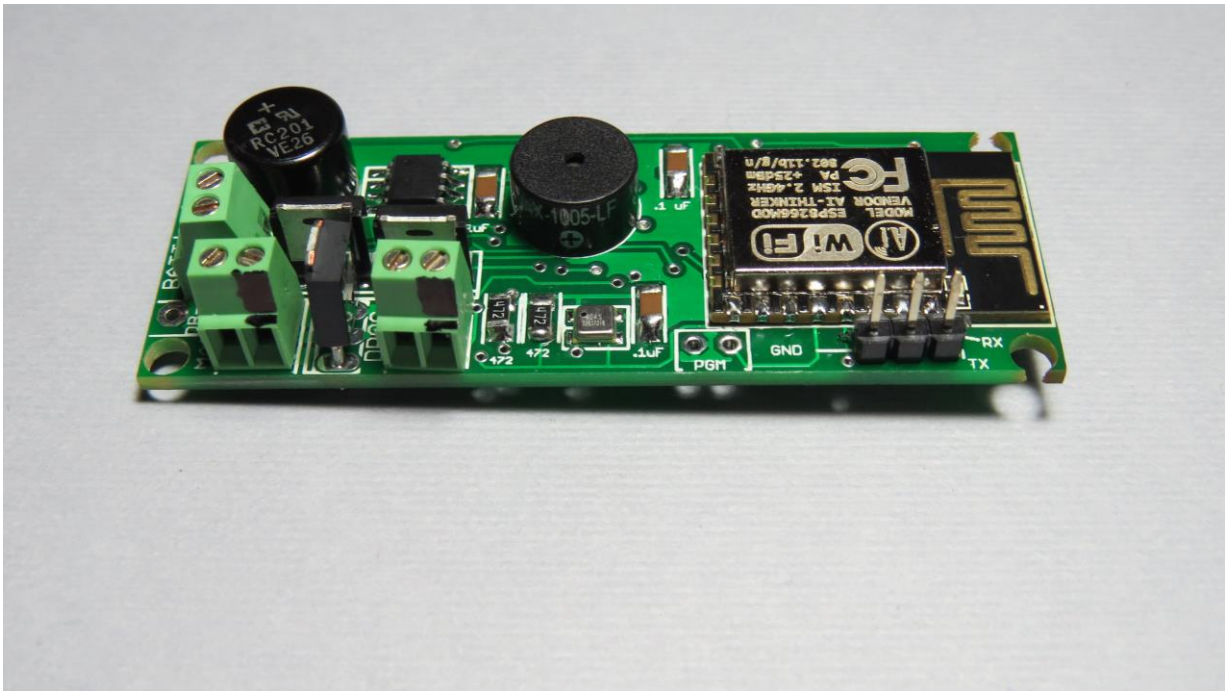
Eggtimer Quantum
WiFi-Enabled Flight Computer
Assembly Manual

Rev A12/A12f



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

Important Regulatory Information

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

It is intended to be used ONLY for educational and experimental use in Class II/III amateur High Power Rockets which are classified as aircraft by the Federal Aircraft Administration (CFR 14 §101.25), and which must by FAA and NFPA regulations be operated at least 1,500' away from any populated buildings. Although unlikely, this device may cause interference with consumer devices that run on the unlicensed 2.4 GHz band, and therefore must not be used in residential areas.

Contains FCC ID: 2ADUIESP-12

The Eggtimer Quantum uses an ESP8266-12 801.11n WiFi module in the 2.4 GHz unlicensed band, per FCC part 15. It is intended to be used only in the United States or other countries in which this band (or a subset of it) is not subject to licensing. We have made a good faith attempt to comply with all technical regulations, and you should too by building it **exactly** as per the instructions, and by not modifying the WiFi module in any way.

Because the Quantum runs on an unlicensed band, there is no protection against interference from other sources; basically, you get what you get. We've done substantial testing and are confident that your Quantum is unlikely to be significantly affected by outside radio sources, but there's no guarantee.

If your Eggtimer Quantum causes interference in a residential setting, or with licensed radio systems (such as TV or ham radio), you **must** stop using it until you correct the problem. This is extremely unlikely given the small amount of power, and in particular the distance from any population that HPR rockets must be flown. Nevertheless, you need to be aware of this, and be willing to abide by the rules. These are the same rules that govern other non-licensed transmitters, such as cordless phones, WiFi and Bluetooth® devices, and garage door openers.

Important Links:

FCC Part 15 (governing unlicensed intentional and unintentional emitters)
http://www.ecfr.gov/cgi-bin/text-idx?SID=adb12f74b498e43ec453f7899d9df0fd&node=47:1.0.1.1.16&rgn=div5

FAA Regulations for Amateur Rocketry (Part 101)
http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&rgn=div5&view=text&node=14:2.0.1.3.15&idno=14

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Before You Start…

• Go to our web site at www.Eggtimerrocketry.com and download the latest Assembly/Users Guide..

• Read them thoroughly before starting… it will save you some grief later, we promise!

