Pilots Guide

EFIS HORIZON

SERIES I

Release 29g 2008-01-23

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FORWARD
by Mike Casey

I have added new sections to this manual:

- This FORWARD
- APPENDIX H: WIRING LIST AND PORT SETTINGS Found in the Technicians Guide. (I strongly recommend that you follow this when wiring your EFIS. Not because it is better, but because it will give all of us a standard by which we can compare notes).
- GLOSSARY

My knowledge of this EFIS was obtained by spending many days sitting in my hangar, in the cockpit and playing with the EFIS buttons. I could not have accomplished this without a re-emitting GPS.

The problem was that inside my heated metal hangar the GPS signal couldn't be received. A re-emitting GPS was the answer. It picked up the GPS signal on the outside of the hangar and re-transmitted it inside the hangar.

The unit I have is GPS Reradiator RA-46 which you can order at http://mobilegpsonline.com for about $90.

The unit plugs into a 12V cigarette lighter. So you will probably want to get a 110V AC to 12V DC adaptor from Radio Shack.

Radio Shack Model: 22-505 and Catalog #: 22-505.

My Experience:

- Electronics Technician in the Navy
- BS-EE from New Mexico State University
- Instrumented Rated Private Pilot with 1,000 hours
- I have built an RV-7A with an Eggenfellner Subaru engine and the following avionics: SL-30, Dual GRT EFIS with weather, GPS, ARINC-429. The autopilot is a TRU-TRAK II VSGV.

Manual Conventions

Indicates that an item has been updated. Inserting new items may change the table of contents and page numbers. I will not alert you to that.

Throughout the manual you may see { } or ____. This is used to indicate the settings I have made on my EFIS. I am learning the same as you, so use my setting with caution.

The first seven sections of the manual are devoted to the pilot. The remainder of the manual is for the technicians setting up the EFIS.

Please eMail any corrections or suggestions to:

mikec@caseyspm.com

1.1 Power Up

The EFIS Horizon will turn on once power is supplied via an avionics master switch. It will determine if the aircraft is in on the ground or in flight.

When an Aircraft On Ground (AOG) and, power-up occurs, the startup screen will show software and navigation database version and EFIS system status shown in Figure 1.1.

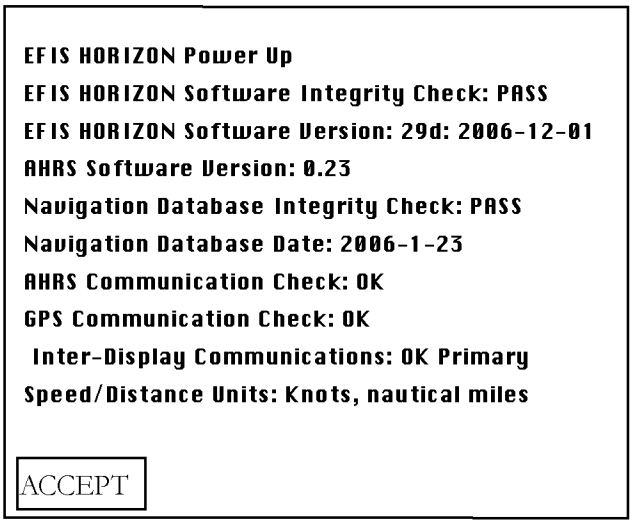


Figure 1.1 Startup Screen

To acknowledge the database information: Press the button [ACCEPT]

Note: The accept button is the white button with the word [ACCEPT] showing on the screen above it.

Once acknowledged the factory default screen appears as shown on the following page.

1.2 Inflight Power-Up

An In-Flight power-up occurs when the following is true:

- Airspeed greater than 50 mph and/or GPS-reported groundspeed greater than 25 mph.

An In-Flight power-up will result in the display unit showing the same screen as was selected when the display unit was last powered down. The startup screen will not show.

1.3 AHARS

The AHRS is subject to an angular rate maximum of 200 deg/second. If this limit is exceeded, the AHRS Unreliable message will be displayed. The air data (airspeed and altimeter) will remain valid however, attitude data will not be.

The AHRS may take up to 180 seconds to align during initial startup. During this time the aircraft should remain motionless. The Align message will show on the screen with the time remaining for alignment.

Figure 1.2 Labels

1.4 Knobs and Buttons

The EFIS Horizon Series I system is designed to make its use and operation simple. The left and right Knobs and the five white Buttons are used to access the many features of the EFIS. Menu Option Labels show functions for each knob and button.

Knobs

The Left and Right black knobs have two motions, rotary and push. These provide particular menu options on different pages.

Examples:

- Rotate the left knob to set the heading.
- To adjust the display brightness, press the left (DIM) knob and then rotate it. To state this another way, repeatedly press the left knob until (DIM) is highlighted. Then rotate it.
- To adjust the altimeter setting rotate the right knob.
- To set the Altitude bug, repeatedly press the right knob until (ALT) is highlighted then rotate the knob.

Buttons

There are five white buttons. Pressing any button will display the corresponding [Labels] for that page.

Labels

Labels are blue boxes over the knobs and buttons. The labels will be different for different pages.

When a Button is pressed the Label will appear then disappear after 5 seconds, unless another button is pressed.

When the Left Knob is pressed the Label will remain until the [Next] or [Exit] Button is pressed.

1.5 Messages

From time to time you will receive an unexpected message on the screen. The following is how to deal with the message. Let's suppose the screen displayed the following message:

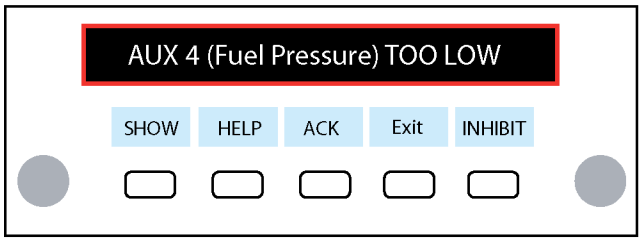


Figure 1.3 Menu — PFD
To View - [automatic]

- [SHOW] — pushing and holding the [SHOW] button will display the engine menu so that you can view the alarm source.
- [HELP] — pushing and holding the [HELP] button will display a help banner.
- [ACK] — momentarily pressing the [ACK] (Acknowledge) button will make the message go away. As long as there is a message to be acknowledged you won't be able to change screens or do much of anything else.
- [INHIBIT] — Let's suppose that you [ACK] the above message but the fuel pressure remains too low. The message will return after each acknowledgement. Pressing [INHIBIT] gets around the problem. Pressing [INHIBIT] will bring up the following menu:

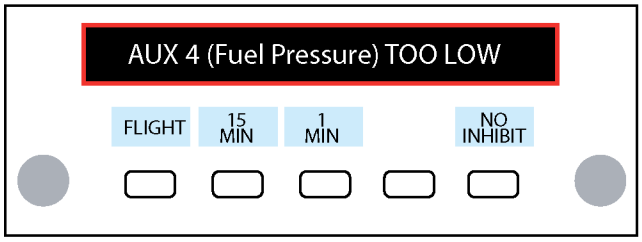


Figure 1.4 Menu — PFD
To View - [INHIBIT]

- [FLIGHT] will make the message go away for the entire flight.
- [15 MIN] will make the message go away for 15 minutes.
- [1 MIN] will make the message go away for 1 minute.
- [NO INHIBIT] will exit the inhibit page.

"**NO VNAV**" means VNAV is unavailable because airspeed or attitude is invalid (the plane is not moving, or the AHRS is aligning).

The blinking red box means there's no target altitude and the target altitude needs to be reset. That usually happens after an approach is aborted, in which case there is a vertical speed set, but the EFIS doesn't know at what altitude to level off.

1.6 PFD Page And Split Screens

The EFIS Horizon PFD page is the first and main page used during flight.

Figure 1.5 Full PFD Screen

Pressing any button will bring up the Figure 1.6 for 5 seconds.

Repeatedly press the left [PFD] button and you will notice the displays change as shown in figures 1.7 through figures 1.9.

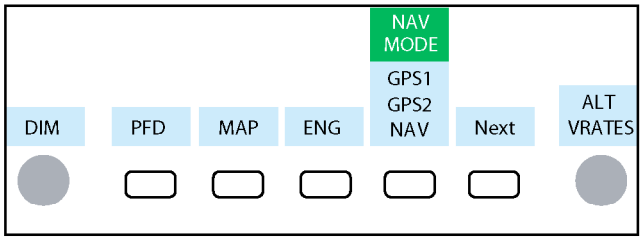


Figure 1.6 Menu — PFD
To View - [any button]

Figure 1.7 Split Screen
PFD/Map Heading-Up

Figure 1.8 Split Screen
PFD/Map HSI

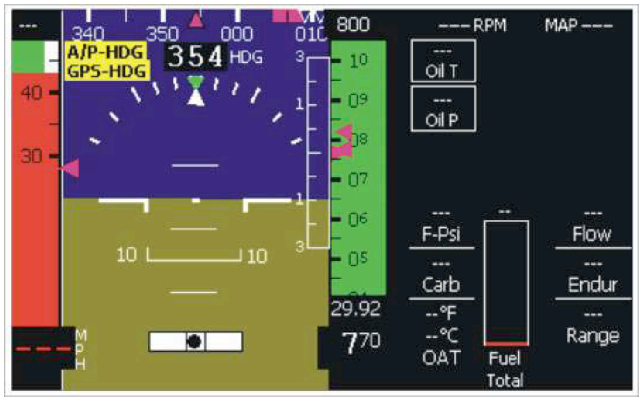


Figure 1.9 Split Screen
PFD/Engine

1.7 Menu Overview

Press any button and you should see the following menu:

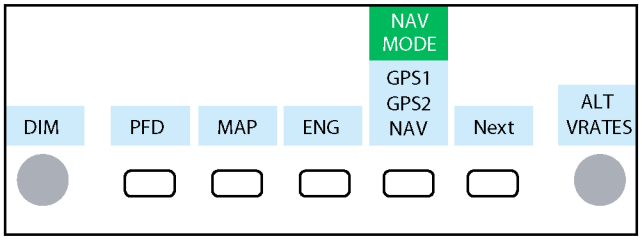


Figure 1.10 Menu — PFD
To View - [any button]

Pressing [MAP] will take you to the Map pages which will be discussed under Section 5: Moving Map.

