

**End Fed Half Wave Tuner Kit**  
**The *original* SOTA tuner**  
**developed and kitted by KI6J**

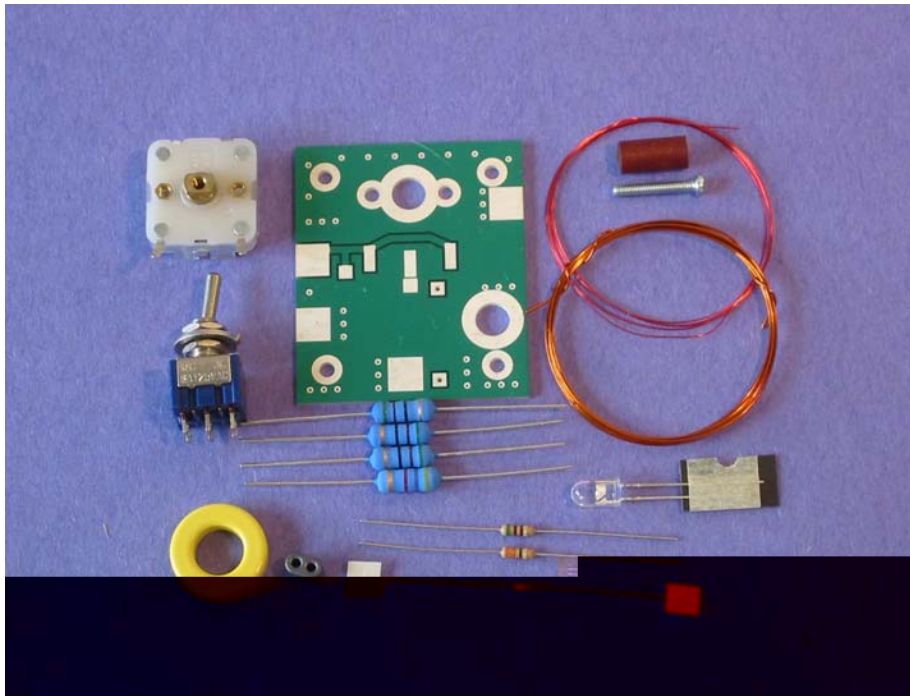


This kit was designed for use by travelers, packers, and other ultra/P amateur operators needing a lightweight, easy to deploy antenna system. Using this tuner, a portable station needs no ground radials and little or no feedline to achieve excellent results. Special attention has been paid to packability, durability, and reliability of operation. The tuner matches the impedance of end fed, half wavelength wires on the 40 through 15 meter amateur bands, and contains a built in SWR indicator.

The tuner handles QRP power levels (5 watt CW/digi and 10 watt PEP SSB).

Please look over the contents of your kit. It should contain:

- 1 Printed circuit board
- 1 DPDT toggle switch with mounting hardware
- 1 variable cap with 2 mounting screws
- 1 T68-6 iron powder core
- 1 BN43-2402 binocular core
- 3 51 ohm, 2 watt resistors
- 1 4.7k ohm, 2 watt resistor
- 1 clear/red high intensity LED
- 1 1N4148 diode
- 1 330 ohm, 1/4 watt resistor
- 1 510 ohm, 1/4 watt resistor
- 2 lengths of enameled wire, #24 and #30
- 1 shaft extender and screw set



If any of these parts are missing or damaged, please notify KI6J for prompt replacement.

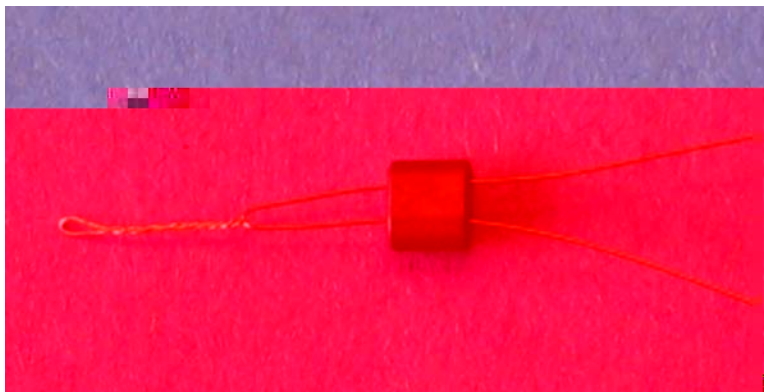
Please refer to the enclosure kit instructions for the contents and assembly of that option.

*Note:* If you intend to panel mount the tuner board, or use an enclosure other than the available pre-drilled option, the blank circuit board is your best choice to use as a drilling template for mounting holes and holes for the user controls. Be sure to orient the board with the “control” side towards the panel or enclosure front when placing holes. At the very least, trace the outline of the blank board and the hole locations using a pencil or fine point pen and some sturdy paper, and save this template for future reference.

