

# EMS-D120 Engine Monitoring System



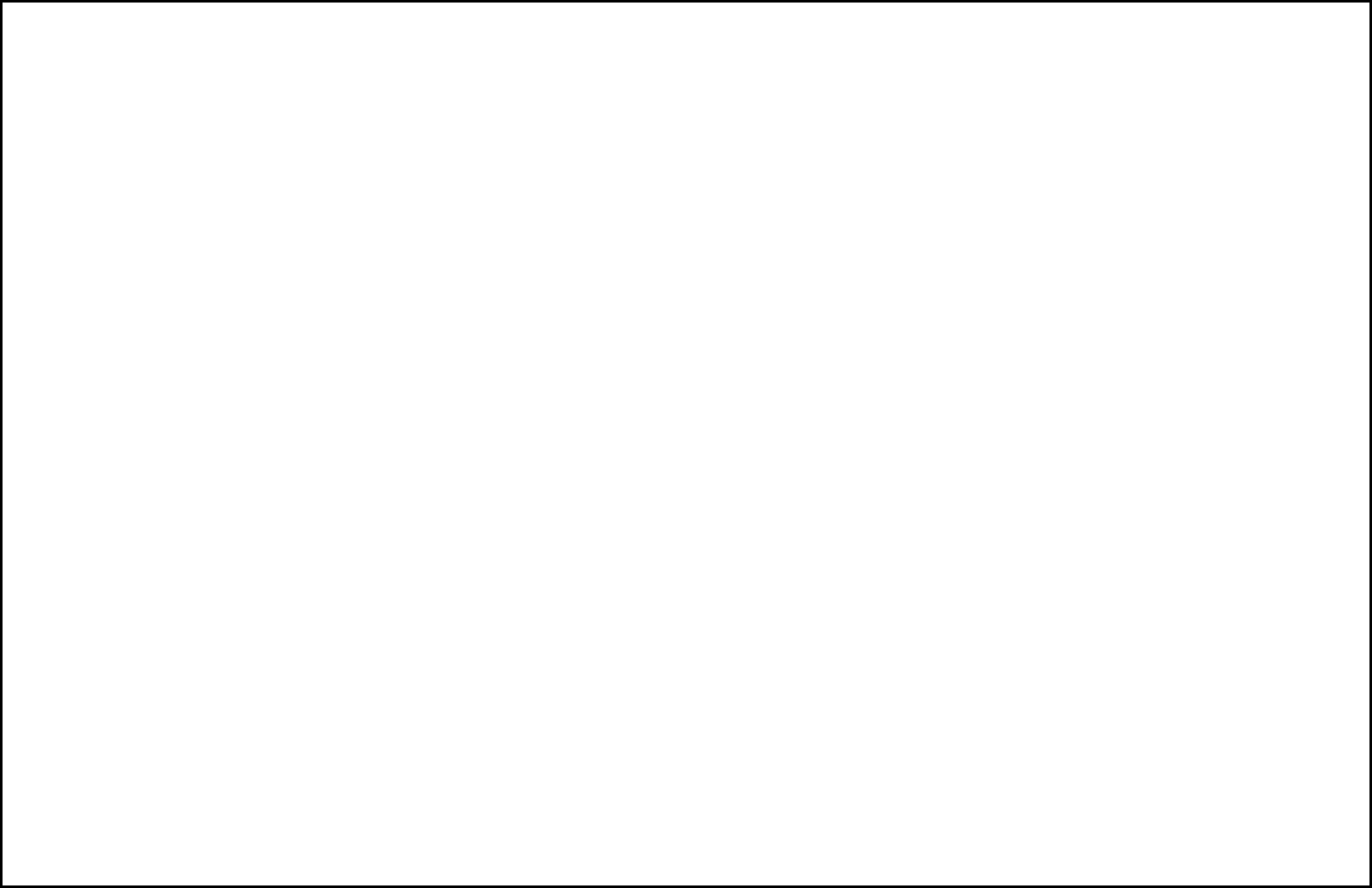
## Pilot's User Guide

Revision A

01/25/2006

Dynon Avionics

*This product is intended for the experimental aircraft category and is not approved for installation in certified aircraft*



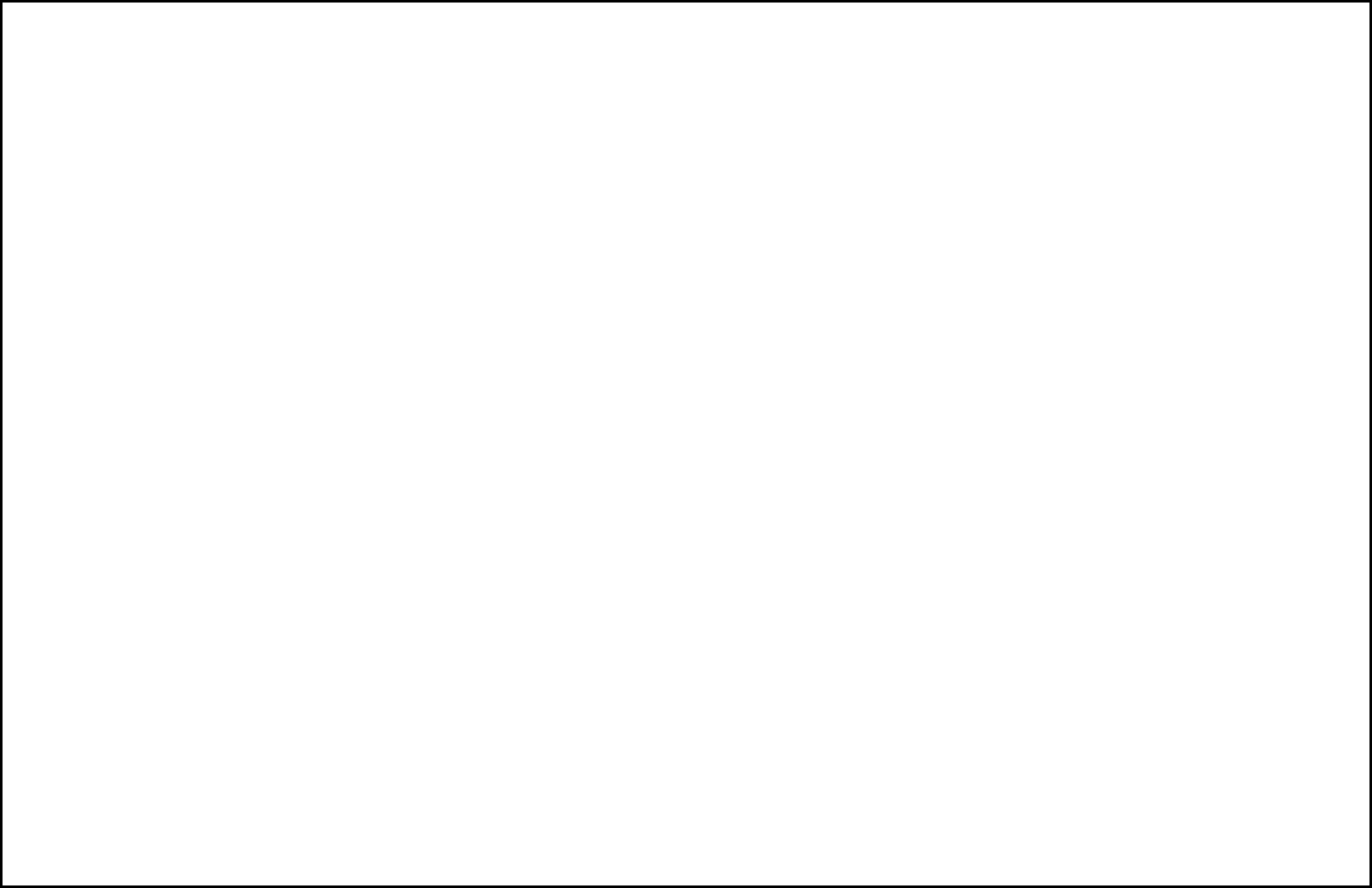
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# 1. INTRODUCTION

