Assembling the MFJ Cub Transceiver

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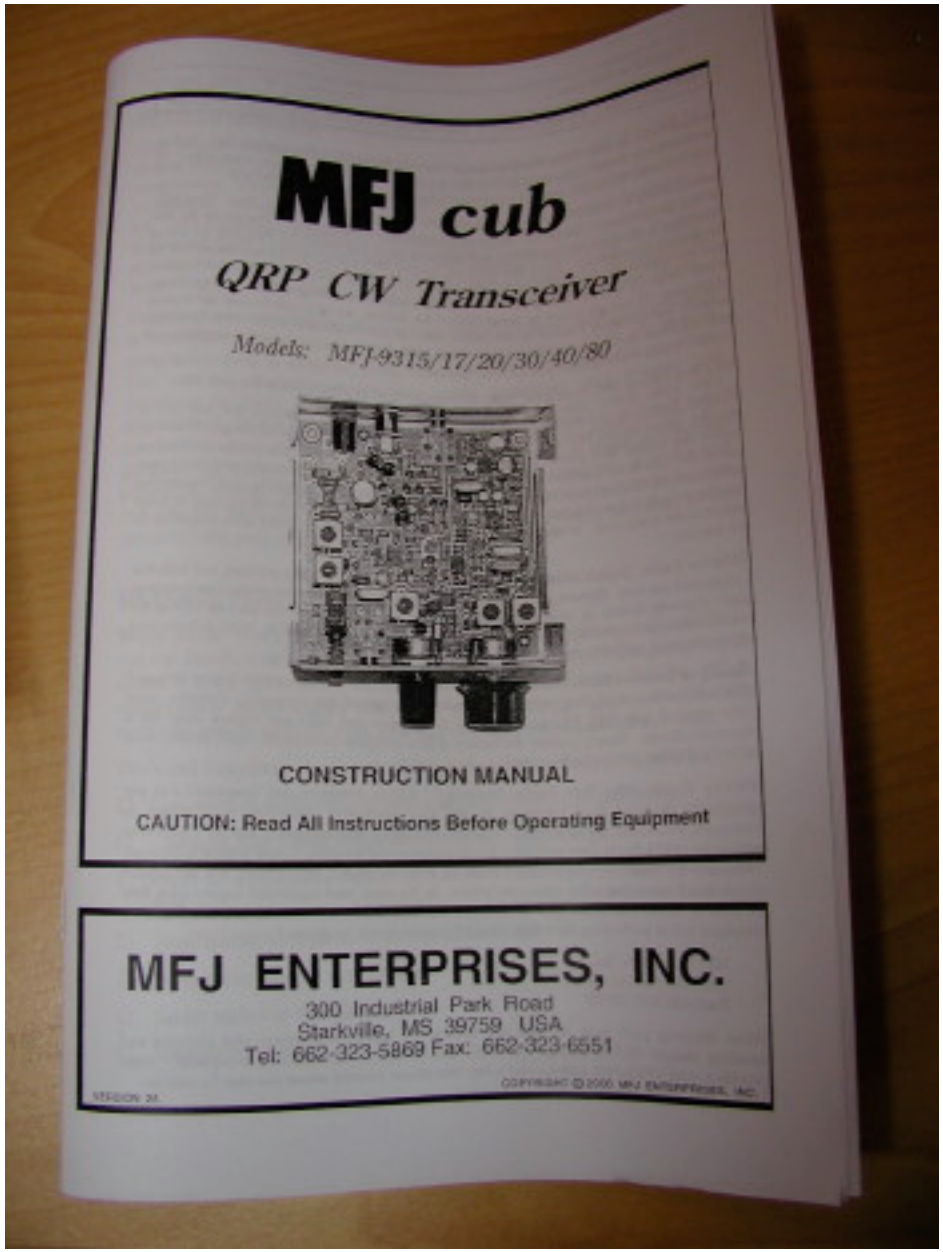
The ARRL has offered a bundled an MFJ-9340K 40m QRP "Cub" transceiver kit with the third edition of Low Power Communication by Richard Arland (W3OSS). The kit is fun to assemble and when you are finished you have a very nice 40m CW rig. The following pages show what goes into building this kit. If you can follow directions, you can build one too!

Step 1

The MFJ-9340K Cub transceiver kit comes in a single long box with bagged parts and two manuals: an assembly manual and an operating manual.

Unlike many kits, this one comes with a very nice enclosure made especially for this radio. When you are finished, it will look as good as any commercial product.

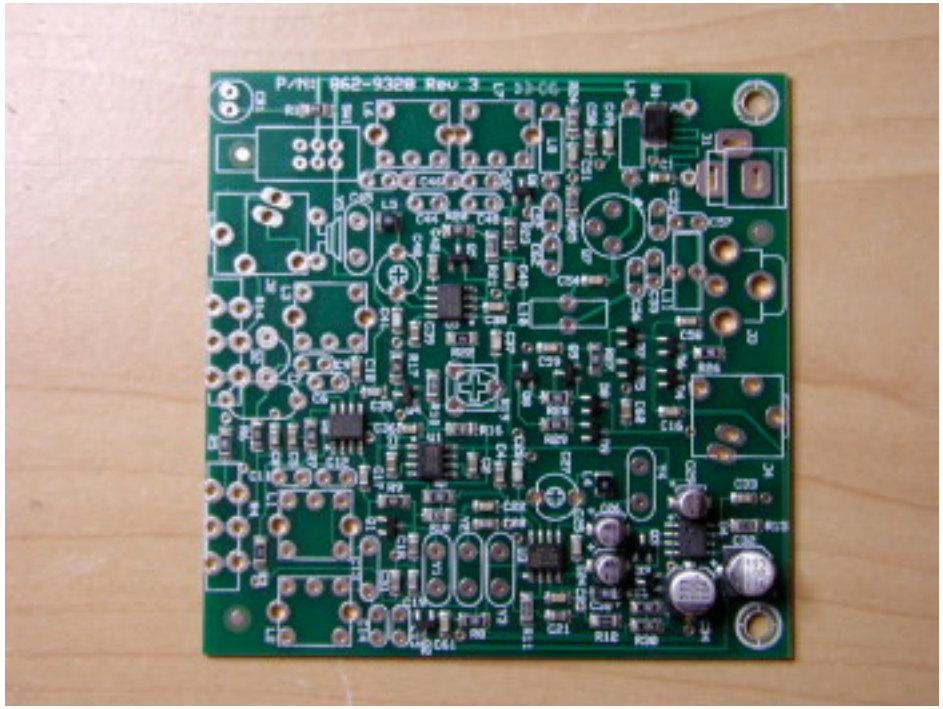
Here is the construction manual.



Here is the operation manual.

Step 2

The MFJ-9340K Cub transceiver is built upon a nicely produced circuit board with silk screen and solder mask. All the really hard parts (like the surface mount devices) are already on the board when you get it. You just need to put some through-hole parts in place, solder them, and align the radio.



The parts specific to this kit are included in a single bag. Note that other kits supporting other bands have different parts. The manual covers the assembly instructions for any of these kits so you'll need to pay attention. We are assembling the 40m version of this kit.

There are a bunch of parts that are common to all the kits in this family. They are bundled in a single bag.

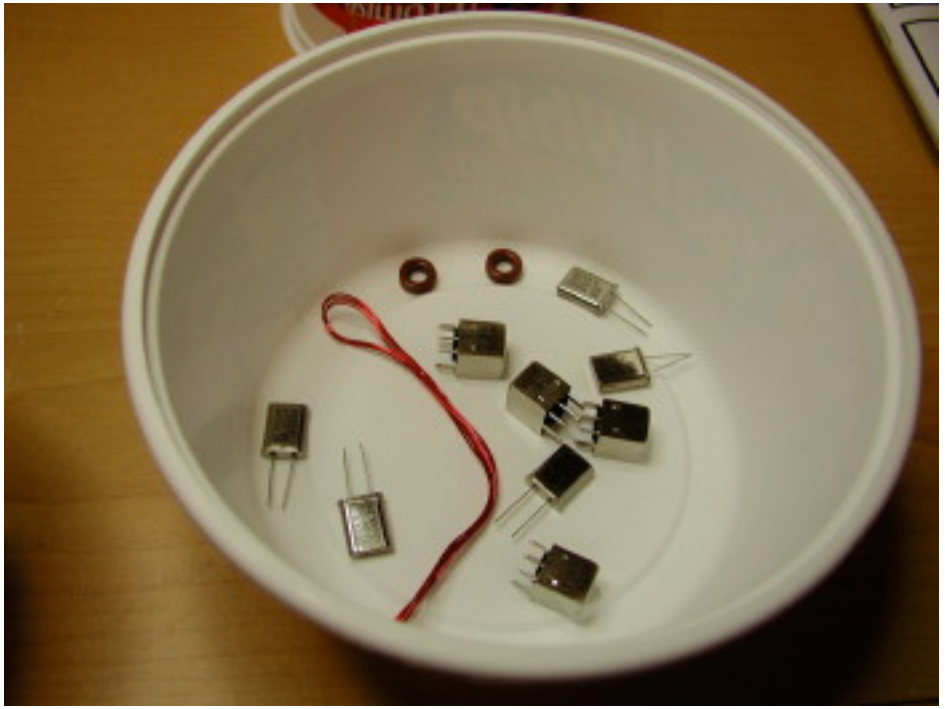
The hardware (screws, nuts, knobs, etc.) are bundled in a third bag.

The kit also comes with a nice power cord with the connector already attached. I immediately added a pair of PowerPoles to make it compatible with all the other facilities I have.

Finally, there is a hole in the back of the radio to accommodate a BNC connector. (The radio's circuit board provides an RCA connector for the antenna.) BNC connectors have become the defacto standard for QRP radios. I'll add this part after assembly is complete.

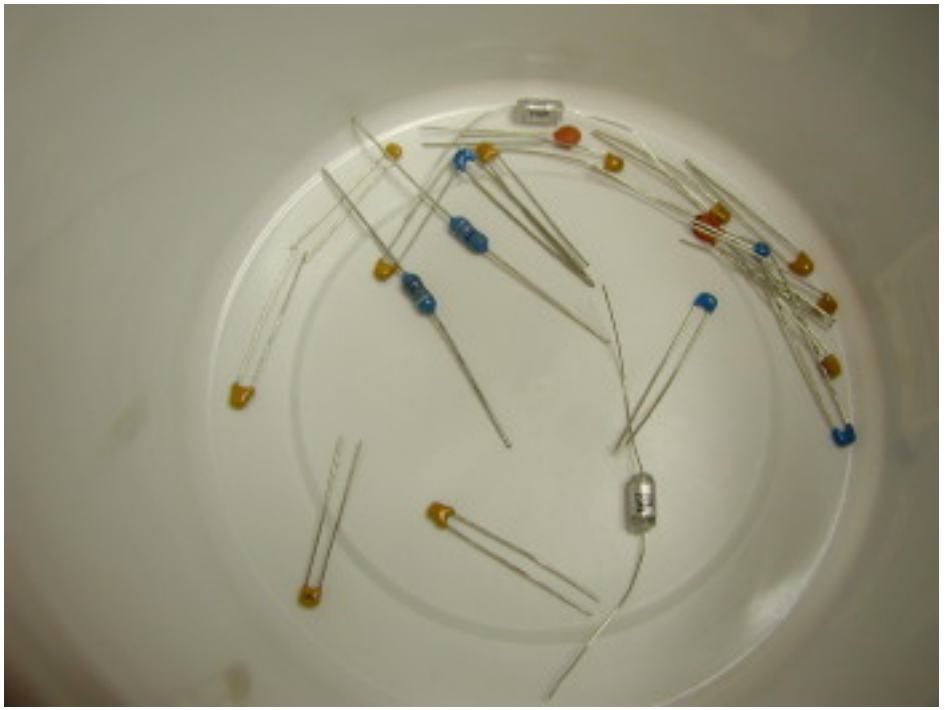
Step 3

The easiest way to lose a part is emptying a bag and having one of those really small, really important parts fly off the bench and on to the floor. I suspect many parts that are claimed to be "missing" by kit builders are simply hiding under the bench, in a corner, or in a crack somewhere.



Plastic containers from food products (after being thoroughly cleaned) can be very helpful to do the initial organization.

Empty the contents of the three bags into separate containers. Before we begin assembly, we must do an inventory of all the parts.



Smaller containers can be used when we start sorting out the parts and grouping them.

The smaller containers help you stay organized while still keeping all the parts easy to spot when you are looking for them.

The bright white containers also help parts "stand out" so you can see them easily.

Step 4

This is the rear of the enclosure. There are four holes that will accommodate a jack for the key (straight key, no paddles), RCA jack for the antenna, a hole above it for an optional BNC connector (which we will use), and a hole for the power jack.

The front of the radio has holes for an LED power-on indicator, a power switch, headphone jack, volume (AF) control, and a tuning (frequency) control.