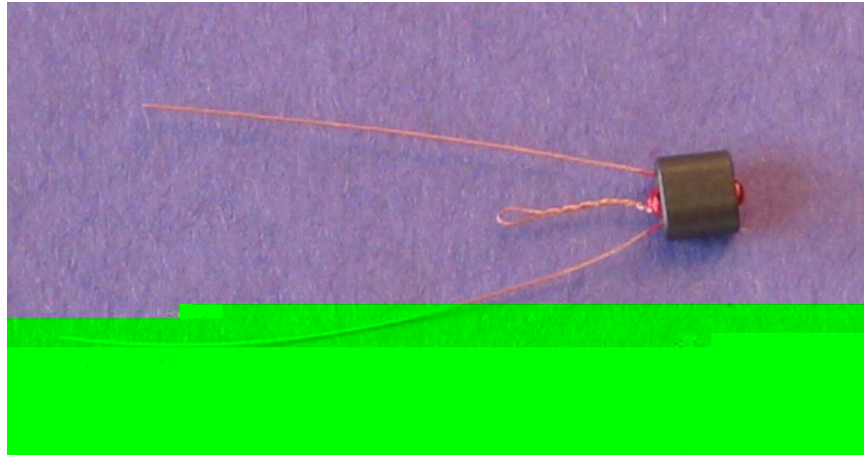
## Assembly

Let's start with the most difficult part of the kit assembly; once you are done with this, the rest is quite easy.

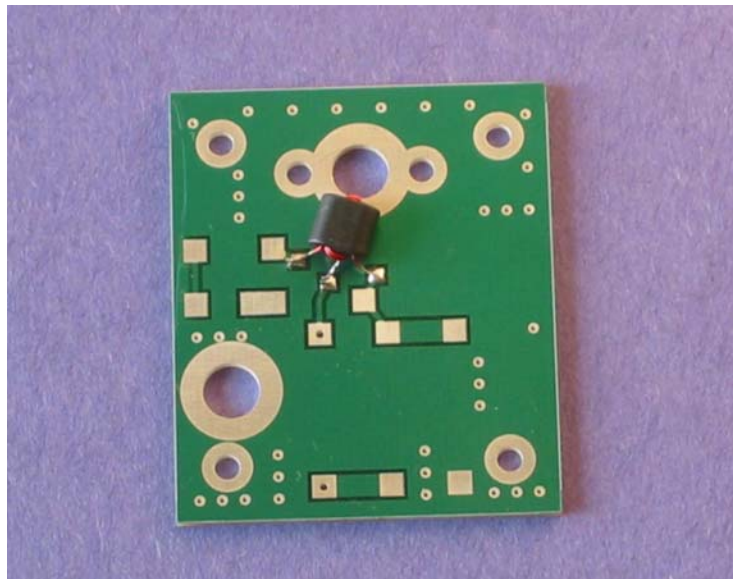
The step up transformer for the SWR bridge is 8 turns, center tapped, wound on the tiny binocular core. Start by cutting off an 8 inch piece of the #30 enameled wire, and cleanly stripping 1 inch of enamel insulation from the center. Fold the stripped section in half and twist the loop formed to create a center tap for the windings. Feed the two free ends through the two holes in the core.



Next, wind each of the two wires through the core such that each wire passes through both holes in the core four times. Wind one wire at a time, and wind nice and neat, so you can fit all 8 turns on the tiny core.

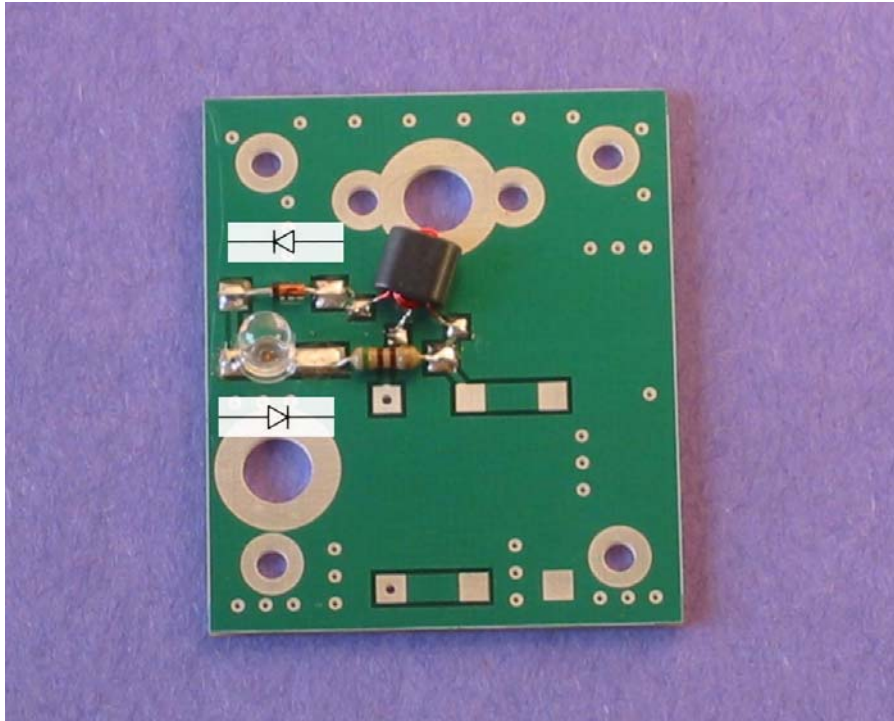


Strip the enamel on the two wires as close to the core as you can, and tin the leads with solder to aid installation. Tin the three mounting pads on the circuit board, and tack the transformer leads to the pads. Take care to locate the transformer clear of the big hole for the capacitor shaft. Trim excess leads neatly.



Don't worry, there is enough wire in the kit for several attempts.

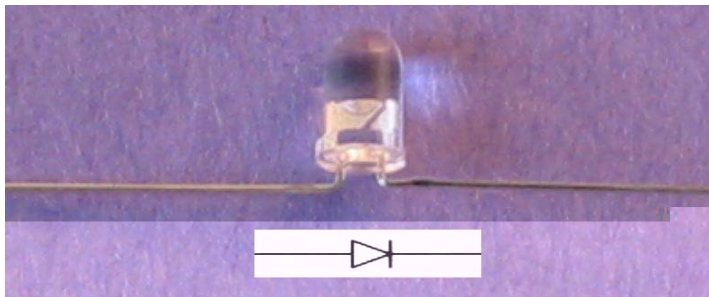
The remainder of the bridge parts are mounted as shown:



Note that the **cathode** band of D1 is oriented towards the **edge** of the board.

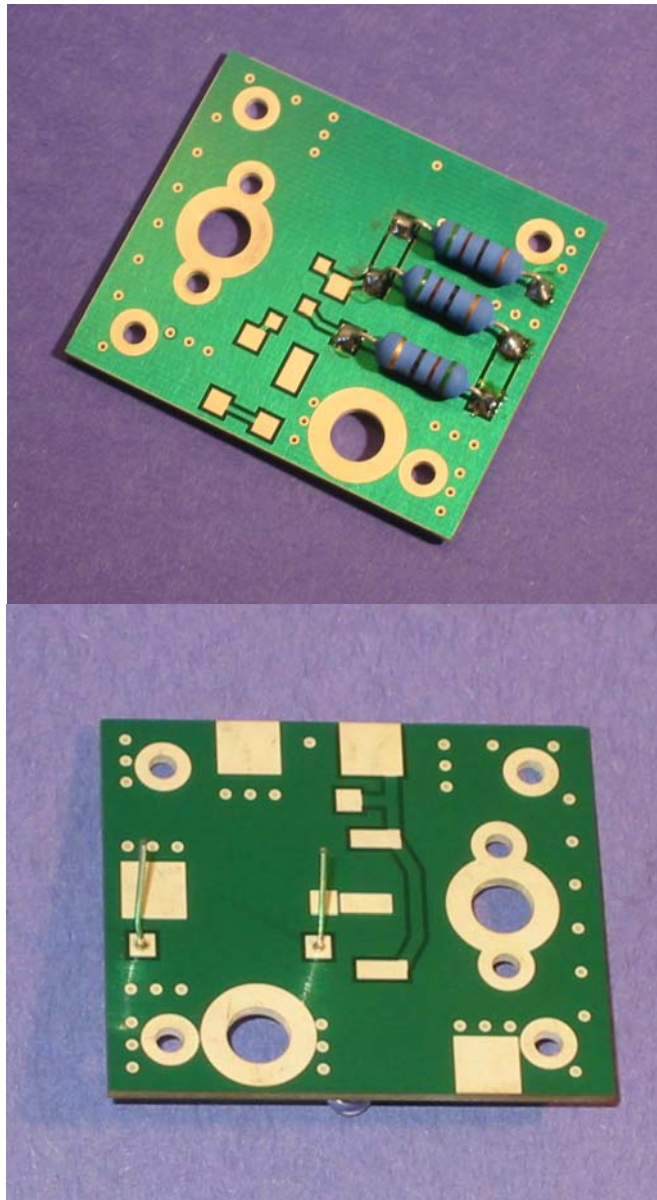
The LED is mounted with its leads bent out about 1/8 inch from the body, and with the **cathode** lead towards the **center** of the board. Take care to center the LED between its mounting pads.

The cathode lead is the one connected to the smaller metal chunk inside the LED.



There are two choices of bridge indicator resistor provided with the kit. If you plan to regularly use this tuner at power levels below 1 watt, choose the 330 ohm, otherwise choose the 510 ohm.

