. The pilot may scroll through each waypoint of the flight plan. Scroll one position past the end of the flight plan to add a waypoint to the end of the flight plan.

Various options appear on the flight plan editing screen to allow modifications as follows:

1) **EXIT (L1)** or **SAVE-EXIT (R1)**: exits the flight plan editing screen. If there are less than two waypoints in the flight plan being edited, the tile reads **EXIT (L1)** and does not store the flight plan being exited upon actuation. If there are two or more waypoints in the flight plan being edited, the tile reads **SAVE-EXIT (R1)** and stores the flight plan being exited upon actuation.

Stored flight plans are named by their first and last waypoints. If a new flight plan has the same start and end points as a previously saved flight plan but has different routing, a number (1-9) is appended to the name to uniquely Identify up to 10 routings with the same start and end points. Up to 100 flight plans of 40 waypoints each may be stored.

2) **INFO (R2)**: presents information on the highlighted waypoint. The tile does not appear when the highlighted position is one position past the end of the flight plan. Highlighted waypoint Information includes datalinked weather information when available. **WX LGND (R2)** and **EXPND WX (R3)** tiles are available at this level to show a weather symbol legend and highlighted waypoint METAR and TAF text respectively.

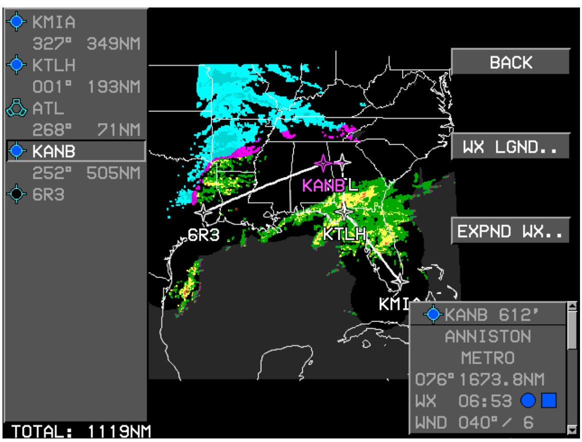


Figure 5-48: Flight Plan Editing Screen

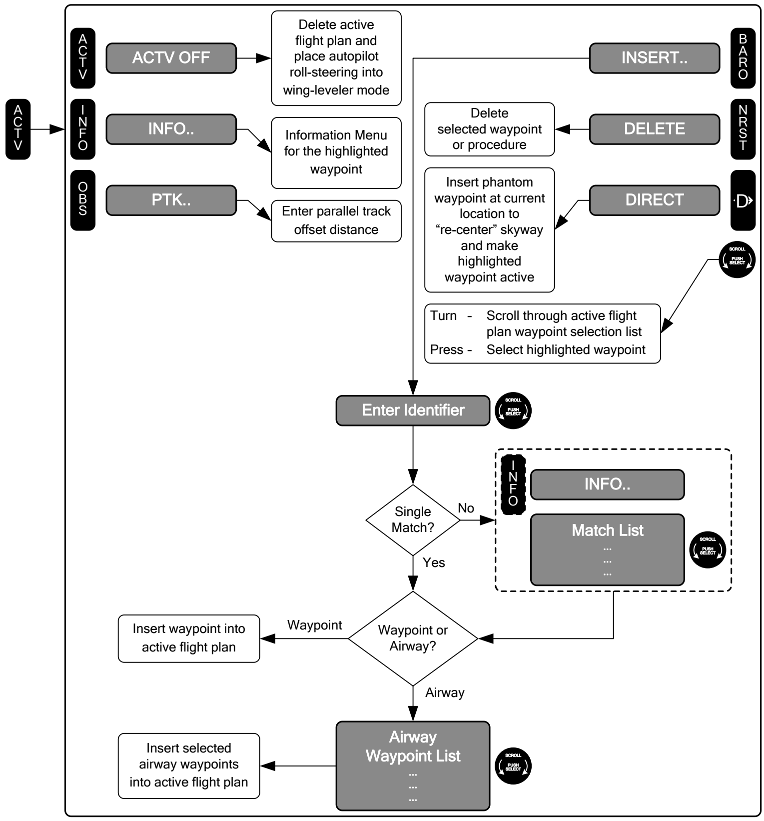
3) **DELETE (R3)**: Deletes the highlighted waypoint from the flight plan, the pilot is prompted to confirm deletion prior to completion of the operation. The tile does not appear when the highlighted position is one position past the end of the flight plan.

4) **INSERT/ADD (R4)**: Allows the pilot to insert or add a waypoint or airway into the flight plan. If the highlighted position is one position past the end of the flight plan, **ADD (R4)** is available, otherwise the tile reads **INSERT (R4)**. 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 is searched.

For waypoints, if there is a single result from the search, it is inserted or added to the 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 flight plan, **INFO (R2)** appears at this level to give access to information for the highlighted result and aid in selection. Highlighted result Information includes datalinked weather information when available, **WX LGND (R2)** and **EXPND WX (R3)** tiles are available at this level to show a weather symbol legend and highlighted result METAR and TAF text respectively.

For airways, a search is performed for all airways that go through the previous waypoint and match the entered identifier (i.e., to acquire a list of all Victor airways that go through the previous waypoint, enter an identifier string of “V”). If there is a single result from the search, a list of airway waypoints is shown so the pilot may 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 the pilot may select the desired exit point. Upon selecting the desired exit point, all airway waypoints from the previous waypoint to the desired exit point are inserted or added to the flight plan.

5.37. Options



* BARO bezel button is applicable to IDU-IV only. It is replaced with HDG bezel button on IDU-III.

Figure 5-49: Flowchart, Options Menu

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 (L2)**: deletes the active flight plan. The pilot is prompted to confirm deletion prior to completion of the operation.

2) **INFO (L3)**: activates the Information menu option for the highlighted waypoint.

3) **PTK (L4)**: The parallel offset is a route parallel to, but offset from, the original active route. The basis of the offset path is the original flight plan leg(s) and one or more offset reference points as computed by the IDU. The computed offset reference point is located so it lies on the intersection of lines drawn parallel to the host route at the desired offset distance and the line bisecting the track change angle. An exception to this occurs if there is a route discontinuity or end of route. In this case, the offset reference point is located abeam of the original flight plan waypoint at the offset distance. The parallel offset function does not propagate through route discontinuities, unreasonable path geometries (defined as turns greater than 120°), flight plan holding patterns, procedures (IFR Approach, VFR Approach, STAR or DP), or waypoints with only context as an aircraft starting position (e.g., anchor waypoint in a DP or Start, Phantom waypoints created by the Direct-To function). When transitioning to and from parallel offset legs, parallel offset entry and exit waypoints is created to allow expeditious entry and exit from the parallel offset.

   The IDU has the capability to provide guidance to parallel tracks at a selected offset distance. When executing a parallel offset, the navigation mode, and all performance requirements of the original route in the active flight plan is applicable to the offset route. The IDU provides for entry of offset distance in increments of 1 nm, left or right of course. The IDU is capable of offsets of at least 20 nm. When the IDU is operating in offset mode, it is clearly indicated. When in offset mode, the IDU provides reference parameters (e.g., cross-track deviation, distance-to-go, time-to-go) relative to the offset path and offset reference points.

4) **INSERT../ADD.. (R2)**: 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, **ADD (R2)**, otherwise **INSERT (R2)** appears. 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, the 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. **INFO (L3)** appears at this level to give access to the information function for the highlighted result and 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 obtain 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, a list of airway waypoints is shown so the pilot may 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 the pilot may select the desired exit point. Upon selecting the desired exit point, the airway waypoints from the previous waypoint to the desired exit point are inserted or added to the active flight plan.

5) **DELETE (R3)**: If the highlighted waypoint is a non-procedure waypoint, the function deletes the highlighted waypoint from the active flight plan. If the highlighted waypoint is part of a procedure, the function deletes the entire procedure from the active flight plan. The pilot is prompted to confirm deletion prior to completion of the operation. This tile does not appear if the highlighted waypoint is a non-procedure waypoint, and there are fewer than three non-procedure waypoints in the active flight plan. This is because an active flight plan must always have at least two non-procedure waypoints. The tile also 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.

6) **Direct**  **(R4)**: Inserts a phantom waypoint at the current aircraft location and makes the highlighted waypoint active. The phantom waypoint is a fly-over defined entry waypoint, and the leg prior to the phantom way point is designated a discontinuity. This assures 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.

5.38. Parallel Track Function-Set a Parallel Track

1) Press **ACTV (L2)**.

2) Choose **PTK..**

Figure 5-50: Parallel Track Function-Set a Parallel Track

3) Scroll ❶ to select offset distance in one NM increments and push to enter.

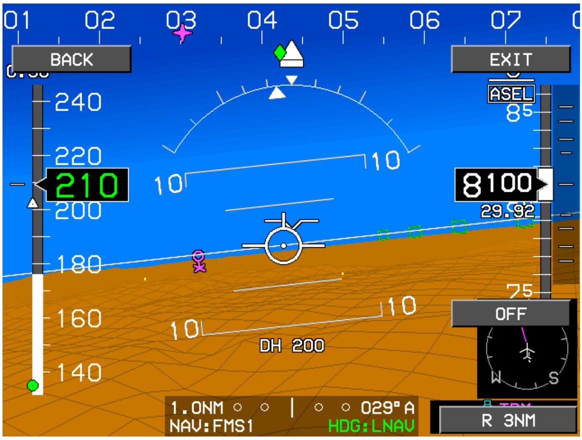
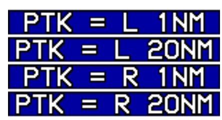


Figure 5-51: Select Offset Distance

Waypoints automatically sequence as the flight progresses.

AUDIBLE ANNUNCIATION



The parallel track function is annunciated by a flag, indicating the direction (left or right) and distance (NM) of the offset, and is accompanied by an auditory chime.

5.39. Turn Off Parallel Track

1) Press **ACTV (L2)**.

2) Press **PTK.. (L4)**.

3) Press **OFF (R4)**.

5.40. Information (INFO) Menu

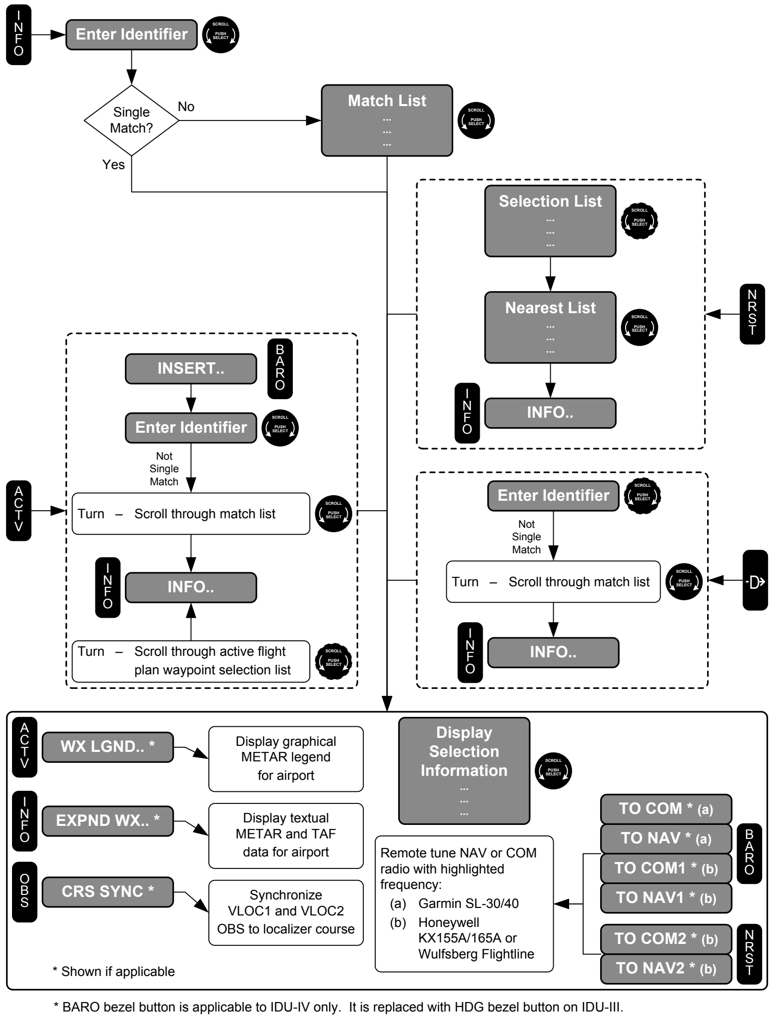


Figure 5-52: Flowchart, Information (INFO) Menu

If **INFO (L3)** is activated from within the **ACTV (L2)**, **NRST (R3)**, or Direct menus, 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, the active waypoint becomes the default entry. If there is no active waypoint, the nearest airport becomes the default entry. If the default entry is accepted, information for the default entry is shown. If the pilot rejects the default entry by entering identifier characters, a search for matching identifiers is performed. If there is a single result from the search, information for it 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), tong 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 are 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#1 (R2)** and the transmission is addressed to NAV radios. If the frequency is greater than or equal to 118MHz, the tiles read **TO COM#1 (R2)** 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 (R2)** 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 FliteLine™, a **TO COM1** or **TO NAV1 (R2)**, while a **TO COM2** or **TO NAV2 (R3)**.

When airport weather information is presented in the information block, a **WX LEGEND (L2)** appears to allow the display of an airport graphical METAR legend. In addition, an **EXPAND WX (L3)** appears 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 (L4)** appears to allow one-touch synchronization of the VLOC1 and VLOC2 omnibearing selectors to the localizer course.

5.41. 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/Garmin AT 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.

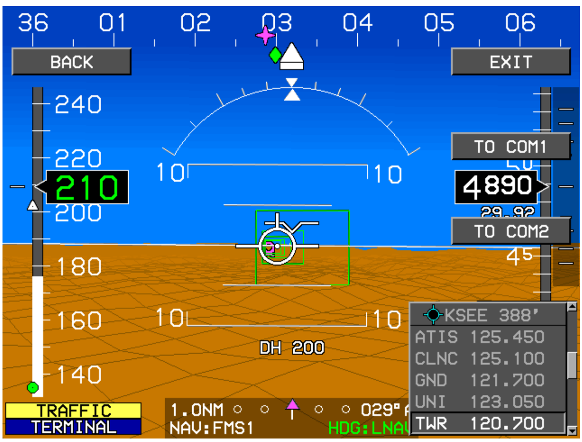


Figure 5-53: Tuning Radios Using the EFIS

1) Display the information for the facility (see § 5.3).

2) Scroll ❶ to highlight the desired frequency. Menu functions appear as appropriate, to send the frequency to the com or nav radios.

3) Press **TO COM1 (R2)** or **TO COM2 (R3)** ((or **NAV1** or **NAV2**) to send the frequency to the standby position of the com (or nav) radio.

4) Press **BACK (L1)** or **EXIT (R1)** when finished.

5.42. Omnibearing Selector (OBS) (L4) Menu

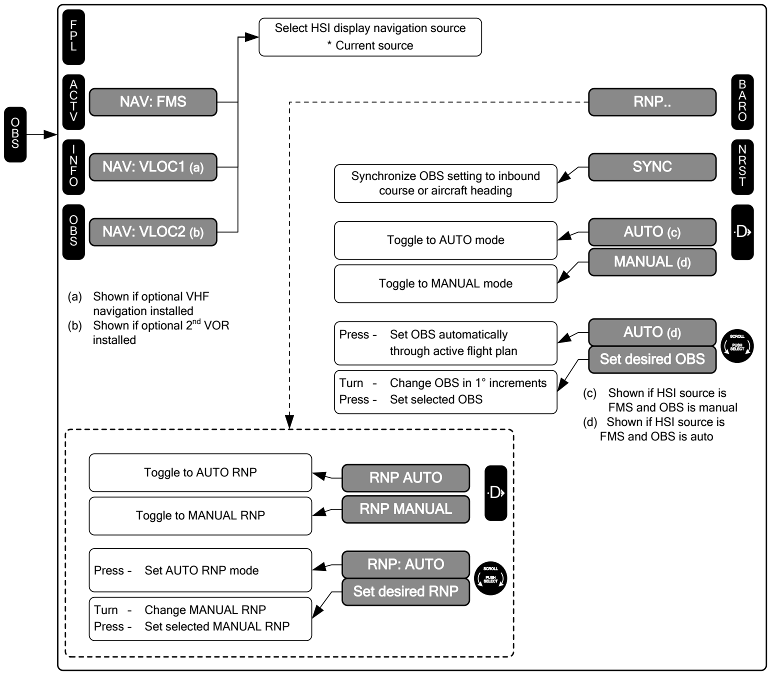


Figure 5-54: Flowchart, Omnibearing Selector (OBS) Menu

The OBS menu allows the pilot to control the setting of the omnibearing selector for purposes of showing course deviations. The OBS for FMS 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 FMS, VLOC1 and VLOC2 OBS settings are settable in increments of 1°. **OBS SYNC (R3)** appears to synchronize the Manual FMS, 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 FMS, **OBS/MANUAL (R4)** is available to enable selection with ❶ of the desired manual course.

With optional VOR symbology enabled, the OBS function permits the pilot to select either FMS, VLOC1 (VOR symbology enabled) or VLOC1 (dual VOR symbology enabled) as the HSI source. The HSI source selects the navigation source used to generate HSI guidance symbology, autopilot course datum, and course deviation signals.

The OBS function also allows the pilot to select between manual and automatic RNP settings. Upon selecting the RNP tile, an **RNP AUTO (R4) / RNP MANUAL (R4)** is available to enable quick toggling between automatic and manual RNP settings. Manual RNP is selectable between 0.10NM and 15NM as follows:

1) 0.01NM increments between RNP 0.10 and RNP 0.3

2) 0.1NM increments between RNP 0.3 and RNP 2

3) INM Increments between RNP 2 and RNP 15

NOTE:

When manual RNP values are set, the ANP value must be lower unless the LOI caution is displayed.

5.43. Omnibearing Selector Function HSI and CDI/Annunciator Source Selection

The source of the navigation information, indicated on the ANNUNCIATOR at the bottom of the PFD and also displayed on the HSI needle, may be set to FMS VLOC1 or VLOC2. Press the **OBS (L4)** on the PFD and select the source next to one of the HSI menu titles. CDI deviations 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 only displays 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 is displayed, and no to/from dot appear at the end of the needle.

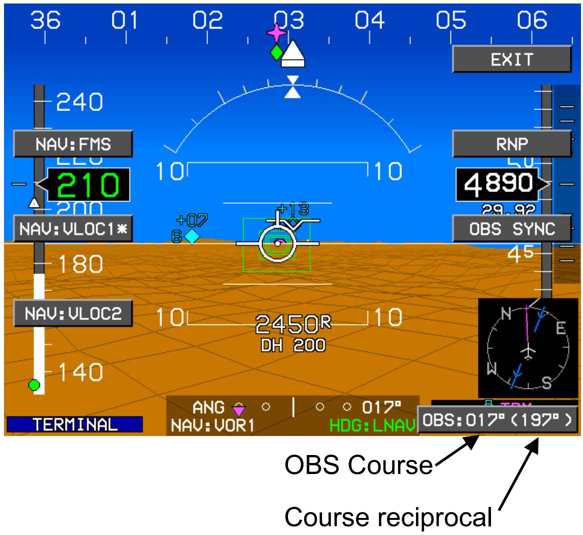


Figure 5-55: OBS Navigation Information

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 reflects a source of the FMS 1/FMS 2, VOR 1/2, LOC 1/2. The selected source also determines the analog course and deviation signals sent from the EFIS to the autopilot the HSI needle, when selected, and reflects a source of FMS or VLOC 1 or VLOC 2 (same as the CDI). The annunciator indicates what source of navigation information is being delivered to the autopilot. The aircraft tracks either signal depending on autopilot mode selected.

The Vertical Deviation Indicator indicates one of the following sources of vertical navigation to enable an autopilot to track a glideslope or VNAV path in conventional GS, VNAV, or APPR modes. Signal source is selectable on the EFIS through the OBS menu. Source for the GS mode is linked to the Nav source as follows:

1) FMS → LPV, VNV-G, or VNV-B as appropriate.

2) FMS1 → LPV1, VNV1-G, or VNV1-B as appropriate.

3) FMS2 → LPV2, VNV2-G, or VNV2-B as appropriate.

4) LOC1 → GS1 (only available if a nav receiver is installed).

5) LOC2 → GS2 (only available if a second nav receiver is installed).

Full scale deflection for the deviation signal depends upon the source. For LPV and VNAV, full scale deflection depends upon mode of flight. For GS1 and GS2, full scale deflection is angular (2 dots).

5.44. Automatic OBS-FMS

1) Press **OBS (L4)**.

2) Press the button next to the desired choice source. An asterisk appears by the currently selected source. (If a localizer source is selected, manual OBS is not available as an option).

3) Push to enter.

Figure 5-56: Automatic OBS-FMS

4) The OBS setting automatically adjusts to reflect the current flight plan segment. Waypoints automatically sequence as the flight progresses.

NOTE:

Automatic OBS is the system default.

5.45. Manual OBS-FMS

1) Press **OBS (L4)**.

2) If it is not already selected, press **NAV: FMS (L2)**, press **OBS MANUAL (R4)**, and scroll ❶ to set desired OBS course and push to enter.

The OBS courseline is displayed passing through the active waypoint. Automatic waypoint sequencing is suspended.

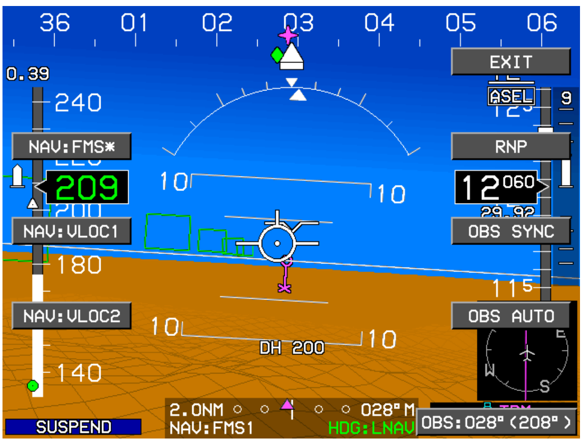


Figure 5-57: Manual OBS-FMS

5.46. OBS-VOR and LOC

When interfaced with the VHF nav radio, this sets the OBS course of the selected VOR or LOC (VOR1/2 or LOC1/2). 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.. (R4)** function.

1) Press **OBS (L4)**.

2) If not already selected, scroll ❶ to select desired OBS course and 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 (FSD), the courseline arrow flashes. The deviation dots are automatically decluttered when needle deflection is less than one dot.

The selected HSI source (VOR1/2 or LOC1/2) drives the autopilot when it is placed in NAV or APPROACH mode.

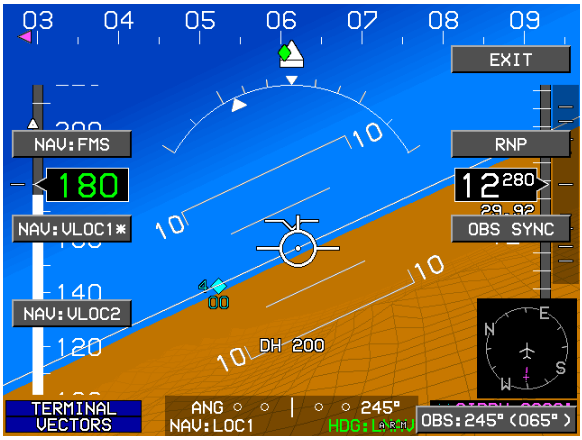
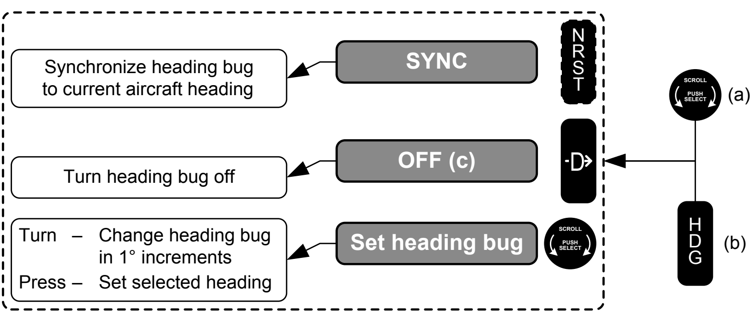


Figure 5-58: OBS-VOR and LOC

5.47. Heading Bug (HDG) Menu



(a) IDU-IV only
(b) IDU-III only
(c) Not available if HeliSAS is installed

Figure 5-59: Flowchart, 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 off the heading bug. If HeliSAS is installed, it is not possible to turn off the heading bug.

5.48. Setting the Heading Bug

For IDU-450 (PFD only), to set the Heading Bug, scroll ❶ to select the desired heading and push to enter.

For IDU-III, (PFD and MFD) press HDG button to enter Heading mode and scroll ❶ to select desired heading and push to enter.

Press **SYNC (R3)** to instantly set the heading bug on the current heading.

If coupled with an autopilot using **HEADING** mode GPS steering, the EFIS commands the autopilot to maintain the selected heading. If the autopilot is flying a flight plan, invoking the heading bug **OVERRIDEs** the flight plan course in favor of the selected heading (heading submode). To exit the selected heading submode, press **LNAV** and resume lateral tracking of the flight planned course.

The EFIS is in selected heading submode. To exit the selected heading submode, press **LNAV** . The EFIS resumes lateral tracking of the flight planned course (EFIS coupled mode).

The following steps may also turn off the heading bug.

IDU-450

1) Scroll ❶.
2) Press **OFF (R4)**.

IDU-III

1) Press **HDG (R2)**.
2) Press **OFF (R4)**.

If coupled with an autopilot using **HEADING** mode GPS steering, turn off the heading bug for the autopilot to re-intercept the active leg of the route (if available and selected). If the heading bug is turned off and there is no active waypoint course, the autopilot is in wing leveler mode.

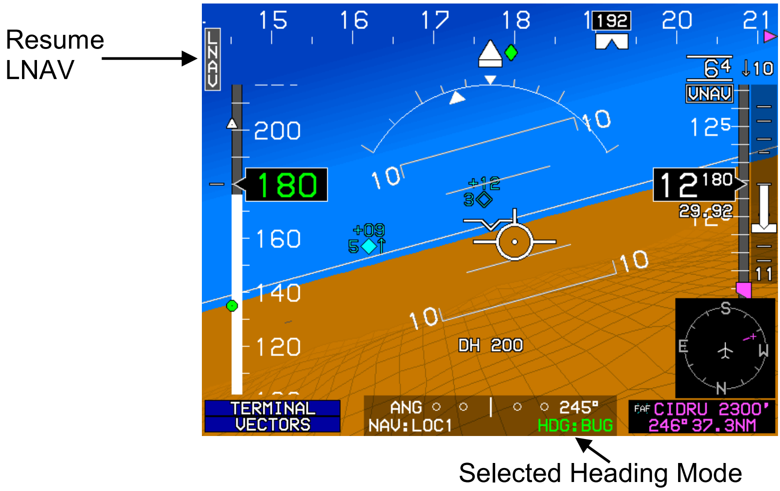


Figure 5-60: Setting the Heading Bug

The selected heading mode annunciator indicates LNAV after the heading bug is turned off.

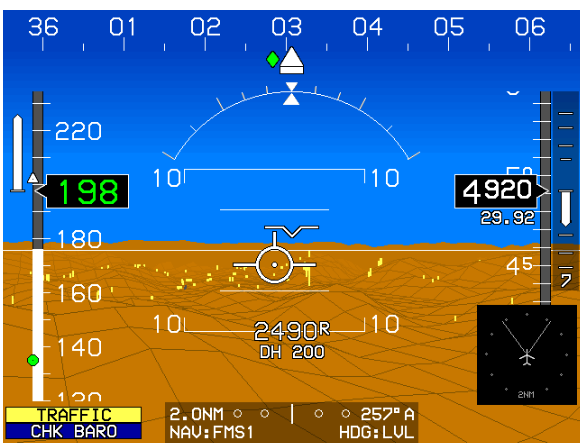


Figure 5-61: Heading Bug Turned Off

If the HDG BUG is turned off and there is no active flight plan course, the HDG mode is LVL.

NOTE:

When a heading bug is selected, it is annunciated at the bottom of the PFD with **HDG:BUG.. LNAV (L1)** arming tile appears. To resume LNAV (lateral navigation or roll steering on an autopilot), either press **LNAV (L1)**, or press **HDG (R2)** then **(R4)**, to turn off the heading bug. As long as the bug is activated, the autopilot follows it. Magenta course lines are not tracked by the autopilot until LNAV is resumed.

5.49. Nearest (NRST) Menu

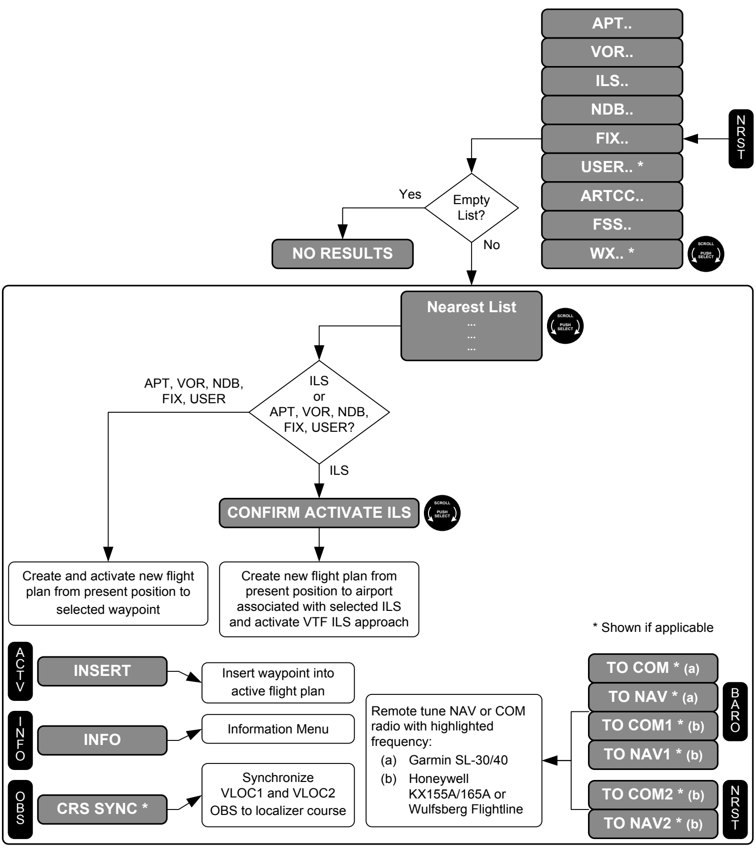


Figure 5-62: Flowchart, Nearest (NRST) Menu

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** label 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, **TO NAV#1 (R2)** and the transmission is addressed to nav radios. If the frequency is greater than or equal to 118MHz, the tiles are read **TO COM#1 (R2)** 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 (R2)** because transmissions to the Sl-30/40 radios cannot be directed to a particular radio number. Where remote tuning is enabled for Honeywell KX155A or 165A and Wulfsberg FliteLine, a **TO COM1 (R2)** or **TO NAV1 (R2)**, while a **TO COM2 (R3)** or **TO NAV2 (R3)** appears.

When the results for airports, VORs NDBs, fixes, and user waypoints are displayed, **INSERT (R2)** 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. **INSERT (R2)** 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, **INFO (L3)** appears 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, **CRS SYNC (L4)** 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:

    a) If the ILS was selected from the pilot side, the pilot side switches to VLOC1 and co-pilot side does not change. If ILS was selected from the co-pilot Side, the co-pilot side switches to VL0C2 and the pilot side does not change.

5) Connected nav radios are remotely tuned to the ILS frequency in the standby position.

5.50. Waypoints-Nearest Waypoint

1) Press **NRST**.

2) Scroll ➊ to highlight nearest airport, VOR, ILS, NDB, fix, or user waypoint and push to enter. Nearest ARTCC and FSS are shown as well but may not be selected for navigation.

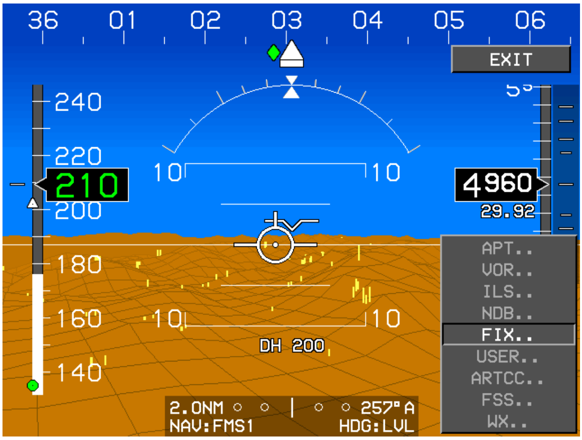


Figure 5-63: Waypoints-Nearest Waypoint

3) A list of waypoints is displayed, each with bearing, distance, longest runway, and frequency as applicable, scroll ❶ to highlight desired choice and push to enter.

Figure 5-64: List of Waypoints

If a frequency is displayed in this step, it may be highlighted and sent to a radio. See § 5.41 for more information.

NOTE:

Press **NRST (R3)** or enter a new destination waypoint. Use Direct-To override an existing flight plan or waypoint.

5.51. Using Airways

Airways, including low-altitude Victor Airways and high-altitude Jet Routes, are extremely easy to enter into the EFIS, and may 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) located on the airway (an airway cannot be added between the START waypoint and the next waypoint, for example).

Airways are identified by their name (V358, 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 is presented).

For example, the following clearance is received:

“ATC clears N1234 to Flagstaff via radar vectors to join V358 to San Antonio, V198 to El Paso, V611 to Albuquerque, direct.”

1) Press **NRST (R3)** and choose **ACT** (the Waco VOR-the nearest fix V358. Remember, airways must be preceded by an airway fix).

2) Press **ACTV (L2)**, scroll the blank space after **ACT**, press **ADD..** or **INSERT..** and enter “V358”. The pilot 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 ACT is shown.

3) Scroll ❶ to select the desired airway, V358 in this case, and push to enter. A list of fixes along the airways is shown.

Figure 5-65: Using Airways

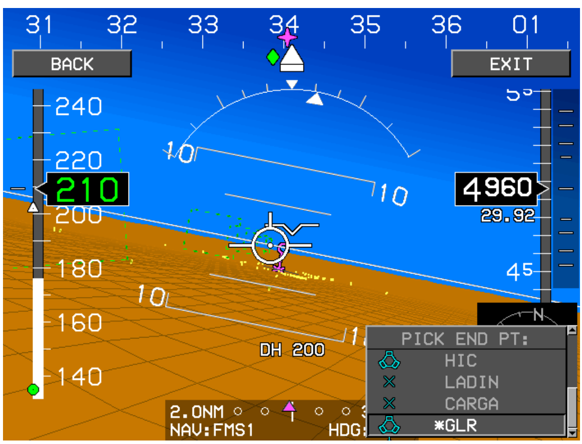


Figure 5-66: End Point on Airway

4) Scroll up or down (Jeppesen determines the order) to the desired end point on the airway (San Antonio-**SAT**) and push to enter.

5) Repeat steps 3 and 4 for each leg until reaching Albuquerque VOR as an end point for V611.

6) Repeat the procedure again and enter **KFLG** for Flagstaff instead of an airway.

All fixes along the airway are added to the route. Press **ACTV (L2)** to review the entire route.

5.52. Direct Menu

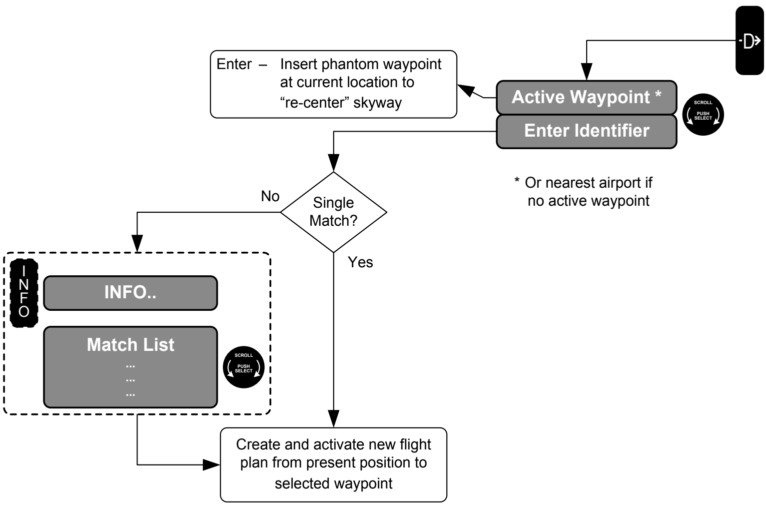


Figure 5-67: Flowchart, Direct Menu

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

If the default entry is the active waypoint and is accepted by the pilot, 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 the skyway is "re-centered" to provide guidance to the new active waypoint. The rest of the active flight plan remains unchanged.

If the default entry is not the active waypoint and is accepted by the pilot, 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 night plan is created from the found airport to the selected waypoint.

5.53. Direct to Any Waypoint

1) Press  **(R4)**.

2) If an active waypoint exists, it is entered as the default. Push ❶ to create a phantom waypoint at the current aircraft location and re-center 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 is the default entry.

3) If desired, enter the identifier of another waypoint, scroll ❶ to select an alphanumeric character, and push to enter and advance to the next character. Press **BACK (L1)** to back up. Entering at least two characters and advancing through the remaining blank character spaces displays a list of potential waypoints if there is no exact match.

Figure 5-68: Direct to Any Waypoint

4) **INFO (L3)** may be used to obtain NavData information about a waypoint before it is activated.

5) Scroll ❶ to highlight desired waypoint, push to enter. Direct course to selected waypoint is displayed with distance in NM.

NOTE:

Unless the default, current active waypoint is accepted, use Direct-To to override an existing flight plan or waypoint to go directly to another waypoint within the active flight plan; press **ACTV**, scroll to the desired waypoint then press **(R4)**.

5.54. Re-Center on Route

1) Press **(R4)**.
2) The active waypoint identifier is displayed in the character spaces (do not change it).

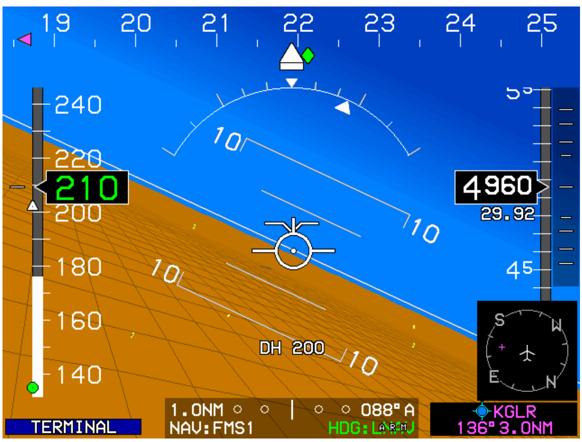


Figure 5-69: Re-Center on Route

3) To fly direct from present position (re-center skyway/courseline), push ❶ to enter.

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

NOTE:

Use Direct-To and enter another waypoint identifier (other than the default) to override an existing flight plan or waypoint.

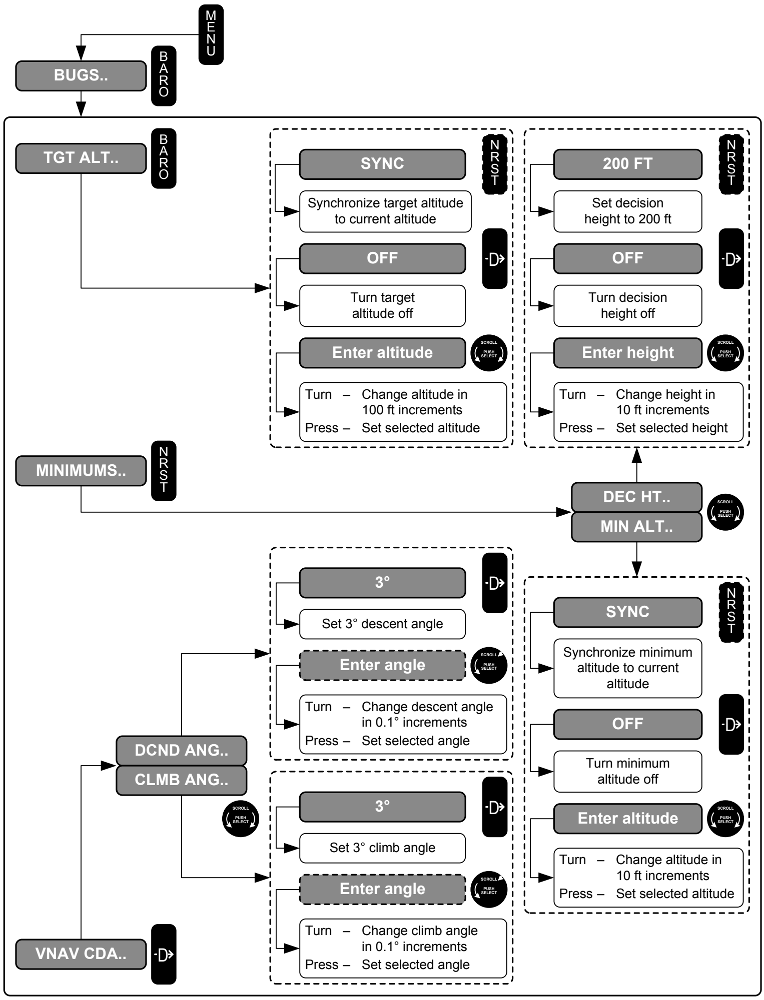
Otherwise, a new active flight plan is created from present aircraft position to the selected waypoint.

If the pilot rejects the default entry by entering identifier characters, a search for matching identifiers is performed. If there is a single result from the search, 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.

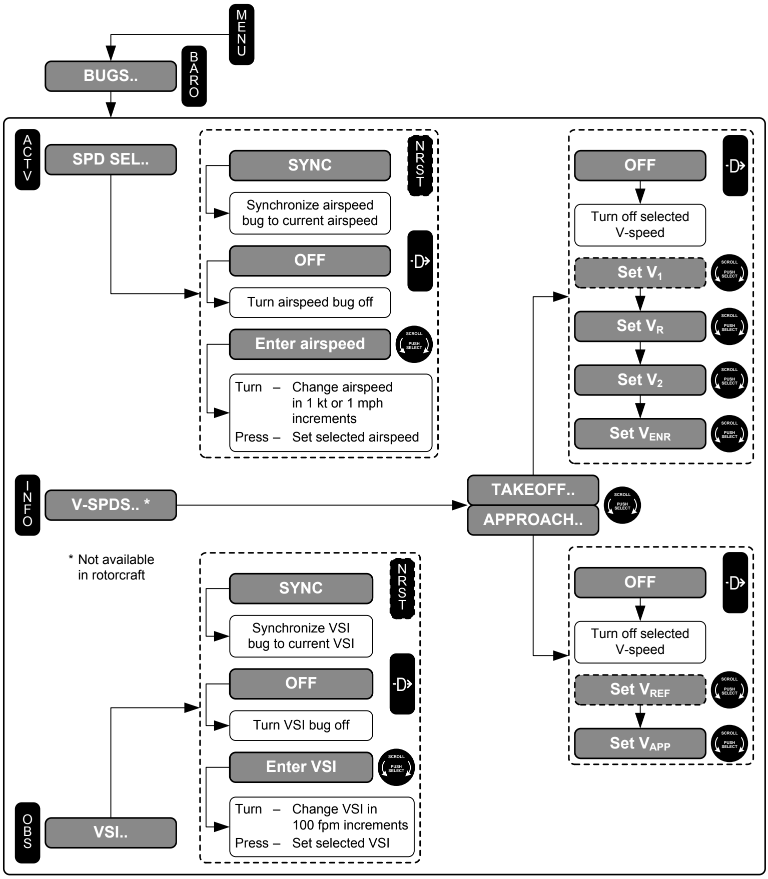
If there are multiple results from the search, a selection list with matching identifiers is presented. Upon selection, the resulting action depends upon whether the aircraft is in the air or on the ground. If in the air, a new active flight plan is created from present aircraft position to the selected 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. **INFO (L3)** appears at this level to provide access to the information function for the highlighted result and aid in selection.

5.55. PFD Bug (BUGS) Menu



* BARO bezel button is applicable to IDU-IV only. It is replaced with HDG bezel button on IDU-III.

Figure 5-70: Flowchart, PFD Bug (BUGS) Menu (Part 1)



* BARO bezel button is applicable to IDU-IV only. It is replaced with HDG bezel button on IDU-III.

Figure 5-71: Flowchart, PFD Bug (BUGS) Menu (Part 2)

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 options 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 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 off the airspeed bug, 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 x $\mathbf{V_{S1}}$), (1.2 x $\mathbf{V_{REF}}$), 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 0.10 (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 ($\mathbf{V_1}$, $\mathbf{V_R}$, $\mathbf{V_2}$, and $\mathbf{V_{ENR}}$) or approach V-speeds ($\mathbf{V_{REF}}$ and $\mathbf{V_{APP}}$). Selecting the takeoff V-speed option allows the pilot to set takeoff V-speeds ($\mathbf{V_1}$, $\mathbf{V_R}$, $\mathbf{V_2}$, and $\mathbf{V_{ENR}}$) in sequence. Selecting the approach V-speed option allows the pilot to set approach V-speeds ($\mathbf{V_{REF}}$ and $\mathbf{V_{APP}}$) in sequence.

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

NOTE:

The airspeed bug and VSI bug are mutually exclusive, and therefore selecting one turns off the other.

5.56. Specify a Target Altitude Bug-Selected Altitude Submode

1) Press **MENU (R1)** while on the PFD display page.

2) Press **BUGS.. (R2)**

3) Press **TGT ALT.. (R2)**

4) Current altitude, rounded to the nearest 10 foot increment in the approach phase and nearest 100 foot increment in the enroute and terminal areas is displayed.

5) Scroll ❶ to set the desired target altitude and push to enter.

   A white bow-tie shaped bug is located on the altimeter tape, centered on the target altitude. The bug is hollow for pre-selected altitudes, and is filled for captured altitudes.

Press **SYNC (R3)** to instantly set the target altitude to the current altitude.

The target altitude value is displayed in white between two horizontal white bars immediately above the altimeter tape. It flashes during altitude capture. **ASEL** for selected altitude submode is shown below the value.

This manually set target altitude bug overrides the magenta VNAV target altitude bug. To de-activate the selected altitude submode, press **VNAV**. The VNAV or level flight submode is entered.

If a lower target altitude is selected, the skyway descends immediately, and a green arc showing altitude capture point appears 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 is either a manually selected vertical speed (VSI bug) or airspeed (airspeed bug). If neither is selected, a default descent value (preset during the Installation programming process) in FPM is used.

If a higher target altitude is selected, the skyway follows 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 is used. Climbs are performance based. They do not follow a geographic profile. Hence, no vertical deviation Indicator is shown.

Descents in VNAV submode are based on defined vertical angles emanating 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 TAPs, DPs, and STARs. All database and manually set VNAV altitudes are depicted in white. System calculated VNAV altitudes is depicted in magenta. When the system is capable of performing vertical navigation but the pilot has manually selected an altitude, a **VNAV** tile appears on the PFD. Once engaged, **ASEL** changes to **VNAV** and the bug goes from white to magenta.

NOTE:

On DPs, set an angle resulting in a minimum performance measured in FPNM (feet per nautical mile). 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 results in a ALTITUDE flag and a single aural warning of “Altitude, Altitude”.

5.57. Specify a Minimum Altitude

1) Press **MENU (R1)** while on the PFD display page.
2) Press **BUGS.. (R2)**
3) Press **MINIMUMS.. (R3)** 1000' AGL above runway, rounded to the nearest 10 foot Increment, is displayed.
4) Select **MIN ALT..** and push to enter. The **MIN ALT..** value is displayed above a single horizontal white bar.

Figure 5-72: Specify a Minimum Altitude

The altimeter tape is displayed in amber (yellow) below the minimum altitude. The minimum altitude value is displayed above a single horizontal white bar.

AUDIBLE ANNUNCIATION

Descending below the minimum altitude results in a MINIMUMS flag, and an annunciation of “Minimums, Minimums”.

5.58. Specify a Decision Height

1) Press **MENU (R1)** while on the PFD display page.

2) Press **BUGS.. (R2)**

3) Press **MINIMUMS.. (R3)**. Scroll ❶ to select either **DEC HT..** or **MIN ALT..** and push to enter.

4) If **DEC HT..** is selected a default value of 200 ft. is shown. Scroll ❶ to select desired decision height and push to enter. Selected value is displayed under the AGL read out on the PFD.

Figure 5-73: Specify a Decision Height

AUDIBLE ANNUNCIATION

Descending below the decision height results in a DEC HT flag, and an annunciation of "Decision Height, Decision Height".

NOTE:

NAV data from the EFIS does not include DH or MDA. Consult the Instrument Approach Chart to determine appropriate Decision Height minima.

5.59. Specify a Target Airspeed

1) Press **MENU (R1)** while on the PFD display page.

2) Press **BUGS.. (R2)**

3) Press **SPD SEL.. (L2)** Current airspeed is displayed.

4) Scroll ❶ to select desired target airspeed and push to enter.

5) Press **SYNC (R3)** to instantly set the airspeed bug to the current airspeed.

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 is colored white, and the airspeed bug is hollow-white. When not vertically integrated with an autopilot, the airspeed bug setting annunciation is colored white, and the airspeed bug is a filled-white.

5.60. Specify a Vertical Speed

1) Press **MENU (R1)** while on the PFD display page.

2) Press **BUGS.. (R2)**.

3) Press **VSI.. (L4).**

4) Scroll ❶ to select the desired vertical speed. Selections are in 100 ft. increments, and may be negative (descent) or positive (climb). Push to enter.

When vertically integrated with an autopilot, the vertical speed bug setting annunciation is colored green, and the vertical speed bug is a filled-white when in VSI climb or descent mode. Otherwise, the vertical speed bug setting annunciation is colored white/and the vertical speed bug is hollow-white. When not vertically Integrated with an autopilot, the vertical speed bug setting annunciation is colored white, and the vertical speed bug is a filled-white at all times.

5.61. Turn Off Bugs

1) Press **MENU (R1)** while on the PFD display page.

2) Press **BUGS.. (R2)**.

3) Press **TGT ALT.. (R2), MINIMUMS.. (R3)**, **DEC HT..**, **MINIMUMS..**, **MIN ALT**, or **SPD SEL.. (L2)**.

4) Press **OFF (R4)**.

