EnGood Engine Monitor

Specification and Installation Instructions

Rev1.3

September 2024

Models

- Engine Monitor Sensors module **EM-01**
- Engine Monitor Display unit (optional if used with EFIS such as ELM350 or ELM1000)

Note:

EnGood Engine Monitor is a non-TSO certified flight instrument.

Credits

This document has been written by **Vladimir Miloslavine**, author, designer, and developer of the **ENGOOD Engine Monitor**. All pictures and other graphical materials are the sole property of the **360 Avionics Company**.

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Revision History

Below is the document's revision hi story.

Revision #	Revision Date	Comments
Rev 1.0	May 20, 2023	Initial Release of this document
Rev 1.1	June 02, 2023	Additional functionality
Rev 1.2	January 06, 2024	Changes and functionality
Rev 1.3	September 26, 2024	Changes and new functionality

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1. Introduction

ENGOOD is an Engine Monitor System designed for fixed-wing experimental airplanes. This compact module offers an additional layer of security for pilots by providing vital engine parameter information in real time.

ENGOOD is a **non-TSO certified** flight instrument. The system consists of two distinct modules: the **EnGood EM-01 Sensor Processing Unit** and the **Display Unit**. The display unit is an optional component; the EnGood Sensor Processing Unit is compatible with EFIS systems such as the **ELM350 or ELM100**. If the display unit is not utilized, all engine monitoring information will be shown on the EFIS.

The engine monitor display unit is available in a form factor that fits standard aviation panel openings of **3 1/8 inches**. This product manual is intended to describe the engine monitor's functionality, installation, and operation.

Please note: In this document, the terms "EnGood," "engine monitor," "device," "unit," and "instrument" are used interchangeably when referring to the EnGood engine monitor.

2. General Description

The **EnGood Engine Monitor System** consists of two distinct modules: the **EnGood Display Unit** and the **EnGood EM-01 Sensor Processing Unit**. Both units feature their own firmware and operate independently of each other, communicating at high speeds using dedicated protocols.

1. **EnGood EM-01 Sensor Processing Unit**
   - This electronic device comprises a high-speed microcontroller, various components, ports, and an aluminum housing.
   - Additionally, the EM-01 Sensor Processing Unit may include various external sensors that can be connected via appropriate ports.

2. **EnGood Display Unit**
   - This electronic device consists of a graphics processor (GPU), LCD display, and various components, including buttons and control knobs.
   - For user controls and inputs, the EnGood Display Unit features two rotating knobs and two push buttons located on the front panel.

If an EFIS is used instead of the EnGood Display Unit, please refer to the EFIS user manual for information related to device operation.

3. Technical Specifications

Description	EnGood EM-01 and Display Unit
Input voltage	+10 to +28 Volts
Power consumption	2.0W
Current	1.1A at 12V
Unit size	95mm x 95mm x 100mm (with knobs)
Weight	150 g
Operation humidity	25% to 90%
GPU processor	ARM Multicore
Sensors processor	ARM
System startup time	26 sec
Display	3.5" ultra-bright 640x480px
SD Card slot	Standard MicroSD
Panel opening	3.125" (79mm)
External communication	CAN bus (proprietary protocol) and RS232
Manufacturer	360Avionics

4. EnGood EM-01 sensors processing unit

The **EnGood EM-01 Sensor Processing Unit** polls all sensors multiple times per second, analyzes the received data, and feeds the engine parameter information to the Display Unit or an external EFIS.

This unit allows for the connection of various sensors, including **Cylinder Head Temperature (CHT)**, **Exhaust Gas Temperature (EGT)**, pressure sensors, fuel flow sensors, and more.

5. EnGood Display Unit

The **EnGood Display Unit** features a **3.5-inch TFT LCD** with a resolution of **640 x 480 pixels**, providing excellent color transmission and contrast. This display utilizes high-brightness, sunlight-readable technology, making it suitable for applications in direct sunlight.

Built into the front panel of the EnGood Display Unit are **ambient light sensors** that enable an **auto brightness** feature. This feature can be turned on or off in the **Settings menu** under **General Config > Disp Brg** submenu.

When the auto brightness feature is activated, the display's brightness automatically adjusts according to ambient light conditions—becoming brighter in direct sunlight and dimming at night.

⚠ Display is non-touch. Avoid pushing on the display with finger or other objects and avoid cleaning the displays with abrasive chemicals not designed for cleaning of LCD displays.

6. Product installation

6.1 Space requirements

All dimensions are given in Millimeters (mm).

EnGood engine monitor consists of two parts:

- EnGoodEM-01 sensor processing unit
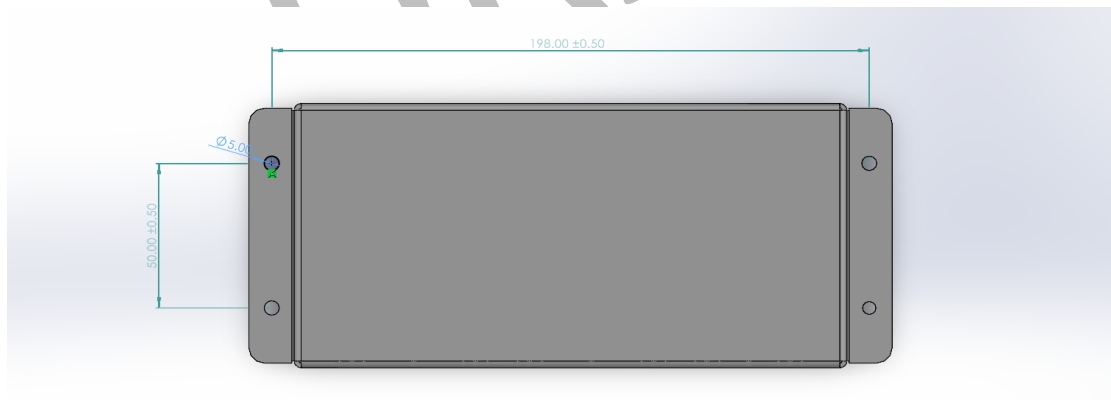- EnGood display unit (optional)

**EnGood EM-01 sensor processing unit**

It is recommended that EnGood EM-01 sensor processing unit is installed behind the instrument panel.
There are 4 mounting holes. Each hole has a diameter of 5mm.
Horizontally, the distance between the mounting holes is 198mm; vertically, the distance between the vertical mounting holes is 50mm.

⚠ *Important: Please allow at least 85mm of clearance between the front panel of Engood sensor processing unit and other parts for connectors and wires.*
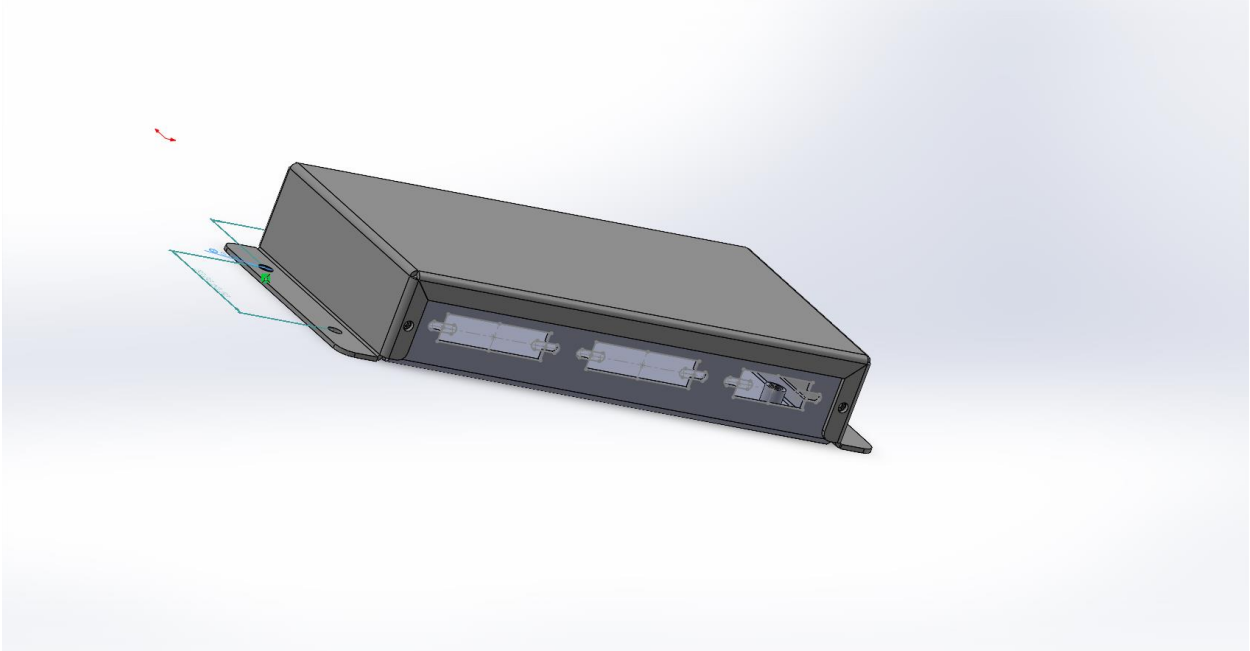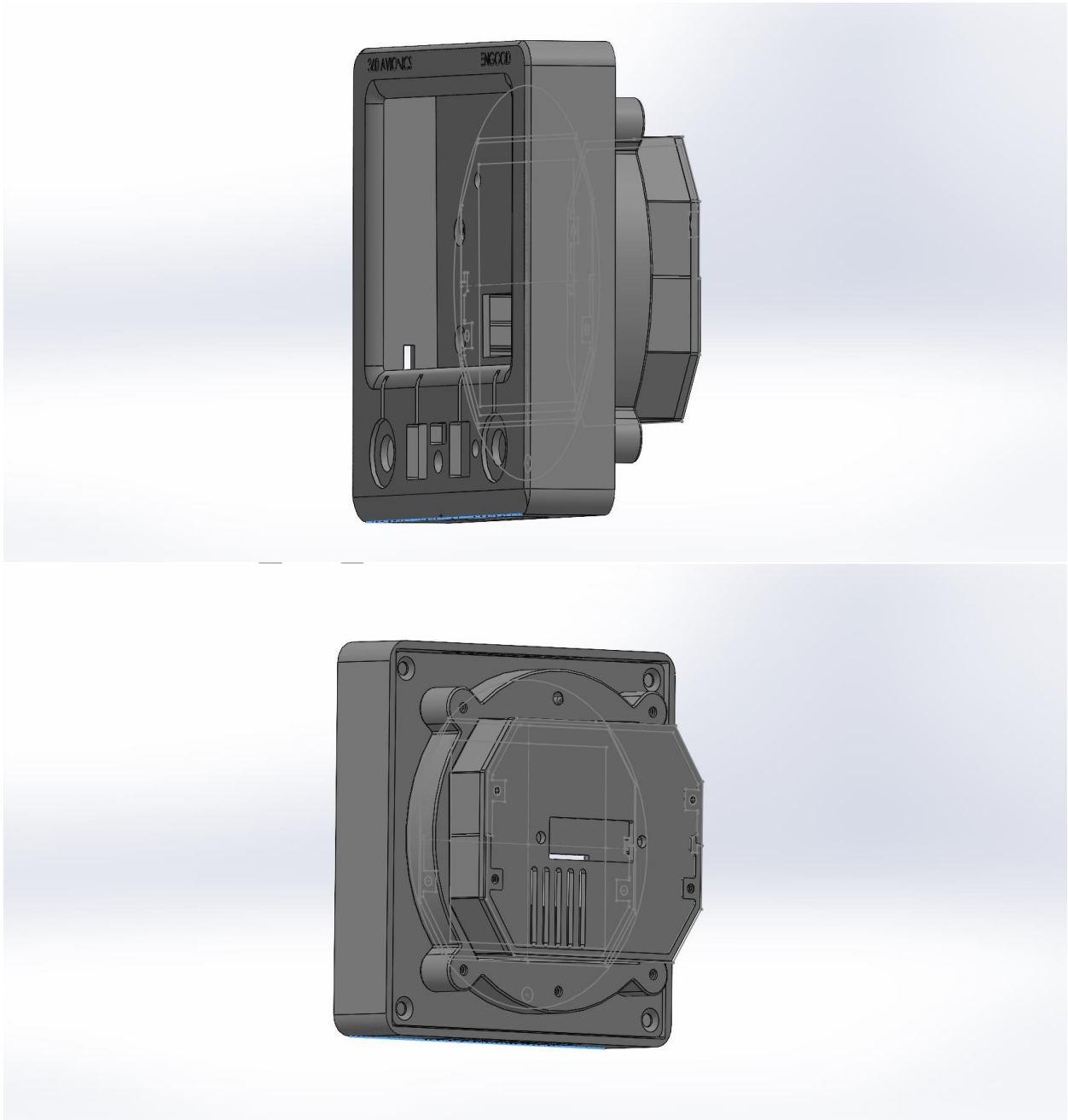
Recommended mounting hardware is #6-32 bolts. It is preferable to have a nut plates installed in the panel to simplify installation and removal of the EM-01 module.

