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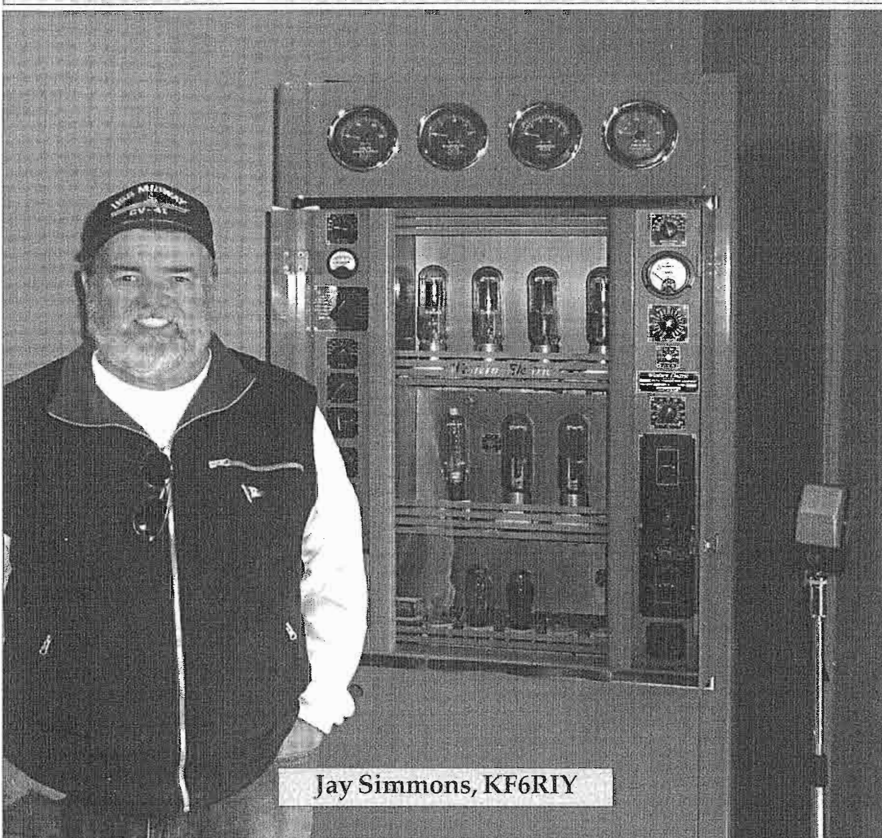
ELECTRIC RADIO

celebrating a bygone era

Number 221 October 2007



Jay Simmons, KF6RIY

ELECTRIC RADIO

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Electric Radio is all about the restoration, maintenance, and continued use of vintage radio equipment. 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. It is dedicated to the generations of radio amateurs, experimenters, and engineers who have preceded us, without whom many features of life, now taken for granted, would not be possible.

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:
Chuck Teeters (W4MEW), Jim Hanlon (W8KGI), Tom Marcellino (W3BYM), Gary Halverson (K6GLH), David Kuraner (K2DK), Bruce Vaughan (NR5Q), Bob Grinder (K7AK), Larry Will (W3LW), Dave Gordon-Smith (G3UUR), Dale Gagnon (KW1I)

Editor's Comments

Electric Radio's "Honor Your Elmer" Contest

The time remaining to enter the Elmer contest is running out! It closes next month, November 30, 2007. Don't wait for the last minute to get in on the fun! In the November issue, I will print a voting form that can be copied and mailed in, or you may send your vote by email. For readers that are not familiar with what we are doing, here are the rules again. The Electric Radio "Honor Your Elmer Contest" is an opportunity to honor the person who helped you and guided your entry into amateur radio and have some fun doing it! These folks deserve some recognition and respect too! Electric Radio is sponsoring the first contest to honor the Elmer that helped you into our avocation, ham radio. The object is to tell your story and share it with the world. What better way to say "thanks" to the person who helped you become the ham you are today? The contest rules are simple, just tell the story! 2000 words would be great, but the story is what's important. Because space is limited in the magazine, we'll put the Elmer stories we receive on the ER web site (www.ermag.com) until November 30, 2007. In December, readers can vote for the winning story, and the winner's story will be printed in Electric Radio. We have lined up some great prizes for the winning stories. Bob Heil at Heil Sound has donated one of his excellent Classic Pro microphones. John Slusser (WF2W) at Radio Daze will be contributing a $100 gift certificate to one of the winners. Other prizes include 1-and-2 year, 1st-class Electric Radio subscriptions. (continued on page 35)

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Cover: Jay Simmons (KF6RIY) is standing in front of a *beautiful* Western Electric 451-A1 broadcast transmitter that was originally installed at radio KIEV, Glendale, California in 1940. It will be on 160 meters shortly. Photographed during a gathering at Brian Thompson's (NI6Q) shack earlier this year this spring, Jay was also instrumental in saving this rare transmitter from destruction, and did part of the restoration work. Jay used to sit in front of the console of this very transmitter in the 1960s. (Photo by Al Parker, N2SAG)

The 1938 National Transmitters
Part 4 , The National NSM Speech Modulator

By Jim Hanlon, W8KGI
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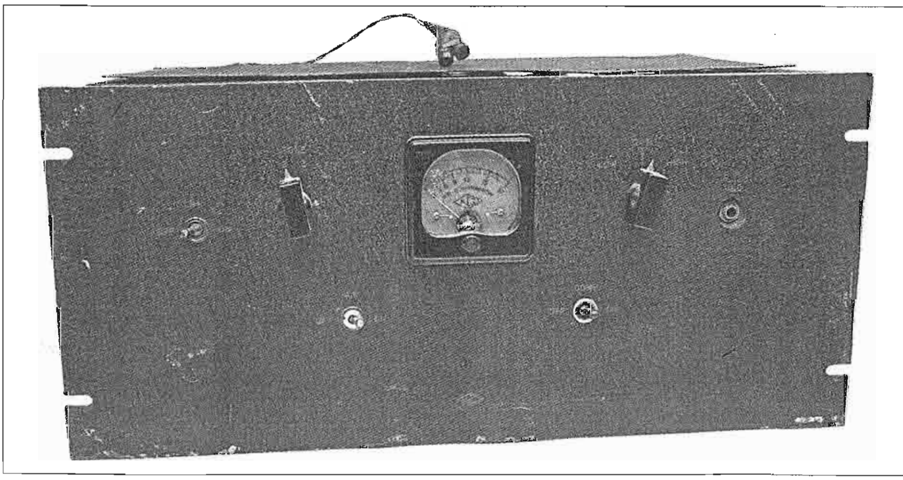
The next unit in the 1938 National Transmitter series that we shall examine is the NSM. The NSM was designed to be the companion modulator for the NTX-30 transmitter. It is interesting that the NSM is not just an NSA, the speech amplifier that we covered in the last article, with 6L6s in the output instead of 2A3s. Beyond the microphone preamp stage, a 6C6 in the NSM and a 57, its 2.5-volt equivalent, in the NSA, the rest of the NSM circuit is quite different from the NSA.

To modulate the NTX-30 fully, National needed at least 30 watts of audio output from its modulator. So, the choice they made for audio-output tubes, not surprisingly, was a pair of 6L6s running in Class AB2. According to the NSM manual, the maximum undistorted output available directly at the tube plates is about 45 watts. The modulation transformer, which is designed to match the 6L6s to a 1400-ohm transmitter load, is about 81% efficient, so the modulation audio available is about 35 watts.

The 6L6s are driven by a 6F8G dual-triode "phase inverter" connected in a "somewhat unusual" circuit, which I'll describe more fully in a moment. A 6D6 remote-cutoff pentode drives the 6F8G, and there is a four-position tone control between this driver and the phase inverter. The variable-gain feature of this remote-cutoff 6D6 is utilized to provide an audio gain-compression feature with control voltage being provided by a 6X5 diode attached to the upper side of the modulation transformer. The microphone-preamp stage is a 6C6, àla the 57 used in the NSA. Again, unlike the NSA where a separate, high-level, input-amplifier stage is employed, a second, high-level, audio-input channel is provided in the NSM by using a center-tapped, audio-gain control between the 6C6 preamp and the 6D6-compression amp



The front view of the NSM shows how it's pretty much a black box.

In the top view, the power supply is on the left and the audio stages are on the right. The 6X5 and 83 sockets in the power supply area are empty.

and by introducing the high-level input on the side of the gain control opposite the mike-preamp input.

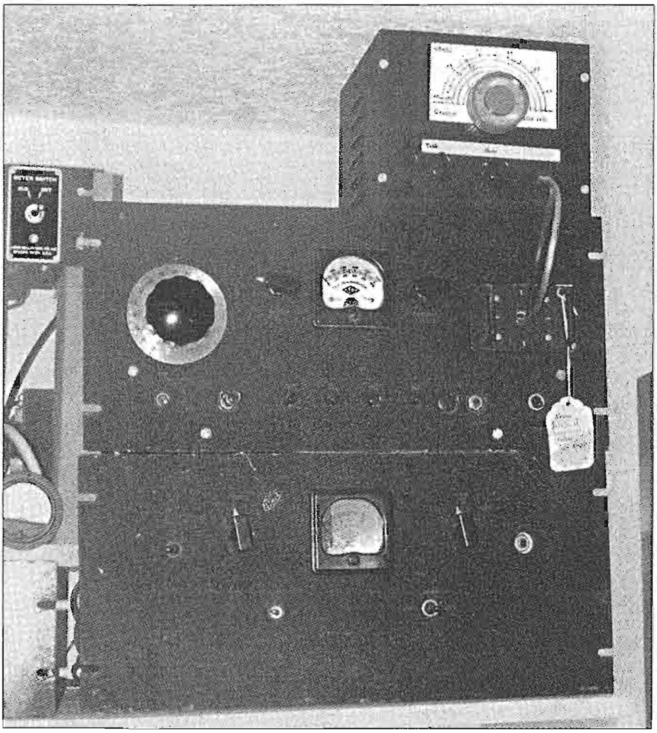
A single 83 mercury-vapor rectifier and a two-section, choke-input filter serves in the power supply. A VR-150 provides a controlled-voltage drop below the plate B+ for the 6L6 screens. Finally, a 6C5 monitors the compression bias developed by the 6X5 and a meter, in its plate, indicates the level of audio compression.

I'll follow the manual for the next few paragraphs to explain the NSM circuit's operating features.

"Frequency Characteristic: The normal frequency characteristic of the NSM has been selected to favor the particular characteristics of voice transmission. ...The frequency characteristic of the NSM is down 10 dB at 25 cycles, 6 dB at 50 cycles, and is flat within 2 dB between 100 and 10,000 cycles.

"A four-position tone control is provided which may be used as follows: In position No. 4, the normal characteristic, as outlined above, is obtained. In position No. 3, the high frequency response is attenuated in such a way that the gain at 5000 cycles is down 10 dB. In position No. 2, the low frequency response is attenuated in such a way that the gain is down 10 dB at 100 cycles. In position No. 1, both high and low frequencies are attenuated.

"Position No. 2 will be found particularly useful when the operator is attempting to work through bad interference, since the effective or 'intelligibility modulation' may be increased about



In the W8KGI shack, the NSM is on the bottom, NTX-30 occupies the middle, and a Geloso VFO is on top.

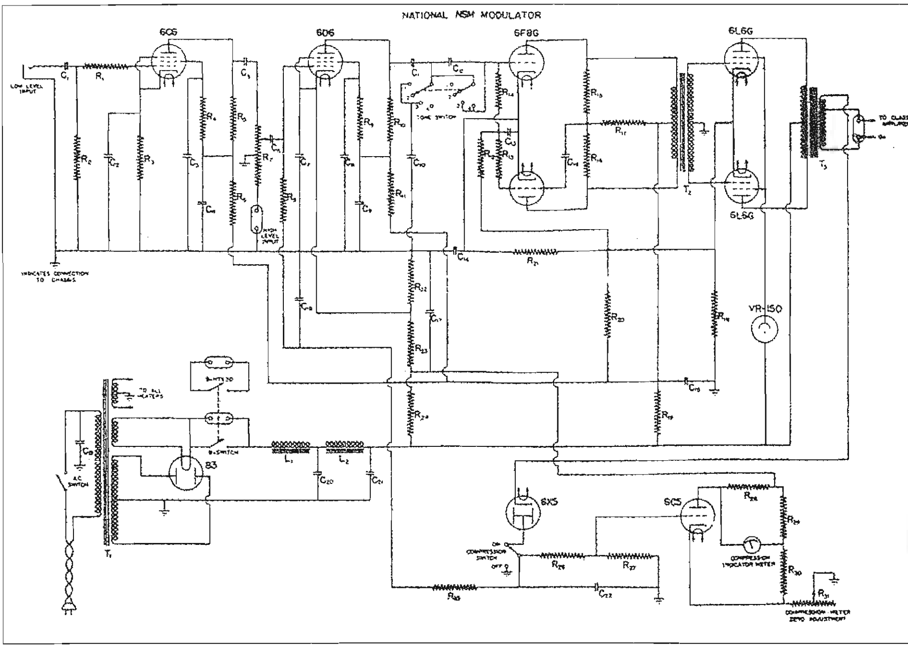
8 dB without actually exceeding 100% modulation. "

Input Circuits

There is about 140 dB of gain from the microphone input to the modulator output. Full output is obtained with an input of about one-half millivolt at the microphone jack. Considering that the average output of a crystal mike is about 30 millivolts, it is no surprise that I barely have to crack the volume control to get full modulation when using my D-104. A relatively low-gain input circuit (90 dB gain) is brought out to terminals at the rear, left-hand side of the chassis. This channel may be used in conjunction with sound equipment having a fairly high-level output, such as would be obtained from a carbon microphone or a phonograph pick-up. Both input circuits utilize the same audio-gain control. Rotating the control clockwise from center connects the high-gain channel, counterclockwise from center connects the low-gain channel.

"Volume Compression: It is doubtful if the average amateur operator realizes that it is practically impossible to operate his transmitter within the limits of 90% and 100% modulation. In order to fulfill this requirement, it would be necessary for him to talk at a uniform level which would not vary more than about one-half of 1 dB. Obviously, this cannot be done and since it is usually necessary to maintain modulation at an average level of at least 80% or 90%, in order to cope with interference and heterodynes, it is no wonder that the majority of phones are considerably over-modulated most of the time. The practical solution to the over-modulation problem lies either in an accurate indicating device, or in volume compression. ...study of the NSM diagram will show how the volume compressor works.

"The high end of the modulation transformer secondary is connected to the cathode of the 6X5 rectifier, the plate circuit of which is grounded through a resistance of 100,000 ohms shunted with a 10 mfd. condenser. The plate end of this network is connected through a suitable filter to the control grid of the 6D6 amplifier tube. It should be noted that the rectifier cathode is supplied with a higher audio voltage than that



The NSM Schematic

connected to the Class C amplifier. Inasmuch as the tap on the transformer secondary is connected directly to the Class C amplifier, modulation voltage will, at the same time, produce enough excess voltage, in that portion of the secondary winding connected to the rectifier cathode, to cause rectification of negative audio peaks. At modulation percentages over 90, the carrier envelope during the negative portion of the cycle is very close to zero since, by definition, 100% modulation occurs when the peak modulator voltage equals the DC supply voltage of the Class C amplifier. Obviously, the extra turns on the modulation transformer secondary will couple an additional modulator voltage to the 6X5 rectifier and as soon as the cathode becomes negative, with respect to ground, current flows in the plate circuit and the resulting voltage drop is impressed upon the grid of the 6D6. This voltage cuts down the amplification of the tube in such a way that the output of the modulator is held essentially constant and it is practically impossible, therefore, to operate the Class C amplifier beyond its modulation capability of 100%.

"This type of compressor 'takes hold' very quickly; in other words, the volume compressor action is almost instantaneous. The action continues, however, until the condenser in the plate circuit of the rectifier discharges through the 100,000-ohm load resistance. Since this action is relatively slow, there is no audio degeneration or distortion in the audio cycle and the compressor simply rides along on the modulation peaks. ...

"The volume compression meter employs a special scale and reads directly the decrease in overall gain of the speech amplifier when the compressor is in operation. ...When it is remembered that a 6 dB increase means a power change of 400% and that this increase would result in 180% modulation (if the modulator tubes could handle it), it is evident

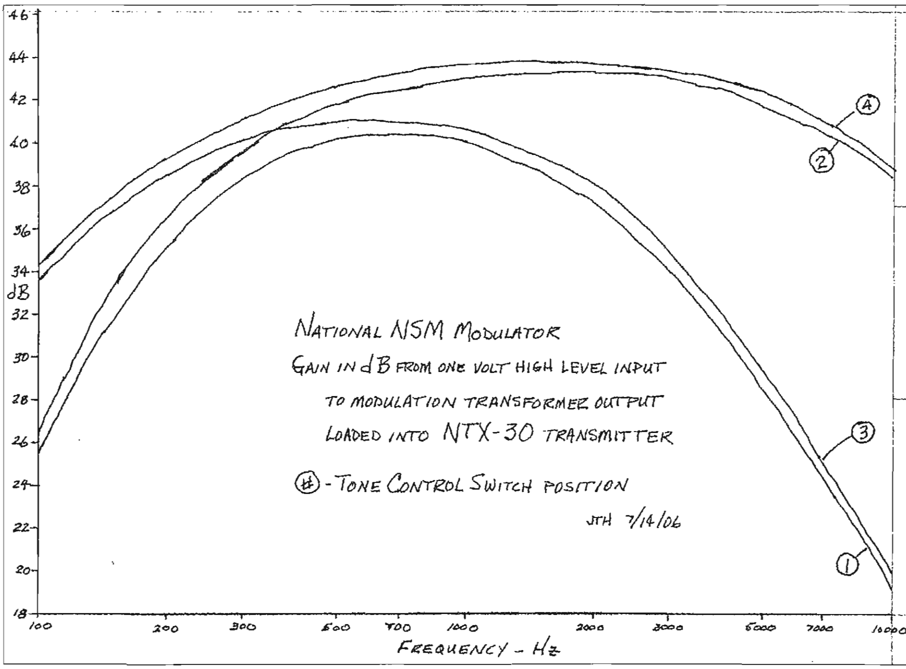


Figure 1: Frequency Response of NSM Modulator as a Function of Tone Control Setting

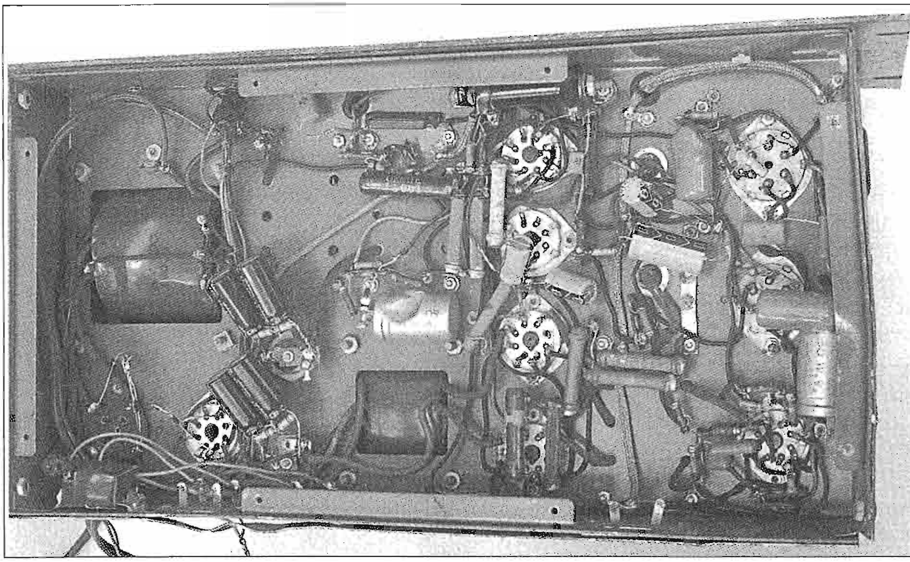
that the 17 dB range of the compression meter is ample and in use the meter seldom reads over 10 dB. "

Phase Inverter

The NSM manual explains the "somewhat unusual" circuit used here: "Referring to the circuit diagram, it will be seen that the upper triode has a voltage divider network connected between the plate and B+ with the grid of the lower triode fed from a tap. This part of the circuit is quite conventional but a self-balancing effect is obtained by connecting a resistor between the plate of the lower triode and the tap which feeds the grid. Briefly, the action is as follows: The resistor network of the upper triode supplies the grid of the lower triode unit with more audio voltage than is actually needed to obtain balanced output. This excess voltage is, of course, amplified by the lower triode and appears in its plate circuit. Since the plate resistor previously mentioned is connected to the grid excitation tap and since a portion of the total resistance (between B+ and the grid tap) is common to both grid and plate circuits, there will be a bucking action which will equalize the excess grid voltage and will keep the circuit as a whole very closely balanced. The self-balancing action is very desirable since it will accurately compensate for any slight differences between the two triode sections of the 6F8G tube and will assure good push-pull action, correct balance in the transformer primary, etc., with negligible distortion. "

Restoration

This particular NSM was not in the best condition when it first came home. It came to me from Bill Fizette (W2DGB) along with its brother NTX-30. Bill had acquired the NSM from John Nagle's estate sometime in the 1990s. I don't know to whom it belonged before John. My wife's favorite cousin shipped it home to me from Pennsylvania via UPS, and



NSM Bottom View: The caps have been replaced, but the resistors are original. Note the crushed capacitor can in the middle. The bends in the metal are not an illusion!

amazingly they did not do any additional damage.

As it arrived, there were dents and bends in the chassis, cabinet and lid, the bottom plate was missing, several parts under the chassis had been crushed, one shielded wire that had been pinched was found shorted, and it was very dirty. But, as discouraging as that may sound, other than those few cosmetic items, there really wasn't much wrong with it! After all, the NSM is a 1930's National and they were able to go through Hell and High Water[1] and still come out working. I did a general cleaning by scrubbing with Formula 409®, straightened the metal as best I could using several Jorgensen clamps and a rubber hammer, and eventually I made a new bottom plate from thin-sheet steel. As with the NTX-30, most of the original capacitors, including the filters, were leaky or shorted, so I replaced all of them. Many of the old, body-end-dot resistors were beyond 20% out of tolerance, but I did not immediately replace them since I didn't want to spoil the vintage looks of the unit any more than necessary to get it running. As it turned out, the NSM worked fine even with the resistors a bit off, so they are still in place.

As with the NTX-30, I replaced the 83 mercury-vapor rectifier with silicon diodes (two, 1000-Volt, 1-amp units in series for each side). I also replaced the 6X5-compressor rectifier with silicon diodes. The peak heater-to-cathode voltage rating for a 6X5 is 450 volts max when the heater is negative with respect to the cathode. While that is theoretically adequate for the job it is called upon to do in the NSM, I fried several 6X5s via heater-to-cathode shorts in the 300-volt power supply for my novice transmitter back in 1952, and I didn't want to chance my 50-year-old-junk box tubes or the NSM-modulation transformer with the same kind of stress.

With those repairs done, I fired up the NSM first into a resistive dummy load and later into the NTX-30, and it worked as advertised! Not at all bad for a 68-year-old semi-basket case!

Just for fun, I did run the NSM's frequency response by driving the high-level input with an audio oscillator. **Figure 1** shows the resulting gain in dB versus frequency for the four positions of the tone control. As you can see, the general shape of the response at the four tone-switch positions is what it should be. Position 4 is broad-banded. Position 3 cuts the high-frequency response. Position 2 cuts the low-frequency response. And, position 1 cuts both high and low-frequency response. The absolute gain dropoff at the low and high ends is a bit more than advertised in the Manual, perhaps due to aging of some of the resistors. But, the overall ranges are still quite acceptable and usable. On the air with the NTX-30 and NSM pair, the guys on the Colorado Morning Net would rather listen to me on either position 4 or 2, but I suspect position 1 would do the best with low signal levels in cutting through the noise.

And yes, the compressor circuit does a very nice job of limiting over-modulation and yet of allowing me to keep a high modulation percentage. I just keep an eye on the meter and talk into the D-104 so that the compression runs at the 10-dB level, or less, and things sound just fine. The NTX-30 and NSM combo is the only one of my many AM rigs where I have certainty that I am modulating properly.

Incidentally, this compression scheme could be easily implemented in a lot of high-level boatanchor modulators. While no ordinary modulation transformers have that additional winding on one end that allows the compression rectifier to go into conduction just a little before the negative modulation peak reaches zero volts, it would be easy to hang a fixed-voltage source, a 9-volt transistor radio battery for example, out at the end of the modulation transformer. Connect the positive end of the battery to the end of the transformer winding and the negative end of the battery to the compression rectifier cathode, and you would start to develop compression bias as soon as the end of the modulation transformer dropped to less than 9-volts positive above ground.

Odds and Ends

The NSM weighs in at a hefty 51 pounds, and it sold in 1939 for $87. A relay-rack model, like mine, was available for an additional $6. It was first advertised in *QST* for March 1939, on the inside back cover. Interestingly, that ad says that the first and second amplifier tubes are a 57 and a 58, the 2.5-volt heater equivalents of the 6C6 and 6D6 that actually showed up in production units. It would appear that the 6.3-volt tubes had improved enough by then, as we have seen in the NSA and NTE articles, so that it was not necessary to use the 2.5-volt tubes to avoid hum. The last ad for the NSM was on *QST*'s cover 3 for January 1941. It showed an NTX-30 and NSM pair in a rack with an HRO receiver. The "National Page" ad in *QST* for April 1942 is devoted to using the NSM as a public-address amplifier for the duration of the war. After that, no mention was made of the NSM or the NTX-30 in any National *QST* ads in.

Next month, if I can keep up with things, we will review the big gun in the National transmitter line, their 600-watt transmitter. This particular rig has a special story associated with it that I hope you will enjoy. So once again, stay tuned!

1. The National ad "Hell – And High Water," *QST*, ARRL, August 1942, Cover 3, shows an HRO burned in a building fire that worked after soot was wiped from the tuning condenser rotors, and it tells about another HRO that was dropped into salt water that worked without any repair.

COMBINATION

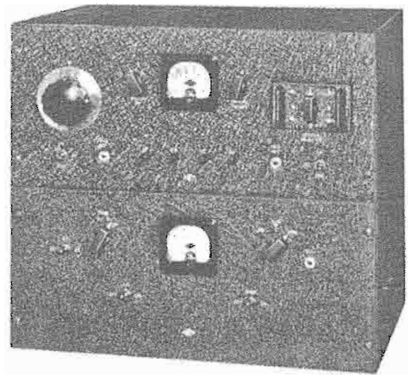
The NSM Modulator unit and NTX-30 transmitter are available as a combination unit in a steel cabinet finished in black wrinkle. Net price for the Combination, with equipment as listed with the single units above.................... $207.00

SINGLE UNITS

The Type NSM Modulator, complete with tubes and mounted in the table model steel cabinet, finished in black wrinkle, as illustrated below. Net Price.... $78.00

The Type NSM can be furnished with a 1/8" steel relay rack panel at an additional net of.................. $6.00

The NTX-30 Transmitter, complete with tubes, crystal holder (but less crystals), and four sets of tank coils for 10, 20, 40 and 80 meter operation, in steel cabinet, black wrinkle finish. Net Price............. $117.00



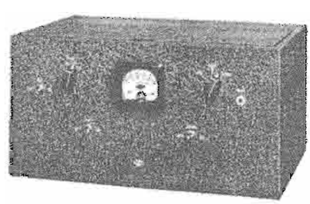
A MODULATOR for the NTX-30 Transmitter

The new Type NSM Modulator Unit is intended particularly for use with the NTX-30 Transmitter, but its many advanced features make it desirable for any modulating job within its 30 watt rating. Typical among its features are Automatic Volume Compression, permitting high modulation levels without danger of overmodulation, its DB meter indicating the amount of compression, its four-position tone control which cuts either highs or lows, or both, or leaves intact the normal range of 50 to 10,000 cycles, and its two separate input circuits. We shall be pleased to have you inspect the new NSM at your dealers. It is thoroughly engineered, and of high quality.

AS A SINGLE UNIT

SPECIFICATIONS

Four stages of resistance-coupled amplification with 57 input, 58 second stage, 6F8G phase inverter, and push pull 6L6G output — Power gain approximately 135 db, output 30 watts — 6X5 high voltage rectifier used in Automatic Volume Compression circuit — VR-150 Voltage Regulator. Two separate input circuits, one of which omits the first 57 amplifier tube — Frequency response flat from 50 to 10,000 cycles.



The NSM Modulator is available as a single unit, with either relay rack mounting or a table model cabinet similar in appearance to the NTX-30 Transmitter.

NATIONAL COMPANY, INC., MALDEN, MASS.

This ad is from a booklet written by James Millen, published February 1939, apparently after Millen left the National Company. It was titled "A Combination Adjustable crystal 1 00-1000 KC Oscillator - For use as a secondary standard of frequency by Amateur Transmitting Stations." It was also used as the March 1939 *QST* ad. (*QST* Scan Courtesy of K4OAH)

ER

RF Performance Testing of the R-390A Receiver
Part 1, Improving Intermod Performance

By Bill Feldmann, N6PY, SK

[Editor's Note: In this issue, I am presenting Bill's last 2-part article that he finished during late fall, 2006. Bill was getting interested in high-performance electron-tube receivers, and this article, and the one that follows next month, reflect Bill's natural ability to find long-standing problems in his equipment and do something about it. I hope the article looks as Bill would have wanted it.]

Introduction

After writing R-390A articles for Electric Radio, issues 207 and 208, I didn't expect to do another one. After discovering an unexpected problem that can compromise the performance of an R-390A and damage its filters, I wrote this part of the article to describe a simple 10-cent solution. In part two, I'll describe the test fixture and the methods I use for testing receiver performance. Hopefully, this article will also serve as an introduction to factors causing poor receiver RF and IF performance for those readers not primarily interested in the R-390A/URR.

While doing an intermod-performance test on my R-390A and moving the "selectivity" switch from 1 kc to 2 kc, the audio level of the spurious intermod tone immediately increased in my headphones. This was totally unexpected because IF selectivity should have had very little affect on the spurious-intermod level. This discovery led to the study described below.

First, let's define receiver "MDS" and "IMD performance" so those readers not familiar with the terms will understand their significance and how they relate to this article.

One of the most important features of a receiver is its sensitivity, or its ability to copy very weak signals. To determine sensitivity, we do an electrical test to find the minimum discernible signal (MDS), which is the lowest signal we can successfully copy. This signal must be of sufficient strength to overcome the receiver's internally-generated noise or you won't be able to copy it. This usually will be +3 dB for a CW signal and +6-to-10 dB for voice modes. (The voice-mode MDS can vary depending on the nature of the test.) For CW sensitivity testing, the MDS is usually defined as a signal

Figure 1: N6PY's IMD test box is shown connected to his R-390A/URR receiver.

that produces an audio-output voltage that is 3 dB above the receiver's internal noise. This is about the weakest CW signal most operators can successfully copy without the presence of QRM or QRN, and typically is less than one millionth of a volt at the input to the receiver!

We also want to know the receiver's ability to copy a weak signal in the presence of strong signal you don't want to copy, that is very close in frequency, and is outside of the IF passband. These unwanted strong signals can cause problems like cross modulation, intermodulation, blocking, and reciprocal mixing.

Blocking will reduce the receiver's gain and cross modulation will transfer the modulation of a very strong signal to a weaker one. Reciprocal mixing is actually a type of modulation that is caused by oscillator noise. It's a problem in newer receivers, caused by digital synthesizers, but is not usually found in older receivers because they use "clean" L/C VFOs and crystal-controlled local oscillators.

The problem that usually occurs in any style of receiver is intermodulation, which are receiver-produced signals, or "phantoms," that are caused by the mixing action between strong signals you can't hear and the weaker signal that you are trying to copy.

Receiver weak-signal dynamic range (DR) is defined as the difference between the power (in dBm) of the IMD and MDS signals. Besides having a low MDS, we want our receivers to have as high a DR as possible. This DR "figure of merit" will also allow some interesting tradeoffs, to be described later in Part 2. (The term "dBm" is the number of decibels above or below 1 milliwatt for power measurements and 1 millivolt for voltage measurements.)

Finding Out About Receiver Defects

My first bad experience with an IMD problem was in the late 1970s. At that time, I worked a lot of CW using a Collins 75A-3 receiver and a 32V-2 transmitter. The 75A-3 was stock except for a homebrew product detector and fast-attack AGC system that made it a good receiver for all modes. It was also desired to work mobile SSB, so a FT-101B imported rig was purchased. After installing a CW filter, some 20-meter CW was tried. At first, I was extremely pleased by all of the new signals. Some were heard that couldn't be heard with the old 75A3. Some had calls of local stations, but sounded strange, like long-path DX. Unfortunately, many were causing QRM to weak stations I was trying to work, and when called they didn't answer. When the FT-101B's attenuator was turned on, they seemed to disappear. Also, when receiving SSB, there seemed to be more splatter from nearby QSOs than noticed with the Collins 75A-3.

When these "ghost" signals and excessive-SSB splatter were described to a very knowledgeable friend, he informed me how my imported FT-101B had poor intermodulation (IMD) performance. He said they were not coming from the antenna, but were spurious signals actually generated within the FT-101B. He then sent me the classic article[1] by Wes Hayward (W7ZOI). It described how such IMD is caused by the mixing action of nearby strong signals and their harmonics, how to test a receiver to find its resistance to IMD, and it mentioned that if you are going to run only one strong-signal test the two-signal IMD test will be the best choice. Also, the article claimed that the test evaluating RF and IF circuit performance for CW will give an excellent indication of the receiver's performance for wider-band modes, like AM or SSB.

Learning to Test a Receiver

I built a battery-powered, IMD-test fixture that generated two equal-strength signals at 14.020 Mc and 14.040 Mc between -35 dBm and -74 dBm of output power, using the oscillator and combiner circuits suggested in the article. By connecting the fixture's two-signal output (through a signal combiner) to a receiver that was tuned to 14.060 kc and adjusting the fixture's attenuators, the receiver's IMD resistance is determined as the power of the two signals that causes a new tone, 3-dB above noise floor, to appear. "Noise floor" is the voltage measured across the audio output when the audio gain is turned up to produce 2/3 of the rated audio-output power.

By turning on the 14.040-Mc oscillator only and tuning the receiver to 14.040 Mc, and with an -80 dB attenuator between the fixture and the receiver, its MDS was found by using the same method used for IMD detection. The dynamic range, or "DR," was then calculated to be the difference in decibels between the MDS and the IMD signal powers. I'll go into more details on this fixture in Part 2.

Using this fixture to test many receivers of known quality showed how the excellent ones had a dynamic range greater than 90 dB and a MDS below minus 40 dBm while poor ones had a DR below 75 dB and a MDS above minus 130 dBm. The Yaesu FT-101B was terrible at 68 dB while the 75A-3 was very good at 86 dB.

The FT-101B's problem was caused by having its IF crystal filter at the end of the IF amplifier, near the detector, allowing out-of-band signals to overload the preceeding IF-amplifier stages. Adding a second filter just before the IF amplifier stages increased the DR to an acceptable 85 dB. After reporting this finding to the Fox Tango Club, they later started selling filter-modification kits.

R-390A IMD and Dynamic Range

When the R-390A's IMD problem was discovered, I didn't really want to believe it existed. So, the MDS, IMD, and resulting dynamic range vs. IF selectivity was tested for both the R-390 and the R-390A. The recorded data are shown in **Table 1**.

One caution: Please don't try to directly compare these power levels with published data taken by technicians that use different test methods. Many of you that are familiar with receiver test precedures will notice how the large change in MDS that accompanies changes in selectivity, usually seen using other test methods, is not seen here. Later, in Part 2, the reason for this discrepancy, and why I feel my method

SELECTIVITY	MDS390	MDS390A	IMD390	IMD390A	DR390	DR390A
0.1kc	-145dbm	-145dbm	-51dbm	-48dbm	94db	97db
1.0kc	-145dbm	-145dbm	-51dbm	-48dbm	94db	97db
2.0kc	-143dbm	-141dbm	-51dbm	-65dbm	92db	76db
4.0kc	-143dbm	-141dbm	-51dbm	-68dbm	92db	73db
8.0kc	-141dbm	-141dbm	-51dbm	-71dbm	90db	70db
16.0kc	-141dbm	-139dbm	-51dbm	-74dbm	90db	65db

Table 1: MDS and IMD data for the R-390A at six diferent bandwidths.
MDS = RF input power at 14.040 Mc to produce an audio signal 3-dB above the receiver's internal noise.
IMD = RF input power at 14.040 Mc and 14.020 Mc to produce an audio signal 3 dB above the receiver's internal noise at 14.000 Mc or 14.060 Mc.
DR = A figure of merit equal to the difference between the IMD and MDS signal levels.

better simulates the way we use our receivers, will be discussed.

In Table 1, the MDS of both receivers is very close for all selectivities. In fact, both have the best MDS of any stock receiver I've tested. The R-390 has a very good, constant IMD resistance of minus 51 dBm and a DR between 94 and 90 dB. Its performance is absolutely outstanding for a 500-kc to 32-Mc receiver whose design dates back to 1949. Unfortunately, the DR performance of the R-390A goes from excellent, 97 dB at .1-kc and 1-kc bandwidth, to basically terrible at 16 kc where it's even worse than my stock FT-101B! But, since the wider bandwidths were mostly used by the military for strong voice or RTTY signals with the AGC switched on, this problem wouldn't have been as noticeable. The Table 1 IMD and DR data may also explain why many of us with both models prefer the R-390 for AM-signal reception.

Those of you with R-390As, don't despair and put them up for sale! Read on for a very simple solution that makes the R-390A's IMD performance equal to the R-390's.

I mentioned these unexpected test results to Ray Osterwald (NØDMS), the Electric Radio editor. He repeated my tests, using equipment much better than my homebrew fixture, on his R-390A that has a stock 8-kc filter and Longwave aftermarket filters . With the stock 8-kc filter, he found reduced IMD performance, and with the Longwave filters there was better IMD performance, which confirmed my own data. Since the stock 2-kc filter is too narrow for good SSB reception, I ordered Longwave 2.5-kc SSB and 6-kc AM filters from the ER store. [Note: These filters have since been discontinued...ed]

After removing the selectivity switch shaft for better access, installing the new filters was fairly easy. The 16-kc filter was removed and replaced with the new 6-kc filter. The switch wiring was connected so it selects the 6-kc filter between the 4-kc and 8-kc positions. I replaced the 2-kc filter with the new 2.5-kc filter, taking care not to damage the brittle plastic standoff attached to one of the mounting screws. The resistor's wires were cut loose from the standoff and then the standoff was unscrewed to exposing the nut securing the old filter's mounting screw. If you try to turn this screw before removing the standoff, you'll break it. Because the Longwave filters contain all the necessary electronic components to match R-390A impedance levels, the caps across the old filter's terminals shouldn't be connected to the new filters. The R-390A was powered up with the IF module connected, but sitting on top of the radio. The crystal calibrator was used to peak the trimmer caps in the new filters. The trimmer adjustment screws are located on the top and bottom of the filter. In the future I'll make a plate to go over the bandwidths on the front panel for showing the new bandwidths. [Editor's note: Years ago, I interviewed Collins engineers who worked with the R-390A. I was told how the trimmers across the stock R-390A filters were to be used to reduce passband ripple and were not to be used as an IF alignment. This requires sweep equipment.]

Retesting the R-390A for IMD and MDS gave the results shown in Column 3 of Table 2. Comparing the "IMD390A" data to that in Column 5 of Table 1 shows how the Longwave filters made a significant improvement of about 13 dB. But, the IMD performance of the stock 4-kc and 8-kc filters still needed improvment.

A Simple IF-Amplifier Modification

Using the IMD fixture to introduce a –48 dBm, 14.040-Mc signal into the R-390A, the selectivity was set at 4 kc and

SELECTIVITY	MDS390A"	IMD390A	IMD390A'	IMD390A"	DR390A"
0.1kc	-145dbm	-48dbm	-48dbm	-48dbm	97db
1.0kc	-145dbm	-51dbm	-48dbm	-48dbm	97db
2.5kc*	-145dbm	-55dbm	-48dbm	-48dbm	97db
4.0kc	-143dbm	-68dbm	-58dbm	-51dbm	92db
6.0kc*	-141dbm	-58dbm	-48dbm	-48dbm	93db
8.0kc	-141dbm	-71dbm	-58dbm	-51dbm	90db

Table 2

* 2.5kc and 6kc selectivity use the aftermarket Longwave filters.
IMD390A = The IMD power after changing to the Longwave filters.
IMD390A' = The IMD power after adding a 10-k resistor at the output of the 1st-IF amp.
IMD390A" = The IMD power after decreasing the 10-k resistor to 3.3k.
DR390A" = The dynamic range after the addition of the 3.3-k resistor and Longwave filters.
MDS390A" = The MDS after both the addition of the 3.3-k resistor and the Longwave filters.

the dial tuned to 14.060 Mc so the signal was 20 kc above the filter's passband. This –48 dBm input level was the same strength as the signal that was causing the IMD spur and was outside the 1-kc selectivity. Using a scope, I looked at the signal at the filter's input and found no evidence of clipping or distortion of the resulting IF-signal's sine wave. This seemed to eliminate problems with the first IF-amplifier's output. But, the nearly 30-volt RMS strength of this signal was nearly 15 dB higher than the 5-volt RMS-maximum level specified for these filters by the Collins Radio Company.

From these observations, the IMD spurs were suspected to have been generated within the stock filters. The R-390A's IMD tested excellent below 2-kc selectivity and poor at wider settings. This is because the crystal filter used in the narrow bandwidths blocks the strong signals that cause the IMD problems. [Editor's note: When the crystal filter is selected, it is in series with the 2-kc filter.]

When informing Mike Student (W7MS) of this IMD problem, he mentioned how Dallas Lankford had found the same problem and had documented it earlier. Lankford also reported excessively-high, 1st-IF amplifier output levels and added an additional 6-kc filter at the last mixer's output to solve the IMD problem. I felt that all of his extra hardware was a "kludged" solution and there must be a much simpler solution if the filters (not the 1st-IF amp) were the cause of IMD.

Researching the history of the R-390A's development in the Collins Radio Company declassified document "Cost Reduction Program for Radio Receivers R-390A/URR, Final Progress Report," dated 20 February 1956, indicated the addition of mechanical filters was done primarily as a cost savings because the R-390's variable-selectivity IF transformers were expensive and difficult to produce. Addition of mechanical filters was evidently done the easiest way possible so as to not affect the existing crystal-filter's design. But, putting the mechanical filters at the output of the 1st-IF amp exposed them to excessively-high input signals.

An experiment was tried. I wanted to reduce the gain of amplifier V501 by placing a 10-k resistor between the input

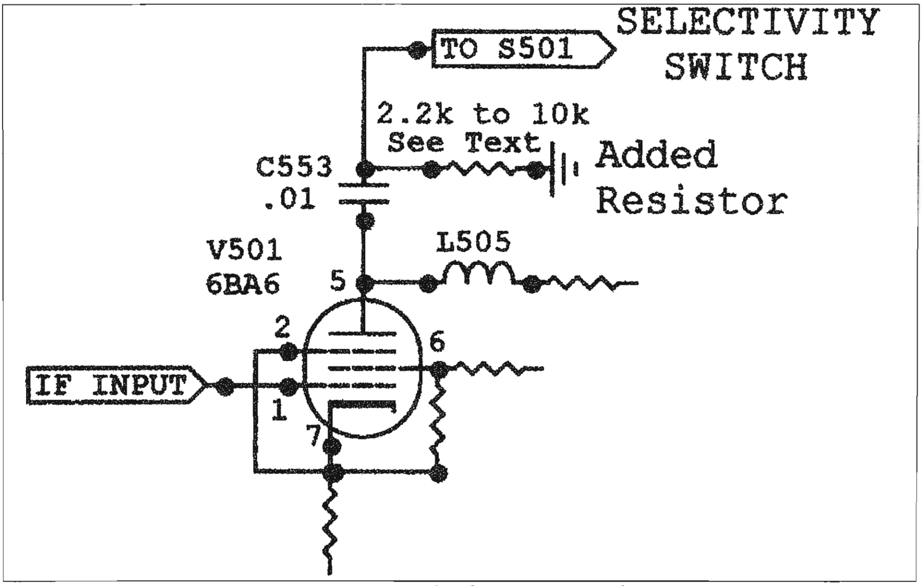


Figure 2: Adding a 10-cent resistor to the first IF-amplifier greatly improves the R-390A/URR IMD performance.

of the selectivity switch and ground, as shown in the **Figure 2** drawing. It was installed next to C553, the cap that was replaced with a 1-kv disc ceramic in my earlier article. If you didn't replace that cap, shame on you! The added resistor resulted in the improvement in IMD performance, documented as IMD390A' in Table 2, and giving additional evidence of how IMD was caused within the filters. The resistor gives this amplifier a load that is lower in resistance and is less reactive, which should also improve its IMD performance.

To maintain the same overall IF gain, the module's gain pot controlling the 3rd-IF stage gain was adjusted for the same carrier-meter sensitivity obtained before adding the resistor. I usually set this pot for a meter reading of 40 dB with a 100-µv antenna signal at 3.900 Mc so the meter will give readings over the 2-µv to .1-volt RF-input dynamic range of the R-390A's AGC. To further improve IMD resistance, the resistor was changed to 3.3k, further decreasing the filter's input voltage. The 1st-IF amplifier gain was now 15 dB below its original stock level. The IF-gain pot was set near 85% of its maximum gain to compensate for the reduced 1st-IF gain.

Repeating the IMD and MDS tests, I was very pleased to find absolutely no decrease in sensitivity when comparing the MDS data in tables 1 and 2. The DR was now excellent when using the 2.5-kc and 6-kc filters, and was as good as the R-390 when using the stock 4-kc and 8-kc filters. (See columns 5 and 6 of Table 2 and columns 4 and 6 of Table 1.) A 2.2-k resistor was also added in series with the input of each of the Longwave filters so the carrier meter's calibration wouldn't change when switching between the old and new filters. This was necessary because of the lower insertion loss (-6 dB) of the Longwave filters.

Because other R-390As may have different overall RF and IF gain, and for those readers not having a way to test for IMD, I recommend custom selection of the added resistor that's shown in Figure 2. Select a resistor value between 2.2k and 10k so the IF-module gain pot will be set between 75% and 90% of the setting for maximum-IF gain, giving a carrier-meter reading of 40 dB with a 100-µv antenna-input signal on 3.900 Mc. The pot setting can be confirmed to be between 2.5k and 1k to ground with an ohmmeter. If you don't have a signal generator, use the crystal-calibrator signal and set the IF-gain pot to obtain the same carrier-meter reading you got before adding the resistor. This is assuming the IF-gain pot was originally set properly!

Some R-390As have sensitivity so poor that they would probably never see excessively-high filter inputs levels because of poor RF or IF performance. If the the IF-gain pot is already set very high, above 75% of its maximum-clockwise setting, you probably have bad RF or IF components or poor RF/IF alignment. These problems should be corrected before adding the resistor.

Some of you may argue that you've never experienced strong-signal problems with a R-390A and it met the military-performance specification. In the mid 1950s, only receiver blocking and cross-modulation resistance for strong signals were specified, and IMD resistance was usually not. The R-390A/URR has excellent IMD performance using 1-kc selectivity, which would most likely be used for weak-CW signals. Wider selectivity would have been used for AM or RTTY reception, strong enough for the AGC system to attenuate any IMD-causing strong signals. It also has an excellent preselector system that greatly reduces the number of strong signals presented to the filters. However, those of us who use our R-390As for weak-signal reception, below its AGC threshold, on the higher amateur bands, where the noise level can be very low, could experience IMD problems. This situation makes this simple-resistor modification worthwhile.

Additionally, because excessively-strong IF signals can be presented to a filter's input with the AGC off, the resistor addition would help to prevent filter damage. I've also noticed less "howling" noise when using .1-kc selectivity after this modification. This is probably because reducing the 1st-IF amp's gain reduces stray-feedback coupling into the high-Q crystal filter. When copying weak AM signals on the noisy lower-HF bands, especially on 160 meters, the R-390A's audio sounds clearer than before the resistor was added. This probably is from lower total-noise power being presented to the filter's input, further reducing distortion. Just for these three reasons, the simple addition of the ten-cent resistor shown in Figure 2 is worth the trouble.

When the IMD study was mentioned to Chuck Seeton (WAØZHH) during a QSO, he made an excellent observation. He said that the filter transducers use little coils with magnetic cores to convert electrical energy into mechanical energy. Excessive coil current could easily cause IMD distortion by saturating the small, iron-transducer cores. This is the best explanation I've found for the mechanism producing the filter's IMD. [Editor's note: New-style Collins mechanical filters use an entirely different transducer, and are called "torsional" mechanical filters.]

Part 2 [next month] will give a detailed description of my fixture and test methods. I'll also discuss some receiver-design factors that influence sensitivity and strong-signal performance. So, stay tuned in!

<u>References</u>:

W. Hayward (W7ZOI), July 1975, "Defining and Measuring Receiver Dynamic Range," <u>QST</u>, page 15.

ER

The Panel-Meter Analyzer

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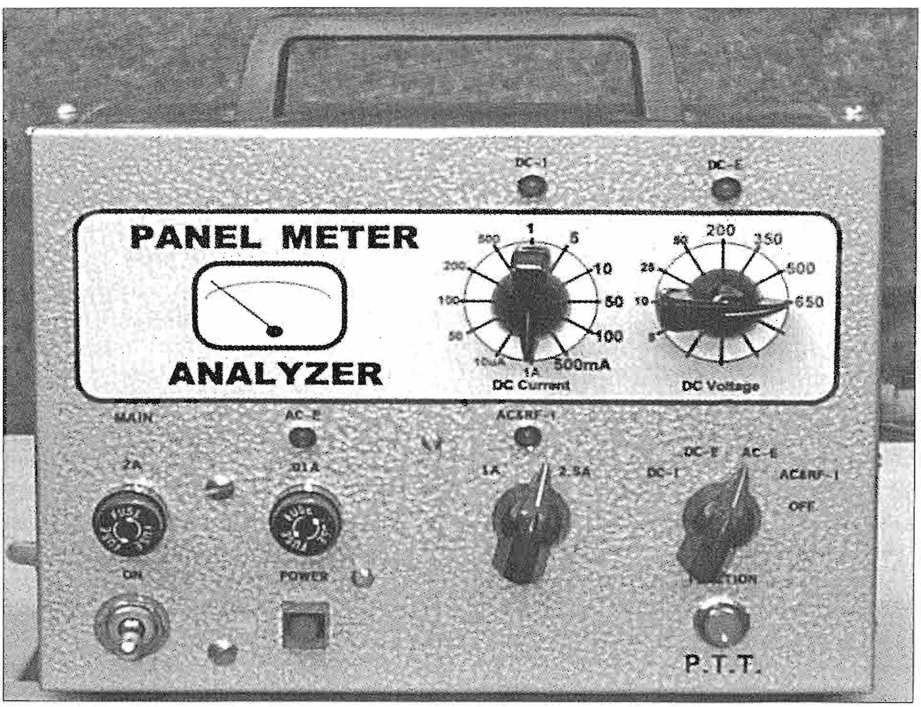
I've always been impressed with the word "analyzer." When part of the label, it makes equipment sound so very professional. According to Webster's New Collegiate Dictionary, analyze means "to study the factors of (a situation, problem, or the like) in detail, in order to determine the solution or outcome." I would imagine this definition hasn't changed much from my dictionary that I purchased in 1961 while in school, and if I stretch the meaning a bit I can apply it to my project.

Builders and restorers will find this project most useful. I have several boxes of meters and just can't leave one on a tailgater's table when the price is right. Now, what do we all do when it comes time to use these precious gems from the past? If you are like me, you gather the necessary equipment, such as a VOM, DVM, power supplies, batteries, resistors, and those invaluable clip leads. The job gets done despite the poor connections and the clip leads that continuously fall off.

The idea for this project has been kicking around here for a long time, but on a much smaller scale. I started out wanting a small pocket current-only tester to take to the hamfest to check



The completed meter tester has a Heathkit handle on the top of the case and a test jack on the right side.

meter movements. Even when spending the enormous sum of two dollars for a meter, it would be nice to know if it still works.

In our boatanchor world, vacuum tubes are most prominent with the solid-state rectifier coming in as a close second in restoration work. Most of my test and measuring equipment contain bottles that glow. I do use a few pieces of 1970's test gear that are hybrids, containing both tubes and solid-state devices. Then, there is the more modern sweep generator, oscilloscope, and DVM that are all solid state.

Let's carry this thought one step further. While we all have filaments glowing between our eyes, we must continue to respect and understand the benefits of more-modern technology and how it can contribute to and enhance our boatanchor-tube mentality. If you have been following my articles, you would have seen the incorporation of newer technology from time to time, as in ER #137 (October 2000), #147 (August 2001), #193 (June 2005), and #197 (October 2005).

Here is some food for thought. Stop and think for a minute just how many test equipment circuits using vacuum tubes have you, or your buddy, designed or seen in print in recent years? I bet I know the answer.

This project falls into the hybrid category, requiring a high-voltage and low-voltage source using both gas-regulator tubes and Zener diodes. Using the 6.3-volt winding as the AC source, the 7805 makes a nice little 5-volt, 1-ampere, solid-state regulator in a TO-220 package. I happen to have a few in the bin. If you don't have any of these, they are available for about 50 cents each.

Looking back though the ARRL handbooks for a vacuum-tube, low-voltage, regulated-power source, you won't find one, the main reason being they weren't needed. The only low-voltage source would have been a battery that was used for tube bias. Going back further in time, you will find only A, B, and C-batteries used as main-power sources.

A vacuum-tube, low-voltage-regulated supply could be designed using several tubes at the expense of much chassis real estate. Therefore, it made good sense to use the newer technology in part of this project.

Using a transformer for the high-voltage source was my last resort. I did try some voltage-quadrupler schemes with solid-state rectifiers and large-filter capacitors. They all worked, but when called to supply any amount of current the voltage fell off rapidly. As you can see, the transformer is small with the standard-secondary windings. The high-voltage winding is rated for 40 mA when only a few mA are needed. The two filament windings are rated for 2 amperes.

Transformer T2 needs some explanation. I first used a 6.3-volt, 300-mA transformer. Its open-circuit voltage was only 106 VAC. This was measured with a high-impedance voltmeter so there was no loading on the winding. I wanted to see a voltage closer to 120 VAC. I imagine that the winding-to-winding (6.3 to 6.3) efficiency is poor, thus the lower voltage. Using a higher-current rated, 6.3-VAC transformer increased the voltage only slightly.

Another scan of my stock revealed two transformers with 2.6-volt windings but unknown current ratings. So, the thought was that I could increase the output voltage because my turns ratio decreased. This was a correct assumption and yielded an open-circuit voltage of 114 VAC. I tested three high-quality, AC-panel meters and they all loaded the 114 volts down to 90 volts.

So, operator, be aware that using this transformer-isolation method for the AC-voltage function will produce levels less than the line voltage. Therefore, an

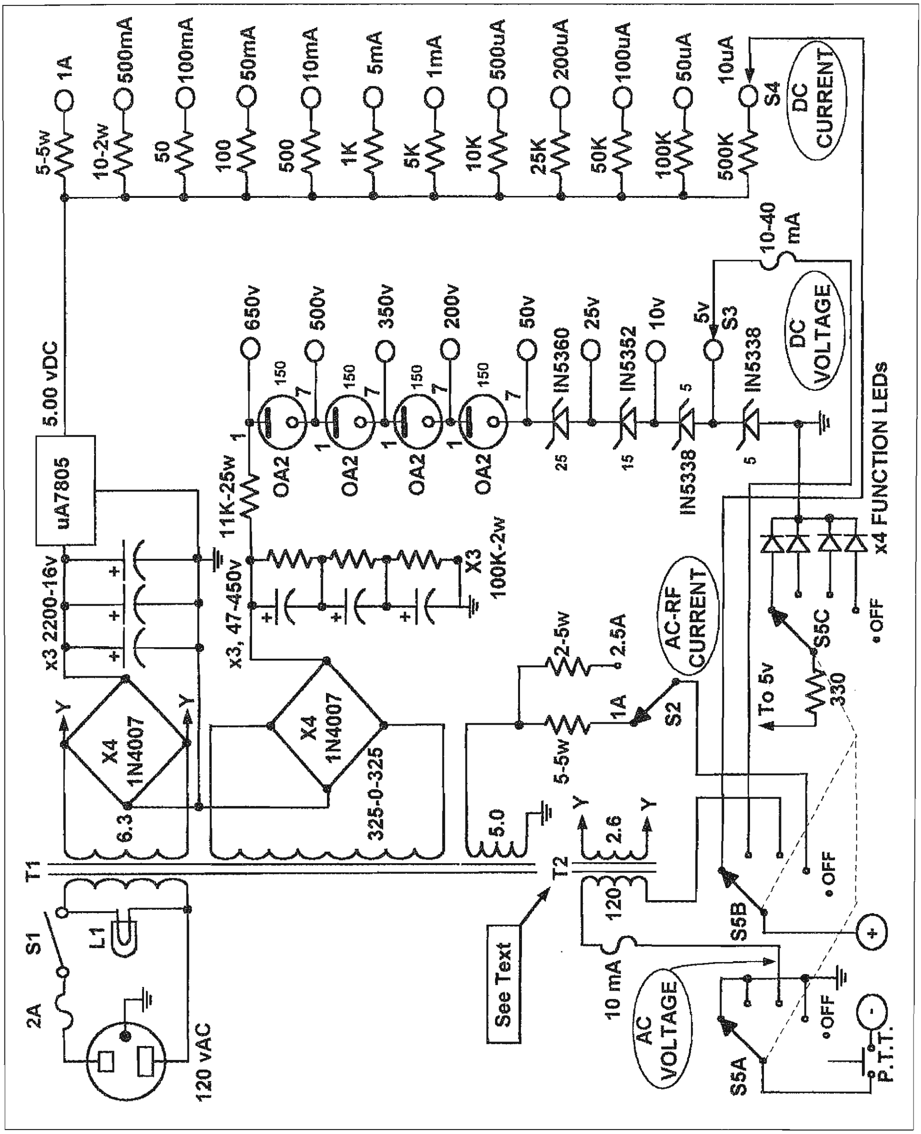


Figure 1: Complete Panel-Meter Analyzer Schematic

external DVM was used along with the analyzer's safe (isolated) source of AC voltage.

I would mention that the best method electrically, but the *poorest* from an operator-safety point of view, is to connect to the primary of T1 and eliminate T2. I'm not advocating using this method because it puts the line voltage directly on the test leads, thus making extremely unsafe operating conditions. Now that I've mentioned it, forget it!

Looking at the circuit diagram, you may wonder how in the world did I go from a simple current-only tester to a full-blown bench analyzer? I don't have a good answer other than "I like a challenge." My original current-only tester is buried within this diagram. It could be extracted, and with the use of a battery-power source, fabricated into a small pocket unit, omitting the high-current ranges.

The analyzer, as shown, is set up to test AC, DC, and RF-thermocouple panel meters. AC and RF-thermocouple meter ranges are: 1 and 2.5 amperes, and 90 volts (AC meter only). DC ranges are: 10, 50, 100, 200, 500 μA, 1, 5 10, 50, 100, 500 mA, 1 ampere and 5, 10, 25, 50, 200, 350, 500, and 650 volts.

Four 0A2 gas-regulator tubes and four Zener diodes develop the voltage ranges. The tubes will regulate their terminal voltage with 5-to-30 mA of current. The additional load (test-panel voltmeter) current must not exceed the total regulator current of 30 mA to maintain regulation. The Zener diodes are rated for 5 watts each. I chose 20 mA for the series current through the tubes and Zeners.

Knowing the fact that most panel voltmeters aren't very sensitive, the value of 20 mA allows for a load of up to 10 mA for test-meter current. Then we have the really poor magnetic-vane movement voltmeter that pulls in excess of the 10 mA. This is where operator knowledge of the actual tester-terminal voltage is helpful. The first indication will be an out-of-specification test meter. When this occurs, I recommend verification across the test meter with a DVM. If the DVM agrees with the lower test meter reading, the meter is acceptable.

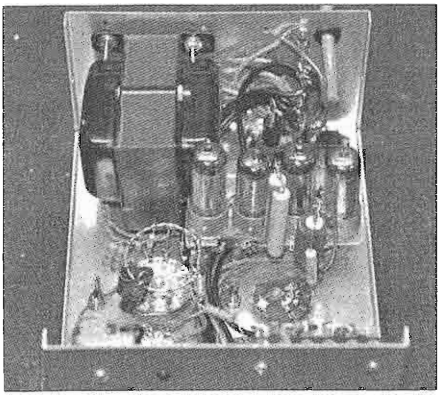
The 0A2 is like all components, it has a tolerance. The terminal voltage specification is 150 volts, implying you can plug in any 0A2 and get that voltage. Those who know how I build things also know that each and every part installed in any project gets pretested. The 0A2 was no exception. I had a bag of these tubes and they ranged from 145-to-150 volts at 20 mA. I picked four that measured 148 to 150 volts.

The values for the DC-current resistors were easy to determine. This is because the 7805, 5-volt regulator, is extremely stable and reads 5.00 volts. You can then use simple ohm's law to get the mathematical value for the resistors. Most likely, the mathematical value won't be a standard-resistor value. Even if it were standard, you would be dependent on the resistor tolerance, and that may put the range out of specification. In my case, I hand picked the resistors while using my Keithly 160 current meter. I would think a good DVM with low-current ranges would suffice. My first choice for resistor type would be metal film and then carbon.

Layout of the components isn't critical. Because there are high voltages involved, the proper level of insulation must be kept in mind for the wiring and component placement. All rotary switches came from my junk box and received a bath in Silver Dip® cleaner before usage. These switches should all be the non-shorting type.

The 7805 is required to produce high currents only for a moment or two in the two high-current positions. Therefore, it doesn't require a heat sink unless you plan on placing a brick on the push-to-test (PTT) switch. I didn't use a socket for the 7805, and this leads to a caution. The 7805 was first bench tested to insure its output was 5.00 volts. Then, after soldering to its terminals, the output shifted and read 5.05 volts. This soldering occurred using minimum heat from the iron but the leads weren't heatsinked during the soldering. Therefore, clamp the little leads to provide a heat path during soldering, or better yet, use a socket.

The mounting for the DC current-range resistors was aided by first making a wire ring from 14-AWG bus wire. All resistors were then connected to this ring and to the proper position on the



The Analyzer's Internal Layout and Construction

switch wafer. The ring is connected to the 5-volt supply.

When testing any unknown meter, I would suggest starting with the lowest DC-current range. This is strongly urged when testing RF-thermocouple meters before going to the AC-RF range. Most of these meters have built-in shunts. If the movement doesn't move, with at least 1 mA of DC, then most likely it has an internal shunt. If the internal shunt is absent and you put the analyzer in the AC-RF current function, the meter movement won't survive.

The output jacks are spaced ¾" apart to accept a standard General Radio (GR) plug-in addition to the test leads, going to a meter. This allows the operator to determine the test-panel meter's internal-meter resistance. This is a nice aid in calculating external-meter shunts when required.

I mounted standard-carbon pots to a few GR plugs for this test. Set the pot to its maximum so it is virtually out of the circuit. Using the DC-current ranges, find the correct one giving a full-scale reading. Then, adjust the pot to reduce the reading to half scale. Remove the GR plug and measure the value of the pot. This value will be the meter's internal resistance. This is called the "half-scale meter-resistance test."

Safety is a major concern with any electronic device no matter what level of complexity. I've incorporated features in this unit that will aid the operator when testing panel meters while maintaining safety. Visual aids are always a good thing. Three of the four analyzer functions have a LED placed on the panel next to their range switch showing the operational function. The AC-voltage LED is positioned above its fuse holder.

The analyzer can be "on" and the function switch "off," thus disconnecting the output jacks. The normally-open PTT switch opens the negative-output jack no matter what settings are in effect. So, you see there are several steps that the operator must conscientiously perform before a meter is subjected to power.

Besides operator safety and operational aids, there is the test equipment itself. How safe is it? Will it self destruct because of test leads momentarily shorting? Will some internal-component overheat and fail? These are all good questions that should be considered and tested in the design.

First and foremost, there is the power cable. I'm still seeing two-wire power cables in homebrew designs. This is a major safety concern and is easily corrected with the three-wire cable. *Always* connect the green safety-wire to bare-metal chassis ground. If a circuit can't tolerate having the green wire grounded then it doesn't deserve design or publication.

Worst than no green-wire ground is the absence of a main fuse for a project. I even worry about using the common wall wart that has no fuse. This project has three fuses; the obvious main fuse, the AC-voltage function, and the DC-voltage circuit.

Operating this tester with the test leads shorted together is not a normal event and to do so would cause internal damage to the circuits if there were not built-in safeguards. Good old Murphy says that "if it can happen, it will happen."

Shorting the test leads while in the AC-RF or DC-current mode isn't harmful to the tester. In the AC-voltage mode the 10-mA fuse will blow if the test leads are shorted *and* the PTT is depressed. In the DC-voltage mode *and* with the PTT depressed, there is sufficient energy in the test lead path to harm the PTT switch contacts in the three high-voltage positions. At 350 volts, the short-circuit current is 44 mA, at 500 volts it's 55 mA, and at 650 volts it's 65 mA. The two highest-voltage positions have enough energy to sustain an arc across the PTT after it is released. If this is allowed to continue, the switch will pit and eventually fail. The simple cure for this rare, possible event is to insert a fuse in the wiper-arm circuit for S3.

When operating a tester supplying current and voltage to an unknown device, cautions must be observed. For instance, take a 1-mA meter and apply voltage from the DC-voltage function. Then, toss the meter in the trash because you have successfully destroyed the movement. In the commercial world, power-producing testers/analyzers have existed for many years and are common in laboratories today.

The values for the current-and-voltage ranges in the text, diagram, and panel labels are expressed in whole numbers. This was purposely done for presentation. The actual values differ due to component tolerance, but are within 2% of what is shown, with the exception being the "AC voltage function," as previously mentioned. In the grand scheme of things, what really matters is the fact that the actual current-and-voltage values are stable, repeatable and known to the operator.

I can remember using a Tektronix Type-575 curve tracer back in the 60s. This instrument was used to test the dynamic characteristics of transistors and diodes and could produce very high currents and voltages. Many a good transistor and diode never made it into space-flight hardware because of failure after exposure to this tester due to operator error. Then, there was the famous fuse tester where all the fuses passed the test but all were open afterwards!

I believe I waved the caution flag enough to alert anyone testing panel meters, whether using this analyzer or the old-fashioned, clip-lead method. This box will make life as a home brewer much easier. All of my panel meters have been tested, sorted, and boxed. As a techno-compulsive guy, the pertinent information has been put on a spreadsheet, printed out, and kept with the sorted meters. Of the 80+ odd meters tested, there were five duds that got tossed and several that fell into the miscellaneous category. The last category was meters whose movements worked fine but didn't match the scale. This was noted on the spreadsheet.

I recently attended a hamfest in Frederick, Maryland and a few treasures followed me home. One was a Triplett 630 VOM for the sum of 5 bucks. After altering the meter by adding three nine-volt batteries in series for the high-value ohm scale, all the voltage and current functions were checked using this new tester. It sure was an easy task with all the necessary calibrated power contained in one box.

I made the main-panel label on my PC using Visio Technical®. With a little innovation, I use this software for circuit diagrams. The label was printed on high-gloss photo paper and dried for 12 hours. For scratch protection, the label was sprayed with Minwax® Poly Satin, which was dried for another 12 hours before attaching to the panel with spray adhesive. The smaller black labels were made using 9-mm, black-on-clear tape.

ER

A Bauer 707 Encore

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Just when you think you have a handle on it, you suddenly discover that it is an illusion. The acquisition of a second Bauer 707, its cleanup and subsequent conversion for 160 through 40 meters, definitely forced me to concede that fact. Recall that the Bauer 707 is broadcasting's answer to Heathkits. It was supplied in kit form to the radio station with the understanding that the station's engineer would construct it and a field engineer from the factory would certify the finished product.

The second unit is older than the first. It may have entered service in the early 1960s. The first one is documented at April 1968. The second, older rig was originally operated from a trailer in Utica, NY. It was along the Mohawk River and close to the historic Erie Canal. It is a marsh area and the environment was not very kind. The box was being stored at a commercial moving-and-storage facility. I found the building, and was introduced to an ecological disaster.

It seems that as the unit was being moved, it was just cut out of the operating location and bounced around until it wound up on its storage pallet. In the process, one of the insulating towers on a HV, oil-filled capacitor was broken. Oil was everywhere. A sticker attached to the front warned of PVC oil-filled components. A sticker on the back door advised that the device was in compliance with Federal Laws and Regulations as of 1983 for PVC. Regardless, it was a mess, with rust, missing tubes and questionable cracked insulators.

The box sat in my garage for several months. During the summer, I used degreasers and the garden hose very liberally. Eventually, around October, we brought it into the basement work shop. Wheels were placed under it and any obvious defects were addressed. It was now time to try the LV supply and stages. This was sometime around December or January. Relief arrived when the low-power stages worked in spite of the mess I had contended with. Now, it was time for the final acid test.

I doubled and tripled checked the connections in the HV section and associated wiring. I repaired or replaced in-

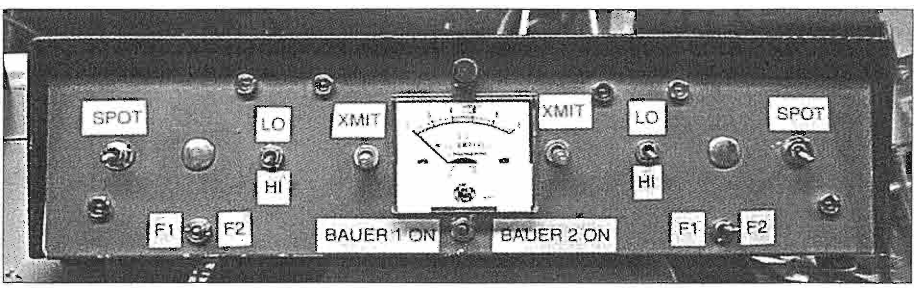

Figure 1: The dual-control box has a field-intensity meter and a center-position, off-on/off AC switch. See text for details on the arrangement.

sulators and checked everything I could think of to insure there would be no fireworks. I really could not muster the nerve to throw the plate switch, fearing catastrophic results. With fire extinguisher in hand and the rig into a dummy load, I held my breath.

The control system had been constructed and installed, so at least I wasn't standing on top of the rig. Kerchuck! The plate voltage came on with some rather weird readings and the final dipped in the low-power position. OK, so the voltmeter-multiplier resistor needed replacing. Relief and joy! Tempting fate, I threw the switch for high power. It just quietly increased the plate-voltage meter reading to a high, unrealistic value. The plate current and output were normal. Everything held. Victory was mine! It was operating on the original broadcast frequency. Now the "fun" was just beginning!

Mr. Murphy and Company, Inc.

Actually, the fun started with the control system and its power supply and relays. Since I now had two Bauer 707 transmitters, I thought it would be neat to control them from the same control box. I recycled a RTTY terminal box and chassis for this purpose. For each transmitter, the controls, status LEDs, and the meter are mirror images on each side of the center-off switch, as shown in the photo, page 23. The control box insures that only one transmitter is powered. The control system is simply duplicated on each side, with one common-key line and mute for the receiver, see ER #198, September 2005. The center-off switch is labeled "Bauer 1 On" and "Bauer 2 On."

The later-vintage broadcast transmitters permit remote monitoring of the meters. They include plate voltage, current and antenna current. Since the recycled control cabinet had a hole for a meter, it needed one. But, bringing all these remote readings from two transmitters would be rather involved. A better approach was to monitor the final product of the transmitter. That is the output from the antenna. So, a simple field-intensity meter was built into the control box. I find that this is great confirmation that everything, including the antenna, is functioning. Having it built into the control box just makes the control position much more compact and it will check the operation of any other transmitter used in the station.

To get the control box to work involved first building a 24-volt power supply. Without regulation, it produced close to 40 volts. Using only half of the transformer's secondary brought the voltage down to 19.5 volts and seemed to work. For the second Bauer, I installed a 24-volt, surplus, RF-coax relay. At first it pulled in. Next, it didn't pull in. Then it did. Then it didn't. OK, back to 40 volts with an appropriate dropping resistor and the problem was solved.

But, next the plate actuator became intermittent. The original control design (again, see ER #198) includes a failsafe-antenna interlock on the secondary contacts of the RF relay. If the coax relay doesn't activate, the plate voltage can not come on. Contact cleaner and readjustment of the contacts resolved that one, a minor annoyance.

Now, it was time to move the transmitter to 160 meters. So what happeed? The coupling joint from the tuning knob to the vacuum-variable tuning capacitor breaks. There are two of them, and yes, they both broke. Replacements came from a DX-100 shaft.

The next problem to work on was low output on 80 meters. The PI network now included a variable-loading capacitor with some fixed values. It turned out that the plate-RF choke was resonant at some critical frequency and started to

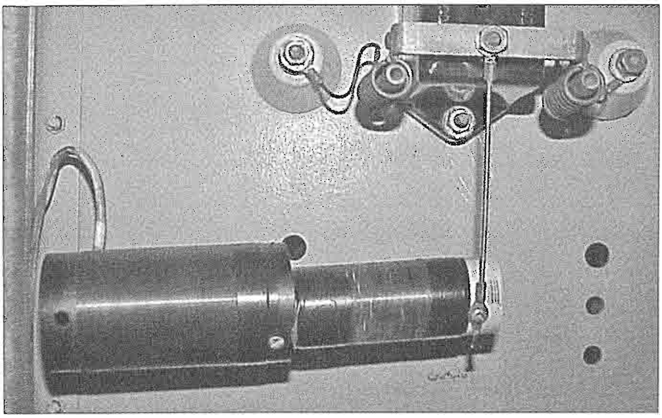

Figure 2: This is the rewound RF-plate choke. The original did not work on 75 meters. This is the older transmitter.

burn. (Refer to ER #220, September 2007.) The photo in **Figure 2** shows the rebuilt choke resolving the problem.

The dummy loads would not go with the program. The Bauer, and many later BC rigs, have an internal dummy load. They are usually made from nichrome or toaster wire. There is no reactance at BC frequencies. As you go up into HF, it gets reactive, so matching into it is not appropriate. Not having an expensive Bird professional 1-kW dummy load, I tried the Heathkit Cantenna. For a device that's supposed to be a 50-ohm resistor, this one was different. It read 80 ohms. And, just to really confuse you, the resistance increased to 95 ohms when heated with RF for a few seconds. It seemed that the only way to get this right was to go into a live antenna.

The driver circuit and low-power stages were retained for 160 meters. For 80-and-40 meters, the final grids were fed directly from an external exciter. The driver coil and variable capacitor from a DX-100 driver stage was used to tune the final grid. Drive was much more than adequate on 40 meters using a Hallicrafters HT-40 in the CW position, lightly loaded. On 80 meters, even with an antenna tuner for better matching and fully loaded, the grid drive to the final was marginal. Attempts to rectify this discrepancy proved fruitless. The conclusion here was that some bands just required more drive from the exciter than others.

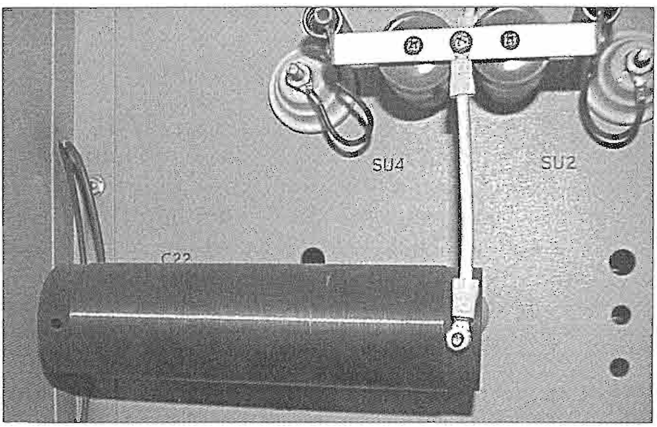

Figure 3: Here is the original RF-plate choke, which did work on 75 meters. Note the different style of blocking capacitor above and to the right of the choke.

The first Bauer drives the grid of the driver tube from an external exciter, rather than going directly into the final grid. It needs 12 watts from the external exciter to produce the required final-grid current. Thinking about this, it would seem that much less should be needed to excite the driver. So, perhaps

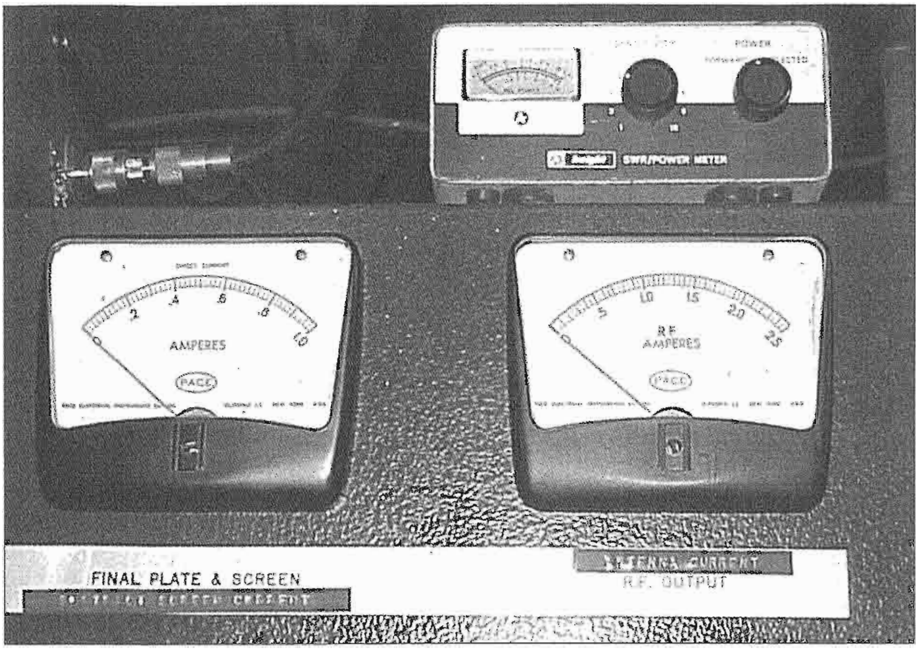

Figure 4: The Knightkit SWR bridge being used as the sensor for the RF antenna-current meter right. The left meter is plate current. The meter style of this older unit is different from the other, newer transmitter.

there is something about 3.5-to-4 MHz with these boxes that acts as if you are driving a car with flat tires.

Back in the 1960s, when solid-state rectifiers were just beginning to be introduced, quality control was not as it is today. The 1960 Bauer was state of the art with solid-state rectifiers. But, they needed a resistor and capacitor across them to equalize back voltage and transient potential. Without them, some of the diodes would take more voltage than others. The photo in ER #207, August 2006, of the "French-fried diodes," is the result. The later Bauer uses sealed-diode bars similar to the K2AW products.

As quality improved, old habits were hard to die. The practice continued–especially by individuals who may have witnessed the dramatic events which produced the damage shown in that photograph. The replacements in the transmitter are modern devices with no resistors or capacitors. They work just fine. Leaving the burnt evidence behind was just one of the many items I had to deal with.

The RF Ammeter

Many of the older Broadcast rigs have an internal RF ammeter which included a thermo-couple sensor to read the RF current to the antenna. The newer units have the same meter, but it's for a remote sensor. The meter is often a 1-mA movement and is not about to indicate any output without that remote thermo-couple sensor.

One way I found to use this RF-ammeter movement employed an external SWR bridge. I used an old Knightkit SWR bridge. A switch and RCA jack was added to the back of the unit. The switch permitted the internal meter to operate, or the RCA jack to receive the voltages from the diode sensors.

The remote meter movement is simply connected to the RCA jack and the switch is set to the position that conects the RCA jack to the diode sensors. A very effective relative-output indicator is obtained, with the meter on the transmitter's panel next to the plate voltage-and-current meters.

This meter can also be used to confirm the SWR, and it functions in place of the SWR bridge's internal meter. If you wish, this meter can be scaled to conform to the SWR meter face of the original meter movement. I have found that there is no real benefit to be gained here. If I need the SWR reading, I just throw the switch on the back to the original internal meter. The indicated RF current on this meter is meaningless. But, it does provide you with a very handy tuning aid and a positive indication of RF output from the transmitter.

The Mickey Mouse Connection

For 80-and-40 meter excitation, the HT-40 and an MJF antenna tuner was used with the initial RF testing and retained for the on-air testing and "maiden voyage." The lash up could be described as Mickey Mouse. However, Mickey was definitely involved with the audio lash up.

The mouse actually contributed to part of the audio equipment, as well as the less-than-sound engineering lash up for the testing and initial contacts. At the head of this abomination was a $1 hamfest mike pictured in ER #199, December 2005. A Behringer Shark, also in the same picture, was used as the preamp and audio compressor. Here comes Mickey.

The audio limiter was a CBS Labs Volumax model 4110. Those of you in the broadcast industry may recognize this as an FM-stereo limiter. Without the pre-emphasis, it works just fine for AM limiting. And, it gives you the benefit of two separately-adjustable outputs. This one was used for the FM-satellite feeds of the Disney Radio Network before being retired. The unit still has the outline of Mickey's silhouette drawn on its face. Completing the test station was a Drake R4-A receiver.

In spite of the kluge of equipment and temporary connections, everything worked. Both signal-and-audio reports were just as complementary as my other broadcast rigs, which include the exalted Orban AM Optimod 9000 in the audio chain. (The Optimod is also in the same photo.) So, I conclude that the differences between professional audio equipment, cheapie dynamic mikes, and more expensive condenser devices is simply in the mind of the beholder. For ham voice communication with QSB, selective fading, static crashes and QRM, who cares? Only if you have the bucks, wish to obtain the last ounce of barely-detectable performance, and want the bragging rights does it matter. And for the record, before all this audio processing equipment became the rage in ham-AM circles, the crystal D-104 sounded and still sounds great! But alas, you can not properly feed a broadcast transmitter with a crystal microphone. (For more Mickey Mouse make-shift engineering see ER #199, December 2005.)

Epilog

On July 1, 2007, 16 months after retrieving the rig from Utica, NY, the maiden voyage was taken. Bob Login (AA8A), in St. Marys, GA, was the first contact on 7290 MHz. Thanks to my friend Bob Henry (KD5MDH), a Gates BC-250-GY waits for me in New Mexico. That would be my fourth BC transmitter. It will be there for quite some time because I'm now still trying to fit three broadcast transmitters in a space designed for one. *ER*

Reconstruction of a Philmore "All-Wave" Super Kit and Regen Operating Notes

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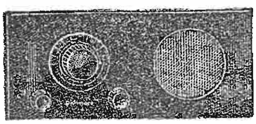
Philmore

With a history going back to the 1920s, the Philmore Manufacturing Company is best known for its line of inexpensive radio kits and parts, and especially its crystal sets and components for building crystal sets. Philmore items that sold for pennies or a few dollars in the 1930s and '40s have become collector's items and now, and on eBay, bring many times their original purchase prices. Philmore no longer supplies the simple radio kits, crystal sets or parts that it once did, but the company still survives as part of L.K.G. Industries Inc. and offers a line of modern electrical and electronic items for the do-it-yourself TV or Hi-Fi fan and other electronic related items.

TRW Comes Through Again

Recently, at the TRW swap meet (W6TRW), I was pleased to find an old Philmore kit radio with plug-in coils. It was in sad condition but the price was reasonable. The only reference about it I've been able to find is in the 1941 Burstein-Applebee catalog where it is listed as a 3-Tube, All-Wave, AC-DC Super Kit with 4" P.M. Dynamic Speaker. The original tube lineup is: 6C6 RF amplifier, 6C6 regenerative detector, and 25A7GT audio power amplifier/rectifier. The original chassis consists of two separate parts, the larger of which has the sockets for the two 6C6 tubes, and the antenna and detector plug-in coils. This chassis has many

AC-DC Super Kits with 4" P.M. Dynamic Speakers

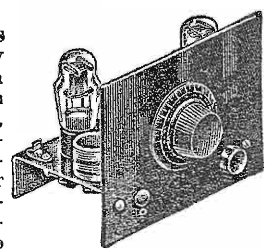


Designed for high efficiency, economy and ease of construction and operation. A combined Rectifier and Output Pentode actually gives each kit an added equivalent of 1 tube in efficiency. Efficient filter circuit eliminates hum. Fine quality 4" P.M. Dynamic Speaker. Complete except for tubes.

3 TUBE AC-DC KIT with SPEAKER
Uses two 6C6 and one 25A7 tubes. Everything included in kit to build complete 3 tube set. This kit contains one 5-prong and one 6-prong Broadcast coil. (Less Tubes.)
No. R3615. YOUR COST. **$6.95**

2 Tube AC-DC Kit

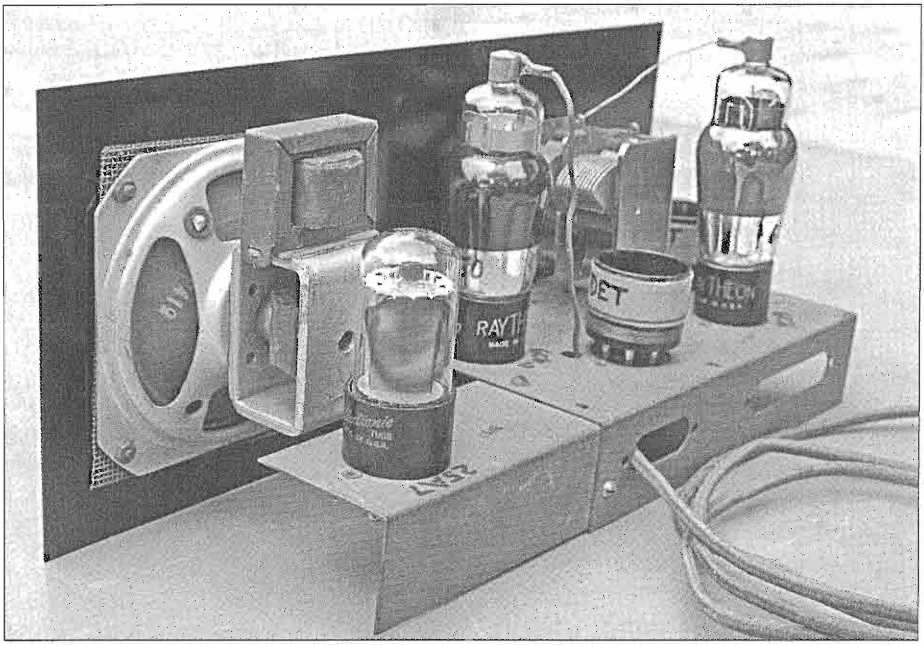
Similar to 3-tube kit except **less speaker.** May be used with speaker on loud stations, but is especially recommended for finest headphone reception. Uses two 76 tubes. Complete with Broadcast Band coil. (Less tubes.)



No. R3620—2-Tube AC-DC KIT. YOUR COST.. **$3.23**

Short Wave Coil Sets
For AC-DC Kits Listed Above
Per set of 4 coils, 13 to 240 meters.
No. D9959.
YOUR COST **72c**

An excerpt from the 1941 Burstein-Applebee catalog shows the Philmore All-Wave Super kit and pricing of the day.

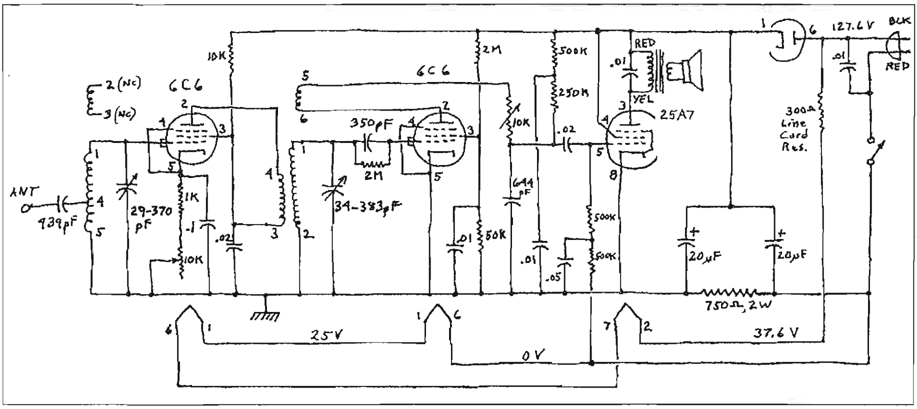


This is a rear view of set, reassembled in its original configuration after initial breakdown and restoration of major components. For the photo, a 25L6GT has been substituted for the broken 25A7GT. The defective resistor-line cord was just projecting from hole in chassis, as shown, with no chassis grommet.

unused holes and cutouts, as it was apparently used for other Philmore kits including 2-tube AC/DC and battery-powered kits. For example, the rear flange has cutouts for mounting two terminal strips that were probably meant for connecting power and phones to a 2-tube battery-powered set, and are not needed for this AC/DC set that includes a speaker. A smaller chassis, which mounts the 25A7GT, is bolted onto one end of this main chassis, behind the speaker. This is how Philmore expanded its 2-tube kits to three tubes without the cost of extensive retooling.

Initial Considerations

There was no possibility of powering up this receiver as found, due to an open resistor-line cord and broken 25A7GT, not to mention defective wiring insulation, general all-around crud on everything, rust on the tuning capacitor and panel, etc. Even with all these things fixed, I would not use it in its original form due to its "hot" chassis. Instead, I proceeded to disassemble it, component by component, making a pictorial diagram as I went, from which I later deduced the original-schematic diagram. As we shall see, this diagram is apparently incorrect due to the original builder soldering some resistors in wrong places. In any case, the circuit proved to be a conventional regenerative receiver with RF amplifier, tickler-coil regenerative detector, and audio-power amplifier. The only unusual circuit feature is in the power supply where the B-supply pie filter is in the B-minus leg rather than B plus. This was occasionally done in re-



This is a as-found schematic of the set. Values shown for capacitors are the measured values of the original components. Wiring shown here for detector section is apparently incorrect.

ceivers of this era, even those with power transformers, as many a radio-repair man discovered the hard way when assuming one end of the high-voltage winding on the power transformer was grounded to the chassis. The steps taken in reconstructing this radio follow.

Chassis

I decided to make a new chassis for my reconstructed set and save the original main chassis for constructing a 2-tube, battery-powered set in this same series of Philmore receivers. I made the new chassis out of a single piece of .05-inch, 3003H14 aluminum that combines the functions of the two-part original and eliminates the extra holes and cutouts. On it, I installed the new power-supply components and the tuning capacitor, tube sockets and coil sockets, as refurbished from the original set.

Panel

As found, the front panel had rust spots and scratches, and a gold-colored Philmore decal that was flaking off. I sanded off all the rust and old paint from this panel with a random-orbit sander and then repainted it. I have temporarily replaced the Philmore decal with a scanned and printed white copy from a Philmore dial plate until I learn how to make a proper decal.

Power and Audio

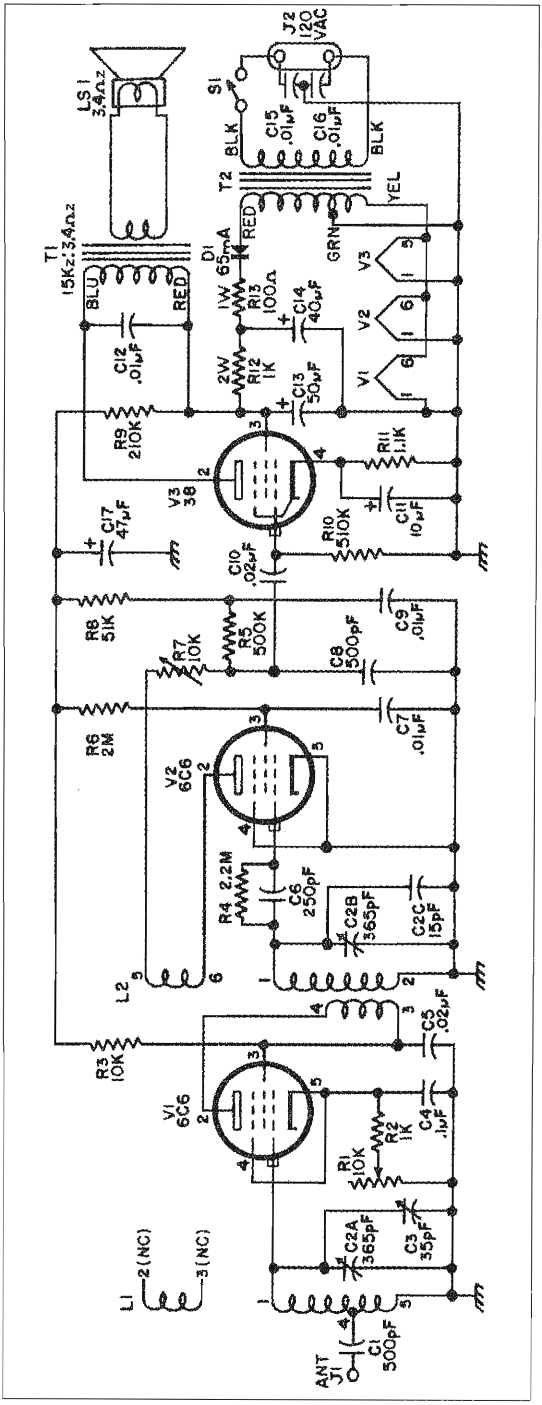
For safety reasons, my reconstructed set has a power transformer, and to satisfy my general dislike of power cords permanently attached to anything, the set receives AC power through a cheater-cord plug mounted on the rear flange of the new chassis. The power transformer is a junk-box item of unknown origin. It has a tap on its secondary to provide the 6.3 VAC needed for the tube heaters. The audio amplifier function of the original 25A7GT is now performed by a 38 tube with the rectifier function performed by a selenium rectifier under the chassis.

Tuning capacitor

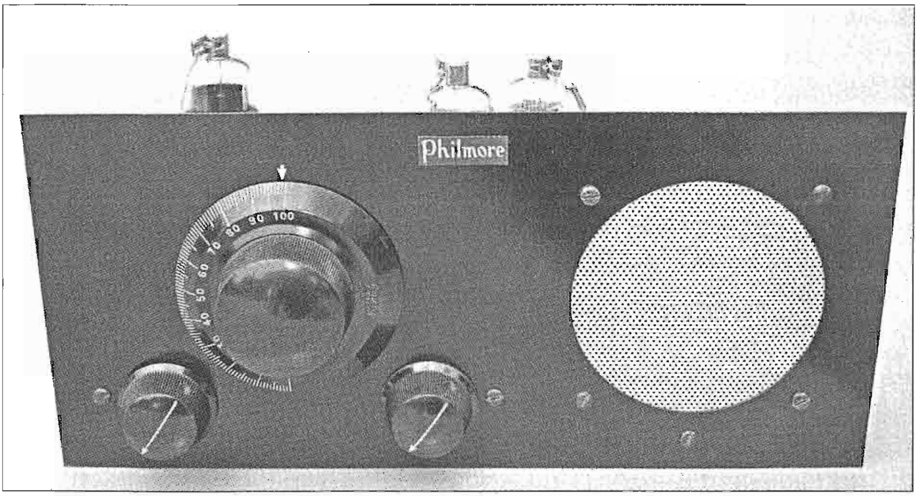
I wire bushed and sanded the rust from the frame of the tuning capacitor with a Dremel® Moto-Tool® and removed the rusted, screwdriver-adjusted trimmer capacitors from it. I then dunked it in my ultrasonic cleaner, followed by rinsing under hot water and drying off with compressed air. Finally, I gave it a light coat of car wax to prevent further rust. I replaced the trimmer for the detector stage with a fixed 15-pF capacitor, and the trimmer for the RF stage with a 35-pF, APC-antenna trimmer located on the rear flange of the new chassis.

Plug-In Coils

As found, the antenna coil required only cleaning, but the detector coil had a frayed-and-open primary winding. I cleaned up this coil and wound a new primary winding on it. These two coils cover 550–1600 kHz with the original 2-gang, 365-pF tuning capacitor. Since the set came with these BCB coils only, I will eventually have to wind my own shortwave coils. I thought tuning shortwave would be difficult with the original-tuning capacitor, unless it were connected for tapped-coil bandspread tuning similar to the method used in the National SW-3 receivers. Therefore, I omitted the wire from the #1 pin of each coil socket to the grid cap (or grid leak as applicable) of each tube and instead I planned on soldering it to the top end of the tank winding of each plug-in coil. This change allows the set to accommodate shortwave coils that are tapped down and connected such that only the tap connects to the tuning capacitor via the coil socket, while the grid connection is made directly from each coil itself. Now, each antenna coil will have its own wire lead and grid cap and each detector coil will have the same, but with the grid-leak



Schematic Diagram of Reconstructed Receiver



Front view of the reconstructed receiver showing refurbished panel and knobs, and new National dial and speaker grill

capacitor/resistor combination in between. This is a somewhat clumsy arrangement, but nevertheless workable. Having decided on this change, I had to provide the BCB coils with similar grid connections to their respective No. 1 pins. This change leaves the original Philmore RF and detector circuits unchanged for BCB, but will allow for easier tuning on shortwave.

Rear view of reconstructed receiver showing original speaker, panel, RF and detector components with new one-piece chassis, audio tube, and power supply components

Speaker

As found, the speaker was in good shape except for some minor rust, but the fabric part of the speaker grill had been mostly eaten away by moths, leaving only the wire-mesh part exposed. In my reconstructed set, I replaced the entire grill with a perforated-aluminum grill made from material salvaged from a junked BCB-portable radio.

Dial and Knobs

The original set had the tuning capacitor bolted directly to the front panel and a Kurz-Kach dial with no vernier drive. In my reconstructed set, I replaced this dial with a National Type "A" dial which looks identical to the K-K dial but has a 5:1 vernier drive. To make room for the behind-panel extension of the vernier drive, I had to move the tuning capacitor backward from its former bolted-to-the-front-panel position and mount it on a new bracket attached to the chassis. I removed the scratches from the original Kurz-Kach tuning dial, and regen and RF gain control knobs by chucking them in an electric drill and with the drill running, polishing them first with fine steel wool, then an abrasive compound used for removing scratches from glass, and finally black-shoe polish. After this, I replacing missing and worn engraving filler by cleaning the necessary areas with lacquer thinner, filling the areas with white typing-correction fluid (sometimes called "whiteout"), and finally cleaning off the excess whiteout with a paper towel dipped in lacquer thinner. The dial will be saved for other purposes and the knobs have been reinstalled on my reconstructed set.

The Smoke Test

No smoke, but dead silence was heard. To make a long troubleshooting story short, the previous owner of this set had apparently wired the detector section incorrectly resulting in wrong voltages to the plate and screen of V3. Fortunately, I found the schematic of a similar Philmore set in D. H. Moore's *Vintage Radio Identification Sketch Book, Vol. 3.* It shows the same components, but wired differently. After making the required changes, my set worked perfectly with excellent loudspeaker volume on daytime broadcast stations within a 150-mile radius and smooth regeneration across the band. 60-Hz hum is barely discernable. However, as mentioned by Mr. Moore, these sets were designed for long antennas. I use a 90-foot, long-wire antenna and I found by experimentation that wire antennas shorter than 30 feet detune the RF stage to the extent that the set will not work at all. If you should be inclined to make a set like this from my schematic diagram, be sure to select R9 such that the B+ supply line to R3, R6, and R8 is 90 volts. This is a key factor for obtaining smooth regeneration. I am sorry that I cannot provide winding data for the original coils as they were wrapped in masking tape which has since hardened in place and I don't want to mess with it.

Operating Notes for Regen Receivers

Now that I've had a time to spin the dials on my rebuilt swap-meet regenerative receiver that was described in "Tale of a 3-Tube, Swap Meet, Homebrew Radio," Parts 1 and 2, *ER* #195 and #196, I've compiled a few notes that apply to any regenerative receiver, may be of interest to regen builders and users.

All listening has been done only with the original pair of plug-in coils that came with the set, covering 5-to-10 MHz, and I've used only a Heathkit PS-2 regulated power supply for powering the set.

The antenna now used is a 90-foot outdoor long wire. All observations presented here are strictly subjective and non-quantitative.

Receiver Hum

For all practical purposes, there is none. Initially, when I turn on the power supply, 60-Hz hum is heard in the earphones. However, when the B+ voltage comes up and the regulation kicks in, the hum decreases to an almost inaudible level. Note that neither leg of the tube-heater supply is grounded nor is it center tapped, and the heaters are fed by twisted pair.

Microphonics

Again, for all practical purposes, there are none. If you deliberately tap the side of a tube, you will hear it in the phones. However, there is absolutely no tendency for any tube to "take off" microphonically on its own as I have observed in some regenerative receivers with filamentary tubes.

Volume Control

This receiver could really use an audio-volume control. It will easily drive a speaker on strong stations. With phones, the RF-gain control does not have sufficient authority to reduce the volume of strong stations to a comfortable level. This could be accomplished by substituting a 500-k potentiometer for the 500-k, grid-leak resistor of the 6F6 output tube and connecting the control grid of that tube to the arm of the pot.

Output Impedance

I get the best audio fidelity when using a set of phones with 17-k impedance, the highest-impedance phones I have. Lower-impedance phones on the order of 2k to 5k result in "muddy" audio characterized by attenuation of the highs and distortion. Note that my choice of output-load inductor was arbitrary and based on what was in my junk box. In the original set, as found, the secondary of a 3:1 audio-interstage transformer with its primary not connected was used as the output-load inductor. I wanted to save this hard-to-find transformer for its original design purpose in a future project.

Hand Capacity

There is none unless you move your hands behind the front panel. As long as you keep in front of the panel, you can take your hands on and off the controls with absolutely no effect on tuning, maintaining zero beat for exalted-carrier reception of AM signals, maintaining intelligibility on SSB signals and keeping a constant beat note on CW signals. With the detector oscillating and your hands behind the panel, you can play the set like a musical instrument, if you wave your hands in just the right way.

Control Interaction

This is a serious problem as all controls interact to detune the set in one direction or the other when the regeneration control is set just below the point of oscillation, as for normal AM reception, or when it is set above the point of oscillation for reception of CW, SSB or exalted-carrier AM. Increasing regeneration shifts the tuning such that it is necessary to retune the bandspread capacitor to a higher capacity in order to re-peak the signal and vice versa. The RF-gain control has an identical but lesser effect and, indeed, it can be used as a fine control of regeneration level to achieve zero beat or whatever. Adjustment of the antenna-tuning capacitor also shifts the main tuning. I suspect these effects may be due, in part, to the capacitive coupling from the plate of the RF amplifier directly to the cathode of the detector. Inductive coupling might alleviate this problem, but I used the swap meet radio's circuit and coils as originally found.

Sensitivity

All listening, thus far, has been casual with no specific effort to log DX stations. However, I've heard all the usual European, South American, Australian and Asian broadcast stations and also 40-meter QSOs between east-coast amateur stations at loudspeaker volume from here in Southern California. I'm convinced the current combination of set and antenna is capable of round-the-world reception. It all depends on band and local-noise conditions.

Selectivity

The set is noticeably more selective than other regen sets I've built, which don't have a tuned-RF amplifier ahead of the detector. However, it cannot compare with even the simplest superhet. Any strong-adjacent signal will easily step on any weak signal I'm trying to hear. In this regard, the separate tuning of the RF and detector stages has proved useful, in that you can tune the RF stage slightly off the frequency of the desired signal so as to attenuate its sideband on the side where the interfering signal is located. When the detector is tuned to a part of the band where only weak signals are present, the RF stage is selective enough to completely silence these signals if not peaked to the same frequency as the detector.

Tuning Procedure

It is nearly impossible to fine-tune signals with the detector bandset control. I usually set this dial and the antenna-bandset dial to the part of the band I want to hear, with the bandspread control at the midpoint on its dial. I then scan with ± tuning on the bandspread dial, re-peaking the antenna-bandset dial as necessary. Since the bandspread capacitor is in parallel with the detector-bandset capacitor, and there is no other capacitor in parallel with the antenna-bandset capacitor, the two bandset dials never agree with each other. A small fixed capacitor in parallel with the antenna-bandset capacitor would bring the two bandset capacitors in closer alignment with each other and facilitate operation from memory without constant reference to an experimentally determined lookup table of dial settings vs. frequency.

ER

(Comments, From Page 1)

As of September 24, I've had 24 entries posted on our web site. That's a good amount, but I'd really like to see many more entries before the contest ends.

Collins Collector's Association First Wednesday Nationwide AM Net

The CCA AM net that meets the first Wednesday of every month on 3870 kc is a nationwide event that starts on the east coast and ends on the west coast 4 hours later. You don't have to be a CCA member and you don't have to use Collins transmitters to check in. I'm mentioning this net because it's a lot of fun for all AMers. SWLs can enjoy hearing classic transmitters from all parts of the USA. The mountain states region, especially, needs more checkins. Propagation in the summer has been very poor, but frequently the net control station (KØOJ) has difficulty finding enough participants to fill the hour that's allotted to the mountain region.

Electric Radio Heavy Metal Rally

This popular annual event is scheduled this year for the evening of Saturday, December 30, 2007. Next month, I'll have the full details, and the rules will mostly be the same as last year.

73, Keep Those Filaments Lit!

Another 1984 Fowler R-390A/URR Has Survived

Part 3, Photo Supplement

By Paolo Viappiani
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This article is a photo supplement to my recent articles that were published in ER numbers 202 and 215 about the Fowler-manufactured R-390A/URR receivers. I wish to thank photographer Dan Gutowski (AB8VM) of Dexter, Michigan, who did a very professional-quality job.

As I discussed in the original article in ER #202 and in the "Frequently Asked Questions" article in ER #215, it has been established that the five units made by Fowler Industries were made with the same-style parts as the former R-390As made by EAC or other manufacturers. The five units by Fowler were built just like all the other R-390As of other production runs, without any improvement or modification. Hence, a number of refurbished parts and subchassis modules could really have been used by Fowler Industries during production. Supposing that refurbished parts were employed, it is thought, for sure, that only mechanical parts such as the gears were reused, and not any electrical components. All of the five-known Fowler re-

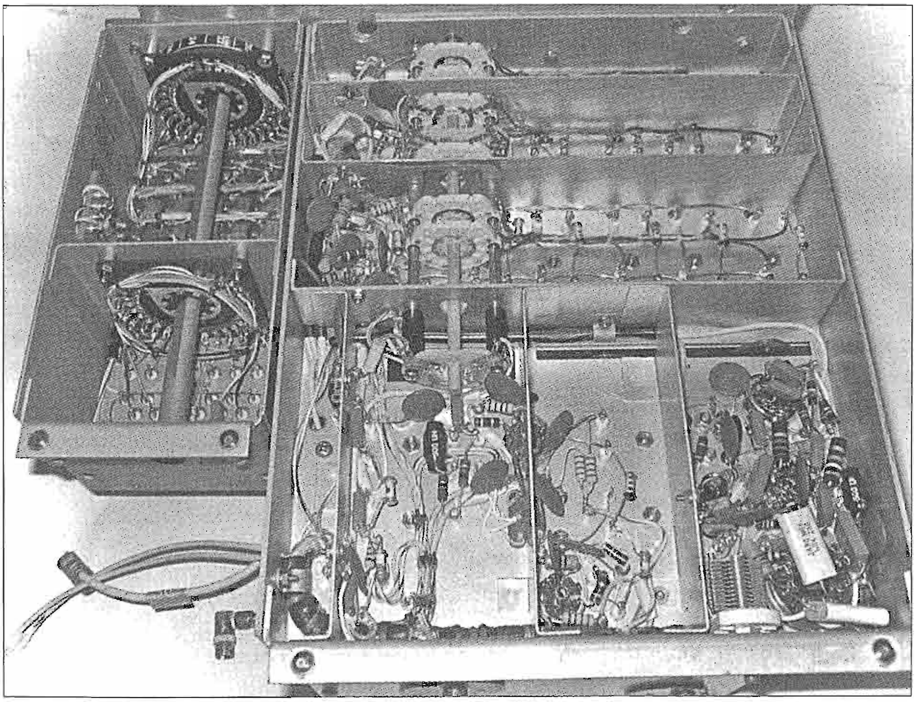


Figure 1: The RF Subchassis (from bottom) shows the use of new components everywhere.

ceivers are believed to have really been made up with all-new components, with the exception of the gear-tuning system.

Looking at the underside of every subchassis supports this conclusion. For example, **Figure 1** shows the RF and the crystal oscillator modules from the bottom side, and it can be seen that there are no refurbished components, all parts seem to be new-production examples from the early 1980s.

Further supporting this conclusion is the Fowler signature and its part number that has been stamped on every subchassis and their individual component parts. In this unit, every subchassis but the mainframe and the PTO shows a Fowler signature. Also, the gear train assembly has one, see **Figure 5**. The three other known Fowler units have Cosmos PTOs without any Fowler marking. However, the rear panel shows the "SYWC" misprint that seems to be common to other Fowler units.

In **Figures 6, 7, and 8** details are shown that support the ideas above. Please notice that all the codes in the form "SM-X-NNNNNN" are part numbers that directly refer to specific drawings of the original R-390A design developed by the Signal Corps and Collins Radio Company or Signal Corps and the EAC designers.

Dan Lunstrum (KAØOPU), wrote with a valid solution for the "mystery" of the "12996" number that appears on every subchassis of my Fowler unit. Dan says, "The number 12996 is what is known as a "CAGE" code and is used by the government to identify each individual vendor that does business with US government. In this case, '12996' is assigned to Fowler Industries Inc., Port Jervis, NY 12771. These numbers were formerly called 'FSCM' numbers which stood for 'Federal Stock Class Manufacturer.' Later, they changed the acronym to 'CAGE' but they are the same thing. I have heard what the acronym 'CAGE' stands for, but do not remember now."

From time to time some brand-new meters by A&M still appear for sale on the surplus market, often in their original package, **Figure 2**. Other receivers, such as the R-392 and R-390, were sometimes provided with meters of the same shape. They are not exclusive to the Fowlers because production of those meters by "A & M Instruments" started well before the Fowler contract, and a number of them were also used for replacement of the old meters with radioactive dials in R-390As and other sets. So, radios may be found that have meters of such a particular shape. In my opinion, they are only replacements because the latest 1968 R-390As by EAC and Dittmore Freimuth were still factory-

Figure 2: Here is a meter from "A&M Instruments" with its original packing, envelope, and label with FSCM number.

provided with the conventional meter types.

The Fowler receivers were not built with a AN/Cannon subpanel with power supply and audio-multipole connectors on the rear panel instead of the usual TB102 and TB103 terminals. TB102 and TB103 terminals are still in place under an added metal "sub-panel" cover,

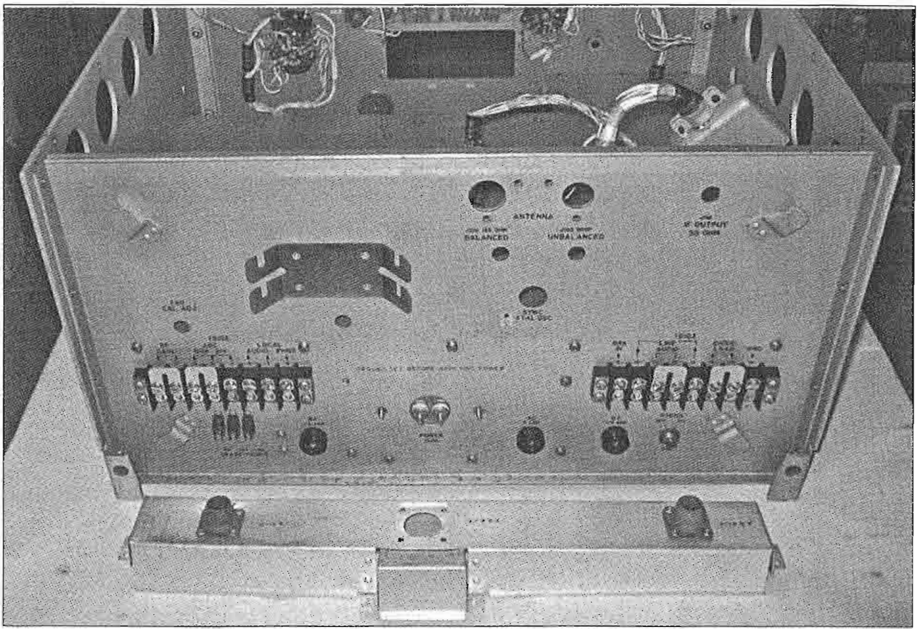


Figure 3: The rear panel with the "AN/Cannon" subpanel removed.

held in place by existing screws. The input and output connections to the "AN" connectors are made by spade lugs to be screwed to the proper rear terminals, no soldering was required. In **Figure 3** the "subpanel," separated from the rear of the receiver, can be seen.

As mentioned in part 2, ER #215, the application of that "sub-panel" in the rear of the R-390A/URR is an official US Navy modification that was listed and described in Navy manuals such as *NAVSHIPS 93053, NAVSHIPS 0967-063-2010*, etc., as "Field Change No. 3 (EIB702) - Conversion to AN Type Connectors, for Shipboard Use Only."

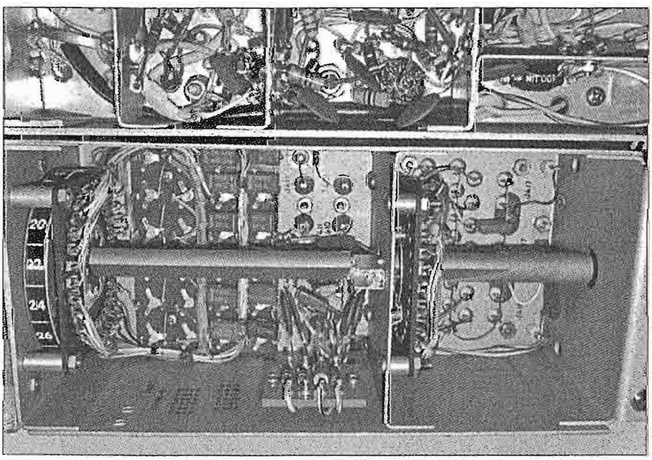


Figure 4: A detail of the underside of the crystal oscillator subchassis.

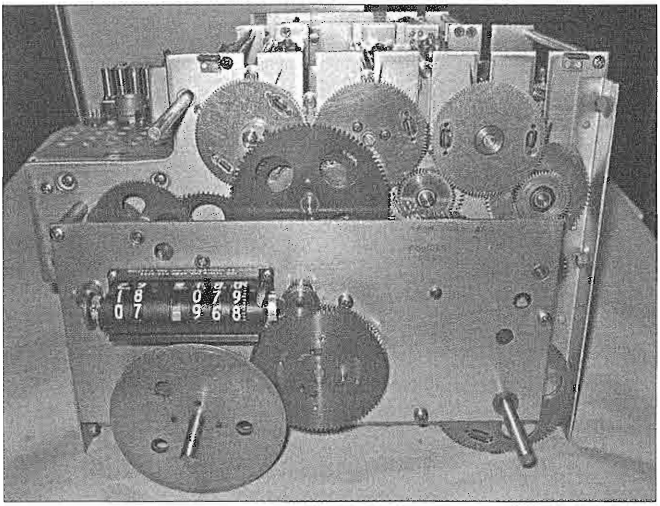


Figure 5: The Fowler gear train during restoration.

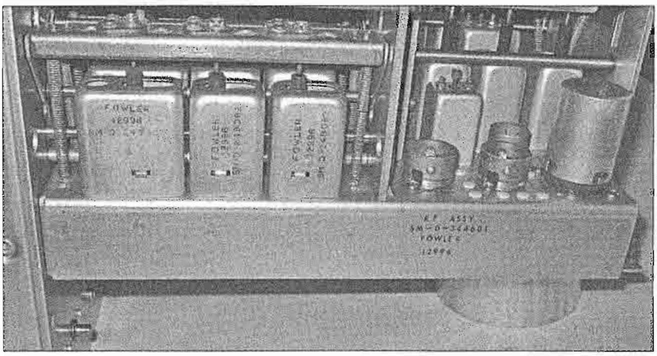


Figure 6: The right side of the RF Subchassis shows the "Fowler" marking on it and on some other transformer shields.

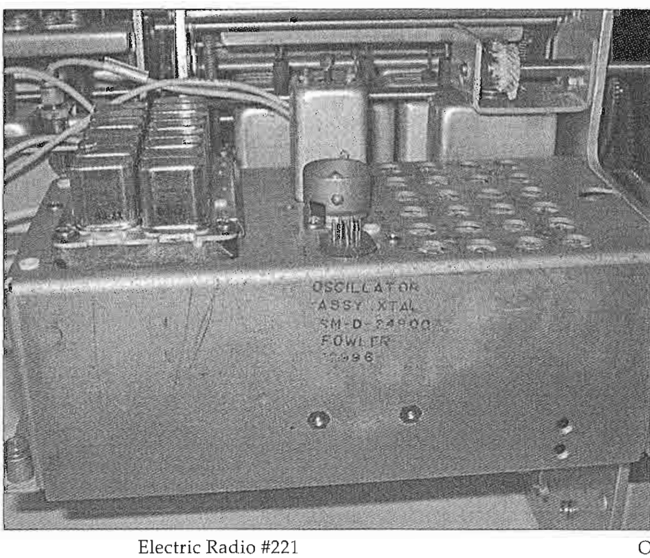


Figure 7: The left side of the crystal oscillator subchassis shows more Fowler painted or inked markings.

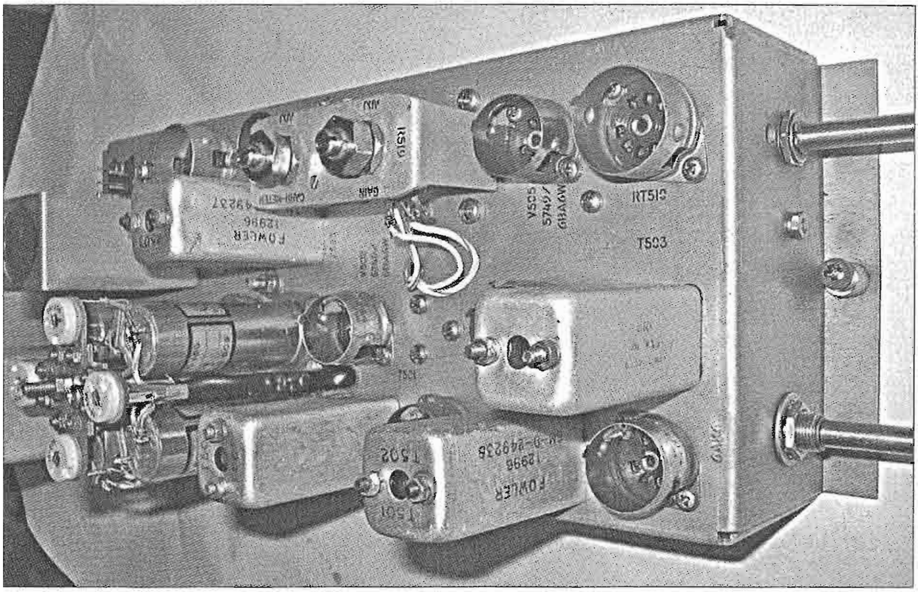


Figure 7: The "Fowler" signature is clearly seen on some cans in the IF Subchassis.

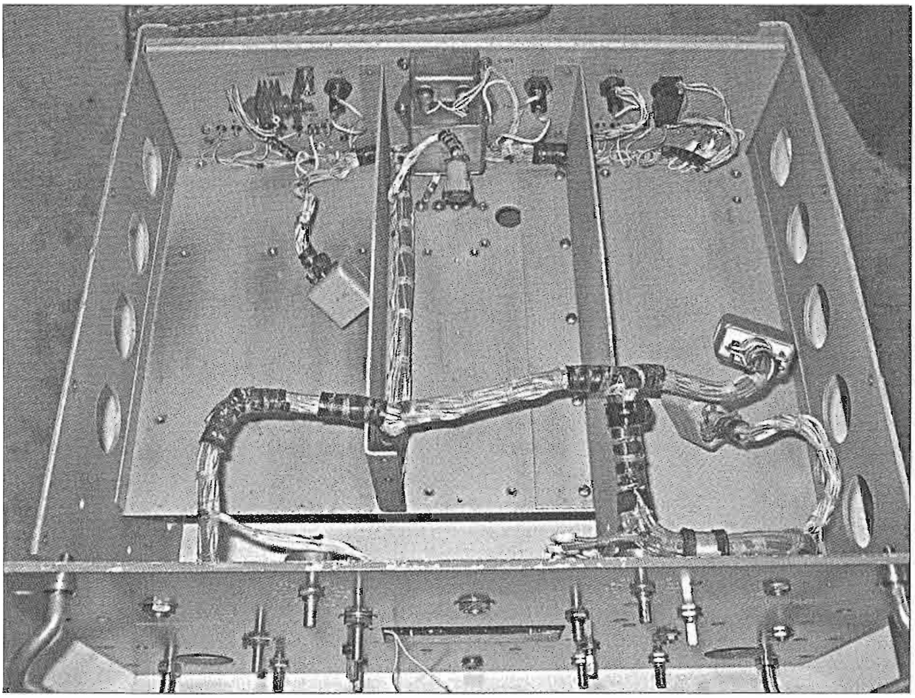


Figure 8: The mainframe of the Fowler receiver during restoration.

ER

Confessions of an Unredeemable Radio Junkie

By Dave Gordon-Smith, G3UUR
Whitehall Lodge, Salhouse Rd.
Rackheath, Norwich
UK, NR13 6LB
daveg3uur@googlemail.com

My conscience started to display all the prickly symptoms of an acute attack of guilt as I read Bob Sullivan's article on restoring a Collins KW-1 in the July 2006 issue of *Electric Radio* (ER #206). When I saw how few of these transmitters had been produced, I felt compelled to confess my guilty secret. Was what I'd done so very much worse than converting a BC-458 into a DSB transmitter, or stripping down a TCS for parts? On reflection, I felt that perhaps it was. There were worse things I could have done, of course, but that was no excuse for what I actually did. Confessions are supposed to be good for the soul, or so we're told, and as a born-again enthusiast for the old tube gear I have to come clean. By now you're probably pretty puzzled by my ramblings, so I'd better begin at the beginning.

Back in the '80s and '90s, I was doing research for the US Department of Defense (DoD) characterising and studying defects and processing damage in advanced crystalline solids. This work was carried out at Brookhaven National Laboratory (BNL) on Long Island, and the funding was put through State University of New York at Stony Brook, where my research collaborator was based. At the end of every research trip to BNL, I would travel down to Washington for a de-briefing and planning session with my contact at one of the US Government laboratories down there, who was the DoD liaison scientist for the project. He just happened to be a ham, and on one occasion in the late '80s or early '90s I was shown their laboratory ham shack. In the corner stood a majestic, but forlorn, Collins KW-1 transmitter. It still looked magnificent to me, but from a distance I could see that the VFO tuning knob was missing and there were no PA tubes visible through the PA compartment window. On closer inspection, I discovered that many of the useful RF components had been removed, and the modulator and PA tubes had also gone. I think that their sockets had also been removed, but, unfortunately, my memory of the whole episode is now beginning to fade, so I can't be sure on that. Someone had obviously plundered the bits to build an HF linear amplifier, or possibly two – those sideband guys will do anything for more power!

My host had obviously picked up on my interest in the KW-1, and after I had been inspecting the remnants for a while he asked me if I would like to have it. Apparently, they wanted to get rid of it, and if I could arrange some transport and remove it from the shack in the next few days I could have it, gratis and for nothing! My mind raced through all the possibilities. It certainly wouldn't go in my little Japanese-hire car, and I'd need a truck of some kind as well as some help to remove it from the shack. Where could I store it until my next trip to the States? How could I get it back to the UK? It was the offer of a lifetime for an enthusiast like me – although I'm British, I'm really only interested in old American amateur tube equipment – but I just couldn't arrange anything at such short notice because I was flying out of BWI Airport the following evening just after five, heading for home. I didn't know anyone in the vintage radio community around the Washington-Baltimore area at the time that I could call upon for help, or to store the remnants of the KW-1 for a few months. The Internet, such as it was at that time, was only available to certain government employees and academics, like myself, purely for mail correspondence (ARPANET/BITNET linked to JANET and EURONET). A few years later, when it became universally available, I could have posted a help notice on one of the boatanchor sites. But, unfortunately, this once-in-a-lifetime offer came too early for all of that.

After what seemed like an age, I sadly declined his very generous offer. I explained my predicament over storing it until my next trip to BNL, and the limited time I had left on this trip to actually remove it from their radio shack. He could see I was tremendously disappointed, and asked if there was anything I'd like to remove as a memento of the KW-1. Selfishly, not thinking of the keen vintage enthusiast who might ultimately acquire this carcass from government surplus and restore it, I said there was. Together we took off the VFO dial plate, and tried to remove the rest of the dial and the VFO assembly, but we couldn't get it out easily. So, instead, we removed the meter panel, complete with all the meters. I couldn't actually get this in my luggage because I had already acquired lots of other radio-related bits and pieces (tubes, aluminium chassis, etc.) up on Long Island, and it wouldn't go in either of my two suitcases or my hand luggage. So, reluctantly, I had to leave it behind. I think the panel, complete with all the meters, still sits on a bookshelf in my host's office at the laboratory to this day!

When I returned to Washington a few months later, I enquired about the Collins KW-1 transmitter, only to be told that it was being disposed of through the normal government surplus channels. I'd missed the one and only opportunity I'd ever have of acquiring my very own Collins KW-1 transmitter. Thinking about it later, it was really only a pipe dream though, which was very enjoyable for the short while it lasted. But, when reality kicked in it was obvious the KW-1 was missing too many bits and I would have had great difficulty in replacing them at that time despite my regular research visits to the States. And besides, it would have been a very costly and difficult process shipping it back home. Using it legally on the amateur bands in the UK would also have been a bit of a problem. It would have been absurd to contemplate using it here, and such a waste as well. Imagine trying to throttle a KW-1 back to 8-watts output on 160m! That's our current AM-carrier power limit from 1850 to 2000 kHz, where most of the AM activity on that band takes place. On 80 through to 10m, we're currently only allowed 100W of carrier power on AM, so the KW-1 would still have had to be throttled back to a fraction of its normal output to meet our power limit on the higher bands.

I did have plans to use the dial plate and build a miniature replica of the KW-1 with smaller modulator and PA tubes, and an output power more suitable for UK power limits, but nothing ever came of it, and the KW-1 dial plate, window glasses, and packet of screws were still languishing in a drawer in my radio room desk until recently when I took them out to take a photograph – I thought this story might possibly seem a bit too tall for many of you to believe – the radio version of a fisherman's tale - so I've included a picture of my ill-gotten gains in **Figure 1**, just to show you this confession isn't a wild fantasy concocted by the distorted and deluded mind of an unfulfilled and obsessed vintage radio collector! As a radio amateur, and particularly as one interested in vintage tube equip-

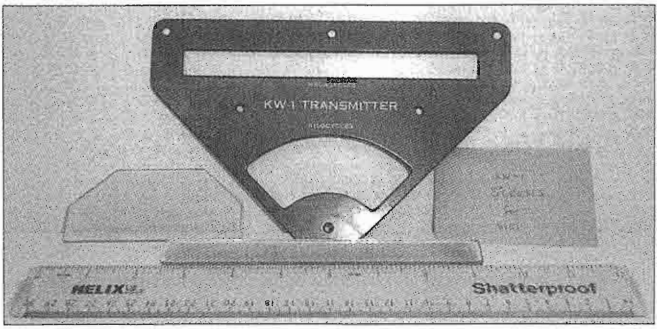


Figure 1: Dial plate, window glasses, and packet of mounting screws removed by the author from a Collins KW-1 transmitter.

ment and AM, a psychologist might consider me to be deluded and my mind to be distorted by any measure of normality, but this story isn't fantasy. The KW-1 dial plate in Figure 1 is clearly marked, and is obviously not a homemade replica. I'm pretty good at metalwork, but not that good!

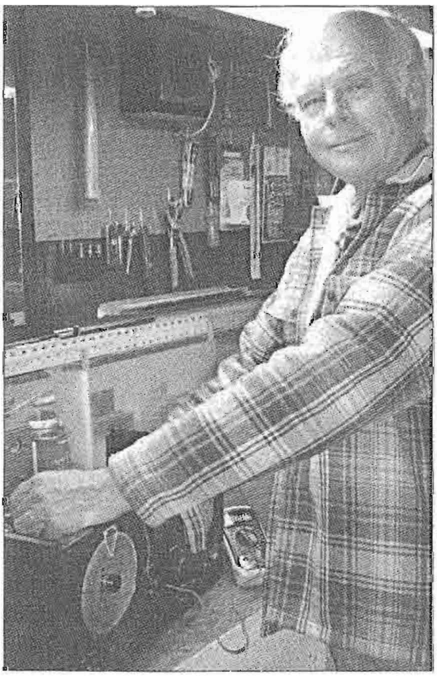
Now, partly to make amends, and partly to stop you guys crying in your beer at the desecration of such a fine old AM transmitter, I'd be happy to return the KW-1 VFO dial plate to its rightful owner, if he can be traced, and also try to help him locate some of the other bits that were removed from that Collins KW-1 transmitter all those years ago. I appreciate that it was all a very long time ago, and the new owner may well have found replacement bits by now. But, there is also the possibility that the KW-1 transmitter carcass in question is languishing somewhere as a part-out unit, and by returning a few of the custom parts I may just tip the balance and enable someone to restore it to its former magnificent glory. I still have a contact at that particular US Government laboratory in Washington, and there is a possibility that some of the sideband delinquents who removed bits from the laboratory KW-1 for use in their own HF linear amplifiers might be prevailed upon now and shamed into giving them up. It's worth a try anyway, considering how rare these beasts are, and I'll do whatever I can to help recover the missing parts. If you're the unhappy owner of that ex-government Collins KW-1 transmitter, please contact me by e-mail at the address given at the head of this article, and make it plain in the subject line that it's about the Ex-US Government KW-1 so it gets through my spam filters okay. Remember to include the serial number of the KW-1, and the details of how you obtained it, so that I can verify positively that it's the one from which I stripped the dial plate and meters. If you're not on the Internet, you can always write to me at the postal address given at the beginning of this article.

Now, having got this little secret off my chest I thought I'd feel a lot better, but I don't feel any different than the way I did before I started writing. This confession business is really highly overrated. Anyway, joking apart, we all do things we regret later, and, for me, this was definitely one of those things. It occurred in a moment of weakness, and just shows how selfish we vintage radio addicts can become when we're obsessed with collecting old gear. Let's hope some good can come out of it now, and despite the fact there isn't even the remotest hope of any redemption for me, an old defunct, cannibalised Collins KW-1 might eventually return to the air waves as a result of this public admission of my past transgressions against a fine piece of vintage equipment. Will Collins collectors ever forgive me?

ER

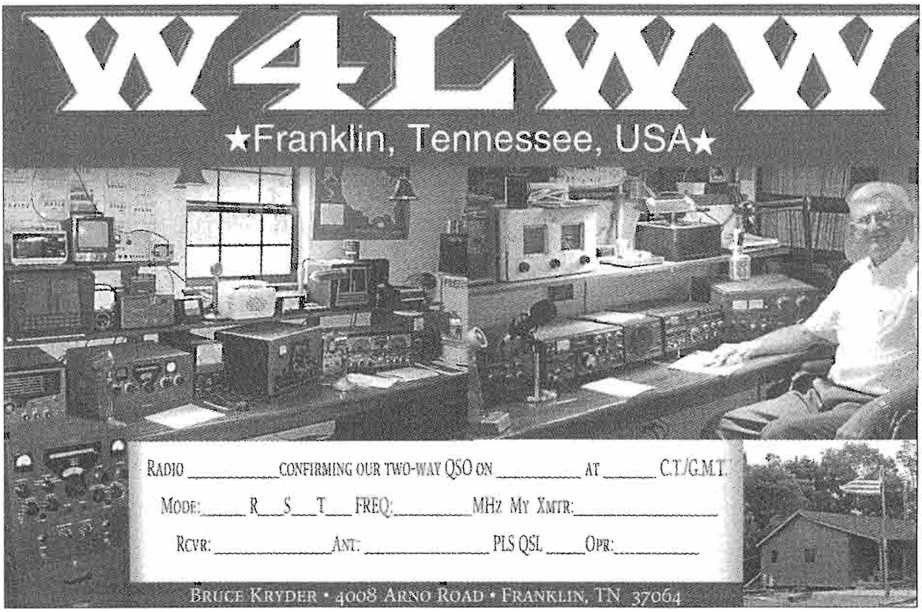
PHOTOS

Editor's Note: "Thank You" to everyone who has recently sent in photos, and please keep "those cards and letters" coming in so I can run the photo column on a regular basis!

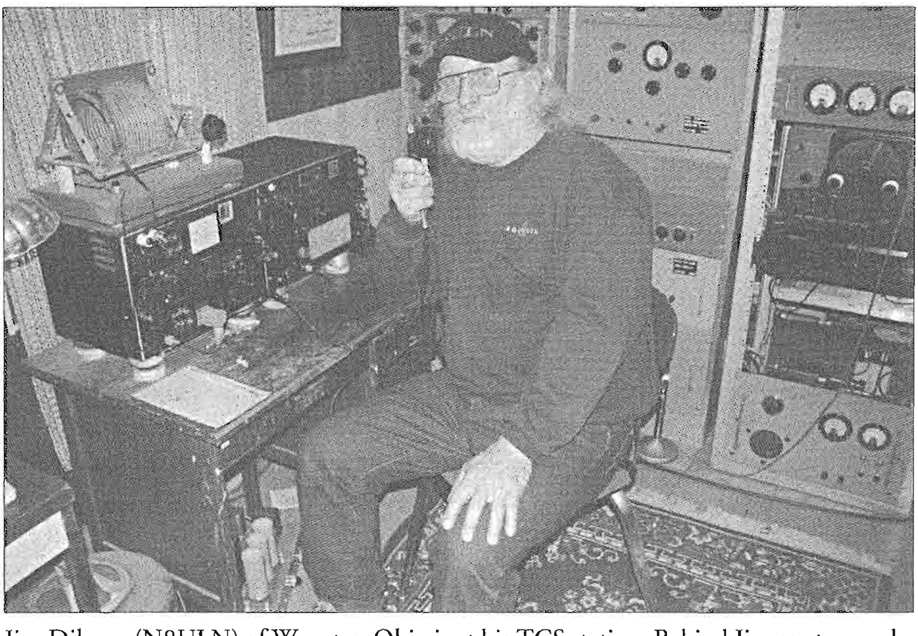


Above: Spencer Cromwell (K6VRS) is putting the finishing touches on his recently-acquired Hallicrafters S-19R that was given to him by a friend in San Diego, California. It turns out that this S-19R is the same one that introduced him to ham radio in the early 1950s! It was owned by a neighbor, now SK, who's son presented it to Spencer on a recent trip to San Diego. The actual restoration turned out to be quite extensive due to mouse damage that happened while in storage. Spencer was assisted by Ed Elder (KE7DOL), who took the photograph, and Spencer got Ed interested in CW after retirement.

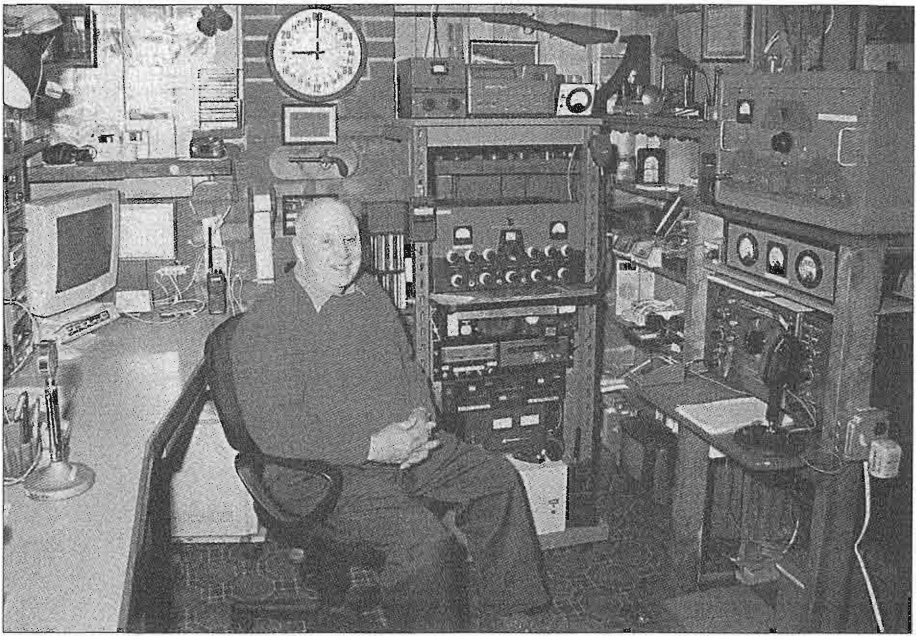
Below: Herman Gibbs (KD8PD) is standing next to his excellent-looking homebrew 813 rig that is designed for 40 meters.



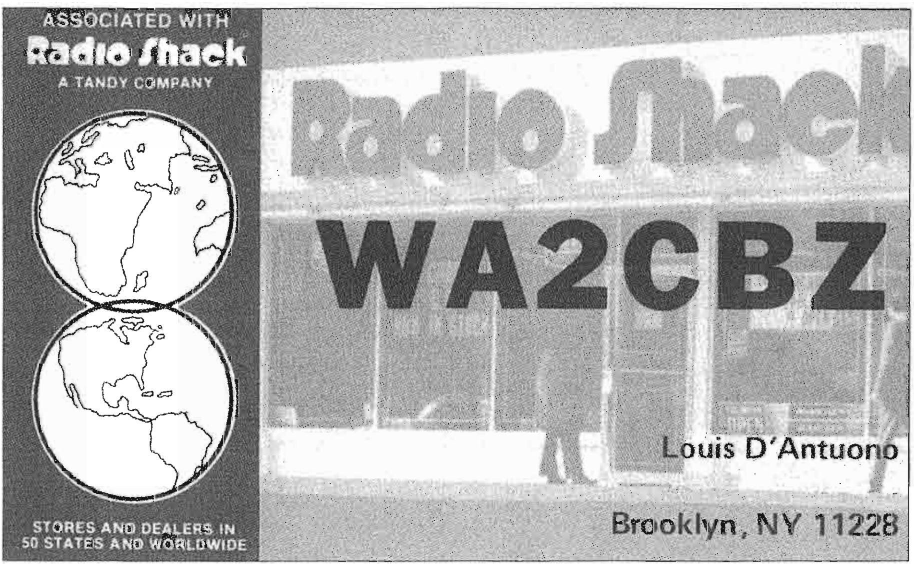
Bruce Kryder's (W4LWW) radio cabin in Franklin, Tennesse has classic equipment mixed with more modern gear. Bruce recently found a Viking Valiant and a Hallicrafters SX-100, both new in the 1957 boxes, which will be the subject of a future ER article!



Jim Dilucca (N8ULN) of Wooster, Ohio is at his TCS station. Behind Jim are two racks of homebrew AM transmitting equipment and their power supplies. (Photo courtesy of Herman Gibbs, KD8PD)



Colin Leath (K1IXU) is on the air from Johnston, RI. The custom meters under the DX-100 read grid drive, plate voltage & final plate mA. Colin got the HRO with only one set of coils, but Bob Wallace (W1HH), who worked at National, guided the alignment of 2 sets of coils, picked up later. The Viking 2 is his 160-meter rig. Colin's SSB station is behind him on the desk.



Louis D'Antuono (WA2CBZ) is a long-time ER reader and contributor from Brooklyn, New York. The QSL card above was given by the company (back in the 1970s) to Radio Shack employees, who had their ham tickets,. *ER*

VINTAGE NETS

AM Carrier Net: Sunday mornings, 8:30AM local Eastern time, 3835 kc. QSX W2DAP. Friendly format.

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 AMers on 3875 kc daily @ 6:00 to 6:15 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: Sunday, 14.263 Mc @ 2000Z. Informal ragchew net Tue. evening, 3805 kc @ 2100 ET, Thu. 3875 kc. West Coast 75M net, 3895 kc 2000 PT. 10M AM net 1800Z, 29.05 Mc Sunday, QSX 1700Z. CCA First Wednesday AM Night each month, 3880 kc starting @ 2000 CST, or 0200 UTC.

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 starting 0500, 3885 kc +/- QRM. QSX Ted, W3PWW. It isn't necessary to check in with military gear, but that is what this net is all about. Late checkins are welcome.

Florida AM Group: A large group meeting every Sunday, 7:30AM ET, 3875 kc and pre-net checkin 7:00AM ET, 3675 kc. QSX Maury, N4GUI. Also, Florida vintage SSB net "AFLAC" meets Wed., 3910 kc, 9PM ET. QSX Warren, W1GUD.

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. @ 6PM CT, 3885 kc, QSX control op W4GCN 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

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 20 Meter Net: Flagship AM net 14.286 Mc daily for 25+ years. Check 5:00 PM Pacific Time.

Lake Erie Boatanchor CW Net: Saturday morning, 1 PM ET, 7094 kc QSX op Steve (WA3JJT) or Ron (W8KYD).

Midwest Classic Radio Net: Sat. morning 3885 kc @ 7:30 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 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 Net Sunday 2200z winter 14.250Mc ±QRM. QSX op rotates Jim (WA5BDR), Jay (WB6MWL), Norm (W7RXG), Bill (W4WHW). Tech Nets: Wednesday 2300z 14.251Mhz / Saturday 1900z 7235 kc QSX op Stu (K4BOV)

Texoma Trader's Net: Sat. morning 8:00AM CT 3890 kc, AM & vintage equip. swap net.

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), or Vic (KF6RIP)

Westcoast Military Radio Collectors Net: Meets Sat. @ 2130 Pacific Time on 3980 kc +/- QRM. QSX W7QHO.

Wireless Set No. 19 Net: Meets second Sun., monthly, 7270 kc (+/- 25 Kc) @ 1800Z. Alternate 3760 kc, +/- 25 kc. QSX Dave (VA3ORP).

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SERVICE FOR SALE: JOHNSON "TURBO" RANGER, Valiant, Viking 500, Viking II, includes panel and cabinet refinish. Hammarlund 180(A), National 300, 303, R390(A). http://w4pnt.8k.com Patty & Dee's Marina: 534 W. Main St. Waynesboro, VA. 22980 w4pnt@highspeedlink.net 540-249-3161 Cell: 540-480-7179

FOR SALE: NOS Stancor P5002 Filament XFMR, 10V, 12A, 15#. $25. + Shipping. Jerry Kessler, N4JL, 6628 Tim Tam Trl, Tallahassee, FL 32309-1937, 850-212-6455, N4JL@att.net.

FOR SALE: National NCX-5 w/NCX-A, $300. NCL-2000 Amp, $500. Orig. Manuals. Desc. & pix. avail. N4GL, sjotrollet@yahoo.com

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FOR SALE: GR 1644A Megohm bridge, $150. Manuals: GR 1217C, $15. GR 726A, $10. Ross Wollrab, 229 N. Oakcrest Ave, Decatur, IL 62522-1810 217-428-7385 REWollrab@aol.com

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FOR SALE: Collins: 51J-3, completely gone through, with new aftermarket cabinet, $900. 30L-1, RE, good, works perfectly, $600. KWS-1, works great, needs alignment, new pair Eimac 4CX250B, relay, book, $1,400. Local pickup only, Kenwood digital TS820S $400, VFO820, $100, looks new. Prices FOB Houston. Guaranteed. Don, K5AAD, 713-942-9747

FOR SALE: Viking Ranger transmitter, all tubes good. Needs line cord and minor repairs in the immediate area. $125 plus shipping. John Snow 1910 Remington Ct., Andover, KS 67002 or 316-733-1856


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FOR SALE: Heathkit Model RX-1 (Mohawk) receiver exc cond with manual $200 plus shipping. John Snow 1910 Remington Ct., Andover, KS 67002 or 316-733-1856

FOR SALE: Triplett tube tester Model 3414 with manual $50 plus shipping. John Snow 1910 Remington Ct., Andover, KS 67002 316-733-1856

FOR SALE: Sencore Model SM-158 Speed Aligner Sweep Generator w/manual, as new, $200 plus shipping. John Snow 1910 Remington Ct., Andover, KS 67002 316-733-1856

FOR SALE: Little Lulu transmitter, $250 + shpg, call for details. Central Electronics MM-2 monitor, $100 + shpg, call for details. Heathkit SB-104A, pwr sply/speaker, remote VFO, monitor scope, call for details. Charles Croatman, K4ZKS, 941-747-2082, k4zks@tampabay.rr.com

FOR SALE: Central Electronic 20A SSB exciter with VFO and manual. Unit is original w/good panel. $125.00 plus shipping. Ron, KBØTME/4, 850-678-8592, (home), 850-729-8549 (work), baron67@embarqmail.com.

FOR SALE: Lampkin Laboratores Model 105B, (Antique) $50 plus shipping. John Snow 1910 Remington Ct., Andover, KS 67002 316-733-1856

FOR SALE: HP 8551B/ 852A 10MHZ-12GHZ spectrum analyzer. Good working condition, $100 plus UPS. Kirk Ellis, KI4RK 203 Edgebrook Dr., Pikeville NC 27863, 919-242-6000, KI4RK@arrl.net

FOR SALE: Ballast tubes; JFD; Amperite: Clarostat and others new in boxes. $5 each plus shipping. LSASE for list. John Snow 1910 Remington Ct. Andover, KS 67002

FOR SALE: BC-454 and BC-455. Both with dynamotors and are painted blue/ BC375 tuning section. Dean, 612-869-9264

FOR SALE: Lot of 7 different HRO-60 coils. $150 + shpg. Bill Ford, VE3CK, 23 George St. N., Smiths Falls, ONT, Canada K7A 1Y3. 613-284-0700

FOR SALE: Collins 20V-2 broadcast transmitter. Nice condx, manual, PU only. Virgil, 423-404-8000

FOR SALE: EICO Model 720 amateur transmitter with manual exc cond $75 plus shipping. John Snow 1910 Remington Ct., Andover, KS 67002 316-733-1856

FOR SALE: TMC GPT-750 from the shack of N6CSW/Ø. Center drawer with parts for AM modulator including solid state preamp, driver using pair 6L6s to drive pair of 810s, very large modulation transformer. Photos via email. Pick up near Tulsa, Oklahoma. Asking $2,000. Also another GPT-750 that's going to need a lot of TLC. Gary Gompf, 918-333-7893, w7fg@w7fg.net

FOR SALE: Jackson Model 648 dynamic plate conductance, checks all modern tubes, exc cond with manual, $175 plus shipping. John _Snow 1910 Remington Ct., Andover, KS 67002 316-733-1856

FOR SALE: B&K MODEL 747 DYNA-JET solid state dynamic mutual conductance tube tester, near new, still in original shipping carton, $375 plus shipping. John Snow 1910 Remington Ct. Andover, KS 67002 or 316-733-1856

FOR SALE: Hallicrafters Model S-38C (run 2) exc cond, all tubes good, $65 plus shipping. John Snow 1910 Remington Ct., Andover, KS 67002 316-733-1856

WANTED: Case for Hickok 800A tube tester; also case for 533/534/539 etc. John Snow, 1910 Remington Ct., Andover, KS 67002 or 316-733-1856

FOR SALE: Heathkit VTVM, QSTs and ARRL year books. Les, WB2DQU, Sewell NJ, 856-218-8838

FOR SALE: Lot of war surplus radio gear, very unusual, also handbooks. Frank Bridges, W4CPK, 828-885-2470

DRAKE OWNERS: Solid State lamp replacements for all 4-line and 7-line equipment. Don, N9OO, Web: http://home.wi.rr.com/n9oo/products/products.html or phone 262-654-0072

FOR SALE: B&W 5100A. Central Electronics 200V. Johnson Ranger. Johnson Viking II. Hamarlund SP600 with original case. Drake B Line. All are working and are very good to excellent condition. Local pickup in Sacramento preferred/will ship, Frank, KBOW/6, 916-635-4442 fdellechaie@sbcglobal.net

FOR SALE OR RENT: 17.5 acre antenna farm w/garage & shack, 80-2M Telrex beams, 160m-4-square, 6kw amp linear, 12-towers Richard, K8CCV, 330-427-2303

FOR SALE: Antique Plastic Radio Dial Covers! No waiting, Quick turnaround. 1200 molds in stock. West Tech Services 570 Hazelgreen Rd. Smithville, WV 26178. 304-349-2149. Email: westtechservices@yahoo.com or Website: www.west-techservices.com. **$15 ppd**. Thanks, Gib & Linda

FOR SALE: Sonar CB model FR102X, $55. Virginia Chen, 2609 Dudley Rd., Kilgore, TX 75662 903-984-4259

FOR SALE: Military microphones: M-80C, unused in mil packing, $20 for two each, postpaid. Tom, KJ7AV, 9764 W. Elmhurst Pl., Littleton, CO 80128, 303-979-6135

MANUALS FOR SALE FOR YOU: Drawers full of vintage manuals, call me on 828-298-1847 for quality reproductions or email me at olg77tr@bellsouth.net. Web: www.w4qcfmanuals.com. I'm John, W4QCF, 66 Willowbrook Rd., Asheville, NC 28805. Licensed 1949.

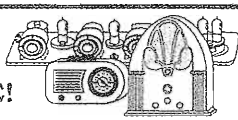
FOR SALE: New Collins handles for transmitters 32V, KWS-1, KW-1. Replace those beat up and gouged front panel handles on your Collins A-line gear! Handles are finished in high gloss epoxy. Uses existing screws. $20 each. Include $37.50 per pair for priority mail shipping. Please order via EMAIL: w3hm@frontiernet.net or by phone, 304-876-6483, or by regular mail with money order to: W3HM Radio Labs, 570 Acorn Circle, Harpers Ferry, WV 25425

FOR SALE: 50 year collection of radios and parts, PU local in W. NY Buffalo area. QSTs Cheap, 1924 to 1990! Rudy, W2ZIA, 716-937-9279

FOR SALE/TRADE: Manuals: Collins, Hallicrafters, National, Hammarlund, RME, WRL, Johnson, Drake, EICO, Heathkit, B&W, Millen. Al, NI4Q, POB 690098, Orlando, FL 32869 407-351-5536 ni4q@juno.com

WANTED: 23 channel CB radios, Johnson 323, Sonar J23 and others. Base or mobile. Ed, WA7DAX, 1649 E. Stratford Ave., Salt Lake City, UT 84106. 801-484-5853

FREE SAMPLE!



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SERVICE FOR SALE: Quality repair of your vintage radios. Work is guaranteed. Check website for info: www.westonelectronics.com Jim Weston, K4COD, PO Box 294, Concord, GA 30206, 770-884-3202

FOR SALE: Terabeam 10dB bi-directional amp, covers 24 GHz ham band, etc. 1/2W output, $56 postpaid. Robert Enemark, W1EC, POB 1607, Duxbury, MA 02331 781-585-6233

FOR SALE: Hammarlund clock reproductions, 12 hour (easier to read) or 24 hour, specify, $35 each, shipped. Rob Hummel, WA9ZTY, 202 Midvale Dr, Marshall WI, 53559-9616

FOR SALE Sprague Orange Drop capacitors New/NOS. Many values/ voltages. 50% off retail. Mix or match values. eMail for complete list. gg136@aol.com

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FOR SALE: KWM-2 CDs. All original material, not a copy of the manual. High resolution color pictures which will really help locate parts, plus much more. For more information visit my web page at http://www.heavymetalradios.com/ or E-Mail me at boatanchors@comcast.net, DW Holtman, WB7SSN

FOR SALE: Technical Books & CDs. Harold Kinley (WA4GIB), 204

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FOR SALE: New, universal power supply for Elmac, Gonset, Harvey Wells, others. SASE for brochure. Harold Smith, W4PQW, 1435 Bush St., Pensacola, Fl. 32534 850-476 8107 w4pqw@cox.net

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FOR SALE: Chinese Army type 65 hand crank generators for 102E radio sets. Ken, KD6B, kd6b@bendbroadband.com 541-923-1013, POB 310, Redmond, OR 97756

FOR SALE: "Unique Radio Parts", LLC. www.wa9tgt.com (Replacement parts for "Drake" radio equipment)

FOR SALE: Atwater-Kent dual speed tuner repair kit. Complete details at www.adamsradio.com Adams Manufacturing CO., POB 1005, Lincoln Park, MI 48146

FOR SALE: Galena crystals and detector assemblies. Also radio tubes at very low prices. Len Gardner, 458 Two Mile Creek Rd, Tonawanda, NY 14150, radiolen@att.net

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FOR SALE: Telephone Filters, suppress >1MHz interference, plug in, 1/$7, 2/$11, 3/$14, 4/$16.75, shipped U.S. Brian Harris WA5UEK 3521 Teakwood Lane, Plano TX 75075 brian.k.harris@philips.com 214-763-5977

DRAKE PARTS FOR SALE: New spun inlays for the B Line or TR4 main knob. $6. Also sell new pointer knobs. Alan, KC9YS, 630-879-1132 after 7pm.

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, carl.bloom@prodigy.net 714-639-1679

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: Let's get that old radio of yours working again! Antique Radio Repair - All Makes- Also Transistor Radio Repair. Tom Senne, N5KCL, 937-865-5213 http://tomsradiorepair.bizland.com

FOR SALE: DRAKE TR-7/TR-7A/R-7/R-7A service kit. Includes 13 extender boards and digital jumper card. $64.60 includes postage. See http://pweb.amerion.com/~w7avk, Bob, W7AVK, 807 Westshore J28, Moses Lake, WA 98837, w7avk@arrl.net 509-766-7277.

FOR SALE/TRADE: Transmitting/Receiving tubes, new and used. LSASE or email for list. WANTED: Taylor 204A, 211, TR40M and Eimac 500T. John H. Walker Jr., 13406 W. 128th Terr., Overland Park, KS. 66213. PH: 913-782-6455, Email: jwalker83@kc.rr.com

DRAKE OWNERS: New Sylvania 6JB6, same date code, tubes for sale. Price: $23 ea. Call Dick at 207-490-5870

FOR SALE: FT243 Crystals: 1000, 1822, 1880, 1942.5, 3530, 3535, 3540, 3545, 3550, 3625, 3675, 3735, 3800, 3825, 3870, 4325, 4335, 4340, 7040, 7050, 7123, 7140, 7143, 8400, 10106, 28238, 28258, 28571 kHz more. 100kHz, 455kHz HC51U wire leads. Some FT171B, HC6U Crystals. Contact af4k@hotmail.com or send SASE to Brian Carling, AF4K, 117 Sterling Pine Street, Sanford, FL 32773 or call 407-323-4178 http://www.af4k.com/crystals.htm

HALLICRAFTERS SERVICE MANUALS: Ham, SWL, CB, Consumer, Military. Need your model number. Write or email. Ardco Electronics, PO Box 24, Palos Park IL, 60464, wa9gob@aol.com 708-361-9012 www.Ardcoelectronics.com

DRAKE INFO FOR SALE: Drake C-Line Service Information. Hi-Res Color photos of boards and chassis with parts identified. CD also includes Hi-Res scans of R-4C and T-4XC manuals, various version schematics and more. Garey Barrell, k4oah@mindspring.com 4126 Howell Ferry Rd, Duluth, GA 30096. 404-641-2717

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

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

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, 1115 S. Greeley Hwy, Cheyenne, WY 82007. 307-634-5858 feltondesign@yahoo.com

FOR SALE: Radio parts and hardware. Some are 60 years young! Free flyer, USA only. Bigelow Electronics, POB 125, Bluffton, OH 45817-0125

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

SERVICE FOR SALE: Repair of tube and solid state 1930 to 1975 radio equipment, auto, shortwave and older amateur gear. Please contact Ken Hubbard, KA9WRN, at 608-362-1896 or write Vintage Radio Service, POB 792, Beloit, WI 53512-0792.

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.

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

JOHNSON PARTS: 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. b.kpvt@provisiontools.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, fixer7526@wmconnect.com

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

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, AF-67. 51J-4 filter replacements, R390A Hi-fi AM $245.00 ea. Chuck Felton, KDØZS, Wyoming, 307-634-5858, feltondesign@yahoo.com

WANTED: R-392 receiver to go with my T-195 xmtr. Also S-meter for SX-28 rcvr. Jimmy Weaver, KB5WLB, 1007 E Bridges, Wynn, AR 72396 870-238-8328

WANTED: Aircraft radio frequencies (110-150 MC approx). Manual for OS-8G/U. Bill, KØIKP, 303-979-1860, WildBillk0ikp@aol.com

WANTED: Manual for Canadian Marconi SSB transceiver CP-34/AN PRC-514. Also military coils for the T-4/VRC transmitter. Also QSTs 1930, '31, '32 complete, good condx. George, K1ANX, 413-527-4304, k1anx@charter.net

WANTED: EF Johnson Citizens Band Matchbox model #250-49. Richard, WAØKKC, 1-913-432-5136

WANTED: Black wrinkle spkr for HRO-5, reasonable, with emblem. Jim, K7BTB, in AZ, 928-635-2117, jeldgl@aol.com

WANTED: A BC348 operational receiver, early model with Ant Align/or a complete one for restoration. Will trade a 392. Ed Allison, 5525 20th Ave, Sacramento, CA 95820 916-454-1788

WANTED: $50 for a clean copy of a late 1950's electronics magazine depicting a "Salt Water Radio" on the cover. $25 for a copy. mhutnick@ptd.net

WANTED: Top and back metal cover for a Hallicrafters S-41 model G or W. Ken Kolthoff, K8AXH, 913-634-3863

WANTED: Allied Radio Corp. Catalogs for 1949 or 1950. Will pay your price, including USPS shipping. R.W. Morris, KG6UBO, tdcrsnf@earthlink.net 858-560-8989

Run Oct-Dec 2007 WANTED: SB230 Heathkit amp with defective 8873 tube or Dentron MLA1200 with defective 8875. Bill Smitherman, KD4AF, 336-699-8699

WANTED: Nice cabinet for Hickock model 600A and Hickok Model 532 same as 533, 534 tube testers. John Snow 1910 Remington Ct. Andover, KS 67002 316-733-1856

WANTED: Gonset mobiles: G66B and G77A w/110 AC power supply. Benard, WA7UUF, 206-768-3070 or benard_wa7uuf@peoplepc.com

WANTED: A Collins parts receiver: 75A-2 or A-3 or A-4. Ed Cole, 303-444-7296

WANTED: Wanted schematic/info for Breting 6 rcvr. Denny, W7BKZ, 208-660-1573 w7bkz@hughes.net

WANTED: I need one SX-101A small knob, the "Notch Depth." Brent Cater, PO Box 1017, Clarksville, AR, 72830. W5FRG @ ARRL.NET

WANTED: HRO 50 or 60 parts unit. Also need nickel PW dial assy. Bob, 516-754-1763

WANTED: Swan 117C power supply/spkr accessory. Martin Piepenbury, W9OLD, 5536E 500N, Monterey, IN 46960 574-542-2591

WANTED: Manual for Dumont model 245 oscillograph, and looking for model 241 scope. Steve Bartkowski, 1-708-863-3090

WANTED: I am looking for a Grebe CR-

18 receiver in good to excellent condition. Will pay any reasonable price, and most unreasonable ones! Bruce, W1UJR, w1ujr@arrl.net

WANTED: DX-100 complete or parts rig for restoration. Chuck Milton, W4MIL, 58 Barrington Dr., Palm Coast, FL 32137 386-446-8571

WANTED: Dead or Alive! Harvey Wells APS-90 power supply for T-90 transmitter. K1MD, Richard San Antonio, san.antonio@cox.net or 401-732-4026

WANTED: Hallicrafters SX-117 rcvr, restorable or parts unit. Still need bias and filament xfmr for HT33, A or B model. John, W8JKS, 740-998-4518

WANTED: Collins Service Bulletins for 651S-1 HF Receiver. Contact mmoss@mindspring.com

WANTED: Someone with a collection of Short Wave Craft, Radio Craft from the 1930s to collaborate on a series of articles on a substantial collection of original items from that time period. Please call Chuck, WØIUH, 320-277-3242

WANTED: James Millen plug in oscillator coils for Millen 90881 linear amplifier, Millen parts #s 43011, 43015, 43021, 43041 and 43081. Gary K2PVC; gschonwald @earthlink.net 917-359-8826

WANTED: Technical Materiel Corp (TMC) power supplies PS4 (low voltage and bias) and PS5 (high voltage) for the TMC PAL 1K kilowatt linear amplifier, also known as the RFD or RFA. Gary K2PVC; gschonwald@earthlink.net 917-359-8826

WANTED: Squires-Sanders SS-1R and SS-1V. Bob, WØYVA. 703-450-7049; robert@isquare.com

WANTED: Hallicrafters HT33 with salvageable power supply. The RF section is not required to be useable, need a power supply to contribute to one that is. Gary Schonwald K2PVC. gschonwald@earthlink.net phone: 917-359-8826

WANTED: Technical Materiel Corp rack mounted antenna tuner and RF /SWR meters to be used with the 350-watt or 1000-watt TMC linear amplifiers. Will consider other TMC transmitting equipment and accessories for collection and on-air use. Gary Schonwald K2PVC. gschonwald@earthlink.net phone: 917-359-8826

WANTED: Meter movement for Western Electric transconductance tube tester KS-15750. Walter Hughes, WB4FPD, 6 Academy Ct., Berryville, VA 22611 540-955-2635

WANTED: Will buy SP-600 and some other Hammarlund equipment, working, not, or incomplete. Al, W8UT, anchor@ec.rr.com 252-636-0837

WANTED: Vacuum Tubes: 279A, 212E, 249B, 258B, 271A, 242A, C120, C100A, 804, RK20, CK70, GL805, C201, ZB-120, 802. Components for rebuilding Collins 30J RF output deck, including Cardwell or equivalent dual section variable 440 pF and 240 pF capacitors. Components for Collins 12H /12N speech input console, including preamplifiers and program amplifiers. Rod, W5CZ, 303-324-2725, rodperala@aol.com

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WANTED: Pearce-Simpson manual/ schematics for VHF marine radio, model "Catalina", JR Linden, K7PUR, PO Box 4927, Cave Creek, AZ 85327, jrlinden@usa.net

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WANTED: Clean National Select-O-Ject, NC-183DTS and Heath VX-1. Contact Ric at c6ani@arrl.net.

WANTED: Early QSL cards from my Grandfather, Hal Smith (SK). His calls were KH6KA, K6YJR, K6OQE. Gladly reimburse postage plus modest finder's fee! Phil Wilson, 1355 Big Otter Dr, Blue Ridge, VA 24064 k6cra@arrl.net

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WANTED: National NTE-30 Transmitter. Any condition, any price! I love National. Sylvia Thompson, n1vj@hotmail.com 33 Lawton Foster Rd., Hopkinton, RI 02833. 401-377-4912.

WANTED: One of my "KN8GCC" QSLs from the mid-1950s. Tom Root, 1508 Henry Court, Flushing, MI 48433, wb8uuj@arrl.net 810-659-5404.

WANTED: Any TMC equipment or manuals, what have you? Will buy or trade. Brent Bailey,109 Belcourt Dr., Greenwood, SC.29649, 864-227-6292, brentw2@earthlink.net

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WANTED: Seeking unbuilt Heathkits, Knight kits. Gene Peroni, POB 7164, St. Davids, PA 19087. 215-806-2005

WANTED: PRESS WIRELESS, NY: Photos, information wanted on Hicksville, Baldwin, Little Neck, Centereach, Northville facilities. George Flanagan, 42 Cygnet Dr., Smithtown, NY 11787 w2krm@optonline.net 631-360-9011

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

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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: 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

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WANTED: WW II German, Japanese, Italian, French equipment, tubes, manuals and parts. Bob Graham, 2105 NW 3Oth, Oklahoma City, OK 73112. 405-525-3376, bglcc@aol.com

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WANTED: QSL card from W9QLY, Frank (Mac) Maruna, from 1956 or before. WILL PAY TOP DOLLAR. Don Barsema, KC8WBM, 1458 Byron SE, Grand Rapids, MI 49506, 616-451-9874

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, 1-708-863-3090

WANTED: TCS & TBY Navy radios. Ken Kolthoff, K8AXH, PO Box 215, Craig, MO 64437. 913-634-3863.

WANTED: ARC-5 rcvrs, racks, dynamotors. Jim Hebert, 900 N. San Marcos Dr. Lot 77, Apache Junction, AZ 85220

WANTED: Front panel for Kenwood VFO-230. KH7TU, Ken Thomas, PO Box 4003, Lihue, HI, 96766, 808-647-0645, captdale2@hotmail.com

WANTED: Harvey-Wells Odds-'N-Ends: Speakers, phones, mikes, manuals, supplies, prototypes, military, aircraft. Kelley, W8GFG, 219-365-4730, 9010 Marquette St., St. John, IN 46373

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 or www.r-389.com

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: Receivers. Telefunken E1800, Rohde Schwarz, EK-56/4, NC-400, Racal 3712, Hallicrafters SX 88, Collins HF8054A, Collins 851S-1. Manual for Racal R2174B(P)URR 310-812-0188(w) alan.royce@ngc.com

I NEED INFO!: Radiomarine T-408/URT-12/USCG/1955. Sam, KF4TXQ, PO Box 161. Dadeville, AL 36853-0161 stimber@lakemartin.net 256-825-7305

WANTED: Scott Special Communications rcvr. EA4JL, please call Kurt Keller, CT, 203-431-6850, kkeller1@comcast.net

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

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

WANTED: Tektronix memorabilia & promotional literature or catalogs from 1946-1980. James True, N5ARW, POB 820, Hot Springs, AR 71902. 501-318-1844, Fax 623-8783 www.boatanchor.com

WANTED: HBR Receiver! HBR-11 HBR-14 etc. any condition–dead or alive, unfinished considered Jeff, KEØMT, ke0mt@aol.com

WANTED: Collins promotional literature, catalogs and manuals for the period 1933-1993. Jim Stitzinger, WA3CEX, 23800 Via Irana, Valencia, CA 91355. 661-259-2011. FAX: 661-259-3830 jstitz@pacbell.net

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WANTED: Westinghouse SSB Transmitters MW-3 (Exciter, Amplifier, Power Supply). Also, MW-2 (AM). Will pickup anywhere. Gary, WA4ODY, Seabrook, TX 77586, 281-291-7701 myctpab@earthlink.net

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DONATIONS WANTED: Southern Appalachian Radio Museum, Asheville, NC, where others can view your radio treasures. For general information or donations call Clinton Gorman, Curator, 828-299-1276

WANTED: Need test set I-135 "G" or "F" will trade WWII I-135 "E" or will purchase, also have BC-611 to trade. Steve Bartkowski, 1-708-430-5080, 7702 Austin Ave, Burkank, IL 60459

WANTED: R390, R390A and R392 receivers dead or alive or parts/assemblies. Any condition considered. Will pickup if you have enough items. Glenn, WA4AOS, 864-684-2956

WANTED: Mint, complete or parts sets. Hammarlund SP-600 JX-28 version, has nomenclature tag R-620, doesn't have name engraved on panel like others, 1937 RCA ACR-111, RCA CR-88B version, RCA AR-8516, TMC CV-1758 SSB converter, and DEI Defense Electronics TR-711 telemetry receivers and modules. Will send custom shipping carton for easy transaction/shipment. Dan Gutowski AB8VM P.O. Box 142 Dexter, MI 48130 734-718-7450. dg16ms26@msn.com

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207-490-5870

FAX: 207-490-2228

WANTED: A Hammarlund SP-600 tuning knob. Will you please let me know your contact information? Katsuhiko, JO1GEG, in Yokohama, Japan. My email is mxc04040@nifty.ne.jp

WANTED: Cabinet similar to unit on page 32, August 2007 ER issue, holds 7" x 11" chassis. Louis L. D'Antuono, WA2CBZ, 8802-Ridge Blvd., Bklyn, NY 11209. 718-748-9612 AFTER 6 PM Eastern Time.

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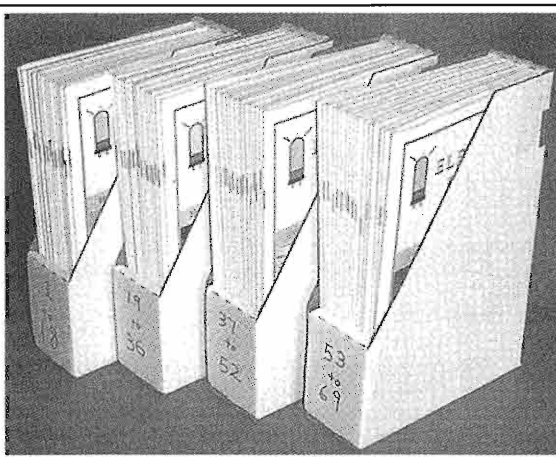

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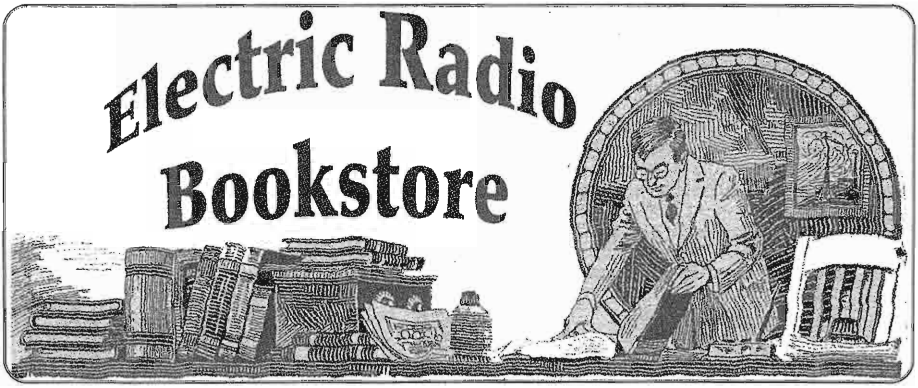

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