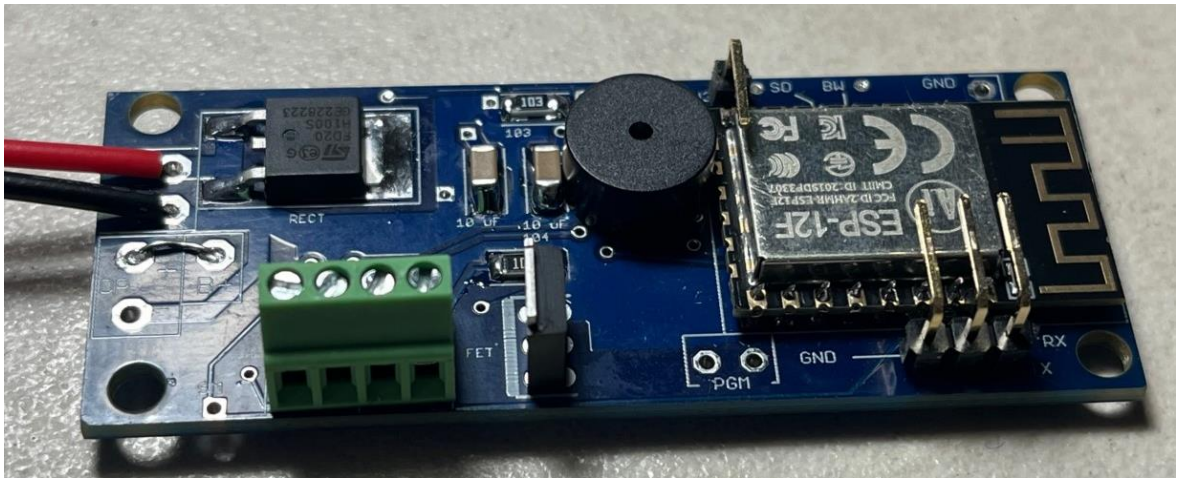
Eggtimer Quantum
WiFi-Enabled Flight Computer
Assembly Manual

Rev B3



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: 2AHMR-ESP12F

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)
https://www.ecfr.gov/current/title-14/part-101

~~~~~~

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!

~~~~~~

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 Internet, 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 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 4 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 100 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 per cell, 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 do not have the capacity to power a relatively high-current device like a Quantum. 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.

About Deployment Power…

The Quantum is designed to handle most typical deployment loads (ematches, small igniters) using a single 2S LiPo battery, which powers both the logic and the deployments. Unlike many other altimeters, the Quantum is designed to current-limit the outputs, so it's essentially impossible to cause a "brown out" that shuts off the altimeter if a deployment draws too much current from the battery.

However, there may be instances in which your deployment power has special requirements, such as a large solenoid for a trapdoor, a servo, or some hot-wire cutters. The Quantum has a provision for using a separate battery to power your deployments. The drivers are designed for a load of up to 10A, and 40V, so it can handle pretty decent sized loads if you have the battery to drive them.

If you 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.

A Note on Switches…

The Quantum is different than most other altimeters 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 drivers, so that the igniters are essentially "dead" until you arm it remotely on the ground, AND the first output event occurs. 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 does 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 remotely with your wireless device using the proper validation code. (You can optionally make it self-arm when power is turned on, if you select that option in the firmware… the default is that it has to be remotely armed).

What this means is that there is an electronic switch on the deployment power, interrupting the circuit and essentially satisfying the NAR/TRA/NFPA requirement for a switch disconnect on the deployment power until it's armed. Because of this, you do not need to use a separate mechanical switch on the battery. You can connect your battery/batteries with confidence at your work table, knowing that there's no way to accidentally fire a deployment channel on the ground.

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"), low temperature, no-residue solder. It's Kester 245 p/n 24-6337-8807… designed for hand soldering small temperature-sensitive parts without transferring excessive 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.

If you're using a soldering station, we recommend that you set the starting temperature to 680F. You can adjust the temperature from there… if the solder seems a bit sticky on the parts, turn it up about 20F, if it wants to "pop" off the tip, turn it down 20F.

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, or a temperature-controlled soldering station, with a fine conical tip (0.8mm recommended)

___ Small needle-nose pliers

___ Small diagonal cutters

___ Tweezers to handle the SMT parts

___ A mesh "sponge" for cleaning your soldering iron tip

___ A tip cleaner block for keeping your iron nice and shiny

___ 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 (if you drop a SMT part in carpet, you'll never find it…)

___ 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 as you build your Quantum, 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.

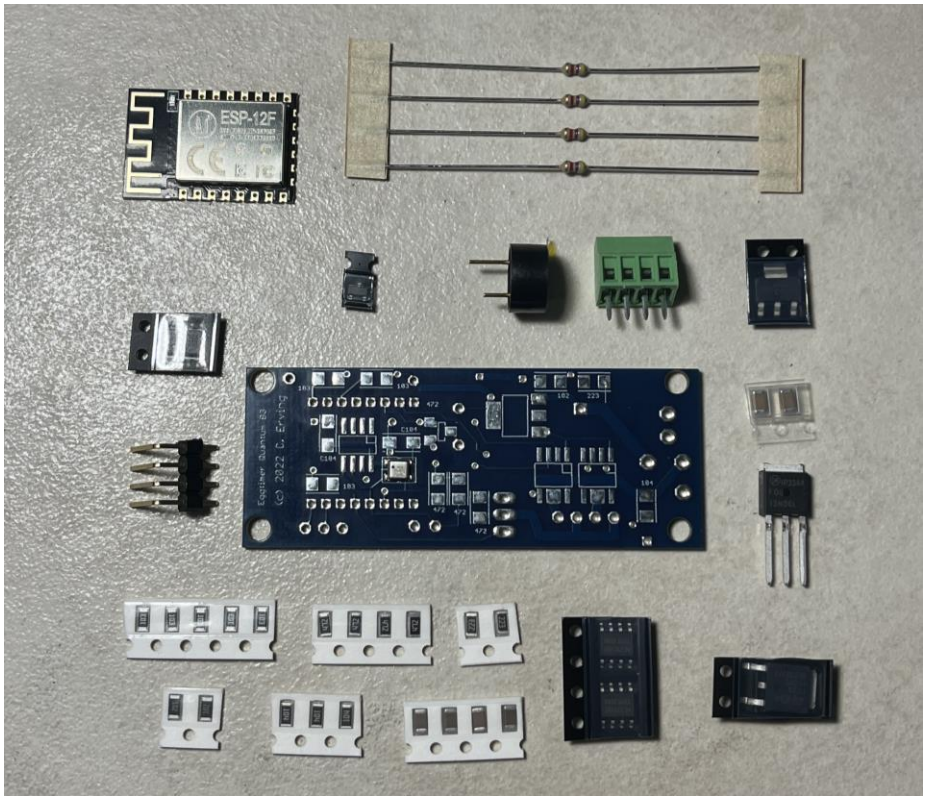
	Qty	Description
__	1	Circuit board with pressure sensor
__	1	Pre-programmed ESP8266-12 WiFi Module
__	1	CAT24C512 512 Kb serial EEPROM (8-pin SOIC)
__	1	LD1117-33 3.3V voltage regulator (SOT-223 package)
__	2	VN5E160S drivers (8-pin SOIC chips, marked VN5E160S)
__	1	FQU13N06 MOSFET (3 leads, marked FQU 13N06LS)
__	1	FERD20H100SB Rectifier (2 J-leads and a tab, marked FD20 H100S)
__	1	SI2302 MOSFET (SOT-23, very small package with 3 leads)
__	1	10mm magnetic Buzzer
__	1	1K 1206 resistor (marked "102")
__	3	4.7K 1206 resistor (marked "472")
__	4	10K 1206 resistors (marked "103" or "1002")
__	1	22K 1206 resistor (marked "223")
__	2	100K 1206 resistor (marked "104")
__	3	.1 uF 1206 ceramic multilayer capacitor (brown) (not marked, but they;re 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 through-hole resistors (value not important… we're just using them for the leads)

__ 1 4-pin tall right-angle header

__ 1 4-pin 2.54mm screw terminal block

Loose

__ 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.

About Soldering the SOIC-Package IC's…

There are a few 8-pin IC's in a "SOIC" (Small Outline IC) package, they have leads that are bent out into a "J" shape. In order to solder these to the board correctly, you MUST have the right soldering tip (0.8mm conical is recommended), and your iron MUST be clean and at the right temperature. If you have a 12W/15W pencil iron, it's probably OK as-is. If you have a temperature-controlled soldering station, we recommend that you start at 680F, and go up or down by about 20F depending on whether the solder sticks and doesn't want to flow (turn it up) or appears to "pop" when you apply the solder (turn it down).

