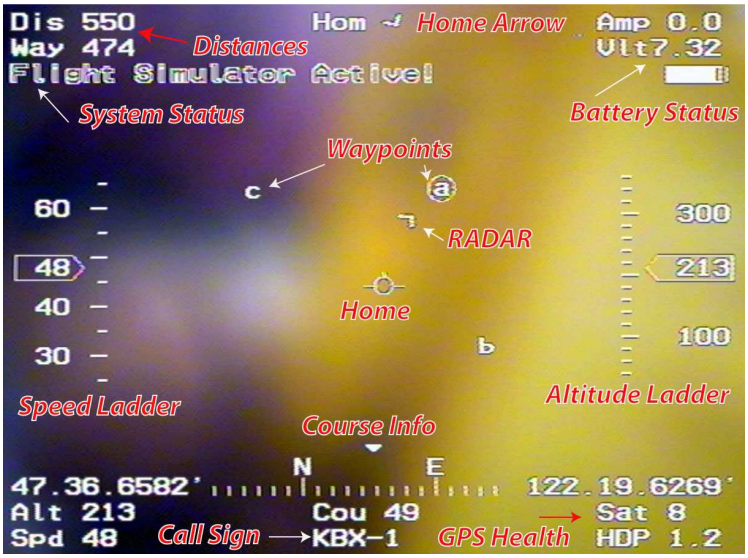
Instruction Manual for OSD Pro Expander™
Document Version 2.9

Introduction

Thank you for your purchase! This instruction manual will guide you through the installation and operation of your OSD Pro Expander™ (OSD Pro™).

Please visit our support web page on http://www.eagletreesystems.com for the full color, electronic version of this manual, which may be updated if changes were made after printing. ***Please read the entire manual carefully before proceeding***.

If, after you read the manual, you have further questions or problems, visit our support web page for information on how to get answers to your questions, 24 hours a day.



Main Screen

Packing List

Your package should include the following: The OSD Pro Expander, five (5) male to male servo connectors, and a printed version of this manual.

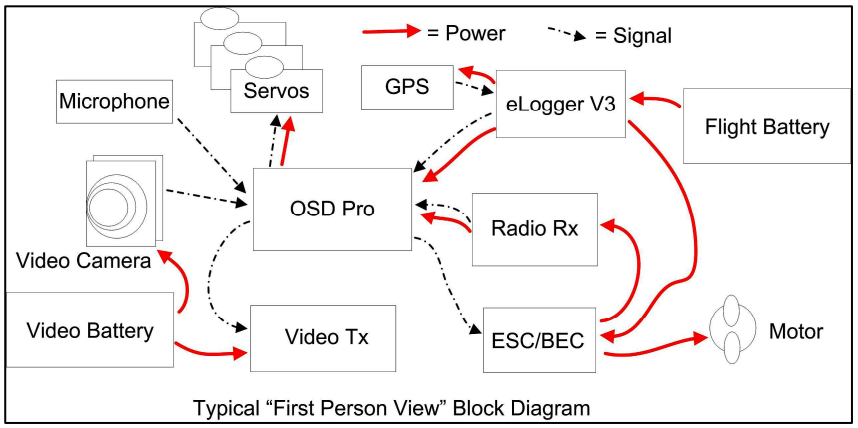
What the OSD Pro™ Does

The OSD Pro is a powerful, modular, fully configurable Video/Audio On-Screen Display (OSD) device, providing graphics, voice announcements, alarms, acoustic variometer with total energy compensation, Home Arrow, Artificial Horizon, Return to Home, Failsafe, "RADAR", waypoints, a flight simulator for testing, and many other features. The information displayed can be as simple or advanced as you like, depending on how you configure the display, and on which optional Eagle Tree sensors are connected.

To use your OSD Pro, you need the OSD Pro Expander, and the eLogger V3 or Data Recorder. To make full use of the OSD Pro, you also need our GPS Expander. Several optional sensors and accessories are available from Eagle Tree to further enhance your OSD Pro, such as our barometric altimeter, pitot airspeed sensor, temperature sensors, and many more. Note that these additional sensors connect to the eLogger V3 or Recorder, rather than directly connecting to the OSD Pro.

When connected to your eLogger or Data Recorder, the OSD Pro superimposes Eagle Tree data onto your video feed, displaying the parameters you want to see on the video screen. The OSD Pro is normally connected between the composite video output of your video camera, and the composite video input of your DVR or video transmitter. The OSD Pro supports NTSC and PAL video modes – the video mode is automatically detected.

The figure at right shows a typical "FPV" onboard setup. Your wiring may vary depending on your video hardware, power system, etc.



Typical "First Person View" Block Diagram

General Safety Precautions

In addition to the warnings and other precautions in this manual, the following precautions should always be observed:

1) The OSD Pro is intended for recreational use only, and is not intended to be a navigation system for your model. You should always use a spotter if your eyes are not on your model. Any use of the OSD Pro to attempt to navigate your model or operate your model outside of Visual Line of Sight (VLS) is not supported, and is done at your own risk.
2) If you have never set up or operated an RC model before, you will need help from an experienced modeler. Local RC clubs are great ways to meet experienced modelers, and receive the required training. This requirement is especially true for "FPV" flying, which can be more challenging than visual-only flying.
3) Never operate your model aircraft near or over buildings, power/telephone lines, or other obstacles. Never operate your model aircraft near or over other people!
4) RC models and accessories are not toys, and should be kept away from children, without proper adult supervision.

Steps to Follow

Installation and use of your OSD Pro should be quite easy and enjoyable if you follow these few steps:

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1. First, read through the manuals for your eLogger V3 or Recorder, your GPS Expander, and any other Eagle Tree sensors, to familiarize yourself with the connection and function of these devices.
2. Read through this manual to understand the warnings, determine the installation and setup sequence, etc., of the OSD Pro.
3. Install or upgrade to the Windows Application and Firmware for your OSD Pro and Recorder as described in the "Windows Application and Firmware Update" section below.
4. Configure your eLogger V3 or Recorder as described in the manuals for those, if you have not already done so. NOTE: It is recommended that you set the "Capture Rate" of your eLogger or Recorder to 10 samples/second, for best OSD Pro update rate and performance.
5. Install and configure the OSD Pro as described below. Note that some features of the OSD Pro are configured with the Windows Application, and some features (ones that may change more often) are configured with the OSD Pro's on-screen menus.
6. Range test and enjoy!

IMPORTANT: It is unlikely that the installation of the OSD Pro will affect your model's radio range or control. But, as always after making an electronics change to your model, it is very important that you range and function test your model once the OSD Pro is installed to ensure that there is no impact on your system. Make sure that your "antenna down" operating range is within the manufacturer's specifications. See your Radio owner's manual for the correct procedure for your equipment. **DO NOT OPERATE IF YOUR MODEL DOESN'T PASS THE ANTENNA DOWN RANGE CHECK**

Connecting your OSD Pro Hardware

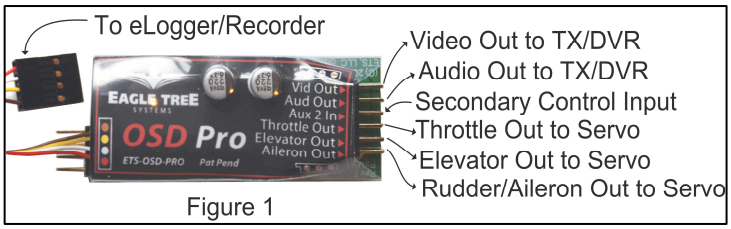


Figure 1

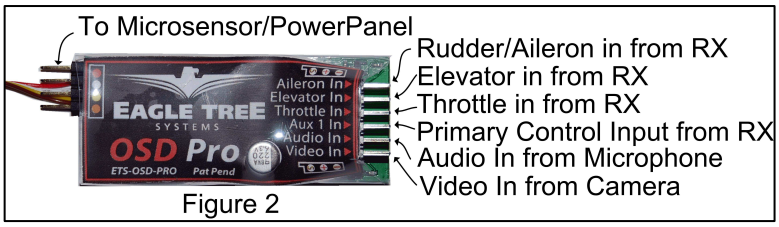


Figure 2

Connecting the OSD Pro™ to Your Camera and Video Recorder/Transmitter

Two 3 pin servo connectors on the OSD Pro are used to route the composite video signal into and out of the OSD Pro. The input and output are compatible with standard 75 Ohm composite video equipment (either NTSC or PAL). See Figures 1 and 2 above, showing the top and bottom of the OSD Pro. The "Video Out" connection goes to your video transmitter (or DVR) and the "Video In" connection connects to the composite output of your camera. For both the video in and video out connections, the pin nearest the circuit board is Ground, the middle pin is Power, and the top pin is Signal. The Ground and Signal pins are the only ones used by the OSD PRO, but the Power pins are connected together internally in the OSD PRO, for your convenience. Note: Eagle Tree offers optional servo to RCA adapter cables, if needed.

Using Audio with the OSD Pro™

If your Video Transmitter (or DVR) has an audio channel, connect the "Audio Out" pins of the OSD Pro to the audio input of your transmitter. The "Audio In" pins allow you to connect an external microphone to the OSD Pro, for hearing flight sounds. For both the audio in and audio out connections, the pin nearest the circuit board is Ground, the middle pin is Power, and the top pin is Signal. The Ground and Signal pins are the only ones used by the OSD PRO, but the Power pins are connected together internally in the OSD PRO, for your convenience. The OSD Pro supports "mic level" or "line level" audio input, and line level audio output. **Never connect an amplified (speaker level) audio signal to the OSD Pro's audio input!**

The OSD Pro's built in voice announcements and the acoustic variometer sounds are sent via the audio output. If a microphone is connected to the OSD Pro, the microphone's output is routed to the audio output when no announcements are being made. When it is time for a voice announcement, or the variometer is sounding, the audio output is automatically switched. See the PC Configuration and onscreen menu information below for configuring the audio options.