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## Welcome

Thank you for purchasing the Dynon Avionics EMS-D120 Engine Monitoring System. This instrument monitors your engine and other vital aircraft systems and displays information in an easy-to-read format. As you will discover, the EMS-D120 is a powerful tool, useful in a variety of small aircraft, at a price that small aircraft owners can afford.

The EMS-D120's color display and menu system are carefully designed to present data ergonomically, facilitating quick scanning. Its warning capabilities provide early notification of problems that might otherwise go unnoticed.

The EMS-D120's versatile design accommodates a wide range of engines and sensors to support most piston type aircraft. You may configure the system to meet your monitoring requirements covering both air and water-cooled engines with up to six cylinders.

When connected to a Dynon EFIS-D10/D10A/D100 series system the EMS-D120 can retrieve and display EFIS information at the push of a button.

The latest version of this manual may be downloaded from our website at [www.dynonavionics.com](http://www.dynonavionics.com).

## Before You Fly

It is strongly recommended that you read this entire guide before attempting to utilize the EMS-D120 in an actual flying situation. Additionally, we encourage you to spend time on the ground familiarizing yourself with the operation of the product. Finally, we encourage you to keep this manual in the plane with you at all times. This document is designed to give you quick access to information that might be needed in flight. **CAUTION:** in a flying situation, it is the pilot's responsibility to use the product and the guide prudently.



## About this Manual

This guide serves two purposes. The first is to help you configure and get acquainted with the EMS-D120's many functions. The second is to give you quick and easy access to vital information.

In the electronic (.PDF) version of this manual, underlined words act as hyperlinks taking you to the relevant section in the manual that the word refers to. Additionally, clicking on any of the sections listed in the [Table of Contents](#) above will jump directly to that section.

## 2. PRODUCT OVERVIEW

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### EMS-D120 Hardware

The information here serves as a reference only and helps familiarize you with the inner workings of the unit. It should not be used for diagnostic or reparative work.

#### ***SENSORS AND INPUTS***

Up to 27 sensors may be connected to the EMS-D120 to present you with operational data for engines with up to six cylinders. When connected to the appropriate sensors, the data presented by this instrument includes RPM, manifold pressure, oil temperature and pressure, exhaust gas temperature (EGT), cylinder head temperature (CHT), fuel levels for up to 4 tanks, volts, amps, fuel pressure, carburetor air temperature, and outside air temperature. Two external contacts may additionally supply status information for a variety of possible auxiliary aircraft systems such as canopy closure, etc.

#### ***OUTPUTS***

The EMS-D120 provides two outputs to drive external visual and audible warning devices (not supplied) to alert the pilot whenever alarms occur.

#### ***BUTTONS***

User interaction takes place via the six buttons along the bottom of the front panel of the unit.

#### ***DISPLAY***

The display is a 7-inch, 854 by 480 pixel, 400 nit LCD screen.



## ***POWER***

The instrument requires 10 to 30 Volts DC for operation.

## **EMS-D120 Installation**

Please refer to the EMS-D120 Installation Guide for detailed installation instructions.

### 3. PRODUCT OPERATION

After reading this section, you will be familiar with the basics of how to utilize the unit. For details regarding specific procedures (e.g., adjusting display brightness, fuel computer, clock, etc.) please refer to the [Common Procedures](#) section.

#### Front Panel Layout

All normal operation of the EMS-D120 happens via the front panel. The front panel contains buttons and a display.

- Buttons – There are six buttons on the front panel of the EMS-D120. These buttons are numbered one through six, with button one being the leftmost and button six being the rightmost. EMS-D120 buttons are used to turn the instrument on and off, cycle between screens, scroll through menus, and adjust instrument parameters.
- Display – The display shows engine parameters, menus, and data obtained from other connected products.



Figure 1 – User interaction takes place via the EMS-D120 main display and the six buttons beneath. Note: buttons are not labeled on actual product



## Display

The EMS-D120 display is the most obvious and commonly used output of the device. It is capable of displaying many useful engine parameters simultaneously.

### SCREENS AND PAGES

The terms in the following bulleted list are used in this section and are defined as follows:

- Screen/Screen Configuration – Screens consist of one or two pages from only the EMS-D120 or a combination of pages from the EMS-D120 and a properly connected Dynon Avionics EFIS-D10/D10A/D100.
- Page – A page is a section of the screen that contains a collection of related data. Pages may occupy the total area of the screen (i.e., 100%) or share the screen with other pages (e.g., 2/3, 1/3 split). Pages that occupy 1/3 of the screen area are sometimes abbreviated versions of their full size (100% or 2/3) counterparts.
- Screen Rotation – The rotation is the list of screen configurations which can be cycled to via the hotkeys. Your rotation is usually smaller than the total list of available screen configurations. The EMS-D120 is shipped with only two screens included in the rotation: EMS/Aux and EMS/Timers.













Figure 2 – Screens contain one or two pages and pages contain groups of similar information.








The EMS-D120 has several pre-defined screen configurations. Screen configuration area allotment is represented by one of three icons show in Figure 3.

