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anywhere between 1 +/- 2 meters/second. That is, the glider could be climbing at 1 meter/second or sinking at 3 meters per second. There isn't enough accuracy in the calculation to know what the true sink rate is. Without more accuracy, the only way to address this is to take measurements farther apart – which requires more time so one can get an average sink rate. The FlyBoy® vario does not do any averaging – it responds with sound within a second to any change of altitude of ½ foot or more. Users will experience few if any "false positives". The graphs of altitude vs. time and glide path will usually be smooth and without "jaggies".

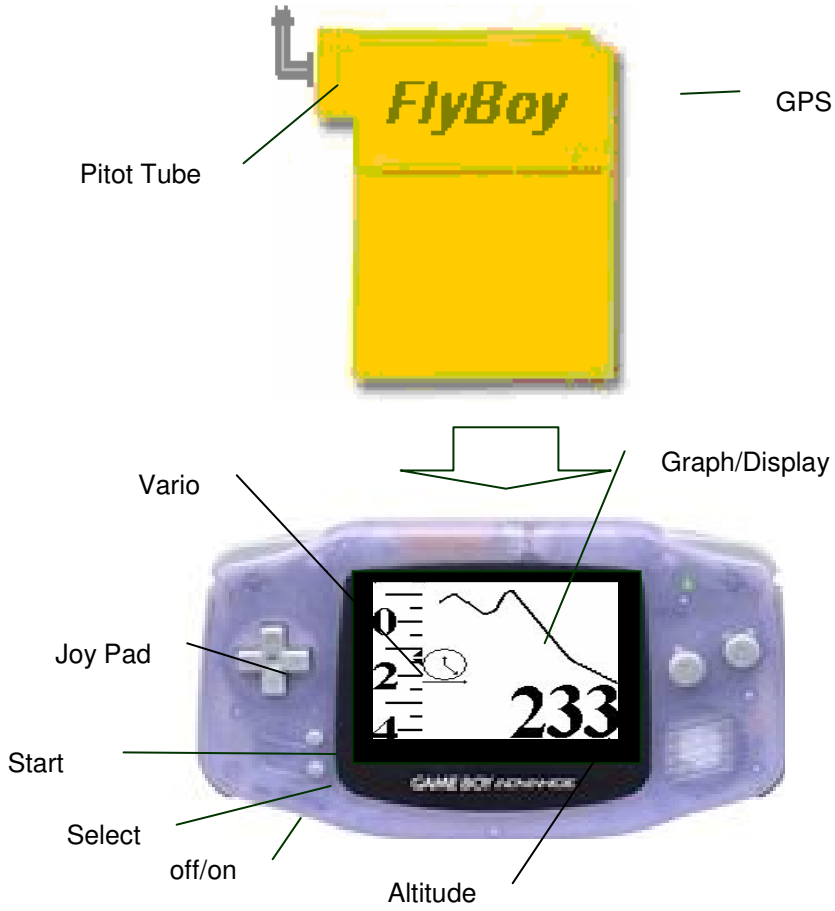
- How long do the batteries last?

That would depend upon the amount of time that alarms are sounded, and the type of GameBoy®. We have tested the GameBoy Color® with two 2000mH AA NmH batteries sitting on a desk. It ran for 24 hours before the batteries went dead.

- Why does the graph line have "gaps" in it.

The GameBoy® has an internal bug which prevents more than 10 "sprites" to be displayed on the same line. In the FlyBoy® vario, this manifests itself as "gaps" in the graph when the graph is a level horizontal line. This would be quite annoying but for the fact that in practice it only occurs when the glider is on the ground and not climbing and/or sinking for a couple of minutes. In practice it is almost never a problem.

Basic Operation



With power off, insert the FlyBoy® vario cartridge as you would any GameBoy® game. Attach the nylon pitot tube and orient it in the desired direction. Turn on the power. The FlyBoy® starts with a calibration phase which lasts about 30 seconds. During this time one should keep the instrument sheltered from windy ground wires. The FlyBoy® has circuitry to protect against inverting these signals so this cannot damage the unit. RS232 cables generally have two wires labeled data out and data in. Unfortunately, in/out depends which way one is looking at the connector. If you think your connecting to out, try connecting to in instead.