Connecting the OSD Pro™ to your Model's Radio Receiver for Menu Setup and Configuration

IMPORTANT: never connect receiver channels to the OSD Pro if your Receiver is powered by more than 15 volts!
Two receiver input channels (Aux1/Up-Down and Aux2/Select) are required to configure the OSD Pro via the on-screen menus. Only one receiver channel (Aux1) needs to be dedicated to the OSD Pro. The other receiver channel, Aux2, can be shared between the OSD Pro and with other features of your model, under certain circumstances. See the "On Screen Menu Configuration" section below for more information on how the Aux1 and Aux2 channels are used.

While it is not necessary to leave Aux1 and Aux2 connected to your receiver after on-screen configuration, it is much more convenient. Many of the advanced features of the OSD Pro are configurable via the menus, and the RTH feature generally requires in-flight testing and configuration, via the menus.
IMPORTANT: never operate your model with only one of the Aux1 or Aux2 channels connected! Either connect both, or neither.

The Aux1 and Aux2 channels are connected to your receiver via two of the male to male servo connectors. The "Futaba" end of each connector plugs into the OSD Pro, and the "Universal/JR" end plugs into your receiver. Note that the Futaba plug enforces correct polarity when connected to the OSD Pro.

Ideally, both the Aux1 and Aux2 are connected to two toggle switches on your radio, such as the "Gear" or "Aux" toggle switches. But, rotary switches will also work fine, when rotated near their extents.

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Note that the OSD Pro will generally ignore the Aux2 channel input unless the Aux1 channel is manipulated to enter menu mode, as described in the Menus section of the manual. So, you can leave the OSD Pro connected to the two channels, and Aux2 movement will not affect the OSD Pro unless you manipulate the Aux1 channel first, to enter menu mode. The only exception is if you have defined multiple main screen pages. In this case, Aux2 will switch between the pages, when toggled outside of menu mode.

If you do need to change OSD settings in flight, you would need to be able to manipulate Aux2 channel after manipulating the Aux1 channel to enter menu mode. If one of your radio channels can be manipulated with only marginal effect on flight (perhaps camera pan or tilt), that channel could be shared with the OSD Pro's Aux2 input.

Note that the OSD Pro may take a small amount of power (up to approximately 200 mA of current) from the receiver. This amount is typically very small compared to the amount of power even a single small servo can consume. The OSD Pro also takes power from its connection to the eLogger or Recorder. It senses which power source has a higher voltage, and uses that power source. The eLogger supplies 5V to the OSD Pro.

Connecting the OSD Pro™ to your Model's Control Surfaces for Return to Home/Failsafe operation (Advanced)

If you intend to use the Return to Home or Failsafe features of the OSD Pro, your throttle, elevator, and aileron/rudder servos connect to the outputs of the OSD Pro, as shown in Figure 1. See the "Safety Mode Overview" section below for more information. We recommend connecting your ailerons to the Aileron/Rudder connection instead of the rudder, if your plane has both ailerons and rudder.

Note that "flying wing" models which use elevon or vtail mixing are supported. The elevator and aileron/rudder servo inputs and outputs are used for the left and right channels, in these modes. Please see the Safety Mode section for details.

The aileron/rudder, elevator and throttle inputs to the OSD Pro (shown in Figure 2) are connected to their respective outputs of your radio receiver, using 3 of the included male to male servo connectors. For all of the OSD Pro servo inputs and outputs, the pins closest to the circuit board are ground, the middle pins are power, and the top pins are signal. Note that when the Futaba™ end of the included male to male connects is connected to the OSD Pro, polarization is enforced.

When connected as described above, the servos receive power from the radio receiver, just as if they were connected directly to the receiver. The input and output servo power pins of the OSD Pro connect to each other internally.

NOTE: the servo connections described above are not necessary if you do not wish to use the safety features.

Using the OSD Pro™ with Stabilization Systems, such as the FMA™ Co-pilot™

If you plan to use Return to Home feature with a stabilization system, please see the "Stabilization System Connection" section in the Safety Mode portion of the manual.

Connecting the OSD Pro™ to your eLogger or Data Recorder

eLogger V3

The four pin wire with black connector on the OSD Pro plugs into the "LCD/TX" port of your eLogger V3, as shown in Figure 3. If you have a PowerPanel or other sensors, those can "daisy chain" to the pins on the OSD Pro, with the polarity as indicated on the OSD Pro label, as shown in Figure 2.

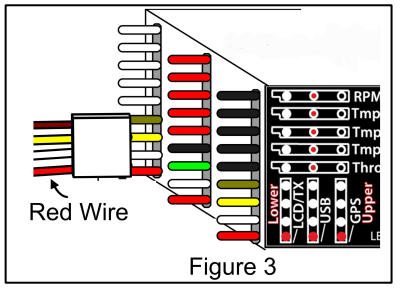


Figure 3

IMPORTANT: when using the OSD Pro Expander with the eLogger V3 **and** the GPS Expander, **and you do not plan on connecting any outputs of your receiver to the OSD Pro,** a maximum voltage of approximately 8 volts (2s LiPo pack) should be used to power the eLogger. If you are using a pack greater than 8 volts, the eLogger's internal regulator may temporarily shut down, which will cause the OSD Expander to turn off, resulting in no video display. To avoid this issue, use our "Battery Backup Harness" which can connect to a spare 5V to 6V BEC or spare receiver channel when using larger battery packs. Note that if you connect receiver outputs to your OSD Pro, the OSD Pro receives backup power from the receiver, so the Battery Backup Harness should not be needed, even with battery packs larger than 4s.

Data Recorder

The four pin wire with black connector on the OSD Pro plugs into the "FCC TX" port of your Data Recorder as shown in Figure 4. Make sure that you connect it in the correct location on the recorder, and with the correct polarity! **IMPORTANT: if you do not plan on connecting a Seagull transmitter to the 4 pin male connection of the OSD Pro, make sure you cover the exposed 4 pin connector with tape, or otherwise keep it from shorting to other metal objects. Touching the exposed 4 pin connector to other metal objects will damage the recorder when it is powered!**

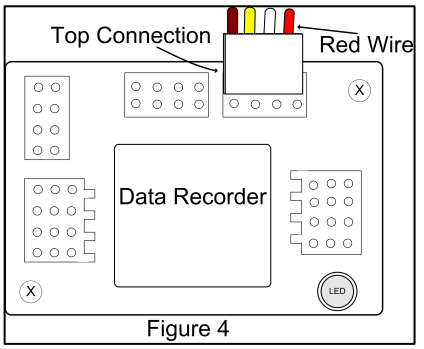


Figure 4

Windows Application and Firmware Update

To use the OSD Pro™, you must update to **Eagle Tree Windows Application version 7.40** or higher. To update, download the latest application from the support page of our website, located at http://eagletreesystems.com/Support/apps.htm. After connecting the OSD Pro to the eLogger/Recorder, and downloading and installing the latest Windows Application, the firmware of both your eLogger/Recorder and the OSD Pro will need to be updated. To upgrade your firmware, just click "Hardware, Firmware Control" and first click the "Update" button for the eLogger/Recorder, and repeat this process to update the firmware for the OSD Pro.

Note: as new features and bug fixes become available to the OSD Pro, the changes can be downloaded from our website. Please check our website periodically for new software versions.

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Configuring the OSD Pro™ with the Windows Application

Some of the features of the OSD Pro are configured with the Windows Application. After updating the Windows application, and updating the firmware, click "Hardware, Choose Parameters to Display on Video OSD" to configure the OSD Pro.

If the hardware is connected correctly, the Video OSD Setup Utility screen (the setup screen) shown in Figure 5 should appear. If it does not appear, and an error messages appears instead, please see the troubleshooting section of this manual.

Configuring Parameters to Display on the Video OSD

The OSD Pro main screen, as shown in the Main Screen figure, supports two rows of user configurable text based data parameters along the top of the screen, and two rows of parameters near the bottom of the screen. Each row can have up to 5 parameters, for a total of 20 parameters. NOTE: parameters are easiest to read if they are positioned with (at most) 3 parameters per line, as shown in Figure 5.

The setup screen's green simulated display corresponds to the rows and colums of these four lines of parameters. To configure a parameter to display, click "Choose the next Parameter to Configure." This dropdown menu lets you choose a parameter to display on the OSD screen. The available parameters depend on your Recorder type, and the sensors you have installed.

The OSD Pro can have more than one "page" of parameters defined for the main screen. So, virtually infinite configuration is possible. The current page being configured is indicated by the "OSD Page: 1" text below the simulated display. Use the left and right arrows below the dropdown menu to switch between OSD Pages on the simulated display.

NOTE: If more than one OSD Pro display page has been configured, toggling your radio's Aux2/Select switch (if configured) when not in menu mode will cause the display page to advance to the next page. Also, an option for timed switching between main screen pages is described in the on-screen menus section below.

Once a parameter is selected from the dropdown menu, it will appear at the next available location on the simulated display. To change the location on the page for displaying the parameter, just click the location with your mouse, and drag the parameter to the desired location.

If there is a parameter that you would like to display on ALL your OSD Pro main pages, click on the parameter on the simulated display, and click the "Display on all pages" checkbox. Note that this has no effect if you have defined only one main page.

The text field labeled "Enter OSD Screen Name for the Parameter" indicates the 3 digit label that will be displayed beside this parameter on the OSD. You can change this 3 digit label to be whatever you want.

If for some reason you wish to clear all the parameters you have programmed, click "Reset Parmeters" and configure them again.

