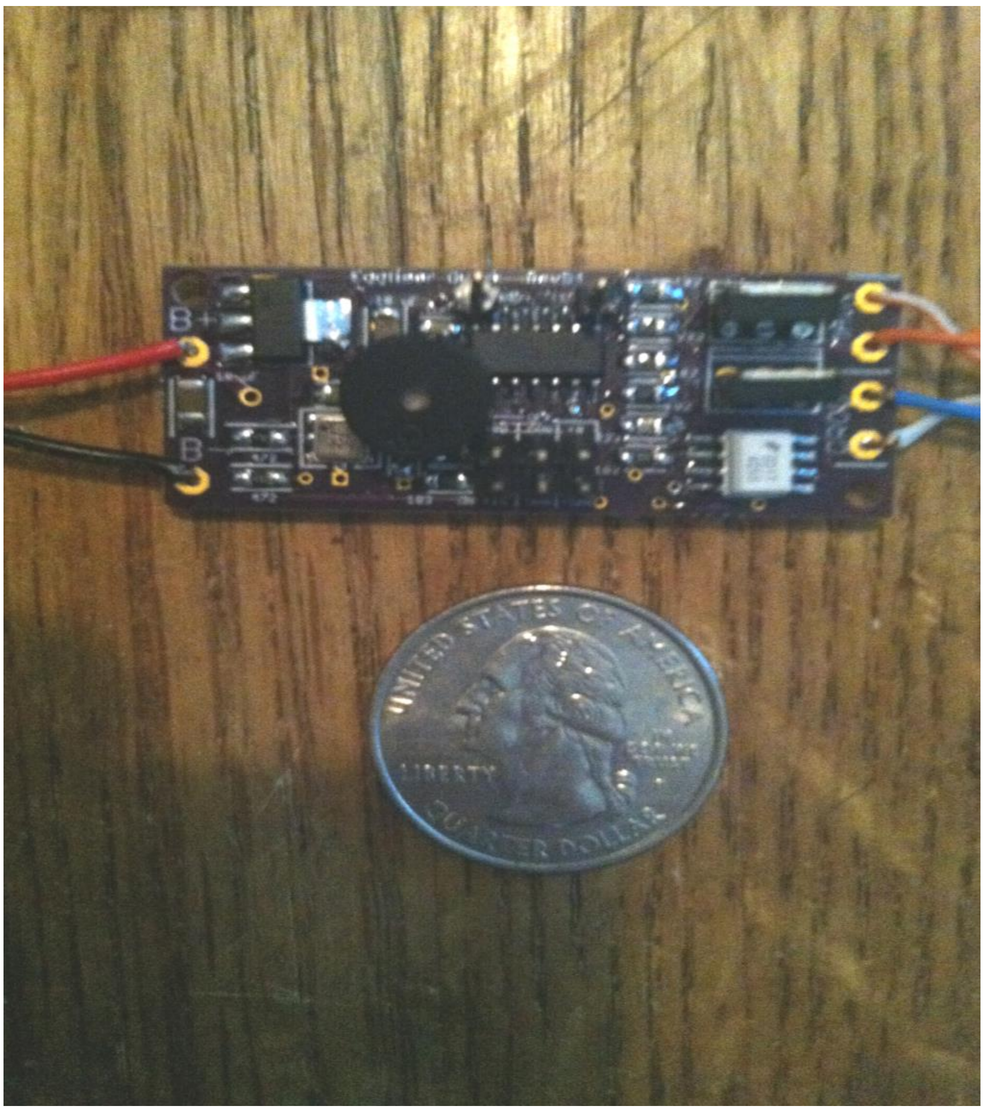
Eggtimer Quark User's Guide

Board RevB4



Eggtimer Quark Features

Very small size: Only 1.85” x .75”, fits easily in a 24mm body tube, weighs only 5 grams

Easy to use: Out of the box it deploys the drogue at nose-over and the main at 500’

Programming is done by just changing a few jumpers

Altimeter rated to 29,500 ft ASL, resolution to approx 1 ft.