EnGood Display Unit:

EnGood Dsplay Unit consists of two main parts: display assembly and mounting bracket. It is designed to fit into a standard aviation 3.125" panel opening.
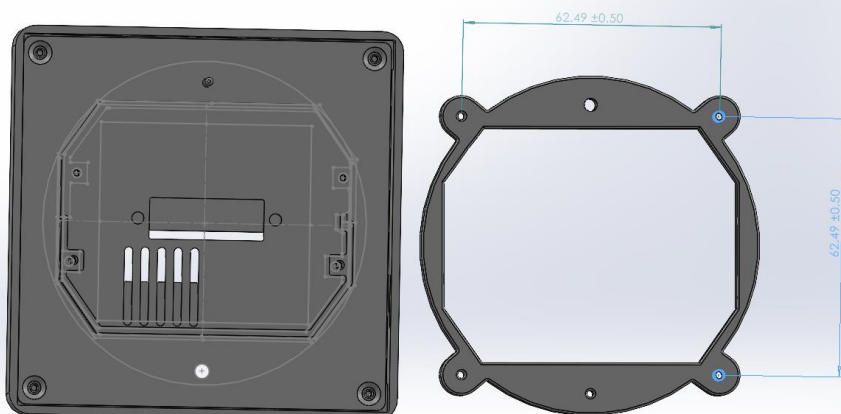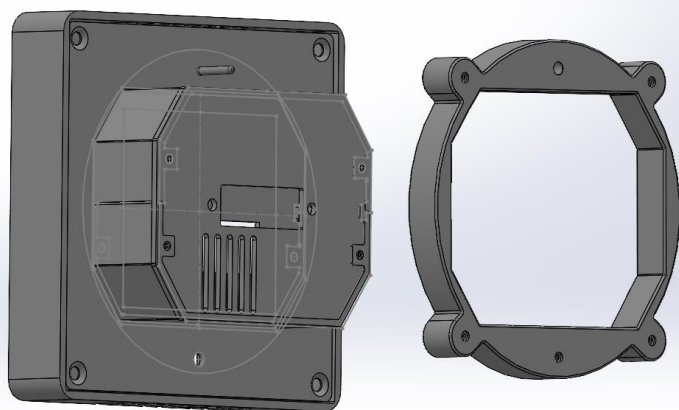
⚠ *Important: There is a connector at the back of the EnGood Display Unit. Please allow at least 120mm of clearance between the rear wall of Engood Display unit and other components for connectors and wires.*
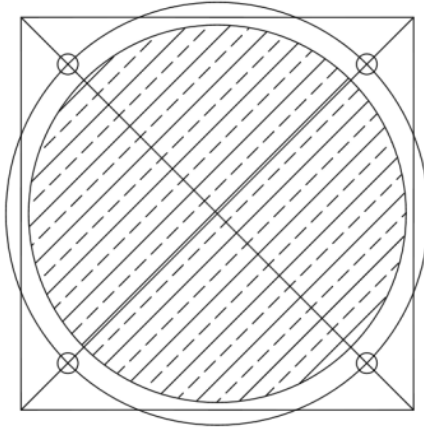
Mounting bracket for Engine Monitor display has four threaded holes in the corners. Thread size is 6-32. It will fit in to standard aviation 3.125" panel opening.

3 1/8 (80mm) Instrument Hole

1. Draw a 3.25" X 3.25" Square
2. Scribe 2 diagonal lines corner to corner
3. Using the center of the lines, scribe a 3.5" diameter circle.
4. At the intersection of the diagonals and the 3.5" dia circle drill 4 holes to clear #8 screw (.170" dia.)
5. Using the center of the diagonal lines cut a hole with a hole saw 3.125" dia.
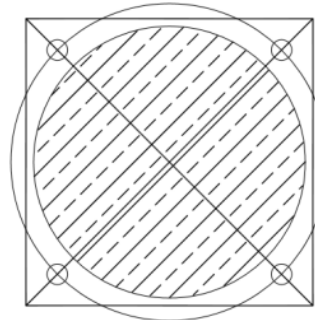
2 1/4 (57mm) Instrument Hole

1. Draw a 2.375" X 2.375" Square
2. Scribe 2 diagonal line corner to corner
3. Using the center of the lines, scribe a 2.625" diameter circle.
4. At the intersection of the diagonals and the 2.625 dia circle drill 4 holes to clear #8 screw (.170" dia.)
5. Using the center of the diagonal lines cut a hole with a hole saw 2.250" dia.

Use 7/64" hex drive to attach display unit to mounting bracket

6.2 Pinout connectors Information

EM-01 Engine Sensor Processing Unit
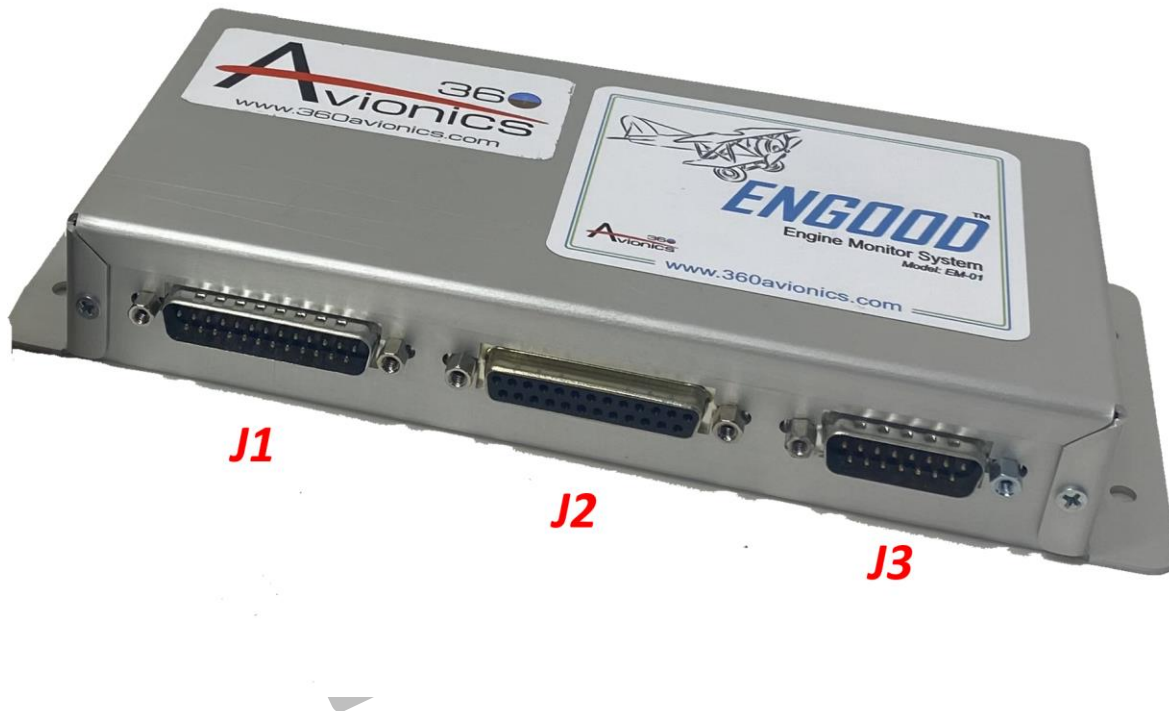
Connector J1 (DB25)

1- CHT1+	11- CHT6+	21- EGT4-
2- CHT1-	12- CHT6-	22- EGT5+
3- CHT2+	13- GND	23- EGT5-
4- CHT2-	14- EGT1+	24- EGT6+
5- CHT3+	15- EGT1-	25- EGT6-
6- CHT3-	16- EGT2+	
7- CHT4+	17- EGT2-	
8- CHT4-	18- EGT3+	
9- CHT5+	19- EGT3-	
10- CHT5-	20- EGT4+	

Connector J2 (DB25)

