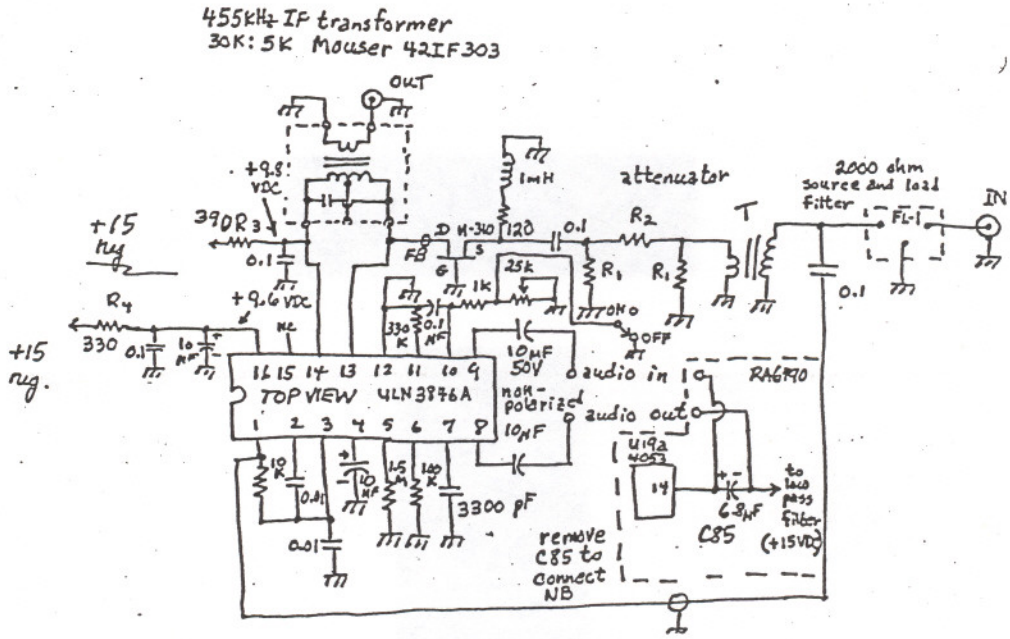
M78-4-1

RA6790GM (R-2174(P)/URR) Noise Blanker

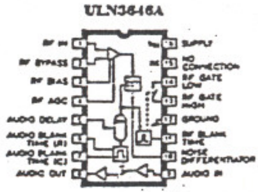
Dallas Lankford, 16 II 95



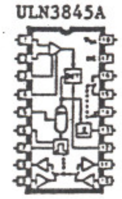
The Allegro MicroSystems, Inc. (115 Northeast Cutoff, Box 15036, Worcester, MA 01615, phone 508-853-5000) ULN3846A noise blanker chip appears to offer the prospect of a high performance, narrow bandwidth noise blanker. My attention was drawn to the ULN3846A because the two channel audio (stereo) version, ULN3845A, is used in the Drake R8 receiver, and is one of the most effect noise blankers I have ever used in a communications receiver. In the R8, the 45 mHz crystal filter ahead of the 3845 chip (which is in the R8 50 kHz IF) establishes a 12.5 kHz (nominal) bandwidth for the noise blanker. This is considerably narrower than the bandwidth for any other noise blanker I have seen, which motivated me to develop the above narrow bandwidth noise blanker for a Racal RA6790GM (R-2174(P)/URR) receiver. Currently, I am using an NTK LF-H6S ceramic filter with about an 8.5 kHz bandwidth for FL-1 above. The noise blanker has worked about equally well with a 6.5 kHz bandwidth LF-H4S and a 5.9 kHz bandwidth Collins torsion filter, part number 526 8636 010. I opted for an 8.5 kHz BW FL-1 filter so that any filter up to 8.5 kHz BW can be used in the RA6790GM plug-in filter array, including the 6.8 kHz BW (nominal) Racal filter which is often found in the 6790, and generally measures 8 kHz or wider BW.

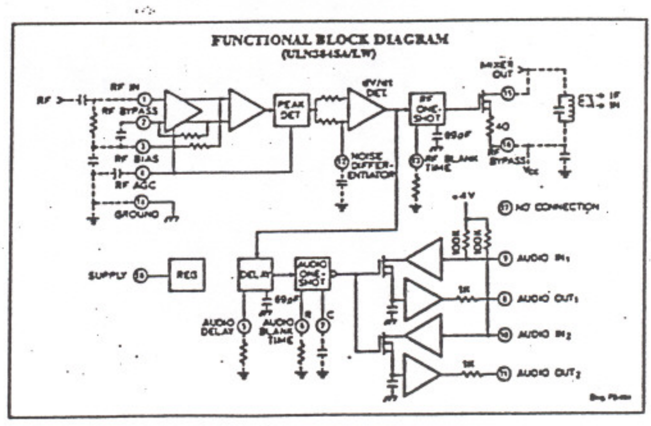
In some places in the Allegro literature the mono chip is referred to as the ULN3646A. However, the chip itself is marked ULN3846A. A block diagram of the stereo 3845A chip is given below together with pin outs of the 3845A and 3846A chips. The two chips are identical except for the 3845A having two audio blanking channels, and slightly different pin out; see the diagram and pin outs below.

ULN3846A



ULN3845A





For the mono 3846A chip, the audio delay time is determined by the resistor at pin 5 (R5), the audio blank time is determined by the resistor at pin 6 (R6) and the capacitor at pin 7 (C7), the RF blank time is determined by the resistor at pin 11 (R11), and the noise differentiator capacitor at pin 10 (C10) "is selected so that audio signals do not cause triggering," according to the Allegro data sheets. No other information is given about C10, except that a value of 1000 pF is given by Allegro in a sample circuit illustrating an AM/FM tuner noise blanker. In the R8, C10 is 1.0 mF. So I chose 0.1 mF as a compromize between those two values. In an initial implementation I used a 10 mF electrolytic for C10, and noticed nothing unusual except when I attempted to increase the RF blank time by raising R11 to 1 Meg ohm (in which case the circuit "died," tho I am not sure why). The RF blank time is given by the equation T(RF) = 157 x 10^{-12} x R13 microseconds. For the 330 K ohms I used, T(RF) = 51.8 microseconds. This is a bit longer than the 33 microseconds used in the R8 NARROW noise blanker mode. The audio delay time T(D) is given by T(D) = 143 x 10^{-12} x R5 microseconds. With 1.5 Meg ohms used, T(D) = 214.5 microseconds. The audio blank time T(AUD) is given by T(AUD) = 2.2 x R6 x C7 seconds. With 100 K ohms and 3300 pF, T(AUD) = 726 microseconds. These delay and audio blank times are about what are used in the R8.

The noise blanker was built on a 4 1/2 by 4 11/16 inch PC board which was mounted on four metal standoffs tapped for 6-32 screws, between the 6790 IF board and the rear panel. SMB connectors were used at the input and output to preserve the appearance of the 6790, and small pins and connectors were used to make the audio connections and +15 VDC connection. To make the +15 VDC connection, L4 was removed from the 6790 IF board, and a small PC board adapter was made which contained L4, and a pin for +15 VDC, and which mounted in the holes vacated by L4. After C85 was removed, small pins were mounted in the vacated 6790 PC board holes (for quick connect and disconnect of the noise blanker). The mini-coax from the output of the 2nd mixer board to the inout of the IF board was re-routed to the vicinity of the four standoffs, which required the 6790 power supply subchassis to be moved (but not removed). And an appropriate length of mini-coax with right angle SMB connectors was fabricated to conenct the output of the noise blanker to the input of the IF PC board. A rectangular metal plate on the 6790 rear panel was removed, and another metal plate fabricated and used to mount a miniature toggle switch on the rear panel for turning the noise blanker on and off. The original 6790 metal plate was saved in case I decide to restore the 6790 to original. With this approach, the noise blanker can be removed in about 30 seconds without any unsoldering.

The 25 K ohm pot is a threshold adjustment, and is set to 25 K for the 6790. The attenuator (R1 and R2) was not needed, so the two resistors R1 were omitted, and R2 was merely a solid wire jumper. The broadband matching transformer T is an Amidon FT-50-75 with 31 turns and 5 turns of #26 enameled copper wire, close wound, with the 5 turns at the center of the 31 turns. The ULN3846A was socketed.

It is believed that a similar circuit can be used to provide noise blankers for many top-of-the-line DX receivers, such as the R-390A, 51J-4, and NRD-525.

Testing of the circuit is not complete, but preliminary results are very encouraging. As yet, I have not experienced any episodes of bad pulse type noise which occasionally occur at my location, so it has not been possible to give the noise blanker a thorough testing. However, the noise blanker has been found effective against fluorescent lights (when I turn them on and can find the noise at sporadic frequencies on my noise reducing vertical antenna) and against the usual pops and clicks at lower frequencies. Fluorescent light noise is not completely eliminated, but on weak AM signals it is greatly reduced. The Allegro data sheet mentions that the 3845A and 3846A chips are also effective against ignition noise and light dimmers. I have not tried the noise blanker on either of these two types of noise.

M78-4-3

RA6790GM (R-2174(P)/URR) Noise Blanker, Mod 2

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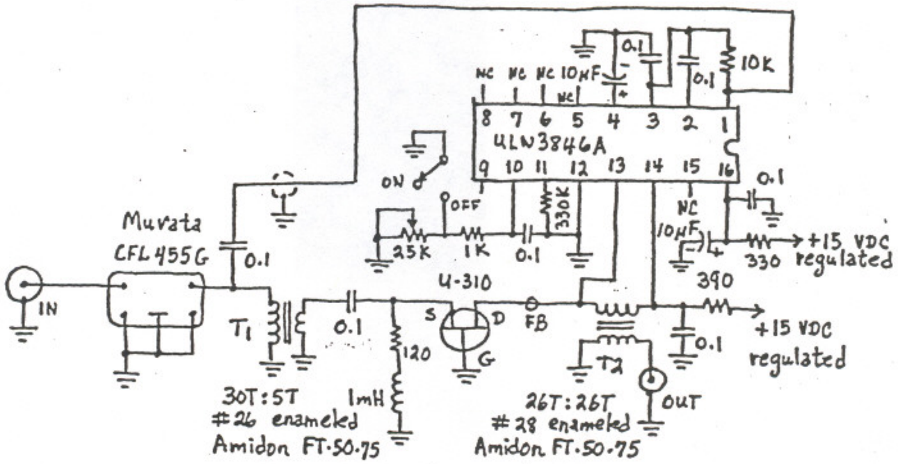
In my article, "RA6790GM (R-2174(P)/URR) Noise Blanker," which was published in DX News Vol. 62, No. 22 [sic] - March 20, 1995, pages 43-44, I described a noise blanker for the 6790 using the Allegro Microsystems ULN3846A IC. Subsequent comparison of the 6790 noise blanker with the Drake R8 noise blanker (which uses the Allegro IC) has led to three improvements which can be made to my original 6790 noise blanker. First, in CW and SSB modes it was observed that a weak but distinctive buzz remained after noise pulses had been blanked in the 6790, but not in the R8. Inspection of the R8 schematic revealed a feature which I had not noticed before: the R8 automatically disables the audio gate of the Allegro IC when in CW and SSB modes. The audio gate part of my original 6790 noise blanker circuit was removed, and the weak buzz in CW and SSB modes was eliminated from the 6790. No change in blanking effectiveness for AM mode has been observed in the 6790 with the audio gate part of the circuit removed. Second, the blanking effectiveness of the 6790 noise blanker in AM mode is improved for some combinations of signal levels and noise pulses by using a wider filter ahead of the noise blanker. Currently I am using a Murata CFL455G with nominal 6 dB bandwidth of 13 kHz and 60 dB bandwidth of 20 kHz, which is similar to the bandwidth of the R8 cascaded 45 mHz crystal filters ahead of the R8 noise blanker. Third, the tuned 455 kHz IF transformer in my original 6790 noise blanker circuit has been removed and replaced by a broadband transformer. This seems to have no effect on the effectiveness of the noise blanker, but should improve the strong signal handling performance of the U-310 common gate amp, and simplifies alignment of the noise blanker. A schematic reflecting these changes is given below. For addition details, refer to the original article.



Racal RA6790GM Noise Blanker Notes

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When 100 microvolts is injected at the RA6790 antenna input, 80 millivolts peak-to-peak is produced at the output of the CFL455G3 filter, i.e., at pin 1, the RF input of the Allegro ULN3846A. The 80 millivolts peak-to-peak is 28,300 microvolts RMS, which is a voltage gain of 283, or 49 dB. Consequently, a 1 microvolt pulse at the antenna input terminal of the RA6790 would be 283 microvolts at the RF input of the Allegro chip, <u>not</u> taking into account the pulse amplitude decrease due to the pulse passing through the CFL455G3 filter. Based on these observations, the RF pulse trigger threshold of the ULN3846A is not more than about 100 microvolts.

To estimate the RF pulse trigger threshold of the ULN3846A, the 0.1 mF coulpling capacitor was replaced by a 6-50 pF ceramic trimmer capacitor. There was no indication of inadequate signal levels to the ULN3846A throughout the 6-50 pF capacitor range. But surprisingly, blanking performance <u>improved</u> for <u>lower</u> pF values. A second smaller trimmer capacitor, 2-15 pF, was used in place of the 6-50 pF trimmer. In this case, evidence of inadequate signal levels to the ULN3846A was found in the 2-4 pF range. At about 4 pF, weak noise pulses began to reappear (with the blanker turned on), and the weak noise pulses had completely reappeared (as if the noise blanker was turned off) at minimum 2 pF capacitance. Thus, about 6-8 pF would be optimal.

Assuming 1 microvolt pulses at the antenna input of the RA6790, and pulsed decreased by 1/2 at the output of the CFL455G3 filter, and taking 4 pF as the threshold point, with these assumptions there is about 50 dB voltage gain to the output of the filter, and about 20 dB loss through the 4 pF capacitor, for a net voltage gain of about 35 dB to the RF inout of the ULN3846A. This corresponds to a voltage gain of 56, which suggests a threshold of 1/2 x 56 = 28 microvolts for the ULN3846A.

It is not known why the low pF ceramic trimmer capacitor improved blanking action of the ULN3846A. Perhaps it is due to a small amount of additional delay introduced by the small pF trimmer capacitor, or perhaps it is due to pulse wave form changes caused by the small pF capacitor, or perhaps it is due to the decreased signal levels at the RF input of the ULN3846A.

Due to possible variations in ULN3846A (or ULN3845A) chips, a 2-15 pF ceramic trimmer is recommended, and the exact setting should be detrmined with the noise blanker turned on and pulse noise being blanked.

An updated schematic of my current RA6790GM noise blanker is given below.

I would like to express my appreciation to Denzil Wraight for motivating this work by asking about the RF blanking threshold of the ULN3846A.