Eggtimer ION
WiFi-Enabled Flight Logger
User's Guide

Board Rev A9
Software Rev. 1.04A

Eggtimer ION Features

WiFi-Enabled, data-logging flight computer

Programming, arming, and downloading can all be done with any WiFi/browser-enabled device

No apps required on your device, just a browser

Small size: Only 1.7" x .9", fits easily in a 24mm body tube, weighs only 6 grams

Altimeter records data up to 60,000'

Detailed flight data for 15 flights is saved, and can be downloaded using your browser

Summary data can be downloaded or viewed on your browser, immediately after the flight

Real-time telemetry is streamed out the serial port during flight for use with the Eggtimer Telemetry Module and Eggfinder LCD Receiver

Works with a 1S/3.7V LiPo battery, 300 mAH or more recommended

Disclaimers, Legal Stuff, Etc.

The Eggtimer ION is meant to be used for hobby and experimental rocketry purposes. Although hobby rocketry has an admirable safety record, largely due to the efforts of the good people at the National Association of Rocketry (NAR) and the Tripoli Rocketry Association (TRA), rocketry can be dangerous if proper safety precautions are not observed. This is particularly true with some of the advanced techniques like pyrotechnic parachute deployment. People can and have been seriously injured by not following recognized and accepted safety practices. We cannot be responsible for your actions.

We *strongly* recommend that if you are not a member of either the NAR or the TRA, you join one of them, join a local rocketry club, and pick the brains of experienced members before you try any kind of multiple deployment or airstart flight. The safety information included in these instructions is by no means comprehensive or complete, and is no substitute for the supervision and advice of experienced rocketeers.

Limited Warranty

Eggtimer Rocketry warrants that all of the parts on the packing list of this Eggtimer Rocketry kit have been included, and that they are all in working condition. If you are missing something, contact us immediately at support@EggtimerRocketry.com and we will send you whatever it is that you are missing. If you are missing something really egregious (like the PC board or the processor, for example), we may ask you to return the entire kit unbuilt, we will send you a prepaid shipping label for this purpose. We'd especially like to see the packing list so we can figure out what went wrong so it doesn't happen again…

If your Eggtimer ION does not work properly after assembly, take a deep breath, get out the magnifying glass and a good light, and see if you have inadvertently created a solder bridge somewhere. Chances are pretty good that you have, or that you have installed a part incorrectly. We are a very small company and we just don't have the resources to repair your board, but we will be more than happy to give you advice and we might be able to help you find your error if you send us some high resolution pictures, to support@EggtimerRocketry.com . We cannot take responsibility for your assembly techniques; if you do not have experience building kits of this nature, we recommend that you enlist some help. (Another reason for joining a rocketry club, there is usually at least one electronically-inclined member who can be bribed with a beverage or two to give you a hand. Engineering types love a challenge, especially it it's easy for them but hard for you.)

Eggtimer Rocketry warrants that when properly assembled this Eggtimer Rocketry product will perform substantially according to the published documentation. This means that we spent a lot of time trying to ensure that it's going to work the way that we say it does, and we try to fix things that don't quite work right in a reasonable time. Nevertheless, we can not and do not warrant that this product is perfect and will meet every rocketry purpose, for the simple reason that we can't test every possible rocket/motor/environmental combination. It is the buyer's responsibility to determine the suitability of the Eggtimer ION for their particular purpose. If you have a problem with this, please contact us and we will be happy to send you a prepaid return label for your unbuilt kit and we will refund your purchase price.

Meet the Eggtimer ION

The Eggtimer ION is a barometric altimeter-based flight computer, its job is to record flight information for later analysis. It can also be connected to an Eggtimer Telemetry Module to send real-time flight data to the ground so you know what your rocket is doing during the flight. The ION can record your last 15 flights, and you can easily view and/or download both summary statistical information and detailed time vs. event information. This tells you how your rocket performed in flight, and can help you better understand how your rockets work.

What makes the ION different from other flight computers is that it has a WiFi interface. Instead of using a data cable to your laptop to read the data, you simply connect to it with your phone, tablet, or computer using WiFi and a browser like Safari, Firefox, Internet Explorer, or Chrome. Flight data is downloaded to your handheld device using WiFi, and with the installation of an appropriate spreadsheet you can view a graph of the flight data right on your phone, or you can simply forward the data to an email account for downloading and analysis on a PC or Mac with a spreadsheet or other data analysis program. Data is in a standard CSV format, so it's easy to read and import into other programs.

Getting to know your ION

Although the ION seems relatively simple, you will want to familiarize yourself with it BEFORE you install it in a rocket, and certainly before you try flying it.

Battery (BATT) – Two solder pads for connecting the ION's battery. It comes with a standard JST-PH connector, which is common on 1S/3.7V LiPo batteries, but you can also install a different connector if that's not the kind that comes with your battery.

Switch Pads (SW) – Two pads for an external switch input, or you can install header pins and turn the ION on/off with a shorting jumper.

Buzzer - "Beeps" out status, apogee at landing, and other important notifications.

Programming Cable Header – 3-pin header that's used with an Eggtimer USB-Serial cable for updating the software or for viewing the WiFi passkey (in case you lose it).   It can also be used to connect to the Eggtimer Telemetry Module for live-streaming flight data to an Eggfinder LCD receiver.

3V3 Pad – Provides 3.3V power for an optional Eggtimer Telemetry Module

Programming Jumper Pads (PGM) – Two pads used to put the ION into programming mode at boot-up, for uploading software updates. Normally you won't do anything with these pads.

Mounting Your Eggtimer ION

The ION is relatively small and light (only 6 grams), and can be mounted several ways. The most common way of mounting it is using four #2 screws, either self-tapping screws for wood sleds (put a drop of CA glue in the hole first to prevent the screws from loosening in flight) or machine screws (we recommend using Nylon-insert nuts so they don't come loose). We strongly recommend that you use Nylon washers between the board and the screw heads to prevent any possibility of shorts. You'll also need to put some kind of spacer between the bottom of the board and the sled, about 3/16" high. There's a mounting template on the Eggtimer Rocketry web site to help you plan your installation.

We do NOT recommend using double-sided foam "servo" tape to mount the ION to your AV sled. There are parts on both sides of the board, so the bottom isn't flat. You won't get 100% coverage with the servo tape, so there's a potential for it coming loose in flight, which is bad. It can also block the barometric pressure sensor's air port, which basically means it won't work at all.

However you mount it, be careful not to overtighten the screws and possibly break components on the circuit board. Some of the components on the bottom of the board can break if you force them against the bottom of your sled… don't ask us how we know. We recommend that you leave a little space between the board and the sled… about the thickness of a credit card.

The ION can be mounted in any direction, there's no "up" or "down" side. We do recommend, however, that you don't mount it so that the pressure sensor is directly across from the vent holes in your AV bay. You can get funny currents during flight, which may compromise the accuracy of the altitude readings.

You can also mount it (along with the battery) in a Nomex chute protector "burrito". Slide the chute protector onto your shock cord, place the ION and the battery in the middle, fold the top and bottom corners down, and roll the chute protector around the ION/battery. Tape it up with a lot of paper masking tape so it won't come apart when it gets ejected from the rocket, and you're in business. Do NOT use plastic electrical tape to wrap up the burrito… besides leaving a nasty sticky residue, it will also melt from the ejection gases.

Since the ION uses a barometric pressure sensor to determine altitude, you'll need to drill a few holes in your AV bay (or airframe, if you're burrito-mounting it) to vent it to the outside air. There's a lot of debate about what the right size for the holes is, how many, etc., but the most accepted rule of thumb is: One ¼" diameter hole for every 100 square inches of AV bay volume.

Now the tricky part is that you don't want ONE vent hole… the optimum number is THREE, equally spaced along the AV bay perimeter. This works out to about three 5/32" holes for every 100 square inches of volume. That's just about the size of a 4" diameter AV bay that's 8" long, so you can work up or down based on that.

ION Battery Options

The ION was designed to use a 1S 3.7V LiPo battery. We recommend one that's at least 300 mAH, since the ION draws 70 mA (it's WiFi… that's the nature of the beast). You CAN get away with smaller batteries, IF (and ONLY IF) you connect the fully-charged battery up right before flying. We've used batteries as small as 110 mAH in testing, but we have several fully-charged batteries on-hand and we change them with a fresh one after each flight. With a larger battery, you can take your time… a 400 mAH 1S LiPo is about the same size as a 9V alkaline battery but half the thickness, and weighs much les; and it will last all day.

Most importantly **DO NOT USE ANY BATTERY OVER 4V WITH THE ION, YOU WILL DAMAGE IT PERMANENTLY!** Be especially careful if you have some 1S batteries with a standard "JST" connector, which is typically also used by 2S/3S batteries; if you plug a 2S/3S battery in the ION, you will fry it almost instantly.

Using your ION

What sets the ION apart from other hobby rocketry flight computers is that it doesn't use any switches, jumpers, or cables to configure or download flight data. It's all done over a WiFi connection to your handheld device, using a common Internet browser. The pages have been written very simply so that they do not require Java, Javascript, .NET, or any other scripting language to operate… they're all just simple HTML 1.1. The pages are simple text with minimal formatting, and while they may not be particularly pretty they are very easy to read, and they render virtually the same on every browser and platform we've tested.

Connecting to Your ION

Each ION has its own WiFi SSID network name, which is going to looks something like

   ION_1a2b3c

The last 5 or 6 characters are derived from the unique MAC address of the ION's WiFi module, so they're pretty much unique. The ION uses the WPA2-PSK WiFi connection protocol, so you need to enter an 8-digit passkey to connect. The passkey for your ION is on a label on the WiFi module that you got when you built it. It's also on a label on the package. If you accidentally lose it, you can also get it by connecting an Eggtimer USB-TTL data cable to the programming header. See the Appendix for instructions on how to do this. We recommend that you put a label on top of the WiFi module with the passkey… you'll be glad you did at some point.

To connect to your ION, hook up the battery and wait about 10 seconds for it to initialize. You'll hear some beeping as it goes through its self-test, and at the end of the long 3-second beep it should be discoverable over WiFi. Go to the WiFi Settings on your handheld device, and browse the wireless networks. You should see your ION listed as something like "ION_1a2b3c". Choose that network, and enter the passkey when prompted. Hint: When asked, be sure to check "save the password" and/or "connect automatically when in range". This will keep you from having to do this every time. Note that if you have multiple ION's you might NOT want to save the passkey… keep it handy by using a memo pad app on your device.

