

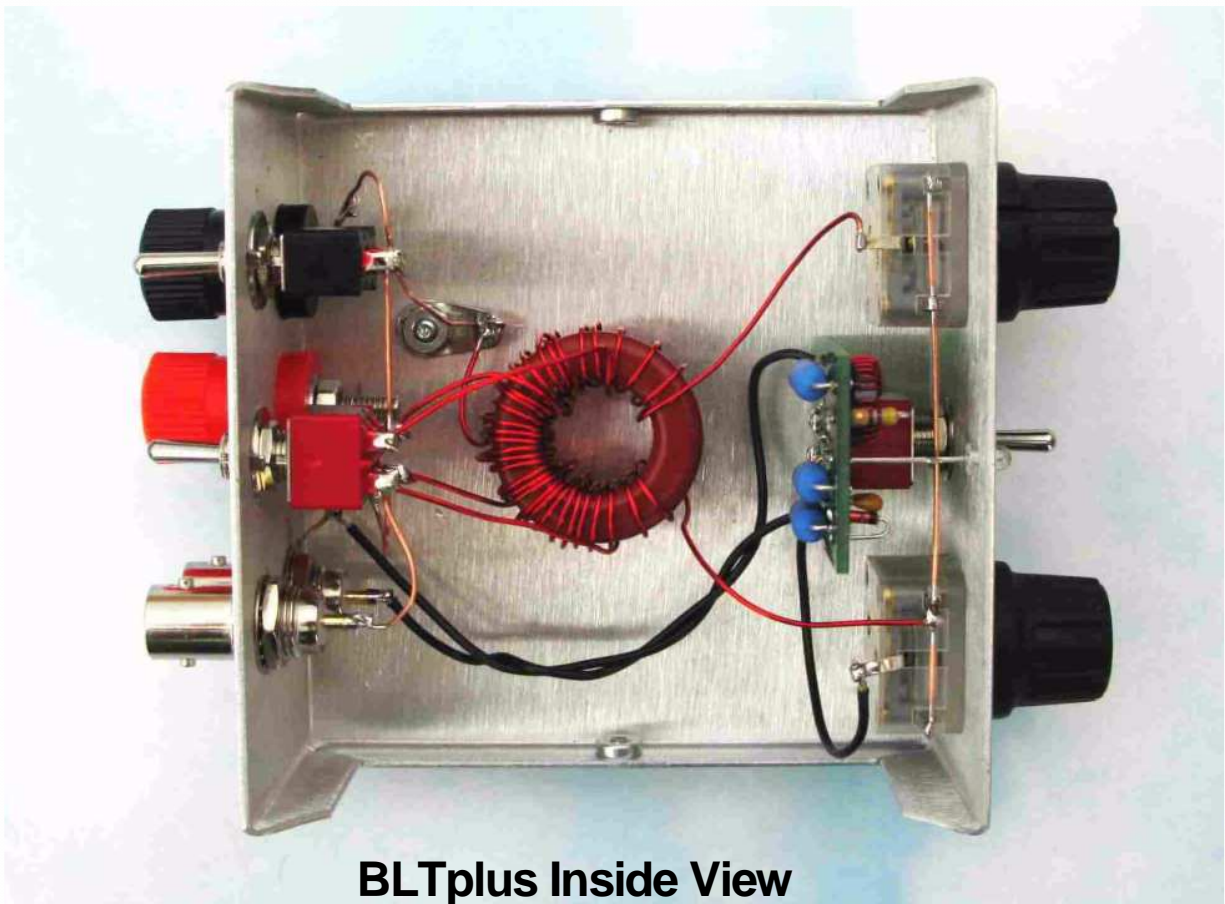
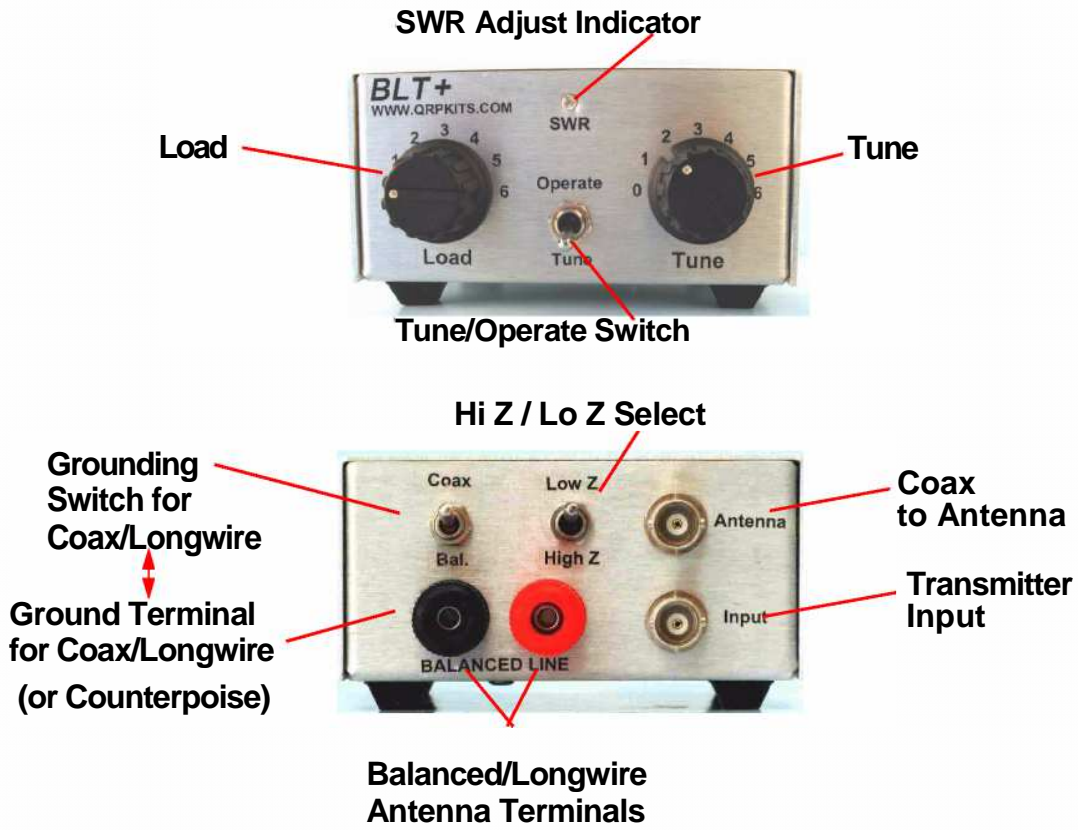
QRP Kits