Pressing either knob will display Figure 1.11.

Pressing [ENG] will take you to the Engine pages which will be discussed under Section 6: Engine Monitor.

[NAV Mode] shown above, may look different on your EFIS due to the instruments in your system.
In this example:

- GPS1 is the EFIS internal GPS
- GPS2 is an external GPS
- NAV is an SL-30 Nav/Com.

Repeatedly pressing the [NAV MODE] button allows the user to highlight (choose) a navigation source. The chosen source is the one that is highlighted.

Pressing and then rotating the right hand knob will allow the user to set an altitude and climb rate. This information will be used by the autopilot to climb or descend to a preset altitude. See: Section 2: Autopilot Coupling

Press [Next] to display the following menu:

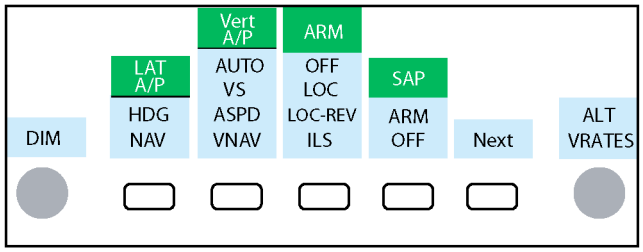


Figure 1.11 Menu — PFD Output to Autopilot
To View - [any button] [Next]

To set VRATES, [VS] must be selected. If [ASPD] is selected then VRATES will set Air Speed.

See Section 3: Autopilot Coupling

1.8 Instrument Approach Submenu

Pressing [NEXT] in Figure 1.11 will bring up Figure 1.12.

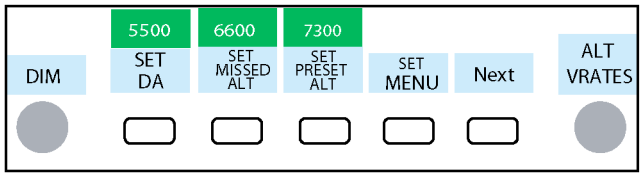


Figure 1.12 PFD Menu — Set Altitudes
To View - [any button] [Next] [Next]

[SET DA] sets the Decision Height MSL for an instrument approach. The Altitude AGL will blink Red when below DA. AGL altitude can be seen in Figure 1.17 and is 963 feet.

[SET MISSED ALT] This is the altitude that the autopilot will climb the aircraft to in the event of a missed approach.

[SET PRESET ALT] This is just a reference number set on the PFD which will have no effect on the autopilot.

[SET MENU] will bring up the dialog box shown in Figure 1.13. Think of SET MENU as a preferences menu. This is where you can configure the EFIS to behave and display in the manner of your choosing. See: The Technicians Guide.

1.9 Settings Menu

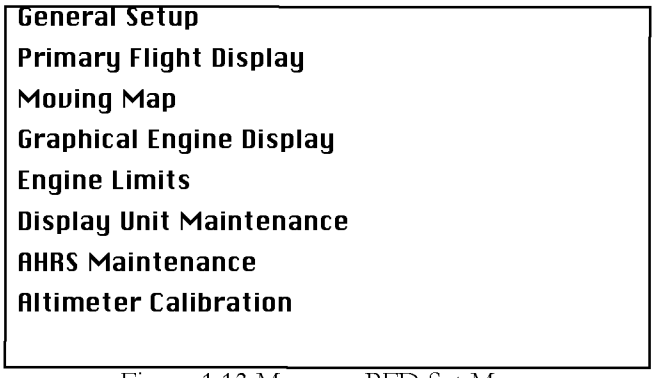


Figure 1.13 Menu — PFD Set Menu
To View - [Next] [Next] [SET MENU]

1.10 Next Submenu

Pressing [Next] in Figure 1.12 will bring up Figure 1.14.

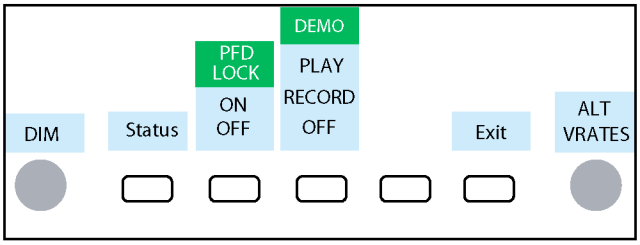


Figure 1.14 Menu — PFD Sub Menu
To View - [any button] [Next] [Next] [Next]

Pressing [Status] displays:

Figure 1.15 PFD Status Menu
To View - [any button] [Next] [Next] [Next] [Status]

[PFD LOCK] locks the screen in the Primary Flight Display mode.

Note: if you can't change screens it is probably because this is set to **[On]**

[DEMO] allows you to record a flight onto the memory stick supplied with the EFIS, and later play that flight back into the EFIS.

[Exit] returns back to the PFD.

1.11 Detail View of The PFD

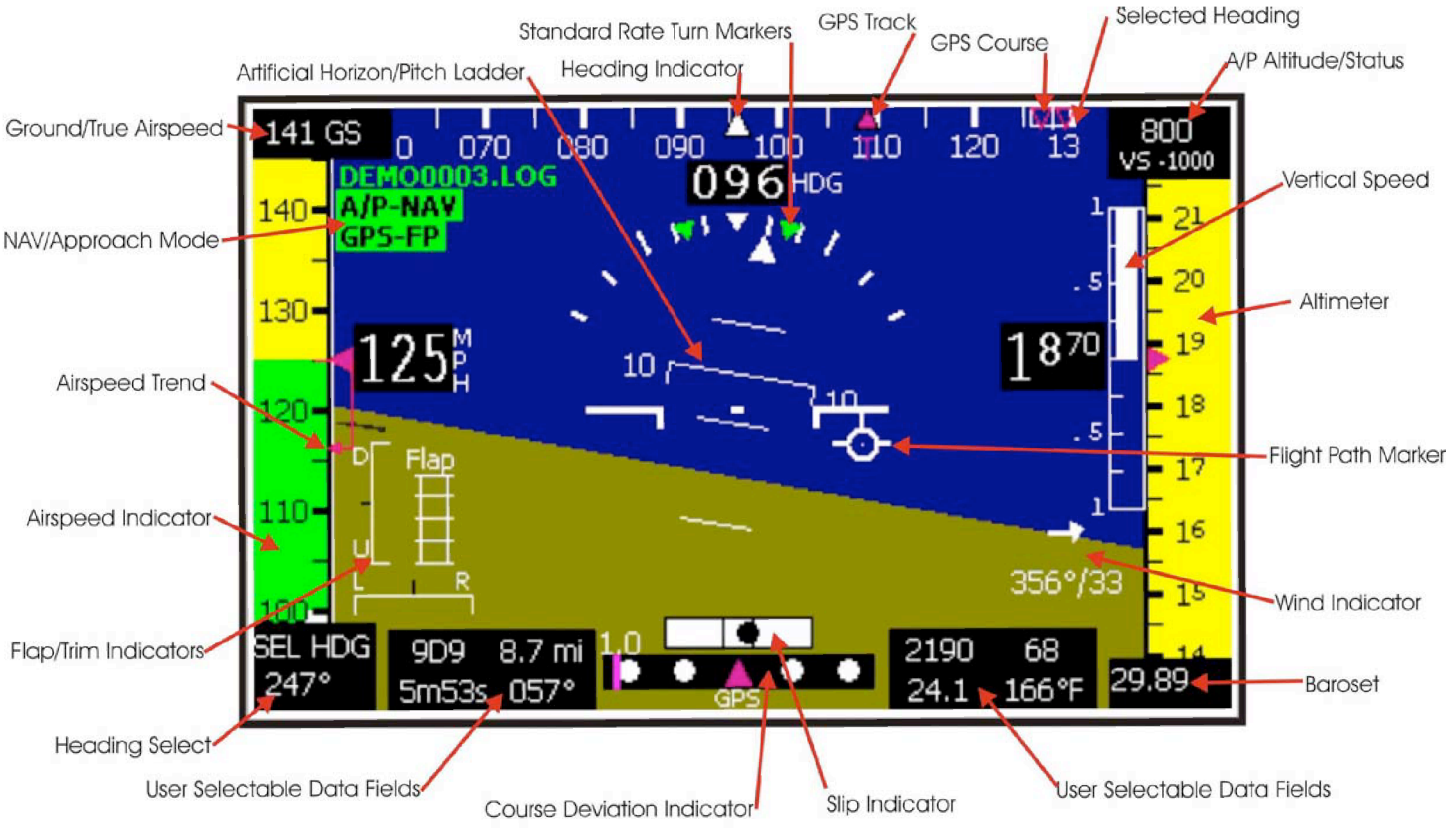


Figure 1.16 PFD

The following is a description of some of the PFD items:

- Flight Track Marker (FTM) is shown at the top of the page under GPS Track.
- indicates that the FTM may be in error.
- The GPS Course as shown at the top right corner of the above screen is hollow. This is because the course to the selected waypoint is off the screen.
- Aligning the Flight Track Marker below this Course marker will result in a ground track directly to the waypoint.
- Heading Bug. A hollow heading bug as shown at the top right of the screen indicates that bug is out of view. This is because the heading selected at the bottom left is 247° which can't be displayed. The wind is from 356° at 33 Knots.
- The Engine RPM is 2190.
- Altimeter is set to 29.89 by the right hand knob.
- The Course Deviation Indicator at the bottom of the screen is deflected to the left.
- The transition from green to yellow on the airspeed tape shows that the Maneuvering speed is 125 MPH.
- The Airspeed Trend shows a decreasing airspeed.
- The ground speed is 141 mph.
- The white bar next to the altitude tape shows that the aircraft is climbing at 1000 fpm.

The user can set-up what information is to be displayed in the black (User Selectable Data Fields) at the bottom of the screen. You would choose this information under [SET MENU]. See Section 9

Tip: The heading bug can be moved to the current heading by simultaneously pressing both Knobs.

Figure 1.17 PFD Synthetic Approach

1.12 Understanding The Primary Flight Display

A few facts you can observe from Figurer 1.17:

- HDG (heading) is 284°
- Indicated Air Speed is 76 Knots
- True Airspeed is 78 Knots
- Altitude is 1750 ft. MSL
- Altitude 963 ft AGL
- Wind is 320° at 30 Knots
- Altimeter is 29.92
- The aircraft is 3 nautical miles from the airport
- RPM is 2200
- Manifold Pressure is 24.0 inches
- Altitude bug is set to 2500 ft and is out of view.

Note: The left knob sets the Heading bug and the right knob sets the Altitude bug.

1.13 Synthetic Approach SAP

Information for the Synthetic Approach (SAP) comes from either an internal or external GPS. The SAP provides altitude and heading information just like an ILS.

Figure 1.17 shows the PFD view of a synthetic approach. At the top left you can see that this is a synthetic approach being made to KGRR airport, runway 26R.

The synthetic approach is flown by simply maneuvering the aircraft so that the FPM (Flight Path Marker) is in the center of the smallest box. The boxes will appear to be three dimensional and to zoom out toward the pilot.

1.14 Primary Flight Display Details

The PFD page consists of the basic flight instruments which are arranged as follows:

- Artificial Horizon in the center
- Airspeed Tape on the left
- Altimeter Tape on the right
- Heading Indicator along the top
- Vertical Speed Indicator next to the Altimeter.

You should also notice the:

- Pitch Ladder and Bank Angle Indicators in the center of the screen
- Trim/Flap Indicator in the lower left (under the Airspeed Digital Display).

To finish the basic PDF page there are five boxes which display:

- Ground or True Airspeed-upper left
- NAV Mode Status — upper left
- Heading Select — lower left
- Altitude Selected — upper right
- Altimeter/Baroset Setting — lower right

1.15 Artificial Horizon

The Artificial Horizon is just that, a pictorial representation of the earth's horizon. The blue portion represents the sky; the brown portion represents the ground.

A portion of the artificial horizon is the Pitch Ladder. It depicts pitch angle of the aircraft in relation to the horizon.

The Flight Path Marker, shown in Figure 1.16 depicts the aircraft's flight path. The FPM will appear to float about the display as the aircraft pitches and rolls. This movement is most evident in strong crosswind or unusual attitudes.

1.16 Airspeed and Altimeter

The Airspeed tape shows airspeed and set points for:

- stall (Vs),
- flap extenion (Vfe)
- maximum structural cruising speed, (Vno)
- never exceed speed (Vne)
- and three user selectable speed bugs.

The Altimeter Tape shows mean sea level (MSL) altitude in hundreds of feet. It also shows the Off Route Obstacle Clearance Altitude (OROCA) which provides obstruction clearance with a 1,000 foot buffer in non-mountainous terrain areas and a 2,000 foot buffer in designated mountainous areas within the United States.

- Yellow — altitude below OROCA
- Green — altitude above OROCA

1.17 Heading

The Heading Tape shows T GPS ground track. Its position relative to the heading scale indicates the current ground track.

Also on the Heading Tape is ▼▼ indicating the bearing to the GPS waypoint. Aligning the ground track indicator with this indicator will result in a ground track directly to the waypoint.

If in Figure 1.11 under [LAT A/P] you choose [HDG] the indicators will be white. If you choose [NAV] the indicators will be red.

When a strong cross-wind component results in a ground track that differs from heading (drift angle) by more than 30 degrees, the ground track triangle becomes hollow to indicate it is "display-limited". Simultaneously, the waypoint bearing indicator also becomes hollow. The relative position between these two indicators remains accurate, allowing the pilot to align these two indicators to achieve a ground track directly to the GPS waypoint in the same manner as if they were not display limited.

When the ground track indicator is display-limited, the flight path marker and ground-referenced symbols (runways and obstacles) are artificially shifted so that they remain on the screen, but in such a way that their position relative to each other is correct. This allows these items to be visible on the screen no matter how large the drift angle.

CAUTION: When the ground track indicator is hollow, indicating it is display-limited; the ground track indicated is necessarily inaccurate. This means that the aircraft's track over the ground is not as indicated, and the pilot should be aware of this inaccuracy with regard to obstacle and terrain clearance.

If the waypoint bearing indicator ▼▼ is off the scale, an arrow will appear in the upper left or upper right portion of the screen indicating the direction to turn to achieve a ground track to the waypoint.

The digital representation of the heading is shown below the Heading Tape. See figure 1.17 and note 284° HDG

You chose [HDG] or [NAV] in figure 1.11.

1.18 Wind Speed/Direction

The wind speed and direction may be displayed in a variety of formats.

The vector representation of wind direction (the arrow drawn on the screen) shows wind direction relative to the aircraft's heading.

A wind vector pointing directly up indicates a tailwind and a vector pointing to the right indicates the wind is blowing from left to right.

In addition to direction and speed Headwind and Crosswind components may be displayed as well.

The numeric display of wind direction is relative to magnetic north.

If insufficient data exists for calculations of winds, the wind vector arrow, and digital data, are blanked (not displayed). Calculated winds are based on GPS ground track and groundspeed, and heading and airspeed data provided by the AHRS. Accurate winds require accurate magnetic heading and airspeed data.

1.19 Turn Coordinator

The Turn Coordinator is depicted at the top of the pitch ladder and below the heading window as inverted green triangles. The EFIS Horizon adjusts the angle of bank required to make a Standard Rate turn (180° in 2 minutes) at a given airspeed. The Turn Coordinator triangles will spread out or in as the airspeed increases or decreases. The markings indicate 10°, 20°, 30°, 45° and 60° bank angles.

1.20 GPS CDI Display & Slip Indicator

The GPS CDI is located at the bottom center of the screen. It displays the direction and magnitude of the GPS cross-track error.

The cross-track deviation is represented by the deflection of the bar from the center of the CDI scale. A deflection to the left indicates the airplane needs to be maneuvered to the left to get back on course. The center of the CDI includes a triangle that points up or down to indicate TO or FROM the GPS waypoint respectively.

Note: FROM indications result in reverse sensing for the deviation indicator, identical to that of a VOR type CDI indicator. This allows normal sensing when tracking outbound from a GPS waypoint.

The deviation bar and TO/FROM indicator are displayed whenever a DirectTo waypoint is active in the GPS flight plan.

The scaling of the CDI indicator changes automatically from:

- 5.0 nm full scale when enroute
- 1.0 nm full scale in terminal phase (within 30 nm of the destination)
- 0.3 nm during approach phase

Approach phase can be detected by the EFIS only when Aviation format of GPS data is provided to the EFIS

1.21 Slip Indicator

The slip indicator works just like a water level slip indicator.

1.22 User Selectable Data Boxes

There are 8 boxes for user selectable data.

Anything from GPS waypoints to engine parameters may be placed in these boxes. These data boxes are configured using [SET MENU].

1.23 Fixed Data Boxes

There are 4 fixed data boxes that display:

- Ground speed or true airspeed in the upper left corner
- Heading selection in the lower left corner
- Autopilot altitude selection and status in the upper right
- Altimeter setting (baroset) in the lower right.

The Primary Flight Display Setting Menu allows to you customize the PFD page. For a description of settings the Technicians Guide — General Setup.

1.24 Reset

To reset the EFIS Horizon: Press both outside (left and right) buttons simultaneously for two seconds.

SECTION 2: AUTOPILOT COUPLING

In the following examples we will assume that your autopilot is connected to the EFIS Horizon via the AIRINC-429 data bus. This will give you the capability of GPSS (GPS Steering) and GPSV (GPS Vertical steering).

When the EFIS is connected to the TruTrak Digiflight IIVS-GV autopilot via ARINC-429 data bus you can expect:

- Horizontal steering using the heading bug
- Vertical steering using the altitude bug.
- Coupled ILS approaches
- Coupled GPS approaches
- Coupled Synthetic GPS Approaches

2.1 Example 1 — Heading and Altitude Bug

In this example we will fly left and right, up and down using nothing but the heading and altitude bugs of the EFIS Horizon.

1 In Figure 2.2 highlight [HDG] and [VNAV].

2 Engage the Autopilot

3 Put the autopilot in GPSS and GPSV modes (press the left and right autopilot buttons).

4 Simultaneously press both the left and right EFIS knobs. This will move the heading bug to your current heading.

5 Change the heading using the left knob.

6 Change the altitude using the right knob.

Note: When you change altitude you may be ask for a vertical rate (Feet Per Minute) or an air speed.

2.2 Example 2 — Flying a GPS Course

In this example we will fly a GPS course line and change altitude using the altitude bug.

1 In Figure 2.1 choose a GPS source. I will choose GPS2 which is my external GPS.

2 In Figure 2.2 choose [NAV] and [VNAV] which will output the GPS course data and the Altitude bug data to the Autopilot.

3 Put the autopilot in GPSS and GPSV mode (press the left and right autopilot buttons). The autopilot should now turn the aircraft to capture the GPS course.

