EVOLUTION
FLIGHT DISPLAY

EFD1000 PFD
Pilot's Guide

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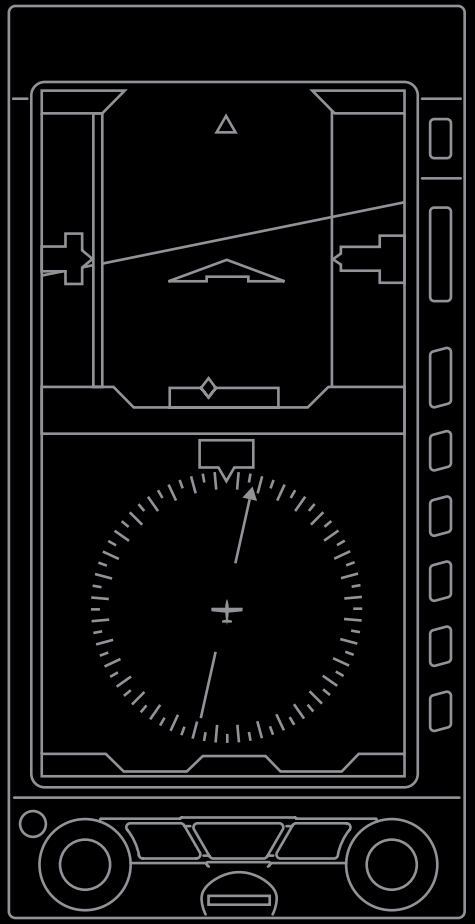

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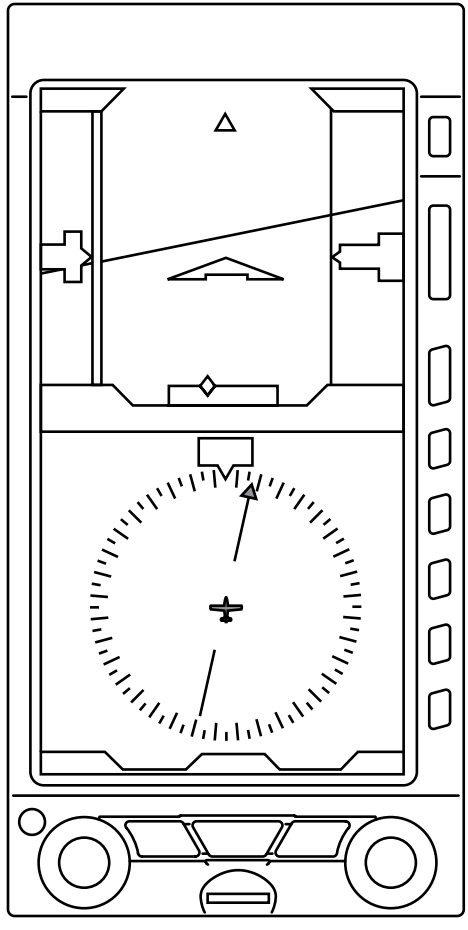

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Document Revisions

Revision	Description of Change
* Legacy P/N revision is displayed above the new CI number Revision	
A	Initial Release
B	Layout Update.
C* ( )	**Part number change: old part number A-01-184-00 REV C; new part number 091-00005-001 REV ( ). Grammatical, pictorial, and technical corrections and updates. Revised to update for software version 1.1, which include: • New start-up splash screen. • Failure message for RSM and Config Module link. • Brightness changes: • Auto brightness range 1% - 70% • Manual brightness range 1% - 100% • During internal battery operation, brightness capped at 40% for Auto mode and 70% for Manual mode. • When temperature is above ≥ 70° C, brightness capped at 30% for Auto mode and 70% for Manual mode. • Main Menu, System Status Page added Unit S/N. • Wind Speed and Direction Degrees do not display when: • When aircraft is on the ground. • When wind speed is ≤10. Additionally, the Wind Arrow does not display. Added Title page, Revision page and Index

A	Using new part number 091-00005-001 Grammatical, pictorial, and technical updates. Revised to update for software v2.0, including the following: • All images updated with v2.0 images. • Updated Color philosophy. • Annotate features unavailable in EFD1000 Pilot PFD. • Hot Key update. Main Menu update. • Added Altitude Trend Vector. • Added Minimums Marker. • Updated range settings; 2 and 3 nm, delete 2.5 nm. • Added ability to select Celsius or Fahrenheit units of measure for OAT. • Entire Emergency and Abnormal Procedures Chapter updated. • Added Map Auto Range. • Updated Vspeed configuration. • Added additional GPSS information. • Addition of Hazard Awareness options, WX-500/Lightning, Data Link Weather, Traffic.
B	Grammatical, pictorial, and technical updates. Added Index.

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Approvals

The FAA has approved the EFD1000 Pro PFD under the following TSOs:

TSO-C2d, TSO-C3d, TSO-C4c, TSO-C6d, TSO-C8d, TSO-C10b, TSO-C106, TSO-C113

The following certification levels also apply to this product:

- Environmental Certification Level: RTCA DO-160E
- Software Certification Level: RTCA DO-178B Level C

This Pilot's Guide provides information on the use and operation of the Evolution Flight Display 1000 Pro Primary Flight Display (EFD1000 Pro PFD). This guide is current as of the Date Published. Specifications and operational details are subject to change without notice when using an earlier or later software version. Please visit the Aspen Avionics web site for the most up-to-date Pilot's Guide.

Installation of the EFD1000 Pro PFD in a type-certificated aircraft must be performed in accordance with the latest revision of the Aspen Avionics EFD1000 Pro PFD Installation Manual, document number A-01-126-00 /

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Conventions

The following conventions, definitions, terminology, and colors are used in this manual and on the EFD1000 PFD.

Covered Functionality

This guide covers all the functionality available in the EFD1000 Pro PFD and EFD1000 Pilot PFD. Some functionality is unavailable in the EFD1000 Pilot PFD and is noted in the text. Additionally this guide covers optional Evolution Hazard Awareness functionality that is only available with the EFD1000 Pro PFD. See Aspen Avionics' document number 091-00006-001 *EFD1000/500 MFD Pilot's Guide* for complete instructions on the EFD1000 and EFD500 MFD.

Terminology

Figure 1 shows a typical EFD1000 Pro PFD display. This guide uses the terminology listed in **Table 1** when referring to specific parts of the EFD1000 Pro PFD. **Chapter 4** provides an in-depth discussion and step-by-step instructions for all the available functionality of the EFD1000 Pro PFD.

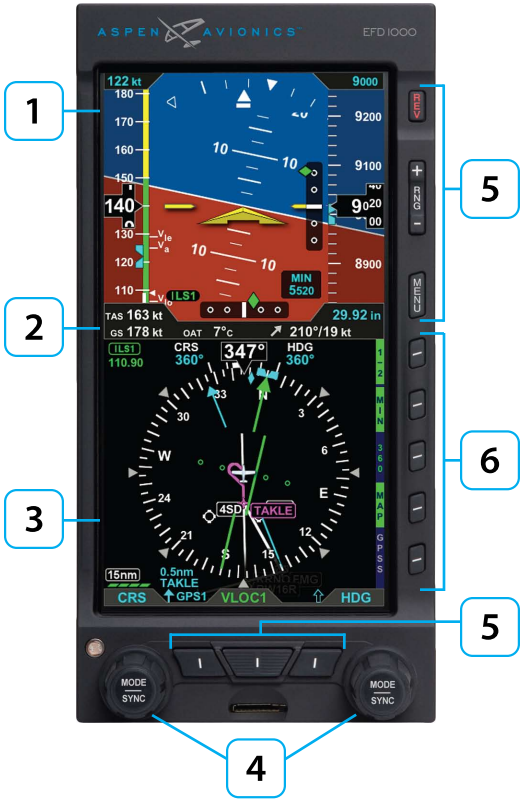

Figure 1 EFD1000 PFD Display, Knobs , Buttons, and Keys

Term		Example
1		Attitude Display
2		Data Bar
3		Navigation Display
4	Knobs	Left (CRS) Knob, Right (HDG) Knob
5	Buttons	Left Button, CDI Button, Right Button, REV Button, Range Buttons, MENU Button
6	Hot Keys Menu Keys	Five buttons on the lower right of the display

Table 1 EFD1000 PFD Display, Knobs , Buttons, and Keys

NOTE

As the number of colors used on the display is limited, to ensure adequate color differentiation under all lighting conditions, there are a few cases where a given color is used in a slightly different context than described in Table 2.

Color Philosophy

Table 2 provides the operational philosophy of color usage on the EFD1000 PFD display.

COLOR	PURPOSE	COLOR	PURPOSE
RED	Used to indicate flight envelope and system limits, and for warning annunciations that require immediate pilot recognition and which may require immediate pilot correction or compensatory action. Red is used to indicate Data Link Weather precipitation areas.	GREEN	Used for navigation information or mode data related to or provided by the navigation source currently selected for display on the Course Deviation Indicator (CDI) (i.e., navigation deviations, equipment operating state, waypoint information). Green is also used to indicate Data Link Weather precipitation areas and the status of user controls (i.e., ON, enabled, or active).
AMBER	Used to indicate abnormal information sources, and for caution information that requires immediate pilot awareness and for which subsequent pilot action may be required. Amber is used to indicate Data Link Weather precipitation areas.	WHITE	Used to show primary flight data (e.g., IAS, ALT, HDG), scales, and menu items that are selectable for editing.
MAGENTA	Used for pilot-selectable references (bugs) enabled for editing, for depicting the active GPS navigation leg on a moving map display, and for depicting the flight director bar.	GRAY	Used to show supplemental flight data, and for hotkey and menu legends that are OFF, disabled, or inactive.
CYAN	Used to indicate editable values that are not currently selected for editing. CYAN is also used to display bearing pointers, proximity and other traffic icons, and GPS track marker.	BLUE	Used to indicate the sky and Data Link Weather precipitation areas.
		BROWN	Used to indicate the ground.

Table 2 Color Guide

Warnings, Cautions, and Notes

Where applicable warnings, cautions, and notes are given. Aspen Avionics uses the following icons and definitions (**Table 3**).

Icon	Definition
Warning	Emphasizes a crucial operating or maintenance procedure, which, if not strictly observed, could result in injury to, or death of, personnel or long term health hazards. Indicates a hazard that may require immediate corrective action.
Caution	Indicates an essential operating or maintenance procedure, which, if not strictly observed, could result in damage to, or destruction of, equipment. Indicates the possible need for future corrective action.
Note	Highlights an important operating or maintenance procedure, condition, or statement. Safe operation.

Table 3 Warning, Caution, and Note

Example Graphics

The example graphics and screen shots used throughout this Pilot's Guide are provided for reference only and are taken from a simulated flight. They should not be used for actual flights.

Most of the example graphics and screen shots used throughout this Pilot's Guide & Reference are based on flying the ILS 16R instrument approach into Reno/Tahoe International Airport (KRNO) in Reno, Nevada, USA. Those images with the airplane in a right bank show the airplane completing the procedure turn in-bound to intercept the Localizer, descending through 8,660 feet to the target altitude of 8,500 feet. The other main group of images, showing the airplane straight and level, are earlier in the approach, tracking outbound for the procedure turn.

Pilot Familiarity

While the EFD1000 is reasonably intuitive and easy to use, some familiarity with Electronic Flight Instrument Systems (EFIS) and Horizontal Situation Indicators (HSI) is required. Aspen Avionics strongly recommends that new users of the EFD1000 get some dual instruction from an experienced instrument CFI, and spend some time becoming familiar with the PFD in day VFR conditions with a safety pilot, before flying in actual instrument meteorological conditions (IMC). To reduce pilot workload, the use of autopilot (when available) is strongly encouraged.

Information Covered in this Pilot's Guide

This Pilot's Guide covers all the features and options available on an EFD1000 Pro PFD. Because of individual configuration and options purchased, some features may not be available on your particular PFD (i.e., traffic or weather). Additionally, the EFD1000 Pilot PFD does not offer the following features:

- Horizontal Situation Indicator (HSI)
- Dual Bearing Pointers
- Lateral and Vertical Deviation Indicators
- Minimums
- GPS and VLOC Navigation ARINC 429 Interface
- GPSS
- Optional Traffic
- Optional Lightning
- Optional Weather

Chapter 1

Welcome and Introduction

Welcome to Aspen Avionics' Evolution Flight Display (EFD) system, the most flexible, expandable, and upgradable Electronic Flight Instrument System (EFIS) available for General Aviation aircraft. Designed to replace traditional mechanical primary flight instruments—in whole or in part, all at once, or in phases. This modularity and upgradability allows the system to grow with you and your airplane, over time and affordably.

The EFD system is built around the EFD1000 Display Unit, which replaces a vertical pair of your six primary flight instruments. The EFD1000 has a bright, high-resolution, six-inch diagonal LCD display, and a number of knobs and buttons the pilot uses to control the system. The three-inch diameter, four-inch deep can on the back of the display slides into existing panel cutouts (where the top mechanical instrument used to be) (**Figure 1-1**).

Figure 1-1
EFD1000 PFD Display Unit

Figure 1-2 Single Display EFD1000 PFD System

The center of the EFD system is the EFD1000 Primary Flight Display (PFD), which replaces the traditional mechanical Attitude Indicator (AI) and Directional Gyro (DG) or Horizontal Situation Indicator (HSI) (**Figure 1-2**). The PFD is available in three models—the Pilot, Pro, and ATP—each with increasing levels of features and capabilities, and each lower model is upgradable through software to the more capable models.

Figure 1-3 Dual Display System: PFD & MFD

Add a second EFD1000 configured as a Multi-Function Display (MFD) (**Figure 1-3**)**,** replacing the altimeter and Vertical Speed Indicator (VSI), and you'll double the capabilities of your system, while also providing complete redundancy and backup to your PFD. The EFD1000 MFD contains the same AHRS, ADC, and I/O capabilities as the PFD for full redundancy and can assume the role of the PFD should your main PFD ever fail.

You can even add another MFD, replacing the Airspeed Indicator (ASI) and turn coordinator, to round out a complete six-pack replacement and gain even more capability and flexibility (**Figure 1-4**). When you are ready to upgrade, simply contact an Aspen Avionics Authorized Dealer for more information.

Figure 1-4 Trio Display System: PFD & Dual MFDs

This Pilot's Guide covers the EFD1000 Pro PFD models. These systems are powerfully flexible, and can be configured in a variety of ways, depending on the other aircraft systems with which they are integrated.

NOTE

Please spend some time with your avionics installer to understand exactly how your PFD is installed and configured in your particular aircraft, to understand the features and capabilities available to you, and to understand how various aircraft system failures and abnormalities may affect your EFD1000 PFD.

NOTE

With multiple EFD installations, an independent, standby attitude indicator must be within the pilot's primary maximum field of view.

1.1. System Overview

The EFD1000 Pro PFD system typically consists of four components:

1. EFD1000 Display Unit
2. Configuration Module (CM)
3. Remote Sensor Module (RSM)
4. Analog Converter Unit (ACU)[1]

The ACU converts older analog signals and interfaces to the industry-standard digital ARINC 429 interface, which is the native language of the EFD1000. In some installations, generally when the aircraft is not equipped with an autopilot and has only digital GPS/nav/comms, the ACU may be omitted.

The system architecture in **Figure 1-5** shows the relationships of the PFD, RSM, Configuration Module and ACU.

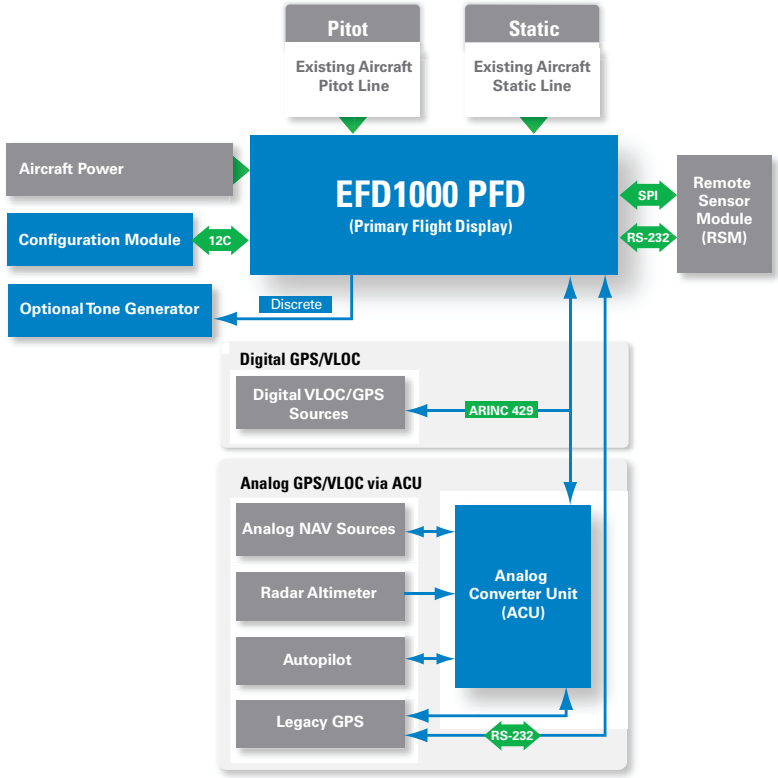

Figure 1-5 EFD 1000 System Architecture

1. Not included with the EFD1000 Pilot PFD.

1.1.1. **EFD1000 Display**

The EFD1000 display unit is a digital system that consists of a high resolution, six-inch diagonal color LCD display, user controls, photocell, and microSD data card slot. The three-inch diameter, four-inch deep can on the back of the display contains a non-removable electronics module that includes:

- A Sensor Board with solid-state Attitude and Heading Reference System (AHRS) and digital Air Data Computer (ADC)
- A Main Application Processor (MAP) board with Central Processing Unit (CPU), graphics processor and system memory
- An Input-Output Processor (IOP) board for integrating communications with other aircraft systems

Also on the rear of the unit (**Figure 1-6**) are:

- An access cover for removing and replacing the built-in backup battery
- Pneumatic connections to the aircraft's pitot and static systems
- 44-pin D-sub connector for electrical connections to the EFD1000
- A cooling fan, to cool the electronics and LCD backlights

The PFD mounts to the front surface of the instrument panel using the standard installation kit; an optional flush-mount installation kit is also available.

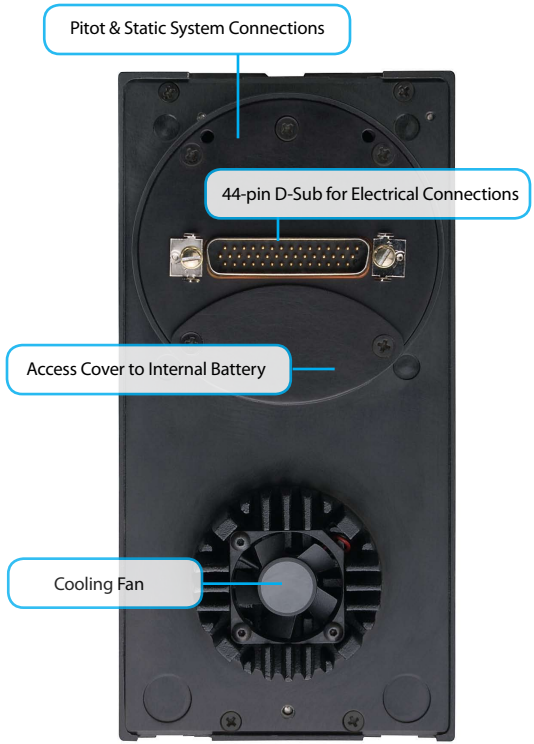

Figure 1-6 PFD Rear Connections

Figure 1-7 PFD Configuration Module (CM)

1.1.2. **Configuration Module (CM)**

The Configuration Module contains an EEPROM device that retains system configuration and calibration data and provides two primary functions:

- Retains aircraft-specific configuration information, calibration data, and user settings, allowing the PFD to be swapped for service purposes without re-entering or re-calibrating the installation
- Contains a license key that configures the PFD software features

The CM is typically attached to the wire bundle coming out of the D-sub connector on the display unit.

Figure 1-8 PFD Remote Sensor Module (RSM)

1.1.3. **Remote Sensor Module (RSM)**

The Remote Sensor Module (RSM) is an integral part of the EFD1000 system and works together with the display unit sensors as part of the AHRS and ADC. The RSM looks and mounts like a GPS antenna and is mounted on the exterior of the fuselage, typically aft of the cabin.

The RSM contains the following sub-systems:

- 3D magnetic flux (heading) sensors
- Outside Air Temperature (OAT) sensor
- Emergency backup GPS engine and antenna

The RSM communicates with the EFD1000 display unit via a digital cable connection.

1.1.4. **Analog Converter Unit (ACU)**

The Analog Converter Unit (ACU), included with most Pro PFD systems, enables the all-digital EFD1000 system to interface with analog avionics when required. The ACU converts multiple analog interfaces to the digital ARINC 429 buses supported by the PFD. Control parameters, such as desired heading, are also sent from the PFD to the ACU for conversion to analog format for autopilot support. The ACU is required when any of the following capabilities are required in a Pro PFD installation:

- Interface to supported autopilots
- Interface to conventional VHF navigation radios
- Interface to legacy (non-ARINC 429) GPS navigators
- Interface to supported radar altimeter decision height annunciations

If ARINC 429-based digital radios, such as the Garmin 400/500-series GPS/nav/comm radios, are installed in the aircraft, and no other aircraft interfaces are desired, the ACU is not required. The ACU is not used with the Pilot PFD.

Figure 1-9 PFD Analog Converter Unit (ACU)

NOTE

A single receiver will supply data to all EFD units installed on the aircraft.

1.1.5. **Evolution Weather Receiver (EWR50) and Antenna - Optional**

The optional Evolution Weather Receiver (EWR50) provides the ability to receive XM WX Satellite Weather data with a paid subscription to XM WX Satellite Weather. The EWR50 consists of a receiver and antenna. The EWR50 converts the XM WX Satellite Weather data into a digital format displayed on the EFD1000 Pro PFD **(Figure 1-10)**.

Figure 1-10
Evolution Weather Receiver (EWR) and Antenna - optional

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Chapter 2

Controls and Display

The EFD1000 Pro PFD is a flat-panel LCD primary flight instrument that presents the pilot on a single display with all the information delivered by the traditional six-pack of mechanical instruments: Airspeed, Attitude, Altitude, Turn Coordinator, Heading Indicator (or HSI) and Vertical Speed Indicator (VSI). Modern technology and standard EFIS symbology enable the consolidation of all six instruments into a single display, tightening the pilot's instrument scan and reducing pilot workload.

The Pro PFD is a single vertical instrument that replaces the existing Attitude Indicator and Heading Indicator/HSI. The display is divided into three parts: an upper Attitude Display, a lower Navigation Display, and a Data Bar in the middle of the upper and lower halves. The Attitude and Navigation displays are highly customizable — from stripped-down, minimalist presentations, to dense, information-rich displays — depending on pilot preference and phase of flight.

This Chapter gives an overview of all the instruments, information, and controls of the EFD1000 Pro PFD. The next two pages show and identify each element of the display and each control with a Reference (Ref.) number and description. Throughout this section, notes like **(Ref. 27)** refer to **Table 2-1** and **Figure 2-2**. For more detailed information on any specific part, see the **Reference Guide, Chapter 4**.

Figure 2-1
EFD1000 Actual Display

2.1. **Controls & Display Orientation**

CONTROLS		
1	Reversion and Power Button	
2	Range Button	
3	Menu Button	
4	1/2 Hot Key Menu 1 of 2	2/2 Hot Key Menu 2 of 2[1]
5	MIN - Minimums On/Off	LTNG – Data link Lightning Overlay On/Off STRK – WX-500 Strikes Overlay CELL – WX-500 Cells Overlay
6	360/ARC - HSI View	NXRD – Data link Weather Overlay On/Off
7	MAP - Map Declutter	TRFC – Traffic Overlay On/OFF
8	GPSS - GPS Steering On/Off	ABV/BLW/NRM/UNR – Traffic Filter (only available when TRFC is On)
9	Right Knob	
10	Double-Line Bearing Pointer Source Select	
11	CDI Source Select	
12	Single-Line Bearing Pointer Source Select	
13	Left Knob	
14	Automatic Dimming Photocell	
15	microSD Card Slot	

ATTITUDE DISPLAY	
16	Attitude Display
17	Aircraft Symbol
18	Single-Cue Flight Director[2, 4]
19	Roll Pointer
20	Slip/Skid Indicator
21	Altitude Tape
22	Selected Altitude Field
23	Altitude Alert
24	Altitude Drum/Pointer
25	Altitude Trend Vector
26	Altitude Bug
27	Decision Height Annunciation[3, 4]
28	Selected Minimums Field[4]
29	MINIMUMS annunication[4]
30	MINIMUMS Marker[4]
31	LDI Navigation Source Indication[4]
32	Airspeed Indicator Tape
33	Selected Airspeed Field
34	Airspeed Bug
35	Airspeed Drum/Pointer
36	Vertical Deviation Indicator[4]
37	Lateral Deviation Indicator[4]

DATABAR	
38	True Airspeed (TAS)
39	Barometric Pressure Setting Field
40	Wind Direction and Speed
41	Wind Direction Arrow
42	Outside Air Temperature (OAT)
43	Ground Speed (GS)
NAVIGATION DISPLAY	
44	Navigation Display
45	Ownship Symbol
46	Course Pointer[4]
47	TO/FROM Indicator[4]
48	Rate of Turn Indicator[4]
49	Track Marker
50	Magnetic Heading
51	Selected Course (CRS) Field[4]
52	Selected Heading Field
53	Heading Bug
54	Course Deviation Scale[4]
55	Course Deviation Indicator[4]
56	Vertical Speed Digital Value
57	Vertical Speed Tape
58	Single-Line Bearing Pointer[4]
59	Single-Line Bearing Pointer Source[4]
60	Single-Line Source Info Block[4]
61	Double-Line Bearing Pointer[4]
62	Double-Line Bearing Pointer Source[4]
63	Double-Line Source Info Block[4]
64	CDI Navigation Source[4]
65	CDI Source Information Block[4]
66	Left Knob State
67	Right Knob State
68	Hot Key Legend

Table 2-1 EFD1000 Pro PFD Components

1. The Hot Key menu 2/2 is only available when the EFD1000 Pro PFD is configured with the optional Hazard Awareness option and the associated sensor(s)..
2. With compatible autopilots.
3. With compatible radar altimeters.
4. Unavailable on EFD1000 Pilot PFD.

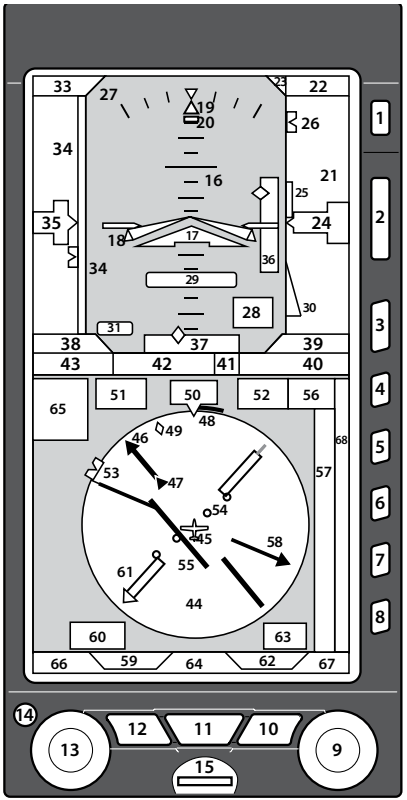

Figure 2-2
EFD1000 Display Elements

2.2. **Controls**

The primary means for the pilot to control the EFD1000 are the two knobs and three buttons at the bottom of the display. The knobs control setting CRS and HDG, and additional bugs and altitude settings. The three buttons control selection of navigation sources for the CDI and bearing pointers.

Additionally, five Hot Keys to the right of the Navigation Display toggle various features on and off. The function of each is indicated by the label on the screen to the left of each button. Three additional buttons above the Hot Keys control entering and exiting the Main Menu, setting the Map range, and reversion or manual power control.

2.2.1. **Left and Right Knobs**

The Left and Right Knobs are both of the push and rotate type. Pressing the knob activates it for control, and subsequent presses cycle through its available control functions in a round-robin sequence.

Each knob has an inactive home state to which it returns automatically after 10 seconds of inactivity. The inactive state is designed to prevent inadvertent adjustment of a setting. The Left Knob Home state is CRS (IAS on the Pilot PFD), and the Right Knob Home state is HDG. A single push of the knob activates the Home state (CRS or HDG) for editing.

To change an available setting, repeatedly press the appropriate knob until the desired function appears in magenta above the knob (the setting you are changing will also appear in magenta on the display). With a little practice, you'll soon know exactly how many presses it takes from the Home state to get to what you want to set.

When the function you want to set is shown in magenta, dial the knob left or right to set the desired value, or press and hold the knob to synchronize (SYNC) the setting.

NOTE

The Pilot PFD Navigation Display has a slaved Directional Gyro instead of an HSI. It does not display any Course Poiner, Course Deviation Indicator, or Bearing Pointers. The Pilot PFD also does not include an approach minimums (MIN) setting. Therefore, those knob functions are unavailable on the Pilot PFD.

Once set, you can either press the knob again to advance to the next function you'd like to set, or you can do nothing, and in 10 seconds the knob will return to its home state (CRS or HDG).

2.2.1.1. **Right Knob Functions**

The Right Knob home state is Heading (HDG). The Right Knob is also used to set the Altitude Alerter selected altitude (ALT), barometric pressure (BARO), and instrument approach minimums (MIN). Successive presses of the Right Knob will cycle through HDG-ALT-BARO-MIN in a round-robin sequence.

From the inactive Home state (HDG shown in cyan above the Right Knob):

- Press once to set the heading bug (HDG) (**Refs. 52 and 53**)
- Press twice to set target altitude (ALT) (**Refs. 22 and 26**)
- Press three times to set barometric pressure (BARO) (**Ref. 39**)
- Press four times to set approach minimums (MIN) (**Ref. 28**) (Unavailable on Pilot PFD)

NOTE

*MIN will only be shown if the MIN function is already active (the MIN label by the second Hot Key (**Ref. 5**) is shown in green, and the MIN value is shown on the Attitude Display (**Ref. 28**)). If the MIN function is inactive (label in gray), pressing the MIN Hot Key will both activate the function and immediately make it available for editing.*

2.2.1.2. **Left Knob Functions**

The Left Knob home state is Course (CRS). The Left Knob is also used to set the Airspeed Bug (IAS).

From the inactive Home state (CRS shown in cyan above the Left Knob):

- Press once to set the course (CRS) (**Refs. 46 and 51** and see note at right about Auto Course)
- Press twice to set the airspeed bug (IAS) (**Refs. 33 and 34**)

NOTE

*When the CDI navigation source is selected to a GPS receiver, and Auto Course is enabled in the Main Menu (see **Section 4.3.6**), the course is set automatically by the GPS and is not pilot-adjustable. This case will be indicated by the CRS field and Knob label being shown in Green with an inverse "A". In this case, pressing the Left Knob will enable you to set only the airspeed bug (IAS).*

Figure 2-3
Left and Right Knobs and
Corresponding Fields

2.2.1.3. **SYNC Function**

Knob SYNC Function (Figure 2-3)

1. Repeatedly press the Knob until the Knob label shows the value you want to set in magenta.
2. Press and hold the Knob for approximately one (1) second to synchronize the setting according to the rules shown in **Table 2-2**.
3. After 10 seconds of inaction, the knob reverts to its Home state (CRS or HDG), and the labels and field are shown in cyan (inactive).

Right Knob		
	SYNC Action	
1	ALT	Bug and alerter are set to the current altitude.
2	MIN	Set to the current altitude.
3	BARO	Set to 29.92 InHg or 1013 mB.
4	HDG	Set to the current heading.
5	Right Knob - Current Field Label [HDG] (Cyan indicates field is inactive.)	

Left Knob			
	SYNC Action		
6	IAS	Set to the current Indicated Airspeed.	
7	CRS	VOR navigation	Set to the reciprocal value of the current VOR radial. The deviation bar centers with a "TO" indication.
		ILS navigation	Current aircraft heading.
		GPS	Set to equal the bearing to the GPS active waypoint. The deviation bar centers with a "TO" indication. (AUTOCRS must be disabled.)
		GPS AUTOCRS enabled	No effect.
8	Left Knob - Current Field Label [CRS] (Cyan indicates field is inactive; green with inverse A indicates Auto Course is enabled.)		

Table 2-2 Left and Right Knob Sync Description

Figure 2-4
Activating the HDG field to edit

Figure 2-5
Editing the HDG field

Figure 2-6
HDG field updated and inactive

2.2.1.4. **Using the Knobs (Example)**

How to Set the Heading Bug (HDG)

1. From the Home state (at least 10 seconds since last using the Right Knob), press the Right Knob once to select HDG for editing. The Knob label (HDG), the Heading Bug, and the Selected Heading field will all turn magenta (**Figure 2-4**).
2. Rotate the Knob to the desired heading value, shown both by the position of the Heading Bug and the numeric value in the Selected Heading field (**Figure 2-5**).
3. After 10 seconds of inaction, the knob reverts to its Home state (HDG), and the Heading Bug and Selected Heading field value are shown in cyan (inactive) (**Figure 2-6**).

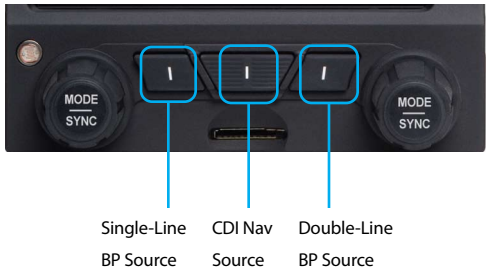

Figure 2-7
CDI and Bearing Pointer Source Select Button

2.2.2. **Navigation Source Select Buttons**

The three buttons on the bottom of the EFD1000 PFD allow the pilot to select the navigation source for the CDI and Bearing Pointers (**Figure 2-7**). See **Section 4.3** for detailed information on the CDI and Bearing Pointers.

