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Memorandum

To: File

From: John Effland, Dave Schmitt, and Mike Reynolds

Date: 2010-12-08

Revisions:

2010-12-03	jee	Initial
2010-12-06	jee	Added cartridge gain (Figure 15), fine IF steps around spike (Figure 19 and Figure 21) and Pol 1 mixer and LO turned off (Figure 22)
2010-12-07	jee	Remeasured with nominal fixed bias Figure 23 and Figure 24. Updated Figure 25 to show agreement between set points and optimal bias values. Removing and reinstalling WCAs Figure 17 produced little change.
2010-12-08	jee	Added Figure 18, increased magnet current Figure 20, stepped IF with fixed LO= 262.8 GHz

Subject: Spikes Found in LO Waveguide Integrity Data for Band 6 Cold Cartridges

1.0 Updates from Measurements, Wed 8 Dec 2010

Added Figure 18 showing partial LO WG integrity with increased magnet current from 25 mA to 45 mA. Figure 20 was added to include the LO where the oscillations were observed using stepped IF with fixed LO= 262.8 GHz.

2.0 Updates from Measurements, Tue 7 Dec 2010

LO WG integrity changed little after removing and reinstalling WCA 6.005, seen by comparing Figure 17 to the original data in Figure 16.

LO WG integrity was measured with nominal fixed bias of V_j = 8.5 mV and I_j = 50 uA (Figure 23) and comparing this to previous optimal bias measurements (Figure 14) shows that the peaks are likely still present, but now almost obscured by suspiciously high noise regions in Pol 0 and have possibly changed frequencies in Pol 1. Preamp bias for this case remains at $V_{D1,2\ and3}$ = 0.7V and $I_{D1,2,\ and\ 3}$ = 3 mA which had eliminated oscillations in most cases. The bias current for nominal fixed bias shows the expected constant I_{j2} *vs.* frequency in Figure 24 while updated Figure 25 demonstrates that the actual bias tracks closely the optimal V_j and I_{j2} values measured in the mixer test system.

3.0 Updates from Measurements, Mon 6 Dec 2010

A plot of cartridge gain (Figure 15) for the measurements in Figure 14 shows a dip at 230 GHz corresponding to the weak spike at that RF that was observed on the spectrum analyzer.

Fixing the LO and stepping the IF in 100 MHz steps shows spikes (Figure 19 and Figure 21) at the same IF (4.2 GHz). This data should be compared to Figure 16 which shows the normal LO WG integrity data with 100 MHz LO steps.

Ensuring the LO pump power was actually turned off in Pol 1 and setting mixer bias to 15 mV for that polarization produces the plots shown in Figure 22 which now show a stronger signal in Pol 0 than when the Pol 1 mixers were biased normally (Figure 16).

Work remains to confirm the algorithm for setting junction current and to check the repeatability when removing and installing the WCA.

4.0 Text from Fri 3 Dec 2010

Recent LO waveguide integrity measurements for Band 6 cartridges show a number of spikes in the data, as summarized below. Two different types of spikes are present, with one at a constant RF at 230 GHz in both sidebands, but the other at a constant LO frequency clustered near 262 GHz in both sidebands.

Cartridges B6.030 and B6.037 exhibiting now-suspicious spikes as reported below have already been accepted or are in the process of being accepted by the project.

Spikes found in Pol 1 LO WG integrity data for B6.042 (Figure 1) were drastically reduced, but not eliminated, when the WCA was changed from WCA6-033 to -050 (Figure 2) but returned again with the golden WCA6-005 (Figure 3). Changing the OMT appeared to reduce the higher frequency spikes significantly, as shown in Figure 4, but the 230 GHz spike remained.

Spikes in B6.039 occurred after swapping the OMT, as shown in Figure 5 and Figure 6. The data in Figure 6 was repeated as shown in Figure 7, and a new spike appears at 248 GHz. The OMT for this cartridge was again swapped, but Figure 8 shows the spikes are little changed, except at 248 GHz.

A new batch of overmoded waveguide showed spikes during VNA measurements in late summer, so LO WG integrity frequency spacing was reduced from the nominal 100 MHz to 20 MHz to search for those spikes in B6.037. Figure 9 shows the same sharp spikes as found recently, but at that time the spikes were thought to not originate in the LO WG because mixer pump currents show no spikes (Figure 10). Additional tests showed B6.037 missed optics specs, so the entire optics system and mixers were replaced, and the spikes disappeared, as shown in Figure 11. Optics problems continued, so the OMT was replaced for this cartridge and the LO WG integrity continued to show no spikes (Figure 12).

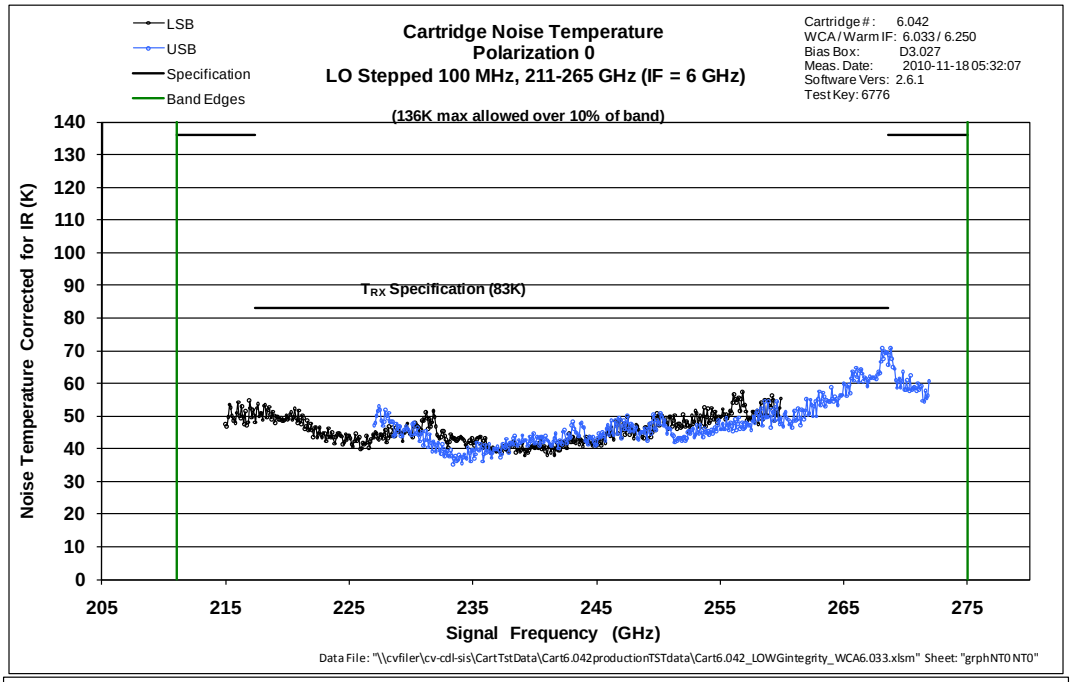
High noise in B6.038 (Figure 13) at the bottom of the band was thought to originate from WCA6-004, and we approved it based on that assumption, but notice the now-suspect spikes in Pol 1.

Spikes in B6.041, currently under test, occur in both polarizations (Figure 14) and repeat with different WCA's (Figure 16) measured just this morning. Mixer junction currents and power amp voltages show no spikes (Figure 25) but increased noise power is present in both sidebands for Pol 1 (Figure 26), and the resulting Y-Factor shows a dip (Figure 27). No spikes are seen in junction bias (Figure 28) nor power amp voltages (Figure 29) which likely means the LO WG chain is okay. Reducing the drain currents to 3 mA didn't change the amplitude of the spikes.

Spikes at the very bottom of the RF band for B6.030 (Figure 30) were thought to originate in WCA-004, since similar spikes were observed on another cartridge. Also note how different that spike is from the others. However, the spikes at the top end of the band for Pol 0 now seem similar to the others reported above.

List of Figures

Figure 1: Cart 6.042, WCA 6.033, CTS-2



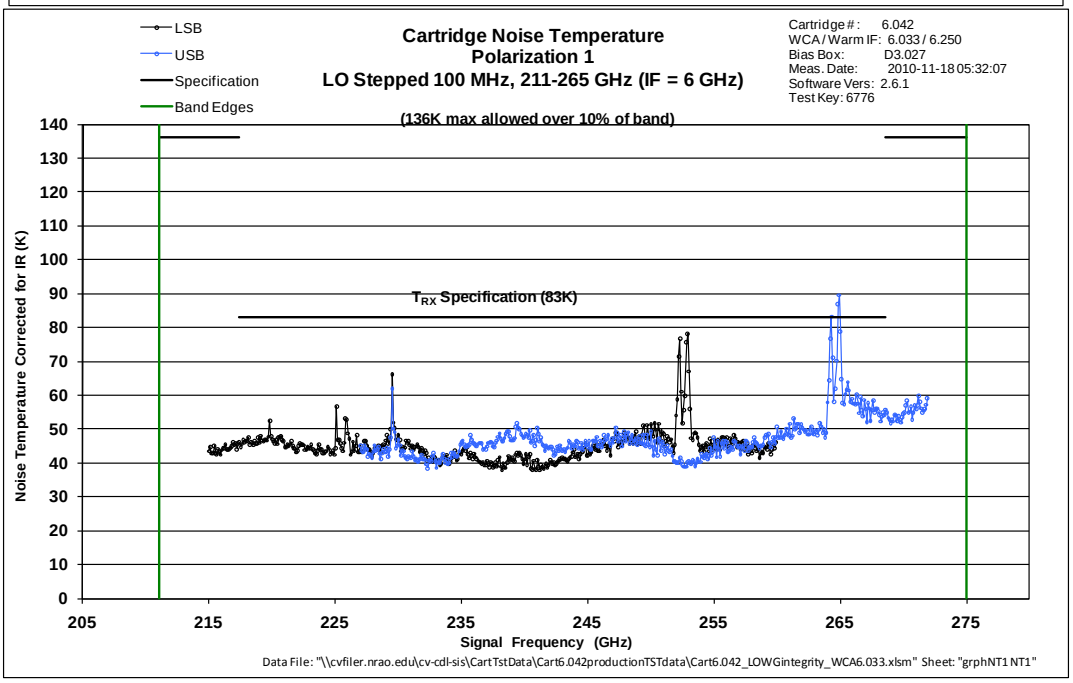
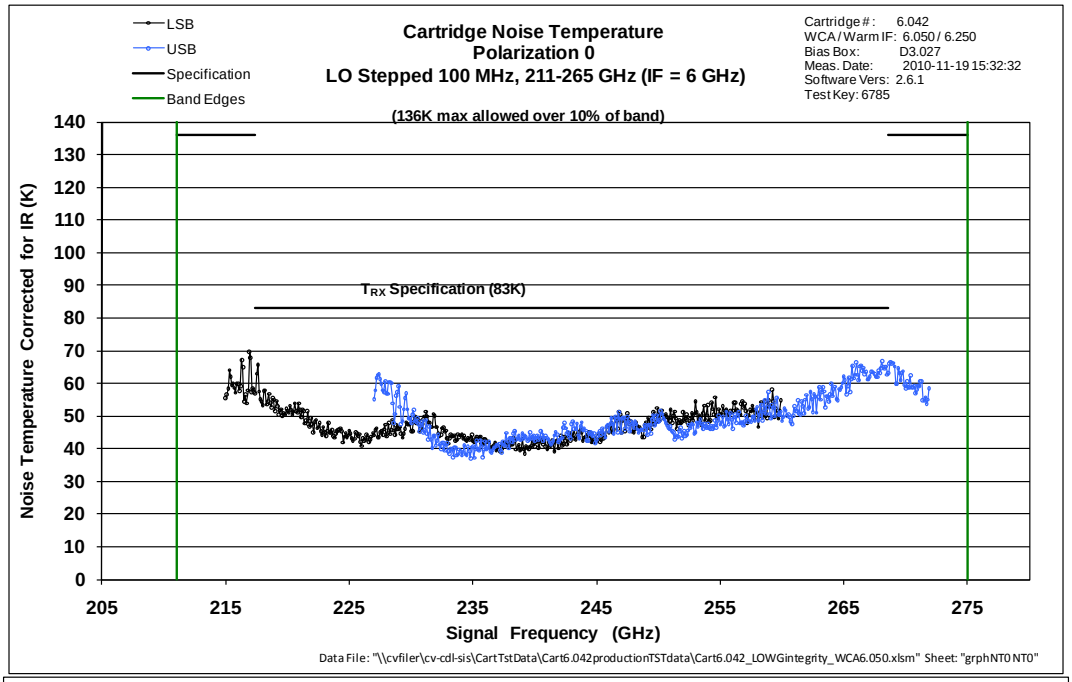


Figure 2: Cart 6.042, WCA 6.050 (changed), CTS-2



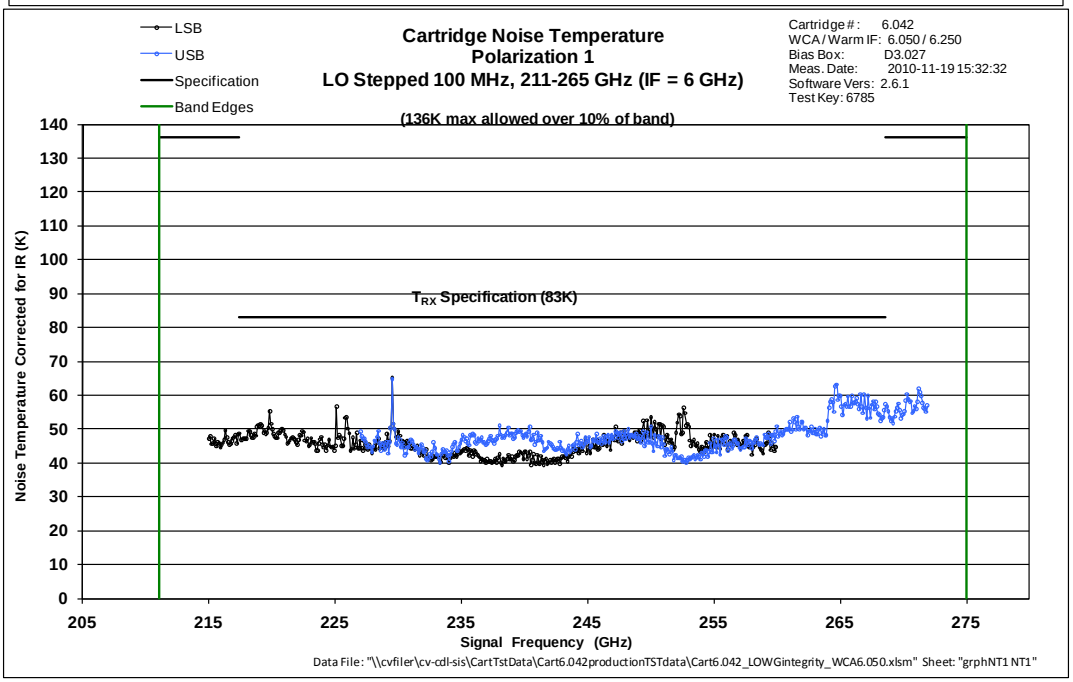
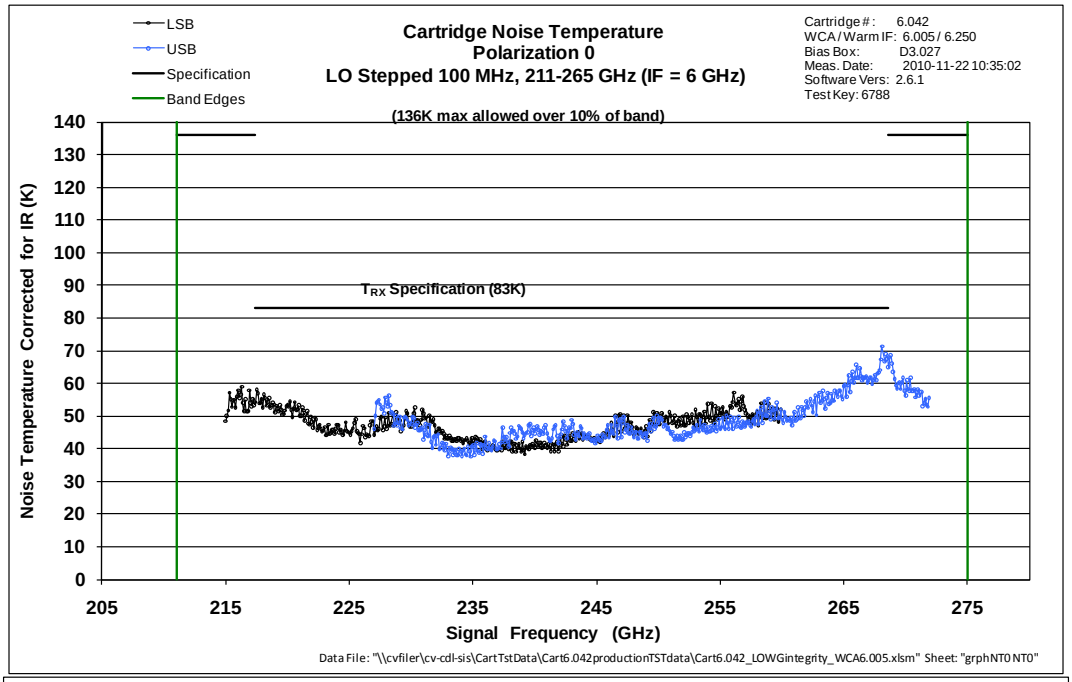


Figure 3: Cart 6.042, WCA 6.005 (changed), CTS-2



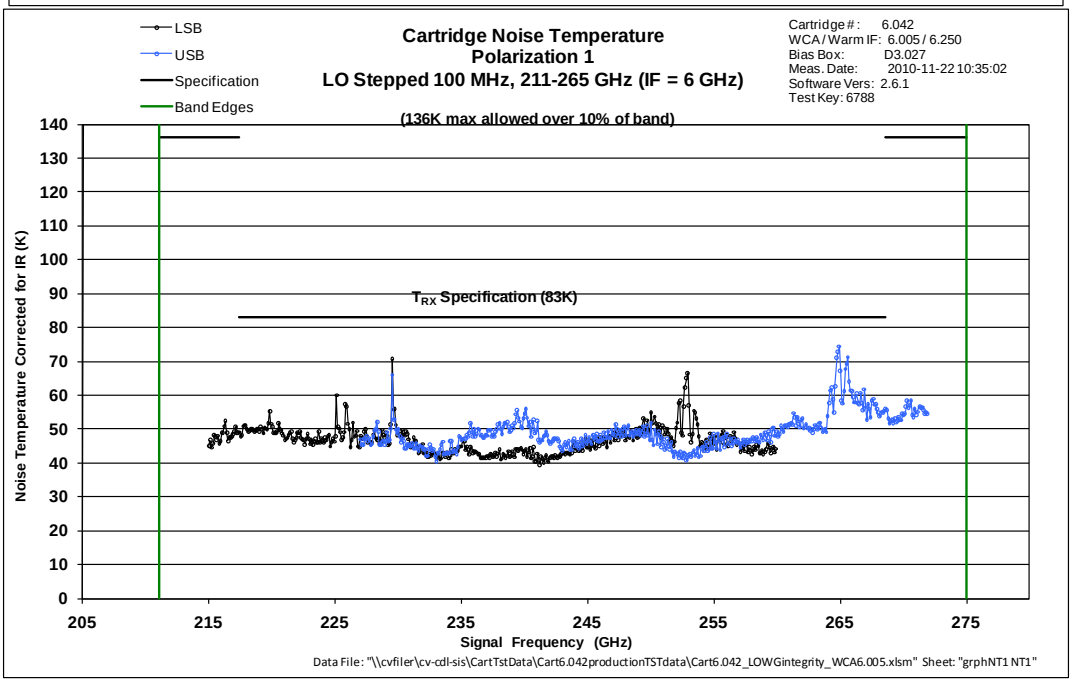
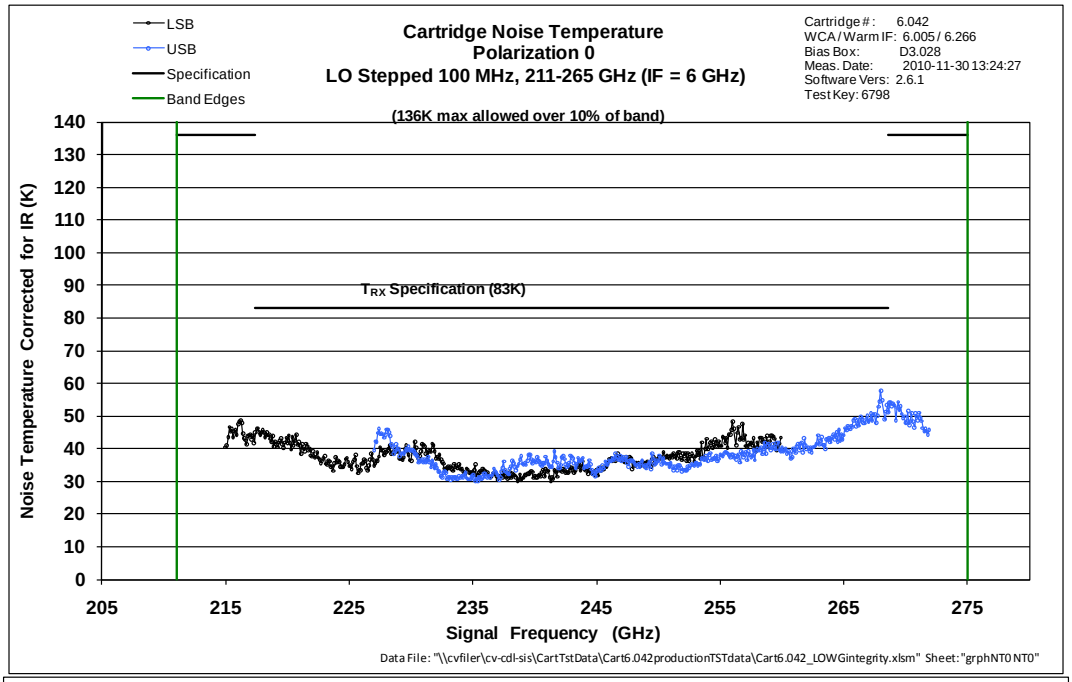


Figure 4: Cart 6.042, WCA 6.005, OMT changed from 062 to 022, CTS-2



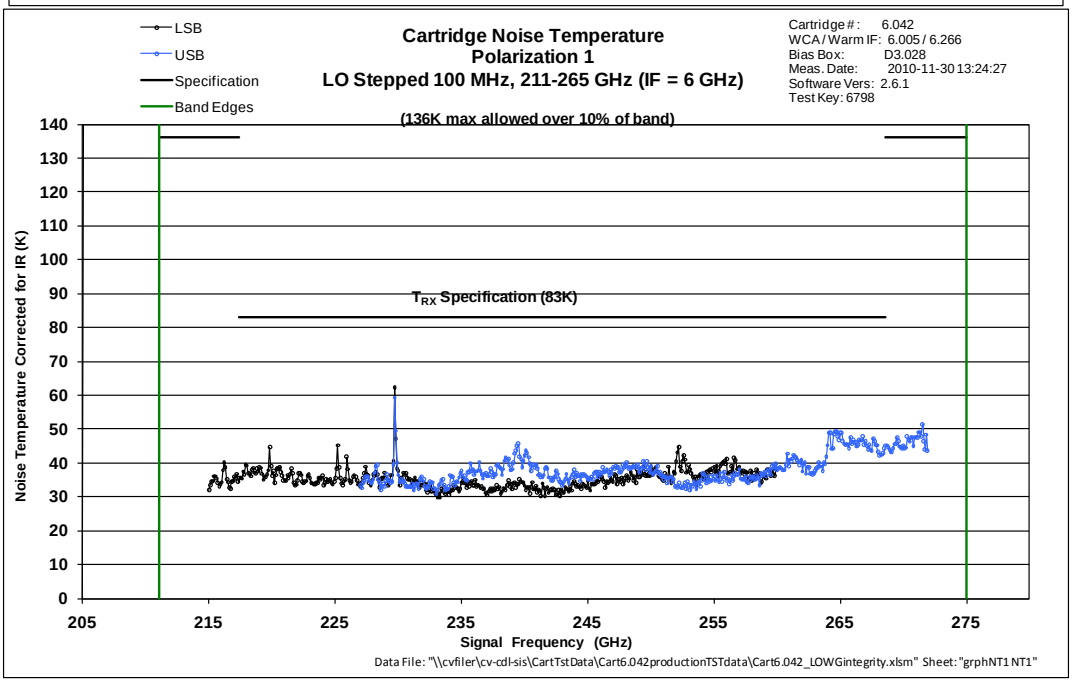
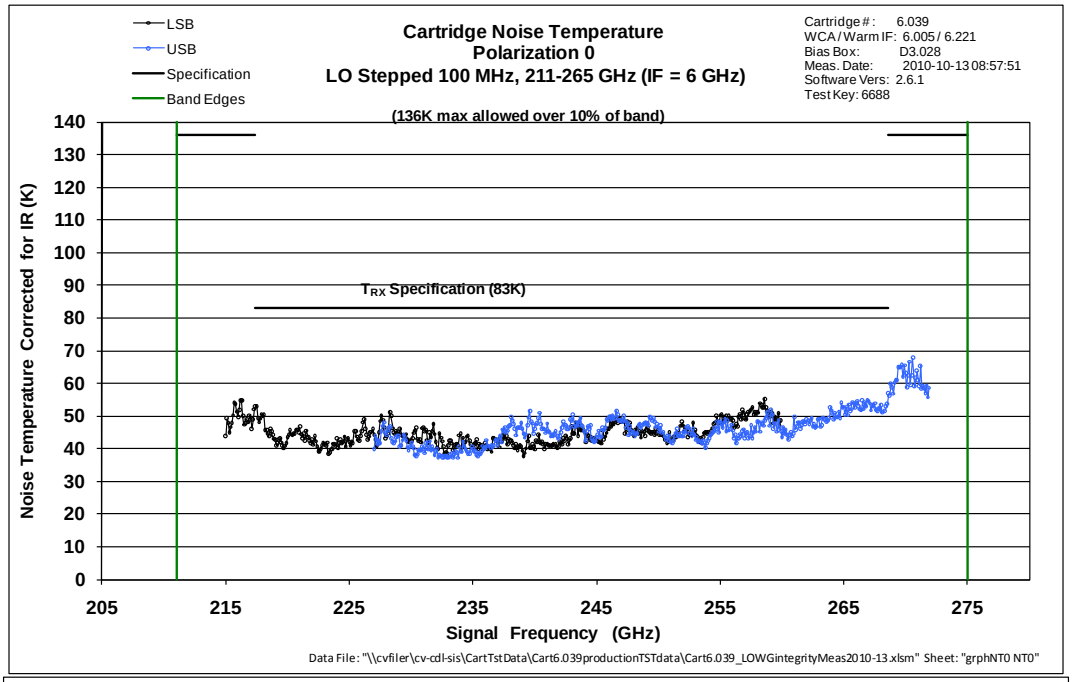