- Cables for OEM units might be confusing. If you've made connections according to OEM Interface 1 above, try connecting according to OEM Interface 2 instead. Likewise, if you've used Interface 2, try Interface 1 instead.

- Power consumption for OEM GPS will vary a lot depending on the unit. The GameBoy® can supply 60 ma of power to an external unit. If more than this drawn from the GameBoy, the unit may shut down. In order to use such a GPS, power will have to be supplied by other means and the 0/5 volts supplied on the FlyBoy® connector should be left unused.

- Voltage requirements for OEM GPS vary a from unit to unit. The FlyBoy® vario supplies 4.5-5.0 volts through its GPS connector. Verify that this is compatible with your OEM unit. We have tested the FlyBoy® vario with the Garmin 18 LVC and found it to function in a satisfactory manner when connected according to OEM Interface 1 from the above table.

- Remember that the GPS takes some time to "sync" and produce valid response. Make sure your testing with a "hot" GPS which has had time to find its current location.

Frequently Asked Questions

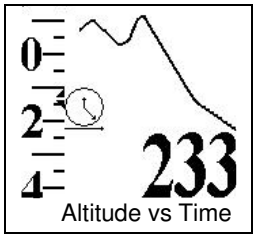
- Why the GameBoy®?

The fundamental goal of this instrument is to provide the most "Bang for the Buck". In this context that means providing the

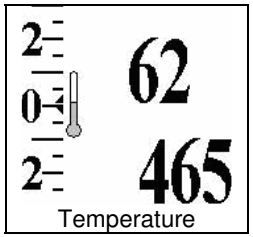
Graph Display Selection

Basic Displays

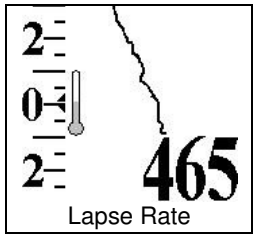
All FlyBoy® varios include the following three basic displays. One can navigate between the displays using the left/right buttons of the GameBoy joypad.



Altitude vs Time



Temperature



Lapse Rate

Altitude vs. Time

Each vertical dot represents one meter of altitude change. Each horizontal dot represents one second. The graph is 128 dots wide so this graph shows the climb and sink for the last 128 seconds. A 45 degree slope will correspond to 1 meter per second (180 feet per minute).

Temperature

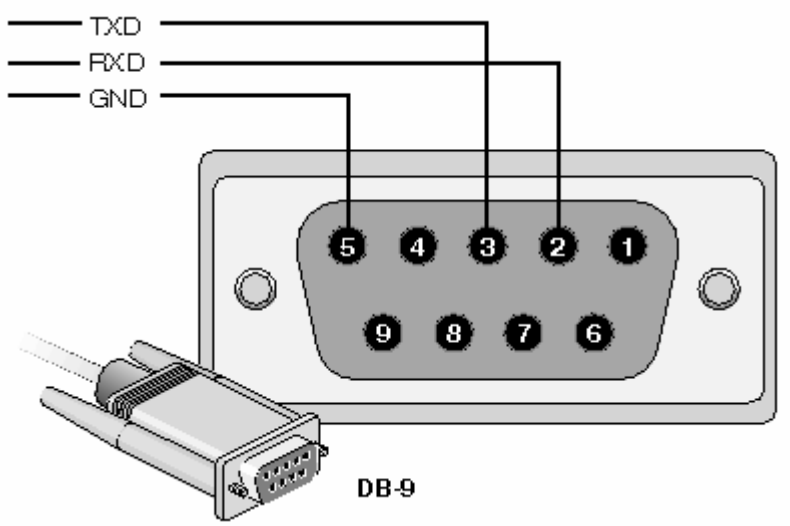
Current temperature in degrees Fahrenheit or Celsius.

Lapse Rate

Temperature vs. Altitude. Each vertical dot represents 10 meters of altitude and each horizontal dot represents 1/16 degree Celsius. Since the graph is 96 dots high, this shows the temperature for the 960 meters (3168 feet) around the current altitude.

RS-232 Serial Connection

This is currently the most common type of GPS output. It is often used to connect the GPS to a PC. Typically, the GPS cable will terminate with female DB9 connector as shown here.