The predefined screen configurations with their respective icons are as follows:

	EFIS/EMS
	EFIS/AUX
	EFIS/FUEL
	EFIS/TIMES
	EMS/EFIS
	EMS/AUX (default EMS-D120 boot-up screen; in default rotation)
	EMS/TIMES (in default screen rotation)
	EMS/FUEL
	EFIS
	EFIS/EMS

Icon	Left Page Area	Right Page Area
	2/3	1/3
	1/3	2/3
	One page that occupies all of the screen area	

**Figure 3 – The SCREEN LIST Menu uses icons to illustrate the layout for each screen configuration.**



## CYCLING BETWEEN SCREENS

There are two methods for cycling between pre-defined screens: via the menu and via hotkeys.

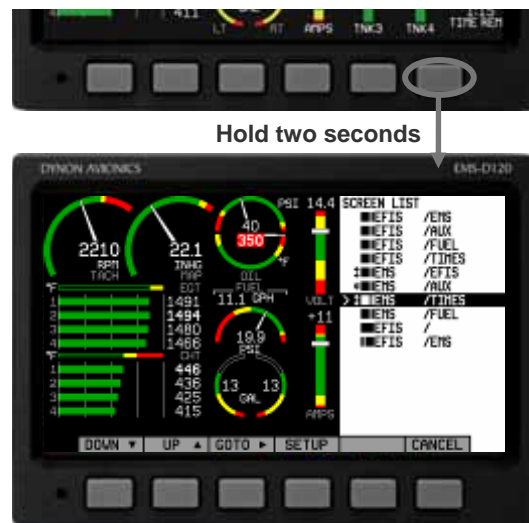
### *Screen Cycling Using the SCREEN LIST*

Navigate to the SCREEN LIST menu by pressing button six for at least two seconds when no menu is present (see Figure 4). Note that if you only press button six momentarily, the display cycles to the next screen in your screen rotation. Use the DOWN ▼/UP ▲ buttons to move the caret (>). The caret denotes the selected screen. Press GOTO ► to remove the SCREEN LIST and display the selected screen. If you wish to stay on the same screen, you may either select your currently displayed screen with the caret and press GOTO ►, or press CANCEL.

### *Screen Cycling Using Hotkeys*

With no menu displayed, press button one to cycle to the previous screen in your rotation. Likewise, press button six to cycle to the next screen in your rotation (see Figure 5). Cycling via hotkeys only allows you to display screens that are in your screen rotation. They are meant to give you quick access to the screen configurations that are most important to you. If you wish to access screens that are not in your rotation, use the SCREEN LIST as described above.

### *Changing the Screen Rotation*



**Figure 4 – With no menus displayed, pressing button six for two seconds displays the SCREEN LIST menu, from which you may switch to, and set up, various screen configurations.**



You may use the out-of-the-box screen rotation or define your own. If you desire to use the initial rotation, no user configuration is required. If you desire to use a custom cycling order, then user configuration is necessary.

To configure a custom rotation, navigate to the SCREEN LIST menu page by pressing button six for approximately two seconds when no menu is present. Press SETUP, then press ROTATN to display the menu used to change the boot and rotation screen. Scroll through the pre-defined screens using the DOWN ▼/UP ▲ buttons.

Press the BOOT\* button on any selected screen to make it the screen that is shown immediately after the instrument is turned on., only one screen may be designated as the boot screen. Next, press the TOGGL↑ button on any selected screen to toggle the “↑” icon. All screens that show the “↑” icon are included in the rotation. Any screen in the rotation may be accessed via the button one and six hotkeys. Press BACK to save any settings.

#### *Changing the Screen List Order*

You may wish to change the order in which screen configurations are displayed in the SCREEN LIST, thus changing the order they are cycled to via hotkeys. To do this, navigate to the SCREEN LIST menu page by pressing button six for approximately two seconds when no menu is present. Press SETUP, then press ORDER to display the menu used to change the screen order. Scroll through the pre-defined screens using the DOWN ▼/UP ▲ buttons. Press the MV DN ▼ button to move the selected screen down in the screen list. Likewise, press the MV UP ▲ button to move the selected screen up in the screen list.



**Figure 5 –Buttons one and six cycle to the previous and next screens, respectively.**



## Menus

All interaction with the EMS-D120 is accomplished through the use of its menu system. The menu system is accessed and navigated via the six buttons located on the front of the unit.

### **PAGE-SENSITIVE MENUS**

On a screen where no menu is already present, buttons two through five are used to display a menu. With no menu displayed, pressing any one of these buttons causes the menu for the page above it to show at the bottom of the screen. For example, if a screen is divided into two pages with the left page occupying 2/3 of the screen and the right page occupying 1/3 of the screen, then pressing EMS-D120 buttons two, three, or four (all below the left 2/3 of the screen) displays the main menu for the left page and pressing button five (below the right 1/3 of the screen) displays the main menu for the right page (see Figure 6).

### **FUNCTIONALITY**

When a menu displays, it consists of two rows of gray boxes containing text. The upper row contains one tab that denotes the currently displayed menu. The lower row contains six labels that denote the function of the button below it. You will also notice that many of the onscreen elements move up to avoid the menu. This prevents the menu from obscuring useful data while it is up. Upon exiting the menu, the screen returns to its normal appearance.

Any given EMS-D120 menu describes the functionality of the buttons below it. The label located directly above the button denotes its current function (e.g., pushing



**Figure 6 - The configuration of the pages on the screen determines which buttons are used to display a page's menu.**



button two in the menu above will invoke the LEAN command). Pressing a button either displays another menu or adjusts a parameter. If there is no text above a button, then that button does not have a function in the context of that menu. Occasionally, a button label spans two buttons. In this case, either button below the label invokes the command.

If a menu contains more options than there are buttons, you will see a MORE label over button five. Pressing this button shows you the next set of options in the current menu.

In any menu, press the BACK button to return to the previous menu and save any changes. In all top-level menus button six is the EXIT button. Pressing EXIT removes the menu system and returns the display to the screen configuration it was in prior to entering the menu system.

## FLOW

Each page has its own main menu, which may contain options for navigating to other menus or choosing and adjusting parameters. Note that when the EMS-D120 is connected to, and displaying data from, a Dynon EFIS product, the EFIS page (full, 2/3, or 1/3 size) does not have menus associated with it. Any configuration or adjustments you wish to make to the connected EFIS must be done on the actual instrument.