Figure 5: Cart 6.039 prior to OMT swap (to fix Beam eff.), WCA 6.005, CTS-1



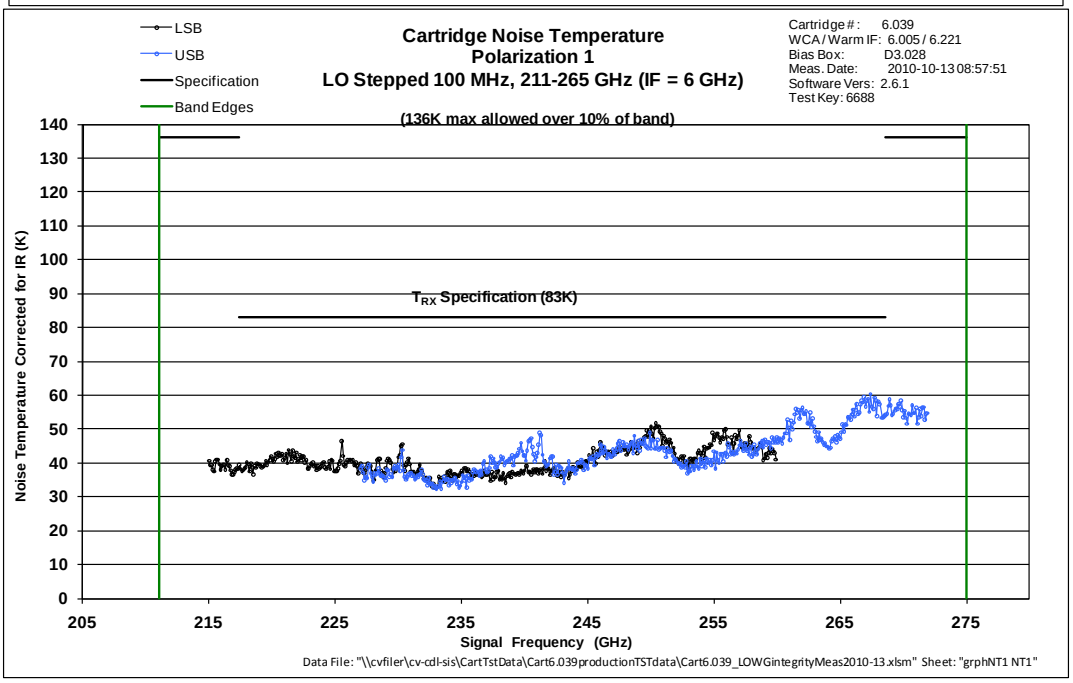
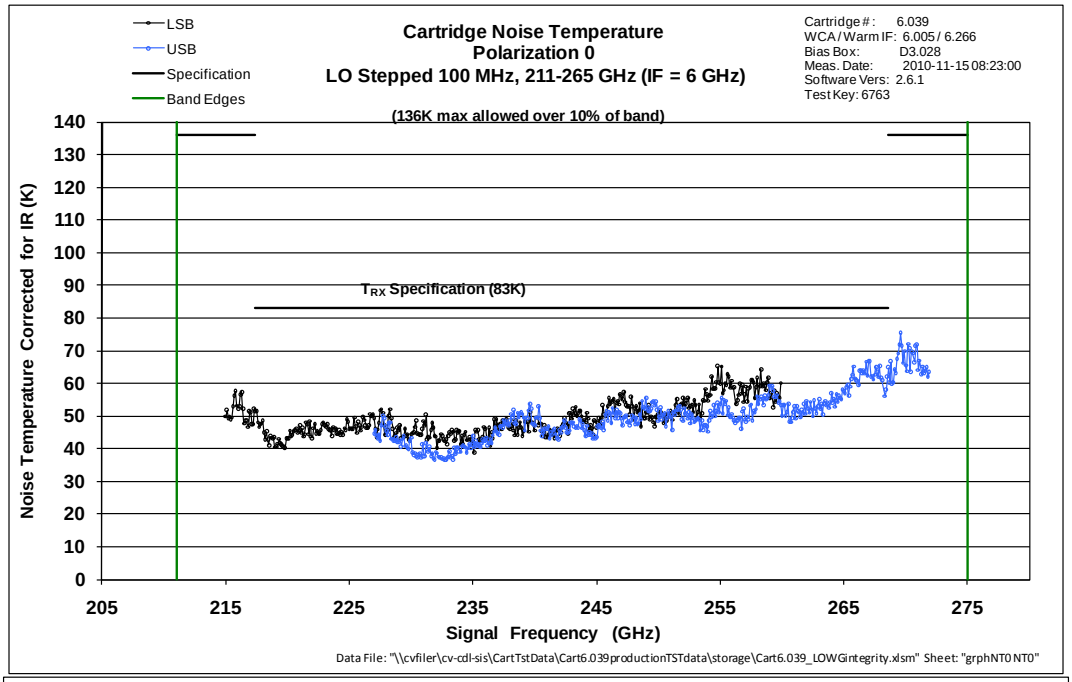


Figure 6: Cart 6.039 after OMT swap, WCA 6.005, CTS-1



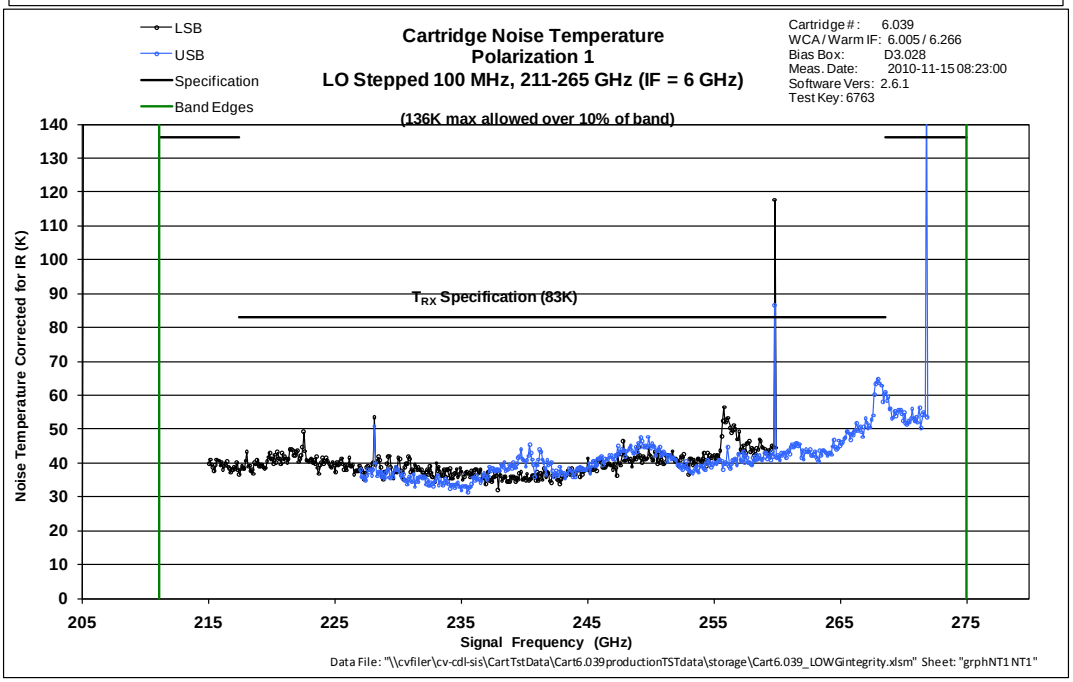
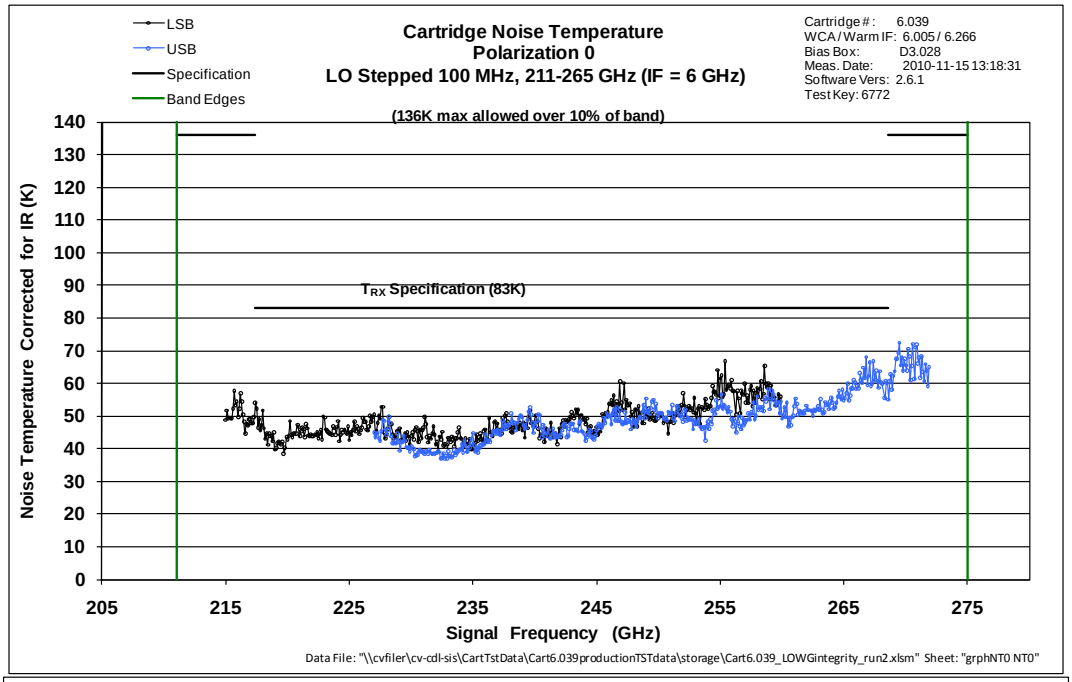


Figure 7: Cart 6.039 repeat, WCA 6.005, CTS-1



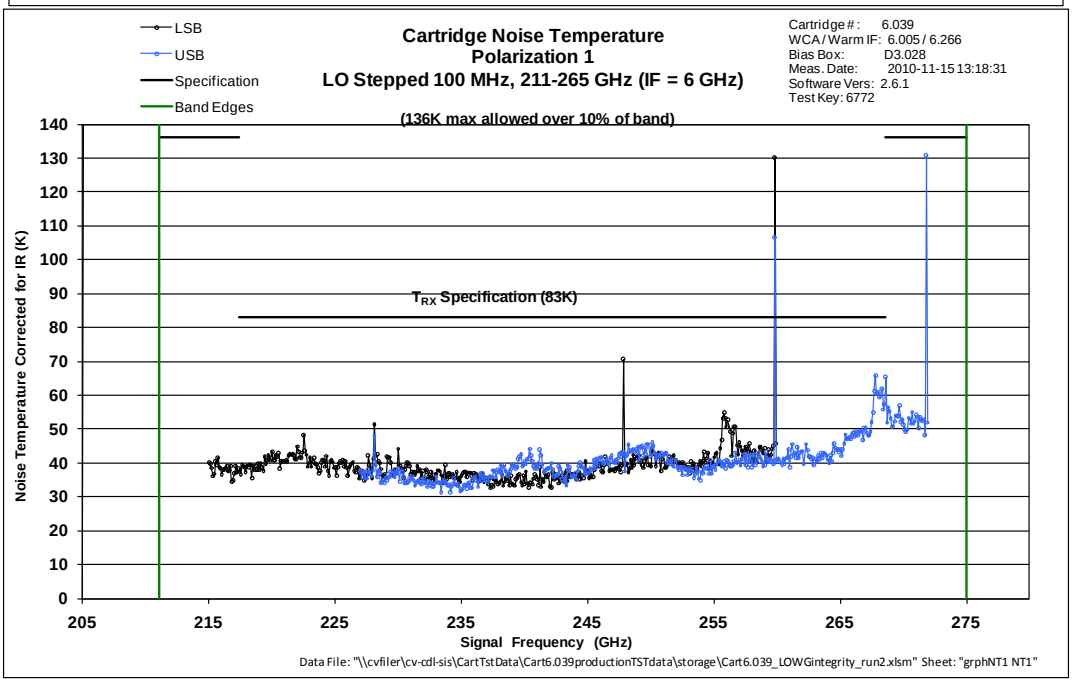
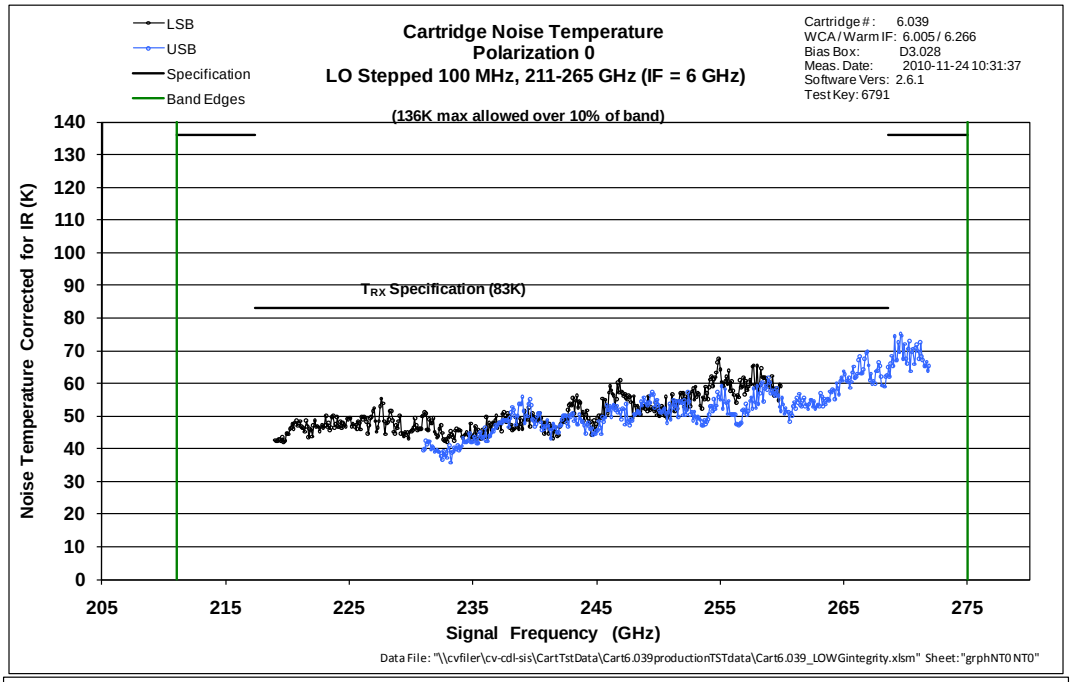


Figure 8: Cart 6.039, Replaced OMT 119 with 127, WCA 6.005, CTS-1



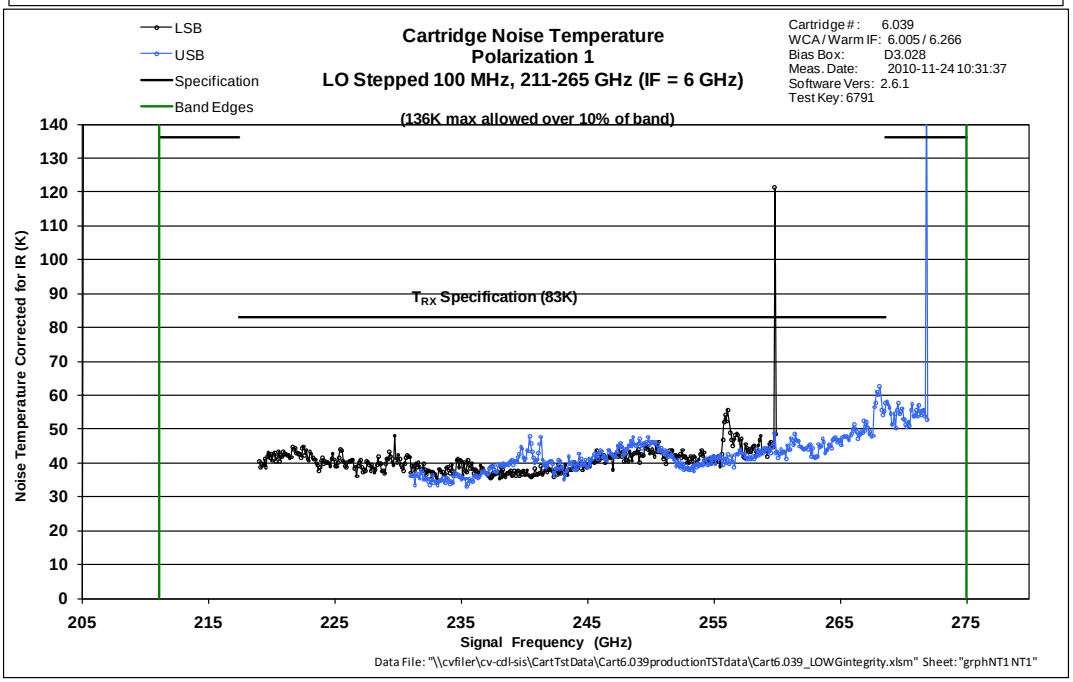
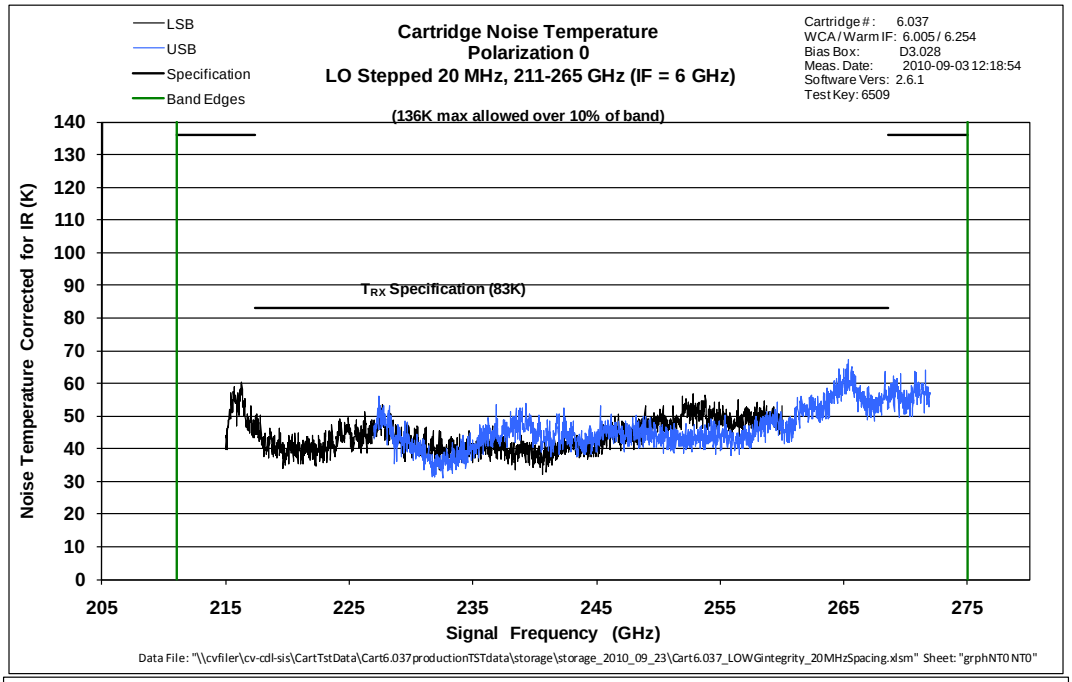


Figure 9: Cart 6.037, check for spikes on OMWG, WCA 6.005, CTS-1



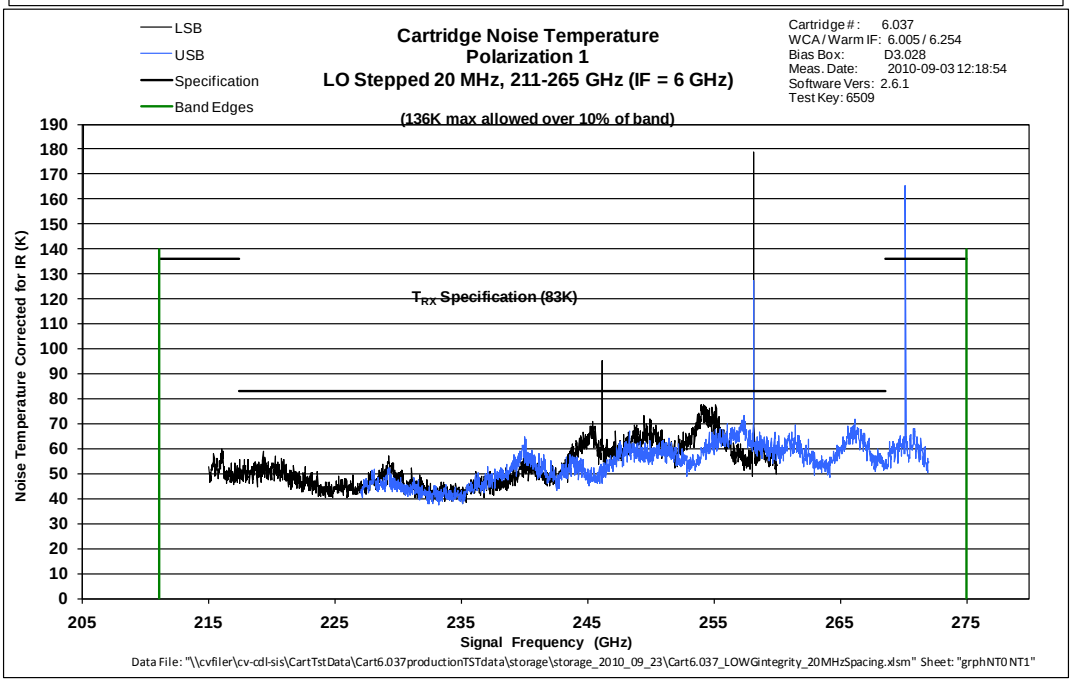
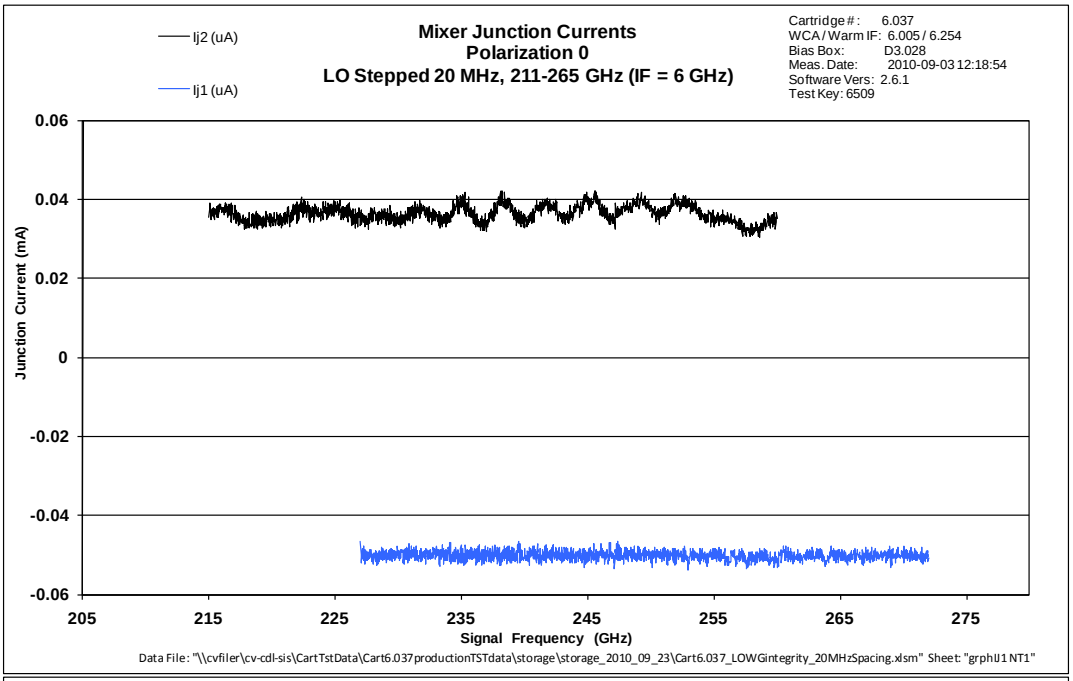


