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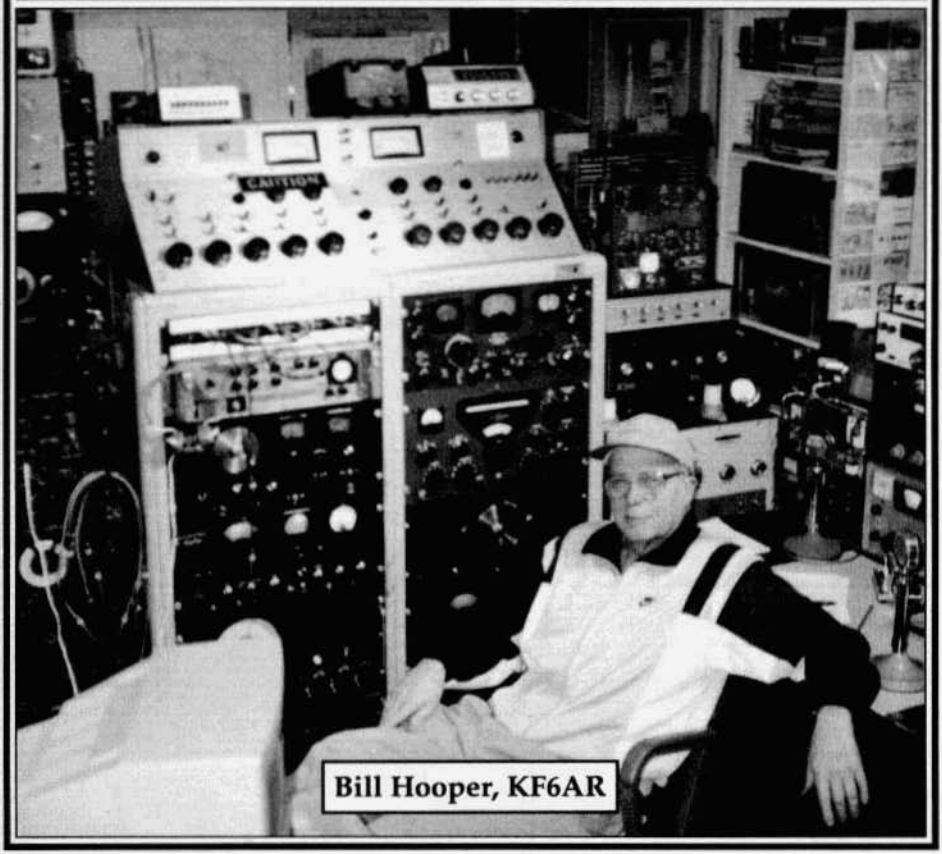
ELECTRIC RADIO

celebrating a bygone era

Number 93 January 1997



Bill Hooper, KF6AR

ELECTRIC RADIO

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Electric Radio is published primarily for those who appreciate vintage gear and those who are interested in the history of radio. It is hoped that the magazine will provide inspiration and encouragement to collectors, restorers and builders.

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

Regular contributors include:

Walt Hutchens, KJ4KV; Bill Kleronomos, KDØHG; Ray Osterwald, NØDMS; John Staples, W6BM; Dave Ishmael, WA6VVL; Jim Hanlon, W8KGI; Chuck Penson, WA7ZZE; Jim Musgrove, K5BZH; Dennis Petrich, KØEOO; Bob Dennison, W2HBE; Dale Gagnon, KW1I; Rob Brownstein, NS6V; Dick Houston, WØPK; Andy Howard, WA4KCY; Skip Green, K7YOO; George Maier, KU1R; Albert Roehm, W2OBJ; Steve Thomason, WB4IJN; Don Meadows, N6DM; Bob Sitterley, K7POF (photos) and others.

EDITOR'S COMMENTS

Here we are at the beginning of another year. It seems that as I grow older the years come and go with increasing speed. I wonder if that's the case with everyone? Anyway, 1996 was a good year for me and I hope it was for everyone else too. I'm looking forward to 1997.

One of the things I'm looking forward to most is improved propagation. According to an article that appeared in the latest QST, we should be seeing some good openings on 10 meters as early as next year. Won't it be wonderful to get back on ten! And of course, as ten opens up we'll see improved propagation on the other bands as well.

A couple of weeks ago I called WA4KCY, K8BZZ, KC4CFE and a couple of others and suggested that we make a concerted attempt to revive activity on 14.286. I suggested that we start at 3 PM Pacific as the band has been going out early. So far it seems that this earlier time is working out much better. I hope that everyone will consider joining us on 14.286, although I know this new time makes it difficult for those who work at regular jobs. Before Les, K6HQI, passed away there was activity on the 14.286 net every night. Let's keep this tradition going.

The reports and logs I've received so far on the annual ER 160-Meter Contest indicate that conditions were awful this year. Next month we'll publish a complete report on the event. I wish there was some way that I could arrange to have the contest on a day that guaranteed good conditions. Maybe the answer is to spread the event over a few days - maybe between Christmas and New Years - and just let everyone submit one log for any 24 hour period. Or maybe I could have it on a weekend. I'm open to suggestions.

All the best to everyone in 1997. N6CSW

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Cover: Bill Hooper, KF6AR, in his truly outstanding hamshack. He retired in 1989 and has spent most of his time since then restoring radios.

What's In A Call?

by Val M. Johnson, K9GAW
104 Railroad Ave.
Henry, IL 61537

In 1955, I was a prospective novice amateur radio operator. I had graduated from BCL to SWL in 1953. By 1955, I had ordered a brand new Hallicrafters S38-D from Allied Radio in Chicago. I also ordered "Gateway To Amateur Radio" from the ARRL.

After taking my novice exam, I anxiously awaited the letter from the FCC with my brand new novice license. It finally came - KN9GAW. My high school friend, Dan, had already received his - -KN9EUV. Dan went on to get his general right away, but I was too slow on CW. It was 1963 before I passed my general exam.

That was in the days when you had to appear in person at the FCC District Office. The code exam was 5 minutes in length and required 1 minute solid copy. I used a code tape (7-inch reel-to-reel) to practice. I was able to copy 5-letter coded groups at 15 WPM prior to the exam. Plain language at 18 WPM was a piece of cake.

I waited for my letter from the FCC in vain. It never came. The FCC examiner had told me that I had passed both the code and written exams. I lived one mile west and one mile south of Knox, Indiana. In the opposite corner of that square mile was the Starke County airport. The FCC form had a question about how far you lived from any runway. Well, I answered truthfully -- and it cost me my license.

In 1964, I moved to Illinois. I wanted my license, so I wrote the FCC. They answered by telling me to fill in a change of address form. I did, and I finally received my general license, WA9DZJ. This was in the days when a general class license had "ALL" the privileges! I wasn't comfortable with a "WA9" call. After all, my original call was a "K9". In those days, you could tell how long someone had been a ham by his call letters. A W9XX or K9XX meant that he was a old timer - 25 years plus.

When the vanity call sign program was first proposed, I couldn't believe it. It was too much to hope for - to get my old call back. I waited - sent for the Form 610V - lost it - sent for it again. When Gate 1 opened, I mailed in the form (no airport for miles of Henry, IL).

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FCC Form 660 Rev. June 1956 — UNITED STATES OF AMERICA — EXPIRES 3 a. m., e. s. t.
STATION CALL SIGN — FEDERAL COMMUNICATIONS COMMISSION — WASHINGTON, D. C. — AMATEUR RADIO LICENSE

K N 9 G A W — 10-29-57 — N18

NOT TRANSFERABLE

Fixed transmitter location: (and remote control position when authorized)

SAME AS BELOW

Licensee and P. O. Address:

VAL MELVIN JOHNSON
R.R. 1 BOX 462-F
KNOX, INDIANA

(This license issued subject to conditions shown on reverse side)

Mary Jane Morris
Secretary

Licensed

Countersigned C. B. Plummer

Operator Privileges	Issuing Officer	Effective Date
Class NOVICE(C)	C. B. Plummer	10-29-56
Class		

SEE UPPER RIGHT CORNER FOR EXPIRATION DATE

Card May Be Trimmed On Border Line

☆ U. S. GOVERNMENT PRINTING OFFICE: 1956—381890

Amplitude Modulation International - January Update

by Dale Gagnon, KW1I, President, Box 1500, Merrimack, NH 03054
dgagnon@concentric.net

Operating Activity, Membership, Financial Report

It was good to hear AMI member activity during the recent holiday operating events. It is very rewarding to hear AMI certificate numbers being exchanged. There seem to be several categories of response to the request for a certificate number exchange. Some AM'ers have their number handy. Many of these have actually printed the certificate number on their QSL or hung their certificates on the wall near their operating position. Some stations are AMI members, but can't locate their certificate and have forgotten their number. The remedy for this is to drop a note to AMI Headquarters and I'll look it up and either mail or e-mail the AMI number out. Then there are new AM stations asking about AMI. These operators are new to amateur radio, new to AM or are historic AM operators who are getting back on AM. If you send their call to me or your AMI Regional Director we will send them an AMI pamphlet in an official AMI envelope! The last category are those AM operators that know about AMI, who haven't joined up. Most of these operators just haven't gotten around to it or don't feel the necessity to join. This may be the largest category of all. Happily, there are very few AM'ers in this category who are negative about AMI.

A number of members have changed their calls recently. Please send your old certificate in with the appropriate corrections and the AMI "office staff" will send out a new, up to date certificate with your new call sign.

Membership at year end has just passed 950. There is well over $100 in AMI's bank account. Though this is not enough to fund an emergency mailing to the membership, it is enough to keep us in certificates and stationery supplies for the foreseeable future.

Organization

AMI is now seeking a West Coast Regional Director to fill the vacancy left by the passing of Bill Neeley, K7INK. The West Coast AMI Region consists of the states of Arizona, California, Hawaii and Nevada. If you would like to consider serving in this capacity and would like more information, write to AMI Headquarters, Box 1500, Merrimack, NH 03054.

AMI 1997 Plans

It is imperative that AM enthusiasts do not become complacent. Our AM operating privileges should not be taken for granted. AMI's challenge is to keep AM operation visible in the Amateur Service. There are two ways we can do this.

One, we can make sure that officials of the FCC and influential Amateur Radio organizations know about us and know that we are activists on behalf of our special branch of the hobby. Some time in the next few months AMI will hit the 1000 member mark. At this time AMI will distribute a press release to appropriate periodicals and news organizations. Regional directors and members alike will be asked to circulate this to local clubs and state and regional amateur radio organizations where you have contacts.

The second thing we can do is to increase our "on air" presence. This does not necessarily mean finding more operating time in our busy schedules. It may mean establishing/participating in AM nets, spreading our existing activity over additional frequency segments and reserving some time to make contacts on the several AM operating events scheduled each year. KW1I

The AM-500

a classic 813 AM amplifier with a few nods to the nineties

Joseph J. Curry K3ICO (ex-KE6LFT)
914 O'Dell Way
Los Altos, CA 94024

After returning to ham radio in 1994 and having fun with some vintage SSB gear, I was drawn back to ham radio the way I remembered it from the late Fifties....good old, smooth sounding AM. After getting a Viking II running and sounding pretty good, I decided that I needed a little more power. My Hallicrafters HT-37 had some great audio on both SSB and AM, so I ran it through a Hallicrafters HT-33A (still, I believe, one of the best linears ever made) and was able to run my legal allotment of AM with some pleasant audio. I ran this combination off and on for about a year with great reports. While it sure was a pretty good substitute, in my mind I knew it wasn't real AM. I had grown up in ham radio as a homebrewer (something I don't believe you ever really outgrow) and even while I was restoring some interesting pieces of vintage amateur gear, I was picking up transformers and filter capacitors, air variable caps, meters: the stuff you use to build things, not just repair them. One day I looked at this pile of "memorabilia" as my wife kindly referred to it and decided that it had almost all of the makings of a real AM rig, but was still short of critical mass by one key item.....that rarest of beasts, a modulation transformer. I had been looking for a 300 watt multi-match transformer for about six months or so to no avail. Even the West Coast AMI Swap Net hadn't located one for me and I was beginning to think that I would forever lack the elusive modulation transformer. I decided to put a posting on Boatanchors and see if the rest of the country was as iron deficient as the Left Coast was and, wonder of wonders, Andy, WA4KCY, came back with an offer of a Thordarson 300 watt multimatch unit. Two e-mail messages later and we had a deal.

Now came the tough part. When you lacked critical mass, there were no expectations, since there was little likelihood that you would ever get to build your ultimate (or even penultimate) transmitter. All that was changed now. It was almost as if I felt compelled to put one together. As a kid, I had built several amps, all of which, in retrospect were under-designed. I could get more power out of less tube and transformer than anybody. Not for long mind you, but while it lasted, I squeezed more RF out than the laws of physics would seemingly allow. Now that I was older, wiser, and most significantly, able to afford doing it right, I decided that this rig was not going to suffer from the maladies of my previous creations. After all, how many of these works of art would I likely create before reaching my three score and ten?

Being a good engineer, I decided to start with a set of design goals and then see just what I needed to acquire to achieve these goals. The list was fairly short and contained the following "requirements":

(1) the amplifier must be able to produce 375 watts of 100% modulated carrier (1500W PEP) in a CCS mode without exceeding the ratings of any transformer, tube or tubes, or any of its components

(2) the amplifier must be capable of

The AM-500 with Ranger exciter

providing this level of performance on 160, 80, and 40 meters

(3) the amplifier must have NO FANS OR BLOWERS

(4) the amplifier must use tubes that are tried and true, readily available, and likely to remain readily available

(5) don't forget rule number 3!

(6) construction should be of the highest achievable quality without purchasing a machine shop. What hand tools can't (or shouldn't do), contract to experts.

With these design rules in hand now I had to decide how I was going to make all this happen. Some choices were pretty easy.

I wanted to have not just good audio, but great audio...not commercial audio, but high quality, unprocessed AM that sounded like me (such as it is). Having listened to a lot of AM in the last two years, I found invariably that the best "stock" audio came from a Johnson Ranger, in fact, you really had to work hard to make one sound bad. Given the fact that the Ranger was designed to drive an amplifier (the Desk KW), it was a natural choice. Easy to tune, ample RF drive, more than ample audio drive.... what could be better? Now all I had to do was find one that wouldn't take more time to restore than it would to build from scratch. Fortunately I was able to find one in Southern California through the help of a local ham. After verifying that the Ranger audio was as good as I expected by running it through the aforementioned HT-33A and receiving a multitude of thumbs-up critiques of the audio, I was really off and running.

Given design rule number one, I decided that technology sometimes yields to nostalgia, even when creating a rig from bygone days. I opted for sand-state rectifiers over mercury vapor tubes or even high pressure argon rectifiers (ala 3B28s). Fire bottle "purists" may skip to the next paragraph. First of all there was efficiency, closely followed by reduced heat load (remember: no fans), and finally, I wouldn't need a pack of filament transformers for the

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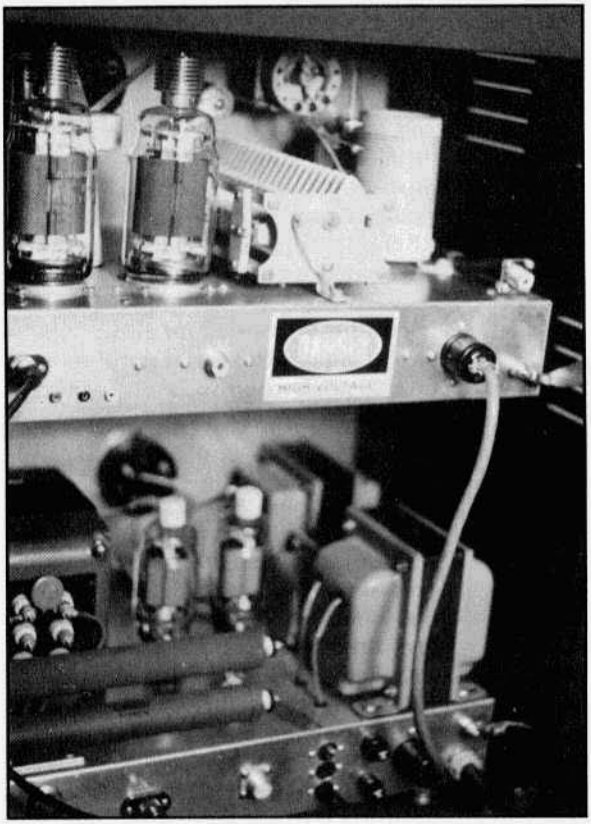
rectifiers. I also wanted to build separate power supplies for the modulator and RF amplifier. I had seen and built too many amps that "pulled" a little bit on modulation. Two different supplies would fix that problem. Fortunately I had picked up a couple of nice Triad transformers which could be run with full-wave rectifier circuits and fill the bill quite nicely.

Now for the tubes and this was a real puzzler: should I use one of the more "modern" tubes such as a 3-500Z or should I go with 4-250s, or even with the venerable 800 series tubes? I looked at the modulator first. Since I wanted to run 375 watts of carrier, I would need an input power to the RF amp of 500 watts or so (Class C), which means I would need an audio output from the modulator of 250+ watts. The 300 watt multimatch modulation transformer would allow for a wide range of both primary and secondary impedances so that wasn't a problem. The logical choice seemed to be 811s. These tubes certainly were readily available, and reasonably inexpensive. I could run them at1500 volts (with -4.5 volts of bias) and get the required output power, but just so. I wanted to have some margin so I decided to go with the 811's bigger brother: the 572B. The 572B, also readily available (and now manufactured by Svetlana in case you can't find any old Cetron's out there) had some major advantages over the 811. It was still a 6.3 volt thoriated tungsten filament tube and drew the same filament power as an 811 (good, I have that transformer). It could also run at 1500 volts at zero bias. But best of all, it had a plate dissipation of 160 watts compared to the 65 watts (ICAS) dissipation of an 811. Having watched a quad of 811s shudder during tuneup in a Collins 30L-1, I realized that a 572B would be better able to take the beating (should one occur) and be able to roll with punches. It wouldn't take up any more room than 811s and those massive, graphite plates in the 572B just gave you confidence that these tubes could perform day in and day out without a whimper.

The final was really perplexing, and there were lots of choices. Nostalgia won this one, however, and I was drawn to the 813, another graphite-plate workhorse. I had worked with the 813 before and found it to be a truly durable tube, very easy to drive, and easy to operate without forced air cooling. A single 813 can run 300 watts output without any trouble but that's it.

The CCS ratings for the tube were 100 watts plate dissipation (125 watts ICAS). In order to give myself the design margin I wanted, I decided on a pair of 813s which would easily supply the requisite 375 watts. I also liked the idea that this tube was still readily available from U.S. or European manufacturers, and was relatively inexpensive. Given the fact that RCA first released this tube in October of 1938, the 813 certainly met the survived-the-test-of-time criteria.

Once the 813s were chosen, the remaining issue was parallel or push-pull and that was pretty easy to resolve. I wanted a simple grid network and a band-switched plate network. I therefore chose a pi-network output. I had earlier acquired a plate output coil from a T-368 (ala Fair Radio), and now that mound of memorabilia was starting to yield some real treasures including the plate loading and plate tuning capacitors. I had a bandswitch for a T-375 transmitter that I had picked up at a hamfest, so I was in pretty good shape for the final plate circuit. I even had a monster RF plate choke, but I'll come back to that later. The grid circuit was still up in the air. I really only needed about 5-7 watts of drive from the Ranger to drive the 813s. And how was I going to link the grid bandswitch with the plate bandswitch or would they be linked at all? There are lots of articles



Rear view of AM-500 showing RF and power supply/modulator decks

on 813s as Class C amps, but most were push-pull and I didn't want to do that. Given the 813's low driving power requirements, I had a choice of either running the Ranger at a very low power output or swamping the input to the 813s, soaking up the excess power in the swamping resistor. The first was easy, but had some problems.

Tuning the Ranger for low output was a sensitive process. I had even heard of people running the 6146 in the final on the 300 volt supply instead of the 600 volt supply to reduce the output.

After a good deal of thought and lots of calculations (there's that engineer again), I decided to go with a totally passive input structure, much like the one in use in my trusty HT-33A.

The Ranger would look at essentially a dummy load resistor. I chose a 100-ohm, 60-watt non-inductive resistor (from Surplus Sales of Nebraska) as a good compromise. At a given wattage, the voltage swing would be higher across 100 ohms than 50 ohms (1.41X higher to be precise) and 100 ohms was still an easy match for the Ranger. It looked like with 45 watts out of the Ranger, I should be able to drive the 813s and all would be well. This was to be my first conflict of design and practice. When I got everything together, the Ranger loaded the resistor just fine. The problem was the grid voltage swing was too low, even after fiddling with the grid leak resistor and the fixed bias, I was close, but no cigar! I had a choice, several actually but only a couple that made any sense at that point. I could replace the resistor with a higher value. The problem was I could not easily find a non-inductive resistor of the right value that would fit the space allotted for the present 100-ohm inhabitant. What I needed was a broadbanded transformer that would give me a step-up of the voltage dropped across the non-inductive resistor. Hmmm, no tuning, broadbanded, handle about 50 watts. What I needed was an unbalanced-to-unbalanced transformer (an unun, as opposed to a balun). I checked with some information I had on Amidon and, lo and behold, they had one with a 9:1 impedance transformation ratio. I called Amidon and they put me in touch with Jerry Sevick, W2FMI, the "Father of Matching Transformers" and

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an old acquaintance from Bell Labs. I called Jerry up and ran the idea by him and he couldn't see any reason why it wouldn't work. A quick call to Amidon, an even quicker exchange of some credit card information, and an unun was on the way. Fortunately, there was enough room for this device and I hooked it up and it worked just as I had hoped. I was little nervous, mind you, because the beauty of my "old design" was a very low grid impedance, about 100 ohms. At that level, neutralization of the 813s would certainly not be necessary, but now the effective grid impedance was 900 ohms. I wasn't sure, but there was an easy way to find out. I disabled the screen and plate voltages, applied excitation to the grids and did the basic neutralization tests....nothing. I even put a scope on the output of the transmitter without the B+ and screen voltages and.....nothing, not even on 40 meters. Best of all, I could get the required grid current with 30 watts of drive from the Ranger leaving me plenty of headroom. I am not sure how well this would work at the higher frequencies, but for 40 meters on down, it works without a hitch.

Well anybody can make one mistake, but I'd fixed it and now I was home free...not quite. I chose 160 meters to shake out the amp because it was easy and the amp tuned up into a dummy load in textbook fashion. I could easily get my 375 watts out, in fact, I could get 500 watts of carrier (unmodulated at this point) without any problem. The output was rock steady and with the key down for 60 minutes straight (nursing it up in 10 minute periods); everything was holding together and cool as a cucumber. Now, I'll just switch over to 80 meters, tune up, that's it, power up to 375 watts, gee, those electrons really did read my schematic after all. Key down, 10 minutes,hmmm, what's that smell? Eau de RF choke! Power down, open the lid, what's this? Two of the pi-wound sections of the RF choke are fried, not just browned, but blackened. What happened? I went back to my handbooks and looked at old designs and then it hit me. All of the Class C finals were push-pulls and the RF choke was on the center tap of the plate coil. As such, the RF choke didn't have a lot of RF voltage developed across it. In a design from the early-60's ARRL Handbook, the 813s in parallel were used for either Class C or AB1 and the choke was not pi-wound, but solenoid-wound. Class C, by its very nature, produces pulses of plate current which are smoothed by the flywheel action of the plate circuit. These pulses have an intrinsically high harmonic content. My poor plate choke was looking at the full RF output of the tubes and lots of harmonics at that point. I obviously had enough harmonic energy on 80 meters that I didn't have on 160. Before removing the abused RF plate choke, I fired it up on 40 meters and no problem. Went back to 80 meters, smoke. I now needed a new plate RF choke. I had several offers from the California AM community before settling on a National R-175. The R-175 had the right look to it. It also was more physically suited to the mechanical layout of the final output circuit.

Two problems, oh well, not too bad, could be worse! Unfortunately I was right, it could be worse. After making sure that I could get the desired output on all bands and hold rock steady without fuss for 60 minutes into the dummy load (that Heath Cantenna sure got a workout) probably now was the time to start modulating that carrier. I had checked out the modulator by itself when I finished construction of the power supply/modulator deck. I used some high power wire wound resistors as a load and convinced myself very quickly that this modulator had what it would take to do the job. The waveforms were excellent. So now I hooked

Topside of the RF deck

it all together, brought up the power on 80 meters and started to slowly run up the audio control on the Ranger while looking at an audio trapezoid on my monitor scope. As I started to speak and advance the audio gain, I heard that telltale RF sparking noise coming from the plate tuning capacitor....a capacitor I had thought was comfortably within the peak voltage requirements, but I guess not. Unfortunately the only replacement capacitor I could find that had a high enough breakdown voltage didn't have a high enough capacitance to cover 160 meters. I "solved" the problem by switching in an extra 200 pF/ 15KV doorknob capacitor on 160 in parallel with the newly-installed air variable capacitor and after that it worked just fine. I really should have put in a vacuum capacitor, which I would heartily recommend, but that would have necessitated a sheetmetal redesign and I was way past the point where that made any sense.

Finally after running some sine waves through the modulator and looking at the audio cutoff frequencies, I was pretty happy with myself. Everything was working just as it should be or at least I thought so. It was time to go on the air for a real test.

I tuned up on 3870, our Left Coast AM frequency, and received some nice reports from some fellows in the Silicon Valley area. I finally felt that this really was worth all the trouble.

The last "problem" to solve wasn't related to the amplifier, but to the Ranger. Unfortunately I tore out more hair trying to fix this problem than all of the others. To make a long story short, I found that I was getting some reports of a hum-like buzz on signal fades and found that my carrier was getting frequency modulated by this buzz. After poking and probing all over the amplifier and the Ranger, I finally found the problem occurred only on VFO control not crystal control. I dug into the Ranger VFO and replaced the VFO tube and the regulator and the problem disappeared.

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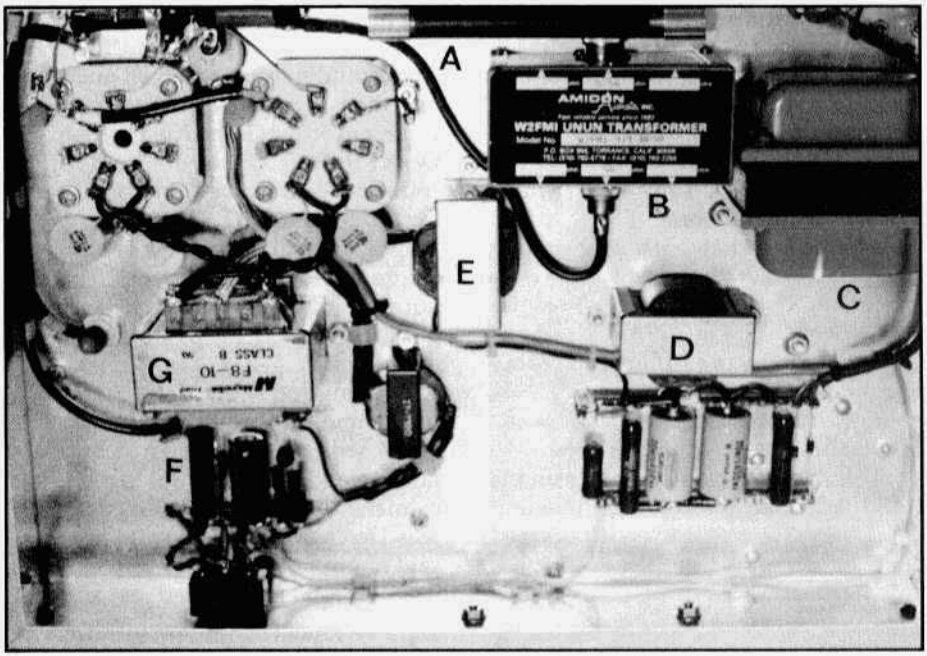
Success! Now I could say that the AM-500 was fully operational.

I have included a few pictures of the amplifier. As you can see the style of the rig is Fifties....lots of black wrinkle. The electrical layout is also of the same period, although parallel tube amps during this period were rare. Since the highest band of operation was going to be 40 meters, I didn't get too agitated about leadlength, but made all the leads as low an inductance as possible (I also had them silver-plated, just in case). I didn't want to shoe-horn things into place such that repairs would be difficult in the highly unlikely event that anything were to fail. In the underside view of the RF deck you can see the unun in its shielded case (not really necessary, but it came with it) and the non-inductive resistor mounted on the back wall. The RF deck contains the amplifier filament, screen and bias supplies as well as an additional 10 Henry choke between the screen supply and the screens of the 813s. The screens are bypassed to RF ground at the sockets. The choke allows the screens to float up to AF voltage as the plates are modulated. I didn't want to go with a screen dropping resistor off the plate supply, since I would need a clamp tube for protection of the screens if I lost excitation. The screens are run at +350 VDC and screen voltage is applied when the plate supplies are keyed. The layout of the modulator and DC supplies is also very straightforward and "classical". There are a few "non-classical" concessions, like the solid state rectifiers, push-on terminals for the primary and secondary connections to the plate transformers, tie wraps, and last but not least, I used energy storage capacitors as filter capacitors. These capacitors are great if you can find them and use them wisely. They are about 8 inches high and have an oval cross-section approximately 1.5" x 3". The ones I have are rated at 35 microfarads at 5000 volts. That's a lot of capacitor for small volume. And that's the problem: energy storage capacitors are meant to run on pure DC with virtually no ripple current.

Here's my recommendation although, as they say, your mileage may vary. For capacitor input filter configurations, I would not run them at any more than 50% of rated voltage, or, in this case, 2500 volts. Since my largest supply was 1800-1900 volts, this was not a problem. For a choke input filter arrangement, I would not go any higher than 60% of rated voltage or about 3000 volts or so. If you push them, they will fail, but not before they get real hot. Mine run with no noticeable heating even on the 60-minute, keydown, torture test. If you treat them appropriately they will do an excellent job.

There were a couple of features I included in the amplifier that, while not particularly novel, are just very convenient and I would recommend them highly. To bring audio into the modulator from the Ranger, I used an old-style (unkeyed) Twinax connector and Twinax cable. The advantage is that this is a nice shielded connector and allows for phase-reversing the audio connections to obtain optimal audio performance. Equally convenient was the addition of test-jacks on the rear panel of the RF deck to monitor voltages and look at the waveforms on the control and screen grids. This can be done without having to access the underside of the RF deck. On the power supply/modulator deck, I included a 20:1 capacitively coupled (0.1 microfarads at 5000 volts) resistive divider network to monitor the high level audio and supply the horizontal input for a trapezoidal waveform monitor. You can tell a lot from an envelope display on AM, but not nearly as much as you can with a trapezoid display. With regard to monitor scopes in general, I am convinced it is extremely difficult if not



Underside of the RF deck: a) non-inductive resistor; b) unun; c) screen transformer; d) screen voltage supply; e) screen audio choke; f) grid bias supply; g) 813s' filament transformer.

impossible to bring up a new piece of AM gear without a monitor scope.

I would like to close with some observations, recommendations and further confessions:

- it all worked, although not quite as I initially planned, but certainly as I modified the plan, without the fans. Design goal: achieved. The cabinet is warm to the touch, but not uncomfortably so on those long keydowns.

- I mentioned in the beginning that I would leave to professionals those things best done by professionals, namely, that for which I didn't have the right tools. Although I was able to borrow a few Greenlee punches including one big enough to make openings for the sub-chassis mounting of the 813 sockets, I was leery about cutting the 2.75" holes for the panel meters in the 1/8" aluminum panels. I turned this over to a local machine shop and the shop punched the holes with a numerically controlled punch and did a beautiful job. You will also notice that I have included on the front panel of the cabinet two ventilated panels not only for ventilation, but to "let the glow out". I can look in at the tubes in either the modulator or the RF deck without the need for large panel cutouts, although these could be easily farmed out as were the meter holes.

- I had acquired the external cabinet from a Northern California ham. The cabinet (made by Bud) sits on four heavy-duty casters and is about 31 inches high overall. It was in excellent mechanical condition (no holes or dents), but the paint was rusting off in spots. I originally planned to refinish the cabinet, but the more I thought about it, the more I didn't like the idea. I finally decided to have the cabinet sandblasted to remove the paint and rust and powder coated it in black wrinkle: a very wise decision. The paint is infi-

continued next page

The AM-500 from previous page

nitely more durable than anything I could have sprayed on and the paint job is perfect. By the way, you'll notice that there is no supplemental RF shielding, just the external cabinet and a good set of grounding procedures. No TVI has been experienced on my own TVs or those of my neighbors.

I was afraid that with high power Class C and its harmonics, I was going to be a candidate for Worked All Neighbors, but no problem. For backup, I use a heavy duty low pass filter on all of my equipment.

- my last concession was to have some label plates engraved professionally to label all the meters and controls on the amplifier. I had put enough time and effort into the project that this seemed like a fairly minor indulgence by the time I got around to it.

- if you decide after reading this article, that you might want to do this yourself, I can only say that if you want good results, you cannot rush the work. I started around Memorial Day on this project and the goal was to be on the air by the Fourth of July. I didn't make it. Since I only had evenings and weekends to do this (and even then not all of those), it took me until the end of August to get it on the air. Some nights I only drilled four holes; that was all the time I had. I am a firm believer in that if it is worth doing, it is worth doing well. Take the time to do it right for you'll be living with the results for some time (hopefully).

- lastly, if I still haven't scared you off the idea, this was not an inexpensive project. As a kid, I built equipment because it was cheaper than buying ready made or even kits. For what I spent on this amplifier, I could buy a nice Globe King 500 and have money left over. The only difference is that it would be Leo Meyerson's design and not mine. Most of the components came from hamfests and swapmeets as well as the Internet and swapnets on the air. Even with that it can still get expensive. The transformers are getting harder to find. Peter Dahl could have handled all my needs, but then I would change my earlier comment on the Globe King to a Johnson Desk Kilowatt. On the other side of the coin, you would have a hard time spending the acquisition cost of a Collins KW-1 on a homebrew project even if you contracted-out all of the work! This was not a project to save me money; it was a project that gave me pride that I could do it myself.

The long and short of it is that I had a great time putting this thing together and I will no doubt own it until my family conducts the silent key sale and even then they may not let it go since "it was Dad's favorite". In spite of what I said about homebrewing and expense, it still hasn't dampened my enthusiasm.

I am toying with an idea now for an SSB linear amplifier with a roller inductor and a vacuum capacitor covering 160-10 meters and all points in between. It is still on paper, mind you, but it will be a little more compact than the AM-500, but not exactly what you would call a desktop unit either. It will probably have a pair of 813s running in grounded-grid (cathode driven) Class B configuration (I have really come to like those vintage firebottles). Now all I need is the time, but then again, I always did enjoy building more than using. Besides, my metal cuts and solder burns have all healed by now. **ER**

Editor's Note:
For a schematic of the AM-500 please send an SASE to ER.

A Unique Instrument - An Analog Capacitance Meter

The BallantineModel 520

by Kurt H. Miska, N8WGW
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Ann Arbor, MI 48103

Well, I really don't know how unique this instrument is but it certainly is vintage electronics at its best. By now many of the readers of Electric Radio will know of my intense interest in test equipment through my articles on some of the more mundane equipment like VTVMs, a test oscillator and a VOM. But now, as the wacky Monty Pythons would say, for something completely different.

About two years ago, I spotted a shrink-wrapped, analog Ballantine Laboratories Model 520 Direct Reading Capacitance Meter at a local swapmeet. Tagged at $20, my offer of $15 was accepted instantly. The advent of digital capacitance meters, derived from sundry digital multimeters, had made Model 520 obsolete. But, before the digital tide swept in DMMs and their sundry derivatives, there were a few companies offering analog capacitance meters.

Ballantine Laboratories, Inc., Boonton, New Jersey, has been in business since the 1940s manufacturing high quality laboratory instruments. For many years the company offered analog instruments much like Hewlett Packard, the usual AC VTVMs, DC instruments of various sorts, signal generators, etc. They continue to do so but, of course, now they're digital.

Ballantine Laboratories Model 520 direct reading capacitance meter

The Outside of the Model 520

Manufactured in the 1960s, the Model 520 is a compact bench instrument measuring approximately 14 in. high, 8 in. wide and 8 in. deep. The front panel controls are simplicity themselves. There is a proper toggle power switch, a single range selector, and two recessed calibration potentiometers marked CAL.1 and CAL.10, power line fuse and the input connections for the test leads. The analog meter with a mirror scale is a standard 4 1/2 inch unit with black numbers from 1 to 10 and red numbers for 11 and 12 on white background. The meter features two adjustable indexes for presetting capacitor inspection limits. Mine, S/N 687, sports a black crackle finish.

continued next page

A Unique Instrument from previous page

The indication of capacitance is displayed by a logarithmically-graded, moving coil meter, which retains the logarithmic scale for the capacitance indication. The scale is read with an accuracy unaffected by the position on scale of the value observed, and this advantage is enhanced by the provision of a large mirror scale meter. An overlap of 25% is provided on the high end of the scale, thus reducing the number of switching operations necessary when measuring values of capacitance at or near 1 or 10 on the meter scale.

The instrument measures direct capacitance of paper, plastic, mica, ceramic and air dielectric capacitors. Under most conditions it does not respond to stray capacitance to ground as is the case with most bridges and resonance-type capacitance measuring instruments. An internal standard permits a rapid calibration check of the 520 without using additional test equipment.

The instrument's range is from 0.01 pF to 12 F in nine steps. Accuracy is 2% of indication from 0.1 pF to 12 F and 5% of indication from 0.01 pF to 0.1 pF for capacitors with a Q of 20 or greater. Q may be as low as 7 (power factor = 0.14) before introducing an additional 1% error.

Inside the 520

Invariably, one of the first things I do when I come home with a treasure from a hamfest is to open it up. For better or worse I must see what lurks inside. Well, the 520 is relieved of its case by the simple expedient of unscrewing two machine screws. The inside of the 520 held no surprises. Neat, tidy cabled wiring, components on brown phenolic terminal boards, the completely shielded range switch as well as other good shielding and all around rugged construction. There is a tag advising the nosy not to take the shielding off the range switch since this might upset the instrument's calibration. No nearly invisible components here!

Electronically, the meter consists of three major subassemblies - an oscillator, a vacuum tube voltmeter and a power supply. Tube complement for the oscillator is a 12AX7 high-mu twin triode, a 6CB6 sharp cutoff pentode and a 6AK6 power amplifier pentode; the VTVM uses a 12AX7 and a 12AT7 high frequency twin triode, and the power supply uses either a 6X4 or 6202 full-wave rectifier and a 0A2 150-volt regulator. My particular instrument uses a 6X4 rectifier.

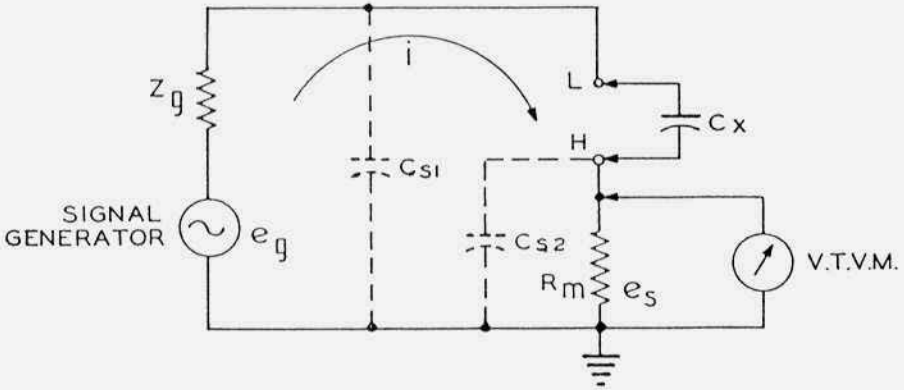
The principle behind this capacitance meter and its modern equivalents is simple. Proper execution into a practical instrument is a little more complicated, however. Essentially, the instrument consists of a 1,000 Hz signal generator (which, if you listen carefully, you can hear when the meter is turned on), a measuring resistor and a VTVM. If the signal generator impedance Zg (see accompanying schematic) and the measuring resistor Rm are kept negligibly small with respect to the reactance of capacitor Cx, the current i which flows will be solely a function of the generator output eg, and the reactance of Cx of the unknown capacitor.

Stray capacitances (Cs1 and Cs2) to ground are made to fall across the signal generator and measuring resistor and do not directly affect the measured value of Cx, unless either should become excessively large.

As discussed here, Cx has been assumed to be ideal or lossless, which is never so in practice. However, the Q of the unknown Cx may be as low as 7 at 1,000 Hz (P.F. = approx 0.14) before introducing an error of 1%. This condition is easily met by air, ceramic, plastic, mica and paper type dielectric capacitors.

Operation

The 520's manual advises a short warm-up followed by a quick calibration check. For this you set the range switch to CAL 1 and, if necessary, ad-



Schematic of the Ballantine Model 520. *Courtesy of Ballantine Laboratories.*

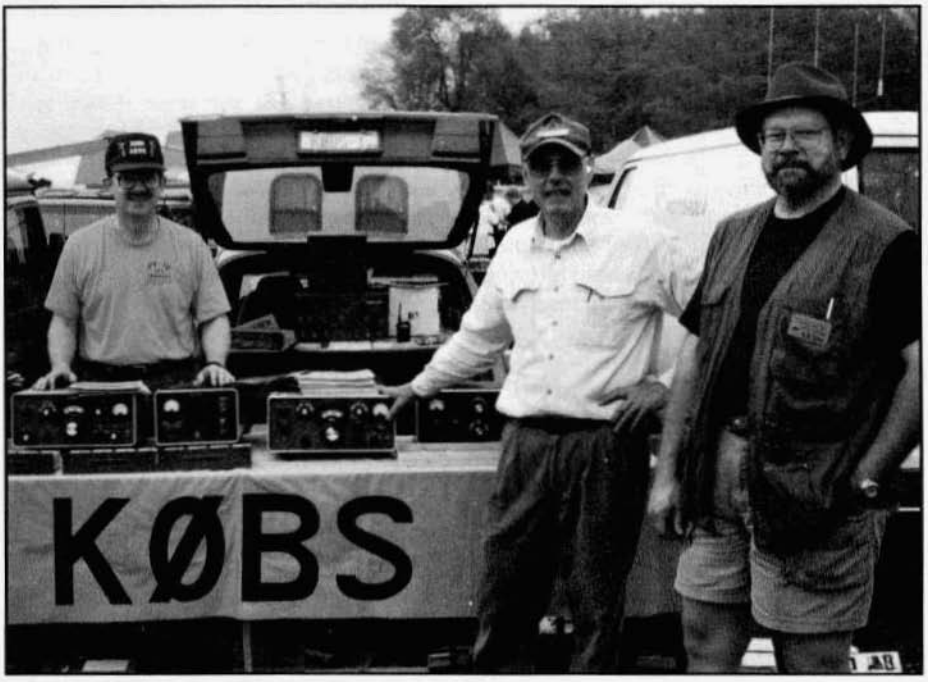
just the CAL.1 recessed front panel control so that the meter pointer reads 1. Then set the range switch, marked CAPACITANCE, to CAL 10 and adjust the CAL. 10 control so that the meter reads 10. It's that simple. There is nothing I do on my bench that requires super accuracy and so I checked my Ballantine 520 against my two capacitance decades - a Heath and an Eico. It came as no surprise that on all settings for microfarads and nanofarads, the instrument was right on. Only when testing the picofarad setting was there some variation in dial indications. But, I suspect that the decades were at fault since these were never meant to be precision devices of the type offered by General Radio and other comparable manufacturers.

I was fortunate that my instrument came with the original shielded test leads. Measuring capacitors is as simple as clipping them to the test leads but, as in working with a sensitive AC VTVM, it is wise to start at the high end of the range and work your way down. At the low end of the range, the input leads are very sensitive to being handled. The meter pointer deflects quite vigorously and, while rugged, I would hate to bend it through careless handling of the test leads. I did a little testing by substituting conventional test leads and, for all practical purposes, did not notice any difference in the meter readings. Again, keep in mind, I don't think I do anything so critical that it would require the accuracy inherent in the instrument. So, if you find a Model 520 at a swap meet and the original test leads are missing, don't reject a possible bargain.

While at times and in jest I may have said to my son, "you can never have too many VTVMs", I'm not so sure that the same applies to analog capacitance meters. Still, the Ballantine 520 is a valuable addition to my messy workbench and using it gives me as much pleasure as do my other instruments. Now, if I could only find an analog inductance meter. **ER**

Reference

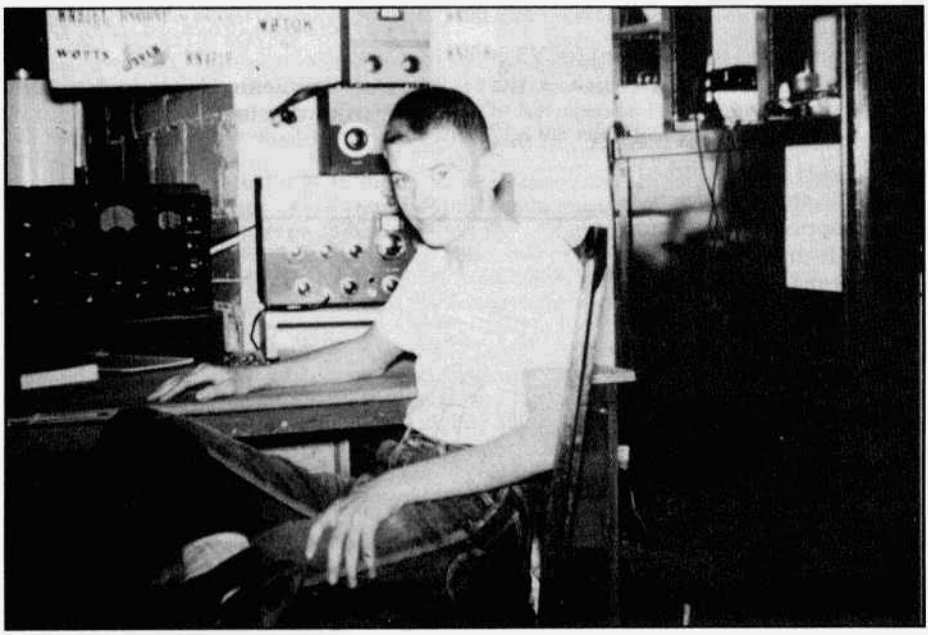
Model 520 Direct Reading Capacitance Meter, issue MC-767F, operating and service manual published by Ballantine Laboratories, Boonton, New Jersey. Date undetermined.



At the 1996 Dayton Hamvention, L to R: John Peterman, AB9G; Butch Schartau, KØBS and Jay Miller, KK5IM.

Bob Rainbolt, WBØAUQ, at his vintage operating position. His station consists of mostly Drake and Heathkit gear.

Norm Hegyi, KG9D, at the Grayslake, IL hamfest, September, '96. ***Phot o by Pat Keogh, WB9GKZ.***



Paul Washa, WØTOK, in his hamshack back in 1955. Paul is well-known to eastcoast hams who see him at almost every hamfest selling books and magazines.

Collecting/Repair/Restoration...Tips

Subject: H-P Model 411A RF Millivoltmeter

by Ed Schaad, W3WDF
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Needle Wiggle on the Lowest Scale

If you are like many of us in the field who procured a used model 411A because it is one of the best analog RF millivoltmeters in its time, now hear this. There is the possibility that the previous owner(s) never got the word on some of the corrections to quite aggravating experiences on the low end of the lowest scale. For example, you may have found difficulty in trying to read a few RF millivolts, that the needle fluctuates in a continuous state of change. This is caused by interelectrode capacitance between filament and cathode of V3, the 12AX7.

Recommended replacement for V3 is H-P part No. 1932-0054 which is the ECC 83 vacuum tube.

A substitute tube to the ECC, in this case, was inserted, a 12AX7A, and the fluctuations stopped. No mention was made of the premium/reliable tubes that may have been used in lieu of the 12AX7A/ECC83. It is a good assumption that they may work perhaps even better.

More Needle Wiggle (Ringing)

The following information affects H-P model 411A serial nos. 938-04685 through 938-04719 only. This is the case of the reversed capacitors. Capacitors C11 and C12 may be reversed in instruments with the foregoing serial numbers. These capacitors are mounted on the printed circuit board behind the meter movement. Reversal of the capacitors causes the meter to undergo several cycles of ringing before reaching the correct reading. Reverse these capacitors if they are found to be interchanged. No other adjustments are necessary since the capacitors affect only the instrument damping of transient input signals.

Reduction Of 10 Hz Beat

Should you own a model 411A, the serial no. below 131-00816, install a 1.5 pF capacitor on tube socket for V3 (12AX7A or ECC 83) from pin 1 (plate) to pin 4 (filament). This will minimize the 10 Hz beat that is usually apparent on the most sensitive ranges.

Appreciation goes to Mr. Dave McCarthey, H-P Englewood, CO., and Mr. Don Baumann, H-P Palo Alto, CA, for sharing this technical information.
ER

VINTAGE NETS

Westcoast AM Net: Meets informally, nightly on 3870 at 9:30 PT. Wednesday at 9:00 PM PT they have their formal AM net which includes a swap session. Net control rotates.
California Early Bird Net: Saturday mornings at 8 AM PST on 3870.
California Vintage SSB Net: Sunday mornings at 8 AM PST on 3835
Southeast Swap Net: Tuesday nights at 7:30 ET on 3885. Net control is Andy, WA4KCY. This same group also has a Sunday afternoon net on 3885 at 2 PM ET.
Eastern AM Swap Net: Thursday evenings on 3885 at 7:30 ET. This net is for the exchange of AM related equipment only.
Northwest AM Net: AM activity daily 3 PM - 5 PM on 3875. This same group meets on 6 meters (50.4) Sundays and Wednesdays at 8:00 PT and on 2 meters (144.4) Tuesdays and Thursdays at 8:00 PT. The formal AM net and swap session is on 3875, Sundays at 3 PM.
K6HQI Memorial Twenty Meter AM Net: This net on 14.286 has been in continuous operation for at least the last 20 years. It starts at 3:00 PM PT, 7 days a week and usually goes for about 2 hours. Net control varies with propagation.
Arizona AM Net: Meets Sundays at 3 PM MT on 3855. On 6 meters (50.4) this group meets at 8 PM MT Saturdays.
Colorado Morning Net: An informal group of AM'ers get together on 3808 Monday, Wednesday and Friday mornings at 7AM MT.
DX-60 Net: This net meets on 7290 at 2 PM ET, Sundays. Net control is Jim, N8LUV. This net is all about entry-level AM rigs like the Heath DX-60.
Military Net: It isn't necessary to check in with military gear but that is what this net is all about. Net control is usually Walt, KJ4KV, but sometimes it rotates to other ops. It starts at 5 AM ET Saturday mornings on 3885.
Westcoast Military Radio Collectors Net: Meets Fri. at 2200 local on 3990 and Sat. at 0800 local on 3990 + or - QRM. Net control is Tom, WA6OPE or Andy, KD6TKX.
Grey Hair Net: The oldest (or one of the oldest) 160-meter AM nets. It meets on Tuesday nights on 1945 at 8:30 PM EST & EDST
Vintage CW Net: For CW ops who enjoy using vintage equipment.This is not a traffic net; speed is not important. The net meets on 3537, Sundays at 7 PM Mountain. Net control is Tracy, WB6TMY.
Vintage SSB Net: Net control is Andy, WBØSNF. The Net meets on 14.293 at 1900Z Sunday and is followed by the New Heathkit Net at about 2030Z on the same frequency. Net control is Don, WB6LRG.
Collins Collectors Association Nets: Technical and swap session each Sunday, 14.263 MHz, 2000Z, is a long-established net run by call areas. Informal ragchew nets meet at 0100Z Tuesday nights on 3805 and on Thursday nights on 3875.
Drake Users Net: Another relatively new net. This group gets together on 3865 Saturday nights at 8 PM ET. Net controls are Criss, KB8IZX; Don, WZ8O; Rob, KE3EE and Huey, KD3UI.
Swan Users Net: This group meets on 14.250 Sunday afternoons at 4 PM CT. The net control is usually Dean, WA9AZK.
Nostalgia/Hi-Fi Net: Meets on Fridays at 7 PM PT on 1930. This net was started in 1978.
K1JCL 6-Meter AM Repeater: Located in Connecticut it operates on 50.4 in and 50.5 out.
JA AM Net: 14.190 at 0100 UTC, Saturdays and Sundays. Stan Tajima, JA1DNQ is net control.
Fort Wayne Area 6-Meter AM Net: Meets nightly at 7 PM ET on 50.58 MHz. This net has been meeting since the late '50's. Most members are using vintage or homebrew gear.
Southern California Sunday Night 6 Meter AM Net: 8 PM Sundays on 50.4. Net controls are Dan, KV6I and Scott, K6PYP. Informal, supports restoring old gear and using it on the air. Loan gear available for those wanting to join in.
Westcoast 40-Meter Sunday Net: Net control varies. The group meets on 7160 starting at 4PM PT.
Collins Swap and Shop Net: Meets every Tuesday at 8PM EST on 3955. Net control is Ed, WA3AMJ.
Old Buzzards Net: Meets daily at 10 AM Local time on 1945. This is an informal net in the New England area .
Canadian Boatanchor Net: Meets Saturday afternoons, 3:00 PM EST on 3745. For hams who enjoy using AM, restoring and operating

Nets that are underlined are new or have changed times or frequency since the last issue.

Finding RF Impedance Along A Transmission Line

by Albert Roehm, W2OBJ
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Cranford, NJ 07016

As I casually tune across the ham bands I am often amazed to hear so many misstatements concerning antenna or feedline theory. One of the most popular myths seems to be how the SWR can be improved by changing the length of the feedline. The simple facts are that the SWR on the feedline is solely and completely determined by the degree of mismatch at the feed point of the antenna; and, the SWR remains constant for the entire length of the feedline (if we ignore very minor I^2R losses). There is no confusion about these matters in the engineering or professional community nor should there be any in the amateur ranks.

Let me introduce you to one form of a simple engineering formula that describes, mathematically, exactly what is happening along the feedline. As many of you know, the impedance so commonly mentioned in ham discussions generally refers to the characteristic impedance of the feedline and not the RF impedance imposed on (or in) it. For example, a typical coaxial cable, such as RG-58, RG-8, or RG-213 has a characteristic impedance of around 50 to 52 ohms. Other coaxial lines may be rated at about 70 to 75 ohms or even as high as 93 ohms. So, what does this mean? Well, first and foremost, it does not mean that by using a 50 ohm cable you are guaranteed a 50 ohm match for the 50 ohm output impedance of your rig. The characteristic impedance of any feedline is a function of the ratio of inductance to capacitance ($\sqrt{L/C}$) per unit length of the line. The impedance of the RF energy imposed on the feedline could be just about anything because its value is determined by the ratio of RF voltage to RF current. Isn't that what Mister Ohm said?

And, what about that transmission line formula? Well, please be patient a while longer. I have another bit of information to talk about first. We all know that $R = V/I$. That's Ohm's Law for DC. It also works for AC if we're dealing with only resistance in the circuit. Introduce some inductive or capacitive reactance and things get a little more complicated, but we can still say that Z (impedance, and not just resistance) follows Ohm's Law, too. You can read all about that in any radio handbook. For our discussion here we need to be reminded that an impedance Z can be written more than one way. In the rectangular format, the series impedance is stated as $Z = R +/- jX$. Another way of noting the impedance is via the polar method where Z is represented by a vector or magnitude (in ohms) at some angle. That sounds pretty confusing but Figure 1 illustrated both methods.

As an example, point A in Figure 1 represents the plot of a 5 ohm impedance composed of 3 ohms of resistance and 4 ohms of inductive reactance. Starting at the origin (point O) you can reach point A by moving horizontally along the R axis for 3 units (ohms) of resistance and then turning 90 degrees upward (the +j operator) for 4 units (ohms of X_L). This is the rectangular coordinate method and point A (which represents the impedance) can be written as $Z = 3 + j4$.

Another way of arriving at point A is to use the polar method and go directly from the origin along the vector OA for 5 units of ohms. The vector is at an angle of 53.13 degrees above the R axis.

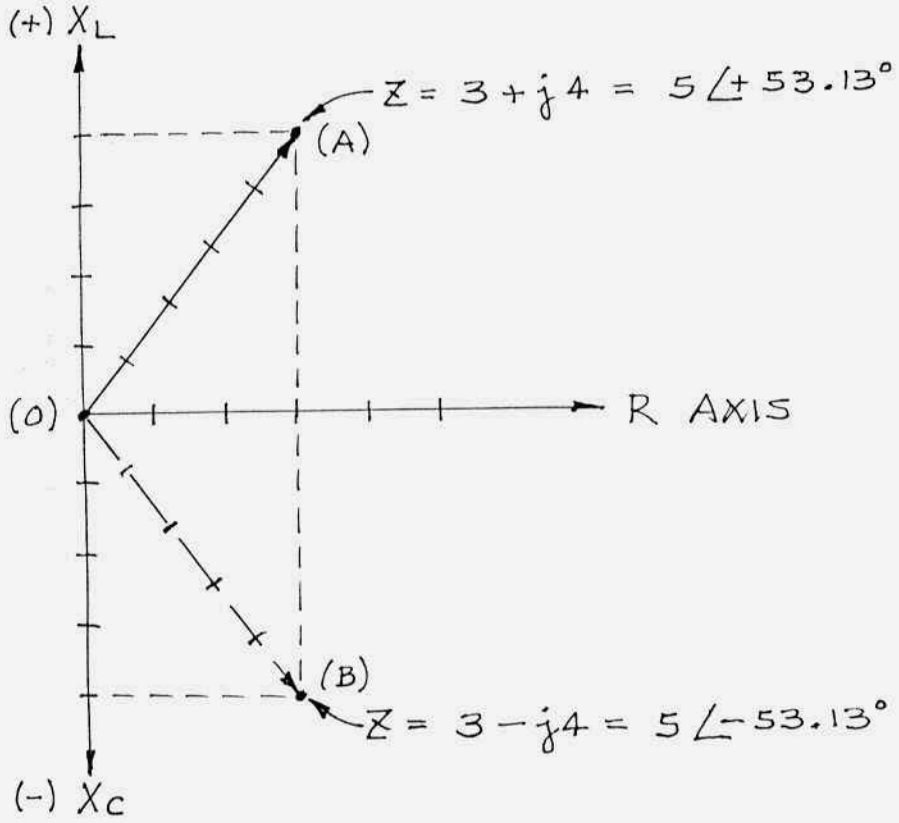

Figure 1

Alternatively, point B also represents an impedance of 5 ohms. But, now we have 3 ohms of resistance and 4 ohms of capacitive reactance. Using the rectangular method, move 3 units along the R axis and then <u>downward</u> 90 degrees (the -j operator) for 4 units (ohms of X_C). Now, the impedance at point B can be written as Z = 3 -j4. Of course, the vector OB is also 5 ohms long so the polar method of describing the impedance at point B is 5/ -53.13 degrees. Note that the only difference between the polar representations for points A and B is the sign of the angle; positive for A, and negative for B.

With this brief background, we can now introduce the transmission line formula mentioned earlier.

$$Z_S = Z_O \left(\frac{Z_L + jZ_O \tan B_S}{Z_O + jZ_L \tan B_S} \right)$$

where:

Z_S = input impedance at a given point.

Z_L = load impedance.

Z_O = characteristic impedance of the transmission line.

B_S = distance from the load to the point where it is desired to know the line impedance (Z_S), <u>in electrical degrees.</u>

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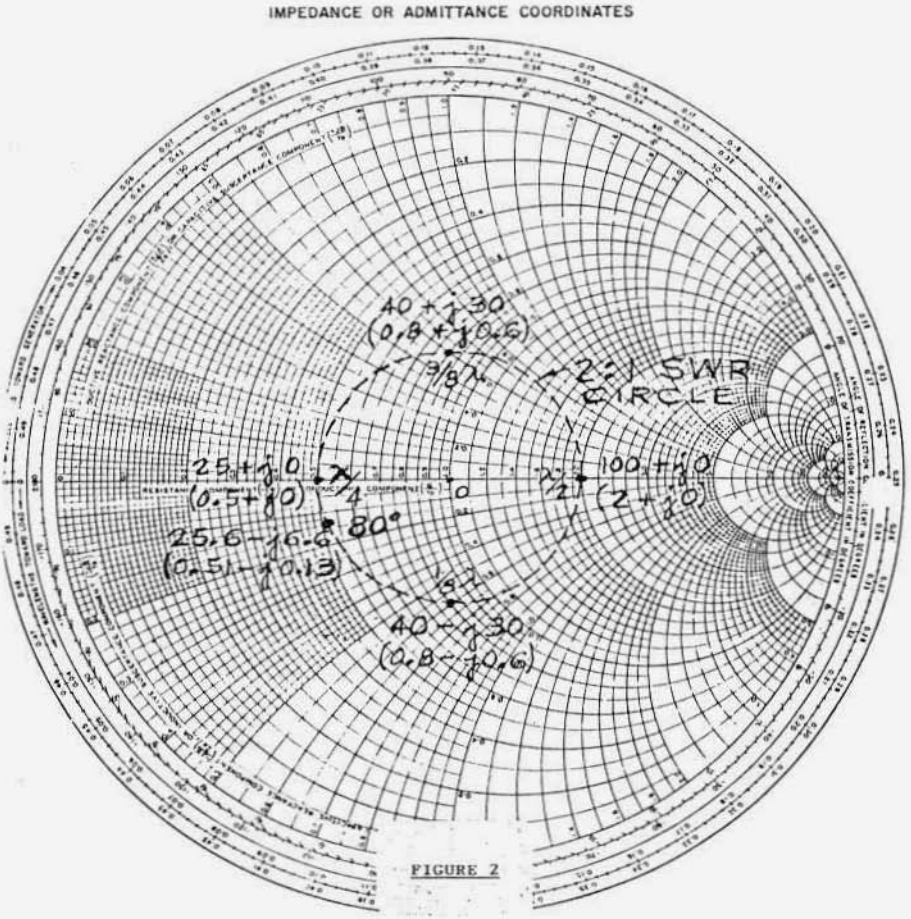

FIGURE 2

Even though the impedance varies along the length of the feedline, the SWR remains the same.

There are other forms of this formula using sine and cosine functions but I have found the version shown here to be easier to solve for most amateur applications. Let's work out a few examples to illustrate how useful this formula is.

EXAMPLE 1: We all know that when the antenna is matched to the feedline and the feedline is matched to the rig we have the maximum transfer of RF energy and the SWR is 1 to 1 (a 'flat' line). Will the formula predict this? Let's say we have a hypothetical dipole antenna (cut to frequency) with a feed point impedance Z_L of 50 ohms. If we use a 50 ohm feedline here's what the formula says:

For

$Z_O = 50$

$Z_L = 50$

$$\mathbf{Z_S = 50 \left(\frac{50 + j50 \tan B_S}{50 + j50 \tan B_S} \right)}$$

Note that the quantity inside the ( )'s is 1 for <u>ANY</u> length of feedline (B_S). This is true because the numerator and de-

nominator are identical. Therefore, Z_S = 50 x (1) = 50 ohms and the SWR is indeed 1 to 1.

EXAMPLE 2: Now let's set up a deliberate mismatch. If we use an antenna with a resonant feed point impedance (Z_L) of 100 ohms and a 50 ohm feedline (Z_O), then the SWR is 100/50 = 2 to 1. Our handbooks tell us that the RF impedance along the feedline is constantly changing but repeats itself every half-wavelength. A half-wavelength is equal to 180 electrical degrees and the tangent of this angle is 0.

For

$Z_O = 50$

$Z_L = 100$

$$Z_S = 50\left(\frac{100 + j50 \times 0}{50 + j100 \times 0}\right) = 50 \times \frac{100}{50} =$$

50 x 2 = 100 ohms

Note that impedance at Z_S, a half-wavelength away from the feed point, is equal to the load impedance Z_L. We will plot this result on the normalized Smith Chart shown in Figure 2. To make the chart universal for any value of feedline impedance, the center of the chart has a value of 1.0. All that is necessary to normalize our data is to divide it by Z_O. In the above example we used a resonant antenna with a Z_L of 100 +/- j0 and the normalized value becomes 2 +/- j0 (divide Z_L by Z_O, or 50 ohms in this case). The plotted point lies on the only straight line of the chart and to the right of the center of the chart.

EXAMPLE 3: Now, let's keep the same antenna and feedline setup to examine a few more points along the feedline (B_S).

For

$Z_O = 50$

$Z_L = 100$

B_S = 3/8 wavelength long, or 135 degrees, and tan = -1

$$Z_S = 50\left(\frac{100 - j50}{50 - j100}\right) = 50\left(\frac{111.8/-26.6^\circ}{111.8/-63.4^\circ}\right)$$

Z_S = 50/+36.8° = 40 +j30 (inductive phase shift)

If you're following the solution of this example, you can see why the two coordinate systems were introduced earlier. To perform division of rectangular coordinates, it is usually easier to convert them to the polar format. Then the real numbers are divided (111.8 divided by 111.8 = 1) and the angle of the denominator is subtracted from the numerator (-26.6° minus -63.4° = +36.8°). The answer can than be converted back to the rectangular system again, if desired. Most scientific or engineering calculators make these conversions at the press of a button. The above values were plotted on the Smith Chart at the top of the SWR circle.

Example 4: Same as Example 3, except we shall determine the RF impedance at 1/8 wavelength.

For

$Z_O = 50$

Z_L = 100 (Resonant)

B_S = 1/8 wavelength long, or 45 degrees, and tan = +1

$$Z_S = 50\left(\frac{100 + j50}{50 + j100}\right) = 50\left(\frac{111.8/+26.6^\circ}{111.8/+63.4^\circ}\right)$$

Z_S = 50/-36.8° = 40-j30 (capacitive phase shift)

The plot for this case appears at the bottom of the SWR circle in Figure 2.

EXAMPLE 5: Same as Example 3, except we shall determine the RF impedance at 80 degrees (approaching 1/4 wavelength)

For

$Z_O = 50$

Z_L = 100 (Resonant)

B_S = 80 degrees, tan = 5.67

$Z_S = 50$

$$\left(\frac{100 + j283.564}{50 + j567.128}\right) = 50\left(\frac{300.68/+70.57^\circ}{569.33/+84.96^\circ}\right)$$

Z_S = 50 (0.528/-14.39°) = 26.4/-14.4° = 25.6 -j6.6

continued on page 40

The BC-191 In War And Peace

by Cliff Kurtz, N6ZU
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Stockton, CA 95207

As a National Guardsman in February of 1941, my unit was called to active duty. It was an infantry regiment and I was a radio operator in the Regimental Headquarters company. After several months of intensive training, we were called to go overseas four days after Dec. 7, 1941 (Pearl Harbor, remember?). We were shipped to Australia, but almost immediately reshipped to the island of New Caledonia.

It was here that we underwent our most serious combat training. During this time we were issued various radio sets for evaluation and eventual use. One of these sets was the BC-191 with its companion receiver, the BC-312. It is a versatile radio in that it can be powered either by 12 volt DC battery or by an AC power supply. It can be operated mobile or fixed station, and can accommodate various antennas. Both receiver and transmitter are shock mounted.

The BC-191 has a counterpart in the BC-375 which is identical except that it was designed for a 28 volt power source and was used primarily in large bombers like the B-17 and B-24. We were all quite excited when we first saw the BC-191. After all, this was an impressive looking piece of equipment compared to the smaller sets we had been operating! I always operated the set with the front cover removed (and still do) to expose

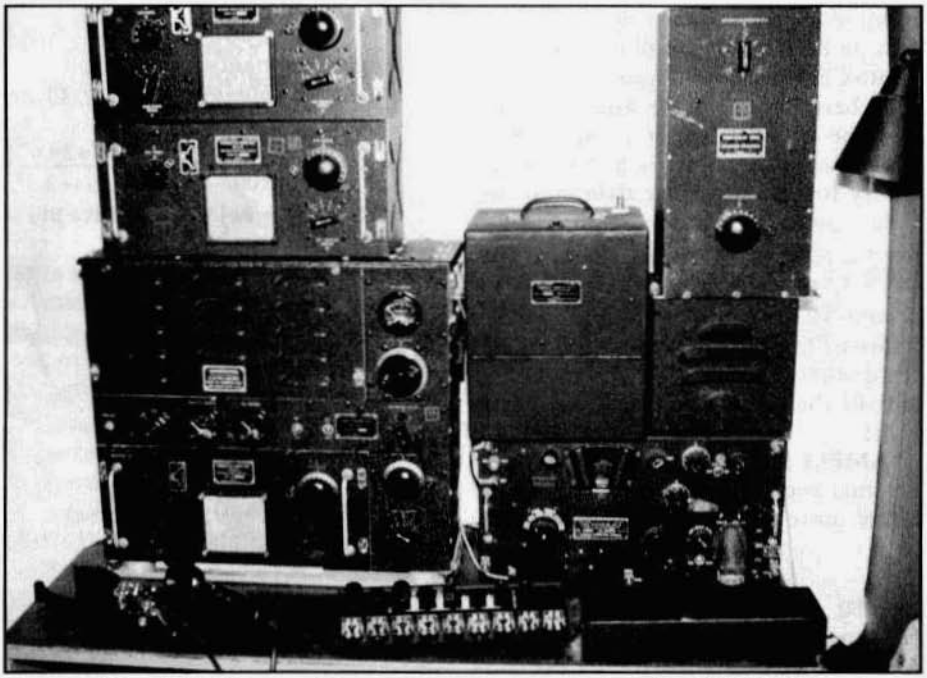
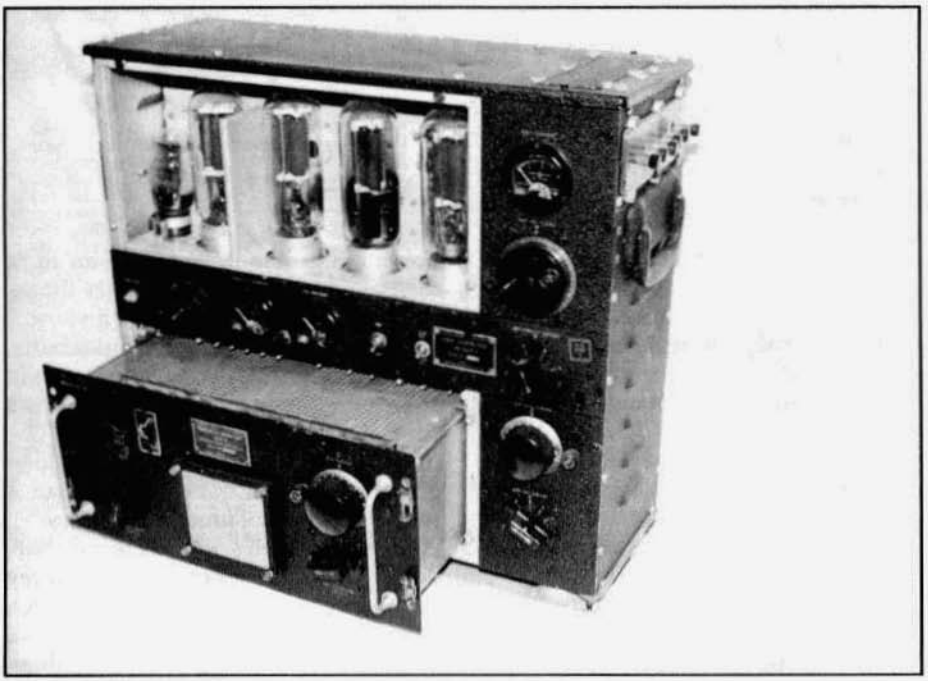


Photo 1. The BC-191 transmitter and companion receiver the BC-312. Also shown is the J-45 'knee-key' and BC-221 frequency meter.



The BC-191 transmitter with front panel removed and tuning unit partially removed.

those four (count 'em!) big 211 tubes plus the type 10 speech amplifier (we love that soft glow, don't we?) The sound of the dynamotor whining away in the middle of the night and the chirping CW signals it put out are hard to forget, even after 55 years!!! When placed in the MCW position, the set puts out a broad modulated CW signal that can cut through any QRM! The signal was broad and "dirty", but after all, the FCC did not have any jurisdiction over there! The dynamotor (BD-77-C) draws 40 amps from a 12 volt battery. I use 2 marine type batteries with good results. The BC-221 frequency meter was also a part of every station.

To back track a bit, the set was designed in 1935 (!) by General Electric to be a rugged, reliable set that could cover a wide frequency range and could be used under almost any conditions. I think they succeeded quite well. I base this opinion on the fact that even after five months of use in the horrible combat conditions we experienced on Guadalcanal, this radio did not fail even once. Humidity was always in the high 90's because it rained every day. Temperatures were in the 95 to 110 range daily. Nighttime temperature sometimes dropped below the dew point, causing condensation and corrosion that often stopped other radios from functioning within a week of use. Later issues of equipment fared a little better because sets were fungicide treated at manufacture. Also, high voltage leads were better insulated and connectors were given better insulation to prevent arc-over. I recall also that the dynamotor on one particular radio set (I think it was the GRC-7) had a case that housed the relays, fuses and other parts as it sat under the dynamotor itself. This case had a snug fitting cover over the top with a rubber seal to keep moisture out. Time after time this filled to a depth of about 1 inch with water. We finally

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Heathkit's 50th: The Green Turns to Gold

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Most hams over 40 probably have at least a vague idea of the history of the Heath company. For those significantly younger—or significantly older—here is brief chronology of the events that lead to one of the most remarkable stories in ham radio.

About 1900—Ed Heath founds the Heath Aeroplane Company. The product is a light plane.

1926—Heath introduces an airplane in kit form.

1931—Ed Heath is killed during a test flight.

1935—Engineer Howard Anthony buys the bankrupt Heath company at auction and goes into production of aircraft parts and accessories—including aircraft radios.

About 1945—After WW II the aircraft business slumps, due in part to a loss of military contracts. A couple of friends persuade Anthony to go in with them on a load of war surplus parts, including aviation and electronics components. Anthony decides there is more money in selling surplus electronics and gives the airplane business to his friends.

About 1946—The surplus electronics business is very good, and Anthony begins to explore the idea of offering test equipment in kit form—an idea he had thought about years earlier. Because his stash of parts included several thousand 5 inch CRTs, the idea of a kit oscilloscope occurs to him as a good trial product.

1947—Anthony invests in some metal fabrication and painting equipment, subcontracts the scope's design, scribbles a few simple instructions on how to assemble it, and buys an ad in the August issue of Electronics magazine. The rest, as they say, is history.

For most hams and electronics buffs, the history of Heathkit really began in 1947 with the release of the company's first electronic kit product—the O-1 oscilloscope. What followed was a flood of products and nothing less than a revolution in consumer electronics.

Because Heath's kits were not burdened with the cost of assembly, they put electronics equipment within reach of virtually every working adult—and almost every kid with a modest allowance. For the first time, the average Joe could afford quality electronic products. The impact of kit-form electronics was thunderous and today, 50 years later, we can still feel the aftershocks.

Opportunities once only available to those with lots of money were suddenly available to anyone with enough smarts to see the possibilities. Low cost Heath test equipment meant those who worked for someone else suddenly had the means to strike out on their own. TV and radio repair shops bloomed like madness. It meant those with ideas for new products could now afford the equipment needed to design and build them. Perhaps most importantly, it meant young electronics enthusiasts now had the means to fully explore their interests. With Heath-equipped test benches set up wherever space permitted, basements, attics, and garages became the proving grounds for a new generation of technicians. And with its introduction of amateur radio products, Heath brought tens of thousands of new hams into the hobby.

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THE HEATH COMPANY
BENTON HARBOR MICHIGAN

The Heath Company's first ad for an oscilloscope in Electronics, August, 1947.

The history of Heathkit is full of superlatives: first, biggest, best, newest, most affordable, most powerful, most features, most advanced, and on and on. With a cadre of clever and innovative engineers, Heath was always coming up with better, simpler, and more efficient ways of doing things. Clearly written and profusely illustrated instruction manuals and an unparalleled commitment to customer service paved the road for a company on a most remarkable journey. And along the way, Heath gathered a following of customers whose unshakable loyalty to the company remains unmatched to this day.

Over the years Heath developed and sold hundreds of kit products. With more than 150 kits, they had the largest amateur radio product line ever amassed by a single company. Heath sold nearly 40,000 HW-101 transceivers alone—more of a single product than anyone before or since, even more than Collins. Its success in test equipment was even greater, with nearly 400 test equipment products over the life of the company. In its first ten years Heath sold an astonishing 500,000 VTVMs. It is likely that by the time the last one went out the door in the early 90's more than 2,000,000 had been sold. It is also likely they sold that many oscilloscopes. Over the years Heath designed more 60 models of scopes. Then, of course, there were all the consumer products—countless hi-fi, stereo, TV, and home improvement kits. There were metal detectors and microwaves, Boonie-Bikes and slot cars, computers and compactors. For a while you could even get furniture in kit form.

For almost 30 years Heathkit could do no wrong. But by the mid 70's the weight of change was beginning to press on Heath with increasing discomfort. Technology was beginning to cycle so quickly Heath could hardly keep up. Halfway through a project, for example, Heath could find itself working on a outmoded idea. And as if that weren't enough, offshore manufacturers were becoming seriously competitive. Then, in 1979, Zenith bought Heath. What at first glance appeared to be a great relationship quickly turned catastrophic. Zenith was interested only in Heath's computer products and began to siphon off huge quantities of cash and other resources to pursue its own agenda. Then came the layoffs and a deadly plunge in morale. In addition to the internal problems, there were major shifts going on outside. Heath's original customer base was aging, and younger folks seemed to have neither the time or inclination to

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A Station Rig Switcher

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Most of us AM'ers have a mix of various receivers, and transmitters in the shack. You know that switching between different units can be difficult. A coax switch helps, but that only solves the transmitted RF problem. If you want to quickly switch from transmitter #1 and receiver #1 to transmitter #1 and receiver #3 there's usually a multiple cable swap required to effect the change over.

This switcher solves that problem. It not only switches the RF sources and receiver antenna connections to the antenna, but also takes care of receiver muting, amplifier keying, and audio output selection to the station speaker. It requires only that each transmitter have either an open or closed set of contacts, when transmitting, to control the switcher.

Receiver muting methods in amateur gear are often different from that of commercial or military equipment. Amateur receivers usually need to have

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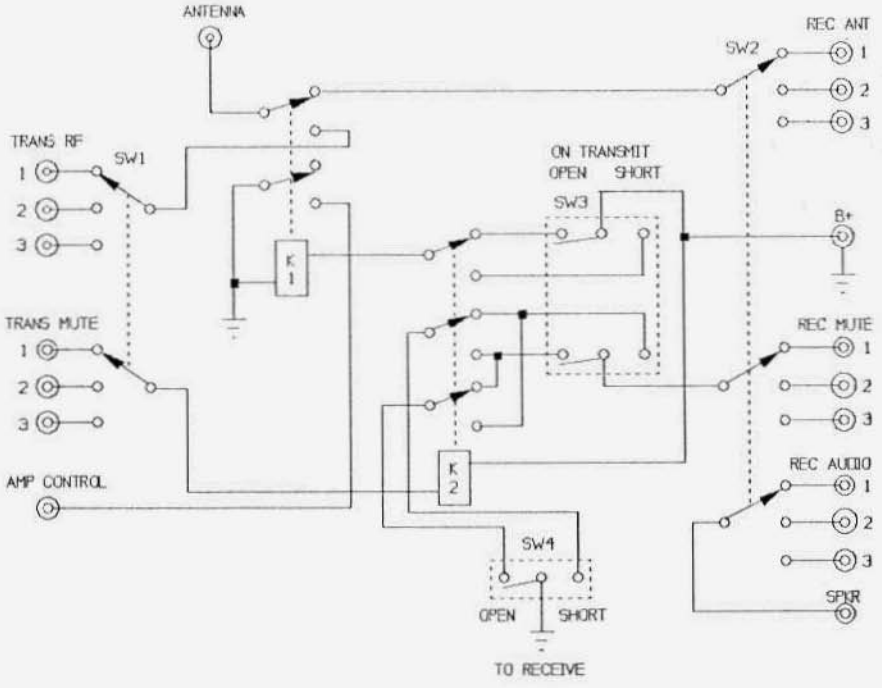

Figure 1

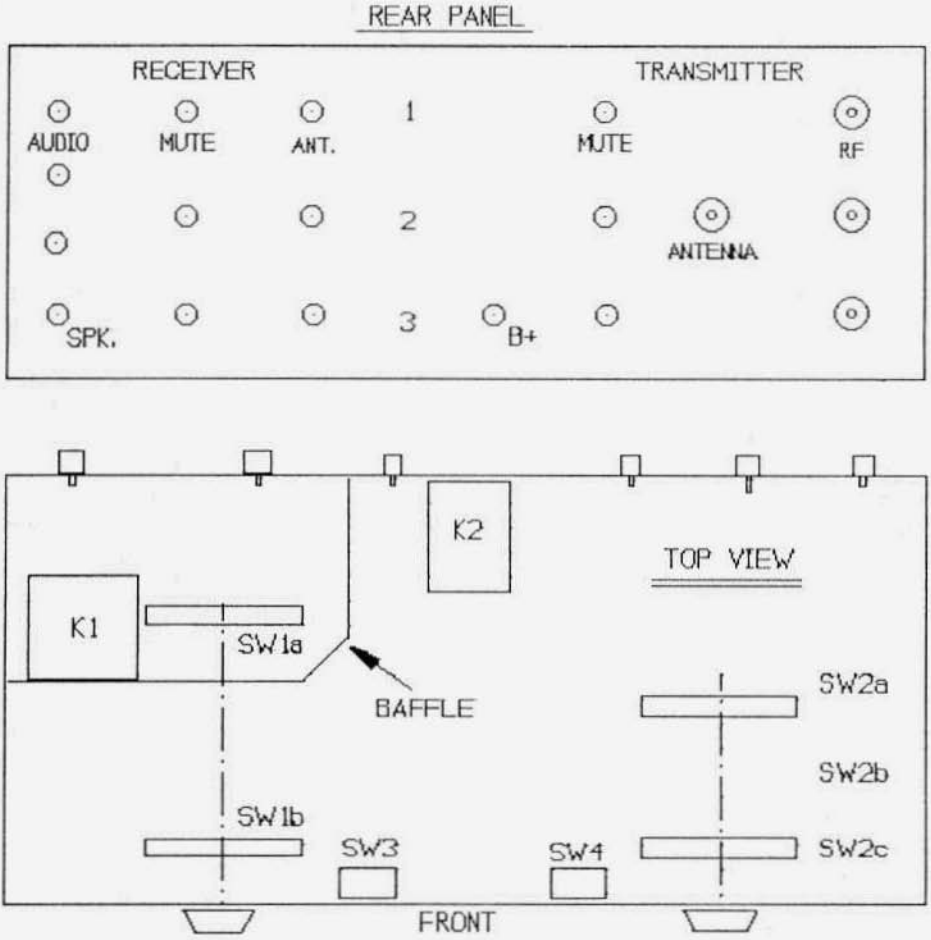
REAR PANEL
RECEIVER
TRANSMITTER
AUDIO
MUTE
ANT.
1
MUTE
RF
2
ANTENNA
SPK.
3
B+
K2
TOP VIEW
K1
SW1a
BAFFLE
SW2a
SW2b
SW1b
SW3
SW4
SW2c
FRONT
FRONT PANEL
STATION SWITCHER
1 2 3
1 2 3
SHORT
OPEN
TRANSMITTER
RECEIVER

Figure 2

the mute line shorted to receive. Amateur transmitters often provide the shorted contacts for the receiver. But commercial or military receivers and transmitters usually have the opposite system, so I have included the necessary controls so that any system can be accommodated. The design also sets a standard when adding a muting system to that really old rig.

A look at the circuit: Fig. 1

- SW1 selects the transmitter in use, both RF and mute control.

- SW2 selects the receiver in use; including RF, mute and audio.

-SW3 is set to either 'open' or 'short' depending of what the individual transmitter does to the mute line on transmit.

- SW4 is set to 'open' or 'short' depending on what the individual receiver requires to receive.

- Relay K1 operates on transmit to switch the antenna from receiver to transmitter, and closes the amplifier control line.

- Relay K2 inverts the function of the mute system as necessary for proper receiver operation.

- Your 'Mind' has to remember to correctly set the muting control switches.

Layout and Construction:

There's nothing critical in the layout. I used a 3.5" x 10" x 5" two-piece box for the housing, but almost any sort of enclosure will do. A shield must be put inside to separate the high power RF components from the rest. Fig. 2 shows the layout I used. There's no reason to limit the capabilities of this switcher to only three transmitters and receivers, just install more or less switch positions and jacks as you need. I built my unit to handle up to 150 watts.

Components:

- SW1 -the RF section should be ceramic and rugged enough to handle the transmitter power you are using. The transmitter mute section doesn't need to be ceramic but must fit on the same index as the RF section.

- SW2 -can be any phenolic 3 pole, multiposition switch.

- SW3 and SW4 can be any toggle switches. I used the Radio Shack miniature units.

- K1 and K2 should be of good quality. The contacts should be large, at least 5A rating. I used P&B type KR, 12 VDC units since I had 12 VDC available. But any DC relays would be fine. I don't like having to deal with 115 VAC for this application, and using DC allows using the cable shields as the relay ground return.

- The transmitter and antenna connectors are UHF panel jacks. The receiver antenna mute and audio connectors are RCA phono panel jacks.

- The B+ connector is a 2.5 mm I.D. coaxial DC power plug. R.S. 274-1573A, but any small connector will do.

Conclusions:

I find that this switcher is helpful in a number of ways. When testing a new rig, being able to easily switch into the station system reduces test time. Secondly, if a rig fails in the middle of a QSO another can be quickly placed on line. And finally, when participating in a large net you can switch quickly between two receivers to accommodate both AM and (gasp) SSB, or swap the old receiver that cannot clear the QRM with one with a sharper bandwidth.

Good luck with this project. I'm sure you will find it worth your time. ER

Please remember to use our new address. A lot of mail is still being forwarded from our old address and this causes needless delays.

ER
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Cortez, CO 81321-9575
(970) 564-9185
er@frontier.net

7010 Kcs

by Mike Zonnefeld, WØLTL
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Tucson, AZ 85749

After obtaining my conditional license in Alamogordo, NM, while stationed at Holloman AFB in 1963 (remember those days of the Conditional?) I operated with a DX-40 that I still had from my Novice days as KNØCXG and a newly purchased Hallicrafters SX-140 along with the regenerative BFO IF. What a combination! The crystals used were 7175, 7185, both in the old Novice bands. These crystals and a Gotham vertical served to work some states and occasionally the SX-140 even allowed me to hear a DX station on 40 CW like maybe Canada, Cuba and once even Japan. The problem was that I had no crystals for the lower DX portion of the band and no money for the VFO and therefore no DX was worked for many months.

One evening while puttering around in the 40 meter Novice band a strong clean station came on the air and promptly responded to my calls. It was Gary Babcock then and now WA5BMN. He heard W5NQY the new Conditional and must have felt sorry, as when we met a few days later he gave me an old military style crystal for 7010 kHz and I promptly modified it to fit my DX-40 crystal socket by welding two #14 gauge wires to the terminals. This crystal resulted in many fine QSO's with WA5BMN as well as the 40 meter CW DX that then and still now operated on that frequency. Gary's ears were superb and he worked much DX on 40 with a dipole up about 40 feet or so and received with a BC-312 and transmitted with a homebrew 813 rig on CW primarily as well as 20 meters. He then was a teenager and slightly younger than me, already out of high school, Lowry Tech Training Center Co., and was already an 'old man' of 19 or 20 or so. Gary and I remained friends to this day although we haven't seen much of each other lately.

This crystal continued with me for many years and excited many rigs, some homebrew, some old then new now vintage rigs. Operating on 7010 kHz and 14020 as well as 21030 this rock resulted in many QSO's in the General band with my trusty old DX-40. Through moves from Alamogordo, NM, to Cedar Rapids, then Wichita, KS; Tucson, AZ; Oklahoma City; back to Wichita, KS and now to Tucson, AZ, again this crystal has always been in the junk box. Whenever I stumble upon it, it brings many fine memories of many DX and local contacts as well as jarring my memory of ham friends from that era as well as some that I helped start into ham radio, like Bob, N5NJN, an old friend from Alamogordo, who also borrowed this "rock". Bob remains on the air today and of course is active in many of the nets that are popular on 75 meters.

Even while working at Collins and being subjected to the "aura" of Collins, the trusty 7010 rock continued to service WØLTL, now an Extra Class license. The past 29 years at Collins/Rockwell and getting to know many of the gentlemen that caused this company to rise among the stars of the ham radio and other electronic product world has also been a delight.

Recently I obtained a Viking II from John, WD7F, here in Tucson, and it did not have the VFO with it. A search into the junk box revealed the much maligned 7010 kHz "rock". I installed it into the Viking and once again it faithfully resonated and excited the old rig. I keyed it and it still keyed without noticeable drift or chirp in this old transmitter. Hearing that old rig come alive with good old "7010" again brought back a flood of memories of all the years

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A 6-Meter 829B Transmitter

by Stan Tajima, JA1DNQ/KD2HB
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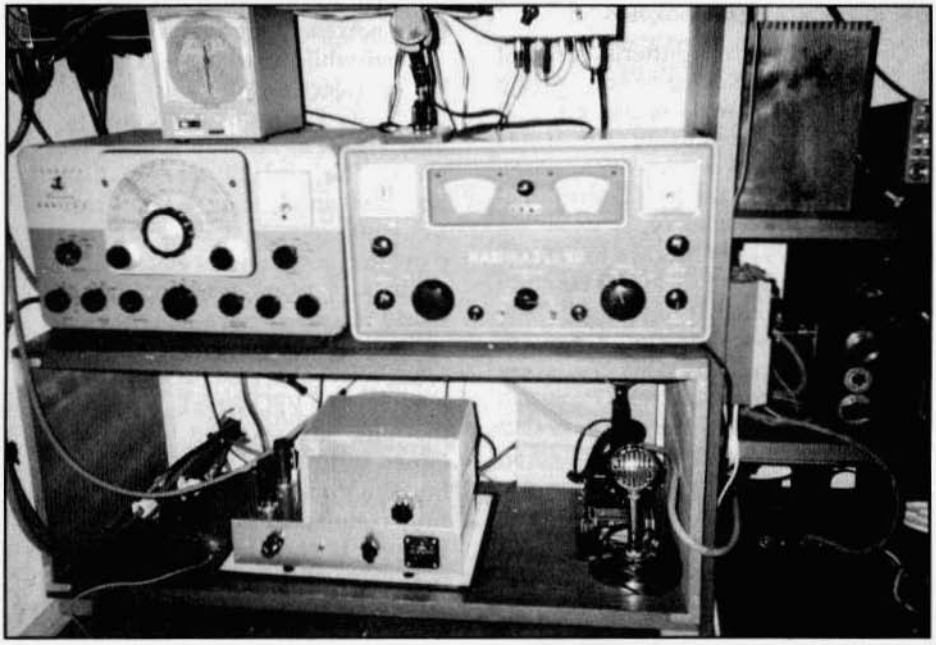
Being a maverick AM operator in JA since early 1992, I am sometimes tired of calling "CQ AM" since most of the time there is no response. I have raised only a limited number of AM'ers on 20 meters. I did not expect before that JA hams were so conservative and that they wouldn't want to try something new like AM!? (This may be because most of the old AM rigs were homebrew and they've been parted or totally abandoned to save space in the shack. Unlike the U.S., space is a problem in JA.)

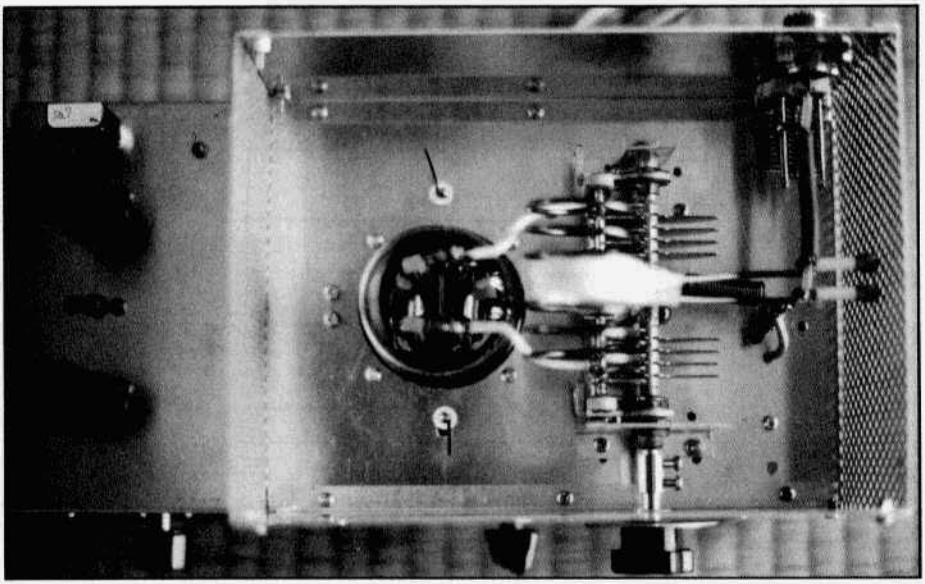
I was told, however, that there was an active AM net on 6 meters. I have a Viking Ranger II and Hammarlund HQ-110 for 20 meter AM operations and both of these cover 6 meters.

So one day I tried 6 meters with the Ranger and HQ-110. The HQ-110 did work somehow, however the Ranger's working performance on 6 meters was marginal. (The drive from 5763 does not seem enough and the dip of 6146 is so little.) The combination does work somehow and I made a few QSOs. But I did not feel comfortable using this setup. I always want to impress people by the good performance of the real AM. AM has to be real "plate/screen grid modulated".

So I have decided to make my own 6 meter rig. Here is how I built a 6 meter AM TX with an 819B. I wondered if I should make the whole TX including the modulator or if I should use whatever facilities were available.



The author's 829B transmitter below his Viking II and HQ-110.



Top view, PA compartment lid removed.

My shack is full of oldies and XYL is very sensitive about the mess in the shack. So any new TX must be small enough so that I can squeeze it somewhere in between. (By the way, the US GI who was stationed in JA after the war spoiled the JA's YL. My father used to tell me that the JA YLs were more friendly before they became 'westernized'.

Fortunately, the Ranger has an auxiliary power supply of 300V, 50 mA, 6.3V 5.5A as well as 500V, 210 mA. So, I decided it was easier to make a separate RF deck to make use of the power outputs from Ranger. I happened to have a few 829Bs and sockets, and the 829B power characteristics (refer to Fig.1) seems to be a perfect match to the Ranger modulator. Also 829B looks very sexy!

I had picked up some circuit diagrams from JA/US handbooks and patch worked them to form the following design. Crystal oscillator and tripler: 6AR5 Doubler; 6AQ5 Power Amplifier; 829B refer to Figure 2.

This lineup could easily be powered by the auxiliary power supply and should be powerful enough to match with the Ranger's 7027A P-P modulation. Also I thought that it would transmit enough power to be bench marked as a real AM station. (Still most of the AMers on 6 meters use modern solid state.) I wanted to have good audio for the same reason. I was concerned if the 6AQ5 doubler/driver would be strong enough to drive the 829B. According to the RCA tube manual, the 829B needs 11 mA grid current for class C operation. But, anyway I wanted to try a 6AQ5 first and if it was too weak then I could always change it to a 5763 etc. Fortunately I had almost all the parts accumulated from Dayton/AWAs in Rochester/other flea markets in both US/JA as well as from some very friendly US hams who had previously donated items such as 829B socket.

The construction is very easy. I installed a shielded box on the 829B RF deck (mainly for high voltage protection purpose.) A 1 mA surplus meter is used to check the PA plate voltage, PA plate current, grid current, and the doublers grid current. For standby, a relay cuts out the B+ for the 6AR5 and 6AQ5

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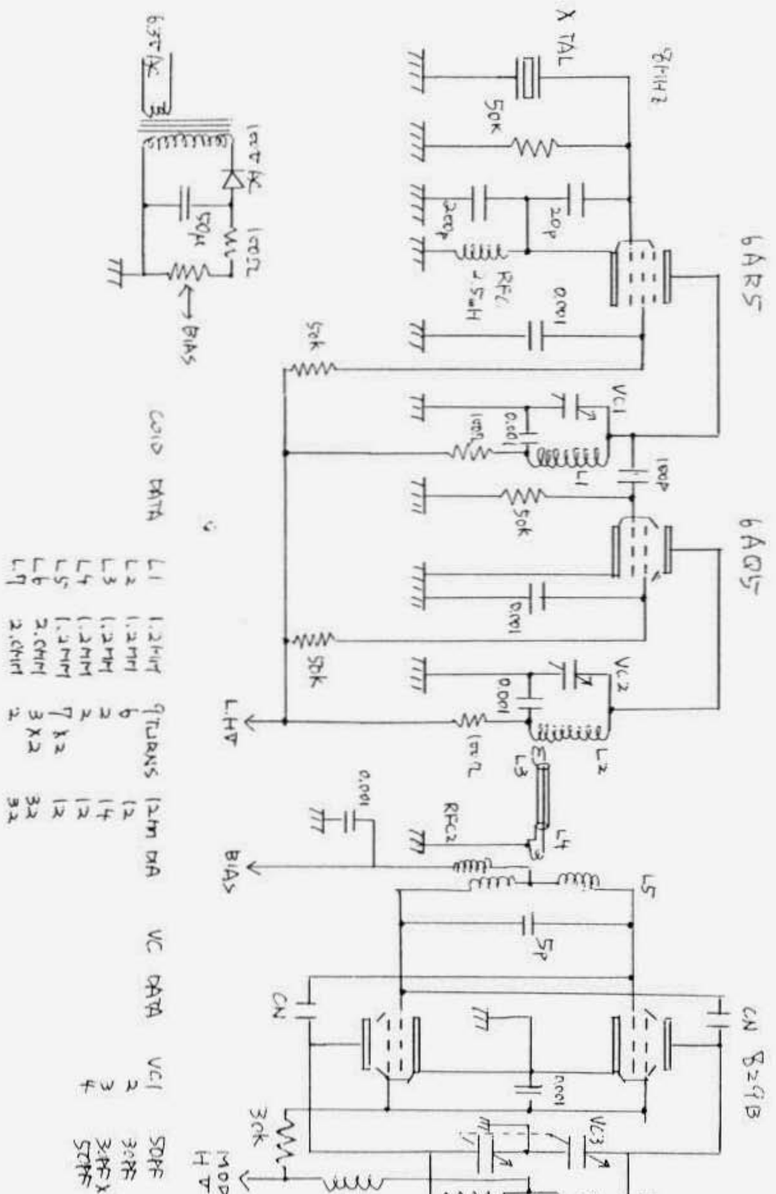
X TAL
50K
20p
RFC
0.001
6AR5
VC1
100p
L1
50K
6AQ5
VC2
L2
L3
L4
RFC2
L.H.T
BIAS
L5
5p
CN
VC3
L6
L7
ANT
VC4
RFC3
30K
MOD. H.T.
COIL DATA
VC DATA

Figure 2

CLASS OF OPERATION	PLATE VOLTAGE	SCREEN VOLTAGE	GRID VOLTAGE	PLATE CURRENT	SCREEN CURRENT	GRID CURRENT	APPROX. DRIVE POWER	APPROX. OUTPUT POWER
CLASS-C CW	500V	200V	-45V	240mA	30mA	12mA	0.7W	83W
CLASS-C PHONE	425V	200V	-60V	212mA	35mA	11mA	0.8W	63W

Figure 1. 829B Typical Operation

	829B	6AQ5	6AR5
PLATE VOLTAGE	500V	280V	250V
CURRENT	90mA		
SCREEN G. VOLTAGE	200V	200V	120V
GRID BIAS VOLTAGE	-60V		

Figure 3. Tube Working Conditions

(829B grid is biased by an external ps, Hi). I was a little concerned about the adjustment of the neutralization of the 829B. It actually turned out to be very easy by adjusting the neutralization wire forward/backward. The construction and adjustment were relatively easy, except for a very funny and difficult to understand trouble.

The trouble I experienced with this transmitter was that the power could not be fed through the coupling coil to the antenna. The drive was OK, the tank coil resonates at 50 Mc, but no power out? Instead, after a few minutes, the RFC which feeds modulation high voltage to 829B starts smoking and becomes very hot. If I transmitted longer, I could have melted the RFC! After some consultations with my friends, I determined that the RFC must be resonating at the transmit frequency. So I have changed the inductance (more turns) and this has eliminated the trouble.

Except for the above, there was no major trouble. The grid current of 6AQ5 is 1.2 mA. The grid current of 829B is 2 mA with the proper grid bias of minus 60V. It would seem that the drive from the 6AQ5 is too weak, but this did not create a problem. Of course if the bias is reduced, more grid current would be available. I was concerned about the overmodulation because of the weaker drive. So far, a little more than 2 mA grid current shows no sign of overmodulation. The working voltages/currents are shown in the Figure 3.

The TX works fine and I receive good audio reports. People are impressed by the audio quality as I hoped. Judging from the variation of the plate current under modulation my home brewed 829B transmitter works better than the Ranger. The input is about 45W, and it appears that my transmission performance supersedes my reception performance (or my RX sensitivity is too poor). My next project is to improve my reception sensitivity on HQ-110. Do you have any suggestions?

It is quite something to say "I am using a home brewed 829B plate/screen grid modulated...!? Very often younger hams do not know what an 829B is.

By the way, I use an HF three element triband phase array antenna (three ele-

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Memories of Allied Radio

by Ken Greenberg
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Skokie, IL 60077-2355

I was in grammar school in Chicago in the 1940's when an older cousin got me hooked on radio by showing me how to build a crystal radio using a Quaker Oats box as the coil form. From that point on, I became an Allied Radio junkie.

A 25-minute ride on the #127 Independence/Jackson bus left me off at the door of Allied Radio, then located at 833 W. Jackson Blvd. For the next 20 years or so, I went to Allied to buy parts for projects or play with the communications receivers at least once or twice every month. Always went on a Saturday. Just for the record, today the Allied building houses a company called Records Management Services Inc., and the building looks much the same in good condition with no major structural changes visible.

Time has dimmed my memory, but I still recall a few things about my visits to Allied. The Allied catalog was a wonderful and fascinating wishbook that came out every year with a lot of new "stuff" in it. I always immediately looked it over from cover to cover.

In the early 40's, Allied was always extremely busy on Saturdays. I always tried to be there the minute they opened. I would take a number and while I was waiting to be called, I would visit the small room full of communication receivers or the room with the audio equipment. Hi-Fi wasn't such a big deal at that time. Neither was television.

When my number was called, I'd bring my list of parts and catalog numbers up to a counter salesman and he would write up the order which was then placed in a 2 foot square wire basket and by means of a rope, was sent upstairs where the orders were filled. If the parts were small and light enough, they came down in the same basket. If they were too heavy or large, the order came down on a small elevator (4' x 3') that was next to the wire basket. It always seemed to take forever for my order to come down, but there was plenty to play with while I waited.

Occasionally, the words OUT OF STOCK were stamped after some parts and my heart sunk. This meant going back to the catalog to look for alternates and starting the order process all over again. If nothing suitable could be found, Lafayette radio was located one block west of Allied. They were a much smaller store, but sometimes I'd get lucky and find the part I needed. And if they failed, Newark Electric was also in town. It was always Allied first as they were the biggest and the best. Oddly enough, Newark is still around and is probably one of the biggest parts distributors in the country. But for me, the Allied catalog was the bible for parts and if they didn't have it, the odds weren't good you could find it elsewhere.

During the 40's, 50's and 60's many magazines contained radio and other electronics construction projects. I was always building something and blowing out tube heaters by being careless. When I was in high school during the war years, things at Allied changed drastically. There were no more crowds for two reasons. First, not a lot of parts were available for civilian use and some of those parts when available required a special priority from the government

for purchase. There was a small trickle of new parts as the government wanted our radios to be kept working.

The second thing was that most of the draft age repairmen were in the service. I clearly recall a lot of old timers doing the servicing. To me as a kid, the war years were interesting and frustrating because it put a damper on my hobby.

After the war, it didn't take long for things to start booming again at Allied. Surplus electronics flooded the market at very cheap prices and the crowds were bigger than ever. More counter salesman were hired. To speed things up a little, the blank order forms were lying on the counter and the customer filled out the form himself and then gave it to a salesperson when your number was called. It helped a little.

One thing that still stands out in my mind is the quality of the people working behind the counter. Most were generally interested and knowledgeable in electronics. More often than not, they were able to help me with a problem I was having with a project. A far cry from much of today's "help." Many were "hams" that worked in the room with all the communications receivers and often they would be making contact with other hams all over the world. It impressed the hell out of me and started me saving for my dream communications receiver, the Hallicrafters S-38. It took me months to save up for the receiver and I can still recall how excited I was when I rushed to Allied to buy it. I loved that radio and used it for years to listen to short wave and "hams".

Now here is where I get rather vague. I tried the Chicago Historical Society and the main library trying to determine what year Allied got started. No luck. Also, I wanted to know in what year they moved to their new, state-of-the-art building at 100 N. Western Ave. in Chicago. It was an enormous very attractive building. I tend to think they moved there in the early 1950's when I was in the Army. What I did find out was that Allied officially went out of business on October 27, 1967 when they were taken over by the ARC Liquidating Corp. And just for the record, the building at 100 N. Western currently looks very run down but is still in use by the State of Illinois with offices for the Department of Correction, Department of Public Aid and a Parents Too Soon program run by the Mount Sanai Hospital. It is in a run down neighborhood.

I was drafted into the Army and became a radar repairman in the early 50's. When I was discharged a couple of years later, I was back at the new Allied in a flash, not only ordering parts, but also applying for a counterman job along with a fellow radar repairman also from Chicago, who I met in the Army. I don't recall why, but he got the job and I didn't. I was frustrated and real envious of him. Fortunately, I did arrange for him to use his 20% employee discount when buying stuff for me. After a couple of years he left Allied and we lost touch.

The new store was great. Plenty of room for everything and much faster counter service. There were separate modern rooms for Hi-Fi equipment where you could switch in different speakers. A room full of the latest communications receivers connected to antennas so you could try them out. And there was a room full of televisions. To me the place was like a fairyland. In 1955 I once again rushed to Allied with the money burning a whole in my pocket to buy my next dream receiver, a National NC-125. I still have it and it's in mint condition.

I recall building a lot of Knight kits. They were OK, but didn't compare to the quality of the Heathkits. Somewhere about 1957 Knighkit became a separate division and moved to Maywood, IL. I tried to get a job with Knight, but after a few weeks of hearing nothing from

continued next page

Memories of Allied Radio from previous page

them, I took a job with DeVry, the school. Sure enough, after I signed on with DeVry, Knight called and offered me a job. I declined and stayed with DeVry which proved wise as not too far in the future, Knightkit went out of business. Couldn't compete with Eico and Heath I suppose. And just for the record, an Olson Electronics store opened across the street of Allied. They were pretty busy for a while as they got the spillover from Allied. In my opinion, Olson was a schlock operation. My first hands-on experience with television occurred I believe in 1947 at the old Allied location. In the room with the communications receivers they had a 7-inch metal cabinet Hallicrafters TV set with push buttons for tuning. I fell in love with that set and begged my father to buy it. They also had a National 7-inch TV but it didn't have the "tech" look of the Hallicrafters. My father said it was way too expensive for such a small screen. As it turned out, we waited until 1948 and bought a round screen 12-inch Zenith that played almost trouble free for 10 years.

The big question to which I hope readers can shed some light on is why did such a successful business fail. A couple of things happened in the mid 60's that may or may not have had any bearing on this.

Just about a block away from me lived a guy who was a few years older than me. I knew he was interested in electronics because on a rare occasion I would talk to him when I bumped into him. I knew that for a long time since Allied moved into their new building, he worked in their shipping department. One day I'm reading the paper and there is his picture with the caption that he was arrested for major theft of electronic equipment from Allied over a long period. He was being watched for a long time and when they entered his house, all the rooms were loaded with expensive stolen Allied equipment. I do recall the he did go to jail.

About the same time I noticed that the normally crowded store was not. Each time I went there, there were less customers and people were telling me that they were switching to Newark Electric because they had better service and more stock. And in fact, I too found myself going to Newark more and more. Being curious, I asked one of the old time counter salesmen who I was friendly with over the years, what's happening to Allied. The answer he gave me was that he heard there was tremendous amount of internal theft going on for several years and that a lot of security was brought in to stop it. That is the end of the line as far as my knowledge and recollections go. I suspect that Allied at their peak was probably the biggest parts distributor in the country.

In the 1960's I began doing a lot of electronic project construction articles for several magazines. I bought all my parts from Newark, Olson and eventually Radio Shack (which I think started with one store in Boston). Radio Shack leaves me cold. **ER**

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6 Meter 829B Transmitter from page 35

ments are driven through a phase line) for 50 Mc. Crazy? Sure I am. I do not know how it works, but the triband resonates at 52 Mc (VSWR 2:1). To perfect the match, I have built a "matching box" which could even lower the VSWR to almost 1:1 at the TX side. This antenna still has a sharp beam and works much better than an indoor dipole. If someone knows why the HF tribander resonates at 50 Mc please let me know.

Well hope to see you on 6 meter when propagation improves. **ER**

The BC-191 In War And Peace from page 25

determined condensation to be the cause, and promptly drilled drain holes into the bottom! (Field fix!)

The BC-191 covers various frequency ranges from below the broadcast band and up to about 20 meters. This is accomplished by changing the tuning unit "drawers" (shown partially removed in photo 2.) Antennas were usually a 15-1/2 foot whip for mobile use and quarter wave single wire with counterpoise for fixed installations. The vehicle used was a 4-wheel drive "Command Car", a 2-seated car with canvas "convertible top". The radio was mounted in the rear seat much as shown in photo 1. The Company Commander and his driver rode up front, while the radio operator occupied the rear seat.

The microphone used was the T-17, a hand held carbon mic that did not do a whole lot for fidelity, but it was rugged and did the job it was intended to do - get the message through! The key most often used was the J-45, the so-called "knee-key". As can be seen in photo 1, it has a spring-clamp base that could be clamped onto the operator's leg while the vehicle was in motion. This worked very well, provided the operator increased the contact spacing to about 3/16" and then "slapped" the key with a hefty wrist action. We all became quite adept at this and could sail along at about 15 wpm. (Bugs and speed keys were not issued to the lowly infantry men, but were reserved for Division and Signal Corps operators!) All CW was in five-letter coded groups, no clear text was used.

This was not meant to be an in-depth article on this radio. As many readers are already quite familiar with it, and as I understand it, there are quite a number in use at the present time on the ham bands. I have used mine sparingly because I am still trying to find ways to clean up the signal a bit more. I would welcome any suggestions some of the users have to accomplish this. (Neutralizing the final stage, has helped a lot).

Just a word or two about the BC-312 receiver. It also came in 12 volt, 28 volt and 115 volt AC models (BC-348 and BC 342). It is a CW and AM only superheterodyne, reasonably stable (considering its vintage) and also very, very rugged. Mine was in mint condition when I bought it, and I have not had to do any thing to it. (I hope I never will, because it will be a bear to work on!)

The BC-191 and the BC-375 were probably as important to the war effort as the M-1 Garand semiautomatic rifle was in winning the war. It provided reliable communications in the air and on the ground, in all theaters of operation, on a daily basis and without fail. We all owe it our respect and gratitude!! Thanks to AMers and military nets this old war-horse is getting a chance to operate in peacetime.

One final word. If you hear me on the AM segments of the bands, feel free to make comments on the signal quality. I will not take offense as long as you are being honest and not nasty!! **ER**

7010 from page 31

enjoying ham radio, the DX that this frequency worked, as well as the many friends that are directly or indirectly related to this crystal.

Modern technology, however, enabled me to learn that the good 7010 kHz rock was actually oscillating at 7011.3 kHz. I was a little sad to learn that as it seemed much more romantic as just plain old 7010 kHz!

Each of us seems to have a favorite piece of gear that no amount of prodding will cause us to part with. These items for me are the 7010 crystal and of course my original J-38 key bought from WRL in late 1960. Both of these pieces of gear have become a sort of symbol of ham radio in my shack.

Thanks for the chance to share a piece of nostalgia with the ER gang. **ER**

Heathkit's 50th from page 27

assemble kits. The age of instant gratification had arrived. All of these forces—and others—conspired to submerged Heath below crush-depth. The resulting implosion left its customers stunned and a void that may never be completely filled. Small wonder.

Today, 50 years after a blurry green wiggle first appeared on the face of the O-1's war surplus CRT, collectors and fans alike are providing a safe and happy home for many of Heath's best products. Hundreds—if not thousands—of Heathkit transmitters and receivers are still in active duty. Circuits are still checked with Heath VTVMs. Audiophiles still listen to vinyl records with Heath's Williamson amplifiers. And somewhere, a Boonie-Bike still roams the back country.

The Heath Company still exists, and while they no longer make kit products, the company is alive and well and profitable, providing many a ham with a glimmer of hope than one day the fire that drove a revolution might be rekindled. Hope springs eternal.

Happy 50th anniversary, Heathkit. As long as there are hams, there will always be a place for you. **ER**

Editor's Note:

The Blossomland Amateur Radio Association in St. Joseph Michigan (home of Heathkit) plans to have a special event station on the air on three separate weekends next summer. The events are part of a celebration of the Heath Company's 50th Anniversary. The dates for the commemorative station operations will be announced in a future issue of ER. The station will run a variety of Heathkit equipment and will be operated by members of the club, many whom are former Heath employees.

ER also plans to sponsor an event to commemorate Heath's anniversary. Details will be announced in a future issue.

Finding RF Impedance from page 23

If you try to use a $B_S = 90°$, the tangent becomes infinitely large and the calculator has a nervous breakdown. You can use 89° or even 89.99999° and the answer will approach 25/0°. As predicted in our handbooks, a quarter-wavelength line inverts the impedance (acts as a matching transformer) and the impedance is now $Z_S/Z_O = 25/50 =$ 1 to 2 SWR at 90° compared to $Z_L/Z_O =$ $100/50 = 2$ to 1 SWR at the antenna.

These examples clearly show how the RF impedance along the feedline changes in the presence of a mismatch (SWR). However, when you plot the impedances of all points along the line, they fall on the SAME SWR CIRCLE as shown in FIGURE 2. You can't improve the SWR by lengthening or shortening the feedline, but the impedance your rig or tuner loads into (Z_S) does change, except it remains constant when the SWR is 1 to 1.

I used a resonant antenna ($Z_L = R +/ -j0$) in the above examples to keep the math simple. When you QSY with a real antenna, Z_L becomes a complex quantity. Then you're working with complex numbers in a complex formula and the calculations get "messy".

Finally, I recognize that some changes in SWR can occur if different lengths of an unbalanced feedline (such as coax) are used without a balun at the feedpoint. This fact has been ignored in this article in an effort to highlight the usefulness of the transmission line formula.

I hope this article helps to reduce some of the confusion and misinformation heard on the ham bands. **ER**

What's in a Call from page 2

Well, recently my wife handed me a letter from the FCC. I couldn't wait to open it. It had been 40 years since I was KN9GAW. I had WA9DZJ for 32 years. And there it was - "K9GAW"! Boy, was I happy!!! That's what's in a call. **ER**

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FOR SALE: Negative cycle loading circuit, instructions - $2; Protect modulation transformer, extend positive peaks. WB8BEM, 410 Robinhood Dr., Florence, Al 35630.

FOR SALE: Collins 51J series drum overlay - $10 ea, specify which. Ron Hankins, KK4PK, 555 Seminole Woods Blvd., Geneva, FL 32732. (407) 349-9150

FOR SALE: National RAS-1 complete, all coils, spkr, coil box, rack, working - $245; SX-28, w/ manual, internal mods, no holes - $145; Hallicrafters PM-23 spkr - $70; TCS xmtr cabinet w/shocks - $20; Johnson TR switch - $50; Multi Elmac PMR-6 rcvr w/book - $40; TMC VOX-(?) ultra stable VFO - $145. U-shp. WA7HDL, ID, (208) 756-4147 after 0030Z

FOR SALE: Heaths: VTVM IM-11 - $20; pwr sply, HP-13B - $50; HV Probe, IM-5210 -$15. Frank S. Law, W8SET, 1 Wildacre Rd., Charleston, WV 25314. (304) 343-0415

FOR SALE: Collins 75A4, 75A3, Collins rack for S-line 32S1, 75S3B/w CW filter, 516F2, 312B4; Dentron DTR-2000L amp w/extra new 8877 - $1350. Make offer on Collins gear. Fred Honnold, W6YM, 17890 Sharon Ct., Pine Grove, CA 95665. fhonnold@juno.com

FOR SALE: Repair! Radio repair, tube or solid state, reasonable rates. Jim Rupe, AB7DR, Western Amateur Radio Repair Co., (WARRC), POB 697, Grayland, WA 98547. (360) 267-4011

FOR SALE: Vintage tubes, (833A, VT4C, etc.); assorted radio/wireless telegraph books & magzines, 1880-1935. SASE list. Jan Perkins, 524 Bonita Canyon Way, Brea, CA 92621.

FOR SALE: Books, some on very early radio, some technical, some Amateur Radio. Send SASE for list. Fenton Wood, 109 Shoreline Dr., Star Harbor, Malakoff, TX. 75148 (903) 489-0204

FOR SALE: RME 45 w/spkr, cosmetically fair, working but needs help, rare A model (well, semi-rare?) - $90. **WANTED:** Dogbone connector for #19 MK II set, or just the six pin pwr plug. Mack Lester, KC5AQO, POB 149, Lewisville, AR 71845. (501) 921-5874.

FOR SALE: Gonset GSB100 w/manual, exc - $150 + shpg. **WANTED:** Back issues of ER. Ron Beaver, WB4OQL, 740 Brookdale Dr., Greer, SC 29651. (864) 879-3133

FOR SALE: Knight T-150 xmtr, works good, apearance 8.5-9 electrically 9, needs new meter switch - $100; Drake T4X-B appearance 8-9+, electrically 7-8, short 2 xtals, 130W keydown 80M - $135. CA, (209) 568-0345, mornings.

FOR SALE: Collins 351R1 rack mount - $75; GD Viking KW RF deck - BO. Bob, KL7HDY, Alaska (907) 346-1044.

WANTED: Very early Hallicrafters and Hallicrafters/Silver Marshall equipment including Skyriders with entire front panel dull aluminum color, S-30 radio compass, S-33 Skytrainer, S-35 panadaptor, wood console speakers - R-8 & R-12, HT-2, HT-3, BC-939 antenna tuner, parts, advertising signs, paper memorabilia of Hallicrafters. Also want RCA model AVR-11 airport tower receiver. Chuck Dachis, WD5EOG, "The Hallicrafters Collector", 4500 Russell Dr., Austin, TX 78745. (512) 443-5027

WANTED: Info on the old Allied Radio in Chicago. I'm researching the company for an article in ER. Need anectodes, stories, history, etc. Kurt H. Miska, N8WGW, 3488 Wagner Woods Ct., Ann Arbor, MI 48103. (810) 641-0044 wk. FAX (810) 641-1718. 76247,1422@compuserve.com

WANTED: Visitors and tubes by museum. Old and odd amateur or commercial tubes, foreign and domestic purchased, traded or donations welcome. All correspondence answered. K6DIA, Ye Olde Transmitting Tube Museum, POB 97, Crescent City, CA 95531. (707) 464-6470

WANTED: Old tube amps & xfmr's by Western Electric, UTC, Acro, Peerless, Thordarson; Jensen, JBL, EV, Altec, WE spkr's. Mike Somers, 2432 W. Fargo, Chicago, IL 60645. (312) 338-0153

WANTED: Military radio's. Canadian or British WS-38 & WS-48. Ron Germain, 717 Waterloo St., St. Clair, MI 48079.

WANTED: Mics by Altec, Neumann, AKG, WE, Sony, any vintage; tube compressors/limiters; will trade my rare NOS tubes for mics. Mike States, Box 81485, Fairbanks, AK 99708. (907) 456-3419 ph/fx

WANTED: ARC51, ARC164, ARC83, ARN118, ARN-127, SST181X, KY28, Wilcox 807, cables, radios, mounts, manuals. James Treherne, 11909 Chapel Rd., Clifton, VA 20124. (703) 830-6272

WANTED: Got a cosmetically good tube rcvr or xmtr you can't get around to fixing? I'll buy it for a fair price & give it a second chance at life. Ron, WØOIZ, 10701 W. 54th St., Shawnee, KS 66203. (913) 268-5973

WANTED: Manual &/or schematic for Flesher TU-300 terminal unit. Jay Budzowski, N3DQU, 109 S. Northview Ave., New Castle, PA 16102-1633.

WANTED: National NC-120 rcvr; BC-348 rcvr; Eico model 753 tri-band xcvr & pwr splys; Temple (brand) luggage type portable radio; 1930-1950 Popular Mechanics magazines. Harry L. McCall, KB4CSY, 9135 Glade Valley Rd, Ennice, NC 28623. (910) 657-8248.

WANTED: Pwr sply or complete set for BC-639A rcvr; manual or schematic for navy UHF rcvr R-266A, AN/URR-13A. Chas, FL, (305) 745-1801, leave message, will return call.

WANTED: Kleinschmidt teleprinter models: 311, 321, (AN/FGC-40, AN/GGC-16, AN/UGC-39...) Tom Kleinschmidt, 506 N. Maple St., Prospect Hts., IL 60070-1321. (847) 255-8128

WANTED: GPR 90, 91, 92; Hallicrafters SX-88; Eddystone rcvr's. James B. Geer, 1013 Overhill, Bedford, TX 76022-7206. (817) 540-4331

WANTED: Scott rcvr SLR-F, RCH or other SLR configuration, any condx. Ken Kinderman, WB9OZR, 50 E. 79th St., New York, NY 10021. (212) 288-1310, fax 288-3070

WANTED: Military radios: Canadian WS #29 (CDN) A set; eastern European RM-31 set. Leroy Sparks, W6SYC, 924 W. McFadden Ave., Santa Ana, CA 92707-1114. (714) 540-8123

WANTED: Heath SB-100, SB-101, SB-102 parts units. Don, K8POU, MI, (616) 649-4646

WANTED: Heath SB100-SB102 parts units, Heath Seneca (must have cabinet); also PL172 amplifier tube. Don, (616) 649-4646, k8pou@juno.com.

WANTED: Collins S-Line xmtrs/rcvrs, KWS-1, 51J-4, R-648/ARR-41, Browning Golden Eagle MK II and MK III. Glenn Finerman, N2BJG, (914) 357-5419, gfiner@nms.com

WANTED: Exc., orig., TCS-14 xmtr. Can trade other dash numbers if desired. Lenox Carruth, WA5OVG, 10135 Ferndale Rd., Dallas, TX 75238-1613. (214) 348-5074, klccarru@tenet.edu

WANTED: Altec-Lansing A341A amplifier; FM stereo adapter for Bogen model ST662 tuner. David, 2445 Boxwood Dr., San Jose CA 95128. (408) 243.9326, varn@altagroup.com.

WANTED: Hallicrafters S-29 or S-39, would pay $100 for complete radio. Bill, N5YGM, 1819 Green Tree Ln., Duncanville, TX 75137. (214) 981-3310, wk

WANTED: Knight V-44 VFO in good condx. Reid Simmons, K7YX, OR, (503) 690-8024

WANTED: Link Radio paperwork, 500C manuals, catalogs, ads, copy OK; 2210 xcvr. Larry, W6WUH, Box 1139, Occidental, CA 95465. (707) 874-1000

WANTED: National 7180AB dog house pwr sply, SW-3 #31, #35 and #33A coils and NC1-10 D1/D2 coils. **FOR TRADE:** Money and/or SW-3 #37 coils and National manuals. Hank Bredehorst, 2440 Adrian St., Newbury Park, CA 91320. (805) 498-8907 or Quailhill@aol.com

WANTED: Tube type CB radios: Courier Royale, Browning Eagle R-27, S-23 xcvr; orig. or copies of operating/owners service instructions for Tram Titan II & above radios. Ed Brown, W6GX, 5702 Goldfield Dr., San Jose, CA 95123. (408) 227-9301

WANTED: (2) National NC-150 or NC-500 or equiv. neutralizing condensers. James T. Schliestett, W4IMQ, POB 93, Cedartown, GA 30125. (770) 748-5968

FOR SALE: New list -hundreds of manuals, schematics and service information. Send 2-stamp LSASE. David Crowell, KA1EDP, 40 Briarwood Rd., North Scituate, RI 02857-2805. (401) 934-1845

FREE: Send for my free illustrated meter list. **WANTED:** Meter literature & brochures. Chris Cross, Box 94, McConnell, IL 61050.

FOR TRADE: Two good RCA 833A's for one Taylor 833A. John H. Walker Jr., 16112 W.125th St., Olathe, KS 66062. (913) 782-6455. johnh.walker@alliedsignal.com

FOR SALE: Grand Systems GD6R frequency display for Drake TR3/TR4, documentation - $125 + shpg. Richard Wayne, W4LN, 1201 Hanover Dr., Concord, NC 28027. (704) 788-4487

FOR SALE: Viking II w/122 VFO - $250; HW101 w/ pwr sply - $150. Robert Braza, N1PRS, 23 Harvard St., Pawtucket, RI 02860. (401) 723-1603

FOR SALE: Used 807 tubes, tested OK, guaranteed - $5 ea + $3 priority mail. James Schliestett, W4IMQ, POB 93, Cedartown, GA 30125. (770) 748-5968

FOR SALE: (2) Atlas 350 XLs & pwr sply w/ manual, exc condx. - $350 ea; CE 20A & 458 VFO w/manual - $135; Gonset GSB100 - $125; Gonset Com III 6 meter & manual - $100; Com IV 2 meter - $125; RME 4300 rcvr - $150. All + shpg. Herb Reich, KØUBK, 1201 8th Ave. S., S. St. Paul, MN 55075. (612) 455-7898

FOR SALE: Battery boards w/connectors to assemble 22.5, 45, 67-1/2 & 9 VDC battery packs. Use your 9V or 1-1/2V AA batteries. SASE for details & prices. James Fred, 5355S, 275 W, Cutler, IN 46920. NOTE: same location new address.

FOR SALE/TRADE: Xmt'g/rcv'g tubes, new & used - 55¢; LSASE for list. Many thousands added lately. I collect old & unique tubes of any type. **WANTED:** Taylor & Heintz-Kaufman types & large tubes from the old Eimac line; 152T through 2000T for display. John H. Walker Jr., 16112 W. 125th St., Olathe, KS 66062. (913) 782-6455. johnh.walker@alliedsignal.com

FOR SALE/TRADE: Clegg 66'er; Thor 6; HT-37. **WANTED:** Clegg 22'er; RME (Globe) VHF-602. Al Bernard, POB 690098, Orlando, FL 32869-0098. (407) 351-5536

FOR SALE: Collins 75A1, 32V1, spkr, all exc. collectors quality - $1200 firm; National NC183, good - $150; Gonset IV 2M - $85; Gonset G76 & G66B, ps, nice - $285. Sam Champie, W7XXX, 105 W. McKenzie, Hermiston, OR 97838. (541) 567-2879, weekends only

WANTED

Collins promotional literature, catalogs and manuals for the period 1933-1993. Jim Stitzinger, WA3CEX, 23800 Via Irana, Valencia, CA 91355. (805) 259-2011. FAX (805) 259-3830

WANTED: TMC GPR-92 HF Rcvr. Hank, W6SKC. (602) 281-1681 FAX: 281-1684

WANTED: GPR-92, SP-600 JX-21A & HQ-170ACX-VHF w/orig. manuals. C6ANI, POB N4106, Nassau NP, Bahamas.

WANTED: PL 172 tube for Hallicrafters HT-33B linear. Gary Youney, K5QT, 18615 Big Cypress Dr., Spring, TX 77388. (713) 355-6153

WANTED: S-meter & BFO xfmr for a Hallicrafters SX-17. Gerry, K4LVZ, 3311 Ellwood Ct., Winter Park, FL 32792. (407) 679-4244

WANTED: J. Miller Co., broadcast band AM tuner, model 565. Al Kaiser, W3LEQ, 713 Marlowe Rd., Cherry Hill, NJ 08003-1551. (609) 424-5387

WANTED: Clean Johnson Rangers, Valiants, Invaders, Five Hundreds, 6N2 Thunderbolt; SSB adapters, top dollar for clean gear. Gene, AA5JR, AZ, (520) 646-0370, eves

WANTED: DX-35, DX-35, DX-35 operational if possible; appreciate your help. Richard D. Cohen, 11802 Willow Pt. Way, Tampa, FL 33624. (813) 962-2460

WANTED: S-76 Hallicrafters in wkg or repairable condx. Joe Frank, W1SOV, 8 Bay Crest Dr., S. Burlington, VT 05403. (802) 862-1816

WANTED: Mics-Shure 707A, 520SL, 545, 54PE/D; Astatic T-3, JT-30; Turner CX/BX, CD/BD, VT-73; EV 638, 619, 719. Tom Ellis, Box 140093, Dallas, TX 75214. (214) 328-3225, Fax 328-4217, 74053.316400Compuserve.com

WANTED: Huge Navy equipment: shipboard & shore radio, radar, & sonar, mint thru junkers. William Donzelli, 304 S. Chester Ave., Park Ridge, IL 60068. (847) 825-2630, integrat@usr.com

WANTED: TMC GPR 92; Hallicrafters SX28, SX42 rcvrs, collector quality, complete. John, NE6G, 7495 Gunter Rd., Pensacola, FL 32526. (904) 944-6563

WANTED: Military electronics, RDF, radar, communications, test, manuals, literature, etc. What have you got? William Van Lennep, POB 211, Pepperell, MA 01463. (508) 433-6031

WANTED: Watkins-Johnson or Communications Electronics Inc. info, catalogs, manuals or equipment. Terry O'Laughlin, WB9GVB, P.O. Box 3461, Madison, WI, 53704-0461, 608-244-3135

WANTED: Reward paid for National SW-4, has 4 tubes but only one set of coils. Robert Enemark, W1EC, POB 1607, Duxbury, MA 02331. (617) 934-5043

WANTED: Globe King 500, A, B or C xmtrs, any condx., reasonably priced. Terry Collins, KB9AUP, 18 N. Tomahawk Ave., Tomahawk, WI 54487. (715) 453-3707 d, 453-4633 eves

WANTED: In pristine condx.: Collins 32V3, 75A1, 30S1, 270G-1, 32S3A (RE), 310B3, 30K1, mech filter adapters, 55G1, SP-600X, cabinet, TV-7 tube checker & 75A-4. Lee, W9VTC, IL, (847) 439-4700 d, 726-1660 eves.

WANTED: Hallicrafters HT-1, HT-4, HT-9; National SW-3 model 1, 2 volt version, uses 32 & 30 tubes; Hammarlund Comet Pro coils & coil sets; Millen 90801 exciter; other pre 1950 ham gear. Dean Showalter, WA6PJR, 72 Buckboard Rd., Tijeras, NM 87059. (505) 286-1370

WANTED: Hallicrafters RCA CR-88A or AR-88. Gene Peroni, KA6NNR, Box 58003, Philadelphia, PA 19102. (215) 665-6182 dys.

WANTED: DM-24 dynamotor; R25/ARC-5, 1.5-3.0 mc rcvr. Pete Hamersma, WB2JWU, 87 Philip Ave., Elmwood Park, NJ 07407.

WANTED: Orig. cabinet for an R390A. Mel Urban, 7190 Mimosa Dr., Germantown, TN 38138. (901) 754-6307

WANTED: Millen 74400 octal socket plug base & blank aluminum shield can, any quantity. Roger Zaun, W9UVV, 4902 Parkview Dr., Mequon, WI 53092. (414) 242-4931

WANTED: Tube type CB radio xcvrs; Courier Royale; Browning Eagle R-27 rcvr; S-23 xmtr. Ed Brown, W6GX, 5702 Goldfield Dr., San Jose, CA 95123. (408) 227-9301

WANTED: Hallicrafters HA-1 TO keyer; HA-5 VFO; HA-20 VFO; SR-2000; SR-160, any condx. Ron, 10701 W. 54th St., Shawnee, KS 66203. Tel/Fax (913) 268-0461

WANTED: WRL-70 xmtr; HB xmtrs for display, must be museum quality; thousands of QSL cards to paper walls of Amateur display. Call Leo, (402) 392-1708, Western Heritage Museum, Omaha.

WANTED: Hammarlund manuals, parts, parts units, from the series Comet, HQ, SP. Also accessories, catalogs, spec sheets, memorabilia. Robert, Amateur Radio Surplus, (517) 789-6721

WANTED: Paying immediate cash for old Fender and VOX guitar amplifiers. Frank Czaja, AI9T, 8968 W. Forest Home #4, Greenfield, WI 53228

WANTED: Manuals, manuals, manuals for radio-related equipment to buy or swap. Catalog available. Pete Markavage, WA2CWA, 27 Walling St., Sayreville, NJ 08872. (908) 238-8964

WANTED: Orig. tube-type CB radio operating/owners manuals; also tube-type CB radios. Walter Ryan, 7114 Geyser Ave., Reseda, CA 91335. (818) 344-8735

WANTED: Knight equip. all types; ham, shortwave, CB test, etc. Thank you. Walter, CA, (818) 297-7249.

WANTED: German WW II radios and clandestine sets any period. Will pay freight. Offering cash / swap. Rag Otterstad, OZ8RO, Hosterkobvej 10, DK 3460 Birkerod Ph:+45-4281 5205, Otterstad@mec.dk

WANTED: 7 & 9-pin tube socket extenders; better grade sig. gen. Gerald Liccione, W2TPL, 118 Hiawatha Trail, Liverpool, NY 13088. (315) 457-7928

WANTED: Vernier main tuning knob for my 75A4; Hallicrafters SR-400A Cyclone III xcvr. **TRADE:** 312B-5 for 312B-4 + cash. Bob Kemp, POB 470, Lake City, MN 55041. (612) 345-5345 dys, 345-3600 eves until 9 PM CST.

WANTED: Manuals/copies: B&K 801, DSI 3240HH, Hallicrafters HG-1, Heath IM-5228, Wavetek 110. Thanks! Robert Baumann, 1985 S. Cape Way, Lakewood, CO 80227.

WANTED: Intermediate xfmrs, 1600 kc (Millen #64161); oscillator xfmrs, 1600 kc (Millen #65163). David Muse, KD4FEB, 510 Minturn Ave., Hamlet, NC 28345.

WANTED: Condenser, carbon and other early broadcast microphones; cash or trade. James Steele, Box 620, Kingsland, GA 31548. (912) 729-2242

WANTED: To buy any Lunch Boxs & related items. Arthur Fritz, N3SFE, 104 2nd St., Montgomery, PA 17752. (717) 547-2674

WANTED: WW II Japanese military radio of any kind; pre-war Japanese QSL cards. Takashi Doi, 1-21-4 Minamidai, Seyaku, Yokohama, Japan. FAX: 011-8145-301-8069

WANTED: WW II Japanese xmtrs & rcvrs (parts, plug-in coils) for restoration & ER articles. Ken Lakin, KD6B, 63140 Britta St., Ste. C106, Bend, OR 97701. (503) 923-1013. klakin@aol.com

WANTED: Hammarlund Comet Pro, AVC model; Comet Pro coils, parts & parts sets; Hallicrafters SX-11 dial plate; Millen 90801 exciter. Dean Showalter, WA6PJR, 72 Buckboard Rd., Tijeras, NM 87059. (505) 286-1370

WANTED: Navy xmtr's: TCA, TCE, TLX, TBW 800 cycle pwr sply; TBM modulator CAY-50065. Steve Finelli, N3NNG, 37 Stonecroft Dr., Easton, PA 18045. (610) 252-8211

WANTED: One and two tube receivers (regenerative), kits or homemade. Bob Mattson, KC2LK. 10 Jane Wood Road, Highland, NY. 12528-2607. (914) 691-6247, rmattson@freemark.com

WANTED: Hal Telereader CWR 6850 Key Board KB 6850 for a deaf friend. Eugene L. Clayton, W7MXM, ID, (208) 522-5854.

WANTED: Johnson Valiant or Ranger II; Hallicrafters HT32 both in good to mint condx. Bob, W7ZSB, UT, (801) 943-7721.

WANTED: Gonset G-50 & G-28. Dan, K3XR, 218 Balthaser Rd., Sinking Spring, PA 19608. (610) 670-2980.

WANTED: Amphenol molded SS type 4-pin tube sockets, spring not needed. James Fred, 5355 S. 275 W, Cutler, IN 46920.

WANTED: Hallicrafters HA-20 VFO/bridge; HA-4 TO keyer; HA-5 VFO; HA-1 TO keyer; HT-44; HT-37; HT-41. Please, no junkers or basket cases. Ron, WØOIZ, days only (913) 268-5973 or 24 hr Fax 268-0461. arongv@aol.com

FOR SALE: Thousands of tested tubes w/ warranty! Both xmit & rec tubes. Buy those spare tubes for your tube radio, audio, ham and electronics. Most tubes are used at about 1/3 of new, many are around $1. I have bunches of octal, 7 & 9-pin tubes. All tubes are tested on TV-7D/U tester and then boxed. I give a 30 day warrenty. Send wants or SASE with two stamps for list. Daniel Nelson, 1025 E. Desert Lane, Phoenix, Ariz. 85040. (602) 243-7421 eves. djn@indirect.com

FOR SALE: Just released: Send 2-stamp LSASE for latest Olde Tyme Radio Co. Flyer 196A. Olde Tyme Radio Company, 2445 Lyttonsville Rd., Ste 317, Silver Spring, MD 20910.

FOR SALE: Brand new Hallicrafters H/T-1E walkie talkies, 1970 - $50 ppd; AF-68, PMR-8, AC/DC - $250. Richard Lucchesi, WA2RQY, 941 N. Park Ave., N. Massapequa, NY 11758.

FOR SALE: HQ 180C, near mint - $300; National SW-3, good - $300; NC46, good - $60; NC125, fair - $50. All + UPS, prefer PU. Larry, CA, (310) 924-7282

FOR SALE: 813 band-switched RF deck/exciter - $75; 3000 V/1500V pwr sply - $75; B & W 5100B - $350. Bill, NY, (914) 356-6553.

FOR SALE: Heath TT-1 tube tester, manuals, like new - $125 + shpg. John, Alaska time (907) 337-9157.

FOR SALE: Heath HX-10 parts, whole box - $15; SB-10 chassis - $10; Allied catalog 1969 - $7; Collins KWS-1, mint - $2000; Collins 30L-1, mint - $500. Marty, NJ, (609) 466-4519.

FOR SALE: SX-28A, unmodified, new caps, w/ cabinet VGC - $275, no shpg; HQ110 w/clock - $100; HQ170 - $140; HQ145 EC - $175; All + shpg, except SX28A. Dave Metz, Staunton, VA, along I-81, (540) 885-7914, eves til 10 PM EST

FOR SALE: Tube list, new & used, wide variety audio, ham. Recently expanded. SASE 52¢. Bill McCombs, WB0WNQ, 10532 Bartlett Ct., Wichita, KS 67212-1212.

FOR SALE: WACO-SNWX telephone interference filters - 1/$12.95, 2/$24.00, 3/$33.00. Add $1 S&H. If these don't work then none will. Just plug in. Cecil Palmer, 4500 Timbercrest Ln., Waco, TX 76705. (817) 799-5931 or W5NWX@juno.com

FOR SALE: KWM2, winged, exceptional condx, 312B4 & 516F2, manual copies - $725; HW101, SB650 digital freq display (rare), SB600 spkr, HP23A P/S, manuals - $350; R388/URR very good shape functionally & cosmetically - $300; SX140 & HT40 pair, both on air, panels exc., cabinets need refinish - $175; SB101 with HP23C PS, perfect but freq display dial has crack - $150. **WANTED:** S200 spkr for HQ180; Collins 30L1. (I trade). Dick Dixon, W7QZO, 16032 Lost Coyote Ln., Mitchell, OR 97750. (541) 462-3078

FOR SALE: B &W 5100 VGC, manual - $200 + shpg. **WANTED:** D coil assembly for HRO-60. Jim Young, AA8XC, 14714 Cowley Rd., Columbia Station, OH 44028-9770. (216) 926-1231

FOR SALE: Johnson mobile xmtr - $125; Gonset G-76, no pwr sply - $160; Yaesu YP-150 dummy load/wattmeter - $50; Collins 75A-3 - $300; Drake MN-2000 - $175; T-4X, AC-4 - $150; Heath DX-40 - $70; Hallicrafters SX-100 - $160; Hammarlund SP-600 in orig. cabinet. repainted - $170; AFtronics Super SCAF audio filter - $40. **WANTED:** Cabinets for 75A-3 & 32V-2; small panel spkr/grill for Racal RA-17; good panel for SX-88 or parts radio; good dial drum for NC-300; matching spkr for Lafayette HE-10; manuals or info for Wells Gardner 250-GSC xmtr or Browning Drake National rcvr. Jim Jorgensen, K9RJ, 1709 Oxnard, Downers Grove, IL 60516. (630) 852-4704

FOR SALE: Vintage equipment manuals starting at - $5; Hallicrafters, Johnson, WRL, others. SASE for list. DSM Diversified, 909 Walnut St., Erie, PA 16502.

FOR SALE: Valiant One w/TR SW, exc. - $300 PU only. Tom, PA, (717) 896-8087 eves.

FOR SALE: Heath SB300 - $115; Sixer - $45; Twoer - $45; AM-2 SWR - $25; Filters: SSB - $50/CW - $50; Lafayette 6/2 VFO - $45; Conar 400 xmtr - $50; Swan 14-X - $35; Gonset 2/6/220 VFO - $75; Millen SWR - $20; Hallicrafters Panadapter - $225; SX100, works - $85. Free list. Richard Prester, 131 Ridge Rd., W. Milford, NJ 07480. (201) 728-2454

FOR SALE: HQ-180 AC, exc + condx. - $375; HRO-60 w/7 coils & wooden box - $500; Viking I & 122 VFO, exc - $175; Pacemaker VG - $200; SX-101 Mark 3, slightly rough but working - $100; parting out Globe Champion 300-A. John, AE4EN, NC, (910) 686-4236

FOR SALE: Harris HFL1000 amp, w/150 lb pwr sply & SG70 exciter - $1500. Lots more. V. Vogt, 2311 Pimmit Dr. #114E, Falls Church, VA 22043. (703) 573-8142

FOR SALE: Fil xf mrs, plate xfmrs, resistors, caps, sockets, octal NOS, all surplus. W6CAS, CA, (916) 731-8261.

FOR SALE: 20 assorted 16 MM old films; Hammarlund Comet PRO; Hallicrafters 5T; Collins 32V-2; Globe 90-A; Heath SSB HW-32A. Bill Coolahan, 1450 Miami Dr. NE, Cedar Rapids, IA 52402-2933. (319) 393-8075

FOR SALE: Viking II - $200; Heath SB400 - $200; SB 102 - $350; SB303 - $200; FTDX560 - $300. Cliff Fleury, AI7Y, 3100 Falk Rd., Vancouver, WA 98661. (360) 735-9416

FOR SALE: NOS 316A tubes, can't test - $10 ea + shpg. L. Schimmel, POB 1234, Spanaway, WA 98387.

FOR SALE: TR-1936 Royal Australian Air force aircraft xmtr/rcvr w/shock mount - $150. Sam Hevener, W8KBF "The Signal Corps", 3583 Everett Rd., Richfield, OH 44286-9723. (216) 659-3244.

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FOR SALE: Dynamotors 12V at 275V-150A & 12V-680V-210A. Bob Napoli, K2LGO, Call from 5-8 PM EST Please. (516) 722-5737

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WANTED: Pwr xfmr for National 183 rcvr. Thank you. Roger Higley, W8CRK, 3507 Glenmore Ave., Cincinnati, OH 45211. (513) 451-1096 res, 481-5885 wrk.

WANTED: Galaxy RF-550, LA-550, F-3 filter; Harvey-Wells TBS-50B, VFO, APS-50 sply; Harvey-Wells TS-90 xmtr. R.D. Kelley, W8GFG, 9010 Marquette, St. John, IN 46373. (219) 365-4730

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WANTED: Manual or schematic (copy fine) for Gates BC1-F; modulation xfmr for same or any that will match pair 833A to pair 833A. Fred Pomrenke, WD5BPP, 10981 F.M.20, Kingsbury TX 78638. (210) 639-4437 after 7PM or lve msge

WANTED: Jewell meter, Pattern No. 54, 0-300 milliamps DC, 3" silver dial. Don Chester, K4KYV, 2116 Old Dover Rd., Woodlawn, TN 37191. (615) 647-2179

WANTED: Manual or copy for Heath MR-II rcvr, HA-20 6M amp, HX-30 6M xmtr. Gary, K5JWK, 6302 Robin Forest, San Antonio, TX 78239-3218. gharmon@txdirect.net

WANTED: Information tech manual ETC for military oscilloscope model TS-64/MPN-1 & military rcvr model R-45/ARR7. Gil Parsons, W8OGL, POB 192, Ross, OH, 45061. (513) 867-0820

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WANTED: Hallicrafters HT-1, HT-9, HT-31, 5-T, SX-11, SX-17, SX-25; Howard rcvrs; Harvey xmtrs. Ken Seymour, KA7OSM, 9115 SW 176th Ave., Beaverton, OR 97007. (503) 306-7439 24 hrs. ken.seymour@attws.com

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FOR SALE: Book ITT Reference Data, 5th edition - $25 ppd. R.J. Eastwick, N2AWC, 224 Chestnut St., Haddonfield, NJ 08033. (609) 429-2477.

FOR SALE: Collins manuals (copies): R388, R390, R390A, R391; large field case for R390/R390A, rack mounted w/bolt down cover. N1FRX, ME, (207) 834-6273.

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WANTED: Johnson Ranger or parts unit; Valiant or Valiant II. Ron, 10701 W. 54th St., Shawnee, KS 66203. Fax (913) 268-0461. arongv@aol.com

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WANTED: ABK-7 (Fl6-Q-123324, other ABK# or SCR-595) transponder & mounting rack; CTZ-50-ACW duplexer; CAGQ-24-AAL ant change over switch; CN-23-AGK relay junction box; CW-23-ABH selector unit; CW-23-ABK control unit, (or CW-23-ABG), Type N-17-5 (or M-17-5) IFF destructor switch; NAF-68963-1 BK junction box; CCL-211014 BK motor generator, (or CCL-211018); CNA-10125 mounting base for RBH-2, J-22/ARC-5 jack box or J-22B/ARC-5 or J-16/ARC-5, C-51/ARC-4 control unit. Richard Pekelney, 1817 Jackson St., San Francisco, CA 94109. (415) 563-5928. pekelney@rspeng.com

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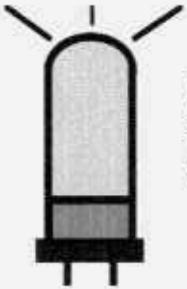

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