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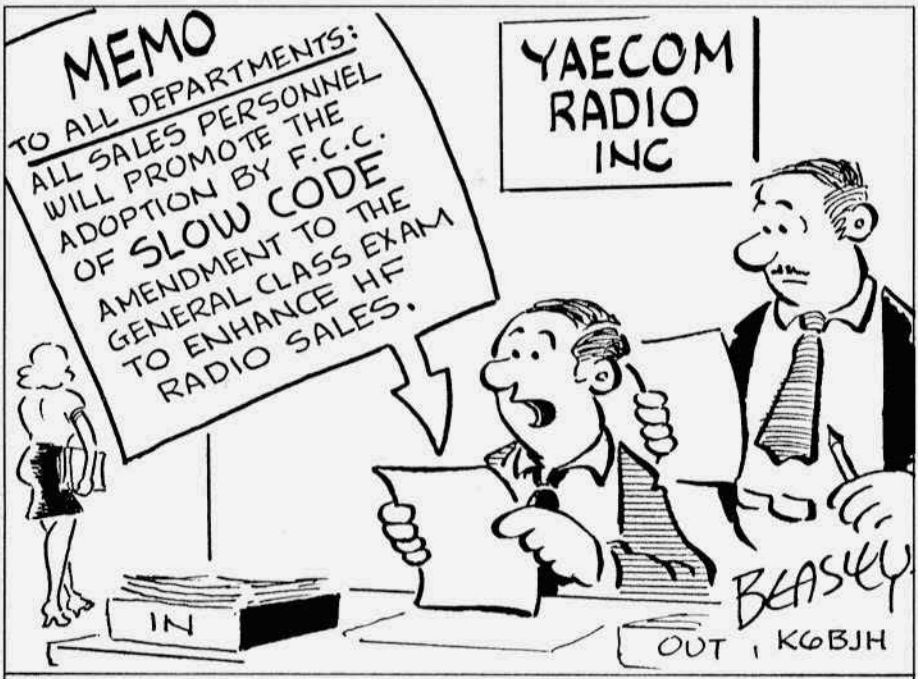
ELECTRIC RADIO

celebrating a bygone era

Number 66 October 1994



I WONDER IF THERE WAS SOME REASON WHY HALLICRAFTERS, HAMMARLUND AND NATIONAL DIDN'T THINK OF THIS.

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; Mike O'Brien, NØNLQ, Steve Thomason, WB4IJN; Don Meadows, N6DM; Bob Sitterley, K7POF (photos) and others.

EDITOR'S COMMENTS Barry Wiseman, N6CSW/Ø

In the August issue we published an editorial by Don Chester, K4KYV, editor/publisher of the AM Press Exchange regarding a proposal from amateur equipment manufacturers that would lower the code speed requirements for general class amateur licenses. We've received many comments regarding this proposal. Most of the comments are in agreement with our position that lowering the code speed would be detrimental to amateur radio and to AM/vintage operation. We don't need another 100,000 new hams on the HF bands; they're crowded enough already. The only benefits that could possibly come out of this "dumbing down of amateur radio" is that manufacturers -mostly Japanese- would have a bonanza selling equipment.

I urge everyone to write their ARRL Division Directors. Let them know where you stand on this issue. I also suggest that you send a copy of the letter to the League President. I've been advised that the letters should be short and to the point to be most effective.

The next meeting of ARRL directors is coming up in January. Let's hope that the directors come out in opposition to the slow code proposal. We need the League on our side.

Dave Ishmael, WA6VVL, has just compiled all the articles he's written for *ER* into a book he calls "Vintage Anthology, Book 1". He and his wife Judy have done a great job. The book - 140 pages, spiral bound - is a very attractive production. Dave published the book himself and is selling it himself. It's very reasonably priced at $14.95. See Dave's ad on page 55 for ordering information.

Another book I've been meaning to talk about is the "Amateur Radio Mail Order Catalog" produced by David Thompson. This is a book that all vintage people should have. We're always looking for parts, materials and equipment for our homebrewing and restoration. This book lists all the manufacturers, distributors, dealers and every company and individual that's in any way involved with amateur radio. It's available from the ER Bookstore. See page 44 for ordering information.

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Cover: A cartoon by Bob Beasley, K6BJH, inspired by the slow-code proposal being advanced by equipment manufacturers.

LETTERS

Dear ER

I am writing to express my solidarity with N6DM and his No. 19 Mk II as expressed in "*A Quartet of Flute Players Under Water*", *ER* #65. I got my license in November 1968 at the age of 17 and at my father's recommendation I purchased a very used and incomplete No. 19 Mk III manufactured in 1944 by the Northern Electric Company in Montreal. Note that mine was a III not a II.

My dad had used 19 sets as a radio operator in WW II and for some unfathomable reason seemed to like them. The Canadian army used 19 sets for the bulk of their battlefield communications and not just in tanks. Personally I think the 19 set deserves credit for the Canadian army's reputations for valour and tenacity - communications were so poor that the personnel never knew just how much trouble they were in.

I built a power supply for my 19 set with a TV transformer that put out some 750 V to the plate of the 807. The transmitter had output so I worked VE7AAQ on 80 M CW but that one QSO flattened the 807. I bought a nice new GE 807 for about $4 but a quick calculation showed I could not afford amateur radio at $4 an hour. It was about then that I decided that there was a reason why the dynamotor only produced 540 V so I modified the power supply to use a choke input filter instead of a pi filter and that dropped the B+ below 600 V. I made my second and last contact with WA7PMW, who gave me a 225C signal report. I sent him a QSL card asking for details on what my signal sounded like but he returned a card with a 579 RST. The 225C report sent me back to the drawing board but circumstances prevented my re-modification and the 19 set never transmitted again. Hmmph, should have kept the DX-100 I borrowed from VE5WL - now THAT was a radio!

In September, 1969, I went to college and a major threat to the DXCC Honour Roll was QRT for three years. After college I went to work for the phone company and got back on the air with a DX-40 and an SB-301. My parents moved and lost most of the accessories for the 19 set including the DC power supply and the variometer but they kept the transceiver and my home brew power supply so I still used it on receive when I was home. Around 1980 my parents buried the 19 set where I couldn't find it but last year I recovered it and now it sleeps in the shack waiting a chance to be restored to life.

Gosh that was an awful radio! It's amazing what a government will spend good money to buy.

Richard Loken, VE6BSV

Dear ER

One evening during the last week of August, I received a phone call from an old buddy I had not seen in nearly 40 years! And it was all due to *Electric Radio*!

Bob (Zeke) Bealmer, WØCAB, of Kansas City, called me after seeing my picture in the August "Photos" section. Bob and I last saw each other in the summer of 1956, after graduating from an Electronics School at Fort Devens, Massachusetts! Bob and I had an enjoyable conversation on the phone, and agreed to try to get together on AM in the near future.

Keep up the good work, *ER*, hope you can find some more of my old buddies!

Fred Clinger, WA8KJJ

Are you a member of AMI? If not send $2 to AMI, Box 1500, Merrimack, NH 03054-1500. AMI promotes and protects AM; we should all be members.

AMI Update

by Dale Gagnon, KW1I, President

AMI Discovery Weekend

Enjoyed operating off and on over the weekend of September 10, 11. Collected over 25 certificate numbers from other AMI members. The big story on this weekend was the special event operation at the Gaithersburg Hamfest in Maryland. [See the story on page 14.] Northeastern Region AMI Director, Steve Ickes, WB3HUZ, reports about 40 stations worked on 75 and 40 meters. Steve also reports that a radio store, "Amateur Radio Center", in Baltimore has, with the help of Tim, N3DRB, and Carl, KA3UPR, set up classic Collins AM stations with a 30 K-1 transmitter, a 310 exciter and a 75A-1 receiver. It is prominently displayed and is in operation. Great PR for classic AM radio!

Amplitude Modulation in QST

The recentAugust, *QST* article about Bob Eslinger, KR1U, and his antique broadcast receivers included Bob's statement that he wanted to get a vintage AM station operational. WB3HUZ mentioned this article to Paul, WA3VJB, and he sent a letter to the article's author, Jim Cain, KT1N, a Senior Editor for *QST*. Jim's return letter showed a well developed interest and knowledge of the AM scene.

Steve also relayed that W1AW has been reported on the air recently running AM!

Rocky Mountain AMI Region

Bill Kleronomos, KDØHG, sent in a copy of his letter responding to some ill advised comments about AM in a summary of a recent 1993 ARRL Rocky Mountain Division member survey. The summary stated as one of the points under the subject "Spectrum Management" that AM operations are perceived to be incompatible with SSB, some think AM should be restricted to some portion of the bands. Bill pointed out that AM'ers are already confining their operations to narrow band segments, both for the benefit of meeting other like-minded amateurs and for the consideration of others. He made several other good points. His letter was filled with facts not perceptions!

AMI Headquarters News

AMI is watching the growing dialog over the 10 wpm industry proposals. This could easily be the first step in a series of events that could ultimately threaten our AM operating privileges. When many of us were discussing whether we should form AMI we agreed that an organization was necessary in the event some challenge to AM materialized in the future. The organization is less than two years old and we may be facing that challenge in this new slow code industry initiative. What can you do now? If your ARRL Division Director circulates a survey in your Division as ours did in New England, be sure to fill it out and send it in. Our survey had questions on the slow code proposals and on AM mode usage. If your ARRL Division Director doesn't survey members, send a letter so he knows where you stand.

I am beginning to hear back from the AMI Regional Directors on some proposals that the board has been considering. One changes substantially the way new AMI officers are installed. In brief it proposes the current AMI Board of Directors vote on new nominations from the membership instead of the nominations being voted on by the membership. This actually protects AMI from a takeover by a small group, something that could happen because so few of the members actually cast votes last year.

The new proposed method recognizes that most officer changes will be managed events with a contested position being a very rare occurrence. The pro-

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The Hammarlund HQ-129-X

.....or, how I almost slid off the church roof

by Jim Hanlon, W8KGI
PO Box 581
Sandia Park, NM 87047

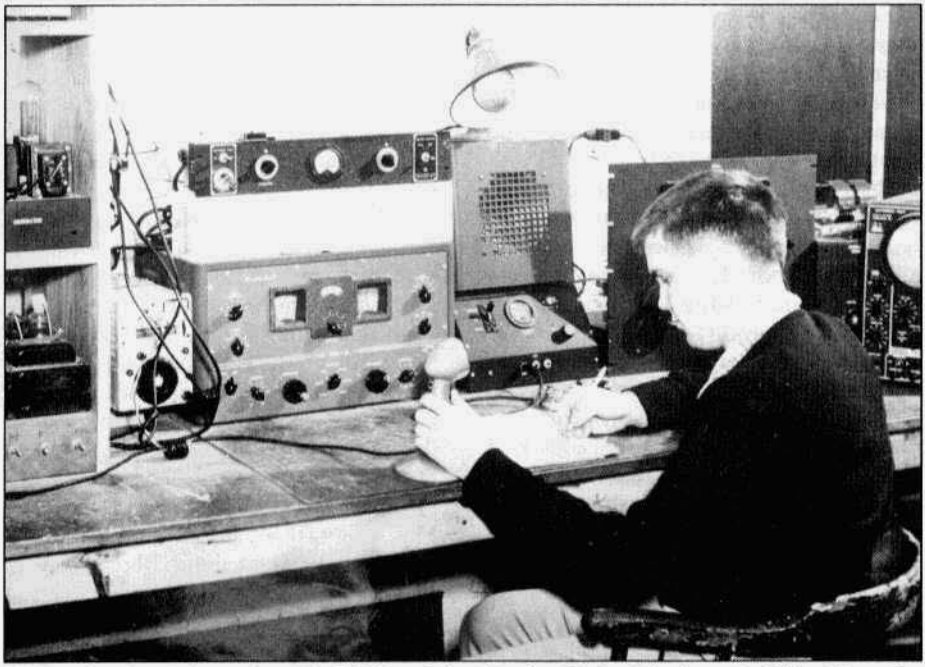
This all started because Barry suggested I write an article about that under-appreciated radio receiver, the Hammarlund HQ-129-X. I said I'd be glad to, because I not only have one but I'd also used one for four years at my high school radio club from 1952 to 1956. The trouble is, every time I've sat down to write about the HQ, memories keep flooding back about the club. They are inseparably tied together. So, you'll just have to put up with a little of each in this story.

Saint Xavier High was a great school. It wasn't one of your new, brick, steel and glass buildings with air conditioning, a gym, an auditorium and sprawling athletic fields in the best part of town. Quite the opposite, it occupied a 130 year old, crumbling red brick, four and five story structure in the grimy midsection of downtown Cincinnati. What made it great was its Jesuit faculty and its students, 800 of the "best" Catholic young men from all over southwestern Ohio and northern Kentucky. The kids who went there were the top survivors of a competitive entrance exam, and we averaged two to three hours of homework every night. Every graduate had at a minimum four years of foreign language, four years of English, three of Math, etc. Those were the days!

One of the high points of "X" as far as I was concerned was its Radio Club. Tucked away in a little fourth floor niche off the Physics Lab, the club room was far from luxurious. Brick walls, a wood plank floor, an iron fire escape outside the single, double hung window, and a back door that led to some storage space underneath the roof and curled around the plaster lath vaulted ceiling of the student chapel, all liberally encrusted in more than a century of downtown soot, that was the setting. I and a few other budding young hams spent a couple of hours there every afternoon that we could, finally leaving for the public transit busses home some time around 5 PM.

One of my fondest Radio Club memories is of re-stringing our antenna. We used a 134 foot "Center Fed Zepp" (that's a dipole with open-wire-line feeders for you young squirts) that stretched between the fifth floor roof of the school and an iron cross at the peak of the church roof next door. One winter when the Zepp blew down, as it did occasionally, I was elected to do the honors on the church roof side. Just getting up to the roof was an adventure.

The church was an old stone building, at least as old as the school. In the rear of the building I climbed one of those old, iron spiral stairways, the kind that are suspended from a single center pole. It went up about five stories. At the third and fourth levels there were rooms that hadn't been used for years. I left "clean" footprints in the dust on the floors when I walked over them, just to see what was in there of course. At the top the stairway lead to a wooden catwalk that ran down the entire length of the church, above the interior arched ceiling and below the slate covered roof. About a quarter of the way down, a side path branched off the catwalk and lead to a trap door that opened to the exte-



The author in club station W8GYH at Saint Xavier High, Cincinnati, Ohio. Note the spinner knobs on the HQ-129X

rior of the steep, slippery slate roof. The peak of the roof was formed by a long, narrow, stone pathway that ran the entire length of the church. I scrambled up what must have been about six feet of slate, but seemed like a mile at that height, to get to the stone peak. Crawling along and hanging on to weathered, green copper lightning rod wire that was fastened periodically to the stone, I finally made it to the iron cross at the rear. The cross was about six feet tall, and it was set in a stone block that was about three feet square, so I had some room to stand and something to hang on to. It was at least a six story drop to the ground off the back of the church, and I tried not to look down or to think about it too much.

From my perch, I tossed a ball of string that I'd brought up in my coat pocket across the chasm to my buddies who were waiting on the flat school roof. They tied my string to a more substantial rope, and that in turn allowed us to haul the broken antenna back to the school roof for repairs and then back to me for installation on the cross again. Boy was I glad when that job was through! From there it was back down the peak on all fours to the trap door, a slide down the slate to that safe haven, and I was back to the relative safety of the catwalk.

The physics teacher who was our club moderator had gotten permission for me to go on this journey, and I was supposed to come right back when I got off the roof. But what the heck, he didn't tell me which way to go. Instead of heading back for the rear of the church, I walked the catwalk to the front and wound up in the belfry. The church had one of those old clocks that chimed the quarter hours and rang the number of each hour, so of course I had to inspect its works. Boy was it loud in there when it rang! There was another spiral staircase going up into the bell tower which of course I took. On the interior side

continued next page

Hammarlund HQ-129-X from previous page
walls of the tower I could see the black scars of a pre civil war fire that had once burned the roof out of the front part of the church. Eventually, at the very top there was a ladder that lead to a trap door that opened into a tiny, dark room in the very top of the tower. Inside that room there was a wooden chair, its wicker bottom long since decayed, and a brass spittoon. It must have been the refuge for one of the Jesuit pastors or teachers long ago.

All that, and we got the antenna back up too.

The club station itself progressed a good bit while I was in school. I had visited it a couple of times before I showed up as a freshman because my older brother, Bob, was a member. The first time I saw the station, the receiver was a green-eyed Hallicrafters SX-43. The transmitter started off with a surplus ATD (*ER*#35, March 1992) whose filaments were powered from the 24 volt battery bank across the wall in the Physics Lab. The ATD drove a push pull 812 final. Modulation was furnished by a pair of 211's and a modulation transformer both of which had come out of a BC-375 whose remains were back in the storage room.

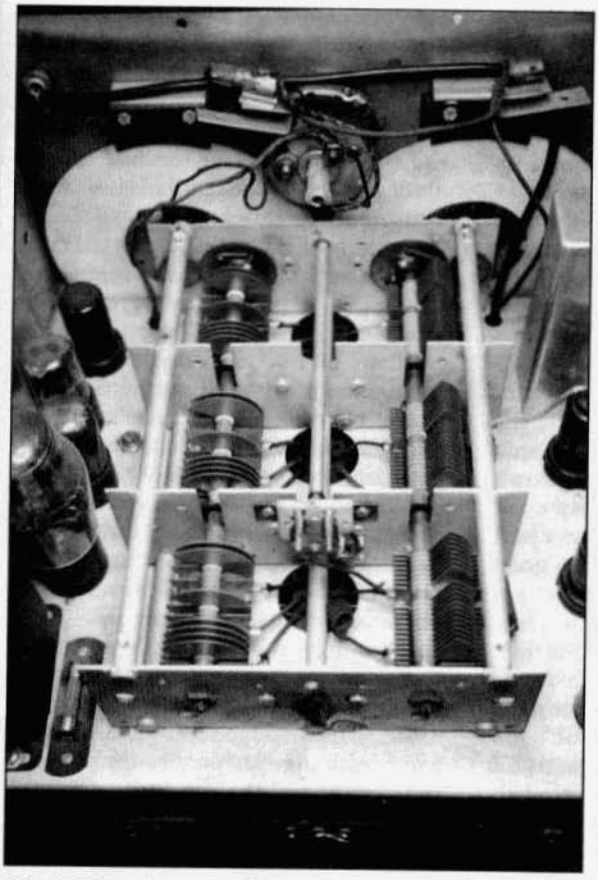
Because the Hallicrafters bounced frequency every time an enthusiastic student stamped on the floor and it also seemed to choke up (crossmodulation?) on all of the downtown Cincinnati noise, neon signs, trolly busses, elevator controllers across the street just to name a few they could identify, the guys in the club wanted something better. The summer before I arrived as a freshman, the Jesuit scholastic who was our moderator, Tom Gideon, talked his dad into donating an HQ-129-X to the club, a much better receiver. And that is where my appreciation for that very good receiver began.

Over the next few years, we also replaced the ATD with a Millen 90800 6L6/807 exciter driven by a BC-696 Command Set VFO. The final acquired a pair of the new, more powerful 812A's, and we added a Masco "high fidelity" amplifier (push-pull 6L6's) which served as our speech amp and audio driver and also played some decent sounding phonograph music for Tom Gideon and Dick Middendorf who succeeded him. You'll also see in the station picture a Dumont 5 inch oscilloscope that we "borrowed" most of the time from the Physics Lab and in the black box on the right between the final and the scope, a National MB150 multiband tank that was our antenna tuner (transmatch for you squirts). Along about 1955, we got a club license for our station, W8GYH. John Duncan MacAulay III, a year younger than myself, was our first trustee. Mac now lives in Dayton, and up till a few years ago he was still the W8GYH trustee. We have remained in touch and friends over all these years.

So you see why I can't think about that HQ-129-X without remembering a few things about the old radio club.

So, how about the HQ-129-X as a receiver? Well, it was the second in a famous line of Hammarlund relatives that started with the HQ-120-X which came out in late 1938 and ran through the HQ-140, HQ-150 and HQ-160 to the HQ-180, made until 1972. Until 1938, Hammarlund made only the Super Pro and its predecessors the Comet and Comet Pro receivers. These were absolute, top-of-the-line radios for their day, and they were priced accordingly, for example $261 for the 1938 SP-110X. The HQ-120 was aimed at the mid price range market, occupied by National's NC-100 and NC-101, the RME 69 and the Hallicrafters SX-17. And the Hammarlund entry was indeed a worthy competitor.

Hammarlund, like National, made most of their own major components, in particular their own tuning capacitors. RME, Hallicrafters and Howard, on the



HQ-129X tuning capacitors, cover removed.

other hand, used available broadcast receiver components, tuning capacitors, IF transformers and such. This is responsible for most of the surviving Hammarlunds and Nationals of the pre and early post war period being much more "solid" than their Hallicrafters and RME brethren. A Cincinnati friend from those days had serviced both Hammarlund-built and Howard-built Super Pros in Europe during WW II. He finally quit transporting the Howard receivers away from his depot. "Damn things wouldn't hold alignment during a jeep ride!" The Howards wound up mostly "on the colonel's desk," doing unofficial duty, while the Hammarlunds did the communicating.

The HQ-120 family up through the HQ-150 was pretty "ordinary" in its circuit layout, following the classic, single conversion superhet scheme originated by Shalkhauser and Planck in the RME 9 in 1932. The Hammarlund HQ-120 version had one 6S7 RF stage, a 6K8 converter, two 6S7 IF's followed by a 6F6 third IF (an audio power pentode yet!), a 6F8G detector and first audio, 6V6 audio output, 6Z7G noise limiter "effective on both phone and CW," 6J7 BFO, 6SF5 S-meter amplifier, 5V4G rectifier, and VR-150 voltage regulator. The '120 was the first receiver in its class to incorporate a VR tube.

The HQ-129-X was a 1945 post-war update, going for the most part to the single-ended octal versions of the tubes originally used in the front end and IF of the HQ-120-X and changing the mix a little at the detector and beyond. Its lineup is a 6SS7 RF, the same 6K8 converter, three 6SS7 IF's, a 6H6 detector and noise limiter, 6SN7 first audio and S-meter amplifier, 6V6 audio output, 6SJ7 BFO, 5U4G rectifier and VR-105 voltage regulator.

As to the tube lineup, I do wonder why Hammarlund chose to use the 6SS7 as the RF amplifier. This tube is lower gain and more noisy than either the 6SK7 or 6SG7, both remote cutoff pentodes commonly found in RF amplifiers of competing receivers of the era. Both factors, greater noise generation to start with and less gain for weak signals and RF stage noise to overcome the substantial mixer noise of the 6K8, contributed to the HQ-129-X being somewhat less sensitive in "quiet" loca-

continued next page

tions than, say, National's NC173 which used a 6SG7 RF and a relatively quiet 6SA7 mixer or even than the Hallicrafters SX43 which used a 6BA6/7F8 combination. But the HQ-129-X's internal noise level never bothered us at W8GYH where it was buried under the din of thousands of noise generators in downtown Cincinnati.

Another item of HQ-129-X note is its three IF stages. Other receivers of its class and era used two IF's. Two IF's supplied plenty of gain, but the addition of a third IF and its attendant double-coupled transformer made the selectivity of the HQ-129-X noticeably superior. This, coupled with an excellent crystal filter with selectivity a tad better than even my HRO-50, was part of the reason for the HQ-129-X's good reputation.

Perhaps the single most outstanding feature of this series of receivers is their tuning capacitor bank. Whereas most of the competition used two, three gang tuning capacitors, a large one for "general coverage" and a smaller one for "bandspread," the HQ family is considerably more elaborate. Let me quote the HQ-120-X manual describing the tuning capacitor assembly. You can compare this to what you see in the picture. "To the right is the main tuning condenser and to the left is the band-spread condenser. The small condenser in the center with the extended shaft is the antenna compensator. The special pure inlaid silver contacts can also be seen along the rotor shafts of the two variable condensers.

"The band-spread condenser has three main units and each of these is divided into three individual sections. This represents 9 individual condensers in the band-spread assembly. This arrangement makes it possible to employ the most suitable capacity for the particular wave range in which the condenser is operated.(The traditional 80, 40, 20 and 10 meter ham bands are spread over almost the entire dial, taking from 7 to 8 spins of the knob for coverage. JTH) The main tuning condenser is also of this design and maintains the proper L/C ratio in each band, regardless of the range in which the receiver is operated. For the broadcast band, the condensers are of the usual capacity. These, however, would ordinarily be too large for proper circuit values at higher frequencies. Here, too, we have sectionalized the condensers with the result that the usual difficulties encountered in a receiver covering both the short wave and broadcast bands are eliminated. In other words, the proper size condensers are always employed on all bands. The high frequency performance in the receiver is in no way jeopardized by the incorporation of the broadcast band. This condenser unit is not a compromise with a regular broadcast tuning condenser. It is especially designed as the photograph reveals. These two multi-sectional condensers are built into a large sturdy frame which can not change shape and thus impair the stability of the receiver under the most adverse conditions. The plates are of heavy brass, cadmium plated and soldered to the rotor shaft. The stators are also of the same material and soldered to the bars which support them on the Isolantite base. The rotor units are suspended on two ball bearings - one at the front and one at the rear, thus assuring smooth operation at all times.

"There are three sets of dual silver-to-silver contacts making six for each unit. These contacts are distributed along the rotor shaft to maintain symmetry and insure perfect electrical contact without noise. These contacts are not silver plated - they are solid inlaid silver.

"The tuning condensers are driven by a special dial arrangement having over 310 degrees spread, and tuning is further simplified by a 9 to 1 ratio knob. Behind the panel, on the knob shaft, there is a heavy flywheel which is an

extreme aid in tuning. It is only necessary to give the dial a twist in order to make it coast a considerable distance across the scale. It will be noticed, by referring to the photograph, that the dial mechanism fastens to the shaft of the condenser on the inside of the bearing with a series of gears. These gears are of the split type with take-up springs to eliminate backlash. The dial is operated with a friction drive. . . ."

So much for why the Hammarlund receivers were a cut above the guys who used broadcast receiver tuning capacitors!

One tip on that capacitor from brother Bob, W4RXK. You can minimize drift in the HQ by "centering" the tuning capacitor. Loosen the bearing tension screws just a little, then retension them for minimum drift. That will be the point where the rotors and stators are evenly spaced and thermal expansion will move them equally and affect tuning the least. (He didn't tell me, but I suspect you should do this to the main tuning capacitor first and then the bandspread capacitor afterwards.)

The HQ-129-X was announced just after the war in December, 1945, and it was immediately popular. Judging from *QST* in the early war years, quite a few of the existing middle to better receivers that had belonged to hams had been purchased by the government for war service. And there had been essentially no new receivers available for hams or SWL's during the entire war outside of perhaps some Echophone EC-1's, something even lower on the ladder than the postwar S-38. So there was a lot of pent-up demand in the market when the HQ-129-X became available. Its immediate competition being offered in the *QST* ads in early 1946 consisted of pre-war models, Hallicrafters SX-28A's at $223, SX-25's at $94.50, National NC-240C's (a gussied up NC-200) at an exorbitant $225, leftover military HRO's without bandspread coils at $217.35, and, surprisingly, pre-war HRO Seniors with bandspread coils for $197.70. War surplus BC342's and BC312's were just beginning to show up, offered for about $95, but they had only general coverage to 18 Mc and a comparatively poor crystal filter. Offered initially at $129 (but up to $239 in 1953) plus an additional $10.50 if you wanted the matching speaker, the HQ-129-X was clearly the best buy available.

When National got around to introducing the NC-173 and Hallicrafters brought out their SX43 in 1947, the HQ-129-X was still a formidable competitor. (Both of these receivers are interesting in their own right, and someone who has one should write an article about them for *ER*. My brother had an NC-173, which featured an outstanding noise limiter, AVC that worked on CW, and 6 meter coverage. The NC-173 was rugged enough to survive Thor Hyerdall's Kon Tiki voyage including a complete soaking in Pacific sea water and still come up running. I had an SX-43, valued for its excellent crystal filter and six meter and FM band coverage which I appreciated immensely in my college room. But it had miserly bandspread on the ham bands, and it was so flimsy that I once bent the chassis when I was taking up the slack in a dial drive cord!)

Beginning in 1949, Hammarlund's competitors in the mid-priced, general coverage receiver market began to get more innovative. Hallicrafters introduced dual conversion that year in its SX71, effectively suppressing images with a 2075 kHz first IF. Then in 1951, they brought out the first of their dual conversion, 50 kHz second IF receivers, the S76, at a very competitive $169.50. This was followed by the SX-96, $249.95 in 1954, the SX-100, $295 in 1955 and the SX-122, $295 in 1964. Hallicrafters also offered the single conversion, crystal filter SX-99 in 1954 for $199.95.

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Electron Tube Survival Primer

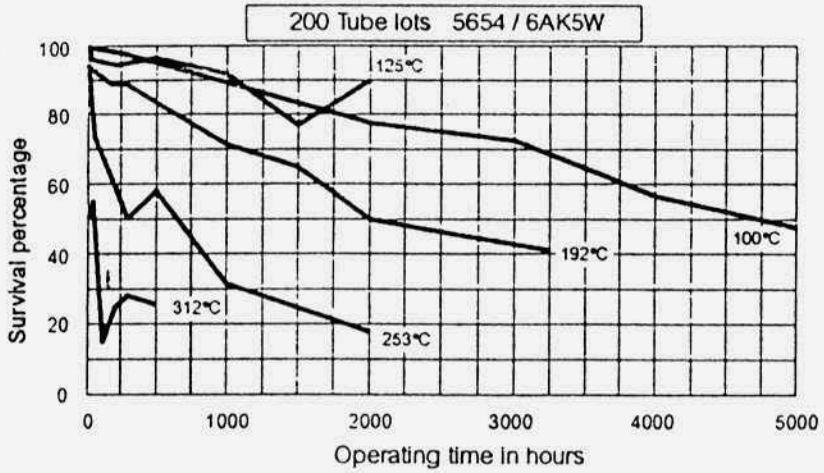
by Bill Kleronomos, KDØHG
P.O. Box 1456
Lyons, CO 80540

Enthusiasts of hollow state ham and audio equipment have known or suspected for years that excessive heat and voltages are the main causes of premature vacuum tube failures. Previous articles here in *ER* have addressed these issues as well as those of cathode interface resistance and cathode stripping due to premature application of high voltages. Recently a firm by the name of Perkins Electro Acoustic Research Lab based in Calgary, Canada, quantified and compiled much of the available information on factors affecting tube life. Research conducted by both government agencies and private industry was evaluated and is of such significance that I thought the findings would be of great interest to readers of **ER**. Please note that much of the following information applies only to receiving and low power transmitting tubes such as the 807 and 6146.

In the 1950s, vacuum tube based electronic equipment evolved into highly complex products with densely packaged components. As equipment complexity progressed, so did failures due to electron tubes. Where Western Electric and other industrial equipment dating back to the 1930's would run up to decades without tube failures, such was not the case with the aerospace gear of the '50's and '60's. Often, a piece of equipment would only run for a few dozen hours before failure due to tubes. Perkins states in their memo 1.1 that a 1954 study was released by Aeronautical Radio, Inc. (ARINC) in which the results were tabulated in the testing of 150,000 tubes of 20 different types. It was found the number one enemy of tube life was excessive heating of the internal structure and envelope closely followed by operation of the heater at excessive voltage as the number two villain. Other tube failure modes were identified but are not generally encountered in the equipment we use.

The key to understanding both heating and proper cooling of a tube's envelope is that common soda glass is virtually opaque to the passage of infrared (heat) energy. (This is the 'real' greenhouse effect.)

Most of the heat radiated by the internal structure of a tube is transferred to the glass envelope itself - it doesn't "pass through" as one might expect. Also note that some is conducted out through the pins to the socket. The direct cause of many tube failures due to overheating of the glass envelope is apparently due to molecular water vapor which is liberated from the glass at high temperatures. The ARINC report states, ". . . ...source of cathode poisoning gas is seen to derive directly or indirectly from the heated glass envelope. Such gas is more destructive in action than any of the normal gas so far examined. This gas is believed to be water vapor which has been shown to have dire effects on cathodes operating in the vicinity of 725° C." Other problems attributable to excess heating of a tube's envelope include vaporization and redeposition of the getter in places it doesn't belong. As the magnesium getter is electrically conductive one ends up with interelement leakage. Finally, a hot glass envelope can allow atoms of atmospheric oxygen to pass through due to various processes occurring at an atomic level. This



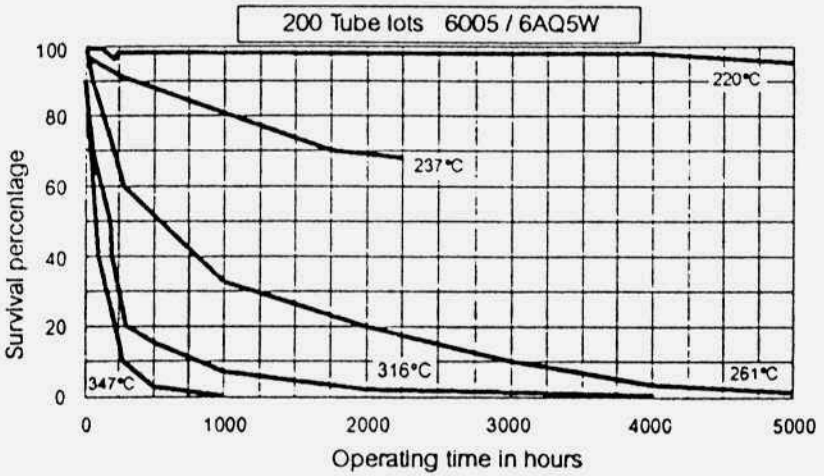


Figure 1 and Figure 2. Tube Life vs Envelope Temperature.

inward leakage of atmospheric gases also contributes to the ruining of the cathode and alters the electrical properties of the tube.

The other problem with soda glass is its poor thermal conductivity. This means that a tube's envelope will have hot spots immediately adjacent to the anode and other heat radiating internal parts and this heat will not be anywhere near evenly distributed throughout the envelope.

With the previous introduction out of the way, we can look at some practical examples of tube life vs. envelope temperature taken from studies conducted by GE Owensboro in the mid 1950's. Graph #1 and 2 show the results of life tests conducted on some common communications tubes, the 6AK5 and the 6AQ5, respectively. Note the tremendous improvement in tube life one can achieve by even moderate reductions in envelope temperature. In the case of a power handling tube such as the 6AQ5 note that 95% of the tubes

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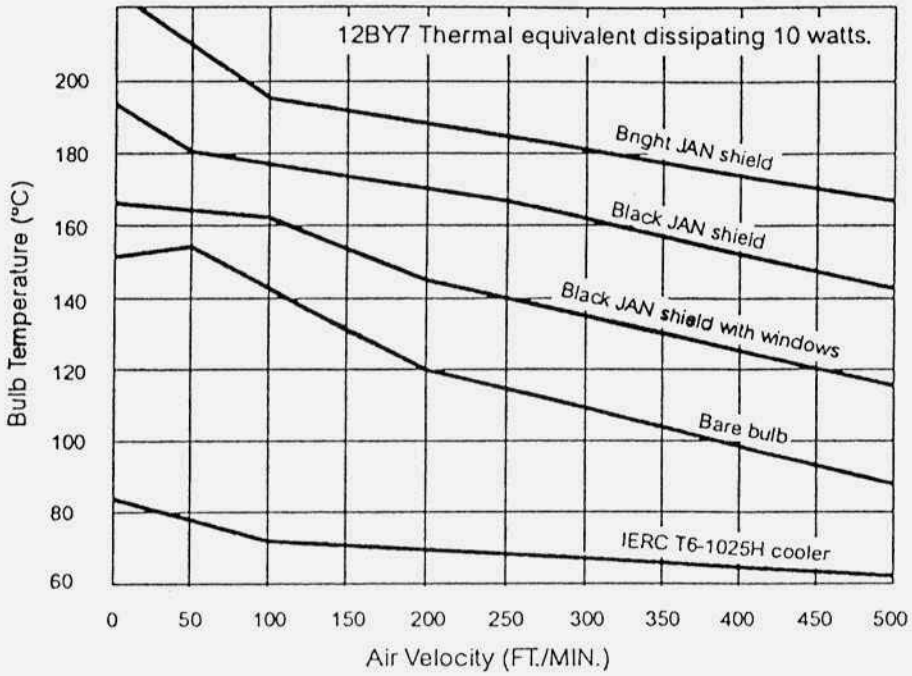

Figure 3.

survived operation at a temperature of 220 C for 5,000 hours but at only 17 degrees hotter fewer than 70% survived even 2,500 hours.

So, how hot is that bulb getting? Graph #3 shows the result of temperature measurements on a 12BY7 thermal equivalent tube dissipating 10 watts, including heater power. These tests show measured bulb temperatures in various types of shields as compared to a bare bulb. The results of these tests explain why the US military banned shiny tube shields by 1960! Depressingly enough, the only shield which improved tube cooling over a bare bulb is the well-known IERC type which has a thermally conductive path from tube envelope to the metal chassis. Note that I said metal chassis; even the IERC shield loses effectiveness when not firmly heat sunk to a chassis rendering them much less effective when slipped over a tube that doesn't have a socket designed to accept a shield. This is where the Perkins Lab comes in - they manufacture an interesting line of slip-on tube coolers made of accordion pleated blackened copper that don't depend on a heat sink for proper action. In any event, what the graph says is clear - one is better off without using tube shields of any kind unless electrical considerations require one. If you must use a shield - for heaven's sake, don't use a shiny nickel or chrome plated one if the tube is dissipating more than a couple of watts!

As I mentioned previously, the other major culprit adversely affecting tube life is elevated heater voltage. Most vintage equipment is tagged to run at a designated line voltage of 115 to 117 volts. Unfortunately, the modern standard for our AC mains is right around 120 volts and levels of up to 122 volts are commonly encountered. Previous *ER* articles have warned of the ill effects of operating tubes at elevated heater

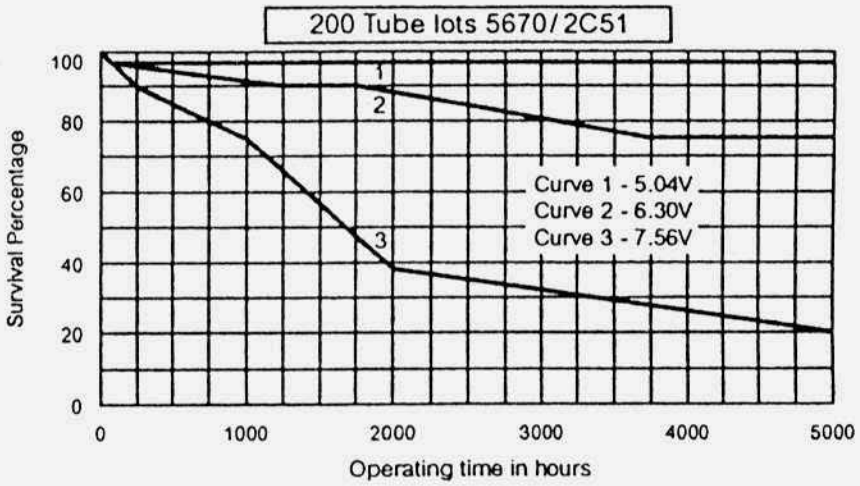

Figure 4, Tube Life vs. Heater Voltage

voltages and a chart from Perkins' AN 1.1 makes this very clear. Figure 4 shows tube survival percentages vs. heater voltage for the type 5670 tube for heater voltage values of 5.4, 6.3 and 7.56. Intermediate values may be extrapolated from the graphs. Note that at the rated 6.3 volt value, 75% of the tube lot survived at least 5,000 operating hours but at 7.56 volts, the same 75% survival was reached at only 1,000 hours. Even more interesting are the incredible survival rates achieved at reduced heater voltages which would imply an advantage to running tubes at the low end of their heater voltage specification where possible.

Conclusions

The preceding material makes it pretty clear what it takes to drastically improve the reliability of vacuum tube equipment. To summarize:

1. Keep tubes as cool as possible. Avoid the use of shiny tube shields and use them only on low heat dissipating tubes. Receivers such as the 51J, 75A, R-390, SP-600 and the like should have the original shiny miniature tube shields replaced with the black milspec or IERC types. (I have also seen shiny shields with a built in corrugated heat sink which might work reasonably well). Tubes that were not originally fitted with shields could benefit by the application of Perkins' heat sinks. These perform even better than the IERC shields but may require some retuning of sensitive RF circuits. For audio applications, they work just great and sizes to fit octal tubes are even available.

2. I hate to harp on the subject but I really don't think replacing tube rectifiers with silicon devices is a real good idea. Doing so only increases localized heating of tubes and other parts due to increased B+. The instant application of B+ of a cold tube often has bad effects on the cathode coating (cathode stripping). Also, the current surge from the 'fast start' is bad on power switches and other expensive items.

3. Know your line voltage. If a good, accurate DVM shows more than 120 volts, use a device such as a Sola transformer or Variac in line with your shack power feed to get it down to 117 or so. Many military receivers have power transformer taps for various line voltages; where I have them they're set to the 125 volt tap as my line voltage generally runs about 122.

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Hamfest Station Draws Big Crowd

Paul Courson, WA3VJB
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Classic Radio, Special Event Station

Organizers of last year's AM Expedition to Dobbins Island have taken the show on the road! Thousands of people have now seen for the first time a vintage Classic Radio station in action.

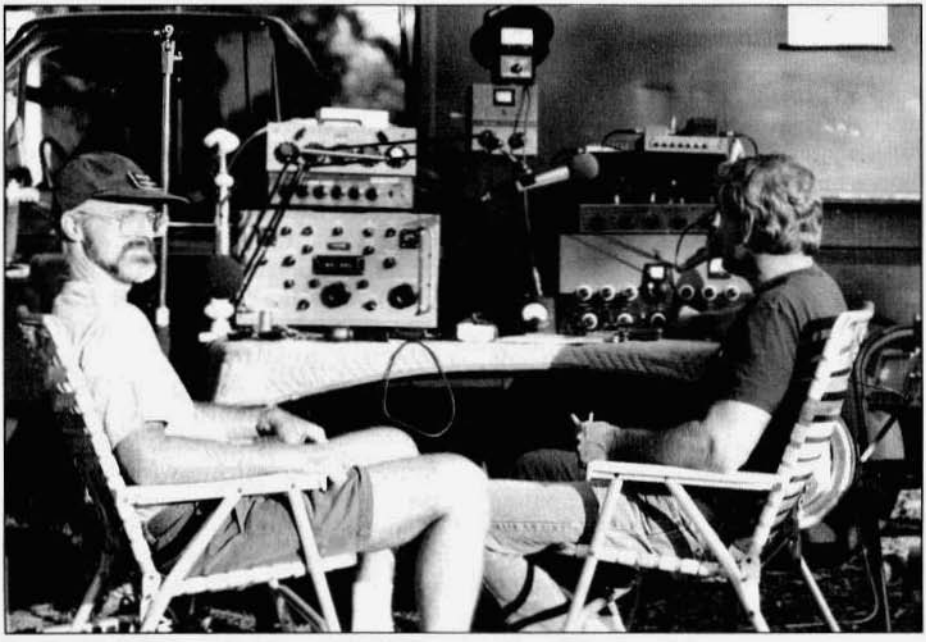
The Foundation for Amateur Radio sponsors one of the biggest hamfests on the East Coast at Gaithersburg, MD. The group invited members of the AM Community to establish a special event station to help draw interest and demonstrate our special facet of the hobby.

It was really a red-carpet treatment too: We were given a prime outdoor spot along the main fleamarket run, at a venue that features 100-year-old oak trees and plenty of open space. A dipole cut to 3885 was sent aloft with bow-and-arrow to an altitude of 60 feet -- as the centerpiece of a promotion shown by signs saying "Classic Radio: LIVE on 75 !!!" posted around the Montgomery County fairgrounds.

The Crowds Went Wild

Old and young alike got bug-eyed as they spotted the station and heard the high-quality, warm-sounding audio coming from our display. Older folks typically volunteered a story about some AM rig they used to own -- or still had, put away somewhere. The kids were often impressed by the *retro-radio* look in this age of MTV and hi-tech.

This hamfest, unlike many these days, is not heavy on computer gear. Perhaps as a result, those in attendance took a lot of time to stop and check out the rigs. An inverted-vee on 40 meters up about 40 feet took advantage of some



Paul, WA3VJB and Greg, K3EWZ man the AM Special Events Station at Gaithersburg.

A crowd at the station and pileups on the air made the hamfest setup an outstanding event for all.

excellent band conditions during the Sunday hamfest.

People would listen to the high-quality sound of stations we worked, like N9GT, Jack at Fort Wayne, Indiana, and WA1EKV, Chuck at Bolton, Massachusetts, as well as N4VIB, Sam near Chatsworth, Georgia, and would be impressed at both the distance and the fidelity of AM signals coming in. We were flattered that our contacts praised our own audio quality before the crowd of onlookers!

Saturday Party Sets The Stage

We were allowed into the hamfest venue a day early to set up, camp out, and have an on-the-air, all night party to "test" the station. About 40 people were at our location sharing the good times there and with those we worked on 75 meters. One of the most dramatic demonstrations happened several times during the night as freight trains would roll by some tracks nearby.

Some of our contacts thought we had a sound-effects tape or something as they heard the sound of a diesel locomotive and a long, low blast from the horn as it passed!

Hamfest officials, having already been impressed by some Saturday afternoon demonstrations on their behalf, were kind enough to supply the overnight bunch with pizza. Some of our number brought suitable 807 to wash it down, and we were all glad no one had to drive, hi!

Other early flea market arrivals also camping out for the night were stopping by to check out the festivities. While walking the fairgrounds in the wee hours of the morning, it was a spooky yet satisfying feeling to hear OUR STATION coming out of little portable shortwave radios and/or DC powered solid-state rigs people had brought with them ! About 10,000 people would fill the site on Sunday.

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Remember Nuvistors?

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In the late fifties, development of the vacuum tube reached an unfortunate stalemate. Fundamental electron tube theory had for years predicted performance far beyond anything yet achieved, but engineers could only seem to make small, gradual increases in tube performance. For example, the theoretical limitation of transconductance to plate current, which depends on the distribution of electron velocities at normal cathode temperatures, is 11 millimhos per milliampere, or a ratio of 11:1. In a mid-fifties miniature high-mu triode, a 6BN4 for example, this ratio is only .8:1. At the end of tube development, ratios of only 6:1 at low plate currents had been reached with some experimental ceramic types.

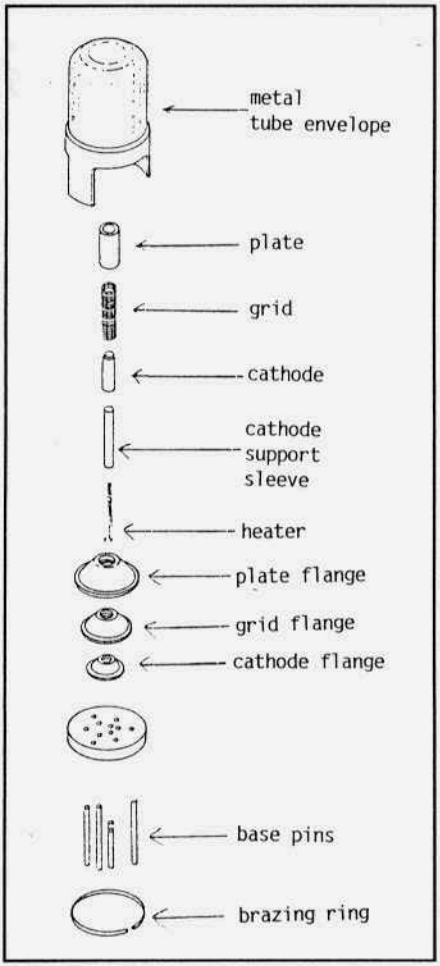
The big tube design "break-through" so long awaited just didn't happen. Instead, what was accomplished were advances in materials engineering and in advanced fabrication techniques.

In the same time period the use of tubes by avionics manufacturers and by the US Military was greatly increasing, and these users became increasingly concerned by the large numbers of tube failures they were seeing in field installations. In 1957, a joint committee of industry and commercial users studied the problem of field failures. This committee was made up of engineering representatives from Westinghouse Electric Company and Aeronautical Radio, Inc, of Washington, D.C. Originally, and logically so, it was thought that inadequate or inappropriate pre-installation tube testing was the reason for so many failures.

The committee studied the histories of 271 different types of tubes purchased from 1955 to 1957. A detailed failure analysis showed that in 82 percent of all of these tubes, an electrical failure accounted for less than 4 percent of the total failures. They decided that the tube testing procedures were at fault, and should be rewritten. In order to evaluate the new testing procedures, 400,000 individual tubes of these same 271 types were individually tested to Military Standard E-1, which includes various test procedures for visual, electrical, and noise defects. Of the entire group, .1% were rejected for visual defects, .4% were rejected for noise, and only 1.8% were rejected for electrical defects. These percentages were far less than the field failure rates for the same group of installed tubes. The committee issued a big report in January 1959, and concluded that extensive tube testing, in contrast to other electronic component testing, does not reduce field failures of tubes. This agreed with similar work done by the U.S. Air Force. The USAF concluded a large, similar study in April 1958, which said that not only does tube testing not increase reliability, but also revealed incomplete knowledge of common tube failure mechanisms. Their engineers were not able to design a dynamic test that will spot a tube which will have a long life and one that won't. They additionally mentioned that it is best to keep tube testing to a minimum, as the test itself reduces tube life.

Since the tube failure rate due to electrical defects was so low, it was decided that an entirely new form of tube structure was needed. This new tube would need some kind of rigid construction to avoid problems with stress-induced field failures and vacuum contamination. It would need to be much smaller than even the smallest of the miniature tubes because of the changing requirements of avionics and missile technologies. It would need to have a high degree of electrical performance, as communications were getting into increasingly higher parts of the radio spectrum. A real dilemma was at hand!

Over at RCA Harrisburg, the Engineering Department was just about to release



Exploded view, typical Nuvistor triode construction.

an all-new tube type. Although designed for television receivers, the new tube was capable of meeting a lot of the tough avionic requirements. Known as the Nuvistor, this little tube was a masterpiece of materials engineering. Let's look a little closer at this often-neglected member of the vacuum-tube family.

From the start, Mr. Nuvistor used entirely new concepts and materials. As can be seen in the cut-away view, there was a ceramic base-wafer which served to support the entire array of tube electrode assemblies. The tube electrodes were really a series of concentric flanged cylinders. They were supported only from their base flanges in a cantilevered technique, but yet rigidly held in position by tripod-like rods. The support rods were small and lightweight, and could withstand a lot of shock and vibration because of their shape and low mass. When fully assembled, the tube enclosure then became an integral part of the mechanical support for the electrodes.

No mica insulators were needed. With no mica in the tube envelope, a major source of stray particles and gas was eliminated. The vaporized-type of getter was also eliminated because of the high-temperature processing which removed the troublemakers while the tube vacuum was being pumped.

Nuvistors were made of special ceramics, and special metals including tungsten, molybdenum, steel, and special alloys.

All of the joints in the tube were processed at 2,000 degrees F. in a brazing furnace and then placed in a vacuum-exhaust furnace. This technique joined all the parts in their original strain-free positions, thus greatly reducing the possibility of internal short circuits developing during tube operation. The high-temperature processing steps eliminated many of the impurities and gases that are difficult or impossible to remove with conventional tube designs, because of the mica and glass used in their construction.

The control grid was held so tightly in position that it had a very high mechanical "Q" at its natural resonance of 8 Kc. Other frequencies were therefore damped out and microphonics were nearly eliminated.

The manufacturing steps in Nuvistor production were fascinating. The first part to be assembled was the ceramic base. It was made of Fosterite, which is strong, has excellent insulating properties, and is a good thermal conductor. This combination of properties was unusual, and led to advances in tube socket and chassis de-

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Review: Steve Johnston's Synchronous Detector Kit

by Walt Novinger
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One of the amenities of modern solid-state radios that SWLs and amateurs have come to regard as *de rigeur* is a synchronous detector, particularly for listening to AM broadcasters whose signals may require several hops to reach our listening posts. Fading due to the individual sidebands arriving asynchronously is nearly always a problem with these signals, more so, it seems, during these times of poor propagation. Under these circumstances, a synchronous detector can make the difference between a comfortably listenable signal and one which is merely adequate to supply the broadcaster with a 3x3 signal report.

The theory of synchronous detectors is beyond the scope of this article; the reader is directed to W6BM's excellent article in a previous *ER*, #34, where John presented both the theory and an example of this type of detector and its application to hollow-state receivers. What I will describe here is a modern kit version of the synchronous detector, available at a very reasonable price and adaptable to both solid-state and vacuum tube radios.

The kit I built and successfully adapted to my boatanchor collection is put together by Steve Johnston, (P.O. Box 3420, York, PA 17402-0420); it sells for $119, including postage. The kit is based around two Sony parts: the CX-857 AM Stereo Detector, and a hybrid encapsulated phase-shift network used to separate the sidebands. During talks with Steve on the telephone, I learned that these two parts are those used as the heart of the synchronous detector circuit in the venerable Sony ICF-2010 receiver many of us have used for years ...still one of the best synch detectors on any radio. These parts are combined with another couple of dozen discrete parts on a single PC board a mere 3" by 4".

The surface-mount CX-857 detector is capable of locking onto any IF signal in the 400-500 kHz range, so long as it is between 100 mV and 1 V; the typical 500 mV 455 kHz signal from a modern solid-state rig is a natural for the chip. As I'll discuss later, boatanchor IFs will probably require an attenuator circuit to prevent overloading the chip's input stage. Because the input to the chip is buffered by an MPF-102 FET and an R-C circuit, the 1 megohm input impedance is unlikely to load the receiver's IF circuit enough to change its alignment. The kit provides a pair of 100 mV outputs, one for each of the sidebands; their 10 k ohm impedances match the input of most audio amplifiers' AUX or phono inputs. The entire circuit requires only 20 mA at between 4 and 14 VDC.

Steve provides a very thorough instruction book with the kit, including a schematic, parts placement diagram, assembly instructions, hook-up and alignment instructions, and specifications. While the instructions are not of the Heathkit "install-and-check-the-box" variety, anyone who has ever put soldering iron to PC board should have no problem building this kit, as least so far as the instructions are concerned. Indeed, from opening the package to "smoke testing" the kit, less than two hours elapsed.

My only qualm with Steve's design is the manner in which parts are mounted

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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: Wednesday nights at 8 PM PT 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: Recently started by Pat, K7YIR, this net is on 3875, Mondays and Fridays at 9:30 PT. 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.
Twenty Meter AM Net: This net on 14.286 has been in continuous operation for at least the last 20 years. It starts at 5:00 PM PT, 7 days a week and usually goes for about 2 hours. Net control is Les, K6HQI.
Arizona AM Net: Meets Sundays at 3 PM MT on 3860. 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 3875 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 Sat. at 2300 local on 3885 and Sun. at 1600 local on 3885. Night net control is Andy, KD6TKX, and daytime net control is Tom, WA6OPE. AM is the mode used at present. It is not necessary to check in with military gear.
Grey Hair Net: The oldest (or one of the oldest) 160-meter AM nets. It meets on Tuesday nights on 1945 at 8 PM in the winter and 9 PM ET in the summer.
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 14.062, Saturdays at 3 PM PT. Net control is Tracy, WB6TMY.
Vintage SSB Net: Net control is Chuck, N5SWO. The group meets on 14.293 at 1 PM CT, Sunday afternoons.
Collins Users Net: The oldest of the 'users nets'. It meets on 14.263 Sunday afternoons at 2 PM CT. The net control revolves. This group also gets together for an informal ragchew on 3805 Tuesday evenings at 7 PM CT.
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.
Heath Users Net: A new net started by Marty, WB2FOU/5. Net control is shared by Fred, AA5LW. It meets on 14.275 at 4 PM CT Sundays. Check in on either AM or SSB.
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 has been meeting since 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.
Westcoast Broadcast Equipment Net: Tuesdays on 1959 at 9 PM PT. Anybody is invited to join the group, but the emphasis will be on broadcast equipment. Moderator is Mike, W6THW.

Solid-Stating The Heath Model VF-1 VFO

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Barry/*ER*'s "noticeably drifty" comments in ER#28 really got me curious about the warm-up characteristics of vintage, vacuum tube, VFO's. Since that issue, I have measured the warm-up characteristics of some two dozen vintage VFO's, accumulating about two hundred hours of drift measurements. I bought several of the test VFO's at local amateur swapmeets and borrowed the rest. Dave Mills, AJ7O, loaned me five: a Heath HG-10B, Eico 722, E.F. Johnson 122, and two T-368's. Probably a hundred hours were concentrated on the Heath VF-1 and HG-10/HG-10B - I had three versions of each. It was in this setting that I discovered that the VF-1 was among the worst VFO's that were tested, giving the phrase "noticeably drifty", a new meaning.

I ended up with a pretty good, relatively low-drift, Heath HG-10, but it was a poor match for my Heath AT-1, DX-20, and DX-40 transmitters - the green just didn't go with the gray - this meant a "noticeably drifty" VF-1. I bought a VF-1 from an *ER* ad and checked its warm-up characteristics. While not as bad as some, it was still "noticeably drifty" and intermittently unstable.

Barry and I had briefly discussed the merits of solid-stating the VF-1 in '91 and he sent me the Dec. '72 *QST* describing a solid-state conversion for the VF-1. I started thinking very seriously about the solid-state mod, dug out the Dec. '72 *QST*, and designed a PCB version of the *QST* mod.

The primary objectives of the VF-1 solid-state conversion include;

* improving the short-term warm-up characteristics and long-term frequency stability.

* getting the heat out. At 350 VDC, the original VF-1 dissipated 10W inside the case.

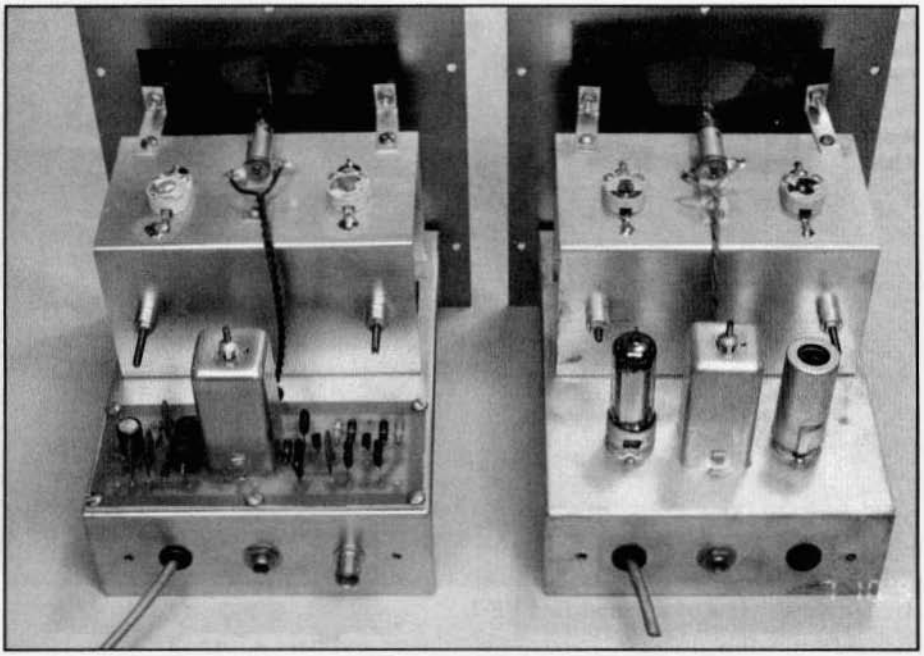
* improving the mechanical stability of the LC and input wiring. The VF-1 uses a series-tuned Clapp oscillator. Walt, KJ4KV, pointed out in his "A Not Noticeably Drifty VFO - Part I" in *ER*#32, that "the junction between the coil and tuning capacitor is a very high impedance point so any change in the surroundings. . . will have serious effects." The original VF-1 used 20 and 24 AWG solid wire to wire the LC components and input to the 6AU6. The input wires were all pushed through a common rubber grommet to reach the bandswitch and 6AU6. Many VF-1's that I have tested are "microphonic" - the output frequency changes as the case is lightly tapped.

* no change in the original appearance or operation.

* using as many of the original VF-1 components as possible.

The following are some of the highlights and comments about solid-stating the VF-1:

* The #1819 28V pilot light, Radio Shack P/N 272-1119, is the largest heat



Modified VF-1 on the left, unmodified on the right.

source with 0.9W. A 470Ω 1W series dropping resistor is connected from the bulb to the unregulated +42V.

* The same dual N-channel junction-FET circuit described in *QST* is used with Radio Shack 276-2062 MPF102 FET's. The original article suggested 2N3823 FET's but I used the alternative MPF102's because of their availability. The values of the major components are the same.

* The one major change I made to W1EBW's original article was supplying the +20V from an external power supply and removing the two 15K 5W resistors and 20V zener - these components dissipated almost four watts inside the VFO's cabinet. The measured temperature rise inside the case is less than 1°C during the first two hours of operation - changes in room temperature can be more significant.

* Stability of the +20V supply is critical. In the 160/80/40 position, the voltage sensitivity varied from -23 Hz/volt at 15V to -64 Hz/volt at 22V. In the 40/20/15/10 position, the voltage sensitivity varied from 96 Hz/volt at 16V to 39 Hz/volt at 22V.

* W1EBW's conversion used the 6AU6 and 0A2 tube sockets as tie strips to mount the additional components. This gives the under chassis a very cluttered appearance. I chose to use a 5.4" x 2.25" single-sided PCB to mount the new VFO components and to cut out a 4.9" x 1.6" rectangular hole on the rear deck of the main chassis to mount the PCB. The PCB is securely mounted to the chassis using 6-32 hardware. The existing P/N 40-56 dual plate coil is retained and mounted on the PCB.

* 16 AWG solid wire is used throughout the front end. A second rectangular hole was cut in the main chassis under the coil assembly to facilitate line-of-sight point-to-point wiring.

* 11M operation was eliminated.

* The original LC components are used. No effort was made to change the ratio or value of the temperature compensating caps.

* In the 160/80/40 position, opera-

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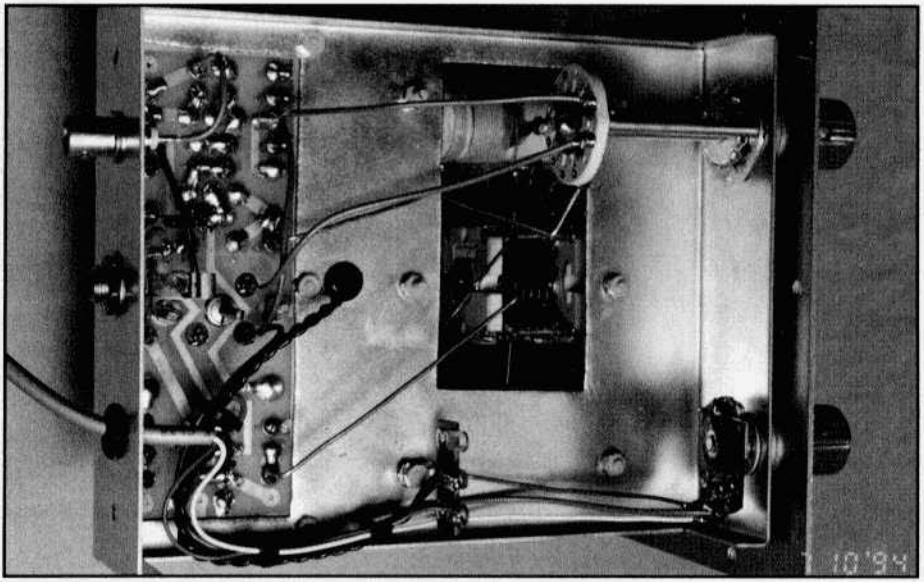


Underchassis view of the modified VF-1.

tion is "noticeably driftless" - warm-up drift is almost nonexistent! One minute after power-on, the worst-case frequency drift at 1.875 MHz was 41 Hz after 3-1/2 hours of operation.

* In the 40/20/15/10 position, the warm-up characteristics are not as good. One minute after power-on, the worst-case frequency drift at 7.150 MHz was 270 Hz after 3-1/2 hours of operation.

* The warm-up drift is somewhat dependant upon the changes in room/ambient temperature during the first two hours of operation.

* The mechanical stability is excellent - as good as any VFO I have built or evaluated. With the slug rotated fully counterclockwise, out of the 160/80/40M coil, and tight against the rear of the coil assembly, this position is particularly immune to shock.

A few words about the +20V power supply:

* The power supply is external to the VF-1. I didn't want to burden the low-drift solid-state design with the heat generated from a built-in power supply. I included a built-in supply with a repackaged HG-10 VFO that I built last year and paid a "penalty" in worsened warm-up drift characteristics.

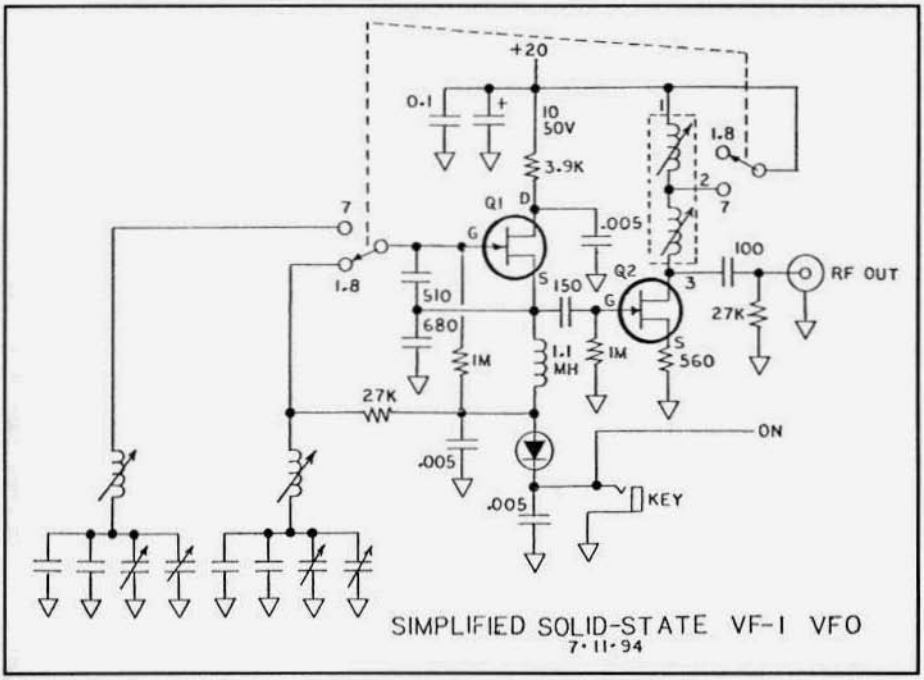
* The power supply components are mounted on a single-sided 2-1/2" x 6-3/4" PCB.

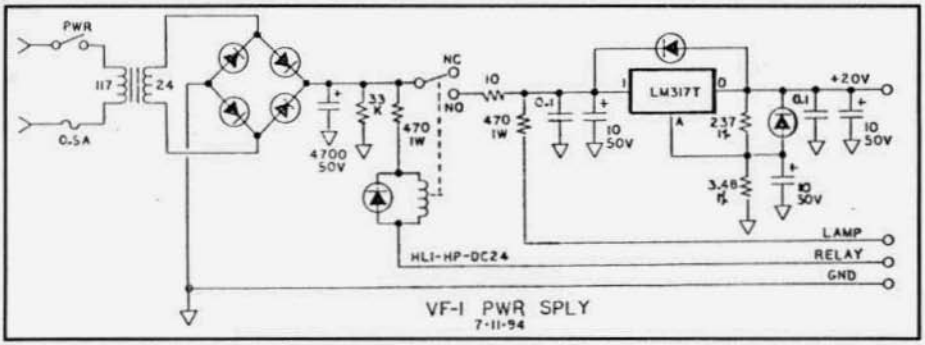
* I selected the LM317T adjustable regulator for the regulator IC. I mounted the LM317T on an IERC black-anodized 1-1/4" tall LA series heat sink to minimize the LM317T's warm-up drift due to the power dissipated.

* The regulator design is right out of the National Linear Databook. The regulator is non-adjustable nominal +20v using fixed-value 237Ω 1% and 3.48KΩ 1% precision metal-film resistors in the output voltage-divider. The added 1N4002 diodes around the LM317T protect it in case I "slip" and ground the wrong terminal.

* I used a 24 VDC relay to switch the input to the regulator so that the OFF/STANDBY/ON switch on the VF-1 functions somewhat like the original.

* The power supply is mounted in an LMB #137 8"D x 3"W x 2-3/4"H aluminum chassis box enclosure. A separate SPDT switch switches the transformer's primary. A standard 4-pin chassis





mounted mic connector, Radio Shack P/N 274-002, and its mating 274-001 plug, are used to connect the power supply to the VF-1.

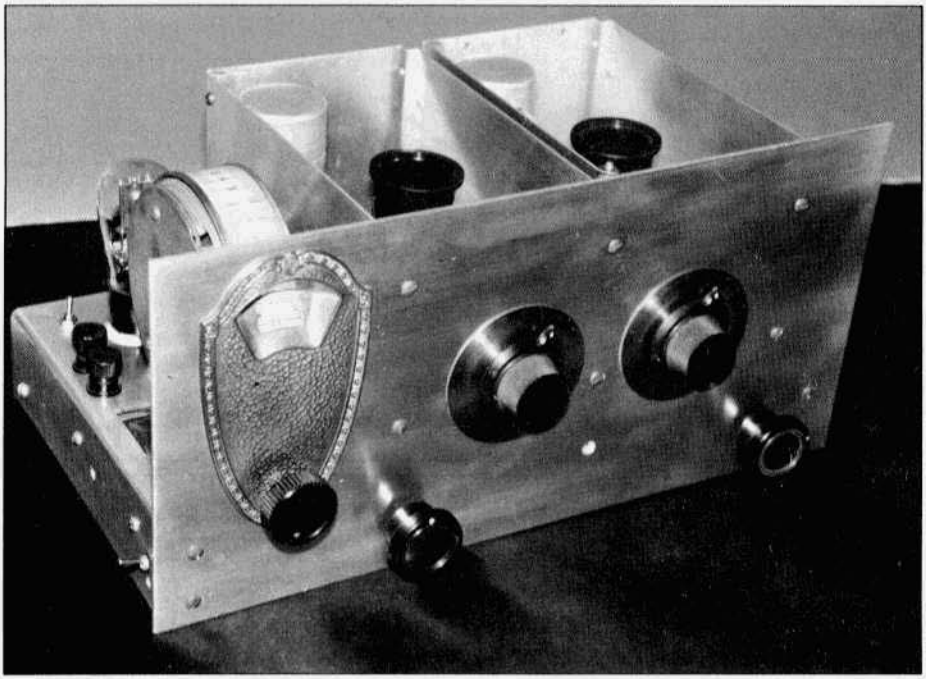
* This power supply is basically "overkill" for a VFO that requires only 5.5 mA @ 20V. Voltage stability, however, is "rock-solid". The #1819 28 VDC pilot light requires an additional 40 mA plus 37 mA for the relay and these currents are supplied from the unregulated +42 VDC.

I think solid-stating the VF-1 was worthwhile. Externally, you haven't a clue that it's been done. The added BNC connector on the rear panel is the only clue that there is something "different" about this VF-1 and I may have made that mod to the tube version anyway. The warm-up characteristics and frequency stability have been significantly improved. However, my version of the solid-state conversion is NOT recommended for the faint of heart - there is NO going back to the original VF-1 configuration. I did not want to possibly compromise the mechanical stability of the conversion by using all of the origi-

continued on page 27

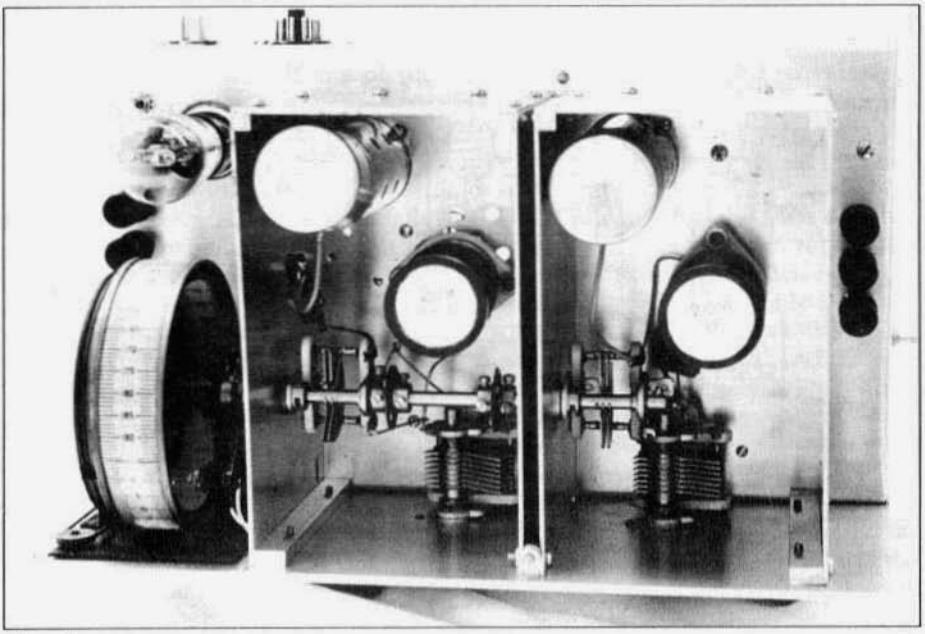
The TRF Receiver

Bob Dennison, W2HBE
82 Virginia Ave.
Westmont, NJ 08108

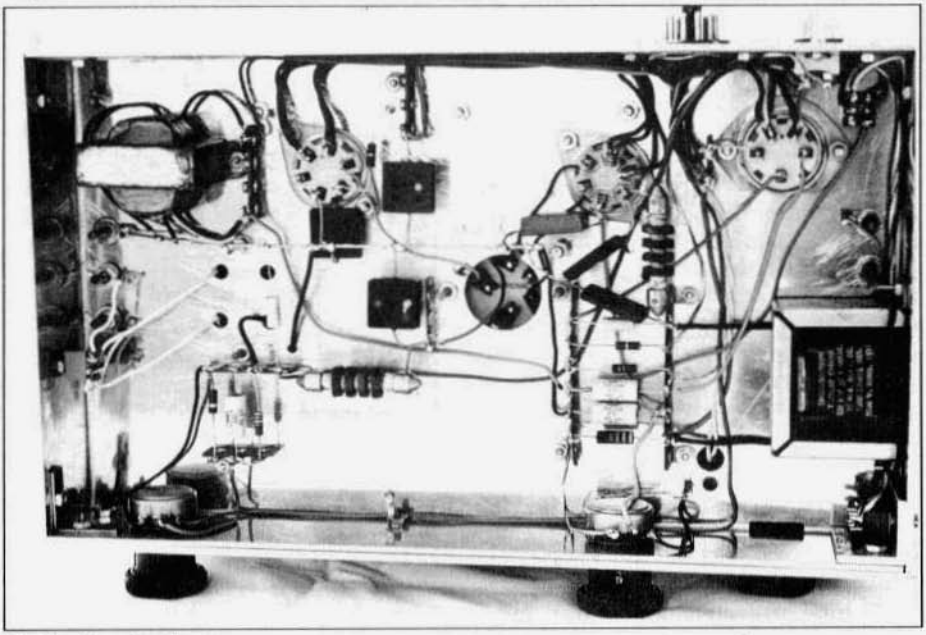


In January 1933, George Grammer, W1DF, told us what was wrong with the currently popular TRF sets and then described an improved TRF receiver which set the standard for many years.[1] That set employed a 58 RF stage, a 58 regenerative detector and a 56 audio amplifier. The mechanical design was rigidly solid and the RF and detector stages were well shielded. See photos. Quite a few of these sets were in use in my home town (Salina, KS) and in 1936 I bought one that had been built by W9FRC and his father who later became W9STC. The price was $10. I had just obtained my ticket, W9YRQ, and was beginning my freshman year in high school. I used that set all through high school, working 46 states and 15 countries. I also had a long-running sked with W9ZAW whom I later met in person at Kansas State College where we both had enrolled as EE students. At one point, I converted the TRF set into a superhet but the regenerative IF stage needed readjustment with every change in humidity so I went back to the trusty TRF circuit.

In the fall of 1992, just before Christmas, I received a big box in the mail sent to me by *ER* contributor, W2OBJ. In the box was a 3-tube TRF like the one in *QST* except modified to use metal tubes. I decided to restore the set to usable condition. First the set was completely dismantled. Then the aluminum parts comprising the chassis and RF shields were cleaned and polished using 0000



Top view.



Underchassis view.

steel wool. I drew up a new schematic (see Fig. 1) similar to the original Grammer design but with the following embellishments:

1. Switchable 20 dB attenuator at the antenna input. (Didn't need this in Salina!)
2. RF gain control employs variable grid bias.

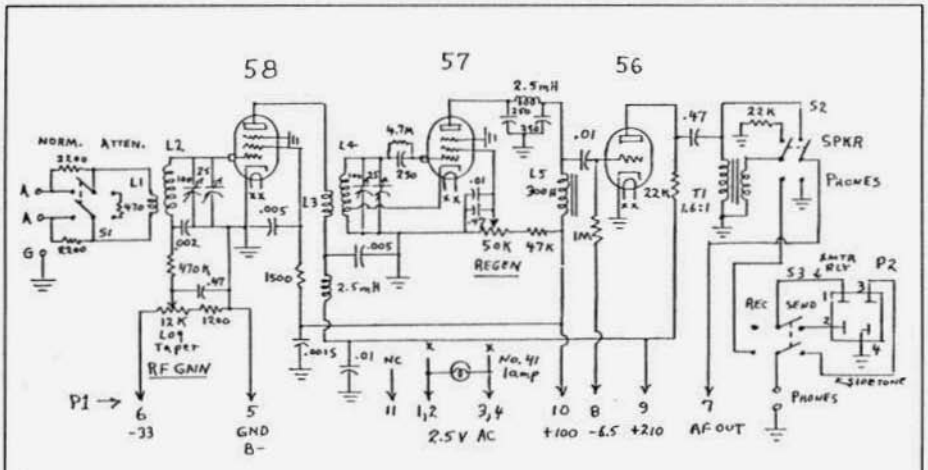


Fig. 1 Wiring Diagram of the Restored TRF Receiver.

W2HBE

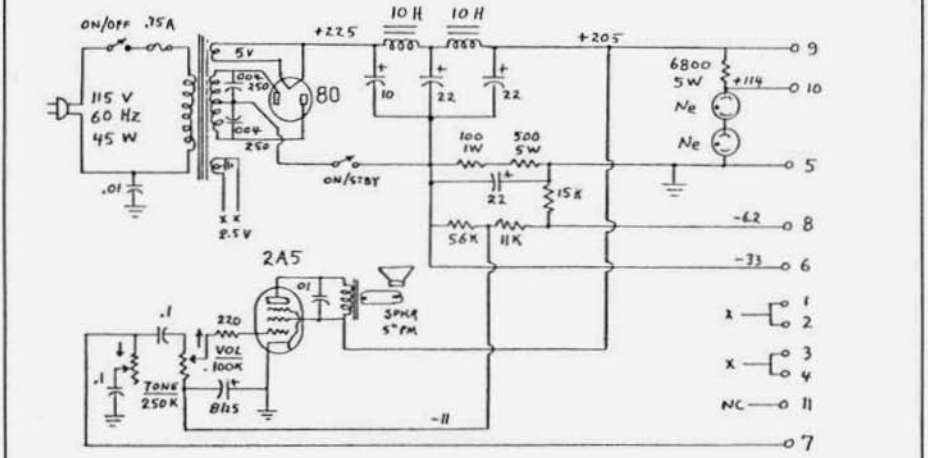


Fig. 2. Power Unit for the TRF Receiver,

W2HBE

3. RF tube protected against transmitter RF by grid leak limiter.
4. Power supply provides neon tube regulated voltages for detector and RF screen.
5. Power unit also incorporates a 2A5 output stage and a 5" PM speaker.
6. A switch (behind drum dial) selects either phones or speaker.
7. A Send-Receive switch - on the left side.
8. An output transformer keeps DC out of the headphones.

In the early days of radio, the regenerative receiver and the TRF enjoyed considerable popularity. Some of the reasons for this are:

1. Simplicity and low cost.
2. Easy construction.
3. Easy to get working.
4. Low power requirements - especially important when batteries are used.

Since there were fewer stations on the air, extreme selectivity was seldom needed. Thus such sets were often used by the newly licensed ham and when he upgraded, the set was passed on to the latest newcomer. Many of these sets were later converted to superhets. First it was necessary to make a bigger chassis with room at the left for the local oscillator. The chassis also had to extend back behind the RF, 1st Det and Osc compartments to provide room for the IF stage, BFO and output tube. Many of these sets were a joy to behold and often achieved a high level of performance. Since the large plug-in coils had high Q, these sets gave fairly good image rejection, even on 40 meters. But they were doomed when the commercial sets came along with bandswitching and calibrated dial scales. Lots of exciting DX was worked with these early sets and they are fondly remembered by the old timers.

Incidentally, some of these old receivers are still around and are occasionally put to use. Every year the Antique Wireless Association sponsors an Old Timer's contest in which the operators must use pre-world war equipment. During this contest many of the old sets are lovingly dusted off and reconnected to the antenna. An hour before the contest starts, the quavering sounds of old Hartley oscillators begin to be heard as various stations start tuning-up. It's exciting to log such info as "rcvr hr TRF". What joy to once again relive those good old days! ER

(1.) Rationalizing the Autodyne, George Grammer, QST, Jan. 1933.

Solid-stating the Heath VF-1 from page 23

nal mtg. holes, etc., so I chose to make the sheet metal changes permanent.

Some of the things I discovered reducing the VF-1 to kit-form to start the conversion shed some light on this VF-1's lousy performance in its original, vacuum tube form:

* Both the function and band switches had contacts that were not repairable. The rotor of the bandswitch is on the inside of the switch assembly and hard to see when the VF-1 is assembled. The rotor was badly "warped" and the pole position was completely full of solder and no "spring" left to the contact. I needed to buy a second VF-1 for the replacement switches.

* Both rotors of the 4.5 - 25 pF NPO frequency adjust padders "fell apart" as they were removed from the top of the coil assembly. These did not look cracked prior to their removal. They would also have "fallen apart" if I had attempted to calibrate the VFO. This was undoubtedly the source of the intermittent.

* Two very-cold solder joints on the inside of the bandswitch and the junction of the two 510 pF divider caps.

* The 4.5 - 25 pF NPO trimmer for the 11M band had a cold solder joint to chassis ground. It "fell off" as soon as I removed the manufactured hardware.

A large SASE w/$ .52 stamp will get you full-sized schematics and copies of the artwork and PCB layout. I will also include a copy of the Dec. '72 QST conversion article and VF-1 calibration procedure. ER

Selected References:

1. "Operating the Heath Models VF-1 and AT-1 at 21 Mc", Hints and Kinks, QST, April '55, pg. 50.
2. "New Life for the Heath VF-1, VFO", Robert M. Glorioso, W1EBW, QST, Dec. '72, pgs. 18-19.

THE HEATH VACUUM TUBE VOLTMETERS

by Kurt Miska, N8WGW
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Ann Arbor, MI 48103

Once the mainstay of nearly every electronics workbench in the country, if not the world, the ubiquitous and classic vacuum tube voltmeter, always known simply as a VTVM, has for all practical purposes disappeared. Its demise can probably be attributed almost entirely to the appearance of the digital multimeter and a few FET analog voltmeters. VTVMs, once made by nearly all manufacturers of test equipment, came in a wide range of shapes, sizes and prices. Many of them were also available as kits.

For this article, it is best to classify VTVMs in two categories.The first would be the relatively simple Heath, EICO, Knight instruments, and the second category would include the much more sophisticated VTVMs produced by Hewlett Packard, Boonton, Ballantine and similar companies. This effectively separates these instruments by price. The meters in the first category were priced within the reach of virtually all amateurs and experimenters and were generally less than $50. On the other hand, the much more complex meters in the second category were well into the three-figure range. This article deals with the classic Heathkit VTVMs.

WHY A VACUUM TUBE VOLTMETER?

As the electronics industry developed rapidly in the 1930s, engineers and designers realized that then available meters loaded sensitive circuits to such a degree that their readings were essentially meaningless. Even 20,000 ohms/volt meters load circuits excessively. If only some way could be found to prevent circuit loading and subsequent degradation of circuit performance.

High input impedance amplifiers were available in the 1930's and it stood to reason that coupling such an amplifier to a meter would produce an instrument that could measure DC voltages. From there it was but a small step to adding a voltage divider to the amplifier input so as not to damage the measuring circuit with high voltages. That was the beginning.

The VTVM has many advantages over non-electronic volt-ohmmeters. One of the greatest is the high and constant input resistance on the DC ranges. This enables much more accurate readings to be obtained on high impedance circuits.

These VTVMs, offered by Heath, Eico, RCA, Hickock and Allied Radio (Knight) basically comprised three circuits--a power supply, the metering circuit, and rectifer circuit to handle alternating current. The power supply was a very simple affair consisting of, in the early days, a selenium rectifier and, in later, more compact models, a silicon diode. The metering circuit was built around a twin triode--a 6SN7 in the earlier instruments and the more compact 12AU7 in later models. Similarly, AC was first handled by a 6H6 and later by a 6AL5.

For an understanding of the theory of operation of these VTVMs, permit me to quote from the 1959 ARRL Handbook.

"While there are several possible circuits, the one commonly used is shown in the accompanying schematic. A dual triode, V1, is arranged so that, with no voltage applied to the left grid, equal currents flow through both sections. Under this condition the two cathodes

are at the same potential and no current flows through meter M. The currents can be adjusted to balance by potentiometer R11, which takes care of variations in the tube sections and in the values of the cathode resistors R9 and R10. When a positive DC voltage is applied to the left grid the current through that tube section increases, so the current balance is upset and the meter indicates. The sensitivity of the meter is regulated by R8, which serves to adjust the calibration. R12, common to the cathodes of both tube sections, is a feedback resistor that stabilizes the system and makes the reading linear. R6 and C1 form a filter for any AC component that may be present, and R6 is balanced by R7 connected to the grid of the second tube section.

"To stay well within the linear range of operation the scale is limited to 3 volts or less in the average commercial instrument. Higher ranges are obtained by means of the voltage divider formed by R1 to R5 inclusive. As many ranges as desired can be used. Common practice is to use 1 megohm at R1, and make the sum of R2 to R5, inclusive, 10 megohms, thus giving a total resistance of 11 megohms, constant for all voltage ranges. R1 should be at the probe end of the DC lead to minimize capacitive loading effects when measuring DC voltages in RF circuits.

"Values used in the circuit depend considerably on the supply voltage and the sensitivity of the meter, M. R12 and R13-R14 should be adjusted by trial so that the voltmeter circuit can be brought to balance, and to give full-scale deflection on M with about 3 volts applied to the left hand grid. The meter connections can be reversed to read negative voltages with respect to ground."

AC VOLTAGE

Again, from the 1959 ARRL Handbook.

"For measuring AC voltages the rectifier circuit shown at the lower left of the diagram is used. One section of the double diode, V2, is a half-wave recti-

continued next page

C_1—0.002- to 0.005-μf. mica.
C_2—0.01 μf., 1000 to 2000 volts, paper or mica.
R_1—1 megohm, ½ watt.
R_2 to R_5, inc.—To give desired voltage ranges, totaling 10 megohms.
R_6, R_7—2 to 3 megohms.
R_8—10,000-ohm variable.
R_9, R_{10}—2000 to 3000 ohms.
R_{11}—5000- to 10,000-ohm control.
R_{12}—10,000 to 50,000 ohms.
R_{13}, R_{14}—App. 25,000 ohms. A 50,000-ohm slider-type wire-wound can be used.
R_{15}—10 megohms.
R_{16}—3 megohms.
R_{17}—10-megohm variable.
M—0-200 μamp. to 0-1 ma. range.
V_1—Dual triode, 6SN7 or 12AU7.
V_2—Dual diode, 6H6 or 6AL5.

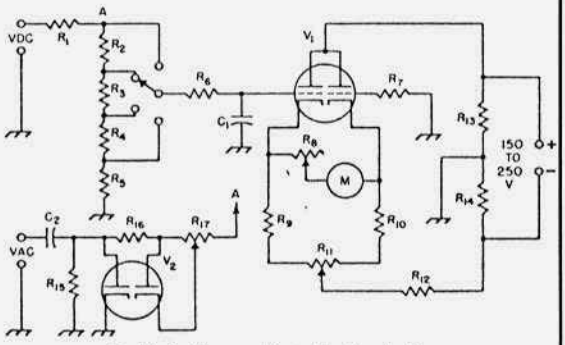


Fig. 21-8—Vacuum-tube voltmeter circuit.

fier and the second half acts as a balancing device, adjustable by R17, to eliminate contact potential effects that would cause residual DC voltage to appear at the VTVM grid.

"The rectifier output voltage is proportional to the peak amplitude of the AC wave rather than to the average RMS values. Since the positive and negative peaks of a complex wave may not have equal amplitudes, a different reading may be obtained on such waveforms when the voltmeter probe terminals are reversed. This "turnover" effect is inherent in any peak-indicating device, but is not necessarily a disadvantage. The fact that the readings are not the same when the voltmeter connections are reversed is an indication that the waveform under measurement is unsymmetrical. In some measurements, as in audio amplifiers, a peak measurement is more useful than an RMS or average value measurement because amplifier capabilities are based on the peak amplitudes.

"The scale calibration usually is based on the RMS value of a sine wave, R5 being set so that the same scale can be used for either AC or DC. The RMS reading can easily be converted to a peak reading by multiplying by 1.41."

The Heath VTVMs, used so widely by radio and TV service shops and by radio amateurs and experimenters measured DC, AC and resistance. Most of them measured up to 1,000 volts AC and DC and resistance up to 1,000 megohms. On many of them the DC range could be extended to a staggering 30,000 volts by means of a well-insulated probe. Some could measure RF voltages with a demodulator probe.

THE QUINTESSENTIAL VTVM

Sometimes the words VTVM and Heathkit seem almost synonymous. Talk to most hams, electronic experimenters, or TV service technicians and they will either fondly recall their first Heathkit VTVM or they will say that they cherish the one still doing yeoman's service on their workbench.

The Heath Company in Benton Harbor, Michigan introduced its first VTVM, the model V-1, in November 1947, shortly after the company started offering its O-1 oscilloscope kits. The model V-1, in kit form, sold for the princely sum of $24.50. It is not known how long the V-1 remained in production.

According to Heath historian Chuck Penson, WA7ZZE, in St. Paul, Minnesota, the basic Heath design philosophy was to reverse engineer and simplify the considerably complex circuits found in expensive industrial instruments, such as those made by Hewlett

Heath's reputation as a maker of quality kits was further enhanced by its excellent construction/instruction manuals. With careful workmanship, and systematically checking off each step, the builder couldn't help but build an instrument that worked when turned on for the first time.

Another line in that same ad reads, and again probably merited, "acclaimed by all who have seen it the most beautiful radio test instrument on the market."

Little is known about the V-2 and V-3 instruments. In all probability they were very similar to the V-1. We do know though that the V-4 was first produced in 1950. Each subsequent model offered small improvements and by the time the model V7A was offered, Heath had sold half a million VTVMs. The V-7A, the last of the V-series, was also the first of Heath's VTVMs to use a printed circuit board. The V-7A's voltage ranges are in sequences of 1.5, 5 for RMS and a 4, 14 for peak-to-peak measurements. (1.5 V RMS x 2.828 = 4.2 V peak-to-peak.)

The multi-function VTVMs (DC, AC, ohms) included the series from the V-1 through the V-7A, the IM-11, IM-18 and the IM-5218. The IM-5218 signalled the end of the line for the company's VTVMs, that model lasting to 1983.

There were three horizontal VTVMs designed to be placed on the workbench or suspended below a shelf over the workbench. They included the IM-13, IM-28 and the IM-5228 from March 1963 to 1968. Like the other Heath VTVMs, they featured seven AC, seven DC, and seven resistance ranges.

Then there were the Deluxe Service Bench VTVMs with the 6 in. meter movements, multi-colored meter scales, and

Packard and other companies like that. Thus, the design embodied in the V-1 became the foundation for all of its VTVMs up to the model V-7A. That first unit used a 6X5 rectifier, a 6SN7 meter amplifier, and a 6H6 half-wave doubler to deal with measuring AC.

Its ranges were 0-3, 0-30, 0-100, and 0-1000 volts AC and DC on a linear scale and up to 1,000 megohms of resistance, a feature largely unmatched by the manufacturers of today's digital multimeters. It also featured a dB scale. The meter movement was a 500 microampere unit in a clear plastic housing and the range switches were hefty ceramic units. The clear meter housing became very much a trademark of all Heath VTVMs.

An advertisement described the V-1 in glowing, but probably justified, terms. "The best quality of materials is supplied -- aluminum cabinet, beautiful two color panel, 500 microamp meter, ceramic switches, glass enclosed precision voltage divider resistors, and every required part right down to the hook-up wire. Detailed blueprints and instructions make the assembly pleasant and simple. Average construction time is less than four short hours, and you have the best and most useful test instrument available."

continued next page

separate low voltage AC scales. Two models were built between 1960 and 1963; the IM-10 from 1960 to 1962 and the IM-32 from July 1962 to 1963.

The IM-11 VTVM represented a departure from the classic V-series. The most obvious change was use of a single switchable AC/DC/ohms test probe with a short ground lead, DC for one setting and AC and ohms for the other.

The following is quoted directly from the Heath instruction manual for the Model V-7A, but applies pretty much equally to all the Heath VTVMs from the V-1 to the V-7A. Obviously, the earlier VTVMs used different tubes, but, in principle, the description applies.

"The sensitive 200 microampere meter movement is in the cathode circuit of a 12AU7 twin-triode. The zero adjust control balances the two sections of the triode such that with zero input voltage applied to the first grid, the voltage drop across each portion of the zero adjust control is the same. This being true, the meter reads zero. Applying a voltage to the first grid, upsets the balance in the cathode circuit and the meter provides an indication. The relationship between the test voltage applied to the first grid and the meter indicating current is linear and therefore the meter is calibrated with a linear scale. The advantage of having the meter in a vacuum tube circuit of this kind is that the voltage to be measured is not applied directly to the meter but rather to the tube. Because the tube is limited to the amount of current it can draw, the meter movement is electronically protected."

"The maximum voltage applied to the 12AU7 is about 3 volts. Higher test voltages are reduced by a voltage divider which has a total resistance of 10 megohms. An additional 1 megohm in the DC test probe permits measurements to be made in circuits carrying RF voltages with minimal disturbance of such circuits.

"When measuring AC, a 6AL5 twin-diode is used as a half-wave doubler to provide a DC voltage proportional to the peak-to-peak value of the applied AC voltage. This DC voltage is applied through the voltage divider to the 12AU7 causing the meter to indicate as previously described.

"For resistance measurements, a 1.5 volt battery is connected through a string of multipliers and the resistance to be tested, thus forming a voltage divider across the battery. A resultant portion of the battery voltage is applied to the twin-triode. The meter scale is calibrated in resistance for this function."

For less than $5 accessory probes could be added to the Heath VTVMs. An RF probe extended the RF measure-

ment capabilities to 250 MHz, and a DC high voltage probe enabled TV service technicians to measure up to 30,000 volts. The probe multiplied each range by a factor of 100.

HEATH'S AC VTVMs

In September 1951 The Heath Company added the AV-1, an AC-only VTVM, to its already successful VTVM offering. This series remained available from 1951 through 1981 and included the AV1 to AV3, the IM-21, IM-38 and IM-5238. The IM-5238 reached the end of the line in 1981.

These instruments featured 10 ranges from 0.01 to 300 volts RMS, had 10 megohms input impedance, and were useful from 10 Hz to 500 kHz.

The IM-21 was a more sophisticated instrument than its predecessor AV-3. The design incorporated a cathode follower stage on all ranges for increased input impedance and a two-stage amplifier for high output stability and linearity. At $33.95 for the kit, and $60.25 assembled, it was one of the more expensive instruments sold by Heath.

With introduction of the IM-5238 Deluxe AC Voltmeter in 1976, Heath competed with the Hewlett Packard or Ballantine type of instrument. Essentially a laboratory meter, this AC voltmeter covered from 1 mV to 300 volts in 12 ranges. Input impedance was 10 megohms shunted by 30 pF with a frequency response from 10 Hz to 1 MHz. Like its much more expensive counterparts, the IM-5238 provided some additional features besides voltage measurements; these were DC output proportional to input volts (1 volt full scale); DC (proprotional to log of input volts), 3 volts full scale, and C (amplified output), 1 volt peak-to-peak, full scale.

GETTING TO KNOW YOUR VTVM

"How to Understand and Use Your Vacuum Tube Voltmeter" was the name of a course once offered by the Heath Company. Reportedly the course was used by many schools and individuals for self study. The course combined text and hands-on work. The course assumed no prior knowledge of electronics but also did not "talk down" to the more experienced student. The advertisement noted that a special power supply and component board were included for doing the experiments. VTVM, power supply and circuit board retailed for $42.

EPILOG

It was a sad day in 1992 when the Heath Company announced that it would no longer offer kits. Countless hams and experimenters would no longer experience the joy of unpacking a Heathkit VTVM kit, laying out the parts and putting these fine instruments together. I once had a model V-4A but made the mistake of lending it to someone and never got it back. So, when, many years later, I spotted a V-7A at Purchase Radio, I snapped it up and now I treasure it highly. Since then I've added two more--an IM11 that works fine and an IM-18 that needs help. Total investment was $15 for both.

But, I digress. Now, new Heath enthusiasts have to depend on hamfests to find those classic instruments. What they find will either be immaculate or beaten to within an inch of its life. To paraphrase a famous quote...."The Heathkit VTVM kit is dead, long live the Heathkit VTVM." ER

The author thanks Chuck Penson, WA7ZZE an historian on Heath electronic products, St. Paul, Minnesota for his valuable assistance in the preparation of this article.

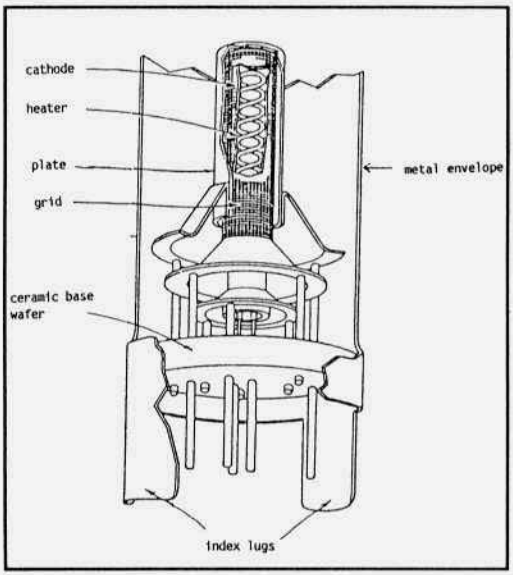
Remember Nuvistors? from page 17

sign, where the thermal coefficients were arranged to provide a greater degree of control over the transfer of heat. This was fortunate, because as the surface area of a device such as an electron tube is reduced, heat transfer must become more efficient, input power must be reduced, or the permissible temperature rise above the ambient must be increased. It was found that temperature rise above the ambient was permissible in some designs. The oxide coating on a cathode surface is actually a semiconductor, and there is a narrow range of permissible operating temperatures. However, the cathode is very hot in relation to the relatively cool surroundings, so the ambient temperature had little influence on the total electron radiation from the cathode.

The ceramic Fosterite powder, with carefully controlled densities and composition, was mixed with an inert binder, and pressed into wafers. The wafers had holes formed through them to accept the steel element support rods.

The round base wafers were dipped in a metalizing solution, and fired in a two-stage process, first in air and then in hydrogen. At the end of the process, they were plated with iron, the iron was ground off of the flat sides, which left the holes plated through and the outer rim metalized.

The grid structures were a radical departure from convention, and were assembled separately on a specially designed machine. Sixty strands of nickel-plated molybdenum wire were placed horizontally along a temporary mandrel, and wrapped with a strand of copper-plated molybdenum. The wrapping operation formed a long helical structure around the horizontal wires. The wrapped mandrels were fed into a small oven, and a Monel braze took place at each point where the copper-plated and the nickel-plated wires crossed. The mandrel was removed and the grids were cut to the proper length for assembly into the electrode structures. This new process yielded an extremely rigid grid structure, free of the problems associated with grid siderods and mica support wafers as found in conventional designs. Much higher transconductance was achieved, even higher than that with the frame-grid tubes, and yielding Gm to plate current ratios of over 6:1 in some of the later power Nuvistor designs.



Cut-away view.

Next, the heater and its leads were inserted into the holes in the base. This was a tricky operation, and was performed by hand.

The flange-shaped tube elements were fabricated next. They were assembled from the plate down, on a relatively simple automated assembly production jig. First, the plate cylinder was set in place on the jig, and then its flange was added. Then came the grid cylinder, its flange, the pre-assembled grid wires, and then the cathode-support cylinder and flange. Copper rings were placed at the junction of every cylinder and flange, and at the junction of the grid wires and grid flange. The ceramic base and the pre-assembled heater were added to com-

plete the electrode structure. The tripod-shaped element support rods, three for each electrode, were set in place against the bottom of the flanges and through the metallized holes in the ceramic base. For each tube element, two support rods were cut off, and a third was retained to make the tube pins, which emerged through the plated holes at the bottom of the ceramic base.

The assembled structure was loaded into a furnace with a hydrogen atmosphere for the brazing operation. (I wonder what kept the line from blowing up?) The copper braze in hydrogen connected the cylinders and flanges, the flanges to their support rods, and the rods to the plated-through holes in one single step. After the brazing was completed, an oxide-coated cathode cup was placed over the cathode support sleeve.

At this point, the Nuvistor was almost complete. All of this work, except for the heater, was automated assembly. This was a first for the tube industry. Skilled technicians were still needed to keep the machines in proper alignment and operation, but they were relieved of the drudgery of assembly line work.

A thin ring of brazing alloy was fitted around the ceramic base, on the plated outer ring. Another fixture, which was capable of holding 100 Nuvistors, sort of like a shish-kebob, was lowered into a bell jar chamber and a high vacuum was pulled. Radiant heat was applied through Nichrome wires inside the vacuum chamber, and after about 15 minutes, the heat and vacuum outgassed the tubes and broke down the cathodes. The temperature was further increased and the brazing alloy melted and sealed the tube. No getter required! Since the three brazing operations were performed at progressively lower temperatures, the difficult problems of heat transfer to the brazing alloys and related timing problems were eliminated.

Extreme uniformity in production was achieved. It was so good that transconductance was typically held to within 10 percent, and inter-electrode capacities were constant, so that fixed neutralizing circuits were possible, even at VHF.

As far as I know, Nuvistors were produced only by RCA, although some were stamped for other U.S. tube makers. There also may have been some late Japanese copies.

Nuvistors were used in nearly every RCA TV set in the early to mid-sixties. Lots of FM receivers used them in the front end, even as late as the mid-seventies.

The Nuvistor saw some use in ham gear too, principally in VHF converters and VHF/UHF preamps. Although I have not researched a complete list of equipment using them, I know that the Parks Co. produced a 100% Nuvistor VHF converter which was considered top of the line. Tecraft and Ameco also produced VHF converters. Ameco made a line of Nuvistor preamps which covered 11 meters through 450 Mc.

Nuvistors were not used much in HF gear. One notable exception was a modification produced for the Navy, called a "Nuvistaplug". Introduced as a field modification in March 1965, it was a low-noise plug-in replacement for the noisy 6BA6 first RF amplifier in the Hammarlund SP-600. I've not tried this modification, but it looks good. I have a copy of the field bulletin and would gladly send it to any reader wishing one. Send me an SASE, please.

VHF AM is a lot of fun. Let's dig out that old Tecraft, or pick up something similar at the next hamfest, and get some more mileage out of the good 'ol Nuvistor. Or better yet, build your own out of the 1963 handbook and be one of the few hams to operate VHF with handmade gear! ER

Review: Synchronous Detector from page 18
on the PC board. Rather than supplying a drilled board for all components except the surface-mount IC, the builder is expected to "surface-mount" all of the components. When I asked Steve why this was the case, he told me that his experience has been that most of his builders liked this technique. All I can say is that they must have a bit of the masochist in them. . .I found this approach rather tedious, to say the least. Were I to build another of Steve's kits, I would first use my Dremel Mototool and a PC board drill to drill holes for all of the components, surface-mounting only the IC. Not only would the kit then go together faster, but my eyes and nerves would be in better shape as well, hi.

Alignment of the circuit to the radio is simplicity itself. . .a single slug-tuned coil is adjusted until the kit's lock LED lights on a well-tuned signal. If your receiver doesn't have IF outputs, Steve provides instructions and sample schematics that should show you where to install a tap in your radio's IF circuit. While he doesn't mention it, a small capacitor of 15-50 pF *must* be used on vacuum tube receivers to block the significant DC voltages that are usually present in the IF circuits; failure to take this step will certainly smoke-test the board!

When I first tested the detector with the 500 kHz IF from my 51-J4, I could not get it to unlock between stations, even on very quiet bands. Backing the RF gain down enough to allow the Sony chip to unlock made the receiver so insensitive as to be useless. During my discussion with Steve, he suggested that a simple attenuator be added ahead of the kit's input. This consists of a 10 k ohm linear taper pot placed across the IF, with a 100 ohm resistor between the wiper and ground to desensitize the action a bit. Once I added this to my unit, the action is perfect. . .between stations on relatively quiet bands, the lock LED just flickers.

I built my kit into a small aluminum cabinet with a sideband-selecting toggle switch, the lock LED, and the attenuator pot on the front, and a pair of phono jacks for input and output and a power jack on the back. I drilled a 1/4" hole in the top of the cabinet, directly over the tuning coil, to allow insertion of a plastic tuning tool while the cabinet is closed (borrowing an idea from military receivers, I put a Fahenstock clip on the back of the cabinet to hold the tuning tool). If you'll be using the detector with a single radio all the time, this probably isn't necessary; if you're like me and will be moving the detector between radios frequently, this will save time and wear-and-tear on the case screws. I have tested the kit on an R-388, RME-84 and -45, SP-600-JX-17, and the 51-J4, with excellent results on all of them.

A note concerning power for the kit is in order here. Initially I fired the detector up and tested it on a lab-grade adjustable supply and the unit, expectedly, sounded great. I then tried a high-quality 12 V power brick and was very disappointed with the AC hum (even after adding a 3300 mF capacitor for filtering). Rather than building or buying a better supply, I simply hooked a mating power plug to a 9 V battery cap, and use a rechargable battery to power the unit. When I want to turn it off for an extended period, I simply pull the power plug. Not pretty, but it works with no hum!

Using the synchronous detector is very simple. Because you will probably install the unit and use a separate amplifier, simply turn the volume on the receiver down and listen through the detector and its amplifier/speaker. Between stations the lock LED will either be out or will flicker, indicating that the synchronous detector has not found a carrier to lock onto. As you approach an AM signal (a synchronous detector won't work on SSB signals having no

carrier), the LED will light and you'll hear a "ripping" or "growling" sound for a very short time as the detector finds the carrier and locks onto it. Depending upon listening conditions, you'll usually find that one sideband sounds better than the other, either due to differential fading, or to interference from another signal nearby the target frequency. By selecting the best sideband, and detuning away from the offending signal, the desired signal will usually sound much better than is possible with a "barefoot" receiver. I haven't been able to receive HCJB's reduced-carrier SSB signal in the last few days, but I expect that this and other stations using this mode of transmission should also benefit from the synchronous detector, as my '2010 and other receivers with synchronous detectors work just fine on the one sideband being transmitted.

Until you have listened to the BBC, or to one of the amateurs running an AM broadcast transmitter, through a high-quality synchronous detector feeding a hi-fi amplifier and speaker, it's difficult to believe just how good your SP-600 or Hallicrafters receiver can sound. I *highly* recommend Steve's kit to the boatanchor community, and hope you enjoy yours as much as I enjoy mine. **ER**

AMI Update from page 3

posal is not firmed up yet and your comments are welcome. Write AMI Headquarters for a copy of what we are considering if you are interested.

It is not too soon to announce the AM Jamboree for the Thanksgiving Holiday. Last year we received comments that a four day event is a bit much. So let's enjoy AM all weekend, but for those who want to keep a score, look for each other on 10 meters (21.410-435 +/- if 10 is dead) and 160 meters on Saturday and Sunday, Nov. 26 and 27. Log transmitter, receiver, antenna and AMI number if your contact has one. And if you go through all that work, send me a copy so I can highlight the activity in this column!

AMI has 650 members and Warren Ziegler, NY2H, AMI treasurer reports $180 in the bank. Remember to inform AMI if you have a change of call sign or address, so we can keep our records up to date. **ER**

Hamfest Station from page 15

AMI Featured At Brochure Table

Dale, KW1I sent along a large AM International banner that instantly explained to passers-by what our station was about. As they stopped to look, most picked up brochures about AMI. We also handed out photocopies of key articles about AM that have appeared in *Electric Radio*, *QST*, and *Popular Communications* over the past few years.

The brochure table included a display of mint-condition vintage gear, the Heath TX-1 "Apache" and its matching receiver the "Mohawk." This enabled people to get up close to such equipment without crowding the active station we were running on-air.

Randy, N3LRX, who supplied the Heath twins, could have sold them many times over! In fact, we had to deflect quite a few offers on the active station as well -- showing us just how much interest there is these days in hollow-state gear!

Of course, it may also show how scarce quality equipment is getting to be ...

Vintage Gear For Sale

This was a good hamfest for those in the market for classic radios, with many receivers and a few transmitters discovered throughout the fleamarket. Next year, with more advance billing, we will probably establish a "vintage" row near the station to help things along! **ER**

The Hammarlund HQ-129X from page 9

National was not particularly innovative with its mid-range, general coverage receivers in that era, but it still offered 1 RF, 2 IF and a crystal filter competition for the HQ series at considerably lower cost, with the NC-98 at $149.95 in 1954 and the NC-109 including a product detector at $199.95 in 1957. National finally went to a dual conversion, selective low frequency second IF, product detector design in the NC190 in 1961, priced at $199.50.

Hammarlund's response to Hallicrafters' advances in mid-range, general coverage receiver technology and features was slow and inadequate. They changed the "HQ" from octal tubes to miniatures with the HQ-140-X in 1953 (and made the tuning knobs bigger, like most of us had done already by substituting larger knobs for the ones that came on the HQ-129-X), added a Q-multiplier with the HQ-150 in 1956, and finally went dual conversion and included a product detector with the HQ-160 in 1958 (but they still retained the 455 kHz second IF and, worst of all, dropped the crystal filter and just kept the Q-multiplier!). If this weren't bad enough, the cost of the HQ was also increasing well beyond the Hallicrafters and National offerings, $264.50 in 1953, $294 in 1956, and $379 in 1958.

The HQ family once again became thoroughly competitive with the introduction of the HQ-180 in 1959. At last, this famous family now had an update to dual/triple conversion, a final IF with multiple selectivity options tailored to AM, SSB and CW, fast and slow AVC, a product detector, and a low noise front end and mixer that brought out the best in the tuning capacitor bank that it still retained from the original HQ-120. The HQ-180, once again the "best in class" of the general coverage receivers, lasted until 1972, a fitting run for the last of this venerable family.

If you get a chance to add an HQ-129-X, or any of its HQ cousins, to your collection, grab it! You will get a receiver from a family that was highly respected in its day, and one still capable of turning in a fine, on-the-air job for you on CW or AM. **ER**

Electron Tube Survival from page 13

All of us love to play with hollow state equipment (or we wouldn't be reading *ER*?) but tracking down and having to replace leaky, weak or dead tubes isn't enjoyable, especially when in the middle of a QSO and the rig fails. And in the last few years since I've been following the previously mentioned recommendations I've only had one hard tube failure out of hundreds in the shack - I find them, they don't find me! Keep 'em cool, man. **ER**

References:

Perkins Electro-Acoustic Research Lab
(Pearl tube coolers)
2510 19th St. SW
Calgary, Alberta T2T 4X3
(403) 244-4434
Retail Cooler Sales:
Audio Advisor
800-942-0220
Radiotron Designer's Handbook, Chapter 1
IERC (Yes, they're still in business!)
135 W. Magnolia Blvd.
Burbank, CA 91507
An extensive bibliography is available as part of Perkins' AN 1.1

Corrections to last month's article "Long Live the 6L6". The author Jack Shutt, N9CT, reports that the following changes should be made to the schematic. "First, the B+ lead which runs to the 6AG7 oscillator should route directly to the power supply output and not to the modulated B+ as shown. Also the tuning capacitor should be changed to 250 mmF from 150 mmF. Finally the Phone-CW switch on the modulator should include an SPST switch ganged to the one shown (Fig. 2) which switches the modulator filament voltage off in the CW position. I used a small rotary switch with two sets of SPDT contacts. I hope these changes do not cause anyone any inconvenience."

CLASSIFIEDS

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DEADLINE FOR THE NOV. ISSUE: NOV. 3

FOR SALE: Repair and restoration on all vintage equipment; 35 years experience. Barney Wooters,W5KSO, 8303 E. Mansfield Ave., Denver, CO 80237. (303) 770-5314

FOR SALE: Drake 2A rcvr w/2AC calibrator and 2AQ Q-multiplier/spkr & orig. manual - $195; Heath Cantenna HN-31, 1 KW dummy load - $25. All plus UPS. Ron, KC6WTG, POB 783, Santa Rosa, CA 95402. (707) 539-8319

WANTED: All types of military electronics, especially RDF and radar items, manuals too. Also need URD2 antenna. William Van Lennep, POB 211 Pepperell, MA 01463. (508) 433-6031

FOR SALE: Rcvrs - Laf. HA-350, Allied A-2516, HB only (80-10 + WWV) - $59 each + UPS. Henry Mohr, W3NCX, 1005 W. Wyoming St., Allentown, PA 18103.

FOR SALE: Manual copies for Eico 720, 730, HQ-110, Elmac AF-68; schematic copies for Knight 50-W xmtr, Ocean Hopper rcvr. Paul Vaughn, 2317 Williamson Rd., Williamson, GA 30292.

WANTED: Help! A Navy model TBA xmtr needs saving but I've no documentation. Orig. manual preferred but anything will do. William Donzelli, 304 South Chester, Park Ridge, IL 60068. (708) 825-2630

FOR SALE: Collins S-Line aluminum knob inlays: small (exciter/PA tuning) - $1; 30L-1 - $2; spinner/plain (main tuning) - $3. Charlie, K3ICH, 13192 Pinnacle Lane, Leesburg, VA 22075. (703) 822-5643

FOR SALE: Collins 75S1, 32S1, 516F2, tubesters - $750; Galaxy 550, matching ps/spkr - $275; 813 - $15; HM-102 - $45; HW-22, HW-32A, SB-630, HP-23 - $195; SB-220, Peter Dahl xfmr, new electrolytics, AG6K mods - $595; thrust bearing - $55; 4-1000 - $45; vacuum variables - call; (3) 4-400's - $150. Lane, KM3C, (619) 462-3857

WANTED: My H.S. rcvr, National NC-125, SN 387. Rich Smith, AB6MM, 1122 Via La Cuesta, Escondido, CA 92029. (619) 739-1838.

FOR SALE: NOS WW II Bendix MN-26Y radio compass rcvr, MN-40D indicator, drive cable and manual. Absolutely new, mint condx - $225. Bob Bakinowski, 1524 Saint Tropaz, Tucson, AZ 85713. (602) 624-8029

WANTED: Collins 75A-4 filters - 500 cycle CW and 6 kc AM. Also 75A-4 matching spkr. Mike, WD6DIR, (216) 371-3142.

FOR SALE: Kenwood R599 - $125. **WANTED:** Eico 730 modulator. George, (805) 682-3094.

FOR SALE: Heath CW filter - $50; National manuals - HRO-50-1, HRO-60 - $16; NC-98 - $7; NC-109, NC-270 - $8. Copies postpaid USA. Richard Prester, 131 Ridge Rd., West Milford, NJ 07480. (201) 728-2454

FOR SALE: New Eimac 4X150A tubes; Jackson 648 tube tester. **WANTED:** RAL; R388A; AN/FRR-22 rcvrs. Tom Brent, Box 1552, Sumas, WA 98295. (604) 826-4051

WANTED: SX-28 pwr xfmr; front panels for Viking II and Globe Chief 90; Eico 722 VFO cabinet. Jack C. Shutt, N9GT, 1820 Dawn Ave., Ft. Wayne, IN 46815. (219) 493-3901

WANTED: Hallicrafters HT-33 amp in good condx. Please call and mention HT-33. Joseph Falcone, 3000 Town Center, Ste. 2370, Southfield, MI 48075. 800-436-7026. Lve msge.

FOR SALE: Hallicrafters SX-25 w/spkr - $125; Hammarlund HQ-129X w/spkr - $125; BC-348R - $50; Knight T-60 - $45. Plus shpg. Bill Jenkins, WA5MWJ, 11916 Donahoe Bend, Fort Smith, AR 72916. (501) 646-3859

FOR SALE: Earthquake forces sale of lifetime collection. Make offer! Johnson Viking Invader 2000; Viking 500; Collins 75A-2; R-388/URR; RME; CEI; other ham, CB, military, xmtrs, rcvrs, parts, etc. For information send large SASE. Steve Philips, POB 4916, Chatsworth, CA 91313. (818) 712-9340, 704-6306

Manuals for Amateur Radio and Related Equipment. Lafayette, Heath, etc. included. Over 3000 Available. Highest Quality Guaranteed. Catalog, two $.29 stamps. Pete Markavage, **Manual Man**, 27 Walling St., Sayreville, NJ 08872. (908) 238-8964

WANTED: SC-101; SC-301; KW-1; 30K-1 thru 5; 302C1; 75A thru 75A-4 rcvrs and spkrs, any condx. Purchase entire estates, pick up 48 states and top $ paid. Rick, (800) 462-2972

FOR SALE: Replica Ocean Hopper front panels - $20 ppd, limited qty. available. Includes copy of Ocean Hopper manual. DWI Engineering, POB 3611, Costa Mesa, CA 92628-3611.

WANTED: Clean Valiant II, SX-88. Gary Lee, KE6MS, 515 No. Central Ave., Ste. A, Glendale, CA 91203. (310) 696-0177

WANTED: ARRL Handbooks, 1st, 5th editions. **FOR SALE:** Many ARRL Handbooks. LSASE for list; Hallicrafters S-38abcd's - $85 includes schmt, shpg; parting Viking I, S-40's, S-38's, NC-33. No Hallicrafter knobs. WA7IHN, POB 442, Aumsville, OR 97325. (503) 749-1149

FOR SALE: Mint Heath Mohawk rcvr, Maurauder xmtr, Warrior linear + accessories - $800; Drake 2B + Q-multiplier - $150; sick SB-34 - $50; SB-110 6 meter - $170. Carl, (913) 681-9875

WANTED: Manuals for Heath AJ10 AM-FM tuner and Sylvania X-7018 modulation meter. Copies OK. K0OCC, 8240 Grogan Ferry Rd., Atlanta, GA 30350. (404) 396-1312

FOR SALE: 6 Heath VF1 VFO's - $250; 3 AC-1 couplers - $125; 4 QF-1's & 1 HD-11 - $75; 2 Johnson & 1 B&W & 1 Dowkey TR switches - $150. All excellent. $500 for everything. Don Winfield, 6080 Anahuac Ave., Ft. Worth, TX 76114.

FOR SALE: Drake C-4 console - $290; Drake TR-22 - $50; Drake 2-NT, xtals - $90; National RCP rcvr - $65; Hallicrafters SX-99 rcvr - $85; Hallicrafters HT-46 xmtr - $85; Hallicrafters HA-18A code osc. - $20; General Radio 1650-A impedance bridge - $200; BC-348 rcvr - $70. Jerry Tastad, KB7M, 519 Flint, Laramie, WY 82070. (307) 742-4033

FOR SALE: Realistic DX-150 - $50; Astatic D-104 - $25; Simpson 460 digital VOM - $30. **WANTED:** Heath SB-110 manual. Ken Johnson, N5US, POB 10063, Austin, TX 78766.

FOR SALE: EX Collins WE 32S-3 - $495; EX WE 30L-1, w/new Pride 811A's, PU only - $695; pristine BC-348-J, FT-154-J, DM-28-J, converted to external P/S but no mech. mods, PU only - $250. Dave Ishmael, WA6VVL, 1118 Paularino Ave., Costa Mesa, CA 92626. (714) 979-5858

FOR SALE: Receiving tubes, new and used; multi-section twistlock electrolytic caps to 500-VDC; SAMS photofacts. Send stamp for lists. Turner Electronics, 16701 Main St., Ste. 121, Hesperia, CA 92345.

WANTED: F500B 6.0 mech. filter for a 51J4. Dan Martin, WB4GRA, 1522 S. Sowell Ct., Visalia, CA 93277. (209) 734-0597

FOR SALE: Crystal radio kits, complete with face panel, base board, variable capacitor, prewound coil and many parts for old style radio. Remit $22.50. Carl & Grace Ent., 5636 Romeyn, Detroit, MI 48209.

WANTED: Johnson Viking 500, Globe King 500 or other 500W class AM HF xmtr. No junk please. Lock, KB7TQ, (602) 870-2871 (d), 581-2778 (n)

FOR SALE: Johnson 6N2 converter - $80; NC-300 - $130; NC-300 6&2 meter converters, new in box - $125; Collins UR-388, like new - $380; Seneca 6/2 110 watt xmtr - $75; Heath SB-300/400 combo, like new - $225; as new DX-60 + HR10 + HG10 - $150; SB-610 scope - $90; SB-620 panadapter to your IF - $110. Manuals with all. Carl, (913) 681-9875

FOR SALE: Telegraph key collectors illustrated quarterly journal. Informative articles, free subscriber ads. $10/yr. USA. Sample, $2. TVC, Box 88-A, Maynard, MA 01754.

FOR SALE: Collins 51J4, 51J2, G-133 (51S1), 75A1, 32V2, (2) R-388's - $2000; rare Supreme AF-100 xmtr, Boulevard Electronics rcvr, & Hallicrafters 8R40 rcvr, Viking 500, no ps - $1000. PU only! Don Winfield, 6080 Anahuac Ave., Ft. Worth, TX 76114.

FOR SALE: Radio tubes; repair and restoration of all vintage amateur and commercial radios, 25 years experience. Herbert Stark, 321 N. Thompson St., Hemet, CA 92543. (714) 658-3444

FOR SALE: Central Electronics sideband slicer model A and Multiphase exciter model 10A; Collins PTO type 689-BM127 (new). Make offer. Frank, W8SET, (304) 343-0415.

WANTED: VG/mint matching spkr for my National NC-270 rcvr. Dale, WA8SHR, Southington, OH (216) 898-8215

ELECTRON TUBES FREE 1994 Catalog, over 2,000 types in stock. **Electron Tube Enterprises,** Box 311, Essex, VT 05451. (802) 879-0611, FAX (802) 879-7764

FOR SALE: Heath AT-1, exc. cosmetic and electrical condx, w/manual copy - $100; set of 4 Millen wavemeters in orig. wooden box - $35; National NC-125TS spkr, exc. condx - $50; National HRO-50 AA coil - $40; National HRO-50 AC coil with dial scale - $75; National XCU-50-2 calibrator - $65; SBE SB2CW Codax CW adaptor for SBE-34 - $45. 1 package, you ship. Al Culbert, KØAL, 328 Norman Dr., Cedar Rapids, IA 52402. (319) 377-4367

WANTED: Collins - Amateur catalogs, sales lit., manuals, promotional items & Signal's. Richard, KD6CPE, POB 992, El Toro, CA 92630-0992. (714) 855-4689

FOR SALE: Racal MA79 xmtr drive unit, all tube, 1.5 - 30 MHz, SSB/CW/FSK, ex-British gov't, matches the RA17 rcvr, tech. manual, very good condx - $450; Racal TA83, 500 W SSB/CW all tube xmtr, 19" rack mounting, 1960's design, unused and mint condx, tech. manual - $3500; Hal ST6000 RTTY terminal unit, mint condx, w/orig. manual and packing - $175. Nigel, AD4AG, (404) 705-9220 (w), 949-1097 (h)

FOR SALE: ART-13 parts & other interesting stuff. SASE for "The Bone Yard List." el.Kay electronics, 231 Shenandoah Trail, Warner Robins, GA 31088-6289.

FOR SALE: HRO-60T, A-D coils, calib., spkr, orig. manual, good working condx - $450. Carter Elliott, WD4AYS, 1460 Pinedale Rd., Charlottesville, VA 22901. (804) 979-7383

WANTED: GW10 or GW11 CB; Johnson Pacemaker manual; Johnson Adventurer manual; Heath Two'er manual, copies OK. **FOR SALE:** General Radio Co. model 727A AC VTVM. John Feltz, WA9LWJ, 973 E. First St., Junction City, WI 54443.

WANTED: Stock tickertape machine and/or pedastal; also Dow, Melihan Valiant, Mac bugs; Marconi Atlanta rcvr; marine station code apparatus. Joe Kramer, K3ES, POB 8102, Pittsburgh, PA 15217. (412) 621-3977

FOR SALE: Collins 75A-2 - $450; RE 312B-4 - $150. All are exc. condx and have manuals. Mike, (209) 435-3159

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

FOR SALE: Collins 4:1 knob kit - $125; Lysco Transmaster, Gonset Communicator 2, 3 with VFO & 4 with VFO, rare Tapetone skysweep rcvr, all excellent - $500. Don Winfield, 6080 Anahuac Ave., Fort Worth, TX 76114.

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: WW II German, Japanese, Italian, French equipment, tubes, manuals and parts. Bob Graham, 2105 NW 30th, Oklahoma City, OK 73112. (405) 525-3376

FOR SALE: Radiotron Designers Handbook, 4th Edition - $50. Pat Person, Box 1063, Bothell, WA 98041. (206) 487-1230

FOR SALE: RME 45 w/spkr - $90; DX-60, not working - $30; HV filter choke, 10 Hy, .5 amp, 48 ohms, test V - 9000 - $15. U-ship. Mike Nichols, 10010 W 59th Pl., #4, Arvada, CO 80004. (303) 431-7298

FOR SALE: Multi-Elmac AF-67 xmtr (new caps), manual - $90 + UPS; Gonset G66B w/ pwr sply - $85 + UPS; tube CB's, various. Charles Zafonte, N1FRX, RFD 1, Box 75, Fort Kent, ME 04743. (207) 834-6273 eves

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FOR SALE: Dials for Collins KWM-2/S-Line, unused in orig. boxes - $50 each; used Collins PM-2, 12V mobile pwr splies - $50 each; used 5V/14.5A ($20 each) and 5V/29A ($30 each) filament xfmrs for 3-500Z's etc; used equipment pulls, near new condx, 4D32 tubes (for older Collins and Hallicrafters xmtrs) - $25 each. All items limited quantity, and plus shpg. WANTED: ARRL manual, "How to Become a Radio Amateur" or copy, circa 1951-1955. Derek, KI6O, callbook address, (916) 965-4904

WANTED: Clean exc. 75A-4 (high serial 5000+) top price. Hiro Sakai, AD4EC, 2555 Collins Ave., PH #102, Miami Beach, FL 33140. FAX (305) 470-4924

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WANTED: All items in WW II B-26 radio compartment, BC-461 antenna control box, clock lamps, oxygen, chair, etc. Greg Greenwood, WB6FZH, Box 1325, Weaverville, CA 96093. Msg. (707) 523-9122

FOR SALE: Repair! Radio repair, tube or solid state, reasonable rates. Jim Rupe, AB7DR, Western Amateur Radio Repair Co., (WARRC), 9330 State Ave., Bldg. B 313, Marysville, WA 98270. (206) 387-6312

FOR SALE: Gonset GSB-201 amplifier - $175; GPT-750D - $1095 OBO; Swan 500 w/117XC - $130; Heath SB-630 station control - $45; parts units - BC-348R - $35, R-388 - $55. U-ship. SASE for tube list. **WANTED:** Good clean TCS dynamotor supply. WA7HDL, Rt. 1, Box 178-A6, Salmon, ID 83467. (208) 756-4147 after 1730 MDT

FOR SALE: Hallicrafters HT-37 parts - pwr xfmr - $40, VFO assembly - $20, meter - $10, other parts. Jerry Tastad, KB7M, 519 Flint, Laramie, WY 82070. (307) 742-4033

WANTED: KT-88 and 300B tubes. Will pay up to $50 each. Frank, AI9T, 8968 W. Forest Home, #4, Greenfield, WI 53228. (414) 529-9395

TRADE: SX-28 FCC for a 75A-1 w/spkr. Gary, K7MHE, (503) 257-6525

WANTED: QST's. All issues before 1930. Feb., July 1951; July 1952; Sept. 1956; Feb. 1958; Jan. thru May 1960; Aug., Dec., 1961. Howard Weinstein, 15 Lakeside Dr., Malton, NJ 08053. (609) 596-3304

FOR SALE: Used (good condx) Jennings vacuum variable caps, CVCH-1000-5N885, 7-1000 pF @ 5000V, 1/2" drive shaft - $40 each; new in orig. boxes, J-45 knee (leg) telegraph keys, complete w/cord and PL-55 plug - $30 each; used (pulls) 3B28 tubes and IN2637 diode replacements for 3B28 and 866A tubes - $4 each, used ceramic plate caps for same - $1 each. All items limited quantity, and plus shpg. Derek, KI6O, callbook address, (916) 965-4904

FOR SALE: Vintage parts. Send stamp and request "Vintage Flyer". USA only. 40 years of mail order electronics. Bigelow Electronics, P.O. Box 125, Bluffton, OH 45817.

FOR SALE or TRADE: National 173, very nice - $125; Gonset Comm. III, w/orig. box, 6M, exc. - $95; Comm. III, 2M, nice - $65; B&W 5100 - $50; 51SB - $50; Swan 500CX, w/PS & VOX - $225; Mosely A310 NIB - $125; military teletype, huge, w/lots of extras for trade only, might deliver; Globe 680 - $25. Fred Watson, KB8NRF, 581 W. Summit St., McClure, OH 43534. (419) 748-8798

WANTED: CQ Feb. 1946; CQ Aug. 1977; Radio Handbook (Orr) 21st Edition; Hints & Kinks (ARRL) Volume 11. Lynn Stolz, N8AJ, 2461 Bean Oller Rd., Delware, OH 43015. (614) 369-9777

WANTED: Johnson 122 VFO; Globe 755 VFO or Heath VF-1 VFO; also a 4-250A tube new or used. Rob, N5eV, (408) 464-0505 weekdays.

AM Broadcast:
Used AGC's, limiters, mixers, consoles, EQ's, mics & tube mic preamps. U-fix-ums to total rebuilds. Send for current availability.
Presley Travis, KA4NNN, Electronic Workshop, Rt 4, Box 36-B, Louisa, VA 23093. (703) 894-0406

WANTED: Intelligence museum wants German, Japanese, Italian, Russian and Chinese communication equipment and any British or U.S. spy radios. LTC William Howard, 219 Harborview Lane, Largo, FL 34640. (813) 585-7756

FOR SALE: SX-115 - $495; S38C - $50; SX-24 - $50; SW54 - $50; 2B, 2BQ, calib. - $150; Omni D, ps - $395. Ron Follmar, K5GIT, 332 Camino Real, Kerrville, TX 78028. (210) 896-8830

FOR SALE: RME DB-23 preselector, VGC - $25; Clegg 22er xcvr, VGC - $50. Postage xtra.
WANTED: Heath HR-10B manual. Al Kaiser, W2ZVR, 713 Marlowe Rd., Cherry Hill, NJ 08003-1551. (609) 424-5387

WANTED: To buy Mallory Sta-loc controls, shafts and switches. Send your list and price. James Fred, R1, Cutler, IN 46920. (317) 268-2214.

FOR SALE: National TRM (looks like SW-3); Johnson Ranger, exc. condx - $250; Heath DX-60B, exc. condx - $65; HRO-50 E coil - $60. Steve, KA9QLF, (217) 243-3920.

Photofacts and Parts for Collectors
Electrolytics, high voltage capacitors, power resistors, plugs, switches and more. Free catalog. **A.G. Tannenbaum, WA2BTB, P.O.Box 110, East Rockaway, NY 11518. (516) 887-0057, FAX 599-6523**

FOR SALE: Tubes, capacitors, sockets, NOS and reproduction parts for antique radios and TV's. Large SASE for tube list or $2 for 20 page catalog refundable with 1st order. Vintage TV-Radio, 3498 West 105 St., Cleveland, OH 44111.

WANTED: McIntosh and Thordarson amplifiers any condx. Marcus Frisch, WA9IXP, Box 28803, Greenfield, WI 53228-0803. (414) 545-5237

FOR SALE: Rare MP-28BA (540 VDC) modulator/dynamotor for Bendix TA-12 series xmtrs. Ted Bracco, WØNZW, Quincy University, 1800 College Ave., Quincy, IL 62301. (217) 228-5213

TRADE: Racal RA929 manpack HF digital rcvr, .5-30 MHz, manuals, charger, carry case, amplified weatherproof vehicle spkr, handset and antenna. Trade for interesting radio such as 32V3, SX-88, SX-115, NC-400, GPR-91 etc. Harry T. Enmark, WA6IUR, (818) 355-0290

WANTED: Manual for Patterson PR 15 rcvr. Also want National NC-125 rcvr. Don, W7KCK, (503) 289-2326

WANTED

Collins promotional literature, catalogs and manuals for the period 1933-1983. Jim Stitzinger, WA3CEX, 23800 Via Irana, Valencia, CA 91355. (805) 259-2011. FAX (805) 259-3830

WANTED: Information on Frontier Electronics, Super 600GTB xcvr; mods for HRO-500 and Squire-Sanders SS-1R; original manuals to buy. Pete Markavage, WA2CWA, 27 Walling St., Sayreville, NJ 08872. (908) 238-8964

FOR SALE: Subscribe to "The Amateur Market Place". A Canadian newsletter, listing new/wanted Amateur/Computer equipment. 10 issues per year $16.50 US. Benefit from $ exchange. P.O. Box 8180, Ottawa, Canada K1G 3H7

FOR SALE: New equipment pulls, Bird 43 directional couplers w/connector and cable for meter but without quick-change connectors - $35 each; same, with two (2) male 'N' or two (2) female TNC quick-change connectors - $45 each; aluminum dummy meter protector slugs for Bird 43 - $5 each; new, in orig. packing, stainless steel replacement tapes for Hy-Gain MD-1 adjustable dipoles - $25 each, two (2) for $40; new, in original boxes, 60" military test lead sets, manufactured in 1987, metal tips 1/16" x 1/2", plus two (2) rubber covered alligator clips for either end of test leads, plus two (2), (1-blk, 1-red) replacement banana plug tips for those whose test sets require banana plugs (must be soldered on) - $3/set. All items limited quantity, and plus shpg. Derek, K160, callbook address, (916) 965-4904

FOR SALE: Repair & restoration of all classic & vintage radio equipment, reasonable rates, prompt turn around, 25 yrs experience. Mike McKean, N3HJQ, 726 McClellan St., Philadelphia, PA 19148. (215) 336-6111

WANTED: Buy and sell all types of electron tubes. Harold Bramstedt, C&N Electronics, 6104 Egg Lake Rd., Hugo, MN 55038. (800) 421-9397, FAX (612) 429-0292

FOR SALE: Drake T4XB, R4B, MS4, manuals; Morrow MBR5, MB560, SP-PS, manuals, cables, mic; Multi-Elmac AF-68, AC/DC PS, manuals; Atlas 210X, console, PS, manuals; Globe Deluxe VFO 10-160, manual; Hallicrafters S40B, w/Heath QF-1, manual. Eugene Clayton, W7MXM, (208) 522-5854

WANTED: Johnson gear, all models, any condition. Also parts and literature. Please state condition and shipped price. Wen Turner, AD7Z, Box 451ER, Cal-Nev-Ari, NV 89039.

FOR SALE: Mallory 1 Meg or 500K ohm, 10% audio taper, single volume controls, 1/4" dia. hollow brass shaft 2-1/4" long - $5 each ppd. James Fred, R1, Cutler, IN 46920. (317) 268-2214

FOR SALE: Nems-Clark type 1306 tube-type rack-mtg VHF/UHF rcvr, 30-60 MHz & 55-260 MHz with dual VFO tuning, AM/FM variable BFO & squelch. 10, 300, 500 kHz & 1 MHz I.F. bw's, good condx - $125; Drake R4 rcvr, orig. w/docs, good condx - $125. Randy, WB6MAI, 1707 SW Coronado St., Portland, OR 97219. (503) 246-8164 (eves)

WANTED: Speaker for Collins 75A-2. David A. Clark, K5PHF, 9225 Lait Dr., El Paso, TX 79925. (915) 591-4184

FOR SALE: Eight pin octal sockets for your Collins 516F-2. Exact replacements that fit the socket and mounting holes - $4 each shpd. Rich, (702) 222-0442

FOR SALE: Collins meatball lapel pin - $5.95 + $.75 S & H. George Pugsley, W6ZZ, 1362 Via Rancho Prky, Escondido, CA 92029.

FOR SALE: Service manuals. Most photocopies $5, shpg $.50 each. Hallicrafters, Heath, Johnson, others. SASE for list. DSM Diversified (formally Miller Radio), 909 Walnut St., Erie, PA 16502.

FOR SALE: AN-TXC-1 FAX mach.; BC-639A - either for $25 + UPS; IBM typewriter terminal - $30 LPU only. Ted Stewart, W6NPB, 2157 Braemar Rd., Oakland, CA 94602. (510) 531-7042

WANTED: Need info for eight band rcvr made in Holland by Norelco. Has tuning eye. Any help appreciatted. Randy Hull, WB3ECC, 1101 Hagy Ln., Dauphin, PA 17018. (717) 921-2966

ELECTRIC RADIO PARTS UNIT DIRECTORY

If you need a part for a vintage restoration send $2 and an SASE (.52 postage) for a 7 page list of parts units. If you have a parts unit, consider putting it on the list. Your dead unit can help bring others to life!

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

FOR SALE: Viking II VFO mint; Hallicrafters HA-5 deluxe VFO w/manual; Morrow CM-3 Conelrad monitor, mint. Dusty Rhodes, W8MOW, 1324 N. Dorset Rd., Troy, OH 45373. (513) 339-1546

WANTED: Beginning collector needs anything Vibroplex. Send me your bug and key list. Mitch, WA4OSR, 11 Midtown Park, E., Mobile, AL 36606. (205) 476-4100, 342-7259

FOR SALE: Viking I front panel refinishing this summer. Call or write for details. Ron Eisenbrey, KC5DFX, 115 First St., Sugar Land, TX 77478. (713) 491-7823

FOR SALE or TRADE: Modulation xfmr UTC S-18, new in box. **WANTED:** Audio choke 300-500 H, 5 mA. Al Bernard, POB 690098, Orlando, FL 32869-0098. (407) 351-5536

WANTED: WW II ex-service equipment. Suitcase sets. **FOR TRADE:** Warzaw-pact sets, German WW II duplicates. Rag Otterstad, OZ8RO, Hosterkobvej 10. DK-3460 Birkerod. FAX 011-45-4468 1514

FOR SALE: NOS TV and radio tubes, parts, SAMS, mostly from '60's and '70's. Send large SASE for list. Charles Preston, K4LJH, 48 N. Ivandale St., Hamilton, VA 22068. (703) 338-4152

FOR SALE: R-392-URR rcvr; Elmac AF-67 xmtr. KØCAB, (319) 377-9126

FOR SALE: DX-20 front panel, very good + - $20; free for shpg, Zenith Transoceanic, ? model, rough exterior but appears complete. Richard Cohen, 11802 Willow Point Way, Tampa, FL 33624. (813) 962-2460

WANTED: Meissner EX Signal Shifter and schematic for FMX modulator. Hank, W2IQ, (615) 397-9796

FOR SALE: Ameco TX-62 and VFO-621 (2 & 6 meter xmtr), exc. condx - $100; Knight tube tester - $30. Marv, AAØHL, 109 McIntosh St., Lehr, ND 58460. (701) 378-2581

FOR SALE: New Ranger I, Valiant I and Navigator plastic dials, 160-10, freq. numbers in green, w/all holes, like original - $17.50 ppd. Bruce Kryder, 4003 Laurawood Ln., Franklin, TN 37064. (615) 794-9692

FOR SALE: Eimac catalogs 1954, '58, '59. Marty Drift, (908) 359-4425

FOR SALE: Cleaning garage. 618T(3) ARC-102, K9 oscillator, w/schematics - $300 OBO; 618T( ) manual, reproduction - $40; ARC-12, less DM - $25; BC-610 plug-ins (2-18 MHz) and (tank coils) 6-18 MHz, both sets - $75; BC-610 plate xfmr, choke and mod xfmr (pickup only) - $100; Apache and SB10 - $150 (PU only); BC-610 speech amp w/cables and tubes - $100; R-390A, w/meters, dust covers and 3TF7's - $250; Dana 500 MHz freq. counter - $100; 16 pole SSB filter, CW filter, USB/LSB xtals, from Swan 600R - $50; R-390A parts, PTO's - $25, IF amps w/filters w/o 3TF7 - $65; crystal osc. decks - $30, audio decks - $20, p/s decks - $20, TR relays - $25, knobs - $1 ea., RF assembly - $40, refinished front panels (engraved lettering type) - $75; 4X150 family air system sockets (screen bypassed) w/chimneys, pulls - $10/set; HP 400L RMS meter - $50; T-368 decks, RF, modulation, and p/s, w/o tubes - $300 for all (PU only); Drake TR3, complete, no p/s - $100; Drake TR3 PTO - $25; ARC 5 rcvrs, Q5er - $20, BC band - $25, 160 meters - $25, 80 meters - $25, ARC-5 xmtrs, 2.1-3 - $25, 3-4 - $30, 4-5.3 - $20, 5.3-7 - $20, 7-9 - $30; CE 20A w/CE 458 VFO - $150; TCS RX/TX w/acps - $150; SP-600 - $250; M-28RO TTY, new (pickup only) - $75; P/S, 2000V @ 250 mA CCS - $40; 2" scope modules from MD-522 tty modem w/docs - $30 each; Tek 535 scope, spotless, new w/used CA plugin - $200 (PU only); GRC-19 w/mount, tty demod, and mod - $350 OBO (PU only); GRC-9 w/28V DM sply - $125; many rcving tubes and misc. parts - LSASE for list. Bob Miller, KE6F, 9655 Appalachian Dr., Sacramento, CA 95827. (916) 732-5908 (w), 362-5481 (h), internet rmmiller@netcom.com

FOR SALE: R-390A orig. shock mount cabinet, very rare - $200; Heath SB-620 spectrum display in true exc. condx - $190; B&W CS-6G ant. selector - $25; R-390A tech manual - $10. Vic, (805) 581-5317

WANTED: Military radios. U.S. RT-136/GRC-13, Soviet R (P)-112, R (P)-113. Leroy E. Sparks, W6SYC, 924 W. McFadden Ave., Santa Ana, CA 92707-1114. (714) 540-8123

TRADE: ACR-175, NC-100X, NC-101X, HRO-M, SX-16, S-19R, AT-1, AF-67, Commander, Spanmaster, SX-110 for keys. Trade only. No calls. Richard Ferranti, WA6NCX, 254 Florence Ave., Arlington, MA 02174-7248

WANTED: Heath Cantenna type HN-31A. W7SBG, Box 355, Nucla, CO 81424. (303) 864-2228

WANTED: Check those basements for WW II radar equipment, units or complete systems. Thanks. Allan H. Weiner, 507 Violet Ave., Hyde Park, NY 12538. (914) 471-9500

FOR SALE: Weston 785 multimeter, VG condx - $25 + shpg. **WANTED:** Schematic, service data for Conelrad monitoradio CM3; good carbon mic '20N406' (or equiv.) for USN TCS-12. Carl Gottsmann, KN6AL, POB 5670, Chico, CA 95927-5670. (916) 899-8675

WANTED: Teletypes, Teletypes, Teletypes and any other teleprinter machines, parts, literature or information from the 1940's to the '70's. Gary Ashbaugh, POB 2008, Corvallis, OR 97339. (503) 758-8006

FOR SALE: Swan 117XC pwr sply/spkr, exc. - $100; Swan 510X xtal oscillator - $30; Drake RV4C, remote VFO - $100. Craig Pitcher, WA9HRN, 1308 Kristin Dr., Libertyville, IL 60048. (708) 367-1599

WANTED: Components of SCR-506-A consisting of xmtr BC-653, rcvr BC-652, shockmount FT-253-A, dynamotor DM-43-A & spares chest CH-263. Steve Finelli, 37 Stonecroft Dr., Easton, PA 18045. (610) 252-8211

FOR SALE/TRADE: R1051, R1051B's, guaranteed good, electrically, physically - $295 + UPS. Looking for any type mil. RF electronics, radio, radar, manuals for military equipment, especially WLR-6 submarine intercept rcvr, ASQ-19 and GRC-144. Please callme if you have leads on these or other military manuals. Tony Snider, 512 Princess Anne Rd., Virginia Beach, VA 23457. (804) 721-7129

WANTED: Hallicrafters xcvrs like the SR-150, SR-160, SR-400, SR-500 and SR-2000. Units need not work. Call Ray collect (407) 676-4952 between the hours of 6 PM - 9PM Eastern.

FOR SALE: Ranger I, factory wired - $175; Collins 26U limiter - $50; Drake 2B w/2AC and 2AQ - $225; EH Scott RCK VHF rcvr; TCS-13 TX and RX - $150. **WANTED:** Large script emblem for early Gates xmtr; base for EV 664 mic. Thanks! Tom Smith, N5AMA, 13034 Elmington Dr., Cypress, TX 77429-2062. (713) 376-3436 (h), 957-6420 (w)

FOR SALE: Hammarlund Comet Pro, RME-69, both need work. Ranger works well, cabinet scratched. Joel Levine, 67 Derby Ave., Greenlawn, NY 11740. (516) 757-7641

FOR SALE: Restoration of vintage radios; 25 years experience. Phil Goodman, K4FXB, 217 Millbrook Farm Rd., Marietta, GA 30068. (404) 509-9493

WANTED: Telegraphic apparatus and keys by collector, not a dealer. Will pay top dollar. Pete, WB2BYQ, (201) 818-4311

FOR SALE: BC-610-E, speech amp, tuning units, coils, ant. tuner, lots of spare tubes, accessories, very clean and operating w/manuals. MO. (816) 524-1541

FOR SALE: Collins-made WW II-vintage Navy TCS-5 and TCS-12 sets, RX & TX are opened but unused, remote spkr, cables & loading coil are used, good, dyno supply, spares kit and noise limiter kit are new-in-unopened boxes. Complete set as described - $499 shpd to your door. Also have some extra Collins TCS noise limiter kits for the TCS rcvr, unopened - $22; TCS dynamotor supplies, unopened - $119 and spares kits, unopened - $59. Don, N3RHT, (412) 234-8819

FOR SALE: Hallicrafters HT-37, appears working - BO, PU only; Collins 2.1 KHz mech. filter - $50. Tony Stalls, K4KYO, (703) 522-1568, FAX 243-8059, Internet: rstalls@access.digex.com

WANTED: GRC-9 AC supply book or schematic to borrow or buy. Supply is a PP327B/GRC-9Y. Ken Schwieker, K4KQR, 1406 Novella St., Opelika, AL 36801. (205) 745-3761

FOR SALE: Original HRO rcvr, converted fastidiously to solid-state (!) by W6VX over 15 years! Includes 10 coils - $200. Harvey, N6HL, (818) 784-9501

WANTED: Screw on front label for the Astatic D-104 Golden Eagle. Paul Mezzapelle, WA6NLJ, P.O. Box 883, Carmichael, CA 95609. (916) 481-0145 eves

WANTED: Ameco AC-1; meter for T-150; knobs for S-38. Bill, N8FOX, 18505 Shawnee, Spring Lake, MI 49456.

WANTED: EV 664 mic; 218 stand for 674; Hallicrafters HT-20; schematic for Radiophone Bandscanner. Top dollar paid. Roy Luxemburg, N5QQM, (504) 272-2563

FOR SALE: ARC-3 rcvr & xmtr; HC-10 keyer; ART-13 & dynamotor. F.W. Nicholas, (602) 864-9987

WANTED: Manual for Heath DX-40 xmtr. Jerry, WB9YMT, (708) 532-9245

FOR SALE: Standard Generator model 80 Boonton, 2-400 MHz, 400 & 1000 Hz modulation - $75 plus shpg. WB2AVE, 378 Albany St., Saddle Brook, NJ 07663. (201) 845-6386

FOR SALE or TRADE: Military DY-98/G dynamotor/pwr sply. Very good condx, complete w/cover - $50. Fred Clinger, WA8KJJ, 417 Beechwood Dr., Galion, OH 44833. (419) 468-6117 after 6 PM Eastern

WANTED: R389 VFO. Cash or trade. David Bertman, AB7B, 1314 S.W. Hall, #E, Portland, OR 97201. (503) 223-5295

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.

FOR SALE: Drake R4C - $275; National NC-173 - $125; parting out HRO-60. **WANTED:** RME DB20; cabinet for SP-600. Doug, (206) 472-3478.

FOR SALE: First user friendly circuit for early BC-348's. Send $2 + (3) $.29 stamps. Ray Larson, 1224-1/2 Gorham Ave., W. Los Angeles, CA 90049-5214

FOR SALE: NIB Simpson meters @ $15 each, Cat # 670 0-1 RF amps, Cat #5280 0-500 mA RF amps, Cat # 73800-50 VDC. Dewey Angerhofer, WØZUS, POB 540, Edgemont, SD 57735. (605) 662-7692

FOR SALE: Surplus unused BB-54A wet cells (2 volts) - $10 FOB N.J. (wgt. 3 lbs), six or more freight included. Abe, POB 4118, Jersey City, NJ 07304.

WANTED: For my HRO-60 - coil C,E,F. Also original spkr. Tnx. Chick, W3BPZ, (610) 437-1608

WANTED: Manual for a Heath DX-40; Collins 51J3 or 51J4; cabinet for a SP-600JX. Roger Quickel, 5511 S. Ridge, W. Geneva, OH 44041. (216) 466-6808

FOR SALE: PJ-068 mic plugs for Collins S-line/KWM-2, new gov't surplus - $8 each shpd in USA. Clint, KM6UJ, (408) 742-4582

FOR SALE: HP 8640B (AN/USM-323) sig. gen., AM, FM, pulse, 0.5-512 MHz w/repro manual - $595; BC-610H w/speech amp, ant. tuner, coils, tuning units, Johnson 122 VFO, manuals - $575; magazines bound w/covers - QST '23-'48 - $500, CQ '59-'84 - $250, 73 '60-'82 - $250, Ham Radio '68-'86 - $350. Larry Wright, N9HRQ, 131 Hilltop Dr., Lake in The Hills, IL 60102. (708) 658-5993

WANTED: Conset G-76; Viking 122 VFO; 6M Halo; 32V-3; Davco DR-30; manuals for Heath DY-60A and HG-10 VFO. Ron Thomas, N4RT, 800-368-6332

WANTED: Any condition, Hallicrafters Sky Master and EP-132 as shown. Also want SX-46, S-48 and S-49. Chuck Dachis, 'The Hallicrafter Collector', 4500 Russell Dr., Austin, Texas 78745. (512) 443-5027

FOR SALE: WW II military - TBX-8 xcvr, exc. - $219; EF-8 gas generator for TBX, unused - $140; GN-4x hand-crank generator leg/seat sets - $21/set; BC-654 legs - $33/set; BC-654 PE-103 dynamotor, good - $59. Jeep radios - BC-1335, battery case - $95; BC-1335, battery case, charger - $139; BC-659, good - $139; PP-114/VRC-3 vibrator sply for BC-1000, good - $85; BC-1000 homing antenna, new-in-box - $45; ARC-5 rcvrs - $35 each, xmtrs - $30 each; 2 hole rcvr rack - $40; dynamotors - $19-$29 each; RM-13J remote (handset cradle on top) exc. - $39; DY-88 pwr splies, good - $79, bad - $35; DAQ xmtr, near-mint, in canvas case - $85; I-83H dynamotor test stand (1943), good - $69. Don, N3RHT, (412) 234-8819

WANTED: 275W Johnson Matchbox w/ manual in good condx. Al Gross, W8PAL, (602) 814-6387

WANTED: Information! Who made professional conversions of BC-433 ADF to include 2-3 Mcs? Seen aboard tuna boats in the '60's. Please write M. Meltzer, 582 Valley St., San Francisco, CA 94131.

FOR SALE: A/N technical manuals, various '40's-'50's vintage. Xmtrs, rcvrs, test gear. Large inventory xmting, rcving tubes, communications rcvrs. Bill Hanks, Box 1004, Salome, AZ 85348. (602) 859-3797, FAX 859-4040

WANTED: WW II Japanese military radio equipment of any kind; early wireless related like spark xmtrs, loose-coupler & slide tuner rcvrs; subminiature & hybrid portable radios; Edison light bulbs; anything S.S. Titanic & German airship related. Takashi Doi, 1-21-4, Minamidai, Seyaku, Yokohama, Japan.

FOR SALE: National NCX-5 w/PS - $250; NCX-3 w/PS - $175; NC-300 rcvr - $185; Heath HW-100 w/PS - $150; HW-101 w/PS - $195; Tek 564B w/plug - $100; Drake TR4CW w/PS/spkr - $395; SB-220 - $595; BC-939 tuner; tubes - call for needs. WA8GLE, 2891 S. Main St., Akron, OH 44319. (216) 644-7804

WANTED: Help! I have two AN/URW 15 rx/tx, 1.2 KW out, 400-500 MHz. Much bigger than breadbox! Can you share info? Do you want them? Dave, AB5PF, (505) 783-4784.

FOR SALE: Used technical books - radio, electronics, mathematics, military, magazines, catalogs, handbooks, etc. $1 for big list (stamps ok). Softwave, Dept. ER, 1515 Sashabaw, Ortonville, MI 48462

FOR SALE: Old rcvr "National Monodyne Tube Set" model GT-1, used WD-12, with red and green coils, wood case. Don Hilliard, WØPW, (417) 451-5892

FOR SALE: NOS military headphones, rubber cups, 600 ohm. These have connector that fits the R-392 audio output plug - $22 plus shpg. Darron Edwards, 31877 Rebel Hill Ln., Tollhouse, CA 93667. (209) 855-2832

FOR SALE: Spinner knob 3" - $8, 2" - $7; National Vernier - $9; M.P. 65A (surplus) insulator w/spring - $8. Joe, W6CAS, (916) 731-8261

FOR SALE: Ocean Hopper manual - $6 ppd. (Xerox). Send a long SASE for list of hundreds more. Low prices. David Crowell, KA1EDP, 40 Briarwood Rd., North Scituate, RI 02857-2805.

WANTED: Test equipment (IE-17E) for WW II walkie-talkies (BC-611); test unit I-135E and artificial antenna A-82A. Richard Mollberg, K6PWF, 2340 Almond Ave., Concord, CA 94520.(510) 283-6786 (n), 827-4056 (d)

HEATHKIT FANS: Don't mourn their passing; enjoy learning more about their past in historic pictures and personal insights from many company oldtimers in 124 page book - $9.95 pp. Heath Nostalgia, 4320 196th S.W., Suite B-111, Lynnwood, WA 98036-6754

FOR SALE: Tubes, tested, clean, boxed, lowest prices, good selection. Business size SASE for list. Bill McCombs, WBØWNQ, 10532 Bartlett Ct., Wichita, KS 67212-1212

FOR SALE: Hammarlund HQ-170 VHF, 160-2M, very good - $195; RME VHF 152A converter 2, 6, 10M, output 40M - $60; Heath WA-P2 preamp + PS, exc. for boosting audio, 5 inputs, bass/treble, etc. - $50; Heath HD-20 wireless 100 Hz calibrator - $20; Utica 6M VFO, 8 MHz out - $40; Monitor Radio 150-174 MHz FM - $20. Xfmrs - Viking driver - $15; 1200 VCT, .12 A DC - $25; 2.5 VCT, 10 amp (10 KV) - $30; 2.5 VCT, 10 amp (UTC) - $12; Globe King 500 modulator (B+) - $70; mil spec matched 6L6WGB (modulator Ranger - will sub rare 7027A) - $20; 35 W solid-state speech amp - $25; HB 20 watt tube amp - $15; Shure (RCA) dynamic desk mic - $20; Western Electric Hi-Z headphones ('20-'30's?) - $25. Jim, (616) 229-4318

FOR SALE: Heath HW-100, fair +, works, w/ pwr sply - $100; TV-4 tube checker for the USM-3A with a copy of the tube test settings - offer?; Yaesu FTdx-400, good, works, but no 10M xtals - $175; ARC-38/38A dynamotor, ugly but works - $35; 3 boxes of CQ's mostly '50-'70's, fair, musty, readable - $25 for lot. All prices + UPS. **WANTED:** A panel meter for a Sideband Engineers SB-34 or maybe just a parts set with a good meter, the same for the SB-33 – also need knobs for this set, accessories such as square blue mic with blue coil cord (for SB-33), calibrators and carrying cases for '33 or '34; SB-35 or SB-36 sets , any condx would be interesting; Eldico S-line parts xmtr with no extra holes in front or rear; HBR-14, HBR-16, DCS-500 or other homebrew superhet rcvr; Johnson Viking Mobile junker with the exciter tune mechanism intact & most knobs; cheap but repairable 312B-4. (Hey, I'm allowed to dream!).Walt Hutchens, KJ4KV, 3123 N. Military Rd., Arlington, VA 22207. (703) 524-9794

WANTED: SSB adapter for RME 4350, call anytime. Ron Weaver, N6VO, (714) 559-6209

WANTED: E.F. Johnson Viking Navigator. Gene Peroni, KA6NNR, POB 58003, Philadelphia, PA 19102. (215) 665-6182 (d)

FOR SALE: 3' x 5' reprint of factory schematic for Collins KW-1. Please send $25 ppd US to Tom Berry, K9ZVE, 1617 W. Highland, Chicago, IL 60660. (312) 262-5360

WANTED: Still collecting WW II vintage radar equipment. Units or the whole set. Allan H. Weiner, Hyde Park, NY 12538. (914) 471-9500

FOR SALE: Big stuff - Hallicrafters BC-669/HT-12 xmtr/rcvr, homebrew sply, as-is - $99; Meissner 150B 150W plate modulated AM xmtr, 1941, 2 Signal Shifter exciters, all coils, manual copy, pick-up only - $229; E.F. Johnson factory-built Invader 2000, looks and works good - $699 shpd to your door; Navy AN/SRR-12, RCA, 2-8 MHz, good condx, rare - $259. Don, N3RHT, (412) 234-8819

WANTED: HQ-100 and Adventurer. Bob Braeger, WA6KER, 6634 Navel Ct., Riverside, CA 92506. (909) 682-5084

WANTED: S-meter for SX-24; clean front panel for HQ-129X; VFO for Globe Scout 65A; Harvey-Wells TBS-50; VG WW II TBY xcvr; mint black crinkle ARC-5's. **FOR TRADE/offer:** Hallicrafters good SX-28/SP44 panadaptor - U-ship. Bob, K6GKU, (619) 792-8227

FOR SALE/TRADE: Transmitting/Receiving tubes, new and used. LSASE for list. I collect old and unique tubes of any type. **WANTED:** Taylor and Heintz-Kaufman types and 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

FOR SALE: Literature - Military TMs (originals), BC-312 (314, 342, 344) - $31, SCR-300 (BC-1000) - $21, TG-5/5A - $21, BC-191 RA-34H rectifier - $6. Boatanchor manuals (originals) - NC-57 - $14, NC-183 - $18, TR-3 - $16, HW-101 - $29. Magazines - Ham Radio, 1968 (V1#1)-1987 - $199; 73, 1962-1980 - $150. Don, N3RHT, (412) 234-8819.

FOR SALE: B&W 370 SSB Slicer - $75; BC-342, poor - $50; MN26Y - $50; TS497C sig. gen. - $50; C1306/GRA14 box - $35; R109/GRC FM rcvr - $25. Mel, K2AOQ, (716) 671-0776

FOR SALE: MFJ artificial ground - $20; Ameco code practice oscillator - $10; Microcraft code star - $30; Heath 1424A active antenna - $15; Heath HD-1422A antenna noise bridge - $15; Heath HD 1420 VLF converter - $15; AA10 active antenna - $10. All items in exc. condx w/ manuals. David L. Muse, KD4FEB, 510 Minturn Ave., Hamlet, NC 28345.

FOR SALE: Manuals TM 11-477, 662, 665, 666, 667, 668, 684 - any manual $5 ppd. R.J. Eastwick, N2AWC, 224 Chestnut St., Haddonfield, NJ 08033. (609) 429-2477

FOR SALE: Collins 75S3, 32S3, 516F2, 312B4, DX Engineering - $925; Yaesu FV-101B VFO for FT-101 series - $165; Swan WM2000 2KW wattmeter - $85; vacuum variables. Lane, KM3C, (619) 462-3857

WANTED: Panoramic Radio Products P.R.I panadapter; also wanted Johnson KW Matchbox, w/SWR meter. Jay Spivack, 325 S. Washington Ave., Kent, WA 98031. (206) 859-2680

WANTED: Vintage tube CB's; pwr sply/modulator for Johnson 500. Send card or call with model you may have. Steve White, WB5UGT, Box 1086, Clute, TX 77531. 800-374-6477 - 9008 (leave message)

FOR SALE or TRADE: Knight T-60 TX. Ray Williams, 4521 Whitfield Ln., St. Louis, MO 63134-3821.

WANTED: Manual/schematic for National Radio Co. model 2 F.S. converter. Jay Budzowski, N3DQU, 109 S. Northview Ave., New Castle, PA 16102.

FOR SALE: Hallicrafters HT-40 AM/CW xmtr - $65; Johnson Challenger, AM/CW xmtr - $65; partially completed W7EL QRP 30M xcvr kit - $25. Dave Roscoe, W1DWZ, 49 Cedar St., East Bridgewater, MA 02222. (508) 378-3619

WANTED: For Collins 75A-1, tuning knob with 3" skirt (or just the skirt) and cover plate for VFO compartment; Millen 500 watt coils, series 42000; Hallicrafters SX-11 dial plate. Dean Showalter, WA6PJR, 7816 Redberry St., NW, Albuquerque, NM 87120. (505) 899-9376

FOR SALE: Heath AC-1, sealed box, stock number 103-2413 - BO; Gonset Communicator IV and 3 band VFO, manuals, exc. condx - $100. The Radio Room, 898 N. Broadway, North Massapequa, NY 11758. (516) 798-1230

WANTED: Manual and/or schematic for Collins RT-380, also known as Collins 18S4. Copy OK. Ted Bracco, WØNZW, Quincy University, 1800 College Ave., Quincy, IL 62301. (217) 228-5213

FOR SALE: Hallicrafters S-120, w/orig. manual, xtra clean - $60 or trade for National items. Jim, K7BTB, Box 50355, Parks, AZ 86018. (602) 635-2117

FOR SALE: HRO-50R w/rack cabinet & ABCD coils - $325; Viking I w/122 VFO - $250. **FOR TRADE:** Globe King 500C for Johnson 500. Bill, (914) 356-6553

WANTED: Collins KW-1. Joel Thurtell, K8PSV, 11803 Priscilla, Plymouth, MI 48170. (313) 453-8303

FOR SALE: Military SP-600-JX6 rcvr. New, never used, working condx but some moisture damage. With cabinet - $275 PU only. Bob, WB6EZK, POB 1081, Sausalito, CA 94966. (415) 332-3905

WANTED: Collecting early Heathkit gear 1940's-'50's; early Heath catalogs and literature; Heath mics, spkrs, supplies, access.; any parts units. Byron, WA5THJ, 1215 Fresa Rd., Pasadena, TX 77502-5017. (713) 941-3631

WANTED: Multi-Elmac PS-2V pwr sply. Also wanted tube CB's. Charles Zafonte, N1FRX, RFD 1, Box 75, Fort Kent, ME 04743. (207) 834-6273 eves & wknds

FOR SALE: PRC47 LSB/USB kit - $40; new machined coax antenna panel - $9. All restorable. Jay Craswell, WBØVNE, 321 West 4th St., Jordan, MN 55352-1313. (612) 492-3913

WANTED: Two BC-645 or ABA IFF sets with dynamotors, coding disc sets, connectors, control boxes and all antennas. Dave Ross, KA6EPI, (206) 465-2117

FOR SALE: High voltage RF xfmr - $65; Gemtronics base CB - $20; older military mics, headset, throat set. **WANTED:** Keys and other older electricals. J.H. Jacobs, 60 Seaview Terrace, Northport, NY 11768. Phone/FAX (516) 261-1576

FOR SALE: Services. To introduce you to our schematic service, we will send you one schematic of your choise for $1 cash plus stamp. Applies to radio's in the 1920-1960 era, except communications receivers. Regular customers included. Offer ends Jan. 1, 1995. Joseph R. Forth, 321 Long Vue Acres, Wheeling, WV 26003. (304) 277-3154

WANTED: SX-115, NC-400 and SX-42 cabinet in exc. to mint condx only. Top $ paid. Tom Scherer, WB2IIS, (716) 634-2545 (d), 741-9574 eves.

WANTED: WW II German and clandestine sets. FOR TRADE: BC-322, BC-655, AVQ-9, BC-306 A.T.U., AN/PRC-10. Warzaw-pact sets. OZ8RO, Rag Otterstad, Hosterkobvej 10. DK-3460 Birkerod. FAX 011-45-4468 1514

FOR SALE or TRADE: Original Hallicrafters manuals: S29, SR34, S36A, S40, SP44, SX-101-MK III, SR-150, SR-400 - $15 each + shpg. Lee Shumway, WB8ZEY, 2820 Yankee Springs Rd., Middleville, MI 49333. (616) 795-3255

FOR SALE: Drake 2B, exc. condx, w/manual (copy), fully reconditioned, 24 yrs experience. Ready to go - $185 shpd. Cory, N2AQS, 1000 E. 14th St., Plano, TX 75074-6249. (214) 751-7535

FOR SALE: (All working, clean, orig. knobs.) Knight Spanmaster - $40; Heath GR-81 - $30; Hallicrafters S-38E - $40; Heath Two'er - $25. U-ship. **WANTED:** Heath - AR-1, AK-7, GR-54, HW-18 (160), PM1, SB-313; Gonset - 220 MHz Communicator; Swan - 140, MB80, 350A/B; Harvey-Wells - R9A, T90, Z-Match; Elmac - PMR6/A, PMR12/A. All should be good, appearance wise. Herman Cone, WB4DBB, 305 Foxwood Dr., Goode, VA 24556. (703) 586-5643

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FOR SALE: RIT for KWM-2 and S-Line. No modifications for KWM-2. $59.95 tested/42.95 for kit. SASE for details and order info. John Webb, W1ETC, Box 747, Amherst, NH 03031.

WANTED: Is anyone running a BC-325 xmtr? Do you know of one operational or in a museum anywhere? Help! Don Merz, 47 Hazel Dr., Pittsburgh, PA 15228. (412) 234-8819

FOR SALE: Central Electronics CE-20A - $65; 458 VFO w/10M installed - $75; Johnson SSB adapter - $175; Hallicrafters S-38 - $45; Heath HR-10 - $25; parts units - Globe DSB-100 xmtr - $30, Gonset G-33 - $20,Hallicrafters S-76 - $40; tubes, lots of NOS rcvg tubes for sale - call with your needs. **WANTED:** Heath SB-620 parts unit wired for 3395 kHz (Heath radios) or coil set for same. Kim, KE8NE, (616) 677-3706

WANTED: Drake R4C rcvr; (Hickok, etc.) mutual conductance tube tester; Kenwood T-599 xmtr; Radio Shack DX-400; Uniden CR 2021; RCA model CRM R6A; Heath SB-610 monitor scope. Rick, K8MLV/Ø, 1802 W. 17th St., Pueblo, CO 81003. (719) 543-2459

FREE: Send 2-stamp LSASE for Olde Tyme Radio's latest flyer, No. 194A to: Olde Tyme Radio Company, 2445 Lyttonsville Rd., Ste. 317, Silver Spring, MD 20910.

FOR SALE: Only 20 813 sockets left, real Johnson ceramic - $7.75 each shpg included in US. Victor, 7224 NE 8th, Portland, OR 97211.

WANTED: Heath HG-10 in VG to exc. conds. Tom Jurgens, KY8I, POB 324, Bridgeport, MI 48722. (517) 777-2334

WANTED: Modulation reactor, approx. 40 Hy, 500 mA. Dewey Angerhofer, WØZUS, POB 540, Edgemont, SD 57735. (605) 662-7692

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FOR SALE: NOS tubes - SASE for list; URM-25F - $95; 51S-1 AM filter - $40. **WANTED:** LS-3 Mil spkr; CQ magazines 1971-76. Joseph Pinner, KC5UD, 201 Ruthwood Dr., Lafayette, LA 70503. (318) 981-7766

WANTED: Johnson Viking 122 VFO; schematic for Hallicrafters 8R40 rcvr & Drake 2NT xmtr. Norm Hall, W6JOD, 6506 Jetta Ave., Bakersfield, CA 93308. (805) 399-4101

FOR SALE: DX-20, as-is - $30; B&W GDO - $25; misc. ARC-5 RX & TX, racks, ART-13's, TCS-13 RX - pls call; '46 & '52 ARRL Handbooks - $7.50 each; 4 Millen wavemeters - $12; parting AF-67 & Viking I; PE-103 - $65. Joe Sloss, K7MKS, (206) 747-5349

FOR SALE: SX-42 from the University of Chicago synchrocyclotron control room. Historically significant tool used in pioneering physics research. Paul, W9IEY, 4708 W. County Line Rd., Grant Park, IL 60940. (708) 258-6274

WANTED: BC-669 spkr bezel (frame with Hallicrafters 'h'); BC-610 coils covering 1.5 MHz - 4.5 MHz; ARB rcvr; ATB tuning units; BC-222 handset & manual; RM-7 remote control; RBM-x (or RBS) rcvr shockmount. Don Merz, 47 Hazel Dr., Pittsburgh, PA 15228. (412) 234-8819

FOR SALE: Texas-size Barn. Rcvrs - Drake SPR-4, working parts set - $60; MS4 spkr - $35; S-19 Sky Buddy - $125; BC-348 - $75; RAK-7 w/ps - $75; Allied AX-190 - $75. Xcvrs - Gonset Communicator 2M - $50; Communicator II w/VFO - $150; Yeasu FTDX-560 - $300; HyGain GT-550A - $250. Tube testers - Hickock 533A - $60; Sencore TC-154 - $45; Simpson 305 - $35. Sig Gens: Measurements 80 (no meter) - $75; 65B - $100; Triplett 2432 - $50; Eico 360 sweep gen. - $40. Misc - Lakeshore Bandhopper VFO - $100; SCR-522 VHF AM rcvr/xmtr w/PE94 dynamotor - $100 (6 ea.); ART-13, no cover/tubes - $75; APX-1, APX-2 airborne IFF sets - $100; 14 pieces GR test equip. including 516C RF bridge - $275; 731A mod. monitor - $125; 724B wave meter - $125; 916AL ant. bridge - $200, etc; many WW II surplus items. Call or write for list. JB Jenkins, W5EU, Box 5087, Red Oak, TX 75154. (214) 723-1835

WANTED: Collins 32RA plug-in coils, crystals, manuals, parts, etc; Collins fixed freq. HF rcvrs. Gary, WA9MZU, 1751 Michon Dr., San Jose, CA 95124. (408) 266-2218

WANTED: Schematic and alignment sheet for Knight model R195 communications rcvr. Don Patton, 400 Pinewood Ct., Fern Park, FL 32730-2228.

WANTED: R-649/UR. Dave, N2ZWX, (315) 446-1258 after 7:30 PM EST.

WANTED: T-368 and SX-88. Joel Thurtell, K8PSV, 11803 Priscilla, Plymouth, MI 48170. (313) 453-8303

WANTED: Spinner knob and gear assembly for 75A-4, AM filter F-455J-60; also looking for clean KWS-1. Don Gies, K4GIT, Box 2790, Rt 2, Melrose, FL 32666. (904) 475-3306

INFORMATION: Johnson front panel/cabinet restoration is in the works. First on the list is the Ranger (one) followed by the Viking II and 122 VFO, then Valiant II. This will be a better than new paint/silkscreen process. Price, naturally will be based on volume and will be on an exchange basis. If interested, please write. Wen Turner, AD7Z, POB 451 ER, Cal-Nev-Ari, NV 89039-0402.

WANTED: Hallicrafters HT-32B; FPM-300; SR-400; orig. SX-28 manual; SX-28 parts radio; Heath RX1 manual. Frank, WB4AYJ, 11780 NW 24th St., Plantation, FL 33323. (305) 472-9474

FOR SALE: AM/PRM 10 military grid dip meter (tube type), see ER in Uniform #63, new - $80; BC-348 w/double conv. mod & 'S' meter - $45; Heath AT-1, no mods, clean - $150; Gates - M5530 (tube) mic preamp, clean - $50, older style - $40. Offers on all items + shpg. Franklin Albanese, 1610 Prince St., #6, Berkeley, CA 94703. (510) 845-2625 eves

WANTED: National HRO-500TS spkr in mint condx and National NCL-2000. Sam Macy, N9WAF, 486 Glenwood Trail, Elgin, IL 60120. (708) 695-0218

FOR SALE: Wife says somethings gotta go! FB-7 w/PS and 20, 40, 80, 160M B/S coils - $430; FB-7 with PS and 'B' G/C coils - $320; Hallicrafters S-38B - $80. Hank Bredehorst, 2440 Adrian St., Newbury Park, CA 91320. (805) 498-8907

WANTED: Hallicrafters SX-17 only in very good condx. Jose Cangas, EA4JL. Contact in the States Kurt Keller, (203) 431-6850

FOR SALE: Collins wattmeter/transmatch for URC-32 - $150; Yaesu FLDX-400 - $250; R-390A carrier meters, NIB - $30. Clark, WØBT, 2546 S.E. Peck Rd., Topeka, KS 66605. (913) 235-2721

WANTED: 2/6 meter AM rigs, amps, converters, etc. Gonset, Clegg, Lafayette, whatever? Scott Swanson, K6PYP, 210 Mantor Rd., Pacific Palisades, CA 90272.

FOR SALE: Ameco AC-1 TX; (2) AF-67's w/ pwr sply; DX-60B; HW-16; HG-10 VFO; S38C; rare Micamold TX, 6AG7/6L6, 80/40/20M; FT-101B; Apex RX, 1920's like Atwater Kent. Joe Perrato, K2QPR, 1341 SW Evergreen Ln., Palm City, FL 34990. (407) 220-7362 anytime

WANTED: 4:1 reduction gear with or w/o spinner knob for 75A-4. Doug Morgan, KH6U, 1576 Kupau St., Kailua, HI 96723. (808) 261-9647

WANTED: Operators manual for model BC-1306 xcvr and companion dynamo model PE-237. Al Hubbard, WB9SAX, 1934 Fallen Leaf Ln., Los Altos, CA 94024. (415) 940-6304

FOR SALE: 7 and 9 pin miniature pull-outs, mixed, 100 for $15 + $5 shpg; brown case, Simpson tubetester meter, black face, tested - $15 + $3 shpg; adapters, any triode to WD-11 socket - $5 each ppd; quantity price available; SW-3 replacement plug-in coil forms - $7.50 each + $2 per order shpg; WD-11 plug-in replacement tubes - $20 each or 2 at $17.50 each + $3 per order shpg. James Fred, R1, Cutler, IN 46920. (317) 268-2214

WANTED: PTO (70K-2) unit for S-line, KWM-2 (CPN 522-1093-000) Pls mail. Toyohiro Haruyama, 1641-6 Dainogou, Ota-City, Gunma-Pre., 373 Japan.

FOR SALE: GR 558P freq. meter (circa 1929) - $40; Pioneer AFT-14 stereo tuner (circa 1963), like new - $45. List - $1. Joe Orgnero, Box 32, Site 7, SS 1, Calgary, AB T2M 4N3 Canada. Phone/FAX (403) 239-0489

WANTED: Cushcraft 2 meter 'Big Wheel' or similar type antenna. Rick, N6NVG, (510) 687-2719

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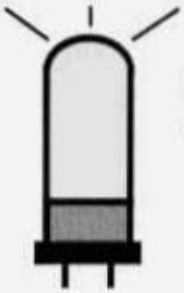

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