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BLTplus



Assembly and Operation Guide v2



BLTplus Inside View

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Manual prepared by W5USJ

QRPkits BLTplus+

QRPkits BLTplus+ is the second generation of the popular QRPkits QRPplus. New features include:

- Revised prepunched enclosure front panel
 - New visual SWR assembly
 - Uncluttered interior assembly and wiring
 - Decals for labeling providing a finished professional look
- Decals must be affixed to the enclosure before doing any assembly!**

Note: Assembly Instructions for the visual SWR bridge are located at: <http://www.qrpkits.com/swrindicator.html>
Log on and download them before starting BLT+ assembly

Background

The following is an updated version of the background section written by Doug for the original NorCal BLT manual.

NorCal's original BLT was designed by Charlie Lofgren, W6JJZ who is renowned in the QRP world as a z-match tuner expert. Charlie has built all the tuners used by the Zuni Loop QRP Expeditionary Force for years. They all swear by them.

The original tuner was a balanced line tuner only, and would not work with coax feedlines unless modified as shown in the mods section of the original manual. It worked great with open wire feeder, ladder line, zip cord and even computer ribbon cable. As long as you used balanced line as a feedline, the BLT would work.

Charlie designed the tuner to work specifically with the polyvaricon variable capacitors that used to be sold by 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, ArkiCon 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 T106-2 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.) [Better coupling]

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 the dimming of LED going out at minimum SWR).

Note: The N7VE SWR kit is now included as part of the BLTplus+

The circuit also includes an absorptive bridge which means that your transmitter sees a 50 Ohm load as you are tuning up. This will help to save your final transistors! This tuner is rated at 5 Watts. I doubt if the polyvaricon caps will take the 100 Watts of your big rig! Now, lets get started to build the kit. First of all, you will need the following tools: 25 – 30 Watt soldering iron, drill, 1/8" bit, small Phillips screw driver, small blade screw driver, pliers, diagonal cutting pliers, needle nose pliers and about 4 feet of #24 solid insulated hookup wire. A Volt/Ohm meter is helpful also. Please read the manual in its entirety before you start building. You may want to print out the schematic, parts layout, parts list [LOM] and wiring diagram.

Note: Update meters to include Digital Multi Meters (DMMs/D VMs).

Parts Inventory

Before starting the assembly, inventory the parts and verify that you have the parts described in the following list of materials (LOM).

List of Material

N7VE LED SWR Kit

Download instruction manual for kit LOM

C2, C3 – 160/60 pF Dual Polyvaricons

SW2 – DPDT Toggle On/On

SW3 – SPDT used as On/Off or SPST On/Off

J1, J2 – BNC Jacks, Single Hole Mounting

J3, J4 – Red and Black Binding Posts

T2 – 16t Primary Center Tapped, 12t Secondary 1, 6t Secondary 2

Wound on T106-2 Toroid

4ea – 3x2.6mm Pan Head Screws

2ea – 12x2.6mm Pan Head Screws

2ea – 1/4 x 3/8 Nylon Bushings

6 feet – #22 Green Wire

2ea – Black Knobs

1 – #4 Internal Tooth Solder Lug

1ea – 4/40 x 1/4 Panhead Screw

1ea – 4/40 Nut

4ea – Bumpers/Feet

Prepunched Enclosure

Panel Decals

Decal Instructions

Download instructions from the qrpkits.com website

Additional materials needed for assembly:

12 inches – #22 Bare Hookup Wire

3 feet – #22 Insulated Hookup Wire

A/R – Solder

Note: Some supplied parts may vary in size, shape and color from those shown in the pictures but the values will work the same.

