Receiver Noise Floor and Band Noise

What Measured Values are Desirable?

Comparisons using a Ten-Tec Eagle and an Omni VII

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Higher dynamic range is desirable, at least up to some point where higher isn't really needed. Arguing whether 100 dB is better than 90 dB is likely pointless MOST of the time. That assumes we are not doing something inadvisable, such as running the preamp on 40 meters at night!

Sensitivity or Noise Floor, however, must be compared to typical Band Noise which is the noise received from external sources. Most radios are designed for 10 or 6 meters and are far too sensitive on the lower bands. That is one reason receivers have attenuators. (A thorough documentation of noise sources and typical noise environments is presented in "Radio Noise", ITU-R P.372-8, available at www.itu.int/dms_pubrec/itu-r/rec/p/R-REC-P.372-8-200304-S!!PDF-E.pdf. See Figure 10 for typical rural, suburban, and urban noise floor values.)

Band Noise and Noise Floor

The NCØB location and contest station – with the emphasis on antennas! (Photo courtesy Rob Sherwood, NCØB)

Typical Band Noise in the rural environment at NCØB, in the noisiest direction, is as follows:

In a 500 Hz bandwidth: 20 meters -110 dBm, 15 meters -115 dBm, and 10 meters -120 dBm.

Noise is 7 dB higher for a 2.4 kHz SSB bandwidth: 20 meters -103 dBm, 15 meters -108 dBm, and 10 meters -113 dBm.

Noise Floor on SSB for the Eagle is -119 dBm (preamp OFF), -126 dBm (preamp ON).

Noise Floor on SSB for the Omni VII is -123 dBm (preamp OFF), -132 dBm (preamp ON).

(Noise Floor values are given on www.sherweng.com/table.html. Look there for the 500 Hz CW bandwidth values. See the document "Terms Explained for the Sherwood Table of Receiver Performance" for information on the various table data items.)

Receiver Noise Performance

You want receiver noise to be 8 to 10 dB lower than band noise, so let's pick the 10 dB value. This means the receiver is contributing less than 0.4 dB to the total noise being heard.

Since typical Band Noise on SSB (in a rural environment) on 20 meters is -103 dBm, then you want the receiver's Noise Floor to be 10 dB lower or -113 dBm. In both cases, the Eagle and the Omni VII have an SSB Noise Floor far lower than -113 dBm even with the preamp OFF.

Let's look at the 10 meter values: Typical Noise Floor on 10 meter SSB is -113 dBm, so we want a receiver Noise Floor of -123 dBm. Neither the Eagle nor the Omni VII have a problem with Noise Floor (or Sensitivity) in a typical 10 meter SSB environment.

NOTE: Typical isn't worst case, so let's look at actual data I measured during an ARRL 10 Meter contest. During the last hour of the contest between 4 PM and 5 PM MST (Colorado), I had my 5-element monoband Yagi at 65 feet pointed west working the Pacific (JA, VK, ZL etc.) At the same time there were a lot of back-scatter stations calling me from the East Coast. Some were quite strong on scatter but many were very weak. Band Noise was measured at -123 dBm in a 2.4 kHz bandwidth. Since the receiver noise should be 8 to 10 dB lower than Band Noise, in this on-air example the receiver needed an SSB Noise Floor of between -131 dBm and -133 dBm. In this case the Eagle would not have been adequate, while the Omni VII would have been fine.

On bands lower in frequency than 20 meters, Noise Floor (or Sensitivity) are of no significance, assuming you are listening with the transmit antenna. (Typical rural nighttime Band Noise on 40 meters on SSB is often between -95 and -100 dBm.) If you are using some special receiving antenna, such as a Beverage or small receiving loop, that is a different matter. If you are living in the city, your noise is likely even higher!