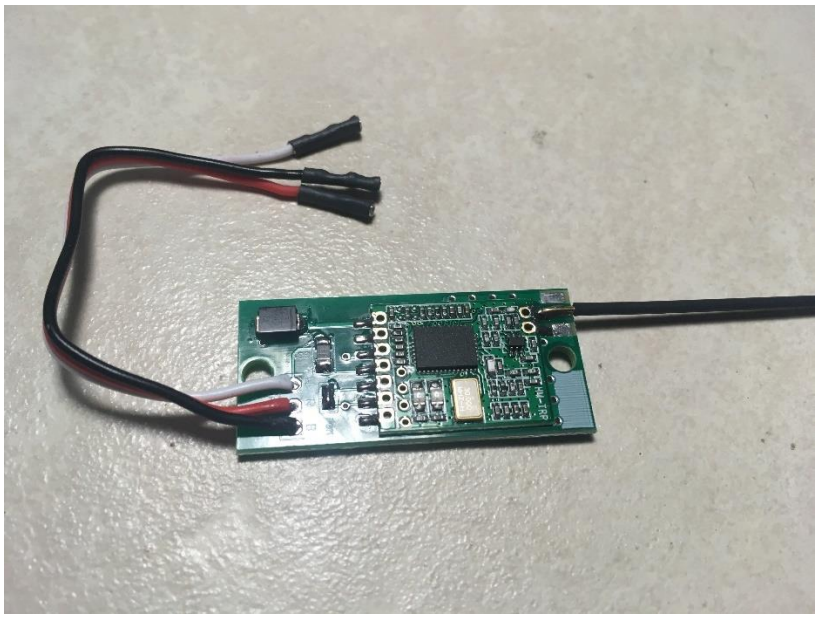
Eggtimer Telemetry Module
Assembly & User's Manual

Board Rev A6



California Proposition 65 Warning

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

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

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

The MSDS can be found at

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

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

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 902-928 MHz band, and therefore must not be used in residential areas.

The Eggtimer Telemetry Module (ETM) uses RF modules in the 902-928 MHz ISM band manufactured by Hope RF, model HM-TRP-915. These modules have been tested by Hope RF to be compliant with the FCC Part 15 regulations for non-licensed intentional emitters, and as such have been permitted to be imported into the US. However, Hope RF (at the time of this document) has not obtained formal certification with the FCC. As a hobby kit, designed for educational and experimental purposes, the ETM is considered by the FCC to be "generally exempt" from authorization requirements. Nonetheless, 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 using only the antenna on the transmitter module that we recommend in the instructions, or a suitable replacement as outlined in the Appendix.

Because the ETM 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 ETM is unlikely to be significantly affected by outside radio sources, but there's no guarantee.

If your ETM 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 the "tightness" of the transmitter's output, 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 cellular phones, WiFi and Bluetooth® devices, and garage door openers.

Important Links:

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

Hope RF HM-TRP Documentation (FCC test documentation)
http://www.hoperf.com/upload/rf/HM-TRP-915(20dBm)-FCC.pdf

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

~~~~~~
~~~~~~

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 Telemetry Module (ETM)! The ETM connects to your Eggtimer altimeter, and transmits telemetry data from the altimeter to your Eggfinder LCD receiver on the ground. Using a radio datalink, you can track your rockets' altitude, velocity, flight status, deployment channel status, and other information in real-time. This data is displayed on the screen of your Eggfinder LCD receiver, and it is also possible to connect to other systems and decode the data if you want a "prettier" display. It's an ideal companion to your Eggfinder GPS system; the GPS tells you where your rocket is, and the ETM tells you what's going on with your rocket during flight.

Like other Eggtimer Rocketry products, we sell it as a kit, to keep costs down and provide an outstanding value. This means that you have to do a little work, of course, but considering that most hobby rocketeers that would use our products have some degree of electronics expertise, this should not be much of an impediment. If you do not have any experience soldering kits such as the ETM, 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 ETM…

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

Important Note: DO NOT use any kind of extra flux with this board. There is no reason for it because the parts are new and clean, and any flux that you buy is almost certainly going to be incompatible with the flux in the no-clean solder. Extra flux just makes a mess, and 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 ETM, 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, and the Hakko FX888D at a bit over $100 is well regarded in hobby circles. 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. We recommend using a .032”/0.8mm or similar tip, conical or spade.

General Assembly Information

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

___ Low-wattage soldering iron, 15W or less, with a .031" or similar tip

___ Small needle-nose pliers

___ Small diagonal cutters

___ Tweezers to handle the SMT parts

___ A brass mesh "sponge" for cleaning the tip of your soldering iron

___ A tinning block to keep your tip clean 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

___ Some PAPER masking tape (do NOT use Scotch® tape or electrical tape)

___ A heat gun (for shrinking heat-shrink tubing)

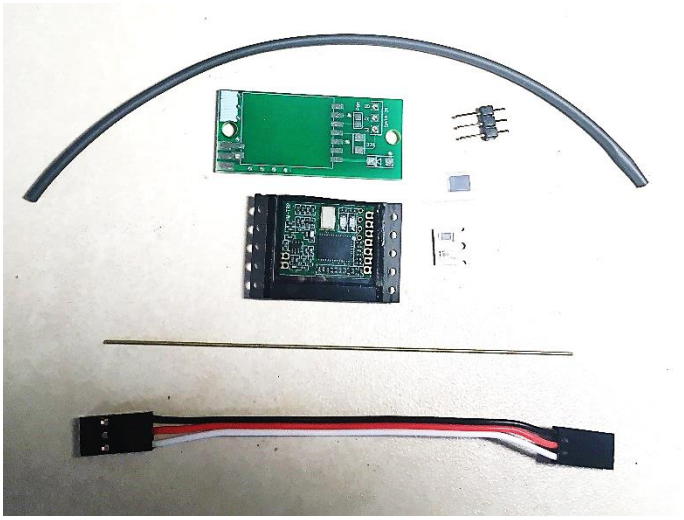
Each installation step has a check-off line, we strongly recommend that you check them off as you go, and that you perform the steps in sequence. We have listed the steps in order to make it easiest to assemble the ETM, deviating from them isn't going to make your life any easier.

Assembling your ETM Board

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.

	Qty	Description
__	1	Circuit board
__	1	Hope RF HM-TRP RF module
__	1	VS-MBRS130L-M3/5BT Rectifier Diode
__	1	1206-330 ohm resistor (marked “331”)
__	1	3-pin 4” “JR Servo” cable (white-red-black)
__	1	3-pin header
__	1	1/32” Brass Antenna wire (4”)
__	1	1/16” Black Heat Shrink Tubing (6”)
__	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 kit 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 ETM, 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 kit 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. 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 Eggtimer 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 ETM 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.

Eggtimer Telemetry Module 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!

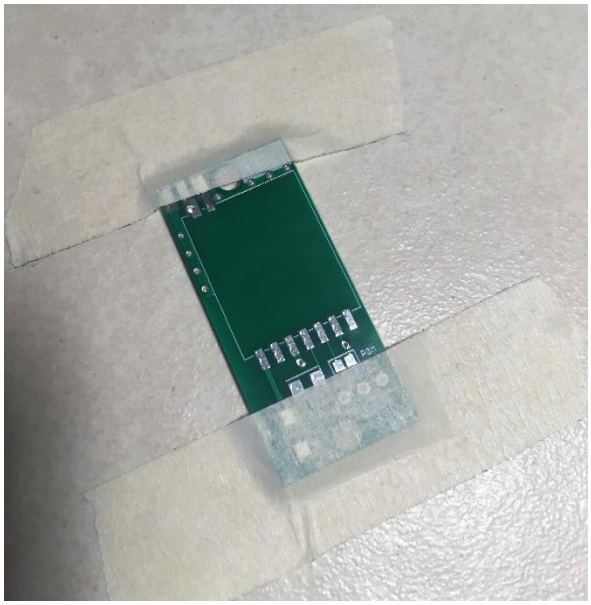
The Eggtimer Limited Warranty does not cover damage to parts while attempting to desolder them because you inserted something incorrectly. We spent a lot of time making sure that the assembly instructions were clear, but once again if you have any questions about the assembly procedures drop us a line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

OK, so let's get started…

Mounting the Hope RF Radio Module

You will be surface-mounting the Hope RF radio module to the board, the pads are relatively large and spaced relatively far apart, however you need to be careful not to oversolder the pads because you can create solder bridges between the pads. If you mount the RF module crooked, you may end up with a short underneath the pads, which will almost certainly fry the RF module and will be difficult to find… so be very careful when positioning it.

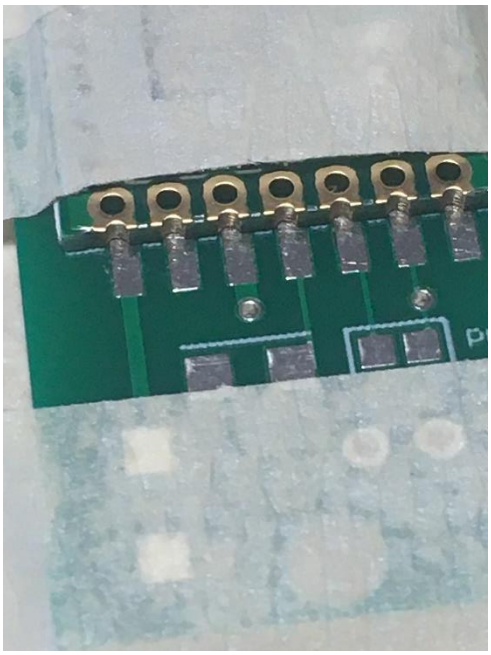
__ With a piece of paper masking tape about 2" long, tape the board to your work surface so it won't move. Don't cover the area where the RF module is going to be mounted!