“Beeps” out maximum altitude after flight, and after power-up

Main deployment channel can be set to fire at 300’, 500’, 800’, or 1000’

Drogue deployment channel can be set to fire at nose-over or +1 second (for backup use)

“Ready” tone changes when you select backup-drogue mode, so you can tell which one is which

Real-time altitude is streamed out the serial port during flight

Fully “mach immune”, deployments are inhibited until the rocket is moving slowly near apogee

Works with 1S/3.7V LiPo batteries all the way up to 15V

Works with almost all common deployment ematches, will even light an Estes® igniter with a 2S LiPo

Channel continuity is checked during power-up, a loud and very annoying tone alerts you to a problem

Test mode so you can do an actual igniter test, and check the baro sensor’s output

Disclaimers, Legal Stuff, Etc.

The Eggtimer Quark 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 and igniting rocket motors in flight (“Airstarts”).   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 Quark 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 Quark 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 Quark

The Eggtimer Quark is a simple altimeter-based deployment controller, its job is to properly deploy your parachutes and bring your high-powered rocket safely to the ground. It has two channels: A Drogue channel, which is typically fired near the apogee of the flight, and a Main channel, which fires at a somewhat lower altitude that you can choose. The idea is that the Drogue parachute is much smaller, so your rocket comes down at a controlled but relatively fast rate, typically between 50-100 ft/sec. This relatively high rate of descent helps minimize the rocket's drift due to wind, and for you impatient types it also helps it come down faster too. The Main parachute is typically opened somewhere between 500'-1000', slowing the rocket down so that it lands gently but preventing it from drifting excessively.

The Quark is programmed with three simple jumpers, two of them are for the Main deployment altitude and the third controls the timing of the Drogue. The Main chute can be deployed at 300, 500, 800, or 1000'. The Drogue is typically deployed at "nose-over", 1 second after apogee; however, the jumper option lets you add one second to that so you can use the Quark as a backup for another altimeter that's set up to fire near apogee. Out of the box with all jumpers removed, it fires the Main at 500' and the Drogue at nose-over, which is the most common configuration.

In addition, there is a serial output port that streams the live-altitude data during your flight. Along with an Eggtimer Quark Telemetry Module, it will send out live altitude data to an Eggfinder receiver. It can also be used in test mode to check the operation of the barometer sensor.

Since one of the tenants of successful electronic deployment is ground testing, the Quark incorporates a ground-test feature so that you can check YOUR battery with YOUR igniters to make sure that they are compatible and will work in flight.

The deployment channels are capable of triggering just about any ematch that you're likely to encounter, we've even fired a medium-current Estes igniter with it using a 2S/7.4V LiPo. You can also use a low-current igniter such as a Quest Q2G2 with a single 3.7v LiPo battery, we've use batteries as small as 100 mAH for very small rockets.

Getting to know your Quark

Although the Quark 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 (B+/B-) – Two solder pads, marked "B+" and "B-", for connecting the Quark's battery. **BE SURE TO CONNECT THE "+" PAD TO THE "+" SIDE OF YOUR BATTERY CONNECTOR (TYPICALLY RED) OR YOU MAY DAMAGE YOUR QUARK**. Typical current draw is about 5 ma when running. You'll need to put some kind of switch on the battery inputs, more on that later.

Buzzer - "Beeps" out status, warnings, altitude, and other important notifications.

Main Deployment (MAIN) - Two solder pads for connecting an electric match or other deployment device. Deployment altitude can be set to 300, 500, 800, or 1000 feet.

Drogue Deployment (DROG) - Two solder pads for connecting an electric match or other deployment device.

Serial Output (GND & TXD) – 2-pin header connector for connecting a USB-TTL serial data cable for monitoring test barometric pressure data, and also for connecting a telemetry device such as an RF serial transmitter (not included).

Drogue Delay Jumper (+1S) – 2-pin header that controls the timing of the Drogue deployment from apogee. When removed (the default) the Drogue will fire at 1 second after apogee, when present it will fire at 2 seconds after apogee. It is also used to initiate a Drogue ground-test… see the Ground Testing section.

Main Base Altitude Jumper (300/500) – 2-pin header that selects the base altitude for the Main deployment. If the jumper is removed (the default), the base altitude will be 500'; if you install the jumper the base altitude will the 300'. It is also used to initiate a MAIN ground test… see the Ground Testing section.

Additional Main Atitude Jumper (0/500) – 2-pin header that allows you to add 500' to the Main altitude (selected by the 300/500 jump). If you install the jumper, the Main deployment altitude will be either 800' or 1000' depending on the selection of the 300/500 jumper; if you leave it off, the 300/500 Main deployment altitude is unaltered. It is also used to test the barometric pressure sensor… see the Ground Testing section.

Mounting Your Eggtimer Quark

The Quark is very small and light, and can be mounted several ways. The most common way of mounting it is using two #2 screws, either self-tapping screws for wood sleds (put a drop of CA glue in the hole to prevent the screws from loosening in flight) or machine screws (we recommend using Nylon-insert nuts so they don't come loose). We recommend that you use Nylon washers between the board and the screw heads to prevent any possibility of shorts, and one or two underneath the board as necessary to act as spacers. This is particularly true if you installed terminal block on the bottom of the board and are mounting it face-down; you should leave at least a 1/16" space between the sled and the components on the board so you don't block the pressure sensor's vent hole. There's a mounting template on the Eggtimer Rocketry web site to help you plan your installation.

If you mounted all the through-hole parts on the top of the board then you can also use servo tape to mount the board to your sled. We do this a lot for small builds or rockets that aren't going to be using high-thrust motors, it's quick and easy. We do NOT recommend it for your minimum-diameter 54mm projects, i.e. something using a K2045. The G forces might rip the Quark right off the sled… that would be bad. You also do NOT want to use servo tape to mount the Quark if you've installed terminal blocks on the bottom side of the board… the tape will block the pressure sensor's vent hole, which would also be bad.

The Quark 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 right across from one of the vent holes in your AV bay.

Since the Quark uses a barometric pressure sensor to determine altitude, you'll need to drill a few holes in your AV bay 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 1/4 " diameter hole for every 100 square inches of AV bay volume

Now the tricky part is that you don't want ONE 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.

Wiring Your Eggtimer Quark

The Quark is designed to have the power connector and output wires directly soldered to the board. This allows you to choose whatever method of terminating the connections you want: barrier strips, solder directly to the switches, etc. It also prevents the connections from coming loose in flight due to vibrations and G-forces. Alternatively, you can solder terminal blocks for the deployment igniters onto the board; see the Assembly Guide for details on that option.

We've found that simply wire-wrapping the igniters to a "pigtail" wire soldered to the board works very well for smaller rockets. By soldering the pigtails to the board rather than having screw terminal blocks, you eliminate the possibility that the wire may work loose from the terminal in flight. We also like the wiring kits made by Doghouse Rocketry, the wire they supply is Teflon-jacketed and lends itself well to solder-type wiring.

We recommend using #22-#26 gauge wire for wiring to the Quark board, we like to use the #24 gauge stranded wire that's found in Cat-5 network cables. It's cheap, easy to find, and just the right size. It's also twisted together in nice solid-striped pairs, so it's easy to tell the "+" from the "-" wire. If you can, get the "plenum" cable, since it has a Teflon jacket and doesn't melt as easily when you solder to it as the standard "riser" cable. You can also use solid wire, but solid wire is harder to work with and has a tendency to break after being bent a few times. These breaks can be a pain to find, because they are typically inside the insulator jacket where you can't see them.

If you use stranded wire, you **MUST** TIN THE WIRES BEFORE SOLDERING TO THE BOARD. This is to prevent stray "whiskers" of wire strands from coming loose and bridging pads, or breaking off and landing on the board in some random place. We've seen the results of this happening, it's not pretty, and they can be very hard to find if the lodge underneath the processor chip or in some other hidden spot on the board.