4 Change the Altitude using the right knob.

2.3 Example 3 — Flying a VOR Course

In this example we will fly a VOR Radial and change altitude using the altitude bug.

1 In Figure 2.1 choose a NAV as your source. NAV on my EFIS represents the SL-30 Nav/Com radio.

2 Tune the NAV radio to the VOR you wish to track.

3 In Figure 2.2 choose NAV which will output the SL-30 left, right course data. Choose [VNAV] which will enable the altitude bug.

4 Put the autopilot in GPSS and GPSV mode (press the left and right autopilot buttons).

5 Change the VOR radial using the EHSI found on the MAP page of the EFIS Horizon.

6 Change the Altitude using the right knob.

2.4 Selecting Navigation Source

From the PFD page pressing any button will bring up the following display for 5 seconds.

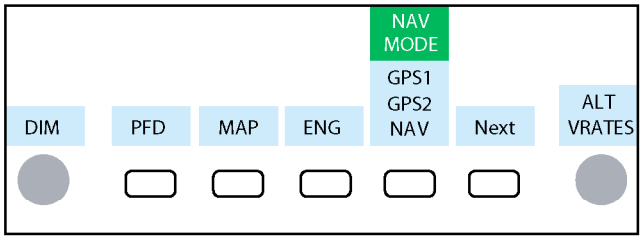


Figure 2.1 Menu — EFIS Input From Navigation Source

To View - [any button]

[NAV Mode] may look different on your EFIS due to the instruments in your system.

In this example:

- GPS1 is the EFIS Horizon internal GPS
- GPS2 is an external GPS
- NAV is an SL-30 Nav/Com.

Pressing the [NAV MODE] button allows the user to highlight a navigation source.

2.5 Selecting Autopilot Coupling

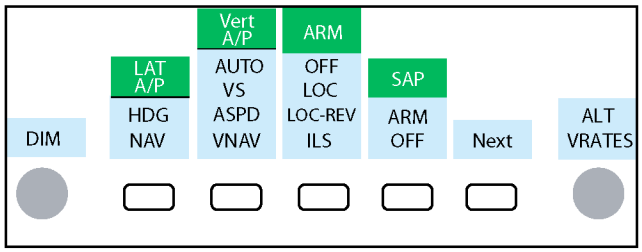


Figure 2.2 Menu — Output to Autopilot.
To View - [any button] [NEXT]
Pressing the left or right knob will also bring up this display.

[LAT A/P] (Lateral Autopilot Coupling) instructs the autopilot to:

- [HDG] follow the heading bug
- [NAV] follow the navigation instrument chosen in Figure 2.1 under [NAV MODE].

[Vert A/P] (Vertical Autopilot Coupling) instructs the autopilot to:

- [AUTO] (Autopilot) allows vertical steering to be controlled at the autopilot. This selects preset airspeed for climb and preset vertical speed for descents.
- [VS] (Vertical Speed) allows the user to set vertical climb and decent rate in feet per minute (fpm).
- [ASPD] (Air Speed) allows the user to set Air Speeds for climbs and descents.
- [VNAV] (Vertical Navigation) enables the altitude bug to control the autopilot. This is selected automatically when a glideslope is captured.

[ARM] Arms the autopilot for:

- [Off] un-arms the approaches
- [LOC] flying a localizer approach
- [LOC-REV] flying a back-course localizer approach
- [ILS] flying an ILS approach.

[SAP] (Synthetic Approach) instructs the autopilot:

- [ARM] Arms the Synthetic Approach
- [Off] un-arms the Synthetic Approach

Note: Both both the ILS and SAP can be armed at the same time. But, the LOC/ILS ARM function will override the SAP function. That means the LOC/ILS could capture, while the SAP would be display-only. SAP will attempt to display the boxes and height above the runway, but all commands to the autopilot will use the LOC/ILS information.

SECTION 3: APPROACHES

All approaches can be hand flown (un-coupled) or coupled to the autopilot (coupled). In the following examples we will only show coupled approaches

The examples assume GPSS (GPS Steering) and GPSV (GPS Vertical steering) is available from your Digiflight II VSGV autopilot.

3.1 Example 1 — Synthetic Approach

The EFIS Horizon uses an internal database and a GPS to calculate a vertical and horizontal approach path (synthetic approach) to a runway. See section 1.13.

1 In Figure 2.1 choose a GPS source.

2 The last waypoint on your GPS flight plan must be an airport.

3 In Figure 2.2 highlight [HDG] and SAP [ARM] then exit the menu

4 You will be asked to pick a runway as shown in figure 3.2

5 Rotate the left knob to highlight a runway then press the knob to select it.

6 You will next see a banner "Check Altimeter Setting"

7 Note: Any messages must be acknowledged [ACK] before you can proceed.

8 [CHG RWY] After selecting a runway, it may be changed by using the [SAP] button again as shown in Figure 3.1

9 Engage the Autopilot

10 Put the autopilot in GPSS and GPSV modes (press the left then the right autopilot buttons).

11 Simultaneously press both the left and right EFIS knobs. This will move the heading bug to your current heading.

12 Use the left knob to change the heading and approach the extended runway at less than a 45° angle and more than 8 miles from the runway end. See Figure 3.4

13 Change the altitude using the right knob.

14 When you get near the runway centerline you will see a message "Synthetic Approach Captured."

15 At this point the heading and altitude bugs no longer function and the aircraft is being automatically flown down the synthetic glideslope and synthetic localizer.

16 You will see a [Missed] button on the EFIS. Press the button if you wish to make a missed approach. See Section 3.3

If the nav radio is tuned to the ILS frequency while making the synthetic approach, you can observe the CDI needles superimposed on the PFD.

Figure 3.1 Menu — Output to Autopilot.

KFTG	35	8000	Hard	PCL	Wind	KTS
KFTG	36	4000	Hard	No Lights	Wind	KTS
KFTG	26	8000	Hard	PCL	Wind	KTS
KFTG	08	8000	Hard	PCL	Wind	KTS
KFTG	18	4000	Hard	No Lights	Wind	KTS
KFTG	17	8000	Hard	PCL	Wind	KTS

Figure 3.2 Menu — Runways

Based on the EFIS calculated winds, favorable runways will be blue and unfavorable runways will be yellow. This may be in error since the winds aloft are not necessarily the same as the winds on the ground.

3.2 Preset Altitudes

From Figure 2.2 Press [NEXT]

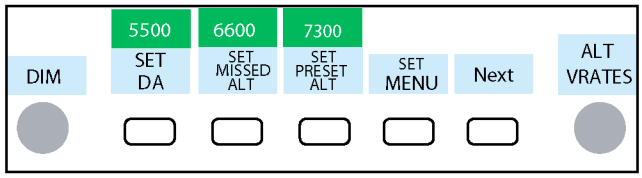


Figure 3.3 Menu — Preset Altitudes
To View - [any button] [NEXT] [NEXT]

There are three altitude settings that can be preset:

- [SET DA] sets the Decision Height MSL for an instrument approach. The Altitude AGL will blink Red when below DA. AGL altitude can be seen in Figure 2.15 and is 963 feet.
- [SET MISSED ALT] After the approach is captured, you will see a [MISSED] button on the PFD. Pressing this button will cause the autopilot to climb straight ahead to the [SET MISSED ALT].
- [SET PRESET ALT] This is just a reference number set on the PFD which will have no effect.

Note: The altitude window will show on the display and blink. Waiting 5 seconds allows the number to be changed by tens of feet.

3.3 Example 2 — ILS Approach

1. Tune the ILS frequency on nav receiver
2. Highlight [NAV] in Figure 2.1
3. Figure 2.2 highlight [HDG], [VNAV], [ILS] and [Off] SAP
4. Verify that the ILS inbound course is set correctly. The EFIS Horizon will attempt to set it for you. You can manually set the course pointer from the map page on the EHSI screen.
5. Engage the Autopilot
6. Put the autopilot in GPSS and GPSV modes (press the left then the right autopilot buttons).
7. Simultaneously press both the left and right EFIS knobs. This will move the heading bug to your current heading.
8. Use the heading and altitude bugs to fly the plane.
9. Use the left knob to change the heading and approach the extended runway at less than a 45° angle and more than 8 miles from the runway end. See Figure 3.4
10. Change the altitude using the right knob.
11. The EFIS Horizon will automatically capture the ILS
12. At this point the heading and altitude bugs no longer function and the aircraft is being automatically flown down the glideslope and localizer.
13. You will see a [Missed] button on the EFIS. Press the button if you wish to make a missed approach. See Section 3.2 for preset altitudes.

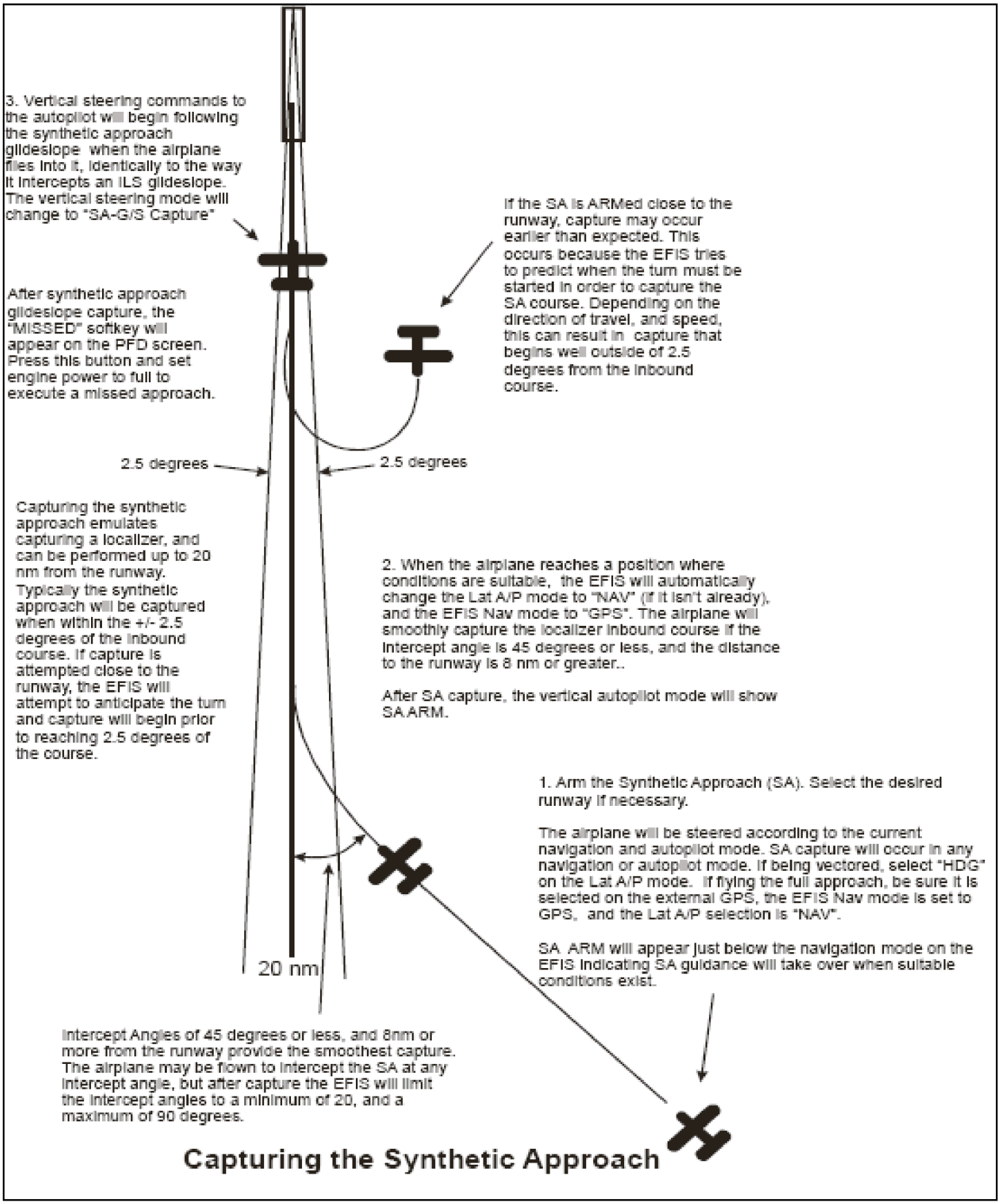
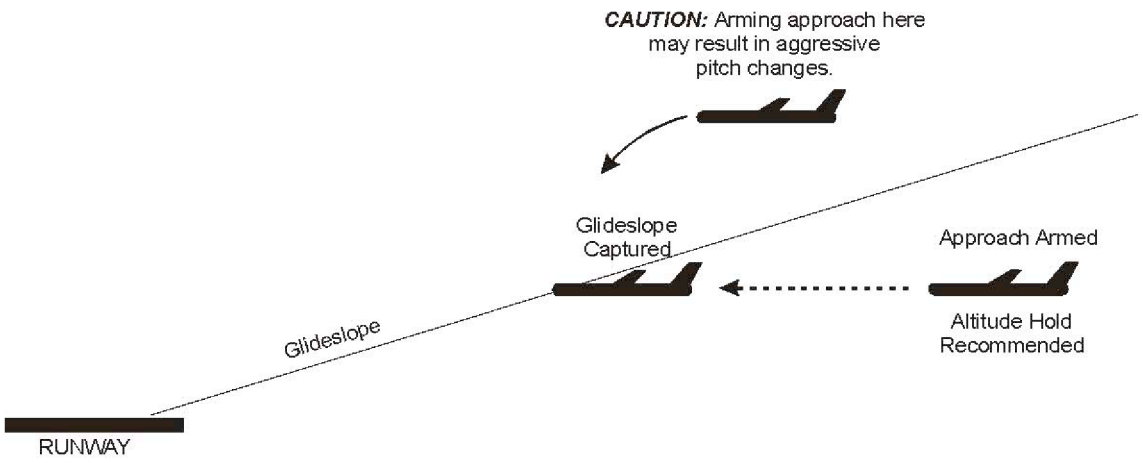


Figure 3.4 Synthetic Approach Capture



The synthetic and ILS glideslope will be captured (meaning, the steering to the autopilot will begin following this guidance) when the airplane flies above it, and, in the case of the ILS, the localizer is valid and is less than +/- 2 dots. Similarly, the synthetic approach will capture the glideslope when the synthetic approach is captured, and the airplane flies above the synthetic glideslope.

If the guidance is armed above the glideslope, the glideslope will be immediately captured, but autopilot commands may result in aggressive pitch changes to bring the the airplane down onto the glideslope.

The recommended method to capture the glideslope is to approach this glideslope in altitude hold mode. This will result in the smoothest transition onto the glideslope. Capture of the glideslope will be allowed no matter what Vert A/P mode is selected however.

It is necessary to set engine power to control airspeed on the approach.

Capturing the Glideslope

Figure 3.5 Synthetic Approach Capture

4.1 Moving Map Group

The MAP page shows:

- Airports
- Airspace
- NAVaids
- GPS/NAV Course
- Heading Select Bug
- HSI
- NAV mode status
- Wind Direction and Speed
- Weather (optional)
- Traffic (optional)

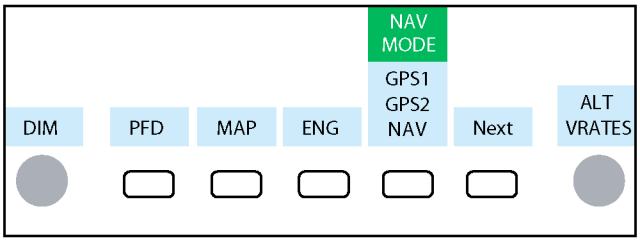


Figure 4.1 Main Menu
To View - [MAP]

Pages within the MAP group are selectable by repeatedly pressing the MAP button. There are 4 MAP pages which are:

- Arc
- North-up
- 360°
- EHSI

Figure 4.2 Map Arc View
To View - [MAP]

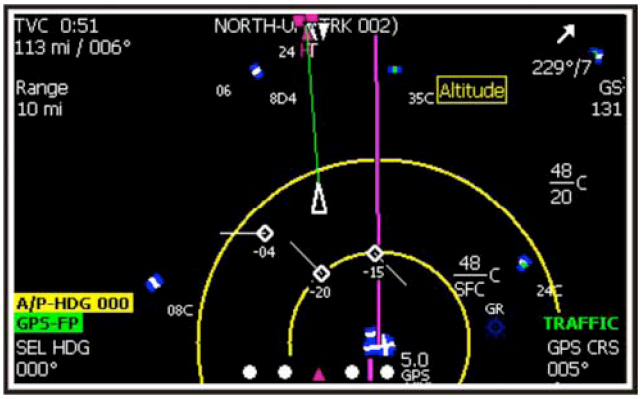


Figure 4.3 North Up
To View - [MAP]

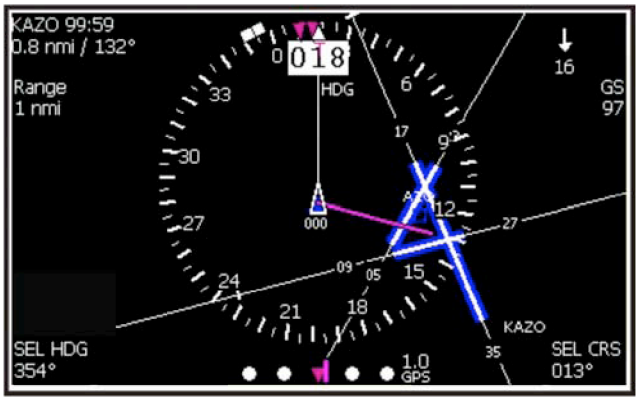


Figure 4.4 Map 360°
To View - [MAP]

Figure 4.5 MAP EHSI
To View - [MAP]

The Electronic Horizontal Situation Indicator (EHSI) works just like a conventional HSI and is displayed in the MAP group.

The Moving Map Display provides a top-down view of the world out to the user's selected range and includes the user's defined data from the settings menu.

4.2 Waypoints and Approaches

User-defined databases are limited to waypoints and airports. The airports may include up to 3 runways (6 runway ends).

Approaches to user-defined airports can be selected if the runway end position, elevation, and runway heading are specified.

Waypoints, previous and current, are shown connected via a magenta line. Subsequent waypoints are shown connected via a white line.

When a DirectTo selection has been made on the internal GPS, the EFIS Horizon will create a course line from the planes present position to the destination.

When in heading select mode, a green line is drawn from the airplane symbol to the heading bug.

4.3 Map Range (RNG)

(Press Left Knob to highlight RNG) (Rotate Left Knob select a range) (Press Left Knob)

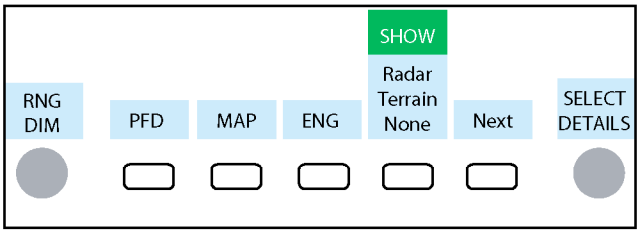


Figure 4.6 Menu — Map
To View - [any button]

4.4 Selecting Map Details

When the MAP page is selected, information about navaids and airports in the database are selectable by pressing the right knob and turning the knob to highlight desired airport or navaid.

