WJ-8711A Microprocessor Noise Fix & Impressions

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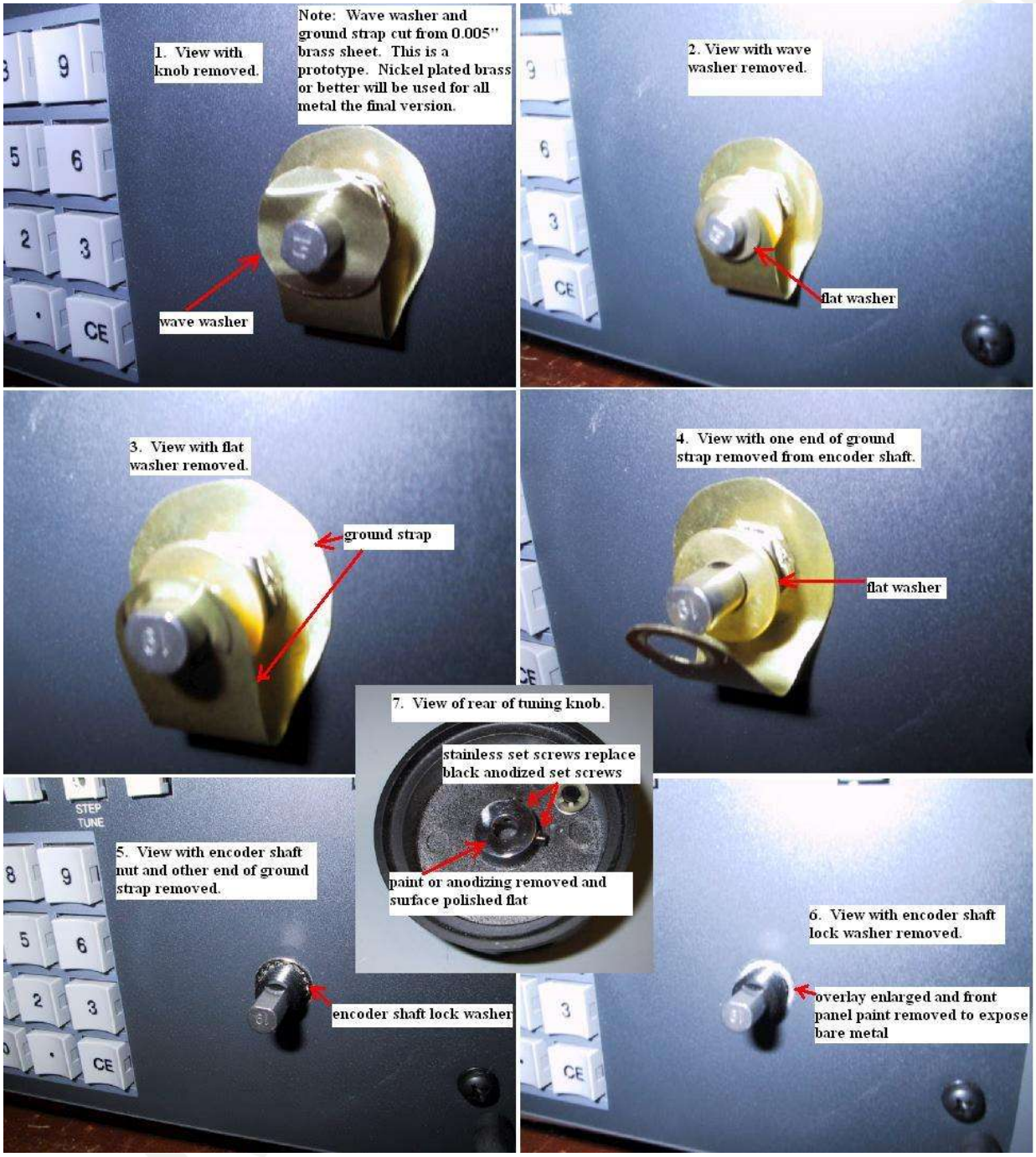
My new WJ-8711A just arrived (4/21/04). I haven't done much more than unpack it and turn it on. There is microprocessor (uP) noise at the higher SW frequencies just as I expected, but nice and quiet in the MW band. I noticed that the preamp is automatically deactivated below 500 kHz. Why? Maybe there is a way to override that. The uP noise at higher SW frequencies appears to be associated with touching or coming near the tuning knob. So the fix appears to be the same as I did for my Racal RA6830's when I changed over to metal spin knobs (and the same as the static cure for the R8 and the 51J-4), namely ground the shaft with a tension washer and grounded wiper.

Yep. It isust as I suspected… the same problem my Racals had, and the cure is the same. Well, not quite. I don't want to go drilling holes in the 8711A front panel. They might void the warranty. The front panel is a plastic overlay, and the encoder bushing is plastic. But there is a stainless nut and stainless internal tooth lock washer on the encoder bushing. So I got out my X-Acto knife, put a new blade in it, and (very carefully) traced around the circumference of the lock washer. I had to do this several times to get down to metal. The tiny annulus of plastic came out, and I used my pen knife (small pocket knife) to scrape away the paint where the annulus had been. When I put the washer and nut back on, you couldn't tell anything had been done to the 8711A. It looked just like it did before. But now the washer and nut were electrically connected (grounded) to the front panel. I used some 0.005" brass sheet to form a "wrap around" from the nut and washer to the shaft. A ¼" hole was made (using a standard ¼" paper punch) in one end of the wrap around (to slip over the shaft) and a 3/8" hole was made in the other end (to slip over the encoder bushing). The 3/8" hole was made by first punching a ¼" hole, and then enlarging it to 3/8 " with a Dremel tool conical grinding wheel. It was deburred with a disk cutoff wheel. Then the nut came off, the wrap around was slipped onto the encoder shaft, the nut was tightened (don't over tighten because the bushing is plastic), a ¼" flat bronze washer was put on the shaft, then the other end of the wrap around was put on the shaft, then another thin flat washer was slipped onto the shaft, then a "wave washer" (made from the same 0.005" brass sheet) was slipped onto the shaft, and finally the knob was slipped onto the shaft (compressing the wave washer), and finally the shaft set screws were tightened. Like I said, no more uP noise. When I make this mod permanent, I will tin the brass part to insure good long term electrical contact. Oh, two more things. The inside rear of the knob where the shaft inserts into the knob is painted black, or has some kind of black finish. Very pretty. But not seen when installed. And non-conductive. Again, using my Dremel tool, I ground off the black whatever by sticking the set screw (which is at the center of the disc) into the knob shaft hole and letting the flat part of a cutting disk grind off the black stuff. Then I polished the bare metal to a mirror finish (to minimize friction and wear). Finally, the Allen (hex) set screws were black anodized, also non-conductive, so they had to go. Moreover, these pretty black set screws always rust as time goes by. I replaced them with stainless steel. The threads in the knob are bare metal, so the knob, shaft, and everything else are grounded to the tiny annulus of bare metal that I made where the encoder bushing comes through the front panel.

Neat, huh? Here are some photos of the mod.



Now my brand new WJ-8711A is the only WJ-8711(A) (or HF-1000(A)) that is microprocessor noise free. Well, that is not entirely true. I still can't put a passive or active antenna anywhere near the 8711. But then I can't put an antenna near my Racals or Harrises either. Incidentally, the antennas of my phased array are 100 feet distant from my receivers, and the feed lines are (balanced) twin lead (which generally has less pickup than coax).

Just finished measuring the AM sensitivity at 1.6 MHz (usual parameters). 1.0 uV with the preamp on and 1.3 uV with the preamp off. They may as well have left the preamp out. I am tempted to go after that tomorrow, but it would void the warranty for sure. Of course, a little thing like that…

Do I like the WJ-8711A? You bet. It has the best frequency display I have seen. And the other LED displays are excellent too. The tuning knob is identical to the Racal RA6778C knob, but finished differently (black anodized or powder coated). It has a nice heavy feel to it, and an attached dimple (quite large) for spinning with your finger. The 8711A seems very intuitive and easy to use. The frequency entry, step change, and other features are simply the best of any receiver I have used. I suppose you can customize the BW's for each mode, but I probably won't bother because it is so easy to select a BW different from the factory default with the push button selected rotary knob (which, with other push buttons, is also used to select mode, AGC release time, noise blanker setting, and so on). It appears to have 100 memories, but I haven't used that feature yet. There are separate audio level knobs for the headphones and speaker. Very nice. The manual specifies 2 Vrms into 8 ohms (1/2 watt) for the speaker output, but I measured 3.5 Vrms (1.5 watts into 8 ohms), and an audio BW of at least 100 Hz to 13,000 Hz at less than 3% harmonic distortion. Connected to a good speaker, it sounds excellent to me. Headphone output through a ¼" stereo headphone jack (stereo for ISB, L and R common in all other modes) is specified as 10 mW (presumably rms) into 600 ohms, no BW given. Low impedanced headphones seem to work fine. Pressing the special function key repeatedly toggles you through various user selectable parameters. In particular, it allows you to choose the release (decay) times for fast, medium, and slow AGC. You don't have complete freedom to choose, but 10 – 100 mS for fast, 100 to 1000 mS for medium, and 1 – 5 seconds for slow. I reset mine to 100, 1000, and 3. I haven't had any hets yet, but the (presumably manual) notch filter is there if you need it. And yes, there is AM synchronous detection if you want it. It is the only feature of the 8711A that is not well implemented. A good AMSD should be transparent to the user, i.e., never lose lock, and lock instantly to the strongest carrier in the passband. The AMSD of the 8711A does not meet these requirements. However, since most people can't tell the difference between a good slow AGC release time and a good AMSD, it doesn't really matter. The 3 second release time I chose for my slow release takes care of strongly fading SW and MW graveyarders. And in the rare event that it won't, the 8711A manual gain control is excellent for those occasions. Tuning around in CW mode with no antenna connected, I did not find any internally generated spurs from 150 kHz to 10 MHz where I got tired of spinning the knob. I did find one at 125 kHz or thereabouts. This WJ-8711A is the most spur-free receiver I have ever tested, bar none. I wish I could say the same about the LO's, or perhaps it is the DSP circuits. I don't really know. But tuning around near a carrier produces all sorts of weak birdies. Most of these are within about +/- 20 kHz of the carrier. But there were additional (presumably 1st LO) spurs at about +32.5, +72.5, … and -47.5, -87.5, …kHz from the carrier, decreasing slowly in level. These correspond to phase noise of about -127 dBc/Hz when using a 6 kHz BW. So they are not really a serious issue, though I would like to see better LO performance in a receiver of this caliber. It is possible that they are spurs of the internal frequency standard. I'll check this later. I have been running the 8711A head to head against one of my R-390A's on some weak signals, and it is almost a dead heat. I am very pleased with it.

6/9/04

Now that I have had the WJ for about 6 weeks, I understand its pluses and minuses a bit better.

The uP noise above 20 MHz is extremely difficult to tame. When using folded dipoles cut for 15 meters and located about 10 meters away from the 8711A, depending on how the 8711A and R-

390A are grounded, the 8711A can (and does) introduce some very weak uP crud into the R-390A then the R390A tuning knob is touches, or when my hand or body comes near the 8711A AGC / BFO / BLANKER display. Most of these residual uP crud problems have been eliminated by using (single) Faraday shielded isolation transformers with balanced outputs, one for each of the R-390A and WK-8711A, with separate earth grounds. An added benefit of this arrangement is that the isolation transformers greatly reduce some bad man-made noise at the low end of the MW band and high end of the LW band which originates at my next door neighbor's house and tends to show up every evening around sundown. But I don't think one should have to go to these extremes to eliminate RFI originating in a $5K+ receiver. The problem should have been eliminated during the R & D stages.

My encoder shaft grounding mod above did not withstand the test of time. After a week or so, weak traces of uP crud when touching the knob were observed. This was traced to ineffective grounding. I had to resort to the Collins procedure, namely to use a clamp on the shaft to keep appropriate tension on the wave washer and ground strap. At least that is my opinion of the cause of the failure. The failure could also have been due to oxidization of the brass. So in my 2nd mod I used 0.01 stainless sheet to fabricate the parts. Additional shaft space was neded, so some of the plastic bushing was trimmed off with a single sided razor blade. The shaft clamp was made from the end clamp of a Jackson Brothers 6:1 planetary reduction drive. This new version has been in use for 5 weeks and has exhibited no problems.

Various DXers have talked about hearing signals on one receiver that they can't hear on another, with all other things being equal. This, in turn, causes them to rate one receiver above the other. These cases have been reported for signals out in the open (no adjacent channel interference) and for signals with strong adjacent interference. I have never observed this. I have top receivers that occasionally (rarely) hear a signal better than another top receiver, but never hear a signal on one and not hear the same signal at all on the other. Also, the tables are invariably turned. That is, occasionally (rarely) the other receiver hears a signal better than the one. I have now spent dozens of hours comparing the WJ-8711A to an R-390A on weak signals in the open (for example, Australia on 21.740 in the early evening hours, Australia on 2385, 2325, and 2310 from first light to after dawn, and R. Huayacocotla MEX 2390 (about 800 miles distant) from about 7 a.m. to 9:30 a.m. local time. Using manual ECSS the 8711A and 390A are about equal. Using AM, the 390A produces clearer audio, especially at the noise floor during fades. With the 8711A using AMS and the 390A using AM, they are about equal. But since the 8711A AMS must be tuned with the carrier centered in the passband, the overall edge goes to the 390A.

What about other top receivers? Because it has fewer spurs, I would rate the 8711A slightly ahead of the NRD-525 in that category. However, the 525 AM detector is AMS by default (JRC calls it DSB), and it works wonderfully with the carrier anywhere in the passband, so the overall edge goes to the 525.

The 8711A is 3rd in my rankings at this point in time. It will probably end up 4th because I am currently evaluating a modified ICOM IC-746Pro (MW & LW attenuator removed and preamp enabled below 1.6 MHz) and it appears the 746P will move into the #2 slot.

Here are a few things that put the 746P at the top of the heap. The AM detector is an AM synchronous detector. Why ICOM doesn't advertise this feature of the 746P is a mystery to me. I

discovered it merely by noticing that it sounded like an AM synchronous detector and asking ICOM Technical Support if it was. They confirmed what my ears had already told me. And it is not just any old AM synchronous detector. It is outstanding. It doesn't lose lock, no growling, and you can tune the AM signal with the carrier anywhere in the passband you please. In other words, the 746P AMSD is completely transparent to the user. You never know it is there except that the quality of AM reception is better than with an ordinary AM detector, and better than ECSS. The 1st LO oscillator phase noise (or more generally the composite noise) at close separations (from 3 to 10 kHz) is better than -120 dBc/Hz. This is easily 10 dB better than any other solid state receiver that I am familiar with… including such receivers as the NRD-525, 535, and 545, the RA6790/GM, 6793, and 6830, the (Harris) RF-590, and 590A, the 651S-1 and HF-2050, and the HF-1000(A) and WJ-8711A. The filters ultimate attenuation is greater than 86 dB, and even though there are only three AM filters, their bandwidths are well chosen. There are three fixed AM filters, nominally 3, 6, and 9 kHz BW, and the operator cannot change the BW's or shapes. I haven't measured the "9" BW filter, identified as #1 on the 746P display. I have measured the other two: #2 (6 kHz nominal): 6.7 @ - 6 dB, 12 @ -60 dB, 18 @ -80 dB, ultimate~ -86 dB, and #3 (3 kHz nominal): 3.4 @ -6 dB, 7.0 @ -60 dB, 110 @ -80 dB, ultimate ~ -86 dB. This is about as good as it gets. The down sides are that the ICOM included a 10 or 11 dB attenuator in the signal path below 1.6 MHz and the preamps are disabled below 1.6 MHz. Furthermore, Preamp 1 gain rolls off fast below 500 kHz. And it is non-trivial to fix these things because of the many tiny 0603 SMD's and tiny PC board traces. But they are fixable.