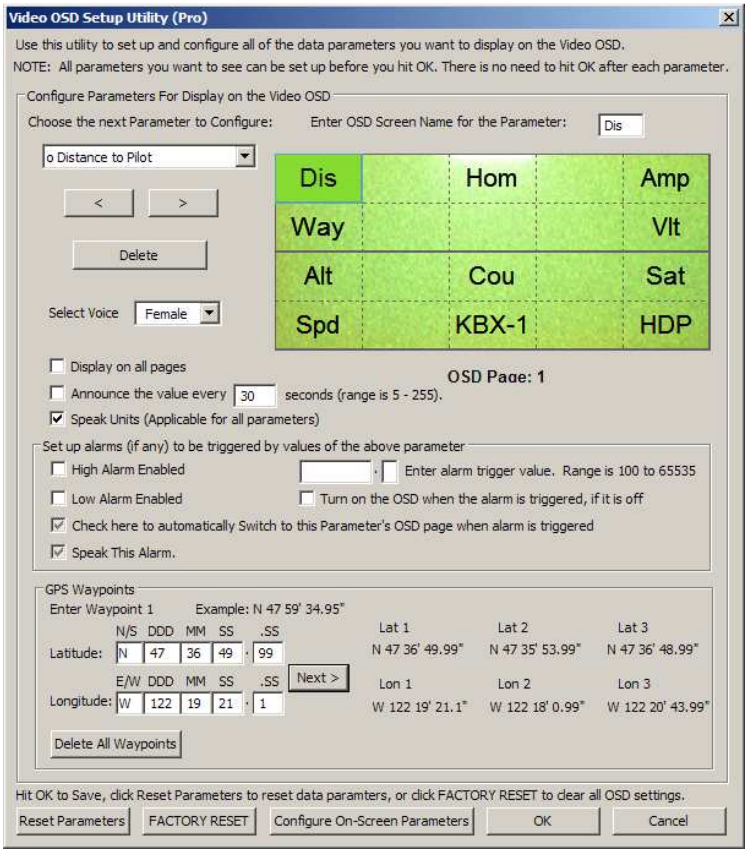


Figure 5

Voice Announcement of Parameters

A powerful feature of the OSD Pro is its ability to speak the status of selected parameters to you, so you don't have to look at numbers on the screen as much.

Both male and female voices are provided (presently only in English). Choose this option with "Select Voice."

To configure a parameter for periodic announcement, highlight the parameter on the simulated display, and check the "Announce this value every X seconds" box. Then, choose the period for announcement. And, if you desire to hear the units spoken for all spoken parameters, check the "Speak Units" box.

For example, if you configured altitude to be spoken every 30 seconds, and click the Speak Units option, the OSD Pro will speak "Altitude XYZ Meters" every 30 seconds (assuming your system is configured for Metric).

Note that if you desire to have a parameter spoken only, but not displayed on the main screen, simply place the parameter to be displayed on a page that you don't plan on using. For example, if you have your parameters on page 1, and you wish to have Altitude periodically spoken, but not displayed on page one, place Altitude on Page 2.

Setting Alarms for Parameters

The OSD Pro setup screen makes it easy for you to set up High or Low trigger threshold alarms for the parameters you have configured. These alarms can be used to alert you of potential problems, before they become serious.

There are 3 ways that the OSD Pro can alert you if a parameter has reached its trigger level:

1) The parameter is displayed in "reverse video" on the screen, with an exclamation point "!" beside it.

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2) Optionally, the parameter can be spoken when an alarm for it is triggered. This will happen whether or not you have configured periodic announcements of that parameter. A “beep” is played before the alarm is spoken, allowing you to differentiate a spoken alarm from a periodic announcement.
3) If the OSD display is turned off via the on-screen menus, you can configure the OSD display automatically turn on when a particular alarm is triggered.
4) If you have multiple display pages defined, you can have the OSD Pro automatically return to the page which contains the parameter that has triggered the alarm.

For example, if you want to configure a low voltage alarm of 10 volts, and want the OSD Pro display to remain turned OFF until a voltage lower than 10 volts is detected, and you want the parameter spoken when the alarm occurs, you would do the following:

1) Add the “Voltage” parameter to the simulated display.
2) With the Voltage parameter highlighted on the simulated display, click “Low Alarm Enabled” and enter “10.0” for the alarm trigger value.
3) Click the “Turn on the OSD Pro when alarm is triggered.” option.
4) Click the “Check here to automatically Switch to this Parameter’s OSD Pro page when alarm is triggered” option (assuming you have configured more than one page)
5) Click the “Speak This Alarm” option.

Then, while you are operating your vehicle, the OSD Pro display can be turned off with the on-screen menus, and will turn itself back on, display the voltage in reverse video, and speak “ <Beep> Pack Voltage 9.9 Volts” when a voltage less than 10 volts is detected.

NOTE: If two or more alarm conditions occur simultaneously, only the last occurring condition will be signaled.
If the last condition to trigger an alarm goes away, the next active alarm condition will be signaled, etc.

Programming GPS Waypoints

Note: See the Waypoints section below for more information on using Waypoints. To program a waypoint, enter the latitude and longitude in the “GPS Waypoints” section of the setup screen, and then click “Next.” That waypoint is then saved, and you can enter the location of the next waypoint. Also, once waypoints are defined, they can be edited by selecting them with the Next button. The “Delete All Waypoints” button clears the waypoints you have entered.

Configuring On-Screen Menu Parameters

Click the “Configure On-Screen Menu Parameters” if you would prefer to use the Windows application to adjust the settings normally adjusted with the on-screen menu. Note: the on-screen wizards cannot be completed with the Windows application.

Completing the Windows Setup

Once you have defined your desired parameters, alarms, and waypoints, click the OK button to download the settings to the OSD Pro. Note that the first time you download settings after updating the Windows software, or whenever you switch between Male and Female voice, the download of the settings will take much longer than normal (about 30-55 seconds). Normally, the download time is less than 10 seconds.

Operating your OSD Pro

After connecting and configuring your OSD Pro as described above, you should see the main OSD Pro screen on your video receiver, as shown in the Main Screen figure. Before the main screen appears, the startup screen, as shown in Figure 7, should appear for about 3-5 seconds. If the startup screen remains for more than this length of time, or no OSD information appears at all, please see the troubleshooting section.



Figure 7

“RADAR” Feature

The RADAR feature is an intuitive feature which makes it easier to keep track of your model’s location relative to home, and the direction of your model’s travel relative to the direction the pilot is facing. See the Main Screen figure. The circular indicator in the center of the screen marks the takeoff point, in a "bird's eye" view map. The RADAR location and direction of travel indicator (the chevron) indicates where you are in relation to home. The up direction is configurable in the on-screen menus described below.

As your model moves relative to home, the chevron moves relative to the center of the screen. Also, the direction the chevron is pointing indicates the direction the model is traveling, relative to home. So, if your model is flying toward home, the chevron will point toward home, regardless of where it is on the display screen. The RADAR feature is the ultimate way to keep tabs on where you are relative to home, as an aid to piloting.

Artificial Horizon Display

When you connect the FMA Direct™ CPD-4™ X/Y horizon sensor (either with our without the FMA™ stabilization Computer), an artifical horizon line can be displayed on the video screen.
Information on how to connect the FMA Direct sensor to the OSD Pro system, and configure the Artifical Horizon display, can be found in this document:

http://www.eagletreesystems.com/support/manuals/FMA-OSD-Pro.pdf

Waypoints

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The OSD Pro includes a powerful, graphical display of up to 3 waypoints, on the main screen, as shown in the Main Screen figure. These are displayed relative to the "Home" position, similar to the RADAR feature described above. When the OSD Pro is initialized, the first waypoint you entered is the active waypoint (circled), and the "Distance to Waypoint" parameter (if you chose to display it) indicates the distance to the first waypoint. As each waypoint is reached, the next defined waypoint becomes the active waypoint (it becomes circled), and the Waypoint Distance indicates the distance to the next waypoint. After all the defined waypoints have been reached, the waypoint order reverses, and the next to last waypoint becomes the active waypoint.

NOTE: the OSD Pro will not autonomously fly to waypoints, and the waypoints must be within Visual Line of Sight (VLS) of "Home". VLS is defined as 5280 feet (1609 meters). So, care must be taken to ensure that you don't configure waypoints farther than the VLS distance from the location you turn your model on. Waypoints farther away than VLS will not appear on the main screen, and an error message will appear.

Flight Simulator

The OSD Pro's built in flight simulator simplifies testing the Return to Home feature, as well as testing alarms, voice prompts, and other features. See the RTH Testing/Adjustment Procedures section for information on using the simulator. The simulator supports both traditional, fixed wing aircraft, and vtail or elevon controlled aircraft. NOTE: the simulator's implementation is simplistic. It is not a full simulator based on the laws of physics. So, your model's operation in the air could be quite different than the characteristics observed in the simulator!

Configuring the OSD Pro™ with the On-Screen Menus

A powerful, intuitive set of menus are provided with the OSD Pro, for configuration at home, in the field, or even in flight.

To invoke the menus and change menu parameters, the Aux1 (Up/Down) and Aux2 (Select) radio channels are used. These are connected as described in the configuration section above.

To invoke menu mode, click the Up/Down channel up. Note: "up" may be "down" depending on how your control channels are configured on your radio. After clicking, the main menu should appear, as shown in Figure 8. Once you are in menu mode, the Up/Down button is used to highlight the parameter to be changed. The ">" menu cursor to the left of the menu items indicates which item is currently highlighted. Moving the Up/Down button in either direction causes the next menu item to be highlighted.