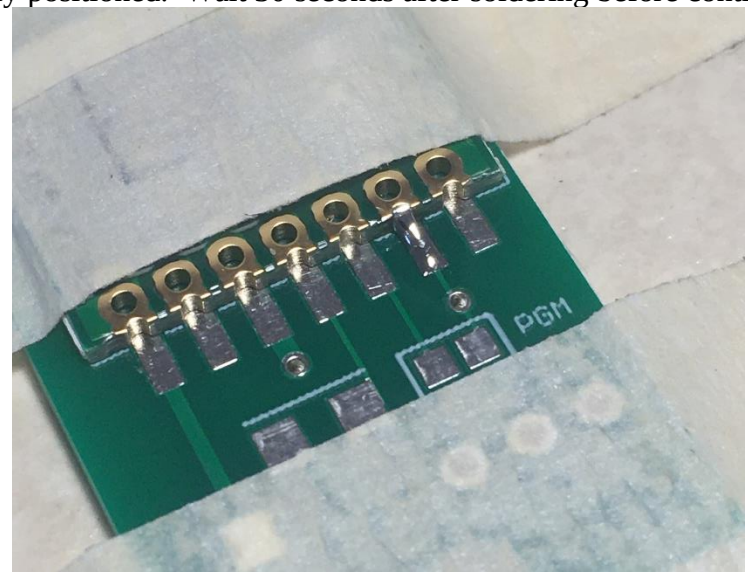
__ Cut another piece of masking tape about 2" long and about 3/4" wide.

__ Carefully position the Hope RF module on the board so that its pads line up with the pads on the PC board. With the masking tape that you just cut, lay it across the top to hold it in place on the board. Make sure that it's properly positioned, the outline of the module should match up with the outline on the board.

It is important that the masking tape covers as much of the RF module as possible, up to the exposed pads. This is to prevent any errant solder splatter from getting onto the RF module. There are some VERY tiny exposed parts on the RF module, if you get the tiniest bit of errant solder on the module chances are excellent that it will be ruined

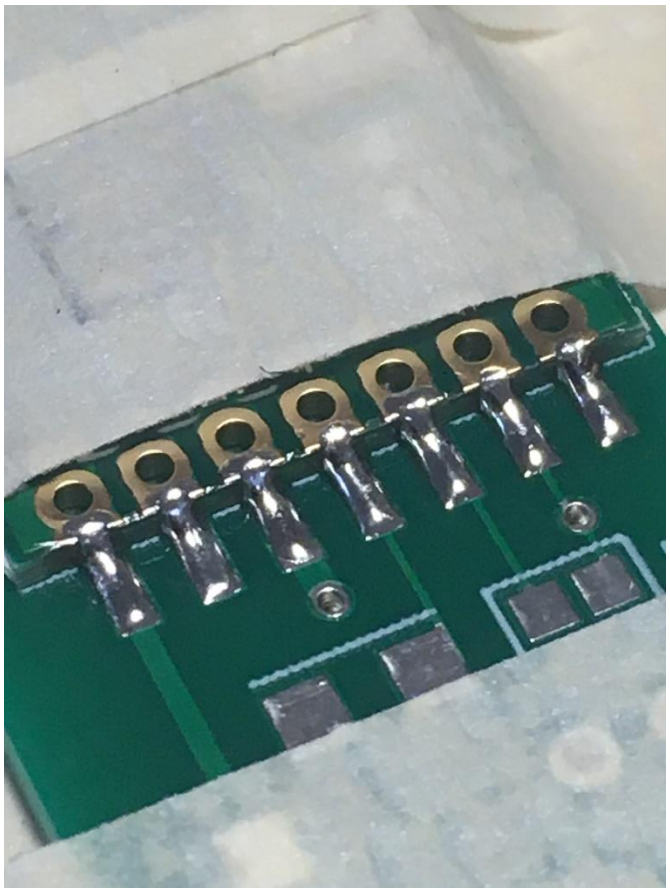


__ Solder the second pad from the bottom-right of the Hope RF module to the board. Make sure that the board is properly positioned after you solder this joint; if it moves, heat up the solder joint and move the board slightly so that it is properly positioned. Wait 30 seconds after soldering before continuing.



__ Check the alignment of the RF module to make sure that the two pads on the other side are centered on the pads. If necessary, heat up the pad that you previously soldered to re-align the module. When you are satisfied with the pad alignment, solder the pad on the left side (the one NOT marked "ANT") to the pad.

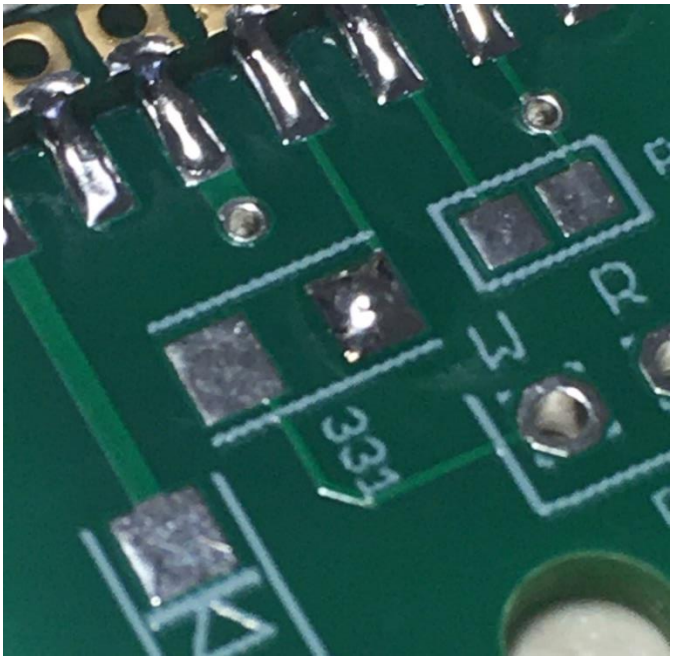
__ Solder the remaining six pads on the bottom side of the RF module to the board, waiting 30 seconds between pads to prevent the module from overheating. Do not solder the pad on the other side yet (the side that has only two pads), the one marked “ANT”; you will solder that when you mount the antenna.



Mount the 330 ohm resistor

__ Locate the spot for the 330 ohm resistor, it's just below the middle of the RF module and is marked "331".

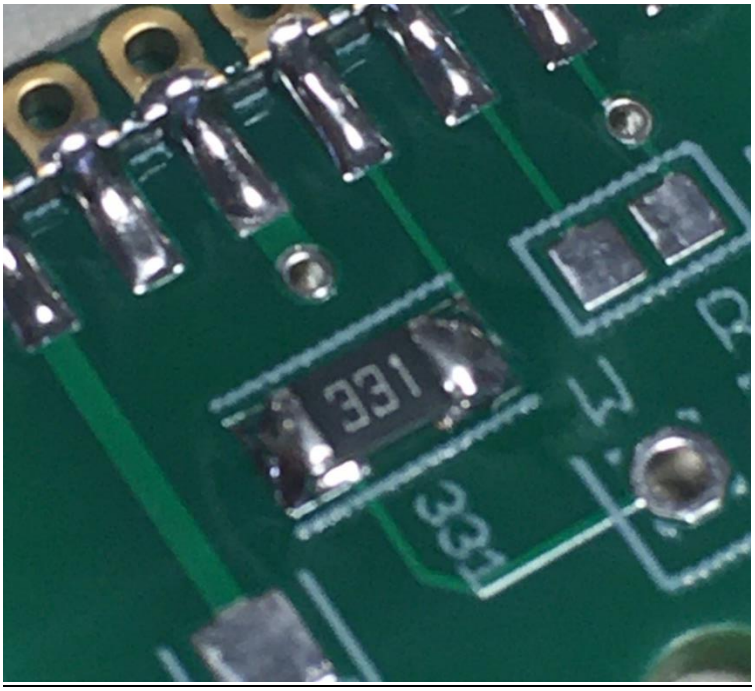
__ Lightly tin the right pad.



__ Heat up the tinned pad, then with tweezers set the resistor onto the pads so that it is centered. Remove the heat, then hold the resistor for about 3-5 seconds so the solder can set.

__ Solder the pad that wasn't tinned. Don't oversolder… you only need enough solder to bond the part to the pads.

__ Examine the solder joints with a 10x jeweler's loupe… if the solder joints look incomplete, resolder them, one at a time.

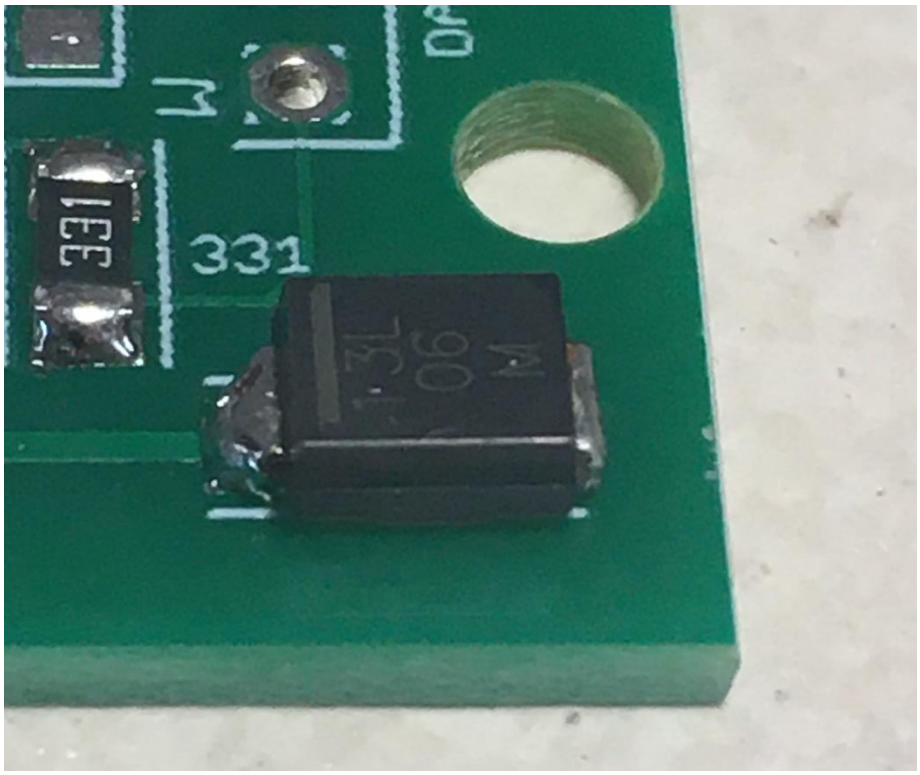


Mount the Diode

__ Locate the spot for the diode, it's just to the left of the RF module. You will notice that there is a stripe on one side of the marking on the PC board, this should correspond with the stripe that's marked on the diode. If you put the diode in backwards your ETM won't power on, so be careful when you mount it.

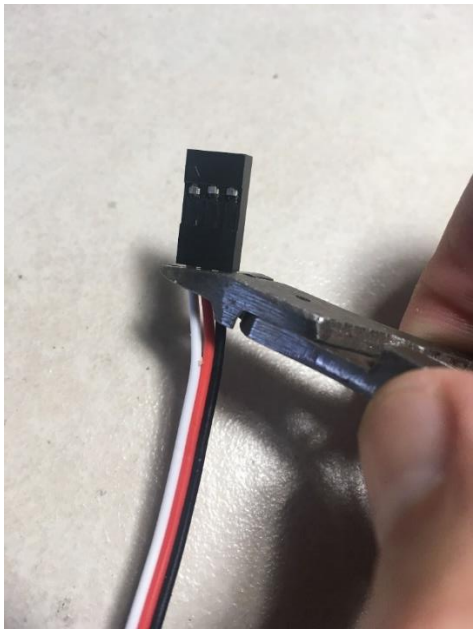
__ Lightly tin the pad on the right… you don't need a ton of solder, just a little bit. With tweezers, hold the diode so that the stripe will line up with the stripe that's marked on the PC board, then heat up the tinned pad and hold the iron there. Gently place the diode on top of the pads, when you are satisfied of its placement remove the soldering iron and continue to hold the diode for another 5 seconds.

__ Let go of the diode, the tinned pad should hold it in place. Solder the other pad… do not oversolder, you only need enough to make contact with the diode's lead and the pad. Examine the solder joints with a 10x jeweler's loupe… if the solder joints look incomplete, resolder them, one at a time.



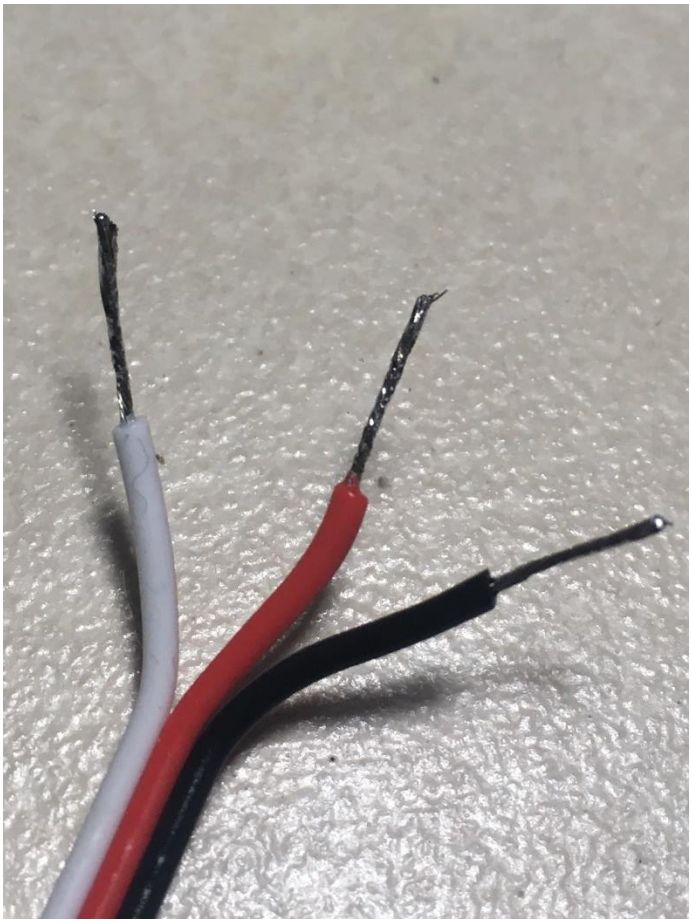
Prepare and mount the data cable

__ With some small diagonal cutters, clip ONE of the connectors off the JR Servo cable, right where the connector meets it.

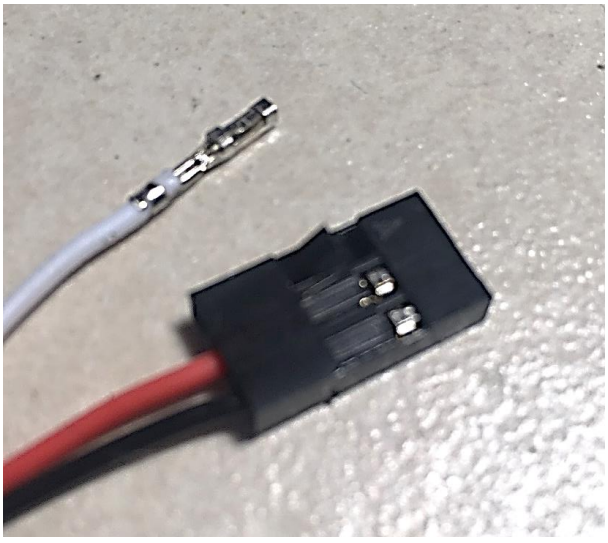


__ Separate the wires about ½” from the end. On the WHITE wire, strip about ¼” off the end of the wire. Twist the strands together tightly, then lightly tin the end of the wire, leaving about 1/32” near the wire jacket untinned.

__ Repeat this for the RED and the BLACK wires.



__ On the connector on the other end of the cable, pry the tab on the white wire up, and gently pull the white wire and socket pin out of the connector.

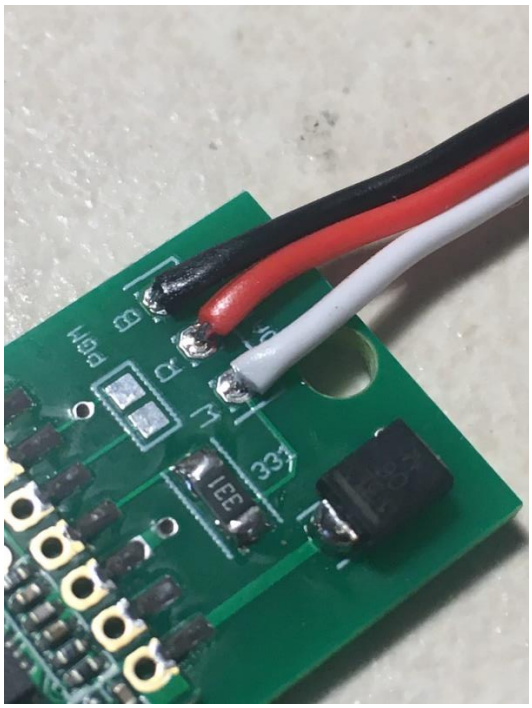


__ Repeat for the red and black wires. When you're done, you should have the three wires terminating in socket pins.

__ Cut three pieces of 1/16" heat shrink tubing about ½" long. Slide a piece onto each of the socket pins on the cable, so that the end of the tubing is even with the end of the socket pins. Heat shrink the tubing onto the socket pins with a heat gun on a low setting.

__ Insert the tinned wires into the three pads marked "DATA IN", so that the colors match the markings on the PC board: WHITE to "W", RED to "R", and BLACK to "B". With a piece of masking tape, hold the cable in place.

__ Turn the board over and solder the three wires to the pads. Don't oversolder… you only need enough to get a "fillet" between the pads and the wires. Trim the excess wires afterwards.



ETM Antenna Options

The ETM has pads for either a permanent "stick" antenna or a RP-SMA edge connector for a removable/remote antenna. Your choice of antenna will depend largely on your rocket, and how much range you need.

The standard ETM ¼ wave "stick" antenna is very simple and produces decent gain without being directional (i.e., the signal strength is pretty much the same in all directions). We have maintained a line-of-sight range of over 30,000' with this antenna and the external antenna for the Eggfinder LCD receiver, we think that most people will find that this simple antenna will suit their needs just fine for most flights.

In some cases, however, you may need to use a different antenna. If you are intending to fly over 30,000', or if you need some kind of special antenna mounting then you may need to use a higher gain antenna, such as a 3 dB dipole antenna. In those cases, you will want to go with the RP-SMA connector option. Note that any antenna that you get must have an RP-SMA MALE connector on it; this connector has INSIDE threads with a JACK in the center of the connector. It must also be rated for the 900 MHZ band, NOT 2.4 GHz. Be careful what you buy, we have seen some eBay-type vendors that are selling 2.4 GHz "WiFi" antennas for use with 900 MHz systems. They "will" work, but they are certainly not optimal, and would most likely produce less range than the stick antenna. Also, be sure that it's a RP-SMA antenna; we've seen some vendors selling standard SMA antennas but calling them RP-SMA.

