AIM USB 1.2 Manual

September 30, 2009

Chapter 1

Introduction

Thank your purchasing the AIM USB altimeter. You will find that this altimeter is a "it just works" device. By making use of a USB connection to a PC or laptop, all that is left to do in the field is switch the device on. No setting of jumper switches! With a USB connection come many more useful features. These will be described later.

1.1 Intended Versions

- Hardware v1.2x
- Firmware v1.44
- Software v1.41

It is recommended that you always use the correct manual for your hardware and firmware version. If your hardware or firmware is of an earlier version, diagrams etc. may differ.

1.2 Hardware Features (v1.20)

1.2.1 Changes since the last release

None. This is the first commercial hardware release.

1.2.2 Features

- Small form factor: 95mmx25mmx15mm (L x W x H)
- Operation from 6 volts to 14 volts.
- Powerful micro-controller running at 16 MHz.
- Maximum MSL value of 13,700 meters (45,000 feet).
- AGL precision of $< \pm 6$ meters at MSL (calibrated to within 50m).
- AGL precision of $< \pm 50$ meters at maximum MSL (calibrated to within 50m).
- AGL accuracy is $\backsimeq$AGL precision because of differential measurements.

- Completely self powered when connecting to a PC or laptop.
- Two lines for firing ejection charges.
- Powerful 4 amp (continuous) MOSFETs.
- Large capacitor to make sure the device doesn't reset when firing lines.

1.3 Firmware Features (v1.44)

1.3.1 Changes since the last release

- No restrictions on flight time length.
- Adjusts ground pressure continiously reducing temprature effects and false launch detects.
- Auto end-of-launch detection, allowing full flight path recording.

1.3.2 Features

- Completely upgradable firmware, making sure you always have the latest!
- Least squares apogee detection.
- Over 6 minutes total flight time.
- No flight length restriction (up to 6 minutes).
- Connect to a PC or laptop to download flight profiles and modify settings.
- Beeps out AGL value upon detecting an "end of launch" event.
- Data stored at 0.1 second intervals.
- Data is stored in non-volatile flash memory.
- Stores data indicating which lines were fired. This can be viewed using the software provided.
- Adjusts ground pressure continiously reducing temprature effects and false launch detects.
- Auto end-of-launch detection, allowing fall flight path recording.

1.4 Software Features (v1.41)

1.4.1 Changes since the last release

- Slight changes to the general look.
- Added the ability to add comments.
- XML export for Internet upload of flight.

1.4.2 Features

- Upgrade your firmware using this software.
- Complete integration with your altimeter.
- Download and export profiles to MS Excel.
- Generates smoothed graphs of both AGL altitude and velocity (kph) using dynamic moving averages.
- Dynamic moving averages ensures all crucial features of your flights are preserved.
- Indicates which lines were fired and when!
- Allows settings to be changed on your device.
- Launch emulation allows for complete testing of device before launch.
- Pressure and altitude can be read from software.
- Ejection lines can be triggered from software.
- Battery voltage can be read from software.

Chapter 2

Hardware Installation

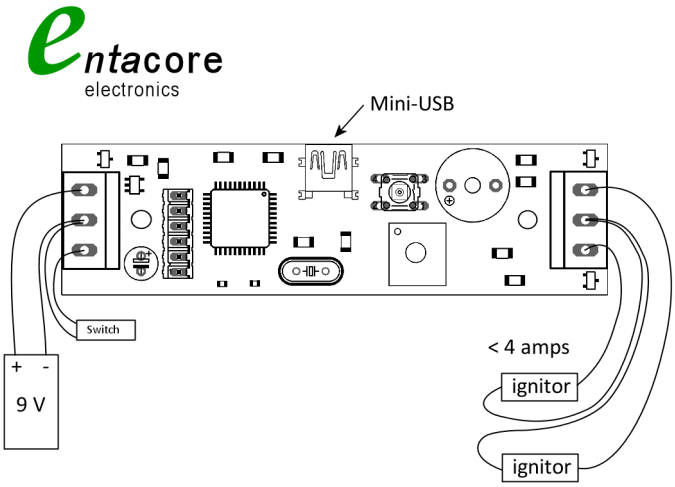

Figure 2.1: Standard configuration

2.1 Battery Power

Figure 2.1 shows the standard setup for the AIM USB device. Power is applied to the device via a terminal block on the left. The top terminal is for the positive connection and the bottom for the negative. The central terminal is a common point (it is not connected internally to the device) that can be used to connect the bare ends of your switch wire and your battery. This is not essential but is there for convenience.

2.2 Ignitors

The terminal block on the right is for the ignitors. Wire your ignitors as shown in 2.1. The top terminal is for line A, and the bottom for line B. The central terminal is the common point for

both. If you would like to test the altimeter using a polarity-sensitive device (like an LED), the central terminal is positive (+), and the outer terminals are internally grounded (-).

2.3 Board Placement

There are two mounting holes that accept standard M3 sized bolts, with enough room for a nut on the top side of the board. Be very careful when securing the PCB (printed circuit board). There should be no conducting surfaces touching any connectors on the board. Most of the board is covered with a green insulating solder mask, but this layer is thin and can be easily damaged. It is therefore recommended that the device be placed on a insulating piece of foam or similar protective layer. The board is free of components on the underside to facilitate this kind of mounting.

2.4 Pressure Port

Make sure to include a pressure port so that external pressures may be sensed by the device. A derivation of calculating the pressure port diameters is given.

2.4.1 Port size

For a certain volume to equalize, a hole with a certain area is required. If we double the volume, we have to double the area of the hole. This means that the area of the hole is directly proportional to the volume of the chamber where the altimeter is located.

$$nA \propto V \tag{2.1}$$

$$d_n \propto \sqrt{\frac{V}{n}} \tag{2.2}$$

$$d_n = k^{'}\sqrt{\frac{V}{n}} \tag{2.3}$$

$$d_n = k^{'}\sqrt{\frac{\pi(\frac{d}{2})^2 l}{n}} \tag{2.4}$$

$$d_n = kd\sqrt{\frac{l}{n}} \tag{2.5}$$

Where d_n is the diameter of the hole, n is the number of holes, k is a constant, d is the diameter of the body tube and l is the length of the chamber. We have found a value for k of 0.01 to work well with the AIM USB altimeter.

Chapter 3

Before the Launch

3.1 Testing

Please ensure that you have fully tested your altimeter and also its integration into your rocket. Although all units are fully tested before shipping, it is highly recommended that you test all aspects of the device, especially the ability to supply enough current to the ignitors.

3.1.1 Basic system test

To test that the device is picking up pressure changes, turn on you altimeter (with no ejection explosives attached). Wait for the device to run through its pre-launch checks (see 4.1) and then the "ringing" to indicate that the device is ready for launch. Suck on the pressure sensor through a straw with a long steady increasing and then decreasing suction, as if to emulate a launch. The first thing to listen out for is the "launch detect". The ringing will stop when the device has detected a launch. When completed the device can be turned off and plugged into to the PC. You should be able download a graph (it will obviously look nothing like a rocket launch).

3.1.2 Software testing

A full test can be performed from the software. There are options available to read the pressure, fire the ejections (highly recommended test) and also check the battery voltage.

3.1.3 Emulation

You can emulate a launch as if it were real data being received by the altimeter. This will show you exactly where you can expect to see your ejections being fired. To emulate a launch you will first need to open an *aim* data file. There should be a pre-recorded file supplied with the release of this manual.

If you connect LEDs or buzzers in place of real ignitors you will be able to see these activated during emulation. You can use real ignitors, but for your safety do not use the complete explosive charges - only the actual ignitor elements.

Chapter 4

On the Launch Pad

4.1 Device Beeps

Once on the launch pad, after all wiring has been done, the device can be turned on. The device will produce a series of beeps to indicate its status.

If the device produces a long 4 second beep initially, then the settings on the device have reverted back to their default values. This can occur if the settings are corrupt (the device was disconnected while settings were being written), or if a new firmware version was uploaded.

There are 4 standard checks which are run when the device starts up. 3 short beeps indicates success, while 3 longer beeps indicates failure.

1. Free memory: Success indicates that over 1:30 is available for flight recording. If there is less time available, the device will still record data until it is completely full. All other functions will remain unaffected, such as firing ejections etc.
2. Battery voltage: Success indicates the the battery voltage is above the minimum setting (default minimum is 8.4 volts).
3. Line A continuity
4. Line B continuity

4.2 Retrieval

Once your rocket has been retrieved, your altimeter should be beeping out the altitude in meters. 1 meter is approximately 3.3 feet. The altitude is beeped out in digits. Wait for a long pause so as to make sure you are at the beginning of the beep-out cycle. Count the number of beeps between pauses to obtain the value of that digit. If the digit is a "0", a short beep will be heard. As an example, 2103 meters will be represented as:

beeeep, beeeep	beeeep	beep	beeeep, beeeep, beeeep
2	1	0	3

Chapter 5

After the launch

When you have completed a launch, you can download the data onto any PC with a USB connection (running Windows). You can export the data to excel for further analysis. There is also an option for exporting to .xml which will allow you to share your launches with other rocket enthuaiasts around the world!

Please upload your flights!