To modify the highlighted menu item, clicking down on the Select channel invokes edit mode for that item. Edit mode is indicated by an up or down arrow to the right of the highlighted item (the direction arrow). Now, when you move the Up/Down switch up or down rapidly, the item's value will be either incremented or decremented, depending on whether the direction arrow is point up or down. This method of entry allows you to quickly increase or decrease an item's value, since each up and each down movement of the Up/Down switch will change the item.

To change the direction arrow from up to down, move the Up/Down switch DOWN, and leave it down for more than one second. Then, the direction arrow will point down, rapidly toggling the Up/Down switch will decrease the item's value. Conversely, to point the direction arrow up, leave the Up/Down switch in the UP position for more than one second.

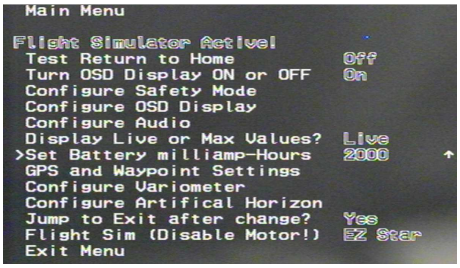


Figure 8

Note: all the on-screen menu settings (except the wizards) can also be configured with the Windows application, as described in the Windows application information above.

Description of On-screen Menus

Main Menu

The Main Menu is shown in Figure 8, with the following settings:

- **Test Return to Home:** see the Safety Mode section below for more information
- **Turn OSD Display ON or OFF:** turns the main screen on or off. When off, no OSD information is visible, but alarms can be programmed to turn the main screen back on. Also, voice announcements are still enabled when the main screen is off.
- **Configure Safety Mode:** Launches the Safety Mode Configuration menu, described below.
- **Configure OSD Display:** Launches the OSD Display configuration menu, described below.
- **Configure Audio:** Launches the Audio Configuration menu, described below.
- **Display Live or Max Values?:** Determines whether live or maximum values are displayed on the main screen. If Max is selected, the maximum values (minimum voltage) encountered since the OSD Pro was powered are displayed. There is an up arrow (or down arrow for voltage) displayed to the left of the parameters, indicating they are the Maximum (Minimum) values. The maximum values of some parameters are not available, which is indicated by an "*" for the value of that parameter.
- **Set Battery milliamp-Hours:** Sets the mAH capacity of your battery pack. This parameter, along with the eLogger's current sensor, is used to display the graphical battery level. **Warning: batteries often have less than their stated mAH capacity when drained at high rates.**
- **GPS, RADAR and Waypoint Settings:** Launches the GPS/RADAR/Waypoint configuration menu.
- **Configure Variometer:** Launches the Variometer configuration menu.
- **Configure Artificial Horizon:** Launches the Artificial Horizon configuration menu
- **Jump to Exit after change?:** If this is set to YES, the menu cursor will jump to "Exit Menu" after a menu item is changed. If it's set to NO, the menu cursor advances to the next menu item.
- **Flight Sim (Disable Motor!):** See the "Flight Simulator" section below.
- **Exit Menu:** Returns to the main screen (Exits Menu Mode) when selected

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Safety Mode Menu

NOTE: carefully read the Safety Mode Overview section before changing these settings!

- **Run Safety Mode Wizard:** This invokes the safety mode configuration wizard, described below.
- **Reset Cruise Stick Positions:** Recaptures the model's aileron/rudder, elevator, and throttle settings for level flight. These settings are captured during the Safety Mode wizard, but sometimes these need to be recaptured, if you have retrimmed your plane.
- **Select Desired Safety Mode:** Selects one of the safety mode options. None: no safety mode enabled. Failsafe: selects the failsafe mode. Rtrn Home: selects the Return to Home safety mode.
- **Choose Model Control Type:** Selects the type of control surfaces you use on your model. For "traditional" fixed wing models, which use ailerons/rudder and elevator, choose "Standard." For models that use elevon or vtail mixing, such as "flying wings" choose "Elevon."
- **Choose Receiver Type:** Sets the type of Radio/Receiver you are using. There are two options. PPM/No FS: this option should be chosen if your receiver stops controlling the servos if you turn off your radio (or the servos start moving randomly). PCM/FS: this option should be chosen if your receiver holds the last servo position (or goes into a failsafe position) when the radio is turned off. Most, but not all, 2.4GHz radios (such as Spektrum™ and Futaba™ 2.4GHz radios) are PCM. If you are unsure of the mode, turn off your radio, and gently move one of the servo arms while the receiver is still powered. If the servo moves without resistance and stays in the new position, or your servos start moving randomly, select "PPM/No FS" receiver mode. Otherwise, choose the "PCM/FS" mode.
- **Number Failsafe Chans on RX:** If your radio does not have any failsafe channels programmed, set this to "No FS Chs." If your receiver only supports throttle failsafe, and you have programmed a throttle failsafe position with your radio, select "1 FS Chns." If your radio supports failsafe positions on your elevator, aileron/rudder, and throttle channels, and you have programmed failsafe positions on all of these, choose "3+ FS Chns."
- **Cruise Speed:** This parameter sets the desired (optimal) cruise speed of your model. Set this parameter to the approximate speed at which your model maintains level flight (either MPH or K/H, depending on units). This should be the speed of the model for it to maintain level flight. Note that when you run the Safety Mode Wizard, and are prompted to set throttle for Cruise Speed, you should adjust your throttle stick position so that it sets a speed at which the model maintains level flight, assuming no turns are being made. So, your throttle setting during the Safety Mode Wizard should result in the approximate speed that you enter here for Cruise Speed.
- **Cruise Altitude (300/120):** Set this parameter to the desired altitude which the Return to Home feature should attempt to maintain. If there are obstacles between your model and home that have higher elevation than this setting, the model may crash into them, so consider this in your setting. Of course, never set this value above the legal flying limit for your area. This setting is in Feet if you have configured your system for English units, or in meters if you are configured for Metric units. The default values for (English, Metric) are show in the menu item in parentheses.
- **Altitude Error(100/40):** This setting has two purposes. First, this setting controls the tolerable window of altitude above and below the Cruise Altitude setting, referred to as the "Cruise Altitude Window." For example, if Cruise Altitude is set to 300, and Altitude Error was set to 100, the Cruise Altitude Window would be between 200 and 400. Never set this value so that this value, when added to "Cruise Altitude" parameter above, exceeds the legal flying limit for your area. Secondly, this setting is also used as the limit to the input of the pitch PID controller. See below. The default values for (English, Metric) are show in the menu item in parentheses.
- **Pitch Proportional Gain (50):** This setting adjusts the proportional input to the elevator PID controller. The default value is shown in parentheses. The elevator PID controller examines the difference between the present altitude, and the desired Cruise Altitude. If the difference is greater than the Altitude Error setting above, the difference is limited to Altitude Error. Then, the elevator controller multiplies this difference by the Pitch Proportional Gain value.
- **Pitch Derivative Gain (50):** This setting adjusts the derivative input to the elevator PID controller. Higher values of this setting damp (reduce) the climbrate. The effect of this parameter is increased as the Cruise altitude is approached, which reduces overshoot. Increase this parameter if the model "porpoises" between too high and too low, during testing. Decrease the value if the model stops climbing too soon or too abruptly.
- **Turn Proportional Limit (20):** this setting controls the maximum error that the heading controller will accept as an input. The heading controller examines the present heading, and the heading for home. If the difference in these headings is greater than Turn Proportional Limit, the Turn Proportional Limit value is used instead. The default value is shown in parentheses.
- **Turn Proportional Gain (50):** This setting amplifies the proportional input to heading controller. The default value is shown in parentheses. The heading controller determines the present heading, and the desired heading for home. The difference in headings (limited by Turn Proportional Limit as described above) is then multiplied by Turn Proportional Gain.
- **Turn Derivative Gain (50):** This setting adjusts the derivative input to the heading PID controller. Higher values of this setting damp (reduce) the rate of turn. The effect of this parameter is increased as the correct home heading is approached, which reduces overshoot. Increase the value of this parameter if the plane continues to turn after reaching the correct home heading. Decrease the value if the model stops turning too soon, or stops turning too abruptly.
- **Turn Integral Gain (50):** This setting controls the integral input to the heading PID controller. The heading PID controller examines how long it is taking to turn to the correct home heading. As time passes during the turn, the aileron/rudder is turned more and more, to increase the rate of turn over time. Normally the impact of the integral gain should be small. But, if a strong wind or other factor is keeping the plane from reaching home in a reasonable amount of time, integral gain will continue to increase the turn rate.

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Safety Mode Wizard

Before running the Safety Mode wizard, ensure your model's motor is disconnected or otherwise disabled. **NOTE: only run the Safety Mode Wizard when your model is on the ground!** Each screen of the safety mode wizard requiring you to make an adjustment to your radio is timed, and remains on the screen for approximately 10 seconds. Ensure that you have completed the adjustment before the timer counts to 0, and make sure that you hold the adjustment until the next screen appears. If you make a mistake during the Safety Mode wizard, just run it again later.

- **Read RTH Manual/Click SELECT:** Ensure that you have fully read this manual, and then click the Aux2/Select switch.
- **DISCONNECT MOTOR / Click SELECT:** Ensure that you have disconnected your motor, and click the Aux2/Select switch.
- **Set Sticks for level flight:** Set your **aileron/rudder, elevator, and throttle** stick positions where you typically set them for level flight, and hold them there until the next screen appears. Note that if you are using Failsafe Safety Mode, the aileron/rudder and elevator positions you choose in this step become the positions the OSD Pro will use for failsafe mode.
- **Turn Transmitter off now:** Turn your transmitter off, and leave it off until the next screen appears.
- **Turn Transmitter back on now:** Turn your transmitter back on.
- **Mov Rudder/Aileron Stick Left:** Move your Rudder/Aileron stick to the position you use for making a normal left turn. **Don't give more left stick than you would do normally during flight!** The OSD Pro's RTH function will never exceed this the rudder/aileron left turn position, or the corresponding right turn position, when it attempts to steer the model. So, the amount of left stick you supply will set the maximum throw of the aileron/rudder during RTH. NOTE: during this step, the OSD Pro also examines the elevator position. If your radio is programmed for elevator aileron mixing, it will be detected during this step, and a proportional amount of up elevator will be applied during RTH turns. If your radio does not do this mixing, but you desire RTH to provide up elevator when turning, move your elevator stick to the desired amount of climb (corresponding to full Aileron/rudder stick left) during this step.
- **Mov Elev TX STICK Down(Climb):** Move the Elevator stick downwardly, to the position you would use for normal climb. **Don't give more down stick (climb) than you would do normally during flight!** Note that this step results in up-elevator. The OSD Pro's RTH function will never exceed this elevator up position, or the corresponding elevator down position, when it attempts to climb or descend the model. So, the amount of down stick you supply will set the maximum throw of the elevator during RTH.
- **Set Throttle for Motor Off:** Set the Throttle stick to the position which turns off the motor. Note that if you are using Failsafe Safety Mode, the throttle position you choose in this step becomes the position the OSD Pro will use for the throttle when in failsafe mode. **IMPORTANT: note that if RTH is invoked, and the GPS signal is not adequate, the OSD Pro will set your throttle to this position. Therefore, if your model is on the ground, and you turn off your transmitter or test RTH, your throttle could be put in the Motor Off position. If full motor off is not chosen for the Motor Off position, your motor will start!**
- **Set Throttle for Climbing:** Set the Throttle stick to the position you would normally use for climbing the model.
- **Wizard complete. Click SELECT:** This is the last page of the wizard. Click the Aux2/Select switch to return to the Safety Configuration Menu.

GPS and Waypoint Settings Menu

This menu page lets you configure GPS and waypoint settings.

- **Display Lat-Lon Position:** This item lets you choose when latitude/longitude position is displayed on the main screen. The choices are:
  - Never: position is never displayed
  - Trouble: position is displayed when the RTH or Failsafe safety modes are invoked, or if an alarm has been triggered
  - Low Alt: position is displayed for Trouble, and additionally if the model's altitude is less than the setting you made in the "Cruise Altitude" item in the Configure Safety Mode menu
  - Distance: position is displayed for Trouble, Low Alt, and additionally if the distance of the model from home exceeds the Maximum "RADAR Radius" item in the *Configure OSD Display menu.*
  - Always: position information is always displayed
- **Enable RADAR Display:** Select YES to enable the RADAR feature, described earlier in the manual.
- **RADAR Up Direction (Degrees):** This parameter sets the UP direction of the RADAR feature. For example, if you fly your model so that your body is facing 15 degrees N, you would set this to 15. This results in the RADAR icon flying up on the OSD Pro main screen when you are flying the model in the direction you are facing. Normally, the runway is perpendicular to the direction you are facing.
- **Set RADAR Maximum Radius:** This sets the maximum radius for the RADAR and Waypoint display. Set this to the maximum distance away from home that you typically fly. For example, if you normally fly a maximum of 5000 feet away from home in any direction, set this to 5000. If your model exceeds this distance, the RADAR icon will change from normal video to reverse video, to indicate you are out of range. Likewise, if you have defined waypoints that exceed this maximum radius, they will be displayed in reverse video.
- **Show Waypoints on RADAR:** Set this to YES if you want to display the waypoints you entered in the Windows Setup Utility on the main display screen.
- **Set Minimum Satellite Count:** Set this to a non-zero value if you wish to specify the minimum number of satellites that must be in view, before the Home location and altitude are finalized. This setting is useful if you find that, in your area, the GPS module initially reports somewhat invalid altitude or position information until a certain number of satellites are in view.
- **Require 3D GPS Fix:** Set this to YES if you wish to wait until a 3D GPS fix is attained, before the Home location and altitude are finalized. If you are using GPS altitude rather than a barometric altitude sensor, this generally should be set to YES, as GPS altitude will not usually be accurate unless a 3D fix is attained.
- **Set Maximum HDOP:** Horizontal Dilution of Precision (HDOP) is a measure of the GPS Expander's fix quality. The lower this number, the better the fix. The HDOP can vary with a variety of factors, including the position of the satellites in view relative to each other. As a very general rule, HDOP less than 2.0 is highly desirable. HDOP less than 1.3 is desirable, but may not always be attainable. The default value of 9.9 essentially turns this check off. If you wish for a certain quality of fix to be attained before the Home location and altitude are finalized, set this to a value lower than 9.9.
- **Distance to Pilot as LOS?:** Set this to YES if you want the Line of Sight distance (computed using altitude as well as ground distance) displayed with the Distance To Pilot display. Set it to NO if you want the ground distance.
- **Seconds to Wait post GPS Fix:** Set this to a non-zero value if you wish to specify the number of seconds that must elapse after the GPS acquires its first fix, before the Home location and altitude are finalized.

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Configure OSD Display Menu

These menu items set options for OSD Display features.

- **Set Page Switch time (secs):** If you have configured multiple pages of data parameters using the Windows Setup Utility, and wish to switch between the pages of data every few seconds, set this parameter to the number of seconds between page switches. NOTE: In addition to this option, toggling your radio's Aux2/Select switch (if configured) when not in menu mode will cause the display page to advance to the next page.
- **Show Airspeed Ladder:** Set this to YES if you would like to display the speed ladder on the main screen. The speed ladder ranges from 0 to 999, and displays in either MPH, or K/H, depending on your chosen units.
- **Show Altitude Ladder:** Set this to YES if you would like to display the altitude ladder on the main screen. The Altitude ladder ranges from -999 to 9999, and displays in either feet or meters, depending on your chosen units.
- **Show Graphical Compass:** Set this to YES if you would like to display the graphical compass on the main screen.
- **Show Crosshairs:** Set this to YES if you would like to display the crosshairs in the center of the screen.
- **Show Graphical Battery:** Set this to YES if you would like to display the graphical battery on the main screen. Don't forget to set your battery's mAH capacity on the Main Menu screen also.
- **Set Horizontal Screen Shift:** This setting lets you adjust the horizontal position of the OSD data on your video screen. Increasing this parameter causes the OSD data to shift rightward on the screen.
- **Set Vertical Screen Shift:** This setting lets you adjust the vertical position of the OSD data on your video screen. Increasing this parameter causes the OSD data to shift downwardly on the screen.
- **Narrow Screen (see manual):** This setting compresses the OSD screen horizontally, decreasing the width. It does not affect the video width. Try this option if your DVR or display does not let you see all of the OSD data, even after adjusting the horizontal screen shift. NOTE: If you select this option, and find that your OSD Pro is suddenly has display issues, email support@eagletreesystems.com.
- **On/Off Display with Aux2?:** Set this to YES if you would like to turn the main display screen on and off, by toggling the Aux2 switch. Note that using this option would likely require the Aux2 channel to be dedicated to the OSD Pro, and not shared with other equipment.
- **Set OSD Text White Level:** Adjusts the white level of the OSD Pro text and graphics. Normally, this does not need to be changed from the default setting of "7."
- **Set OSD Text Black Level:** Adjusts the black level of the OSD Pro text and graphics. Normally, this does not need to be changed from the default setting of "0."
- **Enable EagleEyes Telemetry:** This feature enables embedding of digital telemetry data for our EagleEyes™ FPV Ground Station. See our website for more information.
- **Display Servo Deflections:** This display option can assist in fine-tuning RTH and other settings. It displays the present Aileron/Rudder, Elevator and Throttle servo offsets. The offsets range from extremes of approximately -2000 to 2000. Zero corresponds to the neutral stick settings that you indicated in the "Set Sticks for Level Flight" screen of the Safety Mode Wizard

Configure Sensors and Units

The Configure Sensors and Units menu has the following items:

- **Use Baro Alt for RTH/Ladder:** Set this item to YES only if you have a barometric altimeter (either the Altimeter Microsensor, or a Flight Data Recorder). When set to YES, the barometric altimeter will be used for the altitude ladder, the acoustic variometer, and for the Return to Home altitude input. Set this item to NO if you are using GPS for altitude measurement.
- **Use Pitot Spd for RTH/Ladder:** Set this item to YES only if you have a pitot/static airspeed sensor (either the Airspeed Microsensor, or a Flight Data Recorder). When set to YES, the pitot/static airspeed will be used for the airspeed ladder, the Total Energy function of the acoustic variometer, and for the Return to Home airspeed input. Set this item to NO if you are using GPS for ground speed measurement.
- **Use Temp 1 Input for RSSI:** This advanced feature indicates to the OSD Pro that you have connected the analog RSSI output of your compatible receiver to the center pin of the "Temperature 1" connector on your eLogger or Recorder. When you configure the OSD Pro to display the "Temperature Sensor A" parameter, it will not be converted to a temperature if this option is set.
- **Units for all Speeds:** Normally, all speeds (GPS, pitot/static) are displayed in the default units, chosen under "Software, Choose Units of Measure" in the software. But, this option lets you override the default setting. For example, use this option if you want to set the default units to metric, but want speed in MPH or knots. Choose "Default" for this option if you want the default units to be used (MPH or km/h).
- **Units for all Distances:** Normally, all distances (distance to home, distance to waypoint, and RADAR radius) are displayed in the default units, chosen under "Software, Choose Units of Measure" in the software. But, this option lets you override the default setting. For example, use this option if you want to set the default units to metric, but want distances displayed in feet. Choose "Default" for this option if you want the default units to be used (feet or meters).
- **Units for all Altitudes:** Normally, all altitudes (GPS, barometric) are displayed in the default units, chosen under "Software, Choose Units of Measure" in the software. But, this option lets you override the default setting. For example, use this option if you want to set the default units to metric, but want altitudes displayed in feet. Choose "Default" for this option if you want the default units to be used (feet or meters).

