The Chinese 222-1 Receiver — An Adventure in Restoration

A new-in-box Chinese military receiver proves a fascinating restoration challenge.

Steve Johnston, WD8DAS

Figure 1 — Steve in his restored M-38 military Jeep.

Remember the "Brand New Military Jeep in Crate only $250" offers that used to be advertised in the back of magazines? Those deals were actually just advertisements for information on how to buy US Government surplus and the elusive "crated Jeep" for a bargain price never materialized for the average guy. My desire for a military Jeep had to be satisfied by restoring a certainly not brand new 1951 M-38 (see Figure 1).

My experience with communication equipment has been much the same as with my military vehicle — being only 45 years old, I never had the opportunity of buying a tube-type transmitter or receiver new from a dealer. I've bought some solid-state ham gear new but that's not the same — I missed the experience, the smells, the excitement, of being the first to use a new communications receiver of what we now call *vintage* vacuum tube design. But I craved that feeling.

Thus it was that my mind started racing when I came upon an eBay auction for a new in the crate, sealed in plastic, Chinese military surplus tube type communications receiver — the model 222-1 (see Figure 2). The price was high and likely to go higher but my interest remained. Here was a chance to buy a new receiver and have that unknown experience I sought. And it was military surplus — that was a definite plus, as I have a small collection of surplus gear from the US and other countries and appreciate their design and construction.

A little research revealed the 222-1 was made in the 1970s at the Shanghai Third Radio Factory and the design was based on miniature receiving tubes of Chinese origin. Remarkably, someone had posted a copy of the manual for the receiver at the BoatAnchor Manual Archive (BAMA) Web site (**www2.faculty.sbc.edu/kgrimm/boatanchor**), so I was able to download the file and learn more. Unfortunately for me, the manual was written in Chinese, but there are enough international constants in the conventions of electronics to allow me to make sense of at least some of the information.

I learned that the 222-1 is a single conversion receiver tuning 1.5 to 30 MHz in five bands: 1.5-3, 3-6, 6-12, 12-20 and 20-30 MHz. Four IF bandwidths are available: 0.4, 1.5, 3.0 and 6 kHz. An internal multimeter is intended for diagnostics, showing cathode current for each of the tubes and the overall heater and plate voltages. There is no direct S-meter selection, but you can gauge the strength of incoming signals to some degree by watching amplifier cathode currents.

Audio output is 600 Ω to a medium impedance speaker. Power supply input voltage is adjustable from about 180 to 250 V, 50-60 Hz. The receiver's weight is 48.5 pounds and the power supply is 11.5 pounds.

Radio Fever

Uh, oh. The fever started to build. I *wanted* a brand new, fresh out of the box, shiny tube

Figure 2 — The 222-1 receiver's front panel.

receiver. I wanted one so badly. I'd even take a Chinese receiver. I swallowed hard, considered my bank accounts one more time and placed my auction bid at the level where the two pertinent factors intersected: The point at which I thought I could win and that where I thought I could afford to win.

Okay, okay, if you must know, I paid about $580 for the receiver and $125 for shipping. Resistance was futile — it was expensive by my hobby standards but I figured this is a rare chance to have a new "fresh from the box" tube receiver.

The seller, who clearly has shipped more than one of these receivers to the United States, indicated that surface shipping would take quite a long time but was reliable. I tracked the packages as far as leaving Shanghai — no further information was available on the mysterious China Post Web site. Weeks, then a month, then another, passed. Clearly my equipment was traveling via the proverbial "slow boat from China" to Wisconsin. Finally the first box arrived about 2 months after the auction ended. It contained the manual, two sets of headphones, spare parts, tubes and the power supply all in sealed vinyl bags. The new-in-the-box tube HF receiver couldn't be far behind.

Two weeks later the second box was on my front porch (see Figure 3). It was packed well and was in a hermetically sealed bag as promised, but the cabinet and one of the antenna binding posts did suffer some damage in shipment. Later I pulled the binding post entirely out and put a BNC jack in its place so I can use coaxial cable to connect the antenna.

Initially there was a "cloudy" look to the surfaces of the panels and controls. This turned out to be a coating of oil or grease, perhaps intended as a preservative. A little rubbing with a shop rag and it shined up beautifully with the original glossy finish. The inside of the receiver was pristine — shiny and completely new. No dust, no dirt, no corrosion—oh boy, oh boy, oh boy.

My First Look

I gave the receiver a thorough visual inspection over the next few days — I wanted to savor this experience. Thanks to the sealed storage, the lubricants in the receiver were still quite fresh — not hardened as with most old receivers I've worked on. I added a drop of synthetic turbine oil to any points I thought might benefit and also added a tiny drop of DeOxit D5 contact cleaner (**www.caig.com**) to each exposed switch contact (although there was not a single bit of corrosion or oxidation to be found — everything was bright and shiny — see Figures 4 and 5. Apparently my restoration habits die hard.

After several evenings' work, I'd done about all the prepping I could think of, so I installed a three-wire ac cord on the power supply and gradually increased the applied voltage from 0 to 120 V ac with a Variac over a few hours. This technique seems to allow long-unused electrolytic capacitors to reform their dielectric and prevents premature failures after years of storage. Then I connected the power supply to the receiver and took the input voltage up to the full 220 V ac. No problems — the receiver came alive immediately and signals came pouring forth from the speaker. The 222-1 seemed quite stable — drift from a cold start was minimal and mechanical shocks did not shift the frequency significantly. My "Chinese receiver" was alive and kicking.

The 222-1 was in pretty good alignment, but I could not resist trying to improve it (or at least see how close it was to being optimum). The alignment chart in the manual and silk screen chassis component markings helped identify the proper adjustment points. The usual technique — adjusting the inductor at the low end of the band and trimmer cap at the high end — did the trick nicely. Frequency tracking was especially impressive. I've never had an analog VFO tuned receiver that tracks as well as 222-1. The dial is right on the money at both ends of each of these quite wide frequency bands. Even my R-390A is about a kilohertz off across its narrower 1 MHz bands.

Speaking of tuning, the "feel" of the 222-1 controls under your hand is absolutely wonderful. It has a large, heavy flywheel behind the panel and a tight-tolerance, split-gear VFO drive — making for a "deluxe" tuning experience recalling the Hammarlund SP-600, HROs and other renowned "band cruiser" receivers. You can even give the knob a spin, let go and let the flywheel's inertia scan the band for you. And unlike some military surplus equipment, the style and design of the 222-1 are well suited to amateur and shortwave listener (SWL) use — nothing weird or strange here.

Chinese Checking

I did not know any Chinese characters when I started the project, but I could compare the ideographs in the manual with the labels on the front panel and at least find the same symbol. What it meant was another story. There are a few, very few, recognizable English designations present, such as "47k" or "C141" so that helps. It is like deciphering a mysterious code.

Because the receiver's schematic did not show tube pin numbers, I needed to do some research on the specifications of the unusual tube types in use. Spare tubes were provided in the kit, so I wasn't as concerned about failures as I was about having enough detail to further decipher the design. Information was very sparse on the Web, but by combining material from Chinese, Russian and audiophile Web sites, and my own reverse-engineering, I found that most of the tubes should have direct US substitutes and worked

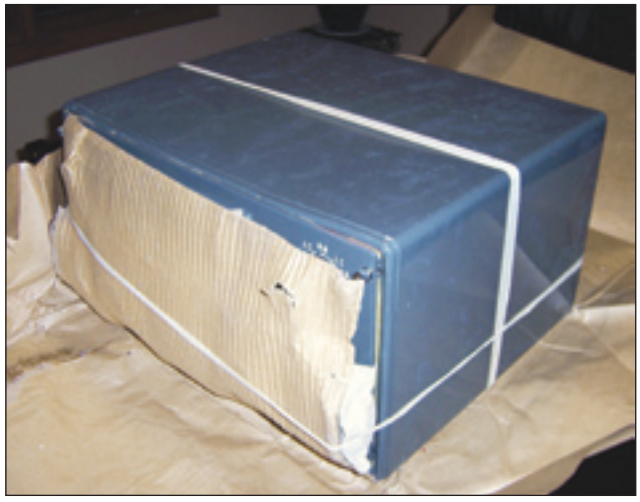
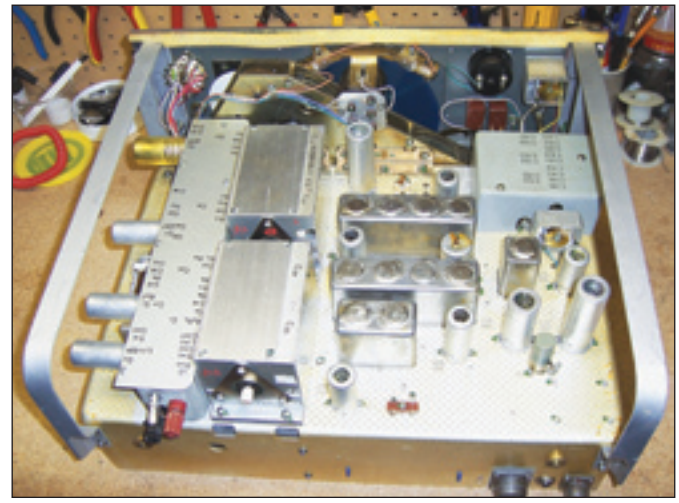


Figure 3 — The receiver as it was being unpacked.



Figures 4 — Top view of the receiver's circuitry.

out the pinouts. For example, I found that the Chinese 6K4 corresponds to a 6BA6 remote cut off pentode and the 6P1 is a beam tetrode very similar in performance to a 6AQ5 but on a nine-pin base.

I used my experience with other receivers, and consultation with the handbooks, to work out more detail from the schematics. The design is clean and straightforward and includes a few advanced touches that show it has benefited from the many years of tube design that has gone before. For example, for maximum stability, the power supply provides regulated plate and heater voltage to the oscillator tubes. Amplifier and detector tubes get their heater voltage with a small dc bias applied for best performance.

Figures 5 — Bottom view of the receiver's circuitry.

Mechanically, the 222-1 is solid. By use of rigid castings and box structures the receiver has excellent mechanical stability. Tune in a steady signal and pound on the rig — you'll hear no change in the beat frequency.

The purpose of some of the front panel controls was not clear at first. By cross-referencing component values, style of construction and other clues from the schematic (as well as some plain experimentation), I located the three front panel gain controls: RF gain, IF gain, AF gain, the power switches and most of the other controls. Initially the automatic gain control (AGC) wasn't working as I would expect — I figured either I didn't know how to switch it on or it wasn't working right. Also, I had no idea about ¾ of the many meter switch positions.

About this point in the project I mentioned it to Jim Amos, N8CAH, and he offered to seek the help of Zhigang Gao, a Chinese-American engineer at his firm. Together we figured out all the controls (see Figure 6).[1] This work revealed to me that the mode switch included positions for AGC as well as manual gain control.

With this information in hand I was ready to trace out the purposes of the many multimeter switch positions. I found that the meter can be switched to read the regulated and unregulated heater (filament) voltages, and cathode current for nearly all stages and a sample of the audio output.

I also traced the wiring to the ¼ inch audio output jack on the back and confirmed it comes from the 600 Ω transformer's speaker output winding, so I initially used one of my US Army speakers, a brand new LS-166/U that has a built-in transformer to convert such medium impedance audio outputs to the 8 Ω speaker. Later I used a bookshelf-size, high fidelity speaker with an external transformer (a RadioShack paging transformer's 10 W tap is quite close to 600 Ω). What a beautiful sound — clearly one of the best sounding communications receivers I have used. The headphone jacks on the front panel are fed by 600 Ω transformer windings as well.

Lessons Learned

What would I change? I would have a built-in 8 Ω output (and I might well do that — there's plenty of room). I would also have added a product detector for SSB and CW reception. The existing diode envelope detector seems to be optimized for excellent results in all modes and does a very good job.

The 222-1 is a high quality, heavy duty communications receiver of vintage design that can be purchased "new" — a rare thing indeed. I greatly enjoyed the experience of being the first person to open and use this receiver and have continued to use the receiver daily. As I write this, the BBC World Service is sounding great on 41 meters. A little later I'll drop down to 75 or 160 meters and listen to the bands — both AM and SSB sound excellent on this remarkable receiver.

All photos by Steve Johnston, WD8DAS.

Steve Johnston, WD8DAS, an ARRL member, has been a destroyer, builder, repairer and restorer of electronic equipment nearly all his life. He holds a BA in history and is Director of Engineering and Operations for Wisconsin Public Radio. In the rare hours not spent with radio and electronics he pursues his other avocation as a writer and historian. He has been a ham for 33 years and lives in Madison, Wisconsin with his wife, Christy and two children, Kaitlin and Noah. He can be reached at 2309 Tulare St, Fitchburg WI 53711, **sbjohnston@aol.com**.

[1]Additional photos and information are available on the *QST* Binaries Web site (**www.arrl.org/files/qst-binaries**).

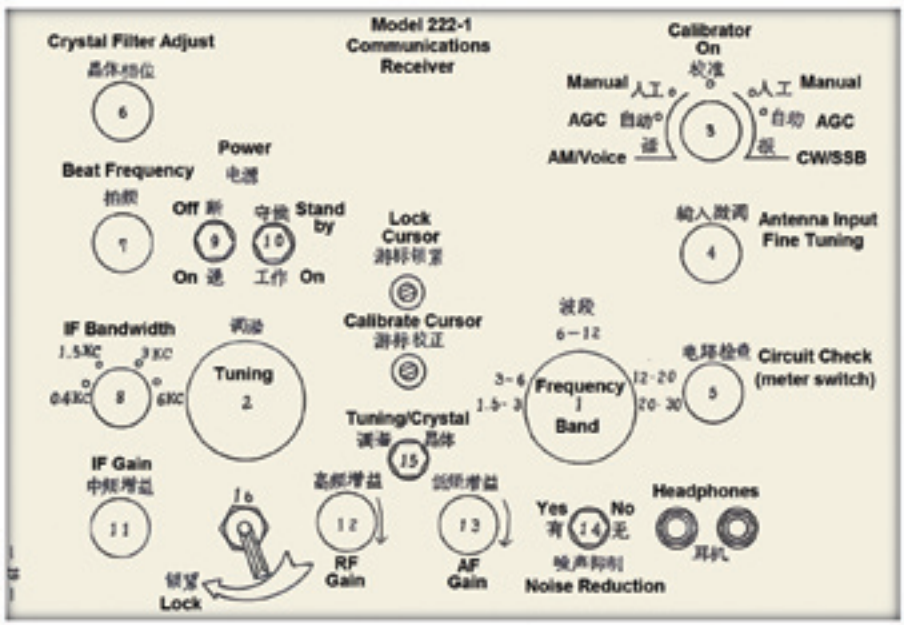


Figure 6 — The 222-1 front panel nomenclature translated into English.

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