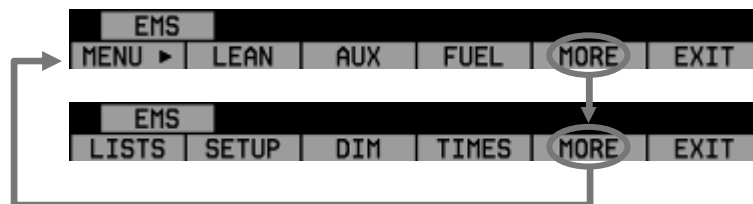
For example, the EMS Main Page menu contains an EMS menu tab and button labels for MENU ►, LEAN, AUX, FUEL, MORE, and BACK. Pressing MORE reveals the rest of the EMS menu. The continuation of this menu contains options for LISTS, SETUP, DIM, TIMES, MORE, and BACK. Pressing MORE or BACK on this menu simply returns you to the first part of the EMS menu.



**Figure 7 - Each menu consists of labels above each button denoting their function.**



In all top-level page menus (EMS, AUX, TIMES, FUEL), the leftmost button is the MENU button. If you have opened up the left page's menu, the label reads MENU ►. Pressing the button switches the menu to display the right page's menu, and the label switches to read ◀MENU. The arrow on this button always points to the side of the screen whose menu will be displayed when pressing the button.



**Figure 8 - In any menu with more options than will fit on a line, the MORE button displays the rest of the menu.**

All EMS 1/3 pages (AUX, TIMES, FUEL) have shortcuts to their page and menu from within the EMS Main Page menu. This means that if you only want to glance at a parameter on another page, quickly returning to your original screen configuration, simply enter the EMS menu, and press the button for the page you'd like to momentarily view. For example, if your current screen configuration is 2/3 EMS on the left, 1/3 FUEL on the right, pressing the AUX button in the EMS menu will display the AUX page in place of the FUEL page and the AUX page menu. Pressing BACK will return you to the main EMS menu, and your original screen configuration (i.e., EMS/FUEL).

If you press the SETUP button on the EMS menu, the SETUP menu is displayed. The SETUP menu contains a menu tab and button labels for CLOCK, VRSION, GLOBAL, SENSOR, FUEL, and BACK. Pressing CLOCK displays options for specifying time format (i.e., standard AM/PM vs. military) and clock adjustment.

To exit the menu system, press the BACK button as many times as is needed to reach an EXIT button. This varies based upon how deep you are into the menu system.



## 4. AVAILABLE PAGES

EMS pages use various combinations of circular gauges, vertical and horizontal bars, tic marks, and text to display EMS data. Appropriate units of measurement accompany their respective values. Color indicators (green, yellow, and red) are used to denote normal and abnormal operational ranges.

Both the EMS Main Pages and the EMS Auxiliary Page allow for “info items,” user-configurable elements such as vertical info bars, contact input readouts, and text-only items. Due to their width, text-only items can only be displayed on the EMS Auxiliary Page. Vertical info bars can display volts, amps, fuel pressure, carburetor air temperature, and outside air temperature. Contact input readouts can display discrete data (e.g., open/closed, on/off, etc.). Vertical info bars, contacts, and text-only items are defined at time of installation and instrument setup. For more information on configuring this display (as well as info items on the EMS Main Page), see the [info bar configuration](#) section on page 7-5. Menu, Checklist and EFIS pages may be displayed and are described in the following sections.

English and Metric units may be specified in the GLOBAL menu. Note that EMS information displayed on screen is unique to the aircraft’s EMS installation.

### EMS MAIN PAGES

*Available in 1/3 and 2/3 formats*

This page displays RPM, manifold pressure (MAP), oil temperature, oil pressure, exhaust gas temperature (EGT), cylinder head temperature (CHT), fuel level, fuel pressure and fuel flow. On the 2/3 page version, up to two user-configurable vertical info bars may be displayed. For information on configuring the function of these info items, see the [info bar configuration](#) section on page 7-5.





Up to six EGT/CHT channels may be displayed simultaneously. Green horizontal bars depict exhaust gas temperatures with their respective values to the right of the bars. In the combined EGT/CHT display, cylinder head temperatures are denoted by the white vertical tic marks overlaying the EGT bars. In the split EGT/CHT display (two and four cylinder engines only), CHTs are displayed using their own set of green bars on a different scale than EGTs. CHT numeric values are displayed to the left of each bar. At the right of the EMS Main Page, two info bars are available. You may configure what parameters are displayed here

### **EMS AUXILIARY PAGE**

*Available in 1/3 format*

This is a customizable page where you may display up to six different info items. You may choose from any of the available info items. For more information on configuring this display (as well as info items on the EMS Main Page), see the [info bar configuration](#) section on page 7-5.

Some info items, when displayed on the Aux Page, have quick commands to be displayed in the AUX menu. This menu is populated with commands in the order that the items appear on screen (from top left to bottom right). The commands are listed below

Info item quick commands

- TIMERS info item – TRPRST (resets the trip timer), TIMER (shortcut to the general purpose timer menu)
- FUEL – FUEL (shortcut to the add fuel menu)







## EMS TIMES PAGE

Available in 1/3 format

The Times Page is divided into three sections: TIME, TIMERS, and ENGINE TIMERS.

- The TIME section shows the present time (both local and Zulu) and can be displayed in either standard or military time formats.
- The Flight Timer shows elapsed Hobbs time since the engine was turned on. Trip Timer shows elapsed Hobbs time since manual reset. The third line of this section contains the general purpose Timer which can be used for a variety of functions including a tank timer.
- The Tach Timer keeps track of engine time (normalized to the user-configured cruise RPM). The Hobbs Timer records the duration of time engine oil pressure is at 15 PSI or higher.



Refer to the [Common Procedures](#) section on page 7-1 for instructions on adjusting clock and timer settings.

## EMS FUEL COMPUTER PAGE

Available in 1/3 format

This page displays fuel level(s), fuel flow, fuel pressure, fuel remaining, fuel used, time remaining. On this page, analog gauges display sensor information and textual readouts display computed data.

Some user input is required for the EMS-D120 Fuel Computer to function properly. Refer to the [Common Procedures](#) section of this guide for instructions on adjusting various Fuel Computer parameters.

**WARNING:** The Fuel Remaining and Time Remaining values are not directly measured. These values are calculated based upon measured flow rates and *user input* of fuel quantity. Do not use these values as primary indicators.



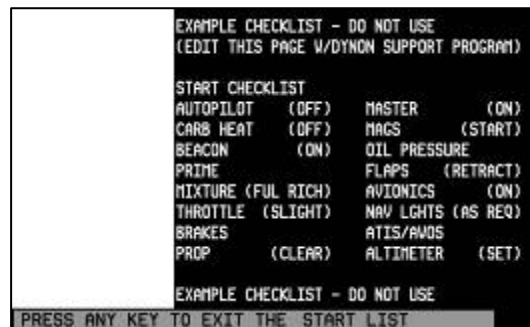


## LISTS PAGES

Available in 2/3 format

This page displays user-defined checklists. Checklists may also be used for waypoint information, lists of radio frequencies, or other informational purposes. A user may define up to twenty-five checklists. Each checklist may contain up to fourteen lines of text with each line containing a maximum of forty characters (14 lines by 40 characters).