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Audio Configuration Menu

The Audio Configuration menu has the following items:

- **Mute Voice Alerts:** Turns off all voice alerts, when set to YES.
- **Set Voice Alerts Volume:** Sets the volume of the voice alerts. Note that the purpose of the volume control is to match the volume of the voice alerts with the volume of the flying sounds (if you use a microphone), and with the volume of the acoustic variometer. In general, this setting should be set as low as possible to avoid saturating the output preamplifier.
- **Mute Variometer:** Mutes the acoustic variometer sounds, when set to YES.
- **Set Variometer Volume:** Sets the volume of the acoustic variometer. Note that the purpose of the volume control is to match the volume of the variometer with the volume of the flying sounds (if you use a microphone), and the voice alerts. In general, this setting should be set as low as possible to avoid saturating the output preamplifier.
- **Mute External Audio:** Mutes the microphone, when set to YES. Note: this should be set to YES if you are not using a microphone. Otherwise a hum may be heard.
- **Set External Audio Volume:** Sets the volume of the external microphone input. Note that the purpose of the volume control is to match the volume of the microphone with the volume of the acoustic variometer, and with the volume of the voice alerts. In general, this setting should be set as low as possible to avoid saturating the output preamplifier.

Configure Artificial Horizon Menu

Information on how to connect the FMA Direct sensor to the OSD Pro system, and configure the Artificial Horizon display, can be found in this document:

http://www.eagletreesystems.com/support/manuals/FMA-OSD-Pro.pdf

Safety Mode Overview

Please read this entire section, and understand the function and limitations of the modes, before enabling a safety mode!

IMPORTANT SAFETY MODE INFORMATION:

- **RTH is an advanced feature requiring pilot tuning and calibration, and is used only at your own risk.**
- **WARNING: Since RTH may increase the throttle setting, YOUR MOTOR MAY START SUDDENLY WITH YOUR MODEL ON THE BENCH, OR ON THE GROUND, WHEN RTH IS TRIGGERED! RTH attempts to avoid starting the motor in this situation, by examining the speed and altitude of the model. But, if the GPS or other sensors are misreporting altitude and/or misreporting speed, RTH could still start the motor on the ground. Further, if the GPS fix quality is not good, RTH will program your throttle to the setting you entered for "Motor Off" during the Safety Mode Wizard. ALWAYS ASSUME THAT THE MOTOR MAY START AT ANY TIME, WHEN RTH MODE IS ENABLED!**
- **RTH is a safety feature of last resort, should you lose radio contact with your model. Never rely on the RTH function to fly or navigate your model. Never fly out of the manufacturer's recommended range, or fly outside VLOS (Visual Line of Sight).**
- **When enabled, Safety Mode will activate based on the *How the OSD Pro Determines when Safety Mode should be Invoked* section below. Read this section carefully!**
- **It is recommended that you set the "Capture Rate" of your eLogger or Recorder to 10 samples/second, since this setting controls the rate at which the OSD Pro receives information from the eLogger/Recorder. The more information received by the RTH feature, the better.**
- **RTH will work best with very stable, self correcting airplanes, and will not work reliably with flying wings, aerobatic planes, helicopters, or similar.**
- **We recommend using ailerons for RTH, if your plane is equipped with both ailerons and a rudder.**
- **RTH performance can vary depending on the flying conditions, the type of airframe, the degree to which it has been configured for your model, the GPS fix quality, and potentially other factors.**
- **Never intentionally turn off your radio to test RTH in the air. There is a chance that your receiver will not link back up with your radio, especially with 2.4GHz radios, which could result in a crash. Always use the "Test RTH" menu item to test RTH in the air.**
- **RTH will NOT engage if the GPS signal quality parameters are below the minimum quality you specify in the "GPS and Waypoint Settings" menu. Failsafe Safety mode will engage instead.**
- **RTH will NOT fully engage if your altitude is less than 60 feet/20 meters above ground level, or if your speed is less than 3 MPH or 3K/H.**
- **If you routinely fly near to the maximum range of your receiver, and have periodic link dropouts from which you are able to recover after sluggish model performance, Safety Mode may engage when you don't want it to. Safety mode is not intended to be used if you routinely fly beyond the maximum range of your receiver.**
- **It is strongly recommended that RTH mode not be used by inexperienced pilots, until they are comfortable with all aspects of flying.**

There are two safety modes:

Failsafe Mode

In Failsafe Mode, the OSD Pro returns the servos to a pre-determined failsafe position if radio contact is lost. If your Receiver supports multiple programmable failsafes, the Failsafe Mode safety is not particularly useful. If you have a receiver that does not have failsafe capability, and does not hold the servos at the last position (your servos move randomly if radio signal is lost), or a radio with only 1 programmable failsafe, then the Failsafe safety mode

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can be used to set a failsafe on all three of your control surfaces, in the event of radio signal loss. The failsafe servo positions are chosen during the Safety Mode Wizard, described earlier in this document. The "Level Flight" aileron/rudder and elevator settings you indicated, and the "Motor Off" throttle setting you indicated during the wizard are recorded for use as the Failsafe Mode failsafe settings.

Return to Home Mode

Return to Home (RTH) attempts to recover your model if you lose radio contact. Both traditional fixed wing models, and elevon or vtail models, such as flying wings, are supported.

The RTH uses enhanced implementations of Proportional, Integral, Derivative (PID) controllers to adjust the model's altitude and direction. Specifically, a PID controller is used for turning, and a PD controller is used for climbing. More information on PID controllers is available here: http://en.wikipedia.org/wiki/PID_controller .

The PID controllers use GPS course, speed, altitude and other information to attempt to return the model to home. NOTE: a later version of the firmware (downloadable from our website) will support an enhanced RTH algorithm which also uses attitude sensing to enhance the RTH feature. Also, note that the use of the FMA™ Co-pilot™ can improve the operation of RTH. See the section above on configuration of this optional equipment.

Additionally, RTH manipulates the throttle to control altitude and cruise speed.

How the OSD Pro Determines when Safety Mode should be Invoked

The OSD Pro constantly monitors your receiver to determine if the selected Safety Mode should be invoked. The things that trigger Safety Mode vary between receiver types.

For receivers which do not hold the servos at the last position or failsafe position when signal is lost (the servos move randomly when the Transmitter is turned off), the OSD Pro looks for bad pulses (pulses of the wrong duration), or the absence of pulses. If enough bad or missing pulses are evident in a short period, Safety Mode is invoked, until the error rate decreases to a good level.

For receivers which do maintain the last position of the servos when signal is lost, but with no failsafe positions programmed, Safety Mode is activated when no servos move for a short period. This setup is not recommended, since Safety Mode will turn on if you don't move your transmitter sticks for a few seconds, even if your radio link is good!

For receivers with throttle failsafe programmed, Safety Mode is invoked whenever the throttle channel reaches the receiver's throttle failsafe position (the one you program into the receiver per your receiver's instruction manual) for more than a brief period. To prevent Safety Mode from activating erroneously during normal flight, make sure your receiver's throttle failsafe is programmed so that the failsafe position is not encountered in normal flight. One way to do this is to temporarily set your receiver's throttle channel for "extended servo travel" or similar, and then program your throttle failsafe to an extreme off position. Then, return your receiver to normal throttle servo travel, so that the failsafe position of the throttle will still turn the motor off, but cannot be reached if you move your throttle stick off. The failsafe positions used by your receiver are detected during the Safety Mode Wizard.

For receivers with 3+ failsafes, Safety Mode is invoked whenever all three receiver channels (throttle, aileron/rudder, elevator) reach the failsafe position for more than a brief period. The failsafe positions used by your receiver are detected during the Safety Mode Wizard. As above, it is recommended that you adjust your throttle failsafe so that the throttle failsafe position cannot be encountered in normal flight.

Using the Return to Home with Stabilization Systems

The Return to Home feature can be improved significantly if a stabilization system**,** such as the FMA™ Co-pilot™, is utilized. The stabilization system's servo inputs would normally be connected to the servo outputs of the OSD Pro. Then, the servos themselves are directly connected to the stabilization system's output.

If you are using the FMA™ Co-pilot™ CPD4™, there are two problems you may encounter. The first problem is that the CPD4™ computer apparently cannot handle receiving two or more servo pulses simultaneously. Futaba™ PCM receivers send simultaneous servo pulses, and FMA™ requires that you use a "servo buffer" (which they sell) to slightly delay one of the incoming pulses.

The OSD Pro sends the servo pulses simultaneously by default (just as Futaba™ PCM receivers do), which might confuse the Copilot unless the "servo buffer" hardware is installed on one of the servo connections. If you set the *FMA co-pilot w/o servo buffer* parameter in the Artificial Horizon Configuration menu to "Yes", it causes the OSD Pro to skew the servo pulses in RTH mode. Unfortunately, this causes the voice announcements to automatically be turned off during RTH mode (including the "signal lost!" announcement that would normally occur when RTH mode is invoked). That's the only drawback of setting this option to "Yes." Note that it is believed that the latest FMA™ Co-pilot II™ product does not have this shortcoming.