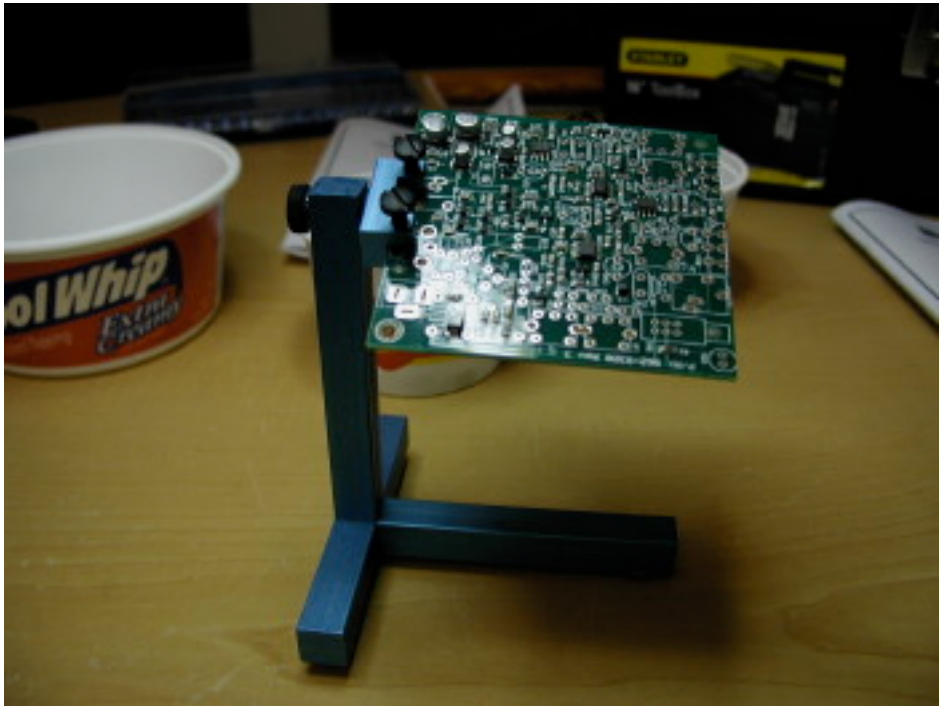
You can see two holes in the rear of the unit on the bottom. Those two holes will be used for stand-offs to hold up the circuit board in the rear of the unit. The potentiometers hold up the circuit board in the front.

The top slips over the bottom when construction is complete. Notice the hole in the middle of the lid. This allows easy access to the RF power gain potentiometer that is mounted on the board so you can adjust the power later without needing to disassemble the unit.

This is a pretty nice box!

Step 5

It is convenient to have a means of holding the circuit board to facilitate easy part insertion and soldering. This is a device that I picked up in Dayton at the Four Days in May conference in 2006.

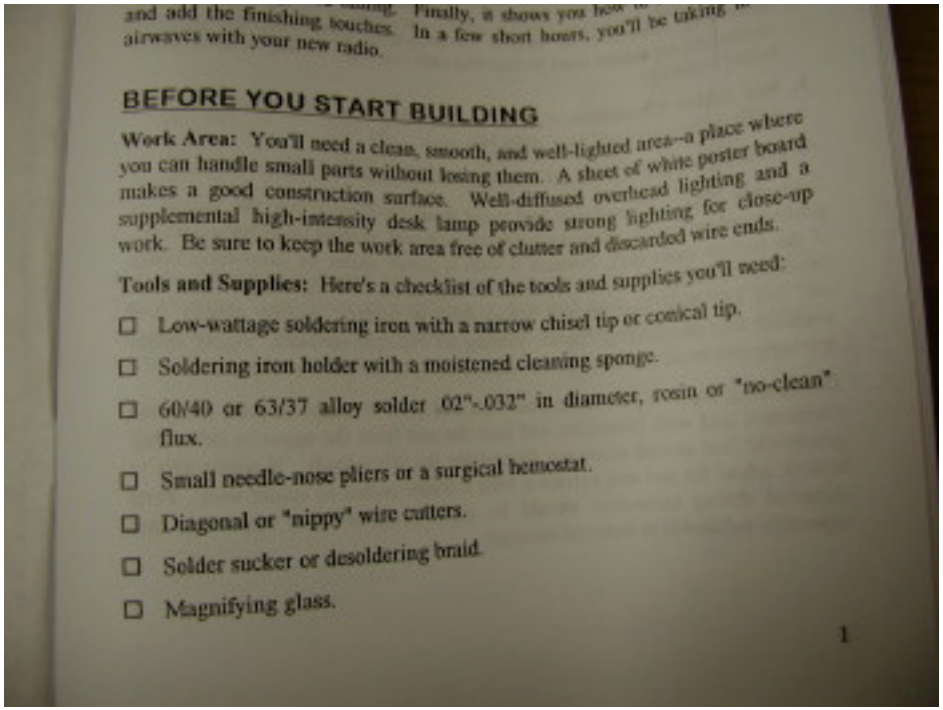


Here is another view of this holder. Recommended.

One of the most important tools to use when you assemble a kit is a pencil. Be methodical. Read each instructioncarefully. Understand it completely before you proceed. Do the step as it is described. Check off the step when you have completed it.

It doesn't need to have the name of a baseball team on it, but I find that many of my pencils do for some reason.

Read the instructions. Most problems with kits can be linked directly back to the kit builder not reading the instructions, being in a hurry, skipping steps, or not executing each step carefully. Take your time. Enjoy the experience! Relax. If you follow the instructions it will almost certainly work.



and add the finishing touches. Finally, it shows you how [illegible]
airwaves with your new radio. In a few short hours, you'll be taking [illegible]

BEFORE YOU START BUILDING

Work Area: You'll need a clean, smooth, and well-lighted area--a place where you can handle small parts without losing them. A sheet of white poster board makes a good construction surface. Well-diffused overhead lighting and a supplemental high-intensity desk lamp provide strong lighting for close-up work. Be sure to keep the work area free of clutter and discarded wire ends.

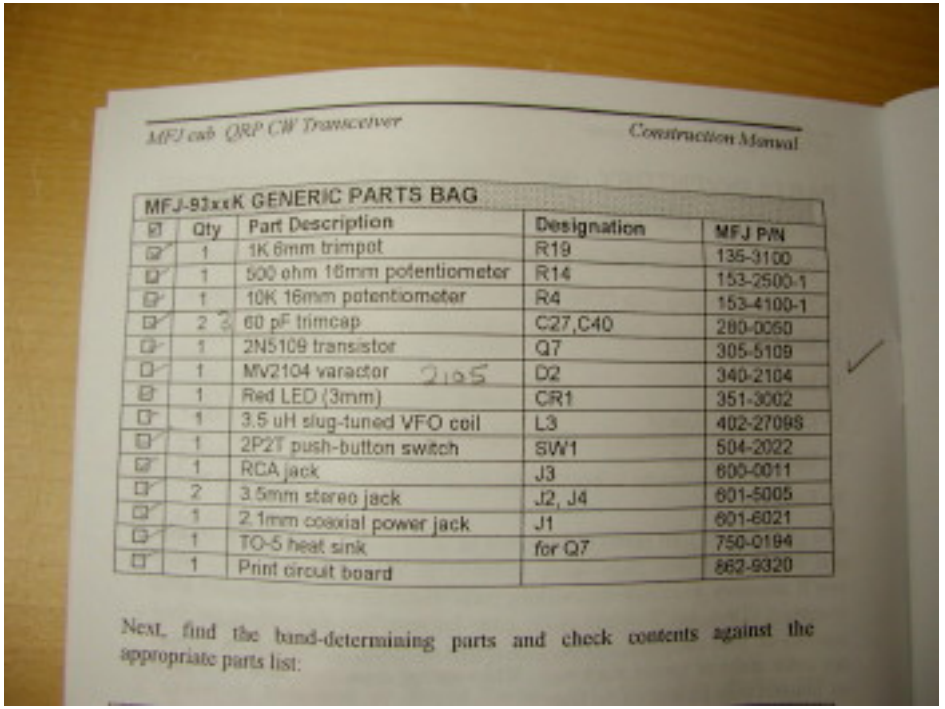
Tools and Supplies: Here's a checklist of the tools and supplies you'll need:

- ☐ Low-wattage soldering iron with a narrow chisel tip or conical tip.
- ☐ Soldering iron holder with a moistened cleaning sponge.
- ☐ 60/40 or 63/37 alloy solder .02"-.032" in diameter, rosin or "no-clean" flux.
- ☐ Small needle-nose pliers or a surgical hemostat.
- ☐ Diagonal or "nippy" wire cutters.
- ☐ Solder sucker or desoldering braid.
- ☐ Magnifying glass.

1

Step 6

There is a checklist for the parts common to all of these kits. Go through the parts from that bag and verify that each of these parts (in the quantities mentioned) are present. Note that the MV2104 varactor was actually a MV2105. That's OK. Also, for some reason, they gave me three of the 60 pF trimcaps. No problem. Extras are OK. Too few is the problem!



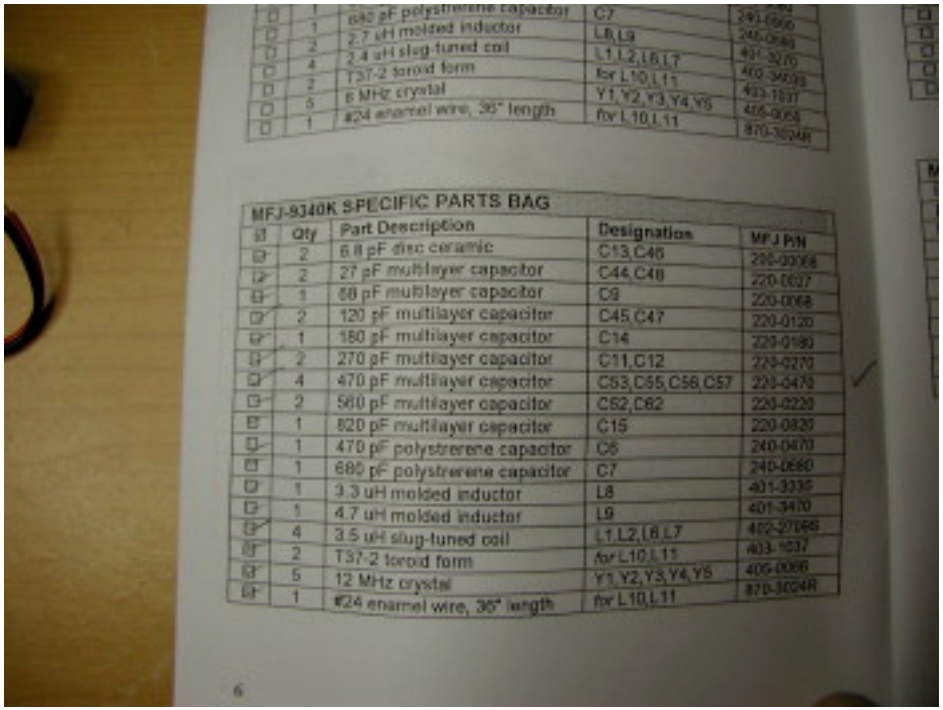
MFJ cub QRP CW Transceiver *Construction Manual*

MFJ-93xxK GENERIC PARTS BAG

☑	Qty	Part Description	Designation	MFJ P/N
☑	1	1K 6mm trimpot	R19	136-3100
☐	1	500 ohm 16mm potentiometer	R14	153-2500-1
☐	1	10K 16mm potentiometer	R4	153-4100-1
☐	2 3	60 pF trimcap	C27,C40	280-0060
☐	1	2N5109 transistor	Q7	305-5109
☐	1	MV2104 varactor 2105	D2	340-2104
☑	1	Red LED (3mm)	CR1	351-3002
☐	1	3.5 uH slug-tuned VFO coil	L3	402-2709S
☐	1	2P2T push-button switch	SW1	504-2022
☑	1	RCA jack	J3	600-0011
☐	2	3.5mm stereo jack	J2, J4	601-5005
☐	1	2.1mm coaxial power jack	J1	601-6021
☐	1	TO-5 heat sink	for Q7	750-0194
☐	1	Print circuit board		862-9320

NEXT, find the band-determining parts and check contents against the appropriate parts list:

Inventory the parts specific for this kit. Do not mix parts from different bags! Parts are segregated for a reason in most kits. If parts came separately, keep them separate.

