

# Building the “Sawdust” Regenerative Receiver

## Introduction

The “Sawdust” is a super regenerative receiver using the basic “Armstrong” design architecture. The receiver uses one toroidal transformer to provide input, frequency band and feedback. The oscillator is placed in constant feedback to eliminate the need for a regeneration control. A single Field Effect Transistor serves as the oscillator and detector and is followed by a TL-431 shunt regulator audio amplifier. The amp provides enough output for ear buds or headphones. Tuning is accomplished by a simple rectifier diode acting as a variator. The tuning range is about 75 to 100 KHz in the 40 meter band as designed. As an added feature, a telegraph key may be attached to a feedback loop in the audio amplifier providing a variable tone for use as a code practice oscillator. The receiver can be aligned for the cw or ssb portion of the band. Options allow for smaller tuning range with more band spread and mute and sidetone input.

## Building Rules

1. Take your time. We recommend that you take at least two or three days to complete your kit. It will take three coats of paint on your breadboard anyway to give it a good finish and a day of drying between each coat is recommended. So, if you take your time, in three days you can have a beautiful working project that you will be proud to own and operate.
2. If you don't know how to solder parts on a circuit board, get help. Learning to solder is not hard, but please do not start this kit if you have never soldered before!
3. Most of the parts are tiny. Please use a magnifying glass.
4. Build the kit by the instructions, one step at a time.
5. Use protective eyewear.
6. Be careful with the ICs and transistors to avoid damage from static.
7. All parts should be mounted flush or as close as possible to the circuit board keeping leads short. After soldering, clip all wires close to the board.

## **Finishing The Breadboard**

The wooden breadboard furnished with your kit is your opportunity to express yourself. The new modern board does not require any finishing unless you want too. You may finish it any way that you like...pick your color, pick your finish.

MAY WE SUGGEST THE FOLLOWING?

1. Use fine grit sand paper to remove any roughness from the wood.
2. You can use brush on or spray paint or stain or no finish at all...it's up to you.
3. You are in charge of getting the board ready. Three coats with light sanding between coats and about 24 hours of drying time will produce great results. NOTE: The decals that will be placed on your breadboard at the end of kit construction are black on white and black on yellow.
4. When the board is finished, locate the circuit board and place it on top of the breadboard. Center the circuit board and using a small nail, phillips screwdriver or other small pointed object, push a small starter hole into the breadboard at each corner mounting hole. Drill the starter hole all the way through the board using a 1/16th inch bit. Place the breadboard aside for now.

## **Building the Circuit Board**

Tools and supplies needed to build the circuit board:

1. needle nose pliers
2. diagonal cutters
3. small flat blade and phillips screwdrivers
4. Magnifying glass
5. 35-40 watt soldering iron
6. Hobby knife or coarse grit sand paper

Locate the parts bag. All of the parts required for circuit board construction are enclosed. You can work from the bag and find each part as it is called for, but placing all of the parts from the bag into a bowl or small plastic tray may make it easier to sort and properly identify the parts.

As each part is called for, be sure to identify it, then locate the proper mounting holes on the board. Insert the part and check its placement before soldering it in place. Cut all leads flush with the board.

## **About The Toroid**

The heart of the Sawdust Receiver is T1 a T-50-2 toroid. There are three separate windings on the toroid. The main winding is 24 turns and puts the oscillator in the 7.0 MHz range. The second winding is 5 turns and provides regeneration. This winding is sometimes referred to as a “tickler” coil. The third winding is 3 turns and serves as the coupling to the antenna. Winding a toroid is not difficult, but must be done correctly or the receiver will not work. Refer to the photos page and large toroid construction guide diagram to guide your winding of the toroid.

1. Wind 24 turns of magnet wire on T1. Cut lead ends to 1/2 inch and strip 1/2 inch of the enamel from the leads. Tin the leads with solder.
2. Wind 5 turns of magnet wire on T1 next to the 24 turn winding. Cut lead ends to 1/2 inch and strip 1/2 inch of the enamel from the leads. Tin the leads with solder.
3. Wind 3 turns of magnet wire on T1 next to the 5 turn winding. Cut lead ends to 1/2 inch and strip 1/2 inch of the enamel from the leads. Tin the leads with solder.
4. Carefully mount T1 on the circuit board by placing the leads in the proper holes. Solder the leads, but do not cut the leads at this time. Refer to the toroid construction guide and the following for testing before cutting the leads.
5. Using an ohmmeter check for continuity between ground and each of the leads at the solder joint. Use the corner mounting hole next to R8 for the ground location. Each lead should indicate a dead short (zero ohms). If not, one or more leads have not been stripped properly and T1 must be removed and the leads stripped and tinned better.

6. Once the test is successfully completed, make sure that the toroid is close to the board and the wires should be tight. You can now cut the leads of T1 on the bottom of the board.
7. Locate Q1 a 2N3819 Field Effect Transistor . Mount it near the center of the board and solder it in place. Observe the screen printed mounting key on the circuit board.
8. Locate IC1 a TL-431 integrated circuit. Mount it on the right-front side of the board and solder it in place. Observe the screen printed mounting key on the circuit board.
9. Locate D1 a 1N4001 diode (black) and mount it near the back of the circuit board. Observe the polarity as shown on the board and the band on the diode. Solder in place.
10. Locate D2 a glass zener diode and mount just below D1. Observe polarity and solder in place.
11. Locate D3 a 1N4001 diode (black) and mount it near the front right of the circuit board. Observe polarity and solder in place.
12. Locate C1 a 0.1uf. (104) ceramic capacitor. Mount and solder it in place.
13. Locate C2 a 47uf. electrolytic capacitor. Observe the proper polarity and solder it in place.
14. Locate C3 a 0.001uf (102) ceramic capacitor. Mount and solder in place.
15. Locate C4 a 0.1uf. (104) ceramic capacitor. Mount and solder in place.
16. Locate C5 a 39pf. ceramic capacitor. Mount and solder in place.
17. Locate C6 a 100pf. (some kits may have 82pf. supplied) ceramic capacitor. Mount and solder in place.
18. Locate C7 a 0.1uf (104) ceramic capacitor Mount and solder in place.
19. Locate C8 a 47uf. electrolytic capacitor. Observe polarity and solder in place.
20. Locate C9 a 4 - 65pf trimmer capacitor. Mount and solder in place.
21. Locate C10 a 0.047uf (473) ceramic capacitor. Mount and solder in place.
22. Locate C11 a 0.001uf (102) ceramic capacitor. Mount and solder in place.
23. Locate R1 a 1K ohm trimmer potentiometer mount and solder in place. The black dial should face the left side of the circuit board.

24. Locate R2 a 470 ohm resistor (yellow, violet, brown) mount and solder in place.

25. Locate R3 a 680 ohm resistor (blue, gray, brown) mount and solder in place.

26. Locate R4 a 1K ohm resistor (brown, black, red) mount and solder in place.

27. Locate R5 a 470K ohm resistor (yellow, violet, yellow) mount and solder in place.

28. Locate R6 a 1M ohm resistor (brown, black, green) and solder in place.

29. Locate R7 a 300K ohm resistor (orange, black, yellow) and solder in place.

30. Locate R8 a 50K ohm potentiometer. Mount and solder in place.

31. Locate R9 a 10K ohm resistor (brown, Black, orange) and solder in place.

32. Locate R10 a 10K ohm potentiometer. Mount and solder in place.

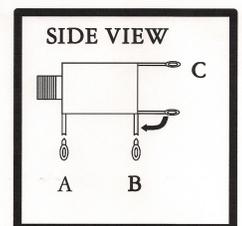
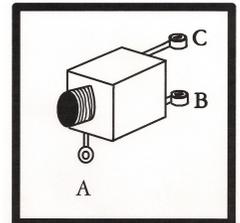
33. Locate SW1 a single pole double throw slide switch. Mount it on the left rear of the board and solder it in place. The mounting pins will be tight and may require some gentle force to push it flush with the board.

34. Locate J1, a RCA phono jack. Mount and solder to board.

35. Locate screw terminal J2 and the mounting position on the top side of the board near SW1. Place J2 in the two mounting holes with the wire insertion holes facing off the back of the board. You can slightly bend the leads on the bottom of the board to help keep J2 flush to the top of the board. Solder the two leads.

36. Locate screw terminal J3 and the mounting position on the top side of the board near J4. Place J3 in the two mounting holes with the wire insertion holes facing off the right side of the board. You can slightly bend the leads on the bottom of the board to help keep J3 flush to the top of the board. Solder the two leads.

37. Locate J4 a 1/8th inch phone jack and it's mounting position on the right edge of the circuit board. Refer to the diagram and modify the two lower soldering lugs to fit in the two mounting holes closest to the left side of the board. Bend the lower back lug (lug B) 90 degrees so that it points down like the front lug. Using diagonal cutters, clip off the ends of lugs A and B as close as possible to the soldering hole. The remaining lugs should be as long as possible so that they will fit through the mounting holes in the circuit board. Place J4 into position with lug A and B in the mounting holes and solder with J1 flush against the board. The lugs may need slight trimming with the diagonal cutters to fit the holes. Lug B may not come all the way through the hole, but



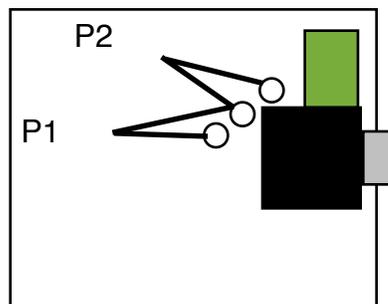
a little extra solder to fill the hole will sufficiently hold it in place. Use a one inch bare wire to complete mounting J4. Pass one end of the wire through lug C of J4 and into the circuit board mounting hole. Secure the top end of the wire to lug C of J4 and solder in place. Solder the other end of the wire on the bottom of the board and clip the excess wire.

## Version 2 Options

There are two options available in this version of the Sawdust. These options are designed to make using the Sawdust with a QRP transmitter. Each option allows you to enable the option or build the Sawdust like the original version.

Option 1. Tuning range and speed can be customized by changing the value of resistor R11. Installing the included 22K ohm resistor will allow tuning control R8 to cover approximately 40 KHz while installing a wire jumper (0 ohms) will allow a range of approximately 100 KHz. 100 KHz is the original design value. You can experiment with different values, for example 47K will give a range of about 20-25 KHz.

Option 2. The function of J3. Placing a small jumper wire at P1 makes J3 work as the key jack for the code practice function. This is as in the original design. If the jumper is placed at P2, the screw terminal nearest to J4 becomes the sidetone input from a transmitter. The screw terminal nearest to J3 becomes the ground to mute input from the transmitter (grounding this terminal during transmit will mute the audio amplifier of the receiver).



This completes construction of the circuit board. Inspect the board for proper parts placement. Make sure that solder connections are good and that there are no solder bridges.

## Final Assembly

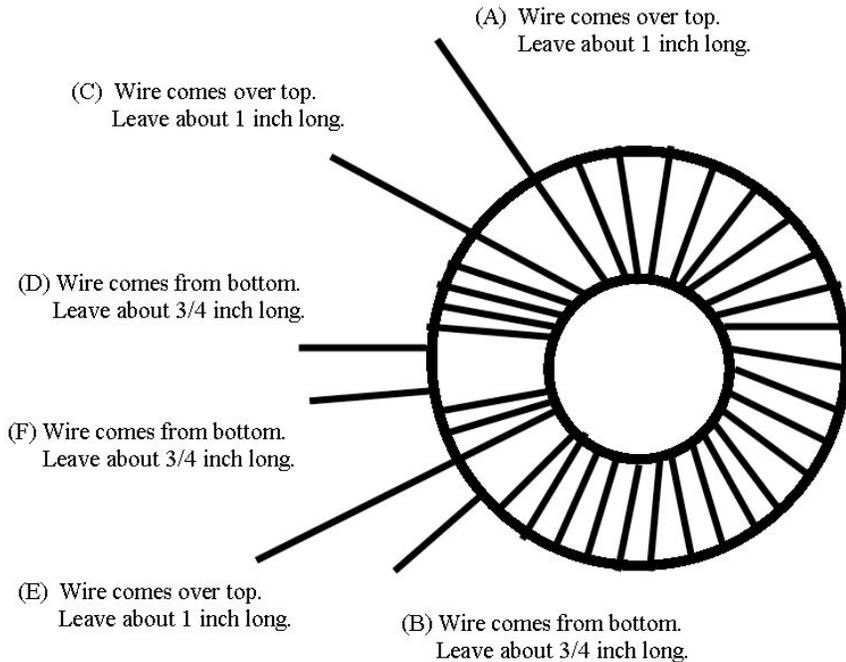
1. Mount the circuit board on your finished wooden breadboard with four brass wood screws and four 3/16th inch black spacers.
2. Install the knobs on potentiometers R7 and R8.
3. Mount the four rubber feet on the bottom of the wooden breadboard in the corners.
4. Mount the stick-on decals on your finished breadboard.

## Alignment and Testing

Before proceeding examine your work to make sure that all parts are in the correct place, all solder joints are good and there are no shorts. Make sure that SW1 is in the off position (to the right). Observe proper polarity and connect 9 to 12 volts D.C. to J2. Connect headphones at J4 and turn R8 fully clockwise. Turn R1 fully clockwise and connect an antenna to J1. Slide SW1 to the left (on). You should hear noise or signals in the earphones...if not, turn SW1 off, disconnect power and re-inspect the wiring for mistakes. There should be no solder bridges, cold joints and all parts placement should be verified. The windings on T1 must be correct. If winding #2 is on backwards, the receiver will not produce any regeneration and will seem dead.

If you are hearing signals or noise you can proceed to aligning the receiver. This can be done several ways. Method 1. If another receiver or transceiver is available, tune it to 7040 KHz. Attach an insulated wire from the antenna connector. Attach an insulated wire to the antenna connector on the other receiver or transceiver and twist several inches of the two insulated wires together. This forms a coupling capacitor. Place the Sawdust Tune control midway to 12 o'clock. Very slowly and carefully tune C9 with a jewelers screwdriver or non-metallic tuning tool if available. As you tune C9, at some point, you will hear a woosh on the receiver or transceiver. That woosh is the oscillator of the Sawdust on 7040 KHz. The trick is to very slowly get that woosh very close to 7040 KHz. If aligned correctly, the woosh (heterodyne) will be there when you remove the screwdriver. Method 2. Attach a six foot long antenna wire to the Sawdust. Place a QRP transmitter next to the Sawdust. Use the signal from the transmitter as a signal source. Adjust C9 and listen for the signal in the earphones. Method 3. Attach a good antenna to the Sawdust. Wait for a good time to receive signals like early evening. While listening to the Sawdust, slowly adjust C9 until you can hear desired signals in the 40 meter band. This may take some patience!

# Sawdust Toroid (T1) Construction Guide



Winding #1: 24 turns, clockwise from top at (A) ending at bottom of toroid at (B).

Winding #2: 5 turns, counter-clockwise from top at (C) ending at bottom of toroid at (D).

Winding #3: 3 turns, clockwise from top at (E) ending at bottom of toroid at (F).

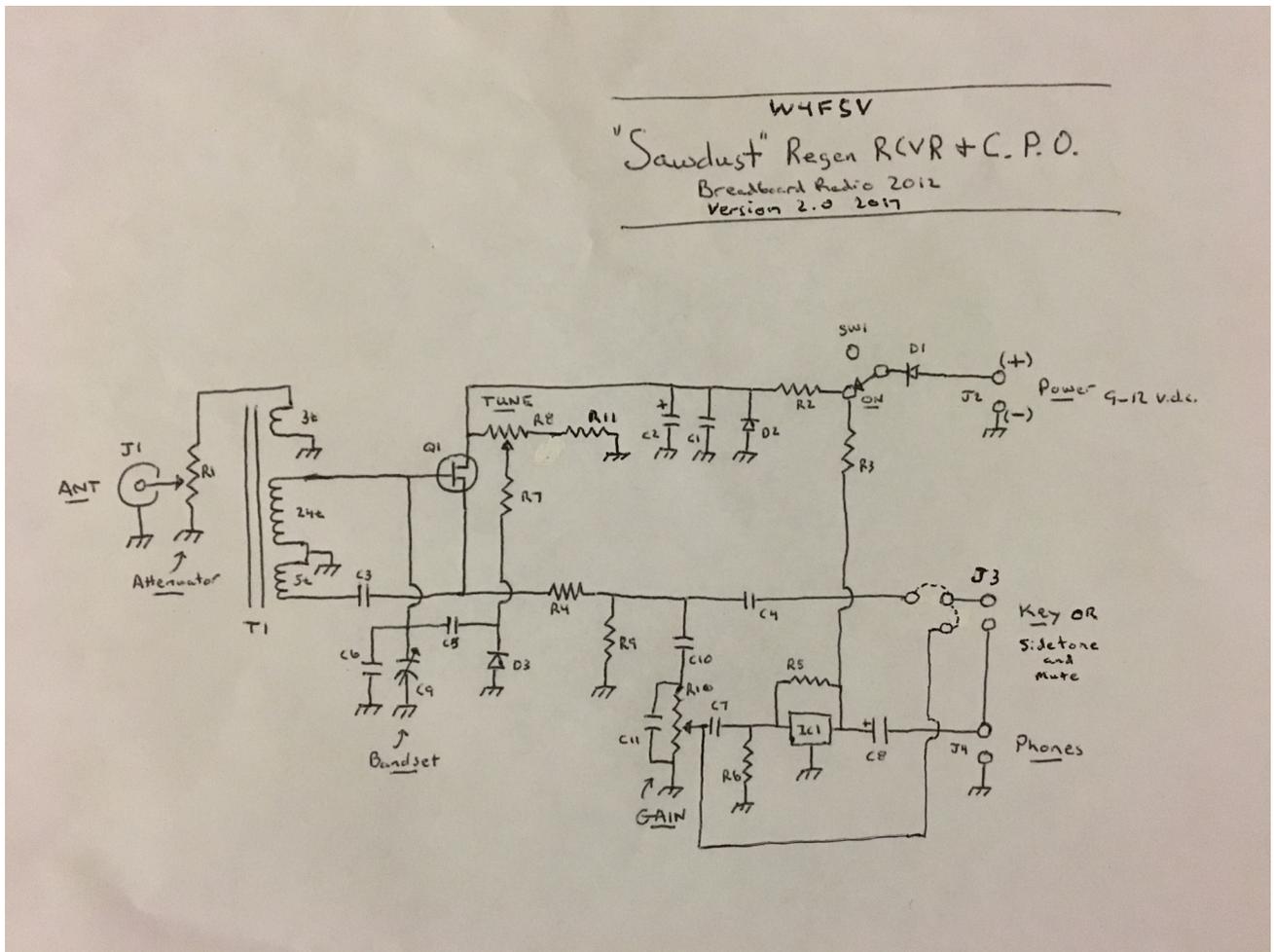
NOTE: Bottom of toroid is grey colored.

NOTE: Turns should be close and tight. Do not overlap any turns!

Strip enamel from wire ends with hobby knife or coarse sand paper. Tin all wires with solder. Bend / shape wires down as in pictures and trim all to 1/2 inch from bottom of toroid.

Mount toroid with bottom flush to circuit board and solder wires. DO NOT cut wires until test is complete.

NOTE: If you are uncomfortable with winding your toroid you should ask someone for help OR we can provide a pre-wound one for a nominal fee.



## Using the Sawdust

The Sawdust receiver is very sensitive and when the band is open an antenna of as little as six feet of wire will allow many signals to be heard. The antenna jack (J1) is an RCA Phono jack. The center conductor is for the antenna and the outside ring is for the ground side of your antenna. R1 is used as an attenuator to reduce the amount of RF signal reaching T1. This is needed when strong signals are present and overloading the receiver. The Tuning control R8 will cover about 75 to 100 KHz as determined by trimmer capacitor C9 during alignment. Volume is controlled by R9. CW signals will be heard on both sidebands, meaning that as you tune across a signal the tone will change in pitch from high to low to zero beat to low to high. On ssb the signal will be deciphered on lower sideband only. To hear AM signals the signal must be zero beated. This will be difficult since the regeneration is set in the Sawdust. AM reception is not advised.

When signals are strong the attenuator may also act like a regeneration control. Setting the control to far foreword will cause the regeneration to cease. If this happens just turn the control towards the rear (less signal) until regeneration resumes.

## Code Practice Oscillator

To use the CPO connect a telegraph key to J3. The Gain (volume) control and Tuning control will both interact to vary the frequency and quality of the tone. (see option 2)

## Problems

If you have any problems with your kit, please email us at:  
[w4fsv@breadboardradio.com](mailto:w4fsv@breadboardradio.com) You can also refer to our website at:  
[www.breadboardradio.com](http://www.breadboardradio.com)

