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New Life for a Pierson KE-93

Part 3 of 3.

Parts one and two of this series restored the companion power supplies and part of the KE-93 receiver to an operational state. But although the receiver appeared to be ready to operate, it still failed to show signs of life.

This final part in the series will discuss the problems that prevented normal operation and the repairs required to fix them. Following repair, the receiver was evaluated for both function and performance, with the results reported herein.

Receiver (continued)

Correcting the dial cord problem, as discussed in part 2, was a major hurdle in preparing the receiver for normal operation. But with power applied to the receiver, it was still "dead," and the reason wasn't immediately apparent.

To begin the troubleshooting process, I removed the RF shield above the front-end tube sockets and tuner, and this allowed me to make voltage measurements on the four front-end tubes. The voltage values measured on the plate and screen grids of tubes V3 and V4 just didn't seem to be correct, but I was momentarily unable to determine the problem. Tubed equipment gets warm after being "on" for a while, and when I touched tubes V3 and V4 to check for heat, I found them to be cold. After substituting one tube and finding that it also remained cold, I immediately concluded that it wasn't a tube problem. Yes, the heater voltage measurements at the tube sockets of tubes V3 and V4 indicated a problem, and the measured values were not as expected.

I traced the wiring for both tubes and found the ground lead tie point for tube V4 to actually be inside of the power supply — but the ground circuit was open and the lead failed to connect to ground. The problem turned out to be a dirty contact in the connector of the power supply cable where it attached to the back of the receiver. Cleaning the connector contacts — again — resolved the problem for tube V4.

Tube V3 still didn't have heater power, and upon tracing the wiring I found a 15-ohm 2W resistor attached to a socket on the underside of the receiver chassis. Someone had cut the resistor lead with diagonals and left it hanging. Soldering the resistor lead to the socket pin resolved tube V3's problem, and the receiver began to operate.

Upon getting the receiver to operate, I worked up the voltage chart shown in **Table 1** for the front-end tubes. With tubes V3 and V4 heating properly, the measured socket voltages appeared to be more logical for the circuit design.

As I began adjusting the controls to tune in stations, the noisy/dirty pots and dirty turret contacts began to "speak loudly" and cried out for help. I sprayed all of the pot resistance cards with a TV tuner cleaner and they cleaned up quickly.

TV tuner cleaner didn't seem to be appropriate for the silver-plated turret

	Tube Pins (B+ = 223 V; band = 80m; max. sens.)								
Tube	1	2	3	4	5	6	7	8	9
V1	0.07	1.24	—	—	193	75	0		
V2	−25	1.88	—	—	193	40	0		
V#	−15.5	0	—	—	115	101	—		
V4	−49	2	—	—	214	35	—		

***Table 1.** Chart showing the voltage values measured at the socket pins of the front-end tubes. The shield must be removed to obtain access to the socket pins.*

Band	Freq. (MHz)	Sens. (μV)
BC	1.0	6
	1.6	1.8
160	1.7	0.25
	3.4	0.6
80	3.5	0.2
	4.0	0.15
40	7.0	0.2
	7.3	0.1
20	14.0	0.25
	14.3	0.2
15	21	0.6
	21.4	0.6
10	28	1.5
	30	0.8

***Table 2.** Signal sensitivity chart as a function of frequency that I measured for one KE-93 receiver.*

contacts, so I wiped them with a dry paper towel and they polished up well, eliminating the contact noise.

At this point, it was obvious to me that the mechanical parts required lubrication. Applying motor oil to each moving point resolved the high friction problems. The oil was transferred to the selected points by dipping the tip end of a thin-shaft screwdriver into the oil and carrying a drop or less of oil to the point where it was needed. All excess oil was wiped up with a paper towel. The important thing was to apply oil only to the points where mechanical friction was occurring and to keep the oil away from all of the electronic circuits.

Operation

Once the receiver was operating without mechanical and electrical problems, it was time to do a performance check to see just how well the receiver was operating and how it compared to a modern solid-state receiver.

One of the first performance tests that I normally do is to measure a receiver's sensitivity to a weak signal. As I've said before, most receiver designs of the 1950 era exhibit a sensitivity of about 2 μV as compared to the modern solid-state receivers that operate down to about 0.2 μV. When measuring a receiver's input sensitivity correctly, signal-to-noise ratios are the most discriminating and meaningful. But not everyone can make such a measurement, so a comparable substitute technique is used. Yes, the comparable test is subjective, but it does provide a means for equating a receiver's performance with a numbered value. The method that I used is a minimum detectable signal level where the modulated signal remains discernible. In this case, signal-to-noise ratio sensitivity accuracy is traded for the ability to perform a "comparable

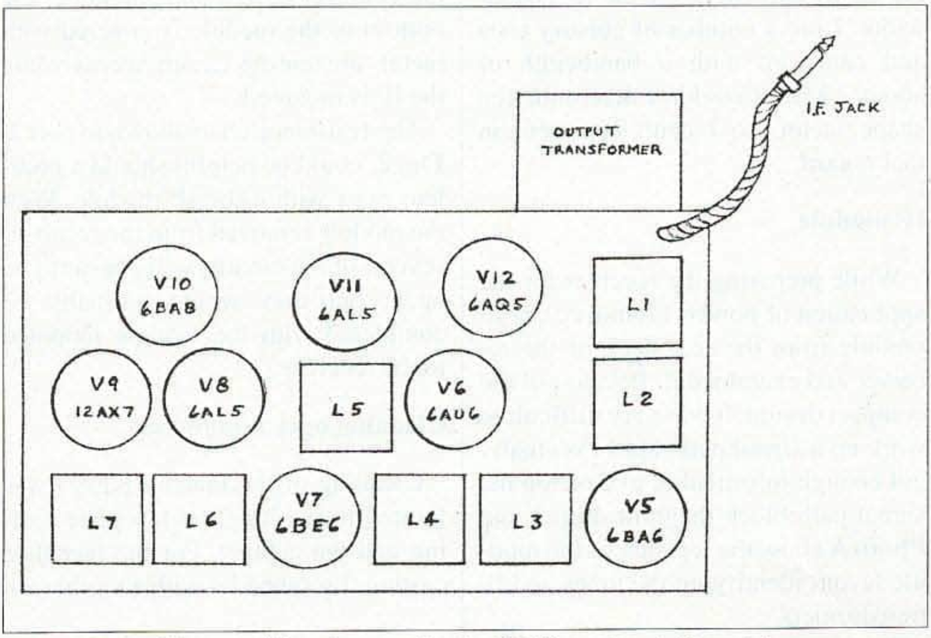

***Fig. 1.** General layout of the tubes used in the KE-93 receiver's IF module.*

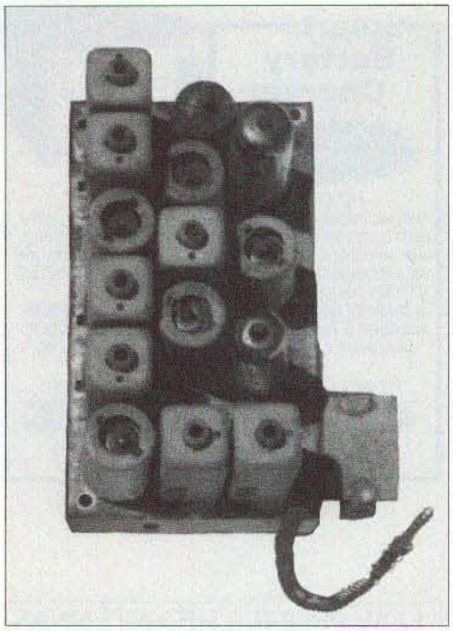

Photo A. Top side of the IF module showing the compact design. The audio output transformer is shown on the rear of the chassis.

measurement" using available equipment such as a calibrated output signal generator.

Table 2 shows the band, frequency of measurement, and sensitivity value that I obtained for the KE-93. The numbers impressed me because no other tubed receiver had performed as well on my test bench. The only thing that I can attribute to the nice performance is

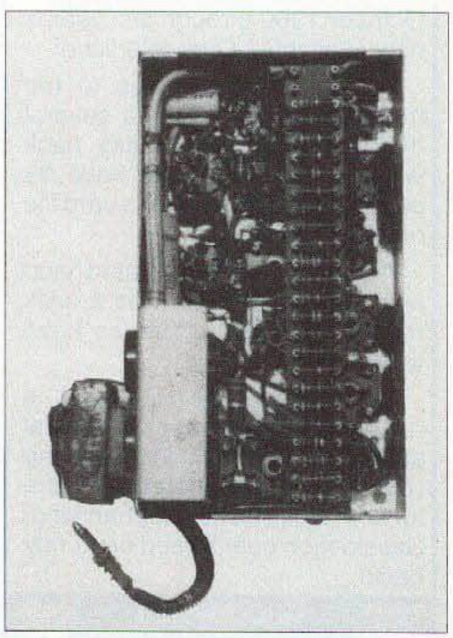

Photo B. Underside of the IF module showing the compact design. The audio output transformer is shown on the rear of the chassis.

the HI-Q turret tuner design. Of course, the low-noise 6BZ6 RF tube helps, too!

Before leaving the sensitivity performance, let's note that most competitive receivers exhibit a better sensitivity with the BFO turned "on" when compared to the AM mode. As I determined for the KE-93, the CW and AM sensitivity remained the same, and I was curious to determine why. What I discovered was that the KE-93 design reduces the BFO injection level when in the SSB mode when it is needed for proper SSB audio recovery.

The KE-93 was one of the first ham band receivers to be designed with SSB as an operating mode. Even though the receiver does not have a product detector, it's hard to tell that from the superb SSB performance that's exhibited.

When operating the receiver in the SSB mode, the AF gain is advanced to near maximum and the SENS level is reduced slightly. Yes, because of the sensitivity factor, the front end can overload when either the CW or SSB mode is selected and the RF gain is set too high. Backing down the SENS level (RF gain) slightly, the receiver became alive and performed well during my tests.

After tuning around the bands and listening to SSB signals, I noticed that the receiver was doing a pretty good job of separating adjacent signals. This raised my curiosity as to the IF's bandwidth. I ran a number of cursory tests and came up with a bandwidth of about 2 kHz. I couldn't determine the shape factor, so I can't comment in that regard.

IF module

While preparing the receiver for the application of power, I removed the IF module from the rear deck of the receiver and examined it. Because of the compact design, it was very difficult to work up a signal path, but I eventually got enough information to develop the signal path block diagram. **Fig. 1** and **Photo A** show the top side of the module layout identifying the tubes and IF transformers.

To remove the IF module from the receiver, I used the following procedure:

1. Pulled back the two connectors located on the underside of the receiver's chassis.

2. Pulled the IF wire/plug from the RF deck.

3. Removed the two screws located on opposite corners of the module.

4. Carefully lifted the module until the connector panel cleared the receiver's chassis.

5. Tilted the module up slightly to achieve connector panel clearance, then moved the module rearward.

A visual inspection of the underside (see **Photo B**) allowed me to detect two capacitor problems and one resistor problem. The 12 μF filter capacitor connected to the cathode of tube V9 had a cracked ceramic case. The other capacitor was a dried-out electrolytic capacitor connected to the cathode of tube V12. Finding the mechanically bad 1/2 watt resistor was interesting. The resistance value had shifted from 4.7k to nearly 9k ohms, and I was really surprised to find a resistance shift in a molded carbon resistor. However, what caught my eye was a very small chip knocked off of the corner of the resistor body near one lead.

When removed from the receiver, performance testing and voltage measurements on the IF module for troubleshooting purposes are difficult without an external test fixture. Due to the compact design and shielding, the bottom of the module is covered with metal, preventing circuit access while the IF is mounted.

The resistance chart shown in part 2, **Fig. 2**, could be helpful should a problem exist within the IF module. With the module removed from the receiver, several of the circuits will appear to be open, but they would normally be completed with the module mounted to the receiver.

Cleaning operation/notes

Cleaning of the Pierson KE-93 was limited to washing the faceplate casting and the cabinet. For the faceplate casting, I scrubbed it with a toothbrush

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and a mixture of dish detergent and water. Immediately after scrubbing, I wiped off all of the moisture with a paper towel. Although the dirt and grime were removed, the original dark color of the casting remained.

Cleaning the cabinet was much easier, because without electronics it was washed with detergent and rinsed with a garden hose. After drying the cabinet in the sun, I waxed the gray hammertone finish with auto wax and polished it with a soft rag.

Conclusion

Working with the Pierson KE-93 communications receiver was quite an experience for me. The design of the receiver exceeded my anticipated performance criteria that I'd considered normal for tubed receivers of the 1950s era. The narrow bandwidth, low intermod, no identifiable images, and high sensitivity of the receiver were very impressive indeed.

On the downside, however, the compact design, though great for both mobile and base applications, makes the receiver very difficult to troubleshoot and repair. For troubleshooting purposes, a complete schematic would be very helpful, but in the absence of a schematic, I'm hopeful that the information that I've provided will assist you in restoring your own KE-93. 73

Tesla: Inventor of Radio and Modern-Day AC

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recognized the business advantages of a claim to invention of the products and services he was marketing as a check on his competition. In those days, most monopolies were formed by merging or buying up the competition, or by driving smaller competitors out of business through costly patent litigation where possible. Today, this is referred to by antitrust lawyers as nonprice predation and considered to be a restraint of trade.

For example, Edison had joined The Gramme Electrical Company in 1882, a group formed expressly not only to fix prices but also to engage in patent litigation against "outside" electric companies (*Electrical Review,* May 15, 1882). The Sherman Act was not enacted until 1890. It outlawed price fixing and other restraints of trade (but by 1890, the business was already pretty well concentrated). In sum, evidence available from historical documents simply does not support Marconi's claim of invention, but shows only a strong incentive for claiming invention.

Marconi's interest in wireless transmission of intelligence did not commence until 1894.

In 1866, an American dentist named Mahlon Loomis showed that one could detect signals between two mountains in Virginia. Loomis applied for and was granted a patent for wireless telegraphy in 1872, some 22 years before Marconi learned of Hertz's experiments.

In 1897, Marconi could only reach a distance of nine miles. Two years later, he sent messages across the English Channel (the English Channel is about 22 miles in width from Dover to Calais) (Bruno, *The Tradition of Technology,* Library of Congress, Washington, 1995, pp. 110, 241).

In contrast, despite a laboratory fire in 1895 that destroyed most of his equipment, less than two years later Tesla was transmitting from his Houston Street laboratory in New York City a distance of 30 miles up the Hudson River to West Point (*Nikola Tesla On His Work With Alternating Currents,* N. Tesla, ed. L.I. Anderson, Sun Publishing, 1992).

Tesla was so confident of his new four-circuit system that in 1899 he wrote a letter to his friend Robert Underwood Johnson proclaiming "how … absolutely sure I am that I shall transmit a message [across the Atlantic] to the Paris Exposition without wire …!" (microfilm letter, Tesla to Robert U. Johnson, August 16, 1899, Library of Congress). 73

Calendar Events

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under 12 admitted free with adult admission. Mobile check-ins and directions until noon on 147.315 and 443.225, backup 145.275. Free parking. Handicap facilities available. Outdoor flea market spaces $2 per 10 ft section. Inside tables $10 per table, gate admission not included. Dealer/flea market setup at 6:30 a.m. Inside tables guaranteed until 9 a.m. with reservation fee in advance; others first come, first served. Dealer registration with SASE and check or MO payable to: *20/9 Amateur Radio Club, Inc., 55 S. Whitney Ave., Youngstown OH 44509.* Payment must be received no later than April 15th. For more info contact *Don Stoddard N8LNE, Chairman, 55 S. Whitney Ave., Youngstown OH 44509,* tel. *330-793-7072,* E-mail *[N8LNE1@neo.rr.com];* or *Rich Hamaker, Co-Chairman, 4939 E. Radio Rd., Youngstown OH 44515,* tel. *330-792-4019.* Uniformed and plain clothes security will be present. Alcoholic beverages, fire arms, and questionable or demoralizing materials are not permitted on school property.

GALVA, IL The Area Amateur Radio Operators club will hold the 3rd annual W9YPS/AA9RO Hamfest "ARRO Fest 2002" on April 28th, 8 a.m. to 2 p.m. at the Galva National Guard Armory. Handicap parking and handicap accessible. Excellent parking. Large outside flea market area. Electricity is available inside the building; bring your own extension cords. VE exams by reservation only. The National Guard Auxiliary will provide an All-U-Can-Eat breakfast as well as lunch. Advance tickets are $5 with three stubs, $7 at the door with one stub. To reserve tables and tickets, or to receive more info, contact *Matt Bullock, 419 E. College St., Kewanee IL 61443, [mbullock@bwsys.net];* or *Phil Imes, 908 Zang Ave., Kewanee IL 61443,* E-mail *[kewphil@cin.net].*

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ABILENE, TX The Key City ARC will sponsor its 17th annual Hamfest at the Abilene Civic Center from 8 a.m. to 5 p.m. Saturday, and from 9 a.m. to 2 p.m. Sunday. Free parking. VE exams. Wheelchair access. Limited RV parking for a nominal fee. Tables $7 each. Preregistration $7 (must be received by April 29th), $8 at the door. Talk-in on 146.160/.760. For reservations and info, contact *Peg Richard KA4UPA, 1442 Lakeside Dr., Abilene TX 79602,* tel. *915-672-8889.* E-mail *[ka4upa@arrl.net].*

MAY 11

RENO, NV The Reno Area Metro Simplex ARC will sponsor the Reno Spring Ham Swap at the KNPB Television Station, 1670 N. Virginia St. (on the campus of the University of Nevada, Reno), from 7 a.m. to 1 p.m. From