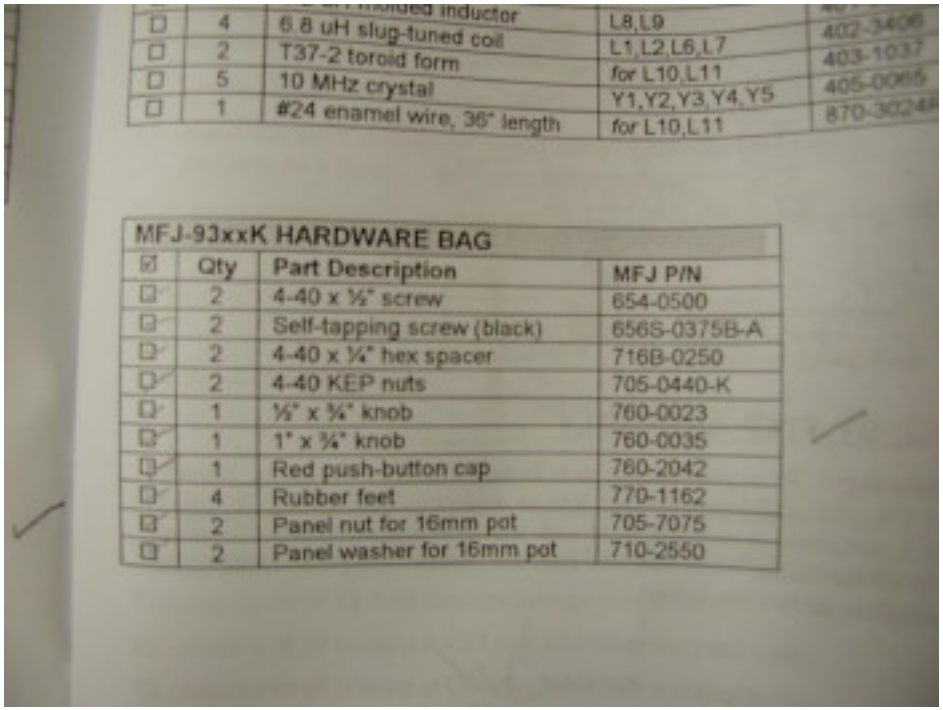


☐	1	680 pF polystyrene capacitor	C7	240-0680
☐	1	2.7 uH molded inductor	L8,L9	401-3270
☐	2	2.4 uH slug-tuned coil	L1,L2,L6,L7	402-2040
☐	4	T37-2 toroid form	for L10,L11	403-1037
☐	2	6 MHz crystal	Y1,Y2,Y3,Y4,Y5	406-0060
☐	5	#24 enamel wire, 36" length	for L10,L11	870-3024R
☐	1			

MFJ-9340K SPECIFIC PARTS BAG

☑	Qty	Part Description	Designation	MFJ P/N
☐	2	6.8 pF disc ceramic	C13,C46	220-0006
☐	2	27 pF multilayer capacitor	C44,C48	220-0027
☐	1	68 pF multilayer capacitor	C9	220-0068
☐	2	120 pF multilayer capacitor	C45,C47	220-0120
☐	1	180 pF multilayer capacitor	C14	220-0180
☐	2	270 pF multilayer capacitor	C11,C12	220-0270
☐	4	470 pF multilayer capacitor	C53,C55,C58,C57	220-0470
☐	2	560 pF multilayer capacitor	C52,C62	220-0220
☐	1	820 pF multilayer capacitor	C15	220-0820
☐	1	470 pF polystrerene capacitor	C6	240-0470
☐	1	680 pF polystrerene capacitor	C7	240-0680
☐	1	3.3 uH molded inductor	L8	401-3330
☐	1	4.7 uH molded inductor	L9	401-3470
☐	4	3.5 uH slug-tuned coil	L1,L2,L6,L7	402-2040
☐	2	T37-2 toroid form	for L10,L11	403-1037
☐	5	12 MHz crystal	Y1,Y2,Y3,Y4,Y5	406-0060
☐	1	#24 enamel wire, 36" length	for L10,L11	870-3024R

Finally, inventory all the hardware parts. If you have everything, you can begin assembly.



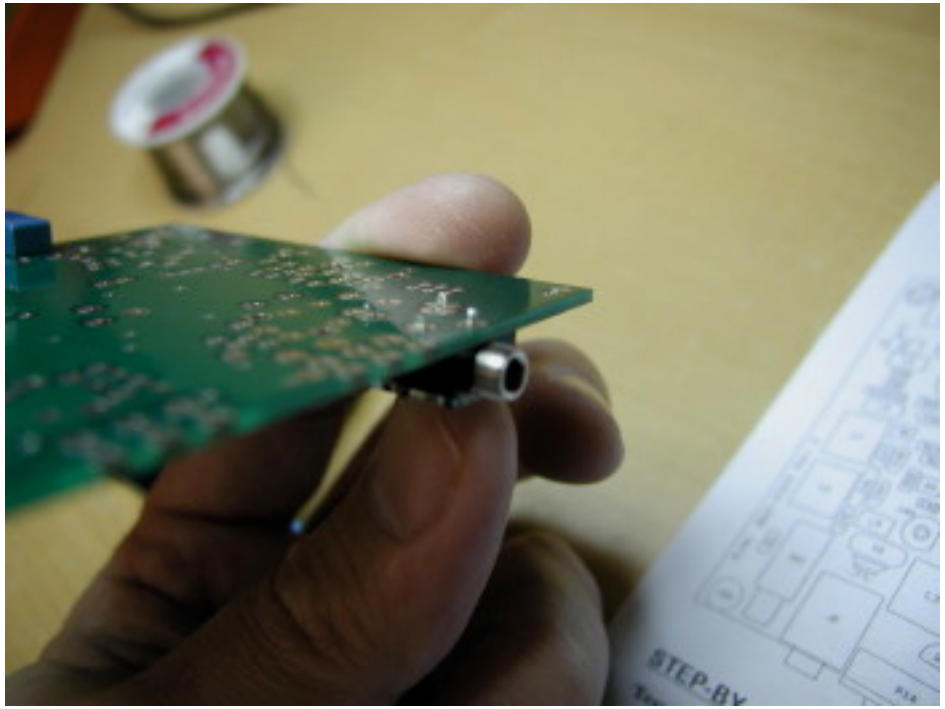
☐	4	6.8 uH slug-tuned coil	L8,L9	402-3406
☐	2	T37-2 toroid form	L1,L2,L6,L7	403-1037
☐	5	10 MHz crystal	for L10,L11	405-0065
☐	1	#24 enamel wire, 36" length	Y1,Y2,Y3,Y4,Y5	870-3024

MFJ-93xxK HARDWARE BAG

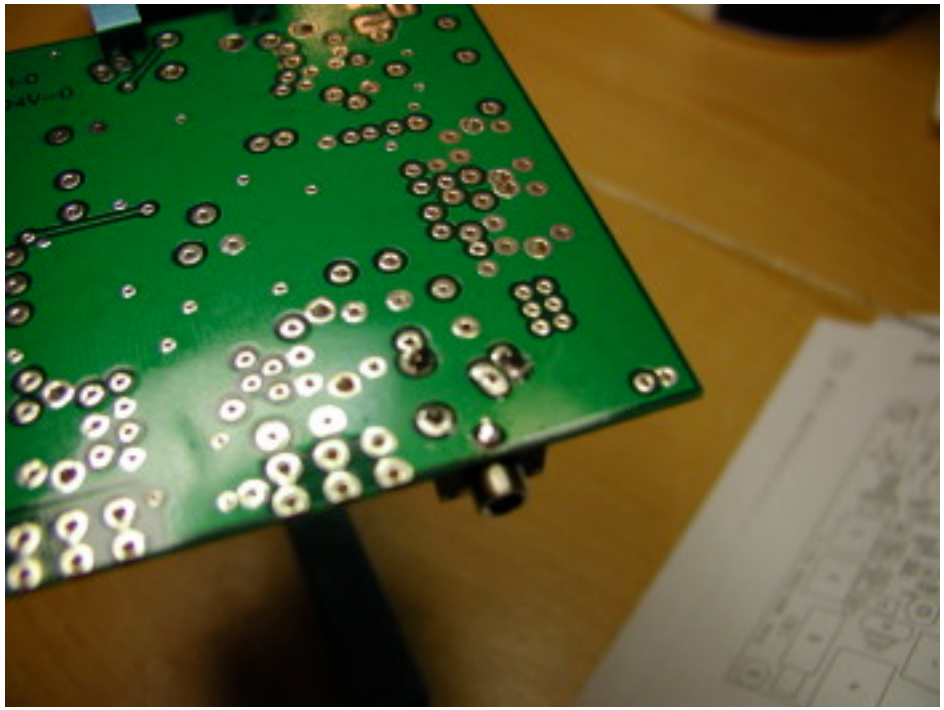
☑	Qty	Part Description	MFJ P/N
☐	2	4-40 x ⅛" screw	654-0500
☐	2	Self-tapping screw (black)	656S-0375B-A
☐	2	4-40 x ¼" hex spacer	716B-0250
☐	2	4-40 KEP nuts	705-0440-K
☐	1	½" x ¾" knob	760-0023
☐	1	1" x ¾" knob	760-0035
☐	1	Red push-button cap	760-2042
☐	4	Rubber feet	770-1162
☐	2	Panel nut for 16mm pot	705-7075
☐	2	Panel washer for 16mm pot	710-2550

Step 7

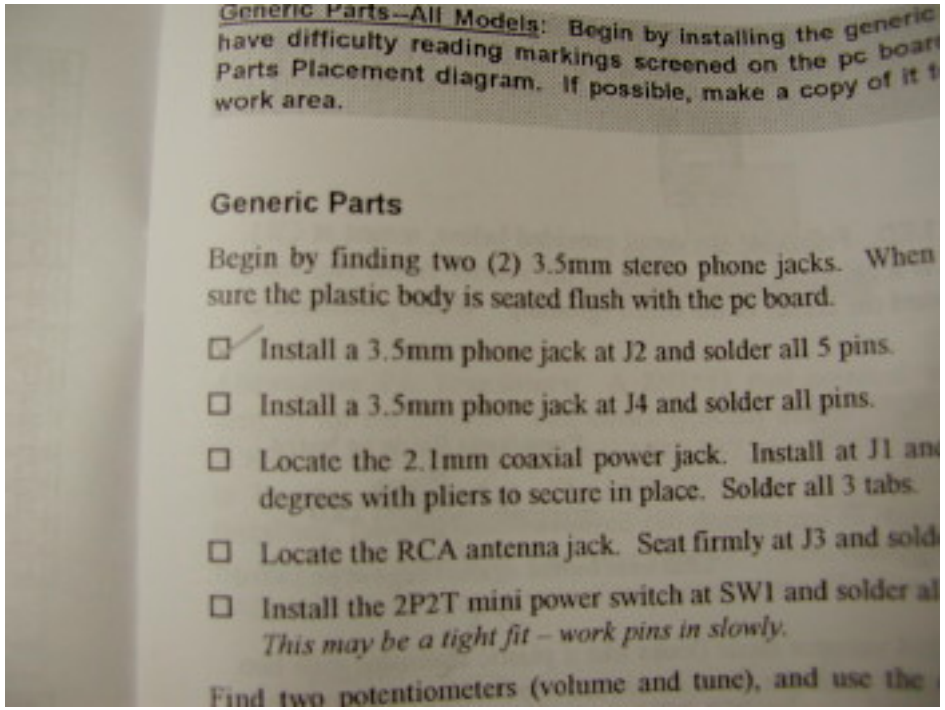
We start at the beginning. The first part to be placed on the board is a phone jack.



Solder it on. Make your joints nice and shiny.



Check off your step when you are done.



Generic Parts–All Models: Begin by installing the generic
have difficulty reading markings screened on the pc boar
Parts Placement diagram. If possible, make a copy of it t
work area.

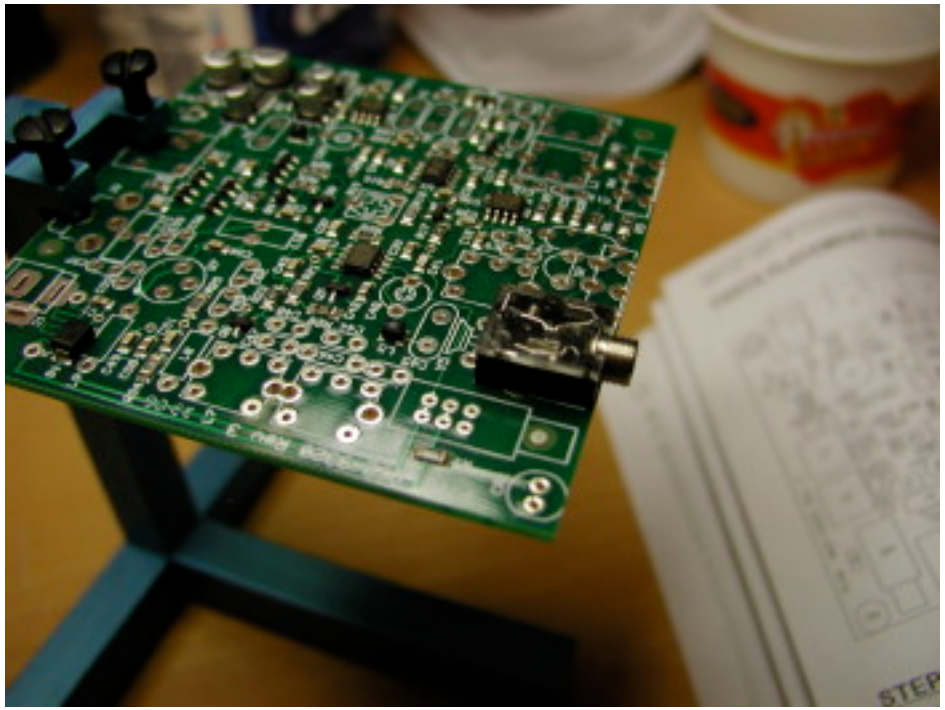
Generic Parts

Begin by finding two (2) 3.5mm stereo phone jacks. When
sure the plastic body is seated flush with the pc board.

- ☑ Install a 3.5mm phone jack at J2 and solder all 5 pins.
- ☐ Install a 3.5mm phone jack at J4 and solder all pins.
- ☐ Locate the 2.1mm coaxial power jack. Install at J1 an
  degrees with pliers to secure in place. Solder all 3 tabs.
- ☐ Locate the RCA antenna jack. Seat firmly at J3 and sold
- ☐ Install the 2P2T mini power switch at SW1 and solder al
  This may be a tight fit – work pins in slowly.

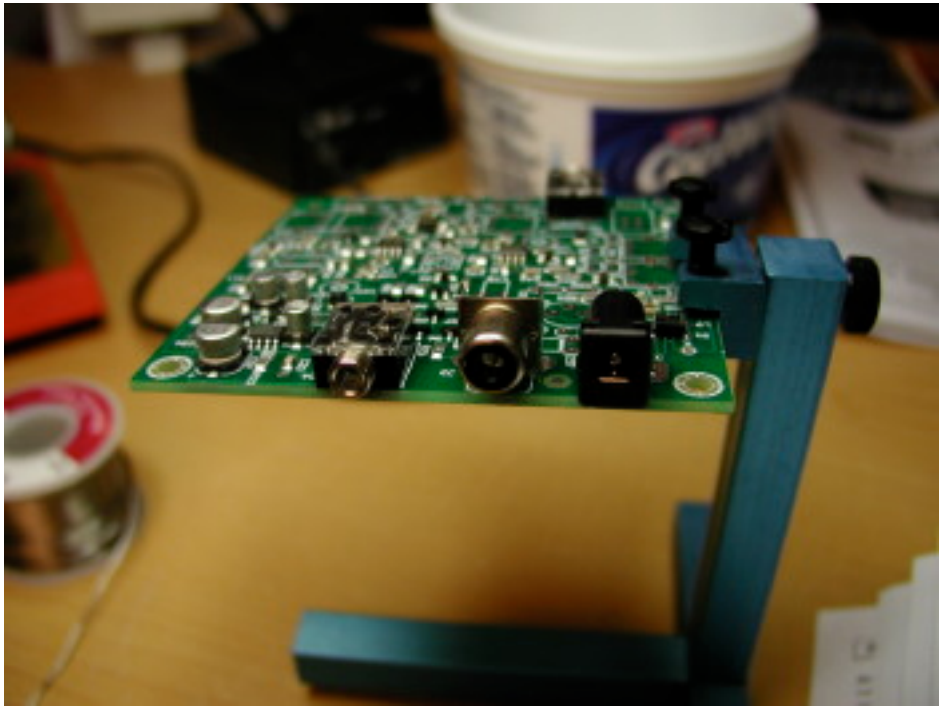
Find two potentiometers (volume and tune), and use the

Stop periodically and admire your work!

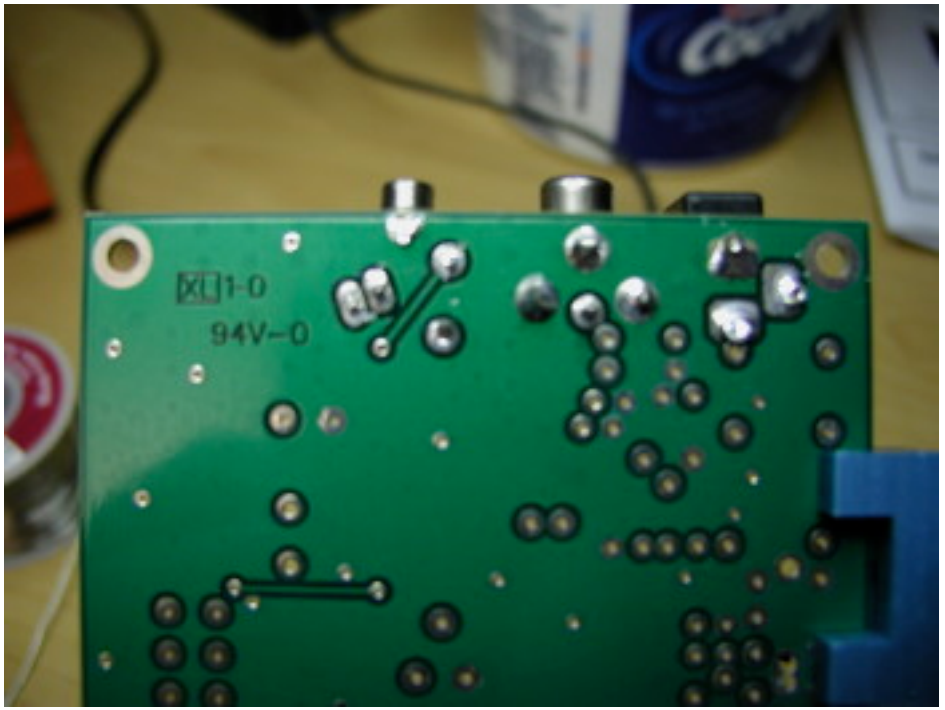


Step 8

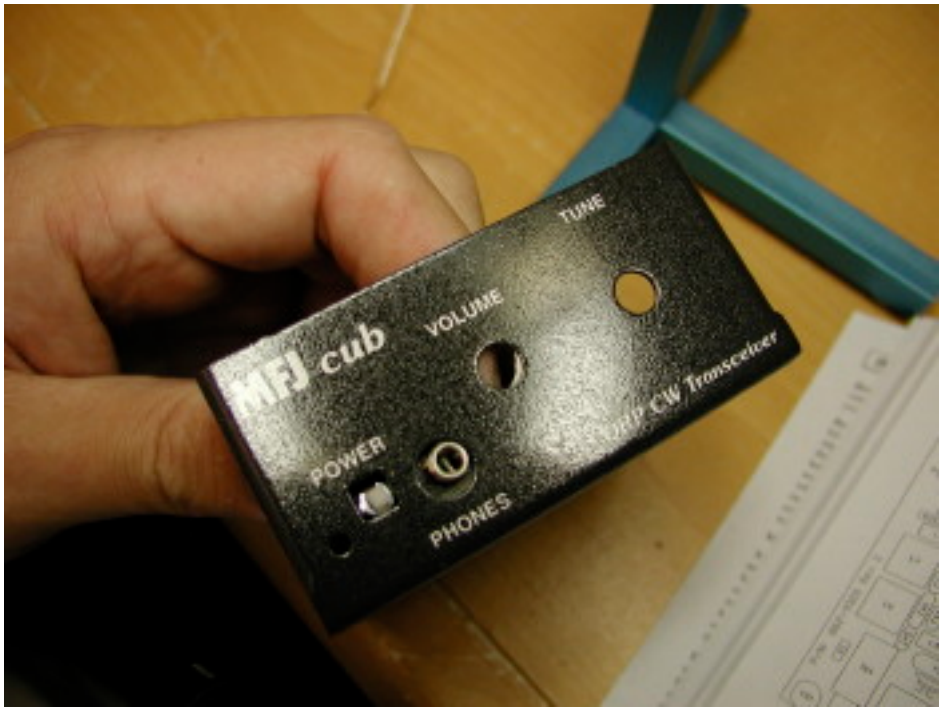
Follow the next steps and continue to add parts.



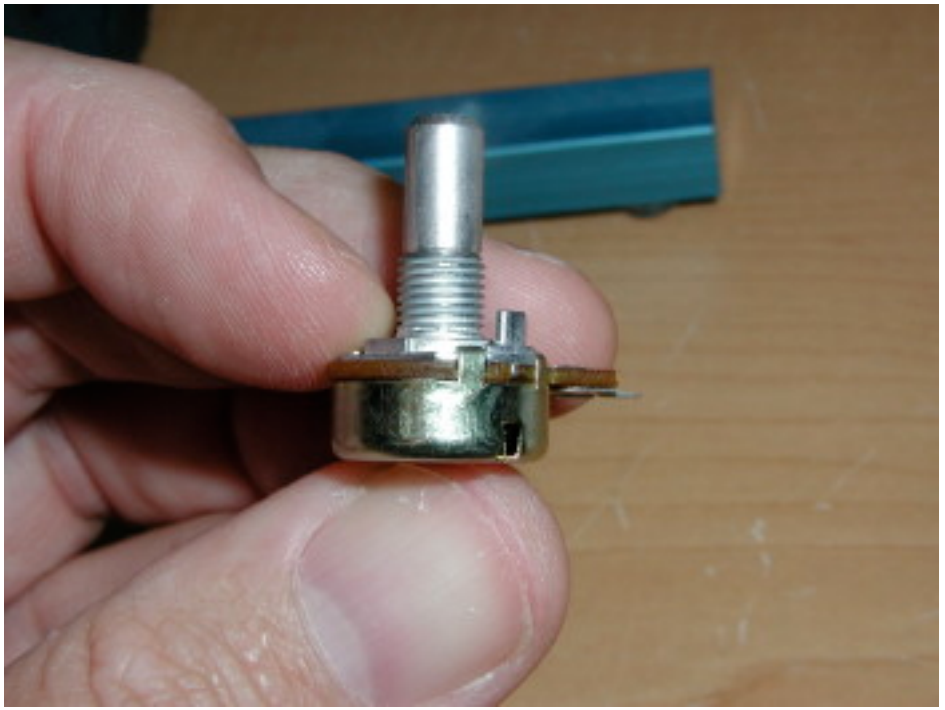
Be sure each connection is clean and there are no solder bridges.



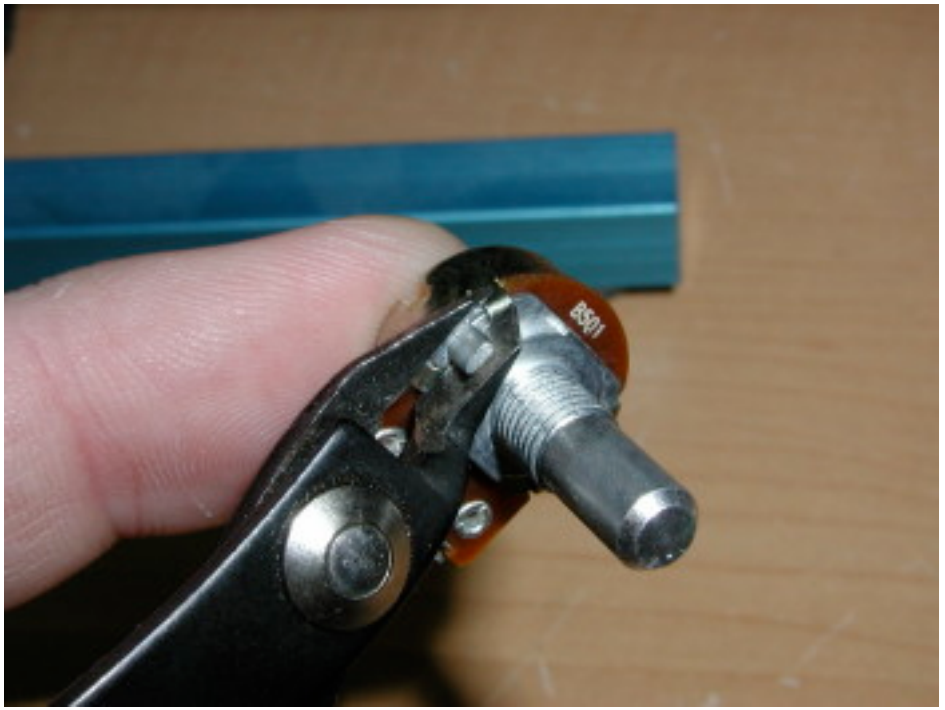
It is a very good idea to ensure that the parts also fit mechanically. Take the circuit board and insert it into the enclosure to make sure that these jacks and switches line up with the holes in the box. If they do not, you've got a problem. Stop. Determine what went wrong. Fix those problems before proceeding.



Sometimes instructions will have you make a change to a part before adding it to the assembly. In this case, the instructions request that the small tab (shown to the right of the shaft) be cut off.

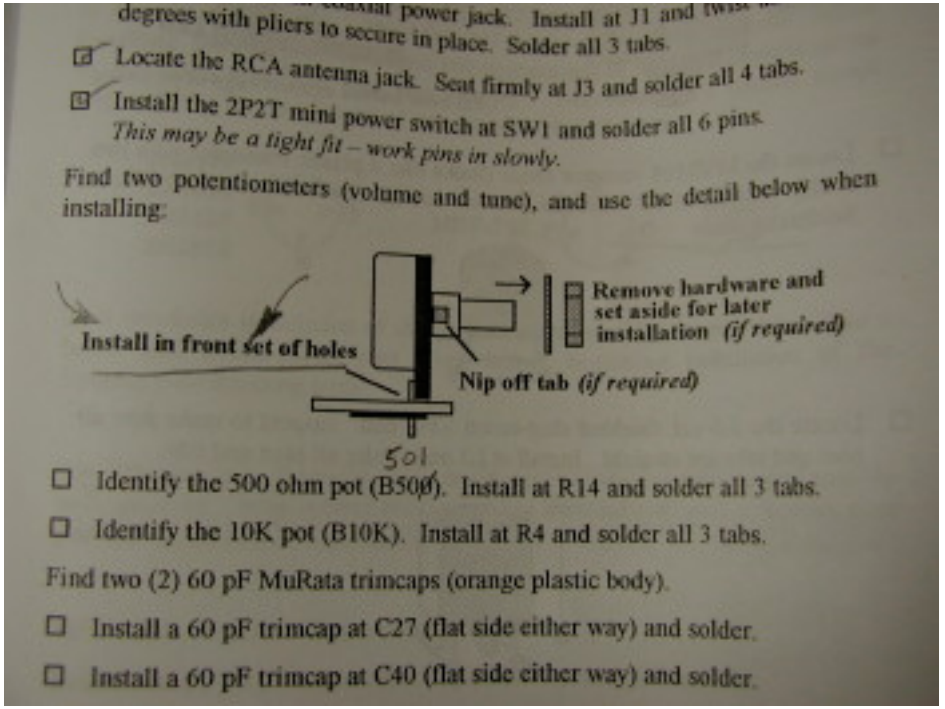


Carefully use diagonal cutters to snip off this tab.

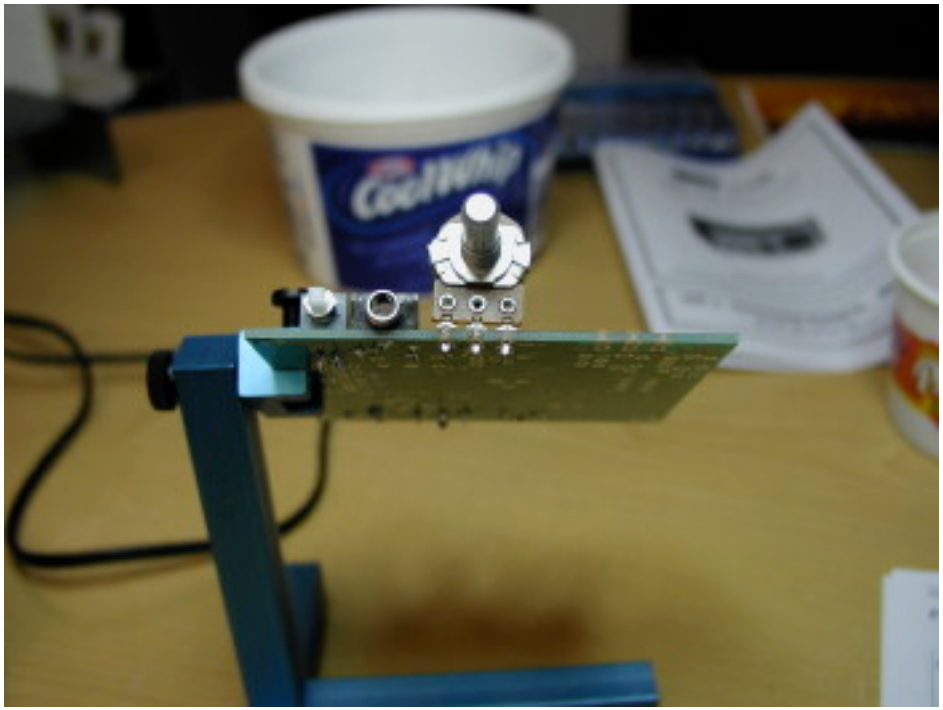


Step 9

Some parts will have more explicit instructions than others. In this case, these instructions have details for which PC board holes should be used to mount the potentiometer, removal of hardware, and so on. Read all instructions before performing a step.

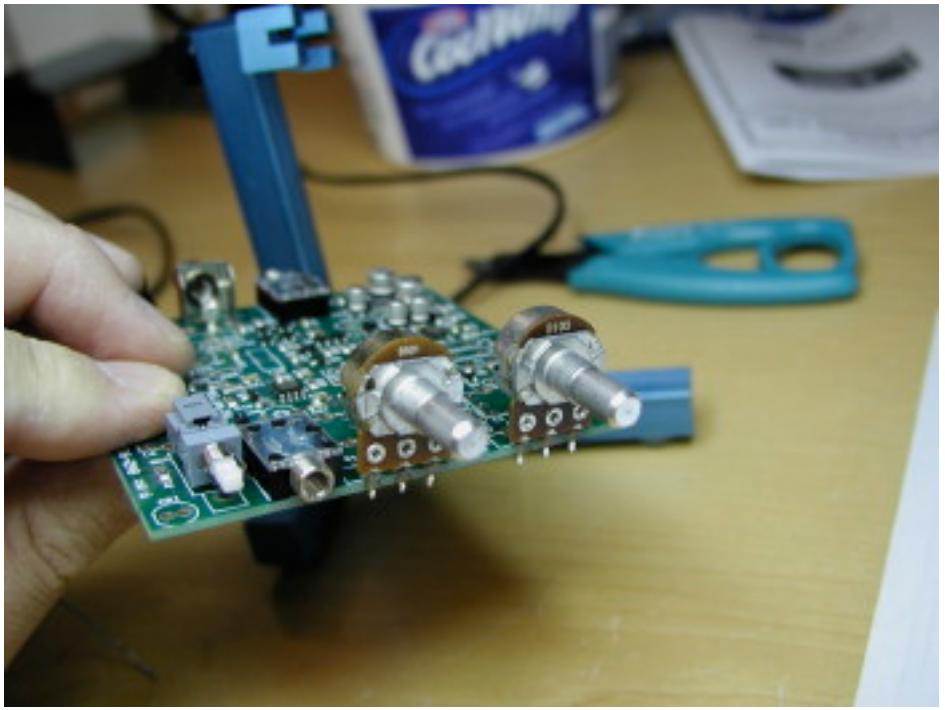


The volume (AF) control is now mounted.



Verify that the shaft will go through the hole in the enclosure before proceeding. In this case, it was an easy fit.

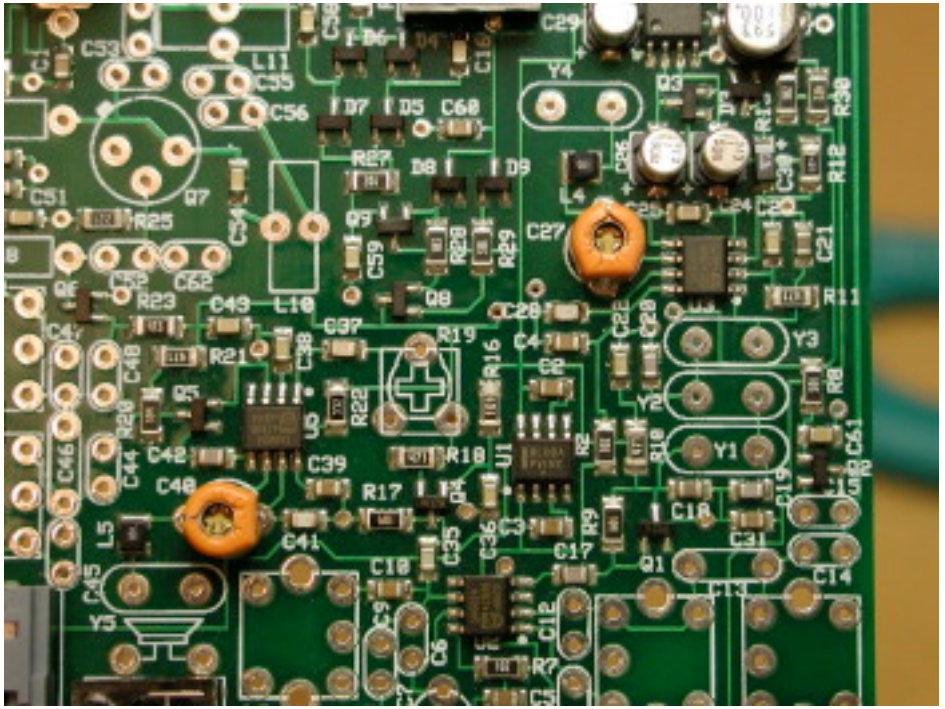
Add the tuning (frequency adjustment) potentiometer.



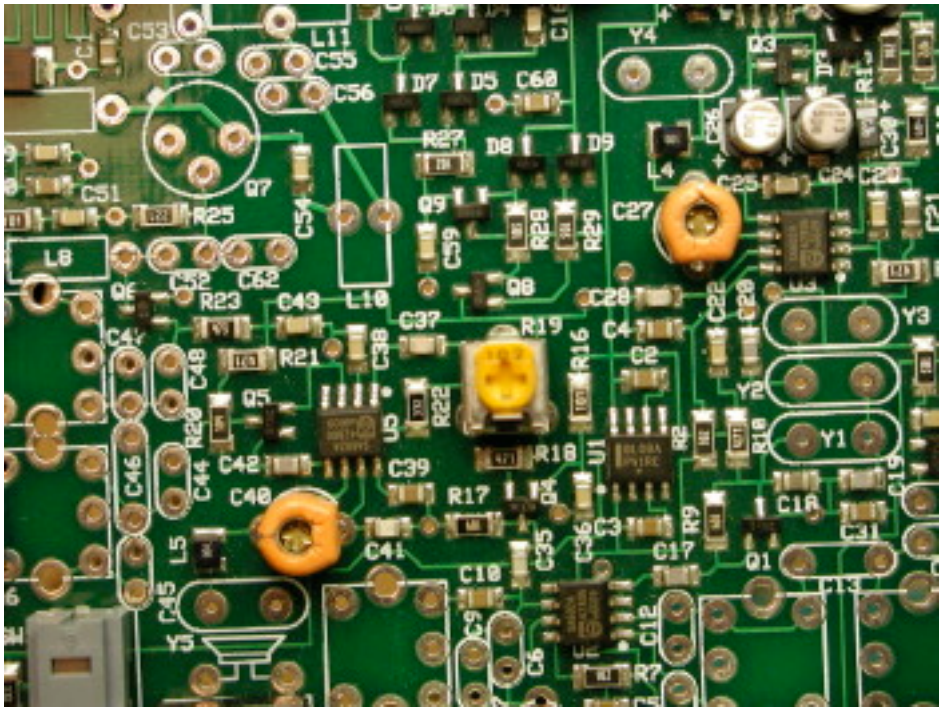
Again, verify everything fits mechanically before proceeding.

Step 10

Now we start adding small parts to the board. The two trimmer caps are first.

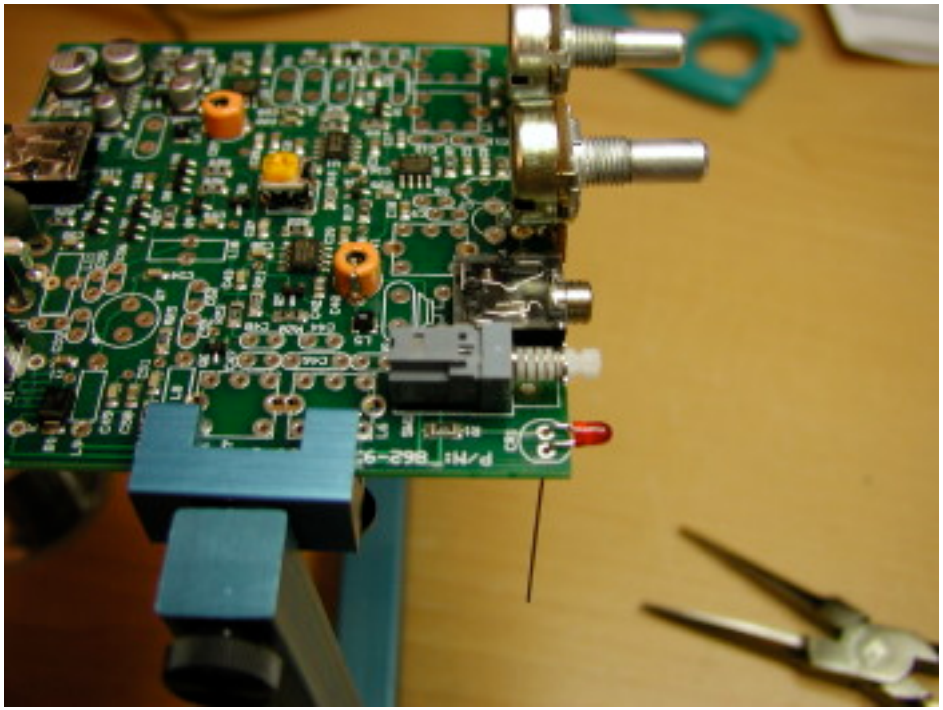


The small potentiometer for RF power adjustment is mounted next.



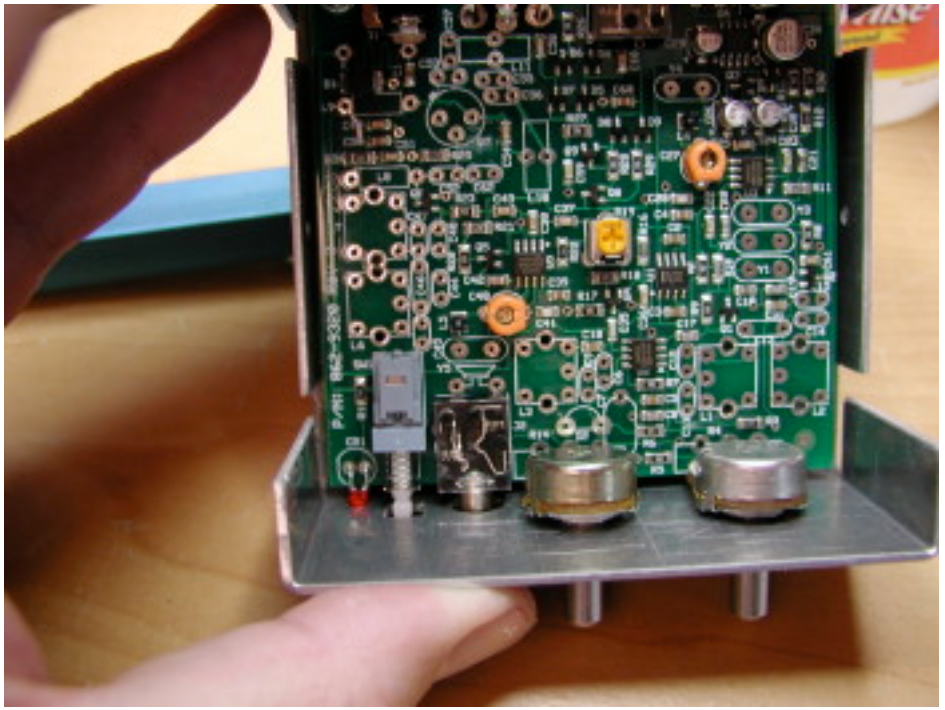
The rig also has a red LED to show when it is powered on. The instructions require that the leads of the LED be bent so it will "hang off the end" of the circuit board. Bending leads in a clean 90 degree angle can be done by grasping the leads with a pair of needle nose plyers and using your finger to bend the exposed leads. Take care to note the short lead of the LED which must be inserted into the correct hole on the board. Read the directions carefully before you make the bend.

Be sure that the LED can fit through the hole in the frontof the unit before proceeding.



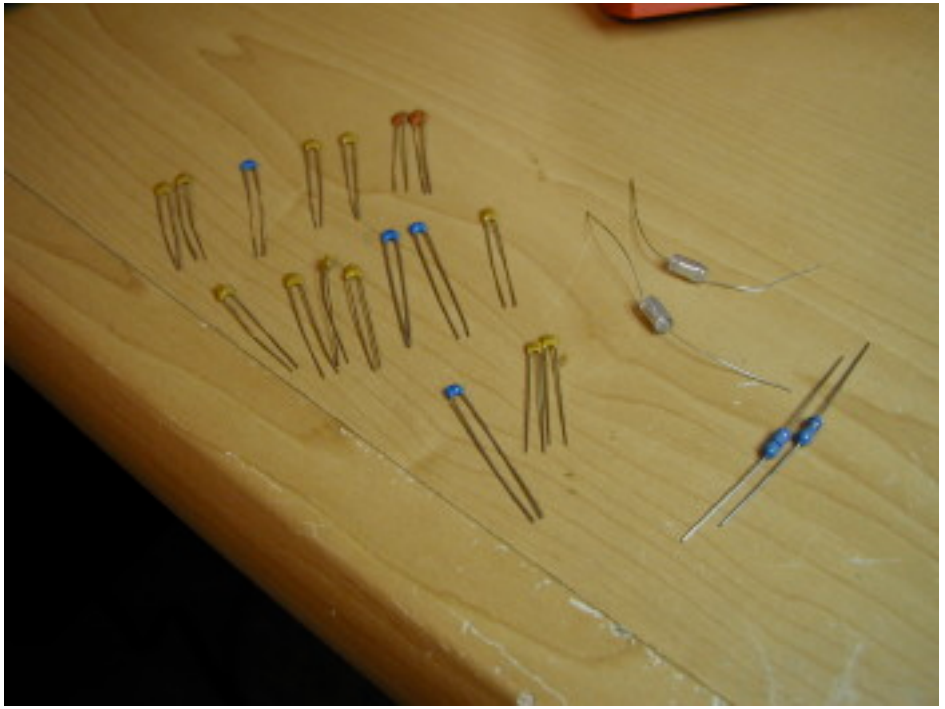
Again, verify everything fits mechanically before proceeding.

This completes the installation of all the parts which feed through the front of the radio.

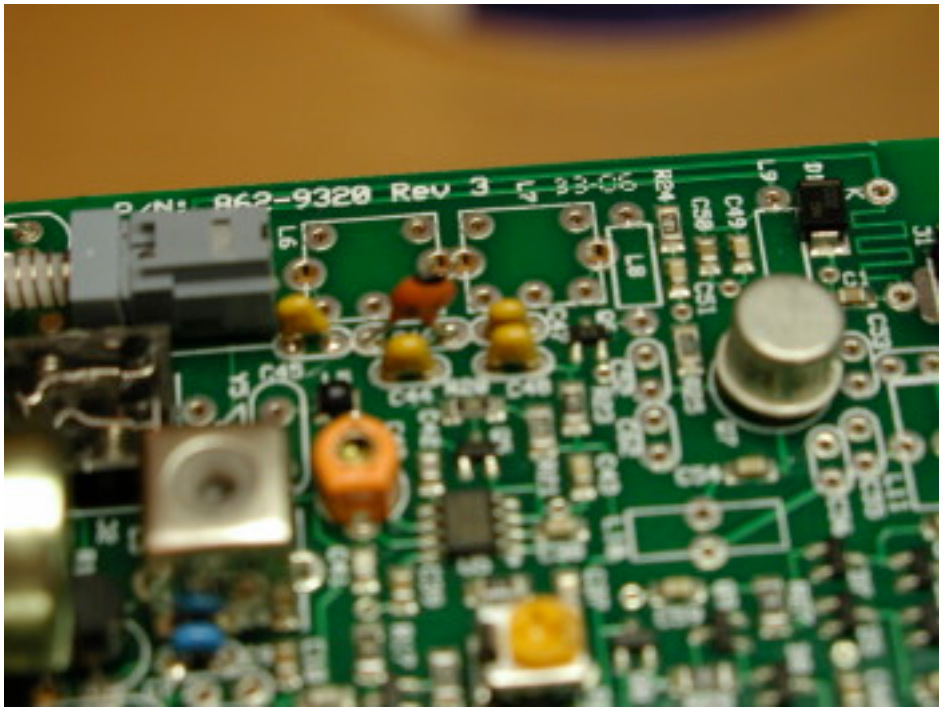


Step 11

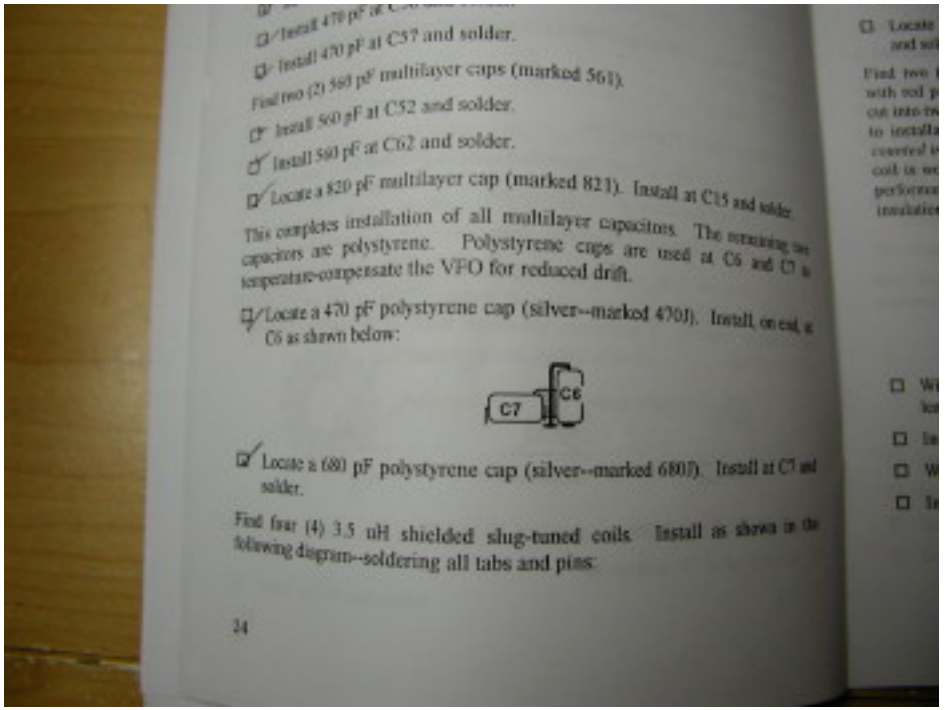
The next step is to install the capacitors. Organize the capacitors into an easy to see and grab arrangement. For this kit I was able to just lay them out in a small area on the bench. For larger kits I have used muffin tins to keep parts organized.



Mount the parts on the board. Try to keep leads short. Also, try to orient the part so that the value printed on the side can be read after installation. If you do need to double-check your work, it will be much easier to do if you can read the values!



Some parts have specific orientation or placement. Again, read the manual carefully and understand each step thoroughly before you proceed.



☑ Install 470 pF at C57 and solder.

☑ Install 470 pF multilayer caps (marked 561).

Find two (2) 560 pF at C52 and solder.

☑ Install 560 pF at C62 and solder.

☑ Locate a 820 pF multilayer cap (marked 821). Install at C15 and solder.

This completes installation of all multilayer capacitors. The remaining two capacitors are polystyrene. Polystyrene caps are used at C6 and C7 to temperature-compensate the VFO for reduced drift.

☑ Locate a 470 pF polystyrene cap (silver--marked 470J). Install on end at C6 as shown below:

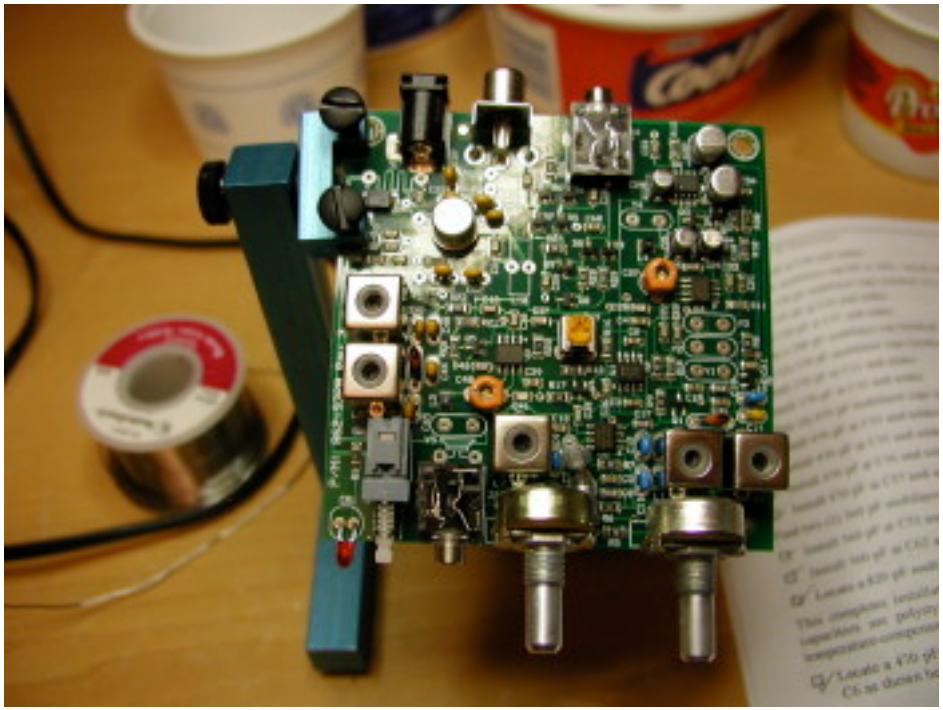
C7 C6

☑ Locate a 680 pF polystyrene cap (silver--marked 680J). Install at C7 and solder.

Find four (4) 3.5 uH shielded slug-tuned coils. Install as shown in the following diagram--soldering all tabs and pins:

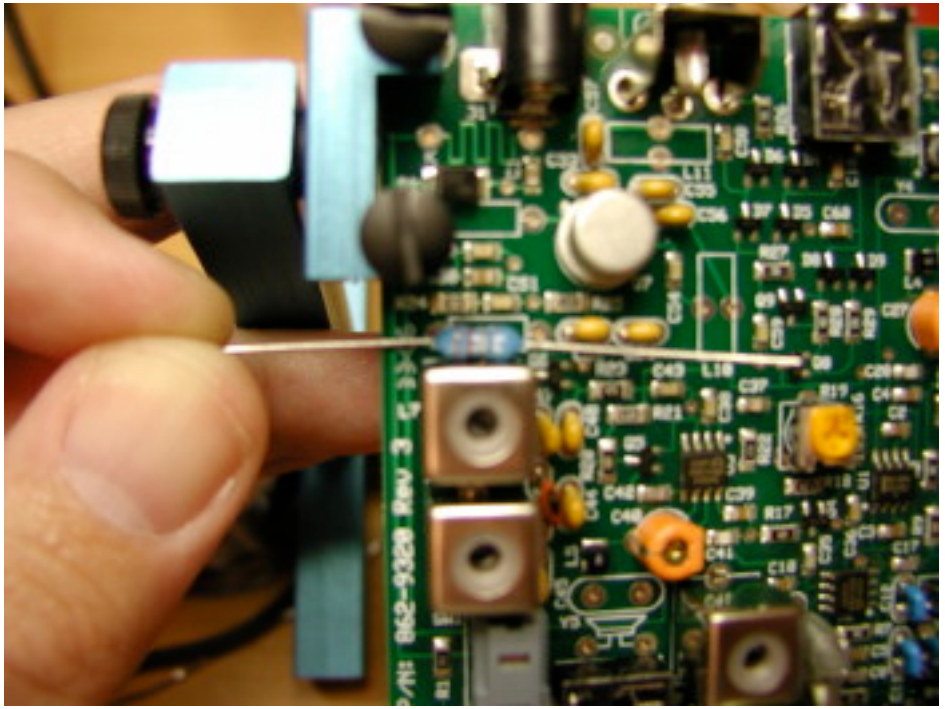
24

Things are shaping up nicely.

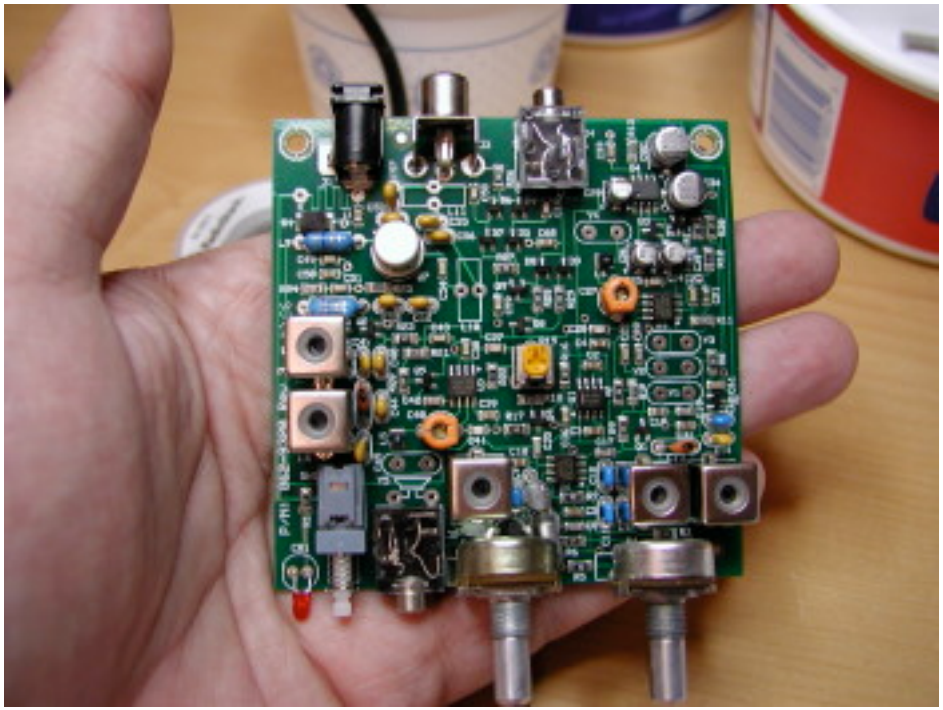


Step 12

The inductors are next. Two of the inductors look like big resistors. These are placed on the board in the upper left quadrant. Lay the part on the board to see how the leads must be bent to feed through the holes. Pre-bend the leads before you insert the parts.

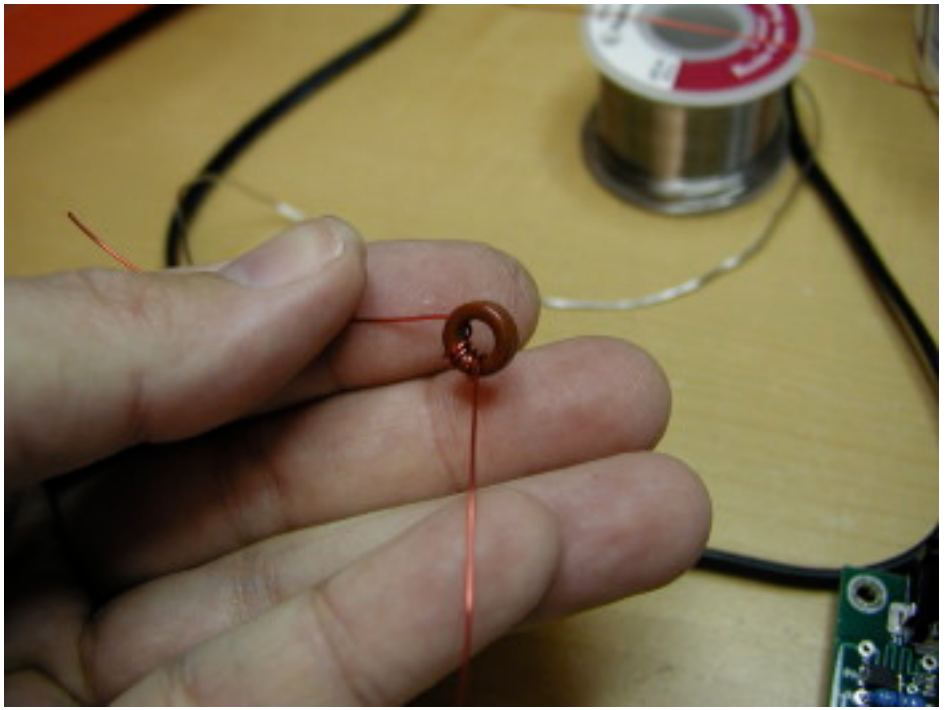


Both inductors should lay on the board flat as shown.

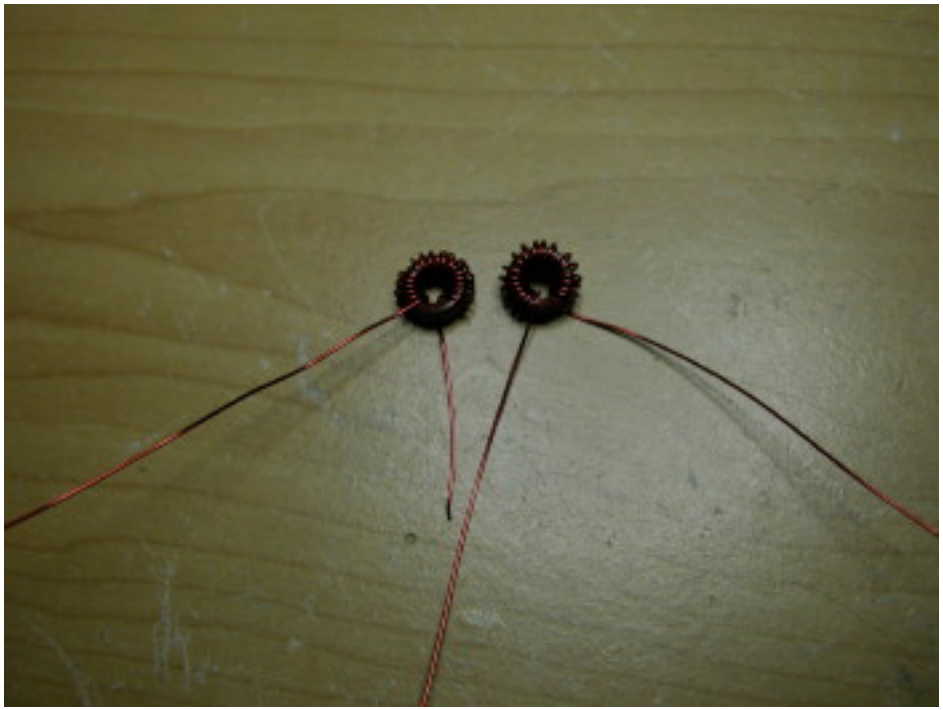


The other two inductors are made by you. Two toroids (metal donuts) will be wound with wire and inserted on the board. Lots of people panic at the thought of "winding toroids". It is no big deal. Really. If you can count and you can stick a wire through a hole in the middle of a metal donut, you can wind toroids!

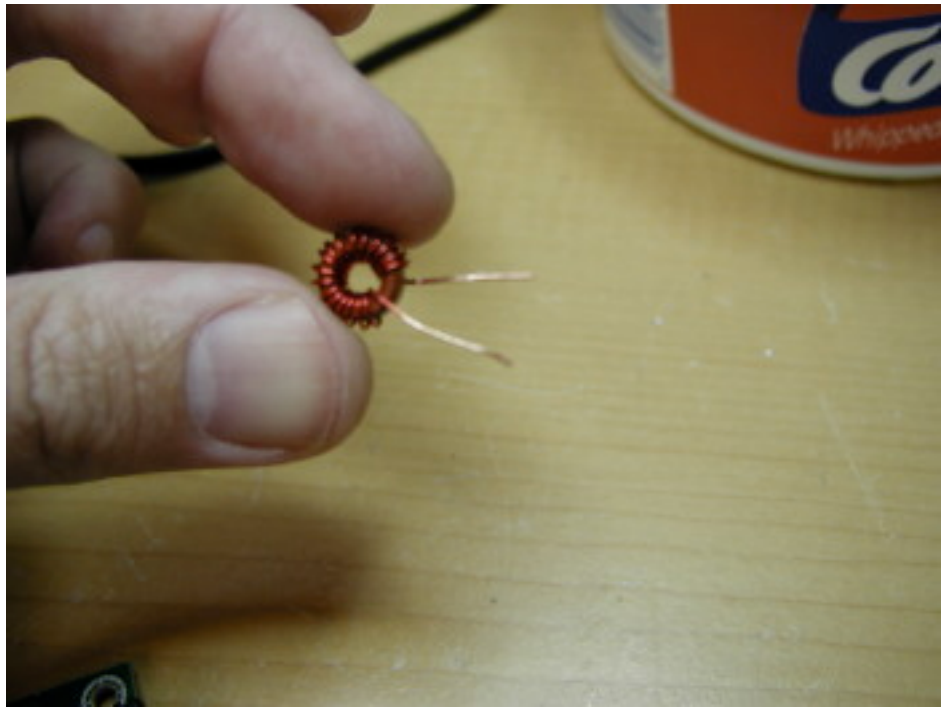
Each time the wire passes through the middle of the donut we count one turn. Here is a toroid with four turns.



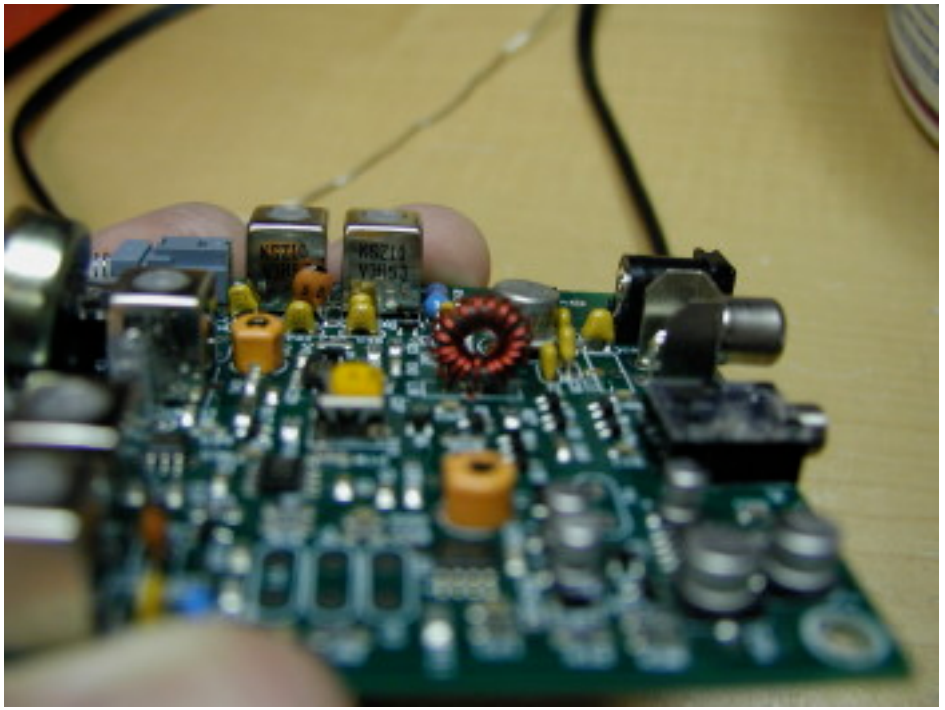
The assembly instructions requested that both toroids have18 turns. Here they are. Easy!



Make the turns evenly spaced around the perimeter of the toroid as described in the assembly instructions. Trim the leads to about an inch and carefully scrape away the red coating.

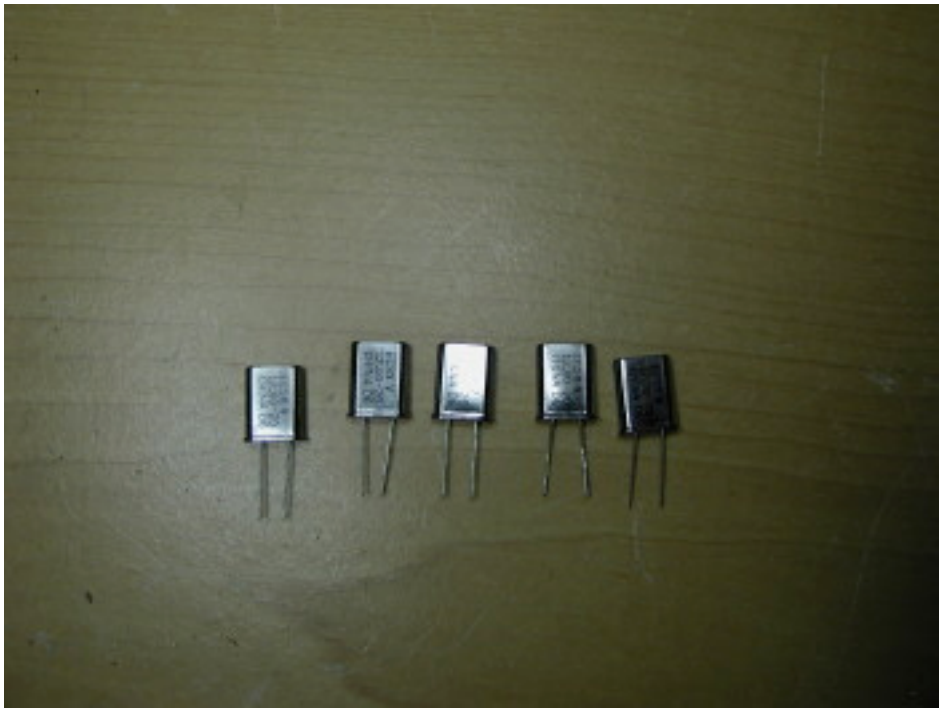


These mount on the board just like any other part. Pull the wires through the board and solder them. The wire will hold the toroid in place if you have pulled it slighly snug.

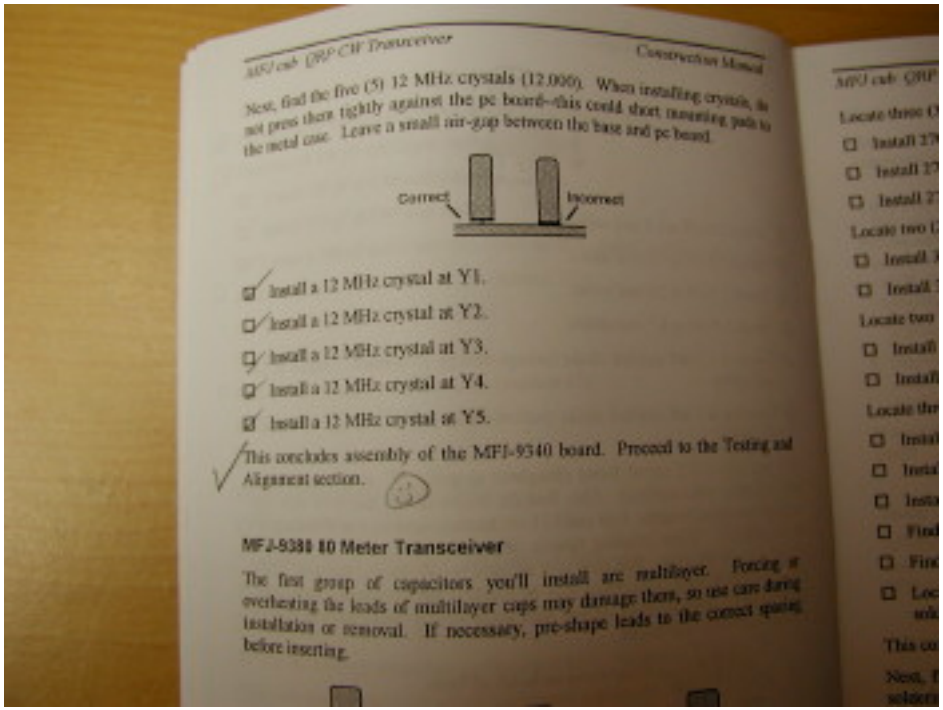


Step 13

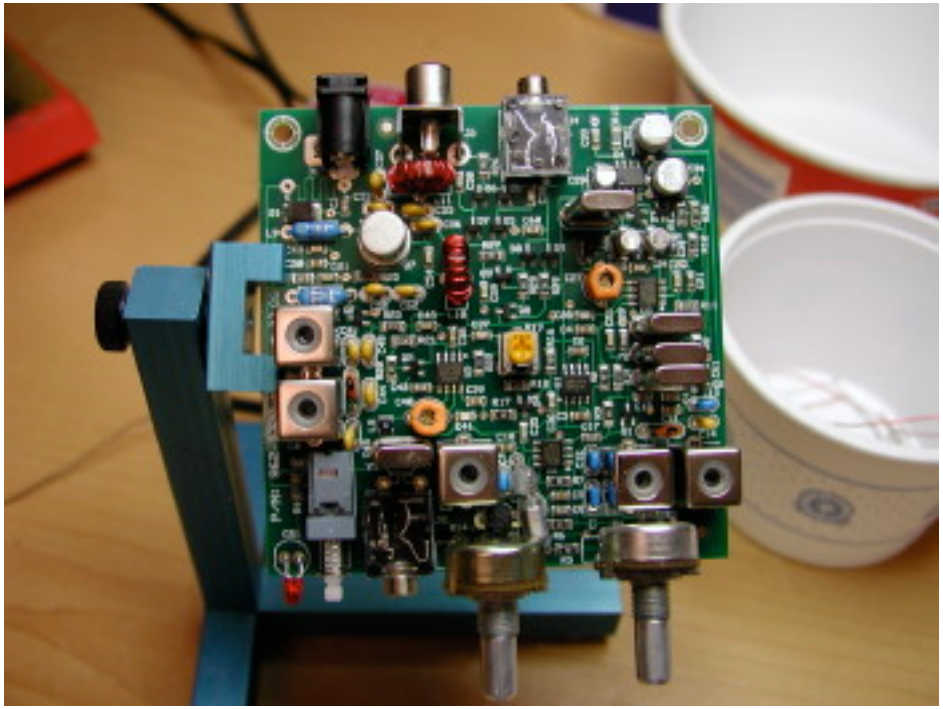
The next step is to install the crystals.



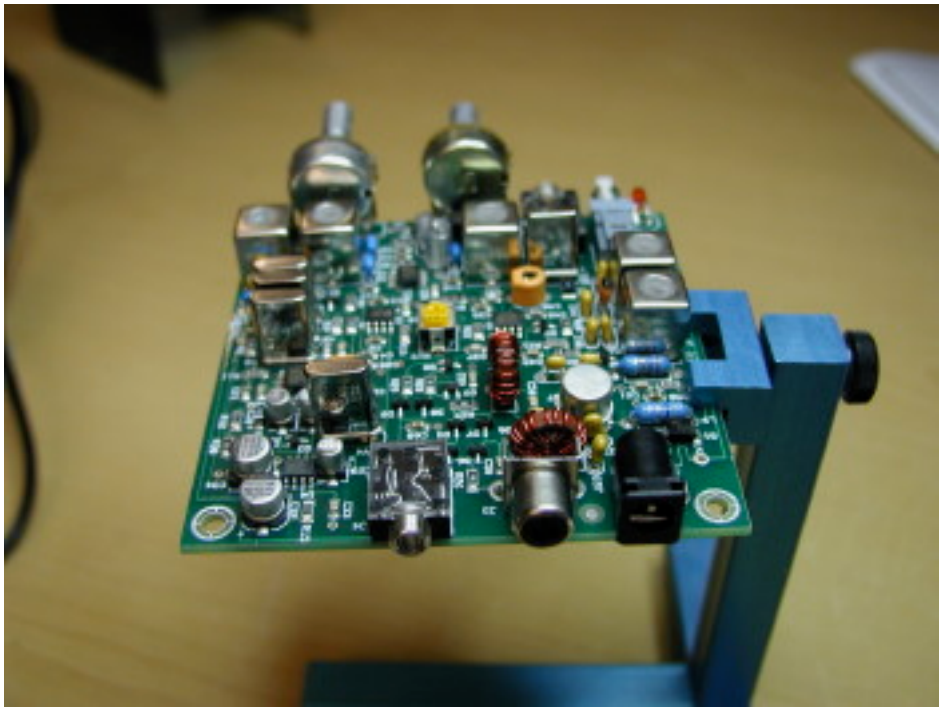
The crystals should have a little space beneath them. Read the instructions carefully about installation of the crystals. Note in the instructions that "This concludes the assembly of the MFJ-3940 board. Proceed to the Testing and Alighment section." Hooray!



Here they are on the board.

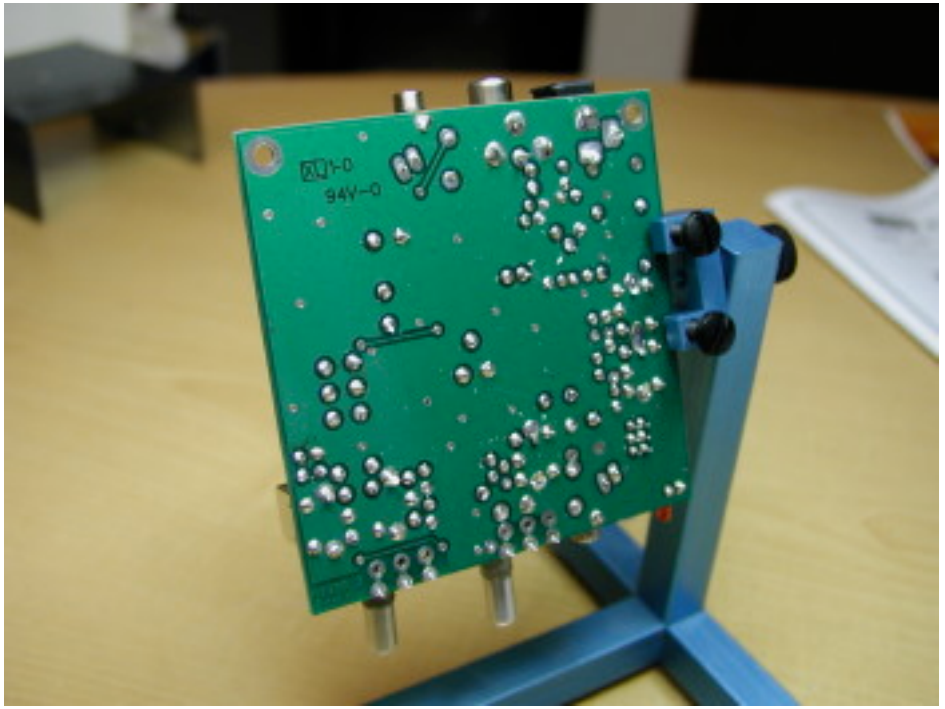


Here is another view of the board with the crystals installed.



Step 14

The instructions now ask that you review your work, check all the solder connection, and verify that work to this point has been done correctly. This is an important step! Take your time. Check yourwork.



I assembled the unit after the careful checking described above was done. Leave the cover off until you have completed all of the alignment. This step, aligning the radio's receiver, BFO, band pass, and so on, is a very important step. It can make the difference between a poorly performing radio and a kit that performs well. Do not put the cover on the radio until you believe you cannot get any more performance from continued adjustment.

This is a great looking radio and it performs well. See that BNC connector? Hook an antenna up and try it!

That's it. I did not capture every step, but most are represented here. The radio was completed easily within a single Saturday morning and afternoon. I spent considerable time making the adjustments to 'peak" the radio to ensure its performance will not disappoint.
This was a very fun kit to assemble and it should be even more fun to put on the air. I hope you will give kit building and QRP a try!