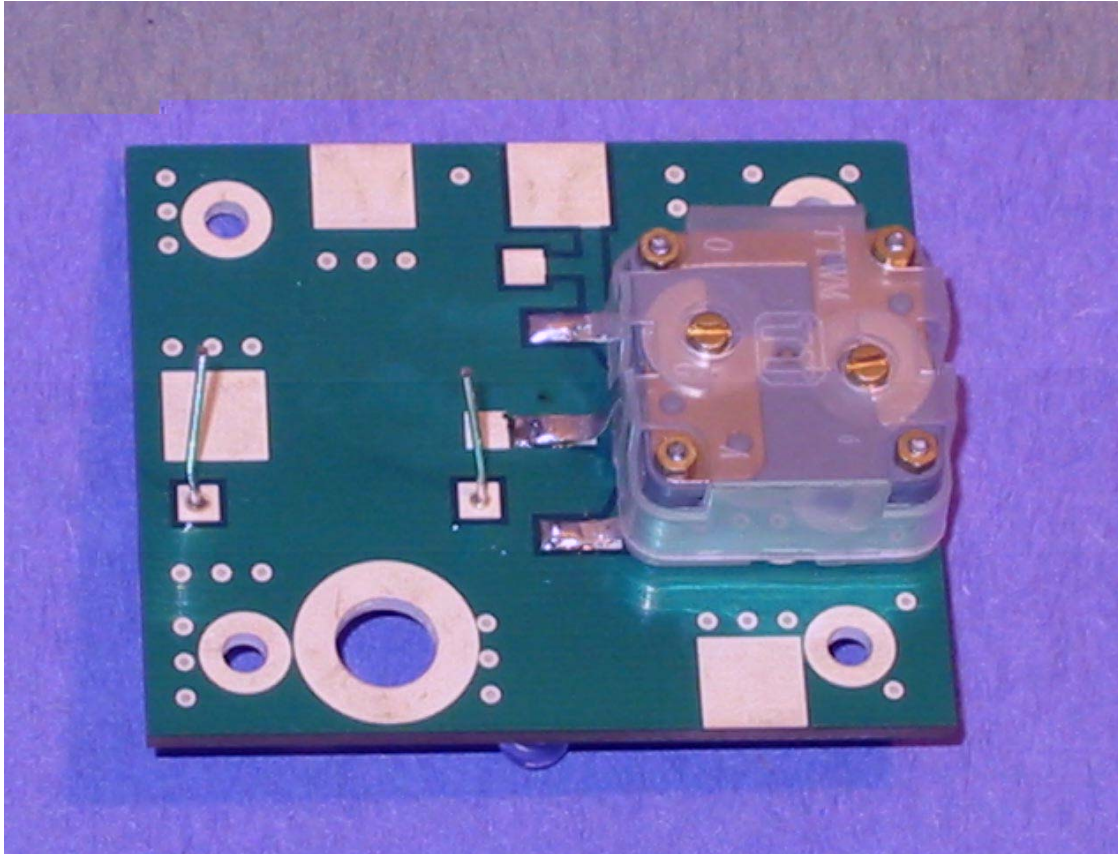
Next, mount the two 51 ohm resistors on their surface mount pads, and the remaining 51 ohm resistor on its through-hole pad. **Do not trim the leads on the through-hole mounted resistor, as you will need them to connect to the switch later.** Take care to mount all of the resistors nice and tight against the board. **Remember, don't trim the through-hole leads!**



**Don't cut the leads!**

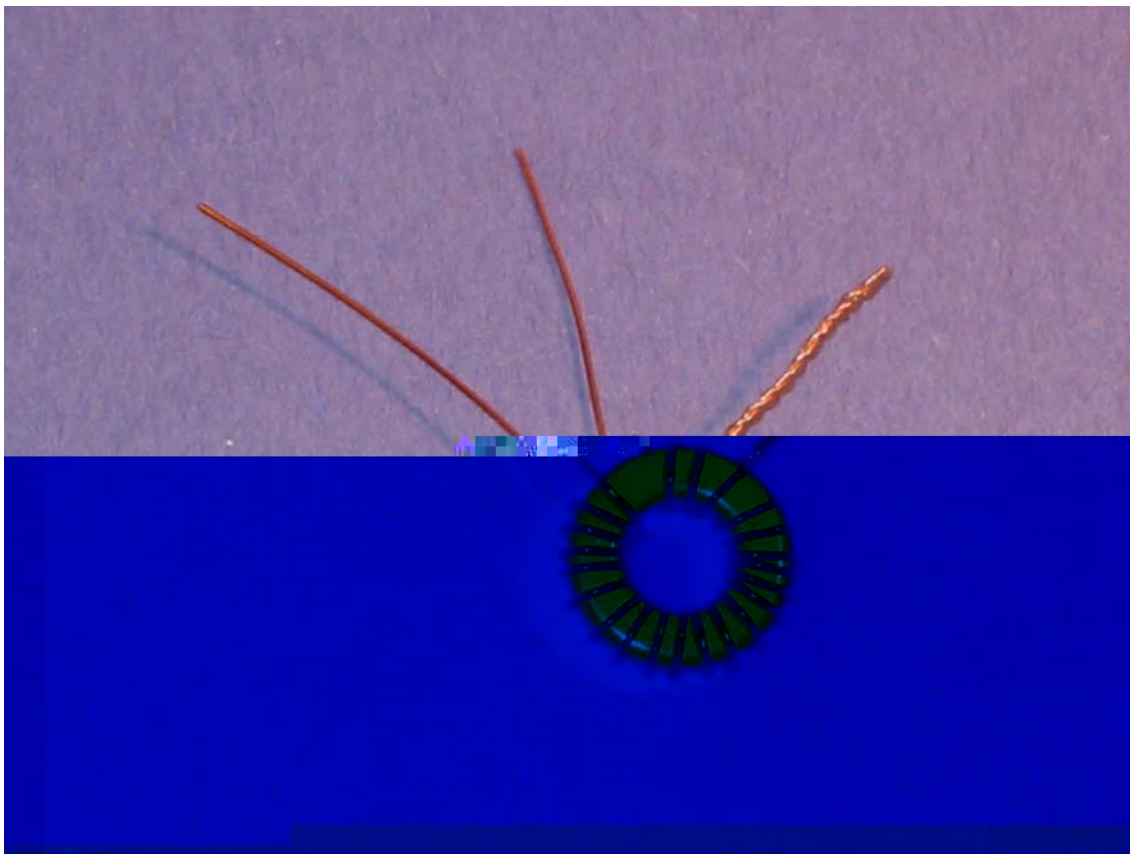
The SWR bridge is now done. Next the matching circuit.

Fit the variable capacitor to the circuit board, carefully bending the three leads to align with the three solder pads. Trim the leads to fit the pads. Remove the capacitor and lightly tin the three mounting pads. Reinstall the capacitor and secure with the two mounting screws. Solder the leads to the pads. Don't linger with the soldering iron; the plastic cap is easily melted! A small flat tipped screwdriver or other appropriate tool will aid in pushing the springy leads down on the board, as well as acting as a heat sink to protect the plastic capacitor.



The tapped inductor is wound with 22 total turns of #24 enameled wire on a T-68-6 core. The inductor is tapped at three turns from one end. To begin, strip about 2½ inches of enamel insulation from the #24 wire, beginning about four inches from one of the ends. Fold and twist to make a tap lead. **Don't make the tap lead too short;** you need the tap to reach the switch terminals when installed.

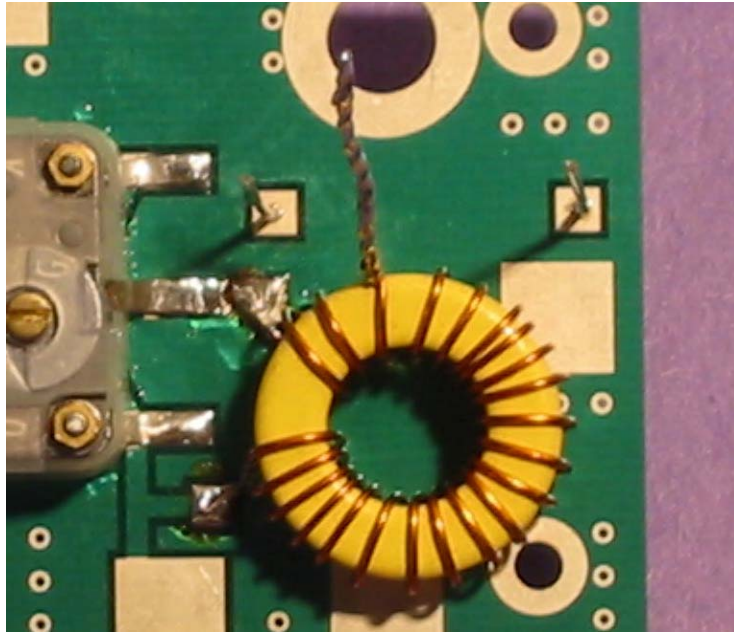
Next, wind the toroid. I'm not going to tell you how, but a nice picture of a properly wound inductor follows:



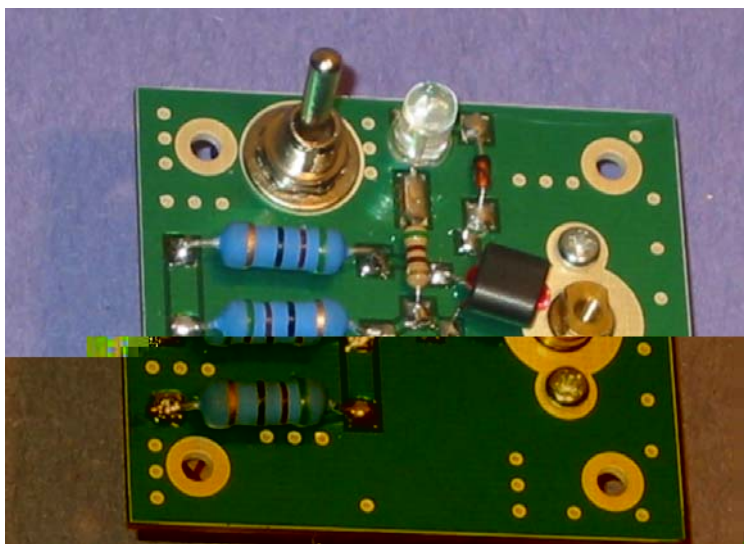
Note that the short section of the wire passes through the interior of the core 3 times, comes out the bottom of the toroid, and forms grounded lead. The long section of the wire passes through the core 19 times, and forms the high-Z lead, coming out at the top. Winding your inductor as shown will make placement on the board much easier.



