R-390A Noise Blanker

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In my 16 II 95 note, "RA6790GM (R-2174(P)/URR) Noise Blanker," I described a noise blanker for the 6790 based on the Allegro Microsystems integrated circuit ULN3846A. In this note, I will describe a noise blanker for the R-390A using the Allegro Microsystems integrated circuit ULN3845A. The only difference between the 3846 and 3845 chips is that the 3846 is mono, while the 3845 is stereo in the sense that the 3845 has two AF gates while the 3846 has only one audio gate. This difference is moot because I have disabled the AF gate for the RA6790 noise blanker (the AF gates introduce noise in CW and SSB modes), and do not use the AF gate at all for the R-390A noise blanker. At one point in the development of the R-390A noise blanker, I did use one of the AF gates, but as was the case for the RA6790 noise blanker, the AF gate introduced noise in CW and SSB modes for the R-390A. Moreover, in AM mode for both noise blankers I could hear no difference in blanking effectiveness with or without the AF gates, so there is really no reason to use the AF gates. I have recently been informed by Dick Nelson that Allegro has discontinued production of the mono ULN3846, so one should use a 3845 for the RA6790 noise blanker, with, of course, appropriate pin-out changes.

Before and after schemaitcs of the R-390A noise blanker are given below in Figure 1.

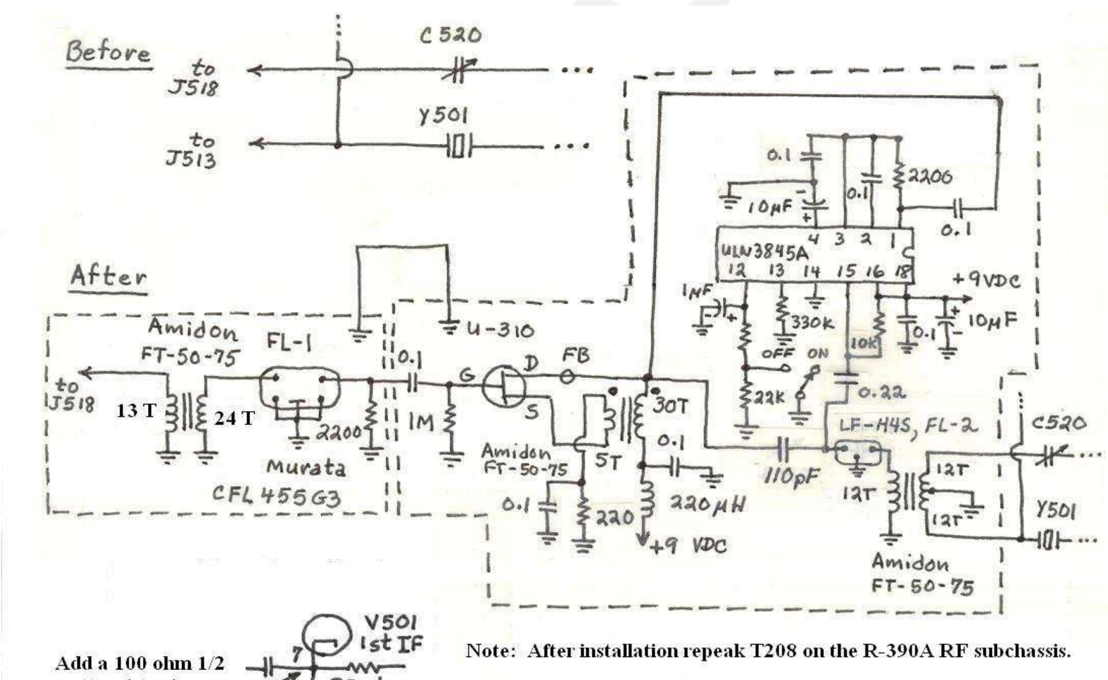


Figure 1

A regulated 9 volt DC power supply for the noise blanker is given below in Figure 2. By using an R-390A style (4-40 threaded) insulated standoff, and using the 7809P regulator pins as solder lug tie points, no PC board or other Circuit mounting arrangement is needed (or desired because of limited space).

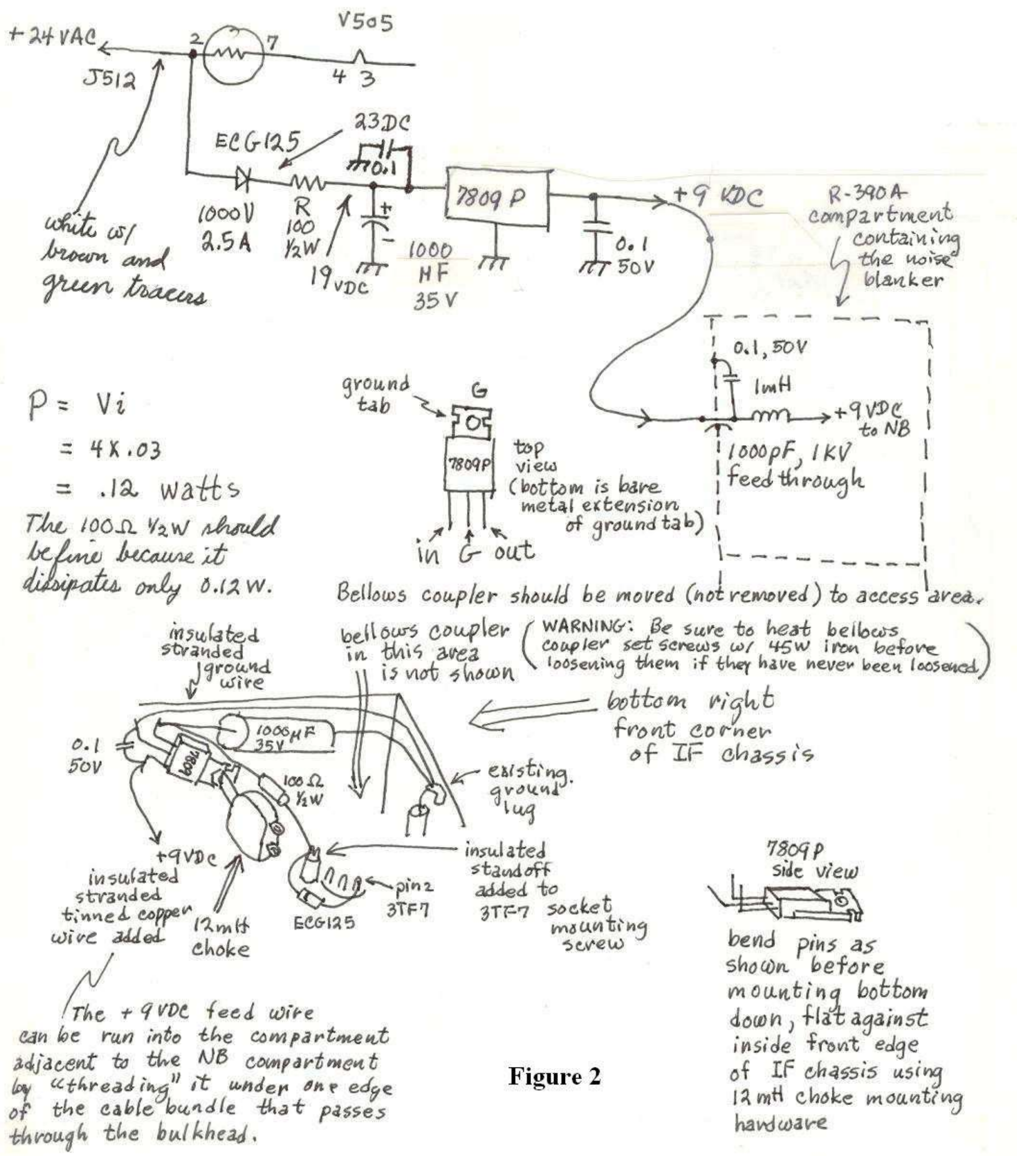


Figure 2

Initially I implemented essentially the same circuit which I used in the RA6790GM, except, of course, a 9 volt DC power supply was needed for the IC (and U-310 amp), which was provided by tapping off the 24 volt AC line to the 3TF7 ballast tube; see the low voltage regulated DC power supply description and schematic above in Figure 2. However, much to my dismay, the noise blanker did not blank noise. When I discussed this surprising situation with Wally Chambers, he suggested that the Allegro IC was not getting enough signal at the RF input, pin 1. To test that hypothesis, I connected a tuned preamp with about 12 dB gain, and found that the R-390A noise blanker worked well on pulse noise available at the time of testing. Clearly additional voltage gain was needed to increase signal levels at the RF input of the Allegro IC. This was accomplished with a U-310 common source amp using negative source feedback. The turns ratio of the negative feedback transformer was chosen to establish about 17 dB voltage gain for a 2200 ohm real load. The common source negative feedback U-310 amp has an additional advantage of having considerably higher 3rd order intercepts than a conventional common source FET amp, about +13 dBm compared to about -1 dBm for an MPF-I02 common source amp without negative feedback and with a 2200 ohm real load. An MPF-I02 or other FET cannot be used in place of the U-310 in the common source negative feedback amp (an MPF-I02 gives lower voltage gain and lower 3rd order intercepts when used in place of the U-310).

While testing the R-390A noise blanker and comparing it to the R8 and RA6790GM noise blankers, it was discovered that in CW and SSB modes the Allegro IC audio gates introduce a weak but noticeable buzz when blanking pulse noise. Inspection of the R8 schematic revealed that the R8 automatically deactivates the audio gate of the Allegro IC in CW and SSB modes. Consequently, the audio gate is not used for the R-390A noise blanker, and the audio gate part of the RA6790GM noise blanker has been removed. Further testing is needed to determine whether the audio gate part of the Allegro IC provides any significant blanking in AM mode, but it is already apparent that most of the noise blanking effectiveness of the Allegro IC is due to the RF gate.

Pin-outs of both the mono and stereo IC's, and a block diagram of the stereo IC (ULN3845A) are given below in Figure 3. A block diagram of the mono IC (ULN3846A) can be deduced from the block diagram of the stereo IC.

The allegro Microsystems ULN3845A/46A family of noise blankers are the most effective noise blankers I have used, and much more effective than the NRD-525/535 noise blankers (perhaps because narrower bandwidths can be and are used ahead of the Allegro family of noise blankers), and the Lowe HF-225E noise blanker which is ineffective against electric fence pulse noise (which the R8 blanks, according to a report by Patrick Martin, communicated to me by Guy Atkins). The Allegro NB family is effective against various kinds of pulse noise, including power line pulse noise, ignition pulse noise, fluorescent light pulse noise, and, according to an Allegro data sheet, light dimmer noise (though I have not confirmed the latter). Becuase I use a noise reducing / interference-reducing antenna (cf. DX News 58, Nos. 28 & 29 - July 29, Aug. 26, 1991), my noise levels are generally quite low, and I rarely need a noise blanker. But occasionally I experience S-7 to S-9 noise (on the R8) which the R8 noise blanker reduces to S-O to S-2, and brings up MW and SW signals to clear audibility which otherwise are completely burried under the noise. Noise limiters and audio DSP noise reducing accessories are totally ineffective against this kind of noise which completely covers a signal.

In my article "RA6790GM (R-2174(P)/URR) Noise Blanker," published in DX News Vol. 62, No. 22 [sic.], I pointed out that one of the main things which attracted me to the Allegro family of noise blankers was that these noise blankers offered the prospect of narrow bandwidth noise blankers. My experiments, first with the RA6790GM, and now with the R-390A, confirm that narrow bandwidth noise blankers are feasible. I do not know at this time whether my circuits are optimal. Denzil Wraight has suggested that a better approach might be to use a narrow bandwidth filter only in the noise blanker signal path, which in principle would minimize the pulse width and perhaps result in a more effective noise blanker. Such an approach may be feasible, but would seem to require a delay line in the main signal path to compensate for the group delay through the noise blanker filter. However, the usual methods of constructing delay lines would be impractical because of the large delay required, and cascading wideband filters would be impractical where space is limited, as in the case of the R-390A. A feasible implementation of this approach might be to use multiple parallel LC tuned circuits. According to a formula in E. F. Terman's book, Electronic and Radio Engineering, 4th Edition, the time delay of a parallel LC tuned circuit is given by T(delay) = 0.31 /Qf where Q is the loaded Q of the parallel LC tuned circuit, f is the resonant frequency of the parallel LC tuned circuit in Hertz, and delay time T(delay) is in seconds. For example, at 500 kHz, a loaded Q of 50 provides 0.13 nS delay.

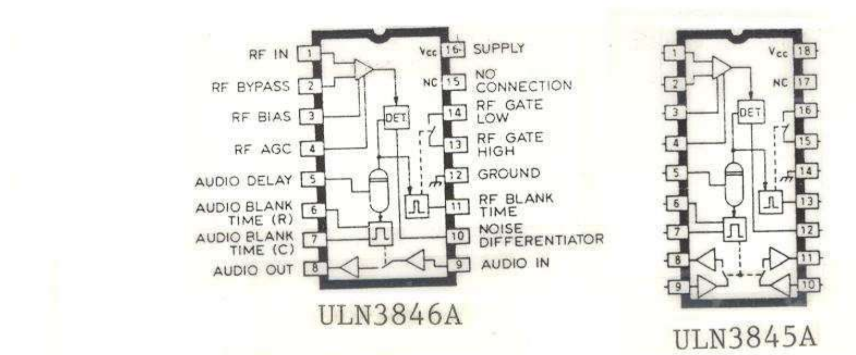
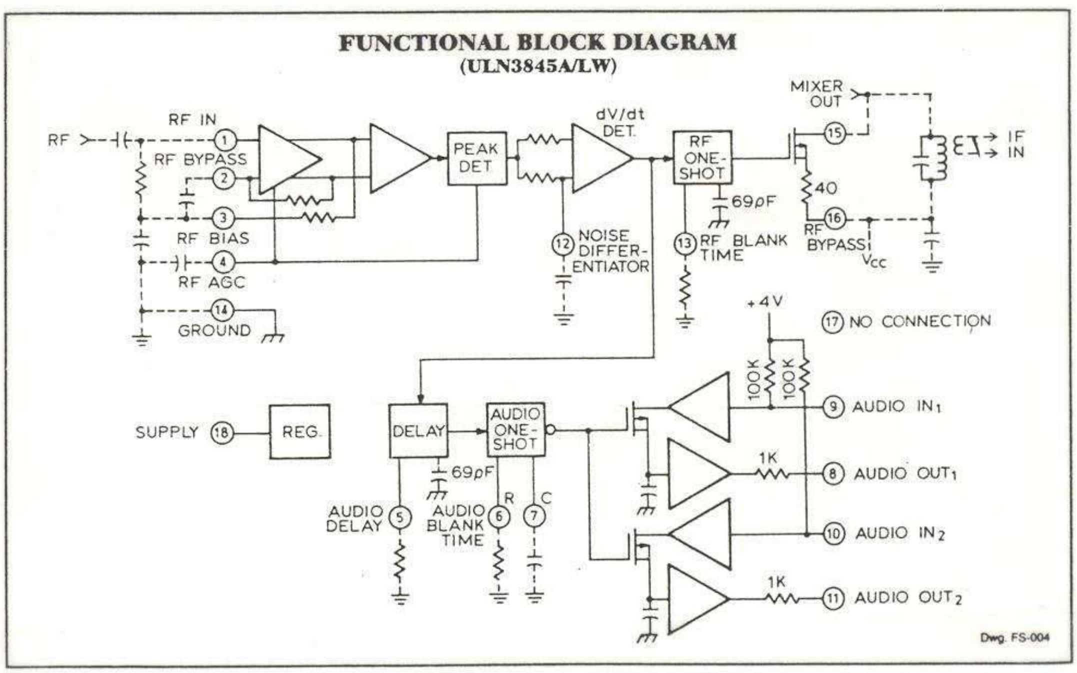


Figure 3



As I have said before, I generally do not experience much man-made noise, including pulse noise, at my location, so it has been a slow process for me to optimize the noise blankers I have developed for the RA6790GM and for the R-390A. Sometimes I have to wait for weeks before I have a brief episode of occasional increased pulse noise. To obtain more information about the effectiveness of the R-390A noise blanker I have developed, I built and installed a second copy and installed it in an R-390A IF deck for Wally Chambers, who lives in Memphis, TN, and has considerable man-made noise, including pulse noise. With a "standard" antenna (an antenna equivalent to a 80 foot inverted L antenna), Wally often has noise at about 15 to 20 dB on his R-390A carrier meter. The R-390A noise blanker frequently reduces his noise 15 to 20 dB or more, which permits him to hear numerous weak signals (both MW and SW) which were completely unheard without the noise blanker. While testing the R-390A noise blanker in the Memphis urban area, Wally observed an effect that I had also observed, but so briefly and infrequently that I was not sure the effect was real. Wally found that in the Memphis urban area there are two types of man-made pulse noise, one with sharp and distinct pulses which the noise blanker blanks very effectively, and another with less sharp and distinct pulses, on which the noise blanker has little or no effect.

The Allegro Microsystems states that the ULN3845 and ULN3846 are effective against many kinds of impulse noise, including that from ignition systems, and from sources producing pulse noise at a power line rate, such as light dimmers and fluorescent lamps. I have found this generally to be the case. In an article in the February 1989 issue of RF Design, "A low-cost, highperformance noise blanker," by Oliver L. Richards, it was stated that the ULN3845 and ULN3846 are also effective against pulse noise caused by SCR controls and meteorological disturbances. Until I read his remark about the effectiveness of the Allegro ICs against thunderstorm static, I had not tested my noise blankers on thunderstorm static. Indeed, the Allegro IC's are effective against thunderstorm static, provided the static levels are not too high, and provided the static crashes are not too frequent.

While the Allegro data sheets recommend against using bandwidths as narrow as 12 kHz ahead of the IC, I have found the that ULN series of noise blankers is more effective with a 12 kHz bandwidth filter than with a considerably wider filter ahead of the noise blanker for virtually all blankable noise commonly encountered in the MW and SW spectrum by DXers and casual listeners. It is not known whether Drake's choice of a 12 kHz bandwidth filter ahead of the Allegro IC was coincidental or deliberate, but in any case, the same 12 kHz bandwidth ahead of the Allegro noise blanker is used in the R8.

This article is not intended as a construction project, so complete details of the PC boards are not given. The filter PC board is similar to the PC board described in my article "R-390A Filter, Mod 2," and published in DX News Vol. 62, No. 19 - February 13, 1995, and published elsewhere. The filter PC board is mounted on one side of the compartment where J513 and J518 enter the R-390A IF chassis. The noise blanker PC board is about 1 inch by 1 11/16 inch, and is mounted on the other side of the compartment. The LF-H4S filter, FL-2, is not necessary, but was included because I wanted a 6 kHz bandwidth for my R-390A. If the LF-H4S filter is omitted, the 110 pF capacitor preceeding the filter should be changed to 47 pF. Adding the 100 ohm resistor in parallel with R504 may not be necessary in some R-390A IF decks; its purpose is to increase the weak signal gain of the 1st IF amplifier, V501, to make up for loss through the filters and noise blanker circuit. To determine whether the 100 ohm resistor is necessary, do a noise performance test before and after the mods are done. The noise performance test consists of tuning the R-390A to 5.500 mHz, peaking the ANT TRIM for maximum noise with no antenna connected, using the 8 kHz bandwidth and AM mode (BFO OFF), and checking that the LINE METER reads no more than VU (0 on the LINE METER) with the LINE METER switch set to 0 and the LINE GAIN control set fully clockwise, and that the LINE METER reads no less than VU with the LINE METER switch set to -10 and the line gain control set fully clockwise, where the FUNCTION switch is set to MGC and the RF GAIN control is set fully clockwise.

Previously I have specified this test with the FUNCTION switch set to AGC, but variations in no-signal AGC line voltage from one IF strip to another are eliminated by using MGC. The (IF) GAIN ADJ control (beside the CARR METER ADJ control) on the IF chassis bracket should be set fully clockwise (minimum gain) for the noise performance test. Although it is unlikely that you will have one of the rare mismarked GAIN ADJ potientiometers, measure the resistance of the GAIN ADJ pot and verify that it is 10 K ohms (+/- 20%) when fully clockwise.