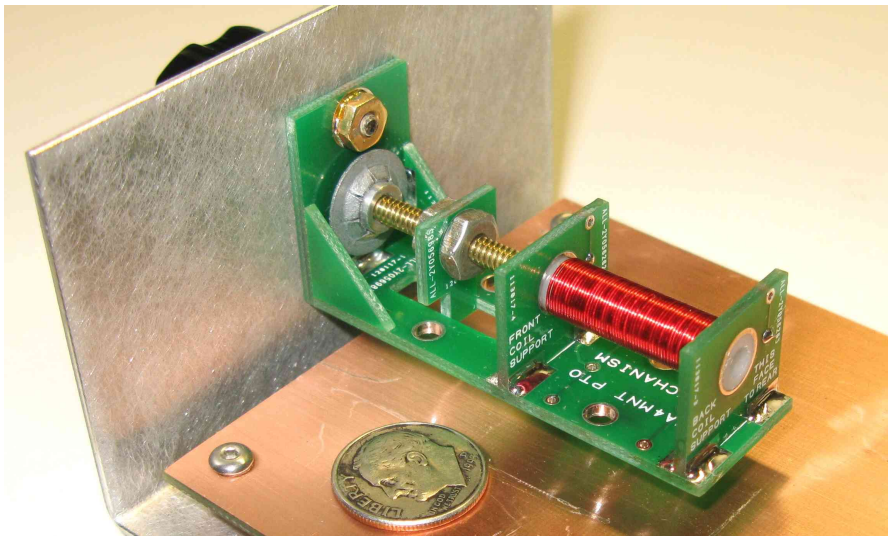
QRP Builder PTO Tuning Mechanism kit



First, familiarize yourself with the parts and check for all the components. If a part is missing, please contact me and I will send one. To request a part, or for any questions email to: qrpbuilder@gmail.com.

Please read all the instructions carefully before starting the assembly. Correct mechanical assembly results the necessary electrical connections with the pcb pieces.

If there is something you don't understand, please ask for clarification before you start. We cannot replace any individual pieces of boards.

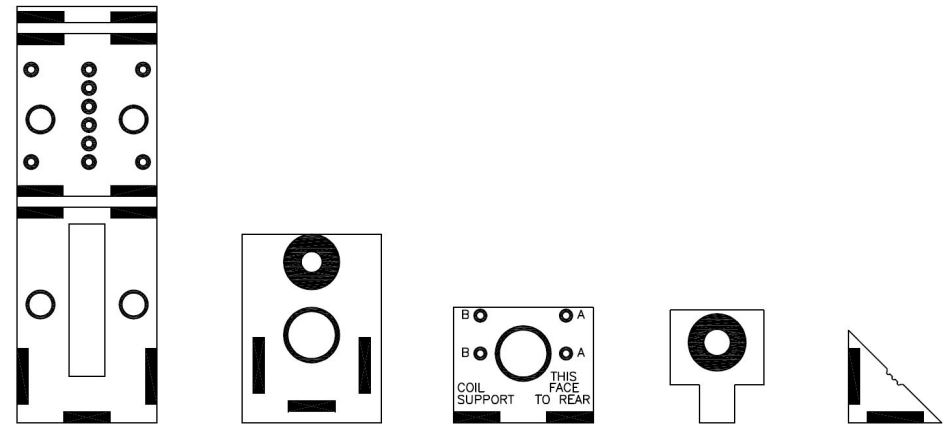
Parts List

1 – PTO mechanism pcbs
1 - .25" dia. x 1.00L #6 clearance, nylon spacer
1 - aluminum shaft assembly, (standoff with push nut installed)
1 - .25" I.D. o-ring
2 - 6-32 hex nut
1 - 4-40 brass hex nut
1 - 4-40 x .25"L. S.S. phillips screw
1 – 6-32 x 2 1/8" L. brass threaded rod
1 – 6-32 x 2 1/8" L. steel threaded rod
1 - .25"" I.D. x .375" O.D. x 1.25" long clear plastic tubing
1 - .25" I.D. x .50" O.D. x 7/16"L nylon spacer
1 – fluted control knob for 1/4" shaft dia. **Every knob has been checked for the presence of the brass set screw. Be careful when unpacking. Do not lose it, as it is metric, and may be difficult to find a replacement.**.

Tools required: Soldering iron 25-40 watt with a small tip, 1/32" rosin core solder, a flat surface to work on. I cut a 10" sq. piece of Formica shelving I got at Habitat for Humanity for $1. *Use your kitchen countertop at your own peril.* Locate an Exacto knife or sharp pointed probe, epoxy or instant adhesive, 3/4" wide masking tape, 3"x5" file card, clear nail polish, needle nose pliers, side cutters, small Phillips screwdriver, small flat blade screwdriver, small 5/16" open end wrench, toothpick, small piece of wax paper, a small daub of Vaseline, and SolderWick, only if you mess up…

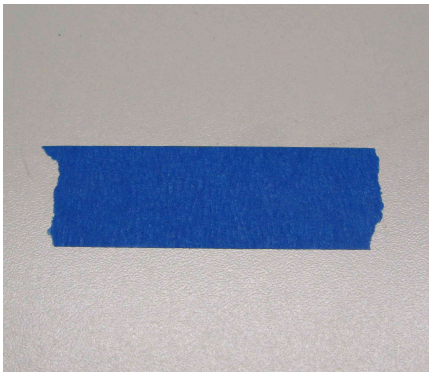
The boards are shown below. The two gussets need to be separated from the spine. You may need to hold the spine with a needle nose pliers.

Frame assembly:

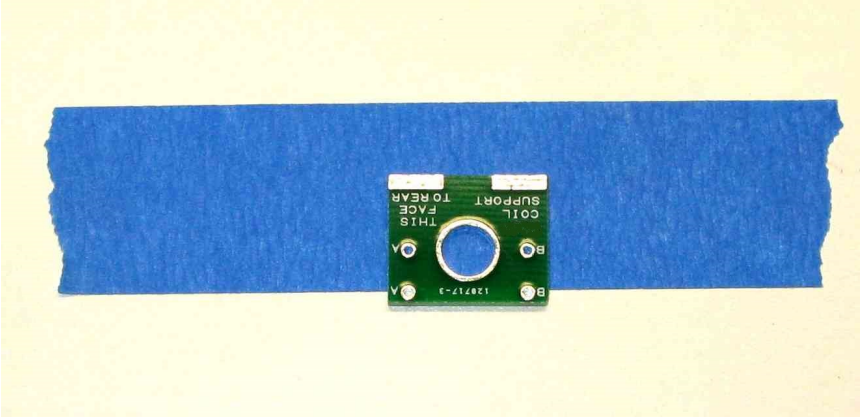


Throughout the assembly we will refer to the pcb pieces by the names above.