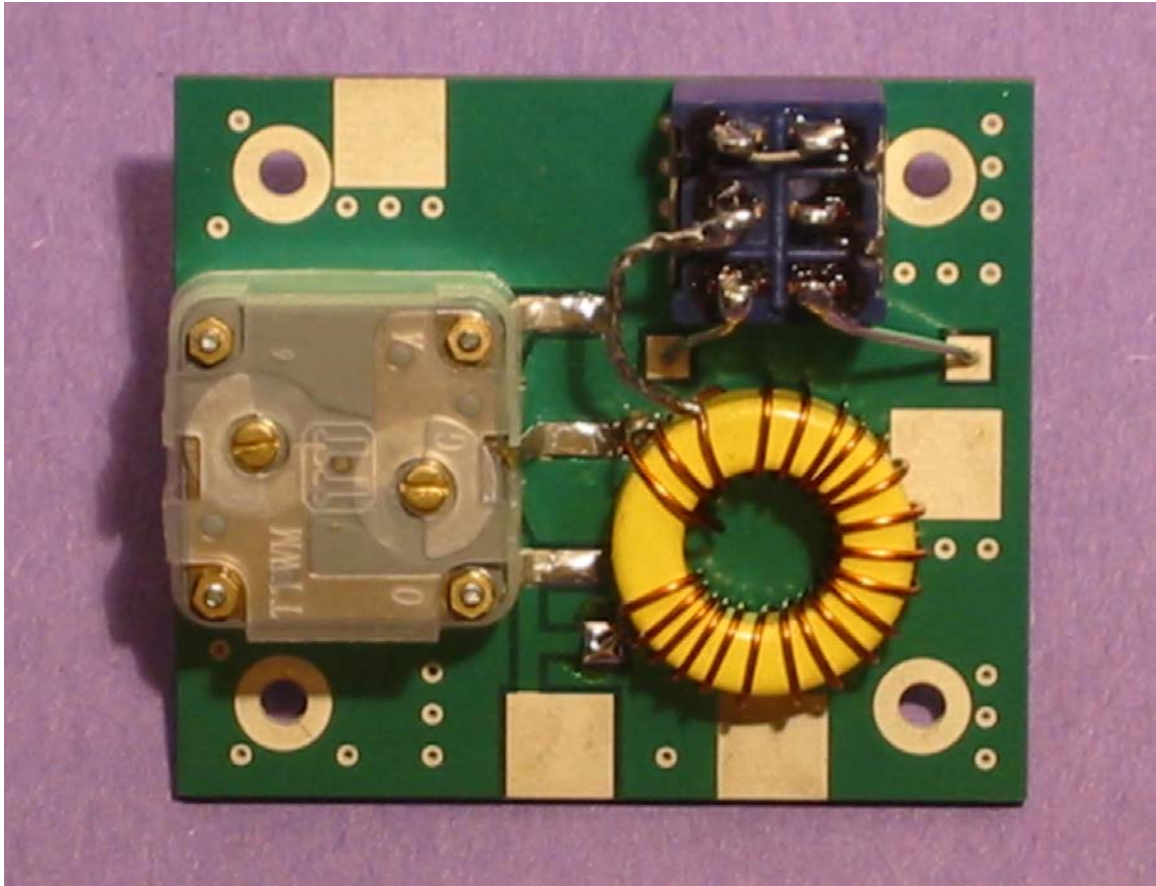
Strip and tin the two single-wire leads (tinning the tap lead later makes it easier to route to the switch neatly). Tin the small ground plane pad next to the capacitor ground and the small high-z pad next to the output pad. Tack the two leads to the board with a minimum of excess wire, and trim.



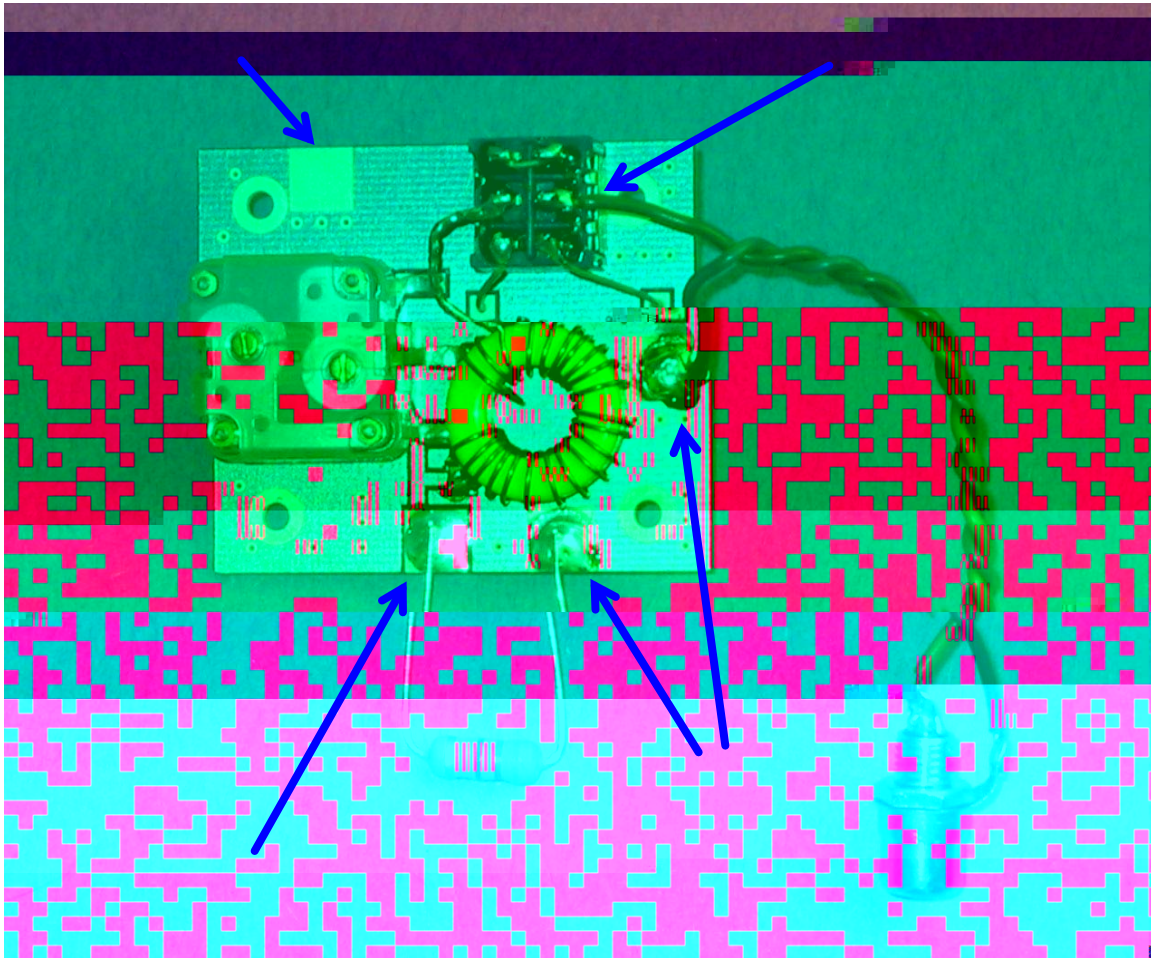
Mounting and connecting the switch will complete the board. Do not put any mounting hardware between the body of the switch and the board, and use the star washer and one nut to secure it. The keyed washer and second nut are not used.



Route the two resistor leads (surely you didn't cut them) and the inductor tap lead to the appropriate terminals on the switch. Place a shorting lead across the two terminals of the switch near the board edge. Solder the switch leads in place. Solder tin the tap lead for added rigidity.



The tuner board is now complete and should be tested before you put it in an enclosure. Temporarily solder the 4.7k dummy load resistor across the output and ground plane pads. Temporarily solder a RF connector to the appropriate switch lead and ground plane pad. Set the trimmers on the cap in the minimum position as shown in the photo, with no overlap of the trimmer's half-circle plates.



Place the switch in the “tune” position to switch in the bridge (toggle towards the center of the board). Apply a watt or two of power, and confirm the operation of the LED indicator. The led should light brightly with the circuit un-tuned. Adjust the trimmer cap to resonance, and confirm that the LED extinguishes, indicating a good match.

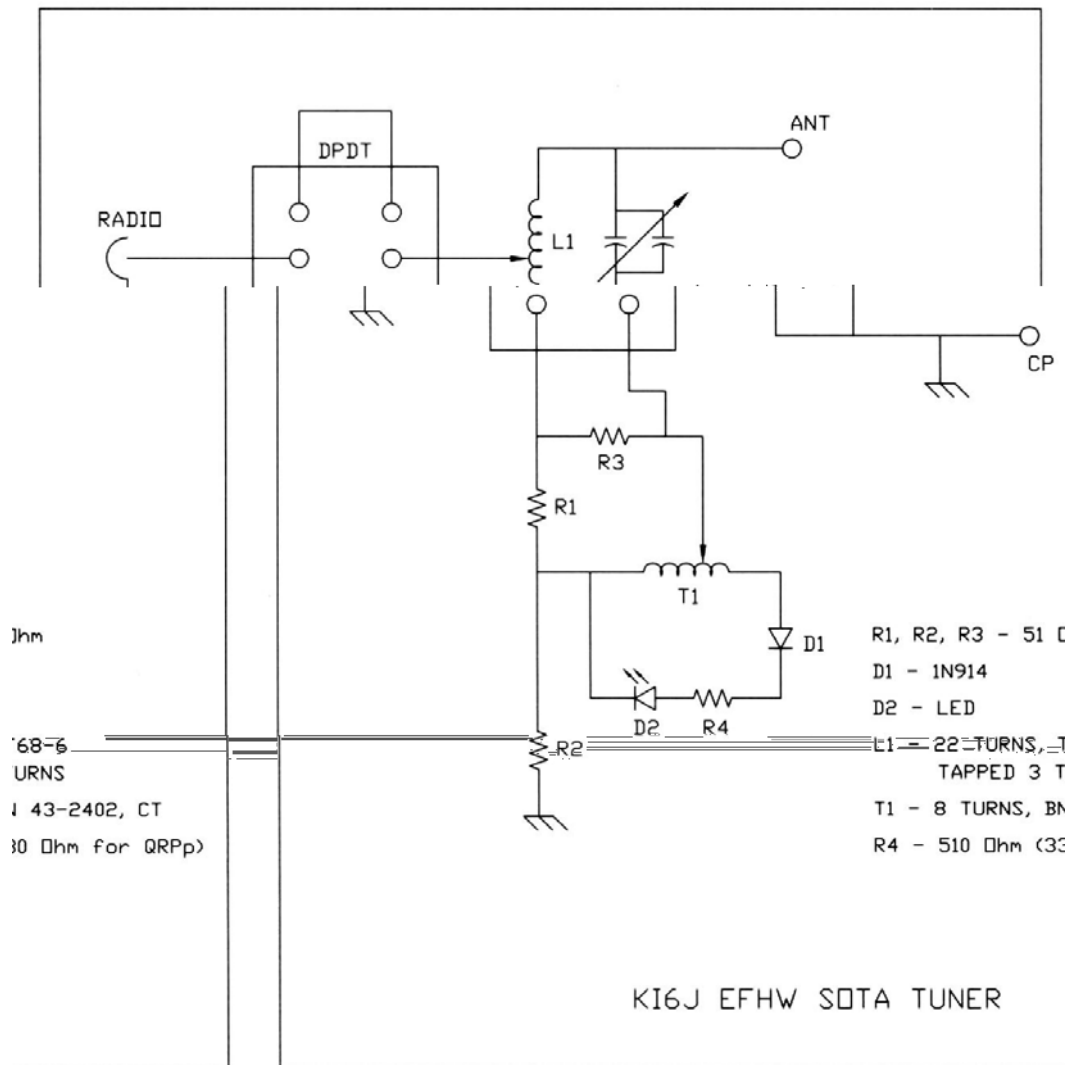
You can repeat the above procedure to confirm matching on the 40 through 15 meter bands, or you can use an antenna analyzer, an

SWR meter, or noise bridge to verify the match. If you use an external instrument, be sure to switch to the “operate” position for these measurements.

If you find that the match for 40 meters occurs too close to the mechanical stop of the capacitor, add a little overlap to the trimmers to move the matching point.

After the tests are successful, you may wish to secure the inductor to the circuit board with a dab of hot melt glue to make the assembly more shock resistant.

## Schematic



## Tips for using the tuner

Cut your antenna element to one half wavelength at the frequency of interest. A wire that is about 3% longer than that given by the standard dipole formula ( $468/f$ ) tends to work best. A single wire length can tune as much as 200 kHz of a band with minor adjustments to the tuning circuit, so this length is not critical.

Use as little coax feedline as possible between your rig and the tuner. Lengths up to three feet give the most consistent results. Feedline length contributes to ground losses, and long feedlines reduce the efficiency of the system, as well as de-tune the radiating element.

The wire element may be deployed vertically, as a sloper, as an inverted V, or as an inverted L. The preferred configuration will be dictated by terrain, available supports, and operator preferences.

Many builders have had consistently good results using no “counterpoise” connected to the tuner’s ground plane. This is especially true when feedline lengths have been kept very short. If a particular deployment tunes up nicely with no additional wire connected to ground, leave it off. If you want to try adding wire to ground to help correct for a stubborn deployment, keep it short. You should never need more than three feet.

It is a good idea to switch in the tuning bridge and check your match occasionally while operating in the field.

Having your 4.7k dummy load in the field can help troubleshoot stubborn deployments. If the tuner indicates a match to the dummy load, then it is working just fine. This is a good reason to include a ground lug on your enclosure.

Enjoy every QSO.

A special thanks is extended to those who helped develop this kit: Jim, K9JWV for initial encouragement and relentless testing of prototypes, Fred, KT5X for sharing modeling and experimental data, and for pioneering the T-68 toroid mod, Mr. Dan Tayloe for blessing the use of his bridge design, and Frank, KR6AL for creating this PDF and sourcing parts. Mostly I want to thank those who have purchased, built, and enjoyed the kit.

72, Stu KI6J