Checklists must be defined and uploaded to the EMS-D120 as described by the Dynon Product Support Program. Reference the help file that accompanies this software for more information.



## MENU PAGES

Available in 1/3 and 2/3 formats

Some of the setup menus require a full 1/3 or 2/3 page to display all the available options. Menu Pages utilize a “>” (a “caret”) symbol to indicate which line is currently selected. Use the DOWN ▼ /UP ▲ buttons to move down and up the displayed list of options.

Any line on a Menu Page that *is not* followed by ► indicates that its value can be toggled between its available options. When the caret is selecting a line followed by ►, press SEL ► to toggle the selected value.



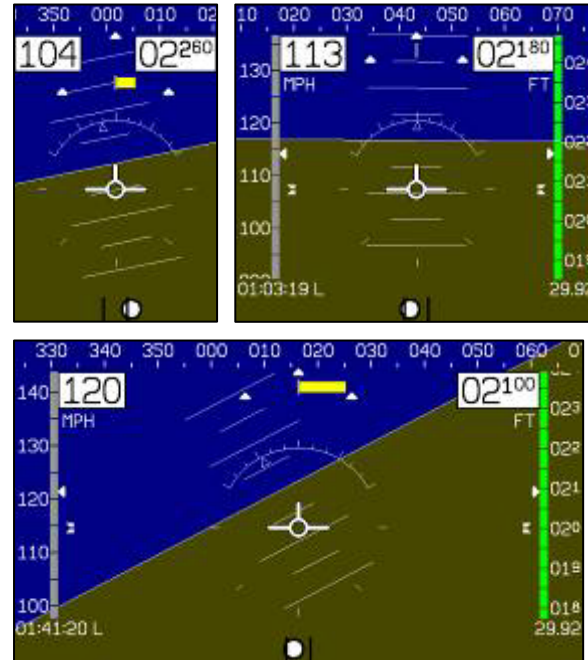
Any line on a Menu Page that *is* followed by ► indicates that it has more options to configure inside of it. When the caret is selecting a line followed by ►, pressing SEL ► expands the menu into another list of options to the right.



## EFIS PAGES

*Available in 1/3, 2/3 and full formats*

The EMS-D120 can display EFIS pages from Dynon's EFIS-D10/D10A/D100 products, when properly connected. By default, no screen with a configured EFIS page is included in the screen rotation. If you have a Dynon EFIS product installed and connected to your EMS-D120, enable any or all of the EFIS screens (found in the SCREEN LIST as described in the Changing the Screen Rotation section on page 3-4) to view EFIS data on your EMS.





## 5. ALARMS

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### Alarm Indicators

Any time a preconfigured alarm set point is exceeded, you are alerted to the fact via both visible and audible (if connected) alarms.

Visual indications include:

- The measurement's value and tick color change to red
- The measurement's value and tick blink
- A red alarm bar appears at the bottom of the screen with a message identifying the out of range measurement
- Below the alarm bar, the alarm menu gives you options for what to do next. See the following subsections for more information
- If an external light is connected to the EMS-D120 harness, the light turns on

The alarm menu appears below the red alarm bar. See Alarm Silencing and Alarm Acknowledgement below for more information on this menu. Note, alarms may not be silenced or acknowledged during the initial two seconds of the first alarm.

In an alarm condition, the EMS-D120 also alerts you audibly, provided the Audio Alert output is connected to your intercom as described in the EMS-D120 Installation Guide. If no audio device is connected, you will not hear an audible alarm.



## ***SHOW PAGE***

If the alarming measurement is not displayed on your current screen, or is available on a page which displays it better, a SHOW [PAGE] button is included in the alarm menu. [PAGE] is replaced with the name of the actual page that is displayed when you press the button. Press this button to display the page where the alarming measurement is best displayed. From there, you may press GO BACK to return to your original screen, leaving the alarm indications active, or press ACK to remove the alarm indications and return to your original screen.

## ***ALARM SILENCING***

To silence the audio alarm, press the SILNCE button.

## ***ALARM ACKNOWLEDGEMENT***

To acknowledge the alarm, press the ACK button. This simultaneously:

- Silences the audio alarm
- Removes the alarm bar
- Removes the alarm menu
- Stops the blinking of the relevant display
- Returns the display to the screen configuration displayed before the alarm occurred (if you pressed SHOW [PAGE])

The tic and numeric value remain red until the condition no longer exists. The alarm automatically rearms whenever the alarm condition is removed.

## **Multiple Alarms**

Any time multiple alarms occur simultaneously, they are handled in the following way:



1. Each numeric value and gauge posts its alarm as described above
2. Alarm messages in the alarm bar are stacked into memory and presented in the order in which they occurred. Removal of the Alarm Bar requires separate pilot acknowledgement of each alarm.
3. When the last alarm is acknowledged, the Alarm Bar and Alarm Menu are removed from the screen
4. All alarmed parameters remain in their alarmed state until the alarm condition no longer exists
5. Pressing SILNCE removes the audio alert for all pending alarms

## **Latching and Self-clearing Alarms**

Depending upon how your EMS-D120 was set up, some of the sensors' alarms may be set to be latching, while others may be self-clearing. The distinction is described below. See the EMS-D120 Installation Guide for more information on configuring this setting for each alarm.

### ***LATCHING ALARMS***

If an alarm occurs on a sensor configured to be latching, the alert displays on screen until the ACK button is pressed, even if the alarm condition goes away. This means if, for example, your oil pressure momentarily gets too high but returns to normal, the instrument continues to alarm on the condition until that alarm is acknowledged. Latching alarms let you to know if an alarm happened momentarily, when you might have otherwise missed it.

### ***SELF-CLEARING ALARMS***

If an alarm occurs on a sensor configured to be self-clearing, the alert displays on screen until either the ACK button is pressed *or* the alarm condition goes away. Consider the example where you have configured your fuel pressure alarm to be self-clearing. If your engine's fuel pressure momentarily rises too high but then returns to normal, the EMS-D120 alarms for that brief instant, but stops as soon as the alarming condition has ceased; no acknowledgement is needed.





## 6. MONITORING FUNCTIONS

This section describes just a few of the advanced ways to use your EMS-D120 to monitor the health of your engine.

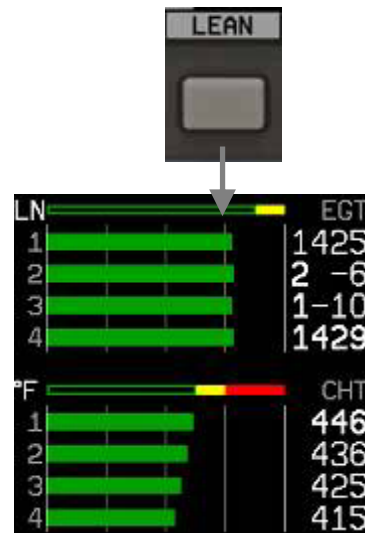
### Engine Leaning

You may lean your engine by adjusting the fuel mixture and watching the EGTs. Leaning to peak EGT can be accomplished via the EMS Main Page; however, an enhanced mode is available to make this process easier for you

This is accomplished by activating the main menu and pressing the LEAN button. With this mode activated, the "Lean Mode" label is displayed underneath the EGT/CHT bars to clearly differentiate it from the normal operating mode. Additionally, the absolute EGT temperatures (indicated on the right side of the graph) are replaced with new data as each cylinder peaks.

As each cylinder peaks, the absolute number is replaced by the number indicating the order (i.e., 1, 2, 3,...) in which it peaked followed by the temperature difference from its peak temperature. Given this new data, pilots can set their mixture more accurately to attain a given EGT delta value on either the rich or lean side of peak EGT. To exit the Lean mode, reactivate the main menu and press the LEAN button; the Systems Overview page then returns to its normal mode.

For best results, lean carefully by making small adjustments and allowing some time for temperatures to stabilize before leaning further. In addition to the EGT temperatures, you can also watch the fuel flow rate and CHT temperatures. Carefully



**Figure 9 – In the above example, cylinder 3's EGT peaked first and is now 10 degrees below its peak temperature; cylinder 2 peaked second and is 6 degrees below its peak.**



read and follow your engine manufacturer's leaning recommendations for best performance.

## Detonation Characterization

Detonation is defined as the uncontrolled explosion of the fuel/air mixture. It occurs when the anti-knock rating of the fuel is lower than required by the pressure and temperature generated during engine operation. Using a fuel octane number less than that required, or over-leaning the engine can result in detonation and induce engine damage. Leaning too aggressively can leave little margin between normal combustion and detonation. Any defect like a bad spark plug, partially blocked fuel injector nozzle or intake manifold leak combined with a minimum margin can result in detonation and engine damage. One key characterization of detonation is lower EGT temperatures with corresponding higher cylinder head temperatures.

## Pre-ignition Characteristics

Pre-ignition manifests itself as high EGT and high CHT temperatures resulting from premature ignition of fuel/air mixture in advance of normal ignition. This is usually caused by a hot spot in a combustion chamber. A hot spot is typically the spark plug electrode or exhaust valve. When pre-ignition occurs, ignition timing is lost and the upward movement of the piston is opposed by the high pressure generated by the early combustion.



## Shock Cooling

Significantly reducing power and dropping the nose simultaneously can cause shock cooling. This can cause the engine to cool rapidly and unevenly. When this happens, the rear of the engine is exposed to less cooling air than the front of the engine. Shock cooling is characterized by rapidly dropping and uneven CHT temperatures and may lead to cylinder cracking.

## Data Logging

While many observations are clearly visible via the color graphical display, some destructive behaviors are too subtle to be noticed during routine flight. Logging engine data over longer periods of operation allows you to spot potential problems before they induce costly damage or result in a flight emergency.

The EMS-D120 constantly streams data out of its RS-232 serial port during normal operation. The data format is described in on page 8-1. To log engine data, you need a laptop (or RS232 data collection device) connected to, and storing data from, your EMS-D120.



## 7. COMMON PROCEDURES

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This section contains common step-by-step procedures performed by the pilot before, during, and after flight. Pilots are encouraged to be familiar with all of these procedures prior to flying to ensure readiness as well as maximizing use of the capabilities of the instrument.

All menu navigation in this section is done with respect to the EMS Main Menu (EMS). A “>” denotes user navigation via the menu to a specified button label.

It is recommended that users review and understand the Product Operation section of this guide before reading this section.

### ON/OFF

**Turn ON:** Press and hold button one.

**Turn OFF:** Exit all menus and press and hold button one.

Users must hold button one down for approximately two seconds for either action. When power is connected, the unit does not completely turn off. It enters a low-power state, and keeps track of time as well as detects changes in the state of button one (the POWER button).

### Display Brightness (DIM)

**Adjust Display Brightness:** EMS > MORE > DIM > BRITR/DRKR

- BRITR increases display brightness.
- DRKR decreases display brightness.



Each press of a button increases or decreases display brightness.

Note: The initial setting of the EMS-D120 display is maximum brightness. There is no way for a user to adjust the display so that it is completely black.

## Fuel Computer

**Add Fuel:** EMS > MORE > FUEL > ADD > INC+/DEC- > SEL▶ > ACCEPT/CANCEL

Use this to add to or subtract fuel from the EMS Fuel Computer. Press INC+ to add fuel. Press DEC- to subtract fuel. Press SEL▶ to enter the value into the computer. Press ACCEPT to confirm the value. Press CANCEL if the value is not correct. Note that you can also access the FUEL menu from the Auxiliary page, if you have the fuel computer info item displayed on it.

**Reset fuel level to pre-configured value:** EMS > MORE > FUEL > PRESET

You may configure the PRESET value using the following path: EMS > MORE > SETUP > FUEL > PRESET VALUE > INC+/DEC- > BACK.

**Reset fuel level to full:** EMS > SETUP > FUEL > FULL

You may configure the FULL value using the following path: EMS > SETUP > FUEL > FULL VALUE > SEL▶ > INC+/DEC- > BACK.

Note: It is necessary to calibrate the EMS Fuel Computer with the sensors for fuel level to work correctly. Reference the EMS-D120 Installation Guide for more details.



## Engine Leaning

**Enter Lean Mode:** EMS > LEAN

This puts the EGT display into lean mode, changing the numerical values for each cylinder to the format “order peaked-temperature below peak.”

**Exit Lean Mode:** EMS > LEAN

This returns the EGT display to normal.

## Clock Setup

**Set Time:** EMS > MORE > TIMES > CLOCK > SEL▶ > INC+/DEC- > BACK

This menu, and corresponding dialog box, allows you to set both your local time and Zulu time in 24-hour format. You may display times in either 12-hour or 24-hour format as described in the next section. Set the local and Zulu times independently. Highlight values using SEL▶. Adjust highlighted values with INC+/DEC-. Each time a button is pressed, the value changes by one. Hold down INC+ or DEC- to adjust values rapidly. Seconds are reset to zero when minutes are adjusted.

