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ELECTRIC RADIO

celebrating a bygone era

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ELECTRIC RADIO

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

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

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

Editor's Comments

Recent AM Operating Events

Many events supporting AM operations were on the air during the holidays. In the Western U.S., the AMI New Year's Day net was very popular. Electric Radio received the event log from Bill McCaa (KØRZ) and it reports activity on 160 and on 75 meters. There were 7 calls logged on 160 meters and 35 calls logged on 75 meters. Several calls used multiple equipment setups, which was great to hear. KØRZ started on 1.915 Mc at 1115Z and was joined by Arne (KØAS) who shared the NCS duties. KØRZ switched to 3.875 at 1315Z and was joined by Bill (KØZL) who shared the NCS duties. The addition of the 160 meter net was new this year. KØRZ plans to operate the net again next year on 1.915 starting at 1100Z.

Heavy Metal Rally

The annual Heavy Metal Rally was more popular than ever, and participation by a special event station even made it into local media outlets. The logs are still coming in, so I won't be able to announce the winner until next month. If you haven't sent in your log, there is still time to do so. I'm sending out the certificates in March.

Dynamotor Night

Last year we ran the Electric Radio Dynamotor Night on January 25th and it worked out much better than when we tried it in late summer, 2003. I would like to try running it this year in March, but every weekend is tied up with either a DX contest or a "QSO Party." I had thought the second weekend would be free for our low-power military equipment, but these contesters are not known to listen before transmitting. The only day looking like a possibility is Saturday, March 12. If we start right after the East Coast Military net, 8:00 AM EST Saturday morning, and continue until midnight Pacific Time it *should* work out OK. The Wisconsin QSO Party has announced specific phone and CW frequencies, and as long as we stay on the traditional AM frequencies it should work out. The rules are simple: You

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Cover: Bruce Strackbein (WR3Q) is operating W3R, a special events station at the Radio History Society of Bowie, Maryland during the recent Electric Radio Heavy Metal Rally event. The big transmitter is a recently-restored Collins 300-G, made in 1951, and carrying S/N 146. The receiver used at this operation was a 1966 R-390A. The rally was mentioned extensively in local radio, TV, and print media. (Photo and text courtesy of Paul Courson, WA3VJB)

The Collins 30J Series Amateur Transmitters

By Gary Halverson, WA9MZU
503 Jessica Ct.
Mokelumne Hill, CA 95245
ghal@ix.netcom.com
——— and ———
J.B. Jenkins, W5EU
1380 Bryson
Midlothian, TX 76065
jenkjb@cnbcom.net

This is the story of the acquisition and restoration of two versions of the last Collins prewar transmitter, one a late production (Gary's) and the other an early production (J.B.'s). The elegant 30J is among the rarest of the Collins prewar AM transmitters.

The article's authors are justifiably proud of their respective Collins 30-J transmitters. On the left is Gary (WA9MZU), and pictured on the right is J.B. (W5EU).

Art's Beautiful Baby

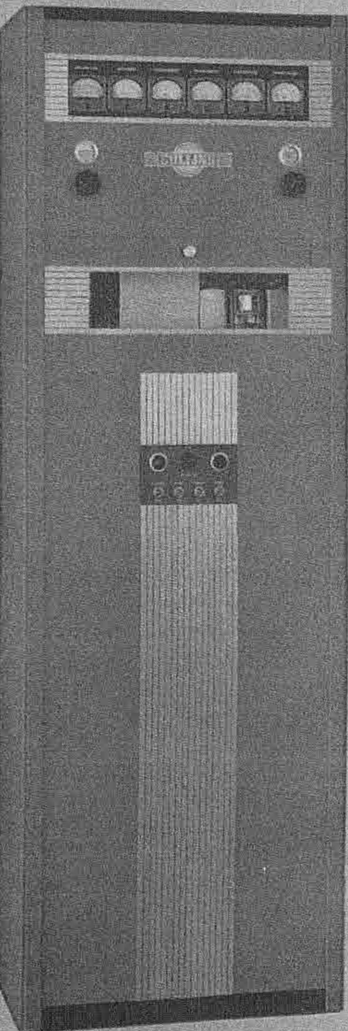
"It's Our Baby and We Love It" was the headline over Collins' inside cover ad in the November 1937 issue of QST magazine. Surrounded by a pretty pink background, the 30J was a stunning new design that set the high water mark for styling and performance of all the Collins prewar transmitters. "Like all proud parents, we could go on and on, but a glance at the specifications will show you that we are not unjustly proud" the ad continued.

Replacing the aging 30FXC, the 30J offered a 40% power increase, a new "streamlined" cabinet, hinged rear door, a tube access window, and rectangular panel meters behind glass, all firsts for a Collins transmitter. Personally, I believe that of all the postwar Collins AM transmitters, only the 30K series was runner-up to the 30J's elegant Deco styling.

The 30J was a general purpose transmitter "designed for general applications such as police service, aeronautical ground stations, or general purpose point-to-point communication where

It's Our Baby and We Love It

If you haven't already heard, we are talking about Collins' newest arrival, the 30J 250 watt Transmitter. With a power increase of 40% over the 30FXC, the 30J remains in the 30FXC price class. New styling and new mechanical features are a pleasure to the eye and an aid to better operating. Simplified tuning has been the key note of the design. Like all proud parents, we could go on and on, but a glance at the specifications will show you that we are not unjustly proud.



30J

SPECIFICATIONS

POWER OUTPUT: 250 watts Phone and CW.
FREQUENCY RANGE: 1.5 to 30 megacycles (.5 mc. to 60 mc. on special order).
FREQUENCY CHANGE: Plug-in coils.
POWER SOURCE: 110 volt, 50-60 cycle, single phase A.C., 1200 V.A.
TUBE COMPLEMENT: 1 — C100D Oscillator.
1 — 807 First Doubler-Amplifier.
1 — 807 Second Doubler-Amplifier.
3 — 807 Third Doubler-Amplifiers.
2 — C101 Final Amplifiers.
2 — 6J5G Audio Amplifiers.
2 — 6F6G Audio Drivers.
2 — C120 Modulators.
2 — C249B Mercury Vapor Rectifiers.
2 — C866A Mercury Vapor Rectifiers.
1 — 5Z3 Low Voltage Rectifier.
MODULATION: High level, Class "B".
CRYSTAL: "A" cut in 294 or 1A holder.
AUDIO FREQUENCY INPUT: From microphone — 40 db at 50,000 ohms.
AUDIO FREQUENCY RESPONSE: Plus or minus 1.5 db from 100 to 5000 cycles.
CARRIER NOISE: More than 40 db below 100% modulation.
OUTPUT CIRCUIT: Pi tank circuit for operation with balanced transmission line or feeder.
CABINET DIMENSIONS: 60" x 20" x 13"
WEIGHT: 300 pounds.
NEW MECHANICAL FEATURES: "Streamlined" cabinet. Hinged rear door. Tube access window. Rectangular instruments behind glass window. Pretuned excitation tank circuits adjustable through access window. Further refinements in workmanship.
NEW ELECTRICAL FEATURES: Simplified output circuit. Link coupling to pushpull final amplifier. Fixed grid bias. Stage by stage metering and switching. Three power supplies. Negative resistance oscillator. Beam excitation tubes. Convenient control circuits.

COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA — NEW YORK, N. Y.: 11 WEST 42 ST.

From QST, November, 1937

service is intermittent" – perfect for the discriminating amateur.

The 30J was rated at 250 watts out on phone and CW. Its audio response was rated at an impressive plus or minus 1.5 dB from 100 to 5000 Hz. Carrier noise rated at more than 40dB below 100% modulation.

Of particular interest is that while the 30J followed the 30FXC, which was introduced in 1936, its styling is dramatically different. So different, in fact, that (in my opinion) there has never been a prettier Collins transmitter. My guess is that as part of Collins' strategy in making a serious effort to gain more broadcast market share, they engaged an industrial designer to do an across-the-board product facelift. The 30J was in the right place at the right time. Its distinct Deco influence can also be seen on the Collins broadcast audio mixers and transmitters from about 1936 to 1938.

Two basic production runs were built, differing mainly in the tube lineups. You may recall that the use of the Collins/Goddard C100D was a legal workaround of the RCA patent on the conventional crystal oscillator, which RCA refused to license to Collins. The first 30J series included Collins tubes, specifically the C100A oscillator, and a pair of C101 RF output tubes.

The RF deck was a ground-up new design using the 7000 series plug in coils later employed in the 32RA in the low-level RF stages. The driver stage, a pair of 807's, used a plug-in shielded box to house the driver tank coils.

The output tuning chassis was also a radical departure from any previous version. Designed for low inductance and capacitive interaction with the plug-in tank coils, the entire frame was constructed from cast aluminum. It was mounted directly above the RF deck and provided easy access to plug-in coils, which were wound on 2.5" by 6" coil. The standard output was balanced, but a phasing coil option could be added to convert the output to unbalanced.

By about 1938 or '39 the patent and licensing issue with RCA had been resolved and the 30J RF deck underwent a minor redesign to use more mainstream tubes including the 802 in the oscillator to replace the C100D and a pair of 813's to replace the C101 finals. This last production run was designated the 30J-18.

The 30J-18 used an 802 crystal oscillator stage feeding either an 807 frequency multiplier, or a pair of 807 buffers (selectable), which drove the push-pull 813s. The same plug-in coils as the first production units were used to set the desired frequency range, then tuned with trimmers or sliders to resonance.

Modulation was high-level Class "B", using a pair of ZB120s, similar to 838s but zero-bias.

The unit measured 60" high, 20" wide, and 13" deep and weighed 300 pounds. It was finished in a St. James Gray crinkle.

It is believed that the electrical design of the 30J was done by Merrill Smith, who later went on to start the Technical Manuals department at Collins.

Engineer Merrill Smith at Collins

Gary's Restoration

As acquired, my 30J-18 was missing the meter panel and the output tuning chassis. A lucky call to J.B. Jenkins, W5EU, a fellow prewar Collins collector, turned up a meter panel in his junkbox. J.B. has always admired the 30J, but never had seen a complete one. While this panel was for the first version 30J, a simple relabeling of the meter legends solved the problem. I was able to match the type style and make laser prints of the required labels with white letters reversed out of a solid black background. The new labels were then glued over the old legend engravings – not perfect but much more cost-effective than engraving the entire backside of the panel.

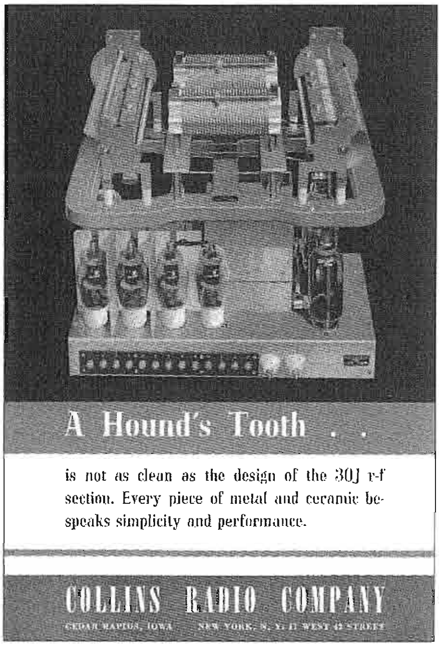
The output tuning chassis, however, was another matter. In assembling all the QST ads Collins produced for the 30J, one showed a photo of the missing chassis. It didn't look anything like a conventional tuning chassis. The cast aluminum frame meant fabrication was going to be a major challenge.

The 30J restoration sat idle for a couple of years while I tried to collect tank components. Then I got lucky once again. A classified ad in ER offered up a 30J "parts radio" in Pennsylvania. Although the whole RF deck and several components were missing and the cabinet damaged, it had the output tuning chassis with everything except the coils. I promptly purchased the unit and presented it to J.B., who made the shipping arrangements.

When J.B. received the 30J parts radio, he surveyed the rig and determined that the damaged corner on the cabinet could be repaired, and most everything else could be restored except for the missing RF and modulator chassis.

J.B. then proceeded to disassemble the output tuning chassis down to the casting. He cleaned it and started shopping for a casting shop that could make a mold and duplicate the casting. The first shop wouldn't touch the project for less than $1000. The second shop wouldn't touch it at all for just a single unit. Things were not looking good at all when someone suggested he talk to a shop that made monument castings, like the brass plaques you see under statues, historical markers, etc. J.B. contacted a shop that did this and was invited to "bring the part by and we'll have a look". He was told that they could easily make a sand casting and duplicate the part, no problem. They did the job and charged J.B. only for the aluminum used -around $20- it was absolutely amazing.

After repainting and resembling the tuning chassis, J.B. forwarded it on to me for installation in my 30J and installed the duplicate in his 30J. Nothin' beats a win-win collaboration with a fellow collector!



The top chassis shown here holds the 30J tank assembly. (QST, March, 1938)

After installing the "new" output tuning assembly, finding the right coil forms proved the next challenge. To make this long story short, the forms had to be made from parts from other Collins coils. A slider mechanism had to be fitted on the top of the coils, and banana pins with the proper spacing on the bottom. The turns count taken from the manual photos was duplicated for 75 meters.

Power Up Rush!

It's now 7 years later and the restoration is finally complete. A 3870 Hz crystal in the National 5-pin crystal holder, and we're ready to rock 'n' roll!

This is a good place to mention that the line voltages these old prewar rigs were designed to use were lower than your average line voltage on steroids today (think 10 volts lower). Not wishing to give Art's Baby indigestion, I found a surplus Topaz isolation transformer from a Silicon Valley surplus store that had the beefy current rating and a tap at 115V. It was the perfect solution to my 125V nominal line voltage.

Flipping the Filament Switch to ON is an emotional rush second only to flipping the Plate Switch ON. Time seems to virtually stand still during these ceremonial "leverage" events.

First, the Filament Switch snapped to "On." No smoke. Quick check of the filament voltmeter — bring it down a little . . . Lookin' good. Everything's copasetic.

I can feel my pulse pounding in my head. Is Art's ghost in the room? Suddenly I'm overtaken by an irrational yet overpowering urge to snap that Plate Switch ON.

SNAP! The big RED Plate lamp comes on. A thunking sound followed by a deep hum permeates my senses – all in slow motion.

Slowly the AGC on my senses recovers. Just a big red light and a throaty low frequency transformer hum. Working! I quickly scan the meters. It's set up for CW so I've got time to check everything before the Next Step: Pressing the Key.

So Far, So Good! I squeeze down on the key and hear major transformer groan. Dipping the plate nulls the groan, but no power out. Calm down, nothing is tuned so start with the crystal oscillator. No current at all. Rotate the Oscillator Tuning control: Whammo, drive! Tune-up went on down the line, like a walk in the park. I'm reading 200 watts on the Bird 43, but will it modulate?

This transmitter originally lived in one of the transmitter outbuildings of a major market AM broadcast station in the Midwest. So instead of the normal -40db into 50K ohm input, it had been modified with a 600 ohm transformer input. Hence this circuit was carefully removed and the 50K mic input restored. A D-104 was connected to the input and a 'scope on the output.

The first test showed no modulation on the scope. I had soldered the mic hot lead to the wrong pin on the 3-pin mic connector. After swapping the hot and ground leads, there was plenty of audio with the D-104. Replacing a bad capacitor in the audio path was the last fix necessary to bring Art's Baby back into the land of the living.

On the air, my first contact was with John, W6MIT. John said the signal was strong and the audio was great. What more could you want?

However, the next time I fired the 30J up to get on the air, there was no output and 813 filaments where dark. In 30 minutes of troubleshooting, the problem was traced to the filament transformer. But the winding wasn't open. The windings were soldered to lugs on the topside of a bakelite plate on the bottom of the transformer. The lugs were riveted to solder lugs on the bottom of the plate, and it was evident that some heating was happening on the 813 filament winding. The sides of the transformer cover showed evidence of smoke from a resistive high-current connection. Flowing solder on both sides of the rivet fixed the problem. I was lucky, again.

Since then, there have been no problems with the 30J. It's been reliable and simply a pleasure to operate. It's also been very gratifying to be on the air with Collins' most elegant transmitter that 99% of the people I talk with never knew existed. And she's my Baby.

J.B.'s Restoration

Shortly after joining the Collins Radio Company in 1959, I met Jim Wisdom, W5HFK. During the next 40 years, we remained good friends, trading parts and equipment for our radio projects. One day, while visiting Jim's shack, I spotted a beautiful transmitter cabinet. It was a Collins 30J cabinet all dressed out in its art deco trim. The power supply, modulator, and RF assemblies had long since been removed and were gone. After twisting Jim's arm a bit, the cabinet was proudly loaded onto my truck for the trip home.

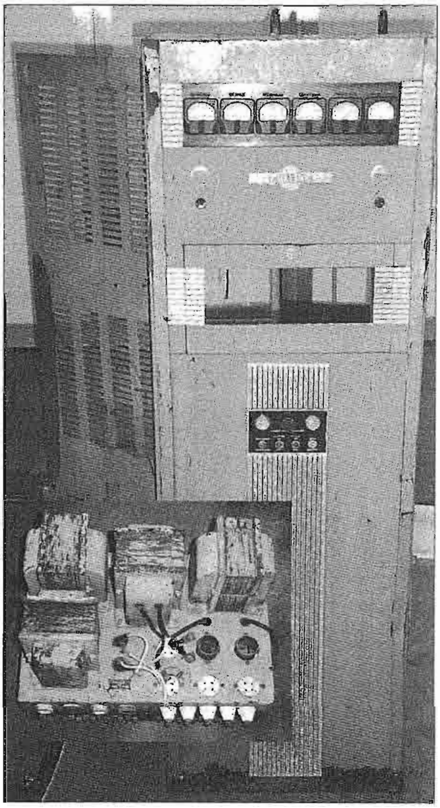
Inside the cabinet was built a legal limit "no tune" amplifier along with its power supply and control cables. Later, another friend wanted the amplifier, and by now, Jim had dreamed up a project which needed the cabinet. So the cabinet went back to Jim, but his project didn't require the meter panel and it remained with me.

About that time, my interests turned to another prewar transmitter, the 30W. After reading Ed Marriner's article in CQ magazine, August 1965*, the idea of duplicating the 30W was born, and the collection of parts for the project began immediately. But that's another story.

While searching the classified ads in ER, I met Gary Halverson, WA9MZU. Our telephone chat started with a general inquiry about parts, and it was soon apparent that Gary was a serious collector of Collins equipment and its associated history. Gary was looking for a meter panel for his 30J and was surprised to find one in my spare parts box.

Later, Gary spotted a 30J "parts" radio in the ER Classified ads. The cabinet contained the 122C Output Network needed by Gary's 30J, the 80Z meter panel, and the 401N2 Power Supply. My wish for a 30J was fulfilled through Gary's generosity. It remains one of my prized possessions.

The 30J arrived in a few weeks and restoration started immediately. The cabinet was completely stripped of its trim, cable harness, meter panel, and assemblies. Unfortunately the cabinet had sustained a heavy blow on the top rear



J.B.'s 30J transmitter was in need of a complete electrical and mechanical restoration when this photograph was made.

corner of the cabinet. The metal was wrinkled and compressed downward. A local auto body shop was able to raise the corner with a "Porta Press." "Bondo" was added to the wrinkles and then sanded smooth. After several attempts the cabinet was sprayed with Saint James Gray paint and left to wrinkle in the hot Texas summer sun. The plate transformer and chokes were cleaned and given a fresh coat of gray enamel paint along with the power supply chassis and assembly. Part of the art deco trim was missing from the cabinet. A local machine shop was able to machine the missing parts using the existing parts as a template. Glass was cut at the local hardware store to fit the missing door and meter windows.

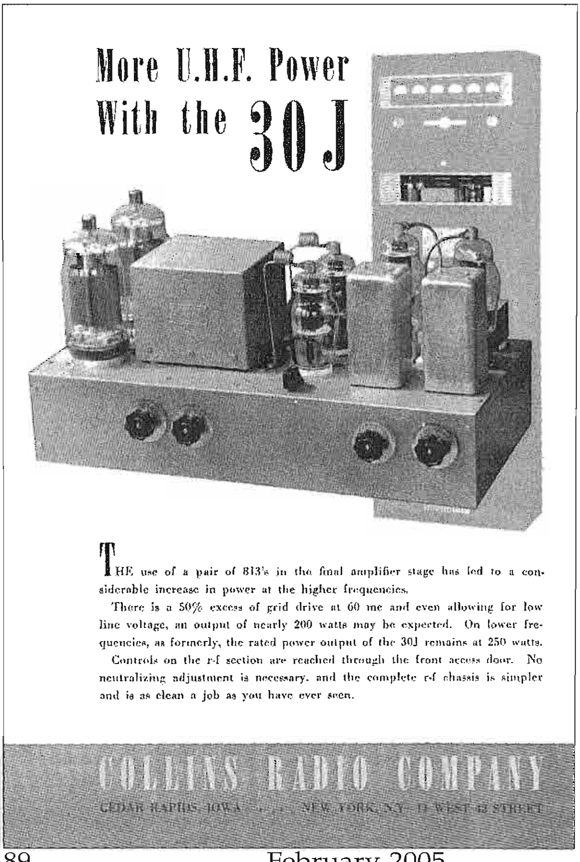
My attention turned to reproducing the missing 10Y R.F. Unit. Fortunately, the March 1938 issue of QST Magazine contained a picture of the 10Y RF Unit and the 122C Network assembly. The caption: " A Hound's Tooth . . . is not as clean as the design of the 30J r-f section. Every piece of metal and ceramic bespeaks simplicity and performance" (see previous picture in the 3/38 QST ad). By changing the 7000B, 131C exciter coils, and the 130B output coil units, the transmitter could be placed on any frequency between 540 kHz and 60 MHz. The 10Y tube line up started with the Collins C100 oscillator, followed by two 807's (or 6L6's) buffer/multiplier stages, which drove parallel 807's. The final amplifier tubes were Collins C101A's also known as Amperex HF100's. Later designs such as the 10Y-12, phased out the Collins tubes using instead, the 802 for the oscillator and push-pull 813s in place of the C101 finals. Unfortunately none of the 10Y assemblies appear to have survived today, but a few 10Y-12 assemblies have been sold on eBay.

My 30J had been found in a salvage yard in Philadelphia, PA. A call was again placed to the previous owner to see if it was possible for him to return to the salvage yard to search for the missing 10Y RF unit and the 9RD modulator. But it was winter time in Philly and the trip would have to wait for spring.

Experience gained from the 30W project revealed that reasonable dimensions can be scaled from a photograph provided it is possible to measure a few dimensions of known parts used on the assembly. With that in mind, a layout of the 10Y was begun on drafting paper. The chassis was viewed as a flat piece of metal and drawn to scale. Parts locations were then measured from the photo and scaled to fit the drawing. Gradually, the drawing began to take shape.

Spring brought the much anticipated call from Pennslvania. The 10Y and 9RD assemblies had not been found. However, a set of 7000 series coils was found along with the missing glass for the cabinet.

It was determined that the coils would not work in Gary's 10Y-12 RF unit. Again, my project gained another piece of the puzzle and the coil assemblies greatly enhanced the layout effort. The chassis was finally punched and folded in my



Right: Collins 30J ad from September, 1939 QST shop and the wiring began.

The oscillator circuit was originally wired for the Collins C-100D tube. The tube worked well when used with the large Collins 2C crystals. With surplus crystals, the oscillator performance was marginal at best. The decision was made to modify the circuit to use a 2A5 tube (this modification was recommended by Collins for users of their 40DA broadcast transmitter exciter). The rest of the circuits were wired and soon 45 mA of grid current was indicated for the HF-100 finals on 160 meters.

At this time, the 401N Power Supply was completely tested. All of the power supplies on the 401N chassis functioned perfectly when powered up, needing only a good cleaning and paint. Although these components have been in the salvage yard enduring the rain and cold for many years, they functioned as well as the day they were removed from service.

Gary's 122C Network was disassembled and the aluminum casting was duplicated. Because all of the other parts were in hand, they were easily fabricated in my shop. The dial assemblies were another matter. But, luck was with me and I found exact duplicates in a Collins- built test set for sale at a local surplus outlet. The original 122C was reassembled and soon found its place in Gary's 30J.

By now, more than two years had been invested in the project and it was set aside for a rest. However, my interest was immediately revived when Gary called to report that another 30J had surfaced in Massachusetts. This 30J had the 9RD modulator intact and the cabinet was mechanically in good shape. Very little time was wasted in making a deal for the transmitter. Arrangements were made with a local amateur in Massachusetts to bring the 30J with him to Dayton (for a little gas money), and my good friend John Orahood brought it back to Texas on his return trip.

This time a different approach was used to refinish the cabinet. A business which powder coats race cars and motor bikes was located. They agreed to strip the cabinet and powder coat the cabinet. The cost was double since the cabinet had to be painted twice (smooth finish on the inside and wrinkle finish on the outside). A color which was a close match to the original paint was chosen. The total cost was about $100.00. Many Collins collectors are surprised to find the 30J cabinet painted 'Machine Gray' rather than 'St. James Gray'. All of the 30J cabinets that I have owned were painted in 'Machine Gray' by Collins. However, the 30J-18s that I have seen are painted 'St. James Gray'.

Unfortunately, one of the audio transformers was missing from the 9RD Modulator. This transformer has a distinct shape. Again, a choke (with the proper shape) was found in the "old Collins test set." The choke was placed in a freezer for a few days. The potted choke slipped out of its case with gentle tapping on its aides. Tar, melted off the old choke coil, was used to pot the replacement transformer. All of the main assemblies were now present and working. Only the final amplifier coils were missing.

Friends tell me that my backside is my most recognizable attribute at the flea markets. That's because experience has proven that the most needed parts are always found in the cardboard boxes under the tables. The coil forms used in the 130B coils are different from those made by National or Hammarlund. They are distinctly Collins and are difficult to find. A pair of these forms was found in a pasteboard box at a hamfest in Belton, Texas. The slider assemblies needed to adjust the number of turns on the coils were fabricated and mounted to the coil forms along with the banana jacks. The 30J restoration is now complete and all of the assemblies are mounted in the cabinet.

Will It Work?

The frequency of 3870 kHz was chosen. Luckily, a 1935 kHz crystal was found in the junk box. Out came the old Measurements Model 59 grid dip meter and

J.B.'s transmitter looked like a new piece of equipment after its restoration was completed. (Photo courtesy of Jay Miller, KK5IM)

in the junk box. Out came the old Measurements Model 59 grid dip meter and the work began. The oscillator started up OK and the doubler, buffer, and drivers dipped. Let's see: "Yes, the final grids peak up and now, there is 40 mA indicated on the grid meter." The final neutralization was rechecked and is holding just fine. Now, for the moment of truth: plate voltage is applied to the final amplifier. The power supply hums from the heavy load and the plate current meter pegs at 600 mA. The final tuning and loading capacitors are frantically turned, but no dip was present. The transmitter is quickly shut down and the output network is inspected again. But, all seems fine here.

The grid tuning capacitor was found to be sitting at minimum capacitance.

at resonance. Again, the plate supply was turned on with the same result: no plate dip. By process of elimination, it was discovered that one of the HF-100 finals was shorted. That fixed, I started removing and adding turns to the final coils without results. A quick e-mail was sent to Gary enquiring about the number of turns on the 80 meter output coil in his 30J. Gary confirmed the number of turns on my final coils were correct.

About this time, a frequency counter was connected to the final grids. What's this? I'm on 5805 kHz? My trusty old grid dip meter had let me down! The frequency "doubler" was a frequency "tripler" all along. The doubler was retuned to 3870 kHz. But now, the final grid coil had too few turns. The grid coil was rewound and tuned to 3870 kHz.

Wearily, the plate supply is switched on. This time, the final is dipped and loaded to 300 mA without difficulty. The RF current meters indicate about 1 amp each into a 360 ohm load. Tuning is smooth and there is no indication of parasitic oscillations.

AM with the 30J

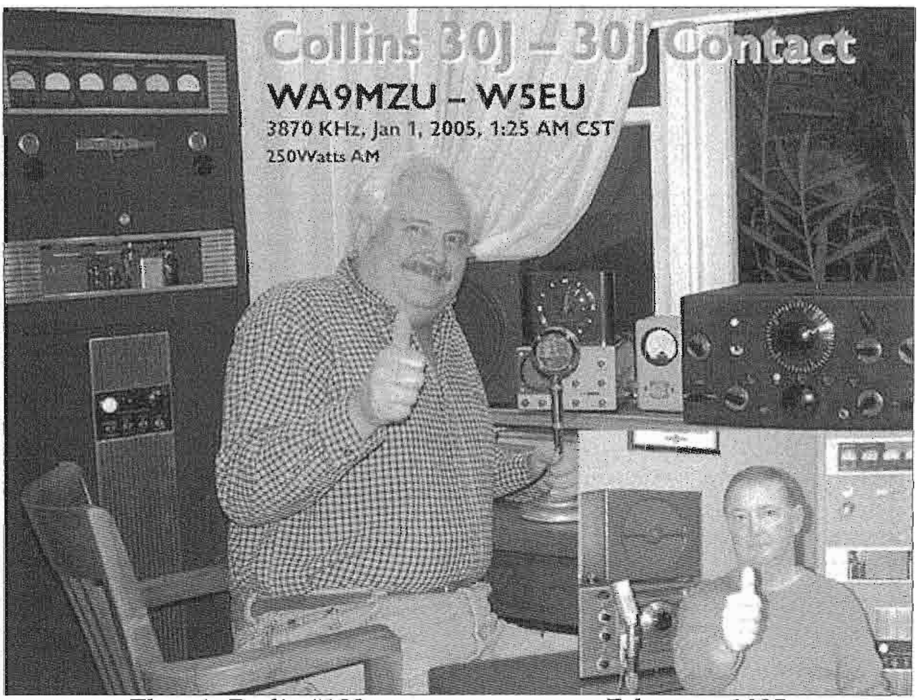
There were two microphones in my collection which have the proper connector for the 9RD modulator. One is the ever popular D-104S and the other, an Electro Voice 638. The Electro Voice was tried first, then the D-104. Both worked well, driving the modulator current upward to 250 Ma. The D-104 sounded tinny while the 638 had a more natural sound in the monitor. Now, let's connect the antenna.

"WA9MZU...WA9MZU...WA9MZU do you copy? This is W5EU standing by!!

*See the Ed Marriner story in ER #187, December, 2004

[Editor's Note: The first 30J to 30J contact in probably 50 years was established between W5EU and WA9MZU New Years Day, 2005 on 3870 kc. Both signals were Q5 with each 30J running 250 watts. Their commerative QSL card is shown below.]

ER



The Refurbishment and Modification of my SX-28s, Part 1

By Bill Feldmann, N6PY
N6PY@arrl.net

After seeing "The Voice of Victory," a WWII Hallicrafters movie with a scene showing a SX-28 Super Skyrider being used with the HT-4 (the predecessor to my BC-610E), I had to have one to use with my BC-610E. The SX-28s I've used seemed to have much better sounding audio than my other receivers. They're a general coverage receiver with variable IF selectivity and with a Lamb noise limiter system, which I hoped would reduce power line noise at my QTH. In the first part of this two-part article I'll describe the SX-28's design and features along with my experience refurbishing two of them. In part two, I'll discuss improvements to its performance. My experience is only with my SX-28s, so I won't say much about the SX-28A or the military GRR-2, except for some information supplied by Brian Thompson (NI6Q). These models are electronically nearly identical to the late SX-28 so my articles should also be useful for SX-28A and AN/GRR-2 owners.

Last May, I bought the SX-28 shown in **Figure 1.** Then, later, I was given another one to use as a parts rig. Since the second receiver was fairly clean mechanically and didn't need any additional parts, I refurbished it to use at my second QTH. My first SX-28 came without a manual so I ordered a copy from www.w7fg.com (1-800-807-6146). When replacing capacitors and resistors, I noticed many differences in the RF section between actual part locations and their locations in the manual's circuit diagram. These differences appeared not to be modifications; rather, they looked like my radio

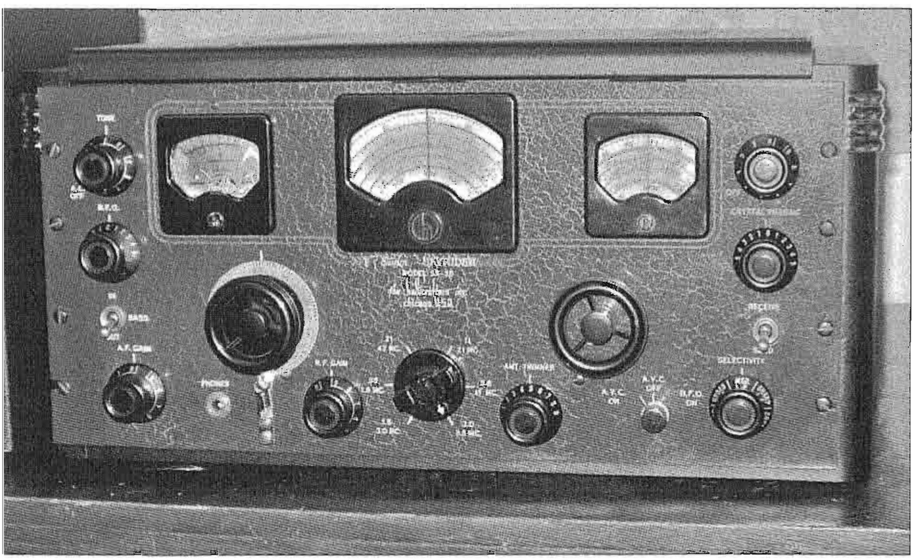


Figure 1: The front view of my first SX-28 purchased in May, 2004.

had been built that way. Brian (NI6Q) found and gave me a copy of an early SX-28 manual, which nearly matched my first SX-28. Later, George (WA6HCX) gave me a revision sheet that completely described my early SX-28 (S/N 120864) along with some service bulletins. The circuit for my second SX-28 (S/N 125618) was nearly identical to the W7FG manual, which was right for the late SX-28. Apparently, many circuit changes had evolved during the production of the early SX-28s. Also, Clay (W7CE) gave me a copy of the SX-28A and AN/GRR-2 manual that showed the differences between these radios and the SX-28. This documentation has been a great help in working on my radios and writing this article.

The SX-28 Design

The original 1941 release of the SX-28 Super Skyrider used two 6SK7 tubes and three sets of tuned coils for each band in its RF/preselector section, except on the two low frequency bands, where the first RF tube and one set of coils are bypassed to keep the RF bandwidth from being too narrow. Just before my first SX-28 was built, the first RF amplifier tube was changed to a 6AB7 to improve sensitivity. George also gave me a manual addendum describing a change of the second RF tube to a 6AB7 in very late SX-28As. A 6SA7 is used as a mixer with the oscillator signal on the first grid and the RF signal on the second grid. Also, the oscillator uses a 6SA7 connected as a high-gain triode. For RF gain control, a 10k-ohm pot is connected in series with the cathode ground returns for the RF, mixer, and IF tubes.

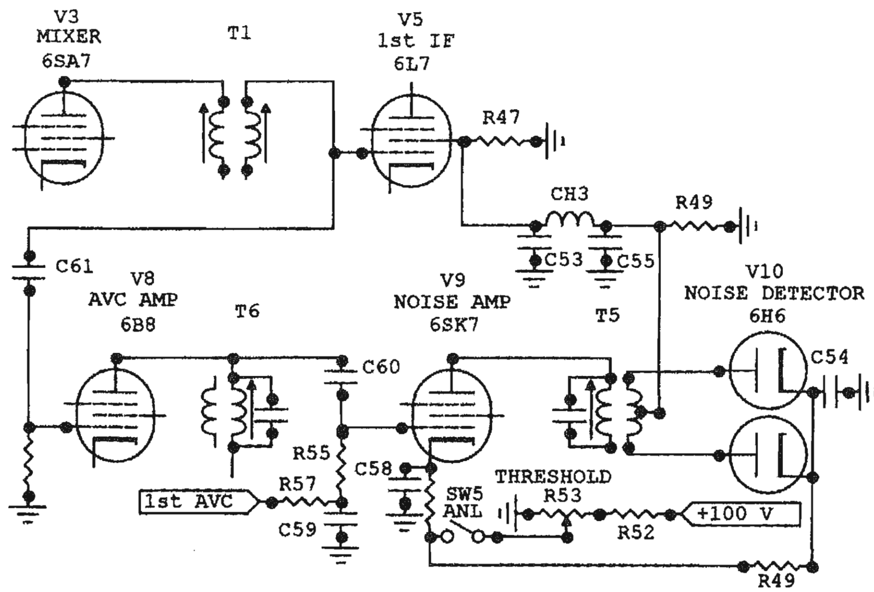
The SX-28's frequency is controlled by a main tuning knob and dial on the left side of the front panel, and it has a band-spread knob and dial on the right side. These are connected through gear or string drive mechanisms to multi-section oscillator and RF-tuning capacitors located on top on the chassis, on either side of the RF and oscillator tubes. The main dial is calibrated in six bands: .55-1.6 Mc, 1.6-3.0 Mc, 3.0-5.8 Mc, 5.8-11.0 Mc, 11.0-21.0 Mc and 21.0-43 Mc. The band-spread dial is calibrated in four amateur bands of 80, 40, 20, and 10 meters and has a logging scale. Targets on the main tuning dial are used for setting the band-spread dial. Back-lighted shadow pointers located behind each dial are string-driven from the band-switch shaft to indicate which band is active.

A 6L7 is used in the first IF amplifier and noise limiter gate. A 6SK7 is in the second amplifier.

An excellent feature of the SX-28 is its two variable-coupling IF transformers, T1 and T2, which are controlled by a six-position selectivity switch. This allows the selection of bandwidths of 12 kc, 6 kc, 4 kc, and crystal positions of wide, mid, and sharp. When T1's coupling coil is switched in, the bandwidth increases from 4 kc to 6 kc, and with T2's coil switched in the bandwidth increases to 12 kc. Between the secondary of T2 and the second IF tube is a crystal filter with a phasing control that is switched in for CW reception, or to reduce heterodynes during phone reception in "crystal wide" selectivity. SX-28s, somewhere before S/N 120864, had a wafer added on the band switch, SW8-14, to change the cathode resistance of the first IF tube to correct the receiver's gain for different bands.

Parallel-connected diodes in a 6B8 are used for audio and second AVC detection. The audio section uses a 6SC7 phase splitter and two push-pull 6V6s for 8 watts of low-distortion audio at 6000 or 600 ohms audio output impedance. This section has an audio peaking filter to reduce low audio frequencies and select its mid-range audio frequency by using the tone control. I've found this feature very useful for reception of amateur AM signals having too much bass in their audio. It's switched in when the "bass-in" switch is set to "out."

A 6J5 Hartley BFO is also provided for



EARLY NOISE LIMITER
FIGURE 2A

CW reception.

A unique, but often troublesome, feature of the SX-28 is its dual-AVC system. The first AVC samples the IF at the output of the mixer, amplifies it in a 6B8 AVC amplifier, and then generates a negative AVC voltage using the 6B8's diodes. This controls the gain of the RF and mixer tubes by detecting signals over a wide bandwidth determined mostly by the RF preselector bandwidth. It's like the attenuator in modern receivers to prevent mixer overload caused by strong nearby signals. It was a great idea in the 1940s when most signals on the Ham bands were AM carriers. Today, with strong and rapidly varying SSB signals, it can cause RF gain reduction when trying to receive a weak AM signal. Sometime after S/N 125618, a wafer, SW8-15, was added to the band switch to increase the first AVC for the two lower frequency bands. The second AVC system uses the negative audio detector's DC voltage to control the gain of the first IF tube and the S-meter amplifier. This amplifier uses the pentode section of the 6B8 detector. The meter reads full scale when the AVC voltage is over minus 15 volts by biasing the amplifier off, then reads S-zero when the AVC voltage is zero by biasing the amplifier on.

An excellent feature of the SX-28 is its IF and audio noise limiter system. This is one of the first commercial implementations of the Lamb IF noise blanker, now used in today's communications receivers, but introduced over 40 years before its wide use. It is very effective in eliminating pulse noise. It samples the wide bandwidth IF after the mixer tube, then amplifies and rectifies it to generate a negative control signal for the duration of a noise pulse that is above a selected level set by the ANL control. This signal is then applied to the second control grid of the first IF amplifier to gate the IF off. There was a major change to this system somewhere between the dates my two SX-28s were built, S/Ns 120864 and

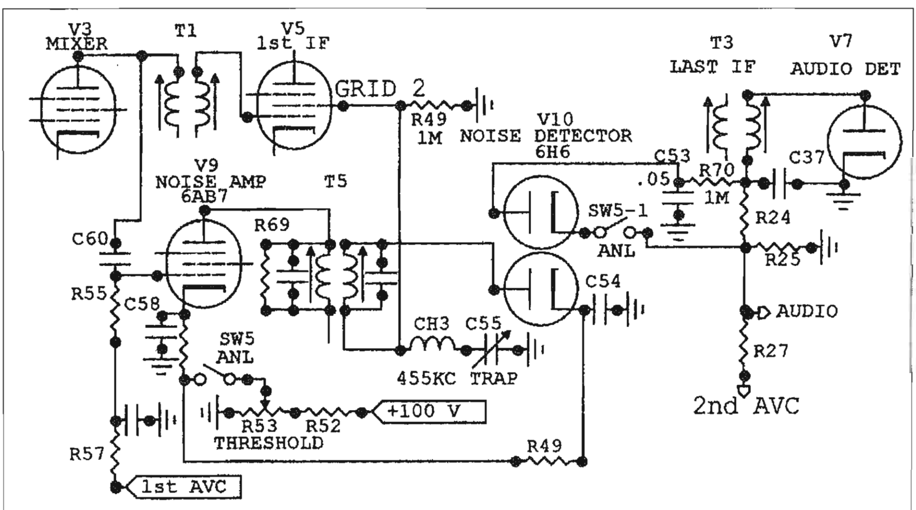
125618.

The early limiter in **Figure 2A** uses the first AVC amplifier as a preamp followed by a 6SK7 noise amplifier. The control signal is generated using a 6H6 as a full-wave rectifier. This signal is filtered using a PI low-pass filter consisting of a series coil and two capacitors to remove any 455 kc IF. But, this filter slowed the control signal, allowing some noise to get through before the IF was gated off. There also could be complete RF stage blockage resulting from rectification of very strong signals at V8's grid getting back into the first AVC though the noise amplifier's grid resistor. Early limiters can be identified by a coil on the chassis next to the S-meter zero pot and by not having a coil with a trimmer capacitor on its top mounted next to V9.

The later limiter in **Figure 2B** solved the control delay and RF blocking problems by replacing the PI filter with a 455 kc series-tuned shunt coil and adjustable capacitor to bypass IF voltage that didn't delay the control signal. Also, not using the AVC amplifier working as a preamp and by changing the noise amplifier tube to a higher-gain 6AB7 reduced RF blocking. It only uses one of the 6H6's diodes in a half-wave noise detector, allowing the other diode to be used in a shunt audio limiter. The added audio limiter removed audio noise generated by the gate tube when it interrupted a carrier. This system works better for AM than any analog noise limiter system I've used.

B+ power is supplied from the high-voltage center-tapped winding of the power transformer through a full-wave 5Z3 rectifier into a capacitor-input filter with a series choke and capacitor-output PI filter. The 280-volt B+ has very low ripple and is well regulated, but on both of my SX-28s the voltage measures almost 312 volts due to the high line voltage of nearly 125 VAC at both my homes. For muting the receiver during standby, the center tap of the transformer's high-voltage winding is disconnected from ground using a front panel "standby" switch, or a receptacle on the back of the chassis. The rectifier and other tube filaments are powered by 5.0 VAC and 6.3 VAC windings on the power transformer.

During the production life of the SX-28 there were some additional changes that had little affect on its performance. After my late SX-28 was made, a power line fuse receptacle was added to the



LATE NOISE LIMITER
FIGURE 2B

chassis. The early SX-28s used a small removable cover secured by thumbscrews that was later changed to a larger removable cover. Early SX-28s used a gear-driven band-spread drive that was later changed to string drive as a cost savings, but has a smoother feel than the gear drive. Early SX-28s used 1/3-watt resistors looking like modern carbon resistors, and later examples used ½-watt resistors with metal capacitors.

The largest difference between the late SX-28 and SX-28A is the mechanical packaging of the RF and mixer coils that were redesigned for ease of manufacturing. Resistors in the SX-28A are the standard values we use today, For example, 500 ohms and 5000 pf in the SX-28 are 470 ohms and 4700 pf in the SX-28A. Values of the resistors on SW8-14 were changed for RF performance differences caused by the different RF coil assemblies. The military AN/GRR-2 model appears to be nearly identical to the SX-28A, with the exception of being designed for rack mounting instead of using a cabinet.

Mechanical and Electronic Refurbishment

To work on or align one of these receivers you'll need the proper tools and the right manual for the particular version of your SX-28. A high-impedance volt ohmmeter is required; I use a Fluke digital meter. You'll need a tube tester that checks transconductance and element leakage. For circuit alignment, a stable and accurate signal generator that works up to 42 Mc is necessary. I use an old HP606 with an inexpensive digital frequency meter. A 1-Mc scope is useful for testing and troubleshooting the IF and audio circuits. If you don't have access to these instruments you shouldn't attempt to work on an SX-28.

I didn't do a full restoration consisting of completely stripping the chassis because the wiring and the overall condition underneath the chassis of my SX-28s appeared good. I started by removing their front panels and cleaning the dirt and old lubrication using a 50% mixture of Simple Green® and water. A water rinse followed, being careful to keep the Simple Green® and water off the dials, the S meter and the IF transformers. Both of my radios had very little corrosion. On really bad examples, Wayne Spring (W6IRD) paints their chassis with Krylon® KSC032 chrome paint that comes in a spray can. This closely matches the original chassis finish and makes them look new.

I cleaned both front panels using hot water and detergent to remove the factory applied brown shellac. The second SX-28's paint was badly oxidized, but I saved its finish by rubbing it with polishing compound. I repaired damaged lettering using lacquer paint sticks from Antique Electronic Supply. After a coating of automobile paste wax, both panels looked great. I had the cabinets for both radios and their speakers powder coated with black crackle, which I think looks better and is more durable than the original finish. The speaker grills, the chrome side rails, and other chrome parts I had re-chromed.

On every SX-28 I've seen, the back cover for the S meter is split. Wayne (W6IRD) fabricated clamps out of .03" thick by 3" inch wide soft brass with flanges and a #4 screw and nut, which wrap around the meter cover and hold it together. I also wrapped vinyl electrical tape around the covers to exclude dust.

I replaced the power cords with modern three-prong chassis-grounding styles. My receiver didn't have chassis-mounted fuse receptacles, so I added inline holders with 1.5A fuses to the black lead of each power cord, under the chassis.

I replaced all the old waxed paper capacitors by ordering two complete sets of yellow tubular film capacitors from Antique Electronic Supply. Orange drop capacitors will work fine, but for the tightly packaged SX-28 the tubular capacitors fit much better. Replacing the capacitors in the audio, power supply and IF circuits was an easy job, but I had to remove the audio filter choke to get at the components on the audio tube sockets. I replaced the two HV capacitors, C48 and C49, with Sprague Atom 80-µF, 450-volt capacitors, which fit nicely into the chassis mounted clips. Since C47, the audio cathode bypass capacitor, is part of C48, I installed a separate 47-µF, 100-volt capacitor between pin 8 of V14 and ground. I used a higher voltage one because of a standby muting modification I'll describe in Part 2.

While I was doing the recapping, I checked all the resistors and replaced any more than 15% out of tolerance. In my earlier SX-28 I found less than five bad resistors, but the later radio had at least one third of its metal-capped resistors bad. In both my SX-28s, R30, the S-meter's 27-k, 2-watt resistor was high in value. I replaced them with 5-watt wire-wound parts. I checked the 100-volt RF and IF tubes screen supply potentiometer, R31 and R32, located on the LH inside of the chassis near the noise limiter tubes, which are known to fail. On one SX-28 R31 was open, so I replaced both resisters with a 10-k, 25-watt Ohmite adjustable wire-wound resistor. After powering up the radio I adjusted it to 100 volts with the AVC off and full RF gain. I'll say more about this in Part 2.

Work on the RF and oscillator circuits was difficult because of tight packaging. By removing the band switch shaft from the back of the radio, removing the antenna capacitor shaft, and removing the screws securing the long side shields for the RF/oscillator stages, I could tilt the shields outward allowing better access to the RF, converter and oscillator circuits. I moved the shield and band switch wafer between the first and second RF sections toward the front of the receiver to replace parts on the first RF tube socket. To do this, I unsoldered four wires going to the variable tuning capacitors on top of the chassis, disconnected the lugged wires from the antenna terminals on the back of the chassis, unsoldered a wire going to the grid-bias system, and then removed the screws securing the shield. I also could work through the hole in the chassis for the band switch indexing mechanism. I used hemostats, small wire clippers, and a soldering pencil to remove and replace capacitors and resistors. I paralleled all the film capacitors in the RF and mixer sections with .005 µF disc ceramic capacitors to improve performance above 10 Mc, where film capacitors develop an inductive component. A web site at www.antiqueradio.org/halli12.htm was helpful for learning how to work on these tightly packaged circuits.

I've never worked on a SX-28A but Brian (NI6Q) supplied the following description of how he recapped his RF section:

"Each stage has two removable sets of three coils. Each set can be removed by removing a couple of screws and unsoldering a few wires to have enough play to pull the coil sets at a 90-degree angle. This will then uncover the resistors and capacitors that need to be replaced. Some capacitors are under the band switch wafers, but with care and patience they can be replaced. A special note: It is easy to make a mistake when resoldering the wires, so be sure to make a drawing of their location and label them before starting."

I finished by checking and replacing all bad or weak tubes using my transconductance tube checker. Aligning a receiver having bad tubes is simply a waste of time. I was especially careful to check the diodes in both 6B8 tubes because these are known to become weak and will affect AVC and audio performance. I also checked all RF and IF tubes for grid leakage since this will also affect AVC performance.

Alignment and Testing

Using a VARAIC, I slowly powered up my SX-28 while looking for smoke. It came up with no problems and when hooked to an antenna I could hear broadcast stations. If you are working on one that's dead, start troubleshooting from the audio stages forward to the RF stages to find the problem.

To align the IF I basically followed the alignment procedure in the manual with the radio out of its cabinet. I found it easier to hook a digital voltmeter across the detector diode load resistor, R25, to measure the IF output voltage, instead of using an AC meter on the speaker terminals as the manual suggests. I connected the output of my signal generator to the mixer tube's RF input tuning capacitor's stator, C1.1. This is the large tuning capacitor to the left of the mixer tube. This was easier than trying to hook to the grid of the mixer tube from underneath the chassis. I placed the band switch on band 1, turned off the AVC, set the selectivity in the non-crystal "sharp" position, and introduced about a 1000-µV, 455-kc signal. During the alignment I adjusted the signal generator for a reading between negative 3 and negative 8 volts on my voltmeter for a good meter response that wouldn't overload the IF stages. I did a rough alignment of T1, T2, T3, and C31. I next found the crystal filter frequency in the crystal "sharp" passband, which was at 451.88 kc on my first SX-28. I realigned T1, T2, T3 and C31 exactly at that frequency. I adjusted C30 to peak the crystal "sharp" selectivity output and then adjusted C29 in crystal "mid" selectivity for a voltmeter reading midway between that in crystal "wide" and "sharp."

To test the IF alignment, I switched to the non-crystal, "wide" selectivity and swept the signal generator output frequency across the IF passband. I found it to be nearly 12 kc wide at 6db down, and peaking at each end of the pass band. One peak was much higher than the other.

I made both peaks nearly equal by tuning the generator to the higher peak and making a small adjustment on the capacitor toward the back of the receiver on T3. Then I tuned to the other peak to make sure it was the same height as the first and readjusted T3 if necessary. After repeating this a few times, each peak was 2 or 3 db and the pass band between the peaks was flat. "Mid" selectivity was about 6 kc wide and "sharp" selectivity was 4 kc wide. In crystal "wide" I was able to notch out signals either side of the crystal frequency using the phasing control.

If you have trouble aligning the crystal filter, be sure that when the phasing knob is on "zero" its capacitor is half meshed. If alignment still doesn't work, carefully disassemble the crystal holder and remove the crystal. Clean the crystal and the crystal holder's interior with a mixture of detergent in water, then alcohol, followed by a distilled water rinse and drying. Using this method, I've repaired crystal filters in a BC-348, an SX-71 and in a 75A-1.

To align the first AVC amplifier I connected my voltmeter to its output at the junction of R61 and C66 and turned the AVC on. I peaked T6 for a maximum meter reading while I was injecting a signal into C1.1 at the crystal filter's frequency. I next aligned the noise amplifier by connecting my voltmeter to pin 5 of V5, turned the AVC off and the ANL control fully on at "9." On a SX-28 with the late noise limiter, a 47-k swamping resistor must be connected across the primary of T5. Don't add a resistor to T5 on an early limiter having only one coil slug. I adjusted both slugs on T5 for maximum meter output and removed the swamping resistor. To adjust the 455-kc trap on my later SX-28, I unplugged the grid capacitor lead from V5, the first RF amplifier, and reconnected my voltmeter to the audio detector resistor, R25. With the AVC off and ANL at "9," I adjusted the signal generator for a small voltmeter reading and adjusted C55 on the trap for a minimum reading.

It's best to align the oscillator and RF stages with the SX-28 in its cabinet because their alignment will change after installation into the cabinet. I carefully followed the RF alignment table in the manual, and afterwards I found the dial tracking to be better than any other pre-WWII receiver I've worked on. But, I noticed the S meter was not accurate. On the air testing of my first receiver showed nice audio on broadcast music, great voice audio in "mid" selectivity, and was great for eliminating QRM in "sharp" selectivity. Its sensitivity was good up to 21 Mc, but much lower on band 6 (21 to 43 Mc). When a strong SSB signal was near, but outside its pass band, both the receiver gain and the S meter reading would vary with the SSB signal. If the AM signal I was copying was weak, the audio would be silenced. Also, the noise limiter wasn't as effective as I had hoped.

I powered up my second SX-28 and tried to align it using the above procedure, but ran into problems typical of those that can be expected with old SX-28s. I found a short in the audio output transformer and couldn't find an original replacement. I found one identical in size and center-tapped for 6V6's, but with an 8-ohm-only output, so I installed it. It also had a hard-to-find short in the S meter from a damaged meter shunt. The soldering of a wire to a screw when the meter was built had burned the paper insulator under the screw's head! The burned paper would occasionally become conductive and break down like a Zener diode, pining the meter over S9. I repaired the insulator by adding vinyl tape over the burned area underneath the screw head. It also had an unreliable BFO that worked when the radio was cold, but quit after it warmed up. I opened up the BFO coil enclosure and found C73 to be a paper capacitor according to its color code, but the parts list specified it should be mica. The BFO worked reliably after replacing it with a dipped-mica capacitor.

After IF alignment, both the wide and mid-band response curves were too wide. I noticed that the IF transformer, T2, looked different than T2 in my first SX-28. I thought it must be a replacement. Joe (W1GFH) gave me a good T2 from a parts rig, and it fixed the response problem. But now, there was a 6db dip in the center of the "wide" selectivity's passband. It was caused by a dip in the mixer's output that could be moved by adjusting T6, the first AVC amplifier's transformer. It should have been isolated from the mixer by the AVC tube. The 6-dB dip could only be removed by disconnecting the first AVC tube from the mixer. I couldn't find a solution to this problem even after improving the bonding of the riveted ground terminals and replacing the bypass capacitors, and the capacitors inside T2 and T6. I suspected it was caused by the rats-nest wiring in the IF section. Here, unshielded wires carrying IF signals run haphazardly near other wiring. Others have told me that no two SX-28s seem to align the same because of this poor IF wiring. When I made a modification to change the point where the first AVC signal is sensed, that eliminated the RF blocking problem, and the 6-dB response problem was solved as an added benefit. I'll describe this change in Part Two.

In this article I have described how I got my two SX-28s cleaned up, working, and aligned along with discussing the problems I encountered. In Part Two, I'll describe the modifications and additions I made to correct these problems. I made my SX-28's excellent AM receivers for use on the broadcast and congested Ham bands.

ER

An Easy Up-Grade for the TCS Receiver

By Doran Platt, K3HVG
12196 Overlook Dr
Monrovia, MD 21770

When I got my TCS-13 system up and running 2 years ago, it was obvious that the receiver bandwidth was painfully broad. During winter evenings, when the whole world was on 75 meters, the TCS would hear them all... at the same time!

Considering some options available, I elected to purchase several lots of Murata filters found on eBay. I obtained both AM and SSB bandwidth ceramic filters, all removed from modified Icom receivers. For information, these small Murata CFK455-series filters have an insertion loss of about 6dB, and a nominal impedance of 2k ohms, and come in several bandwidths. Most other filter installation modifications I've seen understandably require an additional stage of IF amplification to compensate for filter losses. My plan was to do it, hopefully, without the benefit of this additional stage.

Looking at the TCS receiver schematic, I elected to insert a filter between the grid (pin 4) of IF amplifier V-205 and the

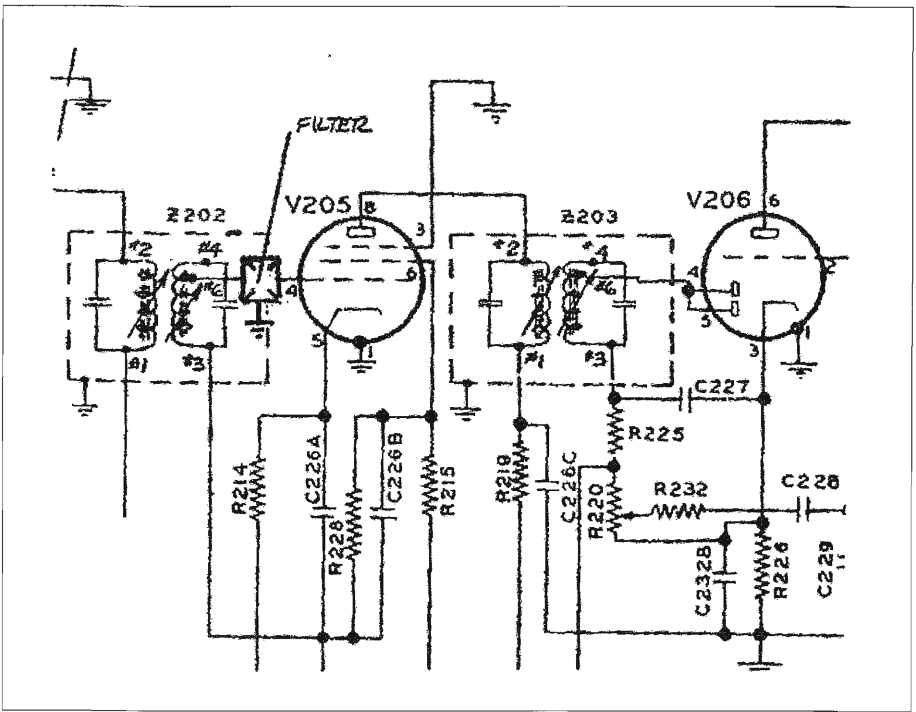
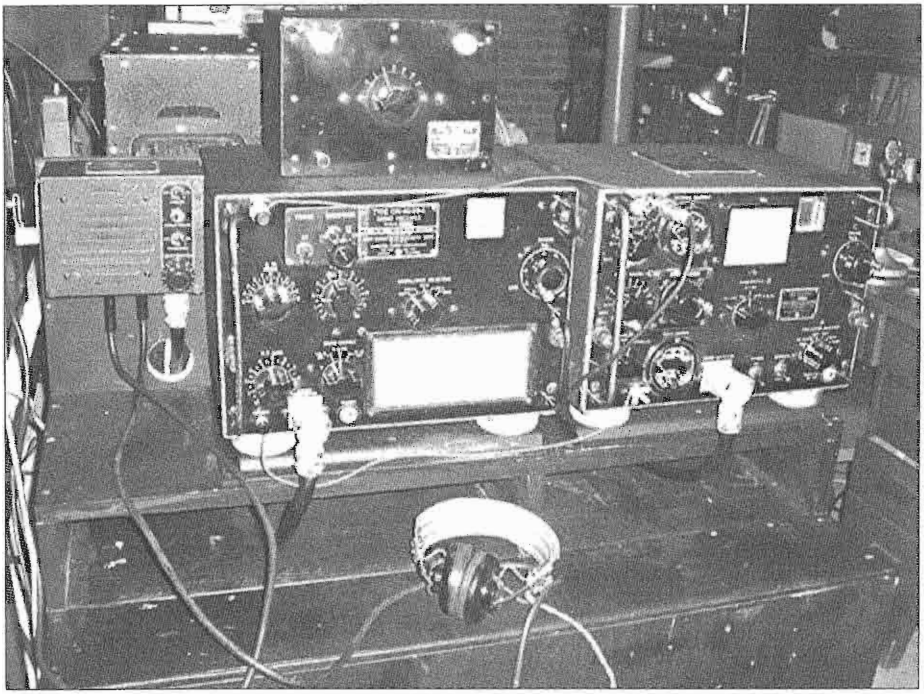
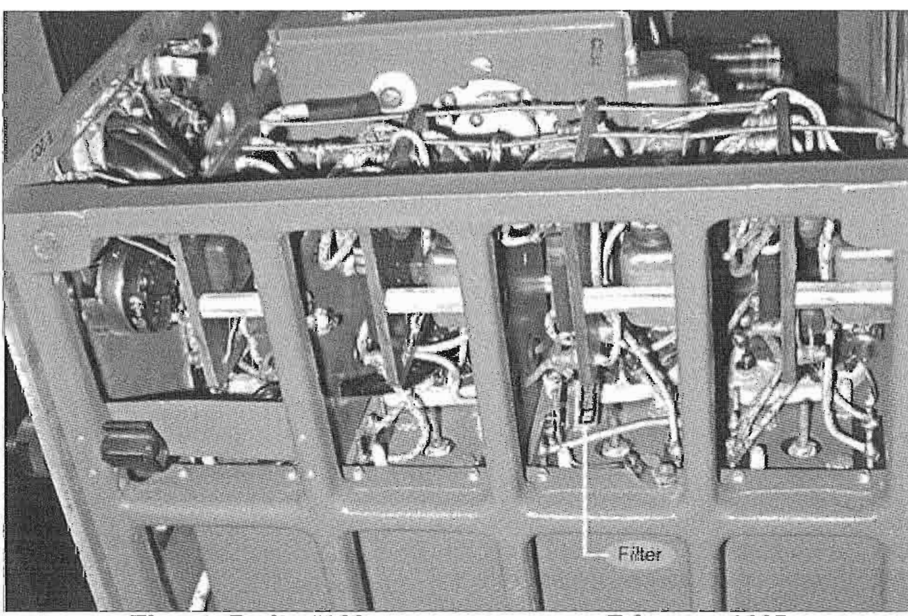


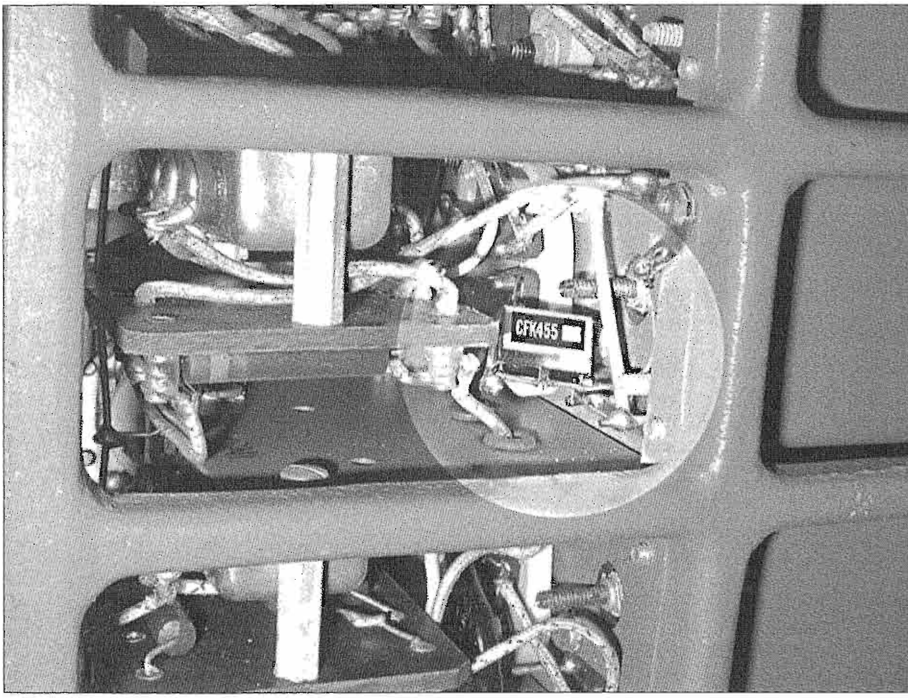
Figure 1: Partial TCS IF amplifier schmatic showing the location of the new filter.



Above: The restored TCS transmitter and reciever equipment at K3HVG.

Below: The new Murata ceramic filter is mounted in the IF amplifier section and the highlight shows the location.





The highlight in this figure is a closeup view of the filter mounting method.

preceding IF transformer, Z-202. There's no appreciable DC on the grid of V205, so I figured the filter would not be harmed. I pre-wired the filter using bus wire and with flying leads for input, output, and ground. The ground wire is connected to one side of the filter input, output, and filter case. A ground lug was installed adjacent to the filter installation location, using an existing protruding screw (see photo). I'm sure that this installation methodology provides leakage paths around the filter but not enough, it appears, to spoil the soup.

When I first turned on the receiver on the bench, I noted that there was almost no audio output, even with the AF and RF gain up all the way. After connecting an antenna, I was able to hear atmospheric noise, but the volume was noticeably reduced. I figured that the insertion loss might just be too great for the filter to work, as is. Later, however, with a moderately open band and lots of signals, strong and weak, the receiver and new filter worked virtual wonders. I can now separate individual QSOs and listening is a pleasure. Even with weaker signals, the reduction in IF gain does not appear to be an issue, at all. Both the AM and SSB filters work equally well, but I settled on the CFK455-I AM filter owing to the fact that I use the TCS mainly for that mode. The SSB filter does do an excellent job on CW but appears to exhibit a bit more loss than the AM filter. In the future, I may install small slide switch, internally, to select either a wide or narrow filter.

Thus, if you're looking for a simple and non-destructive answer to TCS selectivity, give one of these, or similar filters, a try.

ER

Restoring the Heathkit C-3 Condenser Checker

By Ken Gordon, W7KEB
226 N. Washington St.
Moscow, ID 83843

The Heathkit model C-3 Condenser Checker is a small, handy instrument that can help the electronic repairman quickly check the values of unknown resistors and capacitors, and provide a quick and fairly accurate means of checking capacitors for leakage, and electrolytics for power factor. It can also be used to re-form electrolytic capacitors.

Although I have always had the greatest of respect for the Heath Company's design engineers, there is always something the amateur radio operator can do to "improve" Heathkit equipment, even if it is simply to "personalize" it for his own particular way of doing things. Since Heathkit equipment is usually simple, it is usually easy to work on.

This article will discuss the following:

1) Some improvements which will overcome the weaknesses inherent in the design and construction of the Heathkit C-3.

2) The principles by which it operates.

3) How to get the most out of the instrument. It is really a follow-up to Jim Hanlon's (W8KGI) article on the C-3, which was printed in ER #135, starting on page 11. You may wish to peruse that article in conjunction with this one.

Several years ago, I joined several e-mail lists devoted to various military and amateur radios of the BA persuasion, and one of the things often discussed was the great problem of old capacitors leaking badly, and the means of finding them before they could cause damage: capacitor checkers were one of these means.

It is common knowledge amongst the BA (Boat Anchor) and military communications equipment restoration crowd that leaky capacitors are the primary cause of equipment failure years after the gear was first built. Most BA gear should not even be turned on until, at the very least, the electrolytic capacitors in the power supplies have been checked for leakage or shorts and if necessary, replaced or reformed. New capacitors are a lot cheaper and easier to find than unobtainium original specification transformers!

Although many different manufactur-

Pictured above are two versions of the popular and useful Heathkit C-3 Condenser Checker.

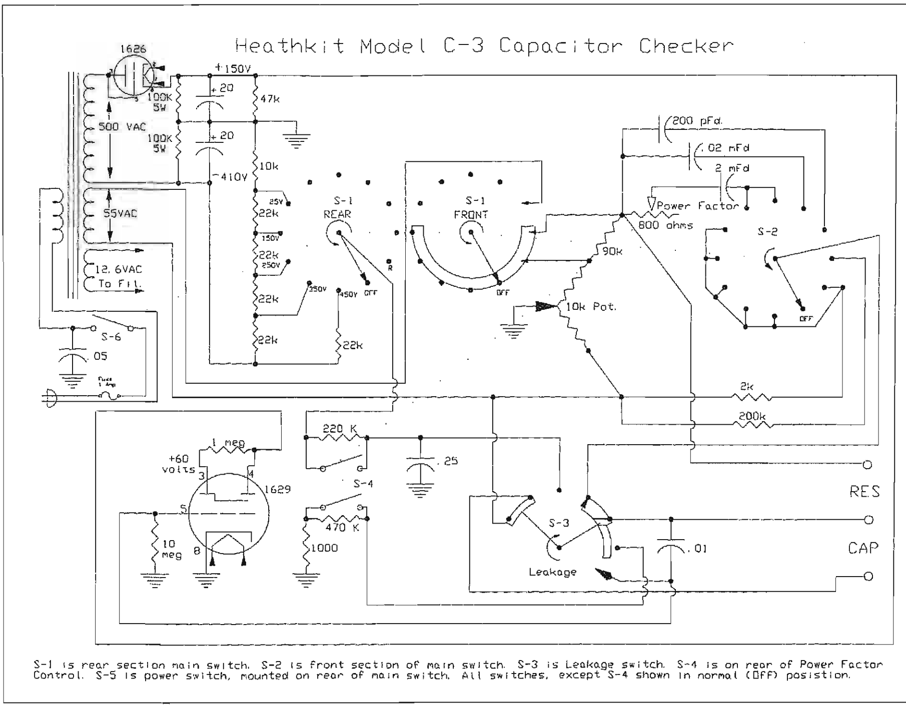


Figure 1: I have redrawn the Heath C-3 schematic to make it simpler and easier to read.

ers have built and sold capacitor checkers capable of performing such checks, the Heathkit C-3 was mentioned favorably as one such instrument. Since I have always liked Heathkit equipment, I thought that would be a good one for me to start with.

After asking around, I obtained a C-3 from a Ham in Texas, whose call I have since forgotten. He sent it to me with instructions to pay him what I thought it was worth, and though I was not able to get to it immediately, I finally dug into it. Although it looked fine cosmetically, electrically it was in pretty bad shape. The power transformer was completely burnt out, and the "Main Control", a 10-k, wire-wound pot, was destroyed.

As I got further into it, I discovered that nearly all of the 22-k ohm divider resistors had drifted well out of tolerance, mostly very low, and some exhibited strong indications of having been subjected to high-temperatures. When I told the Texas Ham about these problems, he told me to just keep the unit, so I decided to try to restore it for use in my shop. Later, I bought another working one from a seller on eBay for $15.00 for use in my other shop at work.

When doing any restoration, the first order of business is to obtain as much complete documentation as possible, preferably an original manual with a schematic, or a good copy of both. I obtained a manual for the C-3 from BAMA, the Boat Anchor Manual Archive. BAMA is found on the Internet at ftp://bama.sbc.edu or http://www.bama.sbc.edu/, or the mirror http://bama.edebris.com/manuals/.

When I started to study the schematic diagram included in the C-3 manual, I found it to be poorly laid out and very difficult to understand, despite its being such a simple instrument. So, I sat down at my computer and redrew the schematic diagram using GenericCadd, separating each circuit from the others to make it more logical and easy to read. That schematic diagram is shown in **Figure 1**.

The first problem I encountered was how to replace the power transformer: from its specifications as shown in the C-3 manual, it looked as though I would not be able to easily find one exactly like it. It required a primary input winding of 110 VAC and three secondary windings : (1) 500 VAC for the capacitor leakage test circuit, (2) 55 VAC for the bridge circuit, and (3) 12.6 VAC for filaments for the two tubes.

Searching through my junque box, I found a small receiver transformer with a 110 VAC primary winding; 525 VCT at 90 mA, 6.3 VAC, and 5 VAC secondary windings; and two small Radio Shack transformers which had 110 VAC primaries, and 12.6 VCT secondary windings at an amp or two each. These I connected as shown in **Figure 2** below.

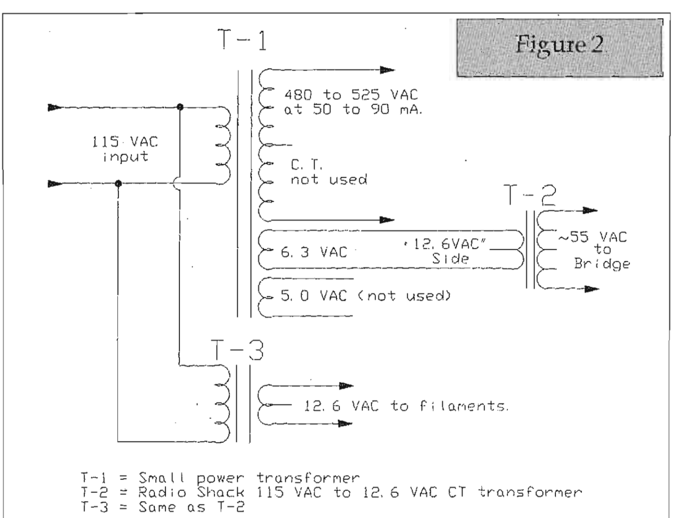
The 12.6 VCT transformer T-2's secondary winding I connected to the main power transformer T-1's 6.3VAC secondary winding so that T-2's primary winding, acting now as a secondary winding, provided the 55 VAC needed for the bridge circuit. I then added T-3 to provide filament voltage for the 1629 eye-tube and the 1626 "rectifier". Depending on your line voltage, you may want to connect the 12.6 VAC winding of T-2 to the 5.0 VAC winding of T-1 instead of to its 6.3 VAC winding as I have done. Measure the 55 VAC. If it is substantially higher than 55 VAC, do the above. My units have worked fine wired as I have drawn the schematic, and my bridge voltage measured 60 VAC. See the photo in **Figure 3** to see how I mounted the transformers. There was actually plenty of room.

Now that I had a reasonably close facsimile of the original power transformer, and after I replaced the 10-k pot "Main Control" (as it is labeled on the schematic), and the DC filter capacitors with new ones from Mouser, I fired it up and made some tests.

The results of my tests and calculations are as follows:

For the leakage tests, the voltages at the various switch-positions (labeled 25, 150, 250, 350, 450 VDC.) are not very exact, even if the resistors are still within tolerance. The current through the voltage-divider string SHOULD be about 4.5 mA (.004545 A). If that is so, and if all the resistors are within tolerance, then the calculated voltages will be about 45, 145, 245, 345, and 445 VDC. However, those resistors were always WAY out of tolerance, sometimes by several hundred percent in those units I checked, including this one. Obviously, the position labeled "25" volts, should have been labeled "50" volts instead.

The 47-k resistor shown on the schematic, which is actually across the 1629 eye-tube, was found to be over 110 k in the units I have checked. This resistor sets a) the voltage across the 1629 and b) the total current in



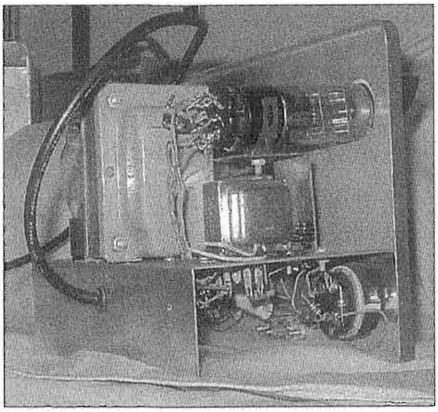


Figure 3: This photo shows the mounting location I chose for the transformer that provides ~55 VAC.

the string. At 4.5 mA, there should be about 210 VDC across the 1629 at "idle". Before I started the restoration, my unit had 330 VDC on the eye tube! This resistor dissipates about 1 watt, so a 2-watt resistor should be OK here.

The filter capacitor closest to the diode only has the voltage across the 1629 on it, which varies, when you are testing leakage, from a low of about 100 volts, to a high of about 430 volts (momentarily), so a capacitor with a working-voltage of

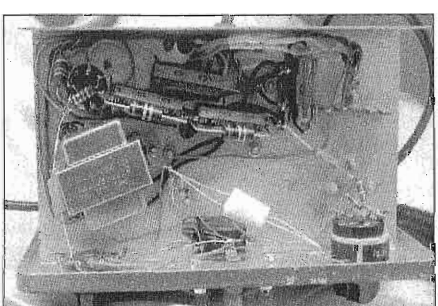


Figure 4: Here is a bottom view of the C-3 chassis showing how I mounted the 12.6 VAC filament transformer for the tubes.

475 VDC, or higher, is not needed here. The other filter capacitor, however, has whatever voltage is left after the 1629's requirements are met. The 1629 will operate properly with voltages as low as 100 VDC. (Don't go over 250 VDC though. Doing so for very long will severely shorten the life of the eye tube.)

Calculating the true resistor values that would give the "correct" voltages for the leakage test resulted in: 11k, 22k, 22k, 22k, and 22k. I adjusted the true value of the "47k" resistor at the "top" of the voltage divider so that the actual current drawn by the string was 4.5 mA, and the voltages were accurate or slightly high at no load. If you want the leakage test voltages to be reasonably accurate, make sure that the current through the voltage-divider string is 4.5 mA, and your resistors are close to what I have listed.

The last 22-k resistor between the voltage-divider string and the 450-VDC switch position connection is only a current limiter, so its true resistance value is not too important.

I replaced all the capacitors, except the filters and the micas, with metalized film capacitors. The increase in accuracy and repeatability of the instrument was amazing! The micas were usually OK, but you may want to test yours anyway, and replace those that are out of tolerance.

All resistors in the voltage divider string were replaced with 2-watt, wire-wound units from Mouser of the values I calculated above. The power dropped by each 22-k resistor in the voltage-divider string will be around 0.45 watt at no load if the current is "set" to 4.5 mA, but can rise much higher when you are testing bad capacitors for leakage. This is undoubtedly why the ½-watt, 22-k ohm resistors were "cooked" in my units. If the unit is left on, those resistors are dissipating nearly ½ watt continuously, which isn't good either.

Make sure the two resistors associated with the 1629 are within tolerance. If either one is much lower in resistance than specified, the eye will not open fully, or could overlap when closed. You may have to experiment with the value of the resistor between pins 3 and 4 in order to get the eye to just close when nothing is being measured. Mine required a resistor of around 6 Megohm rather than the 1 Megohm shown. The "+60 volts" speci-

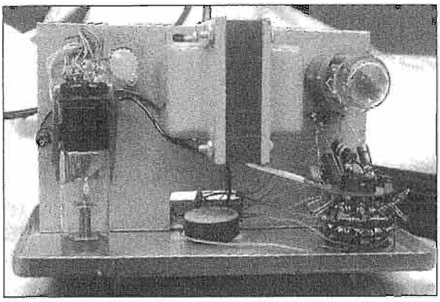


Figure 5: Top view of the chassis and the replacement power transformer.

fied on the schematic at pin 3 varies wildly, depending on where the "Main Control" is set during measurements, so it is not to be taken literally.

The maximum voltage that the 1629 should be subjected to is 250 VDC, and less is better. Cathode current should not be more than about 4 mA. That will be OK, as long as the grid resistor is close to 1 Megohm or larger and the plate voltage is below 250 VDC.

I replaced the line cord on my units with a three-wire grounded type, and added a chassis mounted fuse holder. The repeatability of the instruments was greatly improved, since that, according to the manual, can depend a lot on which way the plug is inserted in the wall socket. With a three-prong plug, it always goes in the same way. The fuse, a 1-amp, fast-blow is adequate, and saves the power transformer if the diode or filter caps short out.

I shunted each power-supply filter cap with a 100-k ohm, 5-watt resistor. This leveled out the power supply variations very noticeably, and made the leakage and other tests much more stable. This should make the filter caps last a lot longer too.

If you have to replace your power transformer as I did, you will have to add a resistor between the 47-k resistor and the rectifier to absorb any voltage above that for which the circuit was designed, unless your transformer puts out 460 to 500 VAC. Measure the voltage at the top and bottom of the filter capacitor string, subtract 660 VDC from that, and find a 2-watt resistor of the proper value, i.e. (R = (E – 660) / .0045). Move the ungrounded end of the 47-k, 2-watt resistor and the 1629 plate lead from pin 8 of the 1626 socket to an unused pin on that socket. Then connect your new resistor between pin 8 and the junction of the 47-k resistor and the 1629 plate lead. You can also adjust the value of this new resistor to set your leakage test voltages to their exactly correct values if desired.

Circuit Description

The measurement circuit of the Heathkit C-3 is a simple AC bridge, powered by 55 VAC, and used for both resistor and capacitor measurements. The "Main Control" varies the resistance in TWO arms of the bridge, one of the other arms consists of the standards, whether resistors or capacitors, while the fourth arm is the unknown.

The resistance standards are two precision resistors, one of 2-k ohms, and the other of 200-k ohms, i.e., 100 times larger than the first. These provide the two ranges for resistance measurement.

The capacitance standards are three capacitors, a 200-pfd mica, and .02 and 2-mfd paper. I replaced these paper capacitors with metalized film capacitors in my units, which have much closer tolerances and lower leakage than the paper ones. The high capacity end of the dial is extended by a 90-k ohm resistor which is switched into one side of the "Main Control" resistance when needed.

Since electrolytic capacitors have much lower internal resistance than mica or other capacitors, in order to balance the bridge, an added variable resistance must be added in series with the standard capacitors to balance out this resistance. This variable resistance is the "Power Factor" control on the lower left of the instrument. Since electrolytic capacitors are usually much higher in capacitance than other capacitors, this control only comes into play on the high and extended ranges for measurement of capacitors.

Since modern electrolytic capacitors now have much higher internal resistance than those which existed when the

C-3 was designed, the modern user of this instrument will find that the "Power Factor" control will ordinarily be adjusted near the left-hand end of its travel, unless there is something wrong with the capacitor undergoing testing.

"Power Factor" as applied to capacitors is a measure of the energy loss in a capacitor as a result of its internal resistance. A higher "Power Factor" decreases the effective capacitance of a capacitor. At 20% PF, the effective capacitance is 98% of measured capacity: at 30% PF, effective capacity is 95% of measured, and at 50% PF, it is only 87% of measured capacitance.

The leakage test, which, by the way, is extremely sensitive, connects reasonably correct test voltages to the capacitor under test, and the degree of leakage is indicated by the degree to which the magic eye tube stays closed; the more closed the eye, the worse the leakage. After the operator becomes familiar with the instrument, leaky capacitors can be found very quickly and accurately. The actual voltage being applied can be measured by connecting a DC voltmeter to the center (+) and right-hand (-) "CAP" test terminals while testing for leakage.

Using the Instrument

When measuring unknown resistors or capacitors, connect the unknown to the appropriate terminals, set the multiposition switch to the approximate range, if known, and swing the "Main Control", watching for the eye to open. Don't swing the knob too quickly, since the opening of the eye at balance can be missed.

For electrolytic capacitors, alternately adjust the "Main Control" and the "Power Factor" control for maximum opening of the eye. Repeat this action until there is no further increase in the opening of the eye. The "Power Factor" control should be turned all the way to the left and switched out for all capacitors other than electrolytics.

According to the manual, a capacitor which, when tested for value (not leakage), will not allow the operator to balance (eye open to maximum) the instrument on any of the ranges, yet will allow the eye to open at the low end of the lowest range, is open. Conversely, if it allows the eye to open only on the high end of the high ranges, the capacitor is shorted. However, I have found that this is not necessarily the case, and depends on whether or not ALL the components in the bridge circuit are up to spec. One instrument I have shows the eye fully open at the high end of the ranges with nothing connected to the instrument at all.

When testing capacitors, there should be no resistor left connected to the "RES" test terminals, and vice-versa, or the instrument will not read properly.

Remember that the center terminal of the three test connections is positive (+) as far as voltage is concerned. This is important when testing electrolytic capacitors, doing leakage testing, or reforming.

When the "Normal/Leakage" switch is moved to the "Leakage" position, the voltage chosen by the setting of the multiposition rotary switch in the upper right corner is applied to the capacitor through the series resistors, which limit the maximum current. A fully discharged capacitor will cause the eye to close all the way as soon as the switch is moved to the "Leakage" position and held there (it is spring-loaded), and as the capacitor charges up, the eye will open at a speed

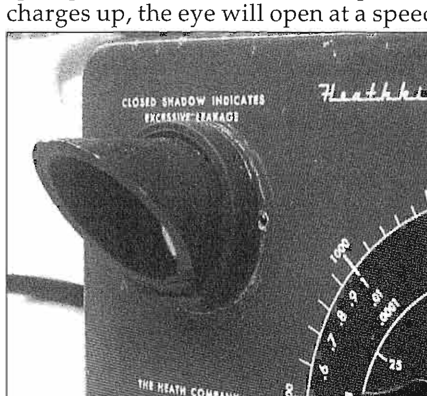


Figure 6: The homebrew eye shade is made from PCV pipe, as described in the text.

determined by the capacitance. The smaller the capacitance, the faster the eye will open. If the eye does not open to the exact point it was open before the leakage test was started, then it is leaky. Extremely leaky capacitors can make the eye tube "oscillate", or blink rapidly. Large values of capacitance may take quite some time to charge up, so the operator shouldn't get impatient. Also, if the operator has a strong set of fingers, he can hold the switch over in the "Leakage" position until the eye opens as far as it can. This procedure can be used to re-form old electrolytics. The "Leakage" test does NOT work properly unless the "Power Factor" switch is in the "Electrolytic" position!

When I use the instrument to re-form a capacitor or two, I use a set of vise-grips pointed out to the right to grip the knob and hold it in position by the weight of the pliers. When the "Leakage" switch is released, it shorts out the capacitor under test, so the operator doesn't get shocked by a charged capacitor.

The 1629 eye-tube can be hard to see in bright light. I have made a shade for one of my instruments out of two differing sizes of PVC pipe, glued together, cut off at an angle, painted flat black, and fastened to the front panel with two small sheet-metal screws. This helps a lot. **Figure 6** shows this modification on my second instrument.

Other Possible Mods and Uses

Since the 1626 "half-wave rectifier" is actually a power triode in which the grid and plate are tied together, it can be easily replaced by a 1N4007 diode. In fact, one could replace it with a full-wave bridge made of 4 each 1N4007 diodes if desired, and then use the 1626 in his ARC-5 transmitter since that was its original function.

It is possible that the C-3 could be used to quickly check unknown diodes for an open or shorted condition, although I have not yet tried this.

Other Instruments

As mentioned above, "Condenser Checkers" have been made by a large number of manufacturers and are still available from sources such as eBay. I recently did a search for "capacitor checker" there and came up with units made by Knight, Allied, Solar, Sprague, and B&K. Heathkit sold several different models, the latest being the IT-28, and IT-11. These last appear to differ only in their color scheme and include a function purposely designed for re-forming electrolytic capacitors.

Conclusion

In my opinion, there are only a couple of instruments that the radio restorer should not be without: a good signal generator, such as the AN/URM-25 or the HP-8640B, or even a pair of good BC-221s, an accurate frequency counter, the best oscilloscope he can afford, a decent multimeter, and lastly the nearly indispensable capacitor checker. The Heathkit C-3 certainly fills the bill.

Author's Footnote: Much of the section on how the unit works was taken directly from the Heathkit C-3 manual. I also included in that a lot of my own personal experience with the unit. I inserted many of my own comments, clarifying many confusing points and details of operation that Heathkit left out.

Kenneth G. Gordon W7EKB, born in 1942 in Kalispel, Montana, is the Electronic Instrument Specialist, Sr. at the University of Idaho's College of Science where he has been since 1981. He was first licensed in 1956 as WN7EKB, obtaining his Conditional Class license a little over 1 year later. He obtained his Amateur Extra Class license in 1963 and has been continuously licensed ever since. He presently resides in Moscow, Idaho with his lovely wife Judith, whom he married in 1980, and 5 children, three of whom are also licensed as KB7QEU, KD7IXC and KD7IXD.

[Mouser Electronics catalogs are available by calling 1-800-346-6873..Ed.]

ER

The KDØZS Equipment Notebook

Optimizing the Multi-Elmac AF-67 Transmitter

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

The Multi-Elmac AF-67 transmitter was produced from 1953 to 1958, and was a popular mobile rig for years. It was also designed to be used as a driver for a higher-powered transmitter, and saw wide use in that service due to its stability. The AF-67 used a simple, well done, standard approach to low-power transmitter design that was well received. There are several things that can be done to the transmitter to improve its performance and increase its usefulness, but it was a much used and heavily-modified radio. It can be a real trick to find all of the old mods and to decide which to keep and which to get rid of. You could say that this transmitter cries out to be worked on. It has, at least in early models, many foibles, yet the basic design and materials are sound.

Neutralization

The AF-67 manual is weak in several areas, does not cover circuit theory, and alignment is covered briefly. Neutralization is not mentioned at all in the AF-67 manual, but it is important. To allow for neutralization, isolate the B+ side of the driver tank circuit from the DC links with 250 mH shielded chokes. The chokes are placed in series with the red or orange wire going from the harness to the spot switch (labeled "VFO"). Also the wire running to the transmit low-B+, at the switch on the back, wall needs a choke and a diode (1N4007) in series with it. The diode's cathode goes to the driver stage. This allows the "Spot" switch position to turn on the driver. Remove the buss wire going to the driver screen; it'll be powered from a new drive control. Remove the existing .005 µF bypass capacitor at L45 and install a new .001 µF capacitor from the L44 B+ buss to the chassis ground at pin 4 of the driver tube, V4. Open the ground lug hole in the shield partition between output plate tuning capacitor and driver tank somewhat, being careful to not break the lug off. Run a length of #20 insulated buss wire between the driver B+ buss, through the shield partition hole near to the plate tuning capacitor connection, about 2.5 inches overall. The desired neutralization capacitance is about 3 pF and a 3.3-pF, 1-kV fixed ceramic cap works well.

Output Coupling

Change final plate coupling cap to .0022 µF, 3 kV.

Modulation

The driver and modulation transformers are pretty good, but there are several things that can be done to broaden the frequency response and reduce distortion. First,

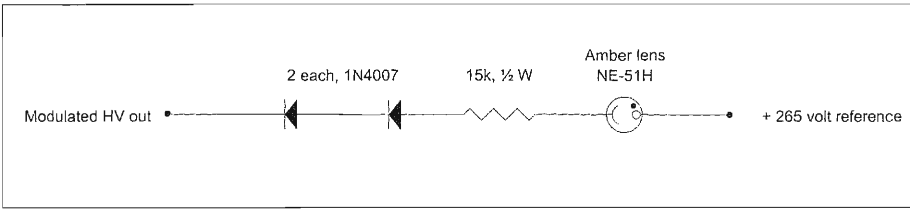


Figure 1: Schematic of the modulation indicator and negative peak limiter.

unground the 5881 cathodes, buss them together, then ground them with an unbypassed 120-ohm, 2-watt resistor. If there are shunt capacitors at the 5881 grids, remove them and connect the grids with a damping network made of a 47-k, ½-watt resistor in series with a .001 µF ceramic capacitor. The damping network will prevent transformer "ringing." Then, recap the amplifier and driver stages with Mylar capacitors of the proper voltage rating, but remove the cathode bypass capacitors. Change the audio coupling capacitors to .01 µF Mylar. Add negative voltage feedback from the 5000 ohm modulator output (the lower connection on the back panel B+ switch) to the driver cathode with an R-C network of .1 µF, I kV in series with 100 k ohms, 2 watts. This gives about 6 dB of feedback to reduce distortion and damp the modulation transformer. If, when you apply the feedback the audio level increases or there is audio oscillation, reverse either the plate or grid leads of the 5881s. Finally, if there is a shunt capacitor at the audio driver's grid (the 12AU7), remove it. Some AF-67s have this capacitor and some do not. Parts may have been added at the factory or may have been later modifications. With a long production history like the AF-67, anything's possible. Modulator response is now - 3dB from 100 cycles to 3 kc.

Microphone

This transmitter works perfectly and sounds good with high-output dynamic mics. For more audio gain, bypass the 6AU6 cathode resistor (2.2k) with a 10-µF, 15-volt electrolytic capacitor.

Combined Modulation Peak Indicator and Negative Cycle Loading

The circuit of **Figure 1** combines a negative peak modulation indicator with some negative cycle loading. The neon indicator's source is the modulated HV output, taken at the same point as the negative feedback. This point is the lower contact (closer to chassis floor, looking down into the inverted transmitter) on the rear-panel mode switch SW81A (AM-NFM-CW). The reference voltage is the

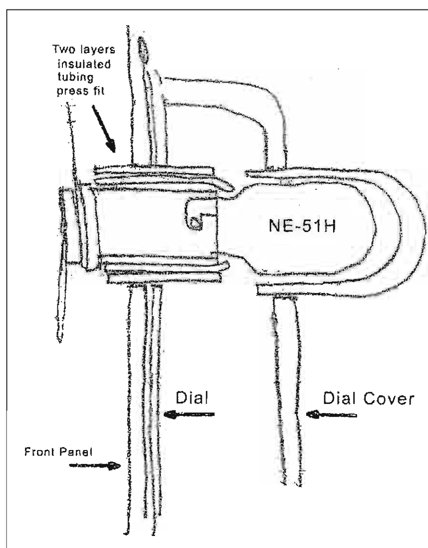


Figure 2: Parts mounting diagram for the neon lamp used in the indicator circuit.

transmitter's low B+ line, found on the upper contact of the same switch. An NE-5IH neon lamp in an incandescent pilot lamp fixture with an amber lens will be mounted in a new half-inch hole centered over the meter, shown in **Figure 2.** This is a "real time" modulation level monitor. Speak loud enough for the indicator to flicker steadily.

The combination of degenerative feedback at the 5881 cathodes, negative feedback around the modulator and driver, decreased distortion from unbypassed cathodes, and negative peak cycle loading by the modulation indicator allow compressed 100% modulation. Significant clipping of 10 dB or so can, and should, occur in the modulator. This generates no splatter and gives excellent intelligibility on the other end.

Dial Lamps

Hot dial lamps will damage the dial face and the dial cover! High-dissipation dial lamps (6.3 volts at 250 mA) are part of the filament current distribution scheme when the transmitter runs on 12 volts. These lamps will quickly melt the dial. Since the 115v power supply provides 6 VAC for the filaments, and everything is in parallel, change the lamps to type #1813. Also, open up the light access hole going into the dial area so that more light gets in for increased dial visibility. Later production AF-67s have this work already done.

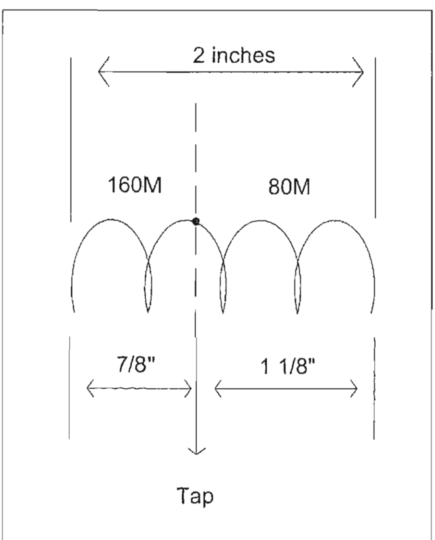


Figure 3: Layout diagram for the new 160-80 meter tank coil.

Final Amplifier Stability

The final amplifier wants to oscillate at low frequencies. Very poor grounding at the 6146 PA cathode and proximity of the grid and cathode unshielded chokes makes feedback likely. Drill out final socket rivets and add 4 chassis ground lugs. Install a "triangle" of #20 wire between pins 1, 4, and 6. Install .01 µF disk ceramic bypass capacitors with short leads from those pins to the nearest ground lug. Bypass the screen, pin 3, to a ground lug with a .001-µF, 1-kV disk ceramic capacitor. Change the grid choke to 1 mH, using short leads, and then add a 270 µH shielded choke to carry the current to the cathode keying line.

Shielded chokes are available from Digi-Key, 1-800-344-4539. Some suggested part numbers are: DN-41274-ND for a 270 µH shielded choke, DN-411105-DN for a 1 mH shielded choke. For a high current, unshielded 270uH choke (PA cathode), use Newark Electronics (1-800-463-9275), #28C9717. Finally, bias batteries (Eveready 412) are $6.95 at Antique Electronic Supply.

The PA plate snubber, whatever form it is, gets replaced with a standard design. Three turns of wire around a 47-ohm, 2-W resistor are used for this new part. When you're done the PA will be solid as a rock.

Power Amplifier Loading Problems

As built, the AF-67 does not have enough capacity in the loading capacitor to fully load the transmitter to its rated plate input power. One wonders why it was designed that way, but to correct the problem, parallel both sections of the variable loading capacitor on all bands, and use switched capacitance to pad the lower bands. 2 variable sections provide good loading on the 40 to 10 meter bands. Switch in 330 pF on 80 meters, and use

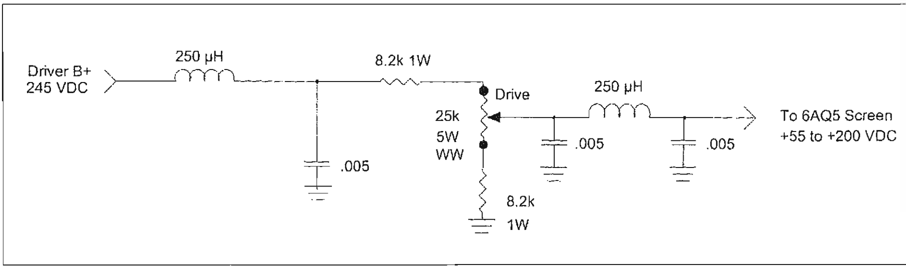


Figure 4: Modification to provide an RF drive control in the 6AQ5 screen circuit.

430 pF on 160 meters. These can be added directly at the band switch, grounded to the chassis. Another problem is that the 15 meter plate inductor is too small. I have seen several AF-67s with modified 15-meter plate coils, and this may have been either a common modification, or a factory change. If your rig has the original coil you need to modify the plate tank for 15 meters. Start by cutting away the 2 turns of the original 15-meter section of the tank coil, leaving something to solder to. Replace the missing 2 turns with 5 turns of 1-inch diameter, 8-TPI Miniductor coil stock, oriented in the same direction. Remove the wire added by the factory to short out 80 and/or 160 meter plate coils on the higher bands. Tune up all the multiplier stages, while paying particular attention to 15 meters. It's possible to tune for the wrong harmonic, which reduces the drive.

160-80 Meter Final Tank Problems

The 160-80 meter output coils on older transmitters are flimsy and usually squashed. The solution is a new tank coil made from a 1-inch diameter, 32-TPI piece of Miniductor coil stock, tapped as shown in the drawing in **Figure 3**. Later units came with this coil already installed.

Miscellaneous Changes

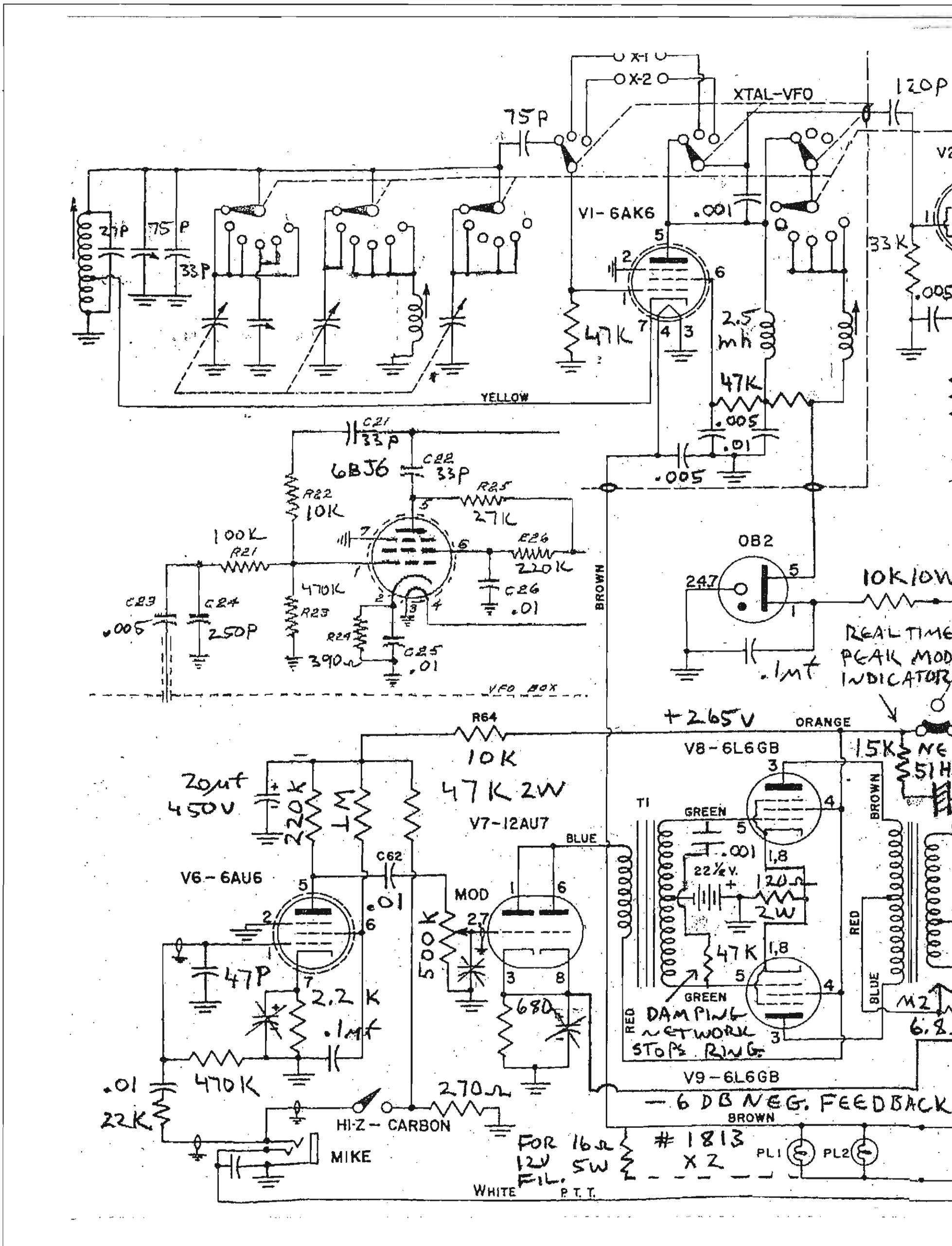
The low B+ power supply has no bleeder, leading to poor dynamic regulation and a rude surprise. Add a bleeder to the low voltage B+ in the form of a 100-k, 1-watt resistor at power supply pin #6. It's amazing how long a fresh filter capacitor will hold its charge!

How Not To Ruin the AF-67 Final Amplifier

There is no protective cut-off bias on the final amplifier! Without drive, the plate current is saturated full-on. Tune up must be quick or you will kill the final tube. You must use the far left "G" meter position and the VFO-spot switch in the "On" position to peak and set drive before ever keying the final. Using the driver tuning to adjust drive level is not satisfactory, particularly on the higher bands where VFO harmonics are close together. There is an unused control location to the upper left on the main tuning dial, which is perfect for a 5-watt rheostat to adjust the driver screen voltage. In fact I'm sure it housed one before the accountants got to the design. A schematic of the drive control is shown in **Figure 4**.

Upgraded Elmac Tuning Instructions

Tune the final grid circuit for peak current with the "Grid" knob, and with the meter in far left "G" position. Set the new drive control for 3 mA of grid current with the VFO switch in the "Spot" position. Put meter switch in the 3:00 "Plate" position and center the loading and plate tuning knobs. Key the transmitter and *quickly* adjust the plate tuning control for a dip. If no dip is visible on the meter, immediately unkey the transmitter, rotate the loading control CCW and try again. If you tune and load in small steps you will avoid ruining a good 6146 final. Be sure to check the position of the meter switch. It is easy to think the plate



is dipping and still be on the grid meter position. You can mark the correct position of the tune and load controls for each band with a fine-point felt-tip pen directly on the metal panel without damaging the finish.

Now, if it just had some protective bias for the final!

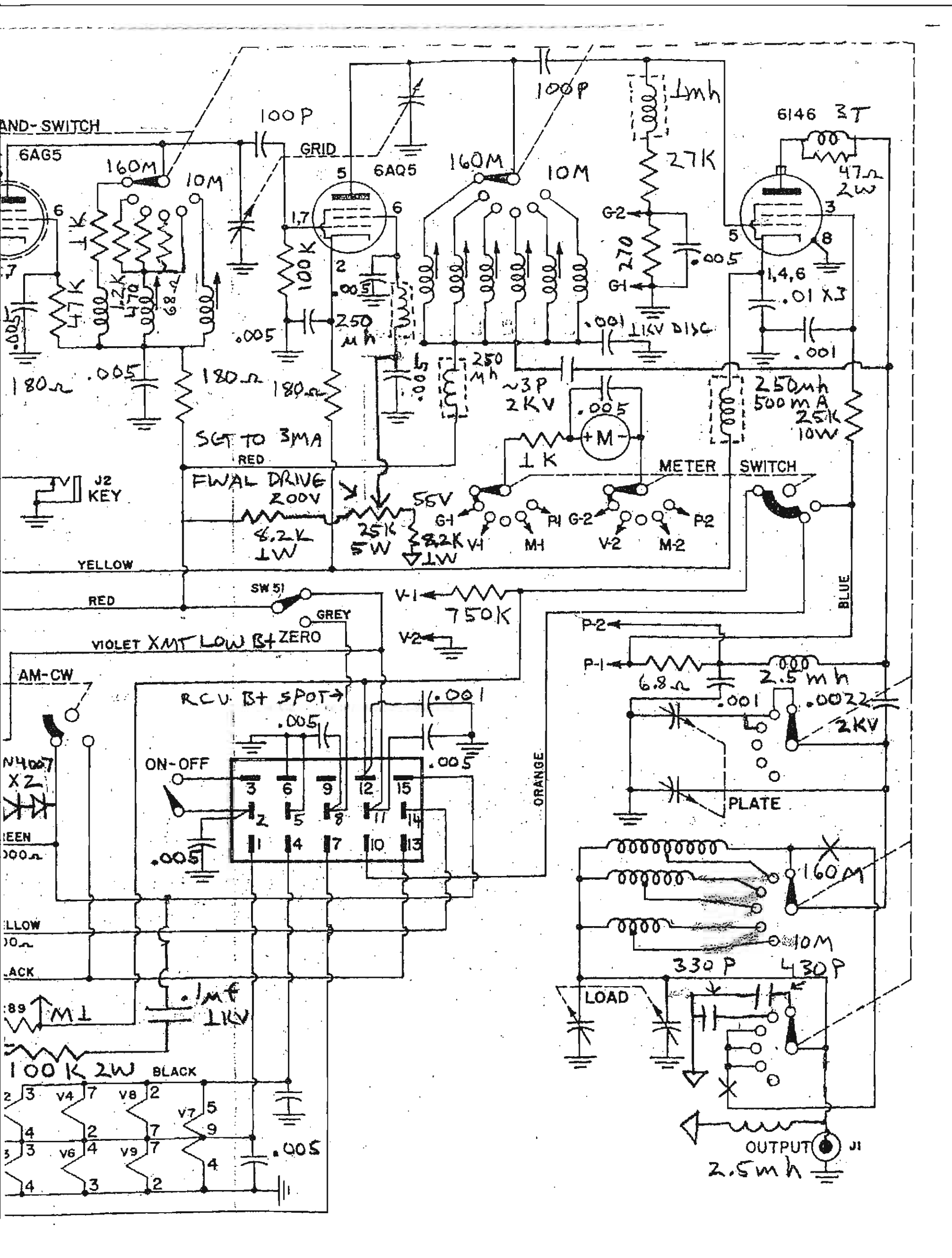


Figure 5: This is a complete AF-67 schematic showing actual parts values and my modifications noted on it. The 6BJ6 tube is the FM reactance modulator. Compare this diagram with the text to find the locations of the updates and changes. (Schematic courtesy of Bob Rhoads, KJ6CA)

ER

The Elmac "Economy" Power Supply

By Hal Guretzky, K6DPZ
Land Air Communications
95-15 108th St.
Richmond Hill, NY 11419

I have designed a simple power supply that can be used with many types of Elmac equipment, including transmitters such as the AF-67 and AF-68. It will also work with the companion Elmac receivers PMR-6A, PMR-7 and PMR-8. It is called an "economy" power supply because it uses inexpensive and commonly available power transformers from Jameco Electronics.

The original AC-DC power supplies for the Elmac, such as the M-1070, were not very well designed, and because of this, few are available in working condition. My power supply is a very robust design, and will power transmitters that are wired for either 6-volt or 12-volt filament strings. The complete schematic is shown on page 37.

Two inexpensive transformers having dual primaries and 12-VCT, 4-amp secondaries are used. The transformers are Jameco part number 14977OCX, and their telephone number is 1-800-831-4242. When wiring the power supply, be sure to connect the transformer winding exactly as shown in the schematic, or the voltages will not come out correctly. A voltage doubler is used to make the 500-volt, 160-mA supply for the 6146 final. The high-voltage supply has a safety bleeder. A tap is taken from the doubler input to provide 250 volts at 75 mA for the transmitter low-B+ supply and for the receiver B+. The 250-volt supply is well filtered with a 10-Henry choke and 100 µF of capacity. The power supply diodes are commonly available 1-kV, 2-amp diodes such as 1N4007.

The power supply has a unique feature that I call a safety indicator. The SPDT switch makes it easy to tell when the chassis is connected to safety ground and that the hot side of the 120-VAC house circuit is connected to the transformer primary. With the transmitter power switch off, flip the switch until the neon lamp fires. When the lamp is lit, it indicates correct polarity. Then you know it is OK to turn the transmitter on with the contacts across points "A" and "B." Note that this arrangement shouldn't be used with a GFI-protected circuit because of the imbalance between hot and neutral that it causes. In these cases, it is best to use a 3-wire polarized plug and verify that your outlets are wired correctly with one of the plug-in continuity testers. The tester may be purchased from Newark Electronics, part number 35F2254 (1-800-463-9275), cost is about $16.00.

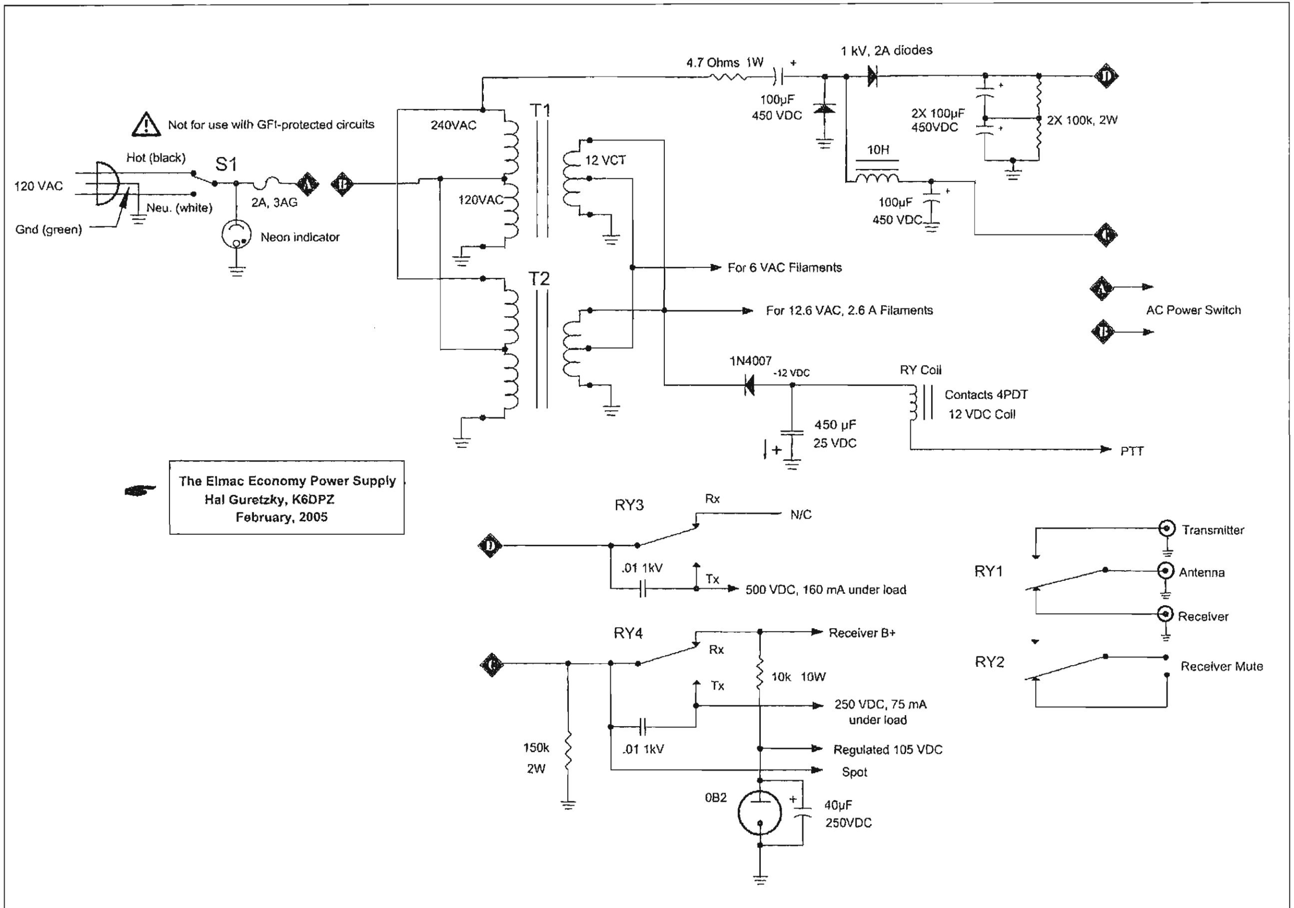
The 4PDT relay with a 12-volt coil is the same style as I used in the power supply for the Gonset Commander in ER #181, June, 2004. It is Radio Shack part number 275-214. The relay provides full Tx/Rx antenna switching and receiver muting capability. Use the chassis box and the parts layout given in my earlier article.

All of the other parts in the diagram will be found at either Radio Shack or at Jameco Electronics.

The 0B2 regulator tube is not needed with the PMR-6 or the PMR-7 because they have an internal 0B2. If you have either of these receivers, don't install the 0B2, the 10-k, 10-watt series resistor, or the 40 µF filter capacitor.

Enjoy your Elmac!

ER


The Elmac Economy Power Supply
Hal Guretzky, K6DPZ
February, 2005
Not for use with GFI-protected circuits
120 VAC
Hot (black)
Neu. (white)
Gnd (green)
S1
2A, 3AG
Neon indicator
240VAC
120VAC
T1
T2
12 VCT
4.7 Ohms 1W
100µF
450 VDC
1 kV, 2A diodes
2X 100µF
450VDC
2X 100k, 2W
10H
100µF
450 VDC
For 6 VAC Filaments
For 12.6 VAC, 2.6 A Filaments
AC Power Switch
1N4007
-12 VDC
RY Coil
Contacts 4PDT
12 VDC Coil
450 µF
25 VDC
PTT
RY3
Rx
N/C
.01 1kV
Tx
500 VDC, 160 mA under load
RY4
Receiver B+
10k 10W
250 VDC, 75 mA
under load
Regulated 105 VDC
Spot
150k
2W
0B2
40µF
250VDC
RY1
RY2
Transmitter
Antenna
Receiver
Receiver Mute

Memories of a KSJB Radio Engineer, Part 2, Conclusion

By Dennis R. "Doc" Murphy, KØGRM
111 W. Arikara Ave.
Bismark, ND 58501

Our Chief Engineer at KSJB always said, "Five miles is about the right distance from the transmitter to the studio!"

When I first went to work at the KSJB transmitter site, I signed the log, fired up the transmitter, read the meters every hour, logged the readings, shut down the transmitter at sign off, signed the log and went home. While I was out there the rest of the time was pretty much my own to do whatever I wanted, unless there was an assigned project. Then came the dreaded day, "Remote Control" arrived. The studio people could now turn on the station, monitor the meter readings and shut it down with only the flip of a few switches. So, there went my job.

Well, I got one good lick in after termination. I came home from Sunday church a week or so later and Mom said, "KSJB isn't on!"

"That's not my problem anymore" I said.

Five minutes later the phone rings and a voice asked, "Can Dennis come out to the transmitter?"

"Sure," I replied. I collected some tools and my VOM, cranked up the '46 Ford, and hit the road.

On my arrival I pulled a "station manager" and peeked in the front window to see what was going on. I observed the newly christened "Announcer / Engineer" push the "Overload Reset" button, and then push the transmitter "On" button on the RCA 4-compartment, 5-kW export rig. I continued to watch as all heck broke loose as it cycled through two high power start attempts, a low power attempt, and then shut down everything. The A/E would then pace back and forth in front of the RCA, hands behind back with a worried look on his face.

Ah, revenge is sweet! I entered the building, heard the sad tale, and got to work. The RCA transmitter had the 5-kW section in the left compartment, the center compartment housed the RF, and the oscillators and drivers were on the left-side wall. The audio amplifiers and audio drivers were on the right-side wall. The right compartment was actually 2 walk-in compartments; the final modulator tubes on the left-side wall, all the high voltage rectifiers and filament transformers on the back wall. The control relays were mounted in the compartment to the right, on the right-side wall. (It could be connected for 10 kW, too.) There were three access doors for the 5-kW RF section. The right door was by the final modulator tubes, and a solid fourth panel with control buttons and filament Power-Stats for the big triode tubes finished the transmitter layout. There were lots of meters across the tops of all the compartments, back lighted too, and it was very pretty rig at night with the room lights off.

Not having any idea myself what to do, I disconnected all the high voltage going to each compartment and pushed the "Filament On" button, all the tube filaments came on. Then, I reconnected the HV to the final RF amplifier and "Hey, 5 kW!" After that, I gave HV to the modulator, and heard a big Pow! Bang! I hit the transmitter "Off" and that was enough of that.

Obviously the problem was in the audio stage, but where? I disconnected the filaments to the final modulator tubes, and then had my "Assistant" push the transmitter "On" button while I watched through the center section door window (all the doors had windows, very handy). When the transmitter went on, one of the modulator driver tubes showed a very nice blue arc in the base, "Off, please and I'll be right back". I got a tube out of spares, installed it, reconnected the modulator filaments and KSJB was back on the air.

The rest of the story comes from the Chief Engineer who had gone on vacation and was in Montana. That Sunday morning, hearing no KSJB on his car radio, he found a telephone and called the station. After hearing the tale of woe, he told them to call Dennis, and said he would head back to the station. When he heard the carrier come on and go off, his comment to his wife was, "Dennis must be there," and then when the music came on, he turned around and continued his vacation.

Later on, I was out of college and was working as a Radio Technician for the North Dakota Highway Department, or Department of Transportation as they now call themselves. KSJB had installed an FM transmitter at the AM site with the antenna mounted on the center tower (I got my first tower climbing experience on that tower, replacing beacon bulbs at 300 feet).

Well, I listened to KSJB-FM a lot when driving between Minot, where I worked, and the folk's home in Jamestown where the major amateur radio equipment still resided. Several years went by and their signal usually pooped out at Manfred, about halfway to Minot, then I would tune in a Minot station with a similar "format". One night after arriving at Manfred, I shut the radio off and enjoyed a nice summer drive the rest of the way. The next day in downtown Minot, I turned on the radio and there was KSJB-FM nice and clear-Wow! It was that way day after day; I was delighted to say the least. Since I worked on low-band, high-band, UHF, and some microwave 2-GHz two-way radio equipment, I had a natural curiosity as to what KSJB was using on FM. When I was in Jamestown, I called the Chief Engineer and asked him if he ever was out at the transmitter site on weekends, and that I'd like to see the FM install (He did beautiful work).

He said, "Not usually on weekends, but for you I will make an exception because my arms aren't long enough! How about next Sunday about 1 AM after sign off?"

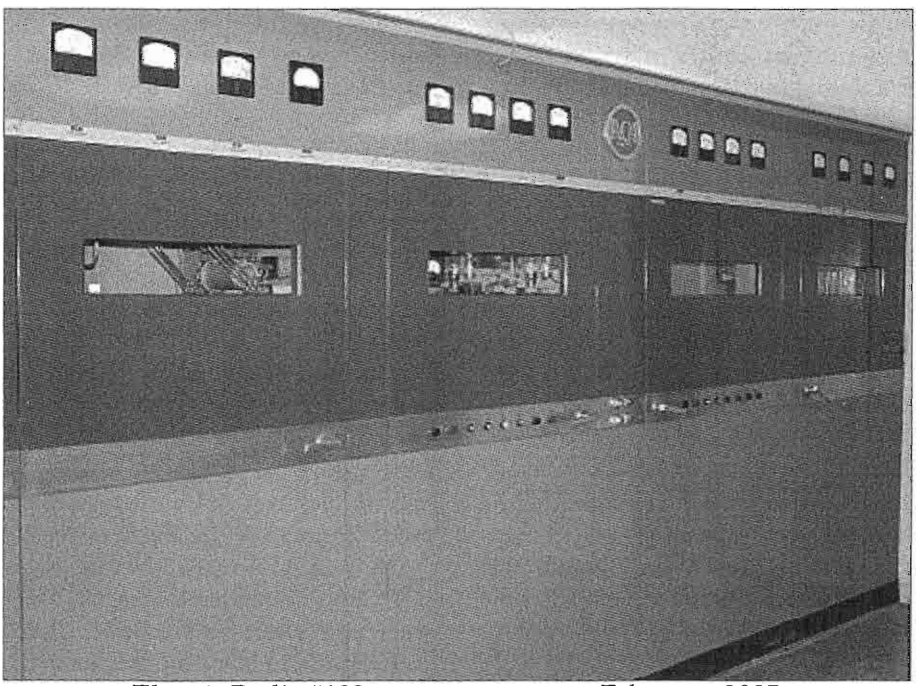
Well, that made me a bit suspicious, but I was interested, so the next week at 1 AM I arrived. The old 5-kW RCA was gone, and was replaced by a wall. There was a 5-kW Gates AM transmitter and a 10-kW Collins FM transmitter along the same wall. Forgive me, but I hadn't got into Collins model numbers and the other significant minutiae at that time. Next to the station monitor rack was either a Federal or Western Electric 1-kW AM transmitter that they used when pulling out the RCA and installing the Gates. This was now the AM standby transmitter.

Either the plate tuning or the antenna coupling drive chain had removed itself from the gear train. He couldn't reach both ends at the same time. His arms would have had to be 16 to 18 feet long as the door to rear of the equipment was at the other end of the wall. Therein explains my exception - HI!

After the chain was put back on and tested to be in good order, we settled down to have some fun. He had several "sort-of-new" FM PA tubes, and wanted to see what they would do. Out with a tube, in with another, and then tune it up; it tuned so smooth getting to 10 kW that I couldn't believe it! I had been working with 100, 300, 250, 350 and 5000 Watt two-way amplifiers, but they behave totally different than that Collins.

During our morning work shift, I mentioned how the FM signal came in so good in Minot which surprised him, and then he told me the FM antenna side arms had all cracked and they had just been replaced that week. I think we did a few other tasks that morning, and so I hit the rack as the Sun was well up. Fun, Fun! Oh yeah, no more KSJB-FM in Minot after the cracked side arms were replaced - Phooey!

ER



[...Comments from Page 1]
have to use something dynamotor powered, typically a receiver or a transmitter. Try to make as many contacts as possible, and send your event log to Electric Radio via the methods listed inside the rear cover. 3885, 7290, and 21,400 kc should be OK for phone, but 14.290 is an announced QSO Party frequency. For CW, I think we should plan on using 3546, 7050, and 14050 kc, +/- existing QSO's.

More BPL

By now, probably everyone knows that the FCC has approved deployment of BPL systems, and this activity is underway in a few areas of the country. This deployment does not necessarily mean the end of HF operations. What it does mean is that we, as Amateur Radio Operators, need to organize into local groups, become better informed about the technology, the rules that govern its use, and our rights as licensed users of the radio spectrum. It seems as though organized groups are speaking with a more credible voice. It is important to be able to tell the difference between incidental band noise and the digital noise caused by BPL systems. There are web sites where one may listen to actual off-air recordings of working BPL systems. One excellent web site is maintained by the Verde Valley ARC, Cottonwood, AZ. This site may be found at http://vvara.org/broadband_bpl.html. (Type this URL in your browser exactly as printed.) The club has headings on their web page which apply to any area of the country, such as "BPL Sound Recordings," "FCC Part 15 Rules," and "How to Report BPL Interference." Your local radio club may be able organize meetings where everyone is able to hear these recordings at once because we don't all have Internet access at home.

In the past, I have quoted parts of public news releases from the Utilities Power Line Council, an industrial trade association supporting BPL technologies. In their public release of January 28, 2005, they quote the results of field strength testing apparently performed by FCC personnel, rather than by the industry testing itself! Below is part of that news release:

"...The FCC released testing data of BPL emissions at several deployments, which showed that BPL equipment was generally operating in compliance with the FCC limits and that the potential for interference to Amateur operations was low. The vast majority of the 648 pages released include e-mail correspondence from complainants to the FCC and to BPL operators, but these complaints are generally refuted by tests of Ambient, Amperion, Main.net and Current Technologies equipment. *The documents were produced in response to a Freedom of Information Act (FOIA) request filed by the Amateur Radio Relay League (ARRL)* [italics by editor]. Tests of Amperion and Main.net equipment in Allentown, PA found that the equipment was operating in compliance generally, but that a Main.net overhead repeater was 3 db over the limit and just needed to be reset at the power level at which the equipment was certified to operate. The FCC also noted that the repeater would have been in compliance had the FCC measured from the ground wire instead of the nearest part of the BPL system. In tests of Current Technologies equipment in Potomac, MD, the FCC prefaced its remarks by thanking Current Technologies for the "excellent support that it provided during these tests." Meanwhile, the FCC found that Ambient equipment at Briarcliffe Manor, NY was "compliant w/emission limits within measurement uncertainty," and that Ambient planned to improve notching issues with one device. Finally, in tests at Raleigh, NC in response to Amateur complaints there, the FCC found nothing in the 15 meter and 12 meter bands; and what little they were able to find in the 10 meter band could be addressed by increasing the notch width by 100 kHz at the low end of the band.

The ARRL was muted in its response to the FCC findings, stating that they "tend to back up" its assertions on BPL. Instead of claiming harmful interference, the worst the ARRL could allege was that the "Part 15 emission limits generates a strong RF signal for long distances along overhead power lines," and that BPL noise levels were higher than otherwise "quiet" ambient noise levels. The ARRL remains concerned that notched noise levels would "obstruct many of the signals that amateur operators routinely use for radio communication," despite FCC findings that notching techniques are an effective means of mitigating interference.

FCC OET Deputy Chief Bruce Franca, agreed with ARRL that BPL operations could cause interference to local ham operators, adding that was the reason "we put into place mechanisms" to ensure that BPL equipment can be "frequency actual" — meaning if interference is caused, BPL operators know it. Responding to ARRL claims of vindication by the FCC documents, Franca said "we certainly recognize that BPL is different than the traditional carrier current systems and have greater potential of causing interference," but that "we put into place mechanisms to make sure that interference doesn't occur and can be cured." He added that the FCC believes amateur radio and BPL can operate in a "compatible way," and was "still optimistic there are technical solutions here and this is not going to be a problem."

The ARRL also released a BPL news item January 28, 2005:

"...Pennsylvania town drops BPL plans (Jan 28, 2005) — The Borough of Chambersburg, Pennsylvania, has decided against plans to offer broadband Internet service via broadband over power line (BPL) technology, according to a January 18 report in Public Opinion. The Cumberland Valley Amateur Radio Club (CVARC) spearheaded ham radio opposition to the plan in the eastern Pennsylvania community of some 17,000 residents through an informational campaign. "We were lucky, but only because many members of the local amateur community put time in to fight BPL right up front, *before the municipality had thrown so much money at it that it had a stake in it succeeding*," CVARC President David Yoder, KB3HUC, told ARRL. "I can't emphasize that enough—putting people in front of the decision-makers, working with the press and so forth paid off, because we jumped in as soon as we heard BPL was being considered." The Public Opinion article by Cathy Mentzer, quoted Chambersburg officials as saying there wasn't enough money in the municipality's Electric Department budget to go forward with a BPL deployment this year. Borough officials also cited state legislation effective last year that encourages telecommunication companies to provide broadband to consumers. While the BPL initiative is off the borough's 2005 projects agenda, Public Opinion quoted Borough Council President Bill McLaughlin as saying, "As far as I'm concerned, it's dead." Public Opinion also noted that CVARC members were pleased by the outcome. "That is good news," the article quoted Yoder as saying. "All Amateur Radio operators in the area are relieved to learn that apparently our concerns were taken into account, along with the recent legislation." Among other things, CVARC members had told the Borough Council last year that BPL would interfere with Amateur Radio and its ability to provide emergency communication. Chambersburg officials had been looking into leasing the borough's power lines to an Internet service provider as a way to generate revenue, and a consultant had recommended Chambersburg look into BPL...."

I think the situation with BPL, as far as we as amateurs is concerned, is far from hopeless. With an organized effort, these systems can be forced to comply with the rules or prevented from starting up with an organized, rational argument.

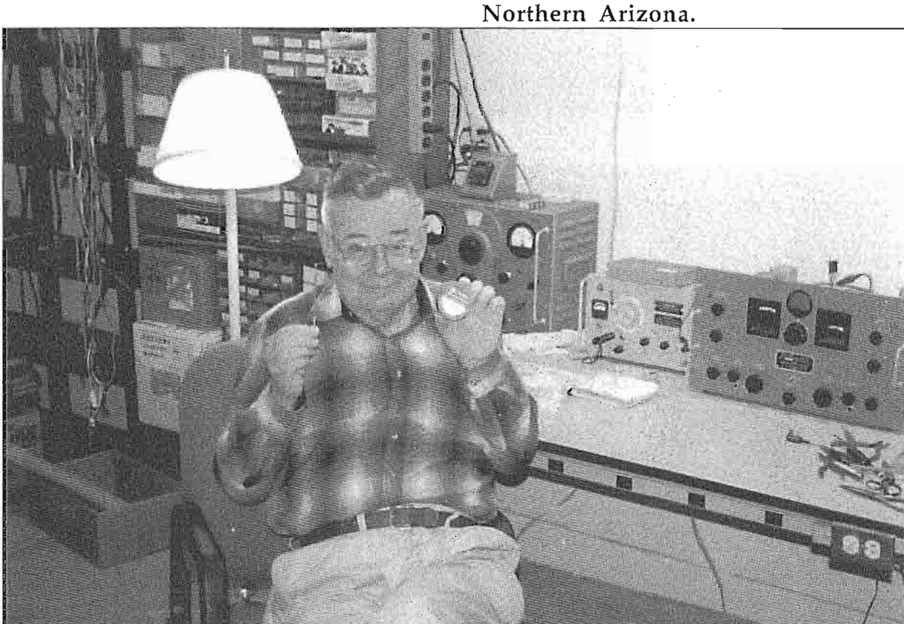
Another thing that might help is restoring more broadcast transmitters so that the average signal is at the legal limit and 3dB above the noise.

73, and keep those filaments lit!
Ray, NØDMS

PHOTOS

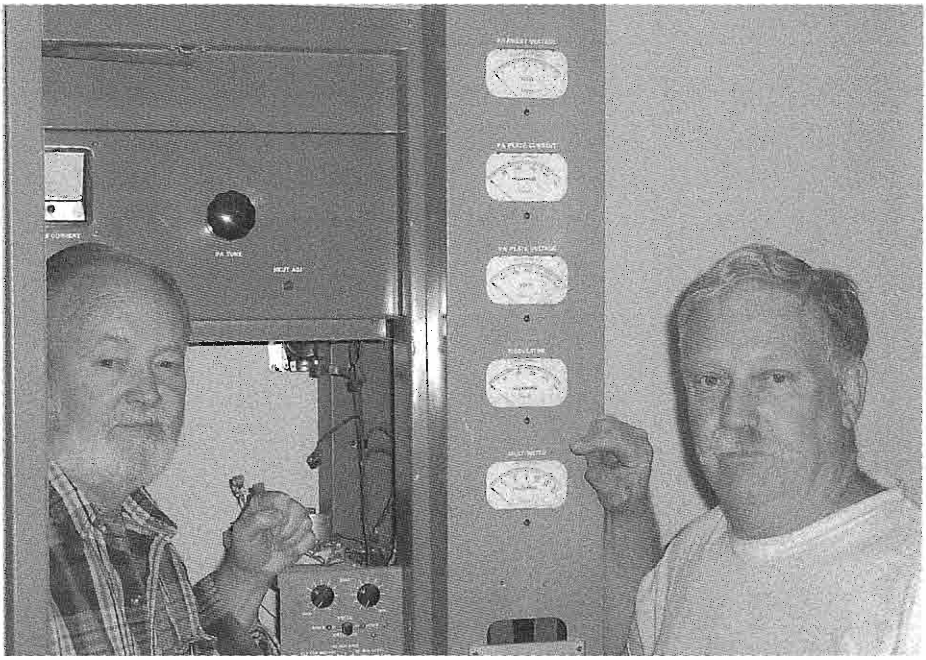
Left: John Thuren (AA5T) operates AM and is frequently heard on the bands with his Globe King from his home in Houston, Texas. John is the organizer of the weekly transatlantic 20-meter AM schedules with the United Kingdom. Conditions have not been very good in recent weeks, and the weekly schedule has been temporarily suspended. Watch for announcements in Electric Radio about the resumption of our AM-DX activities.

Below: Joel Ekstrom (W1UGX) is the author of last year's popular articles about superhet tracking design. This picture was taken in his workshop at Sedona, Arizona, and he is holding a small rat-tail file and a can of soldering paste that he to travel to Mexico to find, as they were not availble in Northern Arizona.



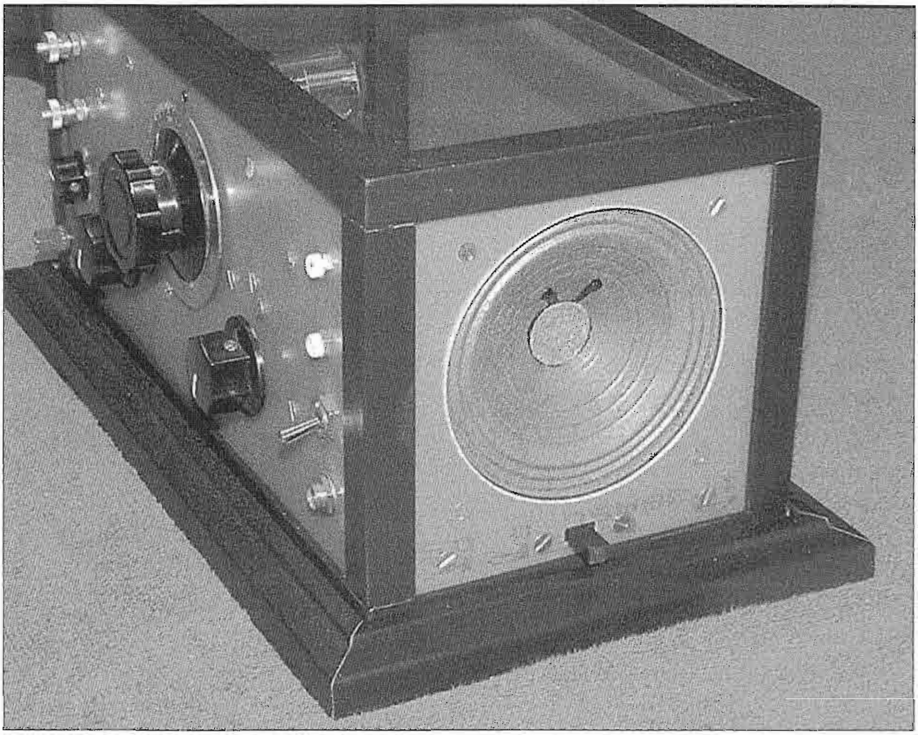
Above: Another familiar call on the AM frequencies is KEØMT. Jeff Garrett operates from his home in Arvada, Colorado, which is near Denver. Here, he is using his BC-610 and BC-614 speech amplifier with a Collins R-388 receiver.

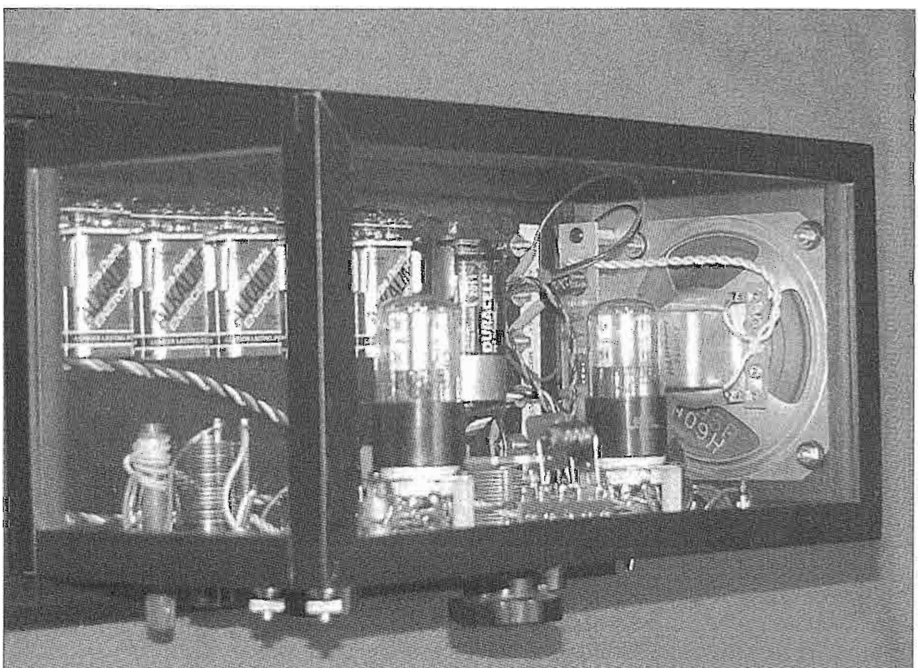
Below: Mike Langston (KL7CD) has equipped his vintage shack in Carrollton, Texas, with fine Hallicrafters and B&W equipment. Pictured to the far left is an SX-115, in the center is a B&W 5100B and a companion sideband generator, and to the right is an SX-101A. Mike is making quality reproduction SX-101 tuning knobs available, see the classified section for details.



Above: Frank Fisher (WA6RBQ), left, is helping Tom Hebb (WA6APN), right, to restore Tom's Gates BC-250T broadcst transmitter. Tom found out that a BC-250T and a BC-1T had been installed at KSLY 1400 AM in 1961. Then, sometime in the mid 1980s, KSLY went FM and the owners got a new AM license as KKJL which is still an AM station in San Luis Obispo, CA. About six years ago a Ham (WA6LJR) found out that both Gates rigs were headed for the metal scrap yard. He got the BC-250T before it made it's final journey and went to the scrap yard to find that the BC-1T had already been "pinched" on the top of the cabinet by the "jaws of death." He talked the people at the scrap yard into letting him salvage parts out of the BC-1T before any further damage was done. He also managed to obtain all the Gates documentation from the broadcast engineer at KKJL. He found out that the BC-250T had received a bullet wound on it's lower right side. No it wasn't an angry station engineer! The transmitters were at a remote site and some idiot shot the building with several rifle rounds. Both transmitters survived the attack. (Photo and story courtesy of Bill Hooper, KF6AR)

Page 46: Master regen builder, Dave Ishmael (WA6VVL), has sent us pictures of his latest design. Here is his description of the receiver pictured on page 46: "...The front panel is 5" x 11". It is fabricated from 0.062" single-sided PCB material and the copper is used as a ground-plane on the component side. The components mounted to the front panel are almost too heavy for an 0.062" panel, but the front panel is supported 360° by the presentation case when fully assembled so it's not an issue. The copper side has been sprayed with several coats of Crystal Clear Krylon to keep it from oxidizing. Where connection to the copper is required, I use external-tooth lock washers to really cut into the copper. The circuit is from the July '34 Short Wave Craft "The Constant Band-Spread Twinplex". I used two 1G4GT's instead of the dual-triode 19. A 1:3





interstage transformer significantly improves the overall gain. I added an audio gain control across the secondary of the interstage transformer and I like the added flexibility it gives me. I'm using a 6.3-VAC filament transformer as an output transformer to drive an external speaker or 4/8 ohm headphones. Speaker volume using an external Kenwood SP-230 speaker is adequate with strong local signals. The toggle switch selects hi-z or lo-z headphones or a 4" speaker. My Kenwood HS-5 lo-z phones are much more comfortable long-term than my vintage Baldwins. The battery supply is 45V using 5 x 9V batteries and a single "D" cell for the 1G4GT's filaments. The loopstick antenna coil is now mounted on the front panel to adjust the tuning range without opening it up. The tickler/feedback winding has been added and can be easily seen in the photos. The tubes are NOS Dumont 1G4GT's that I found on eBay (from The Netherlands). The total cost was about $115 and primary sources for the components included Radio Shack, eBay, and my junkbox.

The 2-tube design would just drive my Kenwood SP230 speaker, but certainly not at any level considered acceptable. So, I started trying to figure out a way to add my "optional" speaker to my regen. I designed a small PCB for the LM386N, an 8-pin DIP audio amplifier IC available from Radio Shack and other places. I used a standard design with the minimum gain of 20. It is powered off of the 9V battery on the bottom of my 45V battery chain and I designed in the 9V tap from the beginning. The speaker board has its own SPST slide switch to turn the power on/off. I am extremely happy with the results. With a minimum gain of 20 for the LM386N, there is more than enough gain for the speaker. With the regen and gain control set for a comfortable listening level, there's no sense that you're listening to a simple 2-tube regen rather than a state-of-the-art radio. A third 1G4GT driving a speaker just didn't provide enough gain and a more "powerful" tube would have been a "burden" on my batteries, so the LM386N was a reasonable compromise. "

Below: Bill Knish (W9ALD) has recently found an extremely rare example of the E.F. Johnson Micro Viking Twenty mobile rig, and there are only a few that have survived. Frequency coverage was from 14.2 - 14.350 Mc, VFO control, noise silencer, USB & LSB, PTT, RIT, S/REL Power out metering, and 10 watts PEP input with 3.6 watts PEP out. Receive sensitivity is .2uVolt for 10 db S/N ratio with a 8.75 Mc crystal filtered IF.

ER reader Fabio Liberatori (IØLBE) keeps the filaments glowing in Hallicrafters receivers and Johnson Viking transmitters from Rome, Italy. Note the collection of Hallicrafters speakers on the shelf over Fabio's operating position.

ER

AM Calling Frequencies

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

Vintage CW Calling Frequencies

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

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

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

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

VINTAGE NETS

Arizona AM Nets: Sat & Sun: 160M 1885 kc @ sunrise. 75M 3855 kc @ 6 AM MST. 40M 7293 kc 10 AM MST. 6M 50.4 Mc Sat 8PM MST. Tuesday: 2M 144.45 7:30 PM MST.

Boatanchors CW Group: QNI "CQ BA or CQ GB" 3546.5, 7050, 7147, 10120, 14050 kc. Check 80M winter nights, 40 summer nights, 20 and 30 meters day. Informal nightly net about 0200-0400Z.

California Early Bird Net: Sat. mornings @ 8 AM PST on 3870 kc.

California Vintage SSB Net: Sun. mornings @ 8AM PST on 3860 +/-

Colorado Morning Net: Informal AM'ers on 3875 kc Mon, Wed, Fri, Sat, and Sun@ 7 AM MT. QSX KØOJ

Canadian Boatanchor Net: Daily 3725 kc (+/-) @ 8:00 PM ET. Hosts are AL (VE3AJM) and Ken (VE3MAW)

Collins Collectors Association (CCA) Nets: Tech./swap sessions every Sun. on 14.263 Mc @ 2000Z. Informal ragchew nets meet Tue. evening on 3805 kc @ 2100 Eastern time, and Thu. on 3875 kc. West Coast 75M net is on 3895 kc 2000 Pacific time. **10M AM net starts 1800Z on 29.05 Mc Sundays, QSX op 1700Z. CCA Monthly AM Night:** First Wed. of each month, 3880 kc starting @ 2000 CST, or 0200 UTC. All AM stations are welcome.

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

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

Drake Users Net: Check 3865 kc, Tue. nights @ 8 PM ET. QSX Gary (KG4D), Don (W8NS), and Dan (WA4SDE)

DX-60 Net: Meets on 3880 Kc @ 0800 AM, ET on Sun. QSX op is Mike (N8ECR), with alternates. The net is all about classic entry-level AM rigs like the Heath DX-60.

Eastern AM Swap Net: Thu. evenings on 3885 kc @ 7:30 PM ET. Net is for exchange of AM related equipment only.

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

Fort Wayne Area 6-Meter AM net: Meets nightly @ 7 PM ET on 50.58 Mc. Another long-time net, meeting since the late '50s. Most members use vintage or homebrew gear.

Gulf Coast Mullet Society: Thu. @ 7PM ET, 3885 kc, QSX op Charles (K4QZO) in Pensacola.

Gray Hair Net: One of the oldest nets, @44+ years ,160 meter AM Tue. evening 1945 kc @8:00 PM EST and 8:30 EDT. Also check www.hamelectronics.com/ghn

Hallicrafters Collectors Association Net: *Sun.*, 14.293 Mc, 1:15 PM EST/EDT. *Sat.*, 7280 kc, 1:00 PM EST/EDT. *Wed.*, 14.315 Mc, 6-8:00PM EST/EDT. QSX op W8DBF.

Heathkit Net: Sun. on 14.293 Mc 2030Z right after the Vintage SSB net. QSX op W6LRG, Don.

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

K6HQI Memorial Twenty Meter Net: This flagship 20-meter net 14.286 Mc running daily for 25+ years. Check 5:00 PM Pacific Time, runs for about 2 hours.

Midwest Classic Radio Net: Sat. morning 3885 kc @ :30 AM, CT. Only AM checkins. Swap/sale, hamfest info, tech. help are frequent topics. QSX op is Rob (WA9ZTY).

Mighty Elmac Net: Wed. nights @8PM ET (not the first Wed., reserved for CCA AM Net), 3880 +5 kc. Closes for a few summer months QSX op is N8ECR

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

Northwest AM Net: AM daily 3870 kc 3PM-5PM winter, 5-7 PM summer, local. 6M @50.4 Mc. Sun., Wed. @8:00 PM. 2M Tues. and Thurs. @ 8:00 PM on 144.4 Mc.

Nostalgia/Hi-Fi Net: Started in 1978, this net meets Fri. @7 PM PT, 1930 kc.

Old Buzzards Net: Daily @10 AM ET, 3945 kc in the New England area. QSX op George (W1GAC) and Paul (W1ECO).

Southeast AM Radio Club: Tue. evening swap, 3885 @7:30 ET/6:30 CT. QSX op Andy (WA4KCY), Sam (KF4TXQ), Wayne (WB4WB). SAMRC also for Sun. Morning Coffee Club Net, 3885 @ 7:30 ET, 6:30 CT.

Southern Calif. Sun. Morning 6 Meter AM Net: 10 AM on 50.4 Mc. QSX op is Will (AA6DD).

Swan Nets: User's Group Sun. @4PM CT, 14.250 Mc. QSX op Dean (WA9AZK). Technical Net is Sat, 7235 kc, 1900Z. QSX op is Stu (K4BOV)

Vintage SSB Net: Sun. 1900Z-2000Z 14.293 & 0300Z Wed. QSX op Lynn (K5LYN) and Andy (WBØSNF)

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

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

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

CLASSIFIEDS

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 e-mail, so it is a good idea to include phone numbers. Non-subscribers: $3.00 minimum for each ad up to 20 words. Each additional word is 25 cents. E-mail ads are fine.

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Deadline for the March, 2005 issue: Saturday, February 26

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) e-mail. Robert Downs, 2027 Mapleton Dr., Houston, TX 77043, wa5cab@cs.com

FOR SALE: Hammarlund Telechron clock plastic face covers, crystal clear, new reproductions, $15 plus shipping. Rick Cutter, WA3MKT, 814-725-9490, richard_cutter@lord.com

FOR SALE/TRADE: Original manuals: Heathkit, EICO, Hickok, Knightkit, Hallicrafters, Hammarlund, National, Lafayette, Conar, Simpson. NI4Q, POB 690098, Orlando, FL 32869. 407-351-5536 ni4q@juno.com

FOR SALE: Collins 75S-1, CW, Waters, VGC $500. 32S-1 VGC $450; 75S-1 repaint cabinet, looks perfect, $400. All working, books, guaranteed. Freight paid lower 48 US states. Don, K5AAD, 713-942-9747

FOR SALE: B&K 500 tube tester with set up chart, adapters, works. $75 shipped. Johnny Unphress, 1415 Moore Terrace, Arlington, TX 76010, 817-915-4706. www.jg-umphress@sbcglobal.net

FOR SALE: 1942 Meissner Signal Calibrator, Model 9-1076. See QST ad Aug. 1942, P107. $75. Alan Lurie, W9KCB, 605 E. Armstrong Ave, Peoria, IL 61603 309-682-1674

FOR SALE: Hallicrafters HT-32A in excellent condition with manual $300. Bob, W1RMB, 508-222-5553.

FOR SALE/TRADE: B&W LPA-1 2KW 813 amp w/ps $850. NC-125 w/Selectoject $125. RT-66/GRC $100. **WTD INFO:** RCA/Radiomarine T-408/URT-12/USCG. Sam KF4TXQ PO Box 161 Dadeville, AL 36853-0161 stimber@lakemartin.net 256-825-7305

FOR SALE: Westinghouse TDE-2 naval transmitter B.O. **WANTED:** Heath SB-620, SB-500. Stan Sepiol 607-739-3276 ab2ma@netzero.net 556 Benjamin Rd, Cayuta, NY 14824

FOR TRADE: Collins TCS-12 package w/ AC PS, Collins TDO package, R388 Rx in Collins cabinet, Hammarlund RBG rx, Signal Corp Control Unit C-113A/TRA-2, Globe King 400B Tx, TMC GPR-90RXD Rx, Morrow 2BC mobile converter, HRO-50 "D" coil. Gary, WA9MZU, 209.286.0931 or ghal@ix.netcom.com.

FOR SALE: Hammarlund Pro 310 receiver, $400. Bill Garbutt, 2665 E. 5th St., Casper, WY 82609. 307-235-4799

FOR SALE: Hallicrafters SX-28, very good $400. P23 speaker $125 pickup only. John, NE6G/4 850-944-6563

FOR SALE: Two Hammarlund rcvrs: HQ-180 w/spkr $375 and HQ170A $250. Also Central Electronics 20A, $250. All equipment in good condition electrically as well as cosmetically. Bud, K5JDU, 580-298-3105 or 580-298-3105. Antlers, OK 74523

FOR SALE: Heathkit OS-1 oscilloscope, works, looks great, $35 + UPS. Johnny Unphress, 1415 Moore Terrace, Arlington, TX 76010, 817-915-4706. www.jg-umphress@sbcglobal.net

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

FOR SALE: RCA VoltOhmyst VTVM nice condition, sell or trade for Heath HG-10 VFO. John W2PRR , 585-671-4228, jandjm130@juno.com

FOR SALE: Heath HS-24 Speaker, $25; Lafayette HA-90 VFO, $95; Ameco SWR Meter, $30. Richard Prester, 131 Ridge Road, West Milford, NJ 07480. 973-728-2454. rprester@warwick.net

FOR SALE: BC639A, RA42B rcvr $105. Heath Xcvr HW100, manual $100. Layayette KT320 Rx $60 Radio Shack PRO2006 $365. Ron, MI, 517-374-1107

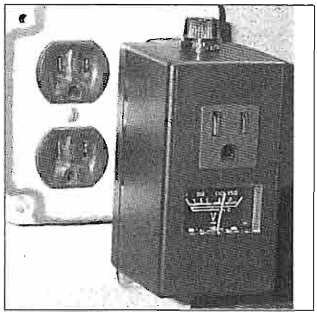
FOR SALE: Heathkit DX60B w/ HG10 VFO HG 10B clean $120. Pwr sply model FRB 24-2-24 (50/60 hz) clean $40. Bernie Samek 113 Old Palmer Rd., Brimfield MA. 01010 413-245-7174 FX 0441 bernies@samnet.net

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

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

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

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



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

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

FOR SALE: Hallicrafters S-40A, mint, original box, $150. TV7-U tube tester $50. CDE rotator control box $30. Drake log book, mint. Richard Cohen, 813-962-2460.

FOR SALE: *QUALITY LETTERPRESS QSLs* LIKE IN THE OLD DAYS!

Send $1 for samples. Smokey, W9STB, 8679 Pinkhurst Drive, Minocqua, WI 54548.

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

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

FOR SALE: 1927 Department of Commerce listing of Amateur Radio Stations. Make offer. Fred Clinger, 417 Beechwood Dr., Galion, OH 44833 419-468-6117 after 6 PM.

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: 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: QRP xcvr, Heathkit HW9 w/ pwr sply PSA9 working condx on 80, 40, 20, 15M, $150 + S&H. Len Gardner, 458 Two Mile Creek Rd., Tonawanda, NY, 14150. radiolen@att.net

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

TUBES FOR SALE: Tested good globe 201A $14, 226 $15, 227 $10 and others. Slightly weak tubes guaranteed to work in early radios ½ price shown. Write or 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

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

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

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

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

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

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

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

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

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

PARTS FOR SALE: Strong steatite

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

WANTED: Commercial or kit-built 1930s and 40s transmitters.Doc, K7SO, 505-920-5528 or doc@cybermesa.com

WANTED: Hallicrafters SX115, SX88, Collins 75A-1, AM broadcast transmitter in New England area, Heath DX100B. Will pay good price for good equipment. Email w1txjohn@aol.com, 802-775-7632 evenings.

WANTED: Looking for a Johnson Valiant 1 cabinet without any extra holes drilled in cabinet. Paint condition not important since I will have it repainted. Joe Fell, W3GMS, 610-648-4425 or joseph.fell@Unisys.com

WANTED: Heathkit AT-1 power transformer. Part #54-21. Steve, VE7SL, 604-942-9152 or jsm@gulfislands.com

WANTED: Schematic, clamp tube modulator for 813 tube. Vernon Fitzpatrick, WA8OIK, 10505 Adams Rd Beaverton MI 458612. vafitz@ejourney.com

WANTED: Guild Teapot radio in good to exc. condition. Dick Bergeron, POB 652, Springvale, ME 207-490-5870

WANTED: Exciter for T368 without 6000 tube OK. Good Condition. Harold, W1SKS, 207-827-4283

WANTED: 100 kHz reference oscillator from SRT-14 transmitter, any condition. John M Franke, WA4WDL, 23 Parkwood Dr. Apt. 201, Yorktown, VA 23693, 757-865-8127

WANTED: I really need power transformers for a Heathkit DX-20 and a Hallicrafters HT-32B! hwlight@sbcglobal.net 209-634-4330

WANTED: Coils A, B, C for National Radio HRO 60 Colin, K1IXU, 401-231-1046 or electric6@juno.com

WANTED: QSL Card from W9QLY, Frank (Mac) Maruna. Will pay TOP DOLLAR. OTs, check your old QSL boxes, please. Donald Barsema, KC8WBN, 616-451-9874 or dbarsema@prodigy.net

WANTED: WWII Navy GP-7 transmitter in any condition with or without tuning units or tubes, etc. Ted Bracco, WØNZW, braccot@hotmail.com A.C. 217-857-6404 Ext. 306

WANTED: For Hallicrafters SX-42: Band change knob (the one with the wings). Excellent condition only. Tom Mackie, W2ILA, 14 Washington St., Jamestown, RI 02835 401-423-0233

WANTED: R390A and R392 receivers in excellent cosmetic and operating condition. Also Dead Tektronics 453 scope. 613-722-4098 or rwboyd@gta.igs.net

WANTED: Crystal filters for Hallicrafters SX-146 rcvr, .5 kc (#049-000321) and 5 kc (#049-000319); Louis L. D'Antuono, WA2CBZ, 8802-Ridge Blvd., Bklyn, NY 11209. 718-748-9612 AFTER 6 PM Eastern Time.

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

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

WANTED: Wanted: Anything by DAVID GRIMES: radios, especially model 3XP, and advertising, ephemera, literature, references, parts; please contact: Mike Grimes, K5MLG; 5306 Creekside Ct.; Plano, Texas, 75094, 972 384-1133. Email: grimesm@flash.net

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

6292 brentw@emeraldis.com

WANTED: Top prices paid for globe shape radio tubes, new or used. Send for buy list or send your list for offers. Write or e-mail: 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, kc4yoy@trellis.net

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

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

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

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

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

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

WANTED: 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: Westinghouse MW-2 Transmitter (RF Unit, Modulator, Power Supply, Coils, Transformers, Parts). Will pickup anywhere. Gary, WA4ODY, Seabrook, TX. 281-291-7701, myctpab@earthlink.net

WANTED: HRO60 slide rule dial assembly or suitable HRO60 junker. Rod Perala W5CZ, 303-324-2725, rodperala@aol.com.

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

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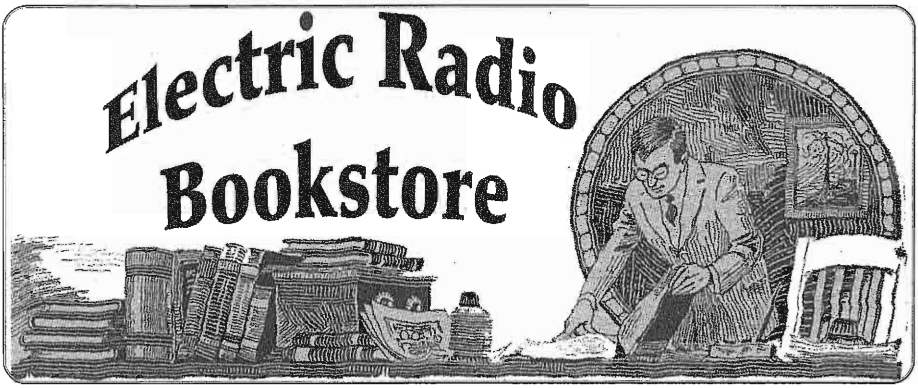

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