1- Oil Temp+	11- Current Sens Input	21- Elevator Trim Sens
2- Oil Temp-	12- Flaps Pos Sens Input	22- 5V for Sens
3- Aux Temp+	13- Rudder Trim Sens Input	23- 5V for Sens
4- Aux Temp-	14- Left Door Sens In	24- 5V for Sens
5- RPM Sens Input	15- Fuel Meter Right Sens Input	25- Right Door Sens In
6- Fuel Flow Sens1 Input	16- GND	
7- Fuel Flow Sens2 Input	17- GND	
8- Oil Press Sens Input	18- GND	
9- Fuel Press Sens Input	19- Flaps Pos Sens Input	
10- MAP Sens Input	20- Fuel Meter Left Sens Input	

Connector J3 (DB15)

1- Power IN (12V)	11- CAN bus High
2- Reserved	12- Warn Lamp Output1
3- Reserved	13- Unused Input
4- Reserved	14- Baggage Door Sens In
5- Unused Input	15- Power Ground Input
6- Roll Trim Sens Input	
7- Reserved	
8- GND	
9- Warn Lamp Output2	
10- CAN bus Low	

Engood Display Unit

26-pin Main connector pinout:

1 – A/C Power **+V** (positive)	14 – RS-232 Tx2
2 - A/C Power **+V** (positive)	15 – RS-232 Rx2
3 – CAN bus Low	17,24 – GND (UART)
4 – CAN bus High	25 – A/C Power **GND** (negative)
7 – RS-232 Tx1	26 – A/C Power **GND** (negative)
8 – RS-232 Rx1	

Wiring Recommendations

It is recommended to use **22 AWG** wire for all power connections (pins **1, 2, 25, and 26**). For all other connections, **24 AWG** wire is acceptable. Ensure that **milspec wires** are used for all connections to guarantee high quality and robustness. For the **CAN bus** connection between the EnGood EM-01 Sensor Processing Unit and the Display Unit (or EFIS), a **twisted wire pair** must be utilized.

Connector Kit

The kit includes a **female D-SUB 26-pin connector header** with options for either soldering or crimping in pins. A **plastic enclosure** for the connector header is also provided. If soldering wires, ensure that the connections are secure and free from cold solder joints.

Additionally, the EM-01 kit includes:

- Two **DB25 connectors** (male/female) with crimping pins
- One **DB15 connector** for soldering or crimping pins

6.3 CAN Bus termination:

EM-01 Sensors Processing Unit can be installed in the airplane together with compatible 360 Avionics EFIS or with EnGood Display Unit and connected to a single CAN line.

It is required to install 120 Ohm resistor (included with kit) between pins 10 and 11 of connector J3 on the EM-01 sensor processing unit.
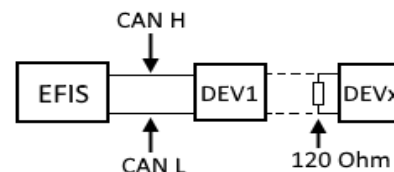
6.4 Power bus:

EM-01 Sensor Processing Unit

Use AWG20 or less gauge of wires to connect power to the sensors unit (pins 1 and 15 of J3 connector). It is required to have 5A circuit breaker on power line for this module. This circuit breaker should be accessible from pilot's seat. Ground wire can be connected to chassis ground or directly to the battery negative terminal.

EnGood Display Unit

Use AWG22 or less gauge of wires to connect power to the EM-01 Sensor Procesing Unit (pins 1,2 and 25,26 of 26-pin connector). It is required to have 3A circuit breaker on power line for this module. This circuit breaker should be accessible from pilot's seat. Ground wire can be connected to chassis ground or directly to the battery negative terminal.

Power line with circuit breaker is usually connected via Avionics master switch or via Main master switch depending on the airplane configuration.

6.5 Data communication bus:

EM-01 Sensor Processing Unit must be connected to *EnGood Display Unit* (or EFIS) using CAN bus for all data exchange between devices.
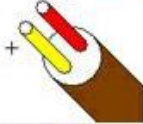
Use only twisted pair of milspec wire AWG22-24 for this connection.

Connect pins as follows:

Signal	EM-01	EnGood Display (if using)	ELM1000 (if using)	ELM350
CAN Low	10 (J3)	3 (Main)	12 (J2)	3 (Main)
CAN High	11 (J3)	4 (Main)	13 (J2)	4 (Main)

6.6 Sensors

CHT, EGT, Oil Temperature, GearBox, Coolant and under Cowling Sensors:

Type	Material		Color Code	Range (°C)	
Thermocouple Grade	Positive Wire	Negative Wire		Minimum	Maximum
J	Iron	Constantan		0	750
K	Chromel	Alumel		-200	1250

Compatible Sensors

The **CHT** (Cylinder Head Temperature) and **EGT** (Exhaust Gas Temperature) sensors compatible with the **EM-01 Sensor Processing Unit** are **K-type thermocouple sensors**. It is also possible to use **J-type thermocouple sensors**; however, this must be specified during production (please inform us when placing your order).

By default, the kit includes **ungrounded K-type thermocouple** CHT and EGT sensors. Each sensor features two wires:

- **"+" positive** (yellow wire)
- **"-" negative** (red wire)

Temperature Sensor Connections

- For **Gearbox**, **Under Cowling**, and **Coolant Temperatures**, the **K-type thermocouple (ungrounded)** is used.
    - **Under Cowling Sensor**: This sensor cannot be used simultaneously with the gearbox temperature sensor. Connect either the gearbox or the cowling temperature sensor to the **AUX temperature input** of the EM-01 (Connector J2, pins **3 and 4**).
    - **Coolant Temperature Sensor**: This sensor should be connected instead of the CHT sensor 5 (Connector J1, pins **9 and 10**). Note that this setup makes it impossible to use both the CHT5 and the coolant sensor at the same time.

⚠ *Important: Please note that the sensor wires cannot be extended or replaced using any wires made of material other than specified in the table above. If extension of K-type thermocouple wires is required you, must source specific K-type extension wires.*

It is recommended to use **crimp-on terminals** for the sensor wires and to join them using **bolts and nuts** with washers. Ensure that such connections are well insulated after the connection is made to prevent any electrical issues.

Important Considerations:

- Pay attention to **heat sources** such as exhaust pipes. Avoid routing sensor wires close to these sources to prevent melting or shorting of the wires.

The supplied **DB25 pin connector** and pins will require the avionics installer to perform appropriate crimping of the wires into the connectors. A description of this procedure is outside the scope of this manual and should be performed based on the installer's experience.

EGT Sensor Installation

1. **Drilling the Hole**:
   o Drill a hole of **5 mm (1/5")** in your exhaust pipe.
   o Position the hole **2" to 4"** from the cylinder exhaust port.
   o Ensure that the hole in each exhaust pipe is drilled at the same distance from the cylinder exhaust port to maintain equal temperature readings across the cylinders.
2. **Installing the Probe**:
   o Install a clamp over the pipe, then insert the probe and tighten the clamp.
   o Adjust the probe's end depth inside the exhaust pipe to be approximately in the middle.
   o Tighten the probe's nut on top.
3. **Final Checks**:
   o Ensure that after installation, the probe will not interfere with your cowling or other components of the engine.

CHT spring loaded sensor for Lycoming engines comes with special fitment adapter. Sensor is installed in the special port available in each cylinder head using the adapter. Sensor can be adjusted using the spring for correct depth.

Depends on engine model various CHT sensors can be used including ring type (under spark plug) sensors.

Pressure Sensors:

Pressure sensors for Oil and Fuel pressure used with EM-01 Sensor Processing Unit are 5 Volt analog sensors.

Sensors threaded: *1/8''-27 NPT / 1/8'' NPT*
Each sensor has three (3) wires:

Red – Positive Power +5V
Black – Negative GND
Green – Signal Output

Pressure sensors connections:

GND (black) should be connected to any of pins: 16,17 or 18 of J2 (EM-01).

Power (red) should be connected to any of pins 22,23 or 24 of J2 (EM-01)

Signal output of the sensor (green) should be connected to appropriate pin of J2 depending on sensor function:
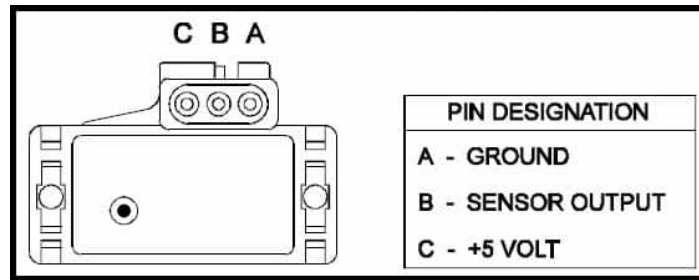
(J2)
8 – Oil pressure
9- Fuel pressure

Both Oil and Fuel pressure sensors should have correct pressure limit spec for planned pressure. We provide sensors of 100PSI but may also provide higher or lower limit sensors upon request.

MAP Sensor:

MAP sensor used with EM-01 Sensor Processing Unit is a 5V analog sensor.

Sensor connector may have the following colors:

(shown in the left picture)
Red – Power+5V should be connected to any of pins 22,23 or 24 of J2 (EM-01)
Black – Negative GND should be connected to any of pins: 16,17 or 18 of J2 (EM-01)
Blue – Signal Output should be connected to pin 10 of J2

(shown in the right picture)
Red – Power+5V should be connected to any of pins 22,23 or 24 of J2 (EM-01)
Yellow – Negative GND should be connected to any of pins: 16,17 or 18 of J2 (EM-01)
Blue – Signal Output should be connected to pin 10 of J2

Fuel Flow Sensor

Fuel flow sensor is not included with the kit but can be ordered separately. We recommend using a Floscan 201 but any other fuel flow sensor which uses PWM as an output can be used.

EM-01 Sensor Processing Unit can support single or dual fuel flow sensors configuration.

