The Xtal Set Society Newsletter

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In this issue (#61) July 1, 2001

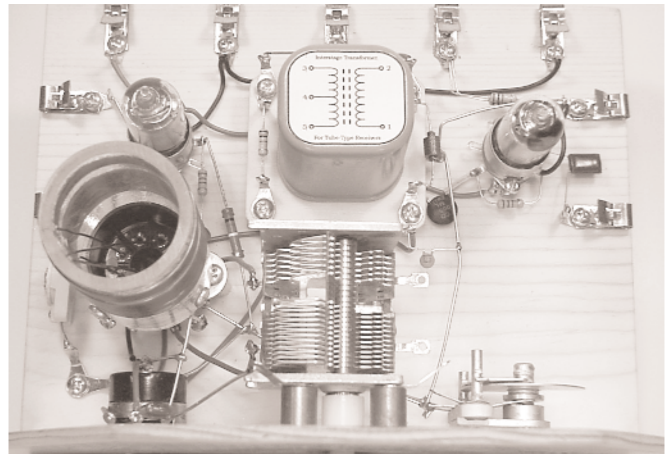


Figure 2: DXer Parts Layout

Dxer, Two Tube Regenerative SW Receiver "The Peebles Choice"

By Mike Peebles

A couple of issues ago, we made a nice little two tube audio amplifier. The short wave set in this issue has been in the back of my head for a long time. Allied

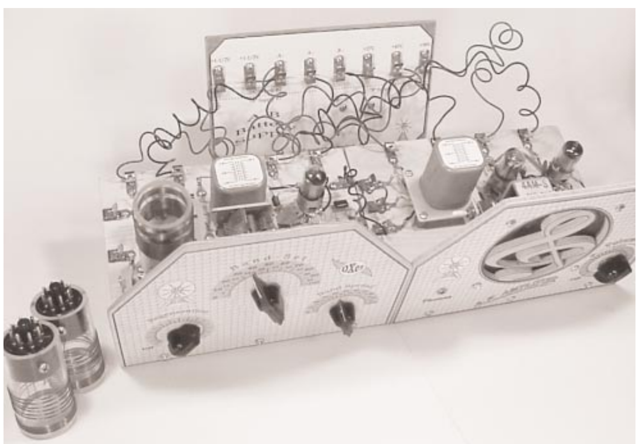


Figure 1: DXer Receiver w/ Audio Amp, and XS-105 Power Supply Kit.

Radio's *Knight* kit line had a two tube, battery operated set called the Dxer. It was a little known set. I'm not certain when it was produced, but my guess would be early '50s. The set in this issue is inspired by that set, but it is quite different. This set is a modified *"Doerle";* the Knight set did not have an inter-stage transformer. For those of you who do not know what a Doerle is, it was a series of sets designed by a man of that name, and it was very popular among experimenters and SW listeners in the '20's era. His sets were basically two tubes (triodes - three elements) with a 1:3 ratio inter-stage transformer between the detector stage and the audio stage. Later the sets were modified, added to, changed, and eventually someone designed a series with pentodes (five element tubes), such as this article. I won't take up a lot of space for further explanation here, but it would be interesting research for those of you who like to "dig up" that sort of stuff. The set in this issue is designed to be a mate to the aforementioned audio amp, and it is a hot little set. One thing I learned from this set, and from studying *Doerle,* is that you can hear around the world with these sets using a whip antenna and a good ground. No fooling, try it! With a set of three plug-in coils, it will cover approximately 1.65 MHz to 18.5 MHz. This set is a little advanced, but I've tried to make the instructions so that most people could build it. I am also just an e-mail away for help.

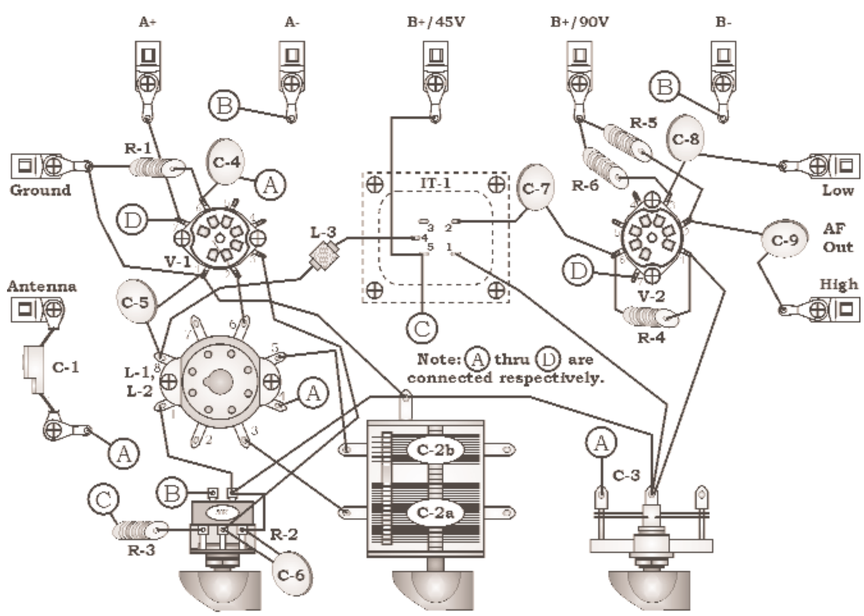


Figure #3, DXer Pictorial Diagram.

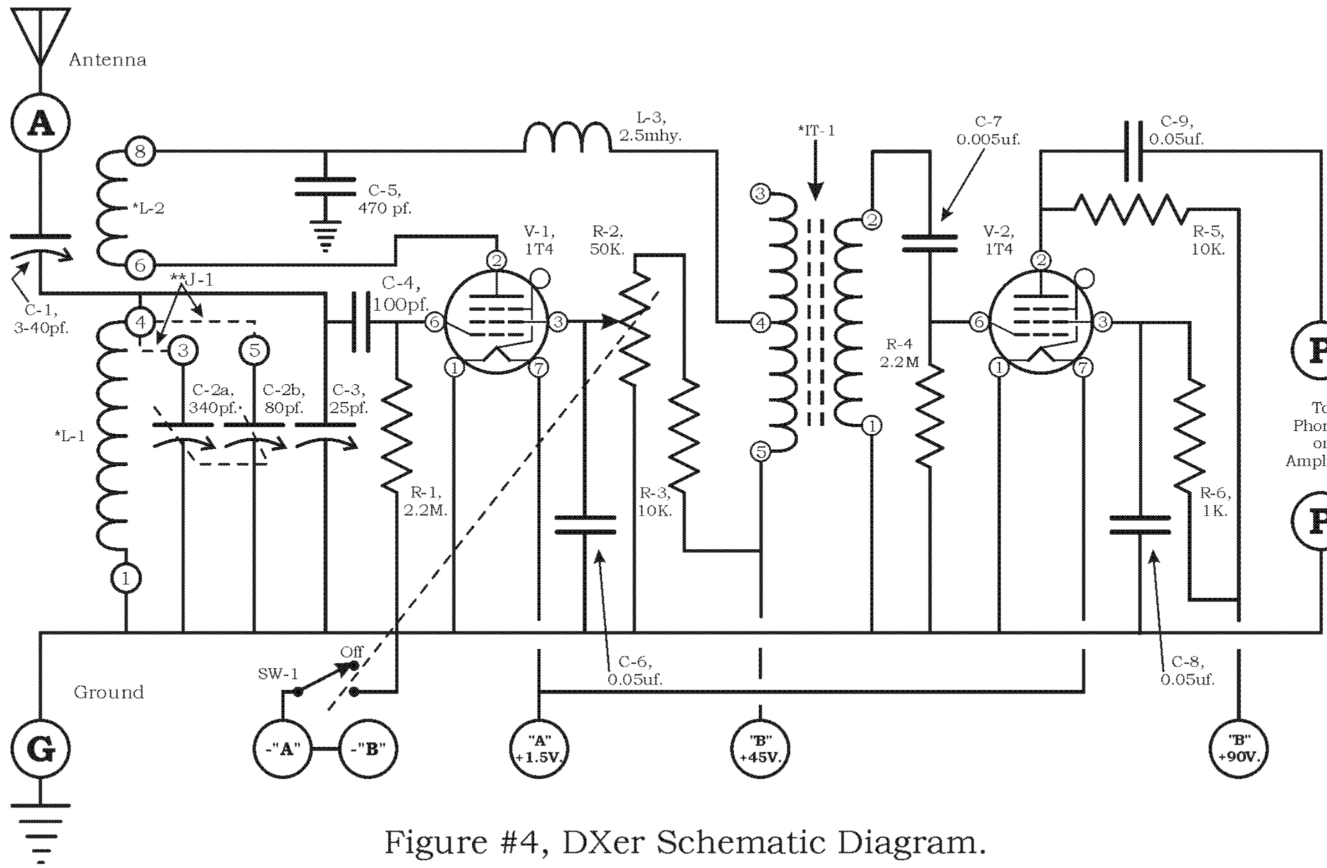


Figure #4, DXer Schematic Diagram.

See Figures #3 and #4: The signal is introduced to the set via C-1, which helps as a neutralizer to help eliminate "empty spots" throughout the bands. L-1, C-2a or C-2b and C-3 make up the tuning circuit, which separate the desired signals. The signal is then passed through C-4 into the first grid of V-1 (Pin #6). C-4 and R-1 act as the detector (grid-leak) circuit. The signal is amplified onto the plate (Pin #2) of V-1. L-2 is connected to the plate of V-1 and serves as "feedback" to L-1, as the process of re-amplification of the signal occurs. The amount of feedback is controlled by R-2, on Pin #3 of V-1. As R-2 increases the B+ potential on the second (control) grid of V-1, the amount of gain in the tube increases. This is also known as the "regeneration control", which I believe is the most efficient method used. Too much gain will put the circuit into oscillation, and too little will degrade the sensitivity of the circuit. The trick is to hit the happy medium, which comes from a little patience and practice. After all, the only way to get to Carnegie Hall is, "practice, young man, practice!", exclaims the elderly cello player. C-5 and C-6 are used for bypassing purposes, and I won't get real technical about that here. B+ potential to the plate of V-1 is provided through Pins #5 and 4 of IT-1. Since all this previous signal amplification is actually audio content (detection occurred at C-4 and R-1), it is then passed on through L-3, choking out any stray RF content, to the primary of IT-1. IT-1's are interesting little transformers. By accident, I discovered these to be great 1:3 ratio audio (rare) transformers (I was about to throw them out). I purchased them to serve as small B+ supplies, and they failed. I told Dan Petersen, "I'll bet these will work for an audio interstage transformer." Dan grunted, "perhaps," as he carried them back from my pickup, which was headed back to the surplus store. The signal through IT-1 is amplified again through the turn's ratio of IT-1 and amplified a third time through V-2. I found that coupling the IT-1 transformer to V-2, via C-2 and R-4 as the grid bias, was more efficient than the conventional way of "hanging" the secondary onto the tube's grid. Another unconventional thing is the R-5 load resistor on V-2's plate, with the audio passing through C-9 to the set's audio output. This is done to allow varied types of audio reproduction devices. The set will accept loads of 1k to 5k and above. Thus,

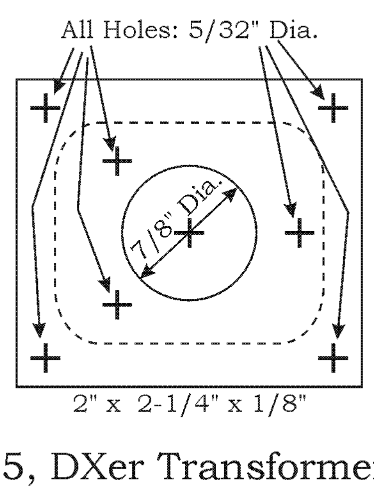


Figure #5, DXer Transformer Mount.

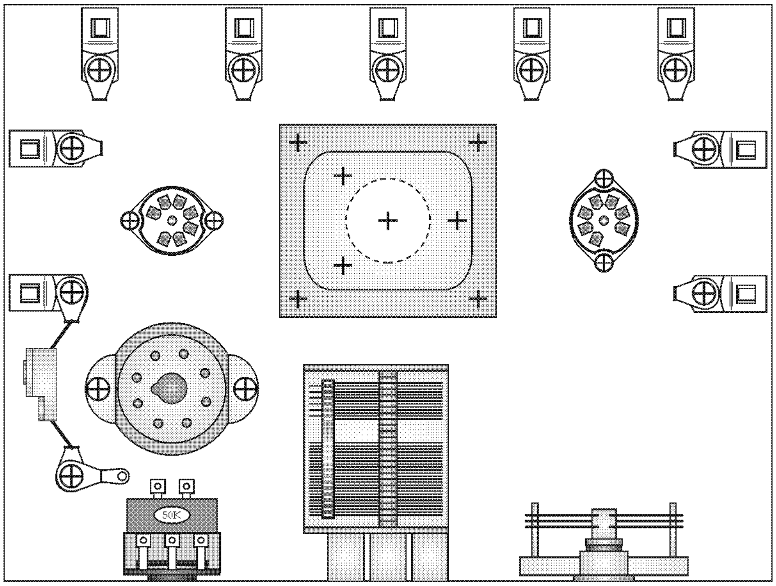


Figure #6, DXer Chassis Template, 6" x 8".

C-3 is not real critical, but I removed all the plates, except for two. This will help to spread the “band-spread” to the best limits. C-4 and C-5 should be silver mica units, but if you’re not using the set in Antarctica, then standard units should be stable enough for most practical purposes. The layout and wiring of V-1 and all associated parts should be kept short, sound, and direct as possible. The backside of the front panel should be lined with aluminum foil and grounded (or made of metal and grounded). This reduces “hand-capacity”, which will de-tune the circuit as your body comes closer to the receiver. This is very aggravating when you are trying to precision tune the set. The shown layout of the set matches the audio amplifier from the March 2001 issue of the newsletter, but this does not need to be followed exactly.

Scott Balderson’s nice 1k surplus phones work nicely. Scott, those are great headphones...my set came all the way from Australia, but what the hey!

Let’s build it! See Figure’s 3-8 for the basic construction details, referring to the parts list for correct components and suggestions for obtaining them. It may be difficult to obtain the exact values for C-2a and C-2b. If you get something close, it will work OK. If you’re fussy about exactness, then add a turn or two on L-1 for smaller values and vice versa for larger values.

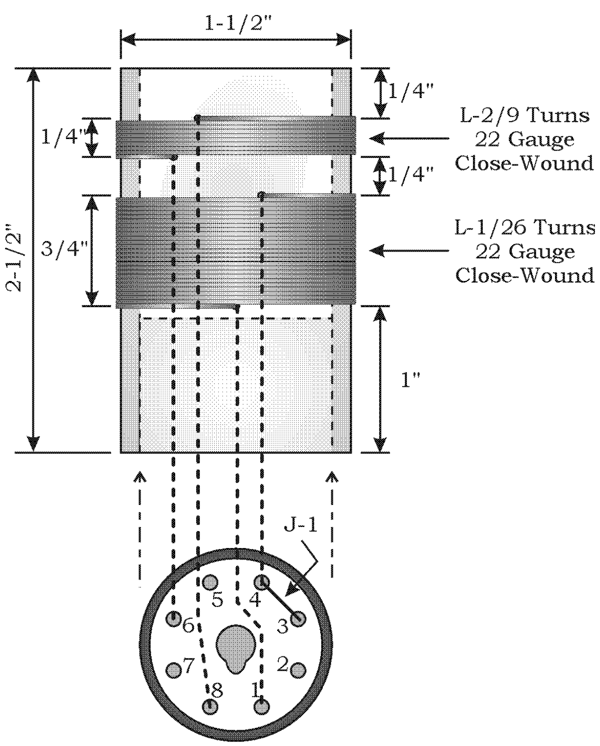


Figure #9, DXer Coil #1,
1.65 to 5.3 MHz.
340pf. Variable Used.

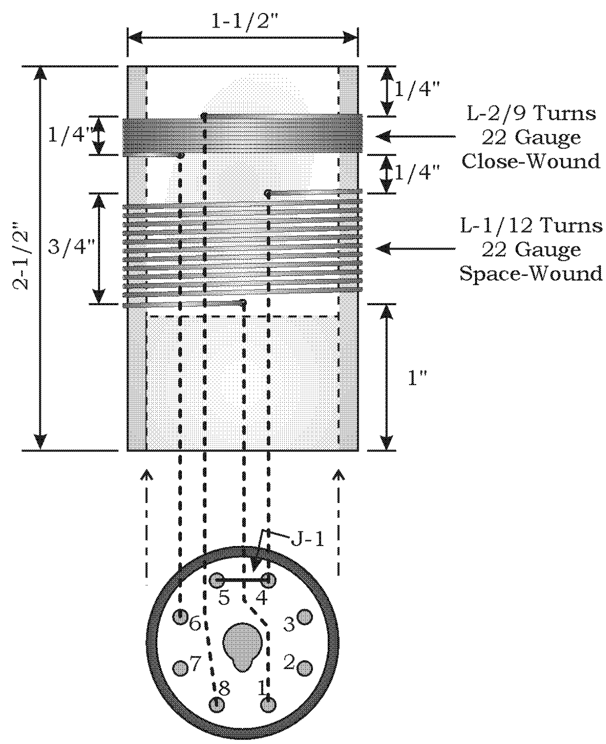


Figure #9a, DXer Coil #2,
5.2 to 11.0 MHz.
80pf. Variable Used.

The performance and ease of use would be greatly enhanced with the following modifications: 1) Use a vernier dial on R-2 or place a second, smaller pot in series with R-2 (about 5k or less). Regeneration control is very critical, as you’ll find-out, and works more nicely with these suggestions, and; 2) Use a vernier dial on C-3 (band-spread), as this is a critical adjustment, especially the higher you go in frequency. You can obtain these controls from some of the vendors I’ve suggested, but get out your heart pills when you see the price...ouch!

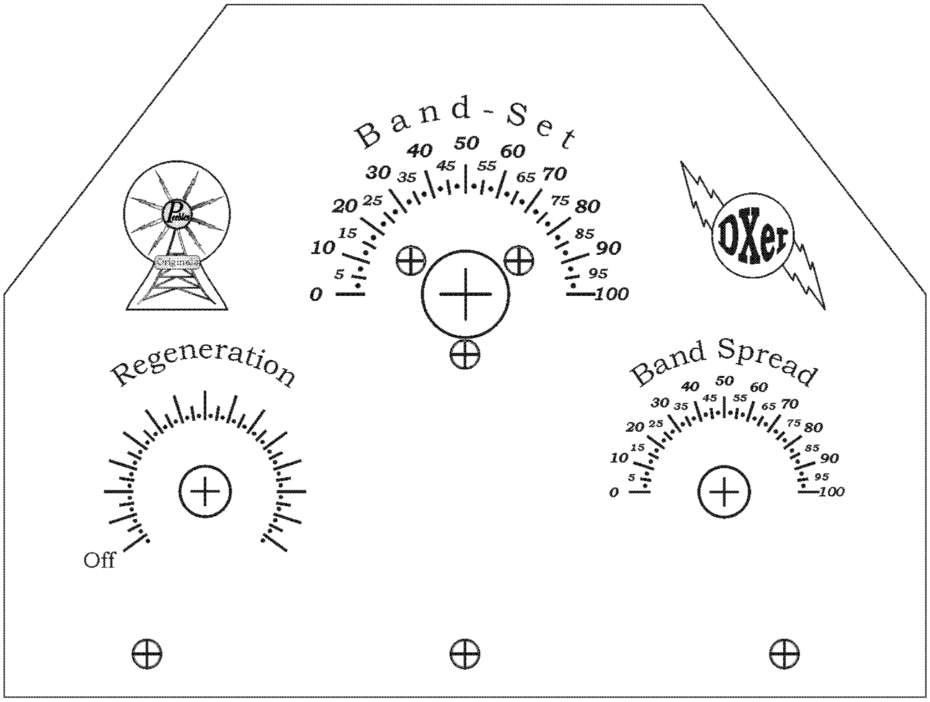


Figure #7, DXer Front Panel Template, 6" x 8" x 1/8".

*Figure reduced by 40%

See Figure 9 (page 3) for coil winding. Be certain to take special note of the J-1 jumper and its positions for each coil. Thoroughly sand the insulation from the magnet wire. Tin and carefully solder each wire into its respective pin in the octal socket. Keep these wires as short and direct as possible without allowing them to cross each other. The windings on the spaced coils do not need to be spaced exactly, but the overall length is critical.

Operating the set is tricky and takes patience and practice. Here are a few hints: 1) Use a good earth ground; 2) Most antenna situations work, even a whip antenna mounted as high as possible. Mine is mounted toward the ceiling of my radio shop, and I heard stuff from all around the world with it; 3) Use a known receiver for reference: i.e., find a signal such as WWV (2.5, 5, 10 and 15 MHz) on your known receiver, then "zero-beat" it with the DXer. This is done by placing the Dxer in full regeneration (squealing), and slowly tuning until you hear the squeal in your known set. In doing this, you will get an idea where you are in the band. Denote the settings. Fully back-off the regeneration control, then advance it until you hear a "rush", then re-tune the set, etc. to locate a station. With practice, you'll soon learn this technique; 4) If you like code or single sideband, locate a signal and then place the regeneration control into feedback (squealing), then slowly tune with the band-spread control until audio comes to clarity. This is a very tricky technique and takes lots of practice, but it's a blast! Have fun! Until next time...Mike.

Note: See Page 12 for Coil #3 Figure 9b.

Figure	Qty.	Description	Vendor
C-1	1	Capacitor, Trimmer, 3-40pf.	OS, AES, RS, Dans
C-2a,b	1	Capacitor, Variable, Dual Gang, 340/80pf. (approx.)	OS, AES, Dans
C-3	1	Capacitor, Variable, 25pf. (approx.)	OS, AES, Dans
C-4	1	Capacitor, Mica, 100pf., 100V.	OS, AES, Dans
C-5	1	Capacitor, Mica, 470pf., 100V.	OS, AES, Dans
C-6,8,9	3	Capacitor, Mylar, 0.05uf., 100V.	OS, AES, Dans, RS
C-7	1	Capacitor, Mylar, 0.005uf., 100V.	OS, AES, Dans, RS
L-1,2	50'	Wire, Magnet, 22ga.	OS, AES, Dans, RS
"	3	Plug-in Coil Form Sets, 8-Pin Octal, 1-1/2" Dia.	*PO
"	1	Socket, 8-Pin Octal	OS, AES, Dans
L-3	1	Choke Coil, 2.5MHy.	OS, AES, Dans
IT-1	1	Transformer, Interstage, 1/3 Ratio	*PO
R-1,4	2	Resistor, 2.2M., 1/2W-5%	RS, OS, AES, Dans
R-2	1	Potentiometer, 50K, Linear, 1/2W., w/Switch	RS, OS, AES, Dans
R-3,5	2	Resistor, 10K., 1/2W-5%	RS, OS, AES, Dans
R-6	1	Resistor, 1K., 1/2W-5%	RS, OS, AES, Dans
V-1,2	2	Tube, 1T4	XSS
	2	Socket, 7-Pin Miniature	XSS
	3	Knobs	RS, OS, AES, Dans
	Misc.	Hardware items as per drawings	RS, OS, AES, Dans
	1	Baseboard, Any Knot-Free Wood, 6" x 8" x 3/4"Thk.	LLY
	1	Front Panel, Plywood, 6" x 8" x 1/8"Thk.	LLY
	1	Aluminum Foil, Front Panel Shield, 6" x 8"	HH
	1	Power Supply, 1-1/2V., 45V., 90V-DC., XS-105	XSS, Suggested
	2	Batteries, 1-1/2V-DC., "C" or "D" Cells, Parallel	LHW
	10	Batteries, 9V-DC., Transistor-Type, Series	LHW

Note:
***PO: Can be purchased from: Mike Peebles, Peebles Originals, 4416 NE 129th Ave, Vancouver, WA 98682. The set includes: 1) IT-1 Transformer & Parts, for 3) Plug-in Coil sets, less wire. Cost: $20.00 in USA and $40.00/Foreign. Check or MO in USA and Int'l MO for Foreign, accepted. Checks held 10 days and other orders shipped the same week.**

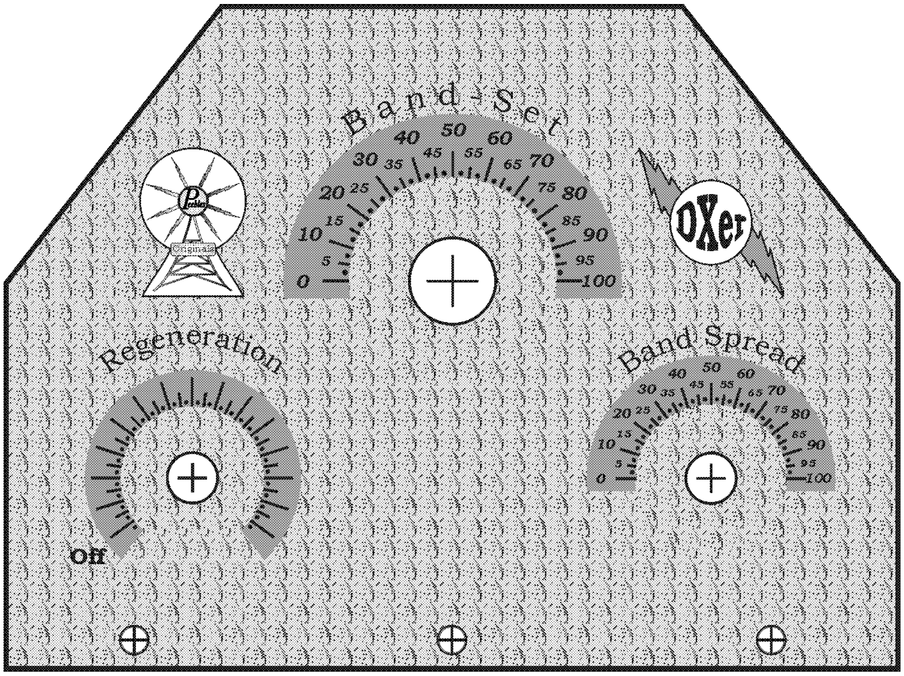


Figure #8, DXer Dial Panel, reduced 40%

Iron Pyrites Negative Resistance Oscillator

By Nyle Steiner

This experiment has been a very exciting experience for me, as it represents the ability to build a simple homemade active semiconductor device. It is almost like making your own homemade transistor. This is the realization of a very old and esoteric experiment so vaguely reported in a few articles that I have often wondered if in fact it had actually been done. Even so, I have always had an extreme fascination with those reports of being able to produce a continuous wave RF signal from a crude semiconductor material

Figure 1: Iron Pyrites with #30 copper wire catwhisker.

back in the very early days of radio.

This oscillating crystal experiment was a sucessful attempt to duplicate those done in the 1920's by W.H. Eccles, Greenleaf W. Pickard and Oleg Losev. This experiment was mentioned in past Xtal Set Society Newsletters, (January 2000 and May 2000).

My fascination led me to purchase an old Tektronix 575 curve tracer to study the curves of iron pyrites (Figure 1), galena and other detector materials that we normally play around with to make crystal sets. The 575 is a vintage but great tool, because it continuously shows the curve in real time as you manually manipulate the samples. This is what is needed in order to make observations while manually touching a piece of wire to a piece of rock. I wanted to be able to display both the positive and negative portions of the curves simultaneously, and so I had to modify the curve tracer in order to do so.

Visable on the curve tracer (Figure 2) is a negative resistance curve that could be obtained from several different pieces of iron pyrites (with much finicky adjusting).

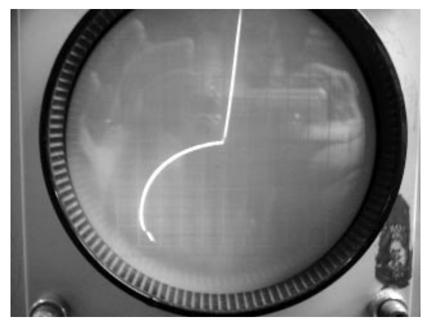


Figure 2: Negative resistance can be seen in the reverse bias portion of curve. 2V/div. horiz. 2mA/div. vert. Curve tracer was modified to apply ac to device.

Not all pieces of iron pyrites seem to work. I found that the kind with a lot of little crystal formations worked the best. The fact that I just happened to have several working pieces makes it appear that a working crystal is not all that rare. It was nice to realize that this phenomenon was not just the result of some fluky one-in-a-trillion find.

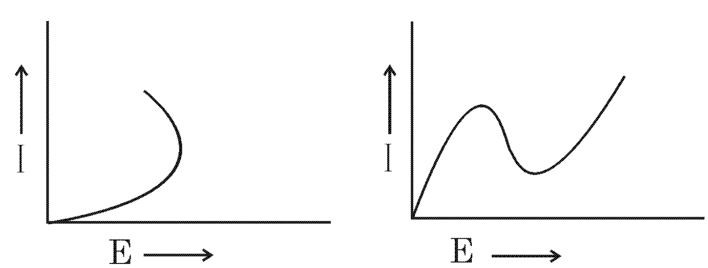


Figure 3: Two types of negative resistance. Left, iron pyrites. Right, tunnel diode.

As the curve tracer photo shows (Figure 2), the negative resistance region is in the reverse bias portion of the curve at approximately -8 Volts and 8 mA. Some of the articles refer to this as being like a tunnel diode. It is true in the sense of having negative resistance, but it is in fact a different type of negative resistance. This is OK, since both types of negative resistance can have the effect of gain, supplying enough energy to an LC circuit for it to become an oscillator. The negative resistance portion of the curve is obtained when negative voltage is applied to the catwhisker.

I am not an expert on negative resistance, but I once read an article many years ago that described how negative resistance is in two forms. I seem to recall them being a type S and a type N (I don't even remember for sure which is which). One type is found in a tunnel diode, and the other type is found here and in other devices such as a neon lamp, a unijunction transistor and what I believe to be in the old carbon arc transmitters. Figure 3 shows how the two types of negative resistance curves are possible. The negative resistance seen on the curve tracer (Figure 2) is upside down with respect to that shown in the left part of Figure 3 so that both the positive and negative portions of the curve can be displayed.

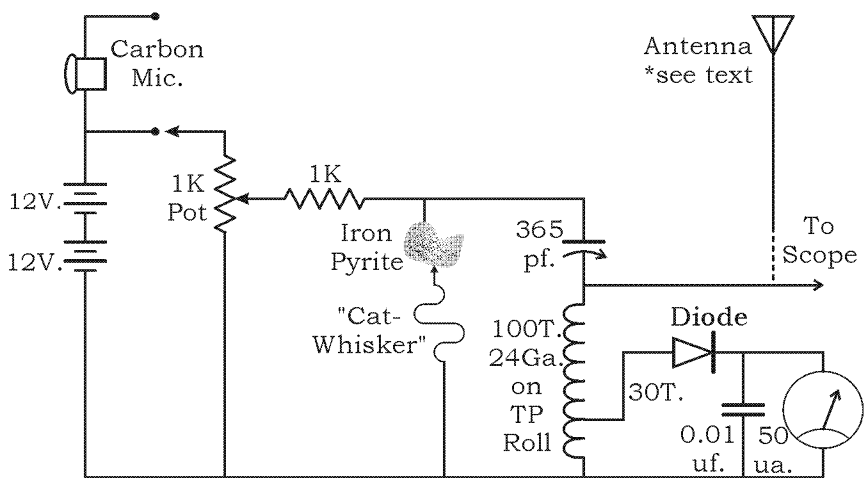


Figure 4: Schematic of broadcast band Iron Pyrites negative resistance oscillator. Carbon mike enables AM broadcast to nearby AM radio.

The circuit shown (Figure 4) will easily produce a continuous wave signal in the broadcast band. It seemed difficult to get it to operate above 2 mHz, but it was easy to get it running at anything below that, including audio frequencies. It seems to prefer certain LC ratios better than others. In the case of the broadcast band, a 365pF variable capacitor worked well with a 190 µH coil (100 turns on a TP roller).

When adjusting the 1k pot, I could find a range where the oscillation amplitude would vary with the voltage from the pot. This suggested the possibility of voice amplitude modulation with a carbon microphone. I was indeed able to hear my voice on a nearby radio with a carbon microphone placed in series with the battery supply. Just imagine the fun it was to be able to talk on the radio with an electrified crystal set.

Once a good piece of iron pyrites is selected, the curve tracer is not necessary. A method of indicating whether the circuit is oscillating or not is the most important tool in making circuit adjustments.

The sole purpose of the diode and 50 microamp meter is to be able to tell when the circuit is oscillating. The meter can only deflect when oscillation occurs, and this makes adjustment possible without the use of an oscilloscope. With an oscilloscope, no meter is necessary. The best way to get the circuit going is to set the 1k pot to a midpoint and then probe the catwhisker around the crystal until oscillation ocurrs. The searching around the crystal is by far the most critical part of the adjustment. If nothing happens, the pot level is raised a bit and searching on the crystal continues. The ranges on the pot that work are fairly wide in relation to the complete range of the pot. This puts most of the burden of adjustment on simply searching the crystal. Use just the oscillation indicator for adjusting. Get the circuit oscillating, and then tune it to a selected frequency on a nearby radio. Trying to adjust by listening to the the radio is futile, because you have to search the crystal for each of many many different tunings as well as for each of many different pot settings. You can imagine how many combinations would have to be tried.

I found it extremely difficult to get steady oscillations with conventional type catwhiskers. I tried a simple idea that I call the Tone Arm catwhisker because of its resemblance to the tone arm of a phonograph. With it, I can often obtain steady oscillations that last indefinite periods of time (several minutes anyway). It is made by soldering a fine #30 piece of copper wire about 1/2 inch long, pointing down, to the end of a piece of thick wire that is made to balance near the middle as shown in Figure 5. Pressure can be adjusted by sliding a small weight along the wire if necessary. This catwhisker also worked very well when used with a normal crystal set. To connect the iron pyrites, several turns of bare #18 copper wire were wrapped around it and twisted tight. I have always found this kind ofarrangement to be as good as anything. It has never seemed that casting in molten metal, etc., is at all necessary for any of the crystals I have ever experimented with. Another copper wire over the crystal and wrapped around a couple of screws in the board works well for mounting the crystal.

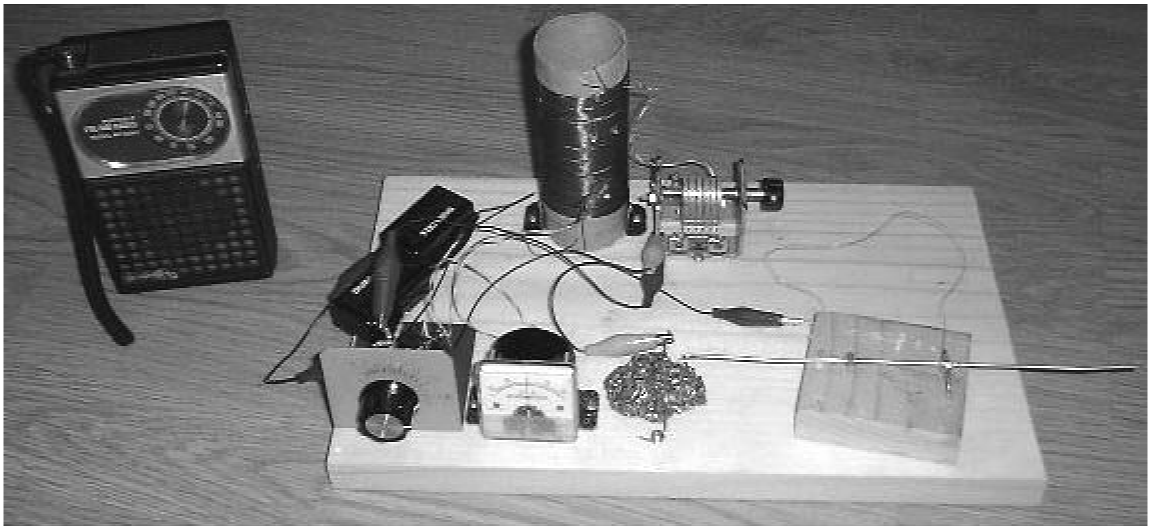


Figure 5: Iron Pyrites Oscillator Board and nearby radio.
Note the “Tone Arm” catwhisker.

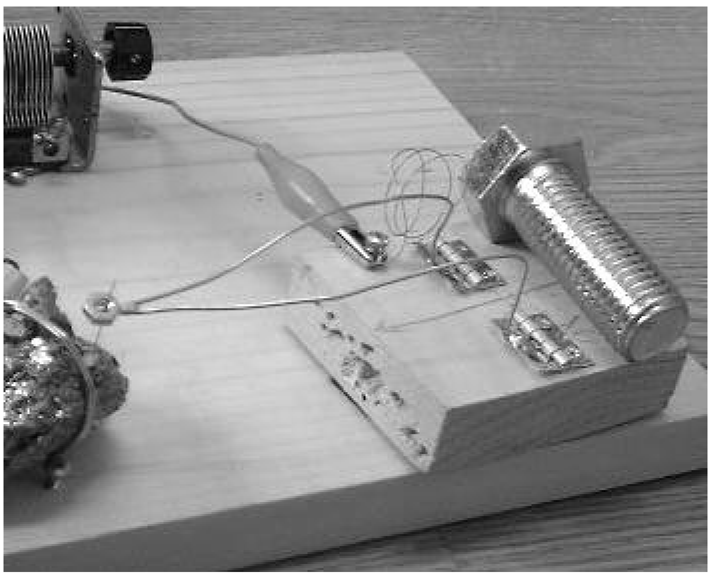


Figure 7: Nyle’s improved Tone Arm catwhisker. A triangular wire frame, a weighted base (with three felt bumpers on the bottom) and hinges to allow the arm to move up and down easily.

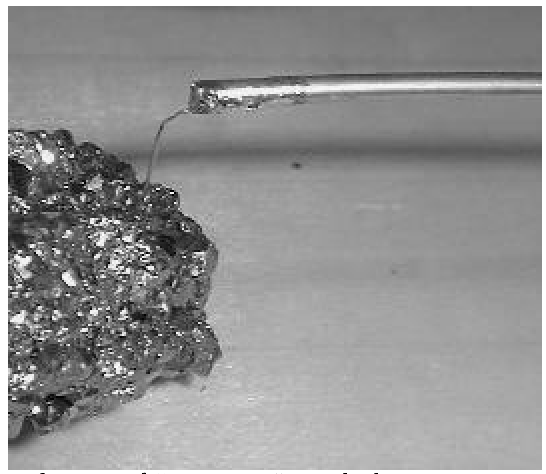


Figure 6: close up of “Tone Arm” catwhisker in contact with iron pyrites.

Do not sell your expensive radio just yet. This circuit is far from being a replacement. It is extremely finicky to adjust and doesn’t stay in adjustment well. However, I can usually find a setting where the circuit can be run for a number of minutes while I walk away and do something else. The biggest feature this circuit has to offer is the thrill of watching it run.

On Q

By Bill Simes

Here are some thoughts, some calculations, some empirical measurements and even a bit of discourse on coil Q as it may apply to the crystal set. Said to be the *quality factor* of a coil, Q is a ratio of like parameters. i.e. Ohms divided by Ohms, energy divided by energy, etc. Since a unit divided by itself is one, Q remains a parameter without dimension. In a resonant system, whether it be mechanical or electrical, energy may accumulate from repetitive low levels of input energy recurring at the resonant frequency of the system. Also in a resonating system, energy continually transfers from one form to another. In the case of a mechanical system, such as a pendulum, energy is transferred between kinetic and potential. When the pendulum reaches its highest position, it stops instantaneously as it reverses direction. At that instant, the system’s energy is entirely potential. At the lowest level of the pendulum’s swing, velocity is maximum, potential energy is zero and the pendulum energy is entirely kinetic. At all other positions the pendulum energy is the summation of these two kinds of energy. In the electrical resonant system, energy is transferred between electrical energy, which is stored in the capacitor, and magnetic energy which is stored in the inductor. In any driven resonant system, energy continues to build up until it reaches a steady state condition where system losses dissipate energy at the rate energy is being added. A resonant system also tends to remain in oscillation after the source of excitation is removed. In that case the amplitude of oscillation diminishes exponentially at a time rate determined by losses in the system. In any resonant system, the two kinds of energy will vary sinusoidally and out of phase with one another. With these conditions in mind, let’s examine the RLC circuit shown in Fig. 1.

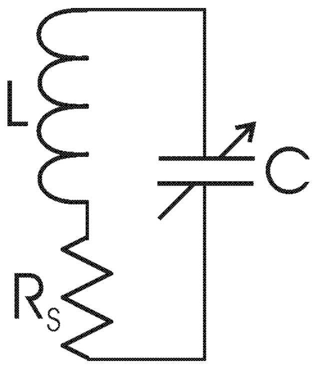


Figure 1: Schematic

The inductance, L, is dimensioned in henries, the capacitor, C, in farads and the series resistor, R_S, in ohms. Let’s assume a condition of oscillation immediately after the driving signal is interrupted. If the losses (designated by R_s) are small, then the decay rate will be exponential and proportional to the amplitude of oscillation. Also, for a small number of cycles, the change in amplitude will be relatively small. In keeping with those conditions, the circuit current, I, can be expressed in the form

(Equation 1)

$$I = Ae^{-\alpha t}\cos\omega_0 t$$

where ω_0 is the angular resonant frequency in radians per second which is 2π times the resonant frequency, f (in cycles per second). Most any physics text will derive the energy in joules, U, stored in an inductor to be

$$U = \frac{1}{2}L\left(I_{\max}\right)^2$$

so without repeating its derivation here, please accept this one on faith, or consult a physics text. When t=0, both cos0 and $e^{-\alpha t}$ and have the value of 1, making A the value for I in Eq. 1 at that instant. The current, I, is then at its maximum value, and the energy stored in the inductance becomes the total energy in the circuit. At that instant, circuit energy in joules can be expressed as

$$U = \frac{1}{2}LA^2e^{-\alpha t}$$

The time rate of change for the energy is then

$$\frac{dU}{dt} = -2\alpha\frac{LA^2}{2}e^{-2\alpha t} = -2\alpha U$$

By definition, power is energy per unit time, so $\frac{dU}{dt}$ then expresses the power being consumed in the process of damping the oscillations. Call the magnitude of this power, W_L. Then

$$W_L = 2\alpha U \quad \text{and} \quad \alpha = \frac{W_L}{2U} \quad \text{(Equation 2)}$$

In the case for damped oscillations, Q can be defined as the ratio of energy stored in the circuit to the energy dissipated during each cycle. That is

$$Q = \frac{\textit{energy.stored.in.the.circuit}}{\textit{energy.lost.each.cycle}}$$

If both numerator and denominator are now multiplied by ω_0, the ratio remains dimensionless and Q can be expressed as

$$Q = \frac{\omega_0\left(energy.stored.in.the.circuit\right)}{average.power.loss} = \frac{\omega_0 U}{W_L}$$

(Equation 3)

From Eq. 3 comes another expression for W_L, i.e.

$$W_L = \frac{\omega_0 U}{Q}$$

and on substituting this in Eq 2,

$$\alpha = \frac{\omega_0}{2Q}$$

thus expressing the exponential decay of the damped oscillations in terms of Q. If energy loss over only a few cycles is neglected, then the current in Eq. 1 for those few cycles may be expressed simply as

$$I = A\cos\omega_0 t$$

making A the peak value of the current at the instant when

$$\omega_0 t = 0$$

Electrical power can always be expressed as I^2R using the rms value of the current. The rms value of sinusoidal current of peak value A is

$$\frac{A}{\sqrt{2}}$$

The average power loss in the circuit series resistance, R_s, in Fig. 1 is then

$$W_L = \frac{R_s A^2}{2}$$

Combining this expression for W_L with that of Eq. 3, yields the familiar expression

$$Q = \frac{\omega_0 L}{R_s}$$

in which R_s is again the circuit series resistance in Fig. 1. All losses in the circuit are manifest in R_s. That would include the winding wire resistance corrected for skin effect, any dielectric losses in the circuit, any interconnecting resistance, any radiation losses, and any other circuit loading. The combination of these rather elusive losses may make the expression of greater practical value for evaluating R_s once Q is determined by other means. Also, keep in mind that both Q and R_s will vary with frequency.

Consider now the same RLC circuit when it is driven by an external resonant sinusoidal source loosely coupled to the inductor. The circuit reactance is the algebraic sum of its capacitive and inductave reactances. The circuit is resonant when the magnitudes of these two reactances are equal. In other words,

$$\omega_0 L = \frac{1}{\omega_0 C} \quad \text{then} \quad \omega_0^{\ 2} = \frac{1}{LC}$$

yielding the familiar $$\omega_0 = \frac{1}{\sqrt{LC}}$$

As explained earlier, the energy in the circuit will be stored entirely in the inductor as

$$\frac{1}{2}LI^2$$

at one extreme of the cycle and stored entirely in the capacitor as

$$\frac{1}{2}CV^2$$

at the other extreme. At any other point in time, both I and V will be at less than their peak values. Still the sum of the two energies remains essentially constant over a short time span. Let's choose a point in time when all the energy is stored in the capacitor. Then if we multiply our expression for electrical energy by

$\frac{\omega_0}{\omega_0}$ and substitute $\frac{1}{\sqrt{LC}}$ for ω_0

then in the numerator we can write

$$U = \frac{1}{2}CV^2 \; * \; \frac{1}{\omega_0\sqrt{LC}} = \frac{V^2}{2\omega_0}\sqrt{\frac{C}{L}}$$

From Eq. 3, it was shown that

$$W_L = \frac{\omega_0 U}{Q}$$

Then using the above expression for U in the expression for W_L, the power loss at resonance becomes

$$W_L = \frac{V^2}{2Q}\sqrt{\frac{C}{L}}$$

An external source applying a sinusoidal voltage across C would then see a rather high resistance, R_0, at resonance. For the system to maintain its steady-state equilibrium that source would have to supply all of the power lost by the system. In which case

$$W_L = \frac{V^2}{2R_0}$$

where V is now the peak value of the sinusoidal driving voltage across C. On equating our two expressions for W_L and solving for R_o, it is seen that

$$R_0 = Q\sqrt{\frac{L}{C}} \quad \text{(Equation 4)}$$

This equation may be useful to the crystal set enthusiast. First, it quantifies the impedance that must be matched to transfer maximum power to the load. Since at resonance, reactances cancel one another the resonant impedance is purely resistive. Secondly, it suggests another approach to measuring Q. On solving Eq. 4 for Q it is seen that

$$Q = \frac{R_0}{\sqrt{\frac{L}{C}}} = R_0\sqrt{\frac{C}{L}}$$

Another relationship of possible interest is the ratio of $\frac{R_0}{R_s}$. Since $Q = \frac{\omega_0 L}{R_s}$ then $R_s = \frac{\omega_0 L}{Q}$ and on using this for the value of the denominator and using Eq. 4 for the value of the numerator and recalling that

$\omega_0 = \frac{1}{\sqrt{LC}}$ it can be shown that $\frac{R_0}{R_s} = Q^2$

Assuming R_0 can be determined more accurately than R_s, this relationship would be useful for calculating R_s.

At this point I went to the basement to measure some of the parameters discussed above. For the inductor, L in Fig. 1, I used an ancient coil (circa 1920) with 57 turns of dcc 1/8-inch square copper bus wire wound on a 5-inch diameter form. Its inductance measured 122 microHenries with a distributed capacity of 75.5 pF. The capacitor, C, was of similar vintage with a maximum capacity of 742 pF. For instrumentation, the signal source was a home brew Hartley oscillator. This was connected to a Mattco model 711 counter with 5-digit readout to give an accurate frequency measurement. A Telequipment DM64 oscilloscope was used as a high impedance voltage indicator. Vertical deflection was assumed to be a linear function of voltage, and this was used to compare relative voltage amplitudes rather than to actually quantify voltages. Included also in the instrumentation collection was a Radio Shack 22-181A digital multimeter for resistance measurement. At a resonant frequencies near 0.71 mHz, coil Q was measured to be 165, as calculated be dividing the resonant frequency by the frequency band width (difference between the frequencies each side of resonance that gave a deflection 0.71 of that at resonance). For all of these measurements, L was excited by positioning it a few inches from the Hartley oscillator coil. To estimate R_0, a 1-megaohm pot with short leads was connected across the capacitor. With one of these pot leads disconnected, the circuit was peaked at resonance and the scope deflection measured. The pot was then reconnected across C, the tuning capacitor was tweaked for maximum deflection, and the pot adjusted for a scope deflection half that measured at no load. The resistance of the pot at this setting was then measured to provide the estimated value of R_0 at the frequency of the test. Measurements for R_0 near 0.7 mhz were of the order 85 k to 90 k Ohms.

Let's now analyze our data for possible application to crystal sets. In general, crystal sets depend on tuned circuits, in one form or another, to separate and enhance incoming signals. Unlike radio circuits that feed tuned signal voltage to the near infinite impedance of a detector or amplifier, the crystal set is a passive device that must exact all of its power from the tuned signal. This brings with it some bad news. Even when the crystal set circuit is matched for maximum power transfer to the headphones, only a part of that signal power is transferable. As an analogy, consider a conventional battery. The battery has an internal resistance, call it R, and a no-load voltage, call it V_{NL}. If the battery is shorted, the power dissipated is $V_{NL}{}^2/R$. This is the maximum power the battery can deliver. Of course this power is not delivered to an external load. Instead it is dissipated internally as heat. It is not too difficult to show that maximum power is transferred to an external load when the load resistance equals the battery's internal resistance. The load voltage is then $V_{NL}/2$ leaving the power delivered to the load $(V_{NL}/2)^2/R$ or $V_{NL}^2/4R$. So even under conditions of maximum power transfer, only ¼ of the battery power capability can be delivered to an external load. As in the battery analogy, Eq. 4 implies that maximum power will be delivered to a load resistance equal to that of R_0. Paralleling R_0 with a load of equal resistance produces a combined resistance to $R_0/2$ which is now in effect the new value for R_0. L and C remain unchanged in Eq. 4, so Q must be reduced to half its no-load value to satisfy the equation. When Q is expressed as the resonant frequency divided by the bandwidth, it is clear that for a given resonant frequency the bandwidth must be doubled when Q is halved. This shows that crystal set selectivity will be sacrificed as sensitivity is maximized. Eq. 4 offers another possibility. On solving Eq. 4 for Q it is seen that

$$Q = R_0\sqrt{\frac{C}{L}}$$

From the basement data, with resonance near 0.71 mHz (w=4.46 E6), Q was measured to be 164 and 165 using $Q=f_0/\Delta f$. Pot resistance measurements for estimating R_0 at this frequency were 85 k and 90 k. Knowing the value of L to be 122 uH and using the relationship ,

$$LC = \frac{1}{\omega^2}$$

$C+C_0$ was calculated to be 411.9 pF. (this value was also confirmed by the variable capacitor calibration data and the previously determined value of C_0 for the inductor). Using measured values of R_0 and the known values for C and L in the expression for Q above, Q was found to be 156 when R_0=85 k and 165 when R_0=90 k. I was pleasantly surprised with the close agreement among Q values evaluated using these two methods of measurement, considering the accuracy and/or precision uncertainty of my instrumentation.

Hopefully, a crystal set enthusiast will find here something of use and/or of interest. In any event, to all readers I extend a heart felt **Thank Q!**

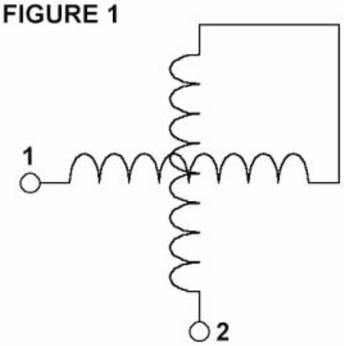
Various Notes on the Variometer

by Dan Petersen, WA6OIL

The Variometer: The very name conjures up images of Boris Karloff movies (Igor! Turn the Variometer to MAXIMUM!!!) or perhaps Edison's laboratory. While it won't raise the dead, the variometer is one of the oldest components used in the radio industry and probably WAS in Edison's inventory. It is also an interesting gadget that can still find use in today's crystal radio.

The variometer is a rather simple device consisting of two coils, one smaller and placed inside the other. A shaft extends through the two coils, enabling the operator to rotate the smaller coil within the larger. The variometer is called a "two-terminal" device– the two coils are wired in series with each other so that only one end of each coil is available to the outside world. Refer to Figure 1 for the schematic diagram. As can be seen, the outside world can be connected to terminals 1 and 2. So what does this wonderful widget do that is so astounding? As you turn the shaft over 180 degrees of rotation, the inductance will smoothly change over about a three to one range. This means no taps are used to change the inductance by switching between taps with its attendant jumps in inductance. If you need a precise inductance to, say, cancel the antenna capacitive reactance, here's just the ticket. What's antenna capacitive reactance? That's another subject – Stick with me on this one.

FIGURE 1



In my research I found plenty of information about variometers and lots of pictures, illustrations, and articles about their construction and use, but I have never found much information about the actual inductances. This is where I gave every consideration to the mechanical and electrical characteristics of the variometer and the calculations required to obtain a satisfactory result…and gave it my best guess. The one I am about to describe varies from 225 to 625 microhenries.

Construction: I wished to make this variometer out of parts that are readily obtainable to just about anyone. With this in mind I visited our local fabric store. If you would take a look at the paper tubes that ribbons and laces are wound on, you will notice some that are 3-1/4 inch diameter and about 2 inches long – just the right size for the outer coil of the variometer. If you ask nice they will probably be glad to give you some. The other coil is made from a 2-1/4 inch diameter mailing tube or from one of the tubes that hold plotter paper that reproduction outfit's use. Look under "copies and reproducing" in the phone book. Of the smaller tube you will need a 2 inch length. The other items you will need are two rubber grommets that will fit snugly over the shaft, consisting of 6 inches of ¼ inch diameter wood dowel. You will also require some #24 and #28 enameled wire.

Coil Form Construction:
The two coils need to be wound in slightly different fashion than normal. As the shaft extends through both of the coil forms you need to provide a space in the center of the form for the shaft. Please refer to Figure 2 for the specifics on the coils. Before winding however, you need to prepare the coil forms by drilling the shaft holes. To get them directly opposite one another do the following: Take a sheet of typing paper and cut a 1/2 inch wide strip from along the long length of the paper. Now wrap the strip around the body of the coil form and put a mark on the strip where the end overlaps the strip. Remove the strip and cut the strip across at the mark. Fold the strip in half. Cut the strip at the fold. The remaining strips each are ½ the circumference of the coil form. Place the strip back on the coil form and mark where the ends of the strip lie. Put the marks roughly halfway between the

ends of the coil. Measure between the ends of the coil form and make another mark halfway from each end. Where the two lines meet is where you want to drill the holes. Use a 1/4 inch drill bit at high speed and use light pressure. Also, have a piece of wood behind where you are drilling for the bit to bore into when it goes through the form.

Winding the coils:
As stated before, the coils need to have a 0.5 inch gap in the center of the coil with half of the windings on each side. If you use the coil forms specified you may start the winding 0.125 inch (1/8 inch) in from the end of both coils. On the primary, wind 25 turns of #24 enameled wire close-wound on the form, then over ½ turn move the wire across the 0.5 inch gap and wind 25 more turns. On the secondary, wind 30 turns of #28, half-turn over the gap, then 30 more turns. A couple coats of varnish suffice to secure the coil on the form. I usually paint my coil forms black before winding them. Once wound and varnished they look really vintage.

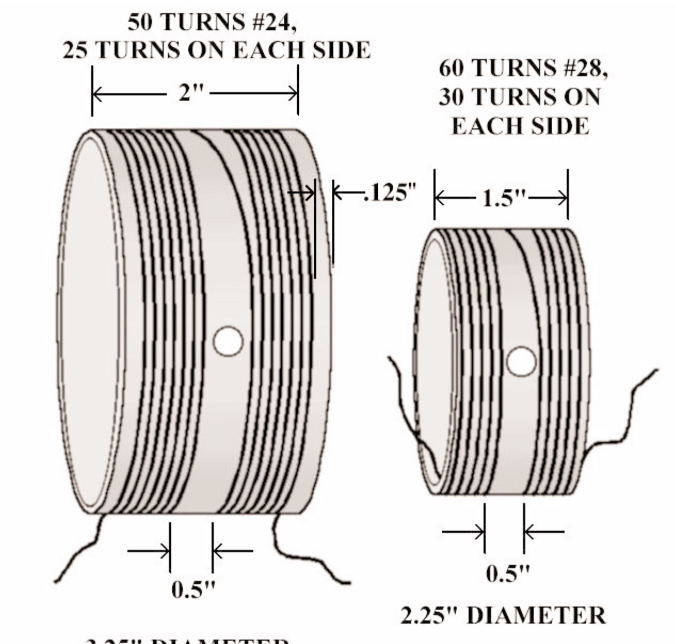
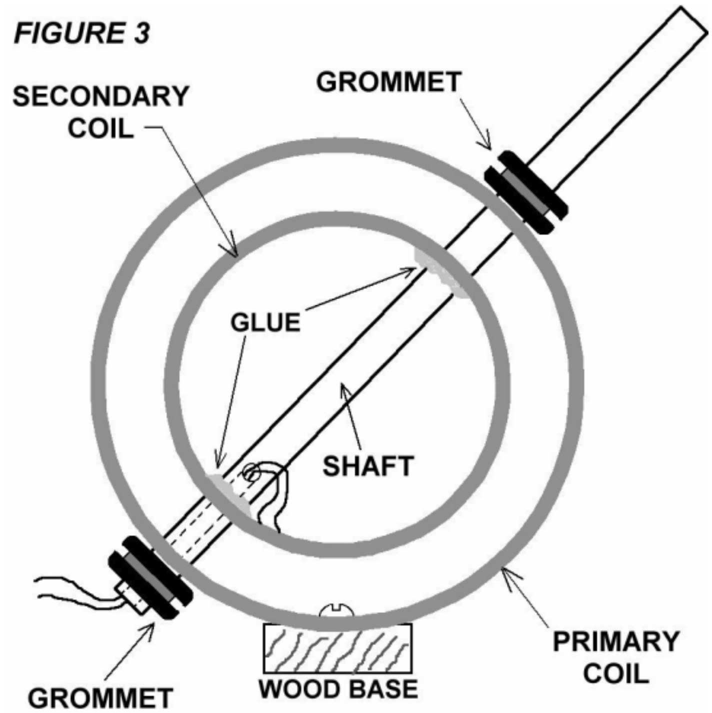


FIGURE 2

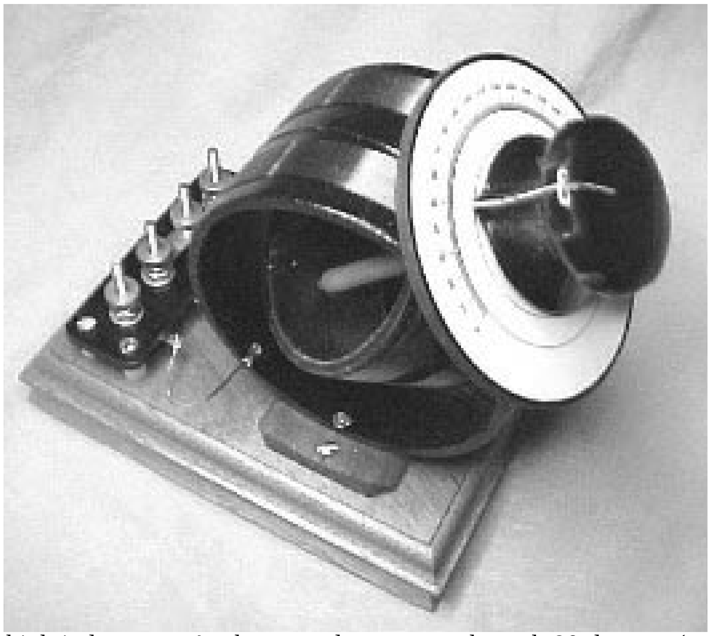
Final Coil Assembly:
Now comes the time to put the thing together. Prepare a shaft from a 6 inch piece of 1/4 inch wood dowel. You will also need the two rubber grommets that will fit snugly over the shaft. Take one grommet and force it onto the shaft, pushing it about 2 inch down the length. Now feed the long part of the shaft into the primary on the side farthest from where the windings end. Push it in until the shaft sticks about 1/4 inch inside the primary. Set the secondary coil inside the primary and push the shaft into the secondary shaft hole on the side farthest from the windings end. Continue pushing the shaft through until the grommet comes up against the primary coil. Force the other grommet onto the other end of the shaft until it comes up to the primary. You next center the secondary inside the primary and using epoxy or other suitable glue, secure the secondary to the shaft. You must NOT glue the primary to the shaft. That kind of negates the whole point of having a rotating shaft! You will note in Figure 3 that the secondary wires go into a hole

FIGURE 3


in the shaft and down a hole drilled along the length of the shaft. This hole only needs to be 1/16 inch diameter and needs to extend far enough to get inside the secondary form. This is a rather nifty way to get the secondary wires out to the outside world. The coil assembly is mounted to the base using a wood block affixed to the coil, then screwed to the base. On mine I have the shaft pointing up at a 45-degree angle to place the adjustment knob at a convenient angle. I mounted a dial on mine by epoxying two small wood blocks on each side of the shaft, then mounting the dial plate using small brass flathead wood screws.

Connections:
The connections to make the thing work are quite simple. You will note that the primary is wound with #24 wire and the rotating secondary is wound with #28 wire. Pick out one of the #24 and one of the #28 wires, scrape the insulation off the ends, twist them together and then solder the connection. The remaining two wires can then be connected to binding posts. On my unit, I have brought out all four wires to binding posts. With the posts in a line as shown in Figure 4 the wire connections are: Large wire-small wire-large wire-small wire. I then made a brass shorting bar to go between the two middle binding posts. Removing the shorting bar makes the unit a “variocoupler”. This differs from the variometer, as it is now two distinct inductances with variable coupling between them. Frankly, I have never needed to use it in the variocoupler mode.

Theory of Operation:
What you have done is to connect the two coils in series. The theory of operation is that you have two coils connected in series AND they are heavily coupled to one another. Normally, two inductors that are physically in series and that are NOT inductively coupled will exhibit the sum of their two inductances. If you start to inductively couple them, the magnetic fields will start to interact, which will change the total inductance. In the case of the variometer the secondary coil can be rotated through 180 degrees. As you do this, the coils will first “boost” each other, creating a



high inductance. As the secondary rotates through 90 degrees (or at a right-angle to the primary, there is minimal coupling, and the inductance is the sum of the two coils. Continuing on, the coil fields start to "buck" one another, causing the inductance to drop to the minimum value. The change is not linear. It flattens out near the ends of rotation. Nonetheless, the change in inductance is at about a three to one ratio.

So What's It Good For?

The variometer saw use in the early days as an alternative to coil-and-slider type tuners. This of course would work well if you had only one station within range. In today's world, making a crystal set with a variometer tuner is fun from the vintage aspect but is about the worst design for trying to separate stations. Another use for the variometer is as a regeneration control. Envision a regen rig using a "throttle" variable capacitor for a regeneration control. Remove the variable and connect the variometer between the tickler coil and the headphones. If the values are right, it will control the regeneration just as well as the throttle capacitor. Where it finds the most use these days, however, is in the antenna tuner. Since an electrically short antenna "looks like" a capacitive load to your set, the variometer is just the ticket for tuning this capacitance out of the circuit. Here's an example. I recently took part in a crystal radio DX contest. For a set I used an Australian design "Mystery" set with the variometer connected in series with the antenna lead-in. I picked up over twenty stations in seven states (and that's BIG western states), two provinces and Mexico. Farthest DX? WOAI in San Antonio, Texas, a distance of over 1700 miles. The variometer made a vast difference in the effectiveness of my antenna. So give 'er a go. -Dan

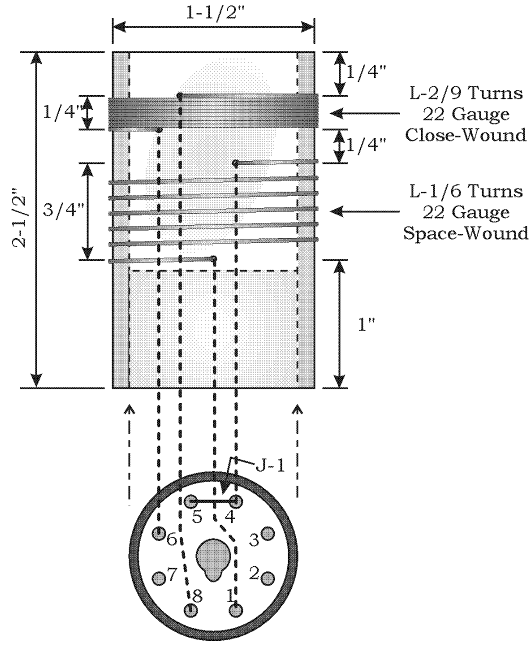


Figure #9b, DXer Coil #3,
10.5 to 18.5 MHz.
80pf. Variable Used.

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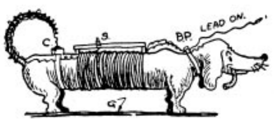


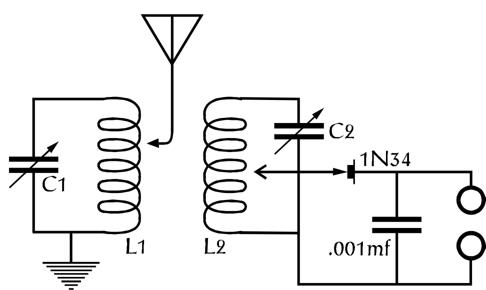
Your July 2001 Newsletter is Enclosed

Crystal Set Projects: 15 Radio Projects You Can Build

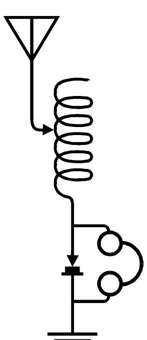
Crystal Set Projects is a collection of radio projects that won a building contest run by the Society. Included are step-by-step instructions so you can build and design your own Xtal sets no matter what your background in electronics. The projects are of various designs and difficulty so that everyone can learn something. "Crystal set circuits have been regularly published in the hobby press since the dawn of radio. But the Xtal Set Society's new project book covers more electronic and mechanical variations of this ever-popular receiver than I have ever seen in one place. You'll find hi tech and low tech versions, vintage and modern versions, sets with loop antennas and short-wave bands. The book is as much fun to read as to build from, but I defy anyone to browse this infectious publication for long without experiencing an uncontrollable urge to break out the soldering iron and double-cotton-covered wire!" —Marc Ellis, Editor, The Old-Timer's Bulletin of the AWA; Get yourself a copy! 6 x 9 paperbk, 160 pgs. **Cat# CSP 14.95**

CRYSTAL RADIO: HISTORY, FUNDAMENTALS, AND DESIGN ★★★★★

Written by a long time member of the XSS, Mr. Phil Kinzie, this book chronicles the fascinating history and development of the crystal detector. Starting with the discovery of solid-state rectification and then through the development of the crystal detector the reader learns about great inventors such as Pickard, Braun, Dunwoody, and others. Radio fundamentals such as antennas, ground, lightning protection, tuned circuits, and detection are covered for the beginner. The unending compromise between selectivity and sensitivity is discussed. Topics such as the use of multi-tuned circuits and wave traps follow for the serious experimenter. Great background for any radio builder. 8½x5½ paperback, 124 pgs. **Cat# XCR $11.95**



THE CRYSTAL SET HANDBOOK



by Phil Anderson. There is nothing else out there like this handbook. It takes the reader beyond the basics and discusses the math and mechanisms behind the mystery of the crystal set. This book is written for crystal set enthusiasts, radio amateurs, first-time radio experimenters, and electronics students. Contents include an introduction to the crystal set with a simple oat box project, formulas for coil inductance and coil Q, a procedure for measuring coil capacitance, introductory and advanced chapters on L-C circuit matching, and **Volume III** of the Society Newsletter (issues 13-15). 8x5½ paper, 133 pp **Cat# XV3 $11.95**

BACK ISSUES OF THE XTAL SET SOCIETY NEWSLETTER

VOLUME I & II Don't miss out on these great Originals! Now combined as one book, the original 12 issues still hold their own. They include a complete set of plans for a "Modern Day Crystal Set," Why did the sets of the 1920's work anyway? Crystal sets and wireless, 1905-1928. Matching your antenna and set for maximum signal reception. The Lead Pencil Detector! Detector Biasing for improved sensitivity. Double-tuned circuit crystal sets. The Universal Crystal Set. FM crystal sets? The electrolytic detector. The coherer revisited. The Miller '595' Tuner. 8½x11, spiral binding, 80 pgs. **Cat# XV2 $18.95**

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VOLUME IV Great stuff from 1994 on measuring coil capacitance, two building projects using Quaker Oats boxes, broadcast and short-wave, how to make home-brew headphones and curve tracers, how crystal earphones work, and a description and schematic of 10 crystal sets. 85 pgs. **Cat# XV4 $10.95**

CRYSTAL SETS: VOLUME V These reprints of the Society newsletter from 1995 are a lot of fun. They include a three part article on the design of unpowered AM receivers made from rocks, including plans for building test equipment such as an impedance meter and a Q meter. Also covered is a radio outfit in a headset, a Marconi type 107-A tuner, the matching secret, and a great ground-noise powered receiver. Get a copy for yourself or for a fellow radio friend! 8½ by 5½ paper, 88 pgs. **Cat# XV5 $10.95**

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1934 Official Shortwave Radio Manual

Edited by Hugo Gernsback & H.W. Secor. Build simple, high-perfomance old time shortwave radios! All of the secrets are here: the circuit diagrams, parts layout, coil specifications, construction details, operation hints, and more. Back in the 20's and 30's the only low-cost way of listening in on the newly discovered and fascinating short-wave radio frequencies was to build a set. This is a compilation of construction articles from "Short Wave Craft" magazine. 8½x11, paperback 259 pages. **Cat# LSW $15.95**

SECRETS OF RF CIRCUIT DESIGN 3rd edition

by Joseph J. Carr The best ways to design, build, and test today's radio frequency (RF) circuits can be found in this very thorough guide. It's filled with projects and experiments that make it easy to apply RF principles to real life applications. Parts lists and component sources are listed for every project; building radio receiver circuits, RF bridges, and amplifiers. The book also covers selecting and repairing variable capacitors, designing wind inductor coils for radio circuits, and constructing and grounding simple wire antennas. If you want to learn more about RF circuits this is a must have. 7½x9 paperback, 568 pgs. **Cat# MSR $39.95**

Theory, Design, and Operation of Crystal Receivers, by K.G. Kott, W8ROG. Originally published in 1953 by Mr. Kott. Recently his daughter Nancy Kott, WZ8C found it in her father's attic and reprinted it. With hand typed pages and nicely done hand drawings, Kott takes the reader from basic electronic theory, to capacitors, antennas, grounds, coil windings and coil design including how many turns & wire diameter, coupled circuits, detectors, and headsets. Booklet, 8x11, 66pp. **Cat# KTD $11.95**

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We are dedicated to once again building and experimenting with radio electronics, often—but not always—through the use of the crystal set, the basis for most modern day radio apparatus. This newsletter helps support our goal of producing excellent quality technical books that encourage learning and building. To join the society and receive one year of the bi-monthly newsletter, remit $12.95 to The Xtal Set Society. Canadians, please remit US $14.00. Outside the US and Canada please remit US $19.00.

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RADIO for the Millions

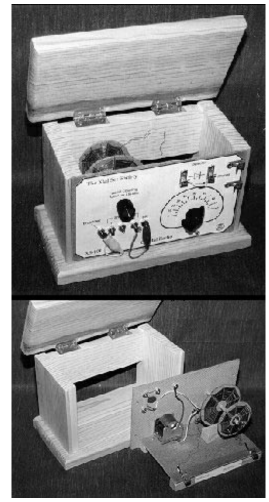
With over 50 different radio plans, this reprint from the 1945 *Popular Science Monthly* is packed with ideas. One to four tubers, TRF, Superhets, you name it! Each project includes photographs, parts list, and a schematic - not a lot of detailed instructions, but complete plans. It's a great book full of tube radio designs for the experimenter. 6x9 paperback, 192 pgs. **Cat# LRM $11.95**

The XS102 Crystal Radio Kit!

Perfect for parents, grandparents, and teachers to build with kids! Also a super starter kit for the beginning adult builder! Includes small coil form, wire, slider assembly, capacitors, and diode. Easy parts layout guide provided for kids. Excellent performance for such a simple but elegant classic slider. Earplug included. **Cat# XS102 $17.95**
Quantity discounts available for teachers & scout leaders.

Radio-Craft: 50 Years of Radio In March of 1938 Radio-Craft magazine commemorated the 50th anniversary of radio with a special "Jubilee Souvenir" issue, now highly sought after by collectors. Its look back at the first 5 decades of radio is priceless, featuring articles on the beginning of commercial broadcasting, technical developments in the evolution of the home radio receiver & the famous Hugo Gernsback predictions of what the future of electronics would bring. 8½x11, paper, 143 pgs. **Cat# SRC $15.95**

The AM/SW XS-101 Crystal Radio Kit



Our radio receives both broadcast and shortwave, and includes two spider-web coils that are variable to each other. Also included are a 365pf variable capacitor, diode, and all the nuts, bolts, clips, knobs, and wire you'll need (antenna and earphone not included). The overall range of the radio is 550kHz to 8.0mHz, depending on your antenna, ground, and local conditions. If you live near a very powerful station the shortwave may be difficult for you, but the broadcast band is very selective. We tested the set here in St. Louis and had great results with both AM and shortwave. The clips for the detector are a nice touch for experimenters; you can attach whatever detectors you'd like to try! It even has an optional, very nice wooden cabinet kit if you want to give the set a finished look. The cabinet is unfinished pine and unassembled.
XS-101, 4½ x 4½ x 7¾, **Cat# XS101 $29.95**
Optional cabinet, **XS-201**, 4¾ x 4¾ x 9¼. **Cat# XS201 $16.95**

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Compiled by H.H. Windsor, reprints of the 1913, 1915, and 1919 editions. Great drawings and just plain fun to read. Here are some examples: "700 Things for Boys to Do. How to construct wireless outfits, boats, camp equipment, aerial gliders, self-propelled vehicles, engines, motors, electrical apparatus, cameras and hundreds of other things which delight every boy." 5½ x 8½ paperbk, 469 pgs ea
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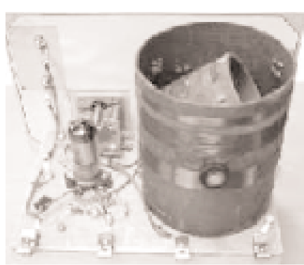
Every imaginable schematic from crystal sets to big multi-tube 1923 receivers & transmitters. A master reference of early radio circuits for the collector & builder. Lots of schematics! 5x8 paperpack. **Cat# LH2 $11.95**

The EASY Wire Antenna Handbook by Dave Ingram, K4TWJ. This book has been around for some time, but it is still one of the best antenna books available. Although Dave is writing for Hams, there is great info for everybody. It is full of ready-to-use designs and dimensions on both "basic" and "gain" antennas. Info on hidden and disguised antennas, tuners and baluns, SWR meters, noise bridges, and antenna tuners. 8x10 paperback, 110 pages. **Cat# CEW $10.95**

The AM/SW XS-104 One-Tube Regenerative



Simple in design but great on performance, our kit has basic, vario-coupler regeneration control. You add an ordinary saltbox, a 1T4 tube (available from the XSS; see below) and a 1.5/45V DC source, and you're on your way to broadcast-band through 8.5 MHz (approx.) listening. Though simple in design, this kit is recommended for those with some prior knowledge of kit building. With a few simple tools and supplies the kit should go together easily. The power supply requirements are simple: one C or D cell and five 9V-transistor batteries in series will work fine. We have put together a nice and neat way to handle this supply in our other new kit, the XS-105 A-B battery supply. Both kits also fit our standard XS-201 cabinet kit. For short wave listening, it is highly recommended that you use an antenna tuner, such as the XS-103 kit. Stations ordinarily missed will be greatly enhanced with the XS-104/XS-103 combination. **Cat# XS104 $29.95**
1T4 Tube for the XS104 Kit Cat# 1T4 $2.95

OUR COMPLETE CATALOG ON-LINE AT WWW.MIDNIGHTSCIENCE.COM

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1937 Sylvania Tube Manual	Cat# LST	$12.95
Homemade Lightning: Creative Experiments in Electricity	Cat# MHL	$19.95
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XS103 Antenna Tuner/Trap Kit	**Cat# XS103**	**$39.95**
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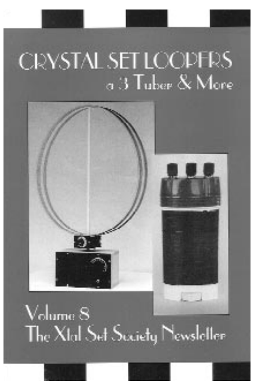
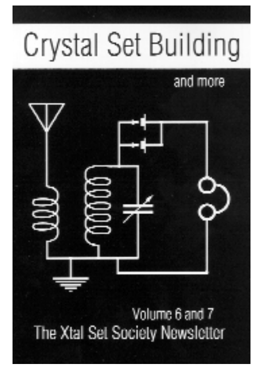


CRYSTAL SET LOOPERS A 3 TUBER & MORE: Volume 8 of the Society Newsletter It's the best volume yet! Build a Shortwave looper, a AM/SW 3 tuber, a Antenna Tuner /AM Trap, a Loop with a new twist, a Frisbee crystal radio, a radio from a deodorant stick, and find more fun building ideas. Learn about biasing effects on diode performance and crystal detector experiments. Discover crystal set secrets from our members all over the world. 6x9 paperback, 128 pp. **Cat# XV8 $15.95**

❋*The Voice of the Crystal*: *How to Build Working Radio Receiver Components Entirely From Scratch* by Peter Friedrichs. Crystal radio construction often means purchasing electronic components. Not anymore with this super new Xtal book! Friedrichs, an XSS member, reveals how to construct all of the parts from scratch. Basic theory and analysis is combined with dozens of examples of historical practice, work by contemporary experimenters, and construction details. Inside are plans for 3 different homemade headphones, including one fabricated from cigarette lighter parts. Also included are detectors, fixed capacitors, and a rotary variable condenser. Plus there are coil plans for single layer, spider web, baskets, and a precision double-slider. Throughout, the author shares his thinking and practical experience, and includes over 120 photos and hand-prepared illustrations. Superbly written, and just plain fun to read. 6x9 paperbk, 185 pgs. **Cat# FVC $14.95**

CRYSTAL SET BUILDING & MORE: VOLUME 6 & 7



of the Society Newsletter. Build these fun projects: An FM Xtal Set, A Crystal Headphone from a Cat Food Can, The Den Two Crystal Radio, From Crystal Set to Superhete, The Simple TRF Set, Flame Detector for the Xtal Set, The Foxhole Set, TRF Receiver Using the ZN414, WWII Underground Xtal Radio, Capacitance of the Parallel Plate Capacitor, How to Make a Double Crystal Receiver, A J-Fet Shortwave Regenerative Receiver. 6x9 paper, 168 pgs. **Cat#XV7 $15.95**

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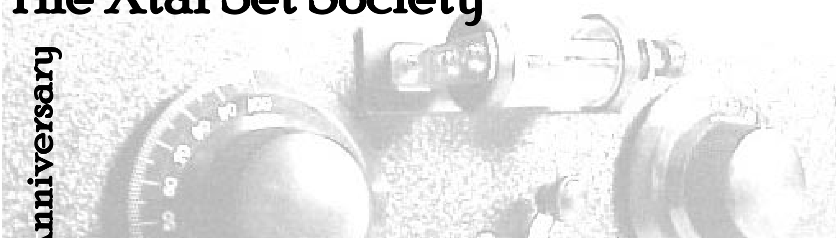
The Xtal Set Society



10th Anniversary

Crystal Earplug, tinned ends Cat#Ear $2.50
Galena Crystals (mounted) Cat# XTAL $3.00
Galena Crystals (raw) Cat# XTAR $3.00
Phospor Bronze Catswhisker Cat# XCAT $1.50
2000 Ohm Headsets - Call for availability
Diodes - 1N695 Cat# DIO .50
Fahnestock clips (25), 5/16 x 3/4 Cat#FC25 $5.25
Brass binder post Cat# BBP $3.00
365 air variable capacitor, single gang Cat#365 $10.95

THE ROCKET RADIO IS BACK!

Remember playing "Spy" with your spy pen radio when you were a kid? This little Rocket Radio takes you back to those times too, digging through the Cheerios box hoping the radio was in there. Some brilliant marketer with gobs of mullah (not me, ha.) had these great remakes of the original 1950's Rocket Radio made. It really works, but be realistic, you're not going to get Radio Japan on it! Instead of the 1950's look, these are packaged for "kids." Get one for you and one for the kids! **Cat# XRR $12.00**

THE IMPOVERISHED RADIO EXPERIMENTER

by TJ Lindsay. Although we are all Xtal radio builders I know you guys are also secretly building tubes radios in your basements. Admit it! And if you aren't you secretly want to try it and don't know where to start, probably intimidated about where to get those old tubes and sockets. TJ lists tube substitutions, using more modern stuff in place of the expensive antiques, and they work just as well. Also included is information on an inexpensive tube power supply, grid-leak detectors, regenerative receivers, list of old magazine references, tube numbering, and nice schematics. Old time radio building for pennies. 5½ x 8½ booklet 48 pages. **Cat# LRE $5.95**

100 Amazing Make-It-Yourself Science Fair Projects

Imaginative projects to impress the science-fair judges, your teachers, and your classmates! From electricity to ecology, plants to perception, light waves to living creatures demonstrate properties and effects from all fields of science. Each project uses readily available materials and includes instructions & diagrams to ensure your success. 7x10 paper 224 pgs.
Cat # SAM $12.95

Your July 2001 Newsletter is Enclosed

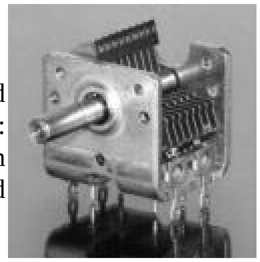
Fan Mail for *The Peebles Choice*

The May issue turned out to be very popular. I worked on the issue with the same goals as always, but somehow it just turned out better. We wouldn't have known it without the fan mail, which just kept coming in. I'd like to take this space to honor our Managing Editor, Mike Peebles, whose committment to the Society has made a real difference. Here is one of the letters we received. -Rebecca

"Dear XSS,
Just received the May issue of the Xtal Set Society Newsletter and enjoyed reading Mike's feature article 'Coil Winding Primer.' Lots of good solid fundamental technical info of benefit to the verteran radio builder, as well as the best start for beginners in their attempts to wind a servicable inductor. Mike's wire gauges and coil form diameters and number of turns is the most comprehensive I've ever seen! And, again, the illustrations which accompanied Mike's text were superior. Also enjoyed Dan Petersen's article 'The Old Timer.' The arrangement for adjusting the coupling between antenna coil and the tuned coil was most interesting. I've never seen any other arrangement as clever as this old-timer... and to think that it was Mike who discovered the cache of 1920's vintage commercial coils! Mike, fellow, you are good for America. I'm looking forward to the July issue, when hopefully we are treated to another project by The Peebles Choice!" - Bob Ryan, Hemet, CA ✪

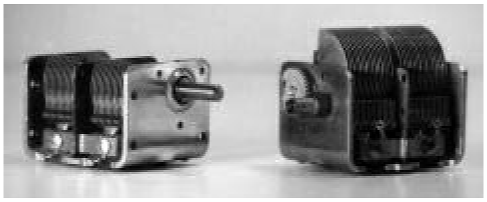
Jeffrey Forrest, D.D.S., Livonia, MI. Jeff has been a loyal member of the XSS - recently he sent some photos of the radios he's been building along with new toothbrushes for the kids! Thanks Jeff, it is always fun getting your messages!

365 pf Air Variable Capacitors



These little beauties are manufactured especially for the XSS. Brand new caps: single gang, 31 blade, .010-air-gap with 5/8" long tuning shaft, CCW rotation, and slotted end rotor blades.

Cat# 365 $10.95



Dual Gang 365 pf Capacitors are now available, same as singles, just two sections with trimmers. **Cat# 365-2 $21.95**

PLEASE NOTE *NEW PO BOX* FOR THE XSS

The Crystal Queen is moving to Oklahoma! No changes to the Society at all...just a new PO Box. The 800# and website remain the same...and as always Rebecca is still in charge!

The Xtal Set Society, PO Box 1625, Norman, OK 73070-1625

