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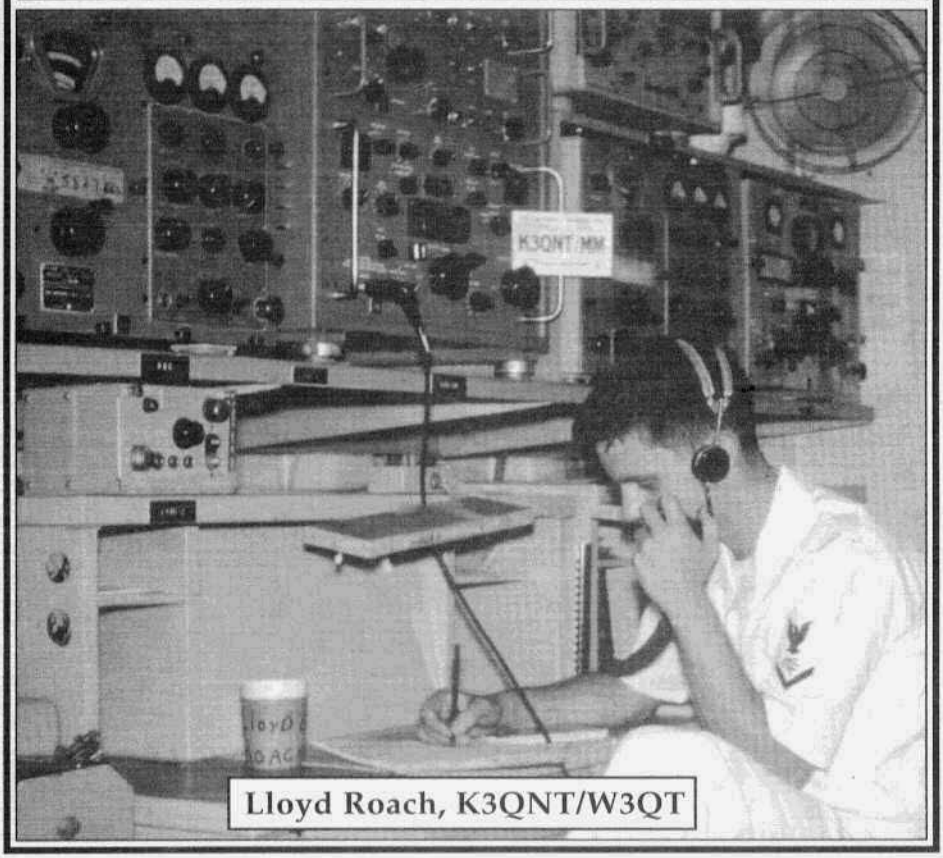
ELECTRIC RADIO

celebrating a bygone era

Number 142 March 2001



Lloyd Roach, K3QNT/W3QT

ELECTRIC RADIO

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

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

Regular contributors include:

Bill Breshears, WC3K; Bob Dennison, W2HBE; Dale Gagnon, KW1I; Bob Grinder, K7AK; Jim Hanlon, W8KGI; Brian Harris, WA5UEK; Tom Marcellino, W3BYM; Ray Osterwald, NØDMS; Chuck Teeters, W4MEW; Bruce Vaughan, NR5Q.

Editor's Comments

15M Jamboree April 20/21

Last year we had a very successful 15M jamboree in January. This year I thought I'd let it go until spring when 10M activity might be dying down a bit and there would be more enthusiasm for some 15M activity. So mark your calendars now and let's make this year's event as successful as last year's. Looking back at my comments in the February issue (#130) I was reminded just what a great jamboree it was. I worked 60 stations over the weekend jamboree. I don't think I've ever done that before. I'm looking forward to seeing if I can do as well (or maybe better) this year. We'll print reports from participants again this year. Logs should contain all the usual information: times, rigs, antennas, names, callsigns and of course AMI numbers. For each AMI member contact add an extra point to your score total. Please try to get your reports in to me ASAP after the jamboree.

Electric Radio Parts Unit Directory

It's been a while since I talked about the Electric Radio Parts Unit Directory and what a benefit it can be to those repairing or restoring vintage rigs. Here's what the directory is (for those new subscribers and for those who have never become aware of the service): The directory is a list of vintage rigs that are being parted out. I list them alphabetically according to manufacturer. Other information in the directory is the owner's name, address and phone number and in some cases e-mail address. There is no charge to put a rig in the directory but there is a $2 charge with a LSASE to obtain a copy of the directory. At the present time there are 144 rigs in the directory. I encourage everyone who has a parts rig to add it to the list. You can do this by letter, phone, fax or e-mail. This is a way to provide a service to other vintage enthusiasts and also to make some money from a rig that might otherwise be worthless. And remember my slogan, "Your dead rig can bring other rigs back to life". N6CSW

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Cover: Lloyd Roach, W3QT, radio operator aboard the LST, Page County back in the '60's during the Vietnam war. See his article on page 28.

Bob Samuelson, Silent Key

whiz kid at Hallicrafters for less than a decade leaves indelible imprint on amateur community[1]

by Robert E. Grinder, K7AK
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Bob Samuelson, exW9RAD, who was born February 28, 1911, passed away February 8, 2001, a few days before his 90th birthday, and only two weeks after Bill Orr died (see Grinder, 2001, ER, #141). Both men attained avatar status during their professional careers, endowing twentieth-century electronics with unparalleled theoretical and technical contributions and tangible accomplishments. Both men were Fellows of the IEEE; however, it is unlikely that they ever met. Bob was almost ten years older than Bill; he had graduated from college in 1933, five years before Bill's freshman year. During those five years, after first distinguishing himself at Collins Radio via a whirlwind of achievements, Bob joined the staff at Hallicrafters, and in a scant few months, put three low-power transmitters in production and had the famed HT-4 ready in 1938 for the assembly-line.

Furthermore, the two men chose career pathways not likely to cross as they pursued their goals. Bob Samuelson's professional career spanned 42 years, from 1933 when he started work at Collins Radio until 1976, when he retired in Phoenix, AZ, following twenty six years with Motorola. He worked at Hallicrafters from 1938 to 1946—he was 27 years of age when he arrived and 35 when he departed—the eight years represent about 20% of his career. The phase at Hallicrafters is the only one marked by contributions to amateur radio, and it is clearly the occasion where he made an indelible imprint on the culture of amateur radio.

A decade before E. F. Johnson, Collins Radio, and Leo Meyerson (World Radio Laboratories) introduced, respectively, such series as the Viking, 32-V, and WRL Globe King, Samuelson pioneered commercial development of plate-modulated transmitters for the amateur market. He is revered deservedly in the current AM community, in general, for his resolute commitment to AM transmitters, and in particular, for his development of the HT-4/BC-610, which has been acclaimed in the communications realm as akin to the Jeep in its significance to WW II. Moreover, the extraordinary rate at which he designed and accelerated production of his transmitter series for Hallicrafters qualifies him as a "quiz kid."

Bob Samuelson's sterling contributions to Hallicrafters are representative of his striving, throughout his professional career, to develop expertise as an "innovator" in the field of electronics [see below]. In contrast-after Samuelson had left Hallicrafters—Bill Orr published systematically for radio amateurs, from 1949 to 1998, scores of Handbooks, topical books, and magazine articles. Bill Orr concentrated essentially, during his career, on becoming a pre-eminent print journalist in the domain of amateur radio.

I aim to acknowledge here my respect for Bob Samuelson by enlarging upon my earlier recounting of his experiences as a young engineer at Hallicrafters (Grinder, 2000, ER, #136) and to comment on his subsequent work at Motorola. I first met Bob in the Spring

This undated photograph was taken in a Chicago hotel probably in 1940 or 1941. The first person standing at the left is Rollie Sherwood, a Hallicrafters' sales representative, next is Robert Finlay, liaison engineer between Hallicrafters and government agencies, the next two persons, including the individual with his back to the others, are unidentifiable, the fifth person standing is Bill Halligan. Seated from left to right are Nelson Case, a Hallicrafters' sales representative; Bob Samuelson; Joe Frendreis, Hallicrafters' comptroller; Ray Durst, Hallicrafters' vice-president; and E.G. Brown, Hallicrafters' advertising manager.

of 1999 after I had done considerable research on the HT-4/BC-610. When I submitted the final draft of my manuscript to Electric Radio, Barry Wiseman informed me that Bob was living hardly a stone's throw away from me and indicated that he might be interested in what I was doing. I was thrilled to learn of his proximity! I found Bob to be an affable, soft-spoken person, who invariably made complimentary comments about his associates. Later, I learned from members of his family that an unfailing trait of his was that of rarely speaking critically of others.

I suggested earlier (Grinder, 2000, ER, #136) criteria for creativity and showed that Bob Samuelson met my definition of a highly creative person. When Bob visited Portland, Oregon, in 1967, on behalf of Motorola [see below], he offered a newspaper reporter his view of a creative person. Specifically, he prescribed the role of an "innovator" in the context of forthcoming scientific advances. In the process, he projected an image of himself: "We are bound to have new technology. But it is not the technology alone that brings another Motorola into being or a Texas Instruments or a Fairchild. It is the next big innovator," he contended. "It is not the scientists, it is the innovator who picks up the ideas and puts them together into a profitable business who makes these things move" (Pratt, 1967).

Bob's sensational success in developing transmitters for Hallicrafters overshadows the fact that his administrative skills were also highly regarded.

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The Eldico SSB-100F

(A Fitting and Affordable Mate for the 75A-4)

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Introduction

With AM being my preferred mode of operation it should come as no surprise that my collection is heavily weighted (literally) with plate modulated transmitters. That said, my penchant for rare, uncommon or highly prized single sideband rigs is quickly revealed to shack visitors when they are greeted by a TRI-X-500, multiple Cosmophones, B&W 6100's, 100V's, an Invader 2000 and a KWS-1. Rounding out the welcoming committee is a pair of Eldico SSB-100F transmitters.

Introduced in December of 1956, these successors to Long Island City-based Eldico Electronics' SSB-100, (ER #113) and SSB-100A retailed for $795 and up. According to Eldico's president, Don Merten K2AAA (now 5K), twelve hundred 'F' models were produced, with some eight hundred being sold to amateurs and the remainder going to commercial or government institutions. That I have only been able to identify units with relatively low serial numbers (70, 75, 80, 108, 160, 166, 195 and 210) makes me question the accuracy of the reported 100F sales. Weakly supporting the premise of a lesser production number, I am aware of only six other 100Fs, whose serial numbers are unknown to me. Additionally, I have seen but three throughout years of hamfest attendance. Regardless of the actual production number, the SSB-100F was not marketed long. The last 100F was apparently produced in August of 1958 and the last related Eldico advertisement in QST was in April of 1959. There is little doubt in my mind the availability of lower cost SSB transmitters like the 32S1/32S2 and HT-32/HT-37 and transceivers like the KWM-1/KWM-2 and Cosmophone contributed to the premature demise of the SSB-100F.

Like most pre-60's amateur equipment, the SSB-100F covers 80, 40, 20, 15, 11 and 10 meters. With its 500 kc VFO range and three 10 meter band segments, there is no support for 29.5 through 29.7 Mc without a crystal change. The transmitter is rated for outputs of 100 Watts (PEP) of SSB, 50 Watts of CW and 20 Watts of AM (one sideband). Its 3.3 Kc (6 dB) voice bandwidth is supported by unwanted sideband and carrier suppression of at least -50 dB and 3rd order distortion of -35 dB or more.

Mechanical Description

Comparisons of the 'F' model to its predecessors reveal vast differences. Whereas the non-A and A models are modular nightmares that rival, if not surpass, the Collins 32V-series in maintenance and repair complexity, the 100F's circuitry is spread over four easily accessible, anodized aluminum chassis (exciter, VFO, power supply, oscilloscope) which makes working on an SSB-100F extremely easy.

Weighing a scant 50 pounds, the 100F is housed in a receiver-like cabinet that measures 17-1/16" wide, 10-3/8" high (not including the rubber feet) and 15-3/8" (not including the knobs and connectors). The paint scheme is simple: durable, high gloss, medium grey with white silk screening. A hinged lid af

Front view of the SSB-100F.

fords access to the top side of the various chassis and, more important, every alignment and calibration adjustment, barring the rear panel mounted bias pot.

In the top left corner of the front panel resides a 200 mA plate current meter, while a 1" oscilloscope occupies the top right. Centered between the instrumentation is a bakelite escutcheon that frames the slide rule-style frequency drum. The top row of controls, left to right, are the carrier level, VFO (note the spinner knob) and plate tuning and loading. On the bottom row, in the same direction, are the sideband selector, audio gain, function, vox level, power switch, QT adjustment, CAL/STBY/XMIT switch, grid tuning and bandswitch. Early, non-PTT equipped units have a single contact Amphenol microphone connector at the bottom left corner. Later units with PTT came with a phone jack as used by Collins and Drake. Along this line, a previous owner of #0080 installed an RCA phono jack on the rear panel and circuitry to allow PTT.

In addition to the bias pot, the sparsely populated rear apron contains an SO-239 RF output connector, an RCA jack for 600 ohm audio input, an eight screw terminal strip, a fuse holder and another RCA jack to provide a SPOT or calibrate output for a receiver. While the calibrate connector is mentioned in the manual it is not shown on the schematic and may not have been included in very early units. The calibrate signal is picked up by an open ended wire, several inches in length, that is laced in the main wiring harness.

Exciter Chassis

Audio amplification is accomplished using both stages of a 12AT7 which drives a second 12AT7 configured as a balanced modulator. The second input to this modulator, a 413 Kc carrier, comes from a third 12AT7, configured as a grid-plate oscillator and cathode

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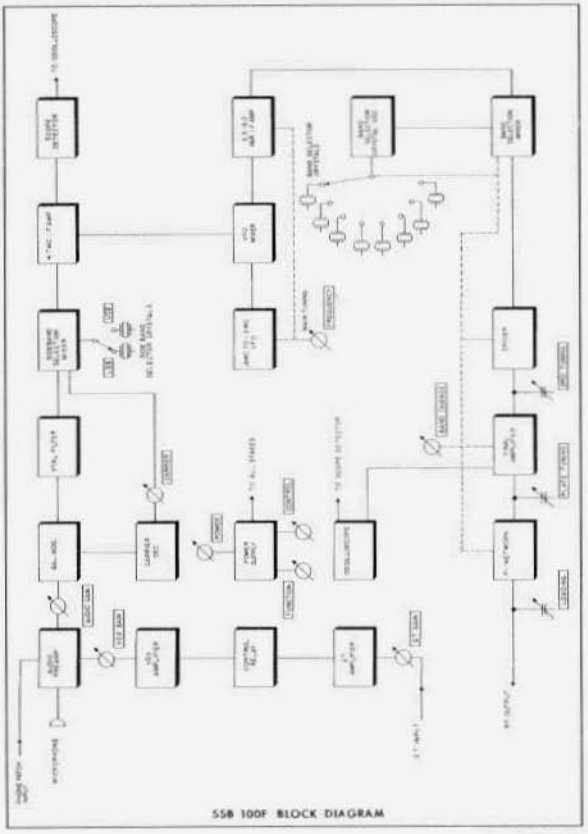

SSB 100F BLOCK DIAGRAM

follower. The output from this cathode follower is level-adjusted via the front panel-mounted 'CARRIER' potentiometer before it is applied to a 6BA7 operating as an electron-coupled oscillator and mixer. Energy at 4700 Kc from this 'converter stage' results from mixing frequencies of either 5113 or 4287 Kc (switch selectable by the LSB/USB panel switch) with the lower sideband (410-413) Kc signal from the crystal filter. The four-crystal lattice filter is followed by two series trap crystals of 413.4 Kc and 413.8 Kc which further reduce unwanted carrier and upper sideband energy. The lengthy jump from the 'A' model to the 'F' model strongly signaled the move to the filter method and away from the phasing method employed in the 100/100A.

A cable from the exciter chassis carries the 4700 Kc sideband signal to the VFO chassis but not before one section of a 6AL5 rectifies a portion of that energy to provide horizontal deflection. Similarly the second 6AL5 section creates a variable DC bias that provides intensity modulation of the CRT, thus allowing the oscilloscope beam to be blanked when there is no modulation or carrier.

In addition to the sideband generator and oscilloscope detector, the exciter chassis also contains the VOX/QT circuit. Amplified speech feeds one section of a 12AT7 and receiver's audio the other. The outputs of the two triode sections are rectified separately in the dual diodes of a second 6AL5 before being passed to another 12AT7 that serves as a controlled, monostable multivibrator.

VFO Chassis

Spectrum segments of 500 Kc are achieved by mixing the output of the 0.8 to 1.3 Mc VFO with the 4700 Kc SSB signal from the exciter. The permeability tuned 6AK6 VFO is of modified Colpitts fashion and uses electron coupling for improved isolation. Before reaching the 12AT7 mixer, the VFO output passes through an elaborate low pass filter for harmonic attenuation. This mixer is grid block keyed in the CW mode. Following the mixer is a 5.5 to 6.0 Mc amplifier implemented with a 6AU6. The mixer plate and amplifier grid are gang tuned with the VFO. An air variable that is adjustable via a small front panel screw allows dial calibration.

The author's Eldico station: Collins 75A-4 receiver on left; SSB-100F transmitter center and SSB-1000F amplifier (the subject of a future article) on the right.

Power Supply Chassis

Why the power supply chassis was so named in the manual seems odd considering the assembly contains the final amplifier, the driver, the last mixer, a crystal oscillator, the oscilloscope and, oh yes, the power supply components.

The SSB-100F's power supply centers on a husky transformer with eight secondaries (five filament, one HV, one LV and one BIAS). A 5R4 serves as a full wave HV (800 Volt) rectifier and a 5U4 similarly handles the LV (360 Volt) requirement. Two half wave, series-connected selenium rectifiers create an unregulated -75 Volts for bias. Regulated plate voltage for the crystal oscillators results from an OA2 while an OB2 holds the VFO oscillator screen to 105 Volts.

In the RF arena, moving from the input to the output, both sides of a parallel-tied 12AT7 Pierce crystal oscillator create an injection signal that is 5.5 to 6.0 Mc higher than the operating frequency. This signal is applied to the grid of one section of another 12AT7 whose plates and cathodes are paralleled, making this third mixer behave like a dual gate MOSFET. The other grid is fed with the 5.5 to 6.0 Mc signal from the VFO chassis.

The output of this third mixer is amplified by a Class A 12BY7 driver that excites a Class AB1 parallel-connected 5894 final. Matching the 5894 plate impedance to the load is a pi network that is bandswitched along with the tuned stages of the previously mentioned oscillator, mixer and driver stages. In addition to the neutralization normally required in a non-multiplying amplifier, linearity improvement is achieved by feeding some of the RF from the 5894 plate to the cathode of its driver.

A small sub-chassis mounted above the 'power supply' chassis contains the 6AU6 and 1CP1 CRT that form the oscilloscope. The 6AU6 amplifies the detected SSB signal from the exciter chassis before passing it to the horizontal deflection plates of the CRT. Vertical deflection is provided by capacitively coupling RF from the plate of the 5894 final.

Restoration

With one paper capacitor, three electrolytics and no postage stamp micas, restoring an SSB-100F should require little effort. At least with mine this was true. Per my normal practice, after reforming and checking the electrolytics, I examined the critical resistors and replaced those few components that showed their age. The single .5 uF paper capacitors were relieved of their duty primarily because I did not like their waxy look. Erratic operation of the 5 watt wirewound bias potentiometers in both transmitters was corrected with DeOxit. While I was at it, I also sprayed the tube sockets and wafer switches and the rotating mechani

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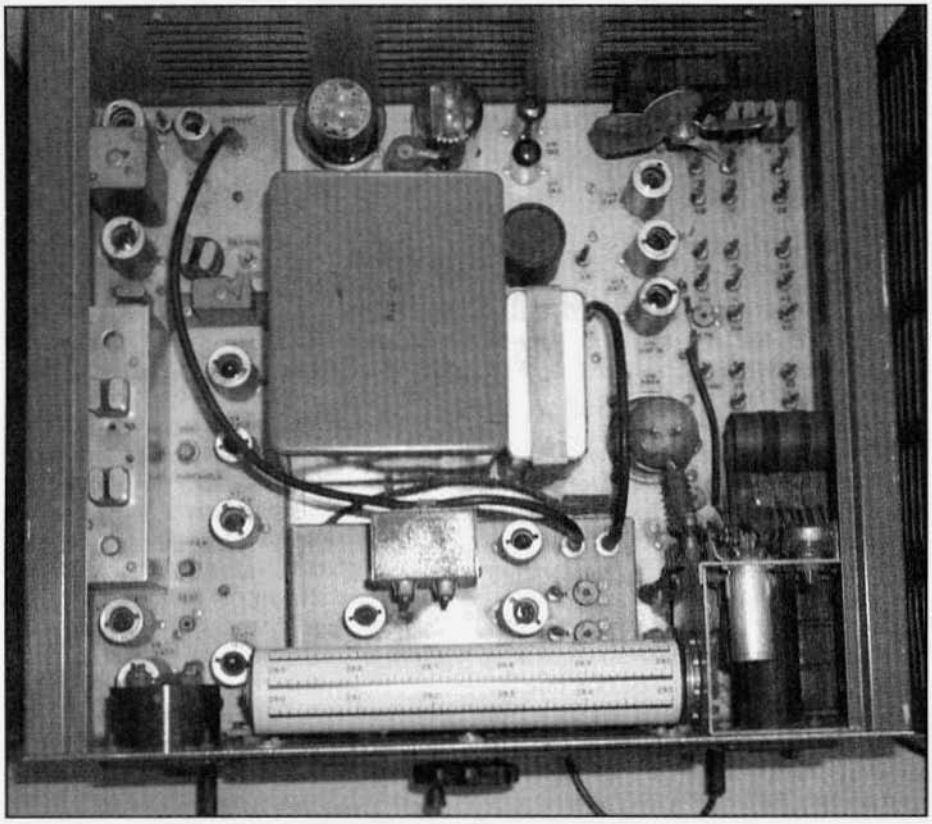


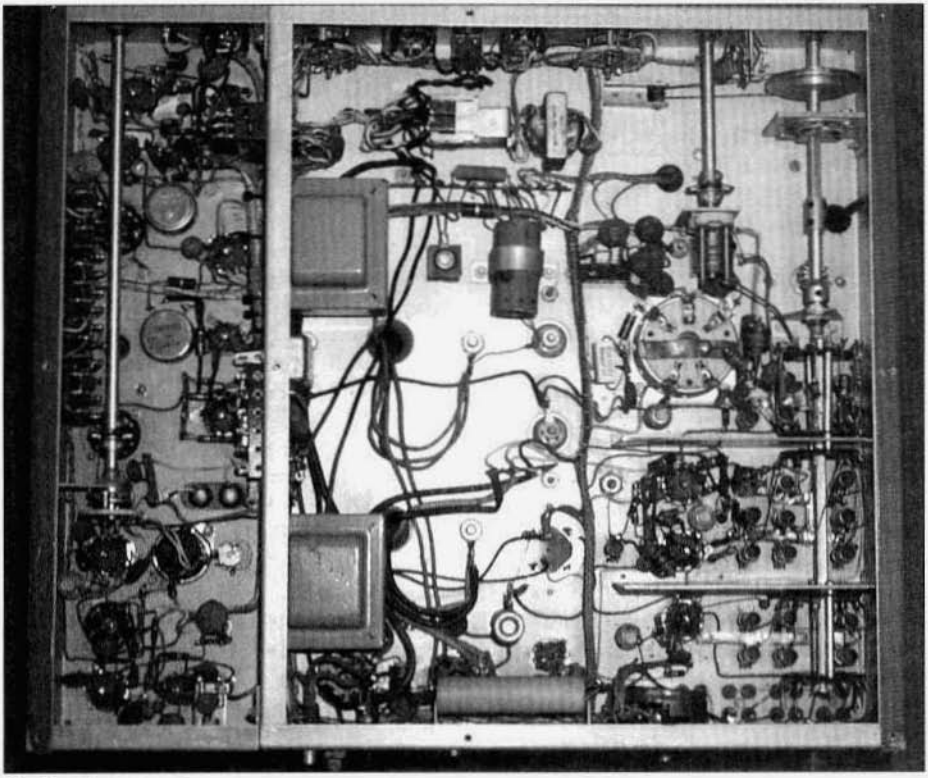
Top of chassis view

cal components received a hint of Mobile One. Unlike many transmitters and receivers, the two pilot lamps are easily replaced. With the new components installed, I discovered that both units worked reasonably well with a dummy load so I elected to put them on the air without going through the lengthy, but straight forward, four page alignment procedure. This procedure requires only an RF Voltmeter (and time). Before going live, I did adjust the carrier balance and sideband selector crystals.

Operation

Zero beating is smooth and easy primarily because the backlash-free VFO requires a quarter turn more to span 100 Kc than the much lauded NC-300. However, there are two minor quirks I observed about the VFO tuning. Around mid-dial there is a slight mechanical drag, regardless of the direction of travel. Initially I thought this was due to a mechanical problem. On inspection I discovered it is caused by the dial stop mechanism and cannot be avoided. Another equally trivial misbehavior is that the frequency pointer has a tendency to drag and, therefore, lean slightly one way or the other as it traverses the dial. Unless you reverse the knob slightly after reaching your destination frequency, the pointer will continue to lean. Like I said, it's trivial.

Although the VFO's stability was apparent early-on, I was curious how it compared to other rigs so I decided to quantify its drift. To do so, I connected



Underchassis view

the output of the VFO chassis directly to my frequency counter. With the transmitter at room temperature, I put the transmitter in the CAL(ibrate) mode, set the VFO for exactly 5750.0 Kc and recorded the counter's display every ten minutes for two hours. The resulting twelve measurements were: 5750.1, 5750.1, 5750.2, 5750.2, 5750.2, 5750.2, 5750.2, 5750.2, 5750.1, 5750.1, 5750.2 and 5750.1. While this is excellent, the drift might be slightly greater with the added heat of transmission.

With the exception of phasing rigs, the SSB-100F tuneup procedure is more complicated than that of any vintage SSB rig I have operated. As there is no provision for metering the final grid current, once the band and frequency are set, the carrier control is merely increased until a small spot appears on the scope. This indicates the presence of the 4700 Kc SSB exciter signal. Next, the grid tuning is adjusted until an increase of plate current is noted, all the while readjusting the carrier downward as required to keep the plate current under 100 mA. Then the plate tuning is adjusted to resonance, using the scope's vertical deflection as a measure. Following this the grid tuning is peaked by monitoring the plate current. When this is done the carrier is reduced to zero and then increased until a scope indication is just visible. Here is where the procedure varies radically from others. The plate circuit is to be detuned so that there is no vertical deflection and then the carrier control is increased until there is 150 mA of plate current. Naturally, the plate circuit needs to be quickly re-resonated, after which one goes through the normal, iterative loading in

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The Johnson Viking Matchbox Antenna Couplers And How to Add 160 Meters

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In 1958 the E. F. Johnson Company introduced two Matchbox Antenna Couplers as an addition to its successful line of Viking transmitters.

One operates at 275 watts input power and the other at one kilowatt. At that time 'antenna tuners', as they were called, were items home built by hams and not considered as a purchased item. Most of us built them on a wooden board that was hung naked on the wall near the place where the feed line exited the shack. It had big coils and breadslicer variable condensers in full view so they could be easily re-configured using clip lead connections. Maximizing antenna current as measured by RF ammeters, or voltage with neon bulbs was the norm. Measuring SWR (VSWR, Voltage Standing Wave Ratio) was less important than deciding whether to series tune or parallel tune the antenna. However the hobby was moving from open racks to compact operating console/table configurations. The enclosed and shielded (TVI proof?) approach came into vogue. The Matchboxes even looked as if they had been just taken off the wall and covered with aluminum. The aluminum cover on the KW Matchbox is secured with no less than 46 screws, a significant hallmark of TVI Proofing of the era. From its appearance it is clear that it is a product of the 'Butt Ugly Square Box School of Design' that reigned at Johnson and Heath for a short period. Probably the same designer who selected 'Un-matchable' purple and 'Un-matchable' green finishes for the two companies.

Despite its looks the Matchbox tuners are a quality product that has no commercial peers for matching balanced line antennas. In addition they are built with quality components husky enough to be used for the higher average power required for AM operation. They can handle the lengthy, old buzzard, contacts without the coils turning into what looks like a toasted 'Slinky' toy in a pool of melted plastic.

The current nominal hamfest price for a workable unit ranges from $100 for the 275 watt model to about $300 for the rarer KW unit. However when compared with the 'Legal Limit' (1500 watt PEP?) units available today in the $400 plus range, the price is not unreasonable. When performance with balanced line and with high AM average power, is considered there is no comparable unit available for that price. For its niche the Johnson Matchbox continues as the leader after almost a half century.

Matchbox Circuits

Figure 1-A is a simple tuner for balanced feeders. A look at this shows that indeed the basic circuit could have been pulled off the wall of a pre World War II ham shack. It is a link coupled, balanced, parallel tuned circuit, with the balanced feeders tapped down to match the transmission line. While the old timers would have tapped the transmission line down the coil turns with two clip leads, Figure 1-B shows how the Matchbox circuit uses a nifty pair of mechanically connected differential variable capacitors to electrically do the same thing; to easily tap down the tuned circuit to find that elusive match.

In Figure 1-B I have created a more

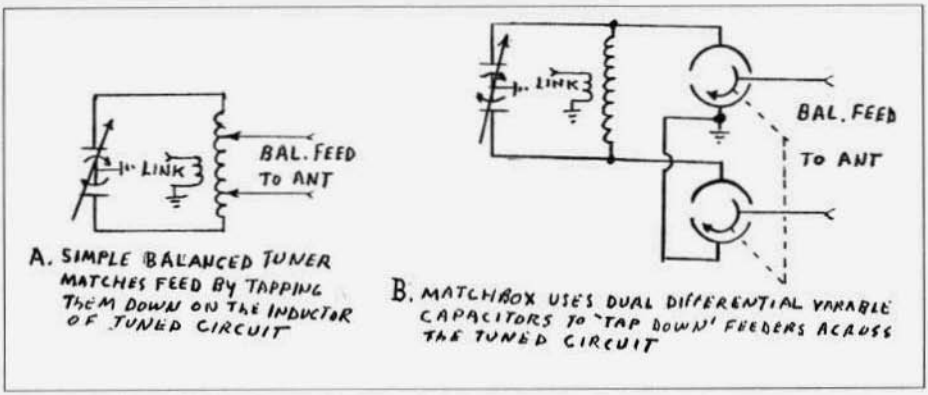

Figure 1. Simplified Tuner Schematics.

physically representative circuit symbol for these capacitors to aid in understanding. The capacitor on the right side of the photographs shows the actual construction of the capacitors. Each of the differential capacitors is composed of two stators and a common rotor. As the single rotor is turned 180 degrees, it goes from fully meshed with the upper stator and not meshed at all with the lower stator to a fully meshed lower stator and not meshed with the upper stator. Thus when the stators are connected across the coil, and an output is taken from the rotor, it behaves like an RF rheostat, with a turn of the common shaft, the capacitor divider changes from low impedance/high impedance to high impedance/low impedance. At the 90 degree position, when both capacitors are equal in capacitance, they have equal impedance to the rotor. This position corresponds to tapping the tuned circuit coil at the 50 % point. All other points are possible with great resolution as the rotor is turned to different ratios of capacitor meshing. Each differential capacitor is placed across half of the center tapped grounded circuit, and mechanically linked such that the stators 'rheostat action' moves the 'tap point' from the coil ends to grounded center in unison. This high resolution tank circuit tapping scheme is the biggest feature of the Matchbox. The other is the quality and power rating of its components. As the line is 'moved' up and down the circuit its impedance affects the total circuit's resonance and the change must be compensated by adjusting the other parallel capacitor in the Matchbox. Thus the tuning controls are interactive and it is a two handed optimization task. Realistically it is fairly easy to attain an acceptable 1.5:1 vswr, however what techno compulsive ham can resist tweaking for 1:1? This requires a finer touch since the capacitors are direct drive.

Schematic Diagrams

The complete Viking Matchbox schematics of Figures 2, 3, and 4 show the differences between models and some of the other features. Why the output connections are different for the two models is a mystery to me but are included here in the hookup diagrams.

The relays provide a transfer of the tuner link between receiver and transmitter, grounds the receiver antenna lead and provides RECEIVER MUTE contacts. The relay operates on 115 volts AC. Many times tuners purchased at swap meets will have the relays removed or 'jammed' into the closed position with a wedge of paper or other material. This will eventually make the contacts develop a poor connection and should be changed by soldering appropriate jumpers, or restored to original

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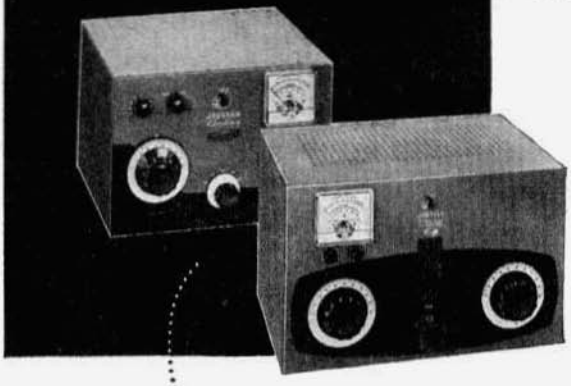
Match transmission line impedance-reduce SWR!



they're new!

Viking "MATCHBOXES"

- *Provides more than 20 db of additional TVI harmonic suppression!*
- *Self-contained–complete with built-in directional coupler and indicator!*
- *Bandswitching–no plug-in coils!*

put more useful RF into your antenna

These new Viking "Matchboxes" provide completely integrated antenna matching and switching systems for kilowatt or 275-watt transmitters. Units are complete with built-in directional coupler and indicator providing continuous monitoring of either incident or reflected transmission line power. Bandswitching 80, 40, 20, 15, and 11-10 meters and completely front panel controlled, these versatile "Matchboxes" quickly and easily match the transmitter to balanced or unbalanced lines over a wide range of antenna impedances. In addition, units are capable of tuning out large amounts of capacitive or inductive reactance. Revolutionary circuit design does away with the annoying use of "plug-in" coils and completely eliminates "load-tapping" necessary in other antenna couplers.

"Matchboxes" are also designed to provide separate matching of the antenna system to receiver. Self-contained, heavy duty change-over relay switches antenna from receiver to transmitter, grounding the receiver antenna terminal and muting the receiver while transmitting. Units are supplied wired and pre-tested only—complete instructions included.

use as your station requires. Note that the KW Matchbox has a resistor, selenium rectifier, and capacitor to provide the transfer relay with a 'fast make, slow break' of about 0.2 seconds when 115 volts AC is removed. The rectifier is often dead of old age and may be replaced with a modern silicon diode if you wish to retain that feature. The capacitor is also likely to be failed. Connections to and from the relay are made via a screw terminal strip in the back. The RF PROBE terminal has nothing connected internally and is available for the user to put a short 'capacitance probe' or loop into the tank coil field to sample a bit of RF for a scope or other use.

Notice the output terminals of the 275 watt unit and the KW unit are labeled somewhat differently when it comes to using the tuner with coax out

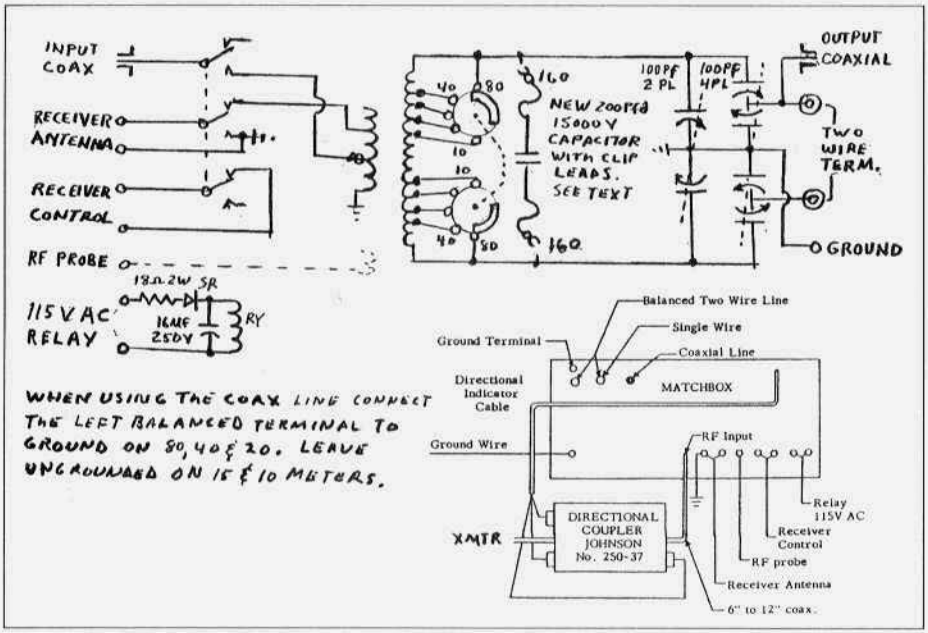


Figure 2. KW Matchbox /160M Mod

put. My feeling is there are other better tuners to deal with the impedances usable with coax so I save the Matchbox for exclusive use on balanced line. Nevertheless, once you understand the circuit there are several ways of dealing with other outputs should you need them.

Both size Matchboxes came with an option that includes a directional coupler and meter circuit as shown by Figure 4. The meter, pot, and switch is an integral part of the tuner. The sensor is separately housed in a 7 inches long by 2 1/4 inches diameter tube that contains a 'strip line type' circuit. It works OK for relative vswr indications for tuning but does not meet today's output power measurement needs very well.

Power Capability

The Matchboxes were specified to handle transmitter input powers as defined by the product of final amplifier tube plate voltage and plate current as observed on meters of the day and expressed in watts. Thus it was an average value, with the general assumption that the tube was class C. If a 70% class C efficiency is assumed, the 275 watts of input would yield 192.5 watts of output power. Normal sine wave AM modulation at 100% produces a peak envelope power of 770 (4 x 192.5) watts PEP. Thus the tuner was specified to handle an output power of almost 200 watts of AM with some margin and still match impedances between 25 and 1500 ohms. Similarly, the KW model is specified to handle 700 watts carrier with 2800 watts PEP. A look at the components themselves helps give an idea about what the margin may be.

One important constraint is the amount of peak voltage the circuit can handle. The weakest link here is the spacing on the variable capacitors. The 275 W spacing is 0.07 inches per section and the KW is 0.175 inches, per the handbook this is good for 3 KV and 7 KV per section respectively.

The amount of circulating current in the tuner coil and through the coil switch contacts is the other power limiting constraint. Heat and the ability to dissipate

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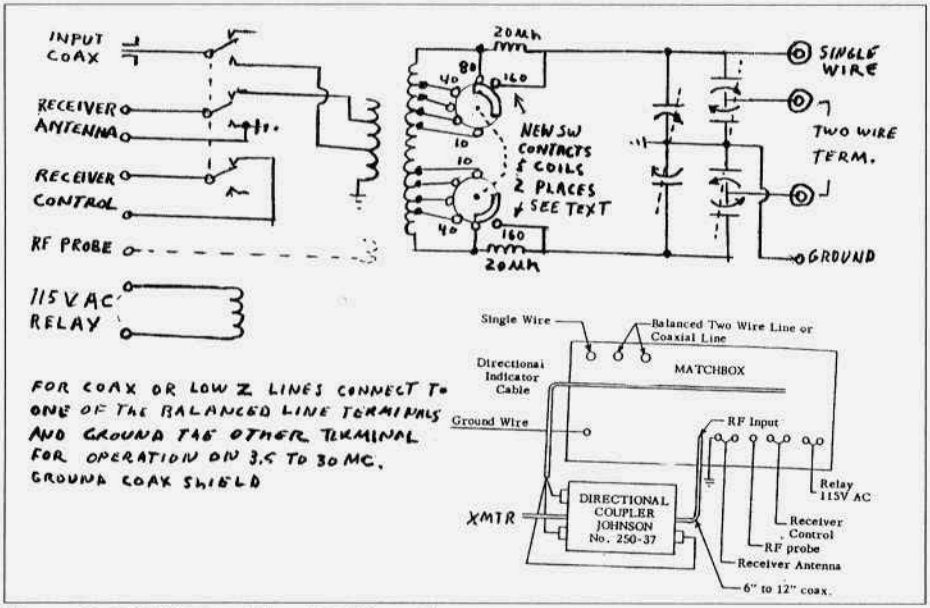


Figure 3. 275 W Matchbox/160M mod

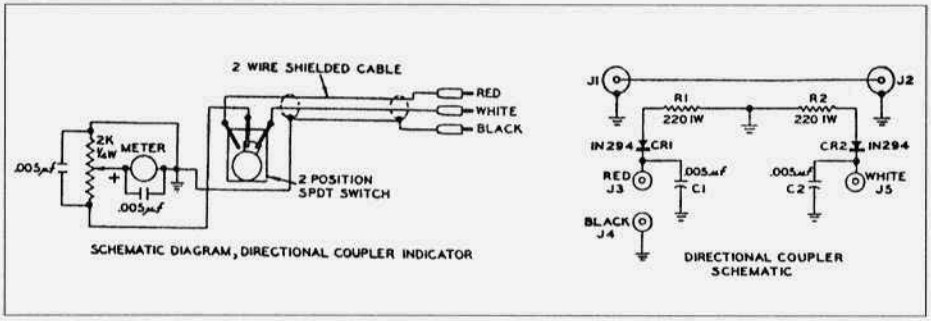
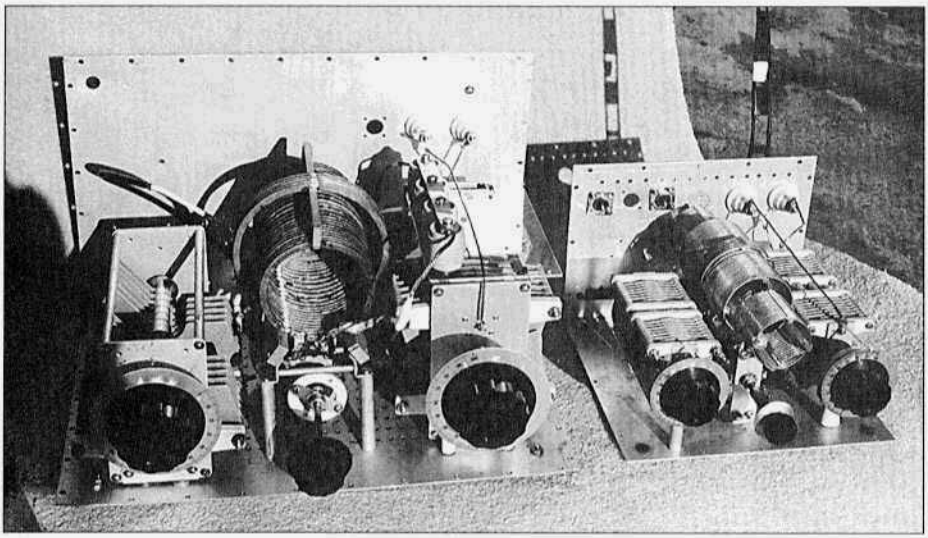


Figure 4. Johnson Matchbox directional coupler schematics

it is the problem. The 275 coil is made of # 12 tinned copper with extra thick, square, Plexiglas like support rods.

Older ARRL handbooks indicate # 12 wire is suitable for transmitters with 500 W @ 1.8 through 14 MHz, and 150 W @ 21 and 28 MHz. The KW coil is really deluxe 1/4 inch by 1/16 inch silver plated edge wound strap with strong ceramic like mechanical support for each turn that is excellent. Clearly kilowatt capable. The switch in the 275 uses double contacts for each connection point, the one in the KW has almost 1/4 inch diameter contacts, as good as any I have seen. Both switches are ceramic.

Exceeding the peak voltage capability is easily determined by the arcing fireworks that result. Checking for excessive current is a subjective process, after an extended period of operation, immediately after turning the transmitter off, test the coil and switch contacts by using 'Ye Olde Finger Test' just like your mom did on the flatiron before permanent press clothes. Warm - OK, very warm - OK, too hot to keep your hand on it, or spit sizzles, or any degree of burn, or discoloration or solder melts, - not OK. With this highly scientific



The working parts of the Johnson Matchbox antenna coupler. The KW model (left) and 275 watt model . Both have 160M modifications.

criteria in mind. I have successfully operated on all specified bands using the 275 model on; SSB - 1000 W PEP, AM - 250 W carrier, 1000 W PEP. (See below for additional antenna impedance considerations.) The KW tuner has routinely operated at measured output of 375 W of AM carrier and 1500 W PEP levels. After 15 minutes, this produced a warm coil and no arcing on modulation. Thus it appears the KW Matchbox is able to safely handle today's "Legal Limit" with considerable margin. I have heard old timers report that they have operated AM phone at a full KW input without difficulty.

The rating of the tuners is also influenced by the amount of reactance needed to make the system load. There are balanced line lengths/antenna systems that cannot be tuned to a 1 to 1 VSWR null with the controls. Either no null can be found or the null will not bottom out near 1:1 VSWR. There are two ways to expand the range to solve this condition. The first is straight forward and amounts to just increasing the length of the feed line (assuming the line is just long enough to reach the shack and can't be shortened.). It usually takes less than 1/4 wavelength (mostly more like 1/8 wavelength) to get within tuning range. The second method I have used for years and have not seen published elsewhere. The link coil on the Matchbox is made up of almost 6 turns, the normal 50 ohm transmitter input is at approximately turn #2 from ground. The remaining turns are there to better match high input impedance receivers, and comes factory wired for 300 ohms. Moving the transmitter tap both directions to find a spot for 1:1 nulls works great. Less than 1/4 turn has an effect and it is relatively sensitive to the exact sweet spot. I have always been able to find a spot that makes the tuner work. In fact I use, and leave in place, a short length of flexible coax with an alligator clip on the center conductor to tap the link. Setting the tuner up to work well on several bands may require a combination of line lengths and link turns to find the compromise configuration, but this process has always been possible for my antennas.

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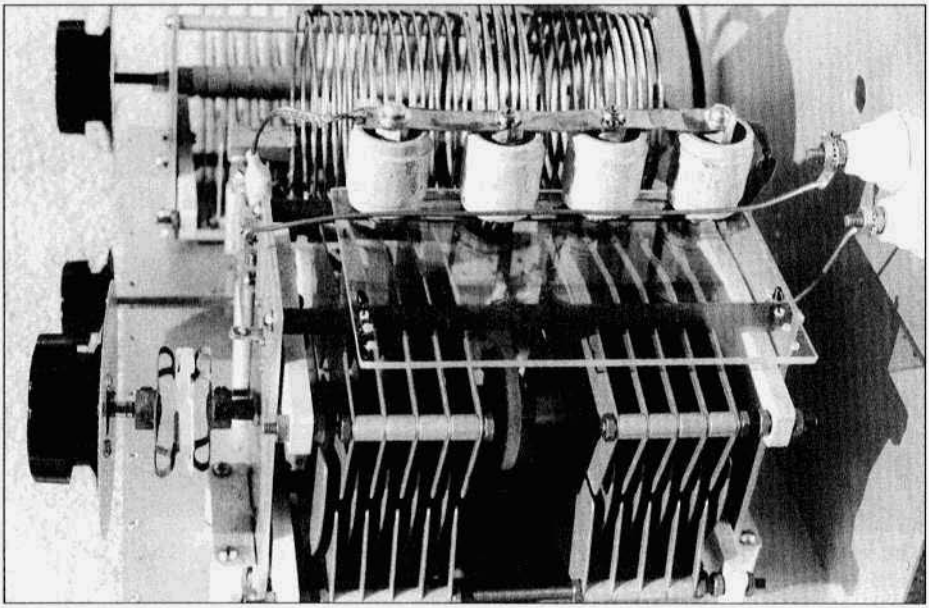


Detail showing the dual differential variable capacitor and 160M modification to the KW Matchbox.

275 Watt Matchbox 160 Meter Modification

The biggest complaint about the Matchbox is that it lacks 160 meters capability. Some years ago I successfully modified a 275 watt Matchbox by modifying the BAND select switch to have an additional 160 meter position which added a 20 uH coil to each end of the existing coil. (See photo) The coil/switch assembly had to be moved to center the longer coil in the available space, and the left antenna wire insulator removed to provide clearance. The modification is fairly easy and tuning range just covered the entire 160 meter band. The tuner worked well with the antenna used at that time to support amplified SSB of about 1 kw pep and a Johnson Valiant of about 120 w AM carrier. The recent 160M QRO Jamboree prompted me to participate with my much enjoyed modified DX-60/amplifier combination. (See, "160 AM For The Heathkit DX-60" Electric Radio, January 2001, P-20.) That controlled carrier AM combination is sometimes operated with 125 W resting carrier and 1200 W pep. I found that with the current antenna/feed line length, the modulation had to be throttled down to something less than 400 W pep to avoid spectacular fireworks displays in the variable capacitor on voice peaks. This relatively low pep tolerance was 160 meters specific so it is probably a function of the new Q of the modified tuner circuit and/or the specific feed line/antenna combination. I chose the brute force, get a bigger one, approach. The station KW Matchbox was modified to add 160 meters.

KW Matchbox 160 Meter Modification

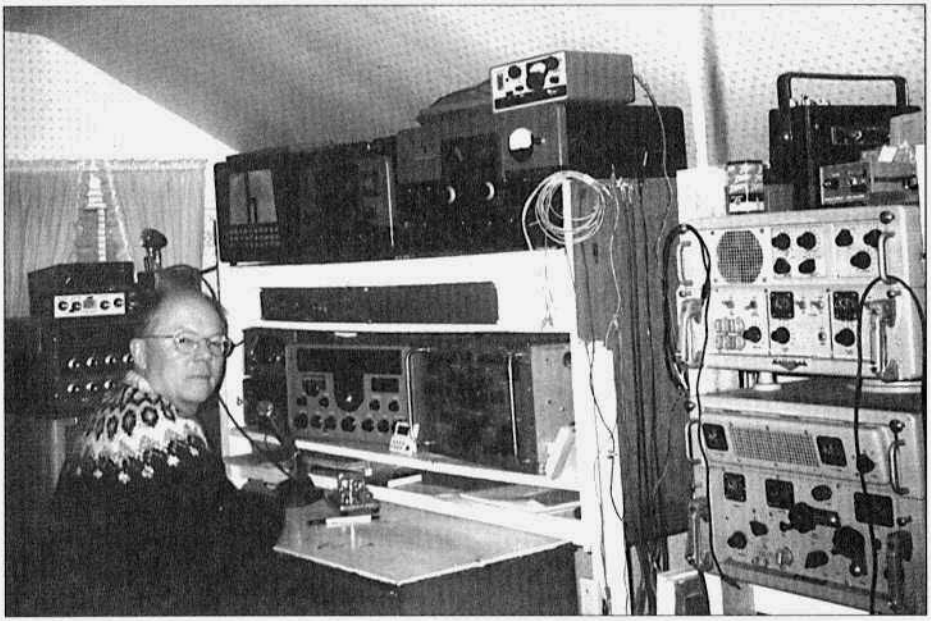
The modification to the switch and coil was judged to be not as easy on the KW model, so another approach was tried using an available variable vacuum capacitor to increase the capacitance of the circuit. Enough capacitance was added to allow the dual 100 pFd variable capacitor to tune across the 1.885 mHz AM frequency on 160 meters. Bench testing indicated that about 175 pFd of shunt capacitance was required, however ac

tual tuning of the reactance on the antenna resulted in 200 pFd giving the greatest dynamic range for the tuner's variable capacitors, a range that would not quite tune 1:1 VSWR at both band edges. Note that the number of turns used in the link 'primary' were also optimized to cover the bands used. (160, 75, 40 meters) The desired goal of operation on this antenna system with controlled carrier AM pep above 1 kw was not immediately achieved. It was found that, with modulation, the vacuum variable capacitor produced a very loud acoustic feedback. (I will not report the result of my quick fix attempt at acoustic suppression with paper towels! However every ham shack should have a fire extinguisher.) A physically neat solution was found by using four 50 pFd doorknob type capacitors, (50 pFd, 15 kv, @ Fair Radio Supply). These were all wired in parallel, however an additional cap was obtained such that they lent themselves to other configurations that would also yield 150, 175, and 250 pFd should future antenna systems require it. These capacitors do not produce significant acoustic output. Upon testing this beefy KW Matchbox, I still had an occasional arc, I had to add some additional ladder line to move the impedance/voltage peaks that resulted across the tuned circuit, the remedy I should have tried in the first place.

The doorknob caps are mounted on a 4 3/8 by 6 1/2 inch piece of 1/8 inch Plexiglas that is secured to the two fiber rods on the top of the differential capacitor with nylon cable ties installed through pairs of 1/8 inch drilled holes. The caps are mounted to the Plexiglas by the screws on one end. One copper strap connects all the bottom terminals together and another strap connects all the top terminals together. Space remains between the sides of each cap as an additional safeguard to prevent possible arcing. Flexible connections to the copper straps are made with copper braid salvaged from coax. An effort was made to both keep the connections short, and balance the configuration. Originally two clip leads were used to connect the shunt capacitors across the coil at the connections to the differential capacitor rotors, however, disconnecting just one end seemed to work OK when used on the other bands. A plan to add a switch and small vacuum relay to perform this function and to reinstall the ugly case was scrapped. I have grown to like the 'old days' flavor and appearance of the bare tuner with beautiful coil, switch, caps, clip leads and all, in the shack. What more impressive sight to the grandkids than waving a bare, unconnected, illuminated, 4 foot, florescent bulb in the hand to sample the modulated field above the coil! "MOM look, just like Darth Vader! Can I be a Ham Grampa?" (He He He.)

Conclusion

The Viking Matchboxes are excellent balanced feeder matching devices and work very well with antennas that use today's convenient 450 ohm ladder line. The antennas I use for AM operations include the following: 160, 75, and 40 meters; a 160 meters, 1/3 wave length dipole, (180 feet long, center fed, with about 80 feet of 450 ohm ladder line). This provides dipole like patterns, broadside to the wire on all three bands. It provides good distances and geographical coverage for AM ragchewing. If you want DX, something else might be better. Note that on 40 meters it is an extended double Zepp providing about 3dB gain. On 10 meters I feed a 3 element beam with the ladder line to allow the Matchbox to provide a good match across the entire band. The Matchbox also allows me to use the dipole on all the other bands with whatever directivity/gain it has. In general the patterns fragment into multiple beams and maximum gain aligns along the wire as frequency increases. In my opinion the Matchbox is a cost effective boatanchor that is hard to beat for what it does best, balanced feed antennas. ER



Dennis Olmstead, WB9EMD, at his operating position. On the right side of the photo is the rare 68-tube National receiver, the URR59A. The bottom piece is the RF deck and the top piece is the IF and SSB deck.

Gary Youney, K5QT, with just a part of his very impressive vintage radio collection. Some of the gear in the photo includes: a Collins 30S-1 (his left hand is resting on it); a National NC-303 (3rd shelf, right hand rack) and an Invader 2000 (lower shelf, left hand rack).

VINTAGE NETS

Arizona 40M AM Group: Meets on 7293 kHz at 10:00 AM MST (1700 UTC) on Sat. and Sun.
West Coast AM Net meets Wednesdays 9PM Pacific on or about 3870kc. Net control alternates between John, W6MIT and Ken, K6CJA.
California Early Bird Net: Saturday mornings at 8 AM PST on 3870.
California Vintage SSB Net: Sunday mornings at 8 AM PST on 3860 +/-
Southeast Swap Net: Tuesday nights at 7:30 ET on 3885. Net controls are Andy, WA4KCY and Sam, KF4TXQ. This same group also has a Sunday afternoon net on 3885 at 2 PM ET.
Eastern AM Swap Net: Thursday evenings on 3885 at 7:30 ET. This net is for the exchange of AM related equipment only.
Northwest AM Net: AM activity daily 3 PM - 5 PM on 3875. This same group meets on 6 meters (50.4) Sundays and Wednesdays at 8:00 PT and on 2 meters (144.4) Tuesdays and Thursdays at 8:00 PT. The formal AM net and swap session is on 3875, Sundays at 3 PM.
K6HQI Memorial Twenty Meter AM Net: This net on 14.286 has been in continuous operation for at least the last 20 years. It starts at 5:00 PM PT, 7 days a week and usually goes for about 2 hours.
Arizona AM Net: Sundays at 3 PM MT on 3855. On 6 meters (50.4) at 8 PM MT Saturdays.
Colorado Morning Net: An informal group of AM'ers get together on 3876 Monday, Wednesday Friday, Saturday and Sunday mornings at 7AM MT.
DX-60 Net: This net meets on 3880 at 0800 AM, ET, Sundays. Net control is Jim, N8LUV, with alternates. This net is all about entry-level AM rigs like the Heath DX-60.
Eastcoast Military Net: It isn't necessary to check in with military gear but that is what this net is all about. Net control is Ted, W3PWW. Saturday mornings at 0900 ET on 3885 + or - QRM.
Westcoast Military Radio Collectors Net: Meets Saturday evenings at 2130 (PT) on 3980 + or - QRM. Net control is Dennis, W7QHO.
Gray Hair Net: The oldest (or one of the oldest - 44+ years) 160-meter AM nets. It meets on Tuesday nights on 1945 at 8:00 PM EST & 8:30 EDT. http://www.crompton.com/grayhair
Vintage SSB Net: Net control is Andy, WB0SNF. The Net meets on 14.293 at 1900Z Sunday and is followed by the New Heathkit Net at about 2030Z on the same freq. Net control is Don, WB6LRG.
Collins Collectors Association Nets: Technical and swap session each Sunday, 14.263 MHz, 2000Z, is a long-established net run by call areas. Informal ragchew nets meet on Tuesday nights on 3805 at 2100 Eastern and on Thursday nights on 3875. West Coast 75M net that takes place on 3895 at 2000 Pacific Time.
Collins Swap and Shop Net: Meets every Tuesday at 8PM EST on 3955. Net control is Ed, WA3AMJ.
Collins Collector Association Monthly AM Night: The first Wed. of each month on 3885 kHz starting at 2000 CST (0200 UTC).
Drake Users Net: This group gets together on 3865 Tuesday nights at 8 PM ET. Net controls are Criss, KB8IZX; Don, W8NS; Rob, KE3EE and Huey, KD3UI.
Swan Users Net: This group meets on 14.250 Sunday afternoons at 4 PM CT. The net control is usually Dean, WA9AZK.
Nostalgia/Hi-Fi Net: Meets on Fridays at 7 PM PT on 1930. This net was started in 1978.
K1JCI 6-Meter AM Repeater: Located in Connecticut it operates on 50.4 in and 50.5 out.
JA AM Net: 14.190 at 0100 UTC, Saturdays and Sundays. Stan Tajima, JA1DNQ is net control.
Fort Wayne Area 6-Meter AM Net: Meets nightly at 7 PM ET on 50.58 MHz. This net has been meeting since the late '50's. Most members are using vintage or homebrew gear.
Southern Calif. Sunday Morning 6 Meter AM Net: 10 AM Sundays on 50.4. NC is Will, AA6DD.
Old Buzzards Net: Meets daily at 10 AM Local time on 3945. This is an informal net in the New England area . Net hosts are George, W1GAC and Paul, W1ECO.
Canadian Boatanchor Net: Meets Saturday afternoons, 3:00 PM EST on 3745.
Midwest Classic Radio Net: Sat. mornings on 3885 at 8AM Central time. Only AM checkins allowed. Swap/sale, hamfest info and technical help are frequent topics. NC is Rob, WA9ZTY.
Boatanchors CW Group: 3546.5, 7050, 7147, 10120, 14050. 80 on winter nights, 40 on summer nights, 30 and 20 meters daytime. Nightly "net" usually around 0200-0400 GMT. Listen for stations calling CQ BA, CQ GB.
Wireless Set No. 19 Net: Meets the second Sunday of every month on 7.175 +/- 25 kHz at 1900Z (3760 +/- 25 kHz alternate). Net control is Dave, VA3ORP.
Hallicrafters Collectors Assoc. Net: Sundays, 1730-1845 UTC on 14.293. Net control varies. Midwest net on Sat. on 7280 at 1700 UTC. Net control Jim, WB8DML. Pacific Northwest net on Sundays at 22:00 UTC on 7220. Net control is Dennis, VE7DH.
Nets that are underlined are new or have changed times or frequency since the last issue.

How to Repair a Receiver Part 1

by Jim Hanlon, W8KGI
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Our ER Editor, Barry, called me recently to ask that I write something about repairing boatanchor radios. He observed that our little corner of the hobby has become a lot more popular over the last few years, and it is likely that there are at least a few ER readers who want to get a tube-type radio up and running but who may not know quite how to approach the job. Now I don't consider myself an expert repairman, but I have been a ham since 1952 and I started fixing up a few older radios for myself and my buddies shortly after that. I currently have twenty-four transmitters and receivers on the air in my Classic Exchange stations that I've repaired and that occasionally need some additional TLC, and I have about a dozen additional receivers also in working condition. So I will start the ball rolling by sharing some of my experiences with receivers, and I'll invite you other readers who have rejuvenated boatanchors to write to Barry with your tips too.

The first bit of advice I'll offer is to familiarize yourself with the way that a receiver works. Pick up an ARRL Radio Amateur's Handbook from the 40's through the 60's and read through the chapter on receivers. This will give you a good foundation on how a superheterodyne receiver works and what kind of circuits you will find in your receiver. Look also at the Construction Practices chapter for information on resistors, capacitors and transformers, what they look like and their color codes. Near the back of the book, just before the catalog pages, is the Vacuum-Tube Data section. Here you will find socket diagrams and typical operating voltages for all of the tubes that you will encounter in your receiver. The next thing, assuming that you already have acquired a receiver to work on, is to get a copy of its instruction manual. There are several good sources for old manual copies. W7FG advertises in the classified section of ER and is on the web at www.w7fg.com. The manuals I've gotten from him have been very good quality. HI Manuals, www.hi-manuals.com, has advertised for many years in the QST classified ads and is also showing up in recent ER classifieds. Al managed the used equipment department of World Radio Labs for many years and as a result he probably has the largest collection including many obscure manuals. I've also had good luck with Pete Markavage, the Manual Man, www.manualman.com. You may also be able to find a free copy of the schematic and some other information for your prize on the web at http://bama.sbc.edu/ .

You will also need at least a few basic tools and measurement instruments. Tools I would not be without include good, needle-nosed pliers and regular pliers, a wire cutter and insulation stripper, a soldering gun in the 75 to 100 watt range, some resin core (absolutely not acid core) solder, safety glasses for soldering, screwdrivers, a set of Allen wrenches, an electric drill with assorted bits, and a good light, possibly the kind with a magnifying glass if you're getting on a little as I am. I also appreciate having a good bench vise, a set of socket wrenches, and an assortment of clip leads.

The first instrument that you should get is an analog multimeter (sometimes called a Volt-Ohm-Milliammeter, VOM) or a Vacuum Tube Voltmeter (VTVM), the kind with a real meter, not a digital readout. It will do a perfectly adequate job of measuring voltage and resistance for you, and you will appreciate that analog meter when you are tuning circuits for peak output during alignment. The next hamfest or flea market is a good place to look for your meter. Simpson and Triplett made excellent VOM's, and you may also find some good off-brands sold by Radio Shack or other sources. If you are buying one, try to get one with a high "ohms-per-volt" rating. My Simpson 260 is one of the better meters and is rated at 20,000 ohms-per-volt on its DC-Volt scales. This rating tells you what the resistance of the meter is when you put it across a circuit, and that can be an important thing to know sometimes. For example, on its 1000 VDC scale, the resistance of my Simpson is 20,000,000 ohms or 20 megohms. Heath, EICO, and RCA all made very good VTVM's. They are usually a constant 10 megohms on DC-Volts and 11 megohms on AC-Volts regardless of the scale.

The next thing you will need is some kind of reasonably stable signal generator that you can set with good accuracy on at least certain spot frequencies. Over the many years when money was scarce, I have used a receiver crystal calibrator or an external crystal oscillator, a well-calibrated transmitter VFO, even a radio station of known frequency like WWV. A real signal generator is much easier to work with. If you can find one, a military surplus BC-221 or LM with its original calibration book is excellent because of its good calibration. I have two, cheap but adequate signal generators that I use all the time, a recently acquired Heathkit IG-42 that covers from 100 kc to 30 mc and a Shield TE-121 that covers from 120 kc to 130 mc that I got a long time ago from Olson Radio. They both have an internal AM modulator that can put a tone on the signal, useful for identification and alignment. Heath, EICO, Knight, General Radio and others made a lot of signal generators, and you are likely to find one at a flea market or a surplus store for not very much money. I use another flea market acquisition, a Heathkit IM-4110 counter, with my signal generators to set them where I want them. If your receiver has a low frequency IF, like 60 or 85 kc, you will need a signal generator that covers that range as well. I found an audio oscillator that goes up to 200 kc that I use for those jobs.

There are other instruments that would be useful but that are far from absolutely necessary. An oscilloscope is great for looking at oscillators and amplifiers in action, but you have to know what you are doing to use one properly. A tube tester is handy since tubes are the most likely parts in an old radio to be bad—that's why they have sockets rather than being soldered in. But you can easily get by without one. You can measure for filament continuity and unwanted shorts with your VOM/VTVM. You can also substitute a known good tube for a questionable one. I just recently picked up a Heathkit Condenser Checker which is nice especially for measuring leakage on old, paper bypass capacitors and for measuring the status of power supply filter capacitors. But you can find bad bypass capacitors in your receiver by measuring the voltage across them with your VOM/VTVM and bad filters by listening for hum. A modern, digital voltmeter is also nice to have as a supplement to your VOM/VTVM.

Now that you are outfitted with tools and instruments and you have a manual or schematic, it's time to begin fixing that receiver. Most of the receivers I get these days have come from a hamfest, a

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flea market, or a private seller that I've found in the local newspaper or in the ER classifieds. I will also confess that I recently picked up an Echophone Commercial from that e-place for more money than I really should have paid. Generally the receiver's condition is either nonfunctional or unknown; it's very seldom that I get one in good working condition any more. So I never start by just plugging it in and turning it on, since that could well do unnecessary damage. Usually a receiver that has been out of service for a long time was put aside because something went wrong with it. You can generally expect it to have some kind of fault, one if you are lucky and several in many cases. Your mission, if you care to accept it, will be to find and fix those faults. Just remember that it worked once upon a time when it was new. If you can put it back into that same, original condition, it will work again for you.

Allow me one tip before you start your repair journey. I usually start a "folder" on every receiver that I repair that contains its instruction manual and a history of the work that I do on the receiver. That way I won't forget half way through the job what things I've done and what possibilities I've eliminated, and if I have to come back to it several years later I will have a case history to work from.

Visual Inspection

A good starting point is to give your prize a thorough visual examination. You should be able to get to almost all of the vital spots in the receiver by opening the lid on top and by taking the bottom plate off. For a few receivers like the Howard family or the just post-war Hallicrafters you may have to get a little more aggressive by removing all or part of the cabinet as well. Don't get enthusiastic and take the knobs and the front panel off, at least at first, unless absolutely necessary. Put the screws and such that you remove in a safe place, a pan or a jar, so that they won't get lost, and if necessary make a few notes on how things go together.

Once inside you will quickly notice things like missing tubes or other major parts. Check the tubes to be sure that they are the correct ones and in the right sockets. If you happen to find a glass tube that doesn't appear to have a type number marked on it, breathe on it like you would breathe on your eyeglasses before cleaning them. Then look very carefully, perhaps at a glancing angle across the glass, and you are likely to find the marking. It is usually on the glass about halfway down from the top or it might be on the top of the tube.

Look at the bottom plate or the bottom of the cabinet for puddles of wax and scorch marks. A puddle of wax will have dripped out of a paper capacitor that got too hot because it is leaky or shorted. A scorch mark was made by some part that got too hot and burned. Look at every capacitor, especially the paper bypass capacitors (they look like round tubes with the leads coming out of the ends). If they look burned or if they are dripping wax, they may have high leakage or be shorted. If I need to replace a paper capacitor, I usually use a modern "Orange Drop" capacitor. They are widely available, Antique Electronic Supply (AES) is one good source, inexpensive, and they work well. Look at the resistors. If they have been overheated, they will be much darker than the other resistors, the bands may be discolored, or their bodies may even be split apart. Most of the 2 watt and under resistors in older receivers will be the Carbon Composition type. You can still buy Carbon Composition resistors from AES, but the newer carbon film and metal film types will work just as well as long as their power rating is sufficient. Look also at the power transformer. Does it look or smell burned? Check the line cord. Is the insulation cracked or brittle? I buy an extension

cord and snip off the multi-socket end when I need a new line cord. Better yet I use a three-wire cord and connect the green, ground lead directly to the chassis on a non AC-DC set that has a power transformer.

Most commercially built sets have good solder joints, but some kits may not. Especially if you have a receiver built from a kit, look at the solder joints. They should be smooth, their edges should end in fillets that adhere to the wire or lug surface. There should be enough solder to cover the joint but not large blobs of it. There should be little or no burned flux or other material remaining on the joints. Occasionally you will find a bad joint, even in a commercially built receiver. My HQ-129X quit just at the beginning of the Classic Exchange last fall because of a bad solder joint at its headphone jack.

Many manuals have tables of resistance measurements and voltage measurements. The next thing to do after your visual exam is to check the resistance measurements in that table. If your manual doesn't have that table, you can still use resistance measurements to indicate potential problems. In general, tube filaments should be within a few ohms of the chassis ground, tube cathodes should be either grounded or within a few thousand ohms of ground. Tube control grids (G-1) should be within a few thousand ohms of ground or less. Tube screen grids (G2) and plates should be at least a few thousand ohms off ground, since they are connected through other parts to the B+ supply. In particular, a screen grid or plate that measures just a few ohms to ground is probably an indication of a shorted bypass capacitor or a shorted power supply filter capacitor.

If you decide at this point that you may have a bad bypass capacitor, you can measure its resistance with your VOM/VTVM, although you may have to unsolder or cut one lead to isolate it from the circuit. The reading should be at the very high end of your resistance range, although it will take a finite time for the meter to get up there since even a good capacitor will take a while to charge. Power supply filter capacitors will take an even longer time to charge, and their ultimate resistance will be at least 100K ohms if they are good. If you need to replace a capacitor or other part you will have to decide whether to unsolder its leads or just to cut them. Unsoldering and removing the leads and attaching your new part in its place is generally the cleanest way to make a repair. But if you cannot easily reach the point where the lead is soldered or you are concerned that you may cause damage removing it, it is better just to cut the leads off the old part near its body and connect your replacement part to the old leads. Keep the resulting leads on your new part no longer than the leads on the original part and shorter if possible. Long leads add inductance in series with your part that may affect its performance especially at higher frequencies.

Have a look at the switches and potentiometers (volume controls and such, called "pots"). You can tell with your VOM/VTVM whether switches are making good contact and whether pots are working smoothly or are scratchy. I usually give any open switches, such as the bandswitch, a good cleaning with Big Bath[1]. It cleans and degreases and then evaporates leaving no residue. For switches or other metal connections that are still scratchy I escalate to Deoxit[1]. For pots, look for a hole in the cover or an open crack around the leads to spray your cleaner. Always work the switch or pot back and forth after you have sprayed the cleaner onto it. It is very seldom that you will have to replace a switch or pot if you work on it for a while with cleaner unless it has physical damage.

Check the tuning and dial mecha

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nism. Is it working smoothly? Are there any broken dial cords? Manuals usually have stringing directions for replacing broken dial cords, but occasionally it is left to the ingenuity of the service person. With patience you can figure it out, as I did recently with an Echophone EC1. Generally a dial cord wraps around the tuning shaft two or three times so that it won't slip. On old tuning shafts that have been worn very smooth, I sometimes wrap them with a piece of paper tape or old-fashioned sticky cloth friction tape so that the cord won't slip. Look for a spring inside of the large pulley attached to the tuning condenser shaft. The end of the dial cord is usually attached to one end of that spring and the other end of the spring to a tab on the inside of the pulley to take any backlash out of the cord.

The National HRO and NC-100 series receivers have beautiful, worm drive tuning mechanisms, and many other receivers have gear drives. You can open the top cap on the National mechanisms, there are four screws holding it on, and check the lubricant. If it is dried out you may want to remove it and replace it with a good quality automobile grease. A drop or two of light oil would not hurt the gear drive in another receiver as well.

Check the tuning capacitor. Does it turn smoothly? You may need to wash out old, hardened lubricant from its bearings with Big Bath and replace it with a little new, light oil. Listen carefully while you turn it for any plates that may be scraping together. If you suspect that plates are scraping you may be able to test them with the resistance range of your VOM/VTVM. If they are touching, look very carefully for the spot. You may try using a piece of paper slid alternately between plates to find the place where they are binding. Use extreme caution in bending plates away from one another so that you don't cause more shorts in other places. Again, with patience it can be done as I found out recently on that same EC1.

You may want to do some general cleaning at this point. I use "Formula 409" cleaner from the grocery store and paper towels to clean up the dust and entrenched dirt. An old tooth brush is handy for the hard to get at places. Be careful about using chemical solvents especially on painted surfaces. I found out the hard way that acetone attacks the paint on a Johnson Adventurer.

Mechanical Repairs

When I look for a receiver to restore, I usually try to avoid the basket cases that have a lot of physical damage. But I've violated that rule on several occasions; usually they find me. One time the UPS man dropped the SX-43 that I'd been wanting for a long time over my fence, smashing in the front panel and breaking the dial glass. Another time a friend in Kansas City gave me an RME-70 for free, all I had to do was carry it home under my seat on the airplane. But the right bottom edge of the front panel was "just a little bent" and the cabinet was similarly whopper-jawed, probably from the same concussion. Another gift was an S-19R Sky Buddy that had been sitting on its side on a damp basement floor for far too long a time so that one end was rusty instead of black crackle. I bought a Meissner Signal Shifter at a hamfest one time that someone had blasted with black spray paint all over its beautiful aluminum front panel. And lastly there is the pair of half-there Echophone EC-1's that I acquired recently hoping to make one whole one out of the two halves.

If your radio is badly damaged, you may need to do some mechanical rescue work before you can begin an electrical restoration. I do not have any sophisticated tools, so I am limited in straightening out bent metal to what I can do with blocks of wood, a vise, and

a few wood working clamps. Generally I try to capture the bent area between two pieces of board and then I apply force gently, clamping the sandwich in my vise and squeezing it and sometimes applying a bending moment by hammer or by hand outside until I get it as straight as possible. A little patience and cut-and-try goes a long way in a project like this. Both my SX-43 and my RME-70 yielded to this kind of treatment. I have made replacement bottom covers and top panels from sheet metal. The "Do-it-yourself" aluminum sheets are nice if you can find them. They bend easily over a straight edge and you can cut them with tin snips. For my Echophone project I was not able to find sheet aluminum, so I used galvanized steel flashing stock from the hardware store. I straightened its built-in bend over my leg, and cut it to the required shape with tin snips. I made the necessary bends with the aid of my vise and those woodworking clamps.

AES (See "Where to find parts" at the end of this article) has black, gray and brown crackle paint in spray cans. I've had good luck getting it to look like the crackle finish on my 1930's and 40's receivers by drying it under a 60 watt light bulb mounted in a 9 inch aluminum reflector that I move to several spots in turn across the surface. I fixed the rusted end of my S-19R and I painted the newly fashioned top for my EC-1 with crackle paint. I also found that I could remove the paint on that Signal Shifter. Acetone from the hardware store melted that cheap, black stuff off the panel and didn't even bother the good paint on the panel labels in the process. But be careful, it may also melt the original paint underneath. Try it in a spot that won't show at first. And if you do need to replace or touch up some original paint, see "Paints and restoration parts" at the end of this article for a source.

I made a passable replacement for my SX-43 and EC-1 dial glasses from a piece of thin Plexiglas sheet that I found at my local hardware store. You can score it with a shop knife cut and break it cleanly, most of the time, over a straight edge. Clamp it firmly between two pieces of wood at the break line and give it a sharp whack with another piece of straight wood just beyond the break line and it will go. You can also cut it with a fine saw blade and smooth it with a file, a technique to use if you need round pieces or corners. You can drill holes in it for mounting purposes. And you can paint calibration lines onto its surface. I tried masking off a line with paper tape and then spraying on a red line for my SX-43 dial, but the line edges came out fuzzy. When I used plastic electrical tape they came out nice and straight.

Some restorers go so far as to completely strip a badly rusted chassis of all parts. They use chemicals, I've heard that Brasso will work, and elbow grease to clean up the chassis and the other large metal parts. They completely repaint the chassis, panel and cabinet and rebuild the receiver from the bottom up. That is a labor of love that I have yet to undertake myself, but I admire the people who have the patience and persistence to do it. So far I have avoided projects that far gone.

I've also been asked by my favorite article reviewer how to go about removing a "stuck knob." I don't have a really good answer for that one that doesn't involve destroying the knob in the process. I have run across a few knobs with setscrews so tight that I can't budge them. I usually try putting a drop or two of penetrating oil on them and letting them set for a day or so. Sometimes that helps to loosen things just enough. Beyond that, though, I start getting physical with things like hacksaws and dynamite. Do any of you readers have better suggestions?

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Applying Power

With your initial visual inspection done and any pressing mechanical repairs taken care of, you are now ready to apply power. I would recommend at this point that you wear safety glasses whenever you are working on a powered-up radio. There is always the chance in an old radio for some fireworks, and you want to be prepared. If the power transformer does not look or smell burned, I would advise pulling the rectifier tube so that you won't get any high voltage DC into the receiver and then plugging it in and turning it on. The tubes and pilot bulbs should light up, and metal tubes should get warm after a few minutes. If you are at all concerned about the power transformer, I suggest putting a 60-watt, 120-volt light bulb in series with one side of the line cord before you turn the set on. If the transformer is all right and the set is drawing only filament power, about 2 watts per tube, the bulb will light only dimly if at all. If the transformer is shorted the bulb will light to nearly full brilliance. If everything at this point is OK, measure the AC high voltage from the plate pins of the rectifier tube socket to ground. It should be several hundred volts, and it should be the same at each plate if the transformer is OK. One other thing that you should do at each step as you apply power is to look for smoke, primarily from under the chassis. I generally have the receiver sitting on its side with a bright light shining on the underside of the chassis, and I do a quick check for plumes whenever I apply a new source of voltage. It is postulated that electrical parts are all built with a certain amount of smoke inside them that they must have to work, and if they lose their hermeticity and the smoke escapes they cease to function properly. So if you see one releasing its smoke, you will have to find out why that is happening and also replace the part with a new one.

The next thing to do, if possible, is to reform the power supply's electrolytic filter capacitors. If they have not been used for a long time, electrolytic capacitors may lose some of their capacitance, and they should be "reformed." In general capacitors that are built into a metal can or tube have a pretty good chance of reforming and working properly, and those in paper tubes are less likely to be recoverable. The process consists of putting a low DC current into the capacitor and charging it slowly up to its full working voltage. There are several ways to do this, but what follows is perhaps the easiest for a beginner. First disconnect the load circuits from the power supply filter, that is temporarily unsolder all lines that supply B+ to any of the tubes or voltage dividers or voltage regulator tubes downstream from the last filter capacitor. Then put a resistor in between the rectifier filament or cathode and the first filter capacitor. That resistor will limit the charging current to about 10 milliamps with no voltage across the capacitors and less as they charge up. Since the average receiver power supply is around 250 to 300 volts, the resistor should be in the range of 25K to 35K ohms and it should be rated for at least 5 watts. You can use a single resistor, or you can put several lower wattage resistors in series. For example, ten 2.7K, 1/2 watt resistors in series would total 27K and would dissipate 5 watts safely. Put your VOM/VTMV across the last filter capacitor set on a voltage scale at least as high as the normal B+ expected in the receiver. I use the 1000-volt scale on my Simpson. Make a mental note of the working voltage rating on your power supply filter capacitors. Then turn the receiver on with the rectifier tube in place of course and watch the B+ voltage indicated on your meter. The voltage will start at zero and climb toward a value somewhat higher than the normal B+ in the receiver under load. (If the voltage just

stays at zero or a very low value that indicates that you have a short in one or more of the capacitors and they should be replaced.) You want to watch the meter and turn off the receiver when the voltage reaches either the rated working voltage for the capacitors or when it tops out at a value at or above the normal B+ value. If the capacitors are good, the voltage will climb somewhat slowly but steadily toward that value. If the capacitors have lost most of their original capacitance, the voltage may climb to that value quite quickly. If the capacitors go through substantial "reforming," it may take them a good while, minutes or more, to charge to their final value. It is possible for the voltage to bounce down a time or two during the reforming process if one of the capacitors develops a temporary short and then clears it. Good capacitors will eventually charge to the final voltage value and stay there. At that point turn the receiver off and let the voltage on the capacitors decay to zero as indicated on your meter. Then remove your series resistor, reattach the connections to the rectifier and receiver loads, and you are ready to try applying B+ to the receiver as a whole.

Attach any necessary external accessories like a loud speaker or headphones and an antenna, say a quick prayer, and turn the receiver on again. Most receivers have a Standby or B+ switch, and you will probably want to keep that switch off until the tubes have warmed up. Then turn it on and look again for smoke.

If at some point you find a part emitting its smoke, you will need to shut the receiver down and do some trouble shooting. Generally parts overheat for a reason. A shorted capacitor is likely to pull a lot of current through any resistor that is between it and the source of B+. So if you find a shorted capacitor, check the resistors associated with it to see if they are still within tolerance, less than 20% off from the original value is generally still OK. Likewise if some other part is smoking you have to use your head and figure out if any other associated parts are involved in the failure.

Sooner or later you will eliminate all of the immediate fires, and then you will turn your attention to making the receiver actually function. At some point in the following sequence, that should happen. I'm going to take the approach that the receiver stays dead as you perform each succeeding step, so I'll take you through a diagnosis of every stage in the receiver. I'm also going to assume that you are working on a single-conversion superhet with a tunable local oscillator, by far the most common type among the older boatanchors. For illustration purposes I will point out the test and alignment points I will be talking about on the schematic of an NC-57B which is very typical of this kind of receiver. If you are working with something more complex that you can't figure out by yourself, see the suggestions at the end of this article for "Where to find help." Once you find a stage that isn't working, you should measure everything you can about it, starting with testing the tube or substituting a known good tube, then measuring voltages at the tube socket and perhaps other points, then measuring resistors and capacitors, and certainly checking the wiring against the original schematic diagram, until you locate the fault(s). As I said at the start, if you are lucky there will be just one bad stage with one fault. Once you find that, the receiver will start making beautiful music of some kind, and you can stop trouble shooting and start into the next phase of repair, alignment. ER

Ed. There will be at least 3 parts to this article on receiver repair. Next month the author begins part 2 with alignment. We invite comments and questions from readers

Long Slow Target!

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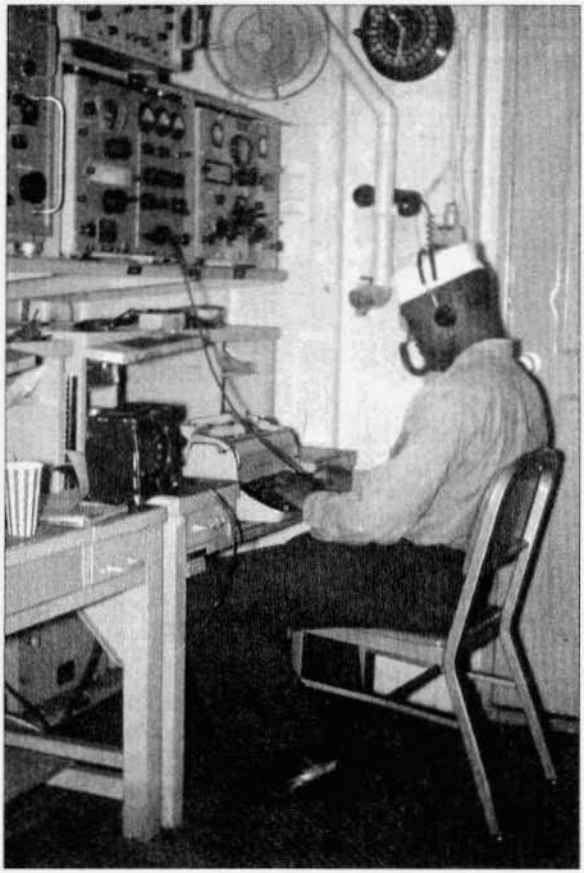
In November of 1962, two weeks after JFK and Nikita had *settled* the Cuban Missile Crisis to their mutual satisfaction, I walked aboard the USS Page County (LST-1076), a World War II, *542 class* LST which the U.S. Navy described as a *Tank Landing Ship*. An LST is a Navy amphibious warship designed to assault the beach with tons of mobile hardware that is deposited right on the beach, either directly or over a shaky pontoon causeway. Like all ships in our class, the ***Page County*** was 328 feet long with a 50-foot beam. She was named after Page County, Virginia. The old timers used to tell me that **LST** really stood for ***Long Slow Target***! I lived aboard this ocean going ferry boat for nearly three years, one of a crew of 90.

After some fine character-building experience on the deck force learning the fine points of chipping paint, listening to Chief Boatswains Mates swear, I was able to persuade the XO of the ship to effect my transfer to the radio shack where I knew it would be warm and dry. At that time I held a General Class Amateur Radio license (K3QNT). Encouraged by my victory over bureaucracy, I made my way into a shipboard radio system unlike anything I had ever seen. By the end of the summer I was a newly minted Radioman, Third Class. Remember, this is the early sixties. The ship's main transmitter was still a TBM, a large vacuum tube behemoth. The only *phone* capability we had was a TCS which was used on the harbor channel 2716 khz, AM. The Page County was part of a five ship squadron called *Landshipron Three*, homeported in San Diego, California. We talked to the CO of this squadron with our little TCS on *3349 kHz*, also on AM. I never knew the CO's name but his call sign was *Comlandshipron Three*. The Navy loves this stuff. So in a way, I spent most of my time in port working versions of 160 and 75 meter AM.

The receiving equipment consisted of an RBA (You've come a long wave baby!), an RBB for Medium Wave, and an RBC for HF. Underway we received our "Fox" broadcast via CW, mostly on the RBA and the RBC. We maintained a CW watch, dual-guard with split-phones. You should try this some time. It can give you a complex! All of our traffic had to be "Typed" on an *Underwood* communications typewriter that had no lower case. After we confirmed the traffic, we then hand-carried the message to the bridge and the OOD (Officer of the Deck). Often the traffic consisted of a reprimand for our supply officer for ordering too many swabs, a sit-rep, move-rep or some other really cool Navy acronym.

Sometimes this *Traffic* was encrypted. A junior officer, usually an Ensign around 18 years of age, went into a little compartment and swore at a mechanical machine for about an hour and then emerged with some sort of message. Later when I was cleared for *TS Crypto*, I learned why foul language always came from that compartment.

In addition to the fixed equipment in the radio shack and transmitter deck, we had to provide communications for our landing craft. LST's carried two or four LCVP landing craft boats. During my "deck ape" days, I went to *Assault Boat Coxswain School* in Coronado. I learned how to "broach," "walk" and "beach" rectangular flat bottom boats with leaky bow doors onto a beach or alongside a pier. Any war movie with an amphibious assault scene features these boats abundantly. John Wayne is usually seen debarking effortlessly with his usual swagger onto the beach. I as



The "other" Lloyd Roach. Two of us on the same ship, both radiomen! We copied all of our CW on a manual Underwood "Mill".

sure you, this is not necessarily how it goes. These boats really have no business floating in anything, especially an ocean while loaded with soldiers, Marines, UDT or even a Jeep!

Aboard these boats we sometimes used little FM transceivers called PRC-9's and PRC-10's. The sailors called them Prick Nines and Prick Tens. I'm pretty sure this was a pejorative term... or maybe an easy mnemonic to remember their nomenclature. They used little instant-heating finals that were anything but instant. For example, an exchange would sound like this:

"....ncake bravo, this is Ziggy Victor one how do you read, over?" "....iggy Victor this is Pancake bravo loud and clear but you were cut off at the beginning, over!" This sort of exchange occurred **all** the time. No manner of training the operators or the officers on the bridge, persuading them to wait a moment before speaking could make it work. I am convinced that this annoying operating factor **alone** prompted the invention of the transistor! The Prick Nines *did* work amazingly well, considering they were constantly being drowned in salt water while in those boats. They ran about one watt on a good day. Later, when I was promoted to Chief Operator, I found the Prick Tens would work on 6 meter FM. However, I must report that six meter FM was not very active in places like Subic Bay or Adak Harbor!

In the fall of 1963, the Page County, along with our sister ship, the USS Stone County (LST-1141), took a cruise to Willamette shipyard in beautiful Richmond, California, outside of Oakland. Richmond was a pretty rough "yard" town and we put in there to have the ship's "FRAM" done. That's *Fleet Rehabilitation and Modernization* for you landlubbers. While there, we chipped more paint than I ever thought possible, received new main propulsion engines, installed a brand new radio shack and participated in a first class dungaree liberty. (Consult with an ex sailor for description of last.) By the time we proceeded to sea trials, many of the transmitters that began with "T" and receivers that began with "R" were gone. The Page County now had

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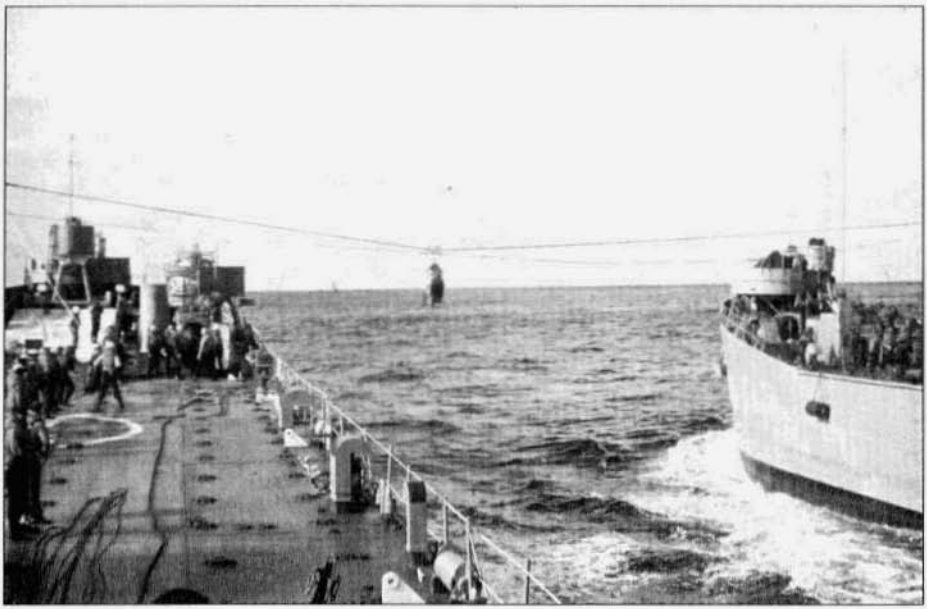
two brand new R-390-A receivers, **three** AN/URC-32 transceivers, and fairly new UHF "TED-REDs".

I discovered that these AN/URC-32's were expensive military transceivers designed and built by Collins Radio; they operated anywhere from 2 to 30 mHz. They were around six feet high and bolted to a shock mount on the deck. They could be operated remotely. Their commercial designation was KWT-6. They had **two** 4X250's in the final and much of the rest was solid state. These rigs had a digital readout similar to a cash register or the "390" and operated either on Single Sideband, CW or AM. The radios used amplified handsets that sounded terrific on the air. They had enormous punch, especially on SSB. The antennas were 35-foot vertical whip antennas welded to both the port and starboard side of the ship. The verticals were loaded with a remotely controlled antenna tuner that clicked and whirred but somehow got the VSWR usually down to 1:1. This was a sensational setup for a guy who had only been a ham for two years. During the FRAM we also were fitted with modern Model 28 Teletype machines, complete with a KWR-37 decrypting machine. These devices replaced copying the "Fox" Broadcast on CW. This addition sure cut down those trips to that little compartment where sailors practiced their profanity.

However, we still had to **transmit** all of our traffic on CW. With this type of equipment, I learned early on that **Military** radio budgets are vastly superior to **Ham** radio budgets. I immediately commandeered one of these fine rigs, got permission from Captain Bruce Tager, the ship's skipper, to operate **K3QNT/MM** on the ship, notified the FCC in Waipahu, Hawaii, and I was on my way. I was now in the phone-patch business and couldn't have been happier. We sailed around the Mid-Pacific for a while, including stops at Christmas Island, Kwajalein, and Pearl Harbor. I was running anywhere between 10 and 15 patches a day on 15 meters, to WA6NKC at the Naval Training Center in San Diego, KH6SP aboard the Sub Base in Pearl Harbor, and W3BQP in Gradyville, Pennsylvania.

Then one day in 1964, while tied up in



"QNT" being Highlined to run patch for the Boss. Note vertical receiving antennas on bow of both ships.

National City, California, we were ordered suddenly to set the special sea detail. After a stop at several San Diego commercial piers and Coronado Amphibious base, we were headed for Okinawa with more Marine trucks, jeeps, LVT's and Army junk than you can imagine.

Earlier that summer many of our squadron took part in exercise *Silver Lance*, which I later learned was the largest Navy/Marine amphibious exercise ever held in peacetime. Of course it didn't take much imagination to figure out that we were practicing for landings in Vietnam, which even then was very much in the news. It was on this initial cruise that I developed my skills as a champion phone patcher. Even at age 20, I quickly realized the enormous political advantage of this activity.

The skipper, XO, and just about every officer on the ship were treating me in a most unusual way! No longer was I being regarded as the swabby scum I had been only a few days earlier. We devised a system where my shipmates would be notified on the **1-MC** (Navy PA System) when the bands were open to a particular spot in the US or when I had a solid stateside station who could make collect long distance calls. Remember, MA Bell was still in charge and she looked mighty dimly on phone patches in general. Instruction books used to warn you that, "*permission must be secured from your local phone company prior to connecting your radio directly to the phone line.*" Yeah, Right! However, when the long-distance operator was notified by the stateside ham operator that he had a **Navy** warship on the circuit, often the Bell supervisor would **assign** you an operator for the duration. Many times these hams would become friends with the AT&T operators who would schedule their shifts around the phone patch times.

It was particularly good when you got a telephone operator who knew the score and could explain to the caller how "***over***" worked. While aboard the

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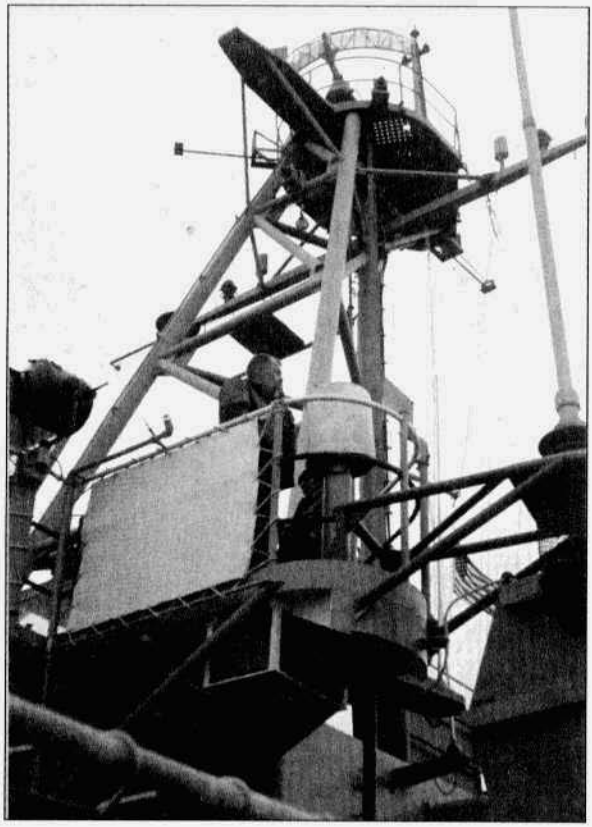

View of superstructure. "Antenna Farm" includes 35-foot vertical for URC-32, end-fed long-wire for 500 khz, and small VHF verticals aloft.

Page County, I ran literally thousands of phone patches for the crew and several of our shipmates elsewhere in the squadron. I was aware that the Stone County also had a ham operator who was aboard. I believe he was the XO! One time I was summoned by the squadron commander who had me "Highlined" to his ship to run a phone patch for him *personally*. Naturally when I arrived aboard I couldn't raise anyone on 20 or 15 meters. I think I told him the radios on ***my*** ship worked better. One of my most memorable phone patches involved a young sailor from North Philadelphia who called his elderly grandmother. We called the house collect to "speak to anyone from 'Beau' from the East China Sea." I must explain that Beau's name was Beauro-dan Lucky. His grandmother was from the South and she could hardly hear him with the QSB and QRM. She thought he was "***missing***" in the East China Sea. That AT&T operator had one helluva time convincing that woman, who was crazy about her grandson, that he was really all right. We finally were blessed with a few good moments on the circuit and he was able to speak with her. A chill still goes up my spine to this day when I think of it.

Another time, I ran a patch from near Attu, Alaska, to the Southeast from a shipmate to his wife. She told him she had to get off the phone because she was about to deliver their first child. Most of the time these contacts were made with the AN/URC-32 using the ship's 35-foot vertical antenna. Occasionally, I would use an R-390-A when the QRM got particularly bad. The "390's" had a small rack-mounted SSB converter right above the receiver (CV-?? something-or-other). We had the capability to patch any receiver or transmitter to the bridge, wheelhouse, CIC or even the Captain's cabin. We ran many a patch for the skipper that way to give him some "privacy" while speaking to his wife. Forget the fact that damned near everyone on 15 meters could listen.

One of the realities of shipboard operations is salt air and salt water. The antennas, their connectors and insulators needed cleaning constantly. We had an end-fed long wire which I often used

on 40 meters. The insulators had to be cleaned of salt or things would arc like crazy. Many a time I had to "Go Aloft" while underway with a bucket of Trichlorethylene to clean those damned insulators. After that experience, climbing a ham tower is a piece of cake!

Early in 1965 I made a call via Hank Conard, W3BQP, who lived not far from my parents in Bryn Mawr, PA. Hank called my father around midnight, local time, and informed him I was on the telephone via ham radio. My Dad had once been a ham himself in the early 1920's but had let his license lapse. After he spoke to me on that phone patch, he went nuts and, after a 35-year absence from the hobby, quickly studied for and got his General Class license. Now as W3ABI, Ike Roach proceeded to build a contest-level station at his home in Bryn Mawr. His station consisted of a Collins "S" Line, a Henry 2-K, a KWM-2/A, a 30S-1, a KWM-1, a 30L-1 500 watts on six meter SSB and 100 watts on two meter SSB. The antennas were mounted on a 70' tower with a tribander, six meter Long John, eight elements on two and a "V" beam cut for 15 meters. The only station in Bryn Mawr, Pennsylvania, that was better than W3ABI was Joe Hertzberg, K3JH, who had beams at 100'. Joe had more money than Ike Roach! By the end of 1966, Ike was totally consumed with ham radio and was running phone patches of his own for ***Operation Deep Freeze***, KC4USV, in Antarctica. According to the U.S. Navy certificate that I still have, he succeeded in running more phone patch traffic that year for the base at McMurdo Sound than anyone else in the nation! By the late 1980's, now operating as K4QM residing in Vero Beach, Florida, he had dozens of certificates from Captains and Admirals for his work in the US Fleet, both on Ham Radio and Navy MARS.

Ike Roach, K4QM, became a silent key on July 3, 1999, at the age of 93. He had been on 40 meter Treasure Coast Net that morning. Ike had been a ham for 78 years.

I had a wonderful experience a few years ago when I ran into Gerry Whited on 40 meters. Gerry was a former shipmate who worked in the "Hole" (the engine room). He used to call his parents from the ship. He later got his ham license, KDØLL, and is now active in Spring Lake Park, Minnesota. Gerry once told me that his experiences with K3QNT/MM sparked his interest. That's rewarding.

Within a year, the Page County sailed across the Pacific twice, including cruises to Japan, Okinawa, Guam and the Aleutian Islands. Later LST-1076 operated extensively between Da Nang and Chu-Lai, South Vietnam. We really kept those AN/URC-32's busy. The Page was one of dozens of LST's that were used in that conflict.

The USS Page County (LST-1076) went on to receive six battle stars for her efforts. I'm pretty sure she ended up in the Greek Navy or somewhere. Later as Vietnam got cranked up, the trend went to MARS operation and much of the shipboard traffic slowly melted away from the ham bands. By the time my friend Larry Will, W3VU, served in Vung Tau in 1967-68, Barry Goldwater, K7UGA, and others had ***monster*** stations that were far superior to what we were offering on our small ship. Larry tells me the Army made it a point to have MARS stations at almost every *"In-Country"* Army facility.

You may have seen in the news recently that a crew of Navy vets traveled to Greece and ***"saved"*** an World War II LST. The ship is **LST-325**. This vessel is identical to the one aboard which I proudly sailed. I plan to make a pilgrimage this fall to Mobile, Alabama, to see the ship which is now on display. I am certain that when I walk into that tiny radio shack the sounds of those phone patches made long ago will again ring in my ears. **ER**

A 2-Tube 150 Watt AM Transmitter

by Chuck Teeters, W4MEW
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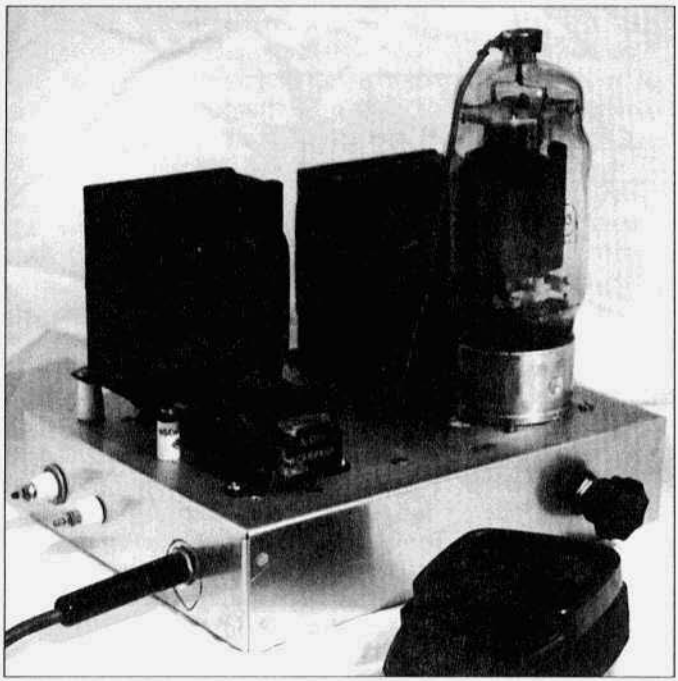
A couple of months ago I ended up with a one tube 80 meter 150 watt CW transmitter that had been built by K4AWY using the schematic in a 1939 RCA advertisement for their then new 813 tube. (ER 138) The RCA ad said that the 813 crystal oscillator could be plate modulated on 75 meters for AM voice. It occurred to me that a single 813 modulator would be an ideal companion for AM operation of the 813 crystal oscillator transmitter. The 813 modulator would have to run as a single ended audio amplifier so that would necessitate class A with its very low plate circuit efficiency. However, it would provide 100% tube interchangeability between the RF and AF sections of the rig and would eliminate all those extra little tubes that always seem to get in the way in a transmitter. After all it's the big tubes that do all the work in a transmitter anyway.

Hunting through the old transmitting tube manuals I could find no data for class A operation of the 813. Larry, W3VU sent me 13 pages of data on the 813, which included data on AB 1 audio operation. It appeared that class AB1 813s could produce 260 watts of audio with no grid driving power using the 1600 volt power supply used for the one tube crystal oscillator. It seemed logical to Larry that I could divide the AB1 values in half for single tube class A operation. I ended up with 1600 volts on the plate, the screen at 750 and a grid bias of -86 volts. Plate current would be 110 mA max, plate dissipation 125 watts, and the audio output should be 75 watts. It would be only 30% efficient as a modulator but as a room heater it would be 70% efficient so I guess it is a "use in the cold weather only" rig. With class A operation that's to be expected and that's why no one except me and some high fidelity addicts use class A for high power.

The grid swing would need to be 160 volts peak to peak to get the 75 watts out. With a commitment to one tube I would need to get the AF grid voltage directly from the mic. A carbon mic through a step up transformer might be able to do it. I jury rigged up a circuit with an F1 carbon mic button, a mic transformer from a BC-1306, and a 9-volt battery. I only got a swing of 60 volts. Hunting through the junk box I found a 1938 Stancor A-4706 mic transformer that the catalog said had a 70 to 1 ratio. Using my test set up I got a swing of 150 volts, close enough for me.

Normal grid bias in a class A amp is from a cathode resistor, but I decided to go with a fixed bias supply. Since there would be no grid current, there would be no regulation problem. A small filament transformer running backwards with a silicon diode could do it easily. The screen voltage would have to come from the high voltage through a voltage divider, and that would take some high wattage resistors that I didn't have. A call for help to Henry, KN4AV, an avid collector got me some 20-watt wire wound resistors. I had a 10 volt 10 amp filament transformer that would light the filament.

The only small modulation transformer I had was from a Johnson Viking II. It could handle 75 watts OK but was normally operated at 700 volts in the Viking II, not 1600 volts. Impedance wise it was 2:1 and I calculated I would need 1:1.5, if the 813s operated the way I had calculated. I decided to run it backwards and it would come closer to the impedance ratio required. To handle the higher voltage I would mount it on 1/2" stand-off insulators and let the case and core float and hope it would hold up to the 1600 volts.



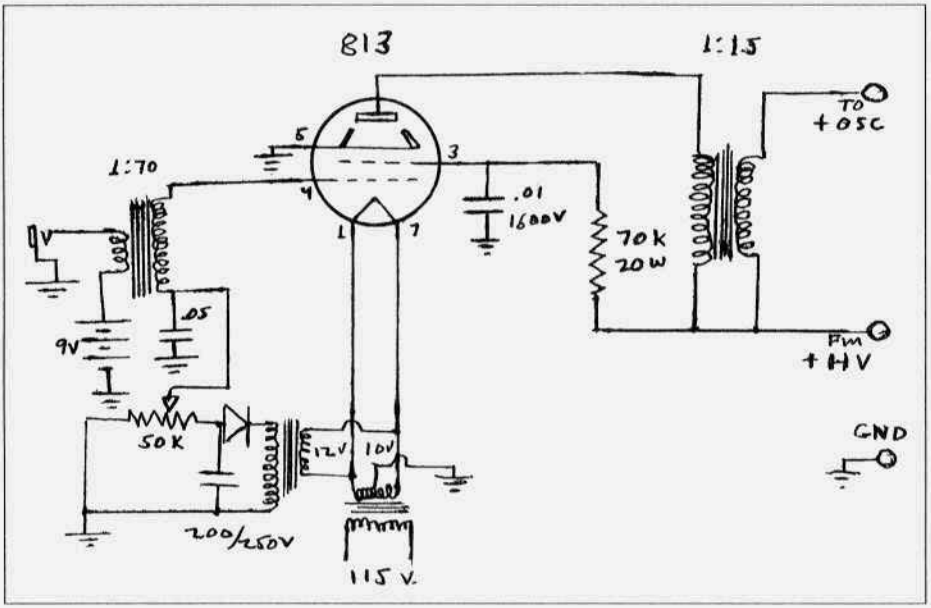
The 813 modulator

To test out my theory, I clipped some short test leads onto the Viking modulation transformer and put 1600 volts to it. No fire flew, so I clipped in the 813 socket and filament transformer. I added the Stancor A-4706 microphone transformer in, added the bias supply, screen circuit, and I had the complete modulator spread out on my work bench. With a 200 mA meter in the high voltage lead I turned on the power. Nothing arced but with no load on the modulation transformer I shut it down. I didn't have any 7 or 8 K resistors that could handle 75 watts of audio so I put the 813 crystal oscillator transmitter on the workbench.

My past efforts with the 813 transmitter had been hard on crystals as there was quite a bit of crystal current, more than FT-243s like. An unknown, nameless ham in Cortez Colorado, with the call of N6CSW, had mailed me a pair of FT-171, BC-610 crystals that I could grind up to 3885 kHz. These rocks are about twice the size of FT-243s, about 7/8" square and can take over 50 mA of current with no problem. The FT-171 will not fit the 243 socket so to save time I wrapped wire around the pins and pushed it into the 243 socket. As luck would have it I had to trim the oscillator tank, as it would only tune up to 3800 kHz. With the tank redone to have a decent Q when tuned to 3885, I fired up the oscillator on 3885. The larger crystal allowed me to load up to 190 watts output with no heating of the crystal.

Time to put the modulator to the test so I connected it in the high voltage leads to the crystal oscillator. I put the power to it through a Variac. I brought the voltage up and nothing arced, and no smoke, I had power output on the Bird, and no strange noises. Both 813s looked very peaceful with no color showing. I always have a scope in the transmitter coax so I woofed into the mic, and I had a bit of modulation. I tuned in the signal on my receiver and it sounded good. When I cut the power to the rig I heard Don, W4YCH near Atlanta just ending a QSO. I switched the transmitter from the dummy load to the 75 meter dipole and gave him a call. Got a 5 by with a report of decent sounding audio. Don said it sounded like my usual signal quality. Since I use carbon mics on everything, AM, FM and SSB that wasn't a bad report and not bad for the first time out with the two tuber. I turned everything off as there were hot

continued next page



Schematic of the 813 modulator

wires all over my workbench. The modulator could not even qualify as a breadboard as nothing was mounted, and the only things soldered were the filament leads to the 813 socket. Twelve test leads with alligator clips held the whole thing together. I guess I was lucky there weren't any nails in that part of my wood bench top.

I found a small 6" by 8" aluminum chassis without too many holes in the junk box. It would be a close fit but other than the 4 transformers and the 813 there wasn't much else, 2 resistors, 3 caps, a PJ-055 mic jack, and a 9-volt mic battery. The transmitter had a plate current meter in the 1600-volt high voltage lead. If I turned off the filament of the 813 modulator, it would read 813 crystal oscillator current only, and with the 813 modulator turned on it would read both so no need for the second meter. When you are working on a small chassis with a simple circuit it is easy to forget that there will be 1600 volts running around. Appropriate feed through insulators, grommets, and proper spacing was cranked in, to eliminate as much as possible any fire flying around. I didn't want any catastrophes, as I was already known to local hams as being hard on smoke detector batteries. The picture shows the results of my second time construction efforts, with everything bolted down and soldered.

I put the completed modulator on the bench next to the crystal oscillator, connected up everything and put the high voltage to it. Plenty of RF but there was no modulation when I keyed the mic. A voltage check on the 813 modulator plate, and the screen showed no voltage. A careful examination and I saw that I had forgotten the ground connection to the modulator chassis. A common ground between the power supply, RF chassis and the modulator got voltage on the modulator. I could put 150 watts into the dummy load but only with about 20% modulation. I backed the RF down to 125 watts output and the modulation came up close to 50%. A check of the 813 modulator screen voltage gave a reading of 675 volts. I

changed the screen resistor to 70K and the voltage came up to 800 volts. By backing the modulator bias down to -80 volts I got the modulation up to 85%. The plate input to the modulator was 165 watts, and the 813 was really running hot. Any attempt to get it up farther resulted in lousy sounding audio with flat topping so I quit with 125 watts RF out with 85% modulation.

When I connected the antenna there wasn't anyone on 75 AM. A phone call to Richard, W1SUJ, across town got me my first contact. A good report from across town, and then a QSO with Mac, W8MPC, in Elijay, GA confirmed that it was working OK. The next evening I checked into the Southeastern AM Club net with no trouble and got some more good reports. The only trouble is when you say you are running a pair of 813s some hams don't understand how the rig works with only two tubes. If they don't understand it the first time I describe the rig I just drop the subject.

If you want to try something different the schematic shows what it takes to build the modulator. The RF schematic was in ER #138. The parts count for the complete transmitter, RF and modulator is 3 filament, 1 mic, and 1 modulation transformer; 9 capacitors; 5 resistors; 2 coils; and a 9 volt battery. A high voltage power supply and a plate current meter complete the whole thing. In terms of watts per component it beats the heck out of a Viking, Valiant, or 5100. While it should be reasonably efficient with only two tubes, it is not. Both 813s run very hot, the modulator really working the hardest. But if your junk box is not overflowing, it is about the simplest decent powered AM transmitter you can build, and you can truthfully say you are running a pair of 813s with high level plate modulation. ER

Clatternet: 850 shift RTTY roundtable, on 10137 kcs USB Saturday, starts 0930-1000 Pacific time.

Bob Samuelson, Deceased from page 3

He began as transmitter engineer, was promoted in 1940 to Chief Engineer, and later, to Vice-President in Charge of Engineering. I have reported details of Bob's professional discussions with Bill Halligan (Grinder, 1999, ER, #126; 2000, ER, #136) mainly in a serious vein, befitting their concern that surviving in a competitive marketplace depended on right decision-making. However, Bill Halligan was anything but a taskmaster. He and members of his senior staff mutually respected one another. He could delegate responsibility comfortably. Each staff member worked hard and no one punched a time clock. Further, Bill Halligan was a natural-born master salesman. His success was due partially to his incomparable social skills. Night after night in hotel bars he would entertain into the wee hours Chicago power-brokers and leaders in the radio industry, including representatives of component manufacturers, vendors of communications receivers, and parts distributors, etc. His favorite drink was the martini straight-up, and he consumed at the slightest temptation several of them on any given evening.

Bill Halligan also recognized that he could heighten company morale by inviting members of his senior staff to social events (see accompanying photograph). Among the cohorts, Bob Samuelson attained a reputation as a clever storyteller, and he was often called upon to liven up events. In fact, he was reputed to be the star performer and lead raconteur at Hallicrafters. For example, at a Thanksgiving feast, in 1943, where forty-one employees had gathered, Bob promoted a new "lure machine"—to wit: "'Professor' Bob Samuelson was called on to discuss postwar plans from the engineers point of view. As a straight-faced comedian, he could be a headliner at Balaban & Katz theaters. With a blackboard he solemnly illustrated a mythical machine

continued on next page

invented by the engineering department as an infallible guide in selecting beauty contestants. This was so sensational [that] it was later requisitioned by a well-know cosmetic firm to test the lure of applied cosmetics. The application was the interesting part, especially the Lana Turner Sweater Girl Developing Cream" ("Reporter's statement," 1943).

Bob Samuelson, by 1946, was a prominent employee of a company that was then the most successful manufacturer in the world of amateur communications receivers and transmitters. Suddenly, however, he resigned from Hallicrafters to join a partner in a tiny business that the two men named, "Voice and Vision." Their intent was to design and install custom high-fidelity FM and TV systems for affluent customers. A brother-in-law of the partner would design the cabinets and Bob would customize the electronics.

I asked incredulously why he had abandoned a prestigious post for such an uncertain enterprise, and he replied, "well, it was an opportunity to be in business for myself, and it provided time for me to enter Northwestern University to work on M.S.E.E. and Ph.D. degrees." Actually, other compelling reasons, with somewhat negative biases, also prompted him to leave Hallicrafters. On the one hand, working at Hallicrafters was exhausting. Bill Halligan certainly did not micro-manage, but he expected results; he did not demand more from his staff members than they could deliver, but he anticipated eagerly what they could deliver. Staff members worked diligently for Bill, out of great respect for him, and the magnitude of their output is truly astounding. Conditions overall were rewarding, and they were proud to work for both Bill Halligan and Hallicrafters, but the personal sacrifices were costly and burnout inevitably took its toll. On the other hand, postwar expansion opportunities were burgeoning, and Bill Halligan informed key staff members that he intended definitely to enter the consumer electronics market. His new product lines would include a broad range of console and table model television sets, as well as a host of shortwave and/or broadcast portable and mantle models, with and without clock-alarms, etc. To Bob, the new directions in which Hallicrafters was heading were unappealing.

Bob Samuelson met the leaders of Motorola-Paul Galvin, Bob Galvin, and Dan Noble-at social events Bill Halligan initiated. Paul Galvin and Bill Halligan were good friends, and Bob highly esteemed Galvin as an innovator because he had pioneered the development of automobile radios. Social interaction between Bob and the people at Motorola was sporadic while Bob was completing his Ph.D. requirements at Northwestern. Meanwhile, Dan Noble had been sent to Phoenix to establish in the desert an electronic-engineering facility. However, Noble returned regularly to Chicago for conferences and visits to radio shows. At one of these events, some time around 1949-1950, he and Bob encountered one another. Bob indicated that he was job hunting, and Noble invited him on the spot to join his team in Phoenix.

Sixteen years earlier, in 1934, Bob had been one of small group of radio engineers whom Art Collins had hired as Collins Radio was springing into corporate life; now, in 1950, Bob was one of an original small cadre of electronic engineers hired to initiate fledgling Motorola programs in Arizona. From 1950-1951 Bob was Senior Project Leader of the technical staff of Military Electronics-later to become the Government Electronics Division (GED). In 1952 he was made Chief Engineer. He held this post until he was appointed Engineering Manager in 1957, when Motorola became increasingly involved in Department of Defense contracts, satel

lites, and other state-of-the-art outer space projects. Then, in 1959 he was placed in charge of all research and development for the Military and Government Electronics Division. His work in electronic research and development required his personal involvement in a wide spectrum of programs ranging from undersea electronics to advanced communications systems for deep space probes, and from radar missile guidance systems to navigation and ordinance controls. Furthermore, his administrative responsibilities included working closely with the managers of the engineering departments for Communications Operations, Radar Operations, and Tactical Electronics Operations. In the context of his administrative responsibilities, he built the GED from a small group of engineers to several thousand employees. When he spoke to a reporter in Portland [see above], he was investigating sites for Motorola in both Portland and Seattle for a 5,000 to 12,000 person electronic plant.

Conclusion. Bob Samuelson's three major career moves enabled him literally to start each time at "ground level." His success appears to have been a product of luck; simply being in the right spot at the right time. The assumption, however, is deceptive. An old aphorism asserts that "nothing ever goes as well in the event as it does prospectively." Some error, misjudgment, or crisis usually saps momentum. The hard evidence of Bob Samuelson's accomplishments indicates that he dealt prospectively with crucial events during every stage of his career. Importantly, his momentum was never impeded by foolish errors or poor judgments. In fact, every challenge that he addressed seems to have turned, metaphorically, into "pure gold."

What, then, was the secret to his success? My belief is that he succeeded primarily because of his unquenchable curiosity and his insatiable capacity for intellectual growth. Whatever he built in the 1930's, whether aircraft gear or commercial amateur transmitters, was state-of-the-art. Yet he was fully aware that electronic technology was advancing swiftly, so that while he was proud of his achievements, he was never complacent. Indeed, his 1949 Ph.D. was a means of ensuring that he would be at the headwaters of new insights. His subsequent employment at Motorola was for him like a post-doctoral odyssey where he could stretch electronic science and technology to outer limits. Bob Samuelson will thus always be remembered as an indefatigable innovator in the progressively more ethereal world of twentieth-century electronics.

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Pratt, G. (1967, January 28). Solid state circuits give computers life. Portland Oregonian.

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[1]Footnote

The data for this tribute to Bob Samuelson are drawn from my conversations with him and materials that he and his family have shared with me. I am especially indebted to Ms. Marcy Samuelson, his wife, and Ms. Suzie Dale, his daughter.

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The Eldico SSB-100F from page 9

creases until 100 mA is reached again. Finally, for CW operation, the carrier control is advanced to yield 125 mA of plate current and, for SSB, it's obviously set to zero. Whew!

Provided the audio gain is set correctly, the reward for following this arduous procedure is linear operation, as evidenced by the picture-perfect trapezoidal display on modulation. During my first QSO I found myself glued to the scope and wishing all my rigs had one. Switching from SSB to AM requires only an increase of the carrier control to achieve a plate current of 100 mA. In either mode, the SSB-100F receives good audio reports, a testimony to its speech circuitry, crystal filter and linearity.

In spite of my personal aversion to VOX, I will say the 100F's speech activated transmit circuitry works well, in that it is adequately sensitive and switches quietly. I found no need to supply the receiver's audio signal to the QT circuit, although in some installations its sensitivity will certainly require doing so. Were I to change anything concerning the VOX it would be to add a delay adjustment.

While the spotting signal is loud and clear (without cabling it to the receiver), the noise of the small induction motor-driven fan is barely perceptible and I mean barely. With more than adequate ventilation, the cabinet gets only slightly warm to the touch after many hours of operation.

Summary

That I chose to pair an SSB-100F with a 75A-4 was no accident. Not only do the two share excellent design, construction and operation, their cabinets are similar in style and dimension, which make an aesthetically pleasing combination. Should you encounter a 75A-4 that is painted to match an SSB-100F you might want to reconsider 'restoring' it. Why? On special order, Collins painted a number of 75A-4 receivers 'Eldico fashion' for use alongside SSB-100Fs at military installations. Conversely, at the risk of attack by Eldico and Collins purists, I will admit I have considered repainting a 100F with St. James grey, replacing the original knobs with Collins-types and installing a 'winged emblem' to make the pair even more compatible.

Speaking from experience, an SSB-100F will hold its own against high-end SSB equipment from any manufacturer and they do not cost an arm and a leg. If you appreciate vintage sideband, one would be a great addition to your shack, especially when paired with its matching amplifier, the SSB-1000F, which will be the topic of a later article. **ER**

Author's Note: Thank you Dave Thompson, K4JRB; Skip Green, K7YOO and others for information generously provided in support this article. To better understand the actual production quantity I would appreciate serial number reports from any 100F reader/owners.

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FOR SALE: Swan basic AC pwr sply model 117X w/ DC module model 14X. Werner, AA4IX, SC, (843) 873-9465, aa4ix@nations.net

FOR SALE: QST binders-small $5 + $2 shpg; large $6 +$2 shpg. R.J. Eastwick, W2RJE, 400 N. Haddon Ave. Unit 109, Haddonfield, NJ 08033. (856)429-2477

FOR SALE: 20% - 50% discount on unsold books, courses, magazines and parts. Free list. Bob Eckert, 133 East 7th Street, Clifton, NJ 07011. (973)-340-0579

FREE: Years of QST, most issues from 1956. Pick up only near Chicago. Dennis Olmstead, 431 Ridgewood, Glen Ellyn, IL 60137. Phone/fax (630) 469-0531, wb9emd@aol.com

FOR SALE: G-186A panoramic adapter (21.4 mHz IF) w/manual - $ 100 or trade for G-186B (500 kHz). Joe Oygenero, VE7LBI, 1349 Leask Rd., Nanaimo, BC V9X 1P8 BC Canada, joseph@pacificcoast.net

FOR SALE: BC-453-Bs, $25 each. Buy all three, will include Command Sets publication by CQ. Carleton Rand, W1PZI, 85 Black Hall Rd., Epsom, NH 03234. (603) 736-9695

FOR SALE: 220 pf@35V caps, new - $2. **WANTED:** Gross, Temco, Hallicrafters HT1, HT2, HT6, HT9 xmtrs. Ken Seymour, 9115 SW 176th Ave., Beaverton, OR, (503) 720-2200. KA7OSM@aol.com

FOR SALE: 2 Hallicrafters S20R recievers. Great condition - $50 each + shpg. Gerry, K4LVZ@juno.com or (386) 673-0197

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FOR SALE/TRADE: Misc. parts, tubes, for tube gear. Sandy Blaize W5TVW, 40460 Edgar Traylor Rd., Hammond, LA 70403. ebjr66@55.com

FOR SALE/TRADE: Xmt'g/rcv'g tubes, new & used - $0.55. LSASE for list. I collect old & unique tubes of any type. **WANTED:** Taylor & Heintz-Kaufman types & lge tubes from the old Eimac line; 152T thru 2000T for display. John H. Walker Jr., 13406 W. 128th Terr., Overland Park, KS 66213. (913) 782-6455, johnh.walker@honeywell.com

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FOR SALE: DowKey relay - $35; Stancor ST-202A xmtr - $235; Bird 74 coax switch - $125; UTC CVM-1, new - $95. Free list. Richard Prester, 131 Ridge Rd., W. Milford, NJ 07480. (973) 728-2454, rprester@warwick.net

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FOR SALE: Solid state amp Avantek AWP-400T, 10-400 MHz, works great. L. W. Gardner, 458 Two Mile Creek Rd., Tanwanada, NY 14150

FOR SALE: Gates BC250-GY broadcast xmtr w/manual, spare finals & assr'y equip such as mod & freq monitors - $500 or trade for lighter boat anchor gear. **WANTED:** E&F coils for my HRO-7. Thanks! Tom Smith, N5AMA, 13034 Elmington Dr., Cypress, TX 77429. (281) 376-3436, tsmith@hal-pc.org

FOR SALE: NCX-3, no pwr sply - $45; NCX-5 & pwr sply - $145; NC-300 - $200; D-104 - $50. James Shank, W3CNS, 21 Terrace Ln, Elizabethtown, PA 17022. (717) 367-3149

FOR SALE: Collins restoration. Everything inside & out to make it as Art Collins built it. 50 yrs experience. W9BJI / N4PZ, IL, (815) 734-4255 or N4PZ@juno.com

WANTED: Collins - Amateur catalogs, sales literature, manuals, promotional items & Signals. Richard Coyne, POB 2000-200, Mission Viejo, CA 92690.

WANTED: Howard radios of any type. Andy Howard, WA4KCY, 133 Carlbody Rd., Carlton, GA 30116. andy@wa4kcy.com

WANTED: For purchase. Equipment & technical information related to AN/ARN-6 Radio Compass. Jim Cavan, 6 Timberline, Norfolk, MA 02056. (508) 528-0908,jcavan566@aol.com

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

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

WANTED: Long wire ants AT101, AT102, GRC-9, DY88/105; PP327/GRC9; counterpoise CP12 & 13 GRC9; BC348 pwr conn PLQ102/103. KA1ZQR, 348 N. Main St., Stonington, CT 06378

WANTED: Manual for Comtronex 6 M FM xcvr, clean copy OK. Jim Everwine, W4APV, 8118 37th St., Pete., Fl 33710. (727) 347-0942

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

WANTED: Knight C-555 (walkie-talkie), C-777 (walkie-talkie), Bandspanner II, TR-108, TR-106, V-107. Willis, (541) 923-2784, W0WH@UNO.COM

WANTED: My school days covetous BC-348 late version Katsu, ex.N8EYH, Japan, mxc04040@nifty.ne.jp

WANTED: NC-400 baskst case. K1MBI, 21 Freestone Ave., Portland, CT 06480.

WANTED: Hallicrafters SX73, Scott special communications xcvr. EA4JL, phone Kurt Keller, CT, (203) 431-6850, k2112@earthlink.net

WANTED: EMC(Electronic Measurement Corp) solid state voltohmeter model 116; Heath catalogs from 1949-1980; manual for Knight (Allied Radio) 10 circuit transistor lab kit #83Y299; Heath amateur license course #ER-3061B; manual for Hickok VTVM model 209B. W. J. Kluwchuk, POB 927, Wadena, Sask S0A 4J0. Canada (306) 338-2264

WANTED: Beginner's key for learning Morse code. Charles Graham, 4 Fieldwood Dr., Bedford Hills, NY 10507. (914) 666-4523

WANTED: Grid dipper coil Serial 989, 0.55 — 1.5 mc, made by Measurements Corp, Boonton NJ for its Model 59LF Megacycle Meter. (I may have to buy lots more than one coil.) L. Bukhardt, POB 465, Los Alamos, NM 87544

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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/ACS coil sets. Jim, KE4DSF, 108 Bayfield Dr., Brandon, FL 33511. jc.clifford@juno.com

WANTED: British, Commonwealth W.S. 62, W.S. 22, W.S. 18, W.S. 48, W.S. 46. George Rancourt, K1ANX, MA, (413) 527-4304

WANTED: PreWW-II Iowa QSL cards; materials of 1920s Iowa Radio Relay League. Will trade or purchase. Bill Smith, W5USM, w5usm@aol.com

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

WANTED: Any info on the Eldico company and the Eldico SSB Twins for future article. Joel Thurtell, finder@radiofinder.com

WANTED: 1930s Army Navy control boxes, pwr splies, dynamotors - any wiend types. William Donzelli, 15 MacArthur Dr., Carmel, NY, 10512. (845) 225-2547, aw2888@osfn.org

WANTED: Back issues of QRP or RADIO AGE magazines. Gary Fender, W5UUO, 450 Cunningham Rd., Celina, TN, 38551. (931) 243-5323, gdfender@multipro.com

WANTED: Antique tubes. Paying $40 ea for good used type 201 tubes (not A). Buy list & new 2000-2001 catalog of collector tubes available. See fathauer@home.com. George H. Fathauer & Assoc., 688 W. First St. Ste 4, Tempe, AZ 85281. (480) 968-7686, tubes@qwest.net

WANTED: Miller 90800 exciter/xmtr with or w/ out coils. Ted Bracco, W0NZW, bracco@hotmail.com

WANTED: All About Missiles & Satellites published by CQ Mag, catalog #104, circa 1960. Louis L. D'Antuono, WA2CBZ, 8802 Ridge Blvd., Brooklyn, NY 11209. (718) 748-9612

WANTED: Yaesu FT-620B xcvr working or repairable. Hoyt Ray, WD4GUA, 2388 Hwy 36 E, Milner, GA 30257.

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516-294-4416, mauricsch@cs.com

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FOR SALE: Military and commercial communications items: http://www.maxpages.com/murphyjunk. Murphy's Surplus, 401 N. Johnson Ave., El Cajon, CA 92020. (619) 444-7717

FOR SALE: Over 600 electronics magazines, mostly 1960's & 70's - 99¢ ea + shpg; also available: electronics books, parts, etc. List for stamp. Bob Eckert, 133 E. 7th St., Clifton, NJ 07011.

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FOR SALE: Heath model AC11 multiplex adapter - BO; SG-8 sig.gen. - $25; CT-1 cap tester - BO; AO-1 audio gen. - $25; AR-3SW rcvr - $25; V-7A VTVM - $25; GD-1B GDO - $25; Conelrad Alarm CA-1 - $10; C3 condenser checker - $15; all + shpg. Will consider BO on any & all + much other junk. Bob Blaney, 127 Westlawn Dr., Decatur, IN 46733.

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FOR SALE: Viking I parts, no panel or case. Duane Vasold, K8CCE, 5768 N. River Rd., Freeland, MI 48623. (517) 695-5140

FOR TRADE: Ham Radio Magazine, CQ; Gil; Ham News; RCA Ham Tips. **WANTED:** Manuals, catalogs, etc. Bernard, NI4Q, POB 690098, Orlando, FL 32869

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WANTED: Small 1" panel meters, especially DC ammeters. Send price info. Chris Cross, POB 94, McConnell, IL 61050

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

WANTED: Mics: Astatic JT 30/40; UT-48; Shure CR80/81/41; 707A; Turner VT-73; CD/BD; parts for same. Tom Ellis, Box 140093, Dallas, TX 75214. (214) 328-3225. tomsmics@flexcomp.com

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WANTED: Heath IB-1103 frequency counter parts unit. Need NL-9505, or NL-58535 readout tubes. Jim Alexander, KO4HP, 1511 N. Jackson, Russellville, AR 72801. ealexand@cswnet.com

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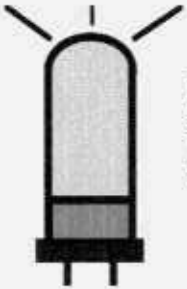

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