

The "Cigar Box" Crystal Radio Set

On this page you will find complete plans for the *Cigar Box Crystal Radio Set*. This project was first published in [Volume 7](#) of the [Xtal Set Society Newsletter](#), but the project has been so popular that we decided to put it online. The plans were written by Joseph Cooper, VE3FMQ, a [member](#) of the Xtal Set Society, so that the set could be built by beginner radio builders. Please note that this is a "novelty" set. Although it does work without an antenna and ground (unless you are in a remote area), the performance is greatly enhanced when they are added. Here in St. Louis it worked fine while we carried it around, but it only received a few stations. The neighborhood kids loved it! When we hooked up a 75 ft horizontal antenna and a good ground, many more stations boomed in that evening.

Please also see the bottom of this page for information about our other [crystal radio project books](#), including our new book, [Crystal Set Projects: 15 Radio Projects You Can Build](#), written by several members of the Society (including another project by Mr. Cooper).

Attention Parents, Teachers, and Beginners! Although the project on this page is great, we also have a version of an Oatbox radio that doesn't require soldering! The directions are also more detailed for those who haven't built much before. Check

them all out and then pick what looks best for you. Download it by clicking on the Oatbox Basic button. [Oat Box Basic](#)

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THE "CIGAR BOX" CRYSTAL RADIO SET
By Joseph Cooper - VE3FMQ

The revival of the practice of smoking Cigars helps to bring back a novel crystal radio set from the 1950's.

- [General information about this set and the cigar box](#)
- [Step by step instructions](#)
- [Notes on how to use the set](#)
- [Parts List](#)
- [Bibliography](#)

INTRODUCTION

This article will show you how to build a crystal radio set using a Cigar box in a novel way. The plans that are presented here are based upon a design that was found in a Radio/TV magazine from the early 1950's. This original design has been updated with modern parts that are easy to locate.

The set has good selectivity and sensitivity characteristics, partly because the tuning coil doubles as a loop antenna. When properly employed, this type of antenna tends to be "quieter" than long wires types, while at the same time having high gain. A further benefit of using a loop is that it is directional, which allows the set to be "aimed" at a station in order to pick up the strongest signal, or turned away from sources of radio noise.

One notable feature of the design is its ease of construction, which makes this project a good "first crystal set." As it requires only the simplest of tools and a minimum of supervision, it is suitable for an older child or young teen, though even the more experienced builder will still enjoy putting one together. You will find the performance level is equal to a regular coil design.

One striking benefit of using a loop for an antenna is the elimination of the need for a ground connection, with the result being that the set is fully portable.

To hear more distant signals, an external antenna can be attached using the connector provided for greater sensitivity. Once this is done, the loop antenna becomes an isolated L/C circuit that operates only as a tuning coil. If you wish to experiment with the design, taps can be added to the loop for greater selectivity in specific portions of the broadcast band. These taps also allow the set to be tuned to the lower shortwave frequencies as well, where foreign broadcasters can be heard. The efficiency of the small loop is surprising, and the design presented is quite useful for listening to local stations with only a headset. To hear more distant stations you also may use an audio amplifier.



A very earnest young man uses a cigar box radio that he built himself. Picture taken in the early 1950's.

The loop antenna is also useful in environments with high levels of electrical noise (such as apartments or downtown areas), as it is "quieter" than the long wire type. This "quiet" characteristic is due to the loop being more sensitive to the magnetic component of the received radio wave, which emphasizes the information portion of the signal. This is the opposite of the long wire antenna. The long wire tends to be more sensitive to the voltage component, which carries more electrical noise and static with the information. (The bibliography at the end of this article will suggest more readings on this topic to help explain why this is so).

The loop antenna's main virtue, however, is its ability to be highly directional. One is able to improve the reception of a broadcaster by simply pointing the receiving side of the loop in the direction of their transmitting antenna. You can also separate out the skywave component of the signal (the part that bounces off of the ionosphere and returns to the earth) from the groundwave component (the signal that comes directly from the transmitting antenna) by tilting the box to a 45 degree angle. The small size of the set easily allows for this type of experimenting.

Part of the attraction of this project is the cigar box itself. For many it may provide an extra bit of nostalgia when undertaking the project. You may remember having used these boxes to store treasured items back in the time of your youth (and possibly for many years past that point as well). Due to their durability and attraction, many old cigar boxes are found today in antique and collectable stores, but because of the resurgence of cigar smoking, it is not as difficult as it once was to find a supply of used cigar boxes.

If you don't know anyone who smokes cigars, then inquire at a store that sells them. They often have empty boxes from their sales of single cigars. These boxes should be made of either strong cardboard or paper covered wood, and should sell for no more than \$1 or \$2 (some specialty wooden boxes will be more expensive, but these are not required for this design). Obtain a large sized box that holds two rows of cigars (approx 5½" x 9" x 2½"), not the smaller box that holds only one row. The small boxes that are used for European and specialty cigars will not provide the space and size needed for this project.

Finally, we sincerely ask the reader not resort to smoking cigars in order to obtain a box. Should you need to reduce the temptation to "light up a stogy," we suggest a shoebox as an alternative. However, you will have to make your own measurements, using this project as a layout guide.

There are five steps in making the set:

1. collecting all the components for the set prior to beginning construction (see the [list of parts and sources](#) at the end of this article)
2. marking the cigar box for mounting the components and drilling mounting holes
3. mounting the components on the inside and outside of the cigar box
4. wiring the component terminals together inside the box with hookup wire and solder
5. and winding the coil on the outside of the box

Step 1 Collecting the Parts. You'll note from the list of parts that you can purchase all but the variable capacitor, the high-impedance headphones, and the cigar box at a full line Radio Shack. The [variable capacitor](#) and [high-impedance headphones](#) can be obtained from the Xtal Set Society, or you can purchase surplus or antique ones from antique radio collectors and suppliers. None of the components are critical, and feel free to substitute for any of the connectors. Make sure you use a germanium diode and not a 1N914 if you substitute for the 1N34, and make sure you use a high-impedance headphone, not an 8-ohm speaker or 8-ohm earplug. If you wish to substitute a [crystal earplug](#) (about 10K ohms) in place of the high-Z headphones, add a 47 K resistor in parallel with the earplug leads.

Overview of Construction. Figures 1 and 2 denote placement of the headphone jacks, optional external antenna and ground jacks, the variable tuning knob and capacitor, and the rubber feet. Note that the bottom of the cigar box becomes the front of the radio and the right side of the cigar box when viewed normally - when lifting the lid and looking inside - becomes the bottom of the radio (with rubber feet, see Figure 2).

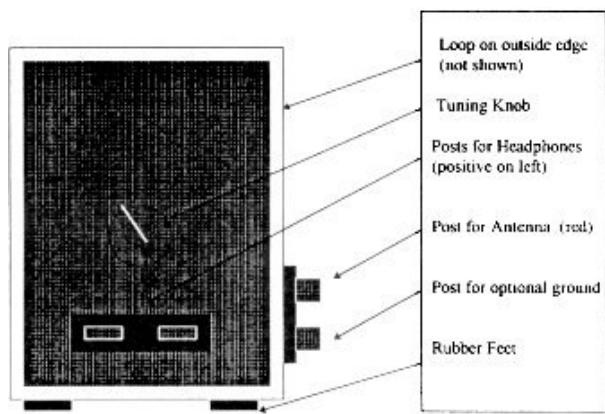


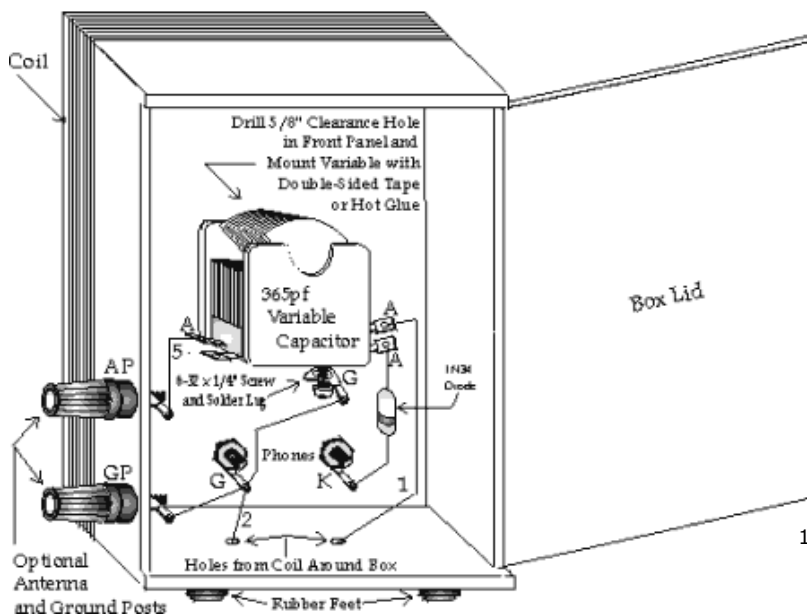
Figure 1: Front of Crystal Radio Set

Step 2 Marking the cigar box for mounting the components and drilling mounting holes.

You'll need to mount four components: the optional antenna and ground jack, the headphone jacks (one piece), the variable capacitor with knob, and the 1N34 diode. While placement is not critical, make sure that you mount all components in the bottom half of the box, and tuck the optional antenna and ground jack towards the lid. This will leave room to wind the coil, and keep the box steady.

Mount the antenna and ground jack about an inch above the right side of the box and do the same for the headphone jack. Eyeball the points where the jack components will go "into" the box and then drill appropriate holes. Then place the components on the box and mark and drill the additional holes for the nuts and bolts to mount these jacks. [We don't give you any more guidelines than this since it is likely that you'll use whatever jacks you may have in your junk box anyway.] Then locate and drill holes for the variable capacitor. Make sure that the tuning shaft will come through the bottom of the box (the front of the radio when it is complete). See Figure 2 for one way of placing the variable 365 μ fd capacitor assembly.

Figure 2: Back of Crystal Radio Set



Step 3 Mounting the components on the inside and outside of the cigar box. Once you are satisfied with the holes for the connections and the mounting nuts and bolts, go ahead and mount these components. Use glue too if necessary.

Step 4 Wiring the terminals together inside the box with hookup wire and solder.

You are now ready to add just three wires to connect the inside-the-box portion of your cigar box crystal radio. You can wire the connections by looking at the schematic (Figure 4), the Layout Diagram (Figure 2), or both. To assist, we've labeled the terminals in both the schematic and the layout diagram with corresponding letters: G (ground connections), A (antenna connections), and K (diode connections). The following steps assume that you'll wire the set by looking at Figure 2, the layout.

a. Strip the ends of three six inch wires and attach them to the terminals as follows:

1. wire one from the headphone jack ground terminal (G) to the ground terminal of the variable capacitor ([click here](#) for details about how to wire a capacitor from the Xtal Set Society),
2. wire another one from the headphone jack ground terminal (GP) to the ground terminal of the optional ground jack - to the left in the diagram,
3. wire a third from the variable capacitor (A) to the antenna terminal of the optional antenna jack (AP).

b. Attach the detector diode (probably a 1N34) between the tuning shaft terminal of the variable capacitor (A) and the positive terminal of the headphone jacks (K). Extend the leads of the diode if necessary with wire.

Step 5 Winding the coil on the outside of the box.

Once you've checked your wiring inside the cigar box, punch or drill a hole in the bottom of the radio (same side as the rubber feet) one-half inch to one side of the middle. (See Figure 3.) The coil will be wound around the edges of the box, not around the top and bottom (Figure 2).

The loop itself is made up of roughly 23 turns of #26 (or #24) gauge enameled covered wire. Clean the end of the enameled wire so

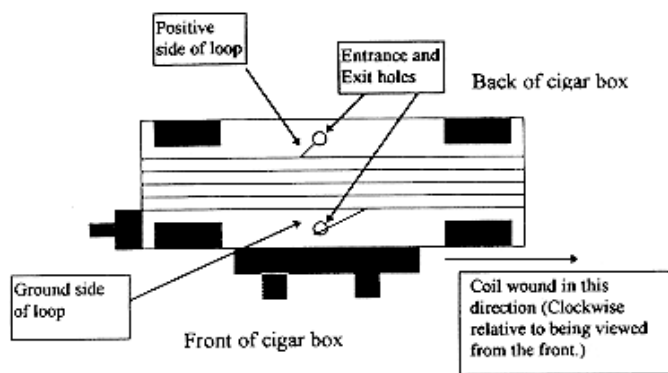
that the bare metal shows, and then thread the end through the hole into the inside of the cigar box. Attach the end to the negative (black) posts solder lug (G), and solder it securely. Once the solder has cooled, you may begin to wind the wire clockwise.

To make the winding of the loop more consistent, place marks on the box where the first loop should lay. You should also apply a small amount of "super glue" to the wire at each corner in order to hold it in place. You may wish to substitute double-sided carpet tape if you are working with children. Simply place the tape around the edge of the box, then wind the wire over it, and the sticky surface will hold the wire securely. (You may wish to reduce the width of the tape by cutting it in half as only a small part of the box's edge is actually covered).

If you wish for the set to have greater sensitivity and selectivity you may wish to add taps on the loop antenna, though this will add to the difficulty of construction. One benefit of this addition will be the ability to tune into the lower shortwave and possibly hear foreign broadcasts within those frequencies.

Once you have reached the 23rd or 24th turn and can reach the original entry hole at the bottom of the set, measure out an extra 6 to 8 inches, and then cut the wire from the spool. Having secured the last loop so that it will not unwind (this may be done by gluing the wire to the last corner that it rests on) proceed to drill a second entry hole in the bottom of the box on the opposite side from the original and away from the loop coil (see Figure 3). Place the loose end of the wire into box through the hole, and measure to its connection point on the stator (A), ensuring that it is neither too tight nor loose then cut off the excess. Remove the wire from the box, and then scrape the end of the wire. Place the wire back into the box and attach it to the positive (fixed stator) side of the variable capacitor (A), as shown in Figure 2. At this time, do not solder the wire, but first test the set and tune the loop antenna for optimal performance, as is explained next.

Figure 3: Bottom of Crystal Radio Set



Attach either a set of high impedance headphones, or an audio amplifier to their posts. Listen for stations by turning the variable capacitor. You should check to see if you are able to receive across the entire Standard Broadcast Band from 535 Khz to 1600 Khz, depending upon the capacitance value of your variable capacitor. Remember that you may have to "point" the set in the direction of a station in order to hear it, due to the directional nature of the loop. Once you have established that the set is working, you can then begin to tune the loop.

To first establish if your loop is out of tune, place the variable capacitor off of a station and listen to the background noise. If the loop is not tuned then you will hear a mix of different stations at all times because an out of tune loop is broad banded by nature. What you will find is that once you have tuned the loop to its proper inductance for working with the variable capacitor used, the selectivity of the loop will be greatly improved. At that point received stations will be louder, and you will hear no "ghost" stations in between. Likewise the set will become much "quieter" in its operation, which will allow you to receive stations from farther away.

To tune the loop simply unwind one loop. Do not cut it, but simply reattach the wire to the capacitor. Listen to the results, and if there is a real improvement then cut off the excessive length, clean the end, and then remove a further loop. Using a strong local station as your test, tune to that stations frequency and around it and check to see if you hear an improvement in signal. Be certain to check to see if the "ghost stations" are being reduced in volume (if not disappearing as well) and also check in the upper and lower ranges of the BCB in order to ensure that you are not losing the range of frequencies that you can bring in.

When you find that the removal of a loop will not improve the signals, and in fact these signals become weaker, add back the removed loop. At this point you can solder the loose end of the loop onto the variable capacitor (A), which ends the main construction steps.

Once the main work has been completed on the set, all that is required are a few finishing touches to personalize the set. Rubber feet, while not totally necessary, do help prevent accidental damage to the loop wire at the bottom of the set. Likewise you may wish to cover the loop wire with PVC tape in order to both protect it and improve the appearance of the set. A tuning dial made of either clear plastic or paper also adds to the look of the set.

USING THE SET

When using the set, remember to use the directional ability of the loop by turning the set in different directions as you tune across the frequencies. Remember that even if you do not hear a station on one frequency, and in one direction, on one particular day, this does not mean that you will not hear something on another. Be certain to try tilting the set from one side to the other when listening to a station in order to hear any changes in the polarity of the radio wave front. In general, vertical radio waves tend to tilt sideways as they move away from their transmitter tower, particularly if they are traveling over earth terrain.

Another phenomenon that you can experiment with is the difference between a groundwave and a skywave. The former comes directly from the transmitting antenna, and moves along the ground as a front, while the latter is the signal that is reflected back from the ionosphere (remember that this only occurs after sundown in the broadcast band frequencies). You can tune into the skywave by tilting the set on a 45 degree angle after having tuned in a distant station, particularly if you hear a "flutter" in the

signal that is characteristic of skywave. You should hear the flutter decrease, and the signal improve. Likewise you should also be able to receive more distant stations at this angle as you capture "skip" signals that are bouncing off the ionosphere and back to earth, often many hundreds of miles from their origin. Try different locations, for the travel of radio waves over land and water can have very different characteristics, and likewise the time of year can also strongly affect reception and radio wave propagation.

PARTS LIST



Item

1 Cigar box 5 1/2" X 9" X 2 1/2"
 1 365 pfd. [variable capacitor](#)
 1 1N34A germanium diode
 1 80 ft roll of #26 (or #24) enameled wire
 1 large headphone post
 1 small headphone post
 1 tuning knob
 4 rubber feet
 1 [high impedance headset](#)

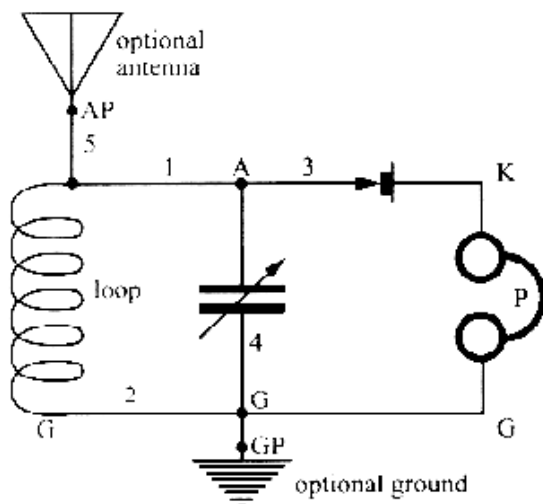
Misc. PVC tape, solder, hook-up wire

Suggested source

See article
[available from](#) the Xtal Set Society
 Radio Shack part# 276-1123
 Radio Shack part# 278-1345
 Radio Shack part# 274-632
 Radio Shack part# 274-621
 Radio Shack part# 274-407
 Radio Shack part# 64-8024
[available from](#) the Xtal Set Society

Radio Shack and hardware stores

Figure 4: Circuit Diagram



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If you enjoy building this crystal set, you can get 15 more detailed crystal radio projects in our new book [Crystal Set Projects: 15 Radio Projects You Can Build](#), written by members of the Xtal Set Society. [Join the society](#) to receive the bimonthly Xtal Set Society Newsletter, which is packed full of crystal radio design information, home-brew instrumentation, project ideas, membership correspondence, crystal radio vendors, and more!



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