X-band Baseline in Lab I
Project TRXRDN030602, June 2, 2003

R. Norrod

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Introduction

The GBT X-band (8-10GHz) receiver was removed from the telescope and placed in the Equipment Room near the Spectrometer for baseline testing. The general goal is to investigate baseline effects that have earlier been shown to originate before the first mixer, and to have amplitudes which increase with continuum source temperature.

The Spectrometer was used in an four-bank, eight sampler, 800MHz mode, with 10 second records. The X-band IF signals were connected into the backs of OR1 and OR3, which were then connected to CM1 and CM5 and then to two of the samplers. The IF Rack noise source was connected to other samplers. Hardware connections are shown in Table 1.

Tests

During these initial tests, the receiver was not fully cold. The 15K temperature was near 100K, and drifting down slowly during the tests. One would expect some baseline ripples due to this, but the tests we ran still produced some interesting results. Throughout the tests, the feedhorn was removed and replaced with a shorting plate over the dewar waveguide window.

Figures 1 and 2 show the baselines for the initial group of scans. The baselines are quite flat, except for some pertubation in the scan 33-34 pair.

Table 1: Hardware Connection Map

ACSBank	Sampler	SF	CM	OR	Source
1	0	1	1	1	XL
1	1	5	5	3	XR
2	2	2	2	2	NS
2	3	6	6	4	NS
3	4	3	11	5	NS
3	5	7	12	7	NS
4	6	4	15	5	NS
4	7	8	16	7	NS

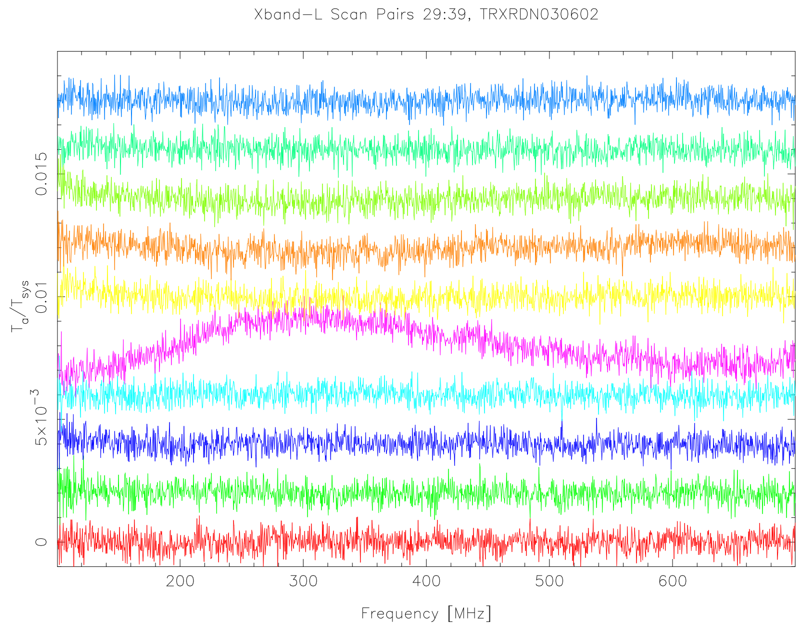

Figure 1: $(sig - ref)/ref$, for the X-band LCP channel, taking each of scans 29-38 as the reference, and the following scan as the signal. The system was undisturbed during this time. The cal off phase only was processed, and the scan times were 60 seconds.

Figures 3 and 4 show the baseline across most of the receiver band, taken by changing the LO1 frequency between scan pairs. The spike at about 9.7 GHz may be due to a problem in the thermal transition. It has similar characteristics to some which were identified in the Ku-band receiver.

A series of scans were taken while manually controlling the receiver noise sources. During the first pair, both the low cal and the high cal sources were off. During the second pair, the low cal was on. During the third pair, the high cal was on. Figures 5 and 6 show the resulting scan ratios for the LCP channel for this sequence of scans, and Figures 7 and 8 for the RCP channel. While there is large ripple when scan pairs with the noise sources on and off are ratioed, there is little evidence of extremely sharp frequency structure like that seen on the antenna in baselines taken on and off continuum sources. For this receiver the low cal is about 2.5K and the high cal is 15-30K, as measured in the lab. While the noise cal is injected past the polarizer, one would expect a standing wave between the LNA isolators (return loss about 20dB) and the waveguide shorting plate that would show the frequency structure seen on the telescope, if it were generated in the receiver.

Tests will continue.

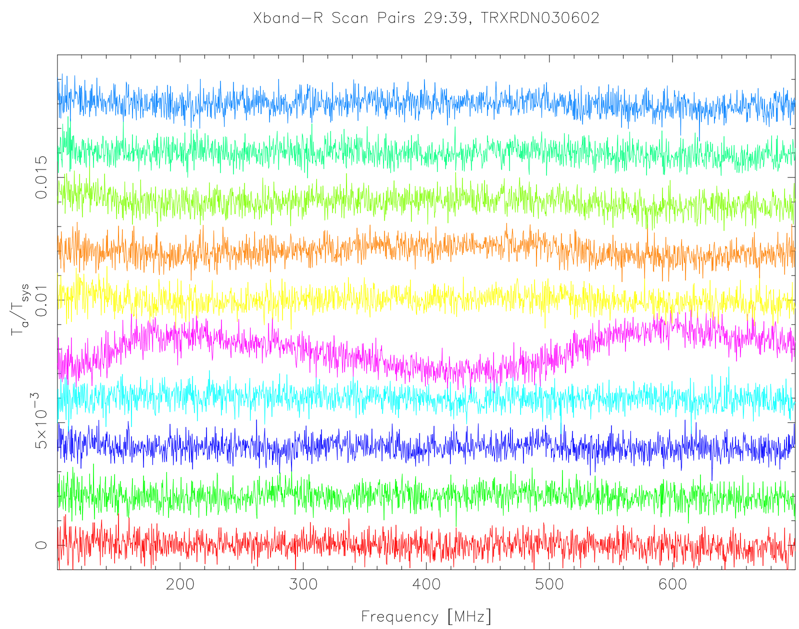

Figure 2: $(sig - ref)/ref$, for the X-band RCP channel, taking each of scans 29-38 as the reference, and the following scan as the signal. The system was undisturbed during this time. Only the cal off phase was processed, and the scan times were 60 seconds.

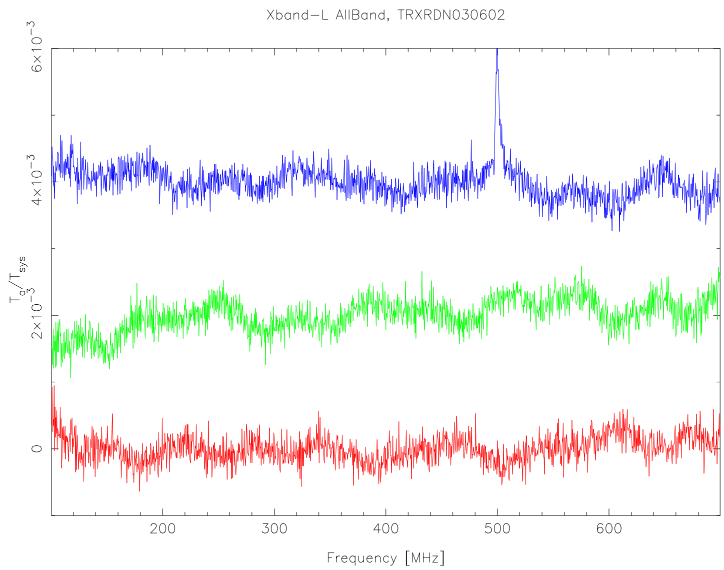

Figure 3: $(sig{-}ref)/ref$, for the X-band LCP channel, for three sky frequencies. Center frequencies are: 8400MHz (red), 9000MHz (green), and 9600MHz (blue). The cal off phase only was processed, and the scan times were 300 seconds.

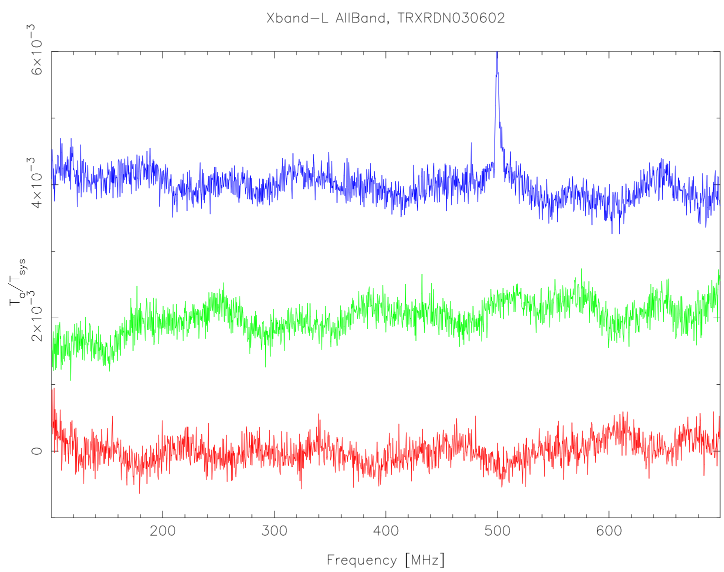

Figure 4: $(sig{-}ref)/ref$, for the X-band RCP channel, for three sky frequencies. Center frequencies are: 8400MHz (red), 9000MHz (green), and 9600MHz (blue). The cal off phase only was processed, and the scan times were 300 seconds.

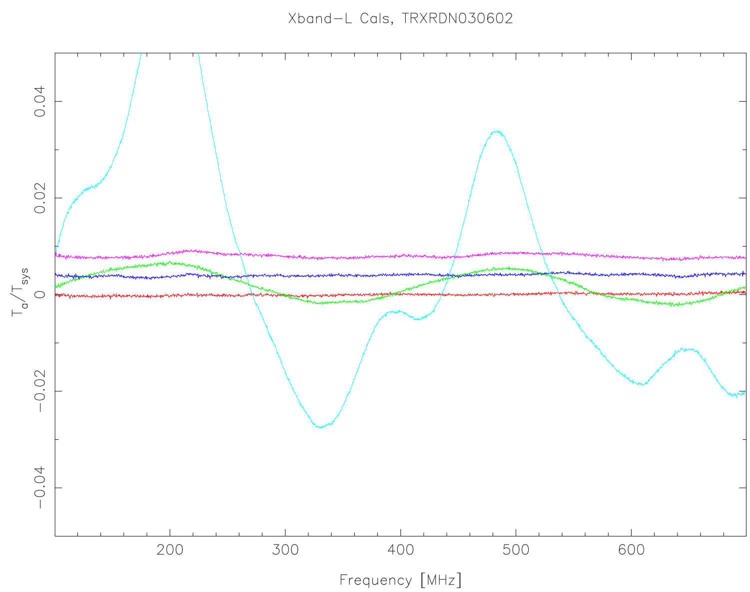

Figure 5: $(sig-ref)/ref$, for the X-band LCP channel, for states of the receiver noise cal sources. Cases are: Cals Off for both scans (red); Low cal off for ref and on for sig (green); Low cal on for both (blue); Low cal on for ref and high cal on for sig (cyan); and high cal on for both (magenta). The cal off phase only was processed, and the scan times were 300 seconds.

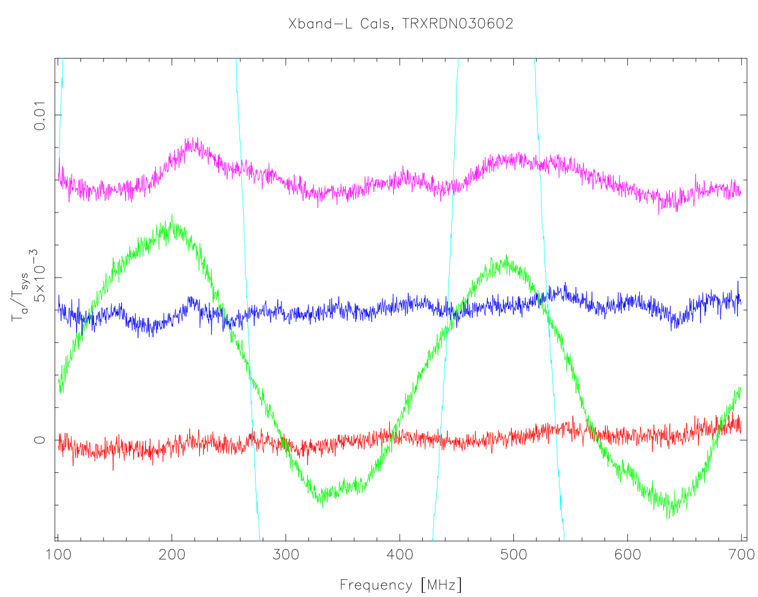

Figure 6: A zoom of the central portion of the previous figure.

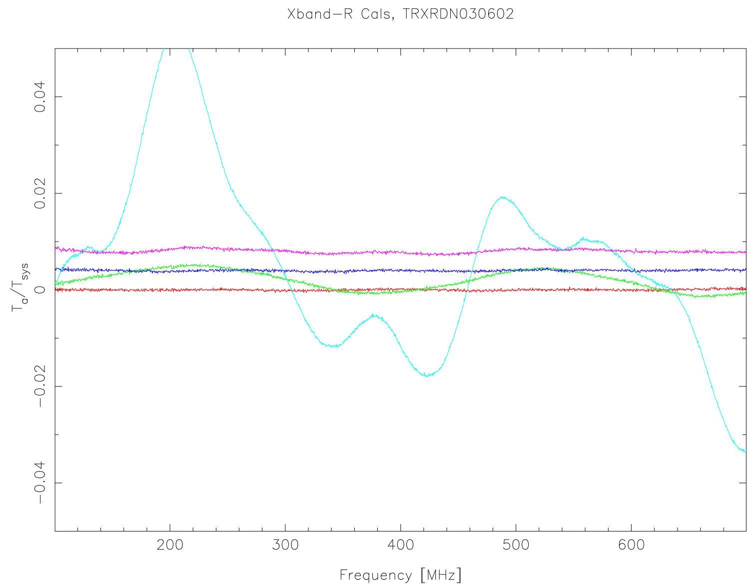

Figure 7: $(sig-ref)/ref$, for the X-band RCP channel, for states of the receiver noise cal sources. Cases are: Cals Off for both scans (red); Low cal off for ref and on for sig (green); Low cal on for both (blue); Low cal on for ref and high cal on for sig (cyan); and high cal on for both (magenta). The cal off phase only was processed, and the scan times were 300 seconds.

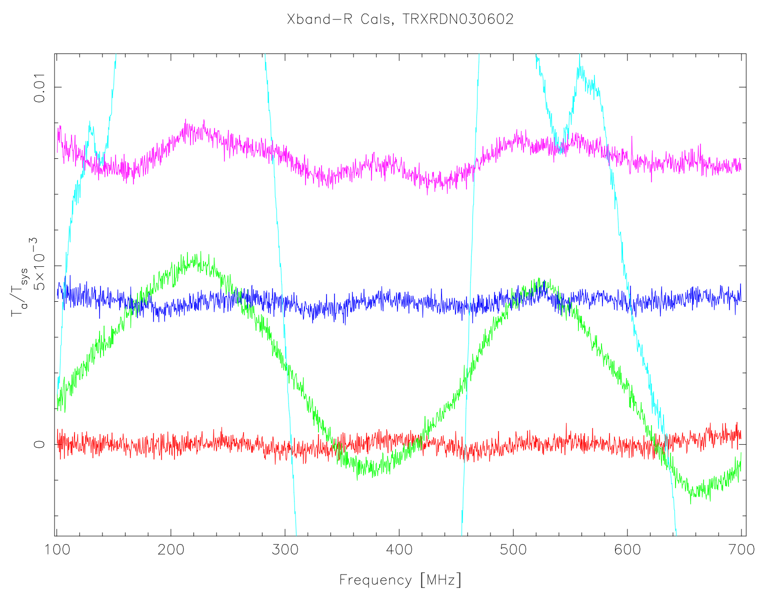

Figure 8: A zoom of the central portion of the previous figure.