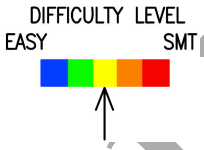
QRPBuilder K8TND Patriot S.W. Regenerative Receiver



First, familiarize yourself with the parts and check for all the components. If a part is missing, please contact us at ***grpbuilder@gmail.com*** and we will send you one. If you are new to parts identification refer to the appendix for part markings.

Please read all the instructions before starting to assemble the receiver.

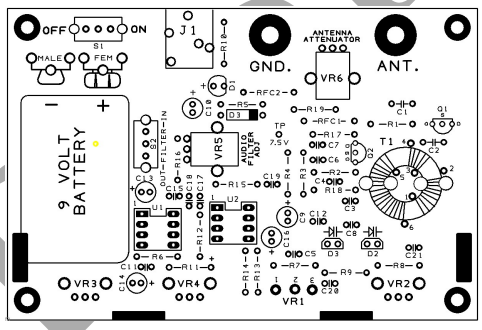
Parts List

1 – QRPGuys K8TND Regen Receiver PCB, 4 pieces
1 – U1, LM386 DIP IC
1 – U2, LM741 OP AMP
2 – Q1,2, J310 FET
1 – D1, green led
2 – D2,4 ISV149 varactor diode, marked v149
1 – D3, 1N4737A, 7.5V zener diode, small glass, black band on one end
1 – R1, 620 ohm resistor (blue-red-brown-gold)
2 – R2,8 1 Meg ohm resistor (brown-black-green-gold)
1 – R3, 3K (orange-black-red-gold)
2 – R7,9 10K resistor (brown-black-orange-gold)
2 – R4,11 5.6K resistor (green-blue-red-gold)
1 – R5, 1K resistor (brown-black-red-gold)
1 – R6, 10 ohm resistor (brown-black-black-gold)
1 – R10, 4.7k ohm (yellow-violet-red-gold)
1 – R12, 220K ohm resistor (red-red-yellow-gold)
1 – R13, 47K ohm resistor (yellow-violet-orange-gold)
2 - R14,16, 330K ohm resistor (orange-orange-yellow-gold)
2 – R15,18, 100K ohm resistor (brown-black-yellow-gold)
1 - R17, 3.3K resistor (orange-orange-red-gold)
1 – R19, 2.2K ohm resistor, (red-red-red-gold)
1 – C1, 220pF MLCC, marked 221
1 – C2, 33pF MLCC, marked 33
1 – C3, 820pF NP0/C0G MLCC, marked 821
1 - C4, 100pF NP0/C0G capacitor, marked 100
3 – C5,9,21, .1uF MLCC, marked 104
1 – C6, .001uF MLCC capacitor, marked 102
8 – C7,11,12,15,17,18,19,20, .01uF, marked 103
1 – C8, 470pF NP0/C0G capacitor, marked 471
2 – C13,16, 10uF electrolytic capacitor

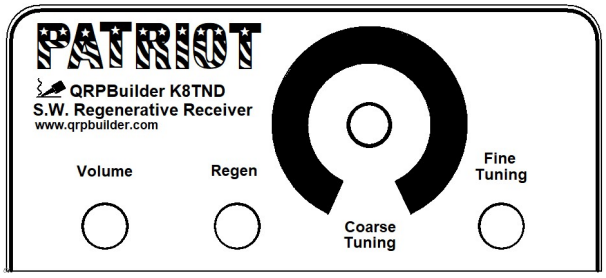
2 – C10,14, 100uF electrolytic capacitor
3 – VR2,3,4, 10K pcb horizontally mounted potentiometer
1 – VR1, 10K panel mount potentiometer
2 – VR5,6 10K, vertically mounted potentiometer
2 – RFC1,2, 1.0mH molded inductor, green body, marked (brown-black-red-silver)
1 – J1, 3.5mm stereo jack
2 – S1,2, SPDT slide switch
2 – 8 pin DIP socket
1 – 9V battery clip-female
1 – 9V battery clip-male
1 – 48” 26awg magnet wire
1 – T68-2 toroid core (red)
2 – 8-32 x 3/4”L SS Phillips pan head screw
4 – 8-32 SS hex nut
2 – 8-32 SS wing nut
2 – 8-32 SS internal tooth lock washer
2 – 4” cable tie
4 – 3/8” dia. rubber foot
1 – 8” hook-up wire
1 – large control knob
3 – small control knob

Even if you have done radio kit assembly before, please read through all the instructions before you start. This kit is a little different, in that the mechanical chassis components are part of the printed circuit board. The instructions give you the scope of the project and an understanding of the techniques we have employed. You will be assembling the kit from four pieces of pcb material. The base pcb contains all the circuitry for the receiver. When you tack and then solder the remaining pcb components it will make a sturdy mechanical assembly. Refer to the figure below for identification of the individual pcb parts. You will be assembling all the electrical components on the Base pcb. When you have completed the assembly you will have a sturdy assembly.

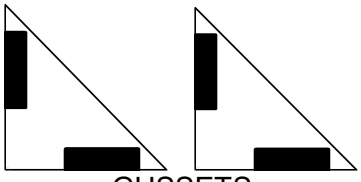
There is much available information on the web for electronic kit building. Also, almost all amateur radio clubs have individuals that are most willing to aid beginners. Seek them out, if this is your first kit or you are unsure how to proceed.



BASE



FRONT PANEL



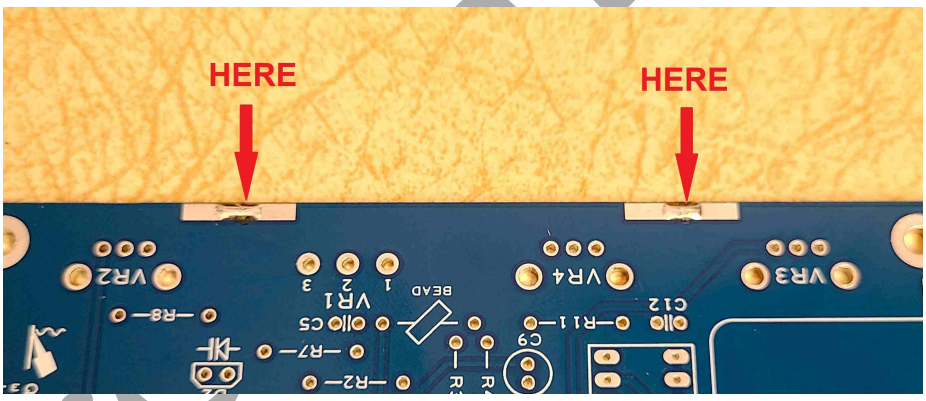
GUSSETS

On all the mechanical assembly soldering of the pcb's, you will use the same technique. You tack (solder) a single tiny point first, and then check to see that it is square and aligned properly with the assembly notes. Take your time and make sure everything is aligned. It is easy to re-heat the joint and adjust the alignment when there is only a single point. You will tack all the other pads, before you do the finish soldering. After finished soldering of the chassis, the assembly will be remarkably strong.

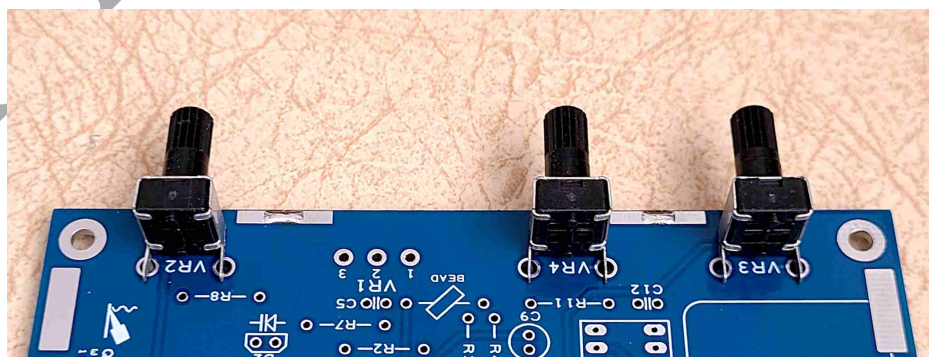
If you don't understand the instructions before you start to solder, please ask for clarification.

Now you are going to solder the four pcb pieces that form the chassis.

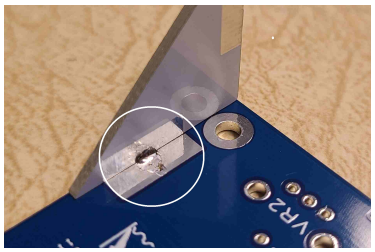
[ ] Apply a small amount of solder to the two pads on the front of the Base pcb as shown below.



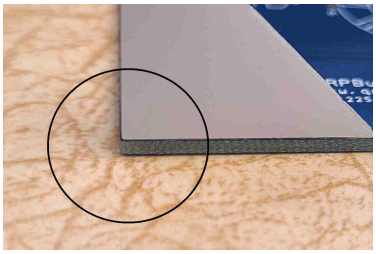
[ ] Install VR2,3,4 as shown below.



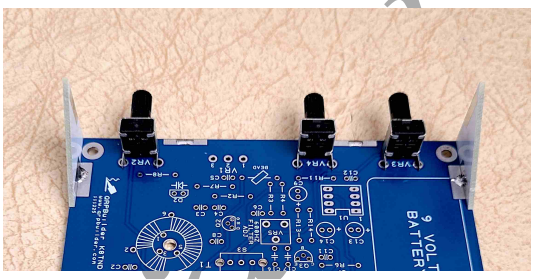
[ ] Tack the two Gussets to the Base. When finished, you want them to be 90° as shown below and flush with the front edge of the Base pcb and flush with the sides. To check the 90°, cut the corner off a piece of printer paper or 3x5 card and use it as a gage on the inside of the boards. If you do more than a small tack, The solder will cool and draw in the gusset to less than the 90° desired. Reheat the tack and reposition. ***Do not try to bend the gusset without reheating, or you pull the copper off the pcb*.** You will go back and finish soldering after the front panel is attached. Refer to the graphics below.



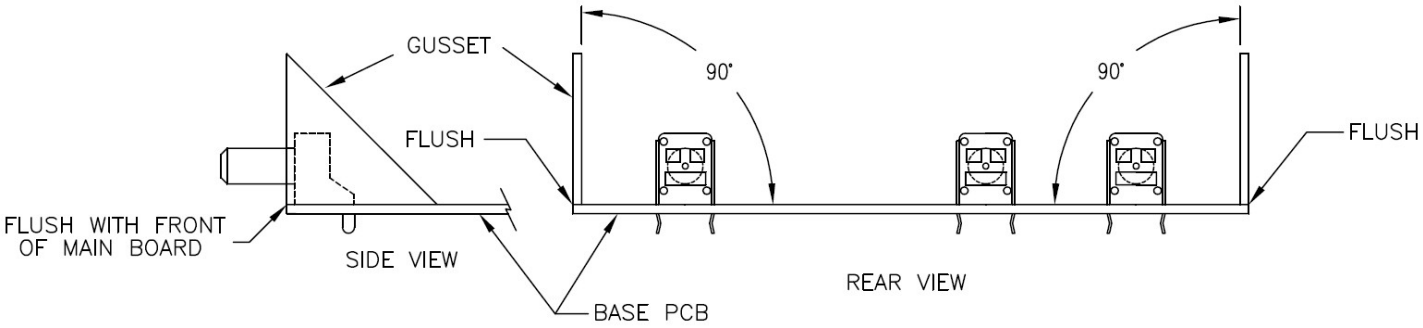
Small tack



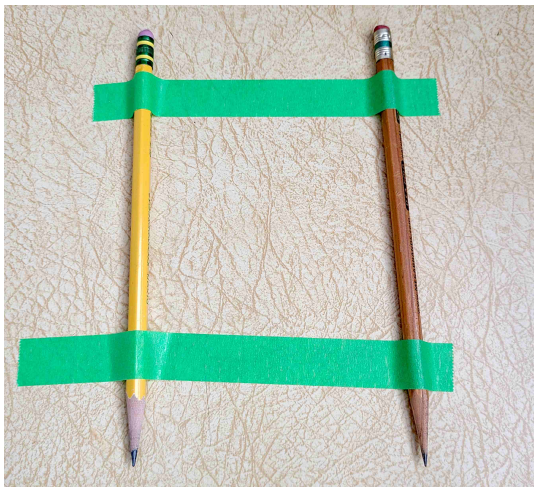
Flush on front and sides



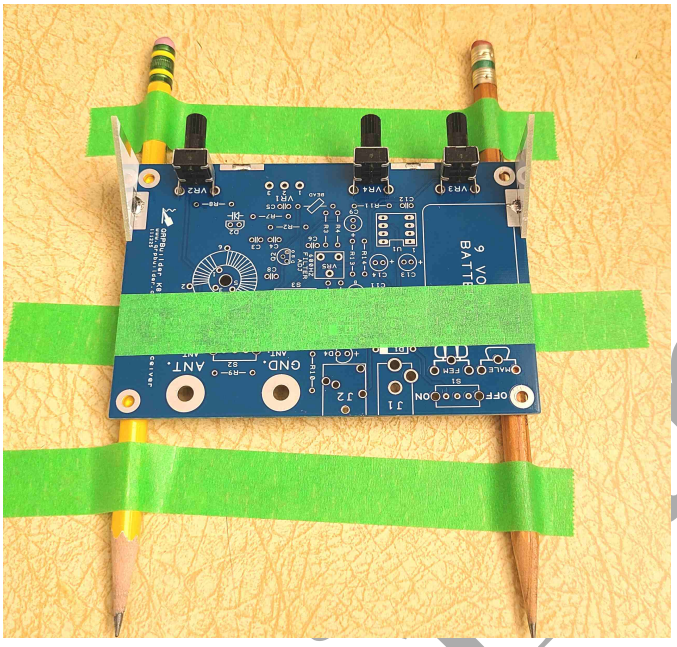
Both sides 90°, ready for next step



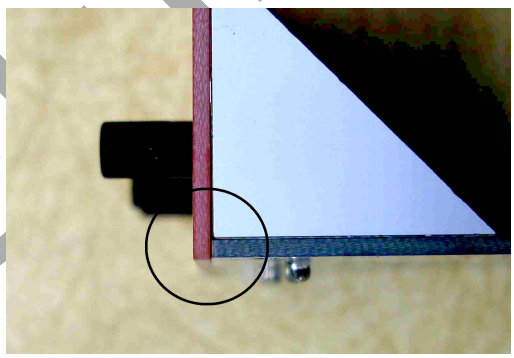
[ ] A flat surface is needed for the next step. If a kitchen counter is used, obtain permission first. Tape two pencils to the surface, 4” apart, as shown below.

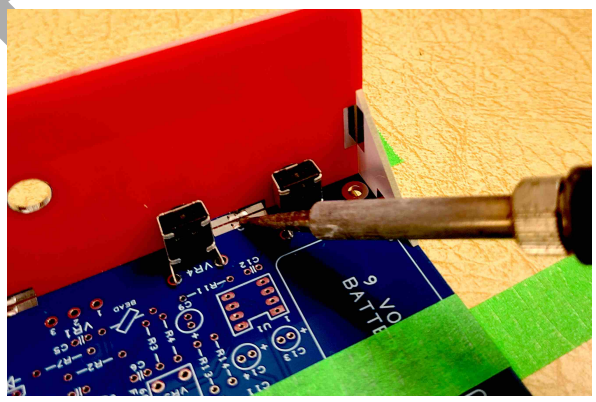


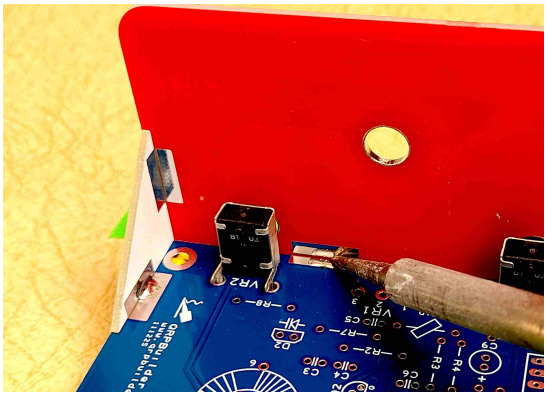
[ ] Tape the board on top of the pencils to the work surface, so the bottom of the board is flush with the top of the pencils. Leave room at the end of the board with the pots, with bare pencil diameter surface exposed.



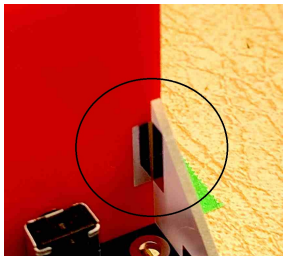
[ ] Position the inside of the Front Panel flush with the top of the pencils, against the front surface of the Base pcb and gussets. When you have centered the Front Panel flush with both sides, melt one of the small tack you previously applied to the base with the Front Panel as shown below. Then do the other.



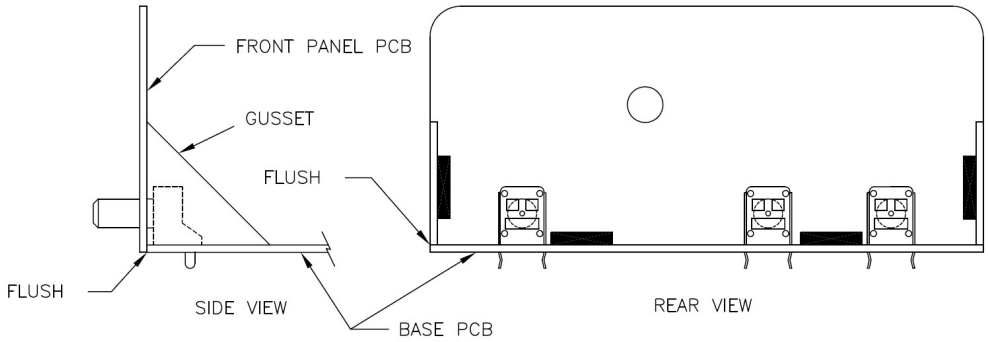


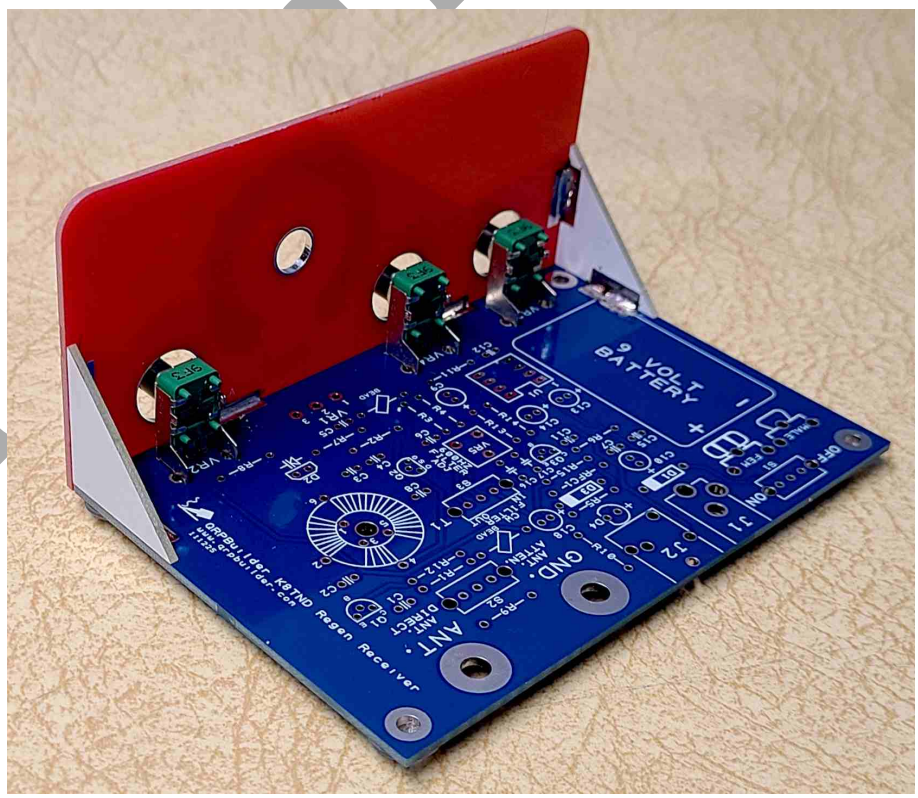


[ ] Next, tack the two gussets to the Front Panel on each side.



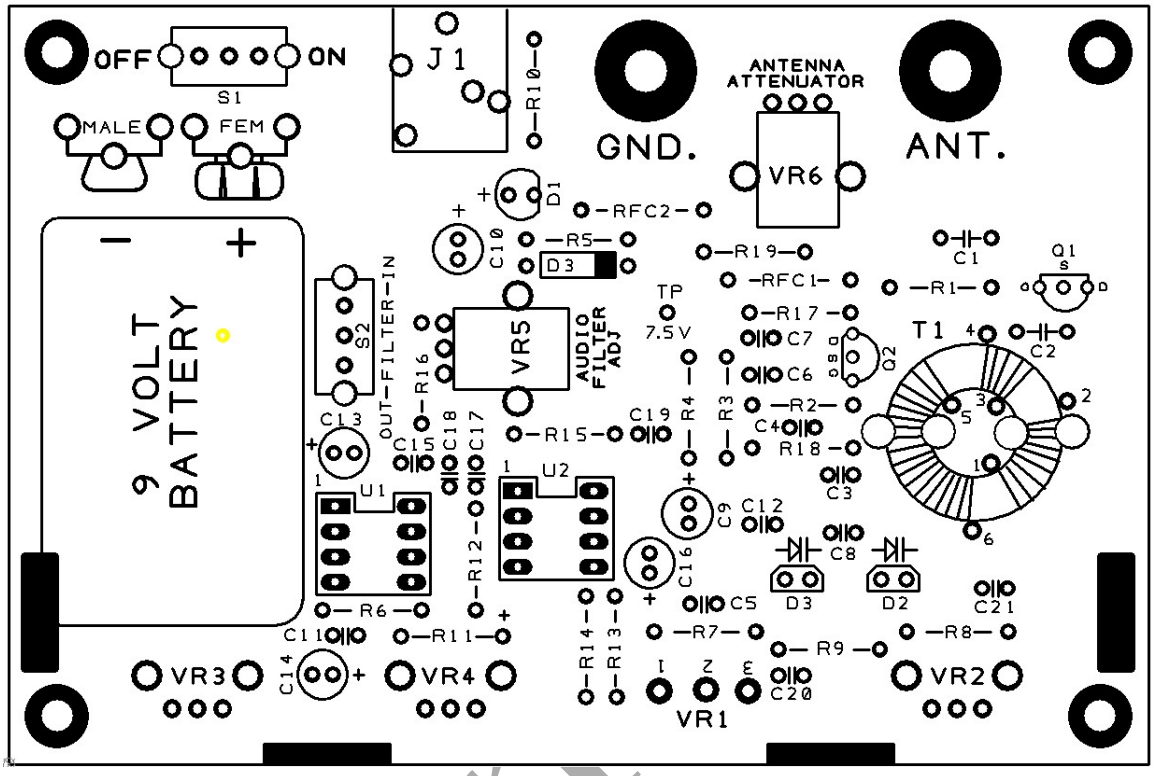
[ ] Take a minute to inspect the position of all the pcb pieces to see if you have met all the requirements. It is easy to re-heat a small tack and re-position. *When you are satisfied all the alignments are met, you may now go back and complete the soldering of all six of the pads.*





Completed chassis assembly

Using the component placement graphic guide below, start assembling and check off as you go. On any component, I always solder a single lead first, align the component if needed, then solder the other pad(s). Clip the leads flush after installing each component or set of components.



[ ] Install R1, 620 ohm resistor (blue-red-brown-gold)

[ ] Install R2,8, 1 meg ohm resistor (brown-black-green-gold)

[ ] Install R3, 3K (orange-black-red-gold)

[ ] Install R4,11 5.6K resistor (green-blue-red-gold)

[ ] Install R5, 1K resistor (brown-black-red-gold)

[ ] Install R6, 10 ohm resistor (brown-black-black-gold)

[ ] Install R7,9, 10K resistor (brown-black-orange-gold)

[ ] Install R10, 4.7k ohm (yellow-violet-red-gold)

[ ] Install R12, 220K ohm resistor (red-red-yellow-gold)

[ ] Install R13, 47K ohm resistor (yellow-violet-orange-gold)

[ ] Install R14,16, 330K ohm resistor (orange-orange-yellow-gold)

[ ] Install R15,18, 100K ohm resistor (brown-black-yellow-gold)

[ ] Install R17, 3.3K resistor (orange-orange-red-gold)

[ ] Install R19, 2.2K ohm resistor, (red-red-red-gold)

[ ] Install C1, 220pF MLCC, marked 221

[ ] Install C2, 33pF MLCC, marked 33

[ ] Install C3, 820pF NP0/C0G MLCC, marked 821

[ ] Install C4, 100pF NP0/C0G capacitor, marked 100

[ ] Install C5,9,21, .1uF MLCC, marked 104

[ ] Install C6, .001uF MLCC capacitor, marked 102

[ ] Install C7,11,12,15,17,18,19,20, .01uF, marked 103

[ ] Install C8, 470pF NP0/C0G capacitor, marked 471

[ ] Install RFC1,2, 1.0mH molded inductor, green body, marked (brown-black-red-silver)

[ ] Install D3, 1N4737A, small glass diode, *match the band on the diode with the outline*

[ ] Install D1, green led, *observe polarity, the long lead is positive*

[ ] Install 8 pin DIP socket. Match the small notch with the board outline.

[ ] Install D2,4 ISV149 varactor diode, marked v149

[ ] Install Q1,2, J310 transistor, *match the board outline*

[ ] Install J1, 3.5mm stereo jack

[ ] Install S1,2, SPDT slide switch

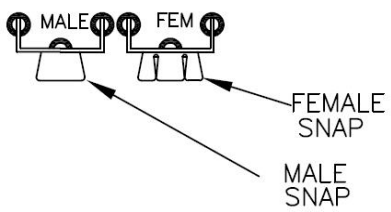
[ ] Install C10,14 100uF electrolytic capacitor, *observe polarity, the long lead is positive*

[ ] Install C13,16, 10uF electrolytic capacitor, *observe polarity, the long lead is positive*

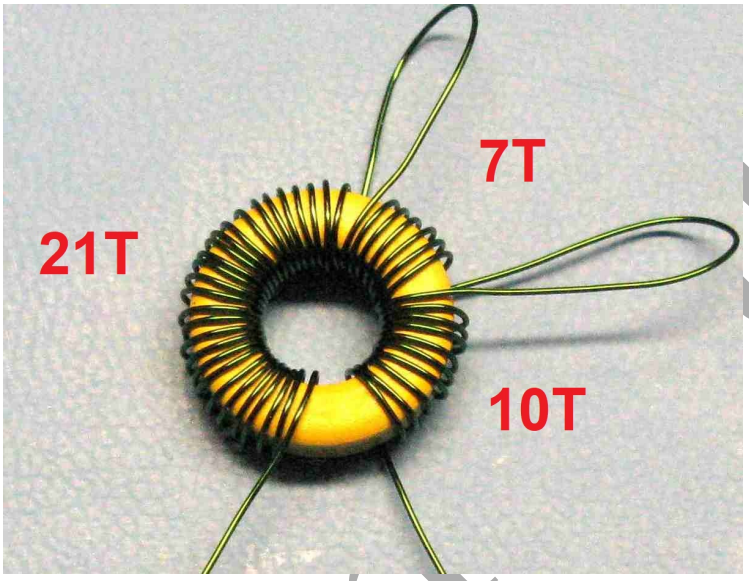
[ ] Install VR5,6, 10K, vertical potentiometer

[ ] Install the 9V battery clip-female, as shown below. ***Don't mix them up.***

[ ] Install the 9V battery clip-male, as shown below. ***Don't mix them up.***

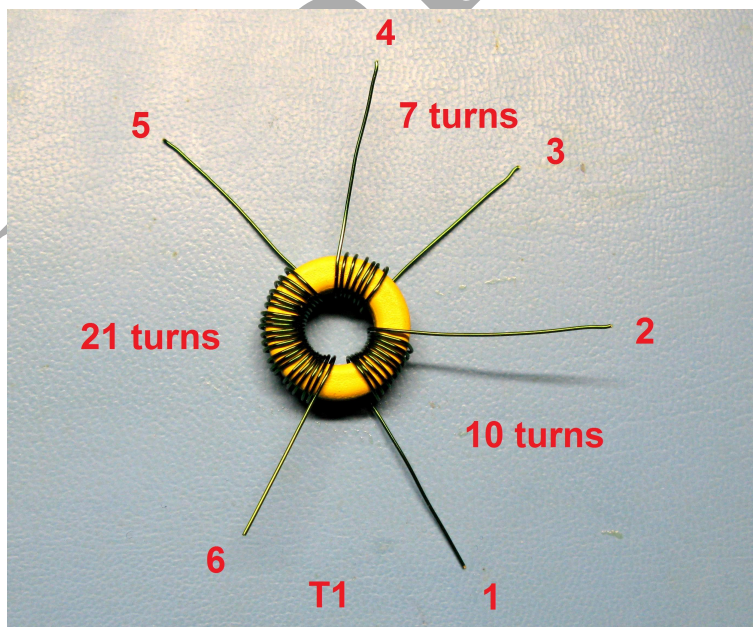


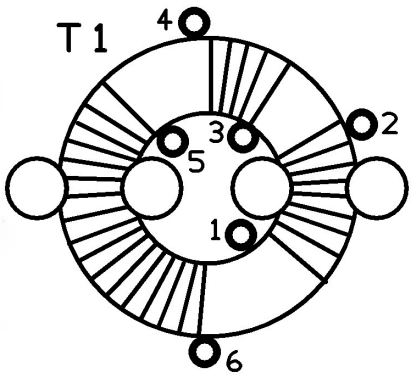
[ ] Use the T68-2 toroid core (red), the supplied magnet wire, and wind T1 as shown below, start winding at the 5 o'clock position. Push 1" of the wire down the hole from the top and hold it, feed the remaining turns up from the bottom. ***Every time the wire goes thru the center counts as one turn*****.** Wind a total of 10 turns, and form a 1" loop, wind another 7 turns, and form another 1" loop, then finish with 21 more turns. If you have your own special technique for winding toroids, use it. The wires must be over the core or under the core for each group of turns as shown below. If the wound core does not look like the picture below, it will not align with the pcb holes. *Be sure to verify the turn counts on each group before you cut the loops.*



Your core is red, this yellow core is shown for clarity.

Note: *Now is a good time to mention a good way for counting the turns on your toroids. Many times if a toroid has a lot of turns, you can lose track going around. A good trick is to take a digital picture of it before you trim the leads and enlarge it on your computer screen. Counting is clearly a lot easier.*





Yellow core is shown for clarity

[ ] Cut the loops and straighten the wires. It should look like the picture above. If you have wound it properly, when the leads are bent down, they will align with the six pcb pads shown in the graphic above. The magnet wire has Thermaleze enamel, and can be removed with a hot soldering iron. Remove the insulation, and ensure the leads are clean of any Thermaleze residue, then ***tin the leads before installing*** on the pcb.

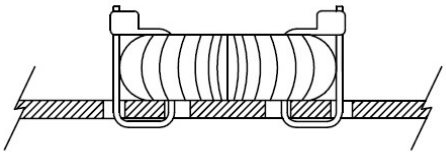
Now Install T1 flush with the pcb.

Another tip: If all the leads are exactly the same length it is difficult to align all 6 leads simultaneously. Cut them slightly different lengths and you can align them easily. Just start with the longest one first.

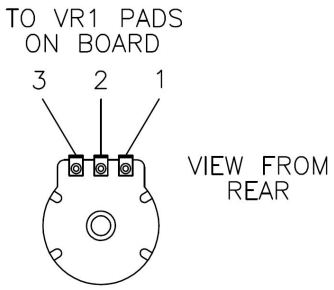
[ ] Solder the six leads.

Faulty toroid soldering is a common fault area for kit builders We always tell you to tin the wires before installing and when installing the toroid, do not pull the lead past where you have it tinned on the back of the board. Attention to detail here will ensure a successful outcome.

[ ] Secure T1 with the two nylon cable ties, as shown below.

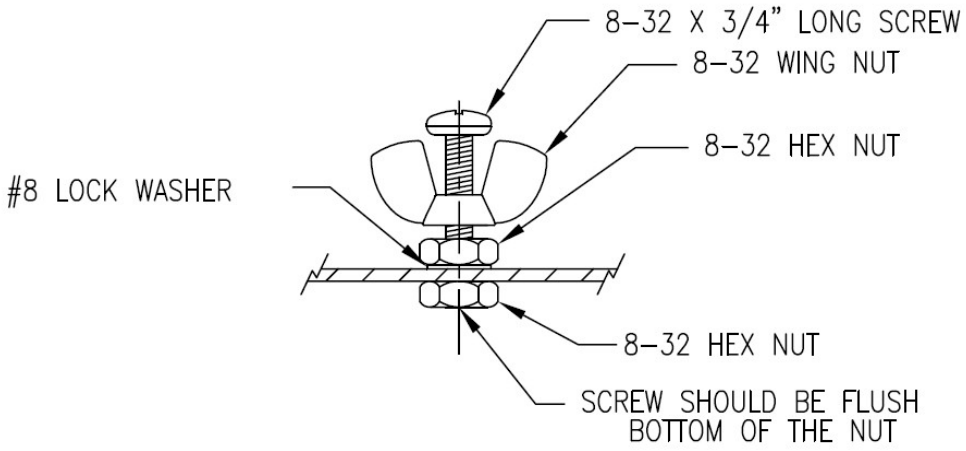


[ ] Mount VR1 to the front panel with the nut that came with the pot. If the potentiometer has a tab for clocking the pot, cut it off. Use three 2 1/2"" long pieces of the hook-up wire supplied to connect the potentiometer to the pcb matching the number sequence in the graphic with the pcb. Finally secure the knob to the shaft.



[ ] Install the three small control knobs on VR2,3,4.

[ ] Install the antenna and ground connection hardware as shown in the graphic below.



[ ] Next, power up the receiver with a 9V battery. With a battery installed, turn on S1 and check for +7.5V at the T.P. and pin 7 of the U2 socket. Check for +9.V at pin 6 of the U1 socket. If all is ok, turn off the power switch and install the LM386 and LM741 IC's into their respective sockets, noting the position of pin 1 shown in the graphic below.

When inserting new IC's, the pins are flared so that they can be retained by automatic insertion tools. Carefully and gently rock it on a flat surface so the pins are parallel and it will insert into the socket more easily reducing the risk of breaking or bending a pin.

[ ] Attach the 4 rubber feet to the corners of base pcb where indicated.

This completes the assembly.

Testing with an antenna and alignment:

It is easiest to mark the approximate locations of the SWL bands, WWV, etc. by using another receiver. Loosely couple the antenna with that of a nearby receiver and it will pick up the local oscillator in your regen receiver. Note the frequency or band of interest and mark with a pencil on the front panel. Make sure your fine tuning pot is in the middle of its range and you will have fine tuning either side of the frequency or band you marked. The “Fine Tuning” will cover a range of about 30Khz.

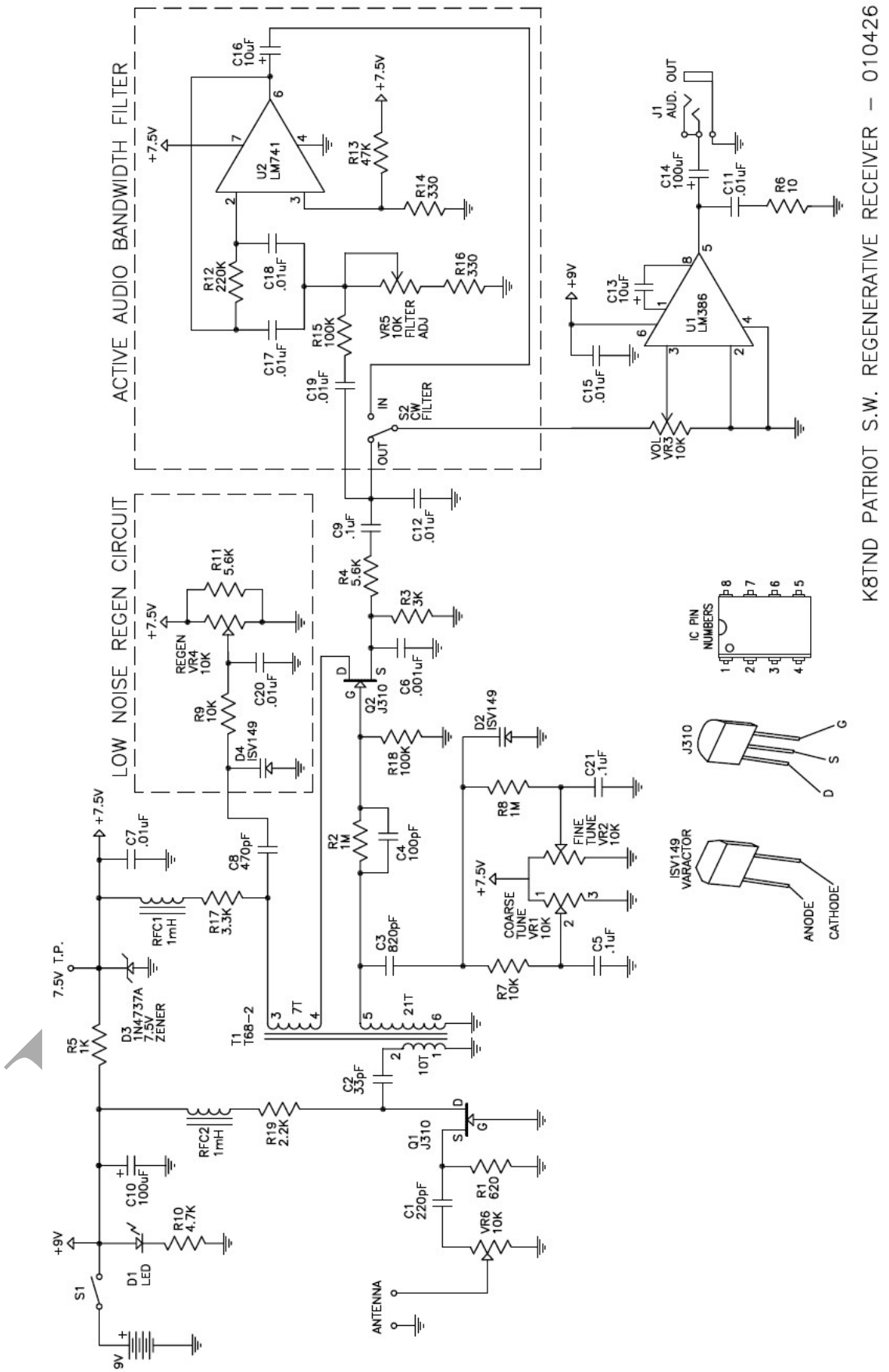
General tips and operation using a Regenerative receiver:

AM stations are best heard with the Regen control to the counterclockwise side of the knob travel, and the advanced clockwise just before sidetones are heard. **CW/SSB** stations are best heard with the Regen control to the clockwise side of the knob travel, as they require the sidetones to be present. The Regen and both Tuning controls interact with each other so a little tweaking is required. For CW reception, switch the filter “IN” and adjust the VR5 trim pot for the best tone and selectivity. For AM and SSB reception, switch the audio filter “OUT”. The Antenna Attenuator potentiometer, VR6 will help with a very strong signal overloading the first stage. Turn CCW to decrease signal strength, and CW to increase.

When changing frequency by any appreciable amount, it will be necessary to re-adjust the “Regen” control for maximum signal strength. Adjustment will also be necessary if the “Regen” starts to oscillate. If you cannot get the regen to stop oscillating, squeeze the winding groups closer together and separate them from each other. Use the minimum amount of volume for comfortable listening. With a regenerative receiver a little back and forth is necessary, and you will get the hang of it after a few tries.

Other great tips on regenerative receiver tuning can be found here at the ARRL site, http://www.arrl.org/tuning-a-regenerative-receiver.

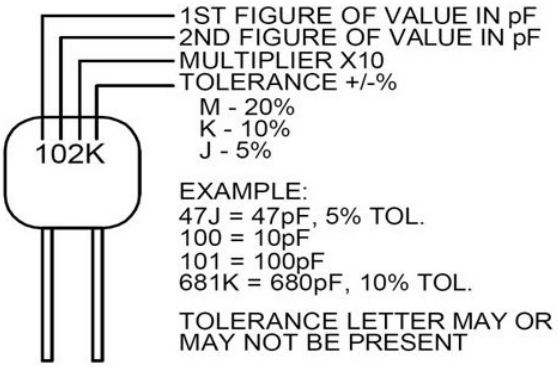
Schematic:


ACTIVE AUDIO BANDWIDTH FILTER
LOW NOISE REGEN CIRCUIT
K8TND PATRIOT S.W. REGENERATIVE RECEIVER - 010426
C9 .1uF WAS 10uF ELE
R3 WAS 3.9K
U1 LM386
U2 LM741
Q1 J310
Q2 J310
T1 T68-2
7T
21T
10T
D1 LED
D2 ISV149
D3 1N4737A 7.5V ZENER
D4 ISV149
S1
S2 CW FILTER
J1 AUD. OUT
VR1 COARSE TUNE 10K
VR2 FINE TUNE 10K
VR3 VOL 10K
VR4 REGEN 10K
VR5 10K FILTER ADJ
VR6 10K
IC PIN NUMBERS
ISV149 VARACTOR
ANODE
CATHODE
ANTENNA
7.5V T.P.
9V
+9V
+7.5V

Notes:

Appendix:

- All the resistors are 4 color, 5% tolerance, 1/4 watt, carbon type, tan body colored so the colors are easy to identify.
- Ceramic disk and multi-layer ceramic capacitors (MLCC) capacitors are all clearly marked, although some may quite small and may need magnification. Tolerance code may be omitted.
- Electrolytic capacitors are polarized, clearly marked, and for this kit, can be 16V, 25V, or 50V.
- Molded inductor bodies are green and identified by the chart below.
- Some of the integrated circuits, diodes and transistor markings may be quite small and require some magnification.

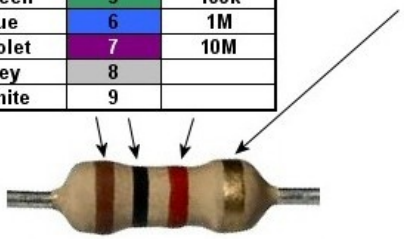


Ceramic capacitor markings

Resistor Color Codes

	Value	Multiplier
Black	0	1
Brown	1	10
Red	2	100
Orange	3	1k
Yellow	4	10k
Green	5	100k
Blue	6	1M
Violet	7	10M
Grey	8	
White	9	

	Tolerance
Silver	10%
Gold	5%
Red	2%
Brown	1%



1 0 2 = 10*100 = 1k Ohm

Note: When reading the mono capacitor values, do not confuse the manufacturing codes with the component value. If it looks strange, it may be a manufacturing code, look on the other side of the component. Also the tolerance letter may be omitted.

INDUCTOR COLOR GUIDE

Result Is In µH

4-BAND-CODE  270µH ± 5%

COLOR	1st BAND	2nd BAND	MULTIPLIER	TOLERANCE
BLACK	0	0	1	± 20%
BROWN	1	1	10	Military ± 1%
RED	2	2	100	Military ± 2%
ORANGE	3	3	1,000	Military ± 3%
YELLOW	4	4	10,000	Military ± 4%
GREEN	5	5		
BLUE	6	6		
VIOLET	7	7		
GREY	8	8		
WHITE	9	9		
NONE				Military ± 20%
GOLD			0.1 / Mil. Dec. Pt.	Both ± 5%
SILVER			0.01	Both ±10%