ASSEMBLY INSTRUCTIONS

for

HamThings Fuse Block

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HamThings

https://HamThings.com

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How does it work?

The HamThings Fuse Block is a very simple device – two pairs of Anderson Powerpoles configured per the ARES/RACES standard, two spots for mini automotive fuses (also known as ATM fuses, available at any auto parts store), and a circuit board which connects the fuses to the Powerpoles.

Its purpose is to provide **over-current protection** for your radio. If the radio draws too much current, the **element** or **fusible link** inside the fuse will heat up until it melts, breaking the connection to the radio, so that no further damage can occur.

The Circuit Board

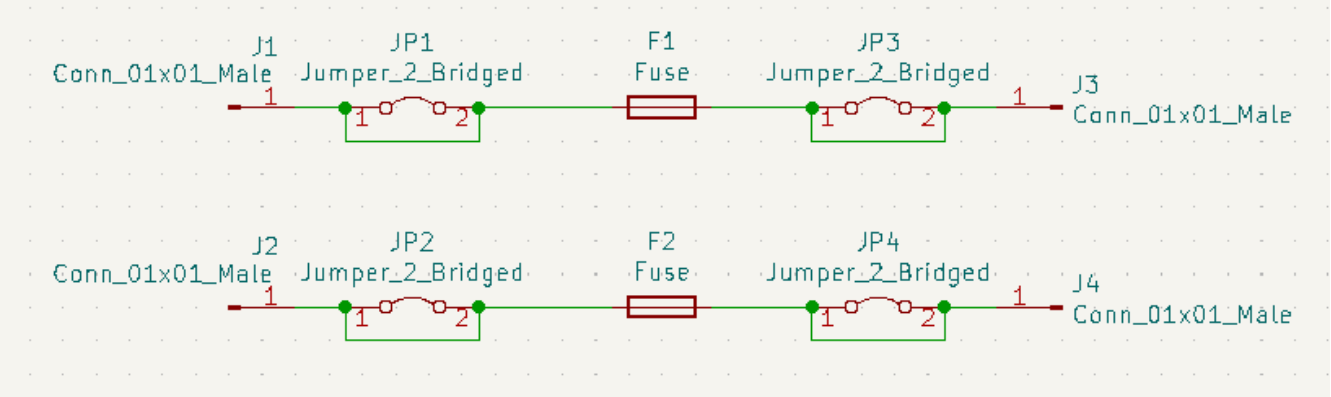


Figure 1: Fuse Block PCB Schematic

Really there are only three special things about the Fuse Block's circuit board:

1. Its traces have been specially designed such that they can support loads of up to 30 amps.
2. The board has been designed to switch the locations of the + and – (red and black) Powerpoles. While Figure 1 shows the correct schematic for the board, it does not show that, if J1 is red, and at the top of the board, J3 will need to be at the bottom of the board to maintain the ARES/RACES standard. This "polarity switch" is mainly accomplished by running circuit traces both on top and on bottom of the board.
3. Both positive and negative are fused. This may seem strange or overkill, so it bears explaining. In a perfect world, your power supply or battery would provide 12VDC (or 13.8 or 14.6 – **nominally** 12V) of potential to your radio. Your radio's case should be **grounded** – connected to the black (-) wire. The **electron flow** theory states that electrons flow from (-) to (+), so a single fuse on the negative side of the power supply should be sufficient to stop an over-current situation.

However, especially in a portable situation, we need to consider another voltage – **ground potential**! While unusual (think during a storm when lightning is about to strike), there are situations where the voltage of the ground you're standing on, or surface you've placed your radio on *is not the same as that of the battery's (-) wire*! This means current could flow from (-) to (+), from the ground to (-), or from the ground to (+), depending on the situation! There are only two ways to solve this issue: driving an 8-foot ground rod and connecting your radio's case to that, or fusing both the positive and negative sides of your radio's power connection. Since most park rangers and auto manufacturers would frown on the use of ground rods for mobile/portable/temporary use, the Fuse Block fuses both positive and negative legs of the power connection.

Powerpoles

Anderson Powerpole® connectors have become a *de facto* (unwritten) standard for nominal 12-volt power applications, especially in emergency communications.

The ARRL has a fantastic article about Powerpole installation: http://arrl.org/files/file/Public%20Service/TrainingModules/Technical/Anderson%20powerpole.pdf

Fuses

You will be supplying the appropriate fuses for your radio, but let's quickly discuss their purpose.