The trick to soldering the SOIC packages is that you need to have the solder get underneath the J-leads, so that it connects the "elbow" on the lead with the PC board pad underneath. To do that, we recommend that you apply the iron to one side of the lead, wait 3-5 seconds for it to heat up, then apply the solder to the other side of the lead. If the temperature is correct, you'll see the solder flow and make a nice junction between the lead and the board. If you don't get it right, remove the excess solder with some narrow desoldering wick, and try again.

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.

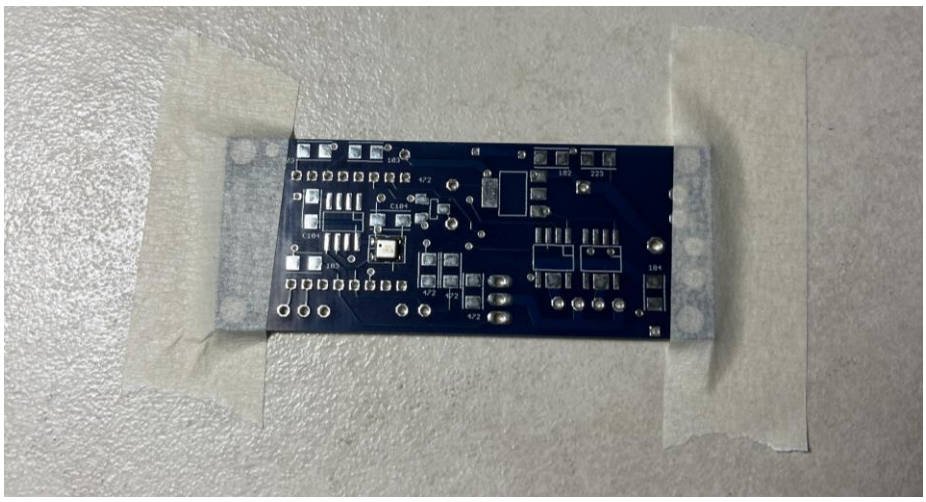
OK, so let's get started…

Mounting the Bottom-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). We'll start with the bottom side, then go to the top side afterwards.

__ Orient the board

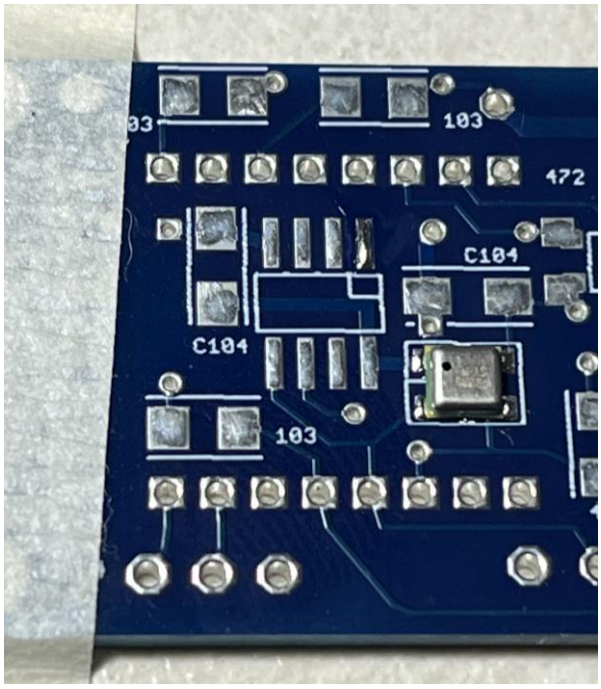
Turn the board so that the pressure sensor is facing up, with the writing rightside-up. Tape the board down to your work surface with masking tape, on the extreme left and right sides so you don't cover any of the small SMT pads.



__ Mount the CAT24C512 EEPROM

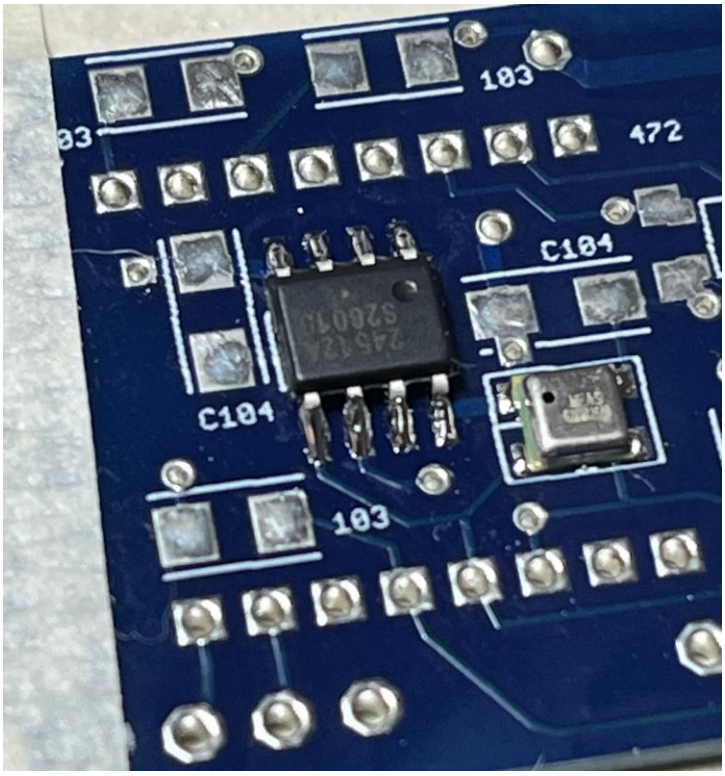
Locate the spot for the EEPROM, it's the 8-pin SOIC on the left side of the board. Remove the EEPROM from its package, you'll see that there is a dot at one corner of the chip. This corresponds to the little square that's marked at the top-left pad.

Tin the upper-right pad with just a little bit of solder.



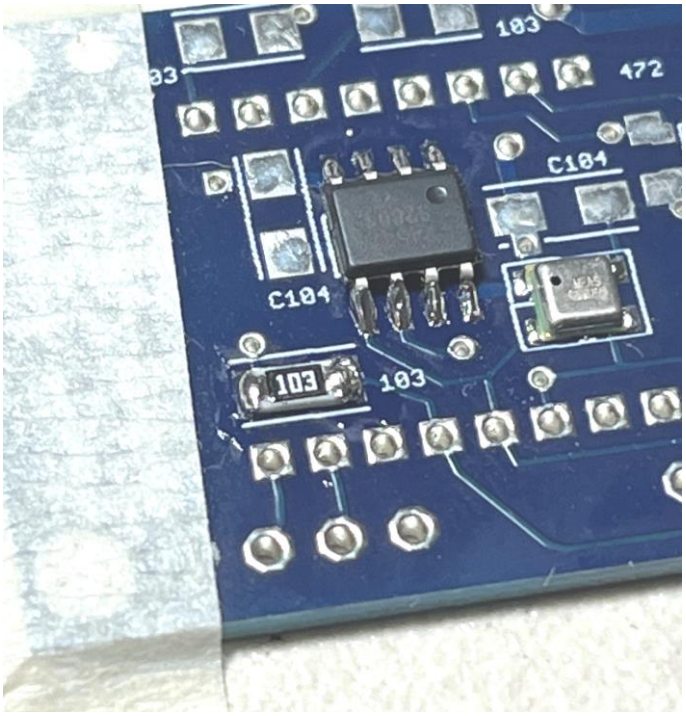
With tweezers, hold the EEPROM in place, and heat the lead over the tinned pad until the solder melts. Keep the heat on for another 3-4 seconds, then remove the iron and let the pad cool.

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.



