



# Memorandum

**To:** Dan Koller

**cc:** Dave Schmitt      Michael Lacasse  
Tony Kerr

**From:** John Effland

**Date:** 2005-05-17

**Revisions:** 2005-05-17      jee      Initial  
2005-05-18      jee      Corrected caption for Fig 2  
2005-06-28      jee      Added path to footer

**Subject:** Review of Band 6 Cartridge Measurement Data in RAL Cryostat and Cartridge Test Systems

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## 1. Summary and Recommendations

A discrepancy of over 7 dB exists between cartridge gain measured in the Cartridge Test System (CTS) compared to gain measured in the RAL cryostat<sup>1</sup>. Noise powers are compared here in an attempt to better understand the cause of this discrepancy.

It's clear that the 62 dB of gain present in the Warm IF Plate is excessive given the over 60 dB of gain present in the cartridge. The entire system therefore has over 120 dB of gain, which compromises gain stability as a function of temperature. A careful analysis of noise temperatures and maximum and minimum expected noise powers for the entire system is recommended to optimize the design.

The noise diode location sets the reference point for the gain measurement, and the same cable configuration used between the cartridge and Warm IF Plate should be installed between the noise diode and Warm IF Plate to refer the cartridge gain to the cartridge output.

## 2. Measurement Results

Data presented in this memo was obtained from the spreadsheet at:

`\\cvfiler.cv.nrao.edu\cv-cdl-sis\Cartridge\SysEngr\RALvsCTS\Summary.xls`

The equipment configuration for the CTS is shown in Figure 1 and is similar to the configuration used for the RAL cryostat measurements. Note that the total gain available from both amplifiers on the Warm IF Plate is 62 dB, which seems excessive given the 60 dB gain already present in the cartridge. Also, the noise diode has a short cable installed between it and the Warm IF Plate, but the cartridge has longer cables and 3 dB attenuators.

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<sup>1</sup> "Comparison of Band 6 Cartridge Measurements in RAL Dewar and Cartridge Test Systems," NRAO memo from J. Effland, 2005-05-02, [http://www.cv.nrao.edu/~jeffland/Cartridge/RAL\\_CTS\\_Compare.pdf](http://www.cv.nrao.edu/~jeffland/Cartridge/RAL_CTS_Compare.pdf)

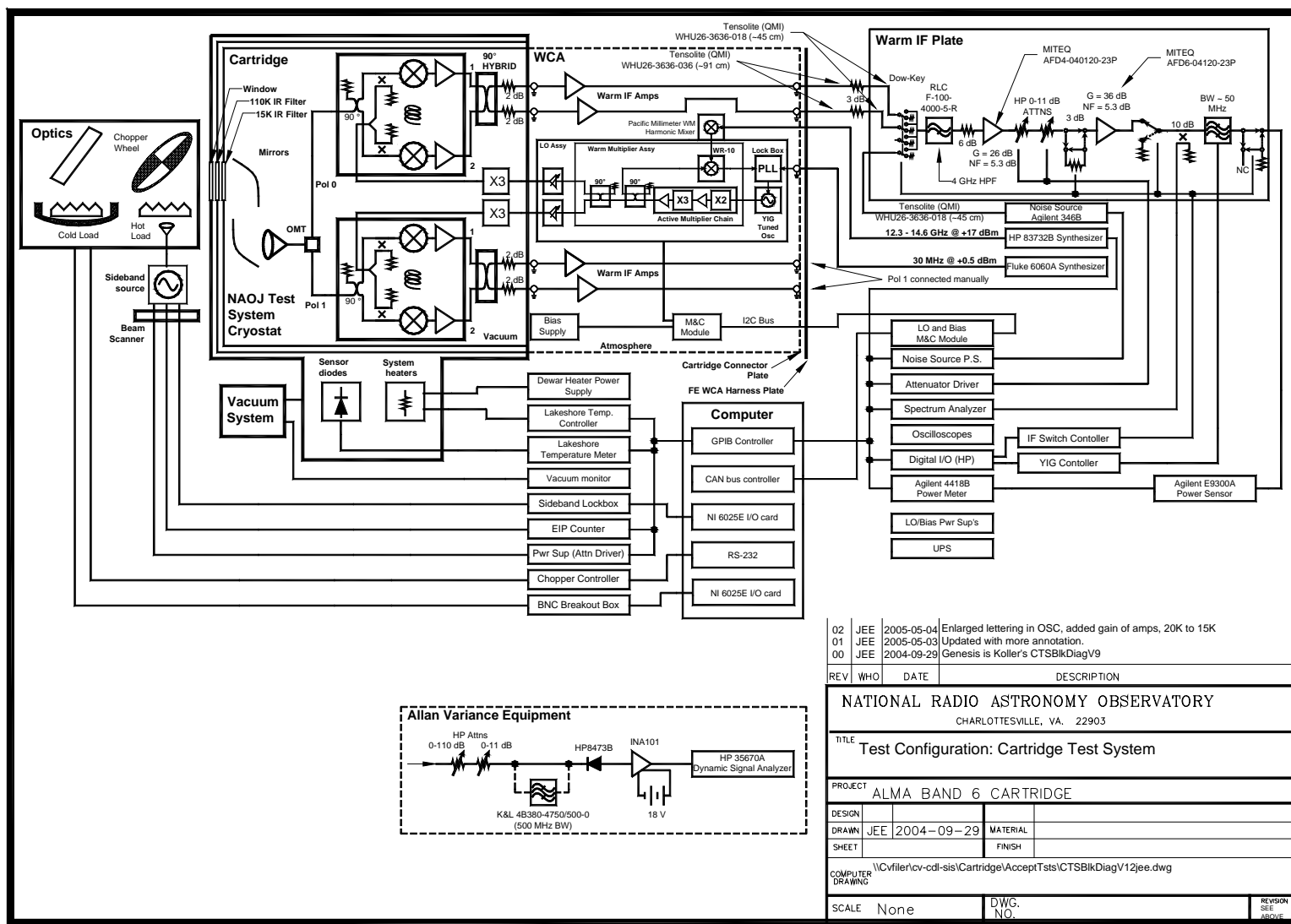
Figure 2 compares total noise powers and gain for the Band 6 Cartridge 001 measured in both systems. Cartridge gain, including warm IF amps, is shown by the heavy curves in Figure 2 and the 7 dB discrepancy is clearly evident at 12 GHz IF.

Noise power curves in Figure 2 are total noise power from the cartridge and Warm IF Plate measured by the power meter at the output of the YIG filter. To simplify comparison, the physical attenuator setting on the Warm IF Plate has been added to the noise power to simulate attenuator settings of 0 dB.

The topmost curves labeled *System Noise ...* are total noise power measurements for the CTS and RAL systems and indicate about 8 dB additional loss exists when the cartridge is installed in the RAL cryostat. The additional attenuation is most likely due to the increased cable length used when measured in the RAL cryostat.

The middle curves labeled *IF Plate Noise RAL/CTS (Attn = 0 dB)* are total power when the Warm IF Plate is connected to the noise diode which is configured in the ON state. Note that these curves differ by only a few dB indicating that the Warm IF system is unchanged.

The bottom curves (*Gain, RAL/CTS (Attn = Auto)*) are actual total power readings recorded for the Warm IF Plate when the attenuator is adjusted to maintain -30 dBm of system noise power when the cartridge is connected. It's interesting to note that the gain discrepancy appears to follow the difference in attenuator values.



|    |     |            |   |
|----|-----|------------|---|
| 02 | JEE | 2005-05-04 | Enlarged lettering in OSC, added gain of amps, 20K to 15K |
| 01 | JEE | 2005-05-03 | Updated with more annotation.                             |
| 00 | JEE | 2004-09-29 | Genesis is Koller's CTSBkDiagV9                           |

| REV | WHO | DATE | DESCRIPTION |
|-----|-----|------|-------------|
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|--|--------------------|
| <b>NATIONAL RADIO ASTRONOMY OBSERVATORY</b>                                      |                    |
| CHARLOTTESVILLE, VA. 22903   |                    |
| TITLE: Test Configuration: Cartridge Test System                                 |                    |
| PROJECT: ALMA BAND 6 CARTRIDGE   |                    |
| DESIGN   |                    |
| DRAWN: JEE   | 2004-09-29         |
| MATERIAL   |                    |
| SHEET  | FINISH             |
| COMPUTER DRAWING: \\Cvfiller\cv-cdi-sis\Cartridge\AcceptTsts\CTSbKDiagV12jee.dwg |                    |
| SCALE: None  | DWG. NO.           |
|  | REVISION SEE ABOVE |

Figure 1: Measurement Equipment for Cartridge Test System

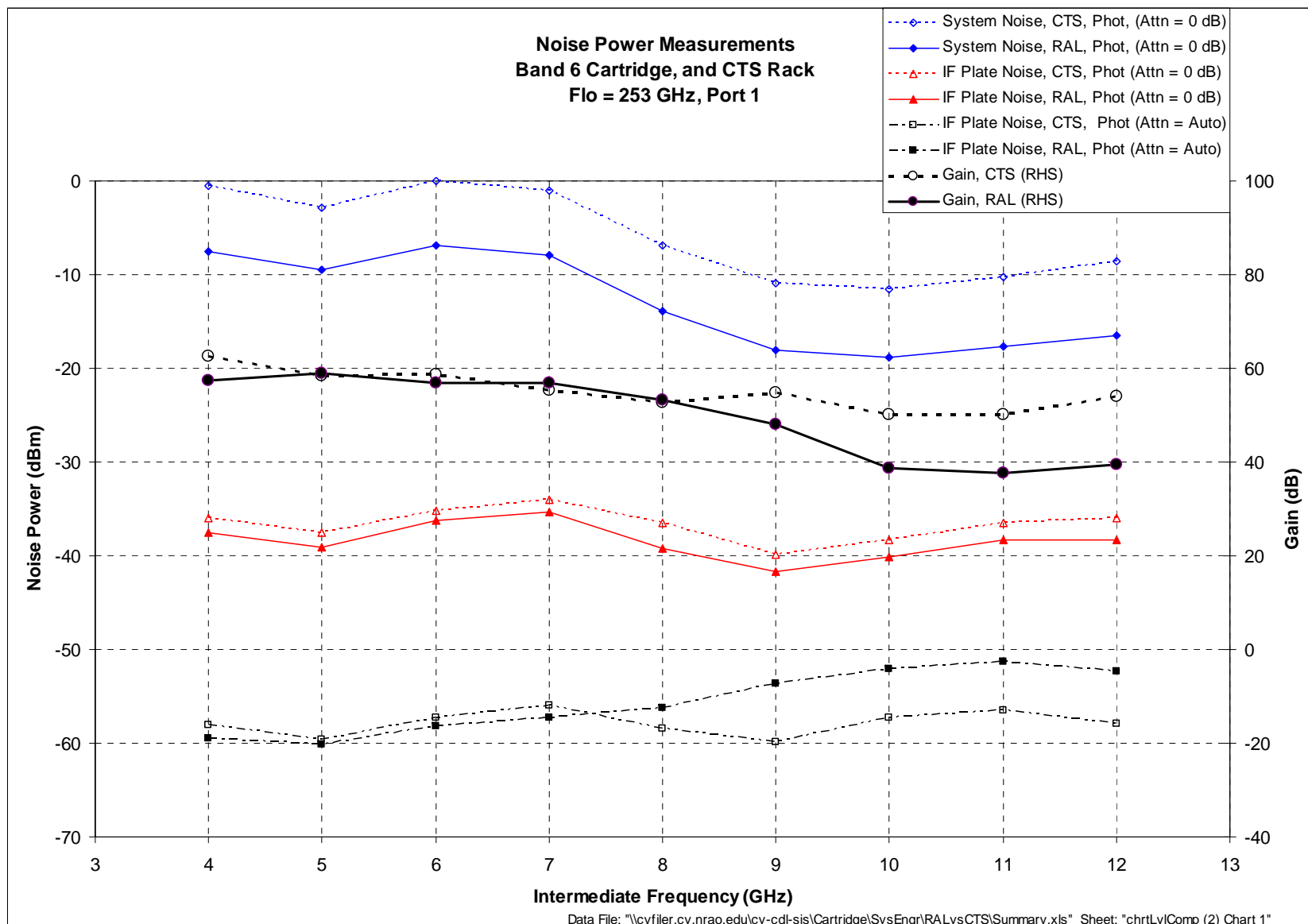


Figure 2: Comparison of RAL and CTS noise powers and gains