

# EMS-D10 Engine Monitoring System



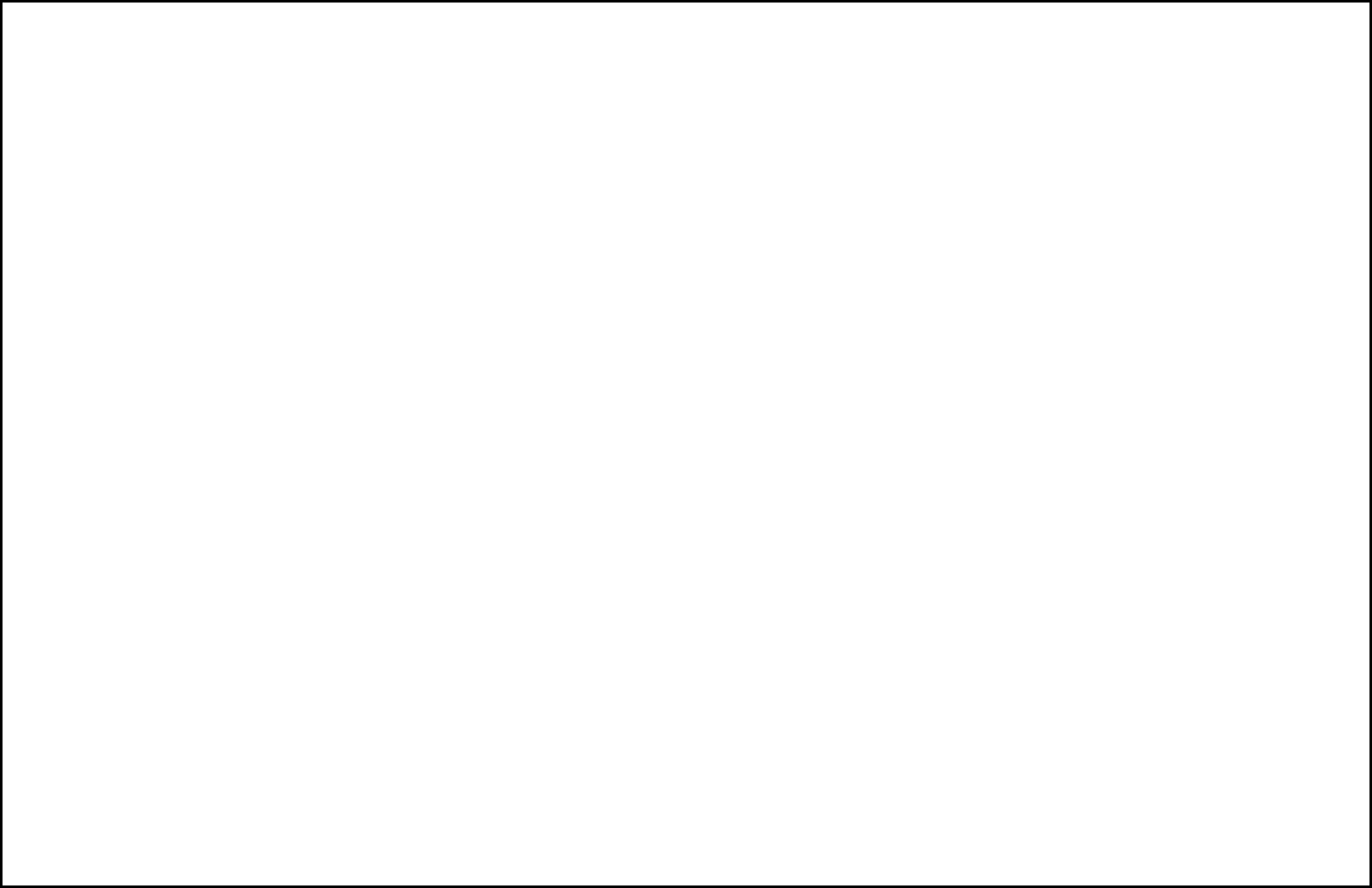
## Pilot's User Guide

**Revision B**  
**For use with firmware version 1.08**

10/27/2006

Dynon Avionics

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



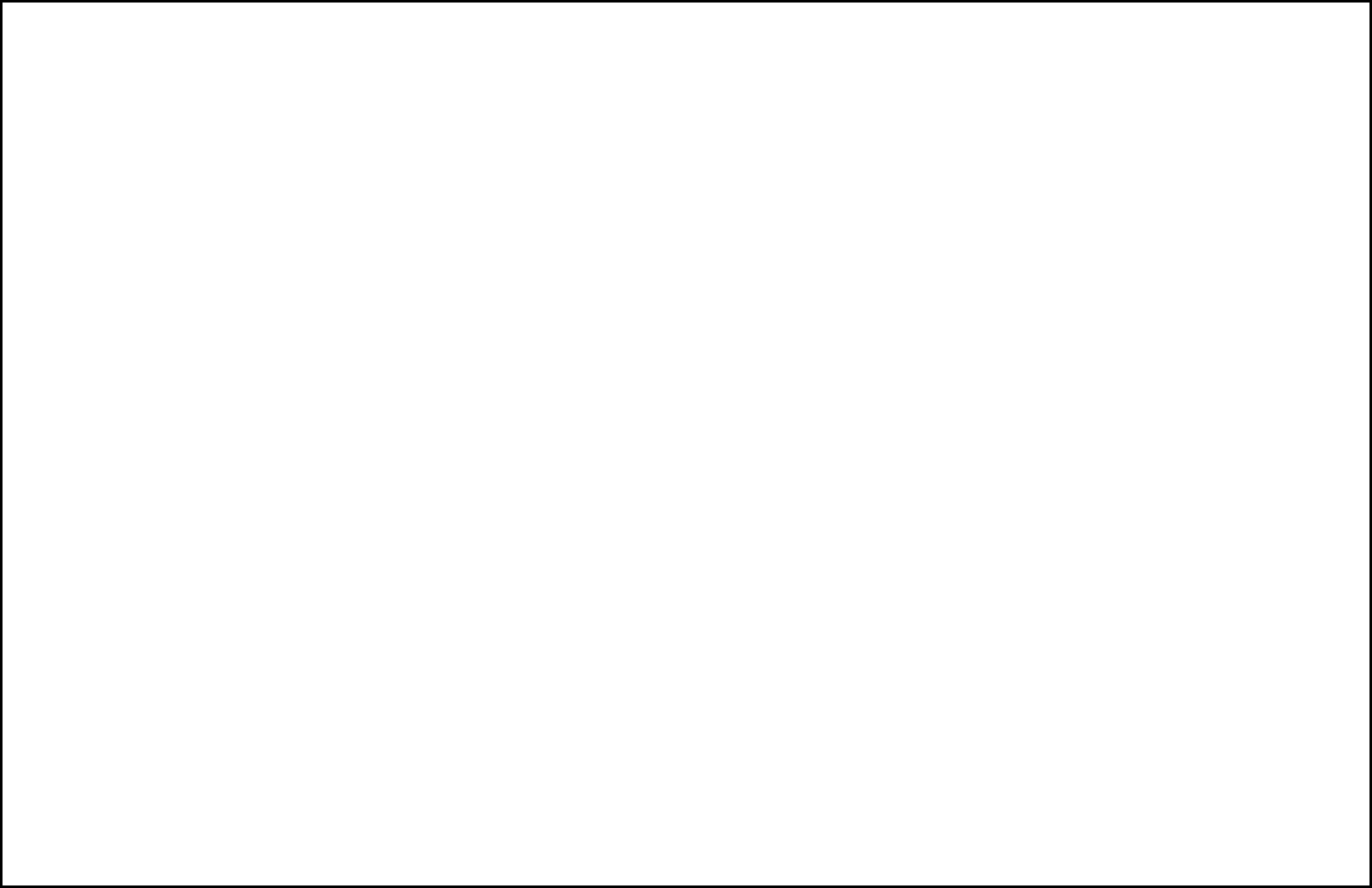
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# 1. INTRODUCTION

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## Welcome

Thank you for purchasing the Dynon Avionics EMS-D10 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-D10 is a powerful tool, useful in a variety of small aircraft, at a price that small aircraft owners can afford.

The EMS-D10'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-D10'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 or a FlightDEK-D180 the EMS-D10 can retrieve and display EFIS information at the push of a button.

The EMS-D10 is also capable of displaying HSI information, provided it is properly connected to a Garmin SL30 or a compatible GPS device.

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

## Before You Fly

We strongly recommend that you read this entire guide before attempting to use the EMS-D10 in an actual flying situation. Additionally, we encourage you to spend time on the ground familiarizing yourself with the operation of the



product. While first learning to use the instrument in the air, we recommend you have a backup pilot with you in the plane. 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-D10's many functions. The second is to give you quick access to vital information.

In the electronic (.PDF) version of this manual, items in the Table of Contents and cross-references act as hyperlinks taking you to the relevant section in the manual that the word refers to.

## 2. PRODUCT OVERVIEW

---

### EMS-D10 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. Please refer to the EMS-D10 Installation Guide for detailed installation instructions.

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

Up to 27 sensors may be connected to the EMS-D10 to present you with operational data for engines with up to six cylinders. When connected to the appropriate sensors, the instrument presents RPM, manifold pressure, oil temperature and pressure, exhaust gas temperature (EGT), cylinder head temperature (CHT), fuel levels for up to 4 tanks, voltage, current, fuel pressure, fuel flow, carburetor air temperature, coolant pressure and temperature, outside air temperature, flaps, and trim. Two external contacts may also be connected, providing status information for a variety of auxiliary aircraft systems such as canopy closure, etc.

Fuel endurance information can be obtained from a compatible GPS unit through a unidirectional serial port.

#### ***OUTPUTS***

The EMS-D10 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.



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***DISPLAY***

The display is a 4-inch, 320 by 240 pixel, 450 nit LCD screen.

***POWER***

The instrument requires 10 to 30 volts DC for operation.

### 3. PRODUCT OPERATION

---

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

#### Front Panel Layout

All normal operation of the EMS-D10 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-D10. These buttons are numbered one through six, with button one being the leftmost and button six being the rightmost. EMS-D10 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.



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-D10 display is the most obvious and commonly used output of the device. It displays all EMS-related data and, when connected to other data sources, can display EFIS and HSI data as well.

### **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 the EMS-D10 or a page from another properly-connected Dynon Avionics product.
- 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 (i.e., 1/2 split).
- Screen Rotation – The rotation is the list of screen configurations which can be cycled by via the hotkeys. Your rotation is usually smaller than the total list of available screen configurations. The EMS-D10 is shipped with three screens included in the rotation: EMS, TIMES/AUX and FUEL.










**Screens contain one or two pages and pages contain groups of similar information.**



The EMS-D10 has several pre-defined screen configurations. Screen configuration area allotment is represented by one of two icons show in the table to the right.

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

-  EMS (default EMS-D10 boot-up screen; in default rotation)
-  TIMES/AUX (in default screen rotation)
-  FUEL (in default screen rotation)
-  EFIS
-  HSI

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

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



## CYCLING BETWEEN SCREENS

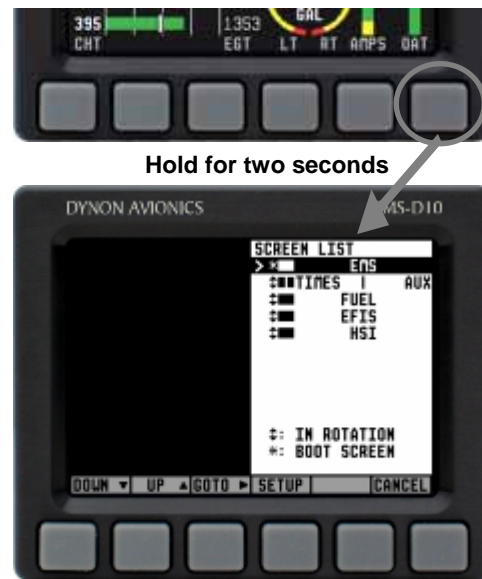
There are two methods for cycling between pre-defined screens: via the menu and via hotkeys.

