Memorandum

To: File

From: Ralph Groves
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Date: 2004-03-03

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Subject: Mixer Noise Temperature Changes as Function of Mixer Physical Temperature

1. Summary

The RAL cryostat is specified to provide a maximum physical temperature of 4.0K[1] when working with the largest expected thermal loads. Initially, cryostat thermal loading will be light, with four or fewer cartridges installed in the cryostat, so the actual physical temperatures will be significantly less than 4.0K. This memo shows that the optimum bias required for Band 6 SIS mixers to meet noise temperature specifications is invariant of the mixer's physical temperature. Hence, no readjustment of bias is required when the physical temperature decreases on the 4K stage of the Band 6 cartridge.

2. Test Procedure

A block diagram of the test system is shown in Figure 1. Mixer-preamp physical temperatures are maintained using a Lakeshore 332 temperature controller to heat the 4K stage in the mixer test cryostat with a Lakeshore DT-670 temperature sensor mounted on the mixer body to close the control loop.

Mixer bias voltage and LO pump current were optimized at a mixer-preamp physical temperature of 4.2K. The temperature controller was then adjusted to several intermediate temperatures and noise temperature data were remeasured after temperatures stabilized. Finally, the mixer bias voltages and LO pump powers were reoptimized at the minimum physical temperature obtainable from the mixer test cryostat, which is 3.6K

3. Results

Figure 2 shows receiver noise temperatures for an LO frequency of 240 GHz with the mixer-preamp's physical temperature as a parameter. Figure 3 is a graph of receiver noise temperature as a function of mixer-preamp physical temperature for a single IF of 8 GHz at the 240 GHz LO frequency shown in Figure 2.

Figure 3 shows the expected reduction in receiver noise temperatures with decreasing mixer-preamp physical temperatures. Further, the individual data points at 3.6K also indicate that receiver noise temperatures are the same (within measurement error) when mixer performance is optimized at either 4.2K or at 3.6K.

[1] "Cryostat Technical Specifications", ALMA FEND 40.03.00.00-002-B-SPE, 2003-09-20.

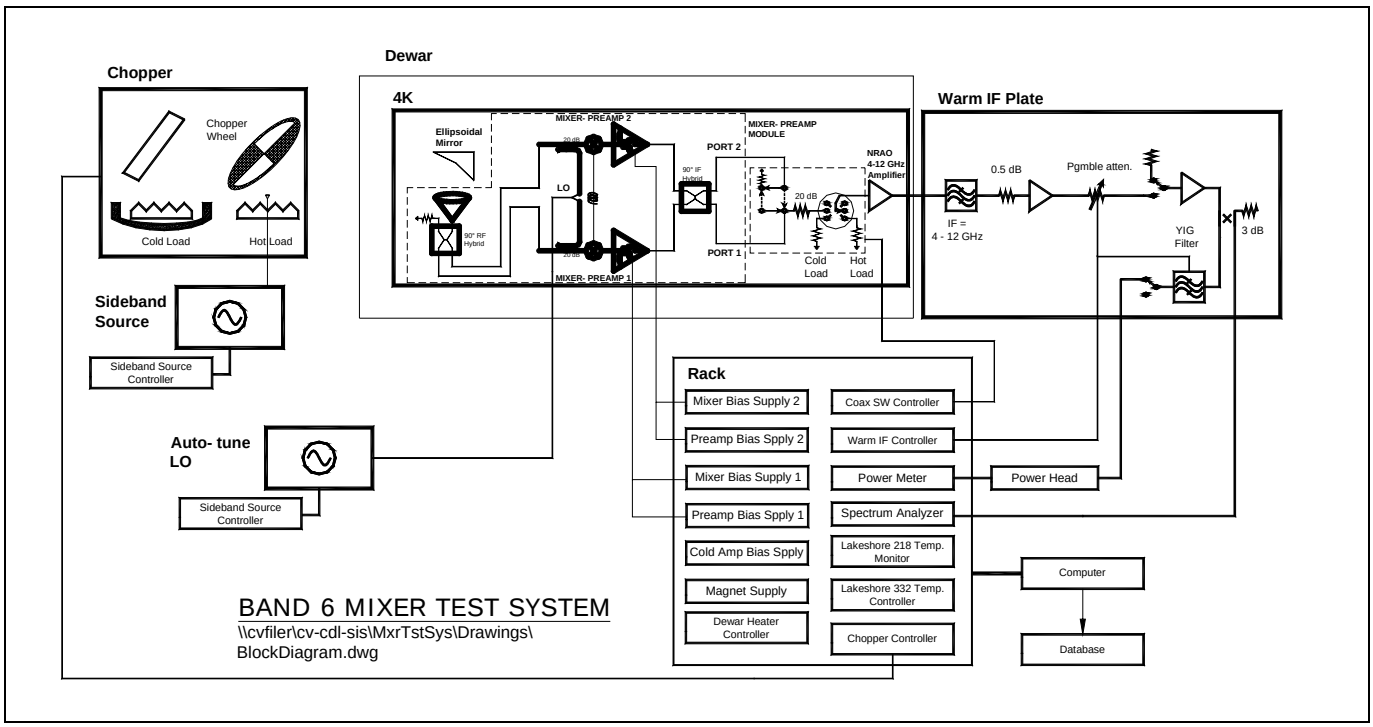

Figure 1: Mixer Test System Block Diagram

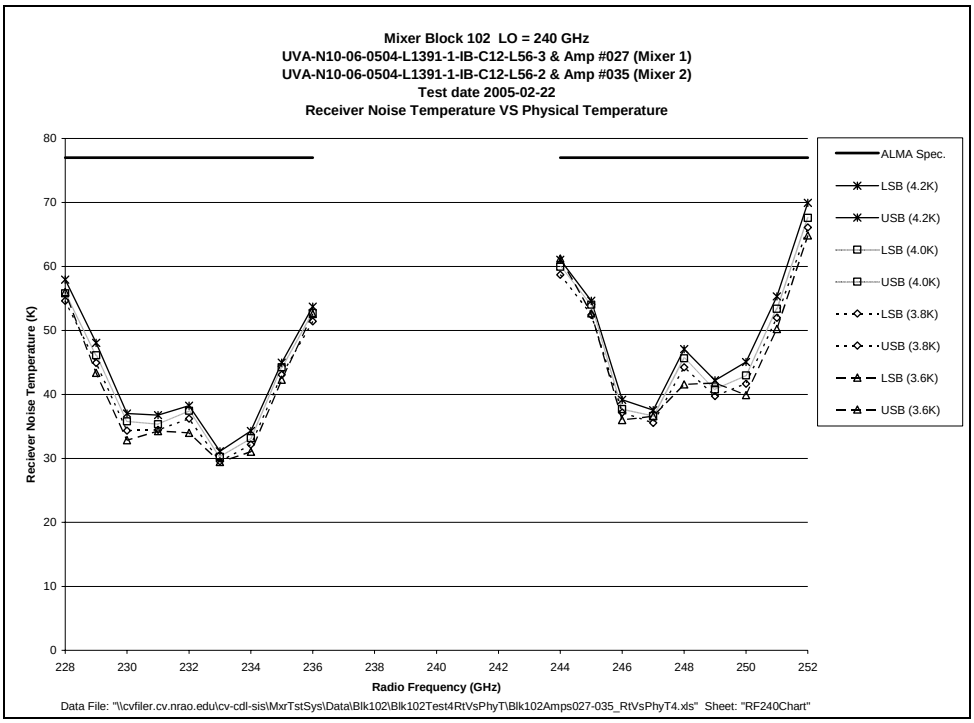

Figure 2: Receiver Noise Temperature for Changing Physical Temperatures

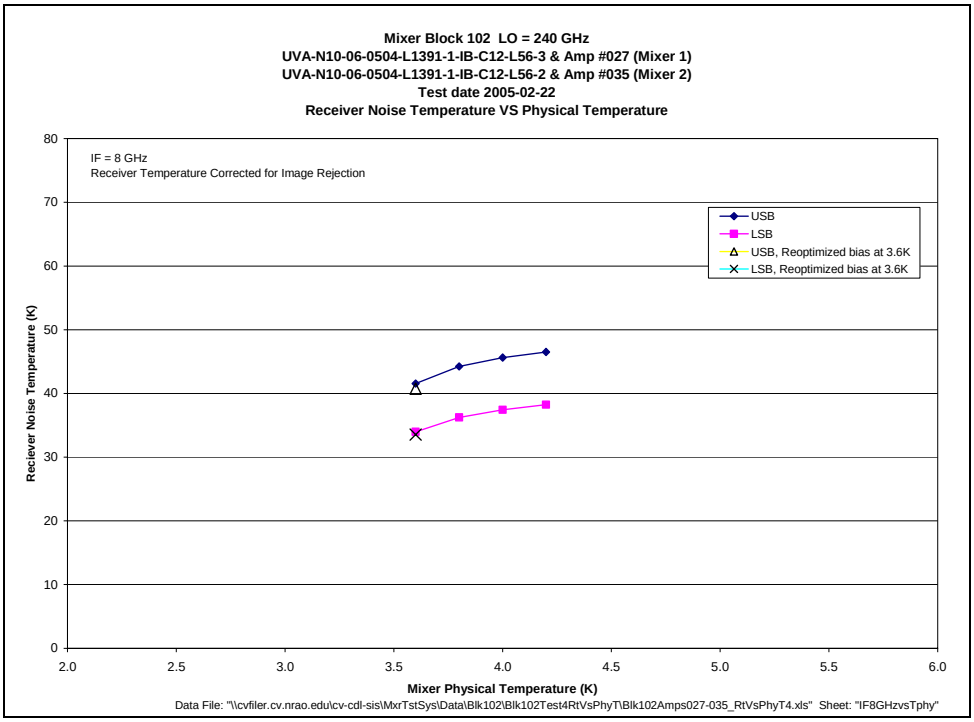

Figure 3: Receiver Noise Temperature *vs.* Physical Temperature