Secondly, another potential problem can occur with the Co-pilot™, if you use a spare receiver channel to control its gain. If you use a spare servo channel to remotely set the gain, and your receiver loses the signal, one of three things might happen:

a) If your radio doesn't send any pulses at all when it loses receiver signal, what happens with the Co-pilot™ is unknown. This is true with or without the OSD Pro connected.
b) If your radio is PCM and has failsafes, but you have not set the failsafe of the spare channel to something reasonable for the Co-pilot™ (or if there is no failsafe setting available on that channel), stabilization will again be in an unknown state. Again, this is true with or without the OSD Pro connected.
c) Even if you have set the failsafe for the spare channel to a reasonable value for the Co-pilot™, a problem can still occur, since the pulses from the receiver to the copilot are not synchronized with the pulses from the OSD Pro to the Co-pilot™, during RTH mode. The copilot can occasionally glitch (moving the servos wildly) whenever the servo gain pulse momentarily overlaps with one of the RTH pulses. Again, this is due to the

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perceived shortcoming of the CPD4™ in receiving two or more servo pulses simultaneously. If, during testing of RTH mode, you observe servo excursions a few seconds apart, use the manual gain setting for your Co-pilot™.

RTH Testing/Adjustment Procedures

Please follow these guidelines for adjusting the Return to Home feature to your plane.

a) Initial setup and coarse testing of rudder/aileron control using the simulator (model on the bench with motor disconnected)

1) With your model's motor disconnected, and with the model on the bench, Run the Safety Wizard in the Configure Safety Mode menu.
2) Select "Return to Home" as the desired safety mode in the Configure Safety Mode menu.
3) Choose Receiver Type in the Configure Safety Mode menu.
4) Indicate number of failsafe channels supported by your receiver in the Configure Safety Mode menu.
5) Adjust the Cruise Altitude, Cruise Speed and Altitude Error settings in the Configure Safety Mode menu, as described above.
6) Set the Turn Derivative Gain and Turn Integral Gain parameters in the Safety Mode Menu to "0".
7) Choose "Display Servo Deflections" from the Configure OSD Display menu. This will display the movement of the servos, relative to the "zero" points established for level flight during the Wizard. These values are displayed both in normal mode, and safety mode.
8) Invoke the Flight Simulator from the Main Menu, choosing one of the flight simulator profiles that is most similar to your plane. **Note: if you have a model that uses elevon or vtail mixing, choose "Funjet."** The message "Flight Simulator Active" should appear in the upper part of the screen.
9) Now, the plane icon should move around the screen, and the displayed speed and altitude should vary, based on the rudder/aileron, throttle and elevator transmitter settings. If the plane icon is not correctly turning, climbing, or changing speed based on your transmitter inputs, something has gone wrong. Please see the troubleshooting section again.
10) As you move your transmitter's sticks, the control surfaces of your model should of course move in the correct directions.
11) Select the "Test Return to Home" option in the Main Menu, and set it to "Both". Then, exit the menus.
12) A few seconds after exiting the menus, the message "RTH Engaged: move sticks to stop test" should appear in the upper part of the screen, assuming you are not moving your transmitter sticks. This indicates that test mode is active. If this message does not appear, see the troubleshooting section.
13) NOTE: RTH will not manipulate the throttle unless your altitude is above about 60 feet (20 m). This is true even when using the simulator. Make sure that your altitude is reading 60 feet or higher before performing these tests, or throttle control will be disabled.
14) When you move your transmitter sticks, the message should change to "RTH Engaged: Release sticks for test." This indicates that the test has been temporarily suspended, returning control of the model to you.
15) Ensure that all your model's control surfaces move correctly with your stick movements.
16) Fly the plane icon away from home, so that it is a considerable distance (more than a few feet or meters) from home in the simulator, and pointing approximately 180 degrees away from home.
17) When you don't move your sticks for a second or two, and test mode activates, the plane icon should begin to turn toward home. Observe your model's rudder or aileron to ensure that it is deflecting in the correct direction, based on the direction the plane icon is turning on the screen. If the surface is moving IN THE WRONG DIRECTION, rerun the Safety Mode Wizard, and pay close attention to the instructions.
18) If the ailerons or rudder move only slightly (or not at all), and in your judgment would not move enough to turn your model significantly in the air, increase the Turn Proportional Gain setting, and repeat the test. Likewise, if the ailerons or rudder have too much deflection, decrease the value of the Turn Proportional Gain setting and repeat the test. If you find that very large adjustments of the Turn Proportional Gain setting are required, increase the Turn Proportional Limit value. Likewise if even low values of Turn Proportional Gain move the ailerons or rudder too much, decrease the Turn Proportional Limit parameter.
19) Repeat the above tests, starting at step 12, but choose headings that are different than 180 degrees, to ensure that the rudder or ailerons turn in the correct direction, for both left turn and right turn.

b) Coarse testing of elevator and throttle control using the simulator (model on the bench with motor disconnected)

NOTE: Since you will not be able to see the throttle movements on electric models, consider temporarily replacing the ESC throttle input with a servo, plugged into your receiver's throttle output, and observe the movement of the servo as you move the throttle. A "Y" cable might be needed if the ESC powers your receiver via the throttle connection.

1) Complete the step a) above, and ensure that "Flight Simulator" is enabled and that "Test Return to Home" is set to "Both."
2) In the Safety Mode menu, set "Pitch Derivative Gain" to "0". This turns off damping.
3) Fly the plane icon away from home, so that it is a considerable distance (more than a few feet or meters) from home, and then point the plane icon so that it is flying toward home (home arrow pointing straight up).
4) Move your transmitter's throttle and elevator sticks to reduce the plane icon's altitude to well below the Cruise Altitude Window, but above about 60 feet (20 meters). Then, release the sticks. A few seconds after exiting the menus, the message "RTH Engaged: move sticks to stop test" should appear in the upper part of the screen, and you should see an increase in altitude, until the altitude reaches the Cruise Altitude Window. On your model, you should see correct movement of the elevator (up deflection). If the elevator is moving IN THE WRONG DIRECTION, rerun the Safety Mode Wizard, and pay close attention to the instructions. NOTE: RTH will not manipulate the throttle unless your altitude is above about 60 feet (20 m). This is true even when using the simulator. Make sure that your altitude is reading 60 feet or higher before performing these tests, or throttle control will be disabled.
5) If the elevator moves up only slightly, and in your judgment would not move enough to significantly increase the model's altitude in the air, increase the Pitch Proportional Gain and repeat the test. Likewise, if the elevator has too much deflection, decrease this value and repeat the test.
6) If you have connected a servo to your receiver's throttle output as suggested above, move your transmitter's throttle and elevator sticks to reduce the plane icon's altitude to well below the Cruise Altitude Window, but above about 60 feet (20 meters), AND make sure your throttle setting results in the simulator showing a speed that is less than the speed you selected for Cruise Speed in the Safety Mode menu. Then, release the sticks

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and observe the throttle servo when RTH mode engages. The servo should slowly increase to the setting you chose for "Throttle Climb" when you ran the Safety Mode Wizard, and should move in the same direction it moved when you manually increased the throttle stick on your transmitter. If the servo does not move in this direction, or does not move at all, rerun the Safety Mode Wizard, and pay close attention to the instructions.

7) Move your transmitter's throttle and elevator sticks to increase the plane icon's altitude to well above the Cruise Altitude Window. Then, release the sticks. Once RTH mode engages, you should begin to see a decrease in altitude, until the altitude reaches the Cruise Altitude Window.
8) If you have connected a servo to your receiver's throttle output as suggested above, observe the throttle servo at this time. The servo should quickly decrease to the setting you chose for "Motor Off" when you ran the Safety Mode Wizard, and should move in the same direction it moved when you manually decreased the throttle stick on your transmitter. If the servo does not move in this direction, rerun the Safety Mode Wizard, and pay close attention to the instructions.
9) Disable the Flight Simulator from the Main Menu.

c) Testing and Adjusting the RTH Altitude Controller Subsystem (while Flying)

1) Complete the steps a) and b) above.
2) **Important: NEVER fly with the Flight Simulator Enabled, and NEVER take off or land with the "Test Return to Home" mode enabled!**
3) Configure the OSD Pro to display Altitudes, Speeds, GPS Satellites, Course, Home Arrow, Compass, and GPS HDOP, at a minimum.
4) It is also recommended that "Servo Deflections" be displayed, for later debugging of any RTH issues, assuming you are recording video.
5) In the Safety Mode menu, set "Pitch Derivative Gain" to "0". This turns off damping.
6) On a calm day, complete your model's range check, and then fly your model.
7) Ensure you have good GPS signal.
8) When it is safe to do so, select the "Test Return to Home" option in the Main Menu, and set it to "Altitude".
9) Ensure that you still have full control of your model. If you do not, immediately set "Test Return to Home" to "No", exit the menus, and see troubleshooting.
10) If you have full control of your model, exit the menus, and fly your model so that it is flying toward Home, at ABOVE the Cruise Altitude Window (but below the legal altitude limit).
11) When safe to do so, release your sticks, but BE PREPARED TO TAKE IMMEDIATE CONTROL OF THE MODEL. The message "RTH Engaged: move sticks to stop test" should appear on the screen, and the model should decrease throttle, so that the model returns to cruise altitude. If the model does not decrease altitude, turn off "Test Return to Home" mode, land, and see troubleshooting.
12) Again, fly your model so that it is flying toward home, and if it is safe to do so, decrease the model's altitude to below the Cruise Altitude Window.
13) When safe to do so, release your sticks, but BE PREPARED TO TAKE IMMEDIATE CONTROL OF THE MODEL. The message "RTH Engaged: move sticks to stop test" should appear on the screen, and the model should increase throttle slowly up to the "Climb" throttle setting you selected in the Safety Wizard, and should apply up elevator, so that the model returns to cruise altitude.
14) If the model climbs too slowly, increase the Pitch Proportional Gain, and try again. Likewise, if the model climbs too rapidly, decrease the Pitch Proportional Gain parameter.
15) Once the model climbs at a reasonable rate, determine if it overshoots the climb (porpoises) when the model reaches cruise altitude. If it does, increase the Pitch Derivative Gain parameter from "0" to approximately "50".
16) Adjust the Pitch Derivative Gain parameter up or down until it is just high enough so that the model climbs and does not porpoise.
17) Turn off the "Test Return to Home" mode before attempting to land, to ensure that the test mode is not invoked during landing.