5.62. Set V-Speeds

1) Press **MENU (R1)** while on the PFD display page.

2) Press **BUGS.. (R2).**

3) Press **V-SPDS (L3)**.

4) Scroll ❶ to highlight **TAKEOFF..** or **APPROACH..** and push to enter.

5) Follow prompts to enter **V_1..**, **V_R..**, **V_2..**, **V_{REF}..**, **V_{APP}..**, and **V_{ENR}..** Scroll ❶ 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.

Figure 5-74: Set V-Speeds

5.63. Vertical Navigation (VNAV)

The 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 § 5.64.

During final approach, the descent angles are derived from the Jeppesen NavData.

5.64. Change VNAV Angles

1) Press **MENU (R1)**.

2) Press **BUGS.. (R2)**

3) Press **VNAV CDA.. (R4)**.

4) Scroll ➊ to highlight **CLIMB ANG..** or **DCND ANG..** and push to enter.

5) Scroll ➊ to select the desired angle or rate in feet per nautical mile, and push to enter. To cancel, press **EXIT (R1)**.

5.65. 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 may be thought 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 gray in the ACTV waypoint list).

To set a manual VNAV altitude, follow these steps.

1) Press **ACTV.. (L2)**

2) Scroll ➊ to highlight the desired waypoint in the active list.

3) Scroll ➊ and select **VNAV..** and push to enter. A crossing altitude and offset distance may be selected.

4) Scroll ➊ 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.

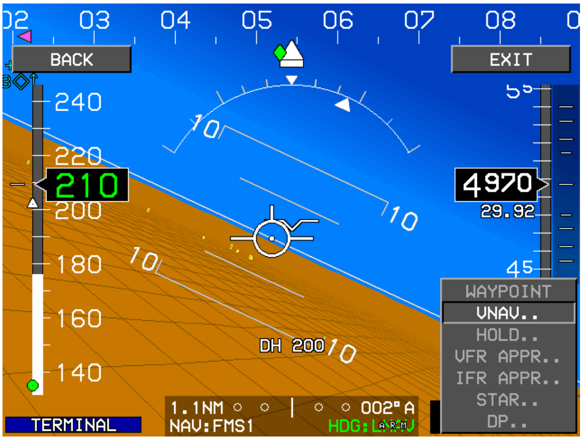


Figure 5-75: Arrival Procedure

1) Press **ACTV (L2)**.
2) Scroll ❶ to **VNAV**.
3) Push to enter.

Figure 5-76: VNAV Altitude and Offset

1) Scroll ❶ to desired VNAV altitude and offset.
2) Push to enter.

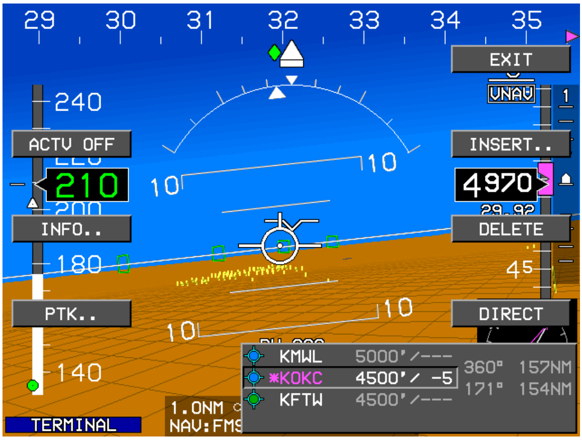


Figure 5-77: Cross KOKC at 8000' 5 Miles Prior

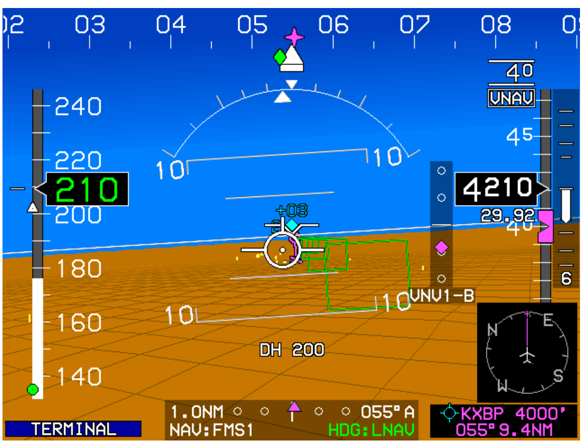


Figure 5-78: VNAV Profile

5.66. PFD Declutter (DCLTR) Menu

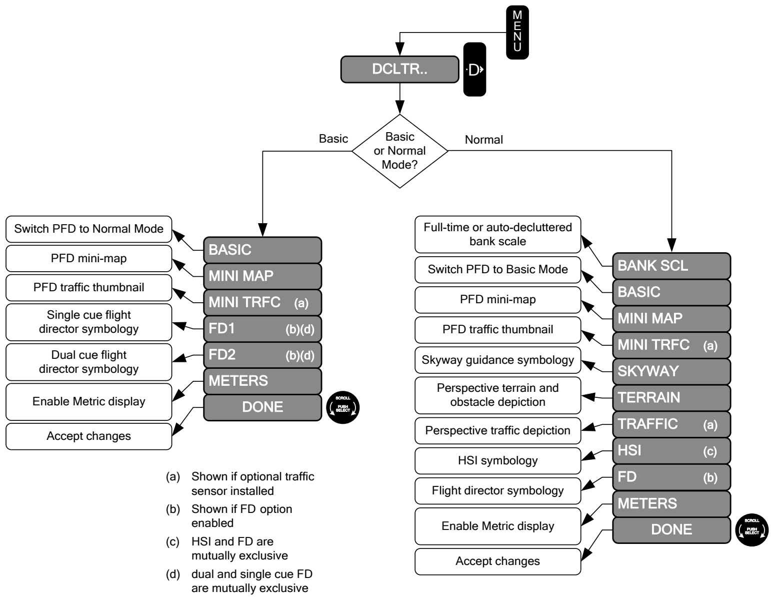


Figure 5-79: Flowchart, PFD Declutter (DCLTR) Menu

Upon activating the PFD declutter menu, an option list of declutter items are shown. In Normal Mode, select or deselect the following items:

1) Fulltime or auto-decluttered bank scale display;

2) Basic Mode (switches 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) Fight Director symbology (only shown with optional Fight Director symbology option and mutually exclusive with HSI symbology).

10) Metric display of barometric altitude and target altitude bug setting.

In Basic Mode, 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).

6) Metric display of barometric altitude and target altitude bug setting.

5.67. Setting Altimeter-PFD and Reversionary PFD Only

The altimeter is set automatically on startup based on the airport elevation. For the IDU-450, to change the altimeter setting, press **BARO (R2)** and scroll the encoder to enter the desired barometric pressure and push to enter. See § 5.68.

For IDU-III, scroll the encoder to enter the BARO page and scroll to select proper BARO value then push to enter.

5.68. Altimeter Menu

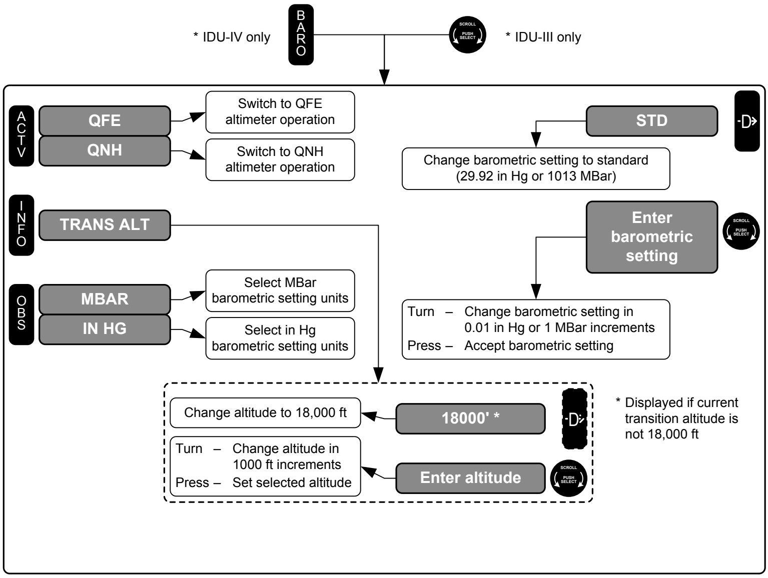


Figure 5-80: Flowchart, Altimeter Menu

Upon activating the altimeter menu, scroll the rotary encoder clockwise to increment or counter-clockwise to decrement the barometric setting. Push the encoder to accept the new barometric setting. In addition, the following options are available in the altimeter menu:

1) **QNH/QFE (L2)**: 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 (L2): Barometric setting results in the altimeter displaying height above a reference elevation (e.g., airport or runway threshold).

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

QNH (L2): Barometric setting results in the altimeter displaying altitude above mean sea level at the reporting station.

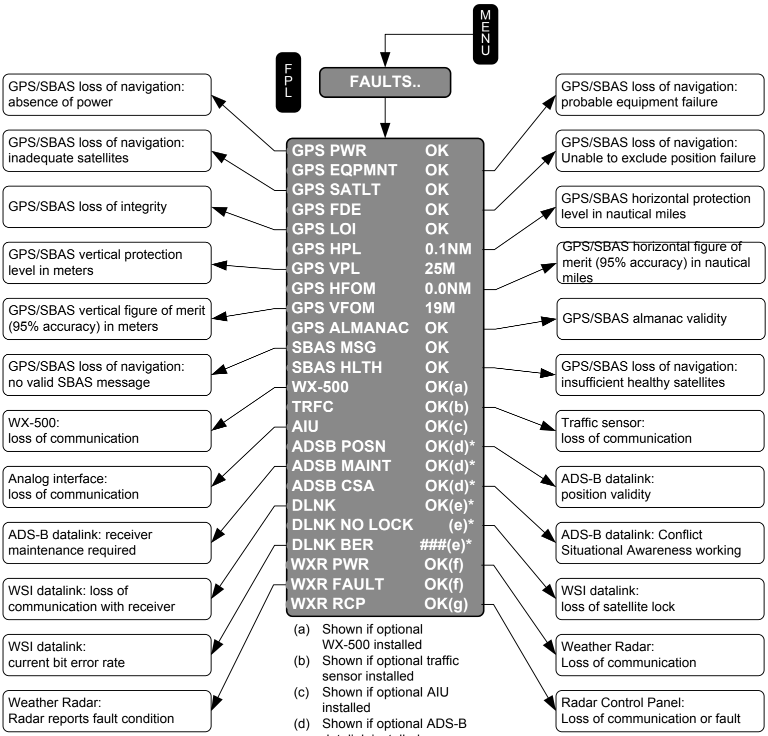
2) **TRANS ALT (L3)**: allows the pilot to change the transition altitude used by the system in units of 1000 feet. Transition altitude is used to generate barometric setting warnings, and to determine QNE/QNH operation. If the current transition altitude is not 18,000 feet, an **18000'** tile is available to quickly set 18,000 feet as the transition altitude.

3) **MBAR/INHG (L4)**: allows the pilot to select the barometric setting units (inHg or mbar).

4) **STD (R4)**: sets the barometric setting to standard (29.92 inHg or 1013 mbar).

Figure 5-81: Altimeter Menu

5.69. MFD Fault Display (FAULTS) Menu



(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 WSI datalink installed
(f) Shown if optional weather radar installed
(g) Shown if optional weather radar installed and weather radar type is RDR-2000 or RDR-2100

*ADS-B and WSI datalink are mutually exlusive

Figure 5-82: Flowchart, MFD Fault Display (FAULTS) Menu

Upon selecting the MFD faults menu, the status of the following system parameters is displayed:

1) GPS/SBAS loss of navigation due to absence of power (**GPS PWR**).

2) GPS/SBAS loss of navigation due to probable equipment failure (**GPS EQPMNT**).

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

4) GPS/SBAS loss of navigation due to a position failure that cannot be excluded within the time to alert (**GPS FDE**).

5) GPS/SBAS loss of integrity and loss of navigation due to loss of integrity (**GPS LOI**).

6) A readout of the current GPS/SBAS horizontal protection level (**GPS HPL**) in nautical miles. This value may be used as the estimate of position uncertainty required in RNP airspace.

7) A readout of the current GPS/SBAS vertical protection level (**GPS VPLN**) in meters.

8) A readout of the current GPS/S8AS horizontal figure of merit (**GPS HFOM**) in nautical miles. This value is an indication of the 95% confidence horizontal position accuracy.

9) A readout of the current GPS/SBAS vertical figure of merit (**GPS VFOM**) in meters. This value is an indication of the 95% confidence vertical position accuracy.

10) GPS/SBAS loss of navigation due to no valid SBAS message received for 4 seconds or more (**SBAS MSG**).

11) GPS/SBAS loss of navigation due to insufficient number of SBAS HEALTHY satellites (**SBAS HLTH**).

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

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

14) If the analog interface option is enabled, loss of communication with the analog interface (**AIU**).

15) If WSI datalink is enabled, the data link 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 ###**). WSI datalink is mutually exclusive with ADS-B datalink.

16) 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 WSI datalink.

17) If a weather radar status message is fresh (IDU-450 only) (i.e., received within the last 2 seconds), an indication of weather radar communication status (**WXR PWR**) and weather radar fault status (**WXR FAULT**). Weather radar fault status (WXR FAULT X) reflects any of the following conditions are true:

18) Weather radar fault status **WXR FAULT-**and weather radar communication status (**WXR PWR XH**) reflects any of the following conditions are true:

    a) Loss of weather radar communication (not available or not accepted for more than 2 seconds).

    b) Weather radar mode is OFF.

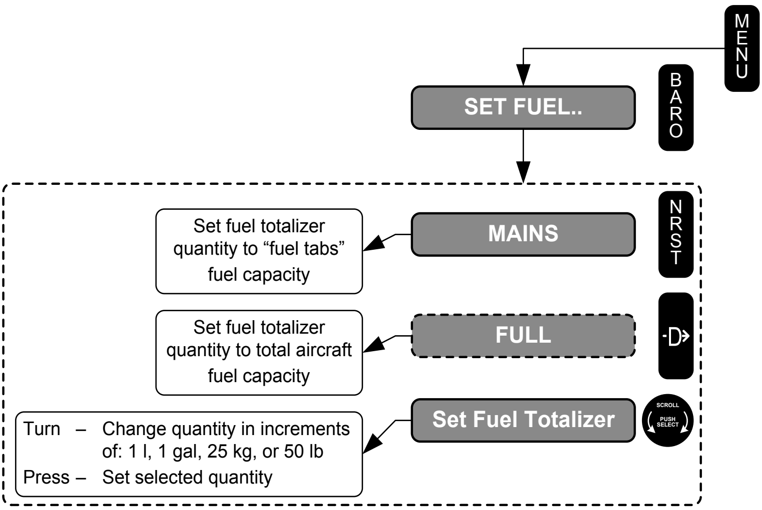
19) If a weather radar status message is fresh (i.e., received within the last 2 seconds) and the weather radar type is RDR-2000 or RDR-2100, an indication of radar control panel status (**WXR RCP**).

Figure 5-83: MFD FAULTS Menu

5.70. MFD Fuel Totalizer Quality Setting (SET FUEL) Menu

NOTE:

If equipped with fuel flow transducer and appropriate ADC.



* BARO bezel button is applicable to IDU-IV only. It is replaced with HDG bezel button on IDU-III.

Figure 5-84: Flowchart, 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 are set during installation). **MAINS (R3)** is available to quickly set the quantity to the "fuel tabs" fuel capacity. **FULL (R4)** 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.

5.71. Setting Fuel Quantity-MFD Only

1) Upon startup, the #1 MFD prompts for adding fuel; otherwise, press **MENU (R1)** and select the **SET FUEL.. (R2)** menu and push to enter. The amount displayed is the lower-right corner is the amount remaining.

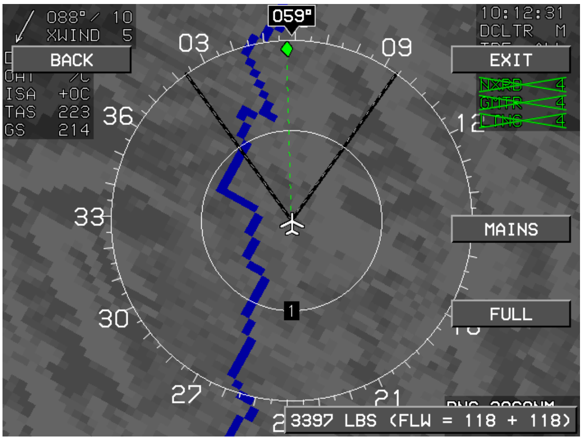


Figure 5-85: Setting Fuel Quantity-MFD Only

2) Scroll ❶ to set fuel quantity on board or press **FULL (R4)** to set to total usable value or press **MAINS (R3)** 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 ❶ to enter.

5.72. MFD Function (FUNCTION) Menu

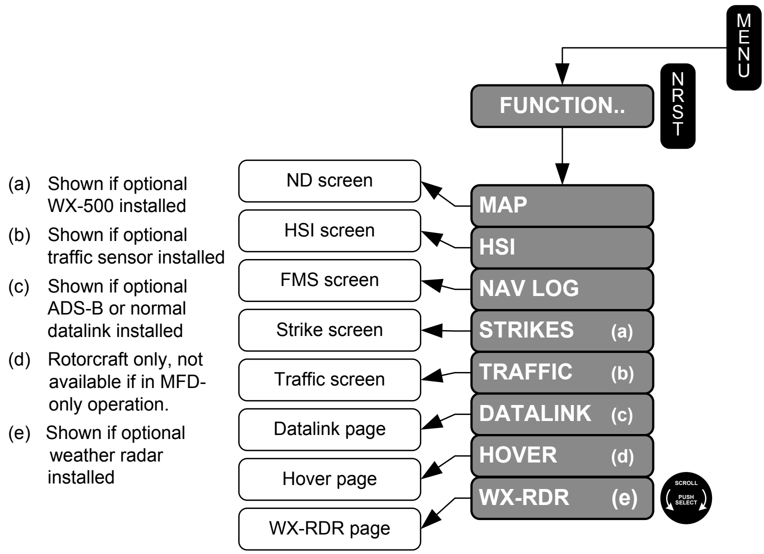


Figure 5-86: Flowchart, MFD Function (FUNCTION) Menu

The **FUNCTION** menu allows the pilot to select which MFD screen to display:

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, only if WX-500 option is enabled.

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

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

7) **HOVER**: shows the Hover page. (Rotorcraft only)

8) **WX-RDR**: shows the Weather Radar page, only if weather radar is enabled. (IDU-450 only)

5.73. Change Moving Map Function

In addition to the moving map, the MFD displays an HSI, a Navigation log, a dedicated lighting display, a dedicated traffic display, and a dedicated DataLink display.

1) Press **MENU (R1)**.

2) Press **FUNCTION.. (R3)**.

3) Scroll ❶ to highlight desired function (**MAP**, **HSI**, **NAV LOG**, **STRIKES**, **TRAFFIC**, **DATALINK**, and [**WX RDR IDU-450 only**]) and push to enter.

Figure 5-87: Change Moving Map Function

NOTE:

When the HSI page is selected on the MFD, this is the only place DME bearing and distance is located.

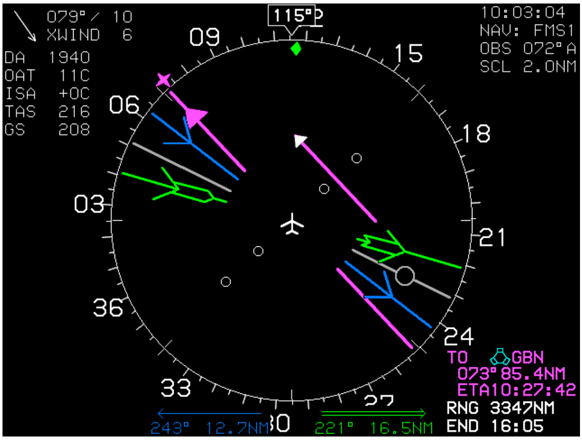


Figure 5-88: HSI Page

5.74. Controlling the NAV Log Display

To view the **NAV Log** display page, press **MENU (R1)** then **FUNCTION (R3)**. Scroll ➊ to highlight **NAV Log** and push to enter. The NAV Log page is 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, press **MENU (R1)** then **FUNCTION (R3)**. Scroll the encoder to highlight **MAP** and push to enter.

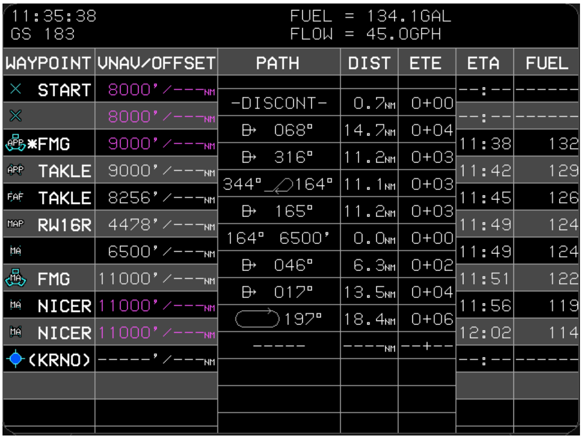


Figure 5-89: NAV Log Page

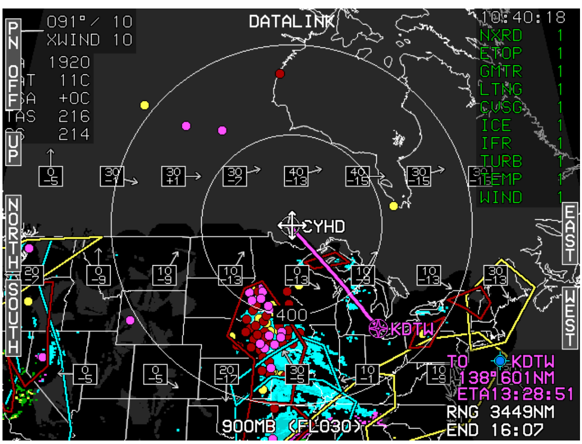


Figure 5-90: DATALINK Weather Page

5.75. Weather Radar Screen (IDU-450 Only)

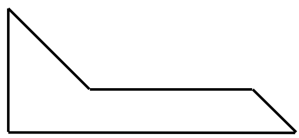
On an IDU-450, a weather radar screen is available when the system is interfaced with an optional Weather Radar Module (WRM) and configured for weather radar. In all cases, a horizontal depiction is available. When configured for weather radar types RDR-2000 or RDR-2100, a profile depiction is available. The weather screen has the following elements:

5.75.1. Ownship Symbol

The ownship symbol is displayed on the weather radar page as follows:

1) Horizontal depiction as specified above;

2) Profile Depiction:



Fixed Wing

Figure 5-91: Ownship Symbol

5.75.2. Weather Screen Format (IDU-450 Only)

In a horizontal depiction, the weather screen uses an arced format with the ownship symbol centered in the bottom of the display with the weather area depicted as an arc ahead of the ownship symbol.

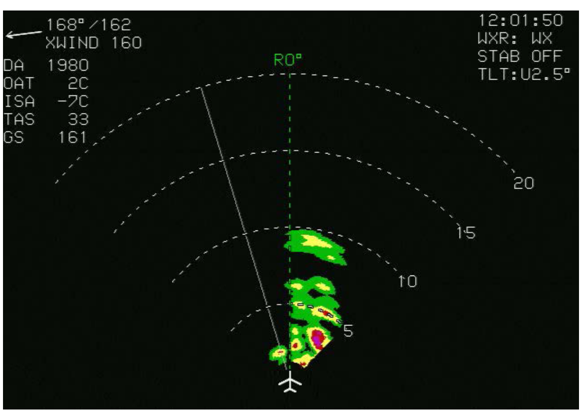


Figure 5-92: Weather Area Depicted as an Arc ahead of the Ownship Symbol

In a profile depiction (only available with RDR-2000 or RDR-2100 weather radar types), the weather screen uses an arced format with the ownship symbol centered on the left side of the display with the weather area depicted as an arc to the right of the ownship symbol.

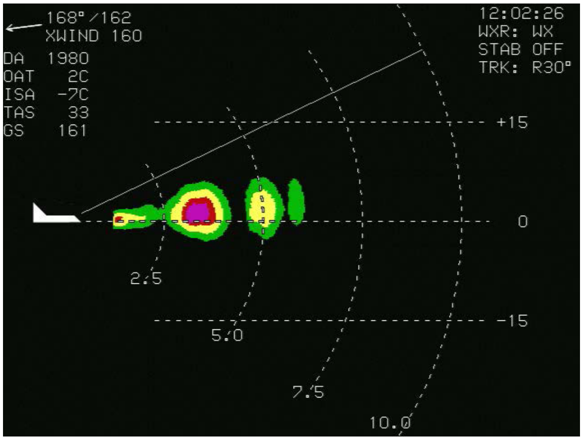


Figure 5-93: Profile Weather Depiction

Pilot selection of the profile depiction is performed using a separate Weather Radar Control Panel. The IDU ensures at least one weather radar-enabled screen is showing the weather radar page prior to entering into the profile depiction. The IDU also automatically disables profile depiction if the pilot sets up the screens so no weather radar page is shown on any weather radar-enabled screen. The purpose of this is to maximize the availability of weather radar information on the moving map. The moving map only shows a horizontal depiction. The IDU automatically disables profile depiction if the weather radar mode is set to off or standby via Radar Control Panel.

5.76. Weather Screen Range (IDU-450 Only)

Weather screen range is pilot-selectable. Selection is made through either ❶ (RDR-2000 and RDR-2100 weather radar types) or a control panel directly attached to the weather radar receiver-transmitter. Weather screen range is displayed as a series of equidistant dashed arcs centered upon the ownship symbol to help the pilot judge range to the displayed weather radar returns. For most screen ranges, there are four equidistant dashed arcs. When in 2SNM range, there are five equidistant dashed arcs. Each arc is labeled with distance in nautical miles at its right-most point (horizontal depiction) or bottom-most point (profile depiction). In the profile depiction mode, there are also be three horizontal altitude lines drawn relative to the aircraft's altitude to help the pilot judge the vertical distance to the displayed weather radar returns. The center line is level with the ownship symbol to represent the aircraft's altitude. The other two lines is equally spaced above and below the center line to represent altitude differences above and below the aircraft. The number of feet above and below the aircraft varies with the selected range to compensate for the radar scan width at the different ranges.

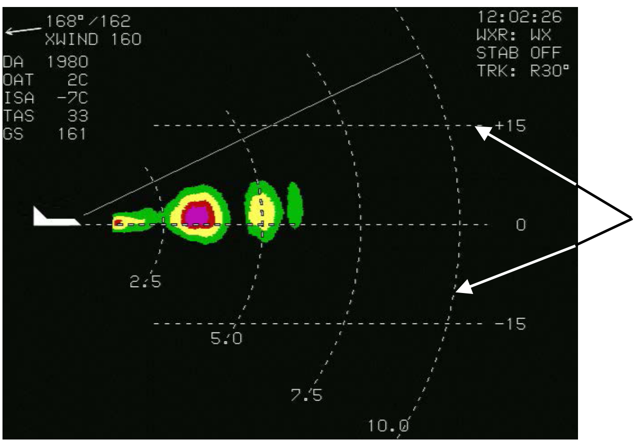


Figure 5-94: Weather Screen Range

Control of screen ranges is dependent on weather radar Installed. The RDR-2000 and RDR-2100 weather radar units internally control screen range from the ownship as follows:

1) SNM (RDR-2100 Only)

2) 10NM, 20NM, 40NM, 80NM, 160NM, 240NM, and 320NM (RDR-2100).

5.77. Track Line (IDU-450 Only)

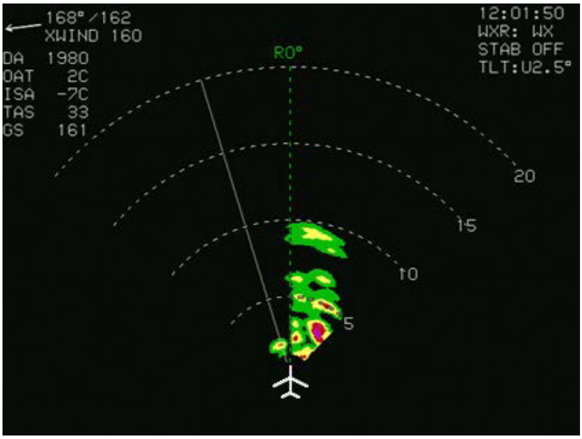


Figure 5-95: Track Line (RDR-2000/2100 Only)

When the weather radar type is RDR-2000 or RDR-2100 and the horizontal depiction is being shown, a dashed track line appears emanating from the ownship symbol to the outer dashed arc. The value of the track line in whole degrees left or right of aircraft heading is displayed adjacent to the outer end of the track line.

5.78. Active Flight Plan Path/Manual Course/Runways (IDU-450 Only)

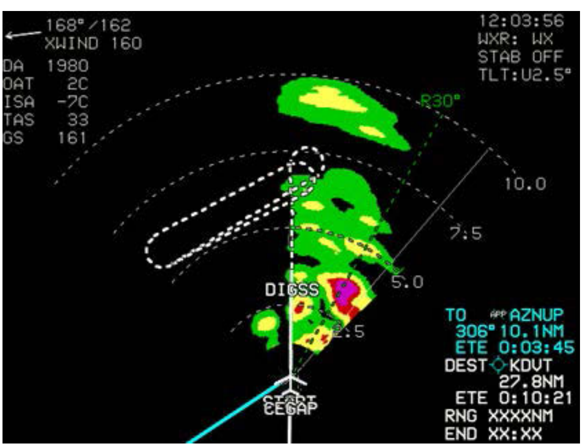


Figure 5-96: Active Flight Plan Path/Manual Course/Runways

The active flight plan path, waypoints, and manual course appear when the weather radar screen is showing horizontal depiction.

The weather radar screen displays airport runways when the weather radar screen is showing horizontal depiction.

Depicting the flight plan paths, manual course, and runways on the weather radar screen showing horizontal orientation is pilot-selectable.

5.79. Weather Radar Return Data (IDU-450 Only)

Weather radar return data is displayed on the weather radar screen in its correct relationship to the ownship symbol.

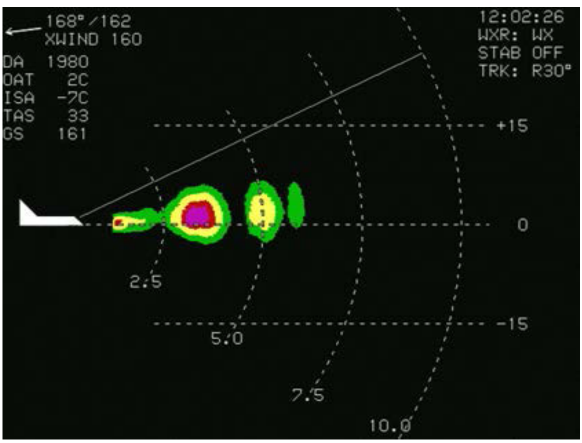


Figure 5-97: Weather Radar Return Data

Weather radar return data is displayed as colored regions according to the value of the ARINC 453 3-bit range bins as follows:

Table 5-2: Weather Radar Return Data

Color	Meaning
BLACK	No Returns
GREEN	Low-Level Weather or Low-Level Ground Returns
AMBER (YELLOW)	Mid-Level Weather or Mid-Level Ground Returns

Table 5-2: Weather Radar Return Data

Color	**Meaning**
RED	Third-Level Weather Returns. This color is replaced with BLACK when in MAP mode. MAP mode is encoded in ARINC 453 label 055 and 171 bits 27-29 as 010b.
MAGENTA	Fourth-Level Weather or Third-Level Ground Returns. With an RDR-2000 or RDR-2100 weather radar type, this color alternates between MAGENTA and BLACK at 1Hz when the internal submode is WXA.
CYAN	Automatic Range Limit Returns. Indicates areas of unreliable returns due to radar power absorption
LIGHT GRAY	Moderate Turbulence Returns
WHITE	Severe Turbulence Returns

The following weather radar-specific warnings appear in a conspicuous area adjacent to the weather radar return data so they do not conflict with the weather radar return data. Only one weather radar-specific warning appears at any given time, with the following order of precedence:

1) **WX ALRT**: Shown when a weather alert condition is active. A weather alert condition is indicated according to weather radar type as follows:

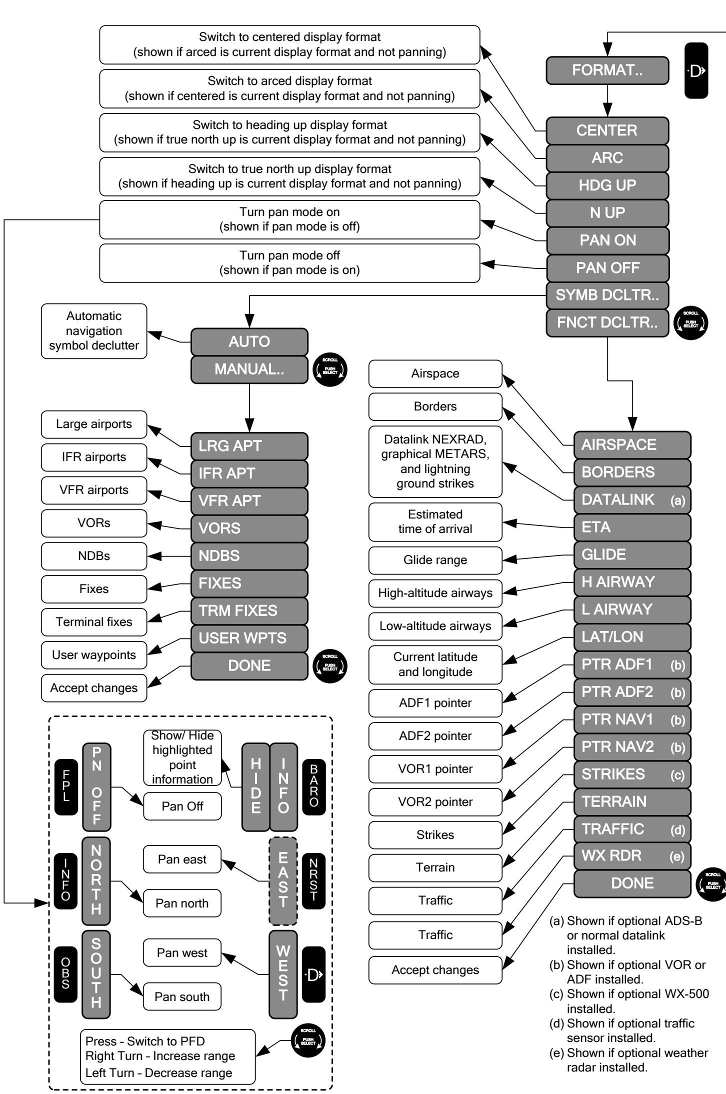
   a) ARINC 708-6: ARINC 453 label 055 Bit 15
   b) Collins 800/840: ARINC 453 label 055 Bit 15
   c) Honeywell Primus: ARINC 453 label 055 Bit 12
   d) Honeywell RDR-2000/2100: ARINC 453 label 055 or label 171 Bit 20

2) **TURB ALRT**: Shown when a turbulence alert condition is active.

3) **STAB LIMIT**: Shown when the aircraft attitude has moved to a point where the weather radar antenna is no longer effectively stabilized.

4) **ANT FAULT**: Shown when the weather radar antenna is temporarily dislodged by turbulence.

5.80. MFD ND Screen (FORMAT) Menu



* BARO bezel button is applicable to IDU-IV only. It is replaced with HDG bezel button on IDU-III.

Figure 5-98: Flowchart, MFD ND Screen Format (FORMAT) Menu

5.81. Scale the Moving Map

Scroll the encoder clockwise to increase scale, and counter-clockwise to decrease scale. Map scales available are 0.5, 1, 2.5, 5, 10, 25, 50, 100, and 200 nautical miles.

5.82. Change Moving Map Format

In addition to the moving map, the MFD displays an HSI, Navigation Log, dedicated Lightning display, dedicated Traffic display, dedicated Datalink display, Weather Radar, and Hover Page (when configured and or applicable for type aircraft).

1) Press **MENU (R1)**.

2) Press **Function.. (R3)**

3) Scroll ❶ to highlight desired function (**MAP**, **HSI**, **NAV LOG**, **STRIKES**, **TRAFFIC**, **DATALINK**, **WX RDR**, or **HOVER** (where applicable).

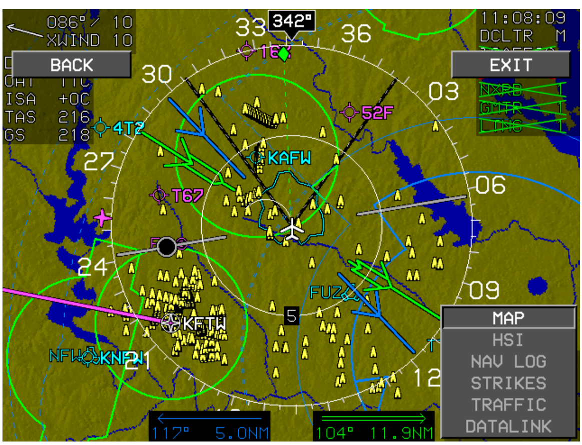


Figure 5-99: Change Moving Map Format

5.83. Centered or Arc Format

1) Press **MENU (R1)**.

2) Press **FORMAT.. (R4)**.

3) Scroll ❶ to highlight **CENTER** or **ARC** and push to enter.

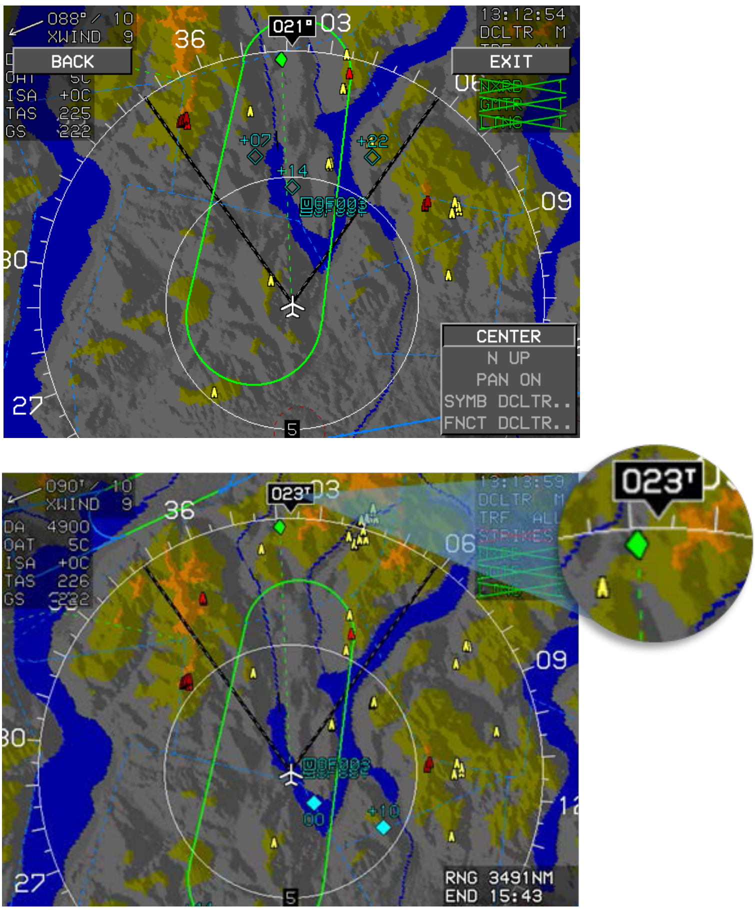


Figure 5-100: Arced Display Format Heading-Up Orientation (True North Mode)

5.84. Heading-Up or North-Up Format

1) Press **MENU (R1)**.

2) Press **FORMAT.. (R4)**.

3) Scroll ❶ to highlight **HDG UP** or **N UP** and push to enter.

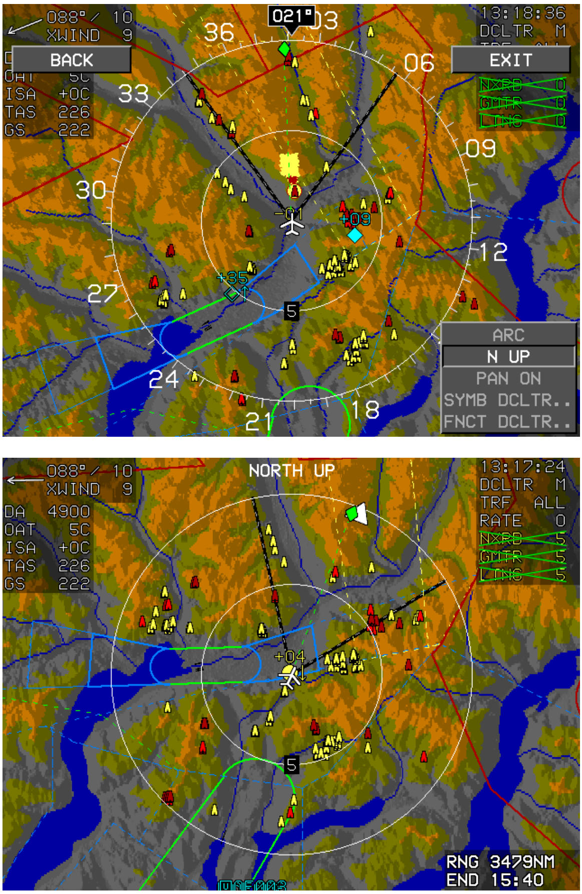


Figure 5-101: Centered Display Format North-Up Orientation

5.85. Pan Mode

The ND screen has a pan mode to allow the pilot to change the location of the center of the screen away from current location. The purpose of pan mode is to allow the pilot to view map details along the route of flight and at the intended destination or alternate destination. When pan mode is active, controls are present to allow the pilot to move the pan mode location North, South, East, and West. The pan mode display format is always in North-up orientation with display format always centered. Upon entering the pan mode, the heading pointer, track pointer, lubber line, way-point pointer, and FOV lines are removed from the display. Entering the pan mode hides the display of all the analog navigation symbology and engine out glide range. When pan mode is active a line from the map center to the aircraft's current position is drawn. When pan mode is active bearing and distance to the map center is displayed above the ownship symbol when the aircraft is more than 0.5 NM away. If referenced to magnetic North, the bearing uses the degree (°) symbol. Otherwise, a stylized True North (^{T}) symbol is used. When panning, the nearest displayed airport, VOR, NDB, or fix within the inner range ring is highlighted with a flashing circle. When such a point is highlighted, controls are present to allow the pilot to view and hide the waypoint information (including datalink weather information) associated with that point. Exiting the pan mode restores the ND settings in place before pan mode was enabled.

1) Press **MENU (R1)** and **FORMAT.. (R4)**.

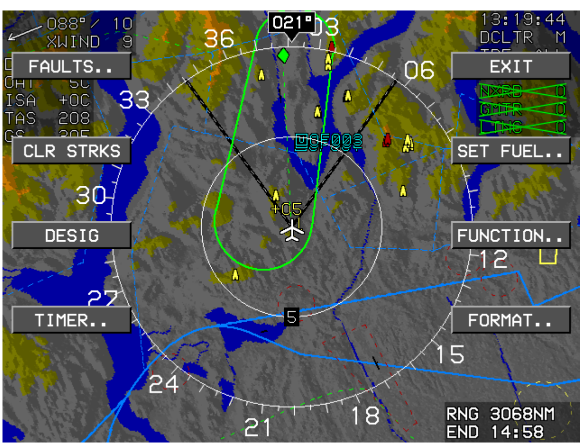


Figure 5-102: Pan Mode

2) Scroll ❶ to **Pan On** and push to enter.

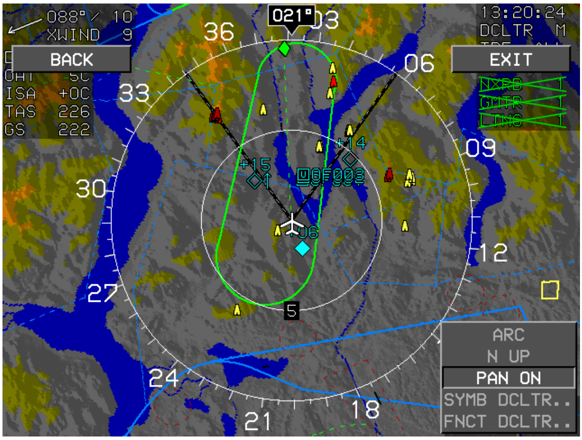


Figure 5-103: Pan On

3) Press button adjacent to desired direction of pan operation.

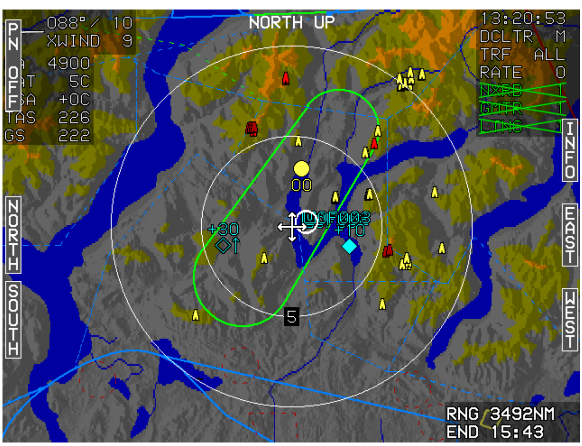


Figure 5-104: Direction of Pan Operation

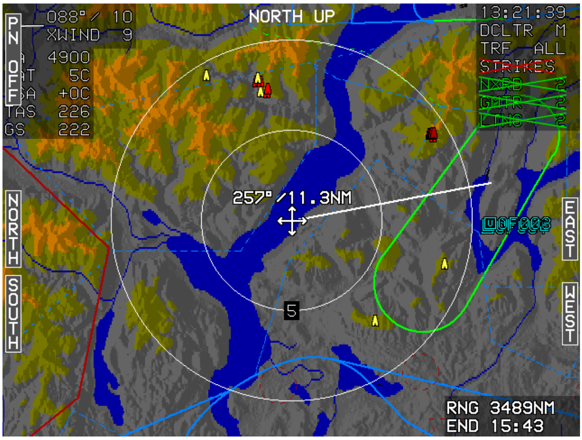


Figure 5-105: Bearing and Distance from Current Position

4) Bearing and distance from current position is drawn. A highlighted circle is presented with **INFO (R2)**.

5) The highlighted circle information for Tuba City is presented. To remove it, press button adjacent to **HIDE (R2)**.

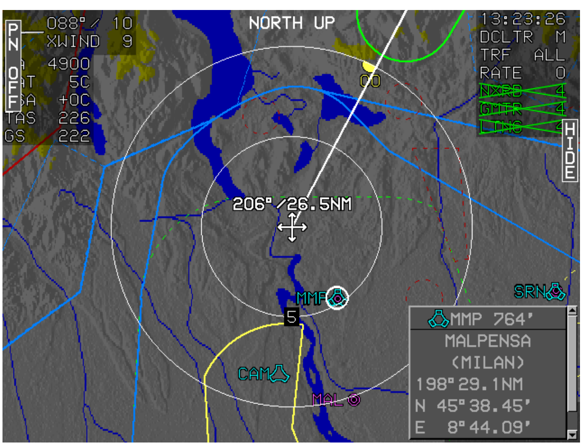


Figure 5-106: Highlighted Circle Information

6) To create a user waypoint press **MENU (R1)** and **DESIG (L3)**.

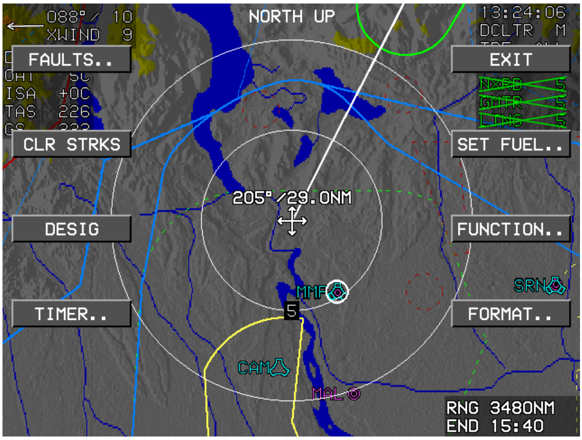


Figure 5-107: Create a User Waypoint

7) Overfly **OF007** is created.

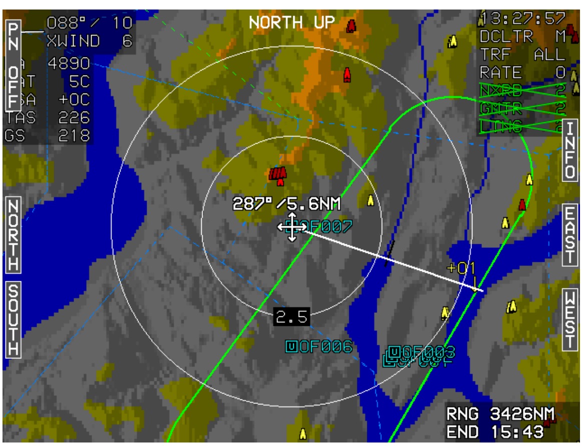


Figure 5-108: Waypoint Created

8) User waypoint of **OF007**. Bearing and distance from original position.

Figure 5-109: Bearing and Distance from Original Position

5.86. Declutter the Moving Map

The moving map may be decluttered in two ways; removing navigation symbology, and removing display functions (e.g., terrain, traffic, or lightning).

5.86.1. Manual Declutter Navigation Symbology

1) Press **MENU (R1)**.

2) Press **FORMAT.. (R4).**

3) Scroll ❶ to highlight **SYMB DCLTR..** then push to enter.

4) Select **MANUAL..** Auto settings are optimized factory defaults.

5) Scroll ❶ to highlight desired elements, and push to enable or disable. A check mark after an element indicates ON.

6) Scroll ❶ to select **DONE** and push to enter.

5.86.2. Auto Declutter Navigation Symbology

To set the system for automatic decluttering:

1) Press **MENU (R1)**.
2) Press **FORMAT.. (R4).**
3) Scroll ➊ to highlight **SYMB DCLTR..** then push to enter.
4) Scroll ➊ to highlight **AUTOMATIC** and push to enter.

5.87. Declutter Display Functions

1) Press **MENU (R1)**.
2) Press **FORMAT.. (R4)**.
3) Scroll ➊ to highlight **FNCT DCLTR..** and push to enter.
4) Scroll ➊ to highlight functions, and push to enable or disable. A check mark after a function Indicates ON.
5) Scroll ➊ to select **DONE** and push to enter.

