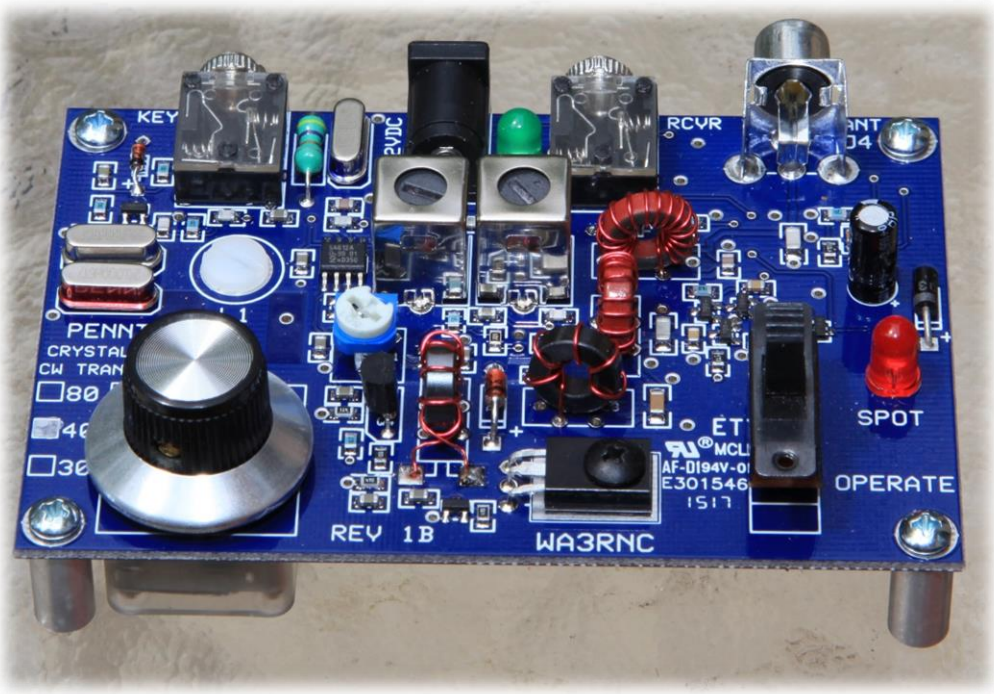
WA3RNC 40 METER

CRYSTALPLEXER TRANSMITTER KIT

ASSEMBLY INSTRUCTIONS



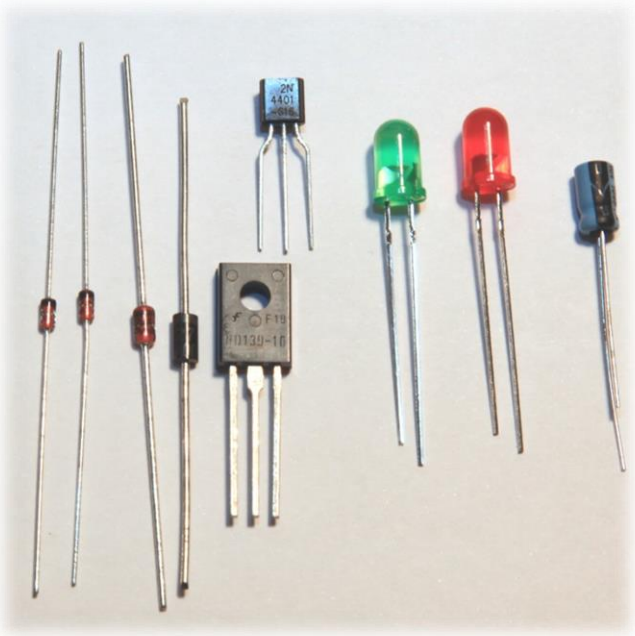
Description

The WA3RNC 40 Meter Crystalplexer is a low power crystal controlled QRP transmitter offering a significantly improved tuning range when compared to the usual crystal controlled unit. A fundamental 7 MHz crystal in VXO circuit might be able to be shifted or “pulled” just a few hundred Hertz. That’s better than no tuning range at all, but is still very confining in terms of frequency coverage. The tuning range of the Crystalplexer is greater than 25 kHz! No more endless CQ’s on your fixed crystal frequency. Stability is excellent because crystal control is maintained. Power output is adjustable from less than 1 to 3 watts. T/R switching permits QSK operation. The board is supplied with 56 SMT parts already installed. You add another 28 parts, and you’re done. It’s really a quick build! This transmitter meets the current FCC requirements for spectral purity with harmonics and spurs at -54dBc.

Assembly

The Crystalplexer kit is supplied in five bags. Bag One contains the PC board with 56 SMT parts machine-installed. This board with all of its SMT components is pretested. The remaining four bags have the 27 parts that the builder installs. Start with Bag two, which contains the polarity sensitive parts (semiconductors and electrolytic capacitor).

Bag Two Parts



The two smaller glass diodes are 7.5 volt zeners, D1 and D2. The larger glass diode is a 47 volt Zener, D6. The black epoxy diode is a 1N4003, D8. All of these diodes have a band at one end which identifies the positive end. All four of these diodes need to have the leads carefully formed to fit onto the board. The smaller 2N4401 transistor, Q4, has a flat side. Install this part so that the flat side matches the assembly drawing. The larger transistor with the hole, a BD139-16, is the final amplifier device, Q5. It must be installed with the printing on the part facing up. The leads of this part will need to be bent down 90 degrees (carefully) so that the hole in the part aligns with the mounting hole in the board. Secure Q5 to the board with the 4-40 hardware included. The green (D7) and the red (D3) LEDs have one longer lead. This is the positive lead. The 10 uF electrolytic capacitor, C21, has one lead longer which indicates the positive lead. After these parts are installed, clip the excess leads.

Bag Three Parts

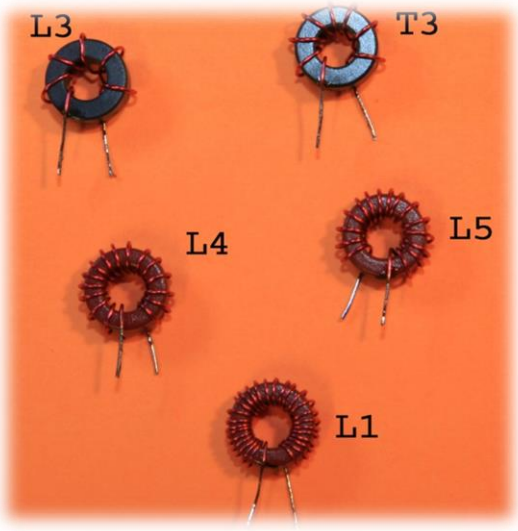
Included in this bag are an RCA jack (J4), two 3.5mm phone jacks (J1 and J2), a DC power jack (J3), two silver color IF transformers (T1 and T2), a 4.7 uH RF choke (L2), a slide switch (S1), a trimmer potentiometer (R11), two 20.00MHz crystals (marked red, X1 and X2), and a 12.96MHz crystal (marked blue, X3). These parts all mount on the top of the board. The choke (L2), the switch (S1), and the crystals (X1, X2, and X3) are not polarity sensitive. Check that X1 and X2 are marked with red. The other parts will need to be orientated properly to fit onto the board. Clip the excess leads.

<u>Important Note</u>: The switch and the crystals must not be mounted tight against the board. Keep them raised up about 1/16" to prevent shorts.

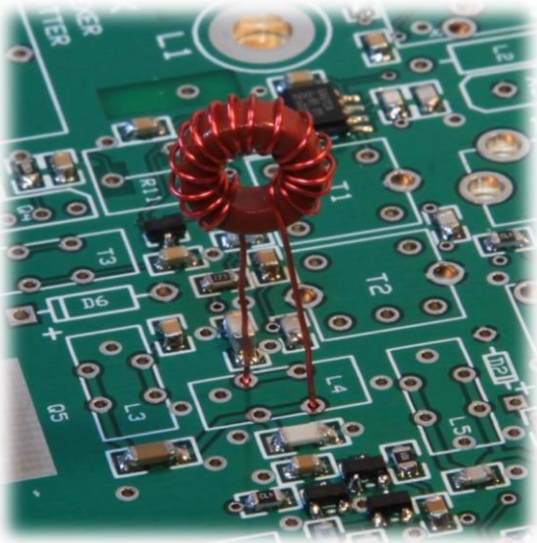
Once Bag Two and Bag Three parts are installed, you have only six more parts to go!

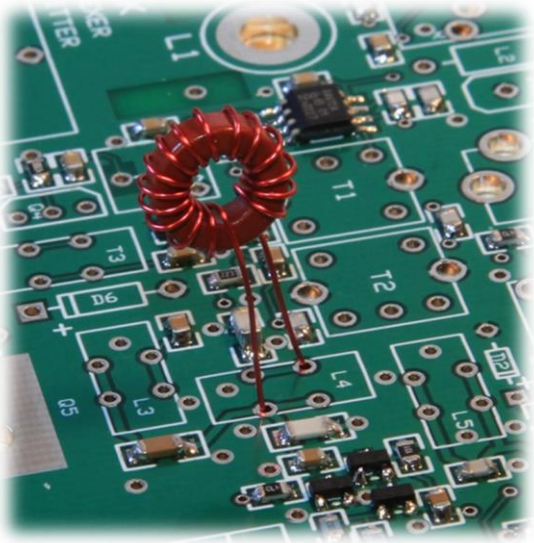
Bag Four Parts – Toroids!

The Crystalplexer requires five toroid inductors. Winding toroidal coils is not difficult. Think of it as winding a shoelace through and around a glazed donut. Anyone could do that. While it's true that the cores are a bit smaller than a donut, the procedure is the same, but not nearly as messy! There are two types of cores included. The two cores that appear all black or dark grey are FT37-43 ferrite cores for L3 and T3. The remaining three are colored red on one side. These are T37-2 powdered iron cores. Please don't mix them up or you will have problems ahead!



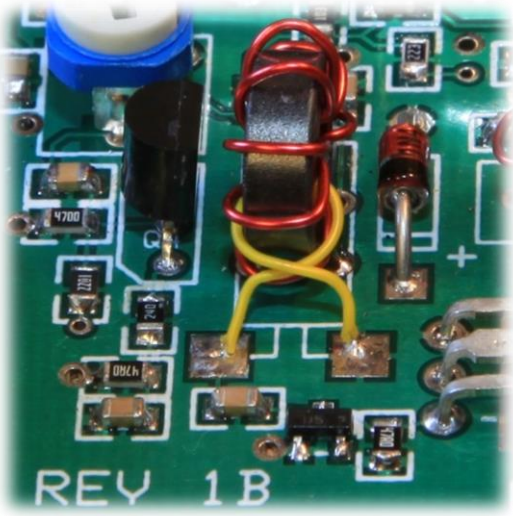
Start with the easiest one, L3. This coil requires 6 turns of wire on one of the all black cores. **Note that the turns must be counted on the inside of the core**. Cut a 5" piece of the larger diameter magnet wire. Thread the wire through and around the core until you have 6 turns. Now adjust and space the turns so that they resemble L3 in the "orange photo". Cut the excess leads allowing about one half inch remaining. The enamel insulation must be removed and the wire tinned before installing the coil on the board. The insulation can be carefully scrapped off with a hobby knife, or can be burned off if your soldering iron can get hot enough. After the leads are tinned, install the coil down against the board. Note that there four mounting holes for each of the coils. Which two you use depends on how you wound the coil. Study the two photos below that show the two possibilities of finished coils (clockwise or counter, left handed or right). Neither is wrong, and both work just the same. Choose the proper mounting holes for your coils. This applies to all of the coils that mount on the top of the board (L3, T3, L4, and L5).





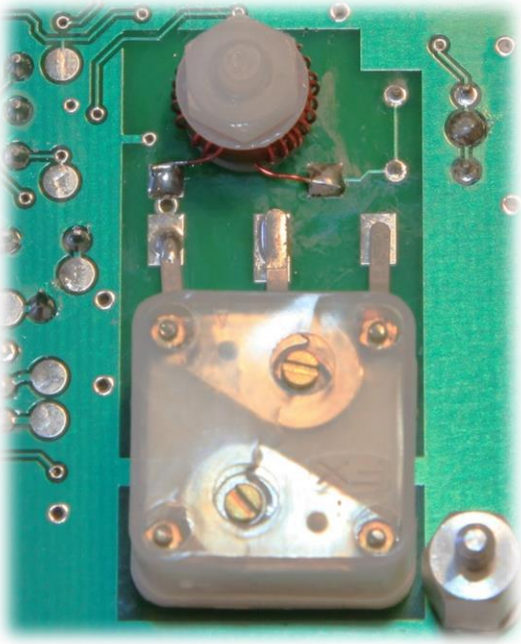
Note: The previous photos show the toroids standing above the board. This is to show the two different mounting options. All of the coils are mounted down against the PC board.

T3 is also wound on one of the all black toroid cores. This coil requires 8 turns. Start with a 6" piece of the heavier magnet wire, and proceed to wind the coil as you did with L3. After adjusting the turns so that it resembles T3 in the orange photo, prepare and tin the ends. T3 can now be soldered to the board. The secondary winding of T3 will be added after it is soldered to the board. Install the one turn secondary winding as shown in the photo below. Use a piece of the magnet wire for this winding. (The photo shows the secondary winding with yellow wire for clarity.)



L4 and L5 are identical and require 16 turns each. Start with 10" of the heavier magnet wire, and wind 16 turns counted on the inside of the core. Be careful to avoid kinks and crossovers while winding. As before, adjust the windings so that the coils resemble L4 and L5 in the orange photo. Once the ends are prepared and tinned, the coils can be mounted on the board.

The remaining coil (L1) consists of 28 turns of wire on a T37-2 core (one side red). Use the smaller magnet wire for this coil. Again, be careful not to kink the wire or get crossover windings. When you have 28 turns and the coil resembles L1 in the orange photo, you can cut the excess wire and tin the leads. L1 is mounted on the bottom of the board, and is secured with the included nylon hardware as shown below. Use one nylon washer under the coil, and one between the coil and the nut. Do not over-torque the hardware.



L1 leads are soldered to the pads as shown in the photo to the left.

Bag Five Parts – Hardware and C1

This bag includes (4) standoffs and (4) screws used to attach the standoffs to the bottom of the board, and tuning capacitor C1 with mounting hardware and knob. The tuning capacitor C1 is mounted on the bottom of the board and secured with the included hardware. Do not over-torque these screws. Solder the capacitor lugs as shown. The C1 trimmer capacitors are set to minimum at the

factory. If they are not at minimum, tuning range will suffer.

The tuning knob can now be installed on the capacitor shaft. The four standoff spacers can be installed at the bottom four corners of the board.

This completes the Crystalplexer construction.

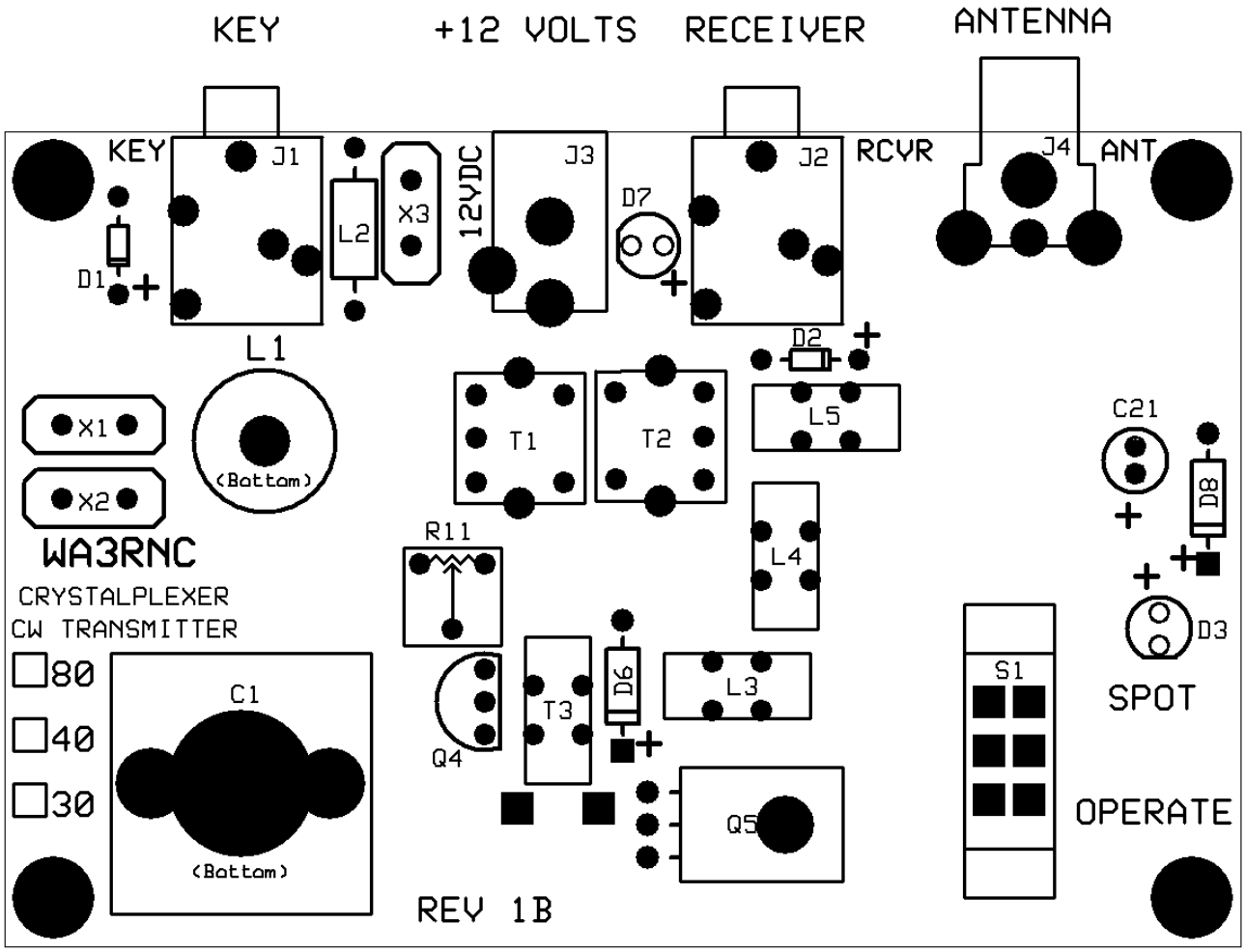
Test and Alignment

Carefully inspect all solder joints. It is a fact that most problems with initial failures will be due to soldering issues. Check for shorts and missed connections, and for missing parts. Before applying 12 volts to J3, set the slide switch to the "SPOT" position, adjust the drive control R11 fully counterclockwise, set the tuning capacitor fully clockwise, and connect a 50 ohm dummy load/wattmeter to the antenna jack J4. With an ammeter in series with the power supply or battery, apply 12 volts to J3. Both D7 (green) and D3 (red) LEDs should light, and current draw should be 10 to 15 milliamps. When the switch is set to the "OPERATE" position, the red LED should go out and the current consumption should decrease to 5 to 10 milliamps. Connect your key to J1 and momentarily close it. The red LED should come on, and the ammeter should show about 40 to 50 milliamps. Adjust drive control R11 until the transmitter is outputting 1 watt. DC current should be less than 250 milliamps. Adjust transformer T1 and T2 cores for maximum RF output. Adjust drive control R11 for 2 to3 watts output. DC current should be less than 500 milliamps. Note: Adjusting R11 for more than 3 watts output results in decreased efficiency, and may cause the output purity and stability to degrade. It is strongly recommended that you keep the RF output level to 3 watts or less. The "sweet spot" is about 2 watts.

Operation

To operate the Crystalplexer transmitter, connect a 50 ohm antenna to J4, and connect your receiver to J2 using a 3.5mm connector and a length of miniature coax such as RG-174. With the slide switch in the "SPOT" position, tune capacitor C1 until you hear the transmitter signal (approximately 7.025-7.050 MHz) in your receiver. If you have trouble hearing the spot signal, depress the key as this will increase the spot signal strength. The final RF amplifier stage does not operate with the slide switch in the "SPOT" position, so you won't be causing QRM while spotting the transmitter signal. With the switch in the "OPERATE" position, you are ready to transmit. The red LED has a dual function: In the "SPOT" position, it will be illuminated whether or not the key is depressed. With the switch in the "OPERATE" position, it will show when the key is closed. The transmit / receive circuit allows for QSK operation, and limits the transmitter signal leakage into the receiver to a very low level. As with all QRP transmitters, best results will occur with an efficient antenna and a good match. A full size dipole or inverted "V" is an excellent choice. A random wire thrown out the window, not so much.

Note: The Crystalplexer Transmitter doesn't employ an on-off power switch. Please unplug the power connector to prevent battery discharge when the unit is not in use. The purpose of the green LED is to show you that power is applied and is being consumed as long as power is connected.



Crystalplexer Thru-Hole Parts Layout Guide