

# **Black Box**

**By Act Labs**

This instruction manual is divided into three sections. Firstly is a basic overview to introduce you to the Black Box and to identify the different parts. Secondly we will deal with the installation of the various components and thirdly there is instruction on how to use the Black Box for video overlay, flight data recording and finally how to use the included software. So find a good place to relax, put your feet up and start to get familiar with the many features of the Black Box.

## **Overview:**

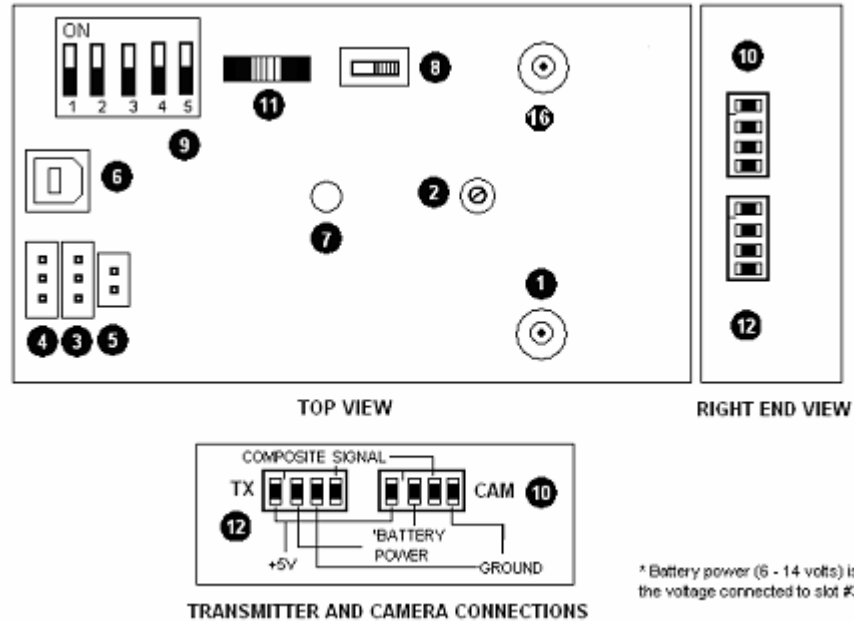
OK, lets get started with a brief overview of the all new Act Labs Black Box or BB for short. The BB is a remarkable piece of electronic engineering designed for you, the radio controlled enthusiast. I am sure that most of us, at one point or another have often thought to ourselves questions such as, “I wonder how fast my plane is flying?” or “How high is it really flying up there?” These questions and many more are answered with the BB.

The BB serves a dual function. Firstly, it can be used for video overlay which means it will display useful information about your aircraft right on top of a video picture when hooked up to an external video source (via the included RCA composite connector). You can also turn off some of the display features if for some reason you do not wish to monitor them. Not only will the display show your given altitude and speed but the BB will display your radio receiver battery in volts **and** an additional battery source such as an on board power supply for your miniature camera or wireless video transmitter. To top it off, the OSD (On Screen Display) can be shown in Metric or Imperial measurements!

The BB has some unique features and is very user friendly. For example, each of us fly our model planes at different locations throughout the world, meaning we are at different altitudes. The folks at Act Labs were aware of this and developed the BB so that the altitude sensor can be adjusted to zero before you fly, therefore what you see displayed is the actual AGL (Above Ground Level) altitude reading and not your above sea level altitude. Sounds great.....well there is more.

Secondly, the BB is a flight data recorder and your flight information can be record up to 106 minutes of data into its 64K internal memory. This information can them be downloaded with the included USB cable to your home or lap top computer. The data from the flight recorder can then be played back using the data recorder software so you can watch and save the information played back on the miniature cockpit gauges.

# Layout

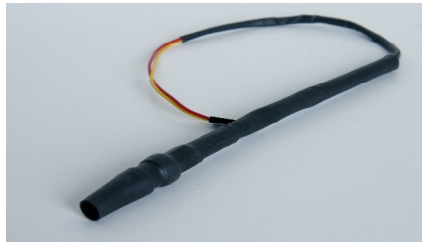


- 1) Speed sensor nozzle
- 2) Altitude sensor calibration
- 3) Battery power connection
- 4) R/C receiver battery monitor connection
- 5) RPM measurement connection
- 6) USB cable connection
- 7) LED indicator
- 8) USB-OFF / ON power switch
- 9) On-screen display settings DIP switches
- 10) Camera connection
- 11) Calibration / Record switch
- 12) Camera transmitter connection
- 13) Altitude sensor nozzle

Alright, lets get to know the components that are included with the BB.