NOTE:

Settings are retained when powered down.

5.87.1. Airspace-Show/Hide Terrain (Moving Map)

1) Press **MENU (R1)**.
2) Press **FORMAT.. (R4)**.
3) Scroll ❶ to select the **FNCT DCLTR** and push to enter.
4) Scroll ❶ to select Airspace.
5) Push ❶ to turn on or off terrain (a check mark indicates Airspace ON).
6) Select **DONE** and push to enter when finished.

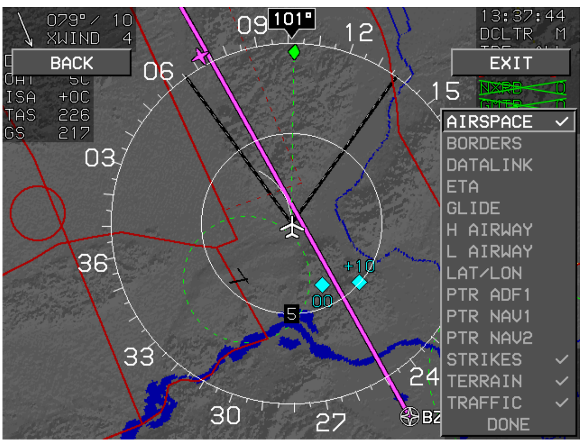


Figure 5-110: Airspace-Show/Hide Terrain (Moving Map)

5.87.2. Borders-Show/Hide Terrain (Moving Map)

1) Press **MENU (R1)**.
2) Press **FORMAT.. (R4)**.
3) Scroll ❶ to select the **FNCT DCLTR** and push to enter.
4) Scroll ❶ to select **BORDERS**. (Drawn at MAP scales 50NM or greater)
5) Push ❶ to turn on or off terrain (a check mark indicates Borders ON).

6) Select **DONE** and push to enter when finished.

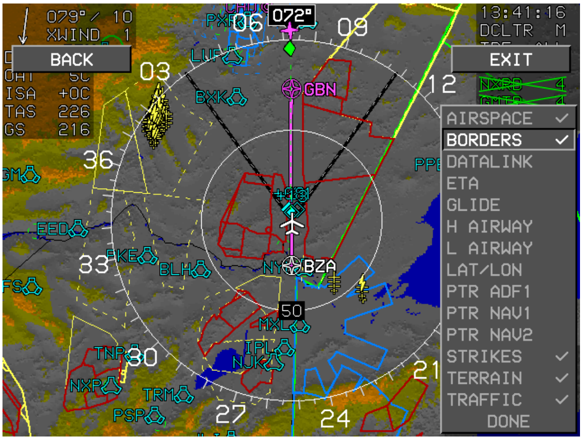


Figure 5-111: Borders-Show/Hide Terrain (Moving Map)

5.87.3. Datalink-Show/Hide Terrain (Moving Map)

1) Press **MENU (R1)**.
2) Press **FORMAT.. (R4)**.
3) Scroll ➊ to select the **FNCT DCLTR** and push to enter.
4) Scroll ➊ to select **DATALINK** and push to enter.
5) Push ➊ to turn on or off terrain (a check mark indicates Datalink ON).
6) Select **DONE** and push to enter when finished.

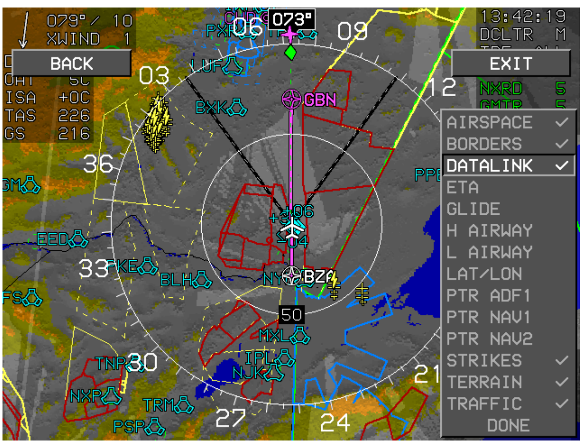


Figure 5-112: Datalink-Show/Hide Terrain (Moving Map)

5.87.4. ETA-Show/Hide Terrain (Moving Map)

1) Press **MENU (R1)**.
2) Press **FORMAT.. (R4)**.
3) Scroll ❶ to select the **FNCT DCLTR** and push to enter.
4) Scroll ❶ to select **ETA** (a check mark indicates ETA ON).
5) Push ❶ to turn on or off terrain
6) 3) Scroll ❶ to **DONE** and push to enter when finished.

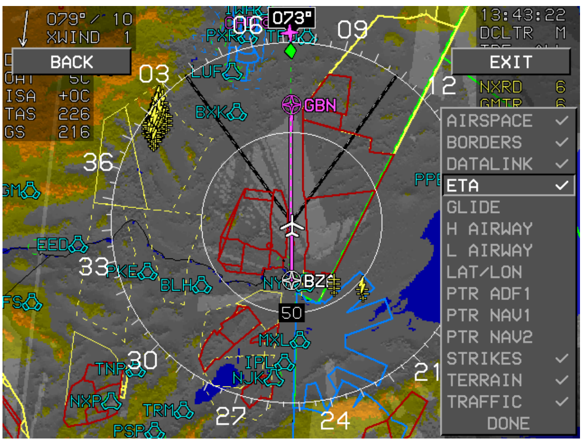


Figure 5-113: ETA-Show/Hide Terrain (Moving Map)

5.87.5. H Airway-Show/Hide Terrain (Moving Map)

1) Press **MENU (R1)**.

2) Press **FORMAT.. (R4)**.

3) Scroll ➊ to select the **FNCT DCLTR** and push to enter.

4) Scroll ➊ to select **H AIRWAY**.

5) Push ➊ to turn on or off terrain (a check mark indicates **H AIRWAY ON**).

6) Scroll ➊ to **DONE** and push to enter when finished.

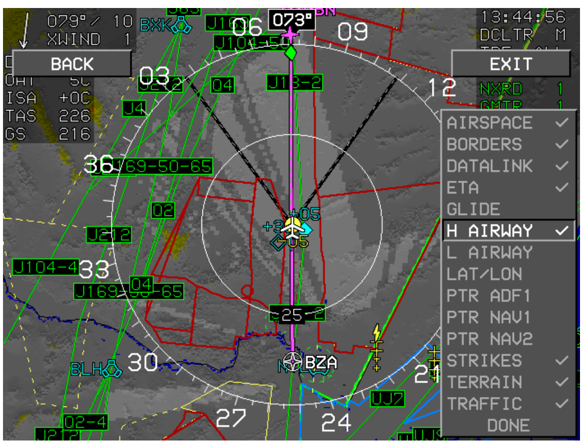


Figure 5-114: H Airway-Show I Hide Terrain (Moving Map)

5.87.6. L Airway-Show/Hide Terrain (Moving Map)

1) Press **MENU (R1)**.
2) Press **FORMAT.. (R4)**.
3) Scroll ➊ to select the **FNCT DCLTR** and push to enter.
4) Scroll ➊ to select **L AIRWAY**.
5) Push ➊ to turn on or off terrain (a check mark indicates **L AIRWAY ON**).
6) Scroll ➊ to **DONE** and push to enter when finished.

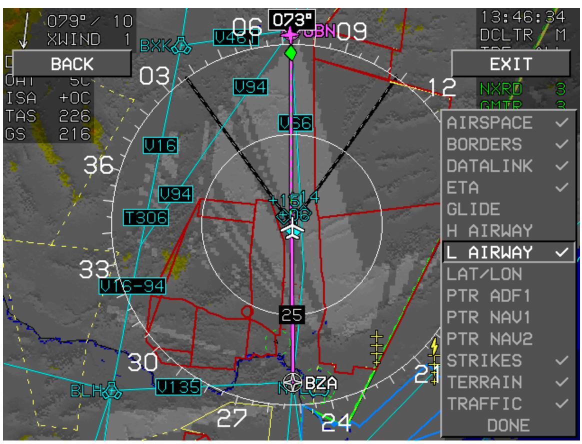


Figure 5-115: L Airway-Show/Hide Terrain (Moving Map)

5.87.7. LAT/LON-Show/Hide Terrain (Moving Map)

1) Press **MENU (R1)**.
2) Press **FORMAT.. (R4)**.
3) Scroll ❶ to select the **FNCT DCLTR** and push to enter.
4) Scroll ❶ to select **LAT/LON**.
5) Push ❶ to turn on or off terrain (a check mark indicates LAT/LON ON).
6) Select **DONE** and push to enter when finished.

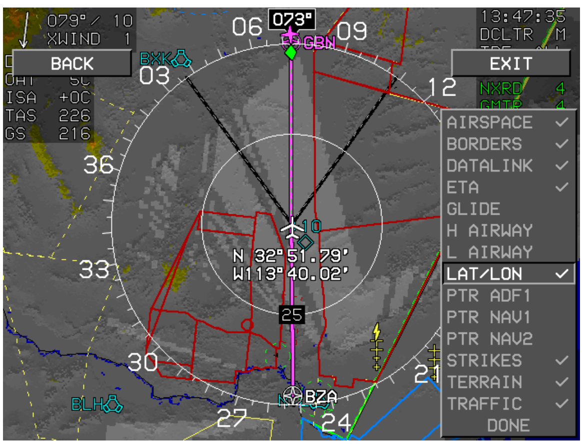


Figure 5-116: LAT/LON-Show/Hide Terrain (Moving Map)

5.87.8. PTR ADF1-Show/Hide Terrain (Moving Map)

1) Press **MENU (R1)**.
2) Press **FORMAT.. (R4)**.
3) Scroll ➊ to select the **FNCT DCLTR** and push to enter.
4) Scroll ➊ to select **PTR ADF1**.
5) Push ➊ to turn on or off terrain (a check mark indicates PTR ADF1 ON).
6) Select **DONE** and push to enter when finished.

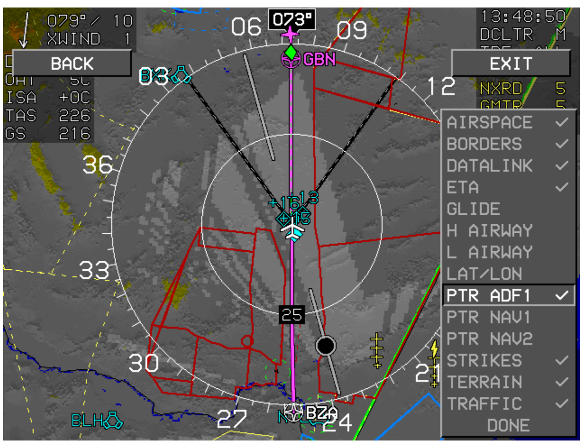


Figure 5-117: PTR ADF1-Show/Hide Terrain (Moving Map)

5.87.9. PTR NAV1-Show/Hide Terrain (Moving Map)

1) Press **MENU (R1)**.

2) Press **FORMAT.. (R4)**.

3) Scroll ❶ to select the **FNCT DCLTR** and push to enter.

4) Scroll ❶ to select **PTR NAV1**.

5) Push ❶ to turn on or off terrain (a check mark indicates PTR NAV1 ON).

6) Scroll ❶ to **DONE** and push to enter when finished.

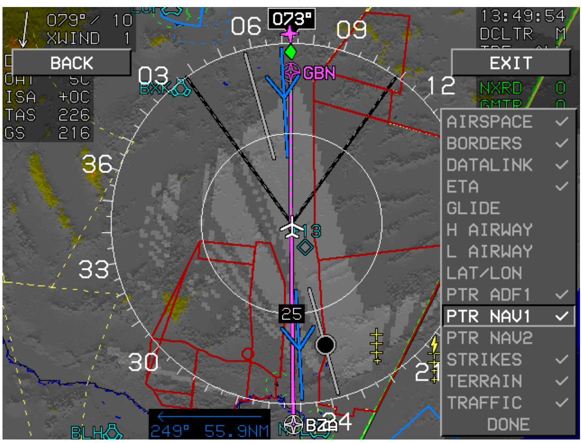


Figure 5-118: PTR NAV1-Show/Hide Terrain (Moving Map)

5.87.10. PTR NAV2-Show/Hide Terrain (Moving Map)

1) Press **MENU (R1)**.

2) Press **FORMAT.. (R4)**.

3) Scroll ❶ to select the **FNCT DCLTR** and push to enter.

4) Scroll ❶ to select **PTR NAV2**.

5) Push ❶ to turn on or off terrain (a check mark indicates **PTR NAV2 ON**).

6) Scroll ❶ to **DONE** and push to enter when finished.

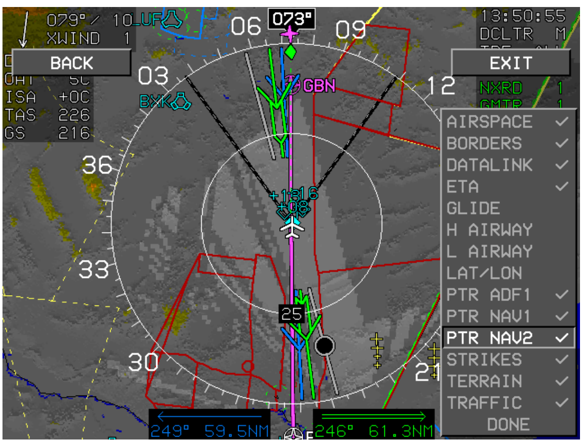


Figure 5-119: PTR NAV2-Show/Hide Terrain (Moving Map)

NOTE:

This option is only available with the optional nav interface. Pointers are only shown if a valid nav signal is present, or the ADF is computing a bearing.

5.88. Terrain-Show/Hide Terrain (Moving Map)

1) Press **MENU (R1)**.

2) Press **FORMAT.. (R4)**.

3) Scroll ❶ to select the **FNCT DCLTR** and push to enter.

4) Scroll ❶ to select **TERRAIN**.

5) Push ❶ to turn on or off terrain (a check mark indicates **TERRAIN** on).

6) Scroll ❶ to **DONE** and push to enter when finished.

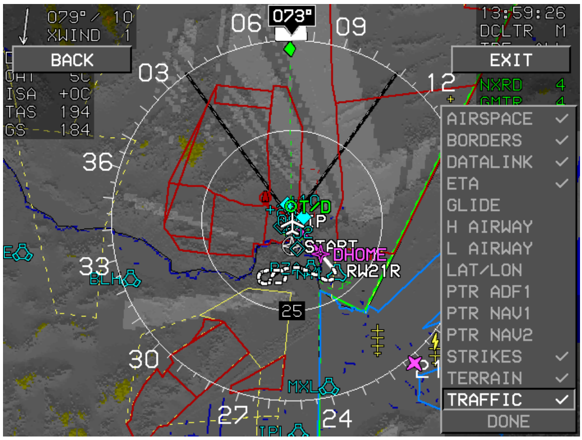


Figure 5-120: Terrain-Show/Hide Terrain (Moving Map)

NOTE:

Terrain and obstructions are controlled simultaneously. If hidden through Function Declutter, terrain and obstructions turn on automatically in the event a threat is detected.

NOTE:

An altitude alert tone sounds at 1000 ft. or 50% of VSI, if greater, from uncaptured VNAV waypoint altitudes.

5.89. Controlling the Displays-Change MFD Display Pages

Push the encoder to advance to the next display. The order is PFD followed by the Navigation Display and back to the PFD.

NOTE:

The primary PFD display in the aircraft cannot be changed to MFD.

5.89.1. Show/Hide Terrain (Moving Map)

1) Press **MENU (R1)**.
2) Press **FORMAT.. (R4)**.
3) Scroll ❶ to select the **FNCT DCLTR** and push to enter.
4) Scroll ❶ to select **TERRAIN**.
5) Push ❶ to turn on or off terrain (a check mark indicates TERRAIN on).
6) Scroll ❶ to **DONE** and push to enter when finished.

NOTE:

Terrain and obstructions are controlled simultaneously. If hidden, terrain and obstructions turn on automatically when a threat is detected.

5.89.2. Show/Hide LAT/LON (Moving MAP)

Current latitude and longitude may be shown on the navigation display.

1) Press **MENU (R1)**.
2) Press **FORMAT.. (R4)**.
3) Scroll ❶ to select the **FNCT DCLTR** and push to enter.
4) Scroll ❶ to select **LAT/LON**.
5) Push ❶ to toggle LAT/LON on or off (a check mark indicates LAT/LON ON).
6) Scroll ❶ to **DONE** and push to enter when finished.

Upon selecting the MFD format menu when in the ND screen, an option appears with the following options:

1) **CENTER/ARC**: Toggles between a centered and arced ND display format (if not panning).
2) **HDG UP/N UP**: Toggles between a heading up and a True North up ND display format (if not panning).

3) **PAN ON/PAN OFF**: Toggles ND screen pan mode.

4) **SYMB DCLTR**: Activates an option list for 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:

   a) large airports

   b) IFR airports

   c) VFR airports

   d) VORs

   e) NDBs

   f) fixes

   g) terminal fixes and user waypoints

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

5) **FNCT DCLTR**: Select this option activates an option list and allow the pilot to individually toggle display of:

   a) airspace

   b) borders

   c) datalinked NEXRAD, graphical METARs and lightning ground strikes (if datalink or ADS-B option is enabled)

   d) estimated time of arrival (ETA)

   e) glide range (if glide ratio is enabled and set in the limits, airplane configuration only)

   f) high-altitude airways

   g) low-altitude airways

   h) current latitude and longitude

   i) display of ADF # 1 pointer (if ADF symbology is enabled)

j) display of ADF #2 pointer (if dual ADF symbology is enabled)

k) display of VOR1 pointer (if VOR symbology is enabled)

l) display of VOR2 pointer (if dual VOR symbology is enabled)

m) display of strikes (if WX-500 option is enabled)

n) display of terrain

o) display of traffic (if traffic option is enabled); and

p) display of weather radar (if weather radar option is enabled)

5.90. MFD HSI Pointer (POINTERS) Menu

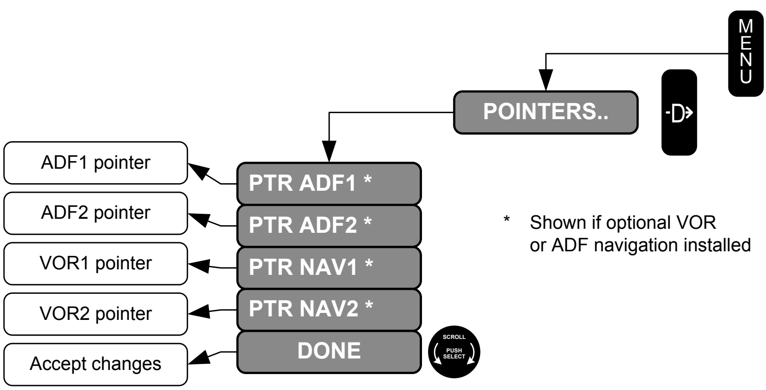


Figure 5-121: Flowchart, MFD HSI Pointer (POINTER) Menu

Upon selecting the **HSI** pointers menu when in the HSI screen, an option list appears to allow the pilot to individually select:

1) Display of ADF1 pointer (if ADF symbology is enabled);

2) Display of ADF2 pointer (if dual ADF symbology is enabled);

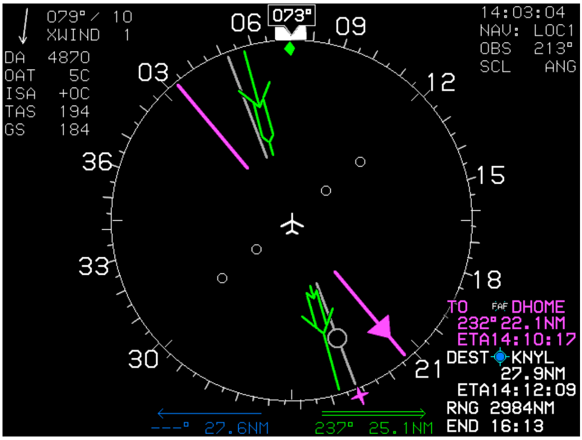
3) Display of VOR1 pointer (if VOR symbology is enabled); and

4) Display of VOR2 pointer (if dual VOR symbology is enabled)

5.90.1. Show/Hide VOR and ADF Pointers on Conventional HSI

A dual Pointer (Similar to RMI) may be displayed on the conventional HSI.

1) When the MFD function has been changed to HSI as described in Section 3 Display Symbology, press **MENU (R1)**.
2) Press **POINTERS.. (R4)**.
3) Scroll ➊ through the list and select from **PTR ADF1, PTR ADF2, PTR NAV1**, **or PTR NAV2.**
4) Push ➊ to toggle on or off (a check mark Indicates on).
5) Scroll ➊ to **DONE** and push to enter when finished.



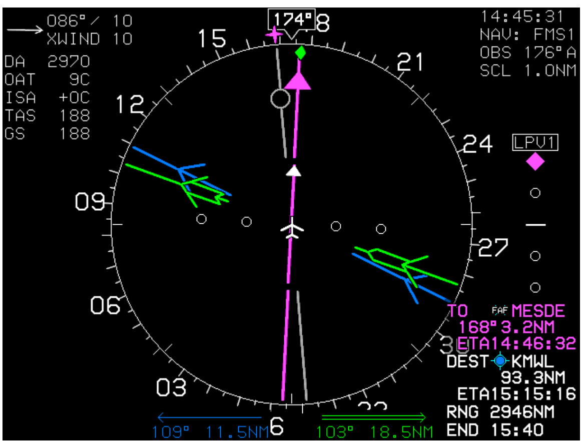


Figure 5-122: Show/Hide VOR and ADF Pointers on Conventional HSI

5.91. MFD Strike Format (FORMAT) Menu

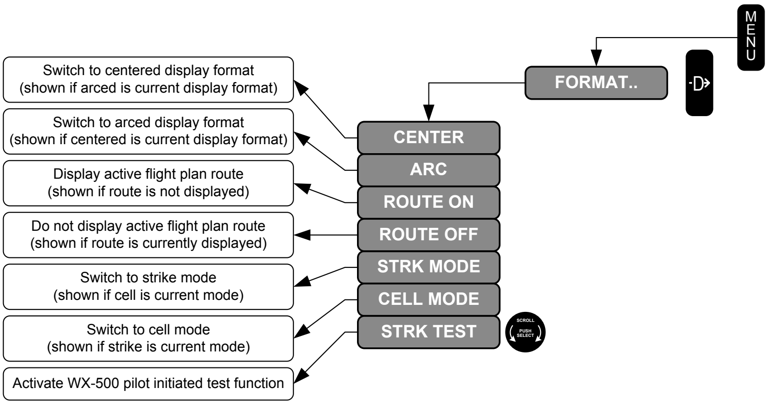


Figure 5-123: Flowchart, MFD Strike Format (FORMAT) Menu

Upon selecting the **MFD** format menu when in the Strike screen, an option list appears with the following options:

1) **CENTER/ARC:** Toggles between a centered and arced Strike screen display format.
2) **ROUTE ON/ROUTE OFF:** Toggles showing the active flight plan route on the Strike screen.
3) **STRK MODE/CELL MODE:** Toggles between strike mode strikes and cell mode strikes on the Strike screen.
4) **STRK TEST:** Activates the WX-500 pilot initiated test function.

5.92. Strikes-Show/Hide Strikes (Moving Map)

1) Press **MENU (R1)**.
2) Select the **FUNCTION.. (R3)**.
3) Scroll ❶ to select **STRIKES** and push to enter.
4) To return to the MAP page, press **MENU (R1)**, **FUNCTION (R3)**, and push ❶ to enter.

5.93. Controlling the Stormscope Display

These procedures are only available when a WX-500 Stormscope is connected to the system and enabled.

5.93.1. Centered or Arc Format

1) Press **MENU (R1)**.

2) Press **FORMAT.. (R4)**.

3) Scroll ➊ to highlight **CENTER** or **ARC** and push to enter.

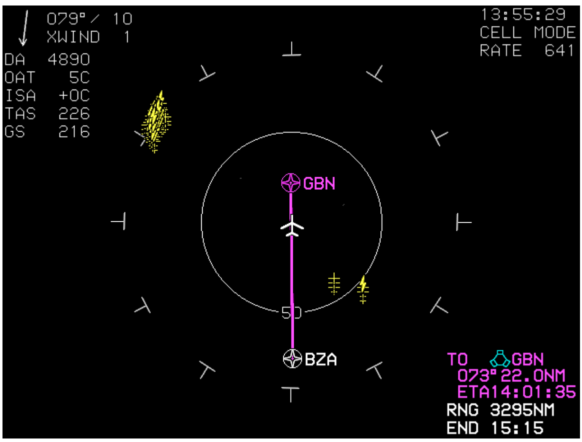


Figure 5-124: Stormscope Display (Centered Format)

Figure 5-125: Stormscope Display (Arced Format)

5.93.2. Route On or Route Off

To show or hide the active route while in the dedicated Stormscope display function:

1) Press **MENU (R1).**

2) Press **FORMAT.. (R4)**.

3) Scroll ❶ to highlight **ROUTE ON** or **ROUTE OFF**, push to enter.

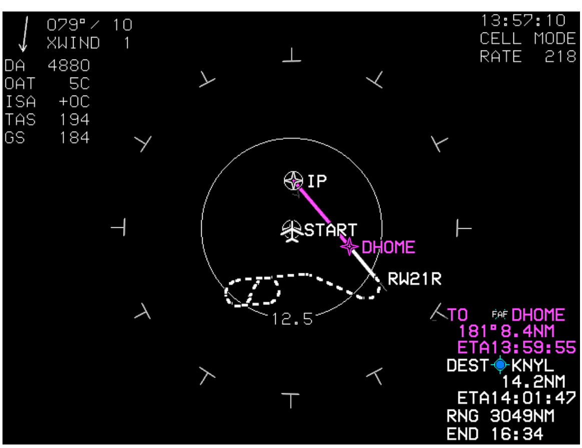


Figure 5-126: Route On or Route Off

5.93.3. Strike or Cell Mode

1) Press **MENU (R1)**.
2) Press **FORMAT.. (R4)**.
3) Scroll ➊ to highlight **STRK MODE** or **CELL** Mode and push to enter.

5.93.4. Clear Strikes

To clear residual strike symbols from the display:

1) Press **MENU (R1)**.
2) Press **CLR STRKS.. (L2)**. Strikes are cleared from screen.

5.93.5. Strike Test

To perform a pilot-initiated test of the WX-500 system:

1) Press **MENU (R1)**.
2) Press **FORMAT.. (R4)**.
3) Scroll ➊ to highlight **STRK TEST** and push to enter.

See the WX-500 documentation for additional information on controlling this display.

5.94. MFD Traffic Format (FORMAT) Menu

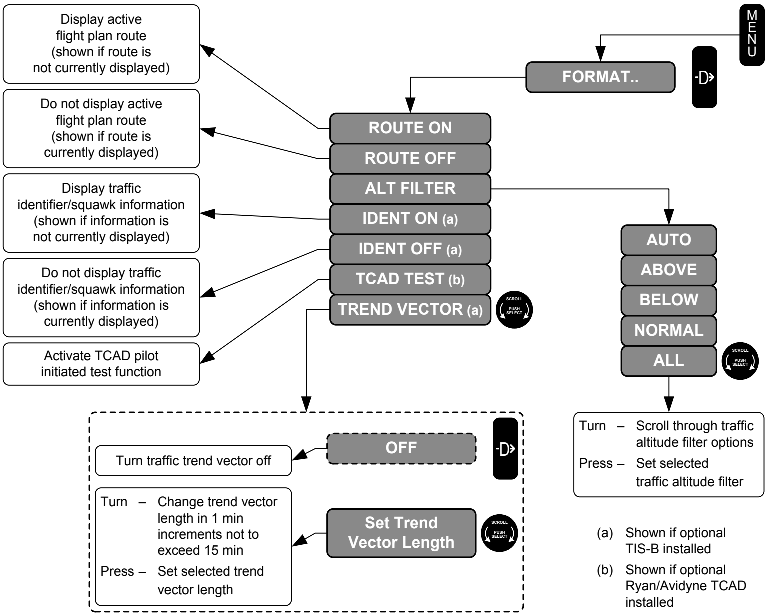


Figure 5-127: Flowchart, MFD Traffic Format (FORMAT) Menu

Upon selecting the MFD format menu when in the Traffic screen, an option list appears with the following options:

1) **ROUTE ON/ROUTE OFF:** Toggles showing the active flight plan route on the Traffic screen.

2) **IDENT OFF/IDENT ON:** When the TCAS flag is TIS B, toggles showing traffic identifier/squawk information.

3) **ALT FILTER:** 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, activates the TCAD pilot initiated test function.

5) **TREND VECTOR:** When the TCAS flag is TIS-B, 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). **OFF (R4)** appears at this level, to allow the pilot to quickly turn off the traffic trend vector.

5.95. Controlling the Traffic Display

These procedures refer 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).

5.95.1. Route On or Route Off

To show or hide the active route while in the dedicated traffic display function:

1) Press **MENU (R1)**.

2) Press **FORMAT.. (R4)**.

3) Scroll ❶ to highlight **ROUTE ON** or **ROUTE OFF** and push to enter.

5.95.2. Traffic Test

If the traffic device is a TCAD, a pilot-initiated test of the TCAD system may be performed:

1) Press **MENU (R1)**.

2) Press **FORMAT.. (R4)**.

3) Scroll ❶ to highlight TCAD TEST and push to enter.

See the TCAD documentation for more information.

NOTE:

See Section 3.43 Traffic.

5.96. Optional TCAS I or TCAS II

The Genesys Aerosystems 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:

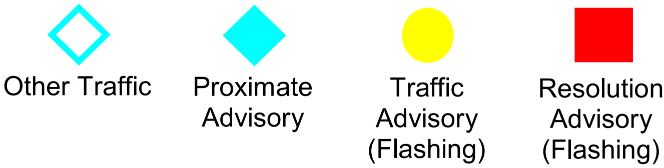


Figure 5-128: TCAS-I, TCAS-II, TAS, and TIS-A Traffic Symbology

Display of other traffic and proximate advisories is altitude-filtered, in accordance with pilot-selected filters as follows:

1) **AUTO**: If aircraft VSI is less-500FPM, traffic within +2,700 and -9,900 feet of aircraft altitude is displayed. If aircraft VSI is more than +500FPM, traffic within -2,700 and +9,900 feet of aircraft altitude is displayed. Otherwise, traffic within -2,700 and +2,700 feet of aircraft altitude is displayed.

2) **ABOVE**: Traffic within -2,700 and +9,900 feet of aircraft altitude is displayed.

3) **BELOW**: Traffic within +2,700 and -9,900 feet of aircraft altitude is displayed.

4) **NORMAL**: Traffic within -2,700 and +2,700 feet of aircraft altitude is displayed.

5) **ALL**: All received traffic is displayed, no altitude filtering is performed.

TCAS rendering rules dictate TA and RA traffic that are off-scale are displayed with half symbols. TA and RA traffic with 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.

5.97. MFD Datalink Format (FORMAT) Menu

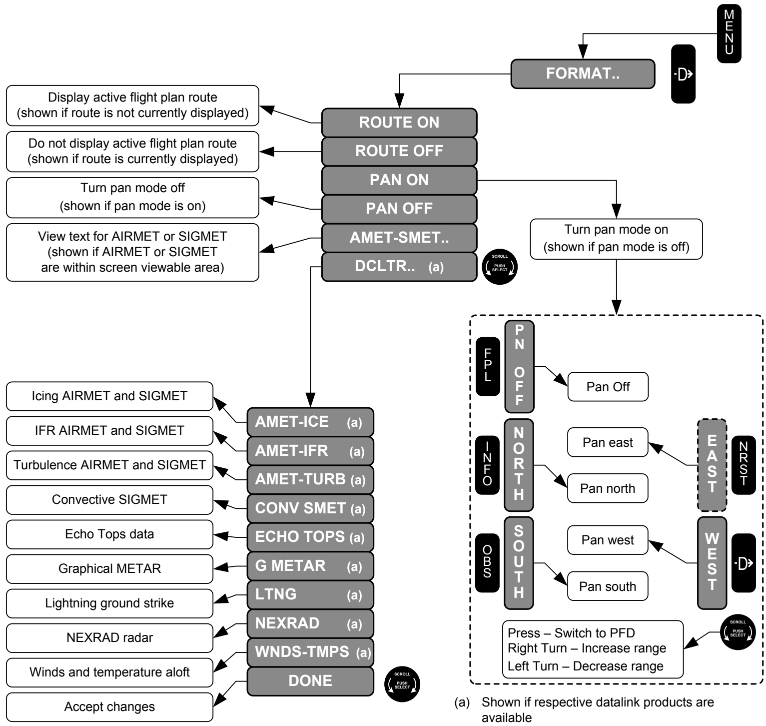


Figure 5-129: Flowchart, MFD Datalink Format (FORMAT) Menu

Upon selecting the MFD format menu when in the Datalink screen, an option list appears with the following options:

1) **ROUTE ON/ROUTE OFF**: Toggles showing the active flight plan route on the Datalink screen.

2) **PAN ON/PAN OFF**: 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. 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. Allows the pilot to select individual datalink weather products for display. Only those datalink weather products available for display appear in the selection box.

5.98. Controlling the Datalink Display

Customers with the optional WSI datalink Installed may receive subscription weather products.

5.98.1. Display Datalink Page

To activate the datalink features from the MFD:

1) Press **MENU (R1)** then **FUNCTION.. (R3)**.

2) Scroll ➊ to highlight **DATALINK** and push to enter.

The main datalink page is displayed. Scroll the encoder to vary the range scale.

5.98.2. Turn On/Off Datalink Products

To select products on or off:

1) Press **MENU (R1)** then **FORMAT.. (R4)**.

2) Scroll ➊ to highlight **DCLTR..** and push to enter.

3) Select the products to be turned on or off. A check mark next to the product name indicates it is turned on. The following products may be available.

   a) AMET-ICE (Airmets for icing)

   b) AMET-I FR (Airmets for IFR flight conditions)

   c) AMET-TURB (Airmets for turbulence)

   d) CONV-SMET (Convective Sigmets)

   e) ECHO-TOPS (Echo tops of convective buildups)

   f) G METAR (Graphical Metars)

   g) LTNG (Lightning Strikes)

   h) NEXRAD (Nexrad radar returns)

i) WNDS-TMPS (Winds and temperatures aloft)-Altitude selectable

5) Select **DONE** when finished, and push to enter.

5.99. 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. Hold one of these direction buttons down to scroll smoothly across the map. When WNDS-TMPS (winds and temperatures) is selected, tiles for UP and DOWN appear on the perimeter of the display. These may be used to select the desired altitude. Selected altitude is annunciated at the bottom of the screen and indicates millibars and flight level.

5.99.1. Changing Range

Scroll the encoder to change range on the map. Maximum range is 1600 NM.

5.100. Display Weather Text

To view text for AIRMET/SIGMET:

1) Press **MENU (R1)** then **FORMAT.. (R4)**.

2) Scroll ❶ to scroll to **AMET-SMET**, and push to enter.

To view text for TAF and METAR:

1) Press **ACTV (L2)** then **INFO**. (If **WNDS-TMPS** were enabled, turn off to have access to ACTV page).

2) Select **EXPAND WX.. (L3)**.

Text data is displayed at the bottom of the screen. The associated area of coverage is shown on the map with a colored border and flashes. Scroll the encoder to scroll through selected areas of coverage. Each in turn flashes to indicate to which area the text refers. Elapsed time indicating the age in minutes of each weather product is shown to the right of the map.

To return to the map display without text, press **EXIT (R1)**.

To return to the map display, press **MENU (R1)** then **FUNCTION (R3)** and push to enter..

5.101. Airport Weather Information

To view selected airport weather information:

1) Press **NRST (R3)** then scroll ➊ **WX..** and push to enter.
2) Scroll through the available list of airports to highlight the choice.
3) Press **INFO (L3)**. Additional weather details may be obtained with this function.
4) Press **WX LEGEND (L2)** to view a legend of weather symbology.

NOTE:

WSI weather datalink services may be received, if the appropriate WSI receiver is installed and subscription services received. 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.

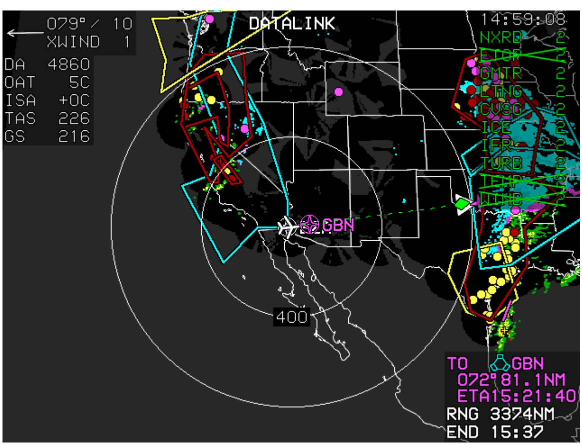


Figure 5-130: WX Depictions

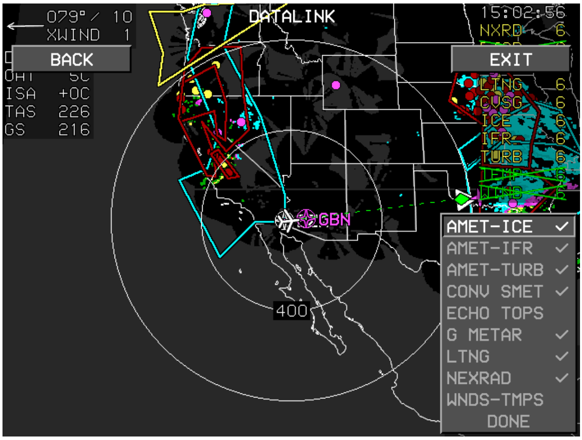


Figure 5-131: Datalink Selections

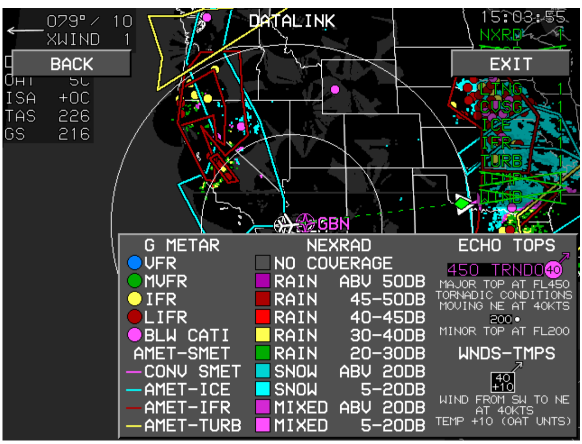


Figure 5-132: Legend of Symbols

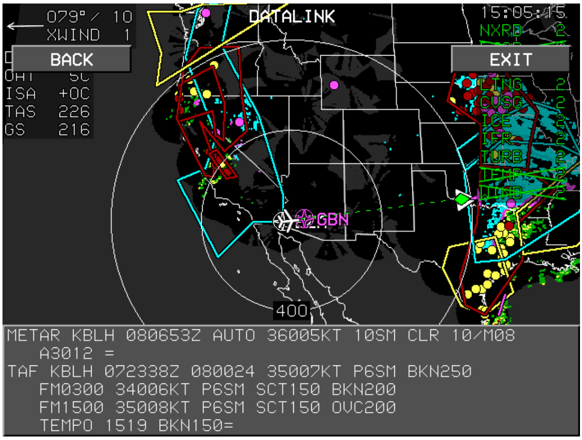


Figure 5-133: Expanded Weather Depictions Data

5.102. Optional ADS-B Datalink and Traffic

Some systems is equipped with optional ADS-B traffic displays. The screens below show sample traffic displayed, along with format options on the MFD. Please refer to the vendor-supplied documentation for further details.

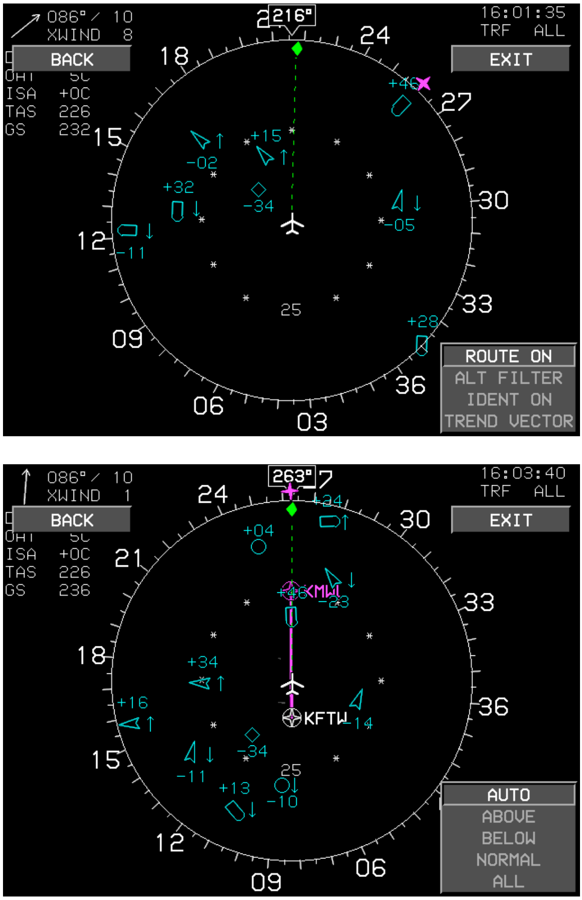
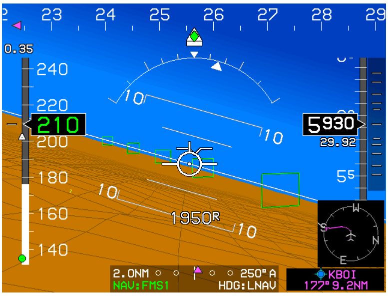


Figure 5-134: Optional ADS-B Datalink and Traffic

Section 6 Quick Start Tutorial

Quick Reference Guide (Doc 64-000053-070E)



Begin by reading the Genesys Aerosystems EFIS Supplement in the aircraft's flight manual. Pay special attention to the Emergency, Abnormal, and Normal Procedures sections (which are included in the Appendix 8 of this guide for reference).

Power up the EFIS. The system performs a built-in test routine. If all tests pass, the system displays a screen identifying the database coverage. Press any button to acknowledge. The system begins a two-minute count down while awaiting sensor initialization (for the purposes of flight planning, etc., press any button to override this countdown).

NOTE:

To ensure proper initialization of the AHRS, wait for a horizon to appear on the PFD before taxiing.

IDU-III

IDU-450

The right-hand encoder is numbered #1 from the right side as noted by ➊.

Scroll ➊ to adjust the heading bug setting. Push ➊ to enter the settings for the IDU-450. For the IDU-III, scroll ➊ to enter the altimeter page and setting of altimeter.

On the MFD, push ➊ to step through the screens:

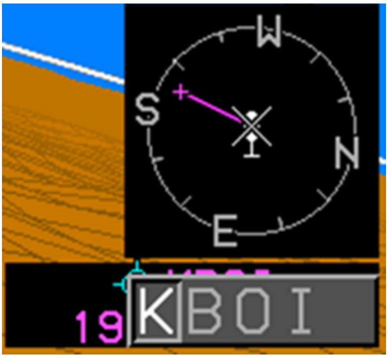
MFD → reversionary PFD

NOTE:

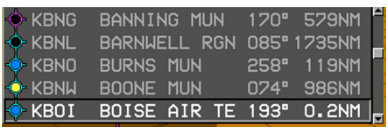
The PFD cannot be changed to an MFD in a 2 screen or more configuration.

MFD. The moving map page, scroll ➊ clockwise to increase scale and counter-clockwise to decrease scale (range is from 1 to 400 miles).

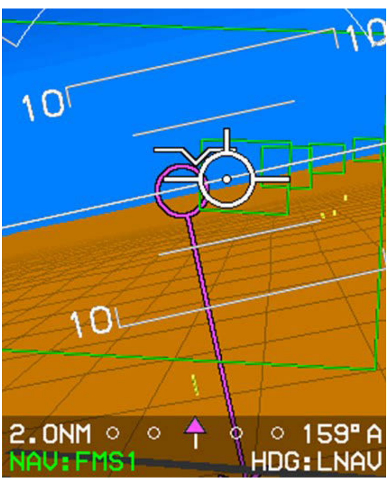
Press the Direct-To button to enter a destination. Use ➊ (scroll to the desired character, push to confirm, and advance to the next position) to enter the desired waypoint.



For example: To enter Boise Airport, scroll to select "B" then push to enter; scroll to select “O" then enter; scroll to select "I" then enter. Push two more times to step through the last two characters spaces (the leading "K" identifier may be entered but is not required). An exact match is accepted and entered automatically.



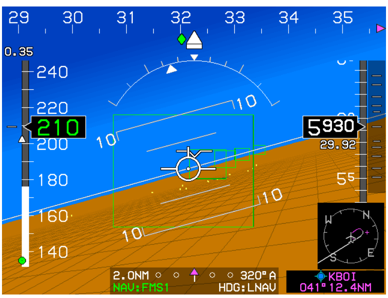
If there is no exact match, a list of potential matches is displayed. Scroll ❶ to highlight the desired waypoint and push to enter.



A route to the selected waypoint is activated. The active waypoint is a tethered balloon displayed on the PFD screen.

A magenta bearing to waypoint symbol is 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 indicates the closest direction to turn.

The waypoint information, indicating waypoint type and identifier, elevation, or crossing altitude, with bearing and distance is displayed immediately below the Mini Map.



Airspeed is on the left, altitude on the right, heading across the top, and a FMS/VLOC CDI at the bottom. VSI is to the right of the altitude tape.

Please read this entire manual and fly with a qualified instructor to gain a detailed understanding of all system features.

Flight Plans (Stored Routes)

Create Flight Plan on MFD Only

1) Press **FPL (L1)**.
2) Scroll ➊ to **CREATE-EDIT..** and push to enter.
3) Scroll ➊ to **CREATE FLIGHT PLAN** and push to enter.
4) Press **ADD (R4)** to begin creating first waypoint with ➊ by entering waypoints from beginning to end.
5) Press **SAVE-EXIT (R1)** to save flight plan.

Activate a Stored Flight Plan

1) Press **FPL (L1)**.
2) Scroll ➊ to highlight **SELECT..** push to enter.
3) Scroll ➊ to highlight desired flight plan and push to enter.

Omnibearing Selector Function

Automatic OBS (FMS OBS Only)

1) Press **OBS (L4)** then select **NAV:FMS (L2)**.

2) Push ➊ **OBS:AUTO** to enter.

Manual OBS

1) Press **OBS (L4)**.

2) Select desired HSI source, press **NAV VLOC1 (L3)** or **NAV VLOC2 (L4)**, or **NAV:FMS (L2)**.

3) If HSI source is NAV FMS, press **OBS MANUAL (R4)** or **OBS SYNC (R3)**.

4) Scroll ➊ to desired **OBS** course and push to enter.

RNP Selection

1) Press **OBS (L4)** then press **RNP (R2)**.

2) Press **RNP MANUAL (R4)** then scroll ➊ to desired OBS value then push to enter.

3) Press **RNP AUTO (R4)** then push ➊ to enter for Automatic RNP operations.

Autopilot Usage

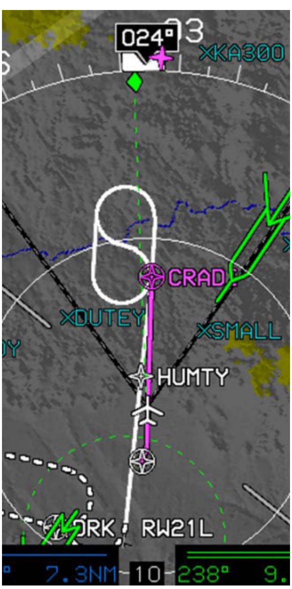
Autopilot Usage

1) Select autopilot in **HEADING** mode.
2) Activate a waypoint, flight plan, **DP**, **STAR**, **IFR APPR**, or manual **GPS OBS**. Use the **HDG (R2)** bug to override any of the above.

Precision Approach

Following step 1 and 2 above then:

3) At the initial approach fix, press **OBS (L4)**, then **NAV:VLOC1 (L3)** or **NAV:VLOC2 (L4)** as appropriate and, use ❶ to set the **OBS** to final approach course. Push to enter.
4) On the inbound course, prior to the final approach fix, select the autopilot In **APPR** mode (or **NAV** mode if appropriate). The autopilot uses the analog signals to fly the coupled approach.



Example of typical approach sequence:

Autopilot is already in Heading mode from enroute legs.

1) 30 miles out, receive ATIS, set altimeter, enter approach procedure and set minimum altitude bug.
2) Tune VLOC frequency and set HSI source. Set the OBS course prior to procedure turn.
3) Select the **APPR** (or **NAV**) function on autopilot when established procedure turn inbound.
4) At the MAWP, select the **HEADING** function on the autopilot and initiate a climb to fly the MAP.

Waypoints

Create a User Waypoint (MFD Only)

1) Press **FPL (L1)**.
2) Scroll ➊ to highlight **CREATE-EDIT..** and push to enter.
3) Scroll ➊ to **CREATE USER WPT (LAT-LON)** and push to enter.
4) Scroll ➊ to create waypoint name, push to enter.
5) Push ➊ to progress and scroll ➊ to make entries.
6) If approach bearing is necessary for VFR APPR option, enter runway bearing.
7) Push ➊ to progress through MAGVAR or change as necessary.
8) Press **EXIT (R1)** to exit flight planner.

Edit a User Waypoint (MFD Only)

1) Press **FPL (L1)**.
2) Scroll ➊ to highlight **CREATE-EDIT..** and push to enter.
3) Scroll ➊ to **EDIT USER WPT** and push to enter.
4) Scroll ➊ to highlight waypoint to be edited and push to enter.
5) Edit waypoint and scroll ➊ to the end of list to save data for new USER WPT data.
6) Press **EXIT (R1)** to exit flight planner.

Activate a New Waypoint to an Active Route

1) Press **ACTV (L2)**.

2) Scroll ❶ to location on waypoint list where added waypoint is to be inserted above.

3) Press ❶ to activate selected way point, or press **(R4)** to go direct to the selected waypoint.

Approach Checklist

1) Approach - Activated

2) Fixes and Altitudes - Confirmed

3) Decision Height or Minimum Altitude - Confirmed

4) Approach Speeds - Set

5) HSI Source - Set

6) OBS - Set

7) Missed Approach - Press **ARM (L2)** at FAF

Direct-To Waypoint

1) Press **(R4)**.

2) Scroll ❶ to enter identifier of desired waypoint. "K" is optional for USA airports. Push ❶ to step through all five empty spaces.

