GENESYS AEROSYSTEMS

IDU-450 EFIS Software Version 8.0H (Rotorcraft)

IDU-450 8.0H (Rotorcraft) Pilot Guide

PRECISE PERFORMANCE.
PROVEN EXPERIENCE.
PERSONALIZED ATTENTION.

Pilot Operating Guide and Reference

(Rotorcraft)

EFIS Software Version 8.0H

Document 64-000102-080H

This pilot guide must be carried in the aircraft and made available to the pilot at all times. It can only be used in conjunction with the Federal Aviation Administration (FAA) approved Rotorcraft Flight Manual (RFM). Refer to the applicable RFM for aircraft specific information, such as unique ground tests, limitations, and emergency procedures.

For service or repairs, contact an authorized Genesys Aerosystems dealer. For product support or inquiries regarding this pilot guide, contact Genesys Aerosystems.

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Retain this record in front of pilot guide. Upon receipt of a revision, insert changes and complete table below.

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Section 1 Introduction

1.1. Introduction

Aviation has become more complex with sophisticated "automation centered" systems, which minimize pilot involvement and automate control of the aircraft and its systems, thereby relegating the pilot to the role of manager and emergency backup.

The Genesys Aerosystems Electronic Flight Instrument System (EFIS) is designed as a "pilot-centered" system. While still highly automated, it presents the pilot with information necessary to make decisions and take appropriate actions. For example, the Highway-in-the-Sky (HITS) allows for highly automated approaches, but its predictive nature provides the pilot awareness of upcoming maneuvers. Instead of overloading the pilot with information and options, the Genesys Aerosystems EFIS presents only necessary information to reduce workload, decrease task complexity, and minimize confusion, which results in safer flying with less stress and fatigue.

The Genesys Aerosystems EFIS goal is IFR-VFR equivalence with HUD symbology overlaying real-time 3-D virtual view of the outside world. This "synthetic vision" provides the pilot in IMC with simple visual clues for navigation and aircraft control as those used in VFR conditions. The "virtual VFR" eliminates the need to scan multiple instruments for aircraft control or interpret complicated enroute and approach procedures. As experience is gained with this integrated system, the pilot will fly with more precision, awareness, and confidence.

1.2. EFIS/FMS Description

The integrated display unit (IDU) has eight buttons along the vertical sides referenced as L1 through L4 starting at the top left corner of the display moving down and R1 through R4 from the top right corner moving down the display from a pilot's perspective.

There are two encoders along the bottom. The left encoder (❷) only controls the backlighting intensity. References throughout this guide refer to the right-hand encoder (❶) and when to push and/or scroll for desired outcomes.

On the bezel between the two encoders, a slip indicator or blank housing acts as the USB memory door. When lifted prior to power-up, the ground maintenance mode is initiated after power-up. If a limits change, software, or database update is planned, the USB drive must be inserted prior to power-up.

Figure 1-1: IDU-450 Input Identification

A sensor on the face of the IDU bezel measures ambient light levels. Use ❷ to control the brightness of the panel or display lighting. To adjust panel lighting (illumination of legends, encoders, inclinometer, and buttons), push and scroll ❷ clockwise to increase or counter clockwise to decrease. To adjust display lighting (illumination of the LCD display), without pushing scroll ❷ as described with panel lighting. Lighting may be controlled locally or remotely with a default state being with the local control.

NOTE:

If entering ground maintenance mode with bright light shining or reflecting directly into the display, shield the light sensor to avoid the IDU from going directly into the flight mode.

1.3. About This Guide

Operation of the Genesys Aerosystems EFIS is described in detail and divided into sections as follows:

TABLE OF CONTENTS: Locate areas by topic

INTRODUCTION (Section 1): Basic explanation of the pilot guide.

SYSTEM OVERVIEW (Section 2): Description of system and hardware; IDU behavior during initialization; warning alerts, time-critical warning alerts, master visual and aural alerts caution alerts, and advisory alerts with conditions; coloring conventions; abbreviations and acronyms; and database update procedures.

DISPLAY SYMBOLOGY (Section 3): Identification of each screen element of the PFD/MFD, and explanation of symbology.

REVERSIONARY MODES (Section 4): Views of displays with various sensor failed conditions and resulting symbology, as well as, examples of various configurations and display formats used with specific tables showing affected functions. Explanation of what to expect when a particular sensor fails and what changes on the display immediately or after a specified amount of time.

MENU FUNCTIONS AND STEP-BY-STEP PROCEDURES (Section 5): Menu structure of each feature and step-by-step procedures for operation of each task. Basic description of all encoder and button functions with menu tile definitions.

QUICK START TUTORIAL (Section 6): Basics necessary for flying a flight with this system. Includes simple steps to manage displays for existing flight conditions to quickly gain familiarity with where to locate controls to manipulate the system for each operation.

IFR PROCEDURES (Section 7): Detailed information and instruction about selecting and flying instrument procedures with examples of the most popular published procedures with views of referenced published procedures. Includes descriptions of selection of departure, published instrument approach, standard terminal arrival procedures, as well as, how the active flight plan quickly reflects changes to ATC clearances.

TERRAIN AWARENESS WARNING SYSTEM (Section 8): Description of Enhanced HTAWS and HTAWS functionality for this aircraft with all configurations. Defines the various parameters, which automatically apply to each mode of flight.

APPENDIX (Section 9): Contains support material and other useful information about system operation, guidance from Jeppesen, and supplemental information such as flight planning; magnetic vs. true north modes; airspeed/altitude miscompare thresholds; EFIS Training Tool; and downloading routes / user waypoints.

APPENDICES: Traffic, Remote Bugs Panel, WX-500 Lightning Strikes, Datalink, and Search and Rescue Patterns. Sections on equipment and features not installed in every aircraft and may be removed at the discretion of the end-user.

INDEX: Alphabetical listing of terms or keywords with corresponding page numbers.

GLOSSARY: Alphabetical listing of definitions for terms.

Section 2 System Overview

2.1 Abbreviations and Acronyms

0R	No Radius
3-D	Three-Dimensional
AC	Advisory Circular
ACTV	Active
ADAHRS	Air Data Attitude Heading Reference System
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADS-B	Automatic Dependent Surveillance-Broadcast
AFCS	Automatic Flight Control System
AFM	Aircraft Flight Manual
AGL	Above Ground Level
AHRS	Attitude Heading Reference System
AIRAC	Aeronautical Information Regulation and Control
AIRMET	Airmen's Meteorological Information
ALT	Pressure Altitude
ALT SEL	Altitude Selection
AMLCD	Active Matrix Liquid Crystal Display
ANP	Actual Navigation Performance
ANT	Antenna
AP	Autopilot
APP	Waypoint is part of an Instrument Approach Procedure
APPR	Approach
APT	Airport
APV	Approach with Vertical Guidance
AOA	Angle of Attack
ARINC	Aeronautical Radio, Inc.
ARTCC	Air Route Traffic Control Center
AS	SAE Aerospace Standard
ASEL	Aircraft Selected Altitude
ATC	Air Traffic Control
ATT	Attitude

Baro	Barometric setting
Baro-VNAV	Barometric Vertical Navigation
BC	Backcourse navigation
BRT	Brightness
BTM	Bottom
C	Celsius
CA	Course to Altitude (ARINC-424 Leg)
CALC	as in RAIM (R2)
CAS	Crew Alerting System
CD	Course to DME Distance (ARINC-424 Leg)
CCW	Counter Clockwise
CDA	Continuous Descent Approach
CDI	Course Deviation Indicator
CF	Course to Fix (ARINC-424 Leg)
CI	Course to Intercept (ARINC-424 Leg)
CLR	Clear
CNX	Cancel
COM	Communication
CONT	Continue
CPLT	Co-Pilot
CPM	Computer Processor Module
CPU	Central Processing Unit
CR	Course to Radial Termination (ARINC-424 Leg)
CRC	Cyclic Redundancy Check
CRS	Course
CSA	Conflict Situation Awareness (ADS-B)
CTRST	Contrast
CW	Clockwise
dBZ	Decibel relative to radar reflectivity (Z)
DCLTR	Declutter
DCND	Descend
DEC HT	Decision Height Bug
DEL	Delete
DESIG	Designate

DF	Direct to Fix (ARINC-424 Leg)
DFCS	Digital Flight Control System
DFLT	Default
DG	Directional Gyro
DH	Decision Height
DLNK	Datalink
DME	Distance Measuring Equipment
DO	RTCA Document
DOD	Department of Defense
DP	Departure Procedure
DR	Dead Reckoning
EFIS	Electronic Flight Instrument System
EGM	Earth Gravity Model
EGNOS	European Geostationary Navigation Overlay Service
EGPWS	Enhanced Ground Proximity Warning System
EQPMNT	Equipment
ESSNTL	Essential
ETA	Estimated Time of Arrival
ETE	Estimated Time Enroute
ETT	EFIS Training Tool
EXCD	Exceedance
EXPND	Expand (also EXP)
F	Fahrenheit
FA	Course from a Fix to Altitude (ARINC-424 Leg)
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FAR	Federal Aviation Regulation
FAWP	Final Approach Waypoint (same as FAF)
FC	Course Fix to along Track Distance (ARINC-424 Leg)
FD	Course from a Fix to DME Distance (ARINC-424 Leg); Flight Director
FDE	Fault Detection and Exclusion
FG	Fixed Gear
FG + F	Fixed Gear with Defined Landing Flaps Position

FIS	Flight Information Service
FIS-B	Flight Information Service-Broadcast
FL	Flight Level
FLTA	Forward Looking Terrain Awareness
FM	Course from Fix to Manual termination (ARINC-424 Leg)
FMS	Flight Management System
FOV	Field of View
FPL	Flight Plan
fpm	Feet per minute
FPM	Flight Path Marker
FPNM	Feet Per Nautical Mile
FRT	Fixed-Radius Transition
FSD	Full Scale Deflection
FT	Feet
FTE	Flight Technical Error
FTP	Fictitious Threshold Point
FNCT	Function
GAGAN	India's GPS and GEO-Augmented Navigation System
GARP	GNSS Azimuth Reference Point
GBAS	Australia's Ground Based Augmentation System
GLS	GNSS Landing System
GMETAR	Graphical METAR (also GMTR)
GMF	Ground Maintenance Function
GN	Gain
GND	Ground
GNSS	Global Navigation Satellite System
GPI	Glidepath Intercept
GPIP	Glide Path Intercept Point
GPS	Global Positioning System
GPSV	Global Positioning System Vertical Navigation
GPWS	Ground Proximity Warning System
GS	Glideslope
H	Hold
HA	Terminates at an altitude (ARINC-424 Leg)

HF	Holding, Pattern to Fix (ARINC-424 Leg)
HM	Altitude or Manual Termination (ARINC-424 Leg)
HAL	Horizontal Alert Limit
HAT	Height Above Threshold
HDG	Heading
HFOM	Horizontal Figure of Merit
hh:mm:ss	Hours: Minutes: Seconds
HITS	Highway in the Sky
HLTH	Health
HORIZ	Horizontal
HOTAS	Hands on Throttle and Stick
hPa	Hectopascal
HPL	Horizontal Protection Level
HRZ SYNC	Horizon Synchronization
HSI	Horizontal Situation Indicator
HUD	Head Up Display
IAP	Instrument Approach Procedure; Initial Approach Point
IAS	Indicated Airspeed
IAWP	Initial Approach Waypoint (same as IAP)
ICAO	International Civil Aviation Organization
ID	Identity or Identification
IDU	Integrated Display Unit
IF	Initial Fix leg
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IM	Inner Marker
INFO	Information
INHBT	Inhibit
inHg	Inches of Mercury
INIT	Initialize
IO	Input/Output
IP	Initial Point
IPV	Instrument Procedure with Vertical Guidance
ISA	International Standard Atmosphere

IVSI	Instantaneous Vertical Speed Indicator
IWP	Intermediate Approach Waypoint
K	Kilo=1000
KB	Kilobyte
kHz	Kilohertz
KIAS	Knots Indicated Airspeed
KT	Knot - Nautical Mile per Hour
KTAS	Knots True Airspeed
LAT	Latitude
LCD	Liquid Crystal Display
LCL	Local
LDA	Localizer-type Directional Aid
LED	Light Emitting Diode
LGND	Legend
LIFR	Low IFR conditions (Ceiling < 100' or visibility < 1 mile)
LNAV	Lateral Navigation
LOC	Localizer
LOI	Loss of Integrity
LON	Loss of Navigation; Longitude
LP	Localizer Performance
LPV	Localizer Performance with Vertical Guidance
LTP	Landing Threshold Point
LVL	Level
MA	Waypoint is part of the missed approach segment of an Instrument Approach Procedure
MAGVAR	Magnetic Declination (Variation)
MAHP	Missed Approach Holding Point
MAHWP	Missed Approach Holding Waypoint (same as MAHP)
MAN	Manual
MAP	Missed Approach Point; Missed Approach Procedure
MASPS	Minimum Aviation System Performance Standard
MAWP	Missed Approach Waypoint (also MAWPT)
mbar	Millibars
MDA	Minimum Descent Altitude

MESO	Mesocyclonic
METAR	Routine hourly weather report
MFD	Multifunction Display
MIN	Minimum
MM	Middle Marker
MOA	Military Operations Area
MOT	Mark On Target
MSAS	Japan's MTSAT-based Satellite Augmentation System
MSG	Message
MSL	Mean Sea Level
MVFR	Marginal Visual Flight Rules
NAS	U.S. National Airspace System
NAV	Navigation
NAVAID	Device or system providing navigational assistance
ND	Navigation Display
NDB	Nondirectional Beacon
NEXRAD	(Next-Generation Radar) network of weather radars operated by the National Weather Service (NWS) (also NXRD)
NIMA	National Imagery and Mapping Agency
NM	Nautical Mile
NRST	Nearest
nT	Nanoteslas (ref. World magnetic Model)
NWS	National Weather Service
OAT	Outside Air Temperature
OBS	Omnibearing Selector
ODP	Obstacle Departure Procedure
OF	Over-fly
OM	Outer Marker
OT	Other Traffic (Traffic Function)
PA	Proximate Advisory (Traffic Function)
PDA	Premature Descent Alert
PFD	Primary Flight Display (also refers to the primary IDU with software that only shows primary flight instrumentation)
PFI	Primary Flight Information

PI	Procedure Turn (ARINC-424 Leg)
PLI	Pitch Limit Indicator
PLT	Pilot
PM	Personality Module
PN	Part Number; Pan
PROC	Procedure
PRN	Pseudo-Random-Noise (Satellite communications)
PRS	Press
PRV	Previous
PSH	Push
PTK	Parallel offset (Parallel Track)
PTRS	Pointers
PWR	Power
QFE	Altimeter setting provides height above reference point
QNE	Altimeter setting provides pressure altitude readout
QNH	Altimeter setting provides MSL altitude at a reporting point
RA	Resolution Advisory (Traffic Function)
RADALT	Radar Altimeter (also RALT)
RAD-DST	Radial and Distance
RAIM	Receiver Autonomous Integrity Monitoring
RBP	Remote Bug Panel
RF	Precision Arc to Fix (ARINC-424 Leg)
RFP	Radio Frequency Panel
RG	Retractable Gear
RG + F	Retractable Gear with Defined Landing Flaps Position
RHT	Radar Height
RMI	Radio Magnetic Indicator
RNAV	Area Navigation
RNP	Required Navigation Performance
RTC	Real Time Computing
RTCA	Radio Technical Commission for Aeronautics
RTD	Resistive Thermal Detector
RW	Runway
SAE	Society of Automotive Engineers

SAR	Search and Rescue
SAT	Saturation
SATLT	Satellite
SBAS	Satellite-Based Augmentation System
SCC	System Configuration Card (personality module)
SECAM	Analog color television system used in France
SIC	Side-in-Command
SID	Standard Instrument Departure
SIGMET	Significant Meteorological Advisory
SSM	Sign Status Matrix
STAB	Stability
STAR	Standard Terminal Arrival Routes
STBY	Stand-by
STD	Standard
STRKS	Strikes (Lightning detection)
SVS	Synthetic Vision System
SYMB	Symbol
SYNC	Synchronize
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; True Airspeed
TAWS	Terrain Awareness and Warning System
TCA	Terminal Control Areas
TCAD	Traffic Collision Alert Device
TCAS	Traffic Collision Alert System
TD	Terrain Data
T/D	Top of Descent
TERPS	Terminal Instrument Procedures
TF	Track to a Fix; Track from Fix to New Fix (ARINC-424 Leg)
TFR	Temporary Flight Restriction
TGT	Target
TIS	Traffic Information Service

TIS-B	Traffic information Service-Broadcast
TLT	Tilt
TRANS	Transition
TRK	Track
TRNDO	Tornadic
TSO	Technical Standard Order
TTA	Time to Alert
TURB	Turbulence
USB	Universal Serial Bus, data storage device
USR	User Waypoint
UTC	Universal Time Coordinated
VA	Heading to Altitude (ARINC-424 Leg)
V_A	Speed above which it is unwise to make full application of any single flight control
VAL	Vertical Alert Limit
V_{APP}	Target approach airspeed
VD	Heading to DME Distance (ARINC-424 Leg)
VDI	Vertical Deviation Indicator
VERT	Vertical
V_{FE}	Maximum flap extended speed
VFOM	Vertical Figure of Merit
VFR	Visual Flight Rules
VHF	Very High Frequency
VI	Heading to Intercept (ARINC-424 Leg)
VLOC	VOR/Localizer
VLON	Vertical Loss of Navigation
VM	Heading to Manual Termination (ARINC-424 Leg)
V_{MO}	Maximum operating limit speed
VNAV	Vertical Navigation (also VNV)
V_{NE}	Never exceed speed
V_{NO}	Maximum structural cruising speed or maximum speed for normal operations
VOR	VHF Omnidirectional Radio
VORTAC	Collocated VOR and TACAN
VP	VFR waypoints (five digits beginning with “VP”)

VPL	Vertical Protection Level
V_{PROC}	Procedure Speed
V_R	Rotation speed
VR	Heading to Radial Termination (ARINC-424 Leg)
V_{REF}	Landing reference speed or threshold crossing speed
VS	Vertical Speed
VSI	Vertical Speed Indicator
VTF	Vectors to Final
V_{TOS}	Minimum speed for a positive rate of climb with one engine inoperative
WAAS	Wide Area Augmentation System
WGS84	World Geodetic System 1984
WPT	Waypoint
WX	Weather
XFILL	Crossfill

2.2 System Overview

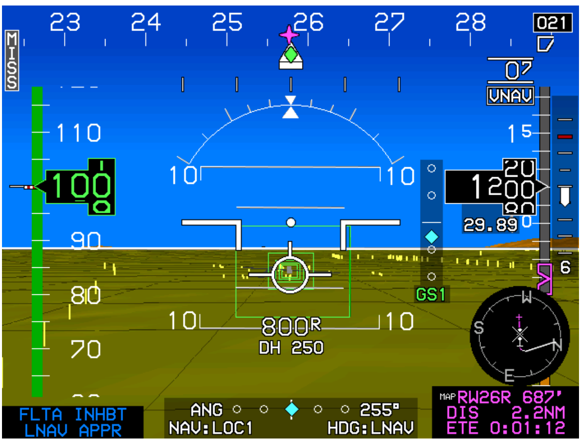


Figure 2-1: IDU-450 Primary Flight Display

The IDU-450 EFIS is a complete flight and navigation instrumentation system intuitively providing information via computer-generated displays. The displays include 3-D, enhanced situational awareness primary flight display (PFD) and multi-function display (MFD), which may be configured to show a moving map, an HSI, terrain, traffic, or datalink weather.

At any given time, each system only has one IDU transmit enabled to send RS-232 and RS-422 system transmissions. By default, the PFD is transmit enabled and, if it subsequently fails, the respective MFD becomes transmit enabled.

Figure 2-2: IDU-450 Multifunction Flight Display

2.2.1 Functional Integration and Display Redundancy

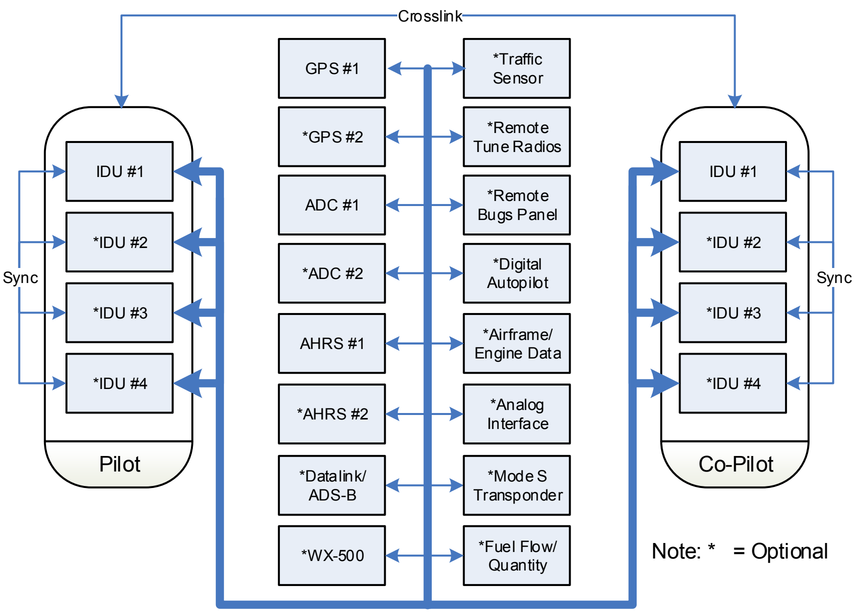


Figure 2-3: System Diagram

IDUs incorporate a high-brightness AMLCD screen; bezel pushbuttons; encoders and enter switches; central processing unit; numerous RS-232, RS-422, and ARINC 429 receive and transmit ports; and discrete IO ports. Hardware and software are identical for all IDUs, and functionality is determined by configuration settings setup during installation. The IDUs are independently connected to all external sensors and independently perform all integrated functions (e.g., TAWS, FMS, ADS-B In, traffic, or strikes). This provides an exceptional level of redundancy as compared to traditional display architectures where most of these functions were performed by external line replaceable units.

Figure 2-3 depicts a typical architecture used by IDUs. The IDUs depend upon intra-system (between IDUs on a side – depicted as "Sync") and inter-system (between IDUs on opposite sides – depicted as "Crosslink") to achieve synchronization of the integrated functions. The IDUs also depend upon intra-system communications to determine which IDU on a side takes over "talker" responsibilities. The "talker" IDU is the IDU providing data to external sensors and generating audible alerts.

2.2.2 IDU Initialization

Figure 2-4: IDU-450 Initialization Screen

Upon power-up, the hardware, including file system, IO, and graphics, is initialized. Immediately after graphics initialization, a logo screen with "INITIALIZING" is displayed with the Genesys Aerosystems logo, software version number, and part number. Software version number delineates: (1) major revision number (i.e., "8.0"), and (2) minor revision letter (i.e., "H").

Table 2-1: IDU Software Version and Part Number	
Version Number	**Part Number**
Rev 8.0H	25-EFIS80H-SW-0002

Aircraft configurations are initially read from flash drive storage to provide IDUs with a default configuration setup in the event of personality module failure.

The personality module contains the CPU number (Table 2-2) and system designation (pilot or co-pilot). The CPU number is identified below the part number on the initialization screen (Figure 2-4).

Table 2-2: CPU Number Designation

CPU Number/IDU#	Definition
"0"	Single-screen installation
"1"	IDU only shows PFD
"2"	First MFD in multi-screen installation
"3"	Second MFD in a multi-screen installation
"4"	Third MFD in a multi-screen installation

Aircraft parameters (latitude, longitude, altitude), as they existed prior to the last system shutdown, are read for a good system initialization, even if system sensors are failed or not yet initialized. For future updates (i.e., updating software version 8.0H to 8.0J), 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 except for the following default values:

1) Selected sensors are initialized to default values.
2) Active flight plan structure and associated values are cleared.
3) ADAHRS set to slaved mode, and slewing value is initialized to zero.
4) Timers are turned off.
5) Map panning modes are set to off.
6) Fuel caution and alarm thresholds are set to default values.
7) Heading bug is set to 360°.
8) Heading mode is turned off.
9) HSI navigation source is set to FMS.
10) Horizon Synchronization status is set to disabled.
11) Minimum altitude setting is turned off.
12) FMS OBS setting is set to automatic.
13) VOR/LOC 1 OBS setting is set to 360°.

14) VOR/LOC 2 OBS setting is set to 360°.

15) Parallel offset is set to 0 NM.

16) PFD zoom mode is set to off.

17) Manual RNP is set to off.

18) PFD skyway is set to on.

19) Airspeed bug is turned off.

20) Target and preselected altitude bugs are turned off

21) True North mode is turned off.

22) Vertical speed bug is turned off.

23) Crosslink is initialized to on.

24) Map modes are set to allowed values.

If configured, the magnetic variation coefficients database is read from the flash drive storage and CRC-32 checked.

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

1) A logo screen with **"TESTING"** is displayed.

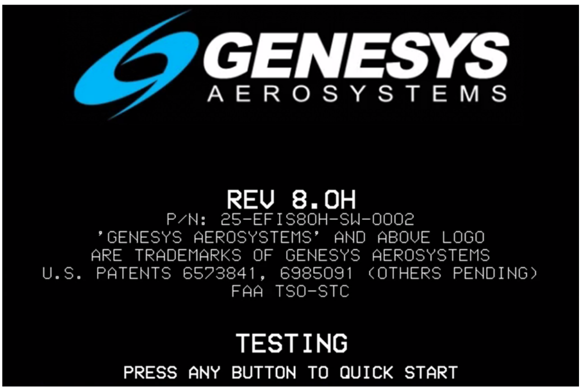


Figure 2-5: Logo Screen with "TESTING"

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

During this action, “**PRESS ANY BUTTON TO QUICK START**” is displayed below “**TESTING**.” Press any button to stop the ground booting and execute the flight booting.

3) If the BIT (built-in-test) check fails, the program exits with an error message and creates a BIT result file indicating failure.

4) If the BIT check passes, the program continues to initialize and creates a BIT result file indicating passage.

5) If “Baro Auto-Setting on Startup Flag” is enabled in EFIS limits, the system auto-sets the altimeter based on the terrain elevation at the startup point (only applicable at surveyed airports.) In case of QFE mode operation, the application will autoset the altimeter to read zero altitude.

6) CRC screen displays:

   a) Software CRC-32;

   b) Aircraft type;

   c) Sounds database name and CRC-32;

   d) Magnetic variation coefficients version and CRC-32; and

   e) Database versions and validity dates are displayed along with “**PRESS ANY BUTTON TO CONTINUE**.”

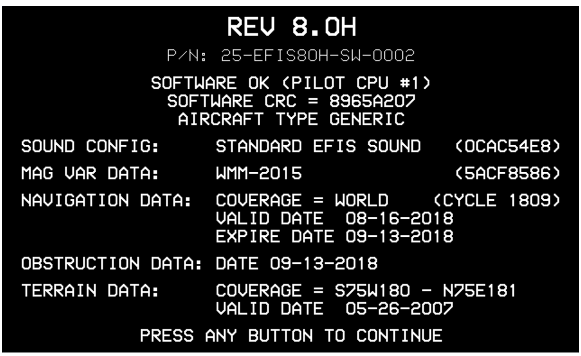


Figure 2-6: CRC Screen

7) If all critical sensors (GPS, ADC, and AHRS) are in normal condition, the display screens are shown immediately.

8) If any critical sensor is not in normal condition, a logo screen with a two-minute countdown timer is displayed along with “**PRESS ANY BUTTON TO SKIP**.”

Figure 2-7: Two-Minute Countdown Screen

9) The display screens initialize at the earliest of:

   a) when 2 minutes have elapsed;

   b) when the pilot presses any button to escape the startup countdown; or

   c) when all critical sensors are in normal condition.

10) Display screens initialize as follows:

   a) IDU #1: PFD screen

   b) Other IDUs: IDU #2 initializes to MFD screen. All other IDUs initialize to MFD screen.

   c) On IDU #0, #2, #3, or #4 with fuel totalizer functions enabled, the fuel set menu is activated to remind the pilot to set the fuel totalizer quantity.

11) All active alerts are automatically acknowledged for 5 seconds to reduce nuisance alerting.

If booting in the air, the following actions happen:

1) A logo screen with “**QUICK START**” is displayed.

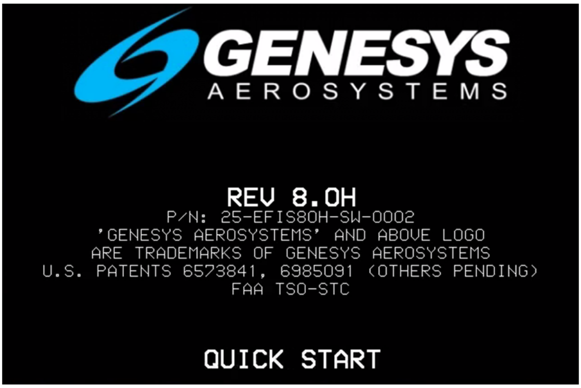


Figure 2-8: QUICK START Screen

2) BIT result file created during the last ground boot is checked.

   a) **Failure** = indicates a failure, program exits with an error message.

   b) **Passage** = program continues.

3) The display screens initialize immediately as follows:

   a) IDU #1: PFD Screen

   b) Other IDUs: IDU #2 initializes to MFD screen. All other IDUs initialize to MFD screen.

4) All active alerts are automatically acknowledged for 5 seconds to reduce nuisance alerting.

NOTE:

Intra-system and inter-system synchronization messages are paused when any IDU menu is active. After IDU initialization, if any menu is active, press **EXIT (R1)** on each display and wait at least 20 seconds to allow PFDs to sync with MFDs and pilot and co-pilot sides to sync.

2.3 General Arrangement

The IDU-450 is 6.375” W x 5.65” H x 4.75” D and weighs less than 7.5 lbs. The IDU-450 has the capacity to accommodate integrated peripherals mechanically attached to the IDU but have electrical isolation and redundancy. These modules may include:

1) Integrated ADAHRS sensor module

2) Integrated GPS/SBAS sensor module

3) Serial protocol converters

4) Video format converters

Data storage is sufficiently sized to hold world terrain, navigation, and obstruction databases. Because the receive ports are connected to the digital sensor modules in parallel, each IDU is independent from all others.

2.3.1 Data Source Monitors

IDUs continuously monitor the ADC, AHRS, and GPS sensors to detect disagreements:

1) Airspeed
2) Altitude
3) Attitude
4) Barometric setting (pilot vs. co-pilot sides)
5) GPS position, track, and groundspeed
6) Heading
7) Localizer and glideslope deviations
8) Radar altitude

2.3.2 IDU Intra-System Communications

Communication between IDUs installed on the same side is referred to as intra-system communications. In a dual system (pilot and co-pilot) configuration, the crosslink side-to-side communications is referred to as inter-system communications. IDUs on a system side (pilot side and co-pilot side individually) monitor each other using intra-system communications and perform the following checks:

1) Intra-system communications freshness
2) Screen counter incrementing (i.e., screen not frozen)
3) Airspeed agreement
4) Altitude agreement
5) Attitude agreement
6) Barometric setting agreement
7) GPS position, track, and groundspeed agreement
8) Heading agreement
9) Localizer and glideslope deviation agreement
10) Radar altitude agreement

2.3.3 GPS Aiding Limitation

To prevent gyro drift in the roll attitude solution, continuous corrections to roll attitude are made based upon speed, accelerations, and rates. The preferred correction speed source is airspeed from the air data computer

(ADC). However, airspeed data becomes noisy and inaccurate as the aircraft slows, and the system automatically transitions to GPS groundspeed (at approximately 55 KIAS) under these conditions.

When flying in a GPS-denied environment, be aware that flight below 55 KIAS could result in a degraded roll attitude solution. Therefore, avoid IMC conditions and crosscheck other attitude instruments when flying below 55 KIAS and transition to flight above 55 KIAS as soon as practicable.

NOTE:

Not applicable for rotorcraft with other AHRS than Genesys ADAHRS installed.

2.4 Color Conventions

The EFIS uses a consistent set of colors to display information. Any color representation may not be identical as it appears on the IDU.

WHITE for items set by pilot and held by the EFIS or items where device feedback is not expected; marker beacon receiver high/low sensitivity modes; 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.)

When used for an analog bar indication, light gray (low-intensity white) is used instead as a large white area on the screen may become overwhelming.

CYAN for IFR navigation dataset items (airports with instrument approach procedures, VORs, and intersections) and VOR #1.

MAGENTA (light magenta for visibility) indicates calculated or derived data and certain navigation database items. Examples:

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

GRAY as background for airspeed and altitude readout and for conformal runway depiction (light gray for usable portion of active runway, dark gray for other runway surfaces).

GREEN (light green for visibility) for VOR #2 and to indicate normal or valid operation (airspeed, altitude tape coloring, status indication, engine, etc.). Examples:

- Aircraft ground track
- Skyway symbology
- Airspeeds in green arc

DARK GREEN for terrain indication on moving map. The slope between adjacent terrain determines the shade used.

AMBER (YELLOW) identifies conditions requiring immediate pilot awareness and possible subsequent action.

OLIVE in various shades shows terrain within 2000' and below aircraft altitude.

BROWN in a variety of shades indicates earth/terrain portion of PFD or when above 100 feet less than aircraft altitude on MFD.

BLUE in a variety of shades indicates sky portion of PFD, bodies of water on moving map, and advisory text on black background.

RED indicates aircraft limitations or conditions, which require immediate pilot action, or a device failure (red "X").

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

2.5 Warning/Caution/Advisory System

The IDU has an integrated audio/visual warning system, which monitors a wide variety of parameters and provides alerts for conditions that demand pilot action or awareness.

Each transmit enabled IDU provides the following alerts:

1) Warning Alerts
2) Time-Critical Warning Alerts
3) Master Visual and Audible Alerts
4) Caution Alerts
5) Advisory Alerts

All warnings, including time-critical warnings, activate the warning (red) light and master caution light. All cautions, including time-critical cautions, activate the caution (yellow) light and master caution light. Once acknowledged, the flashing behavior stops, the audible alert is interrupted, and the discrete outputs are deactivated.

2.5.1 Time-Critical Warning and Caution Alerts

Time-critical warning and caution alerts trigger the following elements (Table 2-3) and display in the pilot's primary field of view with a shaded background (Figure 2-9 and Figure 2-10). EFIS limits may have enabled the option for time-critical alerts to illuminate a master warning/master caution push button annunciator when equipped.

NOTE:

In the following tables, examples show shaded backgrounds on sky and terrain backgrounds for readability.

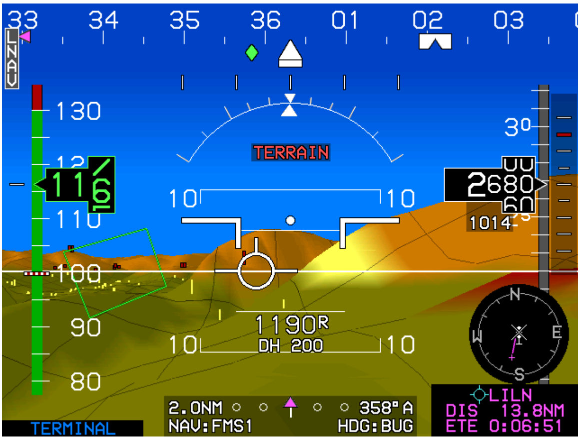


Figure 2-9: Time-Critical Warning Alert

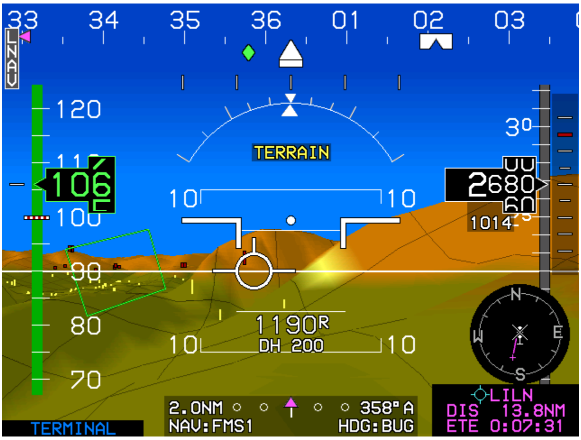


Figure 2-10: Time-Critical Caution Alert

Table 2-3: Time-Critical Warning and Caution Alerts in Primary Field of View			
Alert Type	**Text Color**	**Flash Rate**	**Audio Alert at Full Volume**
WARNING WARNING	Red	2 Hz	Repeated until acknowledged
CAUTION CAUTION	Amber (Yellow)	1 Hz	Plays only once

Table 2-4: Time-Critical Warning and Caution Alerts		
Visual Alert	**Voice Alert** "--" No Voice Alert	**Condition** ** No time delay
OBSTRUCTION OBSTRUCTION	"Warning Obstruction, Warning Obstruction"	Obstruction within TAWS FLTA warning envelope. Half-second time delay.
TRAFFIC TRAFFIC	"Traffic, Traffic"	Resolution advisory. Not given if own aircraft at or below 400' AGL. Not given if target is at or below 200' AGL (ground target). Audio not generated with TCAS-II system. **
TERRAIN TERRAIN	"Warning, Terrain, Warning Terrain"	Terrain cell within HTAWS FLTA warning envelope. Half-second time delay.

Table 2-4: Time-Critical Warning and Caution Alerts

Visual Alert	**Voice Alert** "--" No Voice Alert	**Condition** ** No time delay
PULL UP PULL UP	"Pull Up, Pull Up"	Within GPWS Mode 1 warning envelope. Half-second time delay.
	"Terrain, Terrain, Pull Up, Pull Up"	Within GPWS Mode 2 warning envelope. Half-second time delay.
GLIDESLOPE GLIDESLOPE	"Glideslope, Glideslope"	Within GPWS Mode 5 warning envelope. Half-second time delay.
CHECK GEAR CHECK GEAR	"Check Gear, Check Gear"	Activates if aircraft is below 150' AGL, is descending, and any landing gear is not down. 2-second time delay.
TERRAIN TERRAIN	"Caution Terrain, Caution Terrain"	Within GPWS Mode 2 caution. Terrain cell within TAWS FLTA caution envelope. Half-second time delay.
SINK RATE SINK RATE	"Sink Rate, Sink Rate"	Within GPWS Mode 1 caution envelope. Half-second time delay.
TOO LOW TOO LOW	"Too Low Terrain, Too Low Terrain"	Within GPWS Mode 3 envelope. Half-second time delay.
		Within GPWS Mode 4-1 "Too Low Terrain" envelope. Half-second time delay.
	"Too Low Gear, Too Low Gear"	Within GPWS Mode 4-2 "Too Low Gear" envelope. Half-second time delay.
GLIDESLOPE GLIDESLOPE	"Glideslope, Glideslope"	Within GPWS Mode 5 caution envelope. Half-second time delay.
OBSTRUCTION OBSTRUCTION	"Caution Obstruction, Caution Obstruction"	Obstruction within TAWS FLTA caution envelope. Half-second time delay.
TRAFFIC TRAFFIC	"Traffic, Traffic"	Not given if own aircraft below 400' AGL nor if target is below 200'AGL (ground target). **

Table 2-4: Time-Critical Warning and Caution Alerts		
Visual Alert	**Voice Alert** “--” No Voice Alert	**Condition** ** No time delay
	--	Annunciates horizon synchronization function is engaged. Annunciation does not flash nor illuminate a master visual alert, because it is not really a caution but instead is a pilot selection annunciation.

Time-critical warning and caution alerts are prioritized so only one alert at a time is active:

1) GPWS Mode 1 Warning
2) GPWS Mode 2 Warning
3) TAWS FLTA Warning
4) Obstruction Warning
5) TAWS FLTA Caution
6) Obstruction Caution
7) GPWS Mode 4-1
8) GPWS Mode 4-2
9) GPWS Mode 4-3
10) GPWS Mode 1 Caution
11) GPWS Mode 2 Caution
12) GPWS Mode 3
13) GPWS Mode 5 Warning
14) GPWS Mode 5 Caution
15) Check Gear
16) Traffic Warning (Resolution Advisory)
17) Traffic Caution (Traffic Advisory)
18) Horizon Synchronization Caution

2.5.2 Warning Alerts

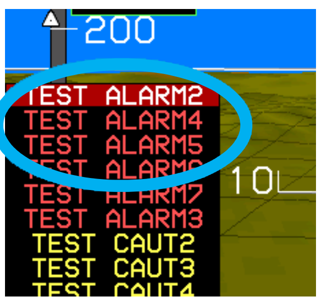


Figure 2-11: Warning Alerts

Table 2-5: Warning Alert Elements			
Type Alert	**Location**	**Flash Rate**	**Audio Alert at Full Volume**
WARNING WARNING	PFD lower left corner of transmit enabled IDU	2 Hz	Repeated until acknowledged

Table 2-6: Warning Alerts		
Visual Alert	**Voice Alert**	**Condition** ** No time delay
LOW FUEL	"Fuel Low, Fuel Low"	One of the following conditions is true: 1) A low fuel warning discrete input is active 2) A sensed fuel tank quantity 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. (Used on CPU #0 only.) Half-second time delay.
TERRAIN	"Warning, Terrain, Warning Terrain"	Terrain cell within HTAWS FLTA warning envelope. (Used on CPU #0 only.) Half-second time delay.
PULL UP	"Pull Up, Pull Up"	Within GPWS Mode 1 warning envelope. (Used on CPU #0 only.) Half-second time delay.
	"Terrain, Terrain, Pull Up, Pull Up"	Within GPWS Mode 2 warning envelope. (Used on CPU #0 only.) Half-second time delay.
GLIDESLOPE	"Glideslope, Glideslope"	Within GPWS Mode 5 warning envelope. (Used on CPU #0 only.) Half-second time delay.

Table 2-6: Warning Alerts		
Visual Alert	**Voice Alert**	**Condition** ** No time delay
TRAFFIC	"Traffic, Traffic"	Resolution advisory. Not given if own aircraft at or below 400' AGL. Not given if target is at or below 200' AGL (ground target). Audio not generated with TCAS-II system. (Used on CPU #0 only.) **

2.5.3 Caution Alerts

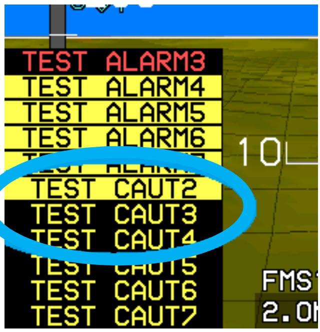


Figure 2-12: Caution Alerts

Table 2-7: Caution Alert Elements			
Type Alert	**Location**	**Flash Rate**	**Audio Alert**
CAUTION CAUTION	PFD lower left corner of transmit enabled IDU	1 Hz	Single alert played at full volume.

Table 2-8: Caution Alerts		
Visual Alert	**Voice Alert/ Alert Tone**	**Condition**
** No time delay [1] Only active in dual-sensor installation with neither sensor in failure condition [2] Only active in dual-system (pilot and co-pilot) [3] Only active when single-pilot mode discrete not asserted		
ADC1 FAIL ADC2 FAIL ADC1/2 FAIL	Alert Tone	Indicates no valid IAS, pressure altitude, nor VSI received from numbered ADC(s) for more than 1 second. ** [1]

Table 2-8: Caution Alerts

Visual Alert	Voice Alert/ Alert Tone	Condition
** No time delay [1] Only active in dual-sensor installation with neither sensor in failure condition [2] Only active in dual-system (pilot and co-pilot) [3] Only active when single-pilot mode discrete not asserted		
ADS-B FAIL	Alert Tone	Enabled by ADS-B out fail warning limits setting. Mode-S transponder indicates bad ADS-B out status. Also, set by audio/radio interface with NGT-9000R transponder. 2-second time delay.
AHRS1 FAIL AHRS2 FAIL AHRS1/2 FAIL	Alert Tone	Indicates no valid bank, pitch, nor heading received from enumerated AHRS(s) for more than 1 second. Inhibited during and for 10 seconds after unusual attitude mode.** [1]
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. Inhibited during and for 10 seconds after unusual attitude mode. Applies to the following optional sensors: 1) RS-232 TAS 2) ADS-B system 3) WX-500 Lightning system 4) Analog interface system
PLT1 OVRTMP PLT2 OVRTMP PLT3 OVRTMP PLT4 OVRTMP CPLT1 OVRTMP CPLT2 OVRTMP CPLT3 OVRTMP CPLT4 OVRTMP	Alert Tone	IDU core temperature greater than 95°C. 2-second time delay.

Table 2-8: Caution Alerts		
Visual Alert	**Voice Alert/ Alert Tone**	**Condition**
** No time delay [1] Only active in dual-sensor installation with neither sensor in failure condition [2] Only active in dual-system (pilot and co-pilot) [3] Only active when single-pilot mode discrete not asserted		
PLT MISCOMP CPLT MISCOMP	Alert Tone	Only when fresh intra-system monitor messages are received. Indicates critical parameters used by displays on the indicated side exceed miscompare thresholds. Compares the following critical parameters: 1) Attitude (pitch and roll) 2) Heading 3) Pressure altitude 4) Indicated airspeed 5) Localizer (both inputs) 6) Glideslope (both inputs) 7) Radar altitude 8) Latitude 9) Longitude 10) Track 11) Groundspeed 1-second time delay. Inhibited during and for 10 seconds after unusual attitude mode. [2]
ALT MISCOMP	Alert Tone	Indicates pressure altitude difference between ADCs is beyond limits. 10-second time delay. Inhibit for 5 minutes after startup. [1]
ATT MISCOMP	Alert Tone	Indicates pitch or roll difference between AHRS is beyond limits (6°). 10-second time delay. Inhibit for 5 minutes after startup. [1]

Table 2-8: Caution Alerts

Visual Alert	Voice Alert/ Alert Tone	Condition
** No time delay [1] Only active in dual-sensor installation with neither sensor in failure condition [2] Only active in dual-system (pilot and co-pilot) [3] Only active when single-pilot mode discrete not asserted		
PLT RANGE CPLT RANGE	"Check Range, Check Range"	Based upon flight plan in use on the indicated side, less than 30 minutes buffer (at current groundspeed) between calculated range and distance to: 1) last waypoint if it is active; or 2) airport if on a missed approach; or 3) along-route distance to destination. Not activated in climbing flight nor if below 60 kts groundspeed. 5-minute time delay.
PLT1 SCC PLT2 SCC PLT3 SCC PLT4 SCC CPLT1 SCC CPLT2 SCC CPLT3 SCC CPLT4 SCC	Alert Tone	Indicates personality module for designated IDU (side and CPU #) could not be read upon power-up. Internal limits are in use by the system. Only active on the ground.
PLT1 TAWS PLT2 TAWS PLT3 TAWS PLT4 TAWS CPLT1 TAWS CPLT2 TAWS CPLT3 TAWS CPLT4 TAWS	Alert Tone	Indicates on the designated IDU (side and CPU #), aircraft is currently beyond extent of terrain database or a failure condition is preventing TAWS FLTA function from operating. Half-second time delay. Inhibited during and for 10 seconds after unusual attitude mode.
COOLING FAN	Alert Tone	Triggered when external cooling fan is commanded on by discrete output, but the cooling fan status discrete input indicates the cooling fan is not rotating. 1-minute time delay.

Table 2-8: Caution Alerts		
Visual Alert	**Voice Alert/ Alert Tone**	**Condition**
** No time delay [1] Only active in dual-sensor installation with neither sensor in failure condition [2] Only active in dual-system (pilot and co-pilot) [3] Only active when single-pilot mode discrete not asserted		
FUEL SPLIT	Alert Tone	Compares the volume of fuel designated left wing tank fuel vs. volume of fuel designated right wing tank fuel to the fuel split caution threshold. Issued if the difference exceeds the fuel split caution threshold. Only performed if the fuel split caution threshold is non-zero and both left and right wing tank fuel is monitored and valid. 1-minute time delay.
LOW FUEL	"Fuel Low, Fuel Low"	A low fuel warning is not active and one of the following conditions is true: 1) One of the low fuel caution discrete inputs is active 2) One of the sensed fuel tank quantities is below its low fuel caution threshold 3) Total aircraft fuel is below the pilot-set minimum fuel threshold. 1-minute time delay.
GPS MISCOMP	Alert Tone	Indicates position, track, or groundspeed difference between GPS/SBAS units is beyond the following limits: **Position**: Enroute Mode 4NM Terminal Mode 2NM Departure Mode .6NM IFR Approach Mode .6NM VFR Approach Mode .6NM

Table 2-8: Caution Alerts

Visual Alert	Voice Alert/ Alert Tone	Condition
** No time delay [1] Only active in dual-sensor installation with neither sensor in failure condition [2] Only active in dual-system (pilot and co-pilot) [3] Only active when single-pilot mode discrete not asserted		
		Track: If groundspeed is greater than 30 kts, miscompare if difference is more than 4°. **Groundspeed**: If difference between GPS#1 and GPS#2 miscompare is more than 10 kts. 10-second time delay. Inhibited during and for 10 seconds after unusual attitude mode. [1]
GS MISCOMP	Alert Tone	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. [1]
HDG MISCOMP	Alert Tone	With neither AHRS failed nor in DG mode. Indicates heading difference between AHRS is beyond the heading miscompare threshold limit. 60-second delay. Inhibited during and for 10 seconds after unusual attitude mode. Inhibit for 5 minutes after startup. [1]
IAS MISCOMP	Alert Tone	Indicates IAS difference between ADCs is beyond limits. 10-second time delay. Inhibit for 5 minutes after startup. [1]
LOC MISCOMP	Alert Tone	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. [1]

Table 2-8: Caution Alerts		
Visual Alert	**Voice Alert/ Alert Tone**	**Condition**
** No time delay [1] Only active in dual-sensor installation with neither sensor in failure condition [2] Only active in dual-system (pilot and co-pilot) [3] Only active when single-pilot mode discrete not asserted		
RALT MISCOMP	Alert Tone	Indicates that 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' [1]
OAT FAIL OAT1 FAIL OAT2 FAIL OAT1/2 FAIL	Alert Tone	OAT FAIL applicable to single ADC installation. OAT# FAIL applicable indicates OAT indication is invalid but other air data parameters are normal (i.e., air data not red-X'd) [1]. Half-second time delay.
RALT FAIL RALT1 FAIL RALT2 FAIL RALT1/2 FAIL	Alert Tone	RALT FAIL applicable to single radar altimeter installation. RALT# FAIL applicable to dual radar altimeter installation. For analog radar altimeter, indicates the aircraft is below 2000' AGL in air mode without a valid radar altimeter reading. For ARINC 429 radar altimeter, indicates an SSM of failure warning is transmitting. 2-second time delay.
SAME ADC	Alert Tone	Indicates both sides are operating from same ADC source. ** [1]
SAME AHRS	Alert Tone	Indicates both sides are operating from same AHRS source. ** [1]
SAME DME	Alert Tone	Indicates both sides are operating from same DME Source **[1] [3]
SAME GPS	Alert Tone	Indicates both sides are operating from same GPS/SBAS source.**[1][2][3]
SAME NAV	Alert Tone	Indicates both sides are operating from same navigation source. ** [2]
SAME RALT	Alert Tone	Indicates both sides are operating from same radar altimeter source. ** [1] [2] [3]

Table 2-8: Caution Alerts		
Visual Alert	**Voice Alert/ Alert Tone**	**Condition**
** No time delay [1] Only active in dual-sensor installation with neither sensor in failure condition [2] Only active in dual-system (pilot and co-pilot) [3] Only active when single-pilot mode discrete not asserted		
TAWS AUTOROT	Alert Tone	TAWS autorotation mode activated through use of discrete input. **
TCAS FAIL	Alert Tone	TAS indicates lack of communications with system or failure indication from system. **
TOTALZR QTY	Alert Tone	Compares the volume of sensed fuel to the fuel totalizer calculation. Issued if the difference exceeds the totalizer mismatch caution threshold. Only performed if: 1) Totalizer mismatch caution threshold is non-zero; 2) Fuel totalizer is enabled; 3) Unmonitored fuel flag is false; 4) Fuel totalizer has a valid value; and 5) Fuel levels are valid. 1-minute time delay.
XFILL FAIL	Alert Tone	Indicates lack of inter-system communications. 32-second delay. [2] [3]
GPS1 FAIL GPS2 FAIL GPS1/2 FAIL	Alert Tone	Indicates no valid message received from numbered GPS/SBAS for more than 5 seconds. ** Inhibited during and for 10 seconds after unusual attitude mode. [1]
CHECK GEAR	"Check Gear, Check Gear"	Activates if aircraft is below 150' AGL, is descending, and any landing gear is not down. (Used on CPU #0 only.) 2-second time delay.
TERRAIN	"Caution Terrain, Caution Terrain"	Terrain cell within TAWS FLTA caution envelope. (Used on CPU #0 only.) Half-second time delay.

Table 2-8: Caution Alerts

Visual Alert	Voice Alert/ Alert Tone	Condition
** No time delay [1] Only active in dual-sensor installation with neither sensor in failure condition [2] Only active in dual-system (pilot and co-pilot) [3] Only active when single-pilot mode discrete not asserted		
SINK RATE	"Sink Rate, Sink Rate"	Within GPWS Mode 1 caution envelope. (Used on CPU #0 only.) Half-second time delay.
GLIDESLOPE	"Glideslope, Glideslope"	Within GPWS Mode 5 caution envelope. (Used on CPU #0 only.) Half-second time delay.
TOO LOW	"Too Low Terrain, Too Low Terrain"	Within GPWS Mode 3 envelope. (Used on CPU #0 only.) Half-second time delay.
		Within GPWS Mode 4-1 "Too Low Terrain" envelope. (Used on CPU #0 only.) Half-second time delay.
	"Too Low Gear, Too Low Gear"	Within GPWS Mode 4-2 "Too Low Gear" envelope. (Used on CPU #0 only.) Half-second time delay.
OBSTRUCTION	"Caution Obstruction, Caution Obstruction"	Obstruction within TAWS FLTA caution envelope. (Used on CPU #0 only.) Half-second time delay.
TRAFFIC	"Traffic, Traffic"	Not given if own aircraft below 400' AGL nor if target is below 200'AGL (ground target). (Used on CPU #0 only.)**

2.5.4 Side-Specific Caution Alerts

Side-specific caution alerts are displayed on all IDUs on a side that detect a failure on an IDU on that side.

Table 2-9: Side-Specific Caution Alerts

Visual Alert	Alert Tone	Condition ** No time delay
CHECK IDU 1 CHECK IDU 2 CHECK IDU 3 CHECK IDU 4	Alert Tone	IDU status has not been received from another same-side IDU in the last second ± 0.1 seconds. # indicates which IDU is failing the check. **

2.5.5 Advisory Alerts

Figure 2-13: Advisory Alerts

Table 2-10: Advisory Alert Elements

Type Alert	Location	Appearance	Audio Alert
ADVISORY	PFD lower left corner of transmit enabled IDU	While condition persists	Single advisory chime played at 80% volume

Table 2-11: Advisory Alerts

Visual Alert	Alert Tone	Condition
** No time delay [1] Only active in dual-sensor installation with neither sensor in failure condition [2] Only active in dual-system (pilot and co-pilot) [3] Only active when single-pilot mode discrete not asserted		
ADC INIT ADC1 INIT ADC2 INIT ADC1/2 INIT	Chime	Indicates ADC# not at full accuracy during warm-up. ** ADC1 INIT, ADC2 INIT, and ADC1/2 INIT [1]
AHRS1 DG AHRS2 DG AHRS1/2 DG	Chime	Indicates numbered AHRS in DG mode. ** [1]
CREW CALL	Chime	Only active with EFIS control of an audio controller and call notice is received from the controller.
PLT1 PWR PLT2 PWR PLT3 PWR PLT4 PWR CPLT1 PWR CPLT2 PWR CPLT3 PWR CPLT4 PWR	Chime	Indicates a dual redundant power supply within the designated IDU (side and CPU #) is not functioning correctly. Only active on the ground. 1-minute time delay.
FPM INHBT	Chime	Flight path marker inhibit function activated through use of momentary discrete input. **

Table 2-11: Advisory Alerts

Visual Alert	Alert Tone	Condition
** No time delay [1] Only active in dual-sensor installation with neither sensor in failure condition [2] Only active in dual-system (pilot and co-pilot) [3] Only active when single-pilot mode discrete not asserted		
BARO MISCOMP	Chime	Indicates mismatch of altimeter settings or altimeter modes between systems. 10-second time delay. [2] [3]
TAS INHBT	Chime	TAS audible inhibited through activation of TCAS/TAS audio inhibit input. **
TAWS GS CNX	Chime	TAWS glideslope cancel (GPWS Mode 5) activated through use of discrete input. Enhanced HTAWS only. **
TAWS INHBT	Chime	TAWS inhibited through discrete input. **
TAWS LOW ALT	Chime	TAWS low altitude mode activated through use of discrete input. **
TCAS STBY	Chime	Only active with TCAS-II. Indicates system is either in standby or executing functional test in flight.**
TA ONLY	Chime	Only active with TCAS-II. Indicates system is unable to display resolution advisories. **
TCAS TEST	Chime	Only active with TCAS-II. Indicates system is in functional test on ground. **
XFILL ARM	Chime	Only active with good inter-system communications and crossfill not inhibited. Indicates systems are not synchronized and synchronized function is available. ** [2] [3]
XFILL INHBT	Chime	Only with good inter-system communications, indicates crossfill is inhibited through discrete input.** [2] [3]

2.5.6 Side-Specific Advisory Alerts

Side-specific advisory alerts have the same characteristics as advisory alerts except, they always appear in the lower-left corner of the transmit enabled IDU screen.

These type of alerts are used where the pilot and copilot systems can generate different alerts, such as when the pilot and co-pilot systems are not crossfilled and are operating on different FMS flight plans.

Table 2-12: Side-Specific Advisory Alerts

Visual Alert	**Alert Tone**	**Condition** ** No time delay
CHK BARO	Chime	Ascending through transition level: Altimeter not set to 29.92 inHg or 1013 mbar. Descending through transition level: Altimeter set to 29.92 inHg or 1013 mbar. Descent warning times out in 10 seconds. Disabled during QFE operation. 2-second time delay.
ANP: 0.01 ANP: 15.0	Chime	GPS/SBAS actual navigation performance in nautical miles based upon current GPS/SBAS HPL. Value ranges from 0.01 to 15.0 NM.
RNP: 0.10A RNP: 15.0A	Chime	GPS/SBAS automatic required navigation performance in nautical miles as acquired from navigation database. Value ranges from 0.01 to 15.0 NM.
RNP: 0.10M RNP: 15.0M	Chime	GPS/SBAS manual required navigation performance in nautical miles as set by pilot. Value ranges from 0.01 to 15.0 NM.
DR 00:00 DR 01:23	Chime	GPS/SBAS in dead reckoning mode with valid ADC and AHRS data. Timer shows time since loss of position (mm:ss) to indicate quality of DR solution. Valid range is from 00:00 to 59:59. Inhibited during and for 10 seconds after unusual attitude mode.**
LNAV APPR	Chime	GPS/SBAS in LNAV approach mode.**
LNV/VNV APPR	Chime	GPS/SBAS in LNAV/VNAV approach mode. **
LP APPR	Chime	GPS/SBAS in LP approach mode. **
LPV APPR	Chime	GPS/SBAS in LPV approach mode.**

Table 2-12: Side-Specific Advisory Alerts

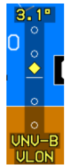
Visual Alert	Alert Tone	Condition ** No time delay
SUSPEND	Chime	Automatic waypoint sequencing is suspended under any of the following conditions: 1) Pilot has selected a manual GPS/SBAS OBS. 2) Active waypoint is the missed approach waypoint, and missed approach procedure has not been armed (ARM) nor initiated (MISS). 3) Aircraft is in a published or manually created holding pattern, and pilot has not chosen to continue (CONT) out of the holding pattern. 4) Leg following active waypoint is a manual termination leg, and the pilot has not chosen to resume (RESUME) to the waypoint following the manual termination. 5) The aircraft is in a repeating SAR pattern (see SAR appendix), and the pilot has not chosen to continue out of SAR pattern.**
TERMINAL	Chime	GPS/SBAS in terminal mode. **
VFR APPR	Chime	GPS/SBAS in VFR approach mode. **
VECTORS	Chime	GPS/SBAS in vectors to final approach mode prior to sequencing FAWP. **
PTK = L 1NM PTK = L 20NM PTK = R 1NM PTK = R 20NM PTK ENDING	Chime	GPS/SBAS parallel offset path advisory. ## is nautical miles left (L) or right (R) of main path. PTK ENDING if within the parallel offset distance from a parallel offset exit waypoint. **
FLTA INHBT	Chime	Shown when FLTA function is automatically inhibited during normal operation. TAWS INHBT advisory has priority. **
TRUE NORTH	Chime	System operating in true north mode.**

2.5.7 Audio-Only Caution and Advisory Alerts

Table 2-13: Audio-Only Caution and Advisory Alerts

Caution or Advisory Alert	**Voice Alert/ Alert Tone**	**Condition** ** No time delay
Minimum Altitude Caution Alert	"Minimums, Minimums"	Deviation from above to below minimum altitude bug. Minimum altitude readout turns amber (yellow) and flashes. **
Selected Altitude Deviation Caution Alert	"Altitude, Altitude"	Deviation greater than 150' from selected altitude after capture (within 100' of altitude). 2-second time delay.
VNAV Altitude Deviation Caution Alert		If not on a descending VNAV profile, deviation greater than 150' from altitude of the current or prior VNAV waypoint after capture (within 100' of altitude). 2-second time delay.
Decision Height Caution Alert	"Decision Height"	Deviation from above to below decision height bug. Decision height readout turns amber (yellow) and flashes. **
GBS/SBAS Failure Caution Alert	Alert Tone	No valid position data available from selected GPS/SBAS for more than 5 seconds and dead reckoning not available. Inhibited during and for 10 seconds after unusual attitude mode. Loss of position data is obvious from symbology changes associated with reversionary modes.**
GPS/SBAS Loss of Integrity Caution Alert	Alert Tone	GPS/SBAS loss of integrity caution. Inhibited during and for 10 seconds after unusual attitude mode. LOI indication is integrated with lateral deviation indicator. ** 
GPS/SBAS Loss of Navigation Caution Alert	Alert Tone	GPS/SBAS loss of navigation caution. Inhibited during and for 10 seconds after unusual attitude mode. LON indication is integrated with lateral deviation indicator. ** 

Table 2-13: Audio-Only Caution and Advisory Alerts

Caution or Advisory Alert	Voice Alert/ Alert Tone	Condition ** No time delay
Loss of Vertical Navigation Caution Alert	Alert Tone	Loss of vertical navigation caution. Inhibited during and for 10 seconds after unusual attitude mode. VLON indication is integrated with vertical deviation indicator. ** 
Countdown Timer Chime	Chime	Sounds when countdown timer reaches 00:00:00. **
Level-off Advisory Alert	Altitude Alert Tone	Within the greater of 1000’ or 50% of VSI from uncaptured selected or VNAV waypoint altitude. Inhibited in approach procedures. **

2.5.8 Voice Alerts and Muting

Only the highest priority (in criticality and recency), unacknowledged voice alert is played at any given time. Any playing audio message is immediately muted by activating the warning/caution acknowledge switch.

2.5.9 Visual Alert Prioritization and Declutter

Visual alerts are visually prioritized, so warnings are displayed above cautions, which are displayed above advisories. Within categories, visual alerts are stacked in chronological order, so the most recent alert appears on top.

The maximum number of visual alerts that can be simultaneously displayed in the standard location is 11. In the event there are more than 11 visual alerts, MORE-PRS MENU appears for guidance in accessing the EXPAND CAS menu.

Only the highest priority (in criticality and recency), unacknowledged audible annunciation is played at a time. In addition, to further minimize cockpit confusion, annunciations are grouped and prioritized so only one annunciation is active. Annunciations prioritized in this manner are as follows (higher in list = higher priority).

In addition, flags are decluttered from all IDUs, which are not “transmit enabled.” Flags only appear on these IDUs if they are IDU-specific (i.e., CHECK IDU #).

2.6 Database and Software Updates

2.6.1 Navigation and Obstruction Databases

The EFIS uses Jeppesen Sanderson NavData® for the navigation database and Jeppesen Sanderson obstacle data for the obstruction database.

Visit www.jeppesen.com to place the order for the correct database.

NOTE:

When ordering, review the EFIS Equipment-Database Compatibility Matrix (document 01-000062) on the Genesys Aerosystems website. This document specifies the compatibility of Genesys Aerosystems EFIS equipment and software versions to navigation database versions.

Three available coverage areas of navigation databases may be used on this EFIS:

Americas - Major airports and navigation for Alaska, Canada, Continental U.S., Hawaii, Puerto Rico, Bahamas, Bermuda, Mexico, Central, and South America.

International - All available coverage except North and South America.

World - Major airports and navigation with the Americas.

The updateable navigation database contains 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 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.

The obstruction database is distributed by a government agency in each country. Not all countries have obstruction databases available.

2.6.2 Update Requirements

Scheduled updates for databases are as follows:

1) Navigation Database - Every 28 days

2) Obstruction Database - Every 28 days

3) MAGVAR Database - Every 5 years (updated as described in a Genesys Aerosystems Service Bulletin)

CAUTION:

Failure to update the EFIS with the correct NavData® causes the IDU to remain in continual reboot mode and does not allow any display page to appear.

The EFIS is updated through the ground maintenance function (GMF). To gain access to the GMF, prior to applying power, slide the slip indicator or non-slip blank door cover at the bottom-center of the IDU bezel upward to the first detent position to expose the USB port.

When an update is performed, the following procedures must be performed separately on every IDU installed in the aircraft.

To update the databases:

1) Load the navigation database (navdata.exe) and obstruction database (obst.exe) on USB flash drive.

2) With the power off insert the USB flash drive into USB port.

CAUTION:

Always install a valid USB flash drive in the IDU prior to activating any ground maintenance function. Operation of the GMF without a valid USB flash drive installed may cause erroneous failure indications or corruption of the IDU.

3) Turn on power to gain access to the GMF page.

4) Scroll ❶ to **Update Databases** and push to enter.

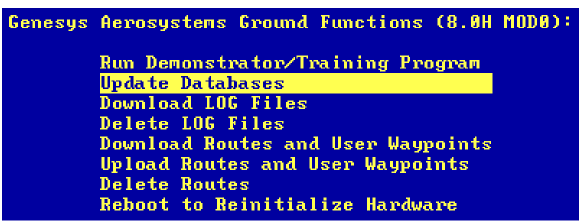


Figure 2-14: Ground Maintenance Page

5) Once each database is loaded, press any button to continue to complete the process.

6) Once both databases have been uploaded, power down the IDU, remove the USB flash drive, and lower the USB door.

7) Once each IDU has been updated, power up the entire EFIS in normal flight mode and verify each IDU successfully updated with the latest database by noting the new navigation database and obstruction database cycle expiration dates before acknowledging the initialization screen (Figure 2-4). Because the obstruction database is advisory in nature, there technically is no expiration date. The listed date is the effective date of the next available obstruction database.

8) A cyclic redundancy check (CRC) self-test verifies the data at every step of the process, thereby ensuring the data installed into the system has not been corrupted at any point during the process.

2.6.3 Software and Terrain Database Update

Updates and terrain database updates are provided on an as-needed basis and performed as per a service bulletin.

2.7 Run Demonstrator /Training Program

The EFIS has a built-in demonstration application to fly anywhere in the world while performing any procedure (except takeoff and landing) based on the current navigation database. Use this feature on the ground in ground mode as follows:

1) With power off, lift the USB flash drive door.

2) Power on the system. Scroll ❶ to **RUN DEMONSTRATOR/ TRAINING PROGRAM** and push to enter.

Use the demonstrator to gain familiarity of the EFIS menu structure and location of button tiles for each operation. Load an instrument procedure prior to take off to view the expected sequence of events.

The demonstrator begins flying over Reno, Nevada, USA at an altitude of approximately 8000’ MSL. Altitude may be changed with altitude bug, VNAV profiles or navigation database procedures. Airspeed remains relatively constant but may be controlled with the airspeed IAS bug in the BUGS menu. The simulated aircraft may be positioned anywhere in the world, by activating a flight plan stored in the memory.

All appropriate navigation signals are simulated, allowing for precision and non-precision instrument approaches found within the current navigation database. All obstructions in the latest obstruction database and all time-critical warning, caution, and advisory audible and flag annunciations are presented as appropriate during simulated flights.

NOTE:

When operating in Demonstrator mode, the IDU is isolated from all sensors and other IDUs. Flight plans created on an IDU are stored on that IDU alone. To make the flight plan available on all other displays, the following action must be taken.

