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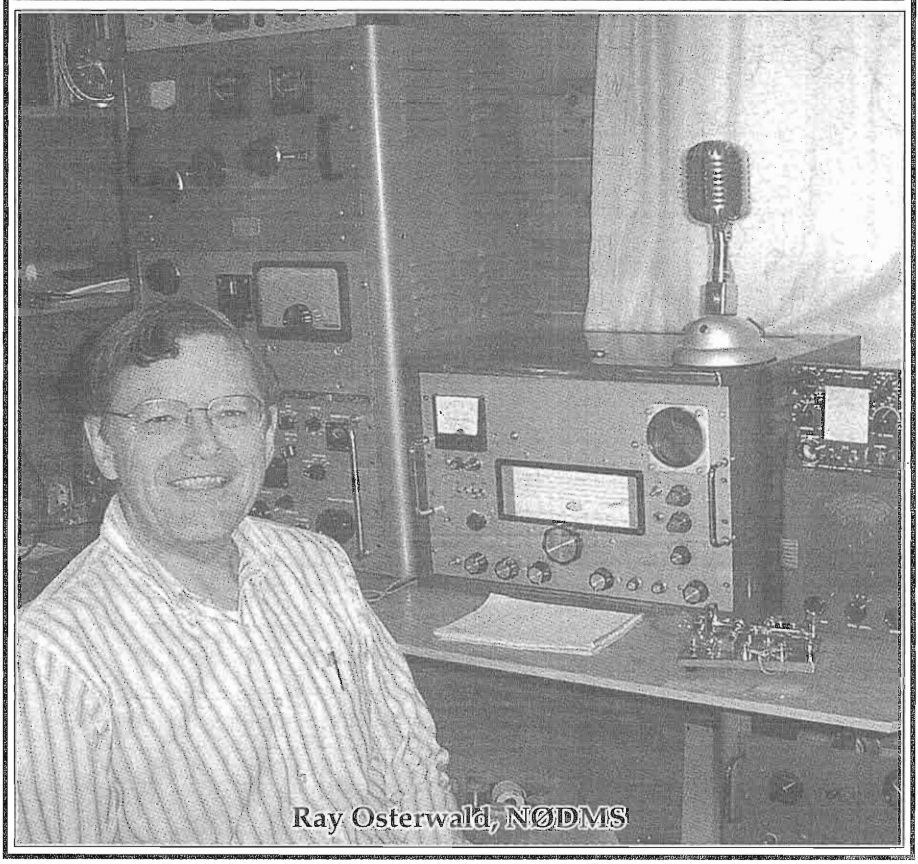
ELECTRIC RADIO

celebrating a bygone era

Number 160 September 2002



Ray Osterwald, NØDMS

ELECTRIC RADIO

published monthly by Electric Radio Press, Inc.
14643 County Road G, Cortez, CO 81321-9575
Periodicals postage paid at Cortez, CO

USPS no. 004-611
ISSN 1048-3020

Postmaster send address changes to:
Electric Radio
14643 County Road G
Cortez, CO 81321-9575

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

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

Regular contributors include:
Bob Dennison, W2HBE; Dale Gagnon, KWll; Bob Grinder, K7AK; Jim Hanlon, W8KGI; Brian Harris, WA5UEK; Tom Marcellino, W3BYM; Ray Osterwald, NØDMS; Chuck Teeters, W4MEW; Bruce Vaughan, NR5Q.

Editor's Comments

New Editor/Publisher for ER

Effective after this issue Ray Osterwald is Editor/Publisher and owner of Electric Radio. Ray is imminently qualified. He has been a frequent contributor to ER since it's beginning and has produced some of the best articles that the magazine has published—most notably the articles on the Collins 75A-4 and R-390A. He is a graduate engineer and has been involved with his family in other publishing ventures. I'm sure that I could not have found anyone as qualified as Ray to keep ER going.

Shirley and I had mixed emotions about selling ER. On the one hand we were very reluctant to let the magazine go but on the other hand we are looking forward to more free time with less stress. I turned 60 last April and Shirley is 61; it's time for more R&R.

ER is like our child that we have nurtured from infancy to adulthood. It is certainly the best thing that either of us have ever been involved in. There is no way we would have passed ER on to someone we weren't 100 per cent confident in. We want ER subscribers to know that the transition will be seamless and that the magazine will continue to provide the same sort of material that it always has. And we think Ray has the capability to make it a better magazine than it has been.

In the months ahead I will be available to help Ray in any way that I can if he needs me. I doubt that he will. I will also be working to complete the Electric Radio photo book. This is a project that I feel very strongly about. I hope I can pull it off. Right now the photos and captions are coming in very slowly. With more time available I'm hoping I can contact more people for their support. If after a couple of months, I feel that I'm just not going to get the 500 entries that we need I'll just send all the photos and info to Ray for use in ER. Some benefit will have come from my efforts anyway.

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Cover: Ray Osterwald, NØDMS, the new Editor of ER in his vintage hamshack. Ray is mostly noted for his modification articles but he is also a fine homebrewer. Note the receiver directly in front of him.

AMI Update - September 2002

by Dale Gagnon, KW1I, AMI President
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ARRL to Petition the FCC for Subbands based on Emission Bandwidth

Earlier this summer many AM'ers were sending comments into the FCC on the recent petition to open up new amateur bands, most notably one from 5.250 - 5.400 MHz. One of the issues the FCC was interested in had to do with whether the new band should be divided into subbands. Most AM'ers did not favor subbands. Some other commentators actually suggested that the new band have subbands with emissions limited by bandwidth, with maximum bandwidth such that AM would not be allowed. My reaction was to chuckle and wonder will some people ever stop trying to get rid of AM.

Within the space of a week or so the AM community began to focus on the minutes from the July ARRL Board of Directors Meeting. Minute 64 authorized the ARRL at the next practical opportunity to petition the FCC to revise Part 97 to regulate subbands by signal bandwidth instead of by mode. At this point my chuckling stopped and I wondered what was up. The same thought was going through the minds of many AM ops. Subsequently, ARRL officials were deluged with calls and e-mail from the AM community asking for details. I spoke to Tom Frenaye, K1KI, ARRL New England Division Director, who made the motion resulting in Minute 64. Tom explained that with the advance of technology there are wide band digital signals that can legally operate in today's CW subbands. These CW subbands, that were originally intended for narrow bandwidth by defining them to be CW and data, are no longer exclusively narrow band because of wide band digital modes. To keep the wideband signals from utilizing the whole band a better definition of wide vs narrow is required. Tom used the example of 20 meters. "Maybe 14.150 MHz should be the subband divider and any emission less than 1.5 kHz is allowed below and greater than 1.5 kHz is allowed above." Tom said that the discussion leading to this BOD minute was focused on how to protect the narrow modes, e.g. CW, PK31, TTY from the wideband digital and voice modes. No limiting of wideband mode bandwidth, e.g. AM was discussed. Paul, WA3VJB reported speaking to Jim Haynie, W5JBP, ARRL President. Paul concluded from Jim's remarks that the focus of the petition development would be on the non-phone segments of our HF allocations. In e-mail to another amateur, Jim Haynie made several points focusing again on the CW/data subbands as the area of interest. He ended his e-mail, "I hope this helps, and if you would pass it on so as to quell the fears of the AM'ers." David Sumner, K1ZZ, ARRL Chief Executive Officer stated in an e-mail about the Minute 64, "The Board has given us no instruction as to what the petition should propose with regard to bandwidth. Absent instructions to the contrary, what we draft (nothing's been done on this as of now) will not propose new restrictions." He also referred to the ARRL's opposition to a 3.5 kHz bandwidth limitation proposed by the FCC in Docket 20777 back

in 1976. He stated, "I don't know anything that's changed in the meantime to alter that position."

It appears that there is no imminent threat to AM operations posed by this latest ARRL action. It is also very heartening to have witnessed the response of so many AM enthusiasts to clarify the situation. It certainly must have impressed the ARRL. ARRL officials were also very responsive. Many e-mails and phone calls were returned and ARRL President Haynie made at least three postings in the QRZ.COM discussion group on this topic.

Before we all relax we need to think about the Pandora's Box effect and the law of unintended consequences. ARRL staffers will now craft a petition for future review by the ARRL Board. When that petition is submitted to the FCC, their staffers will work on it. All along the way there is the danger that a more generalized application of emission bandwidth subband regulation could be proposed. There will be amateurs who try to influence the petition in that direction. The action I recommend is to write your ARRL Division director to make sure they know they represent AM operators. You should make clear you expect no loss of AM operating privileges or available frequencies as a result of this future petition process. After all, the current ARRL leadership has assured us that this is the case. Directors should be contacted now to familiarize them with your feelings. We will need to contact them again in the future before the ARRL BOD meets to vote on this yet-to-be-developed petition.

AMI Discovery Weekend - September 27-29

In the light of the emission bandwidth subband regulation issue and the AM community concerns that were raised, it would be a very appropriate response of AM'ers to come out in large numbers and operate this AMI Discovery Weekend. Remember the purpose of this get together is to have the rest of the amateur radio community "discover" that AM is alive and well on the amateur bands. To make it interesting, certificates are awarded for three levels of participation. Level 1 requires 20 or more AM contacts on any band. To qualify for Level 2, Level 1 must be earned and an AM contact must be made on 20 meters, e.g. 14.286 kHz. In addition to Level 1 and Level 2, Level 3 requires one AM contact on a higher band, e.g.15M, 10M, 6M or 2M "Participant" certificates are awarded to Level 1 achievers. "Participant Plus" certificates are awarded to stations attaining Level 1 and Level 2. The coveted "Participant Primus" is awarded to stations attaining all levels. You do not need to be a member of AMI to participate. Logs should be sent to AMI, Box 1500, Merrimack, NH 03054. Please log AMI certificate numbers if available, as well as transmitter used and transmitters worked. If you have lost your AMI number, e-mail kw1i@earthlink.net or write AMI Headquarters. Impressive 5x7 award certificates, suitable for framing, are sent out to worthy respondents. ER

To Join AMI send $2 to:
Box 1500
Merrimack, NH 03054

AM/Vintage Websites
www.amfone.net
www.amwindow.org

A complete index of the entire 13+ years of ER is available for viewing or downloading at the following website: http://www.qsl.net/n9oo

3rd Annual Fort Stevens Military Radio Enthusiasts Meet

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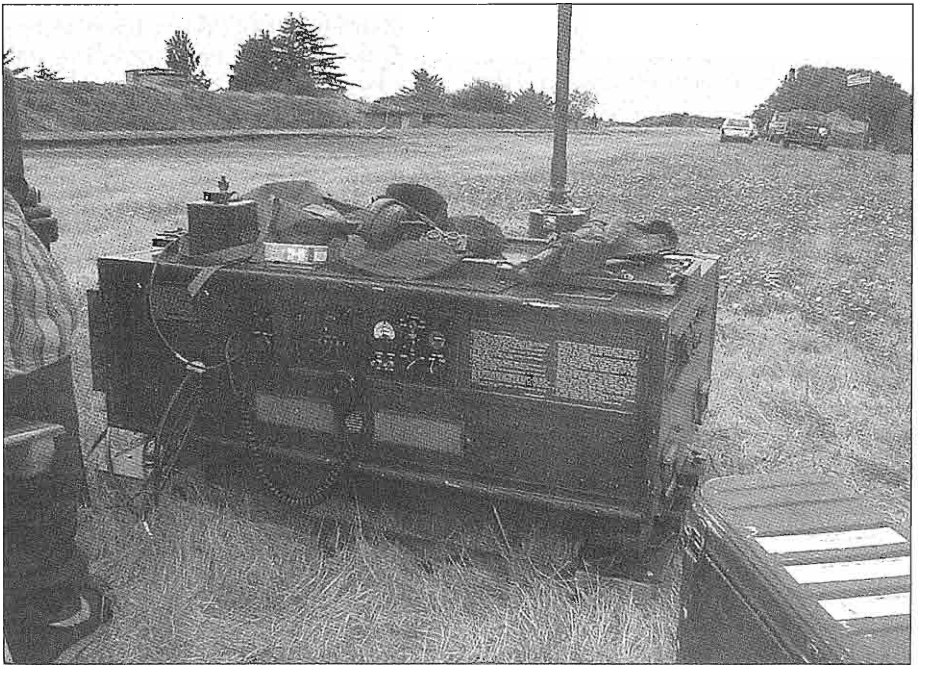
The third annual Pacific Northwest MRE meet was held on the weekend of August 10, 2002. The meet was held at Ft. Stevens (near Astoria, Oregon). Fort Stevens was the primary military defense installation in the three fort 'Harbor Defense System' at the mouth of the Columbia River. The fort served for 84 years, beginning in the days of the Confederate Raiders and closing just after the end of WW II. The fort is now an Oregon State Park. The Pacific Northwest 'Military Radio Enthusiasts' (MRE) meet is held in conjunction with the Oregon Military Vehicle Collectors Club's meet.

Our first meet was held in August of 2000, with Dave, N7EPI and Al, W6GER the only participants. Dave operated a URC-94 (Harris RF-280A) and Dovetron Model 28 'skintight' teleprinter, while Al operated a PRC-47, GRC-19 and GRC-106/MD-522 with a Kleinschmidt TT-4A teleprinter.

In 2001, more of the local Pacific Northwest radio group gathered at the Fort. With more radio activity than in the 2000 meet, interest was sparked in continuing and expanding the meet in 2002.

W6GER's Sunair URC-92 with L-R Chuck, W7HDF, Henry, KH6JJS, Lynn, W7DOU

Dave, N7EPI operating the TT-4A and TT-76 Chuck, W7ZIR observing.



Dave, N7EPI's TRC-75

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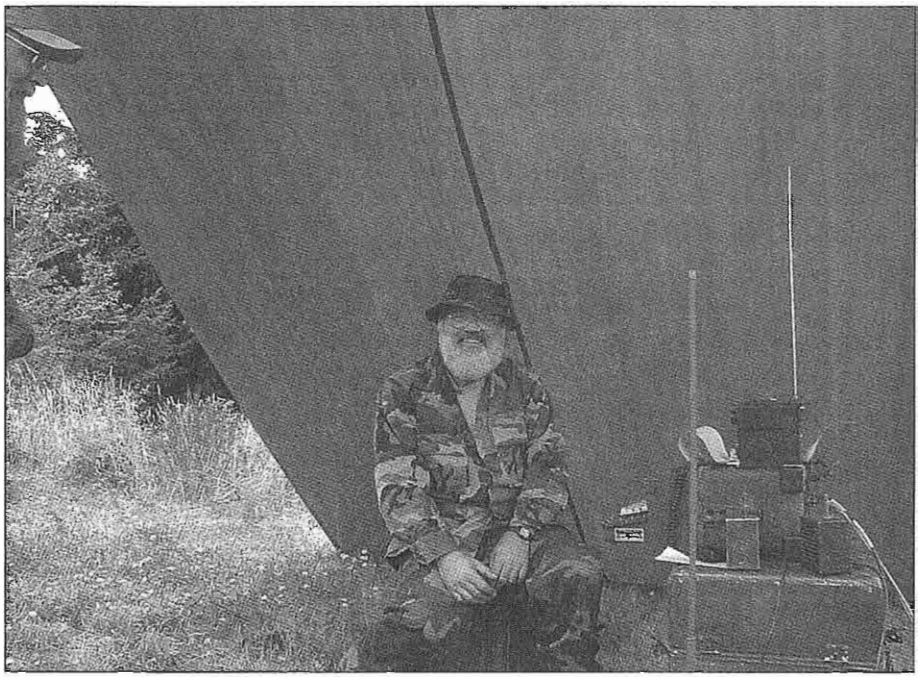


Mike, W7NPA operating his AN/UGC-74B and PRC-47

The 2002 meet included seven radio sites situated along 'radio row', a fortified bluff overlooking the Columbia River. Concrete gun emplacements here saw use during WW I and WW II, when they sheltered several large 'disappearing carriage' rifles. A few hundred yards to the north of the bluff is the Columbia River shipping channel, and the OMVCC vehicle encampment was situated just south of the bluff, on the original Ft. Stevens parade ground.

The seven radio sites contained a varied mixture of military radio gear, including:

Bob, K7MXE operating a PRC-117 with a VRC-94 PA and mount, powered by a battery/solar setup.

Christopher, K6FIB was set up in a two-man tent, and was completely outfitted in a Vietnam-era Army uniform with a backpack PRC-25 radio and correct Vietnam-era accessories.

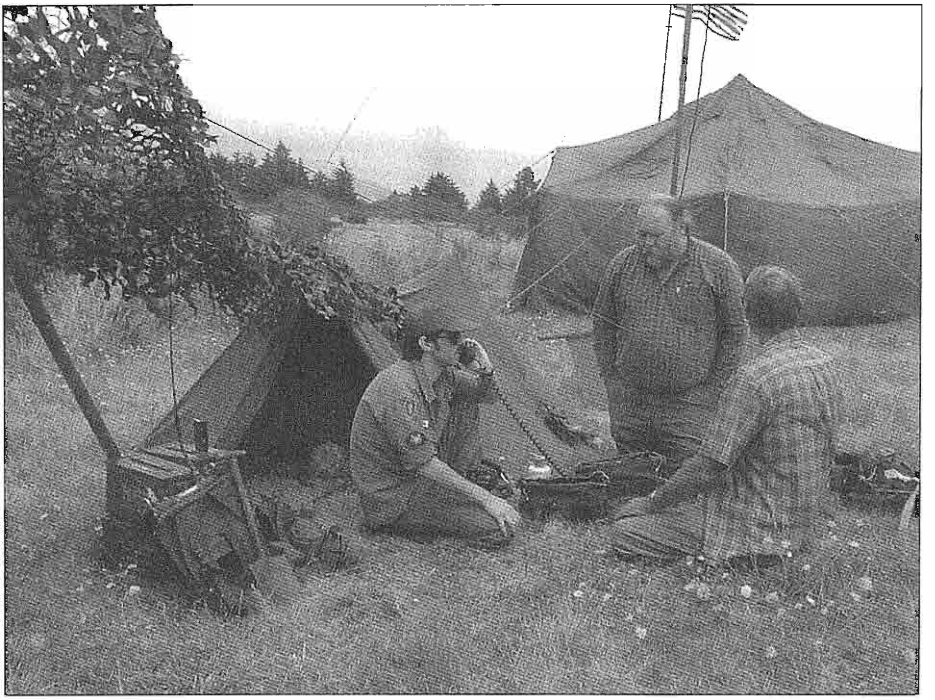
Mike, W7NPA had a RTTY station running from a 1.5 KW mil-std genset. The station consisted of a PRC-47, CV-2455 modem and a UGC-74B teleprinter. Mike also set up a staff tent which was the central meeting place for the group.

Dave, N7EPI, who lives only a few miles away from the Fort, was able to set up two stations, both of which operated 850 shift RTTY. One station consisted of a TRC-75 with Kleinschmidt TT-4A teleprinter and TT-76C paper tape punch/reperf, all powered by a 3 KW mil-std genset. The second station consisted of a PRC-47 and CV-2455 combo with a 28VDC MITE teleprinter all operating from a BB-451 battery.

Chuck, W7HDF brought his AN/GRC-142B radio shelter and operated several commercial radios using the shelter's whips and a longwire antenna.

Fred, WA7OBB installed a TA-1/PT field phone system which connected all of the operating positions together.

Al, W6GER operated a URC-92 (Sunair GSB-920) and automatic antenna coupler with an AT-1011 32' fi-



Chris-K6FIB on the field phone with Fred-WA7OBB, and Chuck-W7ZIR back to camera.

berglass whip antenna. 10M was working well for Al, who checked into his usual Australian USB voice ragchew with the 100W Sunair.

One highlight of the event was the appearance of the Oregon National Guard in a HMMWV. This HMMWV carried a thermal imager and laser rangefinder on the roof, plus an EPLRS (position locating and reporting) setup, and the usual GPS and fluxgate compass systems.

On Saturday morning the MRE participated in the weekly 850 shift RTTY 'clatternet' using the TRC-75 and both PRC-47s. (This was one of the few occasions where conditions were such that all clatternet stations had 100% print as they were located within 1/4 mile of each other...)

Saturday evening the Oregon MVCC put on their annual salmon barbecue in the vehicle encampment area.

If you're interested in military radio equipment or would like to participate in the 2003 event, mark your calendar for the second weekend in August next year. We hope the event will be even larger than the 2002 event. ER

You can see photos of this year's MRE Ft. Stevens event at both:
http://www.qsl.net/w6ger/FtStevens2002/ftsteve2002.html
and
http://www.hypertools.com/FtStevens2002.html

ER Photo Book

A reminder to everyone to send in their photo and bio material to Barry via e-mail or the Post Office.

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The Stancor 110C Transmitter

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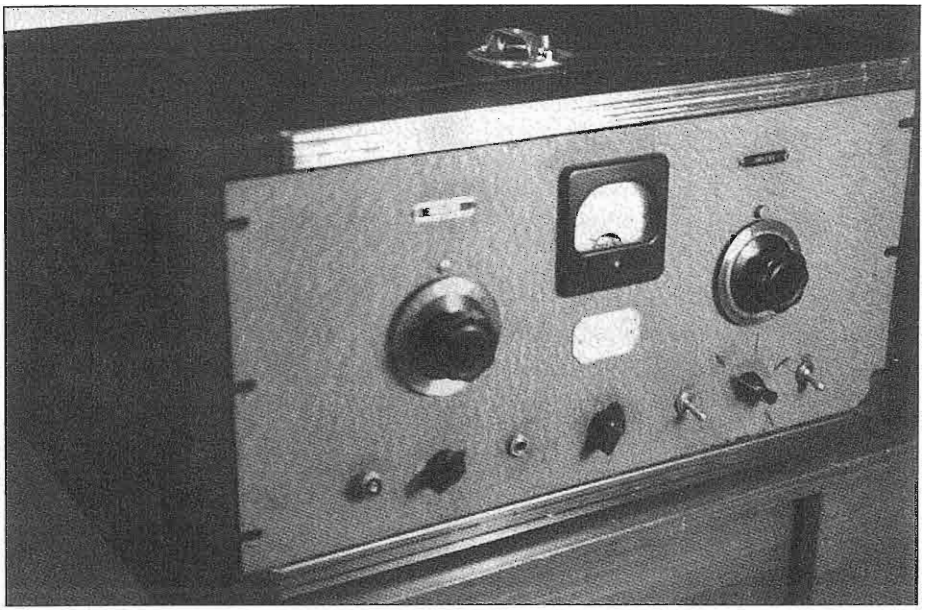
A few months ago I said it looked like no Stancor 110C transmitters survived WW II. HB9DTA corrected me with an e-mail saying one was for sale on the Internet. So thanks to Alex, I am now the owner of a Stancor 110C, the top of the line Stancor transmitter kit in 1940. The 110 watt AM/CW 160 to 10 meter transmitter came from Joe, WA3TDG who picked it up at a flea market near Pittsburgh, PA. The paper work indicated it originally was sold by Tydings Wholesale Radio Company, 937 Liberty Avenue in Pittsburgh.

The 110C kit was introduced in 1940 as "Featuring Cathode Modulation, in keeping abreast of popular developments". It is a self-contained 110 watt crystal controlled phone-CW rig employing two plug-in coils with the then new RCA 812 tube in the final amplifier. The cost, less tubes, coils, meter, and crystals was $48.75. The 110C was the highest powered of the eleven transmitter kits offered in 1940 by Stancor. The 110C was advertised as "a rig with a real wallop."

A Stancor competitor, United Transformer Corporation had come out with a 200-watt transmitter kit for $97 in 1939. Stancors biggest kit at the time was the 60P, a 60-watt transmitter. Stancor was using their standard chassis, cabinet, and transformers, in the 60 P, and there was no way to get more AM power with that combination. They obviously wanted to get over the 100 watt barrier for advertising purposes, but the power supply and space in their standardized configuration would not allow them to up both the final amplifier power and modulator power. Cathode modulation was the answer as it allowed the amplifier power to be upped while allowing a decrease in modulator power so there was no overload on the power supply, and it all fit into the 60P cabinet. Of course there was no mention of amplifier efficiency or power output in the 110C advertising. The cathode modulated 110C only puts out 20 watts more AM than the 60P but that 110 watt number looks much better in the advertising.

Cathode modulation was introduced in 1939 in "Radio" by Frank Jones as a cross between high level plate modulation and grid modulation offering "an economical solution for inexpensive modulation which will give excellent results." Ray Dawley, W6AJF, editor of "Radio Handbook" included cathode modulation in his 1939, '40 and '41 editions saying "it promises to become one of the most widely used methods of amplitude modulating amateur radiophone transmitters. It offers a workable compromise between the good efficiency but expensive modulator of high-level plate modulation, and the poor efficiency but inexpensive modulator of grid modulation." Cathode modulation is a mix of the two types hence it has a portion of the advantages of each with the disadvantages of neither. Carrier efficiency of a plate modulated transmitter is in the vicinity of 75%, while a grid modulated transmitter carrier efficiency runs around 33%. (About the same as the AM carrier efficiency of a class B linear amplifier). Cathode modulated transmitters offer between 55% and 60% carrier efficiency.

Dawley carried Jones' work on by



Front view of the Stancor 110C transmitter

publishing formulas, graphs, and circuits for cathode modulation, and complete construction details of low, medium, and high-powered transmitters employing cathode modulation. Modulation transformers were audio power outputs adapted for cathode modulation until the Kenyon Transformer Company came out with a line of "Cath-O-Drive" transformers. The Kenyon transformers were suitable for powers from 30 watts to a kilowatt. Stancor followed suit with two cathode modulation transformers, the A-3888, a 250 watt and the A-3889, a 600 watt unit. Power limitations of cathode modulation transformers are due to the maximum current allowable through the secondary winding. Audio power levels are low, and the voltage ratings do not have to exceed 300 or 400 volts DC due to installation in the cathode of the final amplifier.

Cathode modulation introduces the audio into the cathode or filament transformer center tap of the final amplifier, this point being common to both the grid and plate circuits. Since the audio at this point is in series with the plate circuit, some modulation of the plate takes place. At the same time the audio is also in series with the grid circuit so the grid is modulated. Normal procedure is to use the full output capability of the modulator to plate modulate the final. The modulator audio power is usually between 15% and 35% of the DC input to the final amplifier. An adjustable amount of the audio is used to modulate the grid to augment the low percentage of plate modulation. The grid is usually tapped down on the modulation transformer to provide the correct amount of audio voltage on the grid. An alternate arrangement is to provide full audio to the grid return, but bypass the excess audio voltage at the bottom end of the grid leak. The Stancor 110C uses the latter method combined with adjustable final amplifier grid bias.

My 110C arrived with some missing tubes, one 40 meter coil, lots of dust and dirt, and a wiring job that did not in any

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way resemble the photos of the underside of the finished transmitter in the Hamanual. An inspection showed no chassis grounds, but a ground buss bar running above the RF tube sockets and a second one running above the AF tube sockets. All the components that needed grounding were connected to the buss. This was the wiring technique suggested for the 60P but not for the 110C. Both ground busses were connected to one common chassis point. Must have been a broadcast audio man worried about ground loops that put this transmitter together. In any event it was a good wiring job and appeared to follow the schematic.

There was rust on the filament transformer mounted under the chassis. This transformer has two five volt windings for the RK-60 and 5Z3 rectifiers, and two six volt windings, for the audio and RF filaments. The unit appeared to have sat in about a 1/4" of water at one time. The plate transformer is mounted on top of the chassis and has more core than I have ever seen on a transformer that size. It supplies high voltage to the RK-60 rectifier and has taps for the low voltage rectifier, the 5Z3. Filter chokes and the audio interstage transformer are mounted under the chassis on the sides. The cathode modulation transformer is at the top rear of the chassis.

All parts appeared original with part numbers matching the Stancor parts list except for the 812 grid bias pot. In place of the pot was a five position switch which switched in fixed wire wound resistors, all of which were open.

The missing pot should have been a 20K 5-watt wirewound. A close inspection of the final tank showed the neutralizing cap connected to the plate end of the final tank, and no RF choke in the HV lead to the middle of the coil. With positive feedback the 812 PA should have made a great oscillator with lots of grid current. This probably caused the grid bias pot and the switched replacement resistors to go up in smoke. It appeared that this transmitter had never been on the air considering the wiring error and the fact that no parts other than the bias stuff had been replaced. My guess would be that the error was made in the original assembly of the kit, and an attempt to replace the burnt up bias pot resulted in a second failure. The amateur radio shut down, FCC order number 87, on December 8th 1941 probably ended any farther attempt at repairs and the 110C was put on the shelf.

The HV caps were oil filled and were as good as the day they were made, however the low voltage caps were all bad. A new line cord, five filter caps, and five orange drops and I was ready to find out if the power transformers had survived. I disconnected the HV transformer center tap from ground and plugged in the new power cord. The 110C filament switch lit up the tubes when I turned it on. After a half hours time the filament transformer was cool to the touch. With a voltmeter on the HV transformer I turned on the plate switch. Readings were just what the book said they should be. I put the ground back on the HV transformer center tap and hit the plate switch—980 volts between the RK-60 filament and ground and 435 on the 5Z3 filament. A check at the output of the filters also gave good readings—950 volts DC HV and 400 volts low voltage. All the power supply stuff, transformers, filters, bleeders and tubes were good.

The RK-60 full wave rectifier with its two plate caps is a great looking tube. I had never seen one before. It is the same size as the 5Z3 but is equivalent to a 5R4. I think the Collins 32RA is the only other ham transmitter that uses RK-60s. There is no bias supply in the 110C. It uses cathode bias for everything including the 812 final amplifier. The 6L6 regenerative crystal oscillator is keyed in the cathode for CW operation. The 6L6

Rear view of the Stancor 110C

plate coil is the same as the 812 plate coil. They are center tapped with a coupling link in the middle. The oscillator coil doesn't need the link, but Stancor kept both coils the same for simplicity. According to Stancor, both tank circuits need additional capacity for 160 meters. The meter switching provides reading of the 6L6 crystal oscillator plate, 812 grid and 812 plate current on a 200 Ma meter. The meter switch is ceramic.

The audio line up is a 6SJ7 voltage amp with a hi-Z input, RC coupled to a 6C5 which is transformer coupled to a pair of 6V6s operating AB1. The 6V6s operate into a Stancor A3888 modulation transformer with its secondary in the filament center tap of the 812. The audio section runs off the 5Z3 low voltage rectifier using the 400 volts. The audio frequency response is restricted only by the driver and modulation transformers and a sweep with the HP 651 looked good from below 200 to over 8500 hertz. So much for narrow bandwidth in 1940. I connected a Turner 9D to the Hi-Z input and a 600 ohm to VC transformer to the secondary of the modulation transformer. It sounded very nice on an old 12" Hallicrafters speaker. With cathode modulation the modulator power level is reasonable and the modulation transformer has a 500 ohm tap so it can be checked out just like a small PA system.

I rewired the final tank circuit to agree with the book. The one coil that came with the transmitter was a Johnson 40 meter 100 watt 5-pin plug-in. I had some B & W junior MC coils which would work in the oscillator plate. They are 25 watt 5-pin air wound center tapped coils with no link, intended for push-pull grid service. With a 7190 KHz crystal plugged in I tuned the 110C on—48 mA oscillator plate current at the dip and 30 mA 812 grid current. The 812 plate current was 50 mA with no load at the dip. A dummy load brought the plate current up to 125 mA and was showing

continued next page

about 68 watts out on the Bird. There was no sign of oscillation in the final so I left the neutralizing cap alone. I connected my 40-meter doublet, and listened on 7190. I heard K4EJS, Bill, in Newnan GA, 30 miles SW of Atlanta, about 175 miles from me, signing with some 8s, so I gave him a call. He came right back with a S9 + report and said it sounded good, except for a bit of hum. Several more 40-meter AM contacts with W8s confirmed the good sound of the 110C, and introduced some of the younger AMers to a Stancor transmitter.

The hum problem turned out to be heater cathode leakage in the 6SJ7, so that was an easy fix. I have some Hammarlund CF-5 coil forms so I went into the coil winding business. The CF-5 is not as heavyduty as the Johnson 100 watt 5-pin, but seems to work OK. Since I only have 80 and 40 B & W MC coils I skipped 160 for the time being and made a 75-meter final coil. It tuned up fine but I added a 50 pFd in the coil form. The final tank cap is only 70 pFd and I wanted a better L/C ratio for harmonic suppression and modulation linearity. We have a Tuesday night net and I gave the Stancor its first outing on 3885 in the Southeastern AM Radio Club net. KF4TXQ was net control and he gave the 110C an outstanding report. Since I normally use a carbon mic on my big AM rig I guess the dynamic sounded better to Sam. In any event the 110C gets good audio reports from almost every one.

The 110C like all the Stancor transmitters is not push to talk, and the plate switch does not have any extra contacts. To provide one switch transmit receive switching, I brought the 110 volts AC from the plate transformer primary out to an external terminal strip. This 110 AC is run to a Dowkey relay with extra contacts and takes care of antenna switching and receiver disabling. So while not push-to-talk, it is a one switch T-R operation. The transmitter audio reports are the same with either the 9D or a D-104. Modulation is never over 90% but the rig seems to get through just fine. Attempts to get up to and over 100% result in unsymmetrical positive and negative peaks and audio distortion. The 812 bias pot adjustment is not critical, and acts more like a gain control on the positive peaks than anything else. Antenna loading seems to be the most critical adjustment. Since the 110C has a fixed link for antenna coupling, the use of an antenna tuner to adjust loading is a necessity. Loading on the heavy side results in better modulation, with slightly less output. Light loading reduces the positive peak modulation and results in some distortion. A scope is very handy, but the 110C can be set by ear reasonably well. There is no RF protection on the hi-Z audio input and with the transmitter out of the cabinet RF feedback shows up at high gain settings. In the Bud cabinet, there is no problem.

Ray Dawleys prediction that cathode modulation would sweep the ranks of ham phone transmitters didn't allow for World War II. When the ham bands were returned to us, large amounts of surplus electronics from the war also showed up. The expensive power and plate modulation transformers of the prewar days were replaced by the $1.98 surplus MD-7 with a pair of 807s, a driver transformer and 35-watt modulation transformer which most hams ran over 100 watts. If you wanted to run a bit more power ART-13 modulation transformers, matching a pair of 811s to an 813 were being sold for under $8. BC-610 transformer sets were only $24.95. The need for a cheap modulation technique had passed cathode modulation by. By 1947 cathode modulation was only a paragraph or two in the AM theory section of the handbooks. High level plate modulation was the way to go.

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Creating Meter & Dial Faces

by Rich Bonkowski, W3HWJ
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If you are like me, you've purchased some beautiful DC meters at swap meets. You've saved them for that power supply or vintage transmitter project. You carefully calculated the shunts and multiplier resistors for the scales you want. But then, you remember that the meter scales don't match your needs. OK, the scale says "0 - 100 microamps," but you will remember that it's really 0-10 amps. Maybe you'll remember, but you will never be happy knowing that the scale isn't correct. Or, how about that old Pilot or Kilograd vernier dial that you bought for your 2-tube regen project? The scale is a bit yellow? Some of the numbers are worn or smudged? Wouldn't you like to have a nice, sharp scale to replace the old one? Or maybe you need some new panel markings for a volume control or bandswitch.

Over the years, I've tried a number of solutions to such problems, including drafting my own scales with compass and T-square, Dymo labels, using computer drawing programs, scanning old scales on a computer scanner, and, finally, finding some really good software to do a nice job.

Computers? Scanners? Software? Wait a minute! I thought this was about "vintage radio" and enjoying the nostalgia of pre-computer age electronics? Well, there is no harm in using new technology to better enjoy the beauties of the past. You can create some high quality artwork for your vintage equipment if you have some basic computer skills and equipment. If you don't have the skills and equipment, I guarantee that your kids or grandkids do have the necessary resources. This could be a wonderful joint project to get you better connected to the younger members of your family. There isn't much investment involved and the results will really improve your projects.

Drafting

I learned to do "mechanical drawing" in high school, and still have the instruments, if not the skills. Trying to draw complex circular dials and divide them with "tick" marks is a losing proposition. Not only is it slow, but it requires better eyes and a steadier hand than I have. When you are all done, chances are you will have a usable scale with a few ink smudges, but the next time you need something similar, you will have to start all over again from the beginning.

Computer Drawing

Back in the 80s, I was reasonably familiar with MacPaint and can still use Paintbrush on my PC. These programs are primarily for sketching, not for serious mechanically exact drawing. They don't have the tools to do the job quickly. Corel Draw has the tools, but has too many tools for me. Learning to use Corel effectively can be a real learning process.

I have made some simple circular scales for variable capacitors and volume controls using Corel. The effort is considerable and the results are "OK," but not what I was seeking. (Figure 1). If you are determined to try this approach, the command "Fit Text to Path" is a good place to start. This works well for control and switch names, but "tick" marks on dials and meter scales require a lot of trial and error.

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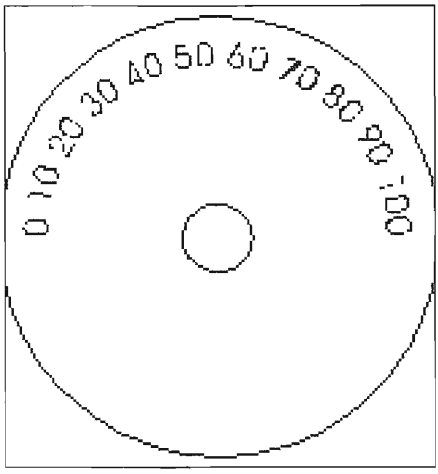

Figure 1.

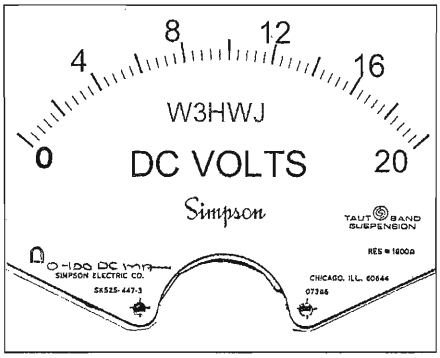

Figure 2.

Scanning

Using a low-cost scanner and some basic software, such as Epson Twain or Adobe Photo Editor, one can begin to do some effective work without a lot of skill or effort. Scanning works only when you have an existing original. The original can be a paper meter face or a metal dial scale plate, or anything that is pretty much two-dimensional. Just lay it carefully on the scanner glass plate and let the computer do its job. After you get the image captured, you can use the editing tools to erase smudges or improve the contrast of an aged paper scale.

My real breakthrough was learning to disassemble Simpson meters, and carefully removing the old dial face. Two small screws usually hold the faceplate to the meter body. The old face can be scanned and saved as an image file. Using Photo Editor, I erased the old numerals of a 0-100 μA meter and using the "add text" tool, inserted numbers for a 0-20 volt scale for my power supply project (Figure 2).

I even added my callsign so that the meters on my supply have that special personal touch. Now I don't have to remember that full scale is 20 volts! Though you can't see it in the figure, my call is in red to make it stand out a bit.

Scanning works well for meter faces, but not so well for dials. Vernier dials, like the National Velvet Vernier B, have a metal hub at the center of the brass dial plate. The paper scale is glued to the brass plate and the hub keeps the scale from sitting directly on the scanner plate. The result is a useless image because of light leaks and de-focusing.

"Graph Paper" Software

My results from scanning and editing were pretty gratifying, but this method still didn't help me to make scales for new projects. I was building a power supply and had a 7-position rotary switch that selects taps on a power transformer (Fig. 3). I could have printed small labels (one for each position of the switch) and pasted them onto the front panel of the power supply, but that wasn't elegant enough. I searched the Internet and found some software, called "Graph Paper", created by Philip Marquis of Metz, France. You can download and try it free for a week. I liked it so much, I sent the $20 to buy a license. "Graph Paper" does a variety of things, including making your own log scale graph paper, Smith Charts, music composition paper, and a variety of geometric designs. One of its features is called "Dial." "Dial" lets you create circular scales of virtually any diameter. You can choose the number of degrees

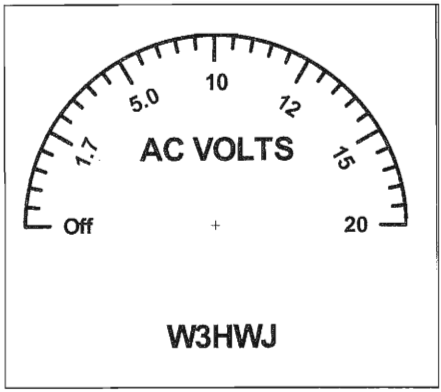

Figure 3.

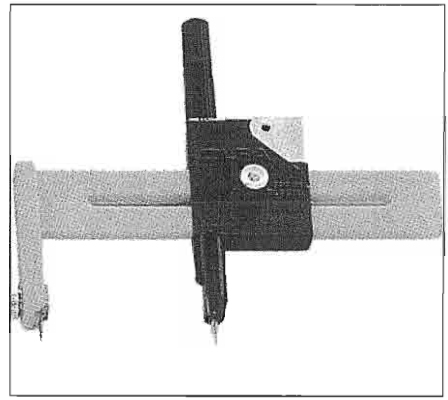

Figure 4.

to display, such as 270° for potentiometers, or 180° for rotary switches and variable capacitors. The scales can be "dressed up" with text, numbering, and a variety of "tick mark" possibilities.

All you need to know before designing your dial:

* Radius of the scale (Graph Paper works in English or Metric)
* Degrees of arc desired
* Number of divisions needed

Tips on making scales

I print my scales on heavy stock paper (30 or 40 lb) and prefer a semigloss finish. Make sure the paper you choose is compatible with your printer. I found that plastic and metallized papers would not absorb ink from an inkjet printer. Some papers will accept the ink, but it doesn't dry correctly. For black and white scales or labels, a laser printer works very well.

After I print my scale, I trim it to a size slightly larger than the final dimensions, and then apply a sheet transfer adhesive, such as Print Mount (available at hobby and "scrap book" stores) to the backside of the printed scale. This transfer adhesive has a front and back protective carrier sheet. Cut the transfer adhesive to the same size as your dial scale sheet, remove one of the carrier sheets and carefully smooth the adhesive sheet and the scale sheet together. I use an artist's rubber roller, called a "brayer," to roll the scale onto the adhesive and smooth out any bubbles. Then I apply either a clear, sticky laminating plastic (perhaps 3M Card Protector) over the scale, or just some wide Scotch tape to protect the print. Now I have a rough-cut scale, with a protective-backing sheet still applied. Using a compass with a razor cutter blade (made by OLFA Fig. 4), I carefully trim the outside dimension, if the scale is to have a circular form or carefully trim with scissors if the final outline is rectangular. Then I cut out the center hole for the switch or pot shaft, again using the compass cutter.

To apply to a panel, carefully remove a portion of the backing sheet and align the scale precisely, putting pressure only on the portion protected by the backing sheet. Once you are satisfied with the alignment, press the unprotected portion (sticky) to the panel to fix it in place. Remove the rest of the protective film and smooth out the label.

Conclusion

Forget about changing meter scales with "whiteout" paint and a marking pen. Stop using Dymo tape to label your switches and pilot lamps. Use a little modern computer help to get more enjoyment out of those vintage radio projects. If you have some computer

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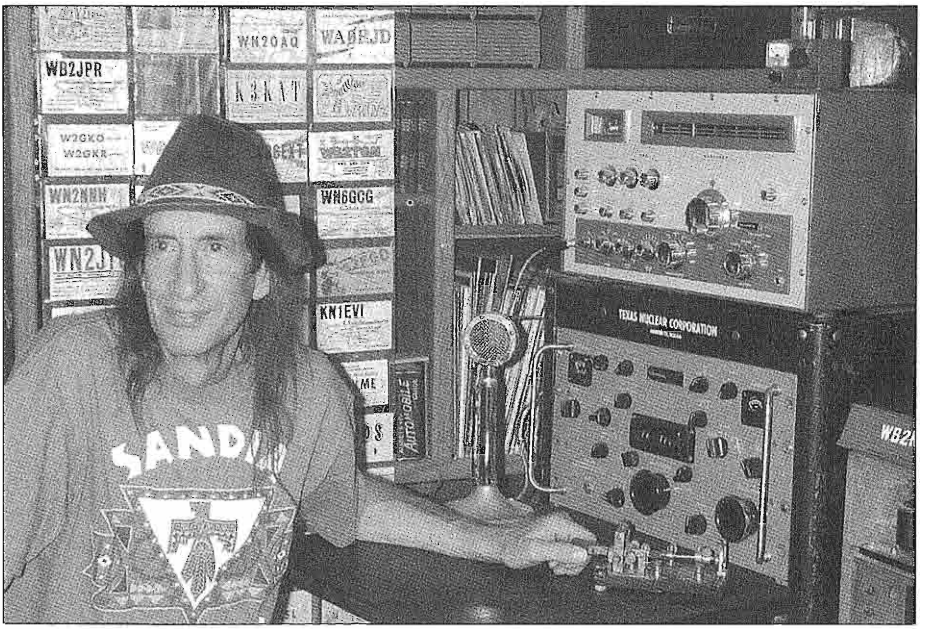

David Fein, WB2KRS, with his present-day station. Last month we ran a photo of him and his first station back in the '50's.

John Hruza, KBØOKU, at his main military station. A Detrola BC-614-E speech amp drives the Bogen BC-610-F. The BC-306-A antenna tuner awaits a BC-639 replacement.. Freq meter is a Hallicrafters BC-221-HA. Receivers are BC-312 and AN/GRR-2 (Hallicrafters SX-28).

Robert Rhoads, KJ6CA with his vintage equipment.

Cora Cobb, KBØLPZ, at her 1961 Hallicrafters CW/AM/SSB station. The station includes an HT-37 transmitter; SX-111, SX-110 and SX-108 receivers. HT-2 and HT-6 transverters are also in the lineup. An HT-41 linear is still needed.

2002 Fall Classic (& Homebrew) Radio Exchange

The Classic Radio Exchange ("CX") is a contest celebrating the older commercial and homebrew equipment that was the pride of our ham shacks and our bands just a few short decades ago. Our object is to encourage restoration, operation and enjoyment of this older equipment. A "Classic" radio is at least ten years old (age figured from first year of manufacture), but is NOT REQUIRED to participate in the Classic Exchange. YOU MAY USE ANYTHING in the contest although new gear is a distinct scoring liability. You can still work the "great ones" with your new equipment!

The Classic Exchange will run from 1900 UTC September 22 to 0500 UTC September 23, 2002 (3PM EST Sunday to 1 AM EST Monday). Exchange your name, RST, QTH (state US, province for Canada; country for DX), receiver and transmitter type (homebrew send final amp tube or transistor), and other interesting conversation. The same station may be worked with different equipment combinations on each band and on each mode. Nonparticipants may be worked for credit.

CW call ~CQ CX;" phone call "CQ Classic Exchange."

Suggested frequencies:

CW: 1.810, 3.545, 7.045, 14.045, 21.135, 28.180 Mc/s

Novice/Tech Plus: 3.695, 7.120, 21.135, 28.180 Mc/s

Phone: 1.890, 3.880, 7.290, 14.280, 21.380, 28.320, 29.000 Mc/s

7.045 and 3.545 are usually the most popular CX frequencies.

Note the addition of 160 meter CW and phone frequencies, and 10M AM frequency!

Visit the CX webpage at http://qsl.asti.com/CX for all the latest CX info!

Scoring Multiply total QSL's (all bands) by total number of different receivers plus transmitters (transceivers count as both xmtr and rcvr) plus states/provinces/countries worked on each band and mode. Multiply that total by your CX Multiplier, the total years old of all receivers and transmitters used, three QSO's minimum per unit. For transceiver, multiply age by two. If equipment is homebrew, count it as a minimum of 25 years old unless actual construction date or date of its construction article (in the case of a "reproduction") is older.

Total QS0's all bands times RCVRs + XMTRs + states/provinces/countries (total each band and mode separately; add totals together) times CX Multiplier:

SCORE = QSO's x (Rx + Tx + QTH's) x CX Mult

Certificates and appropriate memorabilia are awarded every now and then for the highest score, the longest DX. exotic equipment, best excuses and other unusual achievements.

Send logs, comments, anecdotes, pictures to: "Mac" MacAulay at WQ8U@arrl.net or 6235 Wooden Shoe Lane, Centerville, OH 45459-1557.

The next Newsletter / Report will be posted on the CX web site. Paper copies are available upon request.

VINTAGE NETS

Arizona AM Nets: Sat & Sun, 160M 1885 kHz at sunrise,75M 3855 kHz at 6 AM MST, 40M 7293 kHz 10 AM MST; 6M 50.4 MHz on Sat. at 8 PM MST; 2M 144.45 MHz, on Tue. at 7:30 PM MST.
West Coast AM Net meets Wednesdays 9PM Pacific on or about 3870kc. Net control alternates between John, W6MIT and Ken, K6CJA.
California Early Bird Net: Saturday mornings at 8 AM PST on 3870.
California Vintage SSB Net: Sunday mornings at 8 AM PST on 3860 +/-
Southeast Swap Net: Tuesday nights at 7:30 ET on 3885. Net controls are Andy, WA4KCY and Sam, KF4TXQ. This same group also has a Sunday afternoon net on 3885 at 2 PM ET.
Eastern AM Swap Net: Thursday evenings on 3885 at 7:30 ET. This net is for the exchange of AM related equipment only.
Northwest AM Net: AM activity daily 3 PM - 5 PM on 3875. This same group meets on 6 meters (50.4) Sundays and Wednesdays at 8:00 PT and on 2 meters (144.4) Tuesdays and Thursdays at 8:00 PT. The formal AM net and swap session is on 3875, Sundays at 3 PM.
K6HQI Memorial Twenty Meter AM Net: This net on 14.286 has been in continuous operation for at least the last 20 years. It starts at 5:00 PM PT, 7 days a week and usually goes for about 2 hours.
Colorado Morning Net: An informal group of AM'ers get together on 3875 Monday, Wednesday Friday, Saturday and Sunday mornings at 7AM MT.
DX-60 Net: This net meets on 3880 at 0800 AM, ET, Sundays. Net control is Jim, N8LUV, with alternates. This net is all about entry-level AM rigs like the Heath DX-60.
Eastcoast Military Net: It isn't necessary to check in with military gear but that is what this net is all about. Net control is Ted, W3PWW. Saturday mornings at 0500 ET on 3885 + or - QRM.
Westcoast Military Radio Collectors Net: Meets Saturday evenings at 2130 (PT) on 3980 + or - QRM. Net control is Dennis, W7QHO.
Gray Hair Net: The oldest (or one of the oldest - 44+ years) 160-meter AM nets. It meets on Tuesday nights on 1945 at 8:00 PM EST & 8:30 EDT. www.hamelectronics.com/ghn
Vintage SSB Net: Net control is Andy, WBØSNF. The Net meets on 14.293 at 1900Z Sunday and is followed by the New Heathkit Net at about 2030Z on the same freq. Net control is Don, WB6LRG.
Collins Collectors Association Nets: Technical and swap session each Sunday, 14.263 MHz, 2000Z, is a long-established net run by call areas. Informal ragchew nets meet on Tues nights on 3805 at 2100 Eastern and on Thur nights on 3875. West Coast 75M net that takes place on 3895 at 2000 Pacific
Collins Collector Association Monthly AM Night: The first Wed. of each month on 3880 kHz starting at 2000 CST (0200 UTC). All AM stations are welcome.
Drake Users Net: This group gets together on 3865 Tuesday nights at 8 PM ET. Net controls are Criss, KB8IZX; Don, W8NS; Rob, KE3EE and Huey, KD3UI.
Drake Technical Net: Sunday's on 7238 at 4PM Eastern time hosted by John, KB9AT; Gary, KG4D; Jeff, WA8SAJ and Evan, K8SQG.
Swan Users Net: This group meets on 14.250 Sunday afternoons at 4 PM CT. The net control is usually Dean, WA9AZK.
Nostalgia/Hi-Fi Net: Meets on Fridays at 7 PM PT on 1930. This net was started in 1978.
K1JCL 6-Meter AM Repeater: Located in Connecticut it operates on 50.4 in and 50.5 out.
Fort Wayne Area 6-Meter AM Net: Meets nightly at 7 PM ET on 50.58 MHz. This net has been meeting since the late '50's. Most members are using vintage or homebrew gear.
Southern Calif. Sunday Morning 6 Meter AM Net: 10 AM Sundays on 50.4. NC is Will, AA6DD.
Old Buzzards Net: Meets daily at 10 AM Local time on 3945. This is an informal net in the New England area . Net hosts are George, W1GAC and Paul, W1ECO.
Canadian Boatanchor Net: Meets Saturday afternoons, 3:00 PM EST on 3745.
Midwest Classic Radio Net: Sat. mornings on 3885 at 7:30AM Central time. Only AM checkins allowed. Swap/sale, hamfest info and technical help are frequent topics. NC is Rob, WA9ZTY.
Boatanchors CW Group: 3546.5, 7050, 7147, 10120, 14050. 80 on winter nights, 40 on summer nights, 30 and 20 meters daytime. Nightly "net" usually around 0200-0400 GMT. Listen for stations calling CQ BA, CQ GB.
Wireless Set No. 19 Net: Meets the second Sunday of every month on 7.270 +/- 25 kHz at 1800Z (3760 +/- 25 kHz alternate). Net control is Dave, VA3ORP.
Hallicrafters Collectors Assoc. Net: Sundays, 1730-1845 UTC on 14.293. Net control varies. Midwest net on Sat. on 7280 at 1700 UTC. Net control Jim, WB8DML. Pacific Northwest net on Sundays at 22.00 UTC on 7220. Net control is Dennis, VE7DH
Mighty Multi-Elmac 75 meter AM net: Every Tues eve at 8 PM EST. NCS is Mike, N8ECR
Nets that are underlined are new or have changed times or frequency since the last issue.

Ground Loops Revisited

by Ray Osterwald, NØDMS
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Part One

My article in ER #158, "Hum in Sensitive Circuits", discussed low-level causes of noise that show up in the input circuits of speech amplifiers. This article is about the large-scale ground loops that are found in household wiring and in the service loops provided by the power companies. I'm going to present some ideas I've used at installations in the past to reduce the noise that is caused by currents flowing where you wouldn't expect to find them. I'm sure this won't be new information to many of us, but hopefully newer hams will find it useful.

Interference to communications can be the radiated kind or the conducted kind. Radiated interference is someone tuning up on top of your QSO, or when you put digital equipment too close to a communications receiver. Conducted interference requires a source of noise and some kind of metallic path so that current can flow. Metal objects are antennas, so conducted interference can "cross the line" and cause radiated interference. Conducted noise is coupled into your equipment by capacitive or inductive means. Capacity coupling is by an electric field, and inductive coupling is via a magnetic field.

Each noise source causes trouble in different parts of the radio spectrum. The chart I've prepared in Figure 1 shows some common noise sources, their amplitude and the portion of spectrum they usually occupy. In these days of digital products, most of the high-level noise we experience has its roots in digital timing circuits and switching power supplies. Knowing where the noise comes from is fairly easy, but getting rid of it can be difficult. Other sources of conducted interference can come from mechanical equipment. Here are some examples, their spectrum and approximate levels:

Thermostat contacts: 50 kc to 25 mc
Latching Contactors
Coil pulses: 1 to 25 mc
Contact cycling: 50 kc to 25 mc
Fluorescent Lamps: 100 kc to 3 mc, 20 to 300 microvolts per kc
Mercury arc lamps: 100 kc to 1 mc, 8 millivolts per kc
Digital logic 50 kc to 20 mc
Transfer switch: 100 kc to 25 mc
Switching power supplies: 500 kc to 25 mc
Motor armatures: 2 to 4 mc, 20 millivolts per kc with 250-volt transients
Corona discharge: 100 kc to 10 mc, 100 microvolts per kc
Vacuum cleaners: 100 kc to 1 mc, 3 millivolts per kc

Grounding is what we call establishing an electrically conductive path between two points to connect equipment together, or to connect the equipment to a reference point, usually your system ground. A bond is different. Bonding is the attempt to establish a low impedance path between two metal surfaces. Think of grounding as a circuit concept, and that bonding implements the concept. If we could make an ideal ground plane in the shack, it would have a zero voltage potential across it, zero impedance, and if it was used as a reference for all the signals in our equipment, all the noise currents could be easily transferred to it and conducted harmlessly away. Obviously the ideal

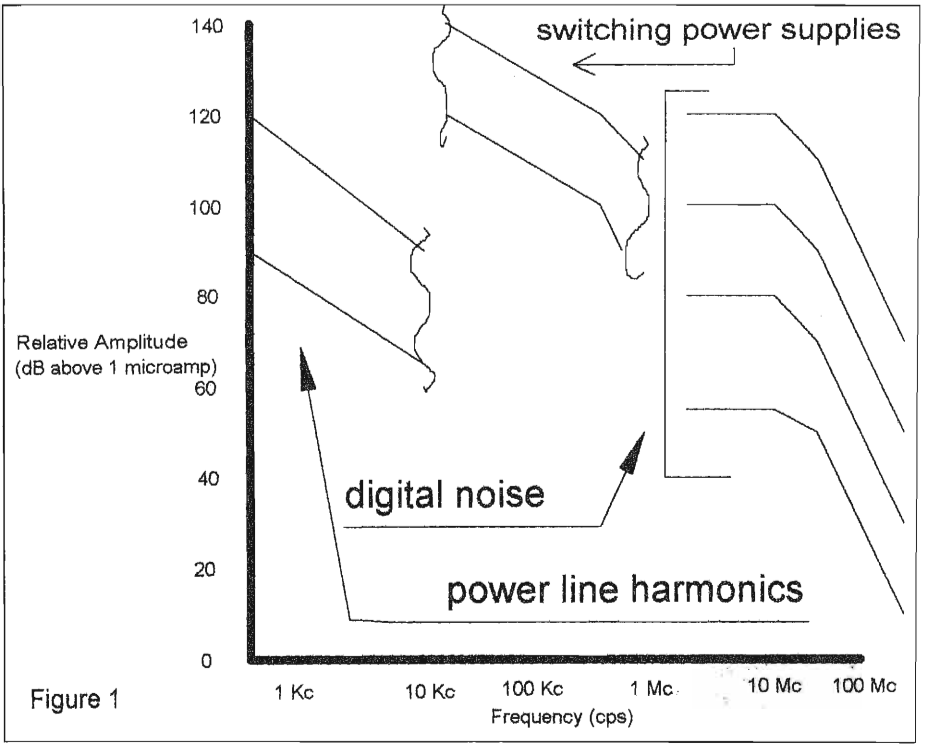

Figure 1

ground plane can't be built. It is good to keep it in mind though, because the effectiveness of your ground system is determined by the voltage potentials between different places in the ground system, and by the currents that flow through the impedances in it. A really good ground system won't have voltage potentials that are greater than the lowest signal voltages in your system.

There are three main types of grounding systems. A floating ground, as in Figure 2, is not used in power wiring because it is dangerous and a violation of electrical codes. It is used occasionally in studio work where it has the advantage of isolating all the equipment from common wiring and a common ground plane. These surfaces might otherwise induce circulating noise currents across the equipment. It is not useful above 1 Mc because capacitive reactance decreases as frequency goes up, and the isolation is bypassed. Both sides of the power circuit, and the chassis are "hot" with respect to ground. In the event of a ground fault serious injury could result.

The single-point ground of Figure 3 is found in all types of installations. It has the great advantage that ground currents that induce noise will produce no voltage drop across the equipment because no common coupling exists. Also, the RF ground impedance is lowered by at least half because of reactance in parallel. The disadvantage to a single-point ground is that at high frequencies (above 30 Mc) capacitive reactance is minimum and noise coupling by the electric field is higher. Above 50 Mc, you no longer have an RF ground. This is because any ground wire that is a quarter wavelength or a multiple is also a shorted transmission line with very high impedance on one end of it. That makes a nice large resistance for noise voltage to drop across. At VHF, any noise pulse with a rise time of 1

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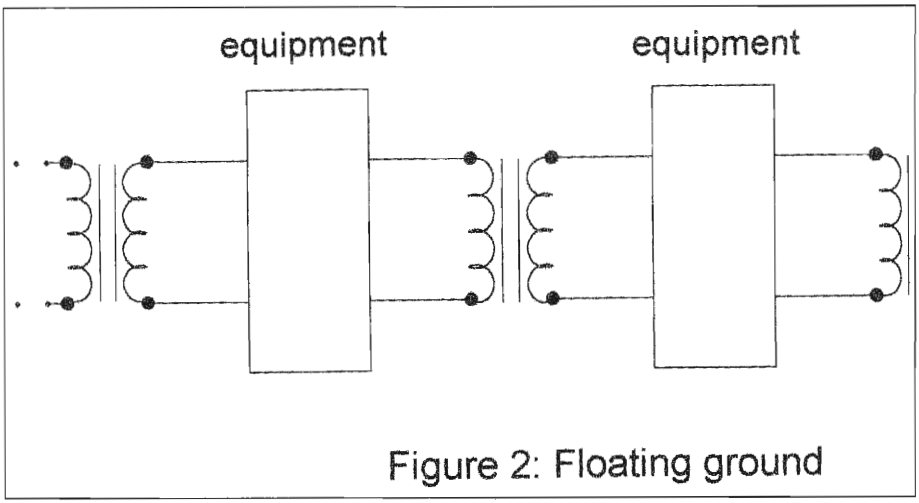

Figure 2: Floating ground

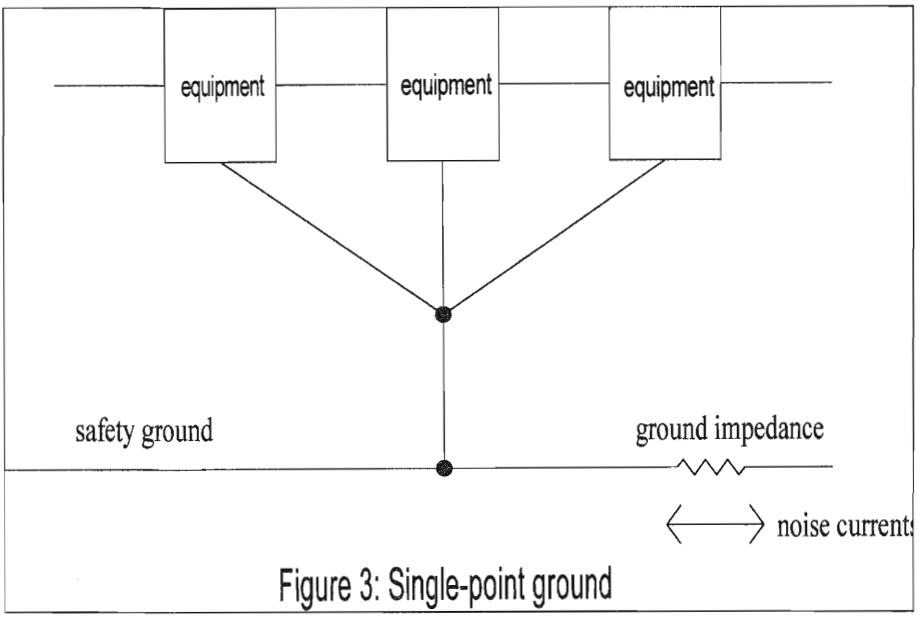

Figure 3: Single-point ground

nanosecond has the possibility to develop a high potential drop across this impedance. To make matters worse, a standard 19-inch relay rack has the right dimensions for noise to develop across it, even though it appears to a casual observer to be solidly "grounded"!

There is another style called the multipoint ground. I've drawn it in Figure 4. It has the advantage of having the ground connections made by the shortest possible path to a ground plane. These multiple paths act to break up LC resonance in the ground leads because the inductance is held to a minimum; they act like resistors in parallel. Therefore the magnitude of the overall impedance in the system is minimum. It is easy to build. Unfortunately there are a great many ground loops that are

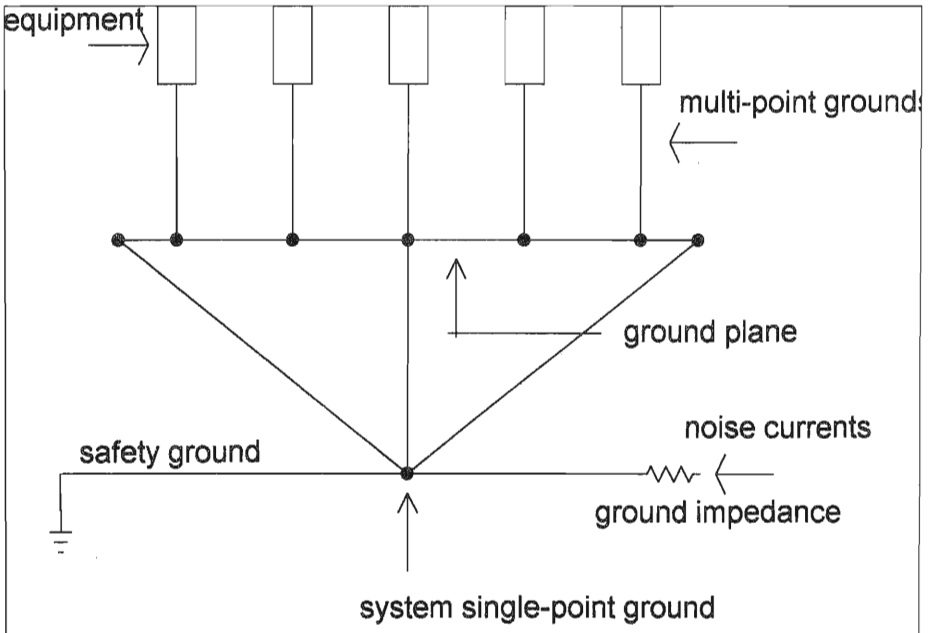

Figure 4: Multi-point ground

formed in all of the ground connections. At frequencies below 1 Mc inductive reactance is minimum and noise coupling by magnetic coupling is very likely. This opens the door for power line hash and harmonics that have been reradiated by nearby metallic conductors. Also a lot of maintenance is usually required to keep all the grounds tight.

In typical house wiring that meets the electrical codes of today, the three-wire plugs with hot, neutral, and safety grounds are none of the above. They are merely multiple grounds.

Lets look at your service loop delivered to your house by the power company. Figure 5 is a sketch of typical service drops in the USA, with a "pole pig" or a distribution transformer that is fed from a 2.4 kV line. The resistors in the diagram are really complex impedance that I am going to call simple resistance. They develop potential drops across them by noise currents. Inside "your house" and "your neighbors house", RL1 through RL4 are load resistances that represent the stuff you use that consumes real power. If the loads in each house were perfectly balanced and if all six impedances were identical, all of the current you pay for would return to neutral at the transformer. This is never the case however. Simply turning on a room light changes the load balance in a circuit. When the loads are not balanced, current flows not only through the neutral, but also through the safety ground and the water pipe, through your neighbor's house, and up through to the neutral back to the transformer center tap. Your house wiring forms a loop that includes everything that is going on in the other houses that are served by the power drops. No wonder the noise level is always going up!

For the sake of argument, proof of the current that flows in the safety ground can be found in basic electricity. Think

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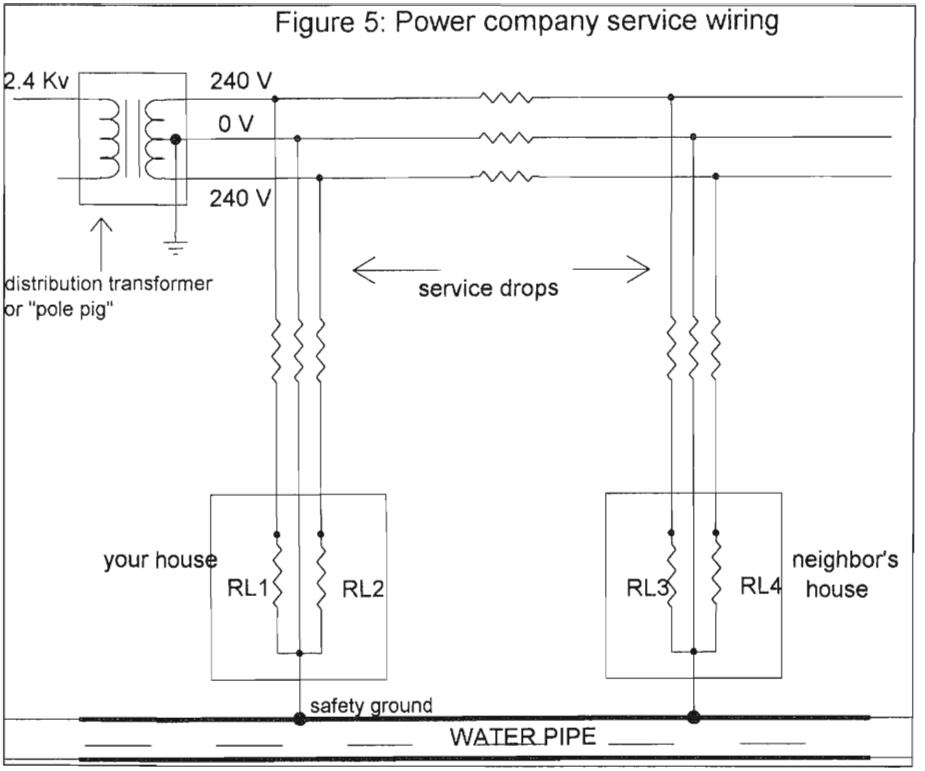

back to what Mr. Kirchhoff had to say with his current law and assume some unequal current numbers through the load resistances. If each house becomes a 4-terminal "node", then the current that flows into the node must equal the current flowing out. During peak times of electrical power usage, it is not uncommon to find 5 amps flowing in the safety ground. Maybe you've noticed that interference always seems to be higher around 6:00 PM local time.

The problem with current in the safety ground, and with the loop that forms between the safety ground and all the neutral wiring, is that the current forms a field around the conductors carrying it, and will induce noise directly into your sensitive communications equipment by magnetic means. Also, all of the power company's neutral wiring makes a great antenna. It efficiently delivers all kinds of electromagnetic trash free of charge.

Let's go on inside the house and down into the shack. I'm going to assume that in Figure 6, all the gear is connected to 120-volt circuits, although 240-volt equipment will develop the exact same type of ground loops. On the operating bench are a linear amplifier, a transmitter, and a receiver, all vintage equipment, of course! The antenna system is connected to the PA. In this drawing, all the impedances in the safety grounds are represented by Zg. Noise current that flows in the safety ground, possibly coming from a neighbor's house or another circuit in your house will drop across any of the impedances and produce a noise voltage. Depending on how much current is flowing, it may or may not cause noise in the receiver. The noise currents circulate around and around whichever loop they please, as directed by Ohm's law. It is also possible for

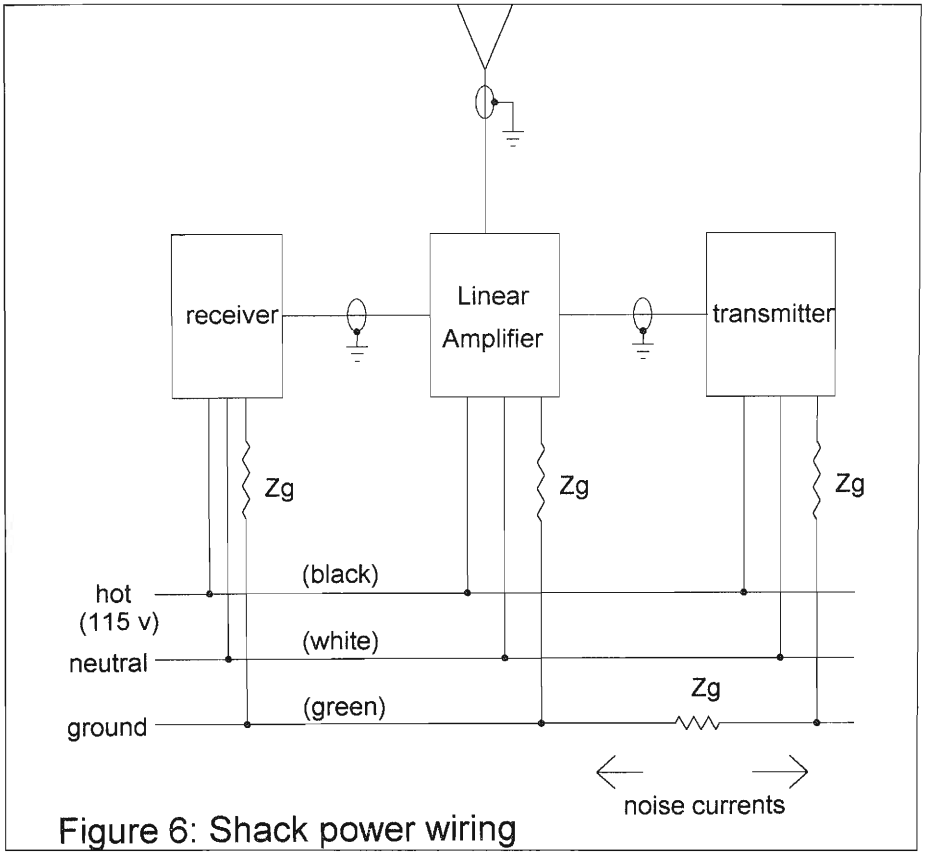

Figure 6: Shack power wiring

your station to be its own RFI source. For example, any oscillator voltage is free to join in the fun and circulate around one of the loops, possibly mixing in the PA's tank circuit!

It is tempting to just disconnect the safety ground at the entry panel and break the loop. DON'T DO IT! The National Electrical Code is not just a scoff law. It was written to save lives and here is why:

The primary purpose of the safety ground is to provide an alternate low impedance path back to the voltage source, so that in the event of a fault, circuit breakers or other protective devices on the power company's system can remove the voltage source. In the event of a ground fault in the power system, either at a substation or at a generation station, thousands of volts can appear across hot or neutral wiring in a few milliseconds. Don't put your life at risk during fault conditions; it isn't worth it. According to the National Electric Code, any exposed metal surfaces that have the possibility of being energized must be connected to the safety ground. Also, according to the code the safety ground and the neutral are only to be connected at one point, the power source. There are ways to eliminate the ground loops and provide good line filtering that will get rid of most of the noise. I'll talk about them in part two of this article. ER

Editor: Part Two of this article will appear in a future issue of ER.

Radio Service in the Golden Age
1930's through the 50's

by Bruce Vaughan, NR5Q
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Episode 16

Impossible Customers

There are few things in this world that I can predict with 100% accuracy. The appearance of impossible customers in a TV repair shop are an exception—they are horribly, and maddeningly predictable. This type of customer will appear with a regularity and certainty that puts the cosmic clock to shame. I can, with no reservation at all, guarantee that there is not a repairman alive today who has not encountered totally impossible customers—customers that defy all reason. Such customers can, and often do, reduce a mild mannered, reasonable, God fearing man, into a raving, screaming, drooling at the mouth monster. The man who wrote the words, "The Customer is Always Right," was never in the Radio and/or TV repair business. Let me tell you a story or two.

It's Saturday afternoon. Our shop, as usual, is running at least six calls behind, and the 'phone is ringing constantly. My wife answers the phone. She listened for a moment, and then handed the phone to me. "Here Bruce, Mr. Feltner up at Lowell wants to talk to you."

"Yes, sir, Mr. Feltner, what can I do for you today?... Then your TV is not working?... OK... What exactly seems to be the problem, Mr. Feltner?... Do you have any picture at all? I see," I said, "You have a picture but it is 'snowy,' and not as clear as usual. Well, it looks like we can put you down for a call about 3:00 pm on Monday afternoon, is that OK?"

No, it was not OK. Mr. Feltner wanted his set fixed NOW—not Monday afternoon. "What did I expect him to do on Saturday night and all day Sunday," he asked. He explained to me that his favorite program, Jackie Gleason would be on tonight and he never missed it.

Finally I relented. "Mr. Feltner, I could send a serviceman up and he can check for repairs that can be made in the home, such as tube replacements, but if the set requires shop service or lowering and repairing your antenna, there is no way we can get to it until next week. Would that be OK with you?"

Mr. Feltner reluctantly agreed to such a call.

Carl, one of my better repairman returned from the service call shortly before closing time. "Did you get Mr. Feltner made happy?" I asked.

"Well, more or less. He had a 6BZ7 tuner tube that was pretty 'soft.' I replaced it, and the signal came up a lot, but that old RCA has trouble in the vertical hold circuit. The hold is very critical. Once you get the rolling stopped the picture appears OK, but within minutes the darn thing will start rolling again. I left him a charge bill for the tube and service call. I told him we would pick up the set Monday, and repair the vertical circuit. He was concerned that he would be paying for two calls. I assured him that we would credit him the original charge, and only charge him for the tuner tube plus the in-shop repair. That seemed to make him happy. I explained that we must keep accurate records of calls and parts, and that his final bill would not show any charge for the service call."

"Those 1954 RCA's never had much of a vertical hold circuit. I remember that when they first came out the company insisted that I was the only one complaining about weak vertical hold on their '54 line." I said. "Then the company issued a service bulletin. If I remember correctly we had to change out one resistor. I'll look up that old bulletin. It might help us on the Feltner set."

Monday morning we picked up the RCA Console, and brought it into the shop. I don't remember the exact problem, but it was minor. The boys on the bench had the set repaired and back on the truck within two hours. I filled out a charge ticket for the repairs. It was a 7-mile trip out to the Feltner farm—twenty-eight miles total driving to pickup and deliver the set back home. I charged the customer $15.00 for pickup and delivery, $10.00 for bench repair, about $4.00 for the 6BZ7, and a dollar or so for parts used to repair the vertical circuit. I remember the total bill was less than $35.00.

A couple of months passed, then one day while I was beating my brains out on a set with intermittent anode voltage my wife came back in the shop, and said, "There is a customer in the office who I cannot reason with. I have been talking to him for one hour, and he absolutely refuses to listen to reason. Would you please go in and see if you can talk to him. I am a nervous wreck. I would like to have a tranquilizer as big as a vanilla wafer. I'd eat a bag full of 'em if I had 'em."

"Hmmm, that bad is it. What's the gentleman's name—I might know him?"

"It's that farmer fellow from Lowell. His name is Feltner."

"Oh yes, I remember him. He is 'tight as bark on a tree' but otherwise not a bad sort. I'll take care of him in short order."

"Yes sir, Mr. Feltner," I said entering the office with a forced smile on my face. "Mary says that you and her are having a little trouble communicating. Please tell me the trouble?"

"The trouble is you are a crook and a thief. You are charging me twice for the same work, and I ain't going to pay but one bill," he said.

"Now, now, Mr. Feltner, no one here is going to charge you twice for anything." I said, "Let's see what kind of statement you received in the mail."

"Here it is," he said, handing me the statement for the in-shop repairs of about $32.00.

"No where on this bill do you deduct the service call you made on the Saturday before bringing my set to the shop," said the old farmer.

"But Mr. Feltner, you never paid my repairman one penny for the Saturday call. I cannot issue credit for bills which have never been paid. We did what we agreed to do—only charge you for the in-shop repair, and the needed tube he put in your tuner."

"That 'so-called' repairman left this bill on top of my TV. It's for a tube, and for a $7.50 service call." Deduct that from this bill and I'll pay it."

"The service bill was for our record only. You have never paid us for the service call, and you are not charged with the call. If you can show me where you have paid for the call, then I'll gladly deduct the call from your bill. The bill you are holding in your hand is for in-shop repairs, I explained. Nowhere are you charged, or have you paid us any money. Do you dispute anything on the in-shop bill?"

"No, I don't argue with that, and I'll pay it as quick as you deduct this other bill from it."

"How, and why should I deduct a bill for which you are no longer charged, and for which you have not paid," I asked.

"Because I am not going to pay one penny until this service call charge is removed."

continued next page

I tried another ploy. "Suppose you went to the shoe store and bought a $20.00 pair of shoes. You had the store put them on a temporary charge until you tried them on. Then suppose later in the week you took the shoes back to the store and bought a pair of shoes for $30.00. How much should you pay the shoe store?"

"Don't try and insult me you little squirt," said the farmer. "Any fool knows that the difference would be ten dollars. You must think I never went to school."

"But Mr. Feltner, you just bought a $30.00 pair of shoes. The shoe store has not received money for the $20.00 shoes. They can't sell you a thirty dollar pair of shoes for ten dollars."

"There you go trying' to make a fool of me. I'm not talking about shoes. I am talking about my TV set and you are double charging me."

I finally lost my cool and told the kindly old farmer what he could do with the statement, and all of his future business. I also told him to be sure and tell all his friends because they might be as hardheaded as he. I was never a very good merchant.

Impossible Customer Number 2..

One of our local auto dealers was known to take an occasional drink. Well, that is not really true—the man was a drunk. After a number of years, and about the same number of wives he settled down, more or less, in a nice new home in the suburbs. Unfortunately, this man thought of me as a friend, and insisted on doing business with me. Heaven knows I would have preferred he go to my competition, it would have made me more money. No matter how hard we tried, his wife always insisted that we, in some way, damaged the cabinet on her console Philco television I sold them some three years previous to this story. The middle-aged lady was also known to occasionally imbibe.

I was on the bench trying to converge one of the early color sets when the phone rang. It was Mrs. Blank, the auto dealer's wife. "We have some TV trouble, and I simply must have it repaired before tonight's shows. This is our favorite TV night."

"Yes, Mam, I understand, we will be at your home in 30 minutes. Will someone be there to let us in?"

"Oh, yes, I'll be here all afternoon, but please come as quickly as you can."

She seemed nice enough on the telephone, but I knew the ax would fall before we were through with her if I was not very careful. Trouble was not far behind when she placed a service order. I called Earl, my one and only employee, to my desk. "I'm going to show you how to handle these impossible customers, Earl," I said. The secret is to eliminate any chance of trouble before it happens."

"One of the first things necessary to make a difficult customer happy is to answer the service call quickly," I said, as we left the store in our Chevrolet pickup. It was about four miles to the customer's home—we were there within minutes.

Both Mr. and Mrs. Blank were home sitting in the living room. From all appearances they were not drinking. Even before the 'small talk' was complete I knew the set would need to go to the shop. I could smell the selenium rectifier odor.

"I'll check your TV Mr. Blank, but I am sure it is going to need shop repair. Can you smell that peculiar odor in the room?" I asked. "That is the odor of a selenium rectifier that has burned out. Your set has two of them, and it is a good idea to replace both when one goes bad."

Mr. Blank agreed that he had, indeed, smelled the odor of something burning since the set quit operating.

I pulled the back off the set and with my ohmmeter confirmed that one of the rectifiers was bad.

I instructed my helper to go to the truck and get our furniture pad. I was careful to bring the very best one that I had. While he was getting the pad, I started writing down every scratch and nick I could find on the cabinet. I asked Mr. and Mrs. Blank to confirm my findings. I then asked them to sign my paper where all cabinet defects were described in detail. "This is just a standard precaution we take with every set we pick up," I explained. "If we should damage your set in any way our insurance company wants to be sure the damage was not preexisting."

I assured the customer that we had no idea of letting any damage occur to their set and that it would be repaired and returned in less than two hours.

As we drove away from the Blank residence I was smiling. I had finally figured out how to handle the most difficult of all customers, Mrs. Blank.

We went to work immediately on the Philco and replaced the selenium rectifiers. When reinstalled in the cabinet we carefully checked it out for operation. Then with a final rub down with furniture polish we carefully loaded the set, and delivered it to the Blank residence. Mrs. Blank answered the door. Once inside the living room I removed the furniture pad and handed it off to Earl. Then I tuned in the TV and ask that Mrs. Blank inspect the cabinet for damage, and to check each channel for proper operation. The old gal went over the set very carefully. She called one scratch to my attention. I removed the inspection paper we had filled out two hours earlier. "Here is the scratch above the channel selector as noted on our previous inspection. You see where we noted a one-inch scratch directly above the channel selector knob. Mrs. Blank, and here is where you signed the inspection report."

I could see that this upset her. She just had to find something to complain about and I had stopped her short.

As we drove away from the attractive residence, I said to Earl, "You just have to learn how to handle customers, Earl. I hope you remember the lesson I taught you today. Stop complaints before they begin."

When we walked in the back door the telephone was ringing. I picked up the 'phone. "Bruce's Radio" I said, "This is Bruce. How can we help you today?"

"I want you to know I am going to sue you," yelled Mrs. Blank. "The very idea. You and your fancy inspection report. You think you are pretty clever, but this time you have gone too far. This is not even our TV. You switched TV sets on me."

"But Mrs. Blank, that is impossible. There is no set in my shop that resembles your TV. Anyway, I keep a record of all sets sold or repaired. Let me read you the serial number off of your file and you can double-check your serial number. I told her where to look for the number."

A few minutes passed while she checked out the serial number. "That is the oldest trick in the book she said. You kept our expensive 21 inch TV, and put a 19 inch TV in this cabinet-then you switched the serial number plate."

"But Mrs. Blank, what you are accusing me of is impossible. A 19 inch TV would not fit that cabinet."

"Well, young man, I have the proof on you this time, and you are not getting away with it. I took my tape measure and measured the size of our tube. It is smaller than a 19 inch TV."

"Now, Mrs. Blank, please let me explain how they measure the size of a TV tube. You must measure on the diagonal."

"Bruce Vaughan, you are trying to insult my intelligence. Any fool knows that a 21-inch TV is 21 inches wide-diagonal indeed! You must think that I am a complete idiot."

Well, she was finally getting close to what I was thinking. Because I was

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Bob Heil's Workshop in Escondido

by David Olsen, W6PSS
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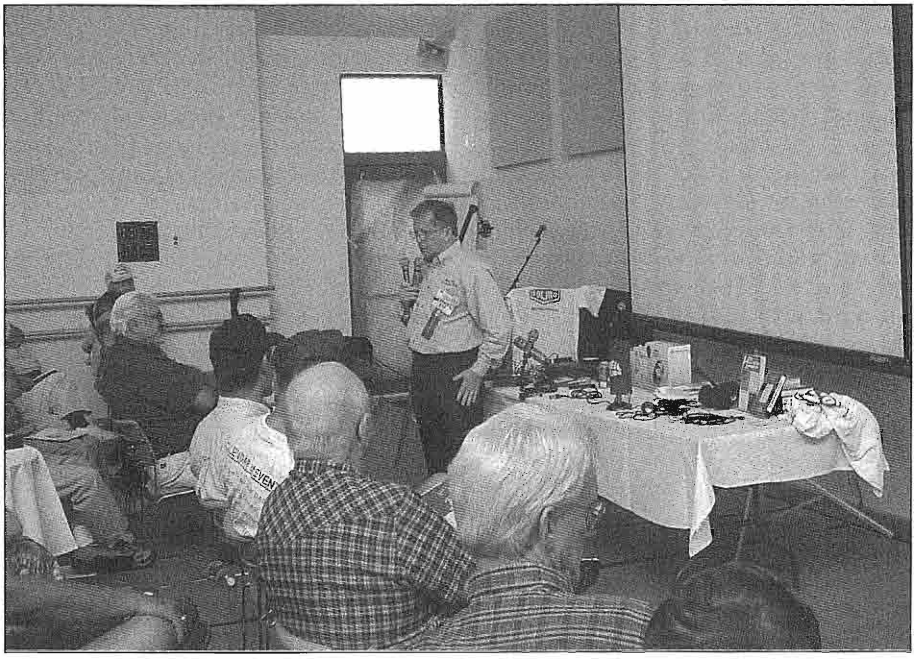
Standing room only! Event: Science of Audio Workshop taught by Bob Heil, K9EID. The venue: ARRL's Southwestern Division Convention 2002 held at California Center for the Arts at Escondido, California, 17 August.

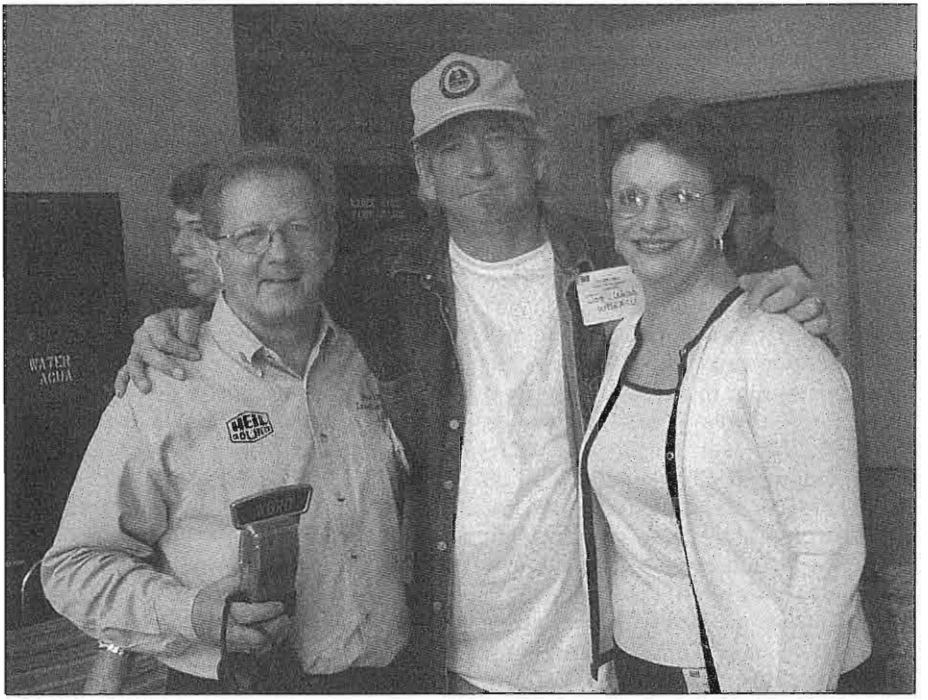
Within minutes, the "Rehearsal Room" was jammed with hams, young and old, all eagerly awaiting "The Microphone Man," of Heil fame who would talk about what he knows best—AUDIO, i.e., audio for hams, rock and roll, commercial communications and the studio.

As the room was filling, a young man wearing denim jacket and jeans was observed helping with mic stands and equipment for the presentation. Someone in back was heard to utter, "That's... that's the famous Rock and Roller who's a ham." In his opening remarks, Bob explained that the person assisting in setup was indeed Joe Walsh, WB6ACU of "James Gang" and "Eagles" fame—his "Roadie!" The crowd roared! Then Bob noted the tables were reversed years earlier when he was Joe's roadie—in 1969 for the "James Gang" and also for the "Who."

Bob had also come to the rescue of a young "Jerry Garcia." Bob credits his early ability to repair Rock and Roll amplifiers on skills of soldering and troubleshooting learned while repair-



Bob Heil conducting his Science of Audio Workshop.



Left to right: Bob Heil, K9EID; Joe Walsh, WB6ACU and Bob Heil's wife Sarah.

ing the modulator in his Harvey-Wells TBS-50D.

"There were few those days who performed repairs on musician's amplifiers.

" Perhaps they feared not being paid - hi.

Bob Heil proudly exclaims that he attributes much of his knowledge and experience to Amateur Radio.

"My life changed at age 15 when I acquired that Harvey-Wells transmitter that I still own. In addition to HF, I used it on 6 and 2 (doubling in final on 2 meters - hi). I continue operating it and my Central Electronics 20A exciter on 14.286 AM.

His impassioned flare for audio excellence is well established. Bob praised his mentor, Paul W. Klipsch whom he met through mutual acquaintances while Bob was organist at the Lincoln Theatre in St. Louis. Klipsch pioneered audio frequency amplifier design and amplifier neutralization in the early 30s.

Many will recall the lifelike sound of the "Klipsch Horn." Under his tutelage Bob learned that microphone, amplifier and speaker systems each must be responsive to the varying frequency sensitivity of the human ear—as shown in the "Fletcher/Munson Curves."

An hour had passed before us—it seemed 5 minutes, and we were primed for what came next. In a loud voice Bob proclaimed, "Nowadays radios are all alike, it's what you put in 'em that makes the difference!

"Let me demonstrate. Most of them have excellent good flat audio. Have you heard any flat audio lately?" Then he proceeded to take a perfectly good microphone, with no equalization added, to say a few words on the PA.

"It sounds bassey doesn't it?" Next using same mic, he adds some "sweetening" by raising EQ by a factor of 3 dB or so in 2 kHz region and...

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The Galaxy Comm 2

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photos by Cora E Cobb, KBØLPZ

This article will examine what seems to me a very unusual radio. At first glance it appears to be a military backpack unit similar to the AN/PRC-25. It even came with a backpack which holds the radio, handset, batteries and antenna components. The antenna mounts on the side of the metal case and includes a good-size base loading coil. Closer inspection, however, reveals that this is a very different beast indeed.

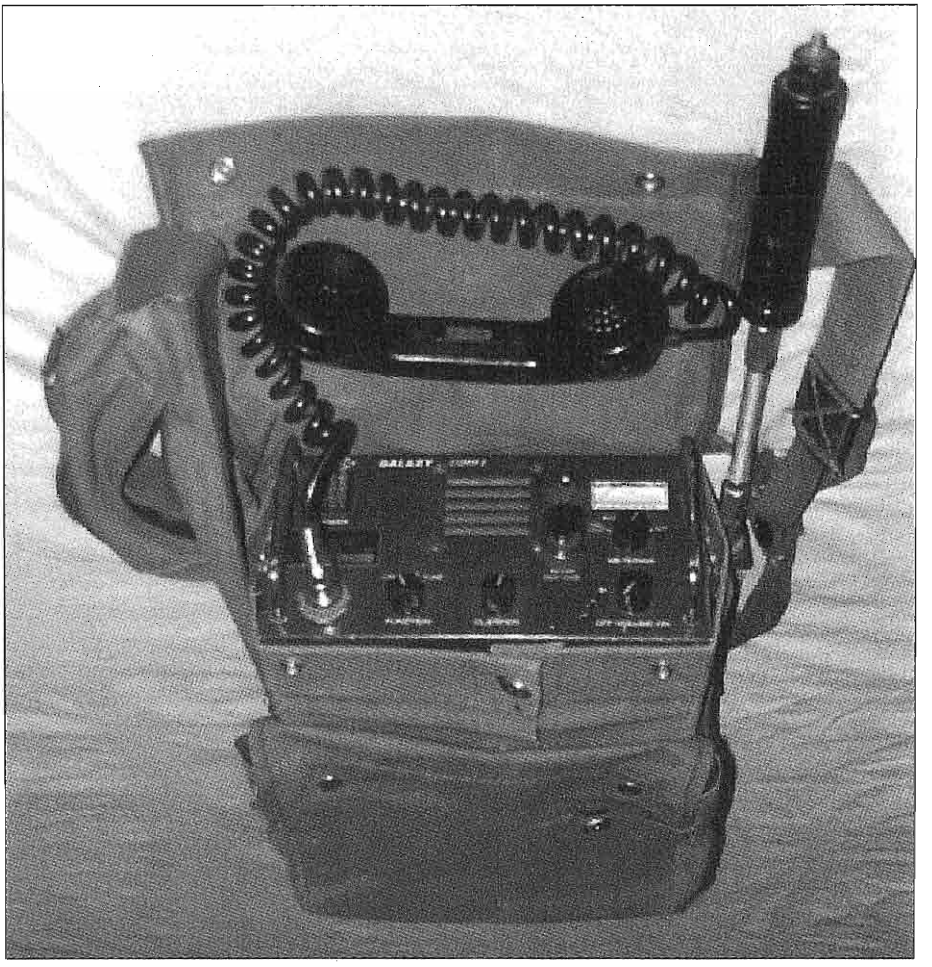
The panel is marked with the Galaxy logo and "Galaxy Comm 2" and has a label that reads: "Galaxy Electronics / 10 South 34th Street / Council Bluffs, Iowa, USA / Serial No. ___." On the serial number blank is scratched: "900.6BL051." This is the address of Leo Meyerson's company of that name, founded in 1962 and sold to Hy-Gain (of which there is no mention on the label) in 1970. Galaxy built a series of desktop HF hamband SSB transceivers and linear amplifiers and at least one 2-meter FM transceiver during these years. But this is the first paramilitary radio I have ever seen by any major amateur radio manufacturer other than Hallicrafters. And none of that company's units of this type are more than distantly similar.

The condition of the radio is excellent. The exterior metal shows very little wear and the canvas backpack shows only a little more. The interior looks new and doesn't even show any dust. One wire looks slightly burned at one end but this is more likely due to a clumsy soldering iron than to any operating damage. There is a slight smell of transformer varnish. This may be due to a component that overheated at one time or may also be a result of a manufacturing process. Is it possible that this unit is a prototype? Possibly even a prototype of a model that never made it into volume production?

The Comm 2 is a paramilitary two-channel high-frequency portable SSB transceiver. The channel is selected by moving a sliding bar in or out, thus operating four 3PDT slide switches. The bar can be locked in either position by a large round nut concentric with the knob that moves the bar. Each channel is crystal controlled. In my unit the crystals are 7951 kHz and 15750 kHz which, with a 1500 kHz offset, give operating frequencies of 6451 kHz and 14250 kHz respectively. These frequencies are just below the 40-meter and just above the 20-meter amateur bands, suggesting the possibility of relatively easy conversion to ham use. I have been reluctant to try such a conversion, however, without more information. In particular, alignment looks complex enough to put me off the attempt, at least for now.

Although these frequencies are within the old 2-20 MHz military range, the radio is not built to a level of quality that would be acceptable to the military, although it's very good by commercial standards. The slide switches are typical low-priced commercial quality. A somewhat haywire nest of point-to-point wiring and a few visually questionable solder joints comment on the quality of assembly. On the other hand, I have no idea what other radio service would legitimately operate SSB on these frequencies with a tactical-type radio. Perhaps Civil Defense?

In addition to the channel selector, the panel contains an LSB/USB/Tune function switch, a clarifier (a small variable capacitor that can "pull" the carrier oscillator up to 100 kc or so from its crystal frequency), a volume control with a power on/off switch, and an on/



The Galaxy Comm 2, a two-channel HF portable SSB transceiver.

off switch for the internal speaker. There are two connectors, a 12-pin Jones plug for power connection and a 4-pin commercial mic jack for connection to the telephone handset with push-to-talk switch that came with the unit.

Finally, there is a meter marked in S-units up to 70 dB over S9 and plate current 0-8, with a meter switch marked REL OUT/AVC/ALC/IP/12V. These settings probably correspond respectively to some kind of RF power/SWR function, receiver automatic volume control (metered in S-units), microphone level, final plate current (metered 0-8 in unknown units) and battery voltage.

Design is typical of the mid-1960s, semi solidstate with at least 23 transistors and eight diodes. The only tubes are a 35-watt RCA 4604 final amplifier driven by a 4-watt RCA 7905. If it weren't for these tubes, I doubt if Barry would publish this! Sideband generation is accomplished by the use of a small Collins mechanical filter with 1956.545 kc and 1645.660 kc crystals.

Wiring is mostly point-to-point, but there are eight printed-circuit boards. The largest is the receiver and another

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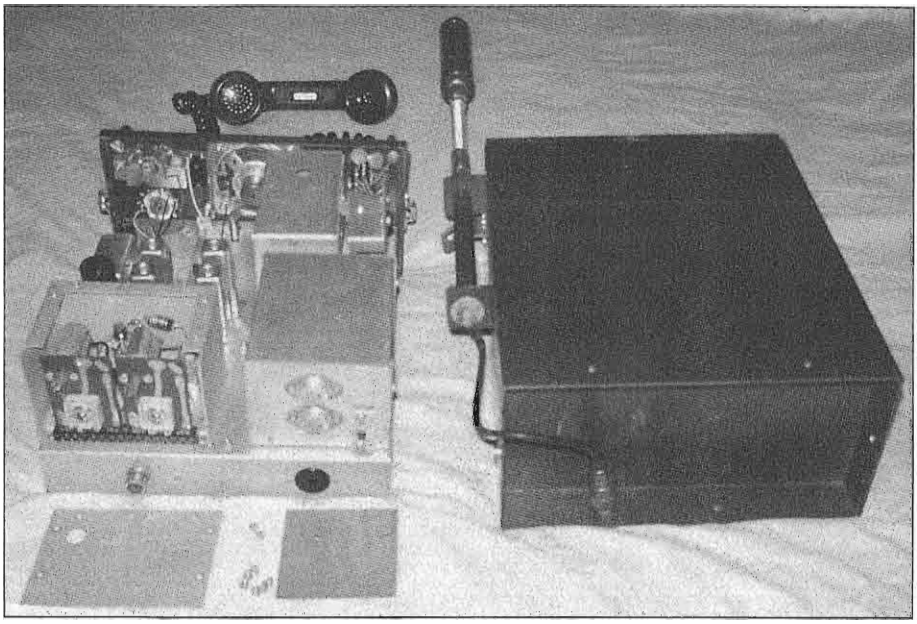

The Galaxy Comm 2 out of its case. The radio is not built to a level of quality that would be acceptable to the military, although it's very good by commercial standards.

appears to be a carrier-insertion oscillator using a 456.3 kc crystal. Two more PC boards are used in the sideband generator and two in the first stages of the transmitter RF section. Each channel has its own final amplifier plate tank circuit on an individual PC board.

The unit is battery powered with the battery carried in a pocket of the backpack. This pocket is about 10"wide x 2"deep x 8"high and comfortably holds six 6V 5-ampere-hour rechargable gel cells, giving 12VDC at 15 aH. At a guess, original power might have come from a pair of either 12.5V BA-4386 or BB-5598 batteries as used in the AN/PRC-25 or -77 VHF FM transceivers.

High voltage for the tubes comes from a transistor multi-vibrator power supply. A pair of Motorola 2N1538 power transistors chop the 12 VDC input into a really neat-looking toroidal transformer and a Motorola 2N1535 seems to be a series regulator. A toroidal RF choke on the antenna lead and well-designed shielding should keep TVI/RFI under control.

I found this unit at a local hamfest, missing its antenna whip and power supply and cable. There was no documentation and the seller could tell me nothing about it. As I have found no mention of this unit in any of my reference materials, everything said in this article is based on my own observation. I have not attempted to operate the radio, as it transmits outside the ham bands. At some time in the future I plan to build a power cable and an antenna whip. Then I will power it up into a 50-ohm 100-watt power resistor and see what more I can learn about it. If I can get it working and converted to legal frequencies, I will report the results in this magazine. Don't hold your breath, though, until I find out a lot more about it. If anyone has any further information, or can correct any of my conclusions (guesses), I would appreciate hearing from them. ER

Barry Wiseman, N6CSW and XYL Shirley. *Photo by Kristie Carriker.*

The 13-plus years that I've spent on ER have been the best years of my life but it was very hard in the beginning for both Shirley and me. We sunk every cent we had or could borrow into the magazine and for the first couple of years it was an awful, worrisome situation. I remember many times when I regretted ever having started ER—how could I have been so stupid as to think that I could start a magazine! I had no experience in the business at all and lacked most of the required qualifications. Gradually, about the third year, we turned the corner, the magazine started to make money and it has been a successful business to this day.

If there's a key to our success (other than hard work or persistence) it was that good writers have been attracted to ER. Nothing makes me more proud than the quality of the articles that have appeared in the magazine over the years.

Shirley and I want everyone that contributed an article to ER to know that we are very grateful and thankful. Without your efforts ER would never have succeeded.

Another thing that contributed to our success was the encouragement we received from our subscribers. I remember that in the beginning this was what kept us going. Whenever we were almost ready to throw in the towel we'd get a call or letter from a reader telling us just how much he (or she) enjoyed the magazine and our spirits would be restored.

And through all the years Shirley and I always felt we were in good company and that we were among friends. The relationship we had with our readers was not purely a business relationship. We feel that vintage radio people are some of the best people around. It has been a true blessing to have been able to come to know so many of you.

If you'd like to contact us on the internet our e-mail address is brw@frontier.net and our phone number is 970-564-9187. Our mailing address will remain the same but address the letter to us personally rather than to ER as that mail is being forwarded to Ray.

Thanks again to everyone for your help and kindness over the years.
73, Barry, N6CSW

The Gates BC-1T Broadcast Transmitter

by Robert B. Login, AA8A
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jlogin@mindspring.com

I was first licensed in 1956 as K2VQM. During those impoverished years, all I could do was to dream about owning the big rigs of that era. So recently when I had a chance to acquire a Globe King 500C, I grabbed it. Shortly after that, I found a Viking 500 that I rescued from a CBer. I had both big rigs on the air after rectifying several problems such as no 2.5V on the 3B28's (substituted solid state replacements), shorted 811A, misalignment, weak tubes etc. I was delighted to get on 40 AM with a big signal. It was fun to be complemented on my audio and signal quality. Comparing the rigs, I must say that the Viking is the more elegant and simpler to operate. With both rigs on the air, I needed a new project! Lets face it! My hobby is to work on the "new BA project". Am I alone in this need or is this the real essence of the avocation?

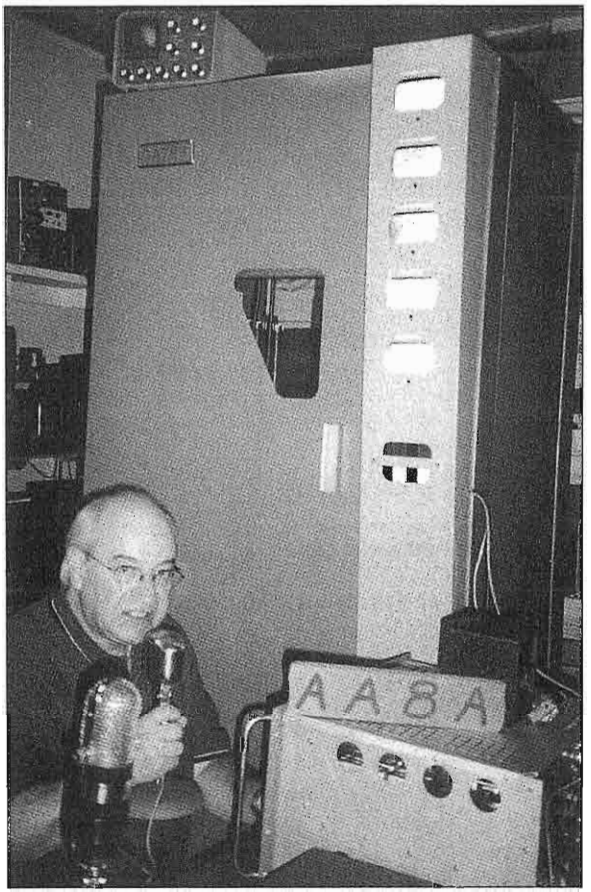
Gates BC-1T References

Well since I was moving in the direction of bigger rigs, I couldn't pass up the opportunity to acquire a retired broadcast transmitter when it was offered. In fact, I convinced the seller, my friend Brian, KN4R to deliver the rig to my QTH and help me position it in the shack. To prepare, I searched ER for every article (ER #36, 37, 38, 40, 41, 141, 143) on BC xmitters and was pleased to find a recent rather detailed account of a Collins 820D conversion, rich in good advice applicable to other rigs. I also searched the Web and found two very well done conversion accounts by N2BC (http://home.stny.rr.com/n2bc/AMRadio.htm) and WA2WHV (www.qsl.net?wa2whv/wa2whv-am.shtml). All these authors did me a big service because good documentation is the lifeblood of the hobby! Without ER, many hams in my opinion would not tackle this type of project. Think about it, when I was first licensed in '56, where did you go for help and advice? I think in those days you could contact the manufacturer directly of course but I could just imagine calling up Gates during the fifties and telling them I wanted their advice on putting their BC-1T on the ham bands! Although I never did it, you could ask the ARRL technical staff for advice. And of course your friends might know something? Who was making copies of manuals during the fifties? I remember the old messy copiers of that era (or was it later)...well they may not have even had copiers. Who new what the future would hold!

Gates is now Harris and I did give them a call. I was transferred to the technical assistance people and talked to one of their engineers. He told me that they still had a file for the BC-1H but it was soon to be eliminated and as far as the BC-1T, he knew nothing about it. In fact he felt that there was no one any longer at Gates who was familiar with that rig. Those of you with the H model might want to see about acquiring the information available as I was told that when they stop supporting an old product they get rid of the file. I was surprised when he asked for my phone number just in case he got another such call; he could give that person my number!

Plywood Platform

I decided that I would build a plywood platform instead of drilling holes in the bottom of the rig as recommended in ER. With the rigs dimensions in hand, I had 3/4" plywood cut so that a lip of



The author with his prized BC-1T

several inches on all sides would afford a safety margin. Strips of 3/4" plywood about 6-8" wide were also used to reinforce the underside lip of the platform with two extra strips going across the open space in the middle. Heavy duty castors, 250-300 lb. jobs with locking bars (Home Depot) were bolted through the two layers of plywood, three in the front and two in the back. I also drilled holes for jacks consisting of three 1/2" bolts across the back that extended to the floor so that the rig could be leveled on my sloping garage floor. After all this overkill, I still worried that I would have trouble supporting the rigs 800 lb. weight! Jim, K4DEE and George, W4BUW, along with Brian and his son unload the big rig. However the platform worked very well and the rig was easily rolled into position. The casters were locked and the jacks used to level the whole works.

Reassembly

The BC-1T was delivered partially disassembled with all of the heavy iron removed. I further removed the back and side doors and front grill work. This afforded easy access from all sides. After a good cleaning, I reinstalled all the iron however a couple of items such as the modulation reactor (replacement choke from Dahl) and low voltage choke were not original and were just jury-rigged in position. I now had the original manual that indicated my rig was built in 1962. It is an excellent detailed manual with the type of pictures and schematics that give you confidence you are doing the right thing during reassembly. The disassemblers also labeled many of the leads and I certainly appreciated their efforts.

Testing on 1340 kHz

Well a week later, I asked my friend Jim, K4DEE to check over my reassembly and then I would fire it up on its original 1340 kHz into the built-in dummy load. The 833's looked impressive, I actually had two 833C's for the RF and 833A's in the modulator position. The driver is a pair of 807s excited by the xtal osc stage (12BY7 osc & 12BY7 buffer). The modulator also uses four 807's; cathode followers feeding push-pull drivers. What classic tubes, I couldn't wait to give it some juice. Jim, a very experienced ham who spent a lifetime professionally in radio instal-

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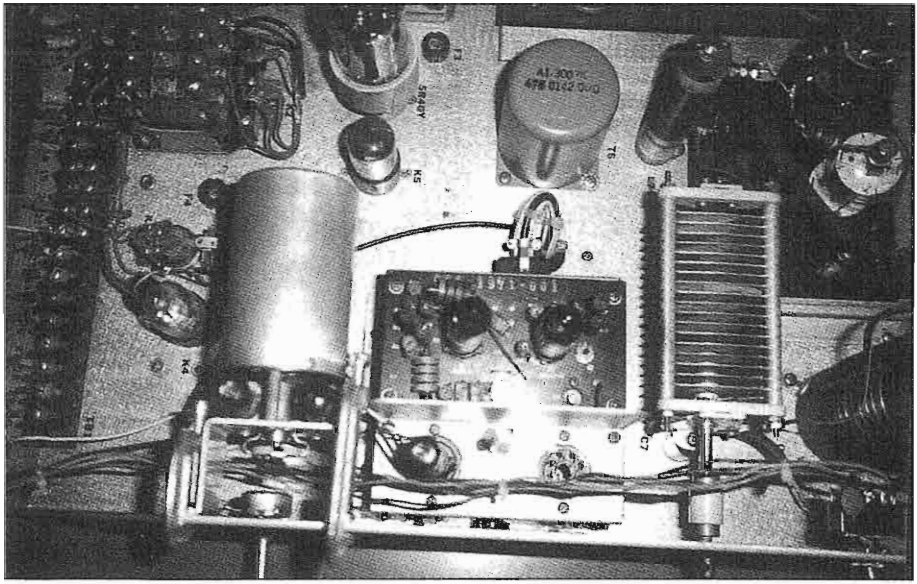
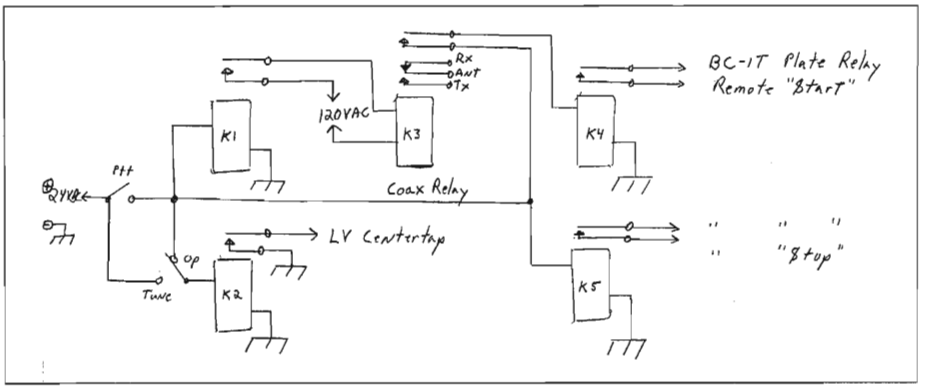


Collins 75A-2 PTO mounted with C-clamps to the front panel. The PTO feeds the crystal oscillator/buffer module above it.

lation and maintenance gave my reassembly the thumbs-up so I pressed the filament start switch and actuated the big filament relay. The 833s lit up and the fans worked. After 30 seconds or so the time delay relays kicked in (the rig is solid stated so these devices are unnecessary) and the driver stages came on. I resonated the driver and listened for the signal in a nearby receiver. It sounded nice and clean. I hit the plate start switch with the transmitter in the low power 250W position and heard a loud crack as both Jim and I quickly backed away from the rig. I turned it off and killed the power. You must be very careful with high voltage and be sure everything is dead before mucking around. This includes disengaging the 240 line circuit breakers and shorting out the HV & LV power supplies.

Well the two 30 amp cartridge fuses were still intact to my surprise. After carefully studying the schematic, I thought that if the plate tuning circuit had been altered by the usual tendency to twirl the knobs and watch the big variable coils move, then the plate might draw more current than where the overload relay was set to trip? Also might the overload relay in the plate supply have been moved out of adjustment by the handling of the rig during its journey? I adjusted the plate tuning according to the generalized instructions in the manual and readjusted the overload relay variable resister to a higher setting. Now when I engaged the plate start switch, I heard relay chatter and saw a power out indication on my wattmeter. Although fleeting it suggested that I adjust the plate resonance one way or another to solve the problem. This worked, I had to disengage the plate relay, make an adjustment finding the right direction for both the plate and load controls and then turn on the plate start until the rig settled down and stayed on. I could now adjust the power out to 250 watts. Everything looked good except for the 807 drivers. One had orange hot plates and the other looked cold. I had checked all the tubes so I decided to measure voltages and



The author's PTT Circuit for the BC1-T

discovered that the cold tube had no screen voltage while the other one was correct. I further discovered that there was a cold solder joint in that circuit which I repaired. Now both 807s were working and the plates were not orange.

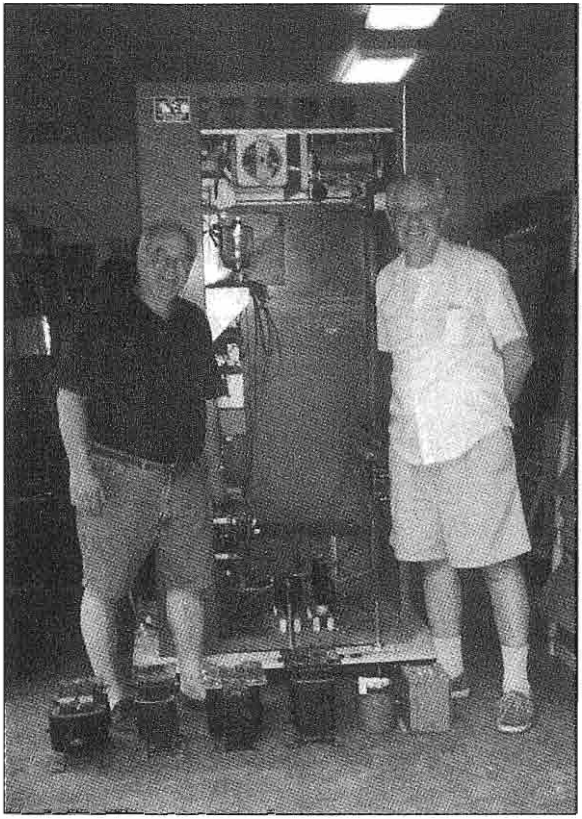
I now tried the rig on the 1 KW setting. With fingers crossed I hit the plate start switch, the big relay clanged on and my wattmeter showed 1.2 KW. I turned the built-in Variac that affords about +-200V until I had 1 KW output. I made sure it was resonant and played around with the loading. I listened in a receiver to the beautiful clean note. I was very pleased. I moved back to the low power position (this puts 120VAC across the power transformer instead of 240VAC) and had 250W out. Playing around with the built-in variac and the loading control, I could easily jack-up the output to 375W. Experimenting with just one 833C in the final, I could run the rig at 500W but who knew about the modulation with one tube? Anyhow, 375W is the legal limit at present. The BC-1T is designed to run a KW night and day and I'm sure this rig did its job for 40 years recently ending its career as the back up to a station in Atlanta. It's kind of ironic that a machine that was never mentioned by name in all that time would end up in a situation where it would be the star?

PTT Circuit

I now had to figure out a PTT circuit. My rig came with the remote relay board and other auxiliary devices to allow the rig to be controlled from a remote location. I essentially rewired this board installing a 24VDC power supply and several DPDT relays. When activated the first 24VDC relay activates the 120VAC coax relay, which then completes the circuit to the plate start relay, which then activates the big plate relay already in the Gates. This is to make sure that the antenna or dummy load is in the output before the rig can be powered up. In parallel with the first 24VAC relay that activates the coax relay is another relay in the low voltage transformer center tap. I also installed a manual switch in this circuit to turn on the driver stages independently. This allows me to tune-up these stages independently of the final and also is designed to make sure everything in the driver stages to both the RF and modulator circuits is off during receive.

When the PTT is activated the center tap in the LV supply is grounded at the same instant the antenna coax rely activates the daisy chain to the plate relay; therefore, the drivers are on a fraction of a second before the finals. I also decided to put a relay in the plate stop circuit just in case the one that controls the plate start failed to disengage. All of

continued on next page



Prior to the restoration Jim, K4DEE and I look over the heavy iron. Notice the playwood base and you can see two of the three jacks across the back. We put one of the 833A's in place to see what it looked like in the rig.

the relays are P&B 24VDC DPDT wired in parallel as redundant SPST just to make sure, and also limit the chance of bouncing the contacts. The daisy chain to the plate start and the large nature (slow) mechanical action of the big Gates relay affords adequate time for the driver stages to come on before the finals. The rig shows no sign of disliking this PTT system!

Fusing

I was concerned about the fusing of the power transformer and decided to try 8 amp inrush current protection devices in both 240VAC leads. I also installed 3ag fuse clips in series and put in 8 amp fast-blo fuses. This was a mistake as they would blow from time to time so I went to 15 amp fuses and this seems OK. I also installed 4 amp inrush current limiters in the LV supply on both legs of the 240VAC. The LV circuit is fused, as is the bias supply. So far I have not blown the 30 amp fuses and feel more comfortable with this added protection. When the PTT is activated, the rig comes on with about 95% of its power and the watt meter then moves to full power in about 1-2 seconds, I believe this to be caused by the current inrush limiters as they go to low resistance as they heat-up. The BC-1T was not designed to come on and off the way hams would use it so I believe I have afforded a softer start situation. I've used the PTT many times so far without a problem!

VFO

I tried a PTO from a 75A-2 that I had on hand to drive the 12BY7 osc. It worked very well and so I rewired one of the octal crystal sockets for the PTO obtaining voltages from a 5W dropping resistor wired inside the osc assembly and added a OA2 regulator piggy-backed on top of the octal plug. The other xtal socket was rewired for FT243 style xtals. The original switch that was used to chose between two xtals now chooses VFO or xtal. I also removed about a third of the plates from the output tank cap of the 12BY7 buffer so that it would resonate at the upper end of the rigs range (2 MHz). The PTO was not permanently mounted but attached with "C" clamps because it just seemed that the rig would be used on only few

160M AM hangouts so I didn't want to go to all the mechanical trouble of installing a dial etc. On 160 as mentioned, with this rig you have to be very accurate with the tuning so that quick QSY is not feasible unless you have an accurate way of resetting the tuning controls. So now I'm on the lookout for panel turns counters!

Modulator

Well while doing all this, I had in the back of my mind that I had not played around with the modulation system. So I used an audio generator with the required 600 ohm output to try to drive the modulator. Watching the sine wave pattern in my SB-610 scope showed I could do about 30-40% modulation because it didn't have the output necessary but it sounded nice. Jim, K4DEE gave me a small PA amp that had about 10W out. Using the 70V line out from this amp, I had no trouble modulating the rig. The input to the modulators is a resistive "H" pad designed to require significant audio drive to avoid hum and instability. During a QSO with the very knowledgeable John, NB2B, his advice was to use a line transformer to isolate the PA amp completely from the BC-1T balance input and this improved the audio quality. You need a preamp to drive this rig but it must be isolated with a matching transformer and not fed with the ground of the PA as the return lead!

On The Air

I now needed to get an antenna up for 160. I read WC3K's wonderful ER article (#142) about the Johnson Matchboxes and I decided to follow his directions. So I put up an inverted-V of 180 feet fed with 450-ohm ladder line and modified my KW matchbox. My MFJ analyzer indicated that I had resonance on 1885 after tweaking so I applied power. The SWR meter showed low SWR to begin with but quickly rose to very high levels. The controls had no effect. I found no sweet spot for the link tap but discovered that the doorknob caps (two 500 mmF in series) were hot as hell! I added some more ladder line and this improved the situation until I tried to modulate. The band switch came alive with sparking and arching. I had visions of Tesla. Well, WC3K used four doorknobs in parallel so that the RF was divided equally in four paths. I was putting all the RF through each cap! I replaced the doorknobs with a Jennings

continued on page 43

Bob Heil's Workshop from page 31

Waaaalaaaa, presence like you wouldn't believe.

"When considering the limitations in your ham audio chain, remember it all starts in the mic." He then compared a Heil mic, they're all speech peaked, to an expensive mike that was not. The difference was spectacular and equivalent to raising transmitter power by a factor of 3 dB. Incidentally, Bob praises the natural presence of the D-104 despite other limitations.

Next Bob drew a parallel between antenna and audio phasing. He noted how improper spacing on a reflector element could lower both gain and directivity and nullify its purpose. Now very animated, Bob rapidly grabbed two identical mics that were out of phase. He held both close and spoke. No amplified sound heard. Then he hit the phase reversal switch and his voice came booming out at us. All were advised to install a similar switch.

Bob's beautiful wife, Sarah, assisted with the last portion of workshop and increased our attention span. We were one captive audience. As the workshop drew to a close, Bob concluded with some neat thoughts.

"If you want to improve your transmitted audio listen to yourself on your receiver or local monitor. Just like radio personalities of old, there's a microphone out there to make you sound good. Take the time to let science work for you."

"I look forward to the day when these 3 or 4 killobuck radios have a tone control in them. But, we must push hard enough for them to change—we are paying the price."

The writer suggests that those who haven't attended Bob's workshop, try and do so when he next comes your way. Despite all you already know, it should be worth your valuable time.

In conclusion, some items were not included above due to lack of space (and memory). Liberty was taken to paraphrase when necessary.

Bob Heil's website is www.heilsound.com. Suggest a visit too to Joe Walsh's at www.joewalsh.net. FYI, Joe is a proud member of the very progressive "Burbank Wrecking Crew." Been talken 'bout our modulation. ER

Meter & Dial Faces from page 15

savvy, you can learn to do it yourself. If you haven't the skill, find someone who does. Spending $20 on the software isn't overwhelming and your kids will discover other projects they can do with it. "Real radios" may "glow in the dark," but don't be afraid to use a computer to make your old radio panels more satisfying. ER

References:

Graph Paper Printer Software: Philip Marquis of Metz, France. www.marquis-soft.com Version 5.4.0.1

Compass/Cutter: OLFA Products. www.thomasregister.com/olc/olfacutters/home.htm Division of World Kitchen, Inc. 1536 Beech Street, Terre Haute, IN 47804

Brayer (rubber roller): Speedball Art. http://www.speedballart.com/index.html Available at art supplies stores in various widths. 3" or 4" is probably best.

OptiMount transfer adhesive: Seal Brands. http://www.sealbrands.com/websites/sealbrands/Web_Prods.nsf/WEB/Seal+Prod+2/1C497017F46368448525697D00653A16?Open Document

Scotch Brand Packaging Tape: #3841 or similar; any clear, wide shipping tape. 3M Self-Laminating Card Protector: LS851 or similar (2 7/16" by 3 7/8").

The Stancor 110C from page12

From my experience with the 110C some of the linears being used for AM might be better off with a small cathode modulator. Just to prove it could be done I took a 20-watt audio amplifier with a 500-ohm output tap and connected it into the filament ground return of my home brew pair of 811As which operate grounded grid. With a little more drive than normal I had 140 watts of AM on 40 meters. Next I opened up my 30L-1 and connected the audio into the 811A filament transformer winding center tap. Very poor audio quality was the result but it was AM. Adding an audio bypass to the grid return cleaned up the audio to where it was acceptable. Power output was almost 250 watts, and the 811s were not running too hot. I could only get about 40% AM modulation, so more work was in order, but I didn't follow up. I was not in the mood to chop up my 30L-1. But I did prove to myself that cathode modulation is not so far in the past that we can write it off and forget it. But for now I'll use my 110C as is, and have some fun on the air while contemplating its 1940 classic look. As Stancor said in its 110C advertising I'll be "keeping abreast of popular developments" 1940 style... ER

Radio Service from page 29

young and somewhat inexperienced I attempted to explain how all TV tubes were round in the beginning, and that when the picture was masked off, the only way a 12-inch TV would actually measure a foot wide was to measure the diagonal.

This really enraged her. "There you go, trying to blame your crooked ways on to someone else. You know any honest manufacturer like Philco would not try and fool a customer. I had a 21 inch TV and I demand you bring my TV back right now or I'm going to have the law on you."

I'm sure some businessmen would have known how to deal with Mrs. Blank. I did not. I could see that the conversation was going to take an unpleasant turn. I did the only sensible thing I could think of. I hung up on the old biddy. She was still talking, as the connection was broken. The phone started ringing immediately—I was not about to answer it. It was near closing time, so I decided to close up for the day. Earl had been standing by listening to the entire conversation.

As we left the store Earl said, "Bruce, if you have time tomorrow how about giving me another lesson on how to handle customers." I still remember the smile on his face. Can you believe that Earl and I are still friends? What about Mrs. Blank? I never heard any more complaints. I doubt that she remembered any part of our talk when she sobered up. ER

BC-1T from page 41

250 mmF vacuum variable and this improved the situation. Jim, K4DEE said why fool around, put up 260 feet, which I did. I also had to move the input from its fixed position by placing an alligator clip on it. Now I have no problems with the Matchbox. I move the input link to the best spot for lowest SWR and this varies from band to band. K4DEE was my first QSO and I have had several since then. I have received very good audio reports and I am very pleased with the rig. I'm looking forward to the coming winter season, as there is very little activity on 160 now that I can hear? Look for me on 1885... please!

I'm now looking through ER for articles on audio (#141, 38) because I now have the bug for audio gear and more importantly understanding audio. Without a hands-on project it's hard to learn new things without specific motivation. Lets see I think I need a compressor/limiter, mixer, equalizer? ER

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FOR SALE: Panel refinishing: Johnson Ranger sets - $250; Valiant sets - $300; Johnson 500 sets - $300; Collins R390(A), front side - $125, both sides - $225; Hammarlund HQ-180 series panel & bezel - $200, cab add $100. http://w4pnt.8k.com. Dee Almquist, 534 W. Main St., Waynesboro, VA 22980. (540) 249-3161 Cell: (540)480-7179

FOR SALE: Philco 46-350 parts chassis - $25; CU-32/ART-13 antenna loading tuner, not complete - $50. Al Jenkins, WA1RWB, POB 1162, Nantucket, MA 02554. (508) 325-7122

FOR SALE: Convert any wattmeter to read PEP! Perfect for AM/SSB - $19.99 ppd for complete kit! HI-RES, 8232 Woodview, Clarkston, MI 48348. (248) 391-6660, hires@rust.net

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

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WANTED: ARC-5 rcvrs, racks, dynamotors. Jim Hebert, 1572 Newman Ave., Lakewood, OH 44107.

WANTED: Antique tubes. Paying $40 ea for good used type 201 tubes (not A). Buy list & new 2000-2001 catalog of collector tubes available. See www.fathauer.com. George H. Fathauer & Assoc., 688 W. First St. Ste 4, Tempe, AZ 85281. (480) 968-7686, tubes@qwest.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: Bendix radio rcvr RA-1B; Belguim set RST-101. George Rancourt, K1ANX, MA, (413) 527-4304 or k1anx@mindspring.com

WANTED: Collins 70K-2 PTOs working or not; IN82A diodes; Bretting 14/14AX manual. Clark, WØBT, KS, (785) 286-2132

WANTED: Seeking unbuilt Heathkits, Knightkits. Gene Peroni, POB 7164, St. Davids, PA 19087. (610) 293-2421

WANTED: Electric Radio; Antique Radio Classifieds; Old Timers Bulletin. Alan Mark, POB 372, Pembroke, MA 02359

CDs From the ER Bookstore

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R390-R390A/URR Technical CD-ROM - $ 57.
RCA HB-3 Tube Handbook - $ 75.
RCA Radiotron Handbook, 4th Edition - $ 62
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80 years of QST - $ 39.95 per set (generally 5 or 10 year set).
All 11 volumes - special package price - $ 373.
Collins Radios Technical CD-ROM series. Vol. 1 - Collins Receivers; Vol. 2 - Collins Transmitters & Amplifiers; Vol. 3 - Collins Transceivers; Vol. 4 - Accessories, Power Supplies, VFO's, etc. Each CD - $ 79, Complete Set - $ 279

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WANTED: Old Callbooks, especially those covering the years before 1930. Alan, W3BV, PA, (215) 795-0943 or W3BV@arrl.net

WANTED: National HRO black wrinkle spkrs, oak coil boxes, coils; Western Electric horns, spkrs, amps, mics. Barry Nadel, POB 29303, San Francisco, CA 94129. bnadel@ccnet.com

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

WANTED: Collecting military electronics including radio, radar, RDF and test, manuals & literature. William Van Lennep, POB 211, Pepperell, MA 01463. (978) 433-6031

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

WANTED: Stancor/Chicago PCC200, PCO/PS0150, RC8150; Triad A-9-J, A-10-J, A-11-J, A-12-J. **FOR SALE:** Books, send SASE. Richard Robinson, POB 1425, Wallingford, CT 06492. (203) 949-0871, richmix@erols.com

WANTED: R-390A rcvrs, parts rigs or restorable, will restore yours at reasonable prices. Walter Wilson, KK4DF, (706) 733-8323, wewilson@knology.net, www.knology.net/~wewilson

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 hm, kc4yoy@trellis.net

WANTED: ARC-2, ARR-7 and ARR-15 racks; BC-1387 for BC-611; whip antenna for PRC-124. Joseph Pinner, KC5IJD, 818 Hill St., Kingston, TN 37763. kc5ijd@bellsouth.net

WANTED: QSL cards from old/pre WW II Ham DX countries; old regen kits. Hajime Suzuki, Nishikuniyoshi 1644-24, Ichihara-Shi, Chiba-Ken, 290-0231 Japan

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: Collins 310B3, basket case OK - welcomed; & Chicago 500W CMS-2, high-level modulation xfmr; Taylor T21. Jerry, W8EGD, CO, (303) 979-2323

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

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WANTED: WWII BC-610-E series or earlier xmtr; BC-739 interphone control box. BC-652 rcvr. Steve Finelli, N3NNG, 37 Stonecroft Dr., Easton, PA 18045. (610) 252-8211, navrad@enter.net

WANTED: 1950's Popular Electronics; 1961-65 Heathkit catalogs & Radio-TV Experimenter. John Curtis, WØCAR, 3146 S. Franklin St., Englewood, CO 80110. (303) 781-8027, wøcar@arrl.net

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: RBB/RBC rcvrs, pwr splys, cables & RAK/RAL equip. Andy Miller, KD6TKX, CA, (831) 484-2389, amillertkx@aol.com

WANTED: Orig Heath manuals for ham & test equip. Please state condx & price. Warren, K1BOX, NC, (828) 688-1922, k1box@arrl.net

WANTED: RCA 140, 141, AVR5A. GE K80, K80X, K85. Any condx. James Treherne, 11909 Chapel Rd., Clifton, VA 20124. treherne@erols.com

WANTED: Vintage four & two pin Cinch-Jones chassis sockets & matching plugs. Louis L. D'Antuono, 8802 Ridge Blvd., Brooklyn, NY 11209. (718) 748-9612 after 6 pm

WANTED: Service manuals, originals, copies for copy of HP 3330B, HP 3582A, HP 11710A. Will pay ALL exp. and more! Reinhard Wieschhoff, 7 rue du Debuche, F-78120 RambouiLLet, France. Tel/Fax: 0033 1 304 111 02

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

WANTED: Russian 1.5-8 MHz military transceiver, type P(R)-131. Will pay well for a good one. Leroy Sparks, W6SYC, 924 W. Mc Fadden Ave., Santa Ana, CA 92707. (714) 540-8123, leroysparks@earthlink.net

WANTED: SW3 #33A and #35 coils. I will trade my extra coils SW3 coils. Hank Bredehorst, 2440 Adrian St., Newbury Park, CA 91320. (805) 498-8907

WANTED: Long wire ants AT101, AT102, GRC-9; DY88/105; PP327GRC9; counterpoise CP12 & 13 GRC9; BC348 pwr conn PLQ102/103. KA1ZQR, 348 N. Main St., Stonington, CT 06378.

WANTED: Globe King 500 B/C; Viking Valiant I/II; Viking 500; Heathkit Mohawk. Frank, (916) 635-4994, frankdellechaie@sprintmail.com

WANTED: National SW-3 model1, version 3. Uses 32-32 30 tubes. Dean Showalter, W5PJR, 72 Buckboard Rd., Tijeras, NM 87059. (505) 286-1370

WANTED: Collins 32V & Collins 75A series; Globe Scout; National SW54. KBØW, CA, (916) 635-4994. frankdellechaie@sprintmail.com

WANTED: Hallicrafters SX88 or SX115. Larry Redmond, 413 Bedfort Dr., Duluth, GA 30096. (770) 495-7196

WANTED: Coils for National 1-10 rcvr or info so I can duplicate. Norm Hall, W6JOD, normiehall@aol.com

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: I wish to correspond with owners of National FB7/FBXA/AGS coil sets. Jim, KE4DSP, 108 Bayfield Dr., Brandon, FL 33511. j.c.clifford@juno.com

WANTED: Parts for a TMC GPT-750 xmtr. I need the AM modulator deck and other parts to restore this unit. John, KF2JQ (716) 873-0524 jprusso@acsu.buffalo.edu

WANTED: Collins 30K1 xmtr; also need orig manuals & literature for 75A1, 32V1, 30K1. Paul Kluwe, W8ZO, POB 84, Manchester, MI 48158. (734) 428-2000

WANTED: Tektronix memorabilia & promotional literature or catalogs from 1946-1980. James True, N5ARW, POB 820, Hot Springs, AR 71902. (501) 318-1844, Fx 623-8783, james.true@ibm.net

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: For Yaesu FT-301: digital display, YO-301 monitor scope. Doug Sanders, W3FYA, 8923 Reisterstown Rd., Baltimore, MD 21208. (410) 484-1103

WANTED: Desk KW low voltage screen xfmr. Bob, KL7HDY, AK, (907) 346-1044

WANTED: Schematic needed for Hallicrafters S-40 rcvr. A. McGinnis, WA2DTQ, 793 Queens Grant, Hilton Head, SC 29928

WANTED: Crystal calibrator for NC-300 or 303. Dave, K9HDQ, IN, (765) 354-2884.

WANTED: DC ammeters, aircraft instruments, panel meters; meter books & gauge catalogs; photos of meters & control panels. Chris Cross, POB 94, McConnell, IL 61050.

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FOR TRADE: Two good RCA 833A's for one Taylor 833A; also looking for Taylor 204A, 813, TR40M. John H. Walker Jr., 13406 W. 128th Terr., Overland Park, KS 66213. (913) 782-6455, jhwalker@prodigy.net

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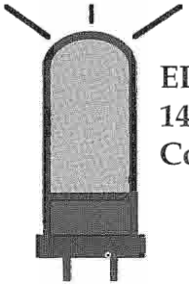

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