Prepare Enclosure

Note: Provided decals must be affixed before starting any assembly.

If you decide to use the decals, download the instructions for applying the decals from the qrpkits.com website.

Decals

Follow the methods and procedures described in the instructions for the affixing the provided decals.

Optional Finishes

If you would like a finish other than brushed aluminum, you can apply a paint color of your choice. Using a light colored paint will ensure that affixed labels or the included decals will be highly visible. If you decide to leave the aluminum unpainted, you may still want to keep it looking nice. A clear coat of a satin finish could be applied to prevent fingerprinting and minimize oxidation.

Do any optional preparation and finishing of the enclosure before doing any mechanical assembly. Allow time for finishes to properly cure. Follow the instructions provided with the finish you choose.

Attach Ground Lug

Using a 1/4 inch 4-40 screw, 4/40 nut and internal tooth ground lug, install and orient as shown in Figure 1.



Figure 1 Attach Ground Lug

Affix Feet/Bumpers

Affix a foot/bumper at each of the four corners of the enclosure bottom.

Assemble Back Panel

Assemble the lower row of parts on the back panel starting with the black binding post. Note the orientation of the solder lugs.

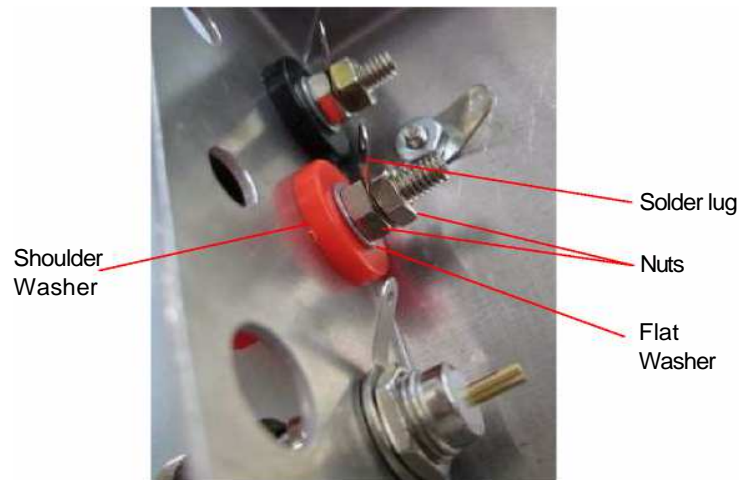


Figure 2 Backpanel Assembly

The assembly sequence used here will facilitate tool use and wiring.

Start the assembly with the black binding post. Then the red post and finally the lower coax connector. Also see Figure 4 below.

Black Post – disassemble the parts then reassemble in reverse order except for the two nuts and solder lug. Place the solder lug between the two nuts. Orient the solder lug about 45 degrees toward the outside of the enclosure.

Red Post – same procedure except orient the solder lug about 45 degrees in the opposite direction.

BNC connector – assemble with the lock washer next to the panel under the solder lug to ensure a good ground. Orient the solder lug toward the red post. It helps to use a BNC connector as a holding tool during the assembly.

DPDT switch – Assemble the top row starting with the middle DPDT switch. Adjust the position of the nuts and lock washer such that there are about two threads showing when the nuts are tightened.

SPST (or SPDT) switch – assemble in a similar fashion.

BNC connector – assemble in a similar fashion to the lower connector. The solder lug is not required. If used assemble as described above.

Wire and Solder Back Panel

Using short lengths of bare hookup wire, connect the binding posts, switches, coax connector and ground terminal as shown in Figure 3 below and the wiring diagram on page 23.

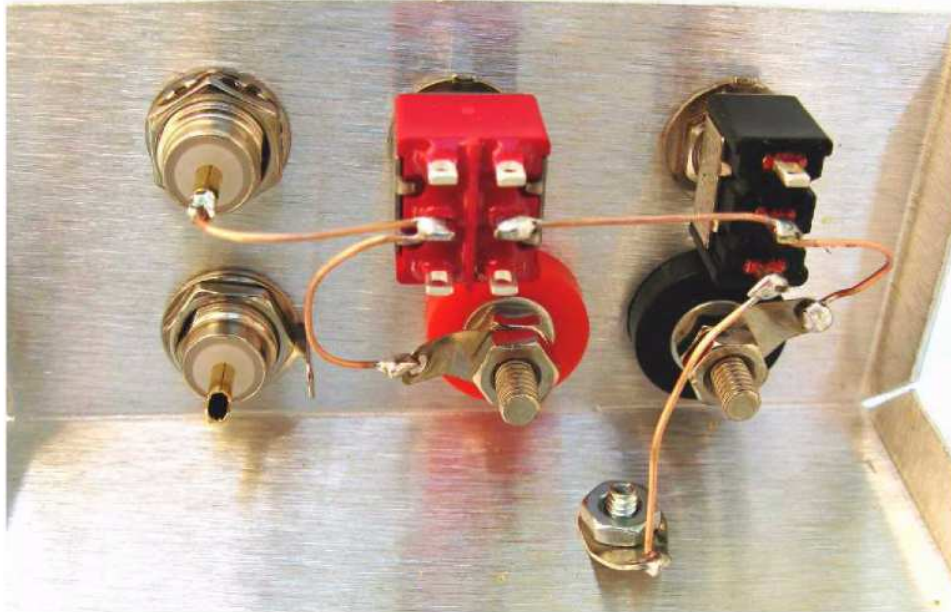


Figure 3 Backpanel Prewiring

Solder the connections to the binding posts, switches and coax connector. Leave the ground terminal until transformer T2 is connected later.

Assemble Front Panel

In this section, variable capacitors C2 and C3 are prepared for assembly onto the enclosure front panel. Next, they are mounted and wired.

Prepare Capacitors for Assembly

Using a 12 x 2.6mm screw attach a nylon spacer to each capacitor as shown in Figure 15 below.

Note: to prevent damage do not force the capacitor shaft against the stops when tightening the screw.

Set the trimmer capacitors to minimum as shown in Figure 4 below

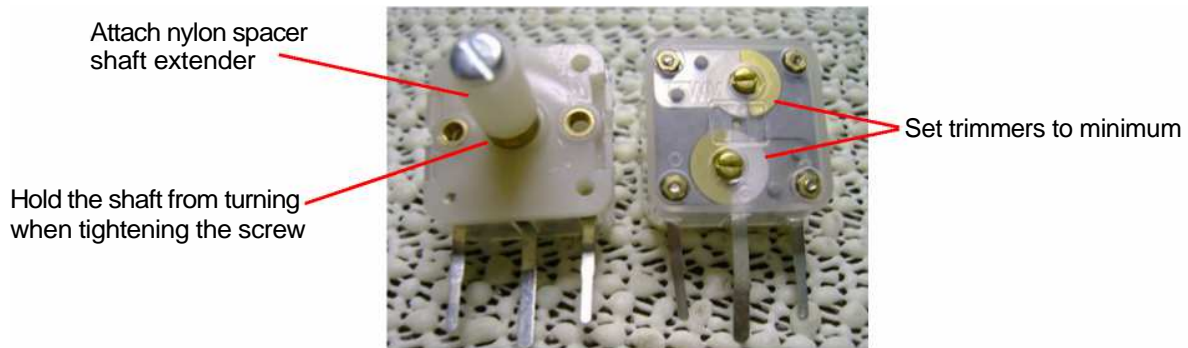


Figure 4 Preparing Capacitors

Using two 3 x 2.6mm screws attach the capacitors to the front panel. Verify that the screws do not extend into the capacitors and hit the plates. Orient the capacitors with the terminals up.

Wire Capacitors C2 and C3

Trim the capacitor terminal length to about 5/16 inch and carefully form a U bend.

Using a length of bare wire carefully crimp the four rear terminals around the wire, solder and trim off any excess. See Figure 5 below

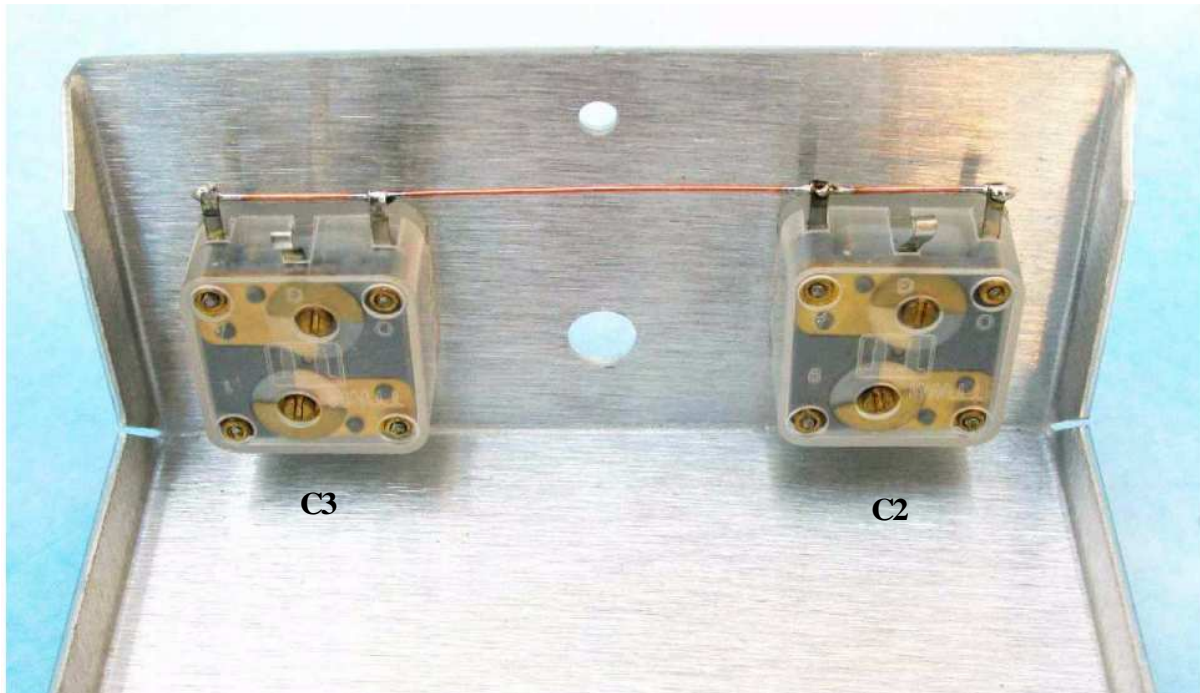


Figure 5 Wiring Capacitors C2 and C3

The two front common capacitor terminals will be connected during the final wiring process.

Note: The trimmers on the capacitors used for this illustration were not set to minimum as described on page 12. You need to do that.

Assemble N7VE LED SWR Kit

If you haven't already done so, download the instructions from the qrpkits.com website. Except for the installed height of the LED as shown in Figure 6 below, assemble the VSWR kit according to bridge manual instructions.

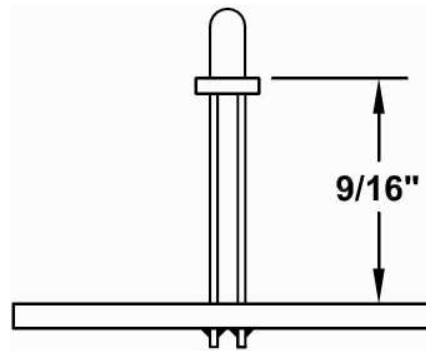


Figure 6 LED Assembly Height

Connect SWR Bridge Wires

Cut and strip the ends of three length of hookup wire.

SWR to C2 = 2 inches

SWR to J1 Center pin = 3.5 inches

SWR to Ground Lug = 3 inches

Attach the wires to the PCB as shown in Figure 7 below.

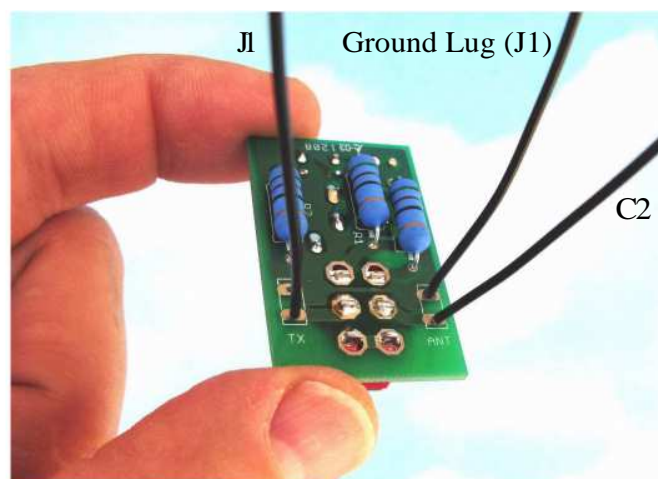


Figure 7 Attach SWR Bridge Wires

You may want to use a black wire for the ground connection and a different color for the connections to J1 and C2.

Gently twist the wires, about 1 turn per inch, that will be connected to the J1 center pin and J1 ground lug.

Using the hardware included with the SWR bridge toggle switch, attach the SWR bridge assembly to the front panel.

Adjust the back nut so as to position the LED and the switch in the same plane on the panel. See Figure 8 below. Tighten the nut.

Note: Ensure that the LED wires do not touch the interconnecting wire between capacitors C2 and C3.

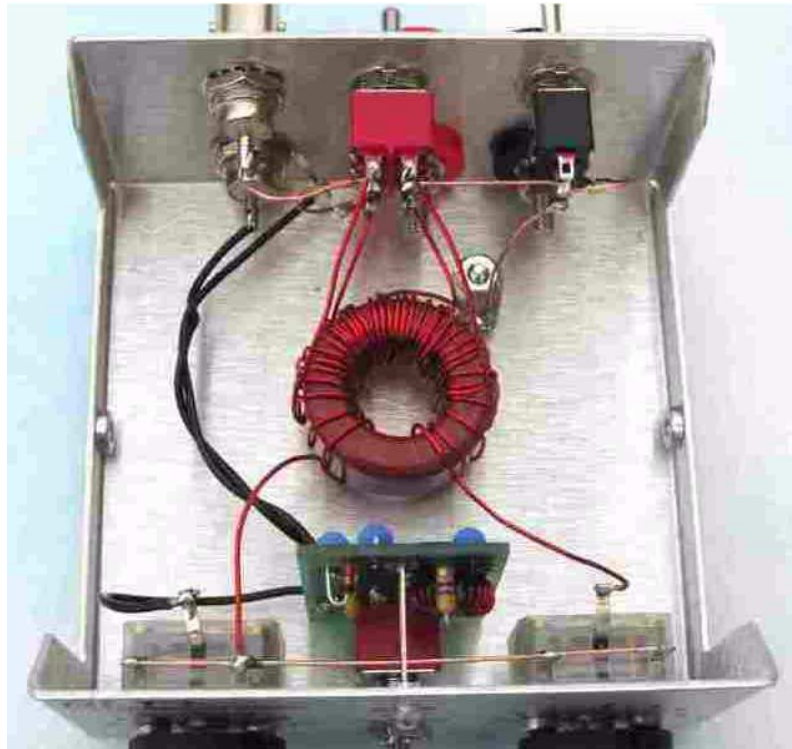


Figure 8 BLTplus Inside View

After twisting the 3 and 3.5 inch wires:

Connect the 2 inch wire to the tab on C2,
Connect the 3 inch wire to the ground lung at J1,
Connect the 3.5 inch wire to J1 center terminal,
and solder the connections.

Winding Output Transformer T2

BLTplus output transformer, T2, consists of a center tapped primary winding, L1, and two secondary windings, L2 and L3. The appendix section, page 21, includes a drawing that provides information to facilitate the winding process.

Referring to the drawing, the winding steps are:

- Choose which center tap option will work best for you
- Choose which of the winding connection methods you'd like to use
- Form the center tap for winding L1
- Wind the 16-turn primary L1 on the toroid
- Wind the 12-turn secondary L2 on the toroid
- Wind the 6-turn secondary L3 on the toroid

If you choose to make connections to the transformer with hookup wire the additional steps are:

- Cut the transformer leads down to about 1/2 inch and strip 3/8 inch
- Form a loop at each wire end and connect a 2-inch length of hookup wire

Your finished transformer should resemble the illustrations on the drawings.

Connecting Transformer T2

Refer to the wiring diagram drawing in the appendix section, page 23, and the inside view of the BLTplus, Figure 8 on page 15.

You may find it useful to put a temporary spacer about 1/4 inch thick under the toroid to position it away from the enclosure.

- Position the wound toroid and route the leads as shown in the pictures.
- Place the wires in the position they will be when attached and cut them to length. Leave enough slack for connection and soldering.
- Strip about 1/4 inch of insulation from the end of each wire.
- Connect secondary wires L3c and L3c' to the bottom terminals of S2
- Connect secondary wires L2b and L2b' to the top terminals of S2
- Connect primary wire L1 a' to the center lug of C3
- Connect primary wire L1a to the center of the wire between C2 and C3

Final Assembly Checkout

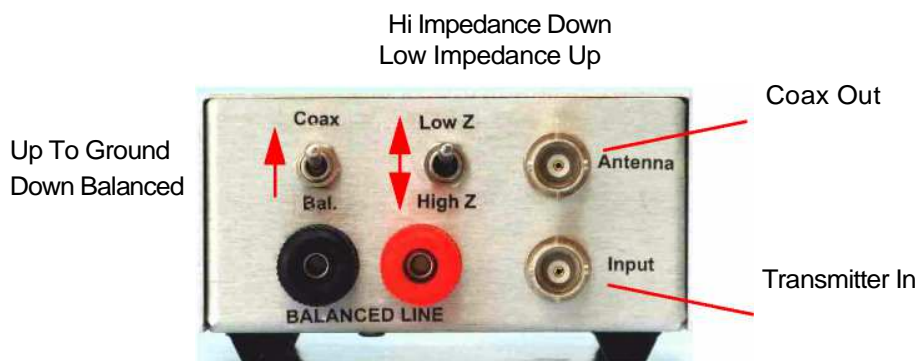
Inspect carefully for good solder connections and ensure that there are no shorts, incorrect or missing connections. Use the wiring diagram from the appendix section page 23 as a guide. Also, compare the wired assembly to the schematic on page 22.

BLTplus Operation

BLTplus is designed to "tune" or match your transmitter to typical antenna systems for the 40, 30, and 20 meter amateur bands. Under ideal conditions, where the impedances and SWR are not at extremes, you may be able to adjust for a match on higher frequency bands.

Antenna Connections

Connections for various types of antennas are shown in Figure 9 below and described in the following text.



Switch positions are correct when wired as described in this manual

Figure 9 Back Panel Connections

Connect your transmitter output to the transmitter input BNC jack. Depending on the type of antenna you will be using select the connections and settings as follows:

Note: The grounding switch connects the black binding post to the BLTplus chassis ground. A physical ground (earthed) connection may also be used when conditions require one.

- Connect balanced feedline to the red and black binding posts. Leave the grounding switch in the down position.
- Connect end fed longwires to the red binding post terminal. Connect a counterpoise wire to the black binding post. Place the grounding switch in the up position.
- Connect coax to the coax out jack. Place the grounding switch in the up position.

Adjusting for a 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, BLTplus 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. Work those DX stations.



Figure 10 Tuner Controls

Experiment and Customize

BLTplus may not work effectively with some antenna systems. You may find it useful to adjust the turns on T2 to provide effective tuning. An excellent resource for experimenting and customizing is the BLT paper by Carey Fuller, NX0R. His paper, in PDF format, can be downloaded from the [QRPkits.com](http://www.qrpkits.com) website on the BLT page. <http://www.qrpkits.com/>

Steve, KD1JV, made some mods to the PFR-3 BLT specifically for a 44 foot EDZ using about 50 feet of 450 Ohm window line.

L1= 11t CT at 5/1/2, L2=6t. L3=2t, L2 and L3 centered around the CT.

Appendix

Supplements to help build and operate the BLTplus.

- Output transformer T2 winding information
- BLTplus Schematic
- BLTplus wiring diagram

T2 Center Tap Forming Options

Method 1



Cut wire 28 inches long

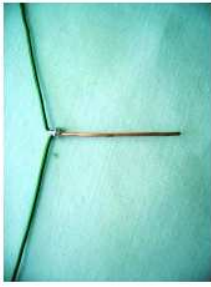
Find the center (14 inches)

Carefully strip about 1/2 inch of insulation from the center (1/4 inch each side).

Attach and solder a 1 inch length of bare wire at the center.

NOTE: Wire lengths for the three methods shown above are for connection ver. 1 shown below

Method 2



Cut wires 15 inches and 14 inches long.

Strip about 1 inch of insulation from the end of the 15 inch length. Strip 1/4 inch from the 14 inch length.

Form a small J-hook at the bare end of the 14 in. wire.

Attach the J-hook end to the point where the insulated and bare wire meet. Solder.

Method 3



Cut wire 30 inches long

Find the center (15 inches)

Carefully strip about 1-1/2 inches of insulation from the center (3/4 inch each side).

At the center location, bend the wires tightly together.

Hold the wires firmly with pliers at 3/4 inch from the bend. Twist 2 turns.

Winding the Primary



Start the primary winding by positioning the center tap in the center of the toroid. Hold firmly and wind a couple of turns in each direction.

These first windings will hold the wire on the core.

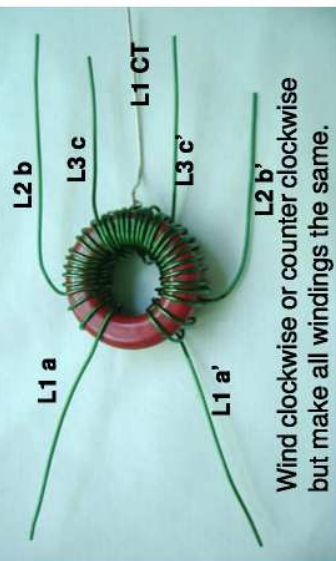
Continue the winding for a total of 8 turns in each direction. Space evenly around the toroid.

Each pass through the middle is 1 turn.

You may find it easier to form the wire against the core by pushing the wire down through the middle.



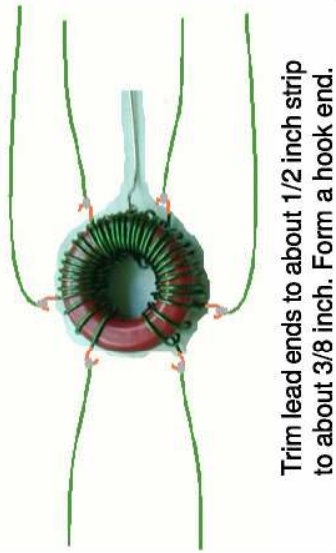
Transformer Connections Ver. 1



Wind clockwise or counter clockwise but make all windings the same.

Transformer Connections Ver. 2

Note: Use 3 inches less wire for this version



Trim lead ends to about 1/2 inch strip to about 3/8 inch. Form a hook end.

Continue Winding Secondaries:

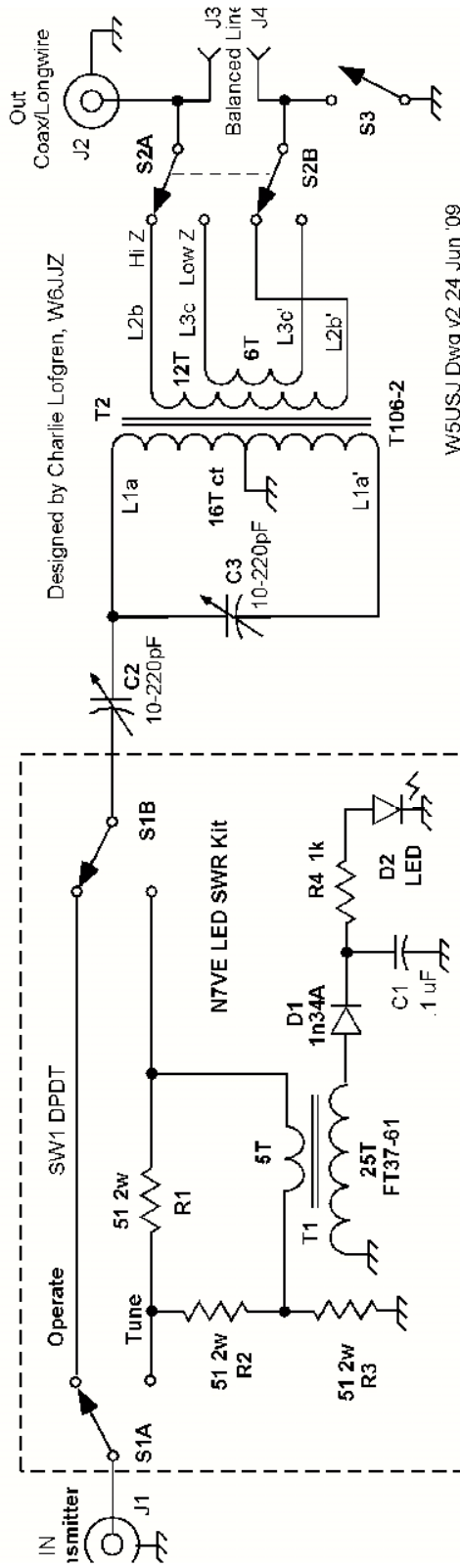
Find the center of each wire length as the starting point for L2 and L3.

Using a 22 inch length of wire, start L2 at the middle next to the center tap and wind 6 turns each side within the turns of the primary winding.

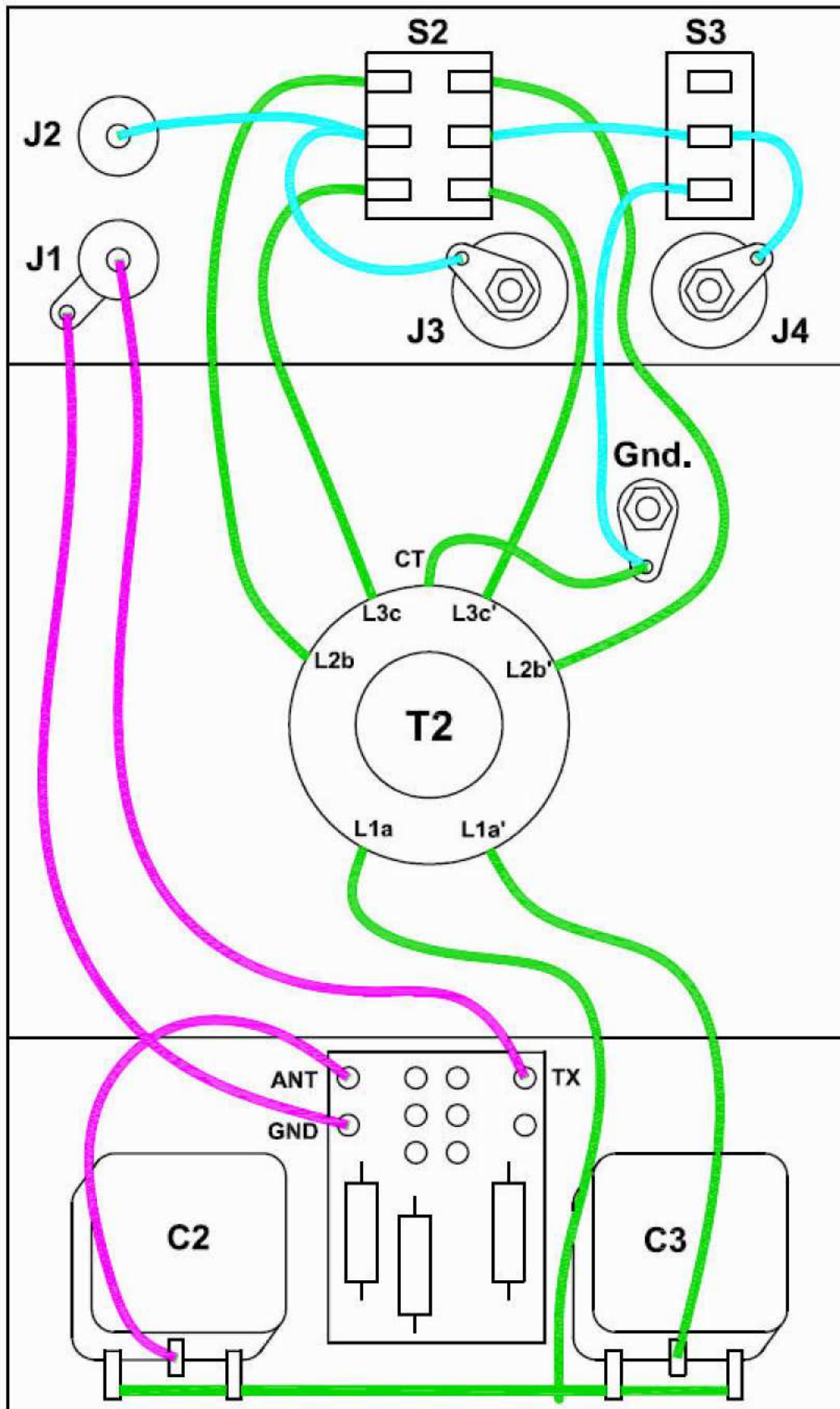
Using a 13 inch length of wire, start L3 at the middle next to the center tap and wind 3 turn in each direction.

Winding Transformer T2

QRP Kits BLT Plus v2



BLTplus v2 Schematic



BLTplus v2 Wiring Diagram