1) While in flight mode, activate the flight plan created in the demonstrator mode.

2) With crossfill enabled (in two sided systems), view active flight plan on any other IDU and press **SAVE (L1)** to save this flight plan on all displays.

2.8 EFIS Training Tool

In addition to the demonstrator program, the EFIS Training Tool (ETT) is available to load on a personal computer. The ETT 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. See user guide distributed with the ETT installer for further details.

2.9 Application Software Air Mode and Ground Mode

Numerous symbology elements change behavior depending upon whether the aircraft is on the ground (ground mode) or in flight (air mode). Mode is determined separately from the system initialization modes. This parameter is continuously calculated as follows:

1) With a weight on wheels/weight on ground discrete input configured, air or ground mode is determined solely from the discrete input position.

2) Otherwise, mode is determined as follows:

    a) If airspeed is valid and AGL altitude is valid, ground mode is set when indicated airspeed is less than 30 knots, and AGL altitude is less than 75 feet.

    b) If airspeed is invalid but AGL altitude is valid, ground mode is set when AGL altitude is less than 75 feet.

    c) Under any other circumstance, air mode is set by default.

Section 3 Display Symbology

3.1. Introduction

This section details the symbology on the pilot and co-pilot PFD and MFD. This section only describes the PFD configured with the airspeed scale digital configuration set to tapes with both "pure" and "rolling" digital configurations.

3.1.1. PFD (PFI) Symbology

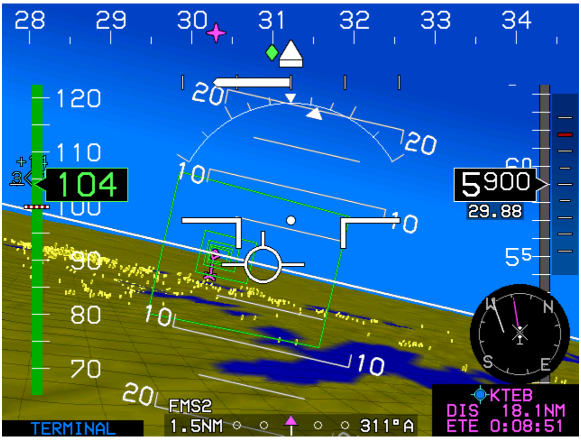


Figure 3-1: PFD, Pure Digital Configuration

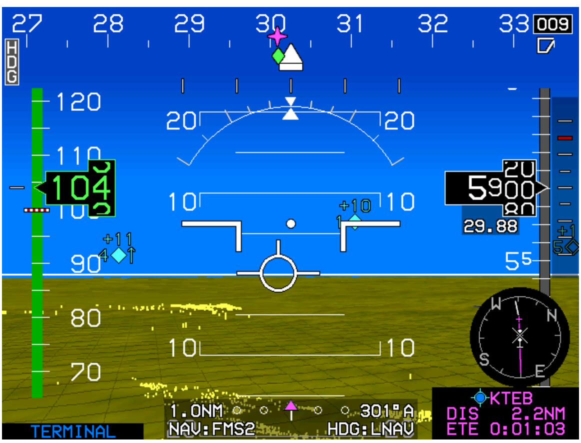


Figure 3-2: PFD, Rolling Digital Configuration

3.1.2. Basic Mode

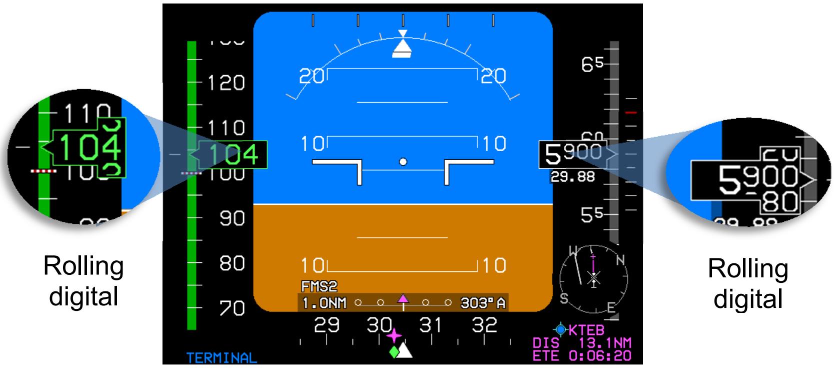
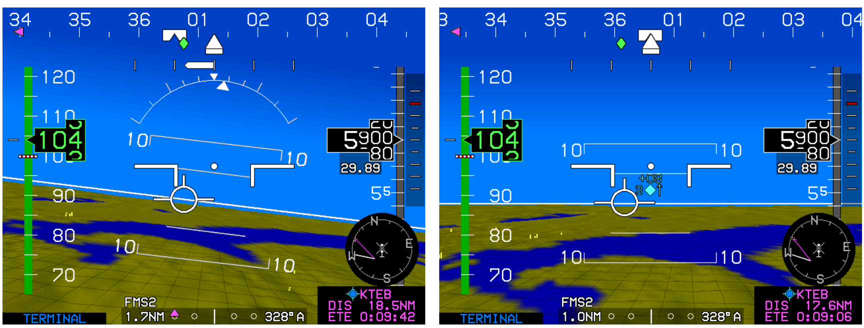


Figure 3-3: PFD in Basic Mode Pure and Rolling Digital

The following are no longer present when Basic mode is displayed:

1) Atmospheric perspective
2) Terrain rendering
3) Obstructions rendering
4) Flight path marker
5) Roll pointer option
6) Bank scale option
7) Airport runways



With Bank Scale **Without Bank Scale**

Figure 3-4: PFD Bank Scale

3.2. Menu Functions

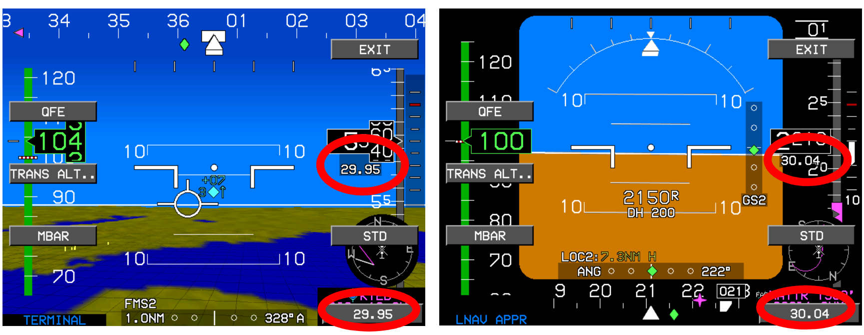
The top-level menu level corresponds to the permanent IDU pushbutton labels and is active when no soft menu tiles appear next to the appropriate IDU button or encoder (❶).

Figure 3-5: Menu Functions

On the PFD, scroll ❶ to activate the heading menu. On MFD pages with an adjustable display (e.g., ND, strikes, traffic, or datalink), scroll ❶ CW to increase scale or CCW to decrease scale.

Selection lists too long to be presented in the available space indicate the location within the list. When the menu system is beyond the top-level, **EXIT (R1)** escapes to the top-level. When a menu level is deeper than the first level, **BACK (L1)** regresses one level through the menu system.

3.2.1. Altitude Display and Altimeter Setting



Synthetic Vision **Basic Mode**

Figure 3-6: Altimeter Setting

Press **BARO (R2)** to enter altimeter setting mode and view the altimeter setting in inches of mercury (inHg) or millibars (mbar) value in the lower right corner. Scroll ➊ CW to increase or CCW to decrease the QNH. Push ➊ to enter the new value. The altimeter setting is immediately below the altitude readout box and digitally displays the altimeter setting in either inches of mercury (inHg) or millibars (mbar) according to the pilot-selected units.

When QFE altimeter setting is selected, QFE is annunciated immediately below the altimeter setting. When QNH altimeter setting is selected, no mode is annunciated below the altimeter setting

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.

Synthetic Vision - QNH

Basic Mode - QNH

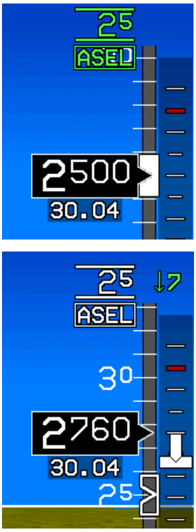
Synthetic Vision - QFE

Basic Mode - QFE

Figure 3-7: Altimeter Setting

3.2.2. Selected Altitude Sub-Mode (Target Altitude)

When in selected altitude sub-mode, the altitude scale has a pilot-settable target altitude bug geometrically interacting with the altitude box pointer. The target altitude bug value has a resolution of 100 ft., and a range from -1000 ft. to 20,000 ft.



When in altitude hold mode, the target altitude bug setting annunciation is green, while the target altitude bug is filled-white.

When in a climb or descent mode, the target altitude bug setting annunciation is white, and the target altitude bug is hollow-white.

During altitude hold capture, the target altitude bug setting annunciation is green and flashes, while the target altitude bug is filled-white.

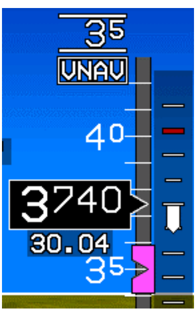
Figure 3-8: Target Altitude Bug (Vertically Integrated)

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

Figure 3-9: Target Altitude Bug (Not Vertically Integrated)

3.2.3. VNAV Sub-Mode

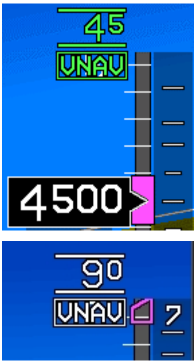
When in VNAV sub-mode, the altitude scale shows the active waypoint VNAV altitude (if it exists) with a bug symbol geometrically interacting with the altitude box pointer. The VNAV altitude bug setting is annunciated above the altitude scale with a resolution of 100 feet.



When not vertically integrated with a fully integrated digital autopilot, the VNAV altitude bug setting annunciation includes “VNAV” indicating VNAV altitude sub-mode. When vertically integrated with a fully integrated digital autopilot, this legend is not needed, because an equivalent indication appears in the autopilot mode annunciation area.

Figure 3-10: VNAV Sub-Mode (Not Vertically Integrated)

The VNAV altitude bug is a visual reference or, when vertically integrated with an autopilot either fully or partially integrated through the vertical mode discrete input, as a control parameter for climbs or descents.



When vertically integrated with an autopilot:

When in altitude hold mode, the VNAV altitude bug setting annunciation is green, and the VNAV altitude bug is filled-magenta. During altitude hold capture, VNAV altitude bug setting annunciation is green and flashes, while the VNAV altitude bug is filled-magenta.

When in a climb or descent mode, the VNAV altitude bug setting annunciation is white, and the VNAV altitude bug is hollow-magenta.

Figure 3-11: VNAV Sub-Mode (Vertically Integrated)

When the VNAV altitude or target altitude differs from aircraft altitude to the extent the associated bug is off-scale, the associated bug is "parked" in the direction of the difference with half of the associated bug visible as in Figure 3-11.

3.2.4. Altitude Display (VNAV Tile)

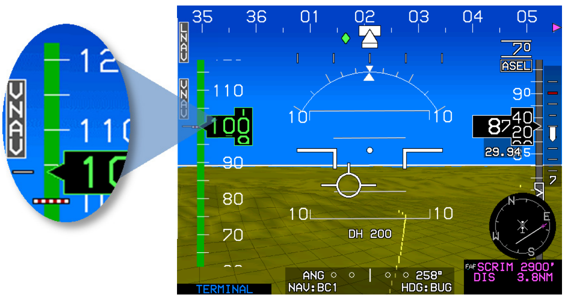
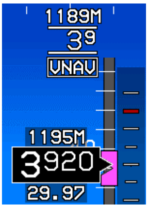


Figure 3-12: Altitude Display (VNAV Tile)

When enabled for performing VNAV with a manually selected altitude entered, **VNAV (L2)** appears.

3.2.5. Altitude Display (Metric Units)



Pilot-selectable altitude values are in metric units with a resolution of 10 meters as depicted.

Figure 3-13: Altitude Display (Metric Units)

3.3. PFD Symbology

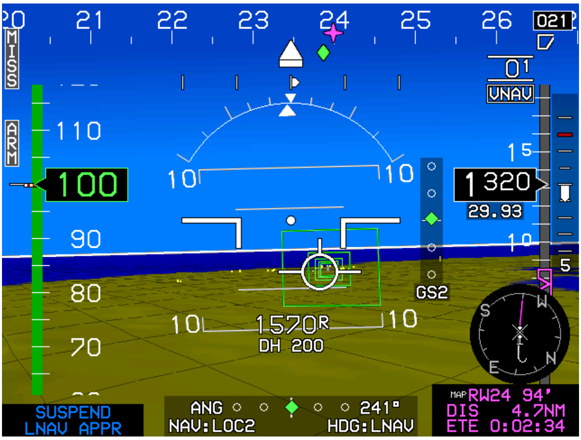


Figure 3-14: PFD Symbology

The PFD combines pitot-static information, heading, attitude, 3-D navigation data, and more overlaid on a virtual background of the outside world. Other objects in the background, including terrain, obstructions, traffic, and runways are presented conformally as if seen directly in front of the aircraft while looking outside.

3.3.1. Minimum Altitude

A user-settable minimum altitude bug consists of a bold yellow line on the altitude scale and a yellow region on the altitude scale from the minimum altitude down to ground level. The minimum altitude bug value is displayed above the altitude scale with a resolution of 10 ft. The minimum altitude bug can be used in conjunction with a selected altitude or VNAV bug. When a minimum altitude is set, descending from above to below causes the “Minimums, Minimums” audible alert and the minimum altitude to turn amber (yellow) and flash.

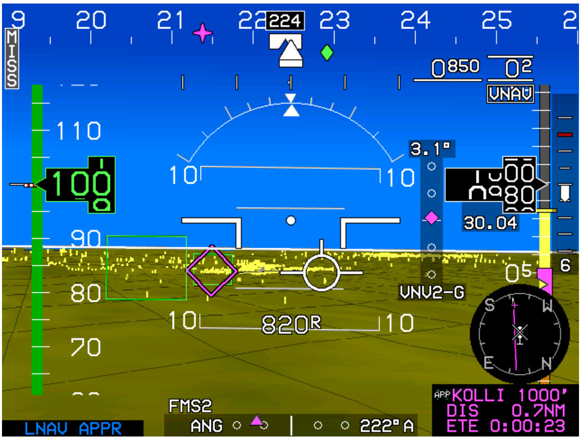


Figure 3-15: Minimum Altitude

3.3.2. Vertical Speed Indicator

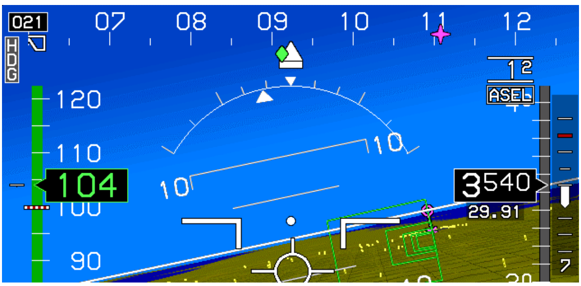
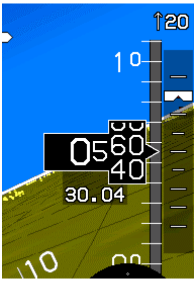


Figure 3-16: VSI

The vertical speed indicator (VSI) is depicted in a "worm" format providing analog and digital representation of VSI in feet per minute (fpm). For example, rate of descent in Figure 3-16 is 700 fpm.

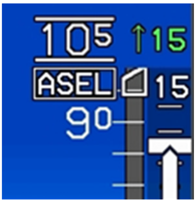
Table 3-1: Scale Graduations and Display

Traffic Installed	Scale Limit	Scale Graduations and Display
With TCAS-II	±2,000 fpm	±500, ±1,000, and ±2,000 Background of VSI functions as an RA display with green and red regions to provide RA maneuver guidance.
Without TCAS-II		±500, ±1,000, and ±2,000 fpm



The pilot-selectable VSI bug setting (100 fpm resolution) in this example is set to 1000 fpm descent rate. The vertical speed bug is 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. It is mutually exclusive with the airspeed bug.

Figure 3-17: VSI Bug



When vertically integrated with an autopilot, the VSI bug-setting annunciation is green with the speed bug filled-white when in VSI climb or descent mode. Otherwise, the VSI bug setting is white, and VSI bug is hollow-white.

Figure 3-18: VSI Bug (Vertically Integrated)

When not vertically integrated with an autopilot, the VSI bug setting annunciation is white, and the vertical speed bug is filled-white at all times.

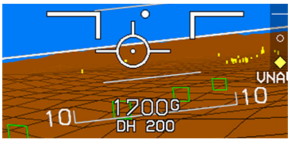
3.3.3. Normal AGL Indication

AGL altitude is displayed in two formats above the course deviation indicator (normal) and as the (analog) AGL indicator. These are mutually exclusive of each other and driven by the AGL altitude source used for TAWS but not displayed when the source is invalid. Source indication designates the source for either format as follows:

R = Radar altitude

G = GPS/SBAS geodetic height less database ground elevation

B = Barometric altitude less database ground elevation



(SVS Basic) AGL
Based on GPS Altitude

(SVS TAWS) AGL
Based on Radar Altimeter

Figure 3-19: Normal AGL Indication

AGL altitude is not displayed in either format when it is greater than the radar altimeter maximum valid altitude nor when it is invalid. Additionally, the AGL indication includes the set decision height (see § 3.3.5).

Table 3-2: AGL Indication

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

3.3.4. Analog AGL Indication

Pilot-selected analog AGL indication is displayed in the lower right corner of the PFD above the active waypoint identifier with a green circular tape and digital readout in the center. The circular tape has a radial line at its end and disappears above 1000' AGL.

Figure 3-20: Analog AGL Indication

The analog AGL indicator disappears in unusual attitude mode and is mutually exclusive with the mini map and traffic thumbnail. Likewise, when the analog AGL altitude display is shown, the normal AGL display is removed.

Table 3-3: Analog AGL Indicator

Analog AGL Indicator Markings 0-1000 Feet		**AGL**	**Scaling (at clock position)**
0-100 Feet	100 Feet-1000 Feet	0'	6:00
Linear	Logarithmic	50'	9:00
		100'	12:00
		200'	1:30
		500'	3:00

Table 3-4: Analog AGL Indicator Markings

	Major Tick Marks	**Minor Tick Marks**
0'	✓	
10'		✓
20'		✓
30'		✓
40'		✓

Table 3-4: Analog AGL Indicator Markings

	Major Tick Marks	Minor Tick Marks
50’	✓	
60’		✓
70’		✓
80’		✓
90’		✓
100’	✓	
200’		✓
300’		✓
400’		✓
500’	✓	
1000’	✓	

3.3.5. Decision Height

Pilot-settable decision height is displayed above the CDI with the abbreviation DH and by a yellow radial on the analog indicator. When the aircraft descends below decision height, **DH ###** turns amber (yellow) and flashes and the circular tape turns amber (yellow). This is accompanied by “Decision Height” audible alert.

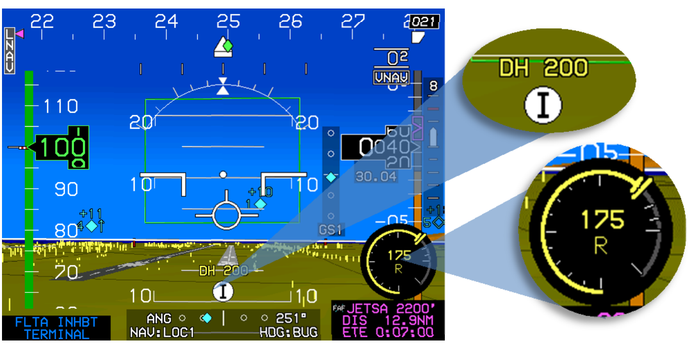
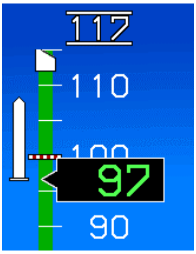


Figure 3-21: Decision Height

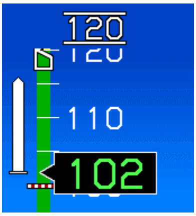
3.3.6. Airspeed Display

Airspeed is digitally displayed in same color as airspeed scale in knots, miles, or kilometers per hour with interactive pointer. The airspeed scale is commensurate with the certification category of the aircraft.



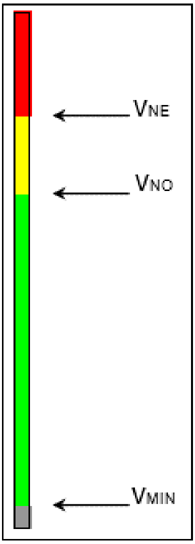
The airspeed box pointer interacts with the airspeed scale and has graduations every five measurement units with labels every 10 measurement units with high numbers at the top. The airspeed scale range has at least 40-75 measurement units. During an ADC failure, a red "X" is displayed in place of the airspeed scale.

Figure 3-22: Airspeed Display



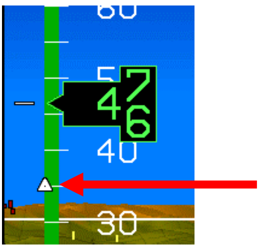
The airspeed trend vector is calculated along the rotorcraft longitudinal axis is in a worm format to provide analog representation of IAS achieved in five seconds assuming the instantaneous longitudinal acceleration is maintained.

Figure 3-23: Airspeed Trend



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

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



If enabled, a white triangle translational lift reference speed marker appears.

Figure 3-24: Airspeed Scale FAR Part 27/29

Table 3-5: Airspeed Bug Limits	
Low end	**High end**
VMIN	Red-line (**VNE**)

The pilot-settable airspeed bug geometrically interacts with the airspeed box pointer and is colored as per Table 3-6. When the bug setting differs from aircraft speed to the extent the bug is off scale, the bug appears to be parked.

Airspeed bug is parked in the direction of the difference if airspeed off scale.

Figure 3-25: Airspeed Scale Bug

Table 3-6: Airspeed Bug Setting Annunciation and Bug Colors		
	Vertically Integrated Autopilot	
	Without	**Without**
Airspeed Bug Setting	White at all times	Green when in airspeed climb or descent mode otherwise white
Airspeed Bug	Filled-white at all times	Filled-white when in airspeed climb or descent mode otherwise hollow-white

3.3.7. Airspeed Display (With EFIS-Coupled)

Airspeed descent to 1,900' with green color and filled airspeed

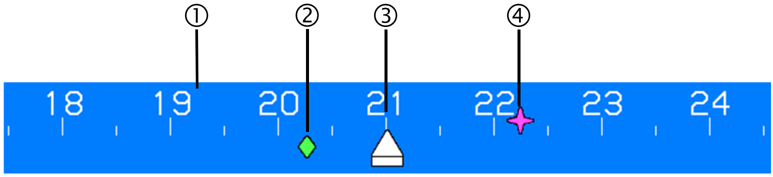
Figure 3-26: Airspeed Display (with EFIS-Coupled)

When the ADC sensor fails, a black circle with red "X" is shown instead of the airspeed readout, dial and pointer.

3.3.8. Heading Display

NOTE:

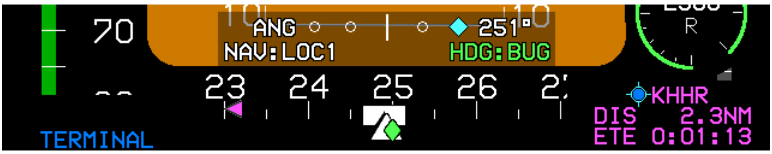
The track pointer is not displayed when indicated airspeed is in the noise range (indicated airspeed or groundspeed is less than 30 knots).



① Heading Scale ③ Heading Pointer

② Ground Track ④ Active Waypoint

Synthetic Vision



Basic Mode

Figure 3-27: Heading Display

An integral 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. The integral slip indicator is responsive to lateral (Y-axis) G-force (the slip indicator is the white rectangular part of the heading pointer) and is damped, so it approximately matches a conventional glass vial indicator.

When the AHRS is in DG mode, the DG symbol appears as shown here.

Figure 3-28: DG Indicated when AHRS in DG Mode

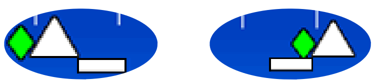


Figure 3-29: Slip/Skid Indicator

Figure 3-30: Displaced Heading Bug

When an active waypoint exists, the heading scale includes a magenta, star-shaped waypoint pointer at a point corresponding with the active waypoint. When the waypoint pointer is displaced from aircraft heading beyond the boundaries of the PFD screen, the waypoint pointer is replaced by a magenta, triangular arrow at either the far-right or far-left limit of the heading scale to indicate the shortest (not necessarily the safest) direction of turn to the active waypoint (Figure 3-30). The waypoint pointer and shortest direction of turn indications turn amber (yellow) in the event of GPS loss of navigation (LON) caution.

Table 3-7: Heading Display

	Track pointer off scale when aircraft track is displaced from boundaries.
	When changed, heading bug value displayed for 5 seconds
	When heading bug is displaced beyond boundaries of heading scale, partial heading bug is shown at the limit of the heading scale with the heading bug value above.

3.3.9. Pitch Scale

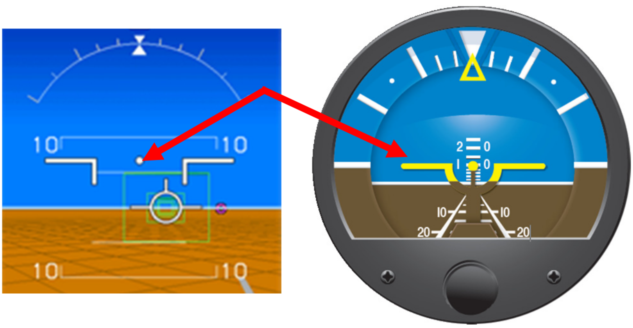


Figure 3-31: Pitch Scale

The PFD has large aircraft symbol reference marks fixed in the center of the display. Rotation of the background, pitch scale, and background oriented display elements occur relative to the location of the waterline symbol or large aircraft reference marks.

Pitch scale has increments every 5° with major increments and pitch scale labels every 10°. Increments are equally spaced to conform approximately to the 3-D PFD background. Pointer bars at the ends of each major increment indicate direction to the horizon and automatically declutter to present the fewest possible increments needed to unambiguously display pitch attitude. The pitch scale terminates with a zenith symbol (small white circle) at +90° and a nadir symbol (small white circle with "+") at -90°.

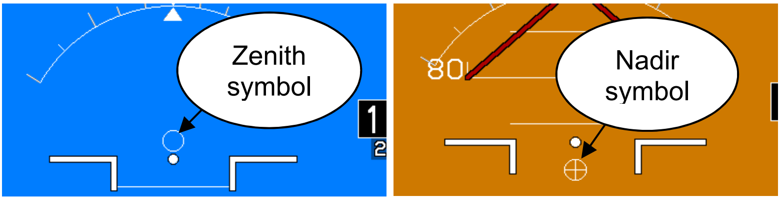


Figure 3-32: Pitch Scale Zenith and Nadir Symbols

3.3.10. Turn Rate Indicator

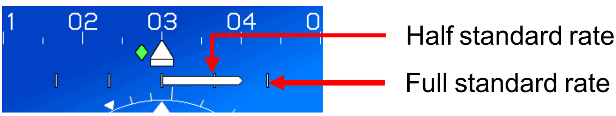


Figure 3-33: Turn Rate Indicator

3.3.11. Landing Gear Indication

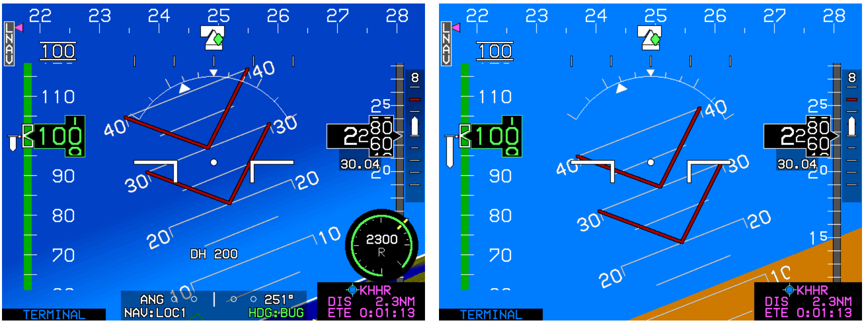
If configured, the PFD displays landing gear position as small "tires" below large aircraft symbol reference marks.

Basic Mode **Normal Mode**

Figure 3-34: Landing Gear Indication

3.3.12. Unusual Attitude Mode

Unusual attitude mode is enabled when pitch attitude exceeds +30° or -30° or bank angle exceeds 50° and remains engaged until pitch attitude returns to within 5° of the horizon and bank attitude returns to within 10° of the horizon. Recovery chevrons tied to the 30° and higher pitch scale indications (both positive and negative) aid in unusual attitude recovery and are a normal part of the pitch scale and are not necessarily tied to unusual attitude mode.



Less than 30° pitch up **More than 30° pitch up**

Figure 3-35: Unusual Attitude Mode

The following features are disabled in unusual attitude mode:

1) Terrain and obstruction rendering
2) CDI
3) VDI
4) Flight path marker
5) Highway in the Sky boxes
6) Atmospheric perspective
7) Analog and digital AGL indication
8) Active waypoint symbology
9) Mini map
10) Traffic thumbnail
11) If in basic mode, PFD reverts to normal mode
12) If in zoom mode FOV, PFD reverts to normal FOV
13) Runways
14) Menus

3.3.13. PFD Background

The PFD has a 3-D background generated from terrain elevation and obstruction elevation data stored in electronic memory. The “actual horizon” displayed on the PFD is based upon the higher of terrain within 90NM or a horizon calculated using a visible horizon equation. Thus, the relative elevation of terrain and obstructions with respect to aircraft altitude and performance is observed by reference to the primary flight information pitch ladder and FPM.

The background has two pilot-selectable field of view (FOV) modes, wide FOV mode (approximately 70°) and narrow FOV mode (approximately 35°). In unusual attitude mode, wide FOV mode is automatically selected.

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.

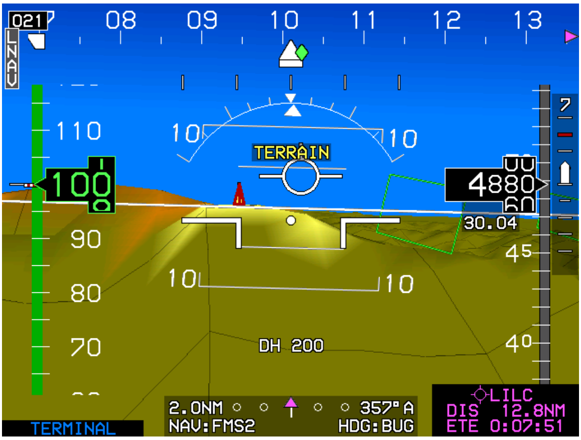


Figure 3-36: PFD Terrain and Obstructions

Terrain and obstruction rendering uses hidden surface removal technique s, while terrain/sky rendering uses atmospheric perspective techniques. Terrain with obstruction rendering is collectively pilot-selectable to declutter the display (***independent declutter of obstructions is not possible***). Terrain and obstruction rendering is disabled in basic mode, unusual attitude mode, and during any reversionary mode. In unusual attitude mode, the blue -brown boundary line of the background decouples from the pitch scale at high pitch angles so a sliver of the blue-brown boundary line always remains visible to give guidance to the horizon.

Terrain ahead of the aircraft is shown conformally with the artificial horizon in the correct scale and perspective for the aircraft's current position and altitude. Worldwide terrain coverage is provided in each IDU and is shown with a resolution as shown in Table 3-8. Terrain is displayed ahead of the aircraft using a grid and simulates "atmospheric perspective" (terrain lines fade into the background "ground" color as they recede into the distance).

NOTE:

There is a one-degree dead band to prevent grid flicker while flying along one of the boundary latitudes. The grid space switching changes at one degree less latitude when flying towards the Equator than it does when flying toward the Poles.

At latitudes greater than 75°, no grid lines are shown. To keep the grid spacing relatively consistent, at latitudes between 45° and 75°, the longitude spacing is increased according as follows.

Table 3-8: LAT-LON Resolution Boundaries

Latitude Range	Longitude Grid Spacing	Heading Boundary	
		Pole	Equator
0° to 46°	24 arc-seconds		
46° to 62°	48 arc-seconds	46°	45°
62° to 70°	72 arc-seconds	62°	61°
70° to 74°	96 arc-seconds	70°	69°
74° to 75°	120 arc-seconds	74°	73°

Table 3-9: Terrain and Obstruction Rendering Levels

Feature	Coloring	Notes
SVS BASIC	Shades of brown for non-water terrain.	Amber and red colors not used for normal display of terrain. Deep blue denotes areas of water and takes precedence over the shades of brown.
SVS TAWS	Shades of olive when at or below 100 ft. below aircraft altitude. Shades of brown when above 100 feet than aircraft altitude. TAWS coloring of FLTA alert or warning cells.	Amber and red colors used for normal display of terrain and to show terrain areas causing FLTA alerts. Deep blue denotes areas of water and takes precedence over other colors.
None	No terrain nor obstructions are shown. Neither, **SVS BASIC** or **SVS TAWS** is selected.	

WARNING:

DO NOT USE THIS EFIS FOR TERRAIN-FOLLOWING FLIGHT. DO NOT ATTEMPT TO NAVIGATE USING THE TERRAIN DEPICTION. ALWAYS ADHERE TO PUBLISHED NAVIGATIONAL INSTRUMENT PROCEDURES AND NAVIGATIONAL CHARTS IN ALL FLIGHT CONDITIONS.

When terrain and obstruction rendering is deselected or disabled, the PFD background is a conventional blue over brown attitude display presentation without atmospheric perspective. Additionally, terrain may be deselected on the PFD and retained on the ND MAP page as seen in Figure 3-37.

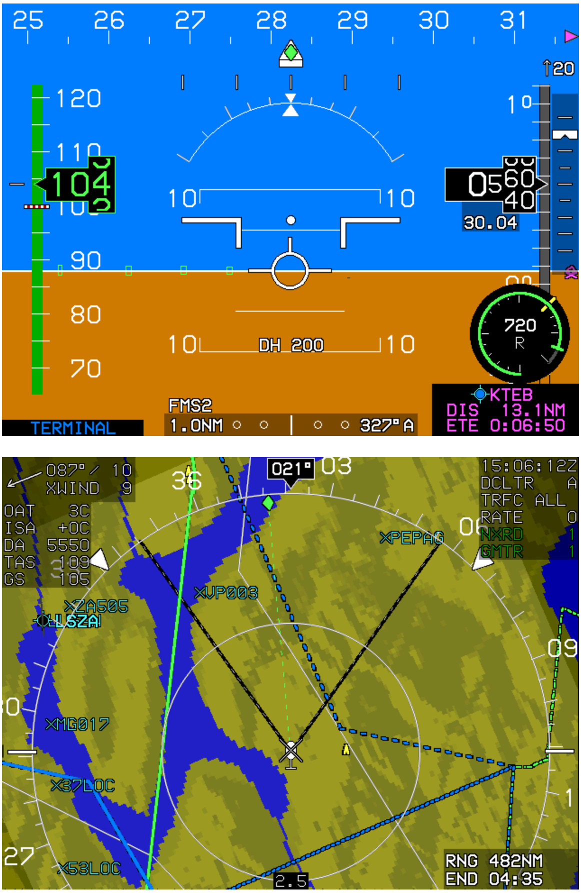


Figure 3-37: Terrain Deselected on PFD but Selected on MFD

Obstructions within the following ranges are depicted on the PFD in SVS Basic or SVS TAWS modes:

1) Narrow FOV: 17NM

2) Wide FOV: 12NM

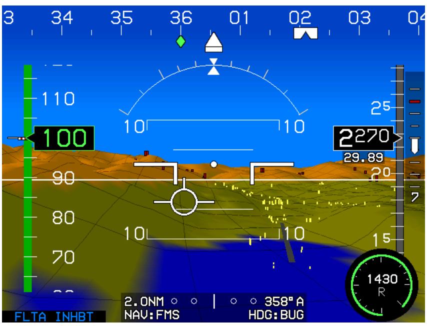
Obstructions such as towers, antennas, buildings, and other manmade structures are shown on the PFD display as vertical amber (yellow) lines (see Figure 3-38). They are conformal in location and size and only shown in conjunction with terrain regardless of altitude. Obstructions representing a collision hazard are annunciated aurally and with a caution or warning flag. See Section 2 System Overview for description of alerts when obstructions represent a collision hazard.

WARNING:

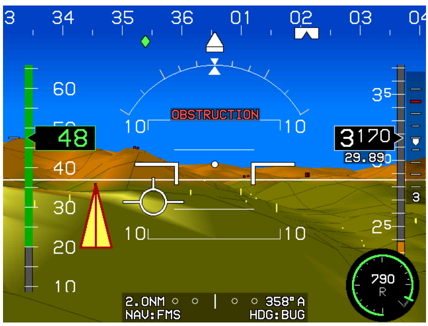
MANY TOWERS, ANTENNAS, STRUCTURES, AND OBSTRUCTIONS ARE NOT IN THE DATABASE.

NOTE:

The obstruction data is provided by Jeppesen and must be updated each 28 days to maintain current database information.



Obstructions without Hazardous Condition



Obstructions Creating an OBSTRUCTION Warning

Figure 3-38: PFD with Obstructions

3.3.14. Flight Path Marker (Velocity Vector)

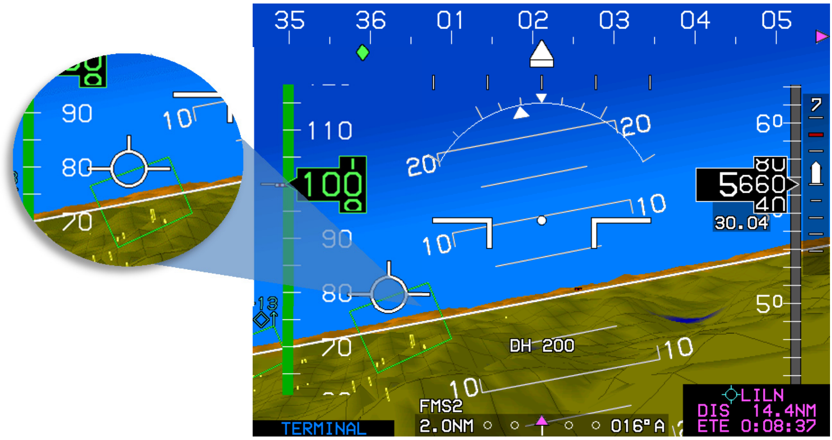
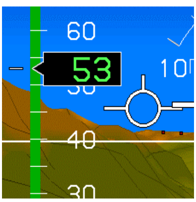


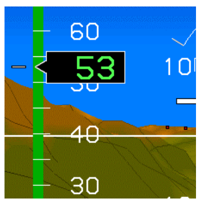
Figure 3-39: Flight Path Marker

The FPM appears on the background to coincide with the aircraft's actual flight path as projected on the outside world. The FPM is 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 is vertically displaced perpendicular to the horizon to account for aircraft climb or descent angle.

Because the FPM is used in conjunction with a 3-D background, the FPM utility normally associated with a HUD is achieved. When the FPM is displaced to the extent it interferes with heading, altitude, or airspeed indications, it is removed from the display as in Figure 3-40.



FPM nearing airspeed tape due to strong crosswind from the right



FPM removed due to excessive crosswinds from the right

Figure 3-40: Flight Path Marker Views

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

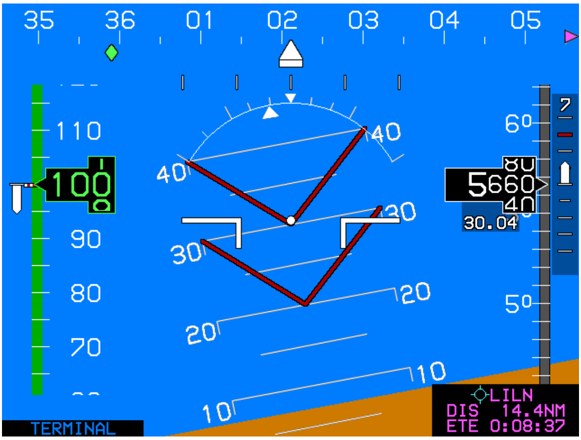


Figure 3-41: FPM Absent (Unusual Attitude Mode)

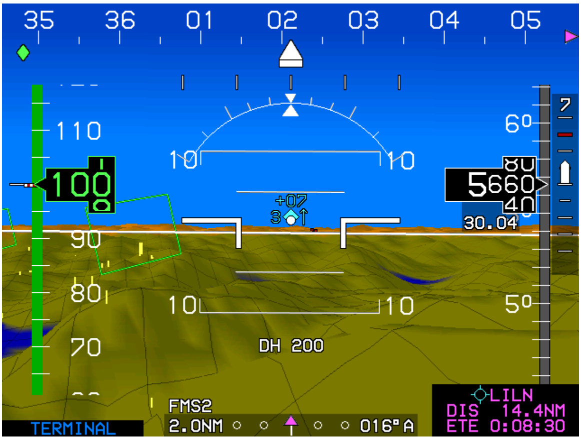


Figure 3-42: PFD with FPM Removed

The FPM is not shown in basic mode. In unusual attitude mode, it disappears to allow the pilot to concentrate on the large aircraft symbol reference marks for unusual attitude recovery.

FPM at low speed (airspeed <= 45 KIAS) behavior further depends upon whether or not the aircraft is in flight or on the ground and whether or not a WOW/WOG discrete input is enabled.

In reversionary mode 1 (GPS failure), the FPM changes to a light gray color after one minute to indicate degraded performance (Figure 3-43).

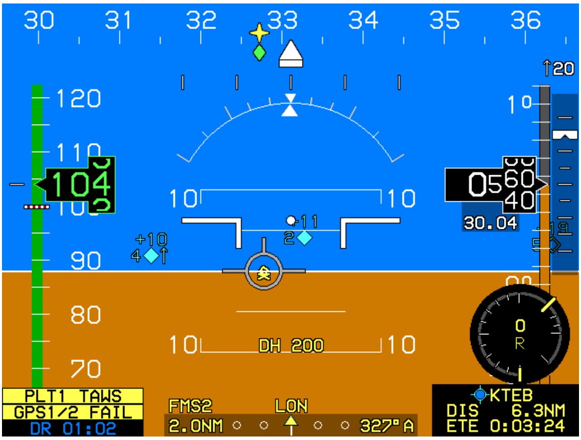
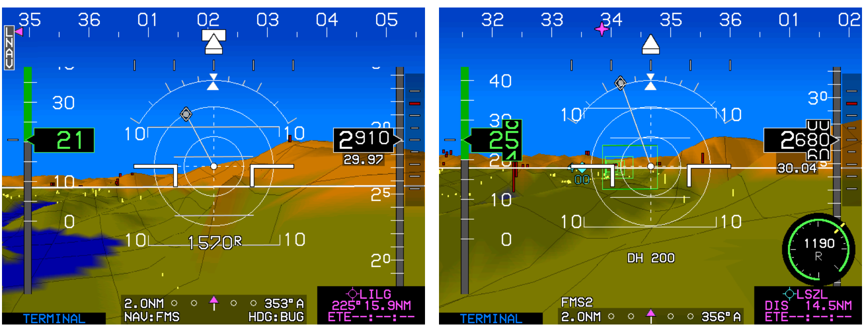


Figure 3-43: PFD with GPS Failure after 1 Minute

3.3.15. Hover Vector

The FPM is removed at low speed, <30 knots groundspeed, and is replaced with hover vector symbology. The hover vector indicates direction and groundspeed of drift at low groundspeeds (when lower than 30 kts) consisting 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. The white dot of the large aircraft symbol reference marks indicates 0 knots groundspeed and is the center for the concentric rings. A gray 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.



AGL Indicator (Normal) AGL Indicator (Analog)

Figure 3-44: PFD Hover Vector Symbology

A diamond-shaped acceleration cue is centered on the gray dot to indicate direction and magnitude of horizontal acceleration. 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 in that direction. The movement of the dot is constrained to less than five knots per second to prevent jumpiness. The example above shows drift, forward and slightly to the right (1 o'clock position) at 20 knots groundspeed. (See § 3.7.2 for full hover vector symbology with Hover page selected on MFD.)

NOTE:

In the event the bank scale was decluttered, it becomes uncluttered while at low speed <30 knots groundspeed.

3.3.16. Bank Angle Scale

The bank scale and roll pointer are centered upon the large aircraft symbol reference marks in basic or unusual attitude modes. When bank angle scale decluttering is selected, the bank angle scale and sky pointer are displayed when the bank angle exceeds 2.8°. With decluttering selected, appearance of the bank angle scale and roll pointer are dampened based upon magnitude and time to prevent nuisance appearances.

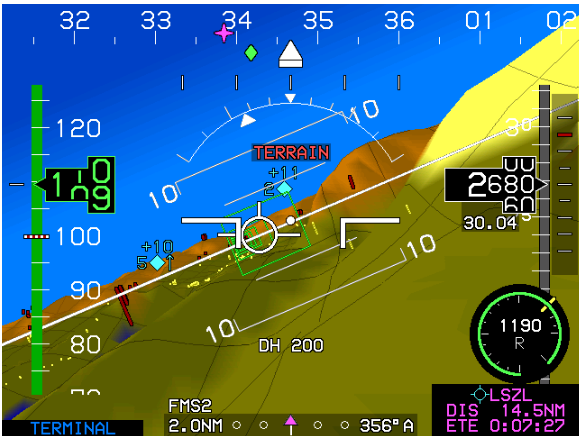
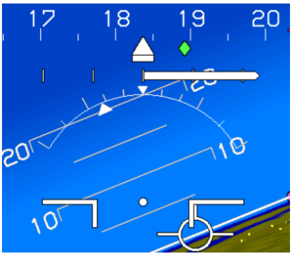


Figure 3-45: Bank Angle

When decluttering is not selected, bank angle scale and sky pointer appear full time with level, 10°, 20°, 30°, 45°, and 60° marks on left and right sides. The bank angle scale and roll pointer are centered upon the large aircraft symbol reference marks (basic mode or unusual attitude mode).

3.3.17. Turn Indication



Rate of turn is available as an option in the PFD declutter menu to show a worm in the direction of turn with full-scale deflection indicating a standard rate of turn and half-standard rate indicated at the mid-scale marking.

Figure 3-46: Turn Indicator

3.3.18. Timer Indication

When selected, a countdown or count-up timer is displayed above the FPM or large aircraft symbol reference marks.

Figure 3-47: Timer

3.3.19. Marker Beacon Symbology

Marker beacons data acquired from the navigation receiver are displayed on the PFD and disabled when the selected NAV source is FMS. Valid marker beacon signals cause circular indicators with appropriate coloring and markings to display in the lower central portion of the PFD.

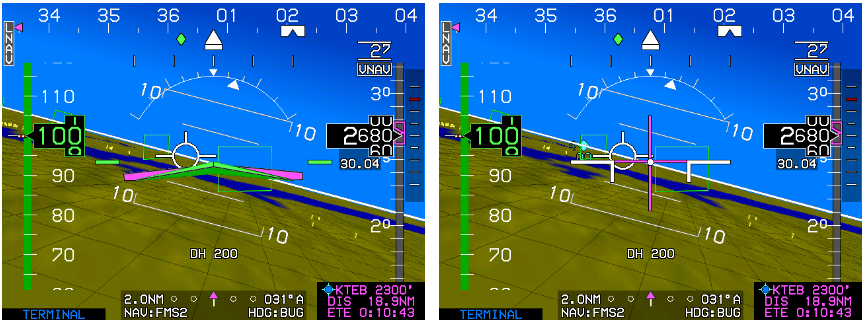
Synthetic Vision

Basic Mode

Figure 3-48: Marker Beacons

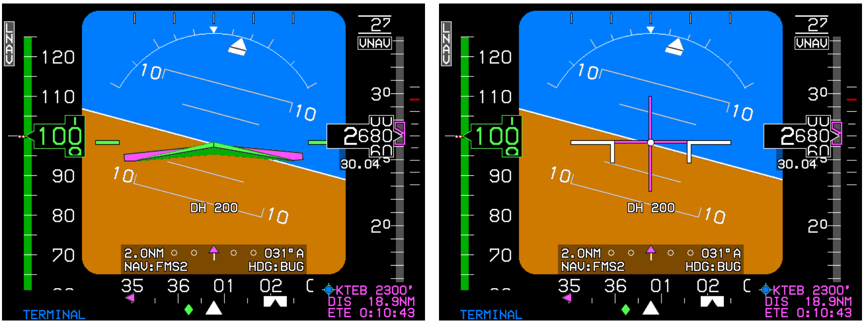
3.3.20. Flight Director Symbology

Flight director (FD) symbology is controlled on the IDU or integrated autopilot/flight director equipment. When selected, FD symbology and valid steering commands are received from the FD with one of the following symbols shown in the normal mode. The PFD has a waterline symbol fixed in the center of the display. Rotation of the background, pitch scale, and background oriented display elements occur relative to the location of the waterline symbol or large aircraft reference marks.



FD1 Single Cue FD2 Dual Cue

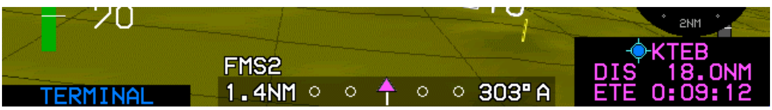
Figure 3-49: Flight Director



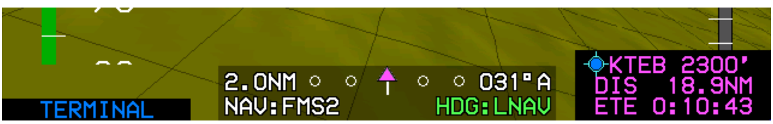
FD1 Single Cue FD2 Dual Cue

Figure 3-50: Flight Director (Basic Mode)

3.3.21. Course Deviation Indicator (CDI)



Without Autopilot



With Autopilot

Figure 3-51: Course Deviation Indicator

The order of precedence of type accuracy used by the system from highest to lowest is as follows:

1) Manual RNP: The pilot may override the automatic accuracy types by setting a manual RNP value.

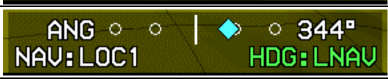
2) Automatic RNP: These are based upon RNP values, which are coded in the navigation database. The EFIS looks at the leg coding on all legs other than those on the final approach segment. On the final approach segment, the EFIS looks at the “Level of Service” record for those approaches, which have RNP transition legs, and then goes to LP or LPV minima for the final approach.

3) Default TSO-C146C operation: As specified as per Table 3-10 for enroute, terminal, and various approach modes according to the “Level of Service” record.

Table 3-10: CDI Behavior and Color

CDI Pointer and Condition	**Color or Behavior**
Full Scale Deflection	Flash
Slaved to GPS/SBAS	Scale is appropriate FSD value for mode of flight: **Enroute:** ±2NM **From Enroute to Terminal:** Change from ±2 NM FSD to ±1 NM FSD over distance of 1 NM; start transition when entering terminal mode. **From Terminal to Enroute:** Change from ±1 NM FSD to ±2 NM FSD over distance of 1 NM; start transition when entering enroute mode. **From Terminal to Approach:** 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 to Terminal:** Change to ±1 NM. **From Departure to Terminal**: If initial leg is aligned with runway, change from ±0.3 NM FSD to ±1 NM FSD at the turn initiation point

Table 3-10: CDI Behavior and Color

CDI Pointer and Condition	Color or Behavior
	of the first fix in the departure procedure.
Slaved to GPS/SBAS (with GPS loss of navigation)	Amber (Yellow)
Normal conditions	Magenta
In sources other than FMS	Angular scale annunciation
Navigation source is localizer (Course error exceeds 105°)	Reverse sensing
Lateral deviations in failed state	Red "X" displayed over CDI
EFIS not coupled with autopilot	
	Selected NAV source FMS2
	Selected NAV source VOR1
	Selected NAV source VOR2
EFIS coupled system with autopilot	
	Holding the wings level*
	Tracking HDG BUG**
	LNAV in ARM mode**
	LNAV captured**
*No positive autopilot feedback/**Positive autopilot feedback	

3.3.22. OBS Setting of CDI

In automatic mode, the system controls the scale and OBS setting. The selected navigation source is annunciated below the CDI as follows:

1) NAV: **FMS1/FMS2**

2) NAV: **VOR1/LOC1**

3) NAV: **BC1/BC2** (annunciated instead of LOC1/2 when course error exceeds 105°)

4) NAV: **VOR2/LOC2**

3.3.23. Heading/Roll-Steering Sub-Mode

Heading/roll-steering sub-mode annunciation appears immediately right of the selected navigation source annunciation and displays:

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)

3.3.24. Heading Bug Sub-Mode

The heading bug sub-mode is active when selected through the menu system and commands roll angles to track the heading bug with aircraft heading (if heading is valid) or aircraft track (if heading is invalid). Figure 3-52 shows this mode with positive feedback from the autopilot (green annunciation and filled heading bug). **LNAV (L1)** is a one-touch method for turning off the HDG bug and engaging in LNAV mode.

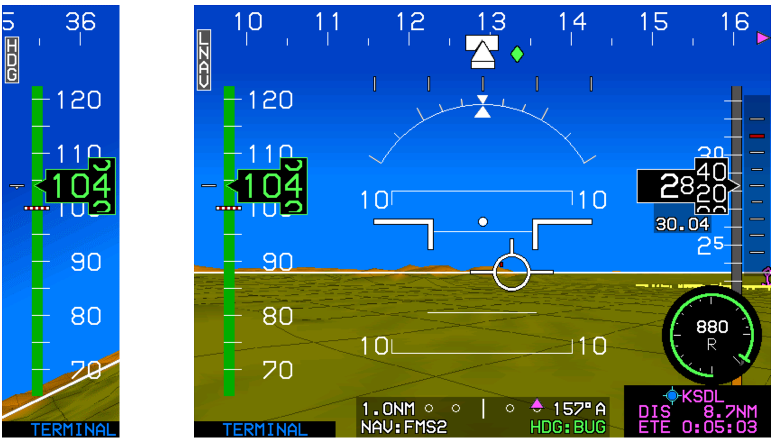


Figure 3-52: Heading Bug

Figure 3-53: LNAV Armed Mode

3.3.25. No Autopilot or Fully-Integrated Autopilot Course Deviation Indicator

Without Autopilot

With HeliSAS-E

Figure 3-54: CDI No Autopilot or Fully-Integrated Autopilot

In an installation without an autopilot or with a fully integrated autopilot (e.g., HeliSAS-E), the heading/roll-steering sub-mode annunciation is not meaningful and should be decluttered from the CDI display. Therefore, the shaded background of the CDI only falls behind the CDI scale. An abbreviated navigation source annunciation (without "NAV:") appears above the top left corner of the CDI scale. The heading/roll-steering sub-mode annunciation does not appear, as it is not required with autopilot mode annunciations or when an installation does not include an autopilot.

3.3.26. Vertical Deviation Indicator

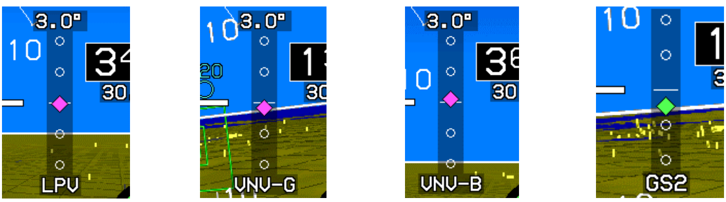


Figure 3-55: Vertical Deviation Indicator

The vertical deviation indicator (VDI) on the right side of the PFD displays vertical deviation for the selected vertical navigation source to display descent profile but disappears in unusual attitude mode.

1) **LPV Mode and LPV1 or LP V2**: When descending on the final approach segment in LPV mode. GPS altitude utilized to generate VDI ; pilot may follow guidance to LPV minima regardless of temperature.

2) **LNAV Mode and VNV1-G or VNV2-G**: When descending on the final approach segment in LP, LNAV/VNAV, and LNAV or RNP modes when

using GPS VNAV. GPS altitude utilized to generate VDI; pilot may follow guidance to LNAV minima regardless of temperature.

3) **LNAV Mode and VNV1-B or VNV2-B**: Default FMS barometric VNAV mode. Using barometric altitude to generate the VDI, pilot may follow guidance to LNAV minima as long as the specified temperature is within limits.

4) **GS1 or GS2**: Glideslope receiver #1 or #2 as indicated. Pilot follows guidance to published barometric DH.

Table 3-11: Vertical Deviation Indicator Behavior

Source (Below VDI)	Behavior/Condition	Pointer Color
FMS	Conforms to the VDI display	Magenta
Glideslope	Source must be valid when a valid glideslope is received.	Cyan
LPV or VNAV mode	Source is valid if: On VNAV descent segments when approaching the Top of Descent point so as to provide descent anticipation as long as the following are true: 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 to provide descent anticipation; Providing: 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	Magenta

Table 3-11: Vertical Deviation Indicator Behavior		
Source (Below VDI)	**Behavior/Condition**	**Pointer Color**
	wedge of the azimuth reference point (either the GARP or MAWPT + 10,000 ft.).	
LPV, VNV-G	During GPS LON or GPS VLON	Pointer and Text Color Amber (Yellow)

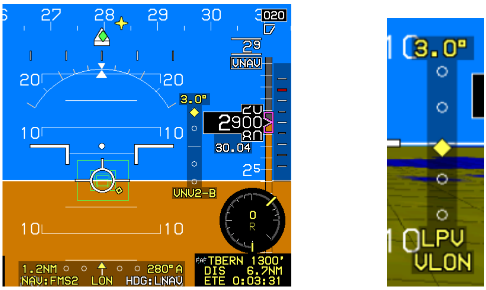


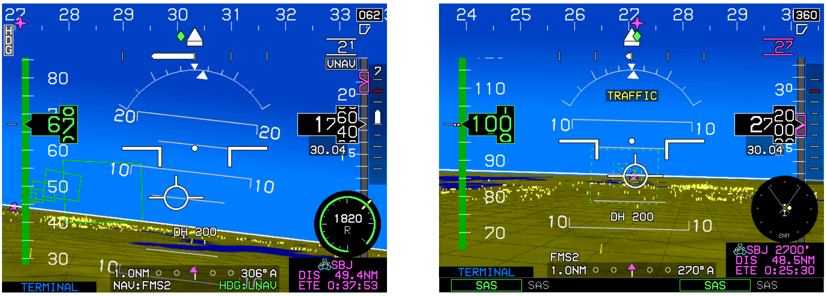
Figure 3-56: VDI Color during GPS/SBAS LON or VLON

3.3.27. Vertical Deviation Indicator (EFIS Coupled)

Figure 3-57: EFIS Coupled Vertically with Glideslope Mode Engaged

When vertically integrated with an autopilot (either fully integrated or partially integrated) through glideslope mode discrete input with glideslope mode engaged, the selected vertical navigation source is green indicating the autopilot is vertically coupled to the selected vertical navigation source. Otherwise, the selected vertical navigation source is white.

3.3.28. Highway in the Sky/Skyway



Coupled **Uncoupled**

Figure 3-58: Highway in the Sky

When not decluttered, the PFD displays the active navigation route or manual OBS course in 3-D with a series of skyway boxes, which overly the flight plan route at a desired altitude and provide lateral and vertical guidance. See Section 7 IFR Procedures for details.

3.3.29. Active Waypoint and Waypoint Identifier

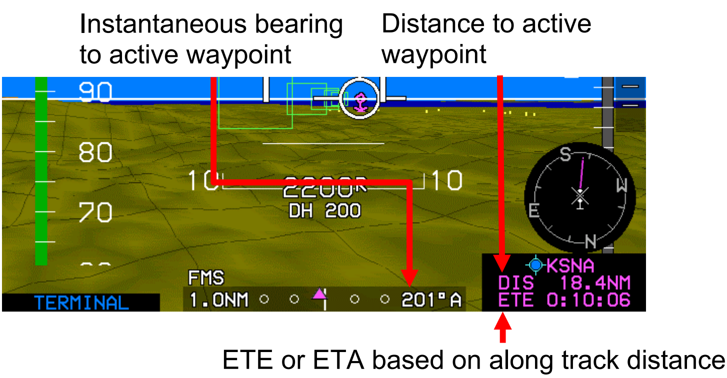


Figure 3-59: Active Waypoint

The PFD displays the active waypoint symbol as a magenta "tethered balloon" consisting of:

1) an "X" depicted at the ground location of the active waypoint;

2) a hoop or “tethered balloon” (for fly-over waypoints) or “tethered diamond” (for fly-by waypoints) depicted at the VNAV altitude or at aircraft altitude (if there is no VNAV altitude), and

3) a line connecting the “X” and the hoop.

The “X” and connecting line are not shown if ground elevation information is not encoded with the NavData waypoint information (e.g., terminal and enroute fixes). The active waypoint symbol is drawn using the hidden surface removal techniques of terrain and obstruction rendering, so an active waypoint behind terrain appears to be so. The active waypoint symbol disappears in unusual attitude mode but turns amber (yellow) in the event of GPS LON caution.

The identifier of the waypoint along with the distance to the waypoint are displayed in the lower right corner of the PFD in magenta. If a target altitude is not set and the active waypoint has a VNAV altitude associated as in Figure 3-55, the identifier includes a display of the VNAV altitude.

NOTE:

Only the active waypoint is shown on the PFD. Subsequent waypoints in a route are displayed sequentially as the current active waypoint is passed. With terrain turned off, the active waypoint is always visible regardless of distance.

If the active waypoint is beyond the lateral limits of the screen, the magenta waypoint direction pointer (i.e., magenta triangle) on the directional scale indicates shortest direction of turn to the waypoint.

If the waypoint is only a hoop hanging in space, it is a fix and not directly associated with a NAVAID on the ground (e.g. VOR, NDB, user waypoint, or airport).

If the waypoint X disappears behind terrain on the PFD, there is terrain between the aircraft present position and the waypoint.

3.3.30. Mini Map

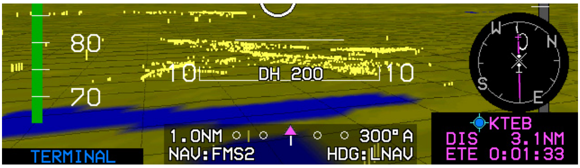
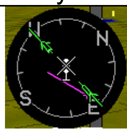


Figure 3-60: Mini Map

Table 3-12: Mini Map Behavior (When Not Decluttered)		
Symbology	**Color**	**Condition**
VOR 1	 Cyan	When Valid
VOR 2	 Green	When Valid
Active Leg	Magenta	GPS/SBAS normal
	Amber (Yellow)	GPS/SBAS LON
Ownship Symbol (Figure 3-63)	White	
Mutually exclusive with analog AGL, and traffic thumbnail.		
Mini Map disappears in Unusual Attitude Mode		

3.3.31. Runways

The PFD displays airport runways in a 3-D manner. Upon activation of a DP, VFR approach, IFR approach, or STAR procedure, runways for the airport associated with the procedure, as well as, runways associated with the three nearest airports (computed by the TAWS algorithms) are displayed.

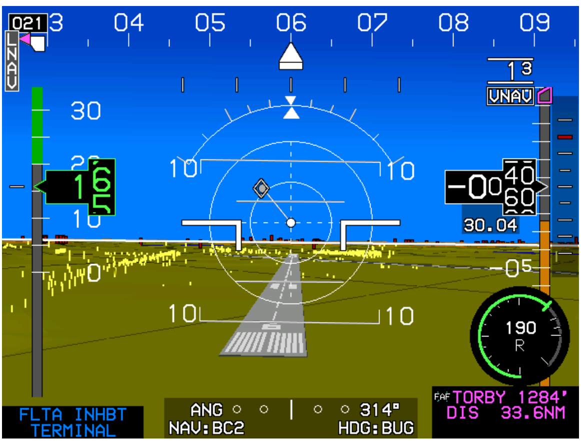
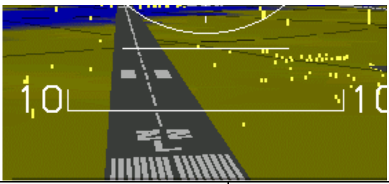


Figure 3-61: Runways

Runways are displayed with hidden surface removal techniques of the terrain and obstruction rendering, so runways behind terrain appear to be so. Runways are based on characteristics in the navigation database, including elevation, position, orientation, length, and width, and displayed as defined in Table 3-13.

Table 3-13: Runway Drawing Criteria

Feature	**Color**	**Notes**
Runway markings, aiming point markings, centerline, designation, and displaced threshold arrows	Dark gray 	According to characteristics from navigation database, e.g., including position, orientation, length, and width.
Runway markings	Medium gray 	
Landing portion of the selected runway.	Light gray 	Taking into account displaced threshold data.
Runway markings for the selected runway	Lighter gray than the light gray	

3.3.32. Heliports

Heliports appear as distinguishable 150’ X 150’ helipads with applicable markings.

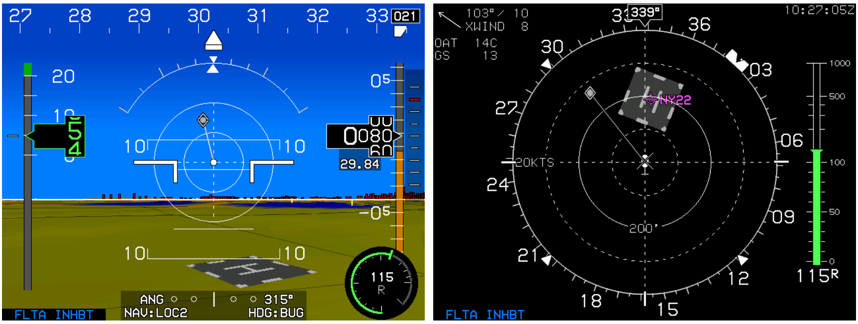


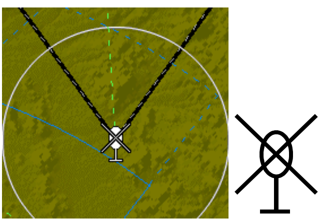
Figure 3-62: Helipads

3.4. MFD Symbology

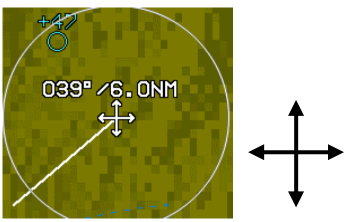
Navigation display (ND) may be configured the following formats:

1) Moving Map
2) Conventional HSI
3) Navigation Log
4) Strikes (see WX-500 Lightning Strikes Appendix)
5) Traffic (see Traffic Appendix)
6) Datalink (see Datalink Appendix)

3.4.1. Ownship Symbology



Rotorcraft



Pan Mode

Figure 3-63: Ownship Symbology

3.4.2. Moving Map

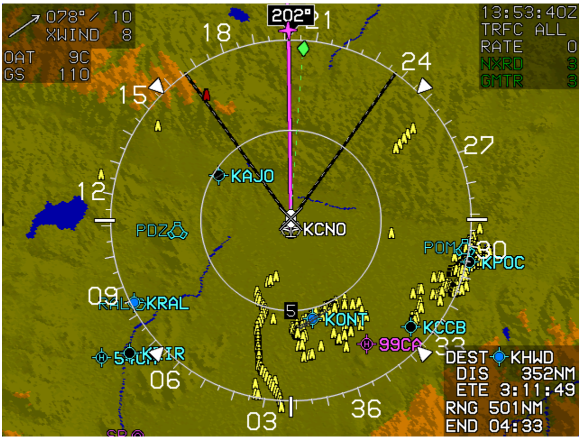


Figure 3-64: Basic Moving Map

NOTE:

When selected, latitude/longitude is displayed below the ownship symbol as aircraft current position.

Figure 3-65: Latitude/Longitude Display Compass Rose/ND Boundary Circle Symbol

Figure 3-66: Moving Map with Instrument Approach

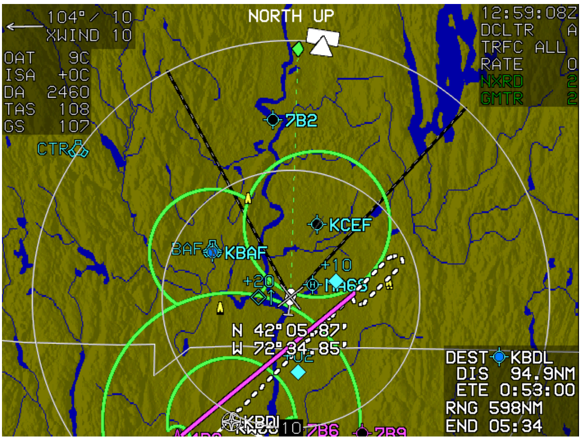


Figure 3-67: North-Up Arc Mode

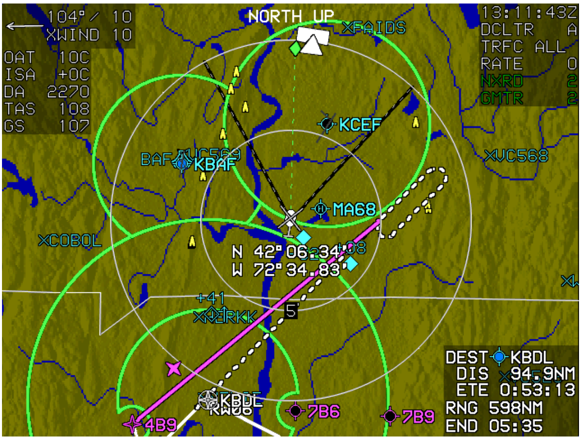


Figure 3-68: North-Up Centered Mode

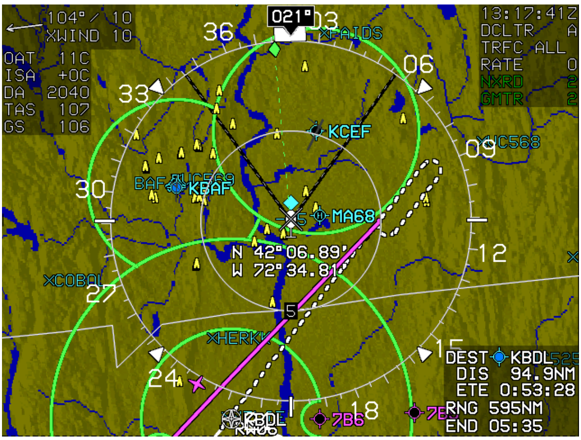


Figure 3-69: Heading-Up Centered Mode

3.4.3. Compass Rose/ND Boundary Circle Symbol

In heading up mode, the magnetic digital heading readout and pointer are aligned with the longitudinal axis of the ownship symbol.

Figure 3-70: Compass Rose/ND Boundary Circle Symbol

3.4.4. Clock/Options

The following are displayed in the upper right corner of the ND.

Table 3-14: Clock Options

Feature	**Options**	**Notes**
Zulu Time or Local Offset	**hh:mm:ssZ hh:mm:ssL**	Synchronized with the GPS/SBAS constellation.
Declutter Mode	**DCLTR A** **DCLTR M**	= Automatic declutter mode = Manual declutter mode
Terrain Status	Enabled or Disabled	Terrain status is indicated by the absence or presence of terrain.
Traffic Status	See Traffic appendix	
WX-500 Status	See Strikes appendix	
Datalink TFR Data Status	See Datalink appendix	
Datalink Weather Status		

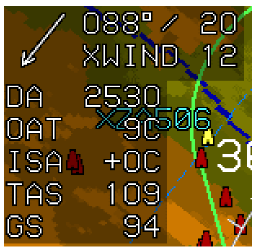
Zulu Time

Local Offset Time

Figure 3-71: Clock/Options

3.4.5. Air Data and Groundspeed

True North Mode



Normal Mode

Figure 3-72: Air Data and Groundspeed

The following are displayed in the upper left corner of the ND:

1) **Wind:** Information consists of the following readouts:

a) Direction in degrees;

b) Speed in knots;

c) Crosswind component in knots; and

d) Graphical wind vector arrow oriented to correspond to the ND orientation.

NOTE:

Wind information is not shown when the aircraft is in the ground mode, or when the AHRS is in DG mode. If referenced to magnetic north, direction readout uses the degree (°) symbol. Otherwise, a stylized true north (^{T}) symbol is used.

2) **Outside Air Temperature:** Digitally in degrees C or F (as configured).

3) **International Standard Atmosphere (ISA)**: Difference between ISA temperature and current outside air temperature is displayed digitally in °C or °F (negative values = less than standard OAT). Decluttered if the “Show ISA Temperature Flag” is disabled in EFIS limits.

4) **Density Altitude:** Digitally in feet. Decluttered if “Show Density altitude Flag” is disabled in EFIS limits.

5) **True Airspeed:** Digitally in knots. Decluttered if “True Airspeed Flag” is disabled in EFIS limits.

6) **Groundspeed:** Digitally in knots.

3.4.6. Fuel Totalizer/Waypoint Distance Functions

GPS in normal state and current active waypoint | **GPS in LON condition** | **GPS in normal state and not the current active waypoint**

Figure 3-73: Fuel Totalizer/Waypoint Distance Functions

Table 3-15: Fuel Totalizer/Waypoint Distance Functions		
Function	**Conditions**	**Type Symbols Options**
DEST Waypoint	If there is an active flight plan, waypoint type, identifier, range, and ETE/ETA for the last waypoint ("DEST" waypoint) are shown. If the active waypoint is not the last waypoint, range and time to destination waypoint are based on the flight plan route. Otherwise, range and time are based on a direct geodetic path. Waypoint information is white but turns amber (yellow) with GPS LON caution.	ETA or ETE Degree (°) or True North (^{T}) symbol
Range	Based on instantaneous fuel flow, fuel remaining and groundspeed are shown immediately below "DEST" waypoint information for easy comparison.	
Endurance	Based on instantaneous fuel flow and fuel remaining is shown.	

3.4.7. Navigation Data

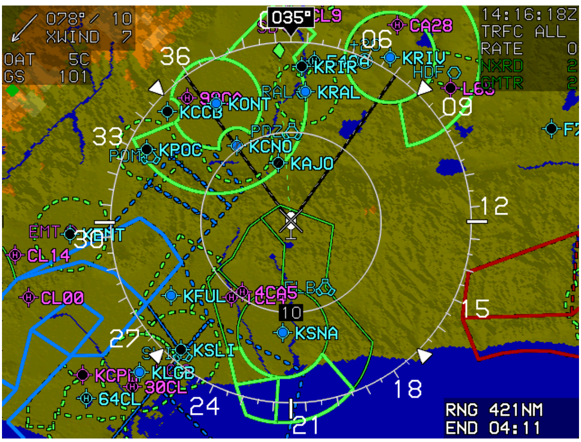
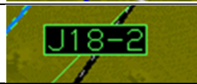
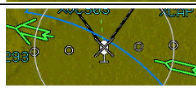


Figure 3-74: Navigation Data and Airspace Depiction

The ND displays navigation data in correct relationship to the ownship symbol with navigation data symbols, which include airport symbols, NDBs, and user waypoints. High altitude and low altitude airways may be shown.

Table 3-16: Navigation Symbology

	IFR Airport		NDB
	VFR Airport		FIX
	VORTAC		High Altitude Airway
	DME only or TACAN		Low Altitude Airway
	VOR		User Waypoint
	User Waypoint in Pan Mode		HSI CDI scale

The ND has manual and automatic decluttering of navigation data. There are six levels of automatic declutter based upon the number of navigation data symbols drawn in the current ND format and range. Decluttering is as follows:

1) **Airports**: Manually or automatically decluttered. In automatic declutter mode, large airports (IFR procedure and longest runway and automatically adjusted threshold needed to achieve desired symbol count) are always shown; IFR airports that are not large airports are shown in levels 1, 2, 3, and 4; and VFR airports are shown in levels 1, 2, and 3.

2) **VORs**: Manually or automatically decluttered. In automatic declutter mode, VORs are shown in levels 1, 2, 3, 4, and 5.

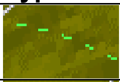
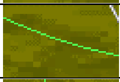
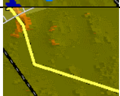
3) **NDBs:** Manually or automatically decluttered. In automatic declutter mode, NDBs are shown in levels 1 and 2. Both enroute and terminal NDBs are shown.

4) **FIXES** (including user waypoints): Manually or automatically decluttered. In automatic declutter mode, enroute fixes are shown in level 1. Terminal fixes are manually selected and not shown in automatic declutter mode. Enroute fixes, terminal fixes, and user waypoints may be manually decluttered separately from each other.

5) **High Altitude Airways**: Manually selected.

6) **Low Altitude Airways**: Manually selected.

Table 3-17: Airspace Depiction

Type of ARINC 424 Airspace		Vertical Limits
	Single pixel dashed lines	More than ±500’
	Single pixel solid lines	Within ±500’
	Triple pixel solid lines	Within airspace vertical limits
		Color of Airspace
	Class C, control area, TRSAs, Class D	Green
	Class B, TCAs (where applicable)	Blue
	Caution, danger, MOAs, training, warning, or unknown areas	Amber (Yellow)
	Prohibited, restricted, or TFR areas (when equipped with Datalink)	Red

3.4.8. Analog Navigation Symbology

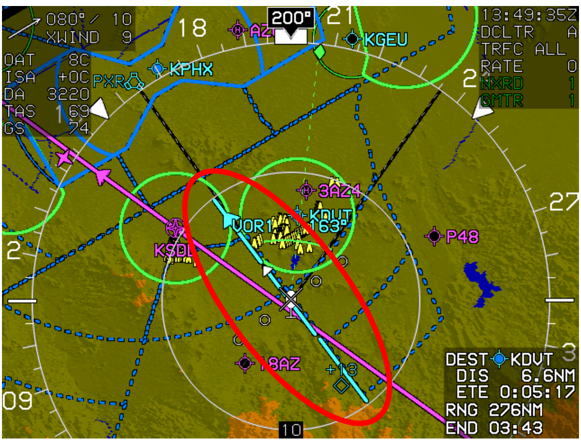


Figure 3-75: Analog Navigation Symbology HSI in ARC Mode

When selected, the ND displays analog (VOR1 and VOR2) navigation symbology, when valid. When the VOR1 and/or VOR2 pointers are selected for display, bearing and distance for the selected VOR pointers appear at the bottom of the ND view (cyan for VOR1; green for VOR2). If the DME channel is in hold mode, the associated distance readout is amber (yellow), and the letter "H" is shown above the distance readout (Figure 3-96). The size of the HSI depends on arc or center modes to ensure a full HSI is always displayed.

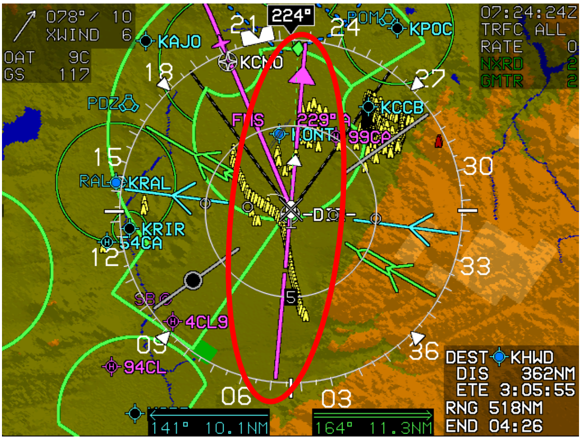


Figure 3-76: Analog Navigation Symbology HSI in Centered Mode

3.4.9. Borders

If national and United States state borders are selected, they are drawn at all map scales. Borders are white if the ND background includes terrain.

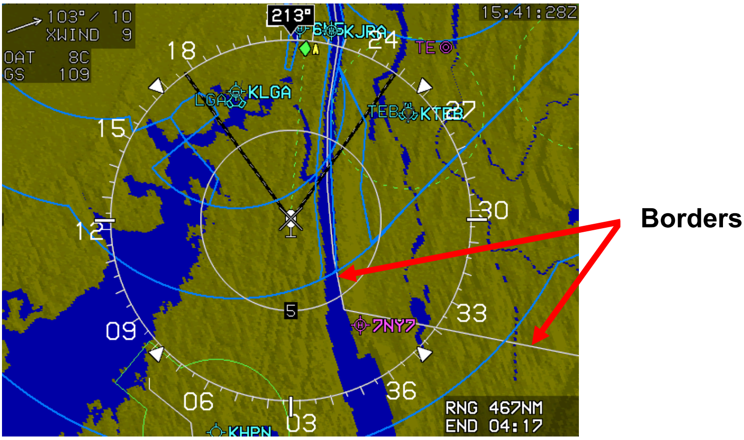


Figure 3-77: State Borders Drawn

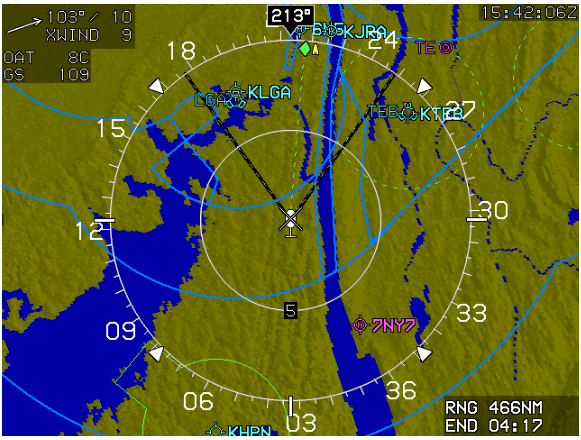


Figure 3-78: Without State Borders Drawn

3.4.10. Terrain/Obstructions

Terrain and obstruction rendering is pilot-selectable to declutter the display by deselecting terrain (*independent declutter of obstructions is not possible*). Furthermore, terrain and obstruction rendering is disabled when:

1) The GPS/SBAS sensor is failed; OR

2) When the ADC is failed; OR

3) When the horizontal figure of merit exceeds the greater of 0.3NM or the horizontal alarm limit for the mode of flight.

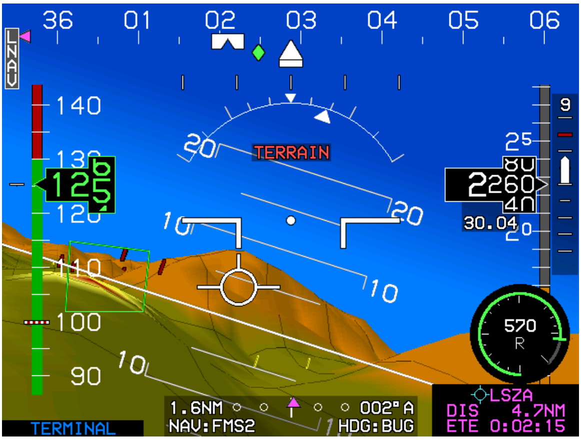


Figure 3-79: Terrain/Obstructions PFD

Figure 3-80: Terrain/Obstructions MFD

Terrain is displayed on the ND in its correct relationship to the ownship symbol using color to show relationship to aircraft altitude.

Table 3-18: Terrain Color

Based on Aircraft Altitude	Color	Notes
Terrain at or below 100 feet below aircraft altitude	Olive shades	Terrain slope determines shade
Terrain above 100 feet below aircraft altitude	Brown shades	
FLTA alerts	Amber and Red	See Section 8 TAWS
Water at all altitudes	Deep Blue	Takes precedence over other colors

Obstructions are displayed on the ND in correct relationship to the ownship symbol using color to show relationship to aircraft altitude.

Table 3-19: Obstructions

Lateral Distance Away	21 NM or less	PFD in narrow FOV
	15 NM or less	PFD in wide FOV
	8.5 NM or greater	Not depicted on the ND
	8.5 NM or less	As described below
Vertical Criteria	More than 2000’ below aircraft	Not depicted on the ND
	Within 2000’ but more than 500’ below aircraft	Depicted in amber
	Within 500’ but below aircraft	Depicted in light red
	At or above aircraft altitude	Depicted in deep red

NOTE:

See Section 8 Terrain Awareness Warning System for obstructions causing TAWS alarms and depiction of separate symbology.

3.4.11. Pan Mode

The ND page has a pan mode for changing the location of the center of the page away from current location and viewing map details along the route of flight and at the intended or alternate destination while either in flight or on the ground. When pan mode is active, use labeled buttons to pan location north, south, east, and west in a north-up, centered orientation. Upon entering pan mode, the heading pointer, track pointer, lubber line, waypoint pointer, analog navigation symbology, and field of view lines are removed from the display.

Figure 3-81 shows the line with bearing and distance from the map center to the aircraft's current position in white when the aircraft is more than 0.5 NM away. When panning, the nearest displayed airport, VOR, NDB, or fix within the inner range ring is highlighted with a flashing circle. Buttons are labeled to allow for viewing or hiding waypoint information (including datalink weather information associated with that point). When exiting pan mode, all previous settings are restored as before pan mode was enabled.

Figure 3-81: Pan Mode

3.4.12. Start Point

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

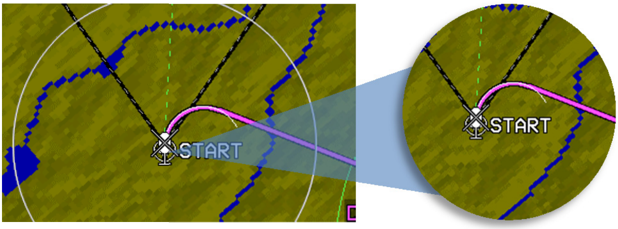
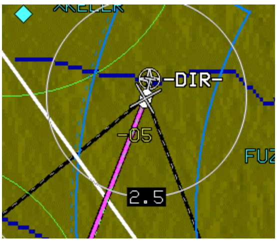


Figure 3-82: Start Point

3.4.13. Direct Point

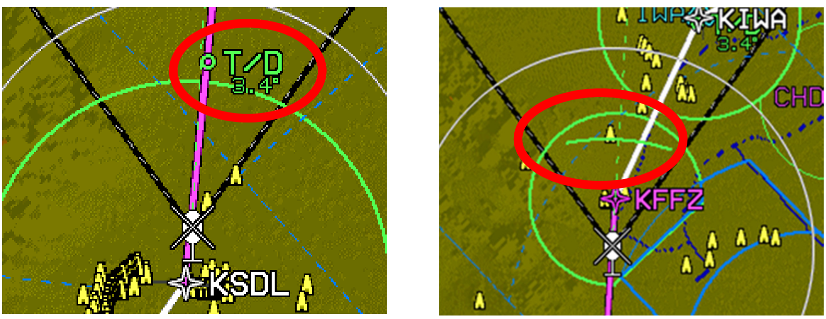
Unnamed waypoints appear depending upon the procedure loaded when a direct-to command is entered. See Section 7 IFR Procedures for more information.



-ALT-	altitude terminations
-DIR-	waypoints that begin a Direct -To leg
-DME -	distance or DME terminations
-INT-	intercept terminations
-RAD-	radial terminations

Figure 3-83: Direct Point

3.4.14. Altitude Capture Predictor/Top of Descent



Top of Descent **Top of Climb**

Figure 3-84: Top of Descent or Top-of-Climb

When a selected altitude or VNAV is specified on the PFD, “T/D” marks correct point on the flight plan path at which descent must be commenced and contains location on the flight plan path with indication of the glidepath angle used to calculate position. After passing top of descent along the lubber line, altitude is captured and shown as a green arc located ahead of the aircraft. The arc marks the bottom-of-descent or top-of-climb point.

3.4.15. Projected Path

When the aircraft is in a bank angle, a projected path emanates from the ownship symbol. This curving path is based upon aircraft bank angle and groundspeed as it projects one minute into the future up to a maximum of 180° of turn. The projected path or "noodle" assists in course interception and making small adjustments to bank angle for proper roll out.

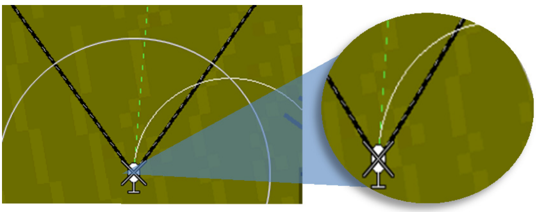


Figure 3-85: Projected Path

3.4.16. Active Flight Plan Path/Manual Course/Runways

When there is an active flight plan and the GPS/SBAS OBS setting is automatic, the flight plan path is shown on the ND in correct relationship to the ownship symbol. The active flight plan path depiction 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). The fly-over waypoint symbol is distinct from fly-by waypoints and consists of the waypoint symbol within a circle. When there is a parallel offset, the active flight plan path depicts the parallel offset path, and the original flight plan path is shown with haloed gray dashed lines. Top of descent symbols with an indication of glidepath angle are shown where VNAV descents are predicted to commence.

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 magenta but turn amber (yellow) in the event of a GPS LON caution.

The ND displays airport runways in correct relationship and scale to the ownship symbol. 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 (as computed by the TAWS algorithms) are displayed.

3.4.16.1. Parallel Track

When there is an active flight plan and GPS/SBAS OBS setting is automatic, the flight plan path is shown on the ND in correct relationship to the ownship symbol. See Section 5 Menu Functions and Procedures for details on creating a parallel track.

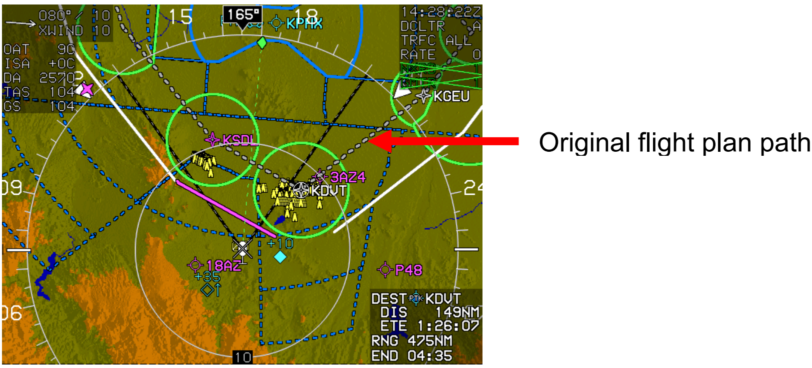


Figure 3-86: Parallel Track

3.4.16.2. Active Flight Plan Path

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

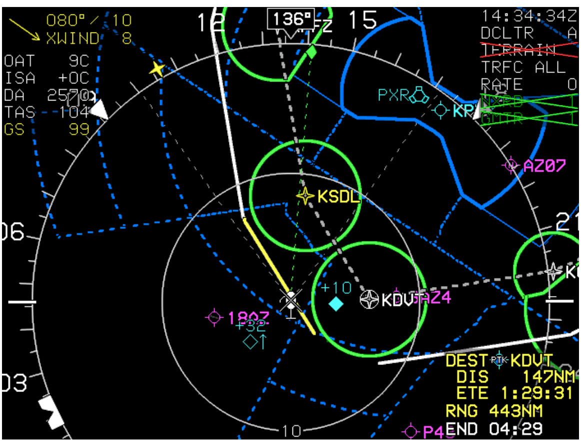
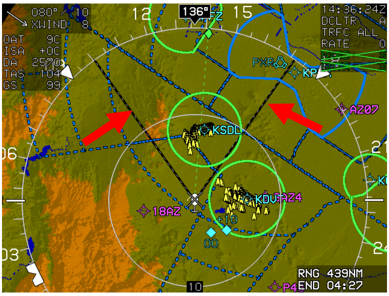


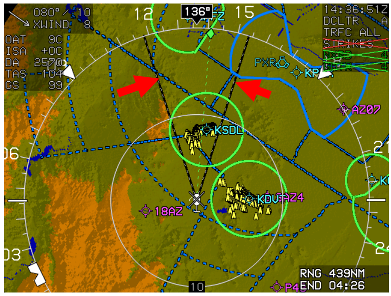
Figure 3-87: Loss of Navigation

3.4.17. Field of View Indication

The ND background indicates the ND FOV with a set of segmented gray lines leading out from the ownship symbol in either 35° or 70° angles depending on the zoom mode setting on the PFD.



Normal FOV (Zoom Off)



Narrow FOV (Zoom On)

Figure 3-88: Field of View

3.4.18. Range

The white range ring is centered on the aircraft's position to quickly estimate distances. Distance (in NM) from the aircraft to the ring is a white number overlaying the 6 o'clock position of the ring. The range ring is half the distance to the directional scale. Consequently, when the range ring shows a distance of 5NM, the directional scale is 10NM. Scroll ❶ to set the overall map scale ranges in NM to of the following values as appropriate:

0.5, 1, 2.5, 5, 10, 25, 100, and, 200.

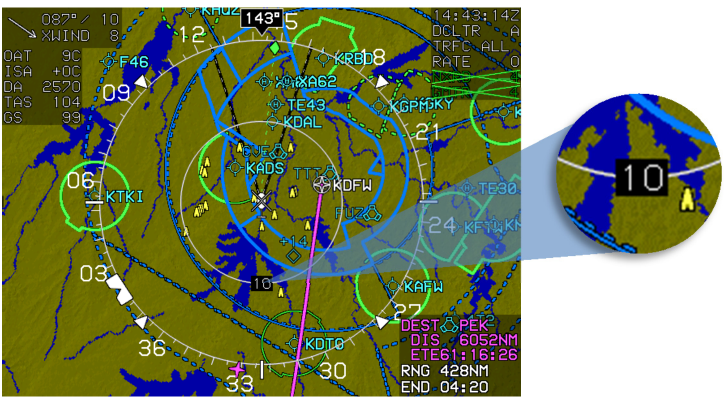


Figure 3-89: Range

3.5. HSI Page

When selected, the ND displays conventional HSI symbology, including a selected course needle, a lateral deviation indicator, and a TO-FROM indicator. VOR1, VOR2, and ADF navigation are displayed with a magenta single line FMS1 (①), a cyan single line VOR1 needle (②), and a green double line VOR2 needle (③), and ADF (④) tuned to an NDB. When the signal is invalid, the associated pointer is not shown. When the HSI NAV source fails, a red “X” is displayed in place of the HSI deviations.

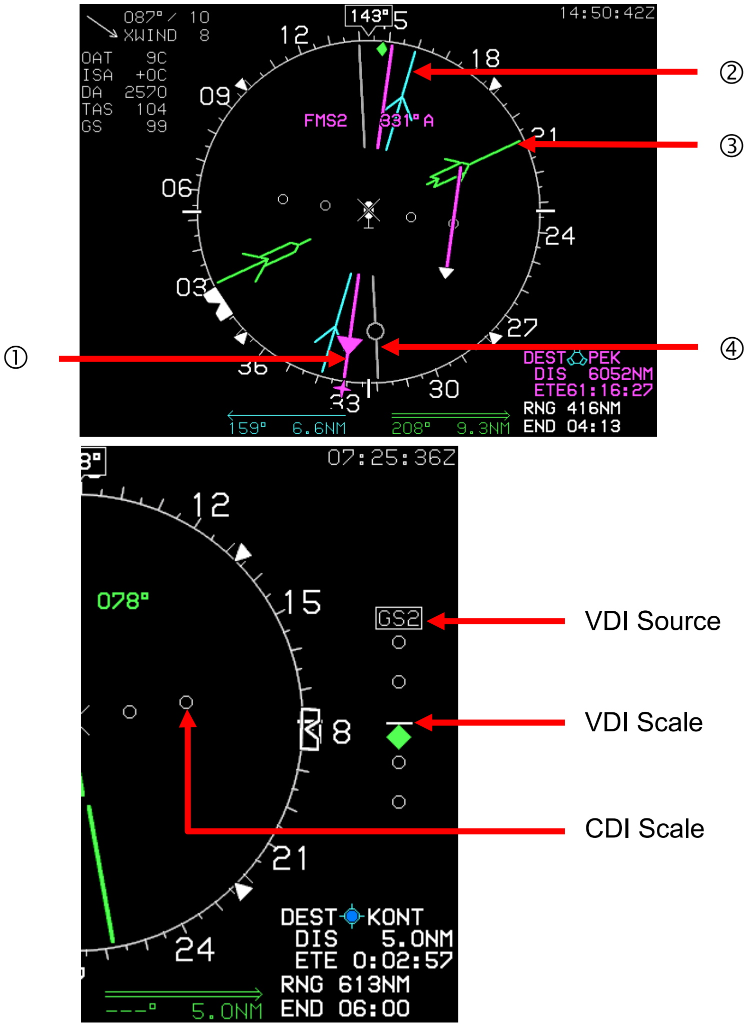


Figure 3-90: HSI Page

A VDI appears, as in Figure 3-90, when the VDI source is valid to display vertical deviation information for the currently selected navigation source. When the selected vertical source is FMS, the VDI displayed on the HSI has the same behavior as the VDI displayed on the PFD with the exception of the VDI source displayed on the top of the VDI to avoid clutter with waypoint information below:

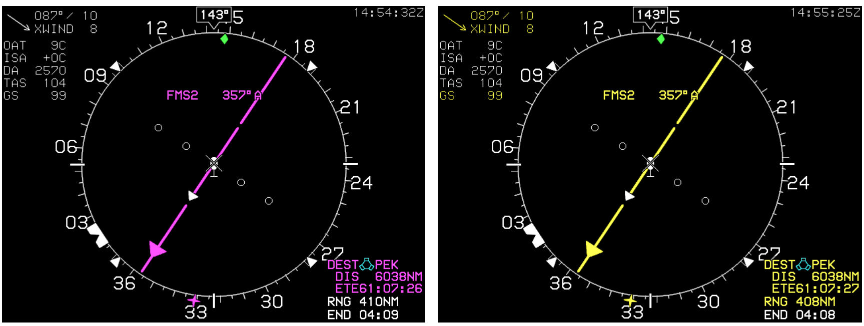
1) VNV1-B: Default FMS barometric VNAV mode
2) VNV2-B: Default FMS barometric VNAV mode
3) GS1: Glideslope #1
4) GS2: Glideslope #2

3.5.1. Conventional HSI/PTR Format

When selected, the ND displays conventional HSI symbology, including a selected course needle, a lateral deviation indicator, and a TO-FROM indicator.

Magenta (if FMS is the selected navigation source);

1) Cyan (if VLOC1 is the selected navigation source);
2) Green (if VLOC2 is the selected navigation source); or
3) Yellow when HSI is slaved to GPS/SBAS and there is a GPS LON condition.



Normal Magenta Pointer **GPS LON Condition Amber (Yellow) Pointer**

Figure 3-91: HSI Pointer Color

As seen in Figure 3-92, a green diamond-shaped track pointer appears on the compass rose and aligns with the aircraft's track across the earth at groundspeeds greater than 30 kts. When selected, the VLOC1, with GS1 is displayed. When the signal is invalid, the associated pointer is not shown.

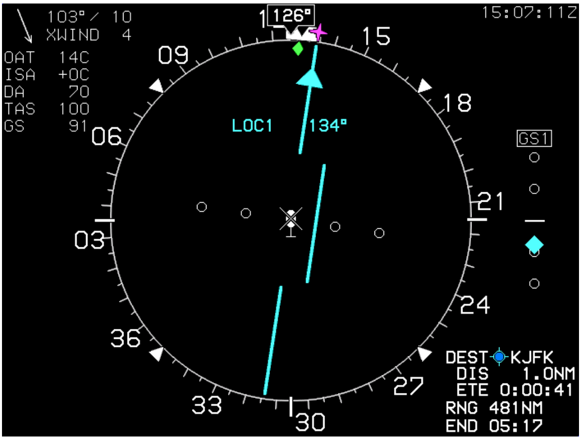


Figure 3-92: Conventional HSI/PTR Format: HSI with VDI and Glideslope

When VOR1 and VOR2 pointers are selected for display, a distance display at the bottom of the ND appear. If bearing or distance is not valid, the respective field is filled with dashes.

Figure 3-93: Conventional HSI/PTR Format with Loss of Navigation Condition

3.5.2. Analog Navigation Symbology

When selected, the HSI displays analog (VOR1 [cyan] and VOR2 [green]) navigation symbology with an RMI pointer format overlaid upon the HSI.

When the signal is invalid, the associated pointer is not shown. When the signal is valid for VOR1 and VOR2, a bearing and distance display for the selected VOR pointers appears at the bottom of the display in the same color of the respective pointer. When an ADF2 is enabled, the ADF2 double needle is as shown in Figure 3-95.

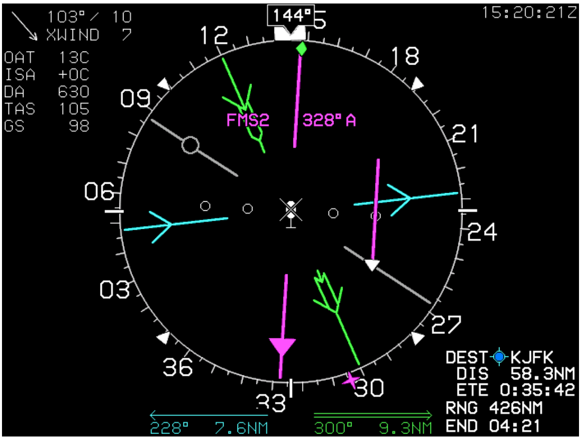


Figure 3-94: Analog Navigation Display VOR1 and VOR2

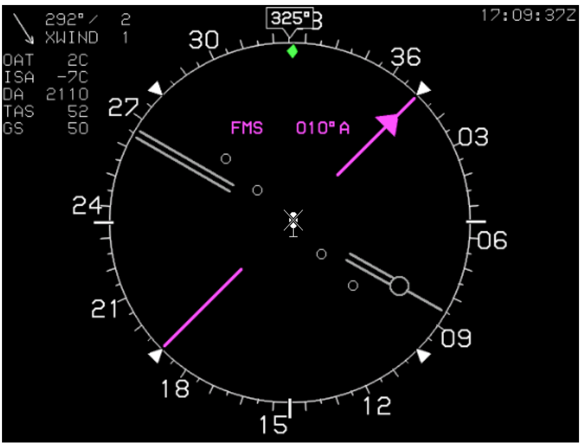


Figure 3-95: Analog Navigation Display FMS and ADF2

If a DME channel is in hold mode, the associated distance readout is displayed in amber (yellow) rather than blue or green, and "H" is shown above the distance readout.

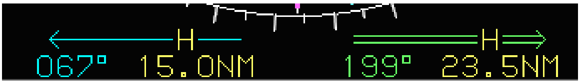


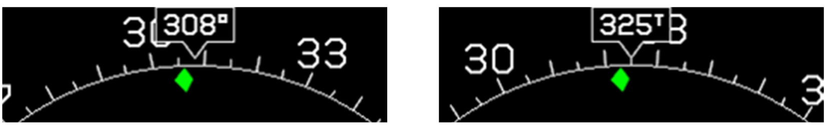
Figure 3-96: HSI Bearing Distance Readout with DME in HOLD

Valid marker beacon discretes are displayed on the PFD and ND HSI with appropriate coloring markings. Only during a built-in-test, more than one marker beacon may be active. Marker beacons are disabled when the NAV source is FMS.

Figure 3-97: HSI with Marker Beacon Displayed

3.5.3. Compass Rose Symbols

When selected, a digital heading readout and pointer aligned with the longitudinal axis of the ownship symbol appear on the compass rose boundary circle.



Normal Mode **True North Mode**

Figure 3-98: Compass Rose

If referenced to magnetic north, the heading readout uses the degree (°) symbol. Otherwise, a stylized true north (^{T}) symbol is used. A green diamond-shaped track pointer is aligned with the aircraft's track across the earth appears on the compass rose when groundspeed is greater than 30 kts. The pilot-settable heading bug geometrically interacts with the heading pointer on the compass rose. A magenta, star-shaped waypoint pointer is displayed on the heading scale at a point corresponding with the active waypoint but turns amber (yellow) in the event of GPS LON caution.

NOTE:

See Section 7 IFR Procedures for description of the following heading modes with the AHRS and EFIS:

1) ADAHRS Slaved—EFIS Magnetic North
2) ADAHRS Slaved—EFIS True North
3) ADAHRS Free/"DG"—EFIS Magnetic North
4) ADAHRS Free/"DG"—EFIS True North

3.5.4. Air Data and Groundspeed

Air data and groundspeed are displayed as specified in § 3.4.5.

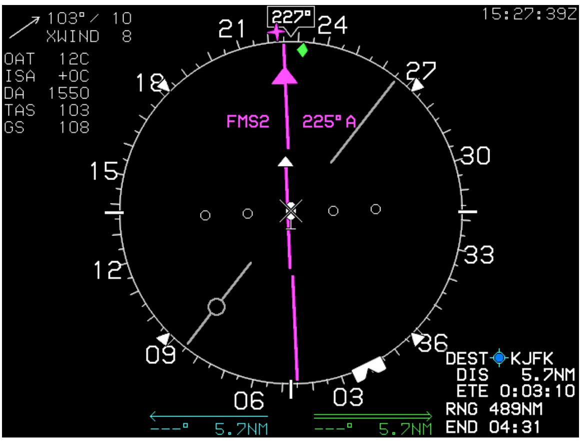


Figure 3-99: HSI Display Air Data and Groundspeed

3.5.5. Clock

Zulu Time or LCL Time: As specified in § 3.4.4 in the upper right corner of the HSI:

Zulu Time

Local Offset Time

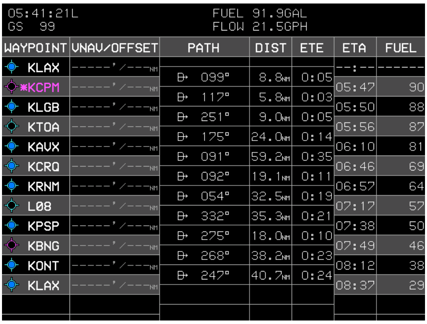
Figure 3-100: HSI Clock

3.5.6. Fuel Totalizer/Waypoint Distance Functions

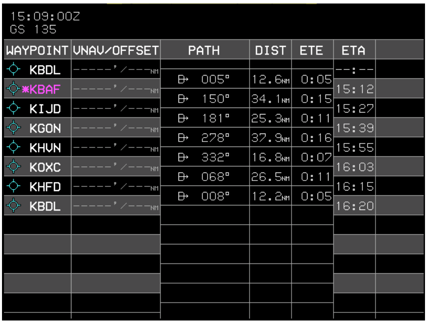
Fuel totalizer and waypoint distance are displayed in the lower right corner of the HSI as specified in § 3.4.6.

Figure 3-101: HSI Fuel Totalizer/Waypoint Distance

3.6. Navigation Log



With Fuel Enabled



Without Fuel Enabled

Figure 3-102: Navigation Log

3.6.1. Clock and Groundspeed

The following are displayed in the upper left corner of the NAV Log:

1) **Zulu or LCL Time**: As specified in § 3.4.4.

2) **Groundspeed:** Displayed digitally in knots

3.6.2. Fuel Remaining and Fuel Flow Data

The following are displayed in the upper right corner of the NAV Log:

Fuel Remaining: If either fuel level or fuel flow is available, current fuel remaining is displayed digitally in fuel units.

Fuel Flow: If fuel flow is available, current total fuel flow is displayed digitally in fuel units.

3.6.3. Waypoint Identifier Column

The identifier for each waypoint of the active flight plan is displayed in the left-most column of the nav log. The active waypoint, indicated with an asterisk, is magenta but turns amber (yellow) in the event of a GPS LON caution. Brackets indicate suppressed waypoints. Navigation data symbols are shown with the waypoint identifier to easily distinguish the waypoint type.

When a waypoint is part of a procedure or parallel offset, the following legends are drawn on top of the navigation data symbol:

1) **FAF** = Waypoint is a final approach fix.
2) **MAP** = Waypoint is a missed approach point.
3) **Airway Designation** = Waypoint is part of the designated Airway.
4) **MA** = Waypoint is part of the missed approach segment of an instrument approach procedure.
5) **APP** = Waypoint is part of an instrument approach procedure but not a final approach fix, missed approach point, nor part of the missed approach segment.
6) **VFR** = Waypoint is part of a VFR approach.
7) **STAR** = Waypoint is part of a standard terminal arrival procedure.
8) **DP =** Waypoint is part of a Departure Procedure.
9) **PTK** = Parallel Offset. In the case of a STAR or DP waypoint subject to a parallel offset, both STAR/DP and PTK are shown.
10) **HOLD** = Waypoint is part of an enroute Holding pattern
11) **SAR** = Waypoint is part of a SAR pattern

3.6.4. VNAV and VNAV Offset Column

VNAV altitude and associated VNAV offset (in NM) are displayed immediately to the right of the waypoint identifier column. In the case of an approach with a final approach segment data block, VNAV offset readout associated with the missed approach point is “GPI” to designate distance to the glidepath intercept point. VNAV altitudes and offsets from the navigation database or manually entered are white; those computed automatically are gray. VNAV and VNAV offset column elements align with waypoint identifier column elements to indicate the VNAV information applies to the associated waypoint.

3.6.5. Path Column

LNAV path between waypoints is displayed immediately to the right of the VNAV and VNAV offset column. The following are displayed:

1) Geodetic path between waypoints is displayed with  **(R4)**, followed by the initial geodetic course for the leg.
2) Suppressed waypoints (not part of the active flight plan) are shown as dashes.
3) Discontinuities (i.e., a leg where FMS is unable to compute a valid path) are shown with the legend “-DISCONT-.”
4) Skipped waypoints are shown with the legend “-SKIPPED-.”
5) Altitude terminations are shown with leg course followed by the altitude at which the leg terminates.
6) Manual legs are shown with leg course followed by “-MAN-.”
7) Procedure turns are shown with a pictorial representation of a procedure turn (either left or right turns) as well as the entry and exit course for the procedure turn.
8) Holding patterns are shown with a pictorial representation of a holding pattern (either left or right turns) as well as the inbound course for the holding pattern.
9) Arc legs are shown with a pictorial representation of an arc (either left or right turns) as well as the entry and exit radials for the arc.
10) Radius to a fix legs are shown with a pictorial representation of an arc (either left or right turns) followed by “RF.”
11) SAR pattern legs are shown with a pictorial representation of the SAR pattern (Expanding Square, Rising Ladder, Orbit, Race Track, or Sector, each with either left or right turns) followed by “SAR.” (See SAR appendix.)
12) Other leg types (Direct, DME termination, radial termination, intercept or course to a fix) are shown using the Direct-To Symbol followed by the leg course.

Path column elements are offset from waypoint identifier column elements to indicate the path information applies to the leg between waypoints.

3.6.6. Distance Column

Distance between waypoints is displayed immediately to the right of the path column and is calculated taking into account the associated path as well as parallel offsets. In the case of a discontinuity, distance between waypoints is the direct geodetic distance between the two waypoints. In the case of suppressed waypoints, skipped waypoints, discontinuities or manual transitions, the distance between waypoints are shown in dashes. Distance column elements are offset from waypoint identifier column elements to indicate distance information applies to the leg between waypoints.

3.6.7. Estimated Time Enroute Column

ETE between waypoints is displayed immediately to the right of the distance column and is calculated taking into account the associated distance between waypoints and current groundspeed. In the case of suppressed waypoints, skipped waypoints, discontinuities or manual transitions, the distance between waypoints are shown in dashes. ETE column elements are offset from waypoint identifier column elements to indicate ETE information applies to the leg between waypoints.

3.6.8. Estimated Time of Arrival Column

ETA at the active waypoint and all subsequent waypoints are displayed immediately to the right of the ETE column. ETA at the active waypoint is calculated taking into account the associated time remaining on the active leg and current time. ETA at subsequent waypoints is calculated taking into account the cumulative ETEs and current time. In the case of suppressed waypoints, skipped waypoints or manual terminations, the ETA is shown as dashes. ETA column elements align with waypoint identifier column elements to indicate the ETA information applies to the associated waypoint.

3.6.9. Fuel Remaining Column

Fuel remaining at the active waypoint and all subsequent waypoints is displayed immediately to the right of the ETA column. Fuel remaining at the active waypoint is calculated taking into account the associated time remaining on the active leg, current fuel flow, and current fuel quantity. Fuel remaining at subsequent waypoints is calculated taking into account the cumulative ETEs, current fuel flow, and current fuel quantity. Fuel remaining column elements are aligned with waypoint identifier column elements to indicate the fuel remaining information applies to the associated waypoint. In the case of suppressed waypoints, skipped waypoints or manual terminations, the fuel remaining is shown in dashes.

NOTE:

Since a suppressed waypoint is not part of the active flight plan, dashes appear in the absence of the following VNAV data associated with a suppressed waypoint:

1) Path data (dashes)
2) Distance data (dashes)
3) ETE data (dashes)
4) ETA data (dashes)
5) Fuel remaining data (dashes)

3.7. Hover Page

The hover page has the following elements. Ownship symbology is as in Figure 3-63.

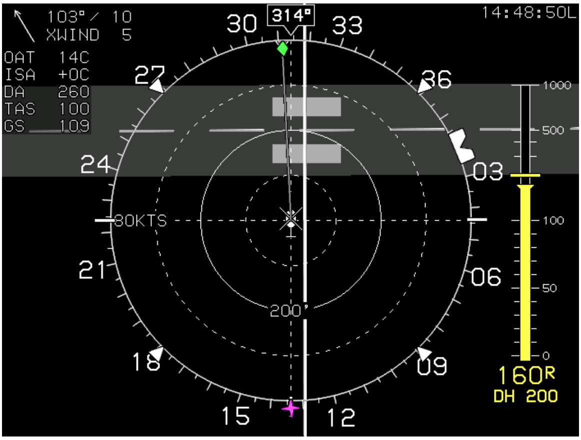


Figure 3-103: Hover Page Orientation

3.7.1. Hover Page Screen Range

The following selectable hover page screen ranges are available (all distances are 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 aids in judging range to displayed symbols. 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).

3.7.2. Hover Vector

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 changes based upon current groundspeed. Available speed ranges are (all speeds represent the speed indicated at the compass rose): 20 kts, 40 kts, and 80 kts 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.

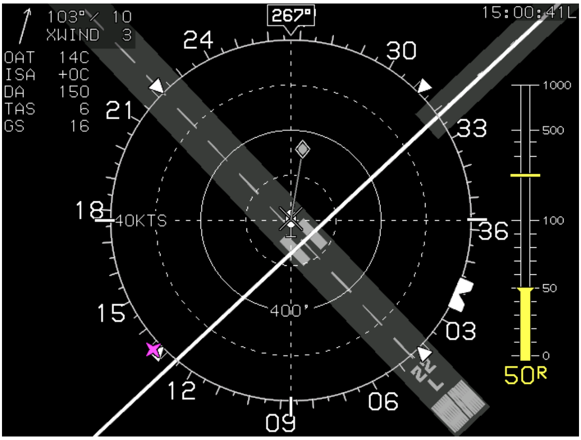


Figure 3-104: Hover Vector Symbology

The ownship symbol indicates 0 knots groundspeed and a dot connected to the ownship symbol by a gray line floating over the hover page 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. 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 page.

3.7.3. Compass Rose Symbols

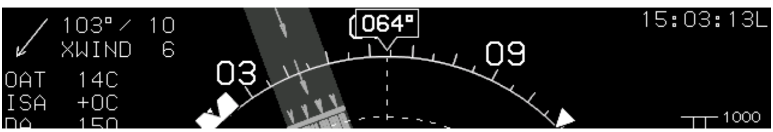


Figure 3-105: Hover Vector Compass Rose

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 LON caution.

3.7.4. Active Flight Plan Path/Manual Course

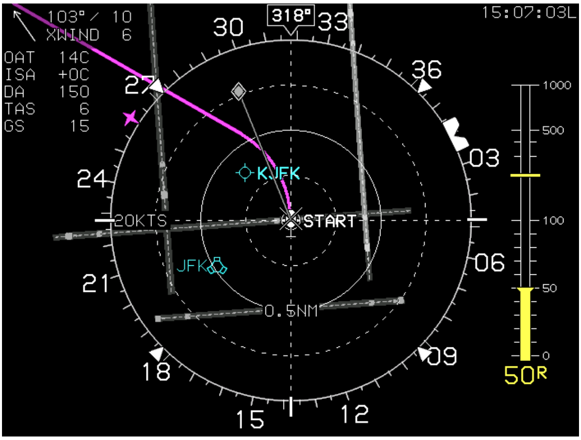


Figure 3-106: Hover Vector Active Flight Plan Path/Manual Course

When there is an active flight plan and the GPS/SBAS OBS setting is automatic, the flight plan path is shown on the hover page 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 shown with haloed gray lines.

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 magenta but turn amber (yellow) in the event of a GPS LON caution.

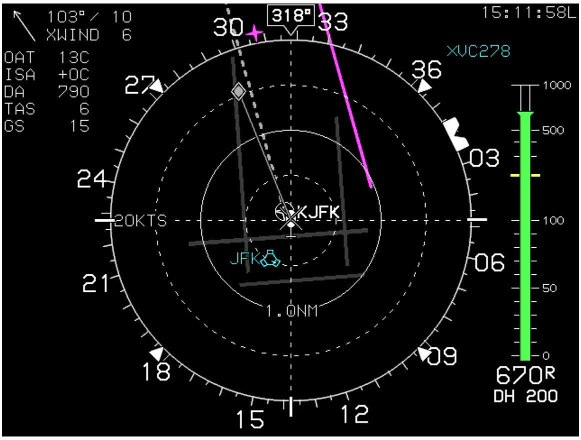


Figure 3-107: Hover Vector Active Flight Plan Path/Parallel Course

3.7.5. Navigation Data

The hover page displays navigation data in 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 page 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 page since there is no **FORMAT..** menu option.

The hover page displays airport runways and some heliports in 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.

3.7.6. Projected Path

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.

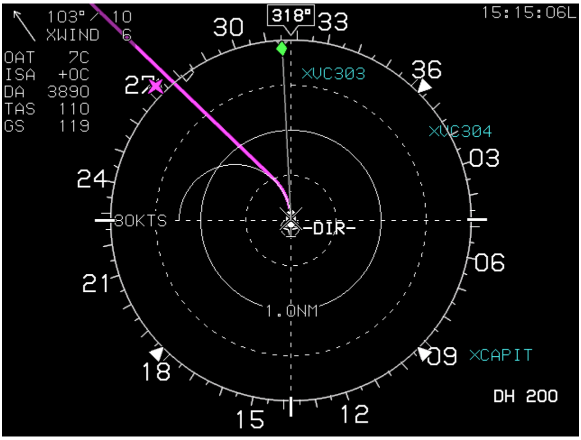


Figure 3-108: Hover Vector Projected Path

3.7.7. Air Data and Groundspeed

Displayed as specified in § 3.4.5.

3.7.8. Clock

Displayed as specified in § 3.4.4.

3.7.9. AGL Indication

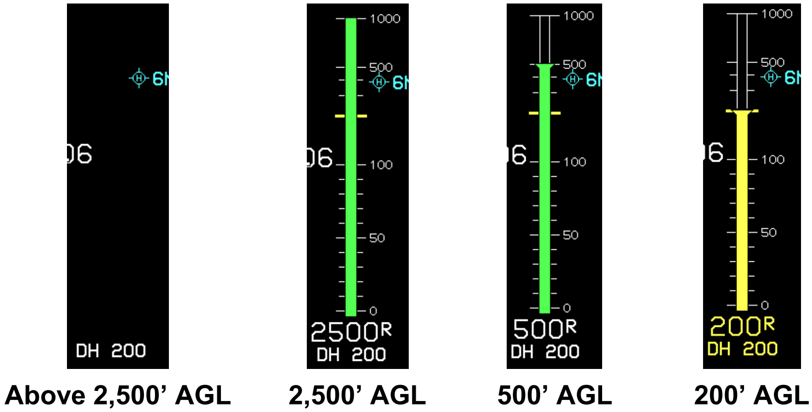


Figure 3-109: Hover Vector AGL Indication

AGL altitude is displayed as an analog indication and digital readout on the right side of the hover page, which is driven by whatever AGL altitude source being used as defined in § 3.3.3.

Digital readout of AGL altitude is not displayed when it is greater than the radar altimeter maximum valid altitude nor 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 (Table 3-2).

Table 3-20: Analog AGL Indication Designed Parameters		
Altitude Range	**Markings**	**Notes**
0-1000’	Green-filled column	Thermometer fashioned style. Top of column has a widened area for better registration against the scale accordingly, so the widened area disappears at AGL altitudes greater than 1,000 feet (i.e., maximum analog indication).
Scaling		
0 to 100’	Linear	0’ AGL is at the bottom, 50’ AGL is at 25% of height, 100’ AGL is at 50% of height, 200’ AGL is at 67% of height, 500’ AGL is at 83% of height, and 1,000’ AGL is at full height
100’-1,000’	Logarithmic	
Major Tick Marks		
0’, 50’, 100’, 500’, and 1,000’		
Minor Tick Marks		
10’, 20’, 30’, 40’, 60’, 70’, 80’, 90’, 200’, 300’, and 400’		
Color-filled column is not displayed when AGL altitude is invalid. Analog indication of AGL altitude (including the scale) 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.		

3.7.10. Decision Height Indication

AGL indication includes a display of the set decision height altitude as described in § 3.3.5.

Section 4 Reversionary Modes

4.1. Reversionary Modes

The equipment has eight reversionary modes as follows:

Mode 0: GPS/SBAS, ADC, and AHRS normal.

Mode 1: GPS/SBAS failed; ADC and AHRS normal.

Mode 2: ADC failed; GPS/SBAS, and AHRS normal.

Mode 3: AHRS failed; GPS/SBAS, and ADC normal.

Mode 4: GPS/SBAS and ADC failed; and AHRS normal.

Mode 5: GPS/SBAS and AHRS failed; and ADC normal.

Mode 6: ADC and AHRS failed; and GPS/SBAS normal.

Mode 7: GPS, ADC, and AHRS failed.

To use this section, review the following table and notes to determine what feature or function is affected by one or more of the three sensors failed conditions. Examples follow with the IDU-450 displays in various configurations with a table breaking down the affected functions.

Not all possible IDU-450 display configurations and format combinations are represented here. All eight modes of system operation are represented for description purposes.

Table 4-1: Reversionary Mode Status (PFD)								
PFD Functions	**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	25	-	-	-	-	-
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	-	-	-	-	-	-
Hover Vector	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 Scale	OK	OK	OK	-	OK	-	-	-
Highway in the Sky	OK	1 + 15	-	-	-	-	-	-
Terrain/Obstructions	OK	-	25	-	-	-	-	-
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	-	-	-	-	-	-

Table 4-2: Reversionary Mode Status (ND)								
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	-
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	-	25	OK	-	-	25+ 9	-
Clock Functions	OK	OK	OK	OK	OK	OK	OK	OK
Waypoint Brg./Dist.	OK	1	OK	OK	-	-	OK	-
Wind	21	3	-	-	-	-	-	-
WX-500 Data	OK	OK	OK	OK	OK	OK	OK	OK
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 4-3: Reversionary Mode Status (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
TCAS-II RA Display Valid	16	16	-	16	-	16	-	-
TCAS-II TA Display Valid	16	16	16	16	16	16	16	16
Transmit Enabled	16	16	16	16	16	16	16	16
Warning Light Output	16	16	16	16	16	16	16	16
Caution Light Output	16	16	16	16	16	16	16	16
Mstr. Caut. Light Output	16	16	16	16	16	16	16	16
MDA/DH Output	16	16	18	16	18	16	18	18
Altitude Capture Output	16	16	-	16	-	16	-	-
IAS Switch Output	16	16	-	16	-	16	-	-

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/SBAS failure.

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

Note 5: Waterline symbol expanded to large attitude bars. Rotorcraft versions (Part 27 or Part 29 airspeed scale), 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 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: Presents 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 1 minute to indicate degraded operation.

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

Note 16: See IDU SCC Card and Limits Requirements 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 (Part 27 or Part 29 airspeed scale), 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 the pilot is unable to dead-reckon due to loss of heading or true airspeed cannot be calculated, endurance only information is presented.

Note 25: Inhibited in accordance with the conditions specified in TAWS automatic inhibit function (abnormal operation).

4.1.1. Oat Sensor Failure Mode

The EFIS has an OAT sensor failure mode. With the OAT sensor failed, wind, OAT, density altitude, and true airspeed are not displayed on the ND.

4.1.2. Heading Failure Mode

The EFIS has a heading failure mode. With heading failed, the PFD heading scale and MFD compass rose align with track (if available) or are removed and replaced with a red-X.

The PFD heading scale includes “GPS TRK” around the track marker to clearly indicate a heading failure mode.

Figure 4-1: GPS TRK

4.1.3. PFD Screen Auto Reversion

For IFR approval in aircraft, flight instrument information essential to safety of flight remains available to the pilot without additional crewmember action after a failure. To accommodate this, MFDs have the ability to sense when the PFD has failed and take over the PFD function automatically. Therefore, when an MFD (IDU #2, 3, or 4) becomes the transmit-enabled IDU, the MFD automatically switches to the PFD screen. Push ❶ to change the MFD to other screens after the automatic switch.

4.1.4. GPS Failure

GPS degrades or fails as a result of loss of satellite information or GPS equipment failure. When SBAS provides the integrity, the EFIS issues a loss of integrity (LOI) caution within two seconds, if the current horizontal protection level (HPL) exceeds the horizontal alert level (HAL). LOI caution appears when there is no integrity monitoring and disappears when it is restored.

Figure 4-2: LOI Caution

Further GPS degradation causes the EFIS to lose GPS updating of aircraft position, ground speed, and ground track, and the ability to calculate the wind information.

1) 

(Loss of Integrity) displayed with no time delay.

2) HPL > HAL for the phase of flight currently in. Position is still presented based upon a GPS navigation solution.

3) 

(Loss of Navigation) displayed with no time delay of the onset of the following:

   a) The absence of power;

   b) Equipment malfunction or failure;

   c) The presence of a condition lasting five seconds or more where there are an inadequate number of satellites to compute position solution;

   d) Fault detects a position failure that cannot be excluded within time-to-alert when integrity is provided by FDE;

   e) HPL > HAL on the final approach segment: Genesys Aerosystems EFIS does not transition to DR navigation at this stage. A GPS navigation solution is still presented; and

   f) Where HPL > HAL on the final approach segment, this position may still be satisfactory for GPS navigation. For example, an HPL of 0.31NM exists, which means as soon as a transition to terminal mode occurs, all alerts disappear. This is significantly important during a wind change if the system had been in a DR mode.

NOTE:

At any time, view HFOM on the FAULTS page to see the system-reported accuracy.

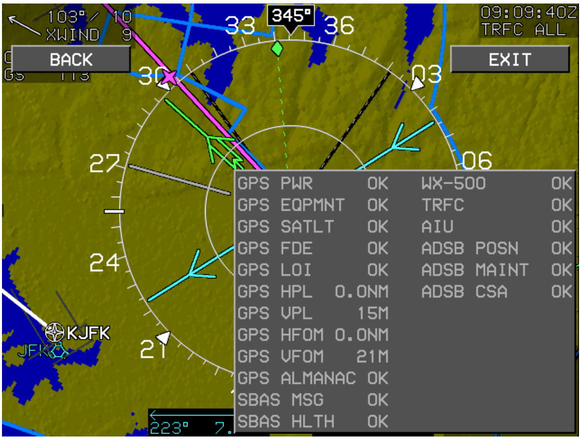


Figure 4-3: FAULTS Page on MFD

1) **DR** (Dead Reckoning)

   a) If a GPS position cannot be calculated, a dead reckoning solution is provided with a timer DR 01:23. This solution is calculated from heading and TAS derived from the AHRS and ADC.

2) **Loss of Vertical Navigation**

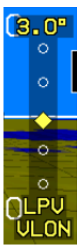


Figure 4-4: Loss of Vertical Navigation (VLON)

If the navigation equipment is no longer adequate to conduct or continue the LNAV/VNAV approach, "VLON" appears within one second of the onset of any of the following conditions:

   a) The absence of power;

   b) Equipment malfunction or failure;

c) The presence of a condition where fault detection detects a position failure that cannot be excluded;

d) There are an insufficient number of SBAS HEALTY satellites;

e) The horizontal protection level exceeds the alert limit as follows for LNAV/VNAV approaches:

   i) Prior to sequencing the FAWP- HAL should be 0.3 NM with no limit on VAL

   ii) After sequencing the FAWP- HAL 556m (0.3NM) and VAL 50m

When in LNAV mode, the fault detection function detects positioning failures within 10 seconds after the onset of the positioning failure.

4.2. PFD and MFD Failure Mode Examples

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. The PFD and MFD are affected as follows.