Figure 10: Cart 6.037, Junction Currents for Figure 9, WCA 6.005, CTS-1



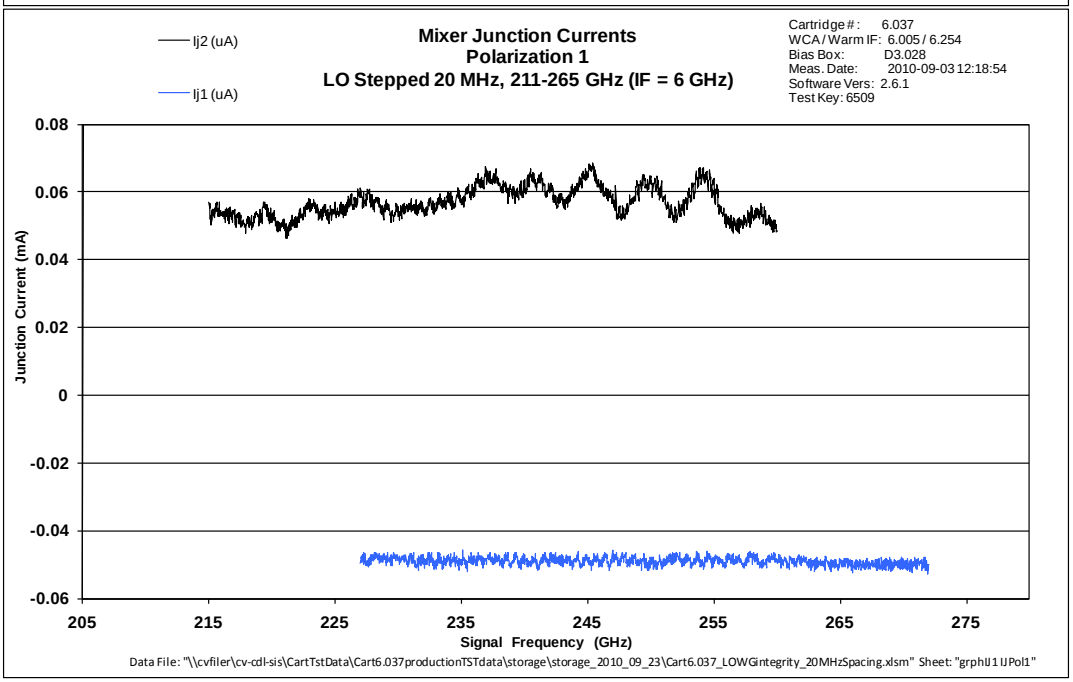
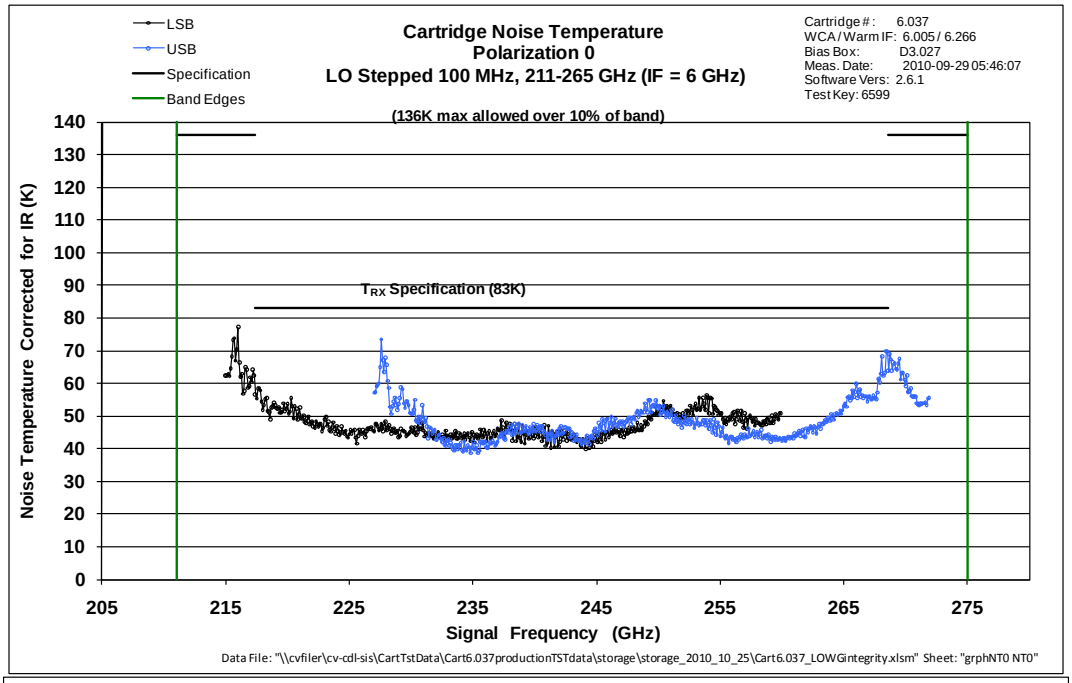


Figure 11: Cart 6.037, Replaced A-frame, mirrors, and both mixers, WCA 6.005, CTS-2



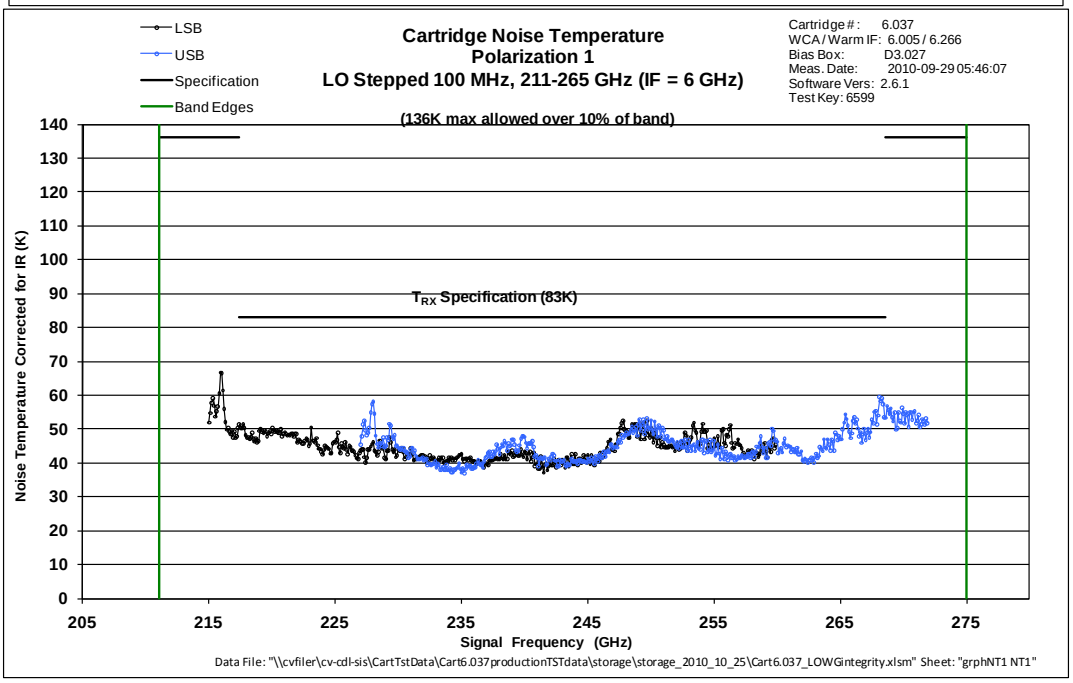
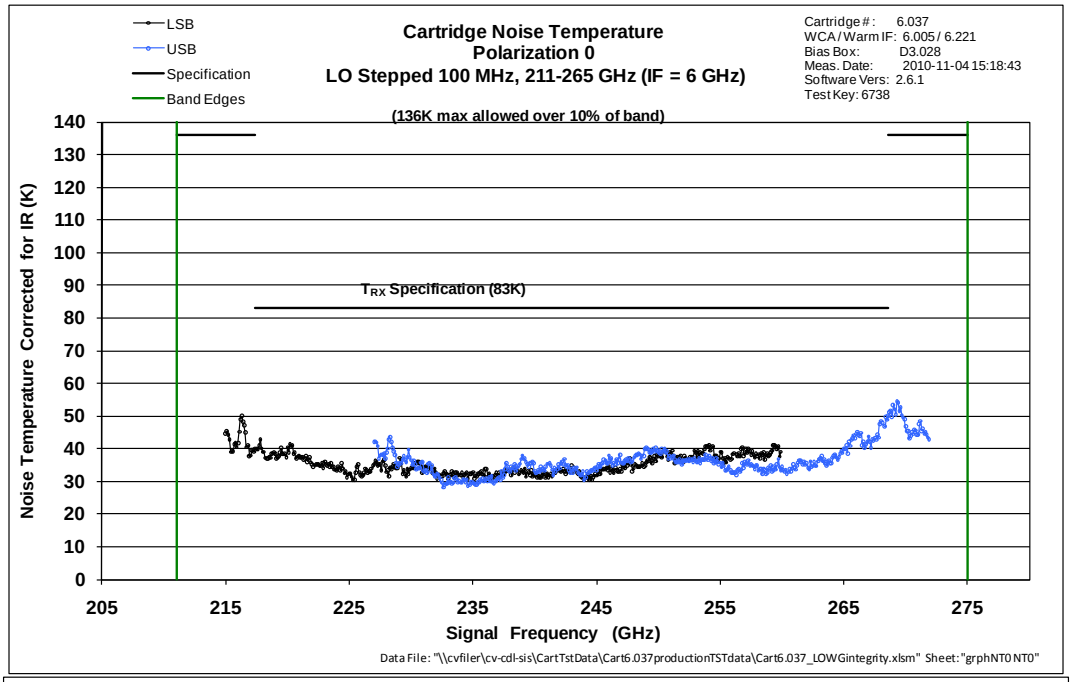


Figure 12: Cart 6.037, Changed OMT, WCA 6.005, CTS-1



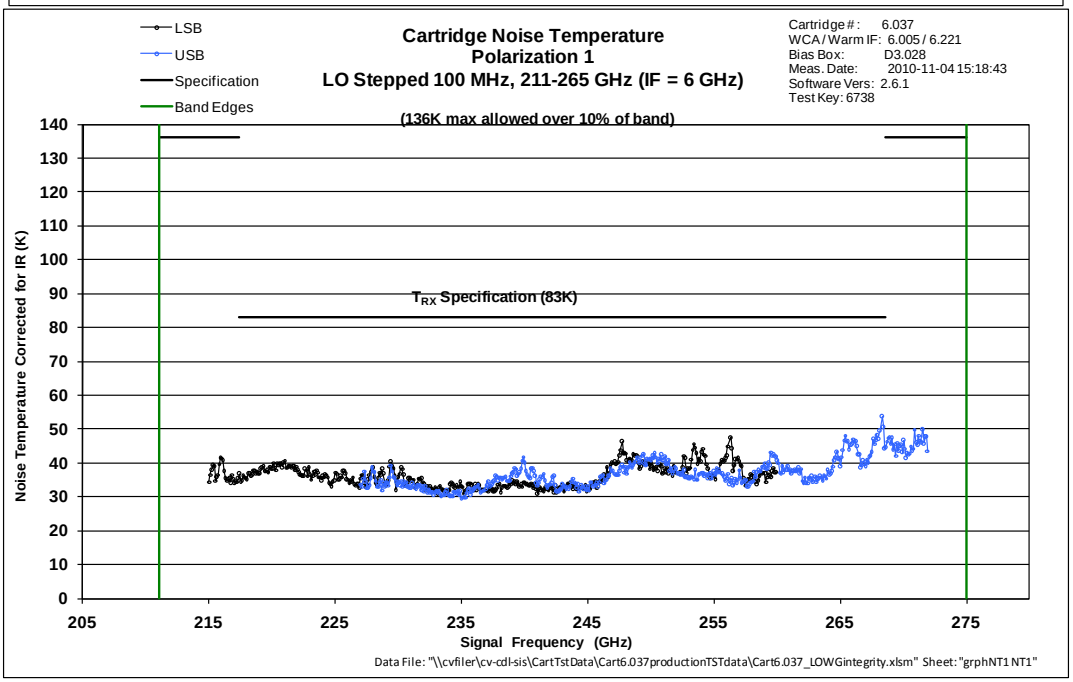
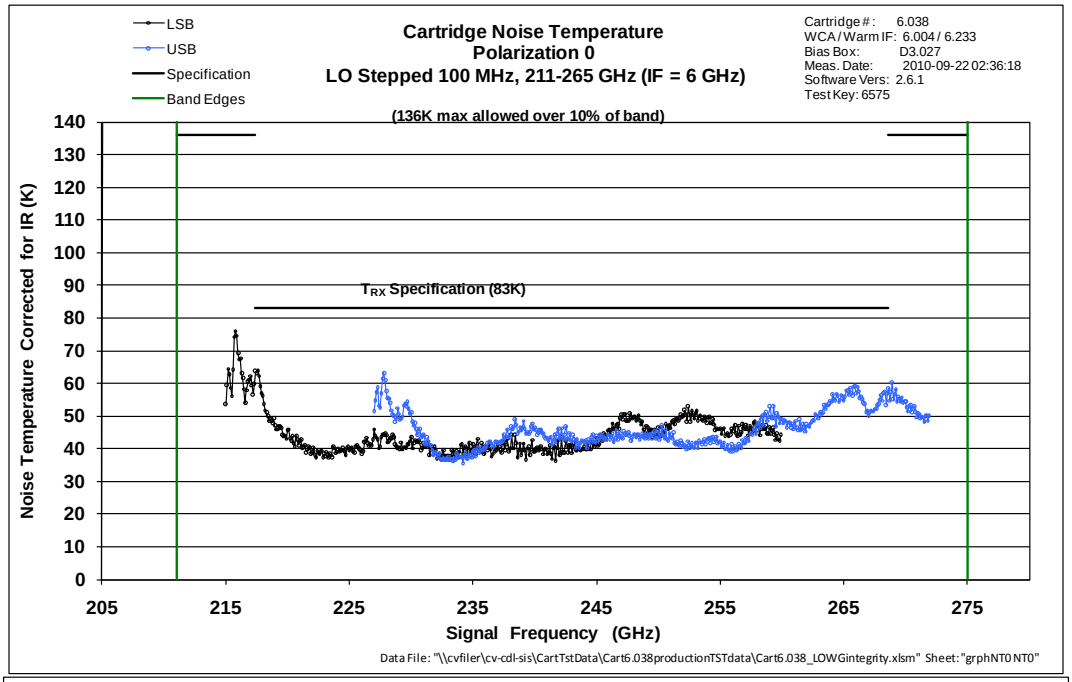


Figure 13: Cart 6.038, WCA 6.004, CTS-2



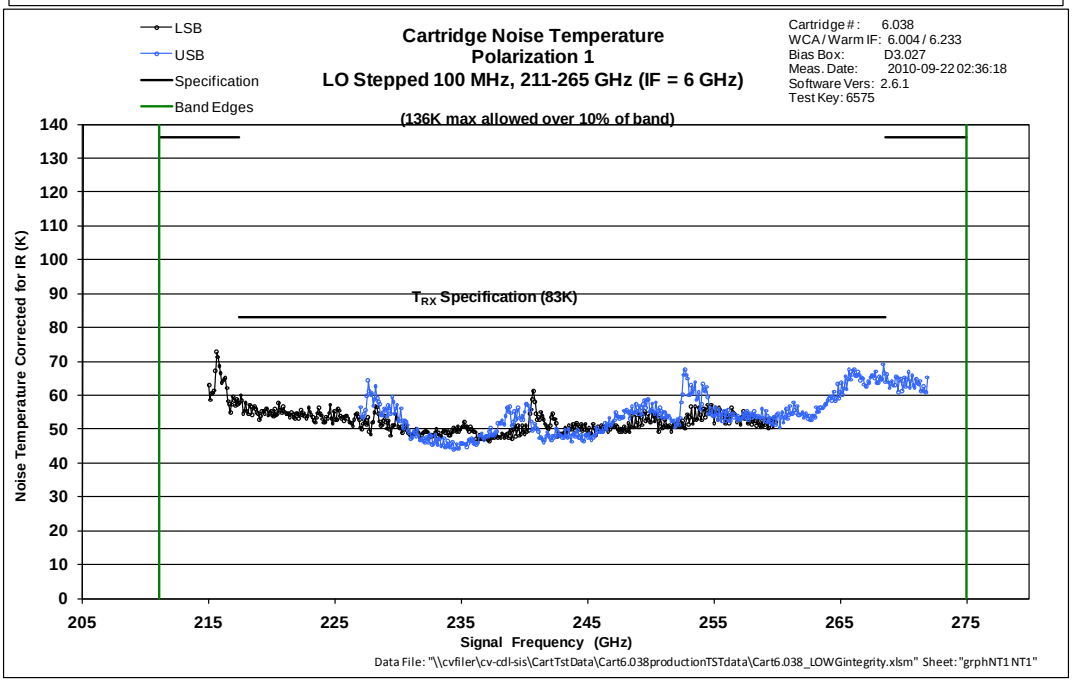
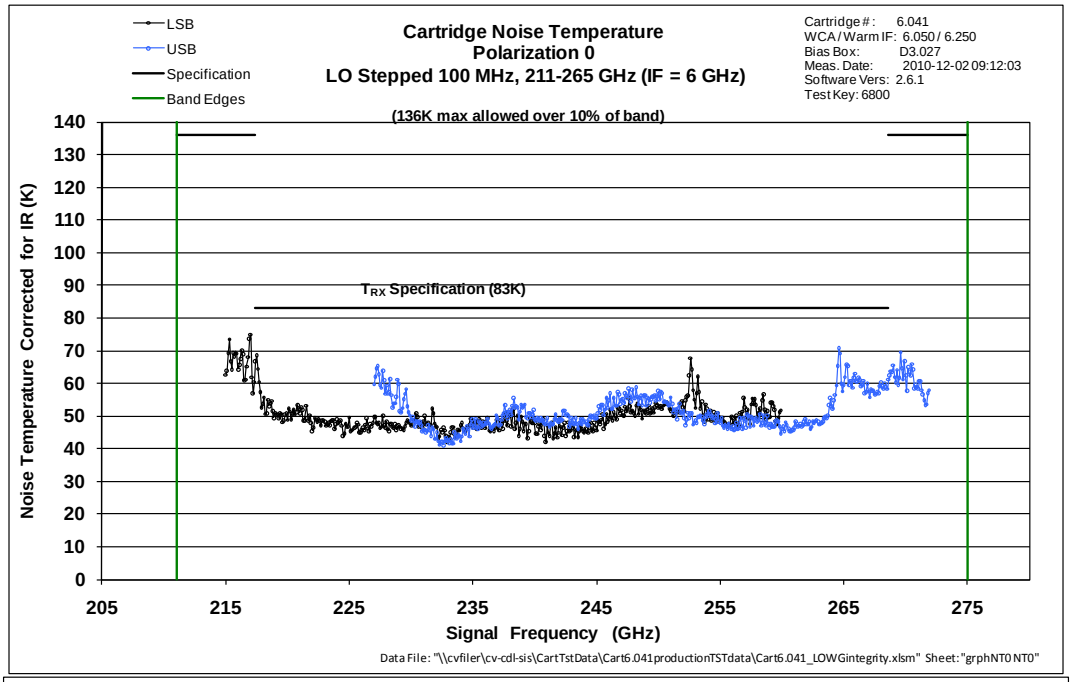


Figure 14: Cart 6.041, WCA 6.050, CTS-2



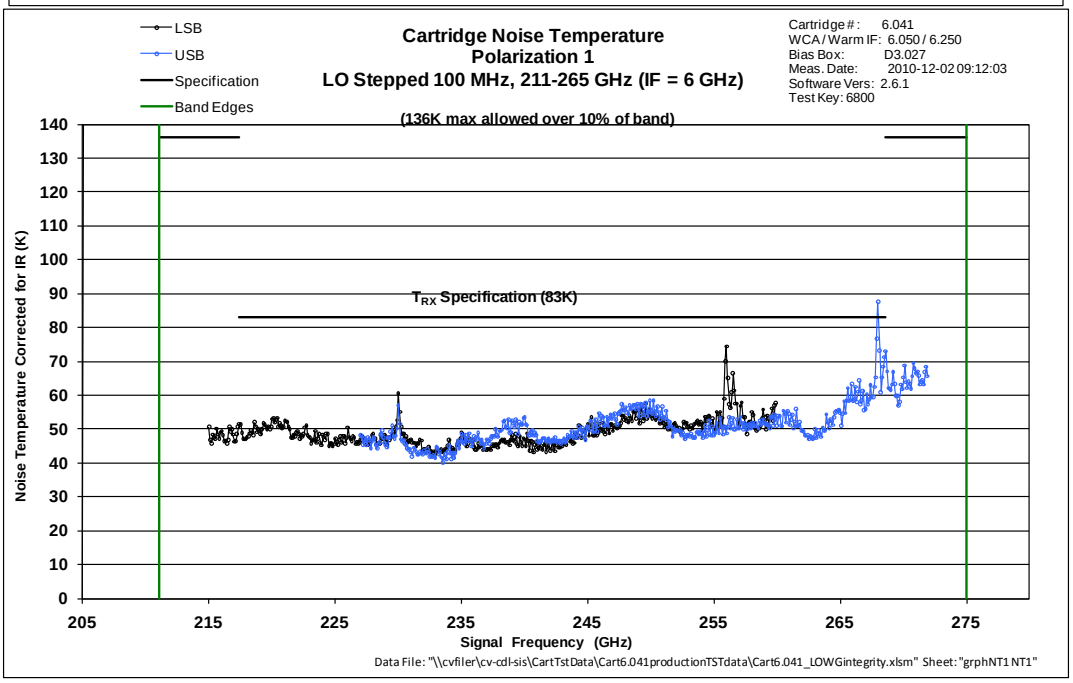
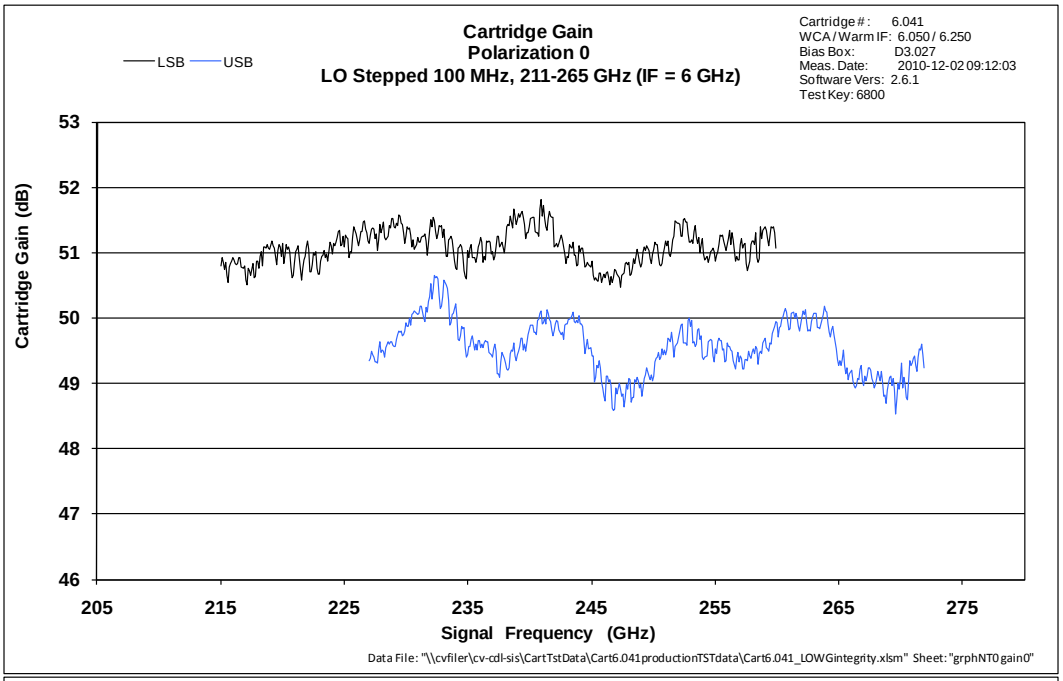


