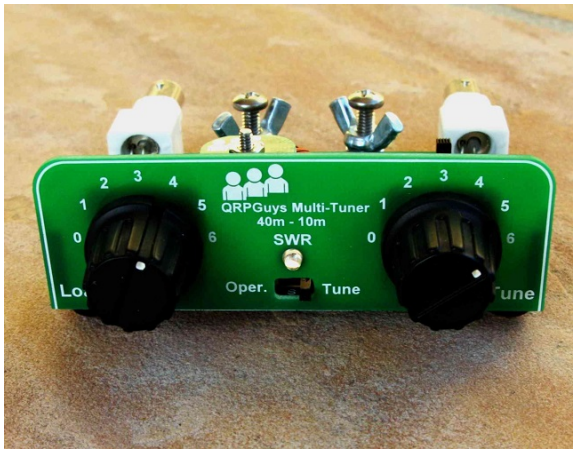
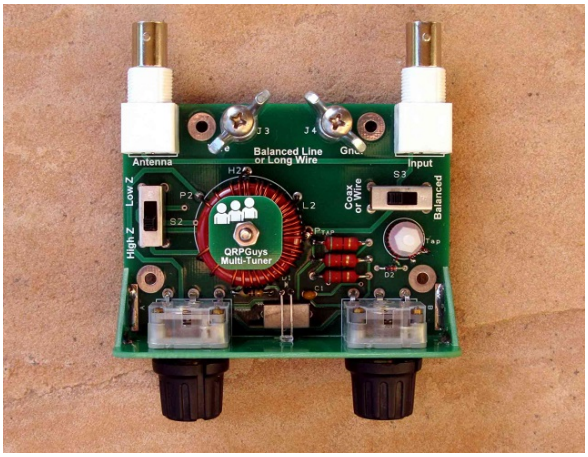
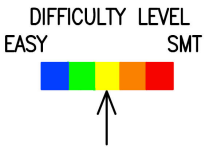
QRPGuys Multi Z Tuner Assembly Manual







First, familiarize yourself with the parts and check for all the components. If a part is missing, please contact us and we will send one. To request a part, please use qrpguys.parts@gmail.com.

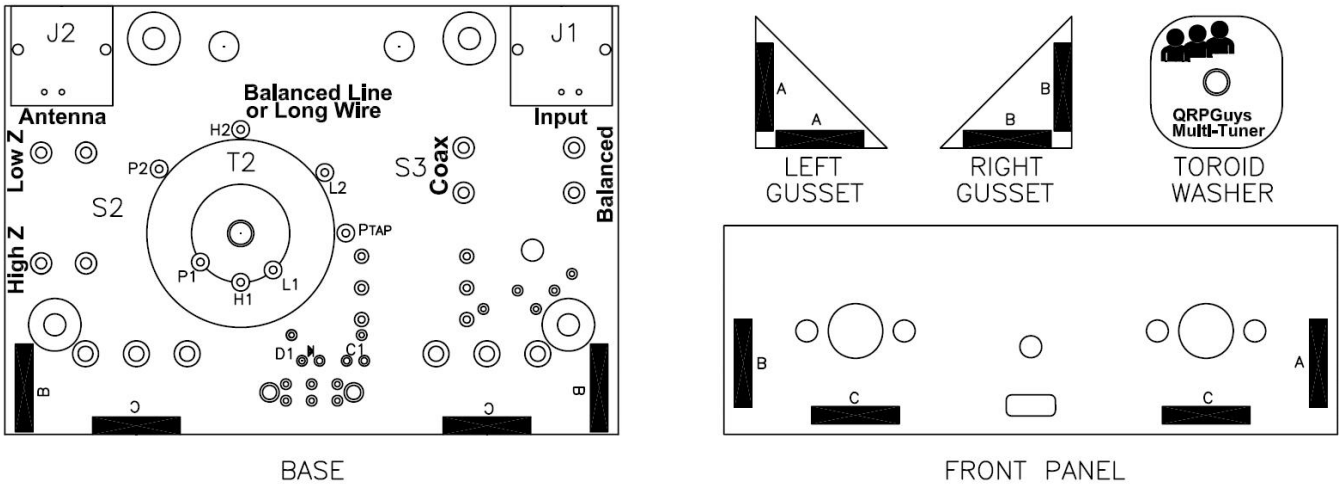
Parts List

1 – QRPGuys Multi-Tuner PCB, 5 pieces
2 – S2, S3 - Slide switch – DPDT
1 – S1 - Slide switch – DPDT, 90º
2 – C2, C3 - Polyvaricon, w/shaft and hardware, 1 long, 2 short metric screws, and nylon spacer 3/8”L
1 – C1 - .1uF mono capacitor, marked 104
1 – D1 - Red LED w/clear lens
1 – D2 - 1N4148 signal diode, sm. glass, w/black band on one end
3 – R1, R2, R3 - 51 ohm 2W power resistor (green-brown-black-gold)
1 – R4 - 470 ohm resistor (yellow-violet-brown-gold)
1 – L1 - FT37-43 toroid core (black)
1 – T1 – T106-2 toroid core (red)
1 – 24” of 26AWG magnet wire
1 – 6’ of 20AWG magnet wire
2 – #2 size control knob
2 - BNC PCB horizontal connector
2 – 8-32 x 3/4”L SS Phillips pan head screw
4 – 8-32 SS nut
2 – #8 internal tooth SS lock washer
2 – 8-32 SS wing nut
1 – 4-40 x 1/2” long nylon screw
1 – 4-40 nylon nut
1 – 3/8” diameter #4 nylon washer
4 – Round self-adhesive rubber foot
1 - 4-40 x 7/8”L SS pan head screw
1 - 4-40 SS nylon insert lock nut