Floscan 201 has the following wire colors:

Red – Connect to +12V. It can be connected to pin1 of J3 (EM-01) or to separate 12V power source via 1A circuit breaker.
Black – *GND* (recommended to ground it near the sensor location)
White – *Signal output* connect to pin6 of J2 if this is a single Fuel flow sensor installation
*Connect White output of second Fuel Flow sensor to pin7 of J2 *(dual Fuel Flow install)*

Current Flow Sensor

EM-01 Sensor Processing Unit supports analog current flow Hall split core sensors connection.
We successfully tested the following Hall split core sensor: **HSTS016L** 100Amp sensor
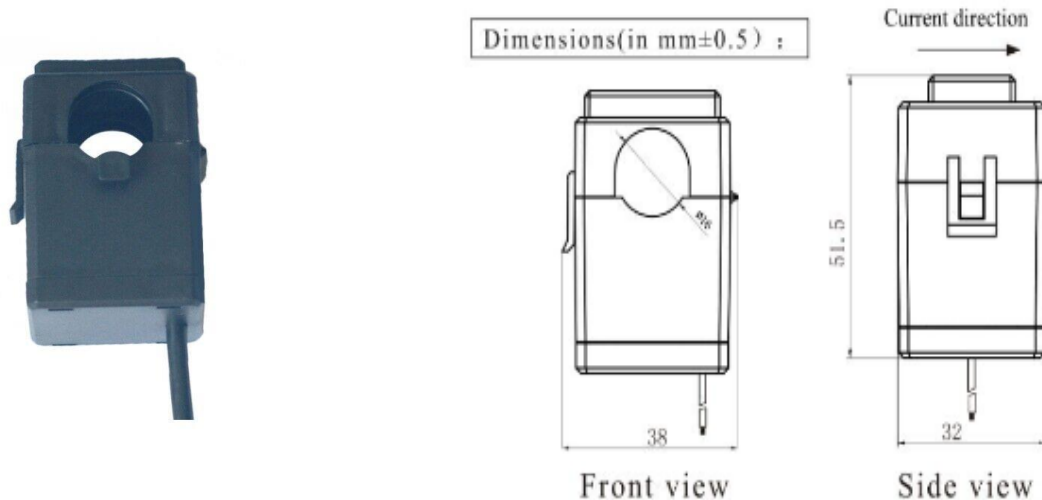
Sensor has the following wire colors:

Red – Power+5V should be connected to any of pins 22,23 or 24 of J2 (EM-01)
Black – Negative GND should be connected to any of pins: 16,17 or 18 of J2 (EM-01)
Yellow – Signal output should be connected to pin11 of J2
White – (not connected)

Current sensor should be installed around the main battery positive wire and secured. The best location for the sensor can be determined by installer, depending on the location of the battery.

Flaps Position, Rudder Trim and Elevator Trim Sensors

Sensors for Flaps, Rudder, Roll and Elevator trim are simple analog sensors with voltage output of 0V to 5V. We have successfully tested the following types of sensors and servo/sensor combos:

- Ray Allen POS-12
- Ray Allen T2-10A
- Other Ray Allen servo/sensor combos

Most of Ray Allen sensors or servo/sensor combos will have three (3) wires for sensing purposes:

Orange – Usually connected to +5V, so unless this wire is already connected in your setup to servo you may safely connect it to any of pins 22,23 or 24 of J2 (EM-01 Sensor Processing Unit). **WARNING! Do not connect this wire to EM-01 module if it is already connected with your servo.**

Green – Signal position output wire. Connect it to appropriate input of EM-01 (flaps, rudder, roll or elevator).

Blue - Usually connected to GND, so unless this wire already connected in your setup to servo you may safely connect it to any of pins: 16,17 or 18 of J2 (EM-01) **WARNING! Do not connect this wire to EM-01 module if it is already connected with your servo.**

Fuel Tank Level Sensors

EM-01 Sensor Processing Unit is capable of reading the data from standard resistor type fuel level sensors with range of resistance from 30 Ohm to 240 Ohm.

Simply connect the wire from fuel level sensor installed in your fuel tank to appropriate input in J2 connector of EM-01.

Use pins:
15 (J2) – Right fuel tank
20 (J2) – Left fuel tank

Main and Baggage Door Sensors

You can use any sort of a trigger sensor for your doors. It can be a simple push button type sensor which has two contacts and acts as a simple button.

Connect one contact of sensor to chassis GND of airplane. Connect second contact of the sensor to appropriate input of J2 and J3 connectors of EM-01 Sensor Processing Unit.

Use pins:
25 (J2) – Right door
14 (J2) – Left door
14 (J3) – Baggage door
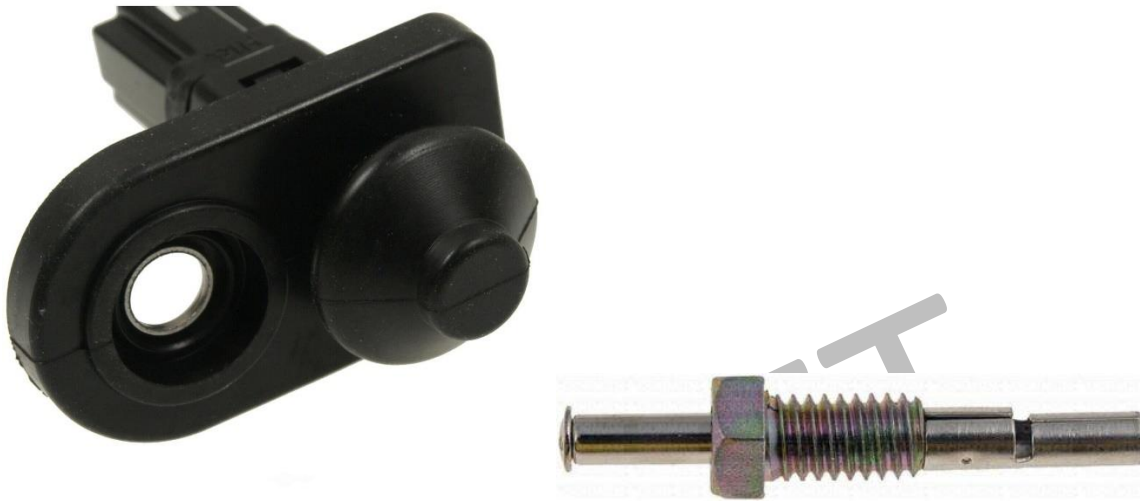
Warning Lamp Outputs

EM-01 Sensor Processing Unit has two warning lamp outputs. These can be used to drive small 12V lamps in panel.

Pins to connect are:
12 (J3) – Lamp1
9 (J3) – Lamp2

When triggered, warning lamp output will become internally grounded via transistor and allow up to 250mA of current to flow.

Connect one contact of lamp to +12V in airplane and connect another contact of lamp to warning lamp output on EM-01 Sensor Processing Unit.

Lamp1 should be labeled on panel as "Oil Pressure". This lamp will turn on if oil pressure is below the pre-set limit. Also this lamp will turn on upon powering of the EnGood Engine Monitor System and will immediately turn off during engine start as soon as engine's oil pressure reaches the minimum trigger limit.

Lamp2 is unused at this time.

7. Normal Operation of the EnGood Engine Monitor

7.1 Modes of Operation

The EnGood Engine Monitor offers the following modes of operation:

- Engine Mode
- Airplane Mode
- Graphs Mode
- Time Mode
- Voltage Mode

On the EnGood Display unit, you can switch to the next mode by pressing the right button on the front panel. If using EFIS instead of the EnGood Display unit, refer to the EFIS operation manual.

Another way of switching between operation modes is via the Main Menu. You can access the 'Main Menu' by pressing left knob.
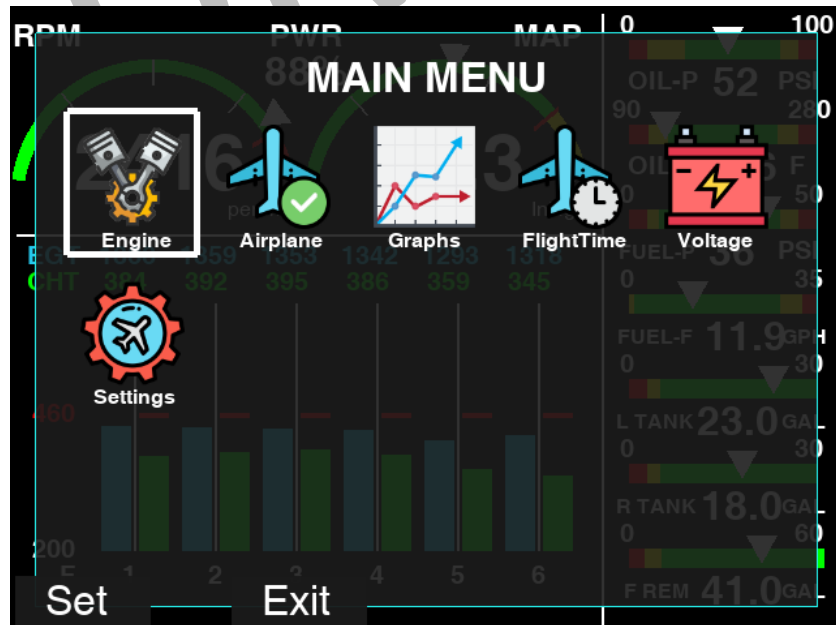
From this menu you may access to Engine, Airplane, Graphs, Time and Voltage Modes, as well as Settings, as shown above.

