Alan's Noise Source & Receiver01

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Memo #120

Objective:

The antenna simulator test source "Alan's Noise Source" will be shipped to MRO to perform in situ verification of receiver performance with the aim to demonstrate that there is no high-order structure in spectra acquired when a receiver is operated at the MRO. Before shipping to MRO, Alan's Noise Source was put in a small metal enclosure with an SMA port and filtered pins for connection to a 12V power source. The aim here is to confirm that the residues of this slightly modified version of the noise source still match expectations in the lab prior to shipping it.

Procedure and Results:

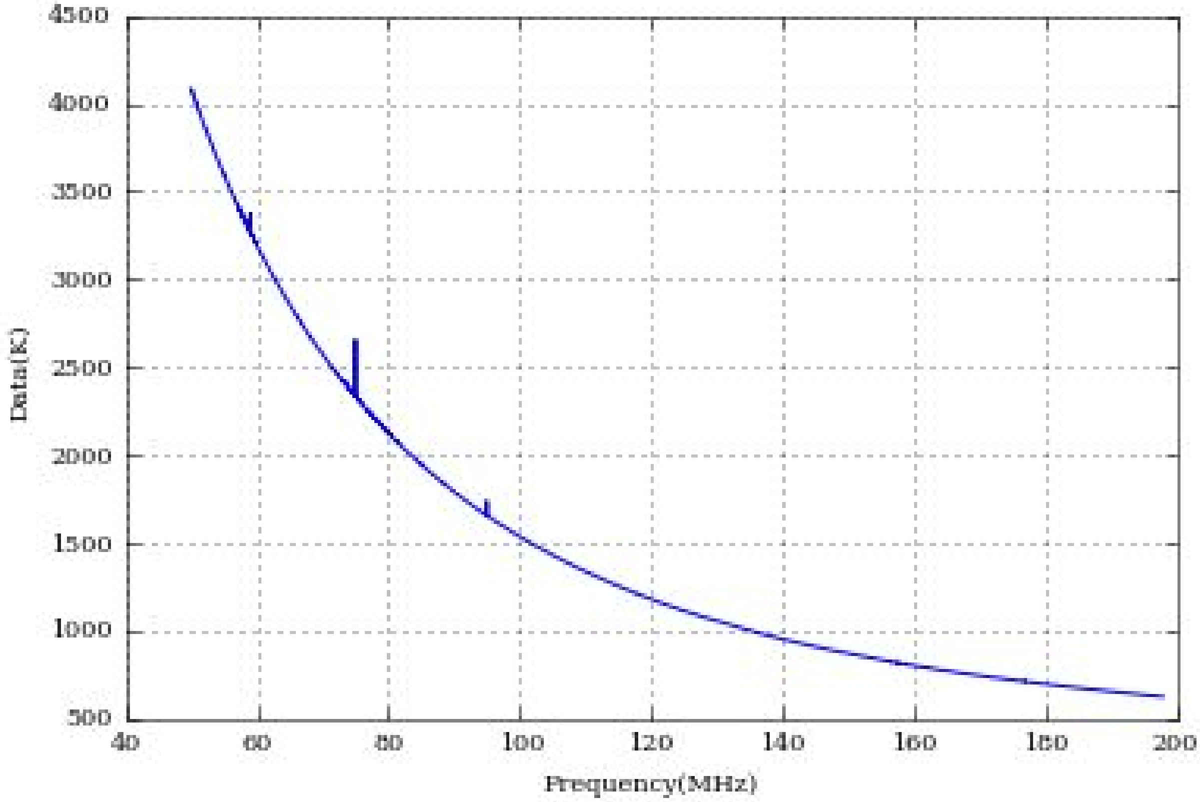
<u>Test 1</u>

The first step was a test performed before enclosing Alan's Noise Source in a metal enclosure. We connected the original version of Alan's Noise source to Receiver01 in the lab for the tests.

All the corresponding data is in:
/data5/edges/data/Receiver01_2018_01_08_040_to_200_MHz/

The receiver was set to 15^{o}C and the noise source used a 3dB attenuator connected between the noise source and the input of the receiver.

Spectra of the data averaged over two days is shown below in Figure 1. A 27 term fourier series was fitted to the spectra and the residues plotted in the bottom panel of Figure 1.


4500
4000
3500
3000
2500
2000
1500
1000
500
Data(K)
40
60
80
100
120
140
160
180
200
Frequency(MHz)

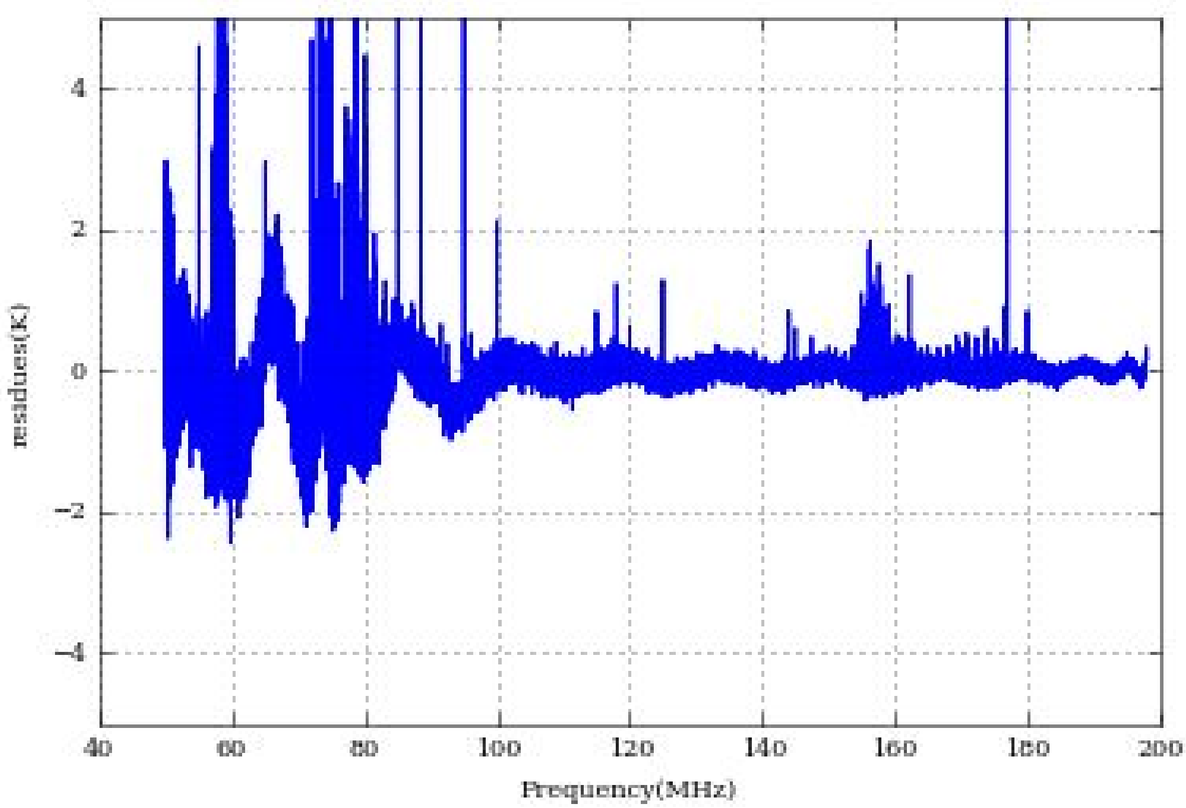

4
2
0
−2
−4
residues(K)
40
60
80
100
120
140
160
180
200
Frequency(MHz)

Figure1: (top) Spectra of data corresponding to Alan's noise source with 3dB attenuator averaged over two days. (bottom) Residues obtained after fitting a 27 term fourier series.

<u>Alan's Noise Source in Metal Enclosure</u>

Next, the noise source was installed in the metal enclosure. As shown in Figure 2 below, filtered DC pins are used to provide the noise source with 12V power. An SMA connector provides the noise output.

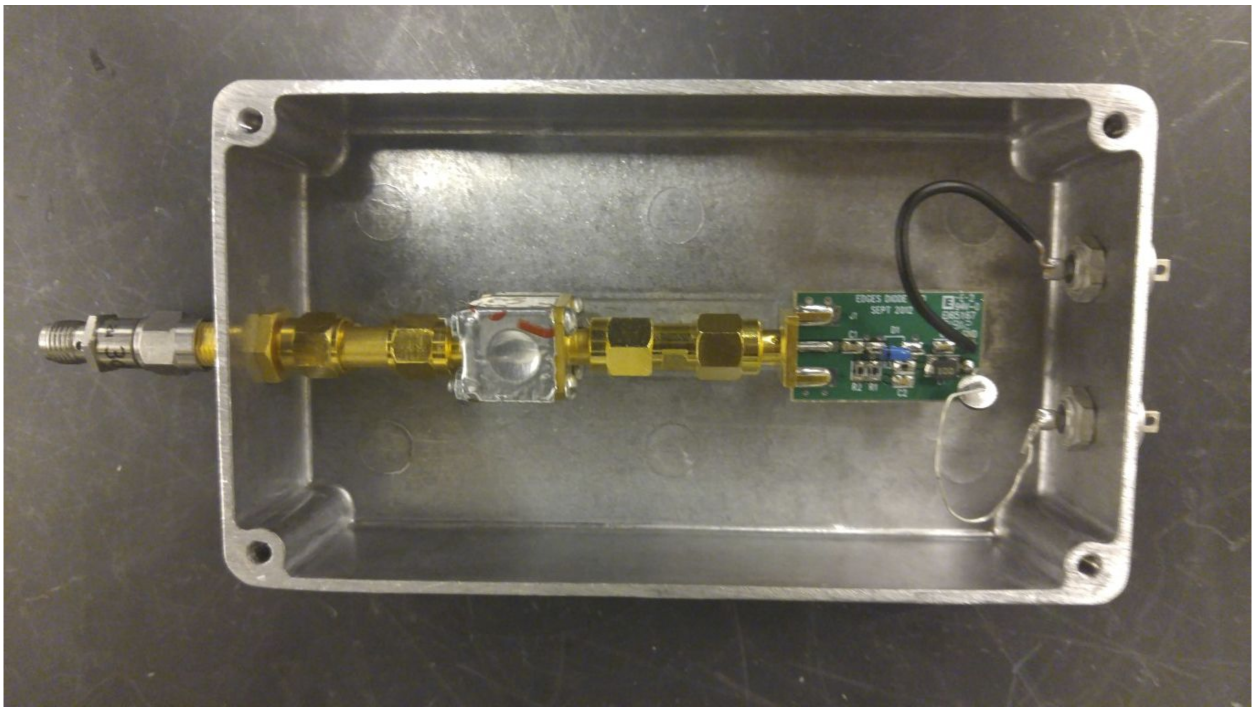


Figure 5. Photo of Alan's Noise Source installed in metal enclosure (with lid removed for photo). The 3dB attenuator used in some of the tests is visible outside of the enclosure to the left.

<u>Test 2</u>

The test was repeated after enclosing Alan's Noise Source in a metal box. Shown below is the data collected for one day after the noise source was enclosed. As before, a 3dB attenuator was connected between the noise source and the receiver.

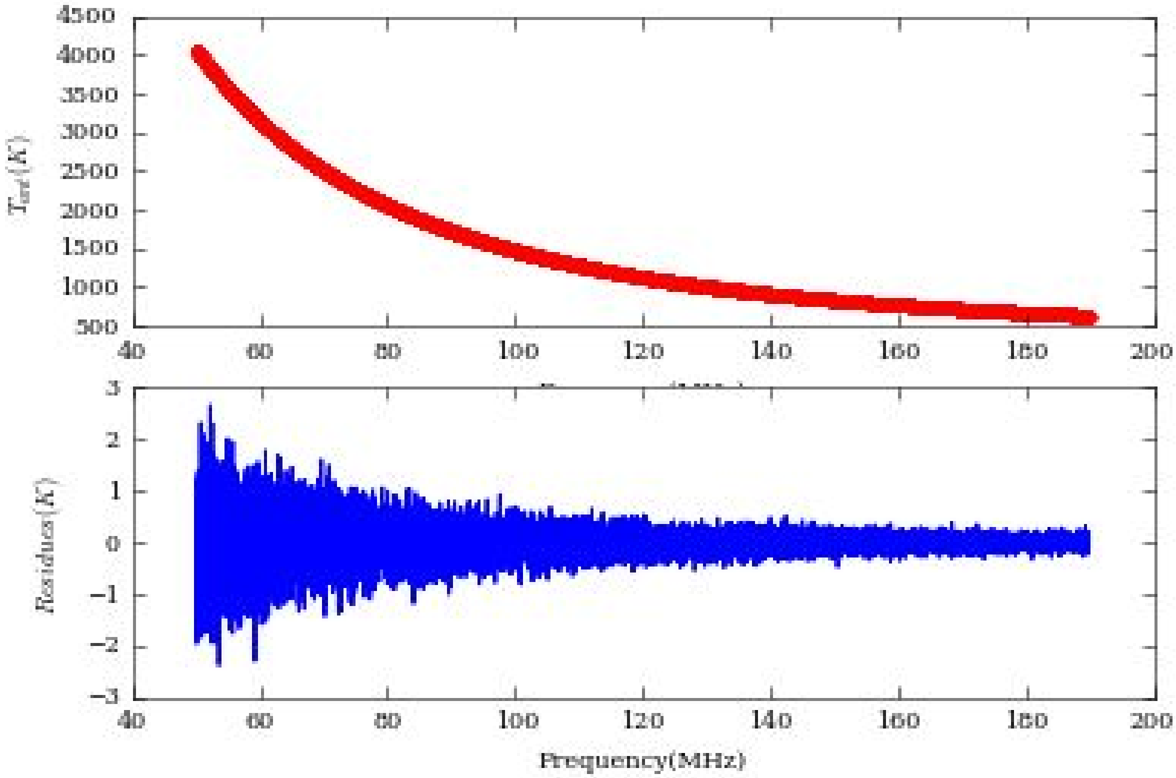


Figure 3. Same as Figure but after enclosing the noise source in a small metal box. No RFI is evident.

After applying the calibration coefficients derived for Receiver01 at 15C, the spectra and the residues obtained are shown below. A 7 term polynomial was fit between 50-100 MHz to obtain the residues. The RMS of the residues is 534mK.

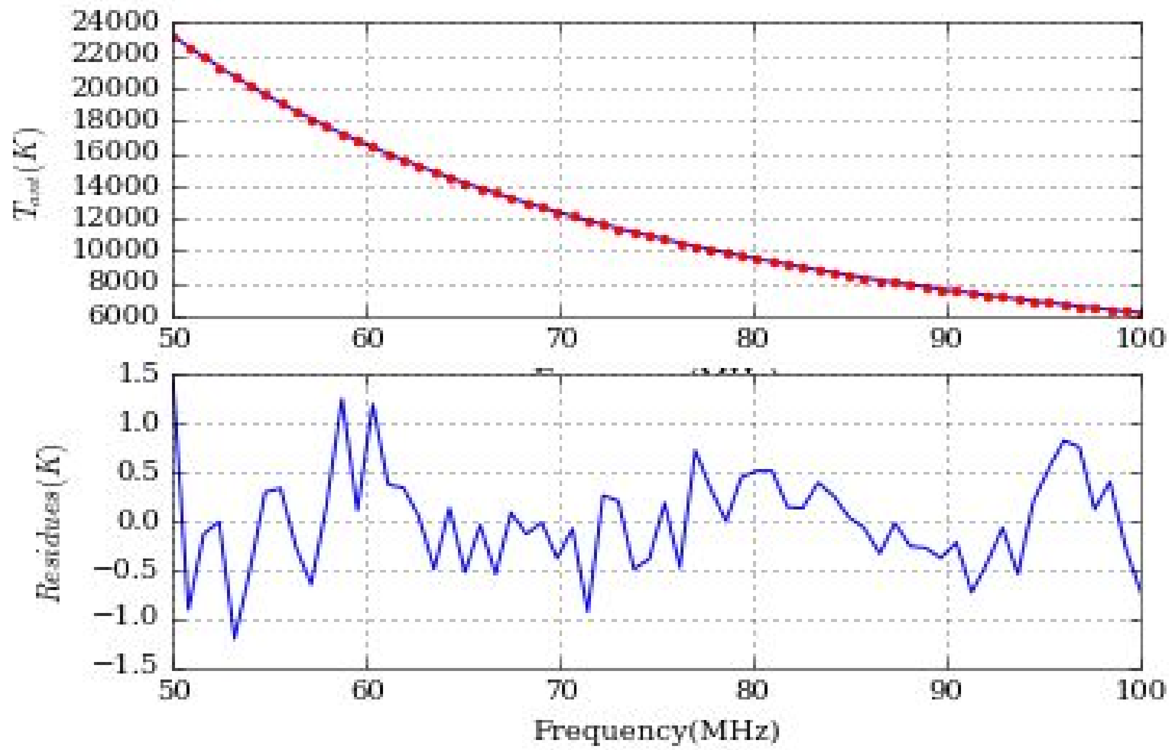
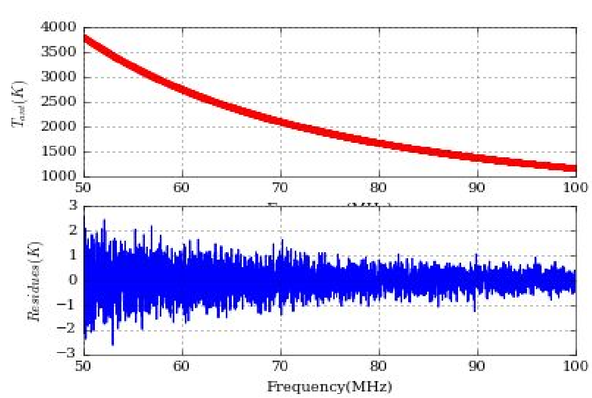
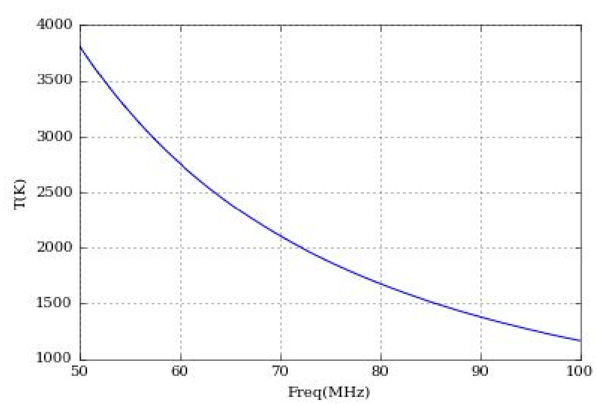


Figure 4. Fully calibrated spectrum of Alan's Noise Source. (bottom) Residues after a 7-term polynomial between 50-100 MHz has been fit and removed. The RMS is 534 mK.

<u>Test 3</u>

To better match the signal strength presented by the noise source to the receiver to the actual sky temperature, we replaced the 3dB attenuator with a 10dB one. The receiver was maintained at 15C again and the data was collected for one day. The calibrated spectra is shown below. After fitting a 9 term polynomial between 50 -100 MHz and binning the residues, we get the RMS of the residues to be ~ 66mK.





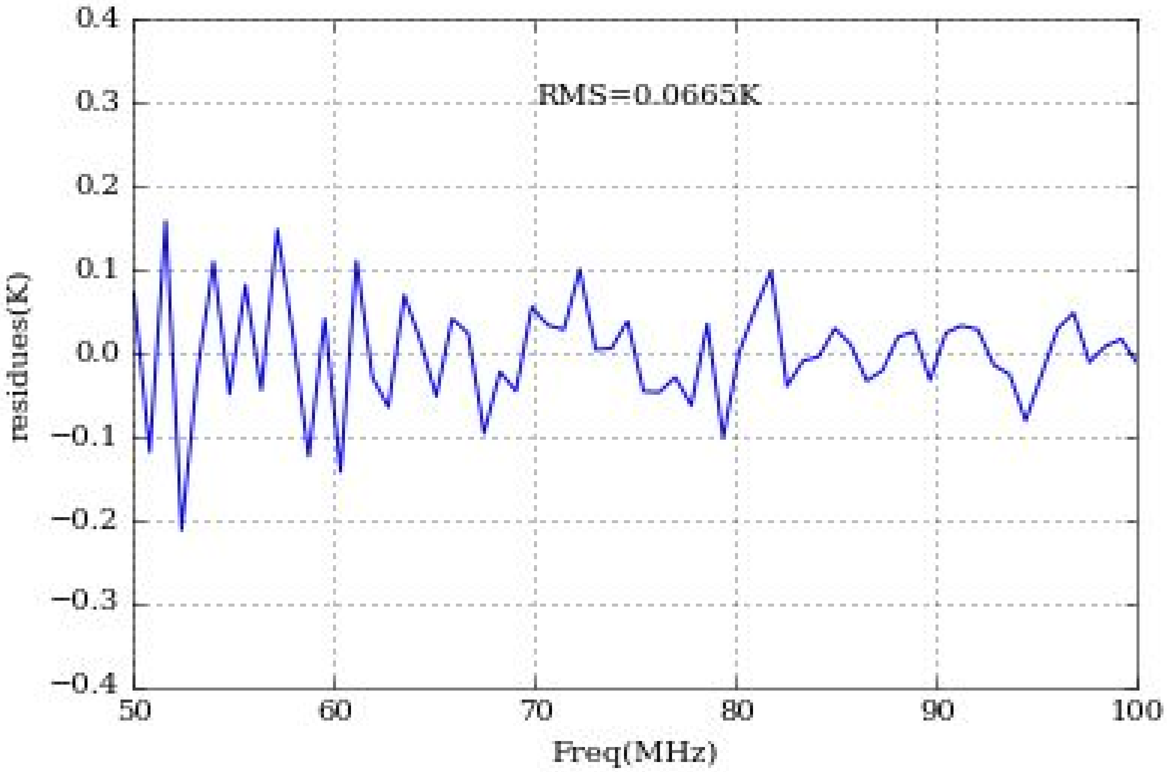


Figure 5. (top) The 3-position corrected spectrum and the residuals to a 27 Fourier term fit are on the left. The fully calibrated spectrum is on the right. (bottom) Residues to a 9-term polynomial fit.

Conclusions:

Based on the final residue spectrum in Figure 4, the enclosed Alan's Noise Source appears to exhibit reasonable spectral smoothness and can be shipped to MRO. Longer integration time in the laboratory would have helped to further reduce the thermal noise.