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ELECTRIC RADIO

celebrating a bygone era

Number 216 May 2007

Ward Kremer (KI4JHA) and Grandson Zach

ELECTRIC RADIO

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

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

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

Editor's Comments

Vintage Field Day

As mentioned last month, the annual ER Vintage Field Day is Saturday, June 2, 2007. It starts at 1200 UTC and runs until 2400 UTC the same day. (Tune to WWV to find the current UTC hour.) It isn't a contest, and the object is to take vintage equipment into the field and make contacts. In the past, we have used the traditional HF AM and CW gathering spots for vintage operations. I will be operating from home because of some other problems, but I would very much appreciate receiving logs and photos from participants.

A Talent in Demand?

I recently received a telephone call from an equipment manufacturer in the Midwest. His company manufactures expensive, high-quality equipment for the electric utility industry. The circuit boards that are used in his equipment, due to the high cost, are not typical consumer-grade, throwaway designs and they still operate in-house repair services. He told me that his company is having a hard time finding electronics technicians within the United States who are qualified to do board-level repair work because the electronics schools have become inadequate in this area. Sadly, his job applicants who are recent graduates do not even know what a resistor color code is. He had heard that hams who build and repair *vintage radio gear* still have the skills, and he wanted to know if I knew of someone who needed a steady job!

A recent editorial in the biggest ham radio magazine seemed to be saying that hams have some kind of a duty to rush out and purchase the latest imported radio gear, and that vintage equipment, while rather quaint, serves no useful purpose.

Many ER readers are able to rescue a receiver or transmitter that no one else wants, bring it back to life, and not only enjoy using it, but also experience tremendous personal satisfaction in completing the project. So, it turns out that such skill is hardly a thing of the past, but is in demand by current employers!

Notable Passings

From Loney Duncan (WØGZV) comes word that Fred Johnson has passed away. Fred was a mechanical engineer at Collins and is the man who put the quality into

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Cover: Ward Kremer (KI4JHA) is showing his grandson Zach how to tune up the ART-13/HRO station. Ward contacted KE4LRL and W4CT, and both enjoyed talking to Zach, who wasn't the least bit mic shy!

Radio Receiver R-100/URR, The "Troop Morale Receiver"

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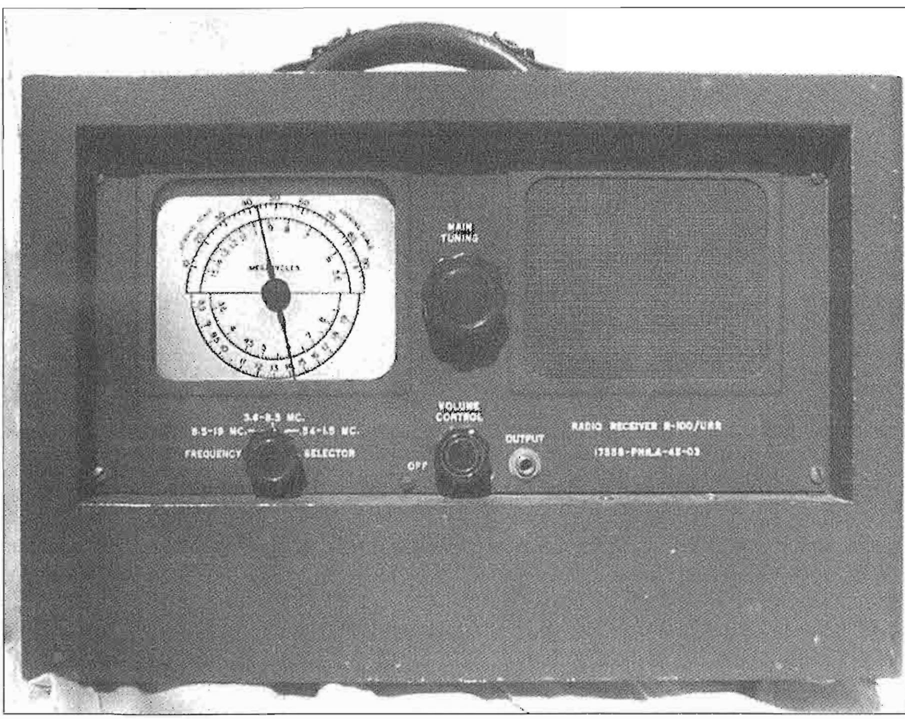
As I write this short article, I am listening to a local AM broadcast station which is advertising one of the many web-based or "Wi-Fi Radios" which enable the listener to "tune in" any of hundreds of on-line streams from radio stations around the world. Of course, on-line streaming is nothing new, but it is a relatively recent development. Debate continues as to whether the Internet will destroy shortwave broadcasting (or for that matter all over-the-air broadcasting). Admittedly, it is a little alarming to note the continuing decline of the "big guns" such as the BBC and the Voice of America, and every monthly issue of *Monitoring Times* seems to bring news of yet another shortwave broadcaster leaving the air. Where all of this will take us remains to be seen, but one constant remains: the Internet and satellites are vulnerable to natural hazards and human intervention, but even at the bottom of a sunspot cycle shortwave broadcasts are always audible on *some* frequency, day or night.

In listening to my favorite local AM talk station in Phoenix, it is not uncommon for the host to mention that our men and women serving around the



The R-100/URR "troop morale" receiver was produced during World War II in moderately large quantities by several contractors.

world are listening to real-time streaming of their home town stations while in the field. This seems to make a 35-pound portable broadcast band/shortwave receiver a real anachronism, however, 64 years ago this piece of gear probably ranked right after a hot meal and a letter from home. My father tells of spending 36 months in the South Pacific during World War II, always waiting for letters from home and *any* news from the outside world. He says that he does not remember ever seeing an R-100, but he tells of receiving a couple of very welcome battery-powered radios sent by civilians in the States.

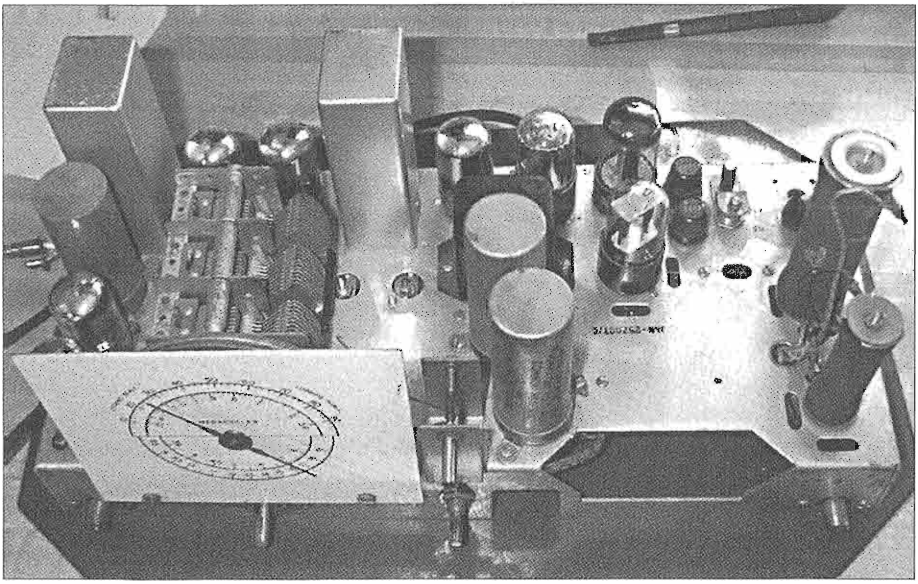
Anyone who has served in the military knows the sense of isolation which comes from not knowing what is going to happen next, or what is happening in the outside world. Combat duty consists of days or weeks of boredom punctuated by days or weeks of sheer terror. This is true of all wars, and it was particularly true of World War II. Far-flung operations made news from home a most important commodity. Military censors deleted references to anything which could possibly be of use to the enemy in both inbound and outbound mail. Keeping troops sharp, maintaining security, and combating boredom is a problem of which the United States military was acutely aware. One of the answers was the so-called "Troop Morale Receiver." The "Radio Receiver R-100/URR" is the subject of this brief paper.

The decade of the 1930s saw truly spectacular growth and developments in radio communications. By the end of the decade, one was hard pressed to purchase a radio receiver of any type which did not include the shortwave bands. Pick up a copy of Hugo Gernsbach's *Short Wave Craft* and read the articles about the latest and greatest shortwave antenna, converter, or receiver. It seemed that *everyone* was listening to shortwave broadcasts.

The US military was a little slow to catch on to all of this. The use of radios in World War I was very limited. Obviously, the state of the art was primitive at best, and shortwave broadcasting had yet to make its appearance. The short waves were unknown to all but a few dreamers, and even they had no idea of the enormous distances over which radio signals would propagate. The normal reluctance of Congress to spend money on the military during peacetime further contributed to the slow development of radio communications. Military communications, up to December 7, 1941, were predominately teletype and voice over wire. In reading the three-volume history of the Signal Corps noted below, I was struck by the notion that a modest ham station in 1941 probably rivaled or even exceeded the best shortwave communications capability of the U.S. military in terms of the ability to communicate reliably. Field commanders and top military brass simply didn't see the need for a far-flung network of radio relay stations. Commercial interests did, however. One simple development forced the military to adopt radio communications: *long-range aircraft*. Of course, war on a global scale does tend to severely limit the use of wire-based communications.

In the years leading up to World War II, the idea of "troop morale" receivers probably did not occur to the Signal Corps and in fact, no truly portable military radio equipment of *any kind* existed until very nearly the outbreak of hostilities in 1941. The definitive work on this subject is the three-volume set I mentioned earlier about the U.S. Army Technical Services.[1]

In any military unit, be it ground troops, aircraft, or ships, the radio operator is the man through whom virtually all communications flow. Unfortunately for the rest of the men and women, much of what the radio operator hears is either classi-



Here is a top-front view of the 9-tube R-100/URR receiver, out of its cabinet.

fied or of little interest to the average soldier. Hanging around the radio shack was, however, a favorite pastime. Virtually every piece of comm gear was able to tune from 1500 kHz to at least 18 MHz, (generally missing 550 – 1500 kHz!) and I'm sure the many movies which date from the period reflect at least a measure of truth when we see the radio operator tune to "Tokyo Rose" or "London." Obviously, the Signal Corps, and in particular the USO, knew of this. Whose idea it was to build a radio just for entertainment I have been unable to discover, but I have learned that posing the question to the readers of Electric Radio Magazine is likely to result in a very good learning experience for the writer!

The R-100/URR formed part of a complete entertainment system; part of which was the AN/TIQ-2 Public Address Set which permitted the R-100 to be played for large groups. One can imagine USO or simply open-air settings near the front lines. A vibrator pack "PP-31( )TIQ-2 provided B+ in the event that AC power or batteries for the 90V B+ were not present. And, if you were in a very lucky outfit, you might have had the PE-214-A gasoline engine generator to power your R-100 and AN/TIQ-2. All of this information is to be found in Training Manual 11-310.

The R-100 is a three-band, "tri-power," AM-only receiver. Unlike most military receivers from WWII, this one covers the broadcast band. Of course, it was intended for recreation and not communications. The band arrangement is as follows:

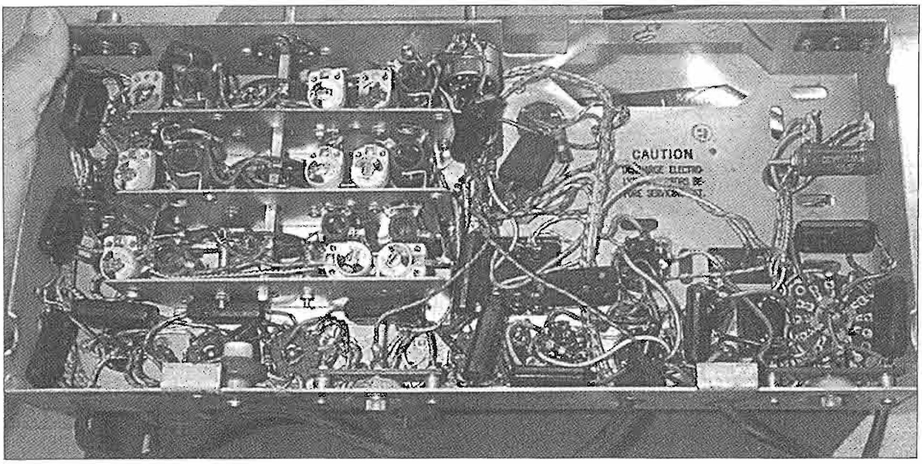
Band 1: .540-1.5 Mc
Band 2: 3.6-8.5 Mc
Band 3: 8.5-19 Mc

There is a small amount of overlap at each end so that there are no gaps between 3.6 Mc through 19 Mc and almost 20 Megs with the overlap.

The tube complement consists of:

- 1LN5 RF Amp
- 1LC6 Converter
- 2 each, 1LN5 IF Amplifiers
- 1LH4 Detector / 1ST AF
- 25L6GT AF Amp (for AC operation)
- 3Q5GT AF Amp for battery operation
- 25Z6GT Rectifier (for AC operation)

For those not familiar with loktal tubes,



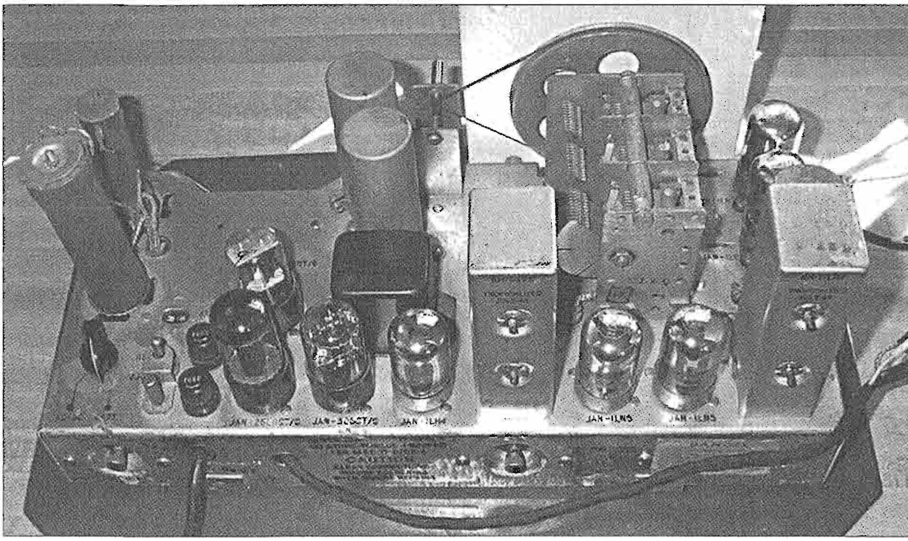
Looking underneath the R-100 chassis shows typical multiband receiver construction of the period. Each bandswitched stage has its own shield partition and the wiring harness is neatly laced in the traditional manner.

they were a short-lived, lock-in design intended to prevent vibration from loosening tubes. My personal experience is that anything from 01As forward require more than rough handling to loosen tubes from their sockets. The loktal seems to have been a solution looking for a problem. While often maligned, in my 45-plus years of tinkering with radios, I have never found a bad loktal (short of physical damage). The bright silver getter makes them quite attractive to look at as the photos will attest. The biggest objection was apparently that the pins are so small that they made poor contact. This doesn't hold water when the miniature tubes which closely followed them with approximately the same pin diameter are considered!

The user had the choice of AC power of either 115V or 230V, or battery power consisting of battery packs BA-36 (two each, 45V in series) and BA-203/U (two each, 6V in series) which provided the necessary 12V DC and 90V DC for filaments and B+. The radio is a "transformerless" design. A stern warning is silk-screened on the voltage selector access door not to let a ground connection (or human fingers) come into contact with the chassis, RF ground being provided through a .005-µF, 600-volt capacitor. Looking at the photo of the chassis top, page 4, two large power resistors are quite obvious: A 220-ohm, 30-watt resistor and a 260-ohm, 60-watt resistor provide the necessary voltage drops for the 25L6. Another stern warning against operating with AC with batteries installed is prominent on the access door. Exploded B batteries are messy!

As mentioned earlier, the R-100 was intended for nontechnical personnel. A glance at the front panel controls reveals three controls and a headphone jack. "On-Off/Volume," "Main Tuning," and "Frequency Selector" comprise (with the dial) the front panel. Obviously, no BFO is included. Although MCW was very common during World War II, this radio was definitely aimed at the Tommy Dorsey crowd!

The receiver is quite heavy—on the order of 35 pounds with batteries installed. The front panel is recessed about an inch which was clearly an attempt to prevent the controls from being sheared off during rough handling, although I can't imagine that GIs ever handled equipment in a rough manner. There



The top rear-chassis view shows very little corrosion on the chassis in the 64 years that have passed since it was built.

were the remains of a carrying handle, which I replaced with a unit from Antique Electronic Supply which fits perfectly and seems appropriate for the time period. I have not seen handles on any photographs of R-100s, but the handle on this one was obviously installed professionally. It is exactly centered and square with the cabinet. It was riveted with the proper tools; so it may be original to the radio, or perhaps some enterprising Special Services sergeant had it installed in a military machine shop.

The under-chassis view, page 5, illustrates the use of high-quality components. All of the trimmers are ceramic. No mica compression trimmers were used here. The tight lacing and neat layout, so common in commercial radios, is evident. There is no manufacturer's label. Thanks to Chuck Teeters (W4MEW) for pointing out that if Zenith had manufactured this unit, the wire insulation would be rubber. This radio has fabric "pushback" insulation. Since the radio has been fungus-proofed and it performs so well, I have not replaced any resistors. I am sure that some or all of them have risen in value, but the radio's performance gives no hint of seriously out-of-spec components.

In conclusion, one cannot point to this receiver as being particularly attractive. It is heavy, bulky, and certainly lacks any of the sophistication of communications equipment being manufactured at the same time. In fact, it is little more than a heavy duty cousin to a Zenith Trans-Oceanic, but its fellow receivers probably brought just a little enjoyment to men and women stationed in very remote; dangerous, and lonely places.

Footnotes:

1. Office of the Chief of Military History, The Technical Services, Vol. I, "The Emergency" Vol. II, "The Test," Vol. III, "The Outcome," U.S. Army in World War II, United States Army, Washington, DC, 1956

ER

The Collins 150C Transmitter

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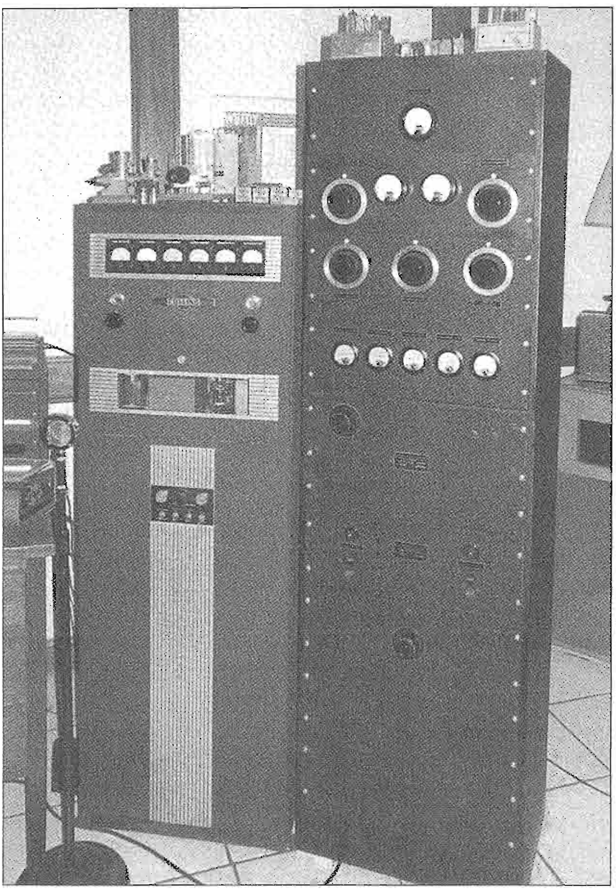
The model 150C transmitter was the last of the 150 series built by Collins Radio Company. The first of this series was the 150BW, which was the first Collins transmitter to have its picture in QST, May 1932. The 150C was introduced in 1935. A full-page QST ad ran in June of that year. It is built in a fully enclosed rack, and shares some design features of its predecessor, the 150B. However, the RF deck was redesigned for use up to 10 meters. In fact, the QST ad of March 1936 announces W6FQY and his 150C as the first transmitter to have worked all continents on 10-meter phone!



The 1936 Collins 150C at W5ZG, on the right, is the subject of this article. The Collins 30J, on the left, keeps it company.

The last revision of the 150C transmitter appears to be the 150C-6, advertised in QST of November 1936, along with optional RF decks for operation up to 5 meters. It is interesting that the production of the 150C transmitter overlapped in time with the somewhat more common 30FXB and 30FXC series. Although the two lines of transmitters are similar, the advertisements tend to indicate that the 30FXB/C was more oriented to the amateur market as a "moderately priced transmitter", while the 150 series was somewhat more for commercial service. To quote the Collins advertisement in QST of November 1936, "150 series transmitters are supplied for airways, police, military, point to point and deluxe amateur service."

With a price tag in the range of $400 it is doubtful that many of these transmitters were produced. Of the ones made, most probably were used in commercial operations such as early commercial aviation

With the rear door of the 150C transmitter open, the RF deck shows at the top, the meter panel below it, then the Type 7C audio panel. The power supply and modulator rests on the chassis at the bottom.

mechanical alignment of things is not quite the level of perfection you see with later Collins equipment such as the KWS-1, 30K-1 or even the 30J (built in 1937-40).

I located my 150C in Cedar Rapids, Iowa, the home of Collins Radio Company. It is believed that this transmitter may have been used in the police service of that city. One can imagine that Art Collins would, indeed, want the local police in his hometown to use one of his fine transmitters! Wherever it was, it had many hours run time on it as there was an amazing amount of soot "plated" around all high voltage areas, probably from a coal-fired furnace.

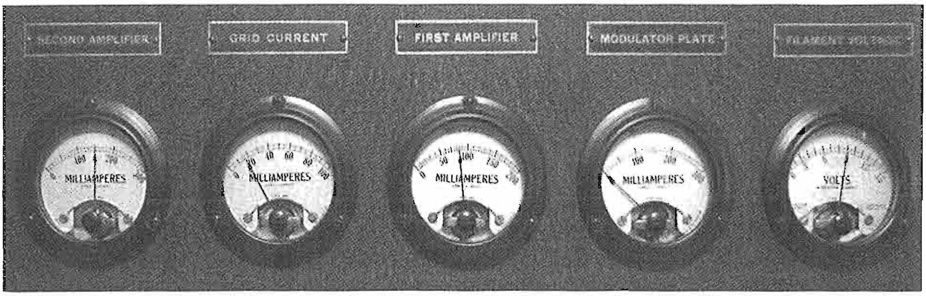
Technical Details

The 150C has full metering, with a switch to select oscillator plate or oscillator plate plus driver current. My particular unit also contains a final amplifier plate-voltage meter. This apparently was an added option. It appears to be original in that the metal tag stating "PA plate voltage" is an exact match to all the other meter tags.

ground stations. Only a few wealthy amateurs were likely to have one.

The construction is somewhat different from later Collins equipment. It is certainly high quality, however, it is obvious that the construction techniques reflect a small shop operation rather than a precision production line. Most chassis holes appear to be hand drilled, and

One interesting feature on the main power-control panel is the use of oil-filled delay and overload relays. Oil flowing through an adjustable metering orifice sets a delay for filament warmup (before the high voltage can be energized). The front panel has nice large "Start" and "Stop" buttons to bring up the filament and high voltage. The large relays behind the panel slam shut with



After restoration, the 70-year-old meters moved once more.

powerful authority!

Another interesting detail within the model 405CA power supply is that a type-45 tube is used as a bias rectifier in the keying circuit, with the grid and plate tied together. Type 45s must have been a little cheaper then than they are today!

The audio section and modulator are also similar to what was used in the 30FXB transmitter, only the location of the modulator tubes and transformer was swapped for some reason. The speech amp unit is a model 7C as in the 30FXB. The 203A modulator tubes operate in Class B and use batteries for biasing.

The RF deck (model 10K) uses parallel oscillator tubes: Type 47. This was done to get more drive for operation in the 10-meter range. The crystal holder is a work of art—a giant ceramic enclosure with a 5-pin base. Type 46 tubes are used as frequency multipliers and driver. The final is a type 203A, delivering 100-watts output AM phone. I run my 150C a lot on 80-meter CW, and get a little more power output in that mode.

The original PA tank circuit was not inductive-link coupled: The plate tank coil was connected to the antenna matching unit via mica capacitors that could be tapped at any location on the coil. I bet this configuration was really rich in harmonic content! The schematic shows this and my 160-meter RF deck appears to have once been used this way. Later photos reveal the use of a link coupling coil on a bakelite form around the plate tank. The 80-meter RF deck I use has this arrangement and it appears to be factory original.

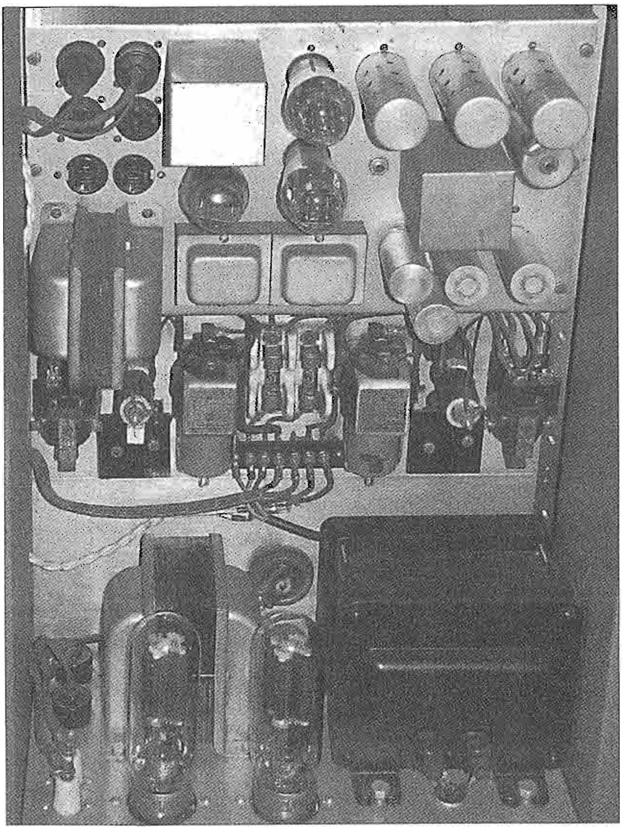
The model 2C antenna-matching unit includes two antenna current meters mounted on a bakelite panel to minimize capacitance for better high frequency performance.

Restoration

Long ago in my transmitter's early career, some modifications were done to connect to another 150-series rack containing additional RF decks for multi-band operation. Along with the transmitter, I acquired one other RF deck that was set up for operation around 160 meters. There is a mysterious second pair of Pyrex glass insulators on top of the rack, possibly used as the feed point for a secondary antenna.

During the restoration process of this transmitter I first brought back the wiring to the original configuration. I also repainted the silver/gray power-supply and modulator-chassis modules and black transformers, but I did not remove anything from the chassis as the wiring insulation is quite brittle. This required some tedious masking.

I had to do very little component replacement to make this transmitter operate. Other than the electrolytic cans and paper capacitors, the only "bad" components were one of the interstage audio transformers and a wire-wound resistor in series with the main pilot lamp. This is quite a testimony to the quality of a transmitter built over 70 years ago!



A close-up view of the Type 7C audio that shows the oil-filled relays at the center of the picture.

transformer that was "in the neighborhood" of the correct ratio. With the end caps removed, the replacement just barely fit inside the original compartment that held the original core.

With the new capacitors in place and the transformer installed the audio section was about ready for a test. After checking for ground faults I determined that the section was ready to go. I put together a dummy load to simulate the modulation transformer load and powered it up. Using a scope to look at the output I determined that the 7C audio unit was again meeting Collins specifications!

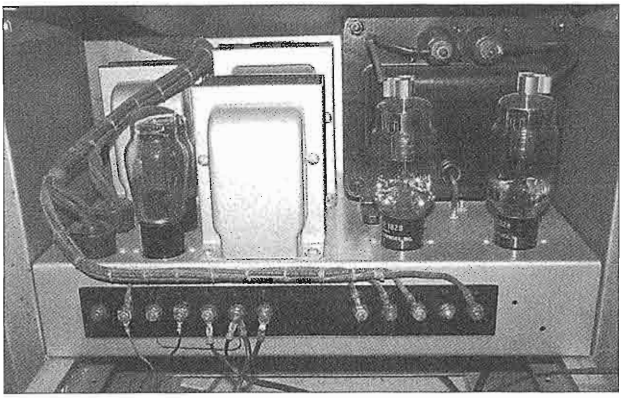
The oil-filled delay relays were something I certainly had no prior experience with. However, from my sports car days, I remembered that automatic transmission fluid worked very well for damping variable-venturi carburetors! Would it work for a delay relay? After cleaning out the thick waxy residue from old oil, I gave it a try. Good old "Dexron®" ATF gave me a 1-minute delay, which would be sufficient for the mercury in the 866 rectifiers to vaporize.

The main power supply uses all oil-filled capacitors, which in my experience rarely fail unless there has been oil leakage. A test for ground faults and leakage showed no issues, so I again set up some load resistors and powered up the supply on the bench. There were no problems at all with this module. I did opt to use 3B28 rectifiers instead of 866s to remove any hazards of mercury. No circuit changes were needed for this change.

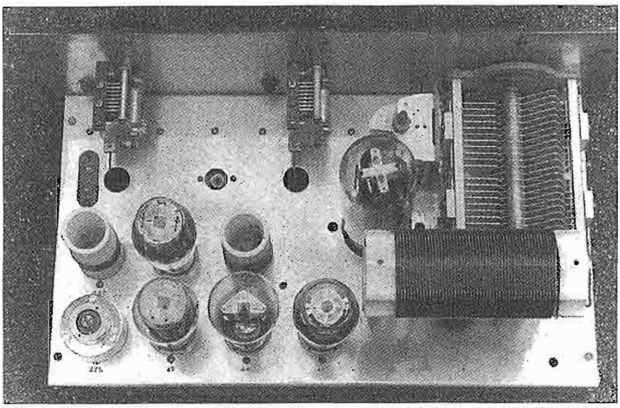
The last stage to test was the RF stage.

The 7C audio section has four electrolytic capacitors that obviously needed to be replaced. In order to salvage the cans, I made a shallow cut around the base to allow the insulator at the base to pull out of the can. Then, the original insides can be removed. I placed a pair of 22-µfd, 450-volt caps in series (with 1-Megohm equalizing resistors) to give a 900-volt rating, well above what is needed.

The next item on the list was the failed audio-interstage transformer. First, I froze the case to harden the potting material. A swift tap on the end popped the core right out. Having no data on the exact transformer Collins used, I studied a few reference books on input and output impedances of the tubes on either side of this transformer and located a Stancor



Rear View of the Power Supply Chassis



Top View of the 160-Meter RF Deck

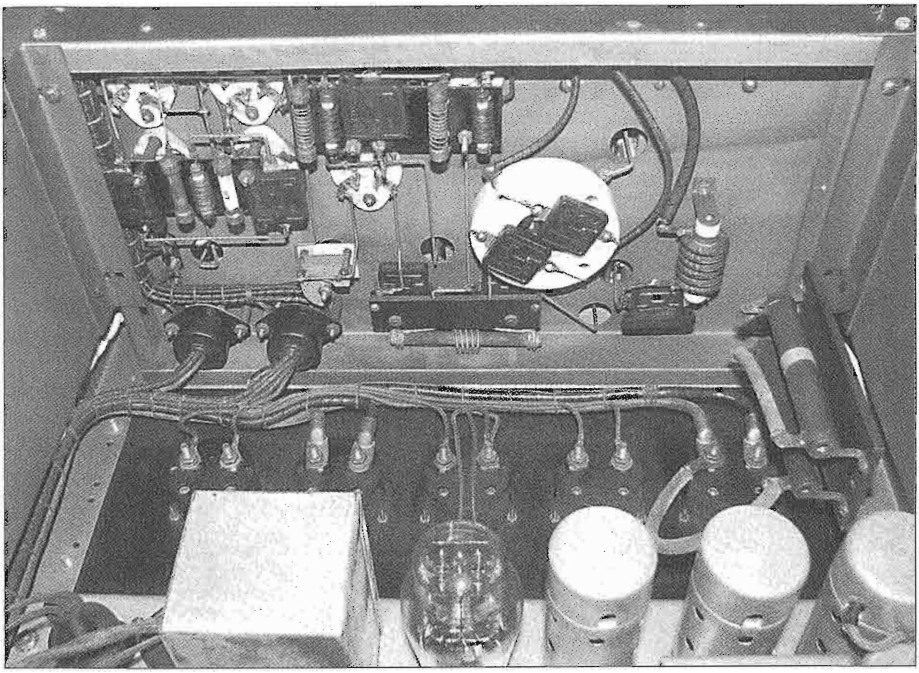
All resistors and capacitors tested good. I used a grid-dip meter to determine the resonance of the coils I got with the two RF decks I had. One set fell in the 80-meter range, so I fine tuned the turns to get the front-panel capacitors to a similar mesh as Collins specified in some tuning charts I have for my Collins 4A, which uses the same capacitors and coil forms. This is not too critical, but for 3.5 MHz I was looking for about a 2/3 mesh. The second stage coil has a tap for the output point and neutralization of the driver stage. Getting this right took patience and some trial and error to find the point with the smallest value of oscillator feed thru (with the HV removed from the driver stage) and best power transfer to the final grid.

Power-Up Time!

Testing was now complete on every module except for the modulator and antenna-matching unit. I was fairly confident that I could at least produce a CW signal at this point. I only had to play around with the taps on the antenna tuner and the output link to get the best power transfer. It turned out that I had some trouble getting the oscillator to restart after it had been tuned to a peak. I experimented a lot with this, trying different coil values (using a test coil form to keep from damaging the original). I found a value that worked the best, but I still am not convinced I have this quite perfect. The oscillator needs to be tuned a little farther than I would like to the high "C" (low) side of the peak to start reliably. I also believe it is impossible to find any reference or design data on an oscillator using two tubes! The only Collins-oscillator design that would be harder to figure out would be the external-grid C100 tube used to get around the RCA patent! That came a few years later, with the 30FXC and the early version 30J transmitters.

I used a 4:1 toroidal balun to convert the open-line feeder output to coax in order to use a coaxial wattmeter and dummy load for the initial tests. After seeing over 100-watts output, I called on Gary Halverson (K6GLH) in California to have a listen. Conditions on 80 meters were not good that night but he did indeed hear my CW signal!

Later that night I tested the modulator and it worked perfectly. Apparently my interstage transformer was a close-



The RF deck still has most of the original parts that were installed at Collins, including the original wiring harness.

enough match as I had plenty of audio drive!

Operation of the 150C

I like to display the 150C station with a National HRO Sr. receiver as a period and technical-quality match, however, I tend to operate it more with a Collins 51J-4 receiver. In order to shut off the crystal oscillator during receive periods, I use a foot switch to lift the B minus voltage from the tubes.

As with most transmitters of this time period there is high voltage across the key terminals (over 500 volts!) although the maximum current is about 35 mA. I enjoy using McElroy "bugs" in most of my vintage stations and for safety concerns have built custom Plexiglas covers that protect against accidental contact with HV. With transmitters of this type, it is as essential in my opinion to do this as it is to ground the rack cabinet. I will deviate from being authentic on this point!

One of the biggest challenges has been to locate large crystals that fall in the frequency ranges used today. I finally found a Bliley that was big enough to fit the Collins ceramic holder and also cut to a useful frequency. I found the oscillator worked better using crystals in the 1750-kHz range, using the second overtone for 80-meter operation.

The transmitter keys cleanly and sounds very good on the air. If I locate additional coil forms I may set it up for 40-meter operation at some point, but I tend to believe it is best to run unshielded transmitters of this power level to the lower bands to minimize possible harmonic interference potential. It is probably one of the oldest Collins transmitters on the air!

ER

A Work of Art:
A Collins 30K-1 Time Capsule Found, Part 2

By Bruce J. Howes, W1UJR
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The Big Box Arrives

Just in time for the weekend, the transmitter arrived on Friday, September 29, 2006. Now the real challenge began, bringing the big 30K-1 back to life. One never knows what to expect when working on old electronics. Was the unit still working when put into storage? Was it put aside due to some major component failure, or had some odd and unavailable component given up the ghost in the preceding decades of storage? I always assume the worst and check for shorted power transformers or other "zorched" components prior to any restoration work. Of course, half the battle is understanding *why* the component failed. For example, did the power transformer burn up because of a defective filter capacitor, or did it die on its own accord? Understanding this helps expedite the restoration process, and allows you to do a targeted, rather than a "shotgun" type of repair.

So, let's talk about the Collins 30K-1. I had plenty of time to read up on the transmitter prior to its arrival. Collins always did an outstanding job with their manuals. They explained not just the operation, but also the theory behind the unit. Reading a Collins manual, with excellent photos, schematics, and theory of operation is an education in itself.

Id like to write a few words about the 30K-1 design. One word that comes right to mind, especially if you are used to other amateur gear of the era, is "robust!" The 30K, although built as an amateur unit, shares many of the design characteristics with its big-brother commercial broadcast gear, and is unusually roomy to work on. As mentioned before, the unit is housed in a 5-½ foot tall cabinet and consists of four separate decks: the high voltage power supply deck, the low voltage power supply deck, the modulator deck, and the RF deck. Power requirements are moderate, 1350 watts at 115 VAC. The RF-output network, which is mounted by four ceramic standoffs to the front of the cabinet, completes the layout. Like most commercial broadcast transmitters, the heavy iron, in this case the plate transformer, is located on the bottom of the cabinet. Each deck is connected via a terminal strip on the rear panel allowing easy removal for servicing.

Tube replacement, and most other standard maintenance items, can be carried out with the decks in place. Should deck removal become necessary, say, for replacement of a under-chassis component, you must remove the four retaining bolts which hold the deck to the support rails. Once these are moved and the wiring disconnected, the deck slides right out. Be careful during deck removal or installation because it's easy to damage the cabinet finish with the deck edges. To prevent this, I use blue painter's tape. It leaves no residue on the cabinet edge or rails. Two or three layers of tape offers plenty of protection against nicks and scratches.

A Tour of the 30K-1

The high-voltage deck uses a pair of 866 mercury-vacuum rectifier tubes to handle the HV-supply duties. The design is both simple and robust, really overbuilt for amateur service. The things to check here are standard with any HV supply. Look for arcing to ground, loose connections or damaged insulation.

Heavy-duty oil-filled caps are used exclusively on this deck, so capacitor failure should not be an issue. I did find a problem with leakage in the 866-filament transformer on my 30K-4 transmitter. Check the obvious, and then bring everything up under low power for testing. In fact, it's a good practice to leave the filaments on for several hours, just to bake any moisture out of the transformers, before you hit the plate switch.

In general, the HV and LV-wiring insulation used by Collins appears to be very resistant to breakdown and thankfully, both of 30K-1 and 30K-4 units have excellent wiring. Failures of the plate transformer have been reported on the Collins Internet email reflector, so be cautious here. The plate transformer is a heavy Thordarson unit, secured to the cabinet base with four 12-24 retaining bolts. Mindful of the mild plate transformer hum on the 30K-4, I did something to try and quiet this rig down. I installed four 1.5-inch diameter rubber washers under the transformer mounting boss. This provides a solid attachment, yet serves to dampen some of the transformer hum under full load.

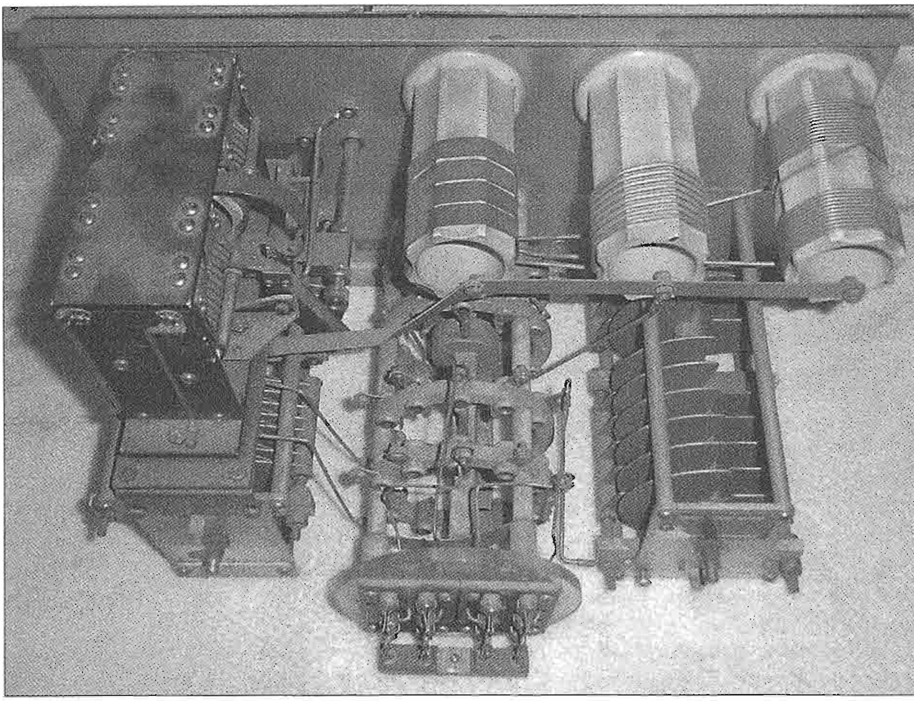
The low-voltage supply deck uses a standard line up of 5R4GYs for bias and low-voltage rectification. The bias potentiometer for the 75TH modulator tubes is located on this deck, so you may want to clean and set it to midsection for now. Later, the bias for the modulators should be set to 45 mA. You may also want to pay special attention to the filter caps on this deck. Given the age of the transmitter, the electrolytics that were used may be suspect. Thankfully, mine required no attention, other than a cosmetic cleaning of the deck itself.

It's on the modulator deck where things really get interesting. Collins chose the pretty, but now-rare 75TH tubes as modulators. The 75TH has a large circular globe with a nice bright filament, and is really a very attractive tube in operation. Unfortunately, Collins did not provide a viewing window for the modulator tubes, so one has to be content with the glow of the 4-125 final. The 75TH has now become a somewhat rare tube; thankfully, I found multiple sets included with my unit. Some folks have reported success using the more-common 100TH tubes as replacements, but I understand a bias modification is necessary.

Electrolytic caps are used on this deck as well, so be certain to check them thoroughly both before and after the initial fire up. I did encounter a problem on this deck with the audio-gain pot in the speech amplifier circuit. A trip to my junk box produced the requisite 500-k potentiometer and we were back in business. Be sure to lubricate and clean up any switch shafts and contacts.

The RF deck is perhaps the simplest of all the decks in the unit to clean and service. Removal from the unit is rather straightforward. Remove the front two adjusting knobs, the large air variable capacitor support insulator, and the plate cap on the 4-125 final tube. Finally, unbolt the two choke leads from the bandswitch. Remove the five wires from the terminal block and you are home free. While you're under the deck, you might as well remove the two screws that retain the two RF chokes, along with the one screw that grounds the RF chokes to the chassis. With the chokes and the large fixed capacitor removed, cleaning the deck is quite straightforward.

Once you have the RF deck on the bench, I advise that you blow off as much loose dust as possible with compressed air. Then, use a strong shop vacuum to pull off any remaining dust and dirt. The large fixed capacitor removes quite easily from the deck, held by just two retaining screws. This capacitor is very difficult to clean when assembled. Because any dirt here provides an easy arc-over path, it's well worth the time it takes to disassemble and thoroughly clean the capacitor plates and hardware. What I like to do with a small chassis, especially if

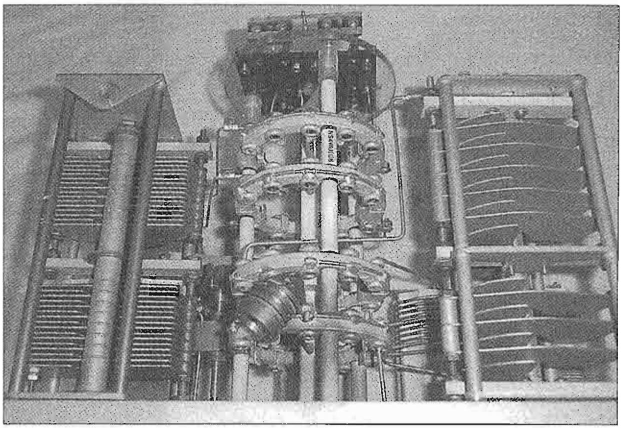


This rear view of the unrestored 30K-1 RF deck, the Lucite disk and knife switch modification is visible at the rear of the band switch, lower center of the photo.

heavily soiled, is to use Simple Green® and shop rags to wipe down the deck. Next, turn the deck on its side and spray a heavy coating of cleaner on the top and underside. Allow this to work its magic for perhaps 5 or 10 minutes, and then rise clean with tap water. A quick trip into a 200-degree oven for 5 to 10 minutes does wonders for the final-dry cycle. Now, you can Q-tip® any residual staining or dirt, especially around the terminal block. Allow the chassis to air dry overnight and it's ready for reinstallation.

Collins built a very robust and flexible link-coupled output network in the 30K-1, allowing both parallel and series tuning. The lower bands, 80 and 40, are handled with one large plug-in coil, while the upper bands use a somewhat smaller coil unit. RF is output through one set of feed-through insulators mounted on the upper rear of the cabinet. Thinking ahead, the Collins design made a provision for the use of multiple antennas, with the installation of additional feedthroughs and the ability to directly tap off each section of the bandswitch. My unit had apparently sustained some impact during its trip from California, as each of the four porcelain standoffs that mount the network to the inside of the front panel were broken. These standoffs are of the standard tapered design, often found at hamfests; thankfully, my junk box yielded four identical spares. My output network was very dirty, and given the complexity of the coils and windings. It was not an easy cleanup job. A trip through the dishwasher, at low heat, was in order. The unit emerged looking like new, and I took a few moments to clean and tighten all the hardware, and to lubricate the shafts and linkages before reinstallation.

Before installing the output network, I removed the large meter panel from the upper top of the cabinet. The 30K uses a meter display similar to many broadcast transmitters of its era, behind glass. The meters were fine, requiring only a cosmetic cleaning, but the glass was filthy. I have yet to find anything that cleans glass better than Windex® and newsprint. Soon, the meter display was reinstalled and looking like the day it left the factory.



After cleaning, the high-quality American-made parts on the RF deck shine like they did in 1947.

A Few Fixes

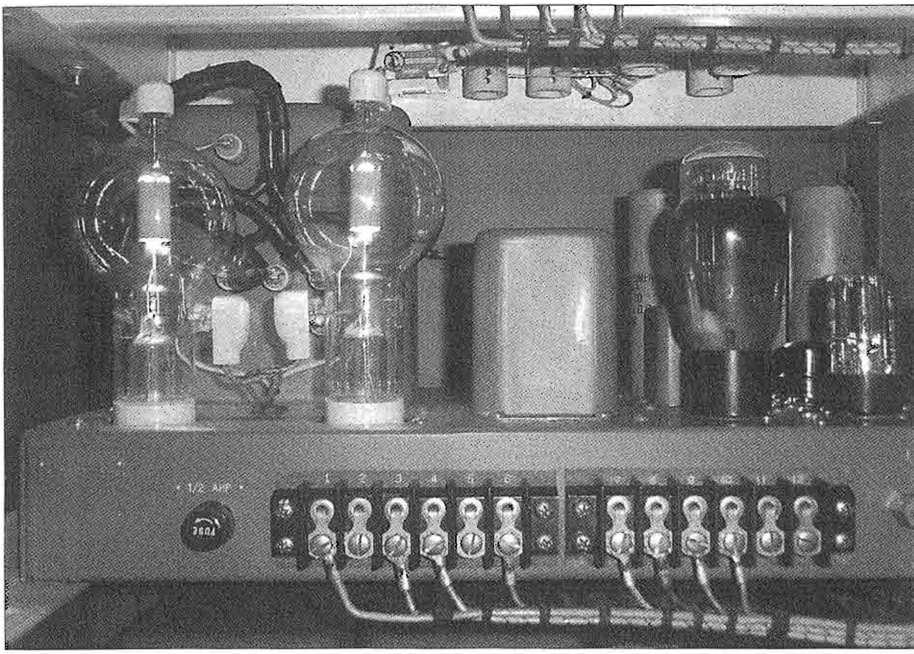
W7MGA had fabricated a very clever antenna-switching arrangement in my 30K-1. If you look closely at the photo of the rear of the bandswitch you will note a pair of black DPDT knife switches mounted on a Lucite disc. Using this unit, he was able to select multiple antennas for different bands. Desiring to return my unit to stock, it was a simple matter to remove the three screws that secured the switch. I then found the original bandswitch jumpers that Collins had installed at the factory. The previous owner had thoughtfully hung them inside the cabinet on a piece of wire when he installed his antenna-switch modification! So, with the addition of just a few jumper wires from the bandswitch to the porcelain feedthroughs, RF was once again ready to flow.

One thing that I should comment on is the respect that W7MGA had given the rig. It was obvious to me that he cared for it greatly, carefully building the Lucite antenna switching device, collecting multiples of spare tubes, retaining the Collins manuals and marketing material, and even fabricating a black wrinkle-finished dolly to move it around on. He went so far as to build a wooden base to hold spare tubes, and to construct a classy glass-and-wood enclosure for the antenna coil used on the higher bands. Unlike much of the vintage amateur gear we see today, no additional holes, switches, or modifications were found. It was clear to me that Walter had a great respect for this transmitter, and that further inspired me to continue on in his tradition.

Glowing Again

With the decks all cleaned, serviced, and tested the final step remained, powering up the unit. I checked and double-checked each connection, making certain that all was good and proper. Preparing for the event, I had both camera and video recording gear on hand and rolling when I threw the filament switch. It was, in a word, a *nonevent*. No spark, arcs, or blow fuses were seen, it just worked. And so, just after 9:30PM on October 2, 2006, Collins 30K-1, serial number 32, returned to life. I joyfully recorded this moment with both still and video cameras, as one would a new child.

Then, after just 5 minutes of operation, the filaments in the 75TH modulator tubes promptly went out. I had intended to just let the filaments run for several hours to dry out the transformers and vaporize the mercury in the 866-rectifier tubes. The apparent filament failure puzzled me, but feeling emotionally and physically exhausted from nearly 12 hours of work, I called it a night and powered down the unit. In my head, I knew it could be anything, but in my heart I



Glowing 75TH Filaments, After Many Years of Neglect

feared the worst, a failed filament transformer. It was with this in mind that I grabbed the schematic on my exit from the workshop.

After staying up until 1AM that night studying the schematics, I tried again the next day. I plugged in the 30K, gingerly turned on the filament power, and checked the modulator tubes. I had no joy, no light. It then occurred to me that, as the 4-125 and 75TH tubes share the same filament transformer and the 4-125 filament was lit, it must be something in the wiring of the mod-deck filaments.

I thought and I pondered, doubled checked my wiring, and looked for smoked components under the chassis. I checked the schematic again, and then broke out the tool kit and DVM to check voltages.

Then, suddenly, I heard the voice of Art—yes, Art Collins himself, calling to me across time and space (not really, but that sure sounds good!). It occurred to me to turn the FONE/CW switch, and like magic the filaments lit! That switch must have been right on the very edge of the detent and snapped over when I was moved things around while checking out the transmitter the night before.

I had noted a problem with the switch while cleaning the mod deck; it was very stiff to turn. I had gently heated it up and applied oil to the shaft, which, after some work, made an improvement. It appears that I must have left the switch not quite on the detent and it snapped over to the CW position, removing filament voltage from the 75TH tubes! It was just sheer coincidence that this occurred while testing out the filament supply.

Getting Excited

With the filament problem now handled, I turned to the Collins 310A exciter. The unit was in very good condition and it was simply a matter of attaching the 5-wire harness from the 30K to the 310 so the unit could be powered up for testing. The RF cable from the exciter uses one of those old single-pin connectors like you would frequently see on transmitters such as the Heathkit DX-

100.

So, with the exciter properly cabled to the transmitter, it was just a matter of putting the exciter switch into the "SEND" position and checking the grid drive. Some tweaking of the input-network controls on the 30K produced grid drive, but with a low reading of 7 mA in the tune position. Ideal grid drive for the 30K-1 is 12-to-15 mA, so some work was indicated here. Just to check for output and make certain that the exciter was near frequency, I turned on the 75A-1 receiver. A quick check confirmed that we were operating on–or about–3885 kc, not bad for a 50-year-old unit. Still more exciter work was indicated before we could properly test the 30K-1 under load.

310A Exciter

The Collins 310A, another Warren Bruene (W5OLY) design, is like a small transmitter in itself. Using the venerable Collins permeability-tuned oscillator and a pair of 807 tubes, the unit is as robust as is the matching transmitter. Servicing the 310A could not be easier. It does not need to be connected to the 30K-1 for service; just a simple line cord to a wall outlet provides all that is needed.

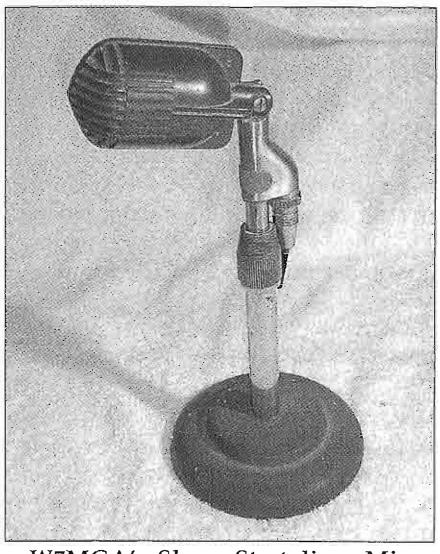
I had a moment of consternation during servicing the 310A which I will relate in the hopes of saving someone else grief. The exciter, which worked fine with the 30K-1 (abet with low output), had no output on the test bench. It was time for a rest break. After a cup of green tea and reading the schematic several times, I figured out the simple cause. The front-panel keying jack is of the shorting type and provides a ground return for the cathode resistor of the 6AG7 tube. When I removed the exciter from the cabinet, I had disconnected the keying jack, therefore disabling the operation of the tube. A jumper was quickly fabricated and we were back in business.

During my initial testing, I had noted low grid drive on the 30K-1, which translated into low output from the exciter. I removed the exciter bottom cover and quickly found the cause. The 310A uses a series of three ganged air-variable caps, driven from the front tuning-gear train. The first air variable, which tunes the low oscillator stages, was fine, but the other two air variables were not tracking with the first, owing to a loose coupling. The rear air variable, used to control tracking of the 310A's output network was not moving, nor was the small cap used to tune the input to the first 807 tube. Thankfully, it was Collins' excellent manuals to the rescue again, and after a quick review I understood the problem and how to correct it. It is a bit of a procedure to get the three air variables tracking properly, but once done it should last for a long time.

Thoughtfully, Collins provided two test points for measuring both the grid input to the 807 and the plate current. By the removal of two jumpers, a milliampere meter can be inserted to quickly align the circuits. An excellent design, and one that allowed me to quickly get the 310A back on line.

Live To Air

Over the next few days, I checked various voltages in the transmitter, ran on



W7MGA's Shure Stratoliner Mic

low power into a dummy load, and was finally ready, a week after its arrival from California, to test it on the air. The maiden voyage of serial number 32 was carried out on October 8, 2006, with KA1KAQ. Both the audio and signal reports were strong, with the D-104 on one end and the balanced-fed, 160-meter dipole on the other. At the rated "fone" plate current, 150 mA, the 4-125 final tube has a dull-red or "cherry" glow, and the complete convection-cooled transmitter, which uses no cooling fans, is remarkably quiet.

Air tests continued, on and off, during the week until I was satisfied that the unit could be moved back against the wall, and the 75A-1 and 310A be installed permanently into the station. Bill (KC2IFR) was kind enough to send a recording of me on the 30K-1, and it was a real pleasure to finally hear myself on the rig.

Operation

Operation of the 30K-1 on the air could not be simpler, once you get used to the lack of push-to-talk operation. Rather than keying from the microphone handle of the D-104, the 30K-1 is designed to be keyed from the front panel switch of the 310A exciter. One simply places the 310A switch in the "CAL" position to zero beat the 75A-1 receiver, uses the "REC" position to listen in, and finally the "SEND" position keys the 30K-1 into transmit. It does take some getting used to, remembering to turn the switch to go from send to receive, but after some use it becomes quite natural. Provision is even made in the 310A to mute the 75A-1 during transmit.

The 30K-1, with its 250 watts of AM "fone" power, is great for those late-night QSOs. You know that you have plenty of reserve power to overcome atmospherics, and still provide the static-quieting, full-bodied AM sound. The stock 30K-1 audio is, as Collins intended it, punchy and crisp, not at all objectionable. An audio peak limiter, using a 6H6 tube, was engineered into the unit to allow full modulation without distortion; I've left this circuit intact. The limiter can be defeated by adjusting the pot, or by just removing the 6H6 tube. In the interests of authenticity, I have chosen to keep my unit entirely stock, feeling that any minor improvement in sound would be a disservice to the true nature of the unit.

With the exception of changing the output coil for the higher bands, everything on the 30K-1 can be controlled from the front panel of the transmitter or exciter. Bandswitching, grid tuning, and output-matching functions are easily accessible.

Collins thought of almost everything with the 30K-1, 310A and 75A-1 station. It really was the dream station of the 1940s radio amateur, and for me remains so today, some 60 years after its introduction.

SK–End of Work

I delight in bringing back this gear, and while I enjoy using it now, I take additional joy in knowing that I am in, some small way, preserving it for future generations of radio amateurs.

In many ways I do not feel that I am so much the owner as I am the caretaker of these radios. They are all that is left of the once-proud American radio industry, and deserve the best treatment so they may be passed on to future generations.

In closing, I want to thank Todd Bigelow (KA1KAQ) for his countless hours of encouragement, Peter Brickey (K6DGH) for his tireless efforts to get the station to me without damage, Conrad Jahries (WB7DHJ) for sharing about his father, the good folks on the Collins Collectors' Association email reflector for their information, and finally Walter (W7MGA) himself, for building and maintaining such a wonderful station. This has been invaluable help to get this transmitter live again, and continues to be part of W7MGA and amateur radio's rich legacy. *ER*

The Mini-Max: A Practical Transmitter Using Unusual Concepts, Part 2

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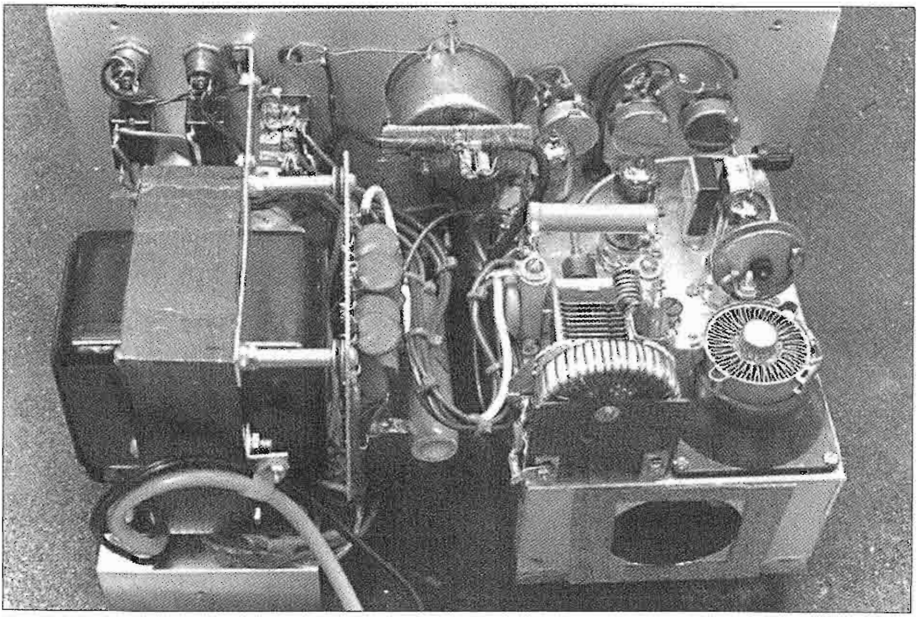
The First QSO

Although there still was the cabinet to address with more drilling and blasting, I was getting really anxious to connect an antenna to the output and have the first QSO with the Mini-Max. I didn't have a T-R relay configured yet, nor did I make provisions to drive a T-R relay. Another scheme of using a spare port on the main coax switch in the shack was used. This slowed the operation down but worked fine.

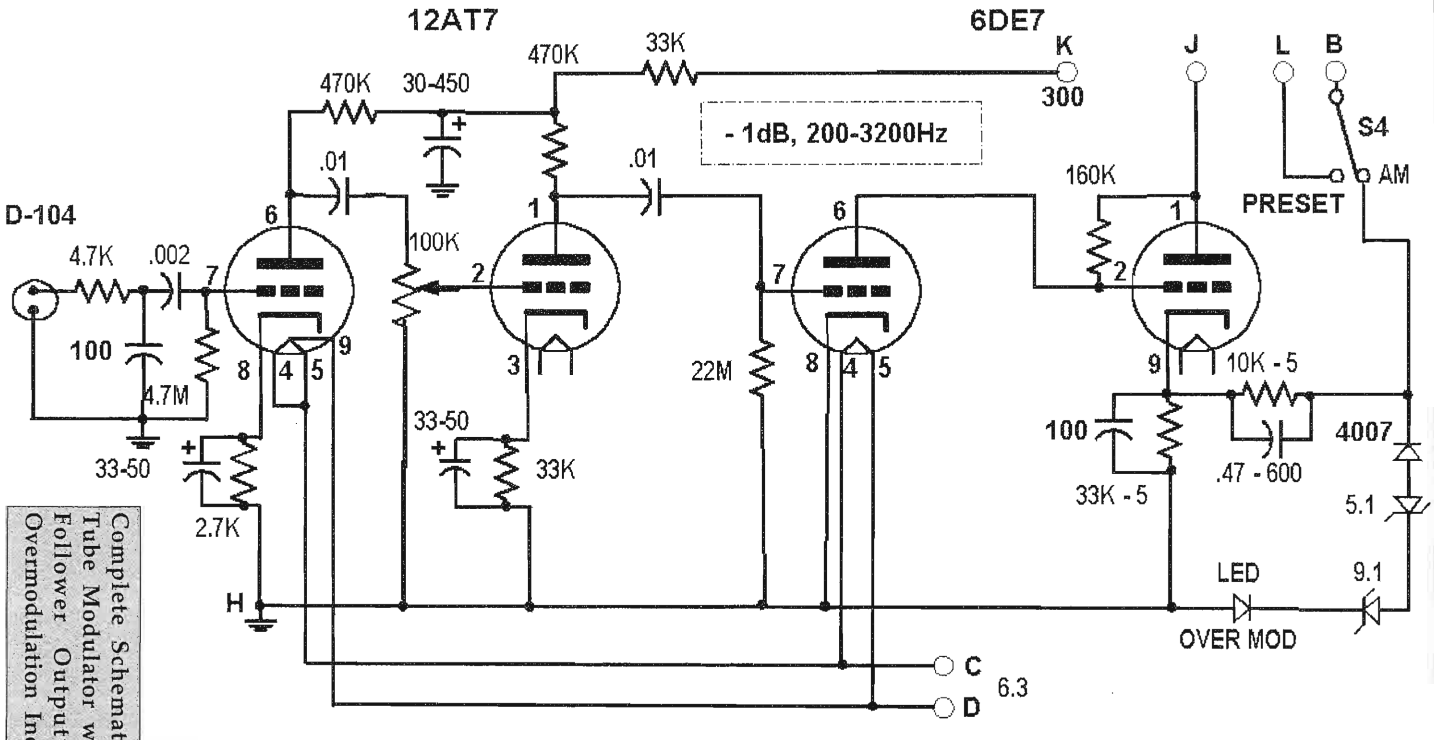
I listened on 7290 kHz and heard my good friend Marty, W3MTG. He was in a QSO with another ham in Canada. Marty would be an excellent choice to surprise because we have both been working on 4CX250B transmitters for several months. I waited for the QSO to finish and gave him a call. He returned my call and I had that rush that only comes when you have your first Novice QSO or see the fruits of your labor pay off. I acted as if I were on one of my other rigs.

Then, on the second go-around, I told him he was honored to be the first contact with the Mini-Max. We had a nice QSO with a good report coming back from Western Pennsylvania for my new rig.

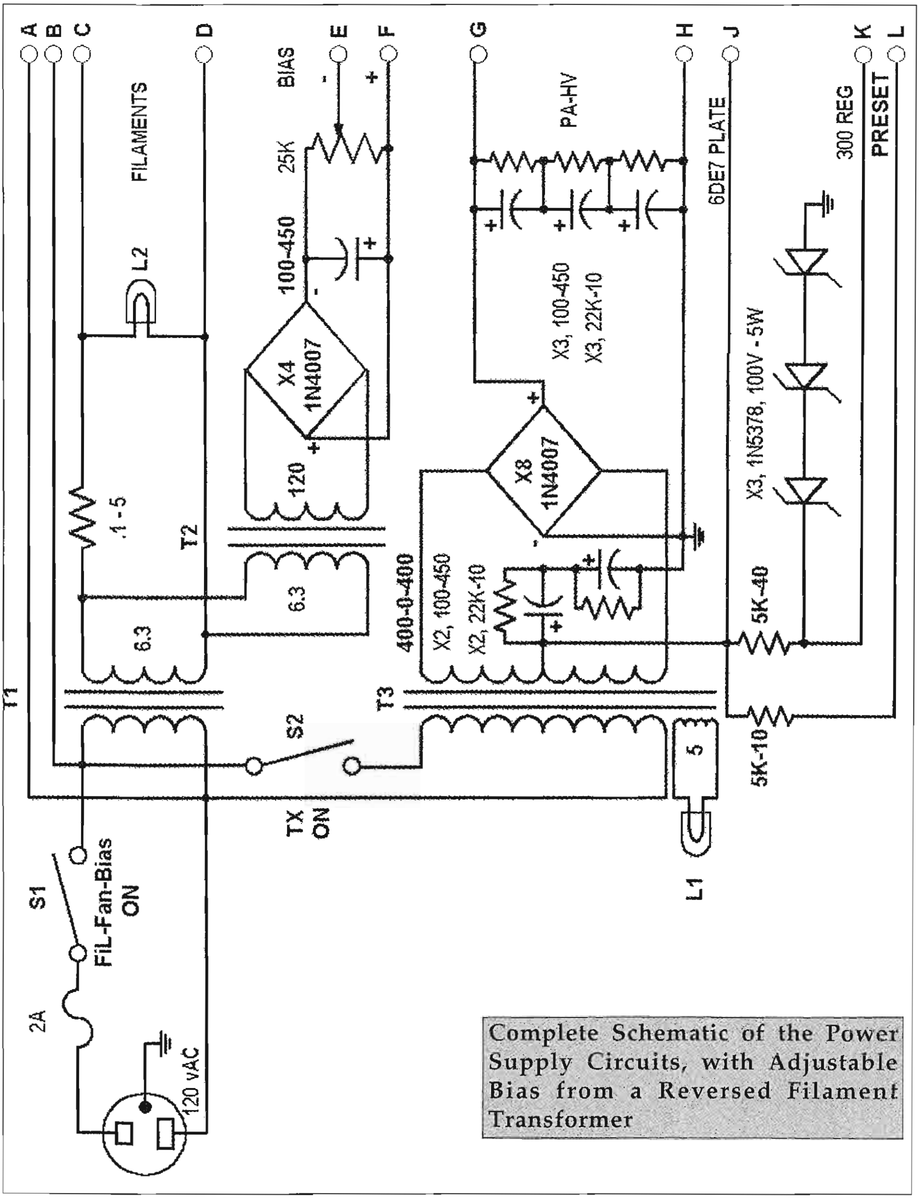
With the first QSO under my belt, it was back into the laboratory for some more cleanup work. I wanted to adjust the carrier, or at least see if there would be any benefit in increasing this level. In



This is the chassis of the Mini-Max with the power supply on the left, and the RF deck on the right. The diode board is mounted to the power transformer with standoff posts.



Complete Schematic of the 2-Tube Modulator with Cathode Follower Output and LED Overmodulation Indicator



Complete Schematic of the Power Supply Circuits, with Adjustable Bias from a Reversed Filament Transformer

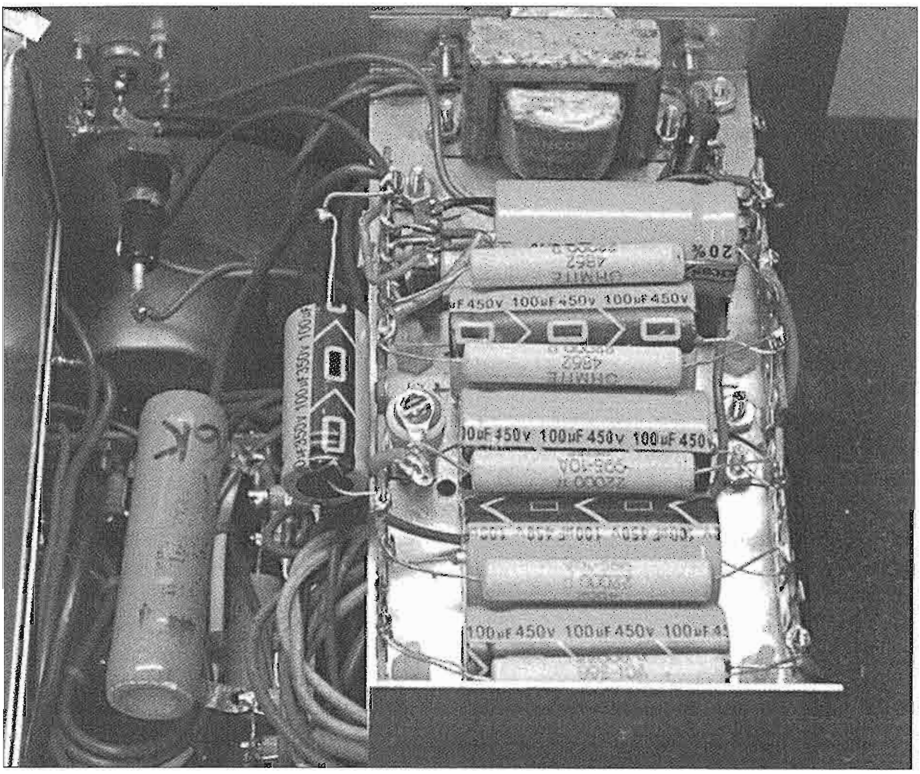
the AM mode, the PA screen voltage is controlled by the cathode output from the 6DE7 modulator. The 6DE7 was biased with a 1-Meg resistor in the DX-60 circuit from plate to grid, and it was left that way for initial testing. This value of resistor yields a cathode voltage of about 70 volts. At this level, the carrier was approximately 10 watts.

The biasing resistor was reduced to 50k, which raised the carrier level to 20 watts. This level was one of the original goals. At this point, I stopped to think. This increase would only be an increase of approximately 3 dB, or about ½ of an S-unit, on the receive end. That surely wasn't enough justification for installing a high-wattage, 50-k resistor. This whole exercise was moving in the direction of defeating the controlled-carrier effect feature, so it was abandoned. As a final point, I did make the biasing resistor 160k at 2 watts for a solid 10-watt carrier.

Let me talk briefly about the crystal frequency-adjustment control. The method has been around for many years and simply loads the crystal with a small capacitance. If too great a value is used the crystal will stop functioning. About 35 pF is the upper limit. Not all crystals will have the same span in frequency from minimum to maximum of the loading capacitor. The best I could do was 500 Hz with either of my crystals.

I know this feature won't amaze many readers, but I wanted the Mini-Max to transmit on 7290.00 and 7295.00 kHz and this method was another thing I had never tried in my 50-plus years in the hobby. Both of my crystals were on the high side, taking them out of range for the control. The first thing I did was to remove the crystals from their cases and clean all the parts in alcohol. Then, I rechecked and measured their frequencies. This information was used to determine how many lines would need to be drawn, using a lead pencil across the face of the crystals, to bring them down into the adjustment range. This process took about three tries with both crystals, but now they were both in range of the control and were rock stable. A slick feature, if I say so myself. I can select the operating crystal and dial in the frequency.

Most of the front-panel controls are



The capacitor and bleeder resistor bank is mounted under the power supply subchassis.

self explanatory or have been mentioned previously in the text. The grid-cathode current monitor uses a ¼-inch, stereo closed-circuit jack. The screen current monitor is located on two test points on the RF deck. The "DRIVE" control was a course correction not included in the prototype. After final checkout, the 5763 produced more than 4 mA of grid current. That is fine for the PA in Class-C operation, but the tube also works well with reduced drive, down to a low of 1 mA.

The microphone connector is one of those troublesome types used on some EF Johnson transmitters. I say they are troublesome because, in the EFJ application, the screw threads are used as the ground for the mic. Since PTT isn't incorporated, the two pins are wired for mic "high" and ground. The "PA BIAS" was originally mounted on the inside, but a 3/8" empty hole suddenly appeared on the front panel and there was nothing else to fill it.

Just for kicks and grins, a temperature test was run on some of the components under the following conditions: the carrier was set to 10 watts, the audio input was a sine wave with 100% modulation, a muffin fan was used for cooling, and the Mini-Max was powered up and in standby for 5 minutes. Then, the rig was put in key-down mode for another 10 minutes. Temperatures were measured after the warm up, and after the key-down mode. The measured temperatures were: PA anode, 24C - 62C; toroid, 20C to 22C; 6DE7, 60C to 82C; and the 5763, 57C to 72C. The PA anode temperature was of most interest and it stayed well below the RCA specification, so that was good news.

The 12AX7 used as the speech amplifier tube was too "hot" for this setup. The common cure is to substitute either a 12AU7 or 12AT7. I've done this in a Ranger transmitter with no problems. In the Mini-Max and using the 12AX7, the gain was barely cracked open for 100% modulation, so a 12AT7 corrected the problem.

Operating this transmitter is a blast and very different from my other tube rigs. Initial setup is done with the chassis out of the cabinet and temporary air supplied to the plenum: Plug in the monitor meters, connect the dummy load, and set the mode to "PRESET." This mode places a fixed voltage on the PA screen and removes the modulator screen drive. *Apply power to the temporary air supply.* Turn the power switch on. This will energize the filaments and bias supplies.

After warm up, turn the "TRANSMIT" switch on and adjust the PA grid-tuning capacitor, located on the RF deck, for maximum grid current. This will be greater than 4 mA with the "DRIVE" set to maximum. Then adjust the PA-tuning control for a dip in the cathode current. Due to high voltage near this capacitor, the control was brought to the side using a flexible shaft. The panel "RF POWER" meter should read 40 watts.

Now, set the mode switch to "AM" and you will see the panel power meter drop back to 10 watts because the modulator is now controlling the PA screen voltage with a much lower value. Reduce the "DRIVE" to 1 mA. Power down, remove the temporary air, and install the chassis back into the cabinet. After warmup, and with the "TRANSMIT" switch on, adjust the mic gain using a scope, while monitoring the panel "OVERMOD LED" indicator. You are ready to go on the air. A little flashing is acceptable.

Cooling air will now be supplied by the fan mounted to the back of the cabinet and controlled by the "POWER" switch. The RF deck is exactly 7" from front to back. That is the exact internal dimension of the cabinet, so a thin cork gasket glued to the back of the deck provides a good air seal.

Final current and voltage readings were measured with a carrier of 10 watts and no modulation. The PA plate voltage is

1100 volts and the screen is 75 volts. PA cathode current is 40 mA, grid current is 1 mA, and the screen current is 2 mA. The monitor meters are no longer needed, so unplug and store them.

So, in summary, how well did I answer my original questions? Referring to Part 1 of this article, the Mini-Max has a maximum of four tubes, a 10-watt, Class-C power amplifier, is self contained with an internal power supply and modulator, and packaged in a fully-enclosed cabinet about 5x10x12 inches. It has fixed tuning with no front panel-tuning controls, no front-panel current meters, and one or two fixed, but adjustable frequencies in the 40-meter band. It uses toroids in the RF circuits and a metal-ceramic PA tube. Therefore, all the original requirements were met, except for the cabinet. The cabinet ended up being taken from an old Heathkit battery eliminator cabinet with 7" x 7" x 13" dimensions.

After several enjoyable QSOs, the only issue that came back was too much low-end response in the audio. Remember, earlier in the text I mentioned that the audio may have to be changed from "Hi-Fi" to more communications-like. Isn't it strange how one knows about things even before they happen? Hi-Fi audio wasn't one of my goals in this project, so it made good sense to modify the circuit.

In the stock DX-60, .005 µF capacitors are used for coupling between the audio stages. In my Hi-Fi version, they were changed to .05 µF. These values gave a low end response down to 75 Hz. Changing the coupling capacitors to .01 µF gives a measured communications-like response of -1 dB from 200 to 3200 Hz.

The 10-watt carrier doesn't produce a strapping signal compared to my 813 rig but it does provide reliable 5x9 AM communication. Making contacts with low power is no surprise, having previous experience using the DX-60 in the AM mode. Designing, building, and debugging the 21-pound Mini-Max was another learning experience in several areas, over a three-month period. I would be extremely surprised, but pleasantly pleased, if the project was ever reproduced by anyone. I have presented some unique concepts that may be of interest and some ideas that could certainly be expanded upon.

Just think about it—a tube rig with no tuning. Have you ever watched that fellow on TV who is hawking the rotisseries and says "just set it and forget it?" What an unusual concept for a practical tube transmitter.

Speaking of expansion, this project was built with just that in mind. The careful reader perhaps picked up on that when I mentioned the 250-watt scale on the power meter. Many areas were designed and fabricated to accommodate future changes.

For instance, the PA plate supply is stiff enough to support a +6 dB increase in S-meter reading. That change would take the carrier from 10 to 50 watts and the available PEP from 40 to 200 watts. Of course, this would ripple down to another cause and effect. The power increase would generate much more heat in the PA tube and increase the ambient cabinet temperature. The cooling fan could be easily changed to a squirrel-cage blower. Other associated changes might be required to support the increase in carrier power. When–and if–these modifications are done, the Mini-Max would then be the Maxi-Max.

References:

• William Orr, W6SAI, Radio Handbook, 23rd Edition, 18th Edition

• Radio Corporation of America, RCA Transmitting Tubes Technical Manual TT-5

• Palomar Engineers Fall 2006 Amateur and SWL Catalog

• ARRL, The Radio Amateur's Handbook, 42nd Ed., 1965

• H. Ward Silver, NØAX, "Experiment #47 - Toroids," QST, December 2006,

• E. L. Klein, W4BRS, "The Whole of the Doughnut," 73 Magazine, June 1967

Broadcast and Amateur Transmitter Audio Revisited, Part 2

By David Kuraner, K2DK
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Last month, we reintroduced the subject of transmitter audio and described some of the issues and modifications for vintage equipment. We discussed connecting tetrodes in triode configuration and driving broadcast modulators.

This month, the discussion continues with numerous examples centering on the audio-driver stage. Impedance matching techniques are discussed, which are used to avoid distorting the driving audio voltage.

A Driver Transformer Alternative—the Audio Phase Inverter

One way to eliminate the driver transformer is to feed the grids of the modulators via a phase-inverter stage. This effectively provides audio to the grids 180 degrees apart just like the original transformer. The trick is to ensure that the voltages are equal. Notice I said "voltages," as this is a Class-A1 stage and the succeeding stage had better be operating Class AB1.

One circuit has been used for defective Multi-Elmac, AF-67 driver-transformer

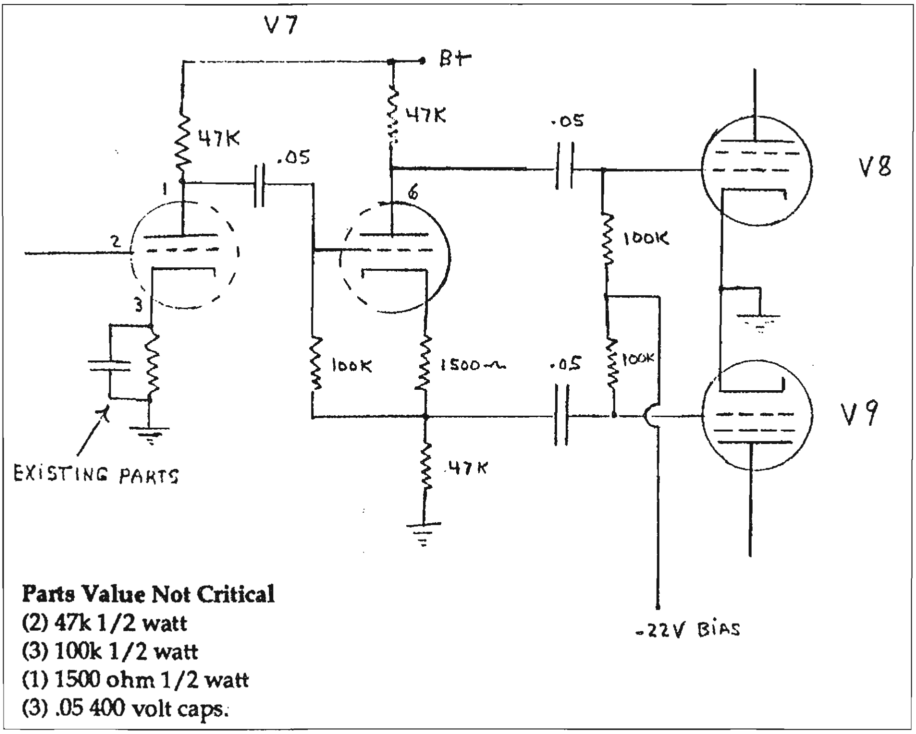

Figure 1: This is Don Winfield's (K5DUT) AF-67 driver modification from ER #24. Note the 47-k resistors in the plate and cathode circuits of the phase inverter. The two outputs are equally split and 180 degrees apart. This is an example of the simplest phase inverter circuit.[1]

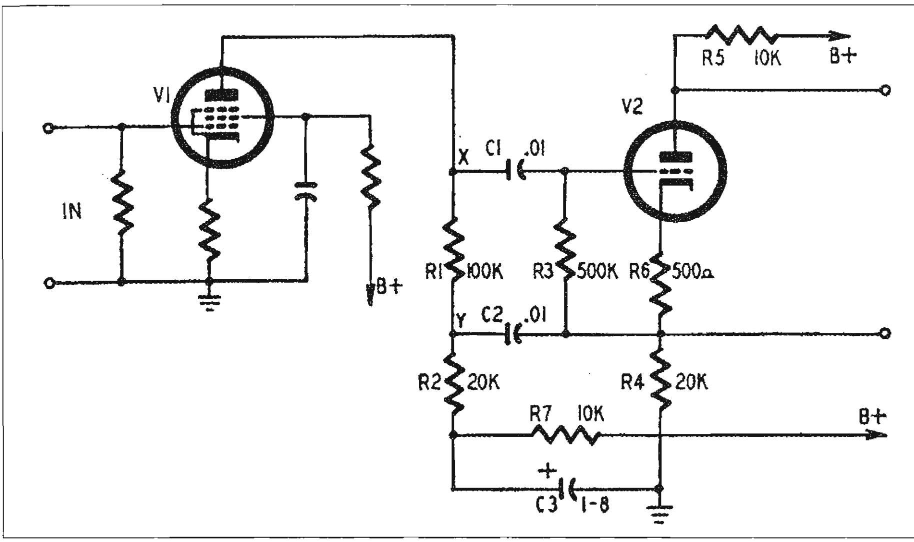

Figure 2: A refined phase-inverter circuit that takes advantage of the cathode follower's high input impedance to overcome gain reduction common in phase splitters. The pentode in the first stage provides higher gain than does a triode stage.[2]

replacement. Donald Winfield (K5DUT), in ER #24, April 1991, described this repair. One section of the paralleled 12AU7 audio driver was rewired as a unity-gain amplifier. The plate feeds one grid of the modulator stage while the cathode (for phase inversion) feeds the other. See **Figure 1**.

The circuit of Figure 1 appears to be adequate for this application, but it is not ideal. A drawback is the fact that the inverter stage is unity gain, at best, and may be less than one. The driver stage to the phase inverter must be considered. In this instance, extreme modification would have been required for the preferred circuit. You have to work with what you have and the space constraints.

Classic vacuum-tube audio phase inverters are driven by pentodes. A 6SJ7 or perhaps a 6AU6 would be employed. Before we discuss why, let's first discuss what's happening in this phase-inverter circuit.

The stage is designed for one half the output voltage to appear at the plate and the other half in the cathode circuit (with respect to ground). Notice that the plate 47-k resistor value is also in the cathode circuit, going to ground. See figure 1. The 1.5-k resistor appears to provide some bias and feedback to the stage. The signal at the cathode is 180 degrees out-of-phase with that of the plate circuit. Thus, the two outputs are mirror images and can now substitute for the center-tapped secondary of a driver transformer.

The phase inverter cathode follower has extremely high input impedance, which is best matched with a pentode. Many classic texts indicate that the input impedance is approximately ten times that of what is between the grid and the cathode. If a pentode with higher gain over a triode is reasonably matched (using a high-value plate resistor) to the input of the inverter, far greater gain is achieved between the two stages. See **Figure 2.**

The issue of driver matching can be addressed by directly connecting the driver plate to the inverter grid. The driver

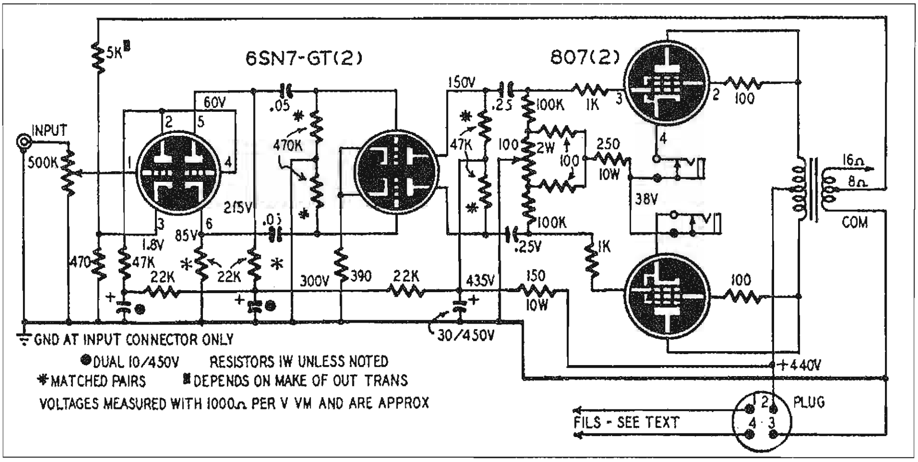

Figure 3: Here is a phase-inverter circuit that uses AC grid-to-plate coupling. Here, the voltage at the second stage cathode terminal is higher than the first stage's plate terminal.[3]

plate voltage is purposely kept low so the grid of the inverter is still negative with respect to its cathode. A circuit using 6SN7s is shown in **Figure 3**, with the voltages at various points shown. This circuit feeds dual triodes of another 6SN7 tube, now in push-pull. This push-pull stage is resistance coupled to 807 output finals in push-pull. A similar design in the inverter stage was incorporated in a Ranger modification by Tim Smith, WA1HLR. (The circuit in the Figure 3 illustration is known as a "Williamson" amplifier.)

Another circuit which can be used is shown in **Figure 4**. This uses the single tube-driver input, but inverts by applying the ground signal reference to the bottom tube of the final stage. This illustration uses output tubes, such as 6L6s, and the plate load is push-pull. Component values are typical. The circuit is also used with triodes, such as the 12AU7, to drive the output stage using resistance coupling to the final grids. If fixed grid bias is required, the grid is grounded through a .1-µF capacitor. The common cathode resistor, not bypassed, yields a small amount of negative feedback. There will be more on bypassing later. Again, these are Class-A1 or Class-AB1 stages.

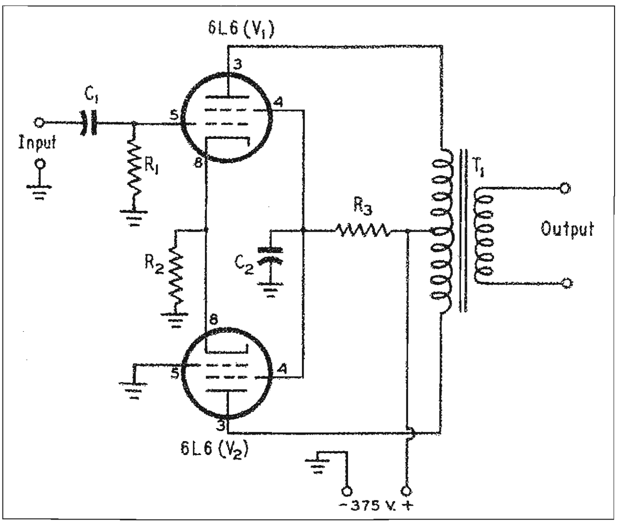

Figure 4: A Push-pull Class-A Amplifier Stage Not Using a Phase Inverter[4]

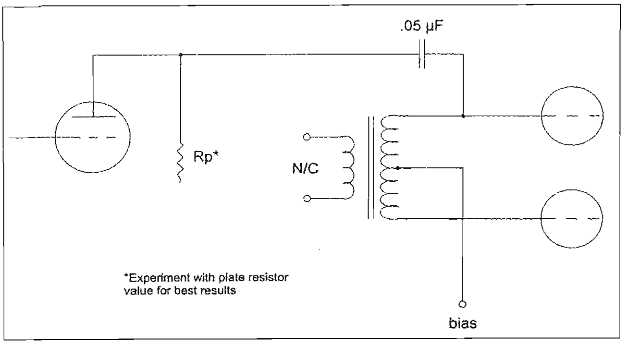

Figure 5: The primary of a small push-pull output transformer has been configured as an audio autotransformer to provide the phase inversion.

If you should have a bad interstage transformer, and don't wish to go the inverter route, **Figure 5** shows another possible fix. The primary of a small push-pull output transformer feeds the grids of the final tubes. Bias is applied to the center tap. You effectively create an audio autotransformer when one end is coupled to the plate of the driver stage via the capacitor, but just don't expect great audio here.

The circuits shown assume you get balanced audio output from the inverter. For most purposes it is adequate, but there can be some critical applications, or you might want to be absolutely sure of good balance. Several complex methods have been developed and have been incorporated in the circuits illustrated in this series. A simple circuit is shown in **Figure 6**.

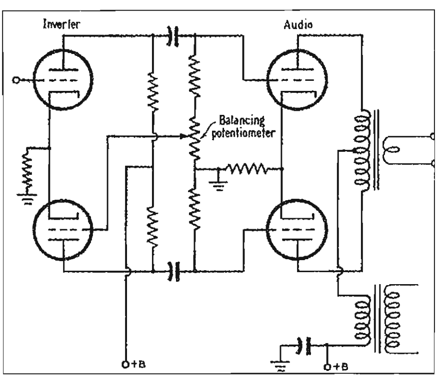

Figure 6: A simple circuit used to balance the phase inverter.[4]

The Driver Tubes

Tom Bonomo (K6AD) brought up the subject of modulator input impedance for proper operation without distortion in an earlier ER article. In his Viking II audio modifications in ER numbers 110, 111, and 112, he addressed this issue. The impedance of the driver stages, as seen by looking back from the modulator grid circuit, should be low to insecure good audio voltage regulation. The biggest factor here is the driver's plate resistance and the interstage transformer. If using an interstage transformer, the primary-to-secondary ratio should be as large as possible.

The K6AD modification uses the Thordarson transformer discussed last month as a step-down transformer, while placing a 5.6-k ohm load resistor across the secondary. The rational is that this helps swamp out load-impedance variations as the modulator tubes start to draw grid current. His empirical data proved this method reduces distortion, although he went further with his modifications that eventually included push-pull triode drivers.

The traditional solution to the low-impedance issue is to use low-µ triodes. The low plate resistance is needed for driving Class-AB2 or Class-B power stages. If you use a tetrode (even a 6V6 or 6L6) to drive the next stage, which is drawing grid current, it is possible to still have distortion. These tubes are normally operated in Class A1 even though you might think of them as beam *power* audio-output tubes. The RCA tube manual does not give parameters for Class-A2 operation. Beam power tubes

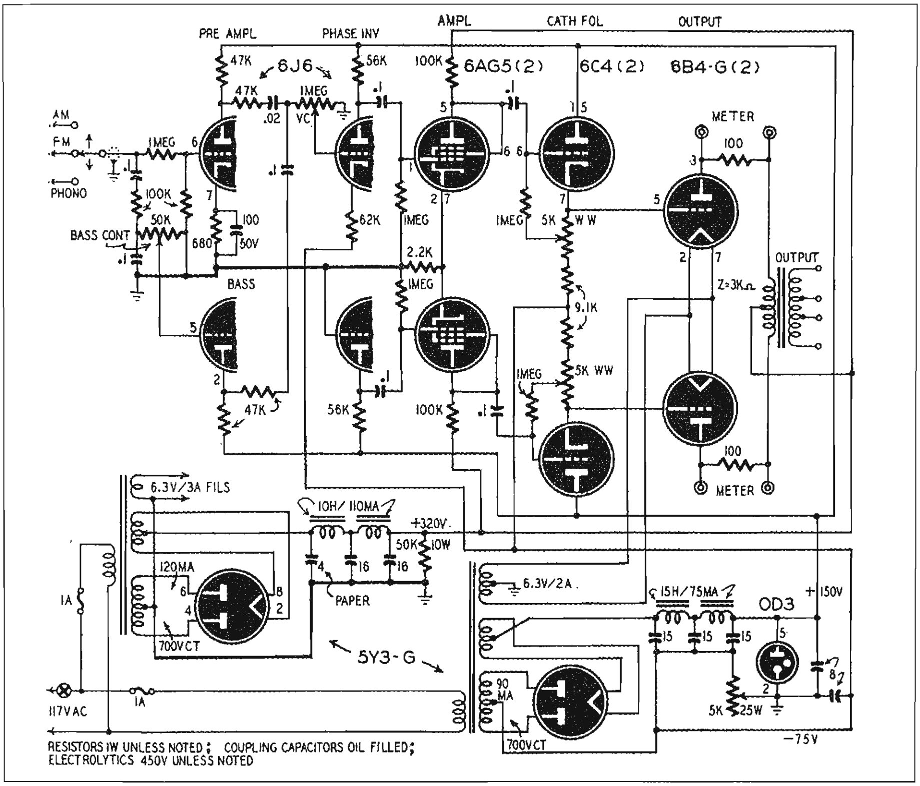

Figure 7: Here is an example of a cathode follower-driven, final-stage amplifier. Note, this stage is using triodes in all stages. Even the beam power 6AG5 is triode connected. Provisions are incorporated to balance the drive to the final tubes via the 5-k resistors in the cathode-follower circuit. Similar circuits can be found in broadcast transmitters.[5]

are specifically designed to be driven by Class-A1 stages and develop power with voltage excitation only. The electrons flowing to the plate are channeled in beams to enable the tube to produce lots of power with only voltage excitation. Thus, in the vast majority of circuits, they can drive Class-AB2 or Class-B stages.

Another way to present low impedance to the grids of a Class-AB2 or Class-B stage is via a resistance-coupled, push-pull, cathode-follower circuit. The voltage gain is unity, or less, but the output impedance is perfect. In the circuit shown in **Figure 7**, the push-pull 6AG5s develop the drive power, while the 6C4 followers provide the impedance match. The 5-k variable resistors in the cathode circuits permit the input to the last stage to be balanced. Notice how the 6AG5s are triode connected.

This same technique is used in some of the Gates BC-1 series transmitters to drive the 833A modulators with 807s. This is essentially the circuit shown in Figure 7, but at a higher power level. Here is another way to feed a broadcast or homebrew, high-power modulator stage with the 807s connected as cathode-follower driver triodes.

As previously stated, tetrodes and beam power tubes can be operated as triodes and this data is provided in the RCA tube manual. This does lower the plate resistance. However, most circuits use negative feedback, which will also lower the plate resistance, and provide the other benefits associated with the feedback circuit. Often, an unbypassed cathode resistor is used for a Class-A1 driver.

Does any of this conflict with the rule about driving a Class A2 with another Class A2? The real issue is power and the need to keep a constant-impedance load so the audio driver voltages are not distorted. They can not become nonlinear. The lower the impedance becomes the lower the voltage becomes and there are fewer possibilities of huge and distorted voltage variations. A beam-power tube as a driver in Class A1 provides power as would a Class-A2 stage.

It is interesting to note that many audiophiles believe that an all-triode amplifier is the only way to go. It was common in the 1940s and 50s. The low impedance of the triode stages best matches impedances into the next stage.

In part three, bypass capacitors and feedback circuits will be discussed.

References:

1. Donald Winfield (K5DUT), "Elmac AF-67 Modulator Fix," Electric Radio #24, April 1991, page 24.

2. Norman Crowhurst and George Cooper, Chapter 6, "Drivers and Inverters," Hi Fidelity Circuit Design, Gernsback Library, Inc., 1956, 2nd printing 1957, page 125, figure 616.

3. Francis Gicca, "Practical Williamson Amplifier, "High Fidelity: Design, Construction, Measurements, number 48, Gernsback Library, Third Printing, May 1957, page 84, fig. 1201.

4. ARRL, Hints and Kinks, 1949, page 40.

5. D.V.R. Drenner, "Cathode-Coupled Amplifier," High Fidelity: Design, Construction, Measurements, Gernsback Library number 48, Third Printing, May 1957, page 115, fig. 1702.

ER

the products we are all familiar with. He designed the military T-195 transmitter, and others. Fred authored 11 articles for this magazine in the mid-1990s.

Ed Marriner (W6XM) was a longtime contributor to CQ magazine during the 1950s. Ed passed away November 20, 2005, and Lynn Fisk (K5LYN) sent me a nice article about his life that I just haven't had room to print. Hopefully, I will be able to have this feature yet this year.

Chuck Teeters (W4MEW) recently wrote to mention the passing of Robert Alder: "...Robert Adler passed away January 7, 2007. He was 92 years old, and had been the lead engineer at Zenith Radio in Chicago. He was the inventor of the mechanical filter, in 1946, which was copied by RCA and Collins in the early fifties and covered in my ER article, February 2006. ...The RCA copies never bothered him, as RCA always gave him credit. However, Collins didn't give him credit, and he said he got a kick out of how Art Collins got around saying anything about where the filter designs came from! Since the filter designs were published in 1947 Collins could not patent them, however, after 1960 they did patent improvements, which referenced his 1946 work at Zenith..."

Tom Elmore (KA1NVZ) wrote to let me know that a well-known AM operator and his good friend, Bob Zarkovich (KL7HDY), of Anchorage, Alaska, passed away unexpectedly the 21st of March, 2007. Bob had quite an AM station and Tom is working to keep it intact as Bob would have wanted, and to preserve the station for future generations.

Dan Brown (W1DAN) let me know about the passing of George Mouridian (W1GAC) of Framingham, Massachusetts. George passed away February 15, 2007. In the 1950s, George started the Old Buzzard's AM net, still meeting every weekday in New England on 3.945 Mc. It is the longest-running AM net in existence and George was consistently on the net. Dan sent me nice material about George that will be running in the June issue of ER.

73, Ray, NØDMS

Milestones in the History of Amateur Radio
The Radio Act of 1912 Ordains Amateur Licensing
Part 1

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The Senate and House of Representatives passed into law August 13, 1912, an act to authorize regulation of radio communication within the continental United States and its far-flung territories. Congress decreed it to take effect on December 13, 1912.

The Radio Act of 1912 supplemented two earlier regulatory events. First, Congress passed the Radio Ship Act, June 24, 1910, which required that wireless equipment be installed on ships carrying fifty or more persons. Second, Congress endorsed the provisions of the first International Radiotelegraphic Convention, also on August 13, 1912, which had been signed by its representatives in London on July 5, 1912. [The latter was ratified by the Senate, January 22, 1913.] The London Convention had distributed combinations of call letter prefixes, starting with K, N, and W, to the United States. The N combinations were reserved for Government stations; the K and W combinations were used for military, coastal, ship, public, and commercial stations. Amateur radio did not figure in the treaty deliberations ("Department of Commerce," 1920).

The Radio Act of 1912 ensured that nearly everyone involved with radio communication within the jurisdiction of the United States would be regulated by the stipulations of a license: "A person, company, or corporation . . . shall not use or operate any apparatus for radio communication . . . except under and in accordance with a license". Two exemptions, however, were allowed: (1) A license was not required for the transmission of signals or exchange of radiograms "by or on behalf of the Government". And importantly, sensitive to abridging States Rights, the framers of the Act also stated: (2) "Nothing in this Act shall be construed to apply . . . to signals between points situated in the same State", providing that they do not interfere with either reception or transmission of signals beyond the borders of the state.

The effects of implementing the Radio Act of 1912 upon classes of both amateur operator and amateur station licenses are described in part 2 of this article. This extended discussion is prefaced briefly with commentary about amateur activity pre-1912. A fifteen-year-old lad is depicted operating a pre-1912, low-power, home-built spark station. It is prototypical of stations hundreds of other young amateurs operated then and created, thereby, the interference that hastened passage of the Radio Act of 1912. The paper concludes with illustrations of amateur licenses issued to 6IZ in 1915 by the Bureau of Navigation, remarks about the impact of the American Radio Relay League (ARRL) upon early amateur licensing, and an illustration of a 1915, "official" relay-station certificate issued to 6IZ by the ARRL.

Amateur Activity Prior to Passage of the Radio Act of 1912

Eleven years prior to effective date of the Radio Act of 1912, on December 12, 1901, Guglielmo Marconi and a single assistant, hunched over a mercury coherer in a frigid, tiny room of an abandoned hospital situated atop Signal Hill, St. John's, Newfoundland. They listened for successive transmissions of the letter

S—three dots sent repetitiously from Poldhu Point, Cornwall, on the Southern coast of England. Their alleged reception of the signal has been acclaimed as the first transatlantic wireless transmission.

Thanks to Marconi's pioneering efforts, the radio spectrum from a few hundred meters to several thousand meters—the optimal range of broadband spark transmitters—swiftly became cluttered with government, military, maritime, commercial, and amateur signals. Interference accelerated excruciatingly during the first decade of the twentieth-century. Operators of wireless stations opened up in the radio spectrum whenever and wherever it suited them. Many of them had honed skills earlier as wire telegraphers. On the other hand, hundreds of youngsters, attracted to wireless by Marconi's triumph, constructed low-power stations with which to send and receive messages. They learned the continental Morse code as best they could by copying maritime and commercial stations. Their clumsy fists more often than not produced halting, incoherent transmissions (Bouck, 1923; Burghard, 1923; Vermilya, 1917). Big-time operators wrung their hands attempting to expedite socially important communication while crescendos of pip-squeak signals ruined reception. Although public, commercial, and government agencies detested the transmissions of the youthful amateurs, their efforts emerged in the first decade of the twentieth century as a cornerstone of amateur radio (DeSoto, 1936).

Youthful amateurs in the years before passage of the Radio Act of 1912 evolved fairly proficient stations as they learned how spark-discharge transmitters functioned and as they procured components for building them. Crystal sets and loose

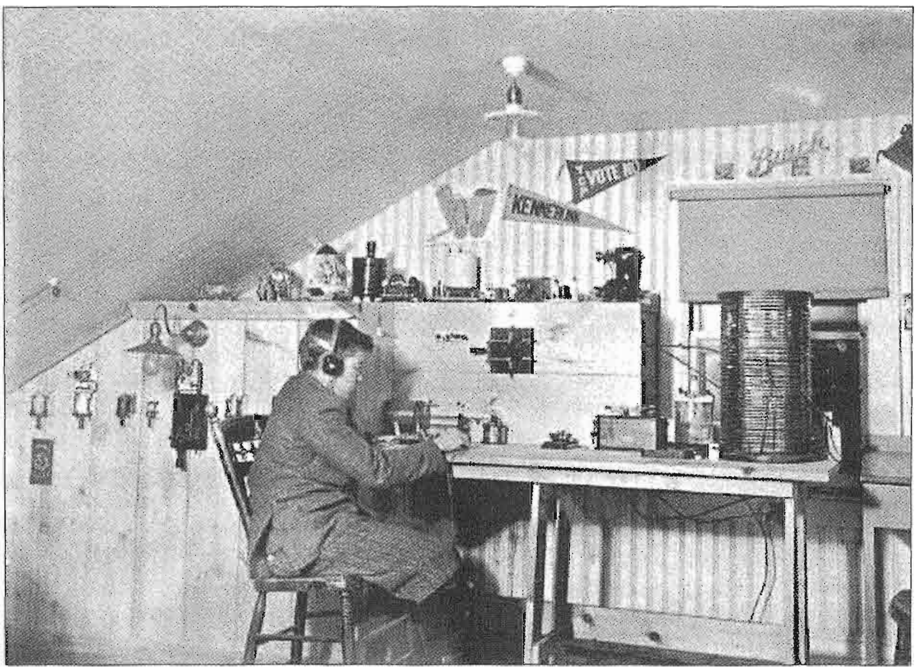

Figure 1: This rare photograph shows Joseph Dane, Jr. operating his wireless station in the attic of his home in Kennebunk, Maine during January, 1913, just after passage of the 1912 Radio Act.

couplers superseded mechanical detectors like the coherer, which helped mitigate problems associated with reception. Countless adolescents thus constructed low-power amateur stations like the one shown in **Figure 1**.

Figure 1 shows Joseph Dane, Jr. seated at the operating position of his wireless station in the attic of his home in Kennebunk, Maine, then a relatively rural community about 20 miles south of Portland. The photograph was taken January, 1913, about one month after the Radio Act of 1912 took effect. Dane was born in 1898, and he was about 3-½ months past his fifteenth birthday at the time. His crystal set is at the left in Figure 1. The secondary coil of a nearby loose coupler, a Murdock #335, appears fully inserted inside its primary coil; the tight coupling suggests that Dane might have been operating around 1,200 meters. A Murdock #361, circular, celluloid-shielded, variable condenser at the right of the loose coupler provided fine tuning.

A home-made oscillation transformer is at the right on Danes' desk. It is basically a spiral induction coil—an autotransformer that is coupled directly to his oscillatory and antenna circuits. Dane's huge coil, which is essentially a helix, is wound with heavy wire and mounted on a wood framework. Clips are distributed strategically on the coil so that he could maximize transference of power to his antenna. A MESCO #495, 3-inch spark coil is housed in a rectangular wooden box to the right of the helix. It requires a power supply of eight 1.5-volt dry cells (not visible). Dane mounted a MESCO #467, adjustable zinc spark gap on top of the spark coil. It is adjusted for about a ½ inch gap—perhaps to attain the fattest blue-spark possible.

The mechanism on the left end of the spark-coil box indicates that he used an "interrupter" or "vibrator" to create AC voltage from a battery in order to step up spark coil voltage output for charging the "discharge" condenser. The flat item sitting on the table in front of the spark coil is a Murdock "Mud" spark "discharge" condenser (.0015 mfd.), which is comprised of two pieces of brass separated by a piece of glass. The unidentifiable object behind it may be a Leyden Jar condenser; perhaps it was attached in parallel with the "Mud" condenser to strengthen the overall spark when discharge occurred.

No one knows how many months or years Joe Dane operated an amateur station before passage of the Radio Act of 1912. He probably had adopted, respectively, the first initial of his first and last names to create "JD" as his call letters. None of the early Callbooks indicates that he ever acquired a license from the Bureau of Navigation. Maybe word of the Radio Act of 1912 failed to reach him during the period of his amateur activity? Perhaps he did learn of the Act but thought that his station was exempt, since with his very low-power transmitter, with its maximum range of about 15 miles, he might not yet have sent a signal beyond the borders of the state of Maine? And he might also have forsaken amateur radio shortly after the Act became effective, because he believed his equipment would not work satisfactorily on 200 meters? Finally, he might have surmised that the effort that he would have to expend to obtain operator and station licenses in 1913 involved too much bureaucratic "red tape?" Whatever the circumstances, Joe Dane abandoned amateur radio shortly thereafter, made the academic honor roll and engaged in extra-curricular activities during his high-school years. He graduated from Kennebunk High School in 1917. Subsequently, he prospered as an architect in both Kennebunk and Boston. He passed away in 1964.

[Editor's Note: Bob continues with part 2 in next month's issue.]

ER

VINTAGE NETS

AM Carrier Net: Sunday mornings, 8:30AM local Eastern time, 3835 kc. QSX W2DAP. Friendly format.
Arizona AM Nets: Sat & Sun: 160M 1885 kc @ sunrise. 75M 3855 kc @ 6 AM MST. 40M 7293 kc 10 AM MST. 6M 50.4 Mc Sat 8PM MST. Tuesday: 2M 144.45 7:30 PM MST.
Boatanchors CW Group: QNI "CQ BA or CQ GB" 3546.5, 7050, 7147, 10120, 14050 kc. Check 80M winter nights, 40 summer nights, 20 and 30 meters day. Informal nightly net about 0200-0400Z.
California Early Bird Net: Sat. mornings @ 8 AM PST on 3870 kc.
California Vintage SSB Net: Sun. mornings @ 8AM PST on 3860 +/-
Colorado Morning Net: Informal AMers on 3875 kc daily @ 6:00 to 6:15 AM, MT. QSX KØOJ
Canadian Boatanchor Net: Daily 3725 kc (+/-) @ 8:00 PM ET. Hosts are AL (VE3AJM) and Ken (VE3MAW)
Collins Collectors Association (CCA) Nets: Sunday, 14.263 Mc @ 2000Z. Informal ragchew net Tue. evening, 3805 kc @ 2100 ET, Thu. 3875 kc. West Coast 75M net, 3895 kc 2000 PT. 10M AM net 1800Z, 29.05 Mc Sunday, QSX 1700Z. CCA First Wednesday AM Night each month, 3880 kc starting @ 2000 CST, or 0200 UTC.
Drake Technical Net: Meets Sun. on 7238 kc, 2000Z. Hosted by John (KB9AT), Jeff (WA8SAJ), and Mark (WBØIQK).
Drake Users Net: Check 3865 kc, Tue. nights @ 8 PM ET. QSX Gary (KG4D), Don (W8NS), and Dan (WA4SDE)
DX-60 Net: Meets on 3880 Kc @ 0800 AM, ET on Sun. QSX op is Mike (N8ECR), with alternates. The net is all about classic entry-level AM rigs like the Heath DX-60.
Eastern AM Swap Net: Thu. evenings on 3885 kc @ 7:30 PM ET. Net is for exchange of AM related equipment only.
Eastcoast Military Net: Sat. mornings starting 0500, 3885 kc +/- QRM. QSX Ted, W3PWW. It isn't necessary to check in with military gear, but that is what this net is all about. Late checkins are welcome.
Florida AM Group: A large group meeting every Sunday, 7:30AM ET, 3875 kc and pre-net checkin 7:00AM ET, 3675 kc. QSX Maury, N4GUI. Also, Florida vintage SSB net "AFLAC" meets Wed., 3910 kc, 9PM ET. QSX Warren, W1GUD.
Fort Wayne Area 6-Meter AM net: Meets nightly @ 7 PM ET on 50.58 Mc. Another long-time net, meeting since the late '50s. Most members use vintage or homebrew gear.
Gulf Coast Mullet Society: Thu. @ 6PM CT, 3885 kc, QSX control op W4GCN in Pensacola.
Gray Hair Net: One of the oldest nets, @44+ years ,160 meter AM Tue. evening 1945 kc @8:00 PM EST and 8:30 EDT. Also check www.hamelectronics.com/ghn
Heathkit Net: Sun. on 14.293 Mc 2030Z right after the Vintage SSB net. QSX op W6LRG, Don.
K1JCL 6-meter AM repeater: Operates 50.4 Mc in, 50.4 Mc out. Repeater QTH is Connecticut.
K6HQI Memorial 20 Meter Net: Flagship AM net 14.286 Mc daily for 25+ years. Check 5:00 PM Pacific Time.
Lake Erie Boatanchor CW Net: Saturday morning, 1 PM ET, 7094 kc QSX op Steve (WA3JJT) or Ron (W8KYD).
Midwest Classic Radio Net: Sat. morning 3885 kc @ 7:30 AM, CT. Only AM checkins. Swap/sale, hamfest info, tech. help are frequent topics. QSX op is Rob (WA9ZTY).
Mighty Elmac Net: Wed. nights @8PM ET (not the first Wed., reserved for CCA AM Net), 3880 +5 kc. Closes for a few summer months. QSX op N8ECR.
MOKAM AM'ers: 1500Z Mon. thru Fri. on 3885 kc. A ragchew net open to all interested in old equipment.
Northwest AM Net: AM daily 3870 kc 3PM-5PM winter, 5-7 PM summer, local. 6M @50.4 Mc. Sun., Wed. @8:00 PM. 2M Tues. and Thurs. @ 8:00 PM on 144.4 Mc.
Nostalgia/Hi-Fi Net: Started in 1978, this net meets Fri. @7 PM PT, 1930 kc.
Old Buzzards Net: Daily @10 AM ET, 3945 kc in the New England area. QSX op George (W1GAC) and Paul (W1ECO).
Southeast AM Radio Club: Tue. evening swap, 3885 @7:30 ET/6:30 CT. QSX op Andy (WA4KCY), Sam (KF4TXQ), Wayne (WB4WB). SAMRC also for Sun. Morning Coffee Club Net, 3885 @ 7:30 ET, 6:30 CT.
Southern Calif. Sun. Morning 6 Meter AM Net: 10 AM on 50.4 Mc. QSX op is Will (AA6DD).
Swan Nets: User Net Sunday 2200z winter 14.250Mc ±QRM. QSX op rotates Jim (WA5BDR), Jay (WB6MWL), Norm (W7RXG), Bill (W4WHW). Tech Nets: Wednesday 2300z 14.251Mhz / Saturday 1900z 7235 kc QSX op Stu (K4BOV)
Texoma Trader's Net: Sat. morning 8:00AM CT 3890 kc, AM & vintage equip. swap net.
Vintage SSB Net: Sun. 1900Z-2000Z 14.293 & 0300Z Wed. QSX op Lynn (K5LYN) and Andy (WBØSNF)
West Coast AMI Net: 3870 kc, Wed. 8PM Pacific Time (winter). Net control rotates between Brian (NI6Q), Skip (K6LGL), Don (W6BCN), or Vic (KF6RIP)
Westcoast Military Radio Collectors Net: Meets Sat. @ 2130 Pacific Time on 3980 kc +/- QRM. QSX W7QHO.
Wireless Set No. 19 Net: Meets second Sun., monthly, 7270 kc (+/- 25 Kc) @ 1800Z. Alternate 3760 kc, +/- 25 kc. QSX Dave (VA3ORP).

160-Meter Modification for the Collins ART-13 Transmitter

By Breckinridge S. Smith, K4CHE
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As I sat at the kitchen table examining a schematic my wife asked "What is that?" I answered, "The schematic to an ART-13." She quickly responded, "You had an ART-13 at Travis." I love my wife, she remembers everything. She hesitated for a few seconds and said "Why are you studying the schematic?"

"I am trying to do 160 meters." She responded, "Is that an Olympic event?"

Background

The ART-13 transmitter VFO was designed to cover the HF frequency range down to 2.0 Mcs, but the set could also could cover the lower frequencies with the 0-16 (200-1510 kcs) and the 0-17 (200-600 kcs) low-frequency oscillator plug-ins. When the low-frequency plug-ins are used, the internal antenna tuning-and-loading circuits are completely bypassed and the output of the 813 power amplifier is fed straight through to the output connector marked "loading coil." The 0-16 plug-in could be a candidate for modification to 1.8 Mc as its upper limit is around 1500 kc. The CDA-T crystal-control unit also offers possible operation down in the 1.8 Mc, but the resulting loss in "drive," due to multiplier operations, would still require modifications to work with the ART-13 multiplier stage. However, the 0-16, 0-17, and CDA-T plug-ins are not readily available.

Mike Murphy (W2UD) published a brief article in ER, "Adding 160 Meter Coverage to the ART-13," where he modified the set with a single relay that switches a fixed and variable capacitor[1]. QST also published a unique modification in its "Hints and Kinks" column, by W2ISL, where a frequency-switching circuit was utilized which plugged into the oscillator socket and then held the oscillator tube[2].

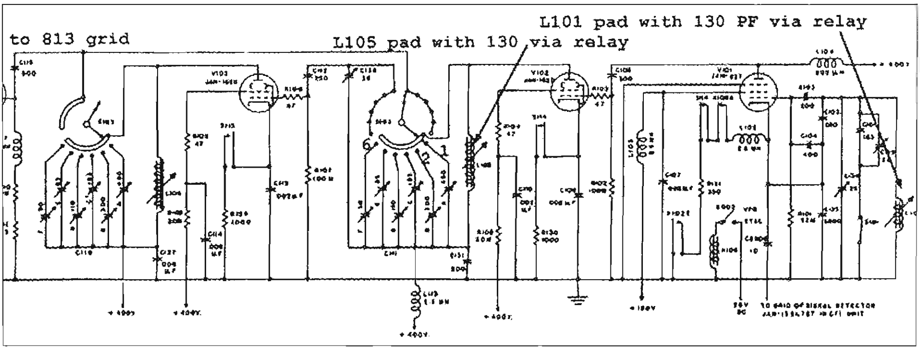
I decided to modify the VFO "A" dial position 1 (2.0 -2.4 Mc) on the "High Frequency Control" to cover the 160-meter band and leave the plug-in units alone. Modification of the transmitter's VFO gives complete operation over the 160-meter band and allows utilization of the existing antenna matching circuits that were all ready in the transmitter to assist in matching the transmitter.

In most cases, external components will have to be utilized to aid in matching the ART-13 to a 160-meter antenna. The overall modification in this article will consist of a single toggle switch and two small relays to switch in a "fixed" capacitance for the oscillator and multiplier stages.

Before you try this modification, you should check and see how far your set will actually tune down in frequency, and then check your drive below 2000 kcs. Usually an unmodified ART-13 can operate at least 25 kc into the top portion of the 160-meter band but the drive level will need to be adjusted. The bad news is that this same drive level on "Position 1" also affects the drive levels on "Position 7" that is used for 40-meter CW. Please read the ART-13 manual, the detailed analysis section on the VFO and multiplier stages, before starting your modification.

Oscillator Modification

On the VFO "A" dial, range position number one, the actual oscillator operates at 1.000 Mc to 1.200 Mc, and is doubled for output in the range of 2.0 to 2.4 Mc. The actual frequency control is accomplished by a variable inductor, L101, which has a slug that moves in and out of the coil. By using reasonable construction precautions, a very stable modification to the basic oscillator circuit is



Locations of L105 and L101 Pads for the ART-13 160-Meter Modification

feasible to move the bottom range limit down, 100 kc to 900 kc.

I experimented and found that a 130-pf capacitor connected to the bottom of oscillator coil L101 and ground would extend the bottom limit of the VFO to 1.8 Mc. The bottom of 160 meters would be around "020" on the dial of VFO tuning control "B" and the top edge of 160 meters would be "840" on the dial. Different sets may require different padding, but 130 pf is a good starting point for the oscillator modification. Note: A fixed capacitor and a variable trimmer may be used in parallel to find the appropriate value. I used a standard NPO-ceramic trimmer. You might also wish to just use the fixed-and-variable combination and leave it in the circuit, but I preferred to keep the parts count to a minimum and to use a fixed value.

A .001 feed-through capacitor was utilized to supply power to the first relay that was mounted inside the oscillator compartment. (See **Figure 1**.) Type 73 ferrite beads are installed on the 24-VDC wire, used on the feed through, for decoupling. The 24-VDC power was borrowed from pin 8 of P220, the male Jones connector that is mounted on top of the chassis, and is used for the power to the crystal calibrator, which is called the "CFI" unit (calibration frequency indicator). The 24-VDC relays are wired in parallel, 12-VDC relays may be used, of course, and should wired in series. If you do not wish to install feed- through capacitors, you can pass the single relay control wire

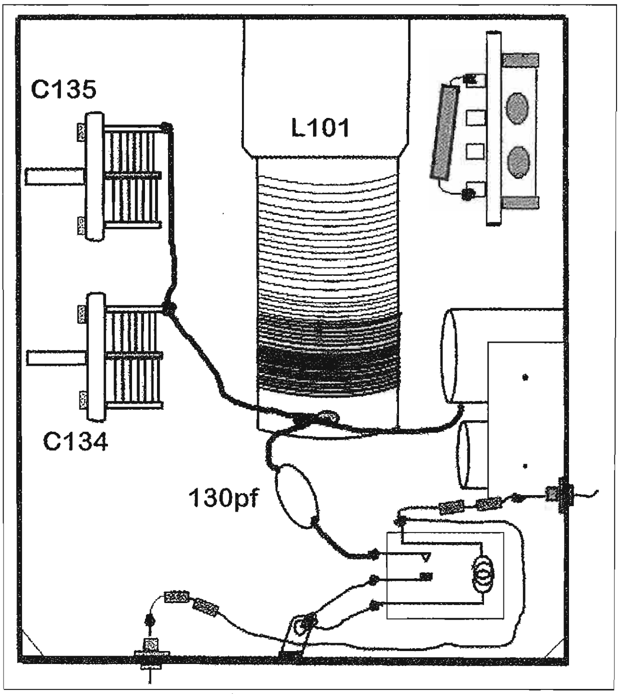
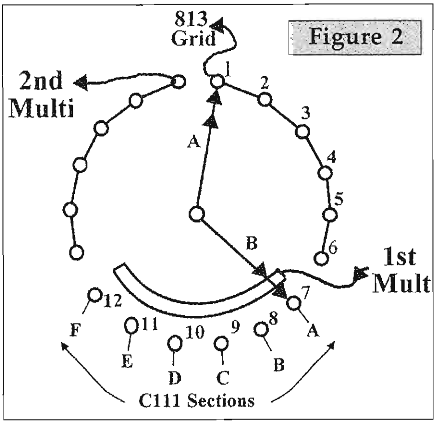


Figure 1, Oscillator Component Locations



through the area near V101, but I strongly recommend installing a feed-through capacitor and ferrite decoupling beads.

24 VDC is available in the oscillator compartment, but the terminals of TB 101 are very inaccessible and would entail running lengthy wiring in the vicinity of L101, which determines the frequency. When installing the relay in the oscillator compartment, remember that the compartment cover that you removed is recessed, so you must leave room for the cover to be reinstalled.

Multiplier and Drive Information

Drive for the 813 final amplifiers consist of a 1st multiplier for frequencies below 6.0 megacycles and a 2nd multiplier is switched in for operations above 6.0 megacycles. The multiplier stages are tuned mechanically, in tandem, and track with the ART-13 VFO by a connecting shaft. When the VFO frequency goes up or down, the driver frequency coverage is also changed. The problem arises when you modify the "A" portion of the VFO for 160 meters. You will not have enough multiplier drive for the lower portion of 160, so you have to peak the drive for your new modified segment by adjusting variable capacitor "A" in the C111 bank of ceramic capacitors, and you usually wind up padding capacitor "A." However, when you pad and peak the drive to cover the new 160-meter segment, you then drive on the upper portion of the original position "1" range, 2.0 to 2.4 Mc. This drive is needed for the CW portion of the 40-meter band, which uses position "7" on the VFO. For example, to operate on 40-meter CW, on a frequency of 7020 kc, the actual VFO output must be on 2340 kc and is tripled by the second multiplier stage. On the ART-13 VFO dial, a dial setting of approximately "1360" would be used for a 40-meter CW frequency of 7020 kc, and that is in the upper portion of the VFO coverage.

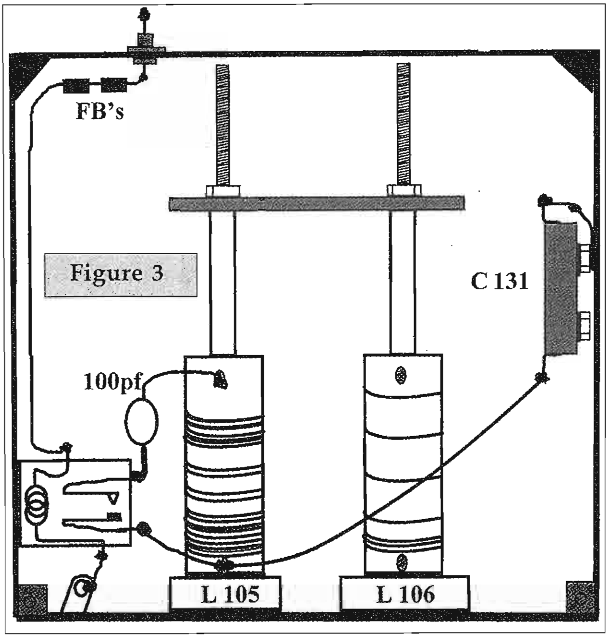
All of the multiplier-switching and drive-signal switching is accomplished by a very rugged ceramic rotary switch, S102. S102 has two arms that have dual taps, or contacts, and is very remarkable. Most of the schematics that I have do not clearly illustrate the switch and I have presented it in **Figure 2**. Note that in Figure 2, in the first six positions of the switch, the drive from the first multiplier goes directly to the 813. When arm "A" finally gets around to position "7," arm "B" is now feeding drive to the 2nd multiplier stage, which will then feed the grid of the 813.

Drive Modification

A second relay is installed in the drive compartment and it switches in a fixed capacitance of 100 pf <u>across</u> coil L105 to lower the multiplier-coil frequency. When the capacitor is removed, the coil returns to its original higher-frequency setting and provides proper drive on 40-meter CW when position "7" on dial "A" is selected. By mounting the relay to the side of L105, the leads can remain short and the installation will be very stable. A .001-µf feedthrough, from the oscillator compartment, provides power for the relay and type 73 ferrite beads are used for decoupling. See **Figure 3**.

Alignment

First, a caution about the multiplier capacitor banks, C111 and C115, which are comprised of 6 large circular-ceramic capacitors, all of which are different values and are mounted side-by-side. First of all, when the set is transmitting, 400 volts is exposed in this area, so beware. The six ceramic capacitors in the bank



40-meter CW band when the 2nd multiplier is switched in, you can just simply turn the VFO dial "B" to approximately "1450" on the dial, which would provide a 2365-kc output. Set the drive level. Then, tune the dial to "430" and that will be the approximate mid-point of the 160-meter band. Then, activate the toggle switch for the relays used in the modification and check for drive. While you have the set on its side and you are satisfied with position "1" drive in the modified and unmodified states, check the drive level on position "7" for 40 meters, which uses C115, capacitor "A." Don't forget to turn the 160-meter modification relay switch off when checking the drive on 40 meters! (The ART-13 technical order for the set has full alignment instructions for the VFO and multiplier stages.) The actual VFO frequency is usually only off by a couple of dial divisions when the relay and capacitor are installed in the VFO compartment, so alignment of the actual VFO frequency may not be necessary. Drive alignment *will* always be needed.

are constructed of two ceramic wafers. One is fixed and the other rotates and provide a variable capacitance similar to any small trimmer cap.

These trimmers in C111 and C115 have adjustment tabs positioned around the cap at three places that are 120 degrees apart. To cover the full range of the capacitor, you must move a single tab at least 180 degrees. You ***must*** adjust these caps carefully. Do not put any side pressure on the adjustment tab or it may create stress on the ceramic, causing a fracture, and possibly resulting in lost drive for the stage that it tunes.

A loosely-coupled grid-dip meter can be used to check for proper resonant frequency of L105 with the capacitor switched across the coil. Most folks don't have a grid-dip meter these days, so you can evaluate the modification by operating the set and observing grid drive on the ART-13 multimeter. I have always preferred setting the drive levels in the lower half of the drive arc for conservation of the 813 final and prevention of spurs, etc. Since position "1" of the VFO is only used for 160 and effects only the

The relay switch can be mounted just about anywhere; I usually mount a small toggle switch just inside under the top cover in the audio-driver area. Be careful with placement of the relay wiring and try to keep it close to the chassis, avoiding the V101, the oscillator tube.

I will be looking for some ART-13s on 160 and maybe I can make my first ART-13 to ART-13 contact on CW!

References:

1. Mike Murphy, W2UD, "Adding 160 Meter Coverage to the ART-13," Electric Radio #32, December 1991, p.24.
2. Porterfield, W2ISL, "ART-13 on 160 Meters", QST, April 1973, p.61

ER

AM Transmit Filter Modification for the Drake TR7 Transceiver

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Willoughby, Oh 44094
wa8saj@ncweb.com

The Drake TR7 is not a typical rig that is known for AM operation, since it is "solid-state" and not as famous as the old tube rigs that many of us folks have used through the years. I have had TR7s for many years in my shack and, until recently, was wondering what could be done to improve the transmit audio because the receiver is great if the optional 6-kHz wide filter is installed.

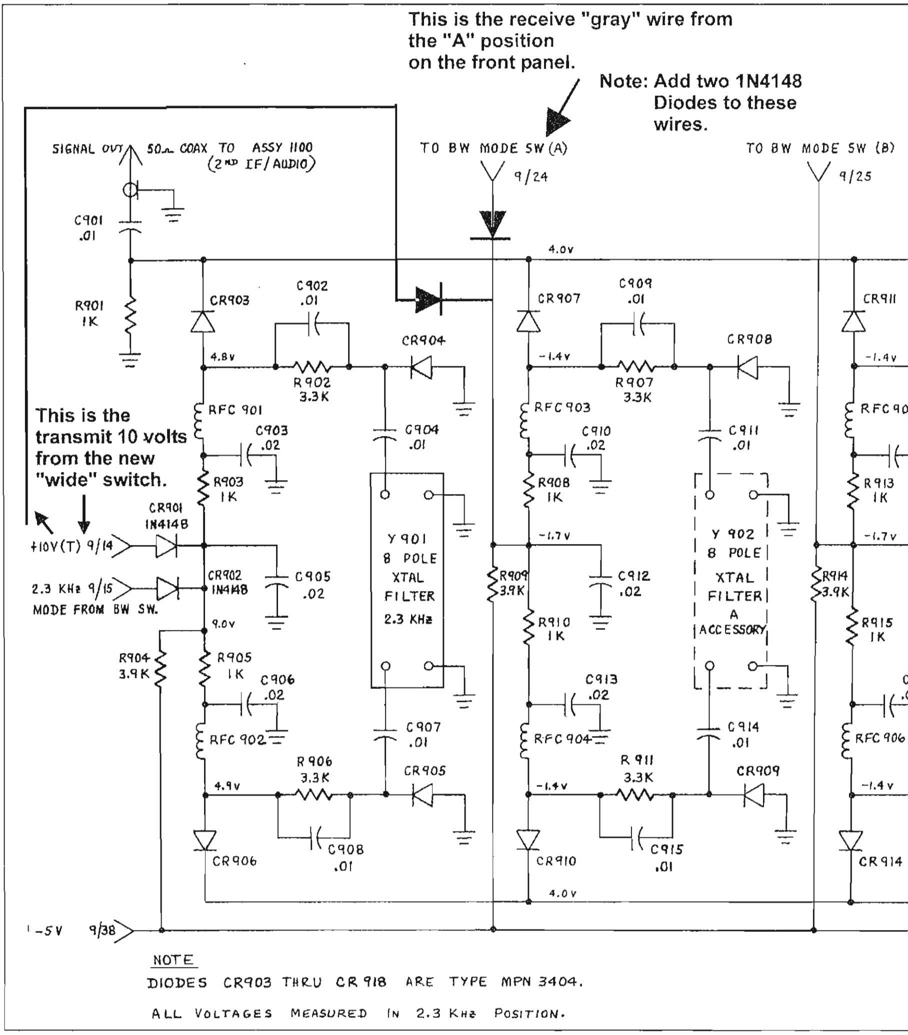
Description

The Drake TR7 is an all "solid-state" transceiver, including the final-power amplifier, which will deliver about 120-watts output across 1.8 to 30 MHz. Running AM, you have to turn down the output to about 25 watts to leave a little "headroom" for the peaks on AM. The AM is derived from the balanced modulator at the 5.645-MHz lower IF by reinjecting the carrier, with audio, to develop the AM signal. This works great, except it defaults through the 2.3-kHz SSB filter, which cuts the lower sideband off on transmit and limits the nice high-quality audio that is coming from the balanced modulator. The reason the signal is defaults through the 2.3-kHz filter is because the TR7 has three positions for optional filters in the receive side, which are independent of the selected mode. So, if the 6-kHz "wide" filter is selected and you operate SSB, then you have double sideband. That would not be nice to your neighbors on the band and you might get a nice QSL from the FCC for doing that!

Solution

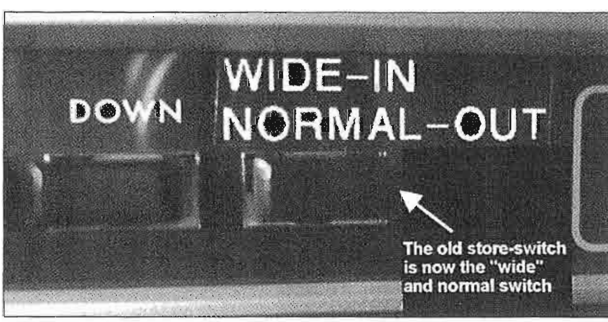
I looked into what Drake did to default to the 2.3-kHz filter while transmitting and found a simple way of making the 6-kHz wide filter work on transmit. There is a diode that is used to steer the voltage toward the 2.3-kHz filter and it is only on the 10-volt "transmit" line.

The AM-Modified Drake TR7A at WA8SAJ

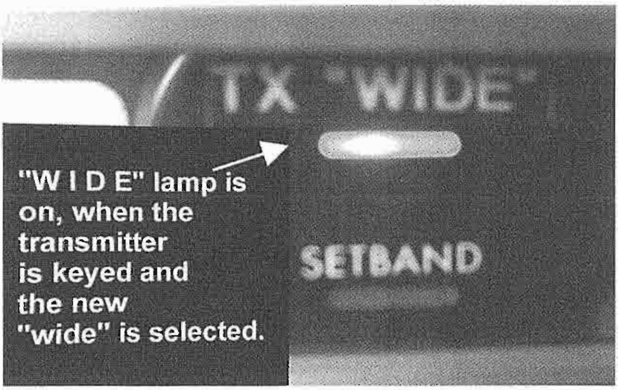


Partial Drake TR7 Schematic Showing Locations of Changes

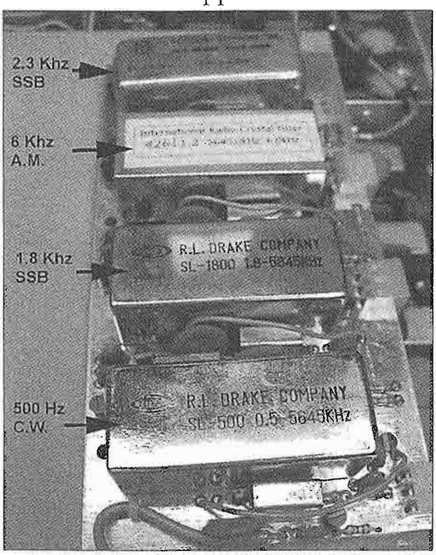
Also, I needed a filter switch and a lamp to tell me when I was transmitting in the "WIDE" mode. I found a very seldom-used switch on the front panel, called a "store" switch. The "store" switch was a gimmick, at the time, and was used to hold the digital dial frequency (it is not a



Modified Front-Panel Switch



memory), for what reason I could never understand, but it was there and was a handy switch, at that. There is also a seldom used "fixed" lamp that comes on for a frequency that you might use for a net or in the marine band when the TR7s were used in the commercial market. So, now I had the two items that were needed to make this all happen.



The TR7 IF Filter Board

Getting Started

Get yourself a muffin pan or several small containers to put all your separate screws that will come off during this project! Taking the cover off the TR7 is easy; just slide the cover off after removing eight machine screws. Next, you will take off the bottom cover after removing more sheet-metal screws. The top of the radio is where you start, since the "store" switch and the lamp have to be wired first. Then go to the bottom of the TR7 and the motherboard.

Note: You may not need to remove the DR-7 digital board if the following steps are done the way I describe.

With the back of the TR7 towards you, start the modifications by following the steps associated with each photo.

Photo 1

A. Remove the existing wires from the "store" switch; these will not be used for this project.

B. The hot wire from the "fixed" lamp can be cut closest to the transmit "fixed" switch.

C. Now solder the cut wire to the "store" switch. If the cut wire is too short, you might have to extend it. (Note: The other wire on the "fixed" lamp already goes to ground.)

Photo 2

A. Take three wires (ribbon wire works great) and solder them to the "store" switch.

Photo 3

A. Now, turn the TR7 around with the front panel towards you.

B. The three wires are now run down to the bottom motherboard and soldered to their connections as seen in the photo. (Note: Make sure you take notice of what position number you are applying the wires to, this is very important!)

C. As seen in Photo 3, follow the directions about cutting the traces on both sides of the #3 position and adding the jumper. Then, add the one diode in series with the #1 position, noting the direction of the diode.

D. Install the rest of the remaining wires

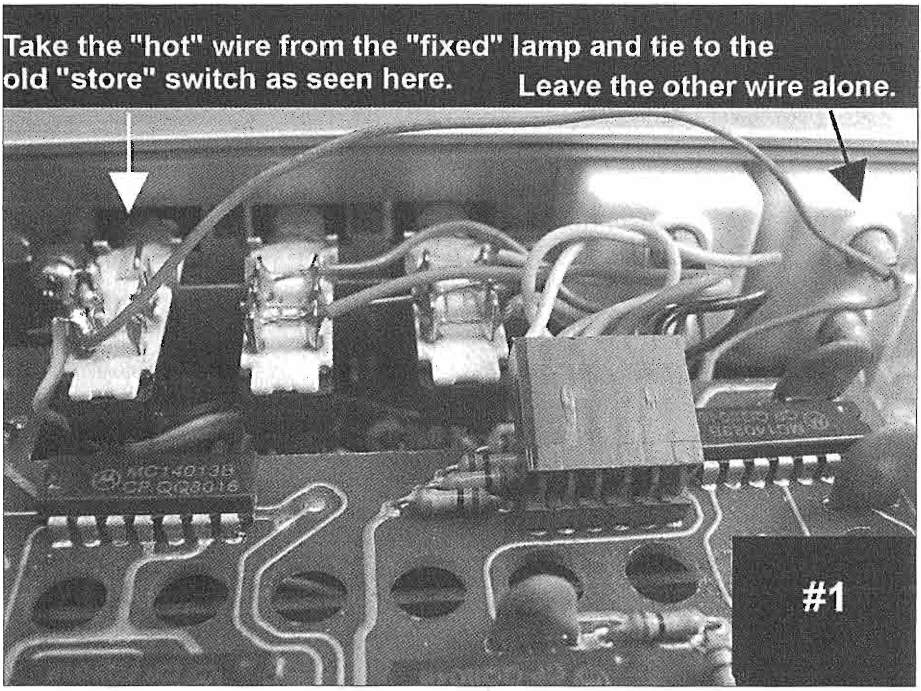


Photo 1

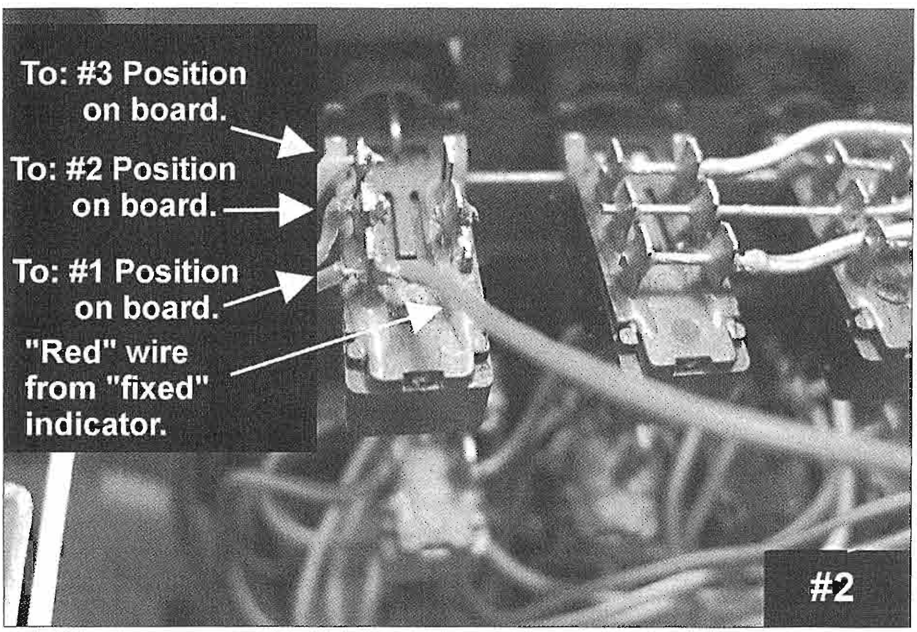


Photo 2

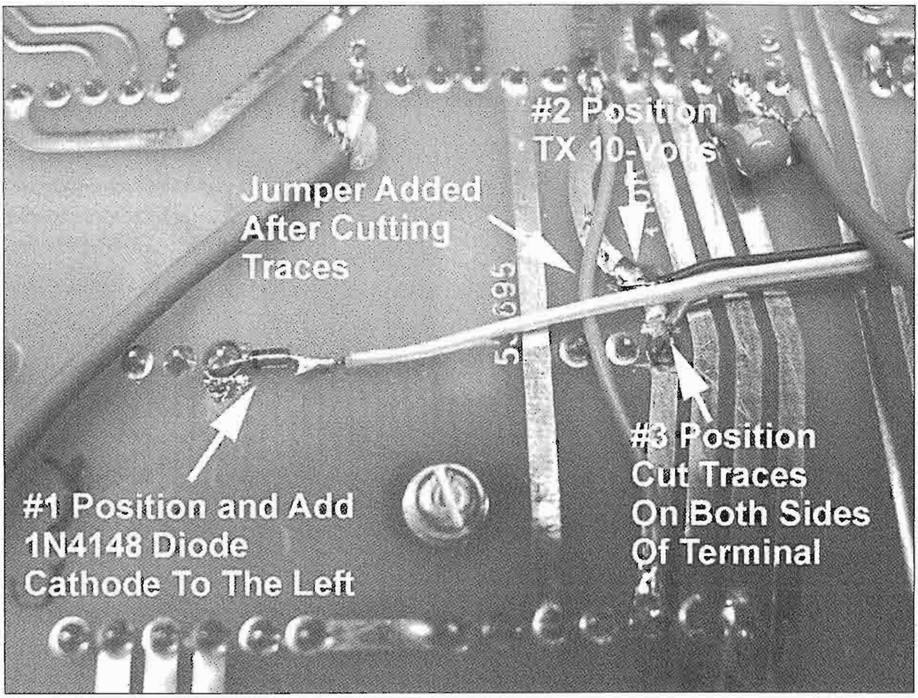


Photo 3

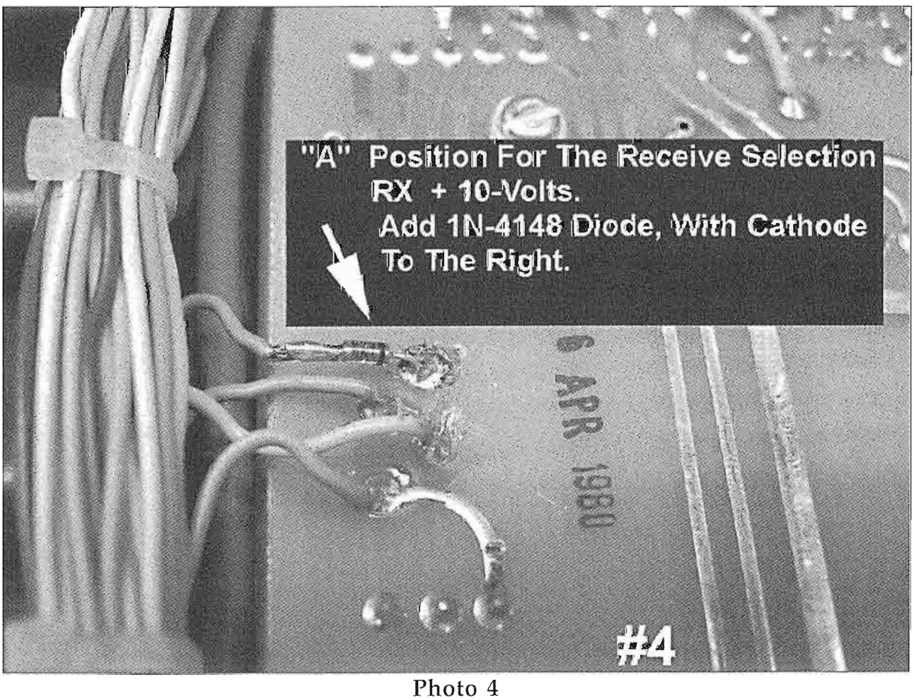


Photo 4

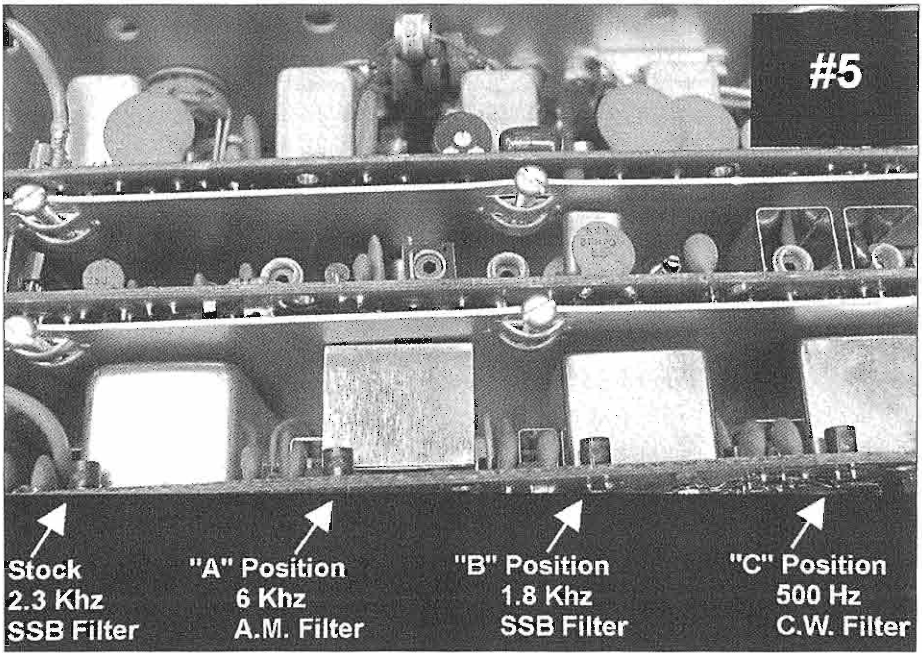


Photo 5

coming from the "store" switch for the #2 and #3 positions.

Photo 4

• The "RX" 10-volt line (top gray wire) on the left of the motherboard has a diode added in series with it (note direction of diode). This is the "A" position on the front-panel selection (See Photo 4).

Photo 5

• Mount the 6-kHz AM filter in the "A" position only (See Photo 5) on the IF filter board. Note: You can try to find a used 6-kHz AM filter, or get a new one from International Radio, or "INRAD." (INRAD, PO Box 2110, Aptos, CA 95001 USA. The new phone number is 831-462-5511. Their email is: sales@inrad.net. Internet URL: www.qth.com/inrad/)

This completes the wiring of the TR7!

Panel Lettering

You can now label the front panel of the TR7 with a P-Touch® label maker using the white-on-black label tape, which looks great. I took one side panel off and then slid the plastic clear cover away, after removing the switch assembly, labeled the front panel, and then reassembled everything. The labels look like original Drake lettering, see the photo of the front panel on page 41.

How to Operate

When you operate on AM with the TR7, first make your filter selection in the "A" position for receive. The old "store" switch is now to be pushed in for the "WIDE" transmit position, and the old "fixed" lamp will light when you transmit. The carrier should be set for no more than 25 watts for any length of time. Bring the microphone gain up until the wattmeter starts to wiggle upward on voice peaks. I recommend using a stock D-104 (no preamp) and solder the microphone audio "hot" lead to pin #4 of the microphone connector. Drake has already installed a 680-k ohm resistor in series with the microphone element and it makes the D-104 sound great! Have fun with the Drake TR7 and enjoy AM with a great rig. ER

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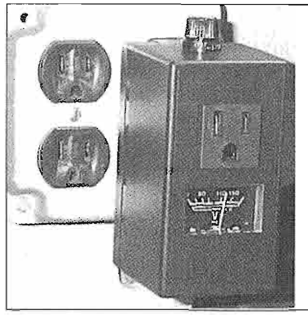

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FOR SALE: Telephone Filters, suppress >1MHz interference, plug in, 1/$7, 2/$11, 3/$14, 4/$16.75, shipped U.S. Brian Harris WA5UEK 3521 Teakwood Lane, Plano TX 75075 brian.k.harris@philips.com 214-763-5977

FOR SALE: Military whip antennas $40. AN/TRC-77 FM transceiver $295. Bruce Beckeney, 5472 Timberway, Presque Isle, MI 49777, 989-595-6483

This is possibly a long shot, but I would like to obtain an unrestorable SX-88 for parts. A chassis with missing unobtainable parts or a complete receiver in very rough condition is preferred to prevent breaking up an otherwise restorable unit. I am willing to pay above-market for the right chassis or parts unit and I will make it available to others whom might also have a project SX-88 on hold due to needing parts.

Greg Gore, WA1KBQ
10291 Kendan Knoll Dr.
Charlotte, NC 28262
704-503-5952
WA1KBQ@AOL.COM

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

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

QSLs FOR SALE: Your old QSL card? Search by call free, buy find at $3.50 ppd. Chuck, NZ5M, nz5m@arrl.net

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

FOR SALE: DRAKE TR-7/TR-7A/R-7/R-7A service kit. Includes 13 extender boards and digital jumper card. $63.85 includes postage. See http://pweb.amerion.com/~w7avk, Bob, W7AVK, 807 Westshore J28, Moses Lake, WA 98837, w7avk@arrl.net 509-766-7277.

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

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

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

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

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

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

FOR SALE: QRP transmitter kits. Step-by-step instructions. Wood model, up to 5 watts 40/80M $15. "Tunatin" one watt 40M $10. You furnish crystal and power. Robert Larson, 1325 Ridgeway, Medford, OR 97504 w7lng@arrl.net

SERVICE FOR SALE: Repair, upgrade, performance modification of tube comm. & test equip. Accepting most military, all Collins & Drake, & better efforts from others. Laboratory performance documentation on request. Work guaranteed. Chuck Felton, KDØZS, Felton Electronic Design, 1115 S. Greeley Hwy, Cheyenne, WY 82007. 307-634-5858 feltondesign@yahoo.com

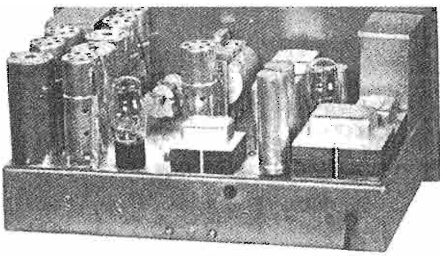
FOR SALE: Radio parts and hardware. Some are 60 years young! Free flyer, USA only. Bigelow Electronics, POB 125, Bluffton, OH 45817-0125

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

FOR SALE: Tubes tested good globe 200A $8.50, 201A $14, 226 $8, 227 $9. Write or e-mail: tubes@qwest.net for price lists or see www.fathauer.com. Slightly weak tubes guaranteed to work in early radios 1/2 regular price. George H. Fathauer & Assoc., 123 N. Centennial Way, Ste. 105, Mesa, AZ 85201. 480-968-7686 or toll free 877-307-1414

REWARD – WANTED!

THE NEW "RME-9" SUPER



Will pay $2000 for complete RME-9 receiver in any condition. Not tested, working order unknown or needs restoration is OK. The RME-9 has a single airplane style tuning dial and was the forerunner to the later RME-9D and RME-69. Greg Gore, WA1KBQ; 10291 Kendan Knoll Dr.; Charlotte, NC 28262 704-503-5952; wa1kbq@aol.com

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

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

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

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

FOR SALE: FT243 CRYSTALS: 1885, 1915, 1925, 1945, 1985, 3870, 3875, 3880, 3885, 3890, 7143, 7280, 7285, 7290, 7293 kHz, more. Contact af4k@hotmail.com or send SASE to Brian Carling, AF4K, 117 Sterling Pine Street, Sanford, FL 32773 or call 407-323-4178 http://www.af4k.com/crystals.htm

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

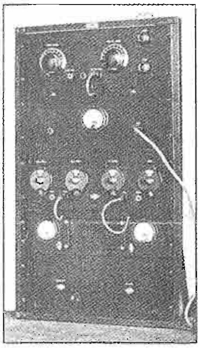
FOR SALE: Vintage electronics at Alameda Antique Mall, 9837 Alameda Genoa in Houston. Visit www.RadioWorld-OnLine.com Carl Blomstran, POB 890473, Houston, TX 77289

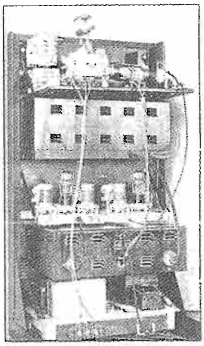
ACCESSORIES FOR SALE: Spun Aluminum Knob Inlays for most Boatanchors. Collins Dial Drum Overlays. Dakaware Knobs. Charlie Talbott, 13192 Pinnacle Lane, Leesburg VA 20176-6146. 540-822-5643, k3ich@arrl.net

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 mobeng@hickorytech.net

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

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 w1etc@adelphia.net





REWARD – WANTED!

Will pay $1000 for a 1930s National type LRR 36" relay rack pictured to left. It is identified by its ¾" wide top and bottom crossmembers with a red "National Co.; Malden, Mass" decal on the top crossmember. Greg Gore, WA1KBQ; 10291 Kendan Knoll Dr.; Charlotte, NC 28262

704-503-5952

wa1kbq@aol.com

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

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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

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SERVICE FOR SALE: I build hot-rod receivers: R-390A, SP-600, R-388/51J. NC-183D and transmitters: Valiant, DX-100, T-4X-A-B, HT-32, AF-67. 51J-4 filter replacements, R390A Hi-fi AM $245.00 ea. Chuck Felton, KDØZS, Wyoming, 307-634-5858, feltondesign@yahoo.com

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WANTED: Johnson Ranger II, avg condx will be fine. Charlie 941-747-2082, k4zks@tampabay.rr.com

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WANTED: Antique radio parts. National RF90 choke. About 1 inch in diameter and fits into grid leak clips. HF impedance #10, looks like a grid leak, is marked #10 HF impedance. Pilot #130 RF choke, has two knurled nuts. United Laboratories (or other?) 200 ohm rheostat, Bakelite, about 1-3/4" diameter. I will be happy to pay an unreasonable price for any or all. Dean Showalter, W5PJR, 72 Buckboard Rd., Tijeras, NM 87059 505-286-1370

WANTED: Hallicrafters model HA-5 VFO. Dick Ridinger, W6ZPE, 909-597-3865, w6zpe1@cs.com

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WANTED: Bottom cover for a HRO-60 table model. Phil, w1gee@yahoo.com

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WANTED: Webster tri-polar magneto. Frank, 828-885-2470

WANTED: Meter and power xfmr for HT-32B. Also need Dow-Key 12V antenna relays, SX-117 50.75 IF transformer T5. John, W8JKS, 740-998-4518

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

WANTED: Johnson CB model 323. Sonar J-23, other 23 channel CB radios, base or mobile. Ed Fluehe, WA7DAX, 1649 E. Stratford Ave., Salt Lake City, UT 84106. 801-484-5853

CAN CAPACITOR REBUILDING

Multi section twist-lock can rebuilding is $35, postpaid return. When any section is 500V, add $5.
One year guarantee.
Ship cans for rebuilding to:
Frontier Capacitor
Everett Hoard
PO Box 218
Lehr, ND 58460

Phone: 701-378-2341 FAX: 701-378-2551, email: frntcap@bektel.com

WANTED: Heathkit Apache in good condition and Kenwood BS-5 Pan Adapter. Pat, W1DLW, Boopat@gis.net

WANTED: Schematic with part values, or parts list for Vista 12V@ 10A. xfmr. Reg. board. Resistors are scorched, unreadable. Advise k9idb@arrl.net or 636-207-0508.

WANTED: National AN/FRR-24 receiver components and info. See http://www.virhistory.com/ham/frr24.htm Nick, KD4CPL, nick@3rdtech.com 919-929-4342 (NC)

SIGNAL ONE CX11 WANTED: Looking for Signal One CX11 / CX11A transceiver. Will consider radios needing work and parts-only radios. Bob KD7FT; kd7ft@earthlink.net 206-375-3234

WANTED: B&W 2008, 3012, 3018 Miniductors, Hammarlund MCD-140M dual 140pf variable, Pete Hamersma, WB2JWU, PO Box 467, Holderness, NH 03245. pehamers@worldpath.net

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

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

WANTED: BC-457A, BC-458A parts. Robert Caponi, 30 Revolution Dr. Leominster, Ma. 01453 recaponi@hotmail.com

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

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

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

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

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

WANTED: Need two Westinghouse RT35 0-1 RF amps, 3-1/2" round Steve Bartkowski, 1-708-430-5080

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

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

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

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

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

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

WANTED: ITT-Mackay Marine 3010-C Receiver, late S/N, complete and in good or VG conditions, with original box and manual. The item has to be shipped to a friend in Ohio (not outside U.S.). Send your offer to Paolo Viappiani, Via Valle 7, 19124 La Spezia, Italy, or pviappiani@tin.it

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

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

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

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

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

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

WANTED: 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., 123 N. Centennial Way, Ste 105, Mesa AZ 85201. 480-968-7686, Call toll free 877-307-1414

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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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

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WANTED: NOS 11" x 7" aluminum natural finish bottom plate for chassis. Louis L. D'Antuono, WA2CBZ, 8802-Ridge Blvd., Bklyn, NY 11209. 718-748-9612 AFTER 6 PM Eastern Time.

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

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

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

WANTED: WW-2 IFF Equip FM-80 rack BC-126F RA-105A 1-221, BC-1293. Will pay top dollar. Steve Bartkowski, 1-708-430-5080, 7702 Austin Ave, Burkank, IL 60459

WANTED: R 390, R 390A and R 392 receivers dead or alive or parts/ assemblies. Any condition considered. Will pickup if you have enough items. Glenn, WA4AOS, 864-684-2956

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

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WANTED: Electric Radio Tuning Meter as shown in many back issues of ER. Also need a 10 Amp Variac, anyone have one for sale? Joel, W7EPA 928-231-3674 or W7EPA@ARRL.net

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WANTED: Johnson knob (white dot) to fit Ranger, Valiant, 6N2, etc. Also special Hammarlund tube shield to fit 6BE6. Herb, K9GTB, POB 161, Nyland CA 92257

WANTED: For SX-42 receiver; Sensitivity control knob, Volume control knob, and Bandswitch knob. This is for a restoration project and possible ER article. Bill Paschall, WD5DZG, 604 Beasley Hollow Rd, Linden, TN 37096 731-847-0717 cheops210@hughes.net

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

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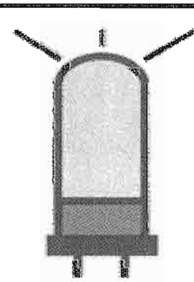
WANTED: The power transformer from either a DX-40 or a DX-35 (both have the same part number) for my DX-35. Ron, W6TUR. 619-303-1307 or w6tur@cox.net



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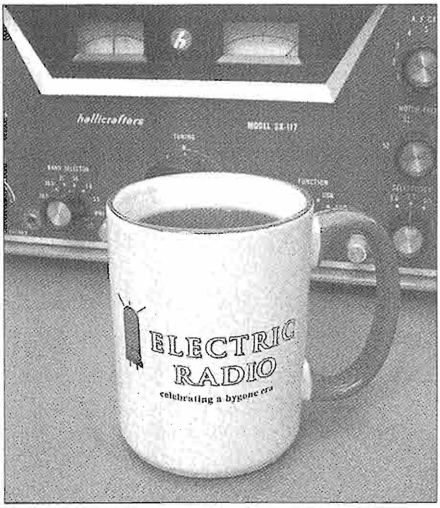
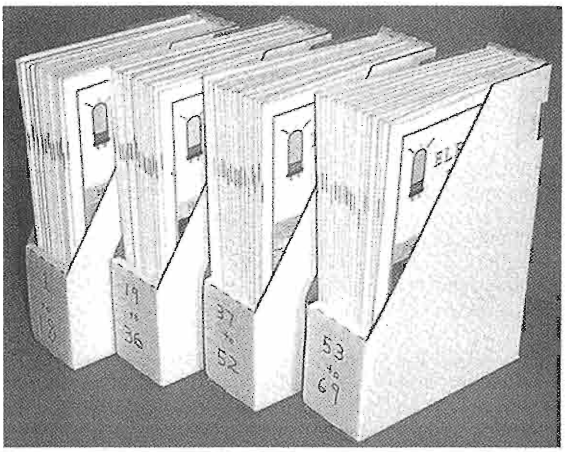


Electric Radio Coffee Mugs!

A new item in the Electric Radio Store is this nice 15-oz white ceramic mug with the ER logo in 3 colors and a maroon-red handle and rim. This large mug is perfect for those long roundtable QSOs and holds a lot of coffee!

$14.49, including priority shipping within the US.

ER Store
PO Box 242
Bailey, CO 80421
720-924-0171
Or on-line: www.ermag.com



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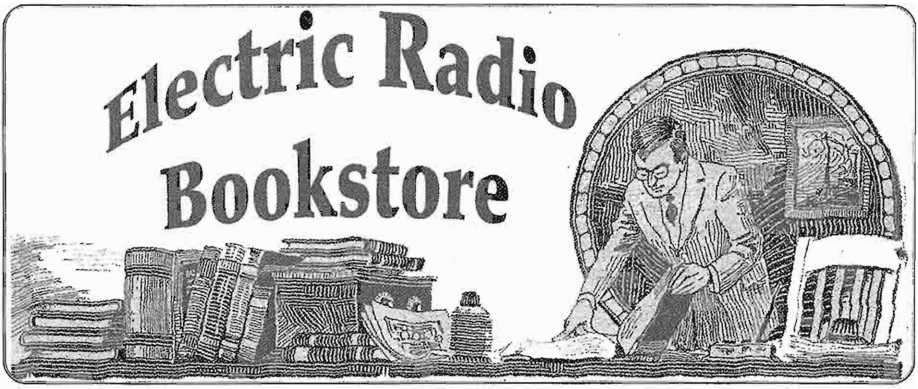
Set of 20: $22.75 + $7.95 S&H

ER Bookstore, 720-924-0171
PO Box 242, Bailey Colorado, 80421-0242

Or order on-line at WWW.ERMAG.COM



— ELECTRIC RADIO BACK ISSUES —

All Electric Radio back issues are either from the original press run or are lithographic reprints from the original negatives on archival quality, acid-free paper. Shipping prices are for delivery by media mail within the USA. Overseas, please inquire for shipping quotes.

- Single issues: **$3.85** each, postpaid
- 1-year sets (or any 12 issues) **$38.00 per year + $3.00 S&H**
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- Buy **the entire run** of Electric Radio from #1 for **$400.00 + $10.00 S&H,** at least a 50% discount the over single-issue price. Shipping is discounted up to 50%.
- For a postpaid 29-page **printed back issue index**, please send $2. Foreign orders please inquire for shipping rates.

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