Engine Mode
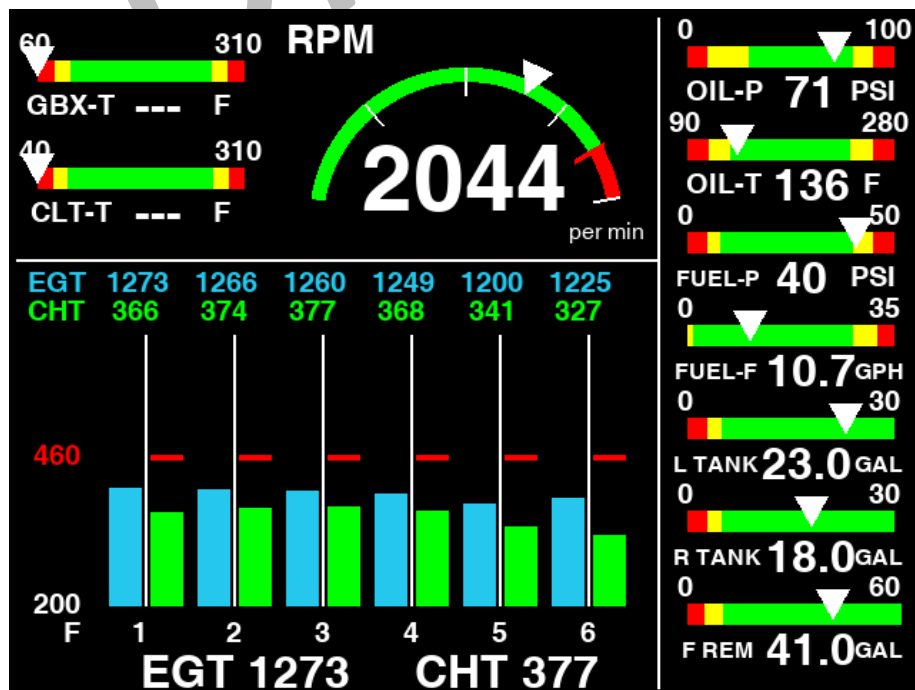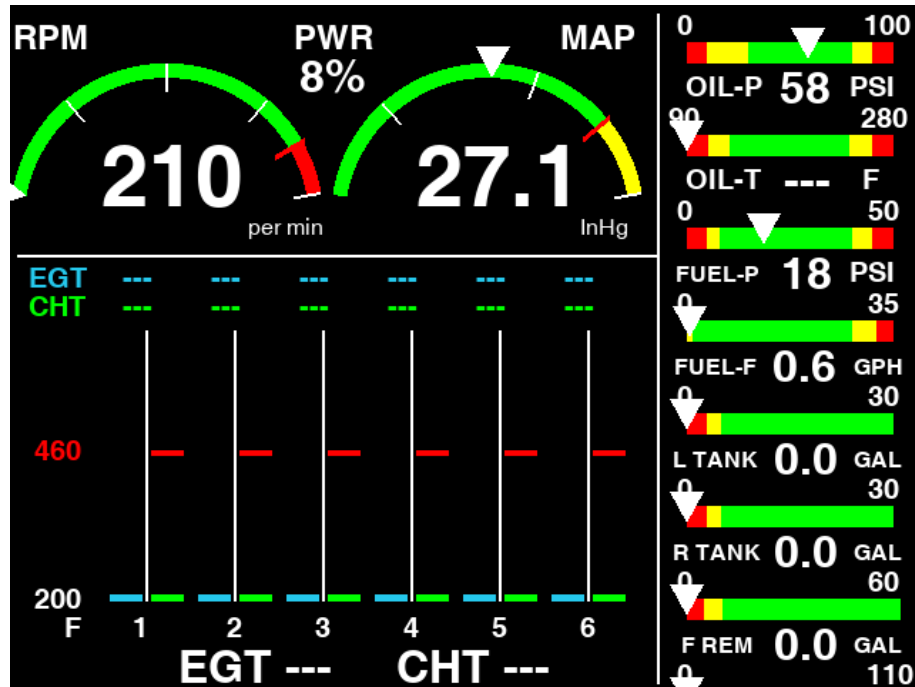
Main Screen Overview

Upon powering up, the **EnGood Display Unit** boots into the **main screen**, where engine parameter information is displayed. The availability of certain engine parameters may vary based on how the **EnGood Engine Monitor** is configured.

- **Top Part of the Display**:
    - Displays information about **RPMs** (Revolutions Per Minute), **MAP** (Manifold Absolute Pressure, optional), and the **current power setting** (available only when both RPM and MAP are in use).
- **Bottom Part of the Display**:
    - Provides readings for **CHT** (Cylinder Head Temperature) and **EGT** (Exhaust Gas Temperature) temperatures of the engine.
- **Right Side of the Display**:
    - Shows various **pressures**, **temperatures**, and additional parameter gauges. A maximum of **seven (7)** parameters can be displayed on this page. Any additional parameters will be shown on the **Airplane Page**.

Setting fuel quantity in tanks

EnGood Engine Monitor can be used with fuel level sensors, however the readings from fuel level sensors are usually not accurate. For more accurate readings it is recommended that you use fuel flow sensors; fuel flow sensors can measure the fuel flow up to 100 grams.

⚠ *Important: For accurate readings, you must manually pre-set the amount of fuel in the airplane after each fueling. EnGood Engine Monitor will calculate the remaining fuel quantity based on pre-set minus fuel used.*

To set the current fuel quantity while in Engine Mode press right knob.
New menu will pop up.
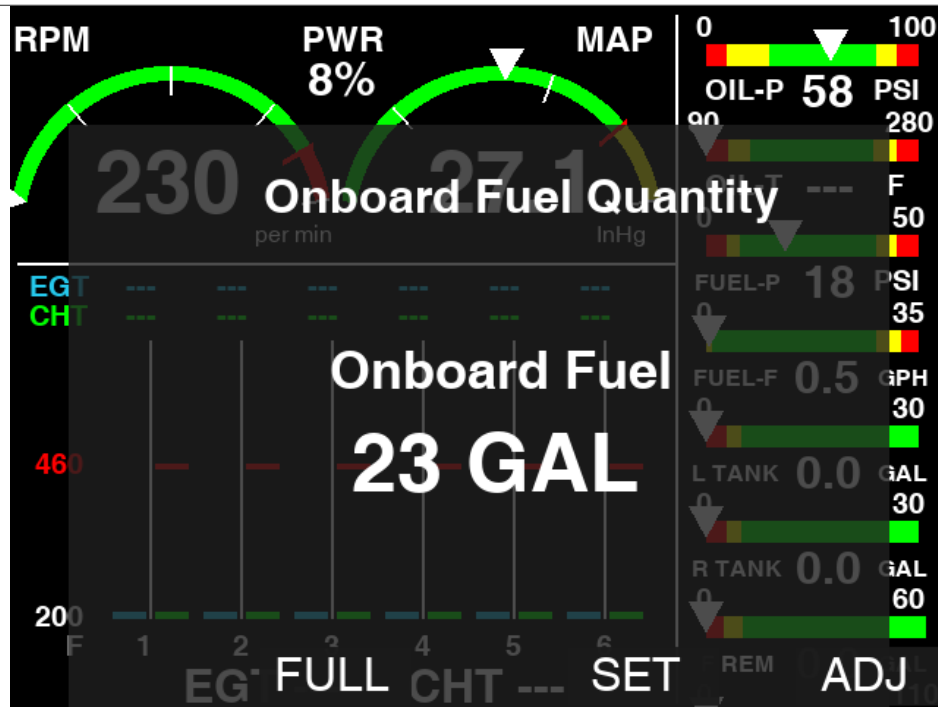
Rotate right knob to set current total fuel amount on board and then press right button "SET".
If you want to set "Full tanks" quantity, simply press the left button "FULL".
This information will be stored in EM-01 EnGood Engine Monitor and will be used to calculate current fuel quantity in airplane based on fuel flow information.

Airplane Mode
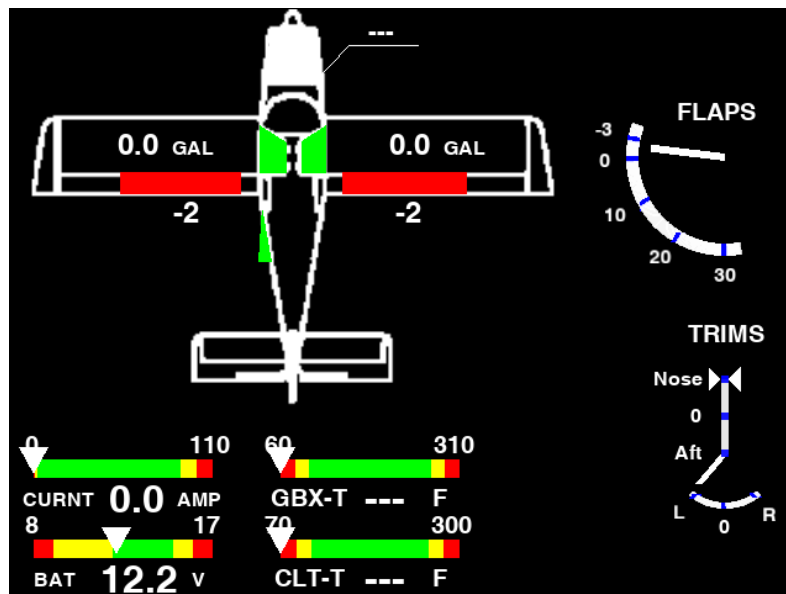
This mode shows airplane status including doors, baggage door, flaps and trims as well as cowling temperature (normally connected via AUX1 input).

Since the main page is limited to only seven (7) gauges at the right side of display, any additional active gauges will appear on this page at the bottom.

Graphs Mode
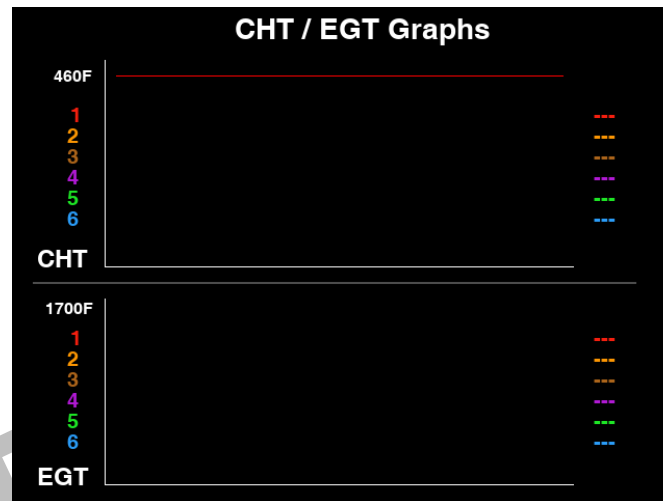
This mode shows live graph of CHT and EGT temperatures for the past 180 seconds. It allows to monitor engine health during leaning, climbing and other types of operations.

Next press the Right button will return display to first screen which appears after power up.

Time Mode
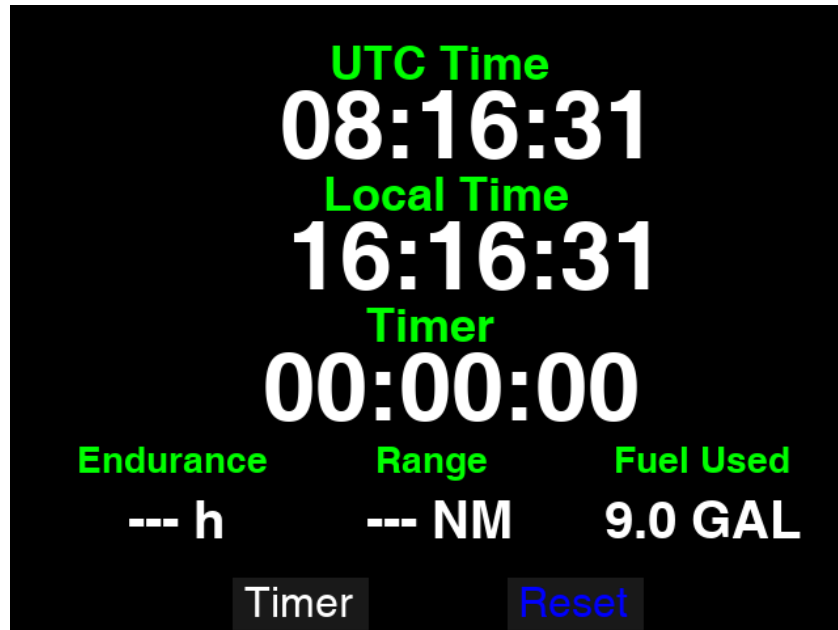
This mode shows current UTC and Local time.
There is a built -n timer, which can be started/stopped at any time by pressing the left button.
If you need to reset time in timer, press and hold the right button.