4.3. PFD Failure Mode 0

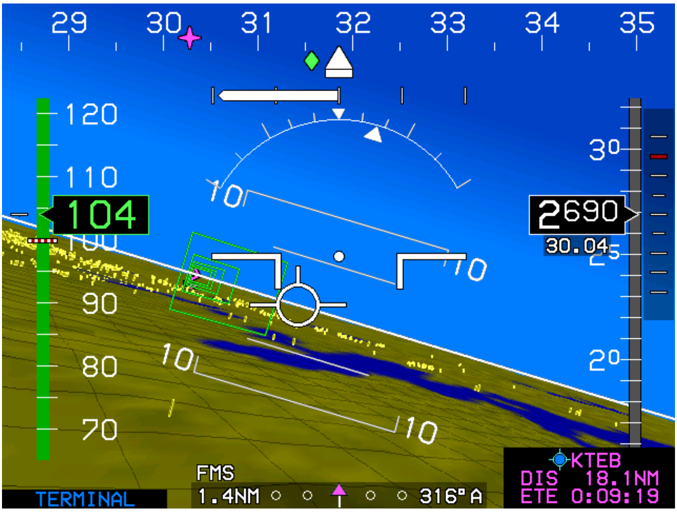


Figure 4-5: PFD Failure Mode 0
GPS, ADC, and AHRS Normal

4.3.1. MFD Failure Mode 0 (Normal Mode)

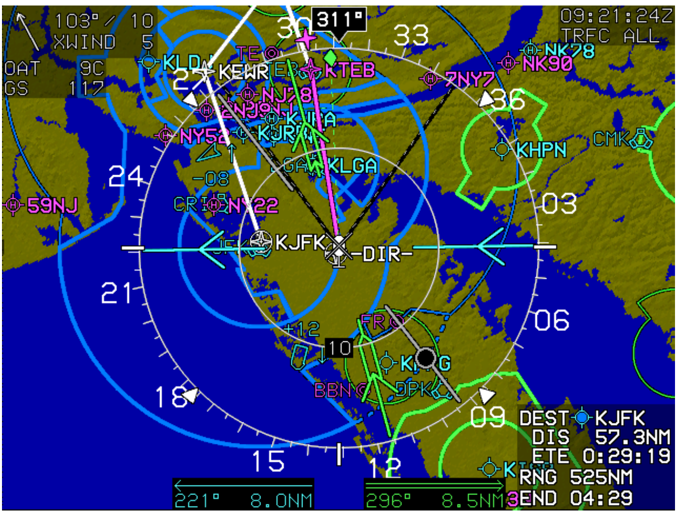


Figure 4-6: MFD Failure Mode 0 (Normal Mode)
GPS, ADC, and AHRS Normal

4.4. PFD Failure Mode 1

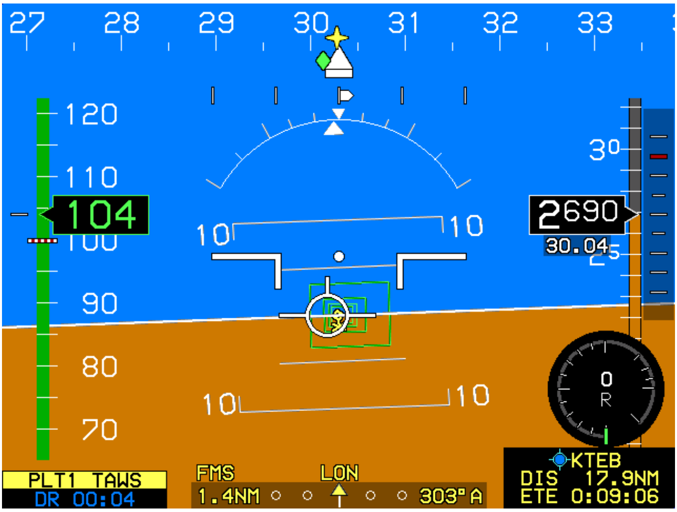


Figure 4-7: PFD Failure Mode 1
GPS/SBAS Failed; ADC and AHRS Normal

4.4.1. MFD Failure Mode 1

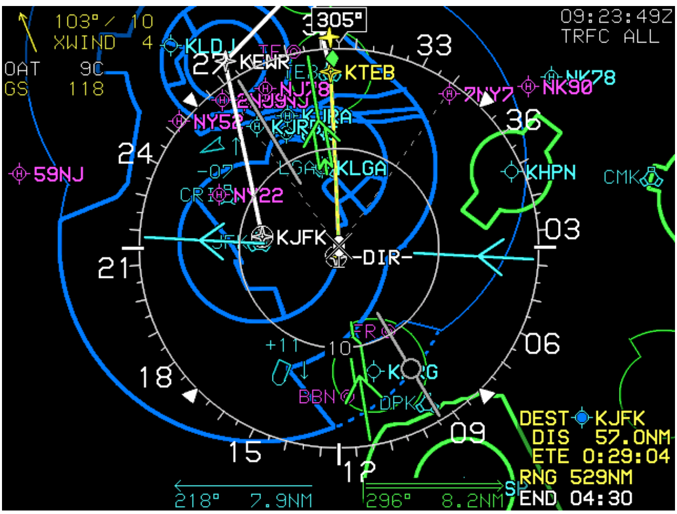


Figure 4-8: MFD Failure Mode 1
GPS/SBAS Failed; ADC and AHRS Normal

4.5. PFD Failure Mode 2 (Normal Mode)

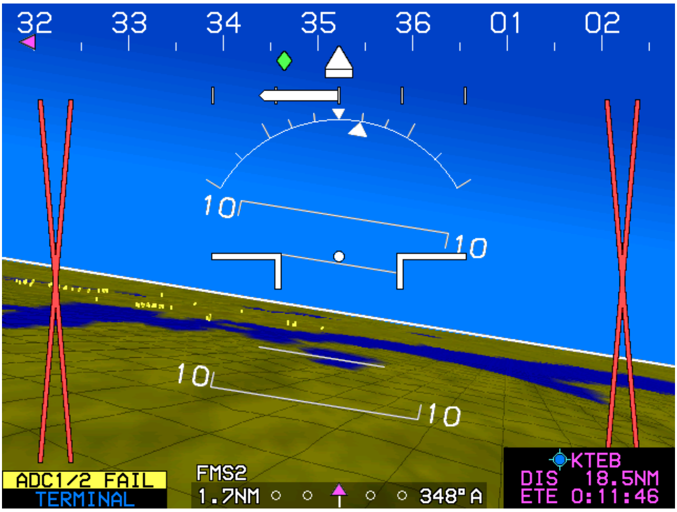


Figure 4-9: PFD Failure Mode 2 (Normal Mode)
ADC Failed; GPS/SBAS and AHRS Normal

4.5.1. MFD Failure Mode 2

Figure 4-10: MFD Failure Mode 2
ADC Failed; GPS/SBAS and AHRS Normal

4.6. PFD Failure Mode 3

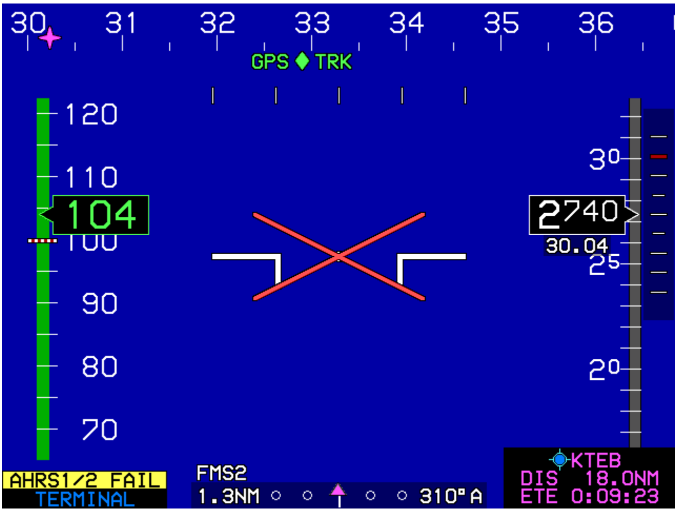


Figure 4-11: PFD Failure Mode 3
AHRS Failed; GPS/SBAS and ADC Normal

4.6.1. MFD Failure Mode 3

Figure 4-12: MFD Failure Mode 3
AHRS Failed; GPS/SBAS and ADC Normal

4.7. PFD Failure Mode 4

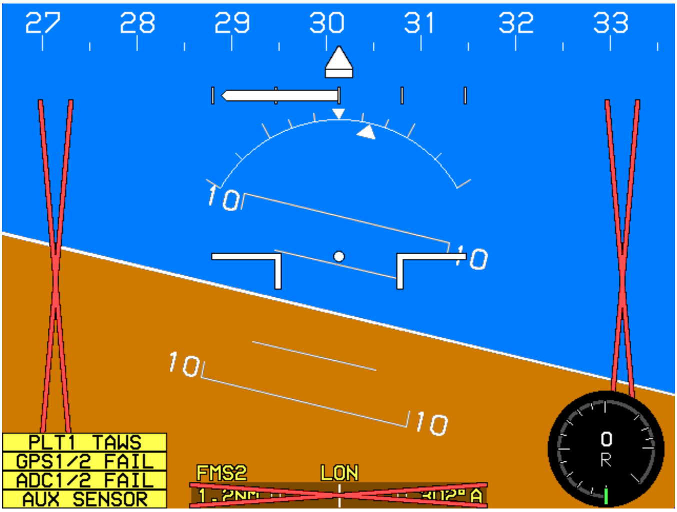


Figure 4-13: PFD Failure Mode 4
GPS/SBAS and ADC Failed; AHRS Normal

4.7.1. MFD Failure Mode 4

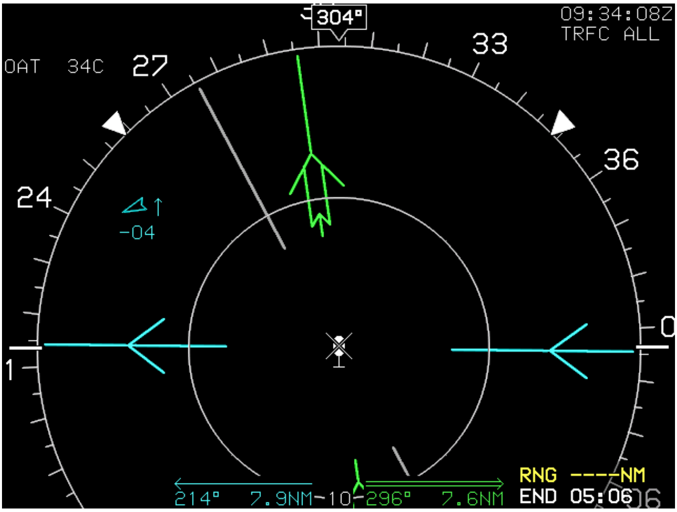


Figure 4-14: MFD Failure Mode 4
GPS/SBAS and ADC Failed; AHRS Normal

4.8. PFD Failure Mode 5

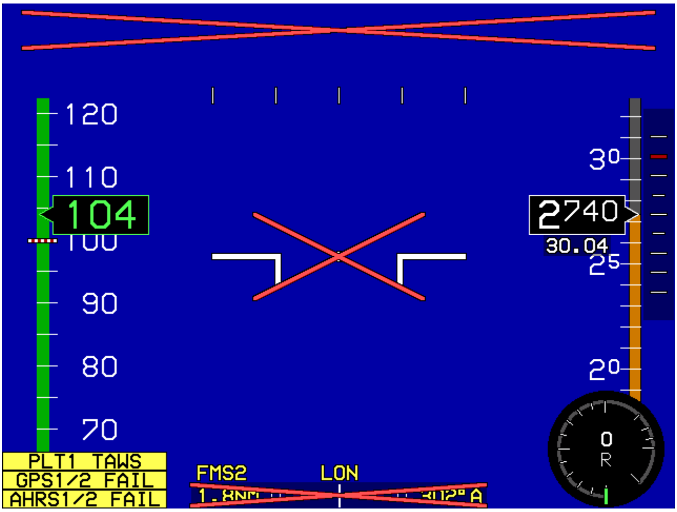


Figure 4-15: PFD Failure Mode 5
GPS/SBAS and AHRS Failed; ADC Normal

4.8.1. MFD Failure Mode 5

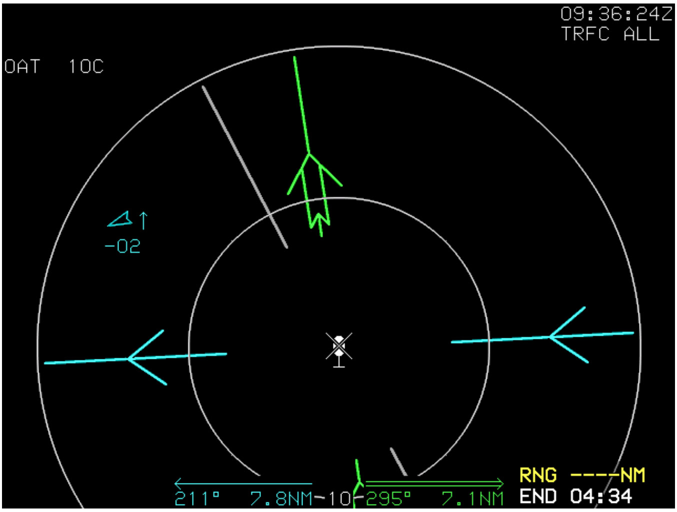


Figure 4-16: MFD Failure Mode 5
GPS/SBAS and AHRS Failed; ADC Normal

4.9. PFD Failure Mode 6

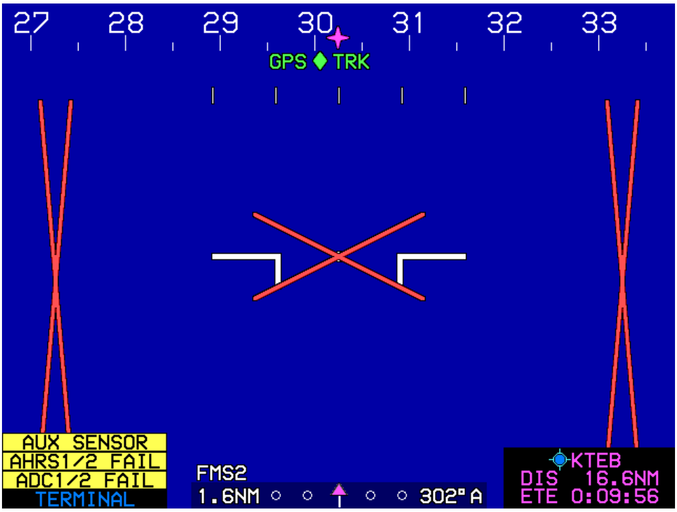


Figure 4-17: PFD Failure Mode 6
ADC and AHRS Failed; GPS/SBAS Normal

4.9.1. MFD Failure Mode 6

Figure 4-18: MFD Failure Mode 6
ADC and AHRS Failed; GPS/SBAS Normal

4.10. PFD Failure Mode 7

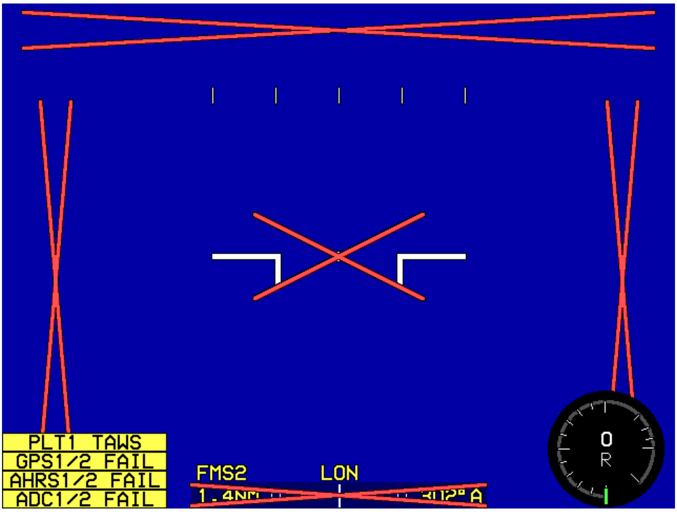


Figure 4-19: PFD Failure Mode 7
GPS/SBAS, ADC, and AHRS Failed

4.10.1. MFD Failure Mode 7

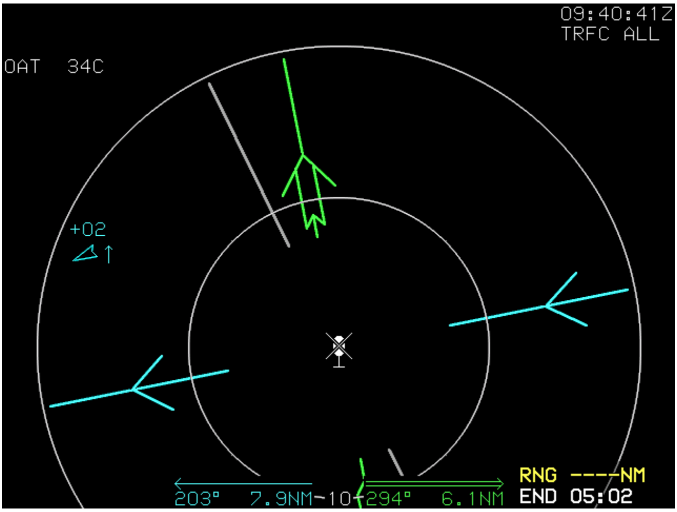


Figure 4-20: MFD Failure Mode 7
GPS/SBAS, ADC, and AHRS Failed

Section 5 Menu Functions and Step-By-Step Procedures

5.1. Menu Functions

Figure 5-1: IDU-450 Input Controls

The top-level menu level corresponds to the permanent labeling of the IDU buttons and is active any time no soft menu options appear on the screen. Soft menu function tiles appear next to the appropriate IDU button and the right encoder (❶) when appropriate.

On the PFD, scroll ❶ to activate the heading menu. On MFD pages with an adjustable display (e.g., ND, strikes, traffic, datalink, or hover) scroll ❶ to change the display scale (CW = increase scale, CCW = decrease scale).

Table 5-1:Encoder Functions for All Pages

	**PFD page**
	**MFD Map page**
	**MFD Datalink page**

With the exception of IDU #1, push ❶ to swap between the PFD and MFD, unless the IDU is in MFD-only mode. IDU #1 is always configured to the PFD page.

5.1.1. Menu Philosophy

The menu system and buttons with an action are clearly labeled. The following rules are in the design of the menu system:

EXIT (R1): Whenever menu system is beyond the top-level, provides a one-touch escape to the top-level.

BACK (L1): Whenever soft menu level is deeper than the first-level, regresses through the menu system by one level.

Soft menu tiles: Used (even at the top-level) and are annunciated on the screen adjacent to the appropriate IDU button or encoder when appropriate.

Selection list: Menus adjacent to ❶ are frequently a selection list. Lists too long to be presented in the space available provide an indication of location within the list.

Within lists or on a soft menu tile, a two-dot trailer indicates further menu levels.

Menu messages are displayed for five seconds but are cleared if no IDU button is pressed or encoder pushed or scrolled.

Figure 5-2: IDU-450 Input Controls

5.1.2. Avoidance of Autonomous Behavior

TAWS/HTAWS popups: When an FLTA alert is generated, a popup function enables PFD SVS TAWS feature and activates terrain at an appropriate scale and format on the MFD moving map page. This is a required function of TSO-C194 for Enhanced HTAWS and is enabled in the other TAWS/HTAWS options integrated in the EFIS software. (See Section 8 Terrain Awareness Warning System for details.)

Traffic popups: When a traffic alert is generated, a popup function displays traffic on the PFD, traffic thumbnail and MFD moving map page.

5.2. Menu Synchronization

System settings changed by the menu system are synchronized between multiple IDUs in MFD-MFD mode. All parameters for rotorcraft are included. Each appendix for Datalink, Strikes, RBP, and Traffic contains specific limitations for menu synchronization for that feature.

Table 5-2: Menu Synchronization

Menu Parameter	**Notes**
The following menu parameters are synchronized across all displays at all times. These are bugs and fundamental aircraft values that should never have independence.	
AHRS 1 and 2 mode and slewing values	
Fuel Totalizer Quantity	
VNAV Climb Angle	
Countdown Timer Start Time	
Countdown Timer Default Value	
Remote Tune Frequencies	
VNAV Descent Angle	
Decision Height Setting	Used when “Dual Decision Height Flag” as set in EFIS limits.
Emergency and Minimum Fuel Settings	
Heading Bug and Heading Sub-Mode	
High Weight V_{NE} selection	
Minimum Altitude Bug Value	
VLOC OBS Settings	
Airspeed Bug Setting	
Target Altitude Bug Setting	
Timer Starting Signal	
True North Mode	
UTC Offset	
VSI Bug Setting	
Crosslink Synchronization Status	
The following menu parameters are synchronized across all displays when crosslink is enabled. Otherwise, they are only synchronized onside. These parameters are FMS parameters and allow the pilot and co-pilot FMSs to be operated independently when crosslink is inhibited.	
Active Flight Plan Parameters	
Runway Display Parameters	
The following menu parameters are only synchronized onside. These parameters are usually sensor selections or PFD options used to keep	

Table 5-2: Menu Synchronization

Menu Parameter	Notes
the appearance of any pilot's PFD consistent in the case of PFD reversion. The onside characteristic means that individual pilots can still adjust their PFD settings to their preference.	
Sensor Selections	
Transition Altitude	
Barometric Setting Parameters (Baro, Transition alt, set QFE Baro)	
Decision Height Setting	Used when "Dual Decision Height Flag" as set in EFIS limits.
Navigation Source	
Horizon Synchronization Parameters	
PFD Basic Mode	
PFD Zoom Mode	
PFD Analog AGL	
PFD Full-time Bank Scale Flag	
PFD Flight Director Show Flag	
PFD Mini map Show Flag	
PFD Altitude (meters) Show Flag	
PFD Skyway Show Flag	
PFD Terrain Show Flag	
Rate of Turn Indication flag	
The following menu parameters are independent between displays. These are used to support non-PFD display options to give the pilot maximum MFD operating flexibility. Note that some of these parameters are also independent between top and bottom MFD areas as specified in the notes.	
CPU Type	To support mixed CPU type installations
MFD Hover Page Scale	
MFD Selected Page	
450 Screen Display Status	Support for 450 reversion
MFD Map Function Declutter Settings	
MFD Show ETA Flag	
MFD Map NavData® Symbol Declutter Settings	
MFD Map and HSI Page Pointer Settings	

5.3. Menu Function Types

There are two types of menu functions on the IDU-450; top-level menu functions corresponding to the labeled button, and soft menu functions indicated by menu tiles, which appear on screen. Soft menu function tiles appear next to the appropriate IDU button or in the lower right corner when use of the encoder is appropriate. Soft menu functions take precedence over IDU button functions.

5.4. Top-Level Menu

On the IDU-450, the top-level menu corresponds to the permanent label of the IDU buttons and is active anytime no soft menu options appear on the screen.

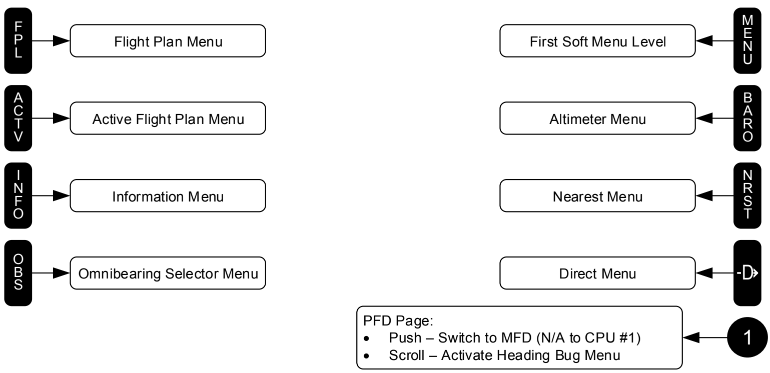


Figure 5-3: PFD Top-Level Menu

5.4.1. Top-Level Menu Option Descriptions

1) **FPL (L1)**: Flight plan menu

2) **ACTV (L2)**: Active flight plan menu (§ 5.8.2)

3) **INFO (L3)**: Information menu

4) **OBS (L4)**: Omnibearing selector menu

5) **MENU (R1)**: First-level associated with the current display page and times out after 10 seconds if there are no subsequent pilot actions.

6) **BARO (R2)**: Altimeter menu

7) **NRST (R3)**: Nearest menu (§ 5.8.2)

8)  **(R4)**: Direct menu (§ 5.8.2)

9) **#1 Encoder** (❶)

a) On a PFD, scroll to activate the heading menu.

b) On MFD pages with an adjustable display scale (e.g., ND, Strikes, Traffic, Datalink, or Hover,), scroll to change display scale (CW = increase, CCW = decrease).

c) With the exception of IDU #1, push to swap between the PFD and MFD. IDU #1 is always fixed to the PFD page.

5.4.2. Top-Level Menu Automatic Pop-up Function Descriptions

Soft menu tiles appear adjacent to buttons under the specified conditions.

Table 5-3: Top-Level Menu Automatic Function Descriptions

	Tile Legend and Action in Order of Precedence
FPL (L1)	1) When a terrain popup occurs during a TAWS FLTA alert, **RESET** appears. (MFD only) 2) When ND page with pan mode enabled, **PN OFF** appears. Press to disable pan mode. **RESET** has precedence over **PN OFF**. (MFD only) 3) When display is transmit enabled, **LNAV** appears when there is an active flight plan, heading bug sub-mode is active, and the system is integrated with an analog autopilot. Press to deactivate heading bug sub-mode and resume guidance to active flight plan path. (PFD only) 4) When display is transmit enabled, **MISS** appears upon transitioning the FAF. Press to activate the missed approach procedure. 5) When the display is transmit enabled, **HDG** appears when LNAV sub-mode is active and the system is integrated with an analog autopilot with HDG mode engaged. Press to deactivate LNAV sub-mode and resume guidance to the heading bug. (PFD only)
ACTV (L2)	1) When showing ND page with: (a) pan mode enabled; (b) information for the nearest highlighted waypoint is shown; and (c) airport weather information present in the information block. 2) When the display is transmit enabled and HRZ SYNC is armed, **HS ON** appears. Press to engage HRZ SYNC mode and apply the appropriate offset to displayed pitch attitude. (PFD only)

Table 5-3: Top-Level Menu Automatic Function Descriptions

	Tile Legend and Action in Order of Precedence
	3) When the display is transmit enabled and HRZ SYNC is engaged, **HS OFF** appears. Press to cancel HRZ SYNC mode. **UP** has precedence over **HS OFF**. HRZ SYNC is also automatically cancelled by flying beyond the arming range. In most cases, it is anticipated that HRZ SYNC will be cancelled automatically by accelerating through the arming speed rather than by pressing **HS OFF**. (PFD only) 4) When the display is transmit enabled, **CONT** appears when in a holding pattern with further active flight plan legs after the holding pattern. Press to re-enabled automatic waypoint sequencing to allow normal sequencing to the leg after the holding pattern. (PFD only) 5) When display is transmit enabled, **RESUME** appears when a manual leg is active with further non-manual active flight plan legs after the manual leg. Press to activate a Direct-To waypoint following the manual leg. (PFD only) 6) When the display is transmit enabled, **VNAV** appears when VNAV guidance is valid, the selected altitude sub-mode is active, and the system is integrated with an analog autopilot. Press to deactivate selected altitude sub-mode and resume guidance to VNAV path. (PFD only) 7) When the display is transmit enabled, **ARM** appears when on the final approach segment (between FAF and MAP). Press to arm missed approach procedure to automatically activate upon sequencing MAP. (PFD only)
INFO (L3)	When ND page with pan mode enabled, **NORTH** appears. Press to shift the center of the page in the specified direction.
OBS (L4)	When ND page with pan mode enabled, **SOUTH** appears. Press to shift the center of the page in the specified direction.
BARO (R2)	When ND page with pan mode enabled, **INFO** or **HIDE** appears. Press to toggle the display of information for the nearest highlighted waypoint.
NRST (R3)	When ND page with pan mode enabled, **EAST** appears. Press to shift the center of the page in the specified direction.
 **(R4)**	When ND page with pan mode enabled, **WEST** appears. Press to shift the center of the page in the specified direction.

5.5. First Page (PFD)

On the IDU-450, IDU #1 is fixed to the PFD page, and other IDUs may show the PFD page as a backup function. IDU-450 PFD page first-level options are as follows.

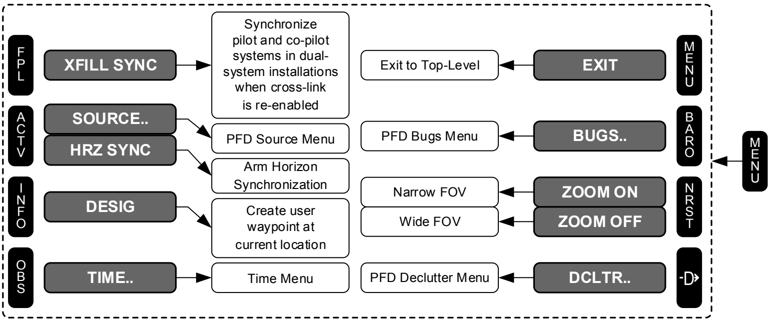


Figure 5-4: First Page PFD

5.5.1. PFD Page First-Level Option Descriptions

1) **XFILL SYNC (FPL) (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.

Table 5-4: Crossfill Inhibit/Arm/Sync Function

Crossfill (1)	Flight Plan	Indication (Pilot and Co-pilot)	Action to Synchronize Flight Plans		Result
			Pilot	Co-pilot	
Enabled (Cond.1)	Synchro-nized	None	None	None	No action required. Pilot and co-pilot sides already synchronized.
Enabled (Cond.2)	Not Synchro-nized (2)	XFILL ARM	**MENU (R1)** **XFILL SYNC (L1)**	None	Pilot's flight plan is sent to co-pilot side and both sides are synchronized going forward. XFILL ARM is removed from both sides.
			None	**MENU (R1)** **XFILL SYNC(L1)**	Co-pilot's flight plan is sent to pilot side and both sides are

Table 5-4: Crossfill Inhibit/Arm/Sync Function

Crossfill [1]	Flight Plan	Indication (Pilot and Co-pilot)	Action to Synchronize Flight Plans		Result
			Pilot	Co-pilot	
					synchronized going forward. XFILL ARM is removed from both sides.
Inhibited (Cond.3)	Not Synchro-nized	XFILL INHBT	Enable crossfill [1] (proceed to Cond. 2)		XFILL INHBT removed. XFILL ARM displayed on both sides.

[1] Crossfill is inhibited with the use of a latching (ON) crossfill inhibit switch. Crossfill is enabled by releasing (OFF) this switch. The location and number of crossfill inhibit switches in a cockpit varies by installation. Usually a single crossfill switch can be centrally located in a side-by-side cockpit within reach of both pilots. If a single switch cannot be installed within reach of both pilots (tandem cockpits or very wide cockpits), two switches can be installed to function in parallel (either switch inhibits or enables crossfill on both the pilot and co-pilot sides).

[2] Pilot and co-pilot flight plans can become unsynchronized under the following conditions:

- Crossfill is inhibited, and pilot and co-pilot flight plans are separately changed before crossfill is re-enabled.
- Either the pilot or co-pilot side is restarted with an active flight plan on the other side and crossfill enabled.

2) **HRZ SYNC (L2)**: When the display is transmit enabled and horizon synchronization function is available, arms horizon synchronization function.

3) **SOURCE (L2)**: Activates PFD source selection menu. **HRZ SYNC** has precedence.

4) **DESIG (INFO) (L3)**: Creates a user waypoint at the current aircraft location. In addition, if pressed with an ND page operating in pan mode, creates a user waypoint at the panning location. User waypoint at current aircraft location is automatically named “OF###,” where ### is the next available over-fly user waypoint number. User waypoint at panning location is automatically named “PN###,” where ### is the next available panning user waypoint number. When pressed and the number of user waypoint count is more than 998, the **USER WPTS FULL** message appears.

5) **TIME (OBS) (L4)**: Activates time menu

6) **BUGS (BARO) (R2)**: Activates PFD bug set menu

7) **ZOOM ON/ZOOM OFF (NRST) (R3)**: Toggles between wide FOV mode and narrow FOV mode. **ZOOM ON** appears when current mode is wide FOV. **ZOOM OFF** appears when current mode is narrow FOV.

8) **DCLTR (R4):** Activates PFD declutter menu option.

5.5.2. PFD Screen First Soft Menu Level

When horizon synchronization is available and the IDU is transmit enabled, **HRZ SYNC (L2)** appears in the PFD screen first soft menu level. **HRZ SYNC** takes precedence over the PFD source menu. Press **HRZ SYNC (L2)** to arm horizon synchronization mode. It is anticipated the pilot takes this action on a Cat. A departure prior to lifting the helicopter into hover flight.

XFILL SYNC (L1) appears in the PFD screen first soft menu level when all of the following conditions are met:

1) Crosslink status is enabled; and

2) Crosslink synchronization status is not enabled; and

3) Discrete input for Crossfill Inhibit is not enabled; and

4) Side in command is valid; and

5) AFCS Status is set to invalid.

5.5.3. First-Level (MFD)

IDUs other than #1 may show various MFD pages as described in § 5.22. MFD first-level options are as follows.

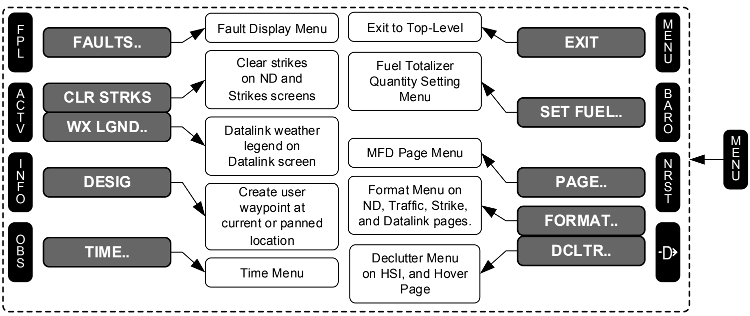


Figure 5-5: First-Level MFD

1) **FAULTS (FPL) (L1)**: Activates fault display menu

2) **CLR STRKS (ACTV) (L2)**: On ND or Strikes page with WX-500 option enabled, **CLR STRKS** activates strike clear option for the Goodrich/L-3 WX-500. On Datalink page, **WX LGND..** activates datalink weather legend (see Datalink appendix).

3) **DESIG (INFO) (L3)**: Same function as PFD page first-level

4) **TIME (OBS) (L4)**: Same function as PFD page first-level

5) **SET FUEL (BARO) (R2)**: Activates fuel totalizer set menu

6) **PAGE (NRST) (R3)**: Activates MFD display page select menu

7) **FORMAT** or **DCLTR (R4)**:

   a) **FORMAT**: On ND, traffic, strikes, and datalink pages, activates appropriate page format menu option.

   b) **DCLTR**: On HSI page with optional VOR or ADF symbology enabled, activates HSI declutter menu.

5.6. Lower-Level Menus (Below First-Level)

Top-level and first-level menus, called lower-level menus, and the eight buttons and encoder control them as seen in Figure 5-1.

5.7. Flight Plan (FPL) Menu

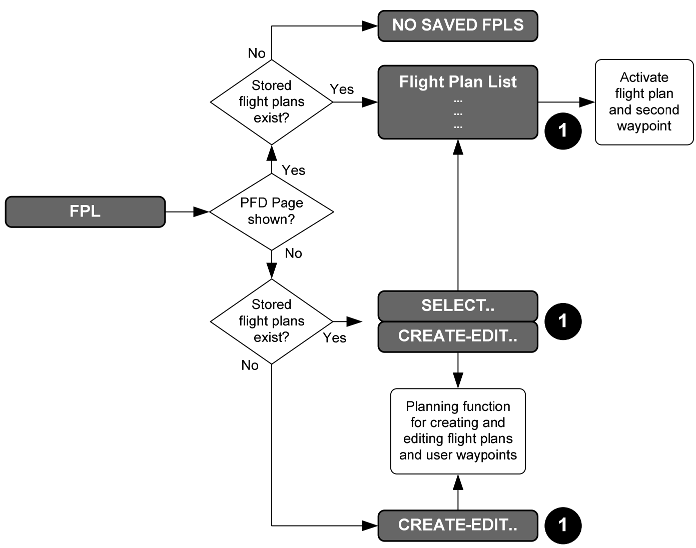


Figure 5-6: Flight Plan Menu

5.7.1. Flight Planner Page

The flight planner is used for following functions on pilot-modifiable elements in the IDU database.

1) Manage stored flight plans (activate, create, edit, delete, and reverse);

2) Manage user waypoints (create, edit, and delete); and

3) Perform RAIM predictions.

Because the flight planner takes over the IDU's controls, limitations are placed upon access and display of the flight planner. The flight planner is not available when a PFD page is being displayed on the IDU. (MFD in reversion mode).

When the flight planner is accessed, it only appears on the MFD to preserve access to crucial PFD page controls such as altimeter settings.

5.7.2. PFD Page Shown

Upon activation of the flight plan menu, the system checks for existing saved flight plans. If there are no saved flight plans, **NO SAVED FPLS** appears. 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.

5.7.3. MFD Page Shown on IDU

Upon activation of the flight plan menu, the system checks for existing saved flight plans. If there are no saved flight plans, the flight planner is activated. Otherwise, an option list is presented for the pilot to either select a saved flight plan or enter the flight planner. Selecting the saved flight plan 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.

5.7.4. Create an Overfly User Waypoint

When flying over intended waypoint, press **MENU (R1)** and then **DESIG (L3)** on the PFD or MFD. A user waypoint is created at the present position and automatically named "OF###", where '###' is the next in sequence overfly user waypoint number available. User waypoint at panning location is automatically named "PN###" accordingly. Change the waypoint name by using the **EDIT USER WPT** function on the MFD (§ 5.7.14).

Figure 5-7: Creation of Overfly User Waypoint

NOTE:

A maximum of 998 user waypoints may be created and stored. When an attempt is made to create additional user waypoints, **USER WPTS FULL** message appears.

5.7.5. Flight Plan (FPL) Menu Selecting (Step-By-Step)

1) Press **FPL (L1)**.
2) Scroll ❶ to desired flight plan and push to enter.

5.7.6. Flight Plan (FPL) Menu Create-Edit (MFD Only) (Step-By-Step)

1) Press **FPL (L1)**.

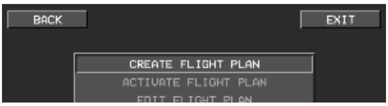
2) Scroll ❶ to **CREATE-EDIT..** and push to enter.

3) Push ❶ to enter.

4) Press **ADD (R2)** to begin creating first waypoint.

5) Either use ❶ to create a new waypoint or press **NRST APT.. (L2)**, **NRST VOR.. (L3)**, **NRST NDB.. (L4), NRST FIX.. (R2)**, or **NRST USR.. (R3)**, and make desired selection. Push ❶ to enter.

6) When finished, press **SAVE (R4)** to store the new flight plan as one of 100 flight plans in memory. If 100 flight plans are present, the **CREATE FLIGHT PLAN** option is absent.



7) If no other action is necessary, press **BACK (L1)** to return to function select page or **EXIT (R1)** to exit the menu.

5.7.7. Activate Flight Plan (MFD Only) (Step-By-Step)

1) Press **FPL (L1)**.

2) Scroll ❶ to **SELECT..** and push to enter.

3) Scroll ❶ to desired saved flight plan and push to enter to exit and return to normal operation.

Or

1) Scroll ❶ to **CREATE-EDIT..** and push to enter.

2) Scroll ❶ to **ACTIVATE FLIGHT PLAN** and push to enter.

3) Scroll ❶ to desired saved flight plan and push to enter.

4) If no other action is necessary, press **BACK (L1)** to return to function select page or **EXIT (R1)** to exit the menu.

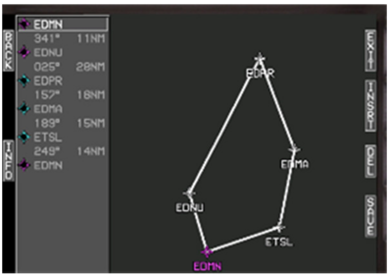
5.7.8. Edit Flight Plan (MFD Only) (Step-By-Step)

1) Press **FPL (L1)**.

2) Scroll ❶ to **CREATE-EDIT..** and push to enter.

3) Scroll ❶ to **EDIT FLIGHT PLAN** and push to enter.

4) Scroll ❶ to desired flight plan and push to enter.



5) Edit flight plan by adding or deleting waypoints as appropriate.

6) To save, press **SAVE (R4)**.

7) If no other action is necessary, press **BACK (L1)** to return to function select page or **EXIT (R1)** to exit the menu.

5.7.9. Reverse Flight Plan (MFD Only) (Step-By-Step)

1) Press **FPL (L1)**.

2) Scroll ❶ to **CREATE-EDIT..** and push to enter.

3) Scroll ❶ to **REVERSE FLIGHT PLAN** and push to enter.

4) Scroll ❶ to desired flight plan and push to enter.

5) If no other action is necessary, press **BACK (L1)** to return to function select page or **EXIT (R1)** to exit the menu.

5.7.10. Delete Flight Plan (MFD Only) (Step-By-Step)

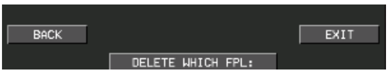
1) Press **FPL (L1)**.

2) Scroll ❶ to **CREATE-EDIT..** and push to enter.

3) Scroll ❶ to **DELETE FLIGHT PLAN** and push to enter.

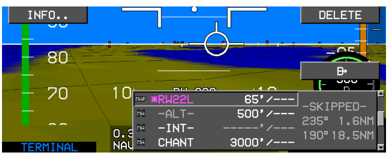
4) Scroll ❶ to desired flight plan to be deleted and push to enter.

5) Push ❶ to **CONFIRM DELETE FPL**.

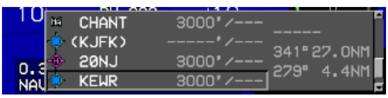


6) Next flight plan is highlighted. If no other action is necessary, press **BACK (L1)** to return to function select page or **EXIT (R1)** to exit the menu.

5.7.11. Changing Procedure in Active Flight Plan



1) Press **ACTV (L2)** to view active flight plan.



2) Scroll ❶ to desired airport where new approach is to be entered and push to enter.

3) Scroll ❶ to **IFR APPR..** and push to enter.

4) Scroll ❶ to desired instrument approach and push to enter.

5) Scroll ❶ to desired Transition and push to enter.

6) Scroll ❶ to desired runway and push to enter.

7) If this new approach is to replace the initial procedure, push ❶ to confirm.

Use same procedure for changing a STAR CONFIRM REPLACE STAR, DP CONFIRM REPLACE DP, or instrument approach procedure.

5.7.12. Create User Waypoint (LAT-LON) (MFD Only) (Step-By-Step)

User waypoints may be created with three methods:

1) Latitude and Longitude

2) Radial and Distance

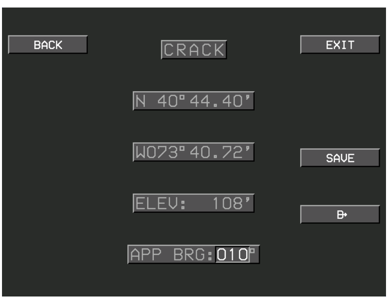
3) Overfly (Designate)

Follow the step-by-step procedure defined below to create a user waypoint using latitude and longitude.

1) Press **FPL (L1)**.

2) Scroll ❶ to **CREATE-EDIT..** and push to enter.

3) Scroll ❶ to **CREATE USER WPT (LAT-LON)** and push to enter. (Maximum of 998 user waypoints saved)



4) With new user waypoint name created, push ❶ to proceed through all fields as necessary.

Approach bearing preloading depends on mode of flight as follows:

On Ground: Preloaded with current heading

In Flight: Preloaded with “OFF” value.

If desired, specify the approach bearing to user waypoint in degrees 1°- 360°. “OFF” disables VFR approaches to the user waypoint.

NOTE:

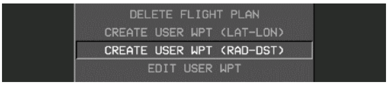
Pressing **EXIT (R1)** only exits menu and does not save the new USER WPT.

5) Press **SAVE (R3)** to save user waypoint or press  **(R4)** to create CRACK as the active waypoint and begin navigation guidance.

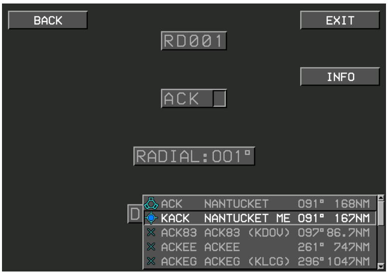
5.7.13. Create User Waypoint (RAD-DST) (MFD Only) (Step-By-Step)

1) Press **FPL (L1)**.

2) Scroll ❶ to **CREATE-EDIT..** and push to enter.



3) Scroll ❶ to **CREATE USER WPT (RAD-DST)** and push to enter. (Maximum of 998 user waypoints saved)



4) The identifier is automatically named RD### where ### is the next available radial distance waypoint number.*

5) In this case, ACK was not the desire waypoint. Scroll ❶ to the desired waypoint and push to enter.

6) Either press **SAVE (R3)** user waypoint or press **(R4)** to create RD001 as the Active waypoint and begin navigation guidance.

NOTE:

Pressing **EXIT (R1)** only exits menu and does not save the new USER WPT.

* **Reference Waypoint:** The pilot is prompted to enter an identifier for the reference waypoint on the second line. Use ❶ to enter the reference waypoint in the same manner as a waypoint is entered for a flight plan. 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. **INFO** menu appears at this level and provides access to information for the highlighted result.

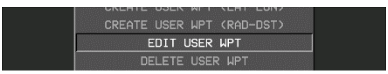
Radial Entry: The third line is for pilot to specify a radial from the reference waypoint in increments of degrees.

Distance Entry: The fourth line allows the pilot to specify a distance from the reference in increments of tenths of nautical miles.

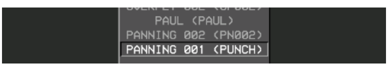
5.7.14. Edit User Waypoint (MFD Only) (Step-By-Step)

1) Press **FPL (L1)**.

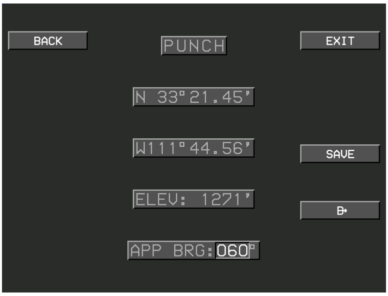
2) Scroll ❶ to **CREATE-EDIT..** and push to enter.



3) Scroll ❶ to **EDIT USER WPT** and push to enter.



4) Scroll ❶ to desired waypoint to be edited.



5) Use ❶ to enter alphanumeric characters; follow prompts to edit information. Push ❶ to step through all character spaces. To back up, press **BACK (L1)** and continue to the end of all character spaces.

6) Either press **SAVE (R3)** to save user waypoint or press  **(R4)** to create PUNCH as the active waypoint and begin navigation guidance.

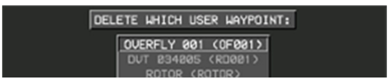
7) Press **EXIT (R1)** to save changes and exit the menu.

5.7.15. Delete User Waypoint (MFD Only) (Step-By-Step)

1) Press **FPL (L1)**.

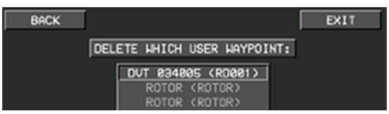
2) Scroll ❶ to **CREATE-EDIT..** and push to enter.

3) Scroll ❶ to **DELETE USER WPT** and push to enter.



4) Scroll ❶ to desired waypoint to be deleted.

5) Push ❶ to **CONFIRM DEL USER WPT**.



6) If no other waypoints to delete, press **EXIT (R1)** to exit the menu and return to MAP.

NOTE:

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, which use the waypoint, it must be deleted and replaced in the flight plans with the following steps:

1) EDIT the user waypoint as described in § 5.7.14.
2) Open a flight plan that uses the user waypoint.
3) Delete the existing waypoint from the flight plan.
4) Save and exit.
5) Reload the flight plan if it were in use.

5.7.16. RAIM Prediction

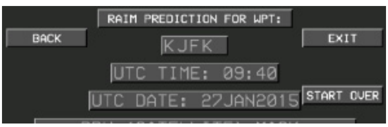
When selected, the RAIM prediction screen is only shown if the GPS/SBAS receiver is capable of performing a RAIM prediction (not suitable for enroute predictions). This requires there be no faults along with a current almanac in memory. Check the **FAULTS** menu to determine if the GPS/SBAS receiver is capable of performing a RAIM prediction.

1) Press **FPL (L1)**.

2) Scroll ❶ to **CREATE-EDIT..** and push to enter.

3) Scroll ❶ to **RAIM PREDICTION** and push to enter.

SEE NOTE BELOW.



4) If another RAIM Prediction is necessary, press **START OVER (R2)** to start the process again or press **EXIT (R1)** to exit the RAIM Prediction menu.

NOTE:

The pilot may perform RAIM prediction at a designated waypoint. The screen has various data entry boxes as follows.

1) Designated Waypoint: 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. **INFO (L3)** gives access to information for the highlighted results.

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.

5) EXIT: Allows exit of the RAIM prediction screen at any time.

6) Once a designated waypoint and UTC estimated time of arrival are entered, **CALC (R2)** appears for the pilot to initiate the RAIM Prediction. Press **CALC (R2)** to check the UTC estimated time of arrival and ensure it 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 ± in 5-minute increments. Once a prediction is complete, **START OVER (R2)** allows the pilot to perform another prediction without exiting the RAIM Prediction screen.

5.8. Active Flight Plan (ACTV) Menu

5.8.1. Main Menu

See Section 7 IFR Procedures for active flight plan description.

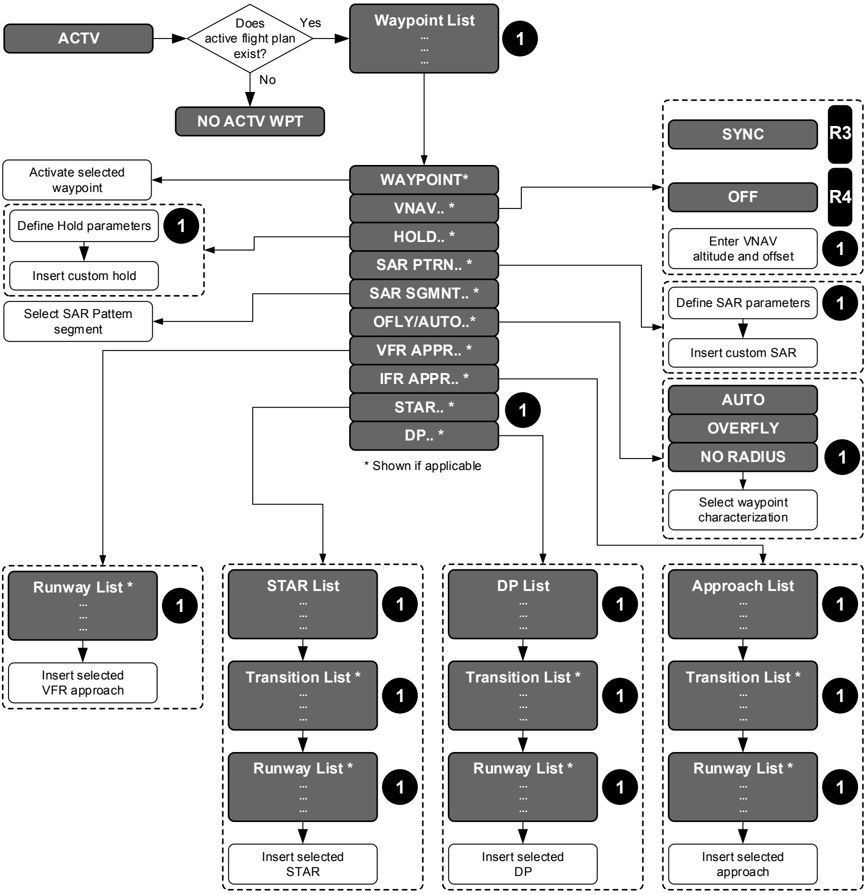


Figure 5-8: Active Flight Plan Main Menu

5.8.2. Active Flight Plan (ACTV) Menu Options

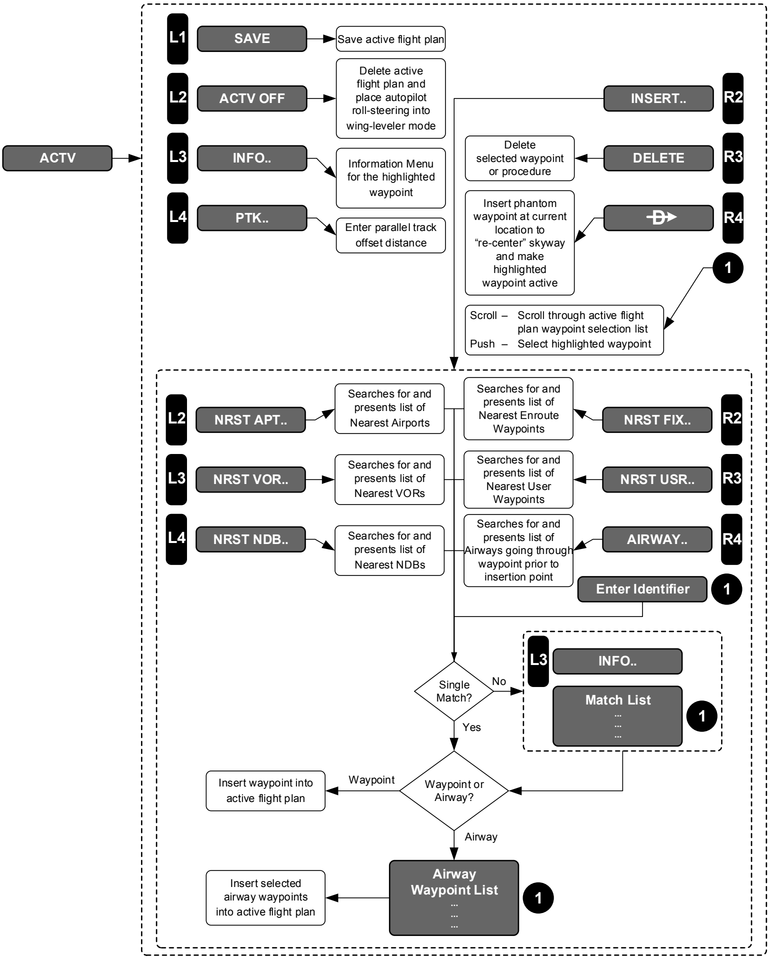


Figure 5-9: Active Flight Plan Menu Options

1) **SAVE (L1)**: Saves active flight plan. Stored flight plans are saved without procedures or phantom waypoint (this is a safety item as procedures potentially change every 28 days). Stored flight plans are named by their first and last waypoints. If the new stored flight plan has the same start and end points as a previously saved flight plan but has different routing, a number (0-9) is appended to the name to uniquely identify up to 10 routings with the same start and end points.

2) **ACTV OFF (L2)**: Deletes active flight plan. The pilot is prompted to confirm deletion prior to completion of the operation.

3) **INFO (L3)**: Activates information menu option for highlighted waypoint.

4) **PTK (L4)**: Shown if the active leg can be offset allowing the pilot to specify a parallel offset distance that applies to the active and contiguous legs. The range of parallel offsets are from 20NM left of track to 20NM right of track in 1NM increments.

5) **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)** appears, 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)** gives access to information for the highlighted result.

   AIRWAY (R4): Performs a search for all airways going through the highlighted waypoint and matching the entered identifier (i.e., to get a list of all Victor airways, Q-Routes and T-Routes going through the highlighted waypoint, enter an identifier string of “V”, “Q” or “T”). If there is a single result from the search, a list of airway waypoints is shown for the pilot to 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 for the pilot to 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 active flight plan.

6) **NRST APT (L2)**: Performs a search for 20 airports within 240NM nearest to the waypoint prior to the insertion point or, if there is no waypoint prior to the insertion point, current aircraft location. If there are no results (i.e., no airports within 240NM with a runway length greater than or equal to the minimum runway length setting), **NO RESULTS** is displayed. Otherwise, a selection list is displayed including identifier, bearing, and distance to each result. Upon selecting a result from the selection list, the item is inserted or added to the flight plan. **INFO (L3)** gives access to information for the highlighted result,

which includes datalinked weather information when available. With optional datalink, **WX LGND (L2)** and **EXPND WX (L3)** are available at this level to show a weather symbol legend and highlighted result METAR and TAF text respectively.

7) **NRST FIX (R2)**: Performs a search for 20 fixes within 240NM nearest to the waypoint prior to the insertion point or, if there is no waypoint prior to the insertion point, current aircraft location. If there are no results (i.e., no fixes within 240NM), **NO RESULTS** is displayed. Otherwise, a list is displayed including identifier, bearing, and distance to each result. Upon selecting a result, it is inserted or added to the flight plan. **INFO (L3)** gives information for the highlighted result.

8) **NRST NDB (L4)**: Performs a search for 20 NDBs within 240NM nearest the waypoint prior to the insertion point or, if there is no waypoint prior to the insertion point, current aircraft location. If there are no results (i.e., no NDBs within 240NM), **NO RESULTS** is displayed. Otherwise, a list is displayed including identifier, bearing, and distance to each result. Upon selecting a result, it is inserted or added to the flight plan. **INFO (L3)** gives information for the highlighted result.

9) **NRST USR (R3)**: Performs a search for 20 user waypoints within 240NM nearest the waypoint prior to the insertion point or, if there is no waypoint prior to the insertion point, current aircraft location. If there are no results (i.e., no user waypoints within 240NM), **NO RESULTS** is displayed. Otherwise, a list is displayed including identifier, bearing, and distance to each result. Upon selecting a result, it is inserted or added to the flight plan. **INFO (L3)** gives information for the highlighted result.

10) **NRST VOR (L3)**: Performs a search for 20 VORs within 240NM nearest the waypoint prior to the insertion point or, if there is no waypoint prior to the insertion point, current aircraft location. If there are no results (i.e., no VORs within 240NM), **NO RESULTS** is displayed. Otherwise, a list is displayed including identifier, bearing, and distance to each result. Upon selecting a result, it is inserted or added to the flight plan. **INFO (L3)** gives information for the highlighted result.

11) **Identifier Entry Box:** Option to enter an identifier where the encoder message otherwise appears. To perform a search, enter at least two characters. After entering two identifier characters, **SEARCH (R8)** appears. If there is a single result, the result is inserted or added to the active flight plan. If there is no result, the pilot is re-prompted to enter identifier. If there are multiple results, a list with matching identifiers is presented. The selected waypoint is inserted or added to the active flight plan. **INFO (L3)** gives information for the highlighted result.

12) **DELETE (R3)**: If highlighted waypoint is a non-procedure waypoint, deletes the highlighted waypoint from active flight plan. If highlighted waypoint is part of a procedure, deletes the entire procedure from the active flight plan after confirmation. **DELETE** does not appear if highlighted waypoint is a non-procedure waypoint and there are fewer than three non-procedure waypoints in the active flight plan, because an active flight plan must always have at least two non-procedure waypoints. **DELETE** also does not appear when highlighted waypoint is suppressed or highlighted position is one position past the end of the active flight plan.

13) **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 waypoint is designated a discontinuity (DISCONT). This assures the skyway is "re-centered" to provide guidance to the new active waypoint. Not shown if the highlighted waypoint is an undrawn waypoint, phantom waypoint, SAR pattern waypoint, dynamic termination waypoint, or parallel offset entry or exit waypoint. 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.

5.8.3. Active Flight Plan (ACTV) Menu Options (Step-By-Step)

1) Press **ACTV (L2)** to view active flight plan.

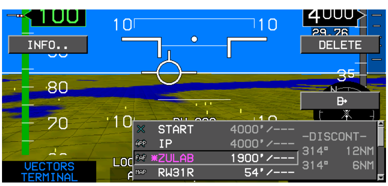
2) Scroll ❶ to desired waypoint. Push to enter.

3) Scroll ❶ to desired option and push to enter.

4) As one option, **VNAV..** is entered.

5) As another option, deleting the next waypoint is accomplished.

5.8.4. Active Flight Plan (ACTV) Menu (Step-By-Step)



1) Press **ACTV (L2)** to view active flight plan. The next steps may be accomplished on the PFD or MFD.

2) Scroll ❶ to desired waypoint. Push to enter.

3) Scroll ❶ to **VNAV..** then to desired altitude and push to enter.

4) If no OFFSET is necessary, push ❶ to enter.

5) View active flight plan for further editing or press **EXIT (R1)** to clear active flight plan from view.

5.8.5. Active Flight Plan (ACTV) Options NRST Menu Option (Step-By-Step)

1) With active flight plan displayed, press **INSERT.. (R2)** to see NRST options.

2) Press **SAVE (L1)** to save active flight plan as one of the 100 stored flight plans. (Any procedure within the saved active flight plan is not saved.)

3) Press **NRST APT.. (L2)**, **NRST VOR.. (L3)**, **NRST NDB.. (L4)**, **NRST FIX.. (R2)**, **NRST USR.. (R3)**, or **AIRWAY.. (R4)** to view applicable list. Scroll ❶ to desired selection and push to insert into active flight plan.

5.9. Information (INFO) Menu

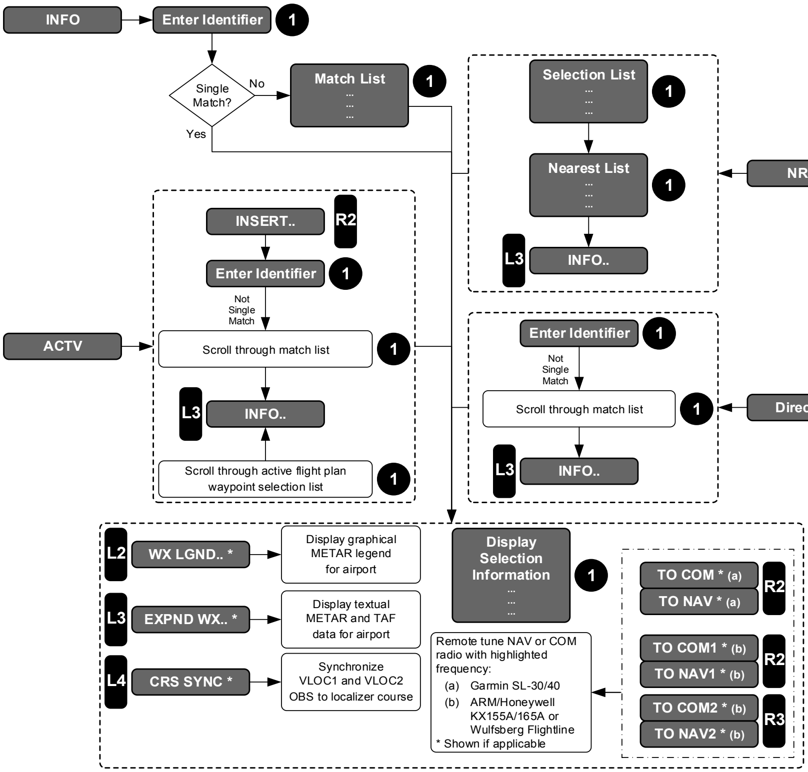


Figure 5-10: Information Menu

If **INFO** is activated from within the **ACTV**, **NRST**, or **Direct** menu, information on the highlighted waypoint is shown. Otherwise, the function checks for an active waypoint. If there is an active waypoint, it is the default entry. If there is no active waypoint, the nearest airport is 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, information for the result is shown. If there is no result, the pilot is re-prompted to enter an identifier. If there are multiple results, a list with matching identifiers is presented.

The amount and type of information presented depends upon the type of waypoint as follows:

1) Waypoints
2) Identifier
3) Type
4) Elevation (if available)
5) Long name
6) Bearing and Distance
7) Latitude/Longitude
8) Navigation aides
9) Frequency
10) Airports
11) Communication frequencies
12) Runway data

NOTE:

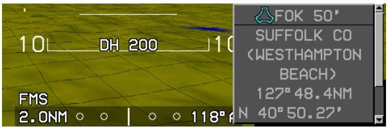
Frequencies are only sent to either com or nav radios in the standby position. It is up to the pilot to swap frequencies to the active position in the applicable radio.

When information is presented for an ILS or localizer waypoint and the current VLOC1 or VLOC2 omnibearing selectors are not synchronized with the localizer course, **CRS SYNC (L4)** synchronizes **VLOC1 (L3)** and **VLOC2 (L4)** omnibearing selectors to the localizer course.

Figure 5-11: CRS SYNC

5.9.1. Information (INFO) Menu (Step-By-Step)

1) Press **INFO.. (L3)** to view active waypoint.



2) Push ❶ to view information.

5.10. Omnibearing Selector (OBS) Menu

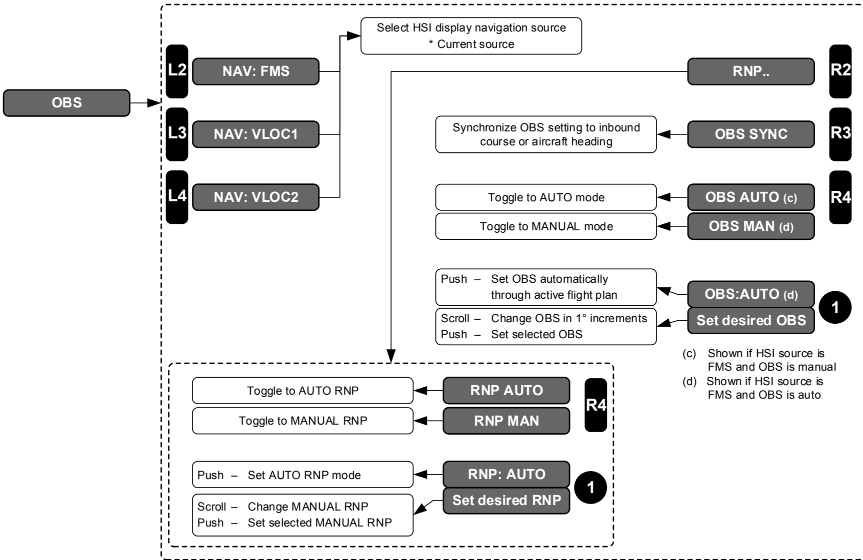


Figure 5-12: Omnibearing Selector (OBS) Menu

OBS menu allows the pilot to control the omnibearing selector for showing course deviations. Press **FMS (L2)** to specify a manual or automatic OBS setting in which the active OBS is controlled by the active flight plan. OBS for VLOC1 allows the pilot to specify the active OBS setting for the VLOC1 navigation function. 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)** synchronizes 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 AUTO/OBS MAN (R4)** toggles between automatic and manual OBS settings.

NOTE:

If a true north mode discrete input is configured, the OBS menu allows the pilot to toggle between **TRUE NORTH** and **MAG NORTH** modes.

With VOR symbology enabled, the OBS function also permits the pilot to select either **FMS, VLOC1**, or **VLOC2** as the HSI source. The HSI source selects the navigation source used to generate HSI guidance symbology. The OBS function also permits the pilot to select between manual and automatic RNP settings.

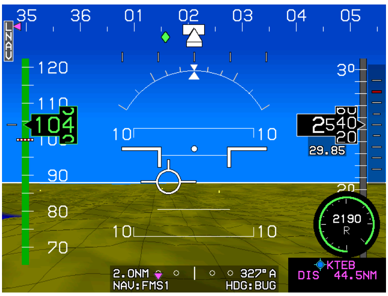
Upon selecting **RNP.. (R2)**, **RNP AUTO/RNP MAN (R4)** toggles between automatic and manual RNP settings. Manual RNP is selectable between 0.10NM and 15NM as follows:

1) 0.01NM increments between RNP 0.10 and RNP 0.3

2) 0.1NM increments between RNP 0.3 and RNP 2

3) 1NM increments between RNP 2 and RNP 15

5.10.1. Omnibearing Selector (OBS) Menu (Step-By-Step)



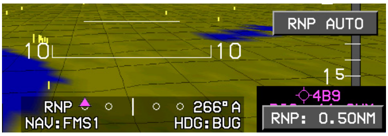
1) Before pressing **OBS (L4)** to make any OBS changes, view the current setting to see if **FMS** is selected.

2) Press **OBS (L4)** and make HSI source selection or change to **OBS MANUAL (R4).** (There must be an active waypoint selected to use manual OBS.)

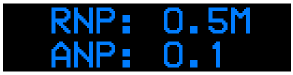
3) When the OBS is set to FMS, VLOC1, or VLOC2, scroll ❶ to select new OBS course.

4) Press **RNP (R2)**.

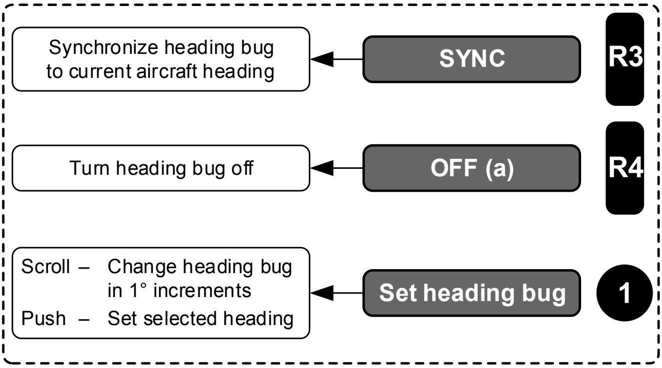
5) Press **RNP MANUAL (R4)**.



6) Scroll ❶ to desired FSD and push to enter to view estimate of position uncertainty required in RNP airspace.



5.11. Heading Bug (HDG) Menu



(a) Not available if integrated autopilot installed

Figure 5-13: 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.

5.11.1. Heading Bug (HDG) Menu (PFD Only) (Step-By-Step)

1) Scroll ❶ to enter Heading mode.

2) Scroll ❶ to change heading bug in 1° increments.

3) Push ❶ to select new heading or press **SYNC (R3)** to sync current heading.

5.12. Nearest (NRST) Menu

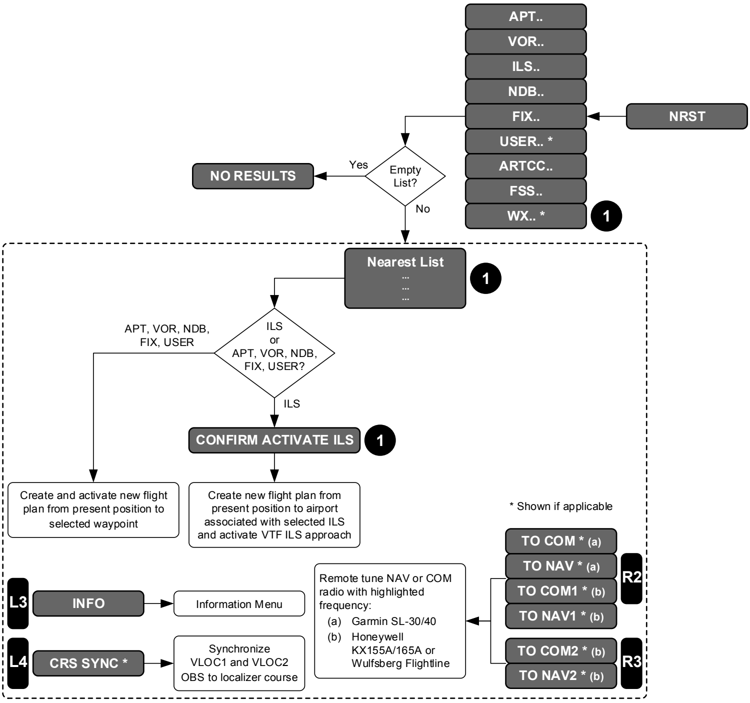


Figure 5-14: Nearest (NRST) Menu

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), **NO RESULTS** is displayed. The selection list includes identifier, bearing, and distance to the item, the list for Heliports and airports also contains an indication of the longest runway length at the airport. The selection list for airports contains only airports with runway length greater than or equal to the minimum runway length setting when the system was configured during installation.

The selection list for airports, VORs, ILSs, NDBs, ARTCCs, and FSSs includes an associated frequency (CTAF in the case of airports). Tiles are shown to allow transmission of the associated frequency to remote NAV or COM radios. If the frequency is greater than or equal to 118MHz, the tiles read **TO COM#** and the transmission is addressed to COM radios. If the frequency is less than 118MHz, the tiles read **TO NAV#**, and the transmission is addressed to NAV radios, **TO COM1** or **TO NAV1 (R2)**, or a **TO COM2** or **TO NAV2 (R3)** position.

NOTE:

Frequencies are only sent to either com or nav radios in the standby position. It is up to the pilot to swap frequencies to the active position in the applicable radio.

When the results for airports, VORs, ILSs, NDBs, fixes, and user waypoints are displayed, **INFO (L3)** appears to 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 type airport, VOR, NDB, fix, or user waypoint, a new active flight plan is created from present aircraft position to the selected waypoint. Upon selecting a waypoint of type ILS, **CONFIRM ACTIVATE ILS** 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) If the heading bug is turned OFF, the heading bug is activated to current heading to act as a starting point for receiving vectors (autopilot enabled systems only);

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

5) HSI source is switched as follows:

    a) If there is only one nav radio installed, the source for the selecting side is changed to VLOC1. The source for the other side does not change.

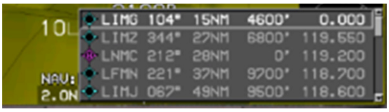
    b) If there are two nav radios installed, the default sensor for the selecting side controls which source is used. The source for the other side does not change.

6) Connected nav radios are remote tuned to ILS frequency.

5.13. Nearest (NRST) Menu (Step-By-Step)

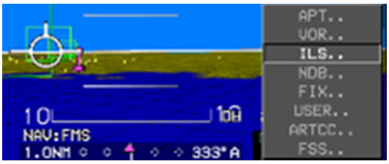
1) Press **NRST (R3)** to enter Nearest Menu.

2) Scroll ❶ to select **APT..** from list, push to enter.



3) Scroll ❶ to desired airport and select to either **INSERT**, **INFO**, or send frequency to **COM1** or **COM2.**

5.13.1. Nearest ILS (NRST) Menu (Step-By-Step)



1) Press **NRST (R3)** to enter Nearest menu.

2) Scroll ❶ to select ILS from list. Push to enter.

3) Scroll ❶ to desired airport and ILS approach then push to enter.

4) Push ❶ to confirm and activate ILS.

5.14. Direct Menu

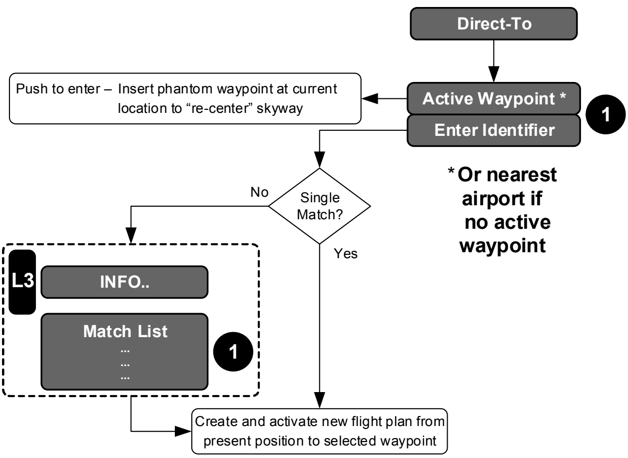


Figure 5-15: Direct Menu

Upon activating the direct menu from the top-level menu, the function checks for a current active waypoint and, if found, 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 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 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 flight plan is created from the found airport to the selected waypoint. Otherwise, a new active flight plan is created from present aircraft position to the selected waypoint.

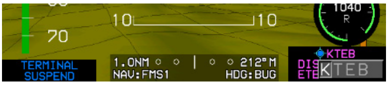
If the pilot rejects the default entry by entering identifier characters, a search for matching identifiers is performed. If there is a single result from the search, the resulting action depends upon whether the aircraft is in the air or on the ground. If in the air, a new active flight plan is created 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)** gives access to the information function for the highlighted result.

5.14.1. Direct Menu (Step-By-Step)

1) Press  **(R4)** to enter the Direct menu. The active waypoint or, in absence of an active waypoint, the nearest airport appears.



2) Either push ❶ to insert a phantom waypoint at the current aircraft location or scroll ❶ to begin entering new identifier.

3) After creating new identifier, scroll ❶ to the end and push to enter. A new active flight plan is created from the present aircraft position.

4) If necessary, search waypoints for selection. Scroll ❶ to desired selection. Push to enter.

5.15. Time (TIME) Menu

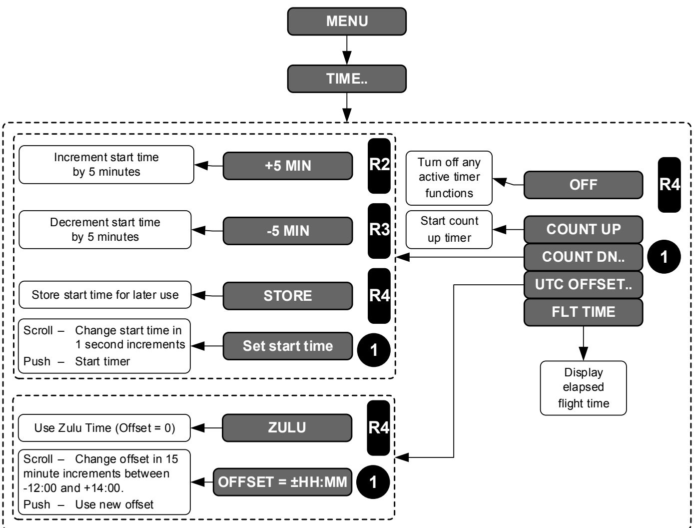


Figure 5-16: Time Menu

Upon selecting the time menu, an option list appears to let the pilot choose the **COUNT UP..** timer, **COUNT DN..** timer, **UTC OFFSET..**, or **FLT TIME** display. Press **OFF (R4)** to turn off any active timer functions.

If the count up timer is selected, the count up timer is activated. If the countdown timer is selected, the pilot is prompted to enter a start time from which the countdown begins. Shortcut tiles to quickly add or decrement by five-minute increments are provided at this level. After entering a start time, the pilot may either start the countdown timer or select **STORE (R4)** to store the start time for later use.

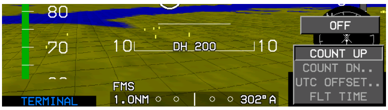
If the UTC offset is selected, the pilot is prompted to enter a UTC offset between -12:00 and +14:00 in 15-minute increments. A shortcut to quickly select Zulu time (UTC offset = 0:00) is provided at this level.

If the pilot selects the flight time display option, the elapsed time since the aircraft transitioned from ground to air mode is displayed for ten 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, elapsed time is displayed as **FLT TM: 00:00:00**.

5.15.1. Time (TIME) Menu (Step-By-Step)

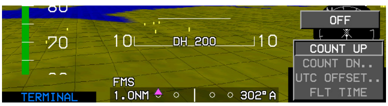
1) Press **MENU (R1)**.

2) Press **TIME.. (L4)** to enter the Time menu.



3) Scroll ❶ to select **COUNT UP**, **COUNT DN..**, **UTC OFFSET..** or **FLT TIME**, and push to enter.

4) If **COUNT UP** is desired, push ❶ to enter. A timer appears on the PFI area above the pitch scale.



5) To turn off timer, press **MENU (R1)** and **TIME.. (L4)** then press **OFF (R4)** on PFD or MFD.

5.16. PFD Source (SOURCE) Menu

Upon activating the PFD source menu, an option list of sensor sources is shown for the pilot to select/deselect the following items:

1) ADC1,
2) ADC2,
3) AHRS1,
4) AHRS2,
5) GPS1,
6) GPS2,
7) Radar altimeter 1, and
8) Radar altimeter 2

AHRS SLAVE/AHRS DG (R2) toggles between the two AHRS modes. **AHRS SLEW (R3)** enters a submenu to adjust the DG mode slewing value (if a DG/Slave discrete input is not configured for that AHRS.)

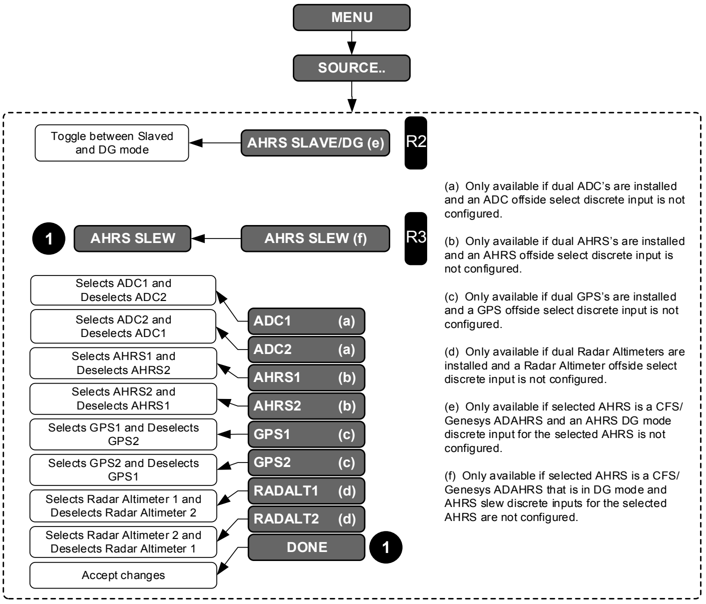
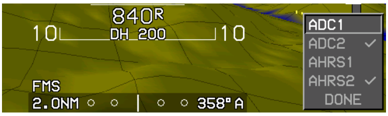


Figure 5-17: PFD Source Menu

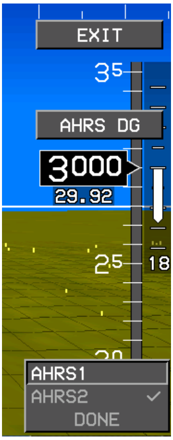
5.16.1. PFD Page First-Level Source Selection (Step-By- Step)

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

2) Press **SOURCE.. (L2)**.



3) Scroll ❶ to desired source, push to check/uncheck, scroll ❶ to **DONE** and push to enter or press **EXIT (R1)**.



4) When dual AHRS are installed with an AHRS off-side select discrete is not configured.

5) When Genesys AHRS is installed and in DG mode without discrete inputs for the selected AHRS are not selected.

5.17. PFD Bugs (BUGS) Menu

Upon selecting the PFD bugs menu, set either:

1) **ALT SEL.. (R2)**: Target altitude option allows the user to either synchronize the target altitude to current altitude, turn the target altitude off or set the target altitude in increments of 100 feet.

NOTE:

"Target altitude" refers to pre-selected altitude in Genesys/S-TEC HeliSAS-E installations.

2) **MINS.. (R3)**: Minimums option brings up a further option list for setting either decision height or minimum altitude. Selecting the minimum altitude option allows the pilot to either synchronize the minimum altitude to current altitude, turn the minimum altitude off, or set the minimum altitude in increments of 10 feet. The decision height option allows the pilot to either, set the decision height to a default height of 200 feet, turn the decision height off, or set the decision height in increments of 10 feet.

3) **VNAV CDA.. (R4)**: VNAV climb or descent angle option brings up a further option list for setting either climb angle or descent angle. At this further level, selecting either option allows the pilot to set the climb angle or the descent angle (as appropriate) in increments of 0.1° (a value of 0 is not allowed). Corresponding feet per nautical mile are shown adjacent to the climb or descent angle setting in parentheses. In addition, a shortcut tile is available to set the climb or descent angle to 3°.

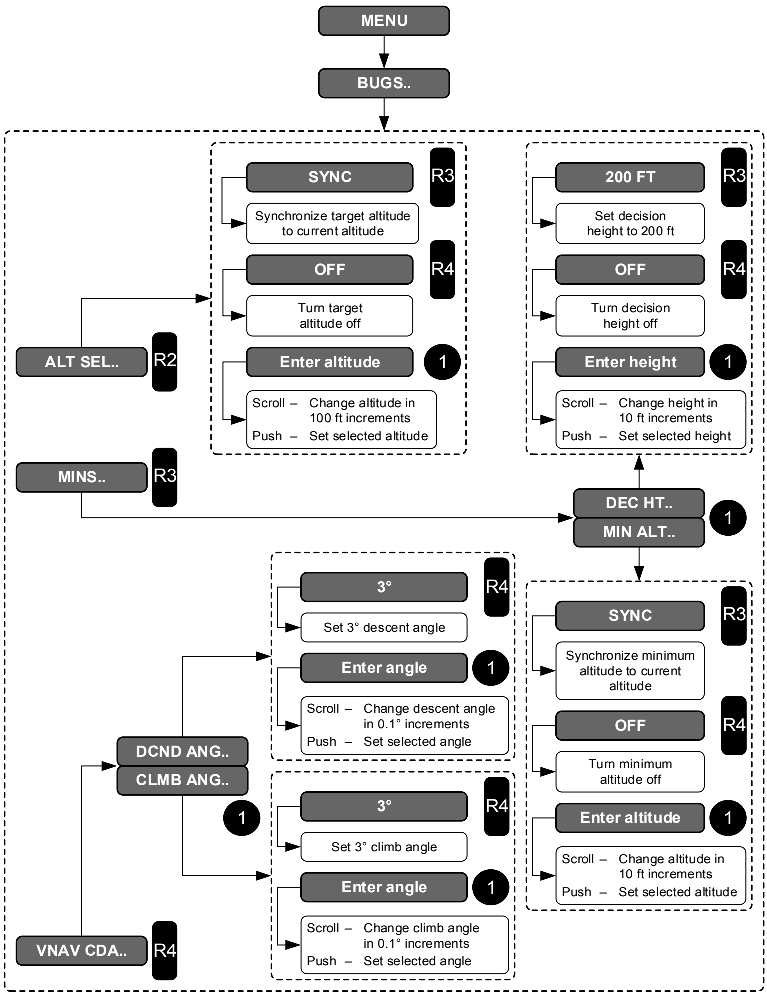


Figure 5-18: PFD Bugs (BUGS) Menu

4) **IAS.. (L2)**: Airspeed bug option allows the pilot to either, synchronize the airspeed bug to current airspeed, turn the airspeed bug off, or set the airspeed bug in increments of one knot indicated airspeed. On the low end, airspeed bug settings are no less than 60KIAS and no greater than **V_{NE}**.

NOTE:

When integrated with a Genesys/HeliSAS-E in IAS mode, it is not possible to turn off the airspeed bug.

5) **VSI.. (L4)**: VSI bug option to either, synchronize the VSI bug to the current VSI, turn the VSI bug off, or set the VSI bug in increments of 100 feet per minute. The airspeed bug and VSI bug are mutually exclusive, therefore selecting one turns off the other.

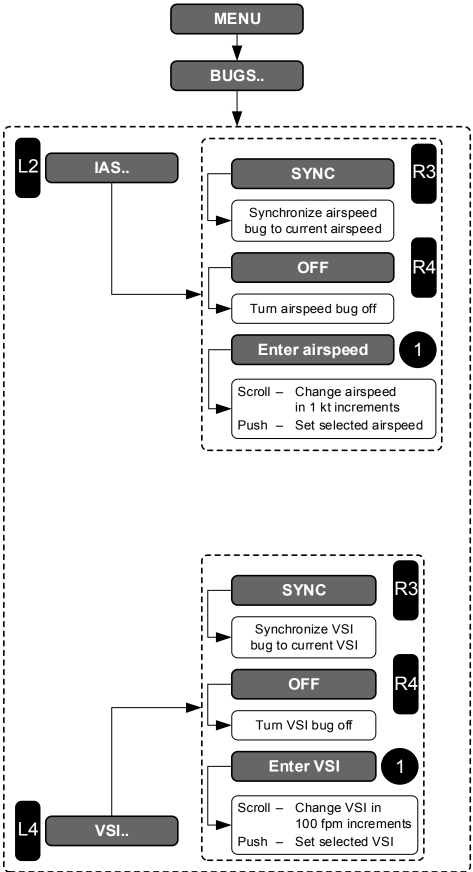


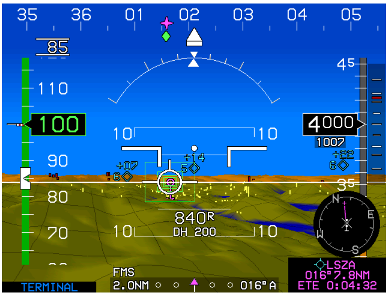
Figure 5-19: PFD Bugs (BUGS) Menu (Continued)

5.17.1. PFD Bugs (BUGS) Menu (Step-By-Step)

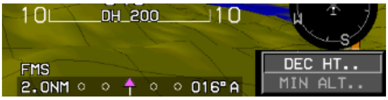
1) Press **MENU (R1)** then **BUGS (R2)** to enter the Bugs menu.

2) Press **IAS (L2)**, **VSI (L4)**, **MINS (R3)**, or **VNAV CDA (R4)** to select desired menu.

3) If **IAS (L2)** is entered, press **SYNC (R3)** or **OFF (R4)** to accept or turn off IAS bug.

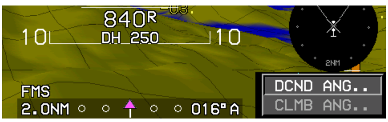


4) If a different **IAS** bug is desired, scroll ❶ to select desired airspeed and push to enter new value.

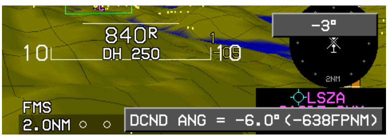


5) If **MINS.. (R3)** is selected, scroll ❶ to select either **DEC HT..** or **MIN ALT..** and push to enter.

6) If **DEC HT..** is selected, scroll ❶ to create new decision height. Push to enter. DH displays on PFI below FPM.



7) If **VNAV CDA (R4)** is selected, scroll ❶ to select either **DCND ANG..** or **CLIMB ANG...** Push to enter.



8) If **DCND ANG..** is selected, Scroll ❶ to create the descent angle. Push to enter new descent angle or select default **3° (R4)**.

5.18. PFD Declutter (DCLTR) Menu

Upon activating the PFD declutter menu, an option list of declutter items is shown.

Table 5-5: PFD Declutter Options and Features

Declutter Options	Configuration		Notes
	Tapes	Basic	
ANLG AGL	✓	✓	Mutually exclusive with MINI MAP and MINI TRFC
Airspeed Trend	✓		Feature only
BASIC	✓	✓	

Table 5-5: PFD Declutter Options and Features

Declutter Options	Configuration Tapes	Configuration Basic	Notes
BANK SCL	✓		Full-time or auto decluttered bank scale display; automatically returns to bank scale when decelerating to hover mode
MINI MAP	✓	✓	Mutually exclusive with ANLG AGL and MINI TRFC
MINI TRFC	✓	✓	Mutually exclusive with ANLG AGL and MINI MAP
SKYWAY	✓		
SVS TAWS	✓		SVS TAWS is labeled “SVS ADVANCED” when TAWS is not enabled
SVS BASIC	✓		
TRAFFIC	✓		
TURN IND	✓	✓	
FD1	✓	✓	
FD2	✓	✓	
METERS	✓	✓	

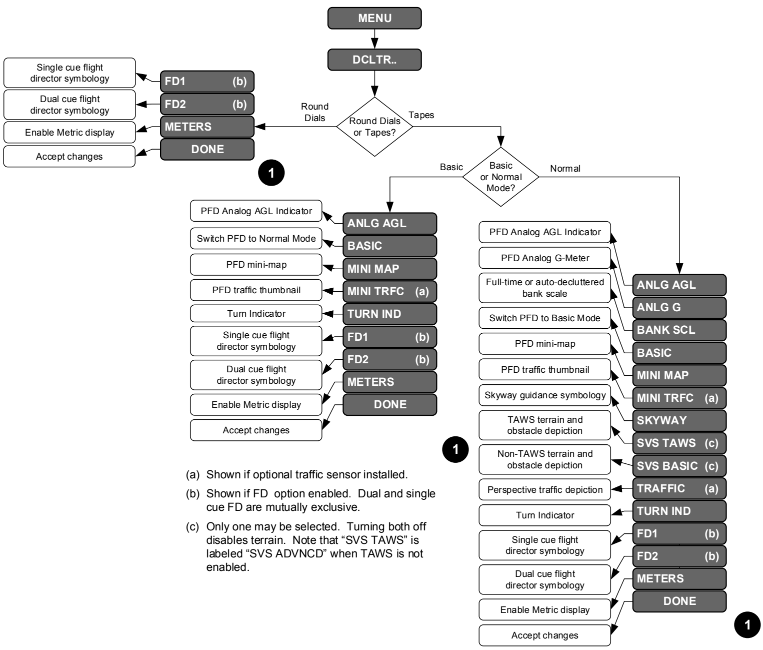
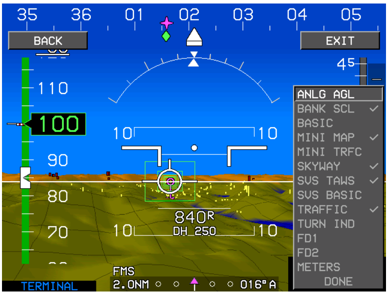


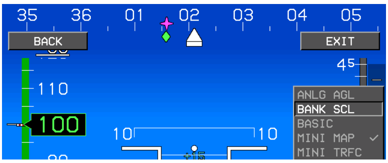
Figure 5-20: PFD Declutter (DCLTR) Menu

5.18.1. PFD Declutter (DCLTR) Menu (Step-By-Step)

1) Press **MENU (R1)** then **DCLTR (R4)** to enter the Declutter menu.

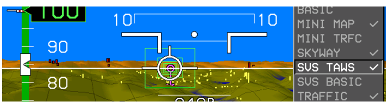


2) Scroll ❶ to **ANLG AGL**, **BANK SCL**, **BASIC**, **MINI MAP**, **MINI TRFC**, **SKYWAY**, **SVS TAWS**, **SVS BASIC**, **TRAFFIC**, **TURN IND**, **FD1**, **FD2**, or **METERS** and push to check/uncheck. Scroll ❶ to **DONE** and push to enter or press **EXIT (R1)**.

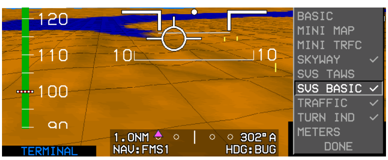


3) If **BANK SCL** is unchecked, scroll ❶ to **DONE** and push to enter, or press **EXIT (R1).**

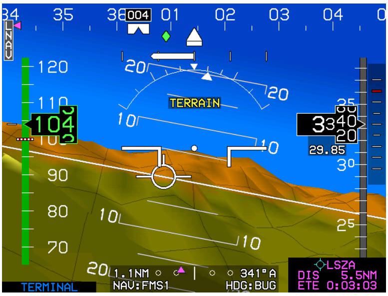
4) Bank scale is removed while in level flight.



5) Scroll ❶ to **SVS TAWS** push to check/uncheck then scroll ❶ to **DONE** and push to enter or press **EXIT (R1)**.



6) If **SVS BASIC** mode is desired, scroll ❶ to **SVS BASIC**, push ❶ to check/uncheck, then scroll ❶ to **DONE** and push to enter or press **EXIT (R1)**.



7) In the event of a TAWS warning, the system automatically switches back to **SVS TAWS** mode if terrain were disabled.

5.19. PFD Altimeter Menu

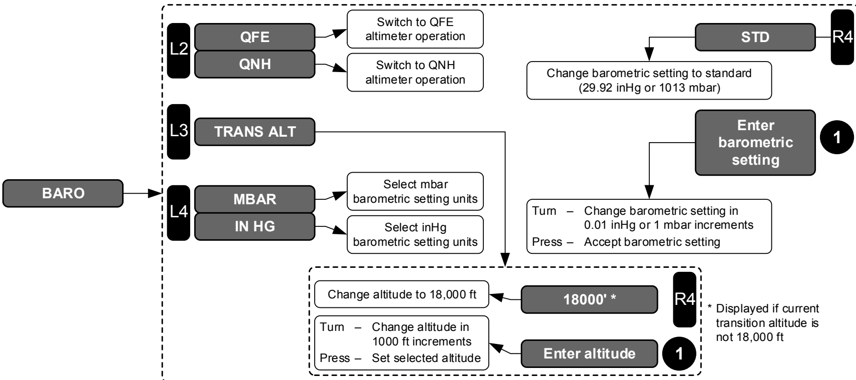


Figure 5-21: PFD Altimeter Menu

Press **BARO (R2)** to activate the altimeter menu. Scroll ❶ to increment (CW) or decrement (CCW) the barometric setting and push ❶ to accept the new barometric setting. In addition, the following options are available in the altimeter menu:

1) **QNH/QFE (L2)**: Toggles between QNH and QFE altimeter operation. When in QNH mode, QNE operation automatically is selected when above the transition altitude with a standard altimeter setting. The following definitions:

   a) **QFE**: Barometric setting resulting in the altimeter displaying height above a reference elevation (e.g., airport or runway threshold). If Baro-Auto-Setting is enabled in EFIS limits, when in QFE mode of operation, the EFIS autosets the altimeter to read zero altitude during a ground start.

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

c) **QNH:** Barometric setting resulting in the altimeter displaying altitude above mean sea level at the reporting station.

2) **TRANS ALT (L3)**: Changes transition altitude in units of 500 feet. Transition altitude is used to generate barometric setting warnings and to determine QNE/QNH operation. If current transition altitude is not 18,000 feet, **18000' (R4)** sets transition altitude as 18,000 feet.

3) **MBAR/IN HG (L4)**: Sets barometric setting units (inHg or mbar).

4) **STD (R4)**: Sets barometric setting to standard (29.92 inHg or 1013 mbar).

5.19.1. PFD Altimeter Menu (Step-By-Step)

1) Press **BARO (R2)** to enter the Altimeter menu.

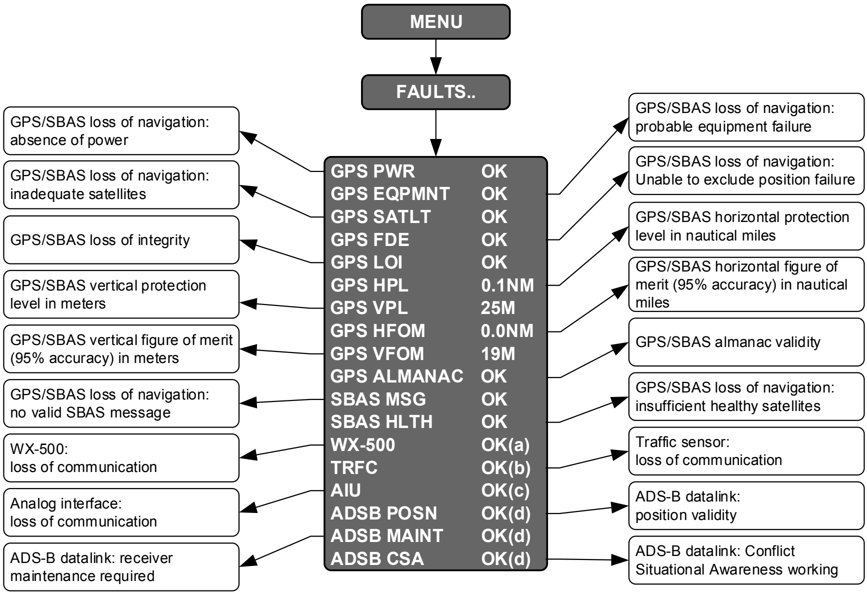
2) Scroll ❶ to set proper QNH and push to enter.

3) Crosscheck proper QNH under altitude indication.

4) Press **BARO (R2)** again and **STD (R4)** to reset altimeter setting to 29.92 inHg or 1013 mbar and push ❶ to enter or press **EXIT (R1)**.

5) Normally the BARO menu is only used on the PFD, but it can be opened and changes made on the MFD. Press **BARO (R2)** and make changes accordingly.

5.20. 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

Figure 5-22: MFD Fault Display Menu

Upon selecting the MFD faults menu, the status of the following system parameters are 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) 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) Readout of the current GPS/SBAS vertical protection level (GPS VPL) in meters.

8) Readout of the current GPS/SBAS horizontal figure of merit (GPS HFOM) in nautical miles. This value is an indication of the 95% confidence horizontal position accuracy.

9) 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) An indication of whether the GPS/SBAS receiver has a valid almanac in memory (GPS ALMANAC).

11) GPS/SBAS loss of navigation due to no valid SBAS message received for four seconds or more (SBAS MSG).

12) GPS/SBAS loss of navigation due to insufficient number of SBAS HEALTHY satellites (SBAS HLTH).

    a) An attitude or range fault condition exists.

    b) A control fault condition exists.

    c) A T/R fault condition exists.

13) If the analog interface option is enabled, loss of communications with the analog interface (AIU).

14) 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).

5.20.1. MFD Fault Display (FAULTS) Menu (Step-By-Step)

1) Press **MENU (R1)** and then **FAULTS.. (L1)** to view the faults menu.

2) View status of GPS and equipment parameters.

5.21. MFD Fuel Totalizer Quantity Setting (SET FUEL) Menu

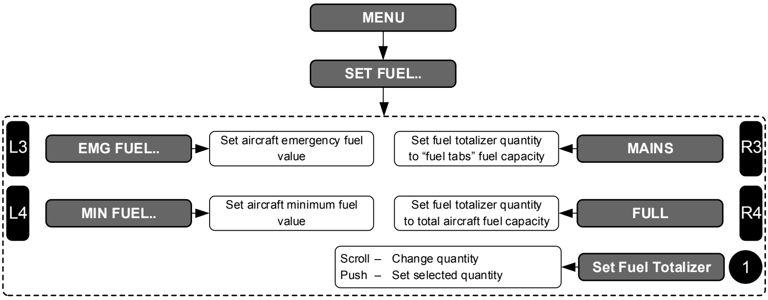


Figure 5-23: MFD Fuel Totalizer Quantity Menu

The fuel quantity setting menu allows the pilot to:

1) Set the fuel totalizer quantity in increments of volume units.
2) If either a fuel totalizer or fuel level sensing (with no unmonitored fuel) is configured in aircraft limits, set emergency and minimum fuel bugs in increments of volume units.
3) If an aircraft fuel caution or aircraft fuel warning is configured in aircraft limits, set emergency and minimum fuel bugs in increments of volume units.

In addition, if a fuel totalizer is configured in aircraft limits, Press **MAINS (R3)** to quickly set the quantity to the "fuel tabs" fuel capacity, and **FULL** (**R4**) to quickly set the quantity to the total aircraft fuel capacity. Units of measure and fuel flow are shown in the quantity window when available.

5.22. MFD Page (PAGE) Menu

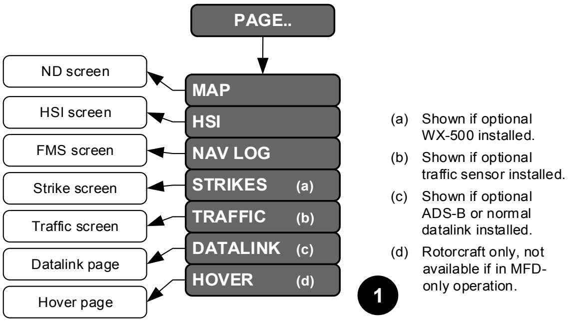


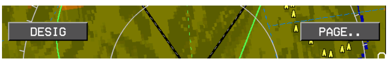
Figure 5-24: MFD Page (PAGE) Menu

PAGE menu allows the pilot to select which MFD page to display:

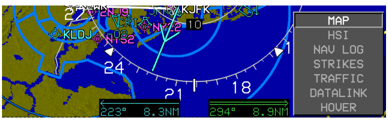
1) **MAP**: Shows the ND page
2) **HSI**: Shows the HSI page
3) **NAV LOG:** Shows the FMS page
4) **STRIKES**: Shows the Strike page (See Strikes appendix)
5) **TRAFFIC**: Shows the Traffic page (See Traffic appendix)
6) **DATALINK**: Shows the Datalink page (See Datalink appendix)

5.22.1. MFD Page (PAGE) Menu (Step-By-Step)

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



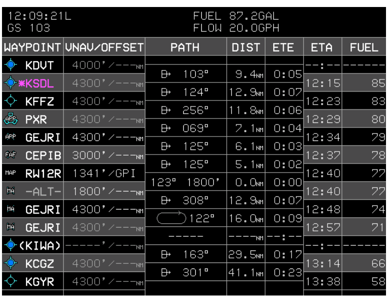
2) Press **PAGE.. (R3)** to view page selection menu.



3) Scroll ❶ to **MAP**, **HSI**, **NAV LOG**, **STRIKES**, **TRAFFIC**, **DATALINK**, or **HOVER**, and push to enter.

5.23. MFD NAV Log Page (Step-By-Step)

1) Press **MENU (R1)** and then **PAGE.. (R3)**. Scroll ❶ to **NAV LOG** and push to enter.



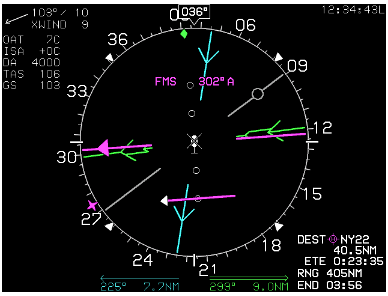
12:09:21L FUEL 87.2GAL
GS 103 FLOW 20.0GPH

WAYPOINT	VNAV/OFFSET	PATH	DIST	ETE	ETA	FUEL
KDVT	4000'/---NM				--:--	------
		103°	9.4NM	0:05		
*KSDL	4300'/---NM				12:15	85
		124°	12.9NM	0:07		
KFFZ	4300'/---NM				12:23	83
		256°	11.8NM	0:06		
PXR	4300'/---NM				12:29	80
		069°	7.1NM	0:04		
GEJRI	4300'/---NM				12:34	79
		125°	6.1NM	0:03		
CEPIB	3000'/---NM				12:37	78
		125°	5.1NM	0:02		
RW12R	1341'/GPI				12:40	77
		123° 1800'	0.0NM	0:00		
-ALT-	1800'/---NM				12:40	77
		308°	12.9NM	0:07		
GEJRI	4300'/---NM				12:48	74
		122°	16.0NM	0:09		
GEJRI	4300'/---NM				12:57	71
		-----	----NM	--:--		
(KIWA)	-----'/---NM				--:--	------
		163°	29.5NM	0:17		
KCGZ	4300'/---NM				13:14	66
		301°	41.1NM	0:23		
KGYR	4300'/---NM				13:38	58

2) **NAV LOG** page cannot be formatted nor used to edit the active flight plan.

5.24. MFD HSI Page (Step-by-Step)

1) Press **MENU (R1)** and then **PAGE.. (R3)**. Scroll ❶ to **HSI** and push to enter.



2) HSI page displayed with full scale deflection and flashing FMS CDI.

5.24.1. MFD HSI Declutter (DCLTR) Menu

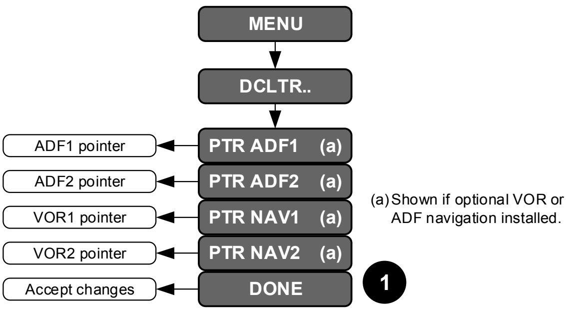


Figure 5-25: MFD HSI Declutter (DCLTR) Menu

Upon selecting the declutter menu when on the HSI page, the following option list appears to allow the pilot to individually select display of:

1) ADF1 pointer (if ADF symbology is enabled);
2) ADF2 pointer (if dual ADF symbology is enabled);
3) VOR1 pointer (if VOR symbology is enabled); and
4) VOR2 pointer (if dual VOR symbology is enabled).

5.25. MFD ND Page Format (FORMAT) Menu

Upon selecting the MFD format menu when in the ND page, an option list appears with the following:

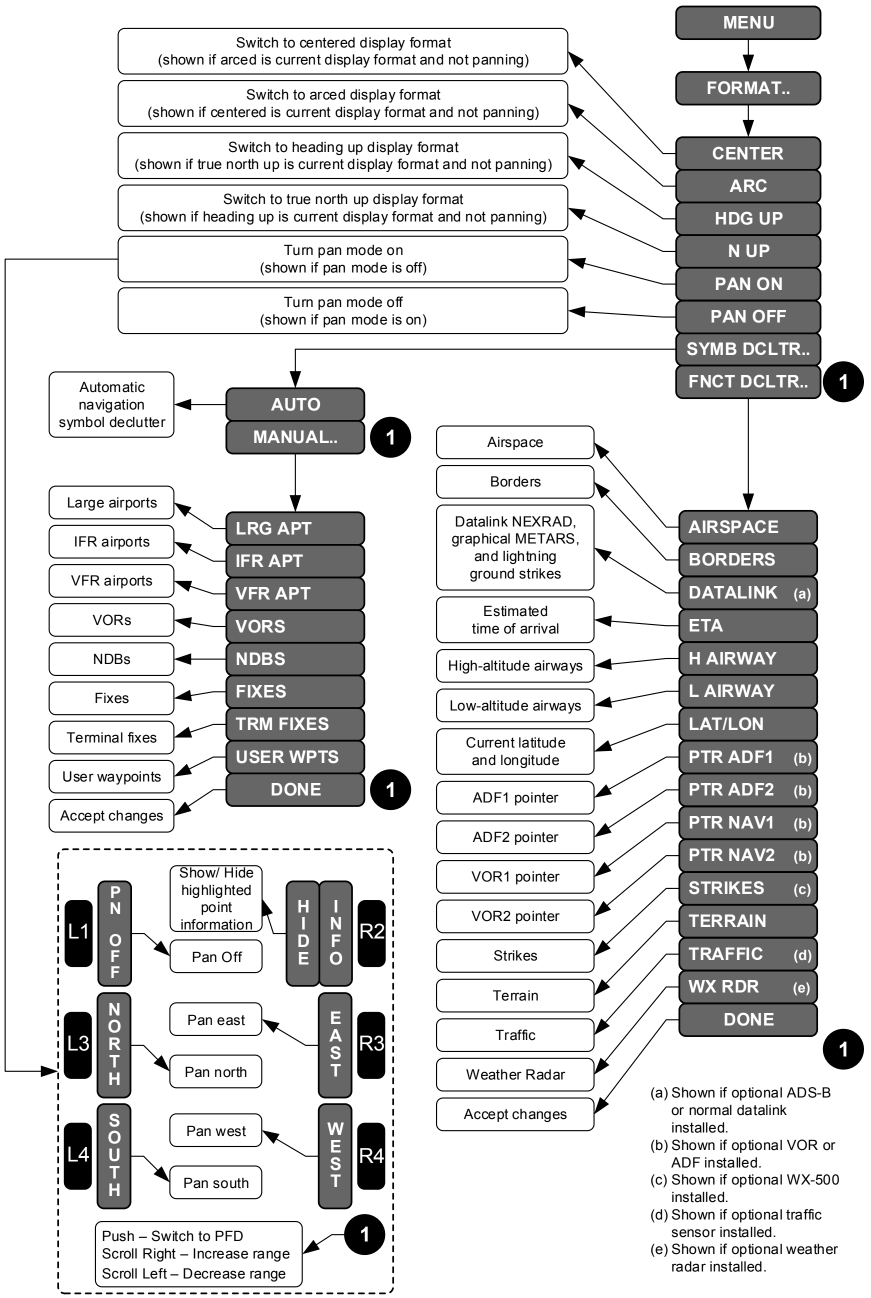


Figure 5-26: MFD ND Page Format Menu

1) **CENTER/ARC:** Toggles between a centered and arced ND display format (if not panning).

2) **HDG UP/N UP:** Toggles between heading up and north up ND display format (if not panning).

3) **PAN ON/PAN OFF:** Toggles ND page pan mode.

4) **SYMB DCLTR:** Activates an option list to choose either automatic 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

    h) user waypoints.

Figure 5-27: MFD Symbol Declutter

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

5) **FNCT DCLTR:** Activates an option list for the pilot to individually toggle display of:

    a) airspace;

    b) borders;

    c) datalinked NEXRAD, graphical METARs (if ADS-B is enabled);

    d) estimated time of arrival (ETA);

    e) high-altitude airways;

    f) low-altitude airways;

    g) current latitude and longitude display of present position;

h) ADF #1 pointer (if ADF symbology is enabled);

i) ADF #2 pointer (if dual ADF symbology is enabled);

j) VOR1 pointer (if VOR symbology is enabled);

k) VOR2 pointer (if dual VOR symbology is enabled);

l) Strikes (if WX-500 option is enabled);

m) Terrain; and

n) Traffic (if enabled).

5.25.1. MFD ND Page Format (FORMAT) Menu (Step-By-Step)

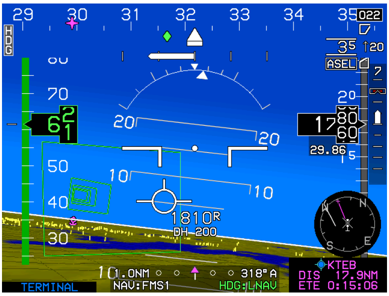
1) Press **MENU (R1)** and **FORMAT.. (R4)**.

2) Scroll ❶ to **FNCT DCLTR..** and push to enter.

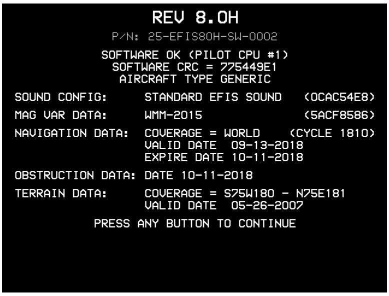
3) Scroll ❶ to **LAT/LON,** scroll ❶ to **DONE** and push to enter, or press **EXIT (R1)**.

Section 6 Quick Start Tutorial

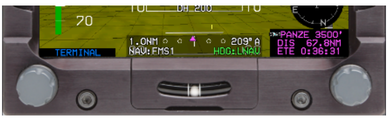
Quick Reference Guide (DOC 64-000100-080H)



Begin by reading the EFIS Rotorcraft Flight Manual (RFM) or Rotorcraft Flight Manual Supplement (RFMS).



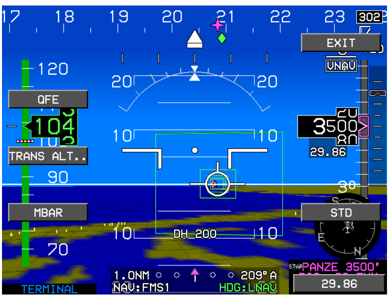
Power up the EFIS. The system performs a built-in test routine. If all tests pass, the system displays a screen with the database coverage. Press any button or push/scroll ❶ to acknowledge. The system begins a two-minute countdown while awaiting sensor initialization. For flight planning purposes or etc., press any button to override this countdown.



❷ ❶

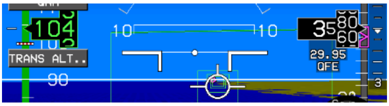
Right encoder is numbered ❶. The left encoder (❷) is for lighting control only.

Changing Altimeter Setting on PFD or MFD



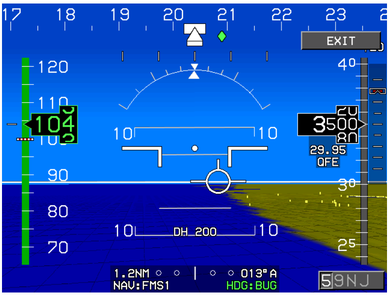
Press **BARO (R2)** and scroll ❶ to desired QNH altimeter setting and push to enter or press **EXIT (R1)**.

If QFE flight operations are in effect, Press **BARO (R2)** then press **QFE (L2)** to enter QFE mode.

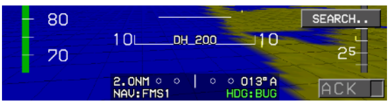


QFE now appears below altimeter window. If set on the ground, the system automatically sets altitude value corresponding with zero altitude.

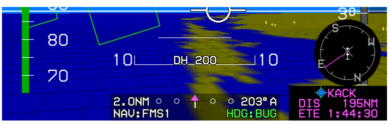
Creating Direct to Active Waypoint on PFD or MFD



In this case of no active waypoint, press  **(R4)** to enter a destination active waypoint to nearest airport.



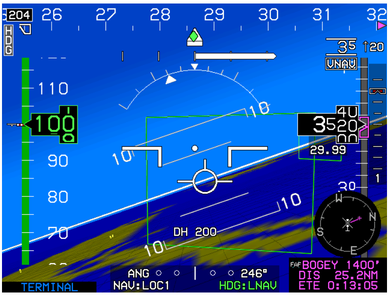
Either accept nearest airport or scroll ❶ to the desired alpha or numerical character, push to confirm, and advance to the next position. Push to enter until all five spaces have been either entered or viewed.



View waypoint information. Scroll and push ❶ to enter the desired destination.

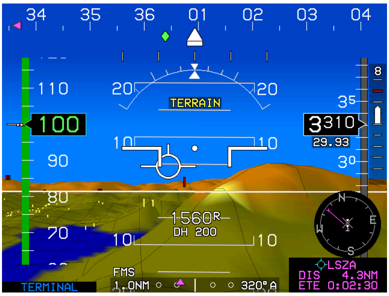
A direct route to the active waypoint is activated and appears as magenta tethered balloon on the PFD as shown.

Active Waypoint on PFD



Active waypoint information, including waypoint type and identifier; elevation or crossing altitude; and along track distance are displayed below the analog AGL indicator, traffic thumbnail, or mini map as configured.

Indicated Airspeed, Heading, and Altitude on PFD

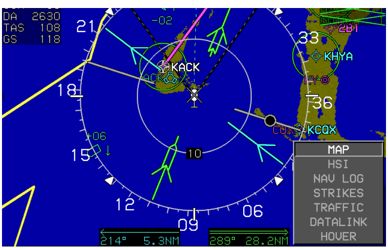


Indicated airspeed is on the left, altitude is on the right, and heading is across the top. FMS/VLOC CDI is located on the bottom. VSI appears on the right side of the altitude tape during climbs and descents. Time-critical warnings and cautions are displayed in the primary field of view.

Menu Options on MFD

On the MFD, press **MENU (R1)** to view soft menu selections for easy access with press of appropriate IDU button.

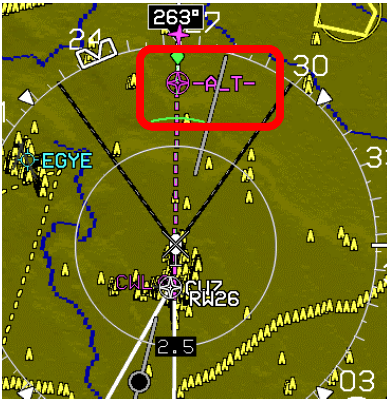
Page Options on MFD



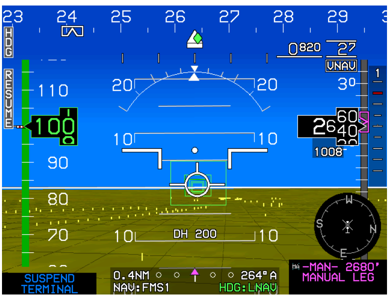
On the MFD, press **MENU (R1)** then **PAGE (R3)** to view list of available pages. Scroll ❶ for selection and push to show desired page.

Manual Termination Leg

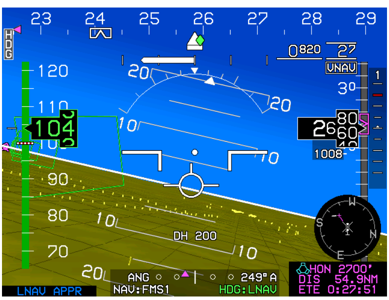
An altitude termination leg created within a procedure and indicated inside the active waypoint information box.



Cropped view of MFD indicating climb performance is satisfactory to meet the ALT termination leg at 2,680' MSL.



Pilot action is necessary to resume normal waypoint sequencing. Press **RESUME (L2).**



After **RESUME (L2)** was pressed, the routing to the next waypoint is resumed as shown with the active waypoint information and the new magenta line on the ND. Normal waypoint sequencing has resumed.

Flight Plans (Stored Routes)

Activate Flight Plan on PFD or MFD

1) Press **FPL (L1)**.
2) Scroll ❶ to **SELECT..** and push to enter.
3) Scroll ❶ to select desired flight plan and push to activate.

Create Flight Plan on MFD

1) Press **FPL (L1)**.
2) Scroll ❶ to **CREATE-EDIT..** and push to enter.
3) Scroll ❶ to **CREATE FLIGHT PLAN** and push to enter.
4) Press **ADD (R2)** to create first waypoint using ❶ to enter waypoints from beginning to end, or press **NRST APT.. (L2)**, **NRST VOR.. (L3)**, **NRST NDB.. (L4)**, **NRST FIX.. (R2)**, **NRST USR.. (R3)** or **AIRWAY.. (R4)** to select next waypoint, and push to enter.
5) Press **SAVE (R4)** to save flight plan. (If not pressed, flight plan is not saved.)
6) Press **EXIT (R1)** to exit flight planner.

Waypoints

Create a User Waypoint on PFD or MFD

1) Press **MENU (R1)**.
2) Press **DESIG (L3)**.

Edit a User Waypoint on MFD

1) Press **FPL (L1)**.
2) Scroll ❶ to **CREATE-EDIT..** and push to enter.
3) Scroll ❶ to **EDIT USER WPT** and push to enter.
4) Scroll ❶ to highlight desired waypoint to edit and push to enter.
5) Press **SAVE (R3)**, **(R4)** to proceed direct, or **EXIT (R1)** to exit flight planner.

Add Waypoint to an Active Route on PFD or MFD

1) Press **ACTV (L2)**.

2) Scroll ❶ to location on waypoint list where added waypoint is to be inserted above.

3) Press **INSERT (R2)**.

4) Press **NRST APT.. (L2)**, **NRST VOR.. (L3)**, **NRST NDB.. (L4)**, **NRST FIX.. (R2)**, **NRST USR.. (R3)**, or **AIRWAY.. (R4)** (when applicable) and then

   a) Scroll ❶ to make selection and push to enter, or

   b) Use ❶ to enter waypoint identifier and push to enter.

5) Press **SAVE (L1)** to save new active flight plan as another stored flight plan or press **EXIT (R1)** to save changes to active flight plan.

Delete Waypoint from an Active Route on PFD or MFD

1) Press **ACTV (L2)**.

2) Scroll ❶ to highlight the waypoint to delete and press **DELETE (R3)** to prompt **CONFIRM DEL WPT**. If part of a published procedure, press **DELETE (R3)** to prompt **CONFIRM DEL PROC**.

3) Push ❶ to **CONFIRM DEL WPT** or **CONFIRM DEL PROC**.

4) Press **SAVE (L1)** to save new active flight plan as another stored flight plan.

Omnibearing Selector Function

Automatic OBS (FMS OBS Only) on PFD or MFD

1) If FMS is in OBS Manual but automatic OBS is desired, press **OBS (L4)**.

2) Press **OBS AUTO (R4)**.

3) Push ❶ **OBS:AUTO** to enter.

Manual OBS on PFD or MFD

1) Press **OBS (L4)**.

2) To select HSI source, press **NAV VLOC1 (L3)** or **NAV VLOC2 (L4)**.

3) If HSI source is **NAV FMS**, press **OBS MANUAL (R4)** then scroll ❶ to desired OBS value and push to enter, or press **OBS SYNC (R3)** and push to enter.

4) If HSI source is **NAV VLOC1 (L3)** or **NAV VLOC2 (L4)** scroll ❶ to desired course (OBS:XXX° (XXX°)) and push to enter.

Approaches/Track

Select a VFR Approach on PFD or MFD

The active flight plan must contain an eligible airport for runway selection and VFR approach creation, or user waypoint.

1) Press **ACTV (L2)**.

2) Scroll ❶ to desired airport or user waypoint and push to enter.

3) Scroll ❶ to **VFR APPR..** and push to enter.

4) Scroll ❶ to desired runway and push to enter.

Change Runway during VFR Approach on PFD or MFD

This deletes the previous VFR approach and creates a new VFR approach to the selected runway.

1) Press **ACTV (L2)**.

2) Scroll ❶ to any waypoint inside the current VFR procedure and press **DELETE (R3)**. Push ❶ to CONFIRM DELETE PROC.

3) Scroll ❶ to desired airport and push to enter.

4) Scroll ❶ to **VFR APPR..** and push to enter.

5) Scroll ❶ to desired new runway and push to enter.

Select an IFR Approach on PFD or MFD

1) Press **ACTV (L2)**.

2) Scroll ❶ to the desired eligible airport and push to enter.

3) Scroll ❶ to **IFR APPR..** and push to enter.

4) Scroll ❶ to desired approach and push to enter.

5) Scroll ❶ to desired transition and push to enter.

6) Scroll ❶ to desired runway and push to enter.

Change Runway on IFR Approach on PFD or MFD

This deletes the previous IFR approach and creates a new IFR approach to the selected runway.

1) Press **ACTV (L2)**.
2) Scroll ❶ to any waypoint inside the current Instrument procedure and press **DELETE (R3)**. Push ❶ to CONFIRM DELETE PROC.
3) Scroll ❶ to the desired airport, which is now unsuppressed, and push to enter.
4) Select **APPR:** Scroll ❶ to desired approach. Push to enter.
5) Select **TRANS:** Scroll ❶ to desired transition. Push to enter.
6) Select **RW:** Scroll ❶ to desired runway. Push to enter.

Create NRST ILS Approach on PFD or MFD

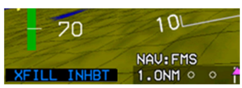
1) Press **NRST (R3)**.
2) Scroll ❶ to ILS.. and push to enter.
3) Scroll ❶ to desired airport beginning with ILS and push to enter.
4) Push ❶ to **CONFIRM ACTIVATE ILS**.

XFILL SYNC Operation

XFILL Sync Operation on PFD

(Crossfill is the normal default mode of operation.)

1) During crossfill inhibited operation, XFILL INHBT appears on the PFD in the lower left corner.



2) After the XFILL switch is pressed again, the pilot and co-pilot sides are not synchronized; XFILL ARM appears in lower left corner of both PFDs.

3) When the pilot and co-pilot sides are not synchronized, press **MENU (R1)** then **XFILL SYNC (L1)** to synchronize the pilot and co-pilot active flight plan parameters from the side where the button press occurred.

Section 7 IFR Procedures

7.1. Active Flight Plan

Before using the Genesys EFIS GPS navigation system to fly any part of an instrument procedure instrument procedure in VMC or IMC conditions, always compare each leg of the applicable and current published charted procedure to the flight plan displayed on the ND. This EFIS and FMS may not support some specific navigation leg types. All pilots must understand how each leg is depicted and navigated prior to conducting the procedure.

After updating the navigation database and planning to fly an instrument procedure, practice in the RUN DEMONSTRATOR/TRAINING PROGRAM to view how each leg is depicted in the aircraft EFIS limits $\mathbf{V_{PROC}}$ setting.

If navigation planning includes manual sequencing of any leg in a procedure, verify what specific navigation guidance the EFIS provides. When any procedure includes ARINC-424 legs defined by headings, or that terminate at a specific altitude, the pilot must understand how the EFIS behaves and how system behavior can affect coupled autopilot operations.

Upon activation of the active flight plan menu, the application checks for an active waypoint. If there is no active waypoint, NO ACTIVE WPT appears. Otherwise, a nav log of waypoints in the active flight plan appears with the following:

1) Waypoint identifier and characterization (default, overfly [**OF**], or no radius [**0R**])

2) Symbol designating waypoint type and what type of procedure (if any) the waypoint is associated

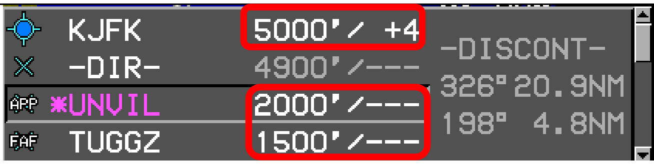
3) VNAV altitudes and offsets associated with each waypoint

4) Information related to flight plan path between each waypoint

In the case of an approach with a final approach segment data block, the VNAV offset readout associated with the missed approach point is “GPI” to designate distance to the glidepath intercept point. 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 discrete input. If referenced to magnetic north, the course is indicated with the degree (°) symbol. Otherwise, a stylized true north (^{T}) symbol appears.

The active waypoint is designated by an asterisk and is magenta but turns amber (yellow) in the event of a GPS LON caution.

Table 7-1: VNAV Altitudes and Offsets

Input Source	Color
Navigation database or manually entered	
Computed automatically	

A suppressed waypoint (designated by brackets) 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 nav log for it to be highlighted for information or to activate other procedures to the airport. Since only one approach may be active at any given time, only one waypoint may be suppressed by adding an Instrument approach procedure at any given time.

NOTE:

Adding a STAR procedure with no instrument approach nor SID does not suppress the airport waypoint. Adding a STAR to a different airport in the active flight plan does not change the original suppressed waypoint airport.

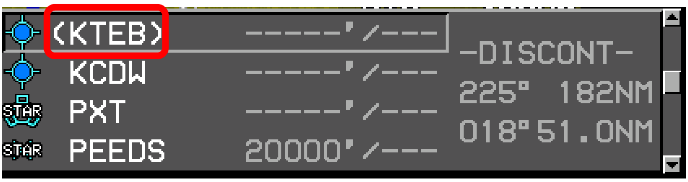


Figure 7-1: Suppressed Waypoint

It is possible to add a departure procedure to another airport within an active flight plan and have two suppressed waypoints within the same active flight plan.

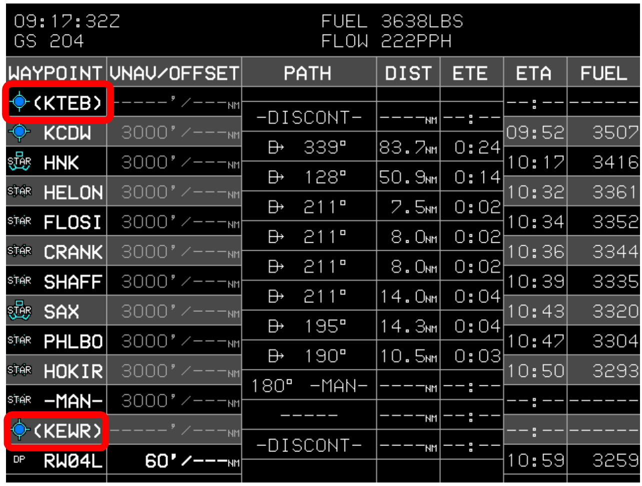


Figure 7-2: Active Flight Plan with Two Suppressed Waypoints

A skipped waypoint is a waypoint associated with a dynamic termination leg with a zero length. These are either:

1) An altitude termination leg when current aircraft altitude is above the termination altitude; or

2) System-created (i.e., not NavData® specified) intercept to a "Course to a Fix" leg where there is insufficient distance to calculate an intercept heading.

To add a waypoint to the end of the active flight plan, scroll through each waypoint of the flight plan to one position past the end. If not, the application makes the selected waypoint active. Otherwise, a list is presented.

Upon selection of a waypoint from the selection list, the EFIS checks whether the selected waypoint meets the criteria for waypoint activation, manual VNAV parameter entry, custom holding pattern entry, SAR pattern entry, SAR pattern segment selection, manual overfly characterization, VFR approach entry, IFR approach entry, STAR entry, or DP entry. If it does, a list is presented as follows:

1) **WAYPOINT**: If valid, this option allows the pilot to make the selected waypoint the active waypoint. Option valid for any waypoint except:

   a) Suppressed waypoint;

   b) Skipped waypoint;

   c) A waypoint following a discontinuity; or

   d) The first waypoint.

2) **VNAV**: If valid, this option allows the pilot to enter a manual VNAV altitude and offset for the selected waypoint. This menu level allows for synchronizing the VNAV altitude to current altitude and for removing the manual VNAV altitude and offset entries. These altitudes are settable in increments of 100 feet and distances of 1 NM. Option valid for any waypoint except:

   a) Suppressed waypoint

   b) Skipped waypoint;

   c) A manual termination waypoint;

   d) A waypoint that is part of an IFR or VFR approach;

   e) A SAR pattern exit waypoint:

   f) A parallel offset entry or exit waypoint; or

   g) One of the following types of termination legs:

      i) Dynamic

      ii) Altitude

      iii) DME

      iv) Radial or

      v) Intercept

3) **HOLD**: If valid, this option allows the pilot to enter a manual holding pattern at the selected waypoint. Option valid for any waypoint except:

   a) Suppressed waypoint;

   b) Skipped waypoint;

   c) A manual termination waypoint;

   d) A waypoint that is part of a missed approach procedure, including the missed approach waypoint;

   e) A waypoint that is part of a VFR approach;

   f) A holding pattern waypoint;

   g) A SAR pattern exit waypoint;

   h) A waypoint that begins with a Departure Procedure;

i) A parallel offset entry or exit waypoint; or

j) One of the following dynamic termination waypoints:

   i) Altitude;

   ii) DME;

   iii) Radial; or

   iv) Intercept

4) **SAR PTRN**: If valid, this option allows the pilot to create and enter a SAR pattern as defined in the SAR appendix. If SAR patterns are enabled in the EFIS limits, this option is valid for any waypoint except:

a) Suppressed waypoint;

b) Skipped waypoint;

c) A manual termination waypoint;

d) A waypoint that is part of an IFR or VFR approach;

e) A holding waypoint;

f) A SAR pattern exit waypoint;

g) A waypoint that begins a departure procedure;

h) A parallel offset entry or exit waypoint; or

i) One of the following dynamic termination waypoints:

   i) Altitude;

   ii) DME;

   iii) Radial; or

   iv) Intercept

5) **SAR SGMNT**: This option allows the pilot to select which segment within the SAR pattern should be active for navigation guidance. If the selected waypoint is the active waypoint and is one of the following types of SAR patterns:

a) Expanding square;

b) Rising ladder; or

c) Sector search

6) **OFLY/AUTO**: If the selected waypoint is neither suppressed, skipped nor a manual termination, change the waypoint's overfly characterization. The choices are:

   a) **AUTO**: Reset automatic overfly characterization by FMS.

   b) **OVERFLY**: Force the overfly characterization to be an overfly adjust-exit waypoint and force the inbound course to go directly to the waypoint regardless of the amount of course change required.

   c) **NO RADIUS**: Force the turn radius at the waypoint to be zero. This forces the inbound course and outbound course to go directly to and from the waypoint regardless of the amount of course change required.

NOTE:

It is not possible to track a "NO RADIUS" path perfectly, but the FMS path guidance quickly recaptures the outbound course after resuming automatic waypoint sequencing. Designating a waypoint as a "NO RADIUS" waypoint affects the turn radius used to calculate procedure turn and holding pattern leg paths.

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

8) **IFR APP**: This option is invalid if the selected waypoint is a holding pattern waypoint or SAR pattern exit waypoint. (This forces a pilot to deactivate a manual holding pattern or SAR pattern prior to activating an IFR approach). Otherwise, If selected waypoint is an airport with an IFR approach, the pilot is presented with a list of available approaches (including, if applicable, the five-digit channel number, followed by a list of available transitions, if there are more than one) and a list of runways (if there are surveyed runways at the airport). After selection, the appropriate IFR approach is created, and the airport waypoint becomes suppressed. Activating an IFR approach deletes any pre-existing IFR 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 active and the activated transition is "Vectors to

Final," activating an IFR approach activates the heading bug on current aircraft heading for purposes of defining the course intercept angle.

9) **STAR**: This option is invalid if the selected waypoint is a holding pattern waypoint or SAR pattern exit waypoint. (This forces a pilot to deactivate a manual holding pattern or SAR pattern prior to activating an IFR approach). If selected waypoint is an airport with a STAR, the pilot is presented with a list of available STARs, followed by a list of available transitions (if there are more than one) and a 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, STAR waypoints are inserted prior to the approach waypoints.

10) **DP**: This option is invalid if the selected waypoint is a holding pattern waypoint or SAR pattern exit waypoint. (This forces a pilot to deactivate a manual holding pattern or SAR pattern prior to activating an IFR approach). If selected waypoint is an airport with a DP, the pilot is presented with a list of DPs, followed by a list of available transitions (if there are more than one) and a list of runways (if there are surveyed runways and more than one runway authorized for the DP). After selection, the appropriate DP is created, and upon activation, deletes any pre-existing DPs.

7.2. IFR Procedures

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. There are two types of departure procedures (DP); obstacle departure procedures (ODP) are printed either textually or graphically, and standard instrument departure procedures (SID) are always printed graphically. All DPs, either textual or graphic, may be designed using either conventional or RNAV criteria. RNAV procedures have RNAV printed in the title.

ODPs are not found in NavData®, 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.

7.3. Overview of Procedures and Instrument Approaches

This Genesys Aerosystems EFIS provides 3-D GPS precision and non-precision instrument approach guidance using a system integral TSO C146c BETA 3 GPS receiver with GPS and augmented GPS with Satellite Based Augmentation System (SBAS) commonly referred to as WAAS (Wide Area Augmentation System).

Use of this GPS receiver provides a level of certified service supporting 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.

Approach with vertical guidance (APV) procedures 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 WAAS BETA 3 GPS receiver and updatable navigation database in this system, these approaches may be flown using an electronic glidepath, which eliminates errors introduced by using barometric altimetry.

In addition to LNAV/VNAV procedures, APV takes advantage of the high accuracy guidance and increased integrity provided by GBS/SBAS. This SBAS (TEROS/ICAO) generated angular guidance allows use of the same TERPS approach criteria for ILS approaches. The resulting approach procedure minima, localizer performance with vertical guidance (LPV), 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 non-precision GPS/SBAS approach is certified as a localizer performance (LP) approach where terrain or obstructions prohibit the certification of the LPV vertically guided approach. This 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 (HITS) 3-D 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 EFIS auto-sequences from one waypoint to the next in accordance with the flight plan along the flight path with the following exceptions:

1) Pilot has selected a manual GPS/SBAS OBS (SUSPEND shown).

2) Active waypoint is the missed approach waypoint, and the missed approach procedure has not been armed (**ARM**) or initiated (**MISS**) (SUSPEND shown).

3) 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 shown).

4) Active waypoint is the last waypoint of active flight plan (no flag shown).

5) Leg following active waypoint is a manual termination leg, and the pilot has not chosen to resume (**RESUME**) to the waypoint following the manual termination (SUSPEND shown).

6) The aircraft is in a repeating SAR pattern (race track, sector search, or orbit) and the pilot has not chosen to continue out of the SAR pattern (SUSPEND shown). (See SAR appendix.)

Where automatic waypoint sequencing is suspended due to reasons 1, 2, or 4 above, 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 the fly-by waypoint, active waypoint for fly-over waypoint) is more than 90° from the current course (transition from “TO” to “From” operation);

2) Aircraft location is within one turn diameter (based upon current true Airspeed and 15° angle of bank) of the transition point; and

3) Aircraft heading is within 90° of the current course (generally pointed in the correct direction).

The linear vertical scale limits of the VDI for LNAV/VNAV and LPV approaches are shown in Figure 7-3.

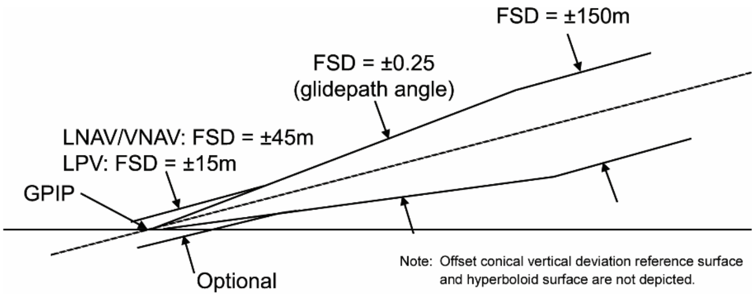


Figure 7-3: Vertical Deviation Indicator Linear Deviation

7.3.1. Highway in the Sky (Skyway)

When not decluttered, the PFD displays the active navigation route or manual OBS course in a 3-D manner with a series of skyway boxes, which overlay the flight plan route at a desired altitude and provide lateral and vertical guidance. Skyway boxes conform to the VNAV requirements of GPS/SBAS receiver requirements (TSO-C-146C). The top and bottom 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 on leg-segment turn radius and groundspeed.

Table 7-2: Highway in the Sky Configuration

Type HITS Lines	Fully Integrated Autopilot	Partially Integrated Analog Autopilot	Un-Integrated Autopilot or No Autopilot
Dashed	Not coupled to skyway		
Solid	Coupled to Skyway	Coupled to skyway. Autopilot is either in HDG mode with LNAV heading/roll-steering sub-mode engaged or in NAV/APR mode with FMS1 or FMS2 as the selected navigation source.	Always Solid

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. 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. Skyway boxes disappear in basic mode and unusual attitude mode. In reversionary mode 1 (GPS failure), skyway boxes disappear after one minute to indicate degraded navigation performance.

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, which are computed automatically 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 on 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 as an anticipatory cue for planning. Climb guidance is depicted in Figure 7-4, Figure 7-5, and Figure 7-6.

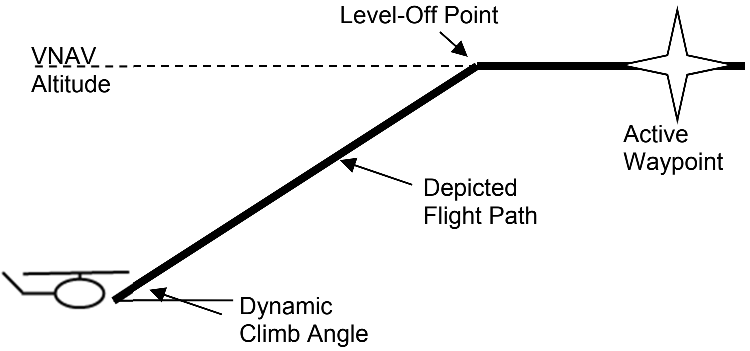


Figure 7-4: Highway in the Sky (Aircraft Referenced)

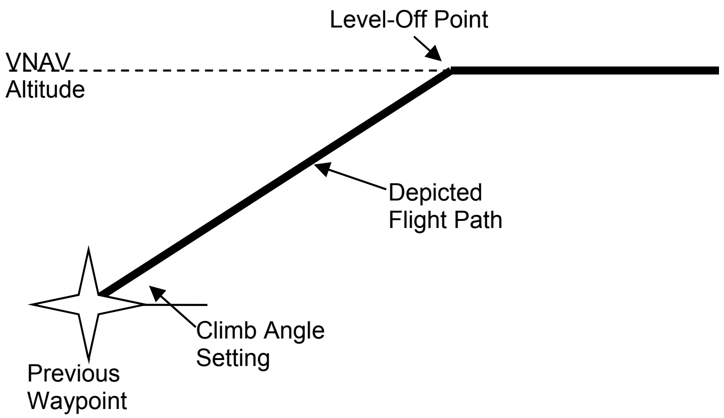


Figure 7-5: Highway in the Sky (Geo-Referenced Backward)

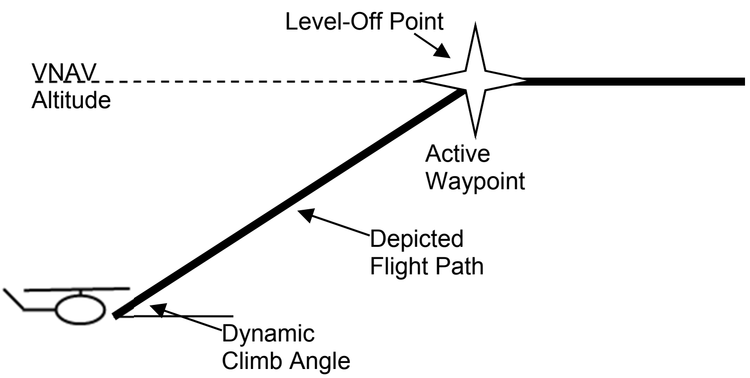


Figure 7-6: Highway in the Sky (Geo-Referenced Forward)

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 7-3: Final Segment of IFR Approach, Descent Angle and VNAV Waypoint

Condition	VNAV Waypoint	Descent Angle
IFR approach with valid final approach segment data block	Glidepath intercept point (GPIP) 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 FAF and MAP	Missed approach point location	Straight line from FAF to MAP location and altitudes.
No or invalid Final Approach Segment data block Intermediate waypoints exist between FAF and MAP	Missed approach point location	Steepest descent angle based upon straight lines from the FAF and subsequent intermediate waypoints to MAP 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 is an anticipatory cue. Figure 7-7 depicts descent guidance and creates 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. The climb paradigm compensates for an aircraft's ability to climb more steeply than specified and 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.

Figure 7-7: Highway in the Sky Final Approach Segments

7.3.2. Waypoint Sequencing

When automatic waypoint sequencing is suspended due to reasons 1, 2, or 4 in § 7.3, the EFIS switches from “TO” to “FROM” operation when appropriate. If not suspended, automatic waypoint sequencing occurs in 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 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. Otherwise, radii for turning segments (other than DME arc or radius to a fix segments) are 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 IFR 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) Within a SAR pattern, speed is the lower of holding speed or procedure speed.