3) If multiple options are listed, scroll ❶ to select and push to enter.

Nearest

1) Press **NRST (R3)**.

2) Scroll ❶, highlight choice of nearest **APT**, **VOR**, **ILS**, **NDB**, **FIX**, **USER**, **ARTCC**, **FSS**, or **WX,** and push to enter.

Re-Center on Direct Route

1) Press  **(R4)**.
2) Active waypoint is displayed.
3) Push ❶ to re-center course.

Delete Waypoint from an Active Route

1) Press **ACTV (L2)**.
2) Scroll ❶ to highlight waypoint to delete
3) Select **DELETE (R3)** menu.
4) Push ❶ to confirm.

DPs/STARs/Approaches

Select DP

(The active flight plan must have an airport with the appropriate procedure.)

1) Press **ACTV (L2)**.
2) Scroll ❶ to highlight take-off airport and push to enter.
3) Scroll ❶ to highlight the following and push to enter:
    a) DP
    b) Desired Departure Procedure
    c) Desired Transition
    d) Desired Runway

NOTE:

Only pilot NAV DPs are available.

Select an IFR Approach

(The active flight plan must have an airport with the appropriate procedure.)

1) Press **ACTV (L2)**.
2) Scroll ❶ to highlight take-off airport and push to enter.
3) Scroll ❶ to highlight the following and push to enter:
    a) IFR APPR
    b) Desired Approach
    c) Desired Transition
    d) Desired Runway

Missed Approach Arming

1) After passing the **FAF** (providing active **WPT** is the **MAP**), press **ARM (L2)**.

2) (If **MAP** specifies minimum climb gradient). On the PFD enter climb angle (ft./nm) from chart using **BUGS (R2)**, then **VNAV CDA (R4)**, **CLMB ANG (R4)**. Scroll ❶ to set desired angle, push to enter.

Select an LPV Approach

(The active flight plan must have an airport with the appropriate procedure.)

1) Press **OBS (L4),** press **FMS (L2) for NAV:FMS** push ❶ to enter

2) Press **ACTV (L2)**.

3) Scroll ❶ to highlight landing airport, push to enter.

4) Scroll ❶ to highlight the following and push to enter.

   a) IFR APPR

   b) Desired Approach with (XXXXX) channel number

   c) Desired Transition

   d) Desired Runway

5) Scroll ❶ to desired way point in **ACTV Flight Plan**.

Select a NRST ILS

1) Press **NRST (R3)**.

2) Scroll ❶ to **ILS..** and push to enter.

3) Scroll ❶ to desired airport ILS/runway and push to enter.

4) Push ❶ to **CONFIRM ACTIVATE ILS**.

Arrivals

Select a STAR

(The active flight plan must have an airport with the appropriate procedure.)

1) Press **ACTV (L2)**.
2) Scroll ➊ to highlighted landing airport and push to enter.
3) Scroll ➊ to highlight the following and push to enter.
   a) STAR
   b) Desired Procedure
   c) Desired Transition
   d) Desired Runway

VNAV

Change VNAV Angles

1) Press **MENU (R1)**.
2) Select the **BUGS (R2)** menu.
3) Scroll ➊ to highlight **VNAV CDA.. (R4)** push to enter.
4) Scroll ➊ to highlight **CLMB ANG..** or **DESC ANG..** and push to enter.
5) Scroll ➊ to set angle, push to enter.

Enroute Descents

1) Press **MENU (R1)**, then select **BUGS.. (R2)**.
2) Scroll ➊ to set a target altitude and push to enter, or select **SYNC (R3)** to stop descent at current altitude.

Approaches/Track

Select a VFR Approach

(The active flight plan must contain an eligible airport for runway selection and VFR approach creation.)

1) Press **ACTV (L2)**.
2) Scroll ➊ to highlight the desired airport or user waypoint, push to enter
3) Scroll ➊ to highlight **VFR APR..** and push to enter
4) Scroll ➊ to select desired runway and push to enter

Change Runway during VFR Approach

1) Press **ACTV (L2)**.
2) Scroll ➊ to highlight the following and push to enter:
    a) Destination airport
    b) **VFR APR..**
    c) Desired runway, push to enter

(This deletes the previous VFR approach and create a new VFR approach to the selected runway.)

Parallel Track Function

1) Press **ACTV (L2)**.
2) Press **PTK.. (L4)**.
3) Scroll ➊ to select desired left or right offset distance in NM increments, push to enter.

To Turn Off Parallel Track

1) Press **ACTV (L2)**.
2) Press **PTK (L4)**.
3) Press **OFF (R4)**.

Timer Functions

Flight Timer

1) Press **MENU (R1)**.
2) Press **TIMER.. (L4)**.
3) Scroll ➊ to **FLT TIME**, push to enter.
4) Timer is displayed for 10 seconds in bottom right hand corner of PFD display.

Count Up

1) Press **MENU (R1)**.
2) Press **TIMER.. (L4)**.
3) Scroll ➊ to highlight **COUNT UP..** and push to enter.

Turn Off Timer

1) Press **MENU (R1)**.
2) Press **TIMER.. (L4)**.
3) Press **OFF (R4)**.

Count Down

1) Press **MENU (R1)**.
2) Press **TIMER.. (L4)**.
3) Scroll ➊ to highlight **COUNT DN..** and push to enter.
4) Scroll ➊ to enter desired time period. Use **+5 MIN (R2)** or menus to set quickly.

Using Airways

Selecting Victor Airways and Jet Routes

Airways may only be added before or after airway fixes (VORS, intersections).

1) When prompted for a waypoint (flight planning or using **ACTV**), enter a “V” (for Victor Airways) or “J” (for Jet Airways). Push ➊ to step through the blank spaces.

2) Scroll ➊ to select desired airway and push to enter.

3) Scroll ➊ to select desired transition fix or end point and push to enter.

Section 7 IFR Procedures

Table of Contents

List of Figures and Tables

7.1. Overview of Approaches

Pilots operating in a radar environment are expected to associate departure headings or an RNAV departure advisory with vectors or the flight path to their planned route or flight. Use of both types of departure procedures, Obstacle Departure Procedures (ODP) are printed either textually or graphically, and Standard Instrument Departure procedures (SIDs) are always printed graphically. All DPs, either textual or graphic, may be designed using conventional or RNAV criteria. RNAV procedures have RNAV printed in the title.

ODPs are not found in the navigation database, and therefore the climb angle found in the PFD BUGS menu should be set to comply with the steeper than normal climb gradient during the departure until established on the enroute structure. ODPs are recommended for obstruction clearance and may be flown without ATC clearance, unless an alternate departure procedure (SID or radar vector) has been specifically assigned by ATC.

Approach minima are never coded in NavData. On some approaches, the altitude coded at the MAP for a non-precision approach coincides with an MDA (normally where the final approach course does not align with the runway), but more often the coded altitude is some height above the threshold.

7.2. Overview of Procedures and Instrument Approaches

This Genesys Aerosystems EFIS provides three-dimensional GPS Precision and Non-precision instrument approach guidance using a system integral TSO C146c BETA 3 GPS receiver. With GPS and augmented GPS with SBAS (Satellite Based Augmentation System) commonly referred to as WAAS (Wide Area Augmentation System). In order to support full integration of RNAV procedures into the National Airspace System (NAS), a new charting format for Instrument Approach Procedures (IAPs) has been designed to avoid confusion and duplication of Instrument Approach Charts.

Use of this GPS receiver provides a level of certified service that supports RNAV (GPS) approaches to LNAV, LP, LNAV/VNAV, and LPV lines of minima within system coverage. Some locations close to the edge of the coverage may have lower availability of vertical guidance.

The new procedures called Approach with Vertical Guidance (APV) are defined in ICAO Annex 6 and include approaches such as the

LNAV/VNAV procedures presently being flown with barometric vertical navigation (BARO-VNAV). These approaches provide vertical guidance but do not meet the more stringent standards of a precision approach. With the BETA 3 GPS receiver and updatable Navigation Database in this system, these approaches may be flown using an electronic glidepath, which eliminates the errors introduced by using barometric altimetry.

In addition to the LNAV/VNAV procedures, the APV approach has been implemented to take advantage of the high accuracy guidance and increased integrity provided by GBS/SBAS. This SBAS generated angular guidance allows the use of the same TERPS approach criteria used for ILS approaches. The resulting approach procedure minima, titled LPV (Localizer Performance with Vertical guidance), may have a decision altitude as low as 200 feet height above touchdown (EASA OPS LPV 250 ft.) with visibility minimums as low as ½ mile (providing the terrain and airport infrastructure and regulations support the lowest minima criteria).

Another new non-precision GPS/SBAS Approach has been certified as an LP (Localizer Performance) approach where terrain or obstructions prohibit the certification of the LPV vertically guided approach. This new approach takes advantage of the angular lateral guidance and smaller position errors (provided by GPS/SBAS) to provide a lateral only procedure similar to an ILS Localizer. LP procedures may provide lower minima than a LNAV procedure due to the narrower obstacle clearance surface. In the LP approach, vertical guidance is for information only and is based on SBAS or BARO information.

The Genesys Aerosystems EFIS guides the pilot through every step of the approach procedure with Highway in the Sky three-dimensional symbology. The system defines a desired flight path based upon the active flight plan. The current position of the aircraft is determined relative to the desired path in order to determine lateral deviation for display on the GPS/SBAS CDI and VDI. The IDU normally auto-sequences from one waypoint to the next in accordance with the flight plan along the flight path with the following exceptions as described:

1) The pilot selected a manual GPS/SBAS OBS (SUSPEND flag shown).

2) The active waypoint is the missed approach waypoint, and the missed approach procedure has not been armed (**ARM**) or initiated (**MISS**) (SUSPEND flag shown).

3) The aircraft is in a published or manually created holding pattern, and the pilot has not chosen to continue (**CONT**) out of the holding pattern (SUSPEND flag shown).

4) The active waypoint is the last waypoint of the active flight plan (no flag shown).

The linear vertical scale limits of the VDI for LNAV/VNAV and LPV approaches are shown below in the figure below.

7.2.1. Vertical Deviation Indicator Linear limits

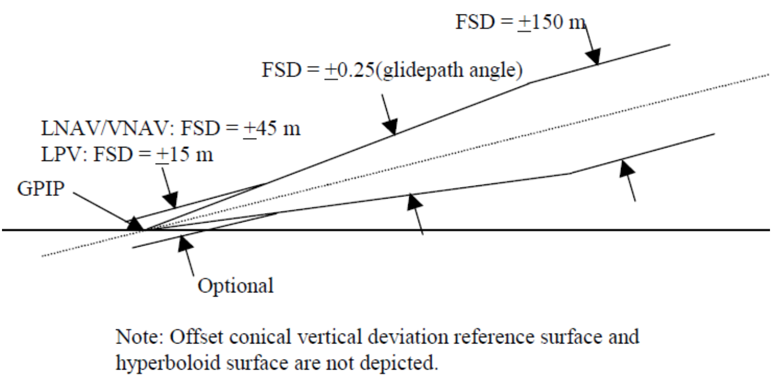


Figure 7-1: Vertical Deviation Indicator Linear Deviation

7.2.2. Highway in the Sky (Skyway)

When not decluttered, the PFD displays the active navigation route or manual OBS course in a three-dimensional manner using a series of skyway boxes, which are a series of perspective objects overlying the flight plan route at a desired altitude providing lateral and vertical guidance. The skyway boxes conform to the VNAV requirements of GPS/SBAS receiver requirements (TSO-C-146C). The top and bottom sides of the boxes are parallel to the horizon on straight leg segments and dynamically tilt with respect to the horizon on turning leg segments based upon leg segment turn radius and groundspeed. When the active route is in view, up to five boxes are shown with the dimensions being a constant 400 feet wide (±200 feet from the desired lateral path) by 320 feet tall (±160 feet from the desired vertical path) spaced horizontally 2000 feet. The skyway boxes are drawn using the hidden surface removal techniques of the terrain and obstruction rendering so a skyway box behind terrain appears to be so. The skyway boxes disappear in Basic Mode and Unusual Attitude Mode. In reversionary mode 1 (GPS failure), the skyway boxes disappear after one minute to indicate degraded navigation performance.

Table 7-1: Highway in the Sky Configuration

Type HITS Lines	**Fully Integrated Autopilot**	**Partially Integrated Analog Autopilot** (Through use of HDG Mode and or NAV/APR mode discrete inputs)	**Un-Integrated Autopilot** **Or** **No Autopilot**
Dashed	Not coupled to Skyway	Not coupled to Skyway	
Solid	Coupled to Skyway	Coupled to Skyway Either autopilot is in HDG mode with LNAV heading/roll-steering sub-mode engaged or autopilot is in NAV/APR mode with the FMS, FMS1 or FMS2 as the currently selected navigation source.	Always Solid

Skyway box altitude is controlled by VNAV altitude, aircraft altitude, aircraft climb performance, and climb/descent angle setting. If no VNAV altitude is set, the skyway boxes describe the desired lateral flight path of the aircraft at the aircraft's current altitude.

With a VNAV altitude set, the boxes provide both lateral and vertical guidance. Climb and descent angle settings are controlled individually with a resolution of 0.1°. VNAV is guided by VNAV waypoints determined by VNAV altitude and VNAV offset from flight plan waypoints. There are two sources for VNAV altitudes, the navigation database and manual input through the ACTV menu. VNAV altitudes for waypoints without a navigation database or manually input VNAV altitude are automatically computed by the system using “look-ahead” rules. When “look-ahead” finds a further VNAV altitude constraint above the previous VNAV altitude constraint (i.e., climb commanded), an automatic VNAV altitude is continuously calculated for the waypoint based upon an immediate climb to the altitude constraint at the higher of actual climb angle or the climb angle setting (dynamic climb angle). When “look-ahead” finds a further VNAV altitude constraint below the previous VNAV altitude constraint (i.e., descent commanded), an automatic VNAV altitude is calculated for the waypoint based upon a descent to reach the VNAV altitude constraint at the associated waypoint using the descent angle setting. If no further VNAV altitude constraints are found, the automatic VNAV altitude is set to the last valid VNAV altitude constraint.

When a VNAV climb is desired, the boxes are drawn at a vertical position the higher of: (a) the dynamic climb angle emanating from the aircraft's present position (aircraft-referenced); (b) the dynamic climb angle emanating from the next waypoint VNAV altitude (geo-referenced forward); or (c) the climb angle setting emanating from the previous waypoint VNAV altitude (geo-referenced backward). The geo-referenced backward calculation 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. Once the boxes intercept the VNAV altitude, further boxes are drawn with a zero angle to show a level off followed by a level flight segment. Because five boxes are shown, the level-off depiction becomes an anticipatory cue for the pilot. Climb guidance is depicted below:

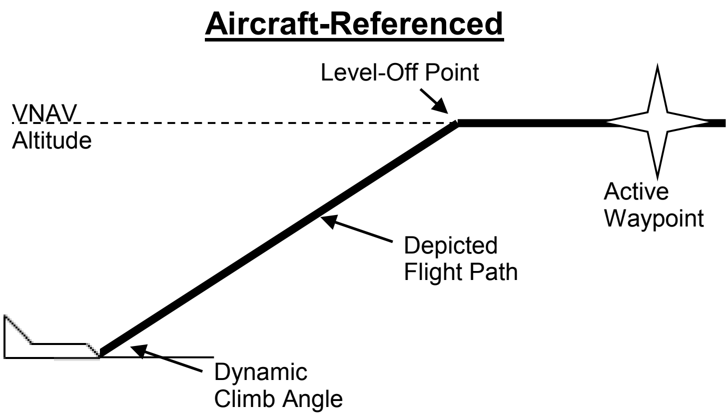


Figure 7-2: Highway in the Sky (Aircraft Referenced)

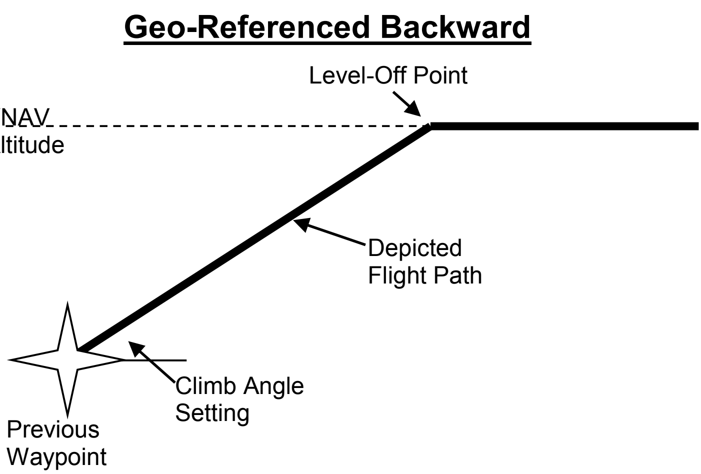


Figure 7-3: Highway in the Sky (Geo-Referenced Backward)

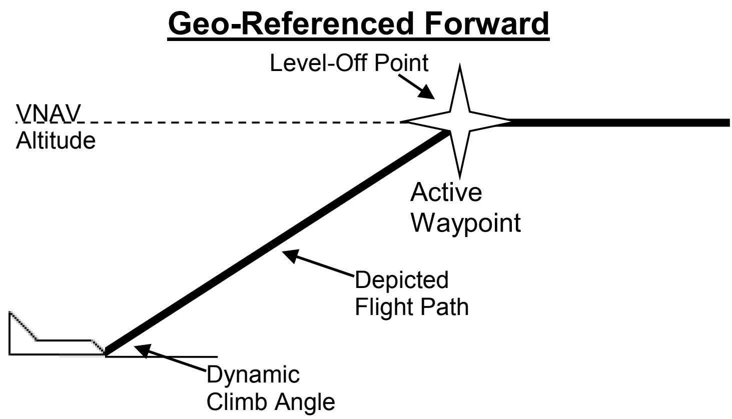


Figure 7-4: Highway in the Sky (Geo-Referenced Forward)

When a VNAV descent is desired, boxes are drawn with a zero angle until reaching a descent point. Further boxes are drawn downward at an angle corresponding to the descent angle setting. The descent point is defined by the intercept of a line emanating upward from the subsequent VNAV waypoint at the descent angle setting and a line representing level flight at the previous VNAV altitude. On the final approach segment of an IFR approach, descent angle and VNAV waypoint are defined as follows:

Table 7-2: Final Segment of IFR Approach, Descent Angle and VNAV Waypoint

Condition	VNAV Waypoint Definition	Descent Angle Definition
IFR Approach with valid Final Approach Segment data block	Glide Path Intercept Point as defined in Final Approach Segment data block	Descent Angle as defined in Final Approach Segment data block
No or invalid Final Approach Segment data block No intermediate waypoints exist between Final Approach Fix and Missed Approach Point.	Missed Approach Point location	Straight line from Final Approach Fix to Missed Approach Point location and altitudes.
No or invalid Final Approach Segment data block. Intermediate waypoints exist between Final Approach Fix and Missed Approach Point.	Missed Approach Point location	The steepest descent angle based upon straight lines from the Final Approach Fix and subsequent Intermediate Waypoints to Missed Approach Point location and altitudes.

On the final approach segment of a VFR approach procedure, the higher of the descent angle setting or 3° is used.

Because five boxes are shown, the descent point depiction becomes an anticipatory cue for the pilot. Descent guidance is depicted below:

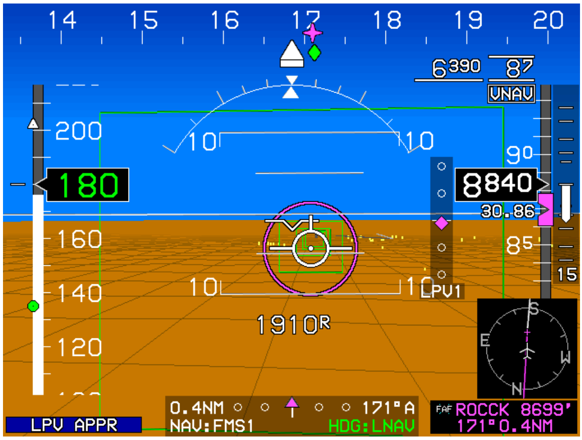


Figure 7-5: Highway in the Sky Final Approach Segments

The above scheme was chosen to create an easily understood, yet safe, VNAV paradigm meeting the VNAV requirements current guidance. Simplicity is a primary objective. Further, the paradigm is biased towards keeping the aircraft at the highest altitude possible for the longest period of time, an important safety benefit for operators of single-engine aircraft. The climb paradigm automatically compensates for an aircraft's ability to climb more steeply than specified and also warns of being below a desired climb gradient when the aircraft is unable to meet the specified climb angle. The descent paradigm encourages flying stabilized approaches.

7.2.3. Waypoint Sequencing

Where automatic waypoint sequencing is suspended, the EFIS automatically switches from TO operation to FROM operation when appropriate. If not suspended, automatic waypoint sequencing occurs upon the following conditions:

1) Bearing to the transition point (turn bisector for fly-by waypoint, active waypoint for fly-over waypoint) is more than 90° from the current course (i.e., transition from “TO” to “FROM” operation);

2) Aircraft location is within two turn diameters (based upon current True Airspeed and 15° angle of bank) of the active waypoint location; and

3) Aircraft heading is within 90° of the current course (i.e., generally pointed in the correct direction).

The desired flight path is created from a sequence of straight, left turning, and right turning leg segments designed to provide smooth skyway, GPS/SBAS CDI, and lateral autopilot guidance. Each leg between waypoints is composed of up to nine segments. Radius for turning segments (other than DME arc or Radius to a Fix segments) is automatically calculated with the parameter speed determined as follows:

1) If the waypoint is part of a DP and within 30 NM of the departure runway, speed is the preprogrammed Procedure Speed.
2) If the waypoint is part of a STAR and within 30 NM of the arrival runway, speed is the preprogrammed Procedure Speed.
3) If the waypoint is part of an IAP or VFR Approach Procedure, speed is the preprogrammed Procedure Speed.
4) If the waypoint is part of a Holding Pattern, speed is the preprogrammed Procedure Speed.
5) Otherwise, speed is the current True Airspeed or preprogrammed Procedure Speed, whichever is higher.

In all cases, if NavData derived speed limit is associated with the waypoint, speed is the lower of the NavData derived speed limit or the speed determined above.

7.2.4. Fly-Over Waypoints

For purposes of creating the desired flight path, each waypoint is designated as a fly-by waypoint or a fly-over waypoint. Waypoints are further subdivided into waypoints having a defined entry heading and waypoints having a defined exit heading. Waypoint auto-sequencing for fly-by waypoints occurs at the bisector of the turn. Waypoint auto-sequencing for fly-over waypoints occurs over the waypoint.

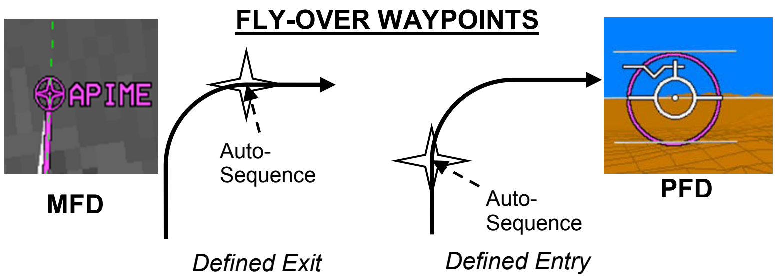


Figure 7-6: Fly-Over Waypoints

The following waypoints are Fly-Over with Defined Entry Heading:

1) Exit from holding pattern;
2) Exit from procedure turn;
3) Entry into holding pattern;
4) Missed Approach Point;
5) Phantom Waypoint (waypoint created by either inserting a waypoint into the active flight plan or performing the Direct-To function within the active flight plan -- avoids S-Turns);
6) Last waypoint;
7) Start waypoint (waypoint created by creating a new active flight plan with the Direct-To function – avoids S-Turns);
8) Reference (takeoff runway end) waypoint of a DP;
9) Waypoint leading into discontinuity; and
10) Altitude, DME, or Radial termination legs (ARINC 424 path types CA, FA, VA, CR, VR, CD, FD, and VD).
11) Waypoints marked as overfly in the navigation database.

The definitions of leg type designators are as follows:

Table 7-3: RNAV Path Terminator Leg Type

Path	Designator		Terminator
Constant DME arc	A	A	Altitude
Course to	C	C	Distance
Direct Track	D	D	DME Distance
Course from a Fix to	F	F	Fix
Holding Pattern	H	I	Next Leg
Initial	I	M	Manual Termination
Constant Radius	R	R	Radial Termination
Track Between	T	V	Heading To

Examples: **CF**= Course to Fix, and **FM**= Course from a Fix to a Manual Termination, etc.

7.2.5. Fly-By Waypoints

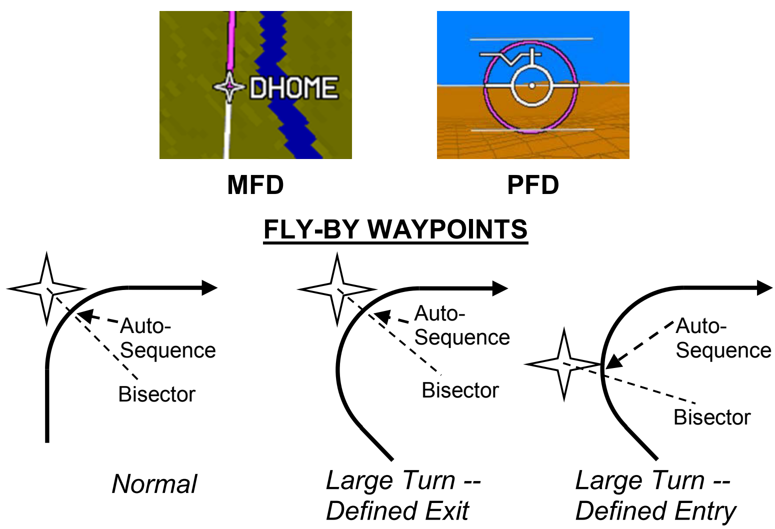


Figure 7-7: Fly-By Waypoints

The following waypoints are Fly-Over with Defined Exit Heading:

1) Entry into procedure turn; and

2) Waypoint exiting a discontinuity with the exception of phantom waypoints or DP reference waypoints;

3) First waypoint with the exception of start waypoints or DP reference waypoints

4) Course to a fix legs that are not to the FAF/FAWP are Fly-By with defined Entry Heading. All other waypoints are Fly-By with the entry adjusted and have a defined Exit Heading.

NOTE:

Entry adjustments should be expected anytime a turn exceeds 120º. Turns greater than 120º should not be used in conjunction with RNP routes. (RNP standards specifically exclude such turns from RNP requirements).

Leg segments for paths are constructed by the IDU as follows:

<table>
<tr><th colspan="4">Table 7-4: Leg Segments for Paths Constructed by the IDU</th></tr>
<tr><th>Path Type</th><th>Entry Waypoint</th><th>Exit Waypoint</th><th># of Segments and Description</th></tr>
<tr><td rowspan="2">Straight Leg, DME Arc, or Radius to a Fix</td><td>Fly-By</td><td>Fly-By</td><td>2nd Half of Fly-By turn at Entry Waypoint.

WGS-84 Geodesic or Arc path from Entry to Exit turns.

1st Half of Fly-By turn at Exit Waypoint.</td></tr>
<tr><td>Fly-By</td><td>Fly-Over Defined Exit Heading</td><td>2nd Half of Fly-By turn at Entry Waypoint.

WGS-84 Geodesic or Arc path from Entry to Exit turns.

Turn to exit heading prior to Exit Waypoint.</td></tr>
</table>

Table 7-4: Leg Segments for Paths Constructed by the IDU

Path Type	Entry Waypoint	Exit Waypoint	# of Segments and Description
	Fly-By	Fly-Over Defined Entry Heading	2nd Half of Fly-By turn at Entry Waypoint. WGS-84 Geodesic or Arc path from Entry turn to Exit Waypoint.
	Fly-Over Defined Exit Heading	Fly-By	WGS-84 Geodesic or Arc path from Entry Waypoint to Exit turn. 1st Half of Fly-By turn at Exit Waypoint.
	Fly-Over Defined Exit Heading	Fly-Over Defined Exit Heading	WGS-84 Geodesic or Arc path from Entry Waypoint to Exit turn. Turn to exit heading prior to Exit Waypoint.
	Fly-Over Defined Exit Heading	Fly-Over Defined Entry Heading	WGS-84 Geodesic or Arc path from Entry Waypoint to Exit Waypoint.
	Fly-Over Defined Entry Heading	Fly-By	Turn from entry heading after Entry Waypoint. WGS-84 Geodesic or Arc path from Entry to Exit turns. 1st Half of Fly-By turn at Exit Waypoint.
	Fly-Over Defined Entry Heading	Fly-Over Defined Exit Heading	Turn from entry heading after Entry Waypoint. WGS-84 Geodesic or Arc path from Entry to Exit turns. Turn to exit heading prior to Exit Waypoint.

Table 7-4: Leg Segments for Paths Constructed by the IDU

Path Type	Entry Waypoint	Exit Waypoint	# of Segments and Description
	Fly-Over Defined Entry Heading	Fly-Over Defined Entry Heading	Turn from entry heading after Entry Waypoint. WGS-84 Geodesic or Arc path from Entry turn to Exit Waypoint.
Proce-dure Turn	Fly-Over Defined Exit Heading	Fly-Over Defined Entry Heading	WGS-84 Geodesic path from Entry Waypoint on outbound heading for 30 seconds. Turn to procedure turn heading (45°). Outbound on procedure turn heading for 72 seconds. Turn to inbound heading (135°). WGS-84 Geodesic path to Exit Waypoint. Entry Waypoint and Exit Waypoint are same point. Turn to proper entry procedure heading. This heading varies. For a parallel entry, it is 180° from the holding course. For direct and teardrop entries, it is the heading required to get to entry of inbound turn.

Table 7-4: Leg Segments for Paths Constructed by the IDU			
Path Type	**Entry Waypoint**	**Exit Waypoint**	**# of Segments and Description**
Holding Pattern	Fly-Over Defined Entry Heading	Fly-Over Defined Entry Heading	WGS-84 Geodesic path to entry of inbound turn. Inbound turn. Degree of turn varies depending upon entry procedure and heading. WGS-84 Geodesic path to holding fix for direct and teardrop entries. WGS-84 Geodesic path to entry of turn to holding pattern heading for parallel entries. Turn to holding pattern heading for parallel entries. This leg is not used for direct and teardrop entries. Turn to holding pattern outbound leg (180°). Holding pattern outbound leg (length based upon time or distance as specified by navigation database). Turn to holding pattern inbound leg (180°). Holding pattern inbound leg (length based upon time or distance as specified by navigation database).

7.2.6. Direct-To

The IDU generates a WGS-84 geodesic path to a designated “To” fix, and the aircraft captures this path without “S-turning” and without undue delay. Where the selected “To” fix is in the active flight plan, the required transition is created as follows:

1) Phantom waypoint is created at the current aircraft location.

2) Leg prior to the Phantom waypoint is designated as a discontinuity.

3) Phantom waypoint is designated as a Fly-Over Defined Entry Heading waypoint where the entry heading is current aircraft track.

Where the selected “To” fix is not in the active flight plan, the required transition is created as follows:

1) New active flight plan is created from “Start” (current aircraft location) to the “To” fix.

2) “Start” waypoint is designated as a Fly-Over Defined Entry Heading waypoint where the entry heading is current aircraft track.

7.3. Magnetic Course

The source of magnetic variation used for paths defined using magnetic course is in accordance with the following:

1) If the leg is part of a database terminal area procedure and the magnetic variation is specified by the State for the procedure, the magnetic variation to be used is the value specified.

2) If the leg is not part of a procedure and the active fix is a VOR, the magnetic variation to be used is the published station declination for the VOR.

3) If the leg is not part of a procedure and the terminating fix is not a VOR, the magnetic variation to be used is defined by the system using an internal model.

The EFIS has the capability of computing magnetic variation at any location within the region where flight operations may be conducted using Magnetic North reference. The assigned magnetic variation is calculated using the NIMA GEOMAG algorithm and the World

Magnetic Model appropriate to the five-year cycle in a MAGVAR database.

7.3.1. AHRS Modes for Heading Source

AHRS Slaved – EFIS Magnetic North: Standard mode of operation. Everything is displayed relative to Magnetic North drift free.

AHRS Slaved – EFIS True North: Everything is displayed relative to True North with drift free heading. This is the preferred way to operate in areas where navigation is done relative to True North. (See Section 8 Appendix for limitations on Earth's magnetic flux horizontal field)

AHRS Free/"DG" – EFIS Magnetic North: Use this mode when operating around significant magnetic disturbances in areas where navigation is done relative to Magnetic North. Ensure the compass rose is slewed to a Magnetic North value.

AHRS Free/"DG" – EFIS True North: Method of operation in high-latitude areas where navigation is accomplished relative to True North. Heading is not drift free and requires periodic correction. This mode may also be used when operating around significant magnetic disturbances in areas where navigation is done relative to True North. Ensure the compass rose is slewed to a True North Value.

7.3.2. GPS Altitude

WGS-84 ellipsoid altitude received from the GPS/SBAS is converted to geodetic (MSL) altitude using the EGM 2008 geoidal database which is revised on a 12-year cycle.

7.3.3. Dead Reckoning

The EFIS provides a Dead Reckoning capability and is active, whenever a valid position is not being sent by the GPS/SBAS sensor. The EFIS projects the last known GPS/SBAS position forward using TAS and heading corrected for last known wind as it continues to navigate using this position and the active flight plan. The system provides the capability to determine bearing to an airport based upon the dead reckoning position.

7.3.4. Geodesic Path Computation Accuracy

The cross-track path deviation error between the computed path used to determine cross-track deviations and the true WGS-84 geodesic is less than 10% of the horizontal alert limit of the navigation mode applicable to the leg containing the path.

7.3.5. Parallel Offsets

The parallel offset is a route parallel to, but offset from, the original active route. The basis of the offset path is the original flight plan leg(s) and one or more offset reference points as computed by the EFIS. The computed offset reference point is located so it lies on the intersection of lines drawn parallel to the host route at the desired offset distance and the line bisecting the track change angle. An exception to this occurs if there is a route discontinuity or end of route. In this case, the offset reference point is located abeam of the original flight plan waypoint at the offset distance. The parallel offset function does not propagate through route discontinuities, unreasonable path geometries (defined as turns greater than 120°), flight plan holding patterns, procedures (IFR Approach, VFR Approach, STAR, or DP), or waypoints with context only as an aircraft starting position (e.g., reference waypoint in a DP or Start/Phantom waypoints created by the Direct-To function).

The EFIS provides guidance to parallel tracks at a selected offset distance. When executing a parallel offset, the navigation mode and all performance requirements of the original route in the active flight plan are applicable to the offset route. The EFIS provides for entry of offset distance in increments of 1 NM, left or right of course, and is capable of offsets of at least 20 NM. When the IDU is operating in offset mode, it is clearly indicated with blue letters on a black background advisory label (PTK = R 20NM). When in offset mode, the EFIS provides reference parameters (e.g., cross-track deviation, distance-to-go, time-to-go) relative to the offset path and offset reference points.

7.4. Default GPS/SBAS Navigation Modes

In the default GPS/SBAS operating mode, the IDU has Enroute, Terminal, LNAV Approach, LNAV/VNAV Approach, LP Approach, LPV Approach, VFR Approach, and Departure navigation modes. Mode annunciation, alert limits (horizontal and vertical), and CDI FSD (horizontal and vertical) are automatically determined by navigation mode as follows:

Table 7-5: Default GPS/SBAS Navigation Modes

Navigation Mode	**Annunciation**
Enroute	None
Terminal	TERMINAL
LNAV Approach	LNAV APPR
LNAV/VNAV Approach	LNAV/VNAV APPR
LP Approach	LP APPR
LPV Approach	LPV APPR
VFR Approach	VFR APPR
Departure	TERMINAL

The system automatically switches to default navigation modes based upon region of operation as follows:

Table 7-6: Default Navigation Modes Based Upon Region of Operation

Default Navigation Mode	**Definition of Region**
Departure	Selected when the active waypoint is the first waypoint of a departure or Missed Approach Procedure <u>and</u> the active leg heading is aligned (±3°) with the active runway heading. Also set when the active waypoint is the MAWP but a missed approach has been manually activated*.
VTF Approach (LNAV, LNAV/VNAV, LP or LPV)	VTF IFR Approach has been selected; <u>and</u> within 30 NM of the active runway*; <u>and</u> the FAWP is the active waypoint*; <u>and</u> the bearing to the FAWP is within 45° of the final approach segment track (treated as a mode entry criteria)*; <u>and</u> the desired track to FAWP is within 45° of the final approach segment track (treated as a mode entry criteria).

Table 7-6: Default Navigation Modes Based Upon Region of Operation

Default Navigation Mode	Definition of Region
Approach (LNAV, LNAV/VNAV, LP or LPV)	IFR Approach has been selected; <u>and</u> within 30 NM of the active runway*; <u>and</u> the MAWP or the FAWP is the active waypoint; <u>and</u> if the FAWP is the active waypoint: the bearing to the FAWP is within 45° of the final approach segment track (treated as a mode entry criteria)*; <u>and</u> the desired track to FAWP is within 45° of the final approach segment track (treated as a mode entry criteria)*; <u>and</u> either the segment leading into the FAWP is not a holding pattern or the pilot has elected to continue out of holding.
VFR Approach	VFR Approach has been selected*; <u>and</u> within 30 NM of the active runway*; <u>and</u> the active runway is the active waypoint.
Terminal	Not in Departure Mode; <u>and</u> Not in Approach Mode; <u>and</u> The active waypoint is part of a departure <u>or</u> the active waypoint and previous waypoint are parts of an arrival or approach <u>or</u> within 30 NM of the departure airport, arrival airport, or runway.
Enroute	Not in Departure, Approach, or Terminal Modes.

7.5. GPS/SBAS CDI Scale

Table 7-7: Summary of Changes In Cross-Track FSD

	To Enroute	To Terminal	To Approach
From Enroute		Change from ±2 NM FSD to ±1 NM FSD over distance of 1 NM; start transition when entering terminal mode.	
From Terminal	Change from ±1 NM FSD to ±2 NM FSD over distance of 1 NM; start transition when entering enroute mode.		If VTF, switch immediately. Otherwise, change from ±1 NM FSD to approach FSD over distance of 2 NM; start transition at 2 NM from FAWP
From Approach		Change to ±1 NM.	
From Departure		If initial leg is aligned with runway, change from ±0.3 NM FSD to ±1 NM FSD at the turn initiation point of the first fix in the departure procedure.	

NOTE:

For RNP 0.3 routes, the Time to Alert is the same as for the approach.

7.6. Approach Type Selection

The IDU automatically selects the approach type (LNAV, LNAV/VNAV, LP, or LPV) when entering approach mode. The automatically-selected approach type is selected with the following order of precedence and prerequisites:

1) LPV:
    a) LPV Enable is enabled;
    b) ARINC-424 “Level of Service” indicates LPV minimums are published;
    c) Valid long-term, fast, and ionospheric SBAS corrections are available and being applied to at least 4 GPS satellites;
    d) Final Approach Segment data block exists and passes CRC check; and
    e) Horizontal and vertical alert limits from Final Approach Segment data block are predicted to be supported.
2) LP:
    a) LPV Enable is enabled;
    b) ARINC-424 “Level of Service” indicates LP minimums are published;
    c) Valid long-term, fast, and ionospheric SBAS corrections are available and being applied to at least 4 GPS satellites;
    d) Final Approach Segment data block exists and passes CRC check; and
    e) Horizontal alert limit from Final Approach Segment data block is predicted to be supported.
3) LNAV/VNAV:
    a) ARINC-424 “Level of Service” indicates LNAV/VNAV minimums are published;
    b) If a Final Approach Segment data block exists, LPV Enable is enabled;
    c) If a Final Approach Segment data block exists, it passes CRC check; and

d) Horizontal alert limit of 556 m. (.3 NM) is predicted to be supported.

NOTE:

Because the IDU inherently supports barometric VNAV, it is not a prerequisite the vertical alert limit be predicted to be supported. Nor is it a prerequisite valid long-term, fast, and ionospheric SBAS corrections be available and applied to at least four GPS satellites. Rather, the vertical alert limit (50 m) and SBAS correction tests are used to determine whether to present guidance based upon GPS altitude or barometric altitude.

4) LNAV: This is the default approach type and is selected when none of the above selections are made. There are no prerequisites for selecting LNAV.

The IDU continuously displays the approach type (mode indication) after selection. The IDU does not degrade the approach type after selection unless the approach procedure is reselected or changed.

NOTE:

These GPS/SBAS modes still appear during a ground based approach such as an ILS approach (see Figure 7-8).

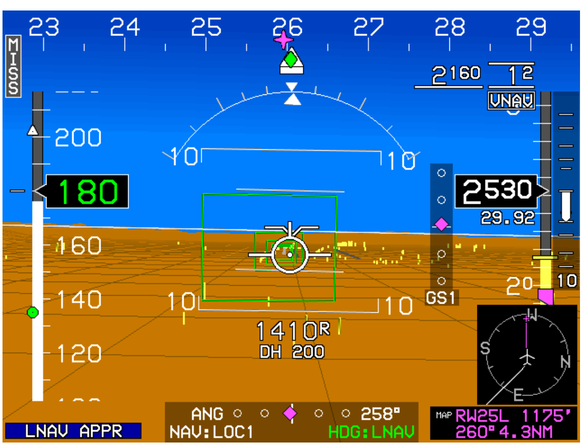


Figure 7-8: GPS Mode (LNAV APPR)

7.6.1. Approach Path Definition

Normal IAP path definitions are as specified in the procedure contained in the navigation database. Deviations are provided with respect to the active leg of the approach procedure.

7.7. VTF IFR Approach

In addition, the IDU provides the capability for the pilot to manually select a VTF IFR approach, indicating the pilot does not intend to fly the entire procedure. When a VTF IFR approach is selected, the IDU creates an "IP" waypoint on the extended final approach course to provide deviations relative to the extended final approach course. The "IP" is designated as a fly-over defined exit heading waypoint, and the leg prior to the "IP" is designated as a discontinuity. Until the FAWP has been sequenced, the IDU indicates a VTF IFR approach has been selected (using the mode annunciation **VECTORS**) to advise the pilot guidance is not relative to a published approach path and TERPS or ICAO DO 8168 clearances are not assured.

7.8. VTF VFR Approach

The IDU also provides the capability for the pilot to manually select a VFR approach to a runway or user waypoint with a defined approach bearing. When a VFR approach is selected, the IDU creates an "IP" waypoint approximately 12 NM on the extended final approach course to provide deviations relative to the extended final approach course. The "IP" is designated as a fly-over defined exit heading waypoint, and the leg prior to the "IP" is designated as a discontinuity.

During this VTF VFR approach, the aircraft is proceeding direct to the IP. Since the IP is designated as a discontinuity, proceeding direct is not possible. When attempting to proceed direct to the IP, only the active leg between the IP and RW16 is activated.

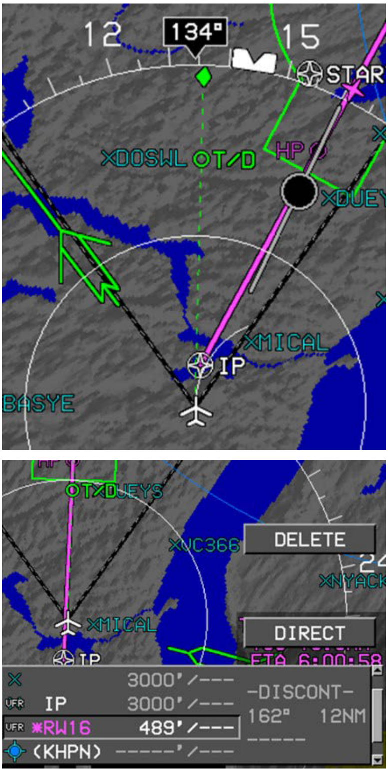


Figure 7-9: Navigating to FAF on VTF VFR Approach

7.9. Missed Approach and Departure Path Definition

The IDU allows the pilot to initiate the missed approach with manual action. Once on the final approach segment, the pilot has the option to initiate an immediate missed approach or to arm the system to execute the missed approach at the MAWP. When arming the missed approach, the pilot may take this action before crossing the MAWP, in which case the equipment arms the missed approach for automatic initiation at the MAWP. If a missed approach is not initiated prior to crossing the MAWP, the IDU automatically switches to FROM mode at the MAWP and continues on the same course.

If the pilot initiates the missed approach, the IDU provides guidance relative to the procedure. If a missed approach is armed prior to crossing the MAWP, the desired path, to and after the MAWP, is defined by the procedure. If the first leg in the missed approach procedure is not a straight path aligned within 3° of the final approach course, the FSD changes to terminal mode FSD (±1 NM) when the missed approach is initiated. Otherwise, the FSD changes to ±0.3 NM, when the missed approach is initiated (DEPARTURE mode), and changes to terminal mode FSD (±1 NM) at the turn initiation point of the first waypoint in the missed approach procedure.

The pilot may manually select DP guidance and, if the first leg in the DP is not a straight path aligned within 3° of the runway heading, terminal mode FSD (±1 NM) is used. Otherwise, the FSD is ±0.3 NM (DEPARTURE mode) and changes to terminal mode FSD (±1 NM) at the turn initiation point of the first waypoint in the DP.

7.10. Loss of Navigation Monitoring

The IDU continuously monitors, independent of any pilot action, for loss of navigation capability.

In Manual RNP mode or Automatic RNP mode prior to sequencing the FAWP, the loss of navigation caution is displayed using a 10-second time to alert if the RNP value is less than 2 NM and a 30-second time to alert otherwise. The FAULTS menu enables the pilot to distinguish the cause of the loss of navigation caution. The caution returns to its normal state upon termination of the responsible condition.

7.11. Discontinuities

Where the IDU is unable to construct a smooth flight path as described above due to active flight plan waypoint spacing (i.e., spacing too close for turn radius), a discontinuity is placed between the waypoints. When a discontinuity exists, no path or skyway is drawn between the waypoints. The pilot cannot activate the waypoint exiting the discontinuity, as it is not possible to provide path guidance to this waypoint. Attempts to activate the waypoint exiting the discontinuity results 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. Discontinuities are created where the NavData coding specifies a manual termination leg (ARINC 424 path types FM (Course from a Fix to Manual Termination) and VM (Heading to Manual Transition).

7.12. Selection of an Instrument Procedure

When an instrument procedure is selected and active, the receiver notifies the pilot of the most accurate level of service supported by the combination of the GPS/SBAS signal, receiver, and selected approach, using naming conventions on the minima lines of the selected approach procedure. Once the level of service has been given, the EFIS operates in this mode for the duration of the procedure, unless the level of service becomes unavailable. The EFIS cannot change back to a more accurate level of service until the next time an approach is activated.

The following includes examples of the following procedures serving as sample Step-By-Step procedures. These examples are created from either AW-109SP configured displays or other rotorcraft configured displays as noted:

1) SID (Step-By-Step) with airplane configuration.

2) STAR (Step-By-Step) with non-specific configuration.

3) ILS Instrument Approach (Step-By-Step) in airplane configuration.

4) LOC BC Instrument Approach (Step-By-Step) with airplane configuration.

5) RNAV GPS Instrument Approach to LPV minima with airplane configuration.

6) NRST ILS Instrument Approach (Step-By-Step) in airplane configuration.

7) VOR DME Instrument Approach (Step-By-Step) in airplane configuration.

NOTE:

Because the IDU inherently supports barometric VNAV, it is not a prerequisite the vertical alert limit be predicted to be supported, nor is it a prerequisite valid long-term, fast, and ionospheric SBAS corrections be available and applied to at least four GPS satellites. Rather, the vertical alert limit (50m) and SBAS correction tests determine whether to present guidance based upon GPS altitude or barometric altitude. (When using Barometric altitude, observe instrument approach procedure temperature limits).

7.13. Basic Instrument Approach Operation

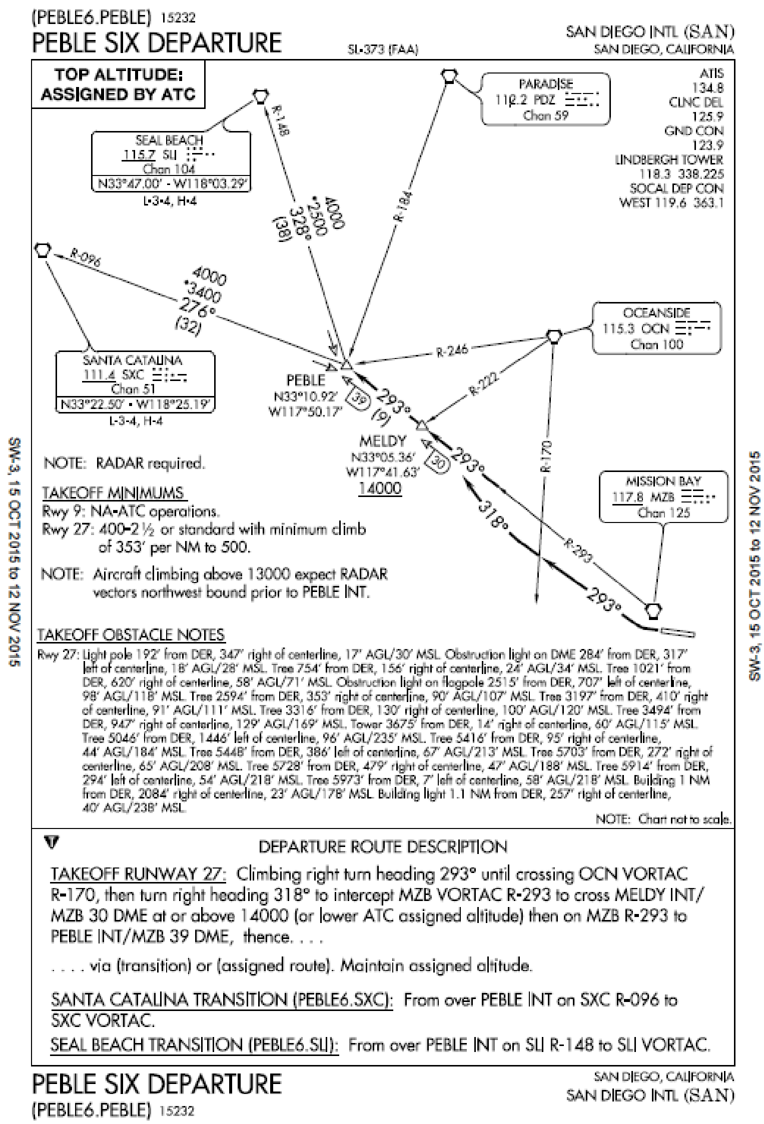
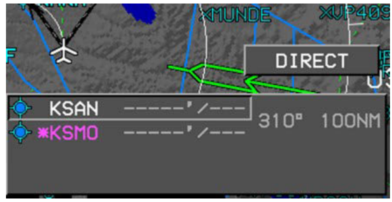
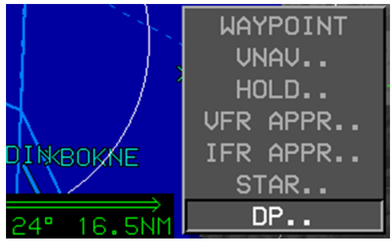


Figure 7-10: Standard Instrument Departure

1) Press **ACTV (L2)** to view active flight plan and scroll ❶ to KSAN and push to enter.

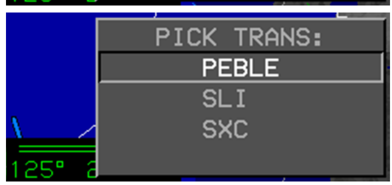


2) Scroll ❶ to **DP..** and push to enter.



3) Scroll ❶ to desired SID procedure and push to enter.

4) Scroll ❶ to desired transition and push to enter.



5) To view NAV LOG on MFD, press **MENU (R1)**, then **FUNCTION.. (R3)**, scroll ❶ to **NAV LOG**, and push to enter.

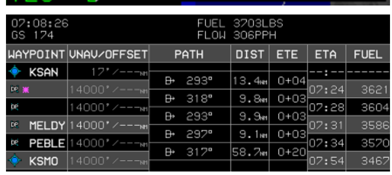


Figure 7-11: Standard Instrument Departure (SID) (Step-by-Step)

7.13.1. Standard Terminal Arrival Route (STAR)

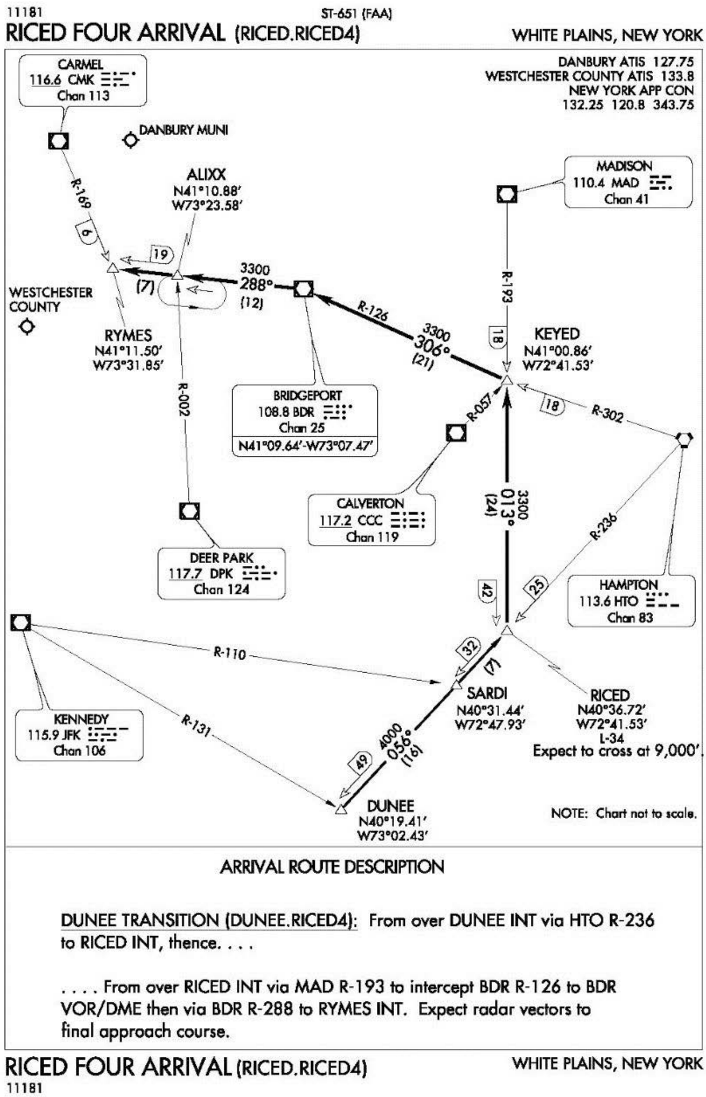


Figure 7-12: Standard Terminal Arrival Route (STAR)

If the selected waypoint is an airport with a published STAR, this option is available for selection from a list of available STARs, transitions, and runways. After selection, the appropriate STAR is created and displayed on the MAP page. Activating a STAR automatically deletes any pre-existing STAR and is inserted prior to any approach waypoints if previously entered.

1) The arrival airport must be in the ACTIVE flight plan and highlighted push ❶ to enter.

2) Scroll ❶ to **STAR..** and push to enter.

3) Scroll ❶ to desired STAR and push to enter.

4) Scroll ❶ to desired transition and push to enter.

5) Scroll ❶ to desired RW and push to enter.

Figure 7-13: Standard Terminal Arrival Route (STAR) (Step-by-Step)

Assume ATC assigned a clearance to cross SARDI at 3500’ 2 NM prior to crossing.

1) Press **ACTV (L2)** and scroll ➊ to the Waypoint in the clearance and push to enter.

2) Scroll ➊ to **VNAV..** and push to enter.

3) Scroll ➊ to enter assigned altitude, push to enter, and scroll ➊ counter clockwise to enter -2 NM to comply with ATC crossing clearance. Push to enter.

4) The altitude is shown on the ACTIVE flight plan with the offset of 2 NM prior to reaching **SARDI**.

Figure 7-14: Standard Terminal Arrival Route (STAR) (Step-by-Step)

STARS normally terminate at a FIX near the airport, so a radar vector or feeder route is used for transition to the approach phase of the arrival. If an instrument approach is activated during the STAR, the approach waypoints are inserted after the STAR.

7.13.2. ILS Instrument Approach

All approach operations typically begin with the same basic steps:

The following example selects the ILS RWY 10 at Louis Armstrong New Orleans INTL (KMSY). The PFD BUGS menu is accessed on the PFD or Remote Bugs Panel if equipped.

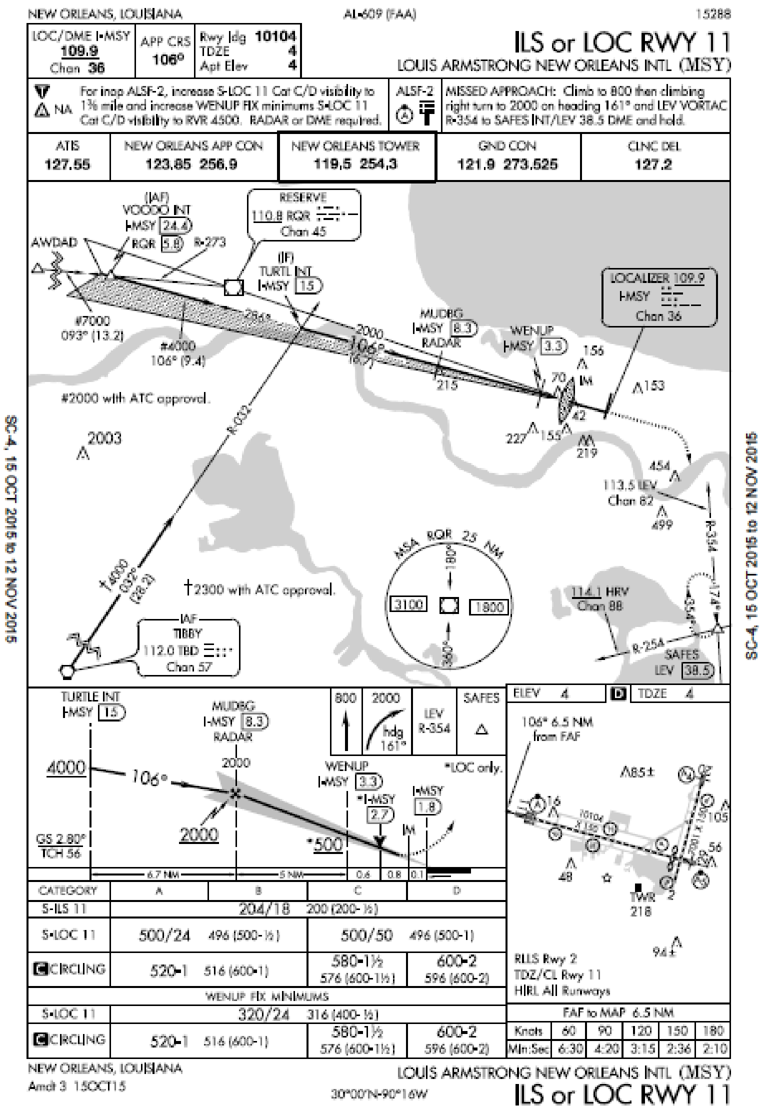


Figure 7-15: ILS RWY 10 (MSY)

1) Press **ACTV (L2)** and scroll ❶ to desired airport and push to enter.

2) Scroll ❶ to **IFR APPR..** and push to enter.

3) Scroll ❶ to desired Approach, Transition, and RW and push to enter for each option. Push to enter for each selection.

4) The turn inbound at **TURTL** is depicted in the ACTIVE flight plan and MFD view.

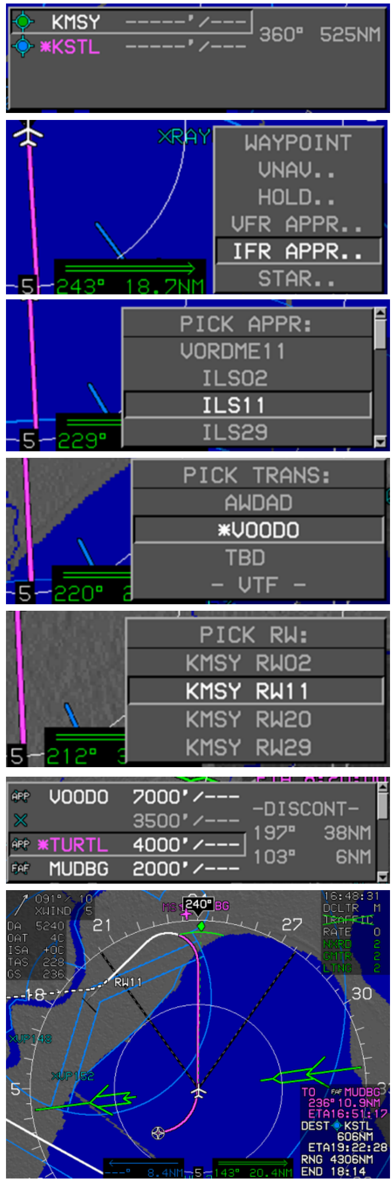
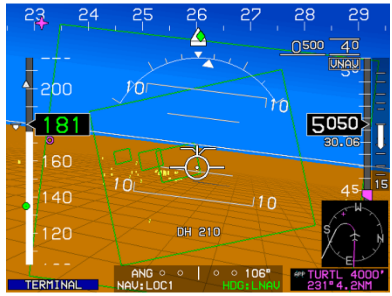


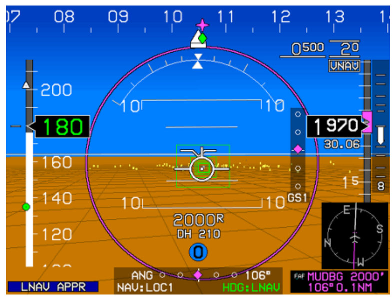
Figure 7-16: ILS RWY 10 (MSY)

5) Barometric Minima is set at 500’ MSL, and DH is set to 210’.

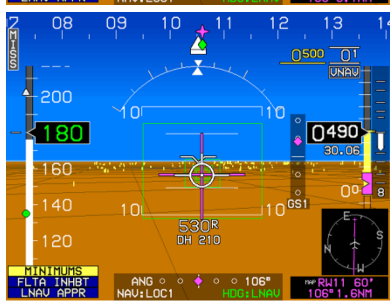
6) PFD BUGS may be set on PFD or RBP if equipped.



7) Approaching **MUDBG** FAF with OM displayed and Glideslope #1.



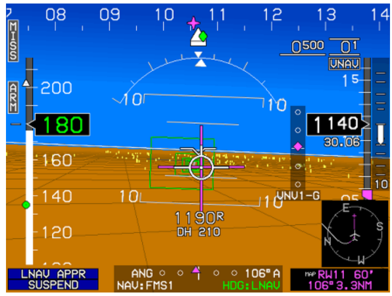
8) At localizer minimums slightly below glideslope with Flight Director showing on course.



9) On the MFD press **MENU (R1)**, then **PAGE.. (R3)**, then scroll ❶ to **HSI** and push to enter.

Figure 7-17: ILS RWY 10 (MSY) (Continued)

1) At the FAF, press **ARM (L2)** to arm the missed approach procedure for automatic waypoint sequencing at the MAWP.



2) As an option, press **MENU (R1)** then **ZOOM ON (R3)** for a narrow field of view for realistic view of runway and surrounding areas.

3) Minimums have been reached in this view.

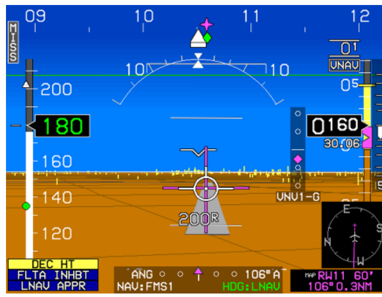


Figure 7-18: ILS RWY 10 (MSY)

7.13.3. LOC Back Course Instrument Approach

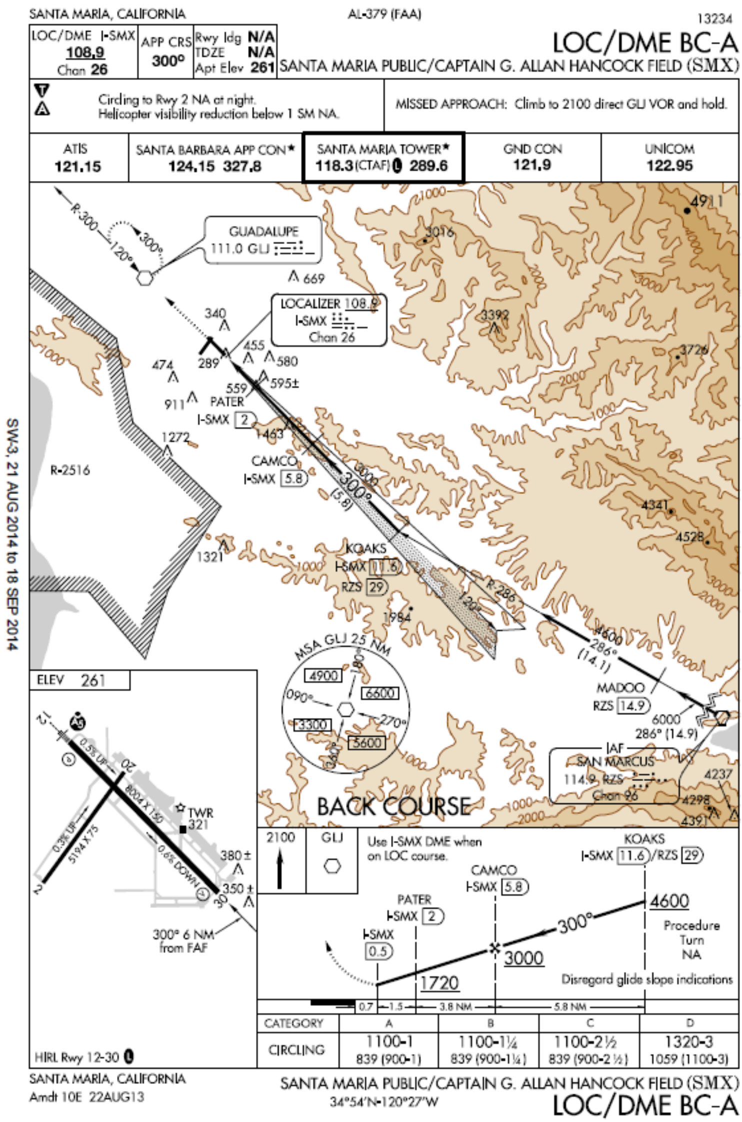


Figure 7-19: LOC Back Course Approach (Step-By-Step)

1) Press **ACTV (L2)** and scroll ❶ to KSMX and push to enter.

2) Scroll ❶ to **IFR APPR..** and push to enter.

3) Scroll ❶ to **LBCA** and push to enter.

4) Scroll ❶ to desired transition and push to enter.

5) Scroll ❶ to desired RW and push to enter.

6) An active waypoint leg is now created for direct to RZS.

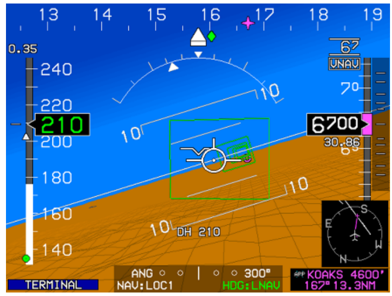
7) ATC provides a clearance direct to **KOAKS** maintain 6000'.

8) Press **ACTV (L2)** scroll ❶ to **KOAKS** and press **(R4)** then push ❶ to enter.

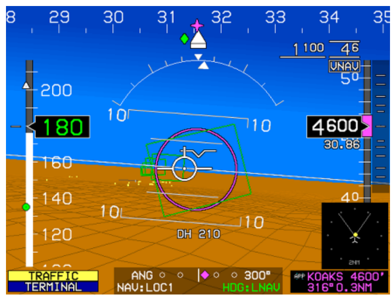
9) After ATC provided a radar vector, a clearance direct **KOAKS** is received.

Figure 7-20: LOC Back Course Approach (Step-By-Step)

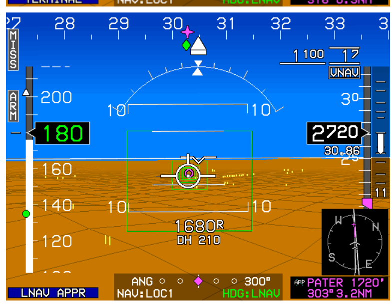
10) Press **OBS (L4)** scroll ❶ to set final approach course 300º then push to enter.



11) Approaching **KOAKS** fix with FLY OVER symbol appearing as a point in space.



12) Past the FAF **MISS (L1)** and **ARM (L2)** appears. Press **ARM (L2)** to arm the MAP upon crossing the MAWP.



13) Past the MAWP, the FMS automatically switches to FMS for the full MAP.

Figure 7-21: LOC Back Course Approach (Step-By-Step) (Continued)

7.13.4. RNAV (GPS) Instrument Approach to LPV Minima

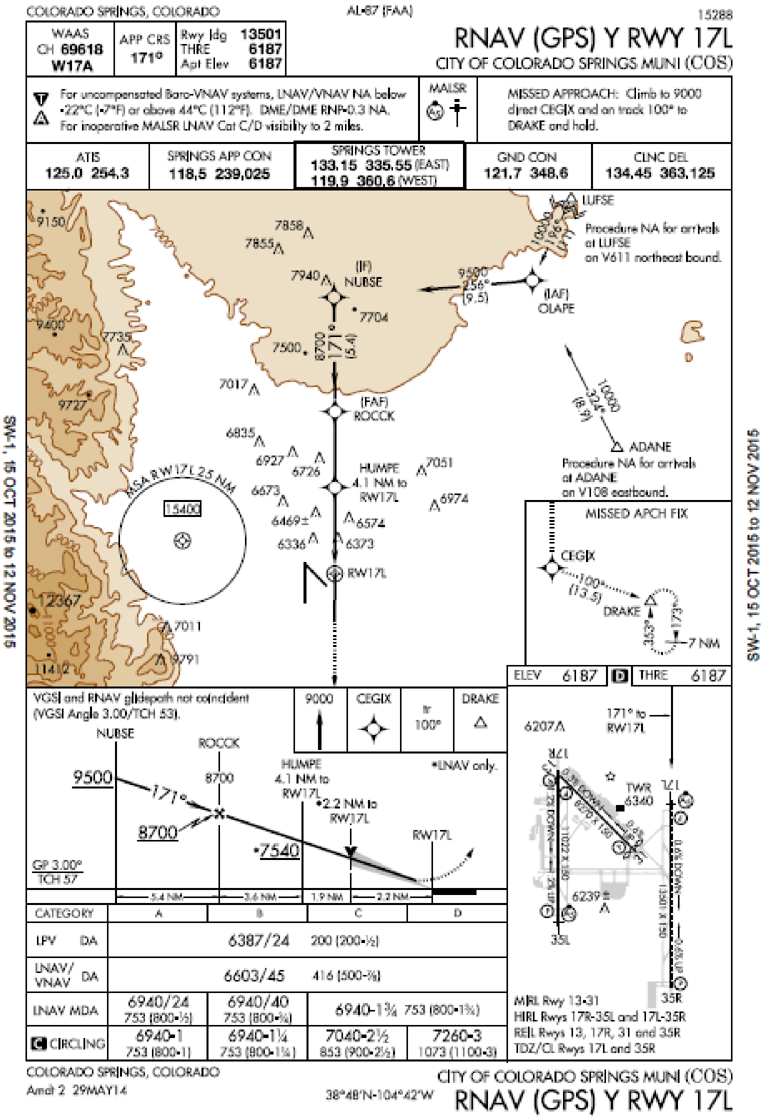
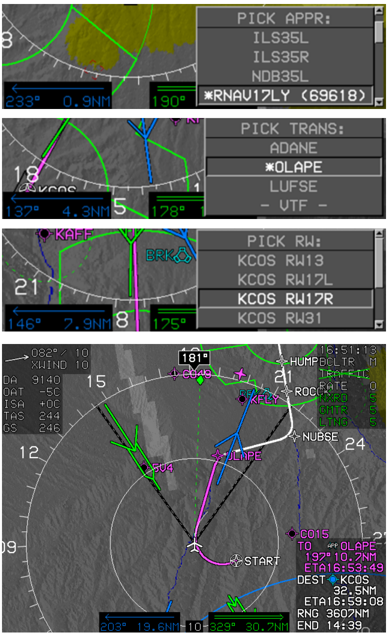


Figure 7-22: RNAV (GPS) Instrument Approach to LPV Minima

7.13.5. RNAV (GPS) Instrument Approach to LPV Minima (Step-By-Step)



1) Select airport as in previous example.

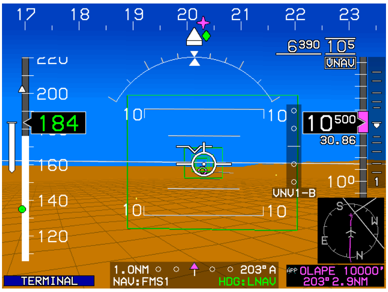
2) In this example scroll ❶ to **RNAV32 (99617)** then push to enter.

3) Scroll ❶ to desired transition and runway then push to enter as described in previous example. In this case, runway 17L is closed, and ATC has assigned 17R.

4) Scroll ❶ to scale map to desired value and observe Top of Descent point within Instrument approach procedure.

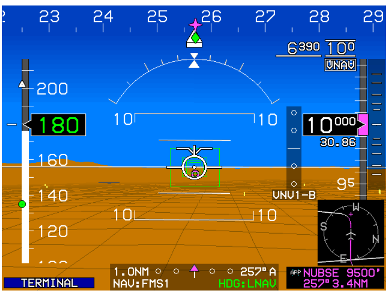
5) Observe active leg magenta line and next leg in white.

Figure 7-23: RNAV (GPS) Instrument Approach to LPV Minima (Step-By-Step)



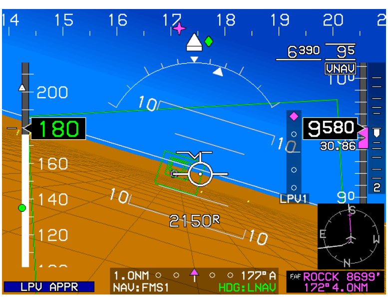
6) Inside FAF, press **ARM (L2)** prior to step down fix, **HUMPE**.

7) Upon passing **HUMPE** with **ARM (L2)** pressed, auto waypoint sequencing continues.



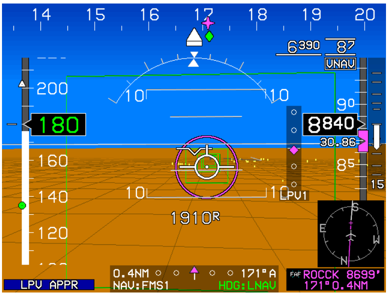
8) The VDI displays vertical guidance for the LPV vertical profile based on GPS/SBAS.

9) Obstructions appear on PFD and MAP page.

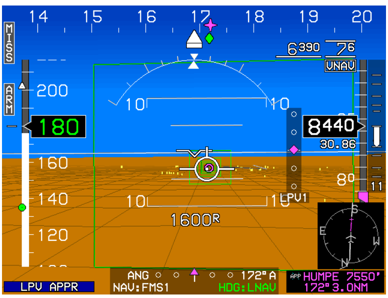


10) The bottom example shows the Flight Path Marker lined up on the active runway after passing through minimums and on glidepath.

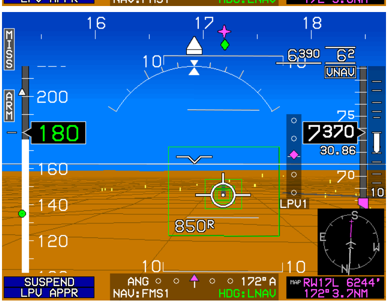
Figure 7-24: RNAV (GPS) Instrument Approach to LPV Minima (Step-By-Step) (Continued)



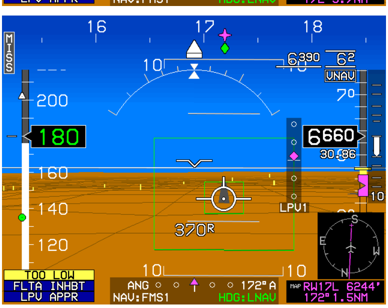
11) Approaching **ROCCK**, the FAF with LPV APPR advisory and **LPV1** labeled VDI.



12) After passing FAF with **MISS (L1)** and **ARM (L2)** appearing. **SUSPEND** is not present until passing **HUMPE** as the step-down-fix.



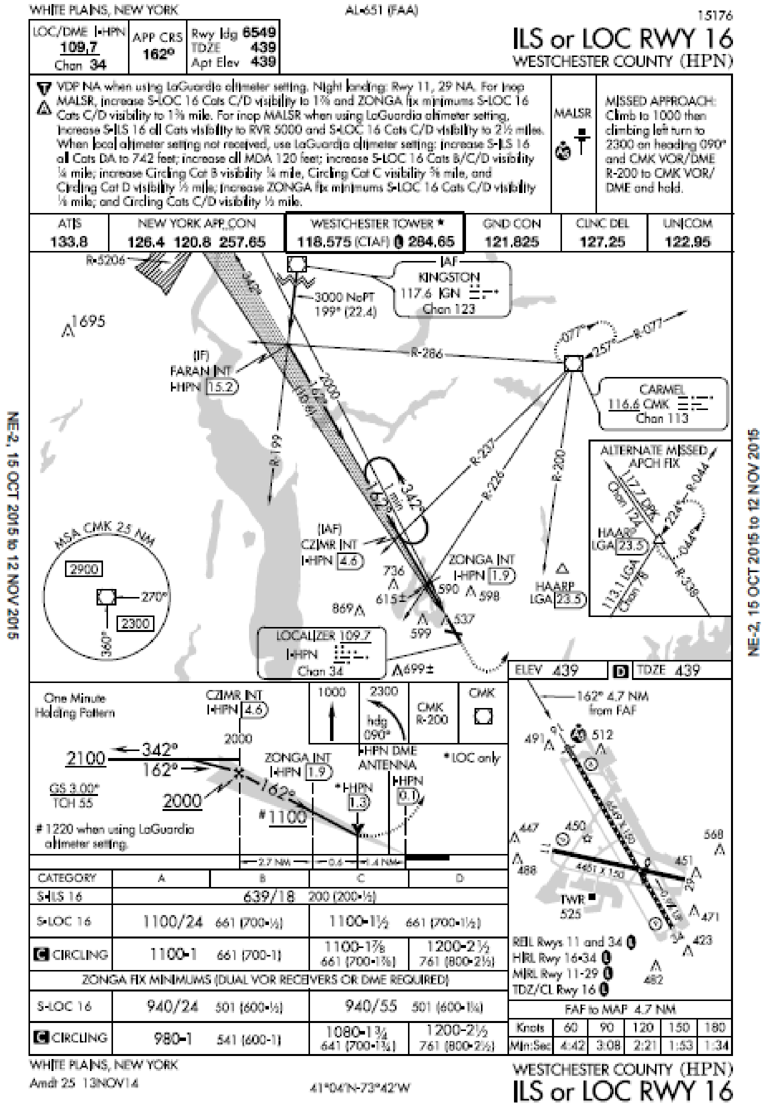
13) After passing **HUMPE**, SUSPEND appears to indicate the MAP does not auto waypoint sequence until **ARM (L2)** is pressed.



14) **ARM (L2)** was pressed and **SUSPEND** is removed as auto waypoint sequencing is continued after passing the MAWP. RWY 17L is dark gray since it is not the active runway.

Figure 7-25: RNAV (GPS) Instrument Approach to LPV Minima (Step-By-Step) (Continued)

7.13.6. NRST ILS Instrument Approach



CATEGORY	A	B	C	D
S-ILS 16	639/18 200 (200-½)			
S-LOC 16	1100/24 661 (700-½)		1100-1½ 661 (700-1½)	
CIRCLING	1100-1 661 (700-1)		1100-1⅞ 661 (700-1⅞)	1200-2½ 761 (800-2½)
ZONGA FIX MINIMUMS (DUAL VOR RECEIVERS OR DME REQUIRED)				
S-LOC 16	940/24 501 (600-½)		940/55 501 (600-1¼)	
CIRCLING	980-1 541 (600-1)		1080-1¾ 641 (700-1¾)	1200-2½ 761 (800-2½)

FAF to MAP 4.7 NM						
Knots	60	90	120	150	180
Min:Sec	4:42	3:08	2:21	1:53	1:34

Figure 7-26: NRST ILS Instrument Approach

7.13.7. NRST ILS Instrument Approach (Step-By-Step)

1) Press **NRST (R3)** then scroll ❶ to **ILS..** and push to enter.

2) Scroll ❶ to desired airport and runway then push to enter. (ILS must precede airport.)

3) Push ❶ to **CONFIRM ACTIVATE ILS**.

The following actions occur:

1) Direct flight plan to the ILS Airport is created.

2) Vectors-to-Final ILS approach is activated.

3) Heading Bug is activated to the current heading.

4) VLOC 1 and VLOC 2 OBS settings are set to the Associated Localizer course.

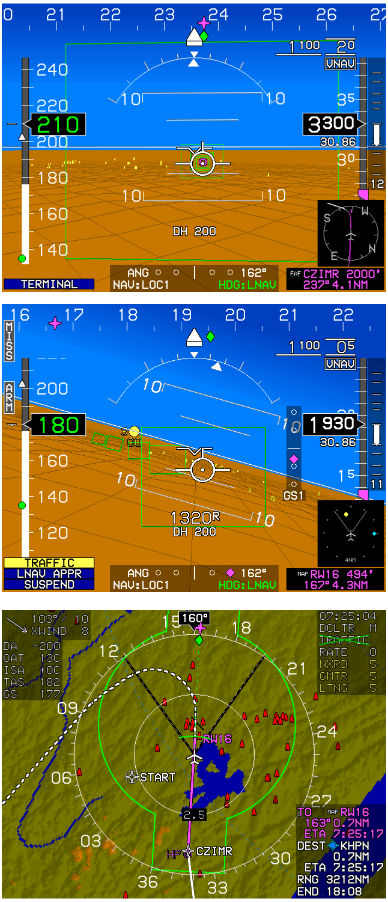
5) HSI source is switched as follows for airplanes:

   a) ILS is automatically switched to NAV #1.

   b) HSI source is switched as follows for Fixed Wing aircraft.

   c) ILS automatically switched to NAV#1.

Figure 7-27: Nearest ILS Instrument Approach (Step-By-Step)



1) The EFIS automatically changes to LOC1 and the VDI indicates source of Glideslope GS1.

2) Inside the **FAF, ARM (L2)** and **MISS (L1)** appear with auto waypoint suspended.

3) Press **ARM (L2)** to continue auto waypoint sequencing.

4) During the Missed Approach, the HSI is automatically reset to FMS1. Dashed magenta and white lines lead the flight to the Holding Waypoint.

5) Scroll ❶ to scale the MAP for desired view of published Missed Approach Procedure.

Figure 7-28: Nearest ILS Instrument Approach (Step-By-Step)

7.13.8. VOR/DME Instrument Approach

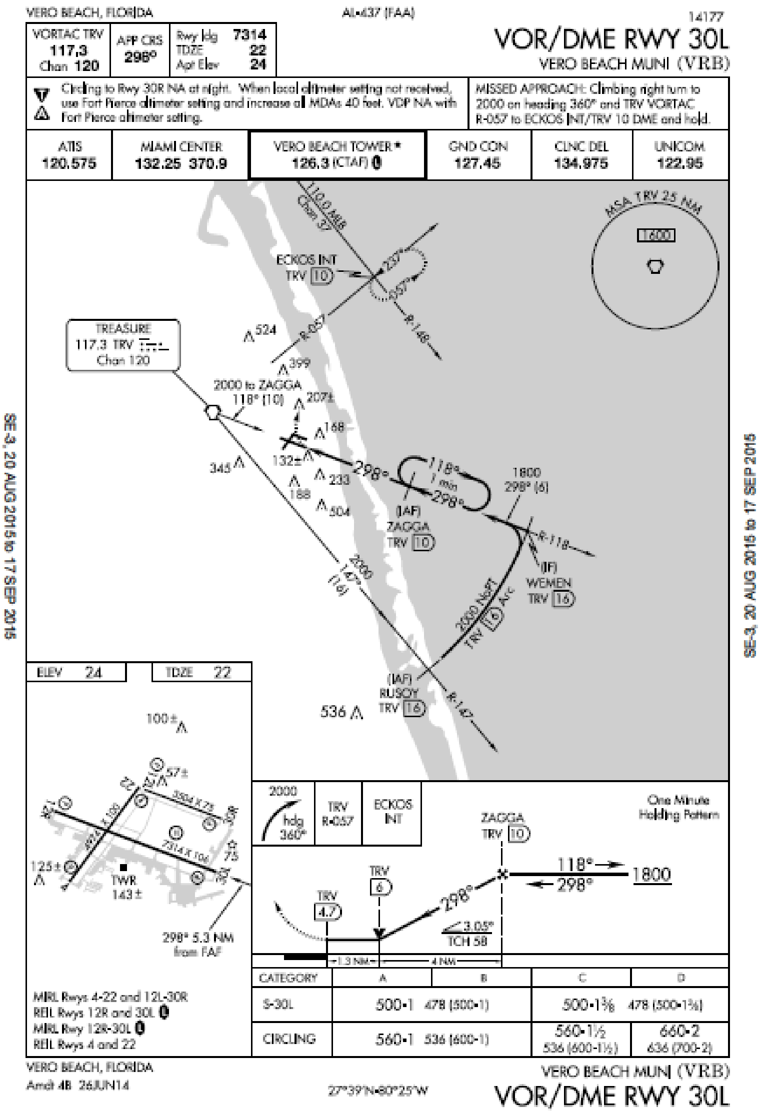


Figure 7-29: VOR/DME Instrument Approach

7.13.9. VOR/DME Instrument Approach (Step-By-Step)

1) With the destination airport entered as the waypoint scroll ❶ to select the **IFR APPR..** and type of approach then push to enter.
2) Scroll ❶ to select desired approach and push to enter.
3) Scroll ❶ to select desired Transition and push to enter.
4) Scroll ❶ to select desired Runway and push to enter.
5) Scroll ❶ to view procedure with desired MAP scale.

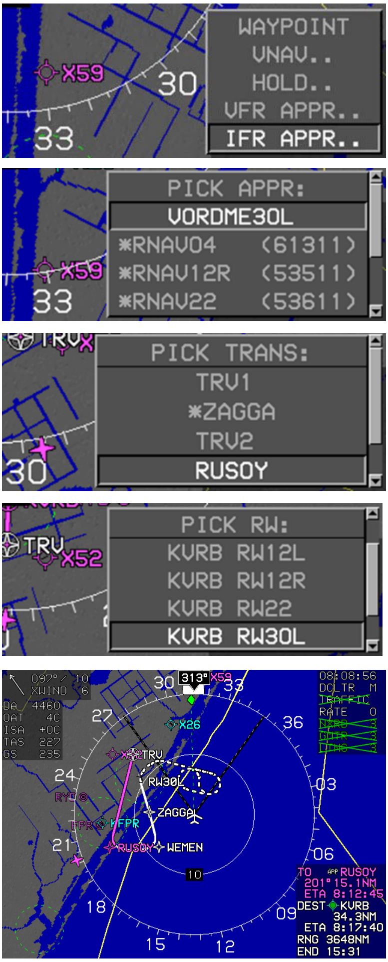
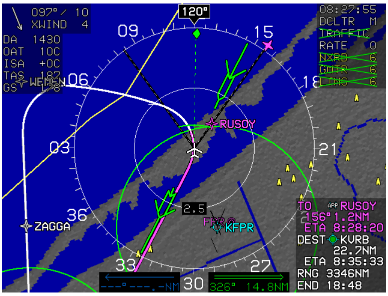
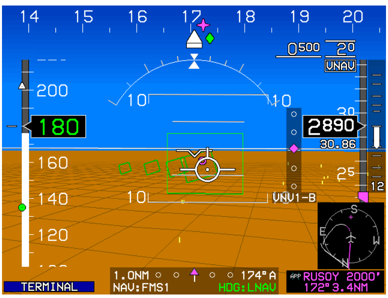


Figure 7-30: VOR/DME Instrument Approach (Step-By-Step)

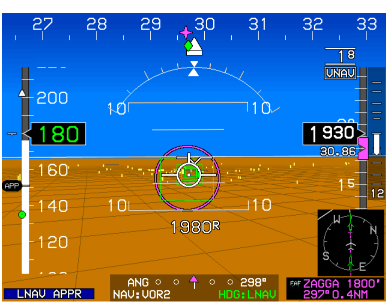


1) MFD showing aircraft approaching **RUSOY** with DME indication on NAV #2.



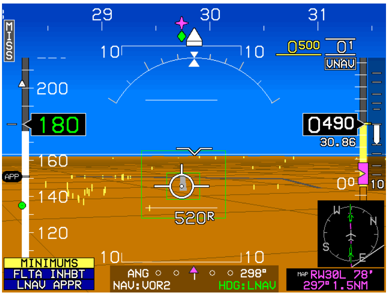
2) Approaching **RUSOY** with FMS1 depicting GPS position on approach.

3) Established on the 16 DME ARC approaching **WEMEN**.



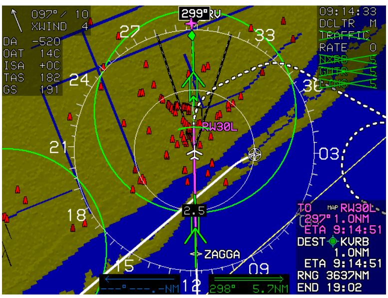
4) Approaching **ZAGGA** FAF with VOR2 set on final approach course 298º.

Figure 7-31: VOR/DME Instrument Approach (Step-By-Step)



1) Approaching minima with 500’ flashing amber (yellow) and on course.

2) The PFD view has been changed to zoom mode.



3) MFD showing the full Missed Approach Procedure during Go-Around. (Zoom Mode still on.)

Figure 7-32: VOR/DME Instrument Approach (Step-By-Step)

NOTE:

Navigation databases are expected to be current for the duration of the flight. If the Aeronautical Information Regulation and Control (AIRAC) cycle is due to change during the flight, operators and pilots should establish procedures to ensure the accuracy of navigation data including suitability of navigation facilities used to define the routes and procedures for flight. Traditionally, this has been accomplished by verifying electronic data against paper products. Once acceptable means is to compare aeronautical charts (new and old) to verify navigation fixes prior to departure. If an amended chart is published for the procedure, the database must not be used to conduct the operation.

NOTE:

Pilots may notice a slight difference between the navigation information portrayed on the chart and their primary navigation display heading. Differences of three degrees or less may result from equipment manufacturer's application of magnetic variation and are operationally acceptable.

NOTE:

GPS Receivers do not "Fail Down" to lower levels of service once the approach has been activated. If only VERT LON appears, the pilot may elect to use the LNAV minima if the rules under which the flight is operating allow changing the type of approach being flown after commencing the procedure. If the lateral integrity limit is exceeded on an LP approach, a missed approach is necessary since there is no way to reset the lateral alarm limit while the approach is active.

Section 8 Appendix

Table of Contents

List of Tables and Figures

8.1. Appendix

The appendix of this pilot guide contains a variety of useful information not found elsewhere in the document. This section includes operating tips, system specifications, feedback forms, and EFIS Training Tool installation and operation instructions.

8.2. Operating Tips

With the Genesys Aerosystems EFIS installed and certified in all categories of certified aircraft, numerous tips and suggestions are available for obtaining the maximum performance and benefit from this system. Additional operating tips are becoming available with future releases of this publication.

8.3. Domestic or International Flight Planning

Due to the differences in every aircraft avionics suite installation, it is up to the pilot to determine what equipment code is applicable for domestic or international flight plans. It is solely up to the aircraft operator to determine what certifications pertain to them. All certifications are outlines in the Airplane or Rotorcraft Flight Manual Supplement. Helpful FAA links for this information may be found at:

http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/air_traffic_services/flight_plan_filing/

8.3.1. Descent Planning

Instead of performing conventional time/speed/distance/descent-rate calculations, use the waypoint symbol for descent planning. Simply maintain the 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. Following the skyway boxes assures the VNAV descent angle is maintained.

8.3.2. Terrain Clearance

Use the flight path marker to evaluate climb performance in regards to terrain clearance. If climbing at the best climb speed to clear terrain and the flight path marker is overlaying the terrain which must be cleared, the climb rate is insufficient. Either the course or climb rate must be altered to adequately clear the terrain. If the flight path marker is well clear of the terrain (overlaying blue), the climb is sufficient for the present time, and no further action is necessary until level-off.

8.3.3. Departure Airport Information

On startup, all information for the departure airport is readily available. The altimeter is automatically set to the nearest IFR runway touchdown zone elevation. When pressed, the NRST button reveals the nearest airports, when highlighted where all important data such as frequencies are displayed.

8.3.4. Unique Names for Flight Plans

Multiple routes between the same airport pairs are numbered automatically (KCEW-KDHN) [0], (KCEW-KDHN) [1], etc.). With some ingenuity, pilots may work around this and apply easily remembered differentiation. If a route is routinely flown from one airport to another, but different routing becomes necessary due to MOA areas being hot or weather, etc., two or more different flight plans may be created for the same destination.

Create two different user waypoints at the departure airport named KCEWN and KCEWS as an example for departing Sikes on a northern routing (KCEWN) or a southern routing (KCEWS) followed by the different routing to clear the MOA or whatever creates the necessity for specific routing.

8.3.5. Altimeter Settings

Use caution when setting the altimeter and inadvertently changing the transition level. If this is reset to a lower than normal altitude, CHK BARO advisory may appear due to the altimeter setting not set on 29.92 inHg or 1013 mbar.

8.3.6. Warnings, Cautions, and Advisories

Review all conditions found in the Section 2 System Overview for Warnings, Cautions, and Advisories. These conditions precisely define the scenario for the various warnings, cautions, and advisory flags as they appear including the time delay where appropriate and any time delay when applicable.

8.4. Magnetic vs. True North Modes of Operation

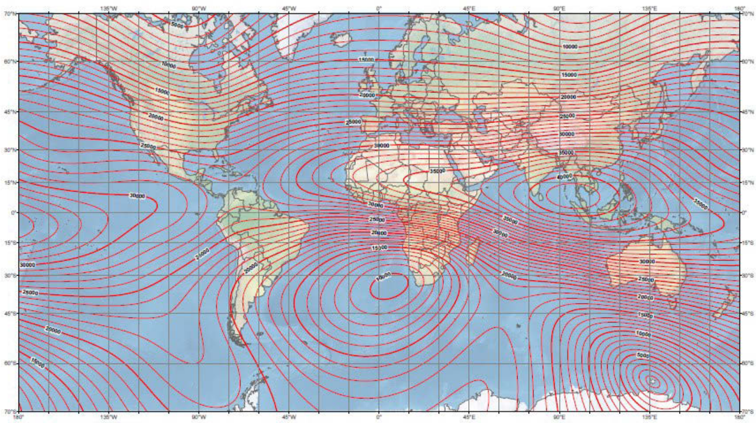


Figure 8-1: US/UK World Magnetic Model

There are two modes for the ADAHRS:

1) Slaved mode (i.e., compass rose stabilized by the Earth's magnetic flux horizontal field) is the normal mode. It works well over most of the surface of the Earth (i.e., areas with a horizontal field of 5000nT or above, which includes about two-thirds of Canadian NDA (see Figure 8-1). The ADAHRS senses magnetic flux with a 3D magnetometer. Performance in small horizontal fields is installation dependent as variable magnetic disturbances from the aircraft may begin to predominate.

2) Free or "DG" mode (i.e., compass rose not stabilized by the Earth's magnetic flux horizontal field and subject to drift) is used in areas of magnetic disturbances (oil rigs, MRI machines, etc.) or in areas where the horizontal field is too weak. In Free/"DG" mode, heading no longer corrects towards the Earth's magnetic flux horizontal field and the heading solution may be "slewed" by the pilot.

There are two modes for the EFIS:

1) Magnetic North mode: In this mode, the heading from the AHRS (whether slaved or Free/"DG") is used as-is and is expected to reflect Magnetic North. GPS Track is converted from True North-referenced to Magnetic North-referenced using a

magnetic variation database. The PFD scenes and compass-rose symbols are aligned with Magnetic North and wind is displayed referenced to Magnetic North.

2) True North mode: In this mode, GPS Track is used as-is and reflects True North. When the AHRS is in Slaved mode, the heading from the AHRS is converted from Magnetic North-referenced to True North-referenced using a magnetic variation database. When the AHRS is in Free/"DG" mode, the heading from the AHRS is used as-is and is expected to reflect True North. The PFD scenes and compass-rose symbols are aligned with True North and wind is displayed referenced to True North.

NOTE:

Designating Magnetic North vs. True North mode is critical in that it determines how the inputs are used – i.e., the relationship between GPS Track and ADAHRS Heading. Mixing things up in Free/"DG" mode (i.e., slewing the compass rose to match Magnetic North when in True North mode and vice-versa) may result in large errors in wind calculations and GPS track/flight path marker displays.

8.5. Altitude Miscompare Threshold

The altitude miscompare threshold is based upon the allowable altitude error. There are two components to allowable altitude error, instrument error and installed system error. Allowable instrument error is based upon the values of SAE AS8002A Table 1 as follows:

Table 8-1: Allowable Instrument Error

Altitude	Allowed Error
Sea Level	25'
1,000'	25'
2,000'	25'
3,000'	25'
4,000'	25'
5,000'	25'
8,000'	30'
11,000'	35'
14,000'	40'
17,000'	45'
20,000'	50'

Table 8-1: Allowable Instrument Error	
Altitude	**Allowed Error**
30,000’	75’
40,000’	100’
50,000’	125’

Allowable installed system error is added on top of instrument error and, these values are derived from the regulations as follows:

Table 8-2: Regulatory Reference	
Regulation	**Allowed Error**
14 CFR § 23.1325	At sea level, the greater of 30’ or 30% of the calibrated airspeed in knots. This increases proportionally to SAE AS8002A Table 1 at higher altitudes.
14 CFR § 25.1325	
14 CFR § 27.1325	
14 CFR § 29.1325	

An allowable altitude error is computed for each compared value and added together to create the altitude miscompare threshold. This accommodates for the values deviating in different directions.

Worked example for a calibrated airspeed of 100 knots and comparing a first altitude of 3,490’ with a second altitude of 3,510’:

1) Calculate allowable instrument error based upon altitudes:
Allowable Instrument Error #1 = 50’
Allowable Instrument Error #2 = 50’

2) Calculate allowable installed system error based upon altitudes and calibrated airspeed:
Allowable Installed System Error #1 = 30’
Allowable Installed System Error #2 = 30’

3) Calculate altitude miscompare threshold based upon sum of above allowable errors:
Altitude Miscompare Threshold = 160’

8.6. Airspeed Miscompare Threshold

The airspeed miscompare threshold is based upon the allowable airspeed error. There are two components to allowable airspeed error, instrument error and installed system error. Allowable instrument error is based upon the values of SAE AS8002A Table 3 as follows:

Table 8-3: Airspeed Error

Calibrated Airspeed	Allowed Error
50 knots	5 knots
80 knots	3 knots
100 knots	2 knots
120 knots	2 knots
150 knots	2 knots
200 knots	2 knots
250 knots	2.4 knots
300 knots	2.8 knots
350 knots	3.2 knots
400 knots	3.6 knots
450 knots	4 knots

Allowable installed system error is added on top of instrument. Error and these values are derived from the regulations as follows:

Table 8-4: Airspeed Regulatory Reference

Regulation	Allowed Error
14 CFR § 23.1323	Starting from (1.3 x V_{S1}): The greater of 5 knots or 3%. Do not perform a comparison if either value is below (1.3 x V_{S1}).
14 CFR § 25.1323	Starting from (1.23 x V_{SR1}): The greater of 5 knots or 3%. Do not perform a comparison if either value is below (1.23 x V_{SR1}). System uses V_{S1} as a substitute for V_{SR1}.

Table 8-4: Airspeed Regulatory Reference	
Regulation	**Allowed Error**
14 CFR § 27.1323	Starting from (0.8 x V_{CLIMB}): The greater of 5 knots or 3%. Do not perform a comparison if either value is below (0.8 x V_{CLIMB}).
14 CFR § 29.1323	For Climbing Flight (VSI > 250 feet per minute): Starting from (V_{TOS} – 10): 10 knots Do not perform a comparison if either value is below (V_{TOS} – 10) For Other Flight Regimes: Starting from (0.8 x V_{TOS}) The greater of 5 knots or 3%. Do not perform a comparison if either value is below (0.8 x V_{TOS}). Note: System uses V_{CLIMB} as a substitute for V_{TOS}.

