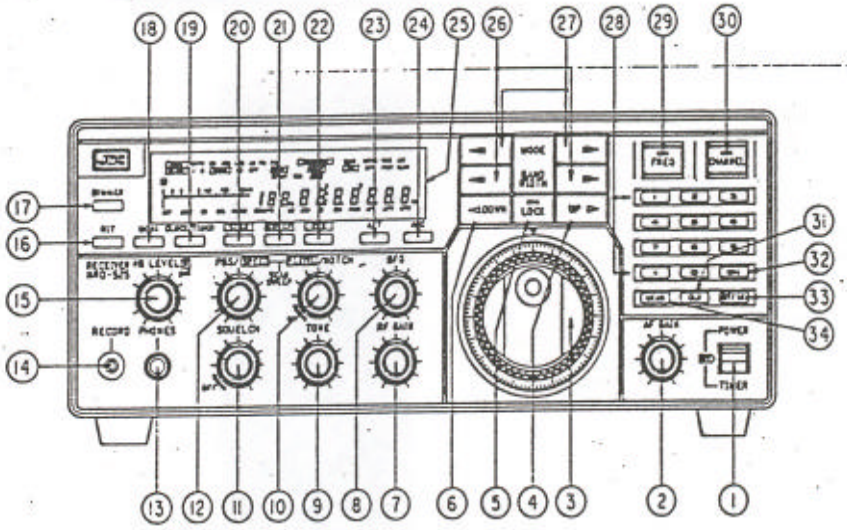
K73-5-1

NRD-525: A Technical Review

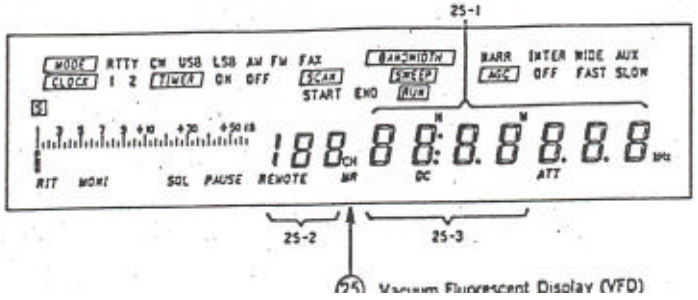
Dallas Lankford, 15 XII 92

There have been a number of reviews of the NRD-525 in the past, but none of them answered certain technical questions I had regarding 525 performance, especially in the MW band. The 525 was discontinued last summer, and the remaining stock was offered at a discount by several retailers. Not being able to resist a bargain, I bought one of these last 525's with a serial number in the high 51,000's. Line drawings of the 525 front panel and vacuum fluorescent display are given below.



Front panel

1 POWER TIMER ON OFF switch
2 AF GAIN control
3 TUNING control (This control also works as RIT control when characters "RIT" are on.)
4 UP switch
5 LOCK switch
6 DOWN switch
7 RF GAIN control
8 BFO control
9 TONE control
10 NOTCH control (It also works as P LEVEL (pause level) control during scan or sweep reception.)
11 SQUELCH control
12 PBS (pass band shift) (It also works as the SPEED control during scan or sweep reception.)
13 PHONES jack
14 RECORD jack
15 NB LEVEL (noise blanker level) control
16 RIT switch
17 DIMMER switch
18 MONI (monitor) switch
19 CLOCK TIMER switch
20 SCAN switch
21 SWEEP switch
22 RUN switch
23 ATT (attenuator) switch
24 AGC control
25 Vacuum Fluorescent Display (VFD)
26 BANDWIDTH switch
27 MODE switch
28 Numerical keys
29 FREQ (frequency) switch
30 CHANNEL switch
31 CLR (clear) switch
32 MHz switch
33 ENT kHz switch
34 MEMO (memory) switch



R73-5-2

Previous reviews of the NRD-525 include Magne's RDI white paper, Edition 2.0, 11 June 1987 (presumably there was an earlier review), the 1987 WRTH, pages 555-556, Rainer Lichte's review in his 1987 book More Radio Receiver - Chance Or Choice, pages 41-48, and John Bryant's Proceedings 1989 review, "Wastegunner on a 525," pages R12.1-R12.9. Because these reviews cover most basic aspects of a 525, my discussion of basic features will be brief in places. For additional details you may consult those sources.

The front panel and vacuum fluorescent display line drawings above tell most of the story about the basic 525 features. Some controls are conventional analog controls, while some are push button switches. Other reviewers have fussed about certain aspects of the controls, but I haven't been seriously annoyed by any of these so-called defects. Yes, it would be nice to have an analog S-meter. But the main reason the S-meter jumps around so much in AM mode is because the AM attack times are not appropriate. My mod described in "NRD-525 AM AGC mod 2" takes care of this annoying defect. And yes, it would be nice if the front of the 525 could be tilted upward to get a better view of the front panel and keep your hand from bumping the table top while twirling the main tuning knob. Nevertheless, the flywheel-weighted, dimpled main tuning knob turns smoothly and is easy to use. Mode changing is easy with two switches which move the mode indication left or right through the following: RTTY CW USB LSB AM FM FAX. By contrast, with the R8 you have to cycle completely through all other modes to get back to the one you want. Similarly, bandwidth changing is easy with two switches which move the bandwidth indication left or right through NARR INTER WIDE AUX. Changing the AGC setting is not as convenient; a single switch cycles through OFF FAST SLOW. In addition to tuning with the main tuning knob, a frequency can be entered either in KHz or MHz using the keypad, and the frequency can be changed with the UP and DOWN switches.

Some operating aspects of the 525 can be changed by the user. The tuning rate of the main tuning knob and the step increment of the UP and DOWN switches can be changed between "coarse" and "fine" by pressing the RUN switch. In "fine" tuning mode, the main tuning knob rate is 2 KHz per revolution and the UP/DOWN increment is 1 KHz, while in "coarse" tuning mode the rate/increment is 20 KHz/10 KH The 10 Hz digit of the frequency display can be turned "off" and "on" by pressing MEMO and 1 switches simultaneously. And the frequency indication in USB and LSB modes can be changed between "automatic" and "manual" modes by pressing MEMO and 0 switches simultaneously. In "automatic" mode the frequency display does not change when changing between USB and LSB (and you do not have to retune).

The NRD-525 Instruction Manual gives the tuning range as 90 KHz to 34 MHz. The 525 can be tuned below 90 KHz, but internally generated noise begins to register on the S-meter at about 70 KHz, so the 525 is not useful much below 90 KHz. VLF DXers will need to use a VLF converter.

In the past, the merit of a receiver was often determined by the three S's - sensitivity, selectivity, and stability. With synthesized solid state receivers like the 525, stability is seldom an issue. Consequently, a more appropriate modern version of the three S's is sensitivity, selectivity, and spurious responses. Nevertheless, for completeness, here is what has been published about 525 stability. The instruction manual specifies "Frequency stability ±3 PPM." Lichte measured "± 5 Hz/hr," while Magne reported "less than ±10 Hz at 10 MHz, excellent." I don't have the equipment to make such precise drift measurements. Suffice it to say that I haven't observed any drift with the 525's I have used, and I don't expect to observe any.

Sensitivity should not be an issue for modern solid state communications receivers, but surprisingly it sometimes is. Some receivers, like the R-5000, are desensitized in the MW band by design. Others, like the R8, are not quite sensitive enough throughout the entire tuning range. Both Magne and Lichte stated that the 525 sensitivity is derated in the MW band. Lichte even provided values of 16 and 19 microvolts at 1000 and 500 KHz respectively for a 10 dB S+N/N using the WIDE bandwidth and AM mode, compared to 2 microvolts for the SW bands. In addition, the 525 instruction manual specifies 15 microvolts or better sensitivity for the 0.90-1.6 MHz frequency range, and 2 microvolts or better for the 1.6-34 MHz frequency range using AM mode. However, I do not know of any 525 with worse sensitivity below 1.6 MHz than above. As a matter of fact, the sensitivity of my 525 is about 0.35 microvolts throughout the MW band for a 10 dB S+N/N using WIDE bandwidth and AM mode, with a 400 Hz modulated source at 50% modulation. The WIDE bandwidth AM sensitivity of my 525 on the SW bands is not quite as good, about 0.45 microvolts, but still excellent. Perhaps some early production 525's were desensitized by design in the MW band. But that appears not to be the case for most 525's. The 525 is one of the few solid state receivers with adequate MW band sensitivity at locations like mine with low levels of man-made noise.

Selectivity should also not be an issue for modern solid state communications receivers, but again it sometimes is. Insufficient number of bandwidths, and inappropriate bandwidths are the common defects. The 525 design is excellent with regard to available bandwidths because it has four available bandwidths which are selectable independent of mode. A 525 comes with three selectivities - AUX, WIDE, and INTER. A fourth bandwidth is available in the NARR position when an optional filter is installed. Unfortunately, no suitable AM filter is currently availavle for the fourth position. So you have to make do with the three stock bandwidths. The instruction manual specifies the AUX, WIDE

R73-5-5

Receiver manufacturers seldom specify 2nd order IMD performance. Yet 2nd order IMD products are routinely observed on some receivers in actual listening situations, like on an R8 in the 15.6 - 15.8 MHz range during the early evening hours. These 2nd order products are due to strong SW broadcasters in the 31 and 49 meter bands (e.g., 6.1 + 9.6 = 15.7 MHz). The 15 MHz ICP2's due to 6 and 9 MHz tones were +49 dBm, greater than +64 dBm, and greater than +67 dBm for the R8, 390A, and 525 respectively, and the corresponding DR2's were 84dB, greater than 96.5 dB, and greater than 100 dB respectively. Again, the 525 edged out the 390A, and the R8 finished a distant third. ICP2's and DR2's within the MW band were not as high for any of the receivers. For example, the 1320 KHz DR2's due to 600 and 720 KHz tones were 80 dB, 86 dB, and 91 dB respectively.

"All so called 'specialists' take note: Here at last is a receiver which is a match to their beloved monster Collins R390A/URR." Thus said Rainer Lichte. It is close, but not quite there. While the 525 edges the 390A in a few important categories like wide dynamic range, the R-390A edges the 525 in other important categories like spurious responses. And the 390A does not generate any display noise which can be received by a nearby MW loop antenna. Were it not for the 525 display noise problem, I would be more inclined to agree with Lichte. But below 1200 KHz the 525 display noise becomes observable above ambient man-made noise at my quiet location, and is very annoying at the low end of the MW band on weaker daytime signals using my 2 foot air core balun loop with amp. At night, however, I haven't noticed any display noise because of greater signal levels, even when using my LIL-4 phasing adapter to combine loop and noise reducing wire antennas for cardioid patterns. So the 525 display noise problem is not as bad as I expected it to be (based on other reports). But I have also heard that the amount of display noise generated by a 525 varies from one 525 to another, so perhaps I have a "tame" 525 in that regard. The 525 display noise is much worse when one uses an amplified ferrite rod MW loop. A ferrite rod loop must be moved further away from a 525 than an air core loop to reduce 525 display noise to an acceptable level. Maybe this accounts for the variation of opinion as to the severity of the 525 display noise problem. Another area where the 390A edges the 525 is AGC performance. The 525 AGC has several annoying characteristics due mainly to inappropriate AM mode attack time constants. Static crashes and noise pulses cause the 525 AGC to "hang," which briefly desensitizes the 525. And at high signal levels the instantaneous fast attack and fast release of the 525 causes low frequency audio distortion on AM signals. Fortunately, these 525 AGC defects can be greatly reduced as described in my article, "NRD-525 AM AGC Mod 2," by replacing R104 with a 220K ohm surface mount resistor, adding a 22K 1/4 watt resistor from pin 2 of IC7 to pin 4 of IC8, and adding a jumper from pin 3 of IC8 to pin 3 of IC9. This mod greatly increases the AM mode attack time constant, which eliminates AM audio distortion due to audio on the AGC line, and greatly reduces AGC "hanging" due to static crashes and noise pulses in AM mode. Also, my 525 does not extract as much signal from my noise reducing vertical antenna at the low frequency end of the MW band as a 390A. The difference is about 6 dB. Perhaps it is due to the reflected capacitance of the zip cord twin-lead detuning the 525 front end. The 525 does not have an antenna trimmer, which would help in analyzing and eliminating problems like this. However, I have not yet heard a signal at the low end of the MW band on a 390A that was not equally audible on a 525. Curiously, a 525 overloads when signals greater than about 50,000 microvolts are applied to the antenna input. This is unlikely to be a problem for most 525 users unless they use antennas which develop excessive signal levels, or have extremely high RF environments. Overload appears to occur first at the 2nd mixer, but the 1st, 2nd, and 3rd 455 KHz IF amps may also be involved. At present I do not have a soultion for the overload. Finally, although I haven't found it much of a problem, many people have complained about the 525 digital S-meter jumping around all over the place. I do agree, however, that an analog S-meter would be an improvement.

Of course, an NRD-525 has a number of advantages over an R-390A: it can be carried around the house easily and on DXpeditions, it can be powered from two 6 volt lantern batteries, you can jump from one frequency to another much quicker, you have available 200 programmable memories which permit even faster frequency jumping, and you don't have to fix it yourself if something goes wrong with it.

revised 28 I 93