Figure 15: Gain corresponding to Figure 14, Cart 6.041, WCA 6.005, CTS-2



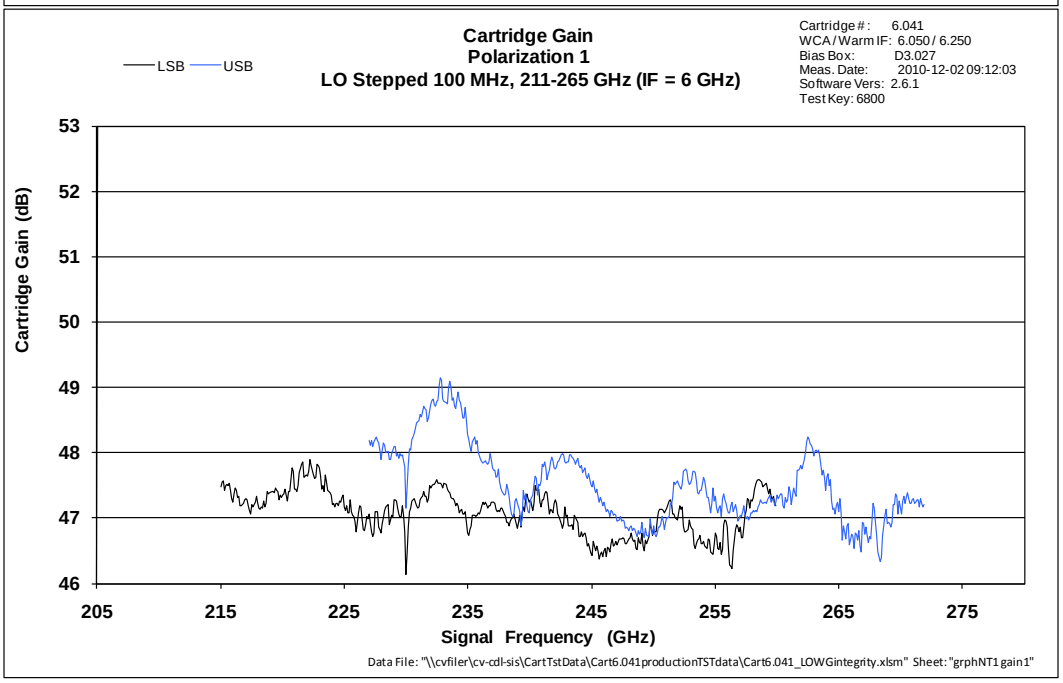
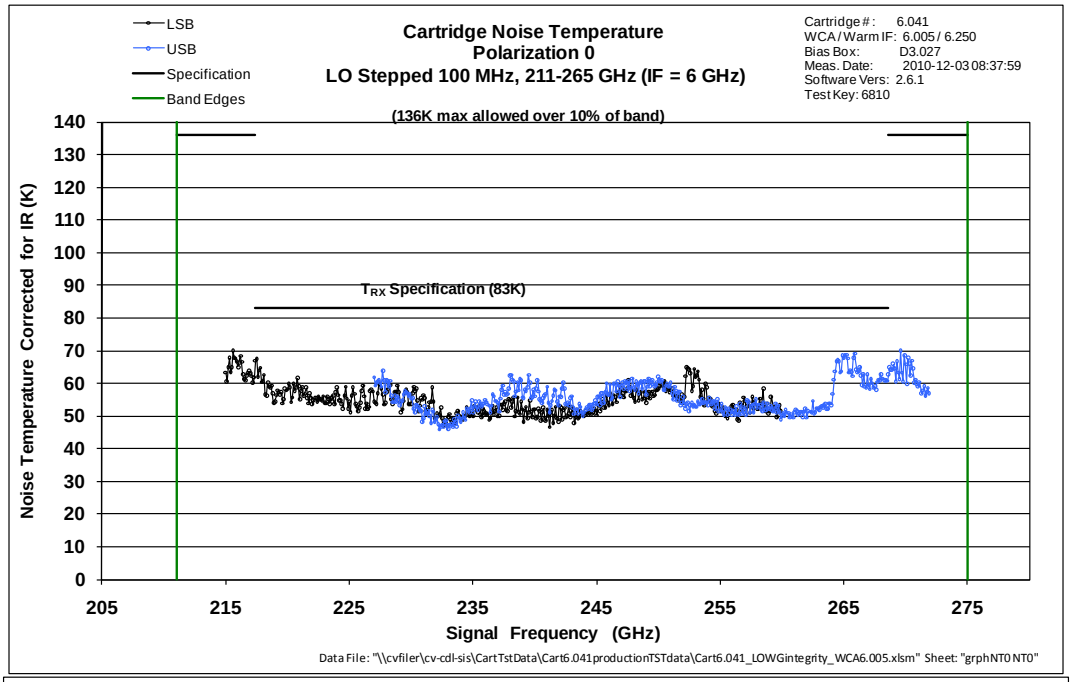


Figure 16: Cart 6.041, WCA 6.005, CTS-2



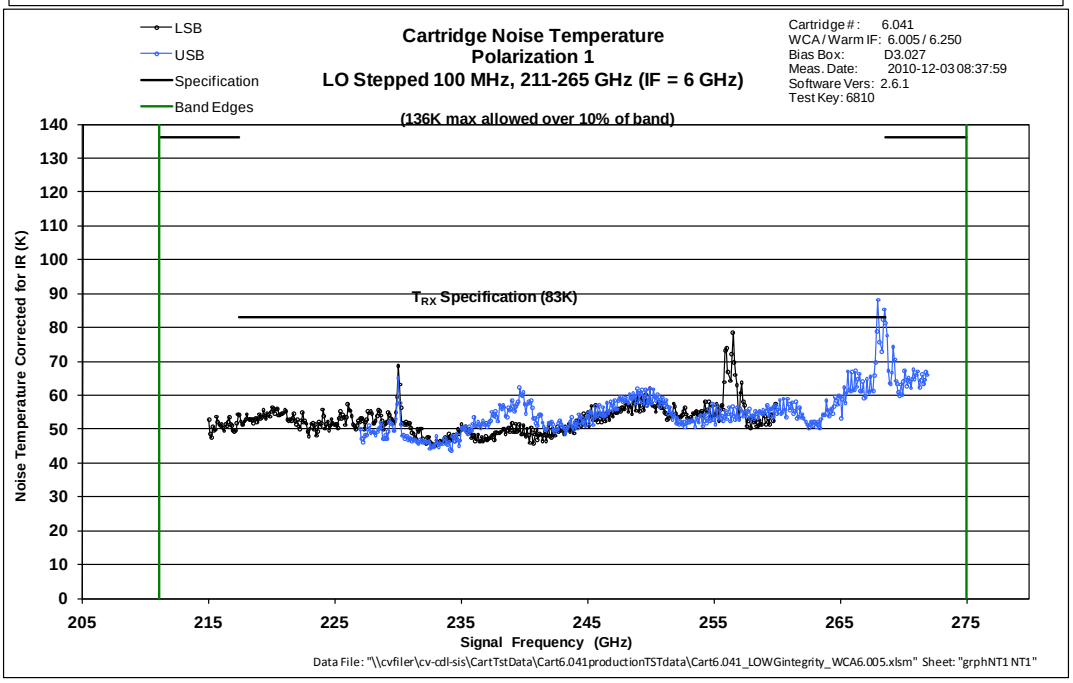


Figure 17: Removed and reinstalled WCA 6.005, compared to Figure 16

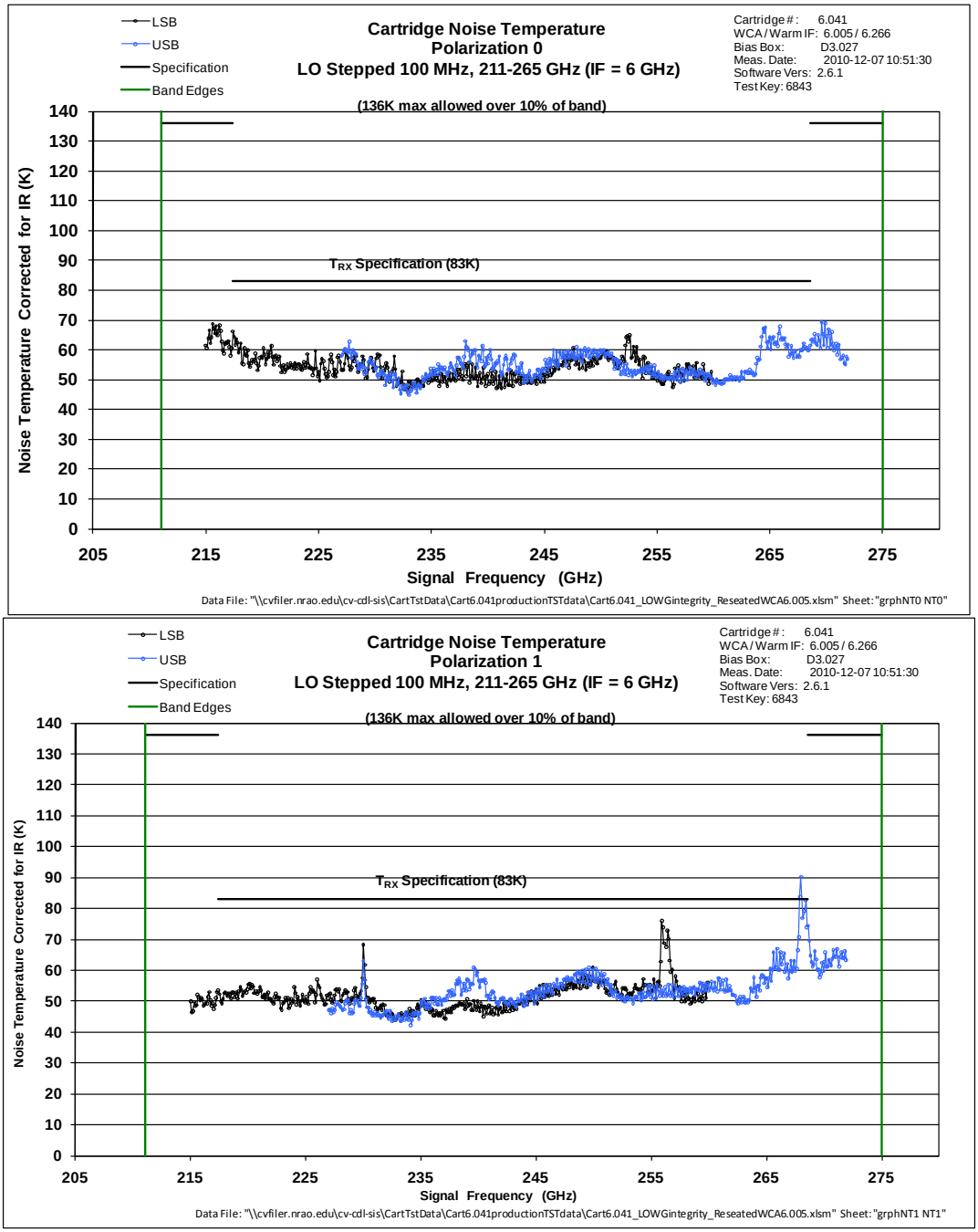


Figure 18: Magnet current increased from 25 to 45 mA, compared to Figure 17

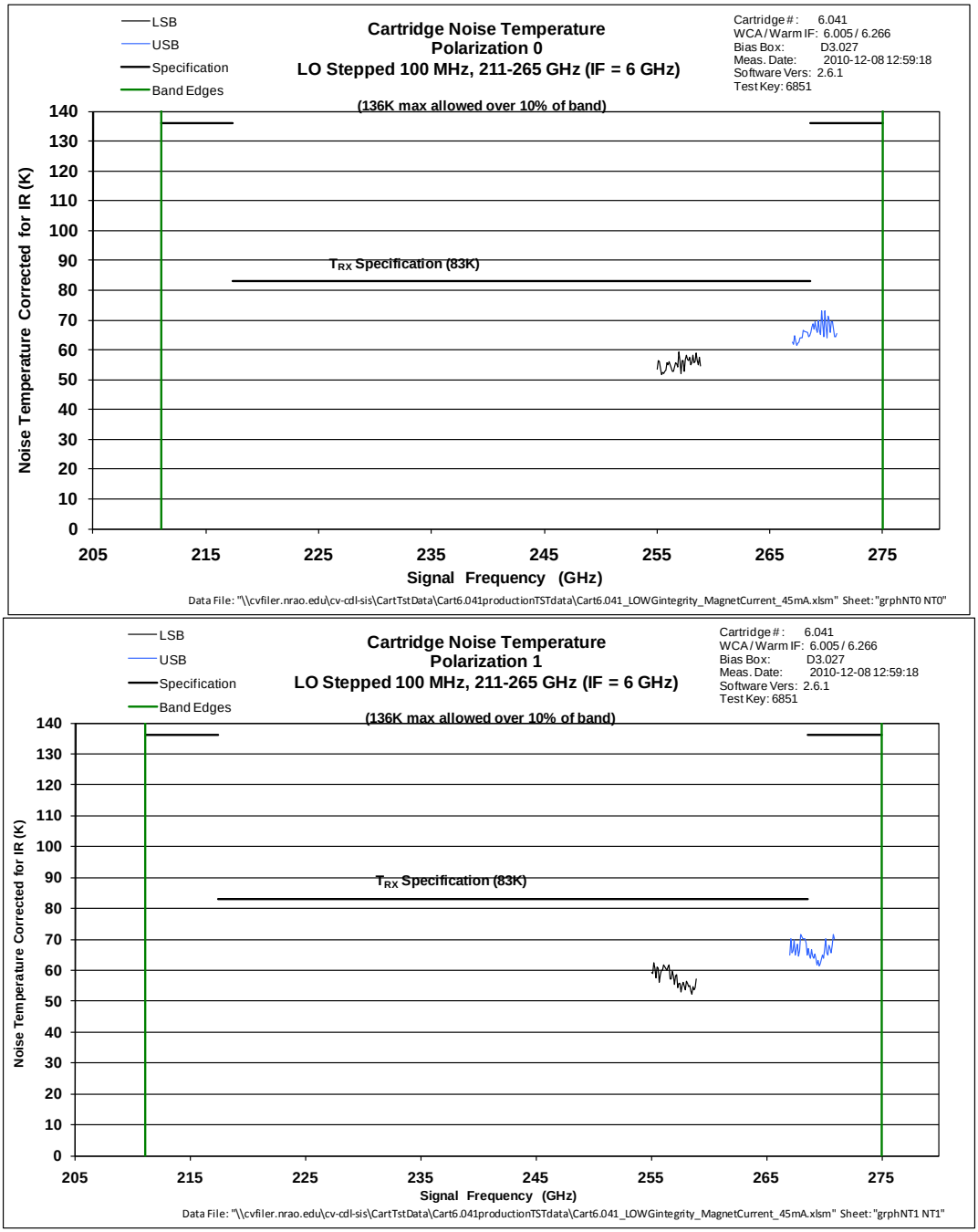
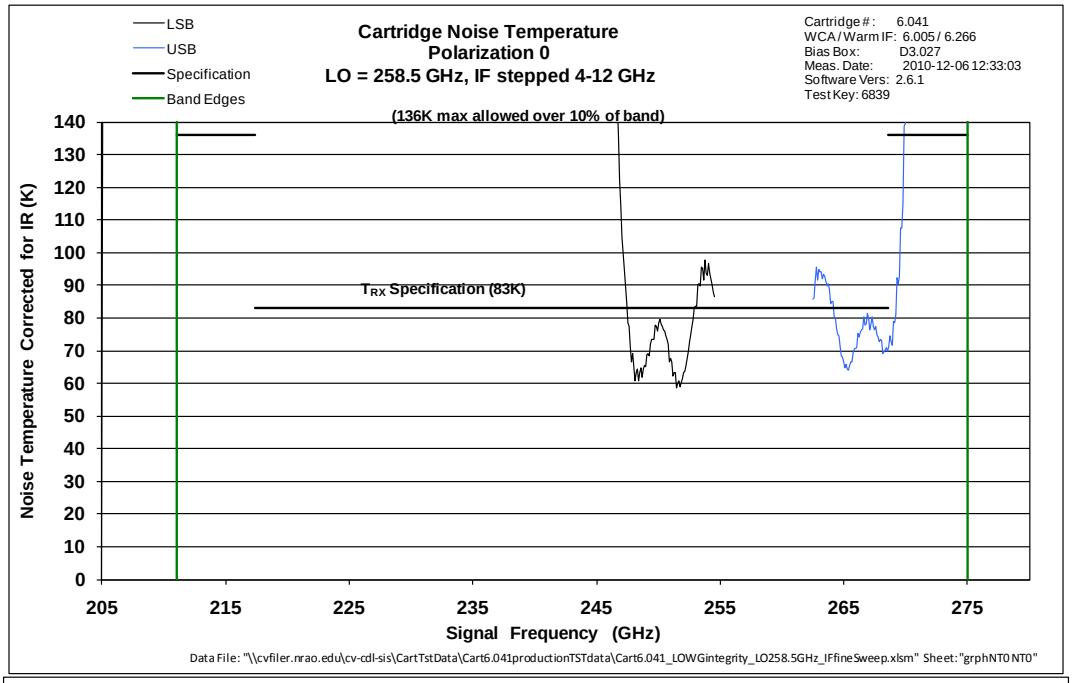


Figure 19: Fine IF steps, LO = 258.5 GHz, otherwise same configuration as Figure 16



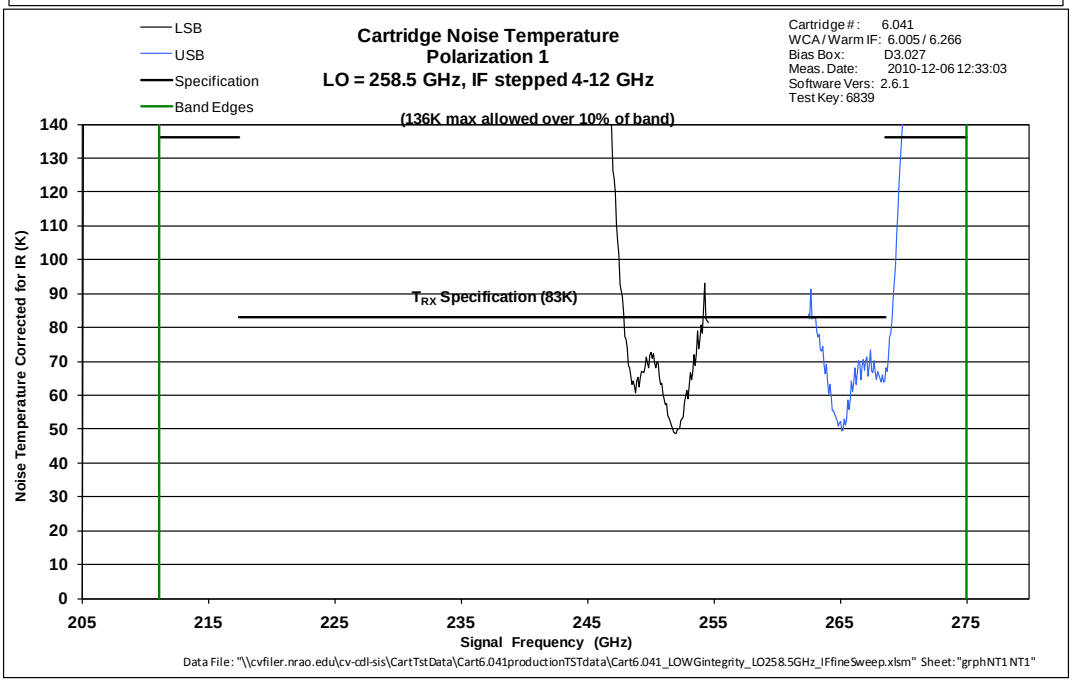
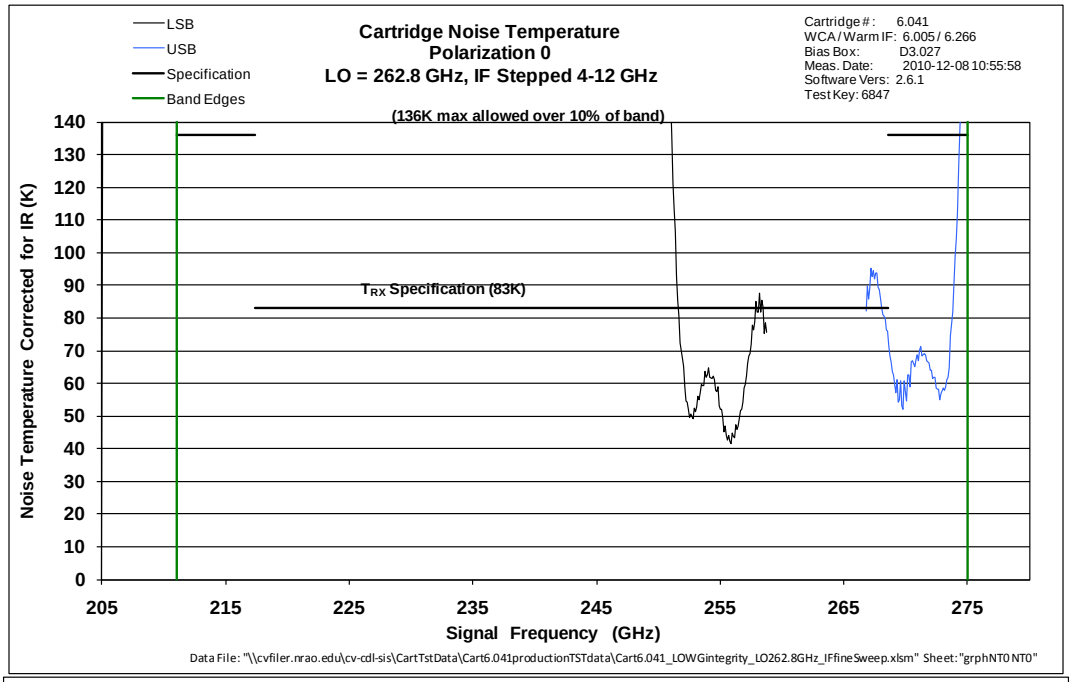


Figure 20: Fine IF steps, LO = 262.8 GHz, otherwise same configuration as Figure 16



