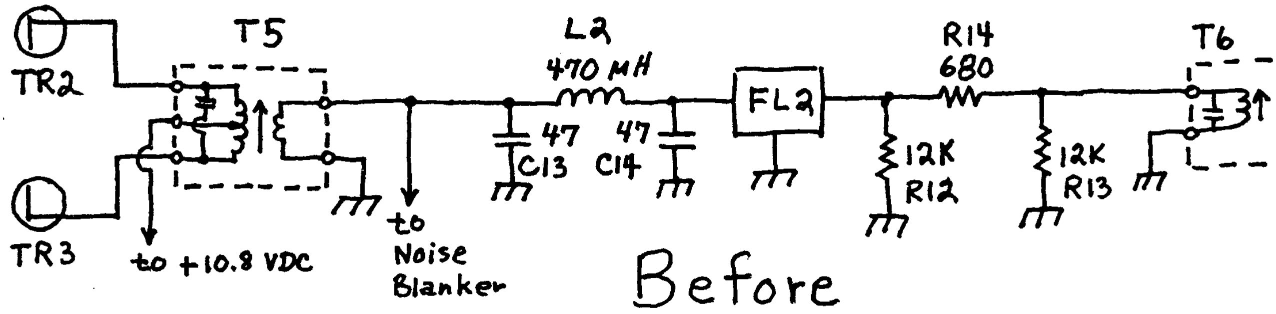
NRD-525 Narrower Bandwidth Noise Blanker

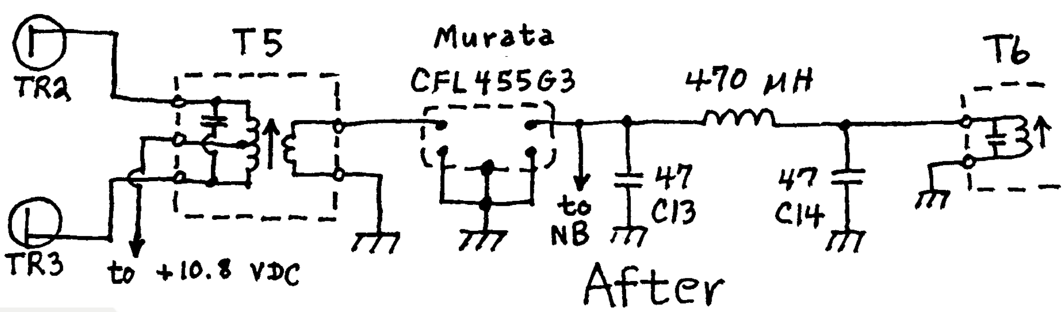
Dallas Lankford, 8 VI 98

Why does one need a narrower bandwidth for the NRD-525 noise blanker? So that one may blank pulse noise on weak signals which are closer to stronger signals than can be done with the unmodified noise blanker. For example, in side-by-side tests, a Drake R8 can often blank pulse noise on domestic MW channels during the day when an NRD-525 cannot. The R8 noise blanker bandwidth is determined by the 45 mHz IF filter, which is about 12 kHz at 6 dB down, while the NRD-525 noise blanker bandwidth is determined by the 70.455 mHz IF filter, which is about 20 kHz at 6 dB down (the latter according to Peter Pühler of Pühler Electronics, Almstrasse 3, 8019 Steinhorling, Germany). This means that an NRD-525 will be unable to blank pulse noise on a weak signal when there is a stronger signal within about +/- 15 kHz. The exact range within which an NRD-525 noise blanker is disabled depends on the signal strengths of the desired signal and nearby stronger signal, and on the shape of FL-1, and similarly for the R8.

Ideally, one would like a noise blanker bandwidth to be the same as the received signal bandwidth. But this is not possible because steep skirted bandwidths of, say, 9 kHz or less begin to progressively disable the noise blanker by lengthening pulse widths and decreasing pulse amplitudes. In my opinion, the 9 kHz bandwidth is where the degradation of noise blanker performance begins to be serious. However, one can go with a 9 kHz bandwidth or less if one is willing to accept reduced noise blanker performance.

Below are before and after schematics of my modified NRD-525 which provide me with a noise blanker with a 6 dB bandwidth of about 13 kHz and a 60 dB bandwidth of about 21 kHz.





The following parts were removed:T5, L2, FL2, R12, R13, and R14. R12, R13, and R14 form a 3 dB resistor pi network attenuator with 2000 ohm input and output impedance. FL2 is a 455 kHz center frequency NTK LF-B12 with a minimum 6 dB bandwidth of 12 kHz and maximum 40 dB bandwidth of 26 kHz. 2000 ohms input and output impedance. 6 dB maximum insertion loss, and a group delay of between 50 and 125 microseconds. Typical 6 and 60 dB bandwidths of LF-B12 filters are not known. C13, C14, and L2 form a 2000 ohm input and output impedance low pass filter with 1510 kHz cutoff frequency. At first the high cutoff.frequency puzzled me, but then I discovered (using formulas and a graph in Electronic Designer's Handbook. by R. W. Landee, D. C. Davis, and A. P. Albrecht, McGraw-Hill. 1957, page 20-60) that a cutoff frequency of about three times the operating frequency was chosen to simplify calculation of delay time through the filter, in this case about 0.21 microseconds.

L2 was replaced by a 470 microHenry choke. 30 turns of #24 enameled copper wire wound on an Amidon FT-50-43 ferrite toroid. Using a ferrite toroid for L2 helps minimize inductive coupling past the Murata CFL455G3 ceramic filter. T5, a micro-miniature 455 kHz IF transformer, was "killed" during tests with a preliminary version of this modification. The T5 pin-outs in its plastic base are not firmly mounted, and rotation caused an internal winding to break. At that point T5 was destructively taken apart to count turns and to measure the internal fixed capacitor: 150 turns center tapped primary, 35 turns secondary. 189 pF fixed capacitor. A replacement IF transformer was made from two Mouser IF transformers, part number 42IF303, by removing all turns from both transformers, and rewinding one of the transformers with a 140 turn center tapped primary and 32 turn secondary. A solder coated piece of copper foil, doubled in thickness, and cut to shape was used to isolate the filter input from the filter output, and to isolate the input and output point-to-point wiring. Point-to-point wiring was used because there was not enough space for PC board construction. Scotch Glass Cloth Electrical Tape was used to insulate the transformer and filter from the shielded compartment. A small piece of self-adhesive velcro and a small piece of self-adhesive foam tape were used to hold the filter assembly down against the top of the PC board when the shielded compartment top was affixed.

After the modification is completed you may need to readjust the S-meter so that a 40 microvolt signal at the antenna input gives an S-9 meter reading with the 525 and signal generator set at 7.104 mHz, and the 525 in DSB mode and WIDE bandwidth. If the S-meter is adjusted (using miniature potientiometer RV6 on the CAE-182 IF AF AMP PC board), check the that the S-meter still settles at S-l with no signal (no signal generator attached. no antenna attached). If not, the AGC gain should be adjusted (using miniature potientiometer RV5 on the CAE-182 IF AF AMP PC board) so that the S-meter can be zeroed.

In my 525 I removed FL2 and the 3 dB attenuator R12/R13/R14 in order to restore the signal loss through the Murata CFL455G3 filter so that in turn, the S-meter could be adjusted for 40 microvolts equals S-9. I was somewhat concerned that removing FL2 might result in inadequate delay for proper noise blanker operation. However, I found (using formulas and a graph from Electronic And Radio Engineering, Fourth Edition, F. E. Terman, International Student Edition, McGraw-Hill, 1955, Fig. 12-9, page 410) that the delay through three parallel LC tuned circuits with Q = 50 at 455 kHz is about 0.036 microseconds, which is considerably less than through the low pass filter. And listening tests confirmed that there was no degradation of noise blanker performance.

As we all know, hindsight is 20/20. Having finished my modification, I noticed that it may be possible to achieve essentially the same result by much simpler means: remove R12, R13, and R14, remove C13, C14, and L2, remove C29 (not shown on the Before and After schematics; C29 is the coupling capacitor from the output of T5 to the input of the noise blanker), install a jumper where L2 was removed, install C13 and C14 in place of R12 and R13 (actually it is recommended that new 47 pF 50 volt 1206 case SMD capacitors be used), install a 470 microHenry surface mount inductor (Mouser 435-18-471K) in place of R14, and use a small discrete 100 pF capacitor to connect the input of the noise blanker to the output of FL2.

For those who try either of the mods above, let me remind you that the easiest way to remove two-terminal surface mount devices is to use two soldering irons with "chisel" tips. And the best desoldering braid is still Chem-Wik Lite 0.100, although Radio Shack desoldering braid rubbed with soldering paste flux will do in an emergency. At least one person suggested to me that this is a "who cares?" mod because the NRD-525 is an outdated receiver. However, the NRD-535 has an identical IF PC board as far as this mod is concerend. And as for performance of top end solid state receivers, the NRD-525 is hard to beat.

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There are two 525 NB adjustments; I think they are labeled RV1 and RV2, in any case two small pots. One (in the middle of the PC board) sets the NB gain (I think), and the other (at the op edge) sets the balance of the blanking diodes. In my experience, the NB gain is set too low at the JRC factory; it should be set for maximum gain (fully clockwise). The balance control (which sets blanking "depth") probably does not need adjustment; but you can check its setting by tuning some blankable noise, blanking the noise, and then rotating the balance control back and forth to check that it "maximizes" blanking... the "maximum" is quite broad.