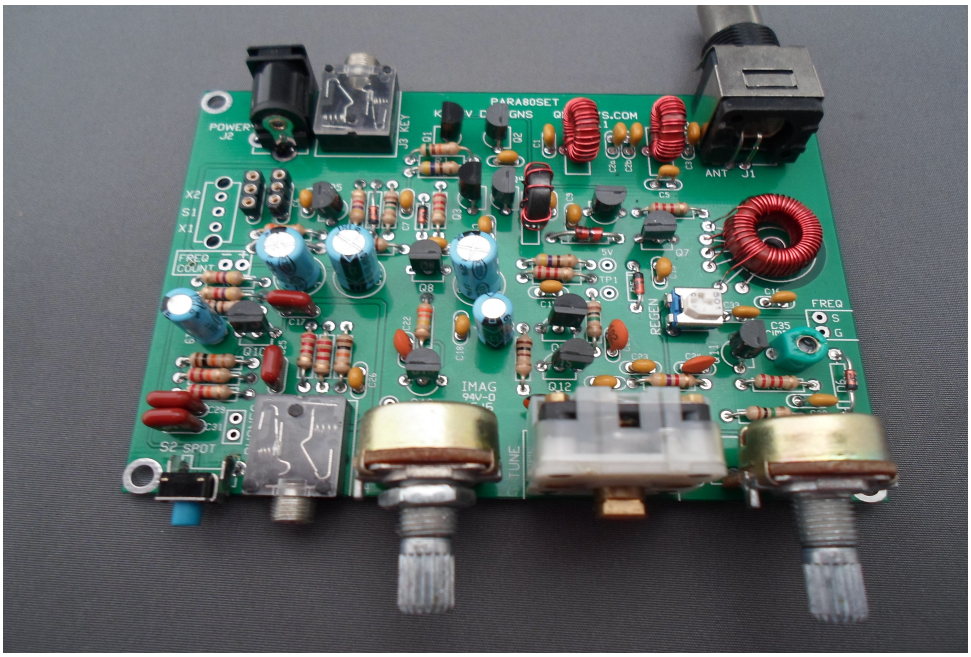
THE PARA80SET

Designed by Steve, KD1JV -- Distributed by the QRP Guys



The “Para80set” is an updated version of the MAS80, which originally designed by Steve, KD1JV for the M.A.S. design contest (minimum art session), a contest started by Dr. Harmut "Hal" Weber, DJ7ST. (Now a SK). The idea behind this contest is to encourage Hams to build and operate a rig using a minimal number of parts. Steve has made some improvements and modifications and the result is the Para80set. It is named to commemorate the “Paraset” clandestine vacuum tube transceiver that was parachuted behind enemy lines to Allied resistance groups in northern Europe, and Scandinavia during WW II.

This new design still incorporates a sensitive regenerative receiver and a 3 watt, 80m crystal controlled CW transmitter, like the original “Paraset”, but with modern solid state components. The improvements over the original MAS80 design include a more efficient transmitter and a “spot” switch to locate the transmit frequency in the receiver, along with a 2 crystal switch option. Some component values have been tweaked to reduce the number of different part values and provide better high frequency roll off of the audio.

Specifications:

Supply voltage range: 12V to 13.8V

Receiver:

Current: ~ 20 ma
Sensitivity: ~ 0.5 uV MDS
Main tuning range: ~ 270 kHz
Fine tuning range: ~ 30 kHz

Transmitter:

Power output: ~ 3.5 watts at 13.8V
Current: ~ 460 ma at 3.5W, 13.8V
Spurious outputs – 50 dBc or better.

First, familiarize yourself with the parts and check for all the components. If a part is missing, please contact us and we will send one. You must use qrpguys.parts@gmail.com to request a part.

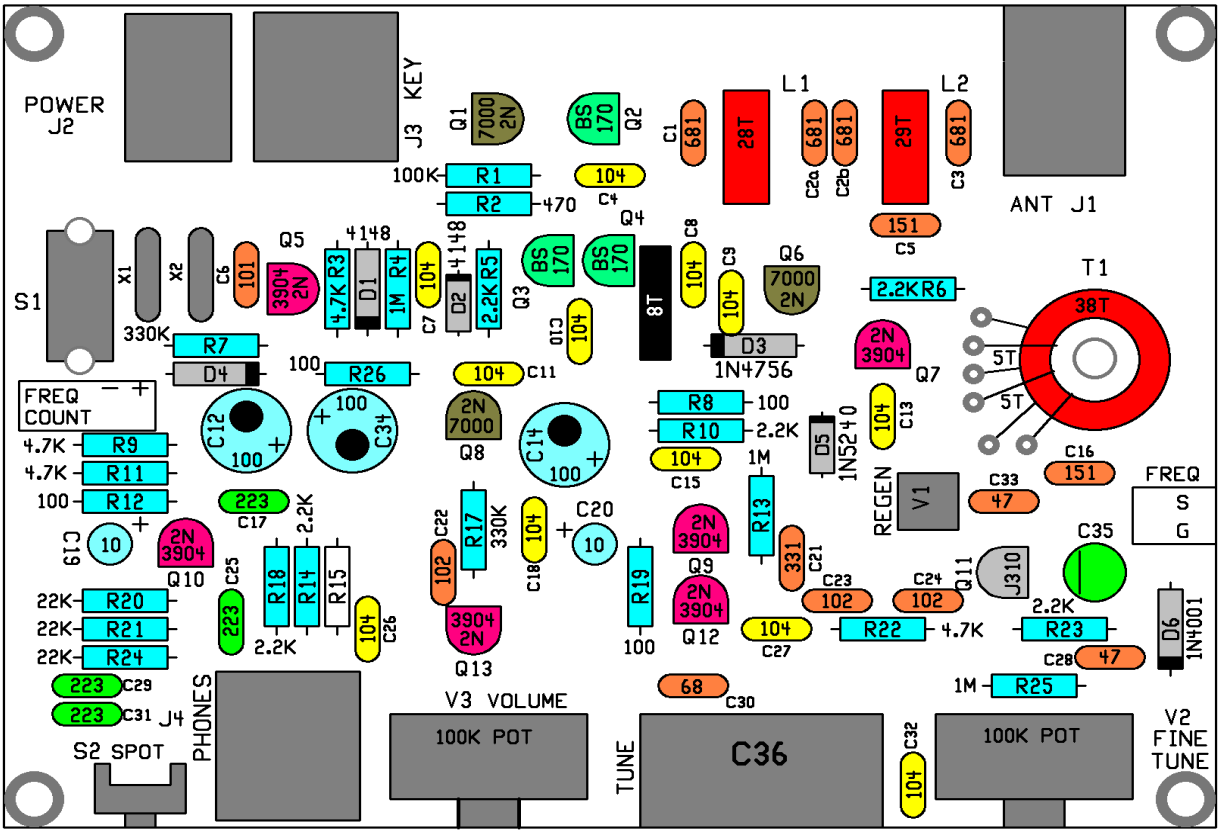
Assembly:

I recommend building up boards in “layers”, starting with the lowest profile parts. This means starting with the resistors and diodes, then the small capacitors, then the transistors, then everything else. Experienced builders will only need to print out the layout diagram to build up the board, but a part-by-part assembly table is also included. You can start by sorting the parts into types and verifying the quantity against the parts list below. Just be sure not to loose any in the process!

	QTY	Value	Identifier		QTY	Value	identifier
	4	100 ohms	BRN/BLK/BRN/GLD		2	1N4001	1A silicon rectifier diode
	1	470 ohms	YEL/VOL/BRN/GLD		2	1N4148	Small signal diode
	6	2.2 K	RED/RED/RED/GLD		1	1N5210B	500 mw 10 V Zener diode
	4	4.7 K	YEL/VOL/RED/GLD		1	1N4756A	1W, 47V Zener diode
	3	22 K	RED/RED/ORG/GLD		1	J-310	N-JFET
	1	100 K	BRN/BLK/YEL/GLD		3	BS170	TO-92 N MOSFET
	2	330 K	ORG/ORG/YEL/GLD		3	2N7000	TO-92 N MOSFET
	3	1 meg	BRN/BLK/GRN/GLD		6	2N3904	TO-92 NPN
					1	3.579 MHz	Crystal
	2	47 pfd	47 C0G/NPO		1	3.560 MHz	Crystal
	1	68 pfd	68 C0G/NPO		1	FT37-43	Ferrite core
	1	100 pfd	101 C0G/NPO				
	2	150 pfd	151 C0G/NPO		2	T37-2	Red iron powder core
	1	330 pfd	331 disk				
	4	680 pfd	681 C0G/NPO		1	T50-2	Red iron powder core
	3	.001 uF	102 disk		1	500 ohm	6mm trimmer resistor
	4	0.022 uF	223 film		2	100 K	16 mm Log tapper pots.
	13	0.1 uF	104 X7R MMLC		2	Phone jack	3.5mm board mount
	2	10 uF/16V	10 electrolytic		1	DC jack	2.1 mm
	3	100 uF/16V	100 electrolytic		1	BNC jack	PC mount
	1	40 pfd	trimmer cap.		1	SPDT slide	Slide switch
					1	PB switch	6mm RT angle TACTILE
	1	Tuning cap	Poly variable		1	7 feet	#28 magnet wire
	1	Tuning cap shaft	hardware		4	Bumper	feet
					1	pcb	Circuit board

Layout Diagram: color

Print out this layout diagram for reference while building.

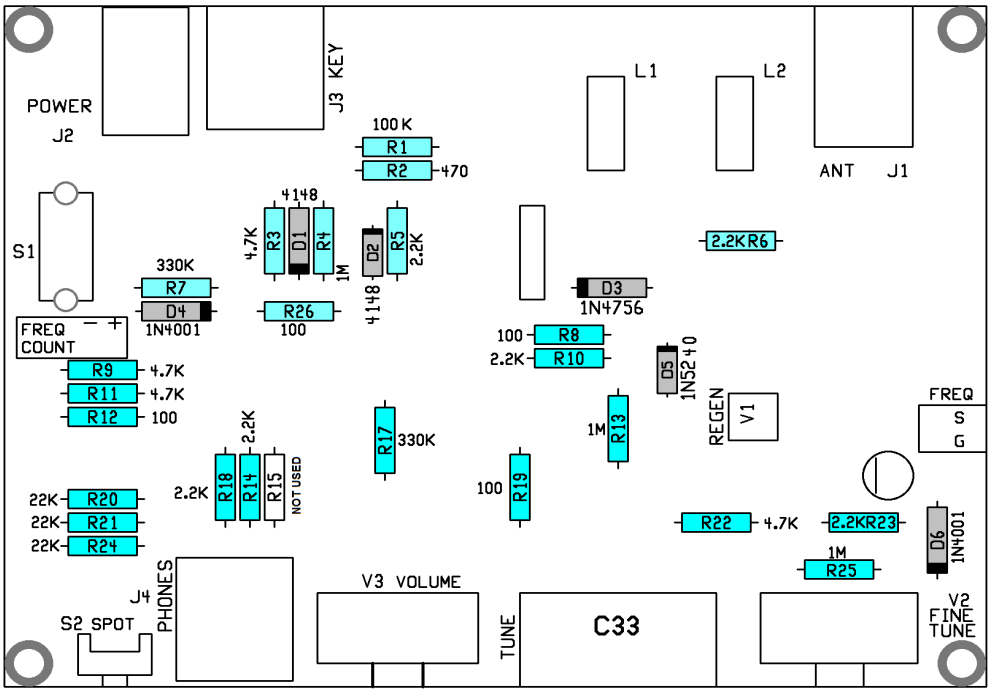


Resistors and diodes:

Parts are numbered on the board from upper left corner, left to right and zig-zag towards the bottom (front edge) of the board.

Look out for resistors with similar color codes which only vary by the 3d zero multiplier band, such as 2.2K vs 22K, 470 ohm vs 4.7K or 47 K and the like.

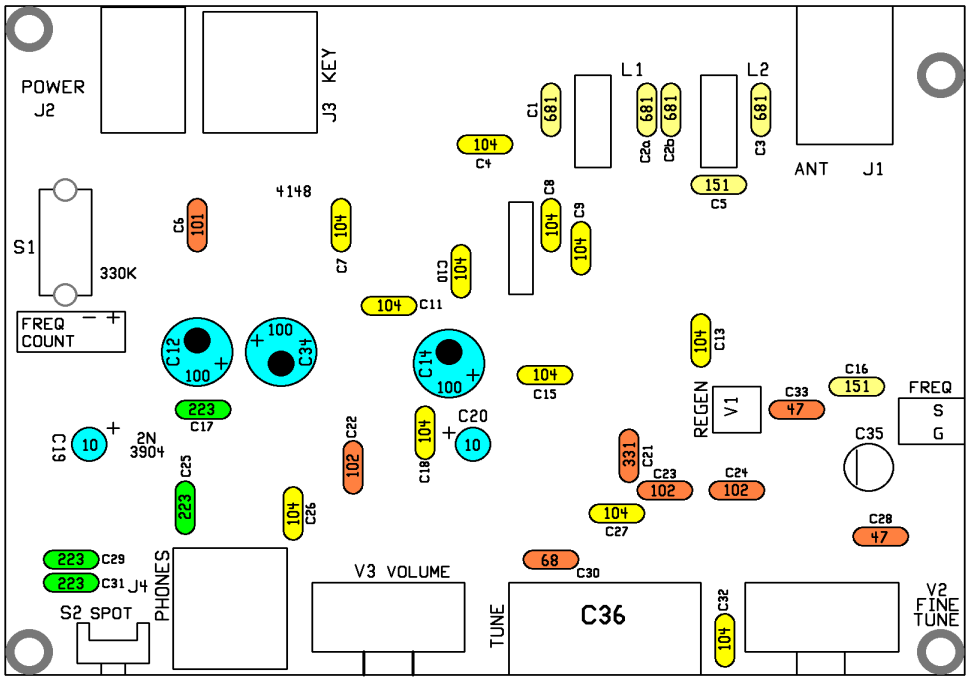
Be careful not to mix up D5 (a zener) with D1 and D2 (small signal silicon) diodes, since they are both in similar glass packages.



	R1	100 K	BRN/BLK/YEL/GLD		R2	470 OHM	YEL/VOL/BRN/GLD
	R3	4.7 K	YEL/VOL/RED/GLD		R4	1 M	BRN/BLK/GRN/GLD
	R5	2.2 K	RED/RED/RED/GLD		R6	2.2 K	RED/RED/RED/GLD
	R7	330 K	ORG/ORG/YEL/GLD		R8	100 OHM	BRN/BLK/BRN/GLD
	R9	4.7 K	YEL/VOL/RED/GLD		R10	2.2 K	RED/RED/RED/GLD
	R11	4.7 K	YEL/VOL/RED/GLD		R12	100 OHM	BRN/BLK/BRN/GLD
	R13	1 M	BRN/BLK/GRN/GLD		R14	2.2 K	RED/RED/RED/GLD
	R15		Not used, leave blank		R16	DELETED	Location
	R17	330 K	ORG/ORG/YEL/GLD		R18	2.2 K	RED/RED/RED/GLD
	R19	100 OHM	BRN/BLK/BRN/GLD		R20	22 K	RED/RED/ORG/GLD
	R21	22 K	RED/RED/ORG/GLD		R22	4.7 K	YEL/VOL/RED/GLD
	R23	2.2 K	RED/RED/RED/GLD		R24	22 K	RED/RED/ORG/GLD
	R25	1 M	BRN/BLK/GRN/GLD		R26	100 OHM	BRN/BLK/BRN/GLD
	D1	1N4148	Small glass		D2	1N4148	Small, glass
	D3	1N4756A	Large, glass		D4	1N4001	Large, black plastic 1A, 50V
	D5	1N5240B	Small, glass – don't mix up with 4148 diodes!		D6	1N4001	Large, black plastic

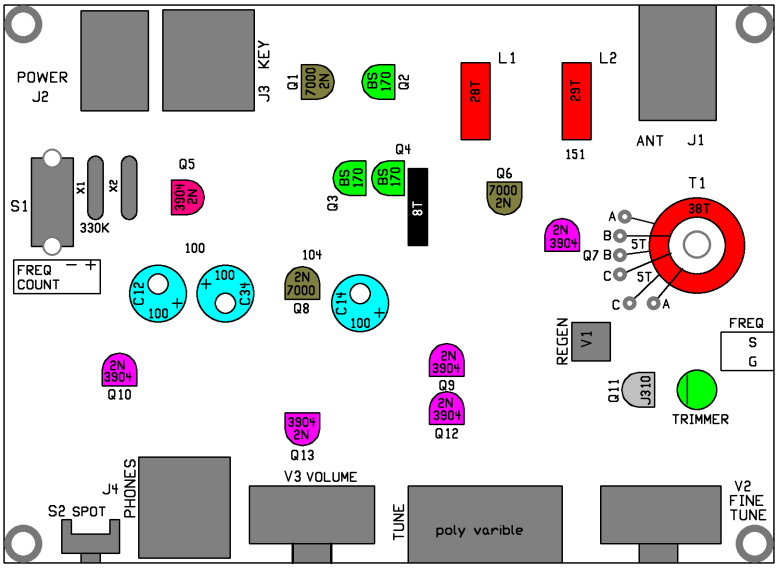
Capacitors:

All the 0.1 uF (104) caps are highlighted in yellow, since these are the most numerous value. The 0.022 uF caps are highlighted in green, as these are film caps. All other values are in light blue. Install the electrolytic caps last. Be sure to observe polarity. The plus end is the long lead. The negative lead pad is circled on the silk screen and highlighted in black below for the 100 uF caps.



	C1	681	680 pfd, C0G		C2a,b	681	680 pfd, C0G
	C3	681	680 pfd, C0G		C4	104	0.1 ufd X7R
	C5	151	150 pfd, C0G/NPO		C6	101	100 pfd C0G/NPO
	C7	104	0.1 ufd X7R		C8	104	0.1 ufd X7R
	C9	104	0.1 ufd X7R		C10	104	0.1 ufd X7R
	C11	104	0.1 ufd X7R		C12	100	100 ufd 16V electrolytic
	C13	104	0.1 ufd X7R		C14	100	100 ufd 16V electrolytic
	C15	104	0.1 ufd X7R		C16	151	150 pfd C0G/NPO
	C17	223	0.022 ufd film		C18	104	0.1 ufd X7R
	C19	10	10 ufd / 16V electrolytic		C20	10	10 ufd / 16V electrolytic
	C21	331	330 pfd disk		C22	102	0.001 ufd disk
	C23	102	0.001 ufd disk		C24	102	0.001 ufd disk
	C25	223	0.022 ufd film		C26	104	0.1 ufd X7R
	C27	104	0.1 ufd X7R		C28	47	47 pfd C0G/NPO
	C29	223	0.022 ufd film		C30	68	68 pfd C0G/NPO
	C31	223	0.022 ufd film		C32	104	0.1 ufd X7R
	C33	47	47 pfd C0G/NPO		C34	100	100 ufd 16V electrolytic

Remaining parts:



Note: due to the close spacing of the variable resistors and tuning cap, you might want to mount the pots to the bottom of the board, although that will make the controls work “backwards” and require a taller box to give clearance to the knobs. Or they could be mounted off the board and the connections jumpered to the board.

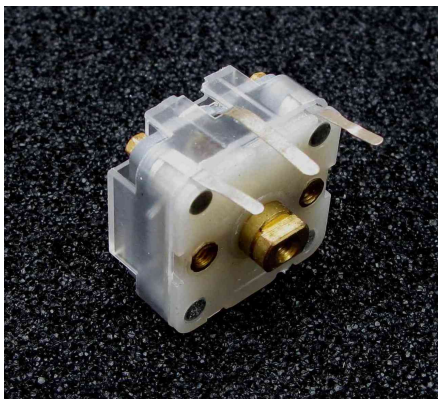
	Q1	2N7000	
	Q2	BS170	
	Q3	BS170	
	Q4	BS170	
	Q5	2N3904	
	Q6	2N7000	
	Q7	2N3904	
	Q8	2N7000	
	Q9	2N3904	
	Q10	2N3904	
	Q11	J310	
	Q12	2N3904	
	Q13	2N3904	
	J3/4	PHONE JACK	
	J2	DC POWER	
	J1	BNC JACK	
	S1	SPDT	SLIDE SWITCH
	S2	PUSH BUTTON	RIGHT ANGLE TACKLE SWITH
	X1	3.579 MHz	CRYSTAL or 3 pin SIP socket
	X2	3.560 MHz	CRYSTAL or 3 pin SIP socket
	V1	501	500 OHM TRIMMER RESISTOR
	V2/3	100 K	16mm Log potentiometer
	C36	VARIABLE	Tuning cap
	C35	Trimmer cap	

Addendum

There are two style poly-varicon capacitors that may come with your kit. Both styles are detailed below and latest variety needs a slight modification.

Poly-varicon installation to kits ordered before 01/20/18

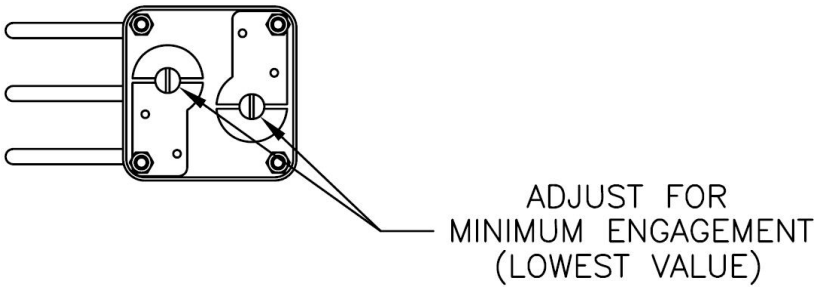
[ ] Prior to installing the poly-varicon variable capacitors the leads must be re-routed through the snap-on cover. The pictures below show the “as received” and “modified” condition. Carefully pry off the cover, bend the leads to the rear, feed them through the cover and snap it back on. There is a small tab, opposite the side with the leads, on the cover that matches the body of the poly-varicon for the cover to fit properly.



As received

Modified

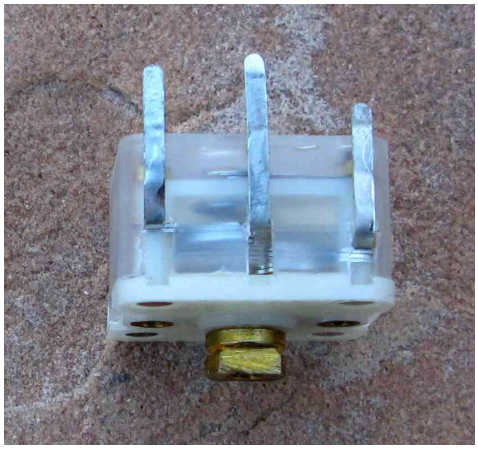
[ ] Adjust the two trimmer caps on the back of each poly-varicon to their *minimum* value as shown below.



[ ] Install the two polyvaricon capacitors on the inside of the front panel. Carefully feed the three leads through the board and secure the capacitors with the two short metric Phillips screws from the outside. Solder and clip the leads flush. Install the nylon spacers, long metric screws, and knobs as shown in the figure below.

Poly-varicon installation to kits ordered after 01/20/18

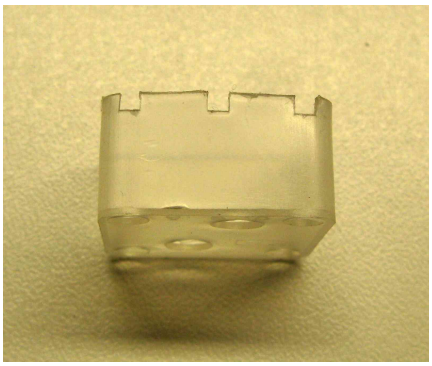
As received

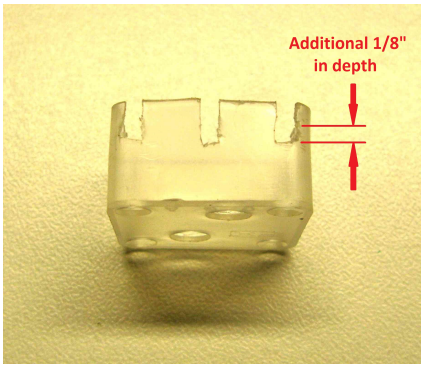


Modified

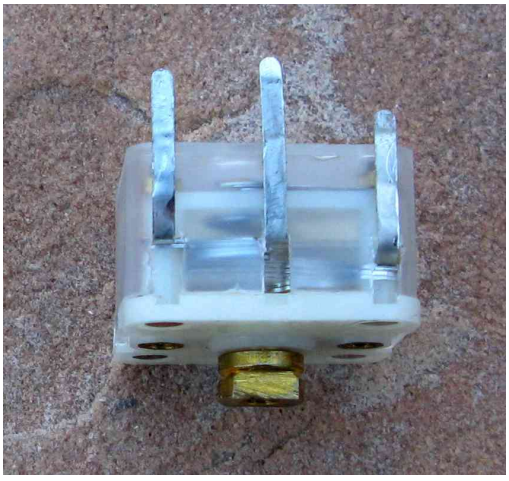
The polyvaricons as received, need a modification to allow the leads to reach the bottom of the device so it can be soldered to the pcb. If bent without modifying the cover, all the leads will not reach. Shown above is the un-modified polyvaricon as received.

Carefully unsnap the protective cover. Deepen all three slots for the connection tabs by ~1/8” with an Exacto knife as shown on the right. Snap the cover back on, and run the leads on the outside of the cover.

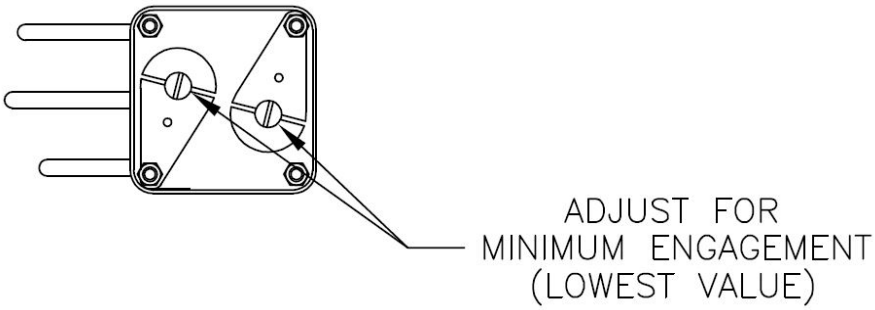




Shown below the modified cover is snapped back on and the leads are bent to the bottom. It is now ready for installation. As you can see, one of the leads is shorter than the others and may need to be soldered on the top of the board. This is not a problem with plated through holes.



[ ] Adjust the two trimmer caps on the back of each poly-varicon to their *minimum* value as shown below.



Toroids:

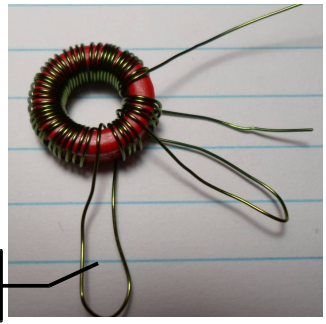
The toroid cores should be wound with the wire fairly tight and flush to the body of the core. Loops which extend much beyond the outside edge of the core need to be avoided. The recommended wire lengths in the table include a 1” start and stop wire length. If you run out of wire, your winding the core too loosely. A loosely wound core will not have the required inductance and will affect the tuning window, stability and power output. Note: When installing L3, you'll need to give it a “half twist” after soldering the leads to make it fit between Q4 and the cap on the other side, so leave a little slack in the leads.

	L1	T37-2 (red)	17” #28 magnet wire, 28 turns
	L2	T37-2 (red)	17” #28 magnet wire, 29 turns
	L3	FT-37-43 (black)	6” #28 magnet wire, 8 turns

Winding the receiver input transformer, T1:

The receiver input has three windings, the input coupling, the receiver tuned circuit inductor and the feedback winding. The tuned circuit inductor winding and the feedback winding require to have a specific phase relationship for the detector to oscillate and produce audio output. Winding the core as explained below will ensure the proper phase relationship when mounted to the board. A piece of double sided foam tape or a nylon screw and fiber washer can be used to secure the T1 core to the board to reduce microphonics and improve stability.

- Cut a length of #28 magnet wire to 40”
- Wind the initial 38 turns for the detector input.
- Make a hairpin about 1” long and continue to wind an additional 5 turns.
- Break out another 1” hairpin and wind 5 more turns.
- All these turns will just fit around the core with little space to spare.
- Now snip the center of the hairpin turn to separate the three windings.
- Tin the leads and install into the board, making sure you don't cross winding leads.
- Once the toroids are installed, assembly is complete.
- Be sure to carefully inspect your solder joints before power up the board.



Test and operation:

A common 13.8V supply is recommended. So is adding a 1A fuse. Since the board it's self isn't fused, using a fused supply cable will prevent any possible damage to the supply or board if something went wrong with the assembly or soldering and a short develops.

Warning: The common on the headphone jack is “hot” and connected to the input supply directly through the headphones. Therefore, a short here to ground could burn out the headphones.

- Plug in a set of headphones
- Connect BNC jack to 80 meter antenna
- Plug in a DC power cable
- Using a small blade screwdriver, adjust the REGEN control pot fully counter clock wise.
- Turn on the power supply
- Check for +10 V at the pad labeled “TP3” If this is not 10V, then you have a 1N4148 diode there instead of the zener.
- Check for about 1.8 V at TP1 and 13.0 V at TP2 (this assumes a 13.8V power supply)
- Turn the REGEN control slowly clockwise. You should start to hear band noise at about ¼ turn. This is when the detector starts to oscillate. Advance the control a little more to ensure reliable start up. If your using a frequency counter adjust for a stable reading on the display.
- You should now be able to tune around and hear stations.
- The C35 trimmer cap can be used to set the lower frequency tuning point you would like.

Transmitter testing:

- Connect a QRP power meter and 50 ohm dummy load to BNC jack
- Plug in a straight key into key jack.
- Power up board with 13.8 volts
- Key the transmitter.
- Power output should be about 2.5 to 3 watts. The power will sag a little if keyed for more then a few seconds.
- Side tone should be audible in the headphones.

SPOT switch:

The spot switch allows finding your transmit frequency in the receiver. Simply push the switch and tune the receiver until you hear the tone you like and side band with the least QRM.

Adding a frequency readout dial.

A frequency counter can be added for a direct readout of the receiver frequency. The pads labeled “S” (signal) and “G” (ground) in the box labeled “FREQ” on the right side of the board connect to the counters signal input. The Pads labeled “+” (plus power) and “-” (ground) in the box labeled “FREQ COUNT” supply power to the counter board. This supply is isolated from the rest of the circuits on the board via a 100 ohm resistor and 100 ufd electrolytic capacitor. This keeps power supply noise from the counter out of the receiver.

Note that the counter can also radiate a fair amount of noise which can be picked up by the transmitter low pass filter coils and the receiver input coil. Therefore, try to mount the counter as far away from the coils as possible or add some shielding behind the counter board.

A suitable counter is available from the QRP Guys, QRPKITS.com or from China sourced from ebay.

Adding a speaker:

The headphone jack has switched contacts, so it would be possible to wire up a small 32 ohm speaker. There should be sufficient volume for most signals. Make sure it's a 32 ohm type, an 8 ohm will be too much of a load. Connect the speaker leads to the two pads to the left of the headphone jack.

Supply voltage:

The Para80set is designed to be powered by 13.8 volts. It will work reliably down to 12 volts with reduced power output. Power output can be improved by removing a turn from L1, making it 27 turns instead of 28.

Excessive SWR:

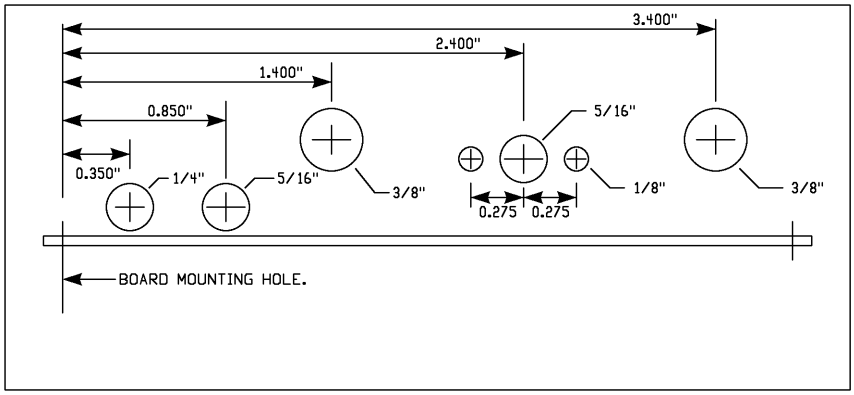
Due to the narrow bandwidth of most 80 meter antennas, high SWR can be a problem. Excessive SWR could lead to stability problems or even damage to the PA. It is recommended to use a resistive SWR bridge when using an antenna tuner to find best match.

Trouble shooting:

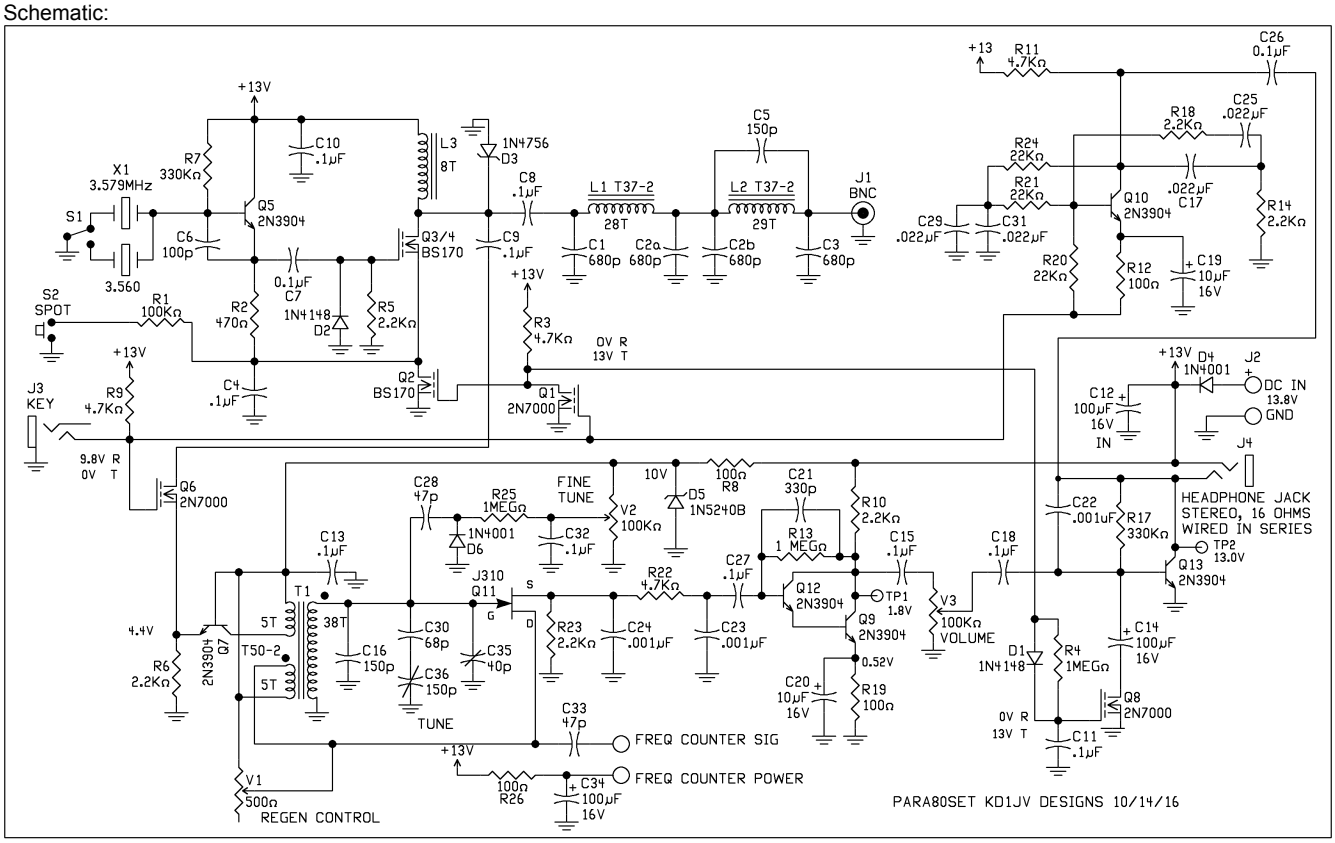
Any trouble getting the rig to work will inevitably be tracked down to an assembly error, the most common of which are soldering issues. A close visual inspection of your soldering will likely find the problem area. Having miss placed parts is less likely, but a possibility, especially the mixing up of resistors with similar color codes. Voltages at critical points are noted on the schematic. Using your voltmeter to verify these voltages can help pin point the problem area. Minor variations from the voltages noted on the schematic are normal due to parts tolerances, voltmeter loading and calibration.

Packaging the board:

The simplest way to make an enclosure for the board would be a “L” shape, made of PCB material or aluminum. Just remember that the exposed mounting sleeve of the headphone jack is “live” with the DC supply so make sure it has good clearance from a conductive front panel. A front panel drill drawing is shown below. To fully enclose the board, a cover could be made of some thin hobby wood which would make for a nice looking package. The diagram below should print out to actual size so it can be used as a drill template, but be sure to double check the dimensions first to make sure. The hight of the panel below the board will depend on what you use for board spacers. I would use at least an inch.



Schematic:



PCB track layout: