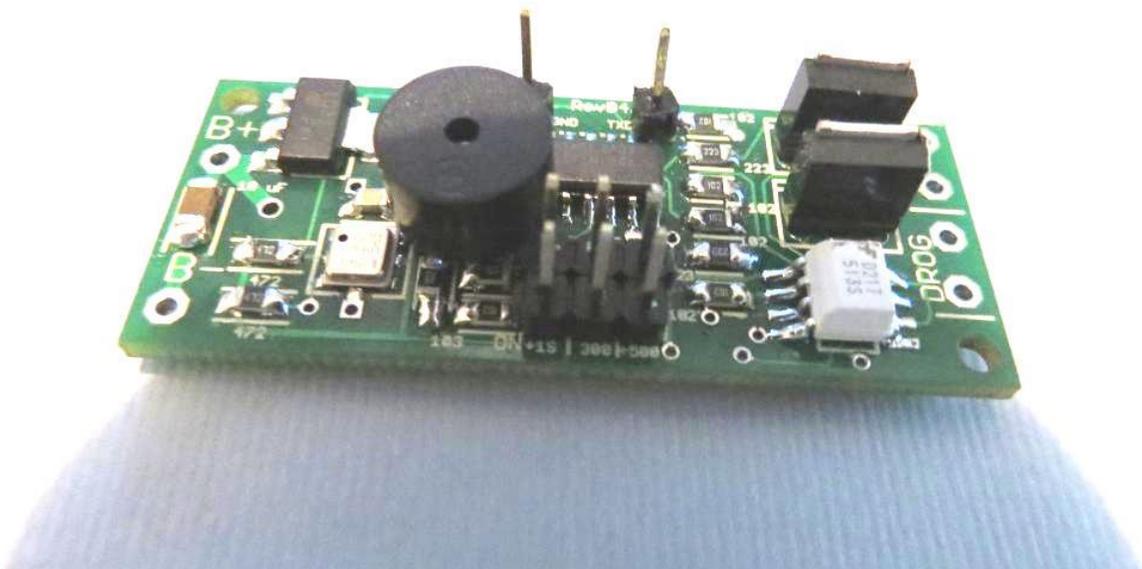


Eggtimer Quark Assembly Manual

Board Rev C1



California Proposition 65 Warning

WARNING: This product contains chemicals (lead) known to the State of California to cause cancer and birth defects or reproductive harm.

This kit includes a special low-temperature ultra-fine leaded solder wire. Including the solder with the kit ensures that you will have solder that can be used to mount the surface-mount parts in the kit. Leaded solders have been used for over a century in electronic assembly, but you should take the following precautions when using it (or just about any chemical, for that matter):

- Do not eat or drink while using it
- Wash your hands after handling it
- Keep it in the protective bag when you're not using it

The MSDS can be found at

<http://www.kester.com/download/245%20FluxCored%20Wire%20Lead%20Alloy%20SDS.pdf>

The European Union RoHS (Restriction on Hazardous Substances) regulations exempt kits such as the Quark from its regulations, because they are not for resale and since it is well known that hand soldering with non-leaded solder is much more difficult and more damaging to heat-sensitive components.

Before You Start...

- Check the parts against the Packing List in the kit, and let us know right away if anything is amiss.
- Go to our web site at www.Eggtimerrocketry.com and download the latest Release Notes.
- Go to our web site at www.EggtimerRocketry.com and download the latest Users Guide..
- Read them thoroughly before starting... it will save you some grief later, we promise!

~~~~~

Thanks for buying an Eggtimer Quark. The Quark is named after a tiny elementary atomic particle, which aptly describes the unit. It is designed to be extremely easy to use, and is also very small so you can put it in virtually any rocket that you could possibly want. You can fire the Drogue chute at either nose-over (just past apogee) or you can add 1 second for backup use, and the Main chute can be fired at 300', 500', 800', or 1000'. It beeps out your apogee after every flight, and you can easily test the deployment channels. Finally, you can actually stream live altitude data out the serial port for simple telemetry use.

Like other Eggtimer Rocketry products, we sell it as a kit, to keep costs down and provide an outstanding value. This means that you have to do a little work, of course, but considering that most hobby rocketeers that would use our products have some degree of electronics expertise, this should not be much of an impediment. If you do not have any experience soldering kits such as the Quark, we recommend that you ask around... chances are that somebody in your rocketry club would be more than happy to assist you for a small bribe (beverages work well!).

## **About Soldering Your Quark...**

Assembling your Quark isn't that hard, but we recommend that you don't choose it as your first kit project. You must be able to solder small components using fine solder and get nice shiny solder joints. If you have never soldered before, you need to learn anyway, because if you are going to do rocketry electronics you're going to be doing some soldering. If you want to get into advanced projects like telemetry, you're probably going to be doing a lot of soldering. We recommend that you get a few small kits from Ramsey or SparkFun, put them together, and hone your skills on them first. There's a lot of fun stuff out there, so go for it!

The Quark uses mostly Surface Mount Technology (SMT) parts, they are large by SMT standards, and are within the realm of being hand-solderable. In order to help make your assembly successful, we have included about 12" of very fine (.020"), very low temperature (about 180°C), no-residue solder. This is not the stuff that you get at Radio Shack... it's designed for soldering small temperature-sensitive parts without transferring much heat to the part itself.