A fuse has two parts – a piece of metal (usually a wire of some sort) which is specially designed to heat up and melt if a certain amount of electrical current (at a given voltage) is sent through it, and some way to hold and connect to that piece of metal. A lot of engineering goes into designing fuses. They can be built to withstand damaging amounts of current for a specific amount of time (slow-blow fuses), or to burn out quickly (fast-blow fuses). However, they are all designed assuming a certain voltage. That is, a 10-amp ATM fuse (automotive mini, designed for nominal 12VDC systems) WILL NOT perform the same as a 10-amp, 250V glass fuse!

Similarly, fuses do not save equipment from **over-voltage** conditions, they only protect against over-current conditions.

Options – Read Carefully!

This kit allows you to build the FB001 in various configurations. YOU are responsible for the electrical safety and fitness for your purpose of whatever you build, so choose your configuration carefully!

FB001 Enclosed (Recommended)

This configuration uses a 3D printed enclosure to encase the FB001's circuitry. We recommend this option.

FB001 "Naked" (DANGER!)

Do not use this option, as tempting as it may be! Some radios can pull as much as 40-50 amps of current. If something conductive (even, say, a sweaty finger during a summer POTA activation) touches exposed metal parts, it will be an experience to remember! (Or maybe not remember…) In any case, if you are hoping to save the weight of the FB001 enclosure, please consider the next option:

FB001 Coated

This configuration uses copper staples to support the Powerpole connectors. Understand that you will need to ensure the FB001 is touch-safe. If you choose to follow this route, you may want to cover exposed parts in heat-shrink tubing (we'd recommend marine, adhesive-lined), and paint the board with a conformal coating. Again, this is not recommended, and YOU will be responsible for ensuring your FB001's safety in your application.

FB001 Potted

This configuration uses the FB001 and the bottom half of the enclosure. You could use potting compound, e.g., epoxy glue, to seal the board into its enclosure. If you choose this option, make sure you understand how to use potting compound, and make sure it doesn't leak out of the enclosure while you're waiting for it to dry!

WARNINGS:

The FB001 is designed for a maximum of a 30amp ATM fuse. A few online retailers sell larger. Do not give in to the temptation; there is a reason no reputable manufacturers sell larger than 30 amp ATM fuses.

Again, DO NOT USE greater than 30 amp ATM fuses, or damage to your FB001 will result.

Required Tools

You will need the following tools to build the FB001:

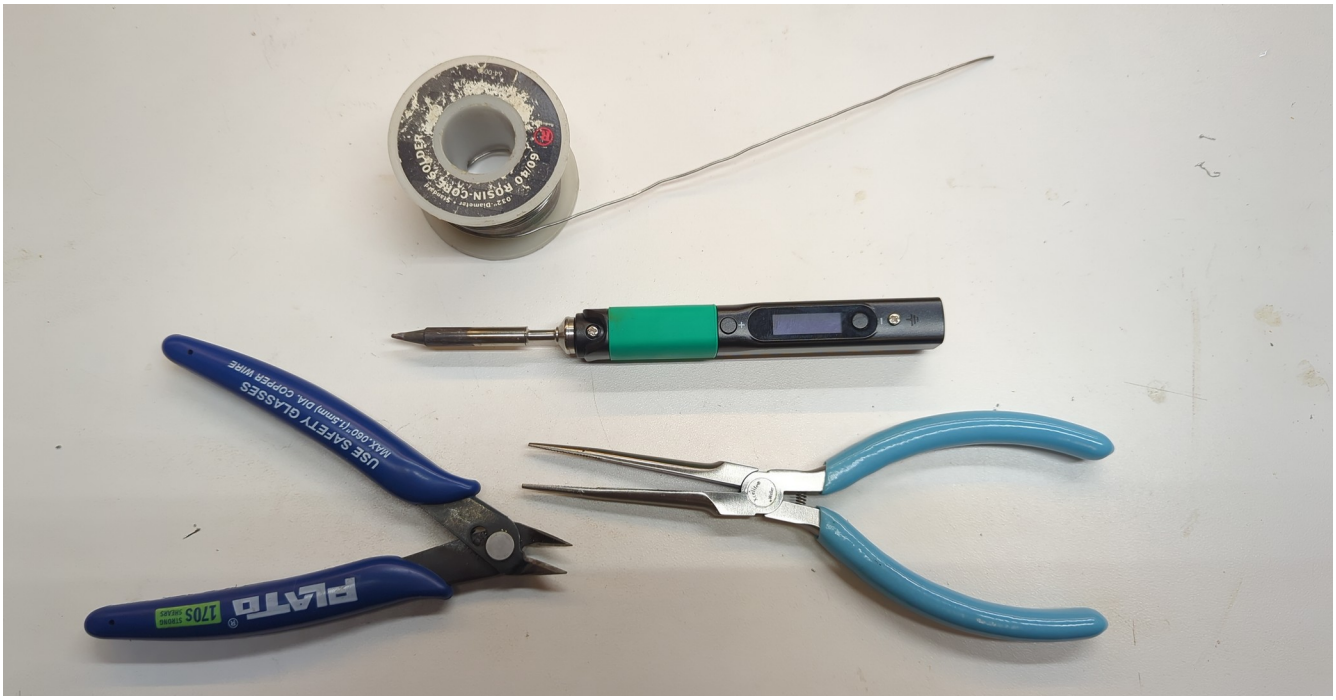


Figure 2: Tools needed to build FB001

- Needle nose pliers
- Wire cutters (preferably heavy-duty cutters)
- soldering iron (at least 50W, otherwise you will struggle to solder the Powerpoles)
- solder
- (Optional: lineman pliers – helpful for Powerpole support staples)
- (Optional: Helping Hands for soldering)
- (Optional: Hot Glue for bedding in 3D printed enclosure)
- (Optional: Super Glue for closing 3D printed enclosure)
- (Optional: small clamps for clamping 3D printed enclosure while it dries)

Kit Contents

The FB001 in kit form contains the following parts. Please check that you received all the correct pieces:

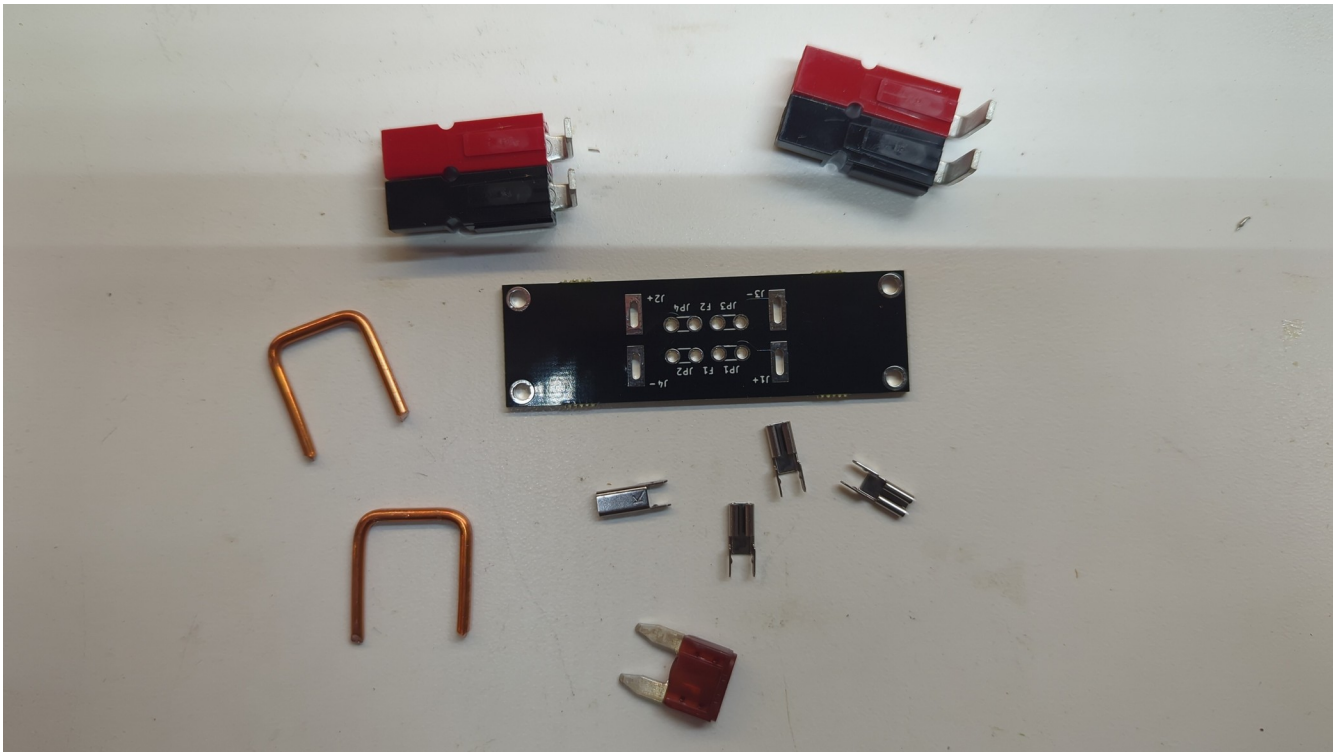


Figure 3: FB001 Kit contents, along with other parts you will need

- 1x FB001 printed circuit board (PCB)
- 2x Powerpole pairs
- 4x fuse blade connectors
- (Optional: 1x 3D printed enclosure with top)

You Will Need

To build the FB001, you will need to supply the following parts:

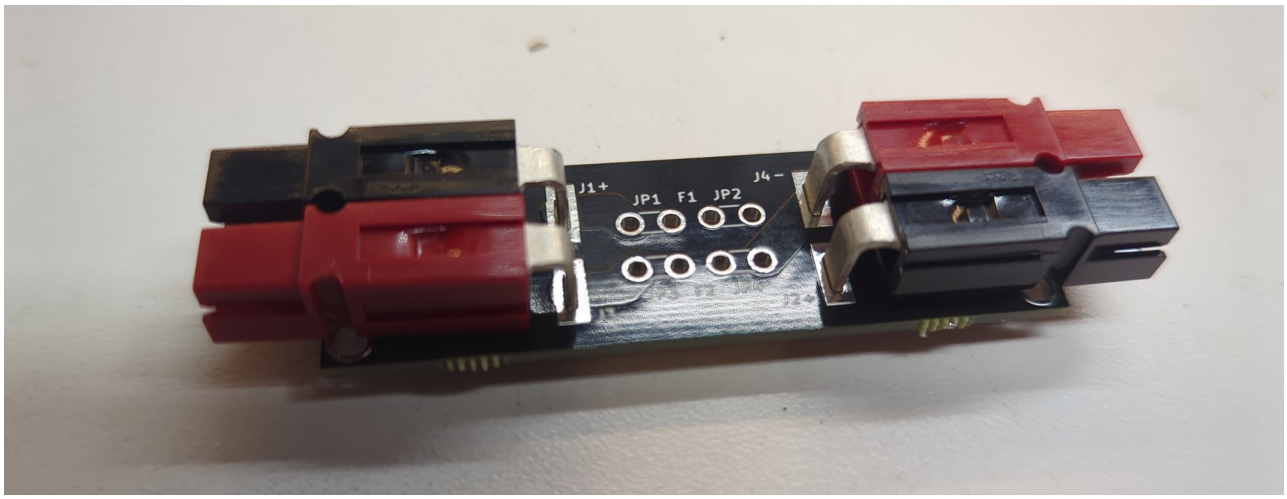
- 2x mini APM/ATM blade fuses (also used to assemble the kit)*
- (Optional: bare 12AWG solid copper wire to make Powerpole support staples)

* There have been reports of blade fuses that were purchased online not limiting current properly. We HIGHLY recommend that you buy your fuses from a reputable manufacturer!

Assembly Instructions

1. Place Powerpoles in Board

Place the Powerpoles in the circuit board as shown below:



1.a. Place Powerpole Support Staples

CAUTION: Do not follow this step if you intend to use the 3D printed enclosure! The staples will make the board too tall to fit in it.

Pull the Powerpoles out a bit, so there's a gap between them and the board. Use a Powerpole pair to help you bend a staple from bare 12AWG solid copper wire. The staple should be about 0.7in tall and 0.65in between centers of the pins.

Use needle nose pliers to help you insert the staple into the holes in the PCB.

Snug everything down. GENTLE application of the pliers may help ensure the Powerpoles are sitting flush with the PCB and the staples are holding them nicely.

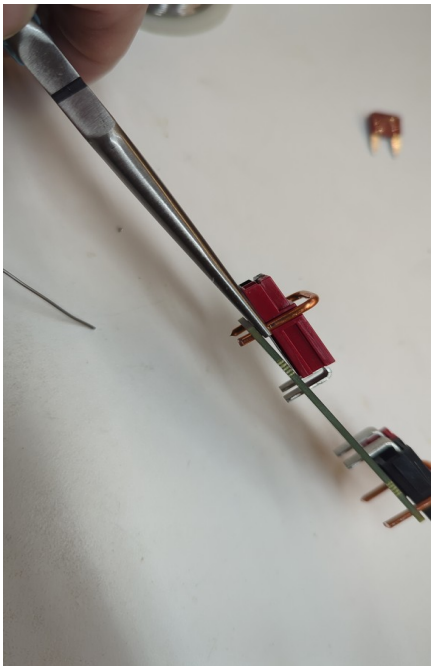


Figure 4: Coaxing staples into PCB

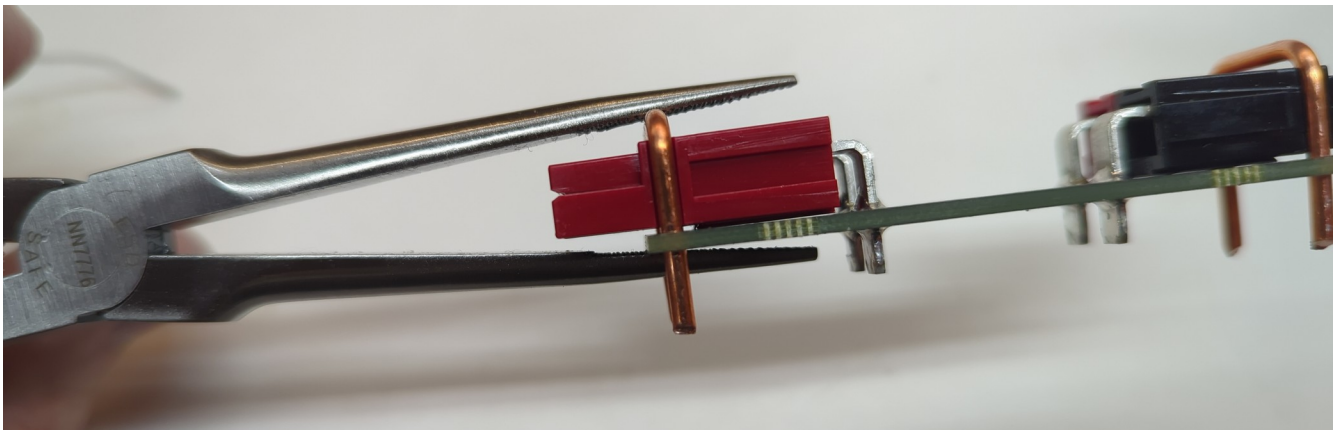


Figure 5: Powerpoles snugged down to PCB, staple GENTLY coaxed into place with pliers

2. Solder Powerpoles

Solder the powerpoles (and staples, if you chose to install them).

Powerpoles are big chunks of metal. Make sure you have a powerful soldering iron. Using the 65W Pinecil iron shown in the images, we were able to solder effectively by using the following procedure:

- From the bottom of the board, place the tip along the long side of the Powerpole, also touching the PCB trace.
- Feed a bunch of solder into it so there's a small drop of solder on the tip
- Wait for everything to heat up enough that the solder starts flowing
- feed a bit more solder into the opposite side of the Powerpole

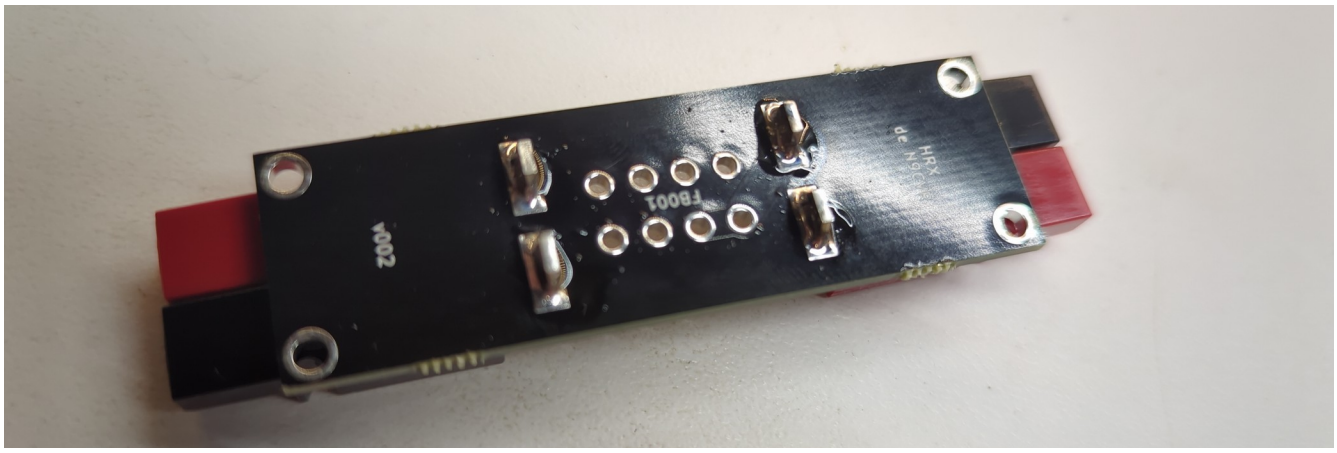


Figure 6: Powerpoles soldered from the bottom of the PCB

3. Slip on Fuse Connectors

Slip two fuse connectors onto a fuse. They may be a tight fit. Just get them started, then you can line them up with the holes in the PCB, and use the PCB to push them on the rest of the way.

Figure 7: Fuse with two connectors on it.

