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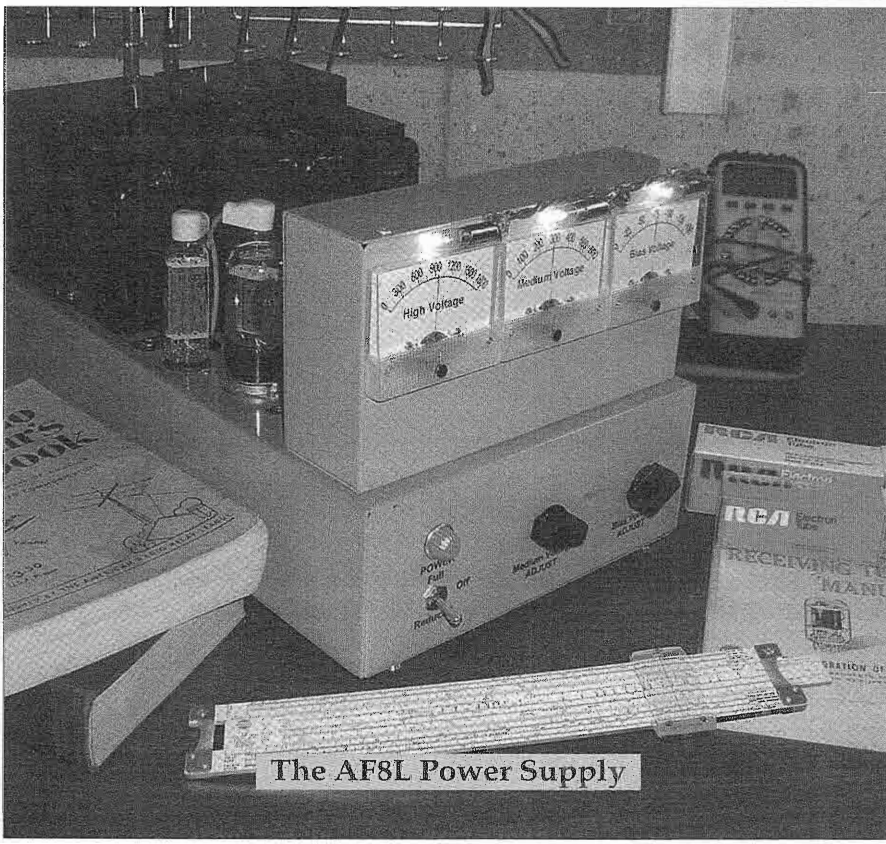
ELECTRIC RADIO

celebrating a bygone era

Number 188 — January 2005



The AF8L Power Supply

ELECTRIC RADIO

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Electric Radio is dedicated to the generations of radio amateurs, experimenters, and engineers who have preceeded us, without whom many features of life, now taken for granted, would not be possible. Founded in May of 1989 by Barry Wiseman (N6CSW), the magazine continues publication for those who appreciate the value of operating vintage equipment and the rich history of radio. It is hoped that the magazine will provide inspiration and encouragement to collectors, restorers and builders.

We depend on our readers to supply material for ER. Our primary interest is in articles that pertain to vintage equipment and operating with a primary emphasis on AM, but articles on CW, SSB, and shortwave listening are also needed. Photos of Hams in their radio shacks are always appreciated. We invite those interested in writing for ER to write, email, or call.

Regular contributors include:
Bob Dennison (W2HBE), Dale Gagnon (KW1I), Chuck Teeters (W4MEW), Bruce Vaughan (NR5Q), Bob Grinder (K7AK), Jim Hanlon (W8KGI), Brian Harris (WA5UEK), Tom Marcellino (W3BYM), John Hruza (KBØOKU), Bill Feldman (N6PY), Hal Guretzky (K6DPZ)

Editor's Comments

Dynamotor Night

I would like to plan on running the2005 Electric Radio Dynamotor Night in March. I'll have the full announcement next month.

The February Classic Exchange (CX) is Coming!

The CX is a no-pressure contest celebrating the older commercial and homebrew equipment that was the pride and joy of ham shacks many decades ago. The object is to encourage restoration, operation and enjoyment of this older "Classic" equipment. However, you need not operate a classic rig to participate in the CX. You may use any rig in the contest although new gear is a distinct scoring disadvantage. You can still work the "great ones" with modern equipment.

When - Where - What

The CX will run from 1400 UTC February 13 to 0800 UTC February 14, 2005. (9 AM Eastern Time on Sunday to 3 AM Eastern Time Monday) CW: Send "CQ CX." Phone: Call "CQ Classic Exchange"

Suggested Frequencies

CW: 1.810, 3.545, 7.045, 14.045, 21.135, 28.180 Mc.
AM: 1.890, 3.880, 7.290, 14.280, 21.380, 28.320, 29.000 Mc.
SSB: 3.870, 7.280, 14.270, 21.370, 28.490 Mc.

Exchange your name, RST, QTH (state US, province for Canada, country for DX), receiver and transmitter manufacturer/model (homebrew send final amp tube or transistor type) and other interesting conversation. The same station may be worked with different equipment combinations on each band and in each mode. Non-participating stations may be worked for credit.

Scoring

Multiply total number of QSO's (all bands and all modes) by the sum of the different types of receivers and transmitters you worked (transceivers count both as a transmitter and a receiver) plus the number states/provinces/countries worked on each band and each mode. Multiply that product by your CX multiplier which

[Continued on page 7...]

TABLE OF CONTENTS

Cover: Gary Steinbaugh (AF8L) has designed an all-vacuum tube regulated experimenter's power supply that is economical and has professional performance. The story begins on page 22.

The Hallicrafters S-41G Skyrider Junior

By Jim Hanlon, W8KGI
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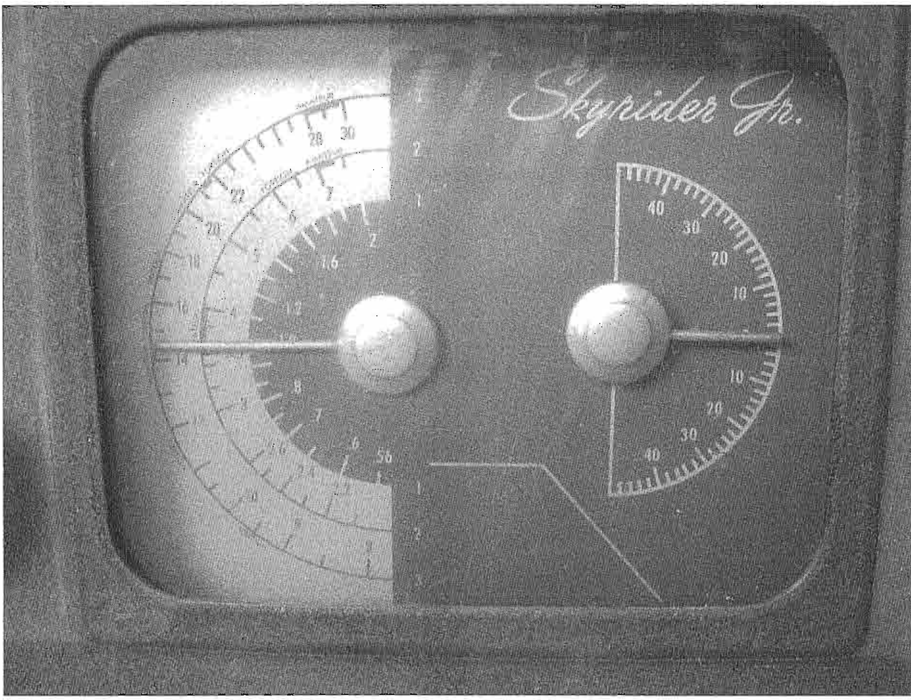
Be careful what you wish for! As long-time ER readers may recall, I have mentioned in past articles that my older brother, Bob, W4RXK, and I were saving our grass-cutting money in the summer of 1950 to buy a used S-41G from Leo Meyerson at World Radio Labs. Our Dad saw what we were doing, thought perhaps it was something worth supporting, and offered to buy us a receiver. Bob talked with his buddies in the Saint Xavier High School Radio Club and came back asking Dad not for an S-41G, but for an HRO-50! Dad gulped and bought it for us, bless him. And that's the reason why I became a radio amateur and later an Electrical Engineer, a career that has served me and my family well for a long time now.

I still have that HRO-50. When Bob and I broke up our shack, we made a deal that gave me the HRO while Bob got everything else. I've always thought I got the better part of that deal. The HRO-50 is still one of the better receivers in my shack even though it is competing with radios such as a 75A-4, HQ-170, HQ-180, NC-303 and R4B. If it's not the absolute best performer, it certainly is my favorite; it's usually the one I turn on first when I want to make a QSO.

But I've always wondered what it would have been like had we gotten that S-41G and I'd operated WN4VIV on 3702.3 kc in 1952 using it instead of the HRO. I said something like that in a recent article, and, wouldn't you know, not one but two S-41G's showed up on my doorstep not too long afterwards. One of them was even from an old friend from my novice days in Fort Thomas, Kentucky, Harold Blocher, W4YWH, who got his start in Ham radio at the same time that Bob and I were cutting grass. I've misplaced the name of the other donor and I feel bad about that, but at least he knows that I have his radio and I'm grateful for it. And at last I have a chance to try out an S-41G.

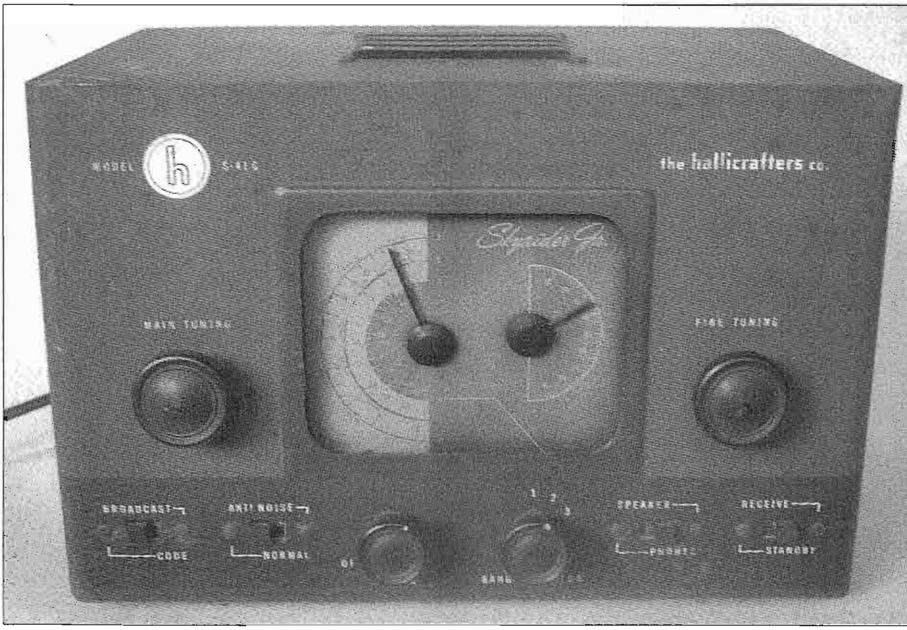
The S-41G is a repainted version of the WWII era Echophone EC-1A and EC-1B. Hallicrafters brought out a line of three, inexpensive, muddy-gray AC-DC receivers in 1941, calling them "Echophone" perhaps because they didn't want to associate such "cheap" sets with the good Hallicrafters name. The original EC-1 was a six-tube very basic superhet that covered the spectrum from the bottom of the broadcast band to 30 Mc in only three tuning bands. It used a 12K8 converter, 12SK7 IF amplifier, 12SQ7 as the detector, first audio and AVC, 35L6 audio output, 12J5 BFO, and 35Z5 rectifier. It also had a built-in speaker, about 3 inches in diameter, so it's bass response and hum output weren't all that much. It would appear from the ads in QST that it was about the only shortwave receiver that continued to be available to the civilian public through the war, until 1945 when it was replaced with the EC-1A/B. These newer versions used a 12SA7 for the converter and changed the BFO tube to a 12SQ7, using the diodes in that tube for a noise limiter as well. The front panel was also rearranged a bit, with the horizontal slide rule bandspread dial in the EC-1 changing into a half-circle pointer in the A/B



The Hallicrafters S-41G was one of the first post-WWII receivers and was introduced in 1945.

models. In 1945 they dropped the Echophone name, gave the cabinet a new, two-tone, maroon-over-gray paint job, and called the same receiver the Hallicrafters S-41G, Skyrider Junior. The "G" stands for "Gray." There was also another version, painted white and with fancy knobs, that was termed the S-41W. Both S-41's sold for $33.50 while they were made in 1945 and 46, fourteen dollars less than the well-known S-38 that was the next receiver up in the Hallicrafters line in those days. The S-38 had the same tube lineup and a similar mechanical layout as the S-41, but it covered the range in four bands rather than in three.

I found out when the two receivers came to me that there were actually two significantly different versions of the S-41. One provides bandspread via a second set of variable plates built into the tuning capacitor, one plate each for both the oscillator and mixer sections. This was the same tuning capacitor used in the Echophone radios. However, it appears that Hallicrafters made a "cost reduction" at some point, because the other S-41 uses just a standard broadcast receiver tuning capacitor with no bandspread section, and derives bandspread by driving a metal slug inside the local oscillator coil form, common to the coils for all three bands, via a string drive mechanism coupled to the front panel "Fine Tuning" knob. You can tell the difference between the two models from the front panel. The capacitor-bandspread receiver has a scale that goes from 0 on the bottom to 100 on the top of its bandspread dial. The slug-bandspread receiver has a scale that goes from 50 on the bottom to 0 in the center and to 50 on the top of its dial. On both radios you are supposed to set the bandspread dial to 0 for the calibration to be correct on the

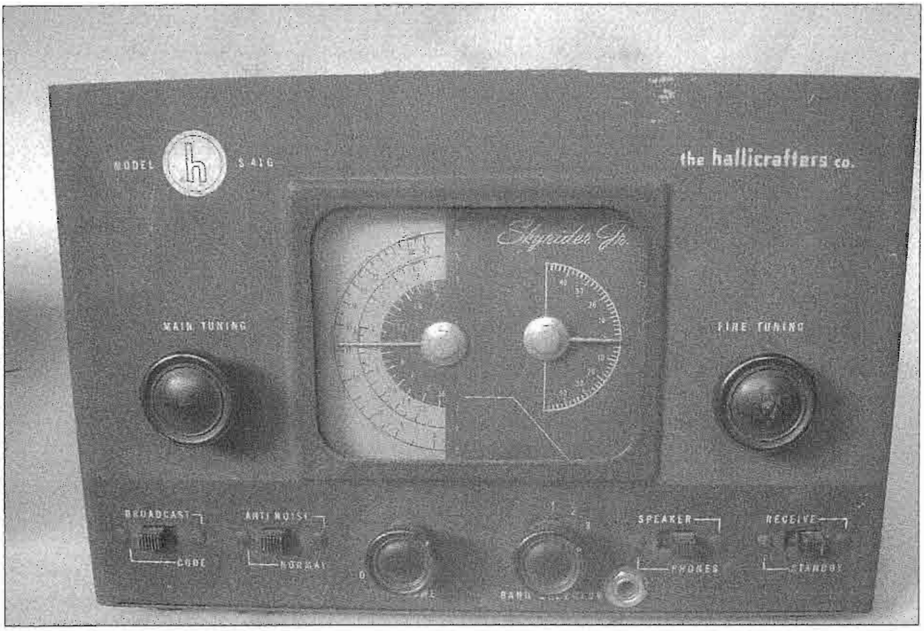


The early version of the S-41G "Skyrider Junior" has a bandspread dial that is calibrated from 0 to 100.

Main Tuning dial, and the Fine Tuning dial then tunes lower in frequency.

The "early" version with the bandspread tuning capacitor has fancy, red, slide-switches on the front panel for turning on the BFO, "Broadcast - Code," for the noise limiter, "Anti Noise – Normal," for Speaker – Phones, and for Receive – Standby. These switches became plain black in the cost-reduced model. They both have Main Tuning and Fine Tuning knobs, a Volume control with an AC switch, and a Band Selector control. On the back are tip jacks for phones, a three-screw terminal bar for antenna and ground, and a hole through which you can adjust the compression trimmer for BFO pitch. There is no BFO pitch knob on the front panel of the S-41G as there is on the upscale S-38. The chassis is hot, being connected to one side of the power line, but it is insulated from the metal cabinet by four rubber grommet mounts, two on each side. The back of the set is covered by a solid cardboard sheet with five vertical rows of horizontal vent slots, and the shafts of the volume control and band switch are not connected to the chassis but are rather at cabinet potential, so there should be no danger of getting a shock from this radio – unless the 0.25 mfd, 200 volt paper capacitor connecting the chassis to the cabinet becomes leaky. If you don't replace anything else in the S-41, it might be a good idea to at least trade this cap in for a new, more dependable part. Also, the phone jacks are isolated from the chassis, being connected only to the secondary of the audio output transformer; so you are not likely to get electrocuted while wearing your headphones.

Both receivers were in remarkably good shape as they came to me. I had only to replace the power supply filter capacitor, the dial cord driving the bandspread tuning slug, and the line cord in the slug-tuned radio and it was basically ready to go, needing only an alignment touch up. The capacitor-tuned radio was in work-



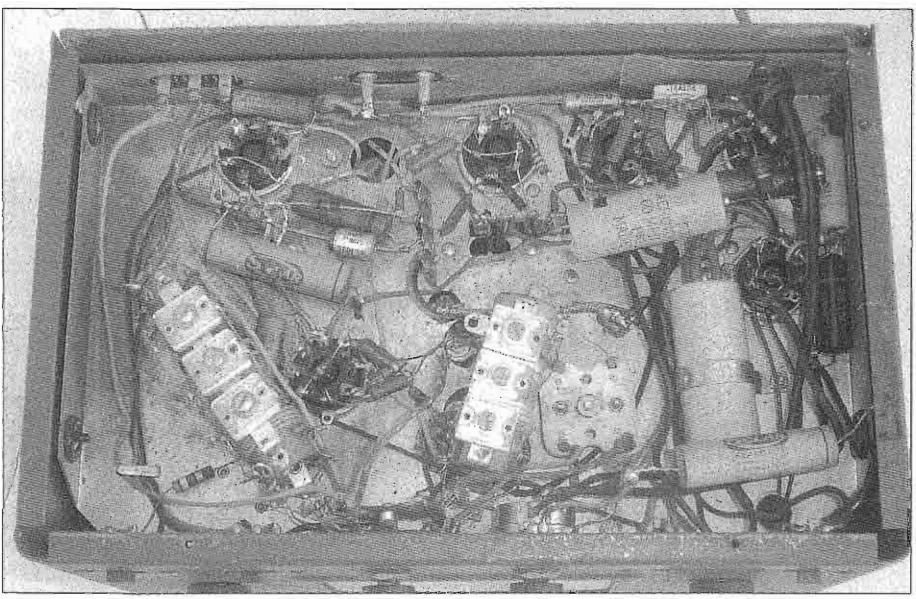
The later version of the S-41G has a bandspread dial calibrated from 50 to 0 to 50.

ing shape as it came; even its alignment was right on. If the original paper bypass capacitors were leaky and the carbon-comp resistors had drifted a bit in value, it didn't seem to make much difference in the way these sets worked - there aren't that many of them in there anyway. Interestingly, Hallicrafters continued to use the more expensive, molded plastic sockets for the tubes in these radios. Perhaps they bought them in bulk for all of their sets and it would not have saved them anything to use the "wafer" sockets common in the broadcast receivers of that day.

If you look under the chassis (and who can resist at least a peek) you will find that the S-41 looks almost identical to its earlier Echophone cousins and for that matter to the S-38. In particular, I'm impressed that all of the coils for the local oscillator are wound on the same single-cardboard coil form and likewise all of the coils for the mixer input. Hallicrafters didn't waste any money or space on separate coil forms or the hardware to mount them. At least all of the components and adjustments are easy to find and access. Servicing an S-41G is easy, not something that can be said for its larger Hallicrafters contemporaries like the SX-28A, SX-42 and SX-43.

On the air, in all honesty, the S-41 leaves a lot to be desired. It's not at all bad for listening to AM signals in the Ham and shortwave broadcast bands, but CW and SSB reception are another matter. Loud signals overwhelm the BFO. They tend to "capture" it and force it to oscillate on their frequency, yielding a bloopy note if they aren't too loud or no note at all if they completely capture it. There is no way to cut back the "RF gain" of the receiver, so there is no way short of playing outside of the set with the antenna coupling to copy loud signals with the BFO on. For CW work I actually prefer my National SW-3, a three tube regenerative receiver, to the S-41 because it has an RF amplifier with a vari-

The early version tuning capacitor has a separate, single-plate section for bandspread tuning. The later version provides bandspread via a tuning slug inside the oscillator coils.



Under the chassis, the S-41G looks a lot like an S-38. All of the oscillator and mixer coils are each on one coil form.

able gain control ahead of the detector. But back in my 80-meter novice days, a lot of the guys I talked to were running "11 watts to an over, overheated 6AG7," and they probably would have come in just fine on the S-41. Quite a few of them were running S-38's as I recall, not all that different from the S-41, and they certainly did make many contacts. But big guns like me with nearly 75 watts to a 6AG7/6146 rig would have smothered an S-41, I suspect.

So here I am 54 years later, still on the air with my HRO-50 and now with a pair of S-41G's. It just doesn't get much better than that!

Reference:

1 - "The Echophone EC-1," Hanlon, ER #146, July, 2001.

ER

[...Comments from page 1]

is the total years old of all receivers and transmitters used. Each receiver or transmitter must be used in a minimum of three QSO's to be counted in the multiplier. If the equipment is homebrew, count it as a minimum of 25 years old unless actual construction date or date of its construction article (in the case of a "reproduction") is older. Total QSO's all bands times RCVRs + XMTRs+ states/provinces/countries (total each band and mode separately; add totals together) times CX Multiplier: SCORE= QSO's x (RX +TX + QTH's) x CX Multiplier

Certificates and appropriate memorabilia are awarded every now and then for the highest score, the longest DX, exotic equipment, best excuses and other unusual achievements.

Send logs, comments, anecdotes, pictures, etc. to J.D. "Mac" Mac Aulay (WQ8U) at WQ8U@ARRL.NET or by U.S. mail to:
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ER

My Experiences with Negative Peak Limiters

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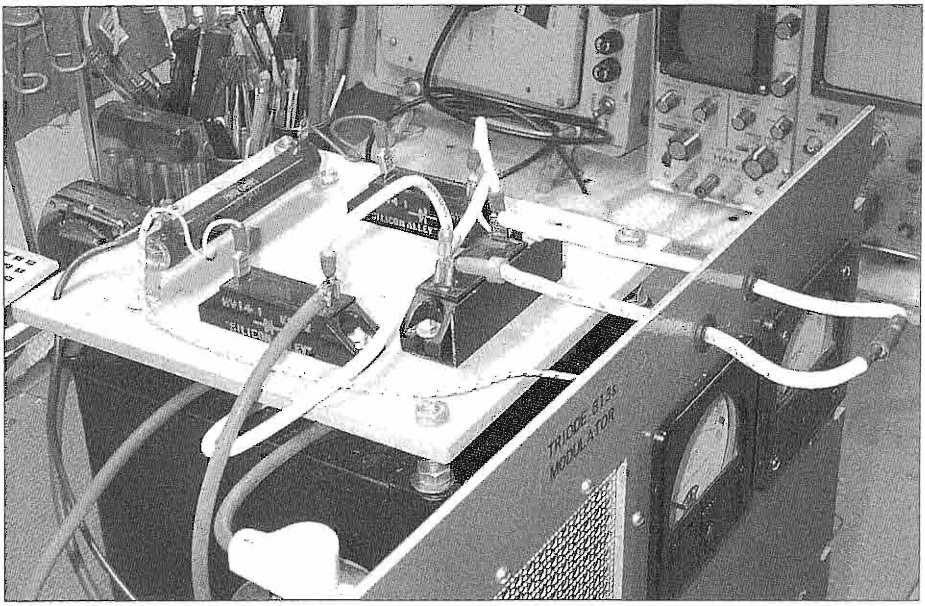
Over the past several years I have built and installed two versions of negative peak limiters. Both of the circuits were obtained from the AM Window web page. The first, titled "Three Diode Negative Peak Limiter" (NPL), uses three diodes, a tapped resistor, and is shown in **Figure 1**, page 10. I'm sorry to say that I don't know the author's name. The second, titled "An Improved Three Diode Negative Peak Limiter" (INPL), uses three diodes, a resistor and a keep-alive power supply. It was designed by Steve Cloutier (WA1QIX), and is shown in **Figure 2**, page 11.

I have to admit it took me awhile to figure out what Steve meant by a 'keep-alive' power supply, but I finally got his drift. I think I would have named it PA bias-offset power supply or maybe anti-PA cutoff power supply for clarification. The NPL circuit was installed into both a Ranger and a Valiant. The INPL circuit is installed in my homebrew 813 rig. In all cases, my main goals of limiting and controlling the negative modulation peaks to nearly 100% while protecting the modulation transformer by providing the necessary loading during limiting were met.

This article concentrates more on the INPL: its installation, its operation, and some "before" and "after" results obtained using a spectrum analyzer (SA). This is not to say I dislike the NPL design, but the INPL just offers more in my opinion. Writing this article has been delayed nearly a year because I didn't want to present my findings without supporting SA data. The year was spent in the procurement phase for the SA but that is a story for another time and place.

Now wait just a Rockville minute! You readers didn't think I was going to let you off the hook that easy did you? Now that I have the floor, I just have to say a "little" something about this past year. You have to admit that in every hobby, be it amateur radio, classic cars, or stamp collecting, there is something that you always wanted to obtain but for whatever reason you never did. It just so happens that Betty and I are also into classic cars and satisfied that passion 8 years ago with our beautiful '60 T-Bird cruiser. But, when it comes to this wonderful radio hobby, I've always wanted a dependable, calibrated spectrum analyzer. So, this being my 50th year in the hobby, I decided this was the time to take the plunge. Besides, I needed the SA to complete this article. To make a very long and unbelievable story short, I finally got what I wanted with the forth unit. In fact I've found so many uses for the SA that I've had success with putting together a 5th unit for the R&D Lab. There now, that wasn't too painful! Let's get back to this article.

In recent months there has been much said about the INPL circuit, but I've not seen any "hard" data to support either the pros or cons. My research on this topic took me back to an article in the October 1956 issue of QST. This article was titled "The Ultra Modulation System". This circuit is very similar to the NPL circuit that I mentioned, but instead of solid state devices, it uses 866 mercury vapor rectifier tubes. Its physical size was obviously large with these tubes and their filament transformer, plus a resistor that had to be one-half the rating of the audio output from the modu-



A top view of my 813 modulator deck shows the INPL components and the D2 switch that is discussed in the text.

lator. The author claimed that: "...Because there were no sharp breaks or bends in the wave form there would be no high-order harmonics of appreciable amplitude, hence the signal occupies no more spectrum space then one with normal modulation percentage." Does this statement still hold true with the INPL circuit? Well, read on and draw you own conclusions.

In the INPL circuit, Steve gives very good guidance for the selection of the three diodes, the resistor, and the keep-alive filter capacitor. Remember the filter capacitor; it's a very important key component. For the diodes, I took the simple path and installed 14kv rectifier blocks from Silicon Alley. In an e-mail I received from K2AW, Frank Fix stated that each block is comprised of multiple matched cells, each rated for 3 amperes and 1kv PIV with no internal equalizing resistors or bypass capacitors. He didn't mention how many cells were in each block, but you can bet it's fourteen or more in the 14kv blocks.

He further commented on how to test his rectifier blocks. Now here's where you can discard your DVM. You will need a period boat anchor Simpson 260 or Tripplett 630 VOM for these tests. The reason is that the meter voltage must be high enough to break down the series string of 14(+) diodes in the forward direction to get a reading. The forward reading will be about half scale on the 100K ohm range. The reverse reading will be infinity for a good block. An infinity reading in both directions means that you have an open block, and of course a zero reading means you have a shorted block. The VOMs mentioned have internal batteries, typically 22 volts, and will get the job done if placed on the 100K ohm range.

A look at the INPL circuit, **Figure 2** on page 11, shows a typical hookup and the actual values for my 813 rig. I've drawn in the AC current path using dotted lines when limiting action is occurring. You can see now why I said the keep-alive power supply filter plays a key role in the

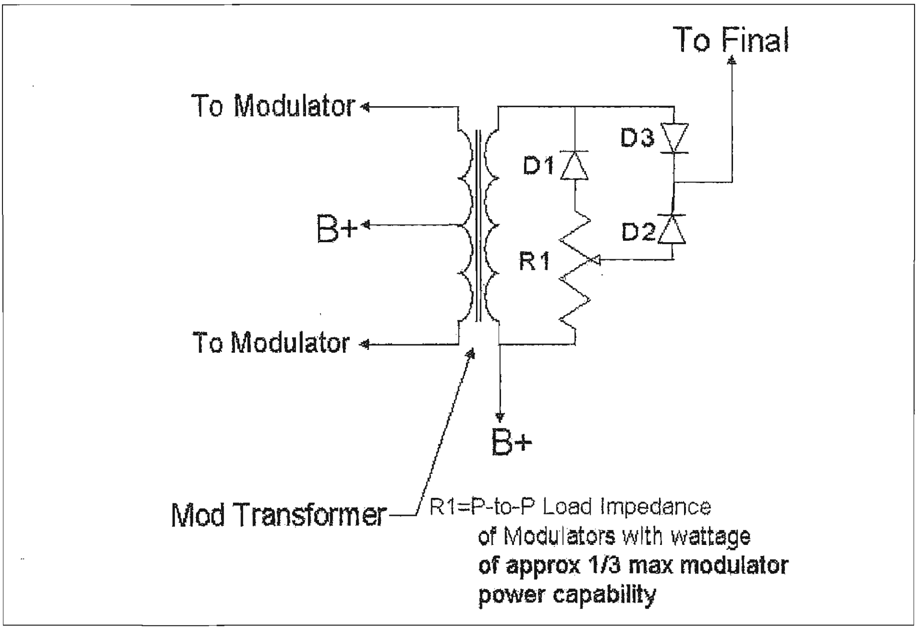


Figure 1: Three-diode Negative Peak Limiter

The Peak Inverse Ratings of D1, D2, and D3 should be 4 times the B+ voltage on the final amplifier. Adjust R1 to set the limiting level on the negative peak. You will need an oscilloscope to adjust this circuit for proper operation.

limiting operation. Of course, the HV-filter capacitor shares equal importance.

The following conditions exist when the rig is switched to transmit with no audio applied: The top of the modulation transformer will have +2kv DC. D1 will be reverse biased; hence no current will flow via D1 and R1. D2 will be forward biased, hence the PA will have +2kv DC. D3 will be reverse biased, and therefore no current will flow from the keep-alive supply.

The following conditions exist when the rig is modulated to 100% on the negative peaks: The top of the modulation transformer will have +2kv DC with superimposed negative peaks of approximately -2kv (near zero volts), and positive peaks of +4kv, assuming there are positive peaks of 100% in the RF modulation envelope. D1 will be forward biased when its cathode falls below the value of the keep-alive voltage, hence AC current will flow through D1, R1, C2, C1, and the modulation transformer secondary. D2 will be reversed biased, hence "opening" the path between the top of the mod transformer and PA. D3 is forward biased, hence keep-alive current flows and applies +200 volts to the PA, which offsets the -190 volts of grid bias and prevents the PA from cutting off.

So, the diodes effectively switch out the modulation transformer and switch in the load resistor R1 when the keep-alive voltage is greater than the voltage being produced at the top of the modulation transformer secondary.

The negative peak amplitude is controlled by the level of keep-alive voltage. In my case, I have the PA deep into Class-C operation. You can see that I'm using a Variac to control this voltage. This can be a fixed voltage, but using the Variac allows for some experimentation. It is usually set for a keep-alive DC out-

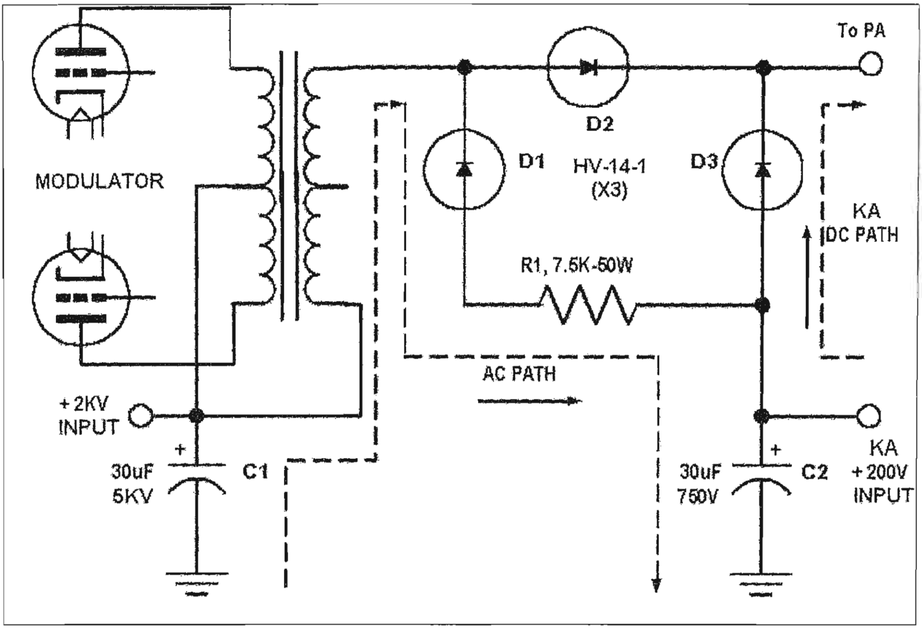


Figure 2: An improved negative peak limiter showing the AC current path that occurs during limiting action.

put of +200 volts. Varying the keep-alive voltage will change the width of the base line as shown in the photos.

The keep-alive power supply voltage may exhibit a "charging" phenomenon. In the standby condition, my 813 rig has zero HV on both the PA and modulators. The keep-alive voltage can be read at this time on my HV meter since the two voltage sources are in parallel. When the rig is switched to transmit, the keep-alive voltage would increase about 40 volts, to 240 VDC. Steve attributed this to the +2kv charging back through D3's leakage to the keep-alive supply. The cure for this was to increase the bleeder resistor on the keep-alive supply. Ideally the keep-alive voltage should remain constant. I ended up with a 4k-ohm, 10-watt bleeder to meet this requirement. Very little current is used by the PA during limiting, so the 85mA transformer worked well supporting the relatively high bleeder current.

Fabrication of the INPL circuit can be seen in the photo on page 9. A piece of 5/8" insulating board was used as the base and mounted to the inverted Kenyon 600-watt modulation transformer. Viewing the board from the top shows the four main components in a layout that matches the circuit diagram. For added insurance, black painted right-angle aluminum was used for heat dissipation and was mounted under each diode block. HV wiring rated at 25kv was used in necessary areas. Of special note are the two HV wires passing through grommets in the front panel.

When I built the home brew 813 rig I hadn't planned for the installation of the INPL. So now that it (the rig) has been in service for almost two years, and the INPL installed for one year, I needed to have the means (switches) to present the "before" INPL circuit characteristics. I did give some thought to just presenting results for the "after" INPL installation but I (for one) would always wonder was there any difference, and for sure I would

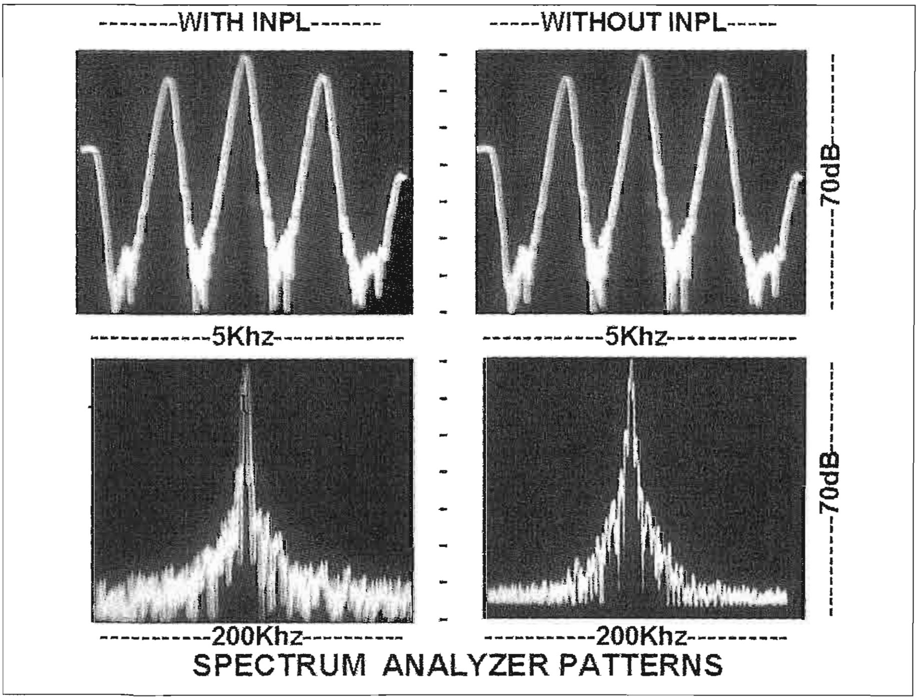


Figure 3: Spectrum Analyzer composite patterns at 5 kHz and 200 kHz scan widths.

get a flood of e-mail from ER readers asking the same question.

To provide for the "before" INPL installation I had to install two switches. The easy one was a front panel toggle switch. The INPL diagram doesn't show this switch, but it is placed in series with the ground side of C2. With this switch in the open position, the AC path for D1-R1 is disabled. The second "switch" is the pair of HV wires passing through the panel previously talked about. I had considered other means, such as a HV vacuum switch, but nothing that fancy was required for this temporary test.

Therefore, the easiest and safest method was two HV wires each connected to one side of D2. Soldered to the D2 connections are two pin jacks. The HV wire ends were stripped, solder coated, and then slipped into the pin jacks. When all testing is completed, all I have to do is pull the HV wires from the panel. This will leave only the small grommets. I used barrel connectors on the ends of the wires. Once the HV wires are connected, C2 opened, and the keep-alive set to 0 VDC, the modulator acts like the INPL isn't there. All I had to do was be mindful of the +2kv protruding out the front panel!

The SA Patterns (waveforms) shown above in **Figure 3** are a wealth of information about my particular transmitter and how it responds to a 1kHz audio input to the modulator. Looking at the first set, shown with 5 and 200 kHz total scan widths, shows the differences with and without the INPL. The top two photos show three main peaks. The center peak is the RF carrier at 7290 kHz. The peaks on either side are the USB and LSB peaks of the audio fundamental at 1 kHz. They are spaced two divisions from the center and each division is 0.5 kHz. These side band peaks are 6db below the carrier

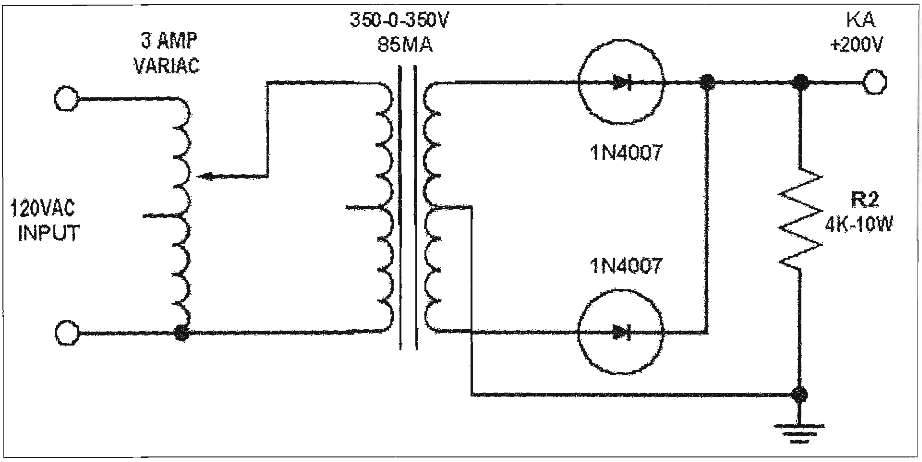


Figure 4: The Variac-controlled, keep-alive power supply.

and this represents 100% modulation. I chose to use a single tone, instead of multiple tones or voice, so the reader could clearly see the waveforms. The vertical axis is 7 divisions high and 10 dB per division.

The bottom two waveforms at 200 kHz total scan width show differences between the "with" and "without" INPL circuit. There is definitely an increase in activity between -50 dB to -70dB when the INPL is in the circuit. The RF carrier is shown as the single peak in the center. Now we can say the INPL circuit does generate artifacts on the RF carrier, and we know that these are well below the carrier peak. We also can see there are no unwanted transients extending 100 kHz from either side of the carrier.

The RF modulation envelope patterns, Figure 5 on page 14, also show much information, as everyone knows. The very familiar waveforms showing the 100% modulation were taken with the scope's vertical gain set to 0.5 volts per division. I set the input audio level so it would be just on the high side of 100% negative as shown in the upper right photo. Below that photo is the same waveform expanded to 50 millivolts per division on the vertical axis. In the center of that photo you see a base line that is often called "flat-line" for over-100% negative peak modulation when the PA is in cutoff.

Now compare these waveforms to the two on the left with INPL. Note the audio input level was left unchanged. You will notice a very nice rounded valley on the negative peaks in the upper waveform and the "flat-line" has now widened to 150mV of vertical deflection in the lower waveform showing the PA is not in cutoff.

The 150mV is variable and can be controlled by the keep-alive (KA) power supply Variac. Now we know the PA does not go into cutoff when 100% negative is exceeded. Instead, what is shown is hard limiting action, and the PA is kept alive by the KA power supply, **Figure 4,** above. Also, as previously pointed out, the secondary of the modulation transformer is loaded with R1 when the PA is under the influence of the keep-alive power supply.

The last test performed was the harmonic distortion test. The SA was set for a total scan width of 10 kHz to show the USB and LSB fundamentals and harmonics. For this test, I used the same RF carrier and audio input frequencies. This test is a measure of how far the audio harmonic peaks are down from the audio

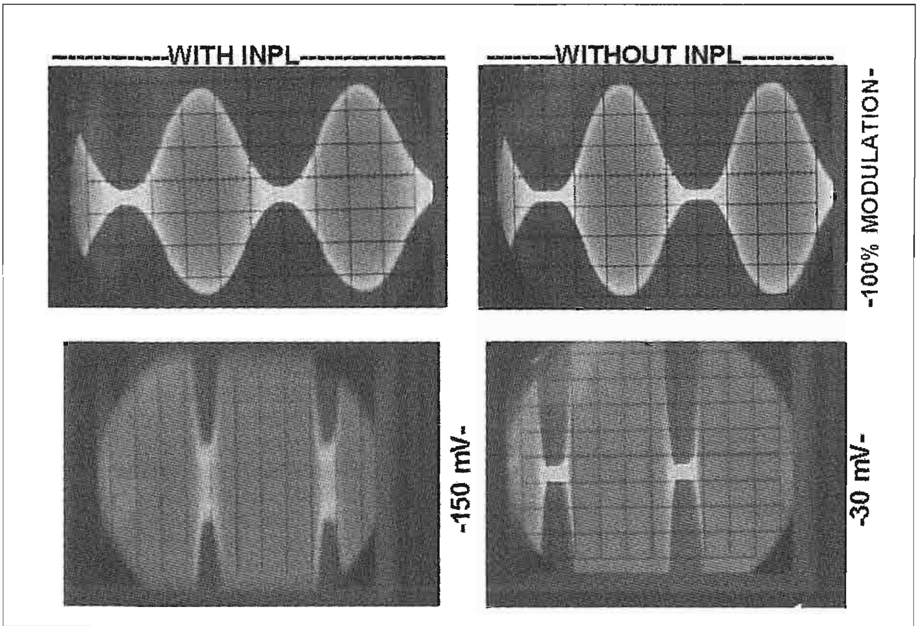


Figure 5: RF Modulation Envelope Patterns.

fundamental peaks. Looking at these two waveforms, **Figure 6,** page 15, you will see eight peaks.

The highest one in the center is again the RF carrier. The two on either side (USB and LSB) are the fundamentals of the 1 kHz audio input. Of the remaining five, the three on the left are the first, second and third harmonics of the LSB audio. The two remaining peaks on the right are the first and second harmonics of the USB audio. The calculation for total harmonic distortion for all sidebands would not be accurate in this particular case because the difference in paired harmonic peaks is more than a few dB in some cases. The rough estimate would be THD = 8%. The calculation is simple but showing it adds no benefit to this text. The main point is that the all peaks remained the same with or without the INPL installed. The waveforms weren't exactly centered on the CRT, which accounts for the odd number of harmonics shown.

dB DOWN	MODULATION IN %
6	100
7	85
8	80
9	70
10	65
11	55
12	50

Sideband level vs. modulation percentage

For those interested in test equipment, the spectrum analyzer used for these tests is the HP-141T with the 8552B and 8553B plug-ins. This isn't a modern digital analyzer, but is a lab quality instrument available at affordable Ham prices. For price comparisons, you could buy a pristine R-390A for about the same money. The instrument could be considered from the post-boat anchor period since it is vintage '70s.

Of the first three units I had pass through this QTH, two were 141Ts and one an 8557A with the 182TR display. I could write a book about all the problems

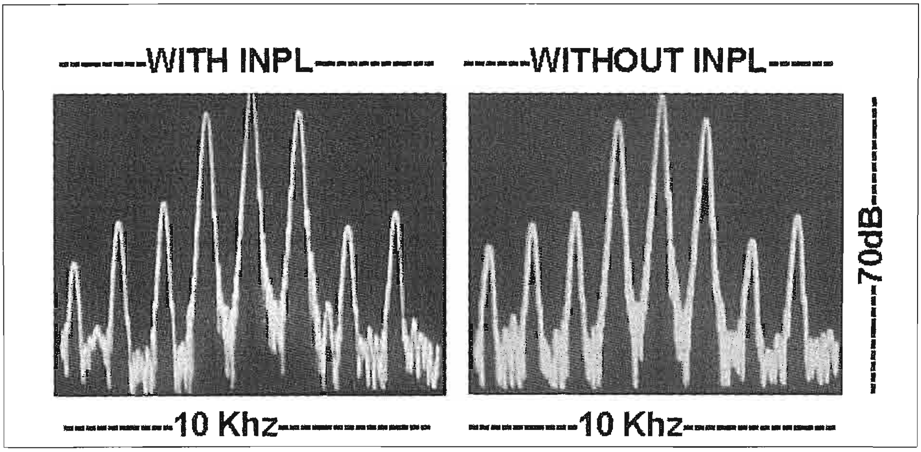


Figure 6: Spectrum analyzer patterns for the harmonic distortion test.

dB DOWN	DISTORTION IN %
10	30
20	10
30	3
40	1
50	0.3
60	0.1

Percent of harmonic distortion shown as a function of sideband levels.

encountered in these units. The forth unit, the 141T used for these tests, was essentially plug-and-play, needing only calibration. My most recent 141T was also plug-and-play, and the mainframe still had the original plastic wrap in place. It came with the HP manual (very rare), the warranty card (!), and the power cord was still wrapped and tagged. Now how lucky can a fellow get?

One very nice and necessary feature of the HP-141T is its CRT storage feature. Without this feature, it would be extremely difficult, if not impossible, to capture the waveforms presented. This is because slow scan times were required to insure maximum charging of the resolution bandwidth filter.

Many thanks are extended to Steve Cloutier (WA1QIX) for being so helpful by answering many e-mails, and for giving me the "green light" to proceed with the article. It's hard to believe that such a simple circuit comprised of just a few components could generate so many questions.

Selected References:

1. "Spectrum Analyzer Fundamentals" Tektronix, 1989, No. 26W-7037-1.

2. "Radio Handbook", Fifteenth Addition, 1959, Editors and Engineers Ltd.

3. "The Ultra Modulation System", QST, October 1956, by Ollie J. Allen W4FHF

ER

What About Old Doc Loomis?

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Regardless of what you may have heard or read on the Internet or other places, an American dentist, by the name of Dr. Mahlon Loomis, was the first person in the world to set up a radio transmitting and receiving system that worked.

In 1865 and 1866, which was nine years before Willie Marconi was even born, (but who studied Loomis's writings) old Doc Loomis and his helpers set up a couple of transmitting and receiving stations on the top of two hills in Virginia. Some say they were 14 miles apart, and some say they were 18 miles apart. Whichever, from these two points they flew kites having wire "strings" a few hundred feet long which were also connected to a thin copper mesh on the face of the kites. They used a metal sheet immersed in a pool of water to make a good electrical connection to the earth, or to "ground" in modern terms. He picked high mountain peaks because he believed there was a "static sea" in the air above the earth's surface all around the world, and that he would be able to charge a wire better the higher it was into this static electric air sea.

If his kite wire is connected to 'ground', it will continually be picking up electrostatic voltages by collecting free electrons out of the atmosphere. The electrons will continually be discharging into the ground as a one-way or direct current (dc). If there is a sensitive dc galvanometer, which is a center-reading dc milliammeter, between the near end of the kite wire and the ground connection, the meter will constantly indicate very weak electron currents flowing through it. Each of the two Loomis kites had galvanometers between their kite wires and their ground connections. **Figure 1** shows the various components that made up each of his hill top stations.

There are two very interesting features about long ungrounded wires up in the air, such as kites with copper strings. The first is that small electrostatic negative-electron voltage charges may constantly be picked up on such wires. They can keep adding charges until they can develop several hundred to several thousand volts of electrical pressure on the wires. If such a wire is suddenly connected to ground the high voltage is discharged and drives a significant electron current into the ground. The second interesting thing is that this dc current flowing into the ground produces an alternating current in the kite wire. The first strong dc current to ground can be thought of as overly depleting the kite wire of its electrons. To make up for this over-depletion of electrons a weaker electron flow moves back up the wire again, negatively charging the wire once more, but to a considerably lesser voltage value. This produces a much weaker electron flow back down to ground again. This ever-decreasing alternating current flow is known as a "damped wave-train." The better the wire is at conducting current (the higher its "Q" or quality of the wire) and the better the ground connection, the larger the number of ac wave-train cycles that may be produced in the wire. So, grounding a charged kite wire will produce an ac wave-train of several cycles in the kite wire at a frequency determined by the length of the kite wire. The longer the wire the longer it takes for electrons to get to the end and start back and the lower the ac frequency of the ac

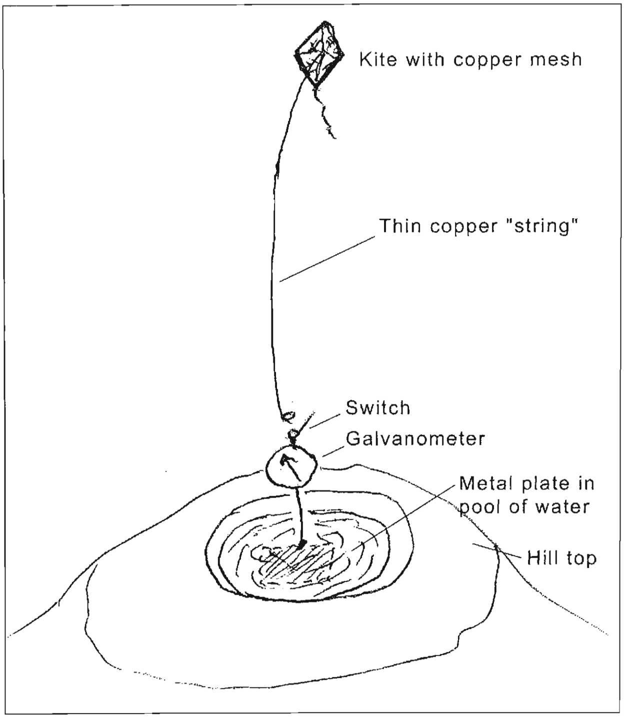

Figure 1: The Loomis radio system components of 1865-1866.

his switch and produced an ac wave-train in his kite wire, which was now acting as an antenna wire. The ac wave-train that was developed produced an alternating electromagnetic ac field around his antenna wire. This field radiated outward in all directions at the speed of light, 186,000 miles/second. We now call this a radio wave. The radio wave crossed the kite wire on the other distant hill and induced the same frequency wave-train ac in this wire, although much weaker of course. The first half cycle of the received wave-train, being relatively strong made the galvanometer at the receiving end give a significant pulse indication. *This was the world's first wireless or radio transmission!*

wave-train.

Incidentally, don't ever touch a long ungrounded antenna wire. You may be shockingly surprised to say the least. However, if the air is too humid such a wire may not pick up much voltage, which was one of the difficulties of the Loomis method of sending and receiving. Some days the wires did not charge adequately. If he had been able to pick up some monetary backing, he might have solved this difficulty and maybe even have come up with a "spark" type transmitter like those that were developed in the early 1900s. These also used radio frequency (RF) ac wave-trains and also depended on the antenna length to set the transmitting frequency.

OK. One fine day old Doc Loomis had his two kites flying. He had his high voltage switch open between his kite wire and his ground connection so his kite wire charged up nicely. He closed

Loomis believed that he was producing an electrical conductor in the air with a return circuit through the ground. He did not know that he was actually producing only electromagnetic lines of force that moved through the air from his transmitter to a receiver. Today we know what he was really doing. No matter what he thought was happening, what he did produced a complete radio transmitter and receiver system.

At the receiving station when his helpers opened their ground connection switch, their antenna immediately charged up. When their switch was then closed they radiated an electromagnetic wave-train and the galvanometer at Doc Loomis's end indicated a return pulse. True, these were just single dots of information, but the letters of the Morse code in use at that time were made up of essentially only differently spaced clicks. So he now had a way to communicate through the air over considerable distances by sending coded letters, words and messages, and old Doc Loomis did just that in the months and years that followed. While testing with the U.S. Navy, he transmitted messages between two ships separated approximately two miles apart on Chesapeake Bay. He had great hopes of eventually communicating from the U.S.A to Japan. Because he was unable to get the proper backing, due to all of the scoffers in the U.S. Congress at the idea of anyone being able to send information over the air without interconnecting wires, had to be crazy, he never had the chance to try to attain his goal. We wonder if the Congress has changed much over these many years.

If the galvanometer was replaced by a sensitive electrical buzzer, a received pulse signal could produce an audible short buzzing sound. And a sensitive telegraph sounder would produce a click-click sound. One difficulty in the Loomis method of radio communicating was the speed at which the signals could be sent. It takes time for an ungrounded antenna wire to charge up to usable voltages, limiting the number of signals that could be produced in a short time.

This discussion has inferred that the kite wires only picked up electrons from the atmosphere to charge the kite wires negatively. Kite wires might also lose electrons to the atmosphere and would then become positively charged. In such a case, when the kite wire was grounded, electrons would rush up the kite wire from the ground, and again producing an RF ac wave-train. (The earth is so large that it can give up any number of electrons or can absorb any number of them.) The polarity of charge of an ungrounded kite wire is essentially determined by the polarity of the bottom of any clouds that happen to be over it at the time. A cloud may be negative at its bottom and positive at its top, or the reverse. If it were positive at its bottom, it would attract free electrons from a kite wire, charging the wire positively, and the galvanometer would move off of its center position in one direction. Conversely, if the bottom of a cloud was negative the kite wire would pick up negative electrons from the atmosphere, become negatively charged and the galvanometer would move off center in the opposite direction.

When we look back at everything that Dr. Loomis actually accomplished in his simple experimenting it is really amazing. He sent and received the world's first "wireless" signal (meaning no interconnecting wires between the transmitter and receiver sites), or what we now would call a "radio" signal. He produced the first antenna wires, although his daughter said he called them "aerial" wires, a term that was used well up into the 20th century. He used two equal length antenna wires that enabled them to resonate close to the same frequency (although he may not have known this, unless he experimented with different length receiving antenna wires and found that a much shorter or much longer such antenna wire would produce weaker received signals). His lengthy "quarter-wavelength" (which he did not know), "top loaded" (another first) antennas would have been transmitting at what we now call medium radio frequencies (MF, or 300-3000 kHz ac), which he could not know at that time. Later he used vertical metal poles on ships or in other experiments. Because these were shorter, they produced higher frequency ac wave-trains. This would produce what we now call high radio frequencies (HF, or 3000-30,000 kHz ac). Doc Loomis probably also learned not to touch his antenna wire when it was not grounded, although nothing seems to have come down anywhere about such a happening. In any case, let's all tip our hats to Dr. Mahlon Loomis for all of his very important pioneering radio work.

ER

How To Pair Up Rigs at the Mere Flip of a Switch...Or Two!

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It is one thing to have a shack full of classic "boatanchors" and yet another to keep them all on the air regularly. When the "boatanchor" bug bit me back in the early '90s and I started acquiring all those rigs I had lusted over as a new ham back in 1957, the problem was how to pair them up.

Actually, I didn't want to pair them up. I wanted to be able to use any combination of receiver and transmitter. So I came up with a simple switching system shown in **Figure 1**.

To keep the system as simple as possible, some concessions needed to be made. Since some transmitters may not have PTT capability, I decided the easiest way to handle the switching was a "Master T-R" operating switch thrown manually. Each transmitter may be keyed either manually or with a dedicated PTT microphone so it becomes a two switch operation. **Figure 2** shows the master switch box containing a large 120 volt

W7JHS was licensed as WN7JHS in June, 1957, and has been active in various aspects of the hobby. His current passion is vintage AM operation on 3870 and 7290 kc.

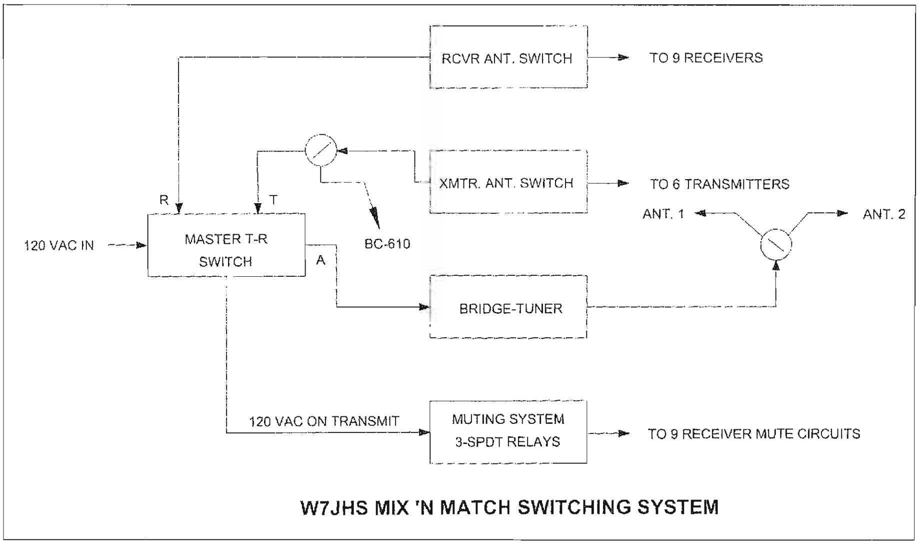

Figure 1: The W7JHS simple rig switching system.

Figure 2: The master T/R switch box.

open frame relay with auxiliary contacts that key the master muting system.

The current version of the W7JHS Mix 'n' Match Switching System allows any combination of up to nine receivers and seven transmitters to be operated at will. All receiver mute lines are keyed simultaneously through a paralleled set of three 3PDT – 120 volt relays. Each set of contacts is brought out to a terminal strip and provides both NO and NC contact options to accommodate a given receivers requirements. This allows multiple receivers to be turned on and selectable for comparative testing, etc. The box containing the muting relays is shown mounted on the back wall of the operating position in **Figure 3**.

A close look at top of the main switch assembly in **Figure 4** shows a switch for selecting two different antennas. This could easily be a four position switch or more depending on your antenna requirements.

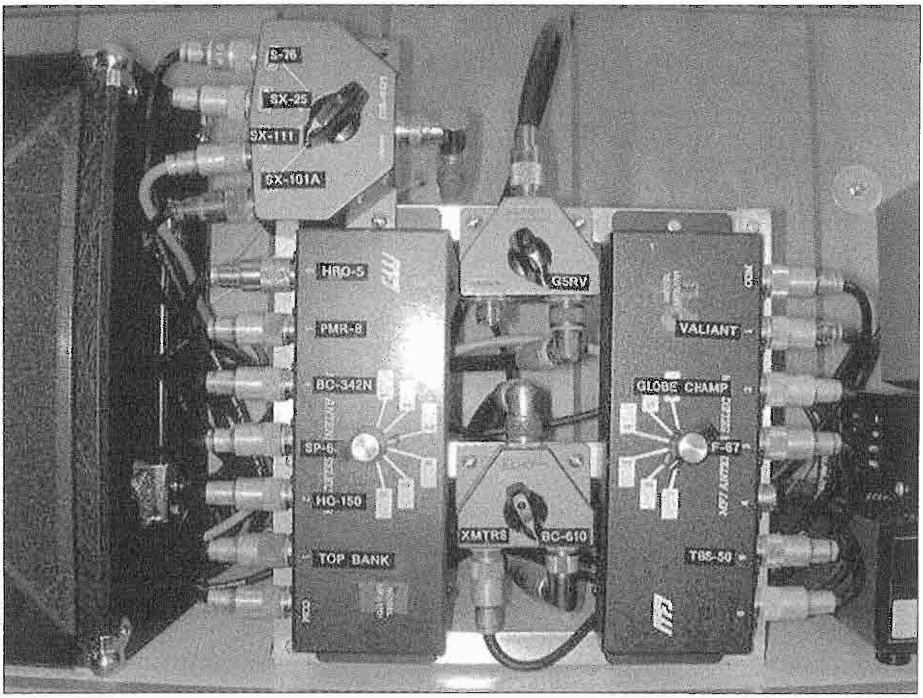

Figure 4: This is the main switching assembly. The center, top two-position switch selects the antenna system, and may be adapted for other antenna requirements.

The nine receiver antennas are switched by the two ganged switches on the left of the main assembly while transmitter switching is on the right side. Note the BC-610 uses RG-8 and required an additional switch since the six position switch was fully used at one time.

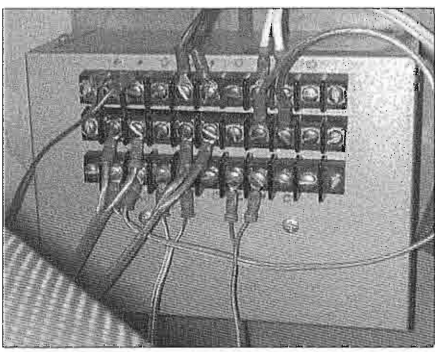

Figure 3: The minibox that holds the muting relays is mounted on a back wall of the operating position.

It looks like a plumber's nightmare but works very effectively and allows all the rigs to be exercised regularly and, of course, in any combination. Now my nine receivers and four transmitters currently online becomes 36 different "pairs" at the flip of two switches without having to move TR relays and coax cables.

ER

A 100% Solid-State-Free Experimenter's Power Supply

The Only Silicon is in the Glass Tube Envelopes

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Once upon a time, many (forty) years ago, transistors were still somewhat novel, circuit boards were slowly replacing point-to-point wiring, every drug store had a tube tester, and my Novice license was waiting in the mailbox. Now, after years of engineering, writing reams of DSP code, and soldering surface-mount components to circuit boards, I got the bright idea that revisiting the hairy-chested parts and techniques I used back then would be rejuvenating. The result of my electronic anthropology is presented here: an all-GlAsFET [glass FET!] power supply that produces a variety of high voltages to accommodate most experimenters' needs. Since there are many components that you won't find on the shelf, I'll discuss obtaining antique parts and the concepts behind the design, so you can adapt it to your situation. Return with us now to those thrill-

His Master's Power Supply

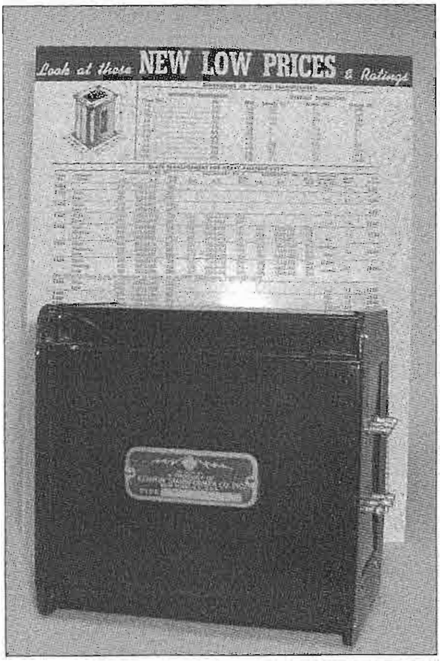


Figure 1: The Kenyon plate transformer that is the basis of my power supply.

ing days of yesteryear.

The Lone Ranger Rides Again!

The Lone Ranger was a new radio show when my Kenyon Type No. T-655 Plate Transformer was wound (**Figure 1**). The associated advertisement shows that it steps up the line voltage eight or ten times, as selected by a tap on the primary, and can deliver 325 mA ICAS (Intermediate Commercial or Amateur Service). It cost someone $4.80, equal to $65 in today's dollars, although I bought it at a flea market for $24.

When building my first circuits, I was puzzled that a transformer's AC output voltage would read properly on my meter, but once rectified and filtered, the DC voltage would be much higher than I expected. I eventually learned that AC RMS (Root Mean Squared, but let's side-step the calculus) voltage refers to the ability to heat a resistor. Look at **Figure 2** [page 24]: if we connect a source of DC across a resistive load (A), it will dissipate power according to the equation $V^2/R = P$; for example, one volt across one ohm will produce $1\ v^2/1$ ohm = 1 watt of heat (B). At (D), we have a transformer producing sinusoidal power peaks of two watts, or an *average* power of one watt; to see this, imagine cutting off the tops of the mountains so that they fit perfectly in the valleys as shown, producing the same line as in (B). Since the previous equation can be rearranged as $\sqrt{PR} = V$, the AC voltage in (C) must have a peak of $\sqrt{2}$ volts, yet we say that the transformer produces *one* volt, with the understanding that equivalent heating and sine waves are involved. (If another wave shape is used, the relationship goes out the window, and we must grind through the math or dig up a True-RMS meter to do the work for us.) Anyway, the solution to the puzzle is that AC meters read RMS, but a rectifier / filter produces a *peak* value.

So, using my center-tapped Kenyon transformer in the so-called "economy" power supply topology with a capacitor-input filter (**Figure 3** [page 24], with L1 and L2 shorted) should produce two voltages, 800 VDC and 1600 VDC. However, when a load is applied, the output voltage sags as shown in the upper curve of **Figure 4** (after Terman[5]) [page 25]. A choke-input filter would provide better voltage regulation while utilizing the transformer and rectifier better, since a higher average load current can be drawn for a given peak current. With a choke, the output voltage begins to drop again, but once enough current is drawn, it levels out as shown in **Figure 4's** lower curve; for the usual 120-Hz ripple, this occurs when $I = E / 1130L$.[6] Some of this minimum current can be drawn by a bleeder resistor across the filter capacitor (always put a conservative-wattage resistor of about 100 ohm/ volt across every electrolytic); the rest can be drawn by the actual load or, if regulation is very important, by a load resistor.

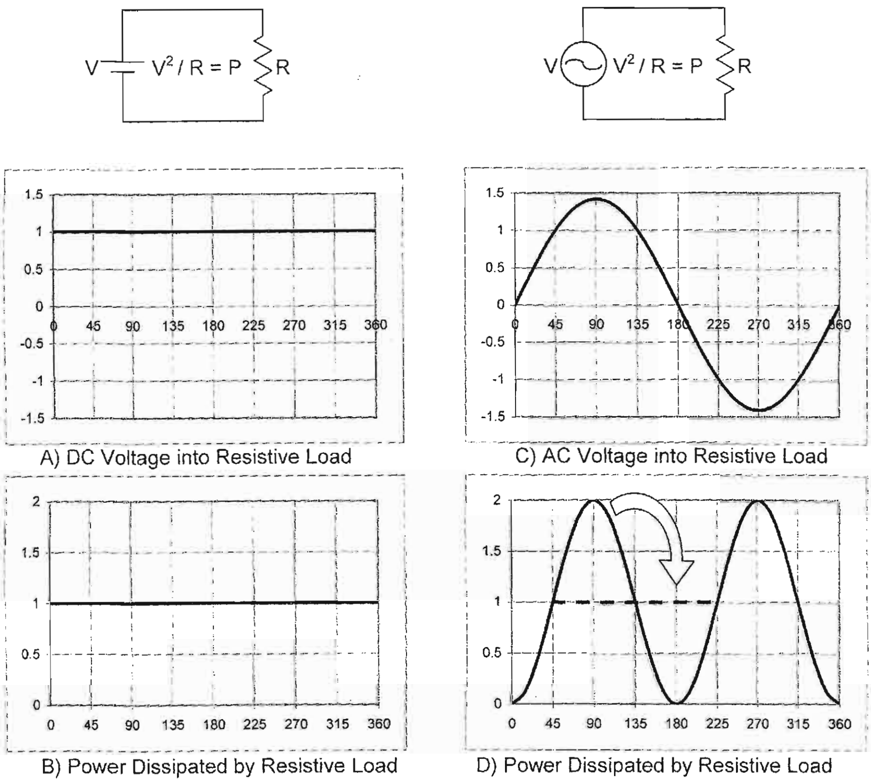


Figure 2 – The Meaning of "Volts AC"

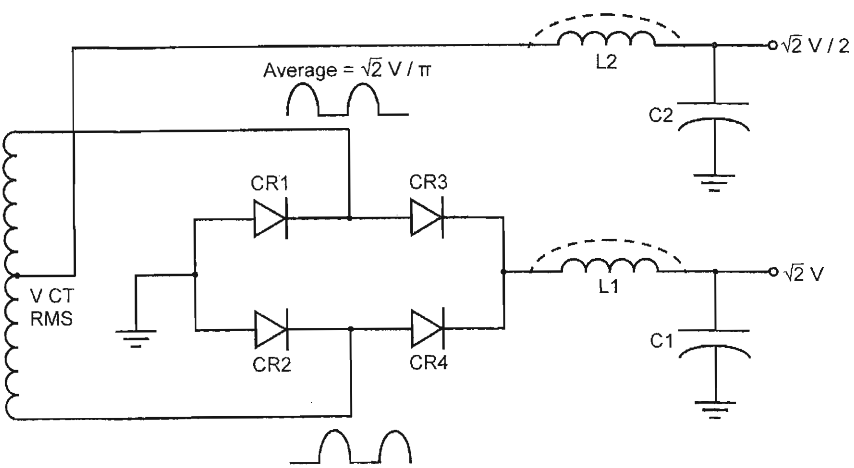


Figure 3 – The "Economy" Power Supply

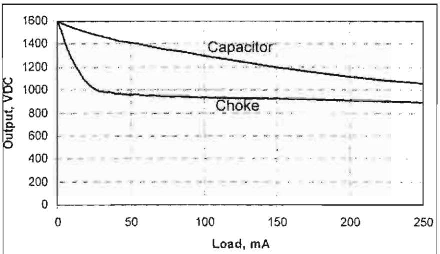
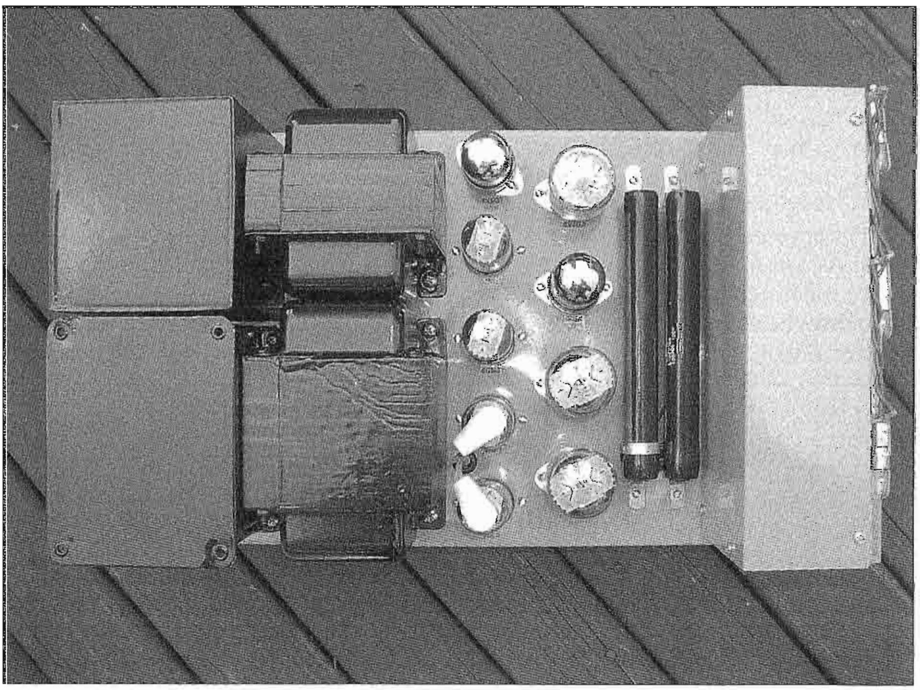


Figure 4 – Capacitor-Input Filter vs. Choke-Input Filter

Using tube rectifiers leapt naturally to my mind, their main disadvantage being the filaments, which require another transformer. I came across a Freed 21650, which has hefty heater windings as well as a 375-VCT, 90-mA winding that was likely meant for a bias supply. It has two 2.5-V, 10-A windings that were probably intended for a pair of mercury-vapor rectifiers like 816's or 866's, but since such gas tubes can be finicky, I decided to investigate what high-vacuum rectifiers could do.

I was surprised to find how readily tubes are available on-line [the Internet], and are often less expensive than the matching sockets! (For tube data, try tdsl.duncanamps.com.) I ordered a few different rectifiers, including the venerable 5U4GT, and began to experiment with them, soon discovering that those using the filament itself as the cathode have higher internal resistance, meaning that as current is drawn, more of the hard-won voltage is lost inside the tube (chokes have resistance losses, too). After that, I bought only indirectly-heated cathode tubes (seeing all of those tube cartons on my work bench made me feel like I'd just returned from a bicycle trip to the drug store). The results of my efforts are given in **Table 1** [page 26], which should prove useful in choosing the appropriate rectifiers for your requirements.

Speaking of sockets, these come in a



This is a top view of the power supply with its top removed.

Table 1 – High Vacuum Rectifiers

TYPE	BASE	HEATER	PIV	CURRENT	DROP @ CURRENT
5BC3	novar	5 V @ 3 A filament	1700 V	380 mA*	50 V @ 275 mA / plate
5U4GT	octal	5 V @ 3 A filament	1550 V	350 mA*	50 V @ 275 ma / plate
5V4GA	octal	5 V @ 2 A	1400 V	175 mA*	25 V @ 175 mA / plate
5Y3GT	octal	5 V @ 2 A filament	1400 V	160 mA*	50 V @ 125 mA / plate
6CG3	duodecar	6.3 V @ 1.8 A	5000 V	350 mA	25 V @ 700 mA
6CJ3	novar	6.3 V @ 1.8 A	5500 V	350 mA	25 V @ 700 mA
6CK3	novar	6.3 V @ 1.2 A	5200 V	250 mA	16 V @ 350 mA
6CL3	novar	6.3 V @ 1.2 A	5500 V	250 mA	16 V @ 350 mA
6CM3	novar	6.3 V @ 2.4 A	5500 V	400 mA	10 V @ 350 mA
6DE4	octal	6.3 V @ 1.6 A	5500 V	180 mA	34 V @ 350 mA
6DK3	novar w/cap	6.3 V @ 1.8 A	6500 V	400 mA	25 V @ 800 mA
6DL3	novar w/cap	6.3 V @ 2.3 A "dark"	6500 V	400 mA	25 V @ 800 mA
6DN3	novar	6.3 V @ 2.4 A	5500 V	350 mA	14 V @ 350 mA
6DQ3	duodecar	6.3 V @ 1.8 A	6500 V	400 mA	25 V @ 800 mA
6DQ3A	duodecar	6.3 V @ 1.8 A	6500 V	450 mA	27 V @ 900 mA
6DW4	novar	6.3 V @ 1.2 A	5000 V	250 mA	25 V @ 350 mA
6X4	7-pin min.	6.3 V @ 0.6 A	1250 V	70 mA*	20 V @ 70 mA / plate
6X5GT	octal	6.3 V @ 0.6 A	1250 V	70 mA*	20 V @ 70 mA / plate

Notes: All rectifiers have indirectly-heated cathodes unless noted as "filament"
Choke-input filters; for capacitor-input filters, derate according to tube data sheet
* = Two plates (total current for both plates)

wide and ill-named variety: try plugging a noval tube into a novar socket, or a neonoval, or a magnoval, etc. **Table 2** [below] should help you sort out your tube's base style.

Who Was That Masked Ham?

Engineering realities can lead to interesting domino effects: I planned on 6CM3's because of their low drop in the 350-mA current range I would be using, but immediately ran into another filament drawback: the maximum cathode-heater voltage. This wasn't a problem for CR1 and CR2, since they could support 900-V average, or half-sine pulses from a 2-kV transformer, as shown in **Figure 3** However, the cathodes of CR3 and CR4 will see the DC output voltage, and this limit would be exceeded. The solution is to float the heaters at the cathode voltage, which requires another heater winding. I had only 5-V windings available; unfortunately, most 5-V heater tubes have filament cathodes. Now what? Running filaments at less than rated voltage is usually a poor idea, but RCA manufac-

Table 2 – Tube Base Dimensions

BASE	BASE DIA.	PIN CIR. DIA.	PIN DIA.	PIN LENGTH
octal (8 pin)	1.29 (32.8)	0.69 (17.5)	0.09 (2.36)	0.44 (11.11)
7-pin miniature	0.75 (19.1)	0.38 (9.53)	0.04 (1.02)	0.28 (7.14)
9-pin miniature (noval)	0.88 (22.2)	0.47 (11.9)	0.04 (1.02)	0.28 (7.14)
novar (E9-75/89) (9 pin)	1.19 (30.2)	0.69 (17.5)	0.04 (1.02)	0.38 (9.65)
novar (E9-76/88) (9 pin)	1.56 (39.7)	0.69 (17.5)	0.04 (1.02)	0.38 (9.65)
neonoval (9 pin)	1.19 (30.2)	0.47 (11.9)	0.04 (1.02)	0.31 (7.94)
magnoval (9 pin)	1.07 to 1.56 (27 to 40)	0.69 (17.5)	0.05 (1.27)	0.34 (8.73)
duodecar (E12-70)(12 pin)	1.19 (30.2)	0.75 (19.1)	0.04 (1.02)	0.33 (8.25)
duodecar (E12-74)(12 pin)	1.56 (39.7)	0.75 (19.1)	0.04 (1.02)	0.33 (8.25)

Note: Dimensions are in inches and (millimeters)

Table 3 – On Line Resources

Action Electronics	actionelectronics.com	panel meters
Angela Instruments	angela.com	Hammond parts
Antique Electronic Supply	tubesandmore.com	misc. components
Chief Aircraft Inc.	chiefaircraft.com	chemical supplies
Industrial Electronic Engineers	ieeinc.com	bezels
Leeds	leedselect.com	sockets
Micro-Mark	micromark.com	decal sheets
Millen	hoagland-instrument.com	hardware
Mouser	mouser.com	misc. components
Ocean State Electronics	oselectronics.com	misc. components
Play Things of Past	oldradioparts.com	misc. components
Radio Daze	radiodaze.com	tubes & misc. components
Radio Electric Supply	vacuumtubes.net	tubes
RF Parts	rfparts.com	misc. high-voltage parts
Speedy Signs	speedysigns.com	placards
Surplus Sales of Nebraska	surplussales.com	misc. "obsolete" parts

tured several tubes with 6.3-V "dark heaters" that could operate satisfactorily down to 5 V (e.g., the 6146A and the 6DL3), so CR3 and CR4 became 6DL3's. Their cathode caps give them a lovely Frankenstein look, but where do you find 3/8" JETEC C1-1 (small) cap connectors? Well, the Radio Amateur's Handbooks[1] used to have a Catalog Section in the back, and I remember drooling over the ads for James Millen hardware. Amazingly, I discovered that some of their parts are still being manufactured (see **Table 3.**) [page 27], so I ordered two No. 36002 ceramic caps, two No. 37501 high-voltage connectors, some knobs, and some miscellaneous parts.

I bought a new Hammond 10-H, ½-A (53 Ohm) choke for the high-voltage filter; the beast weighs in at 21 pounds (the entire supply weighs 52 pounds). Four 100 ¼ F, 450-V electrolytics in series produce a 25 ¼ F, 1800-V filter; a separate bleeder resistor across each capacitor equalizes their voltages. I found an 8-H, 300-mA (80 ohm) Stancor choke for the medium-voltage output. Two 47 ¼ F, 450-V electrolytics (with bleeders, of course) in series made a 23 ¼ F, 900-V capacitor. For versatility and for testing, I included a variable load resistor made of a 10-k, 100-W fixed resistor and a 10-k, 100-W variable resistor. Note: to avoid damage, the slider must be completely loosened before moving.

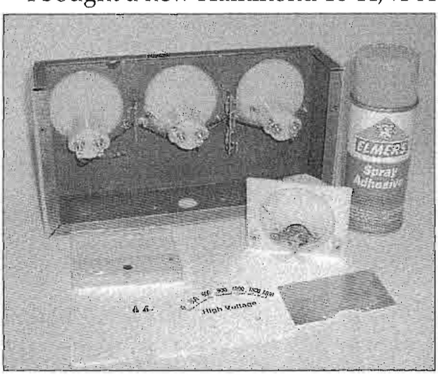


Figure 5: Meters and meter scales.

Output voltage metering would be very desirable, but where do you go to get a 0 to 1800-VDC panel meter? It was easier for me to find 0 to 1-mA panel meters with removable covers and scales, pair them with series resistors according to R= E/I, and make new scales with Word's drawing feature; just print them on high-quality paper and glue over the old scale. See **Figure 5**. Remember to check that the resistor wattage is adequate according to $P = E^2/R$, and that the maximum voltage (typically 360 V for ½-watt resistors and 500 V for 1-watt resistors) is not

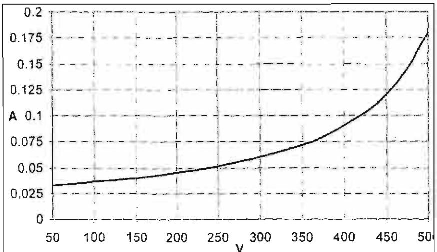


Figure 6 – Variable Medium Voltage Output

exceeded. That's why a string of five 360-k, ½-W resistors was used instead of a single 1.8 M resistor. All of this may seem extravagant, but when turning the supply off, it's very reassuring to watch the meter needles decay to zero before reaching in.

Next came those bias supply windings. With a 5V4GA rectifier and a 47 ¼-F filter capacitor, they produced about -250 V, which was routed to an octal socket, in case I wanted to regulate it externally. I obtained a 150-V regulator tube (much like a Zener diode) with a 40 mA current limit, and a 10-k, 3-W, 10-turn potentiometer for a variable output. A current-limiting resistor is required, roughly equal to the 100-V drop divided by, say, 30 mA plus the 15 mA through the potentiometer (250 V – 150 V) / (30 mA + 15 mA) = 2.2 k. As before, the unregulated voltage droops when a load is applied, so experiment with the final value to ensure that the current is sufficient, but does not exceed the regulator tube limit. Normally the potentiometer bleeds the filter capacitor, but the regulator tube features an internal jumper to switch off voltage if the tube is removed, so I included an extra 220-k bleeder to be sure that the filter is discharged.

A variable medium-voltage supply was designed along the lines of the classic circuit as shown in Terman[6]. I used a 6FW5 beam pentode for the error amplifier because it's hard to find a small-signal tube that can withstand the full output voltage. The pass tube, another 6FW5, "floats" on the output voltage, and so it requires not only a floating heater winding, but also a floating screen supply. A little Hammond 269AX transformer, a 6X5GT rectifier, and a 47 ¼-F, 450-V electrolytic yields a 180-V screen supply. A 100-k, 3-W, 10-turn potentiometer, a couple of resistors, and the minus 150-V bias supply provide the voltage reference. The output capability is shown in **Figure 6**; note that current capability becomes less at lower voltages. This is because the voltage across the pass tube increases, and current must decrease to avoid exceeding the 6FW5's plate dissipation limitation of 18 watts.

Figure 7 [pages 32 and 33] shows the final schematic, and **Figure 8** [page 29] graphs the measured voltage regulation of the high-voltage output at full and reduced ranges. A rough choke check can be made by drawing a line from the origin through the "knee" and applying the equation L = Slope / 1130. In this case, (1200 V / 0.1 A) / 1130 = 10.6 H, well within manufacturing tolerances for the choke.

Scouting For Trusty Parts[7]

Finding components was one of the most enjoyable aspects of this project. I visited flea markets, pored over catalogs, surfed the net, and generally had a ball. Coming home to a cardboard box of goodies can be electrifying (ha), but buying parts sight unseen also has its risks, and I unboxed a few parts that must have been used as boat anchors - literally. Still, many old parts clean up nicely, and a little paint covers a multitude of sins. **Table 3** lists on-line resources that provided me with good quality components, some of which were packaged in the early 1950's.

A Fiery Bottle with the Speed of Light[8]

The urge to miniaturize goes back a long way. I have a 1943 copy of *Radio for the Millions*,[4] which contains about seventy construction articles, half of which

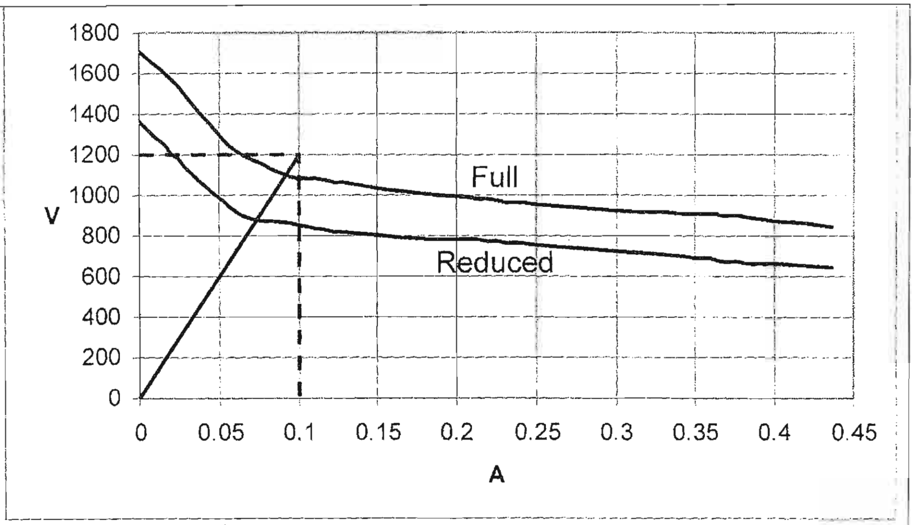
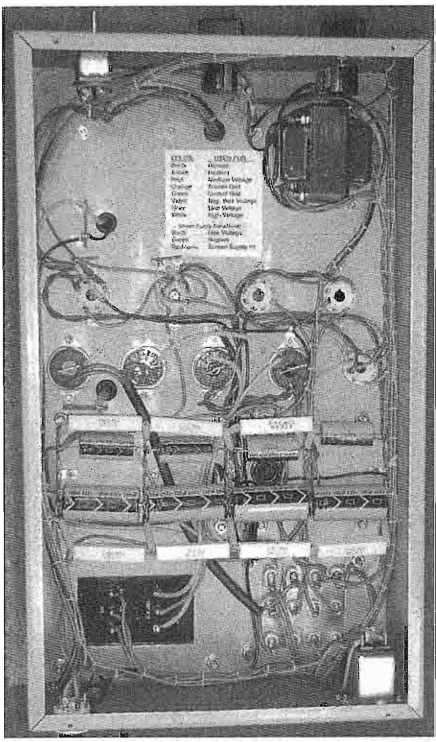
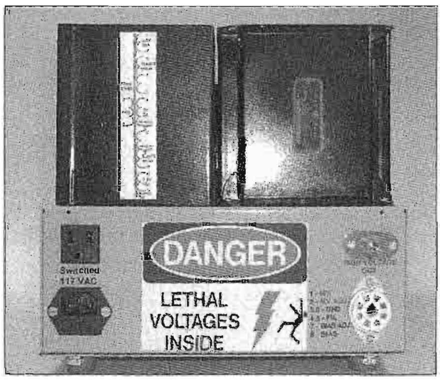


Figure 8 – High Voltage Regulation at Full and Reduced Ranges





Above: The rear panel of the power supply has AC input, switched AC output connectors, and fittings for the power supply's output voltages. Cautionary labels add a finishing touch to the chassis.

Left: A look underneath the chassis shows a thoughtful parts layout, neat cable lacing, and the generous use of tie points to be sure all the components are properly supported. If properly built, a power supply such as this one will last a lifetime.

Figure 9: The AF8L chemical laboratory.

are for "midget" receivers ("Tiny Portable Operates Anywhere," "Tom Thumb Radio," "Vest-Pocket Receiver," etc.). This is not necessarily a good idea! As W6PZV said in his 1963 construction article,[2] "It's better to have room for tubes that you don't need than to have need for tubes for which you don't have room ... Benefit by my experience. Use a larger chassis and cabinet."

Unlike circuit board layouts, engineering aluminum boxes and point-to-point wiring is largely mechanical. I have no access to a machine shop, or even a brake or shears, but with careful selection of available components, I avoided most metalwork. I chose a Hammond 1444-33 17"x10"x4" aluminum chassis and its matching 1451-30 5.2" high perforated chassis cover, their largest parts available, and still wound up with a fairly dense layout. The Bud CU-592A Converta-Box was perfect for my three meters, as was an IEE 8X464 bezel. I disliked its plastic filter, though, and replaced it with glass cut from old picture frame. Also, too much light was escaping through the cover, so I cut a strip from a small mirror and glued it to the cover with RTV, over the meter pilot lamps. If you have never used a glass cutter, you really should try; it's fun to snap pieces of glass in two!

I used only simple hand tools: files, screwdrivers, pliers, etc.; my only power tool was a hand drill, but with a center punch and careful alignment, the results are almost as good as with a drill press. A good nibbling tool saves a lot of filing,

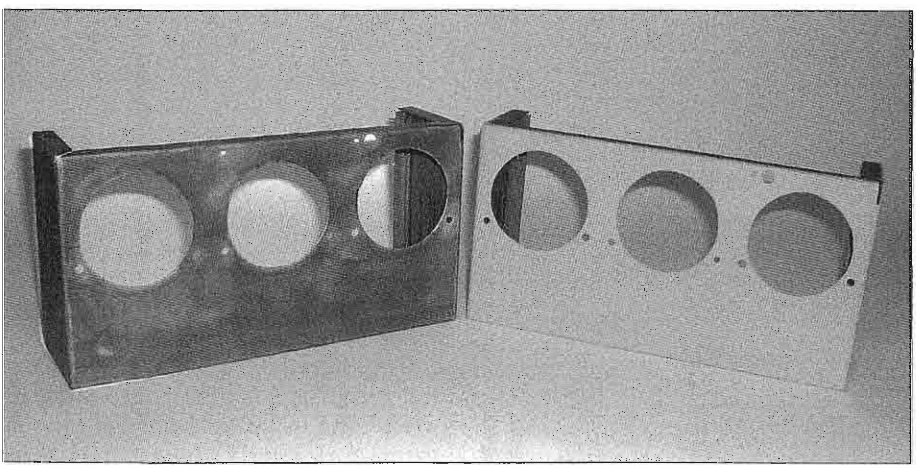


Figure 10: Here are the meter boxes as they look during the chemical treatments described in the text.

and I allowed myself the luxury of a few round chassis punches.

I never depend on the chassis as a conductor, but wire all ground points together. I used #22 hookup wire with 600-V PVC insulation (#18 for heaters) and followed the traditional wiring color code.[3] I had no high-voltage wire, but MIL-C-17 says that RG-58U has a #20 center conductor and is good for 1900 V, so I used the center conductor and insulator pulled from short pieces of RG-58U. Long wire runs were laced for neatness; ARRL Handbooks from 1994 and before show how, but be careful: there's a wrong way to do this, like tying a granny knot instead of a square knot. I also used a piece of old carpet to protect the power supply and bench when inverted. You'll want to search the chassis for those little solder balls and splashes that have no business in a high-voltage power supply. When assembling, put a lockwasher under every nut, of course.

Finishing Touches

Esthetically, the aluminum chassis demanded painting to match the perforated cover. Now, aluminum has amazing corrosion resistance due to a very thin layer of aluminum oxide (Al_2O_3) that forms on its surface almost immediately when exposed to air. Rust on iron (ferric oxide, Fe_2O_3) will spread until the iron is consumed, but the aluminum oxide forms a protective barrier that halts further reaction. This coating is basically sapphire, second only to diamond in hardness (most sandpaper is made of aluminum oxide). Unfortunately, it also discourages paint from adhering.

To allow painting while retaining corrosion resistance, a chromic acid bath is used that converts the surface to an aluminum oxide film with entrapped chromates and dichromates. This is not a difficult process, but it is a goggles-and-gloves procedure requiring knowledge of chemical safety and handling (hexavalent chromium is considered to be a carcinogen) and good ventilation.

Figure 9 [page 30] exhibits the AF8L Chemical Laboratories and Spray Painting Facilities. I purchased a cheap children's swimming pool for use as a water rinse bath, and used buckets to apply the chemical treatments. Here is the procedure that I recommend:

1. Preclean the part by wiping with acetone. Remember that I said goggles and gloves.

2. Clean the part with Dawn dishwashing detergent and rinse with H_2O. If the part does not support an unbroken film of water, grease is present; repeat the first two steps.

3. Clean the part for two or three minutes with PPG DX533 etchant (available at many auto part stores), diluted 1:3 with H_2O. A white coating will form that is actually tiny bubbles of explosive hydrogen gas (ergo the shade-tree locale).

4. Submerge the part in H_2O until ready to proceed to step 5. Don't allow the surface to dry or the Al_2O_3 will reform.

5. Soak the part in (or swab it with) PPG DX503 Aluminum Conditioner (chromic acid) for two or three minutes. The aluminum will acquire a golden coating like the meter box on the left in **Figure 10** [page 30].

6. Rinse the part with H_2O, allow it to dry, and handle it carefully for 24 hours while the coating hardens.

7. Prime the part with Zinc Chromate Primer spray. Maintain good ventilation and use a mask (no, not the Lone Ranger kind). The aluminum will look like the meter box on the right in **Figure 10**.

8. Paint the part with a suitable paint. I used Rustoleum Professional High Performance Enamel, Light Machine Gray (#7581). It likes to run, so take your time.

This treatment derives from my experiences with aircraft construction and may be a little over-the-top for equipment that will (hopefully!) never see salt spray.

Labeling was always a problem for me:

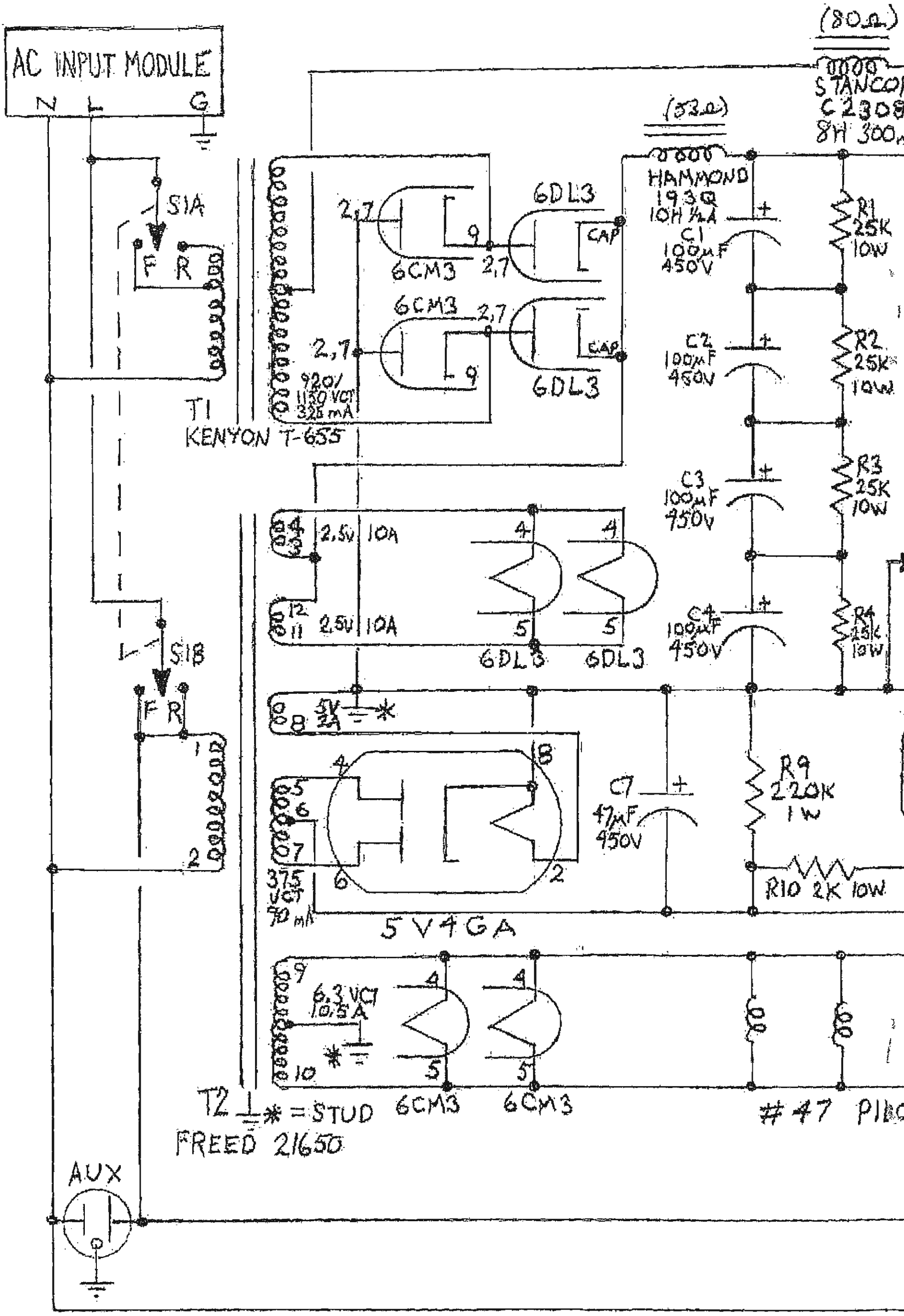
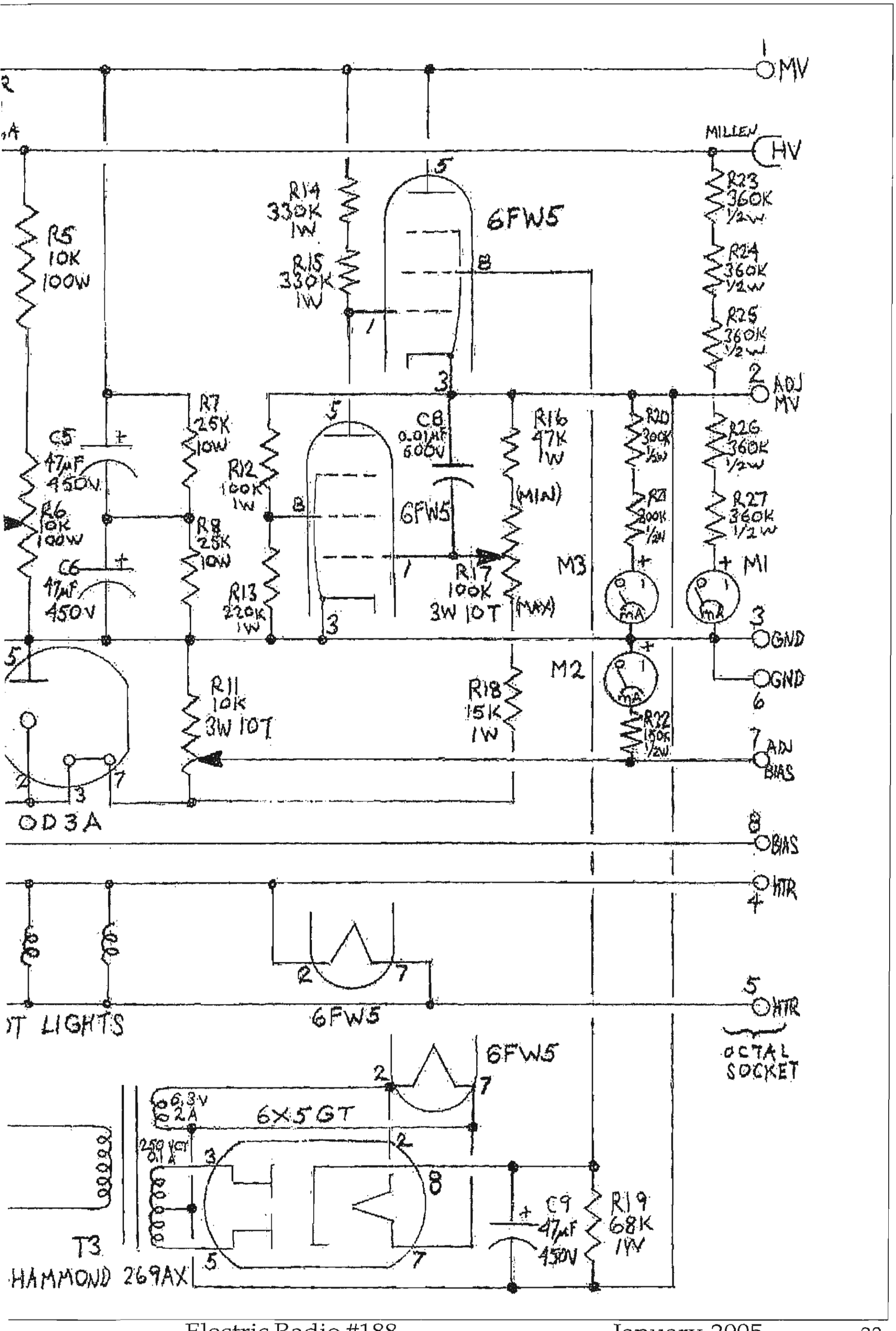


FIGURE 7

100% SOLID-STATE-FREE POWER SUPPLY GS 2004


MV
MILLEN
HV
R14 330K 1W
R15 330K 1W
6FW5
R5 10K 100W
R23 360K 1/2W
R24 360K 1/2W
R25 360K 1/2W
ADJ MV
R7 25K 10W
C5 47μF 450V
R6 10K 100W
R8 25K 10W
C6 47μF 450V
R12 100K 1W
R13 220K 1W
C8 0.01μF 600V
6FW5
R16 47K 1W
(MIN)
(MAX)
R17 100K 3W 10T
M3
R26 360K
R27 360K 1/2W
M1
mA
GND
GND
M2
R11 10K 3W 10T
R18 15K 1W
ADJ BIAS
OD3A
BIAS
HTR
6FW5
HTR
LIGHTS
OCTAL SOCKET
6FW5
6.3V 2A
6X5GT
250 VCT 0.1A
C9 47μF 450V
R19 68K 1W
T3
HAMMOND 269AX

I was never satisfied with typed paper labels, pressure transfer letters, Dymo labels ... then I found Micro-Mark Decal Paper. Simply create full-color graphics, feed a sheet of decal paper through your printer, spray it with Krylon Crystal Clear Acrylic Coating (1303A), and apply it like any other decal. I also use self-seal laminating sheets over paper where appropriate.

Old Time Safety

Before testing, a word of caution: when the highest voltage in your equipment is 5 V, you can thrust your hand into the circuits with impunity. **The voltages produced by this supply, to speak plainly, *are lethal*.** Do not attempt to build or work on such a power supply if you do not respect these voltages... or if you fear them. With equipment like this, there is no such thing as a "little" shock.

I once had a motorcycle whose repair manual began, "In order to repair your motorcycle, it is first necessary to attain a quiet mind." This is apt advice: get away from high-voltage equipment if you are upset or tired.

Begin testing for the correct AC voltages at the sockets before plugging in tubes. Clip test leads onto the circuit, and *always* unplug before moving test leads. Remember that 1150 VAC is in there, so be careful about where your multimeter is connected; mine goes to 750 VAC, and many go only to 600 VAC. You'll probably not get an overvoltage indication ... or any other readings ever again! Wear rubber-soled shoes, and be sure to employ a ground fault circuit interrupter (GFCI); line voltage is present inside the chassis even when the power switch is off, and 20 A of 120 VAC can be lethal, too. Do not use the power switch while the case is open; plug in the line cord instead, and unplug it as soon as the test is done. Never work alone, or lean over live equipment, and if you absolutely, positively must reach into a live circuit, do what us old-timers do and keep one hand in your pocket. That's how we got to be old-timers.

Touching Finishes

I had a tremendous amount of fun throughout this project. Rejuvenating? I doubt that anything could make me feel so much like a teenager again. I'm sure that the design could be simplified by using semiconductors, but you'd never be greeted with that fireplace-ember glow.

Say, that reminds me. Whatever shall I do with that 7094 that I got for a Christmas present?

Notes:

[1]Goodman, Byron, ed. *The Radio Amateur's Handbook*. 41st ed. Newington: American Radio Relay League, 1964.

[2]Isaacs, John. "A 7-Mc. Mobile SSB Transceiver," *QST*, August 1963, Vol. XLVII, no. 8, pg. 11.

[3]Jordan, Edward C., ed. *Reference Data for Engineers: Radio, Electronics, Computer, and Communications*. 7th ed. Indianapolis: Howard W. Sams, 1985.

[4]*Radio for the Millions*. New York: Popular Science Publishing, 1943.

[5]Terman, Frederick E. *Electronic and Radio Engineering*. 4th ed. New York: McGraw-Hill, 1955.

[6]Terman, Frederick E. *Radio Engineers' Handbook*. 1st ed. New York: McGraw-Hill, 1943.

[7]*Kemo sabe* means *trusty scout*. Hi Yo!

[8]The velocity of signals through a vacuum tube (GlAsFET or firebottle) is *c*.

Photos by the author.

Continuously licensed since 1964, Gary Steinbaugh, AF8L, is an ARRL Life Member and a licensed Professional Engineer. He holds a BSEE from Case Institute of Technology (now CWRU) and is a Certified Flight Instructor. He can be reached at gsteinbaugh@yahoo.com.

ER

A Safer Power Transformer Tester

By Louis L. D'Antuono, WA2CBZ
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More often than not, builders come across power transformers that are unboxed and unmarked. This is especially the case when they are taken from discarded equipment. Until the need arises, they are usually relegated to the proverbial junk box. When the occasion does arise, and they are needed, the question remains; do they have the right voltages for the present circuit requirements? At this point, the hobbyist usually digs up a spare line cord, attaches the free end to the transformer primary leads, usually black, or what appears to be the primary lead and plugs the other end into the wall socket. The secondary leads and their center taps are checked and compared until the process is completed. At best, this is an extremely hazardous proposition because of the high voltages present across these leads. Sometimes, these wires contain potentials of hundreds or even thousands of volts. Oftentimes, experimenters will connect a small wattage standard household light bulb in series between the line cord and the primary leads to make sure the transformer primary is not shorted. If the bulb lights brightly, either the primary is shorted or the line cord was connected to the wrong leads.

I intentionally designed this unit to make the process of testing power transformers simpler and safer. The unit is continuously plugged into the wall and this line cord voltage is applied to the

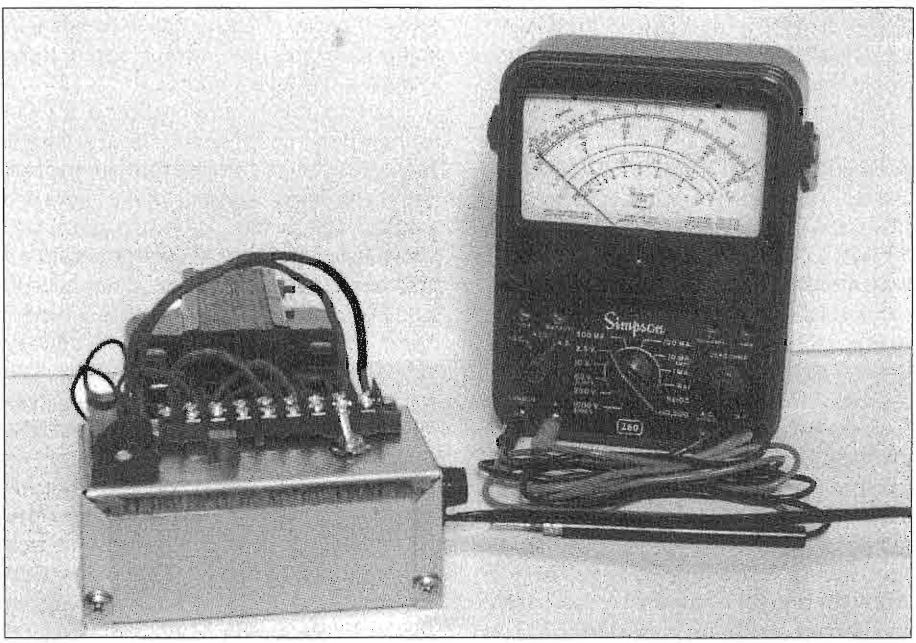

Figure 1: The elements of the WA2CBZ Safer Power Transformer Tester

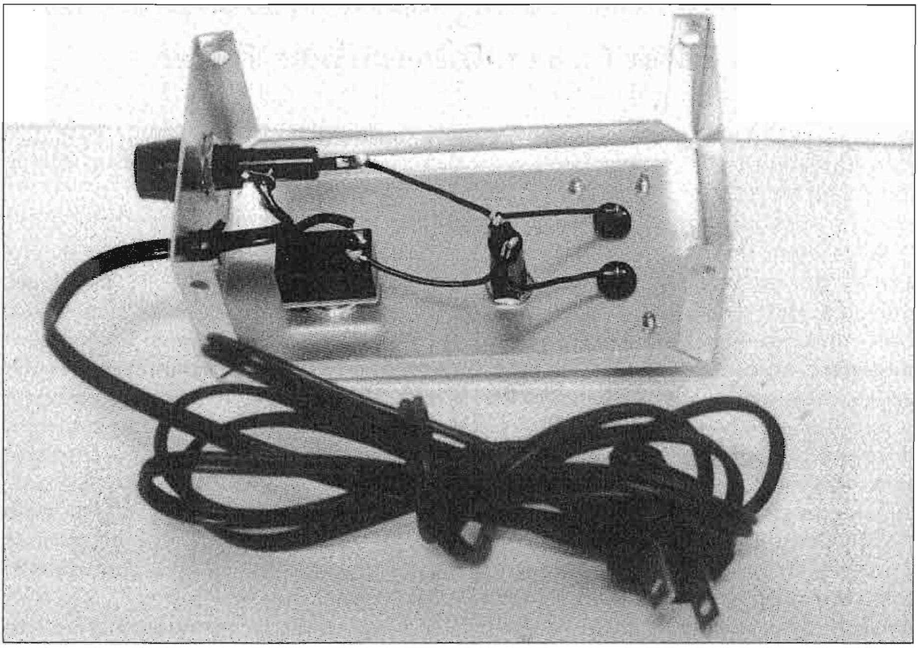

Figure 2: Interior view of the transformer tester's minibox.

power transformer primary leads through a set of speaker terminals. Each of the secondary wires are connected to the barrier strip terminals and secured down tightly. During this preliminary procedure, the builder can differentiate between the leads' colors and their thickness. Finally, AC power is applied to the power transformer primary leads through the speaker terminals. This is accomplished with an SPST toggle switch with a fuse in series and power is indicated with a neon bulb. If the wrong leads were connected to the speaker terminals, the fuse will blow out. This will also occur if there is a shorted primary.

Even if this is true, there are still uses for a power transformer with a shorted primary. If everything goes well, the hobbyist can check the voltage with greater safety from the barrier strip connections rather than using the traditional manner that was outlined previously. There is still some danger from electric shock from the barrier strip but it is lessened. You can also use the barrier strip to combine the windings for lower and higher voltages. I do not recommend using the primary winding as part of an autotransformer because this voltage is not isolated from the line voltage and, consequently, is dangerous.

I would recommend using a VTVM rather than a VOM to test these voltages because of the VTVM's ability to protect the meter's internal circuitry. There are going to be occasions when there are more leads than there are terminals on this barrier strip. Usually, there is only one high voltage winding with a center tap in the power transformer secondary which is the most crucial winding. The barrier strip concept came from my experience in using them to connect and disconnect wires without soldering or unsoldering on model train layouts. All of the components used in this circuit are for efficiency and safety. The SPST switch along with the neon pilot light was used to eliminate plugging and unplugging this unit repeatedly when testing transformers. I considered using a pushbutton

Parts list for the WA2CBZ Safer Power Transformer Tester

1.	S1 - SPST Toggle Switch	RS/275 - 602
2.	N1 - Neon Bulb Assembly	RS/272 - 704
3.	F1 - Fuse Holder	RS/270 - 364
4.	Speaker Terminals	RS/274 - 632
5.	Minibox Enclosure	RS/274 - 238
6.	Barrier Strip	RS/274 - 670
7.	3 Ampere Fuse	RS/270 - 1007

Miscellaneous - Screws, Wire, Grommets, Rubber Feet, Line Cord, Solder, Strain Relief.

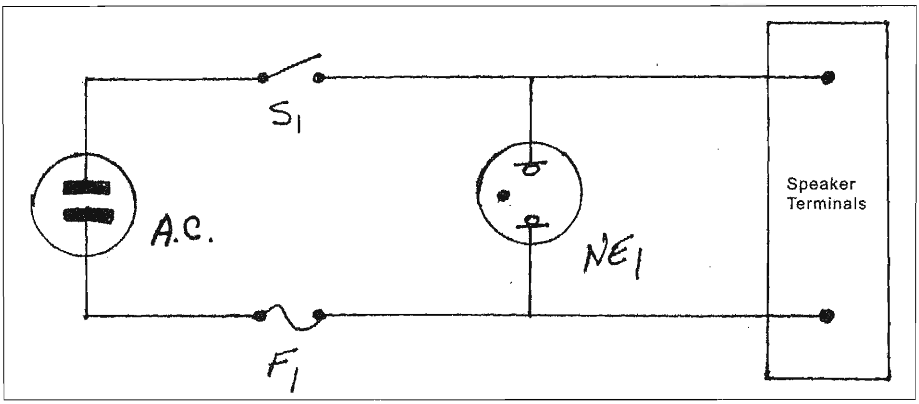

Figure 3: Schematic Diagram

switch instead of a toggle switch for greater safety but this would have made measuring and combining voltages more difficult. I used the speaker terminals to minimize contact with potentially lethal AC line cord voltage. Almost all of the parts needed for this project can be purchased from Radio Shack. In fact, most of these parts could be found in any good junkbox including the line cord. This unit is especially useful when selecting transformers for homebrew projects. The best part about building this unit is its simplicity but the safety factor provided when testing power transformers in invaluable.

Footnotes:

[1]Jack Grimes, W4LLR, "Transformer Tricks" 73 Magazine, June, 1968, Vol. XLVII, No.6

Louis D'Antuono holds an Amateur Extra Class license and is currently teaching Social Studies at James Madison High School in Brooklyn, New York.

ER

Memories of a KSJB Radio Engineer, Part 1

By Dennis R. "Doc" Murphy, KØGRM
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I didn't work very long for KSJB, October 1960 to May 1961, but it was interesting.

These memories came about when I said I would haul the old KSJB RCA Type WM-30A antenna phase monitor to the Pavek Museum of Radio in Minneapolis and that stirred the brain cells.

The station manager just loved the loud station out of Del Rio, Texas, and one night he came out to the transmitter site, just south of Jamestown, North Dakota, and informed me that KSJB was going to have "Punch" like Del Rio had. With that, he turned up the master gain on the transmitter console, so that the over-modulation peak indicator light on the modulation monitor was glowing steadily. I didn't say much, and after he left I decided I wasn't too interested in being cited by the FCC for running an over-modulating commercial AM transmitter and I reset the master gain. That didn't last long, as he returned 'very' shortly and chewed on me for awhile, informing me that my job would cease if I didn't accede to his directive, and turned up the master gain again.

After he had left, confirmed this time, I sat and contemplated my fate, wondering what I could do. Did you ever see the light bulb over your head turn on? I went to the RCA antenna phase monitor and adjusted the scope for a circular trace. When it was set that way, the transmitter modulation closes the circle and it is easy to set the modulation level by watching the scope. After adjusting the master gain for correct modulation, I turned the scope intensity down and then turned up the modulation monitor's over-modulation peak control so the indicator light glowed merrily.

The station manager's visits were always very enjoyable after that, as every time he stopped by, he could see that KSJB had "Punch!"

Sundays were not my favorite day out at the transmitter site, especially around 5 o'clock, plus an hour. Frustrations are more like it. I had Sunday mornings off so I could go to church and read the paper. Because I signed-on the station Saturday and worked till sign off, Sunday afternoon was a nightmare. After the church broadcasts were over there were no studio operations. So, I had a pile of prerecorded taped music with station IDs, time announcements, advertising, etc. all ready to use; fat city, right? Not necessarily!

The transmitter site had the CBS program line, a Wollensak tape machine that could record and playback, a Magnesync playback-only machine, a 78 rpm turntable, a stack of old records (everything was 45 rpm by then), a microphone on an arm, and me.

I had to preplan my moves on the tape machines about 4 hours in advance, because at 4:30PM or so Johnny Dollar came down the program line for me to record on the Wollensak. Two minutes after he was over, I had to have him on the Magnesync and all ready for on-air play. During those same two minutes, I needed to air a station ID, and I had to get a promo record for the U.S. Army or

Air Force on-air as a public service, and then get a blank tape on the Wollensak to record Matt Dillon who was already coming down the program line for later playback. What I have just described is what is "supposed to happen." In reality, it didn't necessarily work out that way.

I would have to clean off the tape that was playing on the Magnesync (a vertical machine with spring-loaded knurled knobs holding the reels on), and rewind Johnny Dollar (where did the knob go?). While it was whining up to light speed, I'd take a prepped tape and reels and load the Wollensak: several loops of tape peel off, of course, and now the Magnesync is getting close to the end. Quick, stop it! The tape went flap, flap, flap! I'm too late, and I'd have to rethread Johnny. The promo was almost over, rethread, rethread, and now Matt's here and he is ready to ride!

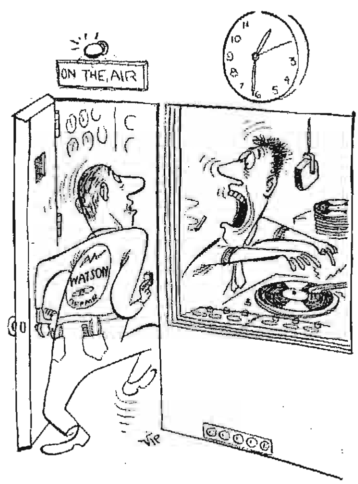
As you can see there were many, many announcements, "Due to technical difficulties, the first two minutes of Gunsmoke will not heard. The following is a musical interlude!" I would quickly get the promo disk off the turntable and hurry to find some music. I'll bet you get my last name right on the first guess. The last Sunday I worked out there it all went perfect. I was so glad I never ever had to do that again.

Remember prerecorded music? Sometimes the announcer, one of our guys, would get the time wrong by an hour, or worse an hour and a half! Man, I couldn't answer the calls fast enough, and when it was possible, I'd sneak in a time announcement!

We also had some Sunday evening prerecorded religious programs such as "The Hour of Power," and they really had the music. We also aired Dr. Billy James Hargas. (Accept my apologies, B.J., if the last name spelling is off.) Anyhow, he was one of the early media "fund raisers," shall we say, I'll stop there! One of the Jamestown College professors certainly got BJ's ire by describing, quite publicly, what he thought of B.J., and they both had southern accents, too!

We got a nice phone call from B.J. one Sunday night, after KSJB had installed remote control. The "engineers" still didn't trust remote control, and kept watch to see if the meter readings stayed in the ball park. We happened to be testing the new reverb unit on his program that night, every time the word "money" came up we used the reverb; it was easy, you could see the word coming.

ER



"Quick, Watson, the JENSEN!"

The Restoration Corner

Improperly Marked Mica Capacitors

By Jim Fitton, W1FMR
Box 2226
Salem, NH 03079

Current wisdom is that mica capacitors seldom fail, but watch out for mismarked colored dots.

A nice looking Heathkit AT-1 transmitter, with the usual extra faceplate hole, was purchased recently at a hamfest. Every crystal tried in it had a low grid current and overheated after a few minutes. Some would not oscillate at all. A favorite 80 meter crystal from my Novice days overheated and "popped", never to be excited again.

The 6AG7 oscillator tube was changed along with some of the wiring. Every part was examined, probed and poked, all voltages measured, RF chokes changed, all to no avail.

Frustrated, I decided to vary the ratio of the two little mica capacitors (The ones that never fail) located in the oscillator grid circuit with little colored dots to indicate value.

A 15pF mica was unsoldered and a 20pf tacked into its place. This brought the oscillator grid current up nicely with no crystal overheating.

The problem was somehow solved. The removed 15pF capacitor that had the correctly colored dots actually measured 458pF and may have been this way from day one. No wonder the little transmitter showed very little use. (Darn that extra hole in the faceplate!)

There is a good lesson here!

The Restoration Corner can run only if your restoration topics are sent in to Electric Radio!

Restoring Johnson Matchbox Decal Lettering

By Cal Eustaquio, N6KYR
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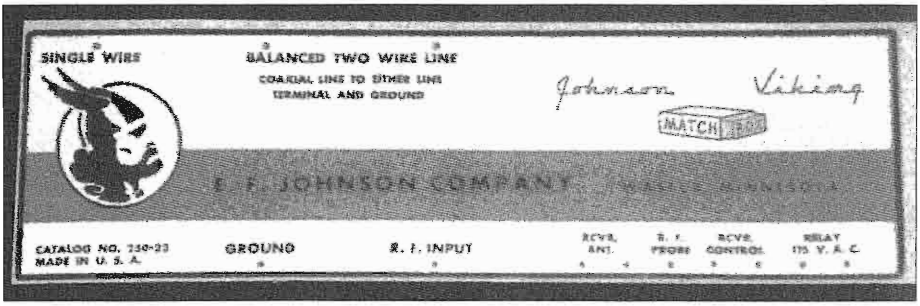
Lansing, MI 48915

A few months ago, I received an irresistibly near mint 275W Johnson Matchbox. I say "near mint" because as anyone who has experience with this type of equipment knows that the Matchbox is subject to the "disintegrating label syndrome". These boxes had been made from the 1950's to the 1960's, enough for "Father Time" to do his damage.

On pure accident, I happened across the services of John Ellingson (K7OSK) (k7osk@boatanchor.com). He had several replacement decals available specifically for the EFJ 275W Matchbox. I looked at the product and it is a doppelganger for the original.

Prior to putting on the replacement decal, I needed to remove the remains of



The replacement Johnson Matchbox decal that is produced by K7OSK.

the old. Some techniques I used in the past included solvents, sandpaper, or other procedures that have the potential to damage the surface of the equipment. I wanted to avoid that part of the restoration and elected to do something else that was least intrusive. I eyed a roll of packaging tape that was lying on my kitchen counter. Voila', a solution! I stretched a piece of tape across the old decal and pulled it off. Large chunks of decal came off. I repeated the process until every last bit of decal disappeared.

After that, I used dish soap and water to remove any residual contaminants. Perhaps a good application of denatured alcohol would work as well.

After drying off the surface, I put the unpeeled new decal over the empty spot and aligned it accordingly. It turns out there was an excess amount of material. I trimmed just enough to fit the space and allow for the backing to be removed (seen as a tab on the right side of the decal positioned on the Matchbox).

The results of the replacement are fairly dramatic. John's decal is virtually indistinguishable from the original. I was impressed and satisfied with the results.

Do you have a nice Matchbox with a bad rear decal? Use the above procedures and give OSK's product a try!

Grid Emission and Induced Noise in Oscillator Circuits.

By Chuck Felton, KDØZS
PO Box 187
Wheatland, WY 82201

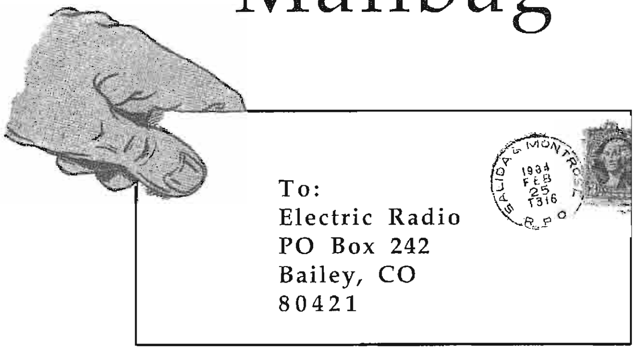
In addition to the gradual loss of cathode emission, an age-related performance limiter in tube radios is grid emission in oscillator tubes. Apparently, because all standard oscillator designs draw grid current over part of their operating cycle, the grids become contaminated fairly quickly, about one year of continuous operation. This contamination is expressed on a tube tester as grid emission and generates oscillator noise that limits receiver performance, on weak signal recption and intermodulation distortion. Simply replacing the high grid emission oscillator tube with one without that defect will restore the receiver's specifications. You read it here first! I have experienced degradation of about 10 dB on several receivers.

A related topic is the control of oscillators that are used only part of the time, such as a crystal calibrator. A running oscillator draws grid current over part of its operating cycle. A conduction grid collects cathode material and develops grid emission. Grid emission not only makes the oscillator noisy, but just turning off the B+ plate voltage on an energized tube causes a constant flow of grid current. This destroys, over time, the tube as an oscillator.

The cure for this problem is to either ground the cathode, which cuts the tube's plate current off, or turn off the heater, or bias the grid past cutoff.

ER

Mailbag



Dear ER

I read W4MEW's December article evaluating the RME 6900 receiver with much interest, having owned an example for 15 years. I've been able to compare this receiver to other ham band only sets of its production period and agree with Chuck's commentary. I found the 6900s overall performance only a tad better than National's NC-155 and Hammarlund's HQ-110A "economy" ham band offerings. The Hallicrafters SX-111, SX-117, Drake 2B and the Hammarlund HQ-170A , are superior units in the same or lower price class.

I also dislike the "invisible" edgewise meter so much so, that I used a traditional outboard S meter in its place. Any mystique surrounding the RME 6900 receiver should be attributed to low production and the end of the line for the RME name, not for any superlative performance aspects. Thanks for the informative piece.

73

Bill Kipping, KE7KK

Dear ER,

Here is some information on the Designation of British Army Radio sets during the WWII period.

In 1929, the somewhat haphazard classification of army radio equipment used from WWI was superseded by a formal system of classification. There were 6 types designated.

1. Short range general purpose;Brigade & Artillery.
2. Short range general purpose &Division.
3. Medium range Corps & division mobile.
4. General Headquarters, long range.
5. GHQ & base long range.
6. Army Chain world wide.

Each category had an initial set designed for it. Thus W/S (wireless set) No. I was the first in the first category, followed by No.11 and so on.

The set numbers soon extended as requirements became more complex, and technology developed.

The final classification which carried on right up until 1948, was as follows:

1, 11, 21, 31 (British version of the BC 1000) , short range artillery etc.

2,12,22 ,52 (Canadian), 62. Short range general purpose. An exception was the W/S 52. This Canadian Marconi set used an 813 in the PA, and is considered by many to be the finest medium power mobile radio used by anyone in WWII.

3,23,33,43,53. Medium range Corps mobile .

5,15-- Long Range Base transportable Army Chain
6--Army Chain
7--Original AFV set.
8,18,28,38,48,58(Canadian),68,78 &88. --Infantry manpack.
9,19,29,49.-- A.F.V sets.

There were a few oddball types such as jammers.

Notes: The W/S 11 was considered obsolete by 1940. Despite this, it remained in use by the Long Range Desert Group for all the North African Campaign.The rationale behind this was that as it was extremely simple, it could be maintained by a competent radio mechanic well behind enemy lines. Communication over ranges of 500 miles was often achieved.

The US had no equivalent of the 22. It was of relatively light weight, and low consumption, and was capable of quite long range communication if set up with a decent antenna. They were particularly good in jungle, and an arrangement using a mule carrying the set slung one side and the 12V batteries on the other was used in Burma.

73,
Alan Morris, G4GEN

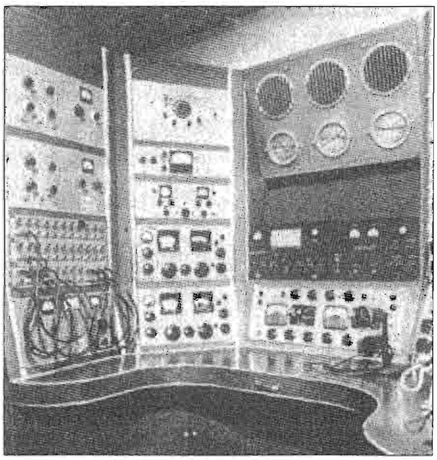
Ham Communications from President's Train

Record-breaking contacts with 45 *states,* 14 *foreign Lands*

To provide the President of the United States with extensive communications facilities from a railroad train, a communications car is included in the President's train. This car, the Albert J. Myer, has also been outfitted with amateur radio equipment which was extensively used during the recent 1956 presidential campaign to advance the amateur cause and to bring to the attention of appropriate parties a tremendous existing communications facility, dedicated to public service.

The amateur station, W3WTE, operated by Al Hart, W4FB, recently completed a record-breaking series of contacts with stations in 45 states and 14 foreign countries. This was done in less than 21 hours of operation from a standing start 60 feet below street level at Union Station in Cleveland and along the trip to Washington, D. C.

The transmitting equipment used was an *Eldico* SSB 100A exciter and a SSB 1000 amplifier. These units were installed on their own rubber feet using wire braid as a snubber to prevent "walking" off the desk due to the car's vibration. The receiver used was a military 390A which is manufactured by *Collins.* The antenna was the permanent system which is normally used for official circuits. It consists of a capacity feed grid network atop the railroad car, which network excites a field whose lines of force go to ground through a return circuit rising vertically on the car, thereby making the car itself a nondirectional vertical radiator. A continuous recording was taken throughout the operation using an *Ampex* 400 recorder.



[From the January, 1957 edition of Radio & Television News--Ed.]

PHOTOS

A Trip to the Hammond Museum of Radio Guelph, Ontario, Canada

By David Payne, KA2J
6 Heather Dale Chase
Henrietta, NY 14467
Photos courtesy of W8KHZ and KA2J

In September 2004 Mike Beachy, (N8ECR) of Pigeon, Michigan, thought it would be nice to plan an outing where some of the AM'ers in the area around the Great Lakes could participate and get a chance to meet eyeball to eyeball. The location needed to be "in-the-middle", to make it as convenient as possible for everyone, as well as be close enough to stay within the boundaries of a day trip. An event of interest to AM'ers was also a prerequisite.

Mike decided on the Hammond Museum as just the place. Participants of the DX-60 net, that meets every Sunday morning on 3.880 MHz, were the first to hear of the potential trip. It was also discussed during the Mighty Elmac net that currently meets Wednesdays, except the first Wednesday of the month, at 8:00 PM on 3.880 – 3.885 MHz. Mike contacted the Hammond Museum and arranged a visit for Saturday, October 16, 2004, at 11:00 AM. He orchestrated a car pool from Port Huron for Amateurs in his area. Once there, the entire group spent the next four hours in RADIO HEAVEN!

The Hammond Museum of Radio (http://www.kwarc.org/hammond/index.html) is a place where radio enthusiasts can spend hours perusing the goodies. Fred Hammond, VE3HC, (1912-1999) started this collection of wireless equipment at the age of 16. It has grown to a wonderful museum full of all kinds of radios and related equipment for all to see. The Hammond Manufacturing Company, started by Fred's dad Oliver Hammond, maintains the museum at their south transformer plant, 595 Southgate Rd, Guelph, Ontario. The museum curator is Noreen Irwin-Hahn (VE3AQZ). As our host, Nori was absolutely wonderful. She arranged a very tasty lunch for us that we consumed with delight at the comfortable facilities at the museum. The lunch was provided as a courtesy of the Hammond Manufacturing Company!

Amateurs that made the trek to Guelph for this fun event were:

Mike (N8ECR), Bob (W8MNQ), Jim (N8LUV), Dave (KA2J), Mark (KA4JVY), Gord (VE3EOS) and Brian(W8KHZ). Brian made a weekend of the trip, so he could show his family Niagara Falls.

Attending and assisting from the museum were:

Nori Irwin-Hahn (VE3AQZ) the curator, and her husband, John Hahn (VA3LKH), Lloyd Swackhammer (VE3IIA and author of Radios of Canada), and Ken Ellis (VA3IX). Once the word gets around, I expect any future outings planned to the Hammond Museum of Radio will be even better attended!

[Editor's note: See also ER #127, Nov. 1999 for another article on the museum.]

Above: The six amateurs from the Great Lakes region of the US who visited the Hammond Radio Museum are shown here with their Canadian hosts.
Below: Mike and Dave are having fun looking for hidden goodies at the museum.

Above: This corner of the museum has mostly Collins equipment, from Fred Hammond's personal KW-1, to an authentic SC-101 control console for the Gold Dust Twins.

Below: Many types of E.F. Johnson equipment are on display on the museum tables. The equipment is not locked away behind glass walls and visitors are able to get close-up views of everything.

Hundreds of vacuum tubes are on display, plus a large amount of classic military surplus radio equipment from all periods and gear from the wireless era.

ER

AM Calling Frequencies

160 meter band: 1885, 1945 kc. In the Midwest, listen on 1980 and 1985 kc.
80 meter band: 3870, 3880, 3885 kc. In the Midwest also try 3891.
40 meter band: 7200, 7290 kc national calling frequencies. Also 7295 in the Midwest.
20 meter band: 14.286 Mc
15 meter band: 21.400 to 21.450 Mc. Try CQ on 21.4, move up for QSO
10 meter band: 29.0 to 29.1 Mc
Try CQ on 29.0, move up for QSO
6 meter band: 50.4 Mc
2 meter band: 144.450 Mc

Vintage CW Calling Frequencies

80 meter band: 3546 kc
40 meter band: 7050 (+/- "Fists" club)
30 meter band: 10120 kc
20 meter band: 14050 kc

[Editor's note: Additions have been coming in, and that's great. I'd like to keep the frequency list as accurate as possible because many newer AM'ers are not familiar with the traditional gathering spots.]

For a lifetime AM International membership, send $2.00 to AM International, PO Box 1500, Merrimack, NH 03054. AMI is our AM organization and it deserves your support!

An on-line, searchable index to the entire 15-year history of Electric Radio Magazine may be found under the "links" tab at www.ermag.com or at Don Buska's web site:
www.qsl.net/n9oo/ersearch.html

VINTAGE NETS

Arizona AM Nets: Sat & Sun: 160M 1885 kc @ sunrise. 75M 3855 kc @ 6 AM MST. 40M 7293 kc 10 AM MST. 6M 50.4 Mc Sat 8PM MST. Tuesday: 2M 144.45 7:30 PM MST.
Boatanchors CW Group: QNI "CQ BA or CQ GB" 3546.5, 7050, 7147, 10120, 14050 kc. Check 80M winter nights, 40 summer nights, 20 and 30 meters day. Informal nightly net about 0200-0400Z.
California Early Bird Net: Sat. mornings @ 8 AM PST on 3870 kc.
California Vintage SSB Net: Sun. mornings @ 8AM PST on 3860 +/-
Colorado Morning Net: Informal AM'ers on 3875 kc Mon, Wed, Fri, Sat, and Sun@ 7 AM MT. QSX KØOJ
Canadian Boatanchor Net: Daily 3725 kc (+/-) @ 8:00 PM ET. Hosts are AL (VE3AJM) and Ken (VE3MAW)
Collins Collectors Association (CCA) Nets: Tech./swap sessions every Sun. on 14.263 Mc @ 2000Z. Informal ragchew nets meet Tue. evening on 3805 kc @ 2100 Eastern time, and Thu. on 3875 kc. West Coast 75M net is on 3895 kc 2000 Pacific time. **10M AM net starts 1800Z on 29.05 Mc Sundays, QSX op 1700Z. CCA Monthly AM Night:** First Wed. of each month, 3880 kc starting @ 2000 CST, or 0200 UTC. All AM stations are welcome.
Collins Radio Association nets: Mon. & Wed. 0100Z on 3805 kc., also Sat 1700Z, 14.250 Mc.
Drake Technical Net: Meets Sun. on 7238 kc, 2000Z. Hosted by John (KB9AT), Jeff (WA8SAJ), and Mark (WBØIQK).
Drake Users Net: Check 3865 kc, Tue. nights @ 8 PM ET. QSX Gary (KG4D), Don (W8NS), and Dan (WA4SDE)
DX-60 Net: Meets on 3880 Kc @ 0800 AM, ET on Sun. QSX op is Mike (N8ECR), with alternates. The net is all about classic entry-level AM rigs like the Heath DX-60.
Eastern AM Swap Net: Thu. evenings on 3885 kc @ 7:30 PM ET. Net is for exchange of AM related equipment only.
Eastcoast Military Net: Sat. mornings, 3885 kc +/- QRM. QSX op W3PWW, Ted. It isn't necessary to check in with military gear, but that is what this net is all about.
Fort Wayne Area 6-Meter AM net: Meets nightly @ 7 PM ET on 50.58 Mc. Another long-time net, meeting since the late '50s. Most members use vintage or homebrew gear.
Gulf Coast Mullet Society: Thu. @ 7PM ET, 3885 kc, QSX op Charles (K4QZO) in Pensacola.
Gray Hair Net: One of the oldest nets, @44+ years ,160 meter AM Tue. evening 1945 kc @8:00 PM EST and 8:30 EDT. Also check www.hamelectronics.com/ghn
Hallicrafters Collectors Association Net: *Sun.*, 14.293 Mc, 1:15 PM EST/EDT. *Sat.*, 7280 kc, 1:00 PM EST/EDT. *Wed.*, 14.315 Mc, 6-8:00PM EST/EDT. QSX op W8DBF.
Heathkit Net: Sun. on 14.293 Mc 2030Z right after the Vintage SSB net. QSX op W6LRG, Don.
K1JCL 6-meter AM repeater: Operates 50.4 Mc in, 50.4 Mc out. Repeater QTH is Connecticut.
K6HQI Memorial Twenty Meter Net: This flagship 20-meter net 14.286 Mc running daily for 25+ years. Check 5:00 PM Pacific Time, runs for about 2 hours.
Midwest Classic Radio Net: Sat. morning 3885 kc @ :30 AM, CT. Only AM checkins. Swap/sale, hamfest info, tech. help are frequent topics. QSX op is Rob (WA9ZTY).
Mighty Elmac Net: Wed. nights @8PM ET (not the first Wed., reserved for CCA AM Net), 3880 +5 kc. Closes for a few summer months QSX op is N8ECR
MOKAM AM'ers: 1500Z Mon. thru Fri. on 3885 kc. A ragchew net open to all interested in old equipment.
Northwest AM Net: AM daily 3870 kc 3PM-5PM winter, 5-7 PM summer, local. 6M @50.4 Mc. Sun., Wed. @8:00 PM. 2M Tues. and Thurs. @ 8:00 PM on 144.4 Mc.
Nostalgia/Hi-Fi Net: Started in 1978, this net meets Fri. @7 PM PT, 1930 kc.
Old Buzzards Net: Daily @10 AM ET, 3945 kc in the New England area. QSX op George (W1GAC) and Paul (W1ECO).
Southeast AM Radio Club: Tue. evening swap, 3885 @7:30 ET/6:30 CT. QSX op Andy (WA4KCY), Sam (KF4TXQ), Wayne (WB4WB). SAMRC also for Sun. Morning Coffee Club Net, 3885 @ 7:30 ET, 6:30 CT.
Southern Calif. Sun. Morning 6 Meter AM Net: 10 AM on 50.4 Mc. QSX op is Will (AA6DD).
Swan Nets: User's Group Sun. @4PM CT, 14.250 Mc. QSX op Dean (WA9AZK). Technical Net is Sat, 7235 kc, 1900Z. QSX op is Stu (K4BOV)
Vintage SSB Net: Sun. 1900Z-2000Z 14.293 & 0300Z Wed. QSX op Lynn (K5LYN) and Andy (WBØSNF)
West Coast AMI Net: 3870 kc, Wed. 8PM Pacific Time (winter). Net control rotates between Brian (NI6Q), Skip (K6LGL), Don (W6BCN), Bill (N6PY) & Vic (KF6RIP)
Westcoast Military Radio Collectors Net: Meets Sat. @ 2130 Pacific Time on 3980 kc +/- QRM. QSX op Dennis (W7QHO).
Wireless Set No. 19 Net: Meets second Sun. every month on 7270 kc (+/- 25 Kc) @ 1800Z. Alternate frequency 3760 kc, +/- 25 kc. QSX op is Dave (VA3ORP).

CLASSIFIEDS

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Subscribers receive 1 free 20-word ad per month. **Extra words are 20 cents.** Here is how to count the words in your ad: "For Sale" or "Wanted" and your contact information counts as 7 words. Hyphenated words count as 2 words. **Please count the words in your ad as described above, and if you are over 20 words, send payment for the extra words at .20 each.** Note: Not all readers use e-mail, so it is a good idea to include phone numbers. Non-subscribers: $3.00 minimum for each ad up to 20 words. Each additional word is 25 cents. E-mail ads are fine.

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Deadline for the February, 2005 issue: Saturday, January 29

SERVICE FOR SALE: Repair and restoration on all vintage equipment; 45 years experience. Barney Wooters, W5KSO, 8303 E. Mansfield Ave., Denver, CO 80237. 303-770-5314

MANUALS FOR SALE: Military Radio manuals, orig. & reprints. List for address label & $1. For specific requests, feel free to write or (best) email. Robert Downs, 2027 Mapleton Dr., Houston, TX 77043, wa5cab@cs.com

FOR SALE/TRADE: Original manuals: Hammarlund, Hallicrafters, Collins, National, Drake, Swan, Johnson, Lafayette, TenTec, Gonset, Heathkit. NI4Q, POB 690098, Orlando, FL 32869. 407-351-5536 ni4q@juno.com

FOR SALE: Elmac AF67A, PMR8, pwr sply, original manuals, $300. Bob, 916-967-7552

FOR SALE: Homebrew SWR meter, 1968(9), handbooks p. 557, works, excellently. Designed aluminum enclosure, $20 ppd. Louis L. D'Antuono, WA2CBZ, 8802-Ridge Blvd., Bklyn, NY 11209. 718-748-9612 AFTER 6 PM Eastern Time.

FOR SALE: Kellogg #501 1925 broadcast microphone, DB carbon, $450. John, W3GDW, 215 William St., Trenton, NJ 08610, 609-392-2095

FOR SALE: Way too nice for ebay: complete Drake B line in excellent condition with manuals & cables $375. Bob, W1RMB, 508-222-5553.

FOR SALE: Hickok 539C tube tester $650.Carter, 434-979-7383, CElliott14@earthlink.net

FOR SALE: Johnson Courier, new 811A, repainted cabinet, nice, $200. T4XB, AC3, average, $160. Swan 500C, 500, 1 supply, VOX-2 $400. Guaranteed, Don, K5AAD, UPS paid 48. 713-942-9747

FOR SALE: Sound amplifiers, Bogen BT-20A 12 volt mobile $15, Bogen Challenger CHB 50 $25 both plus shipping. Fenton Wood, W5AIR, milordwood@verizon.net, 4716 Stonebriar Cir., College Station, TX 77845

FOR SALE: Hallicrafters SX101/101A reproduction main tuning knob. Includes silver inlay and set screws. $35.00 Mike Langston KL7CD, 1933 Diamond Ridge Drive, Carrollton, Texas 75010, 972-392-5336, mlangston@hcpriceco.com

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FOR SALE: RCA VoltOhmyst VTVM nice condition, for sale, or trade for Heath HG-10 VFO. John W2PRR 1549 Shoecraft Road, Penfield, N.Y. 14526 585-671-4228.

FOR SALE: Bird 72-R reversing coax switch, $115; AC Power Supply Console for Atlas 210/215, $95. Richard Prester, 131 Ridge Road, West Milford, NJ 07480. 973-728-2454. rprester@warwick.net

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FOR SALE: R-648/ ARR-41 Collins receiver, original VGC. with 28VDC power cable and manual , $400 plus shipping. 864-855-9570 or k4deejim@aol.com

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FOR SALE: Eimac 250TH NOS $100.100TH good pull Eimac $45. Amperex New 4-250 $75. Broadcast pulls good Amperex $20. BC-779 parts chassis $35. 813 pulls good various $10. Jennings Vac Vari Cap RCS-500 @15000Volts $75.

ART-13 Mod Trans $45. 20A Coils Various roller and tapped. Heathkit Xtal Filter 2.4 kHz $20. Prices Nego. KEØMT Jeff 303-424-4055 or ke0mt@aol.com

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FOR SALE: 60" rack $85. Hallicrafters HT-37 $80. Globe Champ 300, $40. Herb, K9GTB, 618-362-6539

FOR SALE: Complete AM station: Hammarlund HQ-170A, like new, some new tubes, $300. Viking II, exc, new tubes, $300. Viking Model 122 VFO, $125. 1kW antenna tuner, $210. Heathkit wattmeter $60. Homebrew antenna switch $25. $1000 for all OBO. Hybrid-Quad MQ2 antenna 10M to 80M, $200. 30 ft. tower, $30. Model 9521 Channel Master rotor control $75. System still in use, $305 OBO, must be taken down if sold. Robert McManaway, 195 Ruth Ave, Logan, OH 43138, 740-385-2860, mac195@adelphia.net

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DRAKE SERVICE FOR SALE: R.L. Drake repair and reconditioning, most models including TR-7's, 35 years experience. Jeff Covelli, WA8SAJ, 440-951-6406 **AFTER 4 PM**, wa8saj@ncweb.com

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FOR SALE: Model 28 teletype machine in nice condx. Pickup desired. Robert Enemark, W1EC, POB 1607, Duxbury, MA 02331 781-585-6233

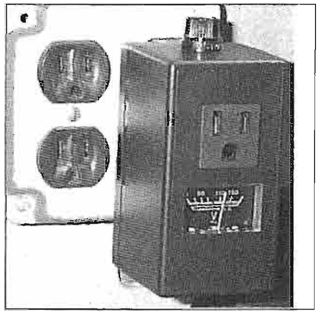
FOR SALE: Hallicrafters TO Keyer $50. New 4D32 $40. **WANTED:** B&W 850A/ 850/851pi-net inductor unit. Richard Cohen, 813-962-2460.

FOR SALE: *QUALITY LETTERPRESS QSLs* LIKE IN THE OLD DAYS! Send $1 for samples. Smokey, W9STB, 8679 Pinkhurst Drive, Minocqua, WI 54548.

Inrush Current Limiters are now available from the Electric Radio store! These inrush limiters were reviewed in the September, 2004 issue of Electric Radio and are available in two versions:

ModelAB-1M (With Voltmeter) $34.95
Model AB-1 (With Pilot Light) $29.95
Priority Shipping $4.95

The Inrush Limiter provides a gentle, slow startup for your vintage equipment in the 150-watt range. They also reduce the line voltage to original design values. Both models come with a full money-back guarantee.



FOR SALE: R390A NOS power micro switches. $11 each postpaid. Dave, WØNBZ, 13020 Lakeview, Burnsville, MN 55337. w0nbz@juno.com

FOR SALE: Ameco PT preamplifier 4B (1.8-54 Mc) w/AC outlet panel $24 + shpg. Henry Mohr, W3NCX, 1005 Wyoming, Allentown, PA 18103

FOR SALE: Old books: Electronics and other subjects. Send SASE for list. John Martin, POB 14, Paloma, IL 62359 217-455-3003.

FOR SALE: National coil boxes; 3-hole, exact mechanical and dimensional reproductions; 1-coat water-based paint; very limited quantity. $55 ea plus $5 shipping. Kelley, W8GFG, 9010 Marquette St., St. John IN, 46373, 219-365-4730

FOR SALE: QRP transmitter kits. Step-by-step instructions. Wood model, up to 5 watts 40/80M $15. "Tunatin" one watt 40M $10. You furnish crystal and power. Robert Larson, 1325 Ridgeway, Medford, OR 97504 W7LNG@arrl.net

FOR SALE: R-390A's, R1051's, Harris RF-550's, URM-25D signal generators, military 28VDC gas generators, AS-2851 antenna kits. Call, Lots more stuff! S. Daniels, 636-343-5263

FOR SALE: 3-year old colonial home on 2 acres of land, 3,500 sq. ft. zoned for tower, finished basement with station and shop area, both wired for 120/240 volts. Near IBM in Poughkeepsie, NY. Asking price 495,000. Call Charlie, WB2ZKS, for additional details, or to arrange a visit. 845-223-8392.

FOR SALE: WWII Army leg key, exc condx. . Fred Clinger, 417 Beechwood Dr., Galion, OH 44833 419-468-6117 after 6 PM.

FOR SALE: Heathkit transciever model GW 42, has pwr, w/mic, all knobs, controls work $90.00 Superior tube tester M-TV - 11 a/o knobs, control panel, roll chart, no problems, $60.00, Johnson Messenger 111 w/mic , no 8-prong plug.Ch A to K, $35.00. Bernie Samek, 113 Old Palmer Rd., Brimfield MA, 01010, 413-245-7174, FAX 0441. Bernie@samnet.net

FOR SALE: Simpson 379 battery tester, manual $60. Mini 8 & 10 tube pin straightener $4. Ross Wollrab, 229 N. Oakcrest Avenue, Decatur, IL 62522-1810. 217-428-7385. rewollrab@aol.com

FOR SALE: 2M Xvrtr Kenwood TV502 + manual. 10W min up to 20W, 2M-AT 8W out $80 +ship. Jerry, K5ULB, 918-724-8272

SERVICE FOR SALE: Repair, upgrade, performance modification of tube comm. & test equip. Accepting most military, all Collins & Drake, & better efforts from others. Laboratory performance documentation on request. Work guaranteed. Chuck Felton, KDØZS, Felton Electronic Design, Box 187, Wheatland, WY 82201. 307-322-5858 feltondesign@yahoo.com

FOR SALE: General Radio lab equipment, over 250 pieces, manuals, write wants, SASE. Stuart T. Carter II, W4NHC, 680 Fernwood Dr., Melbourne, FL 32904, 321-727-3015

FOR SALE: FT243 Crystals: 1815, 1822, 1885, 1945, 1985, 3535, 3560, 3579, 3875, 3880, 3885, 3890, 7035, 7045, 7050, 7143, 7280, 7285, 7290, 7293, 7295, 8400, 10106, 14286 kHz. Many others available. See list at: http://www.af4k.com/crystals.htm or call Brian, AF4K on 407-323-4178

FOR TRADE: 1 set B&W type BVL coils, 10, 20, 40, 80 meters with swinging jack bar...PLUS: 1 B&W type BCL turret with coils 10, 20, 40, 80 on ceramic switch. Offered in trade for 1 Westinghouse Aeriola Sr. 1-tube radio in operating condition. Roland Matson/W1CSO, POB 956, Lake Panasoffkee, FL 33538 1-352-568-1629 after 5PM

REPAIR!: Radio repair reasonable charges. Manuals for sale. I buy Radios. J. Dan Rupe 998 Whipple Ave, Grayland, WA, 98547 360-267-4011 W7ddf@yahoo.com

PARTS FOR SALE: Request free vintage flyer. USA only. 50 years of mail order electronics. Bigelow Electronics, POB 125, Bluffton, OH 45817-0125

FOR SALE: Countermeasures receiving set AN/WLR-1D, 50-10750 MHz, 9 bands, simultaneous display of frequency, spectrum, and modulation info on dual displays, manual, 1200 lbs., $4,500. Carl Bloom, 714-639-1679, carl.bloom@prodigy.net

FOR SALE: 100 RF connectors, gold plated, sub miniature, new, $20 ppd. Len Gardner, 458 Two Mile Creek Rd., Tonawanda, NY, 14150. radiolen@att.net

FOR SALE: Naval Receivers RAK, RAL, RAO, RBA, RBB, RBC, RBL, RBM. Some checked, pwr splys available. $75-$450 depending on condx. Many other types. Carl Bloom, 714-639-1679. carl.bloom@prodigy.net

TUBES FOR SALE: Tested good globe 201A $14, 226 $15, 227 $10 and others. Slightly weak tubes guaranteed to work in early radios ½ price shown. Write or email: tubes@qwest.net for a new price list or see www.fathauer.com. George H. Fathauer & Assoc., 688 W. First St. Ste 4, Tempe, AZ 85281, 480-968-7686. Toll Free 877-307-1414

SERVICE FOR SALE: Authorized repairs and sales of all types of amateur radio, communications, and test equipment. Please call LAND AIR COMMUNICATIONS, 718-847-3090, visit our web site: www.landaircom.com. We have over 3,000 items in inventory and carry all types of communications parts.

SERVICE FOR SALE: Vintage Radio Service. We repair radios, record changers, radios home, auto, tube & transistors. 1930-1980. Ken Hubbard, KA9WRN, POB 792, Beloit, WI 53512. 608-362-1896

BOOKS FOR SALE: Radio books, magazines, catalogs, manuals (copies), radios, hi-fi, parts. Send 2 stamp, LSASE. David Crowell, KA1EDP, 40 Briarwood Rd., North Scituate, RI 02857. ka1edp@juno.com

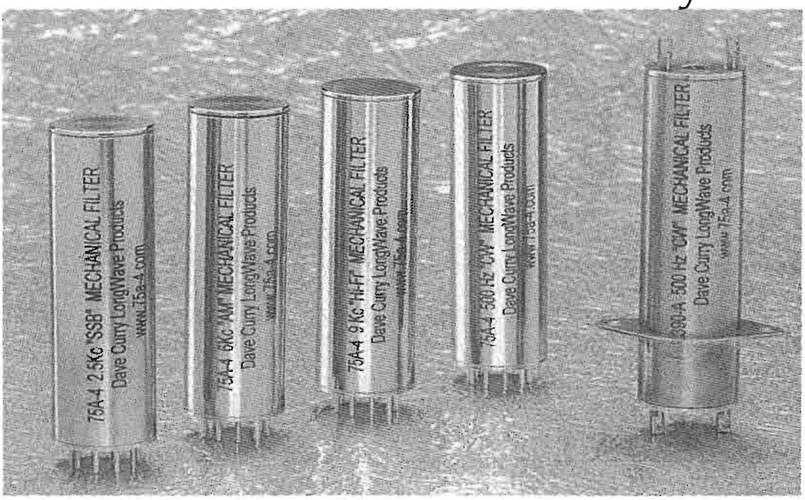
QSLs FOR SALE: Your old QSL card? Search by call free, buy find at $3.50 ppd. Chuck, NZ5M, NZ5M@arrl.net

SERVICE FOR SALE: Repair, Restore, Sales of antique, vintage tube radios. John Hartman, NM1H, www.radioattic.com/nm1h

JOHNSON PARTS FOR SALE: New Ranger 1, Valiant 1, & Navigator plastic dials, freq numbers in green, with all the holes just like orig.-$17.50 ppd. Bruce Kryder, W4LWW, 277 Mallory Station Dr., Ste. 109, Franklin, TN 37067. bak@provisiontools.com

ACCESSORIES FOR SALE: KWM2/S-line metal logo pins. Meatball or winged. Excellent replica of the original. Put one on your hat, badge, or replace a missing logo on your panel. $6.25 shipped. W6ZZ, 1362 Via Rancho Pkwy, Escondido, CA 92029. 760-747-8710, w6zz@cox.net

The Collins Filter Family



By Application, Left to Right:

75A-4 2.5Kc 75A-4 6Kc 75A-4 9Kc 75A-4 .5Kc R-390A .5Kc

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These are exact duplicates of the original filters using the latest, modern design Collins mechanical filters. The electrical specifications exceed the original Collins design.

* CW - 500 cycles
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BOOKS FOR SALE: Used technical books: radio, electronics, math, military, magazines, etc. List: $1 (stamps OK). Softwave, 2 Dept. ER, 1515 Sashabaw, Ortonville, MI 48462

NOTICE: Visit Radioing.com, dedicated to traditional ham radio & vintage radio resources. Let's Radio! Charlie, W5AM. http: / /www.radioing.com.

BOOK FOR SALE: Heath Nostalgia, 124 page book contains history, pictures, many stories by longtime Heath employees. (See ER Bookstore.) Terry Perdue, 18617 65th Ct., NE, Kenmore, WA 98028

TUBES FOR SALE/TRADE: Transmitting/Receiving tubes, new & used. $0.55 & LSASE for list. I collect old & unique tubes of any type. **TUBES WANTED:** Taylor and Heintz-Kaufman types and large tubes from the old Eimac line; 152T through 2000T for display. John H. Walker Jr., 13406 W. 128th Terr. Overland Park, KS 66213. PH: 913-782-6455, jhwalker@prodigy.net

TREASURES FROM THE CLOSET! Go to www.cjpworld.com/micromart to find some unique items many hams would lust for! Gus, WA, 360-699-0038 gus@wa-net.com

MISC FOR SALE: Vintage equipment at the K8CX Ham Gallery Classified Ads section. Visit the largest Antique QSL Card Gallery http:/ /hamgallery.com

BOOKS FOR SALE: Lots of old radio & related books. Eugene Rippen, WB6SZS, www.muchstuff.com

PARTS FOR SALE: Strong steatite antenna insulators. Lengths from two to fifteen inches. SASE for list. John Etter, W2ER, 16 Fairline Dr., East Quogue, NY 11942. 631-653-5350

ACCESSORIES FOR SALE: Spun Aluminum Knob Inlays for most Boatanchors. Collins Dial Drum Overlays. Dakaware Knobs. Charlie Talbott, 13192 Pinnacle Lane, Leesburg VA 20176-6146. 540-822-5643, k3ich@arrl.net

PLEASE VISIT: RadioWorld-Online. Come to see our ham gear, parts, and more. Carl Blomstran PO Box 890473 Houston Tx. 281-660-4571.

PLANS FOR SALE: Build your own "Midget" bug replication by KØYQX, ca 1918, featured by K4TWJ in CQ Magazine, May '98. 10 detailed blueprints. FAX: 507-345-8626 or email bugs@mnic.net

PARTS FOR SALE: Parts, tubes, books, ECT. Send two stamp SASE or email for list. Wayne LeTourneau, POB 62, Wannaska, MN 56761 letourneau@wiktel.com

SERVICE FOR SALE: Collins restoration. Everything inside & out to make it as Art Collins built it. 50 yrs experience. W9OJI / N4FZ, IL, 815-734-4255 or N4PZ@aol.com

PARTS FOR SALE: Complete hardware set to connect Collins PM2 to KWM2 - $19.95 ppd. Warren Hall, KØZQD, POB 282, Ash Grove, MO 65604-0282.

PARTS FOR SALE: New Release. For details send 2-stamp LSASE to: Olde Tyme Radio Co, 2445 Lyttonsville Rd. Ste 317, Silver Spring, MD 20910

EQUIPMENT FOR SALE: Military and commercial communications items. Murphy's Surplus, 401 N. Johnson Ave., El Cajon, CA 92020. 619-444-7717 www.Murphyjunk.com

TUBES FOR SALE: Tube list, new & used, wide variety audio, and ham. Recently expanded. SASE 52c. Bill McCombs, WBØWNQ, 10532 Bartlett Ct., Wichita, KS 67212-1212

WANTED: Original manuals for Heathkit SA-2040 Antenna Tuner and Navy RBM-5 Receiver. Contact Mike 604-988-0112 or mike46@shaw.ca

ACCESSORY FOR SALE: RIT for Collins KWM-2/2A; No modifications needed. $79.95 SASE for details. John Webb, W1ETC, Box 747, Amherst NH 03031 bigspndr@bit-net.com

PARTS FOR SALE: Aluminum heat dissipating plate and grid connectors for all 3, 4 and T series Eimac tubes including 3-500Z, 4-1000, 304T's and others. Alan Price, 1545 S CR 1150 W, Parker City, IN 47368, fixer7526@wmconnect.com

PARTS FOR SALE: Ships radio room clock repros, boatanchor mugs and t-shirts, more. http://www.cafeshops.com/amradio.amradio2 1-877-809-1659

SERVICE FOR SALE: I build hot-rod receivers: R-390A, SP-600, R-388/51J. NC-183D...and transmitters: Valiant, DX-100, T-4X-A-B, HT-32. 51J-4 filter replacements, R390A Hi-fi AM $245.00 ea. Chuck Felton, KDØZS, Wyoming, 307-322-5858, feltondesign@yahoo.com

COLLINS PARTS FOR SALE: Collins reproduction items available through the CRA on www.collinsra.com. Join the CRA and subscribe to the Collins Journal. Dave, W3ST

WANTED: Heathkit GR-81 regen rcvr, working or repairable. Doug Beard, KFØVF, 604 7th St., Springville, IA 52336 319-854-6312

SERVICE FOR SALE: PANEL AND CABINET REFINISHING; Johnson, Hammarlund 180(a), R390(A), & others total restoration & sales; My updated web site: http://w4pnt.8k.com Patty & Dee's Marina; Dee Almquist, 534W. Main St., Waynesboro, VA 22980. 540-249-3161 Cell: 540-480-7179, FAX 540-249-5064, w4pnt@highspeedlink.net

FOR TRADE: Two good RCA 833A's for one Taylor 833A. Also looking for Taylor 204A, 813, TR40M. John H. Walker Jr., 13406W. 128th Terr, Overland Park, KS 66213. PH: 913-782-6455, jhwalker@prodigy.net

WANTED: Meters for following tube testers: Western Electric KS-15750, Weston 774-5 Analyzer. Walter L. Hughes, WB4FPD, 6 Academy Ct., Berryville, VA 22611 540-955-2635

WANTED: Heath amateur band receivers in good to very good condition. Also Kenwood R1000. Jim, 617-489-1498

WANTED: (1N80 diode). 404A 5842/417A – Xtal 43.333 Mcs., Air variable capacitor butterfly two 10pF, Johnson type. FM Unit PB2254 for FT One Yaesu. Msr. Fleureau Claude, F6GGF, 14 Sentier Du Buvier, 92130 Issy-Les, Moulineaux, France

WANTED: 913 CRT for my AM monitor scope. Thanks, Don, w2mpk@dreamscape.com or P.O. Box-73 Chittenango, NY 13037

WANTED: Amps and Detectors for WW I sets, type SE 1071, triode A, triode B, others. Also, Radios: IP 500/SE 143, IP 50llSE 1420, CN 112, CN 239, SE 950, SE 1950, RCA 106, others. Early 20's hi-end sets, like Kennedy 110,220, Grebe CR 18, Cutting and Washington, others. Norden Hauck/Golden Lutz Navy 10 type Superhets, WW I and WW II RDF gear. Looking for DU 1, loop antenna and tuner, coupler CRR 50061 types, Western Electric 540 W cone speaker, a/o driver and pedestal. WW I era headsets, Ericson, Murdock Western Electric Kennedy etc. Knobs: Military type I" and I 3/8" as on Westinghouse RA/DA, WW II spy radios and related stuff. Always buying vintage broadcast tube gear, pre-amps, limiters, compressors, etc., mics by Altec, RCA, Sony, Western Electric, etc. I've got lots of cool radios and stuff to trade or will pay cash. Email best way to contact, but if you use telephone, don't be bashful, leave a message! Ward Kremer, 1119 Petunia Rd, Newport" TN 31821, Ph/Fax: 423-625-1994, witzend99@earthlink.net.

WANTED: GPR90 cabinet, S-Line receiver meter, and a manual for the military TS413U Bill 701-772-6531 ke7kk@earthlink.net

WANTED: Hammarlund SP-600, all models. Need complete unmodified or modified receivers and most all parts. Please call Stan Bryn, AC5TW at 1-800-984-9814 week days between 0800-1100 MST, intor@zianet.com

WANTED: Dial glass for Morrow MB-560 transmitter. Hal, 718-847-3090, landaircom@aol.com

WANTED: GPR90 cabinet, S-Line receiver meter and a manual for the military TS413U Bill, 701-772-6531 ke7kk@earthlink.net

WANTED: Classroom demonstration radio board with AC/DC tube-type radio for our radio club. contact: Mike Grimes, K5MLG, 5306 Creekside Ct. Parker, Texas 75094, 972-384-1133.

WANTED: Aircraft receiver BC-454 control unit MC237A, adaptor FT260A, parts cables for SCR274N. G. Kalisz, AC7YF, 2300 Mt. Ararat Rd, Winslow AZ 86047

WANTED: Eldico SSB-400 or 500, SSB-100 or 100A. Dennis Gehrke, KC7VXD 208-333-8615 kwmssb@cableone.net

WANTED: Top dollar paid for WWII radios, PRC-1, PRC-5, AR-11, SSTR-1, SSTR-5, British B2, need pts for PRS-1 mine detector. Steve Bartkowski, 708-863-3090

WANTED: Metal cabinet that will accept a 19" x 8.75" panel with 17" x 10" chassis. James Schliestett, W4IMQ, 420 Lakeview Dr, Cedartown, GA 30125 770-748-5968, imq@bellsouth.net

WANTED: United Motor Service radios 32VDC schematic & service info model 3205 "Ryder 7-31" 40-49 model "Ryder 4-10" will pay reasonable cost for copies. Don Kuhn, N8KPD, POB 686, Marion, OH, 43301 740-383-5744

WANTED: Audio output transformer for Hallicrafters SX28 part No. 55B009: 10000Ohm C.T. Primary, 100-500-5000 ohm secondary. i3dan@libero.it

WANTED: Working or not, parts sets: Collins R-389 and RYCOM R-1307A "VLF Receivers", Motorola made R-390 "non A", SP-600 "with ceramic disc caps", Nems Clarke and D.E.I. VHF receivers. Dan Gutowski KD8AMS 9753 Easton Rd. Dexter, MI 48130 734-433-1354

WANTED: Sonar CB transceiver model J23 mobile set. 23-channel, tube-type CB radios, also 23-channel mobile sets. Ed, WA7DAX, 1649 E. Stratford Ave., Salt Lake City, UT 84106. 801-484-5853

WANTED: National NTE CW xmtr in working Condx. I love National. Sylvia Thompson, 33 Lawton Foster Rd., Hopkinton, RI 02833. 401-377-4912. n1vj@arrl.net

WANTED: TCS & TBY Navy radios. Ken Kolthoff, K8AXH, PO Box 215, Craig, MO 64437. Work #913-577-8422.

WANTED: PYE, Fairchild, Syncron, Langevin. Richard P. Robinson, PO Box 291666, LA CA 90029 323-839-7293 richmix@erols.com

WANTED: ARC-5 rcvrs, racks, dynamotors. Jim Hebert, 900 N. San Marcos Dr. Lot 15, Apache Junction, AZ 85220

WANTED: Garrard model 80 or similar or Garrard single play turntable. Cartridge and spindle not required but must have pickup shell. Phone 914-666-4523 or write Charles Graham, 4 Fieldwood Dr., Bedford Hills, NY 10507

WANTED: Sideband converters TMC CV-1758, TMC SBC-1, Kahn CV-1982/TSC-26, Kahn RSSB-62-1B, or Delta Electronics ISB-1. working or not, parts sets. Dan Gutowski, KD8AMS, 9753 Easton Rd. Dexter, MI 48130 734-433-1354

WANTED: Scott Special Communications rcvr. EA4JL, please call Kurt Keller, CT, 203-431-9740, k2112@earthlink.net

WANTED: ANY Harvey-Wells speaker, aircraft unit, or military surplus component. Will answer all. Kelley, W8GFG, 9010 Marquette St., St. John IN, 46373, 219-365-4730

WANTED: SCR-602 components, BC-1083, BC-1084 displays, and APS-4 components. Carl Bloom, 714-639-1679

WANTED: Collins 310B-3, basket case OK, 70E-8A PTO per 1948. Chicago CMS-2, pair of Taylor T-21. Jerry, W8GED, CO, 303-979-2323.

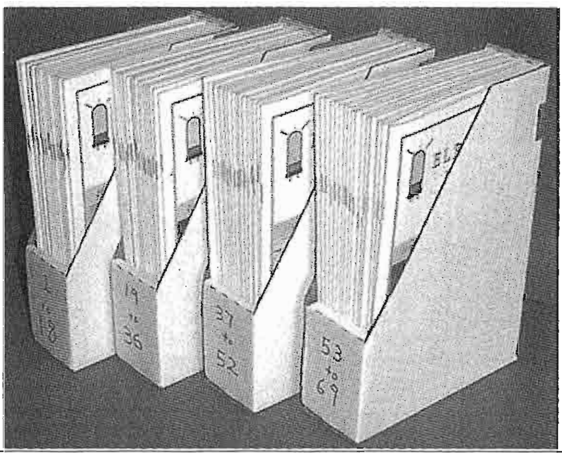
WANTED: Old military radar displays, scopes, antennae, receivers, manuals, etc. Even half ton items! William Donzelli, 15 MacArthur Dr., Carmel, NY 10512. 847-225-2547, aw288@osfn.org

WANTED: Collins R-389 LF receivers, parts, documentation, anecdotes, antidotes. W5OR Don Reaves, PO Box 241455, Little Rock AR, 72223 501-868-1287, w5or@militaryradio.com, www.r-389.com

WANTED: Any TMC Equipment or Manuals, what have you? Will buy or trade. Brent Bailey, 109 Belcourt Dr.,Greenwood, S.C. 29649 864-227-6292 brentw@emeraldis.com

WANTED: Top prices paid for globe shape radio tubes, new or used. Send for buy list or send your list for offers. Write or email: tubes@qwest.net See www.fathauer.com or send for catalog of tubes for sale. George H. Fathauer & Assoc., 688 West. First St., Ste 4, Tempe, AZ 85281. 480-968-7686, Call toll free 877-307-1414

WANTED: Seeking unbuilt Heathkits, Knight kits. Gene Peroni, POB 7164, St. Davids, PA 19087. 610-293-2421



WANTED: Western Electric horns, speakers, amps, and mics. Barry Nadel, POB 29303, San Francisco, CA 94129. museumofsound@earthlink.net

WANTED: Manuals, manuals, and manuals for radio-related equipment to buy or swap. Catalog available. Pete Markavage, WA2CWA, 27 Walling St., Sayreville, NJ 08872. 732-238-8964

WANTED: Postcards of old wireless stations; QSL cards showing pre-WWII ham shacks/equip. George, W2KRM, NY, 631-360-9011, w2krm@optonline.net

WANTED: Info on xmtrs made by Clough-Brengle Co. Used by the CCC, in the mid to late 30's. Any help would be greatly appreciated. Ron Lawrence, KC4YOY, POB 3015, Matthews, NC 28106. 704-289-1166, kc4yoy@trellis.net

WANTED: WW II Japanese xmtrs & rcvrs (parts, plug-in coils) for restoration & ER articles. Ken Lakin, KD6B, 63140 Britta St., Ste. C106, Bend, OR 97701. 541-923-1013. klakin@aol.com

WANTED: Searching for RME CT-100 or 3R9 xmtrs and info about them. David Edsall, W1TDD, 156 Sunset Ave., Amherst, MA 01002. 413-549-0349, dedsall@crocker.com

WANTED: Looking for information on radio and radar equipment aboard the Navy PB4Y-1. Warren, K1BOX, NC, 828-688-1922, k1box@arrl.net

WANTED: WW II German, Japanese, Italian, French equipment, tubes, manuals and parts. Bob Graham, 2105 NW3Oth, Oklahoma City, OK 73112. 405-525-3376, bglcc@aol.com

WANTED: Heath Gear, unassembled kits, catalogs and manuals. Bill Robbins, 5339 Chickadee Dr., Kalamazoo, MI 49009. 616-375-7978, billrobb@net-link.net

WANTED: Incarcerated ham seeks correspondence. w/others on mil (R-390's &backpacks) & tube radios. Also copies of postwar-90's surplus catalogs, backpack specs & photos. W.K. Smith, 44684-083, FCI Cumberland Unit A-1, POB 1000, Cumberland, MD 21501.

WANTED: Hallicrafters HT-33 amplifier dead or alive. W8JKS, 740-998-4518

INFO WANTED: Researching ROTHMAN MODULATION; Have you equipment? Information? Experience using it? Please reply WA2TAK 154 Lexington Ave., Fair Haven, NJ 07704 Tel 732-530-8530 StephenTetorka@cs.com

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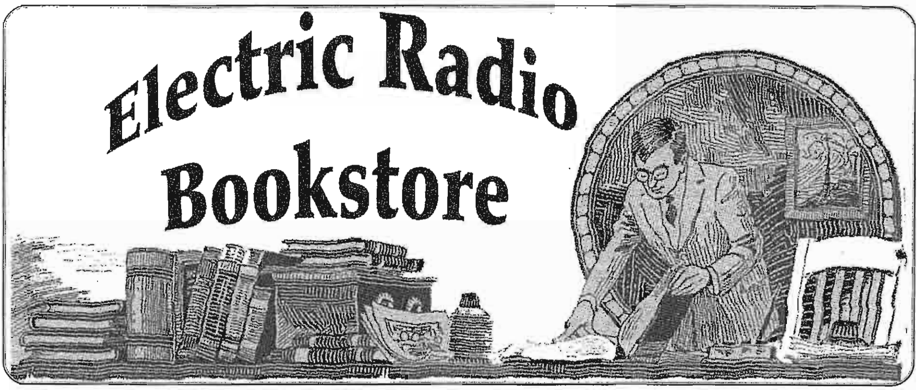

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Heath Nostalgia: Written by Terry Perdue, K8TP, an ex-Heath employee, this 124-page book is a great history of Heath and the Heathkits that we all remember. ------ **$14.95-10% = $13.45**

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Hiram Percy Maxim: Published by Electric Radio, this is the complete biography of HPM, the famous founder of ARRL, by Alice Clink Schumacher, 216 pages. ----- **$19.95-10% = $17.95**

The Collector's Vacuum Tube Handbook: This is a 205 page book that is full of unique, hard-to-find information on tube types that were released before 1934. Includes company histories and good photos. --- **$25.95-10% = $23.35**

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The All-American Five Radio: Although this book is about classic American 5-tube broadcast receivers, it also contains a wealth of accurate information on vacuum tube receivers, proper trouble-shooting, and alignment and is recommended for experienced repairmen and novices alike. 92 pages by Richard McWhorter --**$21.95 - 10% = $19.75**

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Zenith, The Glory Years, 1936 to 1945: 244 high-quality pages all about classic Zenith radios. Hundreds of high-quality color photos, and history from the Zenith company archives, never before available. If you like beautiful Zenith consoles, you will like this book! by Cones, Bryant, and Blakenship --- **$34.95 - 10% = $31.45**

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