If you build the board with the terminal block option, be sure to tin whatever wires you are using for your igniters before you insert them into the terminal block. Loose strands here can prevent deployments, if a strand comes loose and lodges in the wrong place it could cause an immediate deployment when you connect the battery. That would be bad…

Finally, we strongly recommend that all wiring on your sled be zip-tied to the sled so that there's no chance of any wires coming loose in flight. We've seen it happen, and the results are not pretty.

Power Switches

In most cases, you will need to install some kind of power switch, usually a single-pole normally-open switch in series with the "+" (usually red) side of the battery.   NAR and Tripoli rules (as well as common sense) dictate that you need to have the Quark powered off or otherwise disabled when you take it to the RSO for the safety check, and that you should not arm it until your rocket is safely on the pad.

Just about any switch will work with the Quark because the current is < 10 ma. However, you need to use a switch that can handle the expected G forces that you expect the rocket to experience during flight. In general, we recommend that if you use a slide switch that it is mounted so that it slides sideways, not up and down. This will prevent G forces from possibly causing the switch to "bounce", interrupting the power to the Quark, which is not a good thing. Any slide switch that you use must be rated to at least twice the G forces that you are likely to see… a $1 Radio Shack special isn't going to cut it, spend a few bucks and get a high-quality switch.

You can also use a "push-on, push-off" type switch. Many users have had good success with them, also mounted laterally. You can put the switch just behind one of the air ports, and actuate it by pushing a small pin/wire through the hole. Just like with slide switches, spend the money to get a good quality switch.

A better option would be a more positive switch, such as a rotary switch or a screw-type switch that locks down positively. Since the major forces on rockets are almost entirely along the longitudinal axis of the rocket, the contacts on a rotary switch are unlikely to be interrupted by G forces. A good choice is the Schurter 033.4501 rotary switch, they cost about $5. This is a special-purpose rotary switch originally designed to be a 120v/220v power supply selector switch, but it works very well for our purposes. You can get them from a number of online rocketry suppliers, or you can order one directly from Allied Electronics, a direct distributor for Schurter products. They're actually about a buck cheaper from Allied, but you'll have to pay shipping, so chances are pretty good that you're gonna come out ahead if you buy it from one of the rocketry suppliers because you're probably buying a bunch of stuff from them anyway.

Featherweight Rocketry and Missile Works also make good small screw-type switches, they use a screw to positively lock down the contacts and completely eliminate any possibility of the switch being jarred open. You can also make your own screw switch, Google around and you can probably find some good examples.

Finally, if you want to avoid moving contacts altogether, check out our Eggtimer Remote Switch (www.EggtimerRocketry.com/page24.php) You can turn it on or off using a simple 4-button keychain remote, from up to 30' away. You'll have to use a 2S/7.4V LiPo because the RF module won't work with a 1S LiPo, but the convenience of not having to fumble around looking for the switch inside the AV bay more than makes up for the minor weight and size penalty.

Quark Battery Options

The Quark has a very wide range of battery options, since it runs on anything from a small 1S LiPo all the way up to 15V. Your battery choice will be largely dictated by your deployment igniters' requirements. Most common e-matches require about 1A of current, at maybe 6V or so, so your battery must be able to put out this amount of current without causing the voltage to the Quark to drop below its minimum (about 2.7V). This actually isn't all that hard to accomplish.

For most installations, we recommend using a 2S 7.4V LiPo battery. The size actually doesn't matter very much, because the Quark uses very little current, and the pulse that fires the igniters is only one second long; a 200 mAH LiPo battery, which is only about 25 grams, will easily last an entire day, even if you forget to turn the power off. Chances are that you won't though, because as you'll see later on the Quark is very adept at making noises to tell you that it's on.

We recommend that the current-sourcing capacity of the battery should be at least 5x the all-fire current of the igniter, to prevent any chance of the voltage dipping. To get that number, multiply the capacity in mAH by the "C" number of the battery. For example, a 200 mAH battery rated at 20C will easily put out 4,000 mA, or 4A. If you igniter is rated for 750 mA all-fire, 5 x 750 = 3750 mA, so that 200 mAH/20C battery would be just fine.