6) Where a fixed-radius transition (FRT) is defined by the navigation database for a waypoint, that turn radius is used for the turning segment. FRT is used in enroute flight in order to save the number of waypoints and to provide a smoother transition. The RF leg can only be used in a SID or in a STAR. It is the flight plan leg stored in the navigation database, which is defined by constant radius turns around a given fix.

7) Otherwise, speed is the current true airspeed or 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.

Radius for DME arc or radius to a fix segments comes from NavData®.

7.3.3. Fly-Over Waypoints

To create the desired flight path, each waypoint is designated as a fly-by or a fly-over waypoint. Waypoints are further subdivided into waypoints with a defined entry heading and waypoints with 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.

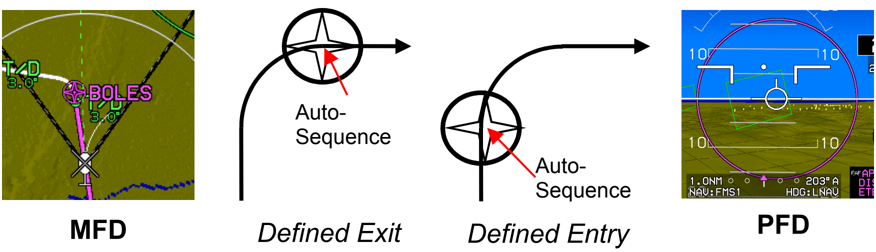


Figure 7-8: Fly-Over Waypoints

These waypoints are type fly-over with defined entry heading:

1) Waypoint leading into discontinuity;
2) Waypoints which are marked as overfly in the navigation database or menu system;
3) Exit from holding pattern;
4) Exit from procedure turn;
5) Entry into holding pattern;
6) Missed approach point;
7) Phantom waypoint (created by inserting a waypoint into the active flight plan or performing Direct-To function within the active flight plan – avoids S-turns);
8) Last waypoint;
9) Start waypoint (created by creating a new active flight plan with the Direct-To function – avoids S-turns);
10) Reference (takeoff runway end) waypoint of a DP;
11) Waypoint leading into discontinuity; and
12) Altitude, DME, or radial termination legs (ARINC-424 path types CA, FA, VA, CR, VR, CD, FD, and VD; see Table 7-4).
13) Waypoints marked as overfly in the navigation database.

Table 7-4: 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		
Heading To	V		
Examples: **CF**= Course to Fix, and **FM**= Course from a Fix to a Manual Termination, etc.			

The following waypoints are fly-over with a defined exit heading:

1) Waypoint exiting a discontinuity with the exception of start, phantom or DP reference points;

2) Entry into procedure turn; and

3) First waypoint with the exception of start or DP reference points.

7.3.4. Fly-By Waypoints

1) CF legs with defined Entry Heading

2) All other waypoints with defined Exit Heading.

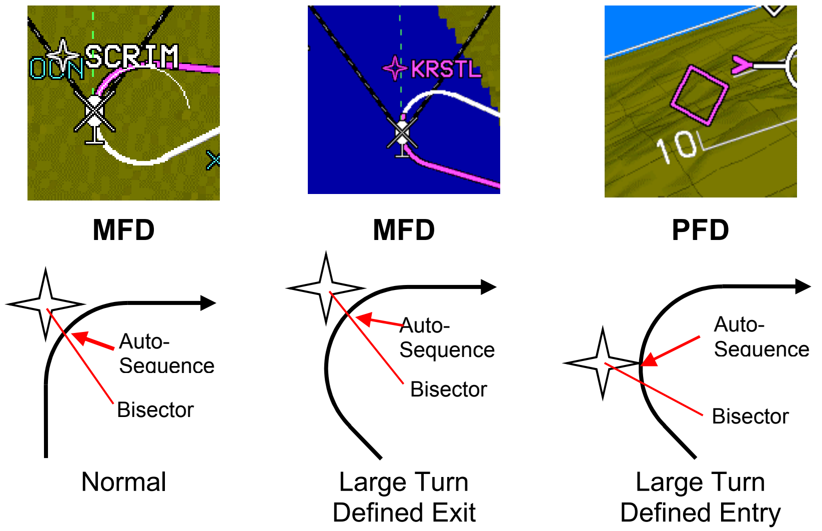


Figure 7-9: Fly-By Waypoints

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 EFIS as follows.

Table 7-5: Leg Segments for Paths Constructed by the EFIS			
Path Type	Waypoint Entry	Waypoint Exit	# of Segments and Description
Straight Leg, DME Arc, or Radius to a Fix	Fly-By	Fly-By	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.
	Fly-By	Fly-Over Defined Exit Heading	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.
	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 7-5: Leg Segments for Paths Constructed by the EFIS

Path Type	Waypoint		# of Segments and Description
	Entry	**Exit**	
	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.
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°).

Table 7-5: Leg Segments for Paths Constructed by the EFIS			
Path Type	Waypoint Entry	Waypoint Exit	# of Segments and Description
			Holding pattern outbound leg (length based upon either time or distance as specified by navigation database). Turn to holding pattern inbound leg (180°). Holding pattern inbound leg (length based upon either time or distance as specified by navigation database).

7.3.5. Direct-To

If the EFIS generates a WGS-84 geodesic path to a designated “To” fix, the aircraft captures this path without “S-turning” or undue delay. Where the selected “To” fix is in the active flight plan, the required transition is created as follows:

1) A 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) A 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.

7.3.5.1. Direct-To Unnamed Waypoints inside Procedures

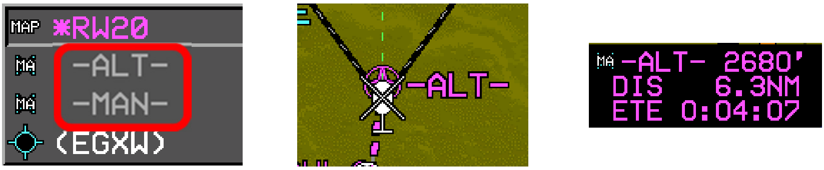
The following identifiers are implemented for unnamed waypoints inside a published procedure and are found on the ND or inside the active flight plan.

1) **-ALT-** for altitude terminations
2) **-DIR-** for waypoints that begin a Direct-To leg
3) **-DME-** for distance or DME terminations

4) **-INT-** for intercept terminations

5) **-RAD-** for radial terminations

6) **-MAN-** for manual terminations



Active Flight Plan | MFD Navigation Display | PFD Waypoint Information

Figure 7-10: Unnamed Waypoints

7.4. Discontinuities

Where the EFIS 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 nor 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 activates 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.

7.4.1. Manual Termination Legs

Manual termination legs (ARINC-424 path types FM and VM) are a special case and are handled as follows:

1) The manual termination leg is rendered as a path on the database course/heading for 10NM beyond either:

   a) the previous waypoint (manual leg not active); or

   b) the nearest on-path point (manual leg active);

2) Rendering of the manual termination leg does not terminate with a waypoint symbol;

3) The manual termination leg is followed by a discontinuity;

4) Waypoint sequencing is suspended on the manual termination leg;

5) Once the CDI transitions to FROM operation, **RESUME (L2)** appears;

6) When ready to end manual navigation and resume a path to the waypoint following the manual termination leg, press **RESUME (L2)** to create and activate a Direct-To path to the waypoint.

NOTE:

If the manual termination leg is not followed by another waypoint (other than a suppressed waypoint), **RESUME (L2)** does not appear, because there would be no waypoint-to-waypoint sequencing to resume.

7.5. 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 is capable 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 world magnetic model appropriate to the five-year cycle in a MAGVAR database.

7.5.1. AHRS Modes for Heading Source

AHRS Slaved—EFIS Magnetic North: Standard mode of operation. Everything displayed relative to magnetic north drift free.

AHRS Slaved—EFIS True North: Everything is displayed relative to true north with drift free heading. The preferred way to operate in areas where navigation is done relative to true north. (See Section 9 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.

7.5.2. EFIS True North Mode

True north mode is selectable either through **OBS (L4)**, **TRUE NORTH (L1)** or a discrete input external switch. This mode is intended to address aircraft requirements during high or low latitude operations and should be used when the AHRS has been set to free-gyro mode. See Section 3 Display Symbology for symbology examples while in true north mode.

7.6. 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.

7.7. Dead Reckoning

The EFIS has 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.

7.8. 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.

7.9. 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 points are located so they lie on the intersection of lines drawn parallel to the host route at the desired offset distance and the line that bisects the track change angle, except where the parallel offset ends. In this case, the offset reference point is located abeam of the original flight plan waypoint at the offset distance.

The parallel offset function is not available nor applies to:

1) Legs that are parts of approach procedures (IFR and VFR); or

2) Legs with complex geometries or that begin or end with dynamically terminations. (ARINC-424 path types other than CF, DF, or TF or any leg where the starting waypoint is not a fixed position); or

3) Legs that begin at an aircraft starting position (reference waypoint in a DP or Start/Phantom waypoints created by the Direct-To function.

Parallel offset function does not propagate through the following:

1) Any waypoint at the beginning or end of a route discontinuity; or

2) Any waypoint at the beginning or end of a prohibited leg type; or

3) A waypoint with an unreasonable path geometry (defined as a turn greater than 120°).

When the parallel offset function begins or ends within a flight plan due to the above constraints, parallel offset entry (PTK+) or exit (PTK-) waypoints are inserted into the flight plan. PTK ENDING appears in sufficient time to alert the pilot to return to the original path. Discontinuities precede parallel offset entry waypoints and follow parallel offset exit waypoints. This allows the pilot to navigate to and from the parallel offset as required.

Figure 7-11: Parallel Offset PTK+/PTK ENTRY

Figure 7-12: Parallel Offset PTK-/PTK ENDING

The EFIS provides guidance to parallel tracks at a selected offset distance. When executing a parallel offset, 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 1NM, left or right of course, and is capable of offsets of at least 20NM. Offset mode is indicated with an advisory flag, e.g., PTK = L 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.

Once a parallel offset is activated, the offset remains active for all flight plan route segments until removed automatically (transitioning through a parallel track exit waypoint), until the flight crew enters a “Direct-To” routing or activates a new flight plan route, or until (manual) cancellation.

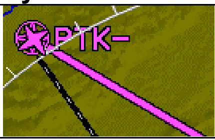
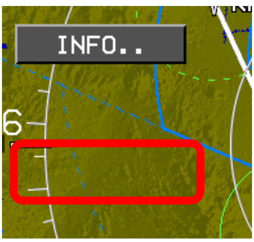
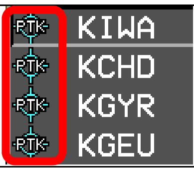
NOTE:

If a parallel offset is entered in the active flight plan and then cancelled, that active flight plan is no longer eligible for configuring another parallel offset without deleting and reopening due to the creation of a discontinuity.

Table 7-6: Parallel Offsets Symbols and Description

Symbol	Description
PTK PTK- DIS 18.4NM ETE 0:08:55	Parallel offset has been created and has a designated ending waypoint.

Table 7-6: Parallel Offsets Symbols and Description

Symbol	Description
	Designated ending waypoint of parallel offset
PTK = R 3NM	Parallel track advisory indicating offset track 3 NM to the right of host route.
	**PTK.. (L4)** appears when active route is eligible for a parallel offset.
PTK ENDING	Approaching end of parallel offset waypoint
VNAV AT EDMN ALTITUDE: 4300' OFFSET: ---NM	VNAV altitude is possible with offset of distance before or after waypoint.
VNAV AT EDMN ALTITUDE: 6800' OFFSET: NA	VNAV altitude input is possible but not an offset of a distance before or after waypoint.
	The absence of **PTK (L4)** indicates a parallel offset is not allowed for reasons stated above.
	Indicates each waypoint is a part of the parallel offset.

7.10. Default GPS/SBAS Navigation Modes

In the default GPS/SBAS mode, the EFIS 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 determined by navigation mode.

Table 7-7: 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 switches to default navigation modes based upon region of operation as follows.

Table 7-8: 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 and 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; and within 30NM of the active runway; and FAWP is active waypoint*; and bearing to FAWP is within 45° of final approach segment track (treated as a mode entry criteria); and desired track to FAWP is within 90° of final approach segment track (treated as a mode entry criteria).
Approach (LNAV, LNAV/VNAV, LP or LPV)	IFR approach has been selected; and within 30NM of the active runway; and MAWP or FAWP is active waypoint; and if FAWP is active waypoint: bearing to FAWP is within 45° of final approach segment track (treated as a mode entry criteria); and desired track to FAWP is within 90° of final approach segment track (treated as a mode entry criteria); and

Table 7-8: Default Navigation Modes Based Upon Region of Operation

Default Navigation Mode	Definition of Region
	either segment leading into FAWP is not a holding pattern, or pilot has elected to continue out of holding.
VFR Approach	VFR approach has been selected; and within 30NM of the active runway; and active runway is the active waypoint; and the bearing to the active runway/user waypoint is within 45° of the final approach segment track (treated as a mode entry criteria); and the aircraft track is within 90° of the final approach segment track (treated as a mode entry criteria).
Terminal	Not in departure mode; and Not in approach mode; and The active waypoint is part of a departure or the active waypoint and previous waypoint are parts of an arrival or approach or within 30 NM of the departure airport, arrival airport, or runway.
Enroute	Not in departure, approach, or terminal modes.

NOTE:

During RNP 0.3 Approach (manually or coded) the scale remains in RNP 0.3.

7.11. GPS/SBAS CDI Scale

Table 7-9: 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		If VTF, switch immediately.

Table 7-9: Summary of Changes In Cross-Track FSD

	To Enroute	To Terminal	To Approach
	distance of 1 NM; start transition when entering enroute mode.		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, time to alert (TTA) is the same as for the approach. For RNP 0.3, the EFIS uses a 10-second TTA when using GPS-only, and a 2-second TTA when using EGNOS.

7.12. Approach Type Selection

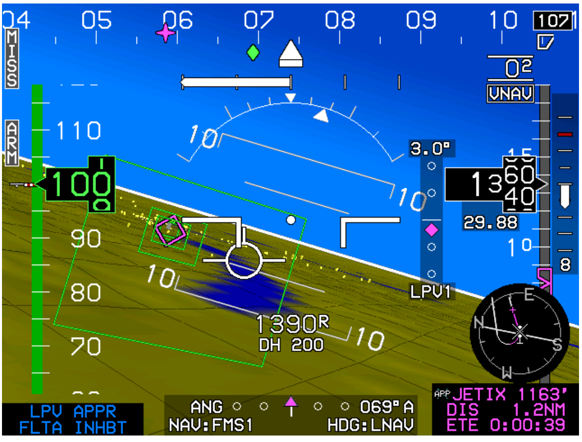


Figure 7-13: GPS Mode (LPV APPR)

The EFIS selects the approach type (LNAV, LNAV/VNAV, LP, or LPV) when entering approach mode with the following order of precedence and prerequisites:

1) **LPV**:

   a) ARINC-424 “Level of Service” indicates LPV minimums are published;

   b) Valid long-term, fast, and ionospheric SBAS corrections are available and being applied to at least 4 GPS satellites;

   c) Final approach segment data block exists and passes CRC; and

   d) Horizontal and vertical alert limits from final approach segment data block are predicted to be supported.

2) **LP**: (Same precedence and prerequisites as **LPV** (except ARINC-424 “Level of Service” indicates LP minimums are published.)

3) **LNAV/VNAV**:

   a) ARINC-424 “Level of Service” indicates LNAV/VNAV minimums are published;

   b) If a final approach segment data block exists, it passes CRC; and

   c) Horizontal alert limit of 556 m. (.3 NM) is predicted to be supported.

NOTE:

Because the EFIS inherently supports barometric VNAV, it is not a prerequisite for the vertical alert limit to be predicted or supported, nor is it a prerequisite for valid long-term, fast, and ionospheric SBAS corrections to be available and applied to at least four GPS satellites. Rather, the vertical alert limit (50m) and SBAS correction tests are used to determine whether to present guidance based upon GPS altitude or barometric altitude.

4) **LNAV**: Default approach type and is selected when none of the above selections is made. There are no prerequisites for selecting LNAV.

The EFIS continuously displays the approach type (mode indication) after selection. It 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.

Some instrument procedures include notes saying the following: “RNP 0.3 required” and are coded as an RNAV procedure. In these cases, select manual RNP to see the RNP and ANP values on the PFD.

7.12.1. 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.

7.12.2. VTF IFR Approach

In addition, the pilot may select a VTF IFR approach, indicating the pilot does not intend to fly the entire procedure. When a VTF IFR approach is selected, the EFIS creates an initial point (IP) waypoint on the extended final approach course to provide deviations relative to the extended final approach course. The IP is a fly-over defined exit heading waypoint, and the leg prior to the IP is designated a discontinuity. Until the FAWP is sequenced, the EFIS indicates a VTF IFR approach has been selected. VECTORS indicates guidance is not relative to a published approach path, and TERPS clearances are not assured.

7.12.3. VTF VFR Approach

The pilot may select a VFR approach to a runway or user waypoint with a defined approach bearing. When a VFR approach is selected, the EFIS 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.

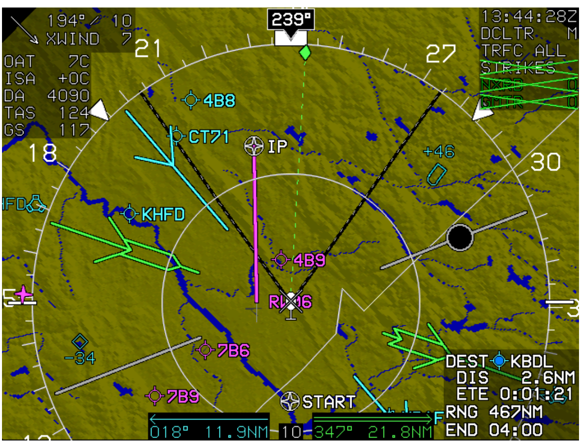


Figure 7-14: Navigating to FAF on VTF VFR Approach

As depicted in Figure 7-14, during this VTF VFR approach, the aircraft proceeds towards 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 RW06 is activated.

7.13. Loss of Navigation Monitoring

The EFIS continuously monitors for loss of navigation capability. In manual or automatic RNP mode prior to sequencing the FAWP, the loss of navigation caution is displayed using a 10-second TTA if the RNP value is less than 2 NM and a 30-second TTA otherwise. Use the Faults menu to distinguish the cause of the LON caution. The caution returns to its normal state upon termination of the responsible condition.

7.13.1. Automatic RNP Mode

In automatic RNP mode, after sequencing the FAWP, the EFIS indicates when the navigation system is no longer adequate to conduct or continue the approach by displaying the LON condition inside the CDI on the transmit enabled display. The flag is latched until no longer in an approach mode.

Figure 7-15: LON Indication

NOTE:

The aircraft is equipped for the following individual levels of RNP but may not be capable due to limited satellite coverage. Manual RNP is selectable between 0.10NM and 15NM as follows:

1) 0.01 NM increments between RNP 0.10 and RNP 0.3

2) 0.1 NM increments between RNP 0.3 and RNP 2

3) 1 NM increments between RNP 2 and RNP 15

7.13.2. Faults Menu

Use the faults menu to distinguish the cause of the LON caution. Table 7-10 explains conditions and caution termination for each mode of flight.

Table 7-10: Summary of Faults Menu

Mode of Flight	Conditions	Caution Termination
Manual RNP 	LON displayed with a 10-second time to alert if RNP value is	Returns to normal state immediately

Table 7-10: Summary of Faults Menu

Mode of Flight	Conditions	Caution Termination
	less than 2NM and a 30-second time to alert.	upon termination of responsible condition
Automatic RNP RNP: 0.10A RNP: 15.0A	After sequencing the FAWP, LON displayed when navigation system is no longer is adequate to conduct or continue the approach.	Latched until equipment no longer in an approach mode.
Enroute and Terminal TERMINAL	LON displayed when navigation system is no longer is adequate to conduct or continue the navigation.	Returns to normal state immediately upon termination of responsible condition
LNAV Approach mode LNAV APPR	Upon passing the FAWP, flag is latched until EFIS is no longer in an approach mode.	Returns to normal state immediately upon termination of responsible condition
LNAV/VNAV Approach mode LNV/VNV APPR	LON displayed when navigation system is no longer adequate to conduct or continue the approach.	After sequencing the FAWP, LON/VERT LON flags are latched until the equipment is no longer in an approach mode. As defined above with the exception that when the LNAV/VNAV approach mode is predicted upon Barometric VNAV. (See Note1)
LP or LPV Approach mode LP APPR LPV APPR	LON or VERT LON displayed when navigation system is no longer adequate to conduct or continue the approach.	Prior to sequencing the FAWP, flags return to normal state immediately upon termination of the responsible condition.
Note 1: A supplemental test is added for lateral and vertical flagging. A supplemental test is added for vertical flagging when barometric altitude information is in a failed state.		

7.13.3. Loss of Integrity Caution Monitoring

The EFIS provides a caution, independent of any operator action, when the equipment has a loss of integrity monitoring. When HPL (Horizontal Protection Level) exceeds the applicable HAL (Horizontal Alert Limit) for the longer than applicable time to alert and HPL_{SBAS} exceeds the HAL for the current navigation mode for longer than 2 seconds. There are two types of HPL, HPL_{FD}, or HPL_{SBAS} but only one transmitted by the receiver as valid at any time.

Table 7-11: Loss of Integrity Caution Monitoring

Mode of Flight	HAL	Time to Alert
RNP: 0.10A RNP: 15.0A (See Note 1)	As manually set or automatically retrieved	10 Seconds (RNP<2NM) 30 Seconds (otherwise)
Enroute	2 NM	30 Seconds
TERMINAL	1 NM	10 Seconds
LNAV APPR	0.3 NM	10 Seconds
LNV/VNV APPR	0.3 NM	10 Seconds
LP APPR LPV APPR	0.3 NM	10 Seconds
Departure	0.3 NM	10 Seconds

Note 1: Only applicable prior to sequencing FAWP. Meeting loss of integrity criteria after sequencing the FAWP is defined as LON.

7.14. Manual Holding Patterns

Most waypoints within an active flight plan can have a manual holding pattern created with the following parameters:

1) Inbound course to the holding fix with 1° increments relative to magnetic or true north.

2) A left or right turn direction.

3) A turn distance, settable in either time (increments of 0.1 minutes from 0.5 minutes to 5.0 minutes) or distance (increments of 1 nautical mile from 1 nautical mile to 25 nautical miles). When a time setting is used, the speed used to calculate distance is the holding speed set in EFIS limits.

7.15. 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 is unavailable. The EFIS cannot change back to a more accurate level of service until the next time an approach is activated.

The following are samples of step-by-step procedures:

1) Standard Instrument Departure (DP)

2) Standard Terminal Arrival Route (STAR)

3) ILS Instrument Approach

4) ILS Instrument Approach with Manual Termination Leg

5) LOC Back Course Instrument Approach

6) RNAV (GPS) Instrument Approach to LPV Minima

7) NRST ILS Instrument Approach

8) VOR/DME Instrument Approach

9) ILS or LOC RWY 1 Instrument Approach with Missed Approach Flown to Alternate Fix

7.15.1. Missed Approach and Departure Path Definition

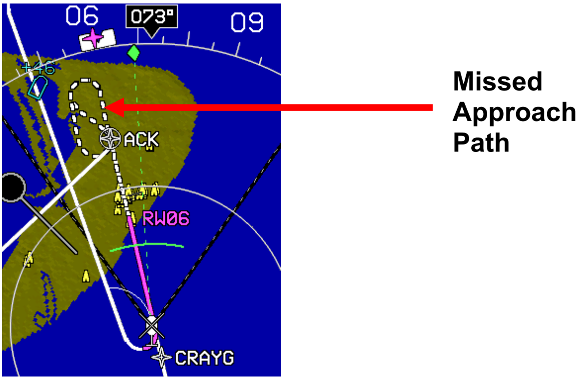


Figure 7-16: Missed Approach and Departure Path

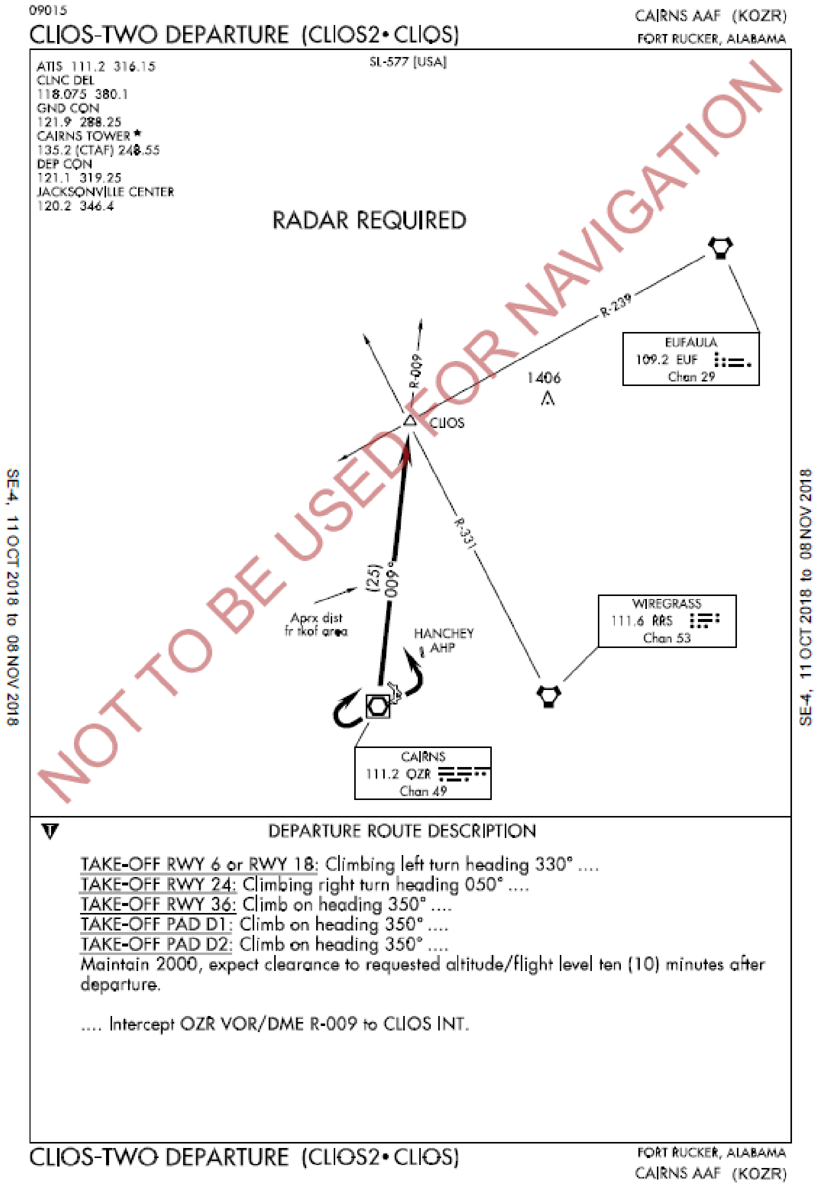
Once on the final approach segment (dashed line course similar to instrument approach chart portrayal), the pilot may initiate an immediate missed approach or arm the system to execute the missed approach at the MAWP. If armed before crossing the MAWP, the missed approach is armed for automatic initiation at the MAWP. If a missed approach is not initiated prior to crossing the MAWP, the EFIS switches to FROM mode at the MAWP and continues on the same course.

If the pilot initiates the missed approach, the EFIS 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 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.

7.15.2. Standard Instrument Departure (DP) (Step-By-Step)

The following example includes the execution of a Standard Instrument Departure procedure from Cairns AAF Alabama USA (KOZR) with radar vectors to the assigned route.



DEPARTURE ROUTE DESCRIPTION

TAKE-OFF RWY 6 or RWY 18: Climbing left turn heading 330° ....
TAKE-OFF RWY 24: Climbing right turn heading 050° ....
TAKE-OFF RWY 36: Climb on heading 350° ....
TAKE-OFF PAD D1: Climb on heading 350° ....
TAKE-OFF PAD D2: Climb on heading 350° ....
Maintain 2000, expect clearance to requested altitude/flight level ten (10) minutes after departure.

.... Intercept OZR VOR/DME R-009 to CLIOS INT.

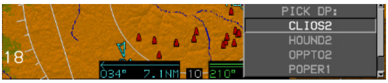
CLIOS-TWO DEPARTURE (CLIOS2•CLIOS)
FORT RUCKER, ALABAMA
CAIRNS AAF (KOZR)

Figure 7-17: Standard Instrument Departure (DP)

1) Press **ACTV (L2)** departure airport must be entered as a waypoint.

2) Scroll ❶ to desired airport (KOZR) and push to enter.

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

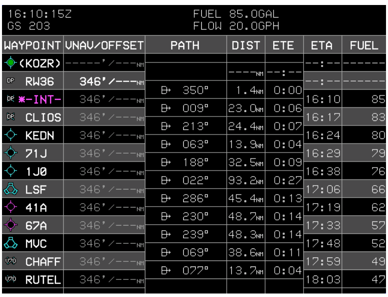


4) Scroll ❶ to desired DP (CLIOS2). Push to enter.

5) Scroll ❶ to desired transition (RW36). Push to enter.

6) Scroll ❶ to desired runway (RW36). Push to enter.

7) ATC issues radar vectors to assigned route as published in the DP text notes.


16:10:15Z FUEL 85.0GAL
GS 203 FLOW 20.0GPH

WAYPOINT	UNAV/OFFSET	PATH	DIST	ETE	ETA	FUEL
(KOZR)	-----'/---NM				--:--	------
RW36	346'/---NM		----NM	--:--	--:--	------
*-INT-	346'/---NM	350°	1.4NM	0:00	16:10	85
CLIOS	346'/---NM	009°	23.0NM	0:06	16:17	83
KEDN	346'/---NM	213°	24.4NM	0:07	16:24	80
71J	346'/---NM	063°	13.9NM	0:04	16:29	79
1J0	346'/---NM	188°	32.5NM	0:09	16:38	76
LSF	346'/---NM	022°	93.2NM	0:27	17:06	66
41A	346'/---NM	286°	45.4NM	0:13	17:19	62
67A	346'/---NM	230°	48.7NM	0:14	17:33	57
MVC	346'/---NM	239°	48.3NM	0:14	17:48	52
CHAFF	346'/---NM	069°	38.6NM	0:11	17:59	49
RUTEL	346'/---NM	077°	13.7NM	0:04	18:03	47

8) Press **MENU (R1)**, press **PAGE.. (R3)**, then scroll ❶ to **NAV LOG** and push to enter. View first portion and then scroll ❶ to view remainder of NAV LOG.

7.15.3. Standard Terminal Arrival Route (STAR) (Step-By-Step)

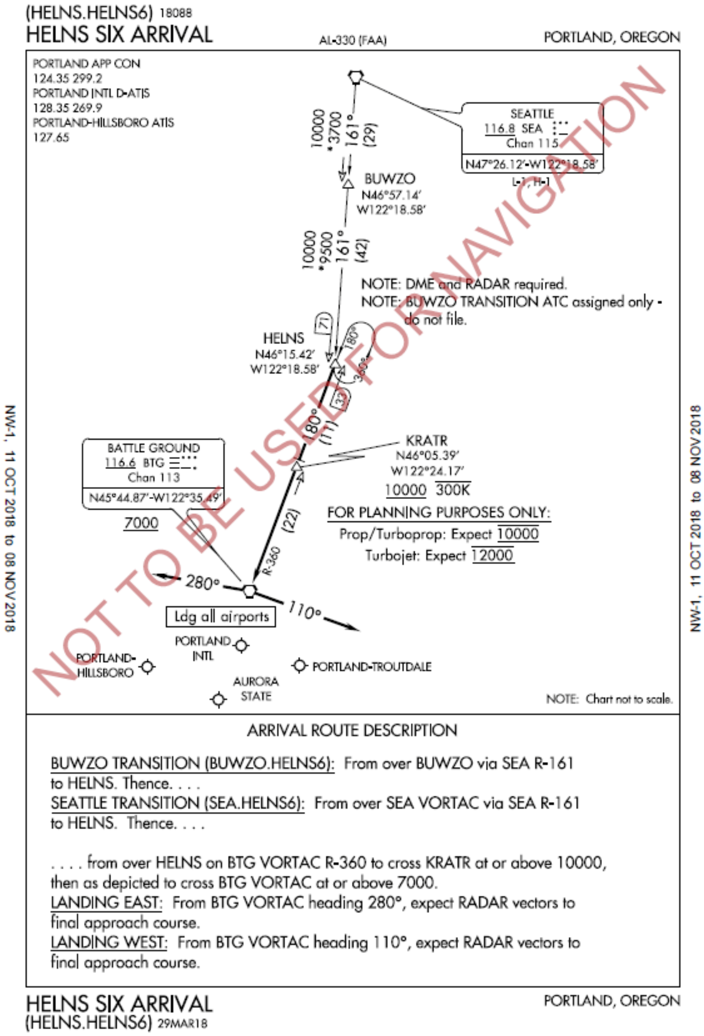


Figure 7-18: Standard Terminal Arrival Route (STAR)

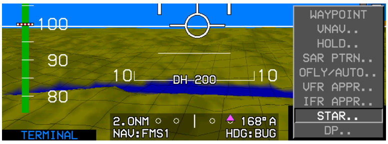
If the selected waypoint is an airport with a published STAR, this option is available for selection from a list of available STARs, transitions, and runways. After selection, the appropriate STAR is created and displayed on the MAP page. Activating a STAR deletes any pre-existing STAR, and it is inserted prior to any approach waypoints if previously entered.

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.

The following example includes the execution of a STAR procedure into Portland-Hillsboro Oregon USA (KHIO)

1) Press **ACTV (L2)** Scroll ❶ to desired airport.

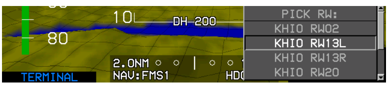
2) Push ❶ with (KHIO) highlighted.



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

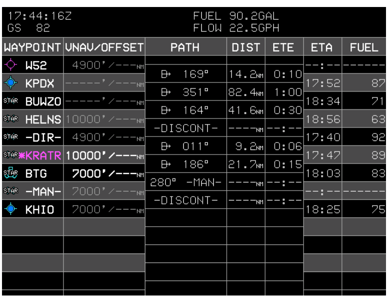
4) Scroll ❶ to desired STAR (HELNS6). Push to enter.

5) Scroll ❶ to desired transition (*BUWZO), push to enter. (*indicates most likely transition based on arrival area and track.)



6) Scroll ❶ to desired runway (RW13L) and push to enter.

7) ATC clears direct to KRATR maintain 5,000' then on course. Press **ACTV (L2)** then scroll ❶ to KRATR press  **(R4)** and push to enter.



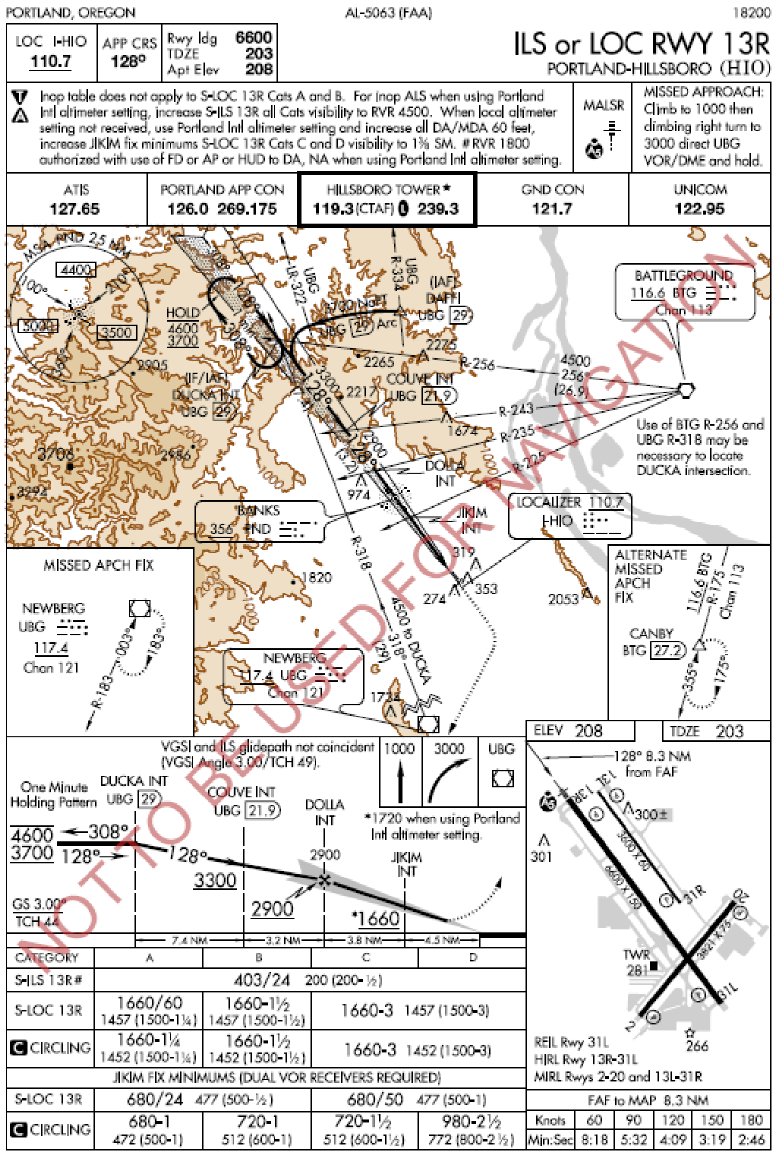
17:44:16Z GS 82 FUEL 90.2GAL FLOW 22.5GPH

WAYPOINT	VNAV/OFFSET	PATH	DIST	ETE	ETA	FUEL
W52	4900'/---				--:--	-----
KPDX	-----'/---	169°	14.2	0:10	17:52	87
BUWZO	-----'/---	351°	82.4	1:00	18:34	71
HELNS	10000'/---	164°	41.6	0:30	18:56	63
-DIR-	4900'/---	-DISCONT-	----	--:--	17:40	92
*KRATR	10000'/---	011°	9.2	0:06	17:47	89
BTG	7000'/---	186°	21.7	0:15	18:03	83
-MAN-	7000'/---	280° -MAN-	----	--:--	--:--	-----
KHIO	7000'/---	-DISCONT-	----	--:--	18:25	75

8) On the MFD, press **MENU (R1)** then **PAGE.. (R3)** and scroll ❶ to NAV LOG and push to enter.

7.15.4. ILS Instrument Approach (Step-By-Step)

All approach operations begin with the same basic steps. This example selects ILS or LOC RWY 13R at Portland-Hillsboro Oregon USA (KHIO).



CATEGORY	A	B	C	D
S-ILS 13R #	403/24 200 (200-½)			
S-LOC 13R	1660/60 1457 (1500-1¼)	1660-1½ 1457 (1500-1½)	1660-3 1457 (1500-3)	
CIRCLING	1660-1¼ 1452 (1500-1¼)	1660-1½ 1452 (1500-1½)	1660-3 1452 (1500-3)	
JIKIM FIX MINIMUMS (DUAL VOR RECEIVERS REQUIRED)				
S-LOC 13R	680/24 477 (500-½)		680/50 477 (500-1)	
CIRCLING	680-1 472 (500-1)	720-1 512 (600-1)	720-1½ 512 (600-1½)	980-2½ 772 (800-2½)

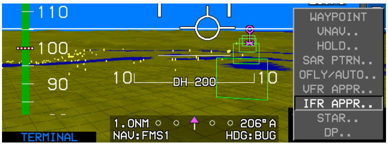
FAF to MAP 8.3 NM					
Knots	60	90	120	150	180
Min:Sec	8:18	5:32	4:09	3:19	2:46

PORTLAND, OREGON
Amdt 10B 19JUL18
45°33'N-122°57'W
PORTLAND-HILLSBORO (HIO)
ILS or LOC RWY 13R

Figure 7-19: ILS Instrument Approach (KHIO)

1) ATC clears direct BTG VOR Press **ACTV (L2)** scroll ❶ to BTG press  **(R4)** and push to enter.

2) ATC says to plan for the KHIO ILS 13R. Scroll ❶ to **KHIO** and push to enter.

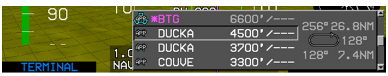


3) Scroll ❶ to **IFR APPR...** Push to enter.

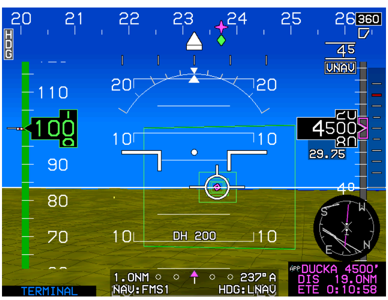
4) Scroll ❶ to desired approach (ILS 13R). Push to enter.

5) Scroll ❶ to transition (*BTG) (*indicates most logical from current position). Push to enter.

6) Scroll ❶ to landing runway (RW13L due to current NOTAMS for RW13R closed). Push to enter.

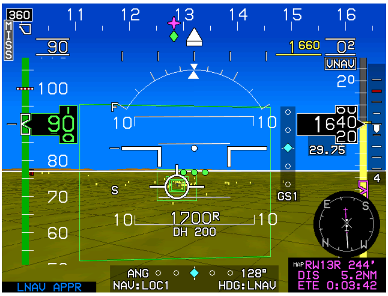


7) ATC issues clearance to proceed to DUCKA and hold as published maintain 4,500' expect further clearance at (XXXX). Scroll ❶ to **DUCKA** and push to enter. Scroll ❶ to **HOLD** and push to enter and enter holding direction and leg length or time. Push to enter.

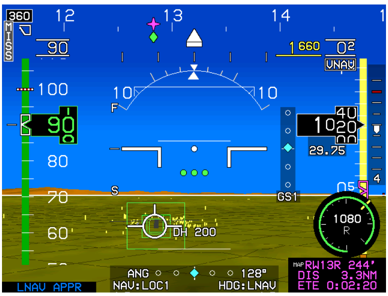


8) Holding pattern was created in the previous step and is the next leg to be sequenced.

9) ATC now cancels the holding clearance at DUCKA and issues clearance for the KHIO ILS RW13R side-step to land on RW13L.



10) Beyond FAF and **ARM (L2)** was pressed. Below circling minimums for side-step to land on RW13L.



11) On a 3-mile final and RW13R is a dark gray to serve as a reminder it is not the landing runway.

12) ATC issues go-around clearance. Press **MISS (L1)**.

13) Navigation source automatically switches to FMS1 and FSD 0.3NM with HITS guidance clearly revealing anticipatory right turn ahead.

7.15.5. ILS Approach with Manual Termination Leg in MAP (Step-By-Step)

This example selects RAF Cranwell United Kingdom (EGYD) with -ALT- termination leg followed by an immediate manual termination leg requiring pilot action to resume automatic waypoint sequencing.

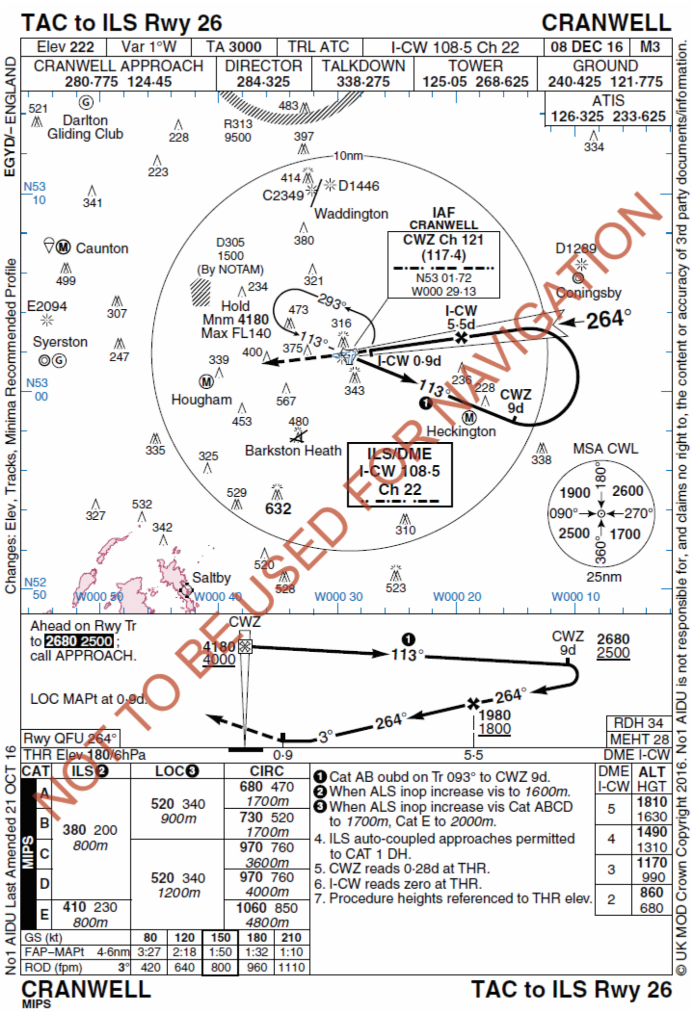
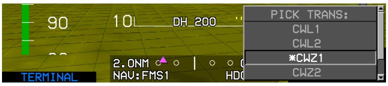


Figure 7-20: ILS Approach (EGYD)

1) Press **ACTV (L2)**. Scroll ❶ to the destination airport (EGYD) and push to enter.

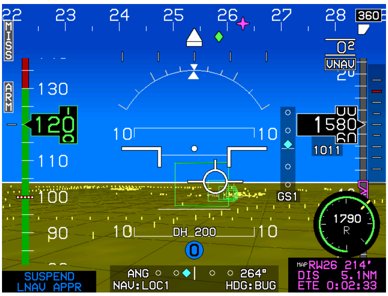
2) Scroll ❶ to **IFR APPR..** and push to enter.

3) Scroll ❶ to desired approach and push to enter.

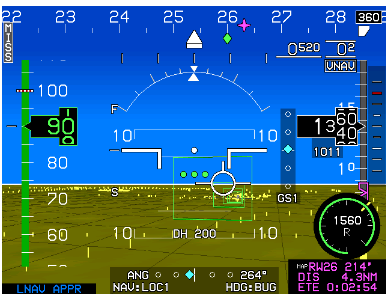


4) Scroll ❶ to desired transition and push to enter. (* indicates most logical from current position)

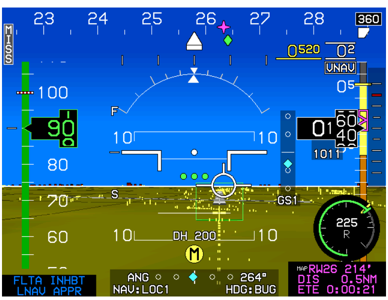
5) Scroll ❶ to desired runway (colors the active runway light gray). Push to enter.



6) Passing the FAF, press **ARM (L2)** to arm the missed approach procedure and resume automatic waypoint sequencing.



7) DH set at 200’, and localizer minimums set as MDA 520’.

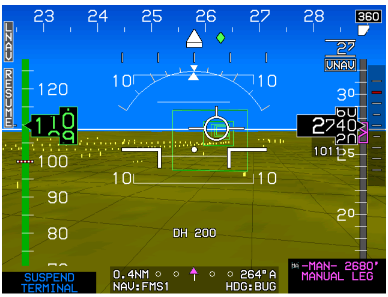


8) On localizer centerline and slightly above glideslope. Below minimum altitude and approaching DH at 225’ AGL.

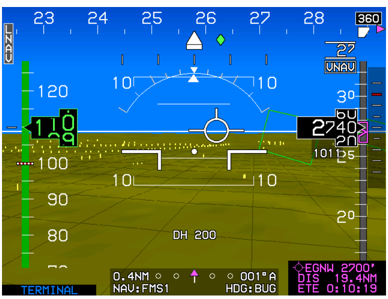
9) Past the MAWP, auto nav source switches to FMS. The -ALT- leg climbing to 2680' is depicted in the active waypoint information box.

10) It is important to note, there is no further navigation guidance beyond the ALT termination leg.

11) MFD showing manual termination leg with no further course guidance. Altitude predictor arc indicates climb performance meets procedure requirements.



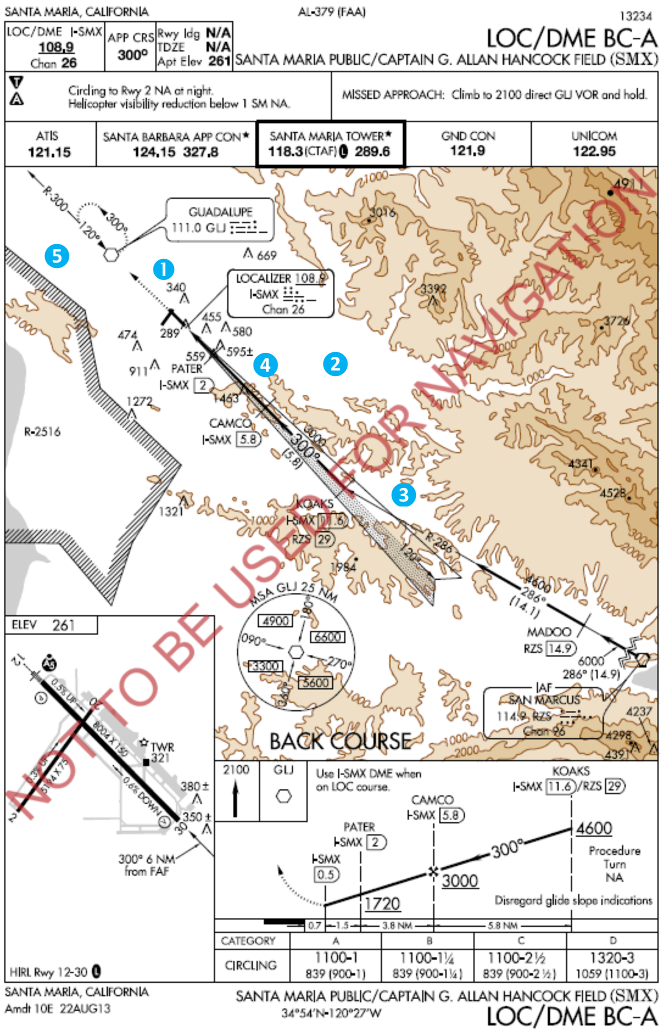
12) Automatic waypoint sequencing still suspended. Press **RESUME (L2)** to resume.



13) After **RESUME (L2)** is pressed, normal waypoint sequencing resumes to next active waypoint (EGNW)

7.15.6. LOC Back Course Instrument Approach (Step-By-Step)

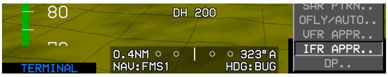
This example includes a LOC/DME Back Course approach at Santa Maria, California, USA (KSMX) with attention drawn to OBS settings and includes blue numbers to associate places of reference on the chart and the EFIS.



CATEGORY	A	B	C	D
CIRCLING	1100-1 839 (900-1)	1100-1¼ 839 (900-1¼)	1100-2½ 839 (900-2½)	1320-3 1059 (1100-3)

Figure 7-21: LOC Back Course Approach

1) ❶ Press **ACTV (L2)**. Scroll ❶ to airport active waypoint. Push to enter.

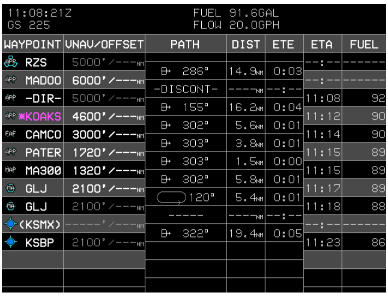


2) Scroll ❶ to **IFR APPR..** and push to enter.

3) Scroll ❶ to desired approach **(LBCA)** and push to enter.

4) Scroll ❶ to transition (*indicates most logical from current position). Push to enter.

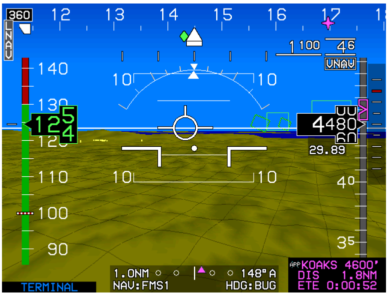
5) Scroll ❶ to desired runway. Push to enter.



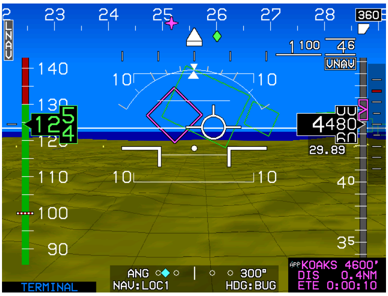
6) Follow ATC clearance and determine where to proceed. To view NAV LOG, press **MENU (R1)** and **PAGE (R3)**. Scroll ❶ to **NAV LOG** and push to enter.

7) ❷ Assume ATC issued clearance to proceed direct to KOAKS, press **ACTV (L2)** and  **(R4)** when KOAKS was highlighted.

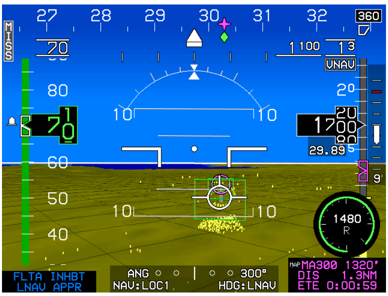
8) It is only desired to cross KOAKS as a waypoint. Push ❶ to enter.



9) To set minimums, press **MENU (R1)**, **BUGS (R2)**, **MINS (R3)**, scroll ❶ to **MIN ALT..**, and push to enter. Scroll ❶ to set minimum altitude and push to enter.

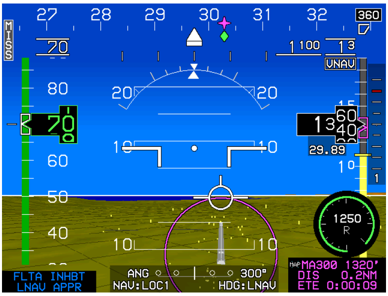


10) ❸ Press **OBS (L4)**. Press **NAV VLOC1 (L3)** or **NAV VLOC2 (L4)** as applicable. Scroll ❶ to set back course bearing of 300° and push to enter. This results in proper sensing of back course CDI indications.

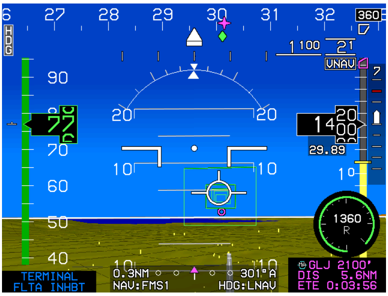


11) ❹ After passing the FAF (CAMCO), **MISS (L1)** and **ARM (L2)** appear. There is no SUSPEND advisory due to the stepdown fix of PATER 0.2NM ahead. Approaching PATER (fly-by waypoint symbol) stepdown fix with the missed approach procedure armed.

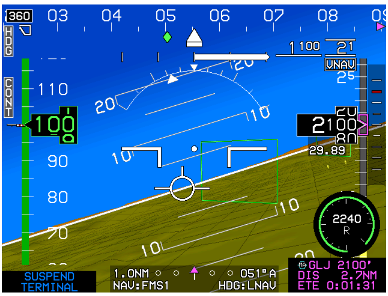
12) On the MFD, the altitude predictor indicates descent planning is adequate for arriving at MA300 at 1,320’ with no further action required.



13) Approaching MAP MA300 with runway in sight. IAS stabilized at 70 KIAS.



14) Passing the MAWP, nav source automatically switches to FMS and FSD 0.3NM.



15) 5 Entering HOLD at GLG and navigating on FMS.

16) **CONT (L2)** appears as a reminder to press when ready to leave the HOLD and continue to the destination KSBP.

7.15.7. RNAV (GPS) Instrument Approach to LPV Minima (Step-By-Step)

This example includes an RNAV (GPS) RWY 32 approach to Wichita, Kansas, USA (KICT) and includes blue numbers to associate places of reference on the chart and the EFIS.

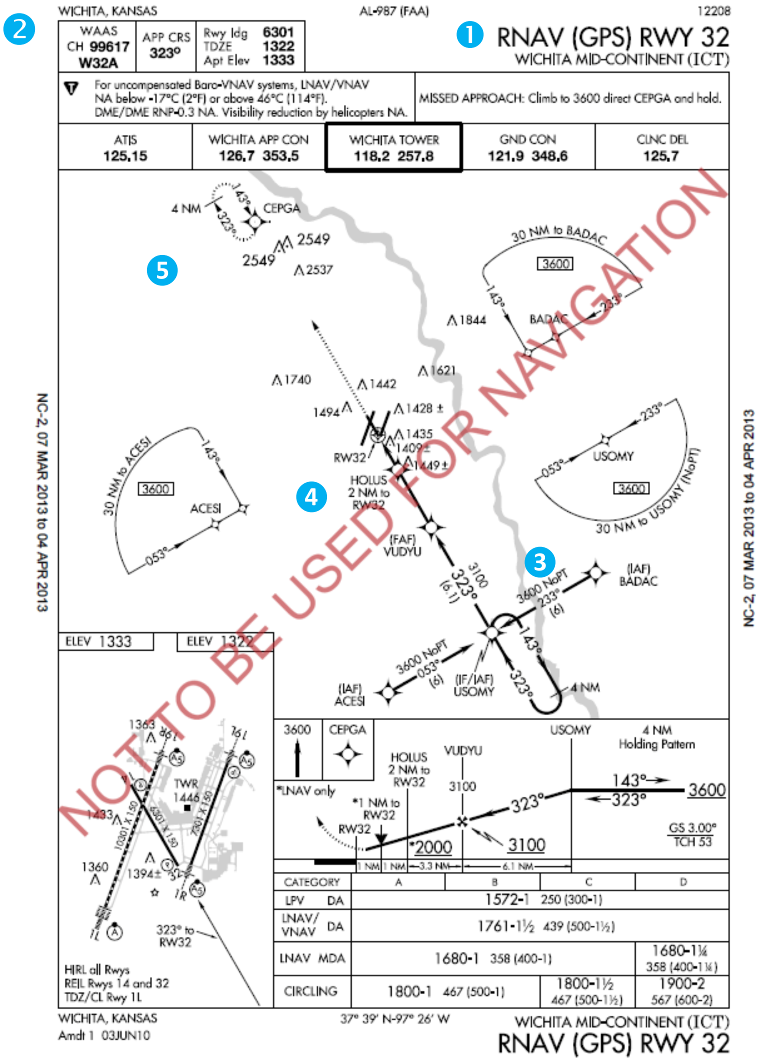
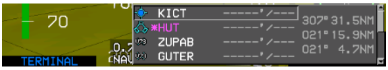
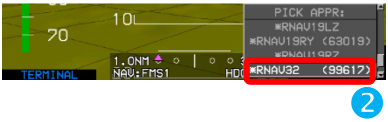


Figure 7-22: RNAV (GPS) Instrument Approach to LPV Minima

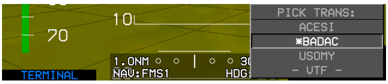


1) Press **ACTV (L2)**. Scroll ❶ to desired airport ❶ from active flight plan and push to enter.

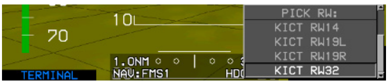
2) Scroll ❶ to **IFR APPR..** and push to enter.



3) Scroll ❶ to desired approach, for example, **RNAV32 (99617)**. Verify WAAS channel number ❷ matches instrument approach chart and push to enter.

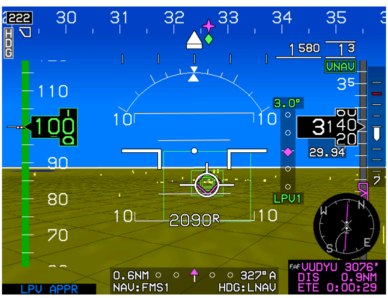


4) Scroll ❶ to the desired transition and push to enter. (* = most logical from present position.)

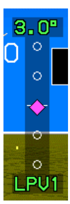


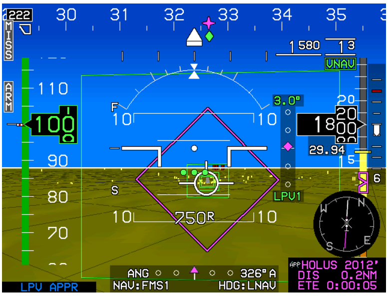
5) Scroll ❶ to assigned landing runway. (Active runway is light gray for identification purposes.)

6) While 2.8NM outside of FAF, the VDI source is LPV1. DA is set to 1,580' and the mini map is selected from the DCLTR menu.



❸ On final approach course and approaching the FAF, LPV APPR appears with the VDI. The source automatically switches to LPV1. The autopilot is coupled in vertical mode.





7) 4 Upon passing HOLUS, press **ARM (L2)** to continue auto waypoint sequencing. This is the latest point on the approach to press **ARM (L2)**.

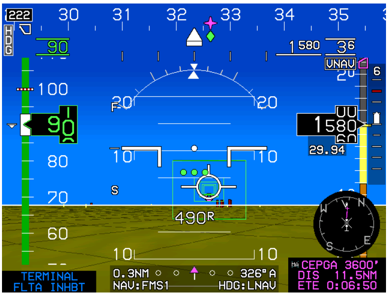
VDI displays vertical guidance for the LPV vertical profile based on GPS/SBAS.

8) Obstructions appear on MFD and altitude predictor arc indicates vertical planning requires no pilot action.

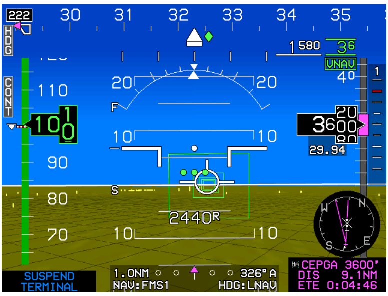
9) Press **MENU (R1)** then **ZOOM (R3)** for wide- angle view of PFI area.

10) FPM lined up on the active runway on glidepath approaching minimums with CDI centered and on glidepath approaching minimums of 1580’ MSL.

11) Below minimums with FPM aligned with touchdown zone on runway. Minimums are amber (yellow) and flashing as the audible alert, “MINMUMS, MINIMUMS,” sounds.



12) Past the MAWP, NAV source remains FMS1 and scale automatically changes to 0.3NM FSD.



13) 5 Established in hold at CEPGA. Press **CONT (L2)** to continue waypoint sequencing to next leg in active flight plan.

7.15.8. NRST ILS Instrument Approach (Step-By-Step)

This method does not require the airport to be in the active flight plan. This example selects ILS RWY 26R at Chino, California (KCNO) with the NRST ILS method of creation.

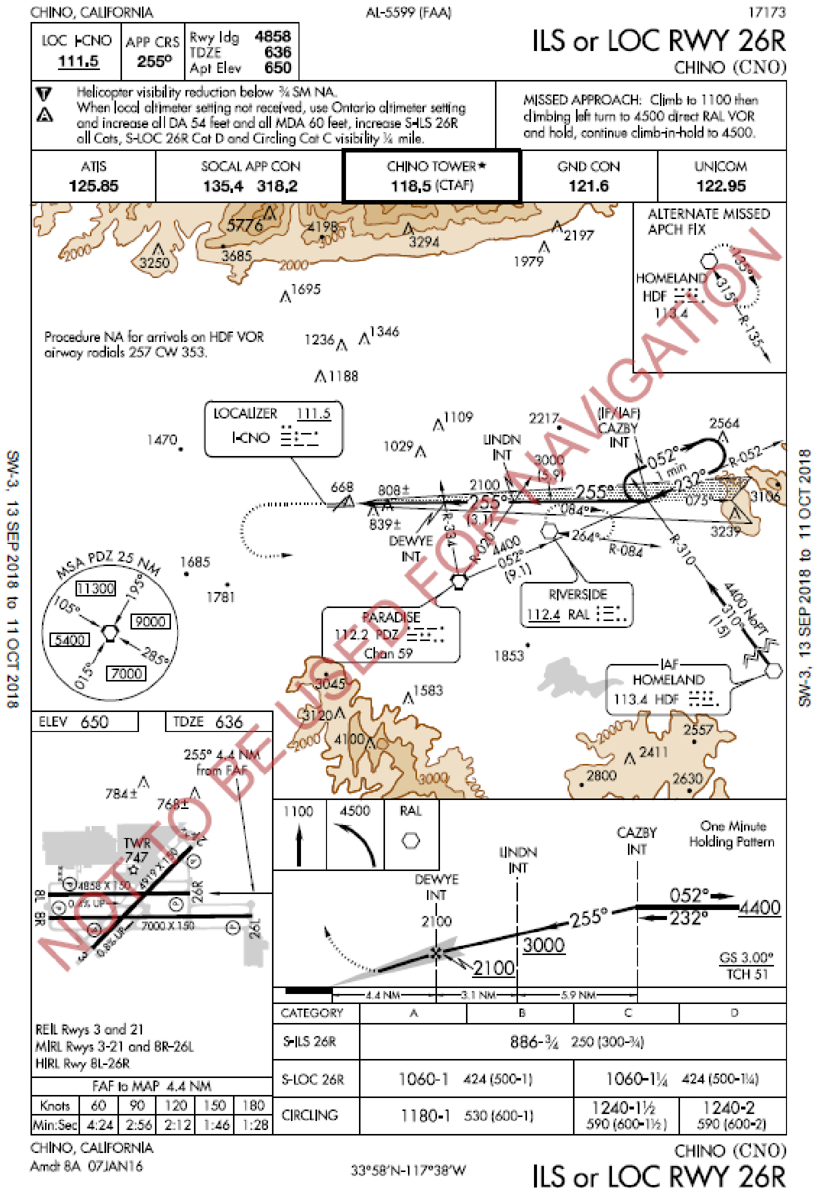
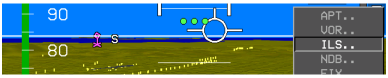


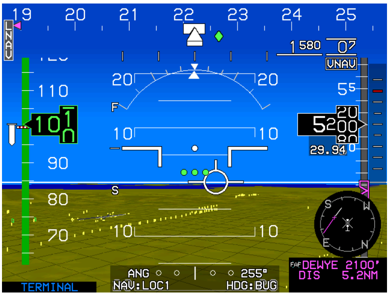
Figure 7-23: NRST ILS Instrument Approach



1) Press **NRST (R3)**. Scroll ❶ to **ILS...** Push to enter. This clears any prior active flight plan.

2) Scroll ❶ to desired NRST ILS. Push to enter.

3) Once confirmed, push ❶ to activate the ILS.



4) The following actions occur:

a) Direct flight plan to the ILS airport is created.

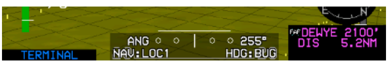
b) A vectors-to-final ILS approach is activated.

c) Heading bug is activated to the current heading.

d) VLOC 1 and VLOC 2 OBS are set to the associated localizer course.

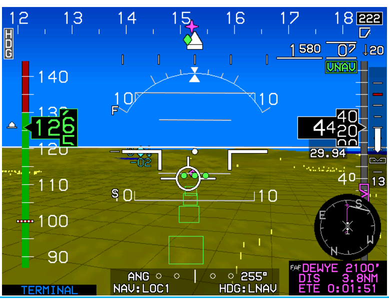
e) ILS frequency is automatically transmitted to NAV#1 in standby position. (When configured)

f) EFIS changes to LOC1, and VDI indicates source of glideslope GS1 when signal is received.



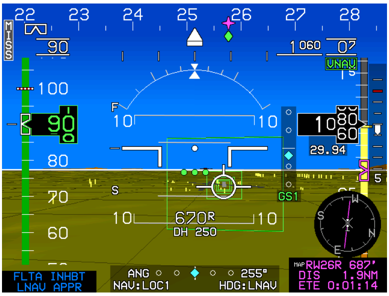
5) DEWYE is the active waypoint.

Press  **(R4)** then push ❶ to enter a direct route with navigation guidance to FAF.

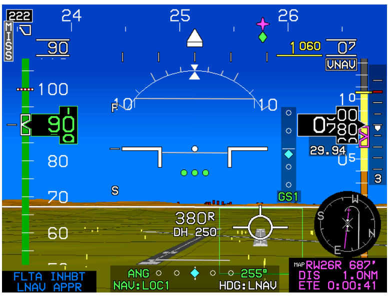


6) HITS indicates guidance to follow GPS overlay of the localizer and glideslope. However, the localizer source for CDI and glideslope receiver VDI are the primary sources for guidance on this ILS approach.