Only two wires need be connected to the FlyBoy® from the GPS. If this is currently attached to a female DB9 serial connector designed to be attached to a PC then

- Locate the signal ground on the GPS output cable. This should be found on pin 5 of that connector. Connect this to pin 3 of the FlyBoy® GPS interface.
- Locate the transmit data signal (TXD) on the GPS output connector. Connect this to pin 2 of the FlyBoy® GPS interface.
- Jumper signals on pin 3 to pin 5 on the USB connector with a separate piece of wire. This can be done inside either end of your connector cable.

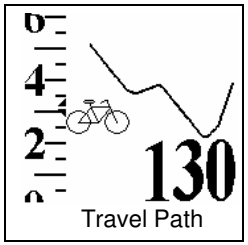
the ground before launching, this display should show a number which approximates the stall speed of the glider. Below, we explain how to set the glider stall speed in the FlyBoy®.

Wind Velocity

Current wind velocity in either miles or kilometers per hour. Note that this is a very accurate measure of wind velocity. This can be verified by walking with the instrument indoors and reading your airspeed. It can be handy for checking wind direction before launching. It differs from Airspeed above, in that there is no adjustment made for the fact that the glider induces a change static pressure under its wing. It is not useful when the glider is in flight.

Global Positioning System

If a GPS unit has been connected to the FlyBoy® and GPS option has been enabled, the following group of displays is available. One navigates



Travel Path

Groundspeed

Wind Direction

Travel Path

This is the true glide path over the ground. It is differs from the glide path in that the horizontal distance is taken from the GPS input. Adjusting glider pitch to “flatten” the slope of this line will maximize distance traveled over the ground for the current air conditions. That is, Lift/Sink as well as Tail/Head wind will be taken into account. The path traced by the graph is the path the glider follows as would be seen by and observer from the ground.

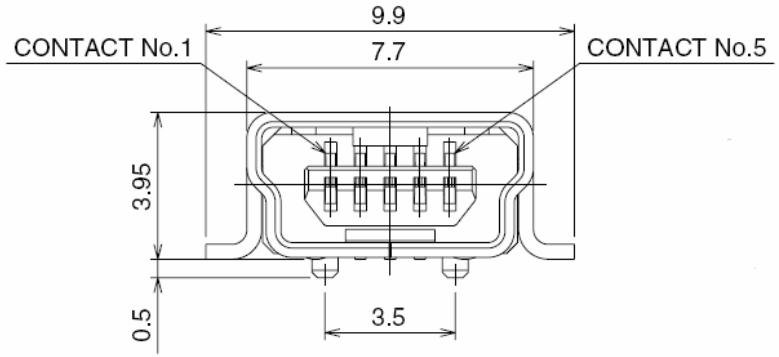
Pitot Tube Installation

The left side of the FlyBoy® has a threaded 1/8 inch barbed elbow. This is the entry point for the Pitot tube. The Pitot tube itself is a 1/8 inch inside diameter nylon tube. Alternatively, a 1/8 flexible PVC tubing can be used to route Pitot tube input from any convenient location.

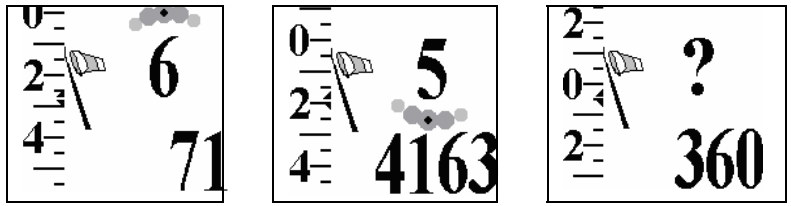
GPS Connection

The right side of the FlyBoy® has a female USB connector for serial data input. Note that this is NOT a USB input. This connector was selected merely for it’s convenient form factor and other features. Do NOT connect the FlyBoy® to a USB port with this connector. This could result in damage to the FlyBoy®, GameBoy®, or the computer it is connected to. To connect your GPS to the FlyBoy®, one will generally need to make a custom cable based on the pin outs of the GPS and pin outs of the FlyBoy® GPS connector as described below.

