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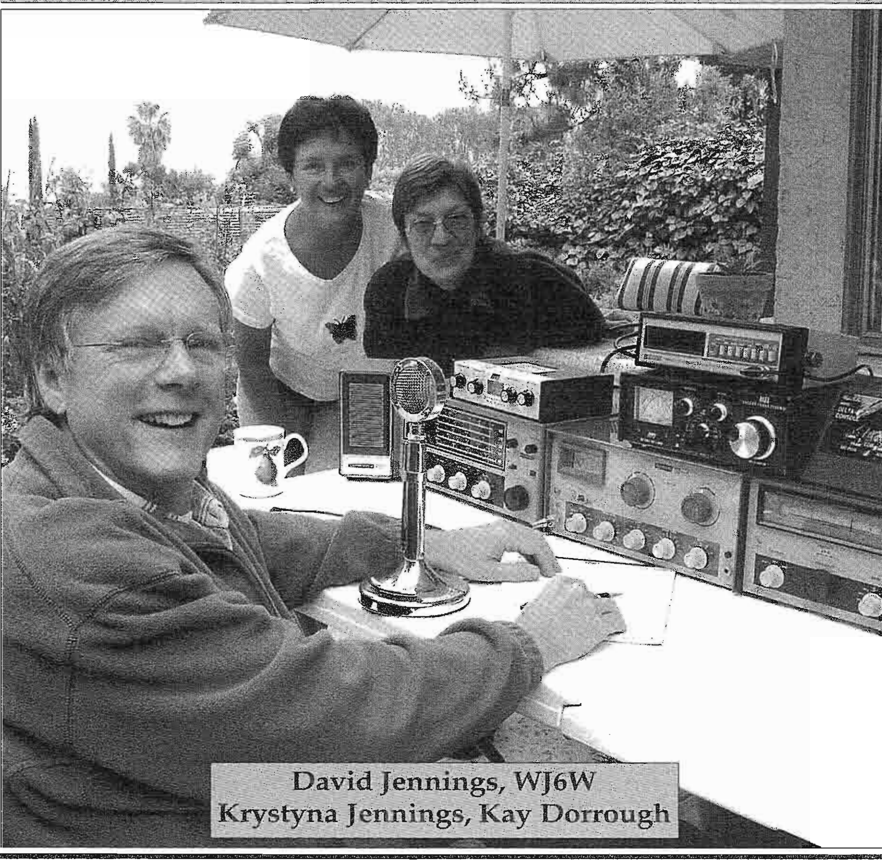
# ELECTRIC RADIO

celebrating a bygone era

Number 194 July 2005



David Jennings, WJ6W
Krystyna Jennings, Kay Dorrough

# ELECTRIC RADIO

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

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

Regular contributors include:
Bob Dennison (W2HBE), Chuck Teeters (W4MEW), Jim Hanlon (W8KGI), Tom Marcellino (W3BYM), Bruce Vaughan (NR5Q), Bob Grinder (K7AK), Bill Feldman (N6PY), Dave Gordon-Smith (G3UUR), Dale Gagnon (KW1I), John Hruza (KBØOKU), Brian Harris (WA5UEK), Hal Guretzky (K6DPZ)

# Editor's Comments

**2005 Vintage Field Day**

I really don't see how the rotten band conditions that we experienced the first week of June can last too much longer. This is at least the second year like this, and as they say in professional sports, "next year." Here in Colorado, it sounded like I was listening to my dummy load, and reports from around the country are saying the same thing. Conditions on the west coast were generally better, but there was more participation out there to begin with. Photos are still coming in, and I'll publish what there is in the August issue.

**The ER Parts Unit Directory**

Last summer I published the Electric Radio Parts Unit Directory, and asked for updates to it. I did get two updates. I really have no idea if the information in the list is still valid, and I don't want to use valuable print space in the magazine to print information that is of no use. I think the list could be a valuable resource for restorers and collectors, and it doesn't cost much to maintain it. Please send in your updates to the ER Parts Unit Directory. "Your dead unit can bring another one to life!"

**The Electric Radio Photo Contest**

Photos for the 1st annual photo contest have been coming in, and it looks like there should be enough for an ER calendar this year. The cutoff date is still September 30, so there is still enough time to send in your photos.

**Spectrum Deregulation**

A group of operators in the Midwest, who are also AMers, recently petitioned the FCC for a spectrum deregulation consideration. I received a copy, and quoting from it in part; "...The petitioners propose to discontinue mandatory segregation of emission modes and the activities using these modes in the Amateur Service, and substitute a voluntary system of coordination to achieve greater, and more efficient, utilization of frequency allocations within the amateur radio service bands. Spectrum utilization would be improved because amateur radio operators would

[Continued on page 33]

# TABLE OF CONTENTS



Cover: David Jennings (WJ6W) and Mike Dorrough (KO6NM) operated from WJ6W during Vintage Field Day 2005 while Krystyna Jennings and Kay Dorrough helped.

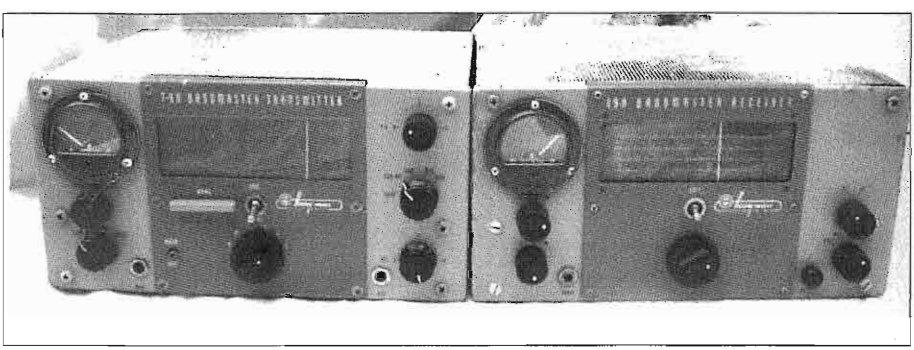
# The Harvey Wells R-9 Receiver and T-90 Transmitter

By Chuck Teeters, W4MEW
110 Red Bud Lane
Martinez, GA 30907
Photos by Tony Chang, WW4TC

My friend across town, Richard (W1SUI) comes up with unusual radios. He is a bit younger than I, but licensed almost as long, so we have a lot in common. He always wins the prize on finding odd boat anchors we can relate to. About two years ago he called me to see if I knew where to find a meter for a Harvey Wells T-90 transmitter. Oddly enough, I had just repaired a Collins 75A-1 receiver for Tom (W4UOC) in Atlanta, and knew he had a spare T-90 with a meter. In Trade, I offered Tom a 500-kHz mechanical filter that would work in his 75A-1 and I had a T-90 meter for Richard. In return for this rapid service, Richard allowed me to repair his T-90.

About a year ago, Richard called me to ask if I could find a dial cord drum friction drive for a Harvey Wells R-9 receiver. A trip to Richard's to look at the R-9 revealed that the slipping friction drive was identical to a tuning drive pinch wheel from a WWII Hammarlund Super Pro that I had in my junk box. I had made dial cord drive wheels out of coffee can lids in the past and it looked like it might work for the R-9, so I volunteered to give the repair job a try. After a reshaping for the R-9 dial cord drum and installing an edge gasket for the friction drive to grab, the Harvey Well receiver dial drive was smooth with no slipping or back lash. Richard asked why not go ahead and finish off the rest of the receiver, which didn't seem to work. While I was at it, I could finish wiring his newly acquired Multi-Elmac PS-2V power supply to run the T-90 transmitter.

It may sound like Tom Sawyer talking to Huckleberry Finn, but I really think Richard takes great delight in coming up with unusual boat anchor projects to keep me off the streets and out of trouble. Regardless of the reason, I now had his Harvey Wells transmitter and receiver to play with for a while. Harvey Wells had introduced the T-90 and R-9 in the October 1954 QST, pages 8 & 9. Building on the success of their 1947 Bandmaster transmitter, the T-90 was called the Super Bandmaster. With 90 watts on CW and 75 watts on AM phone with a built-in VFO in a 7" by 10" by 12" case, it was an improvement in every way over the



**Introduced in the fall of 1954, here are front views of the T-90 transmitter on the left, and the R9-A receiver on the right.**

Bandmaster except in band coverage, operating on 80 through 10 meters only. Promoted as a home or mobile unit in a size to fit any automobile (at least a 1954 style one) or desk, it was factory built for $179.50. The matching R-9 receiver was a dual conversion Ham -band only unit that sold for $149.50. Both were aimed at the same market as the Multi-Elmac AF-67 transmitter and PMR-6 receiver, but the Harvey Wells transmitter had more power and the receiver had a big slide rule dial, an S meter, and a built-in AC power supply for home use. They also offered an antenna tuner in the same size cabinet for home station use for $89.

Harvey-Wells was founded in October 1939 by Cliff Harvey (WIRF) and John Wells (WIZD). Harvey was a 1931 MIT engineering grad who had previously built transmitters with his own company, and Wells was a 1932 Harvard business school grad with excellent money connections. They had met through a mutual Ham friend, Dick Mahler (W1DQH), also an MIT engineering grad, so they hired Mahler as the general manager for their new company. John Wells was from Southbridge, MA where his family was connected with American Optical, so the company started operations in the former Central Mills factory there. Wells was an accomplished aviator, with his own autogyro, and guided the company into aircraft electronics while the Harvey and Mahler MIT connection led the company into contracts with MIT Lincoln Labs radar research agency. As a result of the connections and WWII the company grew rapidly.

After WWII they built light airplane radios, and subcontracted radar systems. In 1947, they introduced the Bandmaster Ham transmitter, an 80 meter through 2 meter 40-watt transmitter with an 807 final. Despite its non-conventional physical layout, it sold well and provided many Hams with their first transmitter. Other than adding a VFO for the Bandmaster, no additional Ham products were built until 1954 due to government contracts that were keeping the H-W factory busy. In October 1954, they introduced the T-90 and R-9 with a three-page spread in QST. After the initial 7-months production, Dick Mahler wanted to advance the technology at the company and up profits at the same time, so he got Harvey and Wells to give printed circuits a try.

The R-9 receiver was an ideal candidate for a printed circuit board assembly so it was the starting point. Mahler did a PC board layout for the new R-9A model. He left the receiver front end, the RF amp and first mixer, and the band switch and coils hand wired, but everything else, except the AC power supply, was on one board. This allowed a low cost XXXP board to be used, and reduced the cost of assembly over 60%. To the best of my memory, H-W must have been the first to offer a Ham product with printed circuit wiring.

A fellow MIT grad had just come up with a solution to PC board dip soldering problems, so in addition to all the new tooling for PC board construction, Mahler bought one of the first wave soldering tanks built by United Shoe Machinery Corp. in near-by Beverly, MA. The first runs of the new R-9A receiver went together in early 1955. It was working out so well that plans were made and equipment was ordered to convert the T-90 to partial PC board construction.

All plans came to an abrupt end in August 1955 with Hurricane Diane. The storm, which killed 184 persons and caused 1-3/4 Billion dollars in damage, hit Southbridge and the Quinebauh River and flooded the Harvey Wells factory wiping out most everything. In addition to the loss inside the factory, over thirty government radar trailers awaiting the installation of equipment were washed away and destroyed. The company insurance covered the factory equipment, but did not cover the US government equipment. The government sued to recover their loss, and while the factory recovered from the loss, things were going downhill finically. After three years of trying to stay afloat and fight the government lawsuit, Harvey Wells gave up and was sold several times, ending up as Bay State Electronics. As a side, the US government lost its suit, but it was too late for Cliff Harvey and John Wells to recoup anything of the business. W1RF died in 1987, and W1ZD in 1989. Electric Radio published an interview in December 1990 with their former general manager, Dick Mahler (WIDQH), about the Harvey Wells Company and the Bandmaster transmitter the month before Dick died.

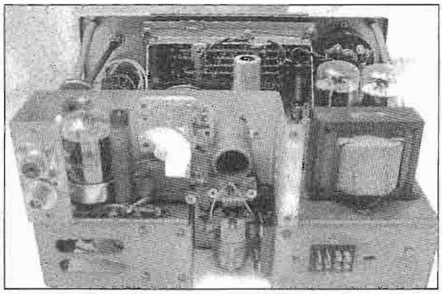
Richard's receiver was an R-9A model with the PC board. The R-9 and 9A are identical electrically except for the BFO coil and reversed dual-tube functions, but the R-9A manual supplement does not mention the changes, probably due to the confusion caused by the flood. The supplement mentions a PC board and a few minor component changes only. A rear chassis Jones connector on both the -9 and -9A allows for external 6 or 12 volt filaments and B+ or the use of the internal AC power supply with the proper jumpers. Apparently, someone had messed up the jumpers on Richard's R-9A, and about half of the copper filament traces on the PC board were burnt open. With these traces fixed, new filter caps, cleaned up switches and controls, the receiver came to life. A touch up alignment, and it worked like new.

The receiver uses a 6BJ6 tuned RF amplifier feeding a 6U8 tunable oscillator mixer. The mixer output is 1620 kHz, the first IF. The second mixer is also a 6U8 with the output at 260 kHz, the second IF frequency. Two 6BJ6s are used as 260-kHz IF amplifiers. A 6AL5 is used as the detector and noise limiter. A 12AX7 is the first audio amp and BFO. A 6CM6 is the audio output. A 0A2 voltage regulator feeds the three oscillators. A transformer-operated AC power supply with a 5Y3 provides filament and plate power when the jumpers are set for AC line operation. The two dual tubes, the 12AX7 and 6AL5, have their two sections reversed between the -9 and 9A. This was probably done to make the PC board layout simpler. The BFO in the 9A, in addition to using the 1-2-3 side of the

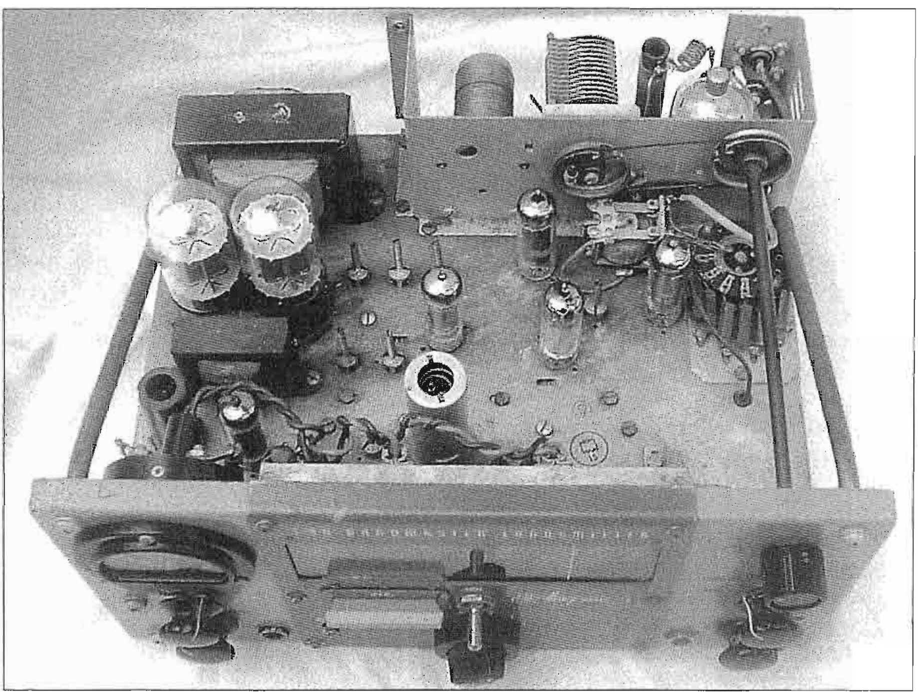
**Above is a top-side view of the R-9A receiver, and the T-90 top-chassis view is on the bottom of the opposite page.**

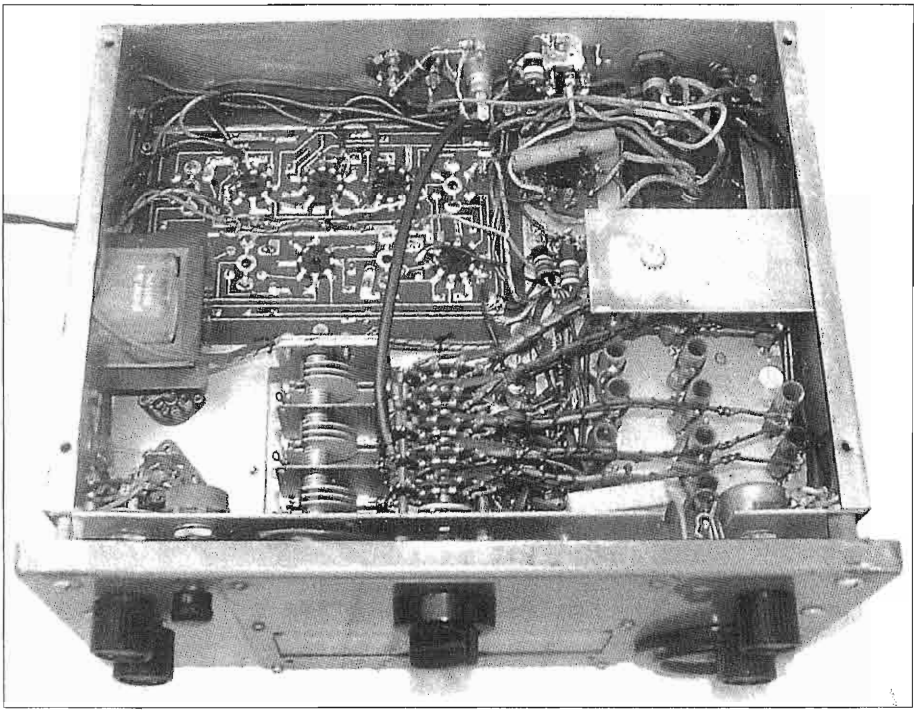
12AX7, uses a different coil than in the -9, but functions the same, with resistance loading of the BFO tuned circuit to change the frequency with a front-panel pot.

Performance wise, the R-9A will hear most anything you want. I measured sensitivities well under 1 µV on 40, 20, and 15 meters. On 75, it could hear 1.4 µV and on 10 it took a little over 1 µV. Selectivity measured 4.1 kHz at 6-db down, and 15 kHz at 40-db down. On 10 meters at 29 MHz, it took over 32 µV on the image frequency, 32.24 MHz, to produce a hearable signal. The noise limiter is as good as series limiters get, taking out strong pulses, but with the usual audio distortion. Like most tube receivers, the R-9 drifts about 3 kHz on 75 and 20 kHz on 10 meters during the first 15 or 20 minutes. It settles down then and stays within 1 or 2 kHz. The dial is calibrated every 25 kHz on all bands except 10, where it is every 100 kHz. Each band is spread over 5" on the slide rule dial and it takes 720 degrees with the tuning knob to cover each band. The BFO tuning is poor and just barely usable, so I just set it and tune with the main dial for SSB and CW. The BFO does not pull with RF gain changes. Overall, it is a nice receiver with better selectivity than most of similar age and cost, due to the 2nd IF of 260 kHz, and with a nice, slow tuning rate it is ideal for SSB and crowded bands. An unusual feature of the R-9 is the auxiliary octal socket. It is unwired and not mentioned in the manual, but offers possibilities for a crystal calibrator or SSB



**The PA compartment on the T-90 transmitter.**



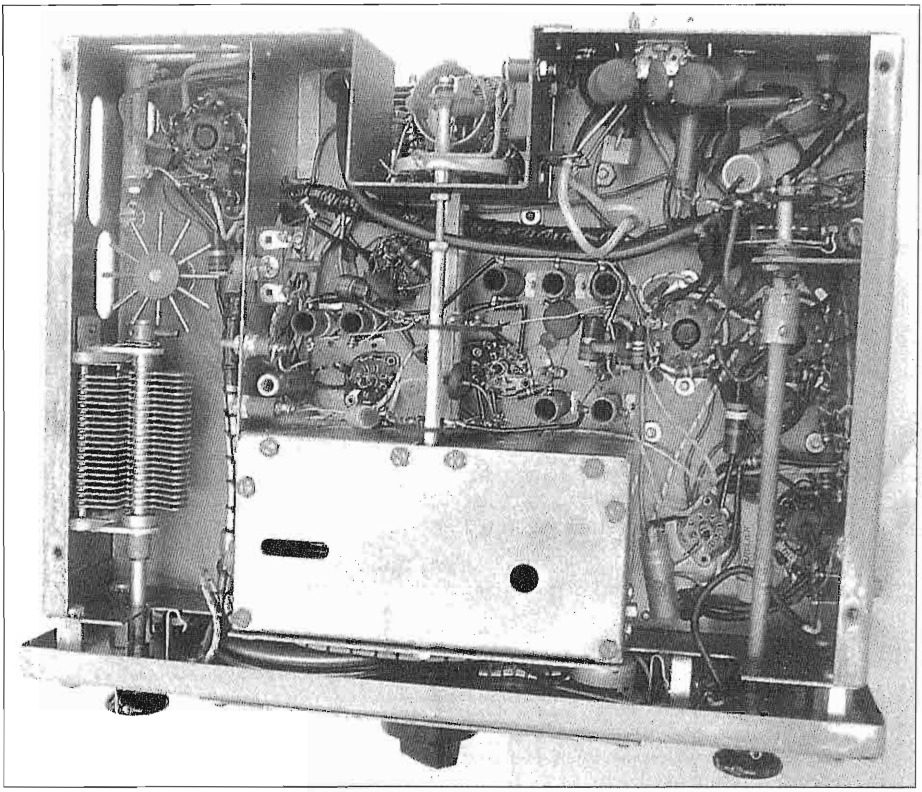


**Above: Bottom view of the R-9A receiver clearly showing Ham radio's first printed circuit board. Right: Bottom view of the T-90 transmitter chassis.**

adapter connection.

Richard's T-90 transmitter must have gone through the 1955 flood, judging by the chassis corrosion. It did not work when he got it and had an open meter. The 3" meter has a 0-to-1 mA movement with a black, back-lighted face, so the exact replacement kept the transmitter looking original thanks to W4UOC. As I remember, a few years ago when I replaced the meter, the reason it was bad was the meter shunt had opened up and tried to put 150 mA through the meter when you switched the meter to the final amp position, which also prevented any plate current flow in the PA. The meter can also read modulator plate current and final grid current, again by switching the meter across appropriate shunts.

The transmitter has several unusual features, such as a front panel crystal socket behind a removable door, wired so that the VFO tuning can pull the crystal frequency several kHz. This, however, requires a shorting plug in the xtal socket when using the internal VFO. The PA grid-drive adjustment is a three-position switch, instead of the usual pot. The most unusual mechanical feature, however, is the PA pi-section output loading control. Like most, the pi loading is a variable cap and a switch-selected bunch of fixed caps. The T-90 loading variable cap does not have any stops and can rotate 360 degrees. A rear-mounted spoked wheel operates the loading switch so one knob can select the proper fixed loading cap and also set the variable cap for the correct loading by rotating through 1020 degrees. The picture of the underside of the T-90 shows the right-angle drive connecting the variable loading cap to the loading switch, which is on the top of the chassis. The transmitter includes an antenna-switching relay, which lets one antenna work



on both the receiver and transmitter, and provides receiver muting on transmit.

The T-90 uses a series-tuned Colpitts oscillator with a voltage regulated 6CL6. The VFO operates on 80 meters on all bands, and has a front-panel crystal socket. By replacing a shorting plug normally in the socket with a crystal, the T-90 is crystal controlled and the frequency of the xtal may be pulled a few kHz with the VFO tuning for exact netting. Two 6AQ5 multiplier amplifiers follow the oscillator. Both the oscillator and first 6AQ5 are keyed for CW. The final amplifier is a 6146 running straight through on all bands. No fixed bias is used in the T-90, and protection of the 6AQ5s is by cathode bias, and the final amplifier has a 6AQ5 clamp tube to hold the screen voltage down when there is no grid drive. The clamp tube is also used to reduce the 6146 screen voltage in the tune position of the function switch. Like the receiver, the T-90 has each band spread over the 5" dial except for 15 meters, which shares the dial with 11 meters. The T-90 was not designed for CB, as when the T-90 was built 11 meters was a Ham band.

The AM modulator has a 6AU6 input speech amp, which can be switched for grid input for hi-Z mikes such as a crystal or dynamic, or cathode input for carbon mikes. The 6AU6 is RC coupled to a 6AQ5 driver, which is transformer coupled to a pair of 6AV5 modulators operating zero bias, push pull. As is sometimes done with 807 and 813 modulators, the drive is applied to the 6AV5 screen grids with reduced input to the control grids. This allows the modulator to operate with zero bias, and low no-signal plate current. The 6AV5 can easily achieve 100% modulation, and the modulator has a reasonably good frequency response of 210 to 3600 Hz within 6db and distortion under 10%.

*Packed with Performance on*

# EVERY BAND

## No. R-9


**9 TUBES**

**MOBILE OR FIXED**

*Same Size cabinet as Transmitter*

**$149.50***

SPEAKER IN MATCHING CABINET AVAILABLE

In our further studies of amateur requirements, we found that the ultimate desire of all was to have equipment which "went together". The difficulty of installing odd sizes of cabinets has always been a source of irritation to the neat and efficient operator. The R-9 is physically an identical twin to the T-90. Now at last without any reservation you can have fixed station performance either in your shack or in your car. This highly stable all-band double conversion receiver has a versatility and a number of refinements which have never before been offered in such small space.

### FEATURES

1. Double conversion on all bands
2. Three tuned circuits on each band, in R.F. section
3. All coils slug tuned, giving high "Q" circuits
4. Separate oscillator coils for each band (no spurious response)
5. Bandwidth: Two kilocycles wide at the 6 db point
6. Complete with tubes and your choice of built-in power supply for 6-12 V. DC or 115 V 50/60 cycles AC
7. Crystal control for net operations
8. Approximately 6" of dial spread on all bands. Accurately calibrated
9. Rigid Steel construction. (Vibration-Proof)
10. 6" height enables easy under dash mounting for mobile installation

**NOW IN PRODUCTION SEE YOUR DEALER**

Compared to the Elmac AF-67 or Johnson Ranger, the T-90 is a joy to work on. Everything is easy to get at, and the band switch has no weird mechanical linkage to contend with during disassembly. The only shield that is necessary to remove for repairs is the VFO cover. Performance wise, the T-90 will show 44 watts out phone and 65 watts output CW on 80 and 40 meters. It drops off about 10% on 20, and 15% on 15 and 10 meters. Drift with the VFO is just about gone after 20 minutes. Operating crystal controlled, some FT-243 crystals could be pulled over 12 kHz on 10 meters, and rocks that were not useable in my other old xmtrs, worked fine and keyed well in the T-90. CW reports were T9 except when using a crystal that was being pulled off frequency more than 2 or 3 kHz. Overall, the T-90 is a nice transmitter to use and gets good reports.

If you are looking for a desk top vacuum-tube AM/CW rig from the fifties, and the price of the Heath or Johnson stuff is too high, look around for a Harvey Wells T-90 and R-9 and give it a try. The price is moderate, and the only hard part is finding or building a transmitter power supply. The power supply needs to furnish 6 or 12 volts AC at 7 or 3.5 amps, 300 volts DC at 100 mA and 500 to 600 volts at 225 mA. A Heath HP-23 will do the job, and if you can find an old vacuum-tube TV power transformer you can build the supply shown in the ARRL handbooks in the late sixties to seventies for use with SSB transceivers of the era. With a power supply, all it takes to run the pair is a mike, speaker and antenna. All the switching, zero beating, and muting is built in. The set will hold its own with most stuff from the fifties, and you can spend some time explaining what a Harvey Wells rig is.

ER

# The AM Broadcast Transmitter Log

## Part 1, Introduction

By David Kuraner, K2DK
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ER is launching a new series on broadcast transmitter conversions for the amateur frequencies. This series will be geared toward the non-broadcast experienced Ham. If a particular transmitter is not covered, the techniques presented should be applicable with minor modifications. Experienced BC engineers will find the information interesting and just as useful. The AM Broadcast Transmitter Log is expected to be published as material is received. There are numerous transmitter models and equally numerous conversion methods. It is our hope that many, who have done so, will share their knowledge and experience.

### Why Are These Rigs Becoming Available?

The answer requires an understanding of the radio broadcast industry evolution. After WWII, many new AM stations started up in small towns even as TV was just around the corner. Stations in the 1-kW range, and below, serviced a small city or town and often were licensed for daytime only. Many operated on channels specifically set aside for local operation. The old Conelrad frequency of 1240 kc was one of these channels. Stations were typically licensed for 1-kW daytime and 250-watt nighttime operation.

Many stations were expected to be able to transmit on 640 or 1240 kc during an emergency. Multiple stations would operate on the same frequency simultaneously. Long before the days of navigation by GPS, air navigation was by non-directional beacons on MF. Even up to a few years ago, a small Piper or Cessna would have MF direction finding equipment. It would be used to navigate and or find the airport in bad weather conditions. By having multiple and geographically dispersed signal sources, the direction finding equipment could not lock on to a single source. The theory was that this would deny a potential enemy navigation aids within the U.S. in time of war.

Originally, the transmitters were manned at the transmitter location. They were often separated from the studio. Sometime around 1960, the reliability of the equipment was such that the FCC permitted many stations to remotely control the transmitter from the studio. Some older transmitters were able to be converted for remote control. Many transmitters made before the new ruling went into effect were not able to be converted and were less desirable even in the 1960s.

As technology improved and FM dominated the radio broadcasting service, several things became factors of the economics of broadcasting. First, the revenue of the local AM 1-kW stations started to dry up from competition with the FM stations. Second, the introduction of solid-state AM broadcast transmitters with their incredibly high efficiency made the older tube rigs costly-to-operate obsolete power hogs. The lower operating cost of solid state pushed these older stations into either abandonment or as use in backup standby spares. As the 1990s rolled around, many fell into complete disuse due to the reliability of the modern solid state equipment. Often one will hear of one of these rigs as having been functional when it was taken out of service a decade or more ago!

At one time, it was economical to export this equipment to third-world countries. New or used modern equipment is much cheaper to buy, operate, and ship overseas than the heavy iron maidens of yesteryear. There is just no commercial market for this equipment, so many are just scrapped. And, there are quite a lot of these rigs out there. Often you can obtain one from a station just by offering to haul it away.

**Why Bother With a BC Rig?**

If you ever at anytime in your Ham career thought about building that ultimate AM transmitter, then you know the answer. The cost of transformers alone makes a BC rig economical. The fact that you have a commercial rig designed for 24/7 operation gives a factor of reliability that you just can not duplicate with HB. The typical voltages and currents to develop this much power in a HB can be outright dangerous in inadequately designed and built amateur equipment. And, the best part is that much of the necessary metal work and wiring is already done for you.

In keeping one of these rigs alive, you are keeping a piece of history alive. These rigs have broadcast the news and music of their period. Many have broadcast the Beatles or the moon walk of Neil Armstrong and they just don't deserve the fate of the junk yard.

Now, granted these rigs are not the most efficient when it comes to power. But, they use about the same amount as your typical clothes dryer at full output. If you can afford to dry your clothes, the cost of power should not be a consideration.

**Finding a Broadcast Transmitter**

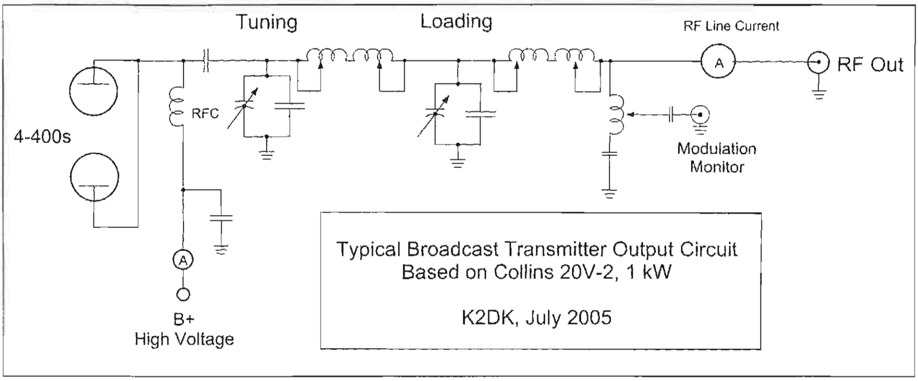
Often the grapevine Ham network will suddenly provide information on broadcast transmitters that are available. I have purchased and have seen others on eBay. Some Hams have simply called around to small AM stations in their area with success. Give some thought to the transportation issues. Is it worth the trip? Commercial shipping can be an alternative. It can cost fewer than five hundred dollars if shipped as scrap with no declared value, or over one thousand if declared as high-value electronics.

Consider the condition. Are you willing to perform much repair and restoration? You can send the cabinet to an automobile body shop for patching and painting. Or, you can accept dents and faded paint as battle scars and clean it up as best you can. The storage environment can be another consideration as wet, damp locations can be deadly to the big-iron chokes and transformers used in the power and modulation circuits. In older units, have the audio stages been recapped? Are there undocumented modifications? There is nothing that can't be returned to service, but how much time, effort, and money are you willing to devote to the project?

**A classic Raytheon AM broadcast transmitter.**

**I Have One Working on its Original Broadcast Frequency, Now What?**

Any broadcast transmitter in the 1-kW range is just like a DX-100 or Viking II on steroids. I may be pushing it here, but the principles are the same. There are significant differences in tuning and control. The major steps in the conversion




are retuning it to the Ham bands and building the control circuitry which you most likely have to interface with the transmitter to operate as a typical PTT-controlled Ham rig. The complexity of each step will depend solely on the model and the band—or bands— you wish to operate. Many Hams have done this and can guide you.

Also, consideration has to be given to feeding it with audio. You just can't plug in a D-104 and talk. Fortunately, relatively inexpensive professional audio equipment for this purpose is available, even if purchased new.

**Not To Worry!**

BC transmitter conversion is not rocket science. Just don't expect to convert anything greater than a kilowatt because you're on your own at 5 kW and above. For the moment, we will talk about a generic 1-kW conversion to 160 meters. Detailed conversions and different bands will be presented in succeeding articles.

Most rigs with pre-transistor exciters use a crystal oscillator, buffer, driver and final in the RF chain. Typical tubes might include the 6AU6, 6SJ7, 807 and 4-400s


WRCA about 1940 (Courtesy Chuck Felton, KDØZS) in the final. The lower-power stages are just the same as any Ham rig, and if the transmitter was originally on the high end of the broadcast band, it should tune up with little or modification to the RF-tuning circuits. Ham crystals work fine here. You can feed excitation with a VFO or other RF source. Typically, expect about 20 mils of grid drive to the final. (Make note of all original meter readings.) With solid-state, low-power stages feeding the tube finals, you may encounter some strange circuitry. Many people simply disable the low-power stages and feed a modern transceiver into the grids of the final. About 15 to 20 watts will do, fed through a tuner for matching purposes.

The final tank circuit is different from what Hams are used to working with. There is an extra coil or two at the antenna end of a PI network. The circuit now becomes a PI-L. Additional variations can include components for a second harmonic trap. The output will surely have some components for a modulation monitor. Often, fixed capacitors are used and the coils are made variable for tuning and loading. Almost any combination of air spaced variable caps, vacuum variable, fixed vacuum, fixed air caps fixed and variable inductors are employed. A typical output circuit based on the Collins 20V is shown in **Figure 1**.The only example of a PI-L I have seen in a commercially-built Ham transmitter is the Globe Scout. The coil is switched in for additional loading on the lower bands if needed.

You can play with the taps on each coil and hope you get it right before burning up the finals. Or, you can set the taps to the points where someone else has found the solution. Also, you can change the circuit to the more basic PI configuration and use the trick shown to me by Fred Cresce, KC4MOP.

Since you are trying to match the final tubes to a fifty-ohm load, the principle of reciprocity can be used. ***With the power OFF and the power supply caps discharged***, simply place a resistor of the approximate value of the final's plate resistance between the tube's plate and ground. Somewhere between 2 and 6 k-ohms should be the correct value. Use something close to 4k if you're not sure. On the antenna end, an antenna impedance analyzer such as the MJF-259 is set to the intended operating frequency and is coupled to the transmitter RF output with the power OFF. As you adjust the taps and caps, the antenna impedance will indicate 50 ohms with minimum SWR at the correct points. I first tried this with the MJF-204B and a DX-100. It worked perfectly. I then used it to get a BC rig into the ball park on 160 and 80 meters. All I had to do was a small adjustment for tuning and a little experimental tap changing for proper loading. So, there you have it.

Because the control circuitry interface is custom to each model, we will save that for the next installment.

**The Maintenance Log**

An interesting lesson in restoring these rigs has just been learned regarding spare parts. A minor event, easily corrected, caused a high-voltage fuse to go south. This one is rated 5000 volts at 1.5 amps and is located in the ground return of a solid-state rectifier bridge. Fuses are easily obtained, except for this one. I called the manufacturer, only to find out that the part hasn't been made since the last ice age. Since this fuse probably costs more that the circuit it protects, there is no problem bypassing it. Some parts, especially mechanical parts, can be a challenge to replace.

For the moment, I will be writing the first group of articles in this series. We invite those with experience on different models or who have taken different approaches to submit articles to ER or provide the information directly to me so it can be included in this series. Rest assured that there is plenty of information and help for those wanting to get one of these beauties on the Ham bands. Now, does anyone have that fuse manufactured during the last ice age? **ER**

# Milestones in the History of Amateur Radio

## Silent Periods, 1923-1924

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Community governments from coast-to-coast in 1923-24 rallied to label amateurs as nuisances. They assumed righteously that amateurs constituted a prime source of broadcast interference. The city of Atchison, Kansas actually enacted an anti-amateur ordinance, which prohibited amateur transmissions within city limits. A popular uprising was in the making as other cities contemplated taking similar action. However, Secretary of Commerce Hoover quashed the stampede to local ordinances when he declared unambiguously: "`The government owns the ether'"—no other government entity has the authority to issue regulations pertaining to the radio spectrum (Warner, 1923b, p. 52).

Amateurs were readily implicated as the origin of interference that stemmed in fact from such industrial-age sources as power-lines, transformers, generators, motors, arc lights, street cars, sewing machines, vacuum cleaners, X-ray machines, storage battery chargers, etc. (Van Dyck, 1924). Warner hoped wistfully that "Damn the Amateur," a "slogan" circulating within the general public, would eventually lose force, not only because the public was recognizing what "a helping hand" the amateur could be, but because it was realizing, too, that something else was causing the interference (Warner, 1923c, p. 36).

Warner had reason to be hopeful. For example, Godley (1923, p. 192) singled out the military services as a major source of interference. He said "the Army now smears the ether with inter-department traffic of no apparent consequence which should long ago have been forced onto land wires." Godley suggested that the Radio Act of 1912 was the root of the problem; it had placed huge bands of wavelengths between 600 and 200 meters solely at the disposal of the Army and the Navy. Today, he argued, these wavelengths must be assigned only for broadcasting. He conceded, however, that neither the Army nor the Navy would be inclined to yield their territory in the radio spectrum. On the other hand, Morecroft (1924, p. 474) narrowed the prime source of interference to commercial spark transmitters, especially in coastal areas. He pointed out that many spark stations near the harbor of New York City operated on 450 meters (666 kHz), which was in the middle of the broadcast band. He proposed that neither land stations nor ships in American waters be allowed to use 450 meters. Morecroft insisted, too, that spark transmitters should be phased out of existence.

Although the ARRL Board presumed that public attitudes were swinging favorably toward amateurs, it moved swiftly and proactively, nonetheless, to preempt criticisms of amateurs as instigators of interference. For example, a QST editorial (Warner, 1923c, p.19) announced that the ARRL was about to implement a program, named the "Rochester Plan" after the city where it began, which specified that "amateurs will not operate transmitters that can cause interference to concert reception between the hours of 7:00pm and 10:30pm." The nine district Radio Inspectors responded ecstatically. One of them enthused that "if it can be carried out . . . the elimination of interference" will convince broadcasting audiences of the amateur's desire to cooperate. Charles Kolster, Radio Inspector of the First District, agonized over whether voluntary cooperation was sufficient to ensure conformity, and he urged amateurs to conform "`strictly to the future policies outlined by the League'" (Warner, 1923a, p19).

The outlook of the Department of Commerce, however, was less sanguine than that of its nine district supervisors. The Department staff began in mid-1923 recalling amateur station licenses in order to endorse them with a provision that disallowed amateur transmitting between the hours of 7:30pm and 10:30pm local standard time. The ARRL voluntary "Rochester Plan" had been wholly preempted before it was implemented, because Commerce staff figured that amateurs who were not members of the ARRL, and perhaps a few who were members, would not agree to "play the game." The staff reasoned that since most amateurs were in favor of the silent period, to avoid conflict and hard feelings between those who complied with the "Plan" and those who ignored it, a silent period should be made mandatory. The ARRL was disconcerted, however, that a regulation that officially prohibited transmissions between certain hours would prevent amateurs from assisting with emergencies while a silent period was in effect (Warner, 1923c, p. 35).

Amateur regulations were re-conceptualized at the second Radio Conference, March 1923, and signed into law, June 28, 1923. District Inspectors were required to place the following statement on every amateur license: "This station is not licensed to transmit between the hours of 8:00pm and 10:30pm, local standard time, nor Sunday mornings during local church services" (Warner, 1923d, p.13). Not unexpectedly, the ARRL Board put a positive spin on the slight time reduction in the new silent period regulation. We are happy, it said, that the operating period has been extended to 8:00pm so that thousands of younger amateurs can "get off lots of traffic before the QRX [waiting] period." Further, in that voluntary quiet hours were indeed unenforceable, "those who won't do it voluntarily can stand a little regulation." "We are thankful for a uniform policy" (Warner, 1923d, p. 15).

A "jumble" of different silent periods prevailed at mid-summer, 1923. A semblance of a uniform national silent period based on local time standards was precluded because rural districts in some states remained on standard time when cities adopted daylight saving time. The fact that the nation was divided into four time zones accentuated confusion because amateur stations were going off and coming on the air as a function of four different "local" times.

Once standard local times were resumed with the coming of autumn, and simultaneously, silent-period regulations were widely publicized, compliance among amateurs became widespread throughout the latter months of 1923 and the first six months of 1924. Then, a QST editorial expressed belief that the Bureau of Navigation might extend the beginning of the silent period to 7:00pm ("Expansion of silent period during summer," 1924). However, about the time that the Bureau was about to implement the extension, it released suddenly, July 24, 1924, several shortwave bands for amateur operation. With equal abruptness, the Bureau rescinded silent-period rules, except for individual cases where an amateur station could not be adjusted so as to avoid objectionable interference to BCLs and other services. The Bureau staff assumed that with substantial radio spectrum distance between broadcast wavelengths and the shortwave bands, that interference caused by amateurs would be greatly ameliorated.

The saga of "Silent Periods," however, failed to expire. Warner (1925a, p.7) reported that the "Bureau is considering clapping the lid back on all stations, "because interference on the broadcast band is horrific. He said that "Headquarters" knows that interference created by amateur transmissions is negligible relative to "foreign ships, overlapping of broadcasting stations themselves, fading, static, power leaks, etc." He pointed out, however, that key clicks from poorly constructed transmitters, use of unregulated power supplies, and antennas tightly or directly coupled to RF circuits, were, nevertheless, likely to interfere with BCL receivers. He implored amateurs to check their transmitters, and if they were troubling BCLs , "don't act as if you owned the earth." Help out the BCLs and recommend solutions. "If we all pull together on this one, there will be no return of quiet hours" (Warner, 1925a, p. 8).

Warner (1925b, p.7) argued persuasively that amateurs individually should be neither relied upon nor expected to solve all the problems of local interference. But he recognized that the problem of interference to BCLs was "the burning question of the day in amateur radio." Therefore, he announced the establishment of "ARRL Local Vigilance Committees." Each committee would be comprised of five members: three transmitting members of the League, a local broadcast listener, and a press representative. Each local committee would publicize its existence via local newspapers. Its purpose would be to identify causes of interference and deal with them. Warner declared that a "Local Vigilance Committee" would be able to exercise the necessary influence upon "violators of law or [sources of] flagrant interference" (Warner, 1925b, p.7). He did not identify from whom the committees would derive authority or how they would exercise it.

Fortunately, even before inevitable bureaucratic suffocation and lethargy could doom the ARRL vigilance committees, accelerated technical developments in the design of both amateur transmitters and BCL receivers, plus the legitimate migration of amateurs to higher frequencies, heralded their demise. The problem of broadcast interference arising from amateur activity abated rapidly during the mid-1920s. Consequently, the burden of silent periods added to the drama associated with amateur-radio activity only during 1923-24.

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**ER**

# A Different Kind of 6L6 Rig

By Richard "Luke" Lucas, K4JEJ
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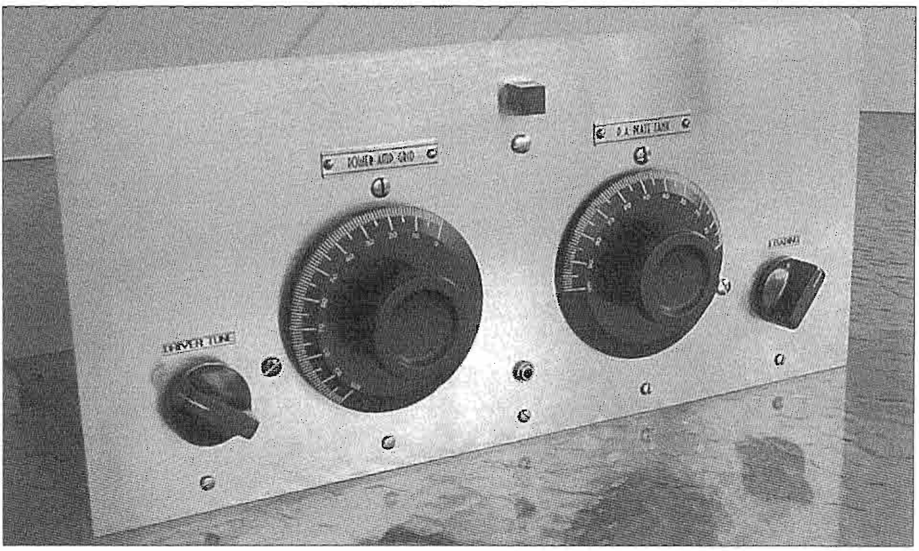
I've had this brand new pair of 6L6s for years and every once in a while I get in the mood to put them to use. If I had a modulation transformer I'd probably build a 25 Watt push-pull modulator and go AM with my DX-60 or something similar. A simple low power bread board CW rig using a 6L6 would have been OK. But still, I kept looking for something a little more interesting and challenging.

So recently, while browsing through some old handbooks, I came across a circuit for a push-push amplifier. I remember learning about these years ago when tubes were king, but I haven't heard the term used since and I'd never built one.

The push-push circuit is used as a frequency doubler with a much higher efficiency than just an amplifier stage tuned to the second harmonic of its input. The circuitry looks a little odd at first, but when you think about the concept it starts to make sense. The two tubes are fed in push-pull, so that they conduct on both halves of the input cycle, thus the increase in efficiency and the cancellation of odd harmonic energy. The split coil and capacitor at the input provide the necessary phase shift, while the output is just a single-ended plate circuit. I used a standard pi-network tuned to the 20-meter second harmonic of the 40-meter input.

**Driver Stage**

The 6AG7 is driven with a 40-meter Ten-Tec QRP rig, which makes an excellent, stable VFO for several of my rigs. A broad-band toroid transformer helps to match the low-impedance VFO to the input grid of the 6AG7. The 40-meter



**The rig was built to have that '30s look. The dials are from an old Atwater Kent radio and the "pointers" are 6-32 screws. The 1/8" key jack is in the middle. Tune up is simplified by watching the neon bulb, which has been wired to indicate 6L6 screen current.**

output is series-fed and coupled to the 6L6 grids with a 2-turn link located on the "cold" end of the driver coil.

Number 20 wire is used to wind the 6.5 microhenry plate coil. The interconnection between the 2 links is a twisted pair using some plastic-insulated #26 wire.

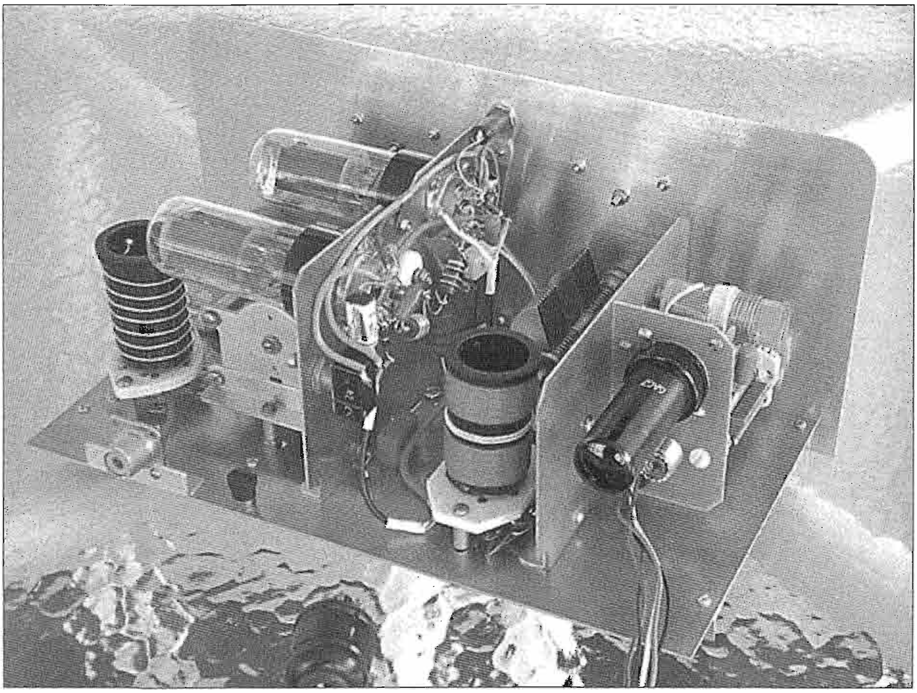
**The Final**

The split capacitor and coil are visible in the photos, between the two shield partitions. Plug-in coils make for longer leads, so I used miniature coax to shield the push-pull 6L6 grid leads. A 10-ohm resistor placed in series with them also helps to keep things stable. In staying with the "old" image, instead of reaching for the usual disk ceramics, I purposely used mostly molded type and Orange Drop capacitors for bypassing. The 6L6 plates are fed through parasitic suppressors and then to a ceramic feed-thru to the RF side. Grid-block keying is used on both stages.

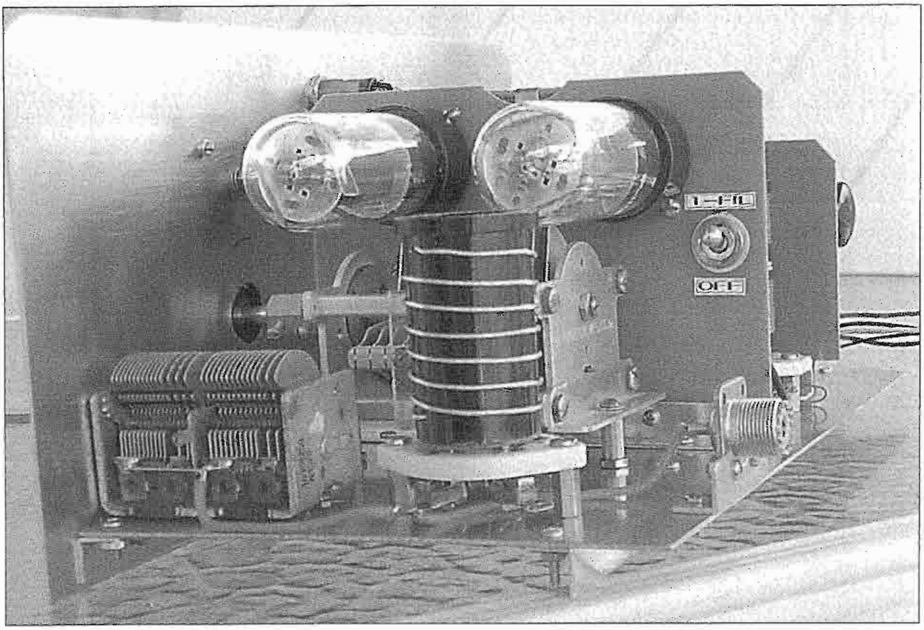
Note the old toggle switch on the 6L6 partition. An old trick used with push-push rigs was to turn off one of the tube's filaments when the amp was to work straight-thru. The cold tube then becomes a neutralizing capacitor of sorts. You simply turn off one 6L6 filament (with the toggle switch) and re-tune the plate tank to 40 meters. With a change of plug-in coils you have a neutralized, single tube 40 meter amplifier: It works!

**Metering**

Metering resistors were included, but no provision was made to bring them out. A 0-to-300 mA meter wired in series with the high-voltage lead works well to read plate current.



**The horizontally-mounted 6L6s make for a pretty light show. The 6AG7 driver stage to the right and the split capacitor and coil are in the 6L6 grid circuit. The balanced grid coil is wound with #24 plastic-covered hookup wire. The single-sided PC board seems to do an excellent job of shielding. All of the components were mounted directly on the copper-clad board, and treated just like it were an aluminum chassis.**




**A look at the business end of the amplifier shows all of the pi-network components. The toggle switch next to the 6L6s cuts off one filament for use as a straight-thru amplifier. The grid-plate capacity of the cold tube then becomes a built-in neutralizing condenser. The 20-meter PA Plate coil is wound with #14 wire.**

The neon pilot light brought an unexpected surprise. Taking the lazy way out, I wired it through a 330-k resistor to an easy-to-reach 6L6 screen grid pin. It turns out that this makes for a good screen current meter and an excellent indicator of transmitter performance. Noting the neon bulb's brightness, you will know you've got B+. You can tune the driver for maximum grid current, peak the grid condenser and tune the plate while watching for a dip or peak of the neon bulb. The 6L6 plate and loading controls can be fairly accurately tuned just by watching the pretty blue glow (and the occasional blush) of the 6L6s along with the neon bulb. Of course, there is no substitute for a good wattmeter.

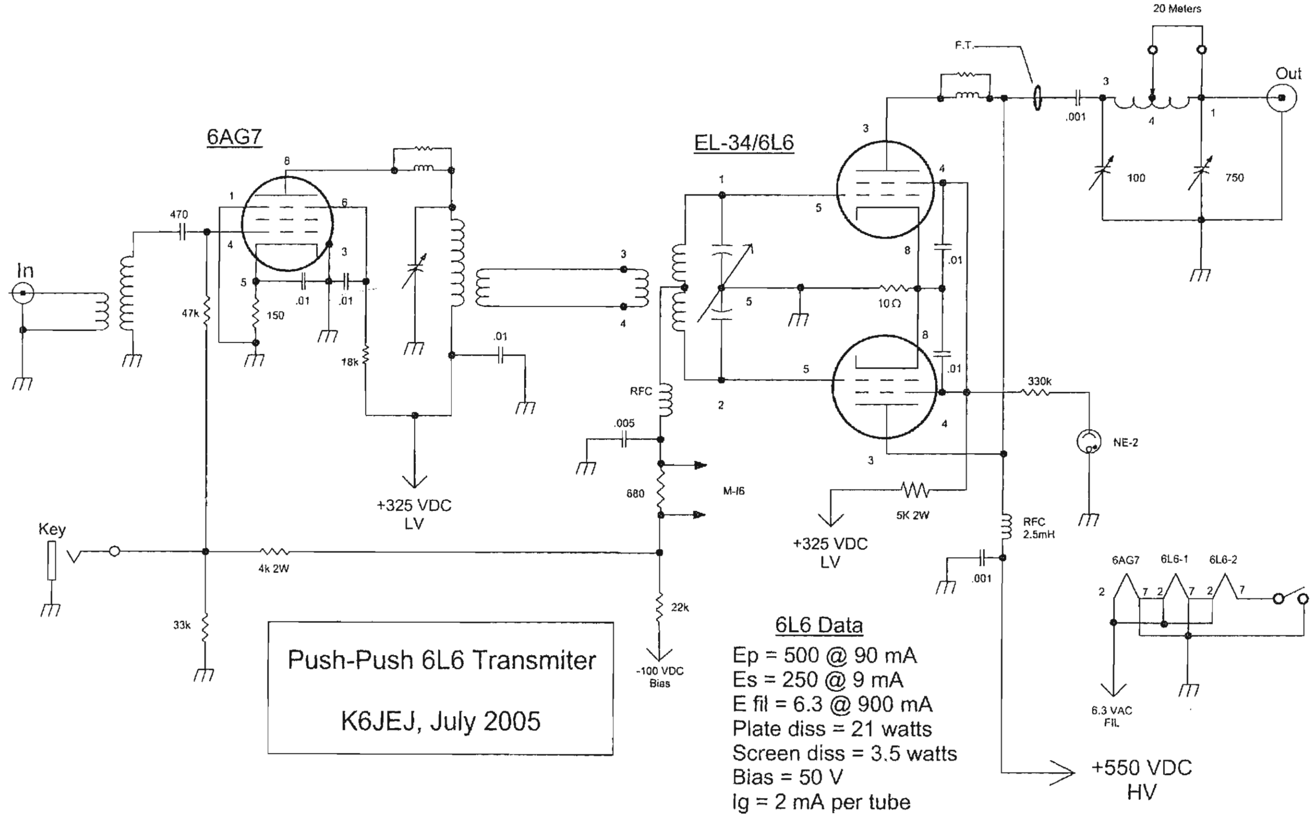
### Performance

I couldn't find any specs for push-push operation, such as what efficiency to expect, etc. I did learn from one website that the term is miss-used and should be called pull-pull. I'll leave that up to the real engineers to figure that out. I can tell you that the pair of 6L6s gave me 40 watts out into a 50-ohm dummy load. My plate voltage was 550 VDC at about 185 mills, producing just over 100 watts input (ouch!), so the efficiency is roughly 40%. I'm certain that figure could be improved with some fine tuning of bias and tuned-circuit Q.

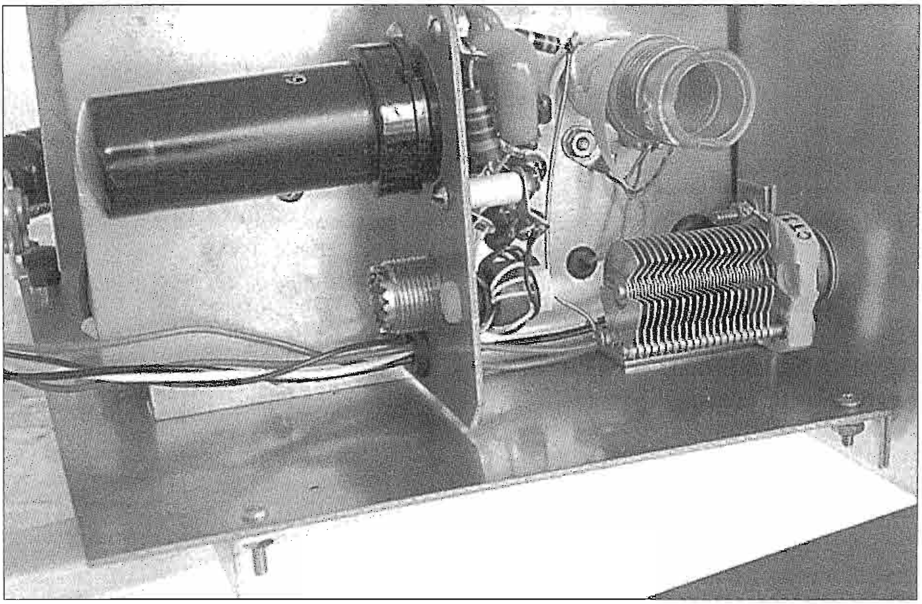
Another unknown is just how much of that 40 watts output is 20-meter RF and how much is harmonics and spurs. One encouraging sign is that the reflected power, as read on a Ham-type SWR meter is zero, when feeding a resonant 20-meter antenna. That usually means that the spurs are down at least 20 db. Now, where did I put that Spectrum Analyzer?

### Construction

My first idea was to build it using old breadboard style construction. It didn't take long, however, to realize I'd need a



6AG7
EL-34/6L6
In
Out
20 Meters
F.T.
470
47k
150
.01
.01
18k
33k
4k 2W
Key
+325 VDC
LV
.01
RFC
.005
680
M-I6
22k
-100 VDC
Bias
10 Ω
.01
.01
5K 2W
+325 VDC
LV
.001
100
750
330k
NE-2
RFC
2.5mH
.001
+550 VDC
HV
6AG7
6L6-1
6L6-2
6.3 VAC
FIL
Push-Push 6L6 Transmiter
K6JEJ, July 2005
6L6 Data
Ep = 500 @ 90 mA
Es = 250 @ 9 mA
E fil = 6.3 @ 900 mA
Plate diss = 21 watts
Screen diss = 3.5 watts
Bias = 50 V
Ig = 2 mA per tube



**A closeup of the 6AG7 driver stage also shows the RF input and power cable entrance. The toroid coil is used to match the VFO output to the 6AG7 grid.**

board about 2 feet long, and that there was no effective way of grounding and/or shielding things.

So, I decided on a hybrid approach. I would make the front panel out of .05" aluminum and give it the look of an old 30's style transmitter. The innards however would be built entirely of single-sided PC board material, using aluminum angle stock for support brackets. My junk box provided the PC board. There is a lesson in this: Glass PC board is hard on drills, punches, etc, and will dull them with just a few passes. 04" aluminum would have been a better choice; a word to the wise.

Modular construction certainly speeds up the project and makes for a better finished product. Each board can be mostly wired on the bench before mounting it to the main frame. Compared to point-to-point wiring within the rig, this is by far my preference.

The 6AG7 socket and its circuitry are built on a small sub-assembly that is attached to the shield partition with 2 spade lugs. The input transformer is wound on a 1/2" toroid core and mounted with plastic hardware. There are 10 secondary turns, 4 on the primary. The input connector and power cable pass thru this module as well.

Mounting the 6L6's horizontally turned out to be a good move. In a project like this one, the accessibility of the tubes is important. Besides, they're fun to watch. I used 1-1/4" plug-in coils for the 6L6's.

The PA tune and load caps and practically everything else is straight from my junkbox.

### Conclusions

This was a fun project with limited practical value. However it was a good exercise in construction techniques as well as a reach back some 70 years in amateur radio history. The rig will no doubt find a place in my archives but I have no plans to keep it on the air. One QSO with a QRP station on 20 CW told me all I needed to know. Hey, if nothing else, it's a great conversation piece.

ER

# The Rocky Road to Ham Radio

## Part One

By Bruce Vaughan, NR5Q
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*How is it that we remember the least triviality that happens to us, and yet not remember how often we have recounted it to the same person?* Francois Duc de la Rochefoucauld (1613-1680)

Due to several uninteresting and totally unimportant projects, my computer time this past year has very been limited. As a result my stories in ER have all but disappeared. Letters to the Editor, and to me have been like water to a parched throat. It is good to know many of you read my little stories, and miss my reminiscing about radio's early times.

Recently, Ray received a letter from a reader asking that I tell about my start in Ham radio. The reader thought my experience might go back to the days of spark. I am sorry to disappoint him, but I was born in 1922, the year that spark began its decline. As a matter of fact I have been working on a book for the past three years titled, "Too Young for Spark—Too Old for Digital."

So, even though I cannot tell any stories about 'King Spark' I can recount how one young fellow first became interested in Ham radio and how he eventually became the proud owner of that little piece of paper from the FCC giving him the right to communicate, by wireless, with other Hams around the world. Please forgive me if I unintentionally repeat something that has appeared in previous writings.

There is little doubt that joining the ranks of Amateur Radio today is much easier than it once was. Has removing barriers, and paving the road to Ham Radio made it better? I will leave that to historians in the future.

I can hear some newcomers challenging my statement. What made it so much more difficult to become a Ham years ago? Radios were cheaper back then, circuits were simple and basic, and there was no charge at all for the license. Before you finish reading this article I think you will understand.

You are all familiar with Ham radio as it exists today and with the steps involved in obtaining a license to operate. I think everyone is aware of the inexpensive or completely free of charge study aids available today. It is rare indeed for anyone wishing to become a Ham to not have available one or more clubs in the area. Anyone desiring assistance can find help in abundance at almost any club. Even equipment to get on the air is often available either as a long time loan, or outright gift. Code tapes are available at most clubs for those wishing to learn CW, and very often classes are offered. Exams can be taken locally, among friends, practically on demand. It is rare that a person desiring to take an Amateur Radio Exam cannot do so within a month, and often much less time. It was not always so.

Let us look backward to a time many old timers remember as though it were yesterday. How did one become a Ham, say for example, before World War Two? What struck the spark, what kindled a fire within a young man in those depression years to spend so much time and effort to become an honest-to-God, Amateur Radio Operator?

Every Old Timer has a story to tell. Most of their memories are similar. Very few stories are more important, or more interesting than those his friends can tell. I think my story is typical of the 45,000 Licensed Hams in the United States back in the 30s.

I suppose you might say that my first exposure to Radio was in 1925. My Dad had a country store and grist mill at Habberton, Arkansas. I doubt you can find it on a map. Habberton was a crossroads store with one gas pump, a Post Office in one corner of the store, a Mill behind the store, Church, and Schoolhouse. There was no 'city limits' as there was no city. Four families lived within a half mile of the store.

One afternoon, I vaguely remember my Dad bringing in a long slender box, and sitting it carefully on our 'library table.' He then carried in a big black horn, and placed it beside the box. Then he put a bunch of heavy boxes on the floor. He called the boxes on the floor 'batteries.'

I asked what he was doing and he told me we were going to have a Radio over which we could hear music—just like our old Victorola, only this box would literally pull music from the air. I was not old enough to have doubts; I took his word for it.

Dad enlisted the help of a neighbor boy to help him stretch a long, gleaming, copper wire from the house to the barn. They kept talking about the wire, but they referred to it as the 'aerial.' I watched as they drove a long rod into the ground beside the house. They called the rod a 'ground rod.' Then they ran a wire from the 'aerial' and 'ground,' under the open window, and into the house. I watched as they carefully read a small booklet and connected wires to the boxes on the floor.

After an afternoon's work, they seemed anxious to try out the 'Radio'. Dad sat down in front of the Radio—the booklet still in front of him—and began to adjust the three big brown dials on front of the box. Nothing happened. Then he adjusted one of the smaller knobs and the radio gave out a loud 'screech' and then a 'plop' and we heard a man talking. After a few minutes he said, "This is Radio Station KUOA, the University of Arkansas, Fayetteville, Arkansas." I don't remember much music but there was a lot of talking on the Radio. After dark, Dad would sometimes pick up KTHS, in Hot Springs, Arkansas.

Dad placed a small writing pad and pencil on the table. When he tuned in a station he carefully noted the settings of the three large dials, and drew a picture of the position of the dot on each of the small knobs so that he could reset the controls to bring in that particular station.

The entire radio table was one of the prohibited areas of our house. I was not allowed to play under the table because Dad warned me of the dangers of battery acid. I was never allowed to touch anything on the radio table—it was an expensive and delicate instrument he explained, time and time again.

I asked my Mother if she knew where the KUOA 'broadcasting station' was located. She replied in the affirmative, and promised to take me to see it. The KUOA transmitter building and tower was located less than 8 miles from our home. She kept her promise. She drove me to the transmitter site. I was disappointed. It was a small white building—much smaller than our little country store. The only thing impressive was the tall metal lattice-work pole behind the building. It looked too tall for me to climb—even if the opportunity ever presented itself. We tried the door. It was locked—apparently the transmitter was unattended at this moment.

KUOA was apparently not practical as a training tool for the U of A. They sold it in the early 1930's to John Brown University, Siloam Springs, Arkansas. I believe the station is still in operation.

The great depression hit our country suddenly and quite unexpectedly. I was about seven years old. I could not understand what was happening. One day a crowd gathered in our yard, and a man stood in the back of a wagon and talked real fast. When the day was over the radio, the country store, and most of our furniture was gone. A few days later a man came, and drove off in our 1928 Chrysler convertible. I was sad—not because the car was gone but because my Dad and Mother sat down in our porch swing, held hands, and cried. I knew something bad was happening.

We had no Radio for over two years, and then somehow Dad acquired another radio very similar to our first one. It never seemed to work very well. I remember the static was ear shattering, and the music or talking on the radio was never quite loud enough.

One night Dad said, "Why don't we go up and visit Uncle Dave tonight. That boy of his, Albert, must be pretty smart. They say he is studying radio through the mail, and can work wonders with one. I'd kinda' like to see what Albert has come up with."

Uncle Dave lived on a farm not many miles from Spring Valley where we now lived. Back then you did not need an invitation to visit—you just dropped by, unexpected, and paid a visit. We arrived just as the family was finishing up their evening meal.

After the usual greetings were exchanged Dad said, "Albert, I am real anxious to hear your radio. The fellows in the store yesterday were all talking about how you had built something that made your radio a lot clearer than others."

Albert was a large boy about 18 years old. He was extremely shy and seemed embarrassed by the comment.

"Ah, it ain't all that much really," said Albert. "I just built a little simple circuit that hooks up between your radio and the aerial. What it does is make a more perfect match between the radio and the aerial. Here, let me turn it on and I'll show you."

The radio came on with a crystal clear voice. We all listened to the voice as clear as if he was in the room with us. Then the station announcer said. "This is the WLS-the voice of the prairie farmer—Chicago."

I was amazed. I asked if I could take a close look at the 'gadget.' It was built on a pine board about 8 by 12 inches in size. There were a couple of parts that looked a lot like a potato slicer, and a round cardboard tube with a lot of wire wrapped around it. Albert explained that the 'potato slicer' was called a condenser. The wire wrapped tube was a coil. He showed me a switch that allowed him to connect of different places along the coil. Here indeed, was something magic. Albert had struck the match that lit a fire deep within me to know more about radio.

By the time I was in the fifth grade, 1932, radio was making a lot of progress, and we had moved again. We now lived in Huntsville, a remote hill country town with a population of almost 1000. The Huntsville Electric Service provided the town with electricity from 6:00 AM until 11:00 PM. Voltage supplied was usually within a range from 100 VAC up to 115 VAC. Then the ideal of 110 VAC was nothing but a goal which was seldom attained by the old Fairbanks-Morse one cylinder diesel engine that drove the large AC Generator. Anywhere in the city one could hear the constant 'poom,' 'poom,' 'poom,' of the slow revving diesel.

Electric radios were now the radio of choice for those with electric service. The result was that many beautiful battery operated radios were simply junked. Those that showed up in second-hand stores were normally priced far below a dollar. Those junked radios became a literal goldmine of parts for kids interested in radio. I made weekly visits to the town dump. I built a few Crystal Radio receivers with practically zero success. I decided to build a two tube 'Dorele' as described in the Gernsback publication, "Short Wave Craft." I cannot remember where my dozen or so copies of Short Wave Craft came from. The magazines were a gift from someone I no longer remember.

I built the two tube regenerative receiver on a baseboard large enough to serve as a base for a pair of 100THs. I remember it had a beautiful bakelite panel, and two tuning condensers turned by shiny brown Atwater Kent dials. The only tubes I owned were 01As. I had no battery, and no way to get money to buy one for the filament supply. I asked Otto Grubbs, the town's radio repairman, if I could use a transformer on my 01As. He told me that the hum would be so loud I might not hear a station.

I was not a purist—I didn't mind if the radio had a lot of hum—all I wanted was to hear a station on a radio I'd built all by myself. I'd use AC on the filaments. I tried it and I did get a hum...nothing but hum—then the 01A flashed and burned out. I had plenty of them so I tried again with the same results. I have no idea what voltage the transformer was.

Then, as now, misery loves company. I developed a deep and lifelong friendship with James Deer, the son of a local merchant in Huntsville. After all, it takes two to communicate—and did we ever want to communicate by radio.

Sometime in the fifth or sixth grade we decided to communicate across the classroom using code. At that age it only took a few days to memorize the dots and dashes that made up the alphabet. Using a vertical pencil—point down for a dot—eraser down for a dash, we communicated with ease across the classroom. Our conversations were rich with obscene words. It was a lot of fun and we felt so clever doing this right under the nose of our teachers.

We followed with the next logical step and built keys from old hacksaw blades, and with batteries from the pile of junk behind the local telephone company office we rigged up a buzzer to use for code practice.

Perhaps this is the reason why I find it hard to understand why code was such an issue with prospective Hams. Before we were out of primary school we were both able to copy code as fast as we could send with the hacksaw key.

But the fact remained—I had yet to build a radio that really received stations with enough audio power to be enjoyable. My time was nearer than I dreamed.

That summer—probably about 1934/35—I spent the summer with my Grandparents in Spring Valley—a community of 12 families—more or less. The man that ran the one pump gas station and garage was a young fellow from California. Harold was perhaps 24 years old, and loved to build and experiment. He was building a 'Model T' hot rod in the back of the garage. He also had an old motorcycle he rode around the countryside.

But the favorite in his collection of his 'toys' was an old one-tube Crosley 'Pup.' We had a lot of fun playing with that little radio. Harold subscribed to one of the Mechanical magazines of the time—Popular Mechanics, or Mechanics Illustrated, I believe. He became very excited about an article called "The Hurricane Receiver." He showed the article to me. It looked like something we might build. The Hurricane was so named because it operated with only 6 volts. The idea being that in case of emergency when normal electric service was interrupted one could operate the receiver off of his automobile battery. Why not use the car radio? Because, in 1935 not many cars were so equipped— auto radios were still an expensive accessory. My Dad bought a new Chevrolet sedan in 1939. He paid $610.00 for the car. It came equipped with a heater—but no radio. A radio would have been $60.00 additional—10% of the cost of the car. Today if car radios cost 10% of a car's retail price very few cars would be so equipped.

The Hurricane receiver was a common detector-one step that operated with only 6 volts on the plate. As you can imagine, results were nothing outstanding. According to the article this low plate voltage operation was possible because of the high efficiency of metal tubes.

Harold made the suggestion that we build two identical receivers at the same time. He figured that everything but the tubes and tube sockets could be scrounged from our junk box—or from one of several old receivers we had awaiting parting out.

The panel was made of metal about 5 by 7 inches in size. The chassis was made from a scrap of the same type metal the width of the panel and perhaps 8 inches long. Two bends were all that were required and Harold had a big bench vise in his auto shop. He suggested that if I came up with the metal he would do the bending. That sounded great to me. I knew where to get the metal. Out behind Sturdivant's sheet metal shop in Springdale you could always find a lot of scraps. Like most would-be Hams of that time, I was an expert on city dumps, and scrap piles behind business firms.

Harold fastened the metal between two pieces of wood, clamped them in the vise, and beat them to shape with a ball peen hammer. Large holes for the tube sockets were drilled with a half inch drill, and filed to shape with a 'rat tail' file.

I have no idea where Harold came up with $2.00 for his tubes and tube sockets, but I know where mine came from. A Drug Store in town would buy medicine bottles, if they were good and clean. They paid one cent for small bottles, and 2 cents for large bottles. They had to be regular Drug Store bottles—not 'patent' medicine bottles.

I searched the city dump and came up with a lot of bottles. Not knowing what had been in them or how many germs might be present I made sure they were good and clean. A small stream ran through Mr. Coger's cow pen. I soaked the bottles in the stream for a day or so, then filled them with sand and water and shook the heck out of them. They seemed clean enough to me. Today, I often wonder if the druggist washed them before filling with medicine and re-selling. I'd make book that they were sold just as I delivered them.

The Hurricane receivers worked—actually better than I expected. I used four 'D' cells for power. My big problem was the current drain of the 6-volt metal tubes. Four 'D' cells cost 40 cents and lasted less than two weeks. It was obvious I could not afford this radio.

Now that I had actually built a working radio and knew the code I started reading about Ham radio in my old Short Wave Craft magazines. I could see I might be getting in over my head. I approached Otto, in his radio shop. As usual he was bending over a radio with a pair of test leads in his hand, and a cigarette dangling from the corner of his mouth. "Otto, what do you know about Amateur Radio," I asked?

"I know enough to tell you that it is very difficult to get a license. I know I could not pass the exam, and I have been in radio quite a while," answered the young man.

"Where do you have to go to take the examination? What sort of questions do they ask? How much does it cost? When do they give examinations?"

"You are asking me questions I can't answer. What you need to do is go over to Springdale, and talk to Clyde Allard, W5FKT. Clyde manages the Concord theatre there."

I made a mental note to do exactly that. Springdale was only 30 miles from Huntsville, and we went there several times a year. There was no good reason why I could not talk to a real live Amateur Radio operator.

Soon I got my opportunity. I was now 14 years old, and had my driver's license.

Yeah, I know the legal age was 16, but I knew the revenue agent. When I approached him about getting a drivers license, his answer was, "Well, why not—you have been driving for a year now—we may as well make it legal." Some things were a lot better years ago.

I convinced my Mother that she needed to go to Springdale for a reason I no longer remember. Springdale was a small town back then with a population of 1400. Everyone knew everyone else. I asked the soda jerk in Coger's Drug if he knew Clyde Allard. "Sure I know Clyde. He manages the Concord theatre you know."

"Yeah, I know that, but I'd like to know where he lives," I said.

"Oh he lives up on 71. (Highway) Just go up this street until you hit the highway, turn right and he is the first house on the left. He lives the first house north of the gas station," he replied.

My knees were knocking when I pressed his door bell. A distinguished looking man about 30 came to the door. He looked at me with a puzzled expression. "Yes," he said, "What can I do for you?"

I stammered and scraped the steps with my foot. "Well, you see," I replied, "It's like this—I heard you were an Amateur Radio Operator, and I was wondering if I could ask you a question or two about becoming a Ham."

It was plain that Clyde had not yet finished his morning coffee—he still had a cup in his hand. He stuck out his hand and said, "I'm W5FKT, why don't you come in and look at my station while I try to answer your questions."

I entered his living room, and looked through a double door into the 'sunroom' which now served as his 'shack.' This room held the most beautiful sight I had ever gazed upon. On a small operating table was a real Hallicrafters Sky Challenger. On top of the receiver was the large Hallicrafters speaker. Beside the table was a six foot high transmitter. The big German silver knobs glistened against the black crinkle finished panels, and served as a perfect foil for the big silver tuning dial of the receiver. Large 3-inch meters were placed here and there on the front of the transmitter. "Let me tell you a little about this rig," he said, "I'm using a 6L6 crystal oscillator, into a T-20 buffer stage, driving a pair of T-55's to about 250 watts. I am using class 'B' modulation. Let's see if anyone is on the air."

Clyde threw a switch on the panel of the transmitter and turned on his receiver. I found out later that he was a 160-meter operator. His enjoyment was in visiting with a few Hams in surrounding towns. He had no interest in DX. At that particular time I understood very little of his description of his rig, but it pleased me that he was not 'talking down' to me.

"Here we go," he said, as he gave a call into the Astatic mike. I felt a chill up my back as the big speaker came alive. Clyde was actually talking to another Ham over the radio. I was completely unprepared at what happened next. He handed me the mike. I was so nervous that I more or less came unglued. I managed a few mumbled words, and then handed the mike back to Clyde as though it were burning my hand.

As I walked from Clyde's house that morning, carrying an arm full of magazines and study material, I knew that this was something that had to happen. Some way—some how—I would one day have a Ham ticket and a station from which I could communicate with other Hams. That time was much nearer than I thought.

[Next month, Bruce continues with Part 2...Ed]

**ER**

# Some Guidance on the Use of Ceramic Filters

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## Introduction

Ceramic filters are a very convenient and cheap way of improving the selectivity of old receivers. The three main manufacturers of ceramic filters, Murata, NTK, and Kyocera, used to offer a wide range of bandwidths, in both plastic and metal cases, with a choice of low, medium, and high stopband performance on 455 kHz, and a much reduced range on 450 kHz. Now, the only company left manufacturing ceramic filters seems to be Murata, and they have drastically reduced the range they offer. It's time to stock up for any projects you've got planned for the future!

The spurious responses of ceramic filters are very often singled out for special criticism. Let me tell you, though, that all filters that make use of mechanical resonance in solid materials suffer from the same problems of unwanted modes. This includes quartz crystal and mechanical filters. None of these filters should be used without additional LC filtering, such as IF transformers, to attenuate the spurious responses to acceptable levels. The main drawback of ceramic resonators is their relatively low Q, which causes rounding of the passband edges and a limitation on the minimum achievable bandwidth. The Q can be rather variable in production as well, and at 455 kHz it can be anything from under 1000 to over 3300. The Q of mechanical filter resonators is not much better than the best ceramic resonators, but they are not so variable. The Q values of quartz crystal resonators are very much higher than either of these at 455 kHz, and they can be used to produce filters with lower insertion loss and less passband rounding, or narrower bandwidths. However, although limited in application by their Q, the great advantage of the ceramic filters that can be produced with reasonably low insertion loss and passband rounding is their size and cost. We're lucky because they cover the range of bandwidths used on AM quite comprehensively at 455 kHz.

## Filter Bandwidths

The bandwidth figures quoted by manufacturers are always the minimum bandwidth likely to be found in production. A typical bandwidth for any ceramic filter is usually much greater than these minimum figures, except for the CFJ455K14 and K15 SSB filters, which appear to be selected from the CFJ455K5 production spread, and are usually within about 100 Hz of the specified bandwidth. The K5 filters available to hobbyists are generally 2.7 to 2.9 kHz bandwidth at the –6dB points. I think this is because all the 2.3 to 2.7 kHz filters have been selected out from the production run for the K14 and K15 versions used in Japanese SSB equipment. The CFJ455K8 is a narrow version of the K5, and has a typical –6dB bandwidth of 1.7 kHz ± 100Hz (specified as a minimum of 1 kHz). These filters make good CW search filters, or can be used on receive for SSB when the going gets really tough! The cheaper CFM455J1 filter, which is often used for SSB reception in Japanese general coverage receivers, is specified as a minimum of 2.6 kHz bandwidth at –6dB, but I have yet to find one that is less than 3.7 kHz, and I have measured at least 7 of them to date. These can make very good narrow AM filters for situations where the adjacent channel interference is bad. Filters for AM bandwidths are very often about 1 to 2 kHz wider than the mini-

| Murata | NTK | Min. BW(-6dB) | Term. Imp. | Ins. Loss | Typ. BW(-6dB) | Stopband |
|---|---|---|---|---|---|---|
| CFG455I | SLF-D4 | 4kHz | 2k | 7dB | 5.2kHz | 85dB |
| CFG455H | SLF-D6 | 6kHz | 1.5k | 6dB | 8.5kHz | 85dB |
| CFG455G | SLF-D8 | 8kHz | 1.5k | 6dB | 10.5kHz | 85dB |
| CFJ455K8 | n/a | 1.0kHz | 2k | 8dB | 1.7kHz | 90dB |
| CFJ455K5 | n/a | 2.4kHz | 2k | 6dB | 2.8kHz | 90dB |
| CFK455I | CLF-D4 | 4kHz | 2k | 8dB | n/a | 80dB |
| CFK455H | CLF-D6 | 6kHz | 2k | 7dB | n/a | 80dB |
| CFK455G | CLF-D8 | 8kHz | 2k | 6dB | n/a | 80dB |
| CFL455I | n/a | 4kHz | 2k | 8dB | n/a | 60dB |
| CFL455H | n/a | 6kHz | 1.5k | 7dB | n/a | 60dB |
| CFL455G | n/a | 8kHz | 1.5k | 6dB | n/a | 60dB |
| CFM455J1 | n/a | 2.6kHz | 2k | 6dB | 3.7kHz | 70dB |
| CFM455I | LF-C4 | 4kHz | 2k | 7dB | 6kHz | 50dB |
| CFM455H | LF-C6 | 6kHz | 2k | 6dB | 8kHz | 50dB |
| CFM455G | LF-C8 | 8kHz | 2k | 6dB | 9.5kHz | 50dB |
| CFS455J | LF-D2? | 3kHz | 2k | 8dB | 5kHz | 95dB |
| CFS455I | LF-D4 | 4kHz | 2k | 8dB | n/a | 95dB |
| CFS455H | LF-D6 | 6kHz | 2k | 7dB | n/a | 95dB |
| CFS455G | LF-D8 | 8kHz | 2k | 6dB | 9.5kHz | 95dB |
| CFX455I | n/a | 4kHz | 2k | 8dB | n/a | 70dB |
| CFX455H | n/a | 6kHz | 1.5k | 7dB | n/a | 70dB |
| CFX455G | n/a | 8kHz | 1.5k | 6dB | n/a | 70dB |
| CFW455IT | LF-H4 | 4kHz | 2k | 6dB | 6.2kHz | 50dB |
| CFW455HT | LF-H6 | 6kHz | 2k | 6dB | 8.1kHz | 50dB |

**Table 1: Data on 455 kHz ceramic filters.**

mum specified figure in the manufacturer's data. NTK LF-C6 and Murata CFS455H filters, which are specified as a minimum of 6 kHz bandwidth, are quite often 8 kHz wide at the –6dB points, but the CFS455I and CFG455I filters (minimum 4 kHz) are usually only 5.1 to 5.3 kHz wide. If you want a filter that is, typically, slightly over 6 kHz wide, it's quite a problem to find one. The only one I've found during the many years I've been looking is the CFW455IT, which doesn't have a great stopband performance, but is adequate and very handy for improving old receivers with an excessive –6dB bandwidth. The best narrow AM filter I've ever come across is the CFS455J, which is specified as a minimum of 3 kHz bandwidth at –6dB, but is actually nearer 5 kHz, and has a –60dB bandwidth of 7 kHz! This is a very good filter, but a bit on the narrow side for good quality AM.

## Recommendations

To improve the selectivity of old receivers that are very broad, I would recommend the use of the CFW455IT for those who want slightly more than 6 kHz bandwidth at the –6dB points, and one of the 'H' suffix Murata filters from the CFS, CFG, CFL, CFK, CFX, or CFM ranges for those who want 8 kHz. I haven't tried the NTK equivalent of the Murata CFW455IT, but the equivalents of the Murata 'H' bandwidth filters are designated '-6' by NTK. For receivers which have a good "on the nose" bandwidth for AM, and only require some help in the transition region and a bit of additional stopband attenuation, the typically 8 kHz, or 10 kHz wide filters from the nominal 6 kHz, or 8 kHz minimum bandwidth range are a good choice. Then, the original 6 kHz bandwidth is hardly reduced at all, but the steepness of the roll-off in the transition regions either side of the passband are greatly improved, and the adjacent channel rejection increased tremendously. The NTK LF-C6, Murata CFS455H, CFG455H, CFM455H and CFL455H filters are all good for this application. The CFS455H has the best stopband attenuation. If you want the slightly wider bandwidth filters, they are identified by the suffix 'G' in the Murata range and '-8' in the NTK range of ceramic filters. For example, the CFS455G is a nominally 8kHz bandwidth (minimum) filter with a typical –6dB bandwidth of 9 to 10 kHz. I've put together all the information I've gathered on ceramic filters over the years, and also added information from my measurements of filters I've used in various sets, to produce **Table 1**. There is no column listing the ripple for each filter because Murata seems to state 3dB maximum for all their filters, despite the fact that it usually 1dB, or less. This table lists data on filters that are now obsolete, but are still available from some suppliers and on the surplus market.

### Matching New to Old

The natural impedance of ceramic filters is around 1.5 to 2k ohms, and matching transformers need to be used to provide the higher input and output impedances suitable for vacuum tube receivers. If this is done properly, the signal voltage at the grid of the following IF stage will be reduced by only slightly more than the insertion loss of the filter. Don't be tempted to transform down from high impedance at the input of the filter, and then terminate the output with a 2k ohm resistor in the grid of the next IF stage. This may seem a very convenient way of doing it, but the impedance drop to the grid will lose too much signal voltage in addition to the insertion loss, and leave the IF short of gain. You're going to lose IF gain, anyway, by fitting a filter and you can probably afford to lose some without it adversely affecting the receiver performance, but not too much. You must transform down and then up again to maintain the original signal level, minus the insertion loss of the ceramic filter and the matching transformer loss, of course. Resistive terminations are required across the IF transformers at some point so that the filter sees a transformed impedance that looks purely resistive to it over a frequency interval slightly greater than the –6dB bandwidth. This can be done very conveniently using the dynamic resistance of the IF transformer, itself, to provide the terminating resistance for narrow filters, but for the wider ones used on AM the transformer responses need to be widened by damping with an external resistor. Miniature 7 and 10mm IF transformers have values of Q around 80 to 120 at 455 kHz, and this needs to be reduced to 20 - 25 for 6 - 8 kHz filters. They usually have resonating capacitors of 150 to 220pF. This means you'll need to use a turns ratio of around 4 or 5:1 between the main tuned winding and the untuned secondary to feed a ceramic filter with a 2k source or load impedance. Alternatively, you can use a single winding from the 455 kHz IF transformer and capacitively tap the tuned circuit for the required source and load impedances. The latter approach can give you more flexibility, and the capacitor ratio can be tailored to give you the best passband response with a bit of experimentation. The tuned circuit must be reduced in Q to provide approximately the right resistance over a bandwidth slightly greater than that of the filter to get the design passband shape. Remember that you only get close to the centre impedance of a tuned circuit over the middle one-third of the response, so the bandwidth defined by the working Q of the matching transformers must be three times the passband of the filter you intend to fit. Very often the built-in tuning capacitor is hidden in a recess in the base of the IF transformer assembly, and can be removed from the circuit by crushing it with a pair of thin-nose pliers. You need to make sure that you've removed all the

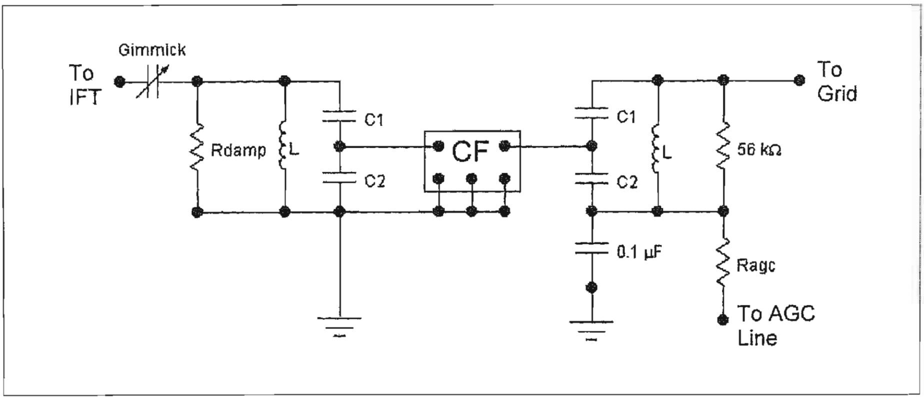


**Figure 1: Ceramic filter circuit application.**

debris from the crushed capacitor so that there is nothing left to short together, or cause any trouble later.

**Circuit Considerations**

Very often, the best place to insert a ceramic filter in a vintage receiver is between the mixer and 1st IF stage if there is no crystal filter there. Otherwise, it has to be between the 1st and 2nd IF stages. These stages usually have AGC applied to the grid, but this is no problem because the new output matching transformer can provide a DC path to the grid of the IF stage. You need to disconnect the secondary of the old IF transformer from the grid of the following IF stage where the filter is to be inserted. Unsolder any AGC connections to the lower terminal of the old IF transformer secondary, and ground it. The new input matching transformer can be coupled by a small capacitor to the top of the secondary of the old IF transformer, as illustrated in **Figure 1**. This capacitor only needs to be a few picofarads, and the simplest way to achieve this sort of value, with the ability to vary it, is to use a 'gimmick'. I don't know whether you use the same expression to describe the same thing in the States, but it's just a pair of insulated wires that are twisted together and trimmed to length to get the right small value of capacitance. The values of the coupling capacitor and the damping resistor across the tuned circuit have to be juggled to get the best response from the filter. There is really no substitute for experimentation here! The exact nature of the IF transformer in the plate circuit of the preceding stage is the big unknown. The Q and inductance of the transformer windings, and the degree of coupling can all vary considerably from one design to another, and from manufacturer to manufacturer, so that makes it impossible to give exact values for the coupling capacitor and damping resistor at the input matching to the filter. In addition, when heavy coupling is used in an IF transformer to get a broader bandwidth, the impedance presented to any subsequent stages varies greatly across the passband, making it difficult provide a good match to a ceramic filter by direct connection at this point. In such cases, the coupling to the secondary of the old IF transformer needs to be very light, and the resistor across the new input IF transformer needs to be low enough that it is the one that determines the source resistance for the ceramic filter. The output matching is much less variable and can be predicted quite easily if the turns ratio and tuning capacitance of the output IF transformer are known. For example, to present 2000 ohms to the filter the turns ratio, n, for a working $Q_L$ of 20 would be

$$n = 0.1\sqrt{2\pi fL}$$

The total terminating resistance on the high impedance side should be

$Rt = 2000n^2$.

This terminating resistance includes the coil loss in parallel with the actual grid resistor, Rg (56k ohms in Figure 1). The parallel equivalent of the coil loss, Rc, is $2\pi fLQ_U$ ohms, where $Q_U$ is the unloaded (natural) Q of the new IF transformer winding (normally 80 to 120), and, therefore, the value of the grid resistor, Rg, required to present 2000 ohms to the filter is Rt.Rc/(Rc-Rt). This is also the minimum value of Rdamp in **Figure 1**. Generally, Rdamp will be higher than this value unless the coupling capacitor (gimmick) is very small, and the coupling to the original IF transformer so light that its contribution to the resistance in parallel with Rdamp is negligible.

For capacitively tapping down the IF transformer, you want a pair of capacitors in the ratio of approximately 3.7:1 (C2:C1) and their series equivalent must be within ±10% of the original tuning capacitor value. For 455 kHz IF transformers that have 180pF resonating capacitors, C1 = 220pF and C2 = 820pF are a good choice to obtain the right step down for a loaded Q of 20. In this case, Rg = 56k ohms, as shown in **Figure 1**. For IF transformers that require 220pf tuning capacitors, try C1=270pF and C2=1000pF, initially. You might also have to reduce the 56k ohm in the IF stage grid to 47k ohm to readjust the working Q of the output matching circuit because of the smaller tuning inductance. Don't be afraid to alter the values if you can't get an acceptable passband shape. Rdamp and the grid resistor across the second matching transformer will both have to be reduced if a filter requiring 1.5k ohm terminations is used.

It helps enormously if you have a wobbulator [sweep generator], or spectrum analyser, to check the passband of the whole IF amplifier while you're experimenting with the values of the coupling capacitor and damping resistor. Don't retune any of the old IF transformers, apart from the secondary of the one to which the coupling capacitor (gimmick) is attached. This may require a slight adjustment to allow for the effect of the coupling capacitor, but the others should be left set up as per the handbook alignment instructions. Only the new ones need to be peaked and tweaked for the best passband response after the ceramic filter and its matching circuitry have been installed. If you don't have a wobbulator, spectrum analyser, or even an 'S' meter to indicate the filter response as you tune through a steady carrier, then you can always attach a VTVM to the AGC line to assess the flatness of the IF passband. There are usually simple alternatives to expensive test equipment. It's just that it's not as accurate, and often takes a bit longer without the right equipment. The grid matching transformer decoupling capacitor is shown as 0.1µF in **Figure 1**, but may need to be reduced to 0.01µF if the AGC action is slowed too much by using the larger value. Don't go lower than this, though, as the reactance of the decoupling capacitor must be very small compared with 2000 ohms at 455 kHz.

**Shielding**

The most sanitary way to add the filter and matching circuitry, RF-wise, is mounted on a specially etched PC board. In order to get the best stopband attenuation from the filter, you need to make sure that components on the input side can't 'see' components on the output side. You can use the metal IF transformer cans and the metal filter case to do this on top of the PC board. Some additional brass shimming, or PC board, might also be required either side of the filter to block input-output coupling. I like to put some screening right over the input pin of the filter on the underside of the board as well as leaving some grounded copper track between input and output. The board also needs to be grounded carefully with low inductance ground leads, or through metal mounting pillars to the chassis of the receiver. The outer from coaxial cable makes good grounding leads. If you use copper strip board instead of a purpose made PC board to carry the filter assembly, you can use the outer from RG174 miniature cable to bond adjacent copper strips together to form larger grounding areas to minimise the ground inductance for the signal return paths and improve screening.

**Results and Final Remarks**

The effect of installing a modern ceramic filter in an old tube receiver with little IF filtering can be quite stupendous. The increase in the off-frequency attenuation and adjacent channel rejection can seem miraculous, with only a slight reduction in the audio output and an upward shift in the AGC threshold point. The signal-to-noise ratio is mainly established in the RF stage, so reducing the IF gain a bit has little effect on that, and the lower audio output is only evident from the fact that you have to turn the audio gain up slightly more on weak signals than you did previous to installing the filter, but now you can actually hear what they're saying!

This treatment is presently limited to receivers that have IFs of 455 kHz. Ceramic filters were, and maybe still are available for 450 kHz. However, if you don't mind a bit of extra work, there are ceramic resonators on a range of frequencies, which can be characterised and built up into ladder filters on other standard IFs, such as 560 kHz, 1 MHz and 2 MHz. I have done this in the past, and in one configuration the homemade AM filters have far more convenient impedances for tube circuits than the Murata and NTK 455 kHz ones – typically 10k ohms to 50k ohms. If I get a chance, I'll write something about them in a future ER article.

One word of warning, though, before I finish. There are old tube receivers that have excellent filtering for AM, and even though they might have an IF of 455 kHz you just wouldn't contemplate fitting a ceramic filter in them. I'm thinking of such receivers as the RCA AR88, which has extensive filtering for the wider bandwidths used on AM. There are other similar, fine receivers from the old days, and if you are unhappy with the performance of one of your old tube receivers, it's best to seek advice from someone who knows how these receivers are supposed to work when in A1 condition before you dive inside, and start modifying it. It may just be that the IF filtering is in need of alignment. However, primitive tube receivers with little IF filtering can really benefit from fitting a ceramic filter. **ER**

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**[Comments, from page 1]**

dynamically select from among the entire range of frequencies available in a given band.

An important component of this change is consideration of the existing system of license classes and the desire to maintain motivation for basic licensees to improve their knowledge and skill. We propose retaining sub-bands that today recognize higher license class levels of achievement. In accord with the basic premise of this proposal, such sub bands by license class would also be permitted all modes of operation..."

I'll have more on this later.

**Corrections**

W2ZM's schematic on page 27 of ER #193 had errors not Bob's. Add a .002 µF, 2kV blocking cap between the plate of the PA and the output tank. Add 500k from the second audio grid to ground, and a 10µF electrolytic from the modulator filament CT to ground. Page 38, VE3CUI's schematic should have pins 4 & 5 of the 12AU7 grounded. 73, NØDMS

# Mechanically Fine Tune Your R-390A

By Ben Robson
Quebec, Canada

### Introduction

Last year I discovered Electric Radio Magazine, wow! I took the plunge and ordered all the back issues. What a delight! I was intrigued by all the articles about the R-390A receiver, and from Fair Radio Sales I ordered the TM-11-5820-358-35 Manual (8-Dec-1961). I'd been looking for a general coverage HF receiver, and after spending days with the manual I went ahead and ordered an unchecked R-390A from Fair Radio Sales. Before delivery of the first, I'd convinced myself I needed a second one and thus ordered a checked R-390A.

Now, on to what I want to pass on to my fellow R-390A enthusiasts, as well as payback to all the wonderful authors (Bruce Vaughan is delightful). I have been learning, relearning, and have been entertained a lot by ER in the last six months. A prerequisite to my work are the instructions detailed in ER #113: "The R-390A RF Module, a New Approach" by Jan Skirrow, VE7DJX. Jan, your opening line resonates with me: "Working on the R-390-A/URR is one of life's pleasures."

### Mechanical Optimization

The mechanical aspect of the R-390A is a marvel of mechanical engineering. Like all machinery, it needs attention to every detail to perform as the designers intended. The first challenge for me was refurbishing each receiver mechanically. I never even turned on the power on the checked receiver before I started dismantling it to clean and optimize its mechanical operation. My XYL says that tells a lot about me. Also, the discipline of restoring one and sacrificing the other didn't last long, so I've worked equally on both.

In fairness to Fair Radio, they warned me about the physical condition of the equipment, including encrusted grime and surface corrosion. However, all components and wiring underneath the electronic modules were 45-year old clean. What a relief!

### Disassembly

I dismantled the mainframe including all the gears and 10-turn counter assemblies. I even unpinned most of the cams from their shafts. While it was labor intensive, after the fact I am glad I did this. Being sensitive to chemical smells, I only used elbow grease, a gallon of ethanol, 2500 Q-Tips, tooth brushes and lots of rags.

### Mechanical Problems

During disassembly, I found incompetent manufacturing, poor assembly, outright sheet metal errors and parts omissions. At times, these problems made for difficult reverse engineering, i.e., what did the designer intend? Sloppy depot service in the military did not help either. The upshot of all this is that you should not to accept what is, but do that which is right. For example, one cam shaft had 4 shim washers bunched up on one end and no washers on the other end. Thus, four wrongly-placed shim washers motivated me to go over everything right down to the length of the screws, presence of lock washers, thickness of washers, and fine tuning the axial play; you get the picture.

Don't get me wrong, I love the modular mechanical design, circuit design, and the challenge of making my R-390As far better then a brand new would be if it were from a contractor. Not now available, of course. No commercial enterprise could afford to pay for the time it takes competent personnel to manufacture a precision-assembled boat anchor. Even today, when you can design-in quality control, I have seen many hand-changed printed circuit boards.

All purists please skip this paragraph; I know you'll think I committed heresy. One of the R-390As now has a shiny aluminum front panel with black legends. All knobs were polished to their natural cast finish using a horizontal mounted hand cranked drill. Elbow grease, #240, #320, and #600 wet sandpaper got me there. Also, several drugstore face masks are a must. Let the wet sludge drop in a water-filled roasting pan.

### Mechanical Objectives

One of my objectives was to have a super-smooth, low-torque, KC-change and MC-change controls on my R-390As. Toward this objective, all 8 spring-loaded slug racks (without the springs attached) must be free to move up and down, and freely follow down their respective cams. Upon rejoining the RF-deck with the gear assembly the last step will be hooking all 16 springs back onto the slug racks.

You should have in front of you the RF-deck circuit module only. Remove all 24 slug-tuned transformers. Clean all their gold plated pins with crocus cloth (rouge), followed by cleaning the pins with ethanol. Next, use about 5 dry Q-Tips for each coil bore and gently clean the bore with an up and down, rotating motion. Do not use solvents. Work gently because the coil forms are paper thin. Do not damage the bore entry edges. Do this until there is no more iron oxide pickup on your Q-Tips. This is very tense work, so take frequent breaks. Re-examine each coil bore, probing with a Q- Tip with a slow, gentle, up and down motion. It should feel as if the bore walls are oily smooth.

### Now the Bad News

Out of 3 sets of 24 coils each, I rejected 3 transformers because it felt as if sandpaper was in the coil bore. No amount of wiping would get them smooth. Upon closer examination I noticed that the 45-year old coil winding pressure had caused a ripple effect in the bore of these paper-thin coil forms. I even had one with a hairline crack the length of the bore. I also had one transformer where the coil form was glued out of vertical. On one brand new transformer, I noticed that the coil bore was so rough it even shredded my Q-Tip.

### Transformer Design Problems

Before remounting all 24 transformers, recognize the following design error. Notice that each transformer has a tab sticking out on each side. As you know, these tabs keep the shielding can in place. Here is the problem. Between the 2.0—4.0 MC transformers and the 1.0—2.0 MC transformers, there is insufficient lateral space for the 2 tabs to not touch each other. The same is true between the 8.0—16.0 MC transformers and the 4.0—8.0 MC transformers. When you mount these transformers, the tabs compete for space and the looser transformer is mounted out of vertical.

Here is my solution to keep the transformer bores vertical. Remount say, the three 2.0 and 4.0 MC transformers normally. Now, remove the shield can on the three 1.0—2.0 MC transformers. Carefully push the tab that is facing the column of the 2.0—4.0 MC transformers inward. Maneuver the shield can back on; this tab must not stick out. Do the same as above with the 4.0—8.0 MC set of transformers.

### Reassembly of the Gear Train

As an addendum to Jan's article, I suggest clamping the main shaft before setting up the cam and anti-backlash gears. Slip a square-inch shim plate between the rear-most main cam and rear-most bearing plate. Use a small C-clamp or a small toolmaker's parallel clamp to immobilize the main camshaft at its marked front-plate position. Setting up the gears and the remaining 5 cams positions is now really easy.

When reassembling the anti-backlash split gears, use everywhere a 2-tooth spring spread. Bear in mind that on some gears a 1-tooth spread just takes up the slack of the spring, so obviously in those cases you should spring-load the gear by 3 teeth. A small 5-inch, fine-tip long nose plier makes for a good spreader on some of the spring-loaded gears.

As to lubrication, I follow more or less ER #25, page 25.

Now, we move on to equally important steps. Before rejoining your RF-deck to the cam-gear assembly please take Jan's advice to heart: Do not force anything! Here is a bad problem I had with both of my R-390As. The rear-most bearing plate is fastened with 3 split lockwashers and screws into the RF-deck module and the bracket for the power entry and mini-BNC. Two of these screws must be just the right length; otherwise they will pierce the RF-deck wiring harness. While you have access to the wiring side, tighten the antenna trimmer shield can with a small nut driver. This takes care of an important ground lug. On both of my rear plates, the screw hole for the bracket did not quite mate with the captive nut in the bracket. The temptation is to push down on the rear-most plate a little bit to make them mate. Don't do this! It takes surprisingly little force to bend both long cam-shafts, thereby increasing the long cam-shaft bearing friction. Either leave this screw off, or as I did, split the RF-deck cam assembly again then elongate the rear plate screw hole with a small round file.

Hey, I've been at this for months!

### Slugs and Slug Racks

Last but not least, on to the slugs and

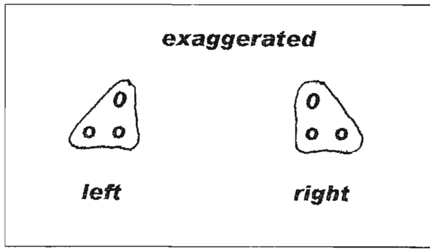



**Figure 1: How to identify left and right-shaped slug-mounting plates.**

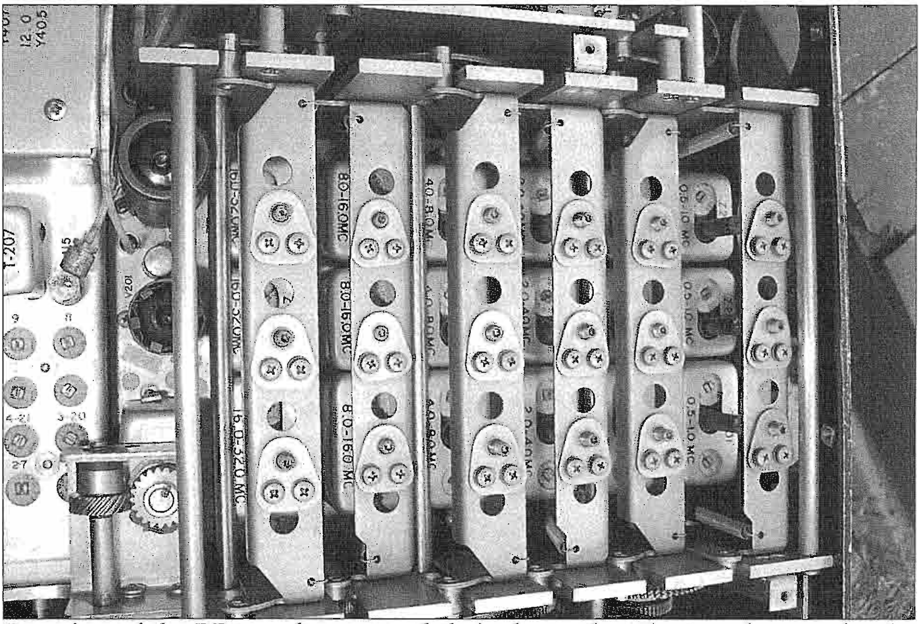
slug racks. Now your RF-deck module should be joined to the cam gear assembly as well as the bandswitch shaft and crystal-oscillator module, ready to be installed in the mainframe. You can reassemble your receiver now.

### Slug Mounting Plates

You may never have noticed that there are two types of the triangular threaded slug-mounting plates orientated either left or right. Please identify them now, see **Figure 1**. You should have 12 right and 12 left-shaped plates. Remove all RF triangle plates with their slugs from their slug rack and sort them out in 2 groups, left and right. Clean and then look at the 6 RF slug racks. These slug racks have variants!

### Slug Rack Variations

All my slug racks are of the kind I prefer, namely, each end of a shaft has a free-moving cam roller and vertical slot roller. On this variant, do not lubricate the outside of these 4 rollers! Lubricate only their bearings. One slug-rack variant I rejected had no shaft, and the vertical rollers did not turn. They were simply riveted onto the slug rack, and only the cam rollers turned. If you have this type you have no choice but to lubricate the vertical slots. Another variant I rejected did have a shaft, but one of the 2 vertical rollers is fixed on the shaft, thereby rotating the whole shaft. It was clever and cheaper to fabricate. It's my second choice, and is better than having a riveted vertical roller. Lubricate only



**Top view of the RF transformers and their slug racks. The transformers for the higher bands are on the left side, and the lowest band is on the far right. The slug-mounting plates are shown on top of the slug racks.**

their bearings.

**Reinstalling the Slug Racks**

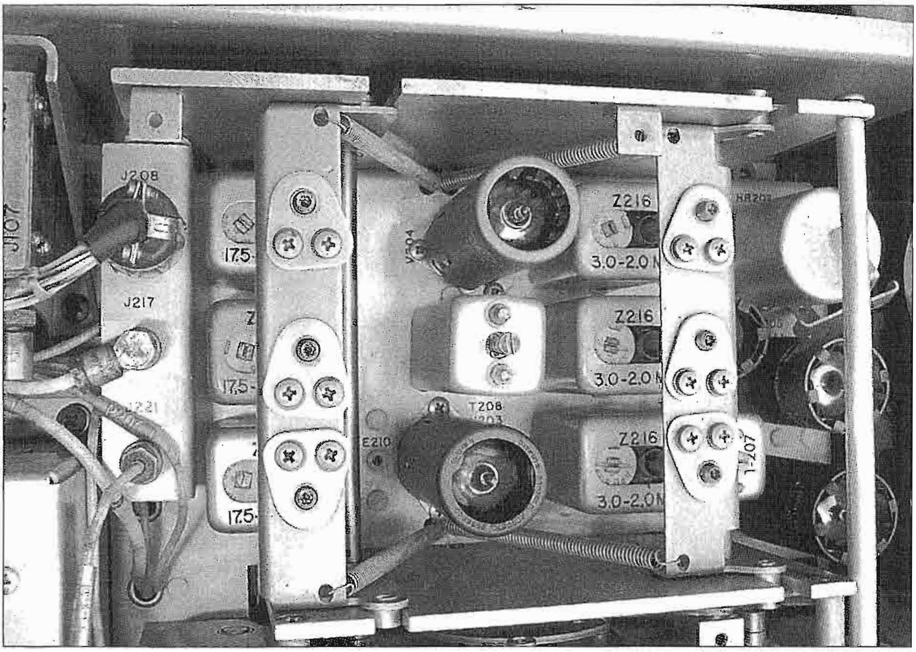
Before reinstalling the slug racks, prepare from an index card two shims, 5/8 inch wide by 5 1/2 inch long. Facing the 6 vertical slots, insert the appropriate slug rack for the column T206 transformer on the extreme left. Manipulate the KC or MC knob for the slug rack to be in the lowest cam position. The slug rack must have lateral play, i.e., no rubbing on the slot plates. If not, correct the cause of friction. It is the slugs which will keep the slug rack centered. The slug rack must drop down freely. Slip your paper shim down the front and rear of the slug rack, between the vertical slot plate. What you are doing is centering the slug rack. Now, take a <u>right</u> slug plate and gently maneuver it, dropping it down in the column-center transformer coil bore. The triangular plate should be flush with the slug rack top surface with no force applied. If not, you might have an obstruction from a slug-thread friction clip, or a bent slug spring. Try another <u>right</u> slug plate. Its friction clip might be in another position and/or the slug spring might be straighter.

Install the 2 screws each with a split lock washer and a thin washer, and then slightly tighten the screws without disturbing the drop-down position of the slug plate. Select two more <u>right</u> slug plates and repeat the above procedure.

Now, remove the card stock shims. Manipulate the MC change or KC change knob as required, being certain that the weight of the slug rack is sufficient to follow the cam downward. Prevent displacement of the slug plates as you tighten them fully. Recheck the up and down tracking.

Continue doing the above procedure with the remaining RF slug racks as follows:

T206 RF-column 3 <u>right</u> plates (done already)




**This photo shows the RF transformers used in the tuneable IF, the slug racks, and the triangular mounting plates that are discussend in the text.**

T205 RF-column 3 left plates
T204 RF-column 3 right plates
T203 RF-column 3 left plates
T202 RF-column 3 right plates
T201 RF-column 3 left plates

Take a break, I took several! Patience, we are almost done. Reminder: IF slugs have a green dot and shiny surface.

Do the same for the two IF slug racks with one difference as follows:

Z213 IF-column, 2 right plates rear, 1 left plate front.
Z216 IF- column, 2 left plates rear, 1 right plate front.

Once you've got it all moving up-down to your satisfaction, rehook the 16 springs. Some day, I might put in weaker springs. Don't forget to electrically realign the IF and RF transformers.

I've made up all the extension cables as per the TM-11-5820-358-35 manual. What a pleasure when working with a live receiver to be able to make measurements on any module's component side. One last point I want to include because it concerns ***safety***, related to the 115-volt power entry. The back panel power-entry cover has very little clearance from the line-filter studs. Do yourself a favor and glue a piece of insulating material on the inside of the power entry cover, 1 1/4 by 1 3/4 will do. Of course, you are using a 3-prong polarized power cable..

[Editor's note: Crocus cloth is available from Small Parts Inc, 800-220-4242.

Ben Robson will be doing more writing for Electric Radio about the R-390A and the SX-71.]

ER

# Linear Plate Modulation of Single-Grid Class-C RF Amplifiers

By Bob Stout, WB9ECK
stout@wpr.org

The intention of this article is to explain in simple terms some of the happenings that occur during plate modulation of a single grid tube (triode) using grid-leak bias only. For CW operation biasing of the grid is simple because you only have two states, on and off, with nothing in between. With audio modulation (gradual keying) not only do you have "on" (100% positive modulation) and "off" (100% negative modulation) but you also have everything else in between these two conditions. This is gradual keying (sine wave) with voice modulation versus instantaneous keying (square wave) as with CW. Other precautions must be taken for "gradual keying" or modulation to cleanly take place.

In order for 100% plate modulation to occur the plate voltage must instantaneously swing to twice the DC plate power supply voltage (100% positive modulation) to zero volts (100% negative modulation). When the plate voltage goes to zero, as is the case at 100% negative modulation, the grid bias and therefore grid current will increase. In other words, during periods of inward modulation the grid current will increase as will grid dissipation. This also changes the "operating angle". We will get back to that issue later. In a single-grid tube some grid modulation inherently occurs when a grid-leak resistor is used (self modulation of the grid as the plate is modulated). This has a tendency to increase the negative grid bias voltage further, cutting off the tube during inward modulation peaks helping to prevent flattening of the peaks at 100% negative or inward modulation. Sounds good, right? There are other factors involved that deserve consideration.

The resistance that the class-C modulated stage (RF Final) presents to the modulator is not exactly constant over the modulation cycle. The RF excitation as well as the bias should be modulated also. The reason for this is to obtain a more constant load to the class-B modulator over the course of the modulation cycle. The RF excitation to the final stage should be "pulsed" or modulated to track the output of the final stage using the same polarity as the final modulated stage.

The operating angle needs to remain constant. The only way you can do this is to have the negative grid bias track the modulation or voltage fluctuations on the plate of the final RF tube. As the plate voltage goes up with positive going modulation, the negative grid bias must also increase to maintain the operating angle. The same is true when the final tube is turning off (100% negative modulation); the negative grid bias must decrease for the operating angle to stay the same.

We can do this by modulating the DC input power (plate or plate/screen in case of a multi-grid tube) of the driver stage (turn it on and off at a syllabic rate) using the same polarity as the class-C final RF amplifier's modulation. This, in turn, will cause the instantaneous value of the negative grid bias to track the modulation on the plate of the class-C final RF stage maintaining the operating angle regardless of where the modulation envelope happens to be. What is the advantage of all of this? It presents a constant resistive load to your class-B modulator. This greatly reduces the amount of distortion produced by the class-B modulator. Linearity or fidelity (the two terms are interchangeable) is what we are after. Your signal can't be too clean. I have incorporated this system into one of my homebrew transmitters with great success.

**ER**

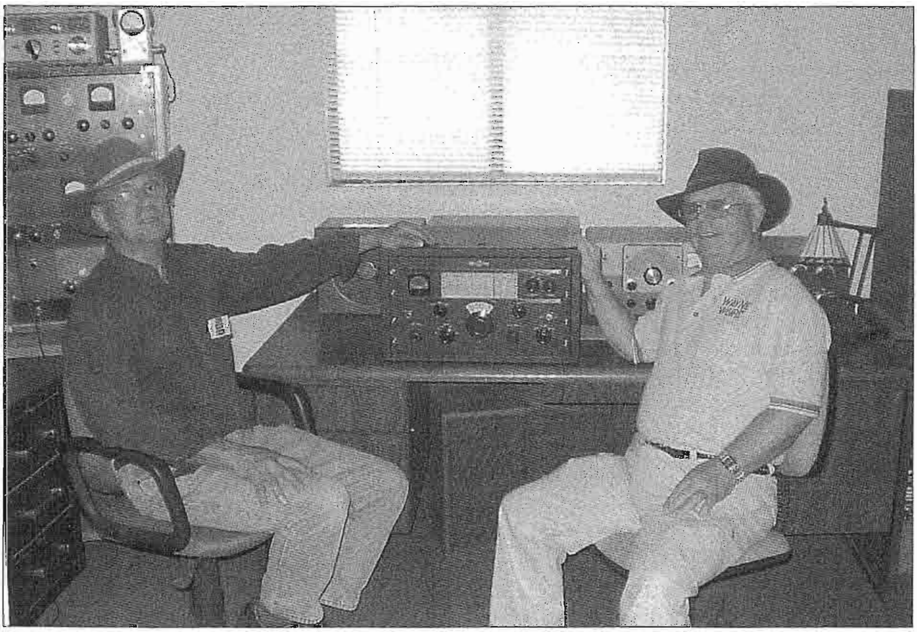
# PHOTOS

Spring 2005 West Coast AMI BBQ
By Bill Feldmann, N6PY
n6py@arrl.net

On Saturday, May 14th fifty west-coast AMI members and many of their wives met at the home of George and Marian Silva for a spring get together and BBQ lunch. This event was an excellent opportunity to meet many of the operators that put out the great AM signals from the West Coast.

The meet started with a flea market where almost everyone found a much needed part, instrument or additional radio for his or her shack. DJ Jones (K6RCL) donated many boxes of tubes and panel meters for donations to the AMI. Additionally, many radios and instruments were given away as door prizes.

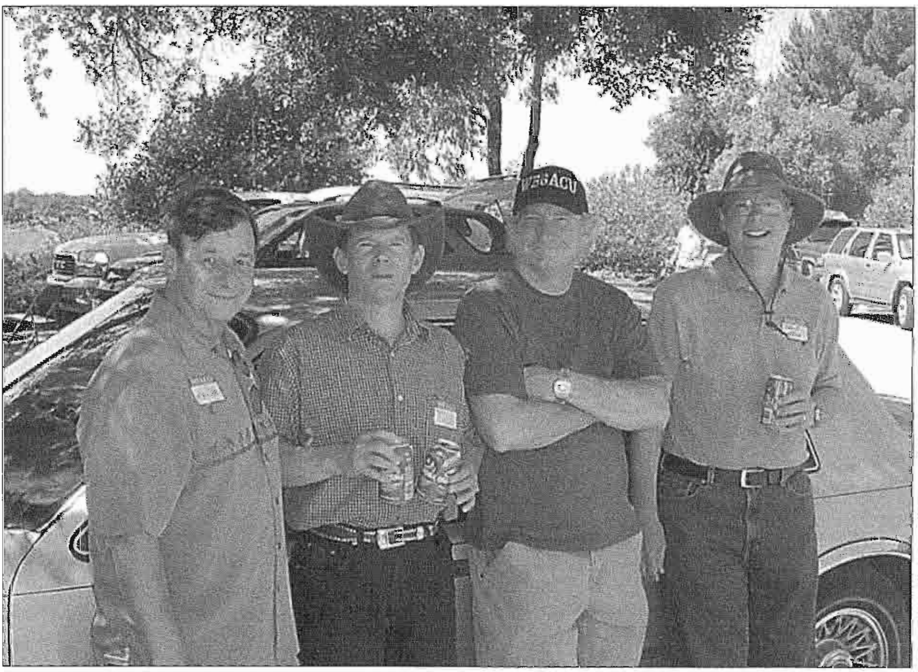
One high point of the meet was the presentation of a very nice Collins 75A-1 to our host George Silva (WA6HCX) by Wayne Spring (W6IRD) for George's work in promoting AM radio here on the West Coast. This Collins 75A-1 will



**Our host George Silva (WA6HCX), on the left, is being presented the Collins 75A-1 receiver by Wayne Spring (W6IRD).**

make a nice match for George's restored Collins 30K-1 transmitter that always puts out a great signal on 75 meters. Besides hosting many AMI meets, George has always helped and encouraged newcomers to AM.

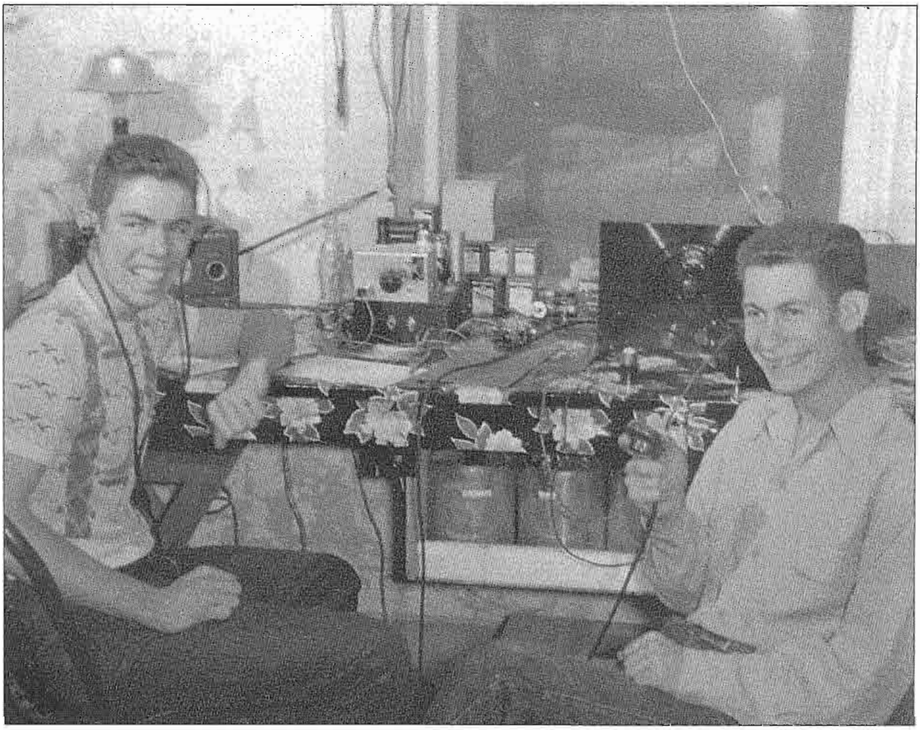
George and Marian served an excellent lunch of BBQ burgers and hot dogs along with many side dishes and soft drinks donated by many of the attendees. This event was an excellent opportunity to swap ideas about restoring or building AM radios, and meet the XYL's of those we often work on the air. Also it was an opportunity to meet our newest and only YL AMI net control operator, Sharon Spring (K6IRD). Sharon is the wife of Wayne--W6IRD--and once a month she serves as the Wednesday evening AMI West Coast Net on 3870 kc. In the short time Sharon has been a net control operator she has introduced many improvements to the net's operation. She also puts out a big signal using her and Wayne's T-368.



**Four of the guys attending the AMI BBQ who have really big signals on 75 meters are shown here from left to right: Mike Dorrough (KO6NM), Brian Thompson (NI6Q), Joe Walsh (WB6ACU), and Dave Jennings (WJ6W).**

## Phoenix Arizona AMers Grubdown, May 24th, 2005

In the Phoenix, Arizona area a group of AMers are active on 40 meters and on 2 meters VHF AM. They met recently at a resturant in Phoenix for their get-together called the "Grubdown." Pictured in the back row, left to right are Tom (NE7X), Warren (K7SA), Dan (KE7ASK), Scott (KC7BGE), Dave (N7RK), Jerry (W5RCQ) and Dick (N7JUG). In the front row, left to right are Max (K7CAX), Jim (K7JEB), Larry (KO6SM), Ron (WAØKDS) and Gary (KD7EQ). Many of these calls are familiar ones in the AM windows. (Photo courtesy of Tom, NE7X)



Above: This was the station of Tom Raymond, W5SIH (now W5JM), in 1950 with his brother John on right, in their college dorm room. The Raymonds used a Hallicrafters S-38 receiver and a homebrew VFO/exciter with a 6L6 final that ran 5 to 10 watts on the 80 and 40 meter bands. The aluminum shield around VFO was made up from a 15-minute transcription disc after the recording acetate was removed. VFO vernier dial is from a BC-375 tuning unit. The amplifier (linear?) is the shiny black panel made from another aluminum transcription disc with the used recording surface still attached. The hollow state/glow in the dark tube was an 829B in a push/pull grid-fed circuit. You can see the open tank coil above John's head that ran 500 volts DC. Outside, beyond the window, is the oak tree used for the end of the "random wire" antenna. And yes, we had to deal with TVI complaints in that fringe area. The exciter is still in my possession 55 years later and was qualified barefoot on 40 meters paired with a HQ-150 in the Fall 1980 Classic Radio Exchange. The large containers on the lower shelf are Karo syrup cans used to store collected radio parts. Tom worked in the kitchen and scarfed up the used containers. (Photo from Tom Raymond, W5SIH)

Lower Left: The annual Butler Hamfest in Butler, Pennsylvania was held this year on June 5. There was an enviable pile of all kinds of boatanchors for sale this time; Collins, Johnson, Heathkit, Hallicrafters, military surplus, accessories, etc. Most of them found new homes right away. (Photo courtesy of Tom Marcellino, W3BYM)

Above: ER Author Dave Kuraner (K2DK) is shown in his shack in Haymarket, Virginia. Out of view to Dave's left is a Bauer 707 broadcast transmitter that's installed in a closet. Dave calles it his "Closet Kilowatt."


Above: Bob Rolfness (W7AVK) was 17, had an Advanced-Class license, and was a Junior in High School when this picture was made. At the time, his interest was 15-meter AM DX. Thus, DX is the reason for the RF preamplifier on top of the HQ-140X and also for the military compass indicator that was coupled to his homemade 3-element beam. The box next to the beam indicator is a DC supply for the military surplus rotating motor that turned the whole mast. Bob made his DXCC before going to college the next year. (Photo courtesy of Bob Rolfness (W7AVK)

Lower Left: In early March 2005 Tony (W5OD) and George (WB5WUX) drove in 30 hours from Dallas, Texas to Northern California to pick up George's newly aquired Collins TDO transmitter. Tony got up at 1:30AM to work his buddies on 3885 AM at WA9MZU with Gary's Collins FRT-24. (Photo courtesy of Gary Halverson, WA9MZU)

ER

# VINTAGE NETS

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

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

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

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

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

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

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

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

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

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

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

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

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

**Gulf Coast Mullet Society:** Thu. @ 9PM CT, 3885 kc, QSX control op W4GCN in Pensacola.

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

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

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

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

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

**Midwest Classic Radio Net:** Sat. morning 3885 kc @ 7:30 AM, CT. Only AM checkins. Swap/sale, hamfest info, tech. help are frequent topics. QSX op is Rob (WA9ZTY).

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

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

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

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

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

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

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

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

Texoma Trader's Net: Sat. morning 8:00AM CT 3890 kc, AM & vintage equip. swap net.

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

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

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

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

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**Deadline for the August 2005 issue: Friday, July 29**

**SERVICE FOR SALE**: Repair and restoration on all vintage equipment; over 50 years of experience. Barney Wooters, W5KSO, 8303 E. Mansfield Ave., Denver, CO 80237. 303-770-5314

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

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

**FOR SALE:** Seven volumes of historic Radio Boys series, circa 1923. Very collectible. Fair to good considering age. $200 pp. John, W6KAS, 661-845-0119

**FOR SALE:** RBM Rect. Pwr unit CAY-20086. See May 2005 ER p. 13. Looks fair, no damage, small rust areas & some screw head corrosion. BO + shipping (31 lbs + packing). Manny, WØPIG, 651-699-7932 or MannyBlock@aol.com

**FOR SALE:** Viking Invader 2000, Good Condition, $1,500, OBO. Parts unit $400, OBO, You ship. Ken Sands, K8TFD, 734-453-7658, ken.sands@juno.com

**FOR SALE:** Lafayette (Radio) HE80 very fine shape with matching speaker $175. Lafeyette (Radio) HE30 very fine shape $125. Antenna auto tuner LDG AT-11MP like new with manual $75. Heathkit code oscillator HD-16 $25. Code key (Changshu) never used $40. DC power supply on bread board 400 volt big transformer $45. TUBES: 2 ea. 5R4GA $5. 1 ea 5U4 $5. 2 ea 6146 $20. 2 ea 807 $15. 3 ea 6V6 $20. Will take $60 for all. All of the above is plus shipping. Robert McManaway, K8VVG, 195 Ruth Ave, Logan OH 43138 740-385-2860 mac195@adelphia.net.

**FOR SALE OR TRADE:** National Rack Mount NC-2-40-CS, VG cosmetics, works great; RBL 3 Navy VLF Receiver, good cosmetics, works fine; Signal Corp BC-344D, has 110 volt power supply, good cosmetics, works well; BC 1066 VHF/ UHF acorn tube receiver WWII; tuning unit for Westinghouse GP7 transmitter, model CAY4755, 1.5-3 megacycles, exc., w/case; Signal Generators: RCA WR49B, Navy URM25-F, both working fine; HP frequency counter 5381A, counts to approx. 30 Mhz. WANTED: Literature for RA 1155 British Bomber receiver; also, RA 1154 transmitter to go with my receiver. Ward Kremer, 1179 Petunia Rd., Newport, TN 37821, Ph/Fax: 423-625-1994, E-mail: witzend99@bellsouth.net

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**FOR SALE:** Johnson Pacemaker Transmitter. $300. Pix/Info from pendragon@netsignia.net, N4GL.

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



**FOR SALE:** Hallicrafters S-76 receiver $169. Huntron Tracker 1000, $125. B&K 1476A dual trace scope $125. B&K 801 capacitor analyst $45. Leader-Lag-120A audio gen. $45. Leader-LMV-181A A.C. Millivolter $45. HP-201C audio gen $45. Heath SM-2410 digital counter $45. Everything in good working order. Will double pack. Plus shipping. Jesus Moreno, 634 15th St., Douglas, AZ. 85607, 520-364-3127

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**FOR SALE:** Yaesu filters for various models, New Old Stock. XF-8.2M-501-01, XF8.2M-601-01, XF-8.9HSN, XF8.9HSW, XF-455C. $42 EACH. Bob W7AVK, 807 Westshore J28, Moses Lake, WA 98837, w7avk@arrl.net 509-766-7277

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**FOR SALE:** National NC-155 $75. Hallicrafters S-38 $25. Hallicrafters R-46B $25. All items priced to sell. Bob, W1RMB, 508- 222 - 5553

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**FOR SALE:** Test equipment: Leeds & Northrop 7554 Type K4 potentiometer. Jerrold Model FD-30 wide band comparator. Leeds & Northrop Cat. 9834 DC null detector. Industrial Control Company, Farmingdale NY Servo Tester 100C. Kay Lab Decade Amp 102A. Gordon Shimmel, Box 101, Hannawa Falls, NY 13647 315-265-4638

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**FOR SALE:** Collins R390A+case $1400. Globe Champion $500. Hallicrafters SX100 $200. National NC100XA+Speaker $650. Hammarlund HQ170; Hallicrafters S36A; two Johnson Valiants $500 each. Heathkit DX100 $400. Apache $350, Mohawk $500. Two ART 13s - $850 and $650. All very clean to mint and functional. Frank KBØW/6, 916-635-4994, E-Mail:

fdellechaie@sbcglobal.net

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**FOR SALE:** *Original* ART-13 instruction book printed by Collins Radio Company, Pub. # AN 08-30ART13-5 (17H-2 ATC or AN/ART-13 equipment). Very nice original condx, cover stamped "Radio Service Engineering File Copy." Full factory pictorials and diagrams. Best reasonable offer Barney, W5KSO, 303-770-5314

**FOR SALE**: Galena crystal sets and parts. Tubes and old radio parts. Len Gardner, 458 Two Mile Creek Rd., Tonawanda, NY 14150. radiolen@att.net

**FOR SALE**: Hickok 539C tube tester, National SW-54- $20, Swan 240- $ 40, Hammarlund SP-200. Carter 434-979-7383, celliott14@earthlink.net

**FOR SALE**: Audimax Automatic Level Control, model 444 and Audimax Automatic Loudness Controller, model 710. John, W6MIT, 530-672-0903, svoboda@directcon.net

**FOR SALE**: National NCL2000 VGC, works, $750. 2 ea NCX5, PS, 1 VFO, calibrator, $600. Freight paid 48 CONUS. Guaranteed. Don, K5AAD, 1-713-942-9747

**FOR SALE**: Hallicrafters HT30, $350. SR150, AC, $150. SR400, AC, $400. Freight paid 48 CONUS. Guaranteed. Don, K5AAD, 1-713-942-9747

**FOR SALE**: Swan 500C, 500, 1 PS V+2, $350. Freight paid 48 CONUS. Guaranteed. Don, K5AAD, 1-713-942-9747

**FOR SALE**: Drake TR4C, AC, $300. AC-3 $50. Freight paid 48 CONUS. Guaranteed. Don, K5AAD, 1-713-942-9747

**FOR SALE**: Hallicrafters SX-28 receiver. Clean, with tubes, unchecked, $550. Stuart T. Carter II, W4NHC, 680 Fernwood Dr., Melbourne FL 32904, 321-727-3015

**FOR SALE**: Yaesu FT101ZD $300. Kenwood TS940S/AT 2CW, $600. Freight paid 48 CONUS. Guaranteed. Don, K5AAD, 1-713-942-9747

**FOR SALE**: B&W 5100 $150. R390A complete $375. R12 Hallicrafters speaker $750. C1306 and C1307 $40 each. Bayshore UPS 191B Multicoupler 2-30 Mc $150. CU52 Multicoupler with heavy shipping box $75. All plus shipping or pick up. Ward Rehkopf, K8FD, 16173 Indian Valley St, Schoolcraft MI 49087. Call 269-679-3435

**FOR SALE**: 3 Air Force Training Manuals (circa mid ' 50's) Receivers,Transmitters and Antenna Systems. Over 500 pages in all. VGC, $ 23 shipped for all. k4deejim@aol.com, 854-855-9570

**FOR SALE**: Parts, chassis, capacitors, crystals, chokes, tube sockets, transformers. SASE for list. E.F. Hayes, WØJFN, 3109 N. Douglas Ave, Loveland, CO 80538-2548.

**FOR SALE**: HEATHKIT LOT: HW-100 w/ manual, HW-12 w/pwr cable, (2)HW-12A, HW-22A w/manual, HW-32A w/manual, (2)HP-23 w/pwr cables, $400 B/O for all. Dentron Clipperton-L amp w/manual, $500 B/O. Prefer meet/pickup in Central N.J. Steve Davis KD2NX, 181 Center Avenue, Keansburg, N.J. 07734, 732-495-8275, kd2nx_66@yahoo.com

**FOR SALE**: Plate Transformer, 4400VCT @ 2.2KVA & Swinging Choke, 2/15 Henry @1 amp, $100. Pickup only. Richard Prester, 131 Ridge Road, West Milford, New Jersey 07480. 973-728-2454. rprester@warwick.net

**FOR SALE**: Drake TR-7/TR-7A/R-7A service Kit. Includes 13 extender boards and digital jumper card. $63.85 including postage. www.atnet.net/~rsrolfne Bob, W7AVK, 807 Westshore J28, Moses Lake, WA 98837, w7avk@arrl.net, 509-766-7277

**FOR SALE**: Lafayette tube tester TE50, c. 1962, complete, near new w/manual, $20 + Shipping. H. Mohr, W3NCX, 1005 Wyoming, Allentown, PA 18103

**FOR SALE**: Swan 117X power supply heavy duty upgrade kit, all new capacitors, diodes, $50. 319-377-7790,boxorox@K0BGH.com

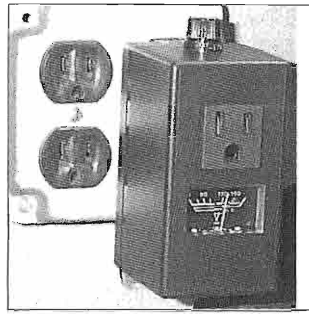
**FOR SALE**: Simpson DC microammeter, $45. Simpson 378 AC milliammeter, $45. Ross Wollrab, 229 N. Oakcrest Avenue, Decatur, IL 62522-1810. 217-428-7385. REWollrab@aol.com

## ZIM ELECTRONICS INRUSH CURRENT LIMITERS

Inrush Current Limiters are now available from the Electric Radio Store or on-line! These inrush limiters were reviewed in the September 2004 issue of Electric Radio and are available in three versions:

**Model AB-1M (With Voltmeter) ................. $34.95**
*NEW! Model AB-300M* **300 watts (2.5 amps x 120 VAC) with meter ....................................................$39.95**
**Model AB-1 (With Pilot Light) ................. $29.95**
**Shipping, each limiter ................................. $4.95**
(4 or more limiters are shipped free for US orders. Overseas customers please ask for shipping quotes.)

The Inrush Limiter provides a gentle, slow startup for your valuable vintage radio equipment. They also reduce the line voltage closer to original design values due to the voltage drop across the limiter element. Both models come with a full money-back guarantee.



Model AB1-M

**Electric Radio Store**
**720-924-0171**

**FREE**: Tektronix Type 545B 30-MHz scope, with Scopemobile cart, vertical plug-ins, manual, good condition. Can't ship; prefer pickup or delivery in the Denver CO area. Call Ray, NØDMS, at ER, 720-924-0171

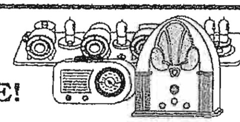
**FREE**: Control box CDR TR2 Rotor. U Pay postage. Dennis Olmstead, WB9EMD, 1124 South 11th St, Montrose, CO 81401. phone 970 249 4099 dwotrans@aol.com

**CRYSTALS FOR SALE**: AM and CW FT243 CRYSTALS - NEW LIST: 1885, 1900, 1930, 1945, 1970, 1985, 3721, 3837, 3855, 3870, 3875, 3880, 3885, 3890, 7018, 7050, 7123, 7143, 7250, 7255, 7260, 7280, 7285, 7290, 7293, 7295, 8400, 10106, 14286 kc. Many others available - See list at http://www.af4k.com/crystals.htm or call Brian, AF4K on 407-323-4178 af4k@hotmail@com

**DRAKE INFO FOR SALE**: Drake C-Line Service Information. Hi-Res Color photos of boards and chassis with parts identified. CD also includes Hi-Res scans of R-4C and T-4XC manuals, various version schematics and more. Garey Barrell, K4OAH@mindspring.com, 4126 Howell Ferry Rd, Duluth, GA 30096. 404-641-2717

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

**FREE SAMPLE!**



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**JOHNSON PARTS**: EFJ replacement parts: Valiant tie bolts-4 for $18.50. Ranger tie bolts-3 for $17. 80-2CM mic connector (also for Heath/Collins/others) 10 All ppd.

**WANTED**: EICO 722 VFO. Contact Cal Eustaquio, N6KYR/8, 823 W. Shiawasee St, Lansing, MI 48915, catman351@yahoo.com

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

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

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

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

**SERVICE FOR SALE**: Repair, upgrade, performance modification of tube comm. & test equip. Accepting most military, all Collins & Drake, & better efforts from others. Laboratory performance documentation on request. Work guaranteed. Chuck Felton, KDØZS, Felton Electronic Design, 1115 S. Greeley Hwy, Cheyenne, WY 82201. 307-634-5858 feltondesign@yahoo.com

**FOR SALE**: Send for Free list TT for obsolete Triplett transformers, chokes and manual copies. USA only. Bigelow Electronics, POB 125, Bluffton, OH 45817-0125



**TUBES FOR SALE**: Tested good globe 201A and 226 $14, 227 $10 and others. Slightly weak 226, 227, 245, 280 guaranteed to work in early radios ½ regular price. Write or e-mail: tubes@qwest.net for a new price list or see www.fathauer.com. George H. Fathauer & Assoc., 123 N. Centennial Way, Ste. 105, Mesa, AZ 85201. 480-968-7686 or toll free 877-307-1414

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

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

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

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

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

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

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

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

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**FOR SALE**: PK232MBX data controller in new condition w/book $125. Bill Riley, W7EXB, 863 W. 38th Ave, Eugene, OR 97405, 541-345-2169

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

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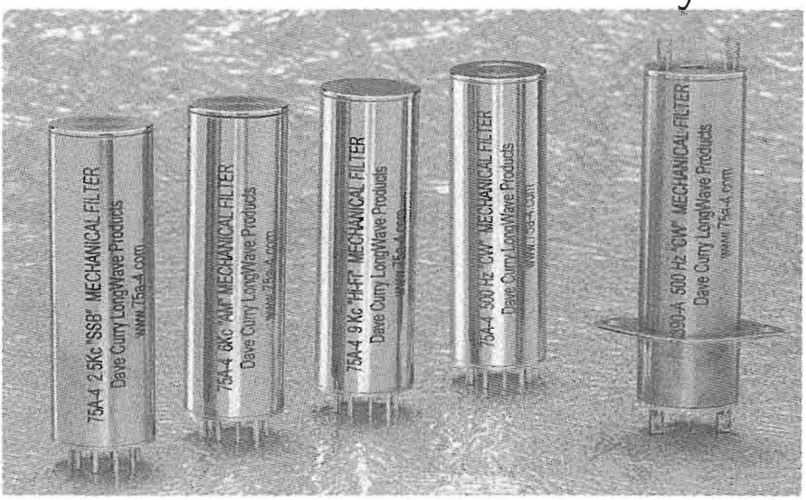
# The Collins Filter Family




By Application, Left to Right:

75A-4 2.5Kc 75A-4 6Kc 75A-4 9Kc 75A-4 .5Kc R-390A .5Kc

## by Dave Curry Longwave Products

These are exact duplicates of the original filters using the latest, modern design Collins mechanical filters. The electrical specifications exceed the original Collins design.

* CW - 500 cycles
* SSB - 2.5 kc
* AM - 6 kc
* Hi-Fi AM - 9 kc Ceramic Filter

$199 each, $178 for 9 kc, plus $4.50 S&H each order.

In stock for immediate shipment from the ER Store, or on-line at

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

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

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**WANTED:** Navy WW2 shipboard receivers and transmitters. Need equipment, manuals and general operating information. Receivers of the type RAK, RAL, RBA, RBB, RBC, RLS etc, Transmitters of the type TBA, TBK & TBM (with modulators), TDE TBS etc. Equipment is for the restoration of Radio facilities aboard the USS Alabama (BB-60), now part of the Battleship Memorial Park, Mobile, Alabama. I was a Radio Technician aboard the Alabama in WW2 and would like to hear from other WW2 RTs and Radio Operators concerning radio operating and maintenance procedures aboard other Navy WW2 ships. Please call Stan Bryn, AC5TW, at 1-800-984-9814 week days between 0800-1100 MST. Or email intor@zianet.com.

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**WANTED:** Speaker, Jenson, CHC 49154 (LS201) for my Navy RBG-2 receiver. Ed Allison, 5525 20th Ave, Sacramento, CA 95820, 916-454-1788.

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**WANTED:** Diagram and manual for Philco Model 7050 tube tester. What type is it: Emission, Dynamic, or Mutual Conductance? Jerry Van, W9VOW, 1150 Kellogg, Green Bay WI 54303, 920-499-2232 Mon-Wed-Thurs 6:30AM-9:30 PM CT, Sat 9:30AM-9:30 PM.

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**WANTED:** Manual for Hallicrafters SX-11 receiver. Manual for Singer FM-9. Programming info for Wilson WU-1516. Programming info for Kenwood TK889. Bob Savage, 330-879-5250, 124 Spankle NE, Navarre OH 44662

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**WANTED:** INTECH R6000 Service Manuals: COM3648, COM1000, COM1005 HF SSB Marine radio set. Wes, K5APL, 870-773-7424, k5apl@cableone.net.

**WANTED:** CU168 or CU5069 Multicoupler, R390, AR88, SX115, and 32S3 with power supply. Ward Rehkopf, K8FD, 16173 Indian Valley St, Schoolcraft MI 49087. Call 269-679-3435

**WANTED:** Meter movement for a Knight KG-600B tube tester or the complete tester for parts. Johnny Umphress, 1415 Moore Terrace, Arlington TX 76010, 817-915-4706

**WANTED:** Figures 12, 13, 19, 23, 24, 28, 29 from the Globe Chief DeLuxe kit construction manual. Al Bernard, PO Box 690098, Orlando FL, 32869-0098, ni4q@juno.com

**WANTED:** CQ Magazines 1945 especially June and August. Tom Berry, W5LTR, 1617 W. Highland, Chicago IL 60660. Cell 1-773-301-7640 Home 773-262-5360

**WANTED:** Power supply for Meissner Signal Shifter. Lee, N2UDF. n2udf@netzero.com.

**WANTED:** Harvey Radio Labs Tri-Tet Exciter or FT-30 Transmitter. $1000 reward! Robert Enemark, W1EC, PO Box 1607, Duxbury, MA 02331, 781-585-6233

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

**WANTED:** Top prices paid for globe shape radio tubes, new or used. Send for buy list or send your list for offers. Write or e-mail: tubes@qwest.net See www.fathauer.com or send for catalog of tubes for sale. George H. Fathauer & Assoc., 123 N. Centennial Way, Ste 105, Mesa AZ 85201. 480-968-7686, Call toll free 877-307-1414

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

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

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

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

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

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

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

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

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

**WANTED**: WW II German, Japanese, Italian, French equipment, tubes, manuals and parts. Bob Graham, 2105 NW 30th, Oklahoma City, OK 73112. 405-525-3376, bglcc@aol.com

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

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

**WANTED**: Looking for a National NTX or NTE transmitter/exciter for use in my vintage hamshack. Any condition, even basket cases or parts, considered. Will pick up in New England, or arrange shipping if outside of area. Paying any reasonable price, and most unreasonable ones! Please email with details or photos, all considered and most likely bought! Thanks! Bruce, W1UJR, 207-882-9969 or w1ujr@arrl.net

**WANTED:** Schematic and related info on Halowatt TR5 broadcast rcvr made mid-1920s in Portland, OR. Fern Rivard, VE7GZ , PO Box 457, Cranbrook, BC V1C4H9 Canada crc@cyberlink.bc.ca

**WANTED:** Manual for Hickok VTVM model 209B. Also manual for Knight (Allied Radio) transistor 10-circuit lab kit #83Y299. WJ Klewchuk, POB 927, Wadena Sask. Canada SØA 4JØ 306-338-2264

**WANTED:** Collins 312A1 speaker, National SW5, Eldico R104 and T102, QSL cards from 1920's, 9CXX or W9CXX. Scott Freeberg, WA9WFA, 327 Wildwood Avenue, Saint Paul MN 55110. 651-653-2054 wa9wfa@qsl.net

**WANTED:** Parts for HT-33 amp. Need T1 & amplifier compartment. John, W8JKS, 740-998-4518

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

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

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

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

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

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

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

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

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

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

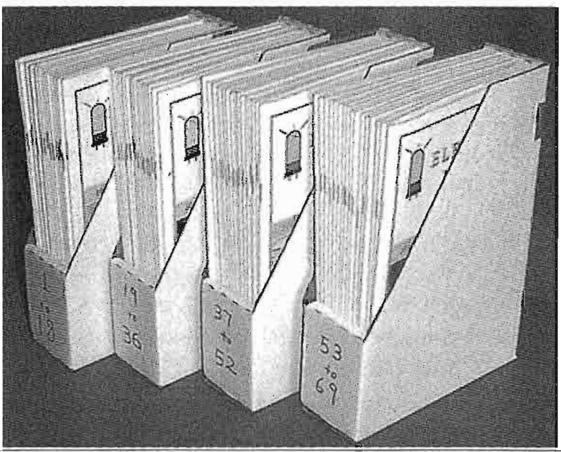
**WANTED:** ANY Harvey-Wells speaker, aircraft unit, or military surplus component. Will answer all. Kelley, W8GFG, 9010 Marquette St., St. John IN, 46373, 219-365-4730

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

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

**WANTED:** Collins R-389 LF receivers, parts, documentation, anecdotes,





antidotes. W5OR Don Reaves, PO Box 241455, Little Rock AR, 72223 501-868-1287, w5or@militaryradio.com or www.r-389.com

**WANTED:** Tektronix memorabilia & promotional literature or catalogs from 1946-1980. James True, N5ARW, POB 820, Hot Springs, AR 71902. 501-318-1844, Fax 623-8783, www.boatanchor.com

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

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

**WANTED:** Westinghouse MW-2 Transmitter (RF unit, modulator, power supply, coils, transformers, parts). Will pickup anywhere. Gary, WA4ODY, Seabrook, TX. 281-291-7701, myctpab@earthlink.net

**WANTED:** WWII Navy GP-7 transmitter in any condition, with or without tuning units or tubes, etc. Ted Bracco, WØNZW, braccot@hotmail.com A.C. 717-857-6404 X306

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

**WANTED:** T-368 Shock Mount. Will pay shipping. Dean KK1K, 802-893-6692 dean.gagnon@juno.com

**WANTED:** Hammarlund ED-4 transmitter. Any condition or information. Bob Mattson, W2AMI 16 Carly Drive Highland NY 12528. 895-691-6247 WANTED: Circuit for the "Mitey-Mite" transmitter-receiver. Harold Schaffner, W2GMX, 519 Perine St., Elmira, NY 14904.

**WANTED:** WW I era and 20' s hi-end sets, amps, detectors: SE 143/IP 500; SE 1420/IP 501; CN 112; RCA 106; SE 1000; SE 1071; Kennedy 110,220; Grebe CR 18; early supers: Norden Hauck Navy 10; Golden Leutz; others; WW I, WW II RDF gear; need DU 1 Loop set-up; others; WW II spy radios. Always buying vintage broadcast gear, tube pre's, compressors, mics, stands, mic flags, by Altec, RCA, Sony, WE. I've got lots of cool radios and stuff to trade or pay cash. Ward Kremer, KI4JHA, 1179 Petunia Rd., Newport, TN 37821, Ph/fax: 423/625-1994. Please note: new e-mail: witzend99@bellsouth.net

**WANTED:** 7x7x2 aluminum chassis with bottom plate NOS. FOR SALE: Vacuum tube C.P.O $20 ppd. Louis L. D'Antuono, WA2CBZ, 8802-Ridge Blvd., Bklyn, NY 11209. 718-748-9612 AFTER 6 PM Eastern Time.

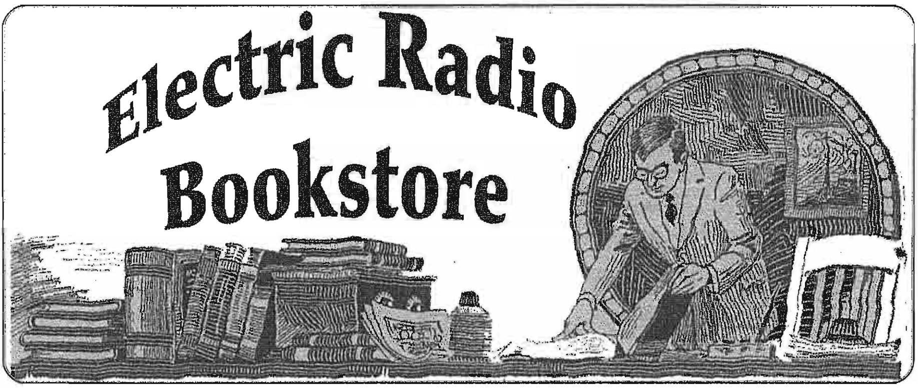
**WANTED:** Scott Special Communications rcvr. EA4JL, please call Kurt Keller, CT, 203-431-9740, k2112@earthlink.net

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

**WANTED:** Cooling fan blade for one of the two cooling fans in my Central Electronics 100V. The fan motors are fine just one fan blade is broken. Jerry, 360-457-6671, coastie@olypen.com

**WANTED:** Copy or photocopy of 'R9 Sigs-Angle Radiation' by A.L. Munzig, W6BY, 1933. Dave Gordon-Smith, g3uur@dg-s.fsnet.co.uk or Whitehall Lodge, Salhouse Road, Norwich, NR13 6LB, UK.

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

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(Note: Shortwave Receivers, Past and Present is out of print and will not be available until at least late 2007 according to the publisher.)

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

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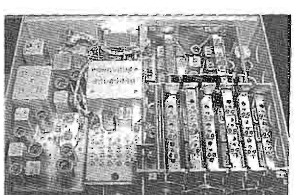

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