More Tests on Q-band Components
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Setup

This report describes measurements and analysis made on a test arrangement consisting of a cooled LNA and mixer, IF filter, and IF amplifier taken from the Q-band receiver and placed in one of our test dewars. The tests are follow-ons to testing done on April 14 and described in a previous report. Some changes were made in the test configuration, namely the cooled isolator was removed and the 13 cm long stainless steel waveguide used to thermally isolate a waveguide load from the LNA was replaced with a 0.38 long stainless shim. VNA measurements on the shim and the load show that the combination has a return loss of 32 dB or better.

The test dewar was located in the Equipment Room and the IF output (centered at 6GHz) was connected into OR1 via heliax cable. Converter Module 1, Sampler/Filter 1, and the spectrometer were then configured for a 800 MHz bandwidth measurement of the spectrum. A 83620 synthesizer was used to provide a LO signal to the cooled mixer via a 4X multiplier, just as in the Q-band receiver.

Results

The procedure followed was similar to that developed on April 14. A pair of scans taken with the LNA input load at two temperatures (T_{cold} and T_{hot}) were used to measure the receiver temperature as a function of frequency, $T_{rx}(f)$. Subsequent scans were taken with a variety of load temperatures, and the "cold" scan used as a reference scan in calculation of the spectral baseline by:

$$BL = T_{sys}(Sig - Ref)/Ref \tag{1}$$

where $T_{sys} = T_{rx} + T_{ref}$, the system temperature during the reference scan.

A description of the scans of interest and related conditions are given in Table 1.

Table 1: Scan Descriptions

Scan	f_{cen}	Load Temp	Notes
22	43GHz	19.1K	T_{cold} and Reference Scan
23	43	33.9	T_{hot} Scan
24	43	33.9	Signal Scan 1
25,26	43	26.7	Signal Scan 2,3
27,28	43	21.8	Signal Scan 4,5
29,30	43	19.4	Signal Scan 6,7

All the scans were 121 seconds long. Scan 22 ended at 19:45:46 UT and scan 30 at approximately 20:17:31 UT, due to waits needed to allow the load temperature to stabilize after changes.

Figure 1 shows that the results were consistant with those seen on April 14. Using the measured $T_{rx}(f)$ removed most of the baseline structure, and the measured load temperature for each signal scan is within $\pm 1K$ of that expected from the temperature readout. That indicates reasonable linearity of the system; the spectrometer was not rebalanced at any point during these tests.

The baseline data's standard deviation measured over the 500-600 MHz IF range was $16 \pm 1mK$ for all the signal scans processed using the measured $T_{rx}(f)$. That value is about 2.4 times theoretical. The reason for the increase is not yet known.

Summary

This day's tests were undertaken to see if the results of April 14 would repeat with an improved LNA input return loss, to rule out any effect due to the cooled input isolator used on April 14, and to see if the results scaled as expected with various input load temperatures.

The plan now is to attempt to do a similar measurement with the Q-band LNA removed, with the waveguide load directly on the mixer signal port. We will add a InP LNA to the setup to serve as a cooled IF amp.

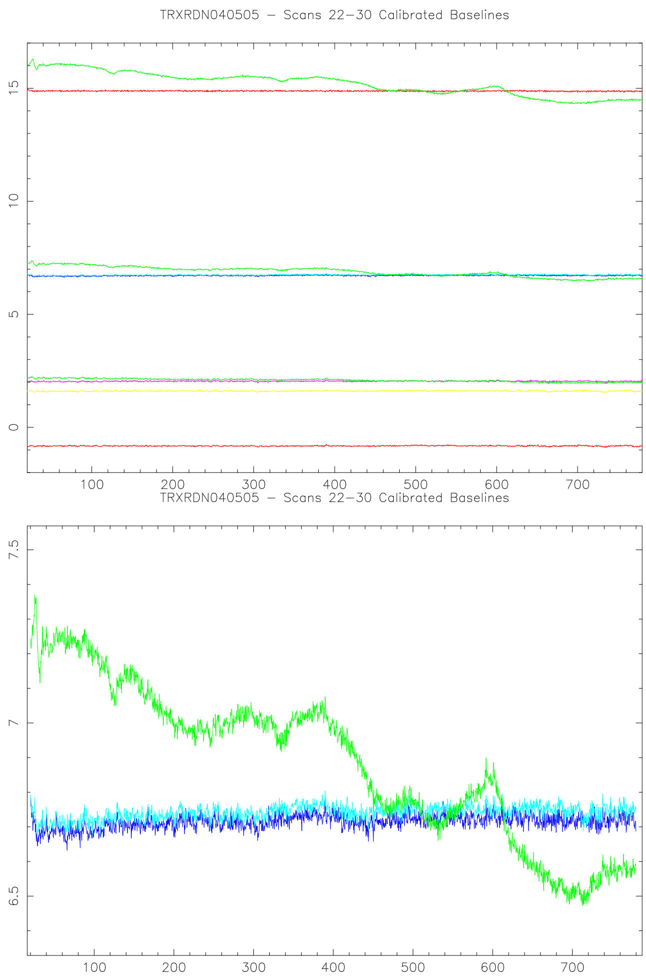

Figure 1: The upper plot shows the spectral baselines (Equation 1) for all the signal scans listed in Table 1. The green traces were calculated using a mean T_{rx} of 15.5K, and the other (flatter) traces used the measured $T_{rx}(f)$. The vertical scale corresponds to $T_{sig} - T_{ref}$ in kelvin, or ideally the LNA input load temperature during the applicable signal scan minus the load temperature during the reference scan (Scan 22). The lower panel zooms into the region around 7 K (signal scans 25 and 26).