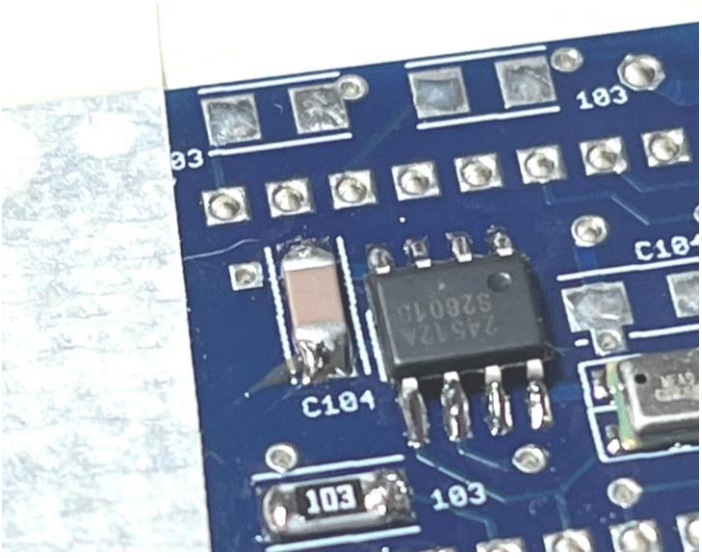
__ Mount the 10K resistor (marked “103”)

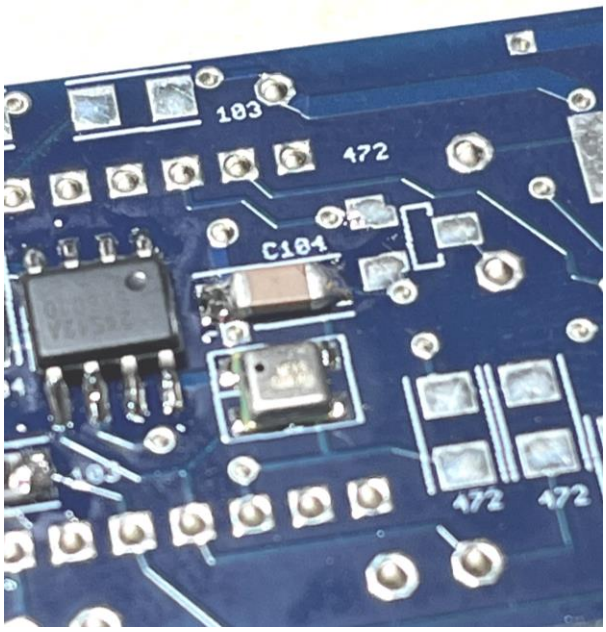
Locate the spot for the 10K resistor near the lower-left edge of the EEPROM, it will be marked “103” on the board. Solder in place.



__ Mount the two .1uF capacitors (unmarked brown part in PAPER carrier)

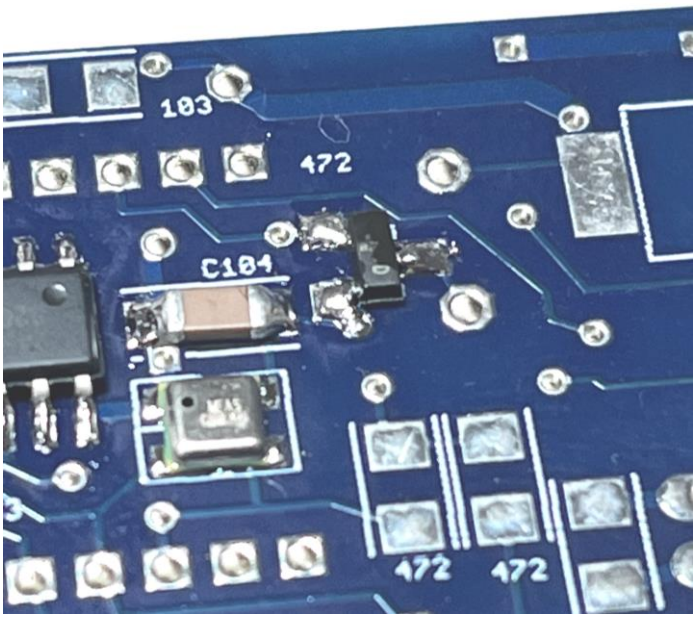
Locate the spots for the .1 uF capacitors,one is just to the left of the EEPROM and another is just to the right of the EEPROM, they will be marked “C104”. Solder in place.





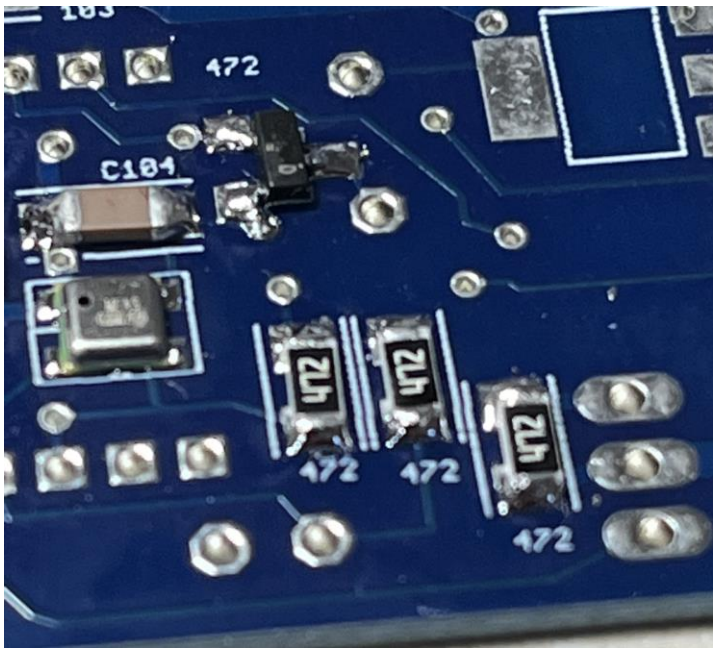
__ Mount the SI2302 FET

Locate the spot for the FET on the PC board, it's a small box with 3 leads: two on one side, and one opposite, just to the right of the 0.1uF capacitor that you just soldered. .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. Make sure that the two leads on the left are on the pads… they should be sitting near the edge of the pads, which have been made oversized to make it easier to solder them. Solder the other two pads, then go back and resolder the single pad if the coverage looks a little thin.



__ Mount the three 4.7K resistors (marked “472”)

Locate the spot for three 4.7K resistors near the bottom center of the board, they will be marked “472”. Solder in place, making sure that they are properly centered so they do not short against one another. Note that the rightmost 4.7K resistor is very close to the three large pads for the FET that you will be soldering later; that is OK, it actually bridges two of those pads.

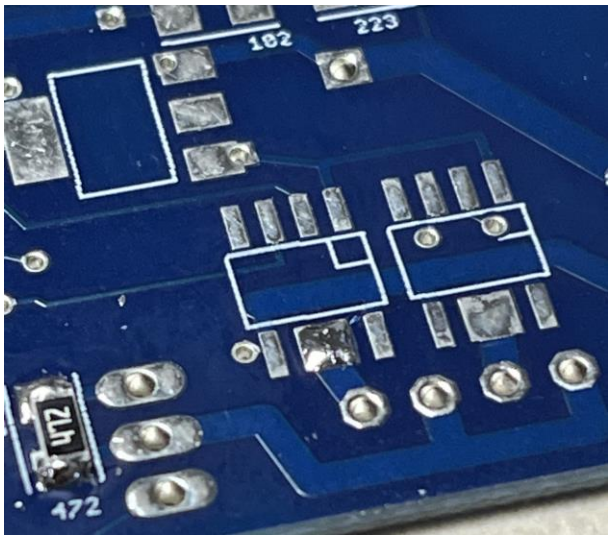


__ Mount the left VN5E160S drivers

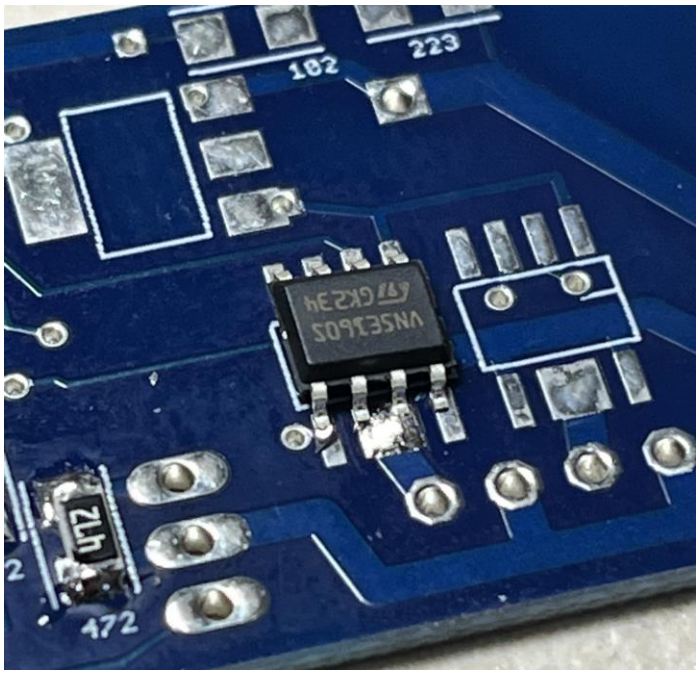
Locate the spots for the two driver chips, they are 8-pin chips just to the right-center of the board. You will notice that the upper-right corner has a square marked out, that’s the Pin 1 mark. You will also notice that the lower-center two pads are connected and have a large pad between them; those are the output pads.