Black Box



RPM Sensor



Pass through power & video cables.

Pass through power & video with RCA style connector

USB Cable

## Installation Steps

### Black Box:

There are a few things to consider before we begin installing the BB and its components. Carefully read through these instructions before beginning your installation. Remember that installing the BB will be different for each model, whether for a fixed wing or rotary aircraft so these instructions are a guide to help you with your particular aircraft design.

Although very light at 62g or 2.18oz it is recommended that the Black Box be installed on or close to your models centre of gravity. On small electric planes this is particularly true. Remember, a nose heavy plane flies poorly and a tail heavy plane flies once!

The Black Box itself can easily be installed using rubber bands or Velcro. When installing into an internal combustion powered model it is recommended to use ¼" rubberized foam as a vibration isolator which is readily available at your local hobby store.



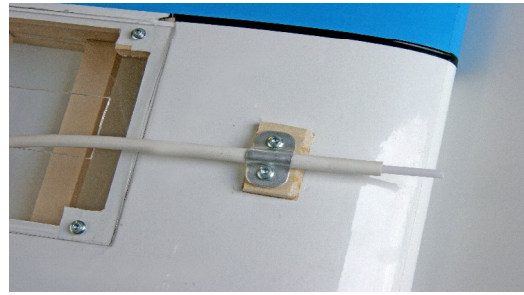
If possible, locate the BB where you have good access to it allowing you to easily adjust the altitude setting screw and other features without having to dig deep within the depths of you model! As you can see from the picture, having ease of access will make things a lot easier.

## Pitot Tube

When planning the installation of the pitot tube there are two important things to remember.

A) the pitot tube must be outside of the propellers arc or you will not get accurate readings and  
B) the least amount of bends and turns that the tubing makes the better. A kinked pitot tube will not provide any speed readings.

Once you have decided on a location cut a length of the plastic extension tubing and insert it into the end of the flexible pitot tube so that it will remain in the proper air stream (see pictures), we don't want any floppy pitot tubes!



The above pictures show a very simple but effective way of installing the pitot tube to the underside of the wing panel, outside of the propeller arc. The tubing is carefully positioned through the wing panel and then into the fuselage to the BB with the least amount of bends as possible.



In this pusher plane configuration the installation is very simple as there is no engine in the way and the pitot tube can exit right out the nose of the aircraft.

The pitot tubing can be cut to the desired length and then secure it to the Speed Sensor fitting on the BB by gently pushing and turning the tubing till it fits nice and snug on the fitting.

## RPM Sensor

The RPM sensor has a photo cell inside of the tubing to shade it from direct light. The end of the tubing needs to be located no closer than 1/2" to the propeller.

There are several methods that can easily be used to hold the RPM sensor in place such as nylon zip ties, small U shaped clamps and a blob of silicone. Again, your particular installation will determine your best method. Just be sure that the sensor is securely fastened to your model so there is no chance of it getting entangled. The opposite end of the RPM sensor is plugged into the corresponding port on the BB, it does not matter which way round it is installed. In the illustration to the right you can see that the RPM sensor has been installed using a blob of clear silicone.



### Altitude Sensor

The altitude sensor fitting on the BB does not need to have any tubing attached to it as it works using air pressure. If you wish to install some tubing left over from the pitot tube that is fine as long as you do not have the exposed end in direct airflow. A length of tubing laying in the bottom of the fuselage is fine but is not necessary.

### Receiver (RX) Battery Voltage Monitor

The BB has the ability to display the voltage of your radio receivers voltage which is particularly useful if you are flying for extended periods. As we all know, there are a few brand names of radio manufactures and their cable ends are different. For this reason you will need to make up your own cable to go from the RX to the BB. The “prongs” in the BB are similar to that of your radio system so it is easy to make a custom cable to fit. The polarity is clearly marked on the BB.

