Notes on the ITS20/30 Noise Figure

In a receiver design of this kind, the Receiver Noise Figure is dominated by the noise figure of the first amplifier in the signal path, and whatever noise-injecting elements that precede it.

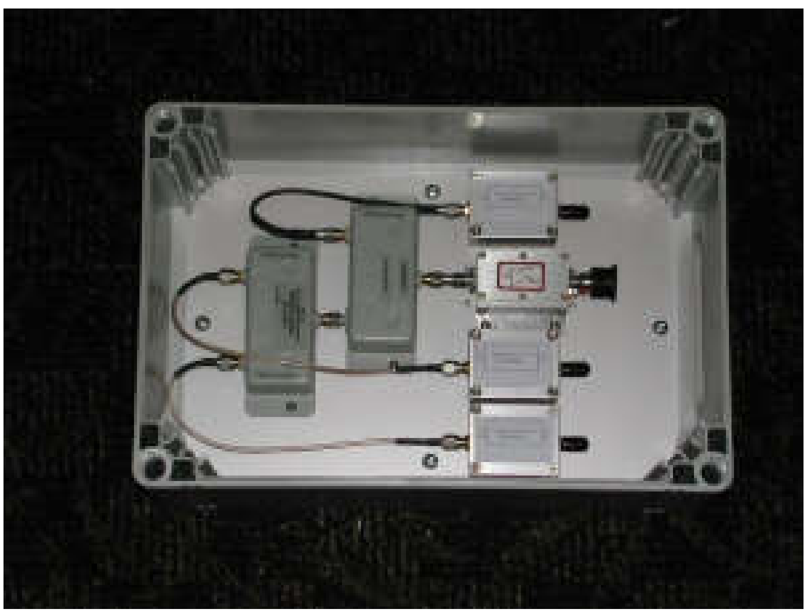
In the case of the ITS20/30, the first amplifier is a Miteq AM-1064 LNA with a noise figure of about 1.9 dB. This alone would lead to a very low-noise receiver.

However, other factors militate against this ideal situation except under rare circumstances. The other factors are the noise-injecting elements mentioned above.

The Miteq LNA is a wide band (110 to 1100 MHz) high gain (+30 dB) amplifier and serves as the front-end amplifier for all three frequencies: VHF, UHF and L-Band. It has a built-in Bias Tee in order for it to be powered through the main cable from the receiver.

Because of the wide bandwidth and high gain, it is sensitive to overload and saturation in the presence of any strong signal. In urban and sub-urban environments, the source of strong signals includes commercial television and FM broadcasts, pager transmitters, public safety transmitters and cell-phone transmitters.

To deal with this unwanted RF energy, the **ITS20/30 LNA Module** is fitted with three preselector bandpass filters, one for each frequency. The three filters feed into a signal combiner (triplexer) and the combined output goes the the Miteq LNA.



So the noise-injecting elements consist of the cable from the antenna to the LNA Module (~0.5 dB at L-Band), the preselector filter (~2 dB), and the triplexer (~0.5 dB). The sum is about 4 dB of insertion loss ahead of the LNA which degrades the overall noise figure to about 4.5 to 5 dB.

In some cases, the local RF energy is so strong, or so close to the receiver frequency, that a sharper filter is necessary.

In the configuration shown above, in Bellevue WA, the VHF preselector being tested was narrow enough to prevent saturation of the LNA, but the insertion loss of that filter was 7 dB. This meant that the receiver noise figure at VHF was nearly 10 dB.

Alternately, at Delta Junction, Alaska, preselector filters are not needed at all and the receiver noise figure is about 3 dB.

Therefore, to get the best possible S+N/N ratio (lowest receiver noise figure) it is necessary to: 1) locate the receiver where RF noise is very low, and 2) fit the LNA Module with preselector filters that have the least insertion loss but are still able to shield the LNA from saturating signals.

Reducing LNA Module Noise Figure in Noisy Environments

The ITS20/30 LNA Module is able to handle most RF environments where it has been used. And of course, in very quiet environments, the preselector filters can be removed from the circuit with only minimal modification and no cost.

However, it is possible to improve the noise figure even in noisy environments, to a certain extent.

One way this has been done is to put an additional LNA in the antenna circuit, just before the preselector filter. The gain of this additional LNA must be low enough not to saturate; ideally it should be only enough to compensate for the insertion loss of the preselector. If such an amplifier is used, the noise figure at that frequency can be nearly that of the inserted LNA.

In a test of this concept in Bellevue, the VHF S+N/N was increased by 5 - 6 dB after putting a +14 dB LNA ahead of the 7 dB loss preselector filter. The LNA was selected based on availability; the gain was higher than ideal.

Of course this concept could be extended to all three frequencies, and the wideband LNA might not be necessary. In that case, however, the individual LNA gains would have to be high enough to compensate for loss in the main cable to the receiver, as well as the insertion loss of the preselector filter.

There is no standard configuration that will fit all installations.

Contact: Frank Smith
NorthWest Research Engineering, LLC
10522 Lake City Way NE #C-201
Seattle WA 98125
(206) 300 5752
frank@nwra.com

rev. 10/2015