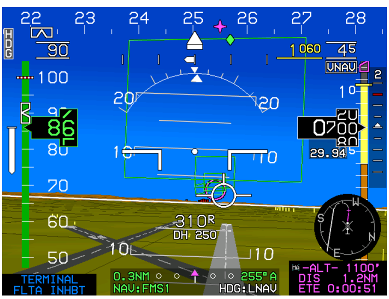
7) MFD press **MENU (R1)** then **PAGE (R3)**. Scroll ❶ to **HSI** and push to enter.



8) Inside 2.0 NM final with FLTA INHBT LNAV APPR indicating no TAWS alerts are triggered and the default GPS mode LNAV APPR is active.



9) Approaching DH with zoom mode on and stabilized at 90 KIAS on the localizer centerline.



10) During the missed approach, the navigation source automatically switches to FMS with 0.3NM FSD. FLTA is still inhibited and terminal mode is active while within the terminal area.

7.15.9. VOR/DME Instrument Approach (Step-By-Step)

This example loads the Lamar Municipal, Colorado, USA VOR/DME RWY 36 approach and is flown via the east arc followed by a missed approach. Blue numbers associate locations on chart and EFIS.

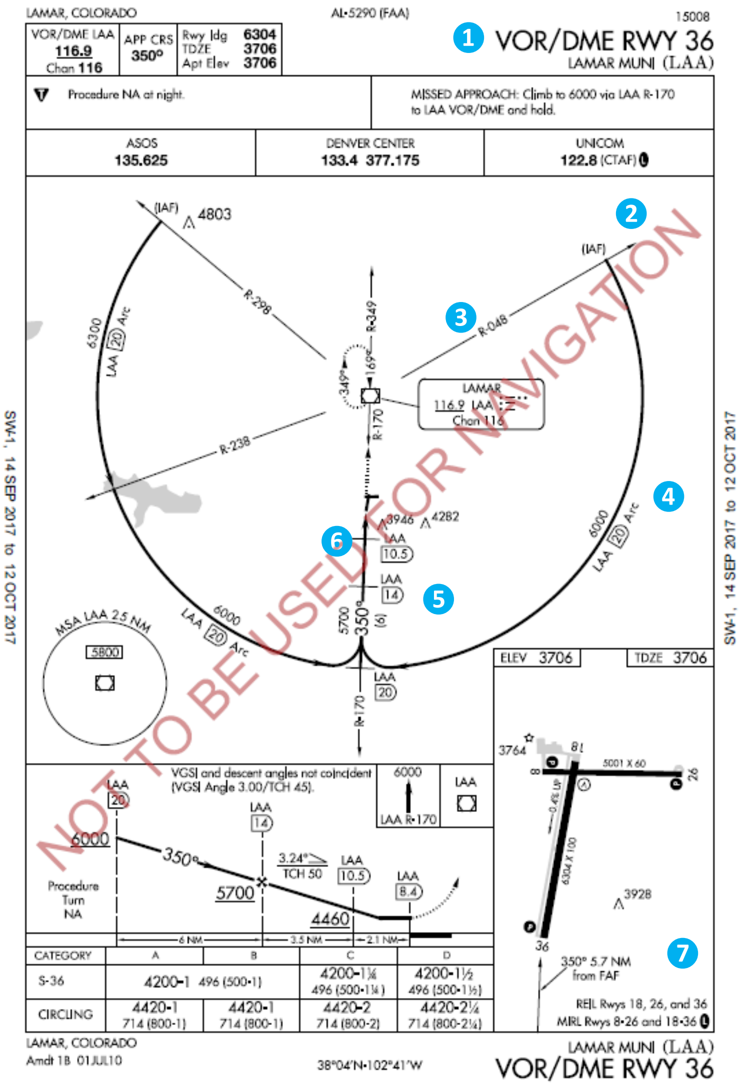


Figure 7-24: VOR/DME Instrument Approach

1) With destination airport entered as the waypoint, scroll ❶ to **IFR APPR..** and push to enter.

2) Scroll ❶ to **IFR APPR..** and push to enter.

3) ① Scroll ❶ to select desired approach (**VORDME36**) and push to enter.

4) Scroll ❶ to desired transition (**DO48T**). (* = most logical from present position.) Push to enter.

5) Scroll ❶ to desired runway. Push to enter.

6) Press **ACTV (L2)** scroll ❶ to view procedure and select fix for compliance with ATC clearance

② (**DO48T**). Press  **(R4)** and push ❶ to enter.

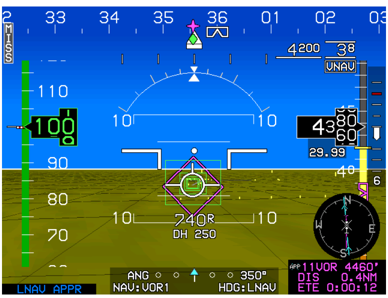
7) A magenta line leads from -DIR- current position to ③ D048T, which is now the active waypoint.

8) Established on the 20 DME ARC ④ with NAV1 and NAV2 set on 116.9 MHz for LAA VOR and inbound FAC set at 350° on both VORs with DME indicating on both nav sources.

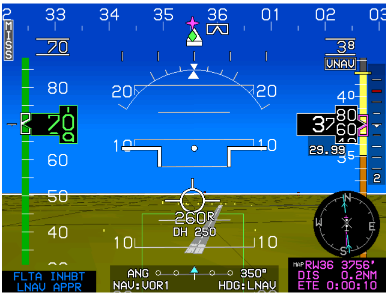
9) To declutter the mini map on the PFD, press **MENU (R1)** and then **DCLTR (R4)**. Scroll ❶ to **MINI MAP** and push to check. Press **EXIT (R1)** or scroll ❶ to **DONE** and push to enter.

10) Established inbound on the final approach course to the FAF (FF36) 5 crossing top of descent symbol ahead indicating when descent can be commenced to cross the FAF at 5700'. Nav source is VOR1 and HITS source is GPS. Primary lateral source is the VOR and DME for this instrument approach.

11) After passing the FAF, **MISS (L1)** and **ARM (L2)** appear. Press **MISS (L1)** to immediately execute the missed approach procedure or press **ARM (L2)** to arm the missed approach procedure upon crossing the MAWPT.

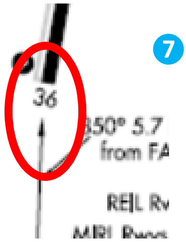


12) Approaching the stepdown fix 6 11VOR at the proper altitude of 4460' as shown in the waypoint information box.



13) Below minimums with audible alert, “MINIMUMS, MINIMUMS.”

14) Established at 70 KIAS on short final with the runway in sight .6 NM ahead at the same angle as shown on the instrument approach chart.



15) After passing the MAWPT and the missed approach procedure automatically sequenced, aircraft begins following the dashed magenta missed approach course lines on the MAP. Nav source automatically switched to FMS1 and 0.3NM FSD.

references to still being in the terminal area and TAWS terrain alerts are still inhibited.

7.15.10. ILS or LOC RWY 1 Instrument Approach with Missed Approach Flown to Alternate fix (Step-By-Step)

This example loads the Akron-Canton, Ohio, USA, ILS or LOC RWY 1 approach with the missed approach flown to the alternate missed approach fix (KEATN)

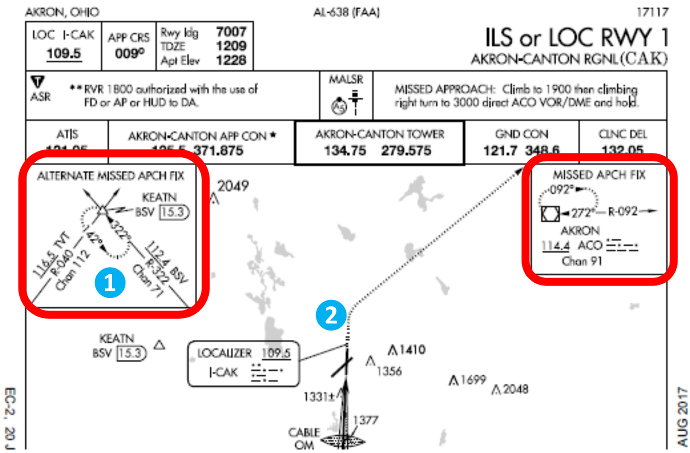
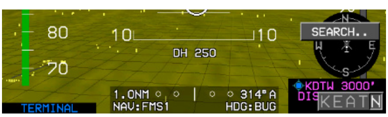
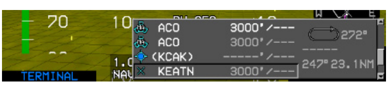


Figure 7-25: ILS or LOC RWY 1 Instrument Approach with Missed Approach Flown to Alternate fix (Step-By-Step)

During the instrument approach clearance, ATC advised that in the event of a missed approach, plan on flying the alternate missed approach instructions to 1 KEATN intersection and hold as published. The ILS RWY 1 instrument approach is loaded and the active flight plan is opened and ❶ is scrolled to one position past (KCAK) and **INSERT (R2)** is pressed and KEATN entered with ❶ and pushed to enter.



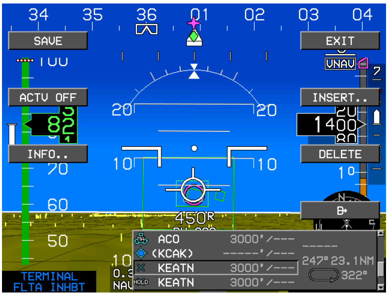
1) 1 Create KEATN waypoint in active flight plan between KCAK and KDTW. Push ❶ to enter.



2) In active flight plan, scroll ❶ to **KEATN** and push to enter.

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

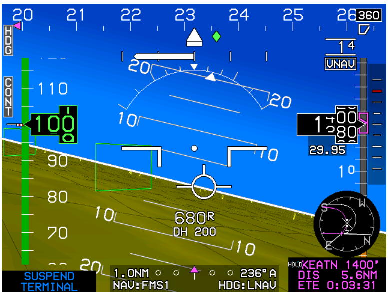
4) To create published holding pattern at KEATN, scroll/push ❶ through the process then push to enter. Observe KEATN is in correct position in active flight plan after (KCAK).



5) ❷ Upon executing the missed approach, press **ACTV (L2)**.

Scroll ❶ to **KEATN** press  **(R4)** and push ❶ to enter direct routing to KEATN.

6) Verify the active flight plan has the holding pattern entered as published and is depicted on the ND correctly.



7) Established holding pattern at KEATN. When cleared to continue to next waypoint, press **CONT (L2)**. Waypoint sequencing resumes to next waypoint.

8) If an instrument approach is necessary at the destination (KDTW) the approach can be loaded without losing the holding pattern at KEATN, since it was not part of the KCAK ILS 01 Instrument approach procedure.

NOTE:

When a procedure is deleted from the flight plan, the original flight plan is correctly restored since the duplicate waypoint is only skipped and not deleted.

Navigation databases should 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. Once acceptable means to compare aeronautical charts (new and old) to verify navigation fixes prior to departure, electronic data have traditionally been verified against paper products. If an amended chart is published for the procedure, do not use the database to conduct the operation.

There may be a slight difference between the navigation information portrayed on the chart and the primary navigation display heading. Differences of three degrees or less may result from equipment manufacturer's application of magnetic variation and are operationally acceptable.

GPS receivers do not "fail down" to lower levels of service once the approach has been activated.

If only 

appears, 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 the lateral alarm limit may not be reset while the approach is active.

Section 8 Terrain Awareness Warning System Enhanced HTAWS and HTAWS

8.1. Enhanced HTAWS and HTAWS (Terrain Awareness 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:

1) **Terrain Display**: Terrain and obstacles on PFD and ND.
2) **Forward Looking Terrain Awareness** (**FLTA**): Alerts to hazardous terrain or obstructions in front of the aircraft.
3) **Excessive Rate of Descent** (**GPWS Mode 1**): Alerts when hazardously high rate of descent above terrain (i.e., descending into terrain).
4) **Excessive Closure Rate to Terrain** (**GPWS Mode 2**): Alerts when hazardously high rate of change above terrain (i.e., flying level over rising terrain).
5) **Sink Rate after Takeoff or Missed Approach** (**GPWS Mode 3**): Alerts when loss of altitude is detected immediately after takeoff or initiation of a missed approach.
6) **Flight into Terrain when not in Landing Configuration** (**GPWS Mode 4**): Alerts when descending into terrain without properly configuring the aircraft for landing.
7) **Excessive Downward Deviation from an ILS Glideslope** (**GPWS Mode 5**): Alerts when deviating below glideslope on the final approach segment of an ILS approach.

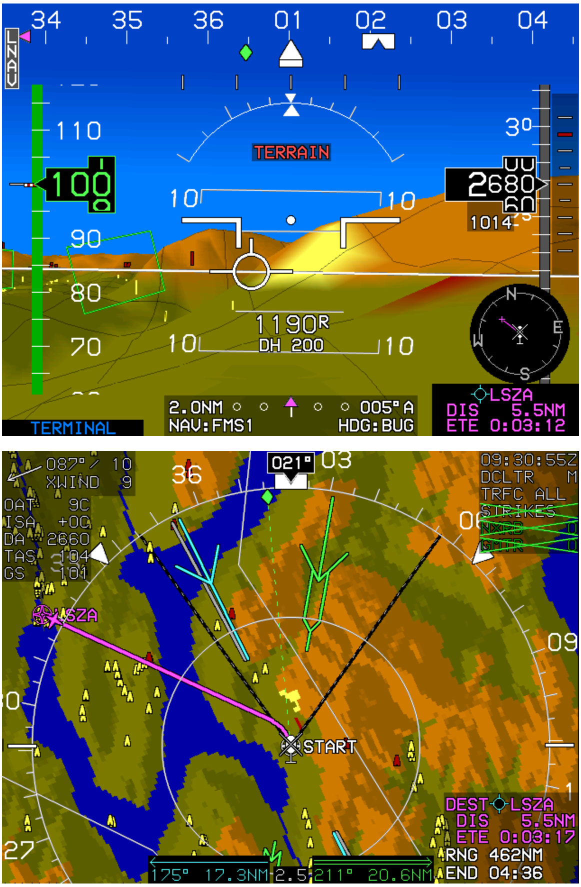
Table 8-1: TAWS Functions Provided by the EFIS

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

Notes: RG = Retractable Gear; FG = Fixed Gear

8.2. Terrain Display

Display of terrain on the PFD and MFD are described in Sections 3 Display Symbology and 5 Menu Functions and Step-By-Step Procedures where applicable.



PFD

MFD

Figure 8-1: Terrain Display

8.3. Forward Looking Terrain Alert (FLTA) Function

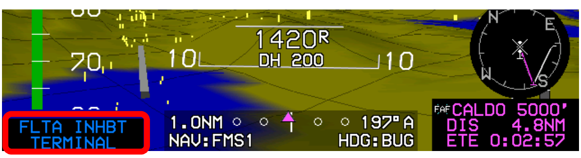


Figure 8-2: FLTA INHBT

FLTA function uses the following to alert 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

8.3.1. FLTA Modes

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

8.3.2. GPS/SBAS Navigation Mode Slaving

The EFIS performs TSO-C146c GPS/SBAS 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 pilot may 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 to change 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.

8.3.3. Default FLTA Mode

If the default FLTA navigation mode is higher in precedence than the GPS/SBAS navigation mode, FLTA mode is slaved to the default FLTA navigation mode. These modes, in order of precedence, are:

1) **Departure Mode**: Enabled when in ground mode. 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). Departure mode ends upon climbing through **1500 feet** above or traveling more than **6NM** from the reference point.

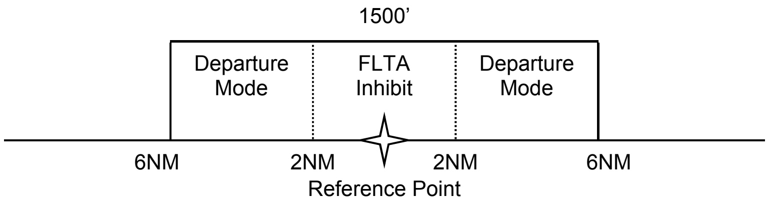


Figure 8-3: Default FLTA INHBT

2) **Other Modes**: For other default FLTA modes, reference point for automatic FLTA inhibiting and mode envelope is the nearest runway threshold or the nearest user waypoint with a defined approach bearing. TAWS continuously searches all runway thresholds at the nearest three airports to determine the nearest runway threshold. TAWS 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**: When within 1900 feet and 5NM of the reference point.

   b) **Terminal Mode**: From 5NM to 15NM from the reference point when below an altitude varying from 1900 feet (at 5NM) to 3500 feet (at 15NM) above the reference point.

   c) **Enroute Mode**: When not in any other mode.

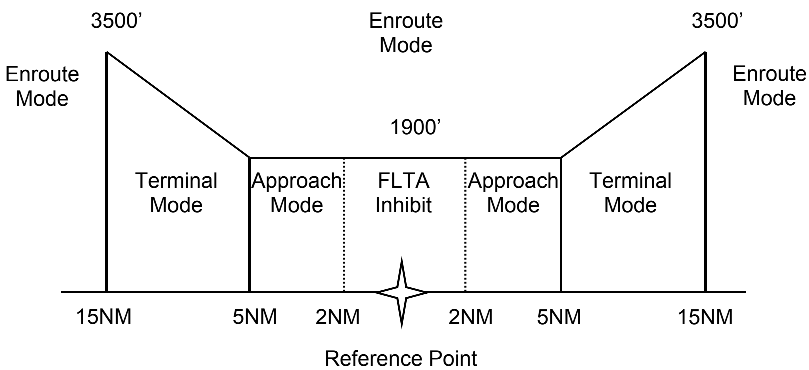


Figure 8-4: FLTA INHBT Mode Areas

8.3.4. 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. Dimensions of the search envelope depend upon TAWS type, FLTA mode, groundspeed, bank angle, and vertical speed. Basic envelope parameters are as follows.

1) **TAWS Type**: Determines value of several parameters used to calculate the search envelope.

Table 8-2: FLTA Search Envelope for HTAWS

Envelope	Parameter
Level-Off Rule	10% of vertical speed Used for level off leading for descending flight reduced required terrain clearance (RTC)
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	
Approach Mode Level/Climbing Flight RTC	
Departure Mode Level/Climbing Flight RTC	100 feet
Enroute Mode Descending RTC	
Terminal Mode Descending RTC	
Approach Mode Descending RTC	
Departure Mode Descending RTC	

2) **Aircraft Track**: Terrain search envelope is aligned with aircraft track.

3) **Aircraft Groundspeed**: Used in conjunction with range parameter to determine look-ahead distance and used in with FLTA mode to determine the search volume width as follows:

   a) **Enroute Mode**: Based on 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**: Based on 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**: Based on 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**: Based on 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, which is reduced linearly with increased bank angle so at 30° of bank there is no delay time.

2) **Aircraft Vertical Speed**: If above 500 fpm, vertical speed is used to determine which RTC values should be used. At vertical speeds less than 500 fpm, level and climbing flight RTC values apply. A three-second pilot reaction time is used and applied to the level-off rule parameters.

8.3.5. FLTA Alerts and Automatic Popup

Figure 8-5: Popup Mode

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 ND).

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 may change any setting automatically changed by the popup mode. In addition, **RESET (L1)** appears for 20 seconds to reset the previous screen configuration with one button press. Popups only occur on IDU #0 or IDU #2 but do not occur if:

1) TAWS inhibit is enabled;

2) IDU#2 is showing the PFI.

8.4. Excessive Rate of Descent (GPWS Mode 1)

GPWS Mode 1 function is present in Enhanced HTAWS and uses aircraft vertical speed information and AGL altitude to alert when the rate of descent is hazardously high as compared to height above terrain. GPWS Mode 1 has a caution and warning threshold. When below the thresholds, a GPWS Mode 1 warning is generated.

Table 8-3: HTAWS GPWS Mode 1 Envelope

Sink Rate (fpm)	AGL Altitude (ft.)	
	Caution Threshold	Warning Threshold
	SINK RATE SINK RATE	PULL UP PULL UP
< 1000	$62.5\% \times (\text{Sink Rate} - 600)$	$66\% \times \left(\begin{matrix}\text{Caution}\\ \text{Threshold}\end{matrix}\right)$
1000 to 3000	Lesser of: 750 or $25\% \times (\text{Sink Rate})$	

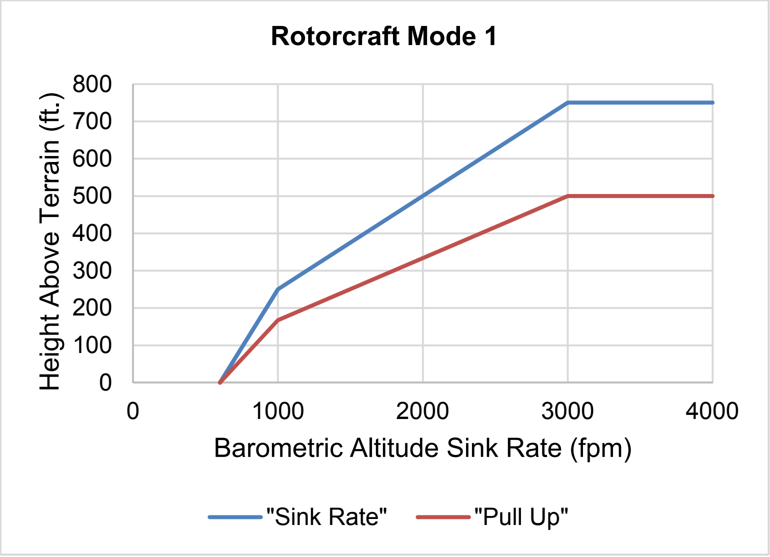


Figure 8-6: Rotorcraft GPWS Mode 1

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

GPWS Mode 2 function is present in Enhanced HTAWS only and uses filtered AGL rate and AGL altitude to alert 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). Envelope selection is determined as follows and 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 8-4: HTAWS GPWS Mode 2 Envelopes

Landing Gear	Mode 2A	Mode 2B
Retractable	Landing Gear Up	Landing Gear Down
Fixed	AGL Altitude > 200 ft or Airspeed > 80 KIAS	AGL Altitude ≤ 200 ft and Airspeed ≤ 80 KIAS

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

<table>
<tr><th colspan="3">Table 8-5: HTAWS GPWS Mode 2A Envelopes (NOT in Landing Configuration)</th></tr>
<tr><th rowspan="3">AGL Rate (fpm)</th><th colspan="2">AGL Altitude (ft.)</th></tr>
<tr><th>Caution Threshold</th><th>Warning Threshold</th></tr>
<tr><td>TERRAIN
TERRAIN</td><td>PULL UP
PULL UP</td></tr>
<tr><td>< 1905</td><td>$125\% \times (\text{AGL Rate} - 1600)$</td><td rowspan="2">$66\% \times \left(\begin{array}{c}\text{Caution}\\ \text{Threshold}\end{array}\right)$</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>
<tr><th colspan="2">Table 8-6: HTAWS GPWS Mode 2B Envelopes (Landing Configuration)</th></tr>
<tr><th colspan="2">AGL Altitude (ft.)</th></tr>
<tr><th>Caution Threshold</th><th>Warning Threshold</th></tr>
<tr><td>TERRAIN TERRAIN</td><td>PULL UP PULL UP</td></tr>
<tr><td>Lesser of:
300 or
$20\% \times (\text{AGL Rate} - 2000)$</td><td>$66\% \times (\text{Caution Threshold})$</td></tr>
</table>

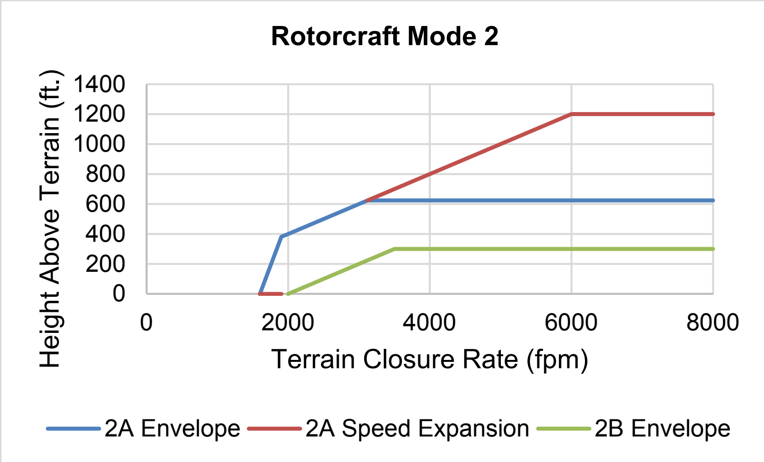


Figure 8-7: Rotorcraft GPWS Mode 2

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

GPWS Mode 3 function uses aircraft vertical speed information and AGL altitude to alert 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 **400 feet AGL**, traveling more than **3 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 (AGL threshold = 1.4 x sink rate), a GPWS Mode 3 caution is generated.

Figure 8-8: GPWS Mode 3 Warning (Sink Rate after Takeoff or Missed Approach)

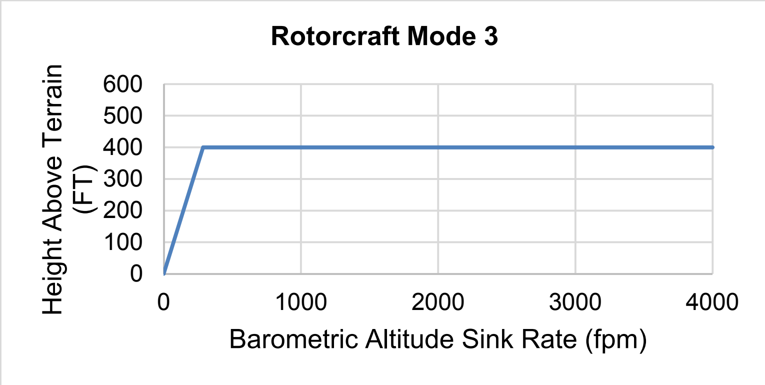


Figure 8-9: Rotorcraft GPWS Mode 3

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

GPWS Mode 4 function is present in Enhanced HTAWS and uses aircraft speed information and AGL altitude to alert 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 are in other than landing configuration. Applicability of Mode 4 envelopes to aircraft types are as follows.

Table 8-7: HTAWS GPWS Mode 4 Envelopes

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

Mode 4 envelope consists of low-speed and high-speed regions.

Table 8-8: HTAWS GPWS Mode 4 Alerting Criteria

Region	Caution Flag	Single Voice Alert
Low-Speed	TOO LOW	"Too Low Gear"
High-Speed		"Too Low Terrain"
Autorotation expansion, when engaged, regardless of speed	TOO LOW	"Too Low Gear"

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 8-9: HTAWS GPWS Mode 4A Envelopes

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

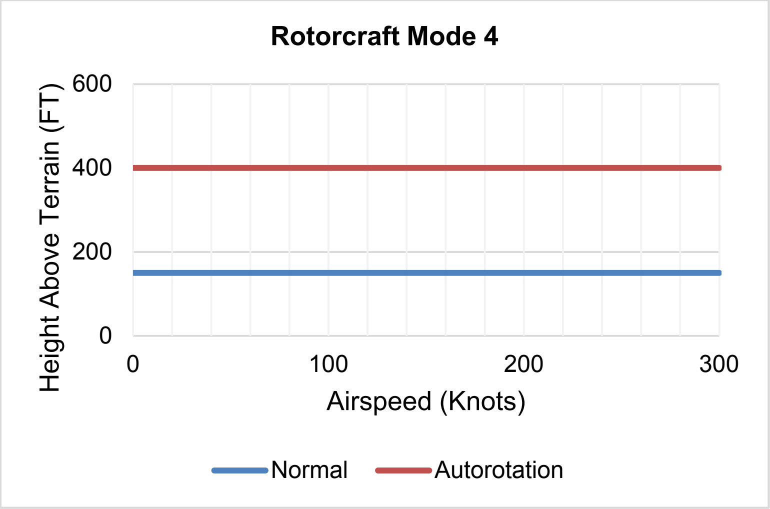


Figure 8-10: Rotorcraft GPWS Mode 4

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

GPWS Mode 5 function is present in Enhanced HTAWS only and uses ILS glideslope deviation information and AGL altitude to alert 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 warning threshold. When below a threshold, a GPWS Mode 5 warning is generated. The curve compares glideslope deviation to AGL altitude.

Table 8-10: HTAWS GPWS Mode 5 Envelopes

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

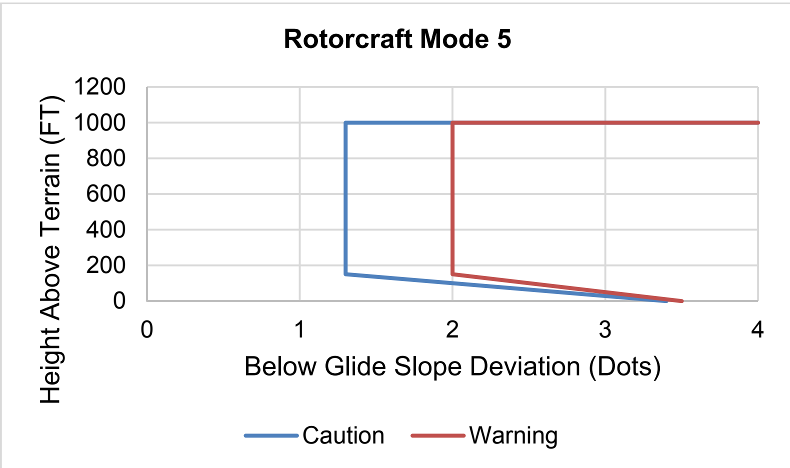


Figure 8-11: Rotorcraft GPWS Mode 5

8.9. External Sensors and Switches

TAWS requires a variety of inputs from external sensors and switches to perform its functions 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.

2) **Air Data Computer (ADC)**: Source of barometric altitude, outside air temperature, and vertical speed.

3) **ILS Receiver**: Glideslope receiver is the source of glideslope deviation.

4) **Radar Altimeter (RA)**: Source for radar altitude.

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

6) **TAWS Inhibit Switch**: As configured in the system limits, used for manual inhibiting of TAWS alerting functions. Gives an indication of actuation (e.g., toggle/rocker or pushbutton with indicator light and TAWS INHBT on the lower left corner of the PFD).

7) **Low Altitude Mode Switch**: As configured in the system limits, used for inhibiting and modifying HTAWS alerting functions to allow normal operation at low altitudes. Gives an indication of actuation (e.g., toggle/rocker or pushbutton with indicator light and TAWS LOW ALT on the lower left corner of the PFD).

8) **Audio Mute Switch**: Momentarily activated to silence active aural alerts is desired. It is connected directly to the EFIS IDU.

9) **Glideslope Deactivate Switch**: As configured in the system limits, momentarily activated to inhibit GPWS Mode 5 function.

10) **Low Torque Sensor**: A low torque discrete, as configured in the system limits, used for inhibiting and modifying HTAWS alerting functions during an autorotation.

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

Table 8-11: External Sensors and Switches (Applicable TAWS)

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	✓	✓	✓
Low Torque Sensor	✓	✓	
ILS	✓	✓	
Radar Altimeter	✓	✓	
Glideslope Deactivate Switch	✓	✓	

Notes: RG = Retractable Gear; FG = Fixed Gear

8.10. TAWS Basic Parameter Determination

The fundamental parameters used for TAWS functions are.

Table 8-12: HTAWS 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 horizontal alert limit (HAL) for mode of flight.
MSL Altitude	GPS/SBAS	Geodetic height converted to MSL with the current EGM database. To be considered valid for use as MSL altitude, the VFOM must be less than or equal to 106 feet. 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 (i.e. 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 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. TAWS uses the lower of the barometric altitude or the temperature-corrected altitude. In the case of QNH-mode barometric setting, reporting station elevation is

Table 8-12: HTAWS Basic Parameters Determination

Parameter	Source	Notes
		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 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 (see Section 3 Display Symbology).
Terrain Data	Terrain Database	Considered valid for use, when the following conditions apply: 1) Aircraft position is valid; 2) Aircraft position is within the boundaries of the terrain database; and 3) Terrain database is not corrupt as determined by CRC-32 checks at system initialization and during runtime.
Obstacle Data	Obstacle Database	Considered valid for use, when the following conditions apply: 1) Aircraft position is valid; 2) Aircraft position is within the boundaries of the obstacle database; and

Table 8-12: HTAWS Basic Parameters Determination		
Parameter	**Source**	**Notes**
		3) Obstacle database is not corrupt as determined by CRC-32 checks at system initialization.
AGL Altitude	Radar Altitude	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. Secondary source for vertical speed is barometric vertical speed from an ADC. 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	Considered valid for use, when the following conditions apply: 1) Aircraft position is valid; 2) Aircraft position is within boundaries of the navigation database; and 3) Navigation database is not corrupt as determined by a CRC-32 check at system initialization.

8.11. TAWS Automatic Inhibit Functions (Normal Operation)

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

1) **FLTA function** is automatically inhibited when in terminal, departure, IFR approach, or VFR approach modes and within 2 NM and 1900' of the reference point.

2) **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).

3) **GPWS Mode 4** is inhibited while Mode 3 is armed.

4) **GPWS Mode 5** is inhibited below 200’ AGL. This form of automatic inhibit remains active until the aircraft climbs above 1000’ AGL and prevents nuisance alarms on missed approach when glideslope receiver detects glideslope sidelobes.

5) **FLTA function** is automatically inhibited when indicated airspeed or groundspeed is below the HTAWS FLTA inhibit speed.

8.11.1. 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 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 § 8.7).

2) **System Sensor/Database Failures**: See Section 4 Revisionary Modes for system sensor failure results.

Table 8-13: TAWS Automatic Inhibit Functions

Sensor	Parameters Lost	Terrain Displaced	FLTA	GPWS Mode				
				1	2	3	4	5
GPS/SBAS (H)	AC Position	Inhibit	Inhibit					
TD	Terrain Elev.	Inhibit	Inhibit					

Table 8-13: 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
ILS	Glideslope 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
MSL + RADLT	MSL Altitude, AGL Altitude	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit

Table 8-13: TAWS Automatic Inhibit Functions

Sensor	Parameters Lost	Terrain Displaced	FLTA	GPWS Mode				
				1	2	3	4	5
GPS/SBAS (V) + ADC + RADLT	MSL Altitude, VSI, AGL ALT	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit

Notes:

1) 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 ADC2 FAIL ADC1/2 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. RALT FAIL RALT1 FAIL RALT2 FAIL RALT1/2 FAIL

8) ILS = ILS Glideslope Deviation. Indication is lack of glideslope needles.

9) MSL = MSL Altitude Invalid. Indication is PLT1 TAWS PLT2 TAWS or CPLT1 TAWS CPLT2 TAWS in the absence of other failures.

8.11.2. TAWS Manual Inhibit Functions

The pilot may select the following manual inhibit functions:

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

Figure 8-12: Terrain Display Functionality

2) **All TAWS** alerting functions (including popup functionality) are inhibited with the external TAWS inhibit switch, which does not affect the terrain display function, including FLTA warning (red) and caution (amber [yellow]) flags on the ND.

3) **Low Altitude Mode Switch** may be actuated to inhibit or modify parameters for alerting functions. This switch desensitizes HTAWS when purposefully flying VFR at low altitudes with the following effects:

   a) GPWS Mode 1 is inhibited.

   b) GPWS Mode 2 is inhibited.

   c) GPWS Mode 3 is inhibited.

4) **GPWS Mode 5** is inhibited with the glideslope cancel switch when below 1000’ AGL. GPWS Mode 5 manual inhibit automatically resets by ascending above 1000’ AGL.

8.12. TAWS Selections on PFD

Terrain and obstruction symbology for FLTA alerts meet the following requirements:

1) Terrain cells that pierce the FLTA warning volume are colored red.

2) Terrain cells that pierce the FLTA caution volume are colored yellow.

3) Obstructions whose tops pierce the FLTA warning volume are visually distinct from the non-alerting obstructions and flash.

4) Obstructions whose tops pierce the FLTA caution volume are visually distinct from non-alerting obstructions.

PFD declutter menu includes three option possibilities for TAWS:

1) SVS TAWS

2) SVS BASIC

3) None

The following figures 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 8-13: PFD SVS BASIC Option

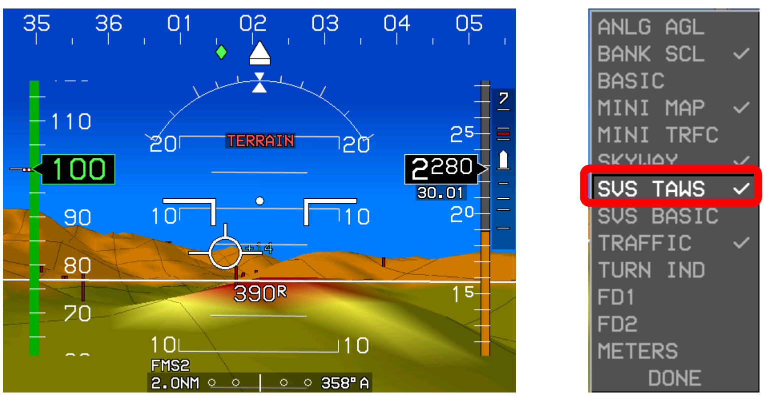


Figure 8-14: PFD SVS TAWS Option

If SVS TAWS and SVS BASIC are not checked and the aircraft pierces the TAWS FLTA terrain envelope, the EFIS automatically enables SVS TAWS. TERRAIN or TERRAIN takes precedence over OBSTRUCTION or OBSTRUCTION.

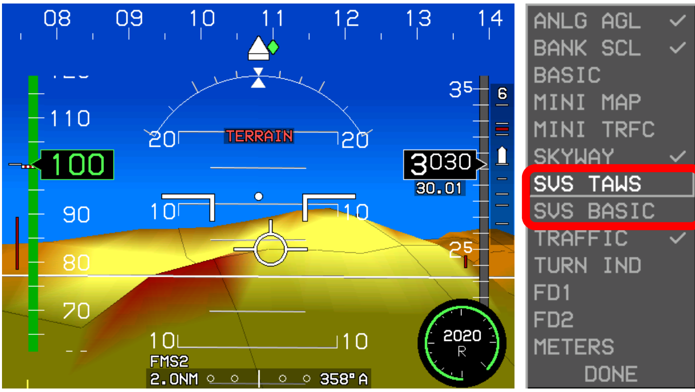


Figure 8-15: Automatic PFD Terrain Warning

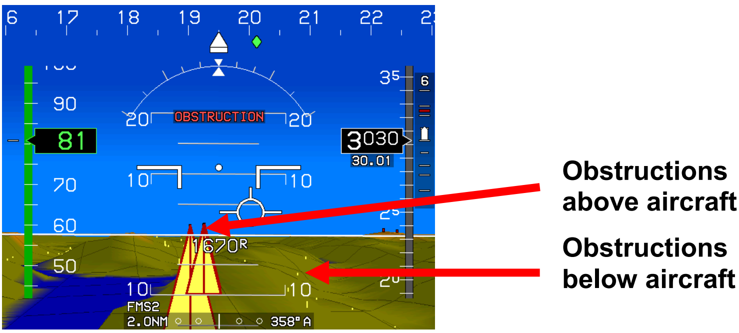


Figure 8-16: PFD SVS TAWS Option and Obstructions

Obstruction within TAWS FLTA caution envelope with audible alert, “Caution Obstruction, Caution Obstruction”. Obstruction symbols flash.

Figure 8-17: PFD Obstruction Caution

Obstruction within TAWS FLTA warning envelope with audible alert “Warning Obstruction, Warning Obstruction.” Obstruction symbols flash.

Figure 8-18: PFD Obstruction Warning

Section 9 Appendix

9.1. Appendix

This section contains a variety of useful information not found elsewhere in the document and includes operating tips, system specifications, and environmental requirements.

9.2. 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 available with future releases of this publication.

9.3. Domestic or International Flight Planning

Due to the differences in every aircraft avionics suite installation, the pilot should determine what equipment code is applicable for domestic or international flight plans. The aircraft operator must determine which certifications pertain to them. Visit the FAA website, www.faa.gov, for flight plan guidance for both domestic and international filers, as well as, information and documentation regarding FAA, ICAO, and flight services agreements and procedures.

9.4. 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), and 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.

9.5. Terrain Clearance

Use the flight path marker to evaluate climb performance for terrain clearance. If climbing at the best climb speed to clear terrain and the flight path marker is overlaying the terrain, 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 sky), the climb is sufficient for the present time, and no further action is necessary until level off.

9.6. 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 (if Baro Autosetting on Startup is enabled in EFIS limits). Press **NRST (R3)** to reveal the nearest airports where all important data such as elevation, frequencies, and runway lengths are displayed.

9.7. Unique Names for Flight Plans

Multiple routes between the same airport pairs are numbered automatically (KCEW-KDHN) [0], (KCEW-KDHN) [1], etc.). The work-around is to apply this easily remembered differentiation. If a route is routinely flown from one airport to another but different routing is necessary due to weather, hot MOA areas, etc., up to 10 different flight plans may be created for the same destination.

As an example for departing Sikes on a northern routing (KCEWN) or a southern routing (KCEWS), create two different user waypoints at the departure airport named KCEWN and KCEWS followed by different routing to clear whatever creates the necessity for specific routing, e.g. a MOA.

9.8. 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 may appear due to the altimeter setting not on 29.92 inHg or 1013 mbar.

9.9. Warnings, Cautions, and Advisories

Review Section 2 System Overview for the conditions precisely defining scenarios for various time-critical warning alerts, warning alerts, master visual and audio alerts, time-critical caution alerts and advisory alerts, as they appear including the conditions and time delay when applicable.

9.10. Magnetic vs. True North Modes of Operation

There are two modes for the ADAHRS:

1) Slaved mode (i.e., compass rose stabilized by 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 2/3rds of Canadian NDA). 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 (oilrigs, MRI machines, etc.) or in areas where the horizontal field is too weak. In Free/”DG” mode, heading no longer corrects towards Earth’s magnetic flux horizontal field, and the pilot may “slew” the heading solution.

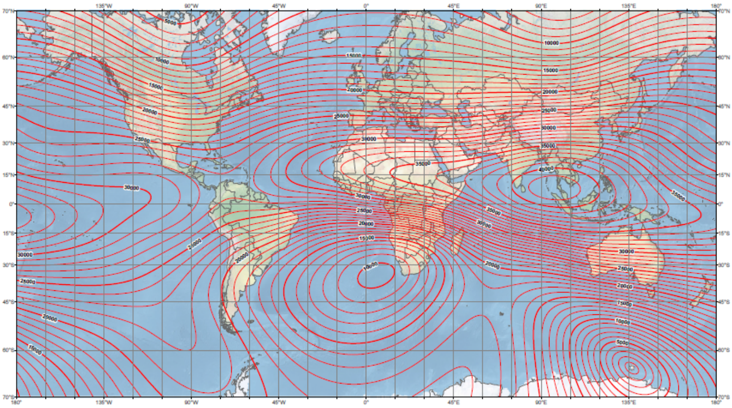


Figure 9-1: US/UK World Magnetic Model

There are two modes for the EFIS:

1) Magnetic North mode: 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. PFD scenes and compass rose symbols are aligned with magnetic north, and wind is displayed referenced to magnetic north.

2) True North mode: GPS track is used as-is and reflects true north. When AHRS is in slaved mode, heading from the AHRS is converted from magnetic north-referenced to true north-referenced using a magnetic variation database. When AHRS is in Free/”DG” mode, heading from the AHRS is used as-is and is expected to reflect true north. PFD scenes and compass rose symbols are aligned with true north. Wind is displayed referenced to true north.

NOTE:

Designating magnetic north vs. true north mode is critical since it determines how 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.

9.11. Altitude Miscompare Threshold

The altitude miscompare threshold is based upon 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 9-1: 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’

Allowable installed system error is added on top of instrument error and these values are derived from the regulations as follows.

Table 9-2: Regulatory Reference

Regulation	Allowed Error
14 CFR § 27.1325	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 § 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'

9.12. Airspeed Miscompare Threshold

Airspeed miscompare threshold is based upon 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 9-3: 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

Allowable installed system error is added on top of instrument. Error and these values are derived from the regulations as follows.

Table 9-4: Airspeed Regulatory Reference

Regulation	Allowed Error
14 CFR § 27.1323	Starting from (0.8 x $\mathbf{V_{CLIMB}}$): Greater of 5 knots or 3%. Do not perform a comparison if either value is below (0.8 x $\mathbf{V_{CLIMB}}$).
14 CFR § 29.1323	For climbing flight (VSI > 250 feet per minute): Starting from ($\mathbf{V_{TOS}}$ – 10): 10 knots Do not perform a comparison if either value is below ($\mathbf{V_{TOS}}$ – 10) For other flight regimes: Starting from (0.8 x $\mathbf{V_{TOS}}$): Greater of 5 knots or 3%. Do not perform a comparison if either value is below (0.8 x $\mathbf{V_{TOS}}$). System uses $\mathbf{V_{CLIMB}}$ as a substitute for $\mathbf{V_{TOS}}$.

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.

9.13. 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. Even with the many systems available today, 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.

9.14. ARINC-424 Path-Terminator Leg Types

For information, definitions, and examples, visit the FAA website, www.faa.gov, to view the Instrument Procedures Handbook (FAA-H-8083-16A).

9.15. Data Logging and Retrieval

The EFIS logs all data associated with a flight, including all flight instrument and navigation data, which may be downloaded for review after flight. Data from the last 5 flights or 20 hours are logged at a one-second interval.

Data logging files contain recordings of flight and engine parameters of up to five hours each from the previous five system operations. 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.

With IDU powered off, open USB door, and insert USB flash drive. Power-up and select **Download Log Files** to create a “\log” directory on the USB flash drive and copy the data logging files into the directory.

CAUTION:

Always install a valid USB flash drive in the IDU prior to activating any GMF to avoid erroneous failure indications or corruption of the IDU.

9.15.1. Delete Log Files

1) If there are problems updating a navigation database or application software due to an excessively large log file, select **Delete Log Files** to delete all log files in the log directory.

   Files named “LOG00.dat” thru “LOG04.DAT” and “MSGLOG.DAT” are deleted. This does not affect operations of the EFIS, as the EFIS generates new “LOG00.DAT” and “MSGLOG.DAT” files once a flight has started.

2) Press any button on the IDU or push ❶ to return to the ground maintenance menu.

9.15.2. Logged Flags and Custom CAS Messages

Flags and custom CAS messages are logged in memory to a file named “caslog00.csv” (*.csv files may be opened in Microsoft Excel or similar spreadsheet software). In addition, data from the previous four flights are saved in files “caslog01.csv” through “caslog04.csv.” Upon system start, the existing “caslog00.csv” through “caslog03.csv” files are renamed “caslog01.csv” through “caslog04.csv,” and “caslog00.csv” is opened for active logging.

The first line of the log files contains column headings related to the flag’s text (for standard warning functions) or the “CAS Log File Text” parameter (for custom CAS messages). All standard warning functions are logged. Only custom CAS messages with valid “CAS Log File Text” parameters (i.e., not an empty string) are logged. Within the data fields of the log file, values are written as in Table 9-5.

Table 9-5: Log File Values

Category	Value
NORMAL	0
ADVISORY	1
CAUTION	2
WARNING	3

9.16. Routes and Waypoints

9.16.1. VFR Flight Planning

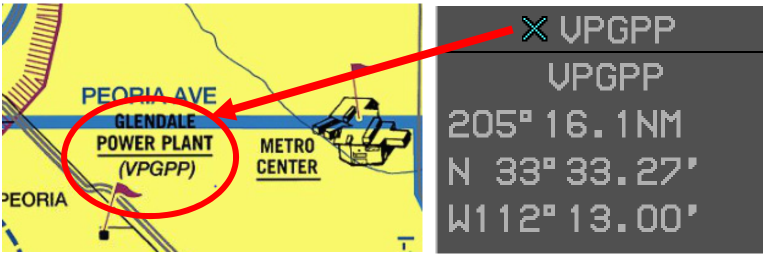


Figure 9-2: VFR Waypoint

The navigation database includes VFR waypoints, which consist of five digits beginning with "VP." These may be 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.

9.16.2. Download Routes and User Waypoints

1) Select **Download Routes and User Waypoints** from the GMF to download all routes and user waypoints stored in the IDU to the USB flash drive. This option is useful for fleet operations where multiple aircraft fly the same routes.

2) Routes are stored on USB flash 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 flash drive as "USER.DAT."

9.16.3. Upload Routes and User Waypoints

To copy all routes and user waypoints from a USB flash drive to the IDU, select **Upload Routes and User Waypoints** from GMF. Use this option in conjunction with the "Download Routes and User Waypoints" option to upload the same routes and user waypoints in multiple aircraft.

9.16.4. Delete Routes

When corrupted routes cause the IDU to continually reboot, select **Delete Routes** on GMF to remove all routes from the IDU.

9.17. EFIS Training Tool (ETT)

See the Installation and User Guide distributed with the ETT install files for directions to install and use the EFIS Training Tool.

Use the ETT to create routes and user waypoints to save and upload into the aircraft mounted IDUs. When uploading a saved flight plan (route) into an aircraft mounted IDU, the following rules apply:

1) Either upload flight plan (route) into each IDU to ensure flight plan (route) is saved in the route directory (all other displays); Or

2) Upload flight plan (route) into one display while in the ground mode. When in flight mode, activate that flight plan and on any other display, view active flight plan and press **SAVE (L1)** to save flight plan in the route directory. This action will save the new uploaded flight plan (route) in all other displays.

NOTE:

In a two-sided system, crossfill must be enabled to save flight plan to all other displays on each side of the system.

The ETT has a bezel with simulated buttons and encoders responsive to mouse and 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 the audio functionality in the actual IDU. This training tool simulates the functionalities of the IDU, which begins flight in Reno, Nevada at approximately 8000’ MSL. If different ETT startup conditions are required, they may be edited.

Flight plans may be created (on the PFD or MFD), stored, and activated in the same manner as on the EFIS displays installed in the aircraft. This allows for moving the start point to anywhere in the world where loaded NavData is present for practicing published procedures. As with the demonstrator program, the aircraft begins flying at approximately 8000’ MSL (unless the simulate.ini program is loaded) intercepting the first leg at a 45° angle.

9.18. USB Flash Drive Limitations

When powering up the IDU with a USB flash drive inserted and “Error: No updater files found on USB drive” displays, the USB is likely not acceptable for loading or transferring data.

1) Ensure the USB flash drive with required files is properly connected.

2) Try again after reboot.

3) Press any button to continue.

4) Try a different USB flash drive.

NOTE:

USB flash drive must be formatted as FAT16 or FAT32.

If the flash drive is not recognized, try another source.

9.19. 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	
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)	

Document Number	Document Title
	Augmented by the Wide Area Augmentation System (WAAS)
N/A	Airplane Aerodynamics and Performance, Lan and Roskam, 1981.

9.20. Environmental Requirements

The IDU-450 meets the requirements of RTCA/DO-160F requirements, Genesys Aerosystems claims the following:

1) The coldest storage temperature is -55°C.

2) Coldest condition in which the units can be powered up is -40°C and will take at least 4 minutes to warm up with the internal heater circuit operating.

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. Operating Low Temp: -55° 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.
5.0	Temperature Variation	B	Equipment in a non-temperature-controlled or partially temperature controlled internal section of the aircraft.	
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.	

Sec.	Condition	Cat.	Test Category Description	Notes
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
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	
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.	

Sec.	Condition	Cat.	Test Category Description	Notes
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.	
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.	
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	Level 4 for MSU and OAT Probe pins.

Sec.	Condition	Cat.	Test Category Description	Notes
			composite structures). Level 3 designates equipment and interconnecting wiring installed in a moderately exposed environment.	
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

Traffic

T 1. Traffic Page Access

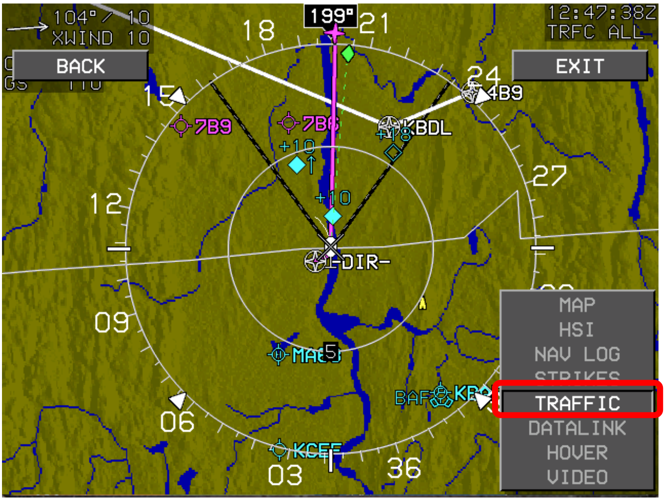


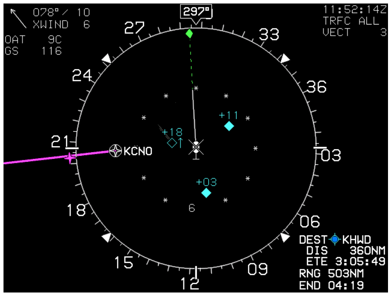
Figure T-1: MFD Traffic Page Access

T 2. Menu Declutter

Figure T-2: PFD MENU DCLTR

T 3. Traffic Symbology

MAP Page



Traffic Page

Figure T-3: Traffic Symbology

Table T-1: Traffic Symbology

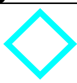
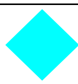
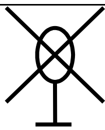
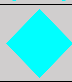
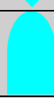
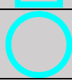
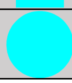
Type Traffic	**Symbology**			
TCAS-I, TCAS-II, TAS, and TIS-A	 Other Traffic	 Proximate Advisory	Traffic Advisory (Flashing)	 Resolution Advisory (Flashing)
Ownship Symbol				

Table T-2: ADS-B and TIS-B Traffic Symbols

	Other Traffic	**Proximate Advisory**	**Traffic Advisory (Flashing)**
High-Integrity Traffic with Track Information			
High-Integrity Traffic without Track Information			
Degraded Position Traffic with Track Information			
Degraded Position Traffic without Track Information			

T 3.2. Traffic Display Definitions

1) Resolution Advisory (**RA**): Traffic with a dangerous closest point of approach and generates climb or descent commands as defined by internal TCAS-II sensor logic.
2) Traffic Advisory (**TA**): Traffic with a dangerous closest point of approach as defined by internal traffic sensor logic.
3) Proximate Advisory (**PA**): Traffic within 6 NM and ±1200 feet from ownship that is not a RA or TA.
4) Other Traffic (**OT**): Traffic beyond 6 NM or ±1200 feet from ownship that is not a RA or TA.

T 3.3. Traffic Rendering Rules

Table T-3: Traffic Rendering Rules

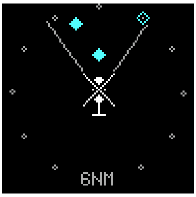
Type Traffic	**Distance**	**Results**
TA and RA Traffic	Off-scale	Displayed with half-symbols
	No bearing	Displayed with text
OT and PA Traffic	Beyond 6 NM	Not displayed
	Off-scale or no bearing	
TCAS-I, TCAS-II, TAS, or TIS-A Sensor	Within 200' of ground	ADS-B and TIS-B ground traffic displayed

Table T-4: Pilot Selected OT and PA Traffic Altitude Filtering

Mode	**Parameter**
AUTO	If aircraft VSI is less than -500FPM, traffic within +2,700 and -9,900 feet of aircraft altitude displayed. If aircraft VSI is more than +500FPM, traffic within -2,700 and +9,900 feet of aircraft altitude displayed. Otherwise, traffic within -2,700 and +2,700 feet of aircraft altitude displayed.
ABOVE	Traffic within -2,700 and +9,900 feet of aircraft altitude displayed.
BELOW	Traffic within +2,700 and -9,900 feet of aircraft altitude displayed.
NORMAL	Traffic within -2,700 and +2,700 feet of aircraft altitude displayed.
ALL	All received traffic displayed, no altitude filtering.

Traffic popups: When a traffic alert is generated, a popup function displays traffic on the PFI, moving map page, and traffic thumbnail on the PFI.

T 3.4. Traffic Thumbnail



When selected from declutter options, the traffic thumbnail is displayed in the lower right corner of the PFD above the active waypoint identifier and has clock face markings fixed at the 6 NM scale.

Figure T-4: Traffic Thumbnail

The traffic thumbnail is automatically enabled while there is an active traffic warning (TA or RA) and the aircraft is above 500' AGL. During a traffic warning, the traffic thumbnail scale automatically adjusts in multiples of 2 NM (2 NM, 4NM, or 6NM), to optimally display the traffic. Since the traffic thumbnail is mutually exclusive with the mini map, it also disappears in unusual attitude mode.

T 4. Dedicated Traffic Page

When selected, a traffic page is available based roughly on the appearance of a TCAS display and has the following elements.

T 4.1. Traffic Display Format

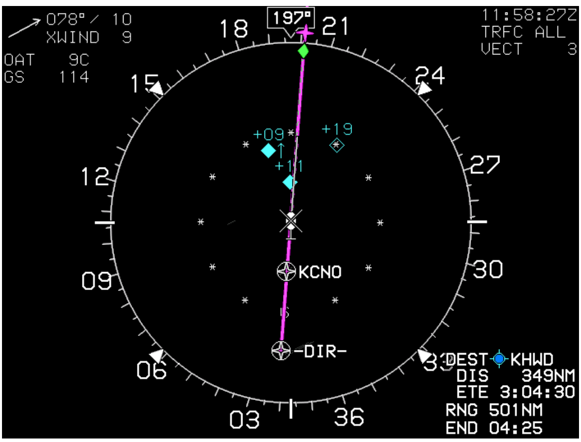


Figure T-5: Traffic Display Format

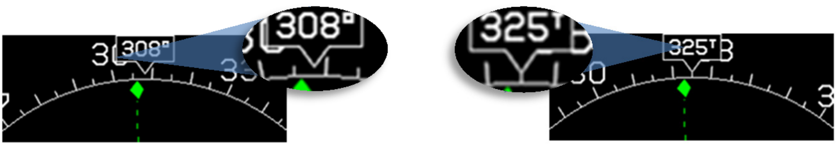
The traffic page is a centered display format with the ownship symbol centered in the traffic page with data displayed out to an equal distance in all directions. When the AHRS is in DG Mode, “DG” appears to the right of the ownship symbol.

T 4.2. Traffic Page Screen Range

The following traffic screen selected ranges are available (all distances represent the distance from the ownship symbol to the compass rose): 5NM, 10NM, and 20NM. A TCAS range ring is centered upon the ownship symbol to help the pilot judge range to displayed symbols with a 3NM radius in 5NM and 10NM ranges, has a radius of half the range in 20NM, 50NM, and 100NM ranges, and is presented on the TCAS range ring (e.g., 3NM, 10NM, 25NM, or 50NM).

T 4.3. Compass Rose Symbols

The compass rose is aligned with either magnetic north or true north depending upon the status of the true north discrete input. A digital heading readout and pointer aligned with the longitudinal axis of the ownship symbol appears on the compass rose boundary circle. Compass rose symbols are as specified in Section 3 Display Symbology. A green dashed lubber line connects the center of the aircraft symbol and the track pointer.



Normal Mode **True North Mode**

Figure T-6: Traffic Screen Range Compass Rose Symbols

If a target altitude is set and not captured, an altitude capture predictor arc is displayed on the lubber line at a point corresponding with predicted climb or descent distance (based upon current VSI). A top of descent symbol is shown at the point where a VNAV descent is predicted to commence. The track pointer, lubber line, altitude capture predictor arc, and top of descent symbol are not displayed when groundspeed is less than 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 and turns amber (yellow) in the event of GPS LON caution.

T 4.4. Clock and Options

The following are displayed in the upper right corner of traffic page.

Zulu Time **Local Offset Time**

Figure T-7: Clock and Options

Table T-5: Clock and Options

Feature	Options	Notes
Zulu Time or Local Offset	**hh:mm:ssZ** **hh:mm:ssL**	Synchronized with the GPS/SBAS constellation.
Traffic Status	Enabled or Disabled	If traffic is disabled, overlying red “X”. When enabled, traffic altitude filtering is as follows (see Table T-4). AUTO = **TRFC AUTO** ABOVE = **TRFC ABV** BELOW = **TRFC BLW** NORMAL = **TRFC NORM** ALL = **TRFC ALL**
ADS-B Traffic Vector Length		Length of traffic vector annunciated as VECT## (traffic vector length in minutes)

T 4.5. Fuel Totalizer/Waypoint Distance Functions

As defined in Section 3 Display Symbology

Figure T-8: Fuel Totalizer/Waypoint Distance Functions

T 4.6. Active Flight Plan Path/Manual Course/Runways

When there is an active flight plan and the GPS/SBAS OBS setting is automatic, the flight plan path, when selected, is shown on the traffic page in correct relationship to the ownship symbol. The active flight plan path depiction 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 waypoint symbols for fly-over waypoints are distinct from fly-by waypoints and consist of the waypoint symbol within a circle. When there is a parallel offset, the active flight plan path depicts the parallel offset path, and the original flight plan path is shown with haloed gray dashed lines.

When there is an active waypoint and manual GPS/SBAS OBS setting, the manual course through the waypoint is shown as a pointer centered on the waypoint and 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 magenta and turn amber (yellow) in the event of a GPS LON caution. The traffic page displays airport runways in correct relationship and scale to the ownship symbol.

When traffic source is ADS-B, traffic vectors and aircraft identification data are shown. The traffic vector is a line connecting the traffic's current position with the traffic's predicted position based on its current track and groundspeed. The prediction time, in minutes, is pilot-selectable. Aircraft identification (e.g. aircraft registration number or scheduled airline flight number) is text located near the traffic symbol in the same color as the traffic symbol.

T 5. MFD Traffic Format (FORMAT) Menu

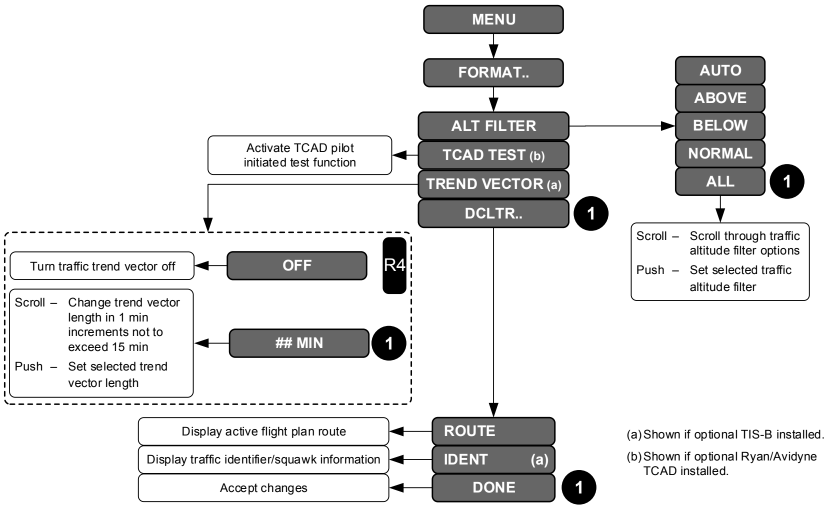


Figure T-9: MFD Traffic Format (FORMAT) Menu

Upon selecting the MFD format menu, a list appears with the following options:

1) **ALT FILTER**: Sets traffic altitude filter to **AUTO**, **ABOVE**, **BELOW**, **NORMAL**, or **ALL**.

2) **TCAD TEST**: Activates test function when Ryan/Avidyne TCAD.

3) **TREND VECTOR**: When TCAS flag is TIS-B, sets traffic trend vector length in minutes. **OFF (R4)** turns off traffic trend vector.

4) **DCLTR..**: Activates option list.

   a) **ROUTE**: Toggles display of active flight plan route.

b) **IDENT**: When EFIS is configured for TIS-B, toggles traffic identifier/squawk information.

This example shows "TEST XX" for aircraft Identifiers.
The actual aircraft shows actual aircraft identification.

Figure T-10: MFD Traffic IDENT (FORMAT) Menu

T 6. MFD Fault Display (FAULTS) Menu

If traffic enabled, loss of communications with traffic sensor (TRFC) is indicated with an X in place of "OK."

T 7. Menu Synchronization

Table T-6: Menu Synchronization

Menu Parameter	Notes
The following menu parameters are synchronized across all displays at all times. These are bugs and fundamental aircraft values that should never have independence.	
Traffic Filter Setting	
The following menu parameters are only synchronized onside. These parameters are usually sensor selections or PFD options used to keep the appearance of any pilot's PFD consistent in the case of PFD reversion. The onside characteristic means that individual pilots can still adjust their PFD settings to their preference.	
PFD Traffic Thumbnail Show Flag	
PFD Traffic Show Flag	
The following menu parameters are independent between displays. These are used to support non-PFD display options to give the pilot maximum MFD operating flexibility.	
MFD Traffic Page Settings	

Remote Bugs Panel (RBP)

RBP 1. Remote Bugs Panel

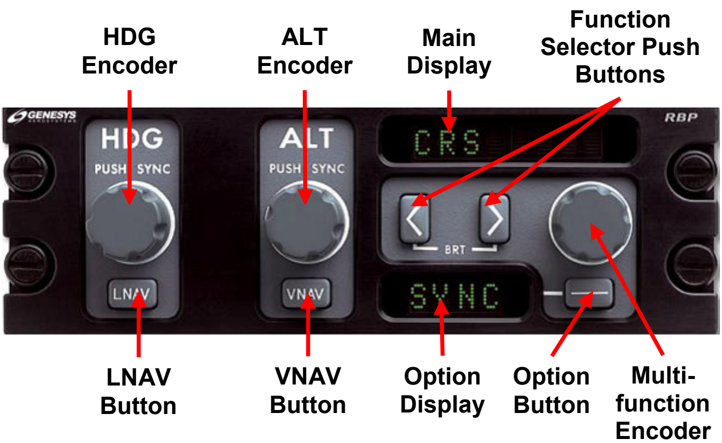


Figure RBP-1: Remote Bugs Panel

The Remote Bugs Panel (RBP) promotes ease of operation while minimizing pilot workload complexity by providing dedicated controls for frequently used bugs and controls for setting IDU parameters as defined in Table RBP-1.

The heading (HDG) and altitude (ALT) encoders behave similarly as the encoders on the IDU. (See Section 5 Menu Functions and Step-By-Step Procedures for HDG and ALT encoder description)

During initialization, the RBP begins with “GENESYS RBP” on the main and option display screens. To access the internal light sensor control for brightness, press the two arrow buttons simultaneously and rotate the multifunction encoder to make adjustments. Press the Option button to exit the brightness control program and return the RBP to normal operation.

Table RBP-1: Remote Bugs Panel (RBP)

Button/Encoder	**Function**	**Scroll**	**Push**
HDG Encoder	Heading Bug	Increase or decrease	Synchronize to current heading
ALT Encoder	Altitude Bug	Increase or decrease target altitude	Synchronize to current altitude

Table RBP-1: Remote Bugs Panel (RBP)

Button/Encoder	Function	Scroll	Push
Multifunction Encoder	GPS Course	Increase or decrease	Synchronize to current bearing to active waypoint
Multifunction Encoder	VOR 1 Course	Increase or decrease	Synchronize to current bearing to the station
Multifunction Encoder	VOR 2 Course		
Multifunction Encoder	Airspeed Bug	Increase or decrease	Synchronize to current airspeed
Multifunction Encoder	Vertical Speed Bug	Increase or decrease	Synchronize to current VSI
Multifunction Encoder	Climb Angle Set	Increase or decrease	Set to 3°
Multifunction Encoder	Descent Angle Set		
Multifunction Encoder	Decision Height Bug	Increase or decrease	Set to 200’ AGL
Multifunction Encoder	Minimum Altitude Bug	Increase or decrease	Synchronize 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		
Option “---“ Button	Airspeed Bug	N/A	Toggle on or off
Option “---“ Button	Vertical Speed Bug	N/A	Toggle 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 on or off

Table RBP-1: Remote Bugs Panel (RBP)			
Button/Encoder	**Function**	**Scroll**	**Push**
Option “---“ Button	Minimum Altitude Bug	N/A	Toggle on or off
Arrow Buttons	Function Scroll	N/A	Move through “Set” options. Press both arrow buttons simultaneously to place into dimming mode.
VNAV Button (With autopilot enabled)	VNAV	N/A	Switch autopilot pitch steering and commanded VSI between VNAV sub-mode and target altitude sub-mode
LNAV Button (With autopilot enabled)	LNAV	N/A	Switch autopilot roll steering between LNAV sub-mode and heading sub-mode

WX-500 Lightning Strikes

S 1. WX-500 Data

When selected, the ND displays cell mode or strike mode lightning strikes in correct relationship to the ownship symbol with the following limits.

