ARRL Periodicals Archive – Search Results

A membership benefit of ARRL and the ARRL Technical Information Service

ARRL Members: You may print a copy for personal use. Any other use of the information requires permission (see Copyright/Reprint Notice below).

Need a higher quality reprint or scan? Some of the scans contained within the periodical archive were produced with older imaging technology. If you require a higher quality reprint or scan, please contact the ARRL Technical Information Service for assistance. Photocopies are $3 for ARRL members, $5 for nonmembers. For members, TIS can send the photocopies immediately and include an invoice. Nonmembers must prepay. Details are available at www.arrl.org/tis or email photocopy@arrl.org.

QST on CD-ROM: Annual CD-ROMs are available for recent publication years. For details and ordering information, visit www.arrl.org/qst.

Non-Members: Get access to the ARRL Periodicals Archive when you join ARRL today at www.arrl.org/join. For a complete list of membership benefits, visit www.arrl.org/benefits.

Copyright/Reprint Notice

QST Issue: Jan 2003
Title: Restoring a Heathkit
Author: Ralph C. Craig, AJ8R

Click Here to Report a Problem with this File

By Ralph C. Craig, AJ8R

Restoring a Heathkit

Bringing a classic radio back to life can be a challenge, but as the author found, it's likely to be a rewarding one.

The letter was ominous. It was unusual for a technician in the Field Office to receive something directly from Corporate; correspondence had always come through the Field Office Manager. What could it mean? With trepidation, the envelope was opened. The words stood out with shocking clarity: *"...due to a reorganization, the position you now hold has been eliminated. A similar position in the Dayton, Ohio area is available. If you accept this position please report to the Dayton office within three weeks."* Its recipient had no idea that this letter would lead to a serendipitous gift, a desperate search and an exhilarating adventure for me, 35 years later.

Serendipitous Gift

The receiver, tuned to the local radio club's repeater, crackled to life—I was being called. I answered to find an offer from an old friend. Knowing that I liked to experiment and build equipment, he asked if I would like to have an old, non-working, SSB, tube-type transceiver to salvage, for parts. I hesitated before answering. My junk box was overflowing; my shack was stuffed...did I really need more of this stuff? However, I hated to disappoint him...so, in a moment of weakness, I answered yes.

That's how it all started, on a rainy November day. Showing up at my door with a tattered, water-stained and faded cardboard box in his hands, he explained how, more than 30 years prior, he had been transferred to the Dayton area. He had just received a license upgrade, permitting voice operation on the HF bands. In anticipation, he purchased a Heathkit[1] SSB transceiver. Although it was just about done, there was no time to complete it before the transfer took place. He placed it in a box and set it aside. After the transfer, he had temporarily abandoned Amateur Radio and stored the boxed kit in the attic. Later, coming back into the hobby, he purchased a new, all mode, solid-state transceiver, forgetting the kit. Now, 35 years later, he found it during an attic cleaning and thought of me. I thanked him and put the box in the shack for safe-keeping.

Surprise

I had become quite curious, so...after a week had passed, I opened the box. Removing some newspapers that were used as padding, I noticed the date on a page, a day in April of 1967... 35 years prior. This transceiver was older than half of the local radio club's members! As I removed it, a few items, including the instruction book, fell out of the box. There, sitting before me, was a Heathkit Model HW-12, 80 meter Single Band SSB Transceiver, in good condition and far from the "junk box" candidate I had expected to see (see Figure 1).

I wondered whether the transceiver would work. Had the parts deteriorated so much in 35 years that they would fail when power was applied? If parts did fail, were replacements available? Where could I find them? And, lastly... how would its operation compare with today's sophisticated equipment? The challenge to place the transceiver into operation seemed daunting, but I felt confident that it could be done.

Expecting the worst, I gently removed the outer case. I was amazed...there was not even a cobweb; just a coating of dust with some minor corrosion on a few metal parts (see Figure 2). Turning the chassis over, I found that the underside was in even better condition than the top. Impatient, I wanted to plug it in immediately but I knew better. From prior experience, I knew that could lead to disaster. I searched for information on restoring older equipment. I found some ideas in *QST*, *Popular Communications* and *Monitoring Times*. It soon became apparent, however, that they dealt primarily with commercially

[1]Notes appear on page 58.

Figure 1—Heathkit HW-12 SSB transceiver, introduced and first sold in 1963.

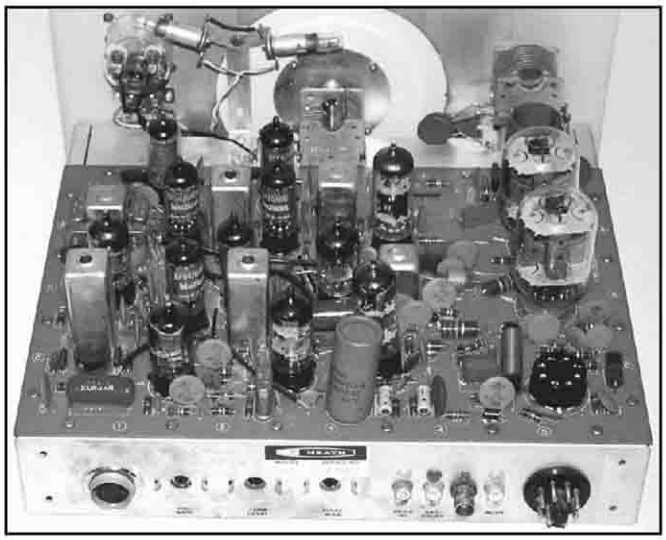

Figure 2—Interior of the HW-12 showing tubes and components.

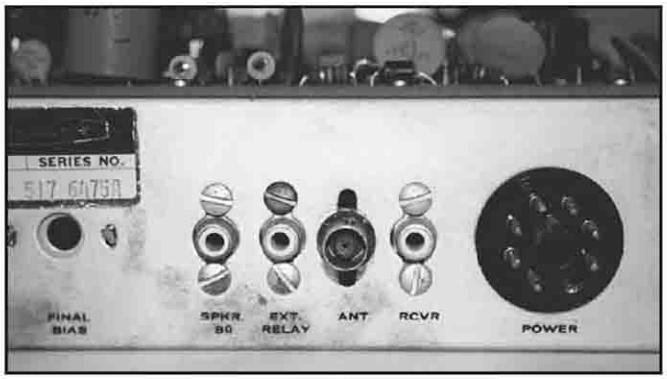

Figure 3—The only modification—a BNC antenna jack substitution by the original builder.

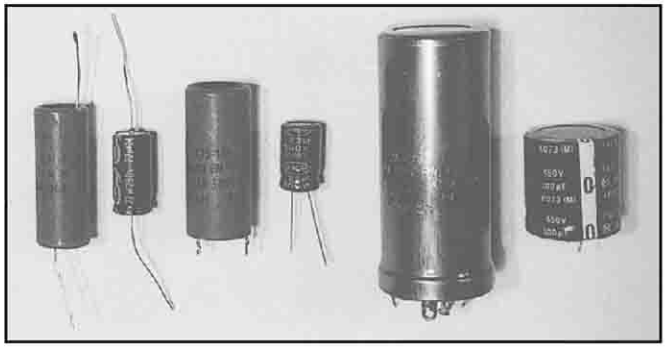

Figure 4—I hollowed out the old capacitors and inserted new, smaller units to preserve the original appearance.

built equipment. Restoration of a kit-built transceiver would require a different approach.

After pondering a course of action, I devised the following basic approach to restoration and used those steps that were applicable:

- Get all the available instruction books, schematics and construction procedures.
- Clean the unit using a vacuum and a soft paintbrush, being careful around delicate components.
- If the unit was stored in a damp area, there was probably moisture penetration into transformers, coils or inductors. Place the unit in an oven set to its lowest temperature to dry it thoroughly.
- If the equipment is extremely dirty, gently wash it with soap and water, then rinse well with distilled water and again dry in an oven set to its lowest temperature.
- Check to see whether the kit has been completed. If not, are parts available to finish it? If not, can those parts be fabricated from other components?
- Check to see that parts have been installed correctly. Look at stenciled locations on PC boards and assembly manual details for parts locations.
- In point to point wiring, check for signs of modification, different types of hookup wire, substitution of similar parts and newly soldered joints.
- By visual inspection, look for any obviously faulty parts—burned resistors, leaking capacitors or broken wires.
- Visually inspect all soldered joints for cold solder joints or faulty soldering technique.
- Check switches or relays for oxidation of contacts; clean all dirty or oxidized contacts with contact cleaner.
- Check all wiring for insulation that has deteriorated and replace damaged wiring.
- Check installed tubes and transistors for proper types.
- Identify any electrolytic capacitors. In older units they surely will be dried out and useless. Replace all electrolytics with new units.
- Be careful not to disturb settings of adjustable coils, trimmer or padder capacitors and IF transformers. Alignment can be done later using proper test equipment and procedures.

Many of these steps can be combined to simplify the process. The wholesale replacement of parts, without proper testing, is not recommended. Aside from electrolytics, more problems can be introduced by indiscriminate part replacement than may already exist.

When a physical inspection is completed and any obviously damaged parts replaced, the equipment is ready for further testing. If possible, use a variable voltage ac transformer to *slowly* raise the line voltage to the unit over a period of an hour or more.[2] This will allow the parts, especially capacitors, to adjust to operating voltages that have been dormant, preventing some failures. Apply the usual troubleshooting procedures: check voltages at key spots against those known from the schematic and replace any parts found faulty with exact component types, if possible.

Restoration

With these steps in mind, I removed the chassis from the case and carefully inspected it. Despite the statement by my benefactor that he did not have time to finish assembling the unit, the transceiver appeared to be complete. The underside of the printed circuit board was impressive; the soldering was impeccable. It was not surprising that the exposed silver contacts of a relay and a wafer switch were dark from oxidation. [Silver oxide is black in color and it is common on older, silver plated conductors. Although it appears ominous, it's as good a conductor as the native silver.—*Ed.*] I cleaned all contacts with contact cleaner. Considering its age, the transceiver was in remarkable condition. There was one modification—a BNC type RF connector had been substituted for the phono connector originally used by Heathkit as the antenna output jack (see Figure 3). I left it alone.

Next, I checked the separate power supply, a Heath model HP-23A. No schematic was available, although its point-to-point wiring made it easy to draw a schematic. The first portion traced was the –130 V bias power supply. Next came the "low voltage" +250 V dc supply and, finally, the transmitter's truly high voltage 800 V dc supply. These voltages can kill you. Use extreme caution when working on energized tube equipment and its power supplies. Discharge all medium voltage and high voltage filter capacitors, even after you remove power. Never trust bleeder resistors—they may be defective. The advice of an old timer came to mind: "Keep one hand in your pocket when troubleshooting live circuits with high voltage."

Dilemma

There were three electrolytic capacitors in the transceiver and seven in the power supply. These capacitors use a wet paste-type electrolyte to form an insulating barrier on an aluminum foil electrode that acts like a dielectric. Over many years, the electrolyte dries out and the barrier is lost. It is therefore routine practice to replace all older electrolytic capacitors. All were faulty, with low capacitance and high leakage. Finding exact replacements was next to impossible; the values listed in numerous catalogs did not match those that needed replacement. I had to choose the closest value to that needed. Because of technological advancements, the physical size of the replacement units was vastly different from the original (see Figure 4).

This posed a dilemma. Should the transceiver be restored to working condition only or should it be restored to working and

Figure 5—The Heathkit HP-23A power supply. Note the 11-pin socket that needed a plug and the 2 conductor ac cable that was replaced with a 3 conductor grounded type.

original physical condition? I decided to compromise. The original capacitors were hollowed out, leaving only the outer shells. I then inserted replacement units into the shells and reinstalled the new package. The original physical appearance was thus retained, but with new, modern components. A second appearance item took more thought. The power supply ac line cord was the old non-grounding, non-polarized type, having only two conductors. Should I replace the cord with a grounded line cord with the ground conductor connected to the metal case? Safety won out and I installed a 3-wire grounding cord.

With inspection and replacements completed it was time for the proverbial "smoke test." I plugged the power supply into a variable voltage ac transformer and slowly raised the ac line voltage. Nothing came out of the supply, even with full line voltage applied. My heart sank. If the power transformer had failed there was no way a replacement could be found, since it was custom designed. Wait…there was an output connector on the power supply, 2 pins of which went to the transceiver, so that primary power could be switched from the transceiver. Quickly, a jumper was made to temporarily connect the two pins. Power once again was applied and, once again, nothing happened. This time, the problem was traced to a circuit breaker in the supply. It was temporarily bypassed with a fuse, and presto, the supply became operational! All voltages were present and within expected limits.

Desperate Search

With the power supply operating properly, it was time to energize the transceiver. There was, however, one last item. Where was the power cable that connected the power supply to the transceiver? In my excitement while restoring the units, I had overlooked this cable. A search revealed that no cable came with the units, nor could my benefactor find one. I would have to fabricate one. The transceiver end of the cable used a standard 8-pin octal tube socket. The power supply end was different; it used an 11-pin plug and socket (see Figure 5).

I made a casual search of several catalogs and then to a local surplus electronics store. Nothing. Then to fellow ham junk boxes and, again…nothing. With no plug available, there were two alternatives, neither entirely satisfactory. A plug would either have to be fabricated using pins from an old octal tube or the connector would have to be changed. A bit discouraged, I waited and procrastinated, which eventually resulted in a pleasant surprise. WD8BMA showed up at the shack with some Motorola, GE and Air Force equipment, circa 1960. As we unloaded an old Motorola commercial FM transceiver chassis, I noticed a cable. One end was cut off. Unplugging the cable to dispose of it, I quickly glanced at the end…hooray! Here was the exact plug I had so desperately searched for. I removed the plug and assembled the power cord, being cautious to use wire with the proper voltage rating, as at least one of the conductors had to handle 800 V dc safely.

Testing...

With the two units connected by the new power cable, it was time for the final "smoke test." I connected a dummy load to the transceiver RF output jack and turned on the ac power. A faint hissing sound came from the speaker. The transceiver was working! To compare the operation of the HW-12 to today's more sophisticated equipment, I decided to align the unit using the instructions contained in the manual rather than use more advanced test equipment, as I wanted it to be representative of the way hams of the day would have built it.

With alignment completed, I connected the transceiver to an 80 meter antenna and compared its performance against a modern transceiver. I found receiver sensitivity to be excellent. Contacts on the less crowded frequencies were satisfactory, although on the more active frequencies the simple two-stage crystal filter was too wide to separate closely spaced signals. Without a narrow IF, sharp filters, passband tuning, a receiver notch filter and RIT, reception was difficult. The transmitter, rated at 200 W PEP input, performed better than expected, reaching every station the modern transceiver did.

Conclusion

Restoring older equipment built from a kit is gratifying, but it requires a different approach than that used to restore commercially built equipment. The original builder may not have used proper soldering techniques or possessed good assembly skills; components might have been custom-designed and modification in later years would have been more likely. In many cases, the original assembly manual might not be available. Restoration is an educational and satisfying experience, however, and it will reward the restorer with a significant sense of accomplishment in resurrecting some of Amateur Radio's past.

Operating with "yesterday's" technology can be challenging, as the performance of older equipment, particularly kits, will probably not equal that of modern equipment. Despite the challenges, the next time you're offered an old kit, take the plunge and restore it…you'll be exploring a bit of the history of Amateur Radio.

Notes

[1]Formerly known as the world's primary producer of electronics kits, the Heath Company of Benton Harbor, Michigan started producing kits for the Amateur Radio market around 1953. During the mid 1980s, a declining electronic kit market caused the company to close its doors. Many an Amateur got his or her start by building a Heathkit.

[2]A word of caution. Too low a line voltage may actually inflict additional damage, as the instability caused by voltage differentials, regulator "starving" and improper bias voltages can upset intended circuit design. Also, fans or other electromechanical components often overheat at reduced voltages. The object is to effect a "soft-start," so capacitors have a chance to "re-form" and not be subject to the shock of rated voltage levels. If this technique is used, it is suggested that the equipment be started at its specified minimum line voltage input, usually 85-90 V ac, rather than at 0.—*Ed.*

Ralph C. Craig, AJ8R, was first licensed in 1948 as W1RAW. After completing a five-year Electronic Technician apprenticeship at the Portsmouth Naval Shipyard in Maine, Ralph worked for the FAA for 25 years, 20 years as Field Office Chief. His wife, daughter, son-in-law and a grandson are all hams. You can contact the author at **ralph.craig@juno.com**.