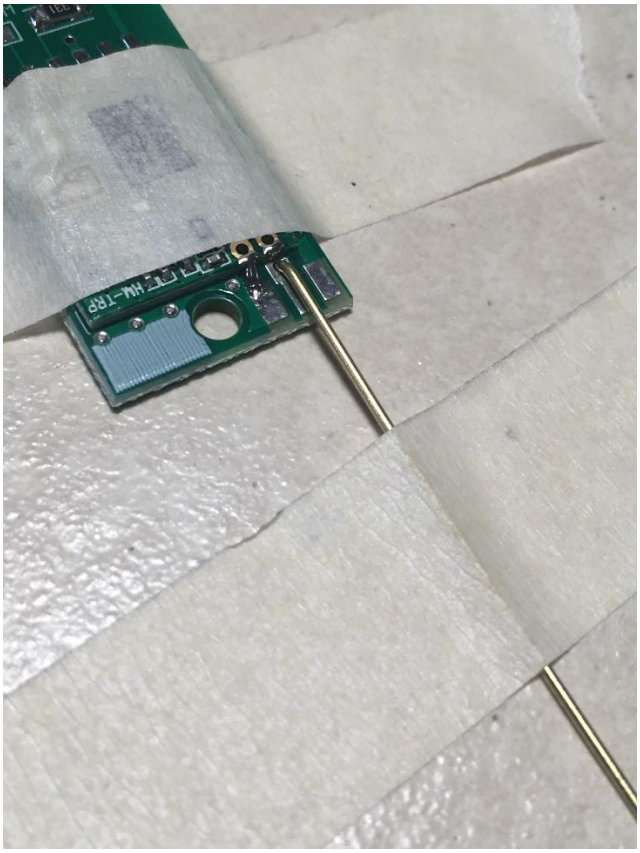
If your antenna requires a pigtail cable, get the shortest length that will work, to minimize signal loss due to cable resistance and impedence mismatch. Usually, you can get them in 10 cm (about 4") lengths, this should be fine for most applications. A pigtail cable rated for 2.4 GHz **will** work fine at 900 MHz, and a ½ meter length is so short that the type of cable (typically RG-174) is irrelevant. Make sure that the pigtail's other connector matches your antenna, of course.

Building the Stick Antenna

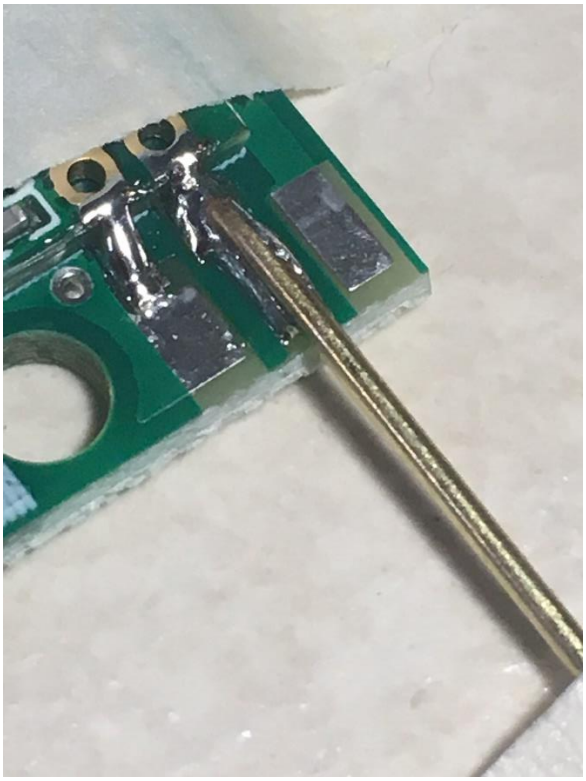
___ Tape the board to your table, so that the tape covers the RF module up to just before the two holes on the antenna side of the RF module.

___ Bend one end of the 1/32" brass antenna wire in a 90° angle, about 1/8" from one end.

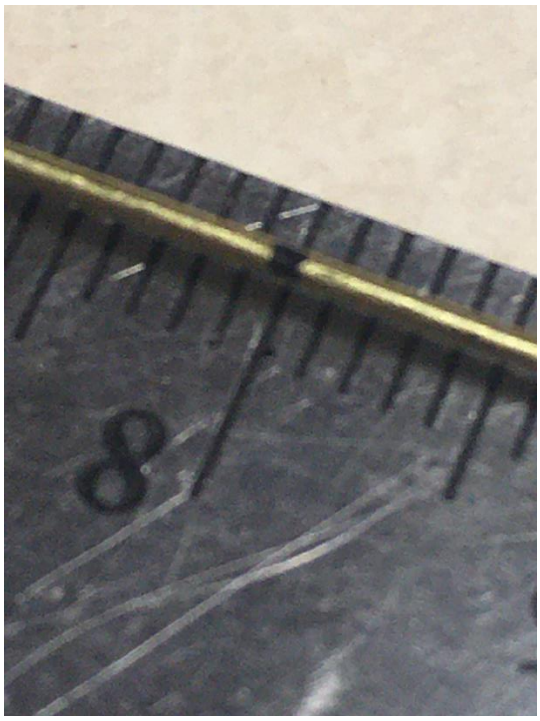
___ Put the bent end of the antenna into the ANT pad, but **do not** solder it in. Have it stick straight out from the board, and tape it in place.



___ Solder the antenna to the board, making sure that the solder also extends to the pad on the RF module. A good solder joint should have the antenna connecting to the pad from the hole all the way to the end of the board.



___ Measure 80 mm (8.0 cm) from the edge of the board, and mark the antenna wire there.

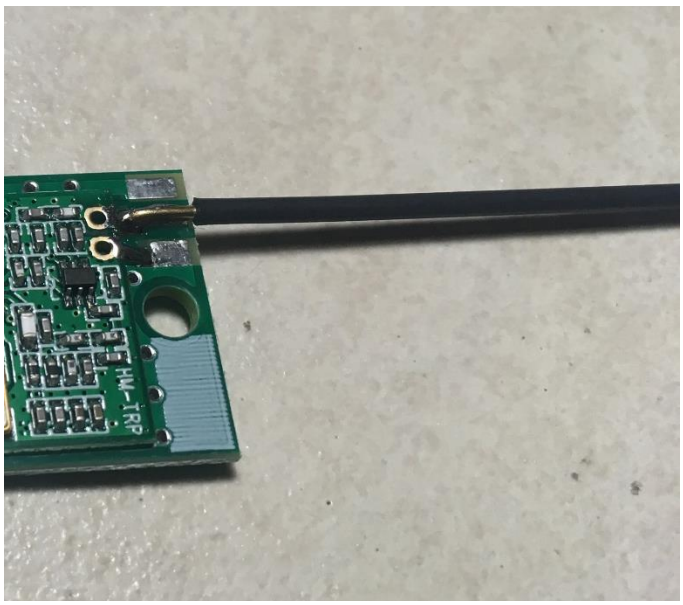


___ With a pair of sharp diagonal pliers, cut the wire at the 80mm mark.

___ With some emery cloth or a jeweler's file, file down any sharp edge at the cut so that it is flat. Feel the edge with your finger, if you feel a sharp edge then keep filing until it's smooth. The goal is to get rid of any sharp edges, as these will reduce the efficiency of your antenna.

___ Remove the masking tape coving the side pads and the RF module.

___ Slide the remaining 1/16" heat-shrink tubing over the antenna wire, then with a heat gun on low shrink it to the wire. Cut it to the end of the wire.



Installing a RP-SMA Connector for an External Antenna

If you decide to install a RP-SMA connector for an external antenna on your ETM board rather than using the "stick" antenna, you will need to follow the directions below.

For each board on which you want to install a connector, you will need:

___ RP-SMA board-edge connector, straight, .062" (1.5mm) board thickness
(Linx Wireless part number CONREVSMA003.062 or equivalent)

You can get these from Eggtimer Rocketry, and you can also get them from electronics distributors such as DigiKey, Mouser, and Future Electronics. They're under $5 each in small quantities.

If you look at the connector, you will see that there are two sides, separated by the thickness of the PC board. The TOP side has three pins, the BOTTOM side only has two (there is no center pin). Inside the outside-threaded connector is a pin; this is why it's called a "reverse" connector, normally outside-threaded connectors have a socket in them and the matching connector (with inside-threads) has a pin.

___ Slide the RP-SMA connector on the edge of the board, so the three pins on the top line up with the pads on the top of the PC board. With some masking tape, tape it into place on the bottom of the board so it won't move, leaving the pins and pads on the top untouched.

___ Solder ONE of the pins on the top side to the pad on the top of the board. Let it cool for at least 30 seconds.

___ Check the connector to make sure that it is straight. If it has gotten a little crooked, heat up the solder joint and gently move the connector into place.

___ Solder the other two pins to the pads on the top of the board.

___ Turn the board over, remove the masking tape, and solder the remaining two pins to the pads on the bottom of the board. Don't be shy with the solder… you want a good fillet to hold the connector firmly to the board.

Testing your Eggtimer Telemetry Module

Before you can test your ETM, you need to do two things…

1) You need to connect your ETM to your Eggtimer altimeter
2) You need to configure your LCD receiver to match your ETM

See the sections "Connecting your ETM to your Eggtimer Altimeter" and "Configuring your Eggfinder LCD Receiver for your ETM", then come back to this section… we'll wait. ☺

Turn on your Eggfinder LCD receiver, and wait until it's in the Real-Time screen. You should see only the reverse "1" in the upper left corner of the display.

With your ETM connected to your Eggtimer altimeter, start a "test flight" by arming your altimeter with test loads (i.e. Christmas tree lights or 47 ohm resistors). Once the Eggtimer starts its "ready for flight" chirping, you should see some data on the Real Time screen, namely a "000" for the altitude, zeroes for the time and velocity, and an appropriate display for the channels (the channel numbers if selected, or –'s if they're disabled).

You should see the red LED on the ETM's RF module blink once every two seconds, and the LCD receiver should beep in sync with that LED. That tells you that data is being sent from the altimeter.

If you press the button, you should see the History Screen, with a reverse "2" in the upper left corner. You should see a zero in the elapsed time field, with the appropriate battery voltage and temperature displayed on the bottom line.

If you see this data, congratulations! You are now ready to mount and fly your ETM!

If you don't… well, time to see the Troubleshooting section, at the end of this manual.

Connecting your ETM to Your Eggtimer Altimeter

The ETM connects to most Eggtimer altimeters using the 3-pin cable included with the ETM.