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Thanks for buying an Eggtimer Quantum! The Quantum integrates a 2-output flight computer with a WiFi access point and server, so you can program, arm/disarm, test, and download all from your handheld device. It uses a simple browser interface, so it will work with virtually any wireless device, no apps or other special software required. You can monitor the battery status and the continuity of your deployment channels, all from over 100' away typically. Each Quantum has a unique WiFi SSID code, and it uses the WPA2-PSK connection protocol with a unique 8-digit passkey, so it's almost impossible for anyone except yourself to connect to your Quantum and turn it on (or off!). To arm your Quantum you need to enter a 4-digit validation code that changes every 60 seconds or whenever you refresh the web page. This prevents it from being accidentally armed or disarmed… you wouldn't want to "pocket dial" your altimeter!

After your flight, you can view summary flight data right on your handheld device, and you can also download a csv-formatted detail file to your device for analysis using a spreadsheet or other program. It holds your last 15 flights, and numbers each one so you know which one is which.

Finally, you can also perform a full-blown deployment test, from over 100' away, without having to worry about 2 or 3 grams of BP going off in your face.

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 this, 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 Quantum…

Assembling your Quantum kit 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 Quantum uses a number of 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 some 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 on using flux: Be VERY careful about your choice of any extra flux. You really don't need to use any, but if you do choose to do so make sure that you use a liquid "no-clean" type of flux such as Kester 951. DO NOT use any kind of rosin or similar organic flux, it is almost certainly going to be incompatible with the flux in the no-clean solder and make a big mess. Extra flux may require excessive heat in order to boil off the flux, possibly damaging the sensitive components in the kit.

For soldering components on a board like the Quantum, 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 with a conical tip that's about the same width as the smallest pad. .032" (.8 mm) conical tip is ideal. We do NOT recommend that you use an extremely-fine "needle nose" tip, we have found that they may not conduct enough heat to the pads to allow the solder to flow out well. A conical tip with a 1/32" width (.031") should be fine.

General Assembly Information

We're sure that you are ready to 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
(mesh "sponge" works great too)

___ A sal ammoniac block or "tip cleaner" (not essential, but helpful)

___ A lighted magnifier, for inspecting solder joints (not essential, but very helpful)

___ A jeweler's loupe or small 10x magnifier, for inspecting the SMT solder joints
(again, not essential but VERY helpful)

___ 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)

___ A few round wooden toothpicks

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 Quantum, 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, www.EggtimerRocketry.com . Go to Photos/Quantum Build.

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 Quantum

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. 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. Note that some of the smaller parts may have extras… you don't want to have to stop just because you drop some teeny little part. Also note that there may be one or two parts that you don't have depending on your board revision; check the revision on the board before you decide that you're missing something.

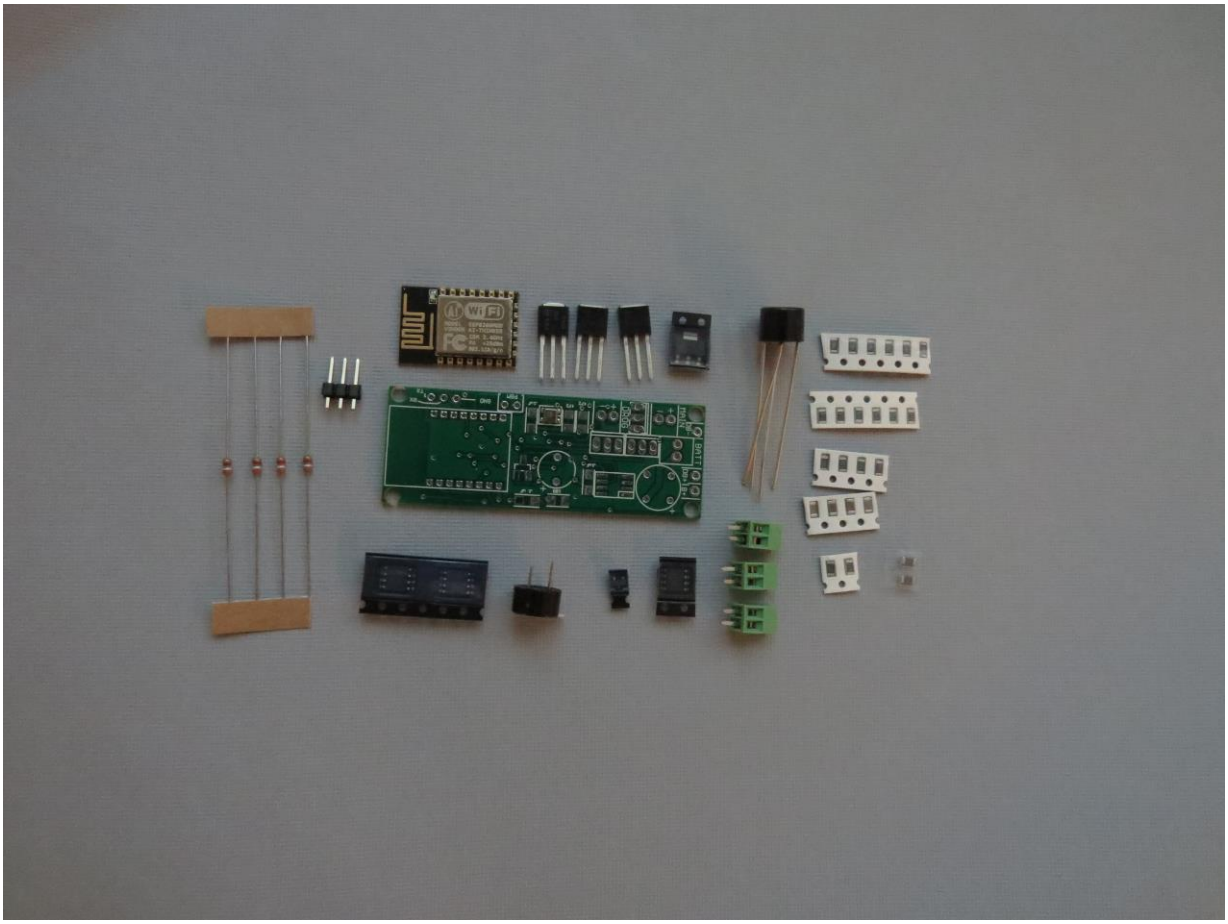
	Qty	Description
__	1	Circuit board with pre-mounted barometric pressure sensor
__	1	Pre-programmed ESP8266-12 WiFi Module
__	1	CAT25C512 64Kx8 I2C EEPROM (8-pin SOIC package)
__	1	LD1117-33 3.3V voltage regulator (SOT-223 package)
__	2	MOCD217 Optoisolators (SOIC-8 package)
__	1	NTD3055L104-1G MOSFET (3 leads, marked "55L 104G")
__	2	KSH122 Darlington transistor (3-leads, marked "KSH 122-1")
__	1	SI2302 FET (very small part with 3 leads; Rev A12f board only)
__	1	RC201 full-wave bridge (round with 4 leads)
__	1	10mm magnetic buzzer
__	3	1K 1206 resistor (marked "102")
__	6	4.7K 1206 resistor (marked "472")
__	6	10K 1206 resistors (marked "103" or possibly "1002")
__	1	22K 1206 resistor (marked "223")
__	3	.1 uF 1206 ceramic multilayer capacitor (brown) (not marked, but it's in a PAPER carrier)
__	2	10 uF 1206 ceramic multilayer capacitors (brown) (not marked, but they're in a CLEAR PLASTIC carrier)

