



Memorandum

To: Jason Ray
John Ford

cc: Antonio Perfetto
Wes Grammer
John Webber

From: John Effland
Dave Schmitt

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Revisions: 2007-01-10 jee Initial
2007-01-10 jee Minor editorial changes

Subject: Band 6 Cartridge Gain Stability Anomalies with Rev C2 Bias Supplies

1. Summary

Gain stability measurements of Band 6 Cartridge B6-004 using the latest bias supply revision, C2, show lobes at short integration times that are similar to those measured with revision B of the bias supply. These lobes, which cause gain stability to exceed specifications, are not present when any of the tested Band 6 cartridges are powered by bias supply revision A.

2. History

Gain stability was measured in October of 2005 for cartridge B6-002 installed in the first RAL cryostat delivered to the NTC¹. Data were measured for just the cartridge and also when the cartridge IF signals were routed through the front-end IF switch.

All measured data shows gain stability is generally invariant of LO frequency and polarization. Differences in stability over long integration times are most likely due to room temperature changes and the concern at present is gain stability for integration times less than 1 second.

As summarized in Table 1 of the B6-002 gain stability memo, stability using bias supply Rev B showed a lobe for integration times from 0.1 to 0.3 seconds, but no such lobe was measured when bias supply Rev A powered the mixer-preamps. Similar differences between Rev's A and B of the bias supplies were observed in formal gain stability tests of the first delivered cartridge B6-001².

¹ "Gain Stability Measurements of Band 6 Cartridge SN002," NRAO Memo from Effland and Schmitt, 2005-12-08 and available at: <http://www.cv.nrao.edu/~jeffland/GainStability2005-11-29.pdf>

² See Section 5 of the B6-001 PAI Test Report (FEND-40.02.06.00-105-A-TDR) at <http://edm.alma.cl/forums/alma/dispatch.cgi/iptfedocs/showFolder/102445>

As discussed in the B6-002 gain stability memo and shown in Figure 17 there (and repeated here for convenience as Figure 1 below), such lobes can result from a spurious tone on the bias voltages for either the mixer or preamp supplies.

3. Recent measurements

Figure 2 below is the gain stability of cartridge B6-004 measured on 2006-12-01 using Rev A of the bias supply. Polarization 0 is shown the upper graph and polarization 0 in the lower, and these latest results are similar to the earlier cartridge B6-002 measurements discussed above. Note that this Rev A bias supply apparently has developed a bad mixer monitoring circuit and causes image rejection to exceed specifications, but the supply is still useful for gain stability testing.

Figure 3 is gain stability measured with Rev B of the bias supply and the lobe again present at short integration times exceeds cartridge gain stability specifications. Our Rev B bias supply ceased operating before we could measure gain stability with cartridge B6-004, so the in Figure 3 is from cartridge B6-001 measured in August 2006. Similar results were obtained in October 2005 with cartridge B6-002³.

Figure 4 shows cartridge B6-004 gain stability measured with Rev C2 of the bias supply, C2-001. A second sample of this same bias supply version, C2-005, shows similar cartridge results (Figure 5).

4. Possible Plan of Action

Below are a number of steps that could be taken by Greenbank, in consultation with the Band 6 group, to solve this problem:

- 1) Use a dynamic signal analyzer to look for spikes in the power spectral density (PSD) of the bias voltages from C2 supplies.
- 2) Ship our Rev A bias supply to Greenbank and have them measure and compare the PSD of Rev A and Rev C2 circuits.
- 3) Confirm that Greenbank's mixer-preamp simulator uses the same isolation resistors as used in Band 6 bias tee circuit. (Gain stability measured by other cartridge groups doesn't show these lobes, so it's possible that the problem is sensitive to the loads presented to the bias supply.)
- 4) Greenbank could investigate bias supply circuit changes between Rev A and Rev B and attempt to understand the circuit changes that caused the problem.

³ Gain stability measured in Oct 2005 using bias supply Rev B with cartridge C6-002 is shown in Fig's 6-10 in the memo referenced in footnote 1.

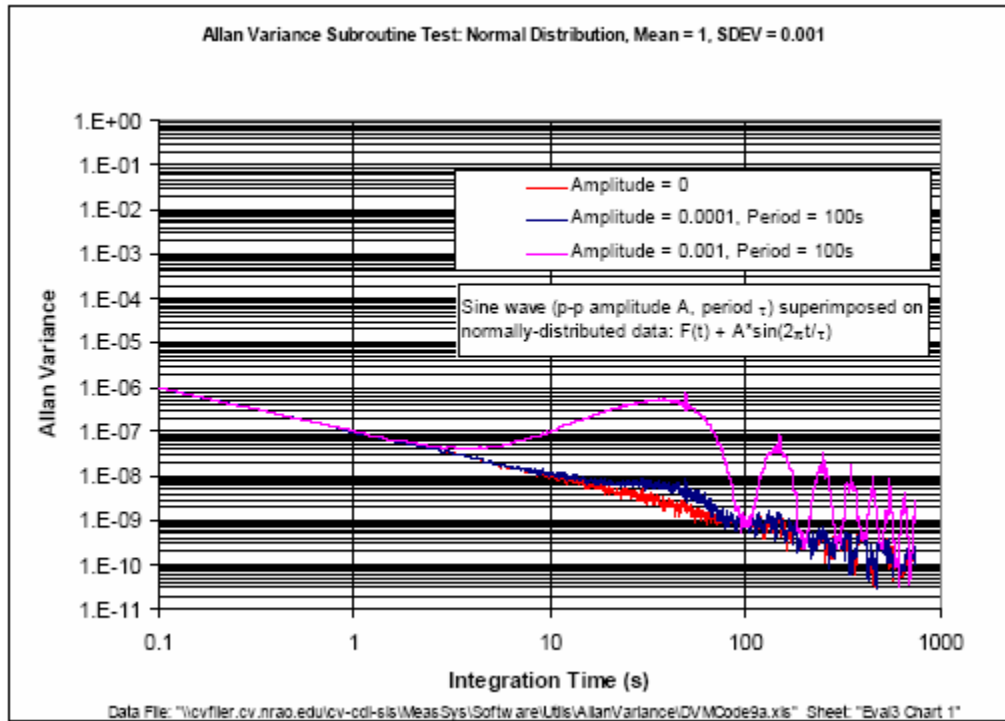


Figure 1: Figure 17 from the memo of footnote 1 showing how a tone with 100s period maps to lobes in Allan Variance

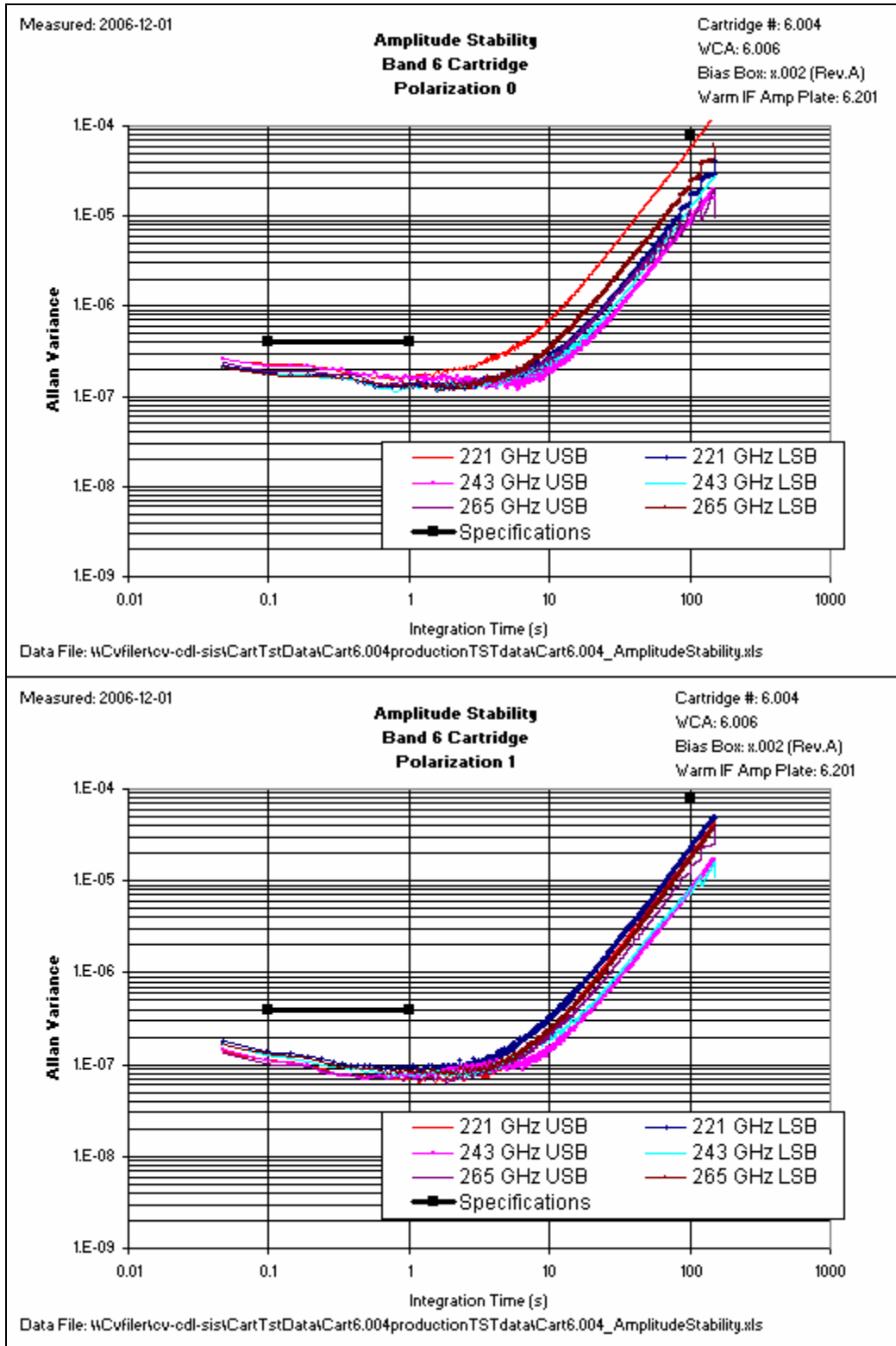


Figure 2: Gain Stability, Bias Supply A-002, Cart B6-004

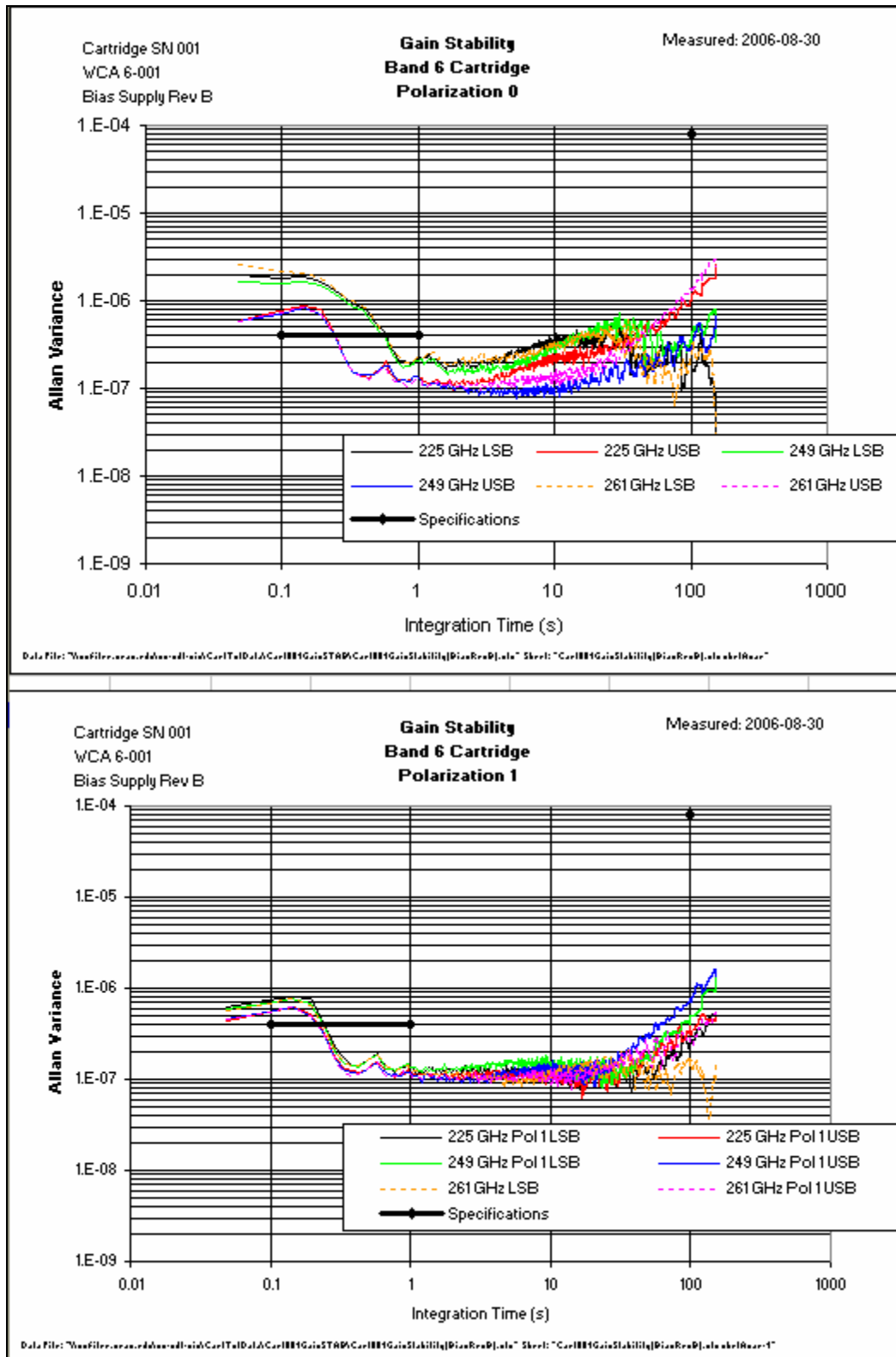


Figure 3: Gain Stability, Bias Supply B-XXX, Cart B6-001

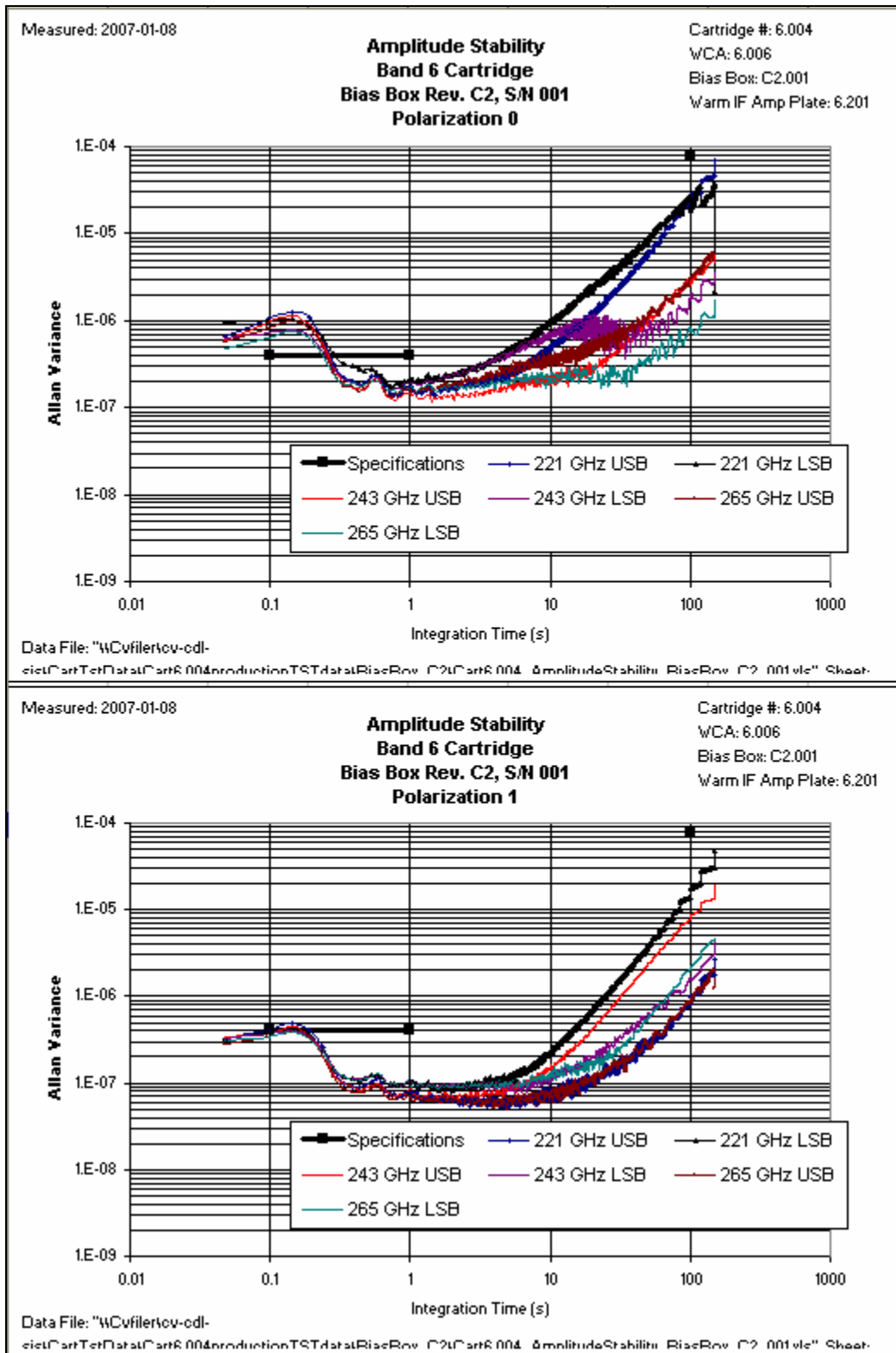


Figure 4: Gain Stability, Bias Supply C2-001, Cart B6-004

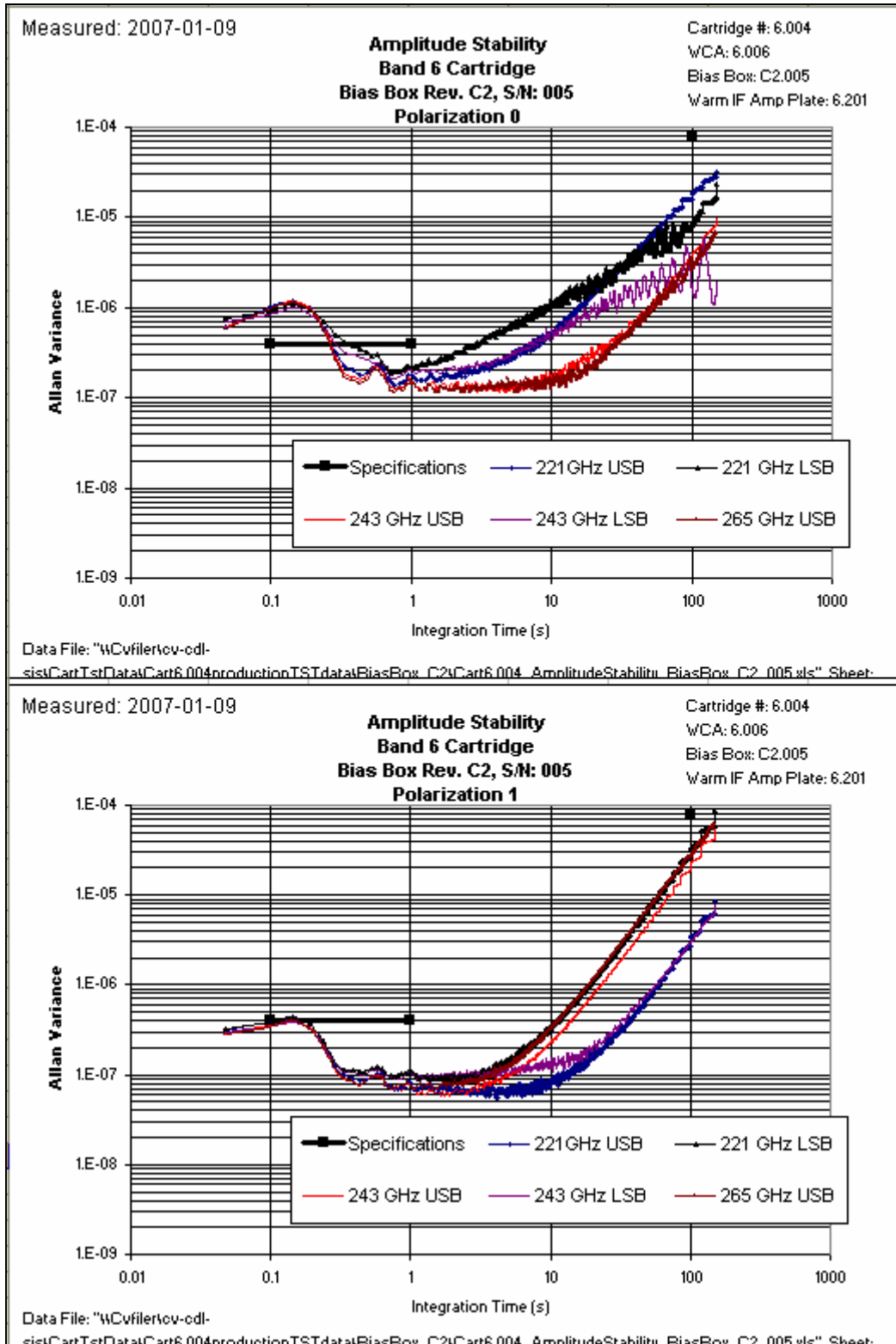


Figure 5: Gain Stability, Bias Supply C2-005, Cart B6-004