The pinout of the ETM connector and the wiring to the cable is:

BLACK – GND
RED - +3.3V
WHITE – TXD (transmitted data from your Eggtimer altimeter)

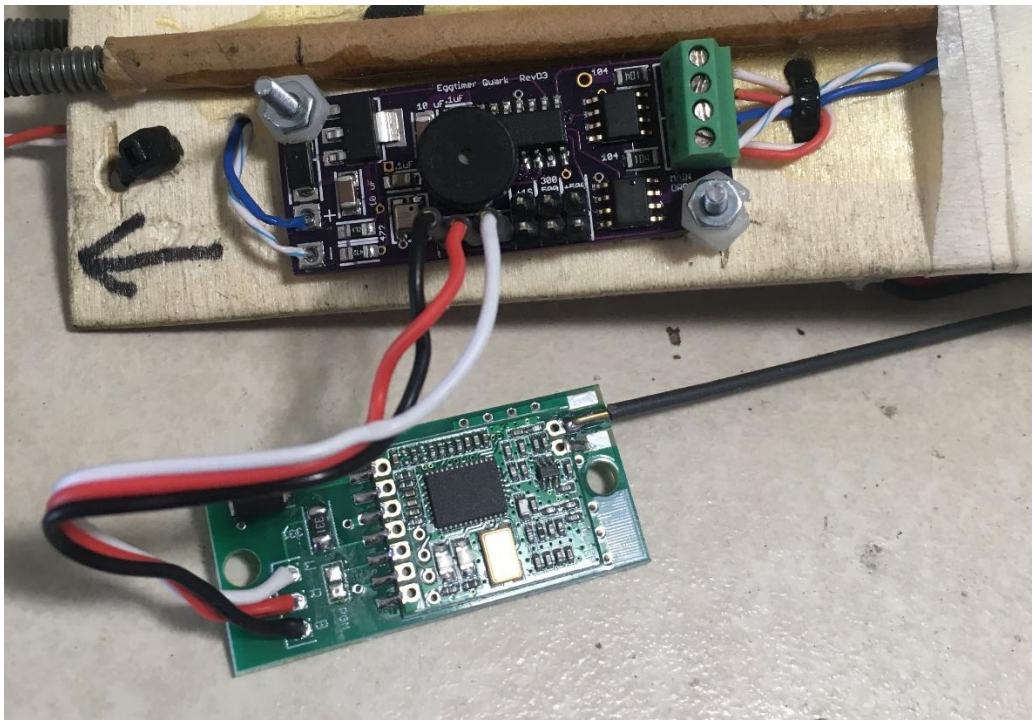
Note that your Eggtimer altimeter must be at or above the specified minimum firmware version… if it is not, you need to update the firmware before you connect the ETM. See the appropriate User's Guide for your altimeter, and visit the Eggtimer Rocketry web site to download the latest firmware.

Eggtimer Quark (D3 and later versions)

The D3 and later versions of the Quark have a dedicated 3-pin connector for the ETM cable, it's plug-and-play.

__ Connect the 3-pin cable to the ETM and the Quark as follows:

ETM	Color	Quark
GND	BLACK	GND
3V3	RED	3V3
TXD	WHITE	TXD



Eggtimer Quark (C2 and earlier versions)

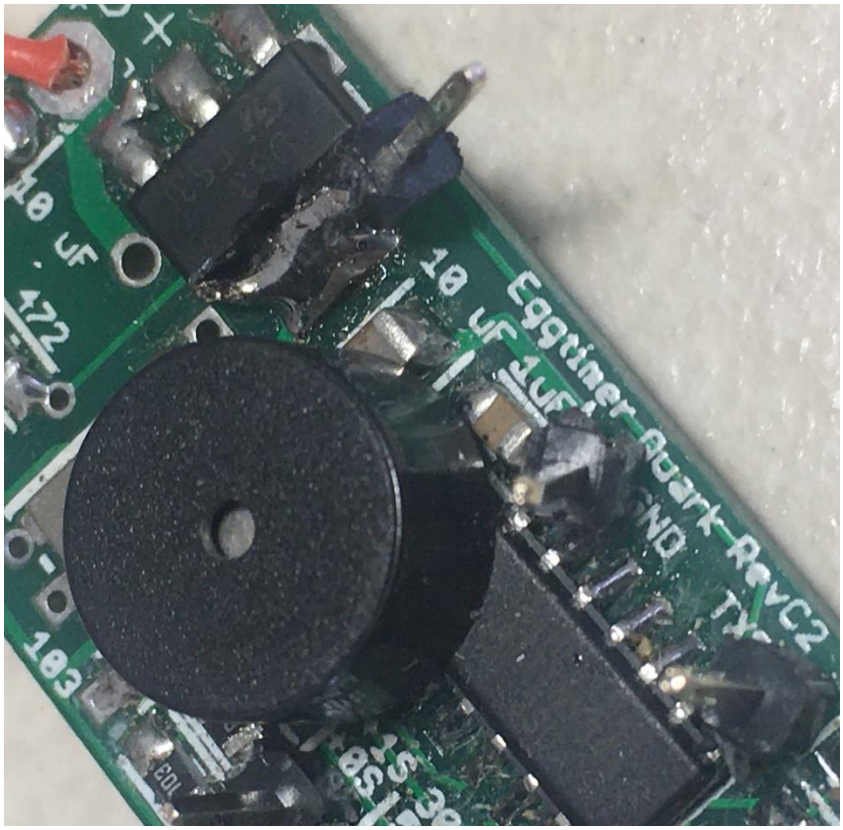
The C2 and earlier versions of the Quark have a 2-pin serial connector for data, however they do not have an output pin/pad for the power. You'll need to add one.

__ Clip off one of the pins of the 3-pin header included with your ETM.

__ With a pair of pliers, bend the short end of the header pin about 30 degrees.

__ Tape your Quark to your work surface.

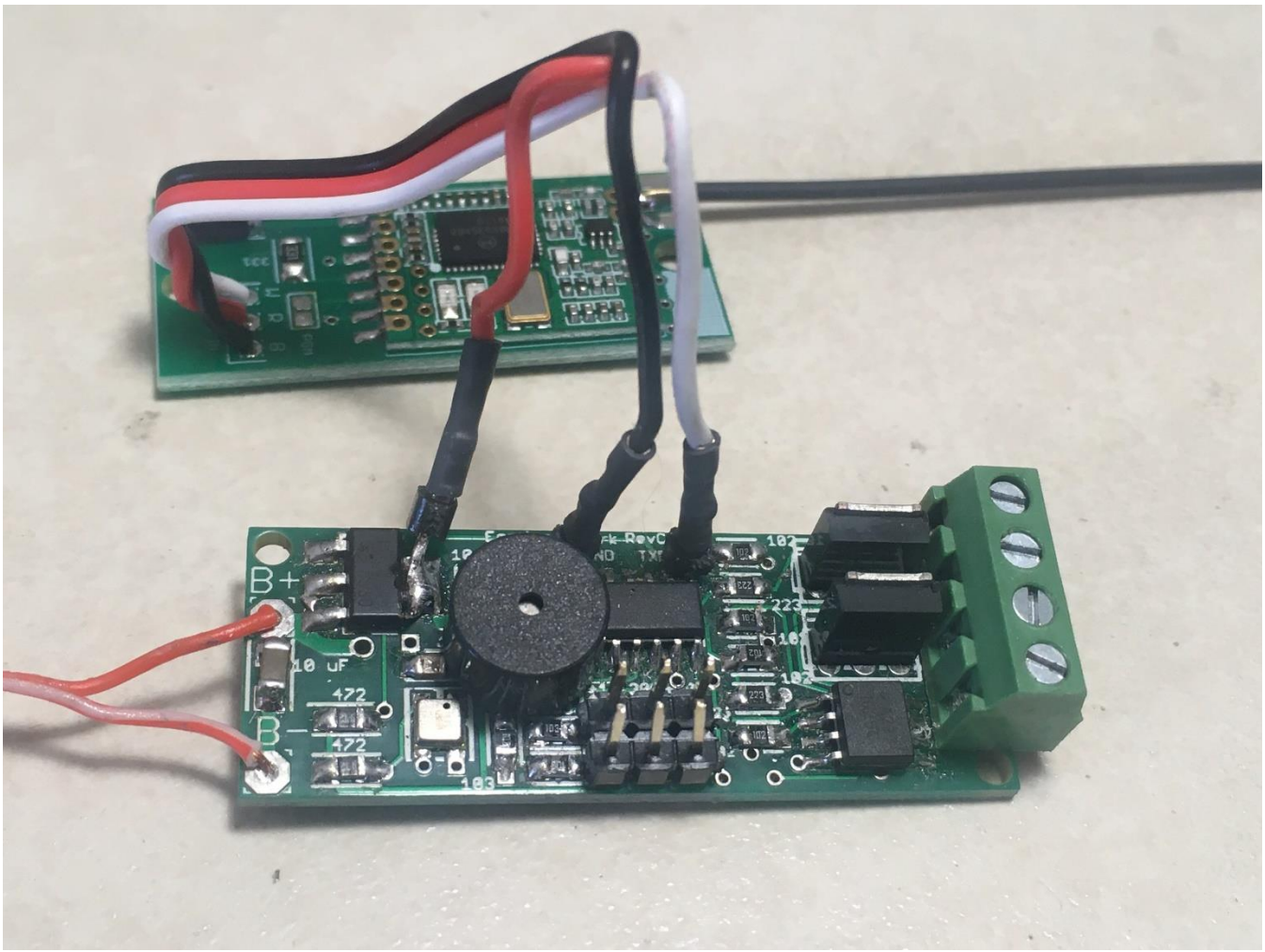
__ Solder the short end of the header pin that you just bent to the large pad on the Quark's voltage regulator, so that the pin is sticking up at a 30 degree angle. See the picture below. This is the 3.3V output that the ETM requires for power.



__ Untape your Quark from the workbench.

__ Connect the 3-pin cable to the ETM and the Quark as follows:

ETM	Color	Quark
GND	BLACK	GND pin
3V3	RED	3.3V pin that you just soldered to the voltage regulator
TXD	WHITE	TXD pin


B+
B-
10 uF
472
472

Eggtimer Quantum (Firmware versions 1.08a and above required)

For the Quantum, you will need to add a pin that supplies 3.3V to the ETM. There's a pad for that, you 'll just need to add the pin.

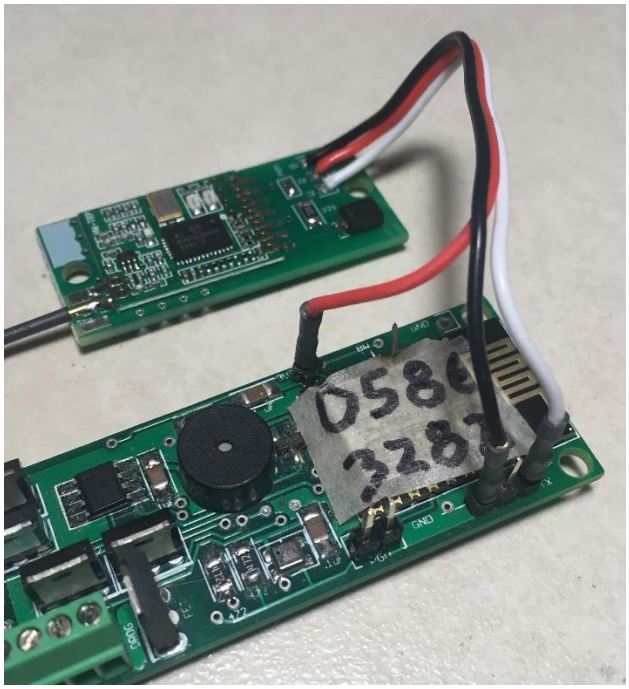
__ Snap a pin off the 3-pin header strip included with the kit.

__ Locate the pad marked "3V3", located next to the .1 uF capacitor below and to the left of the buzzer. Insert the short end of the pin into the pad on the TOP side of the board (the side with the WiFI module and the terminal blocks), hold it in place with a piece of masking tape, then turn the board over and solder the pin in place. Note: On some versions of the Quantum, this pad may not be marked, however it is the same position. See the picture below.

INSERT PICTURE HERE

__ Now, connect the ETM to the Quantum as follows:

ETM	Color	Quantum
GND	BLACK	GND pin on 3-pin header
3V3	RED	3.3V pin that you just soldered to the bopard
TXD	WHITE	TXD pin on 3-pin header



Eggtimer Proton (Firmware versions 1.04a and above required)

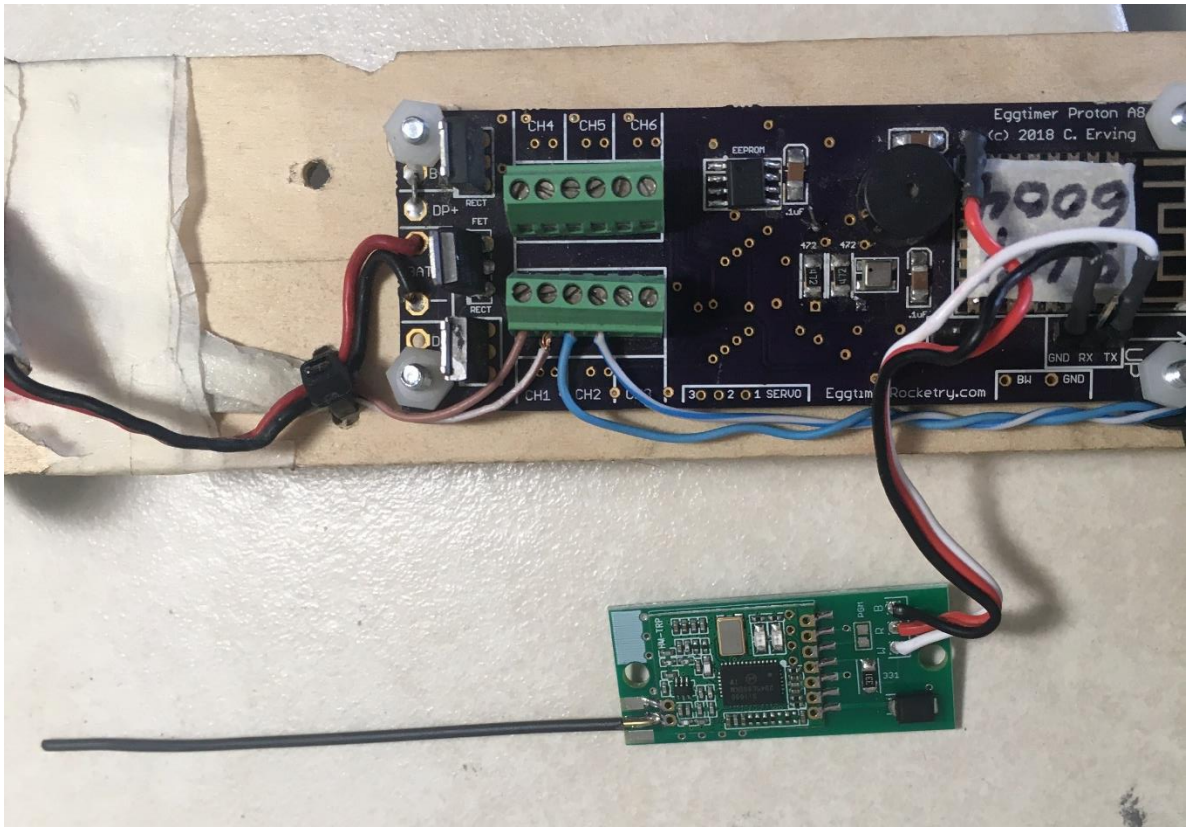
For the Proton, you will need to add a pin that supplies 3.3V to the ETM. There's a pad for that, you'll just need to add the pin.

__ Snap a pin off the 3-pin header strip included with the kit.

__ Locate the pad marked "3V3", located next to the .1 uF capacitor just below the buzzer. Insert the short end of the pin into the pad on the TOP side of the board (the side with the WiFI module and the terminal blocks), hold it in place with a piece of masking tape, then turn the board over and solder the pin in place. Note: On some versions of the Proton, this pad may not be marked, however it is the same position. See the picture below.

_ Now, connect the ETM to the Proton as follows:

ETM	Color	Quantum
GND	BLACK	GND pin on 3-pin header
3V3	RED	3.3V pin that you just soldered to the board
TXD	WHITE	TXD pin on 3-pin header



Mounting Your Eggtimer Telemetry Module

In general, you will want to mount your ETM in your AV bay, or wherever your Eggtimer altimeter is located. The cable that is included is approximately 4" long, we recommend that you zip tie it to the sled to keep it from coming loose in flight. We also recommend that you use masking tape to hold the connectors in flight, by wrapping it around the sled, or similarly secure the socket pins so they can't come loose from the header pins in flight.

The ETM has four #4 screw holes, we recommend using nylon hardware to mount it if possible. Nylon screws, nuts, and spacers prevent anything from shorting between the board and your AV or nose cone sled. In addition if you have a very hard landing they will shear off and absorb the shock of impact, possibly saving your board. Four #4 x 3/4" nylon screws should be fine, we recommend using a nut on the bottom of the board as a spacer. Hole patterns can be found on the Eggtimer Rocketry web site.

If you decide to use metal hardware, we strongly recommend that you isolate both sides of the board with nylon washers, to prevent any metal from shorting out the board.

The ETM is very light and has no parts on the bottom of the board, so it is ideal for mounting with double-sided foam "servo" tape, assuming that you're using the wire antenna. Cut a piece that's the same width as the board, slightly shorter than the length of the board. We do not recommend using servo tape for mounting if you are using an external antenna, the extra weight may cause it to come loose in flight.

If you are using an external antenna rather than the wire antenna, we recommend that you provide some additional support for the antenna. In general, a zip tie to the sled about halfway down the length of the antenna should suffice.

ETM Location and Antenna Considerations

The AV bay of most hobby rockets is not a very hospitable place for a radio antenna. There may be steel allthreads running through the length of the AV bay, the bulkplates may be made of aluminum, there is probably some kind of steel hardware on the bulkplates to mount the shock cord harnesses, and the sled itself may be made from a RF blocking material such as carbon fiber. The easy thing to do when mounting the ETM is to simply mount it like any other device in the AV bay… however in most cases that will not provide the best signal.

The question then becomes, "Is the signal good enough?" That's going to depend on several things, not the least of which is the altitude that you are expecting to achieve, and the kind of antennas that you are using. In general, if you are launching to under 15,000' and you have the external antenna on your Eggfinder LCD receiver, you should be fine with using the wire antenna inside your AV bay, assuming your rocket has a fiberglass/phenolic/cardboard body and a "normal" amount of metal in the AV bay. You may see some occasional signal dropouts, however the Eggtimer altimeters repeat the status and milestone data, so you will probably not miss any important data; in fact, you might not even notice it. We've flown it with the wire antenna to these altitudes and it's worked just fine.

If you are flying above that, we recommend that you make some allowances to help improve your signal. One simple thing that you can do is to remove the stiff wire antenna and replace it with a more flexible antenna, and have the antenna exit from one of the bulkplates so that it's basically not inside the AV bay. This is pretty easy to do and works quite well, as long as you aren't using a metal bulkplate. Mount the antenna end of your ETM as close to the bulkplate as you can, and cut whatever antenna wire you use to 80mm from the end of the ETM circuit board.

Similarly, if you can run the wire outside of the AV bay then you will get a better signal, however that will be true only on the side with clear air. Since most rockets spin a little bit while going up and coming down, this may not be that big of a deal. Note that if your rocket has a carbon fiber airframe, you will **have** to mount the antenna outside the airframe; otherwise you aren't going to get any signal out of it at all, since carbon fiber blocks radio signals.