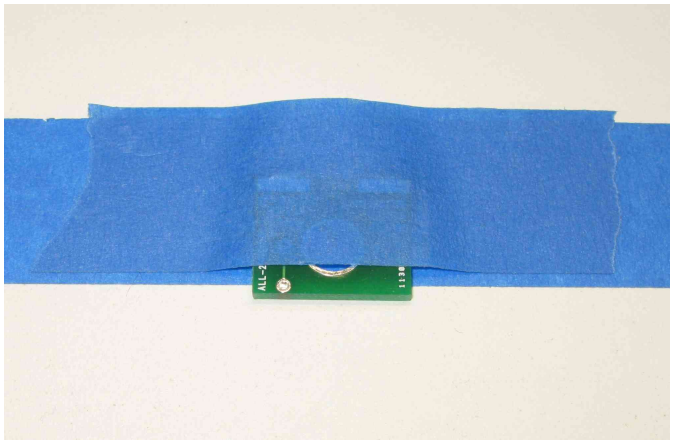
Start by placing a 2” long piece of the masking tape in the middle of the Formica work surface as shown below.



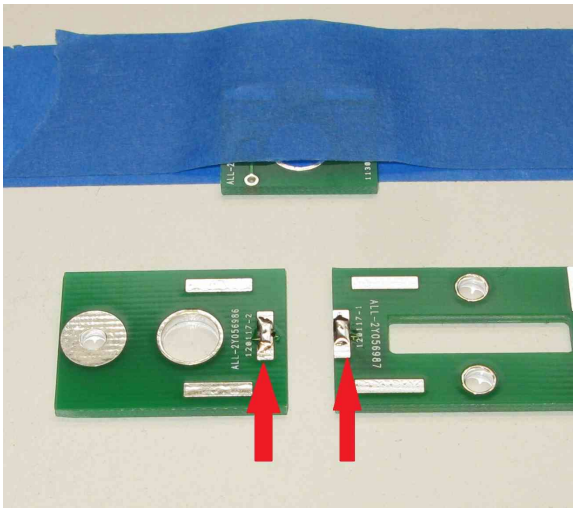
So far, so good. See how easy this is…. Next place one of the Coil Supports overhanging the front edge of the tape by about 1/16” as shown.



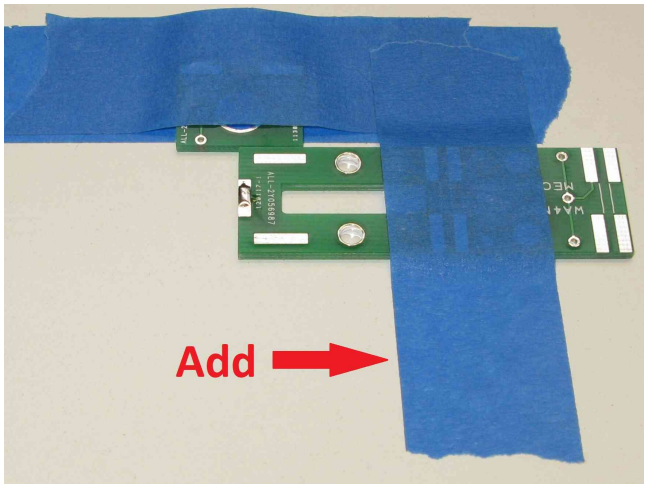
Now tape the Coil Support in place with another piece of tape on top. The Coil Support is now spaced off the surface by the thickness of the tape. This forms a temporary backstop you will be working against.



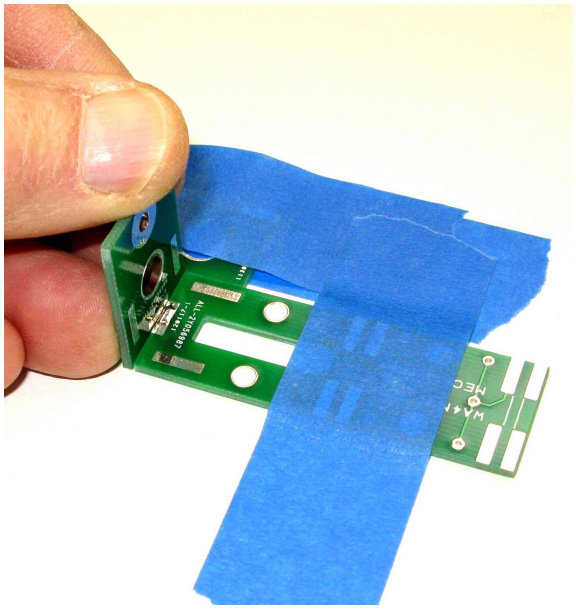
The first two parts to solder together are the Front Plate, and Bottom Plate. Put a small drop of solder on the two pads shown by the red arrows in the picture below. You don't need to fill the whole pad, only a small amount is required.

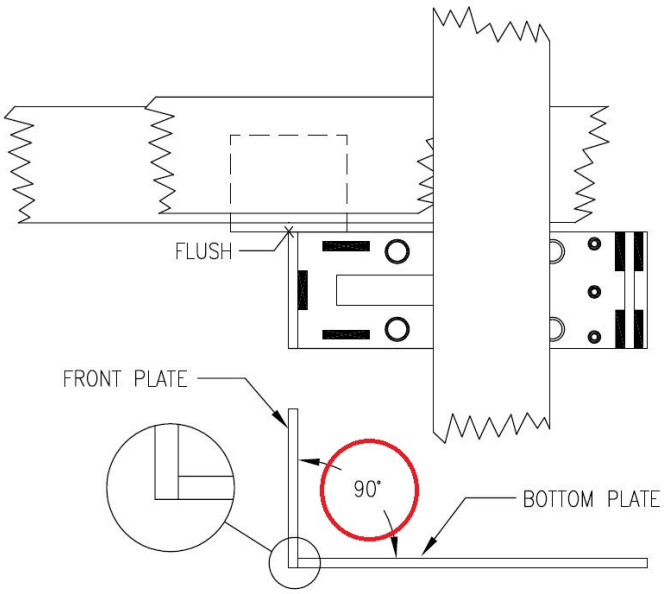


Tape through the center of the Bottom Plate, to keep it in place, so that the front edge is about in the center of the temporary backstop. You want the two edges, flush and completely touching each other.