Remove one VN5E160S driver chip from the tape. You will see that one side is “square” and the other side has a “bevel” cut in the side. The side with the notch is the Pin 1 side; this side MUST line up with the Pin 1 square mark on the PC board. You can also tell the Pin 1 side because if you look at the writing rightside-up, Pin 1 will always be at the lower-left corner.

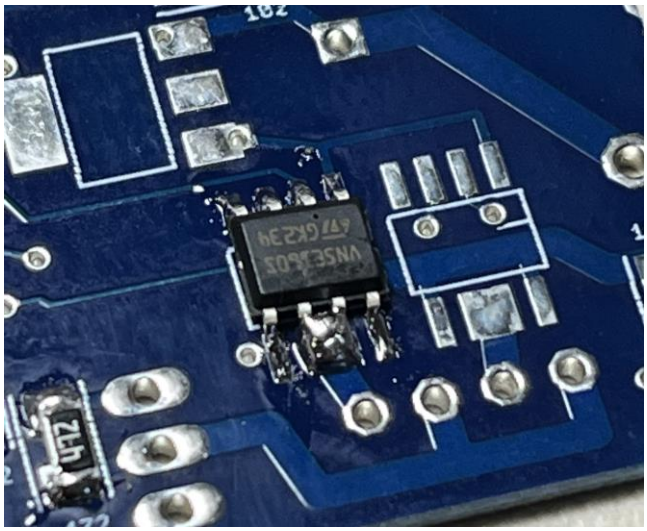
Lightly tin the large pad on the bottom-center of the left driver’s pads.



With a pair of tweezers, position the driver over the pads, hold the driver in place while heating up the tinned pads, then gently slide the driver chip in place. Note that the writing on the driver will be upside-down in relation to the two tinned pads. Remove the iron. Make sure that all 8 leads are centered on the pads, if they are not then heat up the large pad again and re-orient the driver chip. It is CRITICAL that these chips are square on the pads; they carry a large amount of current, and if you get them off-center you may end up with a short that can damage your Quantum.

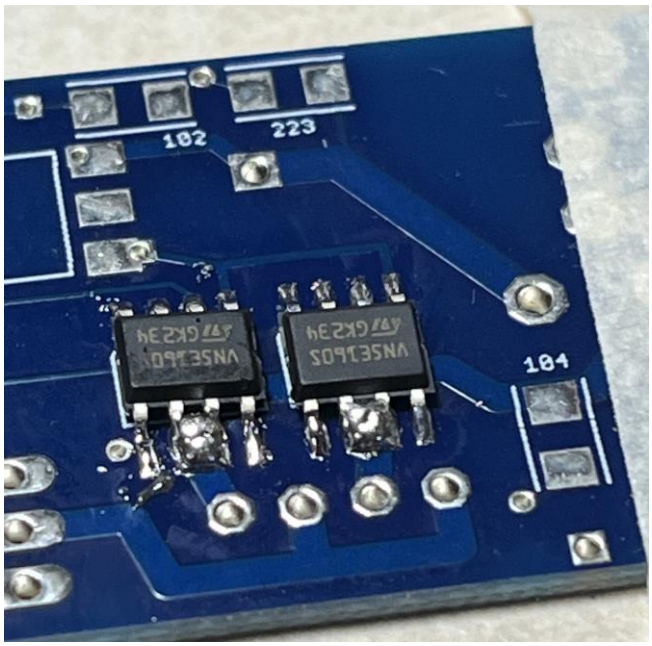


Once you're satisfied with the alignment of the driver chip, solder the remaining leads using the procedure that we detailed earlier. Make sure that you get a good solder joint between the leads and the PC board… it does not take much solder, so do not oversolder them!



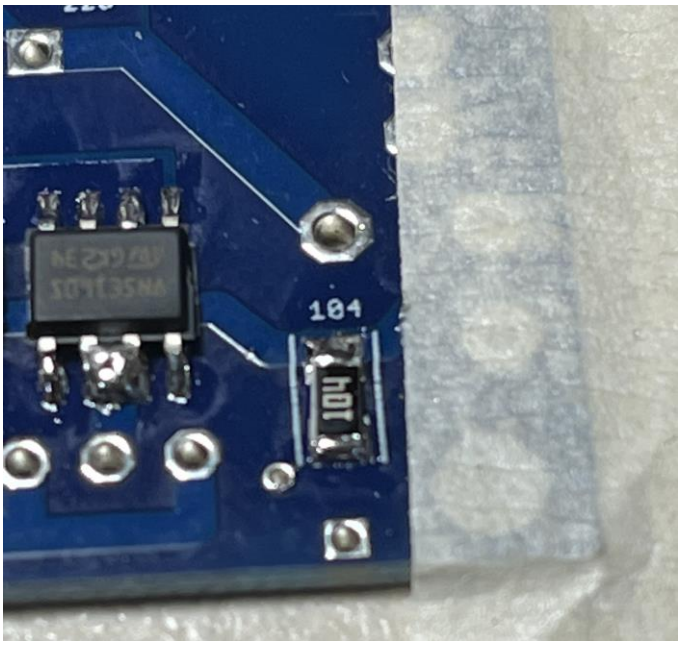
__ Mount the RIGHT VN5E160S driver

Locate the second VN5E160S driver chip, just to the right of the one that you just mounted. Using the same procedure, solder it into place.



__ Mount the 100K resistor (marked “104”)

Locate the spot for the 100K resistor, it’s located at the right edge of the board just to the right of the driver chip that you just mounted, and is marked “104”. Solder in place.



__ Mount the 3.3V Voltage Regulator

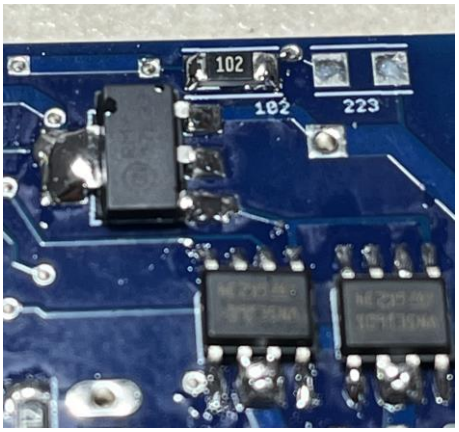
Locate the large pad and the three small pads for the voltage regulator, above and to the left of the two driver chips. Heat up the large pad with your soldering iron and melt a very small amount of solder on the large pad, just enough to cover it. Place the voltage regulator IC in place, and hold it 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.

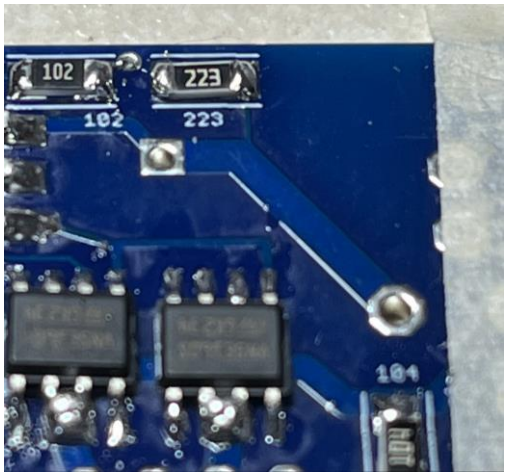
__ Mount the 1K resistor (marked “102)

Locate the space for the 1K resistor just to the upper-right of the regulator, it’s marked “102”. Solder in place.



__ Mount the 22K resistor (marked “223)

Locate the space for the 22K resistor just to the right of the 1K resistor, it’s marked “223”. Solder in place.



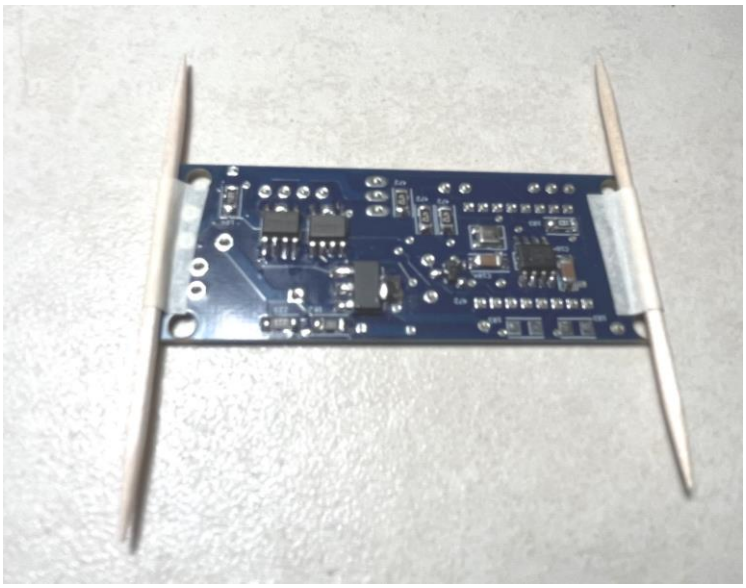
You are now done mounting parts on the bottom of the board… now you’ll be flipping the board over and soldering some parts to the top side.

Note: Do NOT solder the two 10K resistors (marked “103”) that are mounted at the upper-left edge of the board. You’ll be soldering these in later, AFTER you mount the WiFi module. Leaving them off for now makes it easier to solder the WiFi module later.

Mounting the Top-Mount Parts

__ Cut a piece of paper masking tape about ½" long. 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.

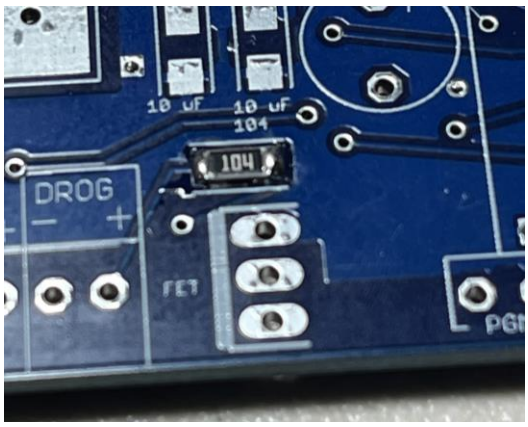
Similarly, tape another round toothpick to the left side of the board.



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 bottom-mounted components while you're working on the top of the board.

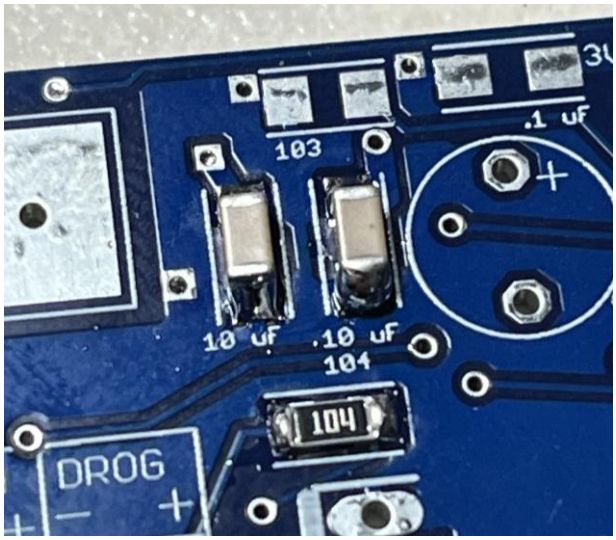
__ Mount the 100K resistor (marked "104)

Locate the spot for the 100K resistor on the top of the board, pretty much dead center, it's marked "104". Solder in place.



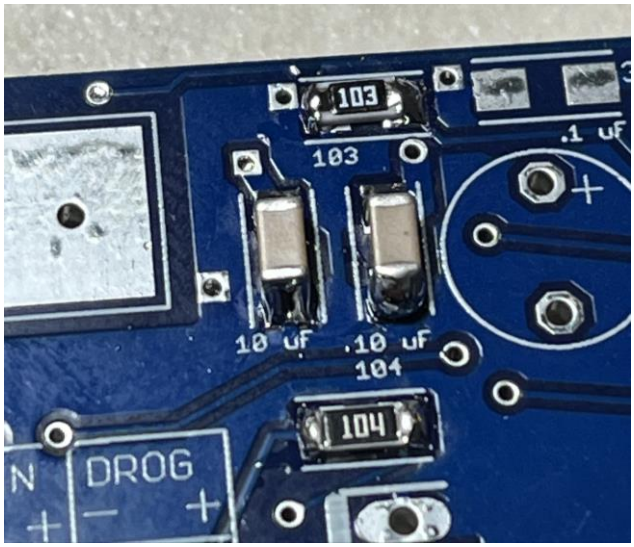
__ Mount the 10 uF capacitors (unmarked brown parts in CLEAR tape)

Locate the spots for the two 10 uF capacitors, just above the 100K resistor that you just mounted; they're marked "10 uF" on the board. Solder into place.



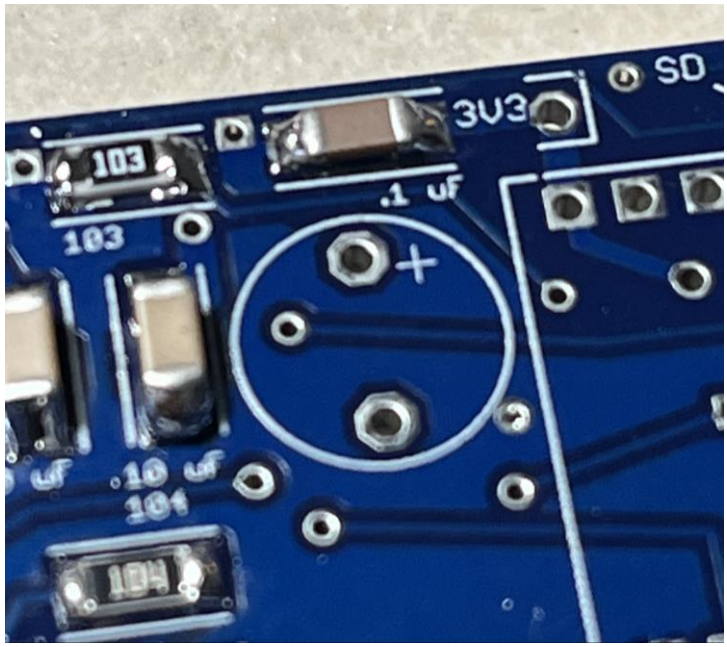
__ Mount the 10K resistor (marked "103")

Locate the spot for the 10K resistor on the upper edge of the board above the two 10 uF capacitors that you just mounted, it's marked "103". Solder into place.



__ Mount the 0.1 uF capacitor (unmarked brown part in PAPER tape)

Locate the spot for the 0.1 uF capacitor, just to the right of the 10K resistor that you just mounted; it's marked ".1 uF" on the board. Solder into place.

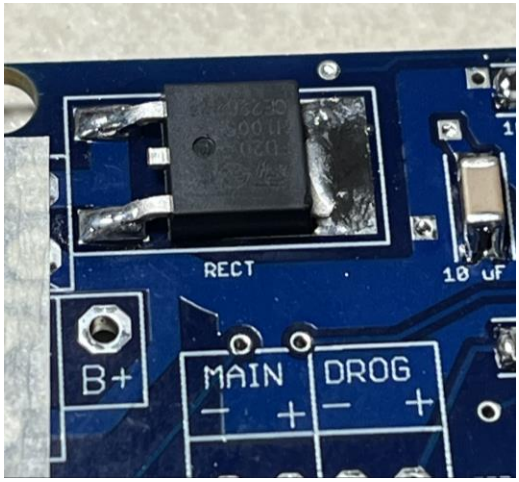


__ Mount the Rectifier

Locate the FERD20H100 rectifier, it's a 2-pin SMT part with a large tab on the other side (marked FD20 H100S), and locate the space for it next to the two pads marked "BAT + -".

Tin the large pad on the PC board lightly. With tweezers, hold the rectifier in place, and heat up the tab so that the tinned solder melts, then hold it in place for a few more seconds before removing the iron. This procedure is similar to how you mounted the voltage regulator. Note that there's a lot of metal and solder here, so it may take a bit more time than other parts to heat up the solder… make sure it flows out, you don't want a cold solder joint here!

Solder each of the two leads opposite the tab to the board. Note that there may be a stubby middle lead that does not extend to the board; do not solder to it!

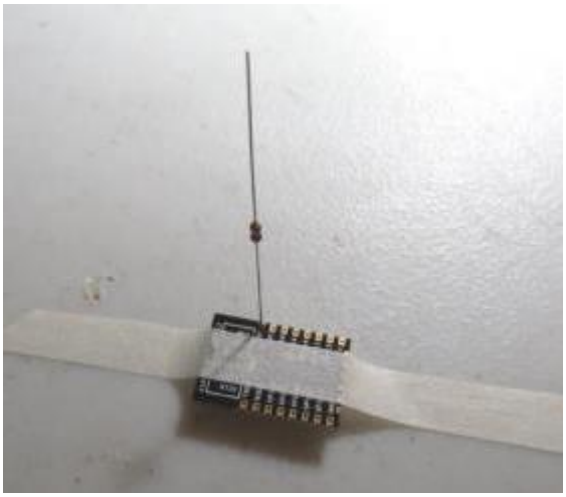


That completes the mounting of the SMT parts on the top of the board. Remove the tape and toothpicks from the board.

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.

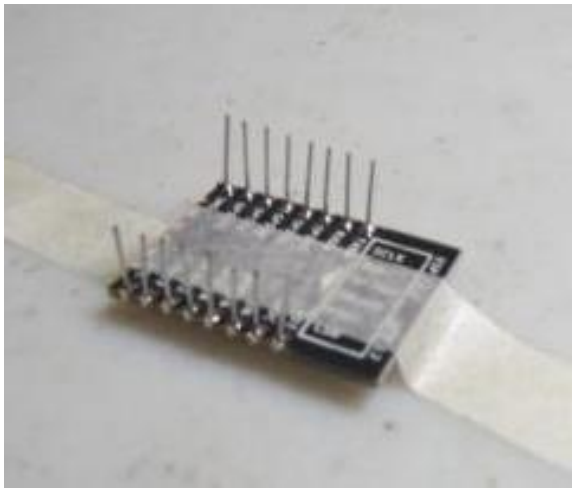
Cut a piece of paper masking tape about ¼" wide and 3" long. Tape the WiFi module to your work tape upside down, so that the metal shield is facing down. Take one of the 1/8W leaded resistors and put it into one of the corner holes of the WiFi module. Yes, it will stick up a lot. Solder the lead to the 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.



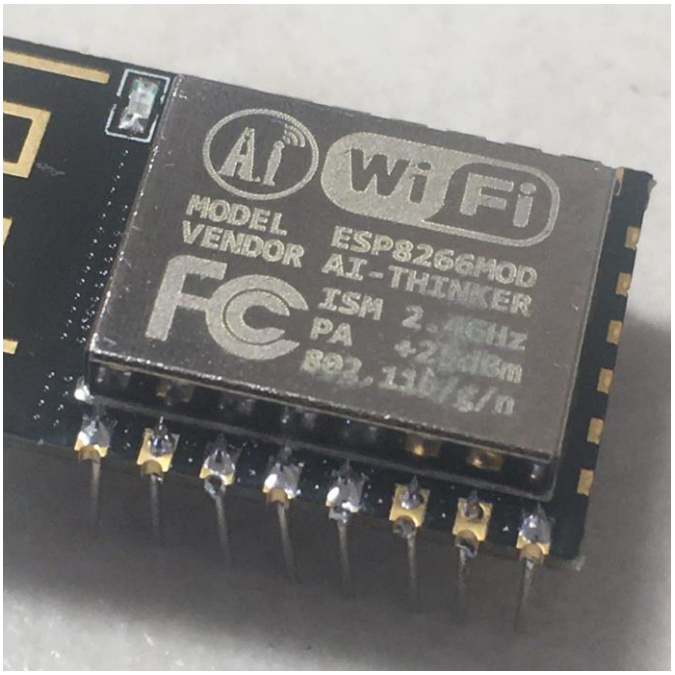
As you clip the resistors' leads, insert it into the next pad, then solder it to that pad. After the second lead on each side, clip it at the resistor body. When you are completely done, there will be a lead on each pad, about ½" long.

Note: If you are going to use the airstart breakwire function, DO NOT solder a wire to the pad on the WiFi module marked GPIO16. It's used for the breakwire function, and there is no separate pad brought out to the board… you can get further guidance on this in the Eggtimer Quantum User's Guide.

Similarly, if you plan on using servos with the Drogue channel, leave the wire off the pad marked GPIO14 for now. The GPIO16/breakwire and the GPIO14/Drogue-Servo pads are adjacent to each other… and there are markings on the PC board for them (BW and DS).



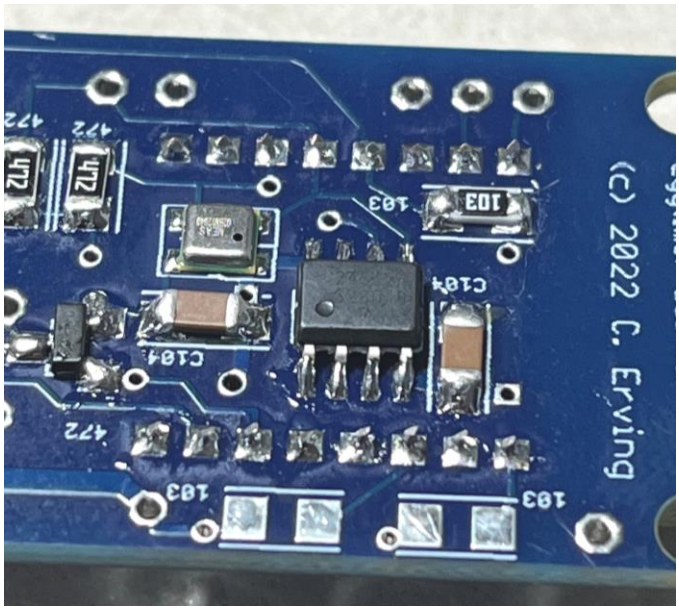
Untape the WiFi module from your work table and turn it over so that the TOP side (with the metal shield) is now up. You will have a short wire sticking out of each pad on the TOP of the WiFi module. With a pair of fine diagonal cutters, clip the stubby lead off close to the WiFi module's PC board. It 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, about 3/8" long.

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. DO NOT try to mount the WiFi module flush with the PC board… you WANT it to stick up a little. This clearance will prevent "vias" on the PC board from shorting against the bottom of the WiFi module.

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.

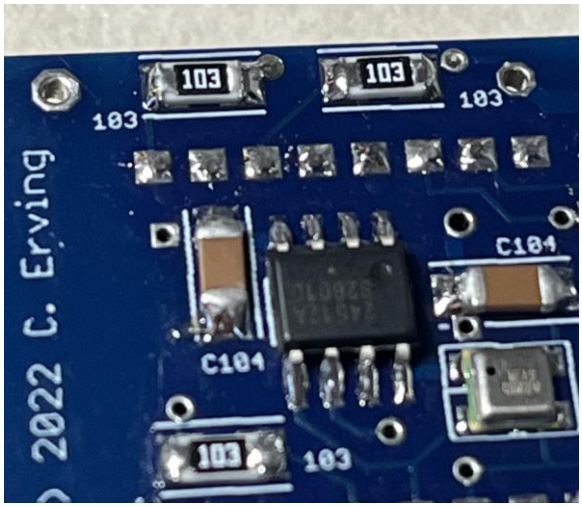


When you are done, all 16 pads (8 on each side) should be soldered on the bottom of the board, and all 16 pads on the WiFi module should be soldered. Inspect the solder joints carefully, and touch up any that look incomplete, particularly the two end pads… they provide the power and ground connections 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.

__ Mount the two 10K resistors (marked “103”)

Locate the two 10K resistors on the top-right edge of the board, marked “103”. These are the ones that you left off when you did the other SMT parts on the bottom side. Solder in place.

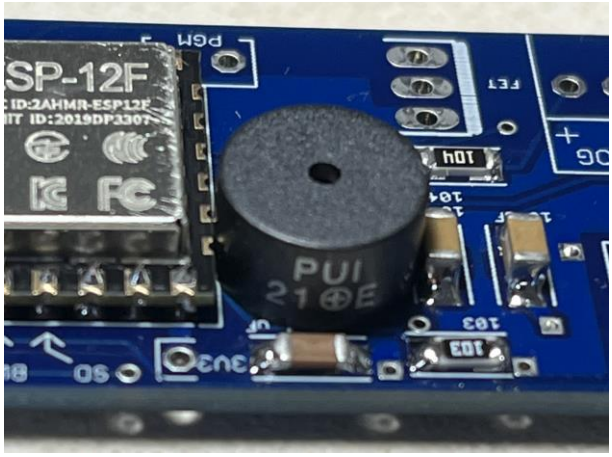


Mounting the Rest of the Top-Mount Parts

__ Mount the Buzzer

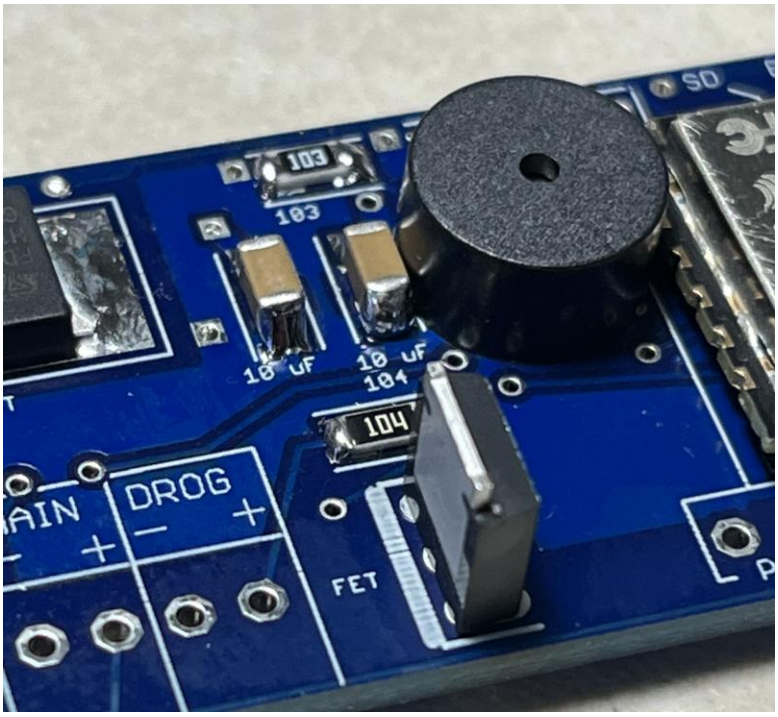
Locate the buzzer, it’s smack dab in the middle of the board. Note that it’s polarized, one lead is marked “+” and it’s also longer than the other lead. Place on the board matching up the “+” with the “+” marking on the board. Hold it in place with masking tape, then turn over the board and solder in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

Note that there is probably a piece of tape covering the hole in the buzzer… you should remove it after soldering, or you’re not going to get much volume out of it...



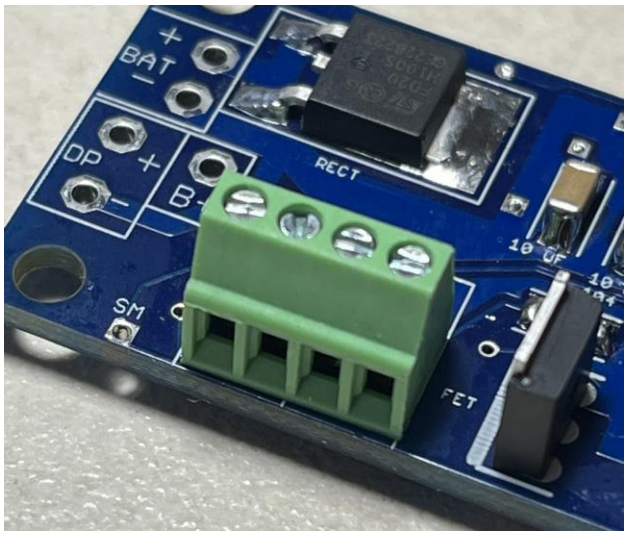
__ Mount the MOSFET

Locate the FQU13N06 MOSFET, it's a 3-pin part with a metal tab on one side. It's marked "FQU 13N06". Check the markings carefully… there are other parts that look similar, and if you get the wrong one things won't work! Locate the spot near the bottom-center of the board marked "FET", there are markings for the pads and the tab. Be sure to orient it correctly; the tab should be facing AWAY from the WiFi module. Use some masking tape to hold it in place and keep it straight, then turn over the board and solder in place. Clip the leads flush.



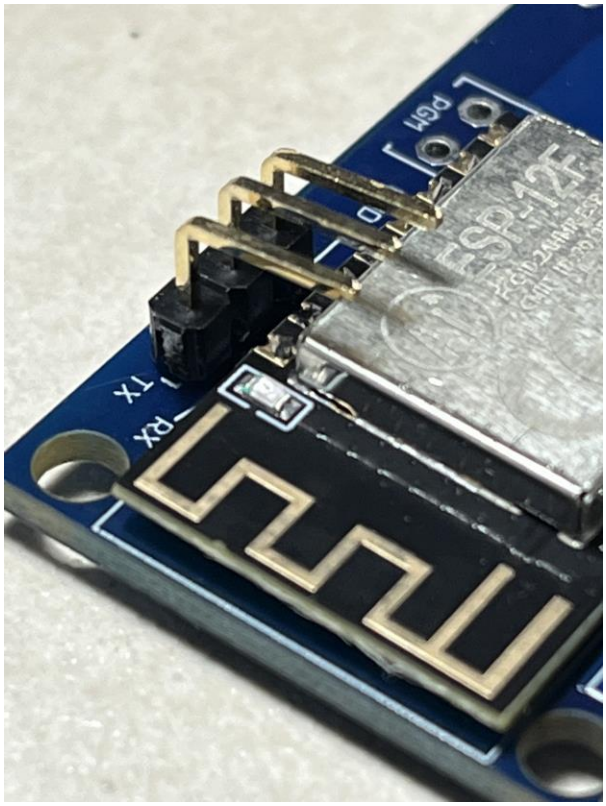
__ Mount the terminal block (Optional)

Locate the spot for the terminal block on the lower-left edge of the board. Place it in the holes, making sure that the side with the wire openings is facing outside. Tape into place, then turn over and solder the leads. Be generous with the solder… you need a good mechanical connection.



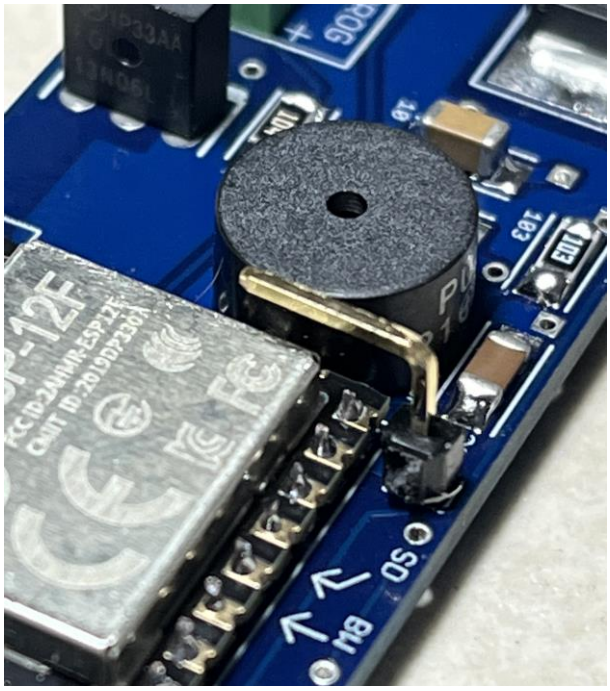
__ Mount the 3-pin header

With a pair of small diagonal cutters, clip one pin off the 4-pin right-angle header. Locate the spot for the 3-pin header, it's on the lower-right edge of the board. Place the 3-pin header so that the short end goes into the board, with the longer end facing inward, and tape into place so that the pins clear the metal can on the RF module by about 1/8". Turn over the board, and solder the pins to the bottom of the board.



__ Mount the 3V3 header pin (Optional – for use with the Eggtimer Telemetry Module)

Locate the spot for the 3V3 header pin, it's on the top edge of the board right at the upper-left side of the WiFi module marked "3V3". Take the single right-angle pin that you clipped earlier, and insert the short end into the pad so that it points inward. Tape the pin down so that it's about 1/8" above the metal can on the WiFi module, then turn the board over and solder in place.



__ Connect your battery pigtail

Locate the two pads marked BATT on the left side of the board, those are the pads for the Quantum's battery. (Note that this may or may not power the deployments… see the next section.) The Quantum requires a 2S LiPo battery to work properly. DO NOT, repeat, DO NOT use a 9V battery…it does not put out enough current to run the Quantum for very long, even though it may seem to work fine when you first connect it.

Almost all battery connectors have a RED wire on the "+" lead of the battery, and a BLACK wire on the "-" lead of the battery. If you are not sure which wire is which, connect your battery to the battery pigtail and use a DVM to check the polarity.

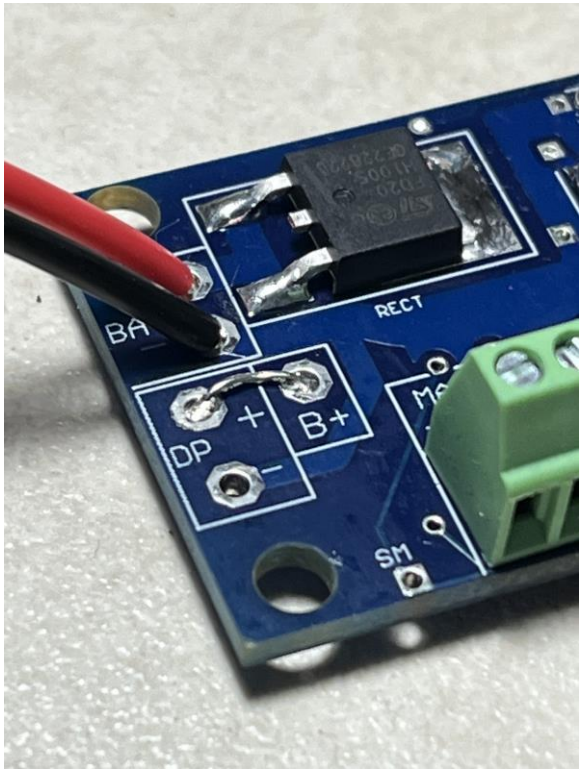
Solder your pigtail's "+" lead to the "BATT +" pad, and the pigtail's "-" lead to the "BATT – " pad.

Wiring Your Deployment Power

If you did not read the discussion on the use of a single battery vs. two batteries earlier, we recommend that you go back now and read it. Most users will configure their Quantum to use a single battery, which is our recommended configuration for ematches and similar relatively low-current loads. If you're using some kind of solenoid, motor, or hot wire cutter, you may need to use a separate deployment battery… again, read the previous discussion.

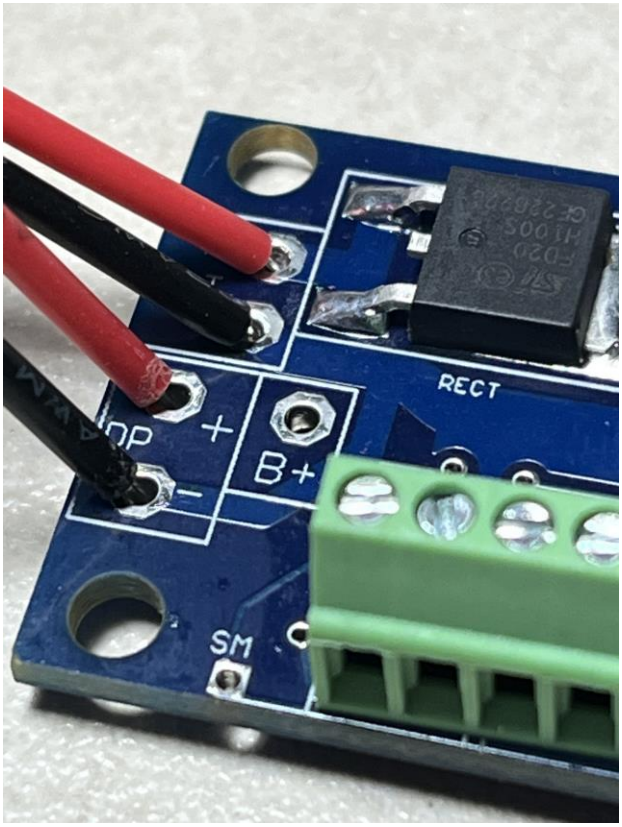
Single Battery Option

To configure your Quantum for a SINGLE BATTERY, use a piece of spare resistor lead or similar wire, and jumper the two pads marked B+ and DB+ that are located right next to the BATT pads. Yes, it's that easy…



Dual-Battery Option

To configure your Quantum for a DUAL-BATTERY, you will need to connect the deployment battery to the two deployment battery pads, marked DP+ and DP-. (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. 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.



In the picture above, the two power leads on the BAT pads are powering the Quantum's flight computer, and the two power leads on the "DP" pads are powering the deployment outputs.

Note that if you are using separate power for the deployments, you MUST provide power to the DP pads BEFORE you turn the Quantum on… **the Quantum will not boot up if there is no deployment power.** This is not an issue for the single-battery setup, because the same battery provides power for both sides. Once the Quantum boots (i.e. you hear the beeps), you can turn off the deployment power if you wish. Details about this are in the Eggtimer Quantum User's Guide.

Preliminary Testing

Connect your battery to the BATT pigtail. (If you are using the two-battery setup with separate power for the deployments, you need to connect that battery first.) 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 web 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 derived from the MAC address of the WiFi module, using a pseudorandom number generating algorithm. 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… see the section on Recoving the Passkey near the end of this manual.

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 5-10 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.

Set your phone's browser to the Quasar's address…

192.168.4.1

…and you should see the Quantum's status page, and hear a beep as it's connected. We recommend that you bookmark this page for future use. We also recommend that you use the "private" (Apple) or "incognito" (Android) modes, so that your browser does not cache pages... see the Eggtimer Quantum User's Guide for more information.

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 of the User's Guide, but we're sure that you'll want to read the long version for all the information… 😊

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 desoldering 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 too.

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. However, things like the 8-pin memory and driver IC's can be installed backwards… and will cause you a lot of pain if you do so.

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

- Battery polarity backwards
- Bad solder joint on voltage regulator
- Bad solder joint on FERD20 rectifier
- 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 deployment power (for two battery setup, power the DP pads first)

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 or bad solder joint

Drogue/Main continuity won't work

- Bad solder joint on the ESP8266-12 module
- Bad solder joint on the VN5E160S drivers (#1 reason!)
- Bad solder joint on the 104 resistors
- Weak battery, or no power to the deployments

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

- Bad solder joint on the ESP8266-12 module
- Bad solder joint on the VN5E160S drivres (#1 reason!)
- Bad solder joint on the 104 resistors
- Bad solder joint and/or reversed FQU13N06 MOSFET
- Weak battery, or no power to the deployments

Recovering the Passkey

If you lose the passkey, don't panic. You can easily retrieve it by connecting 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) – GND
WHITE wire (RXD) – TX
GREEN wire (TXD) – not used

Using an ASCII terminal program such as 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 v1.09A
          Default SSID: Quantum_F87A6E
          PASSKEY:  3718 6501

(more stuff after this, but this is all we need..)
```

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. We recommend that you write the passkey on a piece of masking tape, and put that on top of the WiFi module. That can come in handy if you're swapping altimeters between rockets.

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 at 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.