An allowable airspeed error is computed for each compared value and added together to create the airspeed miscompare threshold and accommodates for the values deviating in different directions.

Worked example for a rotorcraft climbing at 500 feet per minute and comparing a first airspeed of 80 knots with a second airspeed of 85 knots (V_{CLIMB} set to 75 knots in the aircraft limits):

1) Calculate allowable instrument error based upon airspeeds:
   Allowable Instrument Error #1 = 3 knots
   Allowable Instrument Error #2 = 2.75 knots

2) Calculate allowable installed system error based upon VSI, airspeeds and system limits:
   Allowable Installed System Error #1 = 10 knots
   Allowable Installed System Error #2 = 10 knots

3) Calculate airspeed miscompare threshold based upon sum of above allowable errors:
Airspeed Miscompare Threshold = 25.75 knots

8.7. Jeppesen NavData Chart Compatibility

As GPS navigation, flight management systems, computer flight maps, and computer flight planning systems have gained acceptance, avionics companies, and software developers have added more features. Many systems available today make it all too easy to forget paper enroute, departure, arrival, and approach charts are still required and necessary for flight. Avionics systems, flight planning, computer mapping systems, and associated databases *do not* provide all of the navigation information needed to conduct a legal and safe flight. They are not a substitute for current aeronautical charts.

See www.Jeppesen.com for the latest information on coding instrument procedures, naming conventions, altitudes within the database, and aeronautical information compatibility.

8.8. Data Logging and Retrieval

The Genesys Aerosystems EFIS logs all data associated with a flight, including all flight instrument and navigation data. This data may be downloaded for review after flight.

Data from the last five flights or 20 hours are logged at a one-second interval.

Select the "Download LOG Files" option on the IDU to create a "\log" directory on the USB Memory Key and copy the data logging files into the"\log" directory of the USB Memory Key. The data logging files contain recordings of flight and engine parameters of up to five hours each from the previous five operations of the system. During system operation, flight and engine parameters are recorded every one second. Each time the parameters are recorded, a Zulu time stamp followed by three lines of comma delimited ASCII text data are written, where the first line contains flight parameters, and the second line contains engine parameters.

8.9. Log Files

8.9.1. Delete LOG Files

1) Select "Delete LOG Files" option to delete all log files contained in the log directory. This option may be performed if there are problems updating a navigation database or application software due to an excessively large log file.

2) The deleted files are named "LOG00.dat" thru "LOG04.DAT" and "MSGLOG.DAT". Performing this option does not affect operations of the EFIS, as the EFIS automatically generates a new "LOG00.DAT" and "MSGLOG.DAT" file once a flight has started.

3) Press any button on the IDU or ❶ to return to the Ground Maintenance menu.

8.10. Routes and Waypoints

8.10.1. VFR Flight Planning

The navigation database includes VFR waypoints which consist of five digits beginning with the letters "VP". These are found on VFR charts and should be loaded in the FMS prior to flight to ensure they are available in the database and the INFO checked for proper location.

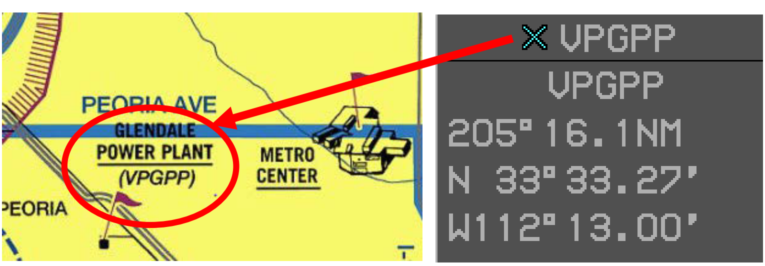


Figure 8-2: VFR Waypoint

8.10.2. Download Routes and User Waypoints

1) Select "Download Routes and User Waypoints" option from the Ground Maintenance Page to download all routes and user waypoints stored in the IDU to the USB External Memory Drive. This option is useful for fleet operations where multiple aircraft fly the same routes.

2) Routes are stored on the USB Memory external drive as NAME1-NAME2.RTE where NAME1 is the 1 to 5 character designation of the origin waypoint and NAME2 is the 1 to 5 character designation of the destination waypoint. User waypoints are stored on the USB External Memory Drive as USER.DAT.

8.11. EFIS Training Tool (ETT) Loading and Use Instructions

When receiving the EFIS Training Tool the following files are loaded on a USB memory device or downloaded from an FTP or ShareFile site:

1) Terrain Directory (approx. 3.8 GB)

2) Code Directory (138 KB)

3) Data Directory (1.3 GB)

4) User Directory (55.3 MB)

5) Utility Directory (8.53 MB)

6) Limt450.exe program (1.42 MB)

7) Sim450.exe program (11.6 MB)

8) Simulate.ini program (3.05 KB)

Copy these directories onto the same PC computer available drive. These programs and files are entirely based on the EFIS code and are compatible with 32- or 64-bit versions of Microsoft Windows® as shown below.

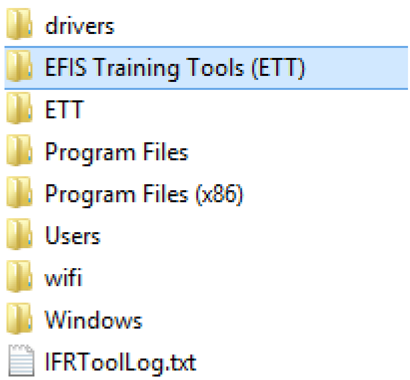


Figure 8-3: EFIS Training Tools (ETT) Directory

When opening the EFIS Training Tools (ETT) directory the following should appear:

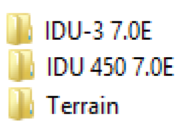


Figure 8-4: EFIS Training Tools (ETT) Sub-Directory

When opening either of the IDU-3 7.0E or IDU-450 7.0E Directories the following should appear:

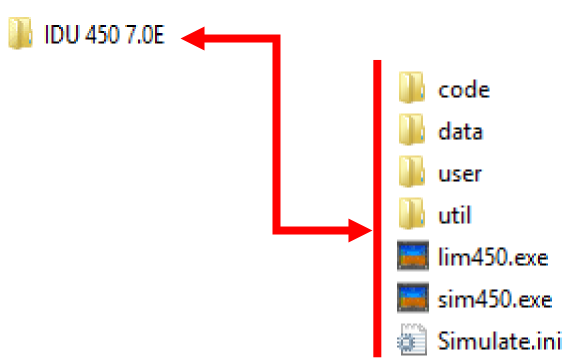


Figure 8-5: Directory Mapping of EFIS Training Tool (IDU-450)

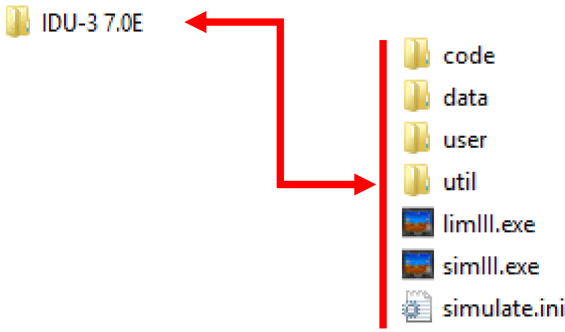


Figure 8-6: Directory Mapping of EFIS Training Tool (IDU-III)

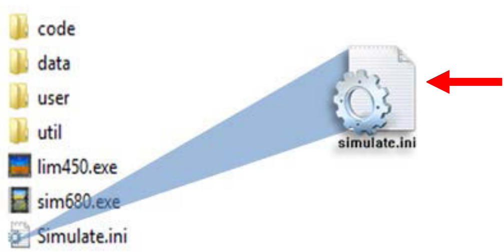
In the IDU-450 and IDU-III EFIS systems, the primary IDU-450 and IDU-III may be configured as PFD, and all other IDUs may be configured to display MFD to show a moving map, an HSI, traffic, terrain, weather, or video input.

Figure 8-7: EFIS Training Tool PFD

8.11.1. EFIS Training Tool Initialization Program Loading

Currently, the ETT program begins flying with the aircraft near Reno, Nevada at approximately 8000’ MSL. With this program loaded into your root directory where the ETT is saved, the pilot may create a position, altitude, heading, and wind condition where the tool begins flying.

As an example, here is where the simulate.ini program is saved in the directory.



Copy and paste this file (sent as an attachment) into the ETT root directory.

Figure 8-8: ETT Initialization Program Loading

When this program is opened, the following instructions may be read for a better understanding of how to control the ETT initialization location and condition. Scroll to the bottom for the actual fields where the data is entered.

After these instructions, use the following fields to control the parameters of where the ETT begins flying.

1) ALT = 5000
2) IAS = 100
3) TAS = 100
4) windspd = 10
5) heading = 21
6) winddir = 90
7) LAT = N 45.52.84
8) LON = E 8.51.10

Change the fields as desired, and the ETT begins flying from this position, speed with heading, and wind condition each time during power up until these values are changed. After changing values, close the file, and the new settings are saved if accepted.

IDU-III PFD

IDU-III MFD

IDU-450 PFD

IDU-450 MFD

Figure 8-9: EFIS Training Tool Displayed as PFD and MFD Initialized at Desired Location

8.11.2. Running the EFIS Training Tool

To run any IDU EFIS Training Tool, either double click on the appropriate ".exe" icon, or right click on the same and select Open to run. For example to IDU-450, select "sim450.exe", respectively and use any one of the above mentioned methods to run the ETT.

8.11.3. Change/Upload Limit Settings

To change or upload the limit settings for the IDU-450 ETT double click on the "lim450.exe" icon. The figure below illustrates how to open the ETT and limits editor.

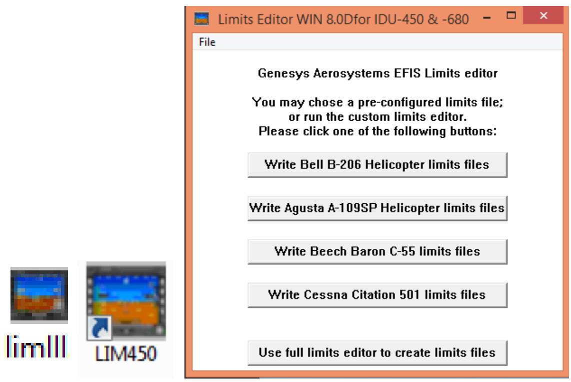


Figure 8-10: ETT Limits Editor Icon and Configuration Tool

NOTE:

To apply the changes made in the limit settings, exit and reopen the ETT.

8.11.4. Configuration File Settings

Select a pre-configured limits file or run the custom limits editor. To run the custom limits editor, select "Use full limits editor to create limits files" button. The figure below shows the button surrounded by a red box. To run the pre-configured limits file, select any one of the buttons surrounded by a black box in the figure below.

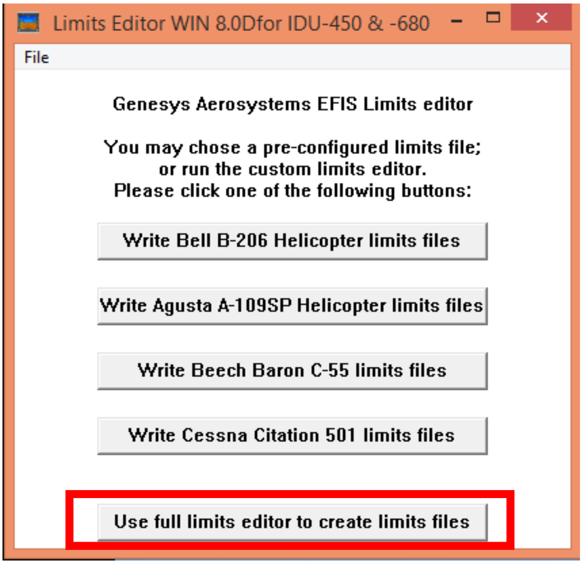


Figure 8-11: Limits Editor for IDU-III or IDU-450

8.11.5. Selecting Buttons and Encoders on ETT

To scroll the encoder, click the arrow to the right of the encoder for clockwise or arrow to the left of the encoder for counter-clockwise.

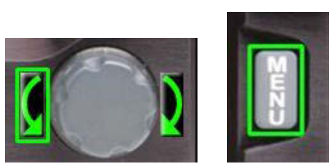


Figure 8-12: Selection of Encoders and Buttons, Illustration of Counter-Clockwise and Clockwise Encoder Rotations

8.11.6. Exit EFIS Training Tool

To close the ETT, either select **File ➔ Exit** or select the close button of the ETT window. The figure below shows first option to close the ETT.

Figure 8-13: Mute, Pause, Control Window, and Exit ETT

8.11.7. Mute Simulator Audio

By default, the ETT sends out aural annunciations. To mute the ETT audio, select **File ➔ Mute**. A check mark appears against Mute indicating the ETT audio is muted as seen below.

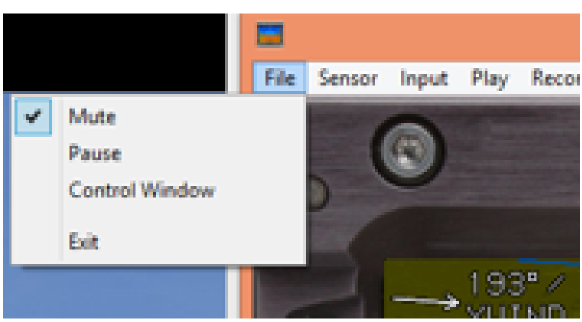


Figure 8-14: Muting EFIS Training Tool

8.11.8. Pause EFIS Training Tool

To pause the ETT, select **File ➔ Pause**. A check mark appears against Pause indicating the ETT is paused as seen below. For example, the ETT has a system clock on top-right of the MFD screen which pauses on invocation of pause command.

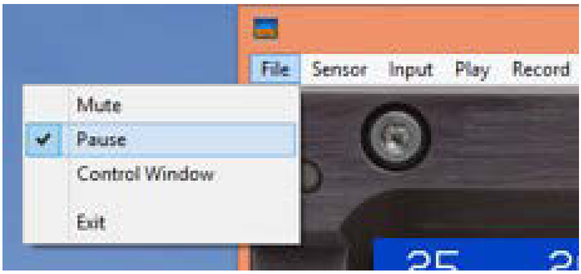


Figure 8-15: EFIS Training Tool Pause Feature

8.11.9. Turn ON/OFF Sensors

The sensors ADC, AHRS, and GPS are populated on the IDU from the pre-defined data available within the simulator. The ETT provides capability to enable/disable sensors with two options.

Method 1: Select Sensor ADC/AHRS/GPS to enable or disable the ADC/AHRS/GPS functions.

Method 2: Use check box options present to the right of the screen to enable or disable the sensor functions.

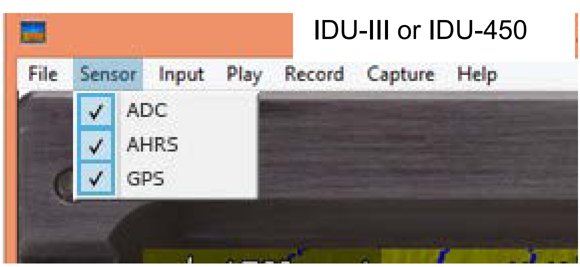


Figure 8-16: EFIS Training Tool Sensor Control (Method 1)

Figure 8-17: EFIS Training Tool Sensor Control (Method 2)

On turning ON/OFF the sensors, the changes are reflected on the ETT screen and appropriate input fields. Figure below shows changes on the ETT screen on turning OFF the ADC sensor by invoking Sensor ADC command item. The ETT does not display the **Air Speed** and **Altitude** (indicated by red crossed lines on both sides of the screen). The ETT displays **ADC2 FAIL** and **ADC1 FAIL** amber (yellow) caution messages in the left-bottom of the EFIS. Note the ADC unchecked check box on the right side of the screen.

Figure 8-18: EFIS Training Tool ADC Sensor Failed

Figure 8-19 below shows the changes on the EFIS screen when turning OFF all the sensors. The corresponding changes are reflected on the left-bottom and right side of the EFIS screen. The ADC, AHRS, and GPS check boxes on the right side of the EFIS screen are unchecked. The ETT does not display the air speed, altitude, heading, and course deviation (indicated by the crossed red lines on the EFIS screen).

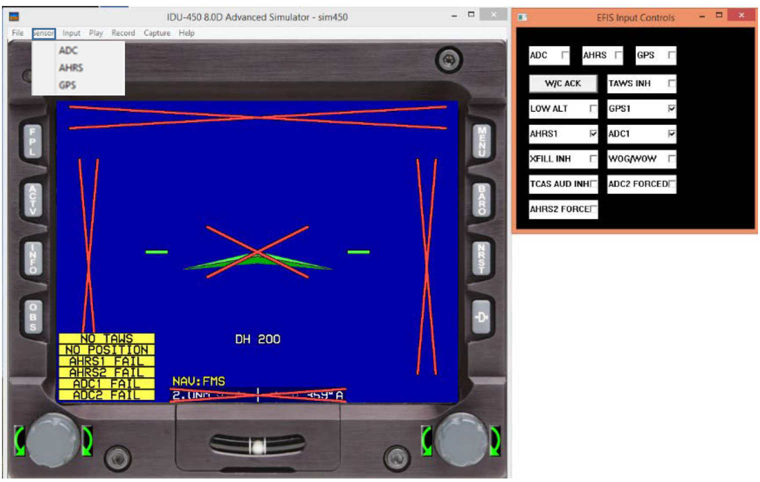


Figure 8-19: EFIS Training Tool with All Sensors Failed

8.11.10. Turn ON/OFF Discrete Inputs

Discrete inputs are populated on the IDU from the pre-defined data available within the ETT, which provides capability to enable/disable discrete inputs with two options. Settings may be changed in the discrete input settings page in the limits editor. Changes are reflected in the "Input" item in the menu bar and check boxes present to the right of the EFIS screen (Figure 8-20 and Figure 8-21). For more about the limits editor, refer to § 8.11.3. The figure below shows the default discrete input settings in the limits editor.

Figure 8-20: Default Discrete Input Settings in Limits Editor

When turning ON/OFF the discrete inputs, the changes are reflected on the EFIS screen and on appropriate input fields. Select command items in Input pop-up menu or check boxes on the right side of the screen to turn ON/OFF the discrete inputs. Figure 8-21 and Figure 8-22 below show the options on the simulator screen to turn ON/OFF the discrete inputs.

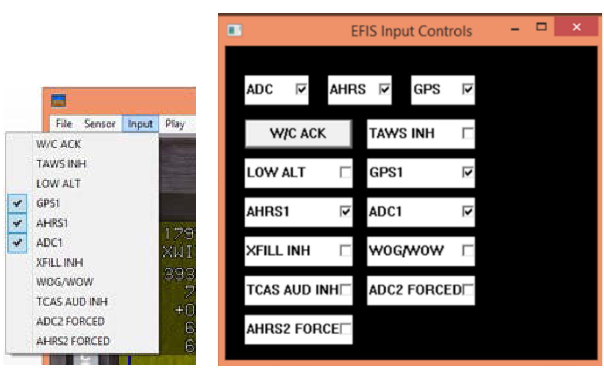


Figure 8-21: Discrete Input Options in the Menu Bar

For example, the discrete input **TRUE NORTH** is selected and the appropriate changes in the EFIS screen are highlighted in Figure 8-22 below.

Figure 8-22: True North Discrete Input Selected

8.11.11. Recording Data from EFIS Training Tool

Record (Figure 8-23) on the menu bar allows the pilot to record a time-stamped log of the ETT to any pilot-selected file name. This recorded file may be played back later.

Figure 8-23: Recording Data from ETT Pop-Up Menu

Select **Record → Record to LOG00.DAT** command item to record simulation log to the filename LOG00.DAT.

Alternatively, select **Record → Record To...** save the simulation log in a pilot-selected file name. On selecting the "Record To..."

command item, a Save As dialog box appears for entering a pilot-specified file name and location. Enter the file name against the "File Name" text box and click “Save”. Figure 8-24 shows the Save As dialog box.

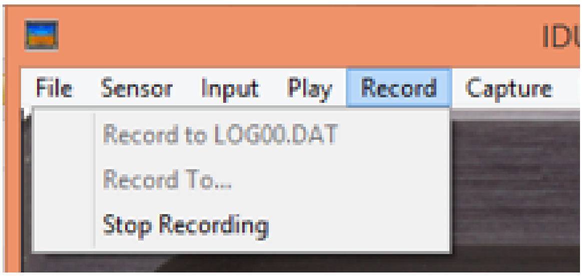


Figure 8-24: Stop Recording Command Item

The pilot may wait for certain amount of time to allow the ETT to save the simulation in the specified file. In order to stop the recording, select **Record → Stop Recording** command item. The **Stop Recording** command item gets enabled only when the recording has started. Figure 8-24 shows the stop recording command item enabled under the record pop-up menu, and Figure 8-25 shows where the log files are stored.

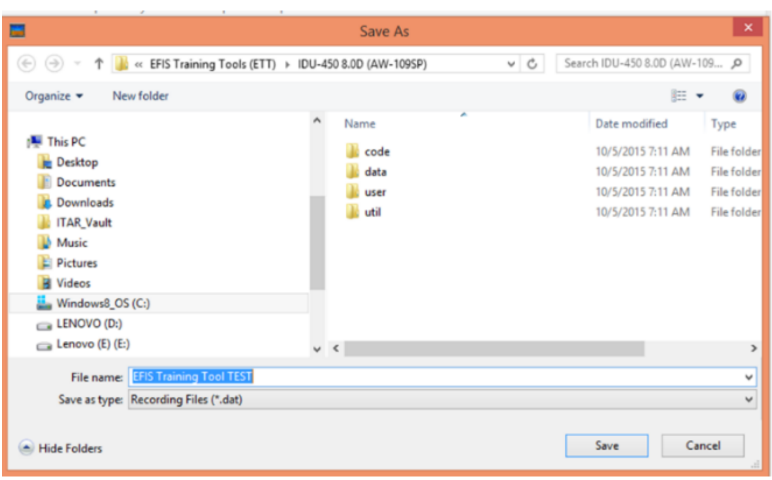


Figure 8-25: Stop Recording and Log Saving

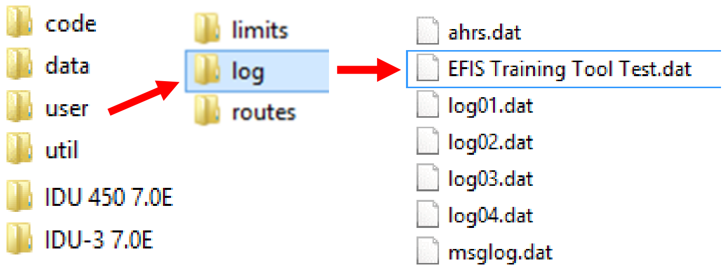


Figure 8-26: EFIS Training Tool Log File Location

8.11.12. Playing Recorded Data on EFIS Training Tool

Play on the menu bar allows the pilot to carry out commands like **Start**, **Play**, **Pause**, **Rewind**, **FFwd**, **End**, and **Halt Playback** on the recorded simulation. The play pop-up menu lists five recently played simulations and an "**Open Playback**..." option to open up other recorded simulations (see Figure 8-27). The commands items (Start, Play, Pause, Rewind, FFwd, End, and Halt Playback) are by default not enabled until a recorded simulation is played.

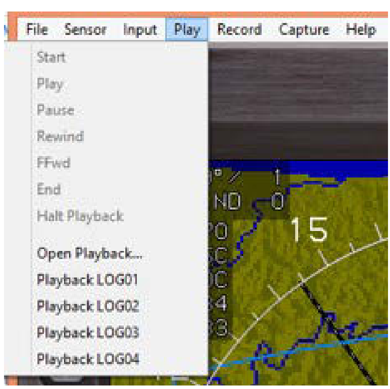


Figure 8-27: EFIS Training Tool Play Pop-Up Menu

The command items under the Play pop-up menu are also present on the right side of the EFIS screen in the form of buttons. It also displays information about the file name of the recorded simulation, date of recording, duration of recording, time elapsed and time remaining to play. Figure 8-28 below shows the screenshot of these command items in the Play pop-up menu.

Table 8-5: Play Pop-Up Menu Command Items

Action for Recorded Simulation	Command Selection	Button
Start	**Play → Start**	
Play	**Play → Play**	
Pause	**Play → Pause**	
Rewind	**Play → Rewind**	
Fast Forward	**Play → FFwd**	
End (go to the end)	**Play → End**	
Halt Playback (stop)	**Play → Halt Playback**	NA

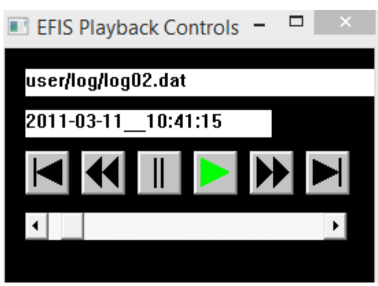


Figure 8-28: ETT Play Command Items in Pop-Up Menu

8.11.13. Capture Image

Capture on the menu bar is used to save the glass image and bezel image of the simulator screen. Figure 8-29 below shows the screenshot of Capture pop-up menu.

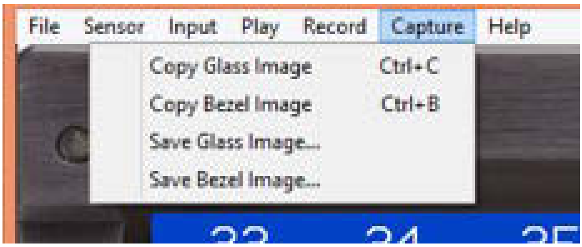


Figure 8-29: EFIS Training Tool Capture Pop-Up Menu

Table 8-6: Capture Pop-Up Menu Command Items

Action for Recorded Simulation	Command Selection	Keyboard Shortcut
Copy Glass Image	**Capture → Copy Glass Image**	**Ctrl+C**
Copy Bezel Image	**Capture → Copy Bezel Image**	**Ctrl+B**
Save Glass Image	**Capture → Save Glass Image…**	NA
Save Bezel Image	**Capture → Save Bezel Image…**	NA

The "Save As" dialog box, as shown below, appears on selecting Save Glass Image… and Save Bezel Image... In both cases, enter file name and click Save for storing image into desired location.

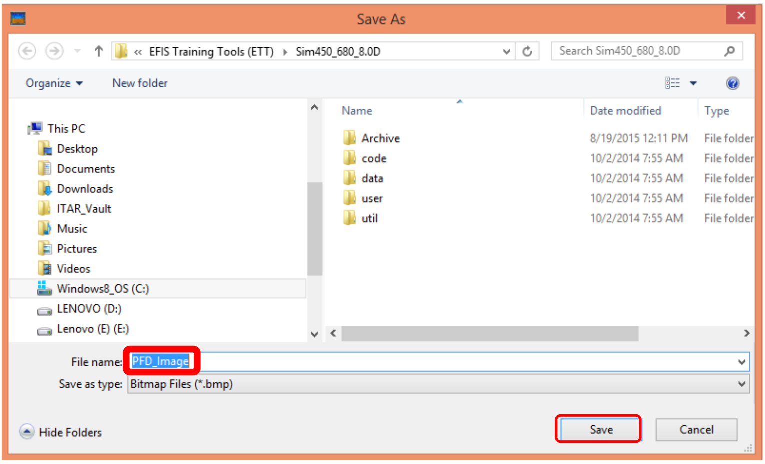
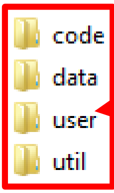
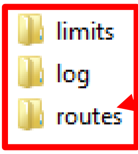


Figure 8-30: EFIS Training Tool "Save As" Dialog Box for Images

Use the ETT to create a route and or user waypoint and save normally. This information is saved in a sub-directory where the ETT program is located.

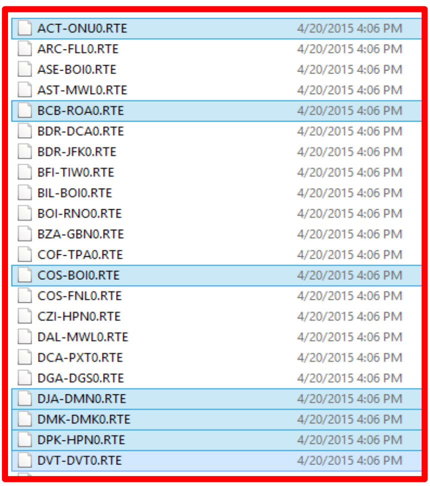


After clicking on the ETT program, these four folders are available. Double click on "user" to see the limits, log, and routes folders.



Double click "routes" to gain access to all routes and the USER.DAT file.

The USER.DAT file contains all user waypoints in one file. Copy this file to the USB memory drive.



All routes are listed alphabetically and may be copied entirely or selected individually and copied to the USB memory drive as shown here.

Figure 8-31: Downloading/Uploading Routes and User Waypoints

8.11.14. Upload Routes and User Waypoints

Select "Upload Routes and User Waypoints" on the Ground Maintenance page option to copy all routes and user waypoints stored on a USB external memory drive to the IDU. This option used in conjunction with the "Download Routes and User Waypoints" option enables the operator to store the same routes and user waypoints in multiple aircraft.

8.11.15. Delete Routes

Select "Delete Routes" on the Ground Maintenance page option to remove all routes and the user waypoint file USER.DAT from the IDU. This option is used to delete the contents of the route directory when corrupted routes cause the IDU to continually reboot.

8.12. USB External Drive Memory Limitations

NOTE:

IDU-450

Maximum USB memory is not a factor, but the following should be considered:

USB must be formatted as FAT.

FAT-16 for USB Drives 2 GB or smaller

FAT-32 for any larger sized drive. If the drive is not recognized try another source.

IDU-III

Smart Media card formatted to FAT 16 and up to 64 MB in size.

8.13. TAWS (Terrain Awareness and Warning System) Functions

The IDU provides TSO-C151b TAWS functionality. The following description is for a TAWS Class A, B, and C depending on aircraft configuration and external sensors/switches. Functions provided by TAWS are:

1) **Terrain Display**: Display of terrain and obstacles on PFD and ND.

2) **Forward Looking Terrain Awareness** (**FLTA**): A warning function using 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 alerting 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 alerting 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 alerting 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 alerting 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 alerting 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 alerting 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 aural callout when descending through 500 feet AGL.

Table 8-7: TAWS Functions Provided by the EFIS					
Aircraft Type	**Airplane**				**Airplane**
	RG + F	**RG**	**FG + F**	**FG**	
TAWS Class	A	A	A	A	B or C
Terrain Display	✓	✓	✓	✓	✓
FLTA	✓	✓	✓	✓	✓
PDA	✓	✓	✓	✓	✓
GPWS Mode 1	✓	✓	✓	✓	✓
GPWS Mode 2	✓	✓	✓	✓	
GPWS Mode 3	✓	✓	✓	✓	✓
GPWS Mode 4	✓	✓	✓		
GPWS Mode 5	✓	✓	✓	✓	
500' Call	✓	✓	✓	✓	✓

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

8.14. Terrain Display

The display of terrain on the PFD and ND are described in Sections 3 Display Symbology and 5 Menu Functions and Step-By-Step Procedures of this pilot guide where applicable.

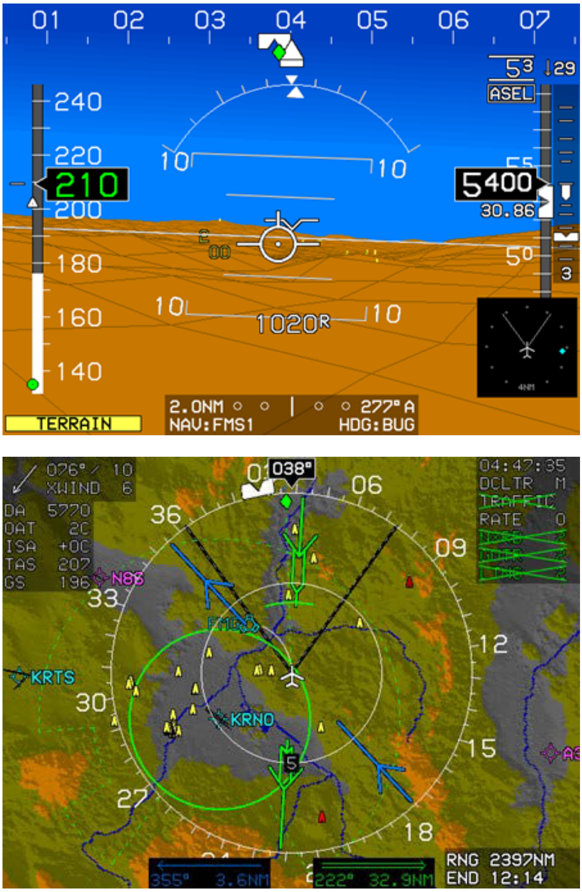


Figure 8-32: Terrain Display

8.15. Forward Looking Terrain Alert Function

The FLTA function uses the following information to alert the pilot to hazardous terrain or obstructions within a search envelope in front of the aircraft:

1) Terrain database

2) Obstruction database

3) Airport and runway database

4) Aircraft position

5) Aircraft track

6) Aircraft groundspeed

7) Aircraft bank angle

8) Aircraft altitude

9) Aircraft vertical speed

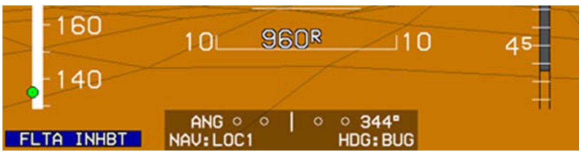


Figure 8-33: FLTA INHBT

8.15.1. FLTA Modes

The EFIS FLTA mode is either slaved to the GPS/SBAS navigation mode or set automatically based upon default mode logic.

8.15.2. GPS/SBAS Navigation Mode Slaving

The EFIS performs TSO-C146c GPS/SBAS system functions in addition to the TAWS functions. As a result, GPS/SBAS navigation mode is available as an input to the TAWS. The pilot may select an IFR procedure (Approach, DP, or STAR) which automatically changes the GPS/SBAS navigation mode to Enroute, Terminal, Departure, or IFR Approach as appropriate. In addition, the EFIS allows the pilot to select a VFR approach to any runway or user waypoint with a defined approach path. Selection of a VFR approach causes automatic GPS/SBAS navigation mode changes to Enroute, Terminal, or VFR Approach as appropriate.

When slaved, the GPS/SBAS active runway threshold or user waypoint is the reference point for automatic FLTA inhibiting. The advantage is the GPS/SBAS navigation modes are a direct indication to the FLTA function of pilot intent.

8.15.3. Default FLTA Mode

If the default FLTA navigation mode is higher in precedence than the GPS/SBAS navigation mode, the FLTA mode is slaved to the default FLTA navigation mode. These modes and order of precedence are:

1) Departure Mode: Enabled when in Ground Mode

   a) The reference point for automatic FLTA inhibiting and mode envelope definition is the last point at which the ground definition was satisfied (this is near the liftoff point). The Departure Mode ends upon climbing through 1500 feet above or traveling more than 6NM from the reference point.

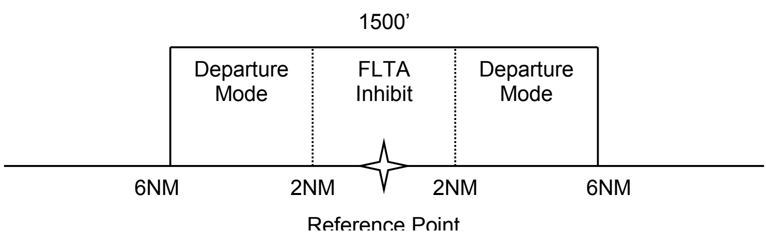


Figure 8-34: Default FLTA INHBT

2) Other Modes. For other default FLTA modes, the reference point for automatic FLTA inhibiting and mode envelope definition is the nearest runway threshold or the nearest user waypoint with a defined approach bearing. The TAWS system continuously searches all runway thresholds at the nearest three airports to determine the nearest runway threshold. The TAWS system performs a search for the nearest three airports and nearest user waypoints with a defined approach bearing every 3NM of distance traveled. Modes are as follows:

   a) Approach Mode. Exists when within 1900 feet and 5NM of the reference point.

   b) Terminal Mode. Exists from 5NM to 15NM from the reference point when below an altitude that varies from 1900 feet (at 5NM) to 3500 feet (at 15NM) above the reference point.

   c) Enroute Mode. Exists when not in any other mode.

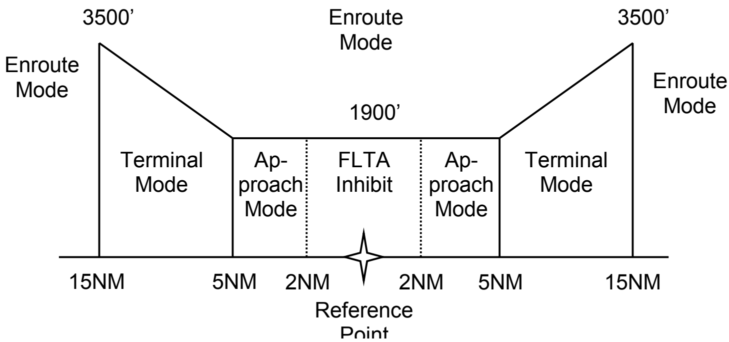


Figure 8-35: FLTA INHBT Mode Areas

8.16. FLTA Search Envelope

The FLTA search envelope is an area in front of and below the aircraft. If terrain or obstructions are found within the FLTA search envelope, a caution or warning is given to the pilot. The dimensions of the search envelope depend upon TAWS type, FLTA mode (described above), aircraft groundspeed, aircraft bank angle, and aircraft vertical speed. Basic envelope parameters are as follows:

TAWS Type: The TAWS type determines the value of several parameters used to calculate the search envelope. These parameters are described below:

Table 8-8: FLTA Search Envelope

Envelope	**Parameter**
Level-Off Rule	**Class A & B:** 20% of vertical speed **Class C:** 10% of vertical speed Used for level-off leading for the descending flight Reduced Required Terrain Clearance (RTC) calculation.
Range	60 seconds forward range search envelope. After calculations GPS/SBAS HFOM is added to range.

Table 8-8: FLTA Search Envelope

Envelope	Parameter
Enroute Mode Level or Climbing Flight RTC:	Class A & B: 700 feet Class C: 250 feet
Terminal Mode Level or Climbing Flight RTC:	Class A & B: 350 feet Class C: 250 feet
Approach Mode Level or Climbing Flight RTC:	150 feet
Departure Mode Level or Climbing Flight RTC:	100 feet
Enroute Mode Descending RTC:	Class A & B: 500 feet Class C: 200 feet
Terminal Mode Descending RTC:	Class A & B: 300 feet Class C: 200 feet
Approach Mode Descending RTC:	100 feet
Departure Mode Descending RTC:	100 feet

1) Aircraft Track: Terrain search envelope is aligned with aircraft track.

2) 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 0.5NM 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.

After calculating search volume width as described above, the GPS/SBAS HFOM is added to search volume width.

1) Aircraft Bank Angle: Used to expand the search volume in the direction of a turn and requires at least 10° of bank. In addition, search volume expansion is delayed so at 10° of bank, the bank angle must be continuously held for 3.25 seconds. The amount of delay is reduced linearly with increased bank angle so at 30° of bank there is no delay time. Delaying is intended to reduce nuisance search volume expansions when experiencing bank angle excursions due to turbulence.

2) Aircraft Vertical Speed: 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 three-second pilot reaction time and VSI leading according to the level-off rule parameter.

8.16.1. FLTA Search Volume

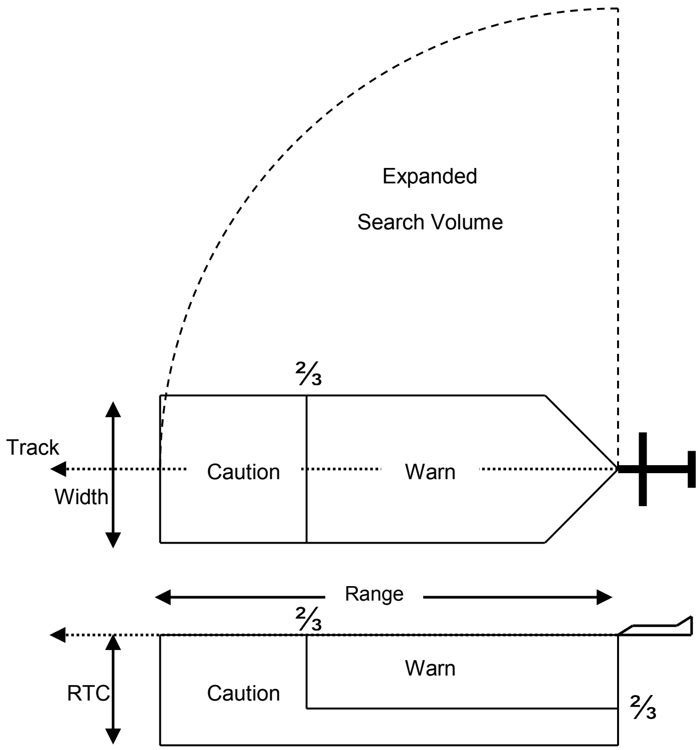


Figure 8-36: FLTA Search Volume

8.16.2. FLTA Alerts and Automatic Popup

When terrain or obstructions fall within the FLTA search envelope, an FLTA warning is generated. Terrain rendering is enabled when an FLTA warning is initiated or upgraded as follows:

1) On PFD screen, terrain rendering is enabled;

2) On navigation display screen, terrain rendering is enabled only if TAWS Inhibit is not enabled (i.e., TAWS Inhibit prevents terrain from being automatically enabled on the navigation display).

In addition, when an FLTA warning is initiated or upgraded, an automatic popup mode is engaged as follows:

1) Display (bottom area) switched to navigation display.

2) Display (bottom area) switched to aircraft centered and heading up.

3) Display (bottom area) panning disabled.

4) Display (bottom area) scale set to:

   a) 10NM (groundspeed > 200 knots);

   b) 5 NM (groundspeed <= 200 knots and groundspeed > 100 knots); or

   c) 2NM (groundspeed <= 100 knots).

After the popup mode is engaged, the pilot may manually change any setting automatically changed by the popup mode. In addition, **RESET** appears for 20 seconds to allow the pilot to reset the previous screen configuration with one button press. Popups only occur on IDU #0 or IDU #2 with Class A TAWS enabled and do not occur if TAWS Inhibit is enabled.

The following figure shows an example of the ND in popup mode.

Figure 8-37: Popup Mode

8.17. Premature Descent Alert Function

This function applies to this airplane TAWS system and uses the following:

1) GPS/SBAS navigation database
2) GPS/SBAS navigation mode
3) Aircraft position
4) Aircraft altitude

This is done to alert the pilot when descending well below a normal approach glidepath 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 0.5º less than the lower of:

1) a straight line from the FAF to the approach runway threshold; or
2) 3º

When the aircraft descends below the threshold, a PDA warning is generated.

The PDA alert threshold is depicted below:

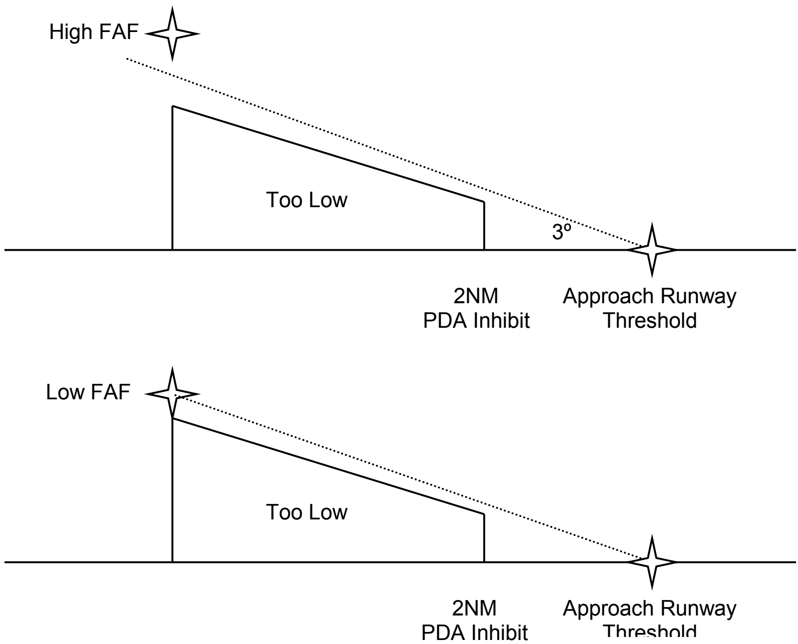


Figure 8-38: PDA Alert Threshold

8.18. Excessive Rate of Descent (GPWS Mode 1)

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 and a warning threshold. When below the thresholds, a GPWS Mode 1 warning is generated.

Table 8-9: GPWS Mode 1 Envelope

Sink Rate (fpm)	AGL Altitude (ft.)	
	"Sink Rate" Caution Threshold	"Pull Up" Warning Threshold
< 2360	$125\% \times (\text{Sink Rate} - 1416)$	$66\% \times \left(\begin{matrix}\text{Caution}\\\text{Threshold}\end{matrix}\right)$
2360 to 4900	Lesser of: 2450, or, $50\% \times (\text{Sink Rate})$	

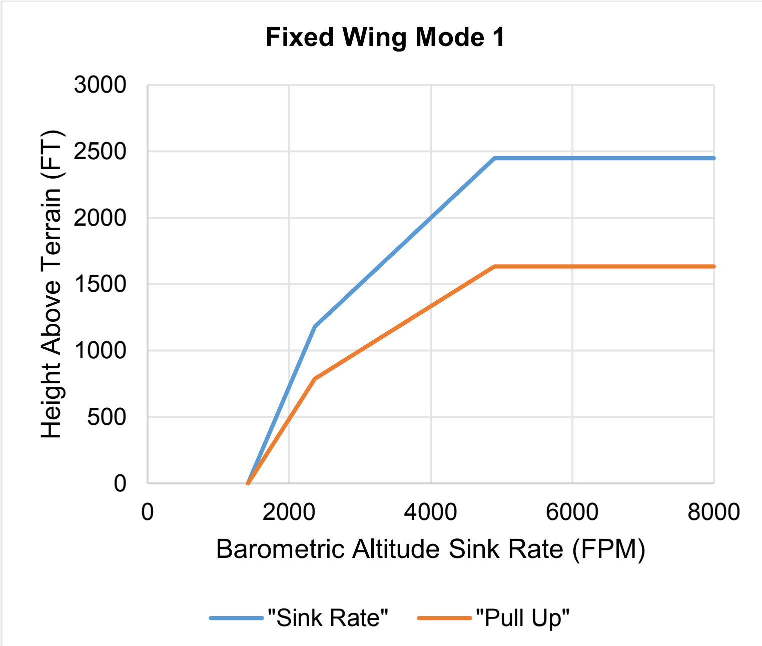


Figure 8-39: Fixed Wing GPWS Mode 1

8.19. Excessive Closure Rate to Terrain (GPWS Mode 2)

This function is present in Class A TAWS system. 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 10 second sampling time.

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:

Table 8-10: GPWS Mode 2 Envelopes

Configuration	Mode 2A	Mode 2B
Retractable Gear with Defined Landing Flaps Position	Flaps NOT in landing configuration	Flaps in landing configuration
Retractable Gear	Landing Gear UP	Landing Gear DOWN
Fixed Gear with Defined Landing Flaps Position	Flaps NOT in landing configuration	Flaps in landing configuration
Fixed Gear	AGL Altitude $>$ 500 ft or Airspeed $> V_{FE}$	AGL Altitude $\leq$ 500 ft or Airspeed $\leq V_{FE}$

When the GPWS Mode 2 envelope is pierced, a GPWS Mode 2 warning is generated.

<table>
<tr><th colspan="3">Table 8-11: GPWS Mode 2A Envelopes (NOT in Landing Configuration)</th></tr>
<tr><th rowspan="2">AGL Rate (fpm)</th><th colspan="2">AGL Altitude (ft.)</th></tr>
<tr><th>“Caution, Terrain” Caution Threshold</th><th>“Pull Up” Warning Threshold</th></tr>
<tr><td>$<$ 3900</td><td>$80\% \times (\text{AGL Rate} - 2000)$</td><td rowspan="2">$66\% \times \left(\begin{matrix}\text{Caution} \\ \text{Threshold}\end{matrix}\right)$</td></tr>
<tr><td>$>$ 3900</td><td>1520 + 15% of the lesser of:
<table>
<tr><th>Airspeed (KIAS)</th><th>AGL Rate (fpm)</th></tr>
<tr><td>$<$ 220</td><td>6000</td></tr>
<tr><td>220 to 300</td><td>$6000 + 50 \times (\text{Airspeed} - 220)$</td></tr>
<tr><td>$>$ 300</td><td>10,000</td></tr>
</table>
or
AGL Rate</td></tr>
</table>

Table 8-12: GPWS Mode 2B Envelopes (Landing Configuration)	
AGL Altitude (ft.)	
"Caution, Terrain" Caution Threshold	**"Pull Up" Warning Threshold**
Lesser of: 800, or, $80\% \times (\text{AGL Rate} - 2000)$	$66\% \times (\text{Caution Threshold})$

Envelope Depictions Mode 2 envelopes are shown below:

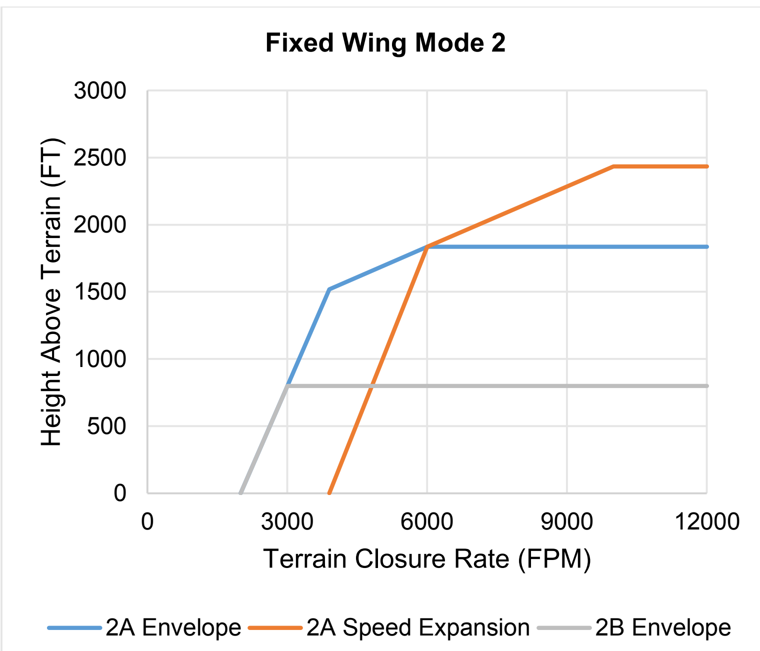


Figure 8-40: Fixed Wing GPWS Mode 2

8.20. Sink Rate after Takeoff or Missed Approach (GPWS Mode 3)

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 in Ground Mode or by being on the first leg of a missed approach procedure (as determined by the GPS/SBAS) 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 is 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 defined below:

“**Don’t Sink**” AGL = 1.4 * sink rate

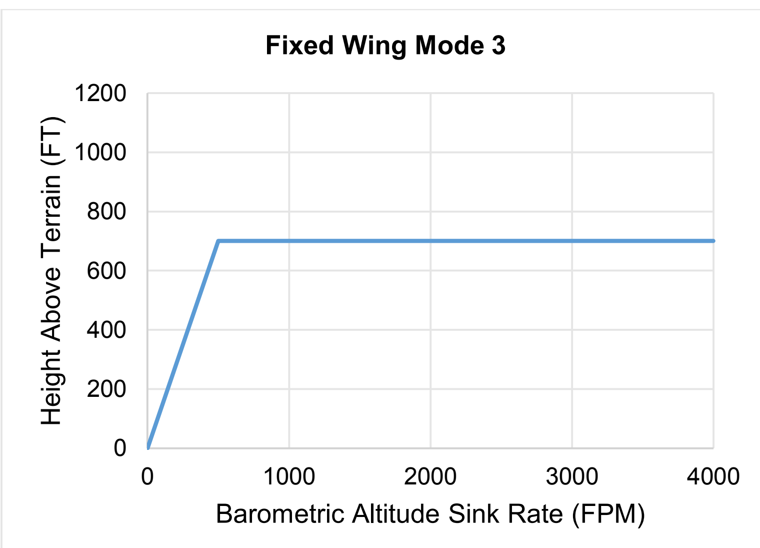


Figure 8-41: Fixed Wing GPWS Mode 3

8.21. Flight into Terrain when not in Landing Configuration (GPWS Mode 4)

This function is present in Class A TAWS systems. The GPWS Mode 4 function uses aircraft speed information and AGL altitude to alert the pilot when descending into terrain without properly configuring the aircraft for landing. There are two Mode 4 envelopes: Mode 4A which gives cautions when landing gear is in other than landing configuration; and Mode 4B which gives cautions when landing gear or flaps are in other than landing configuration. Applicability of Mode 4 envelopes to aircraft types are as follows:

Table 8-13: Mode 4 Envelopes

Configuration	Mode 4A	Mode 4B
Retractable Gear with Defined Landing Flaps Position	Landing Gear UP	Landing Gear UP OR Flaps not in landing configuration.
Retractable Gear	Landing Gear UP	Landing Gear UP
Fixed Gear with Defined Landing Flaps Position	Not Applicable	Flaps not in landing configuration
Fixed Gear	Not Applicable	Not Applicable

Mode 4 alerting criteria requires the Mode 4 envelope be entered from above so changing aircraft configuration while within a Mode 4 envelope does not generate an alert.

Airplane Mode 4 envelopes consists of a low-speed region and a high-speed region.

When Mode 4A alerting criteria are met in the low-speed region, TOO LOW is presented in conjunction with a single "Too Low Gear" aural alert.

When Mode 4B alerting criteria are met in the low-speed region, TOO LOW is presented in conjunction with either a single "Too Low Gear" aural alert (if landing gear is UP) or a single "Too Low Flaps" aural alert (if landing gear is DOWN).

When either Mode 4 alerting criteria are met in the high-speed region, TOO LOW is presented in conjunction with a single “Too Low Terrain” aural alert.

Table 8-14: GPWS Mode 4 Parameters

Mode	Region	Speed (KIAS)	AGL Altitude (ft.)
4A	Low-Speed	< 182.5	500
	High-Speed	≥182.5	Lesser of: 800, or, $8 \times (\text{KIAS} - 120)$
4B	Low-Speed	< 138.75	150
	High-Speed	≥ 138.75	Lesser of: 800, or, $8 \times (\text{KIAS} - 120)$

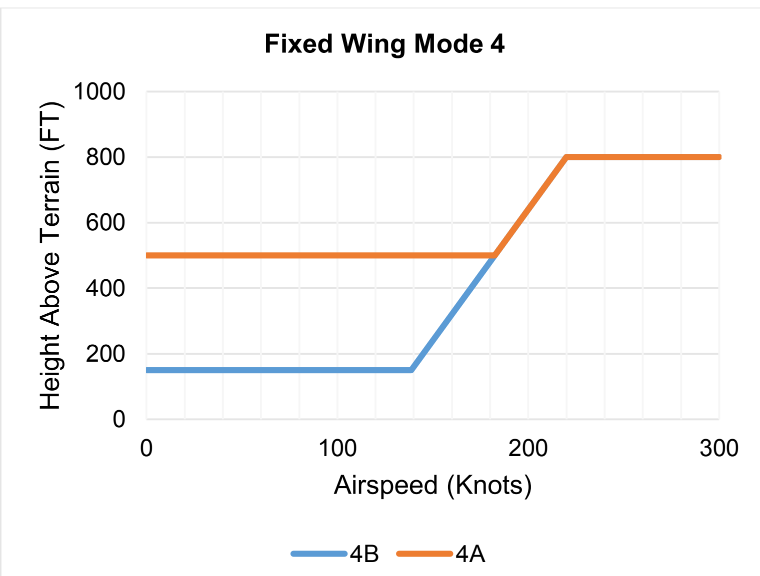


Figure 8-42: Fixed Wing GPWS Mode 4

8.22. Excessive Downward Deviation from an ILS Glideslope (GPWS Mode 5)

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 is below 1000' AGL.

GPWS Mode 5 has a caution and a warning threshold. When below a threshold, a GPWS Mode 5 warning is generated. The curve compares glideslope deviation to AGL altitude as shown below:

(Reference: RTCA/DO-161A Mode 5 for TAWS systems)

Table 8-15: GPWS Mode 5 Envelopes

Caution Threshold	Warning Threshold
Greater of: $\begin{bmatrix} 1.3 + 1.4\% \times \\ (150 - \text{AGL Altitude}) \end{bmatrix}$ Dots or 1.3 Dots	Greater of: $\begin{bmatrix} 2 + 1\% \times \\ (150 - \text{AGL Altitude}) \end{bmatrix}$ Dots or 2 Dots

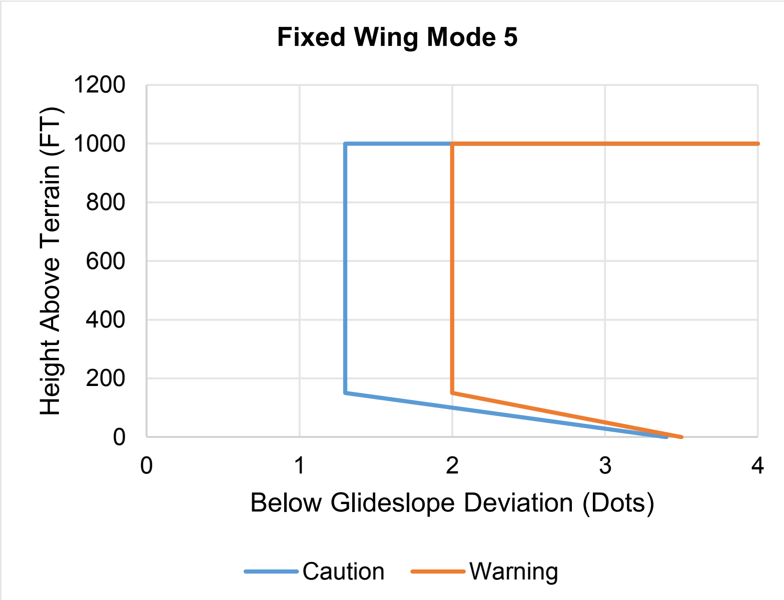


Figure 8-43: Fixed Wing GPWS Mode 5

8.23. 500-Foot Wake-Up Call

This function is present in all TAWS classes. The 500-foot function includes an arming deadband of 500 feet to prevent nuisance warnings during low altitude operations. Thus, the aircraft must climb above 1000 feet AGL to arm the 500-foot function and generate a 500-foot annunciation.

8.24. 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 as follows:

1) **GPS/SBAS Receiver**. Source of aircraft position, geodetic height, horizontal figure of merit (HFOM), vertical figure of merit (VFOM), loss of integrity (LOI), and loss of navigation (LON) inputs for the TAWS. Connects directly to the EFIS IDU.

2) **Air Data Computer (ADC)**. Source of barometric altitude, outside air temperature, and vertical speed for the TAWS and connects directly to the EFIS IDU.

3) **ILS Receiver**. A glideslope receiver is the source of glideslope deviation for the TAWS.

4) **Radar Altimeter (RA)**. Source for radar altitude for the TAWS.

5) **Gear Position Sensors**. Landing gear position discretes, as configured in the system limits, are the source of landing gear position for the TAWS.

6) **Flap Position Sensor**. A flap position discrete, as configured in the system limits is the source of flap position for the TAWS.

7) **TAWS Inhibit Switch**. As configured in the system limits, used for manual inhibiting of TAWS alerting functions. The TAWS Inhibit Switch is of the latching type and gives an obvious indication of actuation (e.g., toggle/rocker or pushbutton with indicator light and TAS INHBT in the lower left corner of the PFD).

8) **Audio Mute Switch**. Used for silencing active aural alerts. The Audio Mute Switch is of the momentary type and connected directly to the EFIS IDU. The Audio Mute Switch is momentarily pulled to ground when silencing of active aural alerts is desired.

9) **Glideslope Deactivate Switch**. As configured in the system limits, used for inhibiting the GPWS Mode 5 function. The Glideslope Deactivate Switch is of the momentary type and momentarily activated when inhibition of the GPWS Mode 5 function is desired.

Applicability of external sensors and switches for the applicable TAWS system is as follows:

Table 8-16: TAWS External Sensors and Switches					
TAWS Class	**A**				**B or C**
Configuration	**RG+F**	**RG**	**FG+F**	**FG**	
GPS/SBAS	✓	✓	✓	✓	✓
ADC	✓	✓	✓	✓	✓
Gear Position Sensor	✓	✓			
TAWS Inhibit Switch	✓	✓	✓	✓	✓
Audio Cancel Switch	✓	✓	✓	✓	✓
ILS	✓	✓	✓	✓	
Radar Altimeter	✓	✓	✓	✓	
Flap Position Sensor	✓	✓	✓	✓	
Glideslope Deactivate Switch	✓	✓	✓	✓	

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

8.25. TAWS System Basic Parameter Determination

The fundamental parameters used for TAWS system functions are:

Table 8-17: Airplane TAWS Basic Parameters Determination		
Parameter	**Source**	**Notes**
Aircraft Position, groundspeed and track	GPS/SBAS	HFOM must be less than or equal to the greater of 0.3 NM or the Horizontal alert limit (HAL) for the mode of flight.

Table 8-17: Airplane TAWS Basic Parameters Determination

Parameter	Source	Notes
MSL Altitude	GPS/SBAS	Geodetic Height converted to MSL with the current EGM (Earth Gravity Model) database. In order for this to be considered valid for use as MSL altitude, the VFOM must be less than or equal to 106 feet. The secondary source of MSL altitude is barometric altitude from an air data computer. Barometric altitude is determined based upon a barometric setting in the following order of preference: 1) If either the pilot or co-pilot system is operating in QNH mode, the QNH barometric setting is used (note: on-side barometric setting preferred); or 2) If GPS/SBAS geodetic height has been valid within the last 30 minutes, a barometric setting derived from the GPS/SBAS geodetic height is used. If neither of the above conditions are met, MSL

Table 8-17: Airplane TAWS Basic Parameters Determination

Parameter	Source	Notes
		altitude is marked as invalid. When a reporting station elevation is determined and outside air temperature is valid, a temperature correction is applied. The TAWS system uses the lower of the barometric altitude or the temperature-corrected altitude. In the case of QNH-mode barometric setting, reporting station elevation is derived from waypoint or active runway elevations in the active flight plan using the following logic: 1) If the aircraft is in **TERMINAL, DEPARTURE**, **IFR APPROACH**, or **VFR APPROACH** mode and an active runway exists, reporting station elevation is the elevation of the active runway threshold. 2) Otherwise, if the aircraft is in **TERMINAL** mode, reporting station elevation is the elevation of the

Table 8-17: Airplane TAWS Basic Parameters Determination		
Parameter	**Source**	**Notes**
		airport causing **TERMINAL** mode. 3) In **ENROUTE** mode, no reporting station elevation is determined. In the case of GPS/SBAS geodetic height-based barometric setting, reporting station elevation is the GPS MSL altitude reported at the time the barometric setting was determined. Note the following definitions: **QFE**: Barometric setting resulting in the altimeter displaying height above a reference elevation (e.g., airport or runway threshold). **QNE**: Standard barometric setting (29.92 inHg or 1013 mbar) used to display pressure altitude for flight above the transition altitude. **QNH**: Barometric setting resulting in the altimeter displaying altitude above mean sea level at the reporting station.
Terrain Data	Terrain Database	In order for terrain data to be considered valid for use by the TAWS, the

Table 8-17: Airplane TAWS Basic Parameters Determination

Parameter	Source	Notes
		following conditions must be met: 1) Aircraft position is valid; 2) Aircraft position is within the boundaries of the terrain database; and 3) The terrain database is not corrupt as determined by CRC-32 checks at system initialization and during runtime.
Obstacle Data	Obstacle Database	In order for obstacle data to be considered valid for use by the TAWS, the following conditions must be met: 1) Aircraft position is valid; 2) Aircraft position is within the boundaries of the obstacle database; and 3) The obstacle database is not corrupt as determined by CRC-32 checks at system initialization.
AGL Altitude	Radar Altitude	The secondary source for AGL Altitude is MSL altitude less terrain altitude.

Table 8-17: Airplane TAWS Basic Parameters Determination

Parameter	Source	Notes
Vertical Speed	Instantaneous vertical speed	IVSI values come from barometric vertical speed from an ADC "quickened" with vertical acceleration from an AHRS. The secondary source for vertical speed is barometric vertical speed from an ADC. The tertiary source for vertical speed is GPS/SBAS vertical speed providing the VFOM is less than or equal to 106 feet.
Terrain Closure Rate	Smoothed first derivative of AGL Altitude	Due to the multiple sources for altitude, there are multiple sources for terrain closure rate.
Runway/ Reference point location	EFIS navigation database	In order to be considered valid for use, the following conditions must apply: 1) Aircraft position is valid; 2) Aircraft position is within the boundaries of the navigation database; and 3) The navigation database is not corrupt as determined by a CRC-32 check at system initialization.

8.26. 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 and 1900’ of the reference point.
2) The PDA function is automatically inhibited when within 2NM and 1900’ of the approach runway threshold.
3) GPWS Modes 1 through 4 are automatically inhibited when below 50 feet AGL (radar altimeter AGL altitude) or below 100 feet AGL (terrain database AGL altitude).
4) GPWS Mode 5 is inhibited below 200’ AGL. This form of automatic inhibit remains active until the aircraft climbs above 1000’ AGL. This form of inhibiting prevents nuisance alarms on missed approach when glideslope sidelobes are detected by the glideslope receiver.

8.26.1. TAWS Automatic Inhibit Functions (Abnormal Operation)

The following automatic inhibit functions occur during the specified abnormal operations:

System Sensor/Database Failures. System sensor failures, non-installation of optional sensors, database failures, and combinations thereof affect the TAWS system as follows:

Table 8-18: TAWS Automatic Inhibit Functions

Sensor	Parameters Lost	Terrain Displaced	FLTA	PDA	GPWS Mode 1	GPWS Mode 2	GPWS Mode 3	GPWS Mode 4	GPWS Mode 5	500’ Wake-Up
GPS/SBAS (H)	AC Position	Inhibit	Inhibit	Inhibit						

Table 8-18: TAWS Automatic Inhibit Functions

Sensor	Parameters Lost	Terrain Displaced	FLTA	PDA	GPWS Mode 1	GPWS Mode 2	GPWS Mode 3	GPWS Mode 4	GPWS Mode 5	500' Wake-Up
TD	Terrain Elev.	Inhibit	Inhibit							
ILS	Glide-slope Dev.								Inhibit	
MSL	MSL Altitude	Inhibit	Inhibit	Inhibit						
GPS/SBAS (H) + RADLT	AC Position, AGL Altitude	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit
GPS/SBAS (V) + ADC	MSL Altitude, VSI	Inhibit	Inhibit	Inhibit	Inhibit		Inhibit			
TD + RADLT	Terrain Elev. AGL Altitude	Inhibit	Inhibit		Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit
MSL + RADLT	MSL Altitude, AGL Altitude	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit

Table 8-18: TAWS Automatic Inhibit Functions											
Sensor	Parameters Lost	Terrain Displaced	FLTA	PDA	GPWS Mode					500' Wake-Up
					1	2	3	4	5	
GPS/SBAS (V) + ADC + RADLT	MSL Altitude, VSI, AGL ALT	Inhibit	Inhibit	Inhibit	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/SBAS (H) = HFOM > max (0.3NM, HAL). Indication is loss of terrain display on PFD and ND.

3) GPS/SBAS (V) = VFOM > 106'.

4) GPS/SBAS = GPS/SBAS (H) + GPS/SBAS (V). Indication is loss of terrain display on PFD and ND.

5) TD = Terrain Data invalid. This would be due to being beyond the database boundaries or database corruption.

6) ADC = Air Data Computer. Indication is ADC1 FAIL or ADC2 FAIL flag, or red Xs indicating a single ADC failure.

7) RADALT = Radar Altimeter. Indication is lack of radar altimeter source indication on radar altimeter display. RADALT FAIL

8) ILS = ILS Glideslope Deviation. Indication is lack of glideslope needles.

9) MSL=MSL Altitude Invalid. Indication is NO TAWS in the absence of other failures.

8.26.2. TAWS Manual Inhibit Functions

The pilot may select the following manual inhibit functions:

1) The Terrain Display function may be inhibited using an EFIS soft menu declutter control.

2) All TAWS alerting functions (including popup functionality) are manually inhibited by actuation of the external TAWS Inhibit Switch. The TAWS Inhibit Switch does not affect the Terrain Display function, including display of FLTA alarm (red) and caution (amber [yellow]) cells on the ND.

3) GPWS Mode 5 is manually inhibited by actuation of the momentary Glideslope Cancel Switch when below 1000’ AGL. GPWS Mode 5 manual inhibit automatically resets by ascending above 1000’AGL.

8.27. TAWS Selections on PFD

The PFD Declutter menu includes three option possibilities for TAWS as follows:

1) TERRAIN

2) None

The figures below show all possible scenarios including “None” where the aircraft pierces the TAWS FLTA Terrain envelope, and TERRAIN automatically becomes enabled for the safest possible warning alert condition.

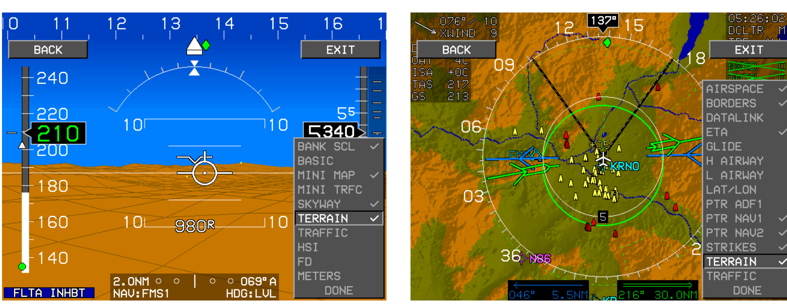


Figure 8-44: PFD MFD TERRAIN Option

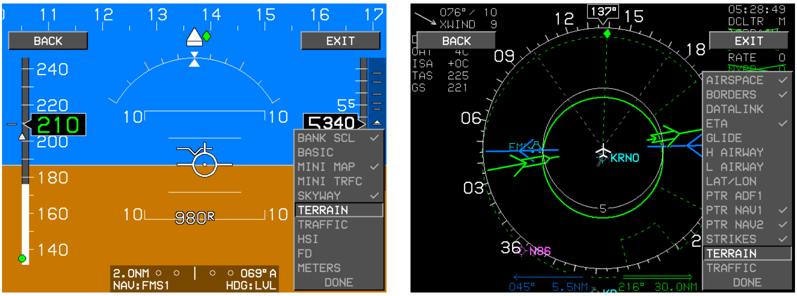


Figure 8-45: PFD MFD No TERRAIN Option

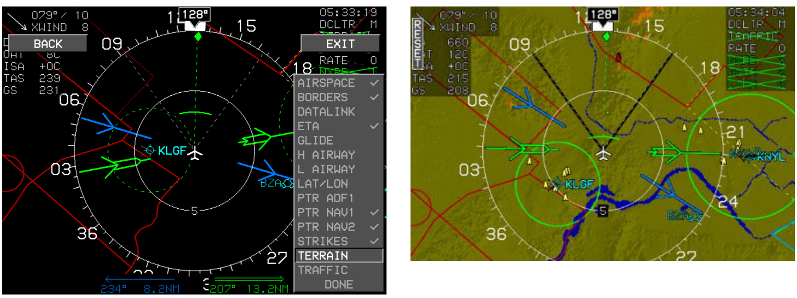


Figure 8-46: PFD MFD No TERRAIN Option with FLTA Popup

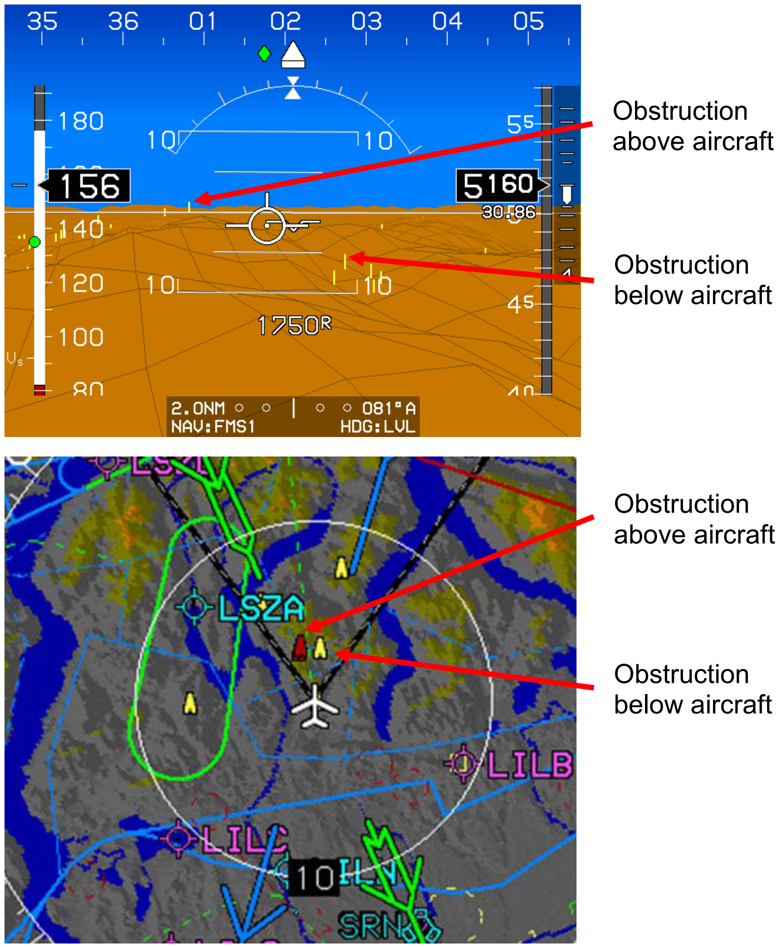
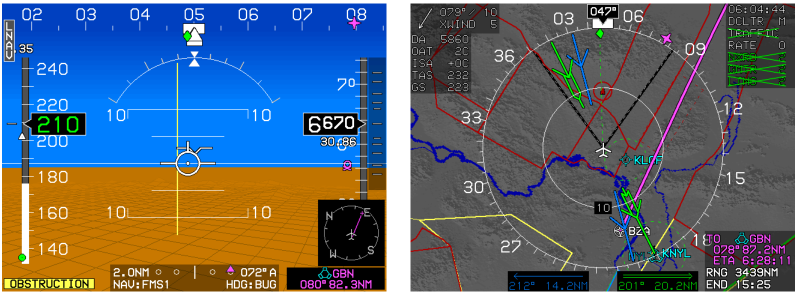
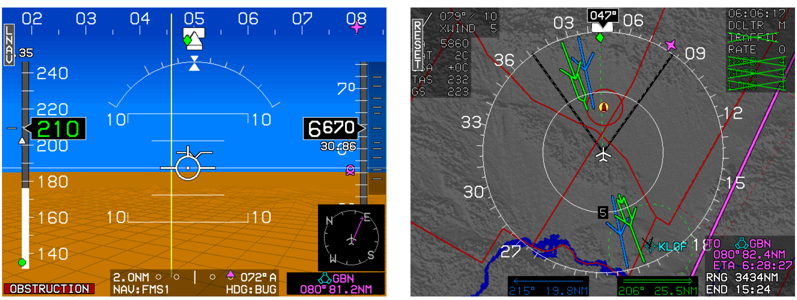


Figure 8-47: PFD MFD Obstructions



Obstruction within TAWS FLTA Caution envelope with aural annunciation “Caution Obstruction, Caution Obstruction”. The obstruction symbols flash on the MFD only.

Figure 8-48: PFD MFD Obstruction Caution



Obstruction within TAWS FLTA warning envelope with aural annunciation “Warning Obstruction, Warning Obstruction”, the obstruction symbols flash on the MFD only.

Figure 8-49: PFD MFD Obstruction Warning

8.28. Failure Modes

8.28.1. 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, the associated sensor is considered to be in a failed condition.

Failure of the following auxiliary sensors results in an amber (yellow) caution flag and aural annunciation "Auxiliary Sensor Failure":

1) RS-232 TAS System
2) ADS-B System
3) WSI Datalink
4) WX-500 System
5) Analog Interface System
6) Weather Radar (IDU-450 Only)
7) Weather Radar Control Panel (IDU-450 Only)

None of these receivers or devices significantly impact the navigational or display capabilities of the EFIS.

Failure of the GPS, AHRS, or ADC, singly or in combination, adversely impacts the EFIS capabilities. These failures are annunciated by the GPS Fail and AHRS Fail amber (yellow) flags and absence of air data information. In addition, the software enables 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, Section 4.13.

8.28.2. Weather Radar (IDU-450 Only)

The supported weather radar architectures are depicted below:

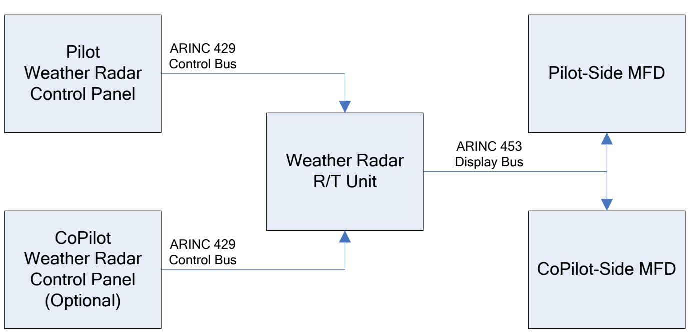


Figure 8-50: Standard ARINC-708, Collins and Most Honeywell Digital Radars

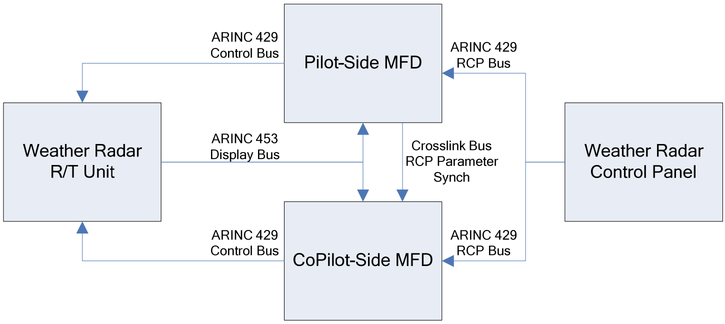


Figure 8-51: Honeywell RDR-2XXX with Single Radar Control Panel

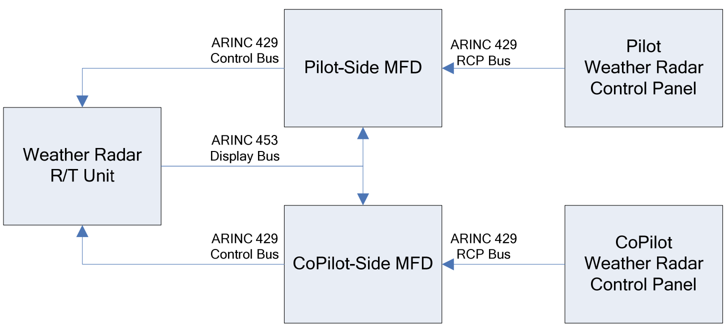


Figure 8-52: Honeywell RDR-2XXX with Dual Radar Control Panel

8.28.3. Weather Radar Module

The Weather Radar Module converts the ARINC 453 Display Bus data into high-speed serial data for use by the IDU and converts high-speed serial data from the IDU into low-speed ARINC 429 Control Bus data. Duplex communications between the Weather Radar Module and the IDU uses integrated peripheral high-speed bus #1.

AUDIBLE ANNUNCIATION

CWA flags are accompanied by an auditory annunciation.

Failure of a weather receiver, datalink receiver, TCAS/TCAD receiver, AIU, and Weather Radar results in the EFIS issuing an amber (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, AHRS, or ADC, singly or in combination, adversely impacts the EFIS capabilities. In addition, the software provides degraded displays, to show as much useful and accurate Information as possible in the failure condition. These degraded displays are described in detail as follows.

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

Mode 0: GPS, ADC, and AHRS normal.

Mode 1: GPS failed, ADC and AHRS normal.

Mode 2: ADC failed, GPS and AHRS normal.

Mode 3: AHRS failed, GPS and ADC normal.

Mode 4: GPS and ADC failed, AHRS normal.

Mode 5: GPS and AHRS failed, ADC normal.

Mode 6: ADC and AHRS failed, GPS normal.

Mode 7: GPS, ADC and AHRS failed.

System operation in the above modes is detailed on the following table.

Table 8-19: PFD Functions

PFD Function	Mode							
	0	1	2	3	4	5	6	7
Airspeed	OK	OK	19	OK	19	OK	19	19
Altimeter	OK	OK	19	OK	19	OK	19	19
Altimeter Set Display	OK	OK	-	OK	-	OK	-	-
Bank Scale	OK	OK	OK	-	OK	-	-	-

Table 8-19: PFD Functions								
PFD Function	Mode							
	0	1	2	3	4	5	6	7
CDI	OK	1 + 20	OK	OK	20	20	OK	20
Runway	OK	1	-	-	-	-	-	-
Waypoint Pointer	7	1	7	7	-	-	7	-
Heading Scale	7	7	7	7	7	-	7	-
AGL Ind.	OK	2	4	OK	11	11	4	-
Flight Path Marker	OK	1 + 14	-	-	-	-	-	-
G-meter	OK	OK	OK	-	OK	-	-	-
Ground Track	7	1	7	7	-	-	7	-
Heading Indicator	7	7	7	-	7	-	-	-
Horizon	OK	OK	OK	-	OK	-	-	-
Mini-Map	7	1	7	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	22	22	5	13	5	13	13	13
Waypoint Symbol	OK	1	-	-	-	-	-	-
Waypoint Brg/Dist	OK	1	OK	OK	-	-	OK	-
Traffic	OK	OK	OK	-	-	-	-	-
Traffic Thumbnail	OK	OK	OK	OK	OK	OK	OK	OK
Speed Trend	OK	OK	-	-	-	-	-	-
Dynamic Stall Speed	OK	OK	-	8	-	8	-	-

Table 8-20: ND Functions

ND Functions	Mode							
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Aircraft Position	OK	1	OK	OK	-	-	OK	-
Special Use Airspace	9	1	6	9	-	-	6 + 9	-
Waypoint Pointer	9	1	9	9	-	-	9	-
Active Flight Plan Path	9	1	9	9	-	-	9	-
Glide Range	9	1	-	10	-	-	-	-
Groundspeed	OK	1	OK	OK	-	-	OK	-
Ground Track	9	1	9	9	-	-	9	-
Heading Indicator	9	9	9	-	9	-	-	-
Navigation Symbols	9	1	9	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	21	3	-	-	-	-	-	-
Compass Rose	9	9	9	9	9	-	9	-
Fuel Totalizer Functions	23	24	23	23	12	12	12	12
True Airspeed	OK	OK	-	OK	-	OK	-	-
Density Altitude	OK	OK	-	OK	-	OK	-	-
OAT/ISA Display	OK	OK	-	OK	-	OK	-	-

Table 8-21: Output Functions								
Output Functions	**Mode**							
	0	**1**	**2**	**3**	**4**	**5**	**6**	**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
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	-	-

Note 1: Presented using inertial dead-reckoning based on last known wind information. If unable to dead-reckon (e.g., heading is failed or true airspeed cannot be calculated), function is disabled.

Note 2: Only radar altitude presented when available.

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. The rotorcraft versions use full-time large attitude bars and do not show the waterline symbol.

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

Note 7: In heading-only failure mode or AHRS failure mode, heading scale aligned with aircraft track and heading indication is removed. In heading-only failure mode or AHRS failure mode combined with GPS failure, heading scale is replaced with a Red-X.

Note 8: Based upon 1G stall speed.

Note 9: In heading-only failure mode or AHRS failure mode, compass rose aligned with aircraft track and heading indication is removed when in heading up mode. In heading-only failure mode or AHRS failure mode combined with GPS failure, compass rose is removed.

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: Assuming valid fuel flow information, endurance is presented.

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

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

Note 15: Highway in the Sky removed after one minute,

Note 16: See IDU IV Personality Module and Limits Requirements (Doc. No. 42-007003-D001) 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.

Note 19: Red “X” in place of scale.

Note 20: VLOC CDI always available if optional VOR symbology enabled.

Note 21: Function removed during heading-only failure mode,

Note 22: Rotorcraft versions use full-time large attitude bars and do not show the waterline symbol.

Note 23: Assuming valid fuel flow information both range and endurance are presented, Note 24: Assuming valid fuel flow information, both range and endurance are presented using inertial dead-reckoning based on last known wind information. If unable to dead-reckon (e.g., heading is failed or true airspeed cannot be calculated), only endurance is presented.

AUDIBLE ANNUNCIATION

Component failures result in amber (yellow) caution flags and a single aural annunciation identifying each failed component.

8.29. GPS Failure

GPS degrades or fails as a result of loss of satellite information, or GPS equipment failure. When the integrity is provided by SBAS, the IDU provides a LOI (Loss of Integrity) monitoring caution within two seconds if the current HPL (Horizontal Protection Level) exceeds the HAL (Horizontal Alert Level). This LOI caution appears when there is not integrity monitoring and disappears when integrity monitoring is restored.

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.

The LON (Loss of Navigation) is displayed within one second of the onset of the following:

1) The absence of power

2) Equipment malfunction or failure

3) The presence of a condition lasting five seconds or more where there are an inadequate number of satellites to compute position solution.

4) Fault detects a position failure that cannot be excluded within time-to-alert when integrity is provided by FDE.

When in LNAV, the fault detection function detects positioning failures within ten seconds after the onset of the positioning failure.

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 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 ##.## flag is displayed to show the pilot the length of time during which the EFIS has been dead reckoning.

NOTE:

SBAS 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 a GPS-Based approach procedure at or after the FAF and still IMC (no TAWS available), initiate the Missed Approach Procedure.

In the event of a loss of GPS during an ILS, LOC, VOR, or NDB approach procedure (no TAWS available) and still IMC, continuation of approach procedure may only be based upon raw data navigational information.

The primary flight and navigation displays are affected as follows:

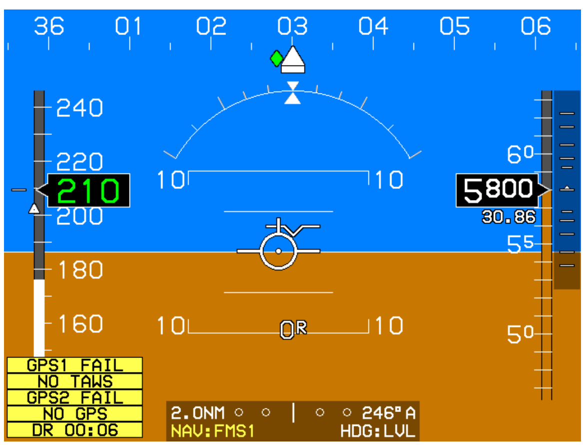


Figure 8-53: PFD Page during GPS Failure

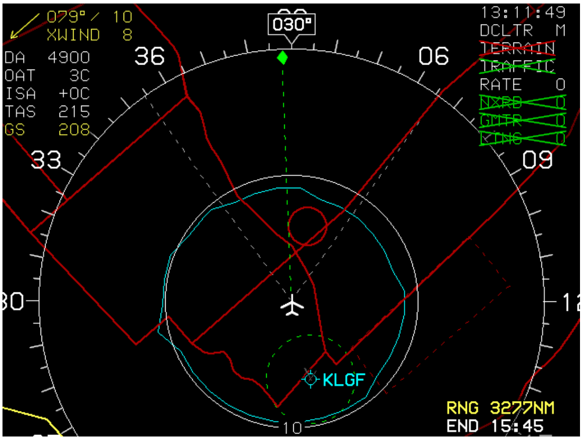


Figure 8-54: ND Page during GPS Failure

CAUTION:

In the event of loss of GPS, transition to other navigation sources as soon as possible. Following system dead reckoning guidance may 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, in the event of a wind mismatch, position errors grow over time and may 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 may be. As an example, with a ten knot wind mismatch, the dead reckoning solution is 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 affecting these parameters may cause inaccuracies in the calculated wind. The pilot should be aware of the following potential error sources:

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

b) Heading: Heading errors may be caused by poor AHRS alignment, carrying iron-bearing materials in proximity to the magnetic sensor, 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.

c) GS: Poor satellite geometry may 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.

d) Track: Poor satellite geometry may 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 Path Marker. 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.

8.30. ADC Failure

Failure of the ADC causes the loss of air data. This failure is annunciated by loss of air data information and a red “X” over the airspeed and altimeter. The primary flight and navigation displays are affected as follows:

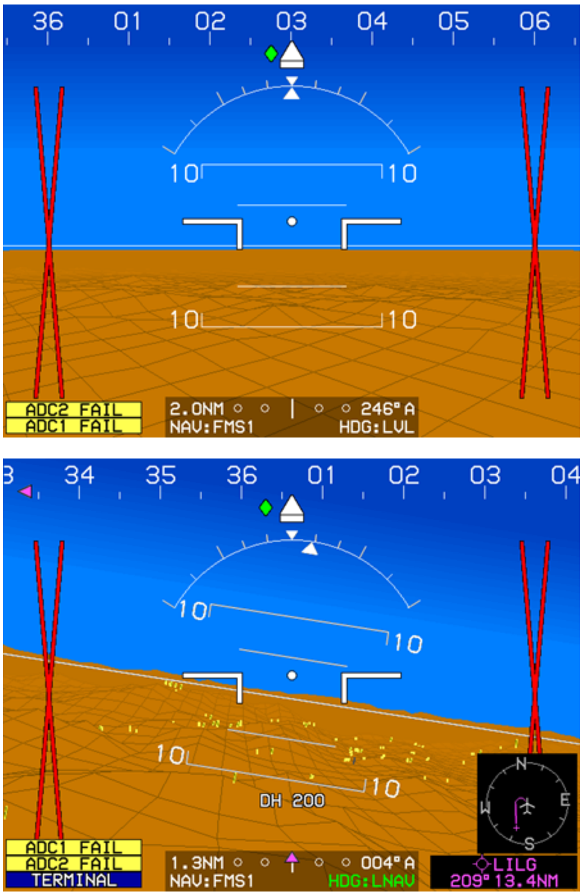


Figure 8-55: PFD Page during ADC Failure

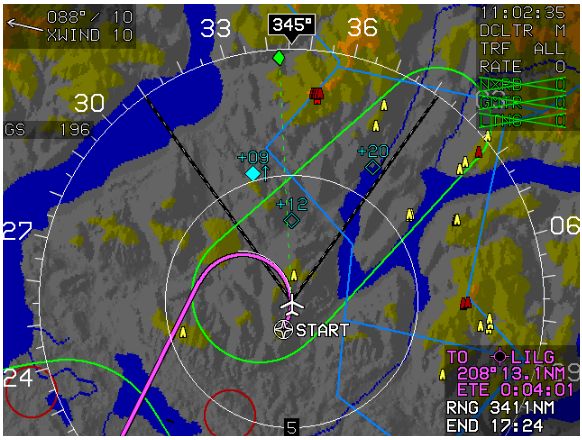


Figure 8-56: ND Page during ADC Failure

NOTE:

Failure of the ADC outside air temperature probe only results in disabled TAS, OAT, ISA, DA, and wind displays and causes OAT SENSOR caution with an alert tone. It does not affect other air data parameters.

In the event of an ADC failure, revert to the standby altimeter and airspeed indicator and switch to the other ADC if so equipped.

8.31. AHRS Failure

Failure of the AHRS results in loss of attitude, magnetic heading, and G-force information. This failure causes the AHRS1 FAIL caution flag to be displayed. The engine display is not affected, and continues normal operation. The primary flight and navigation displays are affected as follows:

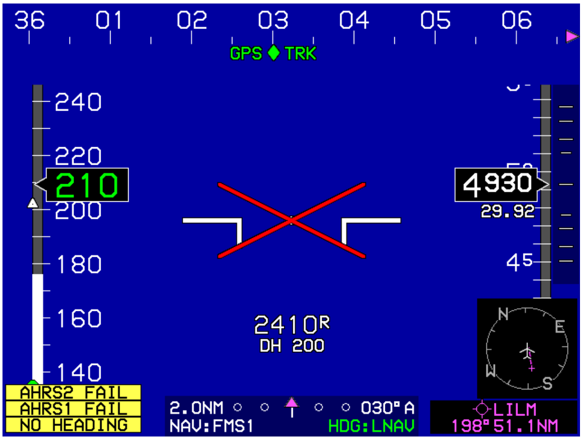


Figure 8-57: PFD Page during AHRS Failure

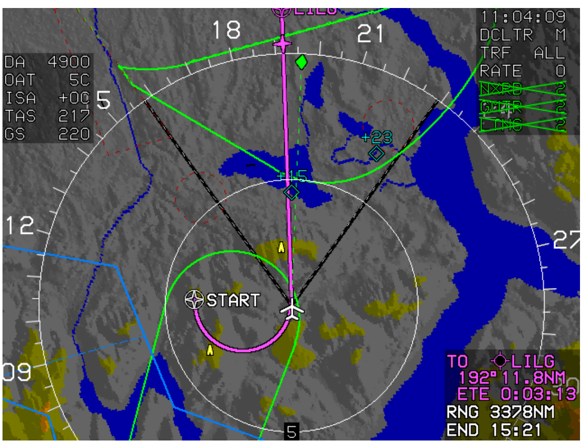


Figure 8-58: ND Page during AHRS Failure

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

8.32. 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 TCASI TCAD information. This failure causes NO GPS and NO TAWS caution flags to be displayed. The primary flight and navigation displays are affected as follows:

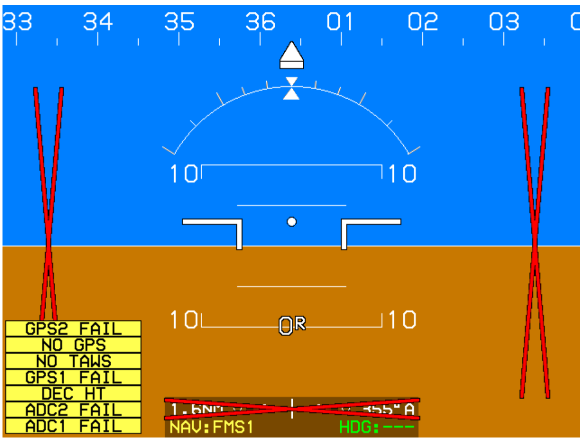


Figure 8-59: PFD Page during ADC and GPS Failure

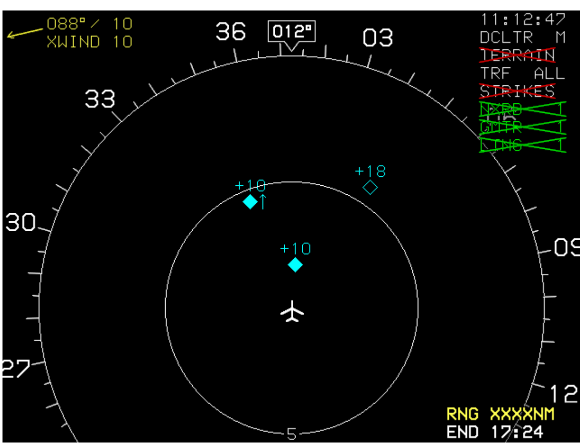


Figure 8-60: ND Page during ADC and GPS Failure

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

8.33. ADC and AHRS Failure

ADC and AHRS failure causes the loss of air data, magnetic heading data, and attitude data. This failure causes NO HEADING and AHRS1 FAIL caution flags to be displayed. The primary flight and navigation displays are affected as follows:

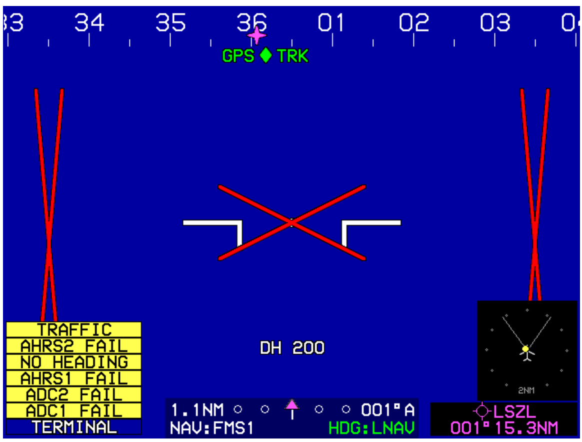


Figure 8-61: PFD Page during ADC and AHRS Failure

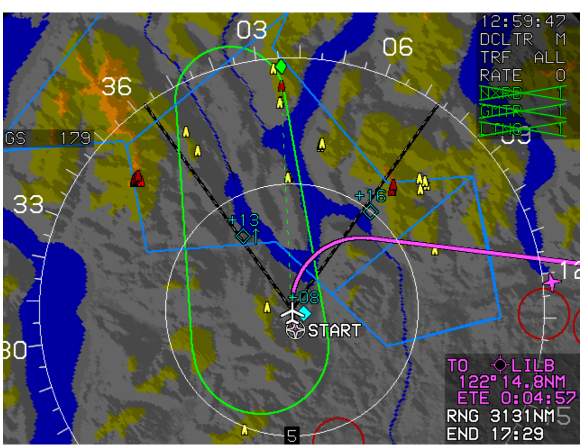


Figure 8-62: ND page during ADC and AHRS Failure

In the event of an ADC and AHRS failure, revert to the standby attitude indicator, airspeed indicator, and altimeter and switch to the other ADC and AHRS if so equipped.

8.34. 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 navigational display is only selectable for the purposes of showing passive lightning detection and traffic information. This failure causes NO TAWS, NO GPS, and NO HEADING flags to be displayed and timer started. The primary flight and navigation displays are affected as follows:

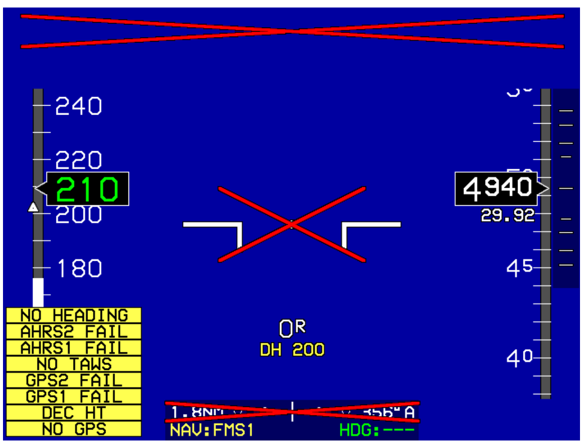


Figure 8-63: PFD Page during GPS and AHRS Failure

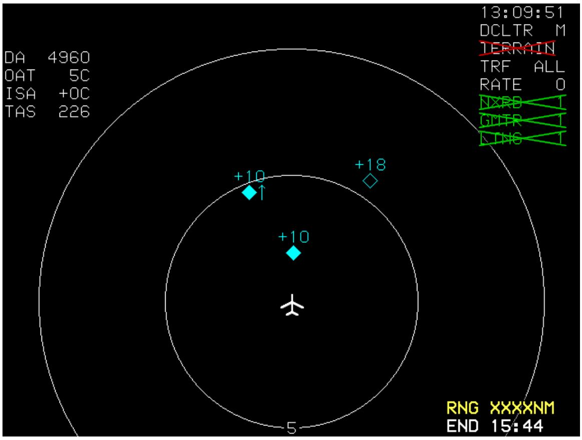


Figure 8-64: ND Page during GPS and AHRS Failure

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 source and switch to other GPS and AHRS if so equipped.

8.35. GPS, ADC, and AHRS Failures

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

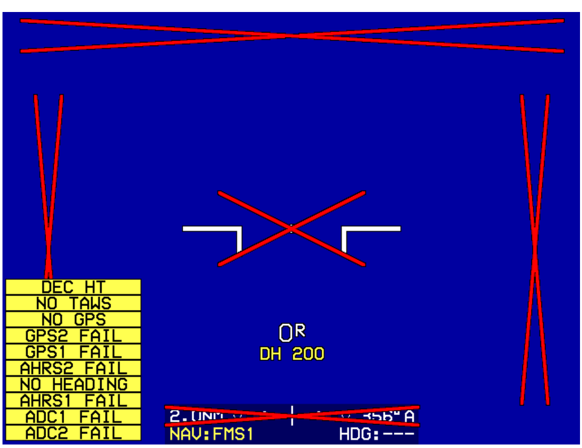


Figure 8-65: PFD Page during GPS, ADC, and AHRS Failure

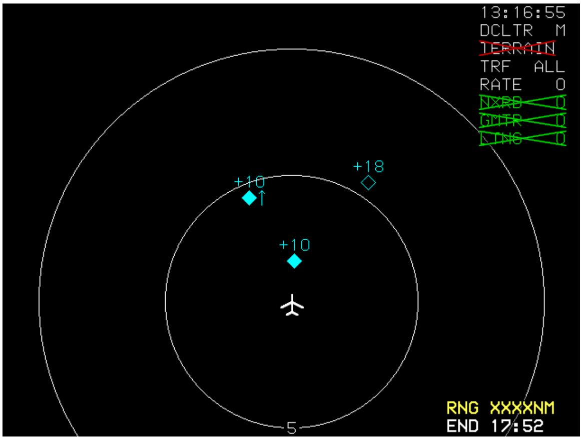


Figure 8-66: ND Page during GPS, ADC, and AHRS Failure

In the event of a GPS, ADC, and AHRS failure, revert to all standby instruments, and use other sources for navigation. In installations where dual GPS, ADC, and AHRS are installed and only one of each has failed, switch to the other sensor as applicable if so equipped.

8.36. Service Difficulty Report

Print, complete, and fax to 940-325-3904

Name:	Phone:
Flight No:	Date:
Aircraft:	Registration#:
Software Version:	Error Code:
Route:	Duration of Flight:
Conditions:	
Remarks: (Include time, altimeter Setting, OAT, ALT, TAS, GS, Heading, track, position, flight segment, pilot action, system response, is problem repeatable?).	

8.37. Certification Basis

The following TSOs are considered applicable to the IDU-450 (depending upon the features of the installed software):

Document Number	Document Title
ARINC 429-16	Mark 33 Digital Information Transfer System (DITS)
ARINC 735A-1	Traffic Alert and Collision Avoidance System
EIA-232D	Interface between Data Terminal Equipment and Data
EIA-422A	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
FAA AC 23.1311-1B	Installation of Electronic Display in Part 23 Airplanes
RTCA/DO-155	Minimum Performance Standards - Airborne Low-Range Radio Altimeters
RTCA/DO-229D	Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment
RTCA/DO-283A	Minimum Operational Performance Standards for Required Navigation Performance for Area Navigation
SAE AS396B	Bank and Pitch Instruments (Indicating Stabilized Type)
SAE AS8002A	Air Data Computer - Minimum Performance Standard
TSO-C4c	Bank and Pitch Instruments
TSO-C87	Airborne Low-Range Radio Altimeter
TSO-C106	Air Data Computer
TSO-C194	Terrain Awareness and Warning System

Document Number	**Document Title**	
TSO-C113	Airborne Multipurpose Electronic Displays	SAE AS8034
TSO-C52b	Flight Director Equipment	SAE AS8008
TSO-C146a	Stand-Alone airborne navigation equipment using the Global Positioning System (GPS) Augmented by the Wide Area Augmentation System (WAAS)	
N/A	Airplane Aerodynamics and Performance, Lan and Roskam, 1981.	

8.38. Environmental Requirements

The IDU-450 meets the requirements of RTCA/DO-160F as defined below:

Sec.	Condition	Cat.	Test Category Description	Notes
4.0	Temperature and Altitude	F2	Equipment intended for installation in non-pressurized and non-controlled temperature location in an aircraft that is operated at altitudes up to 55,000 ft. (16,800 m) MSL. Ground Survival Low -55°C (non-operational test) Short-time operational Low -40°C Operating Low Temp: -20° C Operating High temp: +70°C Ground Survival Low Temp: -55°C Ground Survival High Temp: +85°C Altitude: +55,000 feet	+75°C for Short-Time Operating High Temp. Cat. V (30 minutes) for loss of cooling. See Environmental Qualification Report (EQF) and Installation Manual.
5.0	Temperature Variation	B	Equipment in a non-temperature-controlled or partially temperature controlled internal section of the aircraft.	

Sec.	Condition	Cat.	Test Category Description	Notes
6.0	Humidity	B	Equipment intended for installation in civil aircraft, non-civil transport aircraft and other classes, installed under conditions in which a more severe humidity environment than standard conditions may be encountered.	
7.0	Operational Shocks & Crash Safety	B	Equipment generally installed in fixed-wing aircraft or helicopters and tested for standard operational shock and crash safety.	Aircraft Type 5, Test Type R for Crash Safety Sustained Test

Sec.	Condition	Cat.	Test Category Description	Notes
8.0	Vibration	H + R + U	H – Demonstrates performance at high-level, short duration transient vibration levels R - (Fixed-Wing) Demonstrates performance at higher, robust vibration levels and after long term vibration exposure. U - (Helicopter w/Unknown Frequencies) Demonstrates performance at higher vibration levels and after long term vibration exposure for fuselage and instrument panel equipment when the specific rotor frequencies are unknown.	Cat. H, curve R Cat. R, curves B, B1 Cat. U, curve G
9.0	Explosive Atmosphere	X	Not Applicable	
10.0	Waterproofness	W	Equipment is installed in locations where it may be subjected to falling water, such as condensation	Drip proof test
11.0	Fluids Susceptibility	X	Not Applicable	

Sec.	Condition	Cat.	Test Category Description	Notes
12.0	Sand and Dust	S	Equipment is installed in locations subject to blowing sand and dust.	
13.0	Fungus Resistance	F	Demonstrate whether equipment material is adversely affected by fungi growth.	By Analysis
14.0	Salt Fog	S	Equipment is subjected to a corrosive atmosphere	
15.0	Magnetic Effect	Z	Magnetic deflection distance less than 0.3m.	
16.0	Power Input	Z	Equipment intended for use on aircraft DC electrical systems where the DC supply has a battery whose capacity is small compared with the capacity of the DC generators.	200 ms power interruption capacity
17.0	Voltage Spike	A	Equipment intended primarily for installation where a high degree of protection against damage by voltage spikes is required.	

Sec.	Condition	Cat.	Test Category Description	Notes
18.0	Audio Frequency Conducted Susceptibility-Power Inputs	Z	Equipment intended for use on aircraft DC electrical systems where the DC supply may not have a battery of significant capacity floating on the dc bus at all times.	
19.0	Induced Signal Susceptibility	ZC	Equipment intended primarily for operation in systems where interference-free operation is required on aircraft whose primary power is constant frequency or DC.	
20.0	Radio Frequency Susceptibility (Radiated and Conducted)	Y	Equipment and interconnecting wiring installed in severe electromagnetic environments and to show compliance with the interim HIRF rules.	Radiated: K Minimum level at all frequencies to be 100V/m
21.0	Emission of Radio Frequency Energy	M	Equipment in areas where apertures are EM significant but not in direct view of aircraft antennas, such as passenger cabin or cockpit	

Sec.	Condition	Cat.	Test Category Description	Notes
22.0	Lightning Induced Transient Susceptibility	A3J33	Equipment interconnected with wiring installed within any airframe or airframe section when structural resistance is also a significant source of induced transients, (i.e., carbon fiber composite structures). Level 3 designates equipment and interconnecting wiring installed in a moderately exposed environment.	Level 4 for MSU and OAT Probe pins.
23.0	Lightning Direct Effects	X	Not Applicable	
24.0	Icing	X	Not Applicable	
25.0	Electrostatic Discharge (ESD)	A	Electronic equipment that is installed, repaired, or operated in an aerospace environment.	
26.0	Fire, Flammability	C	Non-metallic equipment, component parts, sub-assemblies installed in pressurized or non-pressurized zones and non-fire zones with largest dimension greater than 50 mm.	By Analysis

Section 9 Finmeccanica (Agusta) AW-109SP Appendix

Table of Contents

List of Tables and Figures

9.1. PFD Symbology

This section describes the symbology specific to the Finmeccanica (Agusta) AW-109SP helicopter. Refer to Section 3 and 4 Display Symbology for generic PFD symbology.

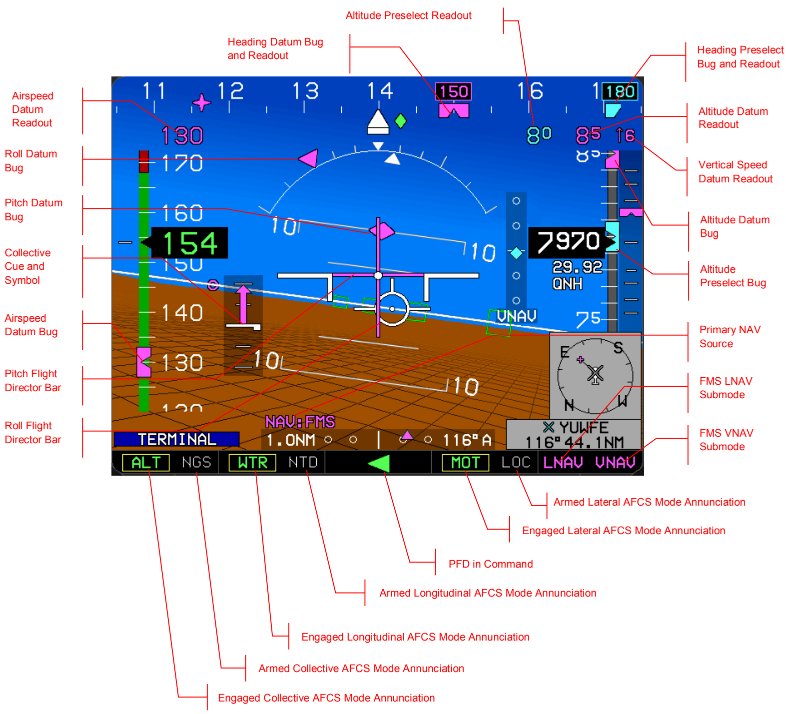
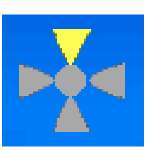


Figure 9-1: AW-109SP Basic PFD



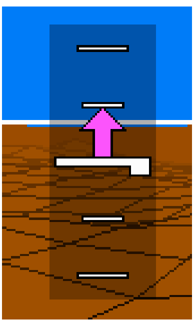
If commanded and controlled by the AFCS, the Cyclic Cue is displayed in the upper left of the PFD. The center circle is either gray or green as commanded by the AFCS. The outer triangles are either gray or amber (yellow) as commanded by the AFCS. (See 9.1.11.)

Figure 9-2: Cyclic Cue Indication

9.1.1. Collective Cue and Symbol

The Collective Cue and Symbol indicate collective position and collective steering. The Collective scale consists of five white tick marks over a shaded background. The distance between tick marks represent a 25% change in value. The Collective Symbol is colored white.

The Collective Symbol input has a range of 0%, which corresponds to the bottom of the scale, to 100%, which corresponds to the top of the scale.



The Collective Cue input has a possible range of -100% to +100%. The Collective Cue originates from the Collective Symbol and points upward to the extent of the value for positive values or points downward to the extent of the value for negative values. Maximum Collective Cue deflection is limited by the range of the scale. At Collective Cue values between -1 and +1 (i.e., no change in collective position being commanded), double arrows are displayed, one above the Collective Symbol and one below.

Figure 9-3: Collective Cue and Symbol (AW-109SP)

9.1.2. Horizon Synchronization

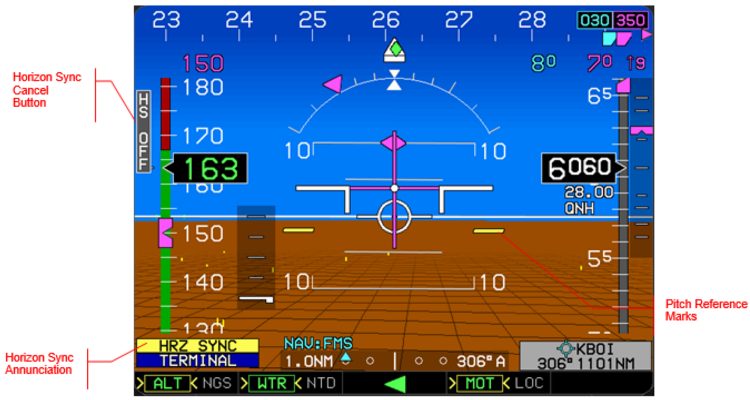


Figure 9-4: Horizon Synchronization (AW-109SP)

Horizon Synchronization functionality allows re-centering of the horizon during Cat A departures. When activated, it introduces an offset to pitch angle and is available for activation when all of the following conditions are met:

1) Cat A is enabled (airspeed<60KIAS);

2) Pitch attitude is valid;

3) No Pitch or Roll Miscompare Alert exists;

4) Pitch is in the range of +/- 11^0; and

5) EFIS system is not in unusual attitude mode.

When Horizon Synchronization is activated (engaged), it remains activated when pitch is greater than +/- 11^0 and less than or equal to +/- 30^0. Horizon Synchronization is deactivated when any of the following is true:

1) Pitch attitude information is invalid;

2) Pitch and Roll miscompare Alert exists;

3) Pitch is greater than +/- 30^0;

4) EFIS system is in unusual attitude mode.

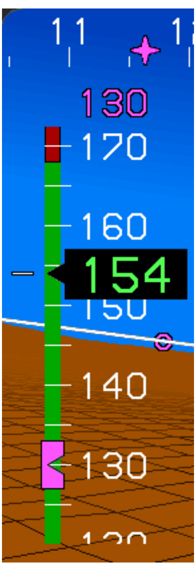
When Horizon Synchronization is activated, the horizon line is re-centered and two amber (yellow) reference marks are displayed at the actual horizon position. If Horizon Synchronization is manually deactivated or automatically deactivated, Horizon Synchronization mode is deactivated and the PFD and/or MFD displays return to normal.

9.1.3. Coloring Conventions

CYAN is used for pre-selected bugs, values, navigation pointers, etc.

MAGENTA is used for currently selected datum bugs, values, navigation pointers, etc.

9.1.4. Airspeed Datum



The AW-109SP airspeed scale has a magenta Airspeed Datum Bug indicating the desired airspeed. A digital readout of the desired airspeed is displayed in magenta above the airspeed scale. The example below indicates a value of 130 knots.

Figure 9-5: Airspeed Datum

When either engine is failed, a red and white barber pole is displayed at V_{NE} on the airspeed scale. Between V_{MIN} and 0 knots, the background color of the airspeed scale is amber (yellow).

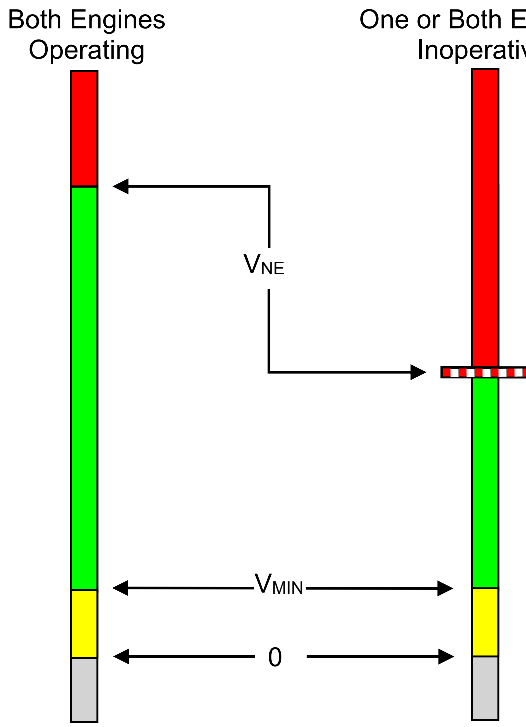


Figure 9-6: Airspeed Scale with Engines Operating and Inoperative

9.1.5. Altitude Datum and Pre-Select

The AW-109SP altitude scale has a magenta Altitude Datum Bug and Altitude Pre-select Bug geometrically interacting with the altitude box pointer. The Altitude Pre-select Bug is cyan. When the two bugs overlap, the Altitude Datum Bug is drawn on top of the Altitude Pre-select Bug. When either bug is limited at the edge of the altitude scale, the bug is cropped. The Altitude Datum Readout is annunciated in magenta above the altitude scale with a resolution of 100 feet. The Altitude Pre-select Readout is annunciated in cyan to the immediate left of the Altitude Datum Readout with a resolution of 100 feet. The example below indicates an Altitude Datum value of 8,500 feet and an Altitude preselect value of 8,000 feet.

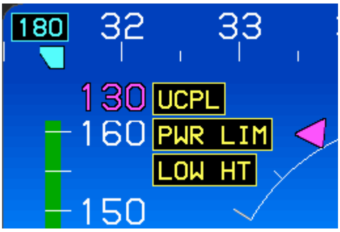
Figure 9-7: Altitude Datum Bug and Altitude Pre-select Bug

9.1.6. Vertical Speed Bug

The AW-109SP VSI indication has a magenta Vertical Speed Datum Bug annunciated above the VSI scale with a resolution of 100 feet per minute.

Figure 9-8: Vertical Speed Bug

9.1.7. AFCS Caution Alert Messages



Alerts from the AW-109SP autopilot may be displayed on the PFD in the upper left corner. The possible alert messages are: UCPL, PWR LIM, and LOW HT.

Figure 9-9: AFCS Caution Alert Messages

The LINK FAIL message indicates there is no communication between the autopilot and the EFIS. If this alert is active, no other AW-109SP specific symbology is displayed.

9.1.8. Autopilot Modes

The AW-109SP Autopilot Modes are shown in the black annunciation bar at the bottom of the PFD.

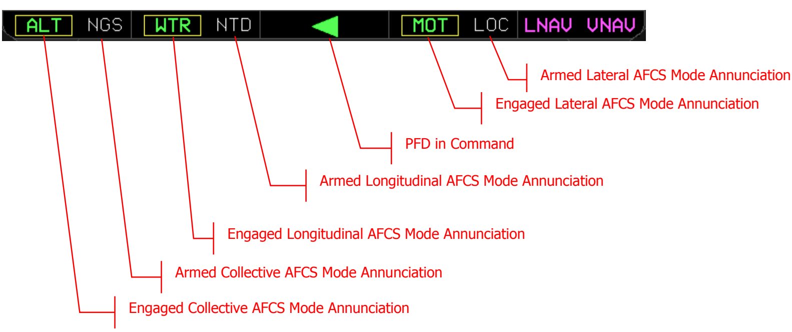


Figure 9-10: AW-109SP Autopilot Modes

The possible AW-109SP Autopilot modes are shown below. Please consult the AW-109SP Autopilot Manual for their meanings.

9.1.8.1. Collective Modes

The possible Engaged Collective Modes are ALT, ALTA, ALVL, GA, GS, MOT, NALT, NALTA, NGA, NGS, NRHT, NTD, NTD1, NTD2, RHT, TD, TD1, TD2, TU, VNAV, and VS. The possible Armed Collective Modes are GS, NGA, NGS, NTD, TD, TU, and VNAV.

9.1.8.2. Longitudinal Modes

The possible Engaged Longitudinal Modes are ALT, ATT, GA, HOV, IAS, MOT, NGA, NIAS, NTD, NTD1, NTD2, SAS, TAC, TD, TD1, TD2, TU, WLVL, and WTR. The possible Armed Longitudinal Modes are NTD, TD, and TU.

9.1.8.3. Lateral Modes

The possible Engaged Lateral Modes are ATT, HDG, HOV, LOC, MOT, NAV, NHDG, NLOC, NTD, NTD2, OS, SAS, TAC, TC, TCN, TD, TD2, TU, VAPP, VOR, WLVL, and WTR. The possible Armed Lateral Modes are LOC, NAV, NLOC, NTD, TCN, TD, TU, VAPP, and VOR.

9.1.8.4. LNAV and VNAV Submodes

The AW-109SP Autopilot Annunciator Bar displays the LNAV and VNAV Submodes on the far right in magenta. The LNAV Submode is either blank, HDG, or LNAV. White indicates “Armed”, while magenta indicates “Active”. The VNAV Submode is either blank, ALTA, or VNAV and remains magenta.

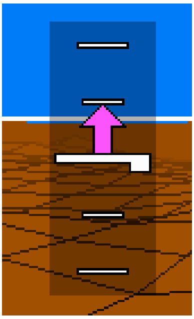
Figure 9-11: LNAV and VNAV Submodes

9.1.9. PFD in Command

A green arrow is displayed in the center of the AW-109SP Autopilot Annunciator Bar, which points to the PFD in Command. The example below indicates the co-pilot's PFD is in command.

Figure 9-12: PFD in Command

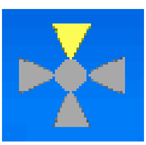
9.1.10. Collective Cue and Position



The AW-109SP Collective Position is displayed as a white bar on the collective scale and indicates the current position of the collective stick. The Collective Cue is displayed as a magenta arrow and indicates the direction in which the collective stick should be moved.

Figure 9-13: Collective Cue and Position

9.1.11. Cyclic Cue



The AW-109SP Cyclic Cue is the autopilot's indication of the direction in which the cyclic control stick should be moved. The example below indicates the cyclic control stick should be moved in the forward direction.

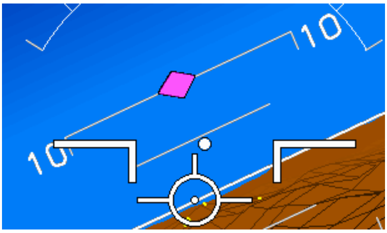
Figure 9-14: Cyclic Cue

9.1.12. Heading Datum and Pre-Select

The AW-109SP directional scale has a magenta Heading Datum Bug indicating the desired heading, and a cyan Heading Pre-select Bug indicating a future desired heading. When commanded by the AFCS, or when a heading bug is limited to the edge of the heading scale, a digital readout is displayed above the bug. When two bugs overlap, the Heading Datum Bug overlays the Heading Pre-select Bug. The example below indicates a Heading Datum value of 150 degrees, and a Heading Pre-select value of 180 degrees.

Figure 9-15: Heading Datum Value of 150 Degrees, Heading Pre-select Value of 180 Degrees

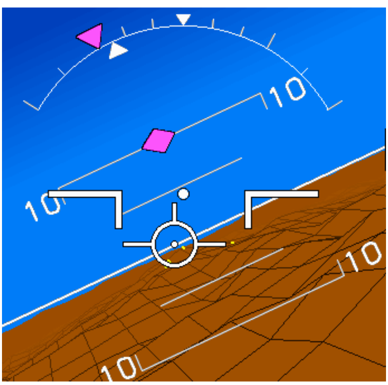
9.1.13. Pitch Datum Bug



The pitch datum bug is a magenta colored diamond bug that moves along the pitch scale to indicate the desired pitch.

Figure 9-16: Pitch Datum Bug

9.1.14. Roll Datum Bug



The roll datum bug is a magenta colored triangle bug that moves along the roll scale to indicate the desired roll.

Figure 9-17: Roll Datum Bug

9.2. AW-109SP Symbology

The Pitch Datum Bug is a magenta colored diamond that moves along the Pitch Scale to indicate the AFCS commanded pitch datum.

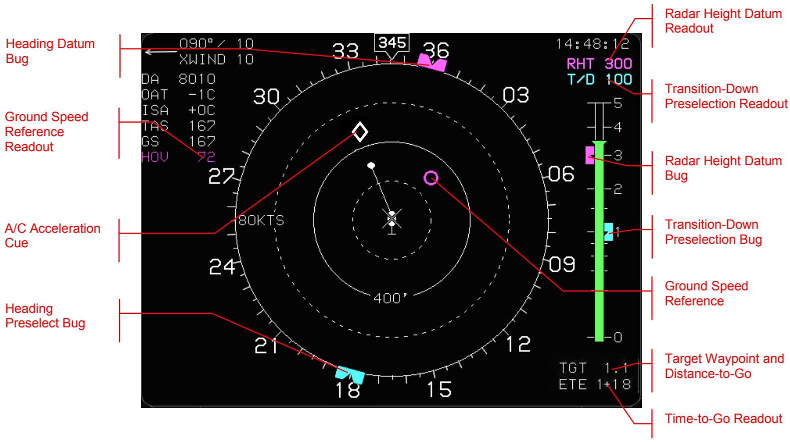


Figure 9-18: AW-109SP Hover

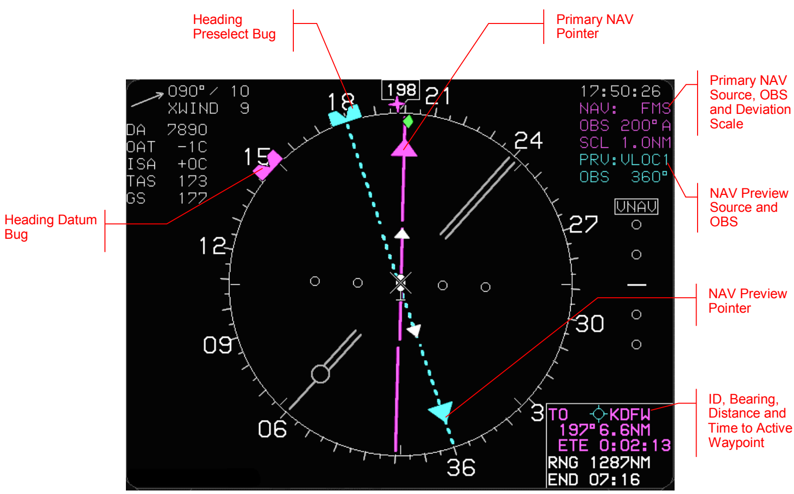


Figure 9-19: AW-109SP HS

9.2.1. Groundspeed Reference

The groundspeed value used for hover vector indication on both MFD and PFD screens is derived from across heading velocity and along heading velocity supplied by the AFCS. If not available or invalid, GPS groundspeed and track is used for hover vector indication.

The Groundspeed Reference is an unfilled circle originating from the ownship symbol scaled according to the current groundspeed scale of the Hover Page. The Groundspeed Reference symbol is limited and cropped at the outer circle of the HSI. The color discrete determines whether the Groundspeed Reference Bug is displayed in magenta or cyan.

A digital readout of the groundspeed is found in the upper left area of the Hover Page, next to the letters “HOV”.

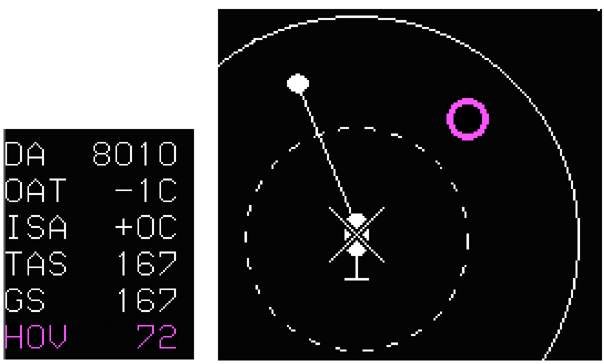
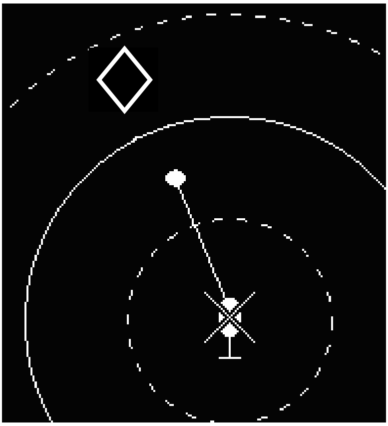


Figure 9-20: Groundspeed Bug and Readout

9.2.2. A/C Acceleration Cue



The A/C Acceleration Cue is an unfilled white diamond indicating the normalized Lateral and Longitudinal Acceleration. This symbol originates from the end of the hover vector and is independent of the current scale of the Hover Page. The input range is -1 to 1, and full scale (1) corresponds to the number of pixels from the center to the outer ring of the display. The A/C Acceleration Cue is limited and cropped at the outer circle of the HSI.

Figure 9-21: A/C Acceleration Cue

9.2.3. NAV Preview Pointer

In addition to the solid-line Primary NAV Pointer, there is also a dashed-line NAV Preview Pointer which indicates the NAV Preview selected course, deviation, and TO/FROM in a standard HSI format. The NAV Preview Source is annunciated in the upper right portion of the HSI display.

When the autopilot armed mode indicates BC, LOC, VAPP, TCN, or VOR, the NAV Preview Pointer flashes. This indicates the autopilot is about to switch from the NAV mode to the armed mode. Upon switching, the armed mode uses the NAV Preview Source as its Primary NAV Source.

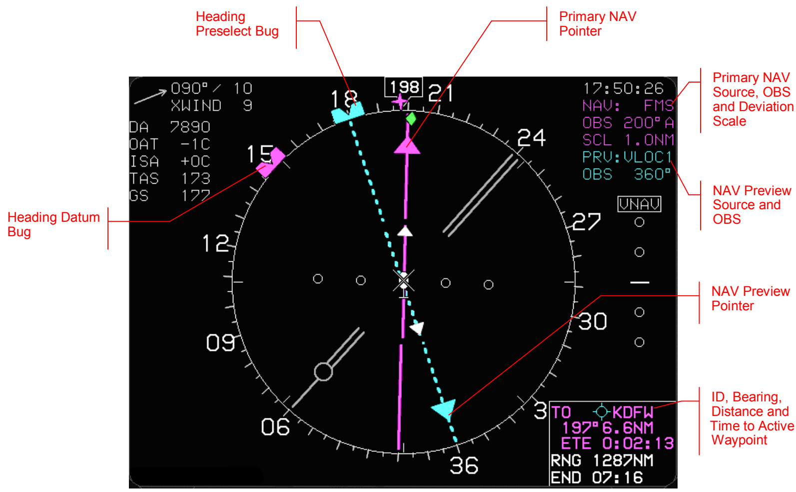
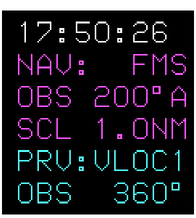


Figure 9-22: NAV Preview Pointer

9.2.4. Clock/Timers/Options



The color of the Primary NAV Source, course, and deviation scale readout is determined using Table 9-1. If a NAV Preview Source is active, the NAV Preview Source and course is displayed in cyan.

Figure 9-23: Clock/Timers/Options

Table 9-1: Lateral Deviation Color Logic

Condition	**Color**	**Notes**
Primary Navigation Source is FMS	Amber (Yellow)	(either FMS1 or FMS2)
<u>Side in Command:</u> • the AFCS engaged lateral navigation mode is NAV and the EFIS is in LNAV Submode; or • the AFCS engaged lateral navigation mode is NLOC	Magenta	(VLOC1 or VLOC2)
If the Primary Navigation Source is not FMS • the AFCS engaged lateral navigation mode is VOR; • the AFCS engaged lateral navigation mode is LOC; • the AFCS engaged lateral navigation mode is TCN; • the AFCS engaged lateral navigation mode is VAPP; or • the AFCS engaged lateral navigation mode is BC.	Magenta	In all other cases, the Lateral Deviation Color for the side in command is cyan.

Table 9-1: Lateral Deviation Color Logic

Condition	Color	Notes
<u>Side Not in Command:</u> Primary Navigation Source FMS • the AFCS engaged lateral navigation mode is NAV and the EFIS is in LNAV Submode; or • the AFCS engaged lateral navigation mode is NLOC	Magenta	(Either FMS1 or FMS 2)
If the Primary Navigation Source (Either VLOC1 or VLOC2) of the Side not in Command is same as the Primary Navigation Source of the Side in Command and either: • the AFCS engaged lateral navigation mode is VOR OR; • the AFCS engaged lateral navigation mode is LOC OR; • the AFCS engaged lateral navigation mode is TCN OR; • the AFCS engaged lateral navigation mode is VAPP OR; • the AFCS engaged lateral navigation mode is BC.	Magenta	In all other cases, the Lateral Deviation Color of the Side Not in Command is cyan.

9.2.5. NAV LOG Screen

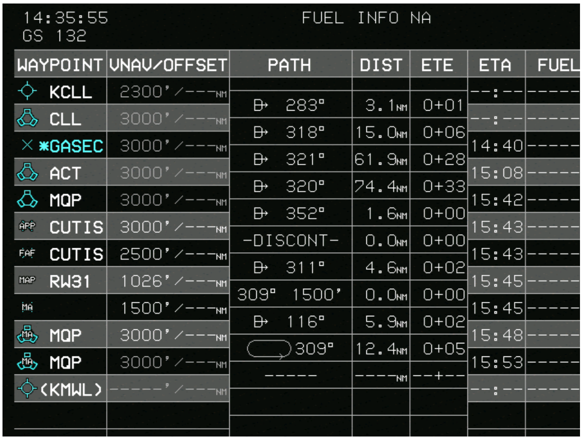


Figure 9-24: NAV LOG Screen

The current active waypoint is the Lateral Navigation color.

9.2.6. Hover Screen

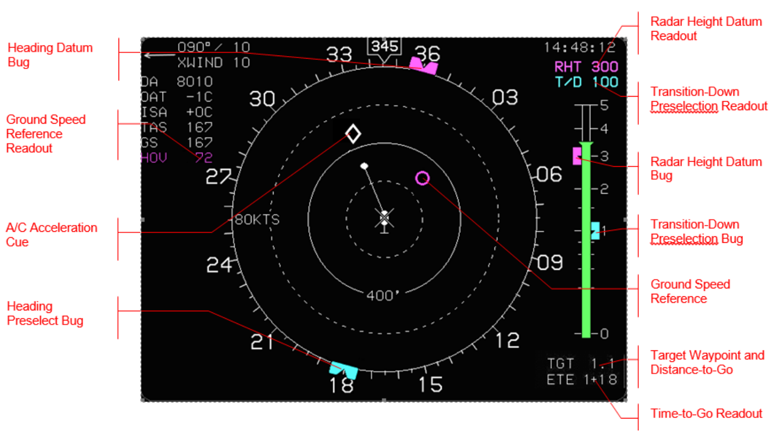


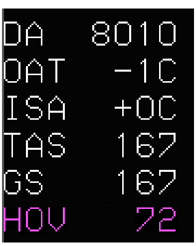
Figure 9-25: Hover Screen

9.2.7. Compass Rose Symbols

The Compass Rose has a Heading Datum Bug and a Heading Preselect Bug which are shaped so as to geometrically interact with the present heading pointer symbol. The Heading Datum Bug is filled-magenta and the Heading Preselect Bug filled-cyan. When the two bugs overlap, the Heading Datum Bug is drawn on top of the Heading Preselect Bug. The AFCS communicates the Heading Preselect and Datum Bug values to the EFIS. The color of the star-shaped active waypoint pointer is determined using Groundspeed Reference.

9.2.8. Active Flight Plan Path

The color of the active leg in the flight plan path is determined using Table 9-2. When an MOT flight pattern is being displayed, the active leg includes all legs between “From” and “To” waypoints.



The Groundspeed Datum Readout is displayed as the magenta or cyan letters “HOV” with the groundspeed datum numerical value. The color discrete determines whether the Groundspeed Readout is displayed in magenta or cyan.

Figure 9-26: Air Data and Groundspeed

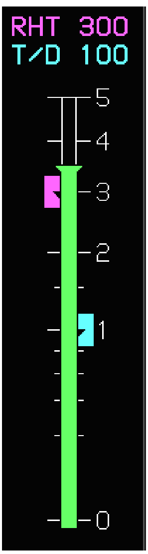
Table 9-2: AW-109SP Lateral Navigation Color Logic

Type of Indicator	Color	Notes
Primary source FMS1 Or FMS2	Amber (Yellow)	During Loss of Navigation Caution
Side in Command and Side Not in Command	Magenta	If FMS1 or FMS2 and either the AFCS engaged, lateral Nav Mode is NAV, and the EFIS is in LNAV mode, or the AFCS engaged lateral Nav Mode is NLOC.

Table 9-2: AW-109SP Lateral Navigation Color Logic

Type of Indicator	Color	Notes
Primary source is not FMS (VLOC1 or VLOC2)	Magenta	The AFCS engaged lateral navigation mode is VOR, LOC, TCN, VAPP, or BC
	Cyan	All other cases

9.2.9. AGL Indication



The Radar Height Bug is a magenta-filled bug with a notch to geometrically interact with the AGL indication. The Radar Height Readout is magenta text "RHT" followed by magenta numerical text indicating the value of the Radar Height Bug, placed above the AGL scale. The AFCS communicates the Radar Height value to the EFIS.

Figure 9-27: Radar Height Bug and Readout

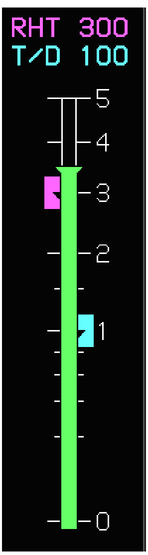
9.2.10. Transition-Down Preselection Bug and Readout

The Transition-Down Preselection Bug is a cyan-filled bug with a notch to geometrically interact with the AGL indication. The Transition-Down Preselection Readout is cyan text "T/D" followed by cyan numerical text indicating the value of the Transition-Down Preselection Bug, placed above the AGL scale. The AFCS communicates the Transition-Down Preselection value to the EFIS.
Identifier, Distance and Time to MOT Waypoint

The MOT waypoint ID and distance to MOT waypoint is displayed in the lower right of the display in white text. Time to MOT waypoint is displayed below the ID and distance formatted as white letters "ETE" and minutes + seconds. The AFCS communicates MOT waypoint ID and distance to MOT waypoint to the EFIS.

Figure 9-28: Identifier, Distance, and Time to MOT Waypoint

9.2.11. Radar Height Datum and Transition-Down Pre-Select Bugs



The Radar Height Datum Bug is a magenta bug sliding along the AGL scale on the Hover Page. The Transition-Down Pre-select Bug is a cyan bug sliding along the AGL scale. Both bugs have digital readouts above the scale.

Figure 9-29: Radar Height Datum Bug

9.3. AW-109SP Specific Functionality

This section describes the functionality specific to the Finmeccanica (Agusta) AW-109SP helicopter.

9.3.1. Horizon Synchronization Mode

Horizon Synchronization allows re-centering of the horizon during Category A departures. When activated, it introduces an offset to pitch angle. Horizon Synchronization is available via MENU (R1) when:

1) Category A is enabled (airspeed < 60KIAS);

2) Pitch attitude information is valid;

3) No pitch or roll miscompare alert exists;

4) Pitch is in the range of ±30 degrees; and

5) EFIS system is not in unusual attitude mode.

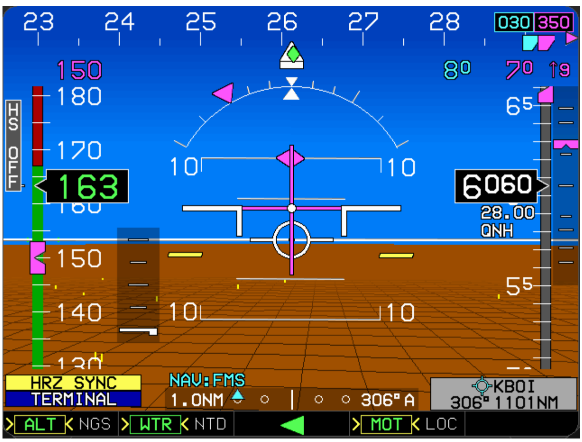


Figure 9-30: Horizon Synchronization

When Horizon Synchronization is activated, the horizon line is re-centered and two amber (yellow) reference marks are displayed at the actual horizon position. If Horizon Synchronization is manually de-activated or automatically de-activated (i.e., any availability condition not true), Horizon Synchronization mode de-activates, and the PFD and/or MFD displays return to normal. Horizon Synchronization automatically de-activates upon acceleration through 60KTS or exceeding ±30 degrees of pitch attitude.

9.4. Swiss Grid Coordinate System

The AW-109SP EFIS supports the Swiss Grid Coordinate System widely used in Switzerland. When in Swiss Grid Mode, the EFIS displays Swiss Grid coordinates in place of latitudes and longitudes.

CAUTION:

The Swiss Grid Mode should only be used when flying in Switzerland, as the coordinates are not valid elsewhere.

9.4.1. Enabling/Disabling Swiss Grid Mode

To enter into Swiss Grid Mode, press **MENU (R1)**, then **FORMAT..**, then **FNCT DCLTR..**. Scroll ❶ to **SWS GRD** and push to enable it.

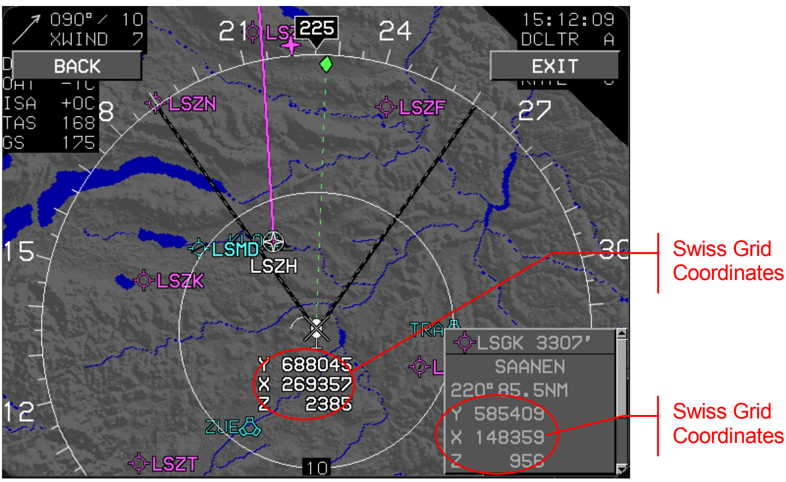


Figure 9-31: Swiss Grid Mode

9.4.2. Swiss Grid Mode Display

When Swiss Grid Mode is enabled the display changes as follows:

1) A blue SWISS GRID annunciation appears in the lower left comer of the MFD.

2) The Swiss Grid YXZ coordinates are displayed below the ownship symbol.

3) The active waypoint info gives the active waypoint location in Swiss Grid YXZ coordinates.

9.4.3. Creating a Waypoint Using Swiss Grid YXZ

When Swiss Grid Mode is enabled, the pilot may enter a new waypoint using Swiss Grid Coordinates. Press **FPL (L1)**, then **CREATE-EDIT..**, then choose **CREATE USER WPT (LAT-LON)**. Once in the editing screen, press **SWISS YXZ** to enter the waypoint using Swiss Grid Coordinates. The waypoints created in Swiss Grid Mode are also available when not in Swiss Grid Mode but are displayed using latitude and longitude.

Figure 9-32: Creating a Waypoint Using Swiss Grid YXZ

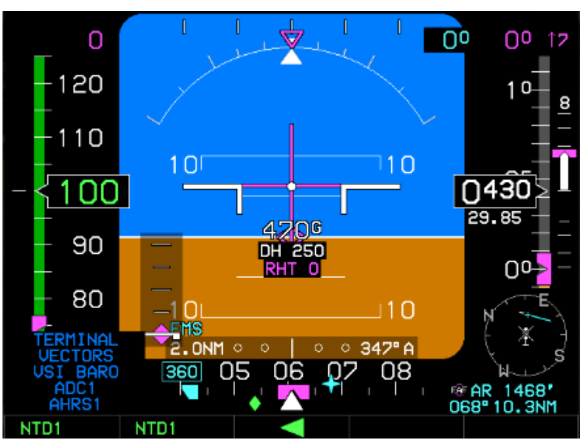


Figure 9-33: AW-109SP Basic PFD

9.5. Remote Bugs Panel

A Remote Bugs Panel (RBP) is included in each AW-109SP EFIS installation. The following section describes the specialized use of the AW-109SP RBP.

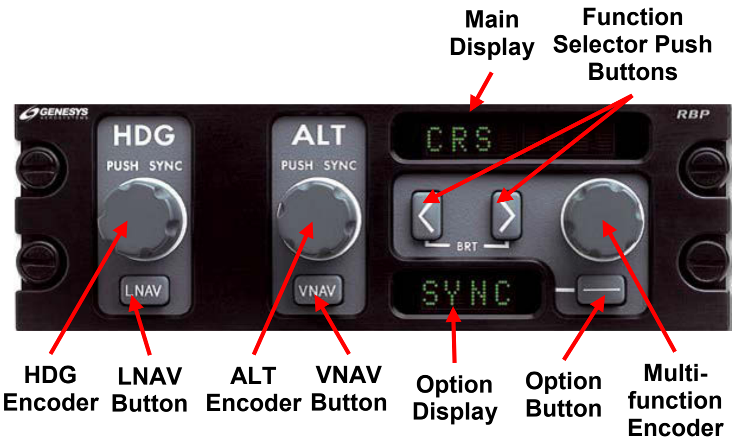


Figure 9-34: AW-109SP Remote Bugs Panel

The Remote Bugs Panel (RBP) provides dedicated controls for frequently needed bugs and additional controls for setting IDU parameters such as defined in the table below.

The RBP has an internal light sensor to control its own initial display and backlight brightness. Press the two arrow buttons simultaneously to gain access for brightness control and use the multifunction encoder to make brightness adjustments. Press the option button to exit the brightness control program and return the RBP to normal operation.

The design of this RBP promotes the ease of operation while minimizing pilot workload complexity. The HDG and ALT encoders behave exactly as the encoders on the IDU-450 where they appear during most screen configurations. During initialization, the RBP always begins with the GENESYS RBP displayed on the main and option display screens.

The RBP is used to select heading and altitude, transition into and out of FMS LNAV and VNAV Submodes, and to perform other miscellaneous functions as follows:

Table 9-3: Remote Bugs Panel (RBP)

Button/ Encoder	Function	Scroll	Press/Push
Heading Encoder	Heading Bug	Increment or decrement heading bug	Synchronize heading bug to current heading
Altitude Encoder	Altitude Bug	Increment or decrement target altitude bug	Synchronize target altitude bug to current altitude
Multifunction Encoder	GPS Course	Increment or decrement GPS course setting	Synchronize GPS course to current bearing to the active waypoint
Multifunction Encoder	VOR 1 Course	Increment or decrement VOR 1 course setting	Synchronize VOR 1 course to the current bearing to the station
Multifunction Encoder	VOR 2 Course	Increment or decrement VOR 2 course setting	Synchronize VOR 2 course to the current bearing to the station
Multifunction Encoder	Airspeed Bug	Increment or decrement Airspeed Bug setting	Synchronize Airspeed Bug to current airspeed
Multifunction Encoder	Vertical Speed Bug	Increment or decrement Vertical Speed Bug setting	Synchronize Vertical Speed Bug to current VSI

Table 9-3: Remote Bugs Panel (RBP)			
Button/ Encoder	**Function**	**Scroll**	**Press/Push**
Multifunction Encoder	Climb Angle Set	Increment or decrement Climb Angle setting	Set Climb Angle Setting to 3º
Multifunction Encoder	Descent Angle Set	Increment or decrement Descent Angle setting	Set Descent Angle Setting to 3º
Multifunction Encoder	Decision Height Bug	Increment or decrement Decision Height Bug	Set Decision Height Bug to 200’ AGL
Multifunction Encoder	Minimum Altitude Bug	Increment or decrement Minimum Altitude Bug	Set Minimum Altitude to current altitude
Option “---“ Button	GPS Course	N/A	Change OBS mode (Manual or Automatic)
Option “---“ Button	VOR 1 Course	N/A	No Function
Option “---“ Button	VOR 2 Course	N/A	No Function
Option “---“ Button	Airspeed Bug	N/A	Toggle Airspeed Bug (On or Off)
Option “---“ Button	Vertical Speed Bug	N/A	Toggle Vertical Speed Bug (On or Off)
Option “---“ Button	Climb Angle Setting	N/A	No Function
Option “---“ Button	Descent Angle Setting	N/A	No Function
Option “---“ Button	Decision Height Bug	N/A	Toggle Decision Height Bug (On or Off)

Table 9-3: Remote Bugs Panel (RBP)			
Button/ Encoder	**Function**	**Scroll**	**Press/Push**
Option "---" Button	Minimum Altitude Bug	N/A	Toggle Decision Height Bug (On or Off)
Arrow Buttons	Function Scroll	N/A	Scroll through possible functions for the "set" Multi-Function Encoder. Press both arrow buttons simultaneously to place RBP into dimming mode
VNAV Button	VNAV	N/A	Switch EFIS autopilot pitch steering and commanded VSI between VNAV sub-mode and target altitude sub-mode
LNAV Button	LNAV	N/A	Switch EFIS autopilot roll steering between LNAV sub-mode and heading sub-mode

9.5.1. Heading Encoder

When pushed or scrolled, the heading encoder communicates with the AFCS. When the AFCS is in NAV mode and the EFIS is in FMS Heading Submode:

1) Push the heading encoder to synchronize the Heading Datum to the AFCS-controlled Heading Preselect;
2) Scroll the heading encoder while pushed to directly change the Heading Datum; and
3) Changing the Heading Datum causes the Heading Datum readout to be displayed on the PFD for five seconds.

The Heading Datum value is communicated to the AFCS.

9.5.2. Altitude Encoder

When pushed or scrolled, altitude encoder communicates with the AFCS. When the AFCS is in VNAV mode and the EFIS is in ALTA Submode:

1) Push the altitude encoder to synchronize the ALTA Datum to the AFCS-controlled Altitude Preselect; and
2) Scroll the altitude encoder while pushed to directly change the ALTA Datum.

The ALTA Datum value is communicated to the AFCS.

9.5.3. Multifunction Encoder

FMS OBS function is available:

1) On the Side in Command; OR
2) When Side in Command cannot be determined; OR
3) If not cross-linked; OR
4) When Side in Command is not using FMS as its NAV source.

VOR1 OBS function is available:

1) On the Side in Command; OR
2) When Side in Command cannot be determined; OR

3) When Side in Command is not using VOR1 as its NAV source.

VOR2 OBS function is available:

1) On the Side in Command; OR

2) When Side in Command cannot be determined; OR

3) When Side in Command is not using VOR2 as its NAV source.

The SPD bug function is disabled (it is driven by a knob on the AFCS panel).

The VSI bug function is available when the AFCS is in VNAV mode with a VSI climb or VSI descent as the current vertical control law AND:

1) On the Side in Command; OR

2) When Side in Command cannot be determined.

The Climb Angle function is available:

1) On the Side in Command; OR

2) When Side in Command cannot be determined.

The Descent Angle function is available:

1) On the Side in Command; OR

2) When Side in Command cannot be determined.

Otherwise, there are no changes to the Multifunction Encoder functions.

9.5.4. LNAV Button

When the AW-109SP AFCS is in NAV mode, press the LNAV button to toggle the EFIS between LNAV Submode and HDG Submode. The EFIS toggles to LNAV Submode by turning OFF the heading bug. The EFIS toggles to HDG Submode by initializing the heading bug to either the AFCS-controlled Heading Preselect value (if valid) or aircraft heading. Upon engagement of HDG Submode, the Heading Datum readout is displayed on the PFD for five seconds.

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