

Products: RXGen & SAT1

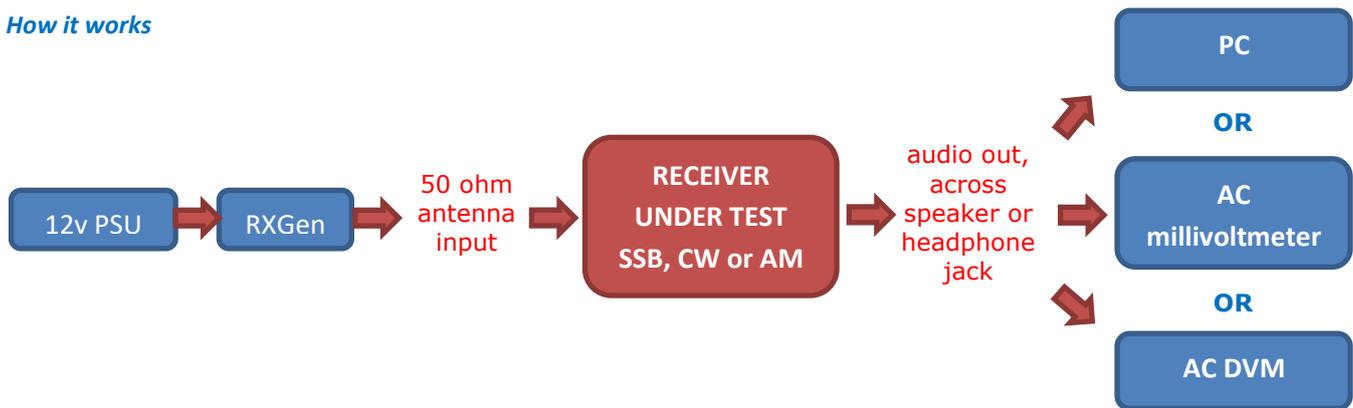
Tuning up your newly constructed low noise amplifier or receive converter for maximum sensitivity often starts with tweaking using off air signals. That’s a useful approach, particularly where higher level signals are available from a beacon for example. Once the alignment is close, finding the absolute optimum tuning position is difficult using off air signals because of propagation changes and interference from other sources.

RXGen is a signal source with stable and calibrated output to rival laboratory grade signal generators. The RXGen 10dB ENR broadband noise source provides excellent flatness across 2MHz to 2400MHz with an absolute level accuracy of +/-0.5dB.

RXGen measurement task examples:

- SSB / CW / AM receiver high accuracy sensitivity testing and comparisons. Not compatible with FM receivers.
- Sensitivity checks following repair
- Transverter receive path alignment
- Low noise amplifier alignment
- Patch cable testing
- Antenna changeover relay testing and through loss measurement
- Filter in band loss measurement

How it works



PC software

Feeding your receiver audio into a PC (line input) running level measuring software is a good option. A suitable shareware program is 'NFM' by Owen Duffy VK1OD, available free of charge from <http://owenduffy.net/software/nfm/index.htm>. NFM works extremely well and offers a route into more complex noise figure measurements too.

NFM provides both Y factor (dB) and noise figure results from your test. The Y factor is simply the audio level *difference* at the output of your receiver between RXGen on and RXGen off. Remember to set the source ENR value field in NFM to 10dB, this is the RXGen output level.

Y factor from a millivoltmeter or DVM

The Y factor may also be measured using an audio millivoltmeter or even a DVM. Measuring noise power with a general purpose DVM is likely to have significant errors in the absolute values but in practice we are only interested in the RXGen on/off ratio and repeatable and useful results are achievable. We would recommend using NFM software as your benchmark to evaluate other hardware options you experiment with.

A tip for using a DVM is to set the RX volume with RXGen off to say 10mV. Then switch RXGen on and the ratio (Y factor) will be easy to see, for example 22mV would be a ratio of 2.2. Use the RXGen supplied graphs to read off the S/N and noise figure. Note that in this example the Y factor is a voltage ratio, NOT a dB value. Graphs are provided for both.

Example measurements

FT736R on 23cm



Tuned: 1296.200MHz

Mode: USB

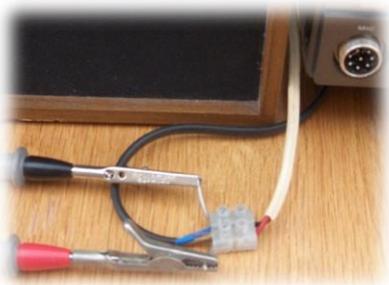


RXGen connected to 23cm antenna input

Connect DVM across the speaker cables

RXGen off - Set volume to 10mV

RXGen on – DVM reads 22mV



The Y factor (voltage ratio) is $22/10 = 2.2$

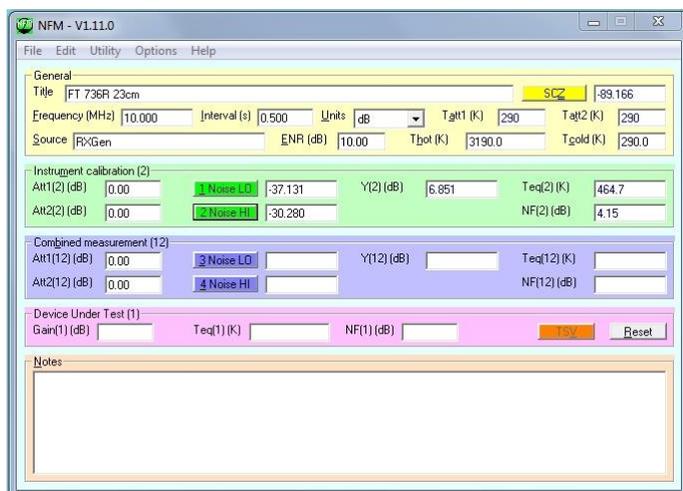
Read sensitivity and noise figure from RXGen supplied graphs:

Noise Figure = **4.0dB**

Equivalent 10dB S/N = **0.11uV** (in a 2.4kHz BW)

And again, using a PC and NFM software. PC line input connected to FT 736R headphone jack.

Please refer to the guidance notes from Owen on using NFM.



The procedure we used here:

With FT736R off, click 'SCZ'

FT736R on, RXGen off, click green button 1 Noise LO

FT736R on, RXGen on, click green button 2 Noise HI

Read Y and NF results ... **6.85dB** and **4.15dB**

Note the NFM Y factor result is given in dB, whilst the DVM test described above uses a voltage ratio.

Use 0.5 (s) 'Interval' time for improved accuracy if you are looking for repeatability to better than a few tenths of dB. Register your shareware with Owen VK10D at a very modest price for integration times >0.5 seconds and unlock other features.

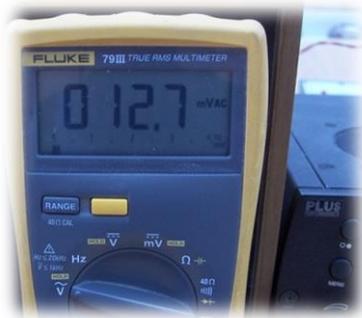
Example measurements at HF

AOR 7030 on 20m



Tuned: 14.200MHz
Mode: USB
DVM across speaker cables

First with the AOR 7030 internal preamp off:



RXGen off - 12.7mV

RXGen on - 15.7mV

The Y factor (voltage ratio) is 15.7/12.7 = 1.24

Read sensitivity and noise figure from RXGen supplied graphs:

Noise Figure = 12.5dB Equivalent 10dB S/N = 0.3uV (in a 2.4kHz BW)

AOR 7030 internal preamp on:



RXGen off - 12.1mV

RXGen on - 20.8mV

The Y factor (voltage ratio) is 20.8/12.1 = 1.72

Read sensitivity and noise figure from RXGen supplied graphs:

Noise Figure = 7dB Equivalent 10dB S/N = 0.16uV (in a 2.4kHz BW)

RXGen hints and tips

Accidental TX

Transmitting into the RXGen will destroy it. Always take effective precautions to avoid transmitters associated with your measurements being keyed with RXGen connected. Turn the MIC and drive controls to zero, remove microphones and keys. The maximum permissible input to the RXGen SMA is 1/4W.

Test frequency selection

Use a test frequency that is free of strong off air signals and local interference.

RXGen power supply

Try to avoid local and PSU noise being fed through the RXGen power input and on to the item under test. Whilst RXGen does have power supply filters on the PCB, the ultimate low noise power supply would be a battery in a screened enclosure. This is particularly useful for HF band tests.

Putting your RXGen in a screened enclosure

Resonances inside large screened enclosures may slightly degrade the RXGen flatness. Rules of thumb for maximum enclosure (any) dimension: For use up to 1296MHz, 150mm max. For use up to 2300MHz, 90mm max. If you exceed these dimensions use black conductive ESD foam inside the enclosure to dampen the resonance effects.

Measuring high gain preamplifiers and RX AGC

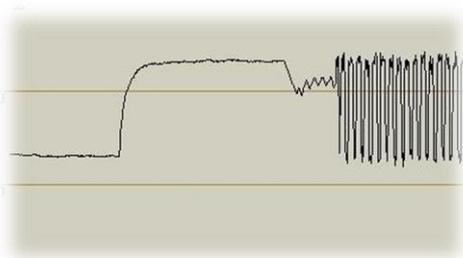
Caution is required measuring high gain preamps because the amplified levels from the RXGen may exceed the AGC threshold of the receiver used for the measurement. This is most effectively dealt with by using a receiver with an AGC off switch. If this is not available, reducing the RF gain control setting can be effective.

Measuring preamplifier noise figure

Noise figure measurement of an additional preamplifier in front of a receiver gives a noise figure result for the preamplifier plus receiver. This combined noise figure will always be higher than that of the preamplifier alone. If the preamplifier gain is low and / or if the RX noise figure is high, the combined noise figure result may be significantly poorer than that of the preamp alone. NFM software allows for a 2 stage measurement, firstly RX only, then LNA plus RX. This measures the noise figure (and gain) of the preamp effectively in isolation.

Real time tweaking for best noise figure

As demonstrated in the test methods and with the RXGen graphs, improved noise figure and sensitivity is achieved with higher Y values. A useful technique is to slowly pulse the RXGen say ½ second on and ½ second off and monitor the RX audio with a PC program with rolling window. The program is set to display a steady state level associated with the two noise levels. In this way the peak to peak Y value is displayed in real time.



SignalMeasure software from G4JNT www.g4jnt.com/dspsw.htm

Or use Spectravue www.moetronix.com/spectravue.htm (Continuum mode)

In the plot here we have several seconds of RXGen off, several seconds of RXGen on, finally 1Hz pulsing.

RX bandwidth

Y factors are independent of RX bandwidth and need not be considered for the noise figure tests described. The RXGen 10dB S/N graphs are specifically for a 2.4kHz SSB bandwidth.