In addition, you may find Endurance time, Range and Fuel used information at the bottom.
It is calculated based on the current fuel flow and quantity of fuel available for flight.

Voltage Mode
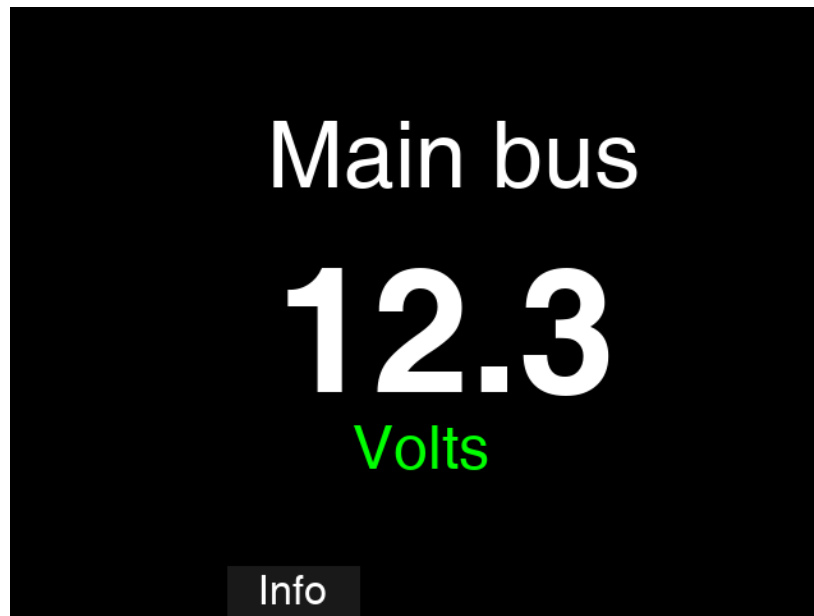
This mode shows current voltage in the airplane power system and measured at EM-01 EnGood Engine Monitor power input pins.

From this mode additional Info screen can be accessed by pressing the left button.
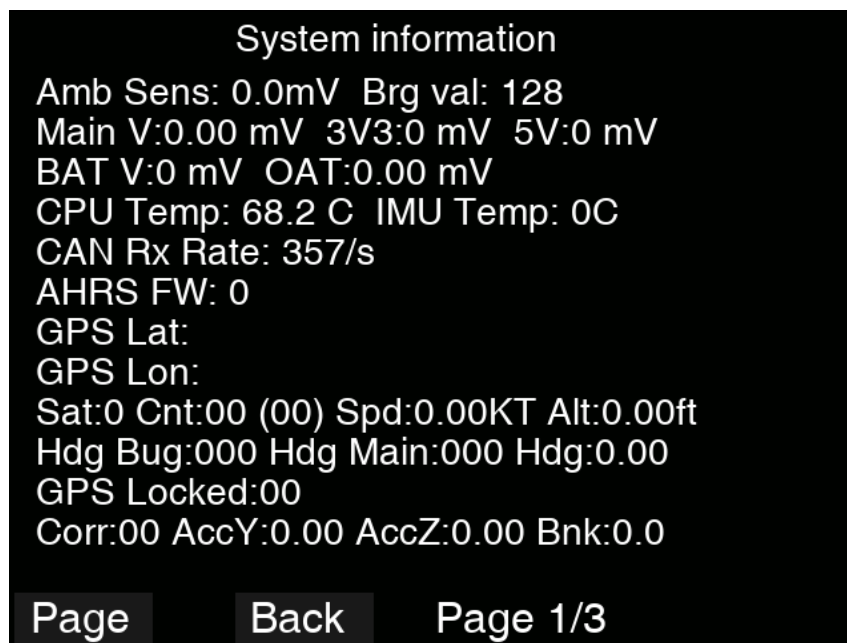
7.2 Fuel Alarm

Fuel Alarm can be enabled or disabled in the 'Settings->Warning Setup' menu. This option allows the user to turn on a repetitive alarm that would display a reminder to switch the fuel tanks at a predefined interval of time (between 0 and 240 minutes). When alarm is set to '0' it is Disabled. When an alarm is turned on (value between 1 and 240 is set), the unit will show on-screen reminder message "Switch Fuel Tanks" every predefined interval of time. To hide warning and return back to the previous screen push the left button.

If external VICS module is connected, the audio reminder 'Switch fuel tanks' will also sound.

7.3 Print Screen Functionality

During EnGood Engine Monitor operation at any time screenshot of the currently displayed image can be taken and stored internally in .png format. This is a useful feature when during normal operation is may be desired to store some parameters shown on the display for future review or for troubleshooting with the manufacturer.

To take a snap shot of the display at any time shortly press and release two buttons simultaneously. Screen shot with name of current time and date in .png format gets stored into internal memory. It can be exported to USB drive later. Please refer to submenu '*BlackBox*' and appropriate function.

8. Maintenance and Repair

AHRS leveling procedure should be performed annually (every 12 months). Pitot/static systems leak test should be performed every 24 months to ensure proper operation of the device.

There are no field repairable parts inside of the xPlaneMini EFIS. In case of any malfunction, the unit must be returned to the manufacturer for test and repair.

9. Firmware Update Procedure

The **Display module** and EM-01 sensor module using two distinct firmware components. Each unit is preloaded with the latest available firmware at the time of production. However, future firmware updates can be performed via the USB port located on the front panel of the **EnGood Display**.

> ⚠ *Note: It is strongly recommended to have airplane battery connected to external trickle charger for the duration of the firmware update. This is needed to avoid unexpected power outage and unsuccessful firmware update.*

To perform a firmware update for your unit, please follow these simple steps:

1. **Download the Firmware:** Obtain the firmware from www.360avionics.com or receive it via email from a 360 Avionics technical support agent.
2. **Prepare the USB Drive:** Copy the firmware update file to a USB flash drive formatted as FAT32. The drive should be under 16GB in size. Place the firmware in the x:/Updates folder at the root of the USB flash drive. Use the adapter cable included with the EnGood to connect the USB flash drive to the miniUSB port located on the display.
3. **Check the Updates Folder:** Ensure that nothing else is saved in the Updates folder except for the firmware files. The update typically consists of a single file with a .360 extension, and the file name usually includes the model of the device being updated.
4. **Power On the EnGood Monitor and EM-01:** Start the EnGood. Ensure that your battery has sufficient power to keep the EnGood running for at least 30 minutes. It is recommended to use a trickle charger connected to your airplane's battery.
5. **Access the Update Menu:** Navigate to "Main Menu" → "Settings" → "Black Box" and select "Software Update."
6. **Insert the USB Drive:** Insert the USB flash drive containing the firmware update into the USB port on the front panel of the display using the adapter cable. Wait at least 20 seconds before proceeding to the next step.

7. **Search for Updates:** Press the "FIND" button to search for the update on the USB drive. The EnGood will search for available updates and display them on the screen.

8. **Select the Update:** Rotate the left knob to choose the desired update. Press the left knob to confirm your selection. A green checkmark will appear in the small square next to the selected update. To initiate the firmware update, press the "UPDT" button once. The update process may take anywhere from a few seconds to 15 minutes, depending on the updates selected.

9. **Complete the Update:** Once the firmware update is complete, a "Software Update Completed" message will be displayed. At this point, reboot the unit by pressing the "RBT" button.
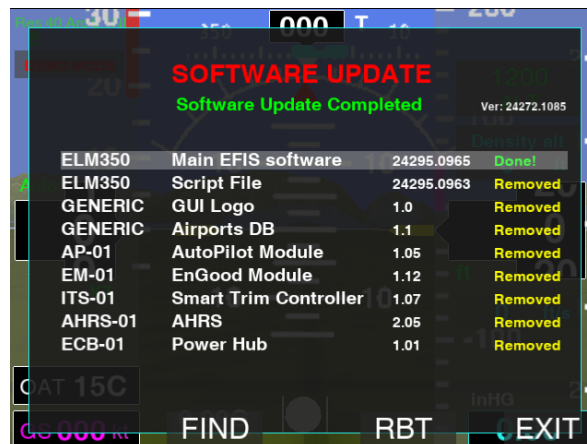
10. Settings Menu
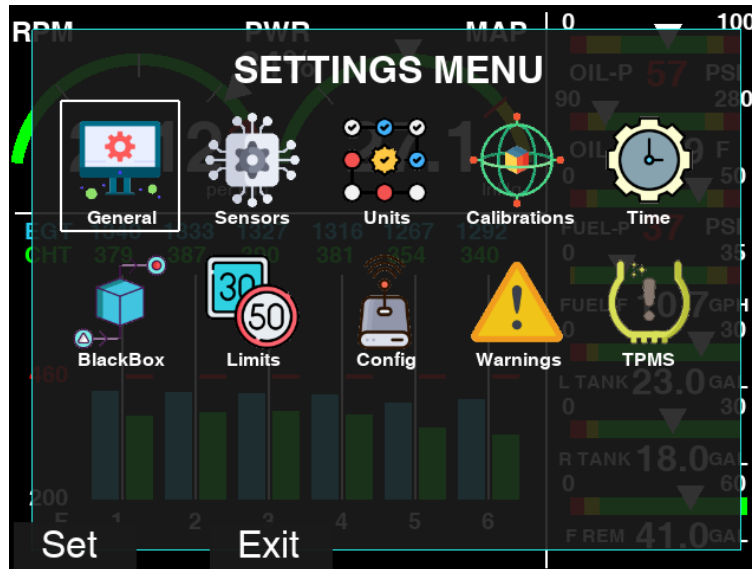
Settings Menu Navigation

The **EnGood Display Unit** features a built-in **Settings Menu** where various parameters can be adjusted and configured. These settings will be stored either in the **EnGood Display Unit** or in the **EM-01 Sensor Processing Unit**, depending on the specific parameter.

Accessing the Settings Menu

1. **To access the Settings Menu**:
   o Press the **left knob**. The **main menu** will appear.
   o Rotate the left knob to select the **Settings menu**, then press the left knob to enter.

Navigating the Settings Menu

The navigation through the **Settings menu** is straightforward:

- **Scrolling Through Menus**:
  o Rotate the left knob **clockwise or counterclockwise** to move the selector up and down through the menu options.
- **Entering a Menu or Submenu**:
  o Press the left knob to select/open a desired menu or submenu.

- **Background Color Indicators**:
    - When the menu selector's background is **blue**, you can scroll through the options using the left knob.
    - Once you find the desired menu or submenu option, press the left knob to select it; the selector's background will change from **blue to orange**.
- **Changing Settings**:
    - When the selector's background color is **orange**, the option is selected, and you can change the settings by rotating the left knob.
    - Once the desired setting is found, press the left knob to apply the selected setting; the menu selector's background will return to **blue**.
- **Exiting a Submenu**:
    - To exit a submenu, move the selector to the **'…'** option (located at the top of any submenu) and press the left knob. This will return you to the root of the settings menu.
- **Exiting the Settings Menu**:
    - At any time, you can exit the **Settings menu** by pressing the left button labeled **'Exit'**.

⚠ *Please note: when certain settings are selected, the changes are not applied instantaneously, instead a message 'Updating. Please Wait' will be displayed. Once the changes are applied, the message will disappear and the "Setting menu" will be displayed.*

11. Settings menu items and their respective settings:

Submenu: General Config
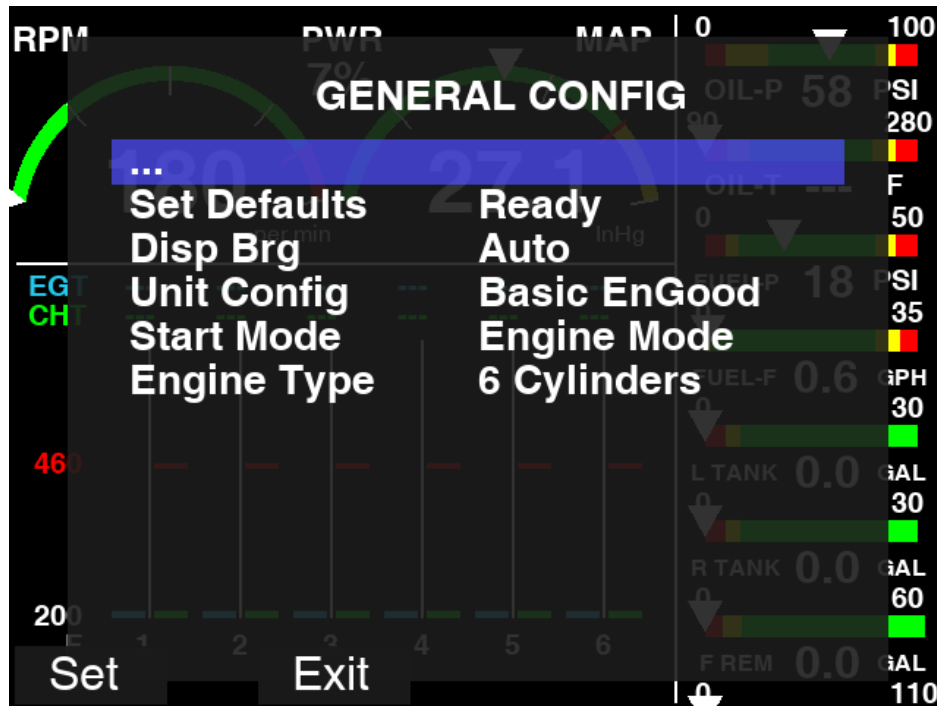
Set Defaults – '*EFIS + EnGood*' will completely reset the settings to default values (factory specified settings), '*EFIS*' will set graphical processing unit to defaults and '*EnGood*' will set the EM-01 Sensor Processing Unit to defaults.

Disp Brg – '*Auto*' setting will use auto brightness mode based on the ambient sensor light. Range of *1 to 84* will allow to manually set display brightness. To select 'Auto' choose '0' value for setting.

Unit config – This setting is normally set by manufacturer. For EnGood EM-01 Sensor Processing Unit it should be set to "*Basic EnGood*".

Start Mode – By default, the unit powers on to the "Engine" mode. The display upon power "ON" can be set to any other mode, such as Airplane, Time or Voltage.

Engine Type – Set either 4 or 6 cylinder engine here to properly format display and show specific to individual cylinders temperature information.

Dev ctrl – This mode is used to switch AHRS, EnGood and other connected supported units to specific mode. Directed by technical support if required.

Demo Mode – Must always be set to Disabled unless used by dealer for ground stand demonstrations.

COM1/2 Speed and Mode – Selects operation models for RS232 port in display

Submenu: Sensors
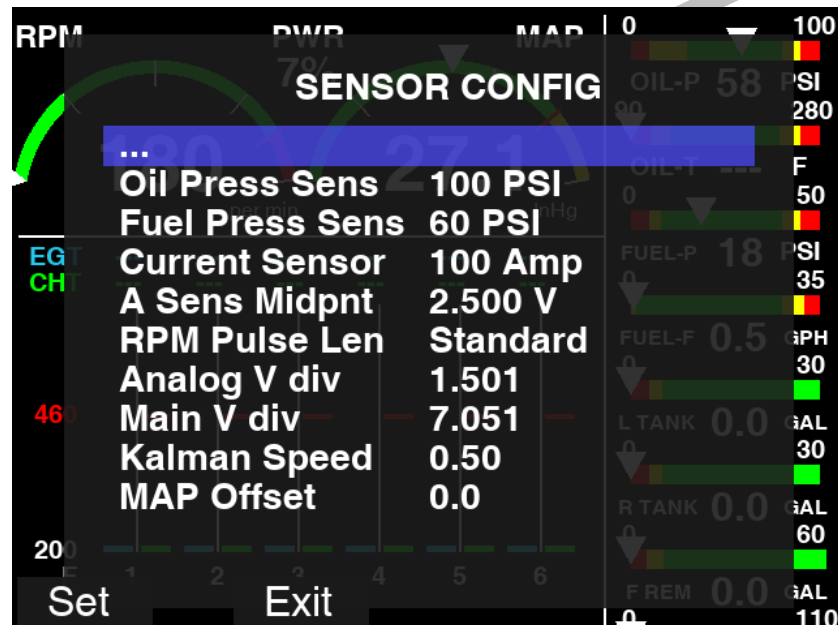
Oil and Fuel pressure sensors – Set here the maximum pressure value for respective sensor installed. We normally set it to 100PSI and use appropriate spec sensors.

Current Sensor – Set here current sensor max spec current

A Sensor Midpoint – Mid point for current sensor. Normally should be set to 2.5V

RPM Pulse Length – For all modern ignition systems which provide a RPM signal it should be set to *"Standard"*. For noisy old type ignition systems where RPM signal comes with additional noise it can be set to other specific value.

Analog and Main V dividers – Do not change these values. Factory predefined.

Kalman Speed – Speed of filter reaction. Preset at manufacturer.

MAP Offset – You can offset MAP pressure in case if readings from the MAP sensor for some reason are different from actual.

MAP Sensor – MAP sensor presence in the system

FF1 and FF2 K-Factors – Fuel Flow K-Factor number for sensor 1 and optional sensor 2. Normally each fuel flow sensor has its K-factor written on it. For example Floscan 201 with standard K-Factor 29.50 is set as: 29500 in this setting
K-Factor is a fine adjustment value for any fuel flow sensor

RPM Factor – This parameter describes how many pulses from RPM sensor are actual 1 RPM of engine. For 6 cylinder it is normally 1.5 while for 4 cylinder engine it is 2. However, it may differ for your particular RPM output type so adjust accordingly.
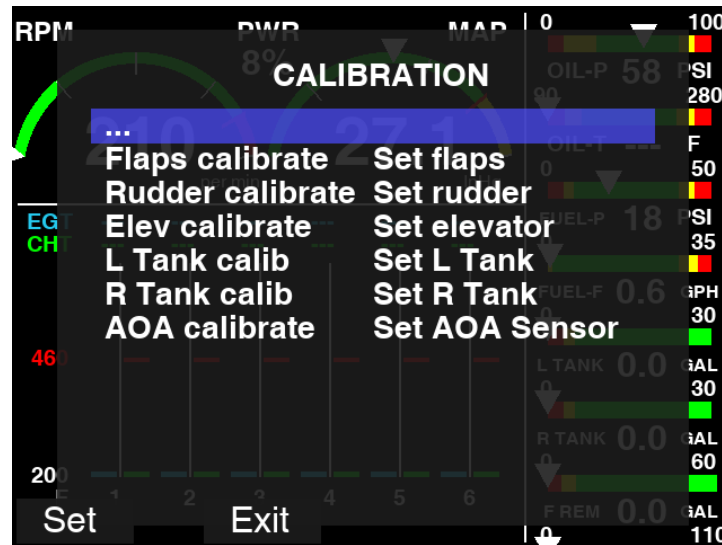
Submenu: Units

Press Units – Display pressure units in '*inHg'* or '*Bar'*

Temp Units – Display temperature units in *'Celsius'* or *'Fahrenheit'*

Fuel Units – Display fuel quantity in Gallons or Liters

Eng Temp Units – Display engine temperatures in Fahrenheit or Celsius

Submenu: Calibration

Flaps Calibration – Designed to calibrate flaps voltage from sensor for various flaps positions. Set flaps with sensor connected to desired position then select the position from the calibration setting and press knob to save new voltage

Rudder Calibration – Designed to calibrate rudder trimmer voltage from sensor for various rudder trimmer positions (center, full left, full right). Set rudder trimmer with sensor connected to desired position then select the position from the calibration setting and press knob to save new voltage

Elevator Calibration – Designed to calibrate elevator trimmer voltage from sensor for various elevator trimmer positions (center, nose up, nose down). Set elevator trimmer with sensor connected to desired position then select the position from the calibration setting and press knob to save new voltage

L and R Tank Calibration – Designed to calibrate fuel tank levels for every 5 gallons. Calibrate first on empty tank, and then add by 5 gallons until full and calibrate every 5 gallon position via the calibration setting. You may calibrate each tank separate or just calibrate one and then copy values to another one (assume identical sensors and tanks are in use)

AOA Calibrate – Angle of Attack calibration. Currently not used.

Roll Calibration – Designed to calibrate roll trimmer voltage from sensor for various rudder trimmer positions (center, full left, full right). Set rudder trimmer with sensor connected to desired position then select the position from the calibration setting and press knob to save new voltage
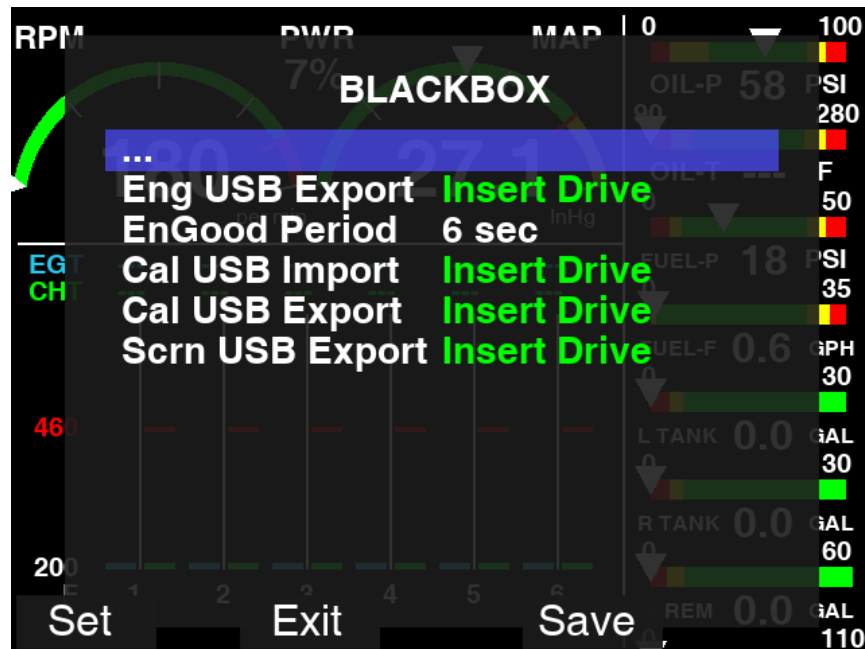
Submenu: Time

Time and Date settings – Current time in 24h format and Date settings.

Time Zone – Setting for current time zone. UTC time is calculated based on this setting and current time.

Total Oil Life, Hobbs and Air time – You can adjust Total Hobbs, Air time and Oil Life times from here.

Submenu: BlackBox

Eng USB Export – allows exporting previously stored Engine Monitor data logs for further use and review. USB flash drive should be connected via adapter cable.

EnGood Period – interval to write Engine Monitor logs to memory during engine running time.

Cal USB Import and Export – All calibration information (sensors values, etc) can be exported to external USB flash and then reimported should you require to replace your Engine Monitor display for some reason.

Scrn USB Export – allows exporting screen shots in .png format. USB flash drive should be connected via adapter cable.

Software Update – Activate software update functionality

Screenshot of the currently displayed information can be taken at any time by simultaneously pressing both buttons for a short period of time. This is useful feature for the case when you want to store your display information for further review. Please refer to section 7.3 for more information.

Submenu: Limits

This menu allows setting all minimum and maximum limits for various engine parameters. Consult your engine documentation to set correct values. By default, values are set for Lycoming IO-360 and Lycoming IO-540 engines.

Submenu: Configuration
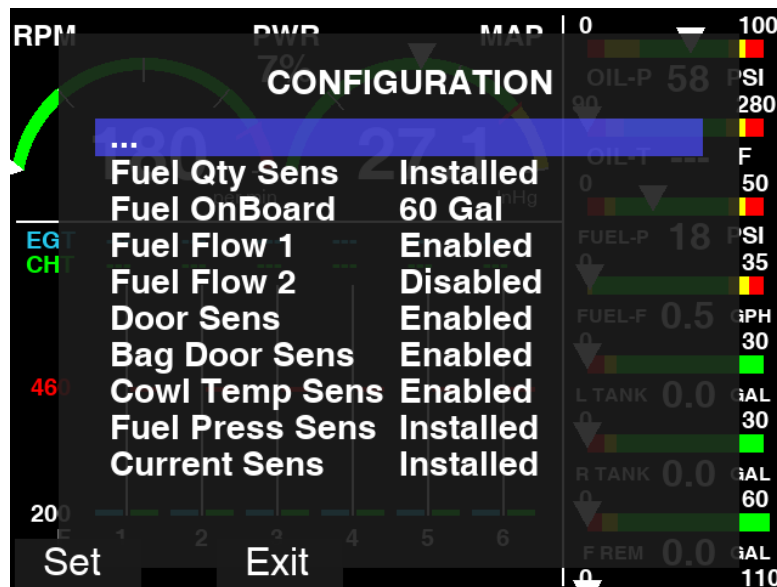
Fuel Quantity Sensors – Set to "Installed" if fuel level sensors are connected

Fuel on Board – Set total fuel on board in all tanks

Fuel Flow1 and 2 – Set if Fuel Flow sensor(s) are in use and installed

Door Sensors – Set if door sensors are connected

Baggage Door Sensor - Set if baggage door sensor is installed

Cowling Temperature Sensor – Set if AUX1 sensor is installed

Fuel Pressure Sensor – Set if Fuel pressure sensor is installed

Current Sensor – Set if current sensor is installed

CHT, EGT, Oil and Cowl Temp Type sensors – Should be set to Standard at all times

GBox Temp Sensor – Set if temperature sensor for Gear Box is installed

Clnt Temp Sensor – Set if coolant temperature sensor is installed

Submenu: Warning Setup

Engine Warning Snooze – When engine warning is raised and then snoozed how long to wait before repetitive warning is issued.

Various warnings – Enable/Disable various warnings depends on desired configuration

Fuel Alarm – Set the time to display a fuel alarm "Switch Tanks" message. Refer to section 7.2 for more information.

Submenu: TPMS SETUP

TPMS Mode – Enables/Disabled TPMS mode in EnGood Monitor EM-01 module

Sensor ABC – Sets 3-byte code of each individual TPMS Sensor.

Sensor 1 is nose wheel while 2 and 3 are the L and R mains.

Print Screen Functionality

During EnGood operation at any time screenshot of the currently displayed image can be taken and stored internally in .png format. This is useful feature when during normal operation is may become required to store some parameters shown on display or for some sort of troubleshooting with manufacturer.
To take a snap shot of the display at any time shortly press and release two button simultaneously. Screen shot with name of current time and date in .png format gets stored in to internal memory. It can be exported to USB drive later. Please refer to submenu '***BlackBox***' and appropriate function.

12. Operation Limitations

• Information from airplane's POH always supersedes information provided in this manual

• This unit is non-TSO certified and cannot be installed on the certified airplane unless special permission is obtained from regulatory agency/airplane manufacturer.

13. Warranty coverage and limitations

360 Avionics company provides the warranty for this product against defects in materials and workmanship for the duration of 24-month (2 calendar years) from the date of retail purchase of this product by end user ('Warranty Period"). If a hardware defect arises and a valid claim is received within the Warranty Period, at its option and as the sole and exclusive remedy available to Purchaser, 360 Avionics company will either (1) repair the hardware defect at no charge, using new or refurbished replacement parts, or (2) exchange the product with a product that is new or which has been manufactured from new or serviceable used parts and is at least functionally equivalent to the original product, or, at its option, if (1) or (2) is not possible (as determined by 360 Avionics company in its sole discretion), (3) refund the purchase price of the product. Prior a refund is given, the product for which the refund should be provided must be returned to 360 Avionics and becomes 360 Avionics's property.

This Limited Warranty applies only to hardware products manufactured by 360 Avionics company that have the "360 Avionics" trademark, tradename, or logo attached to them at the time of manufacture by 360 Avionics company. The Limited Warranty does not apply to any non 360 Avionics hardware products or any software, even if packaged or sold with 360 Avionics hardware. Manufacturers, suppliers, or publishers, other than 360 Avionics company, may provide their own warranties to the Purchaser, but 360 Avionics and its distributors provide their products AS IS, without warranty of any kind. Software distributed by 360 Avionics company (with or without the 360 Avionics's brand name including, but not limited to system software) is not covered under this Limited Warranty. Refer to the licensing agreement accompanying such software for details of your rights with respect to its use. This warranty does not apply: (a) to damage caused by use with non 360 Avionics company products; (b) to damage caused by accident, abuse, misuse, flood, fire, earthquake or other external causes; (c) to damage caused by operating the product outside the permitted or intended uses described by 360 Avionics; (d) to damage caused by service (including upgrades and expansions) performed by anyone who is not a representative of 360 Avionics or an 360 Avionics Authorized Reseller; (e) to a product or part that has been modified to significantly alter functionality or capability without the written permission of 360 Avionics company; (f)to consumable parts, such as batteries, unless damage has occurred due to a defect in materials or workmanship; or (g) if any 360 Avionics serial number has been removed, altered or defaced.
To the extent permitted by applicable law, this warranty and remedies set forth above are exclusive and in lieu of all other warranties, remedies and conditions, whether oral or written, statutory, express or implied, including, without limitation, warranties of merchantability, fitness for a particular purpose, non-infringement, and any warranties against hidden or latent defects. If 360 Avionics cannot lawfully disclaim statutory or implied warranties then to the extent permitted by law, all such warranties shall be limited in duration to the duration of this express warranty and to repair or replacement service as determined by 360 Avionics in its sole discretion. 360 Avionics does not warrant that the operation of the product will be

uninterrupted or error-free. 360 Avionics is not responsible for damage arising from failure to follow instructions relating to the product's use. No 360 Avionics reseller, agent, or employee is authorized to make any modification, extension, or addition to this warranty, and if any of the foregoing are made, they are void with respect to 360 Avionics company.

14. TSO approval and Liability limitations

This product does not yet have any TSO approvals as a flight instrument. 360 Avionics company as a manufacturer of this product will not help and responsibility for any sort of damage or destruction which can be caused by use of this product to any part of airplane caused by operation of this product.

To the extent permitted by applicable law, 360 Avionics company is not responsible for indirect, special, incidental or consequential damages resulting from any breach of warranty or condition, or under any other legal theory, including but not limited to loss of use; loss of revenue; loss of actual or anticipated profits (including loss of profits on contracts); loss of the use of money; loss of anticipated savings; loss of business; loss of opportunity; loss of goodwill; loss of reputation; loss of, damage to or corruption of data; or any other loss or damage howsoever caused including the replacement of equipment and property, any costs of recovering, programming, or reproducing any program or data stored or used with 360 Avionics company products and any failure to maintain the confidentiality of data stored on the product. Under no circumstances will 360 Avionics company be liable for the provision of substitute goods or services. 360 Avionics company disclaims any representation that it will be able to repair any product under this warranty or make a product exchange without risk to or loss of the programs or data. Some jurisdictions do not allow for the limitation of liability for personal injury, or of incidental or consequential damages, so this limitation may not apply to you.

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