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RECEIVER SHOWDOWN

A Comparison of Five Top RXs from a MW DXer's Perspective

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You know, most jobs have their high points and their low points. Doing tests like this one is definitely one of the high points of my job, hi.

As a research scientist for the Navy I'm responsible for, among other things, improving communications, especially radiocommunications, among Naval aviators and other personnel in the aviation environment. In support of this effort, I maintain in my office/laboratory a monitoring post composed of various rxs capable of receiving all types of signals across a very wide frequency range. Because many of the rxs I had been using were well past their typical life span and because I had some money left over from one of my projects, I decided that this was the time to upgrade the monitoring post. Rather than spend $15K-$20K on a single mil-spec rx that was designed for heavy use in hostile environments, I decided to save the government some money and order several commercial grade rxs instead. All of the HF rxs also covered the broadcast band so I spent a few weeks of lunch hours and also stayed late at work several nights to conduct the tests in this report.

I hope that the findings reported here will answer some questions you might have and, perhaps, save you some money and/or disappointment if you are about to plunk down some hard earned cash for a major rx.

THE RECEIVERS

The five receivers tested included the ICOM R-9000, the ICOM R-71A, the Japan Radio Corporation NRD-535D, the R.L. Drake R-8, and the old R-390A. I won't bother re-hashing the manufacturers' specs for each of these rxs; those data are readily available from a number of sources. Rather, I'll just say a few words about each rig and describe how each rx was equipped...

ICOM R-9000 -- This was by far the most expensive rig in the group--about $5,000. As you already know, this rig has a built-in spectrum analyzer for visually displaying the received and surrounding frequencies and covers a frequency range from 100 kHz to 1999 MHz! It was in its stock condition when tested and was equipped with the excellent SP-20 external speaker.

ICOM R-71A -- This rx was purchased several years ago from the Electronic Equipment Bank and was their "upgraded" model with the FL44A 9MHz IF filter and supposedly had their enhanced dynamic range modification, preselector mod, etc. Two of these were purchased at the time; one went down shortly before these tests began so the other "brand new" one was broken out of its box for testing. This model did have the PBT feature and was evaluated using ICOM's SP-3 external speaker.

JRC NRD-535D -- The 535D was the second most expensive rx, available for about $1700 from several sources. Ours had the upgraded 4 kHz "wide" filter rather than the earlier 6 kHz'er and had the ECSS board and the variable bandwidth feature typical of this "D" model. It was tested using the JRC NVA-319 external speaker.

Drake R-8 -- The R-8, at current prices, was the least expensive "new" rx tested -- under $1000. It was tested in its "straight from the manufacturer" condition and was paired with Drake's MS-8 external speaker.

R-390A -- As a point of comparison, I decided to throw this venerable old standby into the fray. As everyone knows, this is an old tube type, designed by Collins and manufactured by several companies (the one I used was made by Amelco). I had aligned and re-tubed this guy about 18 months before this test so it may not have been in absolutely perfect shape but I feel that it was pretty close. I ended up using a pair of communications headphones to monitor the audio on the R-390A.

Before the testing began and before I had even received some of the rxs, I had some questions in mind about the rxs...

1. Yeah, the R-9000 had a lot of bells and whistles and a wide frequency coverage but would the "jack of all trades" nature of this rx result in performance compromises on the tough MW band? Secondly, I wondered if I would be able to "see" carriers on split frequencies even if they weren't producing readable audio?
2. The NRD-535D advertised a variable tuned front-end, sort of an automatic preselector. Was the Q of this feature high enough to place the 535D head and shoulders above the rest when a broadband antenna was used?
3. How would the R-71A perform in this group? My personal, modified R-70 beats the pants off both of the R-71As I have at the lab; I've never known whether my R-70 is super good or whether the R-71A design incorporated some performance compromises to gain operating conveniences (e.g., keypad frequency entry, remote control, etc.).
4. I was really interested in the relative performance of the old R-390A. It didn't have any of the latest features such as synchronous AM detection and IF Shift/PBT and it wasn't designed to be a super sensitive receiver. I didn't know how it would come out.

FIRST (NON-PERFORMANCE) IMPRESSIONS

R-9000 -- My first impression of the R-9000 came when I started wrestling this guy out of its shipping box -- it weighs about 44 lbs., far more than the other rigs but far less than the old R-390A. Visually, there is a bewildering array of buttons and knobs (which is to be expected in a rx with the flexibility of the R-9000) and the overall "appearance" of quality is high.

R-71A -- The R-71A has been around long enough that first impressions have faded from memory. Its appearance and "feel" are, however, professional.

NRD-535D -- The 535D is a handsome rig with a solid feel and a professional demeanor.

R-8 -- Being the least expensive new rx tested, the R-8 lacks some of the pizzazz of the other rigs. The rx sheet metal is a little flimsy, the plastic tuning knob practically shouts "Cheap!" and the rubber-feel buttons may be "the latest thing" but seem better suited to a $100 portable. I also would have preferred a different color of display lighting -- greenish yellow falls just below lavender in my personal ranking of "most disliked display colors."

R-390A -- Everyone knows the R-390A -- heavy, serious, government gray.

The preceding are my own personal, totally subjective impressions of the aesthetics and arm's length judgments of the quality of the rigs. As a general rule, these concerns are way down on my list of considerations in buying a radio. If the rig performs superbly, it can look like a PeeWee Herman kitchen appliance and I'll still buy it.

THE TEST SET-UP

The site of the tests was the Naval Aerospace Medical Research Laboratory located at NAS Pensacola. The building is on a promitory and about a block from the Gulf of Mexico (which can be clearly seen from the roof). Because the monitoring station is located in the basement of this three-story, ferro-concrete building, any desktop antenna (e.g., loop) is out of the question. I didn't really want a tuned antenna anyway; I wanted to test the front ends of the radios without the help of a tuning circuit. I have several antennas on the roof for monitoring HF and higher utility frequencies but didn't have anything specifically for MW so I ended up installing an Alpha/Delta sloper (Model DX-SWL; the one with the MW leg) for these tests (incidentally, this antenna performs quite well on MW).

The antenna was routed through a shielded conduit to the monitoring station and was connected to a six-way antenna switching box. This allowed me to quickly switch among the rigs for A/B (or, I guess, A/B/C/D/E) comparisons.

In comparing the radios, I spent as much time as necessary adjusting knobs and altering settings to get the best possible signal from each rig. This was sometimes a tedious process because the strengths of both the desired and interfering signals would tend to vary. Once I was convinced that no further improvement was possible, I would switch through the rigs and make subjective evaluations. What I'll report here are the comparisons that were most confidently and reliably made.

SENSITIVITY COMPARISONS

Comparing sensitivities using on-the-air stations is a lot trickier than using a signal generator -- signals fade, interference can be present, etc. However, using on-the-air stations can provide more meaningful info than "microvolts for a given S/N ratio" in that the whole system (e.g., quality of the detector, passband of the audio stage, etc.) comes into play. I've seen radios that seem to reveal a greater presence of a carrier, yet produce no audio, or poorer audio than a radio that seems to present a less potent carrier. In other words, for these tests, I've adopted a definition of sensitivity that relates to "the

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radio's ability to produce readable audio from a very weak station not being QRM'd by a nearby station."

At my location here in northwest Florida, perhaps the best ever station for determining sensitivity as I've defined it appeared this summer. The new Turks & Caicos station on 535 kHz has been audible throughout most days this fall and winter. There is no signficant interference from the couple of weak stations on 540 kHz (WGTO and KNOE) and, most importantly, the prevailing signal level of R. Vision Christiana is such that it discriminates nicely among the radios being tested.

Results...

1. NRD-535D -- At high noon, the 535D provided audible, but barely readable SS. The signal was generally too weak for the an ECSS lock and did show some fades. The 535D was always first to fade in and the last to fade out.
2. Drake R-8 -- The R-8 was usually less than 2 secs behind the 535D in fade ins and ahead of the 535D by the same amount on fade outs. If the R-8's preamp had been operative below 1.8 MHz (it's automatically disabled below this frequency), it would have been the most sensitive. Even though the R-8 was a little behind the 535D in producing audio, its audio was crisper and more easily readable than the slightly "woolly" sounding 535D audio.
3. R-390A -- Was last to fade in with readable audio and the first to leave. There were times when the signal level never did manage to cross the R-390A's threshold. When audio was readable, it was very close to the R-8 in clarity.
4. R-71A -- Carrier was almost always detectable but it never did produce readable audio (although some audio would occasionally appear). Switching on the preamp helped little.
5. R-9000 -- Carrier always detectable (not visible on spectrum display) and never produced audio, readable or not, regardless of what I did.

As noted, although the signal would appear first on the 535D, the R-8 was always close behind and always produced more easily readable audio. The R-8 with the MS-8 speaker sounds as though it has a peak audio response between 2 kHz and 4 kHz which makes the information carrying speech consonants stand out. The R-8 was always best at digging out intelligible speech from weak, poorly modulated signals.

SELECTIVITY COMPARISON

One of my standard tests for selectivity on the low end of the band involves tuning in WVOG-600 (1 kW) in New Orleans next to WVTJ-610, a local slopper. WVTJ-610 averaged 25 dB over S-9 on the rigs under test with severe overmodulation during the test session.

Results...

1. Drake R-8 -- Produced a fairly clean signal with the R-8 in the 4 kHz IF position and the PBT adjusted. Activating the synchro (i.e., ECSS) really cleaned up the remaining slop and significantly improved the audio.
2. NRD-535D -- Judicious setting of the PBT and the variable bandwidth feature (i.e., bandwidth control (BWC)) produced clean audio in the INTER(mediate) IF position. After activating the ECSS (LSB) and with the PBT readjusted, the quality further improved but was still not quite as good as the best R-8 reception.
3. R-390A -- In the 4 kHz position and with the rig tuned between about 598 kHz and 599 kHz (the R-390A doesn't have a PBT feature), reception quality was in the same class as the R-8 and 535D, maybe just a little more splash.
4. R-9000 -- In the middle IF selectivity position and with the IF Shift adjusted, the signal was barely audible and intermittent due to the AGC being activated by 610 slop and releasing too slowly--just as the AGC was decaying, it would be reactivated by the rhythms on 610 and the signal would be killed. Reception was best in the "narrow" IF position and with the AGC off but the audio was very muddy.
5. R-71A -- Not audible due to heavy slop and suboptimal AGC timing constants. Neither the wide nor narrow IF filters or any setting of the PBT produced audible audio. I fiddled with the controls for quite some time and was only able to catch a bit of signal (I think) with the AGC off and the IF in the narrow position. Switching back to the R-8, 535D or R-390A was an eye opening contrast to the two ICOMs!

These results were typical of several other tests of selectivity conducted throughout the band -- the R-8 and 535D alternating in first place with the R390A sometimes the equal but always at least very close behind. The two ICOMs always did worse than the top three. The R-71A would sometimes manage to come close if the slop wasn't too bad and the AGC was disabled. The R-9000 almost always did the poorest on the selectivity measure.

Another selectivity test was conducted to determine how useful the 535D's tuned front end was in reducing adjacent channel splash. WRNE-980 is a 10 kW, overmodulated slopper that serves up a steady menu of heavy R&B and rap and pegs S-meters at 50+ dB over S-9. WRNE lies on a direct line to the test's target station, WFLA-970 (5 kW), across the Gulf in Tampa. When particularly heavy splash was occurring, no radio was able to produce audio from WFLA no matter what tricks I tried. In the presence of moderate splash the R-8 and 535D were able to produce intelligible audio; no other rxs could. Between songs on WRNE the R-8, 535D, and R-390A allowed very readable audio to punch through; the R71A produced audible but only intermittently intelligible audio; the R-9000 always remained blocked. So, it appears that the Q of the tuned front end of the 535D is too low to provide help with very heavy adjacent channel slop on the BCB; maybe it helps on further removed slop, I didn't check.

DYNAMIC RANGE

No formal laboratory tests were conducted on this measure, only "ear tests." In brief, on channels with one very strong station and a second, much weaker station under, the 535D, R-8, and R390A were essentially equal. That is, the weaker station was clean and easily readable under the stronger station on these rigs. On the two ICOMs, the weaker station, when it was audible, tended to be muddled and largely unreadable. And, as noted earlier, the ICOMs tended to block up, or desensitize, a target channel when it was located next to a super strong slopper; the other rigs had far less of a tendency to do this.

Besides the performance tests, several other attributes of the radios under test were noted...

ERGONOMICS

The clear winner here was the 535D; no other rx was even close. Everything on the 535D was intuitive and fell nicely under hand. An economy of key presses to get from point A to point B was the rule instead of the exception. The next easiest to operate, in my opinion, was the R-390A, the biggest pain in the neck being the required occasional recalibration of the mechanical digital read-out drum. Next in line was the R-71A where the frequency entry sequence on the keypad kept it from ranking any higher. Last place would have been a tie between the R-8 and the R-9000 had not the R-9000 had a stepped gear dial that, even with this detent feature disabled, produced significant backlash. Chasing a blip on the spectrum display screen (which lagged behind knob turn anyway) was a maddening experience with the knob backlash. This backlash could be reduced by pulling out on the knob while turning it but this was a pain. The R-8 had so many shift/function key combinations and "key press step throughs" to get from one point to another that several weeks of practice would have been required before the process became second nature...give me the array of knobs on the old R7A any day (but frequency hopping was no picnic on the R7A either, come to think of it).

AUDIO QUALITY

With its wide filters and simply superb external speaker, the R-9000 was a joy to listen to, especially for extended periods. The audio was silky smooth (the word "delicious" comes to mind) and was very reminiscent of the quality of sound the old Altec-Lansing stereo speakers produced. Next best was the R-390A, but I was using headphones throughout the testing. For general listening, the 535D and R-71A were about equal using their respective factory external speakers; nothing exceptional, just okay. Using the external MS-8 speaker, I found the audio of the R-8 to be a little fatiguing for extended listening periods. This effect was only noticeable after about an hour of continuous listening when the audio seemed to take on a slightly strident, ringing quality. Maybe it's just my ears but if I were to buy an R-8, I'd search for an external speaker capable of smoothing out this perceived stridency. This is a double edged sword, however, in that the R-8 also produced the most readable signal in tough DX situations...the higher frequency peaking tended to put voice signals atop the masking noise floor.

ECSS

All five of the radios were capable of exalted carrier selectable sideband reception but only two (the 535D and the R-8) did it automatically and tracked the phase of the target signal. The R-9000, R-71A and R-390A all were sufficiently stable to produce good ECSS results but required periodic knob

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tweaking to track the phase of a varying target signal. The 535D and the R-8 use slightly different approaches to ECSS listening. The 535D allows/requires the listener to select either the USB or LSB for ECSS operation and states in the manual that the PBT and notch should be "off." In reality, you can fiddle with the PBT a little to further improve the signal and, at times, this tweaking can significantly improve a tough signal's readability. Trying to use the variable bandwidth feature to any useful degree, however, sometimes locked up the ECSS system which then had to be turned off, then reactivated. The R-8, on the other hand, encourages such fiddling (although the manual suggests optimizing before activating the synchronous detector). A "synchro" button selects this AM detector and the operator can then turn the PBT (slowly or a beat tone will occur while the system tries to lock on the carrier) for best reception. I found that this system often resulted in a dramatically improved signal and was responsible in many cases for the R-8 nudging out the 535D in tough signal situations. With this system, in fact, I was able to get easily readable signals even when using the very narrow 1.8 kHz IF filter! For me, the Drake approach to synchronous AM detection was the better one even though both were effective.

I could go on for many more pages describing the relative merits of these five receivers but I'd better wrap it up...

CONCLUDING REMARKS

I'd like to start by answering some of the questions posed at the beginning of this review.

Yes, it does appear that some compromises were made with the R-9000. The R-9000 has a lot of advantages and would probably be my first choice for DXing utilities (you could visually monitor a band of frequencies for signs of the intermittent signals typical of this kind of monitoring). But in terms of MW DXing or even serious SWLing using the AM mode, the R-9000 falls short. Its best IF filter is the narrow SSB filter; the other filters are shared by the other modes (AM, FM-wide, etc.) and are muRata CFW series ceramics. These are the same little black cubes found in portable radios and cost only a few bucks a piece. For $5000 I expect a little more. The same is true of the R-71A; a very good filter is used for SSB and an inexpensive CFW ceramic in the AM section. It's the age-old story of the wide filter being too wide and the narrow filter too narrow for AM listening. It seems as though ICOM's primary concern is the radio amateur and not the SWL or other AM-oriented listener. Also, regarding the usefulness of the spectrum display -- for HF utility or VHF/UHF scanning, it's fantastic; for MW DXing, it's not very useful. It turned out that, in general, if a signal didn't make the S-meter move, it wouldn't clearly appear on the display. Finally, ICOM needs to re-think their AGC constants.

The tuned front end of the 535D didn't appear to help much when DXing the BCB; its Q was apparently too low. But it was apparent that the 535D was designed by a team intimately familiar with the needs of DXers. It is truly a superb radio.

The Drake R-8 has to be the "buy of the decade" so far. It went head-to-head with the much more expensive 535D and came out on top as often as not. If you can live with its tedious ergonomics, ringing audio, and yellowish display you'll be capable of hearing a lot of DX.

The R-71A continued to disappoint and its shortcomings were glaringly obvious next to the 535D and R-8. The R-71A is super for receiving SSB signals and not-so-tough AM targets but is definitely lacking if you intend to try to dig out the tough stuff. I just hope that the two samples of the R-71A that I've tested are representative of the breed; they were purchased from the same outlet.

Finally, the R-390A held up very well against the R-8 and 535D often equalling these two in tough signal situations. Because the R-390A is available on the surplus market in the $300 range, it has to rank as a top buy for the serious DXer, especially if the DXer feels comfortable maintaining this legendary rx.

In conclusion, I'd estimate that 98%-99% of the signals that were present on the MW band at a given location, at any given time, could be heard by any of the five radios being tested (or by virtually any moderately serious radio, for that matter). It's that remaining 1%-2% that tells the tale (but that's what we call DX, I guess). In the case of these tough signals, being able to run A/B comparisons using identical signal sources is very revealing. After all, if a DXer had access to only one radio, and it was one of the lesser radios, he'd have no idea that he was missing any DX; he'd assume there was no DX to be had. That's kind of an unsettling thought to me, hi.

I hope that the preceding comparisons have been of some value to club members. It's the most fun I've had at work in some time, hi. 73's ...GT