SUPER Tuna Builder's Guide – Ver.4

Corrections & revisions from Manual Ver. 3

1.) Table of capacitor values for the band modules had the values for capacitors C17 and C18 transposed.

2.) L1 toroid core for 20m band corrected to -2 (NOT -6)

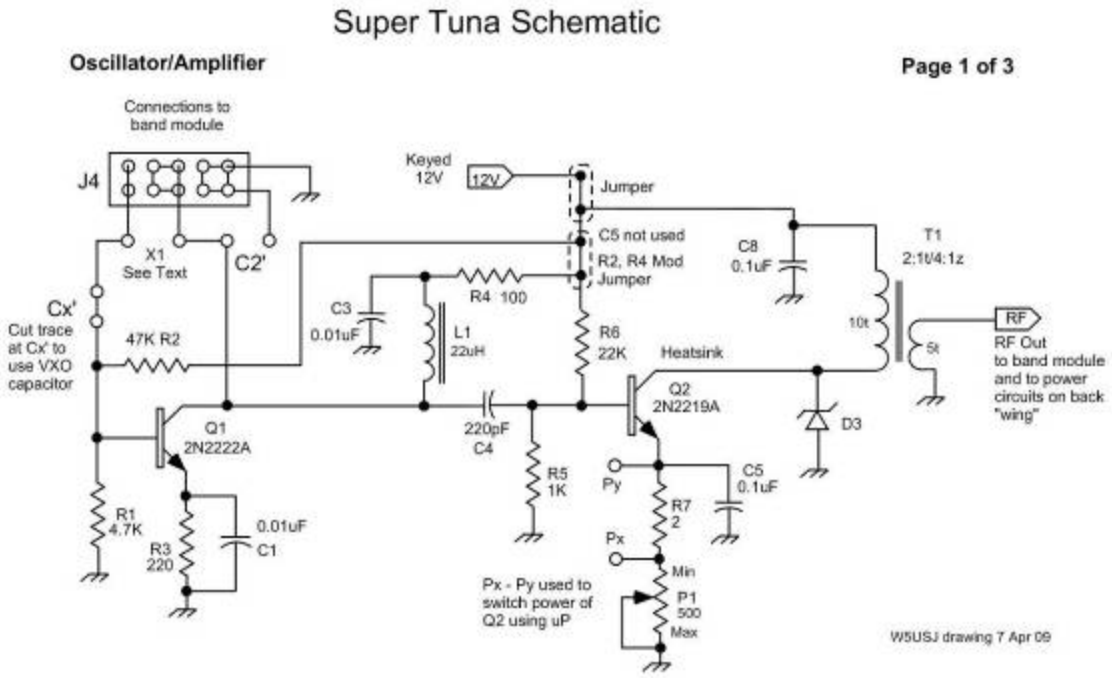
It is a good idea, before you start building any kit, to read through the entire set of instructions in order to get a good feel for the overall construction process. You should also sort through all the parts and compare them to the list of materials in case there is a inventory problem. The sooner you find out you have a missing or problem part, the sooner you can alert the 'crack' (or should I say 'cracked') kitting staff at QRPme and resolve the problem…and the sooner you can get your SUPER Tuna on the air!

On that note, here is a list of materials for the SUPER Tuna:

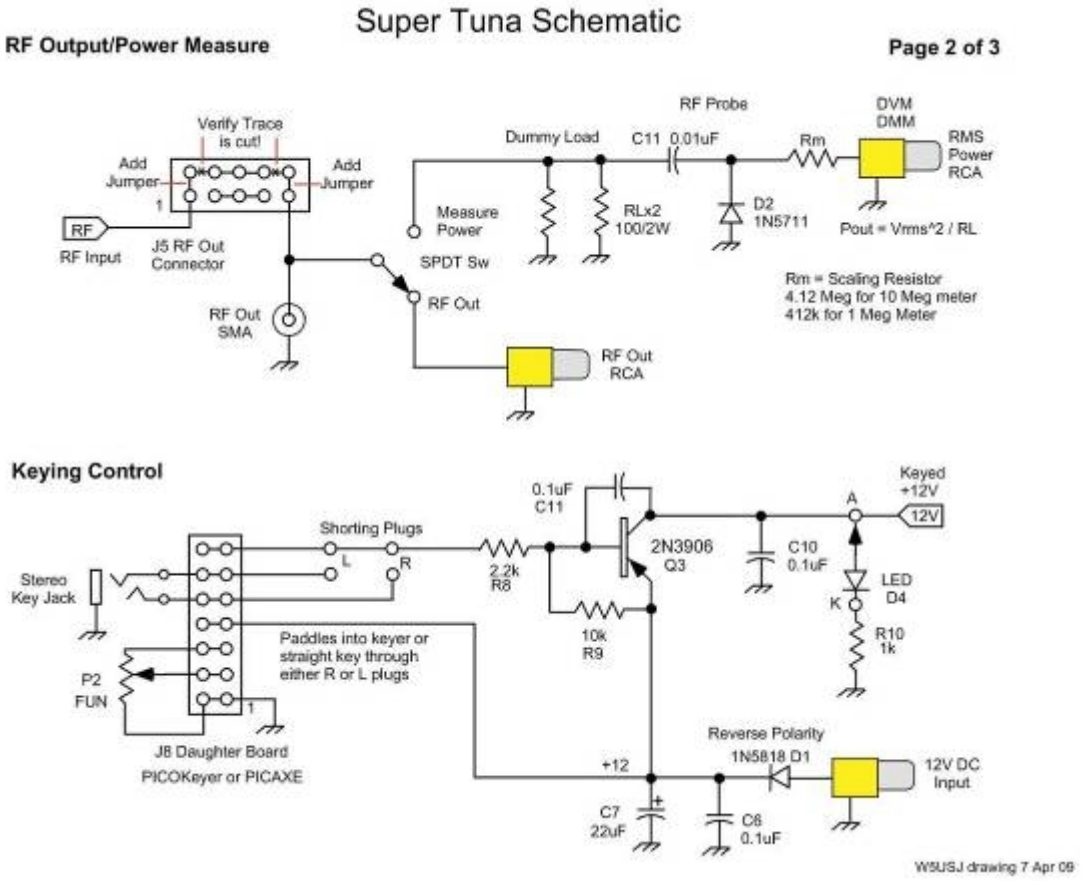
SUPER Tuna List of Materials

R1 = 4.7K	(YEL-VIO-RED)	C1 = .01uF (103)	J1 = RCA jack
R2 = 47K	(YEL-VIO-ORG)	C2 = optional	J2 = RCA jack
R3 = 220	(RED-RED-BRN)	C3 = .01uF (103)	J3 = RCA jack
R4 = 100	(BRN-BLK-BRN)	C4 = 220pF (221)	J4 = 2x5 header
R5 = 1K	(BRN-BLK-RED)	C5 = unused	J5 = 2x5 header
R6 = 22K	(RED-RED-ORG)	C6 = .1uF (104)	J6 = SMA jack
R7 = 2	(RED-BLK-GOLD)	C7 = 22uF electrolytic	(optional)
R8 = 2.2K	(RED-RED-RED)	C8 = .1uF (104)	J7 = 1/8" stereo
R9 = 10K	(BRN-BLK-ORG)	C9 = .01uF (103)	jack
R10 = 1K	(BRN-BLK-RED)	C10 = .1uF (104)	J8 = 2x7 header
RL = 2x100	(BRN-BLK-BRN)	C11 = .1uF (104)	8-Pin SIP socket
	(2w)	C12 = .01uF (104)	2 2-Pin SIP header
RM = 412K	(YEL-BRN-YEL)		
or = 4.3M	(YEL-ORG-GRN)	Cx' = optional VXO var.	TO5 heat sink
P1 = 100 potentiometer		D1 = 1N5818	1/8x11/2" bolt/nut
P2 = 50K potentiometer		D2 = 1N5711	
		D3 = 1N4753	SW = SPDT
Q1 = PN2222A		A-K = LED	ultraminiature
Q2 = 2N2219A		30" 28Ga. magnet wire	
Q3 = 2N3906		L1 = 22uH	T1 = 10t primary
		7t on FT37-43	5t secondary
C11 (oops another C11!) = .01uF (103) this C11 @ RF Probe			on FT37-43

And here are schematics for the circuitry. The oscillator and output amplifier are slightly modified versions of the original W1FB TT2 design. Connector J4 takes the oscillator's feedback out to the band module. If you want to run the oscillator on the main board instead, you can mount the crystal and feedback capacitor on the main board using the additional holes provided. You can also cut the trace between the 2 pads at Cx' and insert a crystal frequency 'rubbering' capacitor. Changing R7 to a higher resistance value (setting the minimum power) and adding a low valued resistor and switch at Px & Py will allow you to easily select between 2 vary different power levels.



The RF output can be obtained at the SMA connector for Altoids tin versions or at the RF output RCA connector for tuna tin versions. The subminiature switch, dummy load and RF probe sircuit components are located outside the 'Altoids footprint' so are only usable for tuna tin versions.

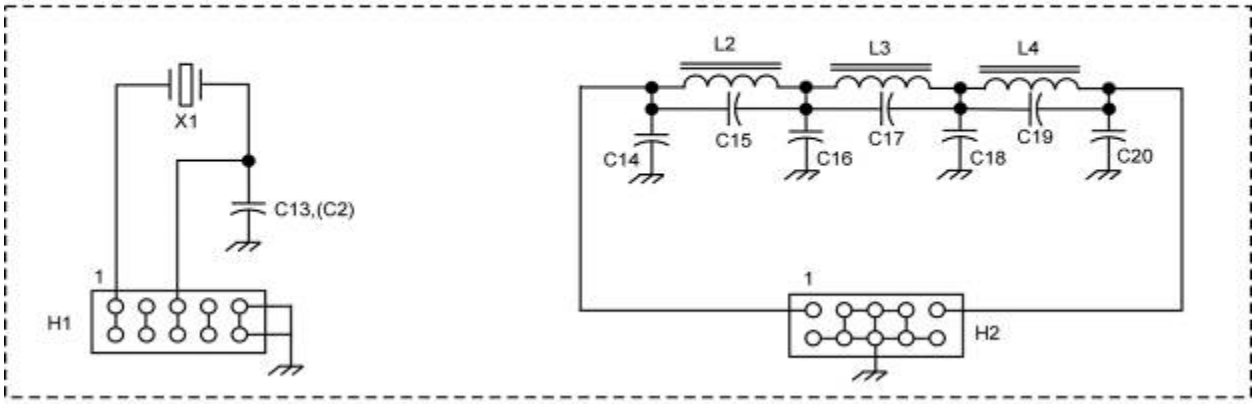


The keying control circuitry is one of the big additions to the SUPER Tuna. A straight key or external keyer can be used at J7 with jack/plug selections made with the L & R shoring plugs. By removing both shorting plugs, you can now key the SUPER Tuna with external paddles plugged into J7 and either a PicoKeyer module or custom PICaxe module inserted into connector J8. Another nifty addition is the optional LED keying indicator at pads A & K.

As you can see from the band module schematic below, the low pass filter for harmonic signal reduction is a VERY generic configuration that enables the builder to construct the low pass filter configuration of their choice. Components are included in the SUPER Tuna kits for constructing the filters as designed for the earlier Two Tinned Tunas kits. We found these filters to work just fine.

Super Tuna Schematic

Band Module



W5USJ drawing rev 17 Nov 09

Here is a table for previous versions of the Two Tinned Tunas harmonic filters using only 4 capacitors and 2 toroids:

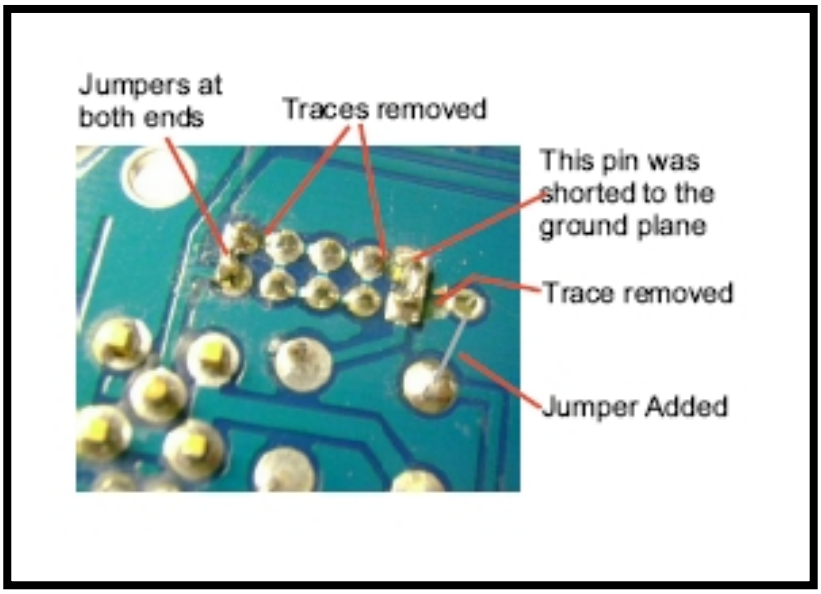
Band	C14	C15	C16	C17	C18	C19	C20	L2	L3	L4
80m	680		1800	250	820			23t on -2	26t on -2	short
40m	390		560	120	470			19t on -6	19t on -6	short
30m	220		470	75	120			20t on -6	17t on -6	short
20m	180		470	47	120			13t on -2	13t on -6	short

You can also use the harmonic filter values in other low pass filter configurations found from several sources:

1.) the work & articles by E. Wetherhold W3NQN
2.) The ARRL Handbook
3.) W1FB's Design Notebook

The first step is to fix the missteaks on the circuit board that I didn't catch before committing the design to actual printed circuit boards. The PCB traces are easier to work with BEFORE any parts are added to the board.

Connector J5 has 3 shorted ground traces between the connector pads that need to be removed. You can also see these mods in the picture on the right and on the circuit diagrams shown previously. The jumpers will be added later after the connector is soldered in.



I try to remove the traces on ALL the boards before I ship them; but, I might miss one here or there so you should check them to make sure that they have been cut.

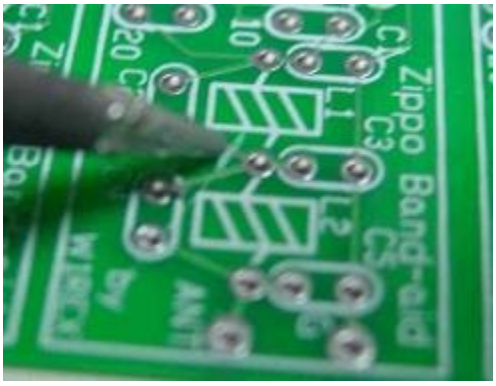
You might want to practice the following pcb trace modifying procedure on some pcb traces on a scrap circuit board.
You could also make the trace cut with a Dremel tool. Using only the edge of a SHARP cutting tool, you can simply grind a little cut across the trace. Practicing the Dremel method is a MUST as a Dremel tool turning at 9,000 rpm can create some real damage REAL fast!

PCB Circuit Board Trace Cutting

CUT

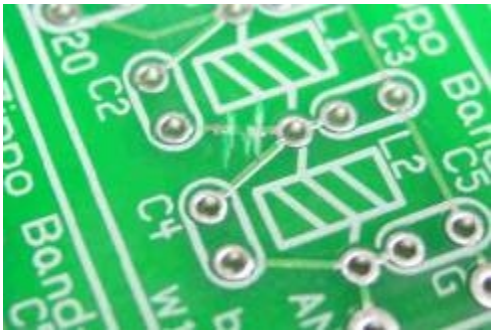
Here is how to remove a trace with just an Exacto knife and a soldering iron: Carefully make 2 parallel cuts, across the trace (and ONLY the trace), with the Exacto at any convienient location along the trace path. A good distance between the cuts is about 1/16". There is now a little 'island' in the trace.

HEAT



Heat up your iron and touch the 'island' with the tip of the iron. Very quickly, you should see the trace lift right up on the board as the heat melts the glue holding the 'island' down.

LIFT

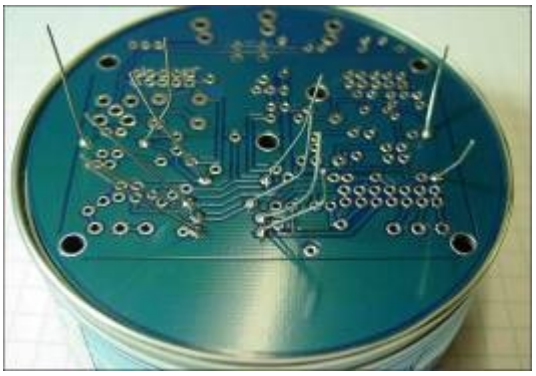


Remove the iron and collect up the 'island' so it doesn't travel someplace and cause a short. It's that simple. Later, when you actually install the connector J5, you will need to add a jumper at both ends of the connector shorting the front and back rows together.

OK! Here we go with the construction details..

Start building the
Super Tuna with
all the low-to-the
board components:

- R1 = 4.7K YEL-VIO-RED
- R3 = 220 RED-RED-BRN
- R5 = 1K BRN-BLK-RED
- R6 = 22K RED-RED-ORG
- R7 = 2 RED-BLK-BLK
- R8 = 2,2K RED-RED-RED
- R9 = 10K BRN-BLK-ORG
- C3 = .01UF (103)
- C4 = 220PF (221)
- C6 = .1UF (104)
- C8 = .1UF (104)
- C9 = ,91UF (103)
- C10 = .1UF (104)
- C11 = .1UF (104)
- Q1 = 2N2222A
- Q3 = 2N3906



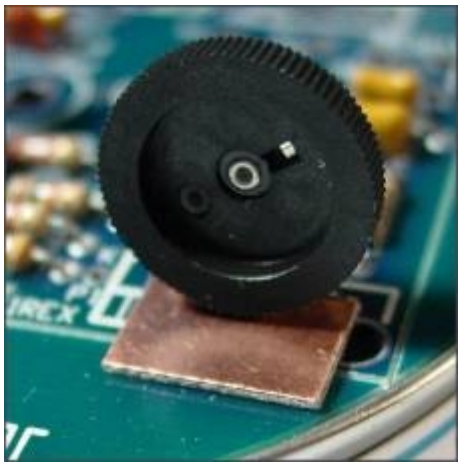
Who needs a vice?

After inserting a
few components and bending the
leads apart slightly to prevent them
from falling out, you can turn the
board upside down, place
it on the can to steady it in place and
solder in the components. Now clip off the excess leads.

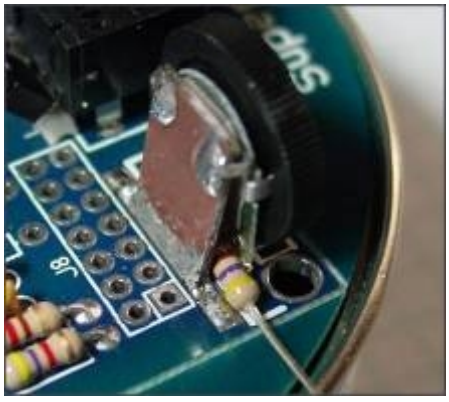
Resistors mods: R2 & R4 are soldered on the bottom side of the board. They have one side (top and left) soldered in their original holes and the other end into the 2 holes for C5.

When mounting the 2 potentiometers, use the small piece of pcb stock to make the thumbwheel have some clearance up off the circuit board.

Then use the same piece of pcb stock to make a backstop stiffener for the potentiometer. Use a resistor to spread out the base for added stability. Solder the pcb stock to the rectangular pad on the circuit board. Make sure that you don't encroach into the area where connector J8 will be installed.



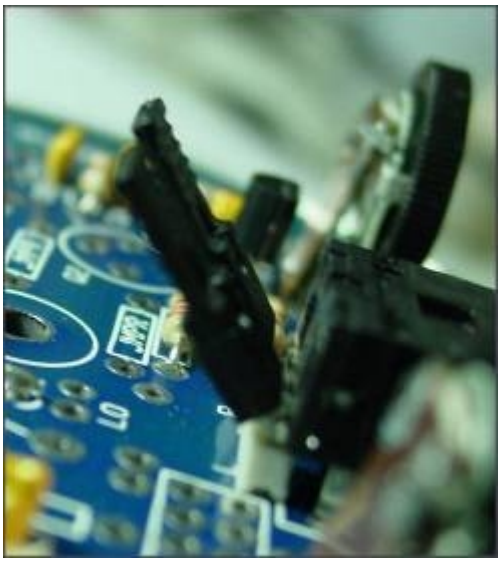
The piece of pcb stock used for the power pot should have a small notch on its base to make sure it does not short over to the resistor nearby. Remove the resistor after soldering. It is only used as a spacer while soldering.



Your SUPER Tuna kit might contain smaller thumbwheel trimmer pots that don't have any clearance 'issues' or require the pcb stiffener. You simply solder them in place using the same 3 potentiometer holes.

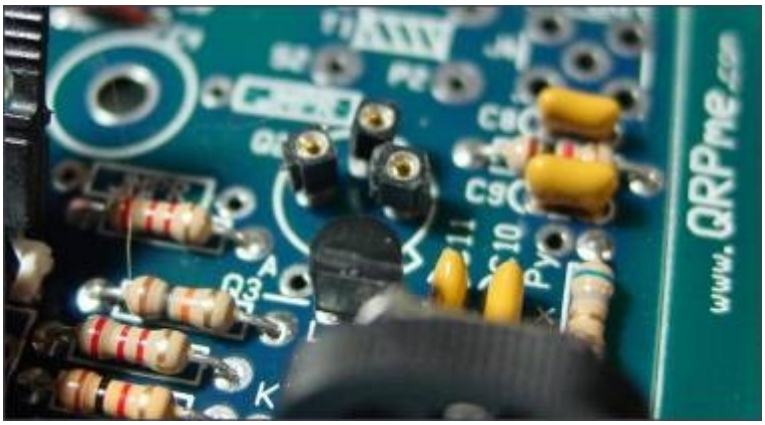
Pre-bend the two pin Molex connectors to allow them to clear the key jack.

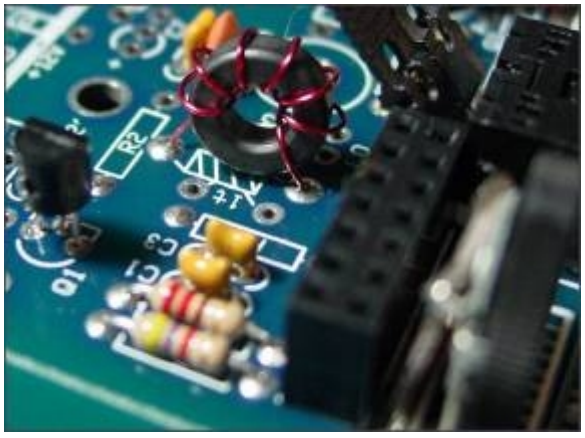
Install the Key jack and then install the two Molex 2-pin connectors with the plug pins bent away from the Key jack to allow for the insertion and removal of the shorting plugs. You can test fit connector J8 at the same time to make sure everything fits. Solder J8 in place once you know everything fits…



The Super Tuna board should look pretty much like this…

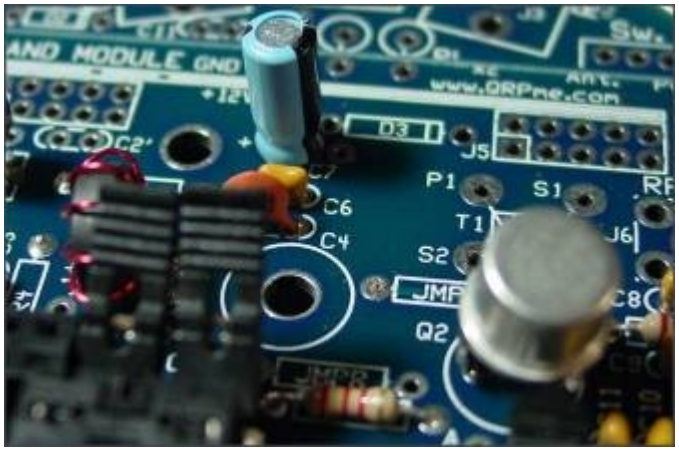
You can now cut the 3 transistor socket pins from the 8 pin SIP connector and install them on the pcb at the Q2 transistor location. You can install the individual pins on the leads of the 2N2219A transistor and then use the transistor as a handle while soldering the pins to the board.



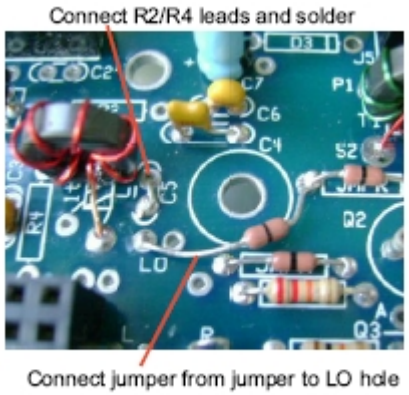


Wind 7 turns of 28 ga. magnet wire to a FT37-43 toroid. Clean the leads free of insulation and solder the toroid into place at location L1. Do NOT add the 1 turn link shown on the pcb.

Now solder in the 22UF capacitor at location C7.



Now add a zero ohm jumper from the jumper hole just above and to the left of the silk screen marking for Q2 over to the leftmost LO hole. Make sure the 0 ohm jumper stays outside the area outlined by the circle. This area is reserved for the nut holding the board to the can. Add a small piece of component lead across the 2 leads coming out of C5. Now both resistors are connected to keyed +12 volts.

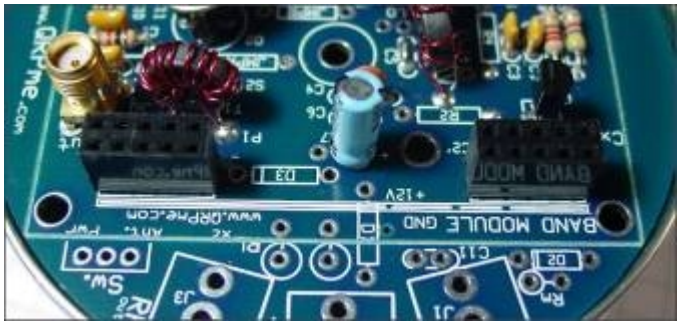


Transformer T1 is a little tricky. Wind 10 turns of 28 ga. magnet wire on a FT37-43 toroid. Strip the insulation off the wire ends and cut the leads to about ¾ inch long. Intersperse a 5 turn secondary winding over the 10 turn primary winding. Leave about 1 ½" of wire ends for ease of identification between the primary and secondary leads. Strip the insulation off these leads. Test fit the installation of the transformer. Primary leads in the P1 & P2 holes and secondary leads in the S1 and S2 holes. When you have it fitting in good and the leads bent and cleaned at the proper spots for good contacts with the pads, solder it in and clip off the excess leads!

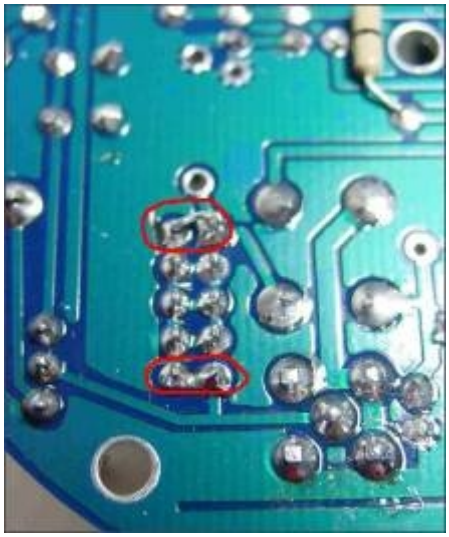
The SMA connector can now be soldered in. You may notice that the assembly procedure used here is to solder in all the low discrete components, then the pots which require good access for mounting and for soldering in the back braces. Now the tall components

can be soldered in starting from the front of the board and working to the back edge of the board.

Next install the band module connectors J4 & J5.



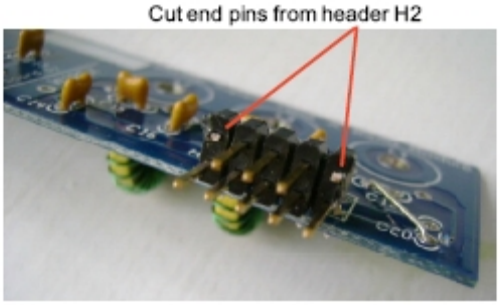
Connector J5 has 2 added solder mods on the underside of the board. On both ends of connector J5, the 2 end pins have to be soldered together.



You are now in the home stretch. The switch, RCA connectors, dummy load resistors, diodes, rf probe capacitor and resistor are now installed…. These parts are only used on the tuna can version as they fit outside the Altoids sized rectangular section of the pcb.

You can now build a band module. The right angle connector pins are first.

Clip off the top pin on each corner of the header H2. Make sure you are cutting the same pins as pictured here. It is awfully hard to put the pins back after cutting off the wrong ones……



The crystal is next. Install the provided crystal. Capacitor C13 is determined by which band you are building the module for.

For 80, 40, 30 & 20m, capacitor C13 is: 220pf, 100pf, 68pf & 47pf.

The low pass filter components C14 through C20 and L2, L3 & L4 are laid out in a very generic arrangement for building commonly specified harmonic filters. Here is a table for previous versions of the Two Tinned Tunas harmonic filters using only 4 capacitors and 2 toroids:

Band	C14	C15	C16	C17	C18	C19	C20	L2	L3	L4
80m	680		1800	250	820			23t on -2	26t on -2	short
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30m	220		470	75	220			20t on -6	17t on -6	short
20m	180		470	47	220			13t on -2	13t on -6	short

You can also use the harmonic filter values in other low pass filter configurations found from several sources:

1.) the work & articles by E. Wetherhold W3NQN
2.) The ARRL Handbook
3.) W1FB's Design Notebook

Mounting the Super Tuna board to the can and inserting the band module into the band module connectors yields a completed Super Tuna Transmitter that can now change bands and frequencies in seconds.

And here is the finished kit!