AIM USB 4 Manual

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Chapter 1

Introduction

Thank you for purchasing an 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.

Please download the AIM USB software from *www.entacore.com/electronics* to access all the features of your altimeter.

1.1   Intended Versions

- Hardware v4.0x

- Firmware v4.00

- Software v4.00

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

1.2   Hardware Features (v4.00)

1.2.1   Changes since the last major release

- Smaller PCB size (65mm x 25mm)

- Expanded altitude limit to ~30 km (100k feet)

- Improved pressure sensor with 20 cm (1 foot) resolution

- New 40 amp transistors!

- Micro USB port to suit the more standard and common cable

- Can run off a single Lithium battery cell (3.6 V).

- Louder piezo buzzer

1.2.2 Features

- Small form factor: 65mmx25mmx15mm (L x W x H).

- Operation from 3.6 volts to 14 volts (2 cell LiPo recommended).

- Maximum MSL value of ~30 km (100k feet)

- AGL resolution of 0.2 meters (< 8 inches).

- Completely self powered when connecting to a PC or laptop.

- Two very high current (40 amp) lines for firing ejection charges.

- Component free underside - much simpler to install.

1.3 Firmware Features (v4.00)

1.3.1 Changes since the last release (v4.00)

- Improved timing accuracy

- Improved piezo sounder

1.3.2 Features

- Peak velocity ejection option (great for staging!).

- Time delay options on both lines (for redundancy and other special requirements).

- Adjustable line firing time for both ejection lines (you can now control an electric motor etc. for a given time).

- Minimum battery voltage alarm settings. Now you can set your altimeter up for any battery type!

- Completely upgradable firmware, making sure you always have the latest!

- Least squares apogee detection.

- Over 30 minutes of total flight time!

- Connect to a PC or laptop to download flight profiles and modify settings.

- Data stored at 0.1 second intervals in non-volatile flash memory.

- Continually records output status, continuity, battery voltage and temperature.

- Imperial or metric beep-out of altitude after launch.

1.4 Software Features (v4.00)

1.4.1 Changes since the last release (v4.00)

- None

1.4.2 Features

- Upgrade your firmware using this software.

- Complete integration with your altimeter!

- Download and export profiles to MS Excel.

- 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.

1.5 Disclaimer

Due care has been employed in the design and construction of this product so as to minimize the dangers inherent in its use. As the installation, setup, preparation, maintenance, and use of this equipment is beyond the control of the manufacturer, the purchaser and user accept sole responsibility for the safe and proper use of this product. The principals, employees, and vendors of the manufacturer shall not be held liable for any damage or claims resulting from any application of this product. If the purchaser and user are not confident in their ability to use the product in a safe manner it should be returned to the point of purchase immediately. Any use of this product signifies acceptance of the above terms by the purchaser and user.

Chapter 2

Hardware Installation

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 Igniters

The terminal block on the right is for the igniters. Wire your igniters as shown in figure 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 with a resistor in series), 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 can be obtained from Entacore. The final result is given below.

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.

$$d_n = (0.1)d\sqrt{\frac{l}{kn}} \tag{2.1}$$

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 that a value for k of $500mm$ ($19.68in$) works well with the AIM USB altimeter.

2.4.2 RF interference

Please note that the AIM USB is sensitive to RF interference. If you do place a tracking transmitter or any kind of telemetry device in close proximity to the AIM USB, it will affect its performance and might even trigger a false launch.

Tests have indicated that a 100mW transmitter with a quarter-wave whip antenna placed adjacent to the AIM will reset it and cause it to malfunction. This is a severe case, but keep it in mind when designing you electronics bay. Other radio controlled sources in the vicinity should not affect the AIM.

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 essential that you test all aspects of the device, especially the ability to supply enough current to the igniters. You should also ensure that all settings are correct, even if you didnt change them yourself.

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 (a highly recommended test) and also check the battery voltage. It is essential that all settings are checked before launch.

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 (on the internet).

If you connect LEDs or buzzers in place of real igniters you will be able to see these activated during emulation. You can use real igniters, but for your safety do not use the complete explosive charges - only the actual igniter 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. When the device is first turned on, it will produce a very short beep to indicate that it has power.

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 enough free memory for a full flight (length specified in firmware). If there is not enough free memory for a full flight then the device will still record data until it is completely full. All other functions will remain unaffected, such as popping ejections etc.

2. Battery voltage: Success indicates the the battery voltage is above the minimum setting (the default minimum is 8.4 volts, but can be changed).

3. Line A continuity

4. Line B continuity

The device will then wait to detect launch from a pressure decrease. It will then stop beeping and start recording and monitoring. While waiting to detect launch, the AIM USB will sound out a continuous "beep" pause "beep" ... until launch is detected.

4.2 Retrieval

Once your rocket has been retrieved, your altimeter should be beeping out the altitude in meters (or feet if you changed the default setting). 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 (or any other spreadsheet package) for further analysis. There is lots of information which can be calculated from the graph the AIM USB produces. One example is the thrust time of your motor. You can also calculate the total impulse of your motor, or even the Cd of your rocket. The possibilities are nearly endless!

There is also an option for exporting an ".xml" file, which can be uploaded onto the Entacore website to share your launches with other rocket enthusiasts around the world!

Chapter 6

Important Notes & FAQs

6.1   Things to remember

- Remember to switch on your altimeter before launching! This might sound like a joke, but it is certainly not. We have had a few reported incidents of this happening and it has happened to us too! It can be very easy to forget to turn on any altimeter if some precautionary measures are not taken. We recommend including an "altimeter on" check in your countdown.

- Check that the settings on your device are correct before launching, even if you didn't change them yourself. Make sure the "mach inhibit" setting is not longer than what you expect apogee to be at.

- Make sure that your battery is fully charged. We recommend 2S LiPo or 9 volt rechargeable NiMH batteries.

- Make sure your vent hole on the rocket is large enough to sense the air pressure as the rocket is launched and descends.

- Seal the altimeter from the ejection bay or bays to prevent damage and large spikes in the readings when the ejection charges fire.

- Make sure the device is switched off after your flight in case the charges have not yet fired.

- Make sure that the altimeter can fire your type of charges, and that your charges are the correct size for your rocket.

- Make sure all contacts (switch, battery and ejection charge connectors) are secure. The connectors for 9 volt PP3 batteries often open up after regular use and should be gently squeezed closed if they are loose or the battery should be replaced.

6.2   FAQs

6.2.1   I have connected my altimeter to my PC and nothing is happening. What's wrong?

The AIM USB does not need any special drivers, but you do need to download some software to interface with your altimeter. You can find the software for your device on the Entacore website (www.entacore.com/electronics). Once downloaded, run the application. Options are available from the menus. If your device still will not connect (a red USB logo will be displayed), please contact us (info@entacore.com).

6.2.2 My rocket has crashed - none of the parachutes were deployed! Help!?

Check that your parachutes were not too tight for your ejection charges. Also make sure that your ejections charges were not faulty, especially if they were assembled from a kit. It is usually very easy to determine when the AIM USB did indeed attempt to initiate the charges. If the unit is still intact, you can view the graph of the flight. The red/blue bars on the horizontal axis indicate when the altimeter attempted to send current through the charges. You can also see if your parachutes might have gotten stuck, as there will usually be a noticeable pressure spike shown on the graph when charges have fired.

6.2.3 My altimeter is broken! Can it be repaired, and at what cost?

We have a very generous returns policy, allowing you to return your unit for up to one year and get a brand new one! Obviously if the damage was caused by something out of our control, we might charge a small fee for shipping and repairs. If we can't repair your unit, we will give you a very good discount on a new one! Unfortunately we don't give cash refunds.

6.2.4 How do I connect a switch?

1. Connect the + end of the battery to the V+ terminal the AIM USB.

2. Connect the - end of the battery and one end of the switch to the central terminal on the AIM USB.

3. Connect the other end of the switch to the V- terminal on the AIM USB.

The central terminal is not connected to anything on the PCB, but is there so you can join two wires for a switch. It's effectively a placeholder.

6.2.5 Does it matter which way around the AIM USB is placed?

No, it does not matter. The AIM USB is a barometric altimeter and uses air pressure to sense altitude. Therefore, you only have to make sure that you have a small hole (or holes) in your electronics bay to sense pressure changes.

6.2.6 Can the AIM USB do staging?

Yes it can! There are dedicated settings for staging which you can access using the software provided (download from our website). The AIM USB can use the peak velocity to determine when to ignite the specified charge. This is the best method and is preferred over time based delays.

6.2.7 Is it possible to get custom software written for my device?

We can do custom software with not too much trouble. If it's something we like, and think it will be used by others, we will attempt to incorporate it into the official product. Send us an email for more information (info@entacore.com).

6.2.8 Can Entacore develop custom hardware?

Yes, we can. We have a range of capabilities from hardware design to software engineering. Contact us if you are interested in what we can offer you!