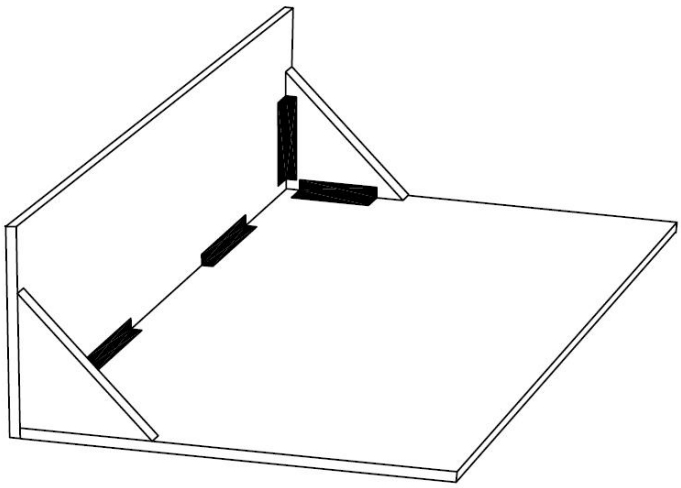
First item to assemble is the PCB chassis.

Even if you have done radio kit assembly before, please read through all the instructions before you start. This kit is a little different, in that the mechanical components are the part of the printed circuit board. The instructions give you the scope of the project and an understanding of the techniques we have employed. You will be assembling the kit from five pieces of PCB material. The base contains all the circuitry for the tuner. There are solder pads, and letter coded parts, that match each other. When you tack and then solder the components it will make a sturdy mechanical assembly.

Refer to the figure below for identification of the individual PCB parts.



On all the mechanical assembly soldering you do, you will use the same technique. You tack a single tiny point first, and then check to see that it is square and aligned with the registration points and assembly notes. It is easy to re-heat the joint and adjust the alignment when there is only a single point. You will tack all the other pads, before you do the finish soldering.

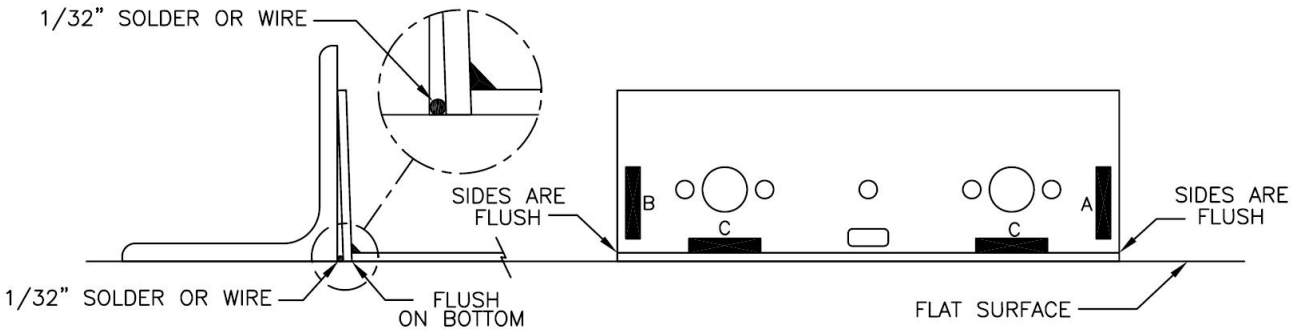


When soldered, the completed chassis will look like this, with all the holes and circuitry needed for the assembly. There will be no drilled holes to be added.

Soldering the chassis together:

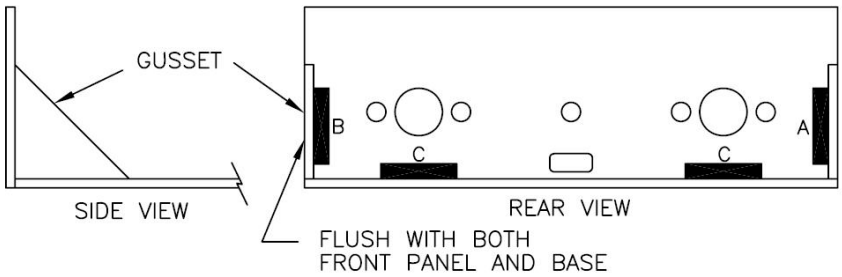
One of the physical properties of solder is that it contracts when it cools. Knowing this, we can allow for it. If two pieces of the pcb material are clamped 90° apart, and you apply solder at the joint, the joint will close about 1°-2°, no matter how well you clamp it, the PCB material will flex and you will end up with an 88° corner. That doesn't sound like a lot, but you don't want that to happen. If you try to straighten it cold, you will lift off the solder pad from the PCB. To counteract this, you position the front panel at slightly greater than 90º. When it's tacked it will pull back to square (90º). Finally, adding the gussets maintain this position and make a strong assembly.

You will need to work on a flat surface. I use a 1 foot square piece of a Formica counter top, but any flat surface will do. The first task is to position the front panel and the base with the "C's" matching, so that both side edges are flush with each other against something you have that is square. It can be a small piece of angle iron, or a square piece of wood with sharp corners. Position a short piece of 1/32" diameter solder or wire 4" long against the bottom of the square corner and lean the front panel back. This gives you the greater than 90º you are looking for. See figures below.



[ ] A small "tack" at one of the "C" pads is all that is required at this time. *Check for squareness, flush on both sides, and flush on the bottom.* If not all these conditions are met you only have to reheat the one tack and reposition the two pieces. When you are satisfied, "tack" the other "C" pad. *Do not completely solder the pads.*

Position either of the side gussets against the inside edge of the previous assembly. Match the letters. You can hold the small triangle of PCB material while you put a small "tack" on one of the pads. As before, check for squareness, and a flush joint. See the figure below.



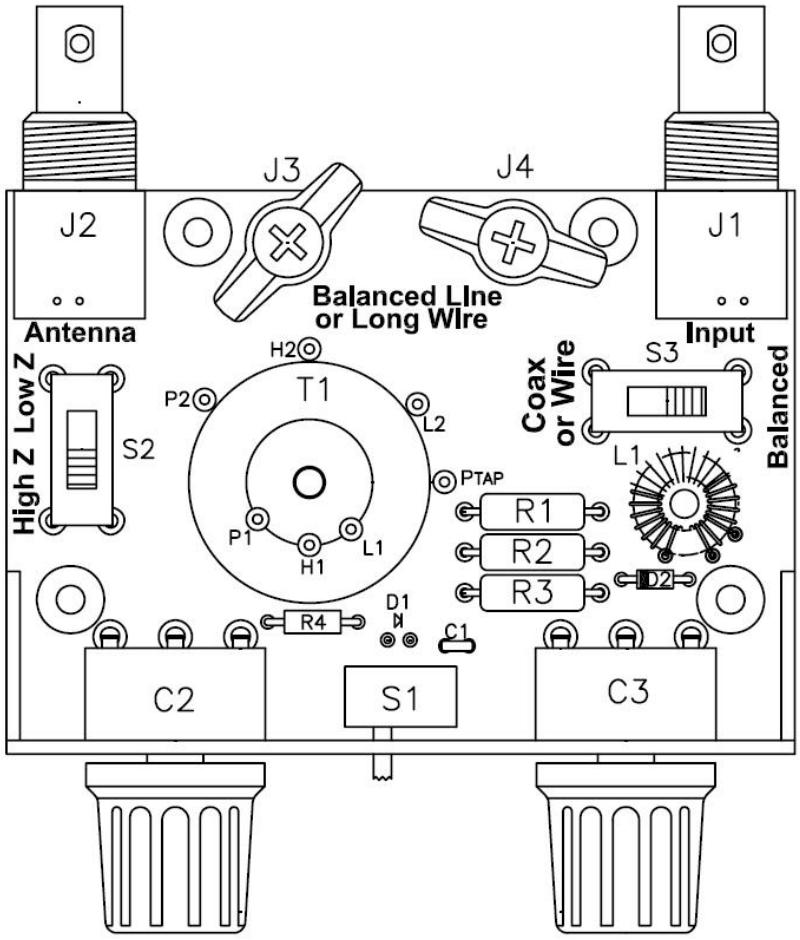
[ ] "Tack" the other pad on that side. *Do not completely solder the pads.*

[ ] Use the same technique with the other gusset.

[ ] When you are satisfied with the alignment and squareness of the "tacked" assembly you can go back and complete the soldering of all the pads. Alternate between different pads and add a small amount on each pad until the joints are complete.

This completes the chassis.

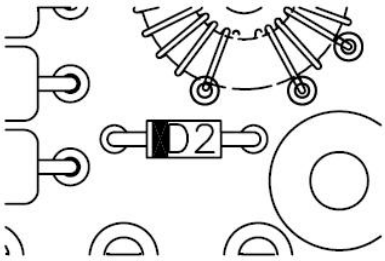
Now that the chassis is complete. Refer to the graphic below and the silk screening for the placement of the components.



[ ] Install S1, so the operating lever passes through the front panel.

[ ] Install C1, .1uF mono capacitor, marked 104.

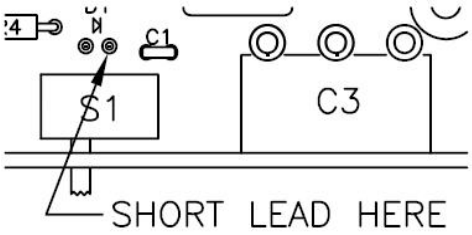
[ ] Install D2, 1N4148 signal diode, observing the black polarity band (cathode) location as shown in the figure below.

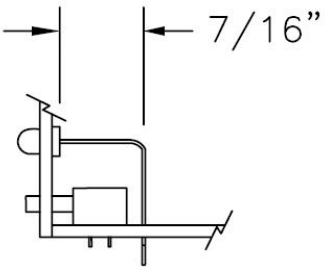


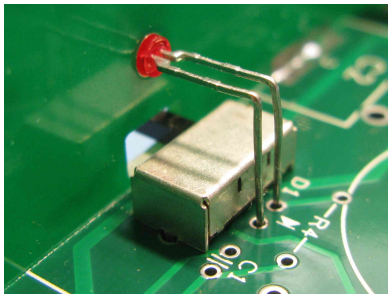
[ ] Install R4, 470 ohm resistor (yellow-violet-brown-gold)

[ ] Install R1 – R3, 51 ohm, 2W, power resistors (green-brown-black-gold), or value is printed on the component.

[ ] Install the clear lens LED protruding thru the front panel into the hole just over the S1 switch position. First, bend the leads as shown below 7/16’ from the back of the LED. The polarity must be correct. The short lead is “negative” and goes towards the right side of the chassis. The long lead to the left pad.

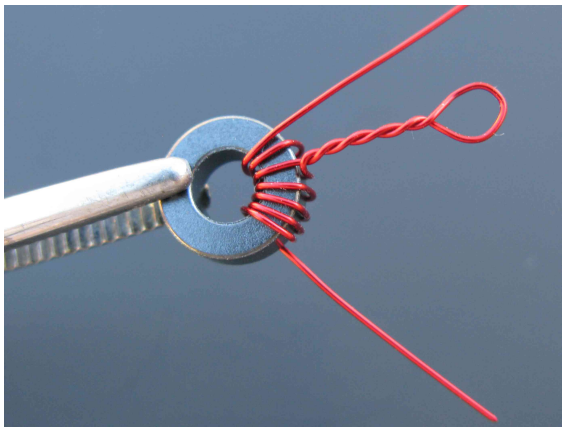


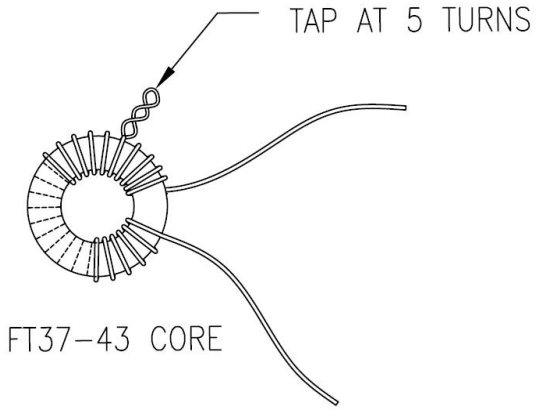




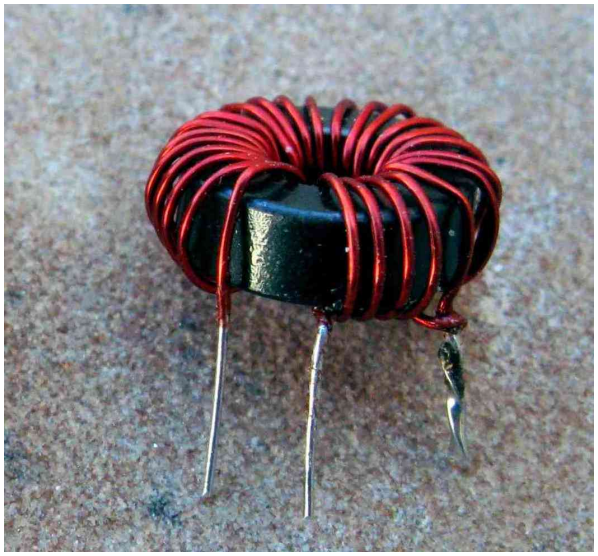
[ ] For L1, use the FT37-43 (black) core and the 24” of the thinner supplied magnet wire. You are winding a total of **25** turns, with a tap at **5** turns from the beginning of winding. Remember, every time the wire goes through the center of the core, it counts as one turn. The picture and figure below shows the beginning of winding and the twisted technique for the tap. The total of 25 turns will completely fill the toroid. Don’t wind it loose, a #4 screw must go through the center for securing.

Note: *Now is a good time to mention a good way for counting the turns on small toroids. Many times on toroids with a lot of turns, you lose track going around. A good trick is to take a digital picture of it and blow it up on your computer screen. Counting is clearly a lot easier. Never cut until you verify the turn count. Too many turns is easy to fix, too few leaves only one option..*



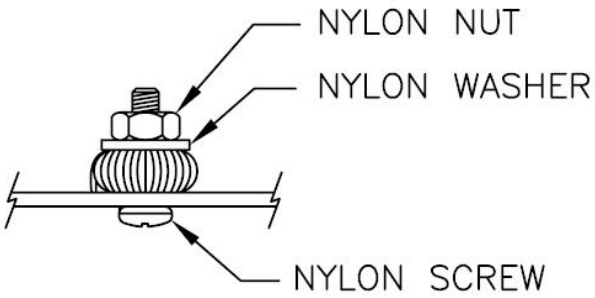


[ ] Bend the leads as shown below, trim to 1/4” long, and tin the leads prior to soldering them to the backside of the board. The magnet wire supplied Is Thermaleze® brand and will tin easily with a soldering iron. Always tin the leads before trying to solder them in place and you will greatly eliminate any continuity problems.



[ ] Solder L1 where indicated on the PCB, and centered on the screw hole. You will notice the tap hole is indicated, and is slightly larger in diameter to accept the double twisted wire. Install the toroid flush with the backside of the board. Do not elevate it off the board. You will be securing it with a nylon screw, nylon washer and nut.

[ ] Secure L1 to the top of the board using the 4-40 nylon screw, nylon washer, and nylon nut, as shown below, with the screw from the bottom. Tighten enough to secure and protect the toroid, but do not over tighten.

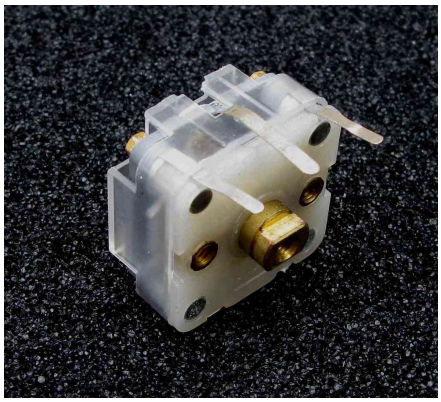


[ ] Install the two BNC connectors flush with the top of the board, and solder the two locating pins and two electrical connections.

[ ] Install the two remaining slide switches at the places indicated, soldering all four corners and electrical pins.

Poly varicon installation to kits ordered before 01/20/18

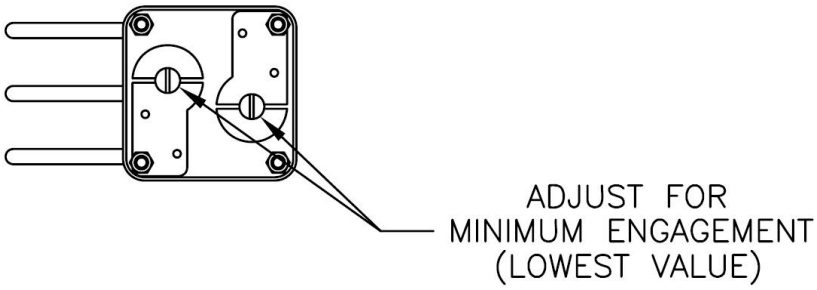
[ ] Prior to installing the poly-varicon variable capacitors the leads must be re-routed through the snap-on cover. The pictures below show the “as received” and “modified” condition. Carefully pry off the cover, bend the leads to the rear, feed them through the cover and snap it back on. There is a small tab, opposite the side with the leads, on the cover that matches the body of the poly-varicon for the cover to fit properly.



As received

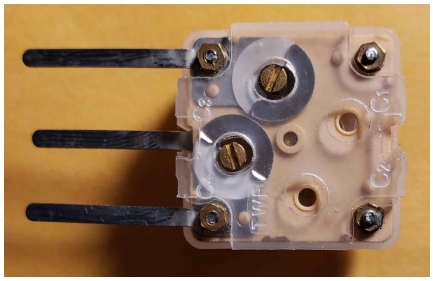
Modified

[ ] Adjust the two trimmer caps on the back of each poly-varicon to their *minimum* value as shown below.



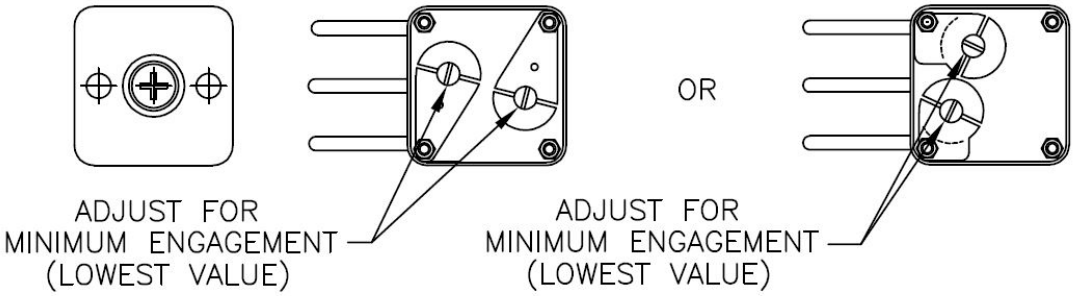
[ ] Install the two polyvaricon capacitors on the inside of the front panel. Carefully feed the three leads through the board and secure the capacitors with the two short metric Phillips screws from the outside. Solder and clip the leads flush. Install the nylon spacers, long metric screws, and knobs as shown in the figure below.

Polyvaricon installation to kits ordered after 01/20/18

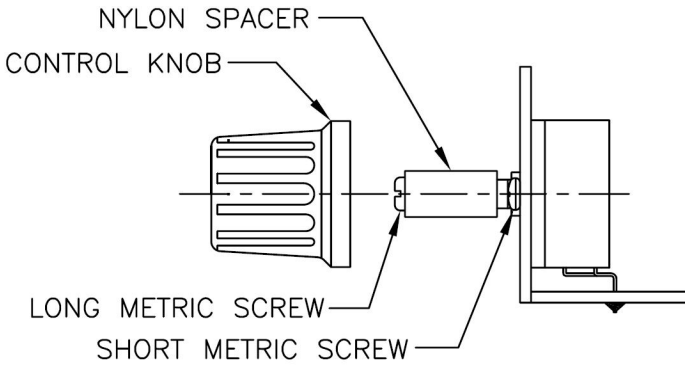


Set for minimum engagement

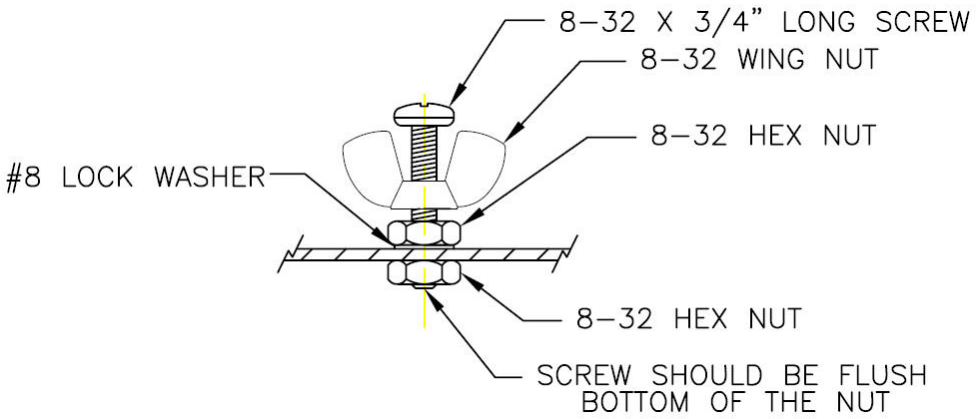
[ ] Adjust the two trimmer caps on the back of each poly-varicon to their *minimum* value as shown below.



[ ] Install the two polyvaricon capacitors on the inside of the front panel. Carefully feed the three leads through the board and secure the capacitors with the two short metric Phillips screws from the outside. Solder and clip the leads flush. Install the nylon spacers, long metric screws, and knobs as shown in the figure below. *One of the leads is shorter than the others and may need to be soldered on the top of the board. This is not a problem with plated through holes.*



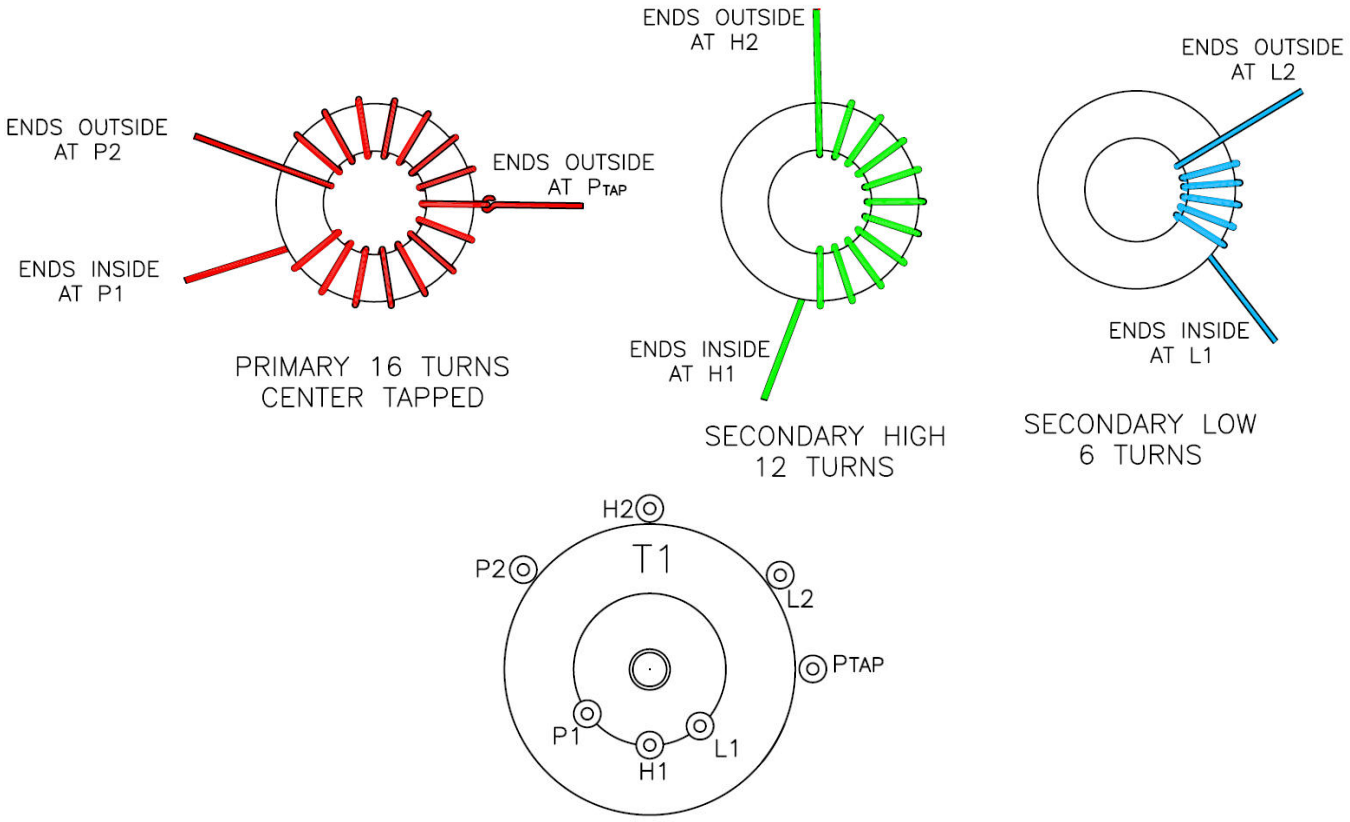
[ ] Install the hardware posts for the antenna wires, as shown in the figure below. The post screw should be flush with the outside of the securing nut on the back side.



T1 assembly

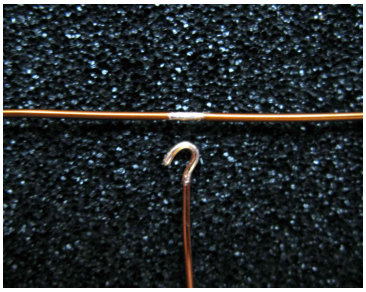
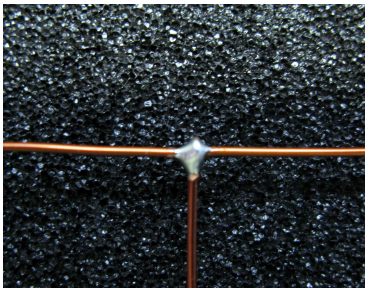
The next item to make and install is T1. This T106-2 toroid has a 16 turn center tapped primary, a 12 turn secondary, and another 6 turn secondary. We have supplied a 6 foot length of 20awg magnet wire for this purpose. Proper winding of the transformer will result in the three different windings ending up at the correct positions on the PCB. The two secondary windings are on top of the primary winding. The graphic below shows the separate windings and how they are positioned on the T160-2 toroid. Please study the following figures and understand the process before you try winding the transformer.

If a winding does not end up as shown below or is not wound in the same direction as shown below, the tuner will not work properly. Note that the ends of the windings must be over or under the core as shown below.

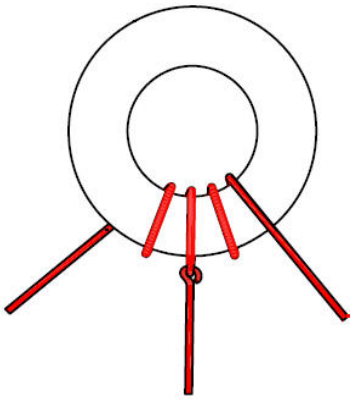
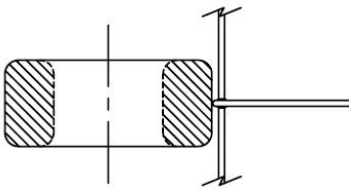
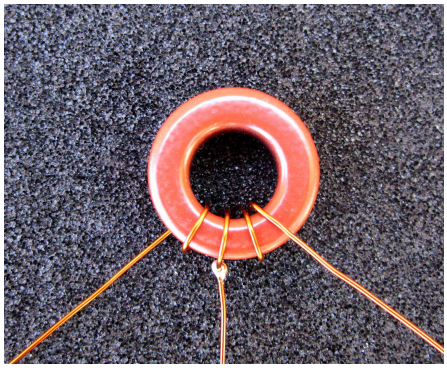


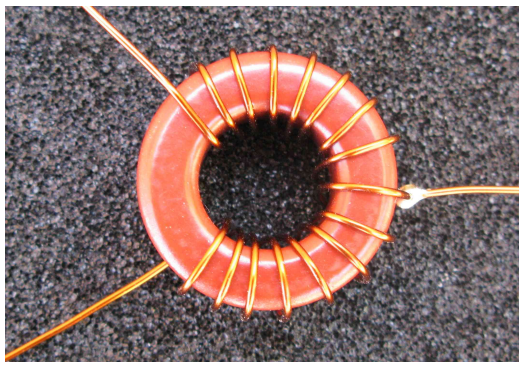
The seven pad positions for T1

[ ] Prepare the primary wire as shown in the figure below. Cut 30” of the supplied 20awg wire and a 2” piece. Strip the insulation off of the 2” piece for 1/4” and make a small loop that will attach to the center of the 30” long section. On the 30” piece measure to the center (15”) and strip off the enamel insulation for 1/8” inch and solder the loop to the center. See photos below.

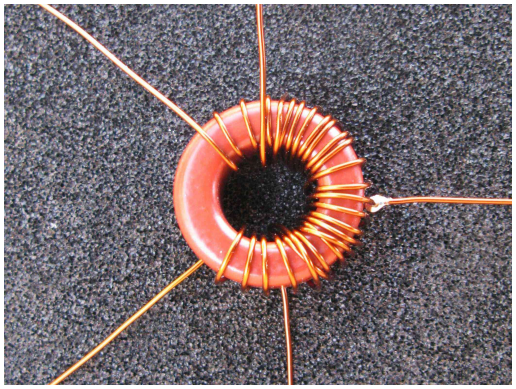
[ ] Start winding by positioning the tap halfway up the outside of the core and pass the right side winding **up** thru the center of the core and the left side winding **down** thru the center of the core. Wind a couple of turns in each direction and compare it to the graphic and picture below. All three windings will be done with this method. If it doesn’t look like this, stop and correct it. Wind a total of 16 turns, eight in each direction. Every time the wire passes through the core, counts as one turn



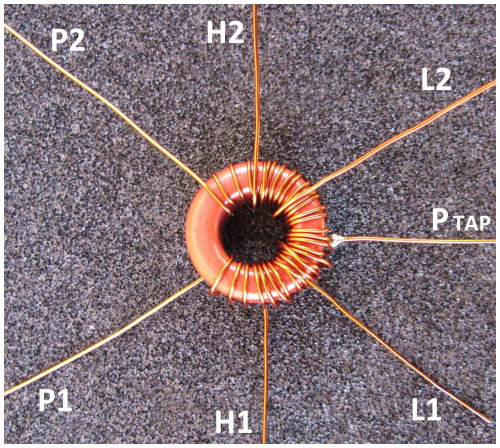
Completed primary winding, 16 turns

[ ] Cut another piece of the 20awg wire 22” long, mark the center at 11” with a marker and start with the center of the wire along one side of the tap, on the outside, and wind 6 turns in each direction. Wind the right side **up** thru the center and the left side **down** thru the center of the core. Space your winding out so that the end up 180º apart centered on the primary tap as shown below.



12 turn secondary added

[ ] Cut another piece of the 20awg wire 13” long, mark the center at 6.5” with a marker and start with the center of the wire along one side of the tap, on the outside, and wind 3 turns in each direction for a total of 6 turns. Wind the right side **up** thru the center and the left side **down** thru the center of the core. Space your winding out so that the end up 60º apart centered on the primary tap as shown below.



Completed with 6 turn secondary

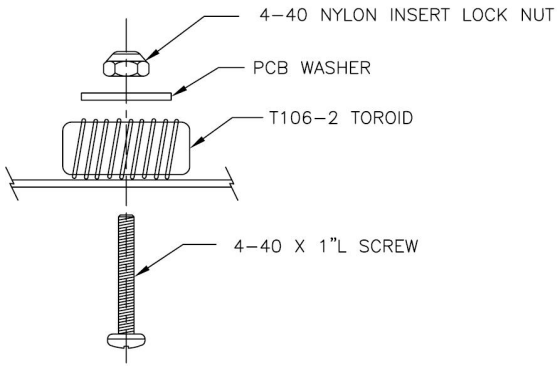
In the picture above, all the leads (P2, H2, L2) above the center tap should exit the core over the top of the toroid and all the leads (P1, H1, L1) below the center tap should exit under the toroid. When all these leads are bent down, they will line up with the lettered pads on the PCB.

[ ] When you are satisfied you have followed these instructions you may bend the leads down, strip the enamel, and tin the leads. **P1**, **H1**, and **L1** pass through the PCB on the inner diameter of the toroid. **P2**, **H2**, **L3**, and **Ptap** pass through the PCB on the outer diameter of the toroid.

Note: Before soldering, if you lose absolute confidence in the name of the leads, verify their identity with an ohmmeter before proceeding.

[ ] Solder the seven leads and trim.

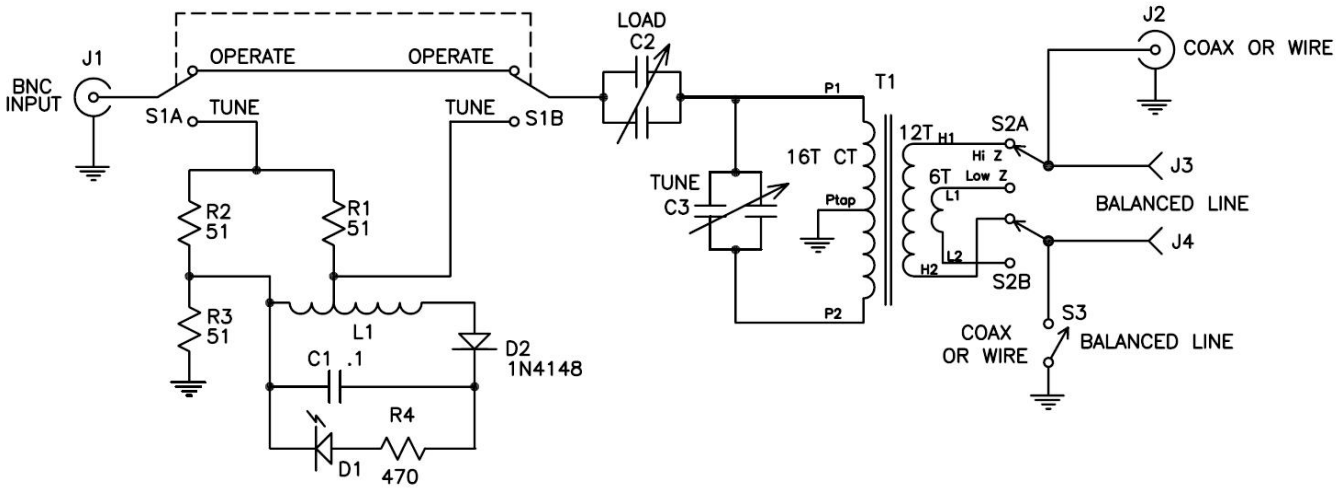
[ ] Secure the toroid to the main board by passing the 4-40 x 7/8” SS pan head screw up from the bottom. Use the PCB washer supplied as a retainer and tighten the 4-40 nylon insert lock nut to secure the assembly as shown below.



[ ] Apply the self adhesive rubber feet to the bottom of the tuner at the four places indicated by the silk screened circles on the bottom.

This completes the assembly.

Schematic:



Tuner usage

The tuner is rated at 5W CW, 10 watts PEP max. and incorporates the N7VE LED absorption bridge circuit for sensing SWR. In the TUNE position, you cannot damage your transmitter caused by a high SWR. The worst your transmitter is looking at is a maximum of 2:1 SWR in the TUNE position. The LED is only showing reflected power. At full brilliance your SWR is 4:1 or greater, at half brilliance your SWR is approximately 2:1, and the LED will completely extinguish at 1:1. *Tip from Dan…If your led does not completely go out at 1:1 there may be a little too much gain on L1, the indicator transformer. Just reduce the turns on the side of the tap with the most turns, one or two turns.*

Adjusting for a wire antenna match

With your transmitter and antenna connected to the tuner, set the tune/operate to the tune position. Set the adjustment knobs to the center position. Note: Tune mode, maximum power Input – 5 Watts.

Place the HI/Low impedance switch in the Hi position. The Hi impedance setting provides the most efficient coupling and operation. Briefly key your transmitter and attempt to adjust the knobs to dim the LED. Continue adjusting back and forth until the LED is out or is as dim as possible. If the adjustments do not produce adequate dimming of the LED switch to the Low impedance position and repeat the adjustment process. Note: Under some conditions of match adjustment the LED will not go completely out. Your antenna will be tuned for proper operation even if the LED does not dim completely out. Switch the tune/operate switch to the operate position.

Use all the normal cautions throwing wires up in the air near power lines.

Additionally, after the antenna is tuned up, keeping the bridge in the circuit (Tune position) will reduce the power by a factor of four to a matched antenna. This can occasionally be useful when trying to bring a 3w QRP transmitter to under the 1w level for certain sub-one watt contest multipliers.

Notes: