$3.75

ELECTRIC RADIO

celebrating a bygone era

Number 179 April 2004

Bill Brandenburg, WØQNI,
Bill Yates, N6YW

ELECTRIC RADIO

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

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

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

Editor's Comments

Like many of us, I had known of the existence of Heathkit Ltd., the UK subsidiary of the American Heathkit company, from a few ads in some British publications. Now, the whole story of Heathkit Ltd. is presented in this issue of Electric Radio by David Gordon-Smith (G3UUR). Mr. Smith has spent 3 years researching this story, and I hope that everyone finds the information as fascinating as I have. It certainly fills a gap in the history of an important company such as Heathkit.

One of our European readers, Federico Baldi (IZ1ZFD), is describing his vintage military equipment in the photo sectio. Mr. Baldi has a lot of rare equipment, and I have not seen photos of some of this equipment before now.

BPL Happenings

The FCC has issued a Notice of Proposed Rulemaking about the BPL system. Print space in Electric Radio prevents full coverage of this important issue, but below is a portion of the FCC Docket, and also some selected comments taken from David Sumner (K1ZZ) in The ARRL Letter and The American Radio Relay League.

FEDERAL COMMUNICATIONS COMMISSION
47 CFR Part 15
[ET Docket No. 03-104 and ET Docket No. 04-37; FCC 04-29]
Broadband Power Line Systems
ACTION: Proposed rule.

SUMMARY: This document proposes to amend the Commission's rules to adopt new requirements and measurement guidelines for a new type of carrier current system that provides access to broadband services using electric utility companies' power lines. Because power lines reach virtually every home and community in the country, we believe that these new systems, known as Access broadband over power line or Access BPL, could play an important role in providing additional competition in the offering of broadband services to the American home and consumers, and in bringing Internet and high-speed broadband access to rural and underserved areas. **[Continued on page 12...]**

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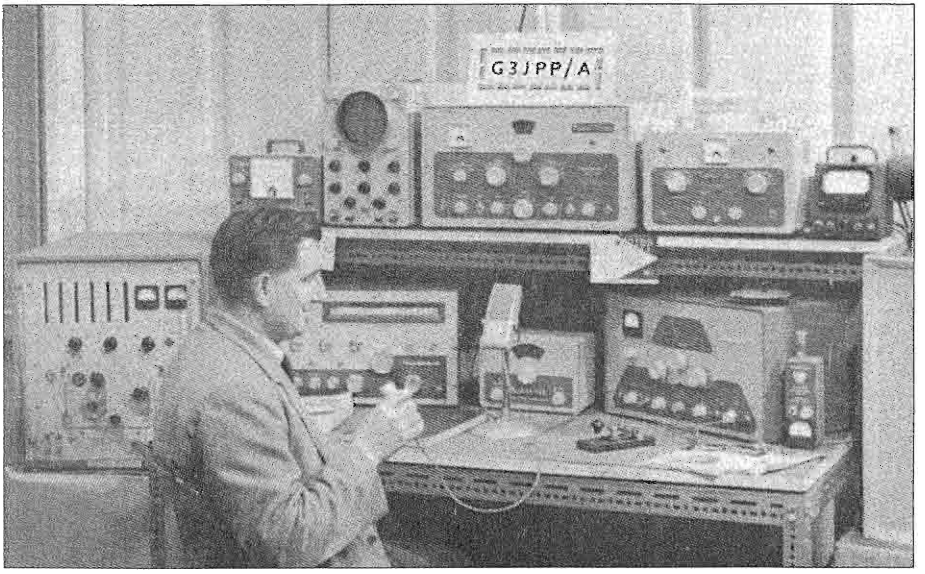
Cover: Bill Brandenburg (WØQNI) and Billy Yates (N6YW) set up vintage Heathkit equipment at the Western Amateur Radio Friendship Net's Spring Retreat, held at Valencia, CA May 22-25, 2003.

The Story of Daystrom Ltd
Home of British Heathkits

By Dave Gordon-Smith, G3UUR
Whitehall Lodge, Salhouse Road
Rackheath, Norwich NR13 6LB
Norfolk, UK.

Very few people outside of the United Kingdom are aware that the Heath Company of Benton Harbor, Michigan, once had a factory and development laboratory in the South West of England. There were a number of Heath sales and servicing depots around the world, but I think I am right in saying that the UK plant was unique, being the only Heath development and manufacturing facility outside of the USA. Heath had a problem with marketing their products in the UK in the 1950s because of the very high import duty, and the draconian foreign currency exchange controls that existed at that time. After WWII the UK Government had massive debts, and the British economy was on its knees. There was no choice but to limit imports and restrict foreign currency exchange, in an attempt to get the British economy back on its feet. This hit Hallicrafters very hard, as from 1946 they were trying to set up a manufacturing plant in the UK using their own American made com-

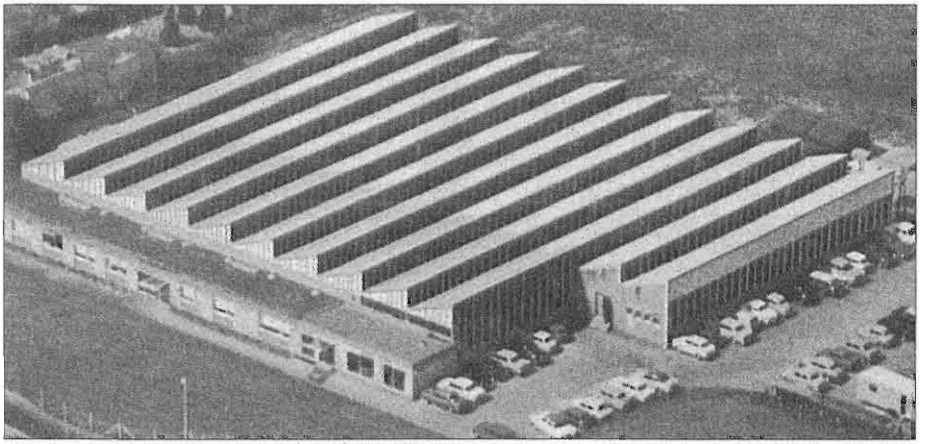


Ted Price (G3JPP), the Amateur Products Project Engineer, is operating /A from the factory at Gloucester in about 1960, using an all-Heath line-up. This shows, beautifully, the difference in styling between the DX-100 (bottom right) and DX-100U (upper centre), as they are both in the picture. The line-up also includes the DX-40U, VF-1U, and the American Mohawk receiver just to the left on the operating bench, partially blocked by Ted, and some other Heath UK products. (Photo courtesy of Ted Price, G3JPP)

ponents. Import duty on these components would have made the equipment too expensive, and Hallicrafters (UK) Ltd never really got off the ground. They wound up their UK subsidiary in 1953, after years of trying, unsuccessfully, to get manufacturing concessions for their own imported components.

In 1956 Bob Erickson, who was president of the Heath Company at the time, came to the UK to survey the situation. He met with British businessmen in London, and formulated a new and quite radical approach. He planned to hire a team of British engineers to re-engineer existing Heath designs to use British components and metalwork. No parts were to be imported, and it was decided that the designs would have to be altered if no direct equivalents of some components could be found, in order to keep the equipment affordable to the UK market. However, the Suez Crisis got in the way of these plans, and the start of the new company was delayed by about a year. The Heath British subsidiary was eventually set up in the city of Gloucester in the Summer of 1958, under the name 'Daystrom Ltd'. Gloucester is in the South West of England, just to the NE of the famous port of Bristol. It is on the fringe of a picturesque part of the country known as the 'Cotswolds,' and lies about 100 miles WNW of London. It may seem strange that the name chosen for the company was not Heath (UK) Ltd, in view of the fact that they only ever produced kits under the Heath name. However, Bob Erickson was very much a Daystrom man, and obviously had some other plans for the UK subsidiary, apart from producing British Heathkit equipment. We never got to find out what these plans were, though, because Erickson left Heath/Daystrom before the UK subsidiary was actually up and running. Later, long after Daystrom Ltd had been acquired by Schlumberger, the name was eventually changed to Heath (Gloucester) Ltd.

Mr. A. E. B. Perrigo, one of the businessmen Bob Erickson had met in London in 1956, was appointed as the first Managing Director of Daystrom Ltd. Bert Perrigo was a graduate of the Imperial College of Science and Technology, one of the several colleges which form the University of London. After distinguished service as an Admiralty scientist during the war, he obtained a Masters in Electrical Engineering at Queen's University in Belfast, and then went into industry, where his interests eventually turned to management. In the early part of 1958, he spent a few months at the Heath Company headquarters in the United States learning the business. Back in the UK, his first task was to hire some engineers and find temporary accommodation, so that the development work on the new range of British Heathkit products could begin as soon as possible. A senior engineer from Benton Harbor came over to the UK for a few months to help him set up the company and interview prospective employees. Initially, they hired a chief engineer, George Tillet, and then 4 engineers; one for amateur radio products, one for hi-fi, one for test equipment and the other for solid-state receiver design. The first home for this fledgling company was an old billiard hall between the city centre and Gloucester docks. Ted Price, G3JPP, was recruited as the engineer responsible for amateur radio products. His first priority, while in the temporary accommodation, was to get some American kits shipped over to the UK and start building up something they could show at the November Radio Hobbies Exhibition in London. Once he had assembled the DX-40, VF-1 and DX-100 kits for the exhibition, he started re-engineering the DX-40 to produce the DX-40U. Their stand at the exhibition attracted a lot of attention, and



This aerial view of the Daystrom-Heathkit UK factory in Gloucester was taken sometime after its construction in early 1959. (Photo from the British Heathkit Catalouge)

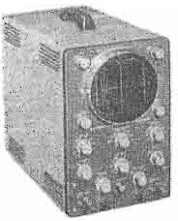
they were able to demonstrate not only the amateur transmitters, but also the V-7A valve voltmeter and O-12 oscilloscope which had been assembled by Geoff Stone, the new test equipment engineer. The reviews in the amateur press the following month were very favourable, and nicely bridged the gap between the exhibition and their advertising campaign, which began early in 1959.

While all the pre-production activity was taking place in the old billiard hall, a purpose-built factory was being constructed for the company, just off the Bristol Road in Gloucester. This was finished early in 1959, and was situated on Cole Avenue. The new factory had management offices, reception, and a showroom along the front of the building, either side of the main entrance. If you refer to the photograph of the factory, the front is the low-level part of the building with a flat roof, in the lower left of the picture. If you've got a sharp eye you can see the porch roof of the main entrance jutting out from the building, slightly to the left of centre. There is a 'Daystrom Ltd' sign above the main entrance that can just about be seen in the photograph. You'll notice another entrance to the right of the main entrance. I believe that this is the entrance to the showroom. The Daystrom-Heathkit factory became such a landmark in Gloucester that the nearby roundabout, which gave Cole Avenue access onto the Bristol Road, became known as "Daystrom Roundabout."

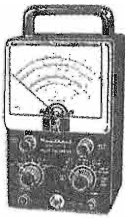
Ted was ready to put the DX-40U into production as soon as they moved into the new factory. The kit was advertised early in 1959, and was ready for shipment then. The VF-1U followed shortly afterwards. Re-engineering the DX-100U took a bit longer, and it was not ready for production until September 1959. Although the DX-40U was not greatly different from the American DX-40, the DX-100U did have some substantial differences in the tube lineup compared to its American counterpart. The greatest departure from the American design was the use of 'Kinkless Tetrodes' in the modulator. GEC KT88s were used, driven by a 6CH6 rather than the 12BY7 used in the American version. This was a curious departure from the American design, since KT88s were not cheap, and 807s and 1625s were abundant and cheap on

THE Heathkit IN THE WORLD

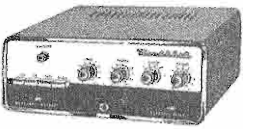
LARGEST-SELLING ELECTRONIC KIT-SETS



MODEL O-12U
5" LABORATORY OSCILLOSCOPE
£34. 15. 0.

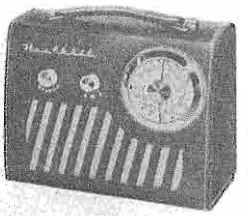


MODEL V-7A
VALVE VOLTMETER
£15. 14. 0.
Complete with leads, test prods and battery



MODEL S-88
HI-FI STEREO AMPLIFIER
£25. 5. 6.
Embodies all latest features

HERE AT LAST!



MODEL UXR-1
TRANSISTOR PORTABLE
£17. 17. 0.
Including £5. 11. 6. P.T.

DX-40U TRANSMITTER

THE "LITTLE BROTHER" OF THE WORLD FAMOUS DX-100
DESIGNED BY HAMS FOR HAMS

£29. 10. 0. *DELIVERED FREE U.K.*

The Heathkit model DX-40U transmitter was designed to achieve maximum versatility and range at a reasonable cost and deliver up to 75 watts final stage and 40 watts to aerial with 3 switch-selected crystal positions. It includes controlled carrier phone operation and provision for VFO excitation required by the average "ham," has sufficient output to drive larger transmitters when the station is expanded, yet is small and light enough for field day operation.

It consists of one power supply, three R.F. stages, and two double triode audio stages. Pi network output coupling is used to facilitate antenna matching. The panel controls consist of a key jack operation switch, band switch, drive control, final tuning, meter switch and antenna tuning. The microphone connector, crystal switch, output connector VFO input and auxiliary power socket are located on the rear chassis apron.

ALL MODELS DELIVERED FREE U.K.
INCLUDING SPEAKER SYSTEM £10. 9. 0.
AND JUNIOR TRANSISTOR SET £2. 19. 6.

DETAILS AND MODELS AVAILABLE DIRECT FROM

DAYSTROM LTD., DEPT RB2 GLOUCESTER

Early Daystrom-Heathkit advertisement announcing the new British DX-40U transmitter. (Advertisement from the February, 1959 RSGB Bulletin.)

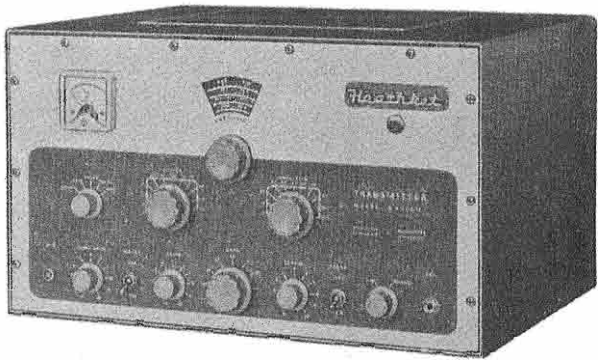
the surplus market. Ted maintains that they decided to go for new components for reliability reasons, and managed to get a good deal on a bulk purchase. That's why KT88s were used instead of 1625s, which could not be purchased new in the UK at the time. I'd always assumed that KT88s were used in the DX-100U because they were also going to be used in one of the hi-fi amplifier designs as well, but that was not the case. No British Heathkit hi-fi amplifiers were ever produced using KT88s. Ted also mentioned that he

Here is the British-made

HEATHKIT DX-100!

The most famous Amateur Transmitter in the world

All models delivered free U.K.



Deferred terms available on orders above £10.

Model DX-100U ... £78.10.0

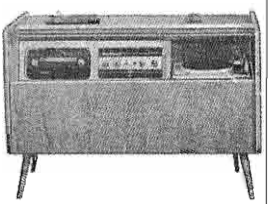
It needs no introduction to "**HAMS**" the world over!

OTHER NEW MODELS INCLUDE:—

"THE GLOUCESTER" Hi-Fi Stereo Cabinet for Tape-Deck and/or Record Player, also FM Tuner and Stereo Amplifier Mk. I ... **£15 18 6.**
Mk. II (Housing both Tape Deck and Record Player) ... **£17 8 6.**

"THE COTSWOLD" A Hi-Fi Speaker System for the most discerning.—
Three units (12" Bass, Mid-range and Pressure) ... ... **£19 18 6.**

F.M. TUNER, £13 10 0. Total. Tuner unit available separately.
Full details of these and other models are available by completing and posting us the following coupon.



"THE GLOUCESTER"

Without obligation on my part, please send me details of the Heathkit models ticked below:—

DX-100U Transmitter ...	£78 10 0	Audio Wattmeter ...	£13 18 6	Transistor Receiver ...	£2 16 6
DX-40U Transmitter ...	£29 10 0	Capacitance Meter ...	£14 10 0	"THE GLOUCESTER" Cabinet	
V.F.O.	£10 12 0	Electronic Switch ...	£9 18 6	Record Player	£12 10 0
Audio Signal Generator	£19 3 0	Oscilloscope	£34 15 0	SSU-1 Speaker System ...	£10 5 6
Audio Valve Millivoltmeter	£13 18 6	Resistance/Capacitance Bridge	£7 19 6	Stereo Amplifier, 6 watt	£11 8 0
		R.F. Probe	£1 5 6	Stereo Amplifier, 12 watt	£25 5 6
NAME		Valve Voltmeter ...	£13 0 0	Stereo Head Booster ...	£5 19 6
.....		F.M. Tuner	£13 12 6	"THE COTSWOLD"	
ADDRESS		Transistor Portable ...	£15 18 6	Complete Stereo System	£42 10 0
.....					
.....					
.....					

"THE COTSWOLD"

F.M. TUNER

DAYSTROM LTD. DEPT. RB9 GLOUCESTER, ENGLAND

a member of the Daystrom Group, manufacturers of
THE LARGEST-SELLING ELECTRONIC KITS IN THE WORLD

Daystrom-Heathkit advertisement from September, 1959 RSGB Bulletin announcing the new British-made DX-100U transmitter. Note the range of British Heathkit products they had on offer just over a year after the company was formed.

couldn't get the British driver coils built to the same standard as the American ones, and they were noticeably inferior to the originals. Apparently, some DX-100Us had insufficient drive on 10m as a result. I can't say that I have found that to be a problem, but there again I have only had three DX-100Us through my hands in the last 20 years, compared with the thousand or two that

were produced, and there were bound to be variations in production that caused some to be adequate, and others to be poor in this respect.

So, all the components used in these British Heathkits were made in the UK. The transformers were obtained from two well-known British transformer manufacturers, Haddon of London and Hinchley of Devizes, Wiltshire. The primary windings of the mains transformers were wound for 240V AC, but were also split and tapped for many other voltages to cater for all the mains voltages that existed at that time in the remnants of the declining British Empire. The audio transformers and chokes were made as close to the specification of American ones as it was possible to achieve using standard British construction techniques. They look different, though, because the cases were made using a folded-sheet construction, rather than being deep-drawn as the American ones were. The metalwork for the transmitters was done by a division of the Plessey Company based in Swindon, Wiltshire. Fabrication of cabinets and chassis is not something you normally associate with Plessey, but I suppose each division had to be independently viable, and they undertook whatever work they could get to fill their capacity. The parent company, of course, is well known these days for specialist communications ICs and military communications equipment. The variable capacitors came from Eddystone in Birmingham and Jackson Bros in London. The former are famous for their range of rather robust communications receivers, but also used to manufacture dials and RF components back then. The latter are well known today for their slow motion drives, and in fact supplied the ones used for the VFO of the DX-100U. Ted had problems getting coil stock for the PA tank coils in the DX-40U and DX-100U, as no companies were commercially producing such coil stock in the UK at that time. Codar, a small English radio firm, did produce some very good coil stock later in the 1960s under the trade name "Codar-Qoils," but they weren't doing it when Ted needed some in the late 1950s. In desperation, Ted persuaded a small local firm, Chinchen, to try making some coil stock. They were successful enough to get the contract to make the PA coils for both the DX-40U and the DX-100U. Chinchen, apparently, was a small company owned and run by a Chinaman, Mr. Chen, that operated from an old woollen mill in nearby Stroud – Yes, I know, I thought Ted was having some fun at my expense when he told me this, but he assures me that it's true!

