TECHNICAL MEMORANDUM (NASA) 27

AUTOMATIC NOISE LIMITER-BLANKER

Modifications of an audio noise limiter circuit, used in WW II era radio communications receivers, provides a noise limiter-blanker for narrow bandwidth low-level audio signals. The method has been evaluated for noise blanking with OMEGA-VLF navigation receivers but is adaptable to more general audio frequency processing systems.

by

R. W. Burhans
Avionics Engineering Center
Department of Electrical Engineering
Ohio University
Athens, Ohio 45701

(NASA-CR-147161) AUTOMATIC NOISE LIMITER-BLANKER (Ohio Univ.) 4 p HC $3.50 CSCL 17B

N76-22421

Unclas
G3/32 26860

May 1976

Supported by

National Aeronautics and Space Administration
Langley Research Center
Hampton, Virginia
Grant NGR 30-009-017

I. INTRODUCTION

Audio noise limiters or automatic noise limiters (ANL) were popular during the 1940-1950 period for HF band radio communications receivers. The usual implementation involved pairs of 6H6 or 6AL5 vacuum tube diodes operated in conjunction with the second detector of a typical AM superheterodyne receiver.[1] Impulse noise caused by local spherics activity or 60 Hz harmonics radiated from AC motor control systems, often causes signal interference problems even in 600 ohm balanced line transmission systems. In particular, low-level signals in the 10 μv to 10 mv range are often contaminated with 1 to 10 volt short duration spikes in long-line (100 meter to 10 km) information transmission systems. A pair of silicon diodes and two RC filters connected across the feedback impedance of an operational amplifier provides an automatic noise limiter-blanker (ANLB) for this type of impulse interference.

II. ANLB CIRCUIT

Current-differencing mode operational amplifiers (CDA) have the interesting property of providing low-level audio amplifiers when operated just above the V_{be} cutoff point (about 0.5V for the LM3900) at the inverting input terminal with the non-inverting input grounded. This low input bias is stabilized with a 470k resistor returned to the +5V power supply for the example circuit shown in Figure 1.

The major impulse noise reduction feature is provided by diode D1. The amplifier is designed such that the normal signal output level is constrained to less than 0.5V p-p. Noise pulses above 0.7V appearing at the output, charge capacitor C1 to cut off the amplifier by reducing the input bias. The greater the amplitude of the interfering noise pulse, the larger the cutoff bias developed at the negative input summing point. Correspondingly, higher input noise pulses increase the recovery time of the R1C1 circuit providing a blanking interval which is approximately proportional to the amplitude of the input noise transient.

III. OPERATING DETAILS

The circuit of Figure 1 has a fast-attack, slow-decay characteristic with the noise transient always appearing as a limited spike (1.4V p-p) at the amplifier output terminal, with a blanking time proportional to the amplitude at the input. This is advantageous in narrow band audio signal processing circuits where the signal is further filtered after the first amplifier stage. Examples might involve the use of prefilters for "touch-tone" information transmission systems, or input noise limiters for VLF receivers. In these cases the initial noise spike is always constrained to <1.4V p-p and the recovery time is effectively "matched" to the following filter stages if the time constant R1C1 is made about equal to 1/f where f is the input frequency in Hz.

For wide band uses, the blanking time constant can be selected for the mid-range frequencies or for the lowest frequency anticipated with a corresponding penalty of a longer blanking time relative to the higher frequency ranges of the system. In wide band systems the initial noise spike may sometimes be objectionable but the transient is always limited to only a 1.4V p-p excursion no matter what the level is at the input to the amplifier. The blanking space can tell any following audio processor to ignore the data at this time. In practical systems the amplifier inputs are usually further protected by Zener diode transient limiters to prevent burn-out on gross (> 10V p-p) noise pulses. The second D2R2C2 filter directly across the amplifier output provides a slight improvement in reducing the output spike from 4.5V p-p down to a constant 1.4V p-p, with a 5V power supply.

IV. OTHER NOISE BLANKING METHODS

A standard technique for narrow band audio systems involves the use of a "reverse squelch" circuit. A wide band input signal is fed to a high speed comparator which is adjusted to fire above some desired threshold. This drives a monostable which generates a gate for a selected blanking time interval. The gate is used as a control signal for a MOSFET type of analog transmission gate or voltage controlled amplifier such as the CA3080 driving the narrow band filters. This obviously requires an order of magnitude more hardware than the method presented here, but with the advantage that the initial noise transient is minimized using suitable high speed comparators.

V. EVALUATION

The ANLB circuit is presently being evaluated for noise reduction with OMEGA-VLF receiver front-ends operating in the 10 to 14 KHz range. Initial results suggest a 10 dB or more improvement in signal reception for local spherics interference and even some reduction in noise for burst type 60 Hz harmonic interference. A more detailed study of audio noise blanking methods is in progress.

VI. ACKNOWLEDGEMENTS

This work was supported by NASA Grant NGR 36-009-017 for application to low-frequency avionics systems for general aviation aircraft. Many helpful discussions with Dr. R. W. Lilley are acknowledged on the general requirements for noise blankers in VLF systems.

VII. REFERENCES

[1] "The Radio Amateur's Handbook", 1944 Edition, page 155, published by American Radio Relay League, Hartford, Connecticut.

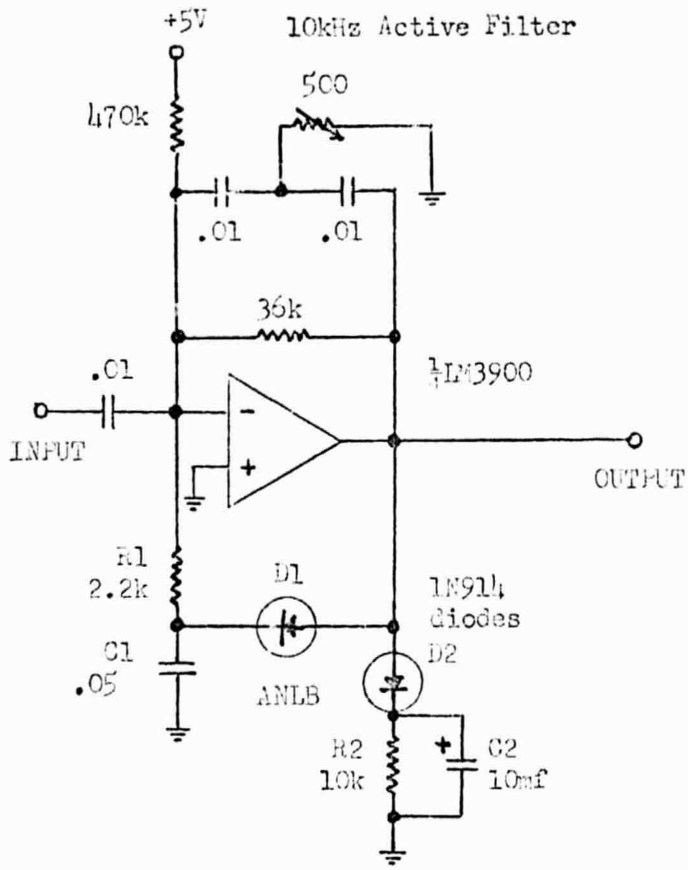

Figure 1. Noise Limiter-Blanker with Active Filter.