Open up your browser. If your home page is something on the Internet, you're gonna get a "Page can not be displayed" message because you're connected to your ION, not the Internet. That's OK and normal. Set your browser to the ION's home page:

192.168.4.1

 and you should see the Status Page. At this point, you should Bookmark this page so you don't have to re-enter the address every time… you're going to be going here a lot.

The Status Page

The first thing you will see is the Status Page. It tells you what your ION is doing, and gives you some other important information:

- ◦ Device Name (important if you have more than one of them in your rocket!)
- ◦ Flight Status: Armed or Disarmed
- ◦ Computer-side battery voltage
- ◦ Above-Sea-Level (ASL) altitude
- ◦ Temperature (it may read low for awhile… it takes 10-15 minutes to stabilize)

For arming:

- ◦ The current validation code (it changes every 60 seconds that you're idle)
- ◦ A text box to enter the validation code into for arming
- ◦ An "ARM" button for arming (once you type in the validation code)

Links:

- ◦ Settings – takes you to the Global Settings page
- ◦ Flights – takes you to the Flight Select page, for displaying saved flight info


ION_6D304C   1.04A

Flight Status: DISARMED

**Validation Code:
7842**

[   ]

ARM

Battery: 3.9
ASL Alt: 700
Temp.: 65.7

Settings   Flights

Arming Your ION

In order for the ION to get ready to record flight data, it must be armed. By default, the ION will self-arm 60 seconds after power-up. This gives you time to close up the nose cone, put it on the pad, etc. You can tell that it's waiting to arm and is not ready for flight because you'll hear a short "blip" every two seconds… when it's armed, it will start "chirping" continuously, indicating that it's in flight mode and is waiting for your flight to begin.

If you're going to be on the pad for awhile, or if you have it mounted in an AV bay and you have to close up and prep the rocket, you may want to stop the automatic arming sequence and manually arm it later. To do that, simply connect to the WiFi page during the 60-second pre-launch wait; it will automatically pause until you arm it manually.

To arm the ION from the page, enter the 4-digit validation code into the text box then click on the ARM button. After about 5-10 seconds you should see an arming confirmation page (shown below), you'll hear a long beep, followed by the "I'm ready" chirping.

ION_6D304C   1.04A

Flight Status: ARMED
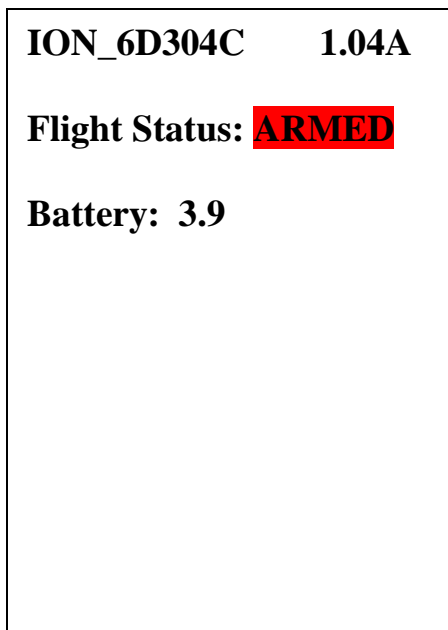
Battery: 3.9

This page looks a lot like the status page, but the status is changed to "ARMED", it doesn't initially have the validation code/box, and only the battery voltage is displayed. A few seconds later you should start hearing the buzzer "chirp" rapidly. This is an audible confirmation that the ION is now in flight sequence mode, and you're ready for launch.

At this point you should CLOSE the browser window on your handheld. Until the flight actually starts, the ION will be listening for activity from your handheld. If you refresh this page or re-connect you will see the same page, but with a validation code, text box, and "DISARM" button, as shown below:

```
ION_6D304C        1.04A

Flight Status: ARMED

Validation Code:
7842

┌─────────────────┐
│                 │
└─────────────────┘
DISARM


Battery:  3.9
```

This allows you to end the flight sequence in case you have an issue, i.e. you burn an igniter and the rocket doesn't launch. In that case, you'd perform a disarm prior to inserting a new igniter, then re-arm it afterwards. Note that refreshing this page will halt the flight sequence for about 5 seconds while it performs processing and updates the statuses, which is why you should close the browser on your handheld after arming. Closing the browser window after arming helps to prevent potential interruptions to the flight sequence. Note that if you refresh the Disarm page without entering a validation code it will force a status and battery check; this is OK if you intentionally want to do this, but remember that it also halts the flight sequence for about 5 seconds, so don't do it right before launching, and close the browser when you're done.

See the section titled "Flying With Your ION" for a further discussion of flight events.

