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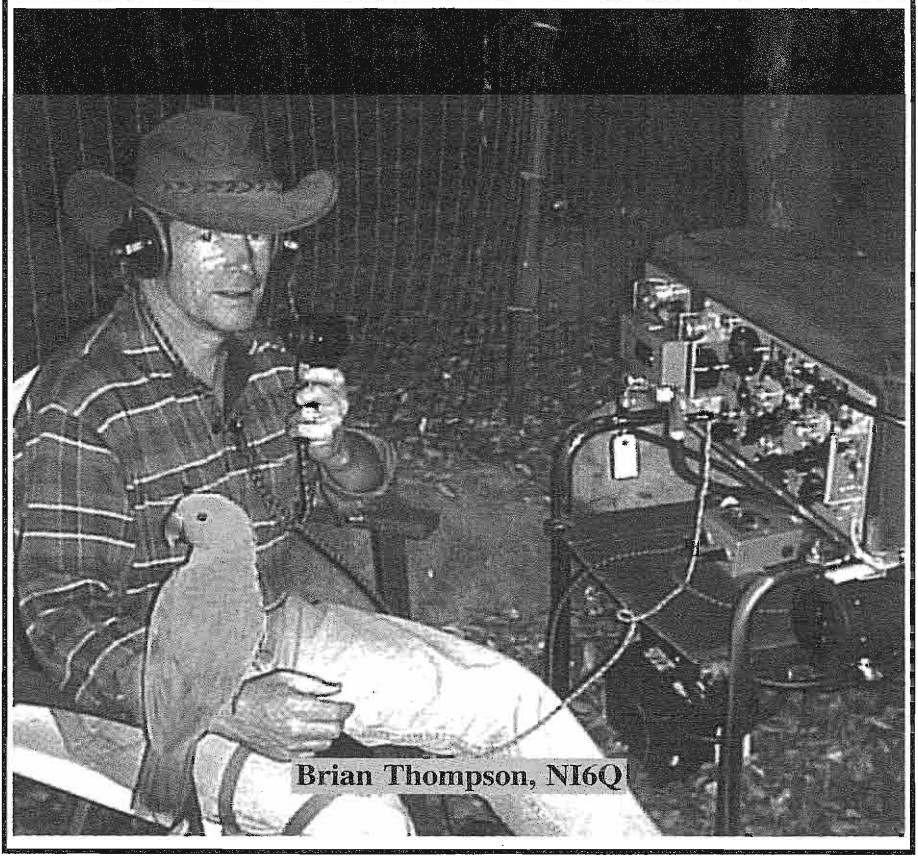
ELECTRIC RADIO

celebrating a bygone era

Number 184 September 2004



Brian Thompson, NI6Q

ELECTRIC RADIO

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

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

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

Editor's Comments

Due to space limitations, I am turning the mic over to Dale Gagnon (KW1I) for an important AMI Update for September, 2004:

AMI Discovery Weekend

This year the weekend will start sundown Friday evening September 24 and end Sunday evening September 27. This event will run again concurrently with the Fall 2004 Classic Exchange "CX." Remember the purpose of this event is to have the rest of the amateur radio community "discover" that AM is alive and well on the amateur bands. Certificates are awarded for three levels of participation. Level 1 requires 20 or more AM contacts on any band. To qualify for Level 2, Level 1 must be earned and an AM contact must be made on 20 meters, e.g. 14.286 kHz. In addition to Level 1 and Level 2, Level 3 requires one AM contact on a higher band, e.g.15m, 10m, 6m or 2m. "Participant" certificates are awarded to Level 1 achievers. "Participant Plus" certificates are awarded to stations attaining Level 1 and Level 2. "Participant Primus" is awarded to stations attaining all levels. You do not need to be a member of AMI to participate. Logs should be sent to AMI, Box 1500, Merrimack, NH 03054. Please log AMI certificate numbers if available. Please total your contacts for the various achievement levels and keep track of the number of states worked to make paper work easier on AMI office staff! If you have lost your AMI number or have questions about the event, e-mail aminternational@earthlink.net. Certificates, suitable for framing, are awarded.

New AM International Regional Director

Earlier this summer Tim Long, N5DWV, Sherman, TX agreed to serve as the AMI Director for the South Central Region replacing John Firey, W5ZG, who has served since the founding of AMI.

ARRL Requests Comments on Draft Bandwidth Proposal

The ARRL is requesting comments on a planned petition to the FCC seeking to regulate amateur sub bands by bandwidth rather than by mode. This petition seeks to create a regulatory environment more accommodating to newer technologies,

[Continued on page 47...]

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Cover: Brian Thompson (NI6Q) operated Vintage Field Day with Lancelot the Parrot and a brand new Wireless Set 19, MK2, made by Zenith in 1944. The WS-19 was unpacked after 60 years in storage, required no restoration or tuning, and Brian made 35 contacts in 3 states with it.

Restoring A Hammarlund SP-600J11 Variant – The Navy R-450/FRR-28

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Glen Mills, Pa 19342-9504

Introduction

The US Navy R-450/FRR-28 that I have is a Hammarlund SP-600J11 modified for diversity reception by Northern Radio Company, New York, as their Model 159 under Navy Contract NObsr 57519. This modification added a rotary switch and several coaxial connectors and one barrier strip to the rear panel and their associated wiring, two switches to the front panel, changed the 3.5 Mcs oscillator tube to a 12AU7, and changed the HFO and BFO oscillator tubes to type 6J6. The 6J6 tubes provide buffers for externally located high accuracy high-frequency and beat-frequency oscillators (HFO and BFO). High accuracy input signals are needed for diversity reception. The 12AU7 3.5 Mcs oscillator circuit is completely redone. The second section of the 12AU7 acts as a cathode follower to feed the internal 3.5 Mcs oscillator signal to the grid of V6, the 6BE6 second mixer, and to the rear panel 3.5 Mcs jack via positions 1 and 2 of the 3-position rear panel rotary switch discussed below.

An ink stamp marker was used by Northern to mark these changes on the chassis. With this receiver, however, the ink had faded or was otherwise disturbed in the cleaning process. More information about this will be given later. The 'J11 does not have the fixed crystal tuning assembly like some versions of the SP-600 do, thus the lack of the "X" in the model number. The radio is single conversion from 540 kcs to 7.4 Mcs utilizing a 455 kcs IF, and double conversion from 7.4 to 54 Mcs by adding a high IF at 3.955 Mcs. Thanks to both Stu (WAØDYJ) and Bill (K3JPB), the radio wound up in my basement last year waiting for me to tackle its restoration. I remember the SP-600 from my high school days as THE Station Receiver at the 6 meter (49.98 MHz) station of our local Air Force MARS facility at what was then Olmstead AFB outside of Harrisburg, PA, which I was a member of in the late 1950's. There have been many articles written before on SP-600 restorations but I thought the Northern Radio Company Navy diversity version was somewhat unique and deserved a write-up.

Diversity reception was common in military and AT&T HF fixed stations to improve circuit reliability, especially for radioteletype (RATT). Raleigh fading criteria says that using two receivers with separate, widely separated antennas (space diversity), or with two different frequencies with the same information (frequency diversity) and a diversity combiner results in a 6 dB (or 4 fold) improvement in circuit reliability. Using space diversity in an amateur HF setup is probably not practical unless you've got enough land to set up duplicate receiving antennas several wavelengths apart and have access to a suitable diversity combiner. The "standard" for U.S. AT&T long distance and DOD overseas strategic HF full duplex radio circuit in the 50's through at least the 70's was a 16 kcs wide ISB [independent sideband] system. Transmitter power outputs ranged from 1 to over 50 kW PEP. The carrier

was reduced by 20 dB to save power and yet allow phase lock by the receiver, and there were two 4 kc wide voice bandwidth circuits stacked on each sideband. One of these channels was always an order wire for the technical controllers to communicate. The remaining three channels could be used in a mixture of long distance telephone circuits and one or two packages of 16 channels of narrow-shift RATT. The very narrow shift of the multichannel RATT required extreme TX and RX oscillator stability and low intermodulation distortion. A pair of the R-450/FRR-28's utilized an external high precision oscillator chassis, the O-165/UR. Also used with the set was the AM-615 Amplifier-Detector (or later the AM-828) and optionally the AN/URA-6 converter-comparator for frequency shift RATT signals, along with associated LS-187/UR speaker, SB-224/UR Patch Panel and other components mounted in a standard 19" relay rack, CY597A/G. The KY-79/UR keyer provided audio tone output from CW or RATT to feed keying line signals over standard telephone lines to a remote transmitter site, if needed.

Additional Details on the R-450 Modifications

After a lot of searching on line, I have found a nice but pricy copy of the Navships 91582 operation and repair manual which describes all of the components of the AN/FRR-28 including the R-450/U with all the Northern Radio modifications. I found the manual after all the work was completed, so initially I bit the bullet and did much wire and circuit tracing to find out the modification details which were generally confirmed in the Navships manual.

The new V4, 6J6, HFO and buffer has completely different oscillator section components around the tube socket from a "typical" SP-600 to allow for switching on and off. A coaxial cable from the HFO INPUT UHF connector on the rear panel feeds the grid of the 2nd section of the tube. The new smaller left front panel 2-pole rotary switch located just above the Band Change knob selects between the internal and external O-165/UR HF oscillator feeds to the RF deck. The modification provides a little 455 kcs trap filter network on the rear chassis of L58, R112 and a few capacitors for inputting the external HFO signal from the O-165/UR. The remaining additional components for this modification are mounted under the chassis on the right side panel near the two filter chokes. All diversity coaxial interconnecting cables, if used, should be 70 ohm RG-59/U type.

The new V8, a 12AU7, 3.5 Mcs 2nd-conversion oscillator and cathode follower, and V6 (the 2nd mixer) are controlled from the rear-panel 3-position, 4-pole switch. The rear-panel switch allows the 3.5 Mcs oscillator to be routed between the two receivers by connecting a coaxial cable between the 3.5 Mcs SO-239 connectors on each receiver as follows:

A: Diversity: Receiver #1 supplying the 3.5 Mcs signal. Receiver 1 has switch in Position 1 and receiver 2 has switch in Position 2.

B: Diversity: Receiver #2 supplying the 3.5 Mcs signal. Receiver 1 has switch in Position 2 and Receiver 2 has switch in Position 1.

C: Independent single-receiver operation: Both receiver switches in Position 3.

This portion of the modification also included changing the IF gate power (screen) switch on the RF drum to a 2-pole 2-position rotary and routing the 150 VDC to the 2nd oscillator thru two sections of the rear-panel switch. The original drum switch was a single-pole two-position unit. This switch is only controlling 3.5 Mcs changes on the upper three bands and has no effect on bands 1 through 3.

The new V13 (BFO second section), which is also a 6J6, provides a UHF connector for injecting an external 455 kcs BFO signal from the O-165/UR, again

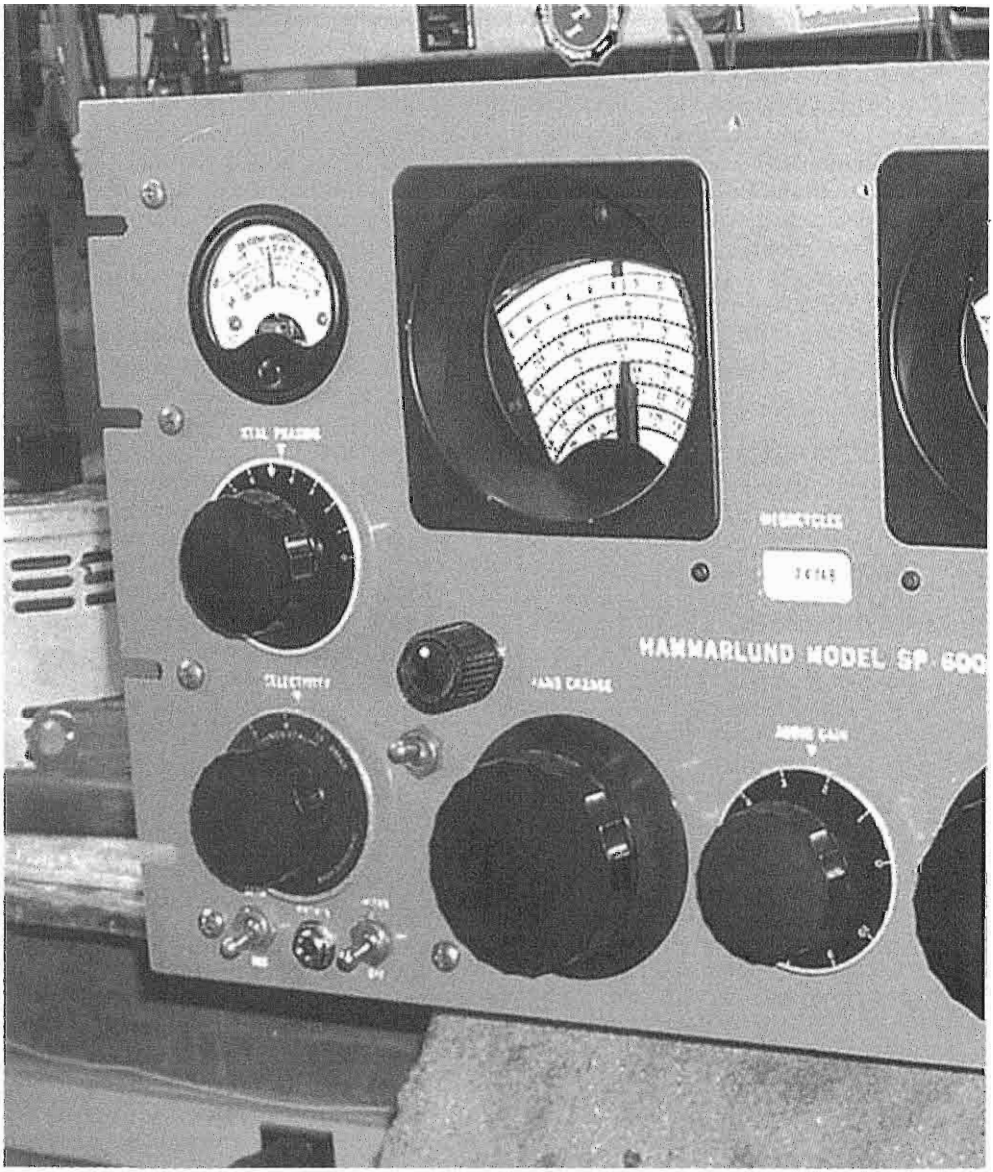
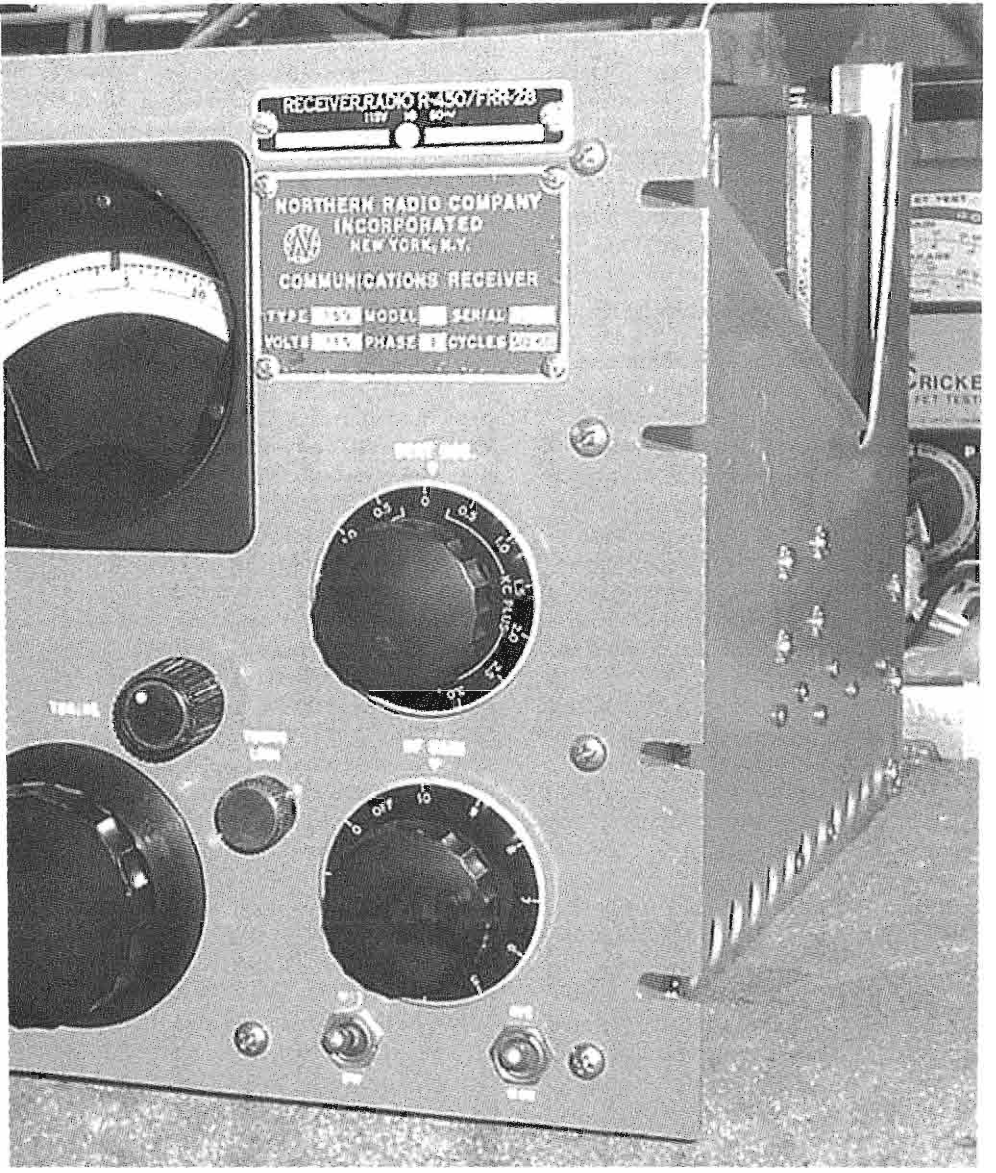


Figure 1: The receiver in final test on the W3L

fed from a SO-239 UHF connector on the rear panel. The new smaller front-panel 4-position 3-pole rotary switch located above the TUNING knob selects between the internal and external BFO with two different AGC time constants in each case. Positions 1 (fast, 0.01 uF) and 2 (slow, 0.25 uF) are for internal BFO and positions 3 and 4 are the same for the external BFO signal from the O-165/UR. The additional components for this modification are mounted on 2 and 7-lug terminal strips near the socket of the BFO under the chassis.



workbench tuned to the CBC on 13.55 Mcs.

Northern relocated the rear-panel audio output barrier strip and added a new 5-terminal barrier strip which provides 6.3 VAC, GND, the AVC line, and the detector output and detector load connections for a loop-thru that was used for maintenance purposes. For normal operation, a jumper between DET and LOAD terminals is required to pass audio to the receiver audio stages. The 6.3 VAC terminal is not utilized elsewhere in the AN/FRR-28. Also added is a toggle switch for AVC connection between the two receivers, an IF gain control to bal-

ance the two receivers in the diversity pair, and, located in the cathode circuit of V9 and V10, an IF output monitor jack. There is an RCA phone plug for an additional detector output connection via shielded cable to the KY-79U/R. The 70 ohm "Z" IF output UHF jack is mounted on a bracket fastened to the left side chassis panel above V12. The AVC line has extensive R/C isolation between all of the various RF and IF stages by means of branch feeds.

To accommodate the new terminal strip and SO-239 connectors, Northern moved the 6AL5 bias supply main filter capacitors and resistors from the inside rear panel to the right side panel under the chassis, relocated the feed wires to this unit, and also added a small amount of additional bias filtering consisting of an additional 10k ohm series resistor and a .01μF mica bypass. This extra filtering is associated with the fixed-bias feed for the BFO oscillator and buffer.

After completing the NC-300's and SX-62's written up in ER earlier, and after trips to West Coast as well as FL, TX, and OH visiting relatives and Ham friends, it was time to start on the R-450 in March of 2004.

What Did I Get Into?

K3JPB had started on the restoration. When he obtained a nicer unit, I got this set in a partially disassembled state. The extent of the work so far dictated that the restoration would have to be completed without any attempt to power up the set before continuing. I did do a check on the health of the power transformer and found it in good shape. The two chokes were checked with a 1000V Meg-ohmmeter and found to have no leakage, not surprising since all the iron in this rig is hermetically sealed.

Restoration

First of all, the radio appeared to have been stored outside for sometime without a cabinet. Most of the hardware had rusted, and the aluminum surfaces facing upward had various amounts of pitting from oxidation. Underneath, the chassis was filthy with grease, plain dirt, and gunk. The rear panel had been bashed in near the AC power connector, probably as a result of being dropped or having something dropped on it. The entire set was covered with nicotine, not an unusual condition for any set from this era. Many of the soldered connections in the set had been MFP'd [multi-fungus proofed], however.

The more I continued disassembling, the more I found that I didn't like. There was hardened grease on bearing surfaces, corroded metal parts, and all of the Mallory-type front and rear panel rotary switches were suspect as the cases had rusted. The bandwidth selection 3-gang switch contacts and wipers, while dirty, were not badly corroded. Two of the front panel short bat handle toggle switches had been replaced with the wrong style. Also noted was the fact that many molded tubular paper capacitors are contained in the various IF and oscillator "cans" in the receiver.

The Black Molded Paper Capacitors

Then there were the molded capacitors. This set had the black tubular capacitors, but not the ones actually labeled "Black Beauty®". The term "Black Beauty®" was (is) a trademark of Sprague Electric Company for their implementation of the plastic encased molded paper capacitors in the later 1940's and 1950's. This style of capacitor was actually made by several manufacturers including Cornell-Dubilier as the "CUB"; Pyramid as the type "IMP"; and Mallory as the "GEM". In my SP-600, and based on pictures and data in early parts catalogs of the 1950's, the molded paper capacitors in this radio were manufactured by Cornell-Dubilier. Unlike the other radios I restored, as a precaution and the fact that many of these capacitors are hard to physically get at, I decided to replace all 43 of these tubular caps as well as a few others that were not of the molded type. In fact, I did not find one

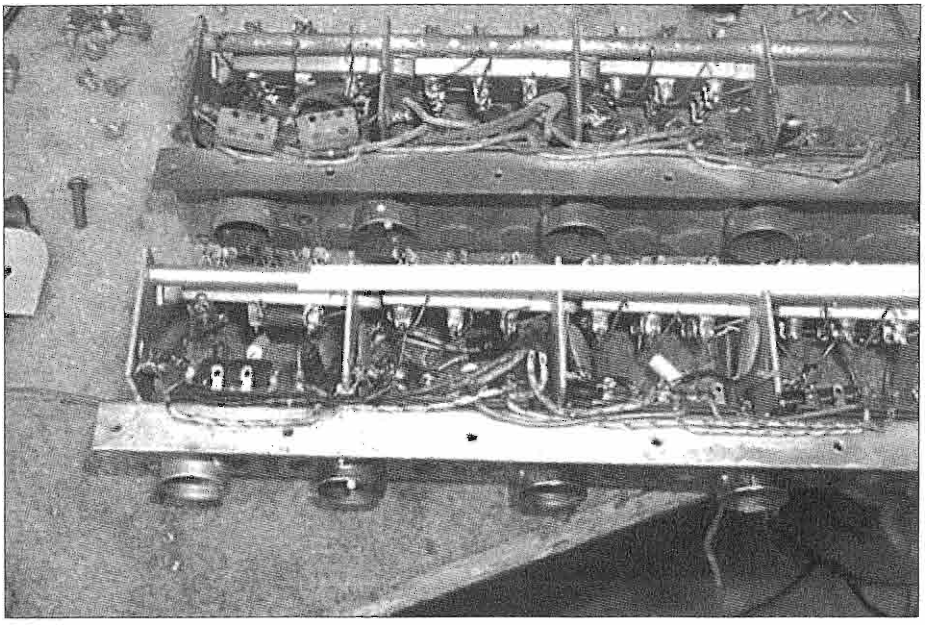


Figure 2: This illustration shows how the old and new RF amplifiers looked during the replacement process.

that was not leaky. Even the 2 x 0.05 "bathtub" type, that was used on the AGC bus and on the screen of the 6BA6 IF output tube, showed some leakage and was replaced.

Restoration Continued

The RF deck and the 8-gang tuning capacitor were quite corroded. I found another assembly for a very reasonable price on-line, and when it arrived I compared it with the one in the receiver. It was clear the one I found needed to replace the original unit. The original had several burnt resistors and virtually all the .01µF tubulars were visibly cracked. The replacement RF deck had all of the .01µF tubulars replaced by its previous owner. There are also black tubulars in some of the coil assemblies on the drum. They don't have much voltage on them but they got changed anyway because it is so much easier with the drum completely out of the radio. This radio used mil-spec carbon resistors and a spot check of those found virtually all of these, except those few cooked by leaking bypass capacitors, to be within tolerance. As mentioned before, in comparing the RF decks, the actual wiring and components associated with the new 6J6 HFO (V4) was considerably different than my stock Air Force T.O. indicated. Based on the other additional components associated with the HFO switching, these changes were made by Northern Radio as part of the modification process and they were left as found. V4 uses a shield with a lead weight to minimize microphonics. This shield should be retained for best performance on the higher bands.

The disassembly included the complete removal of the two filter chokes for repainting, partial removal (without unsoldering wires) of the audio output and power transformers also for cleaning and repainting. All of these had some paint gone and surface rust which was cleaned up and stabilized with Permatex® Rust Treatment. While not exactly the same color, I used the same dark machine grey paint on these iron parts that I used on the transformers in

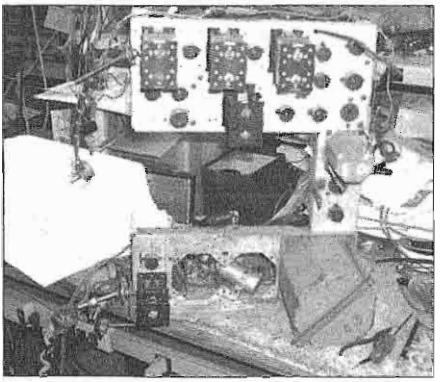
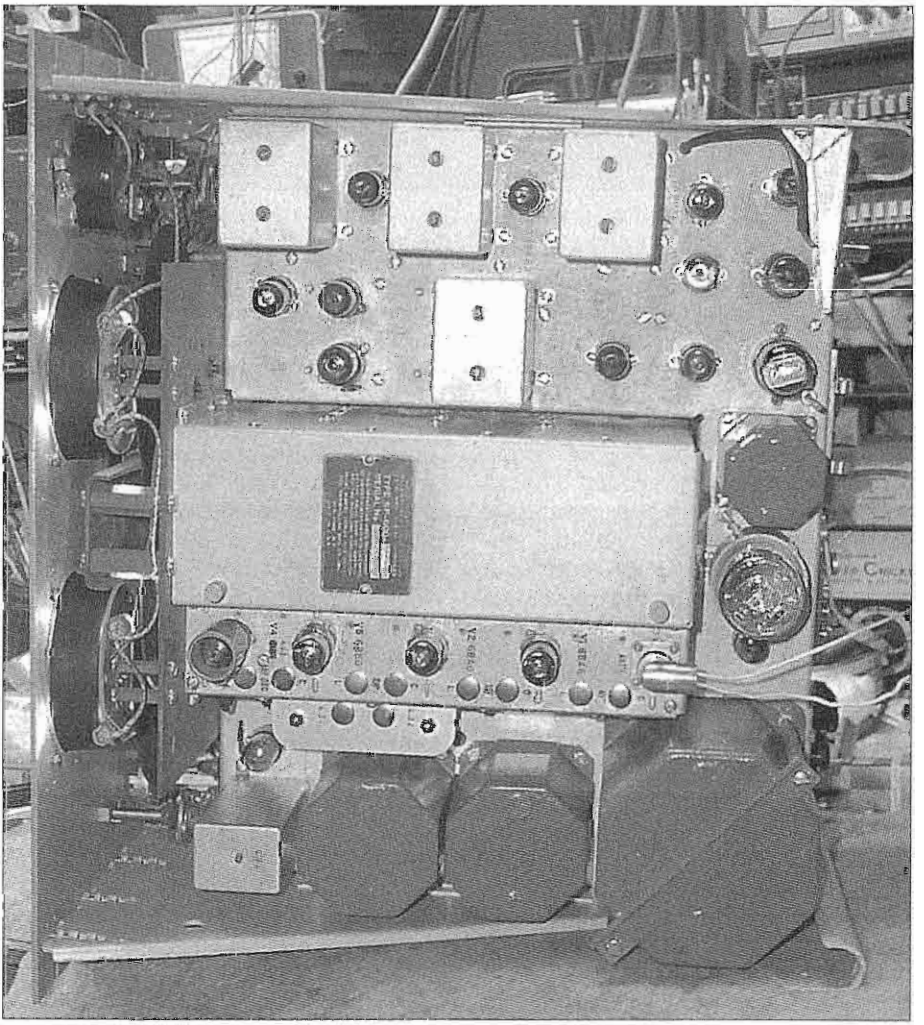


Figure 3, to the left, shows the top of the receiver with filter chokes, can covers, and RF decks removed. Compare this with the photograph of the finished receiver in Figure 4.

Figure 4, below, shows the top of the finished receiver.



the Johnson Desk Kilowatt [ER #169]. To preserve the pinout labeling on each unit, I masked this section off so as not to paint over the markings.

The complete tuning assembly consisting of the RF drum and its housing, the 8-gang capacitor and the RF amplifier deck, were completely removed from the main chassis. Keep track of what you do here, as the reassembly is not simple. This is especially true for the wiring to L31, L32, the first 455 and 3995 kcs IF coils, and the RF deck. The separator shields between the sections of the drum can only be completely removed by taking out three of the RF deck coil assemblies. These coil assemblies come out without any soldering by removing 2 spring clips on the ends. All of these steps made the chassis a lot easier to handle during the cleaning process.

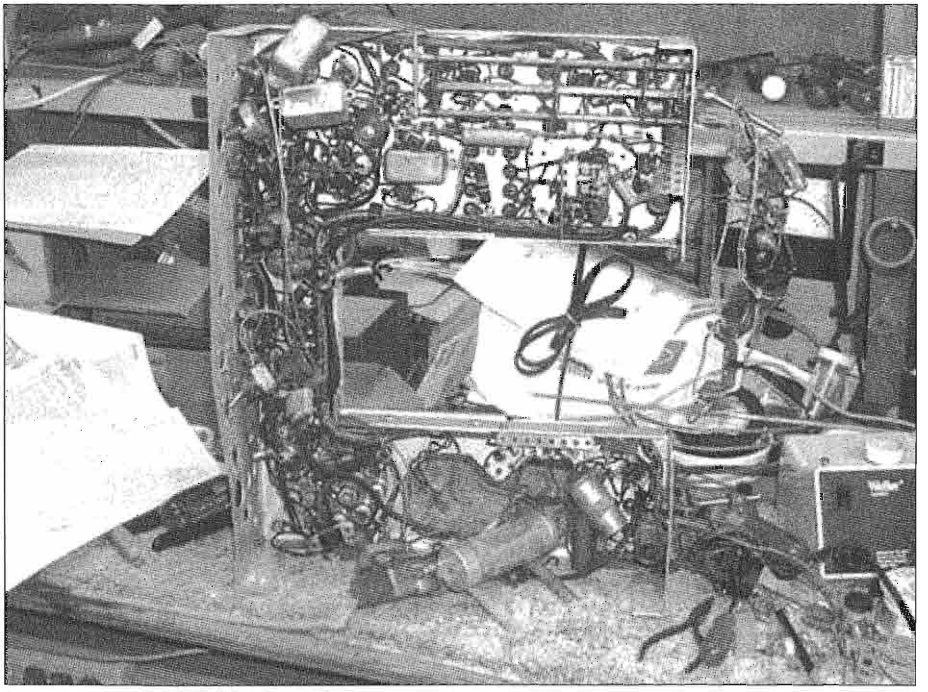
The cleaning of the chassis and most of the parts was completed with Krud Kutter® and/or TARNEX®, available at my local hardware store, followed by a thorough water rinse. The Krud Cutter® does a great job removing both the nicotine and the tarnish on the silver plated items. The rotary switches and the silver plated parts associated with the RF deck coil drum cleaned up nicely with the TARNEX®. All of the dried up grease was removed and at re-assembly, the moving parts were lightly lubricated with Lubriplate®. The points where silver plated contacts associated with the coil drum shaft were touching other parts were lubricated with a small amount of conductive grease [e.g. Circuitworks CW1700 or Caig M260-C8, see Newark Electronics]

My good friend Steve (WA3ZAE) has access to a commercial facility where he degreased and applied clear anodizing to the IF and oscillator coil covers and the large radio side panels. An Oakite® degreaser was used for degreasing and Alodyne® used for the clear coating. (This process was also completed on the can covers on the SX-62's after I had completed the write-up on that project in ER #180.) The corroded can tops were first sanded with #00 steel wool which doesn't leave noticeable scratches. Although not perfect, the degreasing and anodizing sure makes these parts look 1000% better. All the badly rusted steel hardware that needed to be replaced was measured and the correct zinc plated hardware was obtained from McMaster-Carr in New Jersey. One thing to watch out for on disassembly is that there are two 3/16" stainless steel ball bearings on the main tuning flywheel assembly shaft ends and these can be easily lost as happened to me with one of them. I obtained replacements (100 each!) from McMaster-Carr.

After removing all the controls, connectors, and terminal strips, the bashed in rear panel was straightened by first using blocks and c-clamps to remove the worst of the deformation. The clamps were left in place for 3 or 4 days while other work was going on. The final bends were removed with a hammer and blocks as well as with a large open end adjustable wrench used for the final straightening. The panel is now almost perfect. After a cleanup it was relabeled with an alpha-numeric ink labeler àla Northern Radio. WA3ZAE loaned me his alphanumeric stamper to relabel the IF cans and the rear panel.

Another BIG problem was the front panel. It was corroded a fair amount in places. The corrosion was so deep that simple repainting would not hide it. Bill started (and I completed) taking the panel down to bare metal. Hand sanding and wire brushes were used to prepare the surface for a classic car body fix using a product similar to Bondo® available at the auto parts store. The first attempt at this was not completely satisfactory so this winter I'll get a second chance to practice

The main tuning drum assembly was completely stripped down. With the drum out of the frame, it was a simple matter to



This is a bottom view of the dismantled receiver with the RF deck removed.

remove the 6 affected modules with the 0.01 tubulars and replace them with new capacitors.

On the RF deck, one of the ceramic assemblies on the replacement unit that switches the antenna circuit had a broken finger on one of the six contacts that engage the coil drum. Rather than try to change just the one finger, which I do not recommend, I simply unsoldered one of these assemblies from the old deck and installed it in the replacement unit. The ceramic form is only held in place by solder so it is a simple matter to get it loose and pull it out. All the contacts were cleaned to remove the crud off of the silver plated contacts.

Reassembly of the Radio

Due to the construction of the chassis and the method of attaching the RF deck, the entire radio should be completely reassembled prior to operation. So, the first order of business was to reassemble the RF tuning deck prior to mounting it back into the chassis. The complete set of Air Force Technical Orders (TO's) is essential here as the generic Hammarlund manuals and the Navships Manual give no detail on major mechanical assembly. Next the gear train is tackled. The gear train for the band select is pretty straightforward. Before starting, align the drum so that the small holes in the three partitions between the drum sections line up with the similar holes in the front and rear of the tuning drum housing. This sets the drum centered to Band 1, or 0.54 to 1.35 MHz. As discussed before, there is a 2-pole, 2-position rotary switch in the rear of the drum assembly that switches power to the 3.5 Mcs oscillator and to the screen of V7, the IF gate tube, when switching between bands 3 and 4. Be sure that is aligned properly before putting the drum back into the chassis.

The alignment of the main-tuning gear train is a bit trickier. The front panel had previously been removed completely and

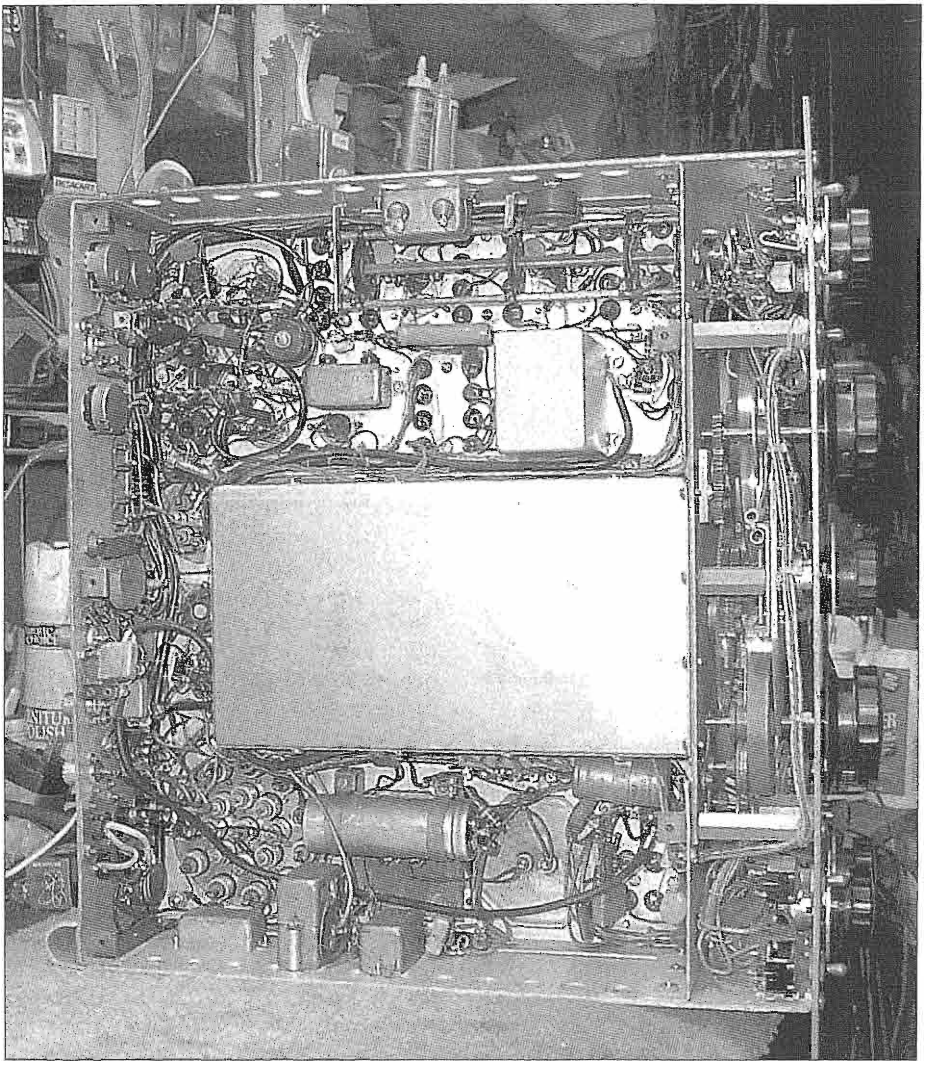
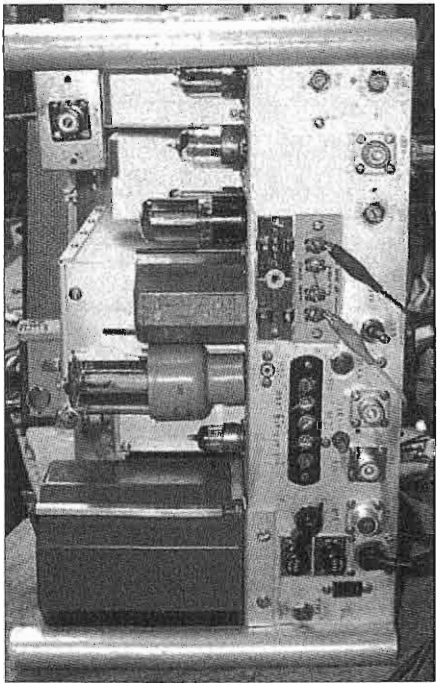


Figure 5: The bottom of the finished receiver.

the entire mechanical system for the band select and tuning was disassembled and cleaned. The Air Force manual calls for no lubrication, so none was used. To make assembly easier, I took several photographs of my unit PRIOR to disassembly to give me an idea how to proceed on reassembly. The gears must be set by trial and error so that the rotating pointer stop actually stops dial rotation very shortly after reaching both the 000 and the 599 effective logging scale readings on the main and logging tuning dials. Meanwhile, the tuning capacitor should rotate smoothly through its *almost* 180 degree rotation. Take time to get this right, as the velvety smooth flywheel tuning is one of the main attributes of the SP-600.

This set uses two "S" spring-loaded assemblies in the gear train to eliminate backlash and this system works very well.



The rear of the finished receiver.

The restoration process included freeing up the anti-backlash assemblies which were "gummed up' by old lubricant. Make sure these assemblies do not bind as you proceed with reassembly. The wiring and switches in this area were very dirty and everything was cleaned with De-Oxit® for the switches or with Fantastic® for the wiring. The corroded headset jack was replaced as well as were several of the toggle switches. I found the hard to find "medium length" bat handle toggles at a local hamfest.

Front Panel, Meter, and Knobs

After the tuning assembly is working satisfactorily, the next step in reassembly was to reinstall the signal meter and bezels on the front panel. The Plexiglas items were cleaned up with Novus® plastic scratch remover and polish. The meter scale had yellowed, but it's printed on paper. It was not cleaned up. Likewise, the tuning and logging dials had yellowed, but any cleaner that would not attack the underlying paint did not remove the yellowing, so I stopped before I had a real problem. The dial lock mechanism was reinstalled next. New dress nuts and flat and lock washers were used on all controls as the originals all were badly corroded. The short black Philips-head machine screws used to attach the Plexiglas pieces were cleaned and repainted, as were the screws fastening the various name plates.

The knobs were all cleaned in my ultrasonic cleaner using some Fantastic®. Some of them came up great and some were still somewhat dull. Polishing on my cotton wheel with jewelers rouge makes them shine. The BFO shaft rotation is limited by pins associated with the front panel bearing, and this needs to be set correctly for centering during alignment. One important note: The shafts associated with the Selectivity and Crystal Phasing controls have retainers both behind *and in front* of the front panel. These retainers prevent undo in-out motion of the flexible shaft couplers and should be reinstalled as the panel is slipped on.

Smoke Test

I first fired up the set using a Variac® and with the 5R4 rectifier removed to check the filament circuits. All seemed in order, so the 5R4 was replaced and the radio brought up slowly. I had previously tested the electrolytics for capacity and ESR and did a reforming. I wasn't worried about them. In spite of all the work that was done on the set, on the first try at full 120 VAC, I heard stronger stations on bands 1, 2 and 3 but nothing above that. The problems with the upper bands involved the correct setting of the various diversity switches, adjusting the lone capacitor on the 3.5 Mcs oscillator for stable operation, clearing a short and replacing an out of tolerance (120 ohms low) cathode resistor on the 6V6 which caused it to draw excessive current (no grid bias!) and pull down the HV enough that the 0A2 would not fire. Finally, I

remembered that the HFO needed to be a 6J6 not a 6C4. Changing that brought the HFO to life on bands 4, 5, and 6.

IF Alignment

I followed the alignment instructions in the air Force T.O. service manual. The manual is silent on calibrating the crystal phasing. I accomplished this by placing the knob so that the zero setting corresponded with the butterfly capacitor at 50%. By tuning in a broadcast station and mixing in my signal generator first about 1 kc low, and then 1 kc high and listening to the beat note, I was able to adequately null out the interferer equally in both cases indicating the phasing was set correctly.

In my unit, the low IF crystal "peak" at 0.2 kcs bandwidth was at 454.9 kcs and the manual has you make ALL IF adjustments, including the BFO zero, at that actual crystal filter pass frequency. As mentioned before, the 3.5 Mcs oscillator has a variable capacitor inside the can under the chassis near V6 and V8. This capacitor is accessible from the rear of the can and may have to be adjusted to insure reliable starting of the oscillator. There are three IF adjustments to peak at 3.955 Mcs and these are straightforward.

HF Alignment

The HF alignment was completed per the instructions in the Air Force T.O. Be sure you have all covers in place and ALL hardware well tightened to minimize microphonics on the higher bands. Don't forget the lead-covered shield on V4, again included to reduce vibration of V4, the 6J6. End-to-end tracking on all bands was easily accomplished in 2 or 3 iterations of the L and C in the various oscillator and RF amplifier sections. Use thin insulated alignment tools to get at these adjustments on the HFO, HF mixer, and the two RF stages. I used a plastic tool with a recessed metal blade for the "L" and one with an exposed metal blade for the "C" in each case. Landing the adjustments is a bit tricky as they are at an angle from the access holes, but after awhile I could hit them pretty easily. A small flashlight helps here. New hole plugs were obtained to close all the access holes when the alignment was completed to keep out dust and dirt. The tracking within the bands was pretty good. The tuning capacitors have slotted outer plates which could be used to improve tracking but, in my case, it wasn't out enough to warrant that effort.

On Air Tests

This bare radio, as shipped, was intended primarily for AM, RATT, and CW. Good SSB reception required an external converter. Quite a bit of casual listening and evaluation has shown good performance up through 10 meters. Since most signals from 30 to 54 Mcs are FM, no real evaluation was made there.

As shown in the manual, this receiver was not intended to be a "hi-fi" design like some of the other boatanchors of this era were. With a decent speaker, it is quite acceptable on AM even though the audio response is somewhat rolled off on both the high and low ends of the audio spectrum. Good quality broadcast and amateur signals sound all OK. No attempt was made to install any type of radio "mods" as of this date. The AVC time constant could be a bit slower for MW BC reception in the presence of co-channel beats.

Future Work

I obtained a copy of Hammarlund Engineering Technical Bulletin No. 107 entitled "Improving the Noise Level of the SP-600 Receiver using a Nuvistaplug." This bulletin can be downloaded from various sites on-line. The Nuvistaplug replaces V1, the 6BA6 1st RF amplifier. I plan to construct a copy of the Nuvistaplug which used a pair of RCA 6DS4 Nuvistors® in a simple cascode circuit. Hammarlund says a 2 to 6 dB improvement in noise figure can be accomplished with a slight reduction in overall receiver gain.

ER

The Codar AT5 Transmitter
"The Tiny TX with a BIG Voice"

By Dave Gordon-Smith, G3UUR
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Rackheath, Norwich, Norfolk
NR13 6LB, United Kingdom.

The Codar AT5 is a remarkably small AM/CW transmitter designed primarily for the British 160m band, which runs a maximum of 10 watts DC input on AM, with high-level plate and screen modulation, and 14 watts on CW. The footprint of this tiny transmitter is about the same size as a single page in ER! It covers the 3.5 to 4.0 MHz band as well as 1.8 to 2.0 MHz. The AT5 was designed and manufactured by the Codar Radio Company (CRC), which was a small, family-run, electronics firm that was founded back in 1960, and produced short wave receivers, model train controllers, and accessories for the hobby market. It was based in Southwick on the South Coast of England, not far from the seaside town of Brighton. Their receivers were aimed at the beginners' market, and included several simple regenerative designs as well as basic all-band superhets. Many British short wave listeners and radio amateurs have fond memories of Codar receivers, but what really made the firm legendary in the UK was their one and only venture into making transmitters. The AT5 transmitter was first announced in Short Wave Magazine in June 1964. The RSGB Bulletin advertisement for it appeared a month later. It was designed specifically to meet the requirements of the UK 160m band, which had a power limit of 10 watts DC input. It also included 75/80m because this was relatively simple to incorporate, and was an added sales feature compared with some of the other commercial, low power, dedicated 160m AM transmitters of the day. A typical sales brochure for the AT5 is shown in **Figure 1**. Codar proclaimed it to be "The Tiny TX with a BIG Voice." They were right. It looked good, sounded good, and by golly it was good! There were quite a few other low power 160m AM/CW transmitters being produced commercially in Britain during the '60s, but Codar must have sold more AT5s than all the other British 160m commercial transmitters combined.

General Details and Circuit

The '**AT5**' model number was derived from the fact that it was an Amateur Transmitter with 5 tubes. The circuit is quite simple and employs 3 tubes in the RF section – EF80 (6BX6/6BW7) Vackar VFO, EF80 (6BX6/6BW7) buffer/doubler, and 6BW6 PA. The modulator is a very simple two tube line-up with an ECC83/12AX7 double triode speech amplifier and a 6BW6 single-ended Class A modulator. The 6BW6 tube was very popular for low power RF and modulator applications in Britain, but doesn't seem to have had the same popularity in the States. It's surprising because it has an American-style designation, and is the B9A version of the popular 6V6. In the UK, most 6BW6s were made by Brimar, a firm who copied and made many American tube types for the British market. The 6CM6 is electrically identical to the 6BW6, but has a different pin-out.

The full circuit diagram of the transmitter is shown in **Figure 2**. This was taken directly from the Codar AT5 handbook. The speech amplifier is a pretty standard capacitively-coupled double tri-

TOP QUALITY — LOW COST CODAR AMATEUR RADIO EQUIPMENT

★ CODAR AT.5 12 WATT MINIATURE TRANSMITTER ★

"THE TINY TX WITH THE BIG VOICE"

The newest, most compact 160–80 metre transmitter designed for fixed or mobile use.

IT'S small ! Only 8½in. x 5in. x 4in., but has all (and more) of the design features of other higher priced and larger units.

IT'S SMART ! Grey Cabinet, Black and Satin silver front panel, grey with chrome trim control knobs.

ITS COST ? Check the outstanding technical specification overleaf, then see the really low cost.

CODAR RADIO COMPANY

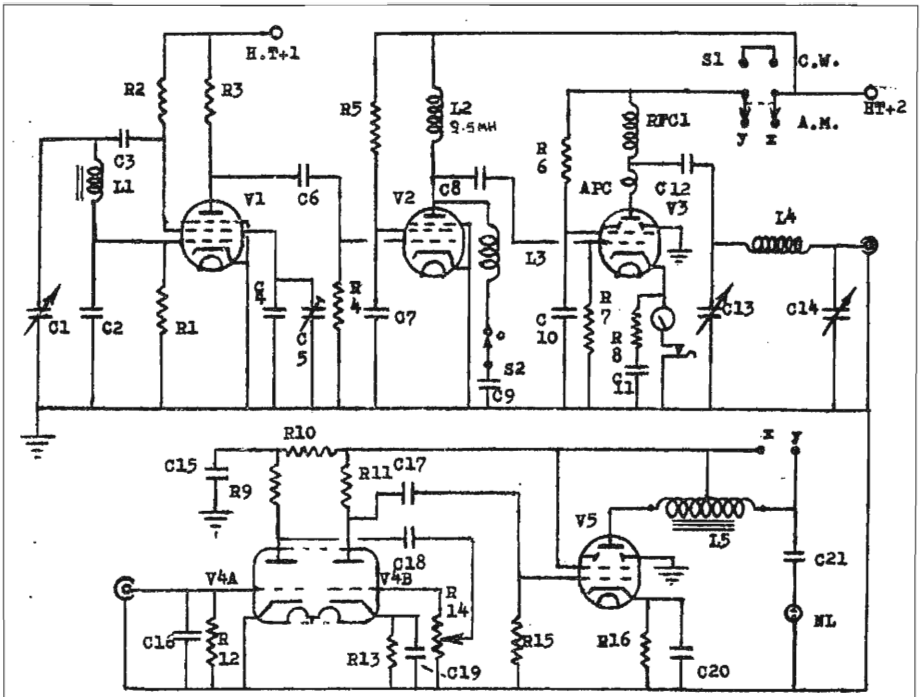
BANK HOUSE, SOUTHWICK SQUARE, SOUTHWICK, SUSSEX

TELEPHONE: SOUTHWICK 3149

CANADA. CODAR RADIO COMPANY OF CANADA TWEED ONTARIO

Figure 1: Sales brochure for the Codar AT5 showing the original cabinet and knob set. Later cabinets had a large ventilation panel in the top of the cabinet. The neon lamp between the plate meter and the band slide switch is the modulation indicator, which flashes when the modulation exceeds 80%.

ode design with no frequency tailoring. The 1 Megohm grid resistor of the first triode is a bit low for a good bass response, and could do with being increased. I find 5 Megohm is good for crystal microphones with my voice, but have given up modifying all my transmitters individually and use a microphone preamplifier built into the base of my old Astatic 'G' stand that gives the



Schematic Drawing

C1. 60 pfd.var.
C2. 2000 pfd.polycap. 2%.
C3. 270 pfd.polycap. 2%.
C4. 270 pfd.polycap 2%.
C5. 10/40 pfd.Temp Comp.
C6. 100 pfd.ceramic.
C7. .01 mfd ceramic/disk.
C8. 100 pfd.ceramic.
C9. 22 pfd.ceramic 2%.
C10.1000 pfd ceramic.
C11..01 mfd.
C12.1000 pfd.ceramic.
C13. 365 pfd var.
C14. 900 pfd.var.
C15. 8µmfd.elect.
C16. 100 pfd ceramic.
C17. 1000 pfd.ceramic
C18. .01 mfd.ceramic/disk.
C19. 10/25 elec.
C20. 10/25 elec.

R1. 100k.
R2. 100K
R3. 22k.
R4. 56k.
R5. 22k.
R6. 12k 2 watt.
R7. 22k.
R8. 1k.
R9. 100k.
R10.10k.
R11.100k.
R12.1 meg.
R13.1k.
R14.500k var.
R15.470k.

C21. 1000 pfd.ceramic.

R.16 270 ohm.2watt.

All resistors ½ watt other than R6/R16.

R1/C3/C4/L1 are in VFO can assembly.

L2 .R.F.C. 2.5 mh.
L3. 3.5 MC/S Dbler Coil.
L4. CODARQOIL T422S.
L5. Auto-Trans.Type TL10.
NL. Neon indicator.
APC.Anti-parasitic choke.

Figure 2: Original circuit diagram and component listing for the Codar AT5 transmitter, as taken from the Codar Radio Company handbook for the equipment.

crystal insert a 5 Megohm load. The modulator in the AT5 is a straight-forward Class A design with automatic bias provided by a 270 ohm cathode resistor. The modulation transformer is a 15VA 110/240V mains autotransformer used with the 110V tap connected to the HT+ line, and gives a 1 to 1.18 turns step-up from the modulator tube to the PA. This arrangement has the great advantage that the magnetic fields produced by the DC currents running thru the two sections of the transformer winding partially cancel, and the transformer core only needs to

be big enough to deal with the much smaller residual DC field plus the AC field of the audio. The inductance of the primary is only about 1.2H, and this does add to the 'toppiness' of the transmission – this is a British expression meaning that the high frequency end of the audio spectrum is unduly emphasised. The modulator has a rising frequency response that flattens out above 2 kHz, and goes up to over 10 kHz. The same autotransformer is used as a choke in the Type 250/S mains power supply, and this is a good source of spare modulation transformers! The step-up modulation transformer and the very 'toppy' response of the modulator, especially when used with a crystal microphone, give the AT5 very clear and powerful sounding modulation for a single-ended design – the "BIG Voice." An indication of the modulation level is provided by a 250V neon lamp (with internal 270k resistor) connected in series with a 1000pF capacitor across the modulated HT line to ground. This is the rectangular lamp just below the PA plate current meter – refer to front panel picture of the AT5 shown in the brochure in **Figure 1**.

The RF Section

Looking at the RF section, L1, C2, C3 and R1 are all contained in a small, screened assembly that looks like a dwarf IF transformer, which was made especially for CRC by Electroniques Ltd of Felixstowe. L1 is a 45µH wave-wound coil, and R1 is 47k – note that this is shown as a 100k resistor in the component listing, but was changed in later versions to improve oscillator starting. The main VFO tuning capacitor, C1, is a Jackson Bros (JB) 60pF variable, type C804. This is driven by a JB 6:1 ball drive (type 4511DAF) mounted on the front panel. The 'D' signifies that the drive has a double mounting lug, and the 'F' that it has a flange for mounting a circular dial, or pointer. There is a modern version of this dial, which is still produced by JB, the 4090/1. It comes with a circular aluminium dial calibrated 0 - 100 over 180°, but the remaining half of the dial can be used and custom calibrated, if desired.

The RF choke in the plate circuit of the buffer/doubler is shown as 2.5mH in the component listing, but I have found this to be a 1mH choke in my AT5. The doubler coil, L3 (an 180µH choke), is connected to ground through a 22pF capacitor when operation on 75/80m is selected. This is accomplished by a slide switch, which is positioned just below the neon modulation indicator on the front panel. This series-tuned circuit to ground provides a very low impedance load to the doubler at the fundamental frequency when operating on 75 or 80m. No attempt was made to reduce the inductance of the PA tank coil for 75/80m operation in most AT5s. This made for very inefficient operation on 80m. The PA coil was even a bit too large for matching 50-ohm loads on160m, and some amateurs reduced the size of the PA coil from 45µH to 35µH and added a 560pF capacitor across C14 for operation on 160m, and an extra switch to short out just under half of the remaining coil for operation on 80m. Obviously, the original PA circuit had been optimised for working into low impedance whip antennas for mobile use, and not 50-ohm loads for fixed station use.

The PA coil (L4) specified by CRC (Codar Qoil T422S) has 64 turns, and is 2 inches long, and 1 inch in diameter. If you're thinking of making a copy of the AT5, about 54 turns of 32tpi coil stock, 1 inch in diameter, should be a good starting point for L4 on 160m. Very late versions of the AT5 (MkII, after 1971) have a switch section for shorting out some of the turns of L4 on 80m. This is mechanically actuated from the front panel slide switch, which is used to bring in the doubler coil on 75/80m. Not many of these improved models of the AT5 were made before Codar gave up amateur radio products entirely, in the '70s, to concentrate on model train controllers and accessories.

The output power of the AT5 is ap-

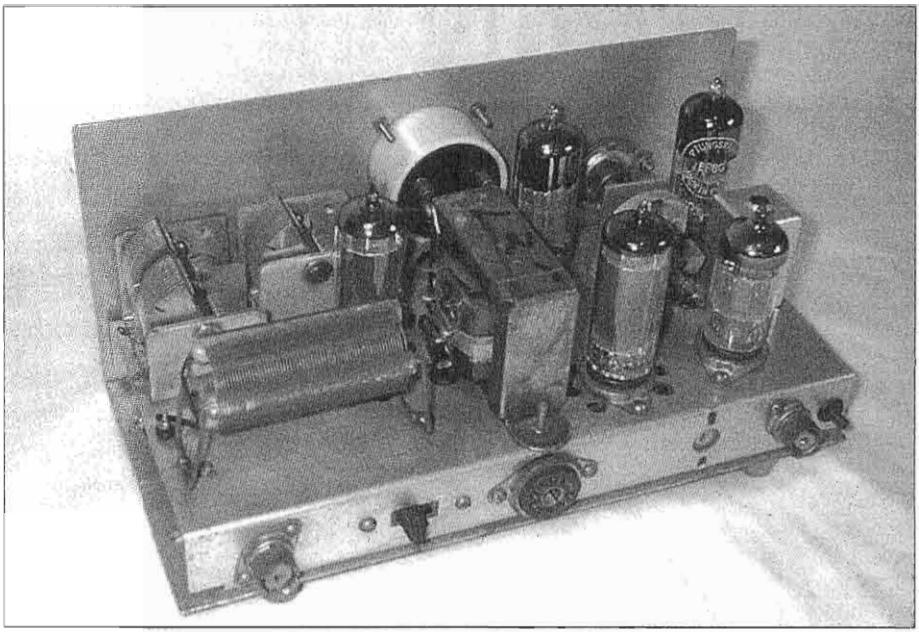


Figure 3: Photograph of above chassis component layout of the Codar AT5 transmitter, including rear apron controls and connectors.

proximately 6.5W on 160m, and slightly less on 75/80m. All the circuit diagrams I've seen for the AT5 show the 100mA meter in the cathode circuit of the PA tube. I've yet to find an example of an AT5 where it is actually inserted there. Undoubtedly, very early versions must have followed the circuit diagram shown in **Figure 2**, but all the rest have the meter in the plate circuit, in series with the cold end of the RF choke just before it joins the 12k screen resistor (R6) at the AM/CW switch, S1.

Chassis and Rear Apron Layout

The photograph of the upper chassis layout in **Figure 3** gives you some idea of the compactness of the transmitter. The chassis on which the whole thing is constructed is only 1 inch high and slightly less than 8.25 inches wide by about 3.75 inches deep. The front panel, which is 8.5 inches wide by 3.75 inches tall, is part of an L-shaped sheet of aluminium that also forms the bottom cover of the transmitter. This cover is attached to the chassis by the four self-tapping screws that also hold on the four plastic feet. The arrangement gives the rather flimsy chassis increased rigidity, but makes it impossible to work on the underside of the chassis without loosening the front panel.

Looking down on the chassis from above, the modulation transformer is more or less in the centre, with the pi-network coil, L4, clearly visible to its left. The 6BW6 PA tube is also to the left of the modulation transformer, between L4 and the two pi-network variable capacitors. The small Jackson Bros C804 variable at the right of the chassis is the 60pF VFO tuning capacitor, which is mounted on an L-shaped aluminium bracket. The screening can to the right of that is the VFO coil assembly. The two EF80s are either side of the VFO tuning capacitor. The two tubes to the back of the chassis (lower right in the photograph) are the modulator (6BW6) and speech amplifier (12AX7). Note that the 6BW6 modulator tube has a series of ventilation holes in the chassis around its socket. There is a similar array of holes in the chassis around

the PA tube.

A small black trimming tool can be seen projecting out of a black grommet on the far right of the rear apron. This trimming tool is for adjusting the modulation gain control, which is a skeleton potentiometer mounted on the rear apron of the chassis, to the left of the Belling-Lee coax connector used for the microphone input. Power is connected to the transmitter thru the 9-pin B9A socket in the centre of the rear apron. To the left of this socket is the slide switch (S1), which selects AM or CW. The Belling-Lee coax connector on the far left of the rear apron is the transmitter antenna socket.

Cabinet and Styling Changes

Very early versions of the AT5 had no ventilation holes in the top of the cabinet at all, and they got very hot inside. Later versions had a ventilation grille in the top of the cabinet. The first attempt to ventilate the cabinet was restricted to a small area just above the PA and modulator tubes. They soon realised this was inadequate, and the area of the ventilation grille was increased to 6.25 x 3.25 inches – most of the top of the cabinet. Several styling changes occurred over the lifetime of the AT5, apart from changes to the cabinet ventilation. These were merely changes to the color and style of the 3 knobs used on the transmitter. The original style grey knobs with chrome trim are shown in the brochure picture of the AT5 – see **Figure 1**. In 1966, black, skirted knobs with chrome trim were used for the PA tuning and loading controls, with a different style of black knob with an inset chrome ring for the VFO. This change occurred around the time that the matching T28 receiver was introduced. Later still, the style of VFO knob was changed again to one that had no chrome trim, but instead had a single diametric ridge across its black face, with the two halves of the face sloping away from the ridge. The matching PA tuning and loading controls were also black, and similar to the skirted ones used in the 1966 set.

Power Supply and Other Accessories

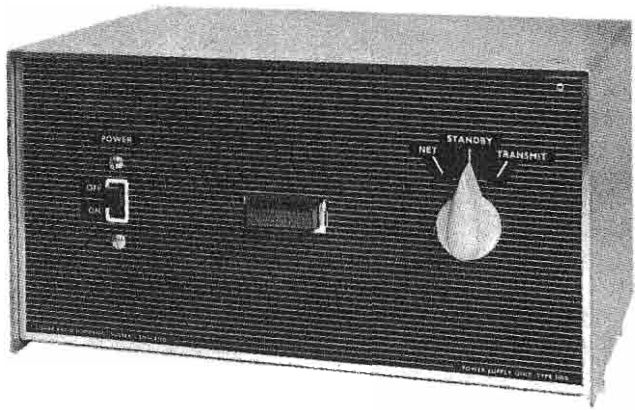
The AT5 accessories include a 12V DC mobile power supply (12/MS), the mains power supply (250/S), a remote control unit for mobile operation (12 R/C) and a transistor 160/80m receiver (T28) based on Mullard RF/ IF and AF modules. The mains power supply includes the antenna changeover and HT switching for base station use. The mobile remote control unit (12 R/C) performs the same functions when the transmitter is used mobile. The mobile power supply (12/MS) provides 150V stabilised and 280V at 100mA from 12V DC.

The Codar sales brochure for the mains power supply (250/S), shown in **Figure 4**, gives the full specification of the unit, as well as a photograph of the front panel. You can see that the NET/STANDBY (RECEIVE)/TRANSMIT function is performed by a single switch on the front panel of the power supply. Note that on the circuit diagram of the power unit, given in **Figure 5**, the middle switching position is labelled 'R' for RECEIVE and not 'S' for STANDBY as it should to be consistent with the front panel lettering. Also, the component listing for the power supply gives L1 as 10H at 100mA. It may have been Codar's original intention to use such a choke, but in the end they used the same autotransformer for the choke as they did for the modulation transformer, and that is barely 5H using the whole of the winding with no current flowing thru it. I imagine that its inductance is nearer 2-3H with 100mA flowing thru it. The power transformer used in the 250/S is 270V-0-270V at 120mA, with 6.3V at 1A for the rectifier and 6.3V at 2.5A for the rest of the tubes. I believe that the American equivalent of the EZ81 B9A rectifier tube is the 6CA4, though I've never come across this one before despite a strong interest in American radio equipment.

Postscript on the Codar AT5

Following the success of the AT5, Codar did plan a 50 watt HF transmitter, but it never made it into production.

TOP QUALITY — LOW COST CODAR AMATEUR RADIO EQUIPMENT



★ MAINS POWER SUPPLY UNIT TYPE 250/S. 200-250 volts A.C. ★

This unit provides all the power supplies for the AT.5 Transmitter together with STANDBY/NET/TRANSMIT and aerial changeover switching. A neon indicator monitors the switching by flashing continuously in the STANDBY position and with a steady glow in the NET and TRANSMIT positions.

In the STANDBY position, H.T. only is off and the aerial switched through to the receiver. In the NET position, 150 volts stabilised H.T. is switched to the VFO only to allow netting without full power being applied to the Transmitter. The aerial remains switched to the receiver.

In the TRANSMIT position, full H.T. is switched to the Transmitter, the aerial transferred to the Transmitter, and the aerial input to the receiver short-circuited to assist in monitoring.

The Unit supplies 270 volts H.T. at 100 MA., 6.3 volts L.T. 2.5 amp., and 150 volts stabilised H.T. A mains voltage selector panel is fitted internally for adjustment to the local mains voltage, and an H.T. fuse provides protection. Smart styling in Silver/Grey Cabinet 8¼in. x 5½in. x 4¼in. with Silver/Black anodised front panel. Weight 7½lb.

Price, complete **£8 0s. 0d.** Carriage **7/6.**

Export Model for 100—125 volts A.C. available. Type 250/SX. Price **£8 12s. 0d.** Carr. extra.

Figure 4: Codar sales brochure from about 1965 for the 250/S mains power pack. Note the NET/STANDBY/TRANSMIT switch on the right-hand side of the power supply front panel. This provides single switch changeover for the AT5. There are 3 coax sockets on the back of the power unit for the antenna, transmitter and receiver connections, which are switched along with the HT supply to facilitate changeover from receive to transmit.

Demand for the AT5 was sufficiently great by 1966 that CRC were thinking of moving to a bigger factory, but I don't think they did, though, because their mail-order address did not change until the '70s when they moved to Lancing. Any-

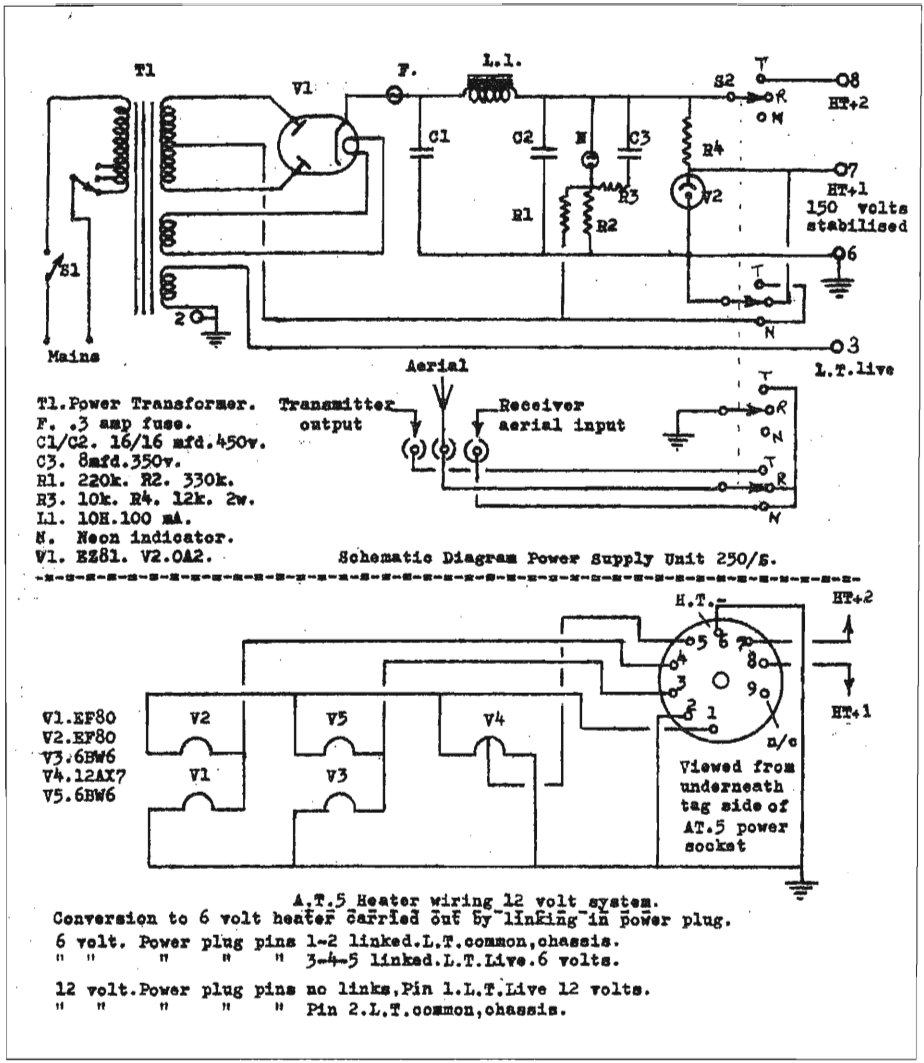


Figure 5: Schematic of the 250/S mains power supply from the Codar AT5 transmitter handbook, showing the antenna changeover circuitry as well as the heater wiring for 6V or 12V supplies.

way, by 1966 they were selling a complete mobile package, including the T28 receiver, which was called the 'Coda – Mobile' and this can be seen in the advertisement shown in **Figure 6**. The 12 R/C mobile control unit is also pictured in this advertisement, just to the right of the AT5 transmitter.

They continued to produce the AT5 transmitter into the '70s. It was an extremely popular transmitter in the UK for both mobile and fixed station use. Many are still in use today on both 160m and 80m AM, but I haven't heard anyone using an AT5 in a mobile installation for many years. You'll notice at the bottom of the sales brochure, shown in **Figure 1**, that Codar also exported to Canada thru

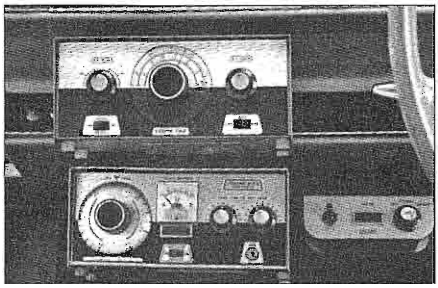


Figure 6: Advertisement for the Codar mobile package from the May 1966 Short Wave Magazine, showing the matching T28 receiver mounted above the AT5 transmitter. The small unit to the right of the AT5 is the 12 R/C remote control switching unit. Note the change in the style of the knobs on the AT5 compared with the original ones in the 1965 brochure.

their subsidiary in Tweed, Ontario. Their advertisements from 1967 onwards make no mention of this Canadian subsidiary, however, and that may be a sign that they were not too successful in exporting to Canada. There is the possibility, though, that some AT5 transmitters got to Canada. So, if you fancy one of these little transmitters, listen in to the Canadian swap nets, or keep an eye on the second-hand advertisements in the amateur radio press there. Codar did make an export version of the power supply (250/SX) for 100 - 125V AC mains input, so you might be lucky and find one that doesn't require an autotransformer to run it off your 115V AC mains supply.

Contemplating a Replica AT5?

If you've got a well-stocked junk box, it's not a hard design to copy. Even special items like the VFO coil assembly can be made up in an old IF transformer can, if you can find one that is small enough. The modulation transformer doesn't have to be a 15VA autotransformer. It could be a dual primary 120/240V input, low voltage, mains transformer, with the low voltage winding connected in phase with one half of the primary to give the required step-up (a 9V-0-9V or 18V secondary should do). Remember that the inductance of each half of the split primary needs to be over 1.2H, though, otherwise the audio may be even more 'toppy' than the original AT5. Another candidate for the modulation transformer of a replica AT5 might be the Hammond 5W driver transformer, type P-T124D (formerly the P-T20D89). This transformer has a turns step-up ratio of 1:1.33 with half of the original secondary winding (3.95k) as the modulator primary and all of the original primary (7k) feeding the PA plate as the new secondary. This step-up ratio may be a touch too high, but it might work fine. Also, I'm not sure whether half the centre-tapped 15.8k winding can handle 45mA. The 7k winding can, according to the specification, and the secondary would have to be wound with very thin wire for it not to be able to carry that sort of current. I've emailed Hammond about this, but received no reply after several months! Certainly, it's a cheap source of new, low power, single-ended modulation transformers if it works, and should be able to handle more than 5W of audio with the DC magnetic fields of the primary and secondary arranged to cancel, partially.

The proper phasing of the primary and secondary windings needs to be established so that partial cancellation of their DC magnetic fields does occur in operation. This is quite easy to do if you have an inductance bridge. Measure the inductance of the whole of the original primary winding (7k, ignoring centre tap), and then connect any end of that winding to the centre tap of the other winding (15.8k). Measure the inductance between the remaining free end of the original primary and one of the free ends of the original 15.8k secondary, and if the inductance is about 3 times that of the original primary winding alone, then they are in the right phase relationship for you to feed the +270V HT to the common connection of the two windings, and the PA and modulator plates to

the free ends of the original primary and secondary, respectively. If they're not in the right phase you'll get a very low inductance reading, but you can remedy this by just using the other free end of the 15.8k centre-tapped winding, instead. This Hammond transformer should give a flatter audio response and better bass than the original Codar modulation transformer because of the higher inductance of the windings, and that may be preferable for North American AM operators.

Many 'Chinese' copies of the Codar AT5 transmitter were constructed by British radio amateurs in the '60s and '70s. Reg Ireland (G3IRE), who owned the Codar Radio Company, even took pity on one impoverished young schoolboy who was building a copy of the AT5 back in 1965, and sold him a VFO assembly and modulation transformer at cost price. Now that young schoolboy is grown up, he'd love to know where that particular homebrew transmitter went! Unfortunately, the fog of time has enveloped any memories that might give a clue as to what happened to it! Reg Ireland didn't make a habit of selling AT5 parts to home constructors, though, and most used multi-tapped, low power, push-pull output transformers for the modulation transformer. It didn't require any inductance measurements to establish the right phase for the windings with these transformers, and the +270V HT went to the centre tap of the original primary. The low impedance secondary was unused. The new secondary (winding feeding the RF PA) used all of the winding on one side of the centre tap, and the modulator plate was tapped back up the winding on the other side of the centre tap to try and establish a suitable turns ratio. Some amateurs who could only get hold of an untapped push-pull output transformer used the slightly higher HT voltage of 300V, and dropped the DC voltage to the PA by 40V thru a 750 ohm resistor that was bypassed at audio frequencies by a 1μF capacitor. The resistor needs to be a 4W type, if you're in the habit of long 'old buzzard' overs, and can be made up with two 1.5k, 2W resistors in parallel. This allows nearly 100% modulation to be achieved without the need for a step-up transformer. Also, if you want to improve the bass response of this arrangement to suit your voice, you can increase the value of the bypass capacitor.

Recently, I've been thinking about building a crystal-controlled version of the AT5. I tend to use only a couple of frequencies for AM on 160m, and really don't need the flexibility of a VFO, anymore. Reducing the oscillator component count, in particular the variable capacitor and coil assembly, make it a lot easier to duplicate the rest of the circuitry and fit it into a small cabinet. The AT5 is such a neat looking little rig, though, that it would be a shame to break up the look of the original front panel with an ugly pointer knob for crystal switching. So, to retain the original style of the AT5 front panel, I intend to switch the crystals using a large round knob with an aluminium skirt, similar to the original dial. There should be enough space on the aluminium skirt to write in the actual crystal frequencies, rather than just channel numbers.

I'm sure that those of you who still build tube AM transmitters can see some potentially useful bits of circuitry and ideas in this description of the AT5, and even if you don't want to build an exact replica you should find something of interest to copy, or modify to suit your own use. I've enjoyed writing about the Codar AT5 transmitter, and hope you've gained an equal amount of pleasure from reading about it.

Acknowledgement

The author gratefully acknowledges the background information on the Codar Radio Company provided by John Wuille (G3SZM).

ER

Cleaning Up the Knight Kit Ocean Hopper

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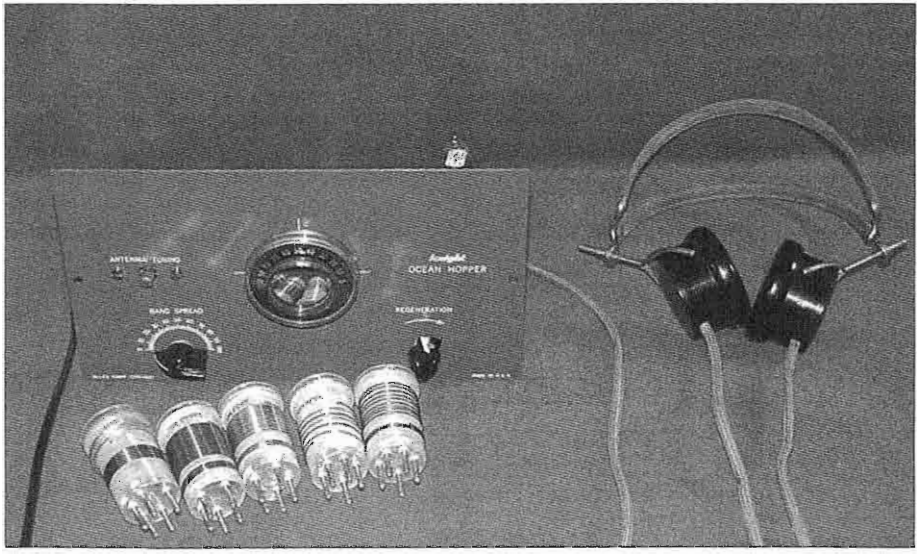
Judging by the activity on eBay and both my "snail" mail and e-mail requests for information during the last six years, the continuing popularity of the Knight Kit Ocean Hopper just never ceases to amaze me. It seems that a lot of us "cut our teeth" on this little regenerative receiver.

The "last generation" of the Knight Kit Ocean Hopper (OH), and the subject of this article, was released in late '53 and appeared for the first time in the '54 Allied Radio catalog. It was sold for 14 years, last appearing in the '67 catalog, and was closeout priced at $18.88 in a May '67 flyer which included the five optional coils and headset. The "last generation" OH featured a 12AT6 regenerative-detector, a 50C5 audio amplifier, and a 35W4 half-wave rectifier, all 7-pin miniature tubes. The frequency coverage was 155-470 kHz ('54 to '59) or 165-540 kHz ('60 to '67 – the long-wave coil's frequency range was increased to 165-540 kHz to cover the 500 kHz International distress frequency for ships at sea) and 530 kHz to 35 MHz using a total of six 5-pin plug-in coils. The 530-1900 kHz Broadcast Band coil came with the kit, the other 5 were optional. An optional cabinet became available in '57 and by the winter of '58 it was included with the kit. The OH is powered off of the 120 VAC line and the chassis is "hot" – one side of the line is connected to the chassis through a 0.05 µF/270K parallel RC network. The design is simple and straight-forward and after restoring/rebuilding several dozen of them during the last twelve years I have yet to find one that doesn't work.

If you are fortunate enough to find an



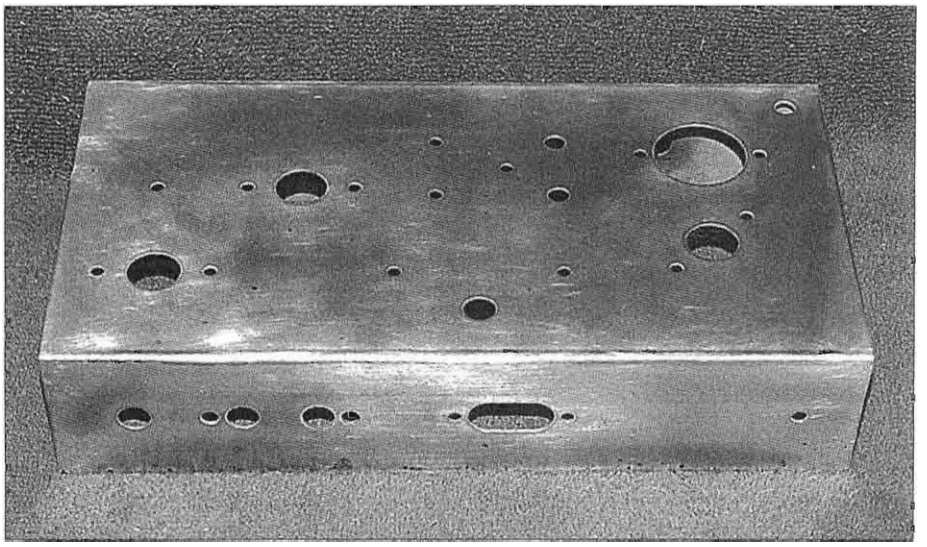
Front view of an Ocean Hopper with the 5 optional coils and Baldwin Type "C" headphones.

OH in original condition, the "Achilles heel" is the 3-section filter capacitor – it will be open. The original filter capacitor was 30/30 µF @ 150 VDC and 20µF @ 25 VDC and has the Allied Radio P/N 213301 printed on it. Fortunately, a satisfactory replacement is available from Antique Electronics Supply, their P/N C-ER33-47-22, a 33/47 µF @ 160 VDC and 22 µF @ 25 VDC. You can also use three individual capacitors and use the original mounting hole to install a terminal strip. Since these are "entry-level" kits and in many cases represent our first attempt at kit building, the quality of the wiring ranges from pristine to mediocre to horrible. Typically, there are three categories that I put OH's into. The overall condition is:

- Such that it's just not worthy of restoration. In this case, I "part it out." This is especially true if the chassis has been modified with extra holes for tube sockets, etc. In addition, it's not unusual to find front panels with additional holes. Another major deficit is the absence of the original plastic main tuning dial since replacements are basically "unobtainium."
- OK, but it needs to be rewired
- OK and the wiring is acceptable

In all three categories, the condition of the steel chassis can also vary from pristine to completely rusted out - the plating used on the OH's chassis does not appear to be very robust – and more times than not is responsible for the biggest single deficit in the cosmetic appearance of an OH next to the front panel. I have successfully used the following procedure in rebuilding a dozen or so OH's in the third category (OK w/ acceptable wiring). This procedure, like the OH, is relatively simple, straightforward, inexpensive, and can breathe new life into an OH.

- Remove the three tubes and coil.
- Remove the filter capacitor, filter choke (if there is one), and line cord.
- Prepare the tube socket pins of the 35W4 for rewiring and new parts. Be **very careful** with the tube socket pins as they are easily broken off. I have had to replace several 35W4 tube sockets because of pins breaking off so I routinely keep a spare 7-pin tube socket handy. A replacement 7-pin wafer socket will have 1-5/16" mounting centers.
- Disconnect the three wires to the main tuning capacitor and "ANTENNA TUNING" trimmer.



Steel chassis after sanding with wet/dry sandpaper. There are still some spots of corrosion visible, so it will need a second treatment.

• Remove the front panel and set it aside.

• Remove **all** the 6-32 hardware from the chassis and the antenna Fahnestock clip.

• Carefully lift out the wired components from the chassis as one unit and lay it aside.

• If there's a label affixed to the rear of the chassis, remove it as carefully as possible.

• You are now looking at a bare chassis. What you do next will depend on the chassis' condition. Here are some of the things I have done in the past:

• If the chassis is just "dirty", clean it in warm soapy water using a "Brillo Pad". This shouldn't be aggressive enough to remove the chassis' protective plating. Typically, the underside of the chassis will be OK.

• If there is a minimum of corrosion and rust, use wet/dry sandpaper or crocus cloth under running water. Do the entire top and rear of the chassis to create a uniform finish (remember, the front of the chassis will be covered by the front panel). After the chassis has dried, apply a coat of "Krylon Crystal Clear Acrylic" to protect the surface from rusting. Again, the underside of the chassis is typically OK.

• If the chassis is severely rusted, use a wire brush in a ¼" drill. This creates a very coarse "line-grained" finish. Do the entire top and rear of the chassis to create a uniform finish. I have "saved" several chassis using this method. If the texture is too coarse for your taste, follow it up with wet/dry sandpaper and crocus cloth. I have taken a chassis following wire brushing and applied a coat of "Krylon Crystal Clear Acrylic" and the results have been acceptable. Or, the chassis can be painted with a primer coat. The advantage of the "Krylon Crystal Clear Acrylic" is that it's cosmetically closest to the original.

• In an extreme case, I have fabricated a new chassis from 0.062" aluminum, but unless you have access to a metal brake, I wouldn't advise going that route and I certainly wouldn't do it again – once was more than enough!! Having said that, if the chassis is junk, and the balance of the OH is near-pristine (as mine was), it might be a consideration.

• Remove the "ANTENNA TUNING" trimmer from the front panel along with the two ceramic standoffs.

• Clean the front panel in warm soapy water followed by several applications of "Meguiar's Cleaner/Wax" or equivalent.

• Install the "ANTENNA TUNING" trimmer and standoffs on the front panel using new 6-32 binder head hardware. Do **not** over-torque the hardware or you will crack the ceramic standoffs. Use new terminal lugs if you have them (similar to Keystone #7332).

• Clean the plastic main tuning dial and the two bar knobs with "Novus Plastic Polish" [from Antique Electronic Supply] or equivalent.

• Install new rubber grommets in the chassis for the filter choke leads (if there is one), the two leads to the main tuning cap, the antenna lead, and the line cord.

• Now, pick up that wired assembly and install it back into the chassis using new 6-32 binder head hardware. I use the old 6-32 hex nuts unless they are rusted.

• Install the Fahnestock antenna clip. Use a new terminal lug if you have one.

• Install the main tuning cap and filter choke using new 6-32 binder head hardware.

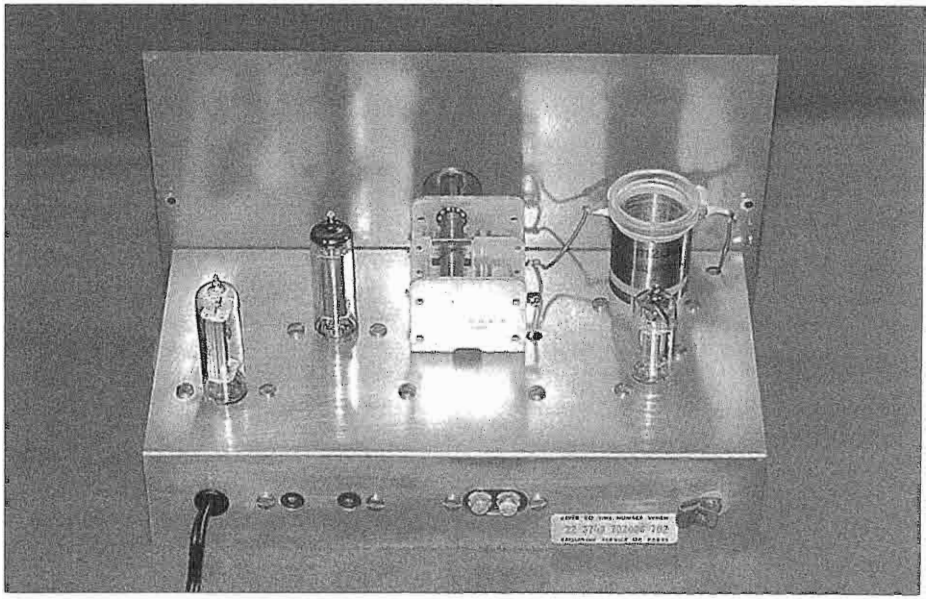
• Install the new 3-section filter capacitor (or individual filter capacitors). I use a nylon cable clamp to install the replacement 3-section filter capacitor from Antique Electronic Supply.

• Install the front panel, bar knobs, and main tuning dial. Solder the antenna leads and both leads to the main tuning capacitor.

• Discard the original unpolarized line cord and replace it with a 2-wire polarized line cord. I have used a black Radio Shack P/N 61-2852 6' line cord, but any 2-wire polarized cordset can be used. The wider of the two pins is neutral and should be connected to the switch.

• Install the tubes and coil.

At this point, the OH is finished and



Rear view of the rebuilt Ocean Hopper. This particular unit is a late Model 749, circa 1966. The fine lines from the wet/dry sanding process are just visable. Several coats of "Krylon Crystal Clear Acrylic" have been applied.

ready for testing. The above steps typically take me a total of 2-4 hours depending upon the condition of the chassis. If I coat it with "Krylon Crystal Clear Acrylic" I let it dry overnight before reassembling it or if it's a warm sunny day, I'll put it outside for several hours in the sun. All of the OH's I have owned, restored, and rebuilt, have worked pretty much the same. That's not to say that they haven't had some individual "idiosyncrasies". Like any regenerative-detector, selecting a 12AT6 for maximum gain and regenerative characteristics is time well spent. Improvements in the audio gain can also be achieved by selecting 50C5's. Remember, using the original OH components, the gain from the antenna to the headphones is absolutely dictated by the tubes and there are considerable variations in gain from tube-to-tube, both as a detector and audio amplifier. Also, a tube checker will not be useful in determining detector gain and regen characteristics – it has to be done in the OH.

Depending on the original condition of the chassis, the results of your 2-4 hours of work in terms of before/after differences can be **spectacular**!!

For those of you that are interested, I have complete sheet metal and cabinet drawings for the OH. I also have the coil winding info. Send me a large SASE or send the request via e-mail. I will also answer all questions, so feel free to e-mail me.

Selected References:

1. "Regeneration Fever", David W. Ishmael, WA6VVL, Electric Radio, Oct.'92, issue #42, pgs. 20-25
2. "The Knight Kit Ocean Hopper", David W. Ishmael, WA6VVL, Vintage Anthology, pgs.1-16.
3. "The Ocean Hopper Story", World of ideas Column ("Homebrew Classics From the Fifties – Part I"), Dave Ingram, K4TWJ, CQ Magazine, Feb.'94, pgs. 94-98.

ER

The HB-2000

A High-Performance Homebrew Ham Band Receiver, Part 1

By Ray Osterwald, NØDMS
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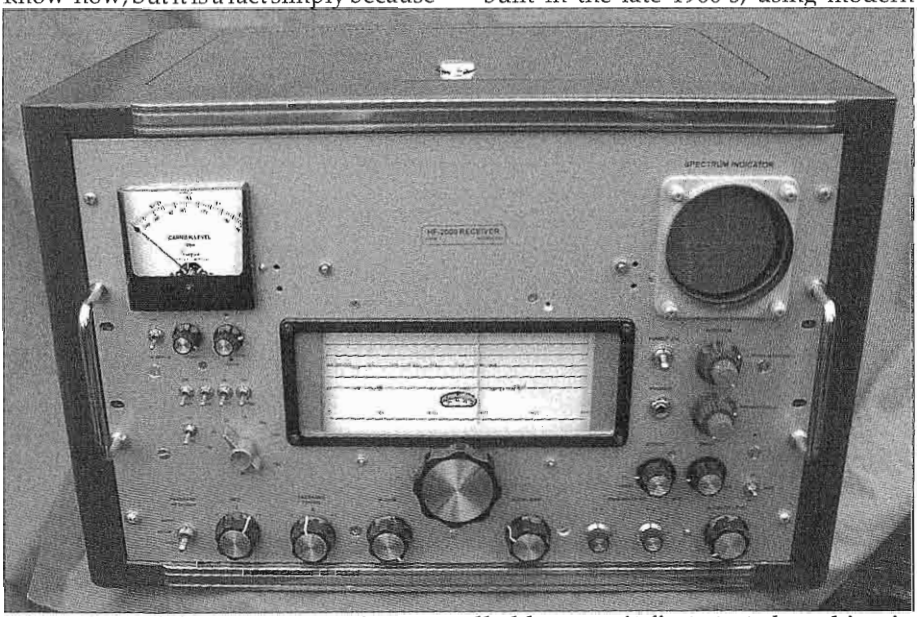
Introduction

One of my favorite articles from the old QST's is "The Case for Homemade Receivers—How to Get What You Want" from January, 1951, written by Byron Goodman. Quoting from By's introduction to the article, "Anyone familiar with radio stores or radio catalogs knows that the manufacturers these days offer a variety of fancy receivers at a variety of fancy prices. The ultimate objective of the majority of hams seems to be to own the most expensive receiver there is." Quoting Goodman further, "The manufacturers will never bring out a receiver that can't be improved—it just isn't possible. This isn't by way of belittling their know-how, but it is a fact simply because the *customers* can't agree on what *they* want...The manufacturer is forced to build a compromise job, hoping that his guess about the average requirements will be a bit better than his competitor's."

Now, this was written 53 years ago and radio has changed a great deal. Some of the change is good and some not so good, but it seems to me that By's words still have a lot of truth in them.

When I started on my receiver design, what I wanted was to find out how good a receiver I could build, given modern-day parts limitations. To have as much fun with the project as possible, I wanted it to be a receiver that might have been built in the late 1960's, using modern



Front view of the HB-2000 receiver, so-called because it first started working in the fall of year 2000. The Premier steel cabinet was rescued from going to the dump.

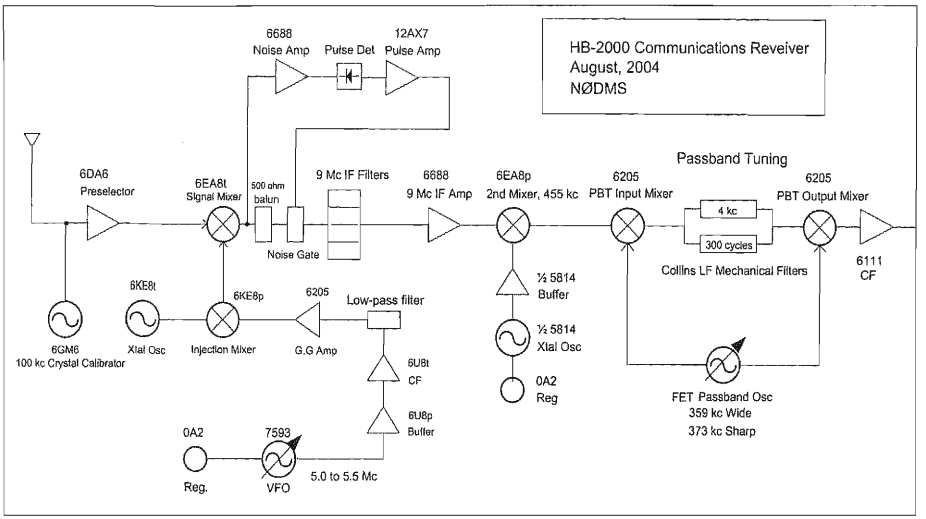
tube types and a few semiconductors. It wasn't that I couldn't *decide* what I wanted—I've had enough receivers over the years to know that. I wanted it to be able to have good-sounding, low-distortion AM detection, but it must be able to dig out weak CW signals on the low end of the 40 meter band with freedom from blocking and spurious response. I wanted the SSB detector to perform as well as possible, given the limitations of the mode. I wanted full electronic passband tuning that would function as well in the AM mode as in narrow CW. The VFO would have no noticeable drift, and ideally be re-settable from a cold start to stay within the passband of the narrowest CW filter. Noise blanking and audio limiting were requirements, as was the ultimate magic eye, a spectrum monitor. I wanted an S-meter that would work with the AGC switched off, and I wanted an AGC system that had full-hang action with no overshoot or pumping in the presence of strong signals, and with an attack time fast enough to follow CW characters and static crashes. I wanted fully-adjustable attack and decay times in the AGC. One last thing that I wanted was a superhet mixing scheme that would allow construction of a matching exciter that would make a homebrew transceiver a possibility.

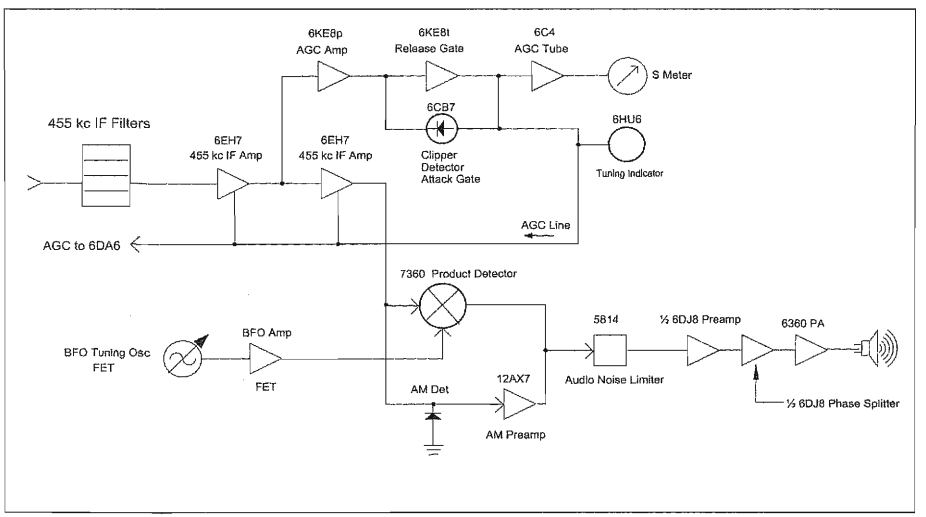
A lot of the operators I've been in QSO with, upon learning that my receiver is homebrewed, have asked me to write about it. I've been hesitant to do so, mainly because of the fact that the good radio parts necessary for point-to-point designs are getting hard to find, and not everyone has the time to complete a big radio project. I've decided to go ahead and describe my receiver, not only because of many requests, but also because it is of a modular design and many of its features can be "lifted" and used in anyone's project. I hope that my findings will help other builders who are already working on a receiver project (or who are contemplating starting one) to save time by avoiding circuits and techniques that don't work very well.

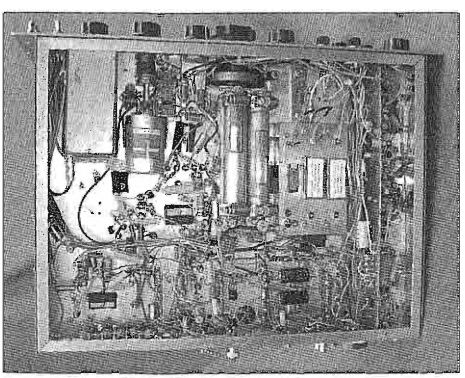
The chart below is a performance comparison that I have prepared. I have compared my receiver with a Collins 75S-3B built in 1970 and the latest, shiny, kilo-

PERFORMANCE COMPARISON

Type of Test	HB-2000	75S-3B	IC-7800
Audio Output Power, Total Harmonic Distortion	2.5W, 2.7%	4W, 14%	2.6W, 10%
CW/SSB Minimun Discernable Signal (MDS)	-135 dBm	-136 dBm	-138 dBm
AM Sensitivity	-110 dBm	-126 dBm	-112 dBm
Blocking Dynamic Range 5 kc Spacing 20 kc Spacing	 119 dB 119 dB	 113.7 dB 113.7 dB	 112dB 138 dB
3rd Order Dynamic Range 5 kc Spacing 20 kc Spacing	 87.7 dB 95 dB	 86.4 125.7 dB	 84 dB 103 dB
Image Rejection	> 152 dB	> 146 dB	121 dB
IF Rejection	106 dB	83 dB	118 dB

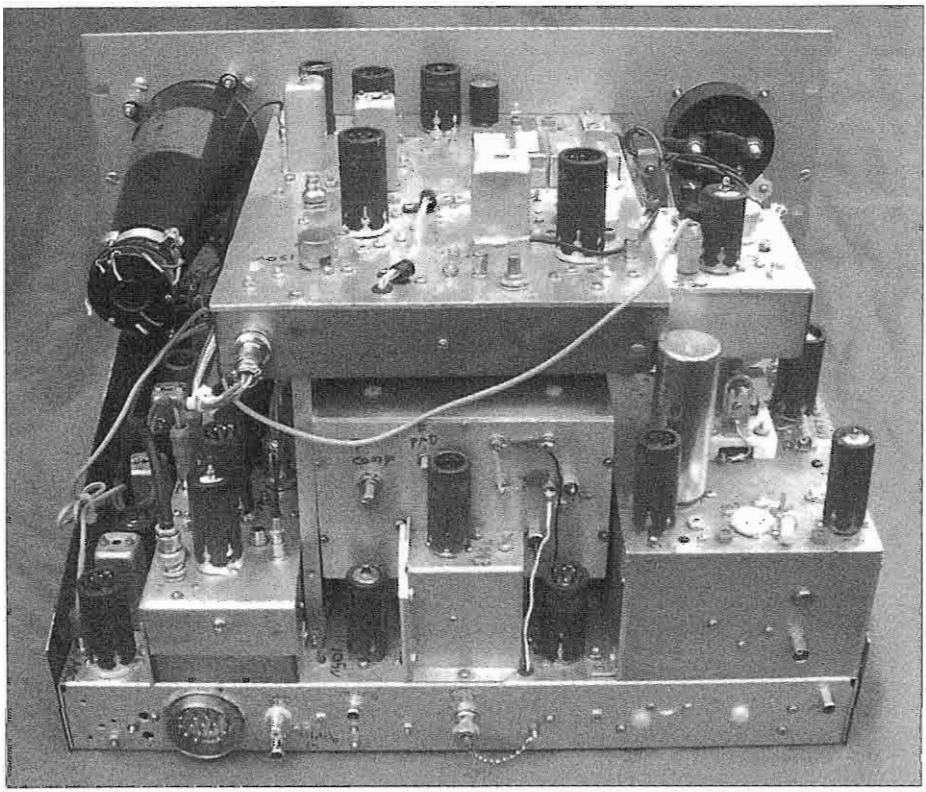






The HB-2000 block diagram is shown in the above two diagrams. The signal flow is from the 6111 cathode follower in the top, and into the 455 kc IF filters in the center illustration.

To the left is a view under the main chassis. At the top left are the BFO and passband tuning units, made from R-390A BFO tuning units. The Passband filters are in the center below the Eddystone flywheel. The 455 kc IF filters just to the right of center, and the IF amplifiers and portions of the AGC are at the far right.



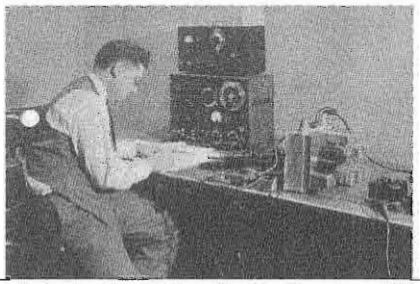
This rear view of the receiver shows the modular construction I used. On the left side, below the long CRT tube, are the IF amplifiers and AGC tubes. The detector and audio subchassis is just above the ARC multi-pin connector on the main chassis. The mixer deck with the 9 Mc crystal filters is at the top, and the VFO is in the large shield box just below the mixer deck. The VFO tube is on the box in lower center, with regulator and buffer tubes to the right and left. The module on the right side of the main chassis contains the calibrator, preselector, crystal oscillator, and injection mixer electronics. In front of the S-meter is the AGC tube. This photo was taken before chassis labeling was completed.

buck imported transceiver that was reviewed in the August, 2004 issue of QST. My equipment used in these tests consisted of two low-noise HP-8640B signal generators, a commercial directional coupler, and an HP-334A distortion analyzer. Although my receiver is always "under development" and hopefully will never be "done," I feel that it is getting close qualifying in the high-performance class.

Part two of this article will start the circuit description with the VFO, which I consider to be the heart of a homebrew superhet receiver. You can put up with a lot of compromise in some areas, but not in the VFO. Poor performance there will frustrate your efforts and will affect nearly every other part of the receiver. The VFO in the HB-2000 will return after a cold start to within 350 cycles from where it was shut down the night before. Its drift over 95 minutes is –445 cycles, or –4 parts per million over a temperature rise of 18.4 degrees C. After 15 minutes of warm-up it drifts an average of 20 cycles during any 5 minute period.

ER

The Restoration Corner



Another BC-312/342 Article

By Ben Booth, W4CT
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The Restoration Corner can run only if your restoration topics are sent in to Electric Radio!

I have only written two articles for ER – as well as submitting a very youthful picture of myself at age 16 – appearing on the front cover of the November 1996 issue of ER.

This is my first article on anything remotely technical, although I am an incurable and inveterate tinkerer. It is most difficult for me to pass up WWII receivers and transmitters, especially ones needing help!

This article is for BC-312/342 and perhaps 348 owners and prospective owners. I had one of each until this year's Dayton hamfest, where I found a 312/342 pleading for rescue. It came with its PS-312 AC power supply, but with wires dangling helplessly from it in the Dayton wind and rain. It did come with its cabinet and appeared not to have been "gotten into too badly." (Wrong!!!!)

After arriving back home in Mentone, Alabama I finally found time to see what I had purchased for $45.00, and found the B+ shorted to ground. I checked/replaced several black rectangular capacitors. These black devils have been warned against in previous ER articles – and the recommendation to a wholesale replacement of them is a point still well taken.

That didn't solve my shorted B+ problem. The problem then took me to the very difficult to remove RF and mixer boxes for the 1st, and 2nd, RF amp and mixer (1st detector) stages.

What I discovered was most disheartening and the subject of this article. Two of the trimmer capacitors – C-12 and C-16 – (there are a total of 24) that are adjustable from the rear of the receiver had failed. How, you ask, can this be?

Well it seems that the rotor shaft on these capacitors are held in tension against a three-prong spring by a thin sleeve pressed on the end of the shaft. This shaft and sleeve can be seen on the outside of the RF and 1st detector boxes without removing the assemblies. Simply remove the rear protective cover from the 1st and 2nd RF and 1st mixer stages and look at the end of the trimmer capacitor shaft and note whether or not the little keeper sleeve is flush with the end of the shaft. If the rotor shaft (with the screwdriver adjust slot in it) has slipped back from the end of the sleeve – you can bet that capacitor is shorted.

The shaft is brass and so too (I think) is the sleeve.

Why do the sleeves slip in their shaft? Age? As has been noted in past ER pages, these rigs were not designed to last more than a few years in keeping with the hope and expectation that WWII soon would end. That fact, however, does not detract from the incredible expense and engineering that went into much, if not

most of the electronic equipment of that era.

I wonder too if overuse of new "super" lubes and penetrants may also contribute to the failure of these capacitors. (Reducing the friction between sleeve and shaft.)

In any event make sure the end shaft and small end sleeve are flush – then work on replacing the little, and not so little, black fixed capacitors.

By the way, I had some spare trimmer capacitors and the receiver works great, especially after replacing a half dozen more caps and the original filter capacitor.

Sometimes, You Just Get Lucky

By Glenn Bowman, KC8WUL
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In some of my earlier articles for Electric Radio where I have dealt with various shortwave radio topics, I have also mentioned the advantages of buying radios through on-line services such as eBay. The topic of this restoration deals with the recent purchase and restoration of a Hallicrafters S-120 shortwave radio and proves that sometimes, you just get lucky.

The S-120 was a very popular hobby radio produced by Hallicrafters during the late sixties and early seventies as a mid-level receiver in their already popular line of shortwave radios. The tuned superhet circuit allowed parents and kids the opportunity to tune in the global shortwave powerhouse stations of the day. Many of those stations are still around today along with some of the radios from that era. So, let's take a quick look at what we have.

The S-120 was classified as a 'four banger' using a 12BE6 Converter, a 12BA6 I.F. Amplifier, a 12AV6 AVC and 1st Audio Amplifier, and a 50C5 Power Output Amplifier. The set used a standard dial cord frequency pointer and analog dial combination that was prevalent at the time. Frequency coverage included the standard AM band and the popular shortwave frequencies in three additional bands, with continuous coverage from about 1.6 MHz to 30 MHz. The radio design also included a calibrated bandspread that was very useful when trying to tune in stations on the crowded shortwave bands.

Radios of similar vintage and quality are readily available on eBay with conditions ranging from "This set appears to be damaged, is not working, and I don't know a thing about radios" to "This radio is in beautiful condition and clearly brings in several foreign stations on every band". When I logged onto eBay earlier tonight I located four S-120's and a couple of Knight Star Roamers with the bids starting at $9.99. Sound interesting? Well, my advice is use the provided e-mail service to ask the seller about the history of the radio and how it was used. Many sellers are simply cruising yard and estate sales and don't know their onions. Bargains are usually available because many sellers just want to make a profit. So, use your best judgment and have a little fun in the process.

This particular S-120 was advertised as "clean, really sharp, and works good on all bands," so I did not anticipate any in-depth restoration work. My bid of around $35 proved to be a winner. The radio arrived in about a week and my general inspection and shake test showed that the radio wasn't falling apart. I then cleaned the radio and performed the compulsory smoke test. I removed the radio from it's case, turned off the shop lights, and saw that all tubes glowed with the appropriate orange color. Nothing seemed to 'go up in smoke' so I attached a short wire antenna and turned up the volume. Things were strangely quiet. No sound was coming from the internal speaker. Not even static or hum. Rats. So, what's going on here?

None of the components showed any signs of overheating and there were no obviously broken wires. So, I decided to contact the seller by e-mail about the nature of the problem. The response I received was a little unsetting and went something like this: "You should have

bought the shipping insurance when you paid for the radio. If something's obviously broken, I'll replace it." I knew that eBay and other reputable on-line merchants had policies when purchased items were damaged upon receipt, but for the money involved it hardly seemed worth the effort. And besides, experience is always a good teacher and the radio really was in beautiful condition with all original components, knobs, and parts. It didn't appear to be a hopeless case so I decided to forge ahead.

I put the radio back in the case and plugged it in. No change. So, I decided to park the receiver in a pile with some other sets I had intentions of fixing at a later date and then moved on to other projects. I allowed about a week for things to settle down then plugged the receiver back in for another try. There was still no sound, so in my frustration I smacked the top of the case with my hand. Boy, I was sure surprised when I heard intermittent static coming from the speaker.

I don't know if this sounds like a familiar restoration technique but it sure seemed to work for Ralph Cramden. And, at least I knew that the speaker seemed to work OK.

I removed the radio from the case and with the aid of the proper schematic and a good DVM, I started to look for the possible cause of the problem. S-120's use a transformer to lower the impedance from the power amplifier tube and drive an internal speaker that's rated at 8 ohms. The speaker did not appear to be damaged and testing with the DVM showed that the transformer was doing it's proper job. I moved on down the line and came to the panel mounted headphone jack that's wired in series with the speaker. Further testing with the DVM showed that I was getting AC voltage at the input side of the phone jack but zero volts at the output side that runs over to the speaker. The signal from the amplifier must pass through the physical connection made by the contact arm on the phone jack. Inserting the headphone plug will engage the points on the contact arm and disconnect the speaker. I unplugged the set and when I took a close look at the contact arm I found that dust, dirt, and general radio crud had accumulated in and around just about every possible surface. I'm now thinking that it can't be this easy, can it? I used an old toothbrush to remove most of the built up crud and finished up by using some window cleaner sprayed on a no-lint shop rag. I then used a two sided emery board to run through the contact points. With the phone jack now properly cleaned up I put everything back together for another try. Wow! I had sound! The radio seemed to be working just as advertised. After doing some additional cleaning and alignment, this radio is now ready for another forty five years of service.

In situations like this I feel it's a good idea to contact the original owner again and let them know how you fixed the problem. They will appreciate your correspondence and you never know when you might do business with them again. Looking back, I felt that my investigation into the problem could have gone a little smoother if I had just taken the time to review some of the information I had received when I was bidding on the radio. I noticed that the previous owner always used headphones when listening to the radio. The headphones were probably left plugged in when the radio was put away after a night of listening and were probably still plugged in when the radio was placed on a shelf in the garage or basement and eventually forgotten. Since the phone jack contact arms remained opened and exposed to the environment, dirt and dust could have easily built up and eventually insulated the contacts which in turn prevented the amplified signal from getting to the speaker.

The other lesson I learned from this experience is that our perceived fixes for ailing radios should not always be based on the expectation of electronic component failure. In our attempts at radio restorations we need to be aware of the physical aspects and operations of the particular unit. And then again, sometimes we just get lucky.

ER

Modifying the Collins 516F-2 Case with a Speaker

By Cal Eustaquio, N6KYR
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Don't get me wrong. I love Collins' S-Line. It is arguably the most graceful of all vintage tube amateur SSB radio equipment ever built. However, there are some things about the line that could stand change. For example, in the Heathkit SB line (which is essentially a distant clone to Collins S-line), the Heath engineers saw it fit to create something similar to the Collins 516F-2 to house their Heathkit HP-23 power supply. Thus, the Heath SB-600 SPEAKER (emphasis added) was born. I thought to myself "why didn't the boys at Cedar Rapids think about something like this?" Rather than add bulk to a compact system, it made complete sense that a speaker and power supply be housed under one roof. I know some hams who have successfully added the Collins standard 5 by 7 speaker to the 516F-2 case by using a pair of cross-braced galvanized material and modifying the unit accordingly (as was shown in a previous Electric Radio article). However, if one has existing parts available from a manufacturer that could be bolted in and used to do this, why not? Enter the Collins reproduction line made by Advanced Optics of England (www.advanced-optics.com). The Collins Radio Association (run by David Knepper) has been selling a series of these successful pieces of S-line repros with great success. They sell excellent

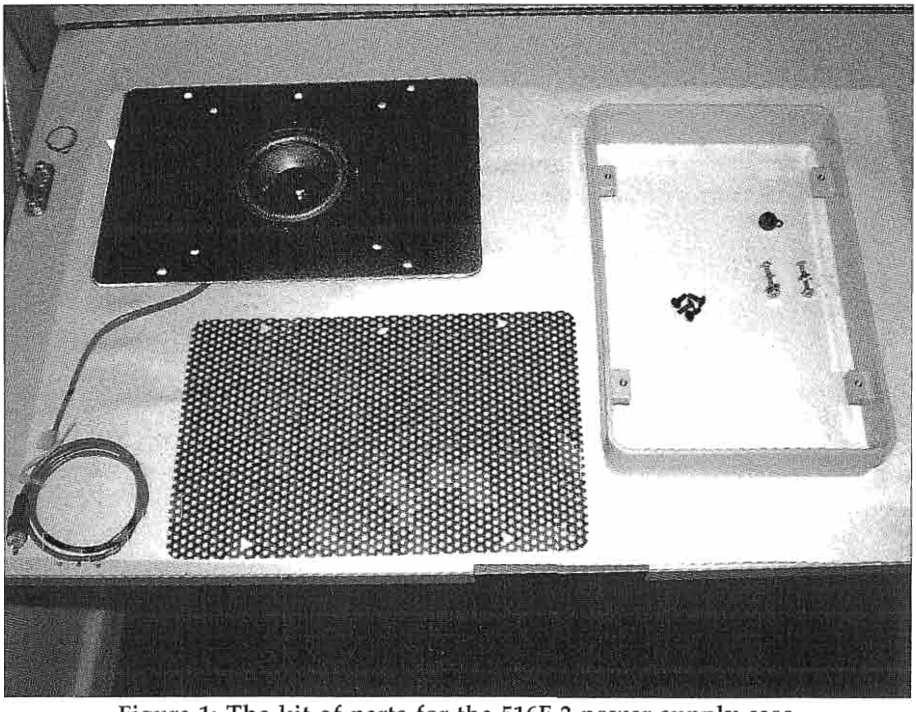

Figure 1: The kit of parts for the 516F-2 power supply case.

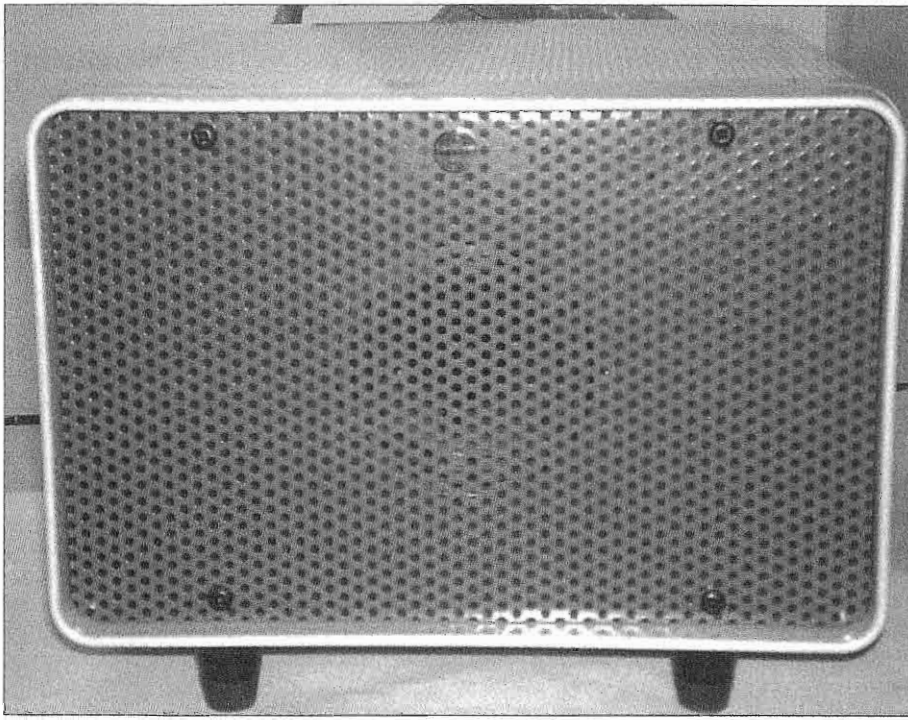

Figure 2: The assembled 516F-2 power supply case.

clones of many of the pedestrian S-line products. The 516F-2 case and the 312B-3 speaker, for example, come to mind. They also sell parts that go into their reproductions: rubber feet and supports, plastic trim rings, round and winged Collins emblems, and front panels are just part of the list. A year ago, I purchased their excellent reproduction 312B-3 speaker for use with a WE 75S-3 that I acquired a little over a year ago. I was impressed with the fit and finish of the unit. Curious, however, was Advanced Optics usage of a 4" round speaker with the reproduction 312B-3. It wasn't the usual 5" by 7" oval unit usually found on the original Collins line but the way the new speaker melded into the reproduction didn't bother me nor did I feel it detracted in any way from the spirit of the S-line (although from a Collins purist perspective, adding this non-stock speaker assembly may be an abomination). I thought that despite its small size, it sounded very good. The speaker was mounted into a steel plate that in turn, was mounted onto the trim ring and front panel screen. I had a spare 516F-2 case from a previous project. I also recently purchased a very good condition transitional model RE/Rockwell Collins KWM-2 from a fellow Collins enthusiast who hawked his unit on the CRA list server. He also sold me a 516F-2 power supply sans case. For me, it was a no brainer: I decided to use the CRA/advanced-optics parts to build up the 516F-2 speaker/power supply combo. I didn't have to do any drilling, cutting, or any metal modifications that would otherwise mar up a nice piece of Collins gear. Of course, I ended up purchasing a trim ring, a replacement Collins round emblem, a the front panel screen for the naked case.

As you can see in **Figure 1** (page 35), these are the parts I purchased from the CRA for the 516F-2 case. You can barely

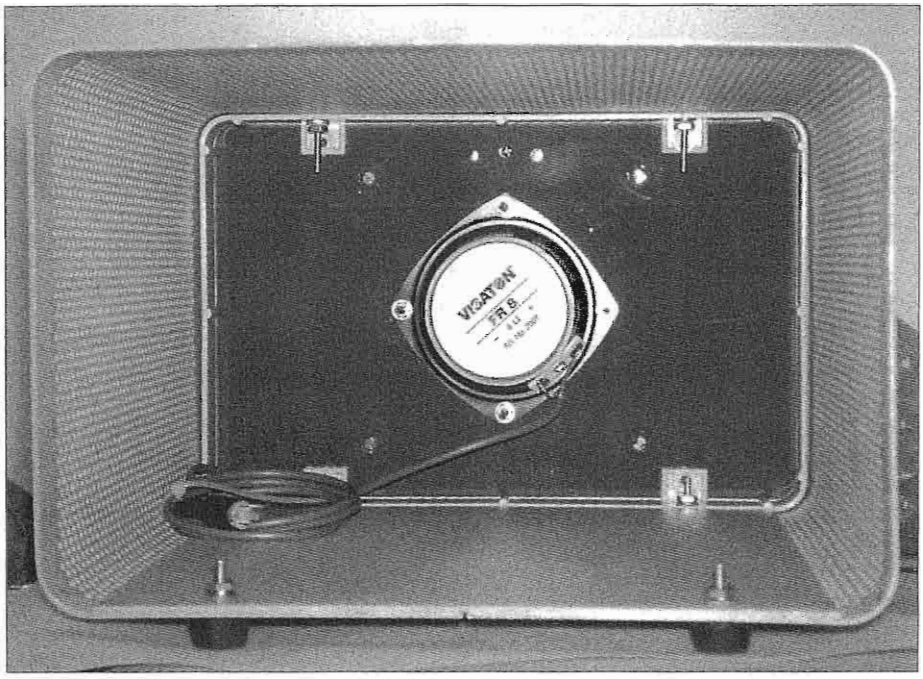

Figure 3: Rear view of the assembled 516F-2 kit.

see, just below the four black trim ring screws, are four 5/16" nylon washers. I purchased these separately from a hardware store. I used these washers in back of the black bolts in order to prevent marring the new front panel. Also, a spare set of grey cabinet Phillips head case screws was donated by Dave Knepper for my project. Not shown in the parts layout are rubber feet, aluminum standoffs, and the 516F-2 case. After inventorying the parts, I noticed that the 516F-2 case had dirt and dust accumulating on the inside. Prior to assembly, I washed the case with dish soap and water, rinsed, and toweled off the excess water and let it air dry.

The assembly of the 516F-2 case was easy and did not take more than half an hour. The only tool I used to assemble the project was a combination Phillips head/flat blade screwdriver. The only note about the assembly was that the Collins round emblem uses a piece of sticky tape to prevent rotation of the emblem in the wrong position. One must remove the wax paper backing of the emblem to expose the adhesive surface to the front panel grill. Align the emblem accordingly, press down, and then press the captive nut on the rear with the emblem on the grill. Everything else is common sense assembly. You can see in **Figure 2** the outline of the 4" speaker through the grill. The steel plate and speaker are flat enough not to cause interference to the grill.

Figure 3 is the speaker shown from the rear of the cabinet. Hidden behind the coil of speaker wire on the left of the speaker is a nylon clamp that acts as a strain relief for the speaker wire. Be sure to bolt that clamp down on either of the bolts that attach the standoffs to the case. Now the completed cabinet is ready to house that homeless 516F-2 power supply and play beautiful music for the S-line or KWM-2.

ER

The Poor Man's Collins 516F-2 Power Supply

By Hal Guretzky, K6DPZ
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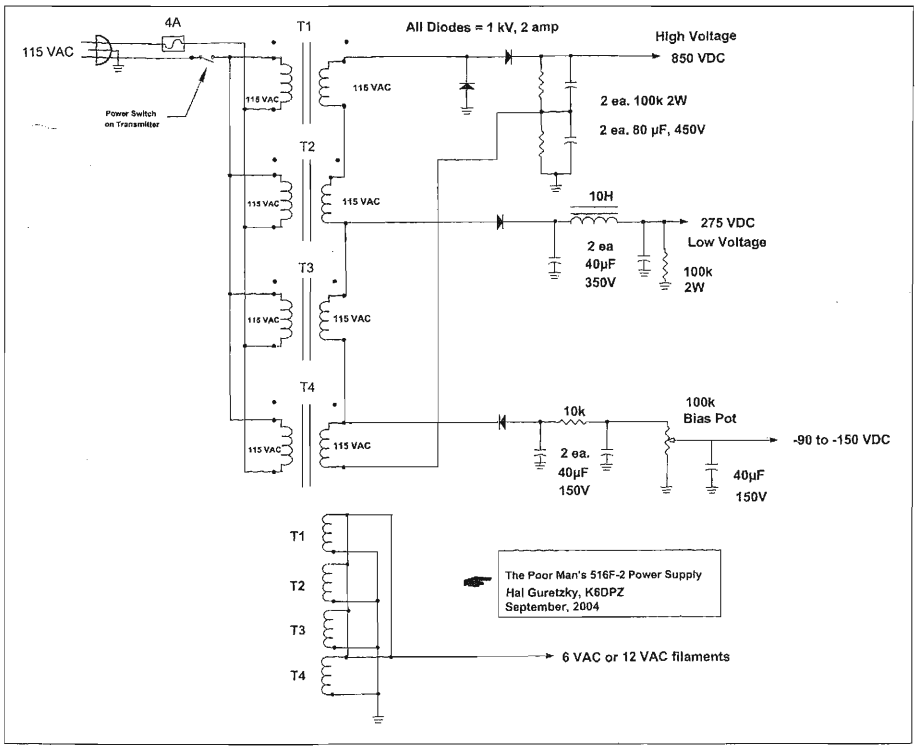
Frequently Collins KWM-2A and 32S-3 transmitters are found without the companion 516F-2 power supply. This may be because they are government surplus transmitters and the power supply might have been separated long ago. Some S-line stations, if sold with a matching 30S-1 linear amplifier, had the power supply for the 32S-3 exciter mounted in the 30S-1 cabinet. Other times, they just got lost. Whatever the reason is, the whole power supply that is shown below can be built for under $100 to operate these transmitters. Depending on the goodies in your junk box, the cost might be well under $100.

The transformers in the schematic are dual-primary filament types, 115/220 VAC styles. The filament windings are shown on the schematic seperately for simplicity on the drawing. The high-voltage supply is a simple full-wave doubler which does not need an elaborate design because the finals are basically drawing pulsed power. The low-voltage supply needs a good choke, and any value from 8H to 12H will work.

Enjoy your new 516F-2 power supply!

ER



The RF-LO Tracking Problem in Superhet Receivers
Part 3, Design Example

By Joel Ekstrom, W1UGX
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Cabin John, MD 20818

In the conclusion that follows, some of the displayed intermediate results have been rounded off for convenience. We will suppose the following:

C_{max} = 400 pF
F_1 = 5.6 MHz
F_2 = 18.1 MHz
f_i = 1.65 MHz
F_a = 6.17 MHz
F_b = 10.71 MHz
F_c = 16.93 MHz (F_a through F_c from equations 10-14)

We have put 100 kHz "pads" on F_1 and F_2 to account for tracking errors, even though the range of interest is 5.7-18 MHz.

Using (1) we find

C_1 = 42.3 pF (25)

which must include the minimum capacity of the tuning capacitor. From (2) we get

L_1 = 1.826 µH (26)

Using (3) we find

C_v (6.17) = 322.1 pF (27)
C_v (10.71) = 78.6 pF (28)
C_v (16.93) = 6.1 pF (29)

where the frequencies used have been calculated using the method of Sturley.

We will assume that C_2 is equal to 27 pf, which is 15.3 pf less than C. Then, using (17)-(22) we find

L = 9342.2
M = 21110.8
N = 52738.6
X = .0028646
Y = .0094665
Z = .030214 L through Z (30)

Using (16), (23), and (24) we find

C_p = 1237 pF

C_3 = 19.44 pF
L_2 = 1.420 µH

I'll move on to the laborious task of computing the tracking errors by hand (no PC available). Our approach here is to pick an RF signal frequency and add the IF frequency to get the LO frequency. Now the LO circuit so far looks like Figure 2:

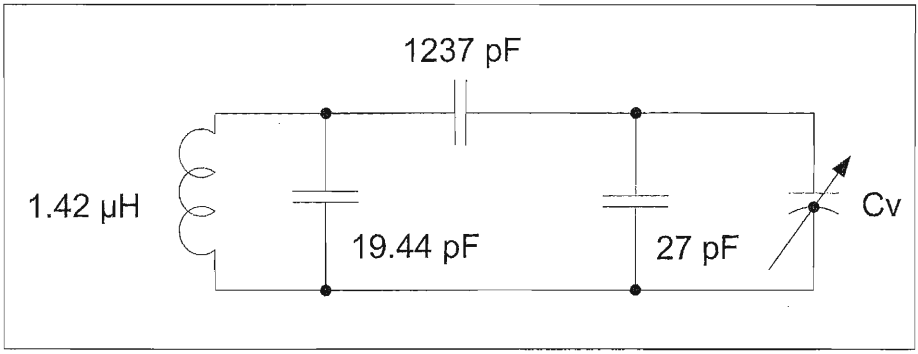

Figure 2: LO Resonant Circuit

For a given LO frequency it is another exercise for the reader to compute C_v for that frequency. That value is then plugged into the RF circuit, which looks like Figure 3:

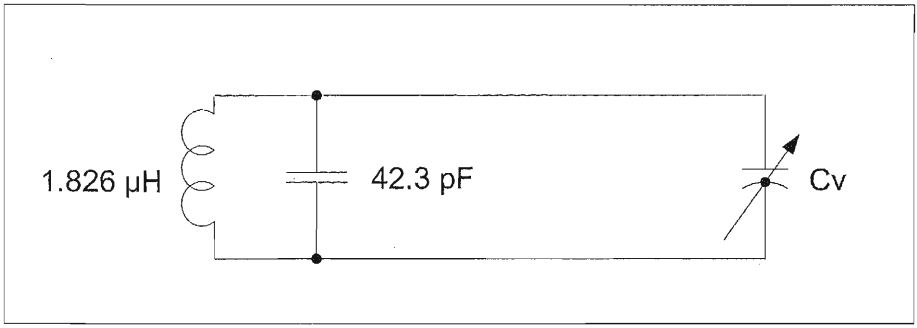

Figure 3: RF Resonant Circuit

The resonant frequency is found in the usual way. When this value is subtracted from the RF signal frequency we started out with, the difference is the tracking error.

The results are given in Table 1, and they don't look too bad.

The peak values are not all equal in magnitude, but at least the worst errors occur at the higher frequencies, where they are less important because the RF circuit bandwidths are larger. Some minor changes in F_a, F_b, and F_c might improve matters, but we will not do so here. Reducing the IF frequency would also reduce all the errors. There are small errors at the 3 tracking frequencies; these are due to cumulative rounding-off errors in the large number of computations.

Let's look at the tracking error at the lowest frequency of 5.7 MHz, and suppose we are using a single RF stage in which an antenna trimmer capacitor (every receiver ought to have one!) can compensate for the tracking error at the RF amplifier input.

RF Signal Frequency	C_v	Tracking error, kHz
5.7	388.02	22
5.9	357.79	12
6.17	322.09	.03
7.305	215.86	-25
8.44	151.21	-27
9.575	108.51	-16
10.71	78.64	.025
12.265	50.22	20
13.82	30.66	32
15.375	16.59	27
16.93	6.10	-.5
17.465	3.09	-16
18.0	0.35	-35

Table 1: Tracking error VS RF signal frequency

What about the circuit at the RF amplifier output? Suppose it has a loaded Q of 100, as a ballpark figure. Then the -3 dB bandwidth would be 57 kHz, so a 22 kHz tracking error would put the RF signal center frequency at a level somewhat above one of the -3 dB points, which are plus and minus 28.5 kHz away from the center frequency. This will lead to some gain loss and possibly some distortion, and this will be investigated when the receiver using these design parameters (together with a 1.65 MHz crystal filter from the junk box) is finished. If the distortion is excessive the interstage Q may have to be artificially lowered or the 3 tracking points jiggled somewhat.

I have compared these design results with those obtainable (with certain interpretations and assumptions I had to make) from the formulas in Terman's Handbook and the totally different formulas in a recently acquired 4th Edition (1950) of the Henney Radio Engineering Handbook. The agreement is pretty good, with the possible advantage of being able to specify C_3 in advance, which my analysis cannot do. However, the Terman and Henney formulas are obviously approximations without obvious sources, and their regions of validity with respect to the starting assumptions are unknown, so all I can say is "use at your own risk". All 3 approaches involve roughly the same amount of algebra, so a choice should not be made on that basis.

The usual alignment procedures should be followed; adjust coils at F_a, and shunt trimmers (C_1 and C_3) at F_c. The value of C_p should be within 2% of the design value.

[Editor's note: It is believed that the superhet tracking material in Sturley's "Radio Receiver Design" book was based upon papers presented by Dr. Martin Wald in a professional journal published in the UK entitled "Wireless Engineer." This material is very difficult to obtain in the USA, and the mathematics are rigorous. Joel Ekstrom's procedure is an excellent contribution that has reduced the problem to simple algebra. I encourage homebrewers to use it in their next design. Here are some references to Wald's work:

Dr. Martin Wald: "Ganging Superheterodyne Receivers," Wireless Engineer, March, 1940, Number 198, Volume XVII, pp 105 - 109.

Dr. Martin Wald: "Further Notes on Ganging Superheterodyne Receivers," Wireless Engineer, April, 1941, Number 211, Volume XVIII. pp 146 - 150.]

ER

Installment 15

W. J. Halligan
Newspaper Reporter and the State of Radio 1923-1924, Part 5
Amateur Radio State Of The Art, 1923-1924

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Full Outline of Part 5*

A. General Happenings
   Calling CQ
B. The American Radio Relay League (ARRL) at work
   ARRL Conventions
   Transatlantic Receiving Tests and Contest
   1-MO–French 8AB Two-Way Contact
C. The Silent Period and the Crises of Interference at Every Turn
   Prevalence of Interference
   Silent Period: Practices and Regulations
   In Defense of Amateurs
   Legislation–The White Bill
D. WNP ("Wireless North Pole") Macmillan's Expedition to Arctic Regions
E. Irving Vermilya, 1ZE
F. Epilogue: Introduction
   1. Traffic Handling and Calling CQ
   2. Intermediate/Interval Sign "U" Supplants "DE"
   3. Amateur License Regulations and Frequency Allocations
   4. Silent Periods and the White Bill
   5. The Hoover Cup Awards
   6. Transatlantic Receiving Tests
   7. The Second ARRL National Convention
   8. The 1MO–French 8AB Two-Way Transatlantic Contact, November 27, 1923
   9. WNP ("Wireless North Pole")
   10. Irving Vermilya, 1ZE

***Topics formatted in bold are covered in this installment.**

WNP: Macmillan's Expedition to Arctic Regions

We just heard from a BCL in Newton who asked for the "low-down" on WNP. He says he has as efficient a set as there is on the market, and he's unable to pick him up. He consequently doubts that 1-CPI, 1-ZE, and 1-CKP and countless other hams ever heard MacMillan's ship. Of course every ham knows that WNP has been worked, and probably will be all the time the vessel is on the polar expedition. The difficulty in this case is that this particular BCL thought that WNP has been worked on phone, which of course is not the case. It is not yet practicable for great distances to covered by radiophone, or at least by such a set as WNP would be able to carry. So all communication must be carried on by radio telegraph, or as some will insist, wireless, because there is no doubt that wireless will be able to bridge all reasonable distances. And to further insure communication, Donald MacMillan has called upon the American Radio Relay League, a national organization of amateur radio telegraphers to listen for his reports and assist the expedition through their very intimate knowledge of radio. So BCL from Newton, the only way you can pick up WNP is to learn the code. Since MacMillan will be north for 15 months, you'll have plenty of time. And you'll have more fun, besides. Of course, Donald Mix might succeed in getting phone signals through the ring of Northern Lights, and then everybody can hear what color the North Pole's painted this year. We hope he does. [5/12/23]

The Artic sun sets at noon tomorrow. What about it? From then on our long-lost friend, WNP, is expected to be with us. And it is for this reason that scores of

radio hams in and around greater Boston are overhauling their sets. We'll probably know Saturday whether one of the local hams has won that Zenith receiver offered by a Chicago radio firm to the first ham station to work WNP and deliver a message at American Radio Relay League headquarters, Hartford. [5/20/23]

1-CRW is in the race for the daylight trans-cons and later on for WNP. He's going to increase his power from 50 to 150 watts. Then he's going to swing his antenna in WNP's direction, and let her go. Best of luck, OM. [5/30/23]

The attention of the entire amateur radio world is focused on MacMillan's expedition to the North Pole. Efforts are being made every night by hundreds of "hams" to get in communication with Donald Mix, operator of WNP. MacMillan's ship. Not all are successful, however. Mid-summer seldom lends itself to record-breaking radio transmission. This fact serves only to emphasize the importance of Waldo Kelley's feat of this morning. Through static and every other kind of summer disturbance. Kelly (1-CPI) succeeded in working WNP while the latter was off the coast of Labrador, a distance of more than 1000 miles. But we neglected to mention the most important aspect of this performance, which is that CPI uses only 10 watts of ICW for his transmitter. [7/9/23]

We're anxious to hear from "hams" in this vicinity who are in communication with WNP. [7/9/23]

Other fellows, although unable to work WNP, report that his sigs come in loud and clear almost every night between 11 and 2:30.

1-ER of Wellesley worked a bunch of 2's, 3's, and 8's last night. He also called WNP, but ND.

1-CKP, 1-ZE, 2-COZ and 1-ANA are others who worked WNP within the past few days.

Not much DX heard around this way after 4:30 a.m. There's always beaucoup static, however. [7/9/23]

None of the local hams have been able to raise WNP since she passed through the straits of Belle Isle. A number of second district stations were heard calling the Bowdoin and 8-YAE in Ohio appeared to be working him early this morning. The heavy static makes it a whole lot harder for the boys to get through. [7/10/23]

Some of the gang are already beginning to snap out of their sound summer sleep. Though they don't appear to be ready to work just yet, you can hear any number of the boys who have for the past month or so been missing from the radio ranks, testing their trusty transmitters. And those among the BCLs who have been slumbering are coming back, as well.

No one is this section has heard a peep out of WNP in nearly a week. Various and sundry 2nd district stations have been heard calling Donald Mix, which seems to indicate that they can hear him down that way. [7/27/23]

A news release from American Radio Relay league headquarters at Hartford, ascribes the absence of communication with WNP to sunlight of the long Arctic summer. It is confidently expected, however, that as soon as the long winter sets in and darkness settles over Arctic region that radio communication between Capt. MacMillan's ship and hundreds of members of the relay league will again be established. [9/10/23]

No word has been received from Donald Mix, radio operator for the exploration party, since August 3, when WNP was off Disco Island, which is about one third the way up the Greenland coast. At that time he worked station 1-ANA at Chatham. When in touch with this station, Mix complained of the very short length of time he had each night in which to communicate with amateurs in this country. Only when the polar sun dipped for a brief interval below the horizon could he hear amateurs and as soon as it came back again, these faint whisperings from the world below disappeared. [9/10/23]

Matthews, 9-ZN, of the Chicago Radio laboratories says that his offer of a Zenith receiver and two-step amplifier to the first station to work WNP and deliver a complete message to American

Radio Relay League headquarters, still holds good. Some of you DX birds should get busy. [9/12/23]

Jack Barnsley of Prince Rupert, B.C., the American Radio Relay league member who was first to establish communication with WNP after the long period of summer quiet, has received many congratulatory messages from all parts of the United States and Canada. Probably the most prized of all these messages was the one received from A.R.R.L. headquarters in Hartford, which announced him as winner of the Zenith receiver and amplifier, offered by the Chicago Radio laboratory. 1-ANA, 1-ZE and other local contenders for the prize were among those who sent messages of congratulations to Barnsley. [10/9/23]

Anyone getting WNP lately? [11/27/23]

Probably the longest trip a radio message ever took over amateur radio lines was that of a message which started at station 8-AB, Nice, France, crossed the Atlantic to the station of John Reinartz (1-XAM), in South Manchester, Conn., from which place it was retransmitted to 6-XAD, Catalina Island, Calif., thence to Jark Barnsley, Canadian 9-BP, who sent it on to Donald Mix, operator of WNP. The distance covered was approximately 9,565 miles.

The distance covered by each relay was about as follows: Nice to Hartford, 3500 miles; Hartford to Catalina Island, 2500 miles; Catalina to Prince Rupert, 1305 miles, and Prince Rupert to Refuge Harbor, 2260 miles, making the greatest amateur relay mileage. [12/26/23]

Countless amateurs in this vicinity who heard messages going through from WNP, announcing long lists of calls heard, are awaiting with great interest the February issue of QST, the official organ of the American Radio Relay league to see if their's is included in the list of calls which Donald Mix, operator of WNP, the Bowdoin, has heard. [1/15/24]

Although WJAZ, the Edgewater Beach broadcasting station at Chicago conducts its Wednesday night broadcasts primarily for the benefit of Capt. Donald B. MacMillan and his crew on the ice-bound ship "Bowdoin," now in winter quarters a few hundred miles from the North Pole, many hundreds of others are listening to and appreciating the concerts.

From remote sections of the country—from farms, ranches, lumber camps, Indian reservations and lonesome districts in the sparsely settled stretches of the United States and Canada have come hundreds of letters of appreciation, not to mention the thousands of testimonials from the larger centers. For many people this occasion offers a means of getting the news.

"Even after MacMillan returns, please keep up the news service," wrote a lumber man. And from a farm 30 miles from the nearest post-office comes a letter, "Keep up the weekly news to MacMillan, and be sure to let us know when another war starts."

One man who stands out as the hero of MacMillan's Artic expedition is 21 year-old Donald Mix, a Connecticut boy who is wireless operator of the Bowdoin, known in radio as WNP, or "Wireless North Pole." Members of the crew realize that it is his ingenuity and intimate knowledge of radio, gained through years of association with the American Radio Relay League, that makes their reception of the concerts possible, not to mention the many messages which they wish to transmit from time to time to their loved ones in the United States. Mix was owner and operator of station 1-TS. He was selected from hundreds of ARRL members to accompany MacMillan on the present expedition. [1/23/24]

And what of WNP, Capt. Donald MacMillan's ice-bound schooner the Bowdoin? We expected that Boston would, by this time, be directly tied up with Wireless North Pole. Has anyone in this vicinity heard Donald Mix, MacMillan's operator, lately? [2/16/24]

Irving Vermilya, 1-ZE

"Who is Irving Vermilya?" asks a new member of the A.R.R.L. We don't know where he was born, or when, but the fact remains that he is one of the earliest experimenters in the country. VN, as he is known to the radio fraternity, was for a long time at the now extinct WCC,

Wellfleet, Mass. We understand he's now at the Radio Corp. station at Marion, down on the Cape. [3/15/23]

1-NAL, erstwhile 1-ZE, is working this week on his 500 watter in an effort to reach 2-KW in Manchester, England. If the trick can be done, VN's the boy to do it. Hiram Percy Maxim, president of the American Radio Relay league, characterized Vermilya as "amateur number one." If VN gets across with his phone set, he'll have still another claim to that title. [5/31/23]

1-CKP, 1-ZE, 2-COZ and 1-ANA are others who worked WNP within the past few days. [7/9/23]

Haven't heard 1-ZE on the air lately. Probably busy fixing things up for a long and DX full winter. [10/19/23]

Irving Vermilya, owner and operator of station, 1-ZE, has opened up on his new location at Mattapoisett, down on the Cape. Despite the heavy QRM, VN has little difficulty in carrying on unbroken communication with stations hundreds and in some cases thousands of miles away. Which illustrates that they were REAL operators in the old days. [12/20/23]

Irving Vermilya, 1-ZE, of Mattapoisett, reports excellent results on his Grebe CR-13. To date he has logged more than a half dozen British and French amateur stations. [12/26/23]

Leave it to Irving Vermilya, of Mattapoisett, to do something novel every now and then. His latest feat is to copy a French amateur, Leon Deloy of Nice, France, using a small indoor aerial. Vermilya, who is Division manager of the American Radio Relay League, operates Station 1-ZE. [12/28/23]

Members of the American Radio league throughout the country are eagerly awaiting announcement of the prize winners in the recent trans-Atlantic listening tests. Nearly 40 European amateur stations are reported to have been heard. Among the amateurs in this vicinity who scored the most points in the contest are Boardman Chase (1-BDU), of Winthrop, and Irving Vermilya (1-ZE), of Mattapoisett. Vermilya reports that several times during the tests he heard French 8-AB while using only an indoor antenna. This reception was done on a Grebe. [1/16/24]

Thousands of amateurs envy Irving Vermilya, 1-ZE, of Mattapoisett, Mass., and his license which permits him to work on practically any wave length and to use any power he chooses. Vermilya is known throughout the length and breadth of the land as "Amateur No. 1," he being the first in the country to own and operate a radio transmitter. So far as radio experimentation is concerned, he is still "Amateur No. 1," for he far and away leads any other individual in point of radio operation.

One example of his activities, is the Saturday night radio-phone schedule he maintains with another station in England. For these experiments he uses the call letters 1-XAL. Thousands of fans have heard his signals and wondered as to their origin, but few have known the history of the operator.

One notable project with which Vermilya was connected for several years before the United States entered the World war, was the old Marconi wireless telegraph station at Wellfleet, Cape Cod. "VN," as Vermilya is known among the old timers, was chief operator at this station, with call letters WCC. Using what would now be regarded as excessively high power, WCC used to send press dispatches to ships at sea at a speed of probably 15 words a minute.

But the value of WCC was not confined simply to supplying passengers and crews of sea-going vessels with reading matter. The station served the far more important purpose of training youthful radio operators in code reception, which, coupled with their natural inclination to improve in this most truly interesting phase of radio, made the amateur radio man—the member of the American Radio Relay league—the government's most valuable asset when the United States became embroiled in the conflict. [4/5/24]

[Next month Bob begins the Epilogue to Part 5..Ed]

ER

New Product Review—Inrush Current Limiter

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If you are concerned about over voltage and/or inrush current on your older equipment or even some newer gear, this little product may be of interest to you. When Ray (Ed.) asked if I were interested in doing a product review, I said "Sure, I'll give it a go." I've had in the back of my mind doing some testing and a little article on similar devices so this was my opportunity to accomplish both.

This unit is small in size measuring 2" x 2.5" x 4" with a sturdy all-plastic case. The rear has the standard three-prong male 120 VAC connector and the front has the standard three-hole female connector. The front also has a nice little AC meter to monitor the load voltage. To complete the package there is a top-mounted fuse holder with the standard 1.25A, 3AG fuse.

The unit has a maximum rating of 150 watts at 1.25 amperes. I looked around the shack for a suitable load that would test the unit to near maximum specifications. The Valiant in standby would have been nice but its standby power of 185 watts was on the high side. My receivers were all on the low side and wouldn't tax the unit enough. So, then I thought a standard incandescent light bulb might work. That was the answer! All testing used a 150 watt bulb with a current draw of 1.0A as the test load.

A bench test setup was configured and included external load voltage and load current meters and the test load. A scope wasn't required since all the "action" is slow enough to be recorded with an analog voltmeter using a stop watch. With no load plugged into the unit and the unit plugged into the AC line, the internal meter will read the line and load voltage as the same value because the current through the unit is nil with no load.

Now with the test load plugged in but still tuned off, the internal meter will still read the line and load voltage as the same value, typically 120 VAC. The instant the test load is turned on, the internal meter will show a drop to about 60 VAC then will rise over the next ten seconds to a value near 100 VAC. This rise will continue for about two minutes where the load voltage will level off and hold for as long as the load in on. The drop in load voltage at turn on from a typical 120 volt line to 60 volts represents substantial inrush current limiting.

When the unit is operating, and well into the stable condition, it will have a constant voltage drop of about 6 VAC. So, at the test load maximum current of 1A, the unit will dissipate about 6 watts and the load voltage will be 114 VAC. Therefore, the unit will get warm which is a normal event.

Since the unit contains thermal devices I was curious about its reset time. Reset time is how long the load can be off then switched back on and get the same characteristic 60 volt drop in load voltage. I did this test with "off" times of 1, 2, 3, and 4 minutes. Before each run the unit was allowed to re-stabilize for 30 minutes.

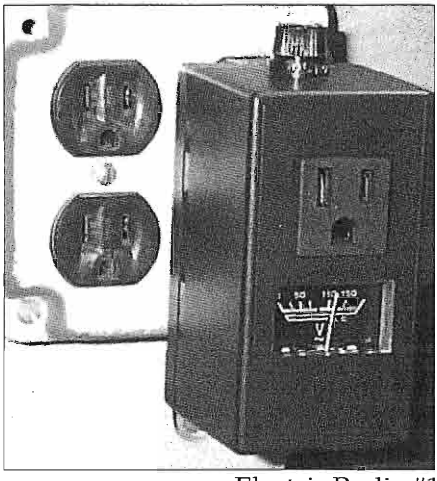
The results were interesting but not surprising. Here are the results of "off time" and the resulting turn on vs. load voltage. One minute - 100 volts, two

minutes - 90 volts, three minutes - 75 volts, four minutes - 60 volts. The data shows that you must wait at least four minutes to obtain maximum benefit (limiting) from the unit. If the load is restarted between one and four minutes there is still inrush limiting, but it's just not the maximum the unit can provide.

The next test was what I call a life test. The test load was tuned on and the unit operated for 12 hours. The idea here is twofold. First, will the unit survive the 12 hours at rated 150 watts of load, and second will the internal thermal devices take a "set" and shift their characteristics? During the 12 hour period the load voltage and current were monitored for any shifts.

Simply put, this test was a total success. The unit's temperature stayed the same, warm to the touch; there were no shifts in recorded values during the 12 hour period. The unit was still operating at the end of the test. The unit was then allowed to cool down over night. The next morning I repeated the turn-on testing plus the reset time testing and the results were the same as first reported.

In conclusion, the unit performed well when tested within its specifications. It is a rugged little package with an apparent long life, especially with no internal mechanical parts to wear out. The 6-volt drop across the unit may seem a waste of power but old gear designed for the lower line voltages will reap the benefit.



[Editor's note: The inrush limiter is available from the Electric Radio Store. Please call 720-924-0171 for pricing and shipping details.]

ER

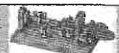
[...Editor's Comments from page 1]

specifically digital modes, while preserving amateurs' prerogatives to use the traditional modes. AM is clearly called out as one of these preserved modes, but it would be very easy for this to be removed in a final draft if there appears to be little interest or a significant negative AM comment volume. AM operators may have different views on creating sub bands by bandwidth, but hundreds of us should contact the ARRL and include as part of our comments how important it is to continue unchanged our present AM privileges.

Find the proposal draft at http://www.arrl.org/announce/bandwidth.html. Send questions or comments—favorable or otherwise—via e-mail to bandwidth@arrl.org. It is also recommended you write your ARRL Division Director (found at http://www.arrl.org/divisions).

ER

VINTAGE NETS



Arizona AM Nets: Sat & Sun: 160M 1885 kc at sunrise. 75M 3855 kc at 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: Saturday mornings at 8 AM PST on 3870 kc.

California Vintage SSB Net: Sunday mornings at 8AM PST on 3860 +/-

Colorado Morning Net: An informal group of AM'ers get together on 3875 kc Monday, Wednesday, Friday, Saturday, and Sunday at 7 AM MT.

Canadian Boatanchor Net: Meets daily on 3725 kc (+/-) at 8:00 PM ET. Hosts are AL (VE3AJM) and Ken (VE3MAW)

Collins Collectors Association Nets: Technical/swap sessions meet every Sunday on 14.263 mc at 2000Z. Informal ragchew nets meet Tuesday evening on 3805 kc at 2100 Eastern time, and Thursday on 3875 kc. West Coast 75M net is on 3895 kc 2000 Pacific time. **10M AM net starts 1800Z on 29.05 mc Sundays, QSX 1700Z.**

Collins Collector Association Monthly AM Night: Meets the first Wednesday of each month on 3880 kc starting at 2000 CST, or 0200 UTC. All AM stations are welcome.

Collins Radio Association nets: Mon. & Wed. 0100Z on 3805 kc., also Sat 1700Z on 14.250 mc.

Drake Technical Net: Meets Sundays on 7238 kc, 2000Z. Hosted by John (KB9AT), Jeff (WA8SAJ), and Mark (WBØIQK).

Drake Users Net: This group gets together on 3865 kc, Tuesday nights at 8 PM Eastern Time. Net controls are Gary (KG4D), Don (W8NS), and Dan (WA4SDE)

DX-60 Net: This net meets on 3880 Kc at 0800 AM, Eastern Time on Sundays. Net control is Mike (N8ECR), with alternates. The net is all about classic entry-level AM rigs like the Heath DX-60.

Eastern AM Swap Net: Thursday evenings on 3885 kc at 7:30 PM Eastern Time. Net is for exchange of AM related equipment only.

Eastcoast Military Net: Check Saturday mornings on 3885 kc +/- QRM. Net control station is W3PWW, Ted. It isn't necessary to check in with military gear, but that is what this net is all about.

Fort Wayne Area 6-Meter AM net: Meets nightly at 7 PM Eastern Time on 50.58 mc. This is another long-time net, meeting since the late '50s. Most members use vintage or homebrew gear.

Gray Hair Net: The oldest (or at least one of the oldest at 44+ years) 160 meter AM nets. Net time is Tuesday evening on 1945 kc at 8:00 PM EST and 8:30 EDT. Also check www.hamelectronics.com/ghn

Hallicrafters Collectors Association Net: Sunday on 14.293 mc, 1730-1845 UTC. Control op varies. Midwest net Sat. 7280 kc 1700Z. Control op Jim (WB8DML). Pacific Northwest net Sunday 7220 kc at 2200Z. Control op Dennis (VE7DH).

Heathkit Net: Sunday on 14.293 mc 2030Z right after the Vintage SSB net. Listen for W6LRG, Don.

K1JCL 6-meter AM repeater: Operates 50.4 mc in, 50.4 mc out. Repeater QTH is Connecticut.

K6HQI Memorial Twenty Meter Net: This flagship 20 meter net on 14.286 mc has been in continuous operation for at least 20 years. It starts at 5:00 PM Pacific Time and goes for about 2 hours.

Midwest Classic Radio Net: Meeting Saturday morning on 3885 kc at 7:30 AM, Central Time. Only AM checkins are allowed. Swap and sale, hamfest info, and technical help are frequent topics. Control op is Rob (WA9ZTY).

MOKAM AM'ers: 1500Z Mon. thru Fri. on 3885 kc. A ragchew net open to all interested in old equipment.

Northwest AM Net: AM activity is daily on 3870 kc 3PM to 5PM winter, 5-7 PM summer, local time. The same group meets on 6 meters at 50.4 mc. Times are Sundays and Wednesdays at 8:00 PM. 2 Meters Tues. and Thurs. at 8:00 PM on 144.4 mc.

Nostalgia/Hi-Fi Net: Started in 1978, this net meets Friday at 7 PM Pacific Time on 1930 kc.

Old Buzzards Net: Daily at 10 AM local time on 3945 kc in the New England area. Listen for net hosts George (W1GAC) and Paul (W1ECO).

Southeast Swap Net: Tuesday at 7:30 PM Eastern Time on 3885 kc. Net controls are Andy (WA4KCY) and Sam (KF4TXQ). Group also meets Sunday on 3885 kc at 2 PM Eastern Time.

Southern Calif. Sunday Morning 6 Meter AM Net: 10 AM on 50.4 mc. Net control op is Will (AA6DD).

Swan Nets: User's Group meets Sunday at 4 PM Central Time on 14.250 mc. Net control op is usually Dean (WA9AZK). Technical Net is Sat, 7235 kc, 1900Z. Net control is Stu (K4BOV)

Vintage SSB Net: Sunday 1900Z-2030Z 14.293 & 0300Z Wednesday. Net control Lynn (K5LYN) and Andy (WBØSNF)

West Coast AMI Net: 3870 kc, Wed. 8PM Pacific Time (winter). Net control rotates between Brian (NI6Q), Skip (K6LGL), Don (W6BCN), Bill (N6PY) & Vic (KF6RIP)

Westcoast Military Radio Collectors Net: Meets Saturday at 2130 Pacific Time on 3980 kc +/- QRM. Net control op is Dennis (W7QHO).

Wireless Set No. 19 Net: Meets the second Sunday of every month on 7270 kc (+/- 25 Kc) at 1800Z. Alternate frequency is 3760 kc, +/- 25 kc. Net control op is Dave (VA3ORP).

CLASSIFIEDS

Advertising Information

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

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NEW email: 1editor2@indra.com

Deadline for the October, 2004 issue: Thursday, Sept. 30

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

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

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

FOR SALE: 6 Volt Vibrators. I have different types. Let me know what you need. Ned K8BZZ 419 294 1213 winter@udata.com

FOR SALE: Johnson Desk Kilowatt. Herb, K9GTB, 618-362-6539

FOR SALE: Military T282D/GR transmitter UHF, R101A/ARN6 receiver, R-19H/TRC-1 receiver Hallicrafters. Jimmy Weaver, KB5WLB, 870-238-8328

FOR SALE: Lafayette HE-45A(2) $45 ea. Manual TR switch $5. TenTec Scout 80 & 40 modules $275. MFJ 949D tuner $50. Two D-104 TUG8 stands, one amplified, one not, exc condx $55 ea. All + shpg. J. Wood, 70 400 Street, Chanute, KS 66720. jwood@terraworld.net

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

FOR SALE OR TRADE: Government reconditioned AM/URM-49A (TS-418 C/U) with all accessories and manuals. Want to trade towards a 51S-1, 51J-4 or ?? Ward Rehkopf, 16173 Indian Valley, Schoolcraft, MI 49087. 269-679-3435 or radiohound2@yahoo.com.

FOR SALE: 4D32 new in box $45 + shipping. Richard Cohen, 813-962-2460

FOR SALE: National SW-3 with coil set #65.No shaft cover or PS. $300. Mike Grimes, K5MLG; 5306 Creekside Ct.; Parker, Texas, 75094, 972- 384-1133. Email: grimesm@flash.net

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

FOR SALE: AN/GRC-9,A,X,Y Maintenance,Repair and Operation Manual, 252 pages in excellent original condition. $22.50 , shipped 864-855-9570 or k4deejim@aol.com

FOR SALE/TRADE: B&W 2KW amp LPA-1 w/LPS-1 ps, runs pair of 813's g-g. trades? RT-66/GRC $100. **WANTED:** Info: RCA/Radiomarine T-408/URT-12/USCG. Sam KF4TXQ PO Box 161 Dadeville, AL 36853-0161 stimber@lakemartin.net 256-825-7305

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

FOR SALE: SX-88 good condition needs electrical cleaning, w/ extra set of rubber drive belts p/u only, asking price 1,000. Call Charlie, WB2ZKS, 845-223-8392.

FOR SALE: Hammarlund HQ-170C receiver, $150 + shipping. Al Jenkins, WA1RWB, 5 Daley Ct., Box 1162, Nantucket, MA 02554 508-325-7122 evening only.

FOR SALE: S-77A works, $75. S-38E works $65. TCS txer, no loading coil, $95. TCS rcvr $95. NC-100 needs work $95. BC-221 freq meter metal $40. BC-348 needs work $50. Surplus VHF freq meter $45. R27 ARC5 LF rcvr Q5'er $55. Misc VTVMs $29 ea. Morrow MBR-6 $65. Heath GR-91 vy clean, needs pwr trans, S-meter, $45. BC-342N, $59.00. Please call John, WB6OVS, 562-256-6411 leave message.

The Collins Radio Association

Supporting the restoration and preservation of Collins Radio, now the world's largest Collins organization. Join today and receive the *Collins Journal,* bimonthly for only $20.00, now in its 11th year of publication. Help Support the CRA.

The No. 1 Collins website is still at www.collinsra.com

FOR SALE: Signa-ICA-tone code practice osc set for groups w/speaker, works, no manual $20. Louis L. D'Antuono, 8802-Ridge Blvd., Bklyn, NY 11209. 718-748-9612 AFTER 6 PM Eastern Time.

FOR SALE: Nice SX-99, works $125. Gonset 10 meter converter $75. Fred Clinger, 417 Beechwood Dr., Galion, OH 44833 419-468-6117 after 6 PM.

FOR SALE: Q Multipliers: Drake QX'er #583 rare $25. Heath QF-1 $17.50. All + shpg. Henry Mohr, W2NCX, 1005 Wyoming St., Allentown, PA 18103 610-435-3276

FOR SALE: Waters 369 Directional Wattmeter, $85; Palomar Keyer w/paddle, $40; Cordless Soldering Iron, $30. Richard Prester, 131 Ridge Road, West Milford, NJ 07480 973-728-2454. rprester@warwick.net

FOR SALE: Radar Analyzer TS-1019/APR-72a. Excellent condition. Gary, 952-96-3794, K7ADF@aol.com

FOR SALE: UTC S-19 multi-tap Mod Transformers, 30W, $30. Tom Berry, W5LTR, 1617 W. Highland, Chicago, IL 60660. 773-301-7640 cell 773-262-5360

FOR SALE: Bud chassis, one-11"x17"x2" w/bottom cover, one-11¾"x17"x3", one-13"x17"x2", one front panel 10½"x19". Make offer. John, W2PRR, 585-671-4228, jandjm130@juno.com

FOR SALE: BC639A rcvr VG $150. RA42B rect. $60. Homebrew modulator 807's $49. Heathkit HW-100 $110. Ron,

MI, 517-374-1107

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

feltondesign@yahoo.com

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

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

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

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

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

FOR SALE: About 100 vintage IC's, logic type, NOS, 1960-70, all ID'd, single pkgs. Len Gardner, 458 Two Mile Creek Rd., Tonawanda, NY, 14150. email: radiolen@att.net

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

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

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

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

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

WANTED:

McMurdo Silver 14-15
Sargent 21-AA
Sargent 21-MA
Sargent WAC-44
Sargent 51-AK

Please contact:
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Yellow Springs, OH 45387
937-767-4551

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

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

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

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

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

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

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

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

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

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

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

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

PARTS FOR SALE: Strong steatite antenna insulators. Lengths from two to fifteen inches. SASE for list. John Etter,

W2ER, 16 Fairline Dr., East Quogue, NY 11942. 631-653-5350

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

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

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

WANTED: Dead Tektronix 453 scope-need case only .613-722-4098, rwboyd@gta.igs.net

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

WANTED: Central Electronics 600-L. Dennis Gehrke, KC7VXD 208-333-8711 kwmssb@cableone.net

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

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

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

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

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

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

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

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

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

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

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

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

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

WANTED: Information and plug-in coil units for CU-52?URR receiver multi coupler. Also want SP-600 or 51J-4. Ward Rehkopf, 16173 Indian Valley, Schoolcraft, MI 49087. 269-679-3435 or radiohound2@yahoo.com.

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

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

WANTED: Tube model grid dip meter, Heathkit or Millen w/coils. Robert Hazuka, 6764 Springborn, China TWP, MI 48054. 810-765-9391

WANTED: PL172 or 8295A tube w/ full output; Yaesu FTDX-570, ART 13, BC 610. Frank, KBØW. 916-635-4994; fdellechaie@sbcglobal.net

WANTED: Manual (s) /copies for Lampkin 105B Frequency Meter and Harmonic Amplifier. Jim, 505-662-5452, jnftaylor@aol.com

WANTED: Old telephone parts, MS-15 miniscope parts to restore (made by Lon Linear Systems). Paul Recupero, 265 Union St., Portsmouth, RI 02871 1-407-847-8589

WANTED: Teletype Model 28 Compact, UCG-20 or 25. CQ Anthology 1, CQ Anthology 2, AWA Review 1, 3, 4, 9, 12. George Rancort, K1ANX, 82 White Loaf Rd, Southampton, MA, 01073. 413-527-4304

WANTED: ARC-5/Command Set MD-7 Modulator, any condition considered. "NOVICE Q5'er CONVERTER", 40/80 Meter (Don Stoner, W6TNS, Jan '56 CQ). Or MILLER transformers for same: Antenna coil #B320A, Mixer coil #B320RF. Bob Clark K9LCR, 847-587-7982 ac4tibet@mc.net

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

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

WANTED: For SCR-178 Generator GN-37, Insulator IN-85, Lamp LM-18, Insulator mounts, leg supports, other parts. Robert Forte, 518-696-2400, rvforte@frontiernet.net

WANTED: Audio amplifiers Bogen DB-10 or similar. Condition not critical...DB-110 lost your phone. Charles Graham, 914-666-4523. 4 Fieldwood Dr., Bedford Hills, NY 10507

WANTED: Johnson Viking II/VFO, Viking Courier, Viking Navigator, Viking Thunderbolt, KW+ Rated antenna Tuner, Please Call Justin Korpal KØRPL 1210 N. Danz Ave. Green Bay, WI 54302 920-680-0416, Jkorpal@Baycominc.com

WANTED: RCA communications receivers, ACR-175, ACR-111, CR-88, AR-8516, CRM-R6A, SRR-13. Dan Gutowski, 9753 Easton Rd, Dexter MI, 48130. 734-718-7450, dg16ms26@msn.com

WANTED: Fully functional with manuals: Johnson AN/FRT505 transmitter, Swan F51 and FC76. Contact Ric at C6ANI@arrl.net

WANTED: A Collins R-389 LF rcvr to complete my SWL shack. Have quality trades/pay cash. Dan Gutowski, 9753 Easton Rd, Dexter MI, 48130. 734-718-7450, dg16ms26@msn.com

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

WANTED: Technical Materials Corp. model DCU combiner, DVM monitor, LPP patch panel, LSP speaker, DCP power panel VOX V.F.O., CFA converter, and PSP-1 power sply. K8CCV, Box 210, Leetonia, OH 44431-0231, 330-427-2303.

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

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

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

WANTED: James Millen coils 42080, 42040, 42015, 43015. Navy SE2511/SE2512 rcvr, SE2513 coil set. Gary Carter, WA4IAM, 1405 Sherwood Drive, Reidsville, NC 27320. Phone: 336-349-1991. Email: gcarter01@triad.rr.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: Collins R-389 LF receivers, parts, documentation, anecdotes, antidotes. W5OR Don Reaves, PO Box 241455, Little Rock AR, 72223 501-868-1287, w5or@militaryradio.com, www.r-389.com

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

WANTED: QSL card from my Grandfather, W9QLY, from before 1957. Also seeking original National Company logos from Ham or military equipment. Don Barsema, KC8WBN, 1458 Byron SE, Grand Rapids, MI 46606. 616-451-9874. dbarsema@prodigy.net

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

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

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

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

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

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

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

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

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

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

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

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

WANTED: I wish to correspond with owners of National FB7/FBXA/AGS coil sets. Jim, KE4DSP, 108 Bayfield Dr., Brandon, FL 33511 j.c.clifford@Juno.com

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: 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

WANTED: Books about flight simulators, aircraft instruments, panel meters, or tube computers. Chris Cross, POB 94, McConnell, IL 61050.

WANTED: JOHNSON RANGER CABS & or BEZELS. Or the whole cab set. Dee Almquist, W4PNT w4pnt@w4pnt.8k.com 540-249-3161 (msg). Cell: 540-480-7179 Virginia. Willing to trade.

The Collins Video Library

The Collins KWM-2 Video (4 hours, $89.95) Highly detailed video on operation, rebuilding, alignment, troubleshooting, and neutralization of this classic! A must for anyone who owns and operates a KWM-2 or 2A. Printed documentation included.

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The Collins 30S-1 video (1 hour, $39.95) Finally, here is the one everybody has wanted! This extraordinary video describes operation and user safety, maintenance and modifications of this classic Collins powerhouse amplifier. Very informative--truly a must for all 30S-1 owners. Complete with printed documentation.

The Collins Amateur Radio Radio Eqipment Video Spotter's Guide (1 hour and 40 minutes, $24.95) Close to 90 individual pieces of Collins Radio equipment are shown in the video. Examples of some of the gear covered are: KW-1, KWS-1, 30K-1, 20V-3, 75A-4, KWM-2, S-Line, KWM-1, 30S-1, 30L-1, KWM-380 and much more. Study up before that next hamfest!

The Collins KWS-1 Video (2 hours, $39.95) This video is the perfect companion to the 75A-4 video for owners of the "Gold Dust Twins"! Butch Schartau (K0BS) shows you how to operate, maintain and repair your KWS-1. Watch as Butch goes theough the entire alignment and neutralization process, as well as showing you how to properly operate this famous transmitter.

The Collins 75A-4 Video (4 hours, $89.95) This video is four hours of great information on how to repair, maintain and restore this classic receiver. Butch Schartau (K0BS) guides you through all aspects of keeping your 75A-4 running like a top.

R-390A Video (7 hours, $109.95) At last it's available! Long awaited by serious "boatanchor" enthusiasts this is a great video all about the ultimate receiver. Now you will have the ultimate video to go along with it. R-390A expert Chuck Rippel (WA4HHG) covers an absolutely incredible array of information in this "heavy duty" video. This video looks at operation, the receiver modules, complete circuit description, front and rear panel details, complete mechanical and electrical alignment, PTO details, and performance evaluation, modifications, troubleshooting, and restoration. There is nothing like this video available today, at any price!

R390A Addendum Video ($49.95) Another 3 hours and 40 miutes of R-390A information from Chuck Rippel (WA4HHG).

SP-600JX Video (4 hours, $89.95) In this video, Chuck Rippel takes us through all aspects of SP-600-JX servicing including repairs, restoration and modifications. This video is a must for any new owner needing to work on the SP-600.

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NOTICE: Expert HRO-500 alignment done with modern test equipment (HP, TEK, etc.) www.nortrex.net or nortrex@bigplanet.com 650-529-9180

WANTED: Unmodified, good condition, Heath AT-1, VF-1, AC-1, Hallicrafters S38D, 5R50, 51,52, Tom Root, wb8uuj@arrl.net, 810-659-5404

WANTED: Any info you may have on Turner +3 and +3V desk mics. Rex, 812-282-4824,

WANTED: Coils Forms for National FB-7 and preselector. Mike Sanders, 18169 Hwy 174, MT Vernon, MO 65712-9171 k0az@arrl.net

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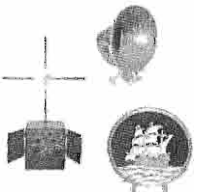
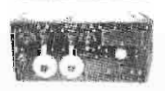


This auction has items from three different radio collections – from Minnesota, Illinois and Pennsylvania – consisting of Early Items,Transoceanics, and Amateur Radio, as well as 30s and 40s Type Radios.

Some of the early items are Western Electric 4-C, Western Electric 4-D, Western Electric 2-A and 2-B Tuning Units, Western Electric 600-A Microphone, Deforest Inter-panel, Deforest D-12 w/Loop, Deforest D-10 w/Loop, Grebe CR-18 w/Coils, Grebe CR-8, Grebe CR-9, Grebe MU-1, Magnavox AC-3 Amp, Magnavox AC-2 Amp, Westinghouse Type DB Crystal Detector, Radiette 1 Tube, RA-DA, Western Coil & Electric WC-12, Ware Type T, Michigan Midget, Shepco 1 Tube, Norden-Hauck-C10, Cutting-Washington Type 11A, Cutting-Washington 11-B, Kennedy Type 110, Kennedy 3 Tube Portable, Ware AD2, Harkness, Paramount 1 Tube, Operadio, Airline 1 Tube, Western Electric 10-A Sounder, Type SE-1420-C Navy, Nesco Two Step Amp, Thordarson Type R Spark Transformer (1919), Burns Horn Speakers, Amplion Dragon Fly Speaker, Pathe, Tower, and Western Electric Cone Speakers, Music Master Horn Speaker, Crosley 50, 51, 51A, 52, Pup, Trirdyn, Crosley Ace, Radiola II, III, IIIA, R/5, Amp Radiola V, 24, 26, Regenoflex, Am-Pli-Tone Speaker for Headset, Breadboards Type 3955, Model 9, Model 10, nice McMurdo Silver Masterpiece V. EH Scott 14 Tube Masterpiece, Scott Type 800-B, rare Scott Projection Television. Predicta TV w/Factory Stand, Zenith Military Transoceanic, Bomber Version 7G605ML, The Clipper Ship 7G605, The Royal 1000, 3000, 7000 and others, including The Brown Case Version. European Radios: Saba, Telefunken, Blaupunkt and others.



Siemens K-32-GWB WWII German Radio, Amateur Radio National SW-3 w/Doghouse P/S, National SW-5, National NC-45, National NC-300, National NC-183-D, Hammarlund HQ-180, Swan 300, Kenwood TS-820, Yaesu-Munsen FR-DX-400, Collins 75S-3, Collins KWM-1, Collins KWM-2, Collins 30L-1, Collins Samsonite Cases, Hallicrafters SX-25, SX-101, SX-28, Sky Rider S-23 w/Speaker, Super Sky Rider, Sky Buddy S-10, S-27, S-40A, Hallicrafters HT-20 XMTR, Sky Challenger Military Type CFL-43059 F.M. XMTR, CND-46155 RCVR, AN-GRC-13 XMTR, BC-348 RCVR, CAY-47155 Tuner, RME VHF-152, RME 69, A Type CMS-2 Audio Transformer, Drake TR-4C, MS-4-RV-4C.

A Wireless Specialty iP-501-A, four Spherical Audions made by Phil Weingarten, a Fleming Valve made by Phil Weingarten, two Experimental Audiotrons, Atwater-Kent Dealers Sales Convention Photograph, Atwater-Kent Model 12 Breadboard, Western Electric Shaw Phone, Crystal Detectors by Freshman, Pacent, Jove, DeForest, Murdock, Paramount, Eugene Turney Crystaldi, Five Way, Philmore, many new old stock parts, some still with original boxes, nice Jewell 538 Tube Tester, Submariner JA7R Converter, Mesco Brass Slide Tuner (ca. 1912), Mesco Catalog #26 (1912), Electro Importing Catalog #22 (1920), Catalog #19 (1917), How To Make Radios (1922), Wireless Station Log (1914) by Murdock. Hudson-Ross Salespeaker (1924), Kenneth Harkness Radio Construction (1922), Electric Experimenter Magazines, Radio News, selection of Early Insulators and Tuning Condensers.

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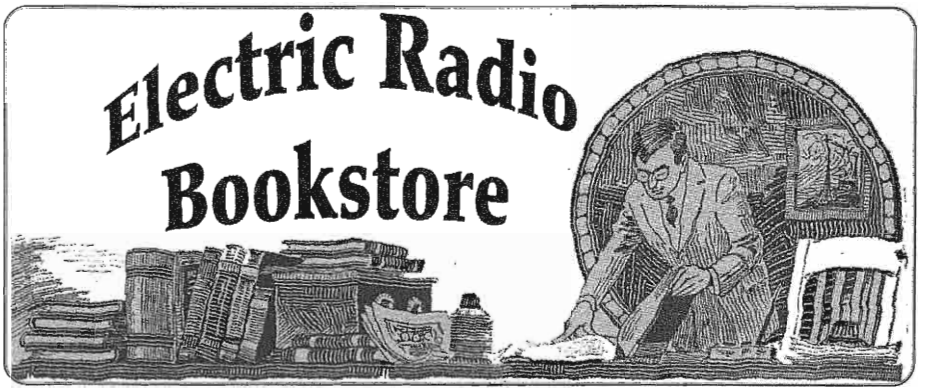

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Collins 75A-4 Modification Compendium: All the factory modification bulletins from Collins Radio Co., and all the articles printed in CQ, Ham Radio, QST and ER over the last 45 years, 85 pages, **$20.00 plus $4.00 S&H.**

Collins S-Line, KWM-1, KWM-2, KWM-2A Service Modification Compendium: 260 pages, **$45.00 plus $5.00 S&H.**

Collins KWS-1, 32V series, and 75A series (A1 thru A-3): 42 pages, $15.00 plus **$4.00 S&H**

BOOKS

A. Atwater Kent, The Man, the Manufacturer and His Radios: This 108 page paperbound book describes Atwater Kent's biography, and his rise from a saleman and inventor of electrical equipment to become one of America's foremost radio manufacturers and a household name. There are historic photographs and diagrams on nearly every page, and color plates with vintage AK advertising, by Ralph Williams and John P. Wolkonowic. -- **$25.95 - 10% = $23.35**

A Pictorial History of Collins Amateur Radio Products: Jay Miller's (KK5IM) classic volume describes the amateur radio products produced by the Collins Radio Company. It has high-quality historic photographs on nearly every page, and the text is backed up by Miller's personal research. ---------- **$39.95 - 10% = $35.95**

A Family Affair, The R.L. Drake Story: The complete story of the R.L. Drake story, as told by John Loughmiller, KB9AT. 273 pages all about the history of the company, product descriptions, technical repair tips, and great shack photos make a must-have volume for Drake users and collectors. ---------- **29.95-10% = $26.95**

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Miller's Collecting Science and Technology: 160 pages of high-quality color photographs from museum collections make this hardback volume an excellent introduction to this new collecting field. Written by Lindsay Sterling ---------- **$29.95-10% = $26.95**

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Heath publications, plus a voice recording of Gene Fiebich. ----------**$18.95 - 10% = $17.05**

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

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

Radio-Craft: 50 Years of Radio by Gernsback: This is a high-quality reprint of the March 1938 edition of Radio-Craft magazine and is about the first 50 years of radio, and contains hundreds of vintage advertisements. ---------- **$15.95-10% = $14.35**

Radios by Hallicrafters : High-Quality photos, descriptions, approximate values, and short histories of nearly everything made by Hallicrafters. By Chuck Dachis -- **$29.95-10% = $26.95**

Radio Tubes and Boxes of the 1920s by Fathauer: If you appreciate the rare and colorful vacuum tubes and advertising art from the early days of radio, then this great 104-page book will be very interesting and informative. ---------- **$26.95-10% = $24.95**

Shortwave Receivers Past and Present, Communications Receivers 1942-1997, 3rd edition:
NOTE: This volume is out of stock and out of print until 2005. Fred Osterman is working on the 4th edition. The ER bookstore will carry it when it becomes available.

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

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Tube Lore : This is one of the best vacuum tube reference books ever published. All types of information is included, such as tube date code information and production history. 173 pages by Ludwell Sibley ---------- **$16.95-10% = $15.25**

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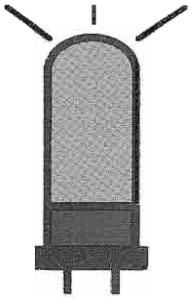

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