__ 4 1/8W resistors (value not important… we're just using them for the leads)

__ 1 3-pin header

__ 3 2-pin 2.54mm screw terminal blocks (optional)

__ 1 Coil of .020" 63/37 No-Clean solder wire



Note that some of the components are static sensitive, so you should avoid sources of static electricity while you are handling them. We recommend that you assemble the Quantum on a wood or metal surface unless you are fortunate enough to have a high-temperature anti-static mat (don't buy one just to build the Quantum, however!) Avoid putting it on plastic surfaces that generate static, and preferably put it together in a room that's not carpeted. That being said, it's very unlikely that you will zap any of the components in the Quantum with static electricity, but consider yourself notified of the possibility…

Also note that some of the components are polarized, i.e. it matters which way you put them in. If you solder one of these components in backwards, the effect will range from something not

making a noise (buzzer) to nothing at all working. It is CRITICAL that you test-fit the parts before you solder, and that you make ***SURE*** that you have them pointed the right direction before soldering. Like the old adage says, "Measure twice, cut once." If you solder a part onto the board incorrectly, it can be a minor pain to remove if it only has two pins, or it can be virtually impossible for something with a lot of pins. ***The Quantum Limited Warranty does not cover incorrect assembly***, so if you mess up badly enough you may end up having to get another kit and starting over; neither of us want that.

It is very important that you assemble the Quantum 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. Some of the instructions will call for you to tack-tape parts to the board to maintain alignment while you solder. You should ONLY use paper masking tape for that purpose, DO NOT use "Scotch"® tape or electrical tape for this; plastic tapes can pick up static electricity and damage parts, and electrical tape tends to leave a sticky residue.

If you have any questions about the assembly, please send us an email, to support@eggtimerrocketry.com , BEFORE you start building. We generally answer all questions the same day, and we do our best to ensure your success.

Eggtimer Quantum Assembly Checklist

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 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 Quantum 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@eggtimerrockety.com ***before*** you solder.

About soldering the resistors and capacitors

A lot of people get put off by the idea of having to solder small SMT parts like resistors and capacitors, but it's really not that hard to do once you get the hang of it. In fact, many of our users prefer SMT parts to through-hole parts, because you don't have to clip the leads and they just plain look cooler. Here's how to mount them… once you do one or two you'll find that it's actually pretty easy.

Lightly tin only ONE of the two pads on the board. With tweezers, lay the part down on the board, and heat up the lead over the tinned pad until the solder flows. Wait a few more seconds, then remove the heat, holding the part there until the solder cools for a few seconds. Let it cool for another 10 seconds, then carefully solder the other pad, being careful not to use too much heat. Once the solder starts to flow, remove the heat and let the joint cool. If you keep the heat on too long, you may heat up the part enough so that both joints melt and the part is likely to lift off the board when you remove your iron. It might also "tombstone", that is, lay on end due to the previously-soldered joint melting. If this happens, just heat up the joint, remove the part with your tweezers, and try again.

After you've soldered the part in place, inspect the joint carefully with a 10x jeweler's loupe. You should see good solder coverage on the pad with the solder wicking up to side/end of the part, and there should not be any solder splatter or bridges. (Splatter means your iron is too hot… turn it down about 50F and try again). If you don't like what you see, heat up the joints and remove the part, and/or clean it up with some solder wick, and start over.

Alternate Method: Using a Hot Air Tool…

If you've done a fair amount of SMT work you may have a hot air rework tool. These are very cool, and they can make SMT soldering a lot easier if you have some experience. You can speed up the assembly a bit if you have some no-clean solder paste and a hot air tool. Just put a very small amount on the pads for each part (it shouldn't be blobbed up… you only need a tiny bit), set the part on the pads, then gently go over the pads with your hot air tool. We recommend about 300C to start with, adjust the temperature up or down depending on your

specific paste. Note that we strongly recommend that if you do it this way you use solder paste containing no-clean flux, most of them are that way nowadays, though. We recommend that you do one part at a time, that helps prevent you from accidentally knocking some part off the pads and smearing the solder paste somewhere that you don't want it to be. Note that only about half of the parts are SMT, so you're still going to have to use a soldering iron and the wire for the through-hole parts.

We do NOT recommend that you use a hot air tool to mount the WiFi module. First, you need to tape over the vias to prevent the bottom of the module from shorting on them, so the module isn't going to be laying flat against the board. Second, if you get it a little too hot you can damage the WiFi module, and/or loosen the metal RF shield (which is there for FCC compliance), possibly shorting the pads. Just mount it as directed as a through hole part and you'll be fine.

OK, so let's get started…

Mounting the Top-Mount SMT Parts

There are parts mounted on both sides of the Quantum board, this is done to save space. It does make the assembly task a little bit more complicated, but in general most of the smaller parts are mounted on the "bottom" side of the board (i.e. the side that you don't see when it's mounted in your AV bay), so the "top" side of the board is pretty easy. We're going to do the relatively few SMT parts on the top side, then flip it over and do the bottom side, then go back and do the through-hole parts that are all on the top side.

__ Orient the board

Turn the board so that the pressure sensor is facing up, with the "BATT" to the left and the outline of the WiFi module (large rectangular part with two rows of pads) to the right. Tape the board down to your work surface with masking tape, on the extreme left and right sides so you don't cover any of the pads.

__ Mount the two .1uF capacitors

Locate the spot for the two .1 uF capacitor, just to the left of the the WiFi module. These are the brown capacitors that comes in the PAPER tape carrier. Solder in place.

__ Mount the two 4.7K resistors

Locate the 4.7K resistor (marked "472") near the bottom center of the board. Solder in place.

__ Mount the SI2302 FET (Rev A12f board only)

Locate the spot for the FET, it's a small box with 3 leads: two on one side, and one opposite. Lightly tin the single pad. With tweezers, hold the FET to the pads as you heat up the tinned pad, then remove the iron. Let it cool for 5 seconds. Solder the other two pads, then go back and resolder the single pad if the coverage looks a little thin.

__ Mount the 10K resistor

Locate the 10K resistor (marked 103) that's located at the edge of the board, just above the FET and next to one of the .1 uF capacitors. Solder in place.

__ Mount the CAT24C512 EEPROM

Locate the spot for the EEPROM, it's the 8 pads just to the left of the top-center of the board. Remove the EEPROM from its package, you'll see that there is a dot at one corner of the chip. This corresponds to the little square that's marked at the top-left pad.

Tin the upper-right pad with just a little bit of solder. With tweezers, hold the EEPROM in place, and heat the lead over the tinned pad until the solder melts. Keep the heat on for another 3-4 seconds, then remove the iron and let the pad cool.

Check the alignment of the EEPROM on the pads, all of the leads should be centered on the pads. If not, heat up the lead and carefully move the EEPROM in place.

Once you're satisfied with the alignment, carefully solder the remaining leads to the pads, waiting 15 seconds between each lead so that the device has a chance to cool down a bit. We recommend that you do the corners first, to help keep the EEPROM in alignment with the pads. When you're done, get out the 10x jeweler's loupe and inspect each solder joint carefully, making sure that the solder contacts both the pad and the leads, and that there are no solder bridges between the pads. If you find one, get out the solder wick and remove any excess solder before resoldering the pads.

__ Mount the last .1uF capacitor

Locate the spot for the .1 uF capacitor, just to the right of the EEPROM. Solder in place.

Untape the board from the work table.

Mounting the Bottom-Mount Parts

__ Cut a piece of paper masking tape about ½" square. Lay a round wooden toothpick across the sticky side, then lay the toothpick flat across the right edge of the board, taping it down. Wrap the rest of the tape across the other side of the board.

Similarly, tape another round toothpick to the left side of the board.

Now, turn the board over and lay it down. The toothpicks should stand the board off from your work surface about 1/8"… this protects the sensitive baro pressure sensor and the other previously top-mounted components while you're working on the bottom of the board.

Tape the board down to your work table so that two rows of pads for the WiFi module are on the left side.

__ Mount the resistors…

Locate the four resistors at the left side of the board that are right next to each other, and in-between the solder pads of the WiFi module. Solder each one in place:

__ 1K (labeled "102")

__ 10K (labeled "103" or "1002")

__ 10K (labeled “103” or “1002”)

__ 1K (labeled “102”)

Note: Do NOT solder the three 10K resistors (marked “103”) that are mounted at the edge of the board outside the WiFi module. You’ll be soldering these in later, AFTER you mount the WiFi module.

__ Mount the 4.7K resistors

Important Note: There’s a silkscreen error on some early Quantum boards, you’ll notice that there are two resistor pads between the optoisolators, one marked 472 and one marked 103. They should BOTH be 472’s… sorry about that, it will be fixed in a subsequent board run.

Locate the two 4.7K resistors (marked “472”) between the two optoisolators (the 8-pin pads next to the four resistors you just soldered). Solder in place, being careful not to get any solder on the optoisolator pads.

__ Mount the Optoisolators

Locate the two spots for the optoisolators, they’re the 8-pin pads on the left side of the board. The optoisolators will be mounted so that the notch/pin is facing the left side of the board. Note that some optoisolators don’t have a notch/pin, but if the writing is right-side up then it’s positioned properly. We’ll do the left one first, then you can do the right one the same way.

Tin the lower-right pad with just a little bit of solder. With tweezers, hold the optoisolator in place, and heat the lead over the tinned pad until the solder melts. Keep the heat on for another 3-4 seconds, then remove the iron and let the pad cool.

Check the alignment of the optoisolator on the pads, all of the leads should be centered on the pads. If not, heat up the lead and carefully move the optoisolator in place.

Once you’re satisfied with the alignment, carefully solder the remaining leads to the pads, waiting 15 seconds between each lead so that the device has a chance to cool down a bit.

Similarly, solder the other other optoisolatore in place using the same procedure as the left one. Inspect the joints carefully with a 10x jeweler’s loupe and a good light… the optoisolators have short stubby leads, and it’s relatively easy to have the solder on the pads miss the leads if you don’t use enough solder.

__ Mount the 3.3V Voltage Regulator

Locate the large pad and the three small pads for the voltage regulator. Heat up the large pad with your soldering iron and melt a very small amount of solder on the large pad, just enough

to cover it. Place the voltage regulator IC in place, and hold it down, then heat up the large pad on the voltage regulator until the solder starts to flow. Hold your soldering iron on the pad for another 5 seconds, then remove it and wait at least 10 seconds. This should hold the regulator in place.

One by one, solder the three small three small leads to the pads, using enough solder to cover the pad and get a good "tenting" on the leads without creating solder "blobs". Wait at least 30 seconds between each pad to prevent the chip from overheating.

Now go back and heat up the tab again and flow more solder on the large pad, covering it and the tab with solder. You don't want a great big blob of solder, but you do want enough so that the tab is covered. This ensures that the pad underneath is well bonded to the tab, and the solder/tab acts as a heat sink for the regulator.

__ Mount the 10 uF capacitors

Locate the two 10 uF capacitors, one on either side of the voltage regulator. Note that the two different valued capacitors look almost identical and are unfortunately not marked… the 10 uF capacitors are the ones that come in a clear plastic carrier (the other ones are in a paper tape carrier). Solder them in place.

__ Mount the 1K resistor

Locate the 1K resistor (marked "102") on the board just above the voltage regulator. Solder in place.

__ Mount the 22K resistor

Locate the 22K resistor (marked "223") on the board just above the voltage regulator. Solder in place

__ Mount the 4.7K resistor

Locate the 4.7K resistor (marked "472") on the board at the bottom edge of the board below the voltage regulator. Solder in place, being careful not to get solder into any of the holes in the adjacent large oval-shaped pads. If you're worried about this, put a round wooden toothpick in the pad's hole before you solder the adjacent resistor's pad.

Inspect all of the solder joints carefully, in particular the ones on the optoisolators (it's REALLY easy to miss a solder joint on them, trust us on this!)

Mounting the ESP8266-12 WiFi Module

Carefully remove the ESP8266-12 WiFi module from the antistatic baggie in which it was shipped. (Be sure to keep the baggie, it has the passkey that you'll need to connect to your WiFi device!) Note that one end has a "squiggly" line and sticks out, this is the antenna side, be sure to line it up with the left side of the PC board.

Cut a piece of paper masking tape about ¼" wide and 3" long. Tape the WiFi module to your work tape upside down, so that the metal shield is facing down. Take one of the 1/8W leaded resistors and put it into one of the corner holes of the WiFi module. Yes, it will stick up a lot. Solder the lead to the pad, holding the resistor straight up, then clip the lead off half-way to the resistor body. You don't need a lot of solder, just enough to fill the hole and ensure that the lead is well attached. Insert the resistor's leads into the next hole, and similarly solder it.

As you clip the resistors' leads, insert it into the next pad, then solder it to that pad. After the second lead on each side, clip it at the resistor body. When you are completely done, there will be a lead on each pad, about ½" long. Untape the WiFi module from your work table and turn it over so that the TOP side (with the metal shield) is now up.

You will have a short wire sticking out of each pad on the TOP of the WiFi module. With a pair of fine diagonal cutters, clip the stubby lead off close to the WiFi module's PC board. It doesn't matter if you have a little bit left, but it matters a lot if you wedge a little piece of the cut leads in the module somewhere, so inspect it carefully to make sure that they're all cut completely off.

Afterwards, turn the WiFi module over, and with your diagonal pliers even out the leads so that they're the same length. Carefully line up the leads with the holes for the WiFi module markings on the TOP of the PC board, and gently work it into the holes until it's about 1/32" above the board.

Now, turn the board over so the WiFi module is on the bottom, and solder the leads to the boards. Again, use only enough solder to ensure that you have a good mechanical connection. Clip the leads as you go, making sure that the remnants don't land somewhere on the board. When you are done, all 16 pads (8 on each side) should be soldered on the bottom of the board, and all 16 pads on the WiFi module should be soldered. Inspect the solder joints carefully, and touch up any that look incomplete, particularly the two end pads… they provide the power and ground connections from the board.

Note: Your WiFi module may have six extra pads opposite the antenna, do not solder these or do anything at all with them.

Mounting the Rest of the Top-Mount Parts

__ Mount the 10K resistors

Locate the three 10K resistors (marked “103” or “1002”) outside the WiFi module near the edge of the board . Solder in place.

__ Mount the Transistors

Locate the two KSH122 Darlington transistors, they are 3-pin parts with a metal tab on one side. Note that there are TWO of them; there is a similar part (a MOSFET) of which there is only ONE. They are marked “KSH 122-1”. Do not interchange them… things will not work!

Turn the board over so that the transistors are on the right side, and insert them into the holes for them so that the metal tab corresponds with the tab marking on the board. The tabs should be facing AWAY from the EEPROM. Use some masking tape to hold them in place, then turn over the board and solder them in place. Note: Do NOT allow the tabs of the transistors to touch each other! Clip the leads flush.

__ Mount the MOSFET

Locate the NTD3055 MOSFET, it’s a 3-pin part with a metal tab on one side. It’s marked “55L 104G”. Locate the spot on the top of the board between the MAIN and DROG pads, there are markings for the pads and the tab. Be sure to orient it correctly; the tab should be facing AWAY from the baro pressure sensor and the WiFi module. Use some masking tape to hold it in place, then turn over the board and solder in place. Clip the leads flush.

__ Mount the Bridge

Locate the RC201 full-wave bridge, it’s a round 4-pin part with a “+” marking near one of the leads. The “+” lead is also longer than the other ones, too. Gently insert the bridge into the holes in the upper left side of the board, lining up the “+”. Hold it into place with masking tape, then turn over the board and solder in place. Clip the leads flush.

__ Mount the Buzzer

Locate the buzzer, it’s smack dab in the middle of the board. Note that it’s polarized, one lead is marked “+” and it’s also longer than the other lead. Place on the board matching up the “+” with the “+” marking on the board, hold in place with masking tape, then turn over the board and solder in place. Clip the leads flush.

__ Mount the Header

Insert the 3-pin header from the top of the board so that the short side goes through the board. Hold it in place with some masking tape, turn the board over, and carefully solder the pins in using just enough solder to bond the pins to the pads.

__ Solder the Screw Terminal Blocks (Optional)

If you're going to use them, insert the screw terminal blocks on the board, making sure that the open side is facing outwards towards the edge of the board. Note that the "+" and "-" markings on the MAIN and DROG will be obscured, if you need them (and you only do for servos, really) we recommend that you use a Sharpie pen and mark the "-" terminal black before soldering them in. Note that there is NO polarity for the BATT terminals; the full-wave bridge design makes it polarity-independent. Hold them in place with some masking tape, turn the board over and solder the pins to the pads. Be generous with the solder, you need a good mechanical connection here.

Get out your lighted magnifier and carefully inspect all of the solder joints. Make sure that there are no solder bridges, particularly on the WiFi module. If something doesn't look 100% right, resolder it, removing it first if you have to.

Congratulations, you're almost done! Just one more thing…

About Deployment Output Power

The Quantum incorporates the signature Eggtimer Rocketry dual-battery architecture, so you can use separate batteries for the logic side of the device and the deployment side. Doing so 100% guarantees that no matter what happens on the deployment side, including a dead-short, will not affect the operation of your Quantum. We recommend this configuration for large projects, and your RSO/TAP may require it as well.

We also realize that this is different than "the other guys" and you may not want to hassle with two batteries. We get it. The reality is that modern ematches are very reliable (especially the "chip" type), and use very little current. Therefore, you can also set up the Quantum to use a single battery, like everybody else. We've used the Quantum with a single battery with no deployment power failures at all in testing (or for that matter, with any other Eggtimer Rocketry altimeter…) so we know that for the vast majority of you out there you'll want to do it this way.

If you do decide on a single battery, we recommend that you make it big enough so that it can handle a short on your igniter for a few seconds without severely lowering the voltage output of the battery. Our general rule is that the battery's output current capability should be at least 5 times the all-fire current of your igniter, 10x would be better. For example, a 7.4V 350 mAH

20C battery can put out 20x 350 mAH, or about 7,000 mA (7A). If the all-fire current on your ematch is 1A, that's a 7x safety margin… plenty enough. In general, we also recommend that you don't fire the igniter any longer than you have to … 1 or 2 seconds is way more than enough for an ematch. Save the longer settings for a hot-wire cutter or something like that.

To configure your Quantum for a DUAL-BATTERY, you will need to connect the deployment battery to the two deployment battery pads, marked DB+ and DB-. (Do NOT use the pad marked "B+"). If you wish, you can put a switch in-series with the DB+ pad and the "+" side of your deployment battery; you may not need to, however, more on that later. Be sure to match up the polarity… normally the RED lead on your battery connector will be "+", and the BLACK lead with be "-". If you have any doubt, check it with a DVM before you solder them onto the board.

To configure your Quantum for a SINGLE BATTERY, use a piece of spare resistor lead and jumper the two pads marked B+ and DB+ that are located right next to the BATT pads. If you want to use a cutoff switch, you can just put the switch between the B+/DB+ pads instead of a jumper… read on.

The Quantum is different than every other altimeter that we're aware of in that it switches both sides of the deployment outputs. Other altimeters have one lead of the igniters tied to a common battery lead (usually but not always "+"), and the igniter is fired by closing a switch on the other lead (usually but not always "-") completing the circuit. The Quantum incorporates a MOSFET switch on the deployment power as well as the typical on/off switching of the deployment transistors, so that the igniters are essentially "dead" until you are almost at apogee in flight. The only way you can fire an igniter on the ground is with the test web page, which you cannot get into from the normal Quantum web pages. In addition, the Quantum will not self-arm… if you turn it on with ematches connected it will just sit there with the deployment power turned off until you arm it with your wireless device using the proper validation code.

What this means is that there is an electronic switch on the deployment power, interrupting the circuit and essentially satisfying the NAR/TRA L3 requirement for a switch disconnect on the deployment power until it's armed. You can connect your battery/batteries with confidence at your work table, knowing that there's no way to accidentally fire a deployment channel.

Preliminary Testing

Loosen the screws on the terminal block screws (if you're using them) and connect your battery "pigtail" to the leads marked BATT. If you're not using the terminal blocks, solder your battery pigtails to the pads marked BATT. Tighten the screws (if you used the terminal block). Note that there is no polarity on the BATT terminals, so it's not marked... there is no "wrong" way to hook up the battery.

Connect your battery to the pigtail. You should hear three quick beeps, then a long one. If you do not hear any beeps, immediately disconnect the battery and go to the troubleshooting section. Chances are pretty good that you have a solder bridge or an incomplete joint, so the first thing you need to do is to examine the board thoroughly with a magnifying glass. About 99% of all the problems that we see are due to soldering issues.

The Quantum acts like a WiFi access point and a server, you simply connect your WiFi-enabled device to it and browse to its home page, and voila! you get a web page that lets you turn your switch on and off.

Like any secured WiFi network, you need two things to connect… the SSID and the passkey. The SSID of your Quantum will be "Quantum_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 generated by a random number algorithm the first time that your Quantum is powered on, and is saved in EEPROM memory at that time. It's going to be unique for every Quantum. 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 Quantum. You should see the following information:

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

Quantum v1.05
SSID: Quantum_F87A6E
PASSKEY:  3718 6501
```

Note 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 Quantum… you'll hear the buzzer beep 3 times then stay on for a second, and in about 10-15 seconds you should see your Quantum'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 Quantum's status page. You're now connected to your Quantum, and ready to start using it.

Get out the Eggtimer Quantum User's Guide and start reading… if you can't stand to wait that long, you can cheat by going to the Eggtimer Quantum Quickstart Guide at the end, but we're sure that you'll want to read the long version for all the information…

Mounting the Quantum in Your AV Bay

The Quantum has four #4 holes for mounting in a AV bay sled. It's about 2.5" x .9" x 3/8", so you'll need to make sure that you have enough room on your sled for it. It doesn't matter which way you mount it, as long as it's mounted so the WiFi module is facing outwards. There's a drilling template on the Eggtimer Rocketry web site, we recommend that you download it, print it, and cut it out with scissors so you can drill the mounting holes accurately.

Our favorite mounting method is to use four #4 hex-head cap screws, about 1/2" long, and a short (about 3/16") piece of 1/8" i.d. rubber tubing to act as a spacer between the bottom of the PC board and the sled. We hold it on with nylon-insert nuts… they don't work loose. If you mount it like this, you can pretty much use whatever monster motor you may have on-hand (like the infamous O5800, for example) without fear of anything coming loose, and the rubber tubing makes a nice cushioned mount.

Be careful not to overtighten any screws that you use. Since the optoisolators stick out at the bottom of the board, it's possible to bend the PC board if you overtighten them, doing that may break solder joints or even a lead on the IC if it's forced against the sled. Don't ask us how we know this…

We generally recommend that you try to mount the Quantum as close to the battery and your altimeter as possible, and keep the wiring as short as possible. Small zip ties work really well for tidying up the wires. Also, we **strongly** recommend that you zip tie the wires connected to the Quantum to your sled, to provide strain relief for them. In general, if a wire can't move, it won't come loose. Enough said…

Note that large bits of metal in your AV bay will reduce the range of your Quantum, as will metallic paint or carbon fiber body tubes. In most cases, the range will be good enough for you to be able to operate the Quantum from a reasonable distance close to the rocket, maybe 10'-20', but you need to be aware of this in case you're thinking that you can arm your 75mm minimum-diameter carbon fiber machbuster sitting on the away pad from the LCO's table… it ain't gonna happen.

About Batteries for Your Quantum…

The Eggtimer Quantum was designed with 2S/7.4V LiPo batteries in mind. The Quantum uses about 85 mA of current, so we recommend that you use a battery with at least 300 mAH of capacity. That will give you about 3 hours of power, which should be enough for almost all flights. Bigger is better. You CAN use a smaller LiPo battery, just remember that the run-time will be less, so if you put a 200 mAH battery in your AV bay and it sits on the pad for two hours, you may have an unpleasant surprise if your battery runs down before your flight. Fortunately, it's easy to monitor the battery voltage of your Quantum, so this shouldn't happen.

Regarding the battery voltage monitor, we recommend that if you're using a LiPo battery you don't fly if the battery voltage registers under 3.5V per cell, i.e. 7.0V for a 2S LiPo. 3.7V is the nominal rated output voltage, but the reality is that a fully-charged LiPo cell will read 4.2V or near. That's a lot of leeway, so if it's already drained down that far before you fly it may

end up going dead (below 3.0V) if you have to spend a lot of time looking for your rocket. As always, the best policy is to charge your batteries completely before each flight, and/or use a fresh battery.

Note: We strongly recommend that you do NOT use a 9V alkaline battery with your Quantum. Most 9V alkaline batteries are only good for 100 mAH, so you may get less than 60 minutes of use out of one. We realize that they ARE easy to get and they ARE convenient because you don't have to mess with charging them, but having an expensive rocket lawn-dart into the ground because of a weak battery is not something we like to see.

Loosen the screws on the BATT side of the screw terminal block, and connect your battery connector to it. Tighten the screws firmly. If you are using stranded wire, you may want to tin just the very end of the wire to prevent it from fraying; a loose strand of wire can short out the battery, which can cause a fire if you're using LiPo batteries, so check your connections carefully to make sure that there are no shorts.

For a flight, we strongly recommend that you zip-tie any and all connections to the sled next to the pads/terminals. This prevents wires from pulling out of the screw terminals due to G forces. Similarly, you should tape closed any connectors, and zip-tie any loose wires to the sled. If it can't move, it can't come loose…

Troubleshooting

If your Eggtimer Quantum doesn't work after assembly and testing, take a deep breath, get out a beverage to clear you 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, or with a 10x jeweler's loupe or magnifier, and make sure that all of the parts are in the right place. 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 holes and 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 solder splatter will almost always cause more damage than the original solder bridge. "Canned air" is actually a refrigerant, and the cold shock can damage electronic components.

Another thing to look out for is "cold" solder joints, they look dull and blobby compared to a nice shiny "tented" solder joint. Cold solder joints won't conduct well; at the low power that the Quantum 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 a vacuum bulb to remove the excess, then heat it up and resolder the joint.

Check Your Component Polarity

Most of the small 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. Some of the components are not symmetrical (i.e. the voltage regulators) so they would be difficult to install backwards, too.

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 Quantum 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.

If It Still Doesn't Work…

There is, of course, always an outside chance that you have a bad component. We pre-program and test every WiFi module, and the other parts are factory-direct so the likelihood that one of them is bad is very small. 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 . 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 power-on beeps when you connect the battery

- Bad solder joint on voltage regulator
- Bad solder joint on bridge
- Bad solder joint on 10 uF capacitors
- Bad solder joint on the ESP8266-12 module
- Buzzer on backwards
- Bad solder joint on SI2302 FET or 103 resistor above it
- Weak battery

No data when I connect the USB-Serial cable

- Serial cable connected incorrectly
- Terminal program not configured correctly
  (should be 115,200 baud, 8 bits, no parity, 1 stop bit)
- Bad solder joint on ESP8266-12 module
- Bad solder joint on header

Don't see a "Quantum_…" SSID

- Bad solder joint on ESP8266-12 module
- Weak battery (especially if you're using 9V alkaline batteries!)

Can't connect to "Quantum…" SSID

- Bad passkey (hook up the serial cable and check it)
- Wrong type/encryption selected
  (set them all to "auto" and let your WiFi manager pick it up)

Can't bring up Quantum web page

- Bad WiFi connection (check your WiFi manager)
- Incorrect URL (use **http://192.168.4.1**)
- Weak battery (use a freshly charged one)
- Bad solder joint on the ESP8266-12 module
- Problem with the two 4.7K resistors next to the baro sensor
- CAT24C512 EEPROM mounted incorrectly

Drogue/Main continuity won't work

- Bad solder joint on the ESP8266-12 module
- Bad solder joint on the optoisolators (#1 reason!)
- Bad solder joint on the resistors around the optoisolators
- Weak battery

Drogue/Main channels won't fire when I do a test

- Bad solder joint on the ESP8266-12 module
- Bad solder joint on the optoisolators (#1 reason!)
- Bad solder joint on the resistors around the optoisolators
- Bad solder joint and/or reversed KSH122 transitor(s)
- Bad solder joint and/or reversed NTD3055 MOSFET
- Weak battery

Eggtimer Quantum Limited Warranty

Eggtimer Rocketry warrants that all of the parts listed in the parts list necessary to build the Eggtimer Quantum are included in the kit, and that they are all new and working. We don't use surplus parts… we like stuff that we know will work. If you open up the package and find that something is missing, send us an email to support@eggtimerrocketry.com letting us know, and we'll get it taken care of right away.

Eggtimer Rocketry warrants that when constructed per the documented assembly procedure the Eggtimer Quantum will perform substantially per the instructions. We try very hard to make sure that our stuff works the way we say it does, but because software isn't perfect we can't always anticipate things that may occur. If we find that there is a problem that prevents the Quantum from operating as documented, we'll do our best to fix it in a timely manner.

Since there is a wide variation of possible configurations using the Eggtimer Quantum and there is no way that we could possibly test them all, we do not warrant the suitability of the Eggtimer Quantum for any particular purpose. Hobby Rocketry is just that…a hobby. It's up to you to decide how to use our products, and whether or not they are suitable for your projects.