**Important note about using extra flux with this board:** The solder that comes with the kit is Kester 245, it uses a water-based "no-clean" flux. If you wish to use extra flux with the board,

it **MUST** be compatible. You want a liquid (not paste) water-based no-clean flux. Kester 951 is ideal, if you can get it. Chip-Quik sells little 2ml tubes for about \$2 each (unfortunately they sell them in 6-packs, you can't just get one) which works very well. If you decide to add flux, you must use only a tiny amount. A few drops will suffice for the entire board. **DO NOT** use Rosin Core flux, or you will make a mess of the board and possibly damage components. We have built many kits without using any additional flux without any issues, the board is pre-tinned to make solder adhesion easier so in general you should not need to use additional flux.

For soldering components on a board like the Quark, we recommend a small pencil soldering iron, about 15W. If you are only going to use it occasionally, Weller makes a decent cheap 12W iron, it's about \$15. There is also a similar iron that's sold by ECG. We like those, but the copper tips seem to oxidize and corrode rather quickly compared to some more expensive irons; fortunately, the tips are replaceable and cheap. Better would be a fancier soldering pencil with iron tips; those run about \$30, but they'll last forever. The best iron would be a temperature-controlled solder station, they typically start at about \$50 for a cheap one and can go to a few hundred dollars if you want to get really fancy. Weller makes a good one for about \$50, if you make the investment that will probably be the last soldering iron you will ever need to buy. These solder stations usually have a little well with a tip-cleaning sponge, so they end up taking less room on your workstation too. Get the smallest tip you can find, preferably a small conical tip. It should be just about the same width as the processor's pads.

## **General Assembly Information**

We're sure that you are ready get started, but before you do you will need to get some tools together. The tools that you will need are:

- \_\_\_ Low-wattage soldering iron, 15W or less, with a fine conical tip
- \_\_\_ Small needle-nose pliers
- \_\_\_ Small diagonal cutters
- \_\_\_ Tweezers to handle the SMT parts
- \_\_\_ A small damp sponge for cleaning the tip of your soldering iron
- \_\_\_ A lighted magnifier... unless you have Superman's eyes
- \_\_\_ A jeweler's loupe or small 10x magnifier, for inspecting the SMT solder joints
- \_\_\_ A well-lighted place to work, preferably with a wood or metal surface, also preferably not carpeted
- \_\_\_ Some PAPER masking tape (do NOT use Scotch® tape or electrical tape)

Each installation step has a check-off line, we strongly recommend that you check them off as you go, and that you perform the steps in sequence. We have listed the steps in order to make it easiest to assemble the Quark, deviating from them isn't going to make your life any easier.

We strongly recommend that you consult the assembly pictures on the Eggtimer Rocketry web site, at:

<http://www.eggtimerrocketry.com/page16.php?view=thumbnailList&category=7>

Each step is pictured, so you can see exactly what you need to be soldering. Looking at the pictures as you go will help prevent you from soldering the wrong thing, or putting something in the wrong way.

# Assembling your Quark

## Step 1: Sort the Components

Before you start soldering anything, you need to lay everything out and make sure that you are familiar with all of components, and that you have everything. (Yes, we ARE human and sometimes make mistakes... if you are missing something, let us know immediately so we can send you whatever you need). You should have the following parts, check them off as you sort them...

| <u>Qty</u> | <u>Description</u>                                             |
|------------|----------------------------------------------------------------|
| — 1        | Circuit board with pre-mounted barometric pressure sensor      |
| — 1        | ATTINY84A-20SU Processor (14-pin SOIC chip)                    |
| — 1        | NCP1117-33 3.3V voltage regulator (SOT223 package)             |
| — 1        | MOCD217M2 Optoisolator (8-pin SOIC chip)                       |
| — 2        | KSH122ITU Darlington Transistors (TO-251 through-hole package) |
| — 4        | 1K ohm 0805-sized resistor (marked “102”)                      |
| — 2        | 4.7K ohm 0805-sized resistor (marked “472”)                    |
| — 4        | 10K ohm 0805-sized resistor (marked “103”)                     |
| — 2        | 22K ohm 0805-sized resistor (marked “223”)                     |
| — 2        | .1 uF 0805-sized capacitors (small brown unmarked parts)       |
| — 2        | 10 uF 1206-sized capacitors (brown, unmarked)                  |
| — 1        | Buzzer                                                         |
| — 1        | 8-pin header strip                                             |
| — 3        | .1” shorting jumpers                                           |
| — 1        | Coil of .020” 63/37 No-Clean solder wire                       |



Quark isn't a lot of fun, even if you have a vacuum desoldering tool. Trust us, we've been there before...

It is very important that you assemble the Quark in the order listed. This makes it easier to access the surface-mount components, if you start soldering out of order it's going to be tough for you to get to the pads of the SMT parts.

Before you solder anything, make **absolutely** sure that you have the correct part and that it is inserted in the board correctly. The board has all of the component values, outlines, and polarities silk-screened on the top, so there shouldn't be any doubt about what goes where and how. Nevertheless, if you have any questions about the assembly procedure, do not hesitate to drop us a line at [support@eggtimerrocketry.com](mailto:support@eggtimerrocketry.com) before you solder the parts to the board. You may have to wait a day for the answer, but it could save you a lot of grief later on!