## Clock Format

**Set 12/24 Display:** EMS > MORE > SETUP > CLOCK > FORMAT

Press the 12/24 button to toggle between STNDRD (12 hour AM/PM format) and MILTRY (24 hour military format).



## Timers

### **Reset trip timer to zero:** EMS > MORE > TIMES > TRPRST

The Trip Timer is a Hobbs timer which can be reset by the user. To reset, simply press the TRPRST button in the TIMES page menu.

### **Set recurring tank timer:** EMS > MORE > TIMES > TIMER

The general purpose timer can be configured to be either an up timer or down timer. For the purposes of tank switch timing, set the timer to count down by pressing UP/DN until you see DOWN in the dialog box above the menu. Push the HOUR, MIN, and SEC button until the desired interval is shown in the dialog box. When ready, press START. When the timer expires, the alert menu will present the RESTRT button. Pressing this button restarts the down timer to the value you initially set it to.

## Global Configuration Settings

### **Configure global settings:** EMS > MORE > SETUP > GLOBAL

The Global page is divided into three sections: PILOT SETUP, SCREEN SETUP, and INSTALL SETUP. Pilot settings and screen settings are addressed in this guide. If you or your installer have completed the procedures outlined in the EMS-D120 Installation Guide, you do not need to modify anything in the INSTALL SETUP section.

You may edit settings for the measurement system (i.e., English or Metric), alarm power, test alarms, and configure EMS-D120 screen and hotkey settings. Scroll between settings by using the UP ▲ / DOWN ▼ buttons. Chosen settings are highlighted. Toggle between parameter settings or display a menu of choices by pressing SEL ►. Press BACK to save.

### **Change measurement system:** EMS > MORE > SETUP > GLOBAL > SEL ► > BACK





All units are changed according to this setting. You may not set individual measurements as English or Metric.

**Change power on alarms status:** EMS > MORE > SETUP > GLOBAL > DOWN ▼ > SEL ► > BACK

Set this parameter to “ON” to immediately enable alarms at engine startup. With this parameter set to “OFF”, all alarms are suppressed whenever ALL of the following conditions exist:

- RPM less than 400
- Oil pressure less than 20 PSI
- First five minutes after master instrument power applied

All alarms are initialized when any of the above conditions are exceeded.

**Test light/audio alarm(s):** EMS > SETUP > GLOBAL > DOWN ▼ > DOWN ▼ > SEL ►

Note: You must select an alarm to test using the UP ▲ / DOWN ▼ buttons. Hold TEST to test an alarm.

**Configure info items:** EMS > SETUP > GLOBAL > DOWN ▼ > DOWN ▼ > DOWN ▼ > SEL ►

The INFO ITEM CONFIG submenu allows you to configure the display of up to 8 different sensors as simple analog bars, on/off contacts, or (Aux Page only) text items. Press the DOWN ▼ button to select the item, INFO ITEM CONFIG ►. Press SEL ► to enter the INFO ITEM CONFIG submenu.

The first two info items are displayed on the EMS Main Page. Info item 1 is at the top right of the page, and info item 2 is at the lower right of the page. The other six info items are located on the Aux Page and are numbered 2 through 5 on the





top row and 6 through 8 on the bottom row.

The submenu shown at right appear, allowing you to move up and down the list, selecting which parameter you would like displayed at each info item position. To change the function that a given item displays, press UP ▲ or DOWN ▼ until it is selected (the > symbol is to its left), and press SEL ► to cycle through the available functions. Repeat this for each info item you'd like displayed. One of the options available is NONE, which prevents that info item from displaying.

Any function that you have selected to be an info item has that fact reflected in its corresponding SENSORS configuration page. In its configuration page (EMS > MORE > SETUP > SENSORS > relevant sensor type), you will see a label indicating which info item the parameter is set up to be displayed at.

## 8. APPENDIX

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This appendix contains information not covered in the main section of the manual. This section contains various tools such as a menu reference, specifications sheet, operating tips, and a configuration table. This section also contains details regarding the EMS-D120 servicing.

### Serial Data Output

The EMS-D120 outputs text data through its serial port constantly during normal operation. This serial data can be logged using any standard serial terminal program such as Hyper Terminal. It can then be parsed into its respective columns by many spreadsheet programs including Microsoft Excel. All numbers are output in decimal and are standard ASCII. To view the data using a terminal program, the following settings should be used:

Baud rate: 115200  
Data: 8 bit  
Parity: none  
Stop: 1 bit  
Flow control: none

The format for the data being sent out the RS232 port is:

Parameter	ASCII Characters	Units	Example
Hour	2	Hours	12 (12 hrs)
Min	2	Minutes	12 (12 mins)
Sec	2	Seconds	12 (12 secs)
Fraction	2	1/64 of sec	12 (12/64 sec)
Manifold Pressure	4	inHg x 100	1215 (12.15inHg) (using 5/100 increments)



Parameter	ASCII Characters	Units	Example
Oil Temp	3	° F	123 (123°F) or -12 (-12°F)
Oil Pressure	3	PSI	099 (99PSI)
Fuel pressure	3	PSI x 10	123 (12.3psi)
Volts	3	Volts x 10	123 (12.3V)
Amps	3	Amps	012 (12A) or -12 (-12A)
RPM	3	RPM/10	123 (1230 RPM)
Fuel Flow	3	GPH x 10	123 (12.3gph)
Gallons remaining	4	Gallons x 10	1234 (123.4g) or -123 (-12.3g)
Fuel_Level_1	3	Gallons x 10	123 (12.3g)
Fuel_Level_2	3	Gallons x 10	123 (12.3g)
GP_1	8	See table below	3 char label; 5 char data; see GP output table
GP_2	8	See table below	3 char label; 5 char data; see GP output table
GP_3	8	See table below	3 char label; 5 char data; see GP output table
GP Thermocouple	4	° F	1234 (1234°F) or -123 (-123°F )
EGT_1	4	° F	1234 (1234°F) or -123 (-123°F )
EGT_2	4	° F	Same as above
EGT_3	4	° F	Same as above
EGT_4	4	° F	Same as above
EGT_5	4	° F	Same as above
EGT_6	4	° F	Same as above
CHT_1	3	° F	123 (123°F) or -12 (-12°F)
CHT_2	3	° F	Same as above
CHT_3	3	° F	Same as above
CHT_4	3	° F	Same as above



Parameter	ASCII Characters	Units	Example
CHT_5	3	° F	Same as above
CHT_6	3	° F	Same as above
Contact_1	1	Boolean	'0' or '1'
Contact_2	1	Boolean	'0' or '1'
Product ID	2	ASCII hex	Internal-use product ID
Checksum	2	ASCII hex	Sum of all preceding bytes
CR	1		0x13
LF	1		0x10

### GP OUTPUT TABLE

General purpose inputs have a unique format in the data output stream. As shown in the table above, they each have 8 characters. 3 are used as a label for the function; 5 are used for the data.