The Global Settings Page

The Global Settings page is used to change settings that are either hardware-specific or are not generally changed from flight to flight.   You get into this page by clicking on the "Settings" link on the Status Page:

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ION_6D304C        1.04A

Global Settings

Launch Detect Alt:   200 v

Launch Samples/Sec:  20 v

Descent Samples/Sec: 2 v

SSID:  _____

Submit
```

Launch Detect Altitude (LDA)

Range: 50'-500' by 50' (default 200')

This setting allows you to select at what altitude the ION decides that a valid flight has started. The 200' default is good for most flights. However, there may be some cases in which you may want to turn it up, and some very special cases in which you may want to turn it down.

If your flying site is subject to wind gusts, you may want to turn it up a bit so that when the wind gust subsides the decrease in pressure isn't viewed as the rocket ascending. That's not likely to happen, however, because we filter the readings to prevent this (and other similar occurrances). You may also want to turn it up if you increase the Launch Samples per Second.

If you have a very low flight you may want to turn it down, although generally we don't recommend it.

Launch Samples per Second

Range: 10,15, 20, 25, 30, 33 samples/sec. (default 20 samples/sec.)

This setting allows you to select the number of samples per second that are taken from the time that you arm the ION until it detects nose-over. The default setting (20 samples per second) is adequate for most flights. However, there may be reasons why you want to turn it up or down. For example, if you have a very short-burn motor (like a CTI V-Max) you may want to turn it up to 33 samples per second to make the velocity and acceleration figures more accurate. If you have a very long-burn motor you may want to turn it down to 15 samples per second, although 20 should be fine.   Note that increasing the sample rate decreases the amount of memory… more on that later.

Descent Samples per Second

Range: 1, 2, 4, 5, 8, 10 samples/sec. (default 2 samples/sec.)

The setting allows you to select the number of samples per second that are taken after nose-over is detected. When you're coming down, you're generally not going to be going very fast relative to your velocity going up, even if you freefall for a few seconds and the FailSafe kicks in. Consequently, there's really no reason to have the same high rate of sampling that you use for the ascent part of the flight. Reducing the sampling rate after nose-over saves a lot of memory, and allows you to record longer flights. For most flights, the default 2 samples/sec. rate is fine.

About Sampling Rates and Memory Usage

At this point you may be wondering about how long a flight the ION can record before running out of memory, and what happens if that occurs. The ION saves about 2,000 samples for each flight. When you're sitting on the pad or launched and have not yet reached LDA, the sampling rotates through those memory locations, saving the last reading < 3' AGL as the "start of flight". Once you hit LDA, the recording continues until either 1) the End of Flight benchmark (your rocket hasn't moved for at least 5 seconds) is reached, or 2) the memory wraps around to the start of flight location. In either case, recording stops there (it won't overwrite valid ascent data).

Now, you may be wondering how long a flight you can have with "only" 2,000 memory locations. Quite a long one, actually. Let's say that you want to fly to 30,000' and your motor will get you there in 30 seconds. At 20 samples per second, that's 600 samples. That leaves about 1,400 samples left for the "down" part of the flight. At 2 samples per second, that's 700 seconds, or over 11 minutes. You'd have to be coming down at a rate of about 40 ft/sec under drogue to exhaust the memory, there's no way you're gonna be coming down that slow from 30,000' (unless you really like walking a lot). More likely, it's going to be 50-70 feet/sec. Let's say that we come down at 60 ft/sec from 30,000', that's about 500 seconds, or 1,000 memory locations at 2 samples/sec. You'd still have over 400 samples left when you land, nearly 20% of your memory.

If you have an extreme flight, say 50,000', it may take a bit longer to get up there, let's say 45 seconds. That's 900 samples, leaving 1100. If you take the rate down to 1 sample per second (reasonable since the events are happening relatively slowly and the air is pretty thin at 50K), you still have 1100 seconds, or over 18 minutes. No way it's gonna take that long to come down, unless for some reason the main comes out near apogee. At a conservative 50 ft/sec average speed under drogue, it's going to take 1,000 seconds, leaving you with at least 100 samples. Remember that at that altitude the air is very thin, so you're going to be coming down faster near apogee than you will be when the air thickens as you descend. It's very likely that you're going to be using a lot less memory than that.

So, as you see, there's plenty of memory for just about any flight scenario if you manage it wisely. For just about any flight under 30,000', just leave it at 20 samples per second for the Launch rate and 2 samples per second for the Descent rate, and you'll be fine.

SSID

 Range: <blank> (default), 8-14 characters (a-z, A-Z, 0-9, "_")

This setting allows you to change the SSID that your ION broadcasts at startup.   If you leave it blank (the default), the SSID will be defaulted to ION_<mac address>.   If you change this field, it must be in the proper format… allowable characters are a-z, A-Z, 0-9, and the underscore ("_").   Spaces are not allowed.   Note that the passkey that you use to connect to your ION does not change; however, if your change the SSID, you will need to reauthenticate your phone to the new SSID.   The SSID change takes effect at the next power-cycle; unlike most other parameters it does not take effect immediately.

The Flights Page

Clicking on the Flights link takes you to a page that allows you to select a flight for flight milestone display, and download a detailed .csv file that you can use with Excel or other data analysis programs to extract graphs and do other fun things. We'll go into that a bit later…

On the Ground

The ION detects that your rocket is on the ground when the AGL altitude doesn't change significantly for over 5 seconds. Once on the ground, the ION will start beeping out the maximum altitude continuously for anyone within earshot to hear. The beeps work like this:

1 Beep = 1
2 Beeps = 2
…..
9 Beeps = 9
10 Beeps = 0

So, if you fly to 12, 360' you will hear:

Long Pause…
Long Beep… ("I'm going to give you're the apogee reading…")
Short Pause…

1 Beep   (10,000')
Short Pause

 2 Beeps (2 x 1000')
Short Pause

3 Beeps (3 x 100')
Short Pause

6 Beeps (6 x 10')
Short Pause

10 Beeps (zero 1' reading)

<sequence repeats>

The beeps continue until you turn off the power, and also act as a verification that you had a successful flight, but getting your rocket back in one piece pretty much told you that, didn't it?

In addition, the WiFi interface will start back up again, and will take you directly to the Flight Summary page for the flight that you just completed.   Note that it may take 10-15 seconds to bring up the Flight Summary page after you connect to the ION, because it sends out the page after it's done beeping out the altitude, so you have to wait until it goes quiet for a few seconds. You'll also

be able to download/view the flight detail too, so if your handheld device has some kind of data analysis program then you can actually look at your flight right after it's on the ground. Pretty cool, huh?

Post-Flight Analysis

The ION saves your last 15 flights, both summary and detailed time/altitude data. Clicking on the 'Flights' link in the ION's Status page takes you to an index page that allows you to select the flight that you want to review. Note that each flight has an index number from 1-15, this is the memory location that it's in, and each flight has a Flight number that is sequential from 1 to however many flights you've had with your ION. If you fly it enough, you'll probably get to the point at which flights drop off, and the flight numbers won't start with 1 anymore, but the indexes will always be from 1 to 15.

Each entry in the Flight Select page shows the Flight Index, the Flight Number, the Apogee, and a 'More' link that takes you to the Flight Summary page. Note that after you land and while it's beeping out the altitude, it will take you directly to the Flight Summary page for that flight only.

The Flight Select Page

You can view the last 15 flights by selecting them from the Flight Select page, you get there by clicking on the "Flights" link from the Status Page. It shows you the Flight Index (the location in memory, 1-15, "Idx"), the Flight Number (which increments every time you start a flight, "Flt"), the Apogee of the flight ("60335" means that there was no flight), and a link to display the Flight Summary/Detail for that flight ("More").

