NRD-92M Noise Problems

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My latest addition is a second NRD-92M. They are identical to the NRD-93, but without memories. The 93/92M may be regarded as a professional grade 525 because they have the same kind of plug-in PC boards, a similar tracked tuned front end, 455 kHz filters, etc. The filters in the 93/92M are almost the same as in the 525 except that the 93/92M has a 3.0 kHz BW (crystal?) filter for INTER instead of 2.5 kHz BW in the 525, and a 6 kHz BW (crystal?) filter instead of a 6 kHz BW ceramic filter. There is also an NRD-92 which is identical to the 92M/ 93 except that it has only 4 BW's (0.3, 1.0, 3.0, 6.0 kHz) while the 92M/93 has 5 BW's (0.3, 1.0, 3.0, 6.0, and AUX). When I bought my first 92M years ago, it had what I thought was a noisy 1st LO. I had concluded that the noise originated in the 1st LO because when I disconnected the 1st LO line and operated the 92M from an external oscillator (HP 8640B) there was no noise. The noise was not so obvious on weak signals, but was quite obvious on stronger signals, similar to the hiss and popping of frying potatoes. I replaced many parts in my first 92M but was never able to eliminate the popping and hissing. Eventually I decided that I needed a 2nd 92M to help me find the problem. Years passed and I never found another 92M until several weeks ago on Ebay. I probably paid more than it is worth, but I was determined to have it. When it arrived it also had the noise problem. I could hardly believe it! (It had several other problems that I had to fix first before the noise problem was evident.) That meant the noise problem was normal for 92M's (and 92's and 93's). So something was badly designed. But what? After studying the schematic again, I kept coming back to a curious thing. The 92M had two separate front end RF tuning controls... one for VLF and MW, and one for all the SW bands. Then I checked the SW bands using a signal generator (which I hadn't done before) for the noise problem. No noise on SW! The noise was only on MW and VLF!! I don't know how I missed that before!!! Maybe I just didn't listen on the SW bands, since I am mostly a MW DXer. Then I disconnected the MW and VLF front end RF tuning line and powered it with an external DC power supply. No noise!!!!!!!!! I had already put chokes and bypass capacitors on the RF tune lines, so it was back to the schematic. At this point I had a very good guess about how to reduce or eliminate the noise. The RF tune line is a DC voltage control line which tunes varactor tuning diodes. If there was noise on this line, it could modulate the RF signal, causing a noisy signal when it was detected and in turn noisy audio. My idea was to use RC filtering on the DC line. After looking around the schematic I found the perfect candidate: C5, 1500 pf, at the junction of R41 (100 K) and pin 5 of IC15 on the CDC-245 CPU board. I replaced the 1500 pF, C5 with a 1.0 uF 50 volt (I also tried an electrolytic which worked just as well as a non-electrolytic). When I turned on the 92M after replacing the cap, there was no noise in the MW and VLF bands!!!!!!!! I replaced the cap in the other 92M, and again there was no noise in the MW and VLF bands!!!!!!! If you know anyone who has a 92, or 92M, or 93, you might want to pass along this information. I am sure the 92 and 93 both have the same problem. What strikes me as especially curious is that no one has ever reported this noise problem before.

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Well, I was overly optimistic when I said the change of C5 1500 uF to 1 uF (on the CDC-245 CPU board) eliminated **all** of the noise. After using the 92M's extensively I observed that some popping and hissing remained on the 1st LO when the receiver was off tuned a kHz or two from a strong signal. This was especially noticeable when using ECSS (which I seldom use).

Recently I noticed there were two 5V lines, and that they were easy to disconnect from the 92M 5V power supply. I did that and powered the 92M 5V line from an external power supply. I could hardly believe it, but the remaining popping and hissing noise went away. As I said, there are two 5V lines, one to the front panel, and one to the mother board (and all the plug-in PC boards). So I powered each of the two 5V lines separately from the external power supply. It turned out that the noise problem was due to one of the plug-in PC boards. It was not difficult to provide 5V power from the external power supply to each of the plug-in boards, one at a time, by unsoldering one end of the 5V line choke on the plug-in board. This isolated the noise problem to the CGA-78 Loop 3 & BFO board.

At first I considered buying a 5V regulated power supply and bolting it to the rear panel. That would have been the simplest approach in terms of time required to modify the 92M. I measured the current drawn by the CGA-78 board 0n its 5V line, and it was about 620 mA., while the entire plug-in board 5V line drew about 1 amp. The internal 92M 5V power was derived from the 92m 24v nominal (25.8V) line. There were no other windings on the power transformer for the lower voltage lines. This is because the 92M is designed to be powered off 24V DC. If I used an external 5V regulated power supply, the 92M could no longer be powered by 24V DC. So I decided to try adding another 5V line to the 92M using a 3 pin 1 amp 7805 regulator. Connecting the regulator directly to the 24V nominal line did not seem like a good idea because of current foldback and power dissipation considerations. According to the 1993 ARRL handbook a 12 volt difference between input and output is the maximum acceptable for full current rating. The 92M nominal 24V line is typically 25.8V, which gives a 20.8V difference. The minimum acceptable voltage difference (dropout voltage) is about 2.5V, so I decided to use power resistors to drop the nominal 24V line to about 8V at the input of the regulator. (Here it might be better to use a 20V, a 15V, and a 10V regulator in series bolted to the side panel as a heat sink.) Most of the excess power is dissipated in the power resistors (four 100 ohm 10 watt in parallel). These must be clamped to the chassis or they will run too hot, 100° C or more.

The voltage regulator must also be heat sinked. At first I used a finned heat sink, but the 7805 ran at 62° C, closer to the 70° C maximum rating than I wanted. So I bolted it to the chassis rear, which also forms part of the rear panel. Now the 7805 runs about 45° C, less than the 92M power supply, which is about 52° C as measured on the heat sink fins through the side panel with the room at 23° C ambient. At turn on, the input voltage is about 7.8V, just slightly higher than is needed to meet the dropout voltage condition. After about 30 minutes warm up, the 5V regulator input voltage is about 9.2V. More details of the mod are given in the pictures below. BTW, now I can hear the close-in LO spurs (which is normal) that I couldn't hear before because they were below the noise.

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Eventually I decided that dropping resistors was not the best solution for the additional 5 volt power supply. So I removed them and used 10, 15, and 20 volt 3 pin regulators bolted to the chassis sides to drop the voltage from 24 volts to 10 volts for the 5 volt 3 pin regulator.