Finally, 9V alkaline batteries work fine too, particularly with Quest Q2G2 igniters. A lot of people like to use them because they're easy to get, but they are heavy (typically 50 grams) and expensive to use compared to rechargeable batteries. One more thing you need to be careful about is that some brands of 9V batteries simply have cells pressed together in a metal case, so high G forces can cause the battery to fail. We recommend Duracell 9V batteries, because they use welded cells and are less likely to come apart. If you do decide to use an alkaline 9V battery, we recommend that you replace it after EVERY flight. Yes, that can get expensive. And yes, you don't have to worry about your battery having been drained too much by a previous flight… enough said.

Regardless of what kind of battery you choose, **charge your battery before every session, and check the voltage with a digital voltmeter before every flight**. You don't want to spend all the time to find the "perfect" battery for your 54mm minimum-diameter mach-buster only to realize after you dig it out of the ground after lawn-staking it that you forgot to charge the battery.

Now, you may be wondering what happens if your igniter fires and causes a "dead short". We've seen that happen a few times, interestingly enough with very low current Quest Q2G2 igniters, probably because their wires are very close together so any mechanical thrashing about after firing can cause the wires to touch.

Unlike deployment controllers that use FET's on the output, the bipolar transistors in the Quark naturally provide some current-limiting to the output igniters, generally around 3A-5A. Especially with a LiPo, this helps prevent dead-shorts from damaging the battery and/or the output transistors. The transistors in the Quark are rated to 8A and 20 Watts continuously, and the actual firing only happens for one second, so it is very unlikely that the transistor itself will be damaged as the result of a short. We've intentionally dead-shorted the Quark's outputs in testing, with no harm to the Quark at all.

What might happen, however, is that the voltage drop due to the short will cause the battery voltage to drop low enough to cause the processor to reset. This is why we recommend having a battery current capacity of at least 5x the all-fire current of your igniter; if you get a short, chances are that the battery is going to simply generate a little heat in the transistor and wires for the one second that it's on, then it will be turned off and everything will be OK. If you battery only has a marginal current capability, the same short may cause the Quark to reset as the voltage drops below the processor threshold (about 2.7V). Depending on when this happens, the effect could range from not getting your peak altitude reading (annoying) to not deploying any chutes at all (very bad).

Flying with Your Quark

The Quark is very simple to operate. In general, a dual-deployment flight with the Quark will look something like this:

At your Table

- Charge or swap out your battery and check it with a DVM to check the voltage
  DON'T SKIP THIS STEP!
- Install the battery with the power switch OFF, then secure everything in the AV bay
- Check the jumpers to make sure they're set the way you want them to be
- Close up the AV bay
- Install your igniters with the switch off, with NO powder
- Turn on the Quark to see if you get any error tones… if it goes into the "Ready" mode, you're good
- Turn off the Quark, add powder to the charge wells, and finish prepping your rocket

At the RSO

- Get your rocket safety-checked, get your pad assignment, and swagger out to the pad

At the Pad

- Put your rocket on the rod/rail
- Turn on the power to the Quark…
- If you get an error, turn it off, take the rocket back to your table, and figure out what went wrong
- When the Quark starts the "Ready" chirp, install your igniter in the motor
- Go back to the safety zone and prepare for an awesome flight!

If you're new to dual-deployments, you can see that it's a lot more involved than just stuffing some wadding and the parachute into the tube, popping in the motor, and hooking up the igniter. Multiple deployments require discipline in order to make them work reliably; we've seen way more than our share of failed deployments, on everything from a small mid-power E-size rocket all the way up to an M-sized 200 pound beast. We've seen deployments fail with the top-end flight computers and with the low-cost units, even with redundancy. The reality is that most deployment failures are not the fault of the electronics; it's usually something mechanical like a bad connection, a nose cone that's too tight, etc. Having your blood, sweat, and tears free-fall from 10,000' bury itself in six feet of dirt is going to ruin your whole day.

