RFBitBanger
Batch 1 – September 2023
Winding the Toroids

There are six toroids on the RFBitBanger main board, wound on the smaller black FT37-43 cores. None of these are optional. In particular, the board won't even power on without T4 installed.

Each band filter board needs two more toroids, wound on the larger yellow/black T50-6 cores. You don't need to build these all at once. You might want to start with your favorite band, or choose one of the bands where the RFBitBanger works the best (80m, 60m, 40m, 20m). We've provided the parts for you to make one filter for each HF band, a total of nine, and three spare filter boards for you to experiment with.

## Coil Winding Basics
Winding a simple coil on a toroid is easy.

See our little video about it at https://openresearch.institute/rfbitbanger-project/batch1

Here are the steps written out:

1. Select an appropriate toroid core. This will be the smaller black FT37-43 core for each of the six toroids on the main board, or the larger yellow/black T50-6 core for the toroids on the band filter boards.
2. Determine the number of turns to be wound. We provide this in a table below. The definition of the number of turns is the number of times the wire passes through the center of the core. Like this:
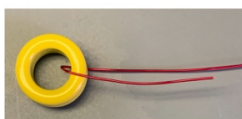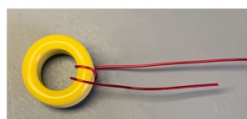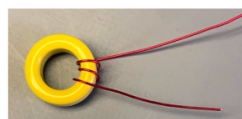
One Turn   Two Turns   Three Turns

3. Cut a piece of 26AWG enameled "magnet" wire to length. We provide suggested lengths in the table. If you use our suggested lengths, the wire we provide should be plenty to build the main board and all nine HF band filters.
4. Pass the wire through the center of the core, leaving about 1.5 inches (4 cm) toward you. This short pigtail will become one lead of the finished coil. You now have a 1-turn coil. Say "one!" out loud so you don't lose count.

5. Clamping the existing wire in place with your thumb, firmly bend the wire around the body of the toroid. You want the wire to follow the contours of the core, but you don't want any overly sharp bends, and you don't want the wire to be under a lot of tension.
6. Pass the free end of the wire through the center of the core again. Say "two!".
7. Repeat steps 5 and 6 until you've *said* the desired number of turns.
8. Examine how the finished coil is supposed to mount on the circuit board. The coils on the main board all stand up, while the coils on the filter board lay flat. Form the two wire ends so they point in the right direction, and trim them to a convenient length.
9. Strip the insulation off both leads, where they will pass through the circuit board. That's right next to the body of the toroid core.
10. When soldering the coil to the circuit board, pull the leads firmly to draw the toroid down close to the top of the board.

Use the above procedure to wind L4 and L6 on the main board, and all toroids on the filter boards.
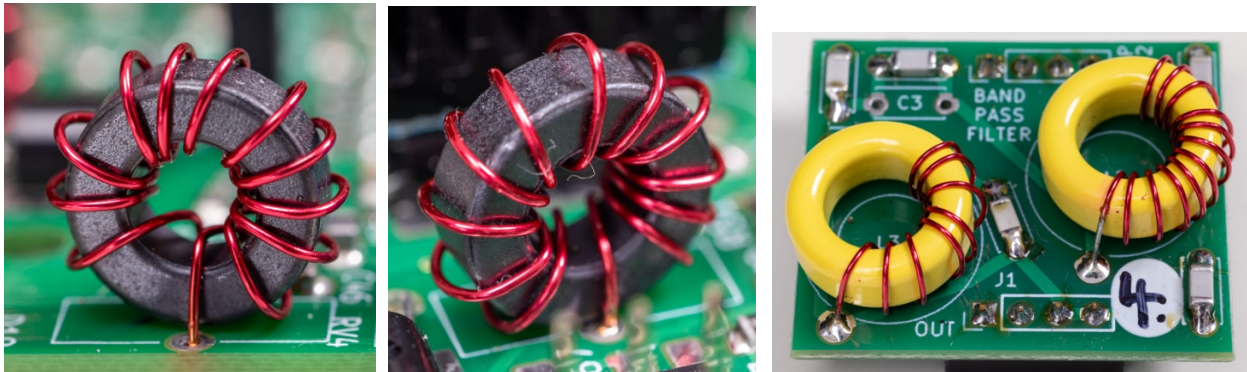
Photos in this document were taken with green prototype circuit boards. They are very similar, but not identical, to the black boards you received in batch 1.
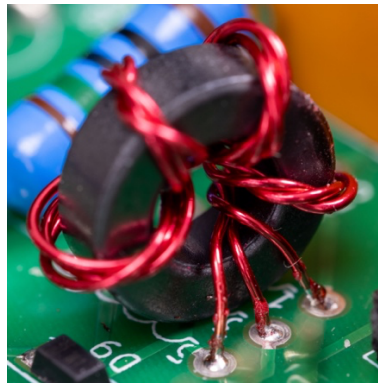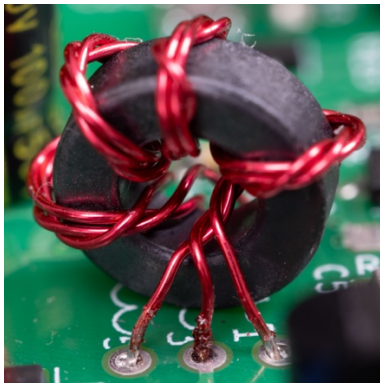
Winding Transformers
T1, T2, and T3 on the main board are transformers, which just means they have more than one winding.

Winding T1 and T2
T1 and T2 are trifilar balun transformers. Trifilar means they have three windings, and the windings are twisted together and then the three-wire cable is wound onto the toroid. Cut the recommended length of wire (30cm) into three equal parts (10cm each). Hold one end of all three wires in one hand (or a vise) and gently twist the other ends around each other so that the three wires together form a sort of rope. You don't need a lot of twists. It's important that all three wires are twisted around the others, not just one wire twisted around the other two.
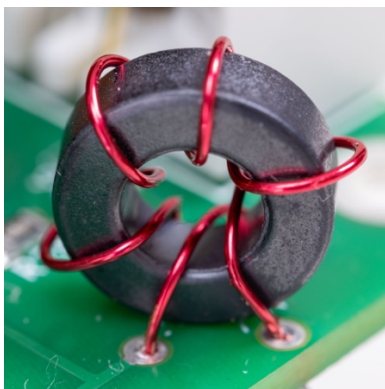
Once you have the wires twisted together, pretend that the rope is just a wire and follow the basic instructions above to wind 5 turns of it onto a small black FT37-43 core. Before stripping, separate the three wires at each end of the rope and strip each one separately. It's important that they don't short together.

Use a continuity tester to sort out the wires so that they are in the same order on both sides of the core. You may need to twist or untwist a little bit to get the right order without any danger of shorting the wires together. Then read the description in the RFBitBanger Manual about how the transformer is supposed to be connected to the board, and study the little diagram on the board's silkscreen. When you're sure you understand how the transformer is supposed to be installed, go ahead and install it.

Winding T3

T3 is a current sampling transformer with two separate windings. One winding is just like a simple coil with five turns. The other winding is a single turn (that is, just a wire that passes through the core). Wind the first winding according to the basic instructions above, and mount it on the circuit board using the two pads with the undulating line between them. Then cut a short piece of magnet wire, strip both ends, pass it through the core, and solder it to the circuit board using the two pads with a dotted line between them.

Winding the Common-Mode Choke T4

T4 on the main board is a common-mode choke. It's wound just like T1 and T2, except with only two windings instead of three. Cut the recommended length of wire (30cm) into two equal parts (15cm each). Hold one end of both wires in one hand (or a vise) and gently twist the other ends around each. You don't need a lot of twists.

Once you have the wires twisted together, pretend that the rope is just a wire and follow the basic instructions above to wind 7 turns of it onto a small black FT37-43 core. Before stripping, separate the two wires at each end of the rope and strip each one separately. It's important that they don't short together.

Use a continuity tester to sort out the wires so that they are in the same order on both sides of the core. You may need to twist or untwist a little bit to get the right order without any danger of shorting the wires together. Then read the description in the RFBitBanger Manual about how the common-mode choke is supposed to be connected to the board, and study the little diagram on the board's silkscreen. When you're sure you understand how the common-mode choke is supposed to be installed, go ahead and install it.
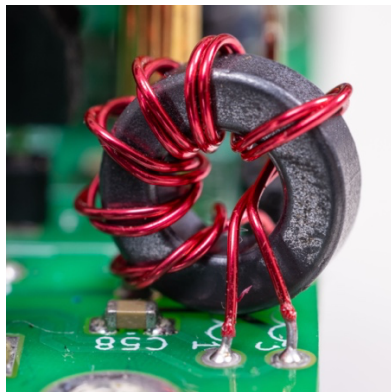
Stripping the Leads

The magnet wire is covered with a thin enamel (plastic) insulating coating. You'll need to remove that coating from the part of each lead that passes through the hole in the circuit board. There are several ways to do this.

1. Draw the wire through a folded piece of medium grit sandpaper a few times. Repeat at various angles until the wire is shiny copper colored where it will pass through the board.
2. Scrape the enamel off with a sharp knife or razor blade. If you drag the knife along the wire away from the sharp edge, chances of cutting or nicking the wire are greatly reduced. Repeat on various sides of the wire until it is shiny copper colored.
3. If you have a solder pot, you can simply dip the leads into the molten solder. Hold the toroid lightly in needle-nose pliers so your fingers don't get too close to the hot solder. Lower it smoothly into the solder until the toroid core almost touches the solder. Wait a

second until the enamel coating is done burning off, and withdraw it from the solder. The wire will be stripped and tinned with solder.

The trick to using a solder pot is to let it get nice and hot. When the solder is just barely melted, it isn't hot enough to burn off the enamel reliably. Wait a while longer. Test with a scrap of the same wire. You'll be able to tell when it's working well.

Solder pots are very inexpensive. The bar solder required to fill up the pot may cost more than the pot itself.

Tuning the Coils

The two toroids on the band filter board are part of the tuned circuit that loads the power amplifier. To get maximum power output from the RFBitBanger on a given band, you may adjust the spacing between the turns on the toroids on the corresponding band filter. A brief procedure and a test circuit are given in the RFBitBanger Manual.

Once you are satisfied with the spacing, lock the windings down with a bit of cyanoacrylate glue.

Winding Table

Device	Core Used	Number of Turns	Wire Used (cm)
Main Board L4	FT37-43 (small, black)	12	21
Main Board L6	FT37-43 (small, black)	12	21
Main Board T1	FT37-43 (small, black)	5 trifilar	30 (3 lengths of 10)
Main Board T2	FT37-43 (small, black)	5 trifilar	30 (3 lengths of 10)
Main Board T3	FT37-43 (small, black)	5 + 1	13 + 4
Main Board T4	FT37-43 (small, black)	7 bifilar	30 (2 lengths of 15)
80m Band L2	T50-6 (large, yellow/black)	19	35
60m Band L2	T50-6 (large, yellow/black)	16	30
40m Band L2	T50-6 (large, yellow/black)	12	23
30m Band L2	T50-6 (large, yellow/black)	11	22
20m Band L2	T50-6 (large, yellow/black)	9	20
17m Band L2	T50-6 (large, yellow/black)	8	19
15m Band L2	T50-6 (large, yellow/black)	8	19
12m Band L2	T50-6 (large, yellow/black)	7	18
10m Band L2	T50-6 (large, yellow/black)	7	18
80m Band L3	T50-6 (large, yellow/black)	13	25
60m Band L3	T50-6 (large, yellow/black)	9	20
40m Band L3	T50-6 (large, yellow/black)	8	19
30m Band L3	T50-6 (large, yellow/black)	7	18
20m Band L3	T50-6 (large, yellow/black)	5	15
17m Band L3	T50-6 (large, yellow/black)	5	15
15m Band L3	T50-6 (large, yellow/black)	5	15
12m Band L3	T50-6 (large, yellow/black)	4	13
10m Band L3	T50-6 (large, yellow/black)	4	13