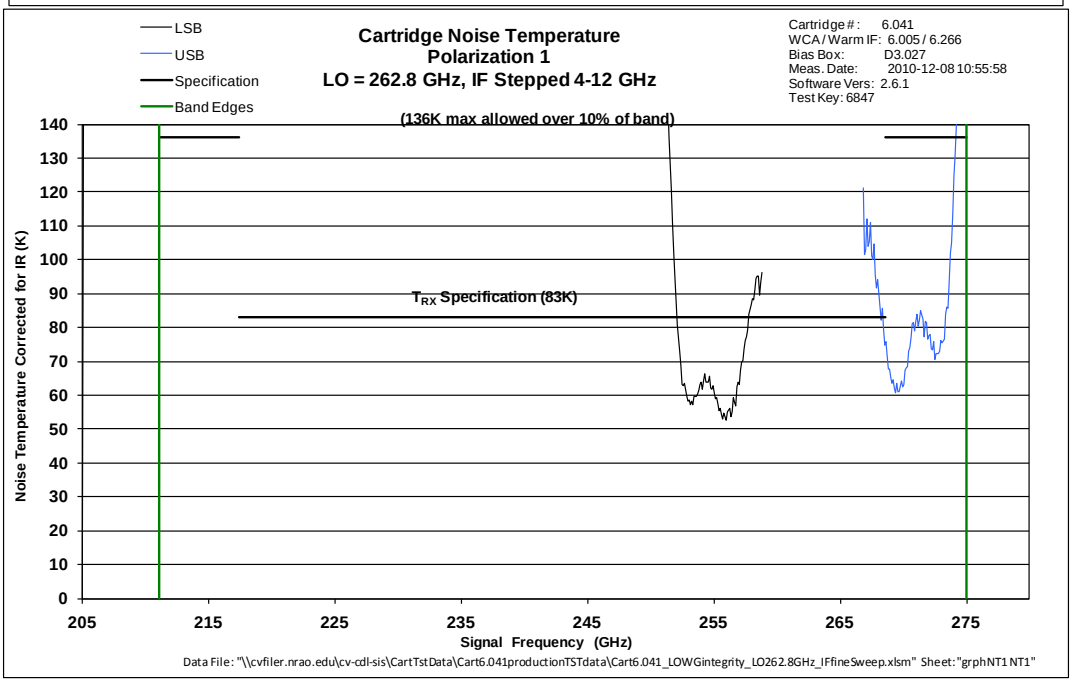
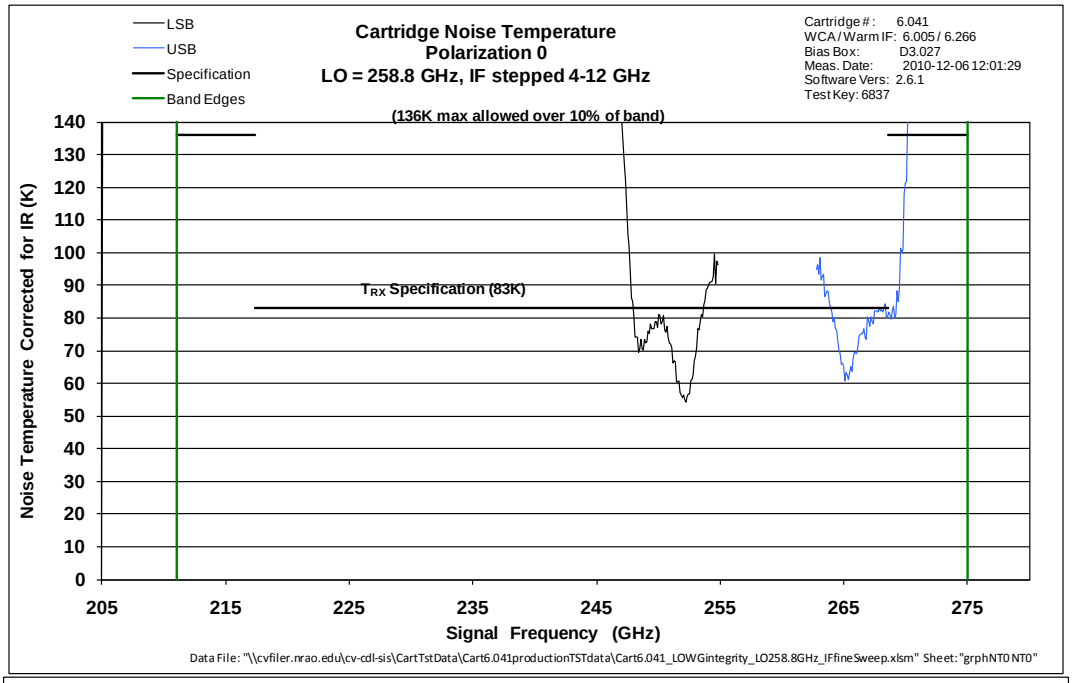


Figure 21: Fine IF steps, LO = 258.8 GHz, otherwise same configuration as Figure 16



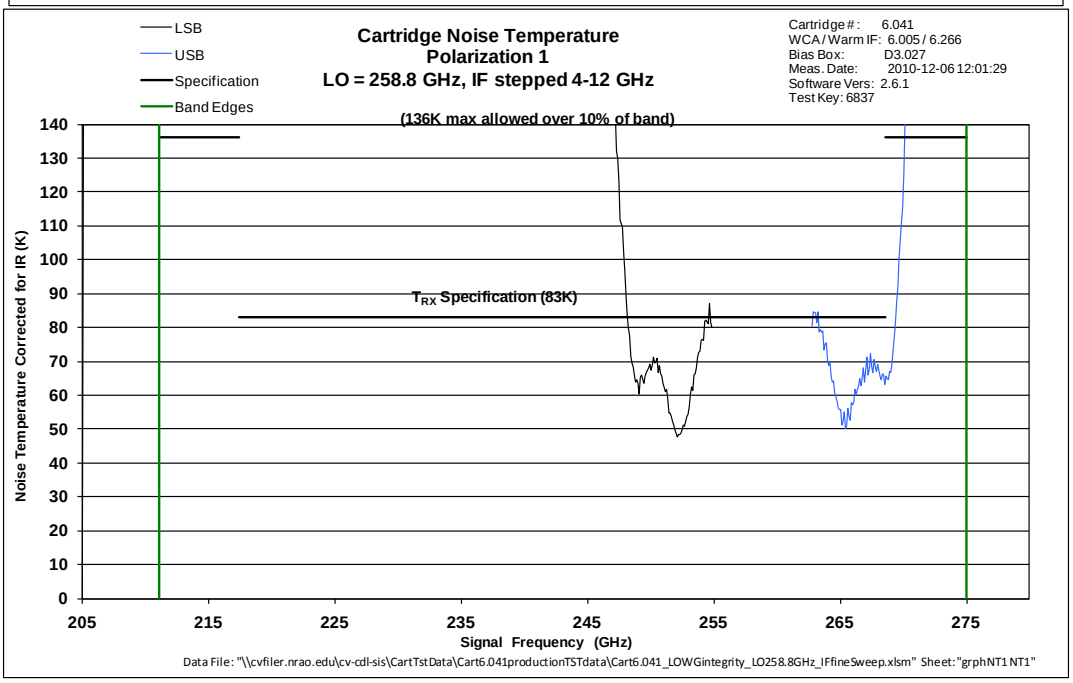


Figure 22: Pol 1 mixer & LO turned off for same configuration as Figure 16

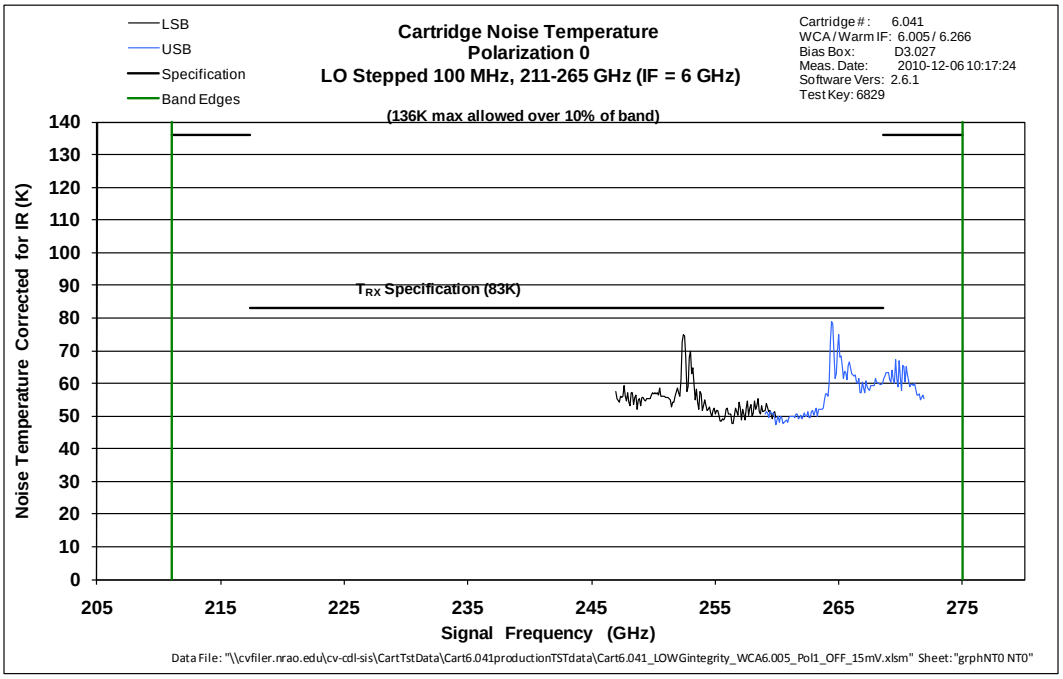


Figure 23: B6.041 with nominal fixed mixer bias, compared to optimal bias in Figure 16 and Figure 14

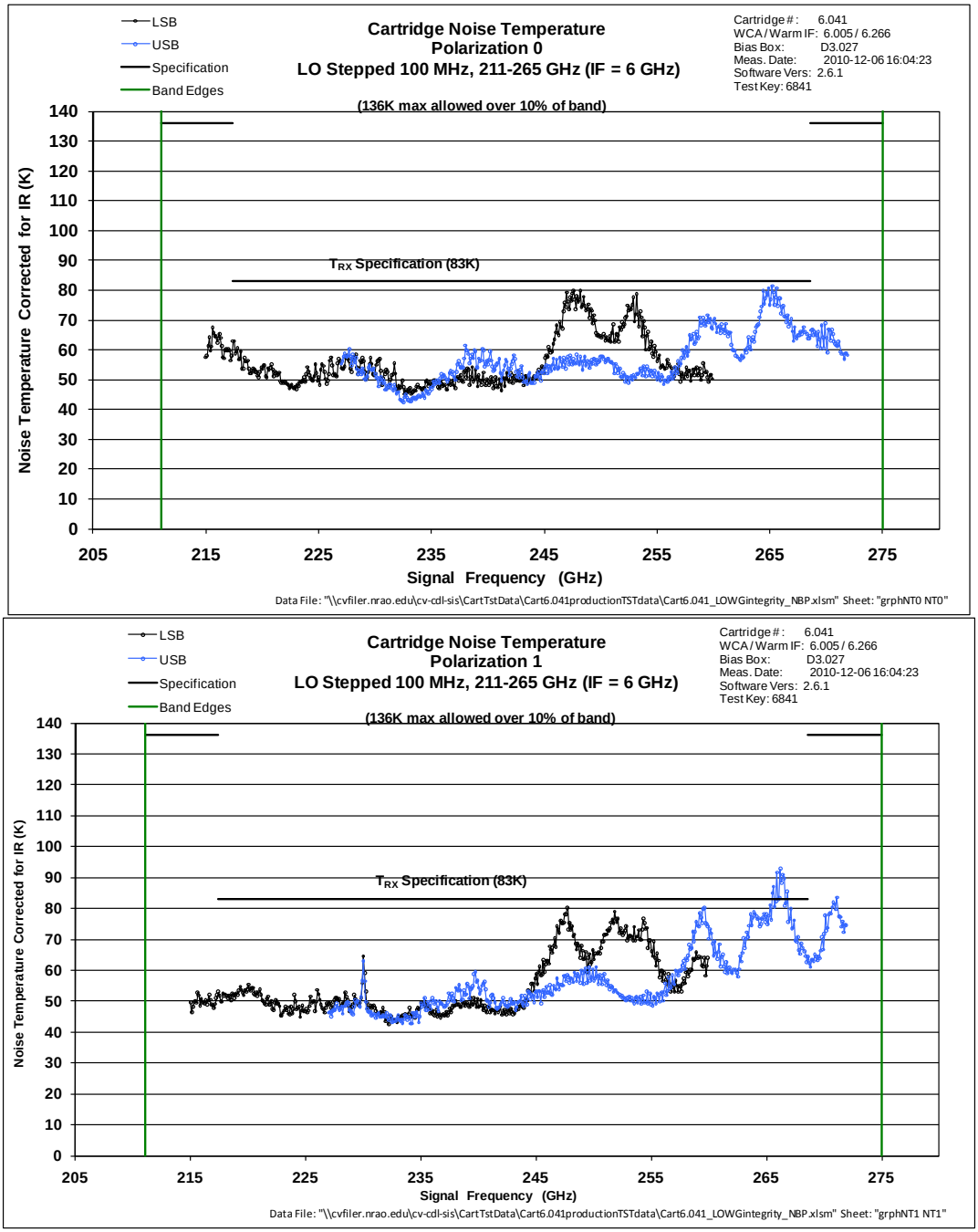
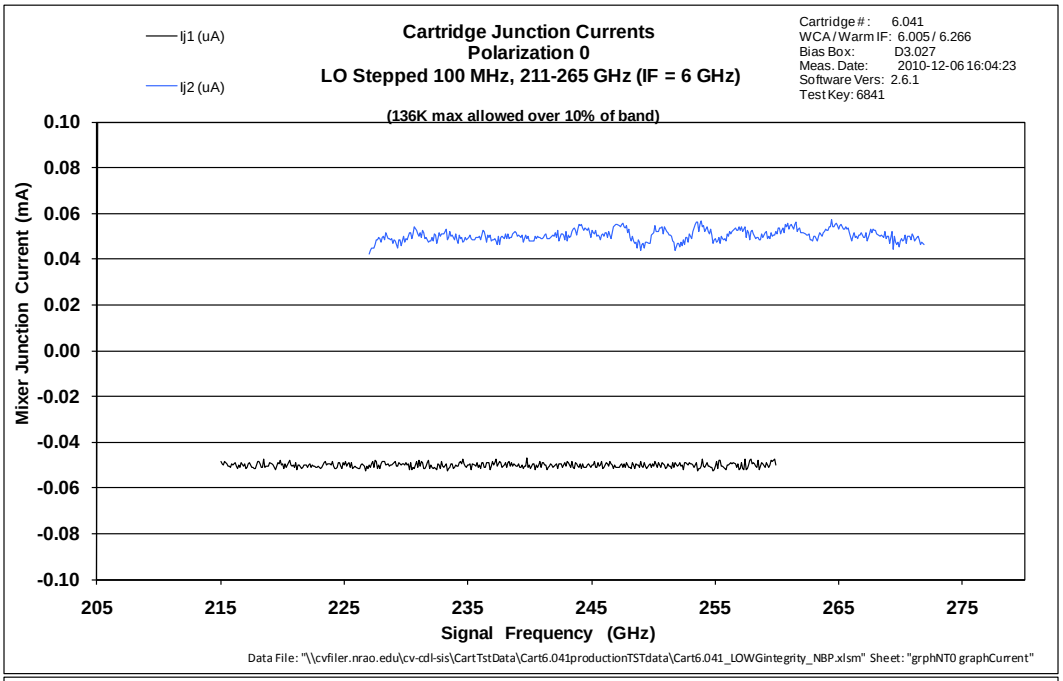


Figure 24: B6.041 with nominal bias, compared to optimal bias in Figure 25



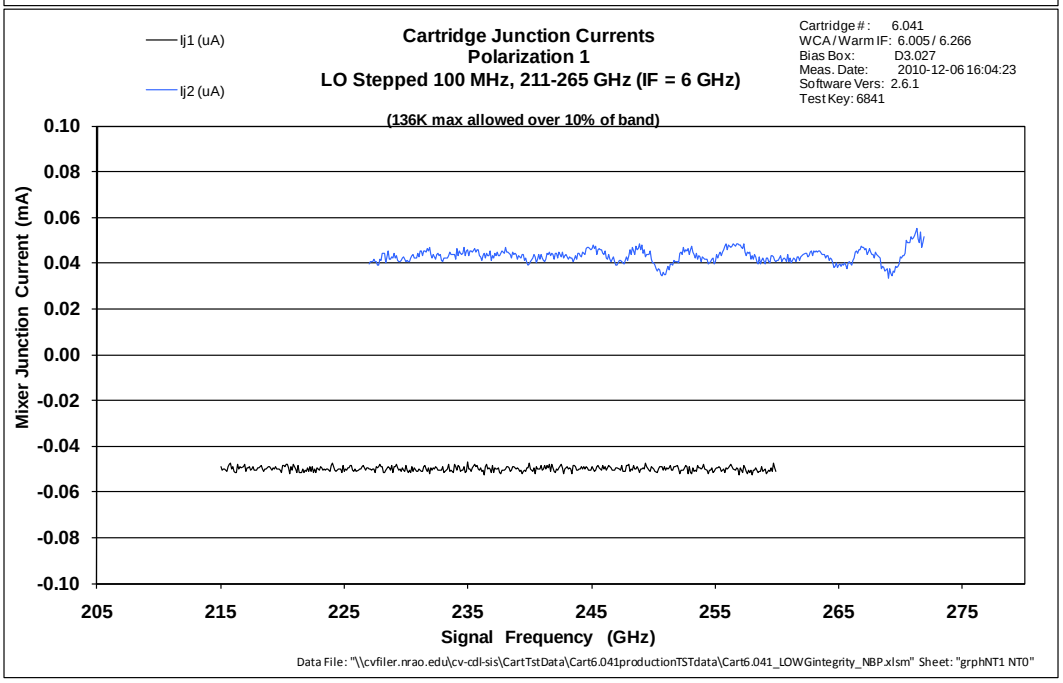
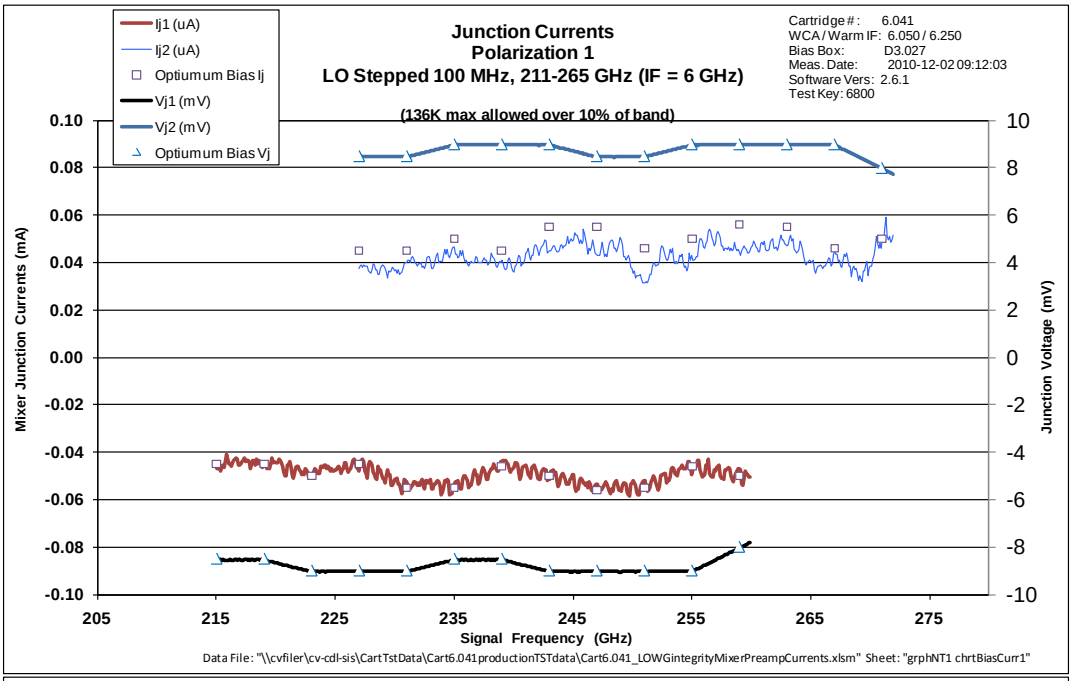


Figure 25: Cart 6.041, WCA 6.050, CTS-2, Junction Currents, Power Amp Volts



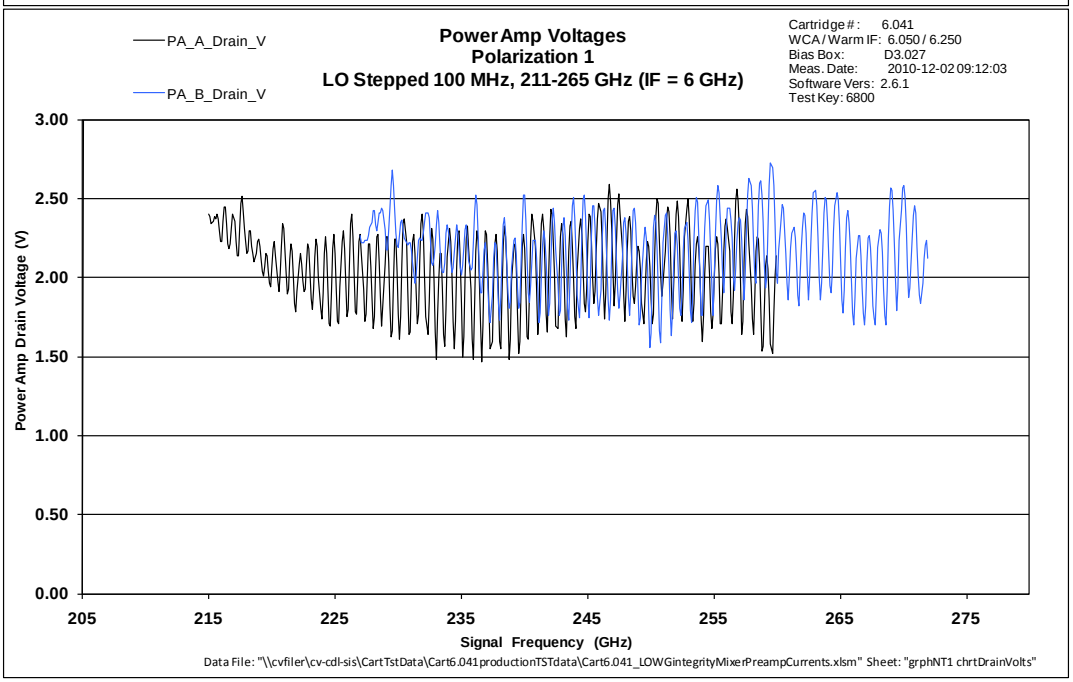


Figure 26: Cart 6.041, Pol 1, Noise Powers Near Spike (From 2010-12-02 09:12 Data)

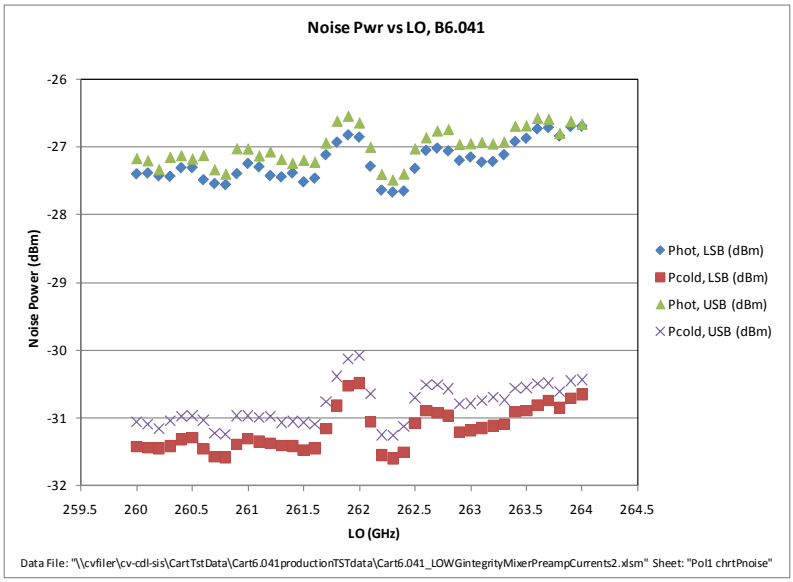


Figure 27: Cart 6.041, Pol 1, Y-Factors Near Spike (From 2010-12-02 09:12 Data)

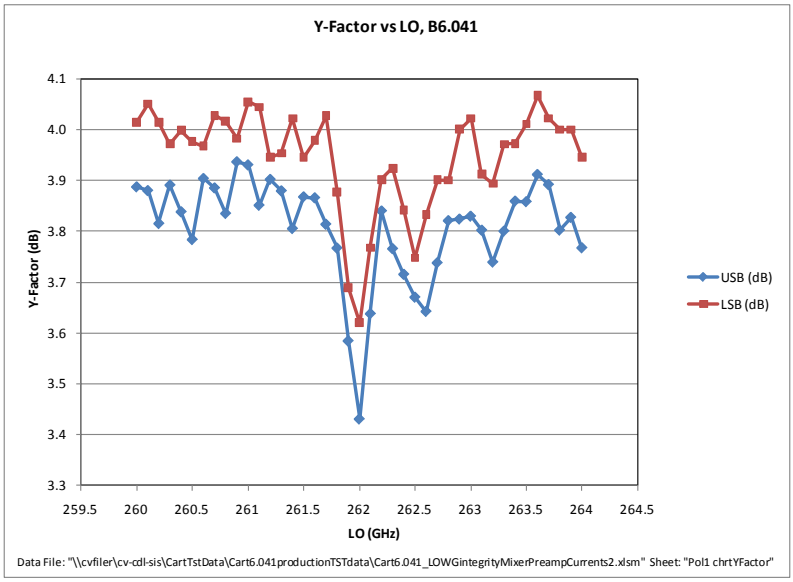


Figure 28: Cart 6.041, Pol 1, Junction Bias Near Spike (From 2010-12-02 09:12 Data)

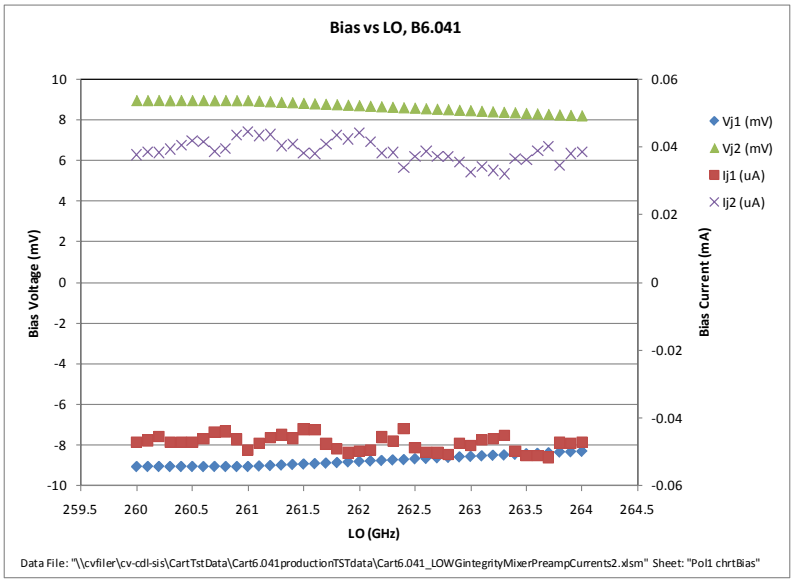


Figure 29: Cart 6.041, Pol 1, Power Amp Volts Near Spike (From 2010-12-02 09:12 Data)

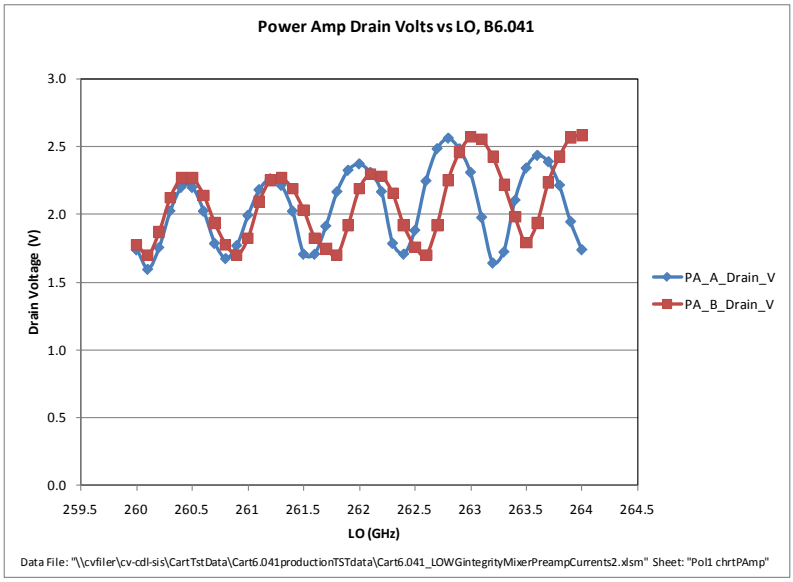
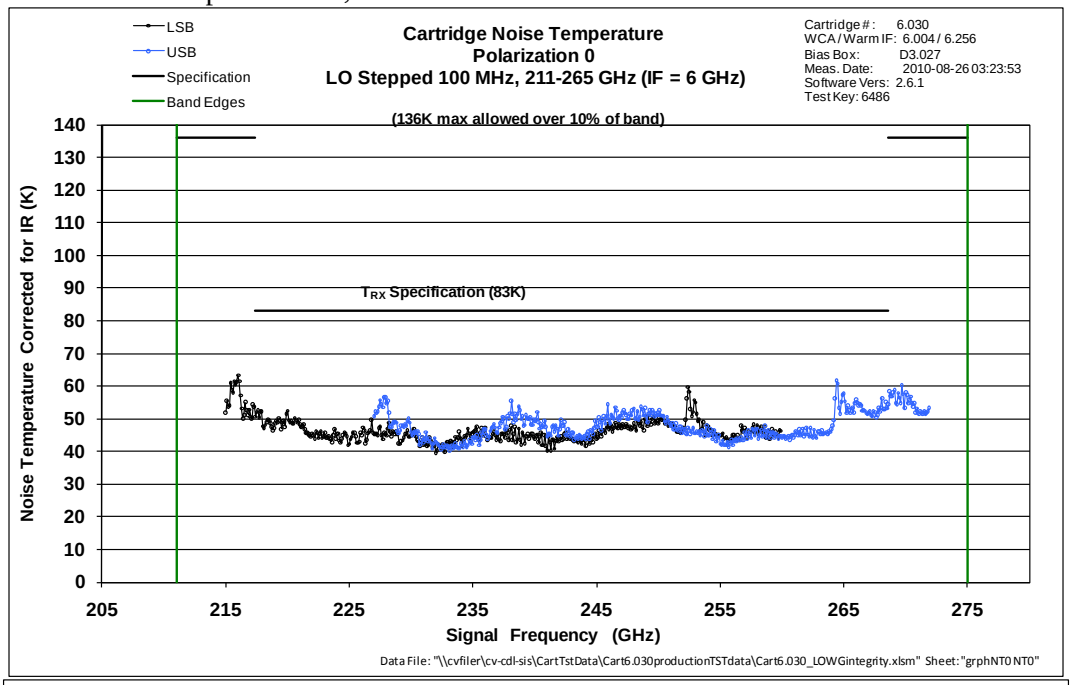


Figure 30: Cart 6.030, WCA 6.004, CTS-1

Spikes found, and later determined to be from WCA 6.004



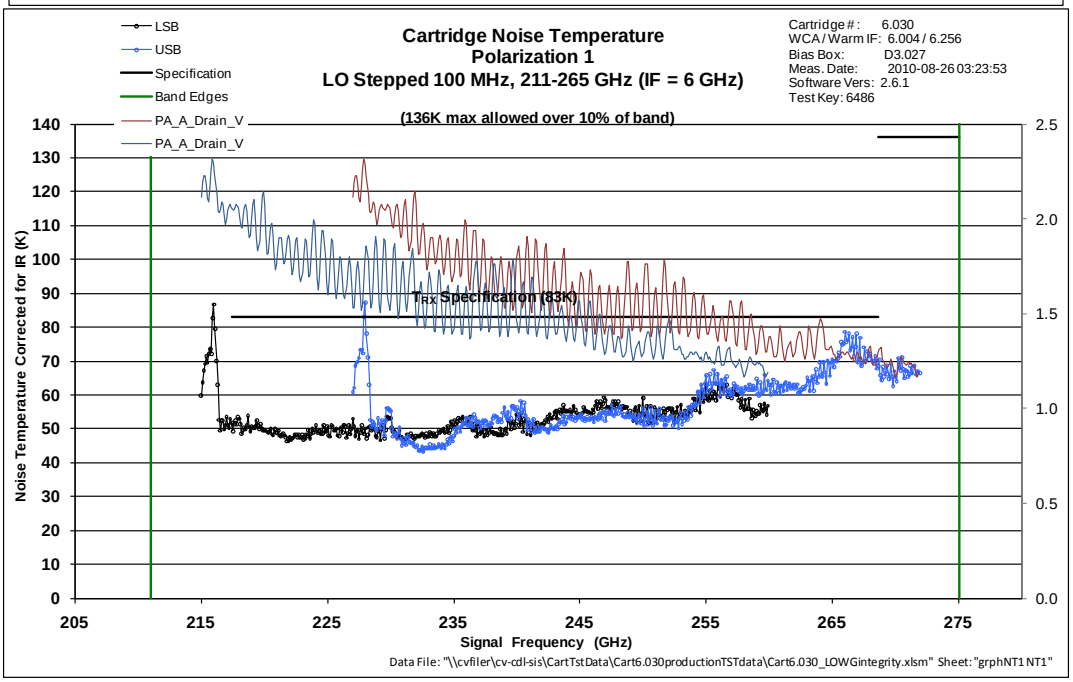


Figure 31: B6.044 Tr vs. RF, with OMT SN 125, Horn SN 331

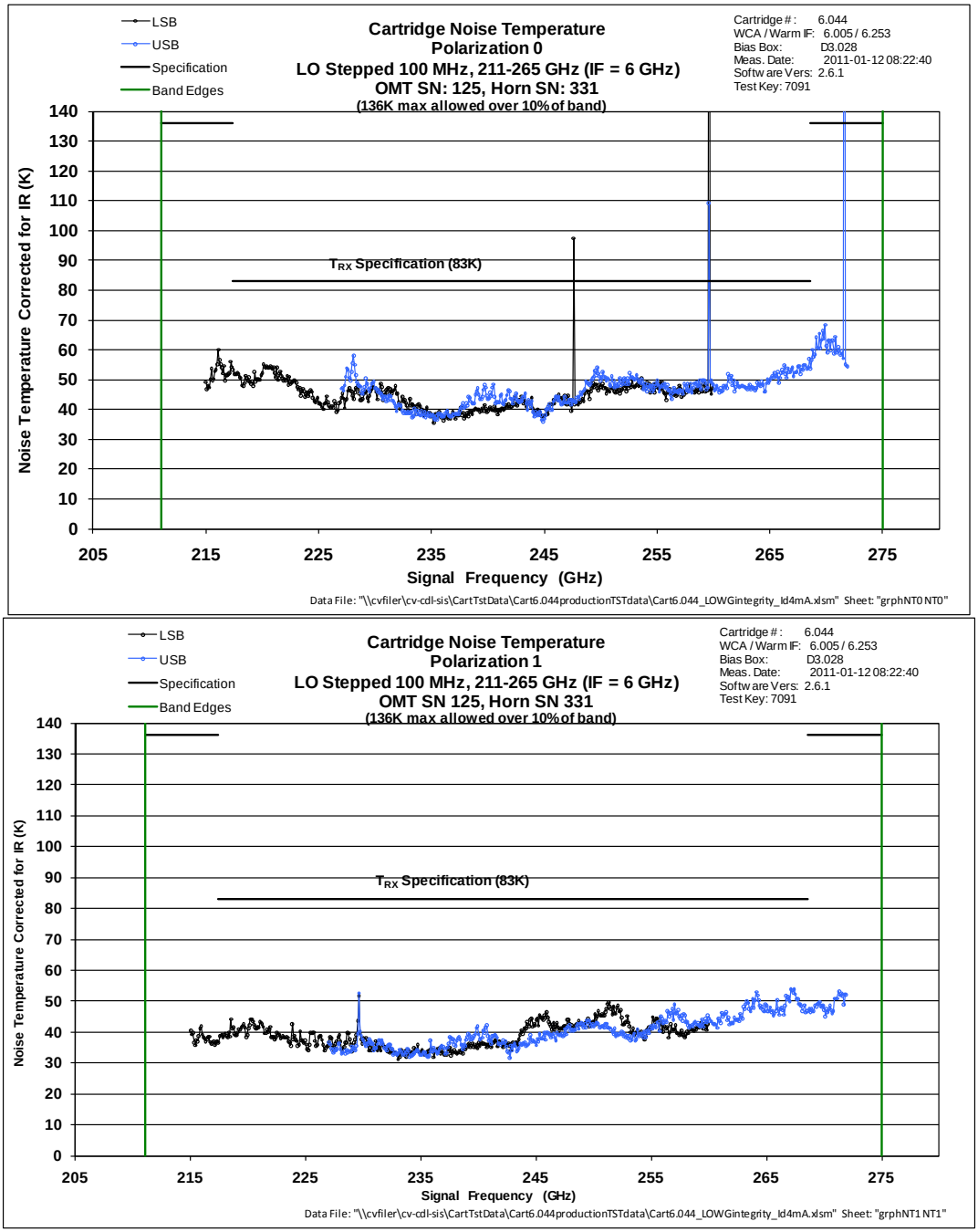
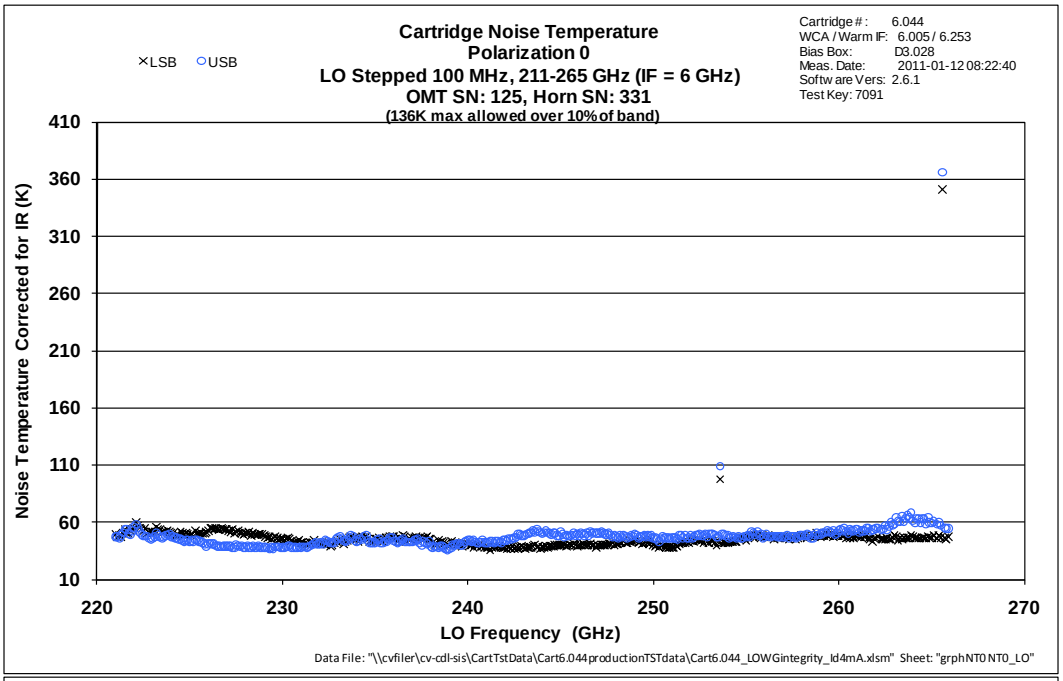


Figure 32: B6.044 Tr vs. LO Freq, with OMT SN 125, Horn SN 331



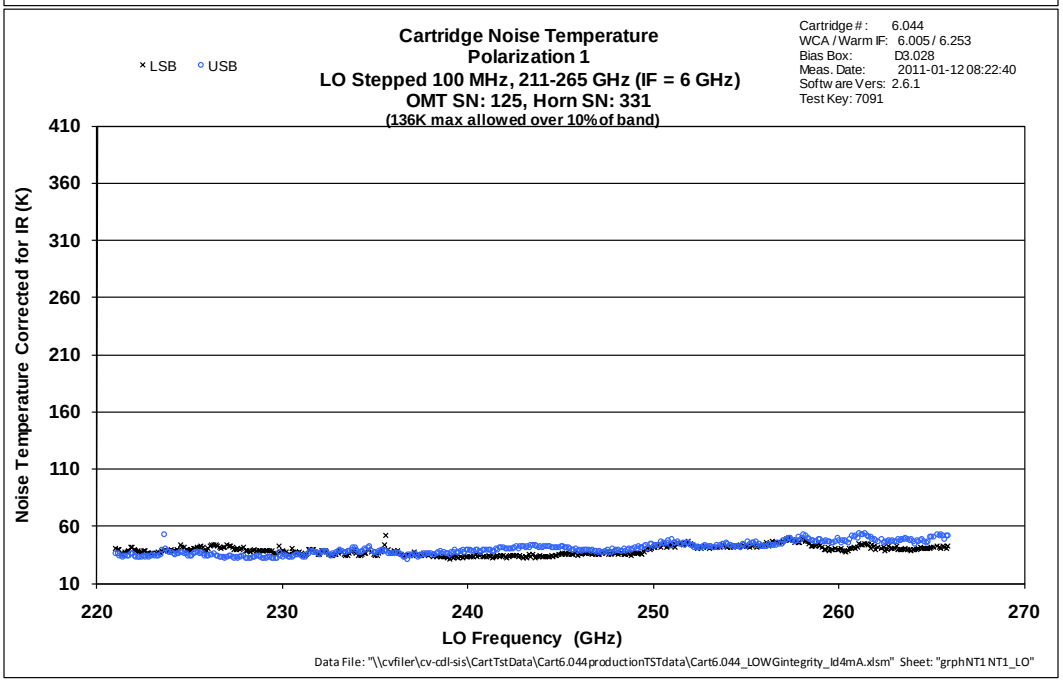
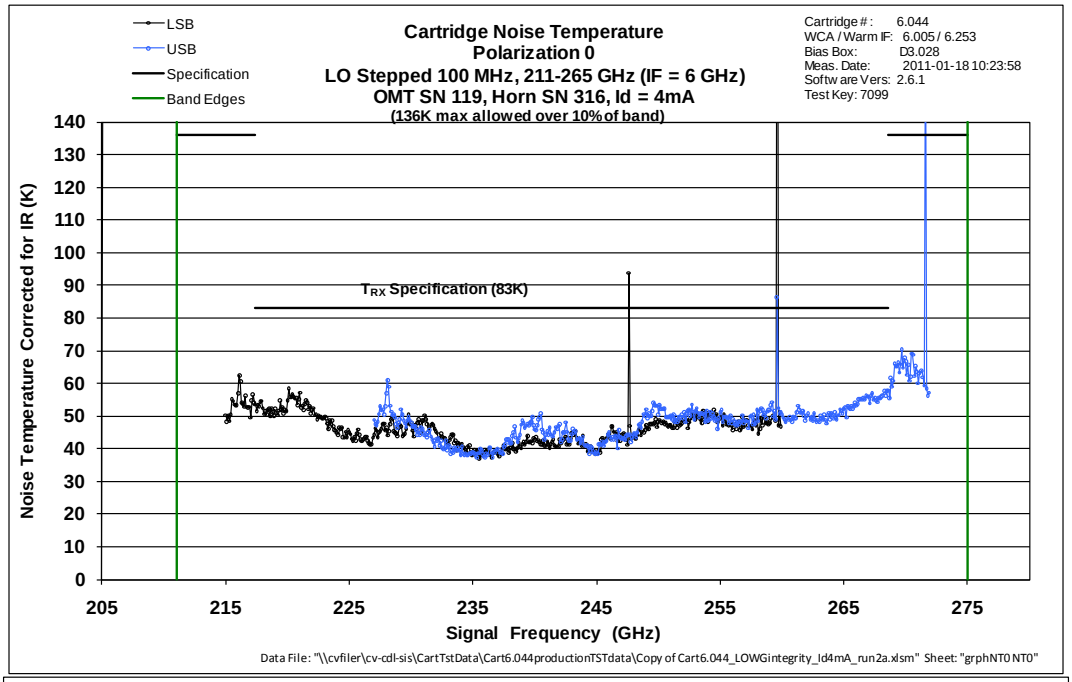


Figure 33: B6.044 Tr vs. RF, with OMT SN 119, Horn SN 316



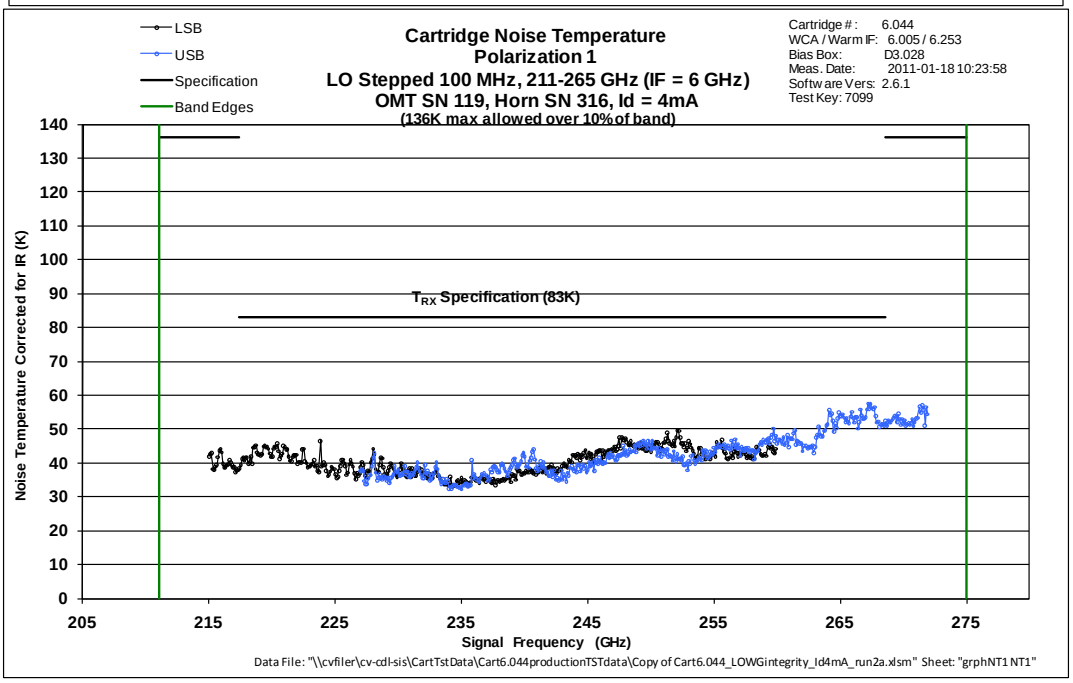
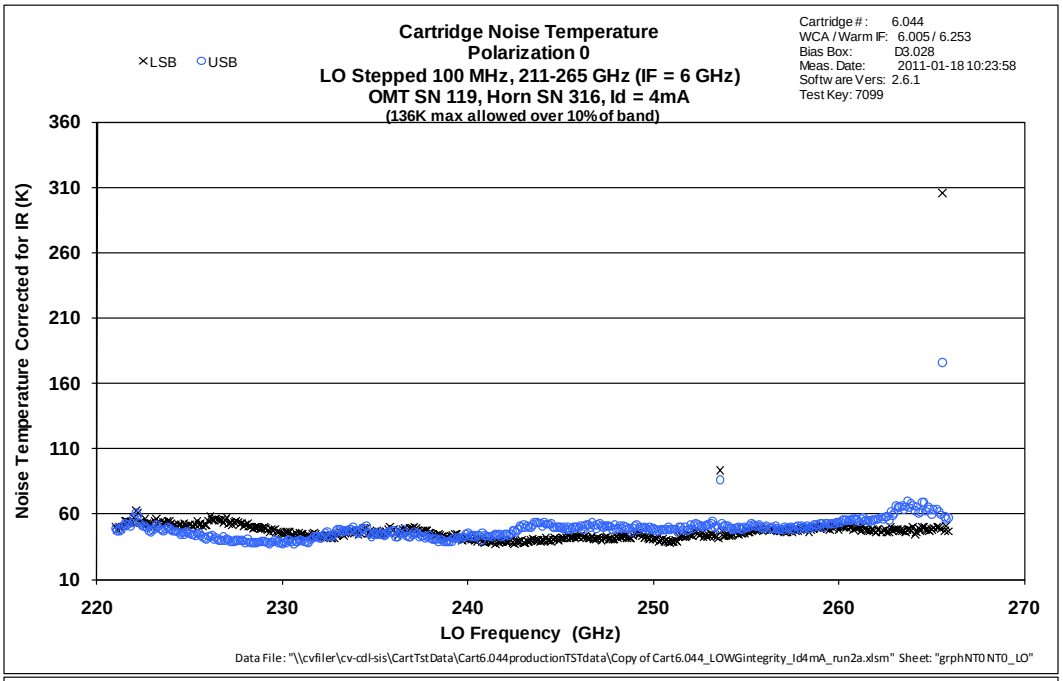