```
ION_6D304C              1.04A

Flight Select

Idx:01  Flt: 1  Apogee:  1965   More
Idx:02  Flt: 2  Apogee: 11314   More
Idx:03  Flt: 3  Apogee:  8461   More
Idx:04  Flt: No Flight
Idx:05  Flt: No Flight
Idx:06  Flt: No Flight
Idx:07  Flt: No Flight
Idx:08  Flt: No Flight
Idx:09  Flt: No Flight
Idx:10  Flt: No Flight
Idx:11  Flt: No Flight
Idx:12  Flt: No Flight
Idx:13  Flt: No Flight
Idx:14  Flt: No Flight
Idx:15  Flt: No Flight

Exit
```

The Flight Summary Page

The Flight Summary page gives you a lot of information about what happened during your flight. You get there by clicking the Flights link from the Status Page. After you land, you can also connect to it… the ION will show you only the status for the current flight, plus the detail, until you power-cycle it. This is for flight #3 on the example screen… it was a Giant Leap Firestorm on an Aerotech K185 longburn motor (one of our favorites…). Click on the More link to see the Flight Summary data. Note that you'll have to scroll down to see all of the data… there's a lot of it.

```
ION_6D304C            1.04A

Flight Summary

Flight No.: 3

Flight Status: Landed

Apogee: 8461
   Time to Apogee……23.05

Max Velocity: 995
   Time to MaxVeloc……5.95

Avg Accel(G)……5.19

LDA Alt……202
   Time to LDA……1.35

Low V Alt……8409
   Time to Low V……21.25

Nose-Over Alt……8445
   Time to Nose-Over……24.05

Flight Time:……156.65

ASL Alt……2543
Temp F……76.6


Settings
LDA Alt……200
Launch Samples/Sec……20
Nose-Over Samples/Sec……2

Exit            Detail

Reset
```

Flight Status – What the last major event was. Typically it will be "Landed", but it may be something else if there was an anomaly in your flight.

Apogee – What the apogee of your flight was, and the time-to-apogee from launch detect (LD).

(About Launch Detect: Because this is a barometric pressure altimeter, there's no definitive way to say "yeah, we just hit 5 G's so we must have launched". To detect launch, the ION uses the last reading below 3' AGL, after the LDA has been reached. While it's technically possible that this figure may be a little off, our experience has shown that it's only off by one or two samples at most… typically under 100 ms.)

Max Velocity – The maximum velocity that was reached, and the time from LD. Note that this figure works for "most" flights, but it may be fooled by very high-thrust or very low-thrust motors… again, that's the nature of baro-only altimeters.

Avg Acceleration in G's – The average acceleration taken at the point of Max Velocity. As with Max Velocity, it's relatively accurate for "most" but not all flights.

LDA Alt – The actual altitude that exceeded the programmed LDA setting, and the time from launch detect.

Low V Alt – The altitude at which apogee check was enabled, i.e. the rocket slowed under 100 ft/sec for at least one second, and the time from launch detect.

Nose Over Alt – The altitude at which the rocket nosed over, typically one second past apogee, and the time from launch detect.

Flight Time – The elapsed time from launch detect until landing detect, which is when the rocket drops below ½ of the apogee and hasn't moved more than 10' in 5 seconds.

ASL Alt – The Above-Sea-Level reading of your launch site.

Temp – The temperature in Fahrenheit at the time of launch. This will be very accurate if the ION has been powered on for 10-15 minutes, but will tend to be on the low side if you fly shortly after powering up.

Settings – All the flight settings that were selected for this flight.

As you can see, that's a lot of stuff to look at. Particularly right after landing, it gives you a pretty good idea of what happened.   There are also a couple of links at the bottom…

Exit : Sends you back to the Status page

Detail: Download the .CSV-formatted detail data (see below)

Reset: (After a flight only): Resets the ION to the Status page, clearing all parameters just like you had powered it off then on.

Downloading the Flight Detail

In addition to the Flight Summary data, each altitude sample during flight is saved into memory, and the data can be retrieved and time/event correlated as a standard comma-separated-variable (.csv) file by clicking on the 'Detail' link at the bottom of the Flight Summary page.

A .csv file is basically just a text file, with commas separating each field. Depending on what apps you have on your device, it may do one of three things when you click on the Detail link:

1) It may display the data as if it were a text-only web page
2) It may open up some kind of application (i.e. Excel if you have a laptop)
3) It may just sit there and hang because it doesn't know what to do with it

Note that it can take some time (over a minute or two in some cases) to download the detail data, because of the "on-the-fly" formatting. When you're downloading the data, the little blue LED on the WiFi module next to the antenna will blink… that's a sign that it's working.
We've had good luck with WPS Office for Android and iOS, it's free and works very well with the simple .csv data that the ION sends out, and it's very easy to get a flight/event graph. For a Windows laptop, we use Excel, but any data analysis program that can take a .csv file will work.

This is what the first few seconds will look like on your device… at 20 samples/sec, there will be a lot of it.

T	Alt	Veloc	FAlt	FVeloc	LDA	LowV	Apogee	N-O
0	9	180	1.8	36	0	0	0	0
0.05	11	40	3.64	36.8	0	0	0	0
0.1	12	20	5.31	33.44	0	0	0	0
0.15	15	60	7.25	38.75	0	0	0	0
0.2	20	100	9.8	51	0	0	0	0
0.25	20	0	11.84	40.8	0	0	0	0
0.3	22	40	13.87	40.64	0	0	0	0
0.35	26	80	16.3	48.51	0	0	0	0
0.4	32	120	19.44	62.81	0	0	0	0
0.45	37	100	22.95	70.25	0	0	0	0
0.5	39	40	26.16	64.2	0	0	0	0
0.55	45	120	29.93	75.36	0	0	0	0
0.6	51	120	34.14	84.29	0	0	0	0
0.65	58	140	38.91	95.43	0	0	0	0
0.7	63	100	43.73	96.34	0	0	0	0
0.75	72	180	49.39	113.07	0	0	0	0
0.8	78	120	55.11	114.46	0	0	0	0
0.85	86	160	61.29	123.57	0	0	0	0
0.9	92	120	67.43	122.85	0	0	0	0
0.95	102	200	74.34	138.28	0	0	0	0

1	108	120	81.07	134.63	0	0	0	0
1.05	112	80	87.26	123.7	0	0	0	0
1.1	121	180	94.01	134.96	0	0	0	0
1.15	133	240	101.81	155.97	0	0	0	0
1.2	145	240	110.44	172.78	0	0	0	0
1.25	162	340	120.76	206.22	0	0	0	0
1.3	183	420	133.2	248.98	0	0	0	0
1.35	202	380	146.96	275.18	202	0	0	0
1.4	218	320	161.17	284.14	0	0	0	0
1.45	231	260	175.14	279.32	0	0	0	0
1.5	242	220	188.51	267.45	0	0	0	0
1.55	249	140	200.61	241.96	0	0	0	0
1.6	257	160	211.89	225.57	0	0	0	0
1.65	267	200	222.91	220.46	0	0	0	0
1.7	279	240	234.13	224.36	0	0	0	0
1.75	298	380	246.9	255.49	0	0	0	0
1.8	312	280	259.92	260.39	0	0	0	0
1.85	328	320	273.54	272.31	0	0	0	0
1.9	348	400	288.43	297.85	0	0	0	0
1.95	368	400	304.34	318.28	0	0	0	0
2	391	460	321.67	346.63	0	0	0	0
2.05	411	400	339.54	357.3	0	0	0	0
2.1	431	400	357.83	365.84	0	0	0	0
2.15	449	360	376.07	364.67	0	0	0	0
2.2	464	300	393.65	351.74	0	0	0	0
2.25	483	380	411.52	357.39	0	0	0	0
2.3	503	400	429.82	365.91	0	0	0	0
2.35	524	420	448.65	376.73	0	0	0	0
2.4	553	580	469.52	417.38	0	0	0	0
2.45	580	540	491.62	441.91	0	0	0	0
2.5	600	400	513.29	433.53	0	0	0	0
2.55	626	520	535.84	450.82	0	0	0	0
2.6	649	460	558.47	452.66	0	0	0	0
2.65	667	360	580.17	434.12	0	0	0	0
2.7	696	580	603.34	463.3	0	0	0	0
2.75	723	540	627.27	478.64	0	0	0	0
2.8	749	520	651.62	486.91	0	0	0	0
2.85	777	560	676.69	501.53	0	0	0	0
2.9	805	560	702.36	513.22	0	0	0	0
2.95	834	580	728.68	526.58	0	0	0	0
3	860	520	754.95	525.26	0	0	0	0
3.05	886	520	781.16	524.21	0	0	0	0

T	Alt	Veloc	FAlt	FVeloc	LDA	LowV	Apogee	N-O
3.1	916	600	808.13	539.37	0	0	0	0
3.15	948	640	836.1	559.49	0	0	0	0
3.2	979	620	864.68	571.6	0	0	0	0
3.25	1010	620	893.74	581.28	0	0	0	0
3.3	1039	580	922.8	581.02	0	0	0	0
3.35	1072	660	952.64	596.82	0	0	0	0
3.4	1104	640	982.91	605.45	0	0	0	0
3.45	1131	540	1012.53	592.36	0	0	0	0
3.5	1168	740	1043.62	621.89	0	0	0	0
3.55	1200	640	1074.9	625.51	0	0	0	0
3.6	1231	620	1106.12	624.41	0	0	0	0
3.65	1266	700	1138.09	639.53	0	0	0	0
3.7	1300	680	1170.48	647.62	0	0	0	0
3.75	1337	740	1203.78	666.1	0	0	0	0
3.8	1374	740	1237.82	680.88	0	0	0	0
3.85	1402	560	1270.66	656.7	0	0	0	0

Each entry in the flight detail file looks like this, of course there's a comma between each field…

T (time) – Seconds from Launch Detect

Alt (altitude) – the RAW pressure-derived altitude value from the altimeter

Veloc (velocity) – the RAW velocity for that sample, derived from the difference in altitude between this sample and the previous sample and the time interval between them

FAlt (filtered altitude) – the FILTERED pressure-derived altitude value

FVeloc (filtered velocity) – the FILTERED velocity for that sample, derived from the difference in FILTERED altitude between this ample and the previous sample and the time interval between them

Following that data are the events. Event data is ZERO unless the sample triggers the event, in which case it's the RAW altitude data, since these events theoretically should occur at a relatively low velocity (sub-mach transition). This format causes a scatter graph of the data to show a little spike where the event occurs, which is a very easy and convenient way of viewing where the event occurred.   Note that in the example data, we've highlighted the LDA, which occurred at 202'.

LDA – Non-zero at the sample when the LDA altitude is first exceeded

LowV – Non-zero at the sample when the low velocity threshold (< 100 ft/sec for 1 second) is reached

Apogee – Non-zero at the sample when apogee is reached

N-O – Non-zero at the sample when Nose-Over is reached, typically one second past apogee

Due to the many programs that can be used to view/manipulate this data, we're not going to go into what you should do to graph/view it… we recommend that you check the documentation for your data analysis program for that information. We can tell you, however, that if you're using Excel you can simply select all of the columns, insert a "scatter graph", and you'll get a nice graph of your flight, with the events marked with a "spike".   It's very easy to do, and it will look like this.
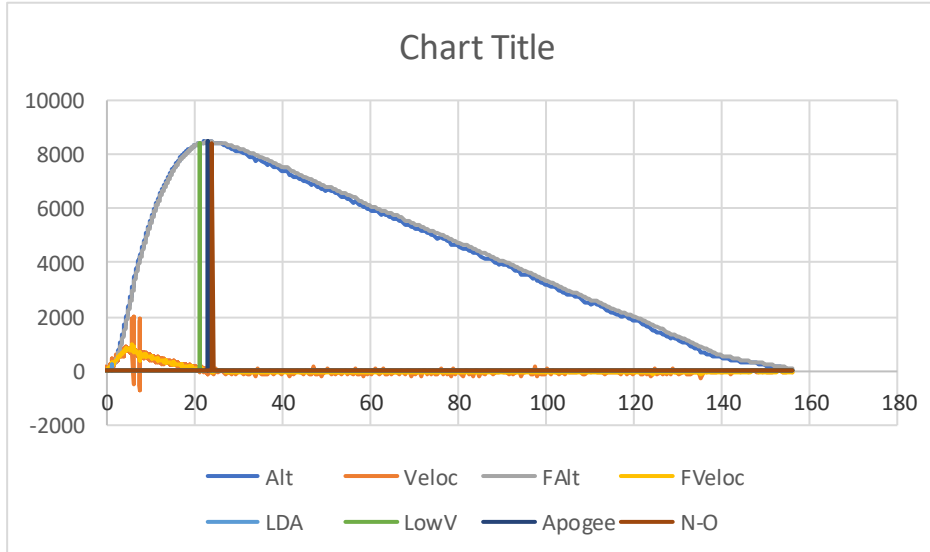
Appendix A - Telemetry

The serial port on the Eggtimer ION sends out a variety of telemetry data during flight, it is easy to connect an Eggtimer Telemetry Module to the 3-pin connector to view the data on the ground using an Eggfinder LCD receiver.

Data sent by the ION includes:

Altitude –   Real-time altitude, in 100' increments
Velocity - Real-time velocity (filtered)
Flight Status – Flight phase (waiting, launch detected, descending, landed)
Temperature – Temperature in F
Battery Voltage
Apogee – Apogee (reported after nose-over)
Maximum Velocity (reported after nose-over)
Device Name – For 70cm Ham version, sends out your FCC call sign

Instructions for connecting your ION to an Eggtimer Telemetry Module and using the Eggfinder LCD receiver for receiving telemetry data can be found in the Eggtimer Telemetry Module User's Guide.

Appendix B - Browser Notes

Here are some notes regarding browser and WiFi compatibility. In particular, some phones REALLY want to connect to the Internet when you select a WiFi network… if they can't, then they'll warn you, and if you don't reply to the warning they'll shut off the network and go back to cellular data. We recommend that you get familiar with how your phone deals with the ION's WiFi pages before you go out to fly it.

WiFi Connection Tips

1. After you turn on your device or arm your altimeter, CLOSE the browser, and go to your Settings and turn OFF WiFi on your phone. This does wonders... believe us.
2. Make sure you're in Private (Apple) or Incognito (Android) mode... you don't want it saving the pages and caching it later.
3. Do NOT use the back arrow for these pages. We disable caching on the pages, but it's up to the device to enforce that... and they do not always do it.
4. If your phone gives you a popup telling you that you don't have Internet connectivity, tell it to KEEP the connection, and DO NOT switch to cellular data.
5. If you use a VPN for security, turn it off while you're connected to the Eggtimer WiFi devices. You can't get on the Internet to use it anyway.
6. If all else fails, turn off cellular data on your phone while you're using your Eggtimer WiFi devices.

Appendix C – Recovering the Passkey

Like any secured WiFi network, you need two things to connect… the SSID and the passkey. The default SSID of your ION will be "ION_nnnnnn" where nnnn is the last 6 hexadecimal digits of your device's MAC address (a unique address given to every Ethernet device). The SSID is broadcast, so you should be able to see it in your device's WiFi manager.

The passkey is an eight-digit number derived from the MAC address of the WiFi module, generated by a random number algorithm the first time that your ION is powered on. It's going to be more or less unique for every ION. There should be a label on the little baggie that the WiFi module came in with the passkey (you kept it, right?), but it's easy to get it if you lose it…

To get the passkey, connect a USB-Serial cable (the same cable that's used with all Eggtimer Rocketry products) to the 3-pin header as follows:

BLACK wire – GND
WHITE wire – TX
GREEN wire – not used

Using an ASCII terminal program such as TeraTerm or Putty, connect to the serial port at 115,200 baud, 8 bits, no parity, 1 stop bit. Now connect the battery on your ION. You should see the following information:

```
        (a few lines of garbage… part of the boot process)

                    ION v1.04A
                    SSID: ION_F87C6E
                    PASSKEY:  3718 6501
```

Note that we're showing that there is a space between the first four digits of the passkey and the second four digits, that's just to make it easier to read; when you actually enter the passkey don't type the space.

Disconnect the battery, and remove the serial cable. You won't need the cable again unless you forget the passkey, or you need to flash the software.

Now, fire up your device's WiFi manager. Connect the battery to your ION… you'll hear the buzzer beep 3 times then stay on for a few seconds, and in about 5 seconds you should see your ION's SSID on your WiFi manager. Connect to the SSID using the passkey that you obtained earlier (but don't put the space between the digits!), and you should see the ION's status page. You're now connected to your ION, and ready to start using it.

Eggtimer ION Quick Start Guide

Power: 3.7V/1S LiPo, 300 mAH or higher recommended. Bigger is Better…
Connect to the two BATT terminals

WiFi Connection

Select the "ION_xxxxx" SSID (or your custom SSID if you set one), and use the passkey
that was on the WiFi module's envelope (you did save it, right?), or recover the passkey
using the data cable (see Appendix E for instructions)

Set your browser to **192.168.4.1** to open the Status Page…bookmark it for later use!

Status Page
Displays:
SSID
Status (Disarmed, normally)
Validation Code (for arming)
Battery Voltage
ASL altitude
Temperature in F

Global Settings
Click on the Settings link on the Status Page to change:
LDA – Launch Detect Altitude
Launch samples/sec
Descent Samples/sec
SSID

Arming
Auto-Arm:
ION will arm itself 60 seconds after power-on…
It makes a "blip" every two seconds while it's waiting,
then a fast "chirping" sound when it's armed for flight

Remote Arming:
Connect to the WiFi interface before the end of the 60-second auto-arm period
To arm, enter the 4-digit validation code, then click ARM
When the "Armed" page displays, CLOSE YOUR BROWSER
It will make a fast "chirping" sound when it's armed for flight

Disarming (for aborted flight)
      Connect to the Status page (192.168.4.1)
      Enter the 4-digit validation code, then click DISARM
      Wait for the normal Status Page… if it takes more than 10 seconds, refresh your browser
        You should hear the "chirping" sound stop… if not, then try again

Downloading Flight Status Data
      Click on the Flights link on the Status Page
      Click on the 'More' link next to the flight
      View the Flight Summary data…
      For detail .csv download, click on the 'Detail' link at the bottom of the Flight Summary page