

Hendricks Qrpkits SOTA tuner

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Here are some of my experiences in building, slightly modifying, and using the Hendricks Qrpkits summits on the air tuner.

I. INTRODUCTION

I like to take my KD1JV designed ATS4a along when I travel. With such a small rig, the only remaining problem is finding an adequate antenna. After first trying a center fed dipole and having difficulty getting it into the clear, I became convinced that the end-fed half-wave antenna was the best compromise for my operations.

I first homebrewed a couple of matching methods. A simple ferrite transformer was one possibility. However, my designs when kept small, while they gave me many QSOs were rather lossy. The tapped tuned transformer tuner I built worked better. As I was trying to figure out the best way to package my tuner, I noticed that Hendricks QRP kits had introduced their summits on the air (SOTA) tuner which was just such a tapped, tuned transformer along with a Dan Tayloe, N7VE designed LED resistive return-loss bridge as a tuning indicator. The cost of the kit is \$30 plus \$7 shipping and handling. You can clearly buy or scrounge all the electrical parts for substantially less, but to get it all into as nice a package would have cost more in my time, so I decided to buy the kit.

On his web site, Doug Hendricks, KI6DS, says to allow 1 to 2 weeks for kits to be shipped. In my case, I ordered the kit on a Thursday, and it arrived in my mailbox on the following Monday, just 4 days later.

II. BUILDING THE KIT

The kit is supplied with decals for the labels on the case. Two sets of decals are supplied in case of a problem, however, the “Antenna” label was left off the second set of my decals so I was extra careful placing it. Decal labels mean that, even though the kit contains only a hand full of parts, it will take several days to put it together. I began by thoroughly washing the aluminum case. I then threaded two junk box 4-40 bolts into the case fasteners to keep them from getting clogged, and sprayed the case with Rustoleum clear lacquer that I had left over from building a W5JH baby black-widow paddle. I let this dry for 24 hours before applying the decals. I then sprayed several more coats on letting it dry between them. Unfortunately, the transparent decal backing is still visible so you can see lines around the labels where I cut out the decals. Looking carefully at the photographs on the qrpkits.com website, I can see similar outlines around the labels there, although they are somewhat less visible in those photographs than on my unit. Figure 1 shows my

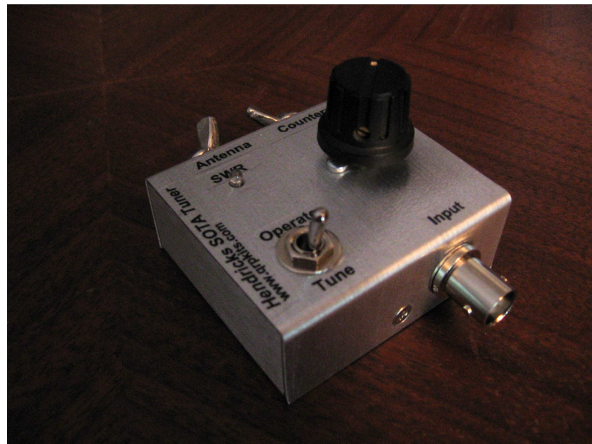


FIG. 1. My SOTA tuner. The decal outlines are visible. The switch has been flush mounted.

unit. I should mention that the assembly manual specifies spraying matte finish clear Krylon over the decals rather than the Rustoleum I had on hand. Krylon may hide the decal edges better.

Looking at the pictures on the qrpkits.com web site and at the assembly manual, I didn't like the fact that the tune-operate switch for the SWR indicator was not mounted flush with the top panel of the box, but instead stuck up from the panel quite a bit. With the kit in my hand, it is clear why the switch was mounted in this manner. The resistors in the return-loss bridge are mounted on the bottom of the circuit board, and the switch body has to stick up through the top panel in order for the resistors to clear the bottom of the box. Further, the circuit board if mounted closer to the bottom of the box gets in the way of the fasteners holding the box together.

It is clear when assembling the circuit board, that there is plenty of room to mount the resistors on the top side, however, one of them has to mount on longer leads above the top of the toroid. Since the tuner's highest frequency is 15 meters, the extra half inch or so of lead length has negligible effect on the performance, so I mounted the resistors on the top of the board. I also connected the wiring to the rest of the tuner on the top of the board. Test mounting the return-loss bridge showed that with the switch flush mounted to the top panel, the circuit board easily cleared the bottom of the box. As mentioned above, there is one remaining problem with this modification. One corner of the circuit board near the switch interferes with one of the fasteners that holds the box together. Since there are no traces on the circuit

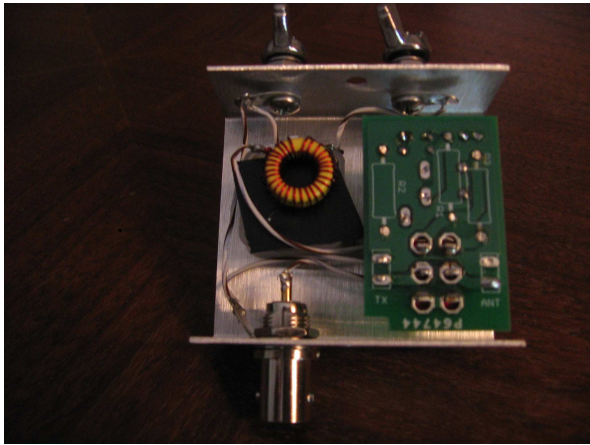


FIG. 2. A bottom view of the inside of the tuner. Note the small notch in the lower left corner of the circuit board, and that no components are mounted on the bottom of the board.

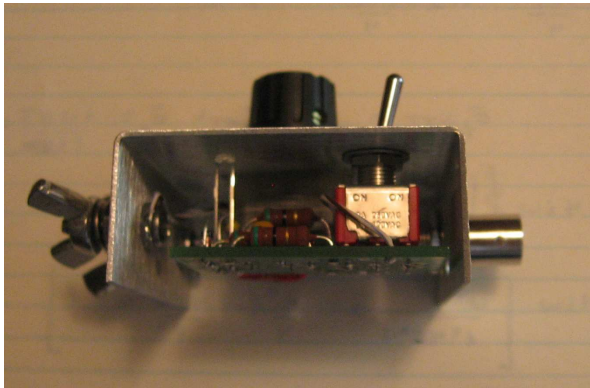


FIG. 3. A side view of the inside of the tuner showing the return-loss bridge resistors mounted on the top of the circuit board and the flush mounted switch.

board in that corner, I cut a small notch in the corner of the board in a few minutes using an ordinary hand file. A photograph of the mounted modified board is shown in figures 2 and 3.

The rest of the kit went together easily.

III. TESTING AND PERFORMANCE

I tested out the kit first using a 3300 ohm half watt resistor across the antenna-counterpoise connections. Using my ATS4a and a separate return-loss bridge as comparison, adjusting the capacitor, the LED dims a lot and the other return-loss bridge shows only a small amount of reflected power. I connected a potentiometer across the output, and found that I got the best match on 20 meters at around 3000 ohms. This seemed reasonable. The toroid transformer has a 7:1 turns ratio, so a perfect transformer would transform 50 ohms to 2450 ohms. Leakage inductance of the secondary would be tuned out

Band	Loss in dB
15m	0.5
20m	0.3
30m	0.3
40m	0.3
80m ^a	0.9

^a An external 500 pF silver mica capacitor was connected between the antenna and counterpoise connections for 80 meters.

TABLE I. The calculated loss in the tuner from my crude rf voltage measurements.

by the capacitor. Tuning out the leakage inductance of the primary would require increasing the capacitance which is like adding an additional L network made up of the primary leakage inductance and the additional tuning capacitance increasing the output impedance.

My tuner worked on 40 meters to 15 meters with the resistor dummy load, but the capacitor was against its stop on 15 meters. I therefore, readjusted the trimmer capacitors on the polyvaricon to put them at minimum capacitance (the instructions say to set them at their midpoints) and I moved the windings of the toroid a bit to minimize self capacitance. After that there was some range for the 15 meter adjustment.

Since my ATS4a also covers 80 meters, I checked to make sure the method I have used with my homebrew breadboard tuner works. I connected a 500 pF silver mica capacitor externally between the antenna and counterpoise terminals. This allowed me to get a low SWR into my 3300 ohm resistor dummy load on 80 meters.

As a quick test to make sure the tuner's efficiency was reasonable, I measured the voltage across the my tuner load (using a voltage divider) with an rf probe. I did this using my ATS4a through a 6 dB pad with the SOTA tuner tuned for minimum LED brightness. I then compared the calculated power with the output power of the ATS4a calculated from the measured voltage across a 50 ohm dummy load, again with an rf probe. The results are shown in table I. I make no claims about the accuracy of this measurement technique, especially since it involves subtraction of two independent measurements at different impedances, and mismatch losses are not separated from real losses. My guess is that the results could easily be off by more than 0.2 dB. In any case, I found these measured losses to be in line with what I expected and completely acceptable. For 5 watts out of the transmitter 0.3 dB corresponds to $\frac{1}{3}$ watt, 0.5 dB corresponds to $\frac{1}{2}$ watt, and 0.9 dB to 1 watt.

IV. USING THE TUNER

Everyone always expects some anecdotal QSO information, so here it is for what little it's worth.

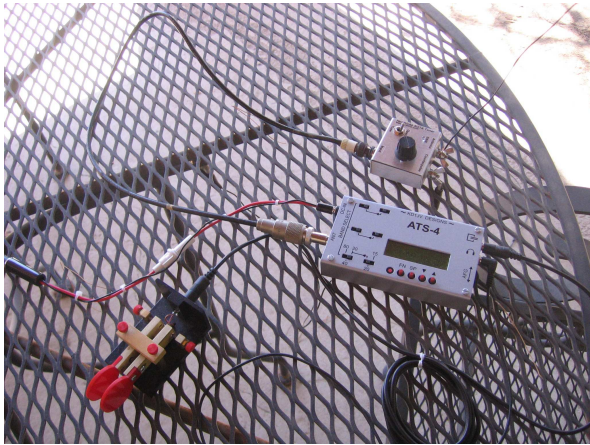


FIG. 4. A top view of my travel rig set up on our backyard patio mesh table. The transceiver is a KD1JV ATS4a, the paddle is a baby black widow by W5JH, and the antenna is fed with the Qrpkits SOTA tuner.

I did my initial testing on our back yard patio with a half wave wire for 20 meters – one end connected to

the tuner and the other end thrown up into a nearby tree limb about 20 feet up. I connected the counterpoise terminal to the metal patio table, although when I disconnected the counterpoise terminal later it didn't seem to change anything. The ATS4a transceiver was running a little less than 5 watts output. The setup is shown in figure 4. The antenna tuned up fine. I tuned around the band a little and heard 6V7Z calling CQ on 14021 KHz. I had to repeat my call before he heard me, but I did manage to get through for a quick QSO. Tuning around a bit more I next worked VP5/W5CW and then V5/DK6XZ. Of course if conditions are decent, you can work anywhere with almost any sort of antenna, but this did show that some rf was leaving the antenna and making it from Arizona to Africa and the caribbean.

V. DISCLAIMER

I have no connection to any of the companies that made products mentioned here other than being a satisfied customer.