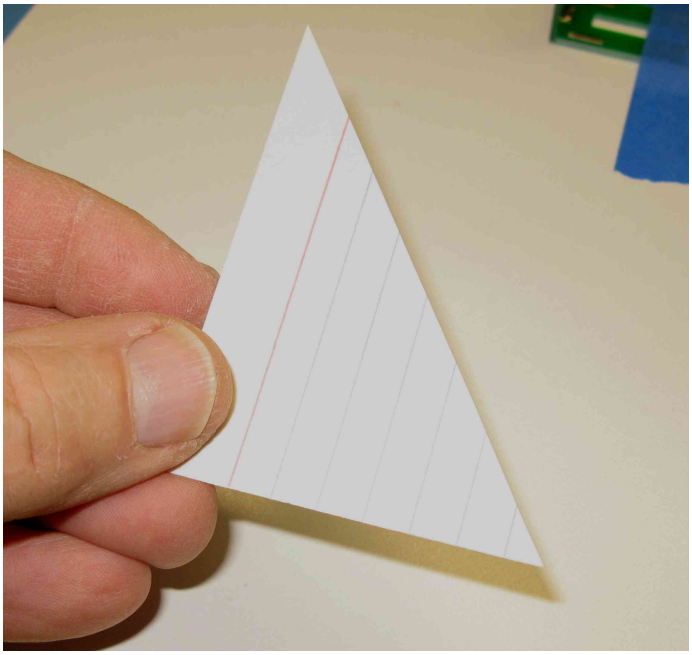
With your hand, position the Front Plate against the backstop, and the back edge of the Bottom Plate, holding it 90º vertically, and back against the backstop. While holding straight up, touch the pad union you previously tinned with your iron. Both beads will fuse together. Hold for a couple of seconds for the solder to harden.



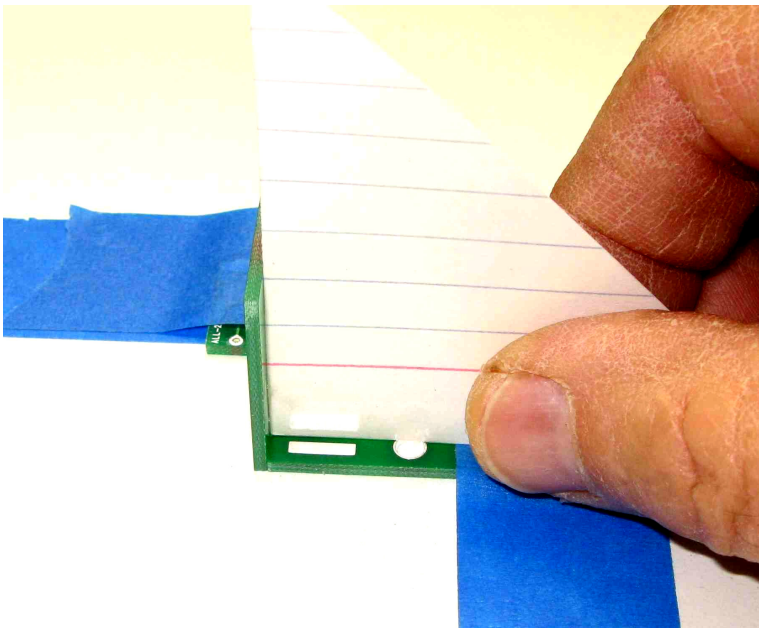


DO NOT TRY TO BEND TO 90º AFTER THE SOLDER HAS HARDENED !!! Unless you want to buy another kit. You will lift the copper off the board, and it cannot be re-attached.

You need this joint to be 90º. If it is not, I will tell you how to fix it, but first you must make a precision square. Take the 3” x 5” file card and cut the corner off as shown below. If you mess, up there are three more corners.

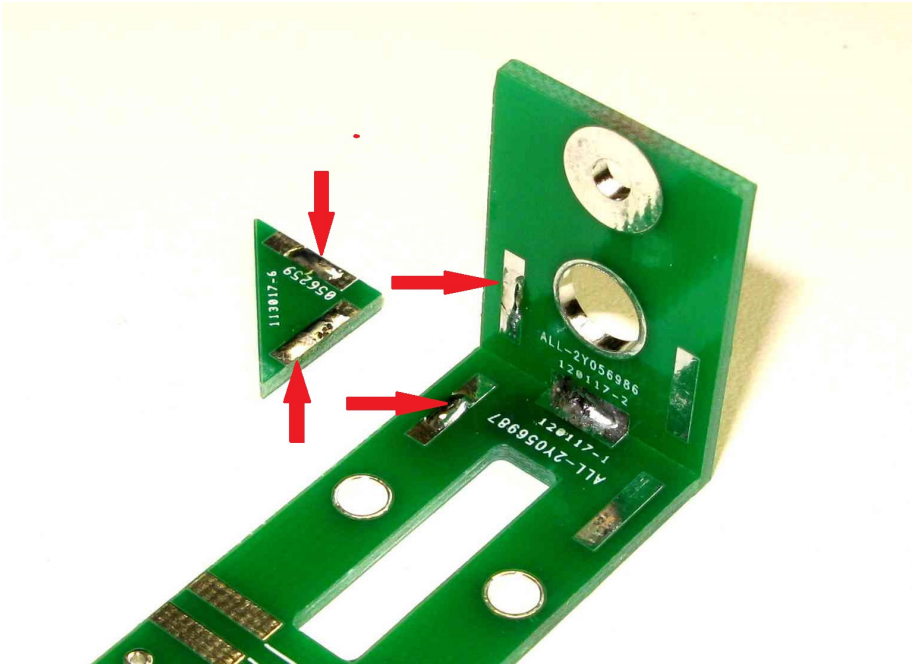


Now, use the newly created precision square to inspect your results.

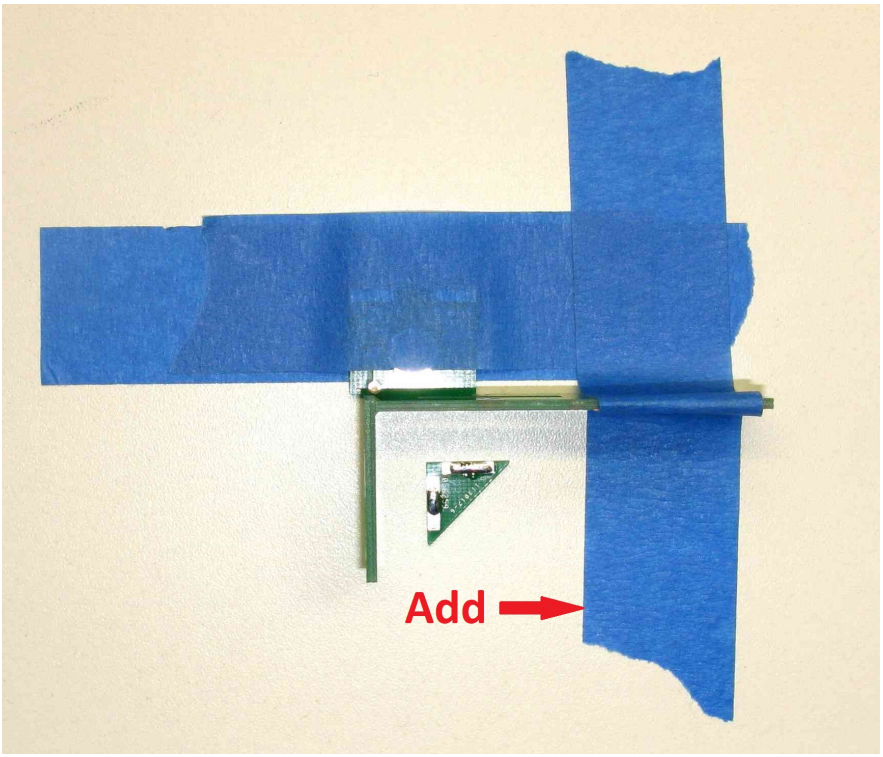


If it is not square, simply re-heat the pad and reposition until it is square. Re-check with your inspection tool, and repeat until you are square. *You must re-heat the joint every time you want to make an adjustment.* When you are finished, it should be flush on the side against the backstop and the Front Plate square with the Bottom Plate. The assembly joined with one soldered pad is quite delicate at this point. It is not stable until the next step. Do not try to flex it in any way and remove the tape holding the Bottom Plate/Front Plate assembly to your work surface carefully. Save the gage.

