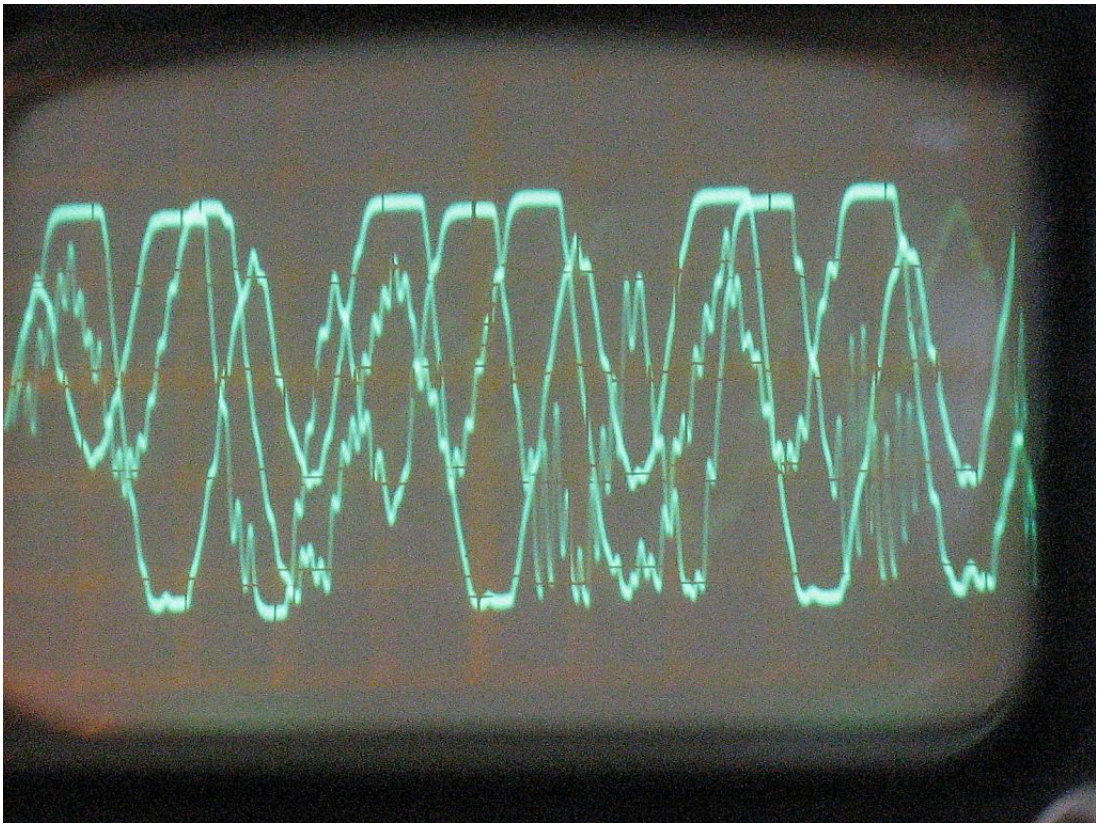
R-390A Noise Limiter Distortion
Larry Haney, 3-10-2025

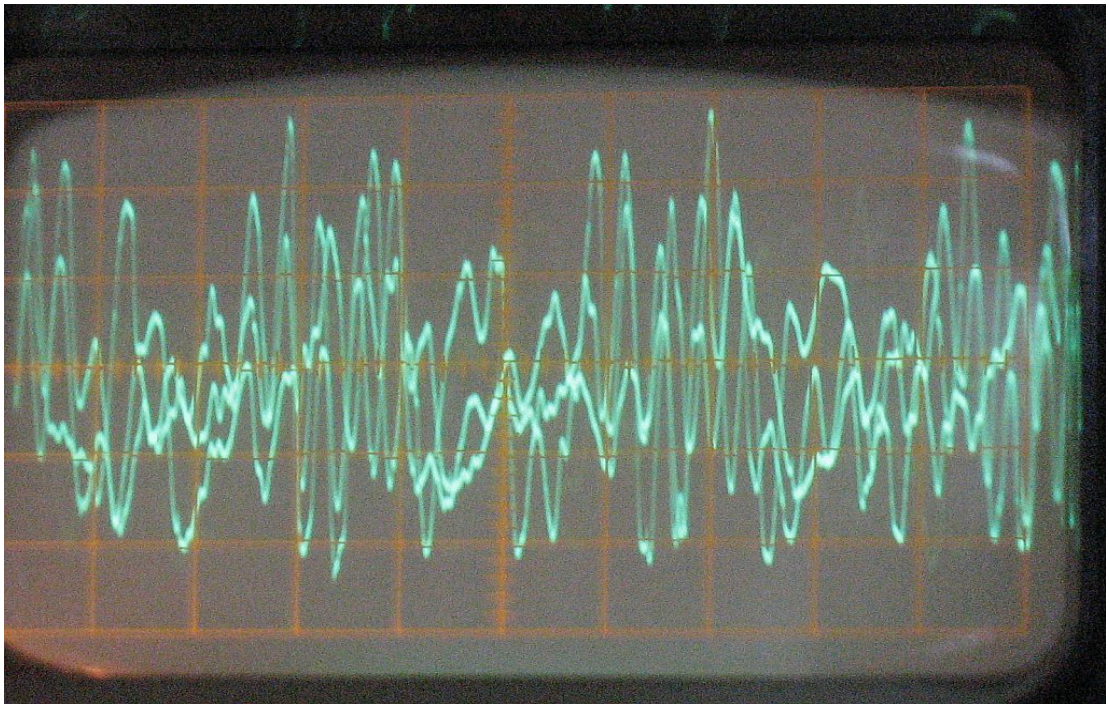
The R-390A Noise Limiter will usually put clipping distortion on the audio when turned on and receiving a station with a very high modulation level. In order to reduce noise on the audio, when the Noise Limiter is on, it uses a low bias on the dual diodes (triodes) Noise Limiter tubes to accomplish it. Unfortunately, this low bias is too low for stations with very high modulation and causes audio clipping.

The following picture shows the unmodified Noise Limiter (NL) audio out with it turned on (the clipping is very noticeable). This is of a high modulation station:



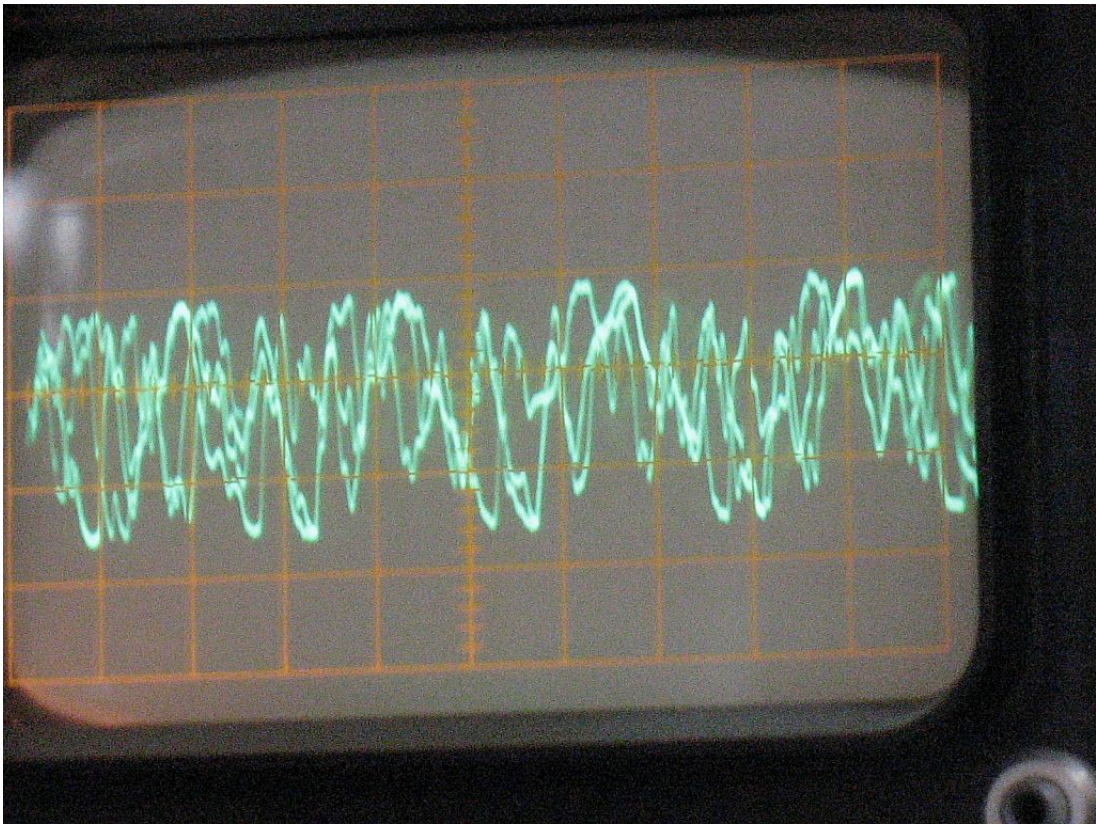
The audio distortion (clipping) is very noticeable to see and hear. Some BCB stations are using very high modulation levels. I tried turning the RF gain down to improve the clipping, but that helped very little. You can look at the modulation level by connecting a scope to the IF output on the back. You'll see the modulated RF there. The modulation level can be determined by seeing how close the valleys get to the center (RF 0 point). The closer it gets to that point, the higher the modulation level. The station I'm referring to gets very close and I estimate it is modulating at 95%, whereas most of the stations I looked at are about 75% and do not cause clipping. There are 5 stations in the SF Bay area that put out very high modulation signals (around 95%).

The following picture shows the same station with the Noise Limiter audio output with the NL turned off:

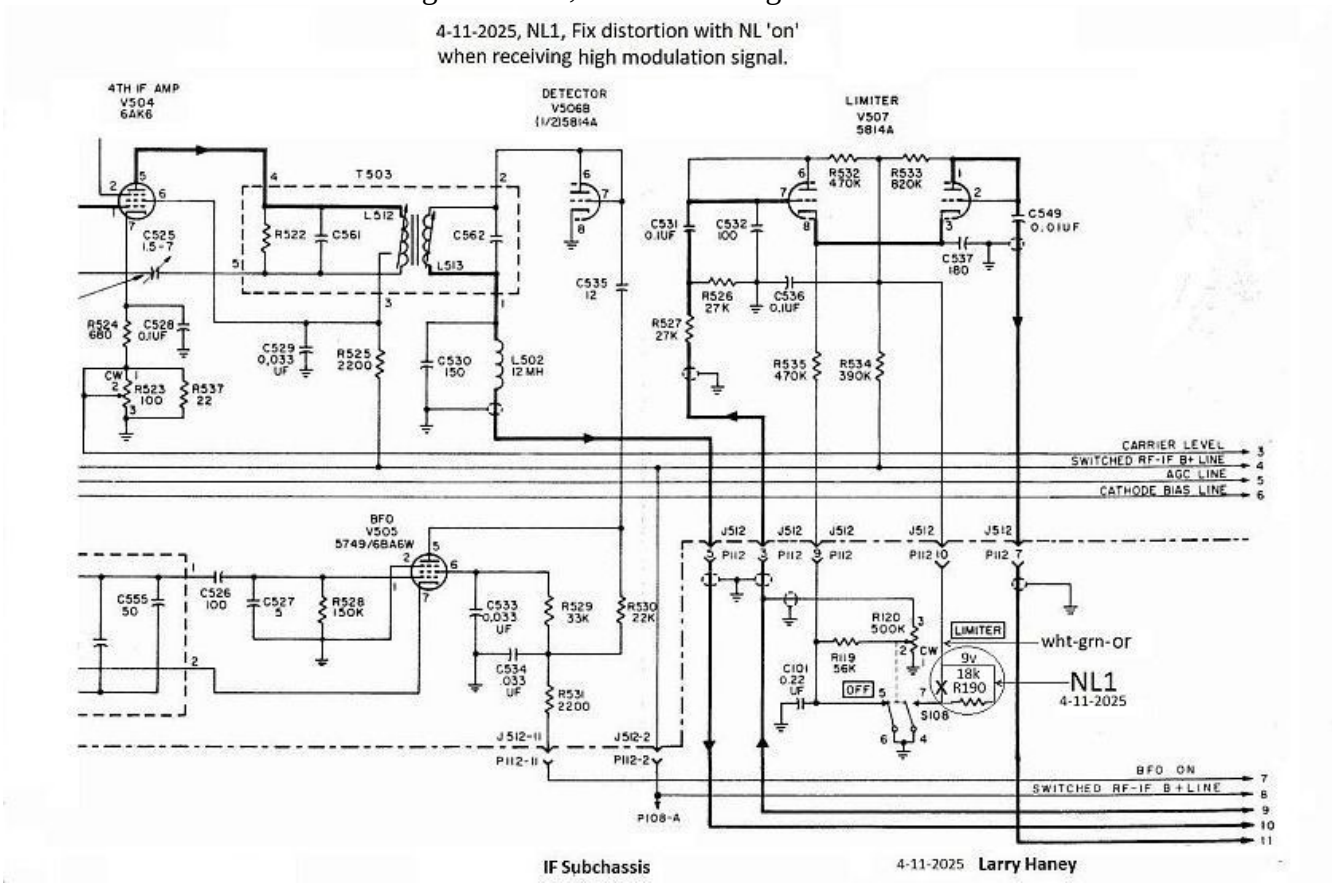


Notice that no clipping is occurring.

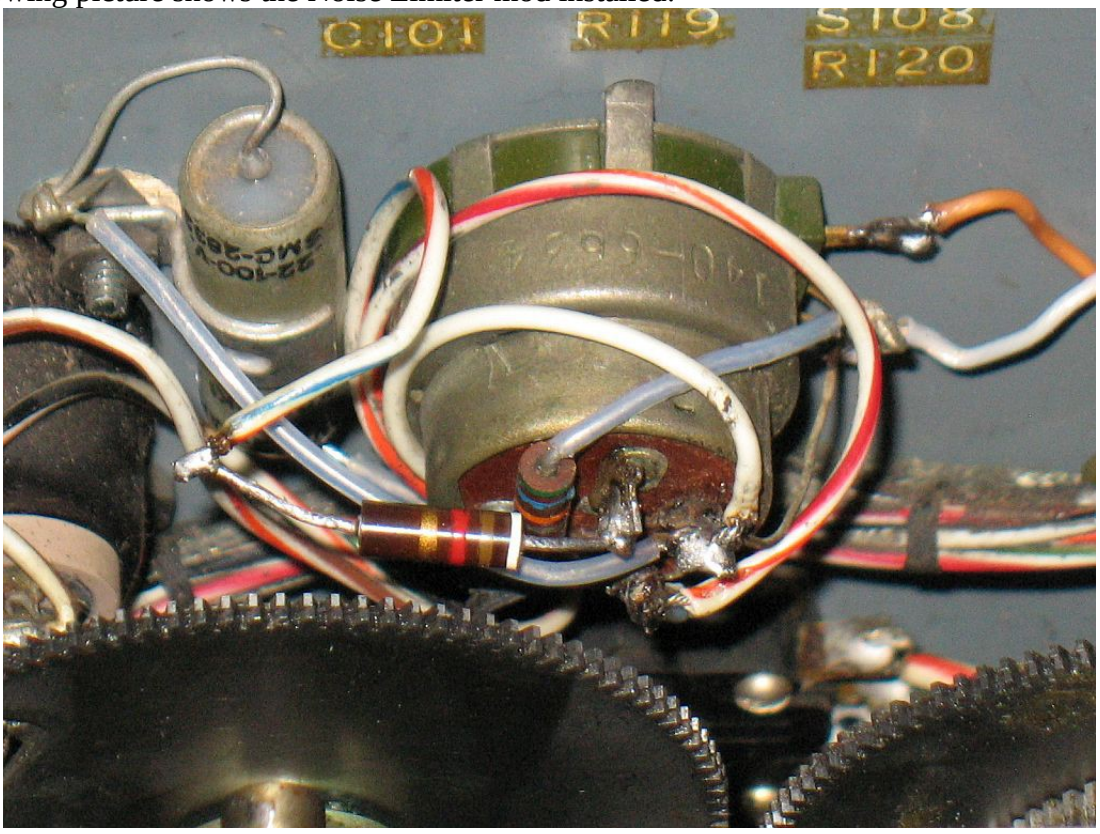
The following picture shows the Noise Limiter audio out with it turned on and with the mod installed (the clipping is hardly noticeable). There again, this is of a very high modulation station:



Here’s the schematic of the fixing mod NL1, in the lower right corner:



The following picture shows the Noise Limiter mod installed:



This mod increases the bias on the limiter diodes (triodes) about 9 vdc (only when turned on), in order to reduce the clipping. It does it by adding an 18 k ohm resistor (10% tolerance) (the picture shows a 9.1 k) in the line that grounds the positive bias on the plates of the two limiter diodes (triodes). This increases the positive voltage on the plates causing them to clip less on higher levels of modulation. This small increase does not detract very much from the normal noise reduction (clipping) when receiving weak stations or no station.

NOTE: When the Noise Limiter is off, the added 18k ohm resistor is at about 135 vdc.

Unfortunately, there are two caveats to this mod:

1. It reduces the ability of the Limiter level knob to reduce the audio level to zero. The increased bias on the Limiter tubes only allows the audio to be reduced to about 40% when the limiter level is turned fully CW.
2. The noise clipping level with the limiter level knob at fully CCW (but still turned on) does not reduce the noise level (when between stations) as much as without the mod. This causes the noise level between stations to be a little higher than without the mod. Since the noise limiter usually reduces this noise to a very low level, the increase is not very bothersome.

So, you need to decide if receiving a high modulation station clearly is worth putting this mod on or not. One thing to consider is how many very high modulation stations you receive normally.

Another thing to consider is that this mod also improves the fidelity of most stations received with the NL turned on. That's because without this mod on, the noise limiter also reduces the fidelity of the received stations by reducing the treble component of the audio (resulting in a bassier sound). This mod fixes this problem by reducing the amount of clipping (which affects the treble component more than the rest of the audio).

If you are experiencing any of the symptoms above, I suggest trying this mod because it is so easy to install. Another good aspect of it is that its location makes it easy to short out with a test lead (with a clip on each end) to see the difference. Remember, when the Noise Limiter is off, the added 18k ohm resistor is at about 135 vdc. To monitor the audio clipping, its easy to hook the scope up to the wiper on the line gain pot.

It also might be a good idea to make sure that the Limiter is receiving the correct input. The audio on pin 7 of V507 (easily measured using a tube extender) should be 50% of the audio level at the Diode Load (DL). If it's a little low that's ok, but not higher. The -vdc at the DL should be between -7 and -18 vdc (depending on station strength) with the NL off, and 15% more (-10 to -21 vdc) with the NL on. And the -vdc at the junction of R119 and C101 must not be more than 10% less than the DL -vdc (-9 to -19 vdc), with the NL on.