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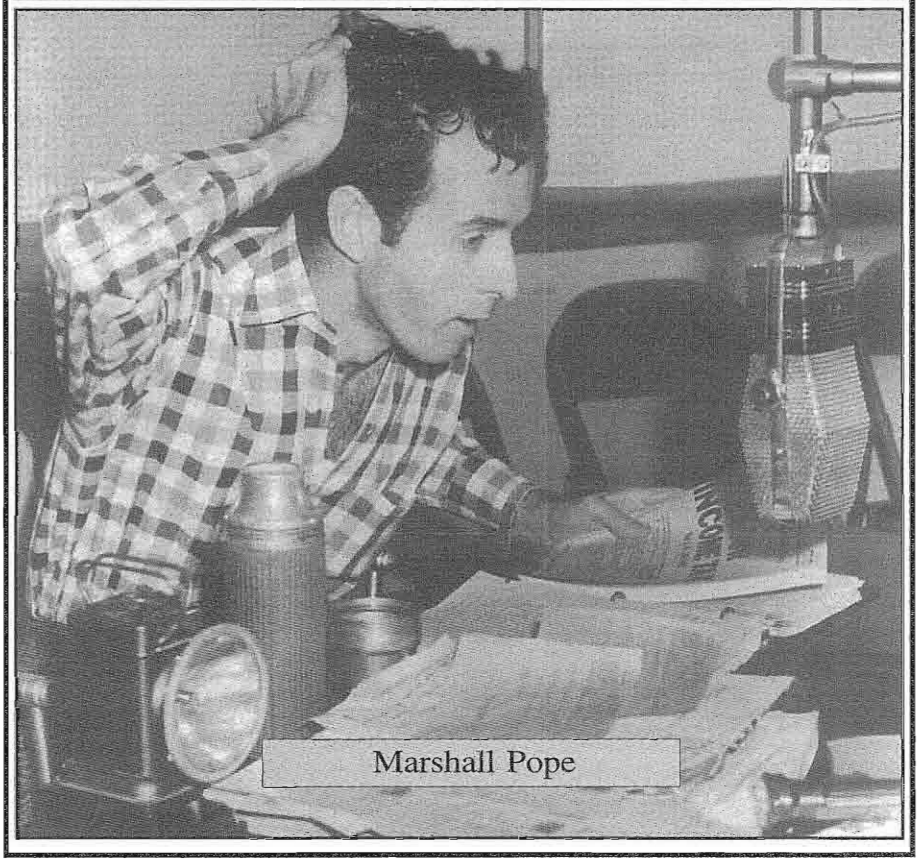
ELECTRIC RADIO

celebrating a bygone era

Number 163 December 2002



Marshall Pope

ELECTRIC RADIO

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Electric Radio was founded May 1989 by Barry Wiseman, N6CSW. The magazine continues publication 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 and operating with a primary 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); Chuck Teeters (W4MEW); Bruce Vaughan (NR5Q); Bob Grinder (K7AK); Jim Hanlon (W8KGI); Brian Harris (WA5UEK); Tom Marcellino (W3BYM); John Hruza (KBØOKU)

Editor's Comments

Season's Greetings and best wishes for 2003 from Electric Radio Magazine!

One of the last of the American electronic manufacturers has joined so many other "fallen flags" and has been dissolved. Long a recognized name with radio amateurs and electronic experimenters, EICO equipment was once a familiar sight on many workbenches. Along with the Heath Company and Allied Radio, ECIO was known for dependable, affordable equipment. According to a Dunn & Bradstreet report obtained at the ER offices, EICO Electronic Instrument Co. Inc is incorporated to sell and mortgage property. According to the report, "...prior to this time, the company used to design, produce and distribute electronic test instruments and security devices. The shareholders of the company have approved a plan of liquidation on May 28, 1999. The liquidation is expected to be complete by December 31, 2002." Their incorporated address was Eico Electronic Instrument Co., Inc., 853 Broadway #2100, New York NY.

There are many special vintage operating events taking place in December that will appeal to AM and CW operators, and to SWL's. Richard, W0BVT, has announced that the annual "Santa Claus Watch" will take place on Christmas Eve, December 24th, on 1985 kcs. Net control is Jim (WA0FBQ), with assistance by Doug (WB4TFQ), and Dick (W0BVT). Start time is 7:00 PM C.S.T. (0100Z) and anyone just wanting to stop by and say hello is welcome. This is a very informal, just for fun, non-competitive event. They will be operating AM, but will make every effort to acknowledge anyone who checks in. Here at ER, we are still trying to find out if Santa runs Gonset Twins, or does he use a sled-mounted dynamotor? We do know that he is an AM'er from way back.

The annual Electric Radio Magazine sponsored Heavy Metal Rally event will be held the evening of December 28th. Bill Kleronomos (KDØHG) is the event coordinator. This is not intended to be a traditional ham radio contest, but should be considered a night

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Cover: Marshall Pope, The Old Nightwatchman, taken at the Texas State Network Studios in Fort Worth, 1939

December West Coast AMI Update

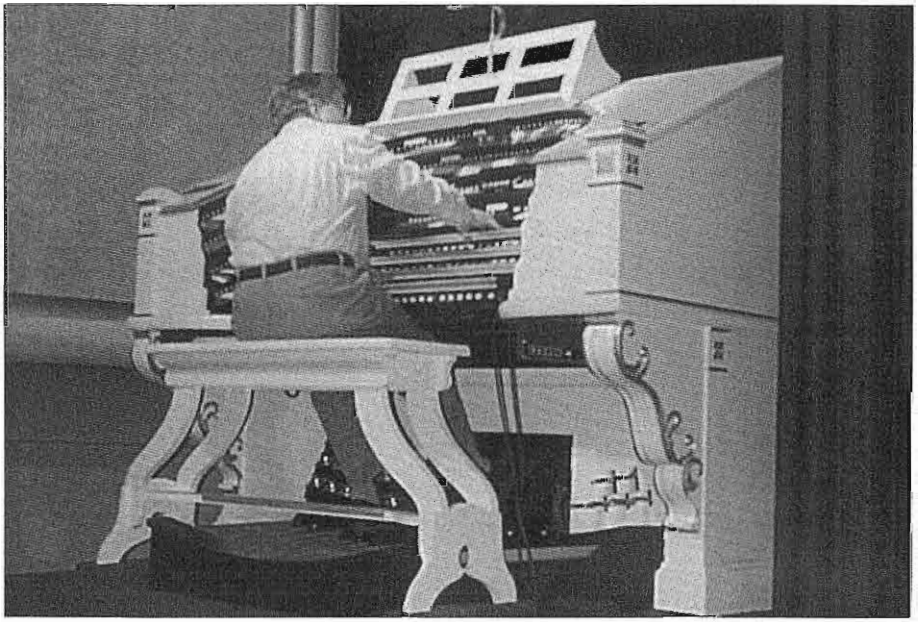
By BILL FELDMANN, N6PY
n6py@qnet.com

On Saturday, Nov. 23rd, about twenty West Coast AMI Net members gathered at the Bay Theater in Seal Beach California to see a beautifully restored Wurlitzer organ and hear it played by Bob Heil, K9EID. This organ was built in 1928 for the Times Square Paramount Theater in New York. It was completely restored by its owner, Richard Loderhose. Richard also purchased the Bay Theater as a home for the organ.

This is one of the few working theater organs in existence today. Words cannot describe the sound from this beautiful instrument. It can reproduce the sounds of many other instruments; remotely play a piano, symbols and drums, along with reproduce frequencies down to 160hz. Additionally, Bob really knew how to get the most out of this instrument and gave an excellent demonstrations if its features. Bob is a highly talented organist and started playing theater organs when he was just 15 years of age; about the time he got his ham ticket. Richard Loderhose gave us a tour behind stage so we could actually see how this air organ worked and how much work went into its restoration and just keeping it working. Many thanks to Richard and Bob for giving us in the AM community the opportunity to see and hear this very rare and beautiful instrument.

Here on the West Coast the skip has been very long in the 75 meter AM window at night causing many of us to QSY to 160 meters at night for local QSO's. Many of us are using this long skip to

[Continued on page 41.....]



Bob Heil (K9EID) goes to work on the keyboard for AMI members at the Bay Theater in California, November 2002.

Real Audio For AM

By Bill Kleronomos, KD0HG
Rocky Mountain AMI Director

As many AMers move into the real radio world of using converted broadcasting equipment, I thought a quick hands-on primer on the ins-n-outs of broadcast audio might be in order within the friendly confines of the pages of ER. By no means can this be a fully comprehensive article because audio processing is a lot like making spaghetti sauce or chili. Everyone has their own recipe and tastes. I've found there is no such thing as a plug-n-play approach; if there were, every radio station on the dial would have stunning fidelity and hair-blowing loudness. Certainly, that's not the case, even with a "professional" radio budget.

THE GOES INTAS AND THE GOES OUTAS

The audio path into traditional ham gear has always been different from that that used in the professional audio field and uses completely different standards. Amateur and consumer audio gear is set up with a single-ended, unbalanced audio path that runs in the few millivolt range, up to maybe -10 dbm.

As a point of reference, 0 dbm refers to the voltage required to develop 1 milliwatt across a 600-ohm load. That calculates out to around .775 volts, RMS, so a –10 dbm consumer level would be close to a quarter of a volt, RMS.

Audio levels used with professional audio gear are considerably higher, offering much better noise immunity. Most gear these days is made to operate with either the +4 dbm or +8 dbm pro audio standard. This is referred to as "Line Level". The other standard that's important to us here is "Mike Level", which runs around –40 dbm.

HOW MUCH?

Even in this 21st century, the best way to measure analog audio levels is still with an analog meter. The industry-standard Simpson 260 is still made, 1950s-1960s vintage Triplett, Heath, Knight, and Simpson VOMs are commonly available at flea markets, garage sales and hamfests. Almost all of them have AC meter scales directly calibrated in db across 600 ohms, which makes audio measurements a no-brainer. There's a lot of surplus HP test equipment out there for those with deeper pockets.

One other essential for setting up audio processing and AM transmitters is a good audio generator, and owning an HP distortion analyzer like the model 330A is a definite plus. In addition to this simple gear, many of the better-equipped broadcast facilities have the audio generator and analyzer set made by Potomac Instruments. The Potomac AA-51 series of meters will do everything but butter your toast; in addition to making absolute level measurements, you can make individual measurements of THD, IMD, S/N, analog tape wow and flutter, all on a fast responding autonulling meter. If you can find one at an affordable price, grab it!

TYING IT TOGETHER

By definition, a balanced, 600-ohm pro audio system uses balanced cabling and connectors. A number of companies manufacture single and multiple pair shielded cable, a quick look at the catalogs of parts houses will turn up plenty of examples. As opposed to the unbalanced audio systems we're familiar with from consumer electronics, the use of shielded cable is usually unnecessary for indoor wiring at line level; the common-mode noise immunity of modern pro audio gear is amazing.

You can walk into almost any radio station and find interconnections done with nothing fancier that standard twisted pair telephone wire; and in many cases the same can be done in the home ham shack. You can even use 18-gauge zip cord from the local hardware store!

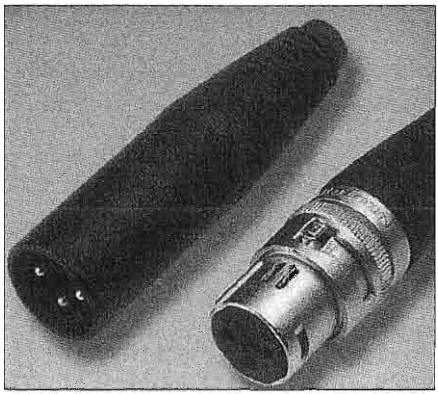
Yes, there are fancier cables than zip cord used with mike level audio levels and that's the only place where the use of a shielded cable is mandatory. Probably the ultimate mike cable is called "Star-Quad" and made by a company called Canare. It's not cheap at almost fifty cents a foot, but it's amazing stuff, using four conductors in a double-balanced configuration within a real braided shield. It's highly durable, flexible, kink-resistant and comes is a rainbow of available colors, useful in studio situations where a bundle of wires might snake around a facility and fast identification is necessary. Belden also makes a similar cable under their part #1192A. This double-balanced cable is so good that you can run it right next to the whip antenna of a 30-watt VHF or UHF "Marti" transmitter used for remote broadcasts and have no RF pickup at all into sensitive microphone preamp circuitry.

Using low-Z balanced audio wiring has another benefit- the ability to use extremely long microphone and line-level audio cables before losses. Noise and high frequency roll off then become a problem. It's not uncommon to use microphone cable that are several hundred feet long, for example, and still have virtually perfect broadcast audio. Try *that* with a D-104!

CONNECTORS

There's two common connectors in use with pro audio gear- the three-pin XLR style and the three-conductor stereo, tip-ring-sleeve style of ¼" plug. It couldn't be easier.

Compare that to the multiple, confusing and often hard-to-find styles used with consumer electronics and traditional ham gear. Japanese radios use an assortment of their own four, five and more pin connectors, American gear, especially our beloved boat anchors have used at least a dozen different styles and types of audio connectors and standards that I can think of, a number of which are getting pretty tough to find.



A typical 3-pin XLR connector as described in the text

There are very simple wiring standards used with pro audio:

If one is using an XLR connector, the balanced pair connects to pins #2 and #3; pin #1 is always cable shield and chassis ground. If you're using the ¼" style of connector instead, the balanced pair connects to tip and ring, the cable shield connects to the sleeve. One more thing, the pins on an XLR cable always "point" towards the direction of audio signal flow; the **output** jack of a mic or a piece of electronics is always a male connector, the **inputs** to a piece of gear are always female connectors, so under normal circumstances, the only XLR cables ever required around the station would be those with a male on one end and a female on the other. As I said, it couldn't be easier!

MICROPHONES FOR AMATEUR AM USE

This is as subject as open to opinion as anything out there, but I'll try to address general questions and confine the dis-

cussion to popular and economical broadcast-style microphones that most of us can afford to use.

Over the years many microphone designs have been used in broadcasting, from carbon microphones in the earliest days, to the superb sounding ribbon mics popular in the mid-20th century, to the modern dynamic and condenser mics. While popular with amateurs, there are several microphone designs that never made it into broadcasting- these include the crystal and related ceramic styles and the more modern inexpensive and compact electret element most commonly used in the two-way radio field; FM walkie-talkies, telephones and answering machines.

The differences between the different designs can be pretty much summed up by our desire for the accurate transformation of sound waves carried in air into electrical currents. Regardless of type or brand, the use of a unidirectional cardioid pattern is almost essential for managing background noise, room echo and acoustic feedback when the audio is run through broadcast-style high-gain compression or other processing. Trying to process the output of an omni directional microphone and have it sound decent can be a true exercise in futility!

Let's take a look at some of the pros, cons and useful characteristics of the different flavors of today's pro and semi-pro microphones.

CONDENSER MICROPHONES

The condenser microphone is probably the ne plus ultra of modern microphone design. Used by both broadcasters and in the recording studio, condenser mics can range from near $100 to many, many thousands of dollars. Modern condenser designs possess a number of valuable virtues: Extremely low distortion and a tremendous sensitivity to audio detail and the subtle nuances of voice and instruments. They are renown for their uniform frequency response, low distortion and clarity when reproducing transient sounds. Condensers are the first

The famous Neumann U87 condenser microphone which is noted for it's nearly perfect reproduction characteristics.

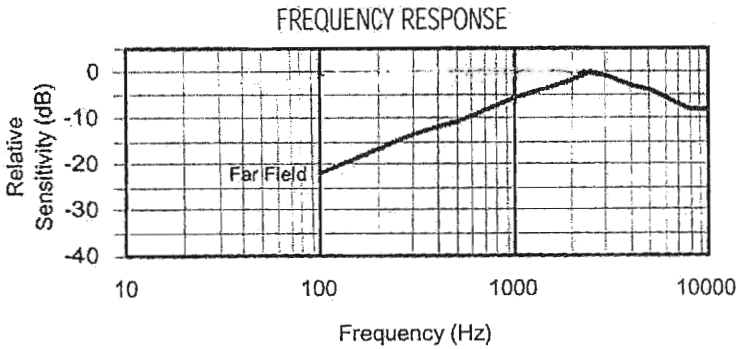
choice in many studios for recording female vocals and acoustic instruments- one not only hears the sound of a plucked guitar string, but you can clearly hear the musician's fingers manipulating the string and the pick plucking it. In my opinion, the most "real" sounding microphones out there.

In general terms, condenser microphones are made using a lightweight membrane and a fixed plate that act as

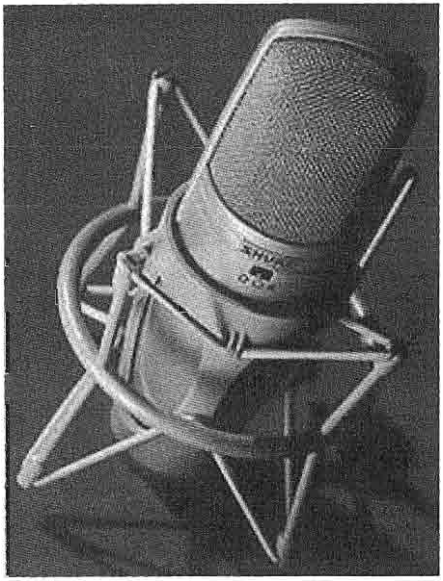
The Shure KSM-27 which is sold as an affordable studio cardioid condenser microphone

Another good looking affordable condenser mic is the Audio-Technica

opposite sides of a capacitor. Sound pressure against this thin metalized polymer film causes it to move. This movement changes the capacitance of the circuit, creating a changing electrical output. Most true condenser microphones need a 48-volt DC source of power to operate; this voltage is referred to as "phantom power". It is generally fed to the microphone through its output cable with the use of decoupling networks. You cannot use most true condenser microphones *without* a preamplifier that can provide a source of phantom power, so check first before considering one. One other thing to remember about condenser mics is that they tend to sound the same regardless of how closely you talk into them, having minimal "proximity effect". For



Above, the frequency response of a high quality electret hand microphone element. The facing page has the curves for the EV RE-1000 cardioid condenser mic.



The Shure KSM-44 is an example of a top-of-the line studio condenser mic featuring multiple pattern selection.

many people, the effect of listening to your own voice on a condenser mic can be almost un-nerving; there can be almost too much detail!

Perhaps the most revered studio condenser microphone out there is the Neumann U87. Manufactured since the mid-1960s, their current retail price runs around $2,500.

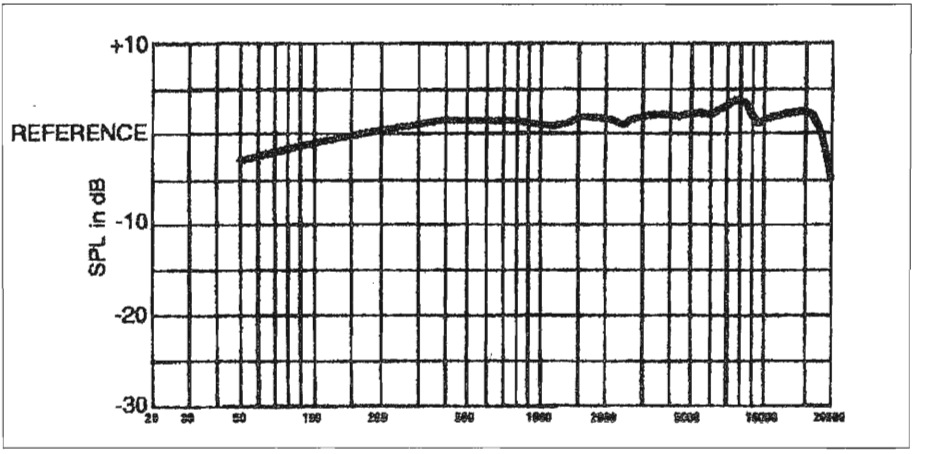
Studios occasionally send them out for aftermarket modifications, which can add several thousand dollars more to the price. Historically, condenser microphones have been completely out of the price range of the hobbyist, but there are now several lower-priced models on the market that are considerably more affordable.

While both Germany and Japan have traditionally been big players in the manufacture of condenser microphones, the Chinese have recently become a major manufacturing source and have brought the price of decent condenser mikes down into the affordable realm.

There is the Marshall MXL 603 condenser at $155, and the Rode NT-1 at $199, among others. Both have desired cardioid patterns.

THE ELECTRET MICROPHONE

The electret is nothing more than a simplified condenser mike, the principle difference it that the plates of the mike element carry a permanent electrical charge, much as a magnet carries a permanent magnetic "charge". Because of this, no external polarizing voltage is required to make the element work, but like its condenser mike cousin, the output is low and a low-noise, high-Z preamp is required to make one play. This preamp is frequently built into the mike cartridge itself.



Here is the reasonably priced, classic Electro-voice RE-1000 supercardioid condenser microphone.

The principal advantages to the electret element are low cost, small size and being able to be easily mass-produced. They are typically used is consumer applications ranging from telephone answering machines to FM walkie-talkies where their compactness and low cost are useful virtues. Historically, their main disadvantages have been a 'peaky' audio response, rather high distortion and substantial roll off at lower audio frequencies. A diaphragm the diameter of a pencil eraser simply won't have much bottom-end response! Electret elements are generally classified as omni directional elements, but they can be used in an enclosure that imparts some directionality.

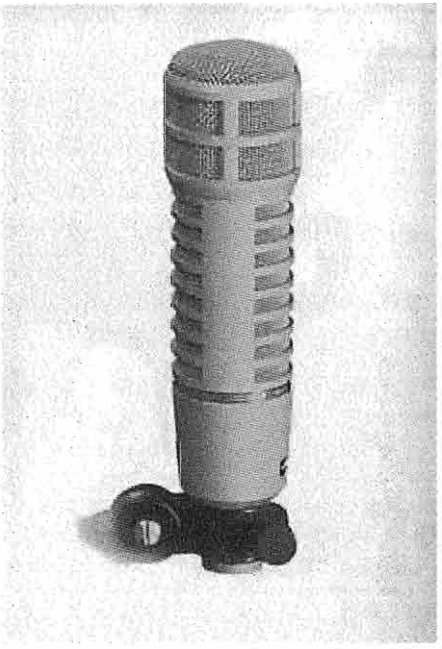
THE DYNAMIC MICROPHONE

Dynamics are the workhorse of the broadcasting world. Manufactured in an astounding variety of designs, a dynamic mike can be specifically designed for almost every application.

Dynamic mikes are nothing more than small electric generators, a coil of wire

The Sennheiser 421 dynamic cardioid microphone

attached to a diaphragm moves through the field of a small, powerful magnet generating a small electric current. The output of most dynamics is inherently low-impedance, ranging from as low as 50 ohms through the low hundreds of ohms. This property is useful as their low source impedance permits them to



Here's an affordable, quality dynamic cardioid, the Electro-voice RE-20

be used with very long lengths of balanced mike cable without significant sonic degradation. In broadcasting, microphone cord lengths of up to several hundred feet are occasionally used.

In addition to being highly durable and shockproof, dynamic mikes are made in an incredible variety of patterns and audio responses.

Some of the better ones, such as my favorite Sennheiser 421 have a switch built in to adjust their frequency response.

The directionality of dynamic mikes is largely determined by the design of the mike housing. Schemes such as ports and vents are used along the sides of the element, carefully tuned so that the pattern remains the same over the entire audio spectrum. In general, the longer the housing, the more directional the mike can be made. An extreme example of this is the "shotgun" mikes used to broadcast sporting events or to pick up specific sounds a long distance away.

There are other factors involved as well. For example, most of the Shure dynamic mikes such as the SM-7 and SM-57 have a great deal of proximity effect. Talking closer, almost 'kissing' the element greatly accentuates the bass response. A good radio DJ will take advantage of this and 'work' around the mike. Many of us have seen film of the best DJs working in their studios. Watch guys like Don Ingram, Larry Lujack, and the legendary Wolfman Jack and even today's Howard Stern. They'll scream, rant and dance around that mike, but when they want to make a point they'll come up close and talk softer, bringing up that bottom end and sounding like God in a 1960s Charlton Heston sandals-and-swords movie.

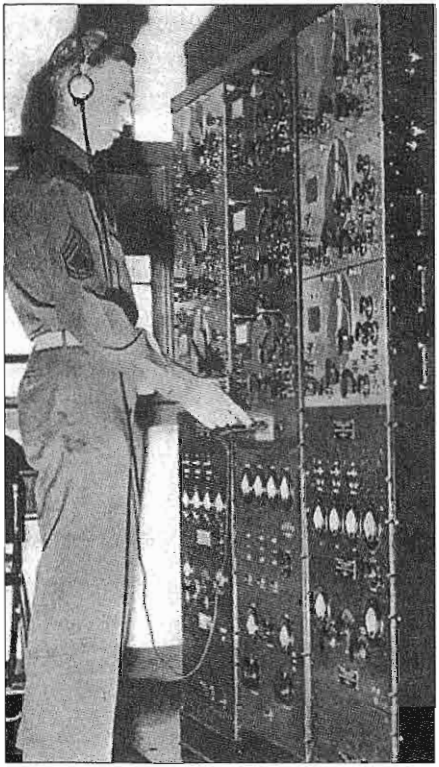
On the other hand, dynamics like the Electro-Voice model RE-20 have very little proximity effect by comparison; they sound pretty much the same regardless of operator distance. This makes them a very good choice for situations where several people might be sitting around a table during a radio talk show or newscast.

You can find a huge variety of dynamic mikes in almost every catalog that deals in broadcast or musician's supplies, and in a limitless price range. One overlooked source of inexpensive mikes is often the local music store or musician's hangout. Garage bands are constantly breaking up and their equipment often ends up for sale a bargain prices. Check out the musician's bulletin boards in these stores for the occasional bargain!

Well, that pretty much covers the front end of a quality AM station. The next installment of this article will cover mike preamps and audio processing. *Stay Tuned!*

[Editor's note: Bill will present part two of this article in a future issue of ER.]

ER

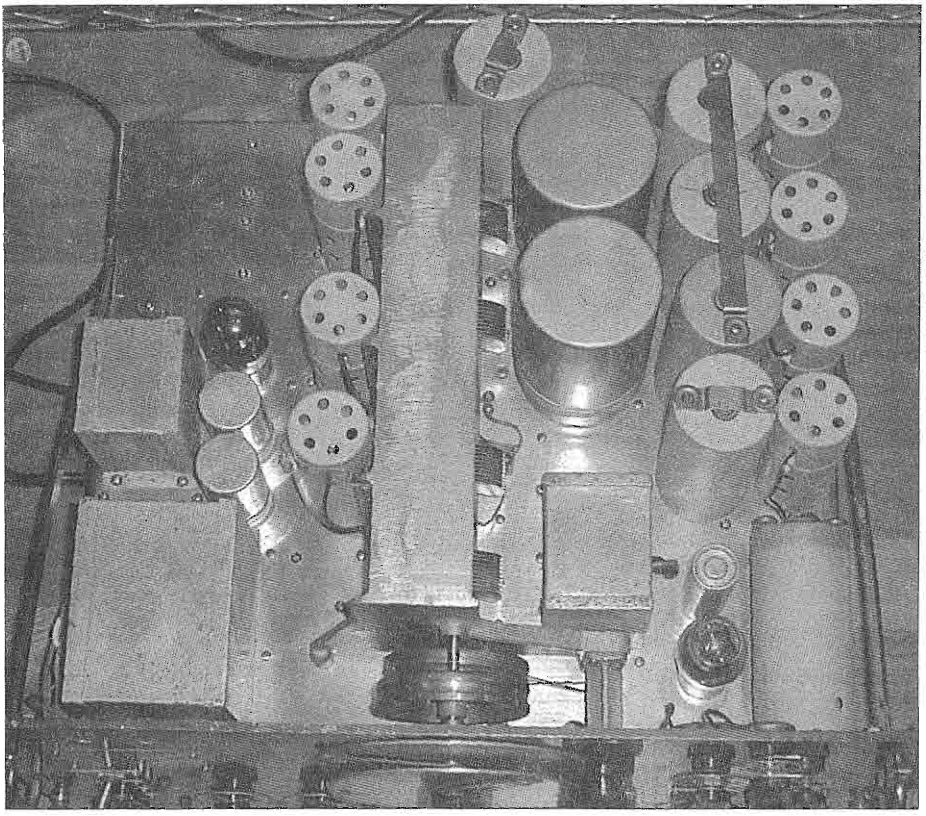


What this photo lacks in quality, it makes up in rarity. According to Chuck Teeters (W4MEW), it was probably taken at RCA in the Plant Engineering Agency about 1940. The Tech Sergeant is probably from the Army Ground Forces assigned to Ft. Monmouth, and he is standing in front of Schutting diversity mixing circuits that were being tested for use with the AR-60's. The Shutting's were used for CW, but not for RATT because of phase distortion on the circuits. Each Schuttig had four input channels (the four top meters) and two combiner level meters (the lower meters). They were used on army high speed automatic CW circuits and early 850 cycle shift RTTY. The Shutting equipment was replaced by AN/FGC-1 during 1944.
[Photo courtesy of Bart Lee, KV6LEE, and the AWA Review]

tuning and bandpass tuning, each with a pointer indicator and a 0-100 logging scale. The manual provides an approximate conversion table. We take calibrated dials for granted these days.

Physical construction of the rig is top-notch. The chassis is plated steel, and the ganged tuning condenser is held to the chassis by a large casting for mechanical damping. The power transformer, choke, and audio transformers are potted and enclosed in plated steel. The air core transformers are encased in shielding cans. All tubes and adjustable transformers are in aluminum shields. Even the tops of the adjustable cans are fitted with twiddle stoppers. You can fill these dish shaped washers with wax, to prevent unauthorized adjustment. Virtually every tube socket and inductor is ceramic for low signal loss. Every part is easy to get at and service.

The manual that I got with it, details all operations, and gives a significant and very technical noise analysis of the receiver, covering several aspects that are not well understood by most hams today. Reading it gives new insight into how technically advanced the state of the art was in the mid 1930s, and suggests that the rig was not empirically built, but carefully designed to particular specifications. The first customers were the U.S.C.G. RCA used the AR-60 in-house at their own facilities. A few were sold to very "well to do" hams. The sale price of $495 was almost completely prohibitive, and so it was not a commercial success. Following usual practices, they may have been able to write off the design costs to the original contractor, but the materials expense kept the price high. [Editor's note: If a person were lucky enough to have a steady job in 1935, you might make $30.00 a month. At that rate of pay, you would have to do without anything else for over a year to get an AR-60. In today's money, this receiver would cost over $53,000. It is little wonder that there are few known examples of



Top Chassis view showing extreme shielding around all components and the bronze castings supporting the tuning condenser. Equipment of this quality was only built for a few more years, and certainly will never be seen in production again.

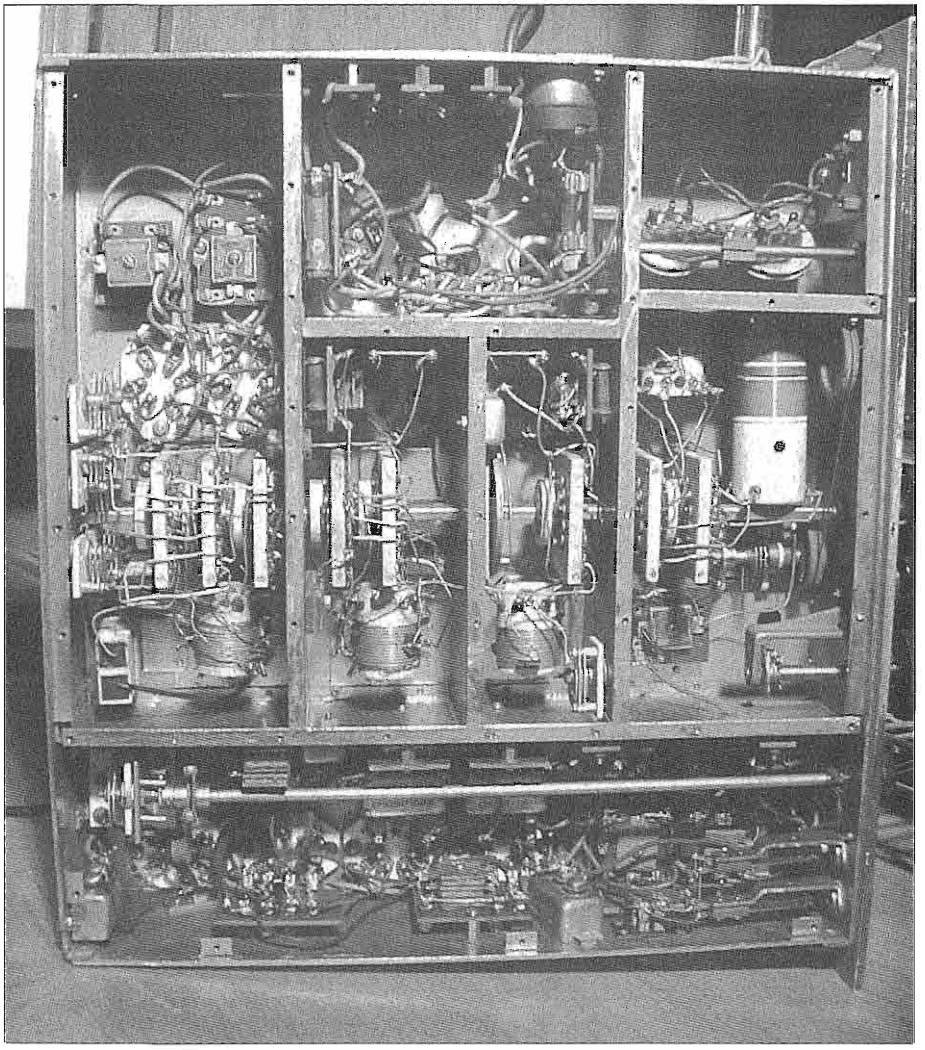
the AR-60.]

Physical Construction and Electrical Performance
(Contributed by Ray Osterwald, N0DMS)

Physical Construction

The chassis is flanged on all four sides, and is attached directly to the front panel. This method actually forms part of the RF shielding system. Under the chassis, there are five shielded partitions that contain the major stages in the receiver. These compartments contain the variable antenna coupling coils, the RF coils, the band change switches, tube sockets for the HF oscillator and mixer, and the filters for all of the power supply leads. The bottom cover for the receiver is nickel-plated brass.

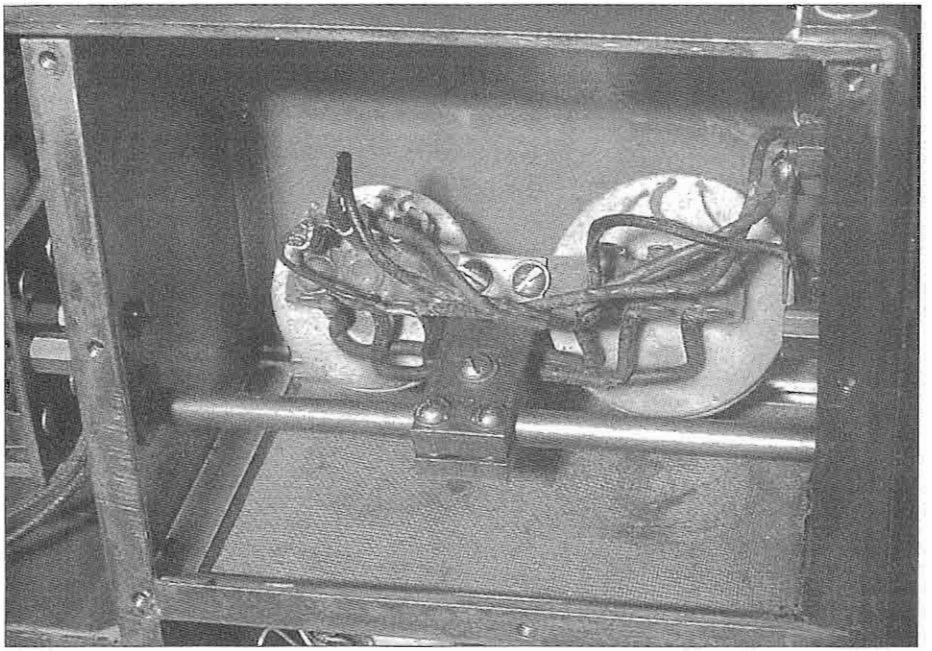
The main tuning capacitor is a four-gang unit, specially built for stability and long service life. It has two shafts and two controls, with the capacitor mounted on a plated, cast bronze frame with three-point suspension from the chassis. These tuning shafts are mounted one above the other, with the lower one carrying the four main condenser sections, and the upper carrying the bandspread sections. All of the stator sections are mounted on Isolantite insulators. Even the grid cou-



Here is the bottom view of the main chassis showing the six main shield compartments and the unbelievably high quality band switch.

pling condensers are mounted on Isolantite standoff insulators. The capacitor shaft is driven with a tuning cord arranged to provide a 9 to 1 reduction from the front panel control shafts. These shafts run in bronze bearings. Each control shaft sticks through the front panel and carries a pointer that reads out on a stationary dial on the front panel.

The band switch is exceptionally high quality. Each switch section has its own rotor bearing. Both the stator plate and the rotating contact supports are made from Isolantite. The physical design of the switch contacts was intended to be self-cleaning and to maintain low contact resistance for long periods, which is now going on 68 years. The Isolantite stator plates have heavy, silver plated surface studs. Rotating springs make contact with these silver studs, and solid silver switch contact buttons are riveted



The variable antenna coupler is in an electrostatically shielded compartment with the coils mounted on Isolantite bases. All hardware is plated. The front panel is to the right in this view.

to the contact springs. No connections are made through the switch bearings, so the shaft is isolated from RF currents.

The I.F. transformers are wound on Isolantite forms, which are mounted on Isolantite bases.

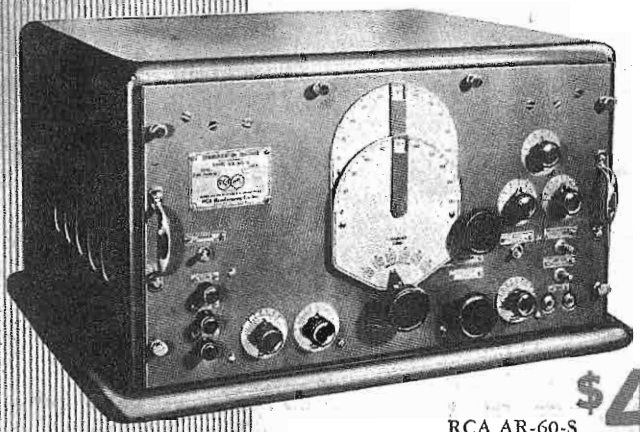
The crystal filter is also specially made. It is completely insulated with Isolantite and shielded at the rear of the chassis.

Throughout the receiver, all of the materials in its construction were selected to produce very long service life. No iron is used except where necessary, for example in transformer cores. Every point that needs RF insulation is made from Isolantite. All other insulation is made from high-grade cloth-based Bakelite. The audio transformers were designed to survive immersion in salt water. The cases for all the transformers were made of double cadmium plated steel. Every part that was of brass or bronze is nickel plated, and every aluminum surface was lightly sandblasted during manufacture and coated with clear lacquer. The overall weight due to all of this unbelievably high-quality construction is 72 pounds.

Electrical Performance

The AR-60 was designed in the 1933-1934 period and was offered for sale by late 1935. In the 1930s, RCA kept an iron-like grip on its superhet patents because of the many advantages in the superhetrodyne principle. The later production Tuned Radio Frequency (TRF) receivers were actually quite good designs, and the early supers had problems competing with them because of I.F. images and spurious response. The TRF had none of these problems because they had no local oscillators and no I.F. amplifiers. RCA engineers had to find a way to compare differing superhet receiver designs, and two new test standards were

For those whose requirements are most exacting



$495

RCA AR-60-S
Rack mounting, $475; black ripple-finished case, $485. Amateur net prices, f.o.b. factory.

The new RCA AR-60 Receiver is built to meet the rigid requirements of commercial communication companies, and represents the ultimate in a general purpose high-frequency receiver. It is offered to those amateurs who can be satisfied only by the best available equipment. Available through your authorized sales outlet. Descriptive folder sent free on request. Send 25¢ in stamps for Service Notes and Operating Instructions, which give detailed specifications.

AMATEUR RADIO SECTION

RCA MFG. CO., CAMDEN, N. J., A SUBSIDIARY OF THE

RADIO CORPORATION OF AMERICA

The rear cover of November 1935 QST. Only $495.00 !

invented. These were called the Noise Equivalent and the Image Ratio. The variable antenna input coupling circuit, unique to the AR-60 at the time, gave the radio operator direct control over both! Today, we use a high IF and simply feed the mixer output into a good crystal or mechanical filter to avoid such problems. These filters hadn't been invented in 1934.

The Noise Equivalent was a way to compare the noise levels of different receiver designs. What it did was to find the signal input voltage that produced the same audio output voltage as did no-signal receiver noise. Here is how they did the test: An output meter was connected to the receiver audio output terminals. The "sensitivity" control, which is a pot in the cathode circuit of the first I.F. amplifier, was adjusted until the meter shows some arbitrary deflection. Because of the high-performance linear detector in the AR-60, RCA could compare high and low level input signals in a linear relationship. For example, assume that the receiver noise that produced some meter deflection was .5 volt. Also assume that the same rig produced 3 volts of audio with 1.2 microvolts of input signal. By equaling the voltage ratios directly, an engineer could determine that an input of .2 microvolts would be equal to receiver noise, and that any signal above .2 microvolts would therefore be above the circuit noise. This became their receiver noise "yardstick". What is noteworthy is that the AR-60 an extremely linear response in the detector due to expert circuit design. The BFO is located ahead of the detector, in one section of the 6F7 1st audio. BFO voltage is bottom coupled to the last I.F. transformer. This arrangement provides high isolation and very light loading of the detector by the BFO.

Briefly, the Image Ratio test describes the numeric ratio between two voltages. It is the ratio between the input signal level that is required to produce a standard audio output voltage at the image frequency, and the input voltage required to produce standard output at whatever frequency the rig is tuned to. Standard output was whatever the designers proclaimed; it was hardly an accepted industry standard. In early superhet design the engineers had to find the right combination of I.F. frequency and the number of tuned RF stages to get rid of images. In a broadcast set, an image ratio of 20,000:1 is possible with a 455 kc I.F., if two tuned RF circuits are used ahead of the mixer, or "1st detector" as it was called. Today, we would specify the image rejection in decibels, which in the case or the AR-60, would be around 86 dB.

By careful manipulation of the front panel antenna coupling control, the radio operator had direct influence over the receivers' image rejection. It had a 9 dB range of control over image ratio. The drawback was that noise was inversely proportional to the control setting. With the control set for maximum image rejection, the signal to noise ratio would be degraded by over 18 dB.

The RCA AR-60 is evidence that high-performance receiver design certainly did not begin in the 1950's. It is unfortunate that the hard times of the 1930's prevented most amateurs from experiencing equipment this well designed and built.

Additional Reading:
AWA Review, Volume 15, 2002 by Bart Lee
AWA Old Timer's Bulletin, November 1988, p.27 and related letter, February 1989 p. 42
AWA Old Timer's Bulletin, by Bob Haworth (W2PUA), February 1996
Also thanks to Ludwell Sibley (KB2EVN)


ER

The Globe Champ 150
The Little Transmitter that Time Forgot

By Steve Marquie – W8TOW
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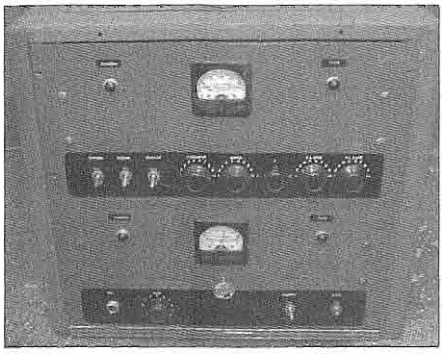
After WWII, "factory-made" transmitters were in high demand. Perhaps it was because so many pre-war homebrew transmitters were disassembled during the war, but also many people were ready for something new. Several companies offered rigs: Harvey, Temco, Collins, Hallicrafters and WRL to name just a few. The majority was pre-war design using parts from war surplus. The WRL Company was one of the many companies that bought up "truck loads" of the war surplus and offered it to the amateur community.

By 1948, the desire by most amateurs was to own a tabletop transmitter with all of the modern features.

Let's just consider these features. Highly desirable would be break-in CW, PTT, VFO, band switching, full metering, and 50-ohm output. Cost, size and performance were also issues. Leo Meyerson, founder of World Radio Labs was a good salesman and offered the amateur community just what it wanted after WWII. Ads in QST during 1948 featured the "Globe King 275" and in October of that year, the Globe Champ selling $150 less than the King. One look inside an early Globe Champ will reflect the abundance of war surplus components. A recent discovery was a couple of the early Globe Champs, which used a Taylor TZ-40 in the final and only a pair of 6L6's as modulators. After 1948, WRL engineers presumably made a design change, because the final amplifier tube was an 812A and the modulators were four 6L6's in push-pull parallel!

So just what was inside the Champ

Restored Globe equipment at W8TOW with a King 400 flanked by a pair of Champs. The Champ on the left is a 1st production run, and on the right is a Champ 175. These are some of the best sounding rigs around.



Front view of the Champ

and how was it constructed?

The Champ 150 (Champ 165 and Champ 175) was physically two deck versions of a Globe King 400. The top deck was the HV/LV power supply and RF deck. The lower deck was the modulator and its power supply. Differences between the four different Champs were mainly in tube selection, although the transformer selection in the 1948 version was also unique. Let's take a closer look at these "old buzzard" transmitters.

The RF section

The RF section, after the first production run, was only changed once. The tube line-up in the GC-150, 165 and 175 began with a 7C5 (octal version of the 6V6) in the hot cathode colpitts oscillator. It was chosen for this transmitter and the Globe King 400 series because it is more stable than the 6V6 as an oscillator. Driver tube is a 2E26 and the final is an 812A triode. All stages are parallel tuned with B&W plug-in coils except the final's grid coil. This is a hard to find type ES (variable end link) BUD coil. The output coil is a B&W BVL, which is of the 150-watt variety. A curious note about the output tank circuit, unlike the Globe King 400's, the Globe Champs match nicely to 50-ohm coax! With approximately 1250-1300 VDC for plate, voltage at 130 mA RF output is about 125 watts of carrier. The only circuit changes in these three versions were in the power supply.

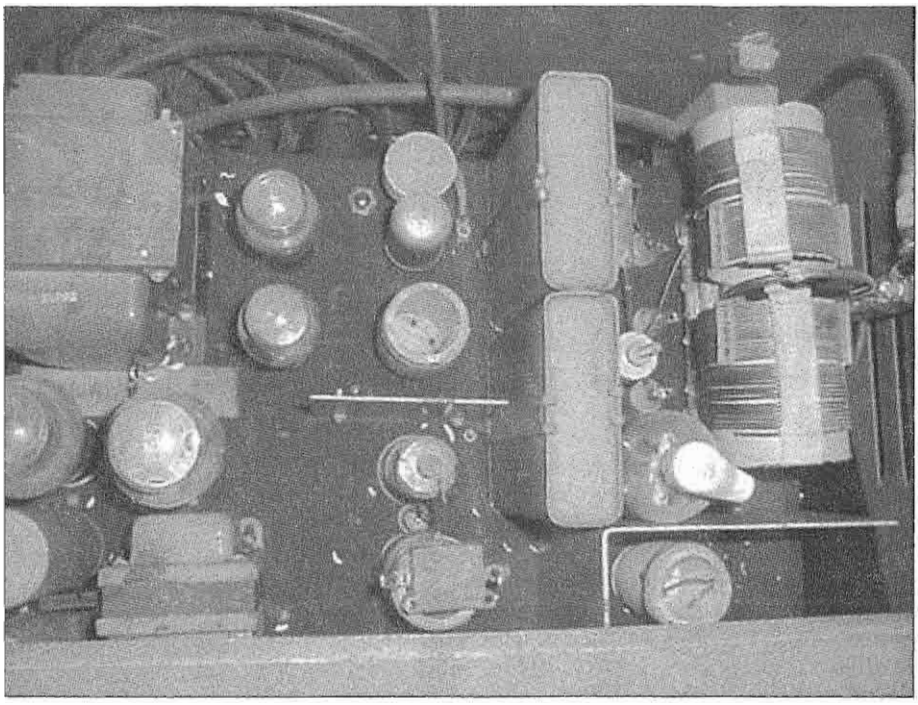
The Champ's RF deck (top) and power supply (lower).

For the final production, the Globe Champ 175 oscillator B+ was regulated off the pair of VR150's.

Modulator and Speech Amp

The modulator/speech amp/power supply is the oddity. One might think that Stu and Leo just couldn't make up their mind on how the rig was to be built. The audio starts out with a standard WRL Mic amp, the good ol' 6SJ7. Then, the designers went for two cascaded 6C5 triodes and a single-ended 6F6 driver tube for a few years with the GC 150 & 165. When the Champ 175 was introduced, the 6C5's were eliminated and a 6N7 phase inverter was used with a pair of triode connected 6F6's in push-pull for drivers.

In these three versions, Stancor iron was used, including a special A-3808 modulation transformer designed for four push-pull parallel 6L6's in class AB1. As far as the power supplies, these rigs are loaded with them! An RF bias supply, RF LV, RF HV, regulated 300 VDC, and filaments are found on the RF deck. There are a pair of 5U4's for the modulator LV,



A top view of the Champ's RF deck is shown in this view, and in the photograph on the facing page.

HV and the modulator filament supplies on the lower deck!

Now we come to the odd 1948 production run. These advertisements can be found in QST for September through December of those years. July and August issues of QST featured the "new" Globe King 275, which physically looked nothing like the GK 275 produced in 1949, as with Champ. The front panel was not a smooth finish but a two-tone wrinkle. On the inside, the RF deck begins with the 7C5 Oscillator & 2E26 driver but then ends with a Taylor TZ40 triode! Guess Leo had a few crates of the war surplus TZ40's. These tubes flooded the market after WWII. As an interesting side note, a few years ago I was fortunate enough to interview a member of the "Taylor Tube" family. He indicated that one of the several factors of which let to the demise of the Taylor Tube Company was the saturation of the tube market after the war by the government surplus. This would have depressed the value of newly manufactured tubes. Seems to me, that his thoughts might have been close to truth!

As for the 1948 Globe Champ modulator, again it is unique compared to the Champ 150-175 versions. Still an old reliable 6SJ7 as the Mic amplifier, a couple of the 6C5's, 6N7 phase inverter and a pair of 6F6's for a drivers. For the modulator tubes, only a *pair* of 6L6's is coupled to do the modulating duties! UTC "S-series" iron was chosen for both the driver (an S-9) and the modulation transformers. A peculiar note is the size of the mod iron; it is a big 110-watt S-21. Must have been a bargain! Some of the mystery remains and perhaps is best left to our imagination.

So just how does this old transmitter

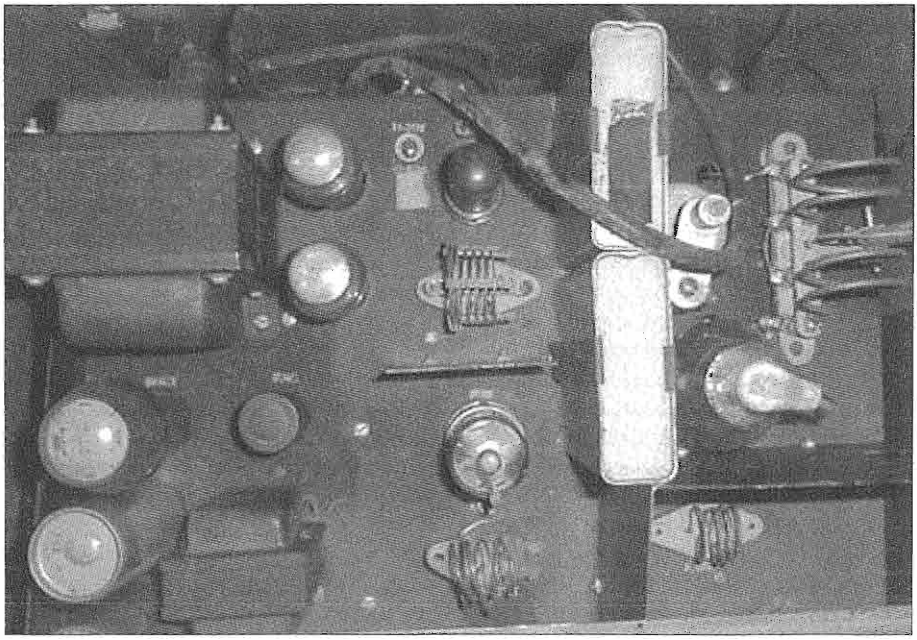
perform after about 50 years? As with all the gear found of this age, replacing all of the resistors and caps, cleaning all the tube and coil sockets, and performing a rigorous cleaning regiment on each coil is necessary if one is to expect dependable operation with it. Cap and resistors: These components may look ok after time and heat but I don't trust them During old buzzard long transmissions, the heat will rise, and count on the resistors to change value! We have all heard the routine about caps drying out. Coils and coil sockets: I like to see shiny contacts for the RF path. Plug-in coils are fine with many an AM operator who desires to operate one band. Before putting that rig on the air, do yourself and the rig a favor and check out the RF path. I even coat questionable coils with a bit of "corona dope". It will prevent that unexpected "flash-over".

Down in the modulator deck, I also recommend replacing all the caps and resistors. Same argument as before, and while you are under there, install PTT. When you are checking tubes, if new modulators are needed, check availability of 5881's and 6550's. Both make nice substitutes for the 6L6's.

[Editor's note: There are current production versions of 5881, 6550 and 6L6. Many tube suppliers have them, including Antique Electronic Supply.]

"On The Air" With A Globe Champ

These are excellent old buzzard transmitters. Other AMers are using them as exciters for larger RF decks and a few are being operated as stand alone transmitters. Unfortunately, I think there are many which are no longer with us or perhaps are forgotten in the basement. Putting one on the air is easy. Remember they are xtal controlled. A VFO or ECO (electron coupled oscillator) will work nicely. If an out board VFO is used, a keying relay will be necessary or an extra set of contacts on the PTT relay. This will do fine for receiver muting too. No additional protection is needed (in case there is a loss of grid drive), since the final has a protective bias for break-in keying.



Running about 100-125 watts Plate Modulated AM on 75 Meters at night is a bit of a challenge. Those who run Vikings, Valiants, and similar rigs at night know the frustrations with band conditions, noise and QRM at this power level. However, for casual operation these old rigs are classics!

In 1977, I was first exposed to AM largely due to the CQ Magazine article "No Harry, AM Isn't Dead". Shortly afterwards, I became active on 40 Meters AM with a Viking I and 51J-2. Someone gave me an old 1949 ARRL Antenna Handbook, which featured a WRL Globe Champ advertisement on the last page. In my youth, I found myself fascinated with the Globe Champ, and this fascination has lasted over 30 years. In the W8TOW shack I have been fortunate to have currently two of the Globe Champs. One of them was acquired a couple of years ago as a recovery from apparent military service. It had been used during the early 1950's as a long-range ground control transmitter in the western USA. Factory modification included: PTT, antenna changeover relay and receiver muting. It is fully restored and mated with a National NC-173 receiver. I use it often to check into the Multi-Elmac Net. My second Globe Champ is a 1948 production run. This version has a Taylor TZ40 triode as the final and had been used on 1600 KC as a 100 watt broadcast transmitter! Over the 2002-3 winter, I plan to restore it and dedicate it to a WRL aspect of my radio shack.

Recently, I had the pleasure of talking with W0GFQ, Leo Meyerson, about the early Globe Champs. Leo is still quite active and graciously called me back providing loads of excellent details regarding WRL and its production of transmitters. Leo says that about 11,000 of them were made. It was an alternative to the Globe King 275, the Globe King 400's predecessor. Sam Feidone and Al McMillan (W0JJK), both who have become silent keys recently, originally designed the 1948 Globe Champ. As mentioned earlier, the early Champs ran the Taylor TZ-40 tube as a final. After the Second World War, Leo says the government flooded the market with surplus parts beyond our imagination. Using the Taylor tube was the obvious choice for both price and reliability. However, by late 1948, the Taylor Tube Company was out of business and changing to the RCA 812A required little re-design work. After Feidone and McMillan redesigned the modulator to match the Globe King 275, little was changed over the next 6 years. During that time, civilian and government versions were produced, similar to the Globe King 400's. Fifty Globe Champs even went to the Pakistani government once!

Leo told me that they sold well, not as good as the Globe Kings, but they filled a particular market. W0GFQ obviously preferred the Globe King. His station was a Globe King and a 75A-2 for many years. He felt it was superior to many rigs produced in the day and one of the reasons they are still around is due to their quality of design. Leo is very pleased to hear so many Champs and Kings still on the air. He is also very inspired by the renewed interest in AM and building. "Keep up the good work"!

There are about 10-12 Globe Champ 150-165-175 transmitters in known existence. If you can't find one of your own, they are easy to duplicate. Drop me an email and I would be happy to share additional details about them. I would like to thank W0GFQ, K4KYV, KA4JVY, K9RJ, N8ECR, W2ZM, W0IR, and W9GQE for all their help over the years finding information and other assistance with these early WRL rigs.


ER

[...Editors Comments from page 1]

of friendly QSO's using restored broadcast or military equipment. We will be using a simple point scoring system this year. Participants will receive one point per contact.

An additional one point is added if the rig weighs over 250 pounds, and another point if it runs the full legal limit. Add one more point for each different state worked, and another point for each different transmitter per QSO. We are planning on using 1885 kc for East coast stations, 1900 kc for West coast stations, and 3870 to 3890 kc for 75-meter activity. 40-meter operation will be on 7290 after the VOA signs off at 0500Z (midnight EST). Event operating times are simply dark to dawn.

All participants submitting an event log will receive an Electric Radio Certificate of Participation. Bill will award the nice looking Heavy Metal Trophy to the station that shows up the most in returned logs. Send your event logs to: Bill Kleronomos, 5325 Getaway Drive, Berthoud CO 80513-9600. They may be emailed to HeavyMetalRally@earthlink.net as well.

Dick Dillman has announced that K6KPH will be active for straight key night. This will be a chance for all of us to work an authentic RCA coastal station. Amateur station K6KPH, operating from the transmitting and receiving sites of ex-RCA coast station KPH, will be on the air for Straight Key Night on New Year's Eve 2002. The transmitters, receivers and antennas of KPH will be used. Commercial station KPH will also be on the air. Straight Key Night is an annual event sponsored by the American Radio Relay League (ARRL) and is intended to promote the use of Morse and non-automatic "straight" keys. Straight Key Night begins at 7 PM EST December 31 and runs for 24 hours through 7 PM EST January 1 (0000-2400 UTC January 1, 2003). K6KPH will be on the air beginning at 0000 UTC. Operations will continue into the evening Pacific Time. More information about Straight Key Night may be found on the ARRL Web site at http://www.arrl.org/contests/rules/2003/skn.html

The K6KPH operating frequencies will be 3545, 7050, 14050kc. Also 21050 mc will be activated if conditions warrant. 1950s vintage RCA commercial transmitters will be used. Transmitter power output will be 1.5kW. Transmitting antennas will be double extended Zepps on 3.5 and 7Mc and H over two antennas on 14 and 21Mc. All antennas are fed with open wire line. Commercial operators, many of them former KPH staff members, will be at the keys.

Commercial station KPH will also be on the air on medium frequency sending Pacific weather and the ARA Free Press. Announcements will be made on 500kc. The broadcasts will take place on 426kc. QSL's and reception reports for K6KPH and KPH may be sent to Denise Stoops "DA", first female operator at KPH, at:

Ms. DA Stoops. P.O. Box 381, Bolinas CA, 94924-0381, USA.

The Maritime Radio Historical Society with the cooperation of the Point Reyes National Seashore and Globe Wireless, Inc operates K6KPH and KPH. For more information about the Maritime Radio Historical Society, please see http://www.radiomarine.org This is a good chance for all CW ops to work a historic station. SWL's will be able to receive a genuine KPH reception report.

W0FD, Mike, will likely be running the AMI New Year's Day Bash from his station in Gunnison Colorado. Other AMI activities are planned for the East and West Coasts. Check the usual AM frequencies January 1.

After the holidays are over, Electric Radio Magazine will be sponsoring the first annual Dynamotor Night to be held later this winter. More information will be available in a future issue.

Keep those filaments lit!


ER

The Gonset G66 and G77 Mobile Twins

By Jim Hanlon, W8KGI
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In the late 40's and early 50's, ten meter mobile operation was as popular with the hams in the Greater Cincinnati area where I lived as 2 meters is in many towns today. My "Elmer" at the time was Will (Willard A.) Friend, W4KKB, the Northern Kentucky, Dan Beard Council, Boy Scout Commissioner. Will's mobile rig was typical of the era, a homebrew transmitter with a 5763-crystal oscillator and doubler, another 5763 doubler, 2E26 final and push-pull 6V6 modulators. It was powered by a PE-103 dynamotor running from the 6-volt battery in his 1950 Ford. This rig was normally tuned up on 29.6 mc., the home frequency of the Queen City Emergency Net and the local equivalent of 146.52 in these days. Will's ten-meter receiver was his car radio headed up by a Gonset 10-11 meter converter.

The Gonset Company that built that

converter was a west coast creation of Faust Gonsett, launched in 1949. From my experience in the era, Gonset got its start by offering a line of "converters," a receiver front-end including a tuned RF amplifier, a local oscillator and a mixer that "converted" the short wave band to a 1500 kc. signal that could be received on a broadcast receiver. Their products included Will's 27 to 30 mc. "10-11," a "Tri-Band" model that covered 75, 20 and 10 meters, a "3 to 30" model that covered the entire range between 3 and 20 mc., and later on others for 2 meters and the FM broadcast band. All of these were "little gray boxes" suitable for mounting under the dash or on the steering column of a 1950's era car, and quite a few of them showed up in home hamshacks including Will's in support of his WWII surplus BC348 receiver that covered only up to 18 mc.

By the mid 1950's, Gonset was well established because of its converter products in the mobile equipment business. So it fit well into their product line to bring out an entire mobile, HF-range receiver and transmitter pair, the Gonset G66 and G77. The Gonset twins looked the part for a 1950's car installation with chrome decorations over a gray hammertone paint finish. And they were just the right size to fit under the dash of those voluminous, 1950's cars.

Gonset's G-66B mobile receiver is distinguished by the great looking emblem overlooking the s-meter. The emblem also protects the meter glass during those long road trips. Route 66 perhaps?

The G-66 and its G66B successor are much better ham-band receivers than one could get just by using a converter ahead of a broadcast receiver. They are dual conversion designs with IF's at 2050 and 262 kc., and the selectivity of the B-model with its additional IF stage is 4kc. at 6 dB down, quite tight for AM phone and not bad for SSB and even for mobile CW. They cover all of the ham bands from 80 through 10 meters and in addition the AM broadcast band up through 2 mc, including 160 meters, just in case their purchaser was thinking of foregoing the purchase of a BC radio for his new car and buying an all-band G66 instead. They offer good, reliable calibration, every 10 kc. on the bands below 10 meters and every 50 kc. on 10. They are vr tube stabilized, smooth tuning with 20 turns per band, and they have a variable pitch bfo and a volume control that switches from AF gain for AM reception with the AVC on to RF gain for CW and SSB reception with the AVC off, well suited for copying CW and SSB with a minimum of effort. And in an era when cars were changing from 6 volt to 12 volt electrical systems, they came with a power supply/speaker that could be mounted to the back of the receiver or stored remotely and that ran off either 6 or 12 volts with an internal vibrator or off 115 volts AC. So they could be used as a very respectable home station receiver when they weren't doing duty in the car. The G66B can be distinguished from the G66 by the Gonset emblem that extends out from the panel above the S-meter.

All of this function is delivered by 10

tubes in the G-66B and is packed into a remarkably small, 4½" high, 6½" wide and 9" deep box, not much bigger than a WW2 Command Set receiver and weighing only 8 pounds. Their tube lineup is a 6DC6 r-f amp, 6U8 mixer-buffer, 6C4 local oscillator, 6BE6 crystal controlled second converter, 6AU6 first I-f amp, 6BH6 second I-f amp in the G66B, 6AL5 detector-avc-anl, 6AW8 audio amp and bfo, 6AQ5 audio output, and 0B2 voltage regulator. When I looked inside my G-66B with an eye toward installing my typical QSK circuit, I found it very hard to find any spare room for even a small relay and quite a challenge to get at the wiring. It would have been interesting to see how Gonset put this little guy together and wired it up, because once it was all together there sure was no easy way to get access to its interior.

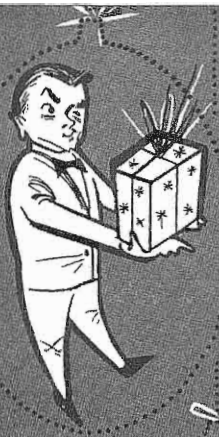
I acquired my Gonset twins from a friend who worked with me at Bell Labs in Columbus, Ohio in the 1980's. By that time they were of no use to him, and he had heard that I was a collector of old equipment and might give them a good home. Because they are both functional and compact, they make a nice addition to my Classic Exchange station.

If you are looking for a receiver to take out into the field for the next Vintage Field Day, keep an eye out for a Gonset G66. It is small, versatile, pretty, and it will do a good job for you while running from almost any readily available source of power.

The Gonset G77 Transmitter is the companion to the G66 and G66B receivers. It has the same outward appearance as the receivers with controls in all the same places, so the two complement other very nicely. To keep the transmitter as small as possible, Gonset split out the power supply and audio stages into a separate box, almost twice as large as the RF unit. The RF unit contains a 6CL6 vfo or crystal oscillator, 6CM6 multiplier, and a neutralized 6146 final amplifier, and it covers all of the pre-WARC ham bands

The Gonset G-77A mobile transmitter that powered many 40 meter signals from 6-volt automobile electrical systems in the 1950's.

Christmas scene



THE TIME: Christmas morning.

THE SCENE: Mrs. Mobile removes the blindfold from Mr. M revealing a lovely Christmas tree and dozens of beautifully wrapped gifts.

Mr. M's eyes dart back and forth as, from long experience, he mentally catalogues the many gifts. Shirts—neckties—

Hold it! A too-much-to-hope-for expression comes over his face as one particular package takes his eye. He hefts it. He holds it to his ear, shakes it. He wonders, can it possibly be? Nooo—probably not but let's just open it and make certain.

WOW! IT IS!

G-66B GONSET'S COMPLETE MOBILE RECEIVER

Beautiful in appearance, precision engineered and constructed, wholly outstanding in performance.

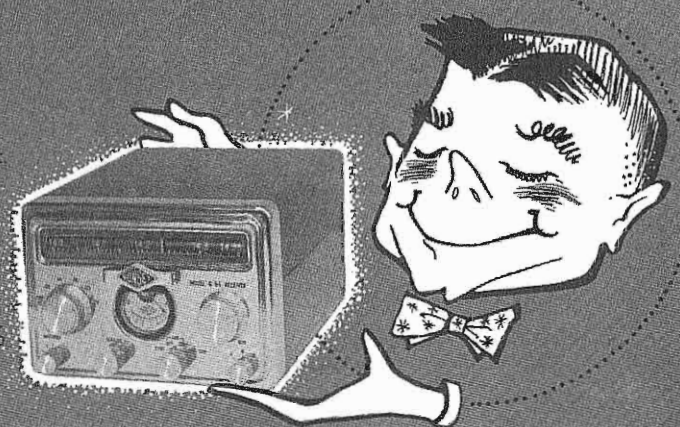
Six, widely spread amateur bands—160 through 10—plus standard broadcast.

Universal power supply for 6 or 12 volts DC and 117V AC.

AM, CW, SSB reception. Highly stable HF and BF oscillators and xtal controlled second conversion oscillator. (Double conversion all bands.)

G-66B receiver only . . . 189.50

Universal power supply/speaker unit . . . 44.50



GONSET BURBANK, CALIF. . . . . DIVISION OF L. A. YOUNG SPRING & WIRE CORPORATION

from 80 through 10 meters. The vfo runs on 160 meters for 80 meter transmitter output, on 80 meters for 40, 20 and 15 meter output, and on 40 meters for 10 meter output. The vfo and multiplier are gang-tuned on all bands, and a section of the bandswitch adjusts the screen voltage on the driver to achieve proper 2½ milliamp final grid current on each band, so tune-up is accomplished just by setting the required frequency and dipping and loading the final pi-match.

The G77 is designed to operate into a 50 to 72 ohm, non-reactive load on all bands. With 500 volts as supplied by the accompanying M3201 Modulator-Power Supply and 120 millamps plate current, the G77 runs at 60 watts input.

The 3201 Modulator-Power Supply operates from either 117 volts, 60 cycles or from a six or twelve volt DC power source and furnishes all required operating power for the transmitter and its modulator. It uses a vibrator circuit, multi-winding transformer, and a silicon rectifier voltage-doubler circuit to deliver 500 volts for the final and modulator, 235 volts for the RF exciter and low-level audio stages, and 150 volts vr regulated for the vfo. The modulator portion consists of a two-stage 12AT7 speech amplifier, a 12AU7 driver, and two, push-pull, Class B 6DQ6A modulators. As the manual describes it, "A high-gain speech amplifier permits full modulation from a high-impedance dynamic or reluctance (or crystal) microphone of average output level. The modulator employs optimized integral speech clipping. This increases 'talk power' without danger of over-modulation splatter of the 'buckshot' type."

My particular G77 came equipped with a DC-only, model 1170A power supply that appears to be like the model 3201 except that it does not have a 117-volt winding on the power transformer. The previous owner rigged it to operate on AC by supplying 12.6 volts from the filament windings of a husky transformer liberated from an old television set to the 12 volt vibrator winding on the Gonset power transformer. It's a bit of a kludge, but it works.

For CW operation, there is a key jack in the final amplifier cathode. But as the manual points out, "It should be noted that objectionable key clicks might be produced in nearby receivers unless a key-click filter of the inductive-capacitive type is inserted in the key lead." That is indeed the case, and I use a 2 henry choke in series with the keying lead shunted by a 0.1 mfd capacitor in series with 47 ohms to ground on the transmitter side of the choke to suppress clicks when I operate my G77 on CW. Only the final is keyed as the transmitter is set up from the factory, the vfo and multiplier stages run continuously. So the stock G77 is not a QSK machine. I have not tried to modify mine to key the oscillator and multiplier as well, though it should not be hard to key both of them together in their cathode leads.

The G77, like the G66B, is an attractive, compact unit that can be used in the shack or car for a very competent, vintage field day transmitter. With its single 6146 and full, high level modulation, it will keep pace with transmitters like the Johnson Ranger and Elmac AF-67 and AF-68, and it will have better modulation than rigs like the DX-60 and Globe Scout. If you are looking for a 60-watt, compact transmitter with a built-in vfo and high level modulation, I would definitely recommend picking up a G77.


ER

Radio's Golden Age—Episode 19

Bruce Vaughan, NR5Q
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The Discovery Years

The universe is full of magical things, patiently waiting for our wits to grow sharper.
Eden Phillpotts (1863-1960)
British author

Knowledge is a wonderful thing, but there is a lot to be said for ignorance. Think of the fun we would have missed if everyone were born with infinite knowledge. In a world where mankind knew everything—a world in which everyone had infinite knowledge—there would be no experimenting, no exploration, no discoveries, no arts, and no enjoyment of life. Those seeking new knowledge are enjoying life to its fullest whether it be in science, politics, or in the arts. Those of us who spent our early years discovering the wonders of electricity and radio are fortunate, indeed. If we had a little fun along the way consider it a plus.

Many of us who were attracted to electronics were avid readers of science fiction. In pulp magazines, and comic strips such as Buck Rogers and Flash Gordon, the enemy invariably possessed two 'scientific' marvels—an anti-gravity device, and the 'death-ray.' I was very intrigued with both ideas. Perhaps such a device as a 'death-ray' was waiting in my junk box—waiting for me to connect the parts in the correct manner. I gave it some thought—thought typical of a 12-year old brain.

If radio waves were related to light waves it just might be possible to project a beam of light, and induce such a beam with an electrical charge. If I could project a second beam with an induced electrical charge of opposite polarity, would it be possible to deliver a substantial amount of discomfort to anyone caught in both beams? It sounded reasonable to me at the time.

I rigged up reflectors made form old electric heaters, used 200 watt bulbs so I would have plenty of light, arranging some lenses from flashlights, and more or less was able to project a spots of light on the wall. As I understood absolutely nothing about AC, or DC theory, I simply connected one side of the line to one filament lead, and the other side to the second 200 watt filament. I should have drawn a schematic. When I plugged the thing in I created a minor fire, and the household was without lights for a time. I was partly correct in my theory—all hell does turn loose when the two leads in an AC circuit converge in a common point. Unfortunately, the convergence took place in my equipment and not at a distant point.

Perhaps, I should confine my experiments to radio. I would estimate that over the next few years I built at least a dozen crystal radio receivers. I heard a very weak signal on one of them. The rest never worked at all.

Next came my 'detector—one step'

regenerative receiver using 01A tubes. This is the first real radio receiver I built. As I mentioned in an earlier article, it hummed a lot when I tried to make it work with AC on the filaments—but nary a sound of music or speech. The 01A's must have been defective—the filaments burned out almost immediately.

Being too young for Spark, it never occurred to my friends and I to try communication using a Model T Ford spark coil. We were more advanced that that. Our first actual attempt to establish radio contact was with simple self-excited oscillators for transmitters, and the household BC radio for a receiver. Some radios were calibrated in KC, but there were a number of radios still in use in the mid 30's that simply had 0-100 analog dials. We made a decision to keep it simple. We settled on a spot just a little below WLW. It cost no more to run with the big dogs, and I seriously doubt that we caused WLW any concern. Everyone knew where WLW came in no matter how the set was calibrated. James and I made the first attempt one summer evening at 7:00 PM. We had to wait until our parents finished listening to the 6:00 PM news—then 'Lum and Abner.' James lived about four miles from my home. We thought we may have heard each other, but were never sure. I suspect now we heard a little line noise or atmospheric static.

My first two-way radio QSO was on the old 5-meter band. My friend and I had a 'borrowed' pair of Knight (Allied Radio) 5-meter transceivers. I cannot remember the tube used. They were very basic, battery powered, units that probably put out less than ½ watt. We had never heard of such things as SWR, Pi-networks, the transmatch, or even antenna loading. Our antenna was a length of #12 copper wire. The length was not measured, but it was a little over two feet. It is just as well we did not understand how to make the transceiver more efficient; we were operating illegally anyway. Our best DX was about three blocks.

Then, as happens with boys, we graduated from the 8th grade, and started attending HSVS that fall. I had heard many stories about the science teacher being a rough teacher, as well as a real 'horses patootie.' I was prepared for the worst when I attended my first General Science class. The teachers name was Murphy Mears. I was hooked on science and physics from that day forward. I found Mr. Mears a most likeable teacher, and one that I admired more than anyone I knew. In retrospect, Murphy Mears is the man that changed my life more than anyone—including my parents.

Mr. Mears was a small athletic looking man, about five feet, eight inches tall. Not yet 30 years old, he would have been the object of dreams of the teen-age girls except for three things. He was very serious, always stern, and had recently married the daughter of one of Huntsville's most respected Medical Doctors.

In addition to regular daily study, he required every student to build a working radio, a telegraph set, and an electric motor. Once built the project had to be demonstrated to the class. The builder was expected to give full details of the projects operation and construction. Sounds like a load doesn't it?

In actuality building the three items was a breeze for the majority of students. The science room had a few teaching aids like 'telephone' batteries, old generators removed from hand cranked telephones, a cheap microscope, headphones, bell jar, and a row of 'Mason' fruit jars stuffed full of pickled snakes and frogs. Any student-built item requiring less than 12 volts could be powered from batteries from our 'lab.'

The telegraph set could be as simple as a broken hacksaw blade fashioned into a 'telegraph key,' then used to apply voltage intermittently to any sort of sounding device. Some students removed car horns from abandoned automobiles in the city dump. Others used old door-

bells, while some actually made a crude 'sounder.' Nowhere in his rules did it say that the sound had to be a relay, or even a pleasant sound. All you had to do was send a letter of code—any code.

Almost all of the electric motors followed a simple design drawn on the blackboard by Mr. Mears, and all radios built by the class were simple crystal receivers. I never actually heard one work but Mr. Mears assumed they would work under proper conditions.

We did not have regular school desks in the science room. Our study tables, built by manual training students in the Agriculture School shop, were crude but serviceable. The table tops, built of inexpensive pine, were large enough to seat about four students on each side. The unpainted tables were held together with large box nails. It was practically impossible to sit at one of the sturdy tables and not have a hand or arm resting on one of the large nail heads.

Because the room was small, the tables were placed together in a row—what I call banquet table style. There were three rows of tables in the room.

The thought occurred to James and I that if we connected a wire underneath the table tops to a few of the exposed nails, and then hooked it up to one of the old telephone generators we might have a little excitement during class. Of course it meant one of us must sit near the back of the room near the shelving where all out equipment was kept. When Mr. Mears turned his back one of us gave a couple of cranks on the generator. Books and pencils went flying through the air. Boys said words not usually used in a classroom, and the girls screamed and squealed. James and I had agreed to jump to our feet quickly mix in with the other students hoping that no one would connect us to the telephone generator. It worked! Most of the class had suspicions about the culprit but the incident was soon forgotten.

This was long before the days of automation—class changes were announced by the manual activation of a large, irritating bell in the main hallway. A simple doorbell button had to be pushed at three minutes before the hour and again on the hour. The chore fell to Mr. Baldwin—our commercial and business room instructor. Dean Baldwin was a small, immaculately dressed, dignified gentleman a few years on the junior side of middle age. His mustache was carefully trimmed, his black suit neatly pressed, and his shoes shined to a mirror like gloss. He would have looked more at home near downtown London than in a small high school in Arkansas.

The bell button was mounted on the outside door facing of Mr. Baldwin's room. The responsibility of pushing the bell button fell his responsibility simply because of his proximity to the bell button. He took the job quite seriously. About five minutes before the hour Mr. Baldwin would walk out into the hallway and take his position in front of the bell. With his gold pocket watch in his left hand, he stood by the door—his right index finger poised just inches away from the bell button. At exactly the right time, no more, no less, Mr. Baldwin jabbed the bell button

Here obviously was another chance for some fun. James and I found that by going into the auditorium, and then climbing up behind the stage props, we could open a scuttle into the attic. In no time at all we located the bell wire, and hooked up another button in parallel with the hallway bell button.

We punched a small hole in the composition board ceiling material. Carefully, we placed the hole in a seam of the ceiling hoping it would not be noticeable. It was never discovered. The vantage point allowed us full view of the commercial room doorway. All was ready now, but first we made a trip down to the hallway to make sure the hole was, indeed, practically invisible.

One of us took our position with an

eye against the tiny hole. If you got close enough you could see the entire doorway and bell button. Our pre-arranged signal was simple—when the observer wanted the button pressed we 'jabbed' an imaginary doorbell button with our upraised hand.

We waited—and waited—and waited. At last Mr. Baldwin stepped into the hallway. He removed his pocket watch, and began his countdown. A few seconds before zero hour minus three he lifted his left hand and extended his index finger. Here it was! His finger moved forward, but not before my hand signaled to James to push the button. Mr. Baldwin literally jumped from surprise when the bell started ringing before he touched the button. I signaled a 'stop ringing' and James let up on the button. Mr. Baldwin slowly lifted his hand toward the bell for a second time. Again, when his finger was at least 6 inches from the button the bell gave a short ring. We tried the joke two more times before quitting and removing all the evidence. The mystery was never solved because Mr. Baldwin never told anyone that we know of. I suppose he thought it too weird to discuss.

Our 'noble' experimenting came to an end later that year. A small mouse brought us down.

One of the boys caught a small mouse in one of the schoolrooms. James and I saw an opportunity for more experimentation. We talked the boy into giving us the mouse. We placed the little fellow in a cardboard box and fed him well while we pondered our next experiment.

We were familiar with the 'bell jar' experiment. A bell, hanging in a bell jar, can be heard by everyone in class when the jar is full of air. When the air is pumped out with a vacuum pump the sound becomes all but inaudible. Ok, but would the sound decrease to someone, or some mouse, if he were in the jar with the bell. We were smart enough, well almost smart enough, to realize the mouse would not do well in a complete vacuum. We reasoned that if we just removed a small amount of air, and then rang the bell the mouse would jump less than if the bell was full of air. We had no intention of exploding a mouse.

We had to wait until the last period in the afternoon to try our experiment. The Physics room was unused during this period and few people were around. We sneaked into the room and set up all our needed material.

With the bell jar full of air the mouse did jump when we pushed the button. Now we applied a little vacuum. We let the bell ring again, and the mouse seemed to jump less but perhaps we were inflicting pain on the mouse—we gave up the idea of a vacuum.

I know, I exclaimed, let's see how well sound travels in pure hydrogen. I'll never know why I thought the mouse would do well in hydrogen environment. We replaced the rubber stopper in the top of the jar with one that would accept a glass tube. Then we got out the zinc filings and hydrochloric acid. All was in readiness when another James, James Brashears, joined us. James was the son of the local undertaker, and had little interest in, and no knowledge of, science. He joined us simply because he was looking for a place to smoke a cigarette.

The experiment was proceeding and the mouse was apparently suffering no life threatening effects from the first shot of hydrogen. Perhaps I needed more hydrogen. I filled the flask with more zinc, and added a shot of HCl, and turned to re-connect my 'hydrogen generator' before all the hydrogen in the jar escaped. The next few seconds played out like a slow motion movie. Before I could connect my flask to the glass tube James Brashears took a lighter from his pocket and snapped it in front of the glass tube where the foggy looking gas was escaping.

The bell jar went up like a dynamite

stick. Some windows were broken. The mouse was never found—not even a small bit of fur. It was later said that a rather heavy-set girl in study hall was sitting with her chair tilted backward. When the explosion occurred, she threw her books into the air, screamed "Oh God" and fell backward in the floor. I do not understand it today after all these years. Not one of the three boys in the lab got one piece of flying glass in us—yet there were glass shards scattered all over the room.

The school administration was surprisingly understanding and lenient. We were admonished, but not expelled. However, the lab was placed off-limits to James and I.

Apparently my days of discovery in the HSVS lab were drawing to a close. Oh well, my main interest was radio so why not build a transmitter? I subscribed to the popular opinion among hams that receivers were far too difficult for home builders. With the introduction of the superheterodyne circuit an idea swept through the ham fraternity that regenerative receivers were badly outdated, and not worthy of serious consideration. Most home builders felt the 'superhet' was best left to commercial constructors. A few hams knew better, or the National Company would not have continued producing the SW-3 for so many years.

Looking through my QSL cards from the late thirties I find that at least 95% of the stations I worked were using home built transmitters, while only about 10% were using home built receivers. After looking through dozens of cards I could only find one using a home built superhet.

My next project should be a transmitter, I decided. But where would I get the money for all my needed parts? The answer came sooner and easier than I expected. At a local auction sale I noticed an old cathedral radio—a nice big heavy AC operated radio—among the items yet to be sold. I had 40 cents in my pocket. When the radio went up for sale I yelled "forty cents." There were no other bidders.

I do not remember the manufacturer of the cathedral radio. I never even plugged the thing in before I started disassembly. My primary interest was the power transformer—I found it had the usual 2.5 voltage filament, and the HV winding put out about 700VAC on my borrowed voltmeter.

I started construction of my transmitter by searching all my old magazines. I found one that appeared to be what I was looking for. It used a 2A5 xtal oscillator, into a pair of PP 2A3's. Because of poverty nothing was purchased new—even the crystal was borrowed from another ham. The 40-cent auction purchase plus my junk box provided everything for the transmitter.

The transmitter went against my 'Elmer's' advice and used a common power supply for both the final and the oscillator. As it was never loaded to more than a few watts chirps were not a problem. One of the most difficult things was setting it aside until my license came. I only made a few QSO's with this rig. My Elmer built one that I thought was better—and it was. The rig was soon scrapped.

The discovery years continue, but they do not compare to that time when I knew nothing and anything you could imagine seemed possible to achieve.

Enough already. I think I've covered more than enough about my early experiments leading up to a career keeping electrical entertainment equipment of others in a working condition. Next month we will return to the problems, and pleasures, of running a small radio and TV shop.

-30-

VINTAGE NETS

Nets that are underlined are either new, or have changed times or frequencies since the last issue.

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

Boatanchors CW Group: 3546.5, 7050, 7147, 10120, 14050 Kc. Check 80 on winter nights, 40 on summer nights, 20 and 30 meters daytime. Nightly informal net usually meets around 0200-0400 UTC. Listen for stations calling "CQ BA" or "CQ GB".

California Early Bird Net: Saturday mornings at 8 AM PST on 3870.

California Vintage SSB Net: Sunday mornings at 8AM PST on 3860 +/-

Colorado Morning Net: An informal group of AM'ers get together on 3875 Kc Monday, Wednesday, Friday, Saturday, and Sunday at 7 AM MT.

Canadian Boatanchor Net: Meets Saturday afternoon on 3745 Kc at 3:00 PM EST.

Collins Collectors Association Nets: Technical/swap sessions meet every Sunday on 14.263 Mc at 2000Z. A long-established net run by call areas. Informal ragchew nets meet Tuesday evening on 3805 Kc at 2100 Eastern time, and Thursday on 3875 Kc. West Coast 75 M net is on 3895 at 2000 Pacific time.

Collins Collector Association Monthly AM Night: Meets the first Wedof each month on 3880 Kc starting at 2000 CST (0200Z). All AM stations are welcome.

Collins Radio Association's Collins Nets: Mon and Wed at 8 PM EST (0100Z) on 3805 mc, Sat 12 Noon EST (1700Z) 14.250 mc.

Drake Technical Net: Meets Sundays on 7238 Kc, 4 PM Eastern time. Hosted by John (KB9AT), Gary (KG4D), Jeff (WA8SAJ) and Evan (K8SQG).

Drake Users Net: This group gets together on 3865 Kc, Tuesday nights at 8 PM Eastern Time. Net controls are Criss (KB8IZX), Don (W8NS), Rob (KE3EE) and Huey (KD3UI).

DX-60 Net: This net meets on 3880 Kc at 0800 AM, Eastern Time on Sundays. Net control is Jim (N8LUV), with alternates. The net is all about entry-level AM rigs like the Heath DX-60.

Eastern AM Swap Net: Thursday evenings on 3885 Kc at 7:30 PM Eastern Time. Net is for exchange of AM related equipment only.

Eastcoast Military Net: Check Saturday mornings on 3885 Kc +/- QRM. Net control station is W3PWW, Ted. It isn't necessary to check in with military gear, but that is what this net is all about.

Fort Wayne Area 6-Meter AM net: Meets nightly at 7 PM Eastern Time on 50.58 Mc. This is another long-time net, meeting since the late '50s. Most members use vintage or homebrew gear.

Gray Hair Net: The oldest (or at least one of the oldest at 44+ years) 160 meter AM nets. Net time is Tuesday evening on 1945 Kc at 8:00 PM EST and 8:30 EDT. Also check www.hamelectronics.com/ghn

Hallicrafters Collectors Association Net: Sunday on 14.293 Mc, 1730-1845 UTC. Control op varies. Midwest net Sat. 7280 Kc 1700Z. Control op Jim (WB8DML). Pacific Northwest net Sunday 7220 Kc at 2200Z. Control op Dennis (VE7DH).

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

K6HQI Memorial Twenty Meter Net: This flagship 20 meter net on 14.286 Mc has been in continuous operation for at least 20 years. It starts at 5:00 PM Pacific Time and goes for about 2 hours.

Midwest Classic Radio Net: Meeting Saturday morning on 3885 Kc at 7:30 AM, Central Time. Only AM checkins are allowed. Swap and sale, hamfest info, and technical help are frequent topics. Control op is Rob (WA9ZTY).

Northwest AM Net: AM activity is daily 3 PM to 5 PM on 3875 Kc. The same group meets on 6 meters at 50.4 Mc. Times are Sundays and Wednesdays at 8:00 PM. 2 Meters Tues. and Thurs. at 8:00 PM on 144.4 Mc. The formal AM net and swap session is on 3875 Kc, Sundays at 3 PM.

Nostalgia/Hi-Fi Net: Started in 1978, this net meets Friday at 7 PM Pacific Time on 1930 Kc.

Old Buzzards Net: Daily at 10 AM local time on 3945 Kc in the New England area. Listen for net hosts George (W1GAC) and Paul (W1ECO).

Southeast Swap Net: Tuesday at 7:30 PM Eastern Time on 3885 Kc. Net controls are Andy (WA4KCY) and Sam (KF4TXQ). Group also meets Sunday on 3885 Kc at 2 PM Eastern Time.

Southern Calif. Sunday Morning 6 Meter AM Net: 10 AM on 50.4 Mc. Net control op is Will (AA6DD).

Swan Users Net: Group meets Sunday at 4 PM Central Time on 14.250 Mc. Net control op is usually Dean (WA9AZK).

Westcoast Military Radio Collectors Net: Meets Saturday at 2130 Pacific Time on 3980 Kc +/- QRM. Net control op is Dennis (W7QHO).

Wireless Set No. 19 Net: Meets the second Sunday of every month on 7270 Kc (+/- 25 Kc) at 1800Z. Alternate frequency is 3760 Kc, +/- 25 Kc. Net control op is Dave (VA3ORP).

Ground Loops Revisited, Part 2

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I have a few corrections for part one of this article, published in ER #160, September 2002. On Figure 5, page 24, I should have indicated the distribution transformer secondary as having a phase-to-neutral voltage of 120-0-120 volts. The phase-to-phase voltage should be 240 volts so that the phase-to-neutral (or ground) comes out 120 volts as found in real-world wiring. In Figure 6, hot-to-neutral voltage should obviously be 120 volts, not 115 volts. I guess I've just been thinking about too much vintage equipment lately! Thanks to Jim (W0JJL) for bringing this to my attention.

This part of the article will consider methods to minimize power wiring noise coupling. Modern households are complex electromagnetic environments, and the problem is only going to get worse from a ham radio point of view. As much as I would like to report on finding a "magic wand", there is no one single fix for all the noise problems we encounter these days. One can only try to eliminate one source at a time, and eventually the layers of noise will be rolled back to a point were the bands become more useable.

The key to reducing or eliminating conducted noise in our communications systems is finding the direction that the noise current is flowing. It's not that hard to do, and once this is done you also know what the source and the coupling paths may be.

Noise currents appear on power wiring in either the common mode or the differential mode. These "modes" merely tell which way the noise current flows. Current probes are used with oscilloscopes to find these currents. Unfortunately, a current probe is a very expensive accessory for the limited use it sees around the ham shack. Boat anchor current probes are available, but hard to find. I've designed an uncalibrated current probe that may be used with nearly any scope; see the photo in Figure 1.

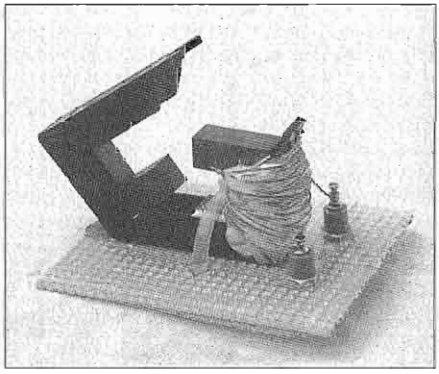


Figure 1: The homebrew current probe

This thing is made from an Amidon rectangular split-core torroid designed as a power cord EMI filter. This particular core has been in my junk box so long that I've forgotten what model number it is. Any similar type will work. The pick-up winding has 200 turns of #28 enameled wire, and measures 3.5 mH. The winding was fixed in position with casting resin, but anything on-hand will work, such as Q-dope. The photo shows it with the core open. Figure 2 shows it closed around

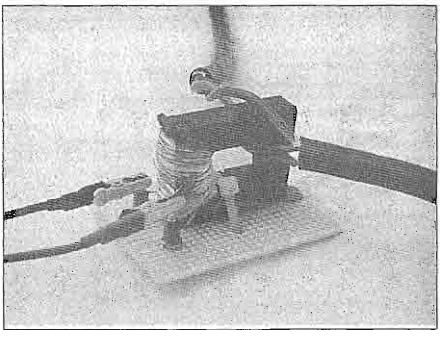


Figure 2: The probe shown closed around line conductors

the hot and neutral conductors of an extension cord, with the safety ground outside the core. When closed in this manner, a transformer is formed with a one-turn primary. The secondary is connected directly to the high-impedance vertical input of an oscilloscope with Pomona clip leads. I've made no attempt to calibrate the probe because for our purposes it isn't necessary.

Apply common sense when using this probe. Make sure there are no exposed conductors when you are doing the testing. You don't want to be the subject of an ambulance call on the scanner!

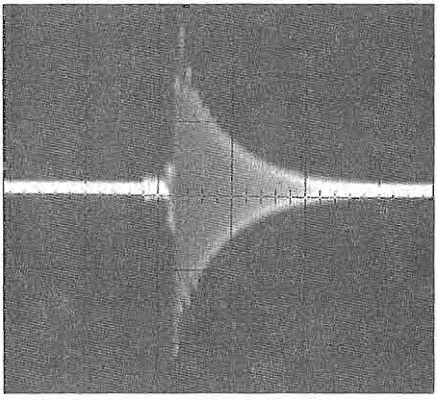


Figure 3: Common-mode current waveform from an oscilloscope screen.

Figure 3 is a waveform of a common-mode noise current in my shack. The trace is somewhat blurry because of incidental FM. What the scope shows is a linear voltage that is in some proportion to the noise current in the conductors. The display is a current-scaled voltage waveform. With such a crude probe we can't tell much about the magnitude of the current because the bandwidth of the probe is not known, and the probe impedance is not known. To calibrate a real current probe, the probe impedance needs to be known because it is transformed back to the conductors as series insertion impedance loading the source. Also, there is a maximum limit of linear operation of any current probe. It is for these reasons that no attempt has been made to calibrate the probe. It is just an indicator.

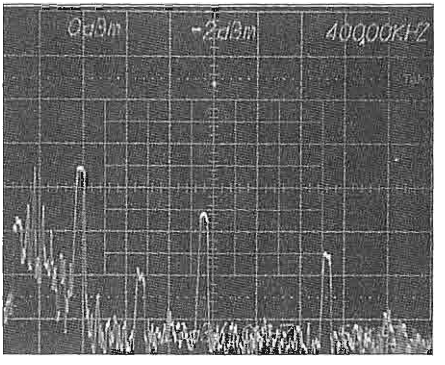


Figure 4: The spectrum of the noise picked up with the probe as shown in figure 2. The three tallest "spikes" are harmonically related to each other from the same source. The shortest is from another source, and unrelated to the three higher signals.

For purposes of this article, Figure 4 shows the spectrum of what was picked up with my probe. The analyzer was centered on 400 kc, with a dispersion of 50 kc per large division. This noise was common-mode current coming from a

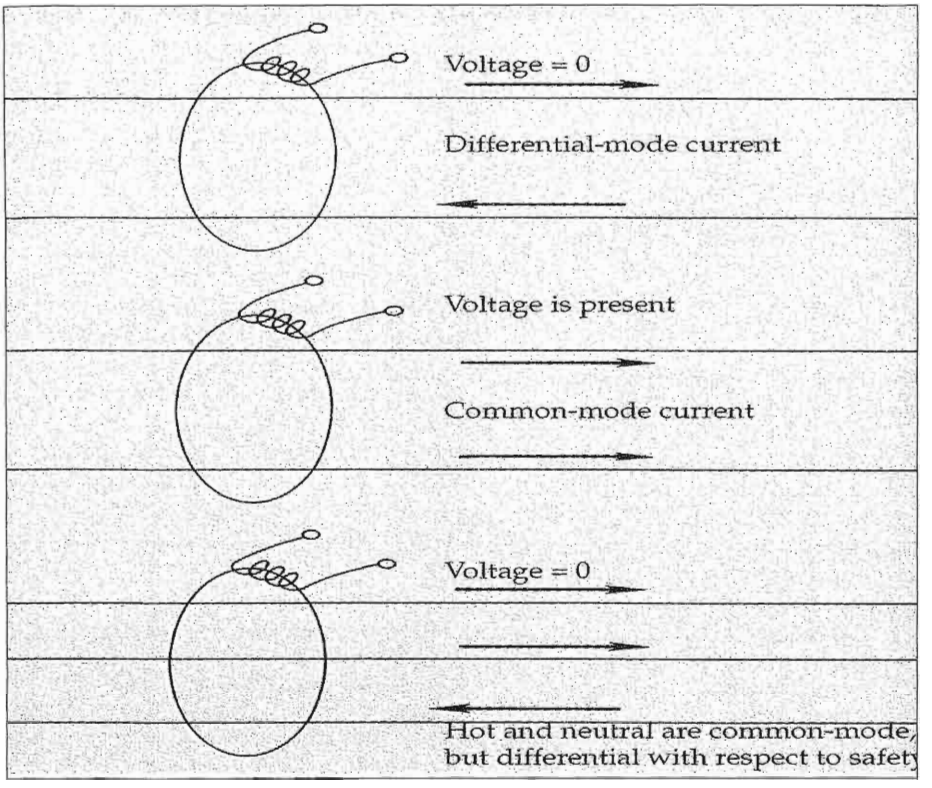


Figure 5: How to use the probe to tell what type of noise current is present in a line circuit.

switching power supply on a different house circuit.

Figure 5 shows how to use the current probe, and what to expect when it is closed around different combinations of conductors. In the top diagram, the probe is closed around the hot and neutral conductors, usually the black and white wires. If no waveform shows, the noise current is in the differential mode because the currents are flowing in opposite directions with equal magnitudes and the total current cancels out as far as the probe is concerned. If there is a waveform present, the current is common-mode because the current is flowing the same way in both conductors.

In the bottom diagram the probe is closed around all three conductors. If no waveform shows on the scope around all three, but there is a waveform when the probe is around hot and neutral, hot and neutral are carrying common-mode noise current, but the total current is differential when the safety ground is included. This is frequently the case with noise which originates in switching power supplies that are found in everything these days.

Occasionally you will find a waveform when the probe is closed around the safety ground only. This typically indicates noise current that has been coupled by re-radiation or safety ground wire crosstalk from closely located equipment.

Now that the direction of the noise current is known, you can go to work on

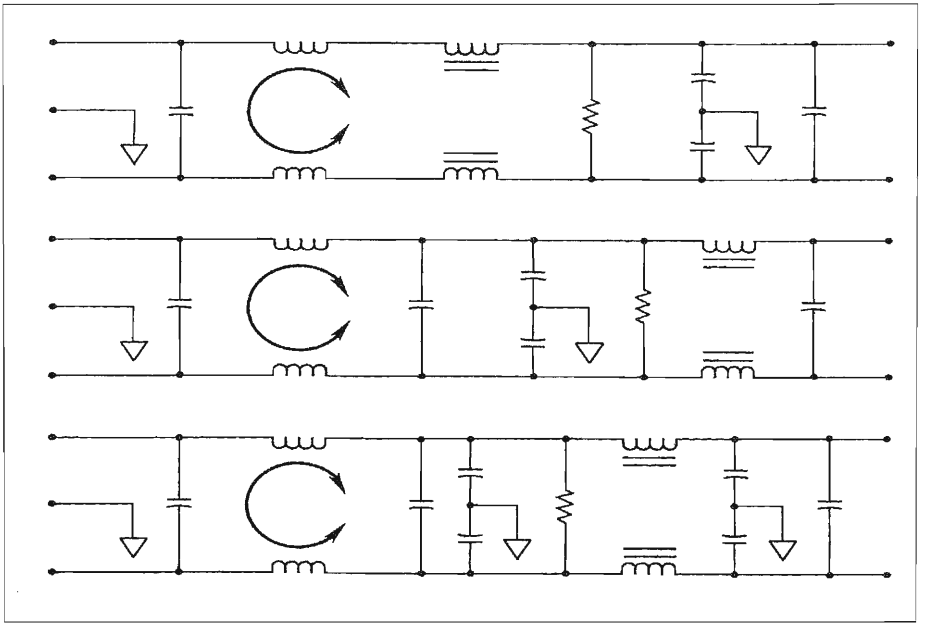


Figure 10: The three basic single-phase line filter "famlies" as described in the text.

minimizing it. The mode of the currents will usually tell what the noise source is and the coupling path. Differential mode currents usually mean that the coupling path is conducted through metal, and that the source is likely found on the same circuit in the house. Common-mode current is usually due to source re-radiation or crosstalk from equipment on different circuits coupled by the safety ground. A remedy for one type of noise current won't work with the other. For example, a bypass capacitor connected hot-to-neutral is effective on differential currents, but won't work for common-mode types. Line-to-ground capacitors work on both types. Common-mode chokes won't reduce differential-mode noise enough to be worthwhile. Figure 5 shows a schematic diagram of a typical common-mode choke.

Now that it is known what type of noise is to be reduced, the next step is to find a good line filter. These must be rated for the total current expected through it, and also for the type of filtering. There are many different types of line filters. "FIG 10" shows the schematics for basic 2-wire, single-phase power line filters, known as the "filter families". These diagrams are frequently printed on the outside of the filter case. Sometimes the filters will have the attenuation in dB to be expected printed on them, with "CM" for common-mode and "DM" for differential mode. The diagram at the top of the figure is a high-impedance common-mode filter, with some additional differential-mode attenuation. The center diagram has equal high-attenuation DM and CM filtering. The bottom schematic has high CM and DM attenuation, with an additional common-mode filter section. These filters can be built at home, but commercial filters are easily available and reasonably priced, and calculation of the component values has already been done.

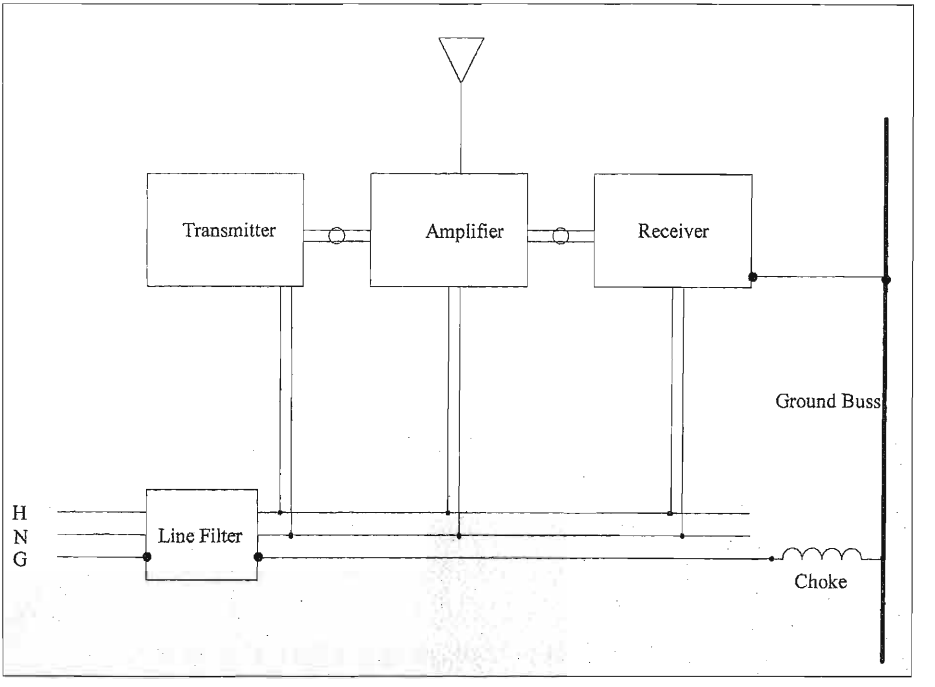


Figure 11: The final wiring diagram that provideds the grounding method discussed in the text.

FIG. 11 is a diagram of a method I have used successfully to reduce noise coupling. Most vintage equipment uses 2-wire power line cords, but many accessories are found in the shack that use 3-wire power cords or DC power and wall transformers. Your grounding strategy needs to allow for all of this equipment. To build a good single-point ground system, the first thing I do is to find some copper wire braid or copper sheeting at the hardware store, the wider the better. This is cut to fit some convenient space at the rear of the operating bench. Most vintage equipment has a ground connection on the chassis. I solder a connector to a length of #12 solid copper wire, and attach the wire to the ground lug on the rig. The wire is routed as directly as possible to the ground bus. At the ground bus, I solder the wire in place. The idea is to keep the ground bus as low-impedance as possible. At one end of the bench, I have an aluminum chassis box with a removable cover. A three-wire extension cord from a 20-amp circuit is run into the box, using properly sized rubber or plastic grommets, and safely terminated on a big, well-insulated terminal strip. The hot and neutral conductors run through 20-amp fast blow fuses mounted in clip-type holders, which are then soldered to the input side of my line filter that is rated for 20 amps. The load side of the filter runs to receptacles for the equipment.

The safety ground is split off from the extension cord before it touches any metal, and runs to the input of a home-made choke. The choke consists of as many turns of #16 copper as I can get around a 4-inch piece of Amidon ferrite rod, but even the loopstick antenna from a junked broadcast radio works. I wind enough wire to get about 3 mH. This usually turns out to be about 200 turns.

This will provide an impedance of about 1 ohm at 60 cycles and 10,000 ohms at 400 kc. This impedance will choke off most of the common-mode noise in a safety ground. If you purchase the core, the best one to use is Amidon part number R33-050-400. That part number means #33 core material, ½ inch diameter, and 4 inches long. Then, I mount the choke on ceramic standoff insulators and keep everything rigid and safely attached as is possible. The "load" end of the choke connects to the aluminum box wall. The effect is to isolate the safety ground for RF, but not for 60 cycles or DC. The ground bus from the bench is attached as firmly as possible to the box, and with as wide a contact area as possible in order to get a low-resistance bond. I also mount several 3-wire receptacles on the box, but their safety ground goes directly to the box wall and not to the line-side of the choke. All accessories that connect to the station equipment should be powered from the filtered side of the box.

If this ground system is carefully constructed, it is possible to reduce conducted noise by 90-100 dB. Common-mode noise currents can typically cause voltage drops as high as 200 millivolts across power wiring. (A rule-of-thumb is to figure an impedance of about 500 ohms for power wiring.) If a 95 dB reduction is made, there is about 4 microvolts of noise remaining. This may still be strong enough to be detected somehow; it all depends on many other factors that are specific to each station.

The single-point ground system won't eliminate noise that is picked up through the antenna. An example is power-line noise. This is known as radiated interference. It is possible to build nulling devices where the amount of cancellation is directly related to how fine an adjustment one is willing to make. Close, strong sources null the best. I have built equipment that will completely remove this noise, but it involves working in low impedance solid-state electronics. I'm not sure that would be appropriate for Electric Radio Magazine. If enough readers request the information, I will publish a third part to this article.

ER

[...AMI update from page 2'

meet and chat with out fellow AM operators in the Midwest and even the east coast on 3885kc. The long skip has caused some problems for local 75 meter AM nets requiring some relaying by out of state stations.

160 meters has been wide open this November with signals from up the coast and Arizona just booming into Southern California at night. Check out 1885kc and 1925kc and if you don't hear any AM QSO, put out a CQ. I'm fortunate to have a lot large enough for my full size 160-meter dipole but many of the guys on city lots are having problems getting antennas up for 160 along with power line noise. I'd like to see an ER article on 160 meter transmitting and receiving antenna's for small city lots with noisy power lines by anyone with some experience with this subject. Now that the sun spot cycle turning downward many of us will want to use 160 for out local AM QSO's.

Ten meters has been great during daylight hours, lot's of QSO's most weekends this fall just above 29.000mc and even great signals from VK land in the late afternoon. The CCA AM net on ten meters has been getting over 60 check ins each Sunday this fall, including some Europeans and Central Americans. Unfortunately, 20 meters has been going out early before there is much AM activity on 14.286mc. I've been checking the high end of 15 meters but have not heard any AM signals lately on that band. Maybe some group like the AMI or CCA could start a 15-meter weekend net.

As I'm writing, the Thanksgiving AM Jamboree is in progress and off to a great start. Last night there were many cross country exchanges on 3885kc due to long skip. This morning there were many exchanges on the high end of 40 meters and also on 10 meters. If you haven't yet, get your Jamboree logs to Dale Gagnon, KW1I, at Box 1500, Merrimack, NH 03304 as soon as possible for a nice certificate if you have 1000 or more points. We all owe our to thanks to Dale for this fun event.

Best wishes for the Holidays to all of you ER readers and I hope Santa leaves lots of goodies under the tree, maybe a restored Johnson Desk KW or KW1, and fills your stocking with 813's, 6146's, and 304TL's.

ER

R390a Mainframe and Module Contract Number Update

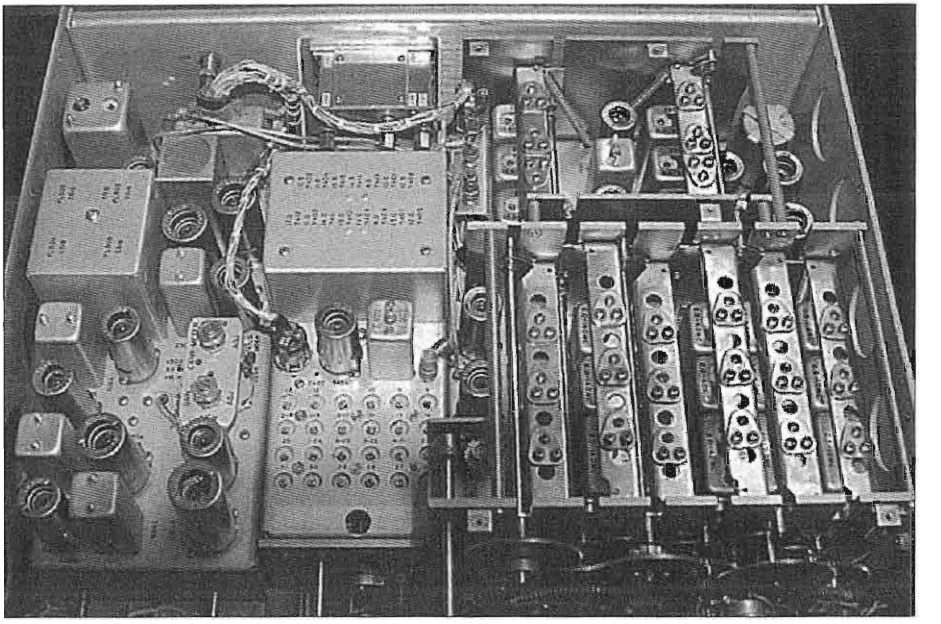
Tom Marcotte N5OFF
210 Clem Dr.
Lafayette, La. 70503

Les Locklear
1122 36th St.
Gulfport, Ms.39501-7116

Recent research has yielded little new information about R390a contract numbers and manufacturer serial numbers. We have turned up the following two updates, however. The table on this page lists newly discovered order numbers or high serial numbers, and the table on the facing page shows manufacturers and serial numbers of modules with no known matching receivers.

MANUFACTURER	CONTRACT OR ORDER NO.	HIGH SERIAL NO.
COLLINS	14214-PH-51	984
COLLINS	375-P-54	310
MOTOROLA	363-PH-54	3427
COLLINS	8719-P-55	4914
MOTOROLA	14-PH-56	4909
MOTOROLA	14385-PC-58-A1-51	5988
STEWART-WARNER	42428-PC-59	2076
STEWART-WARNER	20139-PC-60-A1-51	4511
EAC	23137-PC-61	4255
CAPEHART CORP.	21582-PC-61	4237
CAPEHART CORP	NONE (FOR NBS, SEE NOTE)	12
AMELCO/TELEDYNE SYSTEMS CORP.	35064-PC-61	3646
CAPEHART CORP. (FOR ADLER ELECTRONICS)	20878-PP-63	5
IMPERIAL ELECTRONICS/ TELEDYNE SYSTEMS CORP.	7856-PC-63	3976
EAC	DAAB05-67-C-0155	10717
*SAME PRODUCTION RUN	*FR-36-039-N-6-00189 (E)	
EAC INDUSTRIES/HAMMARLUND CONSUMER		151
DITTMORE-FREIMUTH CORP.	DAAB05-68-C-0040	215
FOWLER INDUSTRIES	N 00024-84-C-2028	5
Total High s.n. Production		**53,354**

Notes: All Dittmore-Friemuth radios were made by EAC at Red Bank, N.J.
Amelco, Teledyne and Imperial radios were all made in the same L.A. plant by Teledyne.
Communcations Systems of Chicago made some whole sets, but they were reportedly so bad that the Army inspectors would not issue them.
Clavier, Capehart and Fowler are all rooted in the same company.
Capehart for NBS s.n.'s start at 10,000.



High performance vacuum tube electronics at it's finest: A late production R390A that shows little or no use. Many of the later units from the late 1960s were built for contract purposes and set aside, never to enter service.

The following list represents known contract numbers appearing on modules, but as of yet no whole sets are known.

MAKER	CONTRACT OR ORDER NO.	HIGH SERIAL NO.	MODULE TYPE
EAC	DAAB05-68-C-0039	145	MULTIPLE
EAC	N00126-70-C-0359	15	MULTIPLE
STEWART-WARNER	42428-PC-59-A1-51	930	MULTIPLE
STEWART-WARNER	DA-36-039-SC-81549	1948	MULTIPLE
COMMUNICATIONS SYSTEMS	FR-11-022-C-4-26418 (E)	24	MULTIPLE
CLAVIER CORP.	DAAG05-67-C-0016	0	
CLAVIER CORP.	DAAG05-67-C-0136	115	MULTIPLE
MOTOROLA	14385-PC-58-51	6516	RF CHASSIS
TELEDYNE	37856-PC-63-	6595	IF CHASSIS
HACKING LABS	DLA400-80-C-2948	1477	P.S. CHASSIS
CAPEHART	21098-PC-61	547	AUDIO CHASSIS

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FOR SALE: Repair and restoration on all vintage equipment; 45 years experience. Barney Wooters, W5KSO, 8303 E. Mansfield Ave., Denver, CO 80237. (303) 770-5314

FOR SALE: TMC GPR-90, $400; Hallicrafter FPM300, $250; Johnson 250 watt Matchbox w/swr, $100; National NC303 w/spkr, $300; Drake MN4 Ant Tuner, $100. TMC GPR-90, $400; Hallicrafter FPM300, $250; Johnson 250 watt Matchbox w/swr, $100; National NC303 w/spkr, $300; Drake MN4 Ant Tuner, $100. Pickup preferred, Harry, WA6IUR, 626-355-0290, flynham@aol.com.

FOR SALE: Knight T150 and R100 w/optional S-meter and calibrator, both for $275.00. J. Kelly, POB 25, Long Lane MO 65590

FOR SALE: Astron LS10a 28-volt pwr sply good condx, $50.00 u-ship. Dave, W4DWG, w4dwg@juno.com

FOR SALE: War Surplus unconverted ARC-5 command sets $45.00; BC-457A, BC-458A, T-21, BC-455B, R-11 (Q5er), T-366 (VHF-TX), J17/ARC-5 Master Control Boxes $40.00, Navy VHF-rcvr TS-587U $50.00, RCA Mod Xfmr #900291-1, 10K pri to 37K (.83 kv) $60.00, Dynamotor PE-103A $50.00, Vietnam era compact Homelite Signal Corp Gen XLA115 $50.00, Early SB-400 Xmtr $50.00. Ed Hammond, WN1I, 207-336-2858, 207-336-2858

FOR SALE: SR2000 with pwr sply, manual, professional mod to use 4X250B's as finals, $1,200 + S&H. George, W8QBG, 480-986-5797

FOR SALE: Plate and MODULATION transformers, ½ to 1 kw, send SASE for list. W7SC, 3932 S. Mesa View Lane, Boise ID, 83706-6052

FOR SALE: Johnson manuals: Ranger II, VFO; Viking II originals $20.00 ea.; Ranger II repro $15.00; Ranger II schematic $5.00. Prices shipped. John, W8VBQ, 513-575-5561

FOR SALE: Wireless Set No. 19, Radio & dynamotor $150.00 Pick Up only please. SW225 triple knife switch for ART-13 $10.00. Shock mount for LM freq meter $15.00. Shock mount for BC-348 $50.00. Mike 510-732-0932

FOR SALE: Drake TR-4 w/RV-4 spkr, pwr sply & manual, good condx. $225.00. Robert Braza, W1RMB (MA) 508-261-8231

FOR SALE: RF-403 VHF Radio $75.00. Meisner Signal Shifter w/coil set $150.00. Al Jenkins, WA1RWB, 5 Daley Ct., Nantucket MA 02554, 508-325-7122

FOR SALE: Heath HW-101 w/pwr sply $175.00; Heath HR 10-B $50.00. Bruce Beckeney, 5472 Timberway Dr., Presque Isle, MI 49777, 989-595-6483

FOR SALE/TRADE: Original manuals; Hammarlund HQ-100, HQ-110A, HQ-145, HXL-1, SP-600-J/JX. A.J. Bernard, NI4Q, PO Box 690098, Orlando, FL 32869-0098, 407-351-5536

FOR SALE: Collins "S" Line 75S-3, 32S-1 312B-4, 516F-2 good to exc condx, $1,400.00, Cliff Fleury, AI7Y, 509-493-8203

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FOR SALE: Collins TCS rcvr complete, working good condx, manual copy $45.00 + shipping. Jim W8HPL, 740-927-2592

FOR SALE: Gonset Super 12 Converter $50.00, Johnson Ranger I parts unit $75.00, Heath SB-200 amplifier $300.00. Richard Cohen, 813-962-2460

FOR SALE: Heath SB300 $150, SB400 $150, HW101 w/ HP23 $200. Drake TR4C $250, TR3 $150. Ken Sands, K8TFD, 734- 453-7658, ken.sands@juno.com

FOR SALE: Heath HR-1680, exc, $150.00; Heath AR-3, $65.00; Hallicrafters S-38C $65.00. New list, FREE! Richard Prester, 131 Ridge Road, West Milford, NJ 07480. 973-728-2454. rprester@warwick.net

FOR SALE: RCA BTA-1R 1000 watt broadcast transmitter. Excellent condition with tubes. No mod transformer. John P. Tiedeck, 212 Grandview Rd., Media, PA 19063. 610-566-8049

FOR SALE: Weston Selective Analyzer Mod 665 Type 3 Bakelite case $30.00. Layfayette rcvr Mod HA 225 $150.00, TOA 900 series amplifier Mod 901A $50.00, Layfayette CB Rcvr 11-13 Mod 115A w/mic $50.00. Military head sets: On head band HB-7 w/Shure ANB-H-1 $30.00, HB-7 w/Murdock P-23 ear piece $40.00, Learadio MOD VCU-1 mouth mic $25.00, Trimm head set $20.00. Bernie Samek, 113 Old Palmer Rd, Brimfield MA 01010, 413-245-7174 ex 0441

FOR SALE: Rare teletype Model 14 Non-typing reperforator, near mint condx $300.00 Bob, KL7HDX, 907-346-1044

FOR SALE: Repro Nameplates, R-390A generic $9, S1J-3 and S1J-4 exact replicas, $12. Tom Marcotte, N5OFF, 210 CIem Dr., Lafayette, LA.70503. courir@yahoo.com

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

FOR SALE: R.L. Drake repair and reconditioning, most models including TR-7's, 35 years experience. Jeff Covelli, WA8SAJ, (440) 951-6406 after 4 PM, ws8saj@ncweb.com

NOTICE: Visit HamRadioUSA.com a website dedicated to traditional ham radio & vintage radio resources. http: //www.radioing.com. Let's radio. W5AM

FOR SALE: Heath Nostalgia, 124 PG book contains history, pictures, many stories by longtime Heath employees. (See BOOKS inside back cover.) Terry Perdue, 18617 65th Ct., NE, Kenmore, WA 98028

FOR SALE/TRADE: Manuals: S53A, DX100, 75A4, DX4O, 75A1, Ranger, TR5, 30L1, HA350, NC183D. A.J. Bernard, POB 690098, Orlando, FL 32869. 407-351-5536

FOR SALE: Pwr sply BC-610-I, BC-375E, PU only, Prescott, AZ. W7RBF, AZ 928-778-1993

FOR SALE/TRADE: Radio & TV test equip; BC-348; BC-221; Bear Cat 4,101. Local PU. Alan Mark, POB 372, Pembroke, MA 02359.

FOR SALE: DX-35, DX-40 reproduction crystal doors. $11.50 shipped. Texans add 8.25% sales tax. Glen Zook, 410 Lawndale Dr., Richardson, TX 75080

FOR SALE: Radio tubes, used, tested, bargain prices, lists free. Galena xtals, detectors, radios, parts, etc. Len Gardner, 458 Two Mile Creek Rd., Tonawanda, NY 14150 radiolen@aol.com

FOR SALE: TX'ers, rcvrs, parts, manuals, etc. Send a large SASE. EFJ Thunderbolt excellent $900.00 YaesuFT-22m FM $50.00 Regency HR2A $35.00 Regency 12V PS $15.00 More at http://come.to/AF4K/ Brian Carling, 117 Sterling Pine Street, Sanford, FL 32773

FOR SALE/TRADE: Transmitting/rcvr'g tubes, new & used. .55 & LSASE for list. I collect old & unique tubes of any type. WANTED: Taylor & Heintz-Kaufman types & large tubes from the old Eimac line; 152T through 2000T for display. John H. Walker Jr., 13406W. 128thTerr. Overland Park, KS 66213. 913- 782-6455 jhwalker@prodigy.net

FOR SALE: Treasurers from the closet! Go to www.cjpworld.com/micromart to find some unique items many hams would lust for! Gus, WA, 360- 699-0038 gus@wa-net.com

FOR SALE: BC-375-E, BC348-Q, xtras, both - $400. Kelly, POB 25, Long Lane, MO 65590.

FOR SALE: Books, send SASE. **WANTED:** Anything by Fairchild or Langevin. send sase for my want list. Richard Robinson POB 1425 Wallingford CT 06492, 203-949-0871 or richmix@erols.com

FOR SALE: OEM Heath belts -$2.50 each shpd or 10+ for $2 each shpd. Send check or money order. Roberta Hummel, 202 Midvale Dr., Marshall, WI 53559

FOR SALE: Manuals for old ham gear of the '30s to the '70s.Check WEB Catalog www.himanuals.com

FOR SALE/TRADE: Misc. parts, tubes, for tube gear. Sandy Blaize W5TVW, 40460 Edgar Traylor Rd., Hammond LA 70403. ebjr@i-55.com

FOR SALE: Vintage equipment at the K8CX Ham Gallery Classified Ads section. Visit the largest Antique QSL Card Gallery http: // hamgallery.com

NOTICE: T-368 Registry. For info w2zr@aol.com Subscribe to the T-368 & BC-610 reflector at http://groups.yahoo.com/group/T-368_BC-610

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

FOR SALE: Strong steatite antenna insulators. Lengths from two to fifteen inches. SASE for list. John Etter, W2ER, 16 Fairline Dr., East Quogue, NY 11942. 516-653-535

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FOR SALE: Build your own "Midget" bug replication by K0YQX, ca 1918, featured by K4TWJ in CQ Magazine, May '98. 10 detailed blueprints. FAX: 507- 345-8626 or e-mail bugs@mnic.net

FOR SALE: Parts, tubes, books, ECT. Send two stamp SASE or email for list. Wayne LeTourneau, POB 62, Wannaska, MN 56761 wb0cte@arrl.net

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FOR SALE: New Release. For details send 2-stamp LSASE to: Olde Tyme Radio Co, 2445 Lyttonsville Rd. Ste 317, Silver Spring, MD 20910

FOR SALE: WACO-5NWX telephone filters. Just plug in. 1 /$13.95, 2/$25, 3/$34. Money back. Cecil Palmer, 4500 Timbercrest Ln., Waco, TX 76705. 254- 799-5931 w5nwx@hotmail.com

FOR SALE: 51J-4 filter replacements, direct plug in—6.0 kc Collins mech. filter, 3.3 xtal lattice, 2.3 kc xtal lattice, 500 cycle xtal lattice - $245 each; R390A 16kHz flat phase filter, for Hi-If AM-$245. Inquire about free AM xmtr parts, PU only, or S&H charge otherwise. Chuck Felton, KD0ZS, WY, 307-322-5858, feltoned@coffey.com, www.feltondesign.com

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

FOR SALE: PANEL AND CABINET REFINISHING; Johnson, Hammarlund 180(a), R390(A), & others total restoration & sales; My updated web site: http://w4pnt.8k.com Patty & Dee's Marina; Dee Almquist, 534W. Main St., Waynesboro, VA 22980. 540-249-3161 Cell: 540-480-7179, FAX 540-249-5064

FOR SALE: RIT for Collins KWM-2/2A; No modifications needed. $79.95 SASE for details. John Webb, W1ETC, Box 747, Amherst NH 03031 bigspndr@bit-net.com

FOR SALE: Knight R100A, T150, $75.00 each; Johnson Ranger 1 parts unit $100.00. Richard Cohen, FL. 813-962-2460

FOR SALE: 2 ¼" dia XP53 plug-in coils; 3 ea. 5 pin, 1 ea. 4 pin, All 4 $6.00 + shipping. Henry Mohr, W3NCX, 1005 Wyoming, Allentown, PA 18103-3131

FOR SALE: Aluminum heat dissipating plate and grid connectors for all 3, 4 and T series Eimac including 3-500Z, 4-1000, 304T's and 1000T's, W1ETC, Box 747, Amherst, NH 03031 etc. Alan Price fixr7526@cs.com

FOR SALE: QST full years '51, '53, '56 $12.00. '43, '46 $16.00 each. Shipped USA. Tom Berry, W5LTR, 1617 West Highland, Chicago IL, 60660, 773-262-5360

FOR SALE: Hammarlund SP-600-JX-17, good condx w/ specific (correct) manual $450.00 shipped. ABe (W3DA) in Delaware 302-349-5389 before 10 PM please.

FOR SALE: Many parts for radio builders please call to discuss needs. Joe Battyany, W6CAS, 1501 Sherwood Ave., Sacremento CA 916-731-8261

FOR TRADE: Two good RCA 833A's for one Taylor 833A; also looking for Taylor 204A, 813, TR4OM. John H. Walker Jr., 13406W. 128th Terr., Overland Park, KS 66213. (913) 782-6455, jhwalker@prodigy.net

FOR SALE: Hallicrafters spkr R-46B $100; Brush BK-401 Soundmirror tape recorder $100; 1959 Bogen stereo amp $50 OBO; Saba-Freiburg Vollautomatic-15M stereo radio $25; ElectroVoice Aristocrat spkr $150; Heathkit A-7 amp $25; Scott 209 amp $150; Scott 300 tuner $150. R-1/ARR $25.00. PP-412/CPS-6B p.s. $25.00. Packing and shipping extra. All items "or best offer" Henry Schwartzman, 32 E. First St., Corning NY, 14830, 607-962-0442 breakacd@hotmail.com

Henry Schwartzman, 32 E. First St., Corning NY, 14830, 607-962-0442 breakacd@hotmail,com

WANTED: (Badly) Harvey Radio Labs Model FT-30, 1935 Xmtr. See E. Rippon guide p.57 or FOS p.257. This was my rig back in 1941 when my call was W1NLL. If needed, I will send you a picture copy. I will pay $1000.00 plus shipping for one in almost any condition. Robert Enemark, W1EC, PO Box 1607, Duxbury MA, 02331. 781-585-6233

WANTED: Hammarlund Super-Pro 200 series pwr sply parts. Buy or Trade. Bill Coolahan, 1450 Miami Dr. NE, Cedar Rapids Iowa, 52402-2933. 1-319-393-8075

WANTED: Wanted: Manuals for Collins Antenna Tuners 180-Y and 180-V Mike Kincaid - W7FKF, 248 Justin Road, Murphy, TX 75094, 972-578-1120

WANTED: Schematics only for Heathkit 180-Y and 180-V SS-9000. Have all other info. Marvin, 770-290-314, moss@mindspring.com

WANTED: Collins 51J-4 complete, reasonable price paid for a nice clean one. Art Plummer, 650-359-1858, w6lr@arrl.net

WANTED: GRC-9 microphone, Headset, speaker. Lee, N2UDF 315-656-9578,or Lcarroll@post.com.

WANTED: Coil sets for HRO-50. Casey, W8FDE MI 231-755-1579 FAX 231-737-3101

WANTED: Panel meter M-100 for Johnson Desk KW. 50-500 MA DC grid-modulator current. Face marked two scales. Bottom 0-50, Top 100, 200, 300, 400. Also bottom of face #796, FS=5MA, 20 ohms 100 mv. Or does

anyone know how to modify the circuits for maybe two separate meters? Bob, WA6ICL, 14463 Astoria St., Sylmar CA, 818-362-7404

WANTED: Hallicrafters SX100 general coverage rcvr (mark 2 preferred): excellent operating condx (others considered). J.I. Lillie, PO Box 128, Onondaga MI 49264. 517-628-3531

WANTED: SB-104 main tuning knob. Ed Cuevas, Ft. Worth, 817-222-5355, ecuevas@juno.com

WANTED: To correspond with Doerle, Gernsback, Shuart, Morgan, Worcester, Radio For The Millions, builders. Bob Ryan, 1000 S. Gilbert St., Apt. 132, Hemet CA, 92543-7065

WANTED: Cakepanion 2 tube regen rcvr. Prefer w/all coils. Doug Reeves, WB6RKY, PO Box 278135, Sacramento CA 95827. wb6rky@hotmail.com

WANTED: Coil "C" for HRO-60. Gerald Park W8QS, 517-351-5106, park@msu.edu

WANTED: Galaxy (WRL or HyGain) LA-550 Linear, RF-550 Wattmeter, CAL-250 calibrator. All answered! Kelley, W8GFG, 9010 Marquette St., St. John IN, 46373; 219-365-4730

WANTED: Used small Greenlee square punches, especially ¾". Also cosmetically perfect, but inoperative BC-611s. Louis L. D'Antuono, 8802-Ridge Blvd, Brooklyn NY 11209, 718-748-9612 6 PM please.

WANTED: Tech help to modify xtal controlled transistor CB rig for ham bands. Rex, PO Box 4518, Jeffersonville IN, 47131, 812-282-4824

WANTED: Small open frame DPDT 110 VAC relays with 3/16 inch contacts, N.I.B., chassis mounting. L. D'Antuono, 8802 Ridge Blvd, Bklyn NY 11209, 718-748-9612

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

WANTED: AN/WRR3-R1134 VLF receiver. Jack Holzer 913-791 5141, days

WANTED: KNOBS and front panel meters for the GRC-19 set, T-195 and R-392. Please contact Gary W5UUO, 450 Cunningham Road, Celina, TN 38551 931-243-5323 w5uuo@info-ed.com

WANTED: James Millen plug-in coils p/n 42080, 42040, 42015, 43015. Bretting 14 manual. Gary Carter, WA4IAM, 1405 Sherwood Drive, Reidsville, NC 27320. Phone: 336-349-1991. Email: gcarter01@triad.rr.com.

WANTED: Westinghouse MW-2 and MW-3 transmitters and parts. Also HP Model 1727A Oscilloscope manual. Gary, WA4ODY, Seabrook TX 77586, 281-244-7695, myctpab@earthlink.net

WANTED: Manual for General Radio Co. Unit Oscillator Type 1211-C (.5-50 Mc.) Jim Eberwine, W4APV, 8118-37th Ave. North, St. Petersburg FL. 727-347-0942

WANTED: Empire PA210 Panadaptor, URM-25 Sig Gen, URM-26 Sig Gen, URM-7 Rec SBT. Dean, 6725 Portland Ave South, Richfield, MN 55423

WANTED: Manual and schematic diagram for LAPP Power Supply Model 73. 0-18v, 0-36v, 30 Amps (?). Alan Lurie, W9KCB, 605 East Armstrong Ave., Peoria, IL, 61603. 309-682-1674

WANTED: Schematic diagram for Freq Meter CRR 74028 (part of LM-13). Frank Hill WA6SYI 1313 Milton Ave., Walnut Creek CA, 94596 fdhill@attglobal.net

WANTED: Hallicrafters HA-20 VFO Line Sampler, or schematic and parts to homebrew. H.I. Stark, K9UBL, 3215 S. Meridian Street, Indianapolis IN 45217-3231

WANTED: Radios Master catalogs, pre vol #12th ed, all before 1947. R.V. Matson, W1CSO, FOB 956, Lake Panasoffkee, FL 33538. (352) 568-1629

WANTED: SCR-522, other WWII radio for flying aircraft restorations. NIB or exc condx. Ian Abbott, KC6UPT, 209-747-3639 ian@wildblueaviation.com

WANTED: TBX radio and/or accessories required by military radio collector. Ray, VK2ILV, ROBINSON@SHLRC.MQ.EDU.AU

WANTED: Older rigs & accessories. Brian Carling, AF4K, 117 Sterling Pine St., Sanford, FL 32773. http://come.to/AF4K/

WANTED: Fully functional w/manuals: Johnson AN/FRT5O5 xmtr, Swan F51 and FC76. Contact Ric at C6ANI@ARRL.NET

WANTED: 70' or larger crank-up tower, prefer Tenn, KY, W8, W9, W0, W5, AZ location, others considered. Tom Berry, W5LTR, 1617W. Highland, Chicago, IL 60660. (773) 262-5360, 262-0016

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

WANTED: National Co. emblems, escutcheons, and logos from equipment, also National AN/WRR2 in working order. Don Barsema, 1458 Byron SE, Grand Rapids, MI 46606. (616) 451-9874. dbarsema@prodigy.net

WANTED: Still looking for manual, schematics, trouble-shooting, RCA F Rx by TMC R-5007A/FRR5O2. David Boardman, VA2DVD, 418-877-1316 radioman@dbtubes.com

WANTED: Heath SB series parts source; B&W 160,80,40 JEL coils; McElroy bug. Brian Roberts, K9VKY, 130 Tara Dr., Fombell, PA 16123.724-758-2688, k9vky@arrl.net

WANTED: BC-348 () rcvr w/following suffix: B,C, H, J, K, M, N, P, S, for collection. Ken Kolthoff, K8AXH, POB 215, Craig, MO 64437. 660-683-5353

WANTED: Any TMC equipment, what have you. Will trade for TMC equip. Brent Bailey, 109 Belcourt Dr., Greenwood, SC 29649. 864-227-6292

WANTED: B&W plug-in coils 80MEL, 800ES, 80BVL, 80JVL, 80TVL. Jim Jorgensen, K9RJ, 1709 Oxnard Dr., Downers Grove, IL 60516. 630-852-4704 k9rj@attbi.com

WANTED: Racal rcvrs; manuals for RA6790/GM/ELF/VLF; Plessey IMR5000 manual; Plessey radios. Allan, Norco CA, (310) 812-0188, alan.royce@trw.com

WANTED: ARC-5 rcvrs, racks, dynamotors. Jim Hebert, 1572 Newman Ave. Lakewood, 0H 44107.

WANTED: Antique tubes. Paying $40 ea for good used type 201 tubes (not A). Buy list catalog of collector tubes available. See www.fathauer.com. George H. Fathauer & Assoc., 688W. 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: Collins 70K-2 PTOs working or not; 1N82A diodes; Bretting 14/14AX manual. Clark, WØBT, KS, (785) 286-2132

WANTED: Seeking unbuilt Heathkits, Knight kits. 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

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

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

WANTED: 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/PSO15O, RC8150; Triad A-9-J, A-l0-J, A-1l-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: 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

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

WANTED: 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, K8OX, K85. Any condx. James Treherne, 11909 Chapel Rd., Clifton, VA 20124. treheme@erols.com

WANTED: ARC-2, ARR-7 and ARR-15 racks; BC1387for BC-611; whip antenna forPRC-124. Joseph Pinner, KC5IJD, 818 Hill St., Kingston, TN 37763. kc5ijd@bellsouth.net

WANTED: WW II German, Japanese, Italian, French equipment, tubes, manuals and parts. Bob Graham, 2105 NW3Oth, 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, Fax 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: DC ammeters, aircraft instruments, panel meters; meter books & gauge catalogs; photos of meters & control panels. Chris Cross, POB 94, McConnell, IL 61050.

WANTED: Service manuals, originals, and copies for copy of HP 3330B, HP 3582A, and HP 11710A. Will pay ALL exp. and more! Reinhard Wieschhoff, 7 rue du Debuche, F-78120 Rambouillet, France. Tel/ Fax: 00331304111 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 antennas AT1O1, AT1O2, GRC-9; Bendix ATD tuning unit Type CRR 47211, 9050 to 15800 kcs; Gas engine generator UPG-12 (GRC-109) 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 model, 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: SB 110/ps (Heath 6 meter transceiver) Bob Speckhals 1-507-331-5103 WB0DMC

WANTED: Parts to complete AN/ARC-59 RDF system for ER avionics article: Need DY-150/ARN dynamotor; MT-1913/ARN mount base; cable assy ARC-17984 or ARC-18637. Please call or email Ray, N0DMS at ER: 720-924-0171, ER@OfficeOnWeb.net Thanks to all who have responded.

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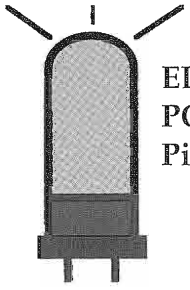

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