The best signal would be achieved by mounting a RP-SMA bulkhead connector on your bulkplate and using an external antenna screwed onto that connector, so that the antenna is 100% outside the AV bay. You will use a short RP-SMA cable to connect your ETM to the side of the bulkhead connector inside the AV bay. Assuming that you have a suitable connector, antenna, and cable, you can expect over 30,000' of range with this setup.

Another approach that you can take is to move the entire ETM outside the AV bay. Since there are only three wires connecting your ETM to the altimeter, it's not a huge stretch to think of ways that you might mount the ETM outside the airframe, or just outside the AV bay. We'll leave that up to the reader as an exercise…

Using Your ETM with the Eggfinder LCD Receiver

The Eggfinder LCD receiver can be used to decode and display the telemetry data from your Eggtimer altimeter when paired with an ETM. Except for the Eggtimer Quark, there are two screens… one for Realtime data, and one for Milestone data. Realtime data consists of things like your current altitude, current velocity, current elapsed time of flight, and deployment channel statuses. Milestone data includes your apogee, maximum velocity, temperature, and battery voltage.

Data that can be displayed depends on your altimeter, here's what you can expect (as of 4/2021):

	Quark (Pre-D3)	Quark (D3+)	Quantum	Proton
Realtime Altitude	X	X	X	X
Realtime Velocity			X	X
Realtime Accleration				X
Deployment Status		X	X	X
Channels Enabled/Disabled			X	X
Elapsed Flight Time			X	X
Flight Phase		X	X	X
Apogee		X	X	X
Max Velocity			X	X
Max Acceleration				X
Temperature			X	X
Battery Voltage			X	X

Configuring your Eggfinder LCD Receiver for the ETM

In order to use an Eggfinder LCD receiver with the ETM, you need to tell it that you're decoding telemetry data vs. GPS data. This is done in the configuration menus of the LCD receiver.

Note: You need to be on at least version 2.01C of the Eggfinder LCD firmware in order to use the ETM… if you need to update it, see the Eggfinder LCD User's Guide.

1) Turn on your LCD receiver, you'll see a welcome screen and the version. After a few seconds, you'll see a screen that displays the options, and the LCD's battery voltage. When you see this screen, hold the button down for about 4 seconds, then release it.

2) The display should read "Programming Mode: Device: xxxxxxx". The default device is "TX/TRS", which will decode GPS data from an Eggfinder TX/Mini, or GPS and telemetry data from an Eggtimer TRS. You'll need to change the device on the Eggfinder LCD so that it matches the device that your ETM is connected to. This is necessary so that the display is formatted correctly for the data that your particular Eggtimer altimeter transmits.

3) Tap the button so that it matches the device that your ETM is connected to, then hold the button down for about 4 seconds to "set" the device value.

4) You may optionally set the display to Feet or Meters, and you will have to set the frequency and ID to match your ETM (or to program your ETM… see that section at the end of the manual).

5) As you go through the options, tap the button to change the options, and hold the button for 3-4 seconds to "set" it. The options are:

   Device: (TX/TRS, TX/Mini, Quark, Quantum, Proton)
   Units: (Feet/Meters)
   Freq: (Depends on the band… for the US, it's 909-925 by 2)
   ID: (Depends on the band… for the US, it's 0-7)

6) When all options are complete (Frequency and ID are the last options), you will see "Reset to Start". Turn off the power on the LCD receiver, then turn it back on for the changed options to take effect.

Note: Make sure that you set the Frequency/ID to be the same as your ETM. Unless otherwise marked, your ETM is set to 915/0… we STRONGLY recommend that you change it from the default, so that you don't run into any conflicts with other devices that are still on the default. Instructions on how to do that are at the end of this guide.

Note that the frequency/ID needs to be on a different value than your Eggfinder GPS transmitter, if you're using one. If you set your ETM to be on the same frequency/ID as your Eggfinder, you will get GPS data but you will not get any altimeter telemetry. This is because the GPS data overrides altimeter telemetry… we figure that it's more important to get your rocket back than to know how high it went while it's in flight. Yes, this means that you need separate LCD receivers to decode both the GPS and the altimeter telemetry data. This is because there's no way to synchronize the data streams because there's no connection between the two units. We COULD have designed the ETM to connect your Eggfinder to your Eggtimer altimeter (similar to the way that the Eggtimer TRS works), but that would mean that your Eggfinder GPS transmitter would have to be located in the same AV bay as your Eggtimer altimeter; in general, they are not. Locating the Eggfinder GPS transmitter in an altimeter AV bay can be challenging, so it's better to keep them separate, and separating the GPS and altimeter telemetry functions works for any rocket configuration.

Displaying Telemetry Data with the Eggfinder LCD Receiver

When the flight sequence on your Eggtimer altimeter begins, initial data will be sent to your LCD receiver through the ETM.

There are two screens of data displayed on the LCD receiver, the first (default) screen is the "live data" screen, and the second screen is the "historical" data screen. The screens show the following data:

Real-Time Data Screen

1 <Altitude in 100's> <Acceleration G's> <Elapsed Time>
<Velocity> <Flight Phase> <Channel Status>

History Data Screen

2 <Apogee> <Max Accel. G's> <Elapsed Time>
<Max Velocity> <Battery Voltage> <Temperature C>

The LCD receiver has a two line display, so in order to expand the data that you can see the button is used to toggle between the screens. Tapping on the button toggles between the screens. The number of the screen is in the upper left hand corner, in reverse; "1" for the Real-Time screen, "2" for the History screen

To view the telemetry data during a flight:

1) Before you arm your Eggtimer altimeter, turn on the LCD receiver, and wait for the first telemetry screen (with a reversed "1" in the upper left corner). Other than the "1", it will be blank; that's because there's no data being sent to it yet.
2) When you're ready for flight, arm your Eggtimer altimeter (with a power switch or remotely if you have an Eggtimer Quantum, Quark, or TRS).
3) You will see that the altitude is "000", since you're on the ground. The elapsed time will be zero, and the flight phase will be "WT" (waiting). If you press the button, you'll get the History screen, with a reversed "2" in the corner. You won't see anything in the Apogee or other "maximum" fields, but you'll be able to see the battery voltage and temperature. Press the button again to go to the "Live" screen.
4) When all is clear, launch.
5) Your ETM will start sending data to your LCD receiver, one update every two seconds. When you get data it will give you a short beep to let you know that you have an update. Don't be surprised if you "miss" a few packets during the flight… that is normal, and the event data is repeated so you never actually miss an event.
6) During your flight, you will see the data on your screen change… see below.

An Example from a Real Flight…

For example, a few seconds into a high-power launch with a Proton might look like this (this is real data, BTW… it was a Wildman Drago XL on an Aerotech M1780BT)

```
1     022       -6          3
     1299       LD      ----56
```

The "1" in reverse tells you that it's the Real-Time Data screen
The "022" means that your altitude is 22 x 100', or 2,200' (to the nearest 100')
The "-4" means that you're pulling -6 G's… it's just after burnout
The "3" means that your elapsed time since launch is 3 seconds
The "1299" means that you're moving at 1,299 fps… Mach 1 plus a bit
The "LD" means that the last status was "Launch Detect"
And the "----56" means that channels 5 and 6 are enabled but not fired, and the rest are not enabled

As cool as it would be to see your acceleration increase in real-time, most hobby rocketry motors don't burn for more than 3 or 4 seconds, so you may not catch it. That's OK… most people would rather look at their rocket than some screen. You'll have plenty of time to see the maximum values a little bit later.

After the rocket coasts for awhile and noses over, the data looks like this:

```
1   125     -1       26
    -10     NO   ----56
```

The "1" in reverse tells you that it's the Real-Time Data screen
The "125" means that your altitude is 125 x 100', or 12,500' (to the nearest 100')
The "-1" means that you're pulling -1 G's… you're falling
The "26" means that your elapsed time since launch is 26 seconds
The "-10" means that you're moving at -10 fps, i.e. you're falling at 10 fps
(pretty slowly, since it's just after apogee)
The "NO" means that the last status was "Nose Over"
And the "----56" means that channel 5 fired (it was the drogue), channel 6 is enabled but not fired, and the rest are not enabled

If you press the button, you'll see some historical data now…

```
2  12548     23      26
    1387    7.9    21.2
```

The "2" in reverse tells you that it's the History screen
The "12548" means that your apogee was 12,548'
The "23" means that your maximum acceleration was 23 G's
The "26" means that your elapsed time since launch is 26 seconds
The "1387" means that your maximum velocity was 1387 fps
The "7.9" means that your battery voltage is 7.9V
And the "21.2" means that the temperature is 21.2 C

Other than the elapsed time, the history screen isn't going to change very much from this time until you land…

When your Main chute fires you'll see this (it was set to fire at 1,000'):

```
1       009        -1          256
        -39        NO       ----56
```

The "1" in reverse tells you that it's the Real-Time Data screen
The "009" means that your altitude is 9 x 100', or 900' (to the nearest 100')
The "-1" means that you're pulling -1 G's… you're falling
The "256" means that your elapsed time since launch is 256 seconds
The "-39" means that you're moving at -39 fps, i.e. you're falling at 39 fps
The "NO" means that the last status was "Nose Over"
And the "----56 " (5 and 6 in reverse) means that channels 5 and 6 fired, and the rest are not enabled. Channel 6 was the Main, so this confirms that it has fired.

Finally, when you land you'll see this:

```
1       000         0          292
          0         NO       ----56
```

The "1" in reverse tells you that it's the Real-Time Data screen
The "000" means that your altitude is zero (to the nearest 100')
The second "0" means that you're pulling 0 G's… you're not moving anymore
The "292" means that your elapsed time is 292 seconds
The "0" in the lower left means that you have no velocity… you're not moving
The "NO" means that the last status was "Nose Over"
And the "----56 " (5 and 6 in reverse) means that channels 5 and 6 fired, and the rest are not enabled.

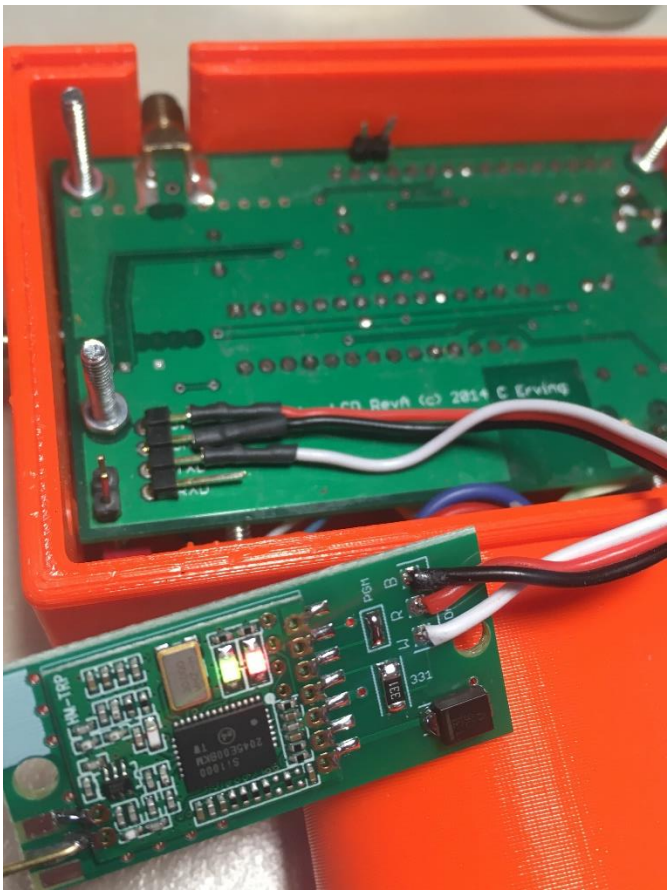
So, you can see from these screens that you can track the progress of your rocket's flight in real-time, and its velocity and deployments to confirm that it's coming down safely. Where this comes in really handy is if you can't see your rocket, possibly because it drifted way out of sight. The ETM data makes a great companion to your Eggfinder GPS, because it tells you what your rocket is doing, whereas the Eggfinder tells you where your rocket is located.

Programming the Frequency on your ETM Using the Eggfinder LCD Receiver

Unless otherwise marked, your ETM comes shipped on the "default" frequency/ID settings that we use for all Eggtimer telemetry products… 915/0. (It is also available on the 70cm Ham band for use with the Eggtimer Quantum/Proton… see below for more information regarding that). That's fine for testing to make sure that it works, but we STRONGLY recommend that you change it before you go out into the field to launch, to prevent you from having a conflict with another user who did not change theirs. Also, if you're using an Eggfinder GPS transmitter you need to make sure that your ETM is on a different frequency/ID pair; if it's set to the the same, you'll get GPS data but you won't get any telemetry data from your ETM.

Programming the Eggtimer Telemetry Module using the LCD receiver as a programmer is nearly identical to the procedure that you use for programming an Eggfinder TX or Mini transmitter. Basically, you use the 3-pin cable to connect to the LCD receiver, then go through the programming screens on the LCD receiver… when you program the frequency on the LCD receiver, it programs the ETM too.

1) Make sure both the Eggfinder LCD and the Eggtimer ETM are turned OFF.
2) Solder a jumper across the "PGM" pads on the Eggtimer ETM board. (You'll be removing it later).
3) Connect the 3-pin cable to the programming header on the LCD receiver as follows:
   RED wire on the pin marked "3V3"; BLACK wire on the pin marked "GND"; and WHITE wire on the pin marked "TXD".



4) Turn ON the Eggfinder LCD receiver. When you do this, both the red and green LED's on the Eggtimer ETM's RF module should come on. If they do no, turn off the Eggfinder LCD receiver and check your connections.

5) Go through the programming screens and program the frequency/ID of the Eggfinder LCD receiver. When you get the "Programming OK" screen at the end you're done… your Eggtimer ETM is now programmed to the same frequency/ID as your Eggfinder LCD receiver. Note: Be sure to select the same device as your Eggtimer altimeter!
6) Turn the Eggfinder LCD receiver off, disconnect the cable, and unsolder the jumper from the PGM pads on the Eggtimer ETM board.
7) You can now connect your ETM to your Eggtimer altimeter, and go through a test "flight" to check your link.

Notes for the 70cm Ham Version of the ETM

The ETM is also available on the 70cm Ham band, for use with the Eggtimer Quantum or Eggtimer Proton. Compared to the 900 MHz version of the ETM, you can expect to get about twice the range, and you will probably see fewer dropouts, too. To be FCC Part 97 legal, your Eggtimer altimeter must send a call sign "occasionally"; this is satisfied on the Quantum/Proton by setting the "Device Name" in the hardware settings page to your FCC-assigned call sign, and this data is sent out with the other telemetry data in the stream.

To get to the hardware settings page, connect to your Quantum/Proton's SSID, and navigate your browser to **192.168.4.1/hsetup** You will see a field labeled "Device Name:". Enter your call sign in that field, blanking out any "junk" characters that may be there. Note that this field will only accept capital letters and numbers, and has a maximum of 8 characters. Click on the "Submit" button to make it "take". Now, when you arm your Quantum/Proton, your call sign will be sent out along with the other telemetry data. It is not displayed on the screen of the LCD receiver, however.

You must use the 70cm ETM with a 70cm Eggfinder LCD receiver. If you already have one, make sure that it's on the 2.01c or later version of the Eggfinder LCD firmware; if you need to update your 70cm LCD receiver, make sure that you download and update it with the 70cm version. You'll need to program the ETM to be at whatever frequency/ID your LCD receiver is at; see the previous section for directions on how to do that.

Notes for International Versions of the ETM

The ETM (and LCD receiver) are also available in the following regional versions:

EU/UK: 869 MHz (869.425, 869.525, and 869.625 MHz); default is 869.525
AUS/NZ: 900 MHz, restricted to frequency/ID 919/0 through 925/7; default is 921/0

Setting the frequency/ID for these versions is exactly the same as mentioned above, however your Eggfinder LCD receiver is restricted to the proper regulatory band for your region. If you need to update an existing LCD receiver to accommodate an ETM, be sure to download and install the correct international version from the Eggtimer Rocketry web site.

Troubleshooting

If your ETM 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. 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 splatter will almost always cause more damage than the original solder bridge.

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 Eggfinder ETM uses this could easily keep things from working. If you have a cold solder joint, heat it up and put just a little bit of solder on it, the main idea is to get a little more flux on the joint. If there's too much solder, use a fine solder wick or (preferably) a vacuum bulb to remove the excess, then heat it up and resolder the joint.

Check Your Component Polarity

There are only a few components on the ETM board, however it won't work if you install the diode backwards. If you inserted a component incorrectly, you will have to carefully unsolder it, clear any solder residue from the holes, and resolder it. If you find that a component was soldered incorrectly, you will have to use a vacuum bulb or vacuum desoldering tool to unsolder it. We cannot stress enough that you need to check the orientation of the parts ***before*** you solder them. The Eggfinder Limited Warranty does not cover damage to a component while attempting to unsolder it, so make take your time and make sure you get it right before you solder.

Check Your Cabling

Make sure that you have the cable connected to your altimeter exactly as detailed in the connection instructions. The ETM is polarity-protected, so if you miscable it you shouldn't break anything, but it won't work either.

If It Still Doesn't Work…

There is, of course, always an outside chance that you have a bad component. It's very rare for a component to be bad from the factory, but 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)

Red LED on the RF Module doesn't come on (i.e. ETM not transmitting)

- Cable wired incorrectly
  (Check the connection guide for your particular Eggtimer altimeter)
- Bad solder joint on RF module or short underneath the pads
- Bad solder joint on diode or diode reversed (the stripe must match the board)
- Bad solder joint on 330 ohm resistor
- Eggtimer altimeter is not at the minimum required version (check it first!)

No LCD data or beeps with ETM transmitting

- LCD receiver not on the same frequency/ID as the ETM
- LCD receiver in GPS mode (set the LCD's "Device" to match your altimeter)
- LCD receiver firmware is not at the minimum version (2.01C or later)

Quick Start for Eggtimer Telemetry Module

Connecting to your Eggtimer Altimeter

Wires:

BLACK – Ground	To GND pin on Serial Data Header
RED -- +3.3V	To "3V3" pin OR large tab on voltage regulator
WHITE – Data	To TXD pin on Serial Data Header

Minimum Firmware Versions for ETM Support

Eggfinder LCD Receiver – 2.01C, "Device" setting must be changed to match altimeter
Eggtimer Quark – Any (Displayed data depends on hardware version)
Eggtimer Quantum – 1.08K
Eggtimer Proton – 1.04L

Eggfinder LCD Screens (Tap on button to change screen):

Real-Time Data Screen

1 <Altitude in 100's> <Acceleration G's> <Elapsed Time>
<Velocity> <Flight Phase> <Channel Status>

History Data Screen (Not available on Eggtimer Quark)

2 <Apogee> <Max Accel. G's> <Elapsed Time>
<Max Velocity> <Battery Voltage> <Temperature C>

Telemetry Data Displayed by Altimeter

	Quark (Pre-D3)	Quark (D3+)	Quantum	Proton
Realtime Altitude	X	X	X	X
Realtime Velocity			X	X
Realtime Accleration				X
Deployment Status		X	X	X
Channels Enabled/Disabled			X	X
Elapsed Flight Time			X	X
Flight Phase		X	X	X
Apogee		X	X	X
Max Velocity			X	X
Max Acceleration				X
Temperature			X	X
Battery Voltage			X	X