d) Testing and Adjusting the RTH Heading Controller Subsystem (while Flying)

1) Complete the steps described in steps a, b and c above.
2) Set the Turn Derivative Gain and Turn Integral Gain parameters in the Safety Mode Menu to "0".
3) On a calm day, complete your model's range check, and then fly your model.
4) When it is safe to do so, select the "Test Return to Home" option in the Main Menu, and set it to "Heading".
5) Ensure that you still have full control of your model. If you do not, immediately set "Test Return to Home" to "No", exit the menus, and see troubleshooting.
6) If you have full control of your model, exit the menus, and fly your model so that it is flying away from Home, at approximately the selected cruise altitude level and cruising speed.
7) When safe to do so, release your sticks, but BE PREPARED TO TAKE IMMEDIATE CONTROL OF THE MODEL. The message "RTH Engaged: move sticks to stop test" should appear on the screen, and the model should begin slowly turn toward home.
8) If the model turns too slowly, increase the Turn Proportional Gain and try again. Likewise, if the model turns too rapidly, decrease the Turn Proportional Gain. If you find that very large adjustments of the Turn Proportional Gain setting are required, increase the Turn Proportional Limit value. Likewise if even low values of Turn Proportional Gain move the ailerons or rudder too much, decrease the Turn Proportional Limit parameter.
9) If the model turns at a reasonable rate, but overshoots the turn when the model reaches the home direction, increase the Turn Derivative Gain parameter, until the model stops turning when pointing to home.
10) Now increase the Turn Integral Gain parameter from "0" to approximately "50". Then, fly your model so that it is flying directly away from home (near 180 degrees from home) which will result in a maximum turn. Then, observe the model's turn. If the model begins to turn too rapidly before reaching the home heading, decrease the Integral Gain parameter. If the model still begins to turn too rapidly even with very low Integral Gain, decrease the Proportional Gain setting and try again.
11) If the model doesn't seem to increase its turn rate much, even after turning almost 180 degrees, increase the Turn Integral Gain Parameter.
12) Turn off the "Test Return to Home" mode before attempting to land, to ensure that the test mode is not invoked during landing.

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Troubleshooting

Below is a list of problems that may be encountered, and steps to remedy them. If your particular issue is not addressed by the below, see the Support page on http://eagletreesystems.com for easy options for getting answers to your questions, 24 hours a day.

Issue: After I power my system, I see the OSD Pro startup screen, but then the OSD turns off, leaving only the video image. And/or, the OSD Pro's data only display briefly, and then only the video is shown. Or, the video screen goes black shortly after I turn on the OSD Pro. Or, I see large, rapid fluctuation in the "Pack Voltage" display parameter.
Solution:

- Invoke the menus, and confirm that you have the OSD Pro turned on, in the main menu settings.
- The OSD Pro may not be getting enough power. When using the OSD Pro Expander with the eLogger V3 **and** the GPS Expander, **and you do not plan on connecting any outputs of your receiver to the OSD Pro,** a maximum voltage of approximately 8 volts (2s LiPo pack) should be used to power the eLogger. If you are using a pack greater than 8 volts, the eLogger's internal regulator may temporarily shut down, which will cause the OSD Pro Expander to turn off, resulting in no video display. To avoid this issue, use our "Battery Backup Harness" which can connect to a spare 5V to 6V BEC or spare receiver channel when using larger battery packs. Note that if you connect receiver outputs to your OSD Pro, the OSD Pro receives backup power from the receiver, so the Battery Backup Harness should not be needed, even with battery packs larger than 4s.

Issue: I am having trouble getting a GPS fix. Or, once GPS fix is acquired, it is periodically lost, or the GPS values seem to move around quite a bit.
Solutions:

- If you are using a 900 MHz video transmitter, it is quite probably generating spurious noise on the frequencies used by GPS. A good description of the causes and solutions of this problem is located here: http://www.dpcav.com/data_sheets/whitepaper_RFI.pdf
- See your GPS Expander manual for other troubleshooting tips.

Issue: I am able to see video and data with my OSD Pro board, but am seeing problems such has "internal error" messages, incorrect data, or random text display.
Solution:

- Run the OSD Pro PC Setup utility, and click 'FACTORY RESET." Then, reconfigure the OSD Pro board.

Issue: The message "OSD Pro Board is not connected. Please connect the OSD and try again." appears when I try to configure the OSD Pro with the Windows Application.
Solutions:

- Ensure that the OSD Pro is connected correctly, with the correct polarity, to the eLogger or Recorder
- Ensure that the eLogger V3 or Recorder is connected correctly to USB. The LED should flash a sequence of three repeating blinks if it is correctly connected.
- Ensure that you have updated the eLogger/recorder firmware and OSD firmware as described in the "Windows Application and Firmware Update" section above.

Issue: I see only a black screen, the OSD Pro startup screen, or no video image at all, on my video monitor after connecting the OSD Pro between the camera and the Video Transmitter/DVR.
Solutions:

- Verify that a correct video image is displayed if you remove the OSD Pro from the circuit, and connect the camera and Transmitter/DVR cable together directly.
- Ensure that the OSD Pro is connected correctly to the eLogger/Recorder, and that the LED on the eLogger/Recorder is flashing. If the LED is not flashing, that means that the eLogger/Recorder is not powered. No video will appear in this case.
- Ensure that the 3 pin "Video In" connector of the OSD Pro is connected to the output from your camera, with the "S" pin connected to the positive output of the camera (the center pin for RCA), and the "-" pin of the OSD Pro is going to the negative output (ground) of the camera (the outer connector for RCA).
- Ensure that the 3 pin "Video Out" connector of the OSD Pro is connected to the input of your Video Transmitter or DVR, with the "S" pin connected to the positive input (the center pin for RCA), and the "-" pin of the OSD Pro going to the negative input (ground - the outer connector for RCA).

Issue: I have connected the OSD Pro's "Audio Out" output to my Video Transmitter or DVR. I hear a buzzing or humming sound, or there is distortion in the audio.

Solutions:

- Mute the External Audio input as described in the audio setup menu above, if you are NOT using an external (microphone) audio source to hear flight noises.
- Make sure you have the voice volume, external volume, and variometer volume set to either 1 or 2.
- The audio input of some video transmitters require higher output impedance. Try connecting a 10K ohm resistor in series with the OSD Pro's audio output and the video transmitter's audio input.

Issue: The OSD Pro text is visible when my camera is turned on, but only a black screen appears when the camera is turned off.
Solution:

- This is correct behavior. The OSD Pro will not overlay text if there is no active video source.

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Issue: I am using the eLogger V3, and the Video and OSD Pro Text is visible for a while, but then the Video goes blank. If I disconnect the eLogger V3 for a few minutes and reconnect it, the Video re-appears. I do not have any outputs from my receiver connected to the OSD Pro.
Solution: The Battery Backup Harness will be needed for your configuration. See the "eLogger V3" installation section above for more information.

Issue: The OSD Pro displays information on the video screen, but I cannot get the menus to appear.
Solution:

- Ensure that you have both Aux1 and Aux2 connected to the receiver.
- If you are using a switch on your radio that has a "center" position as well as "off" and "on", make sure you are switching from "off" to "on" (or vice versa) and not stopping at the center position.
- Consider testing the receiver outputs that are connected to Aux1 and Aux2 with a servo, to ensure the servo moves between its extents when switching.

Issue: The OSD Pro's GPS altitude does not zero correctly, and/or the home position does not seem correct.
Solution:

- Adjust the "required fix quality" parameters under the GPS and Waypoints menu, to ensure that the GPS fix quality is good before the home position is finalized.

Issue: I am having trouble adjusting the Return to Home feature.
Solution:

- Visit our online support forum at http://www.rcgroups.com/eagle-tree-systems-443/ . There is a "sticky" post on that forum, describing how to get help with RTH and other OSD-PRO issues.
- If you can't find what you need on our support forum, consider posting a new thread on the RCGroups "First Person View" forum, at http://www.rcgroups.com/video-piloting-fpv-rpv-469/ explaining the problem you are having. There are many FPV pilots there, and most likely some of them will have a similar setup to yours, and will be able to help you.
- Note that Eagle Tree cannot offer email or telephone support for adjusting the Return to Home feature, due to the many variables involved.

Specifications

- Video Modes: NTSC, PAL
- Parameters Displayed: Limited only by the sensors you have purchased
- Character/Graphic Display Type: High contrast white with black character outline, for optimum visibility.
- Number of Configurable Parameters per OSD Pro Page: 20 maximum (2 lines on top, and 2 lines on bottom, with 5 parameters on each line).

Limited Warranty

Eagle Tree Systems, LLC, warrants the OSD Pro to be free from defects in materials and workmanship for a period of one (1) year from the date of original purchase. This warranty is nontransferable. If your unit requires warranty service during this period, we will replace or repair it at our option. Shipping cost to us is your responsibility. To obtain warranty service, email support@eagletreesystems.com for further instructions.

This limited warranty does not cover:

- The Software. See the Software license agreement for more information on Software restrictions.
- Problems that result from:
    - External causes such as accident, abuse, misuse, or problems with electrical power
    - Servicing not authorized by us
    - Usage that is not in accordance with product instructions
    - Failure to follow the product instructions

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