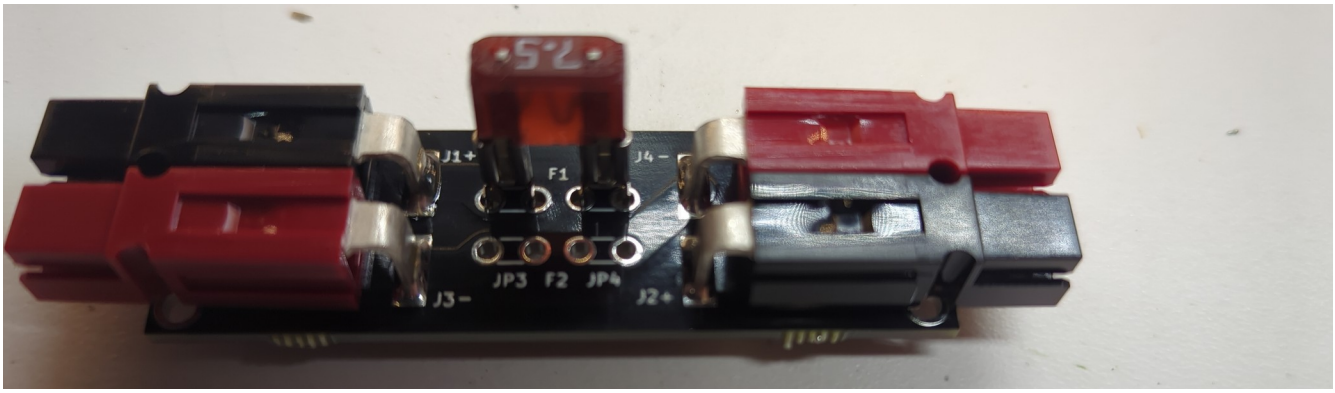


Figure 8: Connectors and fuse placed into PCB

4. Solder Fuse Connectors

Solder the two fuse connectors onto the PCB. You may find it helpful to place the FB001 on a table, resting on the fuse. Then solder one connector pin. After that, you can switch to a pair of helping hands if it's easier for you.

Remove the fuse when you are done soldering.

(NOTE: if you plan to build several FB001s, designate a 'burner' fuse for soldering, as it will eventually fatigue and fall apart.)

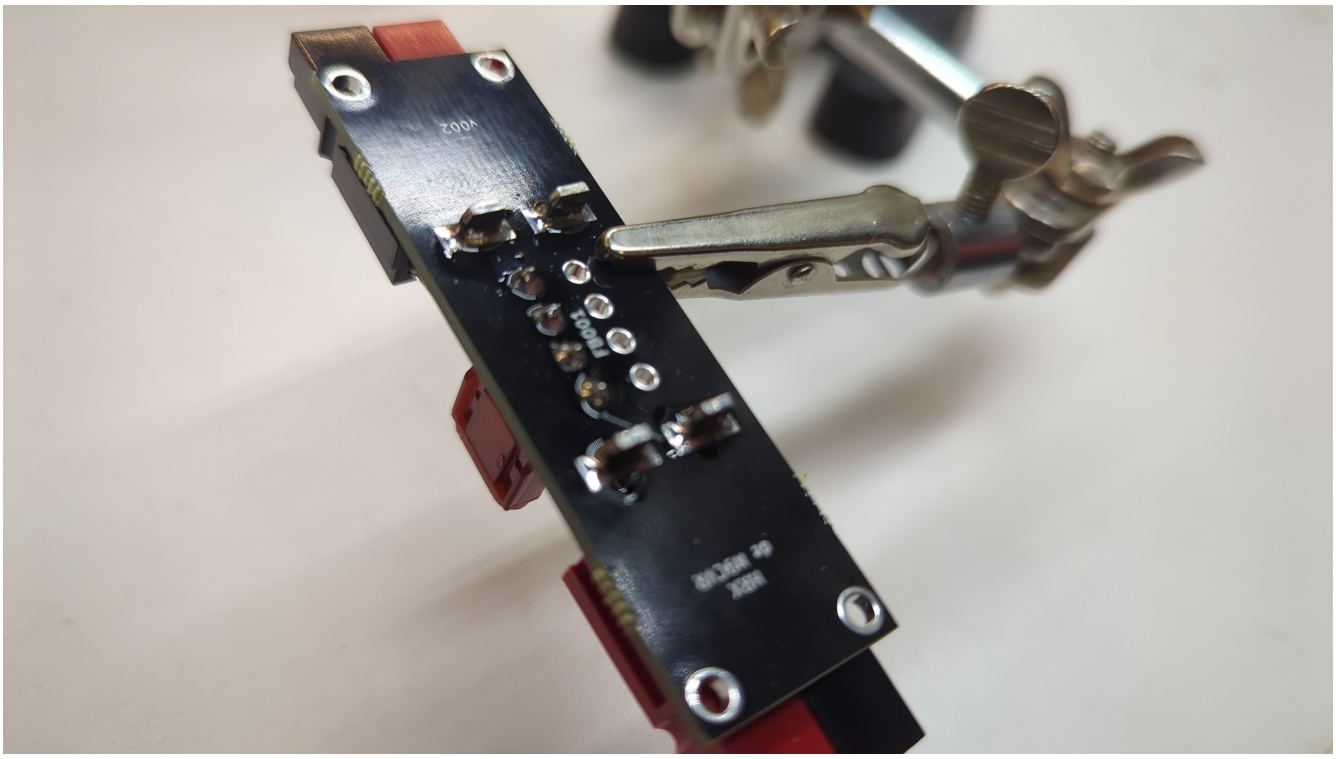


Figure 9: Soldering the first pair of fuse connectors

5. Repeat Steps 3 and 4

Repeat Steps 3 and 4 to install the second fuse connector. If you plan to install the PCB in the optional enclosure, make sure to remove the fuse again.

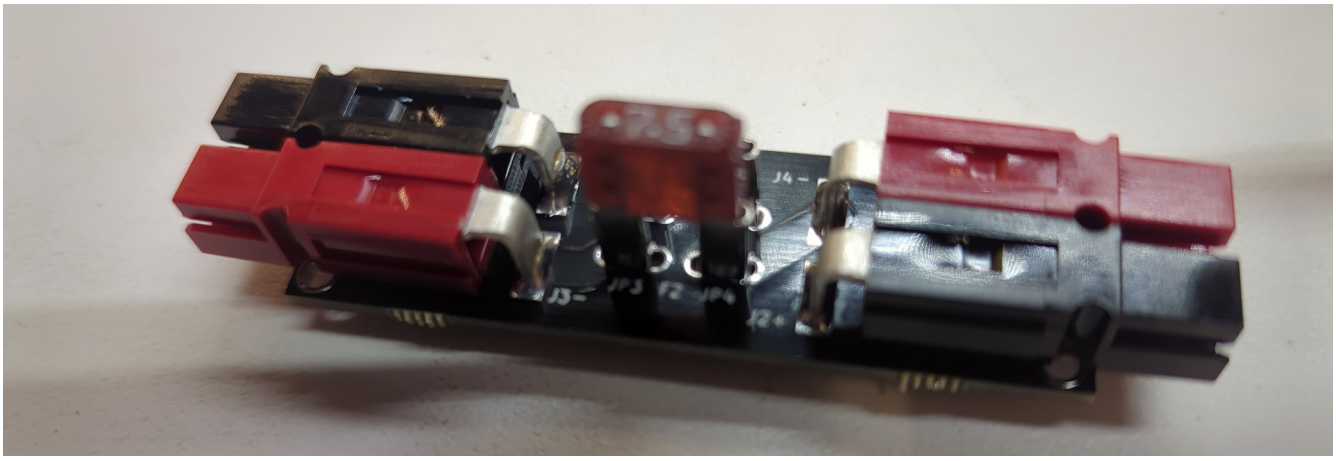


Figure 10: Second set of fuse connectors installed in PCB

6. (Optional) Trim Leads on Bottom of PCB

You may trim the leads on the bottom of the PCB a little to help them fit in the 3D printed enclosure. You may need heavy duty side cutters, such as those on a pair of lineman's pliers, to do this.

Figure 11: Trimming leads

7. (Optional) Conformal Coating

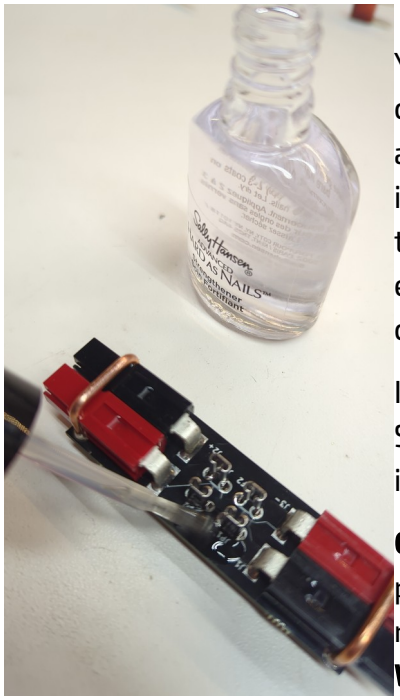


Figure 12: Conformal Coating

You may choose to apply a conformal coating to your FB001. Conformal coating adds a layer of protection to the board and its components. If you are planning to use the board as-is, without the 3D printed enclosure, you may be particularly interested in the conformal coating, as it will make the board a little more weather resistant.

It turns out clear nail polish can make a great conformal coating. Simply paint both sides of the board liberally with it, and wait for it to dry.

CAUTION: DO NOT PAINT the insides of the fuse connectors, or the plug ends of the Powerpoles, otherwise, they won't be able to make a connection!

WARNING: DO NOT use your XYL's nail polish without her approval. Failure to do so may result in damage or injury, including loss of life.

8. (Optional) 3D Printed Enclosure

You may choose to install the FB001 into a 3D printed enclosure. You may print this yourself by downloading the model at Printables.com and importing it into your favorite slicer program. Alternately, you may have bought an enclosure with your kit.

To install the FB001 into the enclosure, simply drop it in. You may hot glue it in if you choose, although this is not required.

CAUTION: DO NOT get hot glue in the fuse connectors or the plug ends of the Powerpoles, or they won't be able to make a connection!

Get the fuses you will be using with your radio and place them nearby. Apply a couple drops of super glue to the top edge of the enclosure. Place the top on the enclosure and quickly install the fuses. You may also choose to clamp the top down for a few minutes.

9: Install and Enjoy!

Install your fuse block inline with your power supply. Enjoy! If anything comes up, please don't hesitate to contact us!

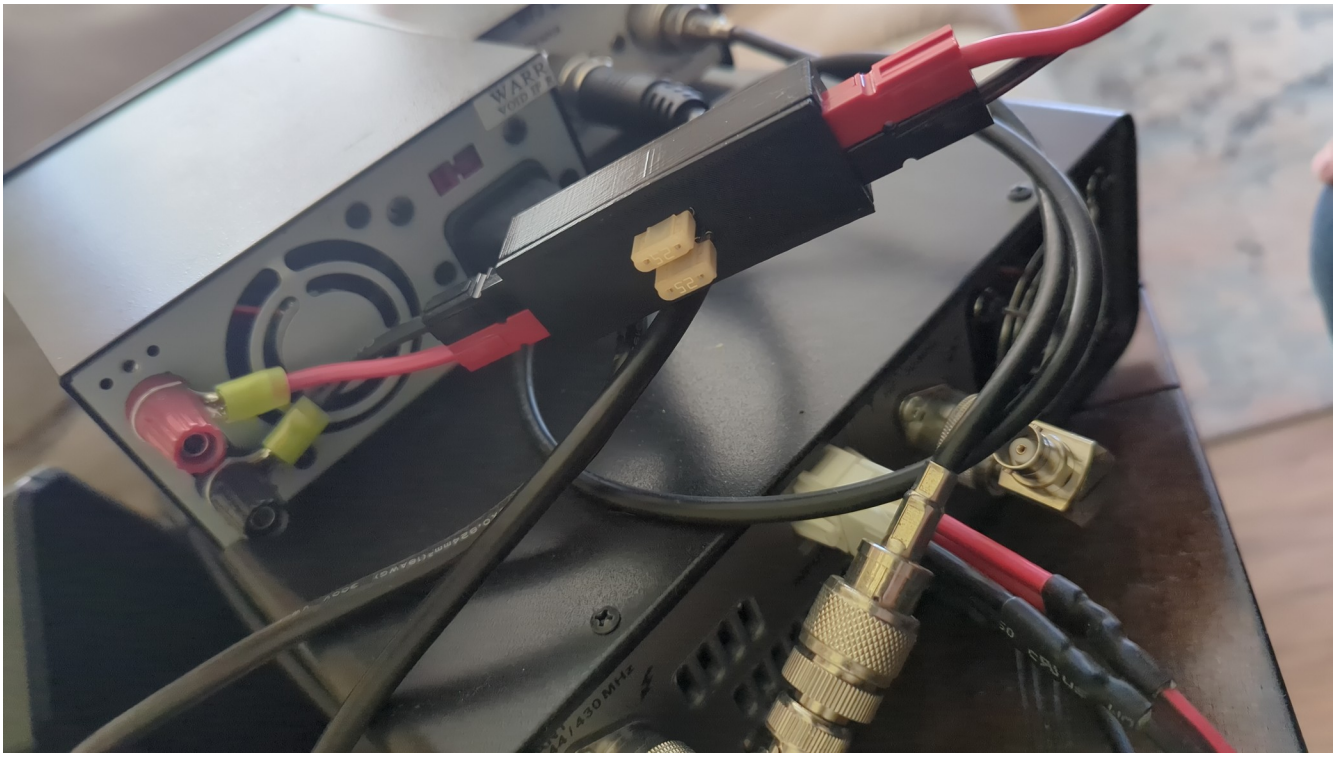


Figure 13: An FB001 in its native habitat

Things You Have Learned

Building the HamThings Fuse Block has exposed you to several concepts. Review them and be proud! If there's anything you don't feel quite comfortable with, feel free to go back and review:

- How a fuse works
- Over-current protection
- Over-voltage protection
- Ground potential
- Grounding
- Fusing both power legs
- Soldering heavy-gauge connections
- (optional) Potting, conformal coating, heat shrinking
- (optional) 3D printing