To signify that these transmitters had been re-engineered, and used only UK components, they were given the "U" suffix after the American model number. An examination of the front panels of both the DX-40U and DX-100U reveal some styling changes in the use, and shape, of contrasting dark areas around the control knobs, and the main tuning dial in the case of the DX-100U. If you check out the photograph of G3JPP/A on page 2 of this issue of ER, you'll be able to compare the differences – the DX-100U is in the centre of the upper shelf, just beneath the G3JPP/A sign, and the American DX-100 is on the right-hand side of the operating bench. I suppose Ted had to put his mark on the outside as well as the inside! You can see examples of the DX-40U and VF-1U in the photograph as well. The VF-1U is sitting between the Mohawk receiver and the American DX-100 on the operating bench, and the DX-40U is to the right of the DX-100U on the upper shelf. Even the Apache TX-1 and Mohawk RX-1 were re-engineered for the UK market. Unfortunately, when the prototypes were completed, and the final cost worked out, they were considered to be too

expensive for the UK market, and were never offered to British amateurs. It's a great disappointment for the vintage wireless buffs in Britain that the prototypes of the TX-1U and RX-1U have disappeared without trace. Hopefully, they will surface again one day and the lucky owner will put them on the air.

During his 3 years with Daystrom Ltd, Ted was occasionally asked to work on the odd test gear and hi-fi design project. For example, in his second year with them he re-engineered the GD-1. Later, he was asked to design a 0.1% distortion, mono hi-fi amplifier. It's not at all surprising that what he actually designed was an ultra-linear 12W amplifier with push-pull EL84s, which could be marketed as either a modulator or hi-fi amplifier, and had a 10kohm output as well as the normal low impedance speaker outputs! This was designated the MA-12 and, as far as I'm aware, doesn't have an American counter-part. The last British Heathkit project that Ted, G3JPP, completed while working at Daystrom Ltd was the Mohican, GC-1U. This design used the new Mullard OC170/OC171 alloy diffusion germanium high frequency transistors. The Mullard sales representative had been pushing Ted very hard to try these new devices. When he did, he found them to be very good, and decided he'd use them in the GC-1U design. Mullard were rather surprised to get a large order from Daystrom Ltd quite so soon, and their new production facilities in Southampton were unprepared for such an order. In fact, the building for the new semiconductor factory had only just been completed, and they were in the process of setting up the new manufacturing lines. You can just imagine the production guys at Mullard cursing the sales representative for putting additional pressure on them at such a stressful time, and while they were working all hours to get the new

Advertisement from October, 1960 RSGB Bulletin showing the range of products on offer just over two years after the British subsidiary of the Heath Company was formed. Note that the "NEW KITS INCLUDE" announcement has the GD-1U and RSW-1 shortwave receiver listed

production lines up and running, he was probably out entertaining some pretty young thing in a local bar with his commission from the sale! A delay in getting the RF transistors may explain why the GC-1U did not go into production until a couple of months after Ted had left the company in February, 1961, even though the project was complete by the end of 1960.

One of the reasons why Ted left Daystrom Ltd was because he had been told that all design and development work in the UK would cease by the end of 1962. This was not surprising, since the economic climate in Britain had improved enormously throughout the 1950s, and even as Daystrom Ltd was being formed in the Summer of 1958, there were signs that the import and currency exchange restrictions would

soon be relaxed. Before he left the company, Ted had started work on the RA-1 and RG-1 tube receivers. Some commentators have claimed that these are only anglicised versions of the HR-10, but in fact they are quite different in many ways. The styling and looks are very similar to the HR-10, but the fact that the RA-1 was not designated the HR-10U is evidence that Daystrom Ltd considered it to be very different. You'll notice that some British Heathkit products have the 'U' suffix appended to the American model number, and some have quite unique model numbers. The ones with the 'U' suffix are merely American designs that have been re-engineered with British components, and the ones with unique model numbers are products that have been designed in the UK, and very often don't have an American equivalent. The RA-1 and RG-1 receivers came with a pre-assembled front-end module that was manufactured by Electroniques Ltd of Felixstowe, England. Electroniques Ltd were already producing radio receiver modules for the hobby market when they were approached by Daystrom Ltd, in late 1960, to do a couple of special versions for the RA-1 and RG-1 receivers. These modules used the latest 'frame grid' tubes in the RF amplifier, and Ted also used the same tubes in the IF stages of both receivers. The IF in both the RA-1 and RG-1 is similar to that in the HR-10, in that it is 1620kHz, but this came about only because the original Electroniques front-end modules had that particular IF. The RA-1 also has 160m, and a totally different tube line-up to the HR-10. The RA-1 has additional refinements that the HR-10 doesn't have, such as the limited range 5:1 slow motion drive built into the main tuning shaft. This is a novel little design by Jackson Bros, which looks just like a simple shaft in a panel-mounting bush. It allows fine tuning back over a small portion of the frequency range until the shaft engages the direct drive again. The RG-1 is just a general coverage version of the ham bands only RA-1. I believe that Sid Boakes, G3HXN, who took over from Ted at Daystrom Ltd, may have put the RA-1 and RG-1 designs into production, but after some considerable delay. Unfortunately, I haven't been able to find out what the reason for this delay was, because Sid became a Silent Key back in 1977, while still working for Heath (Gloucester) Ltd. The other possibility is that the production work was done by Ted's apprentices. He and the other three engineers had each taken on two apprentices to train, once the company was up and running. Anyway, for whatever reason, it wasn't until early 1963 that these receivers were included in the British Heathkit range, despite the fact that Ted had started these designs back in late 1960.

British Heathkit advertisement from Short Wave Magazine, May, 1965. Note the inclusion of the "AMERICAN HEATHKIT SSB EQUIPMENT" announcement in a box in the lower left quarter of the advertisement. Just above this box are the details of the HT-1 self-supporting steel tower.

Heathkit DAYSTROM

Better quality Equipment—at low cost

by BUILDING ANY HEATHKIT MODEL

AMATEUR BANDS RECEIVER, Model RA-1. Covers all amateur bands 10-160 metres. Half-lattice crystal filter at 1.6 Mc/s. I.F. Provision for fixed, portable or mobile uses. Switched USB and LSB for SSB.
£39. 6. 6 Kit £52. 10. Assembled

OPTIONAL EXTRAS. Crystal Calibrator CL-1 £4. 12. 0 Kit. Loudspeaker Cabinet SG-4 £1. 9. 6. Loudspeaker £1. 4. 5 incl. P.T.

AMATEUR TRANSMITTER, Model DX-40U. From 80-10 m. Power input 75 W. CW., 60 W. peak, C.C. phone. Output 40 W. to aerial.
£33. 19. 0 Kit £45 8. 0 Assembled

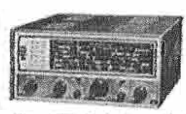
S.S.B. ADAPTOR, Model SB-10U. For use with most A.M. transmitters. Less than 3 W. R.F. input power required for 10 W. output. Operation on 80, 40, 20, 15 and 10 m. on U.S.B., L.B.S. or D.S.B.
£39. 5. 0 Kit £54. 18. 0 Assembled

"MOHICAN" GENERAL COVERAGE RECEIVER, Model GC-1U. In the forefront of design with 4 piezo-electric transfilters, 10 transistors, variable tuned R.F.O. and Zener diode stabilisor.
£37. 17. 6 Kit £45. 17. 6 Assembled

Suitable Battery Eliminator, Model UBE-1 £2. 17. 6 Kit

REFLECTED POWER METER. Model HM-11U. Indicates Antenna/Transmitter match. £8. 5. 0 Kit £10. 10. 0 Assembled

HIGH-SENSITIVITY GENERAL COVERAGE RECEIVER, Model RG-1. A high performance, low cost receiver for the discriminating short-wave listener. Frequency coverage from 600 Kc/s. to 1.5 Mc/s. and 1.7 Mc/s. to 32 Mc/s. Send for details.
£39. 16. 0 Kit £53. 0. 0 Assembled



AMATEUR TRANSMITTER, Model DX-100U. Covers all amateur bands from 160-10 metres, 150 watts D.C. input. Own power supply.
£79. 10. 0 Kit £104. 15. 0 Assembled

Q MULTIPLIER KIT, Model QPM-1. May be used with receivers having 450-470 Kc/s. I.F. Provides either additional selectivity or signal rejection. Self powered. Model QPM-16 for 1.6 Mc/s. I.F. Either model £8. 10. 0 Kit £12. 14. 0 Assembled

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Daystrom-Heathkit advertisement from Short Wave Magazine, January, 1966. Notice that half the area is now taken up by American Heathkit SSB products. The London Showroom is also mentioned - this was first announced several months before this advertisment appeared.

Other uniquely British Heathkits were produced in the hi-fi and domestic radio divisions at Gloucester, such as the RSW-1 short wave portable, which covered 160m, the S-33 and S-88 ultra-linear stereo amplifiers, AM/FM tuners which included the European Long Wave broadcast band, and a wide range of speaker enclosures and transcription decks. The hi-fi market in the UK was deemed sufficiently different to that in the US, that the engineer responsible for products in this division had pretty much a free hand in what he did. The test equipment engineer was constrained even more than Ted, and was only allowed to re-engineer American products. In 1964, Daystrom Ltd introduced what would be the last British Heathkit product, the HT-1, a 32 ft free-standing steel lattice tower. The parts were made for them by a local Gloucestershire firm, Francis and Lewis Ltd of Cheltenham. The tower kit came as a considerable number of individual steel members, some angle and some tubular, that had to be bolted together by the buyer. The base was 3 ft x 3 ft, and it tapered to 1 ft x 1 ft at the top. There was a choice of red oxide or a galvanised finish. Judging by the number of these towers I've come across over the years, they were quite popular. They could take a 20 ft scaffold pole, with a 5 ft overlap, to get the top antenna up to 47 ft without any guys. That was considered pretty good in the UK in those days

From 1964 onwards, Daystrom Ltd began to offer all the American Heath products as well as the British range. No SSB transmitters or transceivers were ever produced at the Gloucester factory, although the SB-10U was produced for use with the DX-100U. The British Heathkit products, re-engineered or designed at Gloucester between 1958 and 1962, were sold alongside American Heathkit products throughout the 1960s. Demand for Heath products in the UK was sufficiently high by the mid-Sixties for Daystrom Ltd to consider a showroom in the capital. The London Heathkit Centre was opened in Tottenham Court Road towards the end of 1965, to make it easier for customers in London, or visiting London, to view the Heathkit range of equipment. Tottenham Court Road in London was a good choice, as it was one of the main places for radio bits and surplus equipment in the Fifties, Sixties and Seventies, much as certain streets in Lower Manhattan were for radio enthusiasts around New York before they were knocked down for redevelopment. Fortunately, Tottenham Court Road was never redeveloped, and survives to this day. It's full of digital gizmos and computers these days, and doesn't have the lure and magic it once had for us wireless buffs. About a year later, another Heathkit Centre was opened at the Bull Ring in Birmingham, to serve the people of the Midlands and Northern England. As SSB took over from AM on the amateur bands, the demand for the older British products fell. The DX-40U, VF-1U, DX-100U and RG-1 were phased out by 1969. The RA-1 and GC-1U were dropped in 1970. The only British Heathkit products that were offered well into the 1970s were from the original test equipment range, and they had undergone styling and colour changes to make them more appealing.

The drop in demand for the older British Heathkit products in the late 1960s led to an expansion of Schlumberger's activities in the Gloucester Heathkit factory. In the Fall of 1970, the company's name was finally changed to one that reflected its core business, and 'Daystrom Ltd' changed to 'Heath (Gloucester) Ltd.' Eventually, by 1975, the remaining British Heathkit test gear products were dropped from the range, and Heath (Gloucester) Ltd no longer had a re-

quirement for manufacturing facilities. They moved out of their factory to smaller premises at the junction of the Stroud and Bristol Roads, a bit nearer to Gloucester city centre and quite close to the "England's Glory" match factory. Schlumberger took over the entire Heathkit factory for their UK instrumentation division. From their new location Heath (Gloucester) Ltd continued to sell, and support, American Heathkit equipment.

After the take-over of the Heath Company by Zenith, the British Heath subsidiary changed its name yet again; this time to 'Heath Electronics (UK) Ltd.' The Gloucester Heathkit Sales and Service depot survived until the beginning of 1984, when Zenith closed it down. The British electronics chain Maplin took over the UK franchise for new Heathkit products for a few years after this, but eventually relinquished it. It was picked up by Cedar Electronics, who had bought the entire stock of Heathkit spares from Heath Electronics (UK) Ltd back in 1984. They continue to sell spares and service Heath equipment. I've been told they have a very good stock of spares for American Heathkit equipment post-1964, but it doesn't extend to the old AM gear, unfortunately! They can be contacted on the UK telephone number (0)44 (0)1242 602402, or if you prefer to write, their address is Cedar Electronics, Cedar House, 12, Isbourne Way, Broadway Road, Winchcombe, Cheltenham, GL54 5NS, United Kingdom.

A special thanks should go to Ted Price, G3JPP, whose recollections of the early years at Daystrom Ltd form the basis of this article. I would also like to thank Pat Perkins, G3MA, Ian Bassett-Smith and Mike Hazell, G1EDP, for help with additional information on Heath (Gloucester) Ltd and Heath Electronics (UK) Ltd.

ER

[...Comments from page 1]

DATES: *Comments must be filed on or before May 3, 2004*, and reply comments must be filed on or before June 1, 2004.

ARRL CEO David Sumner K1ZZ:

...The League recommends that members read the NPRM and develop their own thoughtful, considered comments that specifically address the FCC's BPL proposals, reflect positively on the amateur community and, if possible, offer alternative recommendations. Quoting Mr. Sumner:

"First, this is not a proceeding to 'permit' or 'authorize' BPL," he said. "BPL is already permitted under the existing Part 15 rules."

Second, the NPRM reaffirms that licensed services must be protected from harmful interference and are not required to protect BPL systems. This is good, but we can't take it for granted that the principle will be honored in practice.

Third, the NPRM proposes additional, new constraints on BPL to protect licensed services. The FCC did not go far enough, but at least the proposals aim in the right direction.

We need to prove that the risk of interference is significantly greater than the BPL proponents say it is."

Sumner also asserted that the FCC's proposed "interference mitigation" requirements fall far short of providing real protection from harmful interference, and that the Commission is ignoring the practical problems that will arise when Amateur Radio transmissions disrupt BPL systems. The League encourages anyone, particularly radio amateurs, who has actually experienced BPL interference to file detailed comments documenting the interference.

"BPL proponents claim they are not getting interference complaints," Sumner noted. "If we let them claim their systems are 'clean' when we know they aren't, shame on us."

ER

World War 2 Paraset Resistance Radio

By Michael J. Janis, KE3OQ
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Nazareth, PA 18064
mjanis@ptd.net

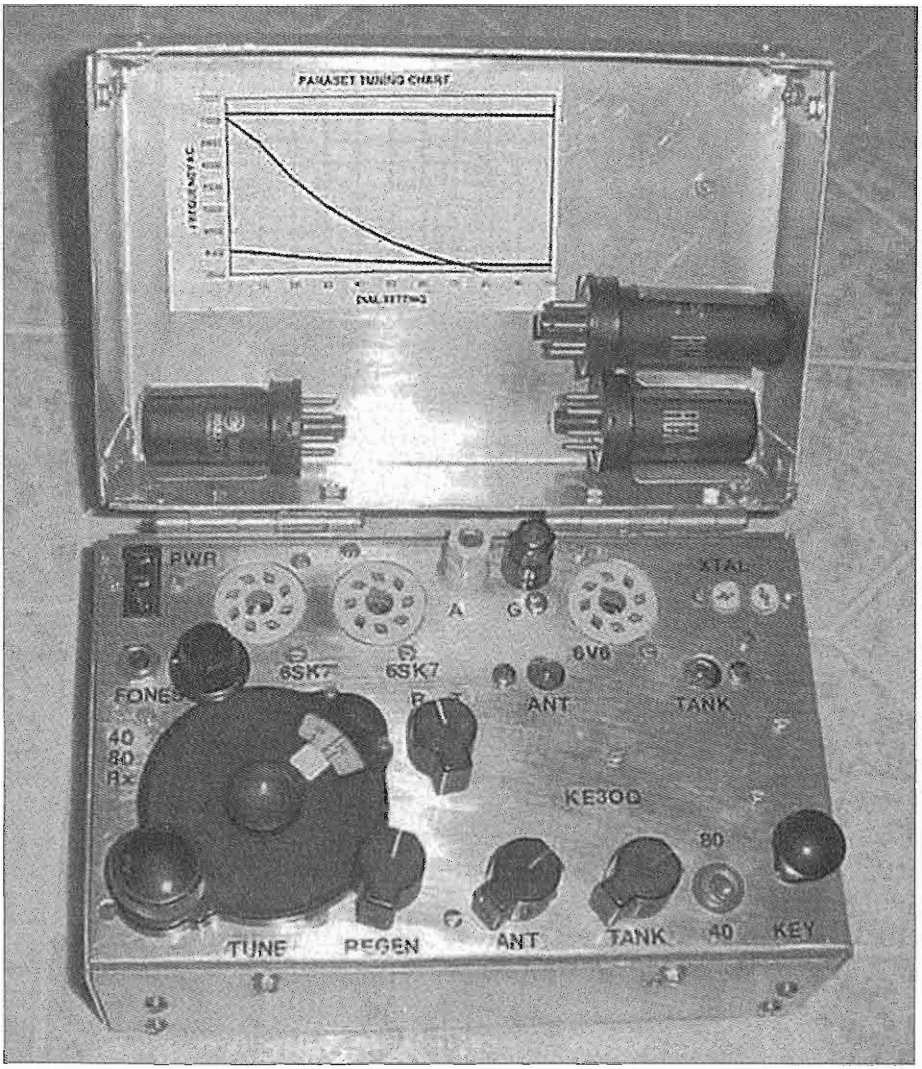
I recently built a replica of a simple Receiver /Transmitter set that was originally used in Europe as a compact radio for clandestine communications by resistance and spy forces behind enemy lines during WW2. The radio was used in Norway, France and other occupied countries as a means of obtaining and of sending information to and from British headquarters. It was small, of simple design and could be powered from a 6V car battery via a vibrator power supply or from house current if a suitable power supply was available. This project may appeal to ER readers who are looking for an interesting and rewarding project.

The receiver is a simple two tube regenerative design and the transmitter is a single tube, crystal controlled oscillator, both assembled on a small chassis and contained within the confines of a small metal box. There is a lot of detail regarding this radio on a web site by IKØMUZ and several amateurs in Europe and North America have reproduced the radio from the information presented.

The receiver uses two 6SK7 tubes. The first 6SK7 is a regenerative detector followed by a second 6SK7 used as an audio amplifier. The LC arrangement is such that the band from 3 to 8 MHz is covered with 180 degrees of tuning dial rotation. This makes the receiver very difficult to fine tune and I made modifications to this arrangement to select only small portions for use in the ham bands. I used a three position, three-pole rotary switch to change the capacitance across the coil to spread out the bands on 80 and 40 meters. I left one position to allow for the original tuning and the second and third positions cover 80 and 40 meters. An attached diagram [page 17] outlines the modifications I made. The final choice of capacitors is by trial and error but the values given may be used as a starting point.

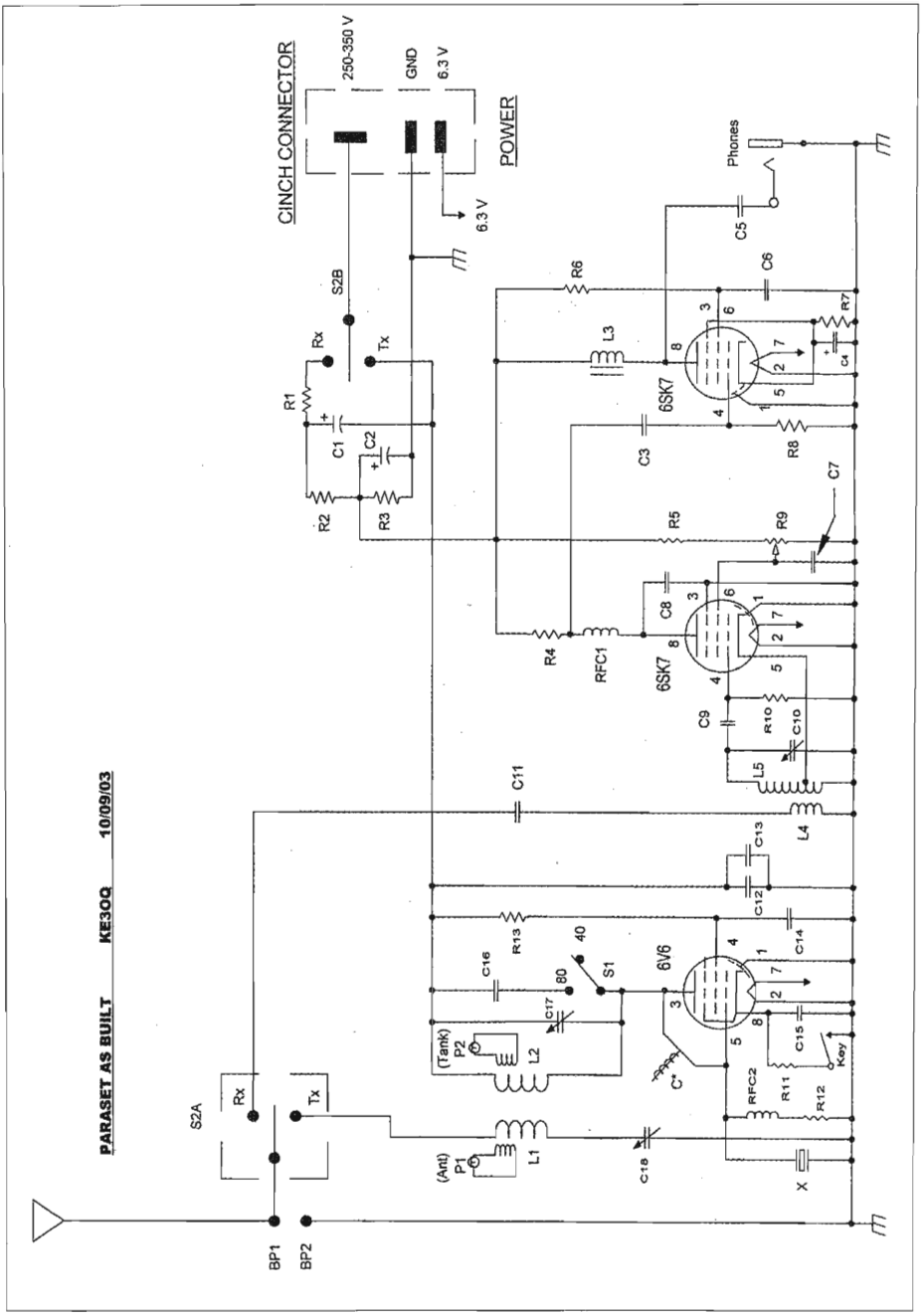
The transmitter employs a single 6V6. It is a crystal-controlled circuit and loads very well into every antenna I have, producing about 5 to 7 watts output. I used a micro-switch as a key with a small knob attached directly to the switch actuator arm. The original spring arm is too soft for comfortable keying and I plan to replace this arm with a stiffer piece of metal in the near future. There are two small pilot lights attached to pickup coils mounted inside the antenna and tank coils for proper tuning adjustment. These work very well for maximum power transfer indication.

The power supply I used is a receiver type with about 260 volts output. The filaments are 6.3 volts and a 3-wire cable and Cinch connector make the hook-up cable. I believe you can increase the HV to about 350 V with no problem and probably obtain higher transmit output. Care must be exercised around these HV supplies to avoid serious shock damage.



The Paraset transmitter/receiver is built in a homemade aluminum case.

The parts all came out of my junk box collection. I hand fabricated the metal pieces to the dimensions found on the web site using 16 ga aluminum. The chassis/panel can be formed in a vise if care is taken making the bends. I scored the break lines with a scratch awl before attempting the break and found the resulting edge was very square with the fold following the impression. The coils were wound on plastic forms using a 1-inch diameter pill container for the RX coil and a 1.5-inch diameter sink drain tube for the TX coil. The dial used is an old National vernier type and the control knobs are military surplus. I believe the original dial was a National Type K with the friction wheel mounted to drive the dial but the use of the vernier dial makes mounting and ad-



Complete as-built schematic of the 3-tube Paraset clandestine transceiver. (See the parts list on page 16.)

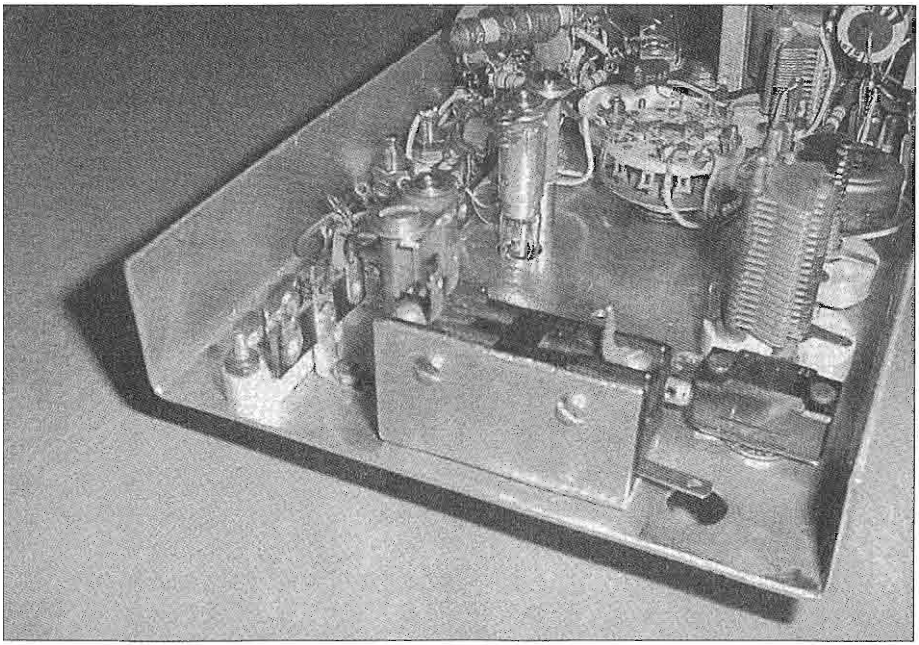
PARTS LIST

R1 1.5k: 1W
R2 10k: 3W
R3, R4, R5: 100k
R6: 75k
R7: 250 ohm
R8: 250k
R9 20k pot
R10: 1 meg
R11: 200 ohm
R12, R13: 20k

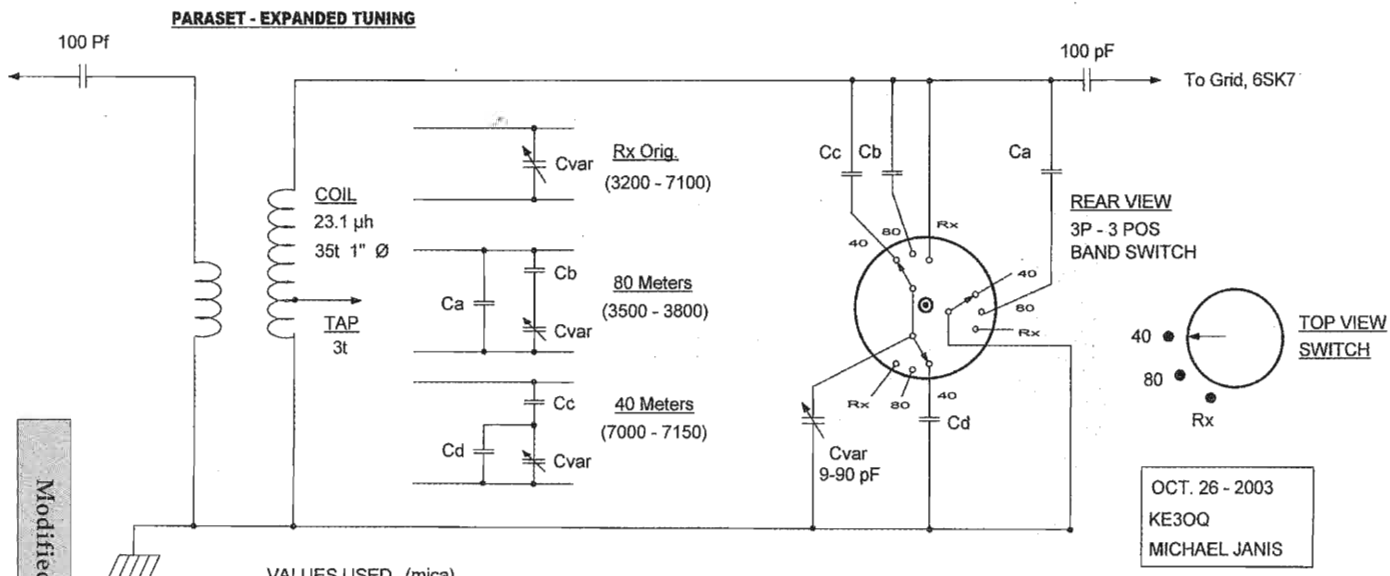
C1, C2: 22 µfd, 450 V
C3: .01
C4: 25 µfd, 25 V
C5, C6, C12: .1
C7: 2 µfd, 200 V
C8, C9, C11, C16: 100 pf silver mica
C10, C17, C18: 100 pf variable
C13, C14, C15: .002
C*: 2 twists (gimmick capacitor)

RFC1, RFC2: 2.5 mH
L1: 1 ½" dia, #22, 22 turns, 7/8" long
L2: 1 ½" dia, #16, 18 turns, 1 1/16 long
(L1 spaced 5/16" from L2)
L3: 15-40 Hy choke
L4: 1" dia, #22, 4 turns, 1/8" long
L5: 1" dia, #22, 35 turns, 7/8" long, tap at 3t from gnd, space L4 to L5 at 1/8".

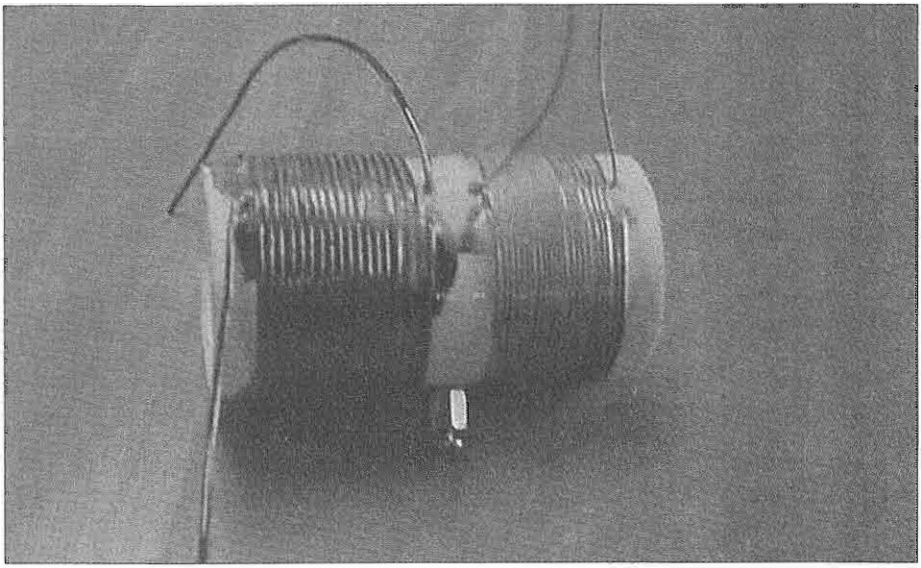
P1: 28 V pilot lamp
P2: 14 V pilot lamp
Pickup coils: 2T, #16 inside L1 & L2 at hot ends.
BP1: Antenna binding post
BP2: Ground binding post
X: crystal
S2: 2 pole, 2 position, N
S1: 1 pole, 2 position, N



The microswitch which acts as a CW key is shown here at the very end of the chassis. It is activated by pushing the lever with a pencil through the chassis hole at the right.



Modified tuning schematic



A closeup view of the tank coil shows how it is wound on an old pill bottle.

justment very easy.

The initial trials went well, with the receiver coming to life immediately. Plenty of signals were present with good sensitivity but poor selectivity as expected. The regeneration control was surprisingly very smooth and well controlled. The transmitter gave a bit more trouble due to a bad tank tuning capacitor but once changed the unit took right off.

This radio is a lot of fun to use as originally designed but I plan to do some experimenting with this set to see if the operation can be optimized. I plan to change the grid leak to a higher value to see if it will make the detector more sensitive as well as fit a small variable capacitor to match the antenna more efficiently on receive to avoid dead spots when tuning with some antennas. Receive volume is not as strong as I would like and I want to add another output stage, possibly changing the second 6SK7 to a dual function tube which would provide a power output stage. As there are a lot of ER readers out there who are experienced with these old designs, I would appreciate any feedback and comment on this historic radio.

This was an interesting project and several photos and the schematic are attached for reference. Typing "PARASET" into your Internet search engine and going to the GREY-GREEN site can access the web site on the Internet.

ER

The Gonset Super-Six Plus Receiver

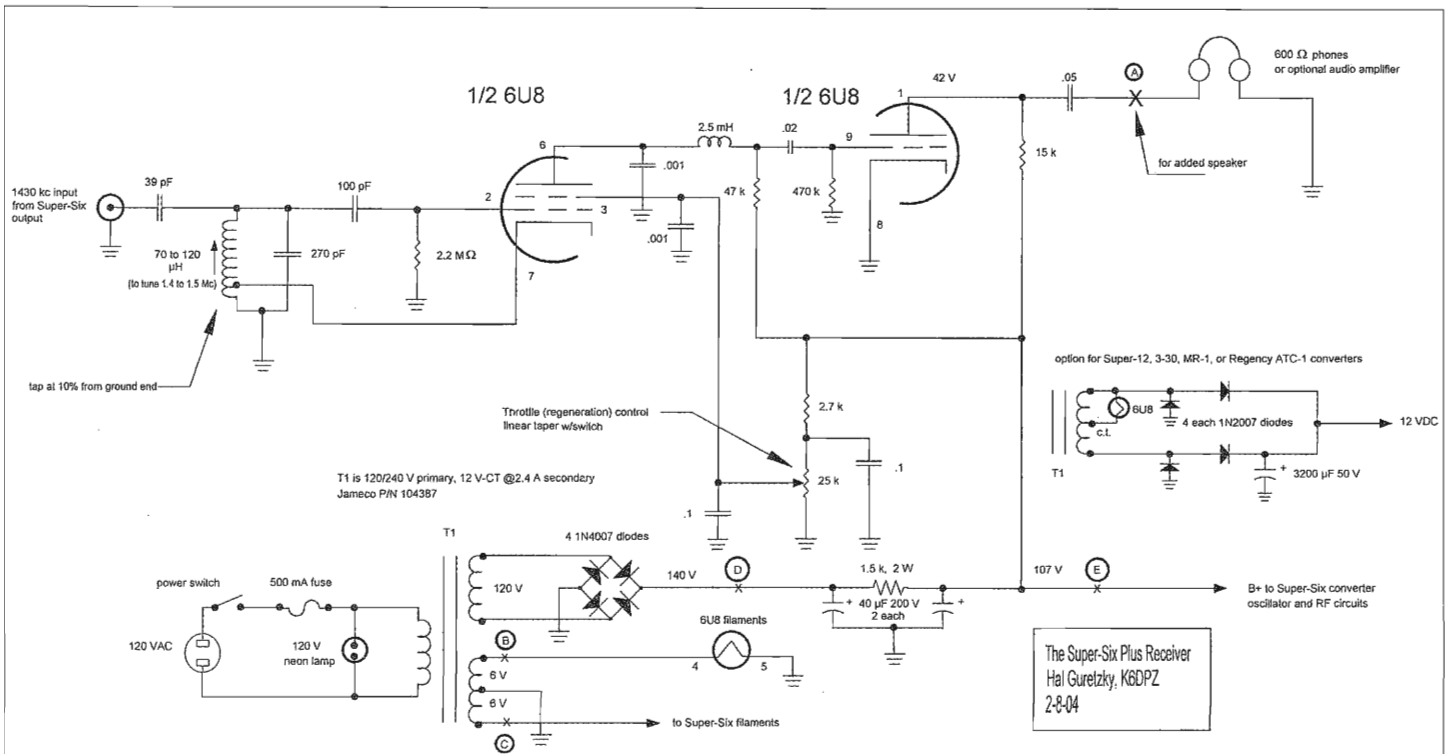
By Hal Guretzky, K6DPZ
Land Air Communications
95-15 108th St.
Richmond Hill, NY 11419

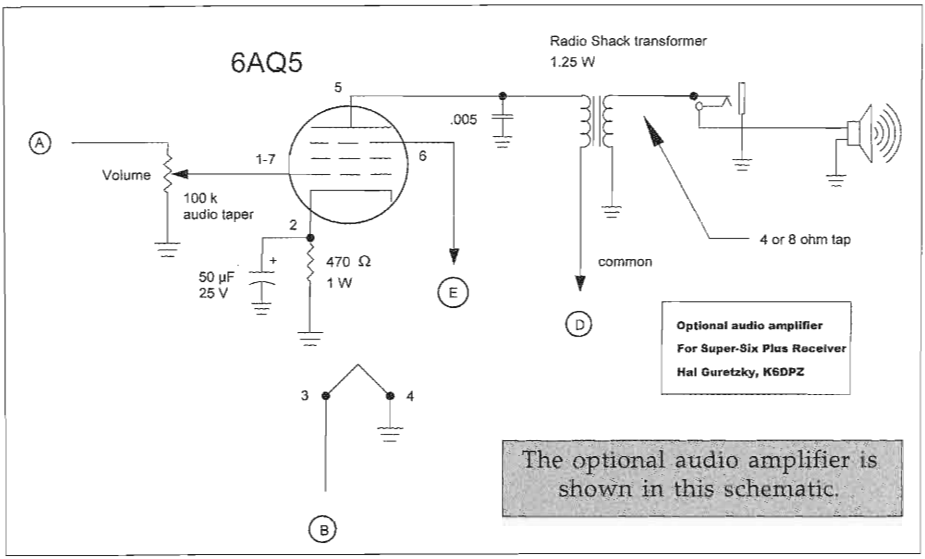
The Gonset Super-Six converter was introduced in the late 1950s and was designed to be used mobile in your vehicle. It covered the HF Ham bands and was intended to be used ahead of your auto radio, and produced a 1450 kc output. Quite a few of these have been showing up at Hamfests and other places, and today they are "orphaned" because the electrical systems in cars are totally different from what we had in 1959. There are many of these converters around, and one day I got to thinking about the possibility of using one as a complete receiver.

The Gonset Super-Six is a complete tuneable front end, and the only thing lacking is the superhet receiver and audio output. I thought about using a portable AM radio, but the lack of a BFO made me decide to use a regenerative detector and single-stage audio.

I designed a detector around the common and reliable 6U8 pentode-triode. The pentode section is the regenerative detector, and the triode is a conventional single-stage amplifier. Also included is a simple power supply to run the Super-Six converter and the Super-Six Plus receiver. The receiver and power supply are built into a plastic Radio Shack box that also serves as a pedestal for the converter. The completed unit works well, and receives AM, SSB, and CW. The sensitivity is

A front view of my Super-Six Plus receiver shows how I have mounted it on top of a Radio Shack plastic project box. This receiver has worked well for me.


1/2 6U8
1/2 6U8
1430 kc input from Super-Six output
39 pF
70 to 120 µH (to tune 1.4 to 1.5 Mc)
tap at 10% from ground end
270 pF
100 pF
2.2 MΩ
2.5 mH
.001
.001
.02
47 k
470 k
42 V
.05
15 k
600 Ω phones or optional audio amplifier
for added speaker
option for Super-12, 3-30, MR-1, or Regency ATC-1 converters
6U8
c.t.
T1
4 each 1N2007 diodes
12 VDC
3200 µF 50 V
Throttle (regeneration) control linear taper w/switch
2.7 k
25 k
.1
.1
T1 is 120/240 V primary, 12 V-CT @2.4 A secondary
Jameco P/N 104387
T1
4 1N4007 diodes
power switch
500 mA fuse
120 VAC
120 V neon lamp
120 V
6U8 filaments
6 V
6 V
to Super-Six filaments
140 V
1.5 k, 2 W
40 µF 200 V 2 each
107 V
B+ to Super-Six converter oscillator and RF circuits
The Super-Six Plus Receiver
Hal Guretzky, K6DPZ
2-8-04



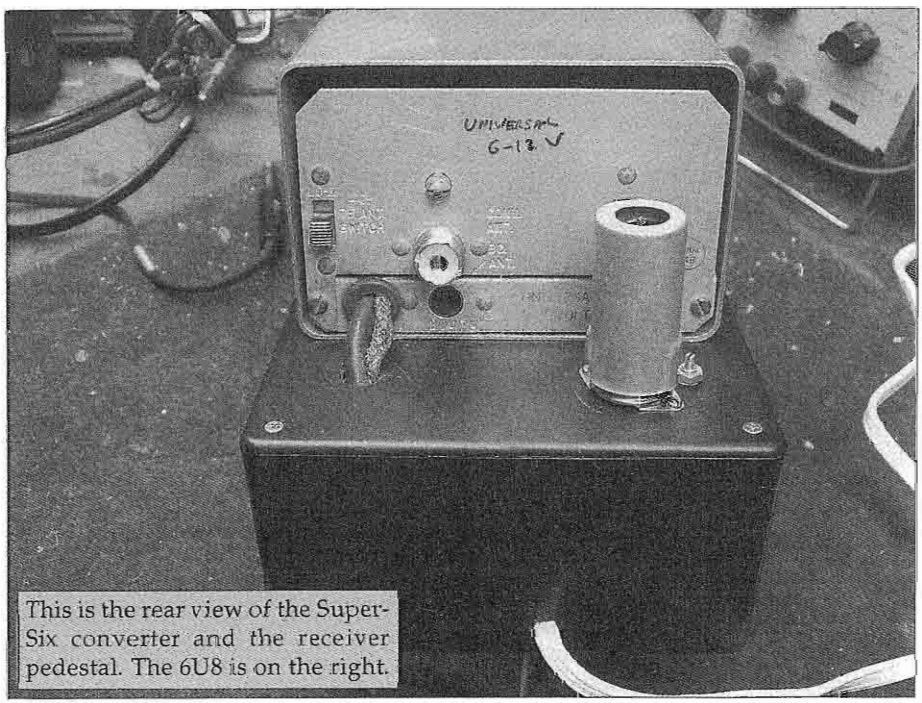
The optional audio amplifier is shown in this schematic.

under 1 microvolt!

The power supply uses a dual primary transformer, with one primary winding wired as a secondary. An optional audio amplifier is shown above for use with a speaker. Another option for T1 is provided for use with the Super-12 converter which used hybrid tubes in a 12-volt configuration.

I hope this receiver is as much fun for you as I've had with it.

ER



This is the rear view of the Super-Six converter and the receiver pedestal. The 6U8 is on the right.

Restoration of a Central Electronics 600L Amplifier

By Bob Sullivan, WØYVA
PO Box 579
Great Falls, VA 22066

One of the neatest amplifiers ever built was the Central Electronics (CE) 600L. Its claim to fame was, like the "matching" CE 100V and 200V transmitters, that is was broad-banded – no tuning necessary. Just select the band and you're ready to go. No big deal today but this amplifier was made in the late 50's! The amplifier utilizes a single 813 positioned horizontally. As you might expect it is a very heavy boat anchor.

These amplifiers are hard to find – not many were made. I was lucky to find one and even luckier to talk my good friend, W7AL, into driving 2000+ miles to pick it up and deliver it to me at Dayton. The amplifier looked okay but as is always the case with this old stuff, a close inspection revealed some problems – the cabinet had been repainted the incorrect color, the entire unit was filthy, some of the silk screening was worn off, and most distressing of all, circuit changes had been made and it looked as if a few items were missing!

The article will chronicle the restora-

This oblique view of my completed 600L amplifier shows how nice the refinished cabinet came out, and the polished front panel.

tion of this amplifier and lay out some of my favorite techniques.

Since I noted early on that some changes had been made to the amplifier I decided not to power it up prior to restoration. The last thing I wanted to see was fireworks! I was lucky enough to get a manual with the amplifier. I made a "bench" copy to work with so that the original would not be damaged.

My first step was to disassemble the amplifier as much as practical in order to clean and inspect.

HINT #1: Use a digital camera to take close-up photos of everything prior to any disassembly. Contrary to what you might think you WILL forget what goes where!

The unit was removed from its cabinet (which was set aside for later painting). Knobs and tubes were removed, followed by the front panel, meter, the large oil filter capacitor, both toggle switches (that had been replaced with improper styles), fans. The amplifier is fairly "open" so at this point I could pretty much see everything. Next step was cleaning.

HINT #2: I cleaned just about everything with a 50-50 mixture of 409 and household ammonia and/or alcohol.

At this point I did resistance checks on the transformers. If one was bad, I wanted to know early so that it could be rewound or replaced. If you have a megger or hipot tester use it on the transformers to confirm there are no insulation problems.

After removing the front panel it was carefully cleaned so as not to disturb any of the silk screening. Some of the bandswitch markings had been rubbed off by the knob rubbing against the panel. These were repaired with dry transfers and burnished into place. The panel was then given a light coat of furniture oil which gives it a "new" look.

The large multimeter and knobs were cleaned and polished using a light polishing compound and set aside for later assembly. They now looked like new.

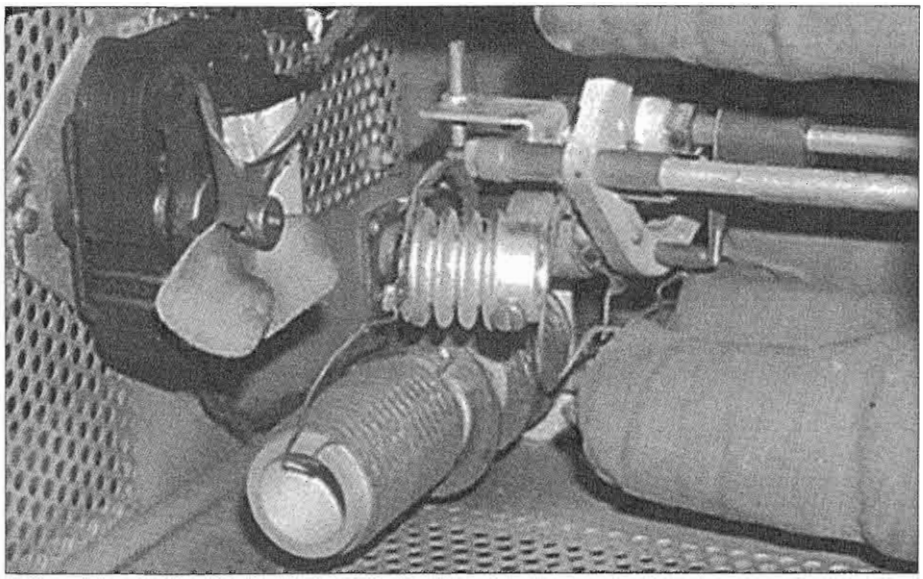
The chassis was cleaned using rags and cotton swabs (get the ones with the 6" wooden extension). This is a time-consuming but very rewarding process. Be prepared to spend hours. Clean everything! Metal, components, wire harnesses, sockets, connectors.

HINT #3: If you have an air compressor, use it. I set mine at about 60 pounds pressure and prior to cleaning. Carefully blow loose dirt and dust from everything.

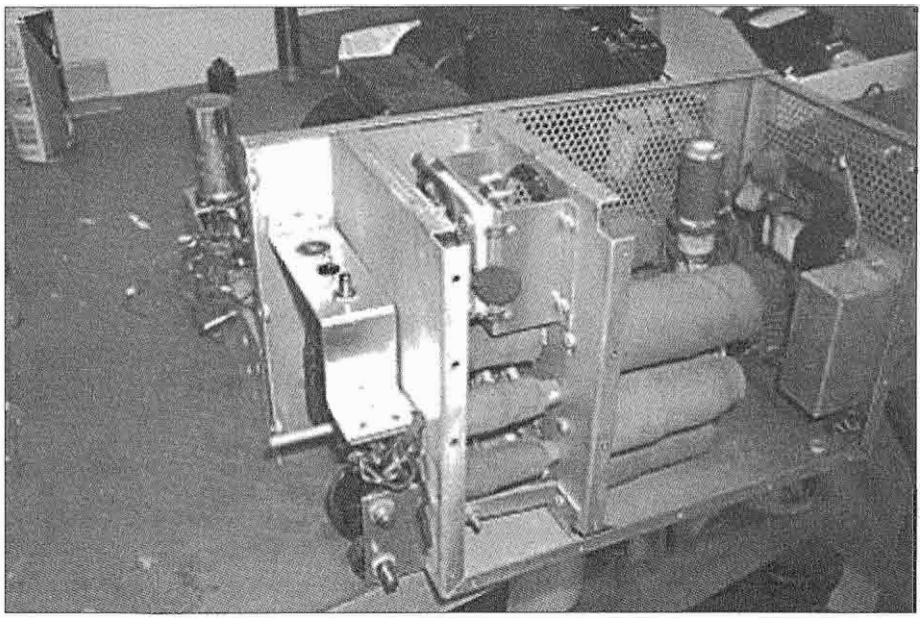
After everything is cleaned up it was time to start looking at the circuitry and components themselves.

Relay contacts were burnished, switches were cleaned with DeOxit.

I found, to my dismay, that someone had removed all the circuitry associated with the "high SWR" protection including a hard to find telephone-type

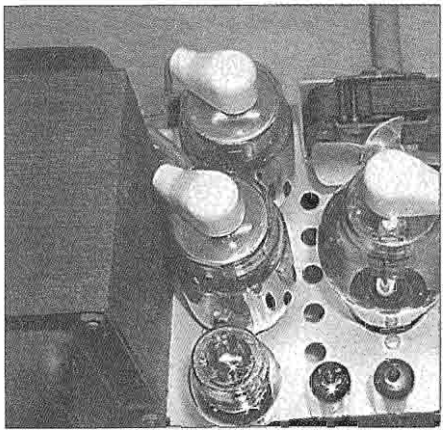


The photo above is how the PA compartment looked before restoration was started. Compare with the photo below to see how nice the metalwork and components came out after the cleanup was done.



relay. Fortunately for me Tusa Consulting had a replacement (Thanks, Nick!). Following the schematic, this circuitry was restored to original along with a few other "changes" that – for some unknown reason – had been made along the way.

A couple of selenium rectifiers are used – these were replaced with 1N4005's (and the original selenium



The restored power supply area looks like new!

unit kept place to make it "look right." (not that anyone would ever see it).

The bias supply uses a couple of small electrolytics – these were also replaced.

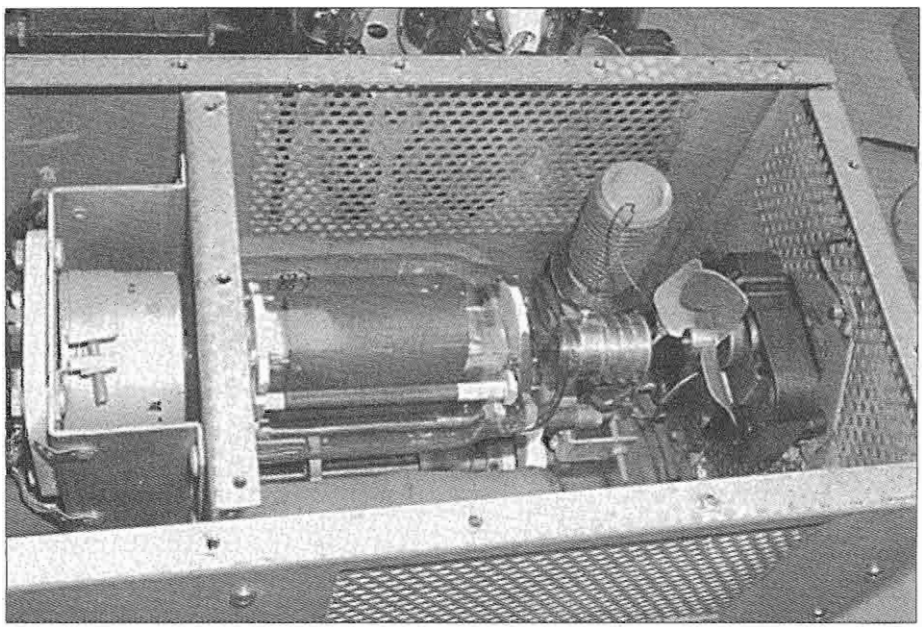
Finally, a new line cord was installed replacing the original with no guard ground.

I carefully checked ALL wiring against the schematic and made corrections as necessary. It was not clear to me why some of the changes were made but I assumed "original" was best.

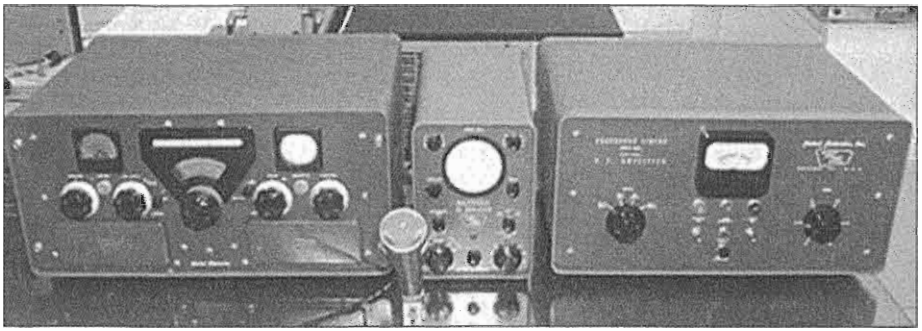
I did some testing before reassembling the panel and side plates since these cover up a lot of wiring access. After carefully dressing loose leads out of the way and performing a few resistance checks to ensure no surprises, I applied power but without any tubes in place. No fireworks – so far, so good. I then installed the voltage regulator tubes and HV rectifiers (but no 813 just yet). HV and bias voltages were checked okay. The trip circuitry for high SWR was also checked.

At this point reassembly was completed. Side panels, front panel, knobs, meter, etc. Reassembly was easy thanks to the photos I took during disassembly. Lastly, the 813 was installed.

Time to see if the 600L would make RF. I used an FT-1000MP as an exciter and carefully applied drive on each



A shiny 813 is reinstalled in the PA cage, and waits for its voltages to be applied.



This is how my restored Central Electronics station looks. Left to right, 200V transmitter, MM1 station monitor, and the 600L linear. An Electro-Voice 667 microphone completes the station. View below is underneath the chassis.

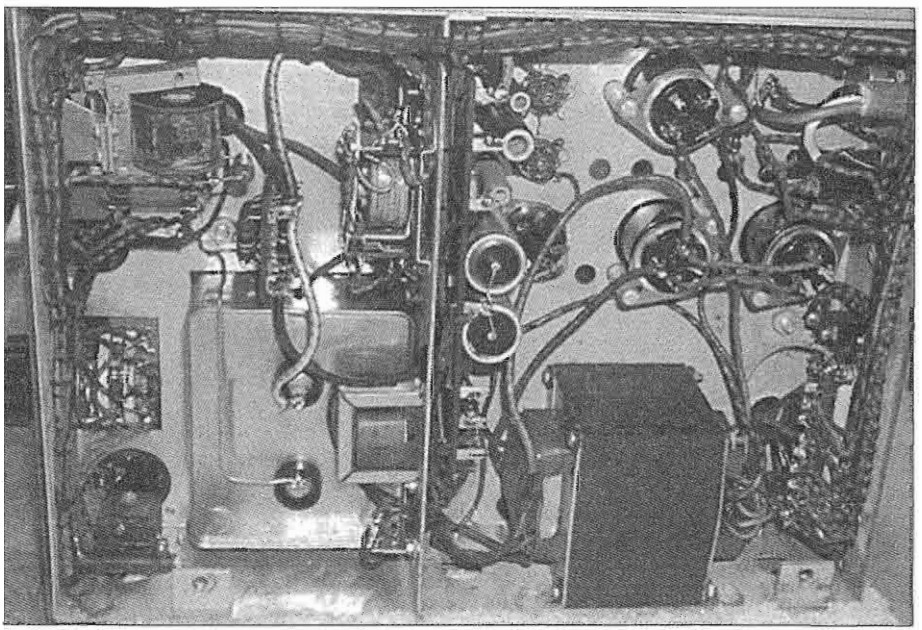
band. Everything worked perfectly – a few hundred watts on all bands 160 through 10. This was a very satisfying moment.

During the restoration process I had the cabinet sent out to be blasted and repainted. Boy, did it look good – the original CE grey paint and texture is easy to match. Many custom auto-body shops can help you out with this.

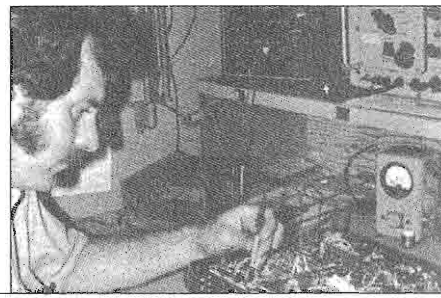
The 600L now sits beside by my restored Central Electronics 200V – they make a good looking pair. Operating them is enhanced by the fact that I lovingly "brought them back to life" myself.

I strongly recommend you think about restoring something yourself. The process is very enjoyable. Obviously the more tools and equipment at your disposal the easier and more complete the process can be but even with basic tools you can do a fairly good job. Pick something that is consistent with your own abilities.

73, Bob, WØYVA **ER**



The Restoration Corner



Viking Valiant Meter Shunts
By Ray Osterwald, NØDMS

The Johnson Viking Valiant is a popular and fairly common AM and CW medium-powered transmitter. Many have been returned to the AM frequencies over the last decade, and many more are waiting restoration. One area that has not been discussed much is the metering circuits which are used to adjust the PA plate, PA grid, and modulator currents.

These shunts need to be fairly accurate in order for the modulator in the Valiant to work properly. If the plate current isn't adjusted to the rated value, the load resistance presented to the modulator--the modulating impedance--will be too low or too high. This will cause undermodulation or overmodulation. If the grid current and modulator current is not within limits the modulation characteristic of the RF output will not be linear.

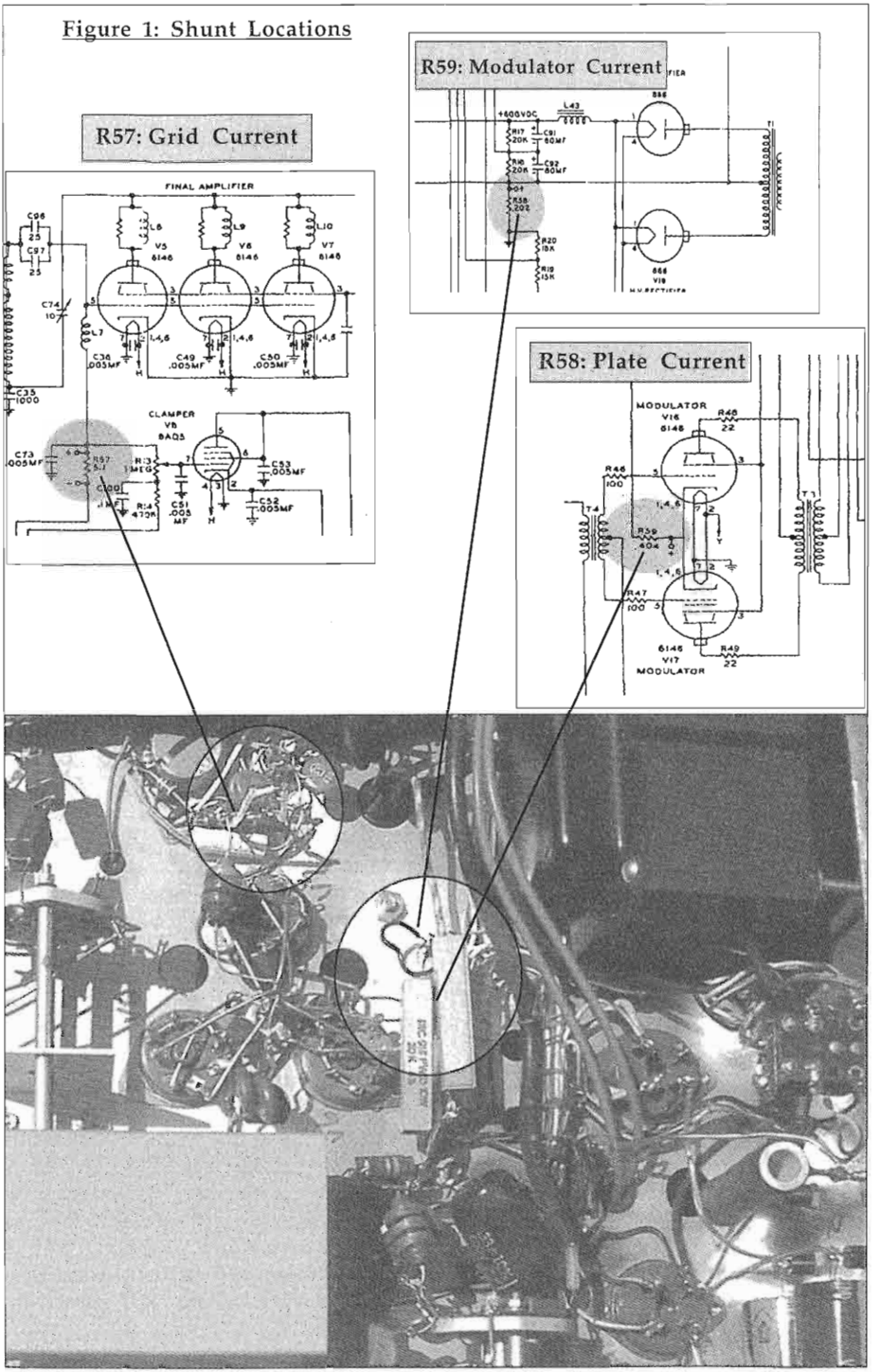
The value for R57, the grid current shunt, is 5.1 ohms at 5%. The value for the modulator shunt is .202 ohms and for the plate current it is .404 ohms. We can assume the shunts need to be accurate to 5% or less. R57 was originally a carbon composition resistor. In every Valiant I've seen, it has drifted up in value, and 30 or 40 ohms is not unusual. The other two shunts are made from precise lengths of high-resistance steel wire.

By checking the actual values of the modulator and plate currents with an ammeter known to be accurate, I have found variations of 30% from what they should be. I removed R59 (.404 ohms) and R58 (.202 ohms) and checked their values on a General Radio resistance bridge which is accurate to 1/10 of 1%. I found out that the length of wire provided by Johnson is exactly right for the given resistance, but they had been installed improperly, and these were factory-wired transmitters.

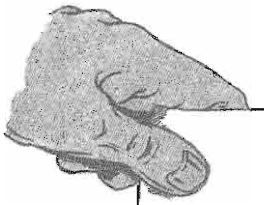
I checked to make sure that the multimeter in the Valiant was free in its pivots, and that it had the rated full-scale deflection of 5 mA. With an accurate ammeter, I adjusted the length of the wire shunts where they are soldered to the terminal strips. I found that an error of 1/32" will cause large errors in the plate and modulator current readings. Originally, both ends of the shunt wires were wrapped around the terminal strip pins and soldered in place. I found that it is necessary to leave one end attached and adjust the length of the shunt with the other end by sticking it into a hot blob of solder.

In Figure 1 on page 28 the locations of the shunts are shown. R57 is mounted across two tie points, R59 is clearly shown, but R58 is underneath the 20k power resistor. R57 should be replaced with a 5% metal film resistor.

Figure 1: Shunt Locations



Mailbag



To:
Electric Radio
PO Box 242
Bailey, CO
80421

Dear ER

The monthly listing of "Vintage Nets" in Electric Radio includes the following announcement under Arizona AM Nets, second line from the top: "Tuesday, 2M 144.45 7:30 PM MST." The AM two-meter Net is nine years old. It is the product of AM aficionados who live in the metropolitan Phoenix area. Participation over the years has been enhanced through the circulation of fliers at local swap meets, notices at club meetings, and word-of-mouth exhortations. Its visibility was heightened, too, when publications of the Frequency-Coordination Committee of Arizona Repeater Owners specified 144.450 MHz to be for Arizona the "official," coordinated, AM simplex, Net/calling frequency.

The Net functions informally via a roundtable format. The first station to announce its presence at 7:30 PM usually assumes responsibility for setting up an orderly rotation of members as they "check-in." Social and technical issues are discussed spontaneously and randomly. Most of the rigs in use are over 40 years old, so any matter pertaining to frequency stability, audio quality, operating efficiency, etc. commands priority attention. Indeed, a major intent of the net is to encourage the acquisition, restoration, and utilization of vintage two-meter equipment for the purpose of preserving the heritage of this equipment and AM!

Conventional net routine took a novel twist one evening several weeks ago when NE7X invited participants to join him for lunch, on his day off from work, at a local restaurant. Six members rendezvoused with Tom, and in a moment of euphoria, he asked a waitress to photograph the group. The picture appeared shortly thereafter on page 9 of the January 2004, issue of ER. Spirited discussion during ensuing roundtables led Net participants to wonder whether two-meter AM nets were functional elsewhere and, importantly, to speculate about whether ER readers might be interested in the equipment that net members are using. They reasoned that should AM two-meter nets not be flourishing in other metropolitan areas, awareness of our circumstances might inspire AM enthusiasts to organize them in their communities.

Thus motivated, we surveyed each of the regular participants in our net to obtain the following data: (1) when and where each participant first engaged AM two-meter operation; (2) current transmitter and power input; (3) current receiver; and (4) current vertical antenna and its feed-point above ground. The results of surveying sixteen net participants are presented below alphabetically by call letters:

K7AK: 1945, Pasadena, CA; Clegg Zeus, 185 watts; Clegg 22'er, MK II; Ringo Ranger, 25 feet.

K7CAX: 1962, Phoenix, AZ; Poly-Comm "2" transceiver, 18 watts; homemade ¼ wave, 30 feet.

K7IEB: 2003, Glendale, AZ; ICOM IC-746pro transceiver, 40 watts; Diamond XM-7, 25 feet.

K7SA: 1969, Minneapolis, MN; Heathkit Seneca, 25 watts; National NC-303 with National VHF converter; Diamond 5/8 wave, 30 feet.

K7SC: 1958, Chicago, IL; Clegg 22'er transceiver, 22 watts; Diamond 5/8 wave, 25 feet.

K7TOP: 2003, Scottsdale, AZ; ICOM IC-746 transceiver, 40 watts; Comet CX-33, 47 feet.

KC7BGE: 1995, Phoenix, AZ; Bendix BC-640, 12 watts; Bendix-639; Copper J-pole, 40 feet.

KO6SM: 2001, Phoenix, AZ; Johnson 6N2 modulated by Johnson Valiant II, 60 watts; Drake SC-2 converter, part of Drake CC-1 6N2 receiving converter with a Drake 2-C receiver; Homebrew ¼ wave ground plane, 20 feet.

N7RK: 1968, Tustin, CA; Hallicrafters SR-42 transceiver, 25 watts; Ringo Ranger, 25 feet.

N7TPJ: 1997, Scottsdale, AZ; Gonset Communicator IV transceiver, 20 watts; 3-element Yagi, 55 feet.

NE7X: 1964, Toledo, OH; AMECO TX62 driving Gonset amp. w/826s, 160 watts; Lafayette HA-350 with AMECO CN-144 VHF converter; Comet 5/8 wave; 20 feet.

W1ZD: 1956, Boston, MA; Johnson 6N2 w/Johnson Valiant as modulator and power supply, 60 watts; Hammarlund HQ160 with Johnson 6N2 receiving converter; Ringo Ranger, 70 feet.

W7CCC: 1957, Columbus, OH; Clegg 22'er driving Gonset 903A amp. 400 watts;National NC-303 with National VHF converter; Comet GP/GP-9N, 35 feet.

W7GMK: 1968, Tucson, AZ; Clegg 22'er transceiver, 20 watts; Homebrew 4-element Beam, 20 feet. [W7GMK's antenna is about 125 miles from Phoenix; however, it is situated at the base of a Tucson TV transmitter antenna; both are at the top of Mt. Lemon (8,100 feet). The location affords W7GMK a line-of-sight path to every AM two-meter station in metropolitan Phoenix.]

W8QYT: 1955, Fairview Park, OH; Johnson 6N2 w/Johnson Ranger as modulator and power supply, 40 watts; Drake R8A with Drake VHF converter; Arrow dual-band J-pole, 50 feet.

WAØKDS: 2003, Phoenix, AZ; Clegg 22'er transceiver, 22 watts input; 5/8 wave, 55 feet.

The survey data reveal substantive differences within nearly all the categories. More than a half-century separates the earliest and latest two-meter devotees; transmitter power input ranges from 400 watts to a floor of about 20 watts [the Phoenix terrain precludes the regular use of such very low-power transmitters as the Heath "lunchbox"]; and no consensus can be derived, respectively, from the myriad transmitters, receivers, and antennas. On the other hand, every net participant is using either a relatively vintage or a relatively modern manufactured rig. No one as yet has brought forth a homebrew transmitter or receiver. Such an event is surely on the horizon, nevertheless, as the Phoenix AM two-meter net continues to evolve.

Tom Boza, NE7X, TOM@ne7x.com
Bob Grinder, K7AK, atreg@asu.edu
Jim Riff, K7SC, K7SC@cybertrails.com

Dear ER,

I was delighted to see K2ORC's article on the series modulated 75m transmitter in the March issue of ER. These little rigs can be tremendous fun, and anyone who hasn't tried one should dive in and have a go! Having studied

the pro's and con's of such designs in the past, I would just like warn potential builders of a few pitfalls, and also advise them of some improvements that might be made.

There seemed to be no mention of the quiescent anode voltage of the modulator tube in the article. You may be tempted to set this at half HT using the string of diodes in the cathode circuit, but I would advise you to set the voltage above this by at least 25 to 50V, to give you near 100% positive modulation and less stress on the modulator screen grid. When the modulator tube anode is being driven low, the screen current soars at anode voltages of around 50V or less, and if your peak modulation is only 80% you might try to talk the modulation up more than you would otherwise, and overheat the screen. It's best to set the quiescent anode voltage of the modulator high and accept a slightly lower power output, as well as adding a 10k resistor in series with the screen to limit its current and power dissipation. The bias diodes in the modulator tube cathode circuit do not experience high reverse voltage, or high forward current, so 1N4001 diodes are ok in this application.

In a series modulated transmitter, the peaks of voltage on the modulator anode can cut off the oscillator, particularly with sluggish crystals. This causes terrible 'spitch' on adjacent channels, and should be avoided at all costs. My solution to provide near 100% modulation and limit screen dissipation actually makes this problem worse, and I always used some negative cycle loading to get around this problem. This can easily be incorporated using a 39k (0.5 or 1W) resistor in series with a UF4007 diode between the modulator anode and the 350V supply (cathode of diode to 350V). By juggling the value of the 39k resistor (lower usually) and the quiescent anode voltage, you can adjust the circuit for the best modulation percentage without stopping the oscillator during troughs of modulation.

Incidentally, I used a metal 6L6 modulator tube in the series modulated transmitter I built. It's better able to take the higher voltages, and has the advantage of already being screened. I added a crude modulation indicator as well. This was just a 250V neon (internal 270k resistor) in series with a 1000pF 1kV capacitor, also connected between the modulator tube anode and the 350V supply.

Finally, the 100pF cathode capacitor in the oscillator circuit of the K2ORC design can experience peaks of over 650V across it, and should really be rated for 1kV.

73, Dave Gordon-Smith (G3UUR).
18th March 2004

Dear ER,

You should mention the new character proposal that the ITU has made for the @ symbol which will go into effect this summer. The @ is presently represented by leaving a space and sending A and T and then another space. (big space DiDah space Dah big space) . This is confusing because it sounds like a W or A and T.

The new symbol will be DiDahDahDiDahDit .

This is the first significant change to the code since the 1930's.

The ITU is the International Telecommunications Union which has a UN working group active in communications regulatory issues. The spokesman is Gary Fowlie.

ARRL had an article as well on the issue:

http://www.arrl.org/news/stories/2003/12/10/2/?nc=1

Thanks,

Mike Murphy, WB2UID

New Book Review: HEATHKIT, A Guide to the Amateur Radio Products, by Chuck Penson, WA7ZZE

By Brad Stone, NB9M
PO Box 521
Morgantown, IN 46160

Most Electric Radio readers have fond memories of Heathkit products, which often seemed to be the only ones within economic reach in our youth. Undoubtedly, Heathkit contributed by giving us entrance into a field that would later affect our lives in a variety of ways. My father once drug home a rusty, non-working GW-10 Heathkit Citizens Band transceiver from the county dump for me to play with on the bench in the cellar. Later, a kindly local WTTV broadcast engineer let me take home an AR-3 receiver. That was nearly 40 years ago – and I still love to own, operate and maintain Heathkits. So, when Roger, W9BZ, loaned me the First Edition of *Heathkit A Guide to the Amateur Radio Products*. I blocked off a couple of delightful evenings to read it from cover to cover.

The Second Edition is still thoroughly enjoyable to browse, and it contains even more useful, targeted information for the radio amateur. Chuck's writing style is smooth and conversational. The pictures are crisp and large enough for aging eyes. Though the Heath Company made many kinds of consumer electronics products, Chuck decided to focus on those specific to the radio amateur. As a result, Chuck reverently makes room for product observations, hamfest experiences and assembly/operation warnings.

Chuck begins with details the history of the Heath Company, from its beginnings as a war surplus vendor to its present incarnation as a provider of educational and training materials. Chuck spends considerable time revealing the thoughts of the engineers as he walks the reader from first transmitter, through the famous "SB" line, to the troublesome end. For veterans in consumer electronics, the sad story of the Heath Company's purchase by Zenith and its subsequent demise is all too familiar.

Next, the author spends some time on buying and collecting Heathkits. The reader will find lots of good advice on what you can expect searching for Heathkits online and at hamfests. Of course, being older kits that are built by people with varying levels of skill and experience, Chuck has lots of advice for the collector regarding parts availability, construction quality variability and commonly found issues - down to specific models.

Finally, Chuck takes us through a pictorial guide to Heathkit amateur radio receivers, transceivers and accessories. Subtle differences between models and production runs are noted. Descriptions are complete, often occupying more than one page. You'll also find Citizens Band transceivers listed. The author doesn't pull any punches about the troublesome products, like the SB-104 and HW-2026. However, it's great fun reading about the successful monobander series, the "SB" line and the venerable HW-100 and HW-101. You'll see the products you have owned and currently own – as well as those you wish you never had

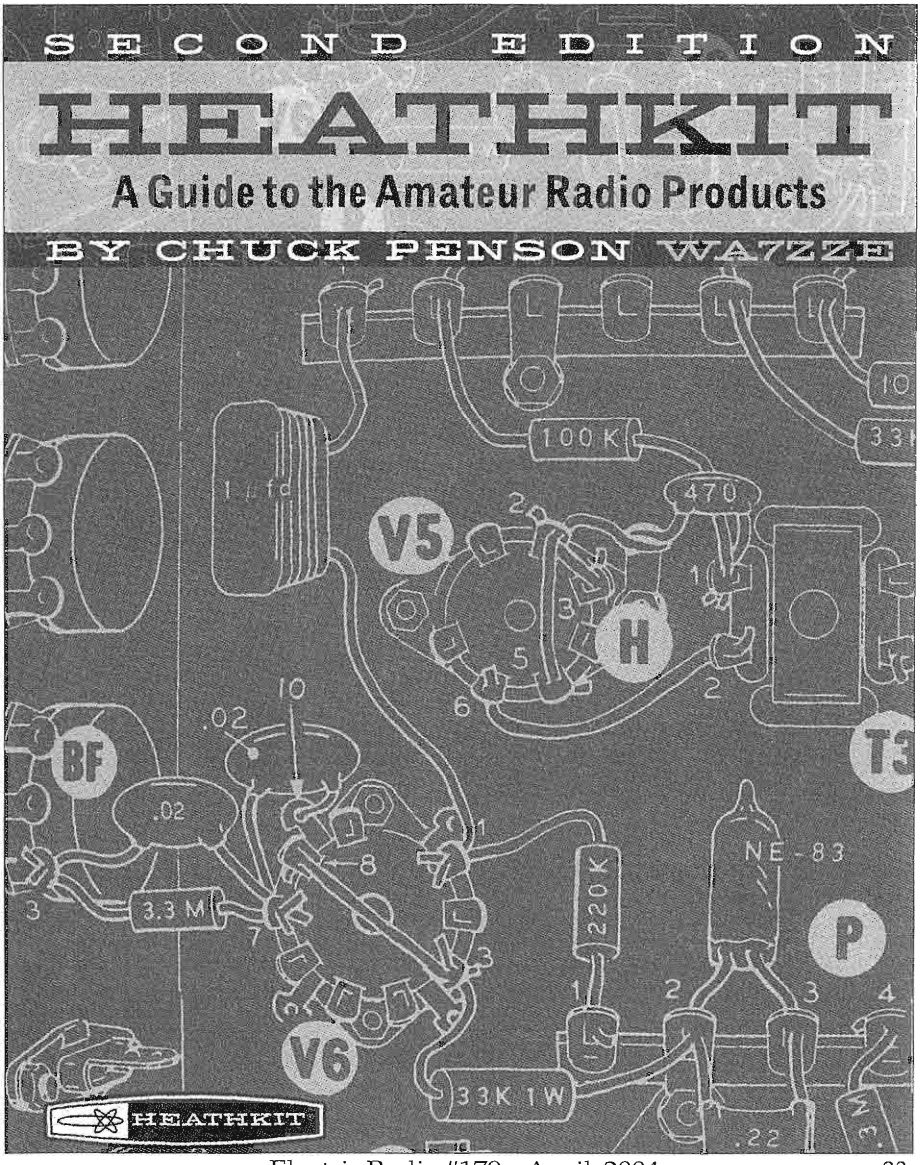
"let go."

At the end of the book you'll find a product index by product type and model number, as well as a handy matrix report showing what tubes were used in various models.

Heathkit A Guide to the Amateur Radio Products Second Edition by Chuck Penson is a valuable resource for the collector, has a place alongside *Radios by Hallicrafters* (Chuck Dachis) and *Shortwave Receivers Past and Present* (Fred Osterman) in my vintage ham shack.

[Available from the ER Bookstore--Ed.]

ER



AM International Update, April 2004

By Dale Gagnon, KW1I

Dayton Hamvention – The AM Forum will be held on Friday, May 14, 2004, at 3:15 pm in Meeting Room #2 at the Hara Arena in Dayton, Ohio. The program will feature a segment on the people, rigs, events and issues of the AM community in the Great Lakes area presented by Steve, W8TOW. There will also be a short segment on AM International, status and operating news and a transmitter restoration project segment. The annual Hamvention gathering of AM ops for pizza at Marion's Restaurant in Dayton will be, as usual, on Saturday at 7:00 pm. See May ER for more information, or better still attend the forum and find out first hand!

New AM International Regional Directors – Steve Marquie, W8TOW has agreed to serve as the Great Lakes Region Director replacing Harold Parshall, N8FRP who became a silent key last year. Dennis DuVall, W7QHO has agreed to serve as Southwest Regional Director. Randy Starace, KK7TV passed the baton to Dennis earlier this year. Many thanks to Randy for his years of service to AMI.

FCC Invites Comments on Restructuring Proposals – The FCC is seeking comment on three plans that would reshape the Amateur Service licensing structure. While differing substantially in many aspects, the three rule making petitions call for modifications at Amateur Radio's entry level and for a three-tiered license system. [RM-10867 (ARRL), RM-10868, RM-10870] A fourth petition focuses solely on the Morse requirement [RM-10869]. Comments are due by April 24 on all four petitions. If you miss this time frame, there will be an additional time frame for replies to comments. Interested parties may view and comment on these petitions and comments via the FCC Electronic Comment Filing System, www.fcc.gov/e-file/ecfs.html. (When entering the RM number in the ECFS "Proceeding" field, RM must be in capital letters and the hyphen must be included.)

Amateurs Operate AM from W1AW – Joe, WB6ACU and Bob, K9EID operated W1AW in Newington, CT on AM for most of a Saturday night recently experiencing some significant pile-ups. This event coupled with the new ARRL publication, "Vintage Radio" is showing encouraging ARRL awareness of the AM segment of the hobby.

AMI Northwest Region News – Pat, K7YIR sent in the following items. KL7OF of Tum Tum, WA near Spokane held the first annual "Tube Shoot". See the results at http://www.qsl.net/k7rld/Tubeshoot.htm. It's one way to dispose of defective tubes and gear. W7JHS hosted a great "Winterfest 2004" at his Prosser, WA airport hanger. This event is a customized January wintertime swapmeet / BBQ for vintage enthusiasts which of course is a haven for AM interests. Cormac, W7JHS is in the middle of homebrewing a transmitter he is appropriately calling "Woody". An "in progress" image can be seen at http://mysite.verizon.net/res17bfm/Woody.jpg. Winter swapmeets in Rickreal (near Salem, OR) and Puyallup, WA (3500 in attendance) were a great success. K7RLD 's Collins 20V-3 went on the air from Bellevue, WA last fall. Six meter AM activity is thriving on 50.4 Wed and Sun evenings in the Western Washington/Seattle area. We are looking forward to the Seaside, Oregon "Hamvention" this coming June 19. (K7YIR maintains an online photo album of Pacific Northwest Hams at http://mysite.verizon.net/res17bfm/ham_photo_album/index.htm.)

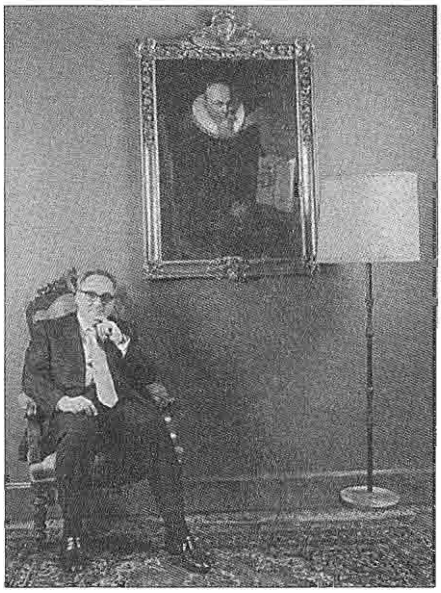
AMI Canada Region News – Ed, VA3ES relays he is back at home now and "all fixed up" after 16 weeks of medical procedure and recovery. He reports that Al, VE3AJM (GPT-750) and Ken VE3MAW (Marconi FRT-501) continue to hold forth on the Canadian Boatanchor Net (3725 nightly at 8 PM Eastern), and are occasionally joined by Duane, VE3NHP, and Bill, VE3LVL, and Nick, VE3OWV. Ed is in the process of rebuilding his station, and should have it on the air by late spring or summer.

Congratulations to Electric Radio – On ER's 15th anniversary AM International recognizes its contribution not only to our enjoyment of the AM phone segment of amateur radio, but possibly its very existence. Ray Osterwald's and earlier Barry Wiseman's decision to promote AM and publicize issues that threaten it is much appreciated. On this anniversary AM International offers its thanks. We could not function as an organization in our present form without the exposure ER gives us.

ER

PHOTOS

By Federico Baldi, IZ1ZFD
via A. Costa n° 27 – 28100
Novara, Italy



My Dear Friends,

I hope that my note and the photos of my military surplus radio shack shall be of interest for some of you as they come from an overseas collector of fine military rigs. I'm a radio-ham (IZ1FID), medical doctor, endocrinology specialist, and I was devoted to military radio equipments from my age of 15-16 years old, when I saw at the home of my uncle an old Ducati AR-18 receiver that he took from a military Italian bomber at the end of the WWII. Now in my shack I have the following equipment that is described in the text and photos.

Rackmounted, from bottom to the top in Figure 1, page 36:

Collins 51J-4

I have two of these fine receivers in my shack, one is very strange having the front panel regularly painted in St. James Gray but is silk-screened in the Yugoslavian language. [See Figure 2] It came from Tanjug, the press agency of the former Yugoslavia. On the tag there is the following writing:

RADIOPRIJEMNIK
Tip 51J-4 Ser 2590
PROIZVOD COLLINS SAD

The other 51J-4 has the front panel painted in the same colour of the R-390 but is regularly silkscreened in English.

R-390/URR

Here in Italy the R-390 is quite difficult to find so I bought this one from Rick Mish of Miltronix in the States and he sent me a very very good radio - Thanks Rick!

R-390A/URR

I have two of these fine radios, one by Collins and one by EAC, actually I'm employing the EAC that is a very good performer and that was overhauled from I2AMC "Charlie" Monti, that here in Italy is a well known expert about Collins equipments.

SSB Adapter CV-1982

This is a very complicated SSB adapter manufactured by Kahn Laboratories, and it employs many nuvistors. It is connected through a switch to the IF output of the R-390A/URR or of R-390/URR

Figure 1: This rack mounted equipment is described in the text from the bottom to the top of the rack. See Figure 2 on the next page for a closeup photo of the rare Yugoslavian 51J-4.

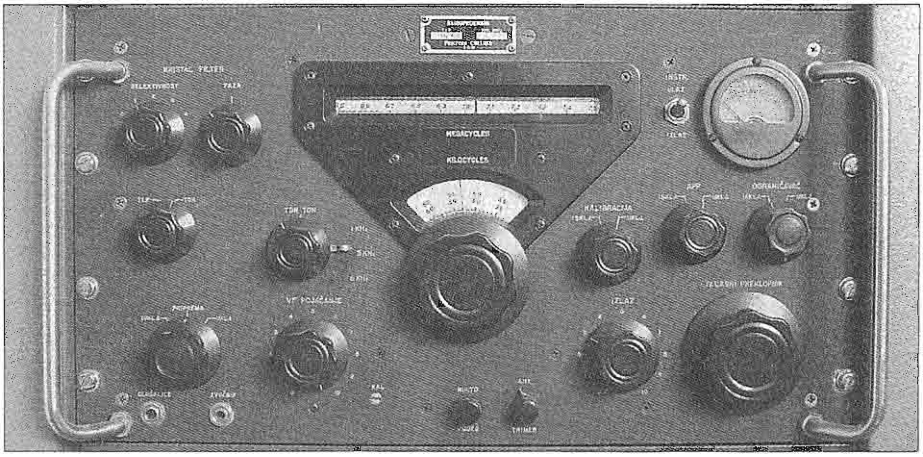


Figure 2: Rare Yugoslavian 51-J4.

Rockwell Collins 651S-1

This is a fairly common solid-state receiver.

Antenna Couplers CU-656A/U and CU-872A/U

I have two of these devices (ex US Navy) connected in cascade, each can feed eight receivers so, in the cascade configuration, with only one antenna you can feed 15 receivers. Each of these antenna couplers employs a bunch of 6922's. I find them very useful devices if you want quickly compare many receivers tuned on the same signal and with the same antenna.

At the bottom of the rack you can see a panel with on the left a rotary selector, it is a home-made selector that takes the audio output from all receivers and feeds headphones, so I can quickly change the receiver that I'm listening. In the center of the panel there is a multi-pin connector that is a microphone input so when you transmit, all receivers go to stand-by and the receive antenna inputs are disconnected. On the far left you can see a solid state Skanti TRP-8000 HF-SB 750 W PEP with its power supply, and over the power supply you can see a 24-hour Chelsea clock.

The central part of the shack from top to bottom is shown in Figure 3. I begin my description with the left side shelving.

Antenna Coupler

The same device as described for my rack in Figure 1, and it stays at the top of the rack.

LTV-Temco G133F

This receiver – a Collins 51S-1 modified for EW operation – was fitted in EC-47 in the Viet Nam war and also onto the U-2 spy plane (somebody told me). Definitively we can say that the different shape and color of the handles serves to operate them with flight gloves in low light conditions and not to help the radio-operator, blinded from a nuclear blast, to recognize them. This radio it is extremely rare in Italy and in Europe too.

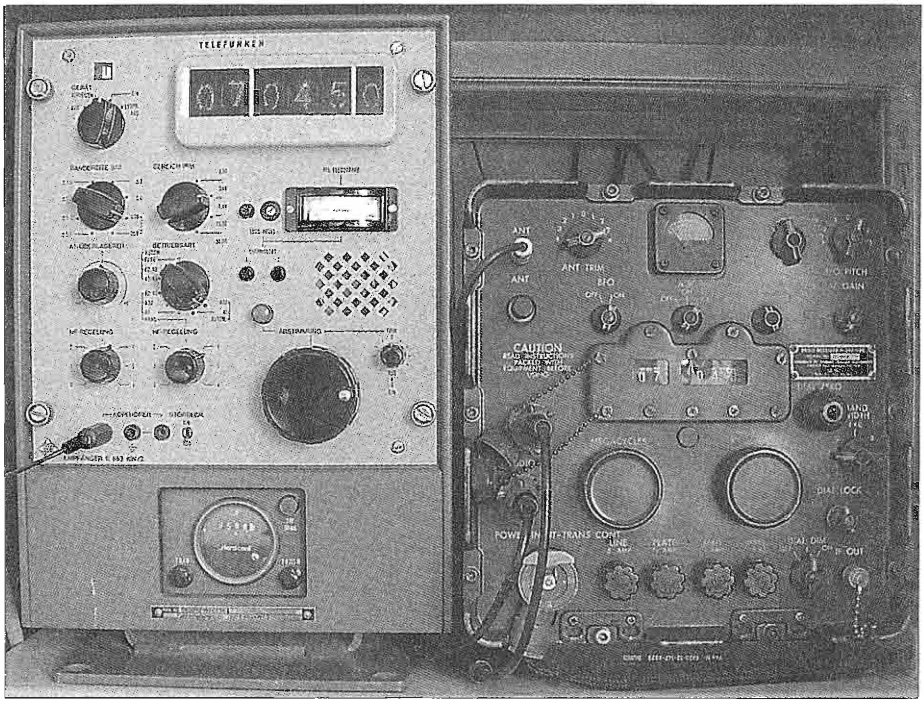
EZ-100 / EKD-500 / EKD-300

These are two very fine receivers, with their pre-selector EZ-100 (on the top) manufactured in the 1990 by R.F.T. in the former-D.D.R.. They have modern mechanical filters and both are superb receivers, the EKD-500 is of more modern development and have 99 memories and scan capabilities by memories or by frequency.

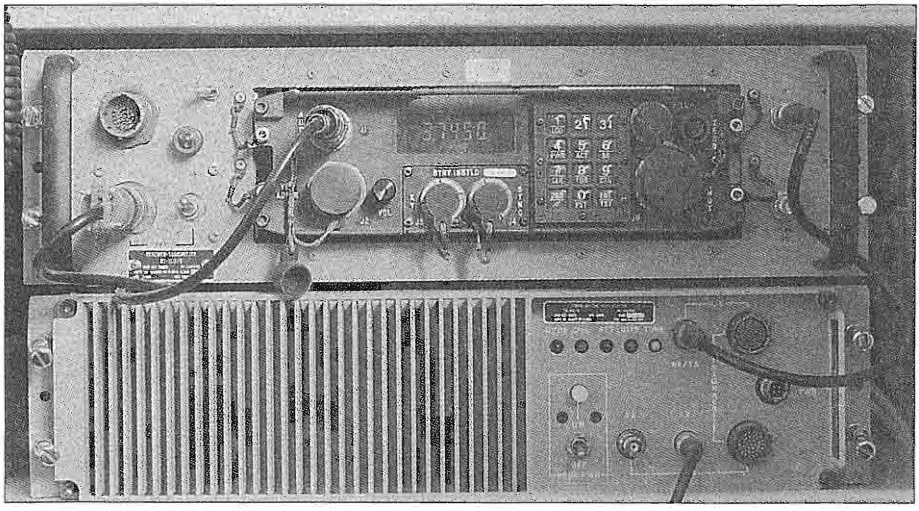
PRC-2000 (on the left)

This is a fine manpack 1.6-30 MHz, 100 Hz steps, USB/LSB/CW/DATA, 4 or 20 W PEP, 9 memories, with automatic

Figure 3: The central part of my shack is described top to bottom, from the shelves on the left side.



Telefunken E-863K Stewart Warner R-392/URR



These units are very rare in Europe: The receiver/exciter RT-1512 is on the top, and the pre-post/selector TN-612G is just below it.

A.T.U., manufactured in 1996 by **MELPHILIPS AN/PRC-515 (on the right)**

This is another fine manpack 1.6-30 MHz, 100 Hz steps, USB/LSB/CW/AME, 4 or 20 W PEP, with automatic A.T.U., developed from Rockwell-Collins as competitor of Hughes PRC-104, when they lost the tender they transferred the plants in Canada that adopted the AN/PRC-515 for its Army. Rockwell-Collins also sold many of the manpacks to Yugoslavia (light green livery), that also assembled some of the RTX with the name of RU-20 in Zagreb.

ITT-MACKAY MSR-8000 (on the left)

I think that in the States this RTX, part of 1 kW station AN/GRC-130, is fairly more common than in Europe.

RACAL PRM-4031 (on the right)

This is a fine manpack 1.6-30 MHz, 100 Hz steps, USB/LSB/CW/AME, 4 or 15 W PEP, with manual tuning unit manufactured in 1980 by Racal. I love this manpack very much: it is tiny and light, this one was captured from British soldiers to Argentinia during Falkland/Malvinas war.

On the bottom there is a German military transformer that allows a separation between the surplus rigs and the line.

RIGHT PART OF THE RACK (from top to bottom)

Here you can find some modern equipment: Icom 756 Pro II and Yaesu Quadra VL-1000, but there is also some interesting surplus equipment.

R-392/URR (on the right)

A fairly common receiver but an Evergreen must. This receiver was reworked from Stewart-Warner, the inside is very clean and on some modules there is printed the date: 1974.

TELEFUNKEN E-863K (on the left)

This is a fine H.F. receiver built from Telefunken in 1970-1975, it is solid state (except for nixies) and employs superb mechanical filters.

AN/GRC-215 REGENCY NETWORK

Unfortunately I have only two parts of this set that is very rare in Europe: the receiver/exciter RT-1512 and the pre-post/selector TN-612G. This set was built in Manassas (USA) and in Pomezia Terme (Rome) from a joint venture of Magnavox and Elmer. The Regency Network System was developed to provide USCINCEUR with an independent, agile, survivable, fully supportable HF C3 system with secure data and voice communications, capable of operating in a wartime environment. The Regency Net was to provide trans and post-attack communications among nuclear capable units in the European Theater. The key to the Regency Net was the GRC-215 radio set in a portable, semi fixed and mobile configuration. Mobile and fixed units used NVIS broad band antennas. The GRC-215 was capable of frequency hopping and encryption using a KY-65A and KG-84A COMSEC device(s). The frequency range is 2.000 to 29.9999 Mhz, 10 Hz steps, USB/LSB/DATA; the control head (C-11760) can drive a manpack or can drive a fixed or mobile bigger station when it stays in its bay onto the RT-1512. Normally I operate the RT-1512 with a Redifon Power Amplifier (100 W) that will accept its 100 mW output.

To maintain properly this surplus equipment I have some instruments, like surplus tube testers TV-2C/U and TV-7, and an URM-25/F signal generator.

I hope that you gentlemen were not tired from this description of my shack, if some of you should like to contact me can send an e-mail to the following address: federico.baldi@virgilio.it or write to my home address.

By the way, I'm searching for the following equipments: (a) AN/SRR-13 (b) R-389/URR (c) Power Amplifier, Power Supply and Manpack Body of GRC-215.

Many thanks to all and 73 de Federico IZ1FID **ER**

Installment 10

W. J. Halligan
Newspaper Reporter and the State of Radio 1923-1924, Part 4
Broadcast Listeners (BCLs)

By Robert E. Grinder, K7AK
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Full Outline of Part 4: Broadcast Listeners

A. Citizens Who Mainly Listen
   Listening Styles
   DX Hounds
   Night Owls
   DX Records
   Proselytizing Converts
   Crystal Sets VS. Vacuum Tube Receivers
B. Listeners Who Tinker
   Obstacles
   Bill Halligan's Advice
   Radio Builders—Wizards
   Radio Builders—Technicians
C. Epilogue
   How Far Have You Heard?
   The Art of Soldering
   Headsets and Loud Speakers

C. Epilogue

Radio broadcasting burst with the force of a monsoon into homes throughout the United States in the early 1920s. It swept cataclysmically across the cultural landscape, leaving no person oblivious. A man living in Freeport, NY, for example, stated in January 1923, that until "a few short months ago," he knew nothing about radio. Nothing more than about "antediluvian reptiles," he insisted. He had heard loud speakers in radio stores, but he had heard not one of them that he could either understand or want to take home. "Radio to him was just one of those things he was satisfied to let the other fellow tinker with . . . ." A friend then gave the neophyte a radio book, which provided "instructions for building and operating a receiver from parts which could be purchased for $10." He decided that "would be a good investment if he was able to make the set half as useful as the book claimed it could be made." Once built, however, he reported "remarkable" results. He had become another enthusiastic convert ("How far," 1923, p. 228).

A relatively small cohort of scientists, radio engineers, and amateur experimenters had toiled relentlessly since the turn-of-the-century to realize practical systems of radio telephony. Entrepreneurs founded General Electric, Westinghouse, and AT&T; then, following WWI, they established RCA as an umbrella conglomerate by which to control the radio industry via patents (see Installment 4). Economic motives subsequently inspired them to promote radio broadcasting. They regarded the new phenomenon to be a powerful temptation for enticing citizens to either purchase ready-made receivers or buy components for building them.

Two complementary, social constituencies thus arose at the outset of the broadcasting era: on the one hand, disparate bodies of financiers, manufacturers, artists, station managers, etc. merged loosely to deliver radio broadcasts. On the other hand, a cadre of BCLs, tantalized by the thrill of having broadcast stations open up the world to them, rose in size exponentially.

Prior to Bill Halligan's discharge at age 19 from the United States Navy following WWI, his life had centered

on amateur radio and employment as a commercial and military radio-telegrapher. Afterwards, he pursued educational objectives, which he abandoned eventually for the imminence of marriage. Nearly four and one-half years passed as he explored vocations, got married, established a household, and landed a job with the Boston Telegram. His interests in radio realms thus temporarily subsided as he matured into a young man.

The cultural detonations that were occurring in every sphere of radio surely startled Bill Halligan when he began his tenure as a reporter for the Boston Telegram. The new regulations governing broadcasting, the tensions fracturing broadcast programming, and the advances in tube technology and receiver development probably were sources of astonishment. The burgeoning BCL population may have thoroughly surprised him. What motives or reasons, he probably wondered, could be ascribed to why so many people had become suddenly radio aficionados?

Bill Halligan's quasi-daily reporting of vignettes in the Boston Telegram constituted an ideal venue for accumulating reasons why radio appealed to BCLs. Nevertheless, he found it difficult to connect with them. His predicament surfaced in the following vignette, which was published in the Boston Telegram, December 19, 1923, about nine months into his career in journalism:

"While it is comparatively simple for the writer to obtain news of the transmitting amateurs, it is a bit more difficult to learn of the doings of the broadcast listeners, the men and women who are interested only in the reception of concerts, lectures, and programs of the broadcasting stations. If you have built a particular kind of set and find it better than some other; if you have heard stations located at what you believe to be exceptional distances for your type of receiver; if some friend of yours has done something with his set which you believe other radio enthusiasts would be interested to know, write to The Telegram Radio Editor."

Bill Halligan's plea for reports from his BCL readership underscores his aim to have been an inclusive radio reporter—to be as solicitous toward BCLs as toward amateurs. He encouraged readers who listened primarily to "concerts, lectures, and programs" to share their "doings" with him. He disclosed a fondness for the BCLs for whom radio entertainment was a major attraction and diversion, and he depicted in vignettes exciting instances in which radio brought joy into their lives. (See "Part 2: Vignettes Inspired by the Oncoming Radio Culture," Installments 2 and 3).

Media pundits and orators expressed generally conventional and palpable reasons for why citizens had turned in droves to broadcast listening: (a) to avoid the monotony of otherwise boring lives, (b) to acquire essential information from agricultural bulletins, daily weather reports, and news broadcasts, (c) to enhance learning from lectures and educational offerings, and importantly, (d) to be entertained by concerts, soloists, comedians, etc. The romanticists and optimists were entranced at the prospect that millions of people might listen simultaneously to programs that exhorted them collectively to uplift moral ideals and democratic principles. Radio broadcasts, it seemed to them, possessed the power to heighten humankind's egalitarian tendencies and temper its competitive, aggressive spirit.

Utopian dreams and lofty abstractions were not part of Bill Halligan's pragmatic mind-set. He read the pulse of the BCL contingent differently. He was very much aware, as a consequence of his experiences as an amateur and commercial operator, of the geyser of emotional satisfaction that always arose

whenever he copied a weak, faraway station. Thus, he perceived intuitively that a distinct segment of the BCL population shared his feelings as it endeavored to squeeze from its receivers every microampere of radio current that might herald reception of a distant station.

Bill Halligan's kinship with BCLs who obtained emotional satisfaction from DX reception [the act of copying a distant station] stemmed from a "political" affinity that he hoped would develop into a strong bond. Specifically, a belief floated about at the outset of broadcasting that powerful commercial and maritime services might preempt all the wavelengths, which would push broadcasting—then a very fragile enterprise—out of existence. Given mysterious machinations within the Department of Commerce, he shared queasiness with colleagues that amateur radio might also be denied access to the radio spectrum. Bill Halligan thus saw a host of potential comrades in BCLs who pursued DX as avidly as amateurs. These BCLs, he believed, were in the process of acquiring the requisite habitual experiences and skills that enabled them to adjust their receivers for maximum performance. His primordial hope was that eventually they would be inspired to step over the threshold, and thereby, obtain transmitting equipment, swell amateur ranks, and strengthen the political clout of radio amateurs. Bill Halligan believed fervently that amateur operation offered BCLs a beneficent goal toward which they might strive. The discussion of the "Commonwealth Radio Association," to follow in Part 7, demonstrates how Bill Halligan worked as tirelessly as humanly possible to draw BCLs into amateur radio.

The vignettes presented in Part 4, "Broadcast Listeners (BCLs)," represent members of the BCL population whom Bill Halligan classified as motivated ostensibly to copy distant stations. The substance of the vignettes suggested two types of BCLs: those who chase DX for no other reason than the lure of copying stations of "exceptional distance" and those BCLs who were not only invigorated by DX accomplishments but also by the exhilaration that stems from experimenting and tinkering with their receivers. I divided the BCLs of Part 4, therefore, into two relatively distinct profiles: Section A, "Citizens Who Mainly Listen" (six sub-topics), and Section B, "Listeners Who Tinker" (four sub-topics).

The first topic of Section A, "Listening Styles," covered a range of ways in which BCL enthusiasts of 1923-24 adapted their physical surroundings to conform to their radio interests. One person abandoned his Victrola, several clubs set up receivers with loud speakers for listeners not "financially flush," a husband and wife team aimed to boost their listening pleasure by copying code practice lessons, etc. The second topic, "DX hounds," described citizens who made ingenuous DX claims. Their alleged DX attainments surely strained Bill Halligan's credulity, yet he dutifully published their reports uncensored, as when he stated that Capt. Burr Leyson is able to "bring in almost any stations he desires."

The third topic of Section A, "Night Owls," embodied zealous "DX Hounds" who patiently listened into the wee hours of the night to hear distant stations. The "stay- up-all-night" phenomenon was particularly popular among listeners in the Eastern United States, because Western stations could be heard after local stations ceased broadcasting. The fourth topic, "DX records," listed reports of achievements so stunning that Bill Halligan acknowledged them as "records." He functioned as a self-appointed judge whenever he proclaimed authoritatively that a new record had been set. His proclamations probably thrilled the BCLs on whom

he bestowed special recognition. Similarly, always aiming to keep morale high, he never chastised a BCL for a blatant exaggeration. For example, when Bill Carroll asserted that with a crystal set he could hear Palm Beach, Florida, Bill Halligan suggested that given the marvelous strides radio has taken, broadcast listeners should be prepared for anything.

The fifth topic, "Proselytizing Converts," described strategies that BCLs adopted to encourage uninitiated, fellow citizens to join them in exploring the wondrous pleasures of radio broadcasts. Bill Halligan disclosed that citizens with receiving sets would invite friends over for a party so that they could listen to a special program, e.g., a concert from Havana, a prizefight, or a drama presentation, etc. Whether their motives were largely altruistic is uncertain, since they may also have been using special events to boost their own statuses among their neighbors.

In the sixth topic of Section A, "Crystal Sets vs. Vacuum-Tube Receivers," the BCLs of 1923-24 expressed their partiality for either crystal sets or a variety of different vacuum-tube receivers, including one-tube, two-tube, and three-tube types. Bill Halligan alluded occasionally to the insensitivity of crystal sets and to the superiority of vacuum-tube receivers. However, in these vignettes, he sidestepped conspicuously opportunities to discuss such topics as types of tubes, power sources, and receiver circuitry and characteristics. Topics such as these, however, will be reviewed in the Epilogue of Part 6, "The Nitty-Gritty of Amateur Radio." The Epilogue will cover historical developments through 1923-24, respectively, of receiving and transmitting tubes, transmitters, and receivers. The discussion in Part 6 will emphasize the challenges confronting radio theoreticians and technicians as they balanced circuit complexities and component costs against attaining equipment effectiveness at minimal expense.

Bill Halligan's comfort level elevated markedly when he dealt with the vignettes of "Listeners Who Tinker," which are presented in Section B. The first topic, named "Obstacles," covered impediments that experimenters encountered in building receivers. The second, "Bill Halligan's Caveats," gathered together vignettes in which he proffered advice to prospective experimenters. The third, "Radio Builders—Wizards," are vignettes about BCLs whom he anointed as "wizards," because they appeared preeminently to possess both theoretical and technical understanding of the radio art. The fourth, "Radio Builders—Technicians," reflected traits of BCLs who appeared to be less interested in radio theory than in adhering slavishly to schematic and construction details.

Three topics associated implicitly with the vignettes of Part 4 warrant further clarification. The first deals with contests in which DX-hounds, night owls, and others competed for recognition and prizes. The second, soldering, was materially the most important skill linked to the art of constructing home-built receivers. Bill Halligan recommended it strongly to BCLs (see his caveats, Section B). The third, headsets and loud speakers, focuses on the two types of transducers that transformed in 1923-24 electrical waves into corresponding acoustical waveforms. The three topics are discussed below under the following three headings: (1) How far have you heard? (2) The art of soldering; and (3) Headphones and loud speakers.

How Far Have You Heard?

The Doubleday, Page & Company published "Radio Broadcast" from May 1922, until April 1930. The monthly magazine, which sold for 25 cents, was printed on relatively acid-free paper. The more celebrated radio engineers of the day, like Edwin H. Armstrong, Lee

De Forest, and John V. L. Hogan, wrote signed technical articles, and its sophisticated editorial staff wrote commentaries dealing with social policies and cultural developments associated with radio applications. Libraries across the United States thus chose to subscribe to Radio Broadcast more frequently than to any other radio-related periodical.

The editors of Radio Broadcast aimed primarily to create a publication that would resonate with the interests of BCLs. Indeed, in the first issue they stated that they wished "to make the magazine an Open Forum for its readers and a common meeting ground for Radio Enthusiasts" ("Advertisement," 1922). Letters received in their editorial offices shortly after the first issues reached newsstands revealed that the thrill of copying faraway broadcast stations intoxicated a great many readers. The editors, therefore, elected to tap into this reservoir of interest in two ways: (1) they would sponsor contests and award prizes for outstanding DX, and (2), they would feature prominently descriptions of the outstanding receivers used by winners. The editors hoped that unsuccessful entrants would thereby be inspired to build the receivers of the winners.

Radio Broadcast inaugurated subsequently three listening contests. The first began November 1, 1922, and extended to February 1, 1923. The second started from a date in March designated as "now" [apparently the date in March on which a prospective contestant became aware of the announcement] and continued until May 31, 1923. The third contest ran from February 19 until March 20, 1924. The first contest was entitled "How far have you heard on one tube?" The second, "How far have you heard on any number of tubes?" and the third, "How far have you heard on either a 'ready made set' or a 'home built set'?"

The initial "one tube" contest arose in the minds of the editors partly because they were aggravated about so much "loose talk about broadcasting concerts being heard at great distances with very simple equipment." Consequently, some "folks wonder why, with a single tube outfit, they have difficulty in hearing anything and feel incredulous about the heralded wonders of radio" ("Editors," 1922a). "We are anxious," the editorial team announced, "to learn of experiences in broadcast reception, believing that their publication may help others to obtain the best results from their outfits."

The first contest invited readers to log every station heard on a one-tube receiver at distances greater than 500 miles at night or 150 miles by day. Contestants were forewarned to be absolutely certain that their reports of the call letters and the names of stations were correct. Each contestant was beseeched, too, both to remark briefly on the design of his or her receiver and to describe experiences with it in a paragraph or two ("Editors," 1922b).

The members of the editorial team, during the first contest, were unable to restrain their eagerness to learn how and why some listeners could hear stations at great distances. When a contestant in the New York City area called excitedly to report intriguing results, team members often rushed out of their offices in mid-afternoon to the home of the contestant, hoping in this manner, to learn first-hand about the receiving apparatus that had produced the feats. They were inundated, however, by so many telephone calls from "misguided experimenters" who professed to have revolutionized radio reception, that soon they "ceased to thrill" over the wonders reported. They lamented that "we have been on many wild goose chases and it is only the 1-percent success we meet with that keeps us going hither and yon, in quest of new and improved circuits . . . When our telephone asked, 'would you like to hear

half the United States without an aerial?' we felt for our money and the temptation to hang up the receiver nearly overcame us. . . . We advised him to make a drawing of his circuit arrangement, have it witnessed and sworn to before a notary, to protect himself and his circuit for its commercial possibilities" ("Listening," 1922, p. 117).

About a month into the first contest, the editorial team at Radio Broadcast altered contest rules by asking contestants to obtain a summary score by aggregating the distances of stations heard from their locations. Stations heard closer than 150 miles at night and 75 miles by day were to be excluded ("Editors," 1922c). To becloud matters, a contestant, January 1923, wrote to recommend that the power input of stations heard be given consideration. Team members replied that "we should very much like to do this were it not for the fact that our contest is already assuming proportions which tax us to the utmost" ("How far," 1923, p. 234)).

The overworked, exhausted, editorial team, after evaluating hundreds of contest submissions, reported belatedly, April, 1923, that a score of contestants had heard stations more than 1,500 miles from their locations, with 1,000 miles being about average. A dozen entrants reported also an aggregate mileage of more than 50,000 miles; the log of the winner, who lived in New Hampshire, reported a total of 111,240 miles. His prize was a Grebe regenerative receiver and a two-stage amplifier (see Grinder, 1996, for a review of Grebe receivers).

The March 1923, issue of Radio Broadcast proclaimed that the first contest was a huge success. Therefore, declared the editors, "we take pleasure in announcing, owing to the enthusiastic response to this contest, A SECOND LONG-DISTANCE RECEIVING CONTEST, to determine who has done the best with any number of tubes and any type of receiver." The rules for submitting results were tightened for the new contest: distances must be measured accurately, no aggregate score of less than 15,000 miles would be considered, and station data had to be listed in three columns—call letters, location, and distance.

The second contest ended May 31, 1923. A progress report, July 1923, indicated that the second contest had generated a great deal of enthusiasm and that its winners would be announced in August 1923 ("Editors," 1923b). However, in August the editorial team bemoaned, "We are snowed under. To be frank about it, we were entirely unprepared to handle the reams of material that arrived in time to be included in the contest." The team stated that the "contestant whose material measured up best had been chosen," however, because "there are several contestants well toward the lead whose work is so nearly equal that a hasty decision might be an unjust one"— all of the prize winners, therefore, would be announced in September ("Editors," 1923c).

The winner of the second contest lived in Garrochales, Puerto Rico, a community 500 miles south and 900 miles east of the lower end of Florida. He reported hearing 90 broadcast stations on a home-built, three tube receiver. He had aggregated a stupendous score of 172,075 miles. All of the stations were more than 1,000 miles from Garrochales, and six were in California, more 3,300 miles away.

Eric G. Shalkhauser, Peoria, Illinois, emerged as the second place winner with an aggregate score of 48,745. He had accumulated his data with a four-tube, home-built, portable receiver, which used only a loop antenna ("Editors," 1923d). Shalkhauser proved, by his success in besting hundreds of other continental BCL contestants, that he was worthy of acclaim as one of the

more skilled, knowledgeable BCLs of the era. However, in 1923, he was essentially an unknown, not atypical radio experimenter, and his accomplishments apparently failed to impress Bill Halligan.

Perhaps Shalkhauser's unrivaled talents should have registered in Halligan's memory, for in little more than ten years hence their paths would cross. Shalkhauser and Halligan would compete vigorously in the tumultuous 1930s for customers in the radio-amateur community. During the winter of 1931, Shalkhauser and R. M. Planck founded "Radio Manufacturers Engineers," two years before Halligan launched Hallicrafters. Although Hallicrafters produced an abundance of fine receivers in the mid- to late-1930s, RME marketed mainly its incomparable RME-69, a designation that stood for "'six bands and nine tubes'." Nothing in the Hallicrafters line surpassed the RME-69, which rose swiftly to become a status symbol among amateurs who worked 20 meter DX (Orr, 1974).

The results of the second contest were summarized in the October 1923, issue of Radio Broadcast. The team exulted that "the turn-out was mighty good." Still, it expressed dismay that "comparatively few people with ready-made sets entered the contest?" The team reasoned that perhaps many readers thought the contest was open only to those with homemade apparatus. Perhaps, it suggested, "the purchaser of a ready-made set is generally interested primarily in the entertainment rather than the experimental phase of broadcasting; while the builder of a set is often 'out after distance,' and learns more about fine tuning than the owner of a bought set" ("Editors," 1923e).

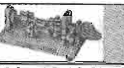
Five months later, in March 1924, Radio Broadcast announced its third and final "How far have you heard" contest. To encourage participation by all BCLs, the third contest was divided into two sections—one for homemade receivers and the other for those ready-made. The contest was conducted for only a month, between February 19 and March 20, 1924. Contestants were required to log data derived from stations heard in five columns: date, time, call letters, location/distance, and remarks. The rules required specifically that "the reception from any station listed should be clear for a period long enough to hear a complete musical selection, the call letters, and location of the station. If this cannot be done—do not list the station." The editors, testy and irritated because so many participants in the first two contests attempted to fudge their scores, warned that "the report [sic] of possible winners will be checked with the broadcasting station managers and an optimistic guess may lose the contest for you. Play the game" ("How far," 1924, p. 420).

The results of the third contest were reported in the July 1924, issue of Radio Broadcast, about one and one-half years after the first contest and a couple of months after Bill Halligan ceased reporting for the Boston Telegram. The winner of the ready-made section, who lived in Utica, NY, logged 140 stations with an aggregate distance from his location of 85,510 miles; the winner of the home–built section, who lived in Linton, North Dakota, logged 148 stations having a aggregate distance of 121,535 miles. Not much in the way of differences between the two sets of contestants was noted. And no wonder! The editorial team admitted wearily that"deciding one of RADIO BROADCAST'S distance receiving contests is only a shade less difficult than the biblical difficultly that wise King Solomon had in deciding the ownership of the infant." Not unexpectedly, the editors of Radio Broadcast never again sponsored a "How far have you heard contest" ("Editors," 1924b).

[Next month Bob finishes the Part 4 Epilogue...Ed.]

ER

VINTAGE NETS



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

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

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

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

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

Canadian Boatanchor Net: Meets daily on 3725 kc (+/-) at 8:00 PM ET. Hosts are AL (VE3AJM) and Ken (VE3MAW)

Collins Collectors Association Nets: Technical/swap sessions meet every Sunday on 14.263 mc at 2000Z. Informal ragchew nets meet Tuesday evening on 3805 kc at 2100 Eastern time, and Thursday on 3875 kc. West Coast 75M net is on 3895 kc 2000 Pacific time. **10M AM net starts 1800Z on 29.05 mc Sundays, QSX 1700Z.**

Collins Collector Association Monthly AM Night: Meets the first Wednesday of each month on 3880 kc starting at 2000 CST, or 0200 UTC. All AM stations are welcome.

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

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

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

DX-60 Net: This net meets on 3880 Kc at 0800 AM, Eastern Time on Sundays. Net control is Mike (N8ECR), with alternates. The net is all about classic entry-level AM rigs like the Heath DX-60.

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

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

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

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

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

Heathkit Net: Sunday on 14.293 mc 2030Z right after the Vintage SSB net. Listen for W6LRG, Don.

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

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

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

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

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

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

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

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

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

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

Vintage SSB Net: Sunday 1900Z-2030Z 14.293 & 0300Z Wednesday. Net control Lynn (K5LYN) and Andy (WBØSNF)

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

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

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

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

FOR SALE: Hallicrafters S-20R in good operating condition. Case fair, bottom cover missing, copy of manual. Photo available. $50 plus shipping. W9KV 970-247-5563, jimscott@bresnan.net

FOR SALE: GR 419A wavemeter, $75. N&N wheatstone bridge, $30. Weston 722 analyzer, $15. Ross Wollrab, 229 N. Oakcrest Ave, Decatur, IL 62522, 217-428-7385

FOR SALE: Mackay 3010B & 3021A rcvrs, EAC 67 R390A & CY979 case, R1051B, National URR-39 / NC 183 MR. All good condx. Delivery to Dayton possible. Radioresearch@compuserve.com or 401-207-9381

FOR SALE: SX115, HT32B, KWM2, SR150, SP-210, T4XB, R4B, TR4, SX117, HT-44, more. Bob Ryals, KIØGF, 719-265-9950, joebob1@adelphia.net

FOR SALE/TRADE: Sale/trade: HRO-50T1/ABCD coils/box/spkr/ $400. NCX-3 $150, Eico/753 $100, RT-66/GRC $100. **WANTED: RCA/Radiomarine T-408/ URT-12, info.** Sam KF4TXQ PO Box 161 Dadeville, AL 36853-0161 stimber@lakemartin.net 256-825-7305.

FOR SALE: Technical Material Corp. receiver GPR-90, good condx, currently in use, $500. KL7BXP, 707-725-9018, will ship UPS

FREE TO A GOOD HOME: Western Electric model 19 teletype and CV 116 frequency shift converter, manuals, extra paper and tape rolls, both working when

disconnected 6 years ago; R-220 URR FM receiver, parts rig. Pick up only in Littleton CO. Bill, KBØOHQ, 303-798-9126

FOR SALE: Tubes, NOS: 6360, 12@ $12 ea, 12AU7A, 9@ $6 ea. Norm Roscoe, PO Box 402, West Bridgewater, MA 02379, 508-583-8349.

FOR TRADE: Collins AM tube transmitter model 20V-3, 1000 watts. Excellent condx, for Western Electric mixer. Sumner McDanel, 800-251-5454 sumnermc@earthlink.net

FOR SALE: Surplus Radio Conversion Manuals Vols. 1-3 (GC-VGC). $15.00 each + USPS. Robert Baumann 1985 South Cape Way, Lakewood, CO 80227 303-988-2089 rgbdenver@att.net

FOR SALE: Rohn HDBX45, extra heavy-duty tower, self-supporting, disassembled, $398, instructions. Oxford, Michigan, 248-969-8899

FOR SALE: Superior tube tester #450, also checks condensers, dovetail case, book, $25 + shpg. Henry Mohr, W3NCX, 610-435-3276, 1005 W. Wyoming, Allentown, PA 18103-3131

FOR SALE: Hayden Electricity One-Series, complete, good condx, all pages, $20 ppd. USA. Louis L. D'Antuono, 8802-Ridge Blvd., Bklyn, NY 11209. 718-748-9612 AFTER 6 PM Eastern Time.

FOR SALE: ARC-5 Command Transmitter 7-9.1 Mc, $75. Jim, KB8RIT, 906-293-3318.

FOR SALE: Kenwood 599D Twins. Looks V.G., works, but could use alignment. Have cable, boxes, but no manuals. Cliff, WA9SUE, 608-625-4527 after 6:00 PM CST.

FOR SALE: MS-15 miniscope, new battery, manual, nice little portable scope. $450 OBO. Paul Recupero, 265 Union St. Portsmouth, RI 02871-2264 1-401-847-8599

FOR SALE: Heathkit, working, manuals: SB102 $165, HW100 $165. Icom R71A $365 w/ manual. Realistic PRO2006, $415. Collector quality Super Pro SP-600JX-26 inquire. Trades w/cash considered. Ron, MI, 517-374-1107

FOR SALE: Variac: General Radio 0-130V in black crinkle metal slant front case @9, $35. Bernie Samek, 113 Old Palmer Rd., Brimfield, MA 01010, 413-245-7174, FAX 0441.

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

FOR SALE: Request free vintage flyer. USA only. 50 years of mail order electronics. Bigelow Electronics, POB 125, Bluffton, OH 45817-0125

FOR SALE: QST: 1939 June, 1944 March, 1945 Nov., 1946 Feb., 1948 Jan., May, June, 1951 Dec., $10 all postpaid. Alan Lurie, W9KCB, 309-682-1674, 606 E. Armstron Ave., Peoria IL 61603

FOR SALE: Countermeasures receiving set AN/WLR-1D, 50-10750 MHz, 9 bands, simultaneous display of frequency, spectrum, and modulation info on dual displays, manual, 1200 lbs., $4,500. Carl Bloom, 714-639-1679 carl.bloom@prodigy.net

FOR SALE: Galena crystal radios and parts to make your own. Also radio parts and tubes. Len Gardener, 458 Two Mile Creek Rd., Tonawanda, NY, 14150. email: radiolen@att.net

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

FOR SALE OR TRADE: QST, full years, excellent condition. 1950 thru 1960, plus 1944 missing September. $10 per year plus shipping from 10021. Or trade for CQ 1950 thru 1969. Ken, W2EWL, 212-288-1310, ken44@nyc.rr.com

FOR SALE/TRADE: Original Heathkit manuals: DX20, DX35, DX40, DX60B, DX100, GR54, HR10B, HW12A, RX1. Ni4q@juno.com 407-351-5536

FOR SALE: Tested good globe 201A $14, 226 $15, 227 $10 and others. Slightly weak tubes guaranteed to work in early radios ½ price shown. Write or e-mail: tubes@qwest.net for a new price list or see www.fathauer.com. George H. Fathauer & Assoc., 688 W. First St. Ste 4, Tempe, AZ 85281, 480-968-7686. Toll Free 877-307-1414

FOR SALE: Authorized repairs and sales of all types of amateur radio and communications equipment, and also test equipment. Please call us at LAND AIR COMMUNICATIONS, 718-847-3090 and visit our web site: www.landaircom.com. We have over 3,000 items in inventory and carry all types of communications parts.

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

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

FOR YOUR MUSEUM. For your rare tube collection. Uranium glass Jennings "Peanut" fixed capacitor. Still in original 1944 box. Unused "mint" condx. Glows bright green under your UV blacklight. $20 postpaid, free info. Bob Ryan, 1000 S. Gilbert St., Apt 132, Hemet CA 92543-7065

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

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

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

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

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

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

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

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

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

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

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

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

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

FOR SALE: Strong steatite antenna insulators. Lengths from two to fifteen inches. SASE for list. John Etter, W2ER, 16 Fairline Dr., East Quogue, NY 11942. 631-653-5350

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

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

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

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

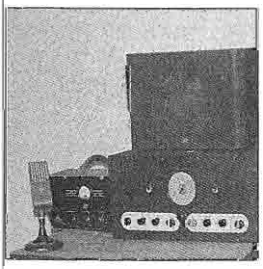
FOR SALE: Collins restoration. Everything inside & out to make it as Art Collins built it. 50 yrs experience. W9OJI /N4FZ, IL, 815-734-4255 or N4PZ@aol.com

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

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

FOR SALE: Repair, upgrade, performance modification of tube communications & test equip. Accepting most military, all Collins & Drake designs,

Complete 1936 RCA Ham Station



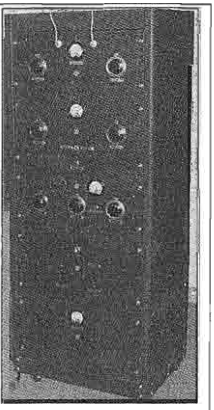
- ACT-200 Transmitter w/plug-in coils 160-10M
- ACR-175 Receiver w/matching 10" speaker
- Portable 2-channel microphone mixer
- MI-6203 B "Varacoustic" ribbon microphone

Best reasonable offer or trade.

Also:

- 810 tubes (tested good): $40 ea.
- Collins 32V-3: $600, pickup only
- Johnson KW Matchbox (stnd): $350

Gary Halverson, WA9MZU (N. CA)
209-286-0931 or ghal@ix.netcom.com



& the better efforts from others. Laboratory performance documentation on request. Work guaranteed. Chuck Felton, KDØZS, Felton Electronic Design, Box 187, Wheatland, WY 82201. 307-322-5858 feltondesign@yahoo.com

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

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

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

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

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

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

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

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

FOR SALE: Collins reproduction items available through the CRA on www.collinsra.com. Join the CRA and subscribe to the Collins Journal. Dave, W3ST

FOR SALE: Kenwood TS-180 Transceiver and manual. 12V. Excellent condition. $200 plus shipping. Mike Grimes, K5MLG; 3805 Appomattox Cir; Plano, Texas, 75023, 972- 867-6373.

FOR SALE: Vintage programmable Regency scanner ACT-100, $35. Realistic DX100 rcvr, Cobra amplified mic, $18. New Grundig YB400 rcvr $120. Sale list, SASE. Matt, K2MAC, 716-876-3259, 174 Lincoln Blvd., Kenmore, NY 14217.

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

WANTED: Power transformer for Ranger 1 transmitter. (P/N 22.985) Please contact Mike VE7MMH at mike46@shaw.ca or phone 604-988-0112

WANTED: 2 pc National RF Coil Shields. Part J30. Any other shield OK if can dia 2.25" min 2.75" max Length 3" min. Material aluminum or copper. Needed on old receiver restoration project. Roger, 262-242-4931, w9uvv@att.net

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

WANTED: International Crystal T-12 Transmitter or just a schematic if you have that - any condition. Please contact me via license address or via http://AF4K.COM - thanks, Brian AF4K

WANTED: An R-390 "Non A Version" in VG or better condx for my SWL shack. Also R-389, R-391. Dan Gutowski, 9753 Easton Rd, Dexter MI, 48130. 734-718-7450, dg16ms25@msn.com

WANTED: Please help me repair my Realistic DX-120 "Star Patrol" radio. Need schematic. Will pay copy cost plus $5 for your efforts. Roger, WØKWJ, 8405 Everett, Raytown, MO 64138

WANTED: Heathkit SB-102, SB-110, SB-500, SB-600, HDP-21 or 21A. Electro Voice 637 or 638. Stan Sepiol, 556 Benjamin Rd, Cayuta, NY 14824 607-739-3276

WANTED: 250 watt multi-match modulation transformer. Chip Owens, NWØO, Boulder, CO 303-673-9019, owensj@atd.ucar.edu

WANTED: Millen 80011 or 80008 coil shield cans to construct a 60's transmitter. Dead 453 scope (I need the case only) Robert 613-722-4098 or rwboyd@gta.igs.net

WANTED: Plugin coils for 80 meter band. Made by Insuline Corp. of America. Variable capactor inside the coil which measures 3"/1.5", 5 pin. Bob WBØDMC 507-331-5103. rspeck@hickorytech.net

WANTED: Good condition Heath AT1, VF1, AC1, Hallicrafters S38D, Tom Root, wb8uuj@arrl.net, 810-659-5404.

WANTED: For ART-13: DY-12, DY-17, or DY-17A, K-101. Bill McCaa, KØRZ, 303-499-1936, billk0rz@aol.com

WANTED: Dow-Key 60-series relay. Bob, KL7HDY, 907-346-1044

WANTED: 19" rack panel blanks, I'm building a studio. N1APC John jrwatterson@snet.net (860-444-0296)

WANTED: NC-183D 1st RF coil for Broadcast Band (L5). Bill, K8DBN 440-333-6644 or billyrieke@aol.com

WANTED: LS-7 speaker, Dy-88 for GRC-9. Lee, N2UDF@netzero.com or 315-656-9578.

WANTED: 250TH,100TH,2A3 Tubes. Johnson Navigator, 1940s-1960s QSTs 4-250 sockets. Trimm featherweight phones. Jeff, texmidnight@aol.com

WANTED: July 1941 QST to complete QST, thanks! Carl. KN6AL, 3290 6th Ave 1E, San Diego, CA 92103 kn6al@earthlink.net phone 619-997-6146.

WANTED: Schematic & info for National NC-98 restoration. Don, N8KPD, 740-383-5744

WANTED: 70 Ft. or taller steel crank-up tower. Prefer TN, KY, AL, AZ, UT, W5, W8, W9, WØ locations, others considered. Tom Berry, W5LTR, 1617 W. Highland, Chicago, IL 60660, 1-773-262-5360, cell #1-773-301-7640.

WANTED: Manual and/or schematic for Conar Model 452 two meter FM transceiver. Kirk Ellis, KI4RK, 203 Edgebrook Drive, Pikeville NC 27863. 919-242-6000, e.kirkellis@netzero.com

WANTED: Johnson 122 model VFO. Please state price & condx. C.M. Allen, HC67 Box 119, Summersville, MO 65571, 417-932-5562 AFTER SIX PM.

WANTED: Gonset "Super 6" amateur converter with manual. Norm Roscoe, PO Box 402, West Bridgewater, MA 02379, 508-583-8349.

WANTED: A manual and cabling for a BC-669D. Frank W. Fisher 541-479-7935 wa6rbq@aol.com

WANTED: Original panel meter for a Gonset GSB-101 amplifier. Ed Cuevas, 1602 Forest Bend Lane, Keller, TX 76248 817-222-5355, ecuevas@juno.com

WANTED: Escutcheon for a Westinghouse WR-5 Low Boy console. J. Kelly, Box 25, Long Lane, MO 65590-0025

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

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

WANTED: Technical Materials Corp. model DCU combiner, DVM monitor, LPP patch panel, LSP speaker, DCP power panel VOX V.F.O., CFA converter, and PSP-1 power supply. K8CCV, Box 210, Leetonia, OH 44431-0231, 330-427-2303.

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

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

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

WANTED: James Millen coils 42080, 42040, 42015, 43015. Navy SE2511/SE2512 receiver, SE2513 coil set. Gary Carter, WA4IAM, 1405 Sherwood Drive, Reidsville, NC 27320. Phone: 336-349-1991. Email: gcarter01@triad.rr.com.

WANTED: Correspondence with others (am incarcerated) on Military (especially R-390's & backpacks) and tube rigs. Also looking for copies of old surplus catalogs postwar thru 90's. W.K. Smith, 44684-083, FCI Cumberland Unit A-1, POB 1000, Cumberland, MD 21501.

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

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

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

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

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

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

WANTED: QSL card from my Grandfather, W9QLY, from before 1957. Also seeking original National Company logos from Ham or military equipment. Don Barsema, KC8WBN, 1458 Byron SE, Grand Rapids, MI 46606. 616-451-9874. dbarsema@prodigy.net

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

WANTED: Top prices paid for globe shape radio tubes, new or used. Send for buy list or send your list for offers. Write or email: tubes@qwest.net See WWW.Fathauer.Com or send for catalog of tubes for sale. George H. Fathauer & Assoc., 688 West. First St., Ste 4, Tempe, AZ 85281. 480-968-7686, Call toll free 877-307-1414

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

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

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

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

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

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

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

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

dedsall@crocker.com

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

WANTED: WW II German, Japanese, Italian, French equipment, tubes, manuals and parts. Bob Graham, 2105 NW3Oth, Oklahoma City, OK 73112. 405-525-3376, bglcc@aol.com

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

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

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

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

WANTED: Any books featuring panel meters, gauges, or flight instruments. Chris Cross, POB 94, McConnell, IL 61050.

WANTED: JOHNSON RANGER CABS & or BEZELS. Or the whole cab set. Dee

Almquist, W4PNT w4pnt@w4pnt.8k.com (540)249-3161 (msg). Cell: 540-480-7179 Virginia. Willing to trade.

WANTED: Help! I need the following for my Gonset Amp 3065: Four knobs for front panel, dark red. Also Elmenco fused AC plug. Joe, K2MZE, 603-652-4873.

WANTED: New Christian radio station - WVCP-Farragut TN looking for donations of FM radio station equipment. Dave, WA4YRK, 865-966-9811

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

The Collins Video Library

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

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Produced by Floyd Soo, W8RO (ex-KF8AT)

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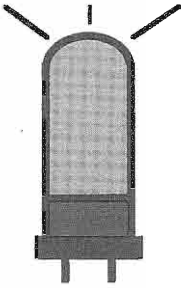

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