We STRONGLY recommend that you use a checklist every flight so that you don't forget anything. We also recommend that you get a copy of the book Modern High Power Rocketry , it's full of good information too, and subscribing to a forum like The Rocket Forum (www.rocketryforum.com) is a really good idea, too.

The Quark Flight Sequence

At the Table… Programming and Testing

The first thing you need to do is to set the jumpers according to your flight. As mentioned before, the Drogue jumper can be set to deploy at nose-over (0S) or to be delayed by one second for backup deployment (+1S). Most of the time, the drogue is going to be at 0S; about the only time you'll use +1S is if you have two altimeters in your AV bay and the Quark is going to be set to fire later to provide redundancy.

The Main deployment can be set to 300', 500', 800', or 1000'. The jumpers work like this:

300/500	+500	Main Deployment Altitude
OFF	OFF	500'
ON	OFF	300'
OFF	ON	1000'
ON	ON	800'

The most popular setting and the default is 500', so for many flights you'll simply leave all the jumpers off.

When you first turn on the Quark, you'll get a 1-second beep to let you know that it's working. After about 5 seconds, you'll hear some additional beeps. That's the apogee from the last flight… more on that later.

After the apogee is beeped-out, there will be a 15 second delay. After that, the Quark runs some tests to make sure that the hardware is operational, and that you have continuity to both channels. If you do NOT have continuity, you will hear some beeps, continuously, and the Quark flight sequence will not start until you fix this condition.

The beeps are:

4 Beeps – No Main Channel continuity
5 Beeps – No Drogue Channel continuity

If you get either of these beeps, **DO NOT FLY YOUR ROCKET UNTIL THE CONDITION IS CORRECTED** because the Quark will not deploy your parachutes.

(Sidebar discussion….)
OK, you may be wondering how to intentionally disable a channel, for example if you only want to use the Quark for single-parachute deployment in lieu of motor ejection. The Quark requires **some** kind of load on the deployment channels to pass the continuity checks, but it's really not very picky about what that load might be. We typically use 100 ohm 1/4W resistors in place of an igniter to disable a channel, they draw very little current but the resistance value is low enough so that it's below the deployment checking circuitry's voltage threshold.
(End of Sidebar…)

Assuming that the continuity checks pass, a few seconds later you will hear the Quark start "chirping". That is the "I'm ready" signal, and it will continue chirping until shortly after launch. Note that the pace of the chirping is dependent on the drogue mode; "Normal" (nose-over) drogue deployment is indicated by fast chirping, "Delayed" (nose-over + 1 second) drogue deployment elicits a slower chirping. Once you hear them, you'll see what we mean. This is done so that you can have two Quarks in your AV bay, one set up for Primary deployment and one set up for Backup deployment… if you hear both types of tones then you know that both of them are OK.

Once you hear the chirping, you know that the Quark is good to fly, so at this point you should turn off the power, finish prepping the rocket, (Don't forget the powder in your charge wells! Don't ask us how we know about this…) and take it to the RSO/LCO along with whatever paperwork your particular club may require.

At the Pad…

Put the rocket up on the rail/rod, then turn the Quark back on. Since you already tested it once, you should hear the same chirping on the pad that you got while you were ground testing at your table. If not, then something probably came loose… better to find out before you fly then when the rocket is 5000' in the air! Turn it off, take it off the rail, and go back and fix it. Don't feel bad, we've all had it happen… learned lessons tend to "take" much better than somebody just telling you things!

Assuming you hear the chirping, you're ready to fly as far as the Quark is concerned. Connect your igniter, test the continuity, then go back to the safety zone to await your flight.

In the Air…

Once your rocket is launched, altitude samples are taken at 20 samples per second. These samples are run through a filter to eliminate "noise" that may be caused by a number of different factors, primarily aerodynamic but also some external factors such as wind and temperature.

Velocity readings are computed based on the difference in altitude between successive samples and the elapsed time between the samples. In a perfect world, this would give you a precise and 100% accurate velocity reading. The reality is somewhat different, however. There are several things that can introduce errors into the velocity reading: angle of attack, wind, errors in the pressure readings due to aerodynamic influences, and time differences. If the pressure ports in your payload bay aren't sized properly, this can introduce an error, particularly if they're too big and you have two of them opposite each other (you'll get a crossflow through the payload bay which makes the pressure readings very noisy). Finally, differences in the processor's timing may introduce errors, although the readings are taking at relatively precise intervals so it's going to be very small.

The good news is that the magnitude of these errors tend to be proportionate to velocity as the rocket ascends, so they respond well to being filtered with mathematical noise filters. Velocity-related events are run through a digital filter to smooth out any peaks or valleys that may develop.

Mach Transition…

As your motor continues to burn and the velocity increases, if the velocity exceeds 800 ft/sec aerodynamic shock wave buildup can fool the pressure sensor into thinking that the rocket is descending when in fact it is actually ascending at a rather rapid speed. If this were not taken into account, the flight computer might deploy the main parachute at near-mach speed, which would undoubtedly break something and ruin your day, not to mention what an object falling from the sky at these speeds could do.

To prevent this from happening, the Quark uses a predictive mechanism to hold off deployments until it's safely out of the mach "danger zone". When the noise-filtered velocity drops below 100 ft/sec for at least 1 second (presumably near apogee), deployments are re-enabled.

Apogee and Nose-Over

Assuming that your rocket is moving more or less straight up, it will continue to slow down during the coast phase until it gets as high as it's going to go. If the rocket was going absolutely straight up, the velocity at this point would be zero; it would simply start falling to the ground. In reality, this almost never happens, because you usually angle the rod/rail at a slight angle so that the rocket takes off away from the flight line. This results in the velocity disparity that we've previously mentioned. The rocket usually has some forward velocity at apogee; hopefully it's relatively small so your parachute deployment happens at a low velocity and won't cause any mechanical problems like a broken shock cord or a zippered tube. It also means that you really don't know that you've reached apogee until ***after*** you've been there.

Accordingly, the Quark fires the drogue parachute at Nose-Over, which we define as one second past apogee (highest recorded altitude). If the rocket is still going up, chances are that its altitude is going to keep increasing before a one second interval elapses, so you're unlikely to get a false apogee detection. If the rocket hasn't gained any more altitude after one second then you must be starting on your way down, so the Quark fires the drogue at that point, for one second.

When Nose-Over is detected, the Quark begins using the Descent Samples value for altitude sampling. This setting is very low, 2 samples/sec. As the rocket descends, when the altitude drops below the Main deployment altitude the Main channel is triggered, for one second. At this point your Main chute should pop out, to thundering applause and a hearty round of high-fives all around.

On the Ground

The Quark detects that your rocket is on the ground when the AGL altitude is below 30 feet for over 5 seconds. Once on the ground, the Quark 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 (no 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?

After the Flight

Once you've noted the maximum altitude so you can brag about it to your friends, you should turn off the Quark. If they don't believe you, you can always play it back to them by turning it back on for them… note that if you wait too long after the apogee is played back (over 15 seconds) the apogee value will be erased since it assumes you're starting a new flight.

Appendix A – Testing

The Quark has some special testing functions built in, in particular you can test the deployment channels with your battery and igniter combination to make sure that when it fires you aren't going to get any nasty surprises (such as the Quark resetting in flight, or the igniter not firing because the battery can't source enough current). In addition, you can test the output of the barometric sensor to confirm that the altitude readings are reasonable.

Deployment Channel Testing

To test a deployment channel, you need to remove all the jumpers except for the channel that you are testing. To test the Drogue, install ONLY the 0S/1S Drogue jumper. To test the Main channel, install ONLY the 300/500 jumper.

To perform a test, install the appropriate jumper, then turn ON the Quark. When you hear the apogee beeps from the previous flight, REMOVE the jumper. After the apogee beep-out ends and the 15 second waiting period ends, the beeper will continuously produce long on-off tones to let you know that it's now in test mode.

To actually fire the selected channel, put the jumper back on the appropriate pins. You will hear a long 5-second tone, then the channel will fire for one second. After the channel fires, you will hear a quick beep-beep followed by a pause, continuously, to let you know that the test is over.

This procedure is designed for testing ematches with your battery, we recommend that the wire from your ematch to to the Quark be at least 3' away from you when you do this, and we also like to put the ematch in a metal can too (soup cans work well) to prevent any chance of flaming debris from getting anywhere you don't want it to be.

You can also do a remote deployment test using your battery, igniter, and a "live" charge, IF AND ONLY IF you build a little remote switch. All you need is a SPST push-button, 10' of dual-conductor wire (Cat-5 wire works well) and two wire-wrap socket pins. Just solder the button to one end of the wire, and the socket pins to the other ends. Connect the socket pins to the header pins that you're going to test, prep the AV bay, close the switch, then turn on the Quark. Just use the switch in place of removing/replacing the jumpers to perform the test, but once you open the switch walk 10' to the **side** of the rocket (away from the nose/tail!) before closing the switch to fire the charge.

Note: NEVER do a deployment test with just a piece of bare wire, you need to have some kind of resistive load such as an ematch, igniter, or small piece of fine nichrome wire (#36 or #40, for example). If you do, you may blow out the output transistors. We've designed the Quark very conservatively, and the optoisolator/transistor combination automatically provides some current limiting to help protect the transistors and your battery. Nevertheless, it is still possible to blow up a transistor if you try hard enough.

Barometric Sensor Testing

To test the baro sensor, you'll need a USB-TTL data cable. Eggtimer Rocketry sells this cable, it's the same one that's used with almost all of our products that have data outputs or programming.

The cable uses the Prolific PL2303-TA USB-Serial chip, you can get the drivers from Prolific's web site. They have drivers compatible with virtually all common platforms… Windows, Mac, Linux, and they have a SDK for Android so there may be some Android drivers around too.

You'll need a simple serial data program, such as Hyperterminal, Tera Term, or PuTTY for Windows, or Terminal for the Mac. Set the data to 9600 baud, 8 bits, 1 stop bit, no parity, and connect the cable as follows:

BLACK Wire → "GND" pin (Ground)
WHITE Wire → "TXD" pin (Transmit)

Put the jumper on the "+500" header pins, then turn on the Quark. When you hear the altitude beep-out, remove the jumper. After the beep-out and the 15-second pause, you will hear a continuous short beep approximately once per second, and data should be streaming through the serial port. Note that the attitude readings is an Above Sea Level (ASL) altitude, NOT an Above Ground Level (AGL) reading, since it has no way of knowing where you are.

Appendix B - Real-Time Altitude Streaming

During flight, the altitude samples are streamed out through the serial port as the readings are taken. The format is the same as for the testing, 9600 baud, 8 bits, no parity, 1 stop bit. This data can be sent to a serial wireless radio in order to get real-time altitude data, or logged to get a flight profile.

We've used 3DR-type radios successfully with the Quark, you can pick up a set of them for about $30 from Internet-based hobby vendors like Hobby King. Note that those radios require their own power supply, which is outside the scope of this manual; check with your vendor for suitable power supply options.

To wire the Quark to a 3DR, connect it like this:

3DR "GND" pin → Quark "GND" pin (Ground)
3DR "RXD" pin → Quark "TXD" pin (Transmit)

Make sure you program the 3DR radio for 9600 baud, 8 bits, no parity, 1 stop bit. This is the default setting for most units we've seen, but we have seen a few that were shipped at 57600 baud or even 115200 baud, so if you're not sure check with your 3DR radio vendor.

On the receiver side, you simply connect the 3DR receiver "dongle" to your laptop (or other USB-enabled device, i.e. Android tablet) and use a serial terminal program to "read" the data being sent through the 3DR radio. With this setup you can see the real-time altitude of your rocket… very cool stuff.

You will also soon be able to stream the live altitude data to an Eggfinder receiver, either the RX "dongle" or the Eggfinder LCD handheld display receiver. This will be done by connecting it to the Eggtimer Quark Telemetry Module… keep an eye on our web site (www.eggtimerrocktry.com) for details.