

# HAM RADIO

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## An audio-noise blanker

**W**hat do you hear when you tune between strong stations on the receiver? Hiss! Garbage! Noise! One of the uncomfortable aspects of operating on the ham bands is the large amount of pure trash that assaults one's ears. Anything that can reduce the level of the trash enhances your operating pleasure, and reduces the stress on your ears and head.

There are a number of things that can be done to make the received signal a

This project is a passive noise limiter that is inserted between the audio output of the receiver and the earphones or loudspeaker (although it works best with headphones). The project serves two purposes: one is to reduce the noise between stations, and the second is to clip large signals and thereby add a little distortion to the CW note.

That's right, distortion, and no, I'm not crazy (at least not on this subject), for some operators report that a mildly distorted CW beat note is more comfortable to copy. The effect is especially noted when a stronger, desired station centered in the receiver passband is distorted, and slightly weaker interfering stations are not. Other operators disagree with that theory, so the project below makes the distortion feature optional.

### BASIS FOR OPERATION

The passive noise limiter is based on the operation of the simple PN junction diode. Figure 1A shows the characteristic curve of such a diode. When the diode is operated in the reverse-bias region, no current flows (except a very tiny, reverse leakage current). But the current doesn't start flowing immediately when the reverse-bias negative voltage passes through zero to become positive. Until a certain critical junction potential ( $V_g$ ) is reached, the diode does not pass current. At voltages above  $V_g$ , the diode operates in the "ohmic region" much like any other conductor; that is, current increases with increasing voltage. The value

of  $V_g$  is 0.2 to 0.3 volt in germanium (Ge) diodes, and 0.6 to 0.7 volt in silicon (Si) units.

When two diodes are connected back-to-back (see Fig. 1B), there is a "dead-band" between  $-V_g$  and  $+V_g$ , with "ohmic" behavior at potentials greater than those values. That is, when two germanium diodes are connected back-to-back, no current flows when the signal voltage applied to the diode pair is between  $-0.2$  volt and  $+0.2$  volt.

There are two basic forms of passive noise limiters: the series type, which is shown in Fig. 2A and the shunt version shown in Fig. 2B. In the series (or "threshold") form of noise limiter, the signals must exceed the threshold set by  $V_g$  before it is passed along the signal line. In the shunt noise limiter, on the other hand, large signals are clipped off above  $V_g$ . Most passive noise limiters use some form of series current-limiting resistor to protect the driving circuit from a short circuit when the shunt diodes conduct.

### THE PROJECT CIRCUIT

Figure 3 shows the schematic diagram for a passive noise-limiter circuit that contains both a series threshold noise limiter and a shunt noise limiter. The circuit is composed of two germanium diodes (D1 and D2) and two germanium PNP transistors connected in the "super-diode" configuration (*i.e.*, bipolar transistors, either NPN or PNP, with their respective collector and base terminals shorted together). Such a noise limiter can enhance

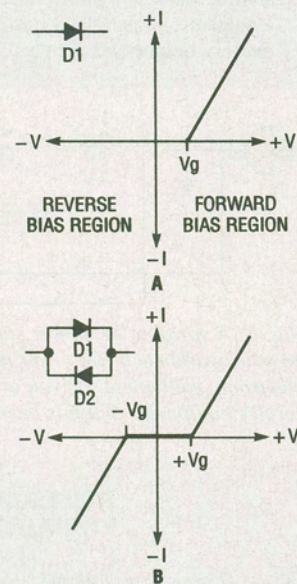


Fig. 1. Shown in A is the current (I) vs voltage (V) curve for a PN diode; B is the curve for a pair of back-to-back diodes.

lot clearer. One could filter the signal, or use a high-priced noise blanker (which doesn't always work). The project that we'll present this month is a simple little device that can be built in one evening with ease, and can make a lot of difference, especially for CW operators.

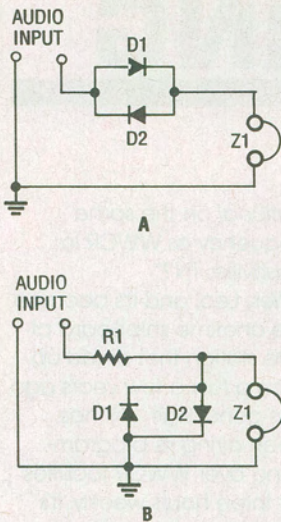


Fig. 2. There are two basic forms of passive noise limiters: the series type (A) and the shunt type (B).

the signal-to-noise ratio at the earphones as much as 40 dB (according to theory), but 20 to 30 dB is more likely (still not a shabby bit of performance improvement).

The series noise limiter is formed by "super-diodes" constructed from a pair of medium gain germanium PNP transistors. The transistors to use include the 2N404, 2N1305, and so forth, if you can find them. Modern equivalents from radio-TV repair replacement lines include the ECG-100, ECG-102, NTE-100, and NTE-102. The idea is to get a medium beta-gain PNP germanium (not silicon) transistor. A switch in parallel with the back-to-back super-diodes bypasses the threshold noise limiter when it's not wanted in the circuit. In other words, with S1 closed, Q1 and Q2 are switched out of the circuit.

The shunt noise-limiter portion of the circuit consists of a pair standard germanium diodes, D1 and D2, such as the 1N34, 1N60, ECG-109, and NTE-109. Such units are available from mail-order suppliers, as well as from Radio Shack in bulk form; *i.e.*, a bunch of odd

diodes in a blister pack at a very low cost per diode. Switch S2 must be closed to turn on the shunt noise-limiter circuit (D1 and D2).

Note that there's a difference in the operation of switches S1 and S2; switch S1 is open when you want the series noise limiter in the circuit, while S2 is closed when the shunt noise limiter is to be in the circuit. The shunt noise limiter requires a series current-limiting resistor in order to protect the audio output stage of the receiver.

When the diodes are forward biased, a large current can flow, which can be detrimental to both the receiver audio-amplifier stage and the diodes themselves. A resistor of about 3.3 to 8 ohms (nominally 5 ohms) can be used as a current limiter. The power rating of the resistor must be sufficient to handle the entire audio output of the receiver. Most ham-radio receivers produce from about 250 milliwatts (mW) to 5 watts of audio power.

Select a resistor that will match your receiver's specification. Alternatively, pick a 5-watt resistor for R1 and be done with it.

The noise limiter can be built into a small metal or plastic box. The input and output jacks should be selected to match the earphones and receiver that you own. In my own case, the receiver's earphone jack is a 1/4-inch phone jack. The noise limiter can then be connected to the receiver by a short jumper cable with mating male plugs on either end. In my case, a one-foot shielded cable with a male PL-55 on each end did the trick.

### USING THE NOISE LIMITER

Plug the earphones into J2, and connect a jumper cable between J1 and the receiver's earphone jack. Close S1 (the out position in Fig. 3) and open S2 (also the out position). Turn on the receiver and tune across the CW portion of a busy

band. Next, open S1. The weaker signals—*i.e.*, those that do not reach the 0.2- to 0.3-volt threshold—and the background hiss should either go away or be reduced a respectable amount.

Try the noise limiter in and out of the signal path on a number of different signal combinations in order to become familiar with the way the circuit works. You will find that you'll want to take the series noise limiter out of the circuit when copying weak signals.

Next, let's try the shunt noise limiter. Close switch S1 and then close S2. You'll find that on strong signals (play with the audio-gain control of the receiver), the CW beat note distorts somewhat; just how much depends on the signal level. If you find the signal when the circuit is in the latter mode easier and more comfortable, then you've improved matters. Otherwise, turn off the shunt limiter and don't use it unless some spark plug or motor noise is received. In some cases, the shunt noise limiter will clip off the high-voltage noise spikes from sparking electrical sources (such as passing cars) when copying weak signals. So it is possible to use the shunt noise limiter when the series noise limiter is out of the circuit.

Additional information on noise limiters, and the more complex noise-blanker circuits, can be found in various editions of *The ARRL Radio Amateur's Handbook*. My new book on ham radio antennas, *Practical Antenna Handbook* (TAB catalog number 3270) includes a large number of antenna construction projects and hints, as well as some BASIC programs for antenna design. The book is available from TAB Books, Inc., Blue Ridge Summit, PA, 17294-0850; 1-800-233-1128. ■

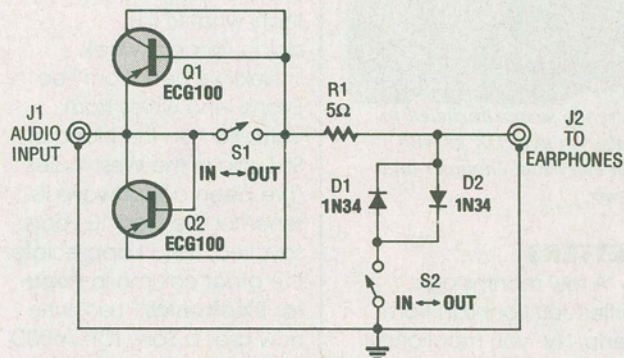


Fig. 3. This passive noise-limiter circuit contains both series ("threshold") and shunt noise-limiter configurations.

### PARTS LIST FOR THE NOISE LIMITER

- Q1, Q2—2N404, 2N1305, ECG-100, ECG-102, NTE-100, NTE-102, or similar germanium PNP transistor
  - D1, D2—1N34, 1N60, ECG-109, NTE-109, or similar germanium diode
  - R1—5-ohm, 1/4-watt resistor
  - S1, S2—SPST toggle switch
  - J1, J2—See text
- Perfboard materials, enclosure, wire, solder, hardware, etc.