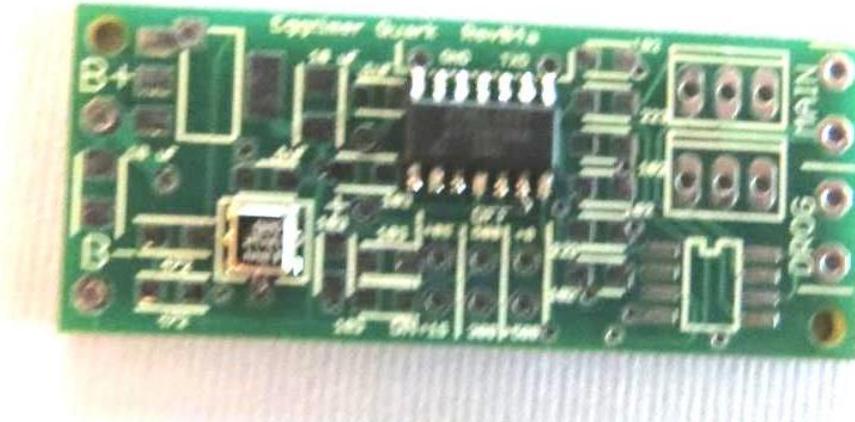
***The Eggtimer Quark Limited Warranty does not cover damage to parts while attempting to desolder them because you inserted something incorrectly.*** We spent a lot of time making sure that the assembly instructions were clear, but once again if you have any questions about the assembly procedures drop us a line at [support@eggtimerrocketry.com](mailto:support@eggtimerrocketry.com) **before** you solder.

OK, so let's get started...

### Processor

- 1) Tape the board down to your work surface using paper masking tape, underneath your lighted magnifier. Make sure you don't cover the spot for the processor (the 14-pin chip in the middle of the board).
- 2) Locate the processor spot on the board, you will notice that there is a "notch" on the silkscreen outline. This **MUST** match with the "Pin 1" side of the processor. If you look at the processor, you will see an indent, dot, triangle, or bar at one end of the package. That side is the one that must be matched up with the notch on the board.
- 3) With a very small amount of solder, tin the upper-right pad of the processor spot of the PC board.
- 4) Using tweezers, hold the processor in the correct spot on the PC board. Make sure that all of the leads on the processor are centered on the PC board's pads. With your soldering iron, heat up the LEAD above the pad that you tinned, and hold the iron there until the solder that you applied to the pad earlier melts. Hold the iron there for another 5 seconds, then carefully remove the heat. The lead should be bonded to the pad, if not then wait 30 seconds for the processor to cool down and try again.
- 5) Solder the bottom-right pad, using just enough solder to bond the lead to the pad.
- 6) With your 10x jeweler's loupe, carefully inspect both of these solder joints, and make sure that the remaining leads are centered over the pads. If not, heat up the joints and gently move the processor into place, then wait 30 seconds for it to cool down and inspect it again.

7) Now, carefully solder the remaining processor leads to the pads, using as little solder as you can to avoid creating solder bridges. Let the processor cool down at least 30 seconds between each solder joint.



### Mounting the Resistors and Capacitors

There's a definite technique to mounting small SMT parts like the 0805 resistors and caps that come with the Quark kit. Once you get the hang of it, a lot of people think it's easier than mounting through-hole parts, because you don't have to bend leads, tape the part down to the board, or clip the leads after you solder them.

To mount these parts...

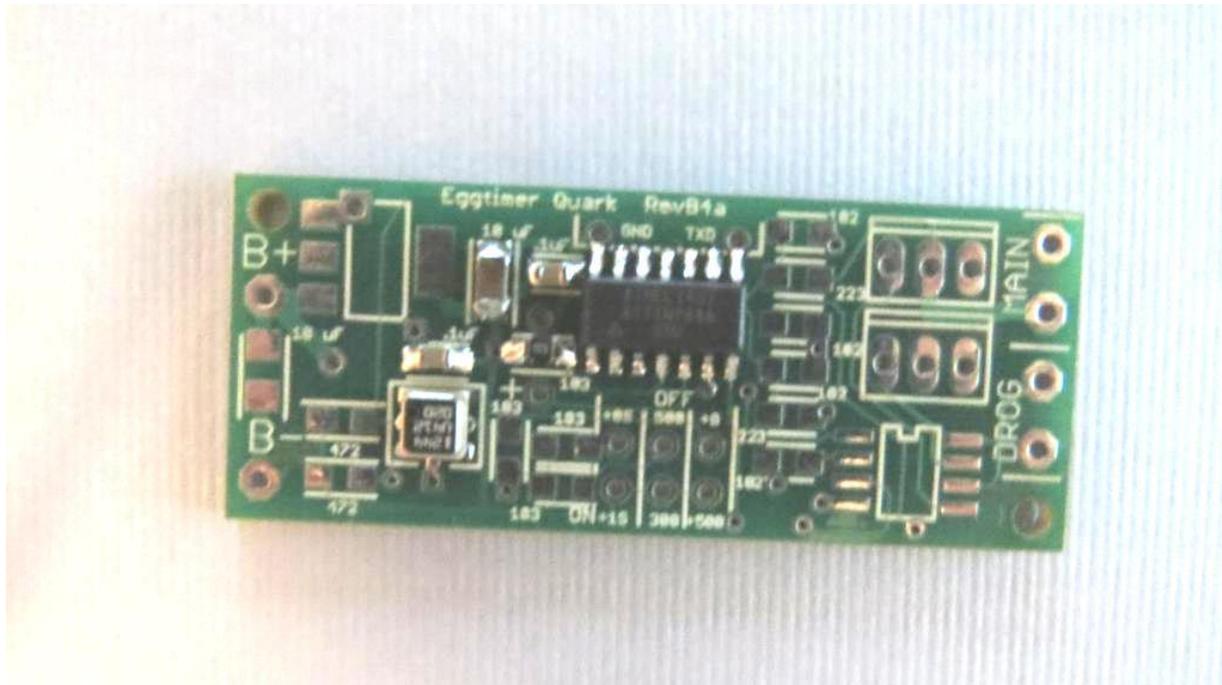
- 1) Lightly tin ONE pad.