Table S-1: Lightning Strikes

Time or Distance Limit	View
Display scale less than 25 NM	Strikes not shown
More than 3 minutes old	
Strikes less than 20 seconds old	Lightning symbol
Strikes between 20 seconds and 2 minutes old	Large cross symbol
Strikes between 2 and 3 minutes old	Small cross symbol

The pilot may select either an arced or centered display format.

Arced: Ownship displaced toward the bottom of the screen. Strike data are displayed in a larger scale while displaying all data within range ahead of the aircraft.

Centered: Ownship symbol is in the center of the ND with navigation data is displayed out to an equal distance in all directions.

The strikes page has Strikefinder markings aligned with either magnetic north or true north depending upon the status of the true north discrete input. When the AHRS is in DG mode, "DG" appears to the right of the ownship symbol.

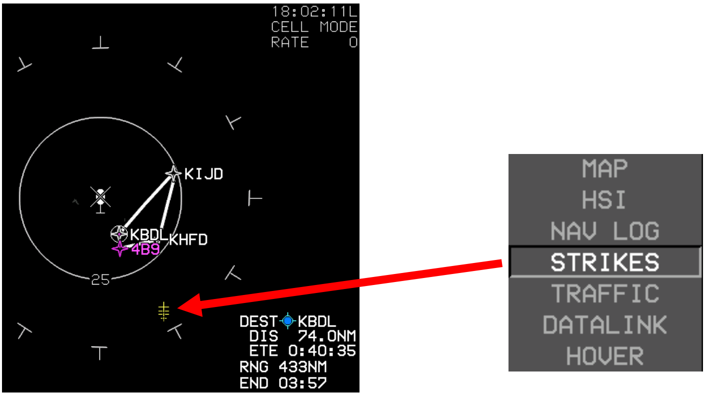


Figure S-1: Strikes Page

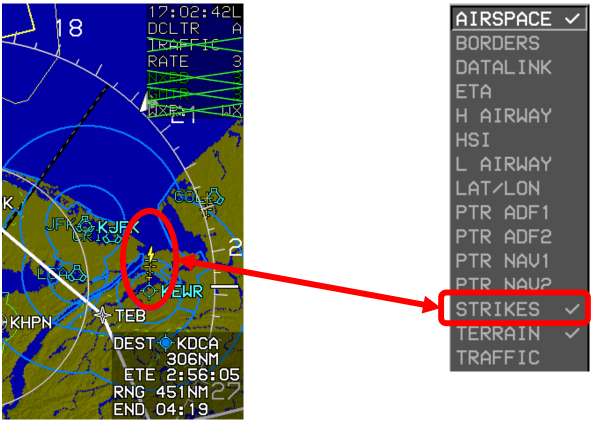


Figure S-2: Lightning Symbols

S 2. Dedicated Strikes Page

S 2.1. MFD Page (PAGE) Menu

PAGE menu allows the pilot to select which MFD page to display:

STRIKES: Shows the Strikes page.

S 2.2. Strikes Page Screen Range

The following screen ranges may be selected with all distances representing the distance from the ownship symbol to the Strikefinder markings: 12.5 NM, 25 NM, 50 NM, 100 NM, and 200 NM. The range ring is centered upon the ownship symbol to help judge range to displayed symbols. It has half the radius of the Strikefinder markings displayed indicating the range corresponding to the radius of the range ring such as (1.5 NM, 25 NM, 50 NM, and 10 NM.) The range ring is completely visible in arced display format for the pilot to ascertain the current strikes page setting.

S 2.3. Air Data and Groundspeed

Figure S-3: Air Data and Groundspeed in Upper Left Corner

S 2.4. Clock and Options

The following are displayed in the upper right corner of traffic screen:

Clock with Local Offset Time

Clock with Zulu Time

Figure S-4: Clock and Options

1) **Zulu Time or LCL Time**: As specified in Section 3 Display Symbology.
2) **WX-500 Status**: When selected, displays cell mode lightning strikes in correct relationship to the ownship symbol with the limits in Table S-2.

Table S-2: WX-500 Status

Condition	Annunciation
System Normal, Cell Mode	**CELL MODE** annunciates mode **RATE ###** depicts strike rate
System Normal, Strike Mode	**STRK MODE** annunciates mode **RATE ###** depicts strike rate
System Failed with “Show Full Sensor Status Flag” enabled in EFIS Limits.	**STRIKES** overlaid with red “X” Strike symbols removed
System in Test Mode	**STRK TST** shown Strike symbols removed

A new strike rate value is calculated every five seconds during normal operation, based upon strikes within the selected display range. The number of fresh strikes (less than 20 seconds old) is used to generate a strike rate representing strikes per minute. Strike rate increases are displayed immediately upon calculation, while decreases in strike rate are damped. Activating the strike clear function resets the strike rate to zero.

S 2.5. Active Flight Plan Path/Manual Course/Runways

When there is an active flight plan and the GPS/SBAS OBS setting is automatic, the flight plan path is shown on the strikes page in correct relationship to the ownship symbol.

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

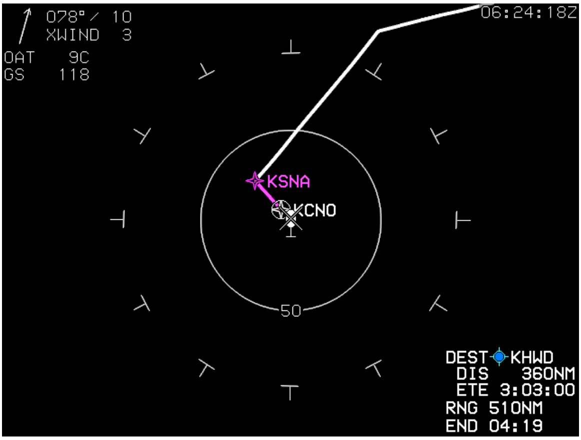


Figure S-5: Active Flight Plan Path/Manual Course/Runways

The active flight plan path's active leg/manual course and active waypoint are magenta but turn amber (yellow) in the event of a GPS LON caution. The strikes page displays airport runways in correct relationship and scale to the ownship symbol.

S 2.6. Fuel Totalizer/Waypoint Distance Functions

Active Waypoint

Active Waypoint as Destination

Figure S-6: Fuel Totalizer/Waypoint Distance Functions

S 3. MFD Strikes Format (FORMAT) Menu

Upon selecting the MFD format menu when in the Strikes page, the following option list appears:

1) **CENTER/ARC**: Toggles centered and arced display format.

2) **STRK MODE/CELL MODE**: Toggles strike and cell mode strikes.

3) **DCLTR..**: Activates option list to toggle active flight plan route.

4) **STRK TEST:** Activates the WX-500 test function.

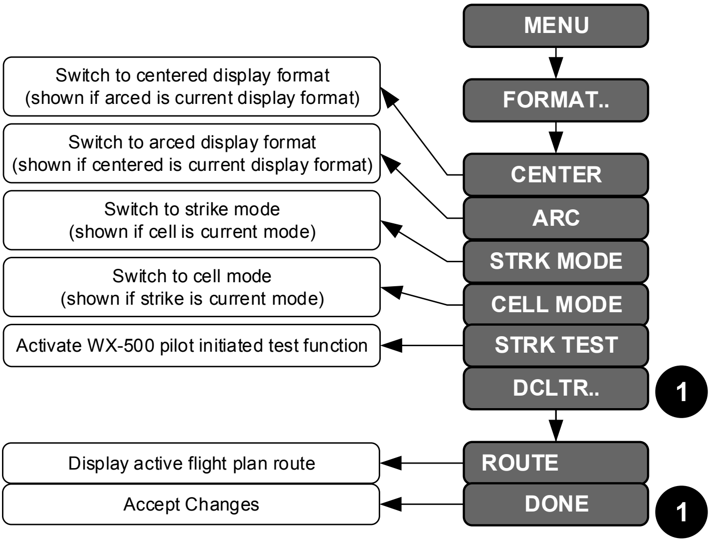


Figure S-7: MFD Strikes Format (FORMAT) Menu

S 4. MFD Page First-Level Option Descriptions

CLR STRKS (L2) or **WX LGND (L2)**: On ND or Strikes page with WX-500 enabled, **CLR STRKS** activates the strike clear option.

S 5. MFD Fault Display (FAULTS) Menu

If the WX-500 option is enabled, loss of communications with the WX-500.

S 6. Menu Synchronization

Table S-3: Menu Synchronization

Menu Parameter	Notes
The following menu parameters are only synchronized onside. These parameters are usually sensor selections or PFD options used to keep the appearance of any pilot's PFD consistent in the case of PFD reversion. The onside characteristic means that individual pilots can still adjust their PFD settings to their preference.	
MFD Strike (WX-500) Page Settings	
The following menu parameters are independent between displays. These are used to support non-PFD display options to give the pilot maximum MFD operating flexibility.	
MFD Strike (WX-500) Page Settings	

Datalink

D 1. Datalink Symbology

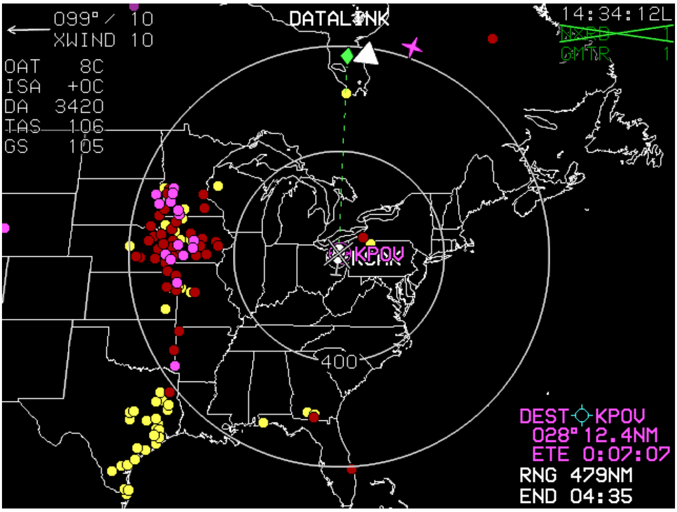


Figure D-1: Datalink Symbology with G METAR On

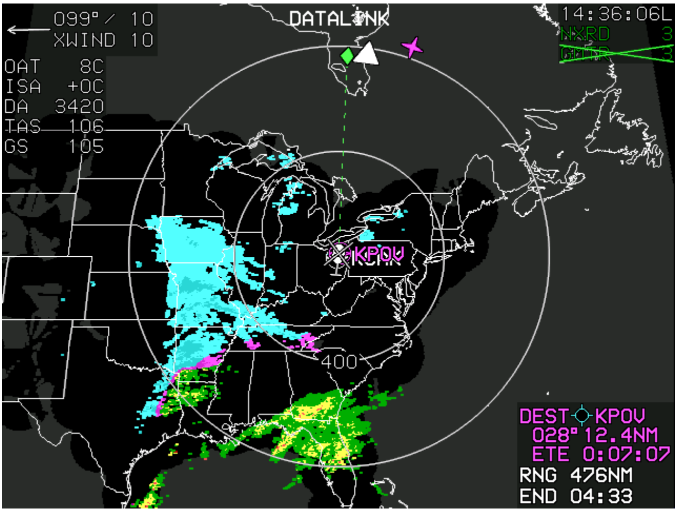


Figure D-2: Datalink Symbology with NEXRAD On

Table D-1: ADS-B Data	
NEXRAD Data	Available if included in user subscription.
Graphical METAR Data	Available if textual METAR data is included in user subscription. Derived from textual METAR data using EFIS algorithm.

NEXRAD data is displayed on the ND in correct relationship as colored regions of precipitation using the convention.

Table D-2: Datalink NEXRAD Data	
Color	**Meaning**
Gray Shading	Areas beyond the limits of radar coverage or areas with missing data
Magenta	Rain >= 50dBZ
Red	Rain >= 45dBZ and < 50dBZ
Light Red	Rain >= 40dBZ and < 45dBZ
Amber (Yellow)	Rain >= 30dBZ and < 40dBZ
Green	Rain >= 20dBZ and < 30dBZ
Cyan	Snow >= 20dBZ
Light Cyan	Snow >= 5dBZ and < 20dBZ
Magenta	Mixed Precipitation >= 20dBZ (Area is distinguishable from rain >= 50dBZ by graphical context)
Light Magenta	Mixed Precipitation >= 5dBZ and < 20dBZ

Graphical METARs are displayed in correct relationship to the ownship symbol as a large color-filled circle as follows.

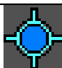
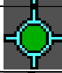
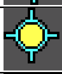
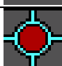
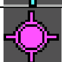
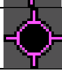
Table D-3: Graphical METARS (GMETARS) Screen Range	
Screen Range	**Display**
50 NM	All GMETARS with Airport Symbol and ID
100 NM	All GMETARS with Airport Symbol only
200 NM	All GMETARS
400 NM	VFR GMETARS are decluttered
800NM and 1,600 NM	VFR and MVFR GMETARS are decluttered

Graphical METARs are also displayed in the menu system "nearest airport," "nearest weather," and "info" functions.

Figure D-3: NRST Airport INFO

If the airport has an available datalinked METAR, the circular part of the airport symbol is colored-fill with the following convention.

Table D-4: Graphical METAR Symbols

Color		Meaning
Sky Blue		Visual Flight Rules (VFR)
Green		Marginal Visual Flight Rules (MVFR)
Amber (Yellow)		Instrument Flight Rules (IFR)
Red		Low Instrument Flight Rules (LIFR)
Magenta		Less than Category 1 Approach Minimums
Black		No Data

Graphical weather conditions data are displayed in the menu system "info" function as large colored squares per the following convention.

Table D-5: Datalink Graphical METAR Precipitation

Color	Meaning
Sky blue	No significant precipitation
Green	Rain
White	Snow
Red	Hazardous weather
Right half gray	Obscuration to visibility
Small black square centered in large square	High wind
Black	No data

Textual METAR and TAF data are displayed when appropriate in the menu system "info" function. Time of observation and forecast are contained within the text.

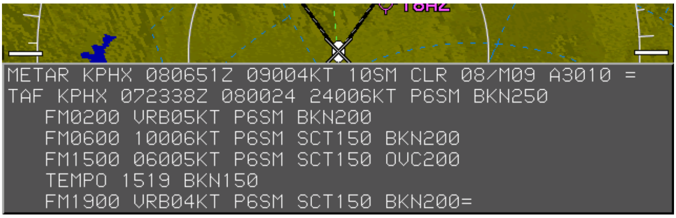


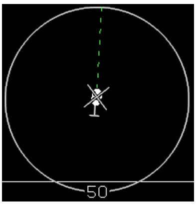
Figure D-4: METAR and TAF Report for KPHX

D 2. Dedicated Datalink Page

D 2.1. MFD Page (PAGE) Menu

DATALINK: Shows the Datalink page.

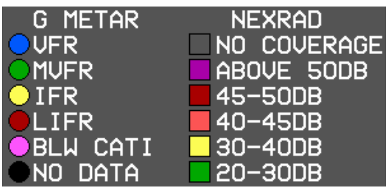
D 2.2. Ownship Symbol



When not panning with AHRS in the DG mode, “DG” appears to the right of the ownship symbol. The datalink page is always displayed in north-up orientation with a boundary circle in place of the compass rose. If not in pan mode, the ownship symbol is aligned with the aircraft heading.

Figure D-5: Datalink Symbology Rotorcraft Ownship Symbol

D 2.3. Datalink Page Legend



When selected, the datalink page legend depicts symbology used for graphical METARs and NEXRAD with winter colors.

Figure D-6: ADS-B Datalink Page Legend

D 2.4. Air Data and Groundspeed

Air data and groundspeed are displayed in the upper left corner of the datalink page as specified in Section 3 Display Symbology.

D 2.5. Clock and Options

The following are displayed in the upper right corner of the ND:

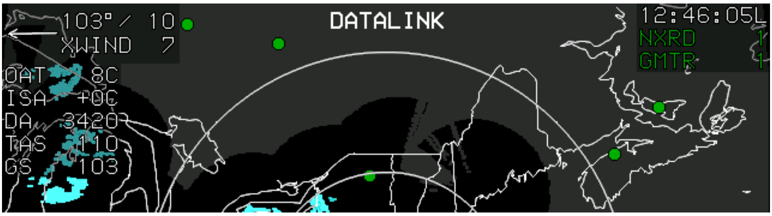


Figure D-7: Clock/Options

1) **Zulu Time or LCL Time:** As in Section 3 Display Symbology.

2) **Datalink Weather Status**: When status of NEXRAD, graphical METARs are displayed as follows.

Table D-6: Datalink NEXRAD Status

Condition	Status Annunciation	
	***NEXRAD**	**Graphical METAR**
Never completely downlinked	No Annunciation	
Downlinked within last 5 minutes and selected for display*. “Show Full Sensor Status Flag” enabled.	“NXRD ##” in green. ## is age in minutes. NEXRAD shown.	“GMTR ##” in green. ## is age in minutes. GMETARS shown.
Downlinked within last 5 minutes and deselected from display*. “Show Full Sensor Status Flag” enabled.	“NXRD ##” in green. ## is age in minutes. “NXRD ##” overlaid with green “X” NEXRAD not shown.	“GMTR ##” in green. ## is age in minutes. “GMTR ##” overlaid with green “X” GMETARS not shown.
Not downlinked within last 5 minutes but downlinked within last 10 minutes and selected for display*. “Show Full Sensor Status Flag” enabled.	“NXRD ##” in amber (yellow). ## is age in minutes. NEXRAD shown.	“GMTR ##” in amber (yellow). ## is age in minutes. GMETARS shown.
Not downlinked within last 5 minutes but downlinked within last 10 minutes and deselected from display*. “Show Full	“NXRD ##” in amber (yellow). ## is age in minutes. “NXRD ##” overlaid with green “X” NEXRAD not shown.	“GMTR ##” in amber (yellow). ## is age in minutes. “GMTR ##” overlaid with green “X”

Table D-6: Datalink NEXRAD Status		
Condition	**Status Annunciation**	
	***NEXRAD**	**Graphical METAR**
Sensor Status Flag" enabled.		GMETARS not shown.
Not downlinked within last 10 minutes but downlinked within last 75 minutes and selected for display*.	"NXRD ##" in red. ## is age in minutes. NEXRAD shown.	"GMTR ##" in red. ## is age in minutes. GMETARS shown.
Not downlinked within last 10 minutes but downlinked within last 75 minutes and deselected from display*. "Show Full Sensor Status Flag" enabled.	"NXRD ##" in red. ## is age in minutes. "NXRD ##" overlaid with green "X" NEXRAD not shown.	"GMTR ##" in red. ## is age in minutes. "GMTR ##" overlaid with green "X" GMETARS not shown.
Not downlinked within last 75 minutes (timed-out). "Show Full Sensor Status Flag" enabled.	"NXRD XX" in red "NXRD XX" overlaid with red "X" NEXRAD not shown.	"GMTR XX" in red "GMTR XX" overlaid with red "X" GMETARS not shown.
* If installed, weather radar selected for display		

D 2.6. Datalink Page Screen Range

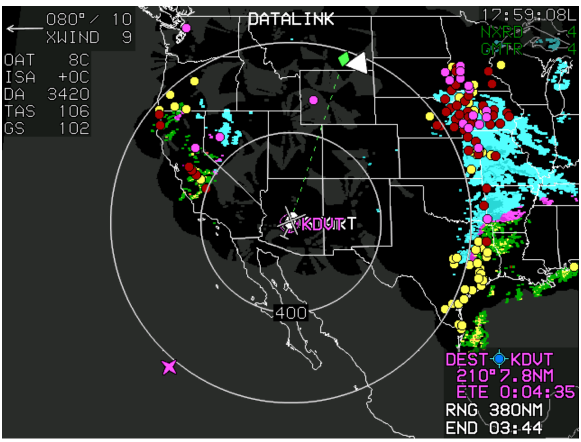


Figure D-8: Datalink Page Screen Range

When selected, the following screen ranges (all distances represent distance from the ownship symbol to the boundary circle) are available. Radius of the range ring is presented on the range ring.

Table D-7: Datalink Page Screen Ranges

Ownship to Boundary Circle	Radius Range Values
50 NM	25 NM
100 NM	50 NM
200 NM	100 NM
400 NM	200 NM
800 NM	400 NM
1,600 NM	800 NM

D 2.7. Boundary Circle Symbols

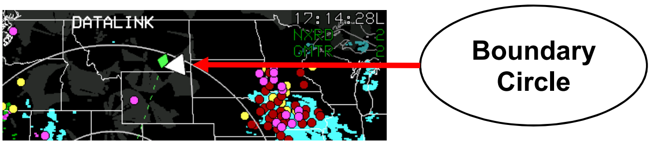


Figure D-9: Boundary Circle Symbol

A white triangular heading pointer aligned with the longitudinal axis of the ownship symbol appears on the boundary circle with a green diamond-shaped track pointer aligned with the aircraft's track across the earth. A green dashed lubber line connects the center of the aircraft symbol and the track pointer.

If a target or VNAV altitude is set and not captured, an altitude capture predictor arc is displayed on the lubber line at a point corresponding with predicted climb or descent distance (based upon current VSI). The track pointer, lubber line, and altitude capture predictor arc are not displayed when groundspeed is less than 60 knots. A pilot-settable heading bug geometrically interacting with the heading pointer appears on the boundary circle. A magenta, star-shaped waypoint pointer displayed on the boundary circle at a point corresponds with the active waypoint. The waypoint pointer turns amber (yellow) in the event of GPS LON caution. Boundary circle symbols are not drawn when in pan mode.

D 2.8. Active Flight Plan Path/Manual Course/Runways

When there is an active flight plan and automatic GPS/SBAS OBS setting, the flight plan path, when selected, is shown in correct relationship to the ownship symbol. The active flight plan path depiction meets all GPS/SBAS path definition requirements and matches the lateral navigation guidance on the PFD (GPS/SBAS CDI in automatic OBS mode, skyway boxes, and mini-map). Active flight plan path fly-over waypoints symbols are distinct from fly-by waypoints and consist of the waypoint symbol within a circle. When there is a parallel offset, the active flight plan path depicts the parallel offset path, and the original flight plan path is shown with haloed gray dashed lines.

When there is an active waypoint and manual GPS/SBAS OBS setting, the course through the waypoint is shown as a pointer centered on the waypoint and matches the lateral navigation guidance 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 magenta but turn amber (yellow) in the event of a GPS LON caution. The datalink page displays airport runways in correct relationship and scale to the ownship symbol.

D 2.9. Borders

National and United States state borders are drawn in white in correct relationship to the ownship symbol.

D 2.10. Pan Mode

Use the pan mode to change the location of the center of the page away from current location and view weather conditions along the route of flight and at the intended destination or alternate destination. When pan mode is active, press **NORTH (L3)**, **SOUTH (L4)**, **EAST (R3)**, or **WEST (R4)** to pan in indicated direction. When pan mode is active, a line is drawn from the map center to the aircraft's current position, and bearing and distance to the map center is always displayed above the ownship symbol when the aircraft is more than 0.5 NM away. If referenced to magnetic north, (as specified in Section 3 Display Symbology) when panning, the nearest displayed graphical METAR symbol within the inner range ring is highlighted with a flashing circle. When such a point is highlighted, dedicated buttons are present to allow the pilot to view and hide the waypoint information (including datalink weather information) associated with that point.

D 3. MFD Datalink Format (FORMAT) Menu

Upon selecting the MFD format menu when in the Datalink page, an option list appears with the following options:

1) **PAN ON/PAN OFF**: Toggles Datalink page pan mode.

2) **DCLTR..**: Activates option list.

a) **ROUTE**: Toggles showing the active flight plan route on the Datalink page.

b) When datalink weather products are available for display, list of individual datalink weather products appears in the selection box, e.g., **G METAR**, **NEXRAD**.

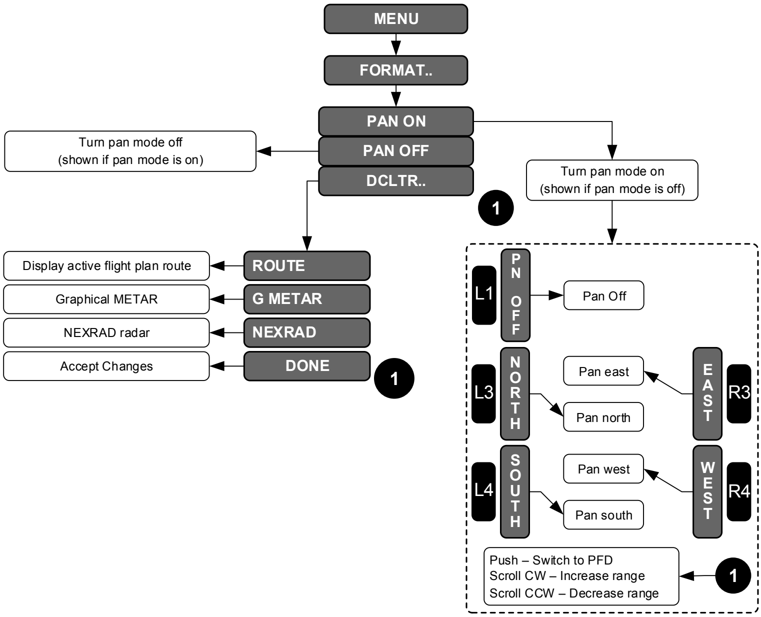
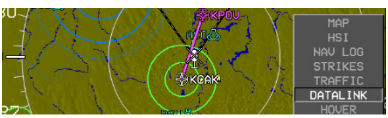
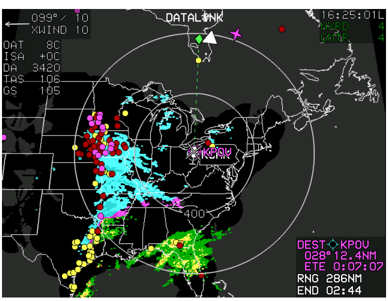


Figure D-10: MFD Datalink Format (FORMAT) Menu

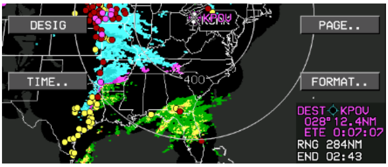
D 3.1. MFD DATALINK Page (Step-By-Step)



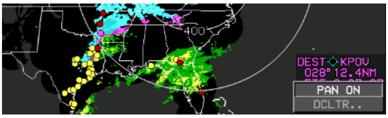
1) Press **MENU (R1)** then **PAGE (R3)** and scroll ❶ to **DATALINK** and push to enter.



2) Example shows MFD with DATALINK.



3) Press **MENU (R1)** then **FORMAT (R4)** to format Datalink page.



4) Scroll ❶ to **PAN ON**, **DCLTR..**, or **ROUTE ON**, Push to enter.

D 4. Top-Level Auto Pop-Up Function Descriptions

Table D-8: Top-Level Auto Pop-Up Function Descriptions

FPL (L1)	When showing Datalink page with pan mode enabled, **PN OFF** appears. Press to disable pan mode. **RESET** has precedence over **PN OFF**.
ACTV (L2)	When showing ND or 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** appears. Press to display textual METAR and TAF data for the airport.
INFO (L3)	When showing Datalink page with pan mode enabled, **NORTH** appears. Press to shift the center of page in the specified direction.
OBS (L4)	When showing Datalink page with pan mode enabled, **SOUTH** appears. Press to shift the center of page in the specified direction.
BARO (R2)	When showing Datalink page with pan mode enabled, **INFO** or **HIDE** 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.
NRST (R3)	When showing Datalink page with pan mode enabled, **EAST** appears. Press to shift the center of page in the specified direction.
 **(R4)**	When showing Datalink page with pan mode enabled, **WEST** appears. Press to shift the center of page in the specified direction.

D 5. MFD Page First-Level Option Descriptions

WX LGND (ACTV) (L2): Activates datalink weather legend.

D 6. Active Flight Plan (ACTV) Menu Options

NRST APT (R3): **WX LGND (L2)** and **EXPND WX (L3)** are available to show a weather symbol legend and highlighted result METAR and TAF text respectively.

Identifier Entry Box: Highlighted result information includes datalinked weather information when available.

D 7. Information (INFO) Menu

When airport weather information is presented in the information block, **WX LGND (L2)** displays an airport graphical METAR legend, and **EXPND WX (L3)** displays textual METAR and TAF data for the airport.

D 8. MFD Fault Display Menu

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).

D 9. Menu Synchronization

Table D-9: Menu Synchronization

Menu Parameter	Notes
The following menu parameters are independent between displays. These are used to support non-PFD display options to give the pilot maximum MFD operating flexibility.	
MFD Datalink Page Settings	

Round Dials

RD 1. Airspeed Display

Figure RD-1: Round Dials Airspeed Display

The airspeed display digitally displays indicated airspeed in knots, miles, or kilometers per hour (as per aircraft "Speed Units" system limit) and is scaled to show the entire operating range of the aircraft. Clockwise movement indicates increasing speed. When an ADC sensor fails, the display appears as shown in Figure RD-8.

Without airspeed bugs

IAS bug set to 80 and indicating 80 KIAS

IAS bug set to 80 and indicating 70 KIAS

Figure RD-2: Round Dials Airspeed Display Limits

1) Gray safe-operating area from bottom of dial to **V$_{MIN}$**. Airspeed is gray at 0 (indicating "dead" airspeed) but otherwise green.

2) Green safe operating range area from **V$_{MIN}$** to **V$_{NO}$**. **V$_{MIN}$** refers to the minimum speed for effective airspeed indication (usually 20KIAS,

depending on the connected ADC). Airspeed readout is gray at 0 (indicating “dead” airspeed) but otherwise green.

3) Amber (yellow) caution range area from **V_{NO}** to **V_{NE}** (power-on). Airspeed readout is yellow.

4) Red radial line at **V_{NE}** (power-on). Airspeed readout is red at or above the red radial line.

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

A red cross-hatched radial line at **V_{NE}** (power-off).

RD 2. Round Dials PFD

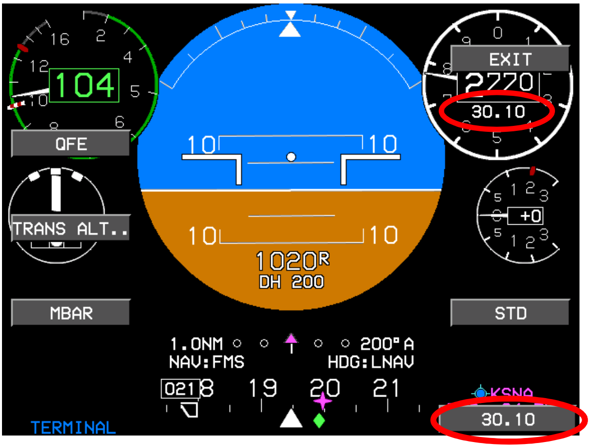


Figure RD-3: Round Dials PFI Area (QNH)

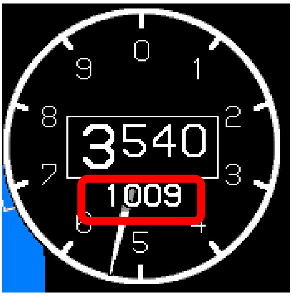
RD 3. Round Dials PFI Configuration

Altitude display and changing altimeter setting:

1) Press **BARO (R2)** to enter BARO mode and view the inches of mercury (inHg) or millibars (mbar) value in the lower right corner.

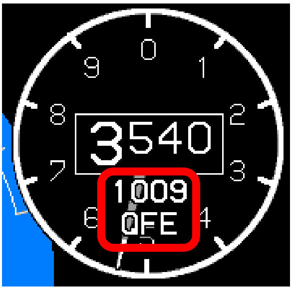
2) Scroll ❶ CW to increase or CCW to decrease QNH. (As shown encircled in red in Figure RD-3, Figure RD-4, and Figure RD-5.)

3) Push ❶ or press **EXIT (R1)** to enter the new value.



The altimeter setting digitally displays the altimeter setting in either inches of mercury (inHg) or millibars (mbar) according to the pilot-selected units.

Figure RD-4: Altimeter QNH



The mode is annunciated as QFE operations otherwise, no mode is annunciated

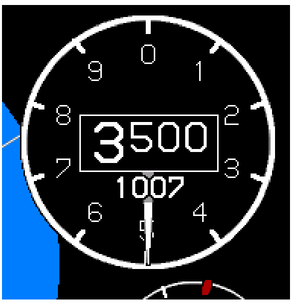
Figure RD-5: Altimeter QFE

QFE: Barometric setting resulting in the altimeter displaying height above a reference elevation (i.e., 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.

RD 4. Altitude Display



The altitude readout digitally displays barometric altitude to the nearest ten feet as adjusted by an altimeter setting and shows a 1000-foot range with labels and graduations every 100 feet. CW rotation of the pointer indicates increasing altitude. All graduations are removed when below sea level.

Figure RD-6: Altitude Display

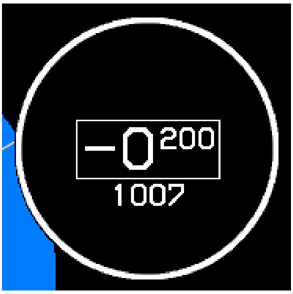


Figure RD-7: Altitude Display (When Below Sea Level)

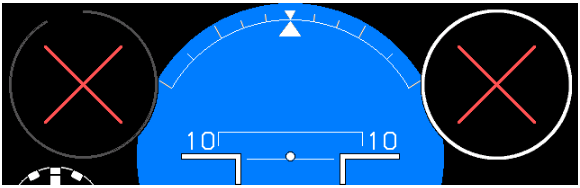


Figure RD-8: Airspeed and Altitude with Loss of ADC

Altitude sub-mode user-selectable triangular target altitude bug shown here at 4,400’. The bug is limited to -1,000’ up to the service ceiling and is removed when more than 500’ away from current altitude.

Figure RD-9: Target Altitude Bug

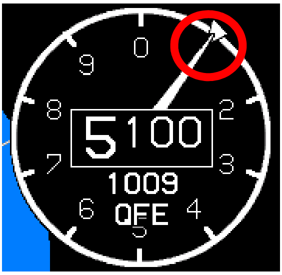
The target altitude bug can be used as a visual reference or when vertically integrated with the Genesys HeliSAS-E or other autopilot, the bug characteristics indicate the following modes:

1) Filled-white when in altitude hold mode.

2) Hollow-white when in a climb or descent mode.

3) Filled-white during altitude hold capture.

When not vertically integrated with the Genesys HeliSAS-E or other autopilot, the target altitude bug is filled-white at all times.



When in VNAV sub-mode, the VNAV altitude bug appears when within 500’ from the current altitude. In this example, the VNAV altitude is 5,100’.

Figure RD-10: VNAV Sub-Mode

The VNAV bug can be used as a visual reference or when vertically integrated with the Genesys HeliSAS-E or partially integrated through use of the vertical mode discrete input as a control parameter for climbs or descents with another autopilot. The following bug characteristics indicate the following modes:

1) Filled-magenta when in altitude hold mode.

2) Hollow-magenta when in a climb or descent mode.

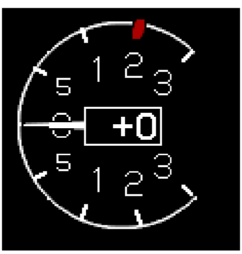
3) Filled-magenta during altitude hold capture.

When not vertically integrated with an autopilot, the VNAV bug is filled-white at all times.

Metric altitude values may be selected from within the declutter menu with a resolution of 1 meter.

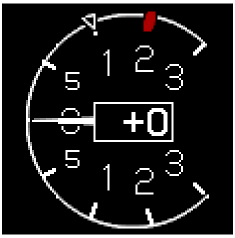
Figure RD-11: Metric Altitude

RD 5. Vertical Speed Indicator

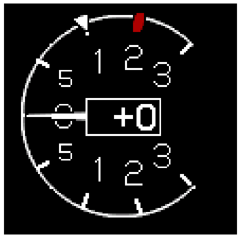


The VSI is located below the altitude display with a readout and dial pointer and scale of ±3,000 feet per minute. The integral scale graduations are ±500, ±1,000, ±2,000, and ±3,000 feet per minute. CW (upward) rotation of the pointer indicates increasing vertical speed while CCW indicates decreasing speed.

Figure RD-12: Vertical Speed Indicator



VSI bug set to +1,000 fpm with HeliSAS enabled



VSI bug set to +1,000 fpm without autopilot enabled.

Figure RD-13: VSI Bugs

The vertical speed bug is mutually exclusive with the IAS bug and can be used either as a visual reference or when vertically integrated with the HeliSAS-E or other autopilot as a control parameter for climbs or descents. When vertically integrated, the vertical speed bug is filled-white when in VSI climb or descent mode. Otherwise, the vertical speed bug is hollow-white as shown above on the left. When not vertically integrated with an autopilot, the vertical bug is filled-white at all times.

RD 6. Heading Display

The heading display appears in a blacked-out area on the bottom to emulate a "Basic-T."

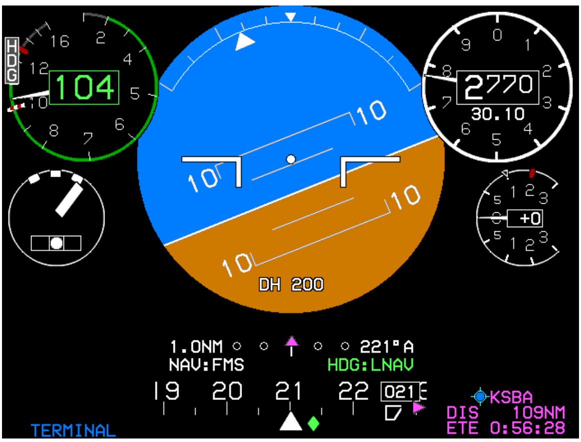


Figure RD-14: Heading Display

RD 7. Turn Rate Indicator

The turn rate indicator is displayed below the airspeed display. This standard turn needle displays marks representing a standard rate turn. The full scale for the turn needle is beyond the standard rate turn mark. This allows the pilot to fly a standard rate turn. The balance ball is driven from accelerometers within the AHRS.

Figure RD-15: Turn Rate Indicator

Table RD-1: PFD Declutter Options and Features

Declutter Options	Configuration			Notes
	Tapes	Basic	Round Dials	
PFD Analog AGL Indicator	✓	✓		
Full-Time or Auto Decluttered Bank Scale Display	✓			
Basic Mode	✓	✓		
PFD Mini-Map	✓	✓		
PFD Traffic Thumbnail	✓	✓		
Skyway Guidance	✓			
Perspective Traffic Depiction	✓			
Turn Rate Indication	✓	✓		
Single Cue Flight Director	✓	✓	✓	
Dual Cue Flight Director	✓	✓	✓	
METERS	✓	✓	✓	

RD 8. RED-X (Invalid Input)

The following round dial items on the PFD screen will have a RED-X in case of invalid input:

1) Turn Indicator

2) Balance Ball

Search and Rescue (SAR) Patterns

SAR 1. Search and Rescue (SAR) Patterns

When enabled by EFIS system limits, the pilot can create one SAR pattern at an eligible flight plan waypoint and only one waypoint within the active flight plan. The current position of the aircraft is determined relative to that desired path for lateral deviation for display on the GPS/SBAS CDI. In most cases, the IDU auto-sequences from one waypoint to the next similar to all other flight plan sequencing along the flight path.

The SAR option is available for any waypoint except the following:

1) Suppressed waypoint
2) Skipped waypoint
3) Manual termination waypoint
4) Waypoint that is part of an IFR or VFR approach
5) Holding pattern waypoint
6) SAR pattern exit waypoint
7) Waypoint that begins a departure procedure
8) Parallel offset entry or exit waypoint
9) Dynamic termination waypoint (altitude termination, DME termination, radial termination or intercept termination)

SAR patterns can be created in the **RUN DEMONSTRATOR/TRAINING PROGRAM** Ground Maintenance Page or the EFIS Training Tool. After the SAR pattern is created and saved, that flight plan can be uploaded to any IDU or all IDUs in an aircraft for later use.

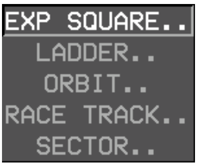
The desired flight path is created from a sequence of straight, left, and right turning leg segments to provide smooth skyway, GPS/SBS CDI, and lateral autopilot guidance. SAR patterns are drawn at the lowest of holding or procedure speed.

SAR 1.1. SAR Pattern Step-by-Step Procedures

To select a SAR pattern, follow these step-by-step procedures. Refer to subsequent sections for additional details and examples for the individual patterns.

1) Press **ACTIVE (L2)** and scroll ❶ to desired eligible waypoint to begin SAR pattern creation process and push to enter.

2) Press **ACTV (L2)** and then scroll ❶ to **SAR PTRN..** and push to enter.



3) Scroll ❶ to one of the five SAR pattern options and push to enter. *Pattern includes the option to select individual legs within the SAR pattern for navigation guidance.

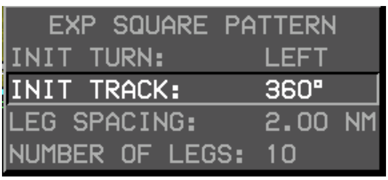
    a) Expanding Square*

    b) Rising Ladder*

    c) Orbit

    d) Race Track

    e) Sector Search*



4) Scroll ❶ through each step and create the desired parameters (e.g., direction, track, leg length, leg spacing, and number of legs) and push to enter.

See following sub-sections for more details for parameters of each pattern.

5) After SAR pattern is created, it appears on the ND MAP, MINI MAP and active flight plan.

6) To select a SAR pattern individual legs scroll ❶ to SAR pattern EXIT WPT as it appears in magenta and push to enter.

7) Scroll ❶ to **SAR SGMNT..** and push to enter.

8) Scroll ❶ to desired leg for navigation guidance.

9) Control the aircraft to new magenta line for maneuvering to begin following navigation guidance.

See § SAR 2, SAR 3, and SAR 6 for examples of selected segments.

10) To delete existing SAR pattern, Press **ACTV (L2)**. Scroll ❶ to SAR pattern and press **DELETE (R3)**.

11) Push ❶ to confirm.

SAR 2. Expanding Square Pattern

Figure SAR-1: Expanding Square Pattern

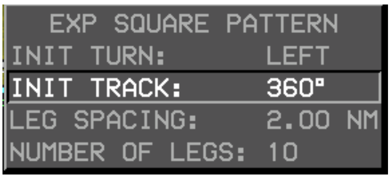


Figure SAR-2: Expanding Square Pattern Parameters

Table SAR-1: Expanding Square Pattern Parameters

Parameters	Increments (Range)/Direction	Notes
Initial Turn	Left or Right	
Initial Track	Outbound from previous waypoint in 1° increments	Magnetic or True
Leg Spacing	0.25NM (0.25 to 10NM)	
Number of Legs	1 to 50	

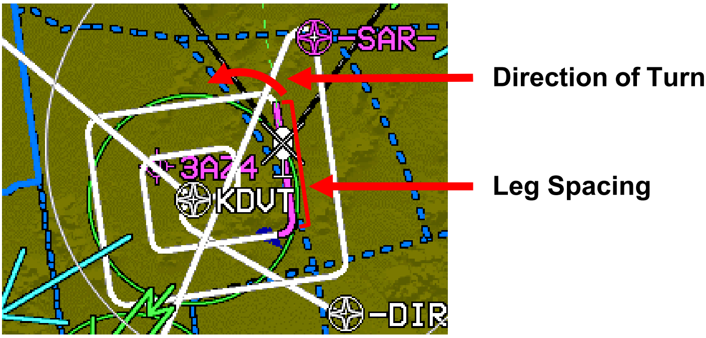


Figure SAR-3: Expanding Square Pattern-Turn and Leg Parameters

Figure SAR-4: Expanding Square Pattern-Individual Leg Selected

SAR 3. Rising Ladder Pattern

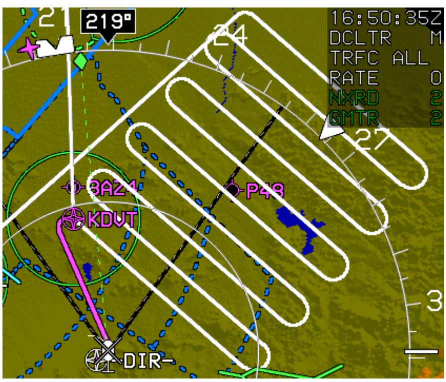


Figure SAR-5: Rising Ladder Pattern

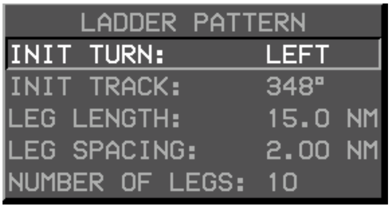


Figure SAR-6: Rising Ladder Pattern Parameters

Table SAR-2: Rising Ladder Pattern Parameters		
Parameters	**Increments (Range)/Direction**	**Notes**
Initial Turn	Left or Right	
Initial Track	Outbound from previous waypoint in 1° increments	Magnetic or True
Leg Length	0.5 NM (1NM to 100NM)	
Leg Spacing	0.25NM (0.25 to 25NM)	
Number of Legs	1 to 50	

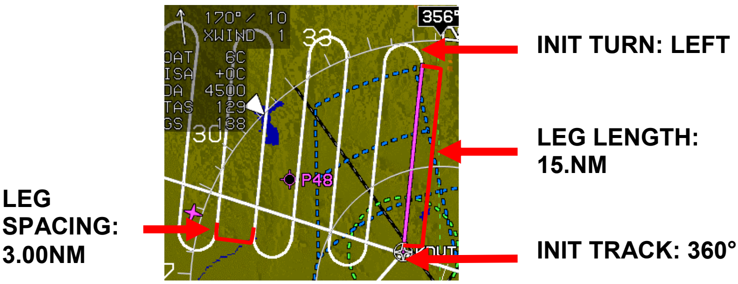
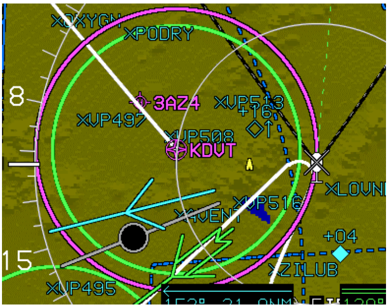


Figure SAR-7: Rising Ladder Pattern-Turn, Leg, and Track Parameters

Figure SAR-8: Expanding Square Pattern-Individual Leg Selected

SAR 4. Orbit Pattern



The SAR exit waypoint is a duplicate of the previous waypoint. This SAR pattern is unique in that the navigation path never goes through the waypoint. The path is a circle around the waypoint intercepted along tangents. With no other menus displayed on the PFD, **CONT (L2)** appears to allow for continuing out of the orbit and normal sequencing in the active flight plan.

Figure SAR-9: Orbit Pattern

Figure SAR-10: Orbit Pattern Parameters

Table SAR-3: Orbit Pattern Parameters	
Parameters	**Increments (Range)/Direction**
Turn Direction	Left or Right
Radius	0.25NM (0.25NM to 10NM)

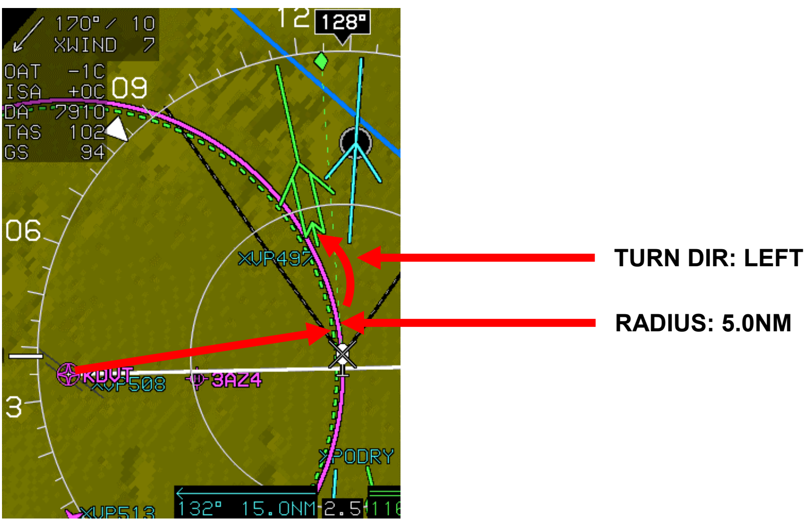


Figure SAR-11: Orbit Pattern-Turn and Radius Parameters

SAR 5. Race Track Pattern

With no other menus displayed on the PFD, **CONT (L2)** appears for continuing out of the racetrack and normal sequencing in the active flight plan.

Figure SAR-12: Race Track Pattern

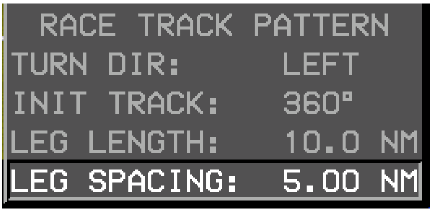


Figure SAR-13: Race Track Pattern Parameters

Table SAR-4: Race Tack Pattern Parameters

Parameters	**Increments (Range)/Direction**	**Notes**
Initial Turn	Left or Right	
Initial Track	Outbound from previous waypoint in 1° increments	Magnetic or True
Leg Length	0.5 NM (1NM to 100NM)	
Leg Spacing	0.25NM (0.25 to 10NM)	

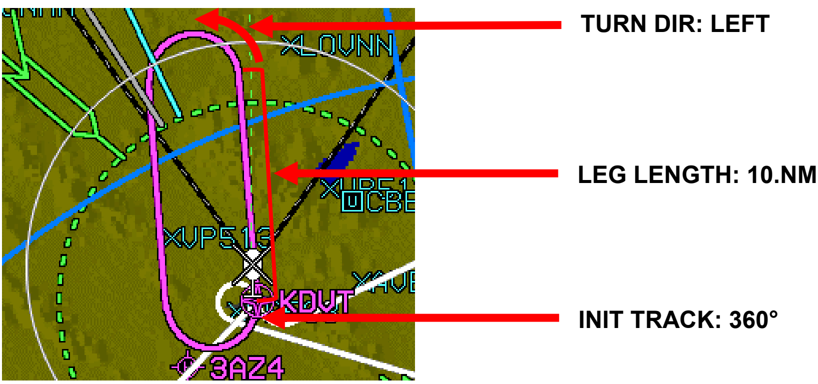


Figure SAR-14: Race Track Pattern-Turn, Leg, and Track Parameters

SAR 6. Sector Search Pattern

Figure SAR-15: Sector Search Pattern

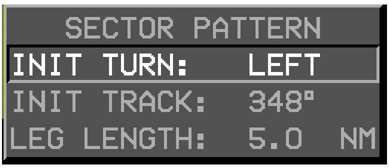


Figure SAR-16: Sector Search Pattern Parameters

Table SAR-5: Sector Search Pattern Parameters		
Parameters	**Increments (Range)/Direction**	**Notes**
Initial Turn	Left or Right	
Initial Track	Outbound from previous waypoint in 1° increments	Magnetic or True
Leg Length	0.5 NM (1NM to 100NM)	

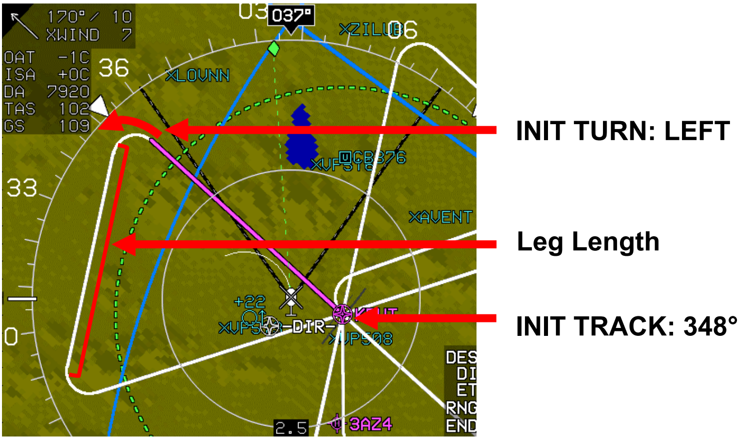


Figure SAR-17: Race Track Pattern-Turn and Track Parameters

Figure SAR-18: Sector Search Pattern-Individual Leg Selected

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Glossary

AGL Indication (Rad Alt, GPS Alt, Baro Alt) – Display of altitude above the ground, with designation of the altitude source as R (radio altitude), G (GPS WAAS geodetic altitude less local ground elevation), or B (barometric altitude less local ground elevation).

Air Data and Groundspeed – Display of density altitude, outside air temperature, ISA temperature deviation, true airspeed, and groundspeed.

Airspeed Information – Display of airspeed is the indicated airspeed tape and airspeed readout with associated data. The airspeed function includes color-coded caution bands for minimum and maximum speeds based on V-speeds set in the EFIS limits.

Altitude Information – Display of altitude information is the altitude tape and altitude readout.

Approach Mode Signal Output – Conventional autopilot approach mode signals are course error output, the left/right deviation signal (localizer output) and the up/down deviation signal (glideslope output). Signals are based on the selected ILS source.

Attitude Information – Display of attitude information includes pitch and roll. The bank angle scale may be set to auto-declutter by the pilot when the bank angle is less than 2.8°. The pitch ladder is limited to ±10° from the flight path marker or aircraft waterline, whichever is greater. The unusual attitude display appears when the aircraft pitch exceeds ± 30° or bank angle exceeds 65° (fixed wing) or 50° (Rotorcraft).

Autoset – Automatically selects features or settings.

Azimuth – Angle between the north vector and the perpendicular projection of the star down onto the horizon. Usually measured in degrees (°).

Barometric Altimetry – Measurement of altitude based on the atmosphere (pressure and temperature).

Barometric Correction – Display and altitude correction for local barometric pressure.

Bezel – Faceplate of the IDU comprised of pushbuttons along the pushbuttons along the sides and rotary encoders along the bottom.

Chroma – Colorfulness relative to the brightness.

Conformally – Angle-preserving. Example: Traffic appears conformally on the PFD.

Course Deviation Indicator – Display of course deviation from selected course, including a To-From indicator.

Critical Flight Phase – Phase(s) of flight where the failure mode would result in a hazard condition using flight phases. For example, failure of ILS would only be a hazard condition during approach and landing.

Crossfill – Transfer of data and information between IDUs in a dual system with two PFDs configured.

Cross-linked – Synchronized across both EFIS systems.

Datalinked – Display of received data such as weather or traffic from peripheral systems such as ADS-B.

dBZ – Decibel relative to radar reflectivity (Z). Composite reflectivity shows the highest dBZ (strongest reflected energy) at all elevations. Unlike base reflectivity, which only shows reflected energy at a single elevation scan of the radar, composite reflectivity displays the highest reflectivity of ALL elevations scans. If there is heavier precipitation in the atmosphere over an area of lighter precipitation (i.e. rain has yet to reach the ground), the composite reflectivity displays the stronger dBZ level.

Deadband – Neutral zone where no action or changes are made.

Directional Scale (Compass Rose or Arc) and Ownship Symbol – Display of general directional information. All MFD pages include a form of the compass rose with current heading pointer and aircraft “ownship” symbol.

Discrete – A logic input or output that identifies a condition or status of or for an ancillary system. Discretes are defined by the operating software or settings programmed specifically for the aircraft.

Display of ADF – Display of single ADF bearing information in the form of an RMI needle.

Display of Glideslope – Display of Glideslope 1 or Glideslope 2 in the form of vertical deviation dots and deviation on PFD or MFD HSI page.

Display of Lightning Cell Information – Display of lightning information from a WX-500 system and shown in the form of lightning cells. The pilot may show individual lightning strike data by selecting the dedicated WX-500 page.

Display of Localizer – Display of Localizer 1 or Localizer 2 in the form of horizontal deviation dots and deviation.

Display of Marker Beacon – Display of outer, middle, and inner marker beacons in the form of a color-coded circle with the corresponding letter (O, M, I).

Display of Traffic Information – When integrated with an appropriate traffic system, the PFD and MFD display traffic information in two formats. One format is via traffic symbols as shown on the PFD and MFD Map page and Traffic page. The second format is with the traffic pop-up thumbnail display showing traffic position in a full 360° format on the PFD.

Display of VOR RMI – Display of VOR1 and VOR2 bearing in the form of RMI needles.

Dot – (CDI scale referenced) represents an additional 2° for VOR and 1.25° for Localizer.

EFIS-Coupled – The EFIS is coupled to an autopilot and controls the lateral and vertical modes of the autopilot.

Failure Condition Hazard Description – A description of the failure mode to be analyzed.

Flight Director (Selectable Function) – Display of flight director in a single or dual cue format when selected for display on the PFD.

Flight Path Marker (Velocity Vector) – Display of aircraft's actual flight path, showing where the aircraft is going as opposed to where the aircraft is pointed.

Flight Plan and Navigation Display – Display of the active GPS WAAS/SBAS-based flight plan, including course line, waypoints, ground track, glide range, projected path, altitude capture predictor, approach procedure, missed approach procedure, and the aircraft present position on the active leg.

Geodetic – Set of reference points used to locate places on the earth.

Geodesic – A generalization of the notion of a straight line to curved spaces. The shortest route between two points on the Earth's surface.

Geoid – Global mean sea level.

G-Force and Fast/Slow Indicator – Indications to show the G-force on the aircraft or, for aircraft equipped with a compatible angle of attack computer, the deviation from the reference speed while in the landing configuration.

Glideslope Sidelobes – False glideslope signals.

GPS WAAS Course Deviation Indicator (CDI) – Display of CDI relative to selected course, either automatic based on active flight plan or manual based on pilot-selected OBS.

GPS WAAS Functions – The EFIS meets the GPS WAAS navigation and flight planning/management requirements of TSO-C146a (RTCA/DO-229D) for Class Gamma 3 equipment. These functions include navigation, flight planning (function select, flight plan generation and editing, selected waypoints, user waypoints, etc.), path definition including approach and departure paths, GPS altitude, dead reckoning, navigation modes with automatic mode switching, loss of navigation monitoring, loss of integrity monitoring, etc. The database used with the GPS WAAS functions meets the integrity requirements of RTCA/DO-200A.

Heading Bug – Display and control of selected heading using a bug. May be used to drive heading bug output to autopilot for HSI-based heading mode.

Heading Display – Display of heading with directional scale is provided at the top of the PFD. This is the same heading information provided on the MFD.

Heading Mode Signal Output – Conventional autopilot heading mode signal is a heading error output based on the difference between the EFIS desired heading and the actual aircraft heading. The EFIS desired heading is either the pilot-selected heading bug or a heading designed to achieve and maintain the active GPS-based flight plan.

Hectopascal (hPa) – International System of Units (SI) unit measure of pressure, equals one millibar (mbar).

HeliSAS – Genesys Aerosystems' helicopter autopilot and stability augmentation system.

Horizontal Situation Indicator (Selectable Function) – Display of VOR or localizer and glideslope deviation when selected for display on the PFD.

HOTAS – Hands On Throttle And Stick

Hover Vector Display (Rotorcraft Only) – Display of hover drift in a rotorcraft installation when the helicopter is traveling less than 30 knots airspeed.

Inches of Mercury (inHg) – Unit of atmospheric pressure used in the United States. Named for the use of mercurial barometers which equate height of a column of mercury with air pressure.

Inhibit – Prevention of activity or occurrence. Examples are:

XFILL INHBT and TAWS INHBT.

Integrated Peripherals – Internal devices of the essential unit.

Ionosphere – Region of the atmosphere between the stratosphere and exosphere, 50 to 250 miles (80 to 400 km) above the surface of the earth.

International Standard Atmosphere (ISA) – Standard model of the change of pressure, temperature, density, and viscosity over a wide range of altitudes or elevations.

Landing Gear Indication – When enabled on retractable landing gear aircraft, PFD shows indication of landing gear extended.

Lubber Line – Line marked on the compass showing the direction straight ahead.

Mach Display – Display of Mach number when the aircraft is traveling at or above 0.35 Mach. This function may be deselected by a setting in the IDU configuration (limits) file.

Magnetic Declination (MAGVAR) – Sometimes called magnetic variation; the angle between magnetic north and true north.

Map Data – Display of map data, including airspace, VFR/IFR airports, VHF navaids such as VOR/NDB/DME, jet/victor airways, and display range rings.

Menu Functions – The EFIS includes menus to access functions on both the PFD and the MFD.

Mesocyclonic – Contains a vortex of air within a convective; air rises and rotates around a vertical axis, often in the same direction as low pressure systems.

Millibar (mbar) – Metric (not SI) unit of pressure, one thousandth of a bar, which is about equal to the atmospheric pressure on Earth at sea level - 1013 millibars.

Miscompare – Disparity of data or information. Examples are:

ALT MISCOMP, ATT MISCOMP, GPS MISCOMP, GS MISCOMP, HDG MISCOMP, IAS MISCOMP, LOC MISCOMP, PLT MISCOMP, RALT MISCOMP, CPLT MISCOMP, and BARO MISCOMP.

NavData® – Jeppesen's aeronautical database to navigate the global airspace system.

Navigation Data Display – Display of active waypoint, bearing to waypoint, and ground track based on active flight plan. The pilot may also select flight plan information as a mini map (thumbnail map). These functions are analyzed as part of the GPS WAAS functions not the PFD functions.

Navigation Log – Display of navigation information based on active flight plan, including next waypoint, destination, estimated time remaining, and fuel totalizer-based range and endurance. This function may be deselected by a setting in the IDU configuration (limits) file. These functions are analyzed as part of the GPS WAAS functions not the MFD functions.

Navigation Mode Signal Output – Conventional autopilot Navigation mode signals are the course error output and the left-right deviation signals. Course error output is based on the difference between the EFIS selected course (OBS) and the actual aircraft heading. These signals are based on the selected navigation signal (VOR, GPS).

Nondirectional – Functions in all directions.

Noodle – Navigation Display (ND) projected path; curving path based upon the aircraft bank angle and groundspeed used effectively to assist in course interception and making small adjustments to bank angle for proper roll out.

Nanoteslas (nT) – A unit of measurement of the strength of the magnetic field. Earth's strongest magnetic field is located at the poles, and the weakest field is near the equator.

Obstructions Display – Display of obstructions identified in the embedded obstruction database which are within 8.5 NM of the aircraft present position. Non-threatening obstructions are displayed by color to identify altitude relative to the aircraft's current altitude (amber [yellow] < 2000' below, light red < 500' below, bright red = at or above aircraft). Threatening obstructions, defined as those that pierce the TAWS envelope, are identified by highlight when producing a caution and identified by flashing highlight when producing a warning. The database used with the obstruction functions meets the integrity requirements of RTCA/DO-200A.

Omnibearing – Magnetic bearing of an omni-range station.

Offset – When referring to parallel track of an active flight plan, "offset" implies the distance paralleling the original track. When referring to

VNAV altitudes, "offset" refers to the distance before or after the waypoint the VNAV altitude must be reached.

Ownship – Principal eye-point; referring to icon of aircraft represented on display.

Pitch Limit Indicator – Appears when the aircraft is within 10 knots of stall speed, based on the VSI setting in the EFIS limits. The intent is to notify the pilot of a possible stall condition so corrective action is taken before the stall occurs. This function may be deselected by a setting in the IDU configuration (limits) file.

Q-Routes – Published RNAV routes, including Q-Routes and T-Routes, can be flight planned for use by the Genesys EFIS, subject to any limitations or requirements noted on enroute charts, in applicable advisory circulars, or by NOTAM. RNAV routes are depicted in blue on aeronautical charts and are identified by the letter "Q" or "T" followed by the airway number, e.g., Q35, T-205. Published RNAV routes are RNAV-2 except when specifically charted as RNAV-1.

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

Recency – State of occurrence, appearance, or origin.

Selection and Display of Selected Course – Omni-Bearing Select (OBS) function for the pilot to select the course for navigation. Selected course is displayed for reference.

Settable V-Speeds, Targets – The pilot may set certain V-speeds for reference during flight. In addition, the pilot may set certain information at any time for reference during flight, including target airspeed (with corresponding bug) and target altitude (with corresponding bug).

Side in Command – Side of aircraft control responsible for its operation.

Skipped Waypoint – A skipped waypoint is a waypoint associated with a dynamic termination leg with a zero length. These are either:

1) An altitude termination leg when current aircraft altitude is above the termination altitude; or

2) System-created (i.e., not NavData® specified) intercept to a "Course to a Fix" leg where there is insufficient distance to calculate an intercept heading.

Skyway VNAV/LNAV Guidance (Synthetic Vision) – Display of GPS-based active navigation route, flight plan, procedure, or OBS course in a three-dimensional series of skyway boxes. Also known as Highway in the Sky (HITS).

Slip Indicator – Display of aircraft lateral accelerations via an integral slip/skid indicator function. 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.

Strikefinder – Lightning detector system (WX-500) connected to EFIS and enabled through factory program settings.

Suppressed Waypoint – A suppressed waypoint (designated by brackets) is an airport associated with an IFR or VFR approach procedure.

Symbology – Use of symbols.

T-Routes – T-Routes are available for use by GPS or GPS/SBAS equipped aircraft from 1,200 feet above the surface (or in some instances higher) up to but not including 18.000 feet MSL. T-Routes are depicted on enroute low altitude charts and considered to include the same attributes of Low altitude airways in the Genesys Aerosystems EFIS declutter menus.

Talker – IDU providing data to external sensors and generating aural alerts. IDUs depend upon intra-system communications to determine which IDU on a side takes over "talker" responsibilities. Only one talker (transmit enabled) per side, two talkers in a two sided system, and a master talker PFD when considering aircraft limits. Any IDU may become a talker through auto reversionary means in the event of the PFD failing.

Terrain Display (PFD Artificial Horizon) – Conformal display of surrounding terrain presented with the artificial horizon, shown in the correct scale and perspective for the aircraft's current position and altitude. Includes conformal display of known runway locations, direction, scale, and perspective based on aircraft's current position and altitude.

Terrain Display and TAWS/HTAWS – Display of terrain, including identification and annunciation of threatening terrain in accordance with Terrain Awareness Warning System (TAWS) requirements.

Coloring scheme for SVS-TAWS PFD and MAP has been simplified as follows:

Non-alerting Terrain below aircraft – Olive Shades

Non-alerting terrain above aircraft – Brown Shades

TAWS FLTA Caution Terrain – Amber (Yellow)

TAWS FLTA Warning Terrain – Red

Obstacles Below aircraft – Amber (Yellow)

Obstacles above aircraft – Red

When over water – Deep Blue

Threatening terrain is determined by the requirements of TAWS TSO-C151b (fixed wing) and TSO-C194 HTAWS (Rotorcraft). Threatening terrain is shaded amber (yellow) for caution situations or shaded red for warning situations per TSO-C151b and TSO-C194. TAWS cautions and warnings are accompanied by an amber (yellow) or red flag and an aural annunciation. TAWS Class A, TAWS Class B, TAWS Class C, Enhanced HTAWS, or HTAWS functions may be activated in the system prior to installation. The database used with the TAWS functions meets the integrity requirements of RTCA/DO-200A.

Timer Indication – Pilot-selected function for a count-up or count-down timer.

Traffic Display – When integrated with an appropriate traffic system, traffic is shown using standard TCAS symbology showing relative position, altitude, climb/decent, and color. The pilot may also show traffic information by selecting the dedicated traffic display page.

Vertical Speed Display – Display of altitude rate of change (vertical speed or climb rate).

V_{PROC} (Procedure Speed) – The aircraft's normal speed (in airspeed units and configured in EFIS limits) for flying instrument approaches (DPs, IAPs, STARs). This value is used for calculating the turn radius used for instrument procedure legs. This speed is not seen on the airspeed tape and only found in the aircraft speed settings inside the limits.

Warning, Caution, and Advisory Flags – Display of, warning, caution, and advisory indications accompanied by aural indications. The flags are stacked in the lower left corner of the PFD. Warnings are always shown at the top of the flag stack, followed by cautions and then advisories. These flags remain in view for as long as the situation exists.

Waterline – Indication of the aircraft's longitudinal axis or waterline (attitude).

Wide Area Augmentation System (WAAS) – Developed by Federal Aviation Administration to provide accurate positioning part of the Satellite Based Augmentation System (SBAS). Other countries have similar systems: Europe: European Geostationary Overlay System (EGNOS); Japan: MTSAT Satellite-based Augmentation System (MSAS); India: GPS Aided GEO Augmented Navigation system (GAGAN).

Wind Information – Display of wind direction, wind speed, and cross wind component.

Zulu – Display of Zulu time (based on GPS data).

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