



AN IMPROVED SHORTWAVE REGENERATIVE RECEIVER

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Sensitivity and selectivity are issues that will invariably concern a short wave listener when he wishes to purchase a new receiver. Commercially available communications equipment will undoubtedly fulfill his expectations, but we are talking here of highly priced products. Low-cost alternatives call mainly for homebrewed radios, and in this sense, the regenerative receiver is the common choice due to its simplicity, low parts count and very acceptable performance.

The author is also a short wave enthusiast and for some time used his family's Philips MW/SW vacuum tube radio. Later, he changed to a solid-state Sony ICF-7600, a high selectivity receiver featuring ceramic filters in the IF stages. Then he would discover how much fun he could have building radios on his spare time. After testing a variety of schematics available in books and on the web, the author finally decided to make his own designs.

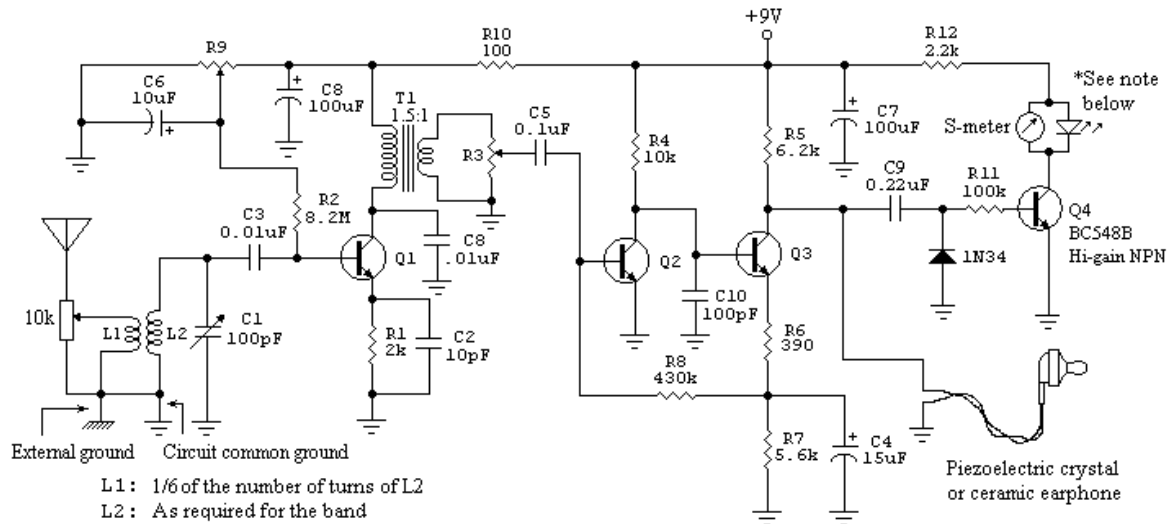
Back in 2003, an experimental Colpitts-type shortwave regenerative receiver was made public on the web by this servant. It was reported to tune from the 22-meter band up to the 11-meter band with a single set of coils. Operation was found to be satisfactory with the prototype built on a protoboard and a ground plane fixed underneath. Further work with the receiver using different sets of coils revealed a larger usable frequency spectrum.

Fig.1 shows the schematic diagram of an improved version of the early receiver. It will tune signals from 3500kHz up to 26MHz, roughly in three bands, each with a 1.96:1 frequency-ratio. It must be quoted that the said frequency ratio is what the author got for his prototype. It is a function of the maximum-to-minimum capacitance of the variable tuning capacitor and the stray capacitance of the circuit layout.

The Colpitts approach uses no tickler coil nor throttle capacitor for regeneration, as opposed to the Armstrong circuit. In our case, it resorts to transistor Q_1 's base-emitter input capacitance and NPO-type ceramic capacitor C_2 to effect the correct impedance transformation and phase shift necessary for regeneration to take place. Q_1 is the amplifier-detector and along with its associated circuitry forms the common-collector Colpitts regenerative amplifier, with R_9 as the reaction control.

The oscillating mode is employed when copying CW or SSB, otherwise, the stage should be left very near the threshold of oscillation for maximum sensitivity and selectivity. It is best that the 100-pF variable capacitor C_1 be a vernier type. It will help a lot when tuning-in the crowded SW bands. Q_2 and Q_3 form a high gain audio amplifier and ample volume should be expected at the output. This is why a volume

control has been included in the circuit. A high-impedance crystal or ceramic piezoelectric earphone should be used for listening. Alternatively, an audio output transformer that will match low-impedance magnetic earpieces to 5kohms 7kohms may be connected to Q₃'s collector through a 0.47-uF capacitor. High-impedance 2k-ohms magnetic headphones do not require a transformer. They can be connected directly to Q₃'s output using the said capacitor.



L1: 1/6 of the number of turns of L2
 L2: As required for the band
 Use AWG #22 insulated hook-up wire and a black plastic 35mm film container as the coils' former. Separation between L1 and L2 should be 5 mm.
 C2 should be a high quality capacitor (NPO type)
 T1 is an audio transistor interstage transformer. Turns ratio 1.5:1
 R3 is a 20K potentiometer. This is the volume control.
 R9 is a 50K potentiometer. It controls reaction. Use an outside random wire antenna.
 This receiver uses a capacitive ground, i.e., a 30cm x 30cm metal sheet thrown on the floor and connected to the receiver with a piece of wire.

*1-mA F.S. S-meter, R_s = 2.64k ohms. Paralleled hi-efficiency blue LED limits voltage across meter to 3 Volts.
 All transistors 2N3904, except as indicated

Fig.1 Short Wave Regenerative Receiver

Components C₉, R₁₁, R₁₂, germanium diode 1N34 (it can be any other germanium detector type), Q₄, the S-meter and the high-efficiency blue LED form a pseudo "tuning-indicator" circuit which gives an idea of the available audio level at the output of Q₃ after demodulation. We have then a visual relative indication of the tuning action of our circuit.

Solderless breadboards known as "protoboards" show parasitic capacitances of about 3pF between adjacent connection lines. Hence, exercising the builder some minimum of care in point-to-point connections on the layout, the protoboard will lend itself as an acceptable breadboarding material for the testing of simple receivers, such as the one dealt with here. The author has tested on a breadboard of this sort the design herein described, with an additional aluminum ground plane fixed underneath. This metallic plane is fundamental for reducing hand-capacitance effects when adjusting the variable tuning capacitor C₁. In order to avoid ground loops it is advisable to connect the circuit's common ground to the plane at a single point. It is very important to use short connecting wires between components.

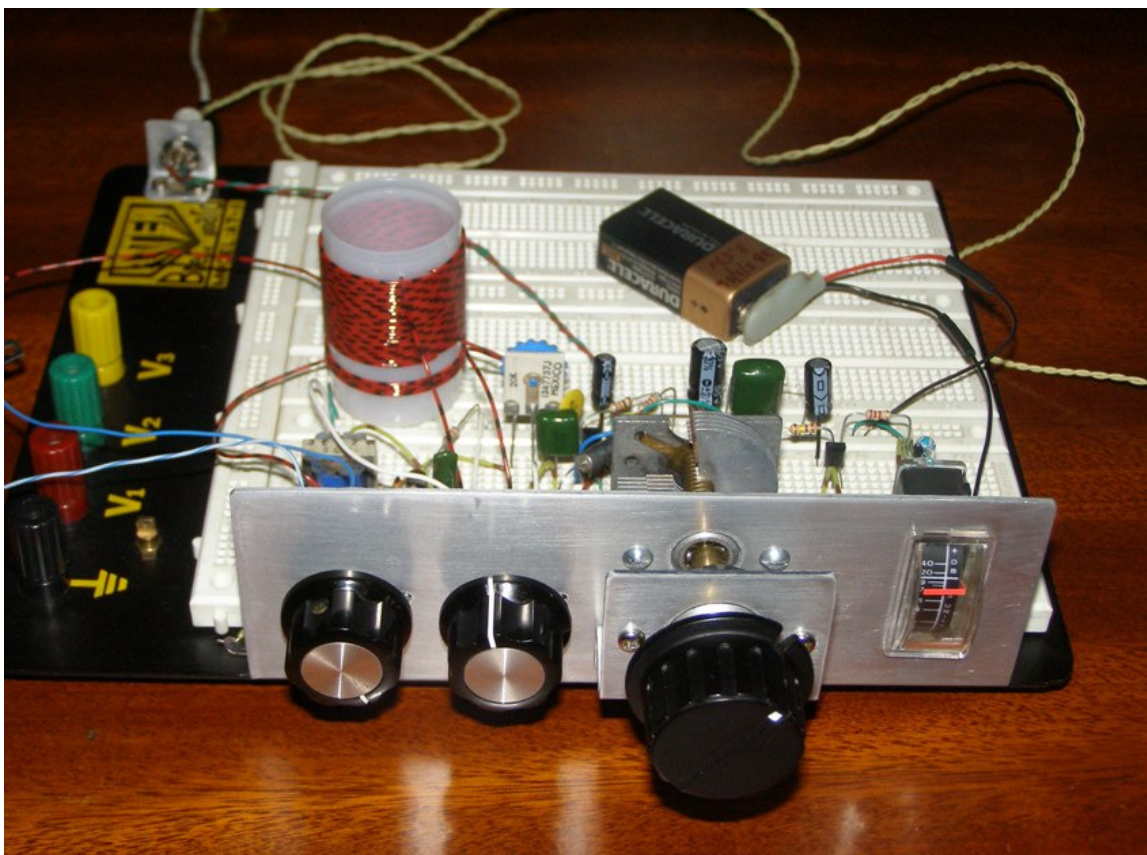
Shortwave frequencies are nicely tuned by the receiver using a random-wire outdoor antenna and a capacitive ground of the type described in Fig.1 above. It is not absolutely necessary to resort to a cold water pipe connection, nor to use a metallic rod buried in the soil out there in the garden.

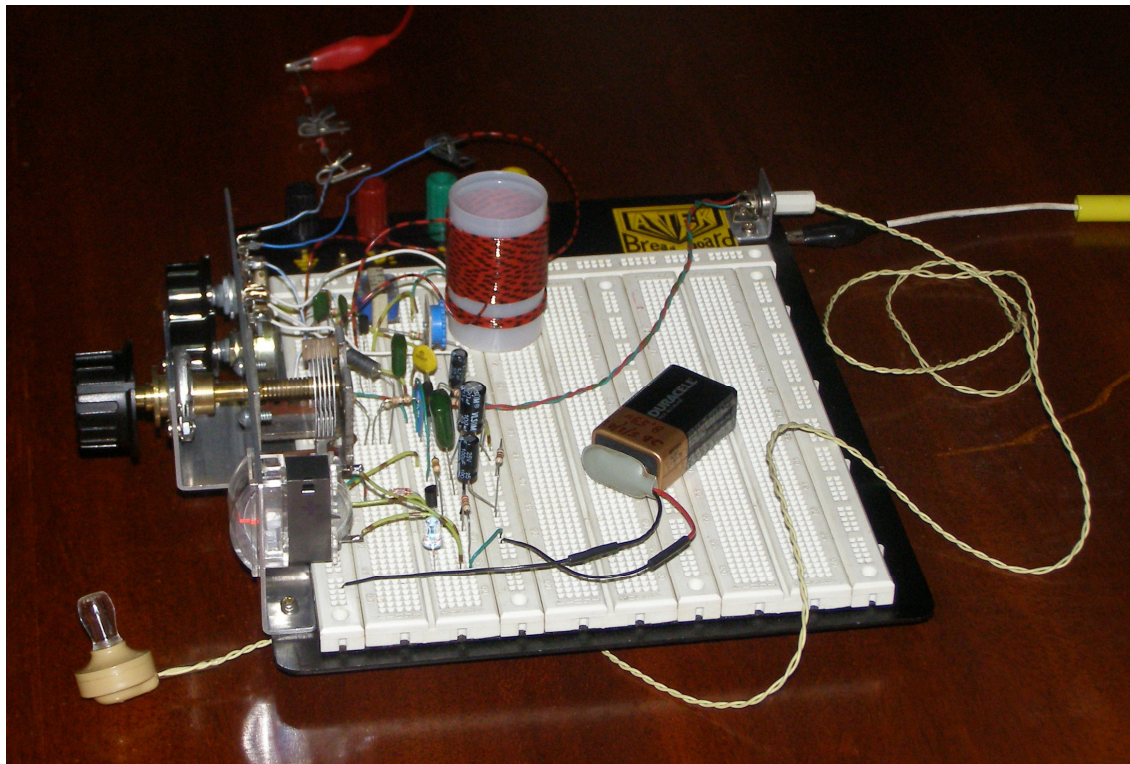
At this point we should avoid any possible confusion between the aluminum ground plane beneath the protoboard and the external capacitive ground connection via a 30cm x 30cm aluminum metal sheet thrown on the floor under the workbench. These are two different issues.

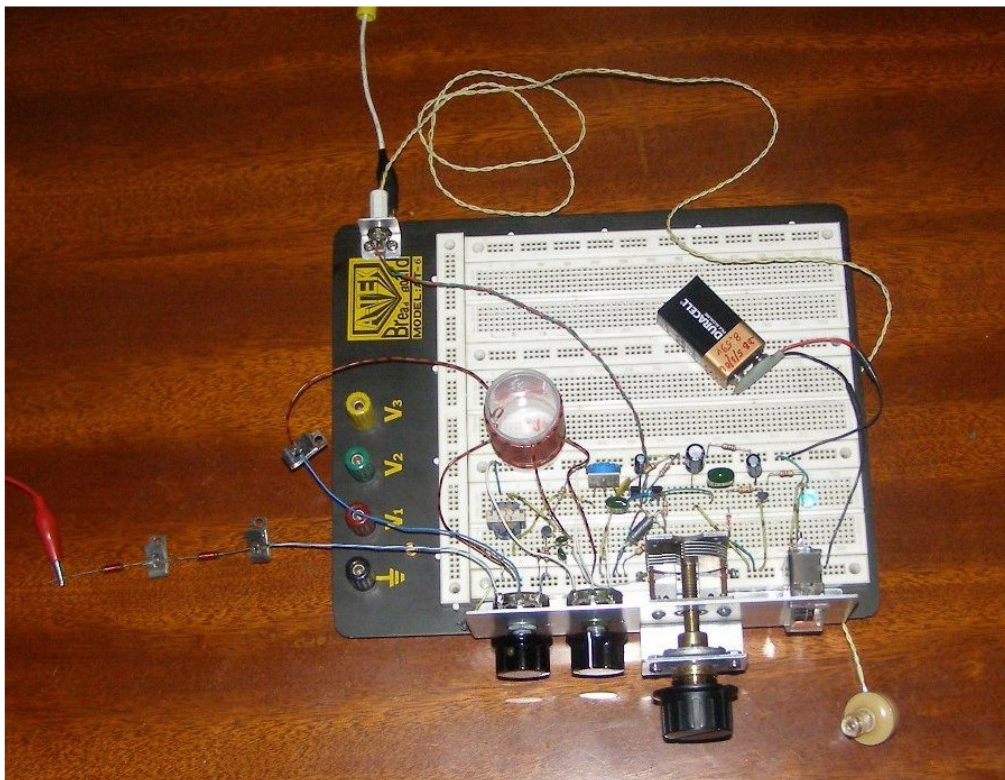
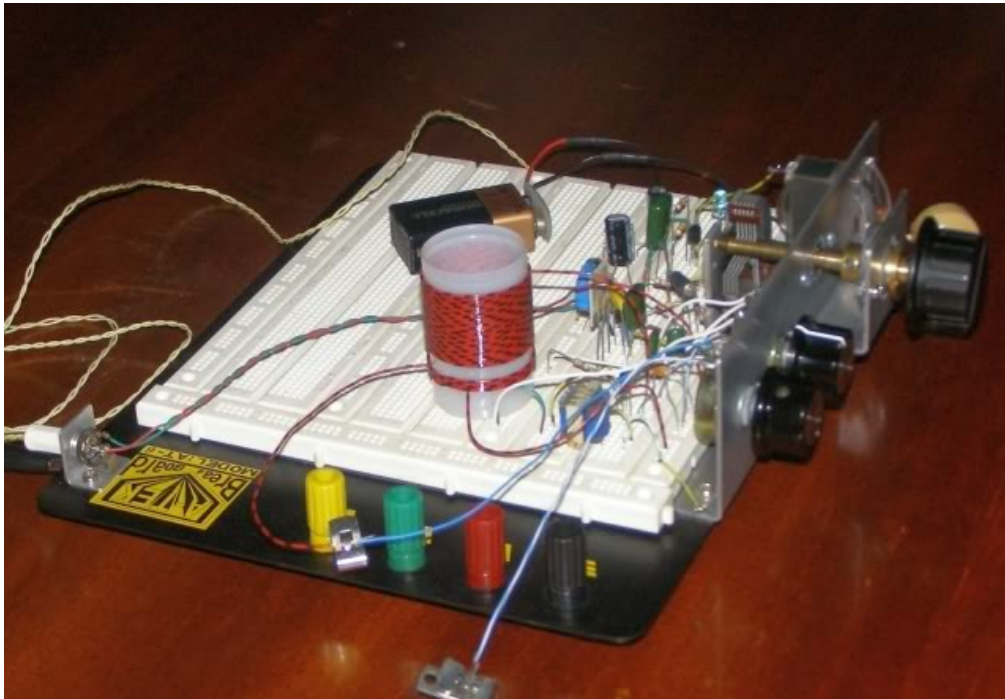
Unwanted interference produced by FM or TV stations is easily blocked connecting a small 10-uH RF choke between the antenna lead-in and the receiver. The author uses two of these chokes in series, which gives further better results. It is best for the RF choke to have low distributed capacitance, so that VHF FM or TV signal leak-in problems can be avoided.

Following, some pictures of the prototype are shown. The RF attenuator R_{13} , the reaction or regeneration control R_9 , the variable tuning capacitor C_1 and the S-meter are mounted on an aluminum panel fixed to the protoboard's ground plane. It is important to have a good mechanical and electrical joint between the aluminum panel and the ground plane.

Views of the completed receiver:







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