Figure 4.7 Waypoint Selection
To View - [MAP]

A yellow line is drawn on the screen from the airplane to the highlighted item.

Details for each navaid or airport, if in the database, are viewable in the Details page. The Details page will also have weather information such as METARs, if equipped with the GRT Weather module and XM subscription.

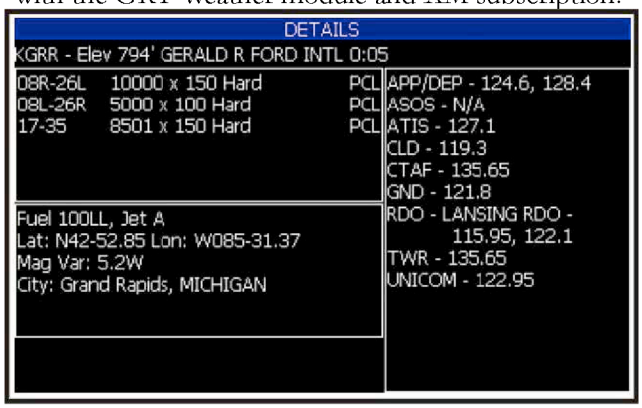


Figure 4.8 Map Details
To View - [Press R-Knob] [Rotate R-Knob] [Press R-Knob]

To access the DETAILS function:

1 Press the right knob and

2 Turn the knob to select the desired navaid or airport.

3 Press again to select DETAILS

4.5 Auto-Tuning (SL30/40)

The EFIS Horizon's auto-tune feature allows the EFIS to program the SL30/40 frequencies.

- SEND LIST — sends all the frequencies both COM and NAV for an airport.
- SET COM — sends all communications frequencies
- SET NAV — sends all navigation frequencies

4.6 XM Weather

XM Weather is an optional feature of the EFIS Horizon. When equipped the MAP group will show precipitation, lighting, meteorological conditions, METARs and AIRMETS according to your XM subscription. (GRT Weather module and XM Weather service required).

While on any Map Page press any button or the left knob to display figure 4.8 Menu.

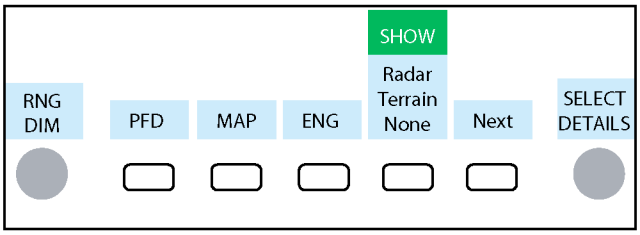


Figure 4.9 Menu — Map
To View - [any Button]

In Figure 4.9 choose [Radar] to display XM weather. Choose Terrain to show the Terrain data.

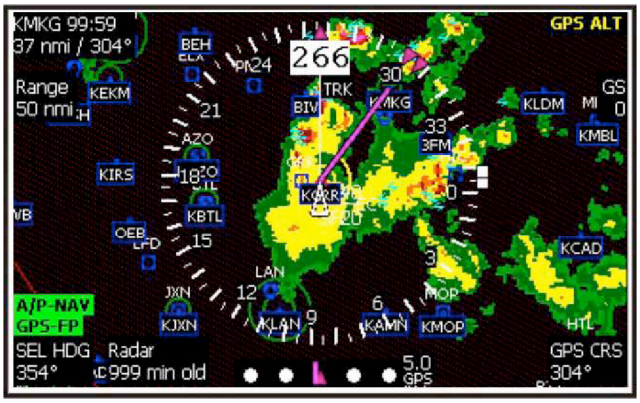


Figure 4.10 XM Weather - IFR Conditions

4.7 Range Select

The map view has user selectable range views from 1-1000 miles.

To access the RNG view setting:

1. While on any MAP page press the left knob, the range box will highlight in yellow and show the current range selection.
2. Turn the knob to the desired viewing range.

4.8 MAP Slew

The MAP Slew feature allows you to move the map without changing the map scale.

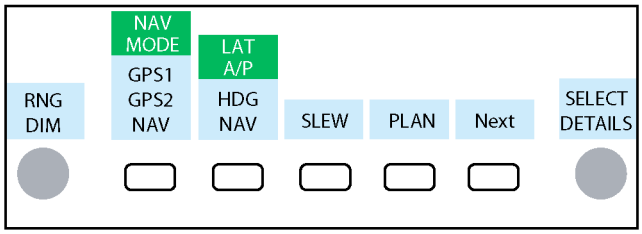


Figure 4.11 Menu — Map [Next]
To View - [any Button] [Next]

To slew the MAP view:

1. Press [SLEW] followed by [WEST], [EAST], [NORTH] or [SOUTH]
2. To return to present position press [EXIT]

Figure 4.11 Menu — Map Slew
To View - [any Button] [Next] [SLEW]

4.9 Traffic

The MAP group is capable of displaying traffic if a Garmin GTX330 Transponder is connected to the EFIS Horizon. Traffic targets are displayed as diamonds with direction of flight and separation in hundreds of feet.

Figure 4.12 Traffic
To View - [MAP]

4.10 Terrain

The EFIS Horizon uses the terrain database currently available on the Grand Rapids Technologies website. Go to www.grtavionics.com/download for the latest version. The colors displayed correspond to terrain as follows:

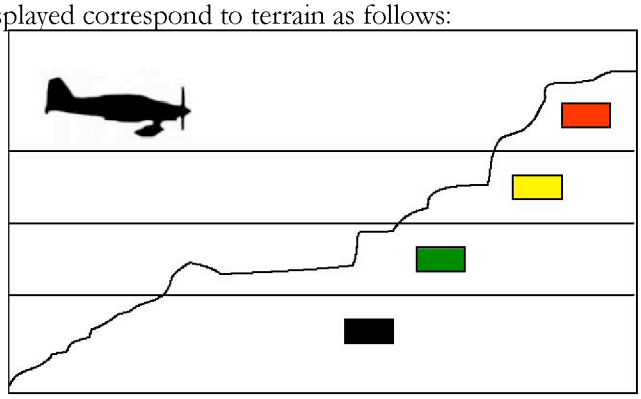


Figure 4.13 Terrain Illustration

- RED terrain less than 500' below
- YELLOW terrain is 500' to 1000' below
- GREEN terrain is 1000' to 2000' below.
- BLACK terrain is more than 2000' below.
- BLUE Ocean coasts.
- BLUE DOTS terrain data not in memory or has not loaded yet.

4.11 Other Menus

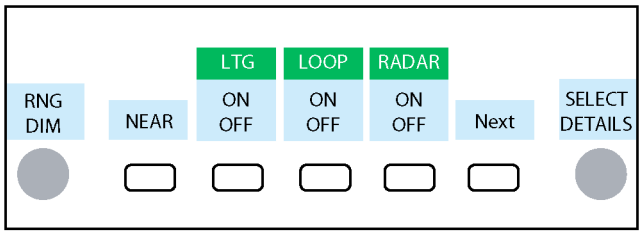


Figure 4.14 Menu — Map XM-Weather
To View - [any Button] [NEXT] [NEXT]

- [NEAR] Brings up the menu for the nearest lists. See: Section 5.
- [LTG] turns on or off the lightning on the weather map.
- [LOOP] Turns the radar and lightning loop on and off. The display holds on to the last 5 radar and lightning updates. You can use the LOOP function to see the movement and development of storms.
- [RADAR] Turns on or off the XM-weather. This appears to be a duplicate since Figure 4.5 also turns on or off Radar.

Press [NEXT]

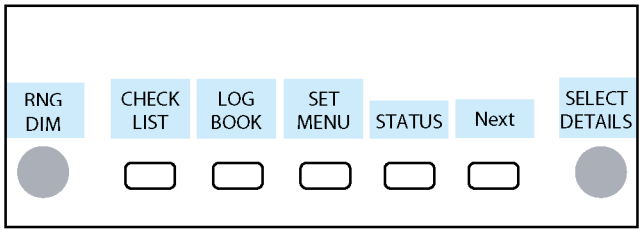


Figure 4.15 Menu — Map Set Menu
To View - [any Button] [NEXT] [NEXT] [NEXT]

- [Check List] the user can write a check list on their home computer and load the check list via the USB memory stick into the EFIS. See: 4.12
- [LOG BOOK] after a few flights click on this button and the information will be self evident.
- [SET MENU] See Technicians Guide
- [STATUS] See Figure 1.15

Press [NEXT]

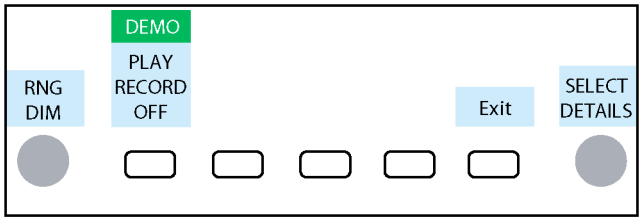


Figure 4.16 Menu — Map Demo
To View - [any Button] [NEXT] [NEXT] [NEXT] [NEXT]

- [DEMO] allows you to record a flight onto the memory stick supplied with the EFIS, and later play that flight back into the EFIS. The DEMO function

records all data coming into the display no matter what page it's on. The only exception is that Display Unit Link data is not currently recorded.

4.12 Check Lists

You can make a file CHECKLIST.TXT file using the notepad on your Personal Computer. Save the file as a text file to the USB flash drive. Use the [IMPORT] function in the [CHECK LIST] to load the checklists into the display from the USB flash drive. All existing lists are replaced by the new file. Here's the format:

```
list NAME OF LIST #1
item ITEM #1
item ITEM #2
item ITEM #3
list NAME OF LIST #2
item ITEM #1
item ITEM #2
item ITEM #3
```

and so on.

There are also codes you can enter, such as :

```
item CHECK OIL PRESSURE - %25%
item SET BAROSET - %53%
```

The %code% will be filled in with the current value (or dashed if unavailable). The following is a test version of CHECKLIST.TXT that includes most of the data codes.

```
list TEST1
item FLAPS - %66%
item AILERON TRIM - %67%
item ELEVATOR TRIM - %68%
item ACTIVE WAYPOINT - %69%
item ESTIMATED TIME TO WAYPOINT - %70%
item RANGE TO WAYPOINT - %71%
item BEARING TO WAYPOINT - %72%
item GROUNDSPEED - %73%
item WIND SPEED - %74%
item WIND DIRECTION - %75%
item NAV MODE - %76%
item A/P MODE - %77%
item VNAV MODE - %78%
item SELECTED HEADING - %79%
item SELECTED COURSE - %80%
item SELECTED ALTITUDE - %81%

list TEST2
item RPM - %0%
item EGT 1 - %1%
item EGT 2 - %2%
item EGT 3 - %3%
item EGT 4 - %4%
item EGT 5 - %5%
item EGT 6 - %6%
item EGT 7 - %7%
item EGT 8 - %8%
item EGT 9 - %9%
item CHT 1 - %10%
item CHT 2 - %11%
item CHT 3 - %12%
item CHT 4 - %13%
item CHT 5 - %14%
item CHT 6 - %15%
item EIS VOLTS - %16%
item FUEL FLOW - %17%
item EIS TEMPERATURE - %18%
item CARB TEMPERATURE - %19%
item COOLANT TEMPERATURE - %20%
item HOURMETER - %21%
item FUEL REMAINING - %22%
item FLIGHT TIME - %23%
item OIL TEMPERATURE - %24%
item OIL PRESSURE - %25%
item EIS AUX 1 - %26%
item EIS AUX 2 - %27%
item EIS AUX 3 - %28%
item EIS AUX 4 - %29%
item EIS AUX 5 - %30%
item EIS AUX 6 - %31%

list TEST3
item FUEL ENDURANCE - %32%
item FUEL RANGE - %33%
item ENGINE PERCENT POWER - %34%
item EFIS VOLTS 1 - %35%
item EFIS VOLTS 2 - %36%
item EFIS VOLTS 3 - %37%
item ANALOG AUX 1 - %38%
item ANALOG AUX 2 - %39%
item ANALOG AUX 3 - %40%
item ANALOG AUX 4 - %41%
item ANALOG AUX 5 - %42%
item ANALOG AUX 6 - %43%
item ANALOG AUX 7 - %44%
item ANALOG AUX 8 - %45%
item OAT - %46%
item INDICATED AIRSPEED - %47%
item TRUE AIRSPEED - %48%
item VERTICAL SPEED - %49%
item ALTIMETER - %50%
item PRESSURE ALTITUDE - %51%
```

item DENSITY ALTITUDE - %52%
item BAROSET - %53%
item AHRS ALIGNMENT - %54%
item AHRS STATUS - %55%
item AHRS ATTITUDE STATUS - %56%
item AHRS ALTITUDE STATUS - %57%
item AHRS ROLL - %58%
item AHRS PITCH - %59%
item AHRS HEADING - %60%
item AHRS SLIP - %61%
item AHRS VOLTS 1 - %62%
item AHRS VOLTS 2 - %63%
item AHRS VOLTS 3 - %64%
item AHRS TEMPERATURE - %65%

Note: Tests 1, 2 and 3 can be a continuous list.

Loading CHECKLIST.TXT into the display:

1. Go to a [MAP] page
2. Push the [CHECK LIST] button
3. Push the [SELECT LIST] button
4. Push the [IMPORT] button
5. The display will look for CHECKLIST.TXT on the USB flash drive and show the list names.
6. Push YES to accept the new lists or NO to keep your previous lists, if any.

SECTION 5: INTERNAL GPS

5.1 Flight Plan

Note: You must be on the MAP page to program the Internal GPS.

The EFIS Horizon allows for quick and easy selection of a way-point for Direct To navigation or a series of way-points for flight PLAN destinations.

5.2 DirecTO Nearest Airport

Press the right hand button several times until you see the [NEAR] button as shown in Figure 5.1.

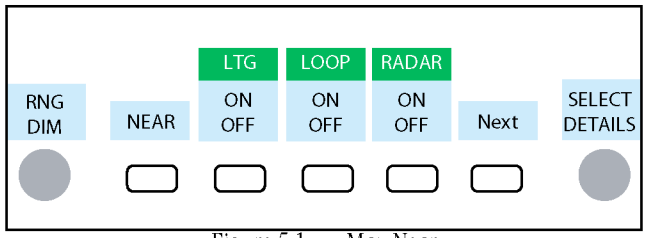


Figure 5.1 — Map Near
To View [any Button] [NEXT] [NEXT]

Press [NEAR] and the display will show Figure 5.2

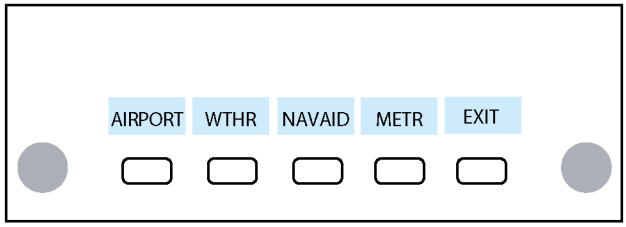


Figure 5.2 Menu — Map
To View [any Button] [NEXT] [NEXT] [NEAR]

In this example press [AIRPORT].

You will now see a list of airports with the closest airports at the top of the list. Select an airport by scrolling with either knob.

NEAREST AIRPORTS

ID	Range	Bearing	CTAF	Length	Surface	Lights
KFTG	0.2	143°	120.200	8000	Hard	Yes
KDEN	7.4	297°		16000	Hard	Yes
KBKF	10.9	232°		11000	Hard	Yes
CO12	13.8	310°		3950	Hard	PCL
KAPA	19.2	218°		10002	Hard	Yes
18V	20.2	330°	122.900	4100	Hard	Yes
1CD2	25.5	324°		3000	Hard	No
KEIK	26.7	290°	123.000	4700	Hard	Yes
03CO	27.1	331°		4000	Hard	No
KBJC	27.3	276°	118.600	9000	Hard	Yes

SELECT | MAP | SL30-1 | ADD WP | SELECT

Figure 5.3 Menu — Map
To View [any Button] [NEXT] [NEXT] [NEAR] [AIRPORT]

If you have a Garmin SL30 Nav/Com connected to the EFIS, then clicking on the SL30-1 button will transfer the selected CTAF frequency into the SL30 standby communications channel.

Pressing [MAP]on the Nearest Airports page is the same as [EXIT] and returns to the map page without setting a waypoint.

To set a waypoint, press [ADD WP] then [EXIT] then [MAP]. You should now see the map page with a magenta line drawn from your current position to the selected airport.

5.3 DirectTO Identifier

While on the map page you can enter an identifier for a navaid or airport you wish to navigate directly to. Press the right button until you see the button [PLAN]. Press [PLAN] then [NEW Goto]. Use the buttons to spell the airport or navaid identifier.

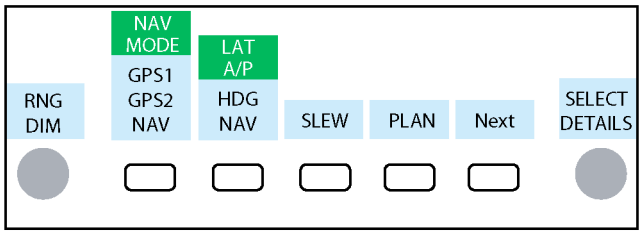


Figure 5.4 — Map Near
To View [any Button] [NEXT]

Figure 5.5 — Map Direct-To
To View [any Button] [NEXT] [PLAN]

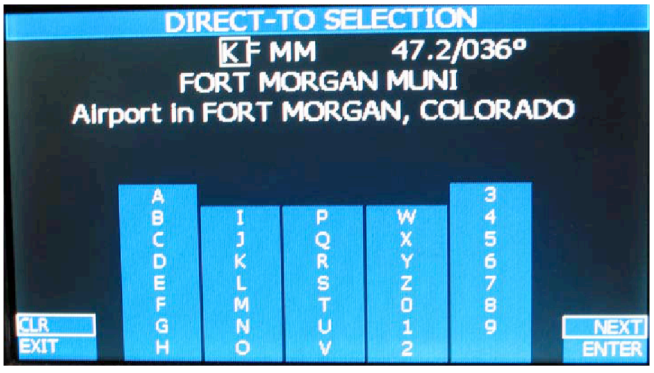


Figure 5.6 Menu — Direct To Selection
To View - [Any Button] [NEXT] [PLAN] [NEW Goto]

[Next] moves to the next character
[Enter] enters the way-point into the GPS
[RemK] or [AddK] removes or adds "K" as the first letter
[Clear] clears the selected character
[Exit] leaves the page without modifying way-point

Then select [ENTER]

Figure 5.7 Menu —Selected Way-point
To View - [Right Knob] [Rotate Knob]

Press the right knob to see the details of the selected way-point.

Press [Exit] to return to the map page, where you should see a magenta line from your present position to the selected way-point.

5.4 DirectTO Knob Selection

While on the map page press the right knob, then rotate the knob. You should observe different navaids and airports being highlighted as you rotate the knob.

Figure 5.8 Menu — Map Flight Plan
To View - [Right Knob] [Rotate Knob]

When the destination is highlighted press [Select] and you should see the Details as shown in Figure 5.9. Rotate the right knob to scroll through the detail list.

Figure 5.9 Menu — Map Flight Plan
To View - [Right Button] [PLAN] [NEW Goto]

[SEND LISTS] — sends all frequencies to the external nav/com.

[SET COMM] — sends all communications frequencies to the nav/com.

[SET NAV] — sends all navigation frequencies to the nav/com.

Press [NEXT] [Add WPT] [Exit] [Map]

When the SL30 is in the [com] mode, press its [SEL] button and rotate the small knob to see the airport identifier and frequency. Or when in the [Nav] mode press [SEL] and rotate the small knob to view the airports runway and ILS frequency..

SECTION 6: ENGINE MONITOR

The EFIS Horizon ENG page displays engine parameters in a variety of user selectable graphics including the following:

- Revolutions per Minute (RPM)
- Manifold Pressure (MAP)
- Oil Temperature/
- Oil Pressure
- Voltage
- Cylinder Head Temperature
- Exhaust Gas Temperature
- Fuel Flow
- Fuel Pressure
- Coolant Temperature
- Carburetor Temperature
- Turbine Inlet Temperature
- N1/N2
- Lean Function

Repeatedly pressing the [ENG] button will switch between the Engine page and the Engine/Map page shown in Figure 6.1.

Figure 6.1 Engine Data and Map

6.1 Engine Lean

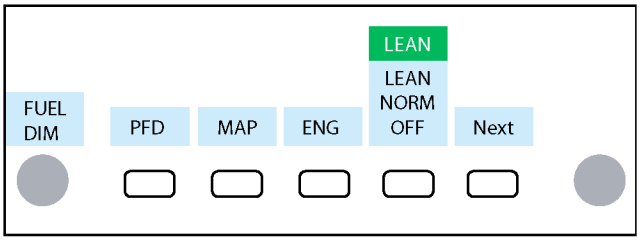


Figure 6.2 Menu Lean
To View - [any Button] [ENG]

Figure 6.3 EGT Page-LEAN Off

With the [LEAN] function on the ENG/EGT page shows the first cylinder to peak surrounded by a white box. The last cylinder to peak is shown in a green box. The [LEAN] function will show the cylinders peak from first to last and their temperature difference from that point in time.

The numbers then shown are the current temperatures near peak or negative (-) representing the difference from peak.

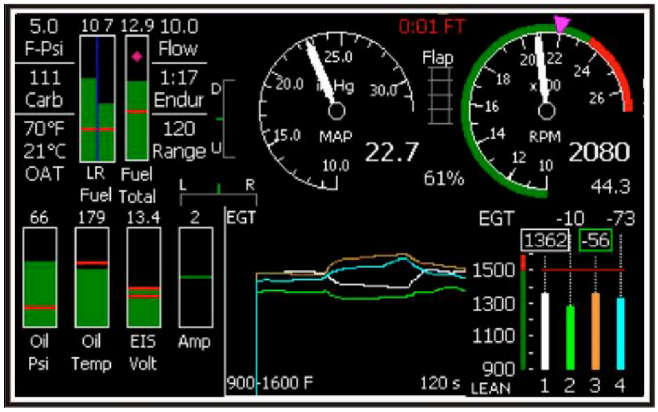


Figure 6.4 EGT Page-LEAN On

The [NORM] function shows the difference between the cylinder temperatures from the time the NORM function is pressed.

6.2 Engine Data

The Engine Monitor Display provides a graphical representation of the information from sensors attached to the Engine Information System (EIS). In this section we will show you the different pages and leaning function.

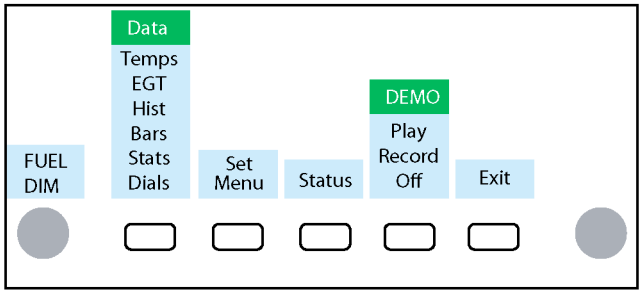


Figure 6.5 Menu Lean
To View - [any Button] [NEXT]

Within the the Engine page you may also select what data you would like to view as standard. Those page views are:

- Temps — Figure 6.6
- EGT — Figure 6.3 and 6.4
- History — Figure 6.7
- Bars — Figure 6.8
- Stats — Figure 6.9
- Dials — Figure 6.10

Figure 6.6 Engine Monitor Temperatures

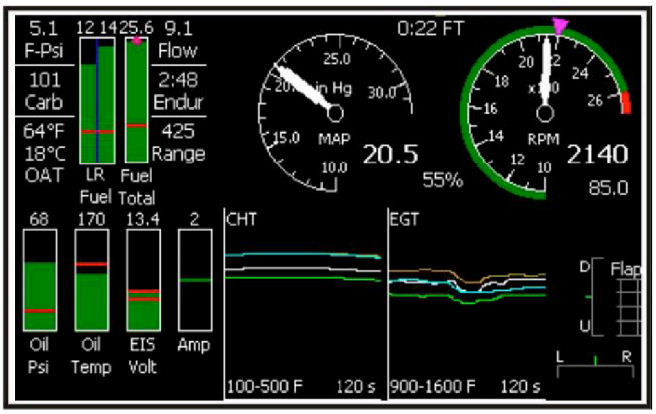


Figure 6.7 Engine History

The Engine History page provides 30-240 user selectable seconds of CHT and EGT history

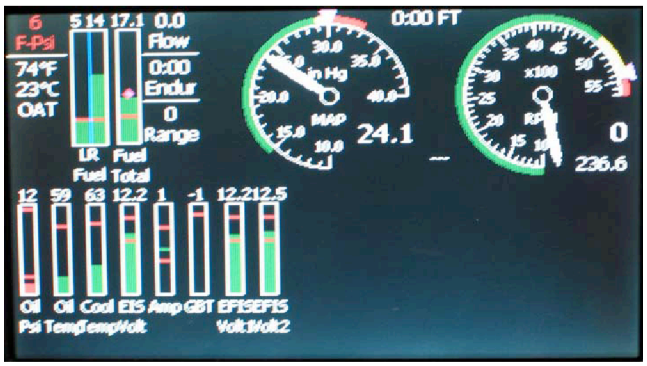


Figure 6.8 Engine Bars

Figure 6.9 EGT Engine Stats

The Engine Stats page provides a quick reference area for a number of different user definable parameters.

Figure 6.10 Engine Dials

The Engine Dials page allows certain parameters to be viewed in a dial format.

6.3 Engine Page Settings

There are two Setting Menus for the Engine Monitor Display page. The first is the Graphical Engine Display menu. It provides settings to customize the bar graphs and dials on the ENG page. See the Technicians Guide

6.4 Fuel Totalizer

You usually set the fuel quantity (the total fuel in all tanks) after a fill-up. To access the Total Fuel function you must be on the [ENG] page:

Press the left knob and you will get Figure 6.2
Press the left knob again

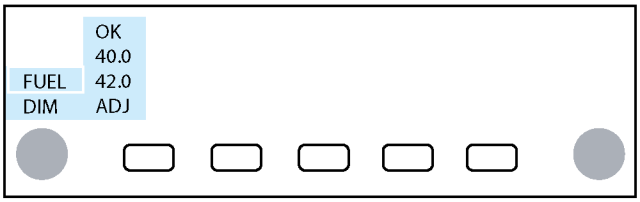


Figure 6.10 Menu Fuel
To View - (Press Left Knob) (Press Left Knob)

Rotate the left knob to highlight a selection. In this example highlight ADJ then press the knob.

Now rotate the left knob to represents the total fuel onboard.. Press the left knob to set the amount.

The Fuel label will show the following:

- OK — no changes will be made
- Total fuel onboard
- (Preset number) See Technicians Guide — Graphical Engine Display, item 100
- ADJ

Preset Number is a preset fuel total. The preset fuel total is set-up in the Graphical Engine Display [SET MENU]. See Section 11

Example: My aircraft holds a total of 42 gallons. So under [SET MENU] I entered 42. And now, every time I fill-up the number 42 is waiting for me to select. I don't need to use ADJ.

GLOSSARY

by Mike Casey

ADC	Air Data Computer
AHRS	Attitude Heading Reference System
AOG	Aircraft On Ground
ARINC-429	Aeronautical Radio Incorporated standard for data communications within an aircraft.
ASCII	American Standard Code for Information Interchange
Button	Button (the 5 white keys)
CDI	Course Deviation Indicator
CTAF	Common Traffic Advisory Frequency
EFIS	Electronic Flight Instrument System
EHSI	Electronic Horizontal Situation Indicator
EIS	Engine Instrument System
FPM	Flight Path Marker
fpm	Climb Rate Feet Per Minute
FTM	Flight Track Marker
GPS	Global Positioning Satellite
GPSS	Global Positioning Satellite Steering
GRT	Grand Rapids Technology
HITS	Highway In The Sky (Synthetic Approach)
HSI	Horizontal Situation Indicator
Knob	Rotary Encoder (two black knobs left and right)
ILS	Instrument Landing System
mph	Miles Per Hour
NDB	NonDirectional Beacon
OROCA	Off Route Obstacle Clearance Altitude
PCL	Pilot Controlled Lighting
PFD	Primary Flight Display
RMI	Radio Magnetic Indicator
TRK	Track
Va	Design Maneuvering Speed
Vc	Design Crusing Speed
Vd	Design Diving Speed
Vf	Design Flap Speed
Vfe	Maximum Flap Extension Speed
Vne	Never-exceed Speed
Vno	Maximum Structural Cruising Speed
VOR	Vhf (Very high frequency) Omnidirectional Range navigation system
Vs	Stall Speed
Vx	Speed for Best Angle of Climb
Vy	Speed for Best Rate of Climb