2.2.2.1. **CDI Nav Source Select Button**

The lower center button (see **Figure 2-7**) is the CDI Nav Source Select Button. It selects which of the available navigation sources will couple to the CDI, which in turn couples to the autopilot (if available). Each press of the CDI Nav Source button selects the next available nav source, cycling through all available sources in a round-robin sequence. The currently coupled CDI nav source is displayed directly above the CDI Nav Source Select Button.

The available nav sources are configured when the EFD1000 is installed (depending on what is installed in the aircraft and connected to the EFD1000). The available nav source choices are: GPS1, GPS2, VLOC1, and VLOC2.

If a nav source is configured to be available, but is not currently putting out valid navigation data, its identifier will be shown with a red slash through it, and the CDI bar will not be shown with the Course Pointer. The pilot will be able to select that invalid source, but no navigation data will be provided.

When one or more of the connected nav sources is a combined GPS/Nav device (e.g., some of the Garmin 400/500-series), the list of nav sources available for selection will be determined by the current CDI mode of that navigator.

NOTE

The Pilot PFD does not display any CDI or Bearing Pointers. Its center CDI Nav Source Select Button is used only to select which connected GPS source (GPS1 or GPS2) is used for display of GPS flight plan legs and waypoints and the base map.

NOTE

When GPS is selected as the nav source, but no active waypoint is programmed in the GPS navigator, that source will be shown as invalid until an active flight plan or direct-to waypoint is programmed into the GPS.

NOTE

For example, with a Garmin GNS-430 installed as the #1 navigation source, if "GPS" is shown immediately above the CDI Button on the GNS-430, then the EFD1000 will show GPS1 as an available nav source. If the pilot presses the CDI Button on the GNS-430 so that VLOC is now displayed on the GNS-430, then the EFD1000 will show VLOC1 as the available nav source, and GPS1 cannot be selected.

2.2.2.2. **Bearing Pointer Source Select Buttons**

The lower two right and left buttons are the Bearing Pointer Nav Source Select Buttons (see **Figure 2-7**). The left button controls BRG1 (the single-line bearing pointer) and the right button controls BRG2 (the double-line bearing pointer). Each button controls which nav source is coupled to the respective bearing pointer.

The bearing pointers act like a conventional RMI (Radio Magnetic Indicator): the needle points to the station. Unlike a conventional RMI, EFD1000 bearing pointers can also point to the active waypoint of a GPS navigator, whether that is a VOR, NDB, airport, intersection, or missed approach point.

Each bearing pointer can be coupled to any of the available navigation sources: GPS1, GPS2, VLOC1, or VLOC2 (depending on configuration), or to none. Each press of the Bearing Pointer Nav Source Select Button selects the next available nav source, cycling through all available nav sources and none, in a round-robin sequence. The currently coupled nav source is displayed directly above the Select Button; blank indicates that no nav source is selected, and the bearing pointer is not displayed.

If the selected nav source is a valid choice, but no usable nav data is being received (e.g., the VOR station is out of range, or the VLOC is tuned to a localizer frequency), the bearing pointer will not be displayed.

2.2.3. **Hot Keys**

The five buttons along the lower right side of the EFD1000 PFD function as either single-action Hot Keys (**Figure 2-8** and **2-9**) for frequently used commands or as Menu selection keys when the Main Menu has been activated.

Hot Key functions are accessible anytime, except when the Menu is active. Each Hot Key provides instant access to the assigned command as listed in **Table 2-3**. Each press of a Hot Key toggles between the settings that key controls. Most Hot Keys are either ON, with a green label, or OFF, with a gray label. The ARC/360 and the Traffic Filter Hot Key labels indicate which mode is currently active on the Navigation Display.

The MAP Hot Key displays the GPS flight plan, legs, waypoints, and base map on the Navigation Display, with one of five levels of declutter. Pressing the MAP key continuously cycles through the available declutter settings. When the MAP is turned off, or is unavailable, the label is gray.

NOTE

When an EFD1000 Pro PFD is configured with the Evolution Hazard Awareness option, there are two levels of Hot Keys, indicated by the first Hot Key label 1/2 or 2/2. The second level provides access to Hazard Awareness overlays as described in **Section 4.7. Hazard Awareness** *(EFD1000 Pro PFD Only).*

NOTE

The Traffic Filter Hot Key is blank when traffic is off.

Figure 2-8
Hot Key Menu 1 of 2

Hot Key		DESCRIPTION	OPTIONS	
1	1/2	Hot Key Menu selection	1/2	Hot Key Menu 1 of 2
			2/2	Hot Key Menu 2 of 25
2	MIN	Enables and displays, or disables and hides, Minimums Alerter[1] (see **Section 4.1.3.4**)	MIN	Minimums displayed and alerter enabled[2]
			MIN	Minimums alerter disabled
3	ARC/ 360	Toggles between 360 and ARC modes of Navigation Display (see **Section 4.3.1**)	ARC	ARC Compass Mode
			360	360° Compass Mode
4	MAP	Selects Map display and feature level[3] (see **Section 4.3.12.1**)	MAP	High (**Figure 2-10**)
			MAP	Medium High (**Figure 2-11**)
			MAP	Medium (**Figure 2-12**)
			MAP	Low (**Figure 2-13**)
			MAP	Off (**Figure 2-14**)
5	GPSS[1]	Toggles between GPS Steering (GPSS) Mode and HDG mode for Autopilot/Flight Director[4] (see **Section 4.6.1**)	GPSS	GPSS On
			GPSS	GPSS Off, HDG mode active
6	2/2	Hot Key Menu selection	2/2	Hot Key Menu 2 of 2[5]
			1/2	Hot Key Menu 1 of 2

Figure 2-10
Map Level HIGH

Figure 2-11
Map Level MEDIUM/HIGH

Figure 2-12
Map Level MEDIUM/LOW

Figure 2-13
Map Level LOW

Figure 2-14
Map Level OFF

Hot Key		DESCRIPTION	OPTIONS	
7	LTNG	Toggles between different lightning overlay options (see **Section 4.7.1. Lightning Underlay**).	LTNG	Data link Lightning Overlay ON
			STRK	WX-500 Strike Overlay ON
			CELL	WX-500 Cell Overlay ON
			LTNG	All Lightning OFF
8	NXRD	Displays data link weather and radar coverage overlay (see **Section 4.7.2. Data Link Weather Underlay**).	NXRD	NEXRAD Overlay ON
			NXRD	NEXRAD Overlay OFF
9	TRFC	Displays traffic overlay (see **Section 4.7.3. Traffic Overlay**).	TRFC	Traffic Overlay ON
			TRFC	Traffic Overlay OFF
10	ABV[6]	Selects Altitude Filter for Traffic (see **Section 4.7.3. Traffic Overlay**).	ABV	Above Filter
			BLW	Below Filter
			NRM	Normal Filter
			UNR	Unrestricted (no filtering)

Table 2-3 Hot Key Description

Figure 2-9
Hot Key Menu 2 of 2

1. Available only in those installations where the original airspeed indicator and altimeter remain in their primary flight instrument positions.
2. When Minimums display and alerting is initially enabled, the minimums value is immediately selected for editing.
3. Flight plan legs and waypoints display available in all installations including a GPS navigator. Base map display of nearby waypoints available with all ARINC 429 GPS navigators and some RS-232 GPS navigators.
4. GPSS available only with ARINC 429-based navigators.
5. Hazard awareness overlays are available only on EFD1000 Pro PFD when Evolution Hazard Awareness (EHA) option and compatible hazard awareness sensors are installed. Hot Key is blank when function is unavailable.Optional Hazard Awareness Overlays. Only available with EFD1000 Pro PFD. Hot Key is blank when unavailable.
6. The traffic filter Hot Key is blank when the traffic overlay is off.

2.2.4. **Main Menu**

The MENU Button is used to access the EFD1000 PFD's Main Menu to change options, and also to change the EFD1000's LCD brightness controls.

2.2.4.1. **Using the Menus**

Press the MENU Button to activate the Main Menu (**Ref. 3**). The current menu page name displays on the bottom center of the Navigation Display. Directly below the menu page name is a segmented menu page bar, giving a graphical representation of the current page relative to the total number of menu pages. The current menu page number displays in the lower right of the Navigation Display.

Menu Page 1, General Settings A, is the one most commonly used in flight. It enables the pilot to enable or disable AUTO COURSE SELECT mode, to display or hide the Vspeeds on the airspeed tape, and to choose the type of CDI display for ARC mode. The other menu pages are used for baro and OAT unit settings, auto range, Vspeed and map customization, abnormal power management, product version information, and information and option settings, depending on the specific equippement and options configured in your installation.

The Main Menu operates either in Navigation or Edit mode, as indicated by the label directly above the Right Knob. When the MENU Button is first pressed, the Main Menu is in Navigation mode, indicated by the magenta label SEL PAGE directly above the Right Knob **(Figure 2-15)**. When in Navigation mode, rotating the Right Knob navigates through the menu pages. Rotate the Right Knob clockwise to advance to the next menu page. Rotate the Right Knob counterclockwise to return to previous menu page.

Figure 2-15
Menu Navigation Mode

Each menu page displays up to five selectable options, each adjacent to one of the five Hot Keys (which double as Menu Keys when the Main Menu is active). After navigating to the menu page containing the option you want to change, press the Menu Key adjacent to that option label, which initiates the menu's Edit mode. When the Menu is in Edit mode, the label EDIT VALUE displays above the Right Knob in magenta (**Figure 2-16**), and the label of the item selected for editing is also shown in magenta. Rotate the Right Knob to change the value of the selected item. When done, either select another displayed option to change , or push the Right Knob to exit Edit mode and return to Navigation mode to select another menu page.

When you are finished changing menu options, press the MENU Button again to exit the Main Menu (**Figure 2-17**).

Figure 2-16
Menu Edit Mode

1. Menu
2. Menu Page number and mode (Navigation mode shown)
3. Menu Page Name
4. Menu Page graphical bar
5. Brightness Control (see **Section 2.2.4.2**)

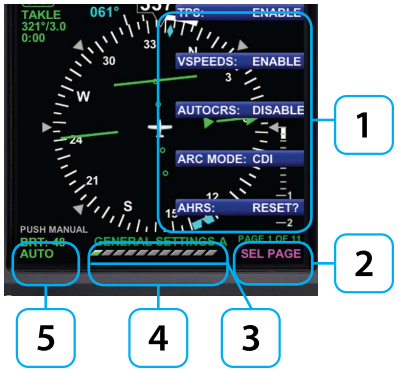

Figure 2-17
Main Menu

Figure 2-18
Menu Text - Editable

Figure 2-19
Menu Text - Enabled

Figure 2-20
Menu Text - Status Only

Figure 2-21
Menu Text - Disabled

Figure 2-22
Menu Display

The menu text will display in one of the four colors listed and described in **Table 2-4**.

DISPLAY TEXT	DESCRIPTION	DISPLAY
WHITE	Editable option	See **Figure 2-18**
MAGENTA	Editable option enabled	See **Figure 2-19**
GREEN	Non-Editable or Status Only	See **Figure 2-20**
GRAY	Disabled	See **Figure 2-21**

Table 2-4 Menu Text

NOTE

These steps are provided as a basic overview. Each menu command is covered in detail in **Chapter 5**.

Access and Navigate the Main Menu

1. Push the MENU Button. The Menu displays on the Navigation Display adjacent to the Hot Keys (**Figure 2-22**).
2. Rotate the Right Knob to navigate through the different pages of the menu. Rotating the Right Knob clockwise advances forward one menu page at a time. Rotating the Right Knob counterclockwise advances backward one menu page at a time.
3. When finished, press the MENU Button to exit the Main Menu.

Edit Main Menu Items

1. Access the Main Menu.
2. Navigate to the desired menu page.
3. Push the Menu Key of the desired option. The menu label turns magenta, and the EDIT VALUE label displays above the Right Knob (**Figure 2-23**).
4. Rotate the Right Knob to the desired value.
5. Push the Right Knob to return to menu navigation mode.
6. Push the MENU Button to exit the Main Menu.

NOTE

Pressing the Right Knob returns to navigation mode and allows selection of other menu options on different pages. Pressing another menu key on the current menu page saves any changes made and activates the newly selected option for editing.

Figure 2-23
EDIT VALUE Displays Above Right Knob

NOTE

Upon reaching the end of a list of editable menu options, continued rotation of the knob will not result in the continuous wrapping through the available editable menu options. Spinning the knob fully clockwise will go to the last menu page, while spinning the knob fully counterclockwise will go to the first menu page.

Figure 2-24
Display Brightness in BRT AUTO Mode

Figure 2-25
Display Brightness in BRT ADJUST Mode

2.2.4.2. **Display Lighting**

When the MENU Button is pressed and the Main Menu is active, the Left Knob can be used to adjust the EFD1000 display brightness.

By default, the LCD brightness operates in AUTO mode, and is adjusted based on photocell sensing of ambient lighting conditions. When the MENU is active and the LCD is in AUTO, the word AUTO and a brightness level of 1-100 will be displayed in green above the Left Knob.

To override the AUTO brightness setting, press the Left Knob once to switch into Manual mode, and then rotate the Left Knob to set the brightness to the desired level. To return to AUTO brightness control, press the Left Knob again.

LCD MODE	DESCRIPTION	DISPLAY
Automatic BRT AUTO	LCD backlight intensity is automatically adjusted based on the current light conditions sensed by the Automatic Dimming Photocell. The maximum intensity in Automatic mode is 70%.	See **Figure 2-24**
Manual BRT ADJUST	Allows the pilot to adjust the LCD backlight intensity manually, from 1–100%.	See **Figure 2-25**

Table 2-5 Brightness Control

NOTE

The AUTO display brightness setting is determined by the amount of light detected by the photocell on the front of the unit. If you use a light to illuminate the instrument panel, the photocell will respond, resulting in a bright display. When this happens, use the MANUAL brightness setting to select a dimmer display setting.

2.2.5. **Range Button**

When the MAP is enabled, the RNG (Range) button is used to zoom in or out in scale to display more or less of the map. The map range available depends on the VIEW. Press the top or (+) of the RNG Button to increase map range. Press the bottom or (–) of the RNG Button to decrease map range. Additionally an Auto Range feature is available.

Pressing and holding either the (+) or (-) of the RNG Button will cause the map range to scale continuously to its maximum or minimum range, respectively. When the map range is at its maximum or minimum setting, pressing and holding the RNG Button again will activate Auto Range mode (see **Section 4.3.12.1.** for complete detail).

2.2.6. **REV Button**

The red REV button on the PFD can be used to override automatic power control in abnormal or emergency situations. See **Chapter 6** for more details. In multi-display EFD1000 systems, the REV button activates Reversionary mode on an EFD1000 MFD, providing backup should the PFD fail.

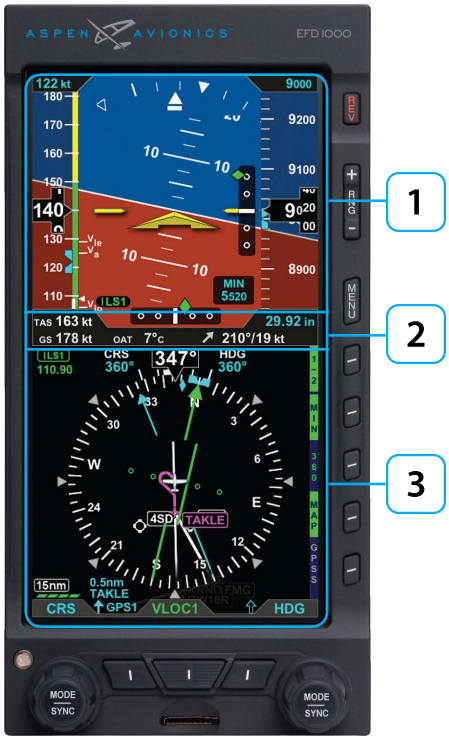

Figure 2-26
EFD1000 Pro PFD Display Areas

2.3. **Display**

The EFD1000 PFD replaces the existing Attitude Indicator and HSI or DG in the center of the primary flight instrument cluster. Like the instruments it replaces, the top half presents an Attitude Display and the bottom half presents a Navigation Display (**Figure 2-26**). Between the two halves is a Data Bar, which presents a dedicated display of real-time winds and temperatures, as well as True Airspeed (TAS) and GPS Ground Speed (GS).

1	Attitude Display
2	Databar
3	Navigation Display

Unlike the mechanical indicators it typically replaces, EFD1000 PFD can also display all the data provided by the remaining four instruments in the six pack (airspeed, altitude, turn and slip, and vertical speed), and much more. Concentrating all primary flight information onto a single instrument directly in front of the pilot improves instrument scan and reduces pilot workload, thereby enhancing safety, especially in busy phases of flight. Additionally, analog backup instruments remain in the pilot's primary field of view, and should be included in the instrument scan to cross-check indications of both the primary (EFIS) and backup (analog) instruments.

The EFD1000 PFD generally follows standard display conventions for Electronic Flight Instrument Systems (EFIS), so a pilot with some experience and familiarity with other EFIS PFDs will usually transition quickly to using the EFD1000. Pilots for whom the

EFD1000 PFD is their first real exposure to EFIS and glass cockpit flying, however, should get some in-flight transition training from a certified instrument flight instructor (CFII) with EFIS experience. Pilots are also encouraged to study some of the excellent publications now available to help the transition from analog to EFIS instrument flying, including the FAA's latest versions of the *Instrument Flying Handbook*.

This section gives an overview of the main display elements and features. For more detail, see the **Reference Guide, Chapter 4**.

2.3.1. Cleaning the Display Screen

The EFD1000 PFD display is an LCD screen that is prone to damage from scratches, smudging, and clouding caused by the use of improper cleaning agents and harsh cloths. Use care when cleaning, using the following tips:

- Only clean the display when the unit is off.
- Use a clean, soft, lint-free cloth dampened with a 50/50 solution of isopropyl alcohol and water, a pre-moistened lens cleaning tissue, such as Bausch & Lomb Sight Savers®, or a cleaning solution made especially for LCD displays.
- Never spray any cleaning solutions directly onto the screen; spray it into the cleaning cloth.
- Gently wipe the screen in a circular motion. Do not press hard on the cloth.
- Remove all excess moisture to prevent damage of the EFD1000 Pro PFD display.
- The EFD1000 Pro PFD display should be dry before powering the unit on.

NOTE

Use caution when using isopropyl alcohol as it is flammable. Using any other chemicals or materials voids the warranty.

2.3.2. **Attitude Display**

The Attitude Display includes an Attitude Director Indicator (ADI) with single-cue Flight Director command V-bars (when connected to a compatible autopilot), an Airspeed tape, an Altimeter tape, an Altitude Alerter (with separate minimums alerting), and Instrument Approach indicators (**Table 2-6** and **Figure 2-27**). For more details on each, see the **Reference Guide, Chapter 4**.

The Airspeed and Altitude tapes are the most obvious differences from a mechanical ADI. These tapes are common on most EFIS PFDs and will be immediately familiar to pilots with EFIS experience. Pilots without prior EFIS experience may need some time, experience, and training to get comfortable using the Airspeed and Altimeter tapes as their primary references.

In single-display EFD1000 PFD installations, where the mechanical airspeed indicator and altimeter remain in their original locations, transitioning pilots can use either their familiar mechanical instruments or the PFD tapes for airspeed and altitude references. Many pilots new to EFIS quickly find themselves relying on the tapes within a flight or two. If the tapes prove distracting at any time, however, the pilot can remove them from the display by disabling them from Main Menu page 1, GENERAL SETTINGS A (single display installations only).

ATTITUDE DISPLAY			
16	Attitude Display	27	Decision Height Annunciation[1, 2]
17	Aircraft Symbol	28	Selected Minimums Field[2]
18	Single-Cue Flight Director[1, 2]	29	MINIMUMS Annunciation[2]
19	Roll Pointer	30	MINIMUMS Marker[2]
20	Slip/Skid Indicator	31	LDI Navigation Source Indication[2]
21	Altitude Tape	32	Airspeed Indicator Tape
22	Selected Altitude Field	33	Selected Airspeed Field
23	Altitude Alert	34	Airspeed Bug
24	Altitude Drum/Pointer	35	Airspeed Drum/Pointer
25	Altitude Trend Vector	36	Vertical Deviation Indicator[2]
26	Altitude Bug	37	Lateral Deviation Indicator[2]

Table 2-6 Attitude Display Components

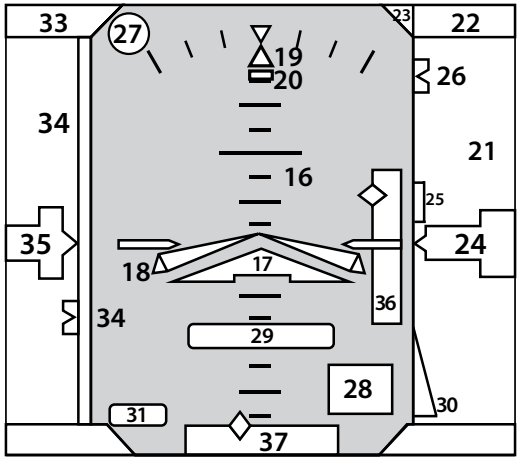

Figure 2-27
Attitude Display Components

1. With compatible autopilots.
2. Unavailable on EFD1000 Pilot PFD

2.3.2.1. **Attitude Director Indicator (ADI)**

The Attitude Director Indicator (ADI) features a conventional blue (sky) over brown (ground) background, with a white horizon line dividing the two areas. A triangular aircraft reference symbol (**Ref. 17**) is in a fixed position and shows aircraft attitude relative to the horizon.

The pitch scale (or ladder) indicates degrees of nose up (blue) or nose down (brown) pitch relative to the apex of the aircraft symbol. Minor pitch marks are shown every 2.5º up to +/-20º of pitch, with major pitch marks every 10º up to +/-90º of pitch. The distance between pitch marks is greater than on most mechanical attitude indicators, making it easier for the pilot to fly more precise pitch attitudes.

At extreme pitch attitudes (above 15º nose up or below 10º nose down), red Unusual Attitude Recovery chevrons come into view, pointing towards the horizon or ground as applicable (see **Section 4.1.1.2. Pitch Scale**). At extreme pitch attitudes, some sky (blue) or ground (brown) will always be displayed to help maintain situational awareness, even though the horizon line may be off-scale.

At the top of the ADI are the roll scale, roll pointer, and slip/skid indicator (**Figure 2-28**). The roll scale is indicated by tick marks at 10º, 20º, 30º, 45º, and 60º on both sides of the zero roll inverted solid white triangle. The 45º marks are represented as hollow triangles.

Slip/skid is indicated by the lateral position of the white rectangle under the roll pointer. One rectangle width is equivalent to one ball width of a conventional inclinometer.

When connected to a compatible autopilot system, the EFD1000 Pro PFD will display a single-cue Flight Director (**Figure 2-29**). The Flight Director command bars visually represent the lateral and vertical steering cues transmitted to the PFD by the autopilot. When the FD output from the autopilot is unavailable or flagged invalid, the FD command bars are removed from the display.

Figure 2-28
Slip/Skid

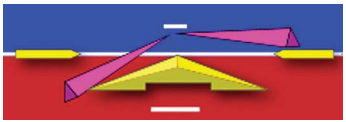

Figure 2-29
Flight Director

2.3.2.2. **Airspeed Tape and Bug**

Airspeed is indicated by a moving airspeed tape against a fixed position airspeed pointer, shown on the left-hand side of the Attitude Display (**Figure 2-30**). A digital, rolling drum readout indicating airspeed values to the closest one knot or mile per hour is provided adjacent to the fixed pointer. Tick marks are provided on the airspeed tape every 10 knots (or mph, if so configured). Airspeeds between 20 kts (23mph) to 450 kts (518mph) are displayed. Outside of this range, the airspeed value is dashed.

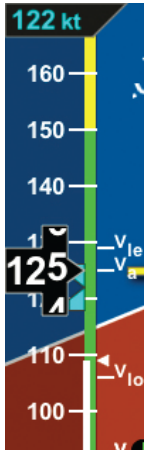

Figure 2-30
Airspeed Tape

Colored speed bands are displayed on the indicated airspeed tape, corresponding to the colored arcs found on a mechanical airspeed indicator.

Colored speed markers are displayed on the indicated airspeed tape, corresponding to the colored radial lines found on traditional airspeed indicators. All aircraft have a red line for aircraft never-exceed speed (Vne). Multi-engine aircraft will usually also have a lower red line for single-engine minimum control speed (Vmc), and a blue line for single-engine best rate of climb speed (Vyse). If the aircraft manufacturer has published an initial flap extension speed, a white triangle will be presented on the airspeed tape at the speed corresponding to this limitation.

Textual Vspeed markers can also be shown on the airspeed tape (e.g., Vx, Vy, Va, etc.). These are typically programmed at installation, and (if left unlocked during installation) may also be programmed by the pilot. Vspeed display can be enabled or disabled by the pilot from Page 1 of the Main Menu (see **Chapter 5**).

The pilot can set a target airspeed using the Left Knob (see **Section 4.1.2.1**). The target airspeed is shown on the Airspeed Tape in the form of an Airspeed Bug (**Figure 2-2, No. 34**) and will also be displayed numerically above the Airspeed Tape (**Figure 2-2, No. 33**). The bug and numerical value are for visual reference only, to help the pilot maintain a target airspeed; there is no alerting for deviations from the target.

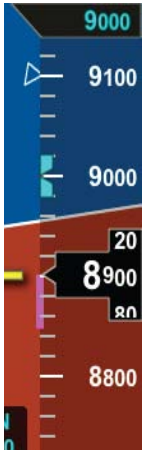

Figure 2-31
Altitude Tape

2.3.2.3. **Altitude Tape and Alerter**

Altitude is indicated by a moving altitude tape against a fixed position altitude pointer (**Figure 2-2, No. 30**), shown on the right-hand side of the Attitude Display (**Figure 2-31**). A digital rolling drum readout indicating altitude values to the closest 20 feet is provided adjacent to the fixed pointer. When climbing or descending, a magenta Altitude Trend Vector displays above or below the altitude pointer, indicating the altitude that will be reached in six seconds if the current rate of climb or descent is maintained.

Minor tick marks are provided on the tape at 20-foot intervals, and major tick marks are provided at 100-foot intervals. The thousand and ten-thousand digits are larger than other digits on the tape. Negative altitudes are indicated by a "-" sign preceding the numerical altitude value in the drum.

The current altimeter barometric setting is shown just below the Altitude tape in the Data Bar (**Figure 2-2, No. 39**), and can be adjusted using the Right Knob.

The Altitude Tape also includes a built-in altitude alerter, which consists of an Altitude Bug on the Altitude Tape (**Figure 2-2, No. 26**), a Selected Altitude display (**Figure 2-2, No. 22**), a visual Altitude Alert (**Figure 2-2, No. 23**), and optionally, an audio alert. For more information on using the Alerter see **Chapter 3** and **Chapter 4**.

The Vertical Speed Indicator (VSI) tape is shown on the Navigation Display (**Figure 2-48** and **Figure 2-2, No. 57**) to the right of the HSI in 360 view, and the numerical value of the current vertical speed is shown in the upper right-hand corner of the Navigation Display during climbs and descents. The VSI tape is not shown in ARC view, but the numerical value display is shown in both 360 and ARC views.

2.3.2.4. **Instrument Approach Indicators (unavailable on Pilot PFD)**

Additional indicators are shown or available on the Attitude Display when flying certain types of instrument approaches. These enable the pilot to maintain a tighter instrument scan on the ADI, reducing workload and improving safety (**Figure 2-32**).

A Lateral Deviation Indicator (LDI) (**Figure 2-2, No. 37**)) is presented on the attitude indicator whenever the pilot has coupled an ILS, LOC, LOC(BC), or a GPS in Approach Mode to the HSI, and valid lateral guidance is being provided. The navigation source coupled to the LDI is annunciated to the left of the LDI (**Figure 2-2, No. 31**). A Vertical Deviation Indicator (VDI) (**Figure 2-2, No. 34**)) is presented on the attitude indicator whenever the LDI is shown and valid 36 guidance is provided, such as from an ILS or WAAS GPS.

Whenever the lateral or vertical deviation exceeds the maximum displayable range of 2.5 dots, the deviation diamond is rendered as a hollow, ghosted image pegged to the corresponding side. As soon as the deviation comes into range, the diamond turns solid green, making it easy to identify when the needle is alive.

Additionally, the pilot can pre-set the minimums (MIN) for the approach, which will be displayed on the ADI (**Figure 2-2, No. 29**) until the pilot toggles off the display using the MIN Hot Key. Once the MIN data field value is set to a Decision Altitude or Minimum Descent Altitude, the EFD1000 Pro PFD provides a visual annunciation when the aircraft reaches or descends below this altitude. Additionally there is a minimums bug presented on the altitude tape. The bug includes three components – a green marker 500 ft. above programmed minimums, a hollow yellow triangle in the area from 100 ft to 200 ft. above minimums, and a red and yellow marker at the programmed minimums value (see **Section 4.1.3.4. MINIMUMS Alert** for detailed information).

If a Radar Altimeter is installed in the aircraft and connected to the EFD1000, a Decision Height annunciation (**Figure 2-2, No. 27**) will be displayed when the aircraft descends to, or below, the selected radar altitude (**Figure 2-33**).

Figure 2-32
Instrument Approach Indications

Figure 2-33
Decision Height Annunciation

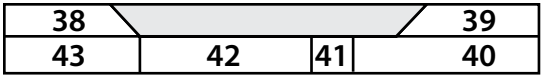

Figure 2-34
Databar Components

NOTE

When the winds aloft are less than 10 knots, the wind data is not displayed.

2.3.3. **Data Bar**

The Data Bar visually separates the upper and lower halves of the PFD display. When available, True Airspeed (TAS), GPS Ground Speed (GS), Outside Air Temperature (OAT), Wind Vector arrow, Wind Direction and Speed, and Barometric Pressure Setting data are presented in the data bar (**Table 2-7** and **Figure 2-34**).

When the of these values is unavailable or invalid, the corresponding data field is dashed. If the Wind Direction and Speed is unavailable or invalid the Wind Direction Arrow is removed. A GPS navigator must be connected and providing valid ground speed and track data to display GS and wind data.

The Data Bar is discussed in detail in **Section 4.2**.

DATABAR	
38	True Airspeed (TAS)
39	Barometric Pressure Setting Field
40	Wind Direction and Speed
41	Wind Direction Arrow
42	Outside Air Temperature (OAT)
43	Ground Speed (GS)

Table 2-7 Databar Components

2.3.4. **Navigation Display**

The lower half of the EFD1000 PFD is the Navigation Display (**Figure 2-35**), which shows a wide range of navigation information and flight data, including:

- Horizontal Situation Indicator (HSI), with Course Pointer and Deviation Indicator (CDI), and Heading Bug, offering both 360º and ARC mode views. The Pilot PFD replaces the HSI with a slaved Directional Gyro (DG) with Heading Bug. It does not include a Course Pointer, CDI, or Bearing Pointers.
- Digital readouts of current magnetic heading, selected heading (HDG), and selected course (CRS).
- Information about the currently selected navigation source, or active GPS waypoint.
- Ground Track Indicator.
- Vertical Speed Indicator (VSI) tape and digital rate value.
- Rate of Turn Iindicator.
- Dual bearing pointers (RMI).
- Situational Awareness Map display.
- Identification of the navigation sources to which the Course Deviation Indicator (CDI) and two bearing pointers are currently coupled.
- GPS Annunciations (TERM, APPR, WPT, and MSG).
- Caution annunciations for abnormal GPS status.

When connected to a GPS navigator, basic mapping can also be displayed under the HSI display, including GPS flight plan legs and waypoints, and (when connected to a compatible GPS) nearby navigation data (airports, VORs, NDBs, and intersections).

NOTE

The Vertical Deviation Indicator (VDI) and Lateral Deviation Indicator (LDI) are part of the navigation instruments but display on the Attitude Display during instrument approaches.

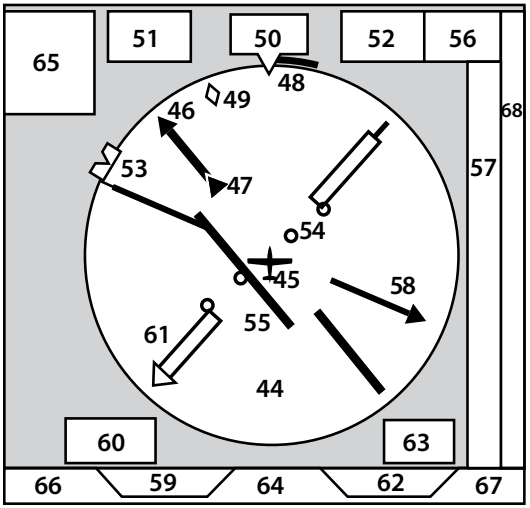

Figure 2-35
Navigation Display Components

NAVIGATION DISPLAY			
44	Navigation Display	57	Vertical Speed Tape
45	Ownship Symbol	58	Single-Line Bearing Pointer[1]
46	Course Pointer[1]	59	Single-Line Bearing Pointer Source[1]
47	TO/FROM Indicator[1]	60	Single-Line Source Info Block[1]
48	Rate of Turn Indicator	61	Double-Line Bearing Pointer[1]
49	Track Marker	62	Double-Line Bearing Pointer Source[1]
50	Magnetic Heading	63	Double-Line Source Info Block[1]
51	Selected Course (CRS) Field[1]	64	CDI Navigation Source[1]
52	Selected Heading Field	65	CDI Source Information Block[1]
53	Heading Bug	66	Left Knob State
54	Course Deviation Scale[1]	67	Right Knob State
55	Course Deviation Indicator[1]	68	Hot Key Legend
56	Vertical Speed Digital Value		

Table 2-8 Navigation Display Components

1. Unavailable on Pilot PFD.

2.3.4.1. **Direction Indicator (Magnetic Compass)**

The center of the Navigation Display is the Direction Indicator, or Magnetic Compass. The compass always shows the current magnetic heading of the aircraft, both with a numerical value of the current heading at the top of the display, and with a lubber line, or pointer, to that heading on either a full or partial compass rose. This slaved compass system compensates both for the turning and acceleration errors exhibited by wet compasses and for precession errors found in common Directional Gyros, so the pilot does not need to make adjustments to the heading indicator during the flight.

The Direction Indicators of both the Pilot and Pro PFDs share many common features, explained below, while the Pro PFD adds features for instrument navigation. The Pilot PFD Direction Indicator is a slaved Directional Gyro (DG) with Heading Bug. The Pro PFD Direction Indicator adds capabilities to make it an electronic Horizontal Situation Indicator (HSI) with dual Bearing Pointers. The HSI features are explained in a separate section below.

Figure 2-36
360° Mode

Compass Modes: 360º vs. ARC

The Direction Indicator on the EFD1000 can be presented in either a full 360º compass rose mode (shown in **Figure 2-36**), or in a 100º ARC format (**Figure 2-37**). In 360 Mode, the compass resembles the mechanical instrument, with the ownship position in the center of the display. ARC Mode provides an extended forward view with the ownship position at the bottom of the display. The ARC mode is especially good for map displays. The middle Hot Key is used to toggle the display between 360 and ARC modes, with the current mode shown in green adjacent to the Hot Key.

Figure 2-37
ARC CDI Mode with
Base Map

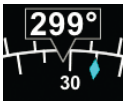

Figure 2-38
Magnetic Heading

Figure 2-39
Navigation Source Information Block

Figure 2-40
Ground Track Marker

Navigation Information

Regardless of compass mode setting, the current magnetic heading is always shown at the top center of the Navigation Display (**Figure 2-2, No. 50** and **Figure 2-38**). The current setting of the HDG Bug is shown in the Selected Heading Field (**Figure 2-2, No. 52**), which is to the right of the ship's Magnetic Heading (**Figure 2-2, No. 50**). This field is always visible even if the HDG Bug itself is not visible in ARC mode. Similarly, on the Pro PFD HSI, the current Course setting (CRS) (**Figure 2-2, No. 51**) is always shown to the left of the ship's heading, whether or not the Course Pointer itself is visible in ARC mode.

A Navigation Source Information Block (**Figure 2-2, No. 65** and **Figure 2-39**) is presented in the upper left corner of the Navigation Display. The Source Information Block indicates the selected navigation source (coupled to the CDI on the Pro PFD's HSI), and its associated mode (e.g., GPS, VOR, ILS, LOC) . Information is provided related to the selected source, including, when available, the waypoint's or navaid's identifier or frequency, bearing and distance, and the estimated time to the active waypoint.

Ground Track Indicator

Whenever the EFD1000 is connected to a compatible GPS, a Ground Track Indicator is displayed. Ground Track is shown as a blue diamond rendered on the compass scale at the value that corresponds to the current aircraft track (**Figure 2-2, No. 49** and **Figure 2-40**).

When the blue track diamond is aligned with the Course Pointer on the Pro PFD HSI, the aircraft is tracking on or parallel to its desired track. To align the track diamond with the Course Pointer, turn away from the direction in which the diamond is offset from the Course Pointer (think of it as pulling the track diamond toward the Course Pointer).

2.3.4.2. **Horizontal Situation Indicator (HSI) (unavailable on Pilot PFD)**

The traditional HSI is an instrument that combines a slaved magnetic Heading Indicator overlaid with a rotating Course Pointer and Deviation Indicator (CDI). This combination has also been called a pictorial navigation indicator because it helps the pilot better visualize the aircraft position relative to its desired course. The HSI is a vast improvement over the older, separate Directional Gyro (DG) and OBS course deviation indicator, because the compass heading is always correct (slaved to a remote magnetic flux detector), and integration of the CDI onto the compass simplifies the instrument scan and provides better situational awareness.

Pilots experienced with mechanical HSIs will find the 360º mode of the EFD1000 PFD Navigation Display immediately familiar. In its basic form, it is just an electronic representation of a mechanical HSI. Pilots transitioning from flying a DG and OBS should get some dual instruction from a CFII on the differences in flying an HSI, because some instrument flying techniques differ from what they may be used to.

2.3.4.3. **Course Pointer and Deviation Indicator (CDI)**

In the 360º compass mode, the Course Pointer and Deviation Indicator (CDI) resemble those of a mechanical HSI, with an arrowhead pointing to the selected course, and a movable center section indicating course deviation against a scale of two dots to either side of the center. A TO/FROM indication is shown as a triangle above (TO) or below (FROM) the end of the deviation bar.

Within the ARC mode, the pilot may select (via the Main Menu) between two different formats of CDI presentation—ARC HSI mode and ARC CDI mode. The ARC HSI mode, presents a full rotating Course Pointer with CDI, which resembles that used in the HSI 360 Compass mode. The ARC CDI mode presents a short Course Pointer stub on the compass arc and a fixed CDI at the bottom of the display, similar to the LDI and resembling that used in contemporary GPS navigation displays. ARC CDI mode leaves more open space for map presentation. A TO indication is shown to the left of the LDI, and a FROM indication is shown to its right.

Figure 2-41
Off Scale CDI

Figure 2-42
Off Scale ARC CDI

Figure 2-43
Auto Course Indication on CRS Field

Figure 2-44
Auto Course Indication over Left Knob

2.3.4.4. **Deviation Off Scale Indication**

Whenever the course deviation exceeds the maximum displayable range of 2.5 dots, the CDI bar or deviation diamond is rendered as a hollow, ghosted image pegged to the corresponding side (**Figure 2-41** and **Figure 2-42**). As soon as the deviation comes into range, the CDI or diamond turns solid green, making it easy to identify when the needle is alive.

2.3.4.5. **Auto Course Select**

When a GPS is selected as the CDI navigation source, the default setting of the EFD1000 is Auto Course Select. When in Auto Course Select the GPS will automatically set the Course Pointer to the current GPS course (CRS) value whenever the GPS sequences between waypoints. This capability relieves the pilot from manually setting the course at each waypoint transition along a GPS route. When Auto Course Select is active, the pilot cannot adjust the CRS value.

Auto Course Select is indicated by an inverse A on a green background, adjacent to both the numerical CRS value and the CRS knob legend (**Figure 2-43** and **Figure 2-44**).

If the GPS navigator enters OBS or HOLD modes, Auto Course Select is automatically disabled on the EFD1000 until the GPS resumes waypoint sequencing. The pilot can also manually disable Auto Course Select from Page 1 of the Main Menu.

2.3.4.6. **Bearing Pointers**

One or two bearing pointers that show the bearing to a VOR station or GPS waypoint can be overlaid on the HSI (**Figure 2-45**). BRG#1 is a single needle (**Figure 2 2, No. 58**), and BRG#2 is the double needle (**Figure 2-2, No. 61**). Use the Nav Source Select Buttons (**Figure 2-2, No. 10** and **No. 12**) to select the nav source for a Bearing Pointer, or select none (blank) to remove the Bearing Pointer from the display.

The head of the needle always points to the station or waypoint. When coupled to a VOR source, the tail of the needle indicates the VOR radial on which the aircraft is currently located. Bearing pointers are excellent tools for identifying crossing radials, flying DME arcs, and general situational awareness.

Bearing Pointers are only available in the 360 Compass mode. Any available navigation source may be coupled to either bearing pointer. If coupled to a source that does not provide angular bearing data, such as a localizer, the bearing pointer is not presented, and the source is flagged as invalid.

Each bearing pointer has an associated source information block that can display information about the source of the bearing pointer data. Information that can be displayed includes distance to station (if coupled to a GPS waypoint) and either the station identifier or the tuned frequency for a VLOC radio. This information is only presented when it is reported to the EFD1000 by the connected equipment, and thus is unavailable in all installations.

Figure 2-45
BRG#1 Set to GPS1 TAKLE

Figure 2-46
Rate of Turn Indicator, Rate Shown >6º/second

Figure 2-47
VSI Tape Capped, Digital Value Showing 2,100 FPM Climb

Figure 2-48
VSI Tape Showing 370 FPM Descent

2.3.4.7. **Rate of Turn Indicator**

A Rate of Turn Indicator (**Figure 2-2, No. 48**) with a range of 0 to 6 degrees per second is provided for both the 360 and ARC Compass modes. The indicator consists of a curved white tape originating from the heading index mark and extending in the direction of the turn along the outer curve of the compass card.

The Rate of Turn Indicator features an outer thick white tick mark for a Standard Rate turn, and an inner thin white tick mark for Half-Standard Rate turns. A Standard Rate, two-minute turn equals 3 degrees per second. When the rate of turn exceeds 6 degrees per second, an arrowhead is added to the end of the tape to show that the rate of turn has exceeded the limits of the indicator (**Figure 2-46**).

2.3.4.8. **Vertical Speed Indicator (VSI)**

Whenever the vertical speed exceeds +/- 100 feet per minute (FPM), the vertical speed is indicated by presenting a rising/sinking white vertical tape and associated scale markers immediately to the right of the compass rose (**Figure 2-2, No. 57** and **Figure 2-47**).

A numerical indication of current aircraft vertical speed is shown directly above the tape (**Figure 2-2, No. 56**). Rates of up to ±2,000 FPM are indicated by the tape, while the numerical value will display rates of up to ±9,990 FPM. A triangle caps the tape whenever rates exceed ±2,000 FPM (**Figure 2-48**). The vertical speed data field will be dashed whenever the vertical speed is 10,000 FPM or greater. In the ARC compass mode, only the digital vertical speed value is presented.

2.3.4.9. **Situational Awareness Map**

When the EFD1000 is connected to a compatible GPS navigator, a base map can be displayed underneath the Direction Indicator in either 360º or ARC modes. Most GPSs put out data to enable the EFD1000 to display the GPS flight plan legs and waypoints. The active GPS flight plan leg, waypoint, and its identifier are shown in magenta. Other waypoints and legs are shown in white.

Some GPS navigators (typically those using the ARINC 429 data protocol, such as the Garmin 400/500 series) additionally put out information on nearby waypoints (e.g., airports, VORs, NDBs, and intersections), which are also displayed on the EFD1000 base map. Often these GPSs also display curved flight paths, such as course reversals and holding patterns.

The base map is always oriented with magnetic heading up and centered so that the current aircraft position coincides with the aircraft ownship symbol. These base map elements underlay all other instruments and annunciations in the Navigation Display.

The MAP Hot Key is used to cycle through four levels of map declutter and to turn off the base map display. Each successive press of the MAP Hot Key selects the next declutter level or OFF.

The map display range is controlled by the Range button (**Figure 2 2, Ref. 2**), enabling the pilot to zoom in or out on the map. Automatic declutter logic changes the map features displayed depending on the selected map range.

The current map settings (range and feature level) are shown in the lower left-hand corner of the navigation display whenever the map is not OFF (**Figure 2-49**). The current map range is displayed in nautical miles, measuring the distance from the ownship symbol to the edge of the map display. The current map feature level is indicated by one to four green trapezoids underneath the range value (one mark is Low, while four marks indicates the highest map feature level).

Figure 2-49
Map in ARC Mode, 20nm Range at Feature Level 3 (Medium/High)

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Chapter 3

Flying the EFD1000 Pro PFD

This chapter provides an overview of flying the EFD1000 Pro PFD on an IFR cross-country flight, explaining how to access and change the necessary settings of the EFD1000 PFD. Refer to **Chapter 4** for detailed step-by-step instructions for all EFD1000 PFD functionality.

While you can jump right in to using the EFD1000 Pro PFD with this chapter, it may be helpful first to read **Chapter 2** to become more familiar with the controls, operating logic, and display elements of the PFD.

The EFD1000 Pro PFD is a powerful Electronic Flight Instrument System (EFIS), offering the same capabilities and features found on larger glass cockpit systems in airliners, business jets, and newer general aviation aircraft. It is capable of far more than the analog instruments it typically replaces. It will take some time and experience to master all of its advanced capabilities, especially if this is your first exposure to flying EFIS and glass cockpits. Nonetheless, in its most basic configuration, the EFD1000 PFD will look immediately familiar to anyone used to flying mechanical instruments, and its basic operation is very similar and intuitive.

Before flying your new EFD1000 installation on an actual IFR flight, first be sure to spend some time with your installer to understand exactly how your aircraft is configured, and also to get some dual instruction and practice time in VFR conditions until you are comfortable with how the EFD1000 performs and integrates with the other avionics in your airplane.

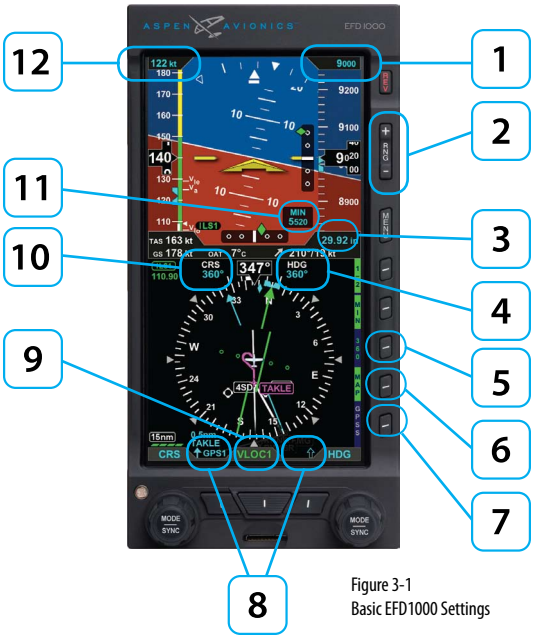

Figure 3-1
Basic EFD1000 Settings

FEATURE		SETTING	FEATURE		SETTING
1	Selected Altitude	Set as desired	7	GPS Steering (GPSS) Hot Key	Enable/Disable
2	Map Range Buttons	Set as desired	8	Bearing Pointers Nav Source	Select as desired
3	Barometric Pressure Setting	Check and set	9	CDI Navigation Source	Select as desired
4	Heading Bug Value	Set as desired	10	Course Pointer Value	Set as desired
5	Compass Hot Key: 360° or ARC	Set as desired	11	MINIMUMS Setting	Set approach minimums
6	Map Settings Hot Key	Set as desired	12	Selected Airspeed	Set as desired

Table 3-1 Basic EFD1000 Settings

3.1. **Quick Controls Overview**

Chapter 2 explains the EFD1000 controls in detail. The following is a quick summary:

Knobs (see 2.2.1 for detail)

The Left and Right Knobs each has a Home state, to which it returns after 10 seconds of inactivity. The Left Knob is the CRS knob, and the Right Knob is the HDG knob.

- The current function of each knob is shown by a legend on the screen immediately above the knob. If the legend is shown in magenta, turning the knob will change the value of the function shown. If the legend is shown in cyan or green, turning the knob will have no effect.
- From the Home state, pressing the knob once will enable the current function to be set (legend color changes from cyan to magenta). Successive presses of the knob will cycle through the functions that knob can control. When the function you want to change is shown in magenta, turning the knob will change the value.
- The Left Knob sets the Course Pointer (CRS, except when Auto Course Select is enabled) and Indicated Airspeed Bug (IAS).
- The Right Knob sets Heading (HDG), Selected Altitude (ALT), Barometric Pressure Setting (BARO), and Approach Minimums (MIN).
- Pressing and holding a knob syncs the function shown to the current value.

Navigation Source Buttons (see 2.2.2 for detail)

- Three buttons at the bottom of the display couple the available navigation sources to the CDI and/or the bearing pointers.
- The center button (**Figure 2-2, Ref. 11**) selects the nav source to couple to the CDI and to drive the autopilot (if installed).
- The outer two buttons (**Figure 2-2, Refs. 10 and 12**) select which nav source couples to each of the two bearing pointers (or none to hide the bearing pointers).

Hot Keys (see 2.2.3 for details)

- The five buttons on the lower right-hand side of the display are Hot Keys, the function of which is shown by the legend on the screen immediately adjacent to each button.
- The current status of each Hot Key is shown by the legend, in GREEN if active and in GRAY if inactive.
- Each press of a Hot Key will either toggle its function on or off, or will cycle among available settings.

3.2. **Example Flight Scenario**

This section will walk you through using the EFD1000 Pro PFD on an IFR flight from Albuquerque International Sunport (KABQ) to Reno/Tahoe International Airport (KRNO), flying Victor airways to the ILS16R approach into KRNO. This scenario uses one pilot's technique for setting up the navigation instruments, but there are many other valid possibilities. Use whatever techniques work best for you.

Our aircraft for this flight is a Beech Bonanza A36TC, equipped with dual Garmin GNS-430W WAAS GPS/nav/comms and the Bendix/King KFC-200 autopilot. The EFD1000 Pro PFD is configured with Auto Course Select enabled, baro setting in inches, Vspeed text markers displayed, ARC compass mode in CDI, and base map configured with its default settings.

The Garmin 430Ws are configured with ILS CDI Capture set to AUTO, meaning that when an ILS approach is loaded and active in the GPS, and the aircraft is established inbound to the FAF, the 430W will automatically switch its CDI output from GPS to the VHF localizer frequency. The EFD1000 will follow this switch on its CDI Source Select, automatically changing from GPS1 to VLOC1.

NOTE

The tasks and procedures you will use in your airplane will vary depending on your aircraft and equipment, and on how they are configured and integrated with the EFD1000 in your specific installation

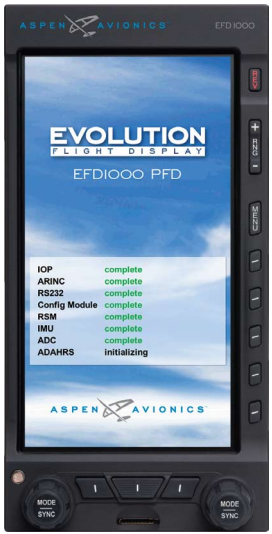

Figure 3-2
EFD1000 PFD Initializing

Figure 3-3
CDI Source Slashed Invalid

3.2.1. **Pre-Departure (Startup)**

Once the pre-flight inspections and checklists are complete, start the engines. After engine starts, turn on the EFIS Master switch (if installed).

When power is applied to the EFD1000, the bezel backlighting illuminates and within a few seconds the EFD1000 PFD splash screen displays while the EFD1000 PFD initializes and AHRS data is validated (**Figure 3-2**).

As the software initializes and the PFD warms up, the Attitude and Navigation Displays will appear first (typically within 20-30 seconds), with red X's showing for the airspeed and altitude tapes and the CDI source slashed as invalid (**Figure 3-3**). In a short while (from a few more seconds to a few minutes, depending on how cold the aircraft is), the air data sensors will warm up to operating temperature, and the airspeed and altitude tapes will appear. At that point, when all red X's are gone, the EFD1000 is ready to go.

NOTE

Start-up times for the EFD1000 are highly dependent on aircraft temperature. In extremely cold weather, when the aircraft has gotten cold soaked overnight, it may take several minutes (usually no more than five) for the PFD to be fully operational. On the second or third flight of the day, and/or on very hot days, the PFD may come up within 30 seconds or less.

Turn the Avionics Master ON. Until the navigation radios are operational, the nav source annunciations on the EFD1000 will be shown with a red line slashed through them (**Figure 3-4**), and the GPS1, GPS2 caution annunciations on the left (**Figure 3-5**) and INTEG caution annunciated on the right edge of the display. The CDI Source Select will default to VLOC1 the first time the PFD is turned on, after that the CDI Source Select will display the last used CDI Source. Once the nav radios have warmed up, the red slash will be removed from the CDI Source annunciation.

Figure 3-4
CDI Source Slashed Invalid

Figure 3-5
GPS Caution Annunciations

NOTE

GPS navigators will not output valid navigation information until programmed with an active flight plan or direct-to waypoint, and thus will be flagged on the EFD1000 and cannot be selected as a CDI or Bearing Pointer navigation source until they are programmed with an active waypoint.

When the EFD1000 is interfaced to a Garmin 4xx /5xx or 4xx(W)/5xx(W) navigator, and the navigator's Instrument Panel Self-Test page is displayed, the indicated lateral deviation can be verified on the EFD1000 Pro PFD CDI. This confirms that a valid digital signal was received from the Garmin system.

The interface between the Garmin 4xx/5xx and EFD1000 system should be considered fully operational once the presence of the digital signal is confirmed. If there is no GPS failure annunciation on the EFD1000, the deviation indicator flags are not asserted, and the lateral deviation indication on the EFD1000 HSI correlates to the indication on the Garmin 4xx/5xx Instrument Panel Self-Test Page, and then the digital signal is confirmed, and the interface is operational.

NOTE

The graphics used in this chapter illustrate the features and tasks being described but do not necessarily correspond to the values associated with this example flight scenario.

NOTE

Whenever there is a new altimeter setting, be certain to set both the EFD1000 PFD and the standby altimeter.

The navigator's indicated lateral and vertical deviation cannot be compared to the EFD1000's Lateral Deviation Indicator (LDI) and Vertical Deviation Indicator (VDI) because the 4xx/5xx Instrument Panel Self-Test Page does not output an Approach Mode assertion.

Due to safety and certification issues, the display of the LDI and VDI without an Approach Mode assertion is not permitted on an EFD1000 system.

The display of deviations on the LDI and VDI are not necessary to verify the communication between the Garmin 4xx/5xx and EFD1000 system.

Once the radios are available, we pick up the ATIS and learn that the local altimeter setting is 30.15 and that Runway 8 is in use for departures.

First set the standby altimeter to 30.15, and then set the EFD1000 PFD baro setting.

Set the Barometric Pressure

1. Press the Right Knob until BARO displays above the knob and the Barometric Pressure field is enabled for editing, both rendered in magenta (**Figure 3-6**). From the Home state, press the Right Knob 3 times to enable setting baro pressure.
2. Rotate the Right Knob to change the value of the Barometric Pressure field. Rotate clockwise to increase, or counterclockwise to decrease, the value. Once the correct value is selected, and after 10 seconds of inaction, the field is disabled, and the label and field are rendered in cyan (**Figure 3-7**).

Figure 3-6
BARO Field Enabled

Figure 3-7
BARO Field Disabled

Next, since we'll be departing from Runway 8, we set our Heading Bug to runway heading, 080°.

Set the Heading Bug

1. Press the Right Knob until HDG displays above the knob and the HDG field is enabled for editing, both rendered in magenta (**Figure 3-8**). The Heading Bug will also be rendered in magenta, and a dashed magenta line will extend from the ownship symbol to the Heading Bug to make it easier to see the bug position.
2. Rotate the Right Knob to change the value of the Heading field. Rotate clockwise to increase, or counterclockwise to decrease, the value. Once the correct heading is selected and after 10 seconds of inaction, the field is disabled, and the label and field are rendered in cyan (**Figure 3-9**).

We call Clearance Delivery to pick up our IFR clearance. It is:

> *Bonanza N66529 is cleared to the Reno/Tahoe Airport via the LARGO2 departure, Zuni (ZUN) transition, then as filed. Maintain 7,000, expect 10,000 in five minutes. Departure frequency is 127.4. Squawk 1234.*

We copy and read back our clearance, and then set up our avionics for an instrument departure. We set our transponder code and comm radio frequencies. Then we enter our flight plan into GPS1, load the LARGO2 departure, crossfill into GPS2, and activate the flight plan. We make sure the CDI button on the 430W is set to GPS.

The LARGO2 departure calls for vectors to our route. From past experience, we expect to be vectored past ABQ VOR, and then given a vector to join the departure on the ABQ-to-ZUN leg (a 255º course). While we'll be navigating on GPS, for situational awareness we tune those first two VOR fixes into our nav radios. We tune ABQ VOR (113.2) into VLOC1 and ZUN VOR (113.4) into VLOC2.

Figure 3-8 Heading Field Enabled

Figure 3-9 Heading Field Disabled

Figure 3-10 CDI Navigation Source Selection Button

Figure 3-11 Bearing Pointer Nav Source Select Buttons

NOTE

When no source is selected, only the bearing pointer icon displays above the applicable button (Figure 3-12).

Figure 3-12 No Bearing Pointer Sources Selected

On the EFD1000, use the CDI Source Select button to select GPS1. Because we have enabled Auto Course Select, the Course Pointer automatically slews to 261º (the initial course from the airport to the first fix on the LARGO2 departure, ABQ VOR).

Select the CDI Navigation Source

- Press the CDI Navigation Source Select button (**Figure 3-10**) until the desired navigation source is shown above the button (in this case,GPS1).

For a traditional RMI view, we could use our two Bearing Pointers to monitor our passing ABQ VOR and then intercepting the course to ZUN. We'd use the left BRG#1 Bearing Pointer Source Select button to select VOR1 (ABQ), and use the right BRG#2 Bearing Pointer Source Select button to select VOR2 (ZUN). Since ZUN VOR is too far away to receive on the ground at Albuquerque, VLOC2 will be shown with a red slash through it above the BRG#2 Bearing Pointer Source Select button, and BRG#2 pointer will not be displayed. But we know the station will come in, and the pointer will be shown, by the time we climb to our initial cruise altitude.

Select Bearing Pointer Nav Sources

- Press the BRG#1 (single-line) or BRG#2 (double-line) Bearing Pointer button until the desired navigation source is shown above the button (**Figure 3-11**).

For even better situational awareness, we choose to display the map of our flight plan legs and waypoints. We press the MAP Hot Key to bring up the base map. We use the Range Control buttons to select the 20 NM. range, which will give a good perspective for intercepting our course to ZUN. Our initial flight plan leg, from the airport to ABQ VOR, is shown in magenta, with subsequent legs and waypoints shown in white.

Select Map Declutter Level

- Push the MAP Hot Key (fourth Hot Key) to cycle through and select the desired level of detail. Each time the Hot Key is pressed, the Map Declutter level icon changes to the next option (**Figure 3-13**).

NOTE

The icons and flight plan legs rendered for each of the map display levels (High, Medium/High, Medium/Low, and Low) are based on the selected map range. Detailed information is provided in **Section 5.2** *of this guide. In addition, some of the icons can be manually reconfigured, as discussed in that same section.*

Figure 3-13 Changing the Map Display Level

Figure 3-14
Range Button

Change the Map Range

- Press the Range Button (**Figure 3-14**) UP (+) to increase the range, or DOWN (-) to decrease the range, until the desired range is reached (**Figures 3-15** and **3-16**).

Figure 3-15
Current Range 200NM from
Ownship to Edge of Compass

Figure 3-16
Current Range 10NM from
Ownship to Edge of Compass

Because we need all the help we can get, and want the best situational awareness tools available, we upgraded our EFD1000 Pro PFD with Aspen's Evolution Hazard Awareness (EHA) option. We installed its EWR50 XM WX datalink weather receiver and connected our WX500 Stormscope® and traffic system to the EFD1000 Pro PFD. These options enable us to display weather and traffic hazards on our PFD Navigation Display.

Our pre-flight weather briefing noted a line of thunderstorms west and south of Albuquerque, moving northeast at 15 knots. Our flight plan route should keep us clear of the weather, but we want to check the latest NEXRAD images before departure just to be sure. So we zoom the map out to its farthest range and turn on the datalink NEXRAD precipitation and lightning underlays to see how things look along our route of flight. (In flight, we'll also use our Stormscope for real-time lightning (spherics) detection, but on the ground, datalink lightning will give us a better indication of where the thunderstorms are.)

Display the Data Link Weather Underlay

1. Display the 2/2 Hot Key menu.
2. Press the NXRD Hot Key to turn Data Link Weather on (label turns green) (**Figure 3-17**).

Figure 3-17
Data Link Weather Underlay On

Display the Lightning Underlay

1. Display the 2/2 Hot Key menu.
2. Press the LTNG Hot Key to select the desired underlay (LTNG label turns green) (**Figure 3-18**).

Figure 3-18
Lightning Underlay On
Displaying WX-500 Strike Data

We see the storms are still moving about as forecast and that our planned route still looks like it will keep us well clear. We leave the Weather underlays turned on so we can monitor them in-flight, and then zoom the map back in to 20nm range for departure.

Since the Albuquerque area can sometimes get busy, and there's a lot of VFR traffic in the vicinity, we also turn on the Traffic overlay.

Figure 3-19 Traffic Overlay On

Display the Traffic Overlay

1. Display the 2/2 Hot Key menu.
2. Press the TRFC Hot Key to turn Traffic on (label turns green). The TFRC annunciation displays in the lower left of the display (**Figure 3-19**).

With our hazard awareness options set the way we want them, we press the top Hot Key to return to the 1/2 Hot Key menu, giving us ready access to GPSS and our map view controls for the departure.

Next, we set our assigned initial altitude of 7,000 feet into the Altitude Alerter. We press the Right Knob twice, changing the legend above the knob to ALT in magenta. Then we turn the Right Knob to set 7,000 into the Selected Altitude Field. This will help us capture and maintain our assigned altitude.

NOTE

Setting the Altitude Alerter provides visual and aural cues to help the pilot capture and maintain target altitudes. When set to a new altitude, the Alerter will illuminate a yellow flag adjacent to the target altitude display and sound a one-second tone; 15 seconds (or 200 feet) before the aircraft will reach the target altitude (based on current rate of climb or descent). The yellow flag will go black upon attaining the target altitude. Subsequently, if the aircraft deviates more than 200 feet above or below the target altitude, the flag will again illuminate, and another one-second tone will sound to alert the pilot to the deviation.

Set the Altitude Alerter

1. Press the Right Knob until ALT displays above the Right Knob and the Altitude numerical field and bug are enabled for editing, all three rendered in magenta (**Figures 3-20 and 3-21**).
2. Rotate the Right Knob to change the value of the Altitude field. Rotate clockwise to increase, or counterclockwise to decrease, the value. Once the correct value is selected, and after 10 seconds of inaction, the field is disabled and the label, numerical field, and bug are rendered in cyan (**Figure 3-22**).

Figure 3-21 Altitude Field Enabled

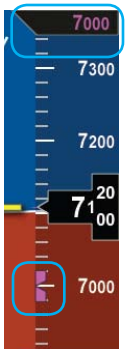

Figure 3-20
Altitude Bug Enabled

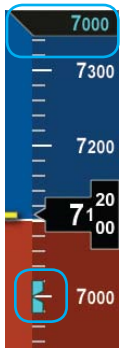

Figure 3-22
Altitude Bug Disabled

NOTE

Synchronizing the altitude sets the selected altitude to the current altitude, see **Section 2.2.1.3**.

Figure 3-24
Selected Airspeed Bug Enabled

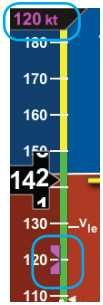

Figure 3-23
Selected Airspeed Field Enabled

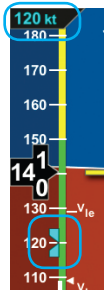

Figure 3-25
Selected Airspeed Field Disabled

NOTE

Synchronizing the airspeed sets the selected airspeed to the current airspeed, see **Section 2.2.1.3.**

Our normal climb speed is 120 KIAS, so we choose to set the airspeed bug as a reminder. To do so, we press the Left Knob twice, until it shows IAS in magenta above the knob. We turn the knob until 120 shows in the Selected Airspeed Field.

Set the Airspeed Bug

1. Press the Left Knob until IAS displays above the Left Knob and the Selected Airspeed field and bug are enabled for editing, all three rendered in magenta (**Figures 3-23 and 3-24**).
2. Rotate the Left Knob to change the value of the Selected Airspeed field. Rotate clockwise to increase, or counterclockwise to decrease, the value. Once the correct value is selected, and after 10 seconds of inaction, the field is disabled, and the label and field are rendered in cyan (**Figure 3-25**).

We plan to hand-fly the plane until reaching our final en route altitude of 10,000 feet. But we like the help the Flight Director gives us (**Figure 3-26**). So, as part of our Before Takeoff set-up, we press the FD button on the autopilot mode selector, and the magenta V-bars display on the EFD1000. As an easy way to give us guidance on the takeoff, we press the Go Around button. This commands wings level and about a 10º pitch-up attitude, which works well for our initial climb.

Now our avionics are all set, so we taxi out to the runway, do our run-up, and call tower, ready for departure. As we taxi into position and hold on Runway 8, we verify that our EFD1000 compass shows 080º, lined up with our pre-set heading bug. As tower clears us for takeoff, it tells us to wait until reaching the end of the runway, and then to turn left to heading 250º. We press the Right Knob once to activate HDG, and turn the knob left to set the Heading Bug to 250.

3.2.2. **Departure**

As we start the takeoff roll, we note the airspeed on the EFD1000 comes alive at 20 KIAS. All indications are normal, so we continue the takeoff, rotate at 80 KIAS and fly the Flight Director command bars at 10º pitch up with wings level. As we run out of usable runway to land, we bring the gear up, and soon we're over the end of the 13,800 ft. runway.

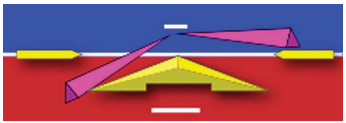

Figure 3-26 Flight Director V-bars

We engage HDG mode on the autopilot mode selector, and the FD commands a left turn to our assigned 250º heading, which we already set with the Heading Bug. Through 1,000 feet AGL, we power back and adjust the pitch attitude to maintain our target 120 KIAS climb speed, as shown by the bug on the airspeed tape, and sync the FD pitch to that attitude.

Soon we hear a one-second tone and see the yellow flag come on next to our Selected Altitude at the top of the EFD1000 airspeed tape (**Figure 3-27**). This means we are 15 seconds away from reaching our assigned altitude. We begin to shallow our climb, and level off at 7,000 feet, engaging ALT hold on the AP/FD mode selector. The yellow Altitude Alert on the EFD1000 goes out as we capture and hold our altitude.

Figure 3-27 Altitude Alerter Flag Illuminated

Around this time, on our 250º vector, we pass abeam ABQ VOR, (BRG#1 points to our 9 o'clock position and begins to swing behind us) which causes the GPS to sequence to the next flight plan leg to ZUN VOR. The Course Pointer on the EFD1000 automatically swings left to the new course, 255º, and that leg on our base map turns magenta.

Albuquerque Departure now tells us to fly heading 220º to join the LARGO2 departure, and climb and maintain 10,000. Departure also calls out slower traffic at our 10 o'clock, seven miles, west-bound at 8,000, and asks us to expedite our climb through 8,000.

1. Press the Right Knob once to activate HDG, and turn it left to set the Heading Bug to 220º.
2. Press the Right Knob again to activate ALT, and turn it right to set 10,000 in the Selected Altitude field at the top of the airspeed tape.

Figure 3-28
CDI Shown Hollow at Full-Scale Deflection

Figure 3-29
CDI Alive and Shown Solid

Auto Course Select has already set our Course Pointer to the 255º course from ABQ to ZUN on the LARGO2 departure, and a 220º heading sets us up for a nice intercept. We disengage ALT hold on the Flight Director, set our cruise climb attitude, sync the V-bars to that pitch, and initiate the climb from 7,000 to 10,000 feet. We pitch a little higher to climb at 115 KIAS through 8,000 for traffic, then lower the nose to maintain our target airspeed of 120 KIAS by reference to the Airspeed Bug.

Even though our traffic should be right ahead of us and about five miles by now, we don't see it out the window. But we see the traffic target on our EFD1000 Nav Display and continue to monitor it even though it appears not to be a factor.

At about 9,700 feet, the Altitude Alerter tone sounds, and the yellow alert flag by the Selected Altitude illuminates, telling us we are 15 seconds from reaching our assigned 10,000 feet. We begin our level-off, and upon reaching 10,000 feet, engage ALT hold on the FD mode selector.

Departure calls again to hand us off to Albuquerque Center on 133.0. As we're tuning the radio, we hear an alert tone. A glance at the EFD1000 shows the Altitude Alerter flag flashing, our altitude at 10,200 and climbing, and our Flight Director V-bars commanding pitch down. We quickly stop the climb, correct back down to our assigned altitude of 10,000, and engage the autopilot before calling to check in with Center.

As we level out, accelerate to cruise speed, and then power back, we finally see our traffic out the left window, same direction, now about two miles and 2,000 feet below us: just where the traffic symbol on our EFD1000 says it should be.

3.2.3. **En Route**

Albuquerque Center gives us a new altimeter setting of 30.11. We set 30.11 on the standby altimeter and then on the EFD1000.

- Press the Right Knob three times to select BARO, shown in magenta above the knob, and turn the knob left four clicks to set 30.11 on the meter.

Soon, the CDI comes alive and attracts our attention as it changes from hollowed out (**Figure 3-28**) to solid (**Figure 3-29**) and begins to move in towards the Course Pointer as we intercept our course. We enable GPS Steering to complete the intercept and steer us along the airways all the way to Reno, and engage the autopilot.

Engage GPSS

1. Press the GPSS Hot Key to Enable GPS Steering (**Figure 3-30**).
2. Verify indications that GPSS is now Enabled on the PFD.
   - The GPSS legend adjacent to the GPSS Hot Key should be shown in inverse green.
   - The annunciation GPSS1 (or GPSS2), along with an inverse A, should be shown next to the HDG reference at the top of the navigation display (**Figure 3-31**).
3. Select HDG mode on the AP/FD mode selector.
   - The Flight Director V-bars should be showing appropriate steering cues to intercept and track the course.
4. Engage the autopilot (if desired).

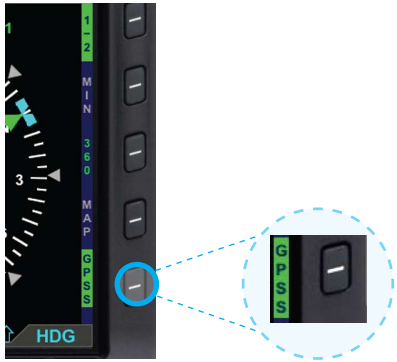

Figure 3-30 GPSS Enabled legend in Green

Figure 3-31
GPSS Enabled

Figure 3-32
360° Compass Mode

Figure 3-33
ARC CDI Compass Mode

NOTE

Each HSI view (360 and ARC) retains its own Range and Map Feature Level settings when switching between the two view modes.

With GPS Steering (GPSS), a compatible GPS navigator (in this case, a Garmin 430W) drives the autopilot directly via its HDG mode, telling it how to bank to stay centered on course. GPSS can drive the autopilot far more accurately than the AP NAV mode (which is based on course deviation indications) because the GPS always knows the ground track and how to adjust to maintain that track, implicitly accounting for changing wind conditions. The GPS also includes turn anticipation based on current ground speed and track, enabling it to turn early and roll out centered on the new course without overshooting. As we'll soon see when flying an instrument approach, GPSS with a WAAS GPS can even fly procedure turns and holding patterns hands-off. For more detail on GPSS, see **Section 4.6.1 GPS Steering**.

Now that we're established at our final cruise altitude and in the en route phase of our flight, we'll switch to the ARC mode of the HSI to maximize a forward view.

1. Press the 360 Hot Key and observe the HSI changes to its ARC view, and the legend adjacent to the Hot Key changes to ARC in GREEN.
2. Adjust the map range to suit your preference.

Select a Compass Mode

- Push the 360/ARC Hot Key (third Hot Key) to alternately select either the 360° (**Figure 3-32**) or the ARC (**Figure 3-33**) compass display.

We set cruise power and lean the mixture. As the airplane stabilizes in cruise, we check the Data Bar to monitor performance. True Airspeed (TAS) is close to book performance for this altitude and power setting. OAT is close to ISA. Winds aloft are close to forecast, about a 30º left quartering headwind at 15 knots, so we'll expect to gain some ground speed due to a stronger tailwind component when we turn northwest toward Reno.

Check TAS, GS, and winds and temperature aloft on the Data Bar (**Figure 3-34**).

Figure 3-34 Data Bar

Ahead, we can see out the window some threatening convective buildups, those that were mentioned in our weather briefing and which we checked using datalink weather on the ground in Albuquerque. We still have the NEXRAD precipitation (NXRD) and datalink lightning (LTNG) underlays selected, and the PFD's nav display shows the weather clearly ahead of us. For a more real-time look at lightning activity in the buildup, we switch to the spherics sensor in our WX500 Stormscope, and see lots of strikes appearing as we also see the lightning flashes out the window.

Display the Lightning Underlay

1. Display the 2/2 Hot Key menu.
2. Press the LTNG Hot Key (repeatedly, if necessary) until the STRK label is shown in green next to the Hot Key (**Figure 3-35**).
3. The STRK mode annunciation appears in the lower left-hand corner of the Navigation Display, showing a yellow X for Strike mode, and a strike rate of 6 (moderate lightning activity) (**Figure 3-36**).

Fortunately, the nav display shows our flight plan will make a right turn at Winslow (INW) and a further right turn at Flagstaff (FLG), which will keep us clear of the weather.

Continuing en route, we monitor progress along our flight plan on the extended forward view of ARC mode, watching as GPSS keeps us exactly centered on course through several turns on the airways.

Figure 3-35
Lightning Underlay On
Displaying WX-500 Cell Data

Figure 3-36
WX-500 Strike Rate Annunciation

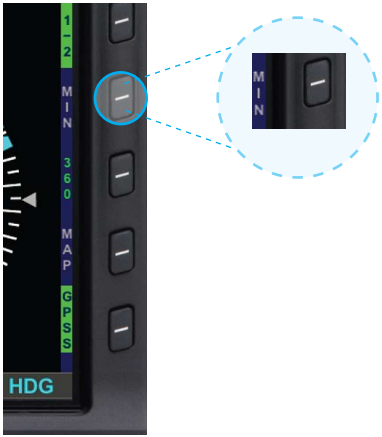

Figure 3-37
MIN Hot Key (shown disabled)

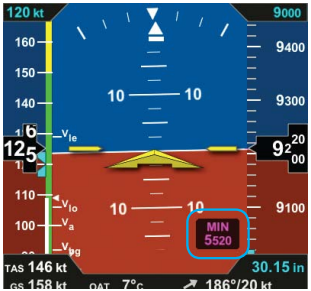

Figure 3-38
MIN Display Selected for Editing

3.2.4. **Arrival and Approach to Landing**

As we near Reno, we prepare for our arrival. Within range, we pick up the ATIS:

> *Reno-Tahoe International Airport, Information Romeo, 2253 Zulu. Winds 180 at 17. Ceiling 1,400 broken. Temperature 23, dewpoint 18, altimeter 30.08. ILS16R approach in use. Advise on initial contact you have Information Romeo.*

Our route along V105 brings us in to Mustang VOR (FMG), which has a published transition to TAKLE, an Initial Approach Fix (IAF) for this procedure. Because we'd like some practice with our new PFD and GPSS, we'll ask to fly the full procedure with pilot nav.

We load the KRNO ILS16R approach into the GPS, selecting TAKLE as our IAF and the ILS frequency (110.9) is placed in the standby window of the 430W. With Auto Course Select enabled on the EFD1000, the HSI Course Pointer will be slewed automatically once we turn inbound to the Final Approach Course of 164º. Briefing the approach, we load ground and tower frequencies into our #2 comm and note our Decision Altitude (DA) is 5,515 feet. We set our approach MINIMUMS on the EFD1000 to 5,520 feet (MINIMUMS are set in increments of 10 feet, so we round up), and we set our Selected Airspeed for the approach at 120 KIAS.

1. Press the MIN Hot Key (**Figure 3-37**). The MIN display appears on the lower right-hand corner of the ADI in magenta (**Figure 3-38**), ready for setting, and the MIN legend adjacent to the Hot Key changes from gray to magenta.
2. Turn the Right Knob to set 5,520 on the MIN display.
3. Press the Left Knob twice to select IAS for editing.
4. Turn the Left Knob to set 120 knots as our target airspeed.

We're all set up for the approach. Nearing Mustang VOR (FMG), Oakland Center hands us off to Reno Approach, and we request nav for the ILS16R. Approach gives us the new altimeter setting of 30.08, clears us down to 9,000 feet, and after FMG direct TAKLE. We initiate the descent, set 30.08 in the standby altimeter, and set the EFD1000:

1. Press the Right Knob twice to select ALT for editing.
2. Turn the Right Knob left to set 9,000 as our Selected Altitude.
3. Press the Right Knob once more to select BARO for editing
4. Turn the Right Knob left to set 30.08 as our baro setting.

Fifteen seconds before reaching 9,000 feet, the Altitude Alerter flag illuminates, and the alert tone sounds. We begin our level-off and re-engage ALT hold on the autopilot upon reaching 9,000 feet. We leave the autopilot in HDG mode and continue with GPSS enabled on the EFD1000.

Approaching FMG, the GPS turn anticipation sequences to TAKLE, our Course Pointer swings automatically from 302º to 316º, and GPSS steers us through the turn, rolling out precisely on course. We power back and select the first notch of flaps to slow down. Reno Approach calls, reports us six miles from TAKLE, and clears us for the ILS16R approach, pilot nav.

We activate the approach on the GPS and move the ILS frequency into the active window.

GPSS continues to steer the plane to the initial approach fix, TAKLE, and, at TAKLE, turns us outbound on a 344º course for the procedure turn (**Figure 3-39**). We see the procedure turn drawn on the base map ahead of us and watch it turn magenta as GPSS turns and flies the procedure turn for us, with no further pilot action required.

Figure 3-39
360º Mode Showing Procedure Turn, GPSS Enabled

As GPSS completes the procedure turn and rolls out centered on our final approach course of 164º, we begin a descent down to 8,500 feet, which we will maintain until glideslope intercept.

1. Press the Right Knob twice to select ALT for editing.
2. Turn the Right Knob to set 8,500 as our Selected Altitude.
3. On reaching 8,500, re-engage ALT hold on the autopilot.

We are still navigating along the ILS16R approach using GPS, with GPS Steering driving the autopilot in HDG mode. We know we'll have to switch the autopilot to APPR mode before glideslope intercept in order for the autopilot to capture the glidescope and fly us down the ILS. But we'll continue in GPSS and HDG mode a while longer because it tracks the course more accurately with our aging autopilot.

Along this intermediate segment of the approach, watch for the 430W to switch automatically from GPS to VLOC output on its CDI.

- Watch for the EFD1000 CDI Source Select field to change from GPS1 to VLOC1.

This automatic switch from GPS to VLOC should occur 2–10 NM outside the Final Approach Fix (FAF). If it has not occurred automatically by 2 NM outside the FAF, manually press the CDI button on the 430W to make the switch to the ILS frequency, and the EFD1000 Pro PFD will follow by switching its Navigation Source Select to VLOC1.

As the PFD navigation source switches to the ILS on VLOC1, the LDI and VDI (**Figure 2-2, Refs. 36 and 37**) will appear on the Attitude Display.

1. The LDI Navigation Source Indication (**Figure 2-2, Ref. 31**) will show ILS, if it is receiving a valid glide slope signal, or LOC, if it is not receiving the glide slope (GS).
2. The CDI Source Information Block (**Figure 2-2, Ref. 65**) will also show ILS or LOC.

Even though the PFD Navigation Source for the CDI has switched to VLOC1 and the ILS, and the CDI, LDI and VDI are showing deviation relative to the localizer and glideslope, we still have GPSS Enabled with the autopilot in HDG mode. We are not yet flying the ILS, required for this approach. GPSS is still shown in the inverse green label next to the GPSS Hot Key, and GPSS1 and an inverse A are still shown at the top of the Navigation Display where the numerical HDG value is usually shown.

Unlike earlier versions of the EFD1000 Pro PFD, v2.0 software now permits GPSS to be enabled even when VLOC is selected as the CDI navigation source.

Whenever GPSS is enabled on the PFD, and the autopilot is in HDG mode, the autopilot will fly the GPS flight plan. The autopilot must be switched to NAV or APPR mode in order to fly the VLOC source selected for the CDI and to capture and track the glideslope of an ILS, or even an RNAV approach with vertical guidance.

A couple of miles outside the FAF (TAKLE), we switch to APPR mode on the autopilot, which begins to track the localizer and is armed for glideslope capture. At this point, we could Disable GPSS on the PFD by pressing the Hot Key to remove potentially confusing annunciations on the PFD, but we know our equipment well. We understand fully that GPSS is just another form of HDG as far as the autopilot is concerned, and the autopilot will not fly GPSS unless it is in HDG mode. So we leave GPSS enabled on the PFD, planning to use it to fly the Missed Approach if necessary.

With that setup, if we have to fly the Missed Approach, we'll do so by hitting Go Around mode on the autopilot and climbing straight ahead to 6,700 feet. Then we'll engage the autopilot in HDG mode, and GPSS will initiate the turn direct to FMG VOR, and (because we have a WAAS GPS) then enter and fly the hold for us, all automatically. All we have to do is level off when reaching 11,000 feet (and if we had Altitude Pre-Select on the autopilot, it would even do that for us, too!).

CAUTION

The Garmin 400/500 series navigators continue to output GPS Steering commands to follow the GPS flight plan even when the CDI source is set to VLOC.

Unlike earlier versions of the EFD1000 Pro PFD, v2.0 software now permits GPSS to be enabled even when VLOC is selected as the CDI navigation source.

Whenever GPSS is Enabled on the PFD, and the autopilot is in HDG mode, the autopilot will fly the GPS flight plan. The autopilot must be switched to NAV or APPR mode in order to fly the VLOC source selected on for the CDI, and to capture and track the glideslope of an ILS or even an RNAV approach with vertical guidance.

Figure 3-40
Vertical and Horizontal Deviation Inidcator Showing Glide Slope

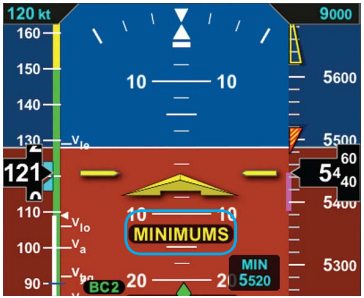

Figure 3-41
MINIMUMS Alert

When the GS is full-scale deflection above us, the GS indicator on the VDI will show as a hollow diamond at the top of the scale (**Figure 3-40**). When the GS comes alive, the indicator will change to a solid green diamond and begin to move down the scale. Just before intercepting the GS, we drop the gear and check for three green lights. On GS intercept, we verify that the autopilot switches to GS capture and begins to track down the glide slope.

We continue to monitor the approach and verify that the autopilot is tracking both localizer and glide slope. The weather is well above minimums, and we intend to land out of the approach but will let the autopilot fly it down to minimums. As we get close to minimums, a green triangle appears on the altimeter tape at 500 feet above minimums; a hollow yellow Minimums Triangle appears with its tip at 200 feet above minimums and its base at 100 feet above. A red striped triangle appears at the MINIMUMS setting. These three colored markers on the altimeter tape give us visual cues that we are approaching minimums.

On reaching our pre-set minimums (5,520 feet):

- The MINIMUMS alert displays below the Aircraft Reference Symbol on the ADI (**Figure 3-41**).
- The alert tone sounds three times.

We disconnect the autopilot and hand-fly the plane to landing, continuing to fly the Flight Director and track the glide slope down to a smooth landing.

3.3. **Conclusion**

The EFD1000 Pro PFD is a powerful addition to any cockpit, providing far more capability, information, and automation than the mechanical instruments it typically replaces. While it is simple and intuitive enough to start using with only a short orientation, fully understanding and exploiting all of its features require some study and experience.

Chapter 4 covers all of the EFD1000 Pro PFD's features in detail. **Chapter 5** explains how to customize the PFD to suit your preferences. **Chapter 6** addresses Emergency and Abnormal procedures. Please read through all these chapters for a fuller understanding of how to use your EFD1000.

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Chapter 4
Reference Guide

The EFD1000 PFD is a panel-mounted Electronic Flight Instrument System (EFIS) that presents the pilot with displays of attitude, altitude, indicated airspeed, heading, rate of turn, slip/skid, and navigation course deviation information. The system also displays supplemental flight data, such as winds, TAS, OAT, moving maps, pilot-selectable indices (bugs), and various annunciations to increase situational awareness and enhance flight safety. Moving map situational awareness information is displayed when the unit is connected to compatible GPS equipment.

The EFD1000 PFD system components include the EFD1000 PFD display head, a Remote Sensor Module (RSM), a Configuration Module (CM), and the optional Analog Converter Unit (ACU). **Chapter 1, Welcome and Introduction**, provides a detailed discussion on the EFD1000 PFD system components.

When interfaced with a compatible autopilot, the EFD1000 PFD system provides heading and course information to the autopilot, which enables the autopilot to follow the Course and Heading values set by the pilot on the EFD1000 PFD in much the same way as with a mechanical HSI. When interfaced with a compatible GPS, the EFD1000 PFD can provide GPS Steering (GPSS) to an autopilot.

NOTE

The optional ACU enables the interface of the EFD1000 PFD system with legacy panel-mounted GPS navigators, VOR/Localizer radios, and autopilots.

4.1. **Air Data, Attitude and Heading Reference System (ADAHRS)**

One of the many benefits of glass cockpit systems like the Aspen Evolution system is that they replace old, less-reliable mechanical instruments and sensors with electronic equivalents. For aircraft primary flight instruments, spinning metal gyros are replaced with electronic gyros and accelerometers, and mechanical air data instruments (airspeed indicator, altimeter, and VSI) are replaced by electronic sensors to measure static and ram air pressures. As we've all seen with computers and consumer goods, these modern electronic systems tend to be smaller, faster, cheaper, and more reliable than the older technologies they replace, while also enabling many new, advanced features and capabilities.

An electronic system that replaces the functions of the six primary flight instruments is often called an ADAHRS (Air Data, Attitude, and Heading Reference System). Sometimes, two separate systems work together to deliver those functions: an AHRS for attitude and heading, and an ADC (Air Data Computer) for airspeed, altitude ,and vertical speed. Aspen uses an integrated ADAHRS mounted to the back of the EFD1000 display. While such systems deliver the same basic information to the pilot as the old mechanical instruments, they work in very different ways. It is important that the pilot have at least a basic understanding of how an ADAHRS works to better understand the sorts of failure modes or degraded performance than can occur, how to recognize the symptoms, and what corrective actions the pilot can take.

The EFD1000 uses Micro Electro-Mechanical Systems (MEMS) technology and solid-state accelerometers and magnetometers on all three axes to provide the attitude reference. Generally, MEMS attitude solutions use multiple sensors and inputs, processed through Kalman filter software, to derive and validate the attitude solution.

The Aspen system uses more than a dozen different inputs to determine and monitor the aircraft attitude. In this way, the system can validate the derived attitude indication by cross-checking the various inputs to the solution for consistency.

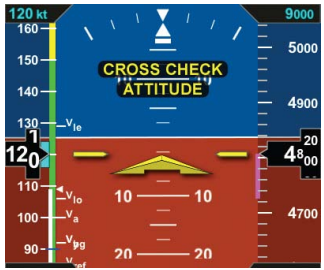
4.1.1. **Attitude**

The Aspen ADAHRS attitude solution uses inputs from its internal three-axis accelerometers, rate gyros,and magnetometers, supplemented by ram and static air pressure inputs from the aircraft pitot-static system. Failures or incorrect input from any of these sensors (such as might occur if the pitot tube or static system become blocked) will affect the attitude solution. The EFD1000 is designed to be robust to such failures, either by being tolerant to incorrect inputs, or by detecting and annunciating a degraded attitude solution.

The Aspen ADAHRS includes a Cross-Check Monitor, which predicts the quality of the attitude solution by performing a continuous, real-time statistical analysis of the various parameters computed within the AHRS Kalman filter. When the predicted quality of the attitude calculation drops below a certain threshold, CROSS CHECK ATTITUDE is annunciated on the attitude indicator (**Figure 4-1**). The annunciation thresholds for the CROSS CHECK ATTITUDE message were determined during company flight tests, and strike a balance between minimizing nuisance annunciations (when the attitude solution is fine) and failing to annunciate (when the attitude solution is significantly degraded). This balance can occasionally result in momentary CROSS CHECK ATTITUDE annunciations, especially during aggressive maneuvering, steep or high-G turns, abrupt pitch changes, etc.

In such situations, these annunciations indicate that the statistical quality of the attitude solution is less than nominal,and that the pilot should cross-check the AHRS against alternate attitude indications. Should the annunciation persist, then degraded AHRS performance is statistically more likely to be experienced. In other words, momentary CROSS CHECK ATTITUDE annunciations indicate that the AHRS solution is working hard enough that the AHRS quality measure has degraded to something less than that associated with normal, unaccelerated flight. This situation demands increased pilot vigilance and cross-monitoring of other cockpit instrumentation.

Figure 4-1
Cross Check Attitude
Annunciation



4.1.2. **Pitot Obstruction Monitor**

Most light aircraft have only a single pitot and static system available for flight instrument use. As such, a common pitot and static input is shared between the EFD1000 PFD and the EFD1000 MFD. Should one or both of these pitot and static lines become blocked, such as might occur due to an inadvertent icing encounter or from water trapped in the lines, then both the EFD1000 PFD and MFD, as well as any standby airspeed and altitude indicators, could display erroneous airspeed and altitude information. Furthermore, because the EFD1000 uses pitot and static pressures as part of the AHRS attitude calculations, loss or corruption of the pitot or static pressures can also influence the accuracy of the displayed attitude information.

The EFD1000 has been tested to be robust to these failures, either by being tolerant to incorrect pitot or static inputs, or by detecting and annunciating a degraded attitude solution. When connected to an IFR-certified GPS, the system is further able to detect and annunciate blockages in the pitot system and will fail the attitude solution before it becomes degraded. In that case, the system will red X the attitude and heading information, and display a CHECK PITOT HEAT message as a reminder to the pilot to check for ice accumulating on the pitot probe.

Once the system detects that the pitot obstruction has been cleared, the CHECK PITOT HEAT annunciation is removed, and the system automatically performs an AHRS in-flight reset.

Should a GPS failure be experienced in flight, the Pitot Obstruction Monitor continues to operate in a fail-safe mode and will continue to detect obstructions in the pitot system that may occur while airborne. However, after landing, the monitor remains active, and, as the airplane slows to taxi speeds, the system will indicate a failure of the AHRS and post the CHECK PITOT HEAT message. In this circumstance, restoring the GPS system will restore normal monitor operation.

In summary, loss or degradation of the EFD1000 attitude solution is unlikely if the pilot takes care to ensure proper operation of the pitot-static systems. If the pitot or static system becomes blocked, an ADAHRS internal sensor fails, or a CROSS CHECK ATTITUDE indication is frequent or persists, the attitude indication on the PFD should be considered to be compromised. In this circumstance, the pilot must use the backup attitude indicator for attitude reference until the cause of the problem is resolved and normal system operation has been restored.

4.1.3. **Heading**

The EFD1000 PFD ADAHRS also includes a slaved compass system that provides accurate magnetic heading indications throughout most operating conditions and phases of flight. Its electronic gyros compensate for northerly turning and acceleration errors, and its remote fluxgate compensates for gyroscopic precession errors, so there is no need for the pilot to adjust heading throughout the flight. Nonetheless, all compass systems are subject to some error, and the pilot should be aware of when and how the EFD1000 PFD's heading indication can be affected.

The earth's magnetic field is measured directly by a 3-axis fluxgate magnetometer built into the Remote Sensor Module (RSM), and magnetic heading is derived from the flux on a plane perpendicular to gravity, providing immunity from pitching and rolling effects. Electronic gyros and accelerometers in the EFD1000 system are then used to stabilize that raw heading data to eliminate the short-term dip and acceleration errors seen in traditional wet compasses.

Together, these systems provide an accurate heading indication even during most abnormal flight maneuvers. The gyros stabilize magnetic errors while maneuvering and are slaved to the fluxgate, which constantly updates heading to compensate for gyroscopic precession. The end result is a compass system that requires no pilot action to show accurate magnetic heading throughout the flight.

The fluxgate's accuracy is affected by where it is installed on the airframe, just like other compass systems. Ferrous metal structures, electrical fields produced by motors, pumps, and wiring, magnets in cabin speakers, and other airframe-related sources of interference (either constant or momentary, such as when an electric trim motor is activated) can all affect the accuracy of the compass. The installer can compensate for much of this interference when swinging the compass, but some effects cannot be eliminated (especially interference from systems that are not in constant use, such as the operation of pumps and motors, and electric windshield heat). Thus, proper location of the RSM during installation of the EFD1000 PFD is critical to the system's accuracy.

Furthermore, all magnetic compass systems are susceptible to local disturbances in the earth's magnetic field (some of which are shown on aviation charts or by NOTAM) and will exhibit degraded performance when operating in extreme northern and southern latitudes close to the earth's magnetic poles.

4.1.4. **Free Gyro Mode**

When the EFD1000 system detects that the horizontal component of the earth's magnetic field is no longer strong enough to provide reliable heading data, the EFD1000 will detect the condition and will annunciate that the heading system is no longer slaved to magnetic north. If the condition persists, attitude and heading are removed.

While the condition can occur at greater distances from the poles, it is most likely to be observed within 750 nautical miles from the magnetic pole. In the Northern Hemisphere, this equates to operations in the Arctic Islands found north of continental North America.

Two minutes after detection, a FREE GYRO MODE message will be presented across the HSI, indicating the heading system is no longer slaved to magnetic North. Some precession of heading is possible, especially during abrupt maneuvers. If the condition persists for four more minutes (six minutes total) the attitude and heading indicators will be removed and replaced with red X indications. When the conditions causing Free Gyro Mode disappear, attitude and heading indications will be restored after automatic reset.

4.1.5. **Degraded ADAHRS Performance**

See **Sections 6.1. Pitot/Static System Blockage**, **6.8. In-Flight AHRS Reset**, and **Geographic Limitations** in the **Aircraft Flight Manual Supplement** document number **0044-00009-001**.

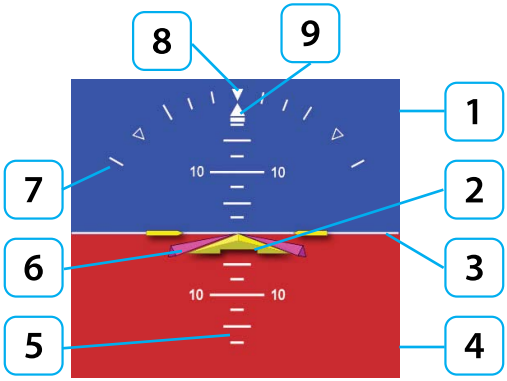


Figure 4-2
Attitude Indicator

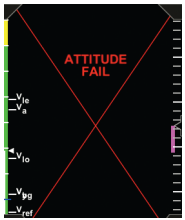


Figure 4-3
Pitch and/or Roll Data Flagged Invalid

NOTE

*A red X and the annunciation ATTITUDE FAIL displays on the Attitude Indicator as long as pitch or roll attitude data is flagged invalid (***Figure 4-3***).*

4.2. **Attitude Display**

4.2.1. **Attitude Indicator**

The Attitude Indicator consists of an aircraft reference symbol on a blue (sky) and brown (ground) background. The white horizon line separates the sky from the ground and extends to the edge of the display. The Roll Scale curves over the top of the Attitude Indicator while the Pitch Scale extends vertically in the middle. The slip/skid rectangle is directly underneath the roll pointer (**Figure 4-2**).

1	Sky	6	Flight Director
2	Aircraft Reference Symbol	7	Roll Scale
3	Horizon Line	8	Roll Pointer
4	Ground	9	Slip/Skid Indicator
5	Pitch Scale		

The Attitude Indicator cannot be disabled by the pilot. The Aircraft Reference Symbol is fixed relative to the Attitude Indicator and overlays all other Attitude Indicator symbols. A pitch offset adjustment (+/- 10°) is provided to installers to compensate for variations in installations and slight panel tilts.

4.2.1.1. **Roll Scale**

The Roll Scale is displayed at the top of the Attitude Indicator and comprises a moving scale set against a fixed, white, triangle roll pointer. Tick marks are displayed at 0º, 10º, 20º, 30º, 45º, and 60º of roll. The 45º marks are triangles.

4.2.1.2. **Pitch Scale**

The pitch scale consists of minor pitch marks in 2.5º increments up to ±20º and major pitch marks in 10º increments up to ±90º. Red chevrons come into view for nose-up pitch angles of 15º or more (**Figure 4-4**), and nose-down pitch angles of 10º or less (**Figure 4-5**). The pitch chevrons aid the pilot in unusual attitude recovery.

The range of movement of the background sky and ground boundaries are limited so that some sky or ground is always visible.

4.2.1.3. **Slip/Skid Indicator**

The Slip/Skid Indicator is the small white rectangle under the roll pointer. The Slip/Skid Indicator moves left and right relative to the roll pointer in proportion to lateral acceleration. The width of the rectangle is equivalent to the width of the ball in a mechanical inclinometer.

4.2.1.4. **Flight Director**

When connected to a compatible autopilot and configured through an ACU during installation, the EFD1000 PFD displays a single-cue (two-axis) flight director on the Attitude Indicator (**Figure 4-6**). The pilot may follow the flight director's pitch and roll cues, even when the autopilot is not engaged, to remain on heading or altitude, climb or descend, turn, or navigate along a programmed flight path.

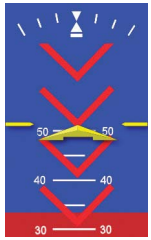


Figure 4-4
Pitch Markings - Large Pitch Down

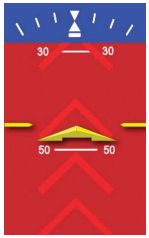
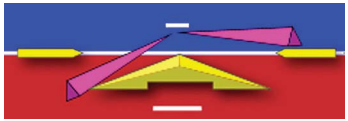


Figure 4-5
Pitch Markings - Large Pitch Up

Figure 4-6
Flight Director



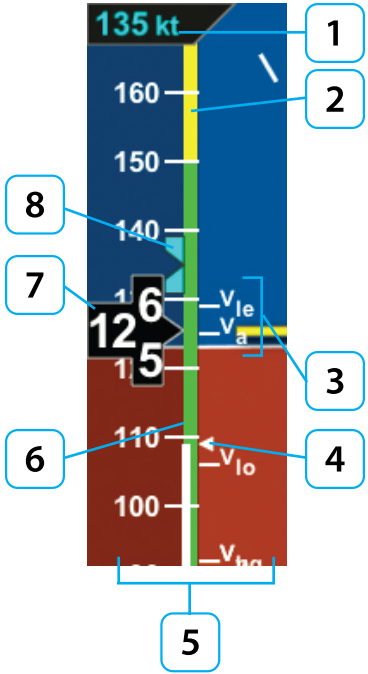
NOTE

Refer to the autopilot's AFMS for information on the operation of the flight director. The Flight Director is a visual representation of the pitch and roll commands from the autopilot. The Flight Director's pitch and bank limits are based on the emulation mode set at installation and are limited to +/- 45° roll and +/- 25° pitch.

4.2.2. **Airspeed Indicator**

The Airspeed Indicator comprises a moving tape, airspeed bug, and numerical airspeed value (drum). Textual Vspeeds, color Speed Bands, and Speed Markers are also rendered on the moving tape (**Figure 4-7**).

Figure 4-7
Airspeed Indicator

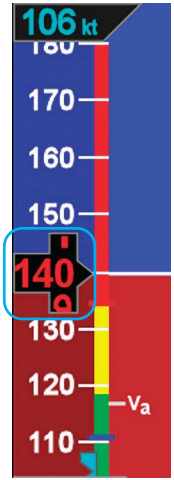


1	Selected Airspeed
2	Color Speed Bands
3	Textual Vspeeds
4	Initial Flap Extension Speed Marker
5	Airspeed Tape
6	Speed Markers
7	Numerical Airspeed Value (drum)
8	Selected Airspeed Bug

Indicated airspeed is displayed in knots or miles per hour, set at installation, with tick marks rendered on the Airspeed tape every ten (10) units. Speed Bands and Speed Markers are configured during installation and cannot be changed or removed by the pilot. The textual Vspeeds are pilot-configurable and are discussed in **Chapter 5, Customizing the PFD**. Although the pilot can set the selected airspeed (bug), there is no visual or aural annunciation provided when the actual airspeed deviates from the selected airspeed value.

The numerical airspeed value is displayed in a rolling drum format in the center of the airspeed tape with numbers moving downward as speed increases, and upward as speed decreases. The display range of the indicated airspeed is 20–450 (knots or miles per hour). The numerical airspeed value is displayed in red when Vne is exceeded or when the airspeed drops below Vs0 during stalls or landing roll-outs (**Figure 4-8**).

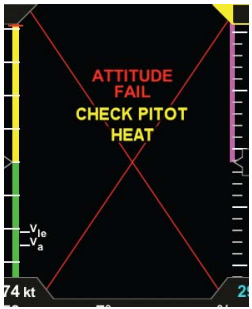
Figure 4-8
Actual Airspeed Greater Than the Vne



NOTE

*When airspeed is less than 30 knots but ground speed is greater than 50 knots for more than 30 seconds, a red X and annunciation of CHECK PITOT HEAT is displayed on the Attitude Indicator (***Figure 4-9***).*

Figure 4-9
Airspeed <30kts, Ground Speed >50kts Annunciation



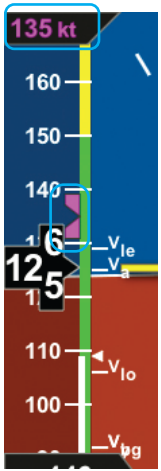


Figure 4-10
Airspeed Bug Selected to Edit

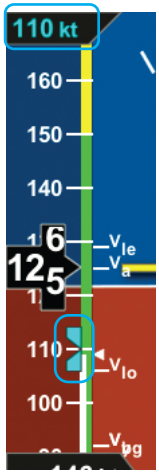


Figure 4-11
New Airspeed Selected

NOTE

A typical installation sets the tapes display to UNLOCKED, allowing the pilot to display or hide the Airspeed and Altitude tapes as desired. If the Airspeed and Altitude Tapes were LOCKED ON during installation, the tapes will remain on. If the Airspeed and Altitude Tapes were LOCKED OFF during installation, the tapes will not display.

4.2.2.1. **Selected Airspeed**

The Selected Airspeed value (bug) is rendered on the Airspeed Tape numerically and graphically. The numerical value is shown at the top of the Airspeed Tape. The bug is displayed adjacent to the Airspeed Tape when the Selected Airspeed value is within the visible range of the tape. The default value of the Selected Airspeed is 20 units, or the value previously set. Synchronizing the IAS field sets the Selected Airspeed value to the current indicated airspeed (**Section 2.2.1.3**). Setting the Selected Airspeed to a value less than 20 disables the bug and dashes the Selected Airspeed display.

Set Airspeed Bug

1. Press the Left Knob until IAS displays above the Left Knob and the Selected Airspeed field and bug are enabled for editing, all rendered in magenta (**Figure 4-10**).
2. Rotate the Left Knob to change the value of the Selected Airspeed field. Rotate clockwise to increase, or counterclockwise to decrease, the value. Once the correct value is selected, and after 10 seconds of inaction, the field is disabled, and the label, field, and bug are rendered in cyan (**Figure 4-11**).

4.2.2.2. **Airspeed Display**

In some configurations, such as a stand-alone PFD, the airspeed tape can be turned off, at the pilot's discretion, to facilitate screen declutter. This setting will be retained when the EFD1000 PFD system is turned off and then powered-on again.

Hide/Display Airspeed Tape

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob counterclockwise until GENERAL SETTINGS B menu page displays (**Figure 4-12**).
3. Push the TPS Menu Key. The menu label turns magenta, and the EDIT VALUE label displays above the Right Knob.
4. Rotate the Right Knob to the desired value, ENABLE (On)or DISABLE (Off) (**Figure 4-13**).
5. Push the MENU Button to exit the Main Menu.

NOTE

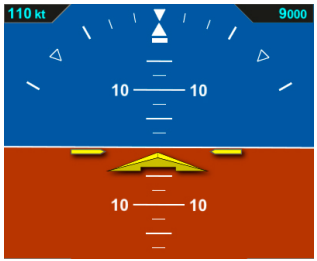
Both the Airspeed and Altitude tape are affected by this action.

NOTE

When the Airspeed tape is disabled, the numerical display of the selected airspeed remains on.

Figure 4-12
Editing Airspeed Tape Display

Figure 4-13
Airspeed Tape Disabled



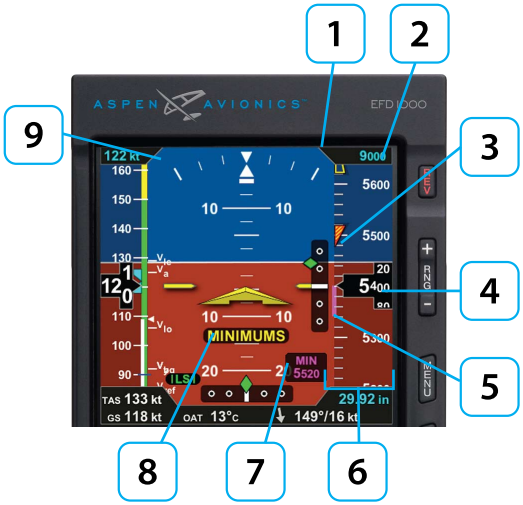


Figure 4-14
Altimeter

Figure 4-15
Altitude Failure

4.2.3. **Altimeter**

The altimeter comprises an altitude bug, a numerical altitude value (drum), a moving tape, a MINIMUMS annunciation and adjustable value, a Decision Height (DH) alert, and a visual/aural altitude alerter (**Figure 4-14**).

1	Altitude Alerter	6	Altitude Tape
2	Selected Altitude	7	MINIMUMS Adjustment
3	Altitude Bug	8	MINIMUMS Alert
4	Numerical Altitude Value	9	Decision Height Alert
5	Altitude Trend Vector		

The Altitude Tape range is from -1,600 to 51,000 feet. Major tick marks are provided every 100 feet and minor tick marks every 20 feet. A barometric pressure adjustment is provided to the pilot for display of altitude above mean sea level.

The numerical altitude value is displayed in a rolling drum format in the center of the altimeter tape, with numbers moving downward as the altitude increases and upward as altitude decreases. The numerical altitude value shows the altitude to the nearest 20 feet. A magenta Altitude Trend Vector predicts the anticipated altitude, in the next six seconds, if the current rate of climb or decent is maintained.

If the altitude exceeds 51,000 feet, the numerical altitude value is dashed, and the tape is frozen at this limit. All altitude information is removed and replaced with a red X with the textual annunciation of ALT FAIL when altitude data is invalid (**Figure 4-15**).

4.2.3.1. **Barometric Pressure Adjustment (BARO)**

Barometric pressure adjustment may be made in either inches of mercury (in) (**Figure 4-16**) or millibars (mB) (**Figure 4-17**), as configured by the pilot. The adjustment range is 28.10 – 30.99 inches Hg or 946 – 1049 mB. The Barometric pressure default value is 29.92 inches, or as previously set.

Figure 4-16
Baro Shown in Inches of Mercury

Figure 4-17
Baro Shown in Millibars

Set Barometric Units of Measure

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob to select the GENERAL SETTINGS B menu page (**Figure 4-18**).
3. Push the BARO Menu Key. The menu label turns magenta, and the EDIT VALUE label displays above the Right Knob (**Figure 4-19**).
4. Rotate the Right Knob to select either IN or mB (**Figure 4-20**).
5. Push the MENU Button to exit the Menu.

Figure 4-18
Editing Baro Setting, GENERAL SETTINGS B

Figure 4-19
Editing BARO

Figure 4-20
BARO Set to mB (millibars)

Figure 4-21
BARO Field Enabled

Set the Barometric Pressure

1. Press the Right Knob until BARO displays above the Right Knob and the barometric pressure field is enabled for editing, both rendered in magenta (**Figure 4-21**).
2. Rotate the Right Knob to change the value of the barometric pressure field. Rotate clockwise to increase, or counterclockwise to decrease, the value. Once the correct value is selected, and after 10 seconds of inaction, the field is disabled, and the label and field are rendered in cyan.

4.2.3.2. **Selected Altitude**

The Selected Altitude value is displayed at the top of the Altitude Tape. The Selected Altitude range is 100 to 51,000 feet, in 100 foot increments. The default value for the Selected Altitude value is 100 feet, or the previously set value. Additionally, an altitude bug is displayed adjacent to the Altitude Tape and at the selected altitude when within the visible range of the current altitude.

NOTE

Adjust the EFD1000's barometric pressure whenever the mechanical altimeter's barometric pressure is adjusted.

NOTE

Since the altitude tape display is limited to approximately 400 feet, the altitude bug symbol only displays on the altitude tape when the selected altitude is within the visible range of the current altitude.

Set Altitude Bug

1. Press the Right Knob until ALT displays above the Right Knob and the Selected Altitude numerical field and bug are enabled for editing, all rendered in magenta (**Figure 4-22**).
2. Rotate the Right Knob to change the value of the numerical Altitude field. Rotate clockwise to increase, or counterclockwise to decrease, the value. Once the correct value is selected, and after 10 seconds of inaction, the field is disabled, and the label, field, and bug are rendered in cyan.

4.2.3.3. Altitude Level-Off and Deviation Alert

The altitude level-off alert is ARMED and rendered on-screen as a yellow alert flag next to the Selected Altitude value when the aircraft altitude transitions within 200 feet of the selected altitude (**Figure 4-23**). If an optional Sonalert tone generator device is installed, a one-second tone also sounds. Once the current altitude is within ± 25 feet of the selected altitude, the alert flag extinguishes and the selected altitude is CAPTURED (**Figure 4-24**).

After reaching the selected altitude, if the aircraft's current altitude differs from the selected altitude by more than 200 feet, the yellow alert flag flashes. If an optional Sonalert tone generator device is installed, a one-second tone also sounds.

4.2.3.4. MINIMUMS Alert

The EFD1000 PFD provides an adjustable MINIMUMS field to enhance situational awareness during instrument approaches. The EFD1000 Pro PFD provides MINIMUM information with an annunciation and with a series of markers on the altitude tape that provide the pilot with advance awareness when approaching and when operating at minimums. There are three different colored markers that are shown on the altitude tape that are associated with the MINIMUMS alert, as described in **Table 4-1**.

NOTE

Rotating the knob quickly will change the altitude value in larger increments.

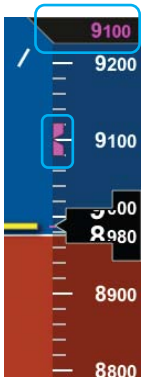


Figure 4-22
Altitude Bug/Alerter Field Enabled

Figure 4-23
Altitude Alert

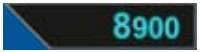


Figure 4-24
Selected Altitude Capture and Aircraft Level-off

Marker Color	Description	
Green	The aircraft is 500 feet above selected MINIMUM.	 Figure 4-25 Minimums Green Triangle
Hollow Yellow	The aircraft is between 200 and 100 feet above the selected MINIMUM. The marker base is at 100 feet above MINIMUM, and the tip is at 200 feet above MINIMUM.	 Figure 4-26 Minimums Yellow Triangle
Red Striped	The aircraft is at the selected MINIMUM.	 Figure 4-27 Minimums Red Striped Triangle

Table 4-1 Selected MINIMUMS Markers

Once the MIN data field value is set to a Decision Height or Minimum Descent Altitude, the EFD1000 PFD provides an alert when the aircraft descends below this altitude. To activate this feature, enable the MINIMUMS display and set the desired MINIMUM altitude using the Right Knob to adjust the field value.

Display/Hide Minimums

- Press the MIN Hot Key to alternately hide or display the MINIMUMS display (**Figures 4-28 and 4-29**).

The range for the MIN data field is 0 – 15,000 feet, in increments of 10 feet. Synchronizing sets the MIN data field value to the current altitude (**Section 2.2.1.3**). The default value is 100 feet, or the previously set value.

Figure 4-28
MIN Hot Key – Selected
Minimums Disabled

NOTE

Pressing the MIN Hot Key turns on the MINIMUMS display and enables the MIN data field for editing. The MIN label displays above the Right Knob in Magenta and the MIN data field's numerical value is also rendered in Magenta. See Step 2 of Set Altitude Minimum.

Figure 4-29
Selected Minimums Enabled

Figure 4-30
MIN Field Enabled

Figure 4-31
New MIN Setting

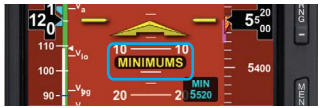


Figure 4-32
Minimums Alert Active

Set Altitude Minimum

1. Press the Right Knob until MIN displays above the Right Knob and the MINIMUMS field is enabled for editing, both rendered in magenta (**Figure 4-30**).
2. Rotate the Right Knob to change the value of the MINIMUMS field. Rotate clockwise to increase, or counterclockwise to decrease, the value. Once the correct value is selected, and after 10 seconds of inaction, the field is disabled (**Figure 4-31**).

If the aircraft's altitude becomes lower than the MINIMUMS field's setting, the MINIMUMS annunciation displays below the Aircraft Reference Symbol and, if configured, the Sonalert tone sounds three times (**Figure 4-32**). If the aircraft reaches an altitude 100 feet greater than the MINIMUMS field setting, the MINIMUMS alert is removed. Additionally, the MINIMUM markers on the altitude tape display provide the pilot with additional awareness of aircraft altitude with respect to the set MINIMUMS.

4.2.3.5. **Decision Height**

If a radar altimeter is installed and connected to the EFD1000 PFD, a Decision Height annunciation displays whenever the external input commands the DH annunciator ON. The Decision Height alert is a fixed-position, yellow DH displayed near the upper right corner of the Attitude Indicator (**Figure 4-33**).

Figure 4-33
DH Alert Active

4.2.3.6. **Altitude Display**

In some configurations, such as a stand-alone PFD, the altitude tape can be turned off, at the pilot's discretion, to facilitate screen declutter. Both the Airspeed and Altitude tape are affected by this action.

Hide/Display Altitude Tape

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob counterclockwise until GENERAL SETTINGS B menu page displays (**Figure 4-34**).
3. Push the TPS Menu Key. The menu label turns magenta, and the EDIT VALUE label displays above the Right Knob.
4. Rotate the Right Knob to the desired value, ENABLE (On)or DISABLE (Off) (**Figure 4-35**).
5. Push the MENU Button to exit the Main Menu.

NOTE

A typical PFD only installation sets the tapes display to UNLOCKED, allowing the pilot to display or hide the Airspeed and Altitude tapes as desired. If the Airspeed and Altitude Tapes were LOCKED ON during installation, such as the case with a PFD and MFD configuration, then the tapes must remain on. If the Airspeed and Altitude Tapes were LOCKED OFF during installation, the tapes will not display.

Figure 4-34
Editing Altitude Tape Display

Figure 4-35
Altitude Tape Disabled

NOTE

When the Altitude tape is disabled, the numerical display of the selected altitude and altitude minimums remain on. The decision height and minimums annunciations operate as configured.

4.2.3.7. **Altitude Trend Vector**

The vertical trend is depicted as a magenta ribbon immediately adjacent to the altitude indicator. The end of the vertical trend ribbon shows where the altitude will be in six (6) seconds, at the current vertical trend. Like the VSI, there is a slight lag in the indication. If the ribbon meets or exceeds the display limit, the vertical trend is large. The Trend Vector does not display when the altitude remains constant.

4.3. **Data Bar**

The Data Bar presents True Airspeed (TAS), GPS Ground Speed (GS), Outside Air Temperature (OAT), Wind Direction, Wind Speed, and Barometric Pressure Setting, as shown in **Figure 4-36**. The data bar is always present on the display. Invalid or out-of-range Data Bar values are dashed.

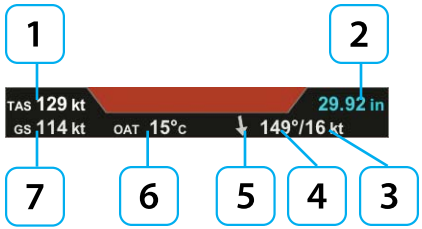


Figure 4-36
Data Bar

1	True Airspeed	5	Wind Direction Arrow
2	Barometric Pressure Setting	6	Outside Air Temperature
3	Wind Speed	7	GPS Ground Speed
4	Wind Direction		

NOTE

If the OAT was set to disabled during installation, as would be the case if the RSM is mounted internally to the aircraft structure, then the OAT, TAS, and Wind Speed and Direction are not displayed.

4.3.1. **True Airspeed (when enabled)**

The True Airspeed (TAS) is displayed on the upper left of the Data Bar with a value range of 20–999 knots or mph, using the same unit of measurement as the Airspeed Indicator. The TAS is a correction of the IAS for nonstandard pressure and temperature.

4.3.2. **Ground Speed**

The Ground Speed (GS) is digitally displayed on the lower left corner of the Data Bar with a value range of 5–999 knots or mph, using the same unit of measurement as the Airspeed Indicator.

Figure 4-37
Select OAT Units of Measure

4.3.3. Outside Air Temperature (when enabled)

The Outside Air Temperature (OAT) is digitally displayed on the center of the Data Bar. The temperature is obtained from the temperature sensor located in the RSM ranges from -99–999 degrees Celsius or Fahrenheit, as set in the Main Menu.

Set OAT Units of Measure

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob counterclockwise until GENERAL SETTINGS B menu page displays.
3. Push the OAT Menu Key. The menu label turns magenta, and the EDIT VALUE label displays above the Right Knob (**Figure 4-37**)
4. Rotate the Right Knob to select either °C or °F (**Figure 4-37**).
5. Push the MENU Button to exit the Menu.

4.3.4. Wind Speed, Direction, and Arrow (when enabled)

Figure 4-38
Wind Direction Arrow

The Wind Speed, Direction, and Direction Arrow are displayed in the lower right portion of the Data Bar. The Wind Speed has a range of 10–999 knots or mph, using the same unit of measure as the Airspeed Indicator.

The Wind Direction and Arrow (**Figure 4-38**) have a range of 001°–360°, using the same direction reference used by the Direction Indicator. The arrow points in the direction of the wind and is displayed relative to the current direction of flight. For example, if the current direction of flight is 360 and the wind is from 360, the arrow will point straight down on the display (a headwind blowing toward your aircraft).

When the computed wind speed is below 10 knots or mph (depending on aircraft configuration) the wind speed and direction values are blank, and the wind arrow is removed. If the wind data is out of range or invalid, the values are dashed, and the wind arrow is removed.

NOTE

The wind computations require a GPS supplied ground track and groundspeed to compute the wind direction and speed. If a GPS is not connected to the EFD1000 PFD or the data are invalid, the wind direction and speed are dashed and the wind direction arrow is removed.

4.3.5. **Barometric Pressure Setting Display**

The Barometric Pressure field is digitally displayed on the upper right corner of the Data Bar and is pilot-adjustable, as discussed in **Section 4.2.3.1**. When the Altitude Tape is disabled, the barometric pressure setting field remains visible. **Section 4.2.3.1** provides complete information and step-by-step instructions for setting the barometric pressure.

Figure 4-39
Horizontal Situation Indicator

4.4. **Navigation Display**

The Horizontal Situation Indicator (HSI) on the Navigation Display of the EFD1000 PFD, combines a Direction Indicator with a Course Deviation Indicator (CDI) (**Figure 4-39**).

The Direction Indicator comprises a compass, numerical direction indication, heading bug, aircraft track marker (when GPS ground track information is available), rate of turn indicator, and aircraft ownship symbol. The CDI is comprises a selected course pointer, deviation scale and indicator, TO/FROM indicators, and selected navigation source label and information block.

1	Navigation Source Info Block	8	Aircraft Ownship Symbol
2	Direction Indicator	9	Heading Bug
3	Rate of Turn Indicator	10	Selected Navigation Source
4	Selected Heading	11	Deviation Scale
5	Track Marker	12	Compass Scale
6	Selected Course Pointer	13	Deviation Indicator
7	TO/FROM Indicators		

NOTE

The shape, location, and size of the course pointer and deviation scale and indicator depend on the compass mode selected.

All instrument values on the HSI are displayed in degrees. The value range is from 001° — 360°, always displayed in three digits, and utilizing leading zeros when applicable. Magnetic North is numerically represented as 360°.

4.4.1. **Compass**

The EFD1000 PFD offers three compass modes: 360°, ARC HSI, and ARC CDI. The default compass mode is 360°. The aircraft's heading is always expressed as magnetic heading. The magnetic headings inside of the compass scale drop the last zero for brevity (i.e., 30°, 60°, 120°, 150°, 210°, 240°, 300°, and 330° are labeled 3, 6, 12, 15, 21, 24, 30, and 33, respectively). The four cardinal compass headings are shown as letters (i.e., N for 360°, E for 090°, S for 180°, and W for 270°).

Figure 4-40
360° Compass Mode

4.4.1.1. **360° Compass Mode**

The 360° Compass mode displays a full 360° compass rose with all other components of the Direction Indicator. The 360° compass rose rotation centers on the aircraft ownship symbol so that the numerical direction indication corresponds to the current aircraft heading (**Figure 4-40**).

Figure 4-41
ARC HSI Compass Mode

4.4.1.2. **ARC Compass Mode**

The two ARC Compass modes show an abbreviated 100° ARC compass scale. All other elements of the Direction Indicator are presented. The ARC compass scale's rotation centers on the aircraft ownship symbol so that the numerical direction indication corresponds to the current aircraft heading. The default ARC Compass mode is ARC HSI.

The ARC HSI Compass mode presents a rotating CDI, similar to that used in the 360° Compass mode (**Figure 4-41**).

The ARC CDI mode uses a fixed, non-rotating CDI indicator resembling a contemporary GPS navigation deviation display. The ARC CDI Compass mode is intended to maximize the lower display area for map and flight plan data (**Figure 4-42**).

Select ARC CDI/HSI Compass Mode

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob to the GENERAL SETTINGS A menu page (**Figure 4-43**).
3. Push the ARC MODE Menu Key. The menu label turns magenta, and the EDIT VALUE label displays above the Right Knob (**Figure 4-44**).
4. Rotate the Right Knob to select either HSI or CDI (**Figure 4-45**).
5. Push the MENU Button to exit the Menu.

Figure 4-42
ARC CDI Compass Mode

Figure 4-43
GENERAL SETTINGS, Page 1 of 7

Figure 4-44
Editing ARC MODE

Figure 4-45
CDI ARC MODE Selected

Select Compass Type

- Push the 360/ARC Hot Key (**Figure 4-46**) to alternately select either the 360° or ARC Compass. The Navigation Display changes and the Hot Key label reflects the currently selected compass type (**Figures 4-47 and 4-48**).

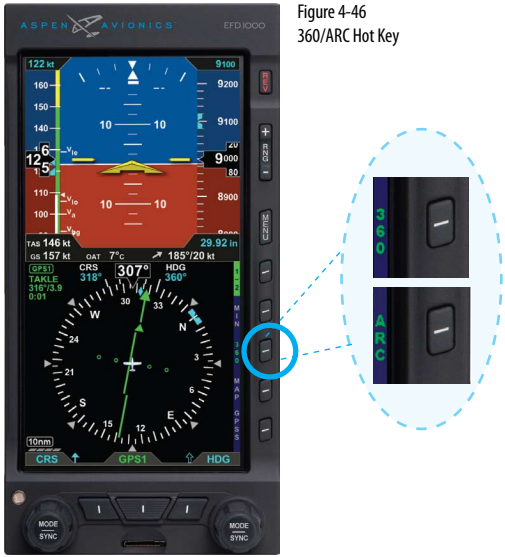


Figure 4-46
360/ARC Hot Key

Figure 4-47
ARC Compass Mode

Figure 4-48
360˚ Compass Mode

Figure 4-49
Reduced Length Course Pointer

Figure 4-50
Stub Course Arrowhead

Figure 4-51
Stub Course Tail

4.4.2. **Course Pointer**

For all compass modes, the arrowhead of the course pointer aligns with the corresponding value on the compass scale regardless of the aircraft heading. The ARC Compass HSI and CDI course pointers are different and are described in **Table 4-2**.

COMPASS	DESCRIPTION
ARC HSI	The course pointer length shortens as necessary when rotated to remain within the display area (**Figure 4-49**).
ARC CDI	The course pointer is shown as a stub arrow or tail whenever the CRS value or its reciprocal falls within the displayable range of the compass scale arc (**Figure 4-50** and **4-51**).

Table 4-2 ARC Compass Pointer Display

4.4.3. **TO/FROM Indicator**

Each of the compass modes has a TO/FROM indicator. The TO/FROM indicator shows whether the aircraft is heading toward a waypoint or radio navaid, or from a waypoint or radio navaid. For each compass mode, the TO/FROM indication is slightly different, as described in **Table 4-3**.

COMPASS	DESCRIPTION
360°	The TO indicator is an arrowhead on the top half of the Selected Course Pointer, oriented in the same direction as the course arrowhead (**Figure 4-52**). The FROM indicator is an arrowhead on the bottom half of the Selected Course Pointer, oriented in the direction opposite to the course arrowhead (**Figure 4-53**).
ARC HSI	The TO indicator is shown as two arrowheads, one on each half of the Selected Course Pointer, oriented in the same direction as the course arrowhead (**Figure 4-54**). The FROM indicator is shown as two arrowheads, one on each half of the Selected Course Pointer, oriented opposite to the direction of the course arrowhead (**Figure 4-55**).
ARC CDI	The TO indication is shown as TO on the left side of the deviation scale (**Figure 4-56**). The FROM indication is shown as FROM on the right of the deviation scale (**Figure 4-57**).

Table 4-3 TO/FROM Indicator Description

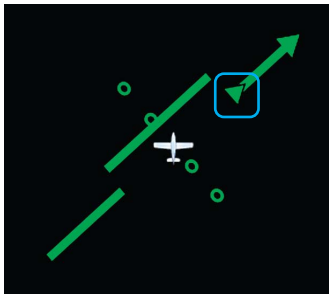


Figure 4-52
360° TO Indication

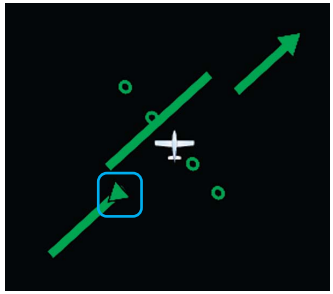


Figure 4-53
360° FROM Indication

Figure 4-54
HSI TO Indication

Figure 4-55
HSI FROM Indication

Figure 4-56
CDI TO Indication

Figure 4-57
CDI FROM Indication

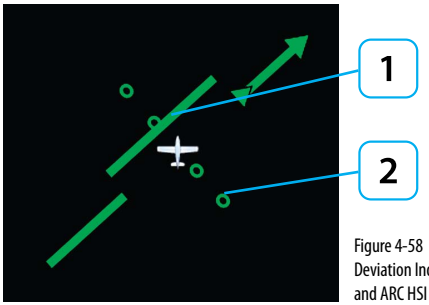


Figure 4-58
Deviation Indicator, 360° and ARC HSI

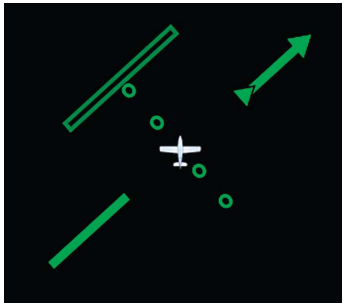


Figure 4-61
Exceeded Deviation, 360° and ARC HSI

4.4.4. **Course Deviation Indicator and Scale**

Selected course deviation is depicted by a Course Deviation Indicator and Scale. Deviation is indicated by positioning the Course Deviation Indicator on the Scale corresponding to the lateral deviation value.

The 360° and ARC HSI compass modes display the CDI as a green line centered on the display and parallel with the course indicator. The scale is a set of four hollow, green dots that are perpendicular to the CDI (**Figure 4-58**).

1 Course Deviation Indicator

2 Course Deviation Scale

The ARC CDI Compass mode's CDI and Scale are located at the bottom of the lower display. The indicator is a green diamond, and the scale is a set of four hollow, white dots with a white index mark at the center (**Figure 4-59**). When in the ARC CDI Compass mode, on a Localizer Back Course approach, a BC label is presented to the left of the scale, and the indicator corrects for reverse sensing (**Figure 4-60**).

When the lateral deviation exceeds the maximum displayable range of 2.5 dots, the deviation bar or diamond, as applicable, becomes hollow and darker (**Figure 4-61** and **4-62**).

Figure 4-59
Course Deviation Indicator, ARC CDI

Figure 4-60
Course Deviation Indicator, ARC CDI with Back Course

Figure 4-62
Exceeded Deviation, ARC CDI

4.4.5. **CDI Navigation Source**

When the EFD1000 PFD powers up, the default CDI Navigation Source is the last source selected. The pilot can select from any of the installed navigation sources using the bottom center button. The EFD1000 PFD supports navigation information display from VHF Omni-directional Radio Range (VOR) navaids, Localizers (LOC), Glide Slope receivers (GS), and Global Positioning Systems (GPS). There can be up to four dedicated, two integrated, or a combination of one integrated and two dedicated navigation systems installed.

When a federated GPS and VLOC equipment is installed, the GPSS signal source, basemap GPS position, flight plan, and basemap information for VLOC1, VLOC2, and GPS1 are provided by the GPS1 navigation source whenever GPS1 is selected as the CDI navigation source and by BPS2 whenever GPS2 is selected as the CDI navigation source.

When integrated GPS/VLOC equipment is installed, the GPSS signal source, basemap GPS position, flight plan and basemap information for the integrated GPS-VLOC is provided by the associated GPS whenever the CDI navigation source is selected to either the GPS side or the VLOC side of the integrated GPS/VLOC receiver.

NOTE

For integrated systems, the CDI navigation source label indicates the current operating mode (GPS or VLOC) of the GPS/VHF NAV system.

When an integrated system is selected, but not reporting its operating mode, the label VLOC# displays.

Refer to the GPS or VHF NAV AFMS for information on the operation of the connected navigation equipment.

NOTE

When the EFD is connected to some GPS systems and the active flight plan is changed (e.g. "Direct To" is selected), the display of the active (magenta) leg on the Nav Map may be delayed for up to 20 seconds. The CDI course pointer and autopilot will react immediately to the flight plan change.

NOTE

There are many radio configurations available. Your authorized Aspen Avionics Dealer can tell you the configuration used on your aircraft.

Figure 4-63
Navigation Source Information Block

Select the CDI Navigation Source

- Press the CDI Navigation Source Select button until the desired navigation source is displayed above the button (e.g., GPS1, GPS2, VLOC1, VLOC2) (**Figure 4-63**).

1	CDI Source Select Button
2	CDI Source Label
3	CDI Source Information Block

Whenever the CDI navigation source navigation data is valid, a navigation information block for the currently selected navigation source is shown in the upper left corner of the lower display, as shown in **Figure 4-64** and described in **Table 4-4**.

Radio Mode	Information Block Label	
GPS		GPS1 or GPS2
VHF	VOR	VOR1 or VOR2
	Localizer	LOC1 or LOC2
	Localizer Back	LOC1(BC) or LOC2
	ILS	ILS1 or ILS2

Table 4-4 VHF NAV Radio Modes

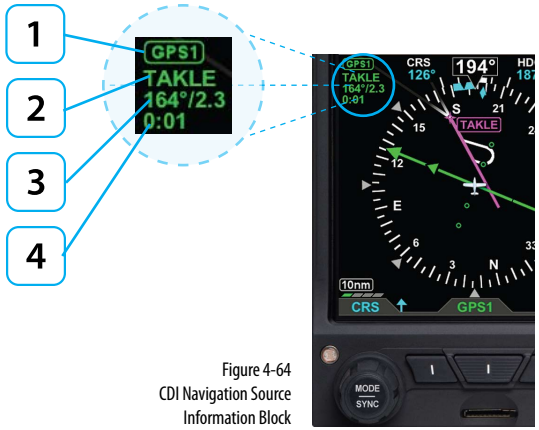


Figure 4-64
CDI Navigation Source
Information Block

1 CDI Source

2 Waypoint identifier or tuned frequency (when available)

3 Bearing (in degrees)/Distance (in Nautical Miles) to waypoint or navaid (when available)

4 Estimated Time En route (Hours:Minutes)

When both the navigation source identifier and the tuned frequency of the associated VHF NAV radio are available, only the source identifier information is displayed on the second line of the information block.

Figure 4-65
No Course Deviation Bar or FROM/TO Info

Figure 4-67
Blank Info Block Fields

Figure 4-68
Menu, GENERAL SETTINGS, Page 1 of 7

When available, the bearing and distance to station is displayed on the third line of the information block in the format dddº/nnnn or dddº/nn.n, where ddd is the bearing in degrees and nnnn or nn.n is the distance in nautical miles (e.g., 360º/1103 or 322º/3.2, shown in **Figure 4-58**). The distance to waypoint is displayed as follows:

- Distance to waypoint < 100 NM, display is in tenths of a mile, i.e., ##.#.
- Distance to waypoint is 100–9999 nm, display in whole miles, i.e., ####.
- Distance to waypoint is > 9999 NM, display is dashed, i.e., ----.

When available, the estimated time en route information is displayed on the fourth line of the information block in the format h:mm (where h is hours and mm is minutes).

When CDI navigation source data is invalid or unavailable from a configured navigation source, the HSI course deviation bar and the FROM/TO indication are removed from the display (**Figure 4-65**). Additionally, the selected CDI Navigation Source label is slashed with a red line (**Figure 4-66**).

When information for a configured and selected navigation source is unavailable or is invalid, the source information block is blank (**Figure 4-67**).

Figure 4-66
Invalid CDI Navigation Source Label

4.4.6. **Auto Course**

The pilot can either use the AUTOCRS or manually set a CRS value. By default, AUTOCRS is enabled. When the selected CDI navigation source is a connected GPS receiver and AUTOCRS is enabled, CRS is not adjustable (current course value is automatically slewed and controlled by the desired track from the GPS). When AUTOCRS is enabled, the CDI navigation source is a GPS system, and that system is configured for automatic waypoint sequencing (i.e., not OBS or HOLD modes) then Auto Course Select is active.

Enable Auto Course

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob to the GENERAL SETTINGS A menu page (**Figure 4-68**).
3. Push the AUTOCRS Menu Key. The menu label turns magenta, and the EDIT VALUE label displays above the Right Knob (**Figure 4-69**).
4. Rotate the Right Knob to select ENABLE (**Figure 4-70**).
5. Push the MENU Button to exit the Menu.

When AUTOCRS is enabled, the CRS value is set to the desired track output from the CDI Navigation Source. The CRS value is shown in the upper left of the lower display area in green under the CRS label. Additionally, an inverse green A is shown beside the CRS label in the upper left of the lower display area and in the legend above the Left Knob. This indicates that the course is being automatically adjusted (**Figure 4-71**).

Figure 4-69
Editing AUTOCRS

Figure 4-70
AUTOCRS Enabled

Figure 4-71
AUTOCRS Enabled

Figure 4-72
Menu, GENERAL SETTINGS, Page 1 of 7

Figure 4-73
Editing AUTOCRS

Figure 4-74
AUTOCRS Disabled

Figure 4-75
CRS Field Enabled for Editing

Disable Auto Course

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob to the GENERAL SETTINGS A menu page (**Figure 4-72**).
3. Push the AUTOCRS Menu Key. The menu label turns magenta, and the EDIT VALUE label displays above the Right Knob (**Figure 4-73**).
4. Rotate the Right Knob to select DISABLE (**Figure 4-74**).
5. Push the MENU Button to exit the Menu.

4.4.7. CDI Selected Course

When the CDI source changes from a GPS source with AUTOCRS to another CDI source, the CRS value reverts to the last set value. When the CDI source is set to a VHF receiver operating in the VOR or Localizer modes, editing the CRS value adjusts the current selected CRS value. When the CDI source is set to a GPS receiver, and AUTOCRS is disabled, the CRS value may be adjusted.

Select CDI Course

1. Press the Left Knob until CRS displays above the Left Knob and the Course field is enabled for editing, both rendered in magenta (**Figure 4-75**).
2. Rotate the Left Knob to change the value of the Course field. Rotate clockwise to increase, or counterclockwise to decrease, the value. Once the CRS value is set, and after 10 seconds of inaction, the CRS field is disabled, and both the label and field are rendered in cyan.

4.4.8. **Bearing Pointer Source Selection**

When the 360° Compass mode is selected, single- and double-line bearing pointers are available (**Figure 4-76**). The bearing pointers are independent of the CDI and provide supplemental navigation information by pointing to active GPS waypoints or navaids. By default, the bearing pointers are off and not displayed.

1	Single-Line Bearing Pointer	
2	Single-Line Bearing Pointer Source Information	
	Top Line	Distance (NM) to active waypoint
	Bottom Line	Waypoint identifier, station identifier, or the tuned frequency of the associated VHF NAV radio (when available)
3	Single-Line Bearing Pointer Legend Name	
4	Double-Line Bearing Pointer	
5	Double-Line Bearing Pointer Source Name	
	Top Line	Distance (NM) to active waypoint
	Bottom Line	Waypoint identifier, station identifier, or the tuned frequency of the associated VHF NAV radio (when available)
6	Double-Line Bearing Pointer Legend Name	

Figure 4-76
Bearing Pointer Description

NOTE

Distance to waypoint < 100 nm, display is in tenths of a mile, i.e., ##.#.

Distance to waypoint is 100 – 9999 nm, display in whole miles, i.e., ####.

Distance to waypoint is > 9999 nm, display is dashed, i.e., ----.

NOTE

When both the station identifier and the tuned frequency of the associated VHF NAV radio are available, only the station identifier information is displayed on the second line of the information block.

Figure 4-77
NO bearing pointers or source information

Figure 4-78
Invalid Bearing Pointer Source Data Label

Figure 4-79
Bearing Pointers OFF

The bearing pointers indicate only the bearing information provided by their selected navigation sources. They resemble and perform like traditional Radio Magnetic Indicator (RMI) needles. Each bearing pointer's head and tail is aligned with the corresponding bearing/radial value on the compass. The pilot can select a navigation source for each of the bearing pointers from the same VOR and GPS sources available to the CDI or simply turn off the bearing pointer, source information, and source legend.

Each bearing pointer is associated with a button, selected source name label, and information block. The button immediately to the left of the CDI source selection button is associated with and controls the Single-Line Bearing Pointer. Likewise, the button immediately to the right of the CDI source selection button is associated with and controls the Double-Line Bearing Pointer. The bearing pointers' source names and information blocks are shown directly above their respective buttons.

Unlike the CDI, which can be adjusted by the pilot, no adjustments can be made to the bearing pointers. When a VOR is selected as a bearing pointer source, the arrow of the needle indicates the direction to the VOR navaid to which the receiver is tuned. The position of the bearing pointer tail, with respect to the compass, indicates the aircraft's current position on the VOR radial. When a GPS source is selected, the bearing pointer indicates the bearing to the active waypoint.

When the bearing pointer source data is unavailable or invalid, the bearing pointer and source information are removed (**Figure 4-77**), and the bearing pointer source legend is slashed with a red line (**Figure 4-78**).

When a bearing pointer is turned OFF, the legend shows the bearing pointer icon, but the selected source, the source information field, and the bearing pointer are removed (**Figure 4-79**).

Select the Single-Line Bearing Pointer Source

- Press the Single-Line Bearing Pointer button (lower left button, **Figure 4-80**) until the desired navigation source displays above the Single-Line Bearing Pointer button.

Select the Double-Line Bearing Pointer Source

- Press the Double-Line Bearing Pointer button (lower right button, **Figure 4-81**) until the desired navigation source displays above the Double-Line Bearing Pointer button.

NOTE

A VOR that is tuned to a localizer frequency is considered an invalid bearing pointer source since Localizer signals provide no bearing information.

Figure 4-80
Single-Line Bearing Pointer and Button

Figure 4-81
Double-Line Bearing Pointer and Button

Figure 4-82
Selected Heading Bug and Numerical Display

Figure 4-83
Selected Heading Bug Outside of ARC Range

Figure 4-84
Heading Selected to Edit

4.4.9. **Heading and Heading Bug**

The EFD1000 PFD offers a pilot-selectable heading bug. The heading bug symbol is positioned on the compass scale according to the heading bug value (HDG) selected by the pilot (**Figure 4-82**).

When the selected HDG value is outside the visible compass scale range in ARC Compass mode, only a portion of the heading bug is shown at the edge of the compass arc, closest to the HDG value (**Figure 4-83**).

When selected for editing, the heading bug and the HDG value are shown in magenta. Additionally, a dashed magenta line extends from the ownship symbol to the heading bug, corresponding to the selected HDG value. When the heading bug is SYNCed, the HDG value is set to the current heading.

Set Heading Bug

1. Press the Right Knob until HDG displays above the Right Knob and the Heading field is enabled for editing, both rendered in magenta (**Figure 4-84**).
2. Rotate the Right Knob to change the value of the Heading field. Rotate clockwise to increase, or counterclockwise to decrease, the value. Once the HDG value is set, and after 10 seconds of inaction, the HDG field is disabled, and both the label and field are displayed in cyan.

4.4.10. **Aircraft Heading Display**

The aircraft heading is displayed in degrees magnetic (**Figure 4-85**).

If the aircraft's heading is unavailable or invalid, all heading and navigation information, including the CDI and bearing pointers (if previously displayed), is removed and replaced with a single red X covering the entire lower display area, along with the annunciation DIRECTION INDICATOR FAIL (**Figure 4-86**).

Figure 4-85
Direction of Flight
Numerical Display

Figure 4-86
Direction Indicator Fail

4.4.11. **Rate of Turn Indicator**

The Rate of Turn Indicator consists of a curved white line originating from the corresponding side of the aircraft heading (i.e., a left turn indication starts on the left side of the index mark) and extends in the direction of the turn along the outer radius of the compass scale. The turn rate indication is provided for every compass mode, 360° (**Figure 4-87**) and ARC (**Figure 4-88**).

The Rate of Turn Indicator features tick marks for full and half-standard rates of turn (a standard rate of turn = 3° per second) in both directions.

The Rate of Turn Indicator has a range of 0° – 6° per second. When the turn rate exceeds 6° per second, an arrowhead is added to the end of the tape to show that the rate of turn has exceeded the limits of the instrument.

Figure 4-87
Rate of Turn Indicator
(360° Compass Mode)

Figure 4-88
Rate of Turn Indicator
(ARC Compass Mode)

NOTE

All map and flight plan elements are received from the GPS and are only available from compatible GPSs (e.g., GNS 430, GNS 530).

NOTE

A VORTAC is shown as a combined VOR and DME symbol. A TACAN is rendered as a DME symbol.

Figure 4-89
Map (ARC Compass Mode Shown)

Figure 4-90
Map Symbol Set

4.4.12. **Map Underlays**

The map comprises symbols depicting the location of flight plan waypoints and legs, airports, VORs, DMEs, NDBs, and intersections. The map is always oriented with magnetic heading up and centered so that the current aircraft position coincides with the aircraft ownship symbol. The current map declutter level and range are shown on the lower left side of the display (**Figure 4-89**).

1. Map Symbols
2. Aircraft Ownship Symbol
3. Map Declutter Level
4. Map Range

When enabled, the map features on the lower half of the display are displayed and layered as detailed in **Table 5-12**. The GPS flight plan is rendered in either straight or curved lines, as supported by the configured GPS navigator. The displayed symbol set includes active waypoints, active flight plan leg, flight plan waypoints, flight plan legs, airports, VORs, VORTACSs, TACANs, DMEs, intersections, and NDBs (**Figure 4-90**).

4.4.12.1. **Map Declutter and Range**

To turn the map on or off, the pilot selects one of the map declutter levels as described in **Section 5.2**. The default map declutter level is HIGH. The map range displays so that the outside radius of the compass represents 2, 3, 5, 10, 15, 20, 30, 40, 60, 80, 100, or 200 nautical miles from the aircraft ownship symbol. The default range is 15 NM. Both the map declutter level and range are pilot-adjustable.

Select Map Declutter Level

- Push the MAP Hot Key (**Figure 4-91**) to cycle through and select the desired map declutter level (**Figure 4-92**).

Change Map Range

- Press the Range Up (+) or the Range Down (-) Button (**Figure 4-93**) until the desired range is displayed (**Figure 4-94**).

Figure 4-91
MAP Hot Key

Figure 4-92
New Map Display Level

Figure 4-93
Map Range Buttons

Figure 4-94
New Map Range

NOTE

If connected to a GPS system that does not provide compatible Map data, then only OFF and FP ONLY display levels are available.

Figure 4-95
Auto Range Mode

Figure 4-96
GENERAL SETTINGS B Page Editing
Auto Range Setting

NOTE

The map range increases or decreases one increment each time the +/-button is pressed. To continuously increase/decrease the range, press and hold either button for more than a half second.

NOTE

Based on the map symbol level and range settings, flight plan way points may not be displayed

The EFD1000 PFD has an Auto Range feature that automatically scales the range (to the closest range setting) to two times the distance between the ownship and the active waypoint, i.e., if the active waypoint is 84 miles away, Auto Range will go to 200 nm (84x2=168, closest range setting is 200). When Auto Range is active, an inverse white A displays next to the numeric range value (**Figure 4-95**).

Enable Auto Range

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob to the GENERAL SETTINGS B menu page.
3. Push the AUTO RNG Menu Key. The AUTO RNG label turns magenta (**Figure 4-96**).
4. Rotate the Right Knob to the desired value, either ENABLE or DISABLE.
5. Push the MENU Button to exit the Main Menu.

Activate Auto Range

1. Press the RNG +/- Button to select the highest or lowest map range.
2. Press and hold the RNG +/- Button for two seconds. The map range changes and the new map range is indicated on the map. An inverse white A displays next to the numeric range value.

Deactivate Auto Range

- When Auto Range is active, press the RNG +/- Button once to deactivate Auto Range mode. The inverse white A next to the numeric range value is removed. Pressing RNG+ moves to the next higher range; pressing RNG- moves to the next lower range.

Auto range is only available when a flight plan is active. Since Auto Range uses the distance between the present position and the next active waypoint to compute the map range, if the currently selected Navigation Source does not have a valid flight plan, then Auto Range is not selectable. If Auto Range cannot be selected check:

- To ensure a flight plan is active
- The GPS source with the flight plan is correctly selected in the EFD menu
- That Auto Range is enabled in the EFD menu

4.4.12.2. **Flight Plan**

When a flight plan is provided by a configured GPS, the map shows flight plan waypoints and legs. The active leg and waypoint and associated identifier are displayed in magenta. Other waypoints and legs are white. Straight and curved flight plan details are rotated within the map display to maintain their correct compass orientations at all times.

4.4.12.3. **Map Data Source and Reversion**

If the selected GPS data is unavailable or invalid:

- The associated flight plan and map data are retained and displayed, as long as an alternate source of position information remains available.
- The flight plan and waypoints become inactive and are displayed in white.
- Position is provided from:
  1. Another configured GPS source if providing valid position data. In this case, a GPS# REVERSION annunciation is shown above the CDI navigation source select legend (**Figure 4-97**) (# indicates the configured GPS source that is now providing the aircraft's position, either 1 or 2).
  2. The RSM GPS, if enabled, and position data are available. In this case, a RSM GPS REVERSION EMER USE ONLY annunciation is shown above the CDI navigation source select legend (**Figure 4-98**).

Figure 4-97
GPS# Failure, Reversionary Navigation

Figure 4-98
RSM GPS Reversionary Navigation

Figure 4-99
Invalid or Failed GPS Annunciations

Figure 4-100
ARC Compass Mode, Ground Track Marker

Figure 4-101
360° Compass Mode, Ground Track Marker

When a GPS source's position data are invalid or no longer available, an amber annunciation, GPS1, GPS2, or RSM GPS, is shown to the left of the lower display to indicate which has failed (**Figure 4-99**).

4.4.13. **Track Indicator**

When configured with a GPS that provides ground track data, a blue track indicator diamond is displayed on the compass scale to indicate the aircraft's ground track. This indicator may be used to compensate for wind drift during flight (**Figures 4-100** and **4-101**). The track marker is removed from the display when ground track data is unavailable or invalid.

4.5. **Lateral and Vertical Deviation Indicator**

In addition to the CDI in the lower display, separate displays of lateral and vertical deviation information are shown in the upper display area during instrument approaches. A Lateral Deviation Indicator (LDI) and a Vertical Deviation Indicator (VDI) (**Figure 4-102**) will automatically appear, depending on the operating mode of the selected navigation sensor and the validity of the associated signal, as described below.

Figure 4-102
Lateral and Vertical Deviation Indicators

1	Vertical Deviation Indicator (VDI)
2	Lateral Deviation Indicator (LDI)
3	LDI Source Indicator

4.5.1. **Lateral Deviation Indicator**

The LDI and corresponding LDI information legend automatically display when:

- The active navigation source is a GPS radio and the GPS is in approach mode and is valid.

Or

- The active navigation source is a VHF navigation radio and a valid LOC, LOC(BC), or ILS signal is received.

Figure 4-103
Lateral Deviation
Indicator Exceed

Figure 4-104
LDI Source Invalid

When the LOC(BC) mode is active, deviation indications (corrected for reverse sensing) are displayed. The deviation shown on the LDI directly corresponds to the deviation indicated on the CDI in the lower display. When the lateral deviation exceeds the displayable range of 2.5 dots, the course deviation diamond becomes dim and hollow, and is parked at the extreme edge of the LDI scale (**Figure 4-103**).

When the LDI navigation source is invalid or is no longer available, the LDI course deviation indicator symbol (diamond) is removed from view, and the navigation source legend is slashed by a red horizontal line (**Figure 4-104**).

4.5.2. **Vertical Deviation Indicator**

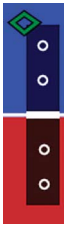


Figure 4-105
Vertical Deviation Indicator Exceed

The Vertical Deviation Indicator (VDI) is enabled and displays on the Attitude Indicator when the active navigation source is a VHF navigation radio, the ILS mode is active, and a valid localizer signal is being received. The VDI is also displayed for a GPS, supplying valid vertical deviation data, when in the approach mode.

The VDI does not display when it is not enabled or when LOC(BC) mode is active. When the vertical deviation exceeds the displayable range, the course deviation diamond becomes dim and hollow, and is parked at the extreme edge of the VDI scale (**Figure 4-105**).

4.6. **Vertical Speed Indicator**

When the 360° compass is used, the Vertical Speed Indicator (VSI) is rendered on the right side of the Navigation Display, showing a digital and graphical representation of vertical speed. The VSI indicates non-barometric change in pressure altitude over time. The graphical display is a white vertical tape, with the numerical value at the top of the VSI tape (**Figure 4-106**). In either Arc Compass mode, only the numerical value is shown.

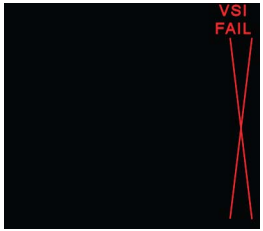
The VSI tape displays rates of ±2,000 FPM while the numerical value displays rates up to ±9,990 FPM. When vertical speed exceeds ±2,000 FPM, a triangle caps the tape (**Figure 4-107**).

The VSI tape is nonlinear, giving more display area to the 0 to ±1,000 FPM range than to the ±1,000 to ±2,000 FPM range. Tick marks are presented only in the direction of the climb or descent to provide visual cues for trends. The VSI numerical value, tape, and scale markers are only shown if the aircraft is climbing or descending more than ±100 FPM. During level flight in calm air conditions, the tape, scale, scale markers, and zero reference line are removed from the display. The numerical value field is always enabled and shows dashes when vertical rates are out of range. If vertical speed is invalid, the tape and digital display are replaced with a red X and the annunciation VSI FAIL (**Figure 4-108**).

Figure 4-106
Vertical Speed Indicator

Figure 4-107
VSI Tape Off-Scale Marker

Figure 4-108
Vertical Speed Indicator Fail – Direction Indicator 360° Compass Mode



4.7. **Autopilot Integration**

> ***NOTE***
>
> *Refer to the autopilot AFMS for information on the operation of the autopilot or flight director.*

The EFD1000 can connect with many different legacy autopilot systems that are typically found in general aviation aircraft. The EFD1000 emulates the HSI and/or Flight Director (FD) indicator with which the autopilot was originally certified. Autopilot integration is limited to heading and navigation modes, including vertical approach modes.

When connected to an autopilot system that includes Nav or Approach couplers, the EFD also acts as the navigation source selector switch to the autopilot. This assures that the navigation information presented on the EFD1000 is the same as that being provided to the autopilot. This arrangement also eliminates the need for external autopilot navigation source selector switches and relays that were previously used to select which navigation radio would be connected to the autopilot. Selection of autopilot modes and mode control is unaffected by installation of the EFD1000 system.

The EFD1000 does not currently provide vertical coupling to barometric references, such as altitude hold, vertical speed, or altitude capture.

See the upcoming **Section 4.6.3 Typical Autopilot Operation** for additional details on EFD1000 operation with the autopilot systems during typical aircraft operations, such as VOR/ILS/GPS approaches.

4.7.1. **GPS Steering (GPSS)**

GPS Steering represents a modernized approach to flying between flight plan waypoints, and offers many advantages of over traditional methods of flying direct course lines between waypoints.

With traditional point-to-point navigation, the autopilot is provided with desired course and cross-track deviation information associated with the current flight leg. From there, it will maneuver the aircraft to center the needle and track the desired course. The autopilot does not anticipate upcoming course changes, nor can it fly curved flight paths without pilot assistance, and it has to recompute wind corrections following each course change. Upon reaching a waypoint, the pilot must set the course for the next leg (unless Auto Course Select is enabled, see **Section 4.3.6**), and the autopilot will then intercept and track that leg. In this type of operation, the CDI must always be set to the current desired navigation course.

With GPSS, the EFD1000 can unlock the GPS Steering capability already available in many models of General Aviation GPS navigators. In GPS systems with this capability, the GPS continually computes the desired bank angle to track the GPS flight plan, and outputs that information over a digital data bus. The GPS Steering command anticipates upcoming turns; this includes the turn rate and turn initiation point required to roll out centered on the next leg with the course deviation needle centered.

Some GPS systems, such as the Garmin 4xx/5xxW series of WAAS navigators, even provide GPS Steering commands for complex procedures, such as DME arcs, holding patterns, and procedure turns allowing the autopilot to fly these maneuvers without pilot input. Check with your GPS manufacturer to see if your GPS supports these capabilities.

WARNING

GPS Steering is a powerful automation tool that can substantially reduce pilot workload. However, using GPSS safely and effectively requires a thorough understanding of your specific aircraft installation and the interaction between the EFD1000, your GPS navigator, and your autopilot. Pilot actions required to use GPSS safely can vary significantly depending on the autopilot and GPS navigator installed, especially when used on instrument approaches, especially those with vertical guidance.

It is imperative that pilots new to GPSS gain experience with it in VFR conditions and, ideally, get dual instruction from a CFII who thoroughly understands GPSS and the autopilot and GPS navigator in your airplane before using GPSS on instrument procedures in IMC.

NOTE

Refer to the Aircraft Flight Manual Supplement for your GPS system for information about GPSS steering commands that may be output by that system.

NOTE

When GPSS is selected on the EFD1000, the autopilot must be in Heading mode to follow the GPSS commands.

NOTE

When GPSS is not enabled, the autopilot will follow the Heading Bug value manually set by the pilot.

The EFD1000 translates GPS Steering commands received over a digital data bus into a signal that is compatible with the autopilot Heading channel. Thus, by selecting GPSS on the EFD1000 and the Heading mode of the autopilot, the autopilot is able to fly GPS Steering commands.

If the connected GPS system does not provide the required GPS Steering commands, the GPSS legend adjacent to the GPSS Hot Key will be rendered in gray, and it will not be possible to enable GPSS operation via the Hot Key.

Enable/Disable GPSS

- Press the GPSS Hot Key to alternately Enable or Disable GPS Steering (**Figure 4-109**).

Figure 4-109
GPSS Hot Key

When GPSS is Enabled, and the autopilot is in HDG mode, the autopilot will follow the steering commands output by the GPS. GPSS Enabled will be indicated on the EFD1000 PFD in two locations: 1) the GPSS legend adjacent to the GPSS Hot Key will be shown in inverse green; and 2) the annunciation GPSS1 (or GPSS2), along with an inverse A, will be shown next to the HDG reference at the top of the navigation display, to the right of the current numerical heading (**Figure 4-110**).

When GPSS is Disabled, and the autopilot is in HDG mode, the autopilot will track the heading selected by the Heading Bug of the EFD1000. GPSS Disabled will be indicated on the EFD1000 PFD in two locations: 1) the GPSS legend adjacent to the GPSS Hot Key will be shown in gray; and 2) the numerical value of the heading at which the Heading Bug is currently set will be shown next to the HDG reference at the top of the navigation display (**Figure 4-111**).

When the EFD1000's basemap navigation source is GPS1, enabling GPSS with the autopilot in HDG mode will cause the autopilot to track the flight plan in GPS1, and GPSS1 will be annunciated by the HDG reference at the top of the navigation display. Similarly, when GPS2 is the basemap navigation source on the EFD1000, and GPSS is enabled, the autopilot (in HDG mode) will track the GPS 2 flight plan, and GPSS2 will be annunciated at the top of the navigation display. See **Section 4.3.5** for additional information on the relationship among the CDI navigation source, basemap navigation sources, and GPSS navigation source.

When using GPSS with a stand-alone VLOC receiver, or with a combined GPS/VLOC navigator (e.g., the GNS-430/530), GPSS will continue to track the GPS output of that combined navigator, even when the VLOC is selected as the navigation source on the EFD1000. With Combined GPS/VLOC receivers, the transition from GPS to VLOC may occur automatically, depending on how that system has been configured by the user.

Figure 4-110
GPSS Enabled with Autopilot in HDG Mode

Figure 4-111
GPSS Disabled and Autopilot in HDG Mode

For example, suppose you use a GNS-430 to fly a GPS flight plan and have an ILS instrument approach loaded and active, and the GNS-430 is set for Auto ILS CDI changeover once you are established inbound on the final approach course. With GPSS Enabled on the EFD1000 and with the autopilot in HDG mode, the GPSS will steer the autopilot laterally through the flight plan using GPS, even after the GNS-430 CDI automatically switches to VLOC, and the EFD1000 navigation source similarly switches to VLOC. However, until you switch the autopilot into NAV or APPR mode, it will not arm or capture the glideslope to fly the ILS approach. This feature is particularly useful for autopilots that do not automatically transition from heading mode to nav mode when the selected course is intercepted.

When flying a full pilot nav ILS on a WAAS GNS-430W, the autopilot in HDG mode can use the GPSS to fly the full course reversal automatically, and the GNS-430W will automatically switch to VLOC once established inbound to the Final Approach Fix. But the pilot must then engage NAV or APPR mode on the autopilot to track the localizer and couple to the glideslope.

NOTE

Refer to the autopilot system Aircraft Flight Manual Supplement and/or POH for details regarding use and operation of the autopilot system.

Examples here are provided for reference only, based on operation of the Bendix/King KFC-200 autopilot, and actual operation may vary depending on the autopilot system installed in your aircraft.

It is your responsibility as Pilot in Command to ensure that you are conversant with the operation of all installed equipment. Operation of the EFD1000 system in IMC conditions should not be undertaken unless you are proficient in its use and operation, as described herein.

Several conditions can cause GPSS to be Disabled automatically (switching to a different GPS steering source on the EFD1000, losing the GPS source, canceling the flight plan, etc.). If that happens, the EFD1000 will command Wings Level on the autopilot in HDG mode, the GPSS Hot Key will annunciate the condition by showing GPSS in inverse amber, and the GPSS# and inverse A annunciation at the top of the navigation display will be shown with a red slash. (See **Figure 4-112**). To re-engage GPSS, select a valid GPS navigation source (with valid flight plan or direct-to selection on the GPS navigator), and then press the GPSS Hot Key. If a valid GPSS signal can not be restored, pressing the GPSS Hot Key will cancel GPSS mode and restore the heading bug output to the autopilot. More detail on these abnormal conditions, and corrective pilot actions, can be found in **Chapter 6 Emergency and Abnormal Procedures**. (See also **Section 4.6.3. Typical Autopilot Operations**.)

Figure 4-112
GPSS Automatically Disabled

4.7.2. **Flight Director**

When connected to a compatible autopilot system, the EFD1000 will display a singlecue Flight Director (FD). The flight director command bars visually represent the lateral and vertical steering cues transmitted to the EFD by the autopilot. When the FD output from the autopilot is unavailable or flagged invalid, the FD command bars are removed from the display (**Figure 4-113**). To hand fly using the flight director, maneuver the airplane to tuck the aircraft reference symbol into the flight director V-bars.

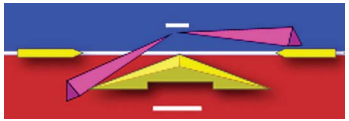
NOTE

With the autopilot in HDG mode, if GPSS is automatically disabled, the autopilot will roll wings level; it will not follow the HDG bug.

4.7.3. **Typical Autopilot Operations**

Whenever the EFD1000 installed configuration includes connections to GPS, VLOC, and autopilot systems, the EFD1000 acts as a conduit of data between the navigation radios and the autopilot system. This configuration enables any navigation sensor available for display on the EFD system to be coupled to the autopilot.

Figure 4-113
Flight Director



NOTE

When GPSS is enabled on theEFD1000, the HSI heading bug is not coupled to the autopilot. To connect the heading bug to the autopilot, disable GPSS via the GPSS Hot Key.

NOTE

The autopilot must be in Heading(HDG) Mode to receive GPSS signals from the EFD1000.

NOTE

*When using an integrated VLOC/GPS radio system, select the VLOC or GPS portion of the integrated radio by pressing the CDI source Button on the GPS select until the desired source is indicated above the EFD1000 CDI (**Section 4.3.5**) Source Select button.*

HDG Mode Operation – Heading Bug Steering

1. Set the heading bug on the EFD1000 to the desired heading (**Section 4.3.9**).
2. Verify that GPSS is not selected (GPSS Legend on Hot Keys shown in GRAY).
3. Select the autopilot's HDG mode.
4. Engage the autopilot.
5. Verify that the autopilot turns the aircraft to the selected heading.

HDG Mode Operation – GPS Steering (GPSS)

1. Couple the EFD1000 CDI to a GPS sensor navigation source with an active flight plan.
2. Enable GPSS by pressing the GPSS Hot Key so that GPSS is rendered in GREEN.
3. Select the autopilot's HDG mode.
4. Engage the autopilot.
5. Verif that the autopilot turns the aircraft to follow the GPS flight plan.

NAV Mode Operation – VLOC Navigation

1. Using the CDI Nav Source Select button, couple a tuned/valid VLOC radio to the CDI and set the desired course (**Section 4.3.7**).
2. Set the EFD1000 heading bug (**Section 4.3.9**) to a value that will intercept the desired course.
3. Engage the autopilot in heading mode and verify that the aircraft turns to the desired heading.
4. If your autopilot supports automatic heading to nav mode transitions, arm NAV capture on the autopilot by selecting its NAV mode. Otherwise, select the autopilot nav mode when the autopilot navigation signal capture criteria are satisfied (see your autopilot AFMS for more information).
5. Monitor the CDI deflection and verify that, upon intercepting the desired course, the autopilot modes transition as appropriate and the autopilot tracks the desired course.

NAV Mode Operation – GPS Navigation

1. With a valid flight plan programmed and active in the GPS, use the CDI Nav Source Select button to couple the GPS to the CDI (**Section 4.3.5**).
2. If Auto Course Select is disabled, set the Course Pointer to the desired course (**Section 4.3.7**), or enable Auto Course Select (**Section 4.3.6**).
3. With GPSS disabled, set the EFD1000 heading bug (**Section 4.3.9**) to a value that will intercept the active leg of the flight plan, or enable GPSS via the GPSS Hot Key.
4. Engage the autopilot in HDG mode and verify that the aircraft turns to a heading to intercept the active leg of the flight plan.
5. If your autopilot supports automatic heading to nav mode transitions, arm NAV capture on the autopilot by selecting its NAV mode. Otherwise, select the autopilot nav mode when the autopilot navigation signal capture criteria are satisfied (see your autopilot AFMS for more information).
6. Monitor the CDI deflection and verify that, upon intercepting the flight plan leg, the autopilot modes transition as appropriate and the autopilot tracks the desired course.

NOTE

Not all autopilots operate in the manner described here for intercepting courses. See the AFMS for your autopilot installation to understand how to adapt these example procedures to your particular autopilot.

NOTE

In order for the autopilot to couple to vertical guidance on WAAS approaches, most autopilots must first be established on the final approach course and in ALT hold mode at least two miles outside the FAF. APPR must be annunciated on the EFD1000 and the GPS system.

APPR Mode Operation – ILS Approach with Vectors to Final

1. Using the CDI Nav Source Select button, couple a tuned/valid ILS radio frequency to the CDI, and set the desired approach course (**Section 4.3.7**).
2. Set the EFD1000 heading bug to a value that will intercept the desired course, or as instructed by ATC (**Section 4.3.9**).
3. Engage the autopilot in HDG and altitude hold (ALT) modes and verify that the aircraft turns to the desired heading.
4. Once cleared for the ILS approach, arm the autopilot's APPR mode, or continue to fly heading mode until the localizer needle centers.
5. Monitor the CDI localizer deflection and verify (if supported by your autopilot) that, upon intercepting the localizer, the autopilot switches to APPR capture, turns to track the localizer course, and arms the glide slope (GS). Otherwise, engage the autopilot navigation or approach mode per the procedures in your autopilot AFMS.
6. Monitor the autopilot localizer tracking performance. Upon intercepting the glide slope, verify that the autopilot switches from GS arm to GS capture (if supported) and initiates a descent to track the glide slope.

APPR Mode Operation – GPS or GPS/RNAV APV WAAS Approach

1. With a valid GPS approach programmed in the GPS, use the CDI Nav Source Select button to couple the GPS to the CDI (**Section 4.3.5**).
2. If Auto Course Select is disabled, set the Course Pointer to the desired course (**Section 4.3.7**), or enable Auto Course Select (**Section 4.3.6**).
3. With GPSS disabled, set the EFD1000 heading bug to a value that will intercept the active leg of the flight plan (**Section 4.3.9**) or enable GPSS via the GPSS Hot Key.
4. Engage the autopilot in HDG mode and verify that the aircraft turns to a heading to intercept the active leg of the approach.
5. For autopilots that do not support automatic heading mode to nav (approach) mode transitions, use the heading bug to establish the aircraft inbound to the Final Approach Fix (FAF) and then engage the autopilot's NAV or APPR mode.
6. For autopilots that support automatic heading mode to nav(approach) mode transitions, monitor the CDI cross track deviation and verify that, upon intercepting the active leg of the approach, the autopilot turns to track the GPS approach guidance.

THE FOLLOWING APPLY FOR WAAS GPS/RNAV APV APPROACHES ONLY

7. Once cleared for the GPS/RNAV approach, arm the autopilot's APPR mode.
8. Monitor the CDI lateral deviation and verify that, while tracking and/or intercepting the final approach course and once the GPS APPR mode goes active and vertical deviation is presented on the EFD1000's VDI, the autopilot arms the glide slope.
9. Most WAAS GPS will not arm or activate vertical guidance until the aircraft is within two miles of the FAF (unlike an ILS where the VDI will display as soon as the aircraft is established in-bound and a valid GS signal is being received). As you approach the FAF, watch for the VDI to appear on the EFD1000's Attitude Display, indicating that the autopilot will likely couple to that glide slope.
10. Monitor the autopilot lateral approach course tracking. Upon intercepting the WAAS glide slope, verify that the autopilot switches from glide slope ARM to glide slope capture, and initiates a descent to track the WASS glide slope.

NOTE

WAAS GPS systems can provide vertical guidance on several types of GPS/RNAV instrument approaches. RNAV (GPS) APV (Approaches with Vertical Guidance), such as LPV and LNAV/VNAV approaches, often have lower approach minima shown on the approach plate, and aircraft equipped with appropriate WAAS GPS systems may use those lower minima.

Even with more traditional lateral guidance- only RNAV (GPS) approaches — (LNAV) with step-down altitudes — WAAS GPS systems may still provide a pseudo-glide slope that enables a continuous descent to the MDA (Minimum Descent Altitude) and that will couple to the autopilot GS.

All these types of approaches are set up and flown the same way by the pilot and autopilot and operate much like an ILS approach. The pilot must be aware of the differences and which minima may be used, however.

NOTE

The EFD1000 enables GPS LPV approaches (Approaches with Vertical Guidance) by providing the autopilot with GPS lateral and vertical deviation signals that are identical to those typically provided by an ILS radio. To fly GPS LPV approaches, configure and operate the autopilot as you would for an ILS approach.

NOTE

Some IFR GPS systems include ILS approaches in their procedures database. GPS may be used to navigate the initial segments of the ILS approach, but the pilot must switch to VLOC navigation outside the FAF and before GS intercept.

Some integrated GPS/nav receivers (like the Garmin 4xx/5xx series) can be configured to do this switch automatically, and the EFD1000 CDI Source will follow that switch automatically. It is the pilot's responsibility to verify that the EFD1000 CDI source is set to VLOC before reaching either GS intercept or the FAF.

GPS APPR Mode Operation – WAAS GPS Underlay to ILS Approach Using Pilot Nav and GPSS

1. With a valid ILS approach loaded and active in the GPS, use the CDI Nav Source Select button to couple the GPS to the CDI (**Section 4.3.9**).
2. Verify that the correct ILS frequency is tuned.
3. When the active flight plan leg is in-bound to the Initial Approach Fix (IAF), enable GPSS via the GPSS Hot Key.
4. Engage the autopilot in HDG mode and verify that the aircraft turns to intercept the course to the IAF.
5. Monitor the CDI and aircraft track to ensure the aircraft tracks in-bound to the IAF and then turns out-bound for the course reversal.
6. Using a WAAS GPS receiver that provides guidance along curved flight paths, the GPS will guide the aircraft through the course reversal and establish it in-bound to the FAF without pilot intervention.
7. Once established inbound to the FAF, engage the autopilot's APPR mode.
8. Couple the EFD1000 to the VLOC source tuned to the correct ILS frequency using the CDI Source Select button (if not done automatically by the GPS/nav receiver).
9. Monitor the CDI localizer deflection and verify that, upon intercepting the localizer, the autopilot switches to APPR capture and arms the GS.
10. Monitor the autopilot localizer tracking performance. Upon intercepting the GS, verify that the autopilot switches from GS ARM to GS capture and initiates a descent to track the glide slope.

GPS APPR Mode Operation – WAAS GPS Underlay to ILS Approach With ATC Vectors to Final

1. With a valid ILS approach loaded and active in the GPS, use the CDI Nav Source Select button to couple the GPS to the CDI (**Section 4.3.5**).
2. Verify that the correct ILS frequency is tuned.
3. Set the HDG Bug to the heading assigned by ATC (**Section 4.3.9**).
4. Disable GPSS via the GPSS Hot Key.
5. Engage the autopilot in HDG mode and verify that the aircraft turns to the selected HDG.
6. When cleared for the approach and given the final heading to intercept the final approach course by ATC, arm the autopilot's APPR mode.
7. Monitor the CDI and aircraft track to verify that the autopilot intercepts the final approach course and begins to track inbound to the FAF.
8. Couple the EFD1000 to the VLOC source tuned to the correct ILS frequency using the CDI Source Select button (if not done automatically by the GPS/nav receiver).
9. Monitor the CDI localizer deflection and verify that, upon intercepting the localizer, the autopilot switches to APPR capture and arms the GS.
10. Monitor the autopilot localizer tracking performance. Upon intercepting the GS, verify that the autopilot switches from GS ARM to GS capture and initiates a descent to track the glide slope.

4.8. **Hazard Awareness (EFD1000 Pro PFD Only)**

The EFD1000 Pro PFD offers three optional hazard awareness options; Lightning (data link weather and WX-500), NEXRAD, and Traffic. Each option requires additional sensors. For data link lightning and NEXRAD, an additional subscription to XM WX Satellite Weather is required. Each hazard awareness option is accessed by a Hot Key and displayed on the Horizontal Situation Indicator (**Figure 4-114**).

Figure 4-114
Horizontal Situation Indicator
Showing Hazard Awareness

4.8.1. **Lightning Underlay**

The LTNG Hot Key is a three position Hot Key that permits display of satellite lightning information or WX500 Spherics data displayed under HSI objects. When enabled, the lightning underlay displays lightning as defined in **Table 4-5**. The Hot Key label, LTNG/CELL/STRK is green when enabled or gray when disabled. The default setting following a power cycle of the unit is disabled.

Hot Key	Display Symbol	Annunciation	Description
LTNG	 Figure 4-115 Data Link Lightning Symbol	 Figure 4-116 Lightning Time Annunciation displays in the lower left corner of the display showing the age of received data.	Data link lightning symbols display as cyan lighting symbols at full intensity for 5 minutes after information is received. Symbols are positioned on the display at their position relative to the ownship symbol. After 5 minutes, the symbols will fade over the next 15 minutes.
STRK	 Figure 4-117 WX-500 Strike Symbol	 Figure 4-118 WX-500 Strike Rate Annunciation displays in the lower left corner of the display showing the current strike rate.	Symbols are positioned on the display at their position relative to the ownship symbol.
CELL	 Figure 4-119 WX-500 Cell Symbol	 Figure 4-120 WX-500 Cell Rate Annunciation displays in the lower left corner of the display showing the current cell rate.	Symbols are positioned on the display at their position relative to the ownship symbol.

Table 4-5 Lighting Display

NOTE

WX-500 data and rate annunciations are removed from the Map for map ranges less than 20nm.

Figure 4-121
WX-500 Data is Unavailable

NOTE

*WX-500 data will not display, and the rate annunciation displays with a red line (***Figure 4-121***) if the Stormscope receiver reports a fault or error, aircraft heading is invalid or unavailable, or WX-500 data is not detected.*

Figure 4-122
Lightning Underlay On
Displaying WX-500 Cell Data

Figure 4-123
Data Link Weather Underlay On

NOTE

When Strike or Cell mode is displayed, pressing and holding the Lightning Hot Key will activate the clear strike/cell function. The strike and cell count will clear, the rate is set to zero, and all displayed strikes/cells are removed from the display. Strike or Cell count may also be cleared from the menus.

NOTE

When US and Puerto Rico NEXRAD and Canada Radar exceeds the specified expiration time, the depiction for the respective radar is rendered as no Radar Coverage.

Display the Lightning Underlay

1. Display the 2/2 Hot Key menu.
2. Press the LTNG Hot Key to select the desired underlay (label turns green) (**Figure 4-122**).

4.8.2. Data Link Weather Underlay

The NXRD Hot Key enables the display of colored Data Link Weather data on the HSI relative to the ownship. The Hot Key label is green when enabled (ON) and gray when disabled (OFF). The Data Link Weather underlay default setting is OFF. NEXRAD coverage includes:

- US and Puerto Rico NEXRAD
- US Precipitation type
- Canada Radar
- US NEXRAD Coverage
- Canada Coverage

Display the Data Link Weather Underlay

1. Display the 2/2 Hot Key menu.
2. Press the NXRD Hot Key to turn Data Link Weather on (label turns green) or off (label turns gray) (**Figure 4-123**).

NEXRAD coverage displays using the following methodology:

- If US Precipitation Type is unavailable and US NEXRAD Radar is available, the US weather depiction is displayed as rain.
- If US Precipitation Type is available and US NEXRAD Radar is unavailable, the US weather depiction is not displayed.
- If US coverage is unavailable or expired and US NEXRAD is available, the US weather depiction is displayed as if all US radar sites are valid.
- If Canada coverage is unavailable and Canada radar is available, the Canada weather depiction is displayed as if all US radar sites are valid.
- If US NEXRAD Radar or Canada Radar exceed the specified expiration time, the depiction for the respective radar is displayed as no Radar Coverage.
- If Puerto Rico NEXRAD Radar exceeds the specified expiration time, the Puerto Rico NEXRAD Radar depiction for the respective radar displays as no Radar Coverage.
- Radar data is displayed as outlined in **Figure 4-124**. Areas without radar coverage are indicated by transparent gray. Radar cells indicating reflectivity below 10 dBZ are not displayed. The PFD offers a Data Link Weather legend accessible from the Main Menu.

Display the Data Link Weather Legend

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob to the XM RECEIVER C menu page.
3. Push and hold the HOLD FOR LGND Menu Key. The Data Link Weather legend displays (**Figure 4-125**).
4. Push the MENU Button to exit the Main Menu.

NOTE

Areas of no coverage are gray. If the aircraft is on the ground before data is received, or in an area of no coverage and the range setting is low, the entire HSI may be underplayed in gray.

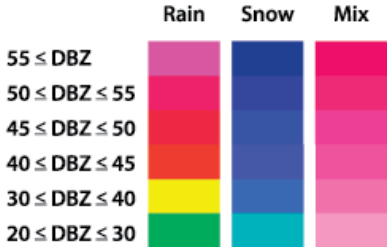


Figure 4-124
NEXRAD Radar Data

Figure 4-125
Data Link Weather Legend

When the Data Link Weather underlay is on, an age annunciation displays in the lower left corner of the HSI. The age annunciation indicates the elapsed time since the information was generated and is usually updated at the Update Frequency indicated in **Table 4-6**. The age of each weather product is displayed in the Main Menu on the XM RECEIVER B and XM RECEIVER C menu page.

Weather Product	Expiration	Annunciation
US NEXRAD	30	5
Puerto Rico NEXRAD	30	5
High Resolution (Canada) Radar	30	10
US Radar Coverage	30	5
Canada Radar Coverage	30	10
Precipitation Type	30	5
Data link Lightning	30	5

Table 4-6 Weather Product Age Limits and Update Frequency

Figure 4-126
Data Link Weather Product Age

View Data Link Weather Age

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob to the XM RECEIVER B menu page. The age of each Data Link Weather product displays (**Figure 4-126**).
3. Push the MENU Button to exit the Main Menu.

The data age (except Puerto Rico NEXRAD) will display in Amber whenever the datalink receiver has failed or stops reporting. When the Expiration time has been reached and no updates have been received, the age annunciation displays with a red dash and all data is removed from the display. **Table 4-7** outlines the age annunciations.

Age Annunciation	Conditions
	Data is being received and updated.
	Datalink receiver failed or unavailable but information has not expired and may still be valid. Check local weather conditions.
 	Data is removed, and the age annunciation displays a red horizontal line, for any of the following conditions: • The age of the data exceeds the expiration time identified in **Table 4-7**; additionally, the corresponding graphical data is removed from the display. • The data age of all displayed products exceeds the specified expiration time. • No valid data has been received from the receiver for 15 minutes. • GPS position information is unavailable or invalid.
	Upon start up, if no valid data has been received from the receiver.

Table 4-7 Weather Age Annunciations

4.8.3. **Traffic Overlay**

The Traffic Hot Key enables the traffic display overlaid on the HSI when the EFD1000 Pro PFD is configured with one of the following traffic sensors:

- Avidyne TAS 600/610/620 (TAS)
- Bendix/King KMH 880 (TAS)
- Bendix/King KTA 870 (TAS)
- Garmin GTX 330 (TIS)
- RYAN 9900BX (TAS)
- SKYWATCH SKY 497 (TAS)
- SKYWATCH SKY 899 (TAS)

When enabled, the Traffic overlay displays traffic threats and allows selection of a traffic altitude filter. The Hot Key label TRFC is green when enabled (ON) and gray when disabled (OFF). The Traffic overlay defaults to enabled after a power cycle of the EFD1000 Pro PFD.

Figure 4-127
Traffic Overlay On

Display the Traffic Overlay

1. Display the 2/2 Hot Key menu.
2. Press the TRFC Hot Key to turn Traffic on (label turns green) or off (label turns gray). The TFRC annunciation displays in the lower left of the display (**Figure 4-127**).

NOTE

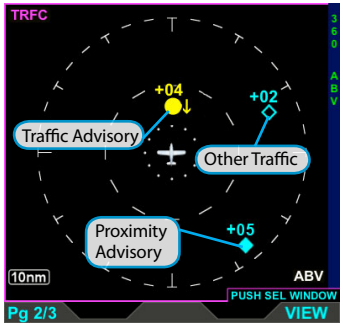
When the EFD1000 Pro PFD traffic overlay is Off and a traffic advisory occurs, the EFD1000 Pro PFD will display the traffic overlay and all current traffic until the Traffic Advisory is no longer a threat.

4.8.3.1. **Traffic Symbols**

The EFD1000 Pro PFD will display intruders prioritized in the order received from the configured traffic sensor. The EFD1000 Pro PFD includes three threat levels using TCAS symbology; traffic advisory (amber circle), proximity advisory (cyan diamond), and other traffic (hollow cyan diamond). All intruders within the current display range and the selected altitude filter are shown. Intruders generating a traffic advisory with range and bearing data are displayed as a traffic symbol at the location representing its position relative to the ownship symbol (**Figure 4-128**).

TAS systems use an airborne interrogator with a half-second update rate; coverage follows the aircraft. The TIS system uses a GTX transponder with a five-second update rate; coverage is limited to specific areas listed in the Aeronautical Information Manual (AIM).

Figure 4-128
Traffic Symbology



WARNING

Do not rely on the EFD1000 PFD as the sole source of data for collision avoidance. It is the pilot's responsibility to visually acquire other aircraft for safe flight. Maneuver your aircraft based only on ATC guidance or positive acquisition of conflicting traffic. Traffic information is:

- *Provided as a proximity warning only*
- *Intended to assist the pilot in the visual acquisition of intruder aircraft*
- *Not Intended to provide recommended avoidance maneuvers*
- *Not provided for aircraft that are not transponder equipped, experiencing a transponder failure, or out of radar coverage*

NOTE

Refer to your traffic sensor's Pilot Guide for detailed information about the sensor's limitations and operational ranges. Additionally, see the Aeronautical Information Manual section titled "Traffic Information Service (TIS)" for detailed information about TIS requirements, capabilities, and limitations.

Figure 4-129
Intruder Data Block

The EFD1000 Pro PFD displays intruder information from the sensor with the threat level assigned by the sensor. The sensor and type of traffic system defines the threat data, range, bearing, altitude, and altitude trend. Each traffic symbol is positioned at a location representing the relative range and bearing to the ownship symbol.

A data block is given for each reported intruder displaying the type, relative altitude, and intruder vertical direction (as acquired from the sensor). The data block text color is the same as the traffic symbol, amber for Traffic Advisory and cyan for proximity and other traffic (**Figure 4-129**).

When an intruder's altitude and vertical speed are available, they are displayed as part of the on-screen data block. The relative altitude is shown as two digits indicating the relative altitude difference, in hundreds of feet, from the ownship. The altitude value for traffic above the ownship is preceded by a plus symbol (+) and is on top of the symbol. The altitude value for traffic below the ownship is preceded by a minus symbol (-) and is on the bottom of the symbol.

An arrow next to the traffic symbol gives the direction of vertical movement in relation to the ownship. Intruders climbing or descending at a rate greater than 500 fpm display an up-arrow (climbing), or down-arrow (descending) to the right of the traffic symbol. Traffic that is at co-altitude with the aircraft and has no vertical trend is indicated by an altitude value of 00 below the traffic symbol.

For example, the intruder shown in **Figure 4-128** is a Traffic Advisory 400 feet above the ownship and is descending. No altitude information is shown in the intruder data block when the altitude is unavailable.

Traffic Advisories that are outside the current range are indicated by a half-symbol at the edge of the display with the appropriate data block. Proximity Advisories and Other Traffic that are outside of the current range are not displayed.

NOTE

Traffic that is within 100 feet of the ownship displays an altitude value of 00, above or below the traffic symbol as appropriate.

NOTE

If an intruder is flying level, no arrow is shown. If the intruder is not reporting altitude, neither the arrow or the altitude indication are shown.

When multiple traffic symbols partially or completely overlap, the symbols are visually stacked, with the highest priority alert data on top, obscuring the lower priority alert. When a traffic symbol and the ownship symbol partially or completely overlap, the traffic symbol and data block will overlay the ownship symbol and indicate if the traffic is above or below the aircraft.

4.8.3.2. **Traffic Altitude Filter**

When the Traffic overlay is enabled, an altitude filter is available, controlled by a Hot Key, allowing the pilot to set the altitude for traffic display. There are four altitude filters available: Above, Below, Normal, and Unrestricted (**Table 4-8**). Only traffic within the selected altitude filter value will display. Normal is the default Traffic altitude filter unless it has been previously set.

Hot Key label	Filter Level	Traffic Display Volume
ABV	Above	+9,900 ft to -2,700 ft
BLW	Below	+2,700 ft to -9,000 ft
NRM	Normal	±2,700 ft
UNR	Unrestricted	±9,900 ft

Table 4-8 Traffic Filter Parameters

The pilot adjusts the altitude filter value by pressing the ABV/BLW/NRM/UNR Hot Key, which cycles through each of the filter levels.

Change the Traffic Altitude Filter

- Press the ABV/BLW/NRM/UNR Hot Key to select the desired altitude filter.

NOTE

Depending on the position of the traffic Advisory, at the edge of the screen, the data block may or may not display.

NOTE

The altitude filters listed in the following table are the EFD1000 Pro PFD's altitude thresholds. The traffic sensor configured with the EFD1000 Pro PFD may have different (i.e., lower) altitude thresholds. Check your traffic sensor's pilot's manual for specifics.

Figure 4-130
Traffic Sensor Invalid

4.8.3.3. **Traffic Unavailable**

If your TAS sensor status is standby, test, or fail, the traffic label displays with a red horizontal line through the TRFC annunciation (**Figure 4-130**), and traffic symbols are removed from the display.

If your traffic interface is a TIS interface and traffic data is:

- Unavailable. the traffic label displays TRFC UNVL
- Not refreshed within 6 seconds, the traffic label displays TRFC COAST
- Not refreshed within 12 seconds, the traffic label displays TRFC RMVD, and traffic objects are removed from the display
- Not refreshed for 60 seconds, the label TRFC RMVD is removed from the display

Chapter 5

Customizing the EFD1000 PFD

5.1. **Main Menu Overview**

There are eleven menu pages, each with up to five menu options. The following tables and figures provide a brief overview of each menu page.

KEY DESCRIPTION		OPTIONS
1	Displays Airspeed and Altitude Tapes[1]	DISABLE or ENABLE
2	Vspeed Textual Markers Display	DISABLE or ENABLE
3	Auto Course Select	DISABLE or ENABLE
4	ARC Compass Mode	HSI or CDI
5	AHRS Reset	Action

Table 5-1 Menu – GENERAL SETTINGS A, Page 1 of 11

Figure 5-1
GENERAL SETTINGS A,
Page 1 of 11

1. Available only in those installations where the original airspeed indicator and altimeter remain in their primary flight instrument positions.

Figure 5-2
GENERAL SETTINGS B,
Page 2 of 11

KEY	DESCRIPTION	OPTIONS
1	Barometer Setting Units of Measure	in or mB
2	Outside Air Temperature Units of Measure	°C or °F
3	Clear WX-500 Strike/Cell Count[1]	Action
4	WX-500 Self Test[1]	Action
5	Auto Range	DISABLE or ENABLE

Table 5-2 Menu – GENERAL SETTINGS B, Page 2 of 11

1. Available only when the EFD1000 Pro PFD is configured with a WX-500 Stormscope sensor.

KEY	DESCRIPTION	OPTIONS
1	360° Flight Plan	OFF, AUTO, or ON
2	360° Airports	OFF, AUTO, or ON
3	360° NDB	OFF, AUTO, or ON
4	360° VORs (High, Low and Terminal)	OFF, AUTO, or ON
5	360° Intersections	OFF, AUTO, or ON

Table 5-3 Menu – 360° MAP SETTINGS, Page 3 of 11

Figure 5-3
360° MAP SETTINGS,
Page 3 of 11

Figure 5-4
ARC MAP SETTINGS,
Page 4 of 11

KEY DESCRIPTION		OPTIONS
1	ARC Flight Plan	OFF, AUTO, or ON
2	ARC Airports	OFF, AUTO, or ON
3	ARC NDB	OFF, AUTO, or ON
4	ARC VORs (High, Low and Terminal)	OFF, AUTO, or ON
5	ARC Intersections	OFF, AUTO, or ON

Table 5-4 Menu – ARC MAP SETTINGS, Page 4 of 11

KEY DESCRIPTION		OPTIONS
1	Va	0 to 450 or LOCKED
2	Vbg	0 to 450 or LOCKED
3	Vref	0 to 450 or LOCKED
4	Vr	0 to 450 or LOCKED
5	Vx	0 to 450 or LOCKED

Table 5-5 Menu – VSPEEDS A, Page 5 of 11

KEY DESCRIPTION		OPTIONS
1	Vy	0 to 450 or LOCKED
2	Vlo	0 to 450 or LOCKED
3	Vle	0 to 450 or LOCKED

Table 5-6 Menu – VSPEEDS B, Page 6 of 11

Figure 5-5
VSPEEDS A, Page 5 of 11

Figure 5-6
VSPEEDS B, Page 6 of 11

NOTE

When V Speeds are LOCKED at installation, the legend and set Value are rendered in gray. Setting any of the above values to zero disables the marker completely.

Figure 5-7
XM RECEIVER A, Page 7 of 11

KEY	DESCRIPTION[1]	OPTIONS
1	XM Serial Number	Status Only
2	XM Receiver Signal Quality	Status Only
3	XM Status	Status Only

Table 5-7 Menu – XM RECEIVER A, Page 7 of 11

1. Only available when the EFD1000 Pro PFD is configured with a valid weather receiver and with a subscription to XM WX Satellite Weather.

KEY	DESCRIPTION[1]	OPTIONS
1	US NEXRAD Age	Status Only
2	Puerto Rico NEXRAD Age	Status Only
3	Lightning Age	Status Only
4	Precipitation Age	Status Only
5	US Coverage Age	Status Only

Table 5-8 Menu – XM RECEIVER B, Page 8 of 11

Figure 5-8
XM RECEIVER B, Page
8 of 11

1. Only available when the EFD1000 Pro PFD is configured with a valid weather receiver and with a subscription to XM WX Satellite Weather.

Figure 5-9
XM RECEIVER C, Page 9 of 11

KEY DESCRIPTION[1]		OPTIONS
1	Canada Radar Age	Status Only
2	Canada Coverage Age	Status Only
3	Display Weather Legend	Action

Table 5-9 Menu – XM RECEIVER C, Page 9 of 11

1. Only available when the EFD1000 Pro PFD is configured with a valid weather receiver and with a subscription to XM WX Satellite Weather.

KEY	DESCRIPTION	OPTIONS
1	Operating from or Switch to Battery Power. Green when current state (Pushing key performs no action). White if selection is possible.	Status or Action
2	Operating from or Switch to External Power. Green when current state (Pushing key performs no action). White if selection is possible.	Status or Action
3	Restart (Depending on Air/Ground Logic State).	Action
4	External Power Source Voltage. Displays voltage level of input power.	Status Only
5	Battery Status. Displays battery % charge, ##%.	Status Only

Table 5-10 Menu – POWER SETTINGS, Page 10 of 11

Figure 5-10
POWER SETTINGS, Page
10 of 11

NOTE

For external/battery power control, the legend of the current power source is shown in green; pressing the associated menu key will perform no action. The legend of an available power source is shown in white, and pressing the associated menu key changes input power to that power source.

Figure 5-11
SYSTEM STATUS, Page
11 of 11

KEY	DESCRIPTION	OPTIONS
1	Main Application Processor Software Versions	Status Only
2	Input Output Processor Software Version	Status Only
3	Unit Serial Number	Status Only

Table 5-11 Menu – SYSTEM STATUS, Page 11 of 11

5.2. **Customizing the Map (Declutter)**

The pilot can customize the display setting for the map symbol levels HIGH, MEDIUM-HIGH, MEDIUM, LOW, and OFF; choosing from:

ON Display symbol is always on.

AUTO The selected display level and range, as described in **Table 5-12**, determine which map symbols are displayed. Symbol labels may also display adjacent to their associated symbol.

OFF Display symbol is always off.

Each compass mode has its own menu page for Map Setting symbol display. The 360° MAP SETTINGS menu page offers Map Setting options for the 360° Compass mode (**Figure 5-12**). The ARC MAP SETTINGS menu page offers Map Setting options for the ARC Compass mode (**Figure 5-13**). The default setting is ON. Complete information about the EFD1000 PFD Compass Mode options are provided in **Section 4.3.1**.

Figure 5-12
360° Compass Mode Display Options

Figure 5-13
ARC Compass Mode Display Options

Figure 5-14
Editing 360° NDB Display Option

Figure 5-15
360° NDB Display Option Set To OFF

Set Map Symbol Display

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob to navigate to the appropriate Map Settings menu page.
3. Push the desired Map Symbol Menu Key. The menu label turns magenta, and the EDIT VALUE label displays above the Right Knob (**Figure 5-14**).
4. Rotate the Right Knob to the desired value (**Figure 5-15**).
5. Either select another Map Symbol Menu Key and edit another display option or push the MENU Button to exit the Menu.

Feature Group & Layer Order (top to bottom)		Max Range	Declutter Setting				
			 Figure 5-16 High	 Figure 5-17 Med. High	 Figure 5-18 Medium	 Figure 5-19 Low	 Figure 5-20 Off
Traffic Overlay Symbols	1	Overlay – enabled via Hot Key	Always ON, regardless of declutter level				No symbols, legs, or waypoints—regardless of selected range— are displayed. When selected, the map symbol level and range icons display for two seconds and then are removed from view. The MAP Hot Key legend displays in gray.
Ownship Symbol	2		Always ON, regardless of declutter level				
Instruments[1] and Annunciations[2]	3		Always ON, regardless of declutter level				
Flight Plan Legs and Waypoints[3]	4	200	●	●	●	●	
Airports[3]	5	100	●	●	●		
NDBs[3]	6	15	●				
VORs, (HIGH, LOW, Terminal)[3]	7	200	●	●			
Intersections	8	15	●				
WX-500 or Data link Lightning	9	Overlay – enabled via Hot Key	Always ON[4]				
NEXRAD or Radar	10	Overlay – enabled via Hot Key	Always ON				

Table 5-12 Map Feature Group Layering, Range, and Declutter Levels

1. e.g., VSI, Direction Indicator, CDI, TO/FROM.
2. e.g., NAV INFO Block, Range.
3. Rendered only when data is provided by a compatible and connected GPS system.
4. Removed at range scales less than 20 nm.

5.3. **Configuring Vspeeds**

Vspeeds are used to designate different operating speeds of the aircraft and are defined in **Table 5-13**.

Vspeed	DEFINITION	PRE-SET BANDS	ADJUSTABLE TEXT LABELS	PRE-SET MARKERS
Vne	Never exceed	●		● (Red Line)
Vno	Maximum structural cruising rate	●		
Vfe	Maximum full flap extension speed	●		
Vs	No flap stall	●		
Vso	Full flap stall	●		
Va	Maneuvering at maximum gross weight		●	
Vbg	Best glide		●	
Vr	Rotation speed		●	
Vref	Approach speed		●	
Vx	Best angle of climb		●	
Vy	Best rate of climb		●	
Vle	Maximum landing gear extension speed		●	

Vspeed	DEFINITION	PRE-SET BANDS	ADJUSTABLE TEXT LABELS	PRE-SET MARKERS
Vlo	Retract maximum landing gear operation speed		●	
Vmc	(Multi-engine planes) Single engine minimum control	●		● (Red Line)
Vyse	(Multi-engine planes) Single engine minimum control	●		
◁	Initial flap extension			●

Table 5-13 EFD1000 PFD Vspeed Definitions

The EFD1000 PFD uses colored speed bands, colored speed markers, and textual labels to help the pilot recall Vspeed settings and limits. The speed band markings are determined by the Federal Regulations and correspond to the aircraft limiting speeds that are identified in the Aircraft Flight Manual. They have a range between two speeds that are pre-set at installation as outlined in **Table 5-14** and shown in **Figure 5-21**.

NOTE

Setting the value of the white triangle, Vyse, and Vmc markers to zero (0) during installation disables the markers. Setting any of the adjustable Vspeed values to zero (0) disables the applicable label.

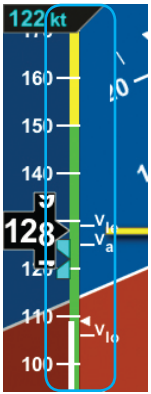


Figure 5-21
Speed Bands

Speed markers are also pre-set during installation, indicating aircraft-specific speed settings, where applicable. The textual Vspeed labels are configured as pilot adjustable or locked during the EFD1000 installation.

BAND COLOR	SPEED RANGE	
Red Band (High Speed)	Vne–top tape	Never Exceed
Yellow Band	Vno – Vne	Caution Range
Green Band	Vs – Vno	Normal Operating Range
White Band	Vso – Vfe	Flap Operating Range
Red Band (Low Speed)	Bottom of tape – Vs0	Disabled on the ground and during takeoff

Table 5-14 Speed Band Ranges

NOTE

On aircraft without flaps the white band is disabled, and the green band is shown full width, as there isn't an applicable Flap Extend (Vfe) or Full Flap Stall (Vso) speed. These two speeds are set to the same speed as the No Flap Stall (Vs) speed. This gives the white band a value of zero, effectively disabling it.

On aircraft with flaps, setting the upper and lower thresholds of the white and/or yellow bands to the same value disables the applicable band. When disabled, the band does not display.

When using the Vspeed textual markers, the pilot must first ENABLE the display of the markers and then set values for each Vspeed. The display setting is on page 1, and value settings are on page 4 and 5 of the Menu. The value range for Vspeed textual markers is 0 – 450 or LOCKED. The default setting is 0 unless previously set to another value. When the value is 0, the Vspeed is individually disabled, and the marker is not rendered on the Airspeed Tape. Once values are set, the pilot can choose to disable all the Vspeed textual markers to aid in screen declutter.

Enable Vspeed Textual Labels

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob to the GENERAL SETTINGS A menu page (**Figure 5-22**).
3. Push the VSPEEDS Menu Key. The menu label turns magenta, and the EDIT VALUE label displays above the Right Knob (**Figure 5-23**).
4. Rotate the Right Knob to select ENABLE. The textual Vspeed labels are enabled (**Figure 5-24**).
5. Push the MENU Button to exit the Menu.

NOTE

A typical installation sets the Airspeed Textual Markers to UNLOCKED, allowing the pilot to edit the indicated Vspeed labels. If the Vspeed setting was LOCKED during installation, no editing is allowed.

Figure 5-22
Menu, GENERAL SETTINGS, Page 1 of 11

Figure 5-23
Editing VSPEEDS

Figure 5-24
VSPEEDS Enabled

Figure 5-25
Menu, VSPEEDS A, Page 5 of 11

Figure 5-26
Editing Va Vspeed

Figure 5-27
Va Vspeed Set With New Value

Set Textual Vspeed Labels

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob to the appropriate Vspeed menu page (**Figure 5-25**).
3. Push the appropriate Vspeed Menu Key. The menu label turns magenta, and the EDIT VALUE label displays above the Right Knob (**Figure 5-26**).
4. Rotate the Right Knob to the desired value (**Figure 5-27**).
5. Either select another Menu Key and edit another Vspeed or push the MENU Button to exit the Menu.

5.4. **LCD Brightness Control**

The LCD brightness of the EFD1000 PFD operates in either of two modes, Automatic or Manual (**Figures 5-28** and **5-29**). The LCD brightness range is displayed as a value from 1–100, displayed above the Left Knob.

LCD MODE	DESCRIPTION
AUTOMATIC BRT AUTO	LCD backlight intensity is automatically adjusted based on the current light conditions sensed by the Automatic Dimming Photocell (**Figure 5-28**). When using the auto-brightness, the display brightness will display up to 70%.
MANUAL BRT ADJUST	Allows the pilot to adjust the LCD backlight intensity manually (**Figure 5-29**) from 1–100%.

Table 5-15 Brightness Control

Switch Brightness Mode

1. Press the MENU Button. The Menu displays.
2. Push the Left Knob to select the desired LCD Brightness Control mode, either Automatic (BRT AUTO) (**Figure 5-28**), or Manual (BRT ADJUST) (**Figure 5-29**).
3. Press the MENU Button. The Menu shuts off.

Adjust Display Brightness Manually

1. Switch to manual LCD Brightness Control mode (BRT ADJUST) (**Figure 5-29**).
2. Rotate the Left Knob clockwise to increase the LCD Brightness value or counterclockwise to decrease the LCD Brightness value. The BRT value changes accordingly.
3. Press the MENU Button. The Menu shuts off and the selected brightness value is retained.

Figure 5-28
Display Brightness in BRT AUTO Mode

Figure 5-29
Display Brightness in BRT ADJUST Mode

NOTE

If the EFD1000 PFD is operating on the internal battery, the maximum brightness level is capped at 40% in automatic mode and 70% in manual mode to preserve emergency battery operating time.

NOTE

To facilitate cooling of the EFD1000 PFD display unit, when the backlight temperature is greater than or equal to 70°C, the display brightness caps at 30% in automatic mode and 70% in manual mode. The cap is removed when the EFD1000 PFD display temperature drops below 60°C.

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Chapter 6

Expanded Emergency and Abnormal Procedures

This section supplements and provides an expanded description of the emergency and abnormal procedures included in the FAA-approved Aircraft Flight Manual Supplement. The information provided here is intended to provide additional background information to enhance the pilot's understanding of the emergency and abnormal conditions and the associated procedures provided in the AFMS. This pilot guide is provided for supplementary purposes only. The approved cockpit reference for in-flight use is the AFMS. Both the Pilot Guide and the AFMS must be immediately available to the pilot at all times in flight. In the event of any conflict between this document and the FAA-approved AFMS, the AFMS instructions must be followed.

6.1. **Pitot/Static System Blockage**

A pitot line blockage will result in the airspeed indicator behaving like an altimeter when the aircraft's altitude changes, and it will not respond to airspeed changes. A pitot line blockage can also affect the EFD1000's attitude indication.

A static line blockage will result in altitude remaining fixed and a zero vertical speed despite aircraft pitch and/or power setting changes. In addition, IAS indications will be incorrect if the static line is blocked. Errors will typically be noticed during climbs or descents. When descending, ambient pressure increases which will result in the indicated airspeed reading less than the actual airspeed. The opposite effect will be observed in a climb. A static line blockage can also affect the EFD1000's attitude indication.

Indication of an obstructed pitot system is provided for EFD1000s when configured as a PFD, an MFD, and as an MFD in reversionary PFD mode. If the EFD1000's indicated airspeed is less than 30 KIAS (35 mph) and GPS groundspeed is greater than 50 kts (58 mph) for more than 30 seconds, then attitude and heading instruments are replaced with red Xs and textual annunciations to indicate their failure. In this case, an amber CHECK PITOT HEAT annunciation accompanies the ATTITUDE FAIL annunciation. If the pitot obstruction is subsequently removed and indicated airspeed ≥ 30 KIAS (35 mph), the CHECK PITOT HEAT annunciation will be removed in 15 seconds. This indicates that the EFD1000 is performing an automatic AHRS reset in the background. No pilot action is required to reset the system.

Blocked Pitot or Static Line Suspected

1. Turn Pitot heat on.
2. Open the Alternate Static Source.
3. Refer to alternate attitude, airspeed, altitude, and heading sources for primary flight information.
4. Consider exiting IMC.
5. Land as soon as practicable.

CAUTION

Most light aircraft have only a single pitot and static port available for flight instrument use. As such, the pitot and static lines used by the EFD1000 (PFD and MFD) are shared with those lines used by the standby airspeed indicator and altimeter. Should these lines become blocked, such as might occur due to an inadvertent icing encounter, both the standby indicators of airspeed and altitude and the EFD1000 indicators will display erroneous information.

Because the EFD1000 uses pitot and static pressures as part of the ADAHRS solution, loss or corruption of this data, such as from a line blockage, will impact the accuracy of data output by the ADAHRS. Affected parameters can include the airspeed, altitude, and attitude information displayed by the EFD1000.

If an erroneous pitot input is detected by the EFD1000 in flight, the EFD1000 will present red Function Fail Xs over the affected instruments and display a CHECK PITOT HEAT annunciation. In this case, the pilot should check pitot heat, select the aircraft's alternate static source, and refer to alternate attitude, airspeed, and heading sources for primary flight information.

6.1.1. **Identifying and Handling Suspected Pitot and/or Static System Failures**

Blocked pitot and/or static system ports will compromise the EFD1000 attitude solution and soon cause it to Red-X (fail). Immediately begin flying by reference to backup attitude sources. Therefore, the pilot must be especially vigilant about verifying proper operation of the pitot and static systems both before and in flight.

It is important to check the pitot tube and static system ports, and to verify pitot heater performance, as part of a thorough pre-flight inspection, especially when anticipating low IMC.

On the takeoff roll, it is good practice to note and call out "airspeed's alive" when the airspeed indicators (both primary and backup) begin moving,and to compare and call out readings at a pre-determined airspeed close to but before rotation speed (e.g., "60 knots cross check"), consciously noting the performance on each takeoff. If the airspeed indicators do not come alive when they usually do, or there is a significant mis-compare between the primary and backup indicators, and if there is sufficient runway remaining, aborting the takeoff may be a prudent decision. Follow the Flight Manual procedures for your aircraft.

If the static port is blocked on takeoff, it is imperative to quickly recognize the condition. Sometimes the airspeed indicator will show substantially less than normal, and the airspeed will reduce as you climb. The natural—but incorrect—response is to lower the nose. In this situation, maintaining proper pitch attitude to climb is vital. The airspeed will continue to reduce as you climb, and at about 1,000 feet AGL the EFD1000 attitude and heading indications will be Red-X'd due to the reduced airspeed indication. As soon as you suspect a blocked static port, try switching to an alternate static source. You should know the location of the alternate static air control in your airplane and learn how it works.

On the initial climb-out after takeoff, it is also good practice to note and call out passing through a pre-determined altitude above ground level (AGL) a couple of minutes after takeoff and ideally before entering the clouds (e.g., "2,000 feet"). If your primary and backup instruments are not showing the altitude and airspeed you normally expect to see at that point, you might have partially blocked static system ports. This AGL check and call-out is also a good time to verify that no fuel is siphoning out from the fuel caps, etc. If indications suggest a static system blockage, try switching to an alternate static air source and consider landing and correct the problem.

In flight, if airspeed or altitude anomalies consistent with an obstructed pitot or static line are observed, the pilot should recognize that the EFD1000 attitude indication will soon be compromised. If in IMC, immediately use the backup attitude indicator to fly the airplane and select pitot heat if icing is suspected. If at any time there is suspicion of an obstructed pitot or static line, use the backup attitude indicator until the situation is resolved.

If the pitot tube becomes blocked in flight, the most common cause is icing. In-flight indications of a blocked pitot tube typically take one of two forms: 1) all airspeed indicators incorrectly show zero (or close to zero); or 2) airspeed in level flight does not change in response to changes in power or drag, and airspeed indications act like an altimeter (decreasing in a descent and increasing in a climb, exactly the opposite of normal behavior). Airspeed going to zero is by far the most common symptom of a blocked pitot tube.

If you see either of these indications of a blocked pitot tube, the first thing to do is turn on the pitot heat to remove any ice blockage. This will quickly restore the attitude and airspeed indications on the EFD1000 systems (it takes about 40 seconds to recover after the pitot pressure is restored). To maintain proper aircraft attitude during the event

(and if the heated pitot does not work), use the outside horizon if possible, or use the backup attitude indicator to continue safe flight. The autopilot attitude source is also independent of the EFD1000 attitude indicators and may be another means to maintain level flight. Use the autopilot carefully, however, and constantly monitor its performance against other flight instruments.

If in flight you suspect blocked static ports (probably due to icing), try switching to the alternate static air source. If the static air sources are blocked, recognize that Terrain AGL indications and the terrain display on the MFD, as well as the readout from the transponder and reports from ATC, will be in error because of the blocked static system. If GPS altitude is available on your GPS navigator, become familiar with how the GPS altitude is displayed. Although it can be in error, it might be your only source of altitude information (WAAS GPS altitude is reasonably accurate). If an instrument approach is necessary, consider a precision approach that will permit vertical guidance with less reliance on the barometric altitude indications.

6.2. **Frequent or Persistent CROSS CHECK ATTITUDE Annunciation**

Refer to alternate attitude, airspeed, altitude, and heading sources for primary flight information. Consider the following:

Cross Check Attitude

1. Reference standby mechanical attitude indicator.
2. Turn Pitot heat on.
3. Consider exiting IMC.
4. Land as soon as practicable

For a detailed explanation of when and why the EFD1000 PFD may display a CROSS CHECK ATTITUDE annunciation, either momentarily or persistently, see **Chapter 4, Section 4.1. Air Data, Attitude and Heading Reference System (ADAHRS)**.

6.3. **Difference Detected Between EFD1000 and Mechanical Attitude Indicators**

Once diagnosed, ensure the correct attitude source is the only one referenced during the remainder of the flight.

Compare Alternate Sources of Available Attitude, Airspeed, and Attitude

1. Compare all sources of available attitude, airspeed, and attitude information to diagnose a faulty indicator.
2. Consider exiting IMC.
3. Land as soon as practicable .

CAUTION

For installations with a single pitot/static system, failures of the pitot or static systems can simultaneously affect both EFD1000 displays. Comparisons between the two EFD1000 attitude sources are not sufficient. Secondary attitude, airspeed, and altitude indications should also be considered.

Figure 6-1
Powering Off the
EFD1000 PFD

6.4. **Abnormal Shutdown Procedure**

The EFD1000 PFD is typically powered through an EFIS Power Control switch that is connected to the aircraft battery bus. The system will power up, based on the position of the EFIS Power Control switch or switch that controls power to the Battery bus. Typically, when on the ground, powering up/down the aircraft simultaneously powers on/off the EFD1000 PFD. If the EFD1000 PFD has been powered off and aircraft power is available to the EFD1000 PFD, pressing the REV button momentarily will turn on the EFD1000 PFD.

Shutdown EFD1000 PFD (with internal battery)

1. Either pull or turn off the EFD Circuit Breaker Switch/Circuit Breaker (as configured).
2. Push and hold the REV Button until the display turns off.

Or

1. Press the MENU Button. The Menu displays.
2. Rotate the Right Knob to the POWER SETTINGS menu page.
3. Press the RESTART Menu Key. The power down sequence initiates, and a power down message displays (**Figure 6-1**).

A powering off annunciation displays indicating that the unit will shut down in 5 seconds. The pilot can press any control to abort the power-down sequence.

Power On Manually

- Press the REV Button until the EFD1000 PFD powers on.

6.5. **Loss of Aircraft Electrical Power**

In the event that aircraft generated power to the EFD is degraded or fails, each EFD will automatically switch to its own dedicated battery (**Figure 6-2**). When continued safe operation depends on the EFD1000, **UNRESTORABLE LOSS OF EXTERNAL POWER IS AN EMERGENCY SITUATION**. The aircraft should divert to the nearest suitable airport.

Loss of or Degraded Aircraft Power or ON BAT Annunciation

1. Electrical System ..... Follow AFM procedures to restore power
2. If unable to restore power ..... Land as soon as possible

The internal battery will normally provide between 30-60 minutes of operation at approximately 20°C and warmer. At extreme cold temperatures operation of the internal battery is not assured.

When on battery the auto backlight intensity defaults to 40% and manual backlight intensity is limited to 70%. Changing the backlight intensity will affect the battery duration, which is reflected in the % remaining indication.

A fully charged battery will indicate a charge level of 99% for some time before beginning to decay. The charge level will steadily decrease when below 95%, with a slight acceleration as the battery nears 0%.

The "ON BAT" annunciation, along with the estimated battery charge remaining, is displayed whenever the system is operating on battery.

Figure 6-2
Battery Operationa

NOTE

When operating on the internal battery or Emergency Backup Battery (EBB) (as configured), the display backlight intensity is capped at a value of 70.

NOTE

Setting the brightness at a value of greater than 40% will reduce the battery time available, perhaps to less than 30 minutes.

WARNING

When fully charged, the EFD1000's optional Emergency Backup Battery (EBB) will allow the operation of the EFD1000's display, AHRS, and RSM's emergency GPS (if enabled) for at least 30 minutes. If aircraft power cannot be restored, the pilot should follow the electrical failure checklist in the Aircraft Flight Manual.

CAUTION

During situations where a high electrical demand is placed on the aircraft electrical system, electrical transients that cause aircraft voltage to drop below 9.0V momentarily or 12.3V for 2 minutes (14V electrical system) or 18.0V momentarily or 24.6V for 2 minutes (28V electrical system) will cause the EFD1000 display to automatically switch to its internal battery or Emergency Backup Battery (EBB) (as configured).

This will be accompanied by an ON BAT annunciation.

The ON BAT annunciation should extinguish shortly after the electric transient demand goes away. If the ON BAT annunciation does not extinguish, then an aircraft power source failure has most likely occurred.

6.6. **GPS Failures and RSM Emergency GPS Use**

Position and flight plan data for the PFD is provided from aircraft panel-mounted GPS equipment. The PFD may be configured to receive data from one or two external GPS systems. In addition, position from the RSM's Emergency GPS system can be used to drive the display if all aircraft GPS systems fail.

The map function in the PFD will follow an automatic position reversion scheme to determine which GPS is used to provide position data to the map. The primary GPS is always the one selected by the pilot using CDI Nav Source Select button. If the selected GPS fails, the PFD automatically switches to the other aircraft GPS (if installed) and will annunciate GPS# Reversion, where # represents the GPS source providing position data.

If all panel-mount GPS systems fail, the PFD will use position data from the RSM Emergency GPS and annunciate RSM GPS REVERSION EMER USE ONLY. In this case, the map data is approved for emergency use only.

Whenever the map has reverted to an alternate position source, all map features and capabilities are retained, including the display of the flight plan from the selected panel-mount GPS. However, when the selected GPS is no longer providing position data, the flight plan is displayed without an active (magenta) leg. The flight plan and map data from each aircraft GPS is retained independently. If two external GPS were connected prior to failure of both, and if each had a different flight plan at the time of failure, both retained flight plans remain available to the pilot and may be selected using the PFD's Nav Source Select button.

In the unlikely event that there is a complete loss of all GPS data to the display, including failure of the RSM GPS, all mapping information is removed from the PFD display.

NOTE

When airborne, if the EFD input voltage is below the 12.8V (14V Electrical System) or 25.6V (28V Electrical System) automatic battery transition threshold, and EXT PWR is selected the EFD will automatically transition back to its internal battery or Emergency Backup Battery (EBB), as configured.

Figure 6-3
External Power Voltage Status

Figure 6-4
Battery Status

6.7. **Power Override**

In the event that the pilot wishes to override the automatic power configuration of the equipment, proceed as follows:

Power Override

1. MENU .....“POWER SETTINGS” Page

To switch FROM aircraft power to Battery:

2. “BATTERY” LINE SELECT KEY.....PRESS

To switch FROM Battery TO aircraft power:

3. “EXT PWR” LINE SELECT KEY .....PRESS

View External Voltage Status

1. Push the MENU Key. The Main Menu displays.
2. Rotate the Right Knob to the POWER SETTINGS menu displays.
3. The EXT PWR Menu Key (**Figure 6-7**) displays the external power voltage.
4. Push the MENU key to exit the Menu.

View Internal Battery Status

1. Push the MENU Key. The Main Menu displays.
2. Rotate the Right Knob to the POWER SETTINGS menu displays.
3. The BAT Menu Key (**Figure 6-8**) displays the current battery status as either charging or a percentage of charge.
4. Push the MENU key to exit the Menu.

6.8. **In-Flight AHRS Reset**

In the unlikely event the EFD1000 determines a potential degradation of attitude information, a warning annunciation, CROSS CHECK ATTITUDE, displays (**Figure 6-5**). If the attitude pitch or roll data become invalid, a red X and the textual annunciation of ATTITUDE FAIL display on the Secondary Attitude Indicator, and all aircraft roll, pitch, and slip information is removed from the Attitude Indicator display (**Figure 6-6**). Use alternate, mechanical flight instruments and reset the AHRS as soon as possible.

During the initialization, the aircraft should not be subjected to excessive turn rates. Typical in-flight initialization will take approximately 30 seconds, but can take longer if the reset is initiated while banked or maneuvering.

Figure 6-5
Attitude Degraded Performance

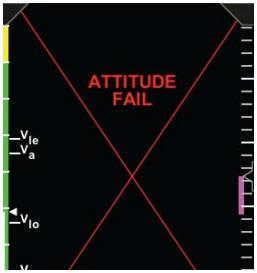
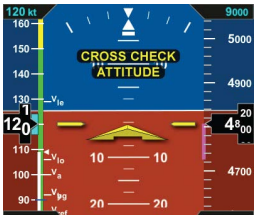


Figure 6-6
Attitude Failure



NOTE

When the EFD1000 AHRS is reset in flight, it performs an abbreviated initialization.

The AHRS reset is considered complete when the EFD1000 attitude and heading is once again displayed, stable, and correct with respect to the horizon or standby attitude indicator.

Figure 6-7 Main Menu GENERAL SETTINGS Page

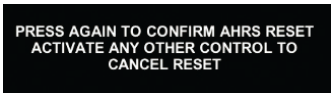


Figure 6-8 AHRS Reset Confirmation Message

NOTE

Pushing any other key, button, or knob cancels the AHRS reset and clears the confirmation message.

Perform an In-Flight AHRS Reset

1. Maintain straight and level flight.
2. Consider exiting IMC.
3. Fly by visual reference or by standby instruments.
4. Disconnect the autopilot.
5. Push the MENU Button. The Menu displays on the Navigation Display.
6 Rotate the Right Knob to display the GENERAL SETTINGS menu page (**Figure 6-7**).
7. Push the AHRS Menu Key. A confirmation message displays, prompting the user to confirm the reset request (**Figure 6-8**).
8. Push the AHRS Menu Key again to confirm the AHRS reset. The AHRS reset is performed, and the confirmation messages clears.
9. Push the MENU Button to exit the Menu.

6.9. **GPSS Operation, Annunciations, and Autopilot Modes**

GPSS is available from the EFD1000 PFD. Three modes, Enabled, Wings Level, and Disabled, are possible and annunciated in the EFD's lower display. When enabled, the configured GPS source not only provides the basemap and flight plan data in the lower display, but also provides GPSS as the heading input to a configured autopilot. When engaged, a configured autopilot will interpret GPSS commands as heading inputs and follow the active GPS flight plan, including anticipated turns, if provided. The GPSS Enabled mode is indicated by a green GPSS hotkey annunciation and a GPSS1 with an inverse A placed next to the HDG reference in the lower display to detail the source (**Figure 6-9**) .

If GPSS is enabled and the GPS source is lost or changed, the GPSS mode automatically changes to the Wings Level mode and annunciates as shown in **Figure 6-10**.

This removes roll steering inputs to the autopilot, causing the aircraft to roll wings level, and displays a red slash through the annunciated A HDG and GPSS# source. The amber GPSS hotkey annunciation requires pilot action. If this occurs, use the following steps:

> ***NOTE***
>
> *When using GPSS with combined GPS / VLOC navigators (e.g., GNS 430/530), VLOC may be selected as the navigation source while GPSS is engaged. To avoid confusion, note that the EFD1000's selected navigation source controls the CDI and the autopilot's navigation and approach modes when engaged. GPSS reflects the heading commands required to navigate the active flight plan leg and controls the autopilot's heading mode when engaged. Complete understanding of autopilot mode functions and their proper selection is recommended.*

Figure 6-9
Operating in GPSS Mode

Figure 6-10
GPSS in Wings Level Mode

Figure 6-11
GPSS Disabled

When GPSS Automatically Changes to Wings Level Mode

1. Check the configured GPS source.
2. Check the EFD1000 navigation source select.
3. If selected GPSS source is restored or changed and GPSS is still desired, press the GPSS Hot Key to activate GPSS (GPSS Hot Key label turns green).

Disable GPSS

1. Adjust the EFD1000 HDG bug as desired.
2. Check or set the Autopilot Control Panel modes as desired.
3. Press the GPSS Hot Key until the Hot Key label is gray (**Figure 6-11**).

NOTE

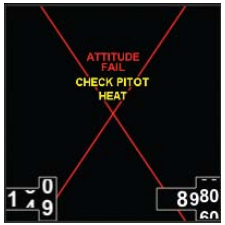
If GPSS is enabled and the autopilot is engaged in the heading mode, disabling the GPSS will cause the autopilot to follow HDG bug steering.

NOTE

The configured GPS source must provide an active flight plan (or Direct-To waypoint) for the GPSS to remain engaged or to be restored.

If the EFD1000 navigation source is changed to another configured GPS or VLOC source for longer than 2 seconds, the GPSS mode will change to Wings Level. The pilot must then press the GPSS hotkey to restore or disable GPSS, as desired.

6.10. **Warning, Caution, and Advisory Summary**

WARNINGS		
 Figure 6-12 Battery Countdown	 Figure 6-13 Battery Operational	Presented when the EFD is operating on the internal or Emergency Backup Battery (EBB) (as configured). The countdown timer begins at 15 seconds and is then replaced by the ON BAT annunciation with the battery's % charge remaining. ***NOTE*** *If the battery temperature is less than 0° C, the countdown timer will begin at 10 minutes.*
 Figure 6-14 Attitude Fail	 Figure 6-15 Direction Indicator Fail	Presented when the EFD1000 has determined that the associated function is invalid or failed and should not be used. The data is removed from the display and replaced by a red X over the affected display feature.

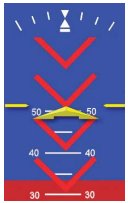
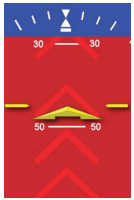
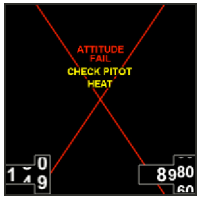
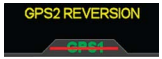
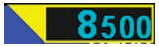
WARNINGS	
 Figure 6-16 Extreme Pitch Down  Figure 6-17 Extreme Pitch Up	Red chevrons displayed on the Attitude Indicator's pitch scale to indicate extreme pitch up and down attitudes and direction to restore level flight.

Table 6-1 Warning Annunciations

CAUTION

 Figure 6-18 Cross Check Attitude	Presented when the EFD1000 AHRS internal integrity monitor determines that attitude is potentially degraded. If a CROSS CHECK ATTITUDE annunciation is provided, the pilot should cross check attitude, airspeed, and altitude indications.
 Figure 6-19 Check Pitot Heat	Annunciation that is accompanied by an ATTITUDE FAIL annunciation, and is presented when the software detects an obstruction in the pitot system that could potentially degrade the attitude solution. This annunciation is removed when the detected condition is resolved, which would be followed by an automatic AHRS reset. A GPS system is required for this monitor to be enabled.

CAUTION

 Figure 6-20 GPS Invalid  Figure 6-21 RSM GPS  Figure 6-22 GPS Reversion  Figure 6-23 GPS Reversion Emergency	Presented when a configured GPS source's data is invalid or unavailable. GPS# or RSM REVERSION annunciations indicate the current GPS basemap source.
 Figure 6-24 GPS Integrity Flag	Presented when the GPS source coupled to the Horizontal Situation Indicator (HSI) flags the GPS integrity. See the GPS AFMS for more information.
 Figure 6-25 Altitude Caution	Presented to indicate the aircraft is reaching (steady) or deviating (flashing) from the preselected altitude. May be accompanied by an optional one-second steady tone.
 Figure 6-26 Decision Height Caution	Presented when a connected radio altimeter indicates it has reached the altitude set by the pilot. See the Radio Altimeter AFMS for more information.

CAUTION	
 Figure 6-27 GPSS Source Lost/Changed	Presented when the previously enabled and valid GPSS source is lost or has changed.
NXRD :26 Figure 6-28 Data link Weather Data Error	Data link weather product data not received for 30 seconds after an error is detected.
 Figure 6-29 Minimums Caution	The minimums bug is presented on the altitude tape when a minimums value has been programmed via the Hot Keys. The bug includes three components – a green marker 500 ft. above programmed minimums, a hollow yellow triangle in the area from 100 ft. to 200 ft. above minimums, and a red and yellow marker at the programmed minimums value. The annunciation MINIMUMS is also presented on the Attitude Indicator whenever the aircraft is at or below the MINIMUMS altitude set by the pilot, and the minimums alerter is armed. May be accompanied by an optional one-second stuttered tone.

Table 6-2 Caution Annunciations

ADVISORY

Figure 6-30 REV Button Off

Presented when the EFD1000 PFD's REV button is pressed.

Figure 6-31 GPSS On

Presented when GPSS is enabled and the GPS source is valid. Either GPSS1 or GPSS2 may be annunciated, depending on selection and the number of configured GPS navigators. This also indicates the autopilot heading source.

NOTE

GPSS will always reflect the GPS basemap in the lower display and follow its source.

ADVISORY	
 Figure 6-32 GPS Annunciations	Associated with the GPS coupled to the HSI or Secondary HSI. See the GPS AFMS for more information. **NOTE** *These annunciations do not display for RS232 based GPS.*
 Figure 6-33 Traffic Enabled	Indicates the traffic sensor is enabled.
 Figure 6-34 WX-500 Strike Rate	WX-500 spherics Strike display mode selected. The rate indicates the approximate number of lightning strikes detected per minute.
 Figure 6-35 WX-500 Cell Rate	WX-500 spherics Cell clustering display mode selected. The rate indicates the approximate number of lightning strikes detected per minute.
 Figure 6-36 WX-500 Self-Test	Self-test mode annunciation that replaces WX-500 spherics Strike / Cell rate information.

ADVISORY	
 Figure 6-37 Data Invalid or Unavailable	A horizontal red line through any legend indicates that the data is invalid or unavailable.
 Figure 6-38 Navigation Source Invalid or Unavailable	A horizontal red line through the selected navigation source indicates that the data is invalid or unavailable. HSI and SHSI only.
 Figure 6-39 GPSS Off	Grey annunciation that indicates that GPSS is disabled.

Table 6-3 Advisory Annunciations

Chapter 7

Appendices

7.1. **Operating Limitations**

The Aspen EFD1000 PFD Airplane Flight Manual Supplement, 044-00009-001 Revision ( ) (or later FAA Approved revision), contains the limitations that apply to your specific aircraft installations, and must be immediately available to the flight crew when the EFD1000 PFD is being used to provide flight or navigation information. In addition this Pilot's Guide must be carried in the aircraft and be immediately available to the pilot in flight. For installations that include the optional EFD1000 or EFD500 MFDs, Aspen Avionics document 091-00006-001, EFD1000/500 MFD Pilot's Guide must be carried in the aircraft and be immediately available to the pilot in flight.

7.2. **Software Versions**

The system software version for the Main Application Processor (MAP) and for the Input-Output Processor (IOP), both of which are contained within the EFD display unit, is displayed via the Menu SYSTEM STATUS page. The ACU software version number is recorded on a software version label affixed to the ACU hardware.

Figure 7-1
View Main Application Processor Software Version

View the Main Application Processor Software Version

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob to the SYSTEM STATUS menu page.
3. The MAP VER Menu Key displays the current Main Application Processor Software Version (**Figure 7-1**).
4. Push the MENU Button to exit the Menu.

Figure 7-2
View Input/Output Processor Software Version

View the Input/Output Processor Software Version

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob to the SYSTEM STATUS menu page.
3. The IOP VER Menu Key displays the current Input/Output Processor Software Version (**Figure 7-2**).
4. Push the MENU Button to exit the Menu.

Figure 7-3
View Unit Serial Number

View the Unit Serial Number

1. Push the MENU Button. The Menu displays on the Navigation Display.
2. Rotate the Right Knob to the SYSTEM STATUS menu page.
3. The S/N Menu Key displays the unit's serial number (**Figure 7-3**).
4. Push the MENU Button to exit the Menu.

7.3. **Specifications**

7.3.1. **EFD1000 Display Unit**

GENERAL SPECIFICATIONS:	
Width	3.50 in. (Measured at Bezel)
Height	7.00 in. (Measured at Bezel)
Can Depth	4.15 in. (Rear of Bezel to Rear of Can)
Overall Depth	6.35 in. (Knob to Rear Pressure Fitting)
Weight	2.9 lbs (with Mounting Bracket)
Display Type	6.0 in. Diagonal TFT Active Matrix LCD (400x760)
Display Colors	32,768
Face	Anti-Reflective Coated Glass
Backlight	High Intensity White LED
Rotary Knobs	Optical Encoder with Momentary Push
Dimming	Manual & Automatic (Front Bezel Mounted Sensor)
OPERATIONAL SPECIFICATIONS:	
Operating Temp	-20°C to +55°C
Storage Temp	-55°C to +85°C
Max Un-Pressurized Operating Altitude	35,000 ft.
Max Pressurized Operating Altitude	55,000 ft.
Cooling	Integral Fan

Max Humidity	95% at 50°C
Input Voltage	+8 to +32 Volts DC
Max Current	2.4 Amps @ 28 VDC
	4.8 Amps @ 14 VDC
I/O SPECIFICATIONS:	
ARINC 429 Inputs	5
ARINC 429 Outputs	1
RS-232 Inputs	5
RS-232 Outputs	3
Pitot / Static	Quick Connect
CERTIFICATION SPECIFICATIONS:	
Technical Standard Order	TSO-C2d Airspeed Instruments TSO-C3d Turn and Slip Instrument TSO-C4c Bank and Pitch Instruments TSO-C6d Direction Instrument Magnetic (Gyroscopically Stabilized) TSO-C8d Vertical Velocity Instrument (Rate of Climb) TSO-C10b Altitude Pressure Activated Sensitive Type TSO-C106 Air Data Computer TSO-C113 Airborne Multipurpose Electronic Displays
Software	RTCA DO-178B Level C
Environmental	RTCA DO-160E
Categories	See Environmental Qualification Sheet found in the installation manual.

Table 7-1 EFD1000 Display Unit Specifications

7.3.2. **Remote Sensor Module (RSM)**

Width	2.65 in.
Length	4.40 in.
Height	1.00 in.
Weight	0.2 lbs
Input Voltage	Provided by EFD1000
Max Current	Included in EFD1000 Current

Table 7-2 Remote Sensor Module (RSM) Specifications

7.3.3. **Analog Converter Unit (ACU)**

Width	5.75 in. (including mounting flange)
Length	4.30 in. (including connector)
Height	1.60 in. (including mounting flange)
Weight	0.8 lbs
Input Voltage	+10 to +32 Volts DC
Max Current	0.5 Amps @ 28 Vdc 1.0 Amps @ 14 Vdc
Interfaces	ARINC-429 and RS-232

Table 7-3 Analog Converter Unit (ACU) Specifications

7.3.4. **Operational Specifications**

Airspeed Range	Minimum displayed airspeed	20 KIAS
	Maximum displayed airspeed	999 KIAS
Altitude Range	Minimum displayed altitude	-1,500 ft. MSL
	Maximum displayed altitude	60,000 ft. MSL
Vertical Speed Range	Maximum displayed vertical speed rates (tape)	+/-2,000 fpm
	Maximum displayed vertical speed rates (numerical value)	+/- 9,990 fpm
Turn Rate	Maximum displayed turn rate	6.0 °/second
Barometric Pressure Correction Range	28.10 to 30.99 In Hg (946 to 1049 mB)	
Internal Battery	Minimum operating time while on internal battery	30 minutes [1]

Table 7-4 Operational Specifications

1. At extreme cold temperatures the internal current limiting protections of the internal battery may cause the battery to shut off and not power the display.

7.4. **Glossary**

ºC	Degrees Celsius
ºF	Degrees Fahrenheit
Accuracy	Estimated position accuracy in feet or meters
A/D	Analog to Digital
AC	Alternating Current
ACU	Analog Converter Unit
ADC	Air Data Computer
ADI	Attitude Director Indicator
ADIZ	Air Defense Identification Zone
AFMS	Airplane Flight Manual Supplement
AGL	Above Ground Level
AHRS	Attitude Heading Reference System
AI	Attitude Indicator
AIM	Airman's Information Manual
AIRMET	Airman's Meteorological Information
Altitude	Elevation above sea level
APPR	Approach
APT	airport
ARC	Partial heading arc format (100°)
ARINC	Aeronautical Radio, Inc.
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
AWOS	Automated Weather Observing System
Back Course	Localizer back course approach where the signal on the back side of the localizer is used for alignment to the runway opposite of normal localizer alignment. Without compensation, the CDI would reverse sense.
Battery Time	The time remaining on the battery before it is fully discharged.
BC	Back Course
Bearing	The compass direction from the current position to the destination.
BP	Bearing Pointer
Calibrated Airspeed	Indicated airspeed corrected for installation and instrument errors.
CDI	Course Deviation Indicator
CFR	Code of Federal Regulations
CM	Configuration Module
COM	communication radio
Course	The route taken from the starting position to destination.
Course to Steer	The recommended direction to steer in order to reduce cross-track error and return to the course line.

Cross Track	The perpendicular distance, left or right, away from the selected course.
Crosstrack Error	The distance the aircraft is off the desired course.
CRS	Course
CTS	Course to Steer
dBZ	decibels 'Z' (radar return)
DC	Direct Current
Decision Height	A specified height or altitude in the precision approach at which a missed approach must be initiated if the required visual reference to continue the approach has not been acquired. This allows the pilot sufficient time to safely reconfigure the aircraft to climb and execute the missed approach procedures while avoiding terrain and obstacles.
Declutter	Reduce amount of objects displayed on screen.
Deg	Degree
Desired Track	The desired course between the active "from" and "to" waypoints.
DH	Decision Height
Distance (Next)	The great circle distance from current location to a Go To destination or the final waypoint in a route.
DME	Distance Measuring Equipment
DTK	Desired Track
EFD	Evolution Flight Display
EFIS	Electronic Flight Instrument System
Elevation	The height above mean sea level.
Enroute Safe Altitude	The recommended minimum altitude within ten miles left or right of the desired course on an active flight plan.
ETA (Destination)	Estimated Time of Arrival. The estimated time you will reach a Go To destination or the final waypoint in a route.
ETA (Next)	Estimated Time of Arrival. The estimated time you will reach a Go To destination or the next waypoint in a route.
ETE (Destination)	Estimated Time En route. The estimated time required to reach a Go To destination or the final waypoint in a route
ETE (Next)	Estimated Time En route. The estimated time required to reach a Go To destination or the next waypoint in a route.
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FD	Flight Director
Flight Timer	The length of time for the current flight.
Fpm	Feet Per Minute
Ft	Feet

Fuel Timer	The fuel required to travel from current location to the indicated route waypoint.
Glide Ratio, G/R	The estimated distance an aircraft will move forward for any given amount of lost altitude.
GPS	Global Positioning System
GPSS	GPS Steering
Ground Track	see Track
Groundspeed	The velocity that the aircraft is travelling relative to a ground position.
GS	Glide Slope or Ground Speed
Heading	The direction an aircraft is pointed, based upon indications from a magnetic compass or a properly set directional gyro.
Hg	Mercury
HSI	Horizontal Situation Indicator
Hz	Hertz (frequency)
IAF	Initial Approach Fix
IAS	Indicated Air Speed
IAT	Indicated Air Temperature
IFR	Instrument Fight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
in Hg	Inches of Mercury
Indicated	Information provided by properly calibrated and set instruments on the aircraft panel.
IOP	Input/Output Processor
kHz	Kilohertz
KIAS	Knots Indicated Air Speed
km	Kilometer
kt	Knots
LAT	Latitude
LCD	Liquid Crystal Display
LDI	Lateral Deviation Indicator
Leg	The portion of a flight plan between two waypoints.
LOC	Localizer
MAP	Main Application Processor
METAR	Aviation Routine Weather Report
MFD	Multi-Function Display
MHz	Megahertz
Minimum Safe Altitude	Uses Grid MORAs to determine a safe altitude within ten miles of the aircraft present position.
MOA	Military Operations Area
MSA	Minimum Safe Altitude
MSG	Message
MSL	Mean Sea Level

NAVAID	Navigation Aid
NDB	Non-Directional Beacon
NEXRAD	Next Generation Radar
NM	Nautical Miles
NRST	Nearest
OAT	Outside Air Temperature
OBS	Omni-Bearing Selector
PFD	Primary Flight Display
RMI	Radio Magnetic Indicator
RSM	Remote Sensor Module
RSS	Roll Sum Steering
SBAS	Satellite-Based Augmentation System
SD	Secure Digital
SIGMET	Significant Meteorological Information
TA	Traffic Advisory
TACAN	Tactical Air Navigation System
TAF	Terminal Aerodrome Forecast
TAS	True Air Speed
TCAS	Traffic Collision Avoidance System
TERM	Terminal Mode
TERR	Terrain
TFR	Temporary Flight Restriction
TIS	Traffic Information System
Track	Direction of aircraft movement relative to a ground position; also 'Ground Track'
TRSA	Terminal Radar Service Area
Vac	Volts, alternating current
Vdc	Volts, direct current
VDI	Vertical Deviation Indicator
VFR	Visual Flight Rules
VHF	Very High Frequency
VLOC	VOR/Localizer
VOR	VHF Omni-Directional Radio Range
VORTAC	Very High Frequency Omni-Directional Radio range station and tactical air navigation
VSI	Vertical Speed Indicator
VSR	Vertical Speed Required
VTF	Vector To Final
WAAS	Wide Area Augmentation System
WPT	Waypoint
WX	Weather

7.5. **Index**

Symbols

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