Figure 34: B6.044 Tr vs. LO Freq, with OMT SN 119, Horn SN 316



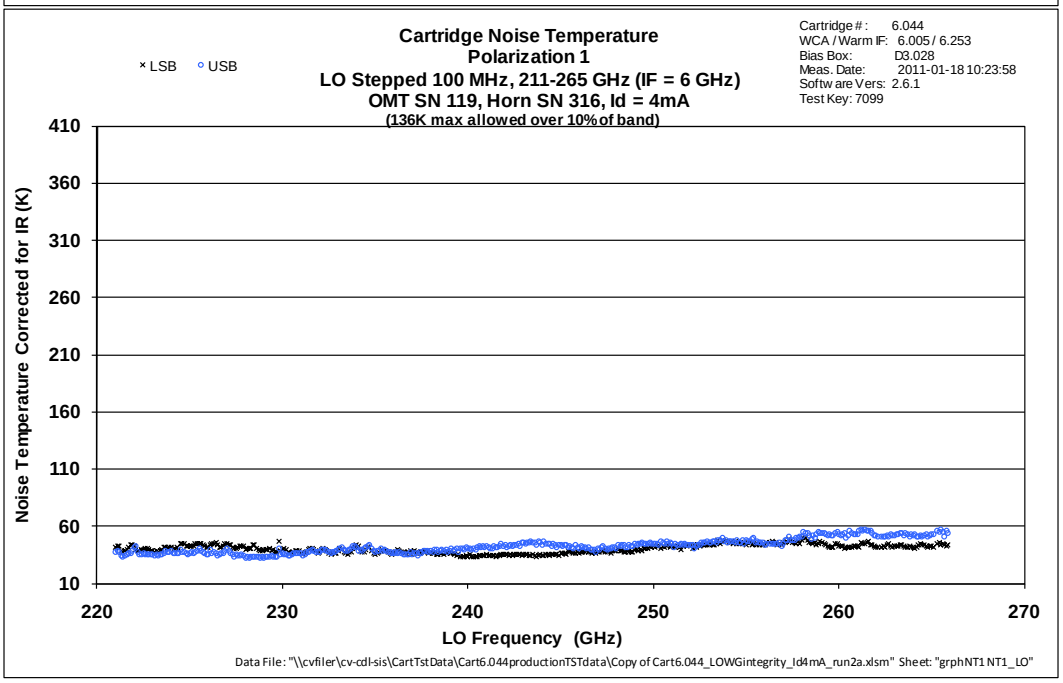
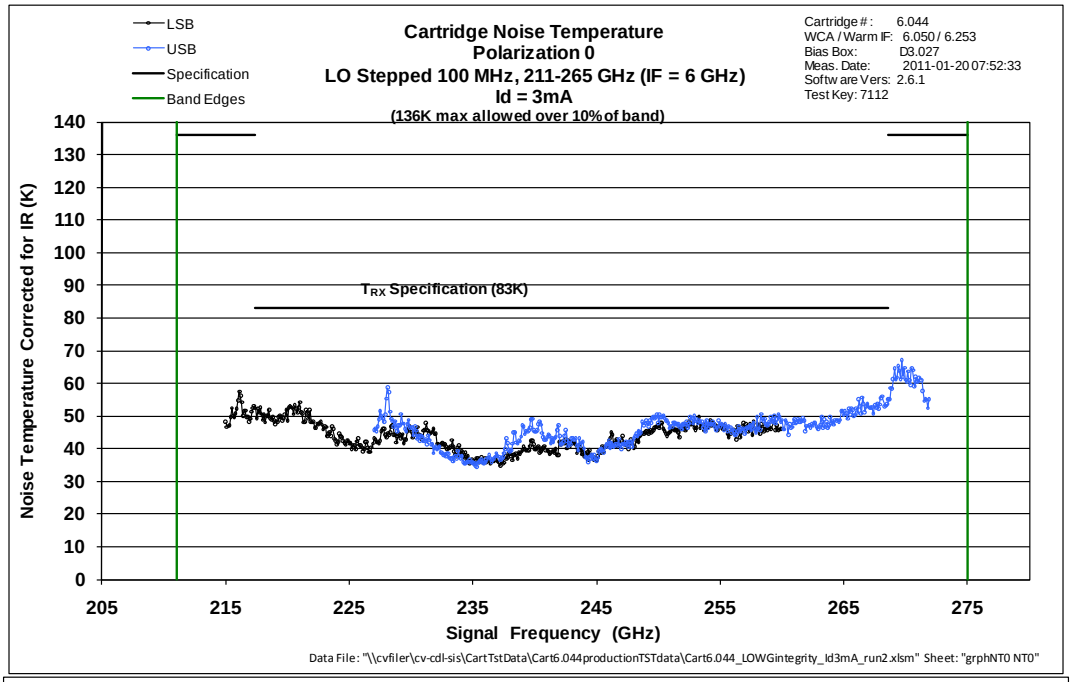


Figure 35: B6.044 Tr vs. RF, Id = 3 mA, with OMT SN 119, Horn SN 316



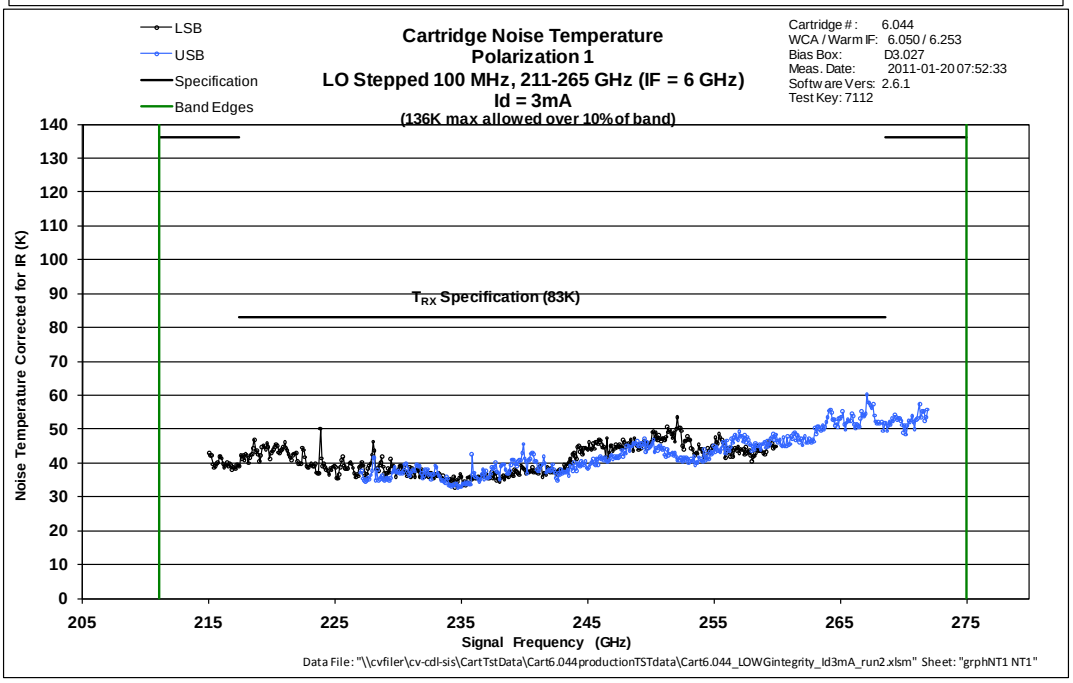
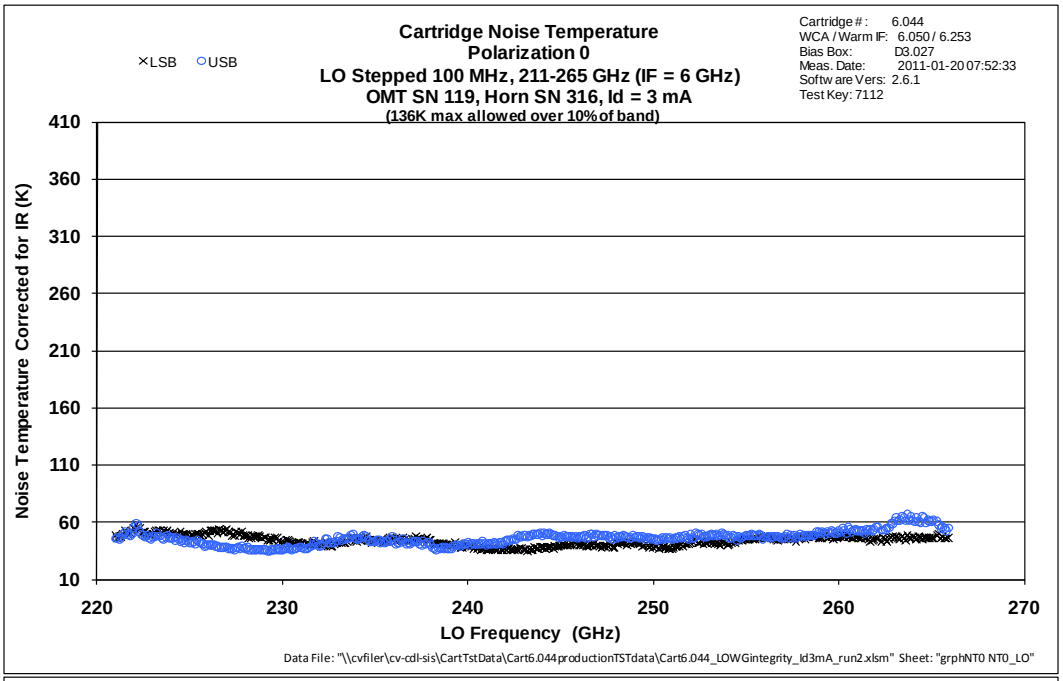


Figure 36: B6.044 Tr vs. LO, Id = 3 mA with OMT SN 119, Horn SN 316



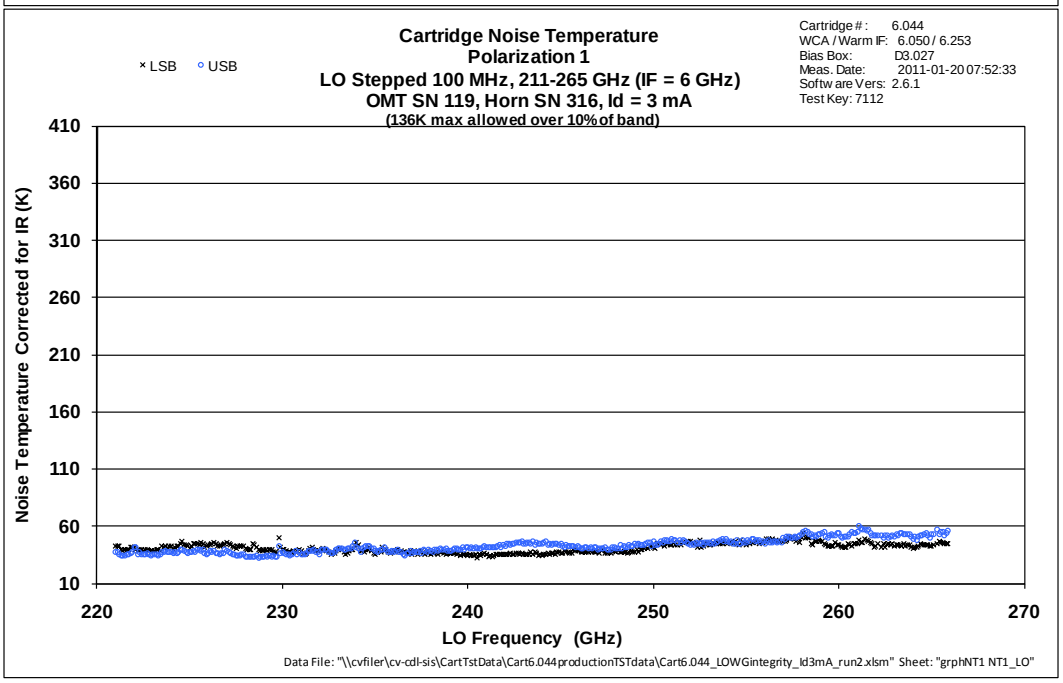
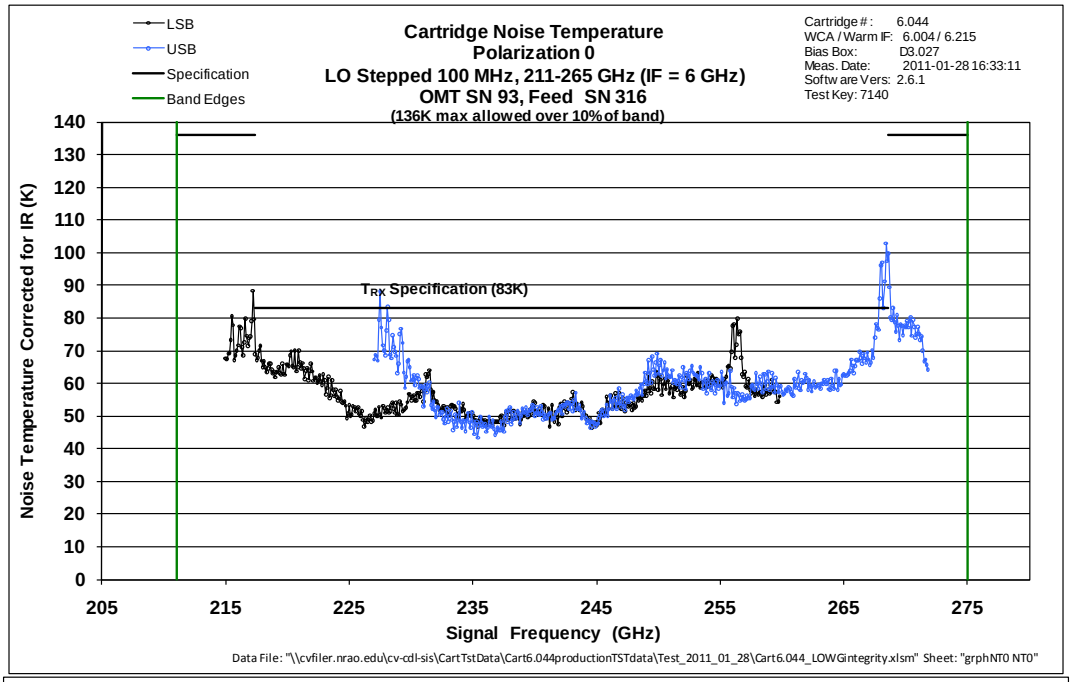


Figure 37: B6.044 Tr vs. RF, Id = 3 mA with OMT SN 93, Horn SN 316



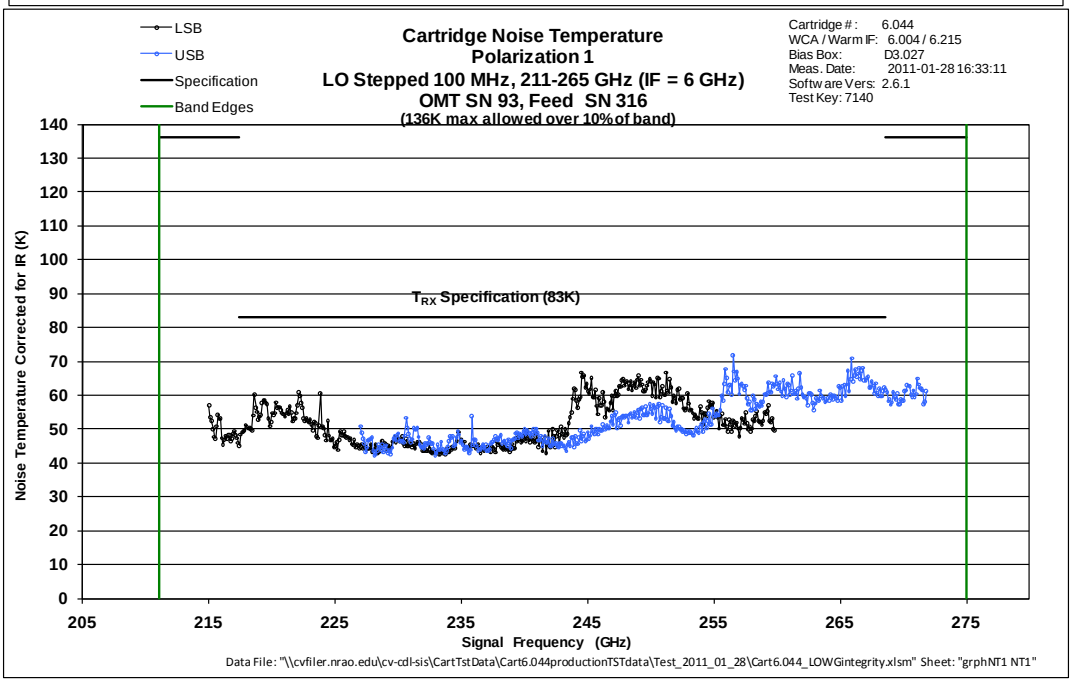
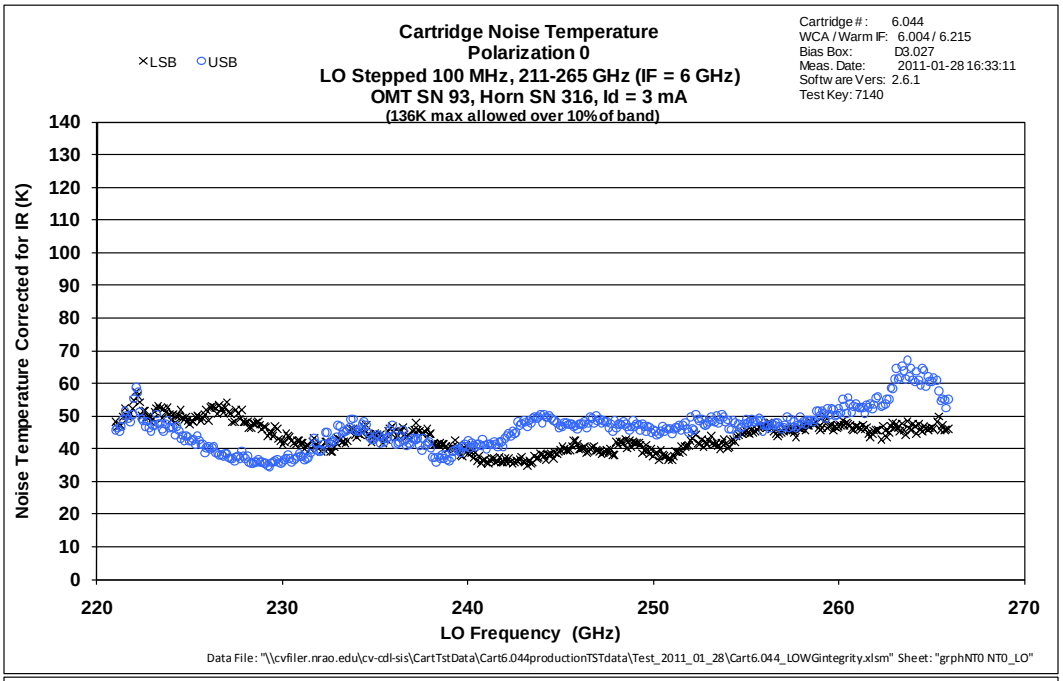


Figure 38: B6.044 Tr vs. LO, Id = 3 mA with OMT SN 93, Horn SN 316



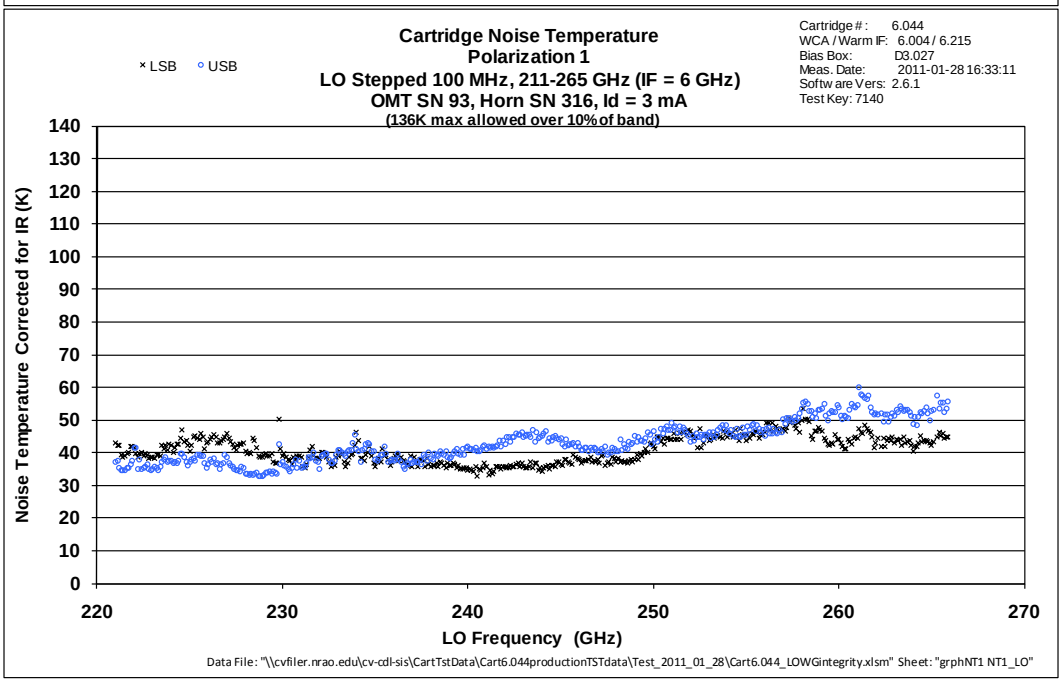
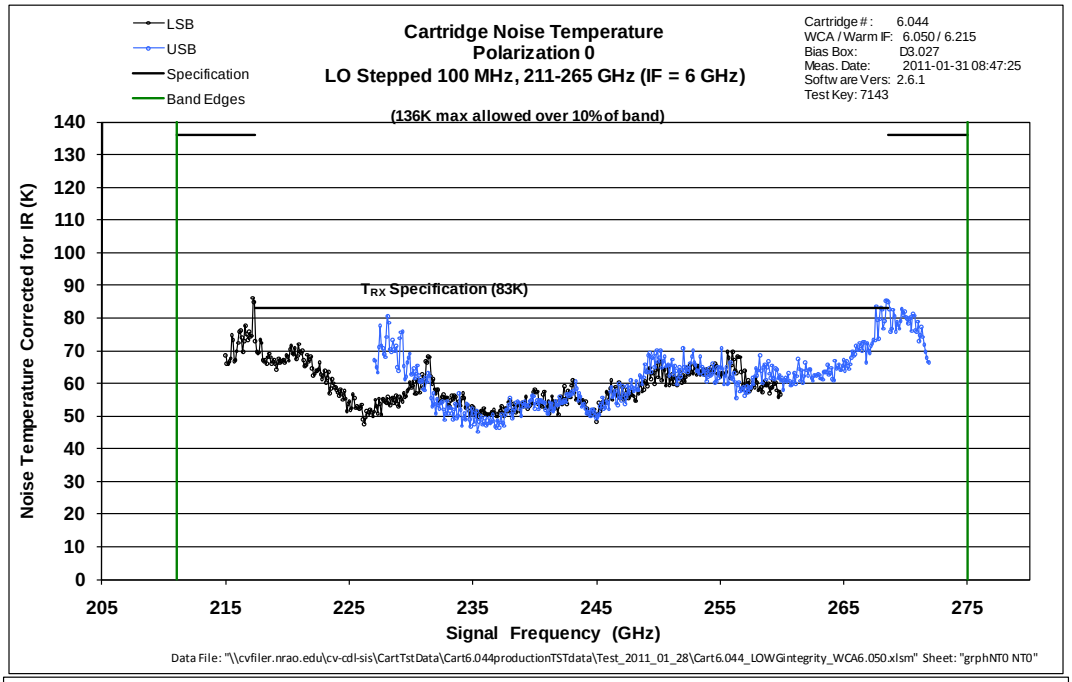


Figure 39: B6.044 Tr vs. RF, WCA 050, Id = 3 mA with OMT SN 93, Horn SN 316



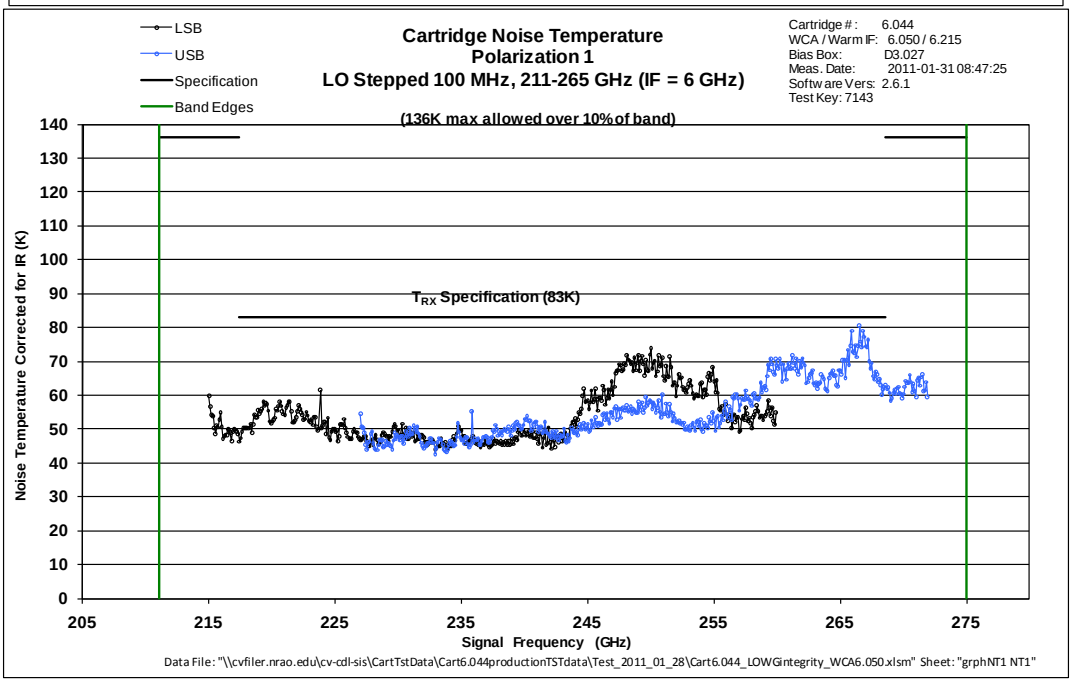
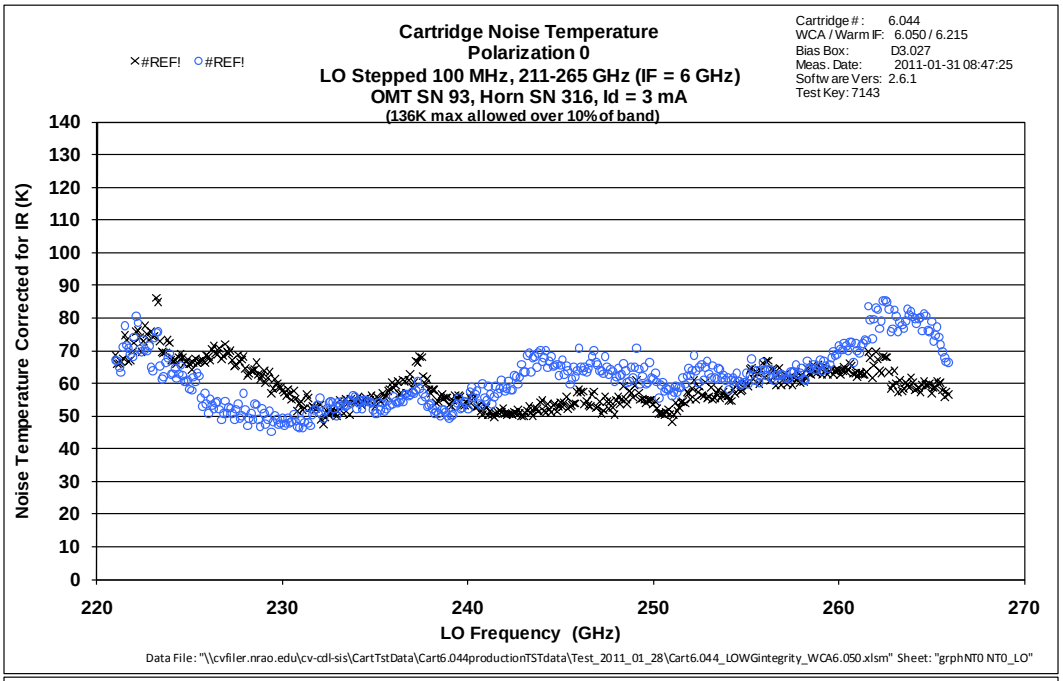


Figure 40: B6.044 Tr vs. LO, WCA 050, Id = 3 mA with OMT SN 93, Horn SN 316



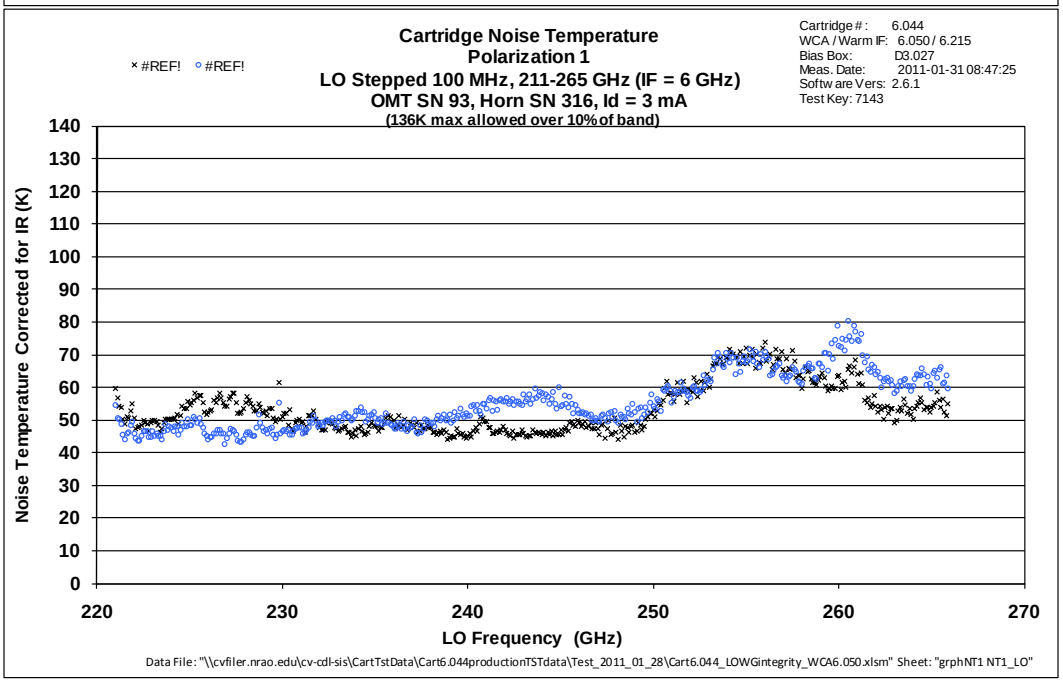
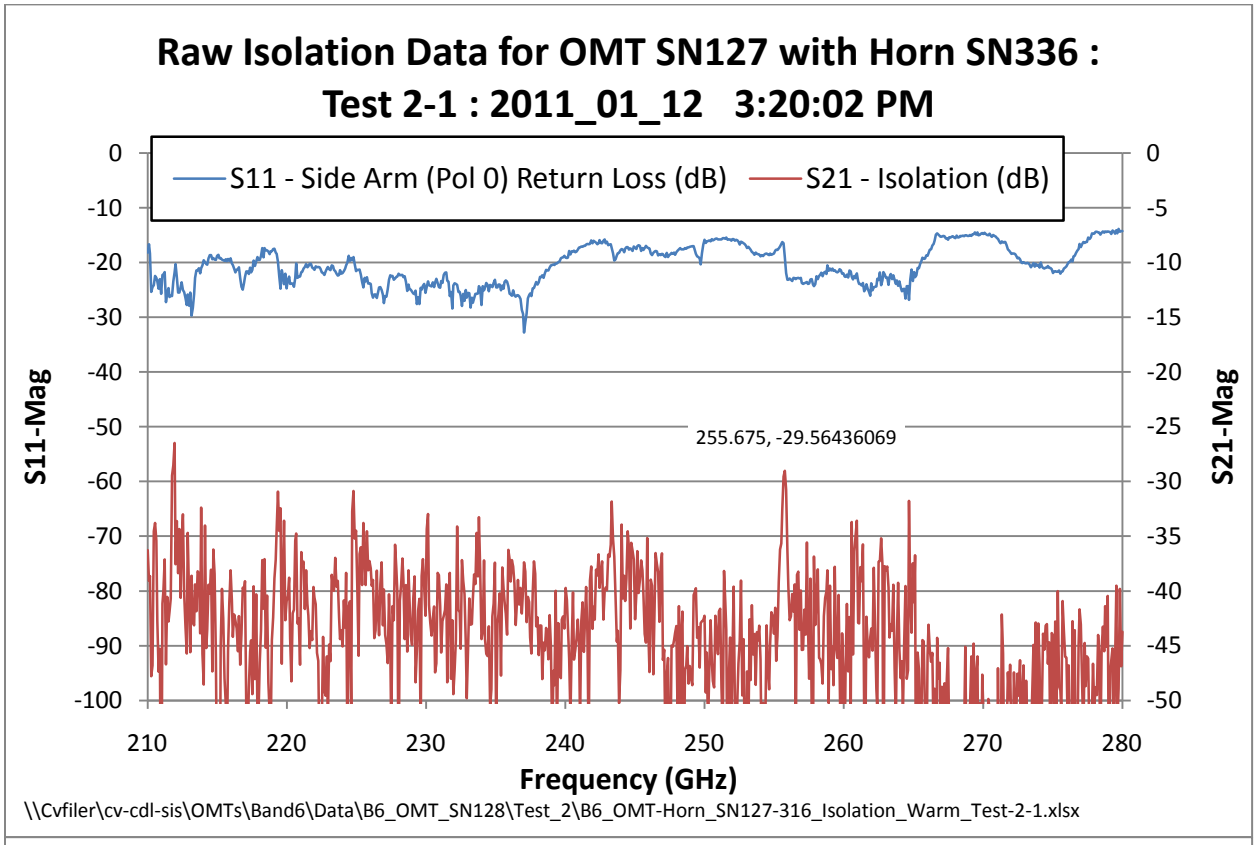


Figure 41: OMT SN 127 with Horn SN 336



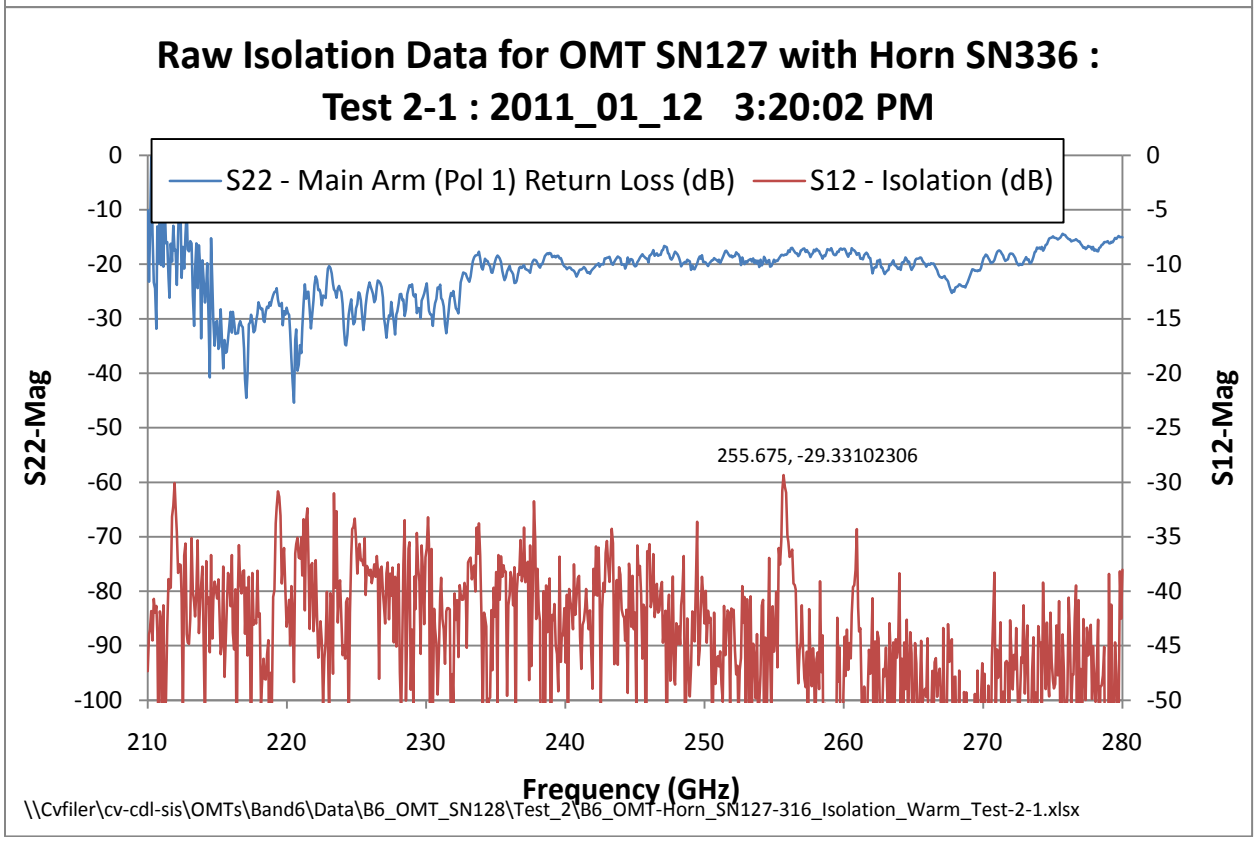
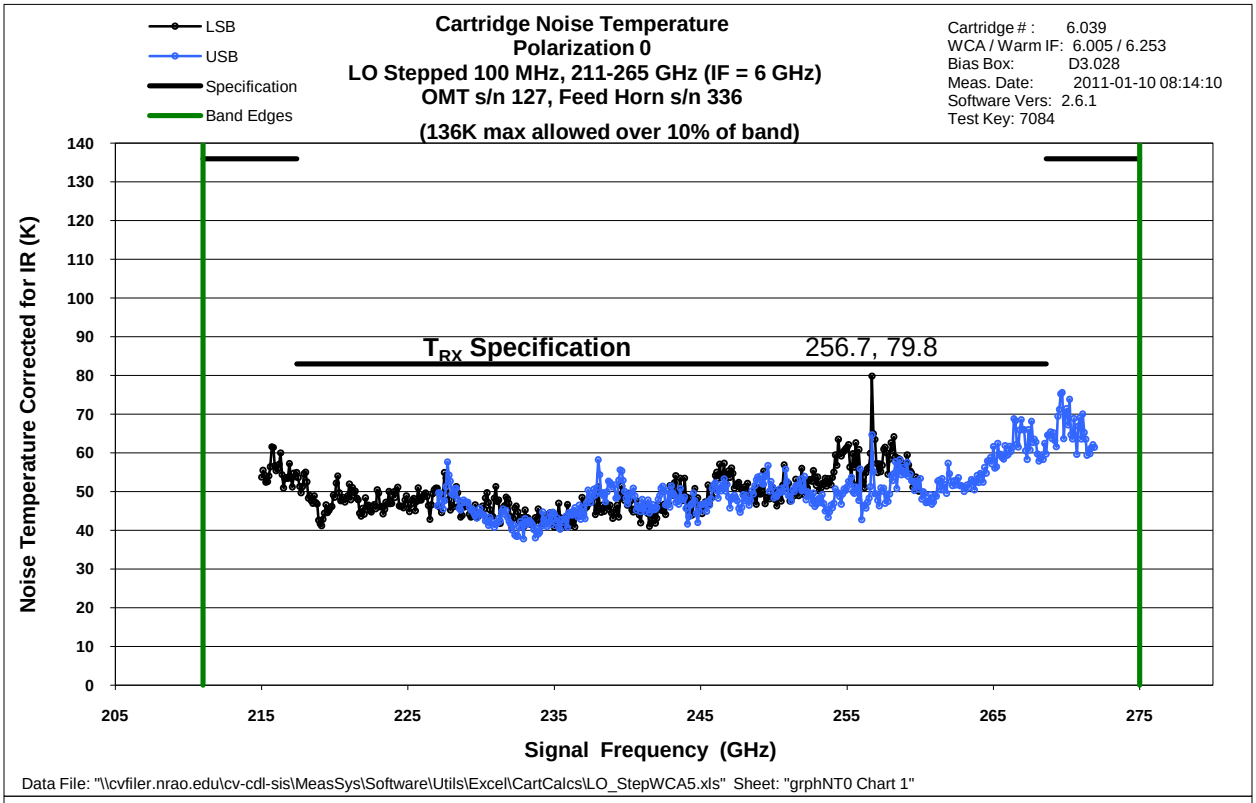
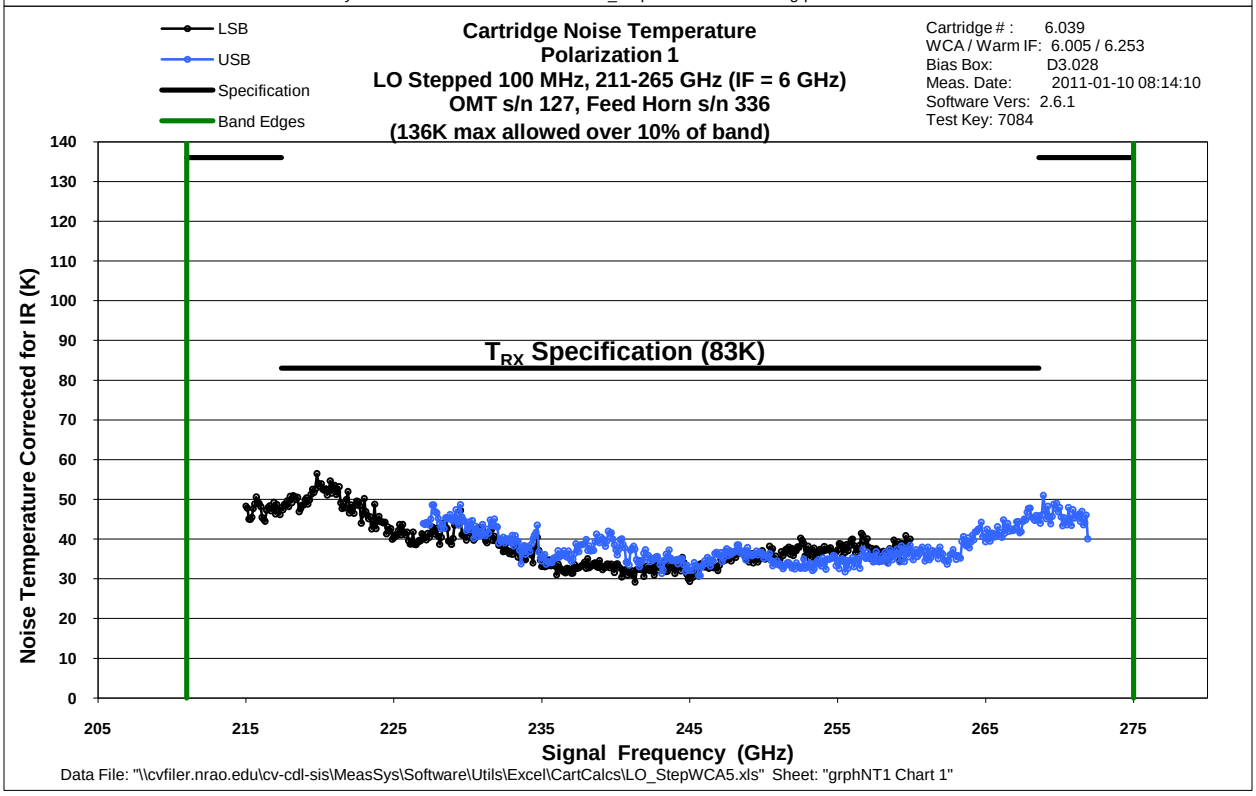
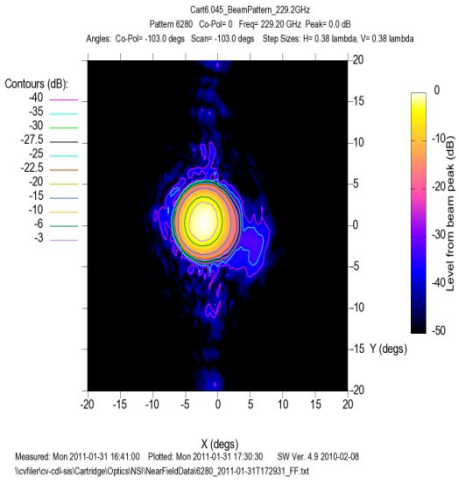


Figure 42: Tr vs RF for OMT SN 127 with Horn SN 336



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Pattern 6280 Co-Pol= 0 Freq= 229.20 GHz Peak= 0.0 dB
Angles: Co-Pol= -103.0 degs Scan= -103.0 degs Step Sizes: H= 0.38 lambda, V= 0.38 lambda
Contours (dB):
-40
-35
-30
-27.5
-25
-22.5
-20
-15
-10
-6
-3
Level from beam peak (dB)
Y (degs)
X (degs)
Measured: Mon 2011-01-31 16:41:00 Plotted: Mon 2011-01-31 17:30:30 SW Ver. 4.9 2010-02-08
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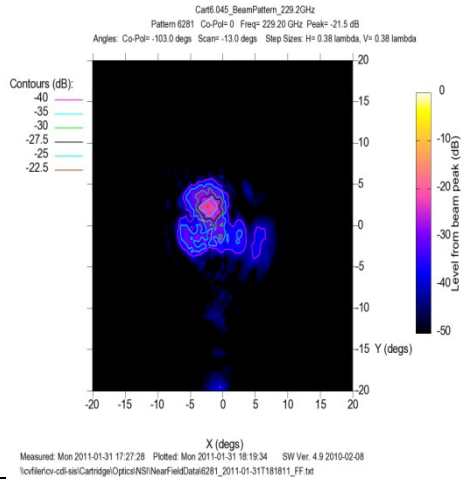
Cart6.045_BeamPattern_229.2GHz
Pattern 6281 Co-Pol= 0 Freq= 229.20 GHz Peak= -21.5 dB
Angles: Co-Pol= -103.0 degs Scan= -13.0 degs Step Sizes: H= 0.38 lambda, V= 0.38 lambda
Contours (dB):
-40
-35
-30
-27.5
-25
-22.5
Level from beam peak (dB)
Y (degs)
X (degs)
Measured: Mon 2011-01-31 17:27:28 Plotted: Mon 2011-01-31 18:19:34 SW Ver. 4.9 2010-02-08
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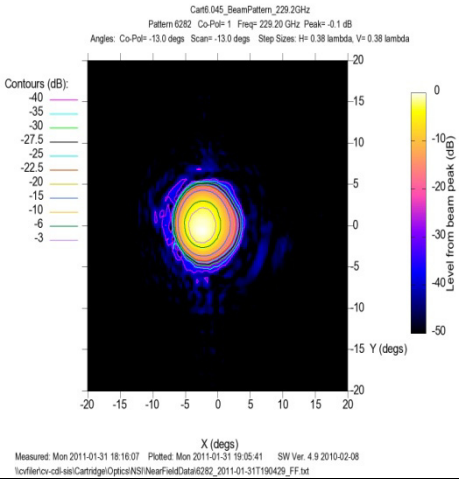
Cart6.045_BeamPattern_229.2GHz
Pattern 6282 Co-Pol= 1 Freq= 229.20 GHz Peak= -0.1 dB
Angles: Co-Pol= -13.0 degs Scan= -13.0 degs Step Sizes: H= 0.38 lambda, V= 0.38 lambda
Contours (dB):
-40
-35
-30
-27.5
-25
-22.5
-20
-15
-10
-6
-3
Level from beam peak (dB)
Y (degs)
X (degs)
Measured: Mon 2011-01-31 18:16:07 Plotted: Mon 2011-01-31 19:05:41 SW Ver. 4.9 2010-02-08
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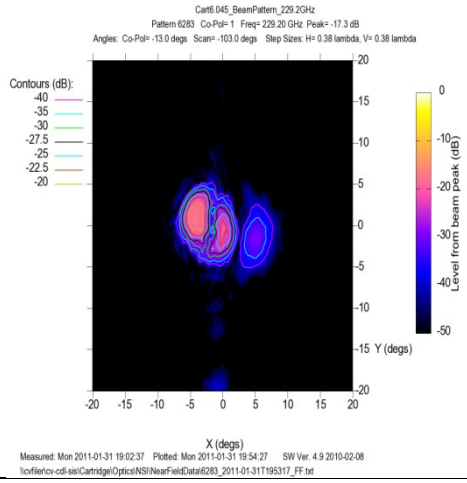
Cart6.045_BeamPattern_229.2GHz
Pattern 6283 Co-Pol= 1 Freq= 229.20 GHz Peak= -17.3 dB
Angles: Co-Pol= -13.0 degs Scan= -103.0 degs Step Sizes: H= 0.38 lambda, V= 0.38 lambda
Contours (dB):
-40
-35
-30
-27.5
-25
-22.5
-20
Level from beam peