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ELECTRIC RADIO

celebrating a bygone era

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Hal Guretzky, K6DPZ

ELECTRIC RADIO

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

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

Regular contributors include:
Bob Dennison (W2HBE); 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

We are fortunate this month to have an article by Van Field (W2OQI). Van was actively involved in the development of early FM and police radio before World War Two, and was one of the first Hams to be active on VHF FM. The W2OQI repeater is probably the oldest in the New Jersey area. Also in this issue, Geoff Fors (WB6NVH) is bringing back "Electric Radio In Uniform" for an article about vintage police radio. Not much has been written on the history of early mobile radio, and I'm hoping that Electric Radio will be able to present some of it in future issues.

Bruce Vaughn (NR5Q) is taking a break this month. His regular column will continue with the July 2003 issue.

Museum Ship Weekend, July 19 and July 20

Bob Callahan (W1QWT) sent me an announcement about an exciting vintage operating event. Here is part of Bob's letter:

"...We now have 45 participating ships for Museum Ship Weekend on July 19th and 20th! Most ships will be on SSB and CW but some will also operate their original radio equipment on AM. For AM please consider 3885 Khz, 7290 Khz, 14286 Khz, 18150 Khz, 21285 Khz, 29000-29200 Khz, 50.4 Mhz. The Cassin Young will also be calling CQ on 144.425 Mhz AM using a RCK receiver and a TDQ transmitter. Both World War Two vintage original equipment on the USS Cassin Young. The USS Cassin Young will have a SRT-15 on 75 meter and 40 meter AM. SSB and CW ops will take place on regular Amateur Radio frequencies at the discretion of the shipboard ops. Hams who work 8 or more of the participating ships and send a copy of their log to K1RMC will receive a certificate. Check it out: http://www.qsl.net/ww2dd/event.html Keep an eye on the web page. I am thinking of giving an award to the ship in both North America and Europe that makes the most QSO's also a Ham who contacts the most ships from North America and from Europe will get an award. This gives the European ships and Hams a chance."

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AM International Update, April 2003

by Dale Gagnon, KW1I
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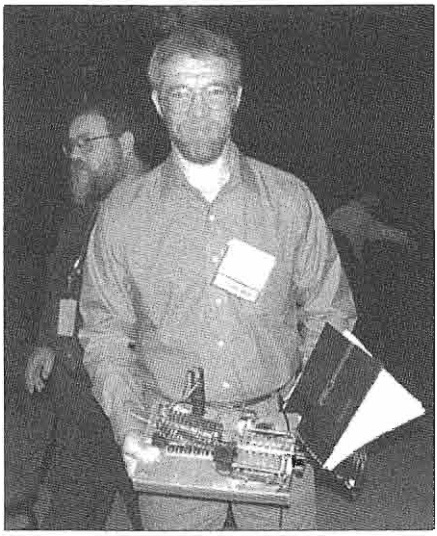
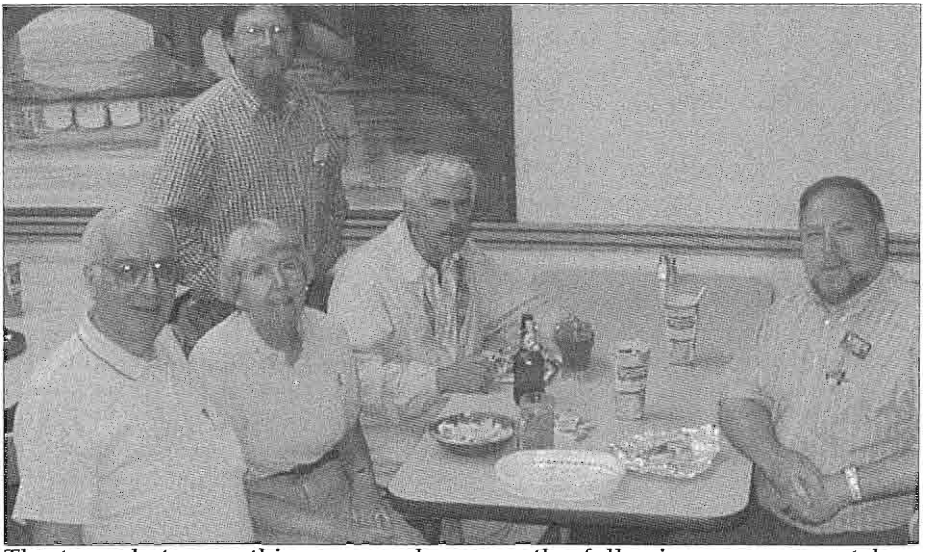
Hamvention 2003 - After missing a year of Dayton I was very excited to get back. My brother Dean (KK1K) and I arrived in Ohio on the Thursday before Hamvention weekend. We first visited Fair Radio Sales in Lima. I had not seen their new location. It was a much better situation than their other facility with lots more showroom and shelf space. I found a BC-191 in pretty good condition for David Olsen (W6PSS). I called him from the showroom floor and he immediately called Fair Radio back and bought the unit. Dean, who had been at Fair shortly after the move from the old location, was very impressed at the progress they had made organizing all the material since the last visit. Later in the afternoon we checked out our flea market spot at Hara Arena on the way to our motel, and found quite a bit of trading activity underway.



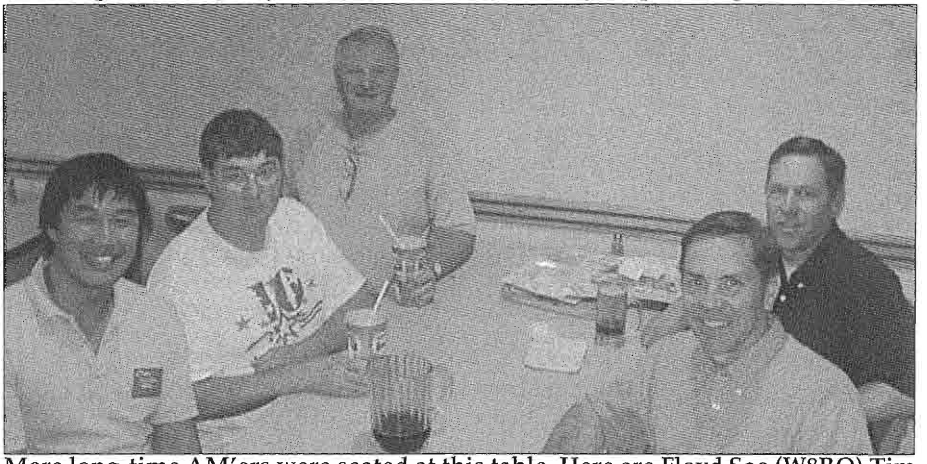
Steve (WA1QIX) was the speaker at the AM Forum this year, and is pictured here with his prototype Class E rig. (Photo by Ken Barber, W2DTC)

Friday dawned gray, but turned into a nice day. Steve (WA1QIX), the AM Forum speaker, had arrived the night before. We had over 50 at the AM Forum. Steve did a great job in spite of a flaky LCD projector. His talk on Class E Transmitters for Amateur AM was well received and there was a lot of interest in his prototype 300-watt transmitter and modulator/ power supply on display. The flea market had plenty of vintage gear. Some images from the flea market are available on Ken's (W2DTC) website. Interested readers may link to it from "2003 Remembered" at www.hamvention.org.

Saturday began misty with light rain. We were not allowed into the flea market until 6:00 am. I had checked into the Military Radio Net on 3885 using my mobile antenna on the way to the flea market, but had hoped to connect up to the 26 ft. vertical with four radials that I had set up in our spaces on Friday. By the time we got to our spot the weather related QRN was up and the signals were down. The weather got worse throughout the day. In fact, "total washout" would be an apt description. The indoor exhibits were busy, but attendance overall during the day was way down. Saturday evening about 35 AM ops and Collins Collector Association people met at Marion's Pizza for several hours. Pictures and stories were swapped and acquaintances renewed. Sunday was overcast to start, but rapidly improved. The number of people in the outdoor exhibit area was more than in other years for the last day of the hamfest. I think the local Ohio population that makes a day trip to the Hamvention did not come at all on Saturday because of the weather, and came instead on Sunday. We did not



The two photos on this page, and one on the following page, were taken Saturday evening, May 17th at Marion's Pizza. At this table were gathered Ken (W2DTC), and Padd, Ken's wife, Don Chester (K4KYV), Dr. John (KN4ME) (standing) and Gary Taylor (WB8BEM). (2 photos by Roger Klingman, KØRMK)



More long-time AM'ers were seated at this table. Here are Floyd Soo (W8RO),Tim Long (N5DWV), Paul Johnston (W9PJ), Dean Gagnon (KK1K), and Dale Gagnon (KW1I).

have a special event AM station this year as we did in 2000 and 2001. The outdoor exhibit tent spaces with AC power were not offered last year or this year.

Hamvention attendance has not been announced, but is expected to be down again. The rumors were circulating about the event moving someday. They no longer have a banquet Saturday evening. The important and well-attended FCC Forum was cancelled a few weeks before the event. But, on the positive side, the staff at the local Waffle Houses all had Hamvention 2003 T shirts on and were telling us to come back and see them in 2004. And that's what we are planning to do! ER

Loy E. Barton, Pioneer of Amplitude Modulation

by Jim Haynes, W6JVE
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Loy E. Barton (1897-1986) was born in Fayetteville, Arkansas and graduated from the University of Arkansas at Fayetteville in 1921 with a Bachelor's degree in Electrical Engineering. He remained at the University as an instructor in Mechanical Engineering while working toward the degree of Electrical Engineer, which he received in 1925. His thesis project was construction of a 500-watt broadcast transmitter for the campus radio station, KUOA. {Footnote: KUOA was later sold to John Brown University at Siloam Springs, AR, where it remains today.} KUOA had started with a 100-watt transmitter built by a small company in Oklahoma. This had given disappointing results, being unable to achieve statewide coverage. The faculty had concluded that a 500-watt transmitter was needed, and it that it could reasonably be built in-house.

Things were rather primitive in those early days. After considering several circuits the designers settled on a Hartley oscillator, using two "250-watt" tubes in parallel. The main tuning coil was wound with 1/2" copper tubing. The modulation scheme was standard for the day, the Heising choke-coupled or constant-current method. Barton noted two drawbacks to this system. First, you can never get 100% modulation, since the modulator tube cannot pull the plate voltage all the way to zero, nor can the inductor make the voltage swing up to twice the steady-state supply voltage. Second, the modulator has to be a linear Class-A amplifier. Class-A amplifiers are inefficient, so you need more and bigger tubes for the modulator than are needed for the RF power stage. He considered using a step-up transformer to couple the modulator to the RF stage and thus achieve 100% modulation; but there was not enough time to pursue this idea. They built a transformer-coupled amplifier for the studio, taking its input from a double-button carbon microphone. This had its share of problems, including shrill sound. An attempt to fix the problem with shunt

Loy E. Barton received his B.E.E. degree in 1921 and the EE degree from the University of Arkansas. From 1921 to 1925 he was an instructor in mechanical engineering at the University of Arkansas and from 1925 to 1927 he was a Radio Test Engineer with General Electric. He was an Associate Professor at U. of Arkansas from 1927 to 1929 in Electrical Engineering. After 1929 he was with RCA and Philco. During WW2 he directed Sonar development with RCA in Camden NJ, and worked on radar at the Naval Research Laboratory in Washington until 1945. He was a senior member of the Institute of Radio Engineers.

capacitors succeeded only in moving the peak lower in the frequency response. Apparently the concept of running a frequency response curve did not exist at the time; or perhaps they lacked the necessary equipment. In any event, they built a new resistance-coupled amplifier which proved satisfactory. Later they rebuilt the first amplifier with better quality transformers and used it for remote pickup applications, as it was battery powered. The modulator consisted of three "250-watt" tubes in parallel. Early attempts to operate this way suffered from horrible audio distortion and excessive plate current in the modulator tubes. Successful operation could be obtained only by running with two tubes at a time. They discovered a parasitic oscillation, which was cured with RF chokes in the plate leads of each modulator tube. The driver amplifier for the modulator was powered by storage batteries. There were four strings of batteries connected in series to give a 400-volt plate supply. During the hours the station was off the air a switching arrangement connected the four strings in parallel so they could be charged from the power line with a Tungar rectifier. They learned the hard way that the audio line between the studio and the transmitter room had to be balanced to avoid intolerable noise pickup. The antenna was a 12-wire flat top strung between masts attached to the two towers of the main University building (which is still standing, but without the masts). The tin roof of the building served as a counterpoise. There was also a water pipe ground, but only for lightning protection. Measurements showed that the bulk of the RF current flowed in the antenna-counterpoise system. B+ for the RF and modulator stages came from a motor-generator set. The filaments were operated on AC. There was a noticeable hum on the transmitted signal. Barton reasoned that this could not be the result of heating and cooling of the filaments; they were far too massive. He concluded the probable cause was magnetic attraction between the filament wires, causing them to bend and straighten at each half cycle of the current. He sent a survey to about 75 broadcasting stations across the country, asking among other things whether they used AC or DC on tube filaments and whether they had problems with hum on the signal. Of the fifty or so replies received, most were using DC on the filaments; and most of those using AC on the filaments reported having hum. A motor-generator set was ordered to supply DC to the filaments of the big tubes, but did not arrive before Barton's thesis was submitted. Other than that, the station was considered satisfactory. Reception reports came from all 48 states, Puerto Rico, and Cuba.

After receiving his advanced degree Barton went to General Electric. He returned to the U of A two years later as Assistant Professor of Electrical Engineering. In 1929 he published a pamphlet, "A Band-Pass Filter for Radio Transmitting Stations." The idea was to add some tuned circuits in the plate circuit of a class-C RF power amplifier to reduce the harmonics and strengthen the fundamental. This is not something you would want to use in an amateur transmitter, since it adds several tuning adjustments; but it is entirely practical and useful in a transmitter that remains on one frequency. What is interesting about this development is not so much the filter itself as the way it was tested. They had no oscilloscope that would have shown them the waveforms in the operating circuit. What they did have was an oscillograph, an instrument in which galvanometers swing tiny mirrors to deflect spots of light onto moving photographic film. The frequency response of this instrument was, as you can imagine, quite

limited. Barton built a model of the transmitter with all the components scaled to operate at a frequency of 175Hz. This allowed the waveforms to be captured on the oscillograph, showing that the circuit performed as predicted.

In 1930 Barton, by then an associate professor, published a pamphlet that remains one of the most important developments in the field of amplitude modulation. It is titled, "A Plate Modulation Transformer for Broadcasting Stations." What it actually contains is a design for a class-B push-pull modulator transformer coupled to the RF power stage of a transmitter. This solves both of the problems of the Heising modulator. The transformer can be made step-up or step-down as needed to deliver a peak voltage equal to the DC plate voltage of the RF stage, so that 100% modulation is achieved. And a class-B amplifier is as efficient as you can get, with the technology of that day, and still be linear, as a modulator must be. This design set the standard for AM transmitters for years to come. Strictly speaking, the modulator cannot be run exactly in class B, because the tube characteristics get a little kinky right around cutoff. Barton showed that satisfactory linearity could be obtained with just a small idling plate current, so that the efficiency was almost as good as class B. Designing the modulation transformer was quite a challenge. Unlike a power transformer it has to operate over the full broadcast audio range of frequencies. This means it must have enough primary inductance for good low-frequency performance and very little leakage inductance to limit high-frequency coupling. Then there is the high current through the secondary on positive peaks, tending to saturate the core. One must either use a lot of iron to prevent saturation, or do as Barton did and put an air gap in the core. (In which case one must use a lot of iron to makeup for loss of inductance caused by the air gap.) The transformer was designed for a 1KW modulator. According to the pamphlet it had been used in the U of A radio station since sometime in 1928 with very satisfactory signal reports. It is interesting that the theoretical discussion does not speak of carrier power and sideband power as we would today. Rather this is addressed intuitively; if you are transmitting a steady carrier you are not producing any audio in the receiver, no matter how powerful the carrier. The power supplied by the modulator is what winds up as receiver audio. In 1929 Barton went to RCA, where he remained for the rest of his career except for three years 1936-1939 when he was at Philco. No doubt the Sarnoff empire wanted his patent. Was the University so naive that it failed to patent the valuable technology for itself? In any event Barton thus avoided joining the tragedies that later played out with Armstrong and Farnsworth as they tried to remain independent of RCA. Although Barton was not a Ham, he had an article published in QST in 1931. The editors' preface reads, "It is our conviction that Mr. Barton's article on the Class B modulator marks an advance in amateur 'phone technic just as significant as was QST's publication of the first practical information on 100% modulation in 1929. It means the realization of a modulation system that meets our present requirements in every respect, giving complete modulation with high quality and, best of all, placing these desirable features within easier reach of our pocketbooks. It offers us more — many more — 100% modulated watts for our dollars." Complete construction information was promised for a future issue. Barton became quite an authority on and advocate for Class B amplifiers, as evidenced by articles published in Proceedings of the I.R.E. in 1931, 1932, and

1936. He observed that the single-ended audio power output tube is the most power-wasteful element in a broadcast receiver, and advocated a Class B push-pull amplifier in that application. He noted that this was especially important in battery-operated receivers since battery power is so costly. He suggested that at certain power levels it might not be convenient to plate modulate the final amplifier of a transmitter. In this case one could modulate a lower-power stage and then use a linear amplifier to get to the desired power level. Now in SSB operation a linear amplifier has to really be linear to preserve that complex waveform we have worked so hard to produce. In AM this is not quite true; it is required only that the amplitude of the output be linearly proportional to that of the input. The tank circuit takes care of making the waveform sinusoidal. Thus it is sufficient to use a single-ended Class B amplifier in this application. The tube amplifies the positive half-cycle and the tank circuit furnishes the negative half-cycle while the tube is cut off. None other than Dr. Heising commended Barton's 1931 I.R.E. Proceedings paper, saying it "should be read by everyone who contemplates developing apparatus in which power efficiency of the radio equipment is important." and "The amplifier possesses requirements of its own that react upon other parts of the equipment. These have been discussed by Barton probably for the first time." Barton's publications on other topics include circuits for amplified AVC, some circuits using transistors (in 1949, when the transistor had just been invented!), an experimental transistor broadcast receiver, and use of semiconductors to measure temperature. His 60 some-odd patents include these topics plus oscillators, flight simulation, loudspeakers, servo amplifiers, pulse circuits, semiconductor devices, and a phase-shifted double-sideband two-channel A.M. communications system. After retirement from RCA he is listed as a co-inventor of a machine to manufacture rugs and carpets.

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Patents

1935 RCA Class B audio amplifier 2,023,506 Shows a possibly zero-bias class B push-pull audio amplifier and means to suppress parasitic oscillations. Refers to two co-pending applications, one for a biased class B amplifier and the other for a zero-bias amplifier.

Barton was issued 65 other patents, the last one being granted in 1968.

The 1-Tube Back to the Future CW Transceiver

by Hal Guretzky, K6DPZ
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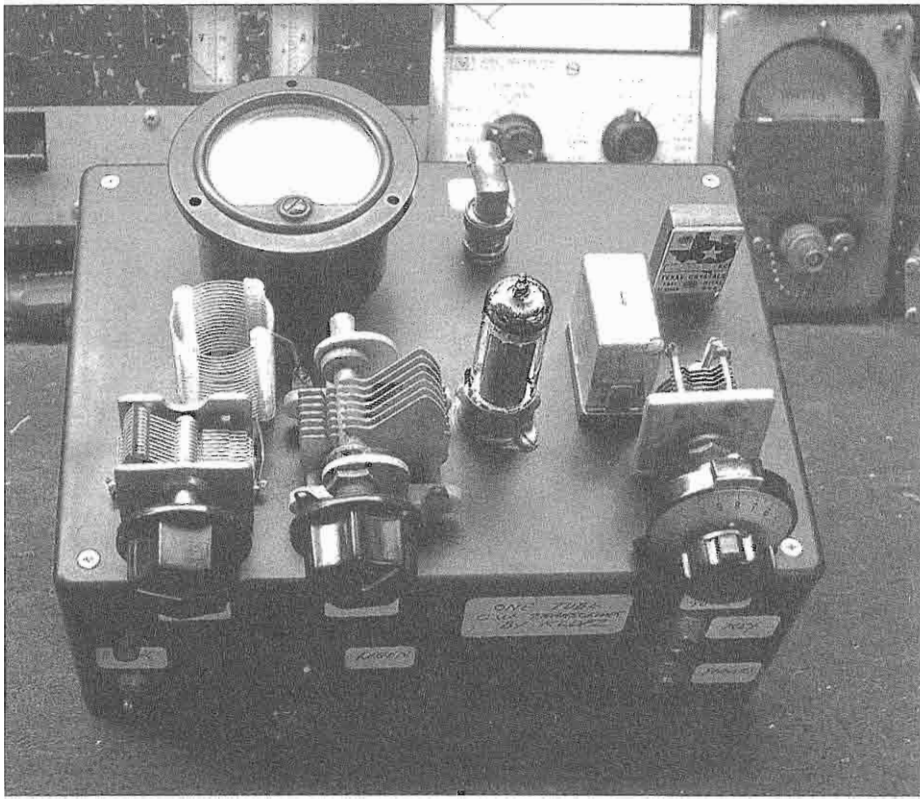
One morning in my favorite coffee shop while I was waiting for the java to show up, I thought up the concept of using just one tube for both receiving and transmitting. My idea was to use this one tube as a self-contained transceiver having a CW sidetone and full break-in keying. I thought to myself "Gee, nobody's done it with just one tube, so why not try it?" The original prints were done on a napkin that morning. I ended up calling the rig my Back to the Future 1-tube CW transceiver. It features a crystal controlled Colpitts oscillator in the transmitter, and a Hartley regenerative detector as the receiver.

The best way to understand the transceiver is to start by looking at the schematic in Figure 1. I use a 6PDT relay with a 10K DC coil, because it is the simplest way to implement a sidetone and full break-in keying in a small space. The high impedance relay will close with the key; the 10-uF capacitor will keep the relay closed until the charge across it has bled off. Then it goes back to receive. The relay is shown in the receive position. Increasing the value of the 10-uF capacitor will produce a little longer time constant if somebody wants a longer keying time.

K1a switches the antenna between the transmitter plate circuit and the receiver coil. K1b switches the input grid circuits of the 6AQ5. In receive, the receiver coil is connected to the grid to form a Hartley regenerative detector, and in transmit it connects to the transmit crystal and the tube becomes a Colpitts crystal oscillator. K1c keeps the transmit crystal grounded in receive so that there is no chance of interaction between the crystal and the regenerative receiver. When I am transmitting, K1d connects the tube's cathode to DC ground through a 1N4007 diode that is isolating the other 1N4007 diode on the 10K relay. Closing the key pulls in the relay. Also during transmit, the plate relay contacts, K1e, switch over to the 275-volt built-in plate supply through a 2.5 mH choke, and a plate current meter. We use a 0-50 mA meter, and the way ours works is that it dips out at about 32 mA for about 5 watts output which is about 7 to 8 watts input. This makes for an ideal, easy to build QRP rig that is about 70% efficient. I got the rig going in only two days.

The basic circuitry of the transmitter can be set up for either 80 or 40 meters with no problem. The transmitter utilizes a pi-output for easy matching to the antenna load. The exact values of the pi network are left to the discretion of the builder as far as the value of inductance goes. I've shown the capacitance I used, but the inductance will depend on the size of the coil you have on hand. Builders will need to play with their grid dip meter to set up the pi network, and the procedures for doing this are found in nearly any radio handbook.

In the transmit position, the transceiver has sidetone. If you look at the schematic you will notice the NE-2 lamp, the .005 and .001 capacitors, a

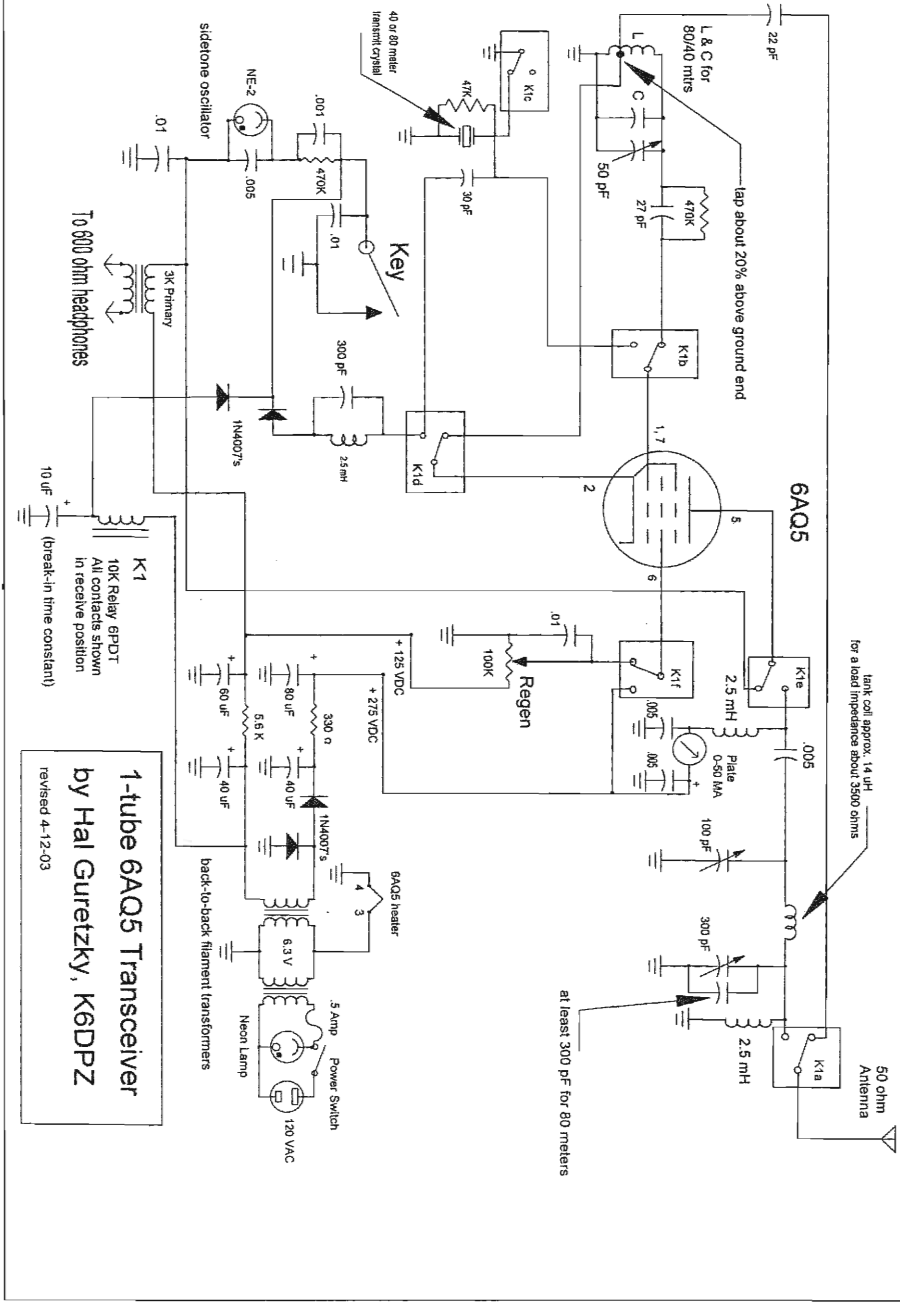


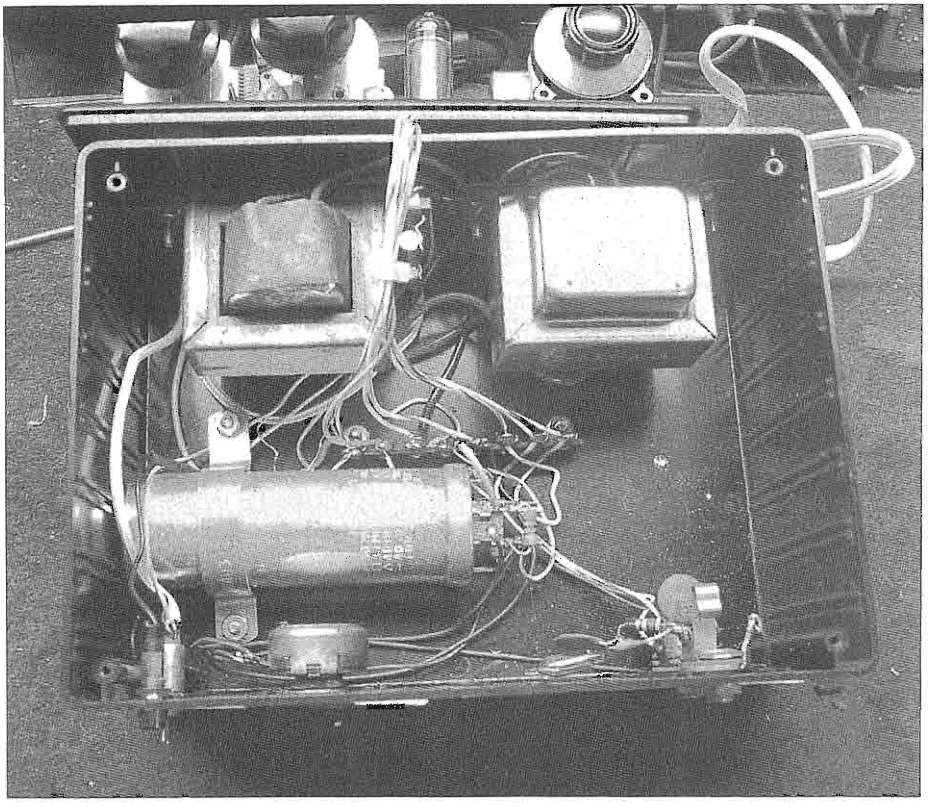
Here is a top view of the 1-tube CW transceiver. At front left is the output pi-tank circuit, in the center is the single 6AQ5 beam-power pentode, and to the right is the receiver tuning vernier dial. The 6PDT relay and transmit crystal are just behind the receiver tuning control. At the left rear is the plate current meter.

470K resistor. They make a tone oscillator circuit. It is automatically keyed to ground when you are in the transmit position. The tone goes through the headphones. In the receive position the sidetone is active and your receiver is going through the headphones. The supply source of 125 volts is in series with a 100K pot, which is varying the screen voltage on the 6AQ5, pin 6. This adjustable voltage brings the tube into regeneration so you can set the receiver right to the point where it is the most sensitive and just before it goes into oscillation for receiving CW. The antenna connects to the receiver coil through relay contacts K1a, through the 22-pF capacitor, and to the tap on the coil. The best place for the tap is found by experiment, but will be about 20% of the coil length above the grounded end. The L-C circuit in the receiver has a slug-tuned coil, a fixed capacitor, and a 3-50 pF capacitor that is my main tuning capacitor.

The power supply uses two Radio Shack transformers back-to-back in a half wave doubler. This arrangement also provides for an isolated 6.3-volt heater supply for the 6AQ5. We use a good amount of filtering on the receive side with 40 uF on the input and 60 uF on the output with a 5.6K resistor. On the transmitter side we use a 40 uF

Figure 1, the complete schematic of the K6DPZ 6AQ5 transceiver





The power supply and some of the controls fit into the bottom section of the Radio Shack box, and the box lid holds the major components of the transceiver. This design makes for a compact, easy to build rig.

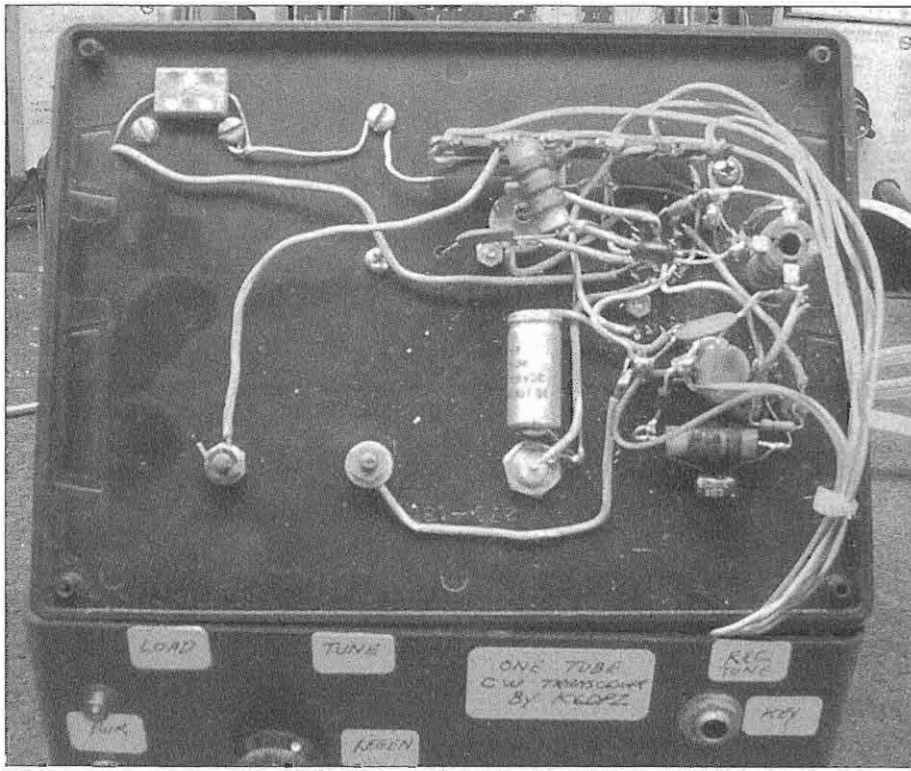
input capacitor and an 80 uF output capacitor, with a 330 ohm resistor. These values worked out rather well. The input circuit has a fuse for protection and we also have a neon bulb indicator. By adding an inexpensive 12-volt power inverter you will have an instant mobile QRP rig.

The relay used was an Allied part number TS154-6C. I have a small supply of these relays, and readers planning to build the rig may contact me for the relay. The case is from Radio Shack, as are the little 3 amp transformers.

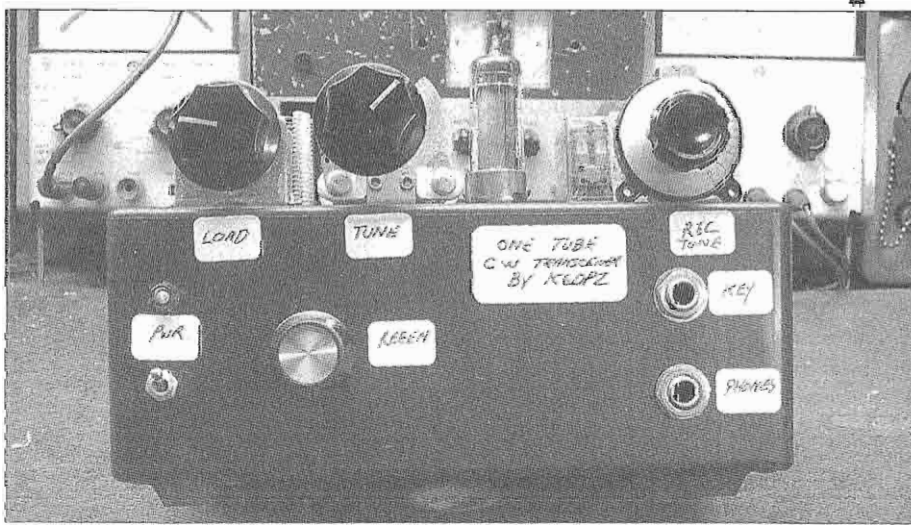
Circuit layout is not overly critical; just keep the leads between the relay and the different circuits as short as possible. I used a relay with a plug-in socket because the relay pins themselves are very hard to solder to. The socket is easier to work on, and after you are done you can plug in the relay and not have to worry about damaging one of the most valuable parts of the rig.

The little rig was designed just as an idea and it worked out very well, and I have made contacts with it on 40 meters, but it could be put on 80 meters just as easily.

Now you can see why I call it the Back to the Future Transceiver, and I hope everyone has fun building a copy of it.



Above is the main circuit wiring of the transceiver which is built underneath the lid of the box. Below is a front view of the rig. The jacks for the key and the headphones are installed on the right side, clearly out of the way of the other controls. Note how easy it is to label all of the controls with peel-off tags available in nearly any office supply store. ER



A Shortwave Radio Journey

by Glenn Bowman, KC8WUL
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"Son, if you hold the soldering iron on the joint and then touch the solder to the wires, you'll get a good, clean solder connection, and not a cold joint."

"But Dad, how can the soldier joint be cold if the soldering iron is hot?"

With those encouraging words given to an eight year old, I was able to create many 'experiments' that never saw any 'juice' but none the less, sparked my interest in radio. I assembled many resistors, capacitors, tubes, filters and chokes into numerous 'experiments' and faithfully, never had a cold solder joint. I knew all the major components by name but their functions were a mystery. That knowledge would come later.

Dad always had a good supply of used components in his workshop that he had scrounged from the radio shops and neighbors located near our northern Virginia home. He was always tinkering with AM radios and working on his own 'experiments.' One of my first memories from the early '50's is how he rigged his phonograph so that records could be played through the speaker in our Muntz TV. With the turntable sitting atop the TV, he wired in a simple amplification circuit that played though the massive speaker at the bottom of that large wooden cabinet. I can only imagine that the size of the speakers back then must have held five pound or ten magnets. He was justly proud of that rig and the music of Chet Atkins usually filled our evenings. With Dad's help I put together a simple oscillator circuit, and with a telegraph key obtained from a war surplus store, I was able to tap out a few letters of Morse code. With my older brother, I often exchanged messages written in Morse code, or tapped out on the knotty pine walls of our upstairs bedroom.

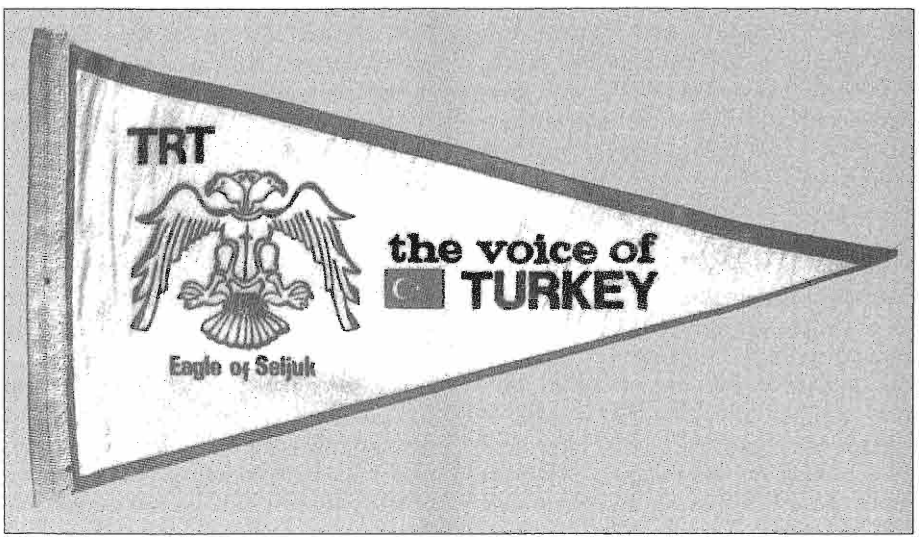
A move to the Maryland countryside in the early sixties brought many new friendships, interests, and experiences. The Colts were playing in Baltimore and the Muntz TV was moved to the attic. A new RCA color TV set was placed in the downstairs rec room and a Magnavox console stereo phonograph now played in our living room. My Dad's hobby in electronics now included several trips to a local electronic supply store to check the usability of his TV or radio receiving tubes. The vertical hold on the RCA TV kept going out and he was able to repair it by replacing the vertical oscillator tube. I can remember reading articles in *Popular Electronics* about shortwave radio while visiting these stores, and I also had a friend in math class who knew about shortwave radio. My interest in the subject soon peaked, because questions about shortwave radio soon peppered my conversations at the dinner table.

Deciding that it was time to polish up on my soldering skills, my Dad brought me a shortwave radio kit from one of his trips overseas, and I was one of the happiest kids on the planet. Although this kit was not really a 'full assembly required' kit in Heathkit terms, it nonetheless contained two or

three pre-assembled circuit boards and all the various parts needed to assemble the radio. Several of the larger parts, such as capacitors, the antenna circuit, and the large gang switch all required point-to-point soldering.

Homebrew was alive and well in those early days. The radio used four D-cell batteries for a power source. So, being back before the days of reliable rechargeable batteries, Dad fashioned an internal rectifier circuit so that I could plug the radio into a regular household electrical outlet. The instructions in the kit also mentioned that an external antenna should be used, but there were no features in the kit for attaching the antenna. The extendable whip antenna brought in the local AM stations, but little else. So, a wire was soldered to the tab on the base of the whip and then tied to a banana plug socket that we put on the back of the case. When I asked my Dad about what I should use for an antenna, we headed for his workshop where he handed me a 250-foot spool of # 18 insulated steel wire. He mentioned that the antenna should go on the roof, so that's where I headed. Dad also mentioned that the best stations would be heard at night.

Our house was a straight, split-level rambler with a chimney in the center that ran well over 100 feet in overall length. With the spool of wire in hand, I headed up onto the roof. I tied one end of the wire to a clip on the gutter on the west gable end, and then ran it along the roof to the chimney. I made a few turns around the chimney and then headed towards the garage on the east end. I ran the wire around a nail that we used to hold our outdoor Christmas lights, and then headed back towards my second floor bedroom on the west end. I secured the wire around a gutter clip and tossed the spool into my bedroom window. Once back inside, I discovered that I had used up almost all of the wire! I cut the wire off to a reasonable length and soldered on a male banana plug so I could plug this into the back of the radio. I now had a 250-foot random length wire antenna. Look-



The author received this decorative banner from Radio Turkey in 1977. In some ways, these are more difficult to earn than QSL cards from Ham DX stations.

ing back I can only figure that this escapade must have been carried out in the warmth of the summer because I can't remember schoolwork interfering with the project. And, there was no protection installed against possible lightning strikes and no grounding devices attached to the receiver. It was just a wire on the roof. I must caution readers about attempting such a project without proper adult supervision or the proper equipment, which includes lightning protection and proper grounding for the receiver.

By this time, I had acquired some books published on the shortwave radio hobby, so I was aware of the main shortwave broadcast bands and the stations of the time. The radio band selector switch had selected positions for shortwave (49-31 meters), and the 25, 19, 16, and 13-meter bands, but as I was later to learn, there was poor, if any, correlation between the frequencies tuned, the station I heard, and the frequency indicated on the radio dial. There was a lack of numerical indications for the four shortwave bands on the plastic dial. This slide rule dial was a simple string and wire indicator needle strung around the wheel on the main variable tuning capacitor. I soon learned that this was a very acceptable method for indicating the tuned frequency. By following the instructions in the owners manual, I was able to tune in a local AM station and then set the string and needle combination to indicate the approximate frequency on the AM broadcast band.

That first night at the radio was a definite awakening to the wonderful world of shortwave radio. I heard the familiar dots and dashes of Morse code on the lower frequencies and then the squeals and beeps of unknown signals as I tuned higher. When I ventured onto the 25 M band, I continued to turn the tuner dial and then stopped suddenly when I heard music, foreign music that seemed to fade in and out like the speaker was on a passing freight train. It must have been nearing the end of an hour when I heard... "You have been listening to the English language broadcast service from Radio Deutsche Welle, in Cologne Germany. Broadcasting on 11,925 kilohertz in the 25 meter band from zero hundred hours to zero one hundred hours GMT. Our broadcast will now continue in German. We thank our English language audience for listening to our station."

"That's impossible!" I said, "and what's GMT?" I ran downstairs to find our globe that sat on a table in the living room. Spinning the globe, I found Germany, and then the city of Cologne. "I'm listening to a station halfway around the world! How is this possible?"

I learned from my Dad about the skip characteristics of certain frequencies and how they can bounce off of the ionosphere. I also learned about the advantages of nighttime broadcasts. The heat from the sun has now dissipated producing an electrically calm atmosphere. I also learned that time was measured on a 24 hour system and that all time was centered on Greenwich Mean Time **(GMT)** from a courtyard somewhere in Greenwich, England. Many nights were spent tuning various foreign stations and being thrilled at each new find on the dial. But as I mentioned earlier, there was poor correlation between the stations heard and the dial location. So, I fashioned thin strips of adhesive masking tape on the dial and then wrote the frequencies on the tape when the station I was listening to stated their broadcast frequency. If they were broadcasting on 9.585, then 9.585 was written on the dial where the needle was positioned for that particular band. It wasn't long before I had about four or five

indicated frequencies for each band. I soon developed a 3x5 card file on each country heard, along with the time and frequency.

The time span from 1966 to 1968 brought a major change to our family as my Dad received a two-year temporary duty assignment in England. My last two years of high school were spent on an U.S. Air Force base in East Anglia. And, like anyone recently infected with the radio bug, I yearned for a bigger and better radio. Advertisements in monthly publications such as *Popular Electronics* showed new communication receivers being offered from Hallicrafters, Drake, Lafayette, Heath, Hammarlund, and Radio Shack, to name a few examples. I soon learned that being perched on Europe's front doorstep allowed me to hear the broadcasts from most of the European shortwave stations. I learned a wealth of information about other countries and cultures, and also learned about the technique of band scanning. I would start at the lower end of a shortwave band, such as 31 meters starting at roughly 9200 kHz, and scan from one end of the band to the other, and then seeing how many stations I could log or identify. Another side benefit of using this technique is discovering that there are many stations out there that you've never heard!

As luck would have it, a friend of mine who happened to be graduating was apparently in need of funds and happened to own a Hallicrafters S-120 shortwave communications receiver that he was willing to sell. The S-120 had tubes! My Dad had bragged about tube receivers and knew their circuit designs almost by heart. The S-120 was a single conversion superhet receiver that covered the AM broadcast band and offered almost continuous coverage from 1.8 to about 35 MHz. The receiver also offered a band-spread dial for fine-tuning and a beat frequency oscillator circuit (BFO) for receiving code or single sideband signals. And, at that time, Hallicrafters boldly included the identity of several foreign broadcast stations on the slide rule dial. This again proved to be relatively inaccurate because most countries will change their broadcast frequencies based on the time of year or varying atmospheric conditions. But I have to admit that seeing all of those countries spread across the dial was certainly cool, and challenged me to log all of those stations.

The S-120 included a standard whip antenna and also offered the additional sophistication of having connections on the back of the receiver for an external antenna and a chassis grounding connection. Luckily, my friend in high school had kept the owners manual, so I now had the proper instructions for erecting a simple antenna cut to a specific frequency and also make the proper ground connections. At a later date, I modified this receiver by installing an SO-239 connection on the back of the cabinet for an external coax antenna connection. I also took the time to identify the 'hot' lead on the power cord. The electric plug for the receiver looked like a typical plug on a lamp cord and was not polarized. It was possible to have the chassis connected to the 'hot' side of the power input line. By tracing the circuit wiring I was able to add a proper polarized plug so that the larger, spaded, 'common' terminal on the plug traced back to the incoming wire that didn't lead directly to the main on/off switch.

It was during this time period that I

learned about sending in station reception reports and receiving QSL cards from the station indicating proper station program verification. I learned that stations are actually interested in hearing how their signals are received at various locations. Several stations had DX programs on their schedule and it was certainly intriguing to hear the comments and loggings of other listeners. My interests were shared with other shortwave radio hobbyists located through out the globe.

Looking back through my current filing system, which, by the way, has improved greatly over the 3x5 card system, I find that my first reception report and subsequent QSL verification was received from Radio Sweden in June of 1967. Many QSL cards from numerous countries soon filled my collection which now included several banners, stickers, calendars, and frequency guides that some stations were sending along with their QSL cards. I was able to log all the major stations using a simple wire antenna strung to the nearest tree. And, the S-120 proved to be a very capable receiver.

We returned back to the states during the summer of 1968, and I very soon headed to the local electronic supply store and purchased spare tubes for the S-120. All of the tubes were 7 pin miniatures: 12BE6 Converter, 12BA6 IF Amplifier, 12AV6 AVC and Audio Amplifier, and a 50C5 Power Output Amplifier. I must have been a cautious and concerned SWL back then, because I still have two full sets of replacement tubes, and a receipt dated from 1973 shows that all four tubes cost less than ten dollars.

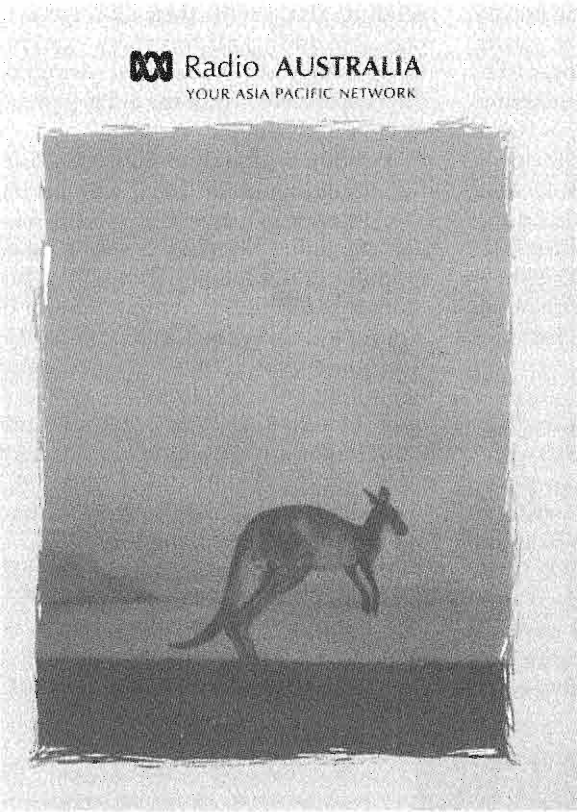
Another life altering change was college where, unfortunately, I was able to devote little time to the hobby. The S-120 was given the duty of receiving the local AM radio stations. The radio

Among the strange treasures of popular art in Sweden are the paintings made a hundred years ago by peasant craftsmen in the central province of Dalarna. The naive art of these painters in the heart of Sweden flourished in geographical isolation. Today they inspire new generations of artists with their direct approach and simple lines.

Radio Sweden

"Here rides the King of the Realm of the Svears, Carl Johan, 1838", by Kers Erik Jönsson (1802—1851), who lived in Lima in the province of Dalarna.

The first QSL verification I received was this full-color card from Radio Sweden in 1967.



This colorful QSL is a recent arrival from Radio Australia, February 2002, after a 31 meter band recption report.

came home with me during summer break and my log shows about four or five QSL's received each summer. Since we had moved back into the same house in Maryland, I was able to use the original antenna that I had installed on the roof several years earlier.

In 1975, fresh out of college and working for a living, I found myself now located on the 2nd floor of a nine story apartment building in Washington, D.C. Could I continue to listen to shortwave? Dismissing the thought of trying to ask the apartment manager about erecting an antenna on the apartment roof, one evening I tossed a random length wire outside the window and up into a nearby tree. This proved to be an acceptable antenna because of my location. The Washington D.C. area was, and still is, the target area for many shortwave broadcasters. As a matter of fact, this receiver and antenna combination yielded my first DX catch, Radio Haiti, station 4VEH that was a relatively low powered station broadcasting on the 25-meter band. Not searching for a particular station, I heard the broadcast, waited for the station identification, and had the catch. The QSL card was soon added to my collection. Most of the stations in Haiti discontinued their external broadcast services a few years later.

We lived in and around the Northern Virginia area for almost twenty years. During that time, home improvement projects, moving, or other activities that included raising a family caused my radios to literally 'stay in a box' for almost ten years.

When the hobby was fully resurrected and the cobwebs were cleared, I discovered that several monthly publications now included the broadcast times and frequencies for most English language shortwave stations. If I wanted to listen to the BBC, I could simply tune in 9.580 MHz at 8 PM local time. With the limited tuning capabilities of the S-120, I found myself again looking for a better receiver, and was able to locate and purchase a used Kenwood R-1000 communication receiver that contained both digital and analog frequency displays. So, tuning in 9.580 became a much easier task.

With dual frequency conversion, pass band filters, stabilized VFO, and solid state, integrated circuitry, the Kenwood proved to be a very reliable receiver that brought in most major stations when coupled with a dipole antenna cut to a specific frequency band or a multi band doublet. In fact, antenna experimentation for optimal reception is an interesting facet of the hobby that I hope to cover in future articles.

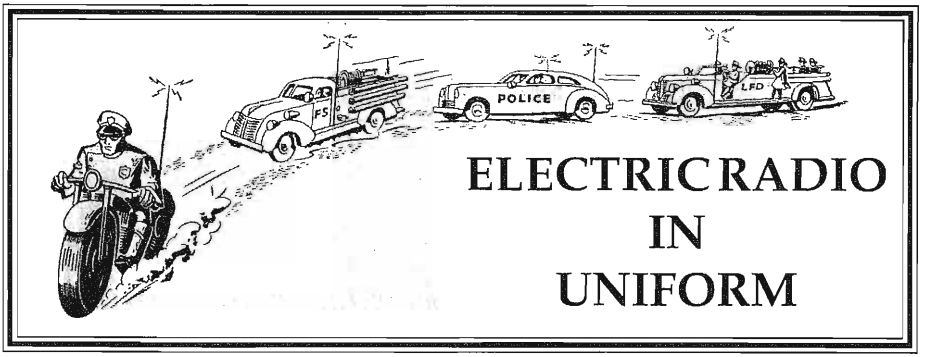
Interestingly, this 'facet' of the hobby was brought into full swing when 1994 brought a major change in my employment situation and ultimately resulted in a move to the Wolverine state of Michigan. The Kenwood and the Hallicrafters came along for the ride. Although still situated in the Eastern Time zone, Michigan is closer to the Central US and is located at the fringe of the target broadcast areas for the major shortwave broadcasters, so regular reception becomes more of a challenge. The Kenwood proved to have the edge here, and became my favored receiver. To capture stations on the other side of the globe, such as New Zealand or Australia, or for DX work on lower powered stations, a tuned dipole antenna and antenna tuner or amplifier become routine necessities. In fact, this combination recently verified AWR, a station broadcasting from Guam. So, your first challenge becomes finding the country of Guam in your World Atlas, and then trying to figure out how a radio signal destined for Japan would be heard in Michigan. Another DX verification and QSL has been added to my station log.

The S-120 still honors my receiving bench and has yet to blow a tube and require me to dig into my supply of replacements. Vintage receivers certainly have a place in this hobby and there are a lot of them out there waiting to go back to work. With restoration, proper antenna design and construction, vintage receivers can still bring the world to your doorstep. And, shortwave broadcasters still rely on reception reports to verify their signal quality.

Using the S-120, I recently heard broadcasts from Radio Netherlands, Radio China, the BBC, the Voice of America, Radio Canada broadcasting in French, HCJB located in Quito, Ecuador, and my long time friend, Deutsche Welle in Germany. I have since acquired and restored a vintage shortwave receiver that I lusted after in my youth. But, you'll have to wait for one of my future articles to hear about that story. Luckily, it has a happy ending.

As I look back through my colorful collection of QSL cards and letters received from station managers, I certainly enjoy my past shortwave adventures and look ahead to many more years in this delightful and always surprising hobby.

ER



ELECTRIC RADIO IN UNIFORM

by Geoff Fors, WB6NVH
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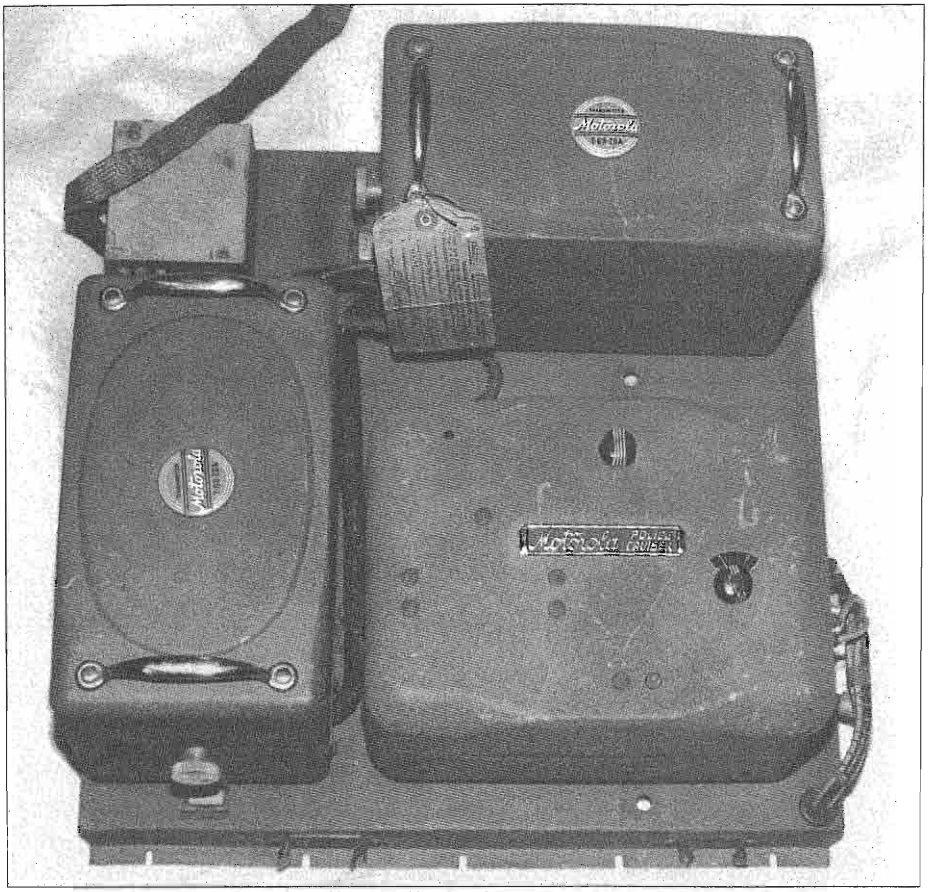
COLLECTING SURPLUS POLICE RADIOS

As long-time readers may remember the column "ER in Uniform" that usually discussed military equipment. This time we'll take a look at some really well made civilian gear which was also used by military units, but was mainly at home in police and fire stations. In other words, just a different kind of uniform!

Some Police Radio History

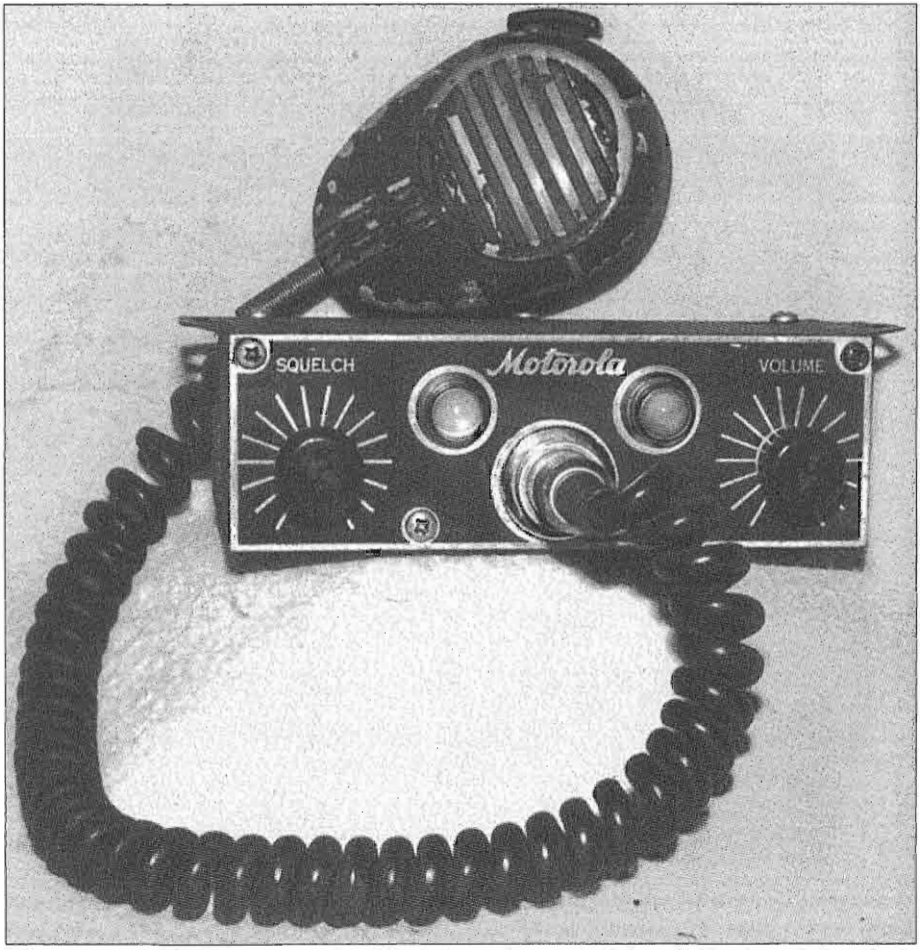
First, a brief background sketch of police radio will be presented. The use of radio in police service paralleled the expansion in popularity of the automobile in American life, and first became practical with the development of rugged, 6-volt filament tubes in the mid 1930's. The earliest police radio experiments were carried out in Detroit in 1929, and encouraged several other cities to begin experiments of their own. Throughout the 1930's, most police radio systems were one-way broadcasting arrangements, where the police station transmitted AM signals to patrol cars on frequencies in the 1500-2500 KHz range. Patrol car radio equipment initially consisted of ordinary broadcast radios, either modified by the police departments themselves or by the radio manufacturers, and the first police stations were actually licensed as broadcasters! Policemen on patrol quickly discovered that the tuning range of the modified broadcast sets still allowed reception of more relaxing musical programming at the upper end of the broadcast band, and excuses for missed calls abounded until crystal control was hastily adopted. Some of the first companies to offer a specially manufactured police radio were American Bosch (Link), RCA, Sparton and General Electric. Station transmitters were often homebrewed by local amateurs, many of whom were officers or otherwise employed by police departments. The higher-powered stations used broadcast transmitters made by Western Electric, RCA and others. Officers on patrol would check in regularly with the dispatcher through police telephone call boxes located at strategic street corners. The dispatcher had no way of knowing whether the calls had been received until the policeman called in, which made repeated broadcasts necessary, and in many cases a gong was rung at the beginning of a transmission to get the attention of



A very early example of police radio is this "One Piece" Police Cruiser model from about 1941. It consists of an AM 1500-2500 kc receiver and the T69-20A 30 to 40 mc AM transmitter. The transmitter and its power supply are the cabinets with handles on top. (Photo from the collection of Geoff Fors)

the force.

By the late 1930's, many small cities had added low-powered AM transmitters to their patrol cars on 30 MHz frequencies, to create "talk back" or "two-way" radio systems. A few went even further and dispatched on VHF as well, using the new and somewhat temperamental "ultra high frequency receivers", when the increased range of a low frequency broadcast system was not needed. At the outbreak of war in 1941, there was a frantic rush to equip police cars throughout the nation with two-way capability. The first successful FM all-VHF two way system created by Link Radio for the Connecticut State Police in 1940 served as a model for other departments and manufacturers to follow, but many remained on the traditional split-band system of medium frequency AM dispatching and VHF AM (or FM) talk-back from the mobile units. For example, the Los Angeles California Police Department was still broadcasting to most divisions on their original 1700 KHz frequency through 1964!



There is no microprocessor in this Motorola control head! Designed for their earliest FM mobiles and the "One Piece" AM mobile, this example dates from bout 1947 because of the presence of the coiled microphone cord, which was a postwar improvement. (Photo from the collection of Geoff Fors)

In the peacetime FCC re-allocations of 1946, the 30-50 MHz and 150-174 MHz VHF frequencies were opened up for permanent two way police licenses, and FM broadcast was re-allocated to its present home at 88-108 MHz. Some of the most advanced VHF police systems that had operated on 118 MHz during the war, such as the Miami Police dispatch and the California Highway Patrol's mobile relay system were re-allocated to other bands. Additional services became eligible for two-way radios, such as fire departments, taxis, auto clubs, ambulances and so forth. By 1947, there were many companies offering rugged, reliable VHF FM two-way radios, including Motorola, GE, RCA, Link Radio, Bendix, Comco, Philco, Federal and Kaar, and hundreds of cities abandoned their old equipment in favor of the latest postwar FM offerings.

Along with the mountains of BC-

348's and Command Sets that filled the surplus stores of the 1950's, retired police equipment appeared at attractive prices. Amateurs quickly found out it offered an inexpensive but high performance way to get on the VHF bands. Even Motorola, one of the largest manufacturers of police radios, tried ads in CQ and QST Magazines in 1949 offering traded-in surplus police equipment "converted to AM or FM at the flick of a switch," including a Gonset 10 meter converter to feed the original low frequency AM police receiver. Amateurs spotted the opportunity offered by this low-priced equipment and began to put it to good use on the 10 and 6-meter bands. One of the first published accounts of ham club use of this gear is in CQ for May, 1955, in an article entitled "Surplus Police Rigs for CD," by Bill Bailey (W9JJD) which describes a Chicago area ham club's use of surplus Motorola equipment for 10 Meter AM Civil Defense and RACES nets.

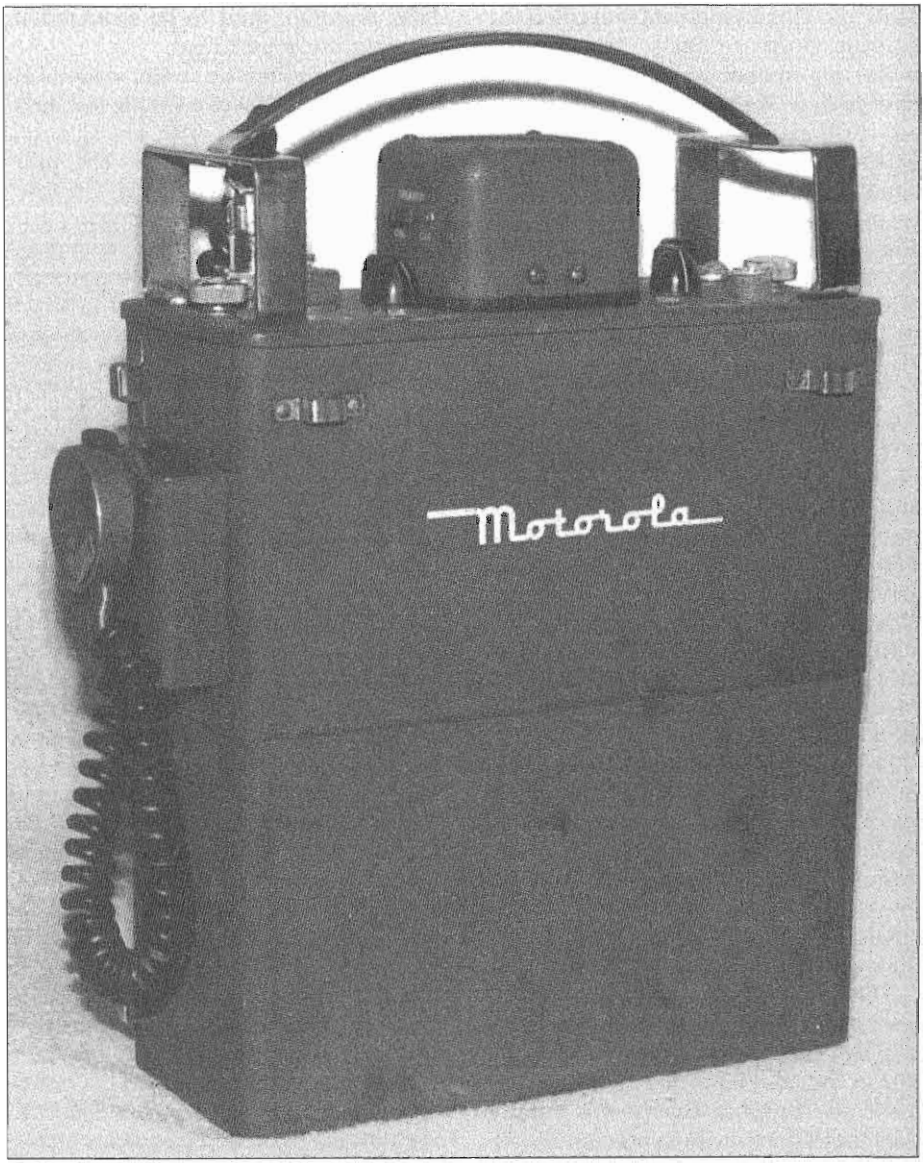
First to arrive on the surplus market in 1947 was the AM split-band equipment, typically consisting of a 1.5-2.5 MHz AM receiver and a 30-40 MHz AM transmitter. A common surplus setup was the Motorola "Police Cruiser" model receiver and the T69-20A transmitter.

The T69-20A was a two piece, crystal controlled transmitter which used a vibrator power supply and featured an 807 in the final amplifier, giving about 10 Watts output. The power supply was located in one housing and the RF section in another. The "Police Cruiser" receiver line warrants a separate discussion, but basically it was Motorola's first (and last) line of stand-alone mobile AM receivers, offered mainly in medium wave band models with a single VHF AM version, the P69-17. The "Police Cruiser" was originally intended to be mounted on the firewall under the automobile dashboard, but later was modified to be mounted in the trunk compartment.

If you wound up with a medium wave receiver, it was a simple matter to add a 10-meter converter, giving you a complete 10-meter station. The military used the P69-17 "Police Cruiser" Motorola VHF receivers during the war, mounted on a large copper plated chassis together with a T69-20A transmitter, for military police and artillery spotting. Many lucky surplus buyers found a ready-made 10-meter mobile station in those "one piece" sets when the war ended.

As the surplus market matured in the 1950's, quantities of FM equipment began to appear on surplus dealer's shelves, as the older all-AM equipment began to disappear. These were usually low band (30-40 MHz) sets with separate transmitters and receivers, retired from police and military use during the 1942-50 period. The transmitters were generally dynamotor powered, and the receivers used a Mallory Vibrapack or similar vibrator power supply. The 6 volt power requirement lent itself nicely to the average automobile owned by amateurs, but FM wasn't catching on, and AM remained king on the VHF phone bands except for local Civil Defense and RACES nets. By the end of the 1950's, more 150 MHz FM gear began to show up at surplus dealers, with easy conversion to 2 meters a possibility.

In 1962, the trickle of surplus police equipment had become a flood as FCC regulations tightened frequency stability requirements, disallowed wideband FM, and as 6 volt mobile equipment began to be replaced with 12 volt equivalents for the new automobiles, most of which switched to 12 volt batteries in 1956. The 2-meter FM boom began in earnest in about 1966, fueled exclusively by this flood of cheap, surplus equipment and by the installation of repeaters throughout the country.



This is a 1949 Motorola pack set that continued the theme of the wartime BC-1000 Walkie Talkie. Because they are filled with rare subminature tubes and an assortment of high voltage batteries, these are best left for the most serious collector!

The book Radio Amateur's FM Repeater Handbook by Ken Sessions (K6MVH) published in 1970, helped popularize the use of surplus two-way equipment as repeaters. By 1971, the Japanese and a few American manufacturers such as Clegg, Swan and Drake had begun to market inexpensive, small multi channel solid state 2 meter FM rigs, and eventually these took over to the extent

that hardly anyone uses surplus police equipment on the VHF bands anymore, other than as repeaters and remote base stations. Nonetheless, many Hams who enjoy restoring and using vintage military and amateur gear are also enthusiastically getting the classic surplus two-way radios out of attics and basements, and back on the air.

This time, we'll take a look at a few of the most popular two-way radios of the 1950's and 1960's, which you can still have fun with today. Unlike the frequent situation with military surplus gear, you aren't likely to have to do a lot of restoration and repair work to get this equipment on the air. Much of it will come back to life without needing any work at all, other than initial alignment and perhaps a tube or two. All of it is crystal controlled, and usually single channel; although on a lucky day you might find a 2-channel set. There is more to it than just plugging in crystals - - you'll need to realign the RF stages of the receiver and all of the transmitter stages, but this really isn't all that much work. In some cases, a few modifications are necessary to bring the equipment up or down into the amateur frequency range. These old rigs, except for being limited in channel capacity, have specifications, which even today outperform current Japanese amateur FM gear, and besides, there's just something special about using a radio that maybe once patrolled the streets of Mayberry or was on the job in Dallas one fateful day in 1963.

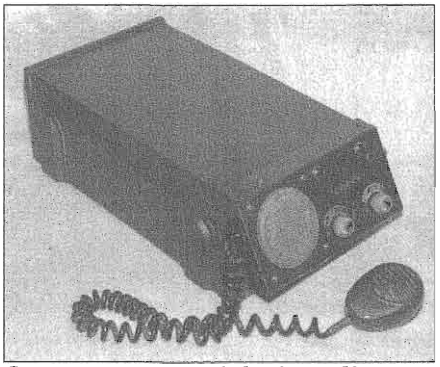
There were a number of articles in 73, CQ and QST Magazines from 1955-73 which described the basics of this equipment and how to convert it to the amateur band. There were also several booklets published to assist the amateur in this regard. By far, the most popular equipment converted by amateurs was Motorola. Nearly all the magazine articles at the time referred to Motorola equipment, with GE gear coming in second place. Apparently the first booklet to be published was Wide Band FM for the Amateur, by Aagard and Dubois, Evanston, Ill. in 1962, which covered the conversion of several models of 1950's vintage Motorola FM equipment to the two-meter band. In the late 1960's, a collection of Motorola schematics and other useful conversion information was published by S. Wolf, called the FM Schematic Digest. (There are at least two editions; the earlier has a yellow cover and the later and probably final one, a red cover.) GE realized that enough amateurs were interested in converting their early VHF FM equipment to warrant publishing a two-volume schematic and data compendium for their "Pre-Progress Line" equipment of the 1949-55 era. In 1973, 73 Magazine published a guide to converting Motorola FM equipment, by Glenn Zook, K9STH, who is still with us today as an active vintage radio enthusiast and ER advertiser.

Where to find the gear

Where do I get such a rig, you ask? The same places you find old amateur gear, and more, such as garage sales, hamfests, ebay, Internet newsgroups, and even commercial surplus auctions. Commercial users have no use whatever for this material, so expect to get it for a very low, almost "take it away please" price, although most of the 1950's-60's vintage equipment has long disappeared from commercial use and will only be found in the most forgotten, dusty corners of warehouse attics and basements. The supply of such vintage equipment has dwindled at flea markets in recent years, but possibly this stems from the low interest among shoppers and the perceived nuisance of bringing it to the flea market. Prices, therefore, remain quite low.

What kind of gear to choose?

My advice today is the same as that



Once a common sight in police stations, fire houses, utilities, railroads, and businesses, the Motorola tabletop "Utility" base station dates from 1951, and currently is happily living on 52.525 mc. (Photo courtesy Geoff Fors)

given by the conversion authors of the 1960's. You are safest with Motorola equipment, because it was the most popular, followed by GE. They are easiest to get manuals and spare parts for. RCA was a prolific manufacturer of well-made equipment but went out of the market in the early 1980's, and it's a challenge to locate documentation and parts for their products today. Makes such as Dumont, Link, Comco, Philco, Bendix and others, while interesting, are probably best avoided by all but the dedicated collector, unless they are accompanied by their service manuals and are in excellent condition.

Today, the most practical among these old workhorses are probably the "lunch box" pack sets and the tabletop base stations of the late 1950's. These are still completely usable on today's 10, 6 and 2-meter channels. There aren't too many of us who want to put a large, single channel, current-hungry dynamotor or vibrator-powered mobile radio into our modern car, as amateurs did in the 1960's, and it's too much bother for most of us to convert one to AC operation or to 12 Volt input. If there is enough interest, in the future I will describe common types of equipment in more detail. Tabletop "utility" base stations are relatively easy to find, and usually consist of the same chassis "strips" used in a mobile unit, but with an AC power supply, built in controls, and an attractive cabinet.

My favorites are the pack sets. They were available in a variety of power supply options and are probably the most useful today. The earliest pack sets, i.e. those made before about 1955, are probably best avoided because of their extensive use of first-generation Raytheon wire-lead subminiature tubes, which were difficult to find even in the 1950's, and because they invariably were supplied only with dry battery power supplies. Those 67.5 and 45-volt batteries were cheap and plentiful when "I Love Lucy" was a new TV show, but not any more. On the other hand, pack sets of the mid 1950's and later can be found with nickel-cadmium battery packs, which are the most versatile and practical for us. Naturally, the NiCad cells are usually either missing or expired, however NiCad "D" cells can usually be fashioned into a replacement, and those power supplies usually also feature 6 or 12V DC optional vehicular power inputs, which charge the NiCad cells. These later pack sets were also offered with AC power supplies. The Motorola pack sets of the late 1950's are hybrids; transmitters use transistors in the modulator stages and tubes in the balance of the circuitry, and the first generation receivers are largely transistorized except for two subminiature wire lead tubes. The second-generation receivers (1962) are fully transistorized. My Motorola 6 meter pack set, with 1.5 Watts output, has given me hundreds of contacts and been in use for 25 years without any repairs needed!

Partially solid-state mobile equipment of the mid to late 1960's is still quite usable today, especially on the 6

Classic 1958-1963 Motorola "Pack Sets" are fairly easy to return to amateur frequencies. On the left is a 5 watt 150 mc version, and on the right is the 1.5 watt 47 mc version. Even today, many police and fire department personnel refer to any hand-held radio as a pack set!

and 10-meter bands. The Motorola Motrac model radio, made famous in the TV police series "Dragnet" and "Adam-12," is still a superb performer and capable of many years of trouble-free service. GE's hybrid MASTR Professional mobiles of 1965, although probably too large for today's car trunks, were an industry standard for amateur repeater use because of their separate and easily detached receiver and transmitter chassis units. Some of the most modern surplus equipment makes up a good percentage of gear in use on the 10 and 6-meter amateur FM bands today, where synthesized high power Motorola and GE equipment far outperforms Japanese amateur gear made for those bands.

What band to use?

Surplus two-way gear is available in 30-50, 150-174, and 450-470 MHz ranges, known as low band, high band, and UHF respectively. I prefer surplus low band equipment, because on bands such as 6 or 10 meters, having only one or two channels is not a disadvantage as it is on today's 2-meter band, and there's even a chance you may run across a kindred soul who is also using

vintage two-way iron. I don't recommend vintage UHF equipment because 450 MHz mobile radio technology was in its infancy until the mid 1960's, and most of the equipment tends to be somewhat unreliable, temperamental and of lower power and sensitivity than other-band equivalents. Transmitter tubes for UHF equipment are rare and expensive as well as short-lived.

What bench work is necessary?

Assuming the equipment is complete and various typical ailments such as rotted microphone cords and disintegrated speaker cones have been dealt with, conversion to the amateur bands generally involves installing the correct crystals, replacing any missing tubes, and following the tune-up procedure listed in the manual. Manuals are fairly easy to come by for this type of equipment, in such places as under the tables at hamfests, on ebay, and even at some of the old-time two-way radio shops in your area. The schematic digests and conversion manuals mentioned above are also sufficient. It doesn't hurt to check all the tubes, but don't discard any unless they are completely dead or have gas or shorts. Electrolytic filter capacitors are generally still okay in mobile and portable equipment, but base stations often require some replacement work. You'll need a good microvolt-attenuated signal generator. This was a costly proposition in the 1960's, but today we are in the golden age of surplus high quality test equipment. It's possible to buy a high quality VHF microvolt attenuated signal generator for less than $ 25, such as the Measurements 80 (Military TS-497B/URR) or the Measurements 560FM (Motorola T-1034,) and that's what was originally used to tune up this equipment. Amateur grade or TV repair type generators won't cut it, as they drift excessively and do not have calibrated outputs. There's no reason to use them. A Bird Corp. or equivalent "Thruline" or "Termaline" wattmeter is nice to have although one of the handbook design homebrew VHF wattmeters will suffice. Most radios (other than pack sets and GE equipment) feature centralized metering sockets, which greatly simplify tune-up. Although originally intended for use with a test set, a VOM can be used on these metering sockets. However, test sets are inexpensive and common on the surplus market.

Crystals can still be ordered from a number of supplies such as International Crystal, Bomar, JAN and others. Expect each crystal to run between $ 10 and $ 15. Some of the crystal manufacturers have sale periods, announced on their websites, so it pays to shop around. And sometimes you'll be lucky enough to find useful amateur channel crystals already in the equipment! For 6 meters, 52.525 MHz is probably the only frequency you'll need. The 10-meter band offers a number of possibilities, but 29.6 MHz, the national calling frequency, is probably the first choice. 2-meter equipment is probably best tuned to your local repeater or the national simplex channel of 146.52. Note that many (most?) 2-meter repeaters require sub audible tone access (PL, CTCSS) and this usually has to be added to the older equipment via an add-on module, which is easy to obtain.

So, the next time you gasp at what the seller is asking for that 75A-4 or HRO-50 at a hamfest, try taking a look under the tables for a 1950's vintage police rig. They are lots of fun and you'll still be able to make your mortgage payment after buying one. But be careful, because as anything else involving collecting, they are addictive. Once you get one, others follow, and before too long things can get out of hand!

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 winter nights, 40 summer nights, 20 and 30 meters day. Nightly informal net about 0200-0400 UTC. QNI "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 daily on 3725 Kc (+/-) at 8:00 PM ET. Hosts are AL(VE3AJM) and Ken (VE3MAW)

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 Wednesday of each month on 3880 Kc starting at 2000 CST, or 0200 UTC. All AM stations are welcome.

Collins Radio Association nets: Mon. & Wed. 0100Z on 3805 kc., also Sat 1700Z on 14.250 Mc.

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

Drake Users Net: This group gets together on 3865 Kc, Tuesday nights at 8 PM Eastern Time. Net controls are Gary (KG4D), Don (W8NS), and Dan (WA4SDE)

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).

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

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 Nets: User's Group meets Sunday at 4 PM Central Time on 14.250 Mc. Net control op is usually Dean (WA9AZK). Technical Net is Sat, 7235 kc, 1900Z. Net control is Stu (K4BOV)

Vintage SSB Net: Sunday 2100Z 14.293 & 0300Z Wednesday. Net control Lynn (K5LYN) and Andy (WBØSNF)

West Coast AMI Net: 3870 kc, Wed. 8PM Pacific Time (winter). Net control rotates between Skip (K6YKZ), DJ (K6RCL), Don (W6BCN), Bill (N6PY) & Vic (KF6RIP)

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).

Old Time FM

by Van Field, W2OQI
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In the beginning, Nikola Tesla got off the boat from Serbia. In a few years he had revolutionized the world by inventing the alternating current generator, thereby putting lights and electrical appliances into millions of homes.

Marconi came along shortly thereafter and using the works of physicists of the day produced the first wireless equipment and used it to span first the English Channel, then the Atlantic Ocean.

Marconi's spark transmitter needed to be modulated by some sort of AC to be able to be detected [rectified] so that sound could be reproduced in earphones.

Later, Major Edwin Armstrong came along with several inventions of interest to the world of communications. First the oscillating detector (regenerative receiver), which made possible to receive pure CW signals and at the same time amplify them. Applying these principles, the super regenerative receiver was born. It found use as a very sensitive detector/receiver above 30 MHz. The sensitivity was around 1 microvolt. Not bad for just one tube! It was still being used during WW2 , in the BC222 etc.

In the 1930s Major Armstrong came along with a new system of modulation by moving the transmitter frequency back and forth at an audio rate rather than increasing its amplitude at an audio rate, as in the case of AM. Previously, AM was the only way audio got on a carrier. This Frequency Modulation system was revolutionary and Armstrong put up a large transmitter and tower in Alpine, New Jersey and came on 42 MHz with the world's first FM broadcast. GE started building converters, which actually were receivers, and the audio was fed into the phono jack of the day's AM broadcast receivers.

The idea behind this new system was the elimination of static, the bane of the broadcast industry. By 1939 GE and Motorola were producing two-way radios for Police Departments using this system. Earlier systems used 1.6-2.5 MHz to transmit from police stations. It was either one way or talk back in the 30-40 MHz range via AM transmitters. Ignition noise at receiving sites could wipe out a transmission from a police car. This was the system in place in my hometown on Long Island in 1940 when I was in High School. I became friendly with the policemen at the local precinct in Center Moriches, L.I. and was soon retuning the transmitter in the police car. The precinct was at the outer fringe of the operating range and bumping over back roads tended to get the transmitter detuned. They would stop at my house and I would go out with my trusty neon bulb and holding it to the base of the antenna, re-tuned, and everyone was happy.

I built the Sergeant a super regenerative receiver for 40 MHz so he could listen to the State Police when they were working on a case nearby. They were very jealous and didn't want the locals to know what was going on. Of course in these days scanners were unheard of and even a receiver covering these frequencies was unusual and expensive (Hallicrafters S-27 for example).

I built a complete police receiver on their frequency of 2490 KHz with squelch for the precinct to listen to headquarters. When World War 2

Commissioner Edward J. Hickey of the Connecticut State Police was responsible for the installation of the first 2-way radio system using Armstrong System FM fixed and mobile equipment. The engineering study was done by Professor Daniel Noble of the University of Connecticut in 1939. No FM system equipment yet existed, but Fred Link agreed to build the prototype. Work was completed in 1940, just 5 years after Armstrong's first public demonstration of FM before the IRE convention in New York City. This photo was taken in 1940, and Hickey is pointing to the state highway map of Connecticut. Behind him on the far left is an original Link remote control unit for the 50 mc FM base station in the perforated metal cover just visible under the shelf. The unit in the rounded case to the right is probably a PA amplifier, and the Astatic desk mic is connected to it. The man at the desk is on the air, using a PTT handset which is connected to the remote. The hang-up cradle for the handset is just visible on the rear edge of the desk. (Photo from the Mobile Radio Handbook, edited by Milton Sleeper, 1950)

started the Army Air corps set up a firing range on the beach opposite town and I built a radio for them to listen to the range on, around 3 MHz.

Maybe all this building was why it took me so long to learn the 13 wpm code I needed to get my Ham ticket! Actually, it took time at RCA Institutes

This is a pre-war ad from Fred Link that was used during the time that the author was employed at Link Communications. Apparently this was not one of Link's better efforts, and the system spent more time on the bench that it did on the air. Several years were required for US-manufactured 2-way FM equipment to become the world standard for reliability which it enjoys to this day. (From the collection of W2OQI)

In a typical GE ad from 1950, the low-band (25-50 mc) FM mobile radio with seperate transmitter and receiver is on the left, and on the right is the high-band (152-162 mc) MC-201 equipment. General Electric offered 50 and 250 watt base station transmitters in heavy 66 inch tall steel cabinets as a system solution, and it sold very well throughout the United States and Canada.

in NYC to learn the code and allow me to get both commercial and Ham tickets. In 1942 these licenses were vital. You took them downtown in New York to the various recruiting offices to see how good a rating could be had. It sure beat getting drafted! The Merchant Marine was recruiting anyone that could copy code, The British were looking for Radiolocation [Radar] technicians and of course all the services were busy recruiting. I ended up in the Coast Guard as a Radio Technician First Class at 19 years of age. They told me at that time I was the youngest first class petty officer in the Coast Guard. (My Coast Guard experiences are at www.jacksjoint.com/cgseabee.htm)

While going to RCA Institutes I worked for Fred M. Link Company building FM equipment for Army tanks. They were just repackaged police FM gear. Early in the war competitive bidding and MIL specs weren't in place.

I had been promised a job with the Police Department when the war was over. I became the township's first radio technician. I specified and helped them replace the old equipment with a new Motorola system on 152 MHz. Between 1939 and 1945 G.E., Motorola and Link turned out thousands of what the Hams called "double humpers" in the 30-40 Mhz band. Identical sized units, one transmitter and one receiver were inter-cabled and installed in the trunks of police cars. After the war the same scheme was used in the new 152-162 MHz police band.

In a few years units were made smaller and put into one package. As these first generation units came out, some of them entered the Ham market. I believe the Indiana State Police donated units to the local Ham emergency groups and by changing a doubler to a tripler the transmitters came out on 52,525 KHz. And that's why this sort of disconnected frequency became the 6-meter national calling frequency!

Some Hams became enamored with channelization and fixed frequency equipment. Repeaters made from this

surplus equipment soon appeared.

When Motorola took radios in trade, they destroyed them. When GE took them in trade they either refurbished them or sold them by bid. A couple of Ham friends and myself got together and bid on a batch and won the bid, which was three trailer truckloads of old FM gear. Some of it was for refurbishing for the commercial market, the rest we sold to Hams.

In this way around the country Hams put FM on the air. Remember no one built a commercial FM Ham rig!

One of the things that were hard to come by was the control cables and control heads. They were often destroyed when new gear was installed.

Commercial Ham gear probably got its start in the VHF Marine radio business. This vast market came about when in the late 60s the use of AM 2MHz pleasure craft radio was terminated and companies started making gear for this market. Pearce Simpson of Miami made identical units for Ham and commercial markets, as did Regency and others. Imports soon flooded the market and you know the rest.

Used tube type FM gear was the staple of the 1970 Ham. 30-50 MHz gear had some wire pulled off of coils to move it above 40 or 50 MHz that it was designed for. 150 MHz gear had a few capacitors added across coils if they didn't quite tune. 450 MHz equipment usually made it without much modification. Vibrator and dynamotor supplies were replaced with AC supplies for home stations. Local control of volume, squelch and frequency was often built in to replace missing control heads.

The Restoration of an Old Workhorse-the EF Johnson Desk Kilowatt Amplifier

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The EF Johnson desk kilowatt amplifier was manufactured for many years starting about the mid 1950's. It consists of a pair of either 4-250 or 4-400 amplifier tubes in parallel which can be operated in CW, SSB, or high level AM modulated by a pair of 810 tubes operating Class B. The audio driver transformer, speech amplifier, and RF driver are all external to the amplifier. The instruction book gives connection information for the Viking, the Ranger, and the Collins 32V series for use as a driver. The power supply utilizes a pair of 872 mercury vapor rectifiers, which have over twice the current capacity of the 866 allowing the use of a single HV supply for both the RF deck and modulator. The heavy iron is all Stancor commercial grade. Some say the Desk KW came closest to the amplifier portion of the Collins KW1 in a production amplifier that was constructed along the lines of typical commercial AM broadcast transmitters during that period.

Let me start by saying that this project was not a "full body off" restoration like one might do on a vintage Corvette. This rig actually belongs to Al (K3PXR) who has graciously loaned it to me for an indefinite period because

This is the main AM operating position at W3LW with the restored Johnson Desk KW and Matchbox tuned up and ready to go on 40 meters. The Hallicrafters SX-100 makes a perfect match to this classic station.

he has moved into a smaller house with no real room to put the amplifier and the accompanying desk in his new shack. This amplifier was stored in Al's garage for over 8 years and was found to be in surprisingly good overall condition. The complete rig weighs in at around 440 pounds. To transport the rig from Al's place to mine, we removed the power and modulation transformers along with the filter reactor, modulator and rectifier tubes, and the plug-in RF deck. All wires were tagged or noted as to location to make reassembly easier. Removing the iron made lifting the main chassis and frame up into and out of a van an easy job for two people. The accompanying desk was already disassembled so it was easy to bring that portion over. The transfer occurred in early December 2002.

After studying the rig and the disassembly process, I felt that a complete restoration was not needed at this time. As you will see, this rig lends itself to a complete teardown, at least of the modulator, control, and power supply sections. There were some signs of rust "punching through" the cadmium plated chassis plates in spots and rust had just started to develop on the transformers and chokes.

From the beginning, since the rig had not been turned on in years, I decided not to apply any power until after all work was completed. After looking at the rig construction and talking with my good friend Bill (K3JPB), I decided to start the project by removing all of the components from the modulator deck. The power supply delivering bias and screen voltage is located on the modulator deck and the small chassis showed the typical 'pitting" of rust that often occurs on an older plated steel chassis. Removal of all the components and subassemblies on the modulator deck only required the unsoldering of the wires from the filament transformer for the 810s and unbolting everything. The HV bleeder resistor, consisting of two 25k, 200-watt resistors, is mounted on the underside of the modulator deck above the filter reactor and the HV lead to this bleeder also had to be unsoldered. The deck itself (as well as the main deck below) is secured to the steel frame with a number of flathead bolts. Once these bolts are removed, the decks each come out in one piece.

Figure 1: Here is the main wiring harness as it looked after it was removed from the rig for cleaning and inspection.

Nicotine and crud was cleaned off with "Fantastic" and water. As I said before, rusting was beginning to show but it was minimal so I tried a product called "Rust Treatment®" made by Permatex and available at auto parts stores. Rust Treatment is used in body-

work to "neutralize" and prevent further rust. The treatment comes in a spray can and turns any remaining rust black. The rest dries clear and is ready for painting a topcoat if desired. In this case, after some paint experimenting with results I didn't like, I just stopped with the Rust Treatment and decided to remount the components back as they were at the end of the project. Time will tell if this approach was the best.

The teardown process continued with the bottom deck. Figure 1 shows the complete wiring harness after all remaining components, tube sockets, 872 filament transformer, bias and screen regular chassis, and relays, etc were unbolted. All relays were cleaned and the contacts burnished. The reset mechanism on the plate overload relay was cleaned and lubricated, as it tended to stick. When the plate O/L trips, a little reset button protrudes out on the front panel next to the "Plate On" dial light. The front panel, which has the HV meter, On-Off key switch, mode switch, etc., came off by removing six machine screws from the front of the frame. These can be accessed better after the front trim bezel is removed. This easy harness removal results from the fact that the "chassis" is really just metal plates with all components mounted on one side. This type of construction was typical of AM broadcast transmitters of that era as well.

Again, I treated the bottom deck with Rust Treatment. The underside, if anything, was in better shape than topside, but I did spray some grey paint on the bottom as a precaution. Since it can't be seen, I didn't worry about the fact that it wasn't original.

The next step was cleaning the rust and repainting the transformers. After a coat or two of Rust Treatment, I used dark machine grey enamel, which turned out a little bluer than the original Stancor grey but nonetheless looks pretty good. Masking tape took care of keeping paint where it should not be, especially on ceramic and Bakelite insulators.

The big power transformer has been cleaned and painted as described in the text.

At the same time, the bias screen supply, the bias screen regulator subchassis and mod iron was cleaned and painted.

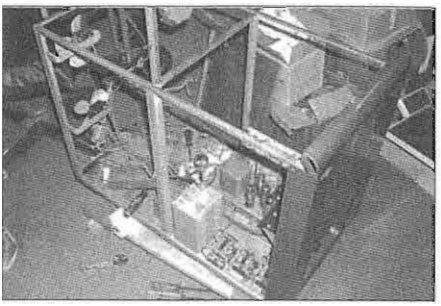
While all this was going on, I decided to tackle with the job of removing hundreds (I didn't really count) of screws that hold the RF deck together. The interior was in excellent shape showing only a little dust and some fuzz around the fans. In fact, it looks so good that I didn't bother taking any pictures of the RF "guts". After disassembly, I removed and lubricated the two fans that cool the 4-400's. They really have to come out to add a drop or two of oil to the oil points on each end of the shafts. To remove them com-

pletely, the 110 VAC wires have to be unsoldered from the units. This task is a bit tricky but, if care is taken, can be accomplished OK. While the amplifier was open, I did apply power to the fan circuit to check their condition. One of the two fans was quite noisy and I didn't want to open up the amplifier later to lubricate it. Lubrication and adjustment of shaft endplay cured the noise. The two fans on the rear of the main assembly were also cleaned and lubricated. Yes, there are a total of four in this rig.

The inside of the amp was cleaned of dust and the control shafts were lubricated. The existing lubrication on the roller inductor looked to be in good shape so it was not touched. Even the ingenious stop mechanism associated with the roller inductor crank worked per specification. The 0.064 HV spark gap inside the bottom of RF deck near the HV connector was cleaned and depitted. The dial cord to the plate-tuning indicator was also in good shape. Some Goo Gone® removed some tape marks which were on the plate tuning indicator bezel, and also above the HV meter panel on the main chassis front bezel. At this time, marks and scratches on the front of the amplifier deck were not addressed except for the initial cleaning. Quite a bit of grunge had accumulated under each of the knobs so they were removed to facilitate cleaning.

With the exception of the bare shielded audio wires in the 810 grid circuit, the wiring harness utilizes all plastic coated wire so I again used the Fantastik® and a rag and small brush to clean up the grunge on the harness. The harness came up nicely. I kept the cleaning materials away from the shielded wire.

About this time, I wanted to change the AC input connector. First, it was an old Hubble unit, and I was unable to get a matching female cord connector. Second, the AC feed is 240V single phase and neutral, which was tied to



The is the Desk KW frame during early dismantling showing the rig with the modulator deck already removed. The high voltage bleeder is lying on the bottom after removal from the modulator chassis.

ground at the back of the connector. In fact the filament, bias, and screen power transformers are all 120V and tied back to the neutral and ground. For reasons of ground loops, I like to keep the neutral floating so it is only grounded at the power panel. Ideally, the connector should have been changed to a 4 prong with AC, neutral, and separate ground. I was unable to find a 4-prong connector with a suitable current rating that form-fit the existing cable entrance bracket, so I stayed with a 3-wire system and added the green ground external to the twist lock power connector. This probably doesn't meet the NEC code so I will continue to look for a suitable 4-pin, 20A connector.

After a little research, I discovered that there appears to be at least two versions of the VR tube bias and screen regulator circuits. The manual I have shows a total of 4 of the VR-150 tubes and a single VR-105. The later schematic, and as it turns out, this rig too, used 3 of the VR-150's, a VR-75, and a VR-90. The VR-90 is the bias regulator (there was not a bias regulator in the early version). The VR-75 is only used in the screen circuit on SSB. The 3

VR150's are also in the screen circuit. You can tell the later regulator version by the two sets of test jacks that accept standard meter lead probes to allow measurement of VR tube current in both the screen and bias circuits. Pictures in my copy of the Johnson instruction book show that these test points were not in the earlier version. The reactor that allows self-screen modulation is also located on the bias regulator chassis. That little bias regulator chassis also disassembles with minimal soldering and I again removed all components to clean up the chassis.

My amplifier looked like the chassis was painted with a hammertone finish, so I used some Rustolium® grey hammered enamel and made it look good, again after application of the Rust Treatment.

The bias and screen supply was also cleaned up, but the transformers and chokes were unbolted and not unsoldered. Unbolting those chokes and transformers facilitated cleaning the chassis along the edges where those components were mounted.

The next big step was re-assembly. The re-assembly was done pretty much in the reverse of disassembly. The bottom deck was completed first by remounting all the components associated with the wiring harness. During the teardown, I noticed evidence of previous arcing between one of the 872 rectifier filament pins and the chassis below. I surmised that this was the filter reactor voltage "kick" that occurs in a choke input power supply upon interruption of the DC current. To check my theory, I hooked up the 6-henry reactor to a low voltage supply and passed ½ to ¾ of an ampere through it and opened up the circuit. You would be amazed at the size of the arc. L di/dt sure was working here! To protect the reactor, I added a similar spark gap across the choke terminals like is done on the modulation transformer secondary and set the gap to 0.030 inch.

INITIAL TESTING

The first step was to test the filament, low voltage and control circuits. These tests were first done with the RF deck removed and the AC primary to the HV transformer disconnected. The filament voltages on the tubes were checked with a known good AC voltmeter and with 243 VAC input, all measured within 4% (high) of the nominal voltage and within manufacturer's recommended limits. The RF deck was in place during the filament voltage checkout.

The Johnson Desk Kilowatt has been reassembled and is ready for 7290 kc.

The operation of the bias and screen regulator tubes was checked and a slight adjustment was made to the current. As a practical matter, without the final operating normally, the VR tube regulator currents cannot be set up. This is because the VR tubes now adsorb the current normally drawn by the finals. The 872 tubes were allowed to cook for at least 30 minutes to evaporate all the liquid mercury. Next I installed the RF deck to ensure that the internal fans and filaments were still all OK. Then I temporarily wired the HV transformer primary to 110 VAC to allow a low HV voltage test without the amplifier plugged in. All behaved

as expected. The 872's sure look nice with the high voltage on.

It was time for the RF testing. An unloaded Heathkit DX-40 on 40 meters was used as an exciter so as to provide the recommended 20 milliamperes of grid current. The RF output was connected through a Bird wattmeter and Heathkit SB-610 monitor scope into a 1000-watt dummy load. The output tuning and loading adjustments were set to the approximate 40-meter settings as shown in the Johnson instruction book. In the final setup, I am using a 3 dB RF pad between the DX-40 and the amplifier to provide a good 'match" between the RF driver and the grid as recommended by Johnson. This T pad was constructed with two 10 ohm and one 100 ohm 35 watt TO-220 resistors mounted on a small heat sink. The resistors are available from Mouser Electronics. The RF grid drive is set to 20 mils.

Since the rig was still out in the open, I had to bypass the interlock on the rear of the unit. I have worked with HV power supplies for many years so I am aware of the precautions needed when working on a rig with the HV terminals exposed. During this testing, there is no reason to get yourself anywhere near the HV terminals. I can't emphasize enough that you must keep "**SAFETY FIRST**" when working with these ***lethal voltages***. By all means have a second person handy to shut off power if necessary. After turning on the filaments and allowing for the plate circuit time delay, I placed the mode switch on the front panel to "TUNE" and flipped the "Plate On" switch on the amplifier deck. I quickly dipped the plate circuit and immediately saw power output. Touchup of all controls resulted in 300+ watts carrier output. I should note that HV is not removed from the 810 tubes in CW or TUNE. The grids are shorted together and the secondary of the modulation transformer is also shorted together to prevent modulation transformer damage. At the same time, the 810 tubes are biased to draw some current to act as an additional HV load resistor to improve HV regulation with SSB and CW. Don't assume the 810's are off during CW, SSB, or TUNE. They still have HV applied!

To test the audio, I employed a Bogen 25 watt PA amplifier scrounged from W8RM with a 70-volt (163 ohm) output. I had a UTC CVM-0 universal modulation transformer, which I setup for a 160-ohm primary and 3,000 ohms G-G on the secondary. I placed two 1500 ohm, 20 watt resistors across the secondary as shown in the Johnson instruction book to "load" the audio driver to improve the audio regulation into the Class B 810 modulators. I operated the Johnson in AM-LOW. This keeps the HV to 1300 volts (the same as TUNE and allows for 300 watts of unmodulated carrier output. The output waveform with tone or speech looked excellent on a Heathkit SB-610 RF envelope monitor.

RE-ASSEMBLY INTO THE DESK

The reassembly went well. During

the whole process, I put the chassis frame on a strong 4-wheel wooden furniture dolly. Using the dolly allowed for easy movement of the assembly as the weight increased. By using two extra 2" x 4" blocks and my trusty "Johnson Bar" pry bar, I could raise the frame enough to allow installation of the mounting hardware nuts for all the components mounted to the main chassis. It turned out that the furniture dolly made the job of placing the completed chassis back in the desk cabinet much easier. Before that re-assembly, I cleaned and lubricated the 8 rollers that the frame rests on inside the cabinet. Also, the felt that protects the top RF deck cover as it is slid down into the side of the cabinet into the storage position was loose and was re-glued with "Twice as Tacky®" white glue. To facilitate that repair, I removed the metal guides that held the felt and used c-clamps to hold the assembly while the glue dried. The routing of the grid input RF cable is a bit tricky to be sure it doesn't come in contact with the HV filter cap or the contacts of the control relays on the bottom deck. Its best to keep both the RF and input cables somewhat snugged up as the frame rolls into the desk.

Once in the rack, the chassis is grounded to the station ground, which ties to earth, as well as the utility safety "green wire" ground. Two ¼-20 wing nuts secure the frame into the desk and insure that the interlock is closed. The AC uses type SJ cord into a 30A 240V twist lock connector. The main power feed is a 30A circuit direct from my main breaker panel. The RF input and output pass through a B&W Number 551A 4-port transfer switch which allows for bypassing the amplifier with the exciter. The Desk Kilowatt does not have an internal RF bypass relay to allow putting the exciter on-air directly without using an external relay or switch.

When the amplifier is completely in the desk, the fan noise is greatly reduced. You'll probably still hear it on the air but it is not annoying.

The rig was connected to my 40-meter double zepp via 500-ohm open wire line and a Johnson KW Matchbox. I returned the Johnson Matchbox to factory original and even used the available unbalanced 300-ohm receiver output to feed my AM operating position receiver, currently an SX-100. Both the SX-100 and Matchbox came from my good friend Lew (W1LI). The 110 VAC keying voltage originates from pins 5 and 6 of the DX-40 accessory socket and feeds both the keying relay in the Matchbox and the KW Amplifier keying input on pin 6 of the kilowatt rig accessory socket. If the Johnson rig doesn't key, reverse the power plug on the exciter. The exciter power can be obtained from the AC accessory socket in the rear of the Johnson KW.

The first time I turned the rig on it came up to over 300 watts output with 1300 volts and about 350 mills on the 4-400's. The first contact was with WA2UKS, John in Owego, NY on 7290. The rig received a good AM report.

All and all, this was a fun project. Thanks to K3PXR, K3JPB, and W1LI for ideas and goodies. Next, and well under way, is an RCA BTA 1R1 AM rig being readied for 160 meters. But that's another story.

73

Larry, W3LW

A "*KISS*" CW Monitor

by Bob Lackey, W4QBE
1252 Worley Creed Road
Lakemont GA, 30552

I have several old military and homebrew transmitters. Several are chirpy and prone to key clicks when the oscillator is keyed. To alleviate this problem, I let the oscillator run and key a following stage. Monitoring the keying on a receiver can be a problem because of the constant running oscillator.

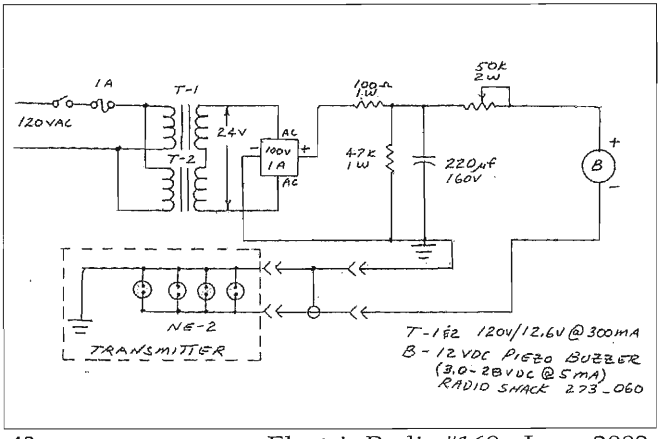
With the newer rigs, the keying is normally monitored and you don't find circuits in *QST* for key monitors. I have a 1958 *ARRL Handbook* that has a vacuum tube key monitor but its method of keying won't work on most of my transmitters. I've tried using keying relays with a contact for monitoring but this also gets messy.

I had some old 1960-1970 *QSTs*, which had some solid-state monitors, but I was unable to find any of the transistors. When I tried to substitute for the transistors, I found that I wasn't as smart as I thought I was.

So, what to do? I like to keep things simple, i.e., I endorse the "*KISS*" principle, (Keep It Simple, Stupid). While shaving one day (all my best thoughts come to me while shaving or taking a shower, and this one was a shaving solution), I realized I could use an RF pickup and key an audio oscillator with it. The simplest thing I came up with was to fire an old NE-2 and key a cheap Radio Shack piezo buzzer. After much "fiddling around", I came up with a circuit that works well for me. I use 4 each NE-2's in parallel mounted near the final tank so they will fire and activate the buzzer. It works well at the fastest speed I dare use on my old Skillman bug.

I can adjust the output level with the 50k pot but being old and a little hard of hearing, I run it wide open.

I use 4 each NE-2's to reduce the drop and give a little higher voltage across the buzzer. One NE-2 will work but actually depends on the type of buzzer used. I tried several buzzers and voltages and found that if the input voltage was too high, the NE-2 would fire all the time. That's why I ended up using 24 VAC, which produces 45 VDC. With the transmitter keyed, I have 24 volts across the buzzer. You may have to play with the supply voltage, buzzer type and number ofNE-2's to get what you want but the schematic shows what works well for me.



The only problem I have is the frequency of the buzzer. I would like for it to be closer to 1 kHz and I am on the lookout for one that will give a 1 kHz output and can be switched with a NE-2.

ER

Contributor's Photo Album

by Tim Tomljanovich, K9SB

My interest in radio began through my other hobby, astronomy!

In high school I was lucky enough to have some of my astro-photos published in Sky & Telescope Magazine. A schoolmate of mine (Joe) who also was interested in astronomy; saw my article and we became good friends.

Joe was a shortwave listener. He collected QSL's from allover the world. I was hooked; I bought and assembled a Heathkit shortwave receiver that actually worked! We would have contests on who could log the best DX heard.

One day Joe told me about a tower with antennas he saw on the other side of town. We decided to pay a visit! His name was Tom (K9MFY), he showed us his station, (pair of drake twins), and we talked all about DX, QSL'S, and antennas. Tom said if we wanted he would give us the novice exam and we could become real Hams. Tom gave us the ARRL manual on how to learn the code. Joe and I send code to each other every day and in May of 1975 we passed the novice exam. On September 15, 1975 I became WN9SBC and Joe WN9SBD.

We fired up my Hallicrafters HT-40 on 40mtrs and called CQ. WA9SIW came back pegging the s-meter on my SX101-A. Walt (WA9SIW) heard my CQ on 20mtrs, turns out he was only 4 blocks away. Walt told me the model HT on my transmitter stood for harmonic thrower. Walt invited Joe and myself to join a new club that was

This is Tim's well-equipped vintage station. Notice that he still has some of his Novice equipment!

Tim operates WN9SBC during the 1976 Novice Roundup.

starting, Tom (K9MFY) was there along with many new friends. Tom was our Elmer, though we got lots of help from everyone.

I was addicted to Amateur Radio; I would spend every spare minute playing on the bands. 40 meters was my favorite band. I traded in the HT-40 for a SR-160, won the Illinois section in the '76 Novice Roundup, got a Heathkit HW-7 for Christmas, built it, and it worked! I met a local ham on 40, Chuck (WN9SOC), and we would send high speed CW to each other. In May of '76 I got the General license (WB9SBC).

I spent 99% of my time hamming on CW. Just love that mode! Saved my money that year and got a rice box (TS-520). I would have loved to get the Drakes but couldn't afford them. I got the Advanced license in '76, spent most of my time rag chewing, chasing DX, and contesting. In November '77 got the Extra and at that time the F.C.C. allowed you to list 10 1x2 call signs you would like to have on your form 610. I got my 3rd choice K9SB.

The next 10 years I spent in the US Navy, 2 Years in school, 5 years on the USS Nathaniel Greene (SSBN-636), and 3 years at Groton Subase. I wanted to be a Radioman but the Navy said I would be a nuclear machinist mate!

While on the submarine I became good friends with the Radiomen. Even though I didn't have a top-secret clearance they would let me hang around the radio room. I could copy CW better than most of them so they would let me copy the incoming messages. Yes, the Military was using CW in the 80's! All transmitted traffic to the sub came in three ways. 1st was vhf RTTY, 2nd VLF RTTY, and 3rd VLF CW. All in 5 letter/number coded groups. Many times the vhf traffic was missed; the copy poor on VLF RTTY, so VLF CW was used for fill-ins. I had a lot of fun playing radioman.

Now I work in the Nuclear Power Generation industry as Radiation Protection Technician. I'm very active on

the HF, VHF bands. I operate, SSTV, fast scan ATV, CW, SSB AND AM rag chewing. I have a lot of tube stuff lying around, as do most of the AM guys.

My AM equipment: DX-100, 75A-4, Ranger, R390A. Other tube stuff: Drake Line Twins, 2B, Hallicrafters SX-115, HT-32B, SX-101A, HT-37, HT-40, SX 140, HT-46, SX-146 Heath HW-101, Hammarlund HQ-145.

TIM TOMLJANOVICH WN9SBC, WB9SBC, K9SB

[.....Editor's Comments from page 1]

Worked All States AM Update

Here is an WAS-AM update from Mark Bell (K3ZX) about a change to the award rules:

"I recently received a letter from Abe Levy (W3DA) in regards to the announcement of the "new" WAS-AM award in the May 2003 issue of Electric Radio. I was quite surprised to find that Abe had already achieved WAS-AM #1 from Electric Radio, and he was kind enough to enclose the article from the April 2000 edition of ER. I immediately contacted Ray (NØDMS) and said we need to recognize Abe's award, as well as anyone else that earned one. Ray did some checking and found that ER had offered the WAS-AM award starting in January 1995. So, the current WAS-AM rules as stated in the May 2003 edition of Electric Radio have been modified so that the starting date of the award is January 1, 1995. And yes, Abe still has the #1 certificate!! Congratulations Abe!!

Mark K3ZX"

Corrections

In last month's article "Submarines On The Air", we obtained some vintage photos of the subs from the Naval History Center. It turns out that the captions that came with them were wrong. Fortunately, William Weinhardt (W9PPG), who is a former LT (SS) USN, a Major in the Indiana Guard Reserve and a member of the SVARN (Sub Vets Amateur Radio Assn.), noticed the error. Bill is a submarine historian, and provided the real captions for these photos:

"...An excellent article by Carl, KGØHS in the May issue. Noticed though the photos of Razorback and Clamagore that the time frame of photos was stated as unknown. In both cases, the boats had been Guppyized and had the FRP sail (sometimes called the Northern Sail) installation so this dates them both sometime after 1960. From the yard cranes seen in background, the photo of Razorback may have been taken near Hunter's Point (SFNSY) or Mare Island NSY both in San Francisco Bay. In fact, in the case of Clamagore, the forward fin of the PUFF's sonar array can be clearly seen on the forward deck. As this was part of the GUPPY 3 conversion, this dates the photo as sometime between 1962 (when she was converted to GUPPY 3) and 1975 when decommissioned rather than during WW2."

In Paul Thompson's (WØOD) article in ER #168, the schematic on page 19, the caption, and the "editor's note" are wrong. Paul was describing modifications to an S-38, not the S-85.

I've been getting lots of requests to run the photo section that was a regular feature in Electric Radio for years. The problem is that I don't have many to run, outside of the photos that have been submitted for Barry's now-discontinued photo book. If everyone will start sending in photos of their Ham station, and photos of Ham events, I will gladly run the photo section, which we will be calling the "Contributor's Photo Album."

73, Keep Those Filaments Lit!

Ray, NØDMS

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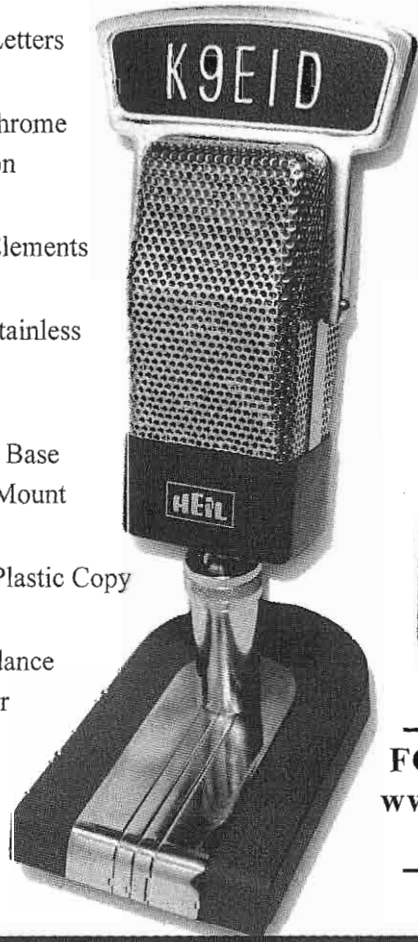

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FOR SALE: ARC-5 transmitters 4-7 mc, unconverted, $50, PE-103 dynamotor $50. Ed, WN1I, 207-336-2858, Buckfield ME.

FOR SALE: Parting out kilowatt commercial AM transmitter. Heavy Stuff. Bargain prices, good condx. Includes three 833 tubes, four mercury vapor rectifiers. For 220 AC power. Request parts list & prices. Charles Graham, K2VGE, 4 Fieldwood Drive, Bedford Hills, NY. 10507. 914-666-4523

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Included in this sale will be the second part of items from the John Haught Collection. To include many of John's beautifully hand build an detailed radio pieces. A crystal set built from a article in Popular Electronics also John's selection of collector tubes. John was a skilled craftmans at building his radios and it certainly show in the finished piece.

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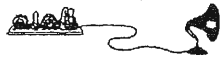

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We are conducting a sale from a Private Collector in Michigan. This will be a large auction that may require two sales. Some of the items are a Protelgram early projection TV, Zenith, Admiral, Emerson, Motorola TV's, Tube Guitar Amps, Tube Type Audio Gear Amps, Tuners and Preamps, Early Radios TRF sets for the 1920's, Horn Speakers, Military type transmitters & receivers, loads of table top radios, early Japanese and USA Transistor radios, hundreds of tubes, tube testers, early recording and tape equipment. Transoceanics tube & transistor type. RCA commercial 20 watt F.M. XMTR. Large Amateur radio selection drake, National Hammarlund, Hallicrafters, Ameco, RME, Gonset, EF Johnson and more. This will be a auction you will not want to miss! Make plans to be at this excellent sale!

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

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

FOR SALE: Collins Radio stock certificates, 33 avail, 10-share (green) or 100-share (blue), issued to various companies. $20.00 each, limit one per customer. Check or MO. No choice on color. William O. Dean, KC7ICH, PO Box 3105, Tonopah, NV, 89049

FOR SALE: Your old QSL card? Search by call free, buy find at $3.50 ppd. Chuck, NZ5M, NZ5M@arrl.net

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

FOR SALE: Communications Receivers, Military Communications and some test equipment. SASE, Don Jeffery, 131 North Ivy Ave., Monrovia CA, 91016, boallan@aol.com

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

FOR SALE: Send SASE for large list of excess parts. Publications, ham & test gear. K4AFW, 104 Glenwood Dr., Williamsburg, VA 23185

FOR SALE: Repro Nameplates, R-390A generic $9, S1J-3 and S1J-4 exact replicas, $12. Tom Marcotte, N5OFF, 210 Clem 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**, wa8saj@ncweb.com

NOTICE: Visit Radioing.com, dedicated to traditional ham radio & vintage radio resources. Let's Radio! Charlie, W5AM. http: / /www.radioing.com.

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: DX-35, DX-40 \reproduction crystal doors. $11.50 shipped. Texans add 8.25% sales tax. Glen Zook, 410 Lawndale Dr., Richardson, TX 75080 972-231-5011

FOR SALE: TX'ers, rcvrs, parts, manuals, etc. Send a large SASE. More at http://come.to/AF4K/ Brian Carling, 117 Sterling Pine Street, Sanford, FL 32773 Brian Carling, AF4K, 117 Sterling Pine St., Sanford, FL 32773.

FOR SALE/TRADE: Transmitting/ Receiving tubes, new & used. $0.55 & LSASE or email for list. I collect old & unique tubes of any type. **WANTED:** Taylor and Heintz-Kaufman types and large tubes from the old Eimac line; 152T through 2000T . John H. Walker Jr., 13406 W. 128th Terr. Overland Park, KS 66213. PH: 913- 782-6455, E-Mail: 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: 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@ao1.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

FOR SALE: Please visit RadioWorld-Online.Come to see our ham gear, parts, and more. Carl Blomstran PO Box 890473 Houston Tx. 281-660-4571.

FOR SALE: Spun Aluminum Knob Inlays for most Boatanchors. Collins Dial Drum Overlays. Dakaware Knobs. Charlie Talbott, 13192 Pinnacle Lane, Leesburg VA 20176-6146. 540-822-5643, k3ich@arrl.net

FOR SALE: Some unused obsolete Triplett tester transformers. Free List. Bigelow Electronics, POB 125, Bluffton, OH 45817-0125

FOR SALE: Build your own "Midget" bug replication by KØYQX, 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

FOR SALE: Collins restoration. Everything inside & out to make it as Art Collins built it. 50 yrs experience. W9OJI/N4FZ, IL, 815-734-4255 or N4PZ@aol.com

FOR SALE: Repair, upgrade, performance modification of tube communications & test equip. Accepting most military, all Collins & Drake designs, & the better efforts from others. Laboratory performance documentation on request. Work guaranteed. Chuck Felton, KDØZS, Felton Electronic Design, Box 187, Wheatland, WY 82201. 307-322-5858 feltoned@coffey.com www.feltondesign.com

FOR SALE: Convert any wattmeter to read PEP! Perfect for AM/SSB-$24.95 ppd for complete kit! HI-RES, 8232 Woodview, Clarkston MI 48348, 248-391-6660, info@hi-rescom.com

FOR SALE: Complete hardware set to connect Collins PM2 to KWM2 -$19.95 ppd. Warren Hall, KØZQD, FOB 282, and Ash Grove, MO 65604-0282.

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: Military and commercial communications items. Murphy's Surplus, 401 N. Johnson Ave., El Cajon, CA 92020. 619-444-7717 www.Murphyjunk.com

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: Aluminum heat dissipating plate and grid connectors for all 3, 4 and T series Eimac tubes including 3-500Z, 4-1000, 304T's and others. Alan Price fixr7526@cs.com

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

FOR SALE: Ships radio room clock repros, boatanchor mugs and t-shirts, more. http://www.cafeshops.com/amradio,amradio2

FOR SALE: Transistors (not radios) most new unused, 255 pcs, free list. L. Gardner, 458 Two Mile Creed Rd., Tonawanda, NY, 14150. radiolen@aol.com

FOR SALE: I built hot-rod receivers; R390A, SP-600, R-388/51J. NC-183D...and transmitters: Valiant, DX-100, T-4X-A-B, HT-32. 51J-4 filter replacements, R390A Hi-fi AM $245.00 ea. Chuck Felton, KDØZS, Wyoming, 307-322-5858, feltondesign@yahoo.com

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

WANTED: Fully functional with manuals: Johnson AN/FRT505 transmitter, Swan F51 and FC76. Contact Ric at C6ANI@arrl.net

WANTED: FRONT COVER for Tektronix model 475 oscilloscope. All Tek 270 and 460 series use same size cover. Please help me find one. Harry Grewlich, WA6IWZ, 442 S. Alpine Rd. Orange CA 92868. 714-978-3121

WANTED: I need a 0.85-800 VAC capacitor as used with Sola transformers. W7SC, 3932 S. Mesa View Ln, Boise ID, 83706-6052

WANTED: Original tuning dial knob dial lock and name plate for my Hallicrafters R-274/FRR. Walter Iacobelli, 2147 Harmon St., Ridgewood NY 11385, 1-718-456-1988

WANTED: #33A and #35 Universal SW-3 coils for cash or other coils. Hank Bredehorst 2440 Adrian St Newbury Park, CA 91320. 805 498-8907 quailhill@earthlink.net

WANTED: Coils Forms for National FB-7 and preselector. Mike Sanders 18169 Hwy 174 MT Vernon, MO 65712-9171 k0az@arrl.net

WANTED: National NC-303 in great physical condx and working, also want B&W 5100S and 51S sideband adapter. C.J. Ryan, PO Box 164, S. Plainfield NJ, 07080

WANTED: Hammarlund HQ180X crystal deck with switch. Ed Cuevas, Fort Worth, TX, 817-222-5355, ecuevas@juno.com

WANTED: National HRO-500-TS speaker for the HRO-500 and a Hallicrafters HT-32b.Bob, WØYVA. bobs@isquare.com; 703-450-7049.

WANTED: HRO 60 Xtal calibrator either original or home brew plug in. Phil, W9DVM 727-944-3226 plamarc1@tampabay.rr.com

WANTED: "H" and "J" VLF coils for my HRO-50. Jack, W8JNH, Greenville OH, 937-548-4110

WANTED: Headset, mic, key, and AC power supply for the Navy/Marine Corps TBY transceiver. Ken Kolthoff, K8AXH, POB 215, Craig, MO 64437. Work #: 913-577-8422

WANTED: 23 channel tube-type CB radios for 10-meter conversions. Also tube-type 10-meter linear amplifiers. Ed, WA7DAX, 1649 East Stratford Ave., Salt Lake City, UT., 84106. 801-484-5853

WANTED: James Millen plug-in coils: p/n 42080, 42040, 42015 43015. National NC-101X w/meter. Gary Carter, WA4IAM, 1405 Sherwood Drive, Reidsville, NC 27320. Phone: 336-349-1991. Email: gcarter01@triad.rr.com.

WANTED: W.E. Type 215-A (military VT-5) vacuum tubes. Roland V. Matson, POB 956, Lake Panasoffkee FL 33538 1-352-568-1629

WANTED: Info on Electro Tone Labs M100. Maybe a screen modulator. Has volume control & 2 slide switches, CW-phone, Tone-mic on front. 4 terminal on rear plus adjustable control that controls voltage to 2 of the terminals. Randy, 411 Woodhaven Dr., Lynchburg, VA 24502, 434-239-6127.

RWC-radiocollector@worldnet.att.net

WANTED: Eldico SSB-100F linear amplifier, good condx, working. Bill, W4TXL, 336-969-2057, W4TXL@msn.com

WANTED: Manual, info on Hallicrafters SX-96A (NOT SX-96). Jim Novak, WA9FIH, 2335 S. 2nd Ave., North Riverside IL, 60546-1308, WA9FIH@arrl.net

WANTED: Looking for the emblem of National "NC". Katsu JO1GEG/ex.N8EYH, khirai@ieee.org

WANTED: One tuning knob for SX-96, SX-99, or SX-100. Herb, K9GTB, 6486 Bow Lane, Gillespie IL, 62033. 618-362-6539

WANTED: Meter for Hammarlund HXL-One linear. Paul, KU6T, 310-453-6631, pkcwang@ee.ucla.edu

WANTED: National HRO-500-TS and LF-10 preselector. Information on improving SSB distortion in the HRO-500. Bob, WØYVA. bobs@isquare.com; 703-450-7049.

WANTED: 111C telephone company repeat coils. Jim Alexander, K0HIP, 479-968-7270, ealexand@cswnet.com

WANTED: Poly-impedance modulation xfmr, 125 watt plus. Bill, KØRZ, 303-499-1936, billK0RZ@aol.com

WANTED: Audio transformers, with good windings, for Westinghouse RADA and Aeriola Sr amplifier. Paying $40.00 each plus shipping. Roland V. Matson, POB 956, Lake Panasoffkee FL

WANTED: Waters Q-Multiplier for Collins KWM-2. Claude Fleureau, F6GGF, 14 Sentier-Du-Buvier, 92130 Issy-Les-Moulineaux, France

WANTED: Anyone interested in forming an email discussion group on OS-8/U oscilloscopes please email Mike at: mikehardie@shaw.ca

WANTED: Power transformer for Collins 310B3 exciter—will buy junk unit if needed. Brian Roberts K9VKY, 130 Tara Dr., Fombell, PA 16123 (724)758-2688 k9vky@arrl.net

WANTED: Marantz first power amp, uses EL39 tubes. Condx unimportant. Or pay well for photo of same. For use in upcoming "History of Audio" book. Charles Graham, 914-666-4523

WANTED: WW-2 Japanese Military Radio of any kind. Yokohama WW-2 Japanese Military Radio Museum, Takashi Doi, 1-21-4,Minamidai, Seyaku, Yokohama, 246 Japan takadoi@carrot.ocn.ne.jp http://www.yokohamaradiomuseum.com/

WANTED: Collins R-389 LF receivers, parts, documentation, anecdotes, antidotes. W5OR Don Reaves, PO Box 241455, Little Rock AR, 72223 501-868-1287, w5or@militaryradio.com, www.r-389.com

WANTED: HELP: I need information on an E.M. Sargent Co.Model 205A 5-band radio circa late 30's (?). David Miller, 307 754-4351 or K7ALR@arrl.net.

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

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: Hallicrafters SX 88 parts chassis with cabinet, power,audio output, 50khz IF and 2mhz I F transformers. Ops service manual for Eddystone EC958. 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: Top prices paid for globe shape radio tubes, new or used. Send for buy list or send your list for offers. Write or email: tubes@qwest.net

See WWW.Fathauer.Com or send for catalog of tubes for sale. George H. Fathauer & Assoc., 688 West. First St., Ste 4, Tempe, AZ 85281. 480-968-7686, Call toll free 877-307-1414

The Collins Video Library

The Collins KWM-2 Video (4 hours, $89.95) Highly detailed video on operation, rebuilding, alignment, troubleshooting, and neutralization of this classic! A must for anyone who owns and operates a KWM-2 or 2A. Printed documentation included.

The Collins 75S-3 and 32S-3 Video (3.5 hours, $74.95) An excellent in-depth examination of the most popular version of the S-Line equipment. Operation, modification, alignment, neutralization are covered and more! Much of this information applies to all versions of the S-Line!

The Collins 30L-1 video (1 hour, $39.95) This is a complete guide to the 30L-1 amplifier. Topics covered are operation and safety, updates, and a discussion of the classic 811A triode. Learn the secrets to greater performance.

The Collins 30S-1 video (1 hour, $39.95) Finally, here is the one everybody has wanted! This extraordinary video describes operation and user safety, maintenance and modifications of this classic Collins powerhouse amplifier. Very informative--truly a must for all 30S-1 owners. Complete with printed documentation.

The Collins Amateur Radio Radio Eqipment Video Spotter's Guide (1 hour and 40 minutes, $24.95) Close to 90 individual pieces of Collins Radio equipment are shown in the video. Examples of some of the gear covered are: KW-1, KWS-1, 30K-1, 20V-3, 75A-4, KWM-2, S-Line, KWM-1, 30S-1, 30L-1, KWM-380 and much more. Study up before that next hamfest!

The Collins KWS-1 Video (2 hours, $39.95) This video is the perfect companion to the 75A-4 video for owners of the "Gold Dust Twins"! Butch Schartau (K0BS) shows you how to operate, maintain and repair your KWS-1. Watch as Butch goes theough the entire alignment and neutralization process, as well as showing you how to properly operate this famous transmitter.

The Collins 75A-4 Video (4 hours, $89.95) This video is four hours of great information on how to repair, maintain and restore this classic receiver. Butch Schartau (K0BS) guides you through all aspects of keeping your 75A-4 running like a top.

R-390A Video (7 hours, $109.95) At last it's available! Long awaited by serious "boatanchor" enthusiasts this is a great video all about the ultimate receiver. Now you will have the ultimate video to go along with it. R-390A expert Chuck Rippel (WA4HHG) covers an absolutely incredible array of information in this "heavy duty" video. This video looks at operation, the receiver modules, complete circuit description, front and rear panel details, complete mechanical and electrical alignment, PTO details, and performance evaluation, modifications, troubleshooting, and restoration. There is nothing like this video available today, at any price!

R390A Addendum Video ($49.95) Another 3 hours and 40 miutes of R-390A information from Chuck Rippel (WA4HHG).

SP-600JX Video (4 hours, $89.95) In this video, Chuck Rippel takes us through all aspects of SP-600-JX servicing including repairs, restoration and modifications. This video is a must for any new owner needing to work on the SP-600.

Purchase three or more videos and get 10% off of the retail price!
Add $5.95 each for the first two videos for shipping and handling in the USA, additional videos are shipped free.

Produced by Floyd Soo, W8RO (ex-KF8AT)

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

WANTED: Seeking unbuilt Heathkits, Knight kits. Gene Peroni, POB 7164, St. Davids, PA 19087. 610-293-2421

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

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

Announcing the Felton Electronic Design R390F High Performance HF Receiver

The Felton Update Engineered R390A comes with speaker, antenna, lab quality alignment and service, plus full guarantees. All the upgrades are hand wired with parts like original and include the following excellent upgrades:

Audio: 2 watts hi-fi audio, low-distortion Class A stages with all low-level stages reworked for lowest distortion and noise. Three new audio filters are front-panel selectable: 4 kc LP, voice only 250-2700 cps, or CW at 250 cps BW.

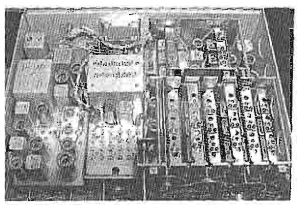
Enhanced sensitivity and large signal handling: This includes installation of a new 6BZ6 RF amplifier and a linear diode detector. Minimum discernable signal is at least -145 dbm.

All-new AGC system: No overshoot, pumping or distortion. Many advanced features, characteristics are optimized for both AM and CW-SSB.

Line audio channel reworked to drive your low-impedance headphones through a stereo panel-mounted headphone jack.

Hand-selected Eminence loudspeaker for precisely defined music and voice.

The KDØZS R390A answers that nagging question in the back of your mind as you look through the ever larger and more glossy advertisments: "Are these things for real?"



For full details and pricing of this once-a-lifetime opportunity call Chuck Felton (KDØZS) at 307-322-5858, or email at: Feltondesign@yahoo.com web: FeltonDesign.com

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: 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: Orig Heath manuals for ham & test equip. Please state condx & price. Warren, K1BOX, NC, 828-688-1922, k1box@arrl.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: Tektronix memorabilia & promotional literature or catalogs from 1946-1980. James True, N5ARW, POB 820, Hot Springs, AR 71902. 501-318-1844, Fax 501-623-8783, www.boatanchor.com

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

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

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: Lloyd's AM/SW table radio, gray, slide rule dial, early 1960's, AC/DC picture verification; Louis L. D'Antuono, 8802-Ridge Blvd, Brooklyn NY 11209. 718-748-9612, AFTER 6PM. Eastern Time

WANTED: Manual (copy OK) for Tapetone Skysweep 345 Receiver; correspondence w/other Skysweep owners. Geoff Fors, POB 342, Monterey CA 93942 wb6nvh@mbay.net

WANTED: SCR602 components, BC-1083, BC-1084 displays, any APS-4 components. Carl Bloom, 714-639-1679, carl.bloom@prodigy.net

WANTED: BC 611C Main Power Switch needed (The switch that is activated by extending the antenna). Dean.Gagnon@juno.com, KK1K, 802-878-8293

WANTED: Harvey Radio Labs FT-30 or its tritet exciter using 2-59's top dollar paid. Robert Enemark, W1EC POB 1607, Duxbury MA, 781-585-6233

FOR SALE: RME-45 $100. S-108 $110. WWV rcvr $150. BC-312N(AC) $125. BC-348Q $125. HW-12A xcvr $125. Wanted/manual: RCA/Radiomarine/T-408/URT-12 xmtr. Sam KF4TXQ PO Box 161 Dadeville, AL 36853-0161 stimber@lakemartin.net 256-825-7305

FOR SALE: NOS TUBES: 807s, $15 each; 813s, $10 each; 1616s, $5 each. Mike Grimes, K5MLG; 3805 Appomattox Cir; Plano, Texas, 75023, 972- 867-6373. Email: grimesm@flash.net

FOR SALE: Navy RBC receiver with PS, cables, fair, restorable, pickup only Tampa Bay, $50. George Guler, WØOIR, fguler@ij.net, 813-634-9489.

FOR SALE: Johnson Desk Kilowatt w/ 1 new 4-400C tube. $2,300. Herb, K9GTB, 618-362-6539

FOR SALE/SWAP: Swan 250 six meter rig with supply. Looking for Hallicrafters HA-5 VFO in good shape. Sandy W5TVW, 40460 Edgar Traylor, Hammond, LA 70403 or ebjr@i-55.com

FOR SALE: Heathkit 1680. James, WØKNJ, 605-842-2915

NOTICE: Congratulations to Tom Lewis (KE4RFT) who recently got his General ticket. Be sure to congratulate Tom when you hear him on the air!

ELECTRIC RADIO STORE

BACK ISSUES

All back issues are available at $38.00 per year (or any 12 issues), or $3.75 for individual copies. Buy the entire first 14 years (#1 to #167) for $350. **Special deal on last four years (10th year through 13th year (or any 48 issues): $100.00.** These prices include delivery by media mail in the USA. Foreign orders please inquire for shipping rates.

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The front displays the logo from the cover of ER (the tube logo, Electric Radio, and "celebrating a bygone era"). The back has "Real Radios Glow in the Dark" (used with the permission of Classic Radio). The T-shirts are U.S. made by Hanes and come in Small, Large, X-Large, XX-Large. The color is slightly lighter than the cover of ER. $15.00 delivered, $16.00 for XXL.

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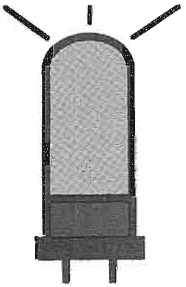

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