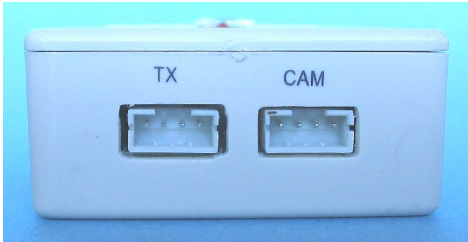


The top connection is for your RX battery voltage. The middle connection is to monitor the power to the BB. The bottom connection is for the RPM sensor.

A minimum of 6 volts and a maximum of 14 volts is required to operate the BB.

## Camera & Wireless Transmitter Connections:

On the end of the BB you will see two ports marked “TX” & CAM” for the corresponding supplied leads. Act Labs has supplied 2 simple plug n play cables to connect your camera and wireless video transmitter to the BB. Simply plug in the corresponding leads into each port. Each lead is fitted with an RCA style composite fitting. If you do not want to use RCA connectors then just use the supplied leads that have no connectors and install the connectors of choice. Some modelers have been using common servo connectors as they are less bulky. The choice is yours.



## Set Up:

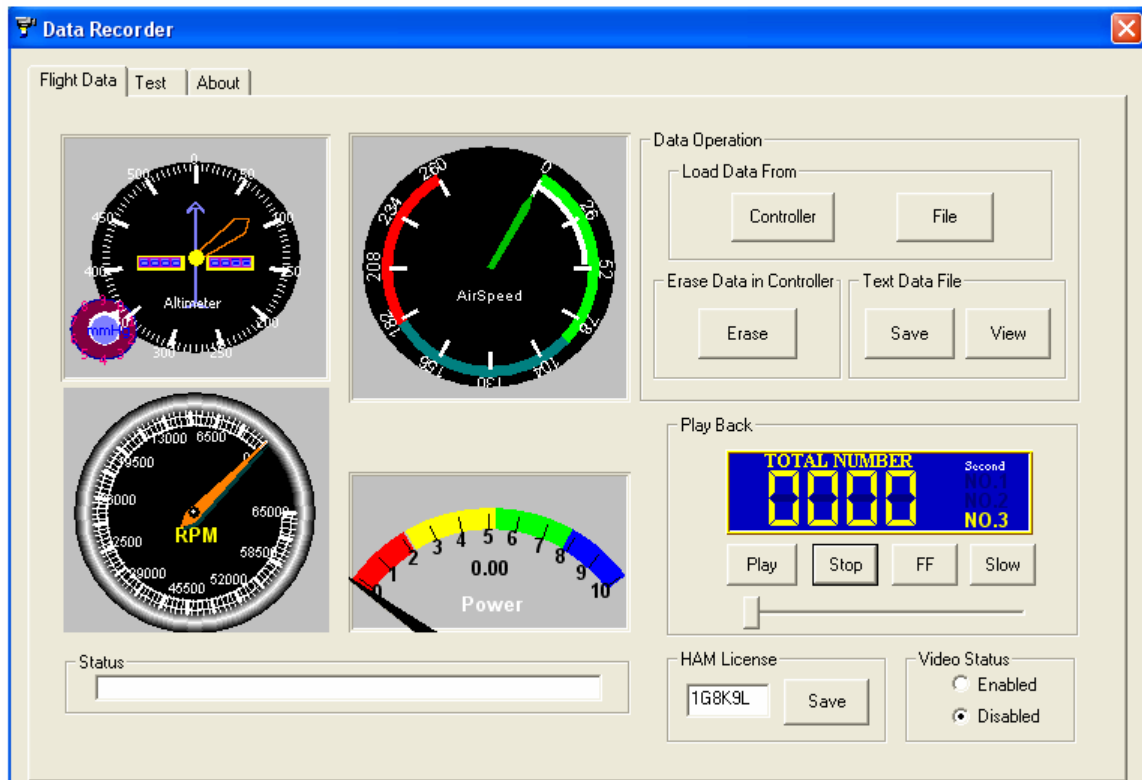
Well that pretty well wraps up the installation of your BB. Before you go any further you need to install the BB software. **NB: Follow the instructions on the next page and note that unless you check the video status to “Enabled” you will not get any video image from on your monitor, only the telemetry information.**

Following the section on the software you will find the instructions to complete the set up for your BB. You should calibrate the altitude sensor each time you go to your particular flying site.

