Evasive Noise Blanking

Independent tuning of the noise-blanker channel provides crunch-proof noise blanking.

Mark Mandelkern, KN5S

For the low-band HF DXer, breaking the pile-up may be the biggest problem. But on the higher HF bands, and especially for competitive weak-signal SSB/CW work on the VHF bands, hearing signals through that ubiquitous man-made noise often becomes the crucial determining factor for success. Efforts to eliminate the noise take various avenues, from replacing the neighbor's doorbell transformer to persuading the power company to fix the lines, or escaping to a mountaintop for a contest. But after all other efforts, we are reduced to dependency on our noise blankers. Alas, were it only so easy as pushing a button! The cold, cruel reality is that noise blankers do sometimes blank the noise, but they often also add more trouble than they remove.

A typical response from a nearby station, when asked "Is my signal troubling your receiver," is "Well, you're not overloading my receiver, but you're crunching my noise blanker." Modern strong-receiver technology has just about eliminated the problem of receiver overload, once a serious matter. But modern noise blankers are notorious for folding up under the stress of strong signals on nearby frequencies. Strong signals cause two problems with noise blankers. My experience shows that one of these has by far the worst effect, and I've recently built a transceiver that avoids the problem.

Let us first briefly review the operation of a noise blanker. A block diagram of a typical blanker is shown in Fig 1. There are three main sections. The noise amplifier amplifies the noise pulses to a level sufficient for the detector and pulse-forming network, which produces a control signal, called the blanking pulse. This blanking pulse is routed to the receiver gate, where it disables the receiver during the noise pulse. Sounds simple, right?

Now, what goes wrong? First, the blanking pulses modulate any signal in the passband, turning them on and off rapidly. The effect is to create noise sidebands on either side of the signal, just like key clicks from a transmitter without proper key shaping. But this effect is minor compared to the second problem: A strong nearby signal—one outside the 2-kHz filter but *within* the 25-kHz filter—will enter the noise amplifying channel and create false blank-

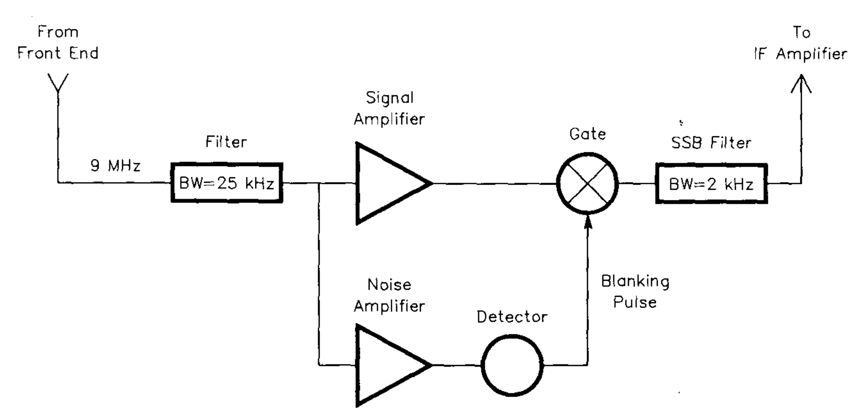

Fig 1—Block diagram of a typical modern noise blanker.

5259 Singer Road
Las Cruces, NM 88005

ing pulses which tend to quiet the receiver, eliminating the desired signal. We say the receiver is "crunched."

I know of three noise blanker systems which avoid this problem. First is the Collins system of the 1950s. Second, in 1967 I built a copy of the Collins system which I adapted to a Heath SB-301 and a 6-meter converter, for noise-free 50-MHz reception. Third is the system I recently built into my new home-brew transceiver. I've tried to design *everything* into this new radio. It covers all the bands from 1.8 to 144 MHz, has dual VFOs, all-quartz reference oscillators (no microprocessor or synthesizer—and no birdies or phase noise!), IF shift, RF speech clipping, panel-adjustable CW offset, dual receive—the works! But most important, I wanted to get rid of the infuriating power line noise—without being crunched. The result is the evasive noise blanking system described here.

The Collins System

The Collins system is shown in Fig 2; it was designed mainly for mobile operation with the KWM-2. It differs from the modern blanker in that the noise is picked up at 40 MHz by a separate antenna. In a mobile installation, the vehicle's broadcast radio antenna would be used. The main disadvantages of this system were twofold. First, the noise heard at the operating frequency might not also appear at 40 MHz. The second disadvantage occurred in a receiver used in a home station with an antenna having some gain (a 10-meter beam, for example), and a separate 40-MHz whip for noise pick-up. Even if the noise were also at 40 MHz, still the whip might not hear noise heard by the beam. No blanking would occur. A separate 40-MHz rotatable beam would be ideal, but I don't know if anyone actually did this.

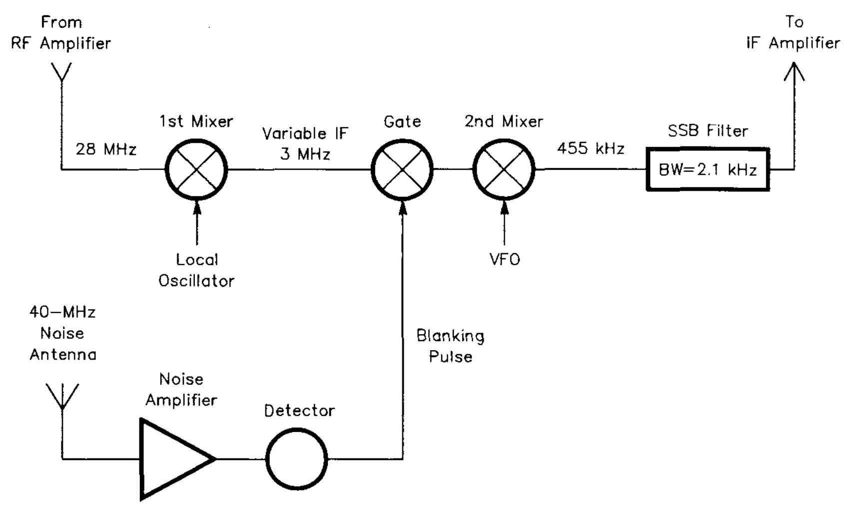

Fig 2—Block diagram of the Collins blanker. The noise amplifier limits the bandwidth of the noise channel to about 500 kHz.

A Six-Meter System

The system I built into my SB-301, shown in Fig 3, was adapted from the Collins circuit.[1] The gate was built for the Heath first IF frequency at 8 MHz. More important, the noise amplifier was built for 51 MHz, and the 51-MHz noise was taken from a tap after the RF amplifier in the 6-meter converter. Thus the noise amplifier had the advantage of using the large 6-meter beam and could hear noise that was no louder than the weakest 6-meter DX signal. This system avoided both disadvantages of the Collins system, and the results were spectacular.

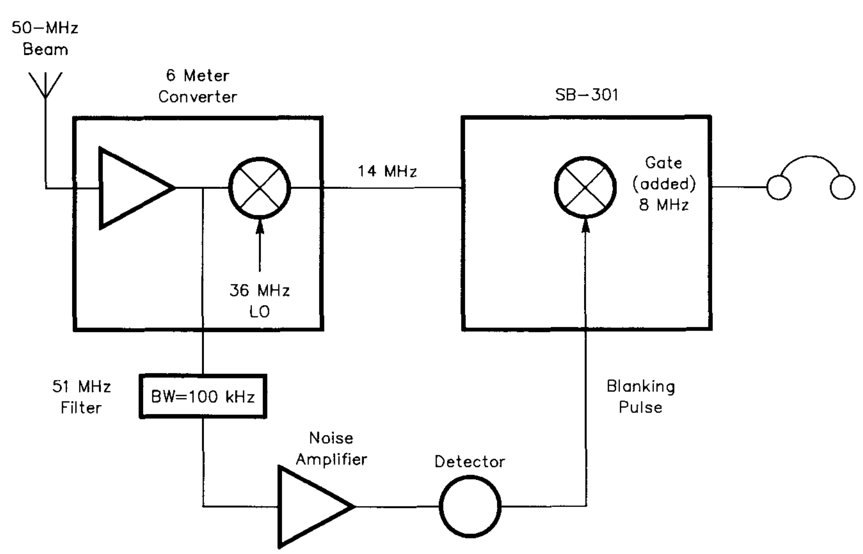

Fig 3—Block diagram of the blanker for 6 meters built for a Heath SB-301 in 1967. The noise channel operates at 51 MHz, while the desired signals are at 50-50.5 MHz.

The Modern System

After many years of missing the old Heath, I began a 3-year project of building a transceiver, the last piece in a completely home-brew station. The design goal for the blanker in the new radio was that it should provide the advantages of the old 51-MHz system on all bands. The transceiver tunes 1-MHz segments, and a natural extension of the old system would be to listen for noise at the top of the band in use. But now a third problem could be foreseen. While such a fixed frequency noise amplifier was okay for 6 meters, where I could predict where signals would be found, it might not work so well on other bands. (Is there a local repeater on 145 MHz?)

The solution was a tunable noise amplifier—to *evade* the strong signals. Working 24.9 MHz? Just tune the noise amplifier to any clear frequency between 24.0 MHz and 24.8 MHz. One panel knob does the tuning. Once a clear

[1]Notes appear on page 6.

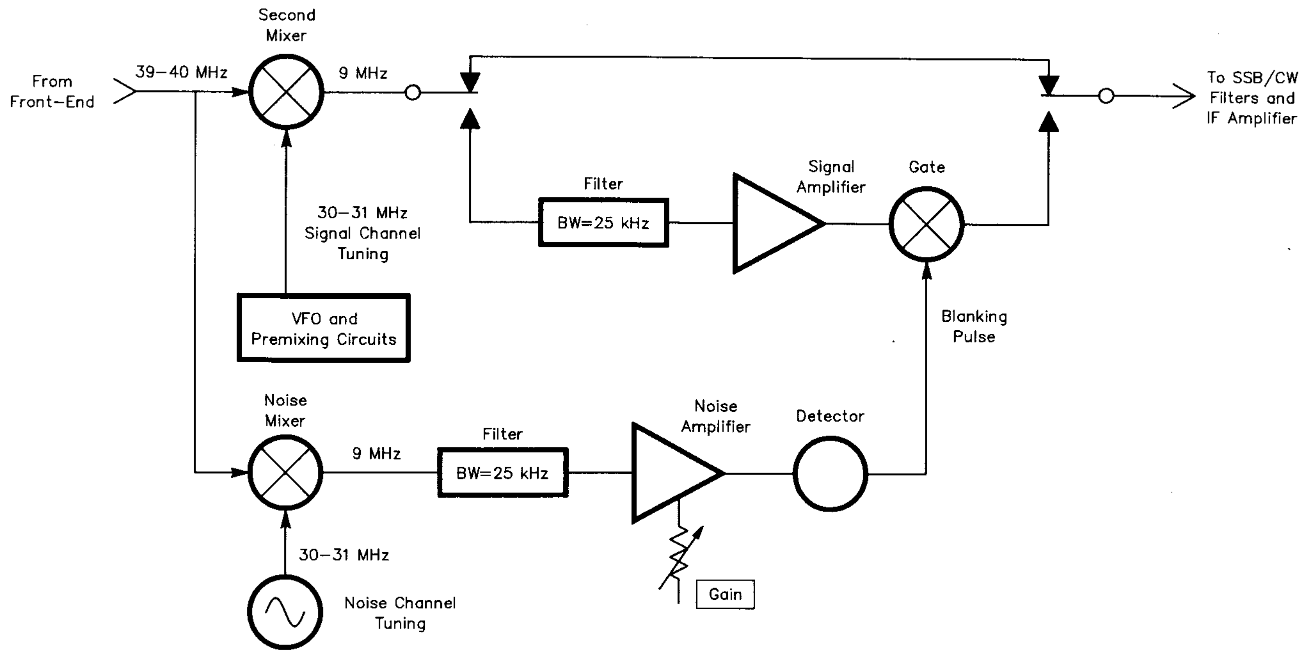

Fig 4—Block diagram of the evasive noise blanker.

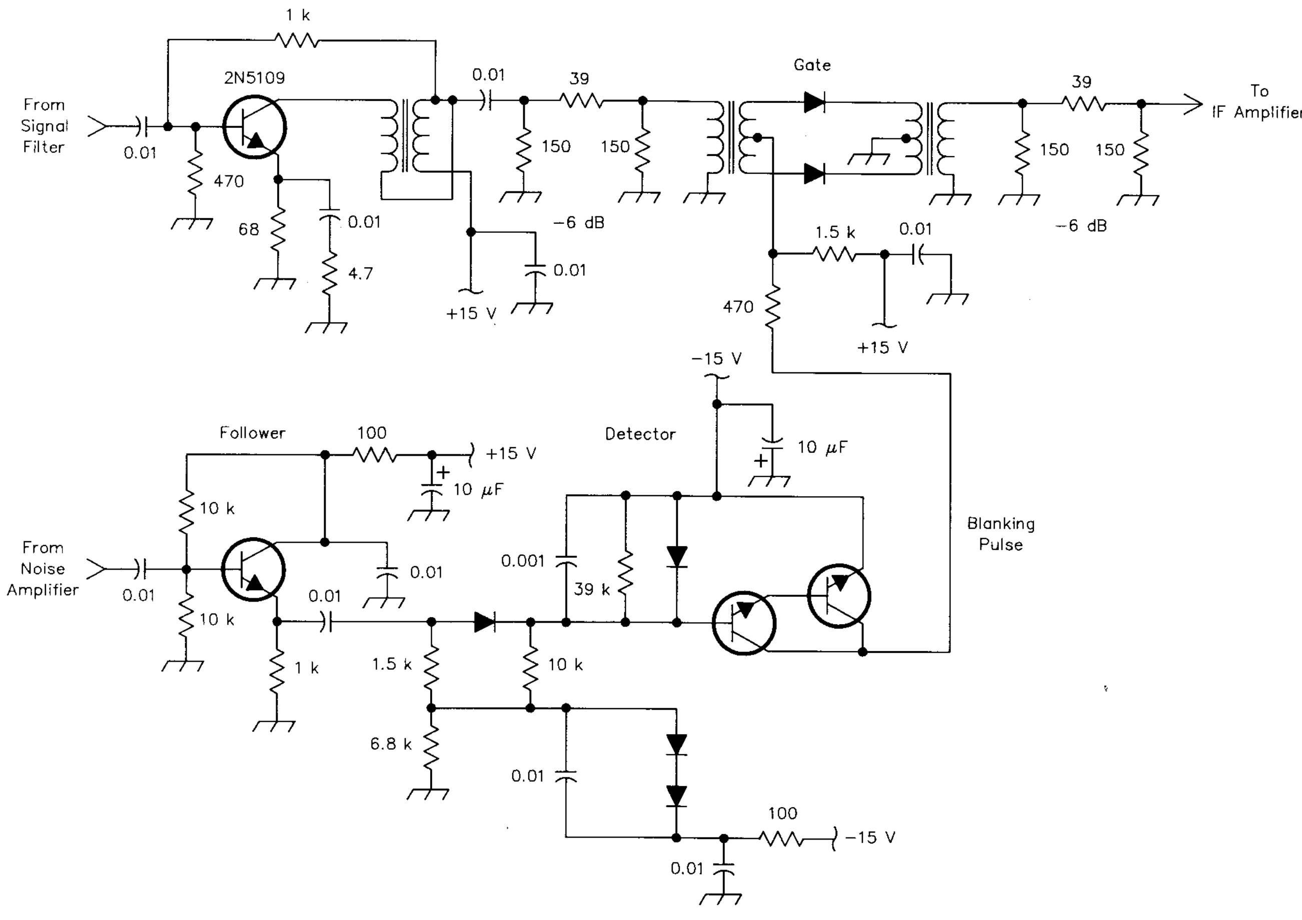

Fig 5—Schematic diagram of the noise detector, pulse-forming network, and receiver gate used in the author's home-brew transceiver.

spot is found, it seldom needs attention. Another knob adjusts the noise blanker gain, which is set according to the ambient noise level. Any noise above this level at the noise channel frequency will cause a blanking pulse. This control is a push/pull type for on/off blanker switching. Both the noise amplifier and the receiver IF at the gate have bandwidths of 25 kHz. This width prevents the noise pulses from being excessively broadened, as they would be with sharp filters. Some noise blankers use a somewhat narrower bandwidth. I had the 25-kHz filters in the junk box, but some experimentation might be called for here. The usual sharp SSB/CW filters come only after the gate. (I have 2-kHz, 400-Hz, and 200-Hz IF filters available.)

The block diagram of my evasive noise blanker is shown in Fig 4. The radio uses dual conversion on all bands from 1.8 to 144 MHz, with high-side first injection. The IF frequencies are 40 MHz and about 9 MHz. The first IF tunes from 40 to 39 MHz. The noise blanker samples the first IF and gates the second IF. When the noise blanker is off, relays switch it completely out of the circuit. The amplifier ahead of the gate replaces the gain lost in the filter and gate, so there is no change in overall receiver gain when the noise blanker is switched in or out.

The evasive noise blanker can be adapted to any IF. Any of the *Handbook* circuits can be used for the noise mixer, oscillator, and amplifier, since these are non-critical.[2] For the noise detector and receiver gate, you can copy the circuit from your favorite commercial radio. The circuit I used is shown in Fig 5. The noise amplifier has no AGC and the operator must use the noise amplifier gain control on the panel. This may be a disadvantage compared to some modern "automatic" types, but my hunch is that it may actually be an advantage. There is also room for experimentation here.

One point which does not show up in the schematic should be mentioned. My radio has no AGC applied to the front end. One reason for this is out of consideration for the blanker. When AGC from the narrow IF is allowed to reduce the gain ahead of the noise channel, some weird effects result. Noise may be actuating the AGC, then the blanker gain is increased, the noise is driven out of the IF, the AGC voltage drops and the front-end gain increases. This has a positive feedback effect which may saturate the noise detector. The operator experiences a hysteresis type of blanker latch-up. This problem is avoided by applying AGC only to the IF amplifier.

Adapting the Evasive Noise Blanker

Perhaps the most likely adaptation of this system would be as a stand-alone device at 28 MHz for use between VHF converters and an HF radio. It might have a noise channel at 29 MHz, and blank the entire IF. Or it might have a tunable noise channel and also use down/up mixing to blank only a tunable 25-kHz segment. It sounds like a lot of work, but serious operators will stop at nothing to hear the DX!

Another possible variation would be to simply take a 28-MHz tap off the VHF converter output. Tune, filter, amplify, and detect the noise, and then (here's the rub) find the spot in your receiver's original noise blanker gate at which to apply the blanking pulse. Still other variations would involve two receivers.

On the lower bands there is a special problem. The noise is usually of atmospheric origin rather than the man-made pulse noise on which noise blanking has half a chance. And there may be signals in the entire 1-MHz segment. Narrow bandwidth antennas, as on 160 meters, are another limitation. The next step is to try using a VHF band to feed the noise channel while operating a lower HF band. This just means separate band switches for the operating channel and the noise channel.

This evasive noise blanker has been in constant use for over a year. Results on the VHF and higher HF bands have been excellent. I can use the blanker as close as I wish to loud stations. I hope you have fun trying the evasive blanker; please write to me about your results. There is still much room for experimentation to fight this noise problem. New noise sources are being invented faster than better blankers!

Notes

[1] *Fundamentals of Single Side Band*, 2nd edition, Collins Radio Company, Cedar Rapids, Iowa, 1959.

[2] *The 1993 ARRL Handbook for Radio Amateurs*, Newington, CT, 1992 □□