- 2) Hold the part in place with tweezers, then heat up the tinned pad until the solder flows underneath the part.
- 3) Hold the iron for another 5 seconds, then remove the iron.
- 4) Hold the part in place for another 10 seconds until the solder cools. When you let it go, it shouldn't move... if it does, you didn't get a good solder joint, you need to start over.
- 5) Using as little solder as possible, solder the OTHER pad to the part.
- 6) Inspect both solder joints with a 10x jewelers loupe, making sure that the solder covers the pad and wicks up to the lead on the part. Touch up the solder joint if necessary, adding just a tiny bit of solder if necessary. Don't overheat the part if you do this, because the whole part can lift off the board and stick to your soldering iron if you do.

It is critical that you both inspect the solder joints, AND make sure that no solder has bridged over to other parts. In particular, the parts that are mounted around the silver-colored pressure sensor need to be soldered carefully, if you get a solder bridge onto the pressure sensor it may be very difficult to fix since the pads on the pressure sensor are on the bottom of the part, not the sides.

We provide a few extra parts for the 0805-sized parts because they're easy to lose. Chances are good that you'll be thanking us for that at some point in the assembly...

OK, now that you know how to solder these parts, install them in this order:

- .1 uF capacitor just to the left of the processor (next to the notch)
- 10K resistor (marked "103") just below the .1 uF cap you just installed
- 10 uF cap (larger brown part) just to the left of the .1 uF cap you installed
- .1 uF cap, just above the little silver pressure sensor.



### Mounting the Voltage Regulator

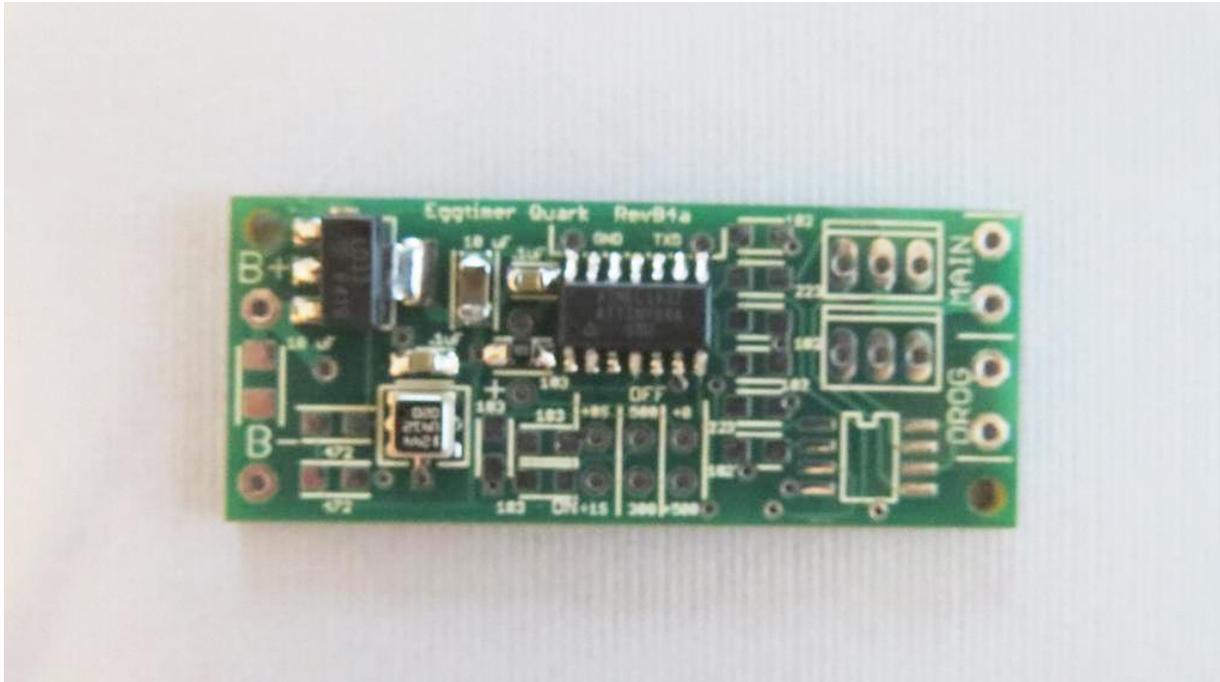
- 1) Lightly tin the large pad on the board where the voltage regulator mounts.
- 2) With your tweezers, hold the voltage regulator in place, making sure that the 3 leads opposite the large tab are centered on the pads.
- 3) Heat up the pad until the solder melts, hold the iron for another 5 seconds, then wait 10 seconds to allow the solder to cool before letting go.

4) Solder the 3 smaller leads to the pads. You should be a bit generous with the solder, it helps conduct heat away from the regulator.

5) Go back and fully solder the large tab to the pad.

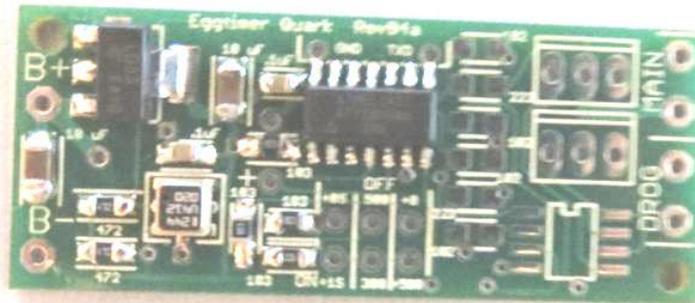
Inspect the solder joints, making sure that there's no bridge and that they fully contact the pads. Particularly with the regulator, a solder bridge can cause some nasty problems, so be careful.

OK, now that the regulator is out of the way, mount the following parts in order:



- 10 uF capacitor (larger brown part) just below the voltage regulator
- Two 4.7 K resistors (marked “472”) just to the left of the pressure sensor. We’ve said it before but it bears saying again, be **EXTREMELY** careful not to allow any solder to bridge over from these resistors to the pressure sensor.
- Three 10K resistors (marked “103”) to the right of the pressure sensor. Note that one of them is mounted “up and down” and the other two are mounted “left and right”. If you have any doubt about how they mount, consult the assembly pictures on the Eggtimer Rocketry web site.

Be especially careful no to create any solder bridges across these resistors. It’s pretty easy if you get a little carried away with the solder... use just enough to cover the pads, and check them afterwards with a 10x jeweler’s loupe to make sure you don’t have any bridges.



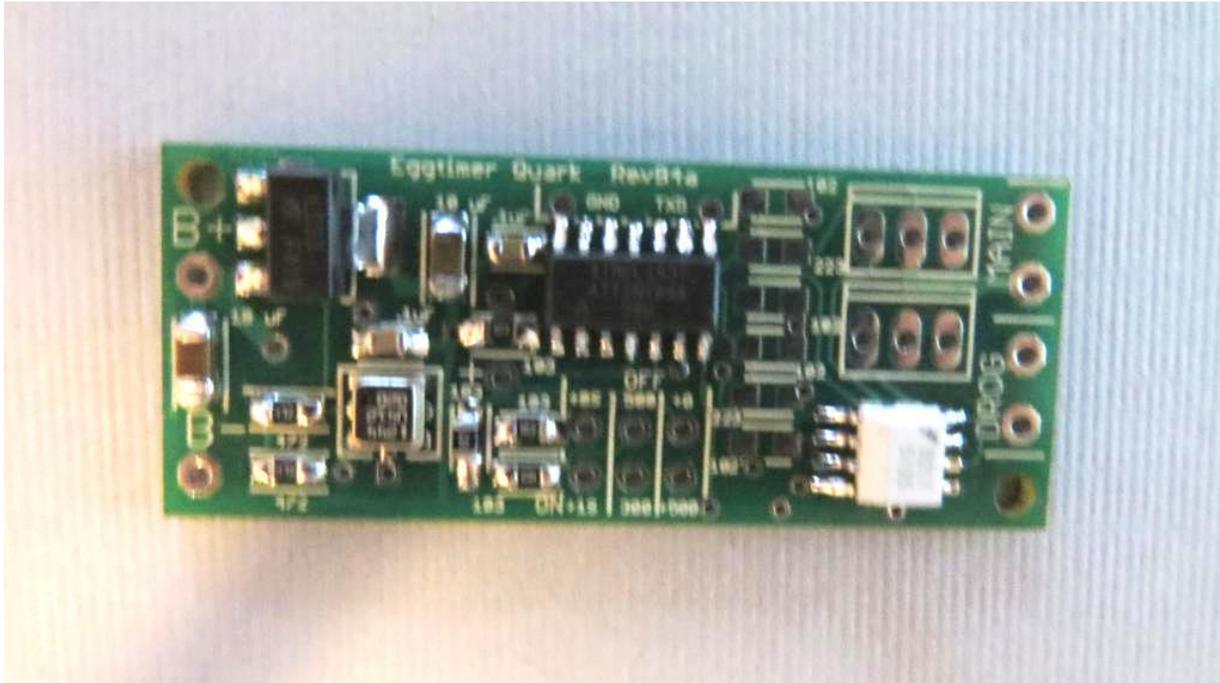
### Mounting the Components on the Deployment Side

The components to the right of the processor control the deployment. There is a row of resistors, then the two transistors and the optoisolator. You'll mount the optoisolator first, then the resistors, top to bottom. We'll have the transistors for later... you'll see why.

#### Optoisolator

- Locate the optoisolator spot on the board, you will notice that there is a “notch” on the silkscreen outline. This MUST match with the “Pin 1” side of the optoisolator. If you look at the optoisolator, you will see an indent, dot, triangle, or bar at one end of the package. That side is the one that must be matched up with the notch on the board.
- With a very small amount of solder, tin the upper-right pad of the optoisolator spot of the PC board.
- Using tweezers, hold the optoisolator in the correct spot on the PC board. Make sure that all of the leads on the optoisolator are centered on the PC board's pads. With your soldering iron, heat up the pad that you tinned, and hold the iron there until the solder that you applied to the pad earlier melts. Hold the iron there for another 5 seconds, then carefully remove the heat. The lead should be bonded to the pad, if not then wait 30 seconds for the optoisolator to cool down and try again, adding a little more solder if necessary.
- Solder the bottom-right pad, using just enough solder to bond the lead to the pad. The leads are a little stubby, so make sure the solder actually contacts the lead (we've seen it cover the pads and miss the leads).

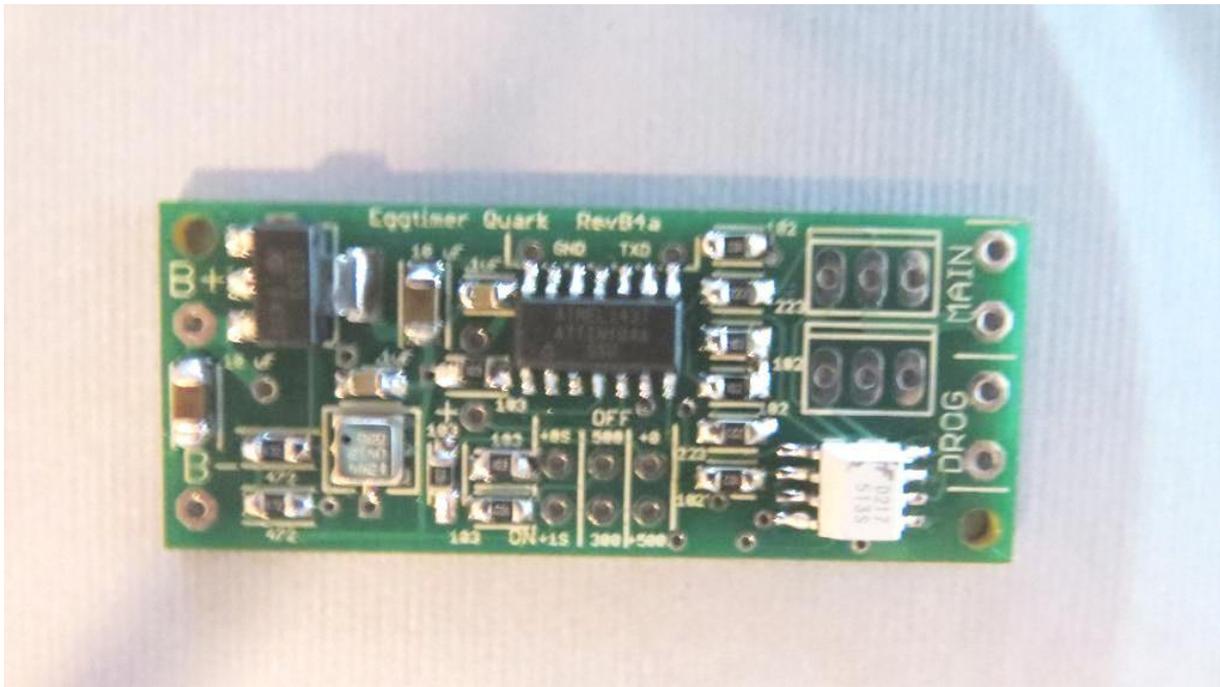
- With your 10x jeweler's loupe, carefully inspect both of these solder joints, and make sure that the remaining leads are centered over the pads. If not, heat up the joints and gently move the optoisolator into place, then wait 30 seconds for it to cool down and inspect it again.
- Now, carefully solder the remaining leads to the pads, using as little solder as you can to avoid creating solder bridges. Let the optoisolator cool down at least 30 seconds between each solder joint.



### Resistors

From top to bottom, solder the six resistors just to the right of the processor. Inspect each one after soldering to make sure that the solder covers the pad and bonds the resistor leads.

- 1K Resistor (marked 102)
- 22K Resistor (marked 223)
- 1K Resistor (marked 102)
- 1K Resistor (marked 102)
- 22K Resistor (marked 223)
- 1K Resistor (marked 102)



OK, that takes care of the SMT parts. Before you continue, get out the jewelers loupe and a good light, and carefully inspect every solder joint on the board. They should be nice and shiny, and the solder should cover the pad and wick up to the part. If you have any doubt whatsoever about a solder joint, redo it.

### **Mounting the Through-Hole Parts**

Now it's time for the easy parts... the through-hole parts. First, you have a decision to make...

You can mount the through-hole parts on either side of the board, but they all need to be mounted on the same side. Why would you do this, you may ask? Well, it's mainly going to depend on whether you are going to wire your deployment connectors/wires to the board, or whether you want to use a 4-pin .150" pitch screw terminal block (not included) instead. There are advantages and disadvantages to both...

#### Hardwired

- Smaller Profile
- Requires soldering the wires
- Can't come loose in flight
- Not easy to move
- Servo tape mounting OK

#### Terminal Blocks

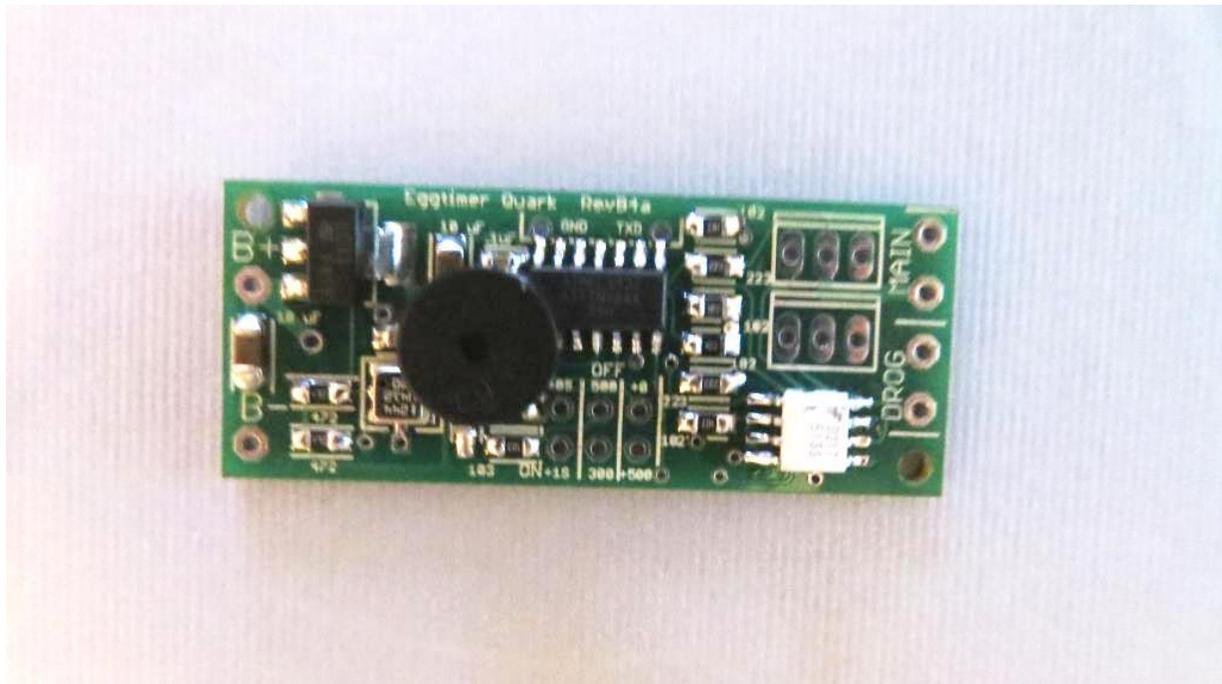
- Slightly taller profile
- Wires are simply screwed into the blocks
- Can vibrate loose in flight
- Easier to move between rockets
- Requires screw mounting

Given the relatively low cost of a Quark, we generally recommend that you hardwire it to your sled, and don't remove it. However, some people like the convenience of removable screw terminal blocks, so we've designed the board to take them too, when mounted on the bottom of the board.

- Decide whether you're going to mount the through-hole parts of the top (for hardwiring) or the bottom (for optional screw terminal blocks). Note that if you are going to mount the parts on the bottom of the board, you will be soldering pads on the top of the board, some of them will be close to the SMT parts that you soldered. Be careful not to use more solder than you need to use to bond the parts to the pads, and inspect each joint carefully with the 10x jeweler's loupe to make sure you don't create any solder bridges.

- Mount the buzzer

Locate the two holes for the buzzer, next to the processor. Note that the buzzer is polarized, one lead is longer than the other, and is marked “+” on the top of the buzzer. Set the buzzer in place so that the “+” lead is at the bottom of the board, and hold it in place with a small piece of PAPER masking tape. Do not use Scotch tape or electrical tape. Turn the board over, solder the leads in place, then trim the excess leads with a small pair of diagonal cutters. Remove the tape.

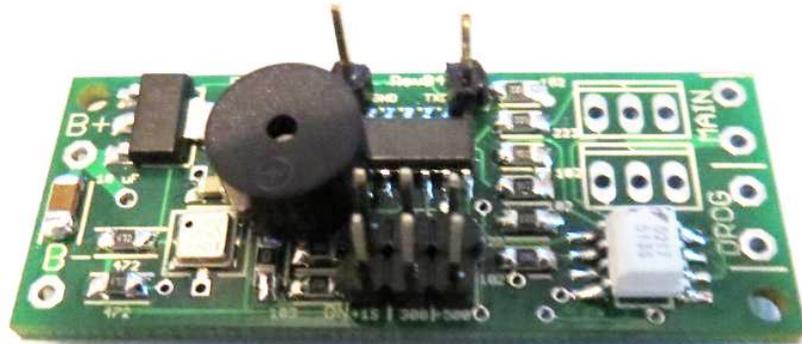


- Mount the Headers

Cut the 8-pin header into two 3-pin headers and two single pins.

Put the two 3-pin headers in place, at the bottom of the board. Hold them in place with paper masking tape. Turn the board over, and solder the leads in place. Remove the tape.

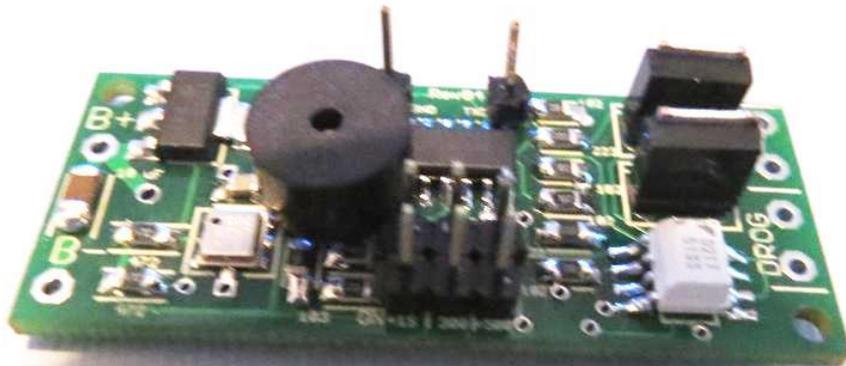
Place each of the remaining pins in the holes at the top of the board just above the processor, in the holes marked “GND” and “TXD”. Tape it in place, turn the board over and solder the pins, then remove the tape.



- Mount the Transistors

Put the top transistor in place, so that the flat silver side is aligned with the skinny rectangle on the transistor silkscreen. Tape in place, turn the board over, then solder in place. The pads are relatively large, so be sure to get good solder coverage. Trim the leads flush.

Similarly, mount the second transistor.



- Mount the Screw Terminal Block (Bottom-Mount option only, optional)

If you've decided to go with the screw terminal blocks and the bottom-mount option, place the terminal block in place so that the opening faces to the OUTSIDE. Tape in place, turn the board over, then solder to the pads.



Congratulations, you are now done! Time for some testing....

## Preliminary Testing

For preliminary testing, you can use any battery that is compatible with the Quark. We like to use a cheap 9V “heavy duty” battery for testing (but NOT for flying...) because they don’t put out as much current as a LiPo, so if there’s a short somewhere it’s much less likely to cause damage to the circuitry. Not necessary, of course, but it’s a suggestion...

Take the “pigtail” for the battery you are using, and compare it to your battery. Identify which lead is “+” and which lead is “-“... normally, the “+” lead is RED and the “-“ lead is BLACK. **IF YOU HAVE ANY DOUBT AT ALL, USE A DVM TO TEST IT WITH THE BATTERY BEFORE YOU MOUNT IT TO THE BOARD.** You WILL damage the Quark if you connect the battery backwards!

We use JST connectors for almost all of our LiPo batteries, 1S, 2S, or 3S. They’re polarized so theoretically you can’t connect the battery backwards. We say “theoretically” because some of the cheap ones aren’t molded very precisely and it IS possible to insert them backwards, particularly since these connectors require a little bit of force to insert (and remove!) anyway. To help prevent against this, we take a black Sharpie marker and color the black side of both the pigtail and the battery connectors so that we have an easy reference: Match up the black stripes and you’re good.

Strip about 1/8” from each lead of the pigtail, and tin the leads. Tack-solder the “+” lead to the TOP side of the pad marked “B+”. Do not solder it through the hole in the pad, because you’re gonna want to unsolder this so you can permanently mount the Quark in your AV bay; this solder joint is just for testing, so just use enough solder to hold the wire to the pad, and try not to get too much (if any) in the hole.

Similarly, tack-solder the “-“ lead to the BOTTOM side of the pad marked “B-”. Like the other pad, use just enough solder to hold the wire to the pad.

Connect your battery to the pigtail. You should immediately hear a 1-second beep, and after a few seconds you should hear the “last apogee” beeps. Since it’s just been programmed, it will beep 10 times twice. After another 15 seconds, you should hear four beeps, followed by a pause, then five beeps followed by a pause, with this sequence repeating for as long as you have the battery connected. This is telling you that neither of the deployment channels has continuity, which isn’t surprising considering that there’s nothing soldered to them yet.

If you get this far, congratulations! Chances are pretty good that everything else is going to work too. Gently unsolder the two tacked-on pigtail connections, and clean them up with solder wick if necessary. You can now get ready to mount your Quark... at this point, you need to get out the EggTimer Quark User’s Guide.

## Troubleshooting

If your Quark doesn't work after assembly and testing, take a deep breath, get out a beverage to clear your mind, and start troubleshooting...

### Check Your Solder Joints

The very first thing you should do is to check out all of the solder joints under a lighted magnifier. The most common reason for things not working are solder bridges, i.e. putting too much solder on the pads and shorting two adjacent pads together. You can also get into problems by bridging pads with "vias" on the board, the smaller holes that don't have any components soldered to them. Most of the pads are very small, so it doesn't take much solder to get a nice "tented" solder joint. If you get a solder bridge, heat it up and use a solder wick or a vacuum bulb to remove the excess; afterwards, we recommend resoldering the joints. Note: NEVER use "canned air" or compressed air to "blow away" excess solder. The resulting splatter will almost always cause more damage than the original solder bridge, and if you get solder splatter under the baro module there's no easy way to fix it.

Another thing to look out for is "cold" solder joints, they look dull and blobby compared to a nice shiny "tented" solder joint. If you have a cold solder joint, it won't conduct well; at the low power that the Quark uses this could easily keep things from working. If you have a cold solder joint, heat it up and put just a little bit of solder on it, the main idea is to get a little more flux on the joint. If there's too much solder, use a fine solder wick or (preferably) a vacuum bulb to remove the excess, then heat it up and resolder the joint.

Finally, it is relatively easy to actually miss a solder joint, especially with the optoisolator since it has very "stubby" leads. When you solder the pads, don't just melt the solder on top of the leads... it can get stuck there and actually miss the pads. We've had it happen. Head up the pads, not the leads, then gently apply the solder until it flows around the leads.

### Check Your Component Polarity

Most of the components aren't polarized, with some notable exceptions. The outline of the parts is silk-screened on the board, so you should be able to see readily if you have a component soldered in backwards.

If you inserted a component incorrectly, you will have to carefully unsolder it, clear any solder residue from the holes, and resolder it. If you find that a component was soldered incorrectly, you will have to use a vacuum bulb or vacuum desoldering tool to unsolder it. We cannot stress enough that you need to check the orientation of the parts *before* you solder them. The Eggtimer Quark Limited Warranty does not cover damage to a component while attempting to unsolder it, so make take your time and make sure you get it right before you solder.

## **Check Your Battery & Connector**

Make sure that you are using one of the recommended batteries to test with. Make sure that you have the polarity correct: The RED wires must go to the “B+” side and the BLACK wires must go to the “B-“ side. Your battery connector must be soldered to the pads marked “B+” and “B-“. If you connect a LiPo battery backwards, it WILL damage your Quark!

## **If It Still Doesn't Work...**

There is, of course, always an outside chance that you have a bad component. We test each PC board and the surface mounted components before they leave us. Nevertheless, it is always possible that something may be wrong; there may be a bridge on the PC board itself, etc. If you have gone through all of the troubleshooting steps and the board still doesn't work, let us know at [support@eggtimerrocketry.com](mailto:support@eggtimerrocketry.com) . A high-resolution picture (5 megapixel or better) of both sides of your circuit board and a description of the problem would be very helpful...

## **Troubleshooting Tips (in approximate order of likelihood)**

### No Beep When the Battery is Connected

- Check the polarity of the buzzer... it may be in backwards
- Bad solder joint on the processor
- Incorrect battery polarity, or bad solder joint on battery connector pads  
(Bad polarity WILL damage your Quark!)
- Bad solder joint on voltage regulator
- Bad solder joint on the 10 uF capacitors
- Bad solder joint on the 4.7K resistors

### Unexpected Beeps When the Battery is Connected

- Bad solder joint and/or short on the processor
- Bad solder joint on the two 4.7K resistors