## Installing the software

Install the Black Box software onto your computer. Connect the Black Box to your computer using the supplied USB cable. Move the USB select switch to the “ON” position. At this point the LED will start to blink slowly.

Run the flight data recorder software. Under the Windows Start menu, click on START->Programs->Blackbox->Data Recorder. It is quite possible that you will receive the “EEPROM CONTROLLER NOT FOUND” message, click “OK” The flight data menu will greet you as shown below. This menu gives you loading, saving, play-back, data erasing, custom text, and video options. It can play back the speed, altitude, voltage, and rpm values of one session you recorded.



**Controller** button: Press this button to load the flight data from the Black Box so it can be played back using the “Play Back” controls.

**File** button: Use this button to load a previously saved file to be played back using the “Play Back” controls.

**Erase** button: Use this button to erase the entire data memory on the Black Box telemetry unit.

**Save** button: Press this button to save all the flight data from the telemetry unit into a text file on your computer. The file will have the speed, altitude, rpm, and voltage aligned in columns.

**View** button: Use this button to view a previously saved data file from your computer.

**Play Back** buttons: Use these buttons to view the flight data on the dials and meters.

**Status** box: This box will indicate the status of any read or write operation.

**HAM license:** Input your HAM call sign (FCC ID) or any other six alphanumeric characters into this box and press “Save” to transfer it to the telemetry unit where it will show up on the bottom left corner of a monitor. Your HAM call sign can only have a maximum length of six alphanumeric characters. You can also put custom alphanumeric text but the length is also limited to six characters.

**Video Status:** This box indicates whether the video image coming from your video camera (if attached) is turned on or off. **To get video from your camera to be displayed on your monitor you must check the “ENABLED”** button or you will not receive a picture on your viewing monitor.

### **Loading Data from Black Box for Playback**

To load the data from the telemetry unit for playback, press the **Controller** button. The message “Loading data from controller successful!” will appear in the status window if the data was downloaded correctly. If there is no data recorded, you will get the message, “No data in memory.” Otherwise, you will get the error message, “Something wrong with loading.” In this case, try clicking the Controller button again or check the USB cable connection. Data from a saved file can also be loaded for playback by pressing the **File** button. The numbers under **Total Number** are the seconds elapsed.

### **Saving Data from Black Box**

To save the data from the telemetry unit to a text file on the PC, press the **Save** button. If the data was already loaded by pressing the **Controller** button, then the file will be saved instantaneously. Otherwise, the data will be loaded from the telemetry unit first and then saved to a file. The time required to load and save the data is dependant on the amount of data recorded.

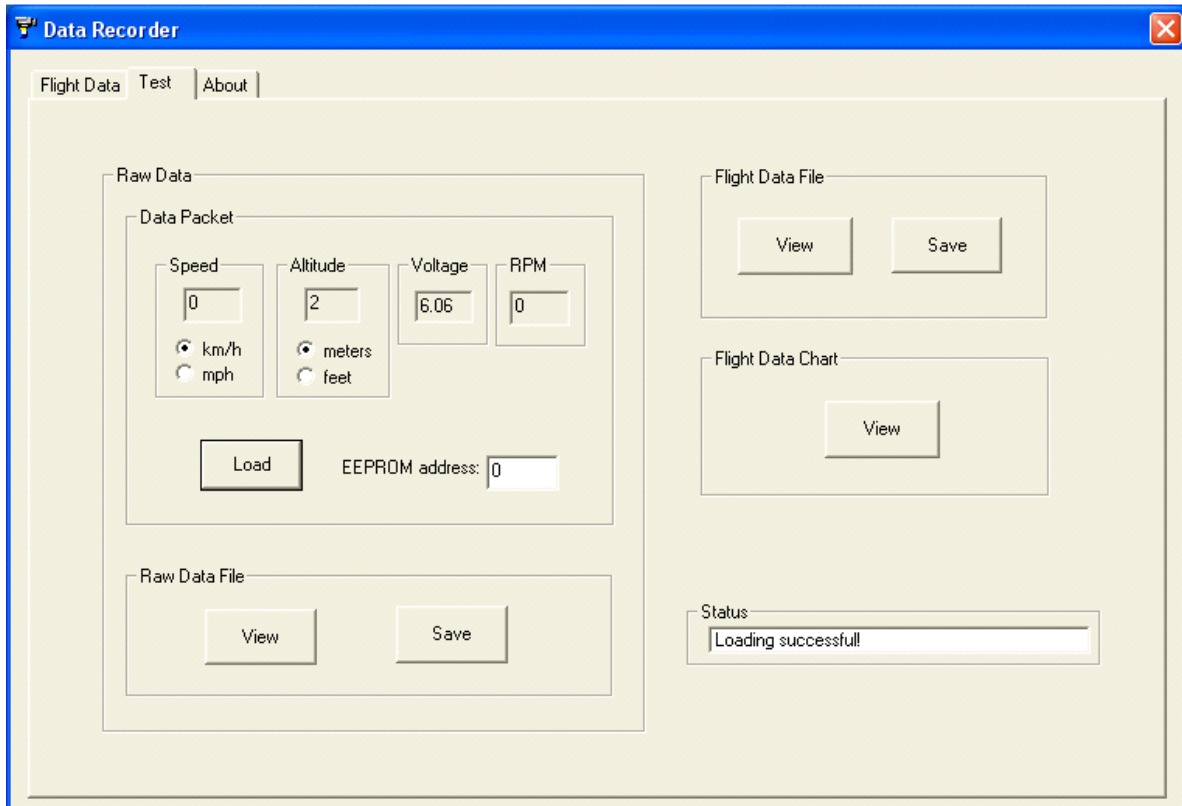
### **Erasing Data on Black Box**

To erase all the data recorded on the Black Box unit, press the Erase button. Wait until you get the message, “Erasing successful,” before doing any other operations.

### **Viewing Data**

To view all of the unmodified data downloaded from the Black Box unit, click on the **Test** tab. This menu lets you view all the raw and processed data. The processed data, or Flight Data, contains only the speed, altitude, voltage, and rpm values.



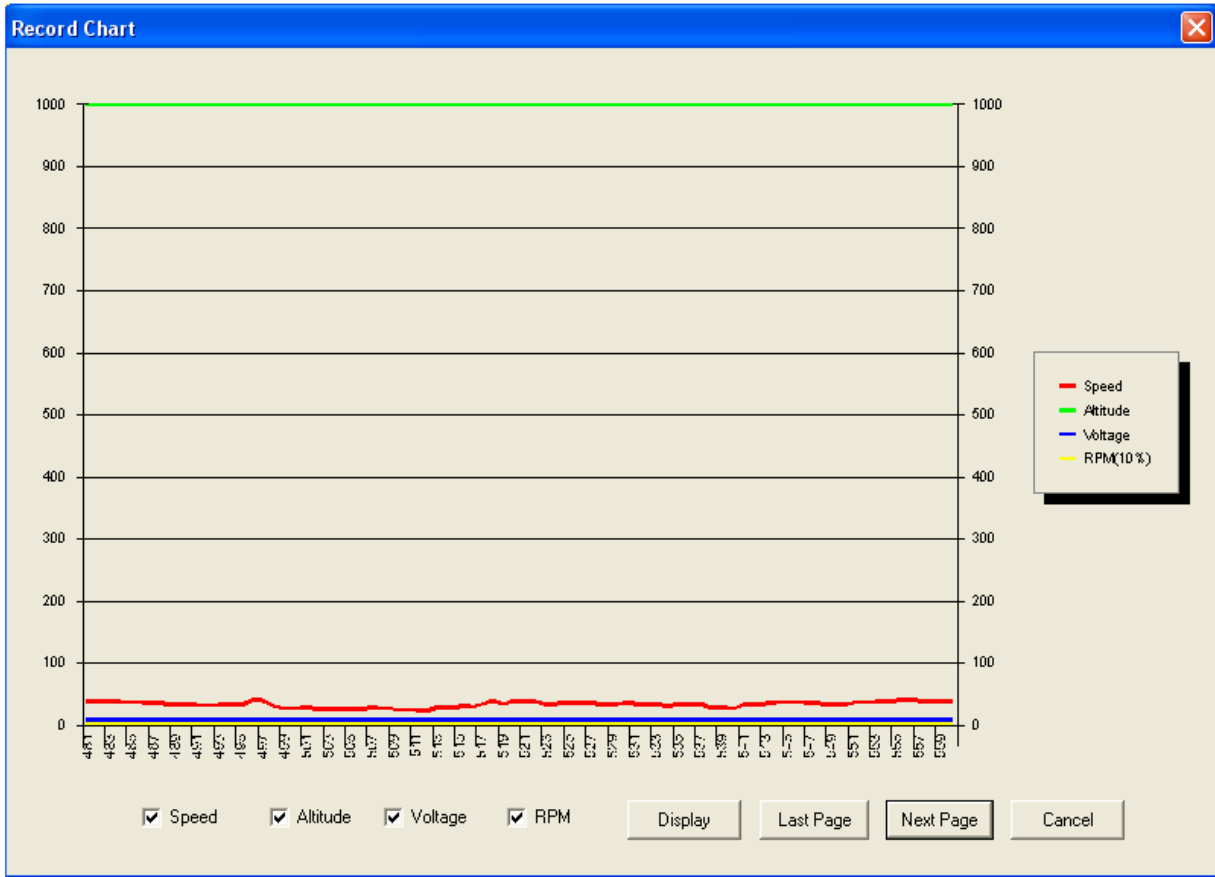


.To view a packet of data, input a value that is a multiple of ten (i.e. 10, 20, 30, etc.) into the EEPROM address box and click on the Load button. One packet of data is recorded once per second. One packet contains speed, altitude, voltage, and rpm data.

To save the raw data, click on the **Save** button in the **Raw Data File** box. Choose a filename and click on save. Then click on View and choose the filename to view the file. You can edit this file as required. The raw data file contains all the unformatted memory addresses, data, and packet numbers.

To save the processed data, click on the **Save** button in the “Flight Data File” box. Choose a filename and click on save. Then click on View and choose the filename to view the file. You can edit this file as required. The processed data contains the formatted flight data that can be readily graphed.

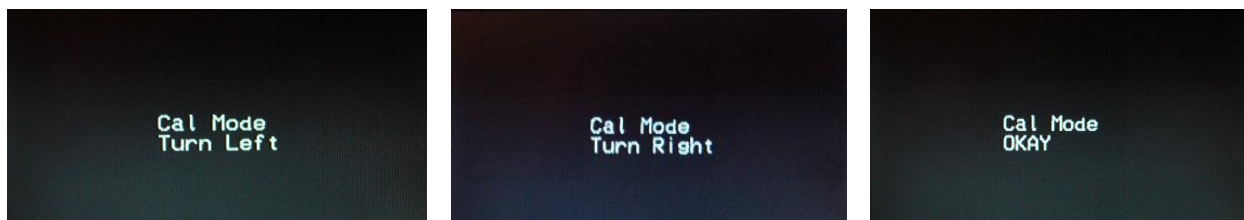
To view the processed data in chart form, click on the **View** button in the Chart box. A previously saved “Flight Data” file is required to view the chart.



Flight Data in Graph Form

### Calibrating the Black Box Altitude Sensor

You can calibrate the Black Box with the aid of your video monitor or by watching the red LED light. Move the REC/NORM/CALIB switch to the "CALIB" position. Looking at your monitor you will see one of the displays shown below. By using a small flat blade screwdriver simply turn the "ALTITUDE ADJUST" screw in the Black Box in the direction shown. The Altitude calibration is set once you see the "OKAY" display

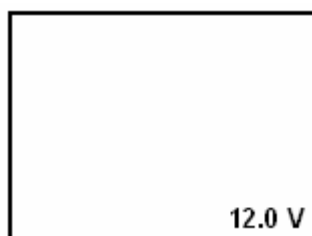


If you do not using a monitor you can also calibrate the altitude by watching the flashing LED light.  
Blinking LED rapidly = turn left  
Solid color LED = turn right  
LED off = calibration successful

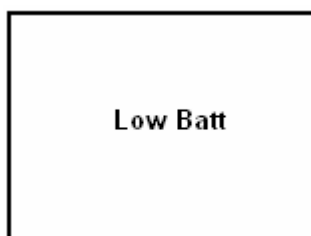
Note: It is recommended to calibrate the altitude sensor before your flight session at the flying field for best altitude readings. Once the altitude has been calibrated to zero it will only display altitude to a maximum of 1000 feet.

### Battery power connection

Connect your battery for the Black Box R/C Telemetry Unit to this port. A minimum of 6 volts and a maximum of 14 volts is required to operate this unit properly. We suggest using a battery containing five cells of 1.2V each for 6V operation. The battery power will show on a monitor (if connected) as follows:



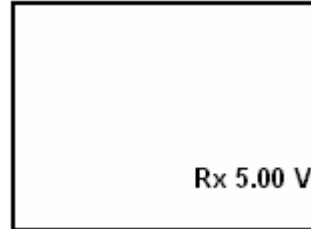
When the battery goes below 5.5 volts, a low battery warning will appear on a monitor:



**WARNING:** When the low battery warning appears, the data may be inaccurate. Change the battery as soon as possible to avoid inaccurate data.

### R/C RX battery monitor connection

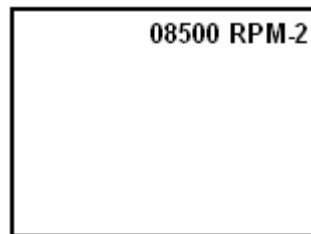
Connect your R/C receiver battery to this port (top port) to monitor its voltage. The R/C receiver battery voltage can be seen on a monitor (if connected) on the bottom right hand corner as follows:



*Caution: If the low battery warning appears, the R/C receiver battery voltage readings may be inaccurate.*

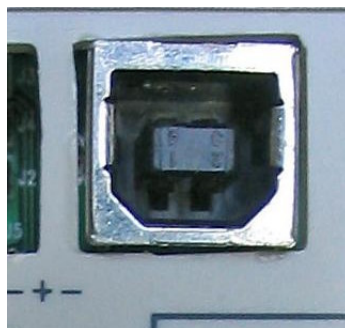
### RPM measurement connection

Connect the included RPM sensor to this port to monitor the rpm (revolutions per minute) of your R/C aircraft propeller blades. This sensor should point directly at the blades with a minimum clearance of one inch. The rpm sensor will only work properly outdoors with natural lighting. The rpm of your R/C aircraft propeller blades is shown on a monitor as follows (the number after the hyphen indicates the number of propeller blades on the aircraft,



### 6) USB cable connection

Connect the included USB cable to this port to retrieve the recorded data from the Black Box R/C Telemetry Unit to your PC. The USB-OFF/ON power switch must be on the USB- "ON" position in order to power the unit from the USB port. The battery does not need to be connected to download data from the Black Box unit. The red LED will continuously blink while the Black Box unit is connected and enumerated properly by the computer. If a monitor is connected, the word "USB" will appear on the bottom center of the screen.



## LED indicator

This red LED indicates calibration, data recording, memory erasing, and USB status.

Blinking LED = turn altitude potentiometer left; or recording in progress; or USB connection made.

Solid color LED = turn altitude potentiometer right or battery-powered operation.

LED off = calibration successful.

## USB Power Switch

When the Black Box is hooked up to your computer using the USB cable the switch needs to be in the “ON” position. You should remove the Black Box battery supply from the unit when the USB cable is in use.

## On-screen display settings DIP switches

These five switches are used to control the display of the speed, altitude, rpm, and voltage on the Black Box R/C Telemetry Unit.



Switch 1 = R/C receiver and Black Box battery voltage displays, ON = display on, OFF = display OFF

Switch 4 = Speed/altitude display, ON = display on, OFF = display OFF

**Switch 4 is also used in conjunction with the calibration/record switch for other functions. See #11 below.**

Switch 3 & 2 = RPM blade configuration

Switch 3 ON / switch 2 ON = 3 blade propeller rpm measurement

Switch 3 ON / switch 2 OFF = 4 blade propeller rpm measurement

Switch 3 OFF / switch 2 ON = 2 blade propeller rpm measurement

Switch 3 OFF / switch 2 OFF = no rpm display

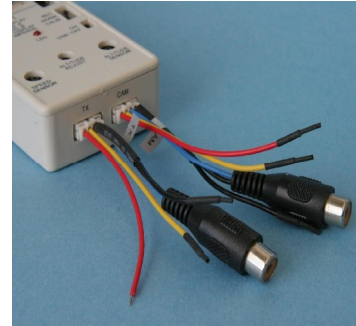
Switch 5 = Unit conversion, ON = km/h & m, OFF = mph & ft

**Switch 5 is also used in conjunction with the calibration/record switch for other functions.**

**NOTE: Whenever a parameter (i.e. speed, altitude) is not displayed, that parameter will not be recorded into the memory if data recording is activated.**

### Camera connection

Connect a wireless camera with separated 5-volt power, ground, and composite wires into this socket. This socket can supply power for either a 5 Volt or 6-14 Volt camera (using the unit's power source) with a maximum current usage of 350mA. Secure the camera to the vehicle or aircraft to prevent vibrations from affecting the video signal quality. Alternatively, the CAM composite video adaptor can be used for an RCA video input connection. The following illustrates the CAM composite video adaptor.



### Calibration / Record switch



This 3-position switch is used to switch between calibration mode and record mode. Used in conjunction with DIP switches 5 and 4, it can also erase the data memory and turn on/off the camera video, respectively.

Down position = Altitude sensor calibration mode (CALIB).

Middle position = Normal (NORM) operating mode

Up position = Data record mode (REC) (record data such as speed, altitude, rpm, and voltage). Whenever there are numerous record sessions, the data will not be overwritten. The data will start recording from the last point and continue until the memory is full. If the memory is full, the following will appear on the monitor:



**NOTE:** whenever a parameter (i.e. speed, altitude) is not displayed, that parameter will not be recorded into the memory if data recording is activated.

Left position and DIP switch 5 = data memory erase option. To erase the memory, move the calibration/record switch to the left position and then move DIP switch 5. If a monitor is connected, it will display the message,

A rectangular box with a black border containing the text "Cal Mode Erase MEM?" in a bold, sans-serif font, centered within the box.

Move DIP switch 5 again to confirm erasing of the memory or move the calibration/record switch to the middle position to cancel. When erasing the memory, the following message will appear on the monitor,

A rectangular box with a black border containing the text "Cal Mode Erasing ..." in a bold, sans-serif font, centered within the box.

When the memory is erasing, the red LED will show no indication. Please wait at least 20 seconds before moving any switches.

Left position and DIP switch 4 = camera video on/off switch. This switch is used to turn the video from the wireless camera (not included) on or off. To turn the video on or off, move the calibration/record switch to the left position and move DIP switch 4. The following message will be displayed (if monitor is connected).

A rectangular box with a black border containing the text "Cal Mode Switch Video?" in a bold, sans-serif font, centered within the box.

To turn the video on or off (depending on current status), move DIP switch 4 again or move the calibration/video switch to the middle position to cancel.

***Note: If the camera video is turned on and the camera is not connected, nothing will be displayed on the monitor. Switch off the camera video to see the on-screen display.***

***Note: The video status setting is saved into the onboard memory. If the onboard memory is erased, the video will default to off (no camera video).***



### Camera transmitter connection

Connect a wireless camera transmitter with separated power, ground, and composite wires into this socket. This socket can supply power for either a 5-volt or 6-14 volt (using the unit's power source) transmitter with a maximum current usage of 500 mA (see layout diagram). Secure the transmitter to the vehicle or aircraft to prevent vibrations from affecting the video signal quality. Alternatively, the TX composite video adaptor can be used for an RCA video output connection directly to a composite display. The following illustrates the CAM composite video adaptor.



Parameter	Min.	Max.	Units
Supply Voltage	6	14	V
Operating Current	90	150	mA
Altitude Measurement range above Sea Level ** (The black box altitude sensor will operate at the highest level of 15000 ft above sea level. Above this it will not function properly limited to the atmospheric pressure. But the altitude reading range that it will display will be from 0 to 1000 ft when it was calibrated/zeroed.)	0 0	15000 4572	Ft M
Altitude Pressure	2.2 15	16.7 115	psi kPa
Altitude Resolution	-	4	Ft
Speed Measurement	29	185	Km/h
Speed Pressure	0 0	0.57 3.92	psi kPa
Speed Resolution	-	1	Km/h
RPM Measurement	40	65000	RPM
Battery Measurement	0	9	V
Camera Supply Voltage	-	5	V
Camera Supply Current	-	350	mA
Transmitter Supply Voltage	-	5-15	V
Transmitter Supply Current	-	500	mA
Recording Memory	-	64	KB
Recording Time	-	~106	min
Memory Erase Time	-	~19	sec
Operating Temperature	0	+70	°C
Storage Temperature	-30	+75	°C
Size	-	3.5 x 2 x 0.75	in.
Weight	-	~2.1	oz.