Description	Units	Label (3-Bytes)	Example (5-Bytes)
Unused		N/A	XXXXX ('X's will output as place holders)
OAT	° F	OAT	00123 (123 °F) or -0123 (-123 °F)
Carb Temp	° F	CRB	00123 (123 °F) or -0123 (-123 °F)
Coolant Temp	° F	CLT	00123 (123 °F) or -0123 (-123 °F)
Fuel Level 3	Gallons	FL3	00123 (12.3g)
Fuel Level 4	Gallons	FL4	00123 (12.3g)

As an example, the following is what one line of serial data might look like:

```
0000366348953460004113400000000000000000000OAT-0004N/AXXXXXN/AXXXXX-0120013004100
63006800390060-00442105486129399
```



## EMS-D120 Menu Reference

The following tables contain menu tabs and button labels and their respective descriptions or functions.

Menu Tabs	Description
AUX	EMS Auxiliary Page
CALIB	Fuel Computer Calibration Page
CLOCK	EMS Clock Settings
DIM	Display Brightness/Darkness
EMS	EMS Main Page
FORMAT	Clock Format Settings
FUEL	EMS Fuel Computer Page
GLOBAL	EMS Global Settings Page
LISTS	EMS Lists Page
SENSOR	EMS Sensors Page
SETUP	EMS Setup Page
TIMER	EMS Timers
TIMES	EMS Times Page
VRSION	EMS Firmware Version and hours in service

Other Labels	Description
12/24	Denotes standard 12-hour AM/PM time format; toggles between STNDRD (12-hour) and MILTRY (24-hour) formats
ACCEPT	Accept fuel adjustment
ADD	Add fuel to the Fuel Computer
BACK	Navigate to the previous menu and save any changes



Other Labels	Description
CANCEL	Cancels the action of the currently displayed menu
DEC-	Decrements the current parameter
DOWN ▼	Move cursor down
EXIT	Exits the menu system
FLTHRS	Flight-hours
FULL	Resets fuel available in EMS Fuel Computer to predefined FULL value.
HOUR	Increments the hours digit of the timer
INC+	Increment the current parameter
MIN	Increments the minutes digit of the timer
MENU ►	Switches to the menu for the opposing page
MORE	Shows more menu options
PRESET	Resets fuel available in EMS Fuel Computer to predefined PRESET value.
SEC	Increments the seconds digit of the timer
SEL ►	Selects the current parameter for adjustment
START	Starts the timer
STOP	Stops the timer
TRPRST	Resets trip timers
UP ▲	Move cursor up
UP/DN	Toggles the timer between count-up and count-down
VERSION	Denotes the version of firmware running on the product
<CUSTOM>	Some labels, such as checklist labels, are user configurable



## PC Support Program

Dynon offers a free PC Support Program which allows you to upload new firmware and checklists. The latest version of this program is available from our website at <http://www.dynonavionics.com/downloads>.

## Troubleshooting

Should you experience difficulty with your product, please contact us by calling us at (425) 402-0433 or emailing us at [support@dynonavionics.com](mailto:support@dynonavionics.com).

You may also reach us and other active users at our online support forums located at: <http://www.dynonavionics.com/forum/>

### ***FIRMWARE VERSION DISPLAY***

The firmware version submenu gives you two important pieces of information: the version of EMS-D120 firmware that your unit is currently running and the number of hours the EMS-D120 has been on.

To display this information, activate the EMS Main Page menu then press MORE > SETUP > VRSION. When calling Dynon for assistance it is often helpful to know what firmware version the instrument is currently using. This menu is simply for informational purposes; pressing any button besides BACK has no effect.

To determine whether you have the latest version of EMS-D120 firmware, please refer to Dynon's website at: <http://www.dynonavionics.com/downloads> where the most recent program is freely available.

If you should have need for technical support or other assistance from Dynon, please have your firmware version ready when you call or write.





## EMS-D120 Specifications

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<b>Mechanical</b>	Mounting: 6.95" wide x 4.90" tall x 4.51" deep (177 x 125 x 115 mm) Weight: 2 lb. (0.9 kg)
<b>Operating Temperature</b>	-22° to 122° F (-30° to 50° C)
<b>Power</b>	Voltage: 10 - 30 VDC Power: 10 Watts maximum
<b>Connections</b>	Wiring: D-25 & D-37 pin male connectors
<b>Screen</b>	Type: AMLCD, TFT (Thin Film Transistor) Backlight: 400 nits Size: 7.0" diagonal (178 mm) Resolution: 854 x 480 color pixels

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## EMS-D120 Specifications

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### Sensor Inputs

- 6 - EGT (Type K Thermocouple)
  - 6 - CHT (Type J Thermocouple)
  - 2 - Fuel Level (Resistive or Capacitance with 5 volt output)
  - 2 - RPM (P-lead or pickup)
  - 2 - Contacts
    - 1 - Manifold Pressure (Voltage)
    - 1 - Oil Temperature (Resistive)
    - 1 - Oil Pressure (Resistive)
    - 1 - Fuel Pressure (Resistive)
    - 1 - Fuel Flow (Frequency)
    - 1 - Amps (Shunt)
    - 1 - Volts (from supply power)
    - 1 - Turbine Inlet Temperature (Type K Thermocouple)
  - 3 - General Purpose (Either resistive or voltage for OAT, Fuel Tanks 3&4, Coolant Temp, Coolant Press, Carburetor Temp)
- 

### Outputs

- 1 - Alarm Light Contact
  - 1 - Audio Alarm
  - 1 - RS-232
-



## EMS-D120 Configuration Table

EMS-D120 Serial Number: \_\_\_\_\_ Installation Date: \_\_\_\_\_

Function	Installed (Y/N)	Bottom	Low Yellow/Red (alarm value)	Low Green/Yellow	High Yellow/Green	High Red/Yellow (alarm value)	Top
Tachometer							
Manifold Pressure							
Oil Pressure							
Oil Temperature							
EGT		800					1600
CHT		200					600
Fuel Level		0					
Fuel Pressure							
Fuel Flow							
Voltage							
Current (0 to 60)							
Current (-60 to 60)							
GP 1 – type: _____							
GP 2 – type: _____							
GP 3 – type: _____							