### *Screen Cycling Using the SCREEN LIST*

Navigate to the SCREEN LIST menu by holding button six for at least two seconds when no menu is present (see the figure to the right). 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 the figure on the next page). 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.



**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.**



### *Changing the Screen Rotation*

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 configuration 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.



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



### *Changing the Screen List Order*

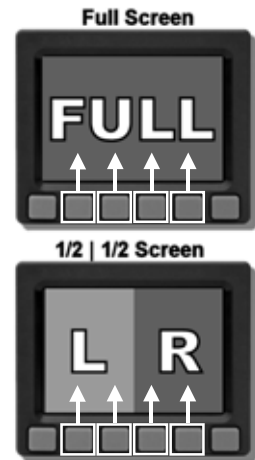
You may wish to change the order in which screen configurations are displayed in the SCREEN LIST, thus changing the order they are cycled to via hotkeys. To do this, navigate to the SCREEN LIST menu page by pressing button six for approximately two seconds when no menu is present. Press SETUP, then press 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.

## Menu

All interaction with the EMS-D10 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 1/2 of the screen and the right page occupying 1/2 of the screen, then pressing EMS-D10 buttons two or three (all below the left 1/2 of the screen) displays the main menu for the left page and pressing buttons four or five (below the right 1/2 of the screen) displays the main menu for the right page (see the figure to the right).



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



## 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-D10 menu describes the functionality of the buttons below it. The label located directly above the button denotes its current function (e.g., pushing button two in the menu to the right 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 menu 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.



**Each menu consists of labels above each button denoting their function. Note button 1 does not have a function in this menu.**



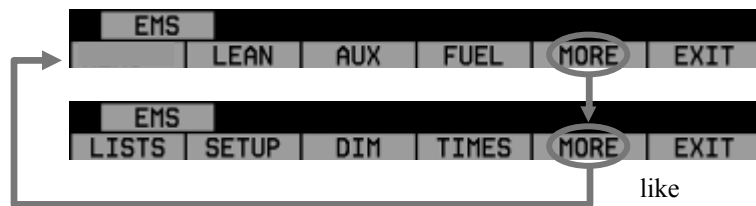
## FLOW

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-D10 is connected to, and displaying data from, a Dynon EFIS product, the EFIS page (full or 1/2 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 LEAN, AUX, FUEL, MORE, and EXIT. Pressing MORE reveals the rest of the EMS menu. The continuation of this menu contains options for LISTS, SETUP, DIM, TIMES, MORE, and EXIT. Pressing MORE on this menu simply returns you to the first part of the EMS menu.

In all top-level split-screen menus (TIMES/AUX only), 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.

All EMS 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 to momentarily view. For example, if your current screen configuration is full EMS pressing the AUX button in the EMS menu will display the AUX page in place of the EMS page. Pressing BACK will return you to the main EMS menu, and your original screen configuration (i.e., EMS).



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



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.

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.

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, flaps/trim indication, 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, coolant temp/pressure, and outside air temperature. Contact input readouts can display discrete data (e.g., open/closed, on/off, etc.). Flaps and trim displays display icons indicating the absolute position of the flaps and trim. Vertical info bars, contacts, flaps/trim indicators, 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 item configuration](#) section on page 7-5. Menu and Checklist pages may be displayed and are described in the following sections.

EFIS main pages use various tapes, digital displays, and other indicators overlaid on an artificial horizon. On the 2/3 and full-screen pages, you may also display up to two “info items” on the left and right side of the main page. HSI pages use text and a DG style compass by itself or overlaid with lines and arrows of different colors.

**Note: EFIS-based pages use data that is obtained from Dynon's EFIS products. You may only display these pages on your EMS-D10 if you own a Dynon EFIS-based product, and the two units are connected. Refer to the EMS-D10 Installation Manual for details regarding proper connection between Dynon products and other devices in your system. Please see your EFIS-based product's Pilot's User Guide for information on configuring the various displays sourced from it.**



## EMS MAIN PAGE

*Available in full format*

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. Up to four user-configurable info items may be displayed at the right side of the screen. For information on configuring the function of these info items, see the [Common Procedures](#) 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 with their respective numeric values to the left of the bars. In the split EGT/CHT display (two cylinder engines only) CHTs are displayed using their own set of green bars on a different scale than EGTs with their respective numeric values displayed to the right of each bar.





## EMS TIMES/AUXILIARY PAGE

Available in 1/2 | 1/2 format

This page displays times information on the left half of the screen and user-customizable auxiliary information on the right half of the screen.

The times half 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 the total amount of time that oil pressure was above 15 PSI since the EMS-D10 was turned on. The Trip Timer shows cumulative flight time since a 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.



The auxiliary half is customizable and allows you to display up to four different info items. You may choose from any of the available info items.

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 TIMERS – FUEL (shortcut to the add fuel menu)

For more information on configuring clock and timer settings and info items (both on this page and on the EMS main page), see the Clock Setup section on page 7-3 and the Info Item section on page 7-5.

### **EMS FUEL COMPUTER PAGE**

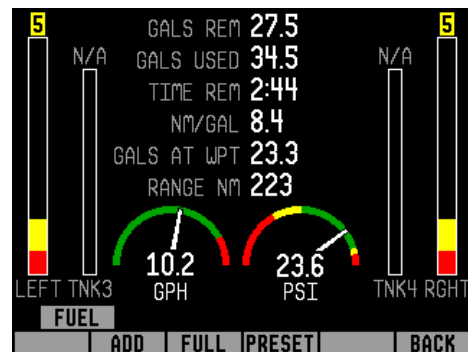
*Available in full format*

This page displays fuel level(s), fuel flow, fuel pressure, fuel remaining, fuel used, time remaining, distance per fuel unit, fuel units remaining at waypoint, and the calculated range remaining with the remaining fuel. On this page, analog gauges display sensor information and textual readouts display computed data. Much of the computed data is reliant on the optional fuel flow sensor, available from Dynon Avionics. To obtain accurate data, you must reset the fuel computer *every time you add fuel to the aircraft*.

If a compatible GPS is connected to your Dynon system as described in the EMS-D10 Installation Guide, this page will also display current distance per unit fuel, fuel at waypoint, and distance to empty (range).

Some user input is required for the EMS-D10 Fuel Computer to function properly. Refer to [Common Procedures](#) on page 7-2 for instructions on adjusting various Fuel Computer parameters.

**WARNING:** The Fuel Remaining, Time Remaining, Distance per Fuel Unit, Fuel Remaining at Waypoint, and the Calculated Range 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 full format*

This page displays user-defined checklists. Checklists may also be used for waypoint information, lists of radio frequencies, or other informational purposes. You 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-D10 as described by the Dynon Product Support Program. Reference the help file that accompanies this software for more information. To download the Dynon Product Support Program, visit [www.dynonavionics.com/downloads](http://www.dynonavionics.com/downloads).

## MENU PAGES

*Available in full format*

The setup menus require a full page to display all the available options. Menu Pages use 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.

```

EXAMPLE CHECKLIST - DO NOT USE
INITIAL CHECKLIST
WEATHER/DNSTY ALT      FUEL QUANTITY
WEIGHT/BALANCE         FUEL QUALITY
PERFORMANCE REQS      CAPS/DRAINS/VENTS
FLT PLAN (FILE)       ENGINE OIL/BELT
CTRL LOCKS (RMV)     PROP/AIR INTAKE
MASTER (ON)          EXHAUST SYSTEM
FLAPS (EXTND)        STALL IND (TEST)
PITOT HT (TEST)     SURFACES/CONTROLS
NAV/BEACON/STROBE   PITOT/STATIC PORTS
TAXI/LANDING LGHT   GEAR/TIRES/BRAKES
FUEL GAUGES (TRUE)  ANTENNAS
MASTER (OFF)        TIES/CHOKS/WALKRND
PRESS ANY KEY TO EXIT THE INTIAL LIST

```

```

GLOBAL
-PILOT SETUP-
> UNITS ►
ALARM CONFIG ►

-SCREEN SETUP-
INFO ITEM CONFIG ►
ROTATION ►
ORDER ►

-INSTALL SETUP-
# OF CHT: 4
-- MORE --
DOWN ▼ UP ▲ SEL ► BACK

```



## 5. ALARMS

---

### Alarm Indicators

Any time a built-in or preconfigured alarm set point is exceeded, you are alerted via both visible and audible (if connected) alarms.

Visual indications include:

- The measurement's value and tick color are highlighted 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-D10 EMS main 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 be silenced immediately; they may not be acknowledged during the first half second of the alarm.

In an alarm condition, the EMS-D10 also alerts you audibly, provided the EMS Audio Alert output is connected to your intercom as described in the EMS-D10 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. The ACK button has a number next to it indicating the number of currently posted alarms. If this number is higher than 1, after you press ACK, you will see the alarm text for the next posted alarm. Pressing ACK does the following:

- Silences the audio alarm
- Removes the alarm bar and alarm menu (if no other alarms are stacked up)
- 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 highlighted 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 by being highlighted red, blinking, bringing up the alarm bar, and triggering the external light and audio alert.
2. Alarm messages in the alarm bar are stacked into memory and presented in the order in which they occurred, unless a higher priority alarm occurs. Removal of the Alarm Bar requires separate pilot acknowledgement of each alarm.
3. The ACK button displays a number indicating the number of stacked up alarms.
4. When the last alarm is acknowledged, the Alarm Bar and Alarm Menu are removed from the screen.
5. All alarmed parameters remain in their alarmed state until the alarm condition no longer exists.
6. Pressing SILNCE removes the audio alert for the displayed pending alarm.
7. Once the top alarm is acknowledged, the next alarm in the stack is shown, triggering the audio alarm again.

## Latching and Self-clearing Alarms

Depending upon how your EMS-D10 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-D10 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.



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### ***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-D10 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-D10 to monitor the health and operation of your engine.

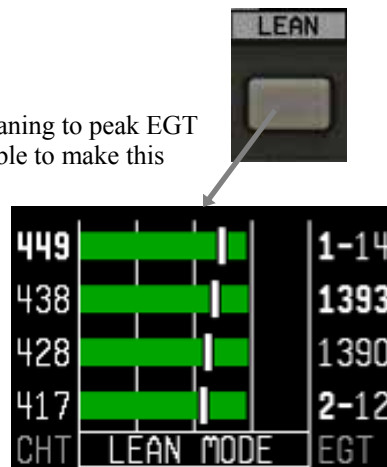
### Engine Leaning

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 label "Lean Mode" is displayed underneath the EGT/CHT bars to clearly differentiate it from the normal operating mode. In split EGT/CHT mode, the label "LN" is displayed at the upper left of the EGT/CHT display. 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



**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.**



temperatures, you can also watch the fuel flow rate and CHT temperatures. Carefully 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.

## Ignition Misfire

When a magneto fails or a plug gets fouled, one of the plugs in the cylinder stops firing. This causes the fuel to burn slower than it usually does, since only one plug ignites the mixture. This slow burn means some unburned fuel makes its way into the exhaust stack and burns there, causing high EGT values. This also means less energy is being put into the



head, so the CHTs will also fall. If it occurs on one cylinder, suspect a fouled plug and try clearing it out. If it occurs on all cylinders at once, suspect a magneto and take appropriate action for your aircraft.

## **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. You may configure shock cooling and span alarms; see the EMS-D10 Installation Guide for more details.

## **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-D10 constantly streams data out of its RS-232 serial port during normal operation. The data format is described in on page 8-2. To log engine data, you need a laptop (or RS232 data collection device) connected to, and storing data from, your EMS-D10.



## 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.

We recommend that you 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.

You 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). It is acceptable to have the EMS-D10 on during engine crank. It will immediately power on upon application of external power.

### 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-D10 display is maximum brightness. There is no way for you to adjust the display to be 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-D10 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 you can reset. 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-D10 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-D10 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 power on alarms status:** EMS > MORE > SETUP > GLOBAL > DOWN ▼ > SEL ► > BACK

Set this parameter to “ON” to enable alarms before 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.

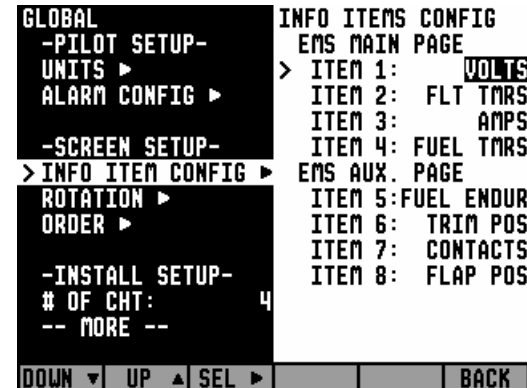
**Test light/audio alarm(s):** EMS > SETUP > GLOBAL > DOWN ▼ > DOWN ▼ > SEL ►

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 Info Items Config submenu appears, 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 reference tools such as a detailed description of the serial data format output by the EMS-D10, a specifications sheet, and a troubleshooting guide. This section also contains details regarding EMS-D10 servicing.



## Appendix A: Serial Data Output

The EMS-D10 outputs text data through its serial port constantly during normal operation. Technical information on the installation and connection to this serial port can be found in the EMS-D10 Installation Guide. To log EMS data you must connect the serial port to a PC. This serial data can be logged using any standard serial terminal program such as HyperTerminal®. 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 for the serial port:

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

### ***EMS SERIAL DATA OUTPUT***

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

| Parameter         | ASCII Characters | Units       | Example                                   |
|-------------------|------------------|-------------|---|
| Zulu Hour         | 2                | Hours       | 12 (12 hrs)                               |
| Zulu Min          | 2                | Minutes     | 12 (12 mins)                              |
| Zulu 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) |
| Oil Temp          | 3                | ° F         | 123 (123°F) or -12 (-12°F)                |



| Parameter         | ASCII Characters | Units           | Example  |
|-------------------|------------------|-----------------|--|
| 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                                  |



| Parameter  | ASCII Characters | Units     | Example                    |
|------------|------------------|-----------|----------------------------|
| CHT_4      | 3                | ° F       | Same as above              |
| 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)                             |





## ***FIRMWARE VERSION DISPLAY***

The firmware version submenu gives you two important pieces of information: the version of EMS-D10 firmware that your unit is currently running and the number of hours the EMS-D10 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-D10 firmware, please refer to Dynon's website at: [www.dynonavionics.com/downloads](http://www.dynonavionics.com/downloads) here 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.



## Appendix D: EMS-D10 Specifications

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|                   |           |  |
|-------------------|-----------|--|
| <b>Mechanical</b> | Mounting: | Fits into standard 3 1/8" panel hole<br>Optional flush mount bracket available |
|                   | Weight:   | 1 lb. 4 oz. (0.57 kg)  |

---

|                              |                                |  |
|------------------------------|--------------------------------|--|
| <b>Operating Temperature</b> | -22° to 122° F (-30° to 50° C) |  |
|------------------------------|--------------------------------|--|

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|              |          |                         |
|--------------|----------|-------------------------|
| <b>Power</b> | Voltage: | 10 - 30 Vdc             |
|              | Power:   | <b>10 watts</b> maximum |

---

|                    |         |                                  |
|--------------------|---------|----------------------------------|
| <b>Connections</b> | Wiring: | D-25 male & D-37 male connectors |
|--------------------|---------|----------------------------------|

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|               |             |                                   |
|---------------|-------------|-----------------------------------|
| <b>Screen</b> | Type:       | AMLCD, TFT (Thin Film Transistor) |
|               | Backlight:  | 450 nits                          |
|               | Size:       | 4.0" diagonal (101.6 mm)          |
|               | Resolution: | 320 x 240 color pixels            |

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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 - Current (Shunt)
- 1 - Voltage (from supply power)
- 3 - General Purpose (Either resistive or voltage for OAT, Fuel Tanks 3&4, Coolant Temp, Coolant Press, Carburetor Temp, Flaps, Trim)

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**Inputs/Outputs**

- 1 - Alarm Light Contact
  - 1 - Audio Alarm
  - 1 - RS-232 bidirectional PC communication or external data input
  - 1 - RS-232 data input (GPS, SL30, etc.)
  - 2 - Dynon Smart Avionics Bus (DSAB)
-