Here is what the FlyBoy® GPS connector looks like as seen from the left side of the FlyBoy®. The dimensions are in millimeters. Note the pin numbers. This is a standard female mini-USB 2.0 type B connector with 5 pins.



correspond to 67% certainty and the outer dots correspond to 95% certainty in the estimate.

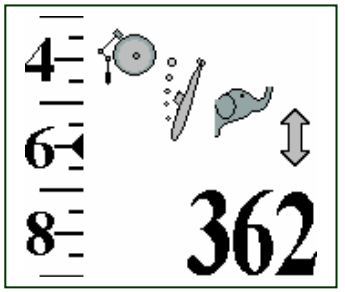


Remember that the wind direction crescent is relative to your glider's current heading. As you turn the glider, the crescent will rotate in the opposite direction so that it always shows the current wind direction. You can use this information to improve your flying skills. If you're setting up to land, you'll want the crescent at the top of the display so you'll be headed into the wind. If you're sinking out and looking for a thermal, you'll want to have the crescent at the bottom of display – indicating at tail wind. This will permit you to cover the maximum amount of territory thereby maximizing your chances of finding a thermal.

If wind conditions are unstable, there is no such thing as a "true" wind direction. The size of the crescent will reflect that this fact and provide a visual cue as to the variability of the direction. Above we see a glider landing in wind whose direction is varying +/- 25 degrees.

If the glider heading has not changed in a while, there may not be enough information to precisely calculate the wind direction and velocity. In the case of the former, the crescent will disappear. In the latter case, the wind velocity will be shows as a "?". When this happens, turning the glider should result in enough information so that reliable estimates can be regenerated.

for hang gliders to be the buzz sound with a threshold of 600 feet / minute down, the screen will look like:



- To change the alarm or sound selection navigate back to the left, change the selection and more forward to the right again.

- When a balloon is the selected aircraft, the airspeed alarms cannot be set.

- Sounds with a pitch like doodle-ooldle-do and booonnngg, increase in pitch when they are used for climb and max events. That is, as the climb rate increases, the pitch increases. Similarly, if this sound is used for the sink alarm (used by balloonists), the pitch DECREASES as the aircraft sinks faster.

- Alarms for stall and for min altitude sound three times each when the threshold is crossed. This prevents the alarm from continuing to sound once the aircraft comes in to land. It also makes this alarm useful for hang glider and paraglider pilots who want to flair at the correct instant. Naturally, using it for this purpose will require some investment in effort to select the correct alarm threshold for stall speed.

- Airspeed alarms are really measures of the dynamic pressure detected by the Pitot tube. The airspeed

Calibration and Configuration

		Calibrate altitude. Use up/down on joy pad to adjust current altitude.
		Select foreground color.
		Select background color.
		Select English or metric units.
	(see below)	Configure alarms
		Calibrate stall speed.
(see below)		Select current aircraft

The Flyboy® can be configured to taste. Enter configuration mode by pressing the Select button on the GameBoy®. One of the icons in the left hand column will be displayed. Using the up/down buttons on the joy pad, move up and down through the icons until the row corresponding to the desired setting is selected. Now navigate to the right to select this setting for modification. At this point, the display will match the second column. Using the up/down buttons, alter the setting as desired. When finished, return to the first column with the left arrow.

At any time, one can return to normal operation by pressing Start. At this point the settings are saved in the FlyBoy® cartridge. They will be reloaded every time the FlyBoy® is turned on.

Alarms

The FlyBoy® has a complete set of alarms. These alarms are pre-configured to common settings. However, many pilots will want to set these alarms according to their own requirements. To begin the process of setting the alarms, navigate to the right from the alarm icon on the configuration screen (above).

Select Alarm

Now navigate to the right to select which alarm you want to configure. By navigating up/down will select the desired alarm from the following table

	Climb	Used by soaring pilots to indicate that the glider has found lift
	Sink	Used when vario detects
	Stall	Sounds three times when the airspeed drops below a minimum threshold. Useful as a “flair alarm” for hang glider pilots
	Max Speed	Sounds whenever the glider airspeed exceeds the specified value
	Max Altitude	Sounds whenever the glider altitude exceeds the specified value
	Min Altitude	Sounds whenever the glider altitude drops below a specified value. Useful for balloonists.

Sound Selection

Once the alarm has been selected, navigate to the right and select the sound desired for the alarm by then navigating up and