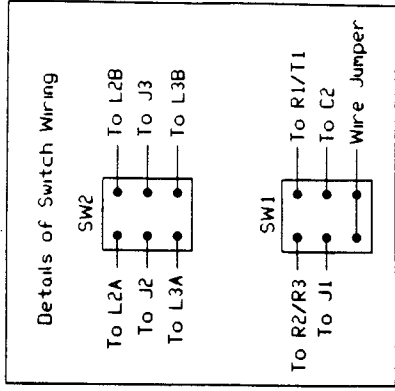
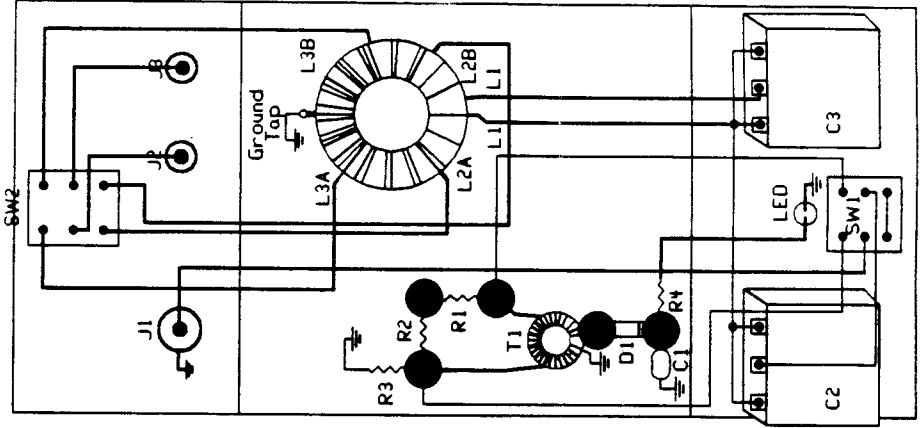
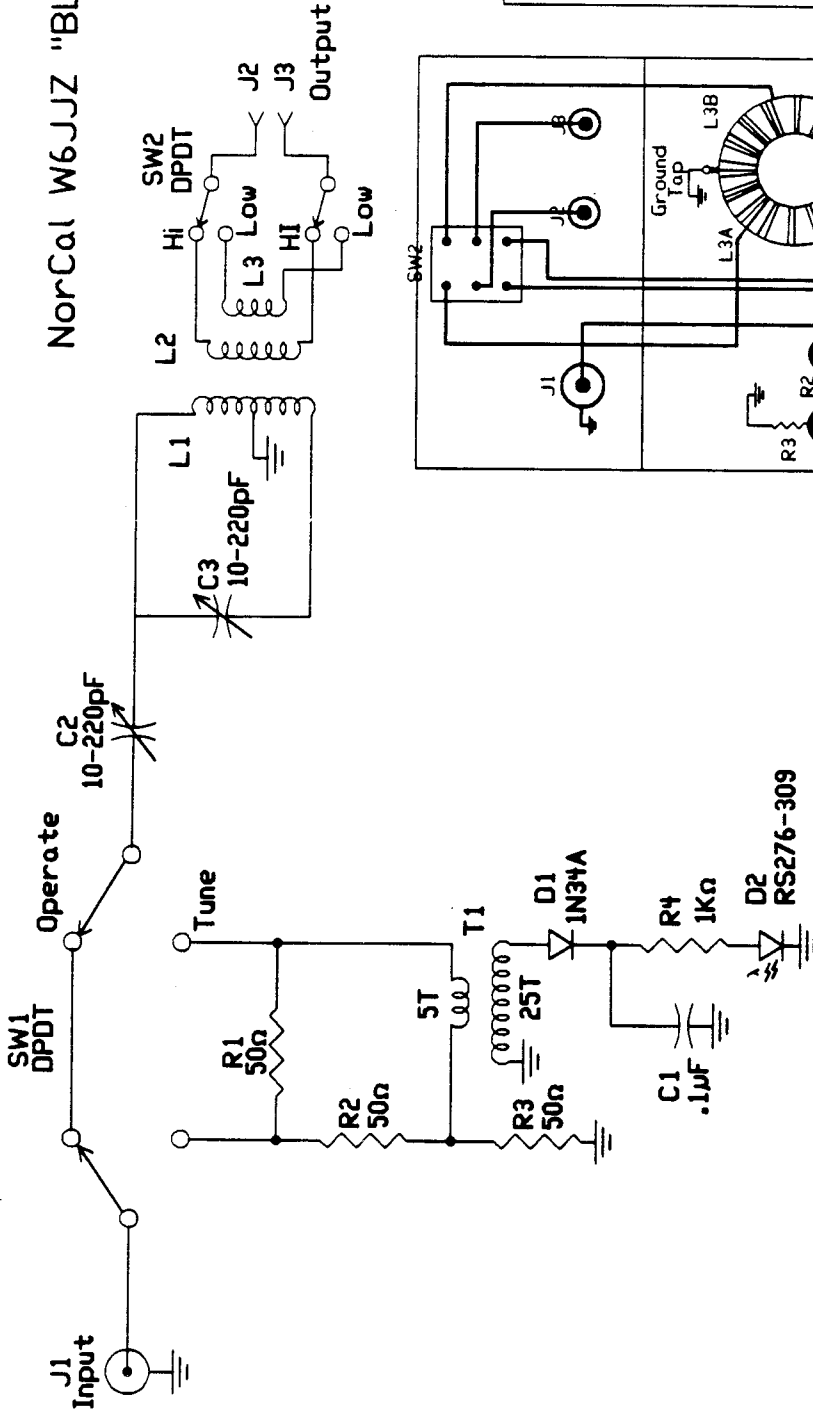


NorCal W6JJZ "BLT" Tuner



- C1, C2 = 140/80 "Poly" caps with sections in parallel
Be Sure to set trimmers to 0.
- L1 = 16T #22 Enameled Wire on T106-2 Toroid
Tapped at 8 Turns to ground
- L2 = 12T#24 Enameled Wire centered around
ground tap on L1, and interwoven with turns of L1
- L3 = 6T #24 Enameled Wire centered around ground tap
on L1, and interwoven with turns of L1 & L2.
- T1 = 5T Primary, 25T Secondary on FT37-61
- R1, R2, R3 = 2 - 100 ohm resistors in parallel.

NorCal W6JJZ "BLT" Tuner Kit Manual

Designed by Charlie Lofgren, W6JJZ

Thank you for purchasing a NorCal W6JJZ Balanced Line Tuner Kit. The tuner was designed by Charlie Lofgren, W6JJZ, who is renowned in the QRP World as a tuner expert. Charlie has built all of the tuners used by the Zuni Loop QRP Expeditionary Force for years, and they all swear by them.

This tuner is a balanced line tuner only, and will not work with coax feedlines unless modified as shown in the mods and improvement section. But it works great with open wire feeder, ladder line, zip cord, and ribbon cable. As long as you are using balanced line as a feedline, this tuner will work.

Charlie designed this tuner to work specifically with the polyvaricon variable capacitors available from Mouser. I asked him to design it at first because I wanted a simple tuner for a presentation that I was doing at the Ft. Smith QRP Group Forum, ArkieCon 2000. It turned out so well that everyone who saw it wanted one. Thus the NorCal W6JJZ BLT Kit was born. I would like to thank Charlie for his efforts on behalf of NorCal. This one is going to be a classic.

The design is for a classic Z match, using inductive coupling with L1, L2 and L3 wound on a single T206-2 toroid. L2 or L3 is switched in and out of the circuit by Switch 2, located on the back panel of the tuner. The "high" and "low" positions on the switch for the output links may need clarification. The positions are for "high" and "low" in terms of impedance, not frequency. For a given band and antenna, try the high Z link first and use the low Z link only if a match can't be found with the high link. (Often either link will allow a match. In these instances, the high Z link produces better efficiency as a result of loading the tank circuit more heavily.)

The circuit also includes the famous N7VE LED SWR indicator circuit. Dan Tayloe invented this several years ago, and it has proven a great addition to the qrp fraternity. This allows us to have an indication of lowest SWR on the tuner (indicated by dimming or LED going out at minimum SWR).

The circuit also is an absorptive bridge, which means that your transmitter sees a 50 ohm load as you are tuning up, which will help to save your finals. This tuner is rated at 5 Watts. I doubt if the polyvaricon caps will take the 100 Watts of your big rig!!

The first step in building the rig is to build the custom case. The case is made out of .060 pboard stock, and has been precut to size for you. All that you have to do is drill the holes for the front and rear panels, and then solder the kit together.

If you have tried to build a case out of pc board and had trouble keeping the sides square, you are not alone. But George Heron, of the NJ QRP Club has figured out the secret of building these cases and shares his secrets here.

The parts for the case have been mass produced. You need to check them to make sure that you will have a good fit. Start with the sides and the bottom. They should be exactly the same length. If not, file to size. Also, be sure that you keep it square. Next, check the front and back panels, make sure that they are the same width as the bottom, if not mark and file as before.

Next, use the drilling templates to mark the holes as indi-

cated and drill the front and back panels to the size indicated. Make sure that you are accurate on the capacitor holes, as you do not want to have the center shaft of the capacitor touching the case.

Now that you have the holes drilled we are ready to start the case assembly. Take the bottom piece and one of the side rails. Line up the side rail with the ends flush and the side or the bottom so that the edge of the bottom is flush with the outside surface of the side. Tack solder it on one end. Get it as straight as you can, but don't worry about it, we will adjust it later. What we are concerned about is that the ends are flush. Now, place the front panel against the ends of the bottom and the side panel. Make sure that it is oriented correctly, lined up, and solder it on one end. Check your work. If everything is lined up, unsolder the side rail and make it fit straight, flush with the edge of the front panel. Now, solder the bottom of the side rail and the junction of the top side of the side rail and the front panel. Do the other side rail as you did the first. This will hold the front panel square, and now you may tilt it up to solder the seam.

When you finish the front panel, do the same with the back, making sure that you orient the panel correctly. The case is really quite easy to build and the neat thing about it is that you use the parts to self align it. Many thanks to George Heron, N2APB for his invaluable assistance with these instructions. In other words, George, thanks for the trade secret, grin.

The last step with the case is to fit the Lexan plastic top to the case you have built. Place the top over the case, and secure with tap. Drill a 1/8" hole in the middle of the side rail. Repeat on the other side. Make sure that your top is square before you drill the holes. Drill them through the plastic and the case.

Use a 4/40 x 1/4" Machine screw to attach the top. You will need to place the screw through the hole of the case, then tighten a brass 4-40 nut on the inside of the side. Solder the nut to the inside. Instant pem nut, grin. Remove the screw, let cool, and place the top on to make sure it fits. The top can be trimmed with ordinary scissors if you wish to have a tapered front.

Now we are ready to start building the tuner. The first step is to prepare 6 wires that are 4" long. Solder 4 wires to Switch 1 as shown in the figure below along with the jumper. Mount Switch 1 in the front panel. Next, solder two wires to the middle connections of Switch 2. Mount Switch 2 in the back panel.

We are ready to wind the two toroids now. Start with the larger one, the T106-2. Cut off 30" of the heavy red enameled wire. Bend it in half, and clean off the insulation for 1/2" on either side of the center of the wire. Then, twist the wires together 3 times forming a tiny loop that will be the center tap of L1. Take the toroid, put the wire through the center of the toroid and hold the twisted loop against the edge. Wind the wire 8 times around the toroid, counting 1 turn each time the wire goes through the center of the toroid. Now, wind the other end of the wire 8 more times going in the opposite direction. When you finish, spread the turns evenly around the toroid, and bring the ends of the wire up to the side opposite the twisted loop,

clean the insulation from the ends and make a small loop to solder to. See Fig. 3.

The coils for L2 and L3 are wound interspersed and in the same direction as L1. The wire for L2 is 24" long, and the wire for L3 is 12". When you finish winding L2, the toroid should look like Fig. 4. When you finish with L3, it should look like Fig. 5. Place the toroid in the case approximately where it will be and trim the wires to the lengths needed to attach L2 and L3 to Switch 1 and to attach L1 to C3. Clean off the insulation by burning it back for about 2/2" and then carefully scraping off the residue with a knife. Now you are ready to mount the big toroid. Place it where it goes in the case, and solder the tap of L2 to the bottom of the case. Then solder L2 and L3 wires to Switch 2. We will solder the connections to C3 later.

Now let's wind the smaller toroid. You have two smaller diameter pieces of wire, one red and one green. Start with the red wire and wind 25 turns on the toroid. Count the turns on the inside of the toroid with each time the wire passes through the center of the toroid as one turn. Trim the wire to 1 inch leads, remove the insulation and tin the leads. Now, take the piece of green wire and wind 5 turns. Start the winding in the middle of the red wire and the toroid should look like the drawing below. Trim the ends of the green wire to 1", remove the insulation and tin the leads. Set the toroid aside for now.

Prepare the six 100 ohm 2 watt resistors by twisting the leads together to make 3 pairs of resistors. This will result in 3 - 50 ohm resistors.

Now we are ready to build the SWR absorptive bridge and LED indicator circuit.

Use the layout drawing as a guide and build the circuit Manhattan style. You will find several round pads provided in the kit. Use these as "tie points" as shown. They are glued down to the base of the case using super glue. One small drop per pad is plenty. Place the drop where you want the pad, then with tweezers or needle nose pliers place the pad on the glue. Press down and hold for 30 seconds. Tin the pad. When you have the pads in place, build the circuit. The ground symbol means that you solder the end of the component to the base of the case, which is ground. Make sure that you orient the diodes correctly. The LED has the short lead grounded to the case front which holds it in place, or you may use a drop of super glue here, just be careful to not get it on the lens. The other lead of the LED connects to R4, the 1K resistor.

Now we will prepare C2 and C3. Put a jumper between the outside leads of each capacitor as shown. Then, make sure that the trimmer adjustment caps on the back are set at lowest capacitance, which means fully unmeshed. Now mount the two caps to the front panel. Make sure that the center

conductor does not touch the case, or your tuner will not work right. Tighten the small screws snug, but be careful to not strip the threads. Run a jumper wire from the two tied together connectors on C2 to the two tied together connectors on C3. Connect the middle connector of C2 to SW1 as shown.

The caps do not have shafts for knobs, but we can fix that easily. In your kit of parts you will find two nylon spacers. Attach them to the center hole of the cap with the 2.5 x 16mm screws provided. You will want to put a drop of super glue between the spacer and the cap to keep it from spinning, or you could use a tiny lock washer here (not provided). Just be careful to not get any glue in the cap!! Now you have a shaft to attach the knobs to!! Thanks to Dave Gauding, NF0R who showed me that trick.

We are now ready to wire the tuner. Mount SW1, J1, J2 & J3 on the back panel. Place L1 on the bottom of the tuner where it goes using the layout as a guide. Solder the ground tab of L1 to the bottom of the case as a means of mounting L1. Then, connect the leads from L2 & L3 to J2 and J3 as shown. Then connect the leads for L1 to C3 as shown. Connect a lead from the center conductor of J1 to SW1 as shown.

Finish wiring the connections for SW1 and SW2. Check the diagrams to make sure that you have connected all the wires. That is all there is to it. Your tuner is now finished!!

To operate the tuner, connect a balanced feedline to J2 and J3. Run coax from the BNC to your rig. Place SW1 in the Tune Position. Place SW2 in the High impedance position. Press the key or put your rig in "tune" mode, and use the two tuning knobs on the front panel to get the LED to go out, or at least dim significantly. If you can't get a match on high impedance, change to low impedance with SW2. My tuner tunes a NorCal doublet made from ribbon cable and 20 feet up in the air on all bands from 10 - 40 meters. Your mileage may vary.

If you wish to use the tuner with unbalanced feedlines, i.e. coax or long wires, then you need to do the following mod. Mount a spdt toggle switch on the back panel and another chassis mount BNC. You will use the toggle switch to ground one side of the balance input connectors. Wire it as shown. To operate as a balanced tune, switch to the unground position. To operate as an unbalanced tuner place the switch in the ground position. Simple mod. But if you are going to do it, I suggest that you do it before you build the tuner, as it is easier to do at that time. Radio Shack has a nice miniature SPDT switch and they also carry BNC chassis mount connectors.

Good luck, enjoy your tuner, and have fun on the air. Many thanks to Charlie Lofgren, W6JJZ for his invaluable assistance on this project. 72, Doug, KI6DS