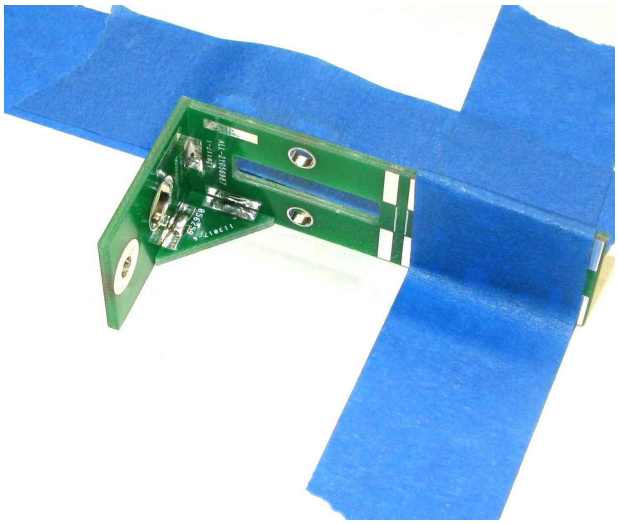
Place a small drop of solder on the two pads shown below on the Front Plate and Bottom Plate assembly, and the two pads on one of the Gussets. Both Gussets are the same.

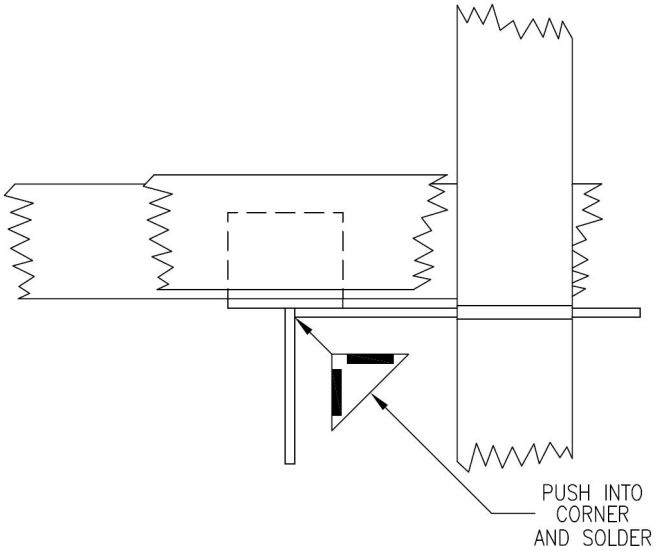


Position the Front Plate/Bottom Plate assembly against the backstop, and tape in place with the 3/4” wide tape as shown to keep it in place.

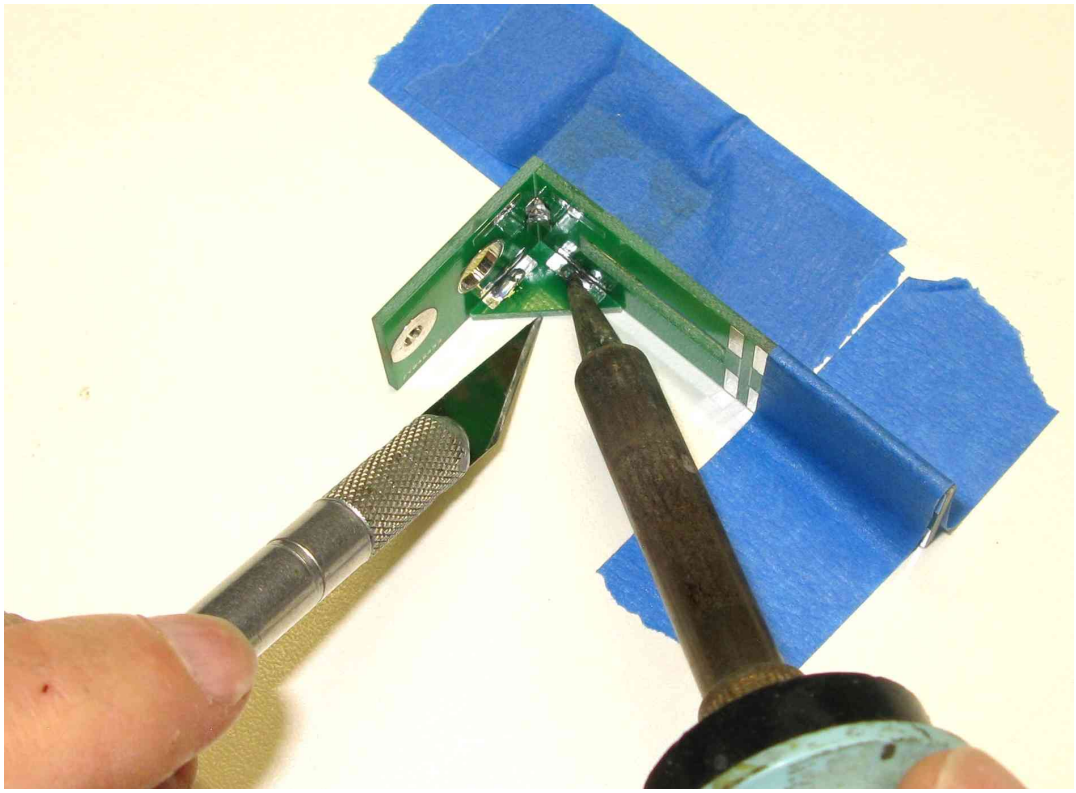


Lay the Gusset into the corner and push it into the corner with an Exacto knife or sharp probe to hold in place.



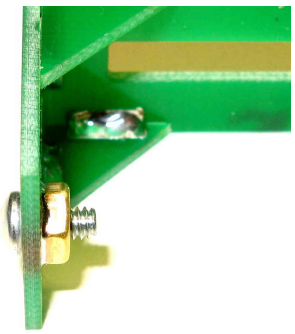


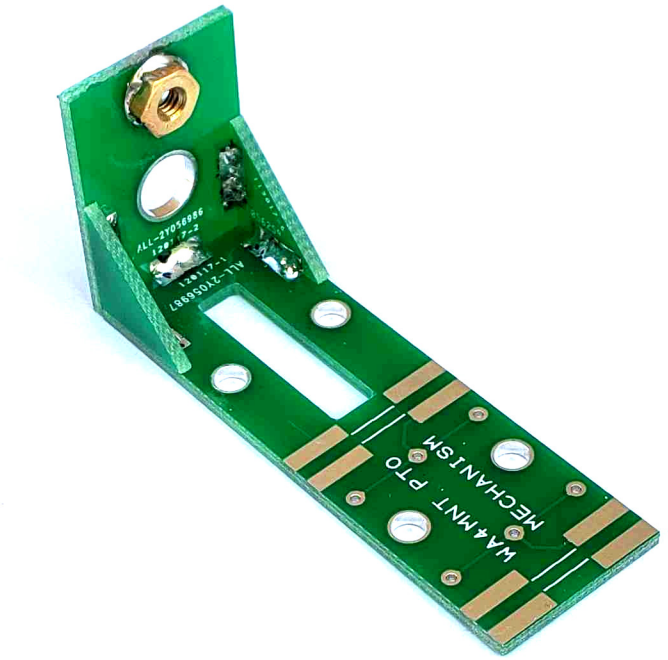
Hold the gusset into the corner, push flush with the working surfaces, and touch the iron to one of the pad unions, and then the other.



Flip the assembly over and install the other Gusset. You can now un-tape it and go back over all the pads, one at a time, and complete filling the solder of the five pads. It should now look like the picture below.

Solder the 4-40 brass nut to the inside of the frame using the supplied 4-40 x .25L S.S. screw to hold it in place. Clean any corrosion or surface treatment off the side of the nut you are soldering. Just a light sanding will do. It makes soldering a lot quicker.





The frame assembly should now look like the above pic.

Shaft assembly:

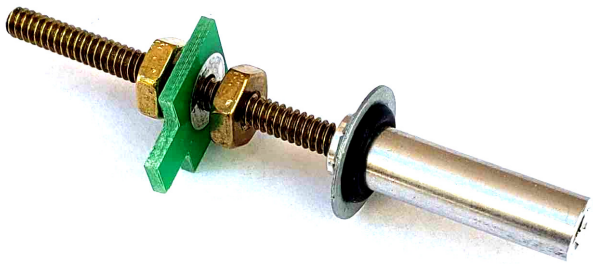
The first step is to slide the 1/4” I.D. o-ring over the threaded aluminum standoff assembly as shown below, and slide down against the push nut. The o-ring may be brown or black. Then with the toothpick, place a small amount of Vaseline on the o-ring, as shown below.

We have included a brass and steel 6-32 threaded rod. Mechanically the function is the same. Electrically each has a different effect on the magnetic field when tuning. My test show more inductance change using the brass slug. Either one can be changed out easily while testing.

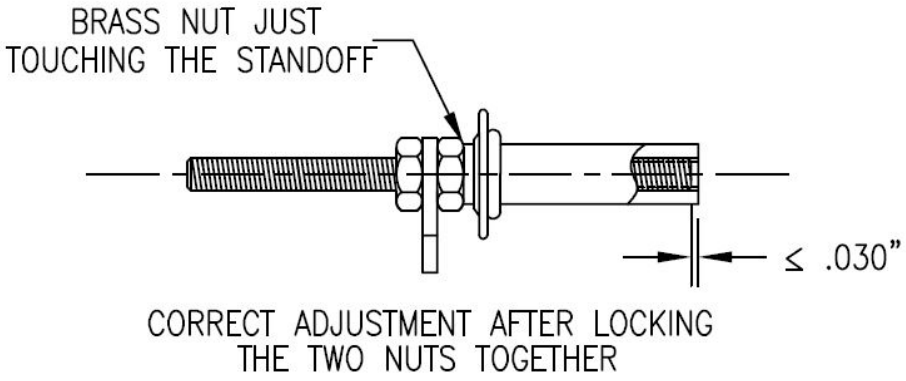
Place a small daub of Vaseline on the threads to lubricate them while inside the aluminum standoff.

Thread the 6-32 rod into the end of the aluminum standoff as shown below.

Thread the two 6-32 nuts onto the threaded rod sandwiching the “Tab” as shown below.

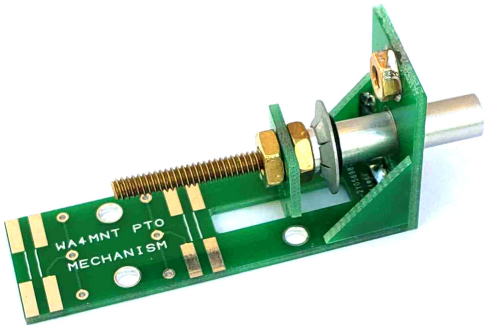


Thread the 6-32 into the aluminum shaft until it is just below the end of the shaft about 1/32”. Run the 6-32 nut down the shaft until it just touches the end of the aluminum shaft, then follow with the other nut, sandwiching the “Tab”. Tighten the two nuts against the “Tab”. The finished assembly should look like the graphic below. This configuration is important to the overall performance.



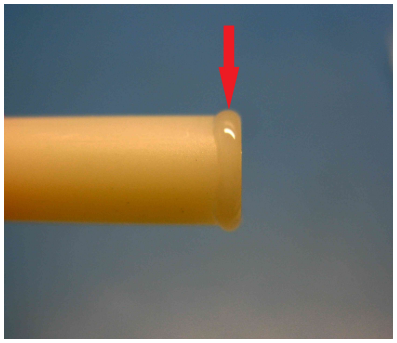
*****THIS IS IMPORTANT*****

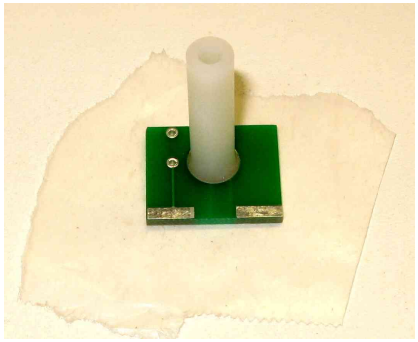
The shaft assembly can now be inserted into the frame assembly. Be sure the tap is in the slot of the base.

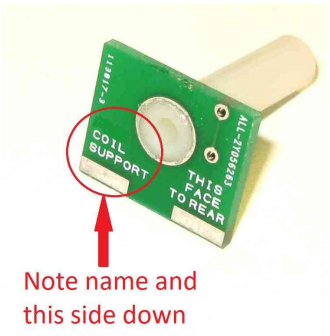


Preparing the coil form:

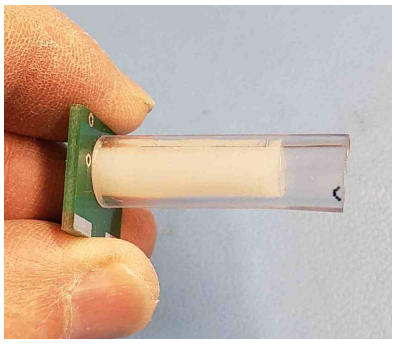
The 1/4” diameter coil form is designed as a light press fit into the Coil Support. With the varying tolerances of the support and coil form, it can be anything from a heavy press, to slip fit. Place the Coil Support with the text “THIS SIDE TO REAR” **down** against the flat work surface on a small piece of wax paper. If it’s a hard press, tap the nylon coil form in flush with the outside of the support. If it’s a slip fit, it may be necessary to use some adhesive. If so, use an epoxy or an instant adhesive. *Don’t forget the wax paper*, especially if you use an instant adhesive, or the coil support will become a permanent fixture on the work surface. Place a small amount of adhesive around the periphery at the end of the spacer and place in the 1/4” diameter hole *flush* with the bottom of the Coil Support as shown at the center picture, and shown finished on the right. Let it harden.

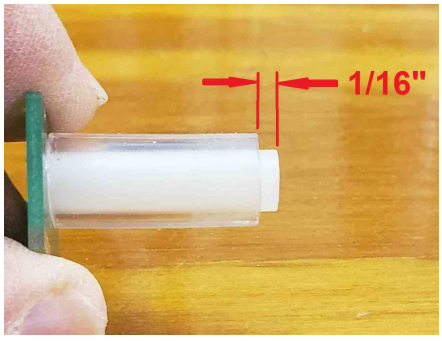






This next step is only necessary if you are going to use a Ø.375 coil form diameter. Square up one end of the Ø3/8” plastic tube, and slide over the end of the nylon spacer, then trim the excess back with your Exacto knife to a little more than 1/16” from the end of the 1/4” nylon spacer. It is easy to roll the assembly over a hard surface and pressing with your Exacto knife to trim the 1/16” shown below.

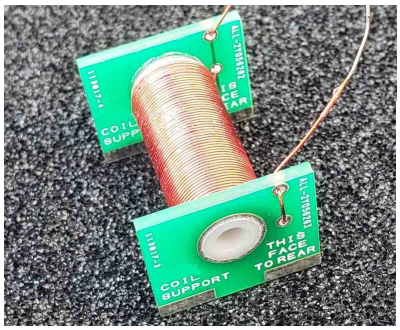


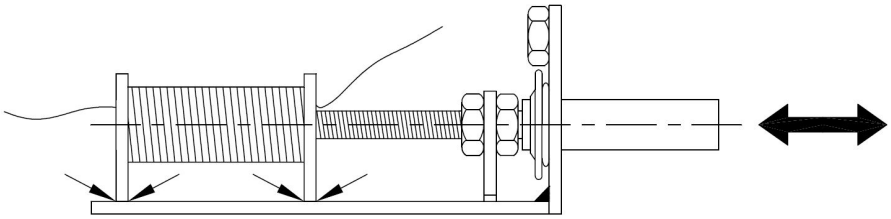


Next, press or cement the other coil support as shown below. Be sure both front and rear coil support are flush on the bottom edge before the glue sets up. The text on the supports should be facing the same direction, and be flush on the bottom edge as shown below.

Winding the coil form:

When you are winding, remember that the usable length of coil starts 1/16" from the inside faces of both coil supports, for a total of 3/4". You can route the wires through the front Coil Support, and the rear Coil Support holes temporarily if you are experimenting for the inductance. During testing, without the knob attached you can just slide the rod back and forth to check your inductance.

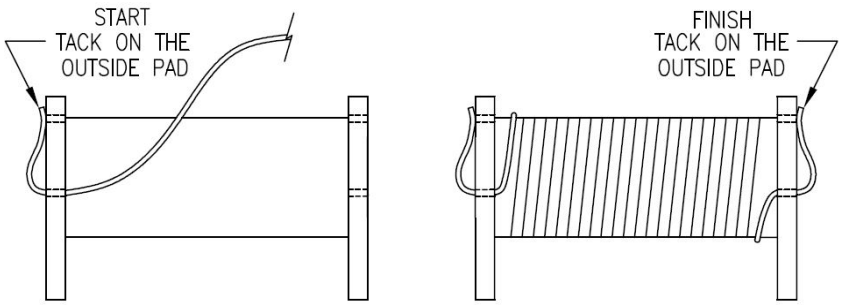




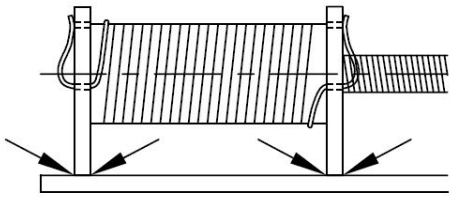
Note: During testing the contact pads in the Bottom Plate are not functional. When you are satisfied with the inductance, solder all the pads supporting the coil supports and the electrical connections in the base are functional.

Tip: I wind the coil, keeping it tight against the coil form, coat it with some clear nail polish, and let it dry. If you don't, and turn loose of it during or after winding you have a miniature Slinky to wrestle with. Been there, done that. With the nail polish dried, it is easy to take off a few turns if needed.

When you are satisfied with the inductance insert one end from the inside lower hole and tack it to the upper pad on the outside. Start winding from that point, do your winding, and secure to the other support in the same manner. This eliminates stress on the plated thru holes that can lead to problems. Keep the lower hole free of solder and the wire pass thru easily tacking on the upper pad on the outside. This technique can be used for both the primary and optional secondary winding if needed.



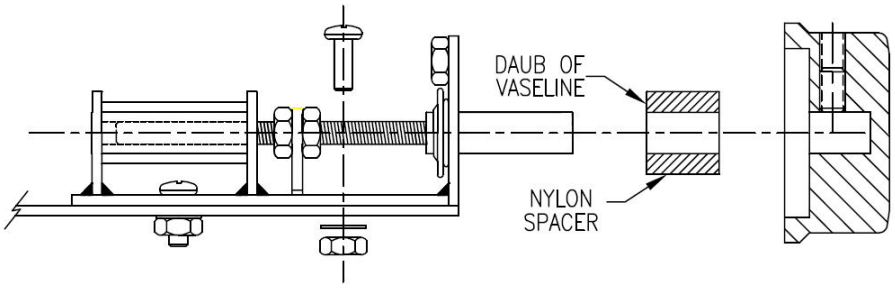
Finally, solder the two coil supports to the base on both sides as shown by the arrows and terminate the coils ends, completing the electrical connection between the coil and the interconnecting pads on the base. *Note, for temporarily testing, only the inside pads need to be tacked for the electrical connections to the SIP to be active.*



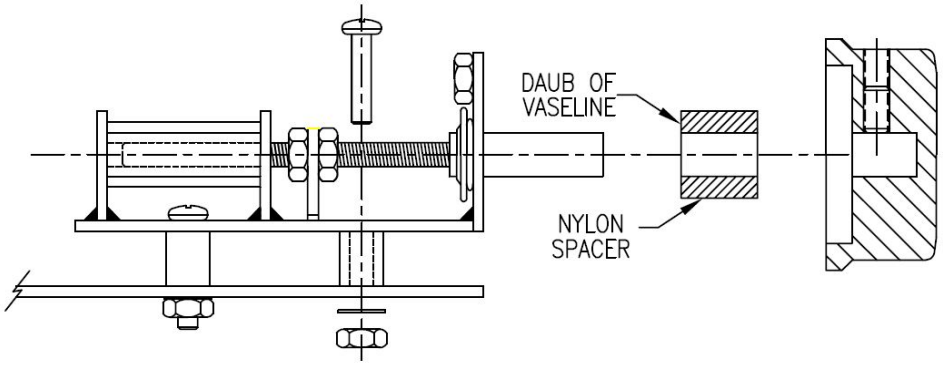
Mounting the PTO mechanism:

The envelope and interface dimensions are referenced at the end of this document. With the knob and spacer chosen in the BOM, there is enough 1/4" dia. depth in the knob to accommodate the aluminum standoff and the 7/16"L nylon spacer, in all three mounting options. The knob, nylon spacer, 1/16" thk. chassis thickness, o-ring compression, and shaft protrusion interact with one another. To mount the knob, put a small daub of Vaseline on the nylon spacer that faces the chassis or Front Plate. Then slide the nylon spacer onto the shaft, then the knob. Reach on the inside and very lightly compress the o-ring, pushing the shaft assembly into the 1/4" I.D. of the knob. Tighten the set screw on the knob. When the knob is secured to the shaft, you want a *some* compression of the small o-ring on the shaft. This acts as a light spring and eliminates any clearance between the shaft components. *If you compress the o-ring too much the knob is hard to turn, re-adjust for very slight compression.*

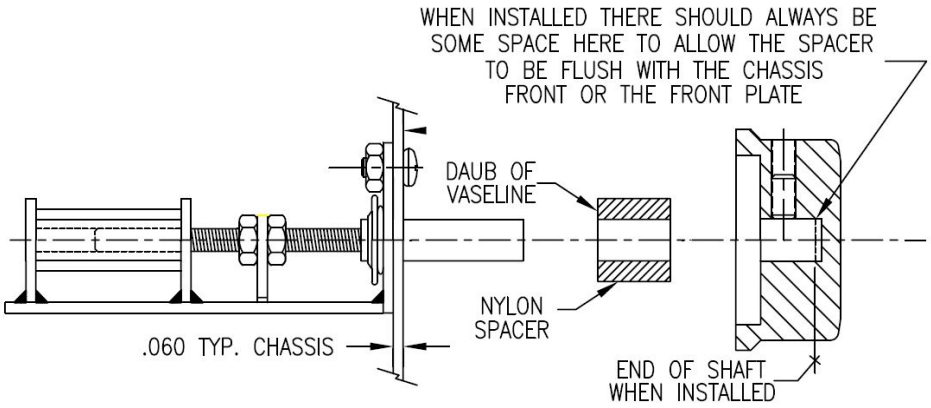
If you substitute a different knob, they vary in the amount of the backside counterbore and 1/4" shaft depth. A nylon spacer thickness change may be necessary.



Option 1



Option 2



Option 3

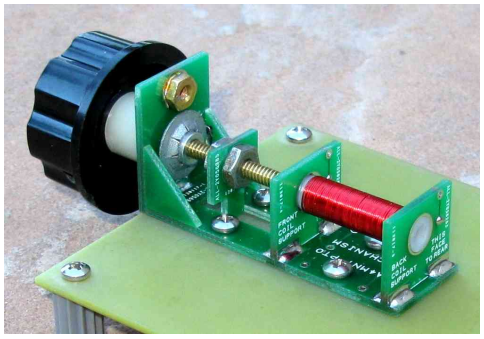
As shown above and below, the device can be mounted four ways.

1. Mounted with #4 hardware flush on a pcb.
2. Mounted to the pcb with spacers and longer #4 hardware to accommodate components underneath.
3. Mounted to the front of a 1/16” thk. chassis, suspended over a pcb, using the supplied 4-40 screw.
4. Mounted to the Development Board similar to Opt. 2. Download the separate document on the product web page.

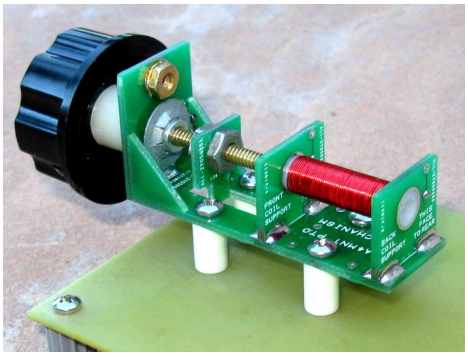
In the third configuration the device can be rotated 180º or 90º to either side to accommodate your circuit layout. For mounting this way, just maintain the 7/16” center distance between the Ø.25” and Ø.125” holes. Refer to the outline dimensions for details.

The device has a solid stop when the knob is turned in the CW direction. In the CCW direction there is increased resistance at the end of travel. The same knob and nylon shaft spacer works with all three mounting options shown here.

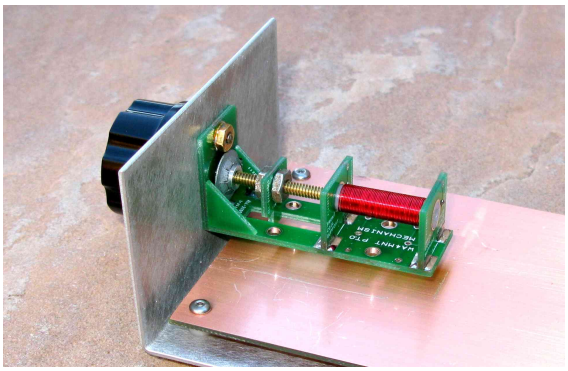
Option 1:



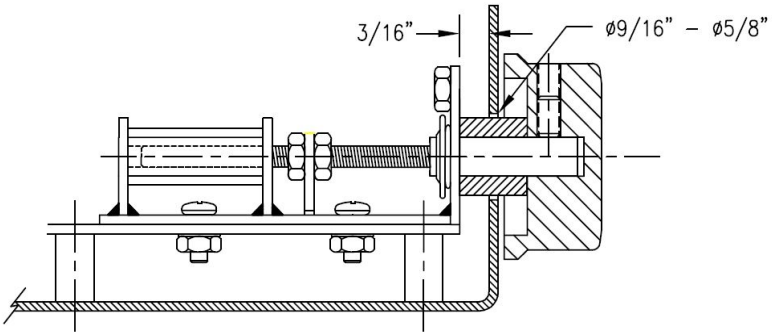
Option 2:



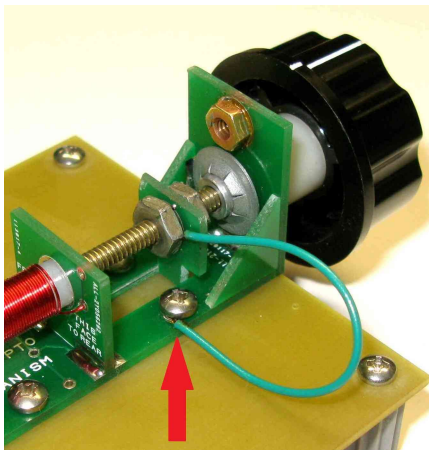
Option 3

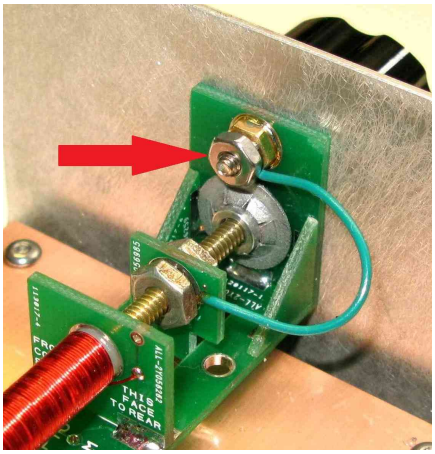


Option 1 and Option 2 can also be used in a chassis situation. Drill a Ø9/16” – Ø5/8” hole instead of the Ø.250”/Ø.260” hole in your chassis for clearance of the nylon shaft spacer, and mount the edge of the pcb 3/16” from the inside wall of the chassis. This also results in the ability to have the knob closer to the face of a chassis.



Depending on your VFO design you may encounter stray hand capacitance change in frequency when approaching the control knob. The threaded rod is insulated from the circuit and ground. To remedy this, simply run a ~2” long jumper wire between the 6-32 nut and the Tab, closest to the coil, to a ground connection with some 24-26AWG stranded wire. If you are laying out a pcb, put pads around the four mounting holes and tie them to ground. That way, you can easily run the jumper to under one of the screw heads. If you are using the chassis mount method, ground your chassis, and use a longer 4-40 securing screw and a extra nut to secure the end of the jumper wire. Consult the pictures below:





Why and how this works:

The reason this works is that the threaded rod (slug), that is moving inside the coil form, is prevented from rotating at all times, and the threaded aluminum spacer, tied to the knob, does rotate as the knob is turned but is prevented from moving towards or away from the coil form at all times. So, as the aluminum spacer is rotated, the rod *must* move forward or in reverse depending on CCW or CW rotation of the knob. The device is designed for .75" of travel of the threaded rod. I designed it with a threaded rod of 32 turns/inch, hence the total of 24 turns of linear adjustment.

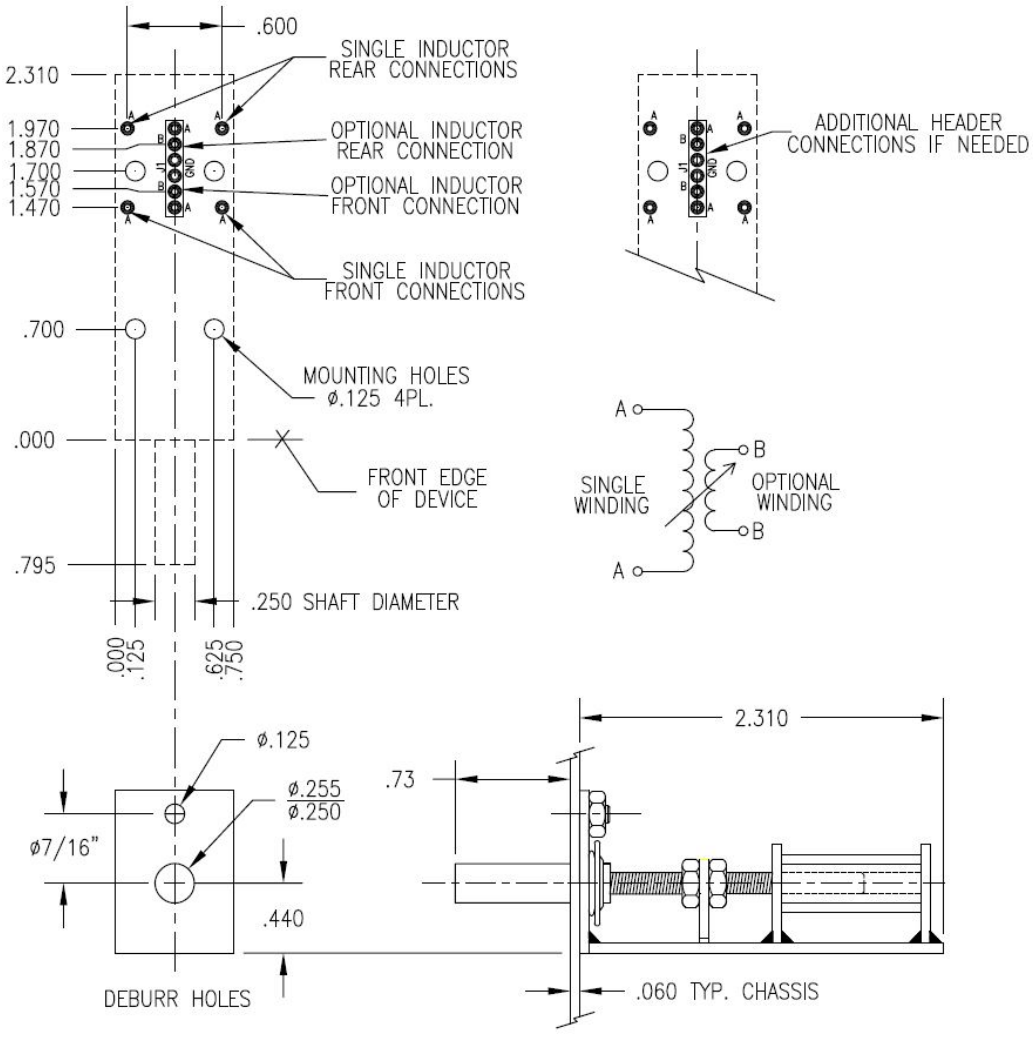
Depending on your circuit, I have allowed for an additional winding over the single inductor if desired. The "A" designated holes are used if you are going to have only a single inductor. Use the "B" set of connections if you desire an additional winding on top. If phasing is important, wind and terminate the winding accordingly.

Some general design observations: If you want to decrease the overall inductance and still can maintain the 3/4" ideal coil length, calculate for a heavier wire, as it will reduce the number of turns.

Check out the Complimentary PTO/VFO Development board, TinEar 40m Receiver, and the NorCal 2030 for how they used PTO designs. Let us know how you use the device.

Ken – wa4mnt

Outline and interface dimensions:



Notes: