Modifications for the NRD-525 ... by John R. Tow

The NRD-525 is one of the most popular of today's DX rigs for the serious SWL/DXer. It has not been received with quite the same reverence in the MW circle, however. Some of its problems, such as the poor AGC action, background hiss, filter bandwidths, and generated noise, are remediable. The remedies do involve some technical expertise and will invalidate anyone's warranty. I shall begin at the output and work my way forward.

The audio response is too wide. The low end is a bit boomy and the high end is too high - allowing too much of that 525 hiss for my taste. The low end can be rolled off below 200 Hz by replacing C29 (10 uF) on the IF AF Board (CAE-182) with a 2.2 uF tantalum capacitor. This change affects only the speaker/headphone output - not the line or record output. Suitable R-C components for all of my modifications can be purchased at Radio Shack. To roll-off at a higher frequency (even less bass), use a 1 uF instead. ECSSB users may not like this change since zero-beating is not quite so easy with the poor low frequency response resulting from this change.

The high end can be rolled off above 6 kHz by placing a 470 pF ceramic capacitor on the bottom of the same board from pin 1 to 2 on IC5. Watch lead dress to insure that you don't short the capacitor leads to other circuit lands. This change will be noted on each of the audio outputs. The improvement in speech quality is quite noticeable. To lessen the hiss even more, but on all outputs, you can parallel C54 (2200 pF) with a small ceramic 0.0047 uF capacitor.

The AGC has a too rapid attack time, a large amount of overshoot, and excessive demodulated audio riding on the AGC line. My cures were developed over the last 18 months - and are surpassed in effectiveness by the ESKAB AGC modification. But my modifications are simple to implement and involve IF AF Board CAE-182. Replace R103 and R104, both SMD's which must be pried loose with a hobby knife while gently unsoldering them, with 10 kOhm 1/8 W or smaller resistors. This slows the attack time. Replace C77 (0.22 uF) with a 1 uF tantalum capacitor to further slow the attack and decay time. If you want a bit less speed - try a 2.2 uF instead. Finally, solder a 1 uF tantalum capacitor on the bottom of the board from pin 4 (-) to pin 5 (+) of IC9. These changes will lower the audio distortion on AM as well as improve the AGC response tremendously. The ESKAB (see address at end) AGC modification is still better - but harder to implement.

The front end first IF filter, FL1, is too broad. ESKAB suggests that it is 68 kHz wide at -60 db while they supply a 15 kHz width at -60 db 8 pole 70.455 MHz filter. The second IF''s first filter, FL2, is also too broad. ESKAB suggests that it is 36 kHz wide at -40 db while they supply a 12 kHz wide at -40 db filter. The replacement of FL1 is straight forward while FL2 requires the drilling of a couple of small holes (Some users have replaced the stock FL2 with the stock WIDE filter, a bit more difficult than the ESKAB modification.). The end result of changing FL1 & FL2 is unbelieveable. The (S+N)/N ratio improved by as much as 5 db over the stock receiver (see table). There is no free lunch - the tighter bandwidth renders the reception of narrowband FM much less than acceptable while it lengthens the noise impulses such that the noise blanker circuitry is no longer as effective. I find these minor detrements in comparison to the vast selectivity improvements yielded by the changes. Ultimate selectivity, so important in working splits, is vastly superior to the unaltered NRD. Additionally, a better use for the FM mode will be given later.

ESKAB also has the best approach to augmenting the JRC filters for bandwidth selection. I purchased a "Sharp 4 kHz" filter and board from ESKAB for my AUX position. What I received was a small PC board with matching components and a CFJ series filter. The board included pins to permit inserting it in place of a JRC filter. It yielded a flat passband, no more insertion loss than the JRC filters (same signal strength regardless of bandwidth), and a very professional appearing installation. I have seen what has to be done to put the excellent quality Collins filters on a 525's filter board. The excessive modifications of the JRC board required to mount the Collins filter still yield more attenuation and passband ripple than I feel is acceptable. Most installations of said mechanical filters offer neither resonating capacitance nor impedance matching. The filter supplied by ESKAB, though not as good a filter ultimately as a Collins mechanical, is quite acceptable in my application. I am afraid that the ultimate isolation of a good mechanical IF filter would be wasted on the JRC filter board because of the crosstalk and poor isolation. ESKAB has the best approach in spreading the filters between the original JRC board and the PLAM detector board they offer. I have not tried this approach yet.

The above modifications yield a receiver with selectable bandwidths of 1.8, 2.2, 3.4, and 4.7 kHz @ - 6 db. To regain a wider bandwidth for listening to those clear channel stations, while using an otherwise useless FM mode, is quite simple. I found that by cutting the land from J28-13 to J30-9 on the motherboard the FM mode would yield AM reception bypassing the bandwith filters as the original 'AUX' position did prior to the installation of the additional filter. This added 6.8 kHz bandwidth as a possibility. The new 'AUX' position is narrower than the original because of the cascading effect of the two tighter replacement filters for FL1 & FL2.

The land to be cut carries the signal from the BW decoder on the IF filter board to the IF AF board to turn off the AGC and turn on the FM detector audio path during FM reception. By interupting the path, the AM detector and AGC will remain on when the BW decoder senses the selection of the FM mode. Unfortunately, the CPU still thinks you are using FM and ignores the AGC switch. You will be stuck on AGC Slow only and either 5 or 10 kHz depending on the resolution (10 or 100 Hz) selected for UP and DOWN slewing. The keypad and frequency knob function normally, as do the NB, PBT, and Notch controls. The loss of FM reception I find acceptable. A SPST toggle switch could be wired across the land cutting and placed on the back panel if you want to select the FM detection mode at some future time.

A slight improvement in signal feed-thru and S/N should result from completely disconnecting the FM detector from the signal path and power supply. This modification is difficult to reverse. To effect this change, simply remove the SMD capacitor C11 located near T2 and cut the land feeding Vcc to IC10 and T1.

To slightly improve the receiver's ability to withstand the detremental effects of IM and CM distortion, the front end protection diodes can be easily removed. Simply lift one end of CD1 and CD3 located on the HF Tune board CFL-205. Be sure to disconnect the antenna when not in use. If you are the least bit concerned about a strong local RF signal, leave the diodes in place, as they do offer some front-end protection. I reconnected mine after an unexplained failure of the decoding chip IC-1 and two attached decoupling capacitors.

The back panel heat is the result of too wide an input AC voltage capability on the power transformer. The bridge rectifier output is +17 V. This has to be dropped to the appropriate levels by the three voltage regulator ICs and the discrete VR circuit with a pass transistor. Two of the IC's, the pass transistor, and the power transformer provide the back panel heat. Operating from a well regulated external DC source of 12-13.6 V will drop the power dissipation back there by about 8-10 Watts plus the transformer losses. I now use a marine battery of gelled cell construction (No liquid electrolyte or vent caps to leak onto the floor!) and rated at 105 Amp-Hours to power nearly everything in my shack. I also use the same battery on DXpeditions. It has only been re-charged four times in the past year! The NRD-525 works flawlessly on DC until the battery voltage drops to around 10.8-11.0 V. In addition, line noise is not as frequently a problem with an external dedicated ground and no "mains" connection.

I was simply not satisfied with the low audio level available at the front panel headphone jack. If you use the traditional mini-phones from your carry along portable or the Icom, Yaesu, or Kenwood communications headphones then you know how low the level is. The aforementioned headphones have 8 - 16 Ohms impedance. A 100 Ohm resistor, R7 located on the front panel mounted board CQB-40, limits the output to low Z phones to a few mW maximum. If you use the JRC headphones with their 600 Ohm impedance you'll get around 15 mW. Change R7 to 33 Ohms and the maximum level increases to around 80 mW. This has made listening with my Icom HP1 or Koss HV-1A headphones more enjoyable. This level is not great enough to damage your 'phones. At minimum audio level no AC hum or noise is heard through the headphones.

To further increase audio output ESKAB suggests operating the audio power amplifier off of the unregulated power supply instead of the +10.8 V supply as it normally is. This would greatly increase the audio power and the power dissipation on the audio/IF circuit board and most likely reduce the audio distortion to boot. It should also increase the audio hum. I have not tried this modification.

I have one area yet to address. The CPU clock noise emmanating from the NRD prevents the use of a loop antenna in its vicinity. In fact, I have had to resort to remotely tuned loop antennas (1 meter on a side) mounted outdoors to use this receiver. I have even been asked, in the past, to take my radio out of the DX tent while on DXpeditions because of its emissions. To prove this, simply place a simple AM portable - or even a Sony ICF-2010 on LW/MW - near the operating NRD. The receiver emmits a tremendous amount of clock hash. The top and bottom panels would offer electrostatic (E field) shielding if they made good electrical contact with the chassis. To improve this, I simply sanded the paint off of the inside covers around the screw holes using a fine emery cloth. This seems to be effective for reducing some clock type signals. Check your receiver with an ohmmeter for continuity between the back panel and the edge of the painted top and bottom. You may not need to alter yours.

Much of the interference is from the various clock oscillators and their sub-harmonics. For example, the main CPU has a clock at 4,915 kHz - four times the 1228.8 kHz birdie the receiver is known for. Other clock type signals include the 12.8 MHz TCXO reference, the 6 MHz front panel CPU, the 32.xx kHz "clock" signal, and the absolute worst offender of all, the fluorescent display inverter supply operating around 13 kHz. This last source is horrendous. Just place a MW portable in the vicinity of the front panel and listen!

Most of the true clock signals are MOS or C-MOS level. The only exception is the power inverter for the display's filament and the -35V supply. The filaments run the whole width of the plastic front panel and radiate the 13 kHz square wave and its harmonics quite well. This is the source of the majority of the hash. I have tried to decouple the 9V supply feeding the inverter with no improvement. The only improvement I have found is by cutting off the power to the inverter! This, of course, makes the entire display go blank requiring you to remember the Mode/BW/AGC/Frequency settings, etc. I have found this cure to be conditionally acceptable.

You can disable the inverter by cutting the wire going to the front panel display P/J-38-1 (+9 V) and splicing two short wires to the severed ends. Now connect the other ends of the wires to the unused normally closed contacts of the Noise Blanker switch. When the NB switch is now pulled out (Wide), the display will go off and the majority of the noise and hash your loop antennas receive will disappear as well. LCD and LED displays have distinct advantages!

I enjoy my 525 now as I never did before. It is truely a DX rig. I now use my headphones directly connected to the 525 for the majority of my weak signal DXing. When conditions allow speaker monitoring, I either DX with a rather inexpensive 6.5" 4 Ohm auto speaker in a baffle or use an external audio amplifier and a Radio Shack Minimus 7.

I now have better and steeper selectivity choices, a more responsive AGC, cleaner audio, better weak signal (S+N)/N ratio, and practically no more background hiss. The cost for all of these modifications was less than the cost of one Collins filter! The improvements have certainly helped adjacent channel performance on MW with both a long wire and a loop antenna. Write Harm-Heyen Broers, a very helpful fellow DXer at ESKAB, P.O.B. 32001, S-200 64, Malmoe, Sweden for current prices and availability of the filters and AGC modification boards.

Test Conditions
Signal Source: AN/URM-25D modulated by HP-209A
(S+N)/N Measurements made with AGC off, AM detection, RF gain = max, AF gain = 10:00, Output taken at Speaker = 8 Ohm load
Receiver Input = 1 uV 30% modulated by 400 Hz
Bandwidth Measurements made with AGC On; 1 uV (unmod) = reference
-6 db points found when 2 uV input applied, tune for reference
-60 db points found when 1,000 uV applied, tune for reference
-100 db points found when 100,000 uV applied, tune for reference
Bandwidth = difference between reference frequencies
(crude measurement technique - but only method available)

Bandwidth	Original -6db/-60db (kHz)	Original (S+N)/N (db)	Modified -6db/-60db/-100db (kHz)	Modified (S+N)/N (db)
AUX	12.2/22.3	9.6	3.4/4.5/11.1	16.1
WIDE	5.7/8.3	10.8	4.7/7.8/10.0	15.3
INTER	2.2/4.2	12.4	2.2/3.8/6.1	17.2
NAR	1.8/3.5	13.6	1.8/3.1/5.3	18.1
FM Mode	(See AUX)		6.8/13/ -	>14

Note: -100db BW not measureable on unmodified 525

Modifications:

1. Audio modifications
2. Increase AGC attack & decay time
3. Decouple AGC
4. ESKAB FL1 & FL2
5. ESKAB 4 kHz AUX filter with board
6. ESKAB AGC modification
7. Cut FM detector (add wider BW)
8. Operate from battery
9. Increase headphone level
10. Decrease radiated CPU clock noise
11. Employ unused NB switch to lower display inverter radiation

Sensitivity

Preamp	NRD-525 - Stock	Modified	R-71A On/Off	R-8 On/Off
	(uV)			
3 db S+N/N USB 7.105 MHz	.o6	.04	.04/.09	.05/.13
BW (AGC = Off)	INTER	INTER	2.7 kHz	2.3 kHz
30% Mod 400 Hz AM 7.105 MHz 1 uV LINE or REC Output S+N/N (SYNCH)	10 db	14+db	12/8 db 6.5/4 db	17/12 db
BW (AGC = Off)	WIDE	WIDE	4 kHz	Wide (8 kHz)
S9 =	100 uV	100 uV	50 uV	110 uV

Selectivity

Bandwidth @ -6/-80 db (Shape Factor)

	Stock NRD-525	Modified NRD-525
AUX	14.5/27 kHz (1.9)	3.2/6.8 kHz (2.1)
WIDE	6.1/10.4 kHz (1.7)	4.4/7.9 kHz (1.8)
INT	2.4/6.8 kHz (2.8)	2.2/4.3 kHz (2.0)
NAR	0.3/2.8 kHz (9.3)	1.8/3.7 kHz (2.1)
FM	- - - - - - - - - - - - - - - - - -	6.9/13.6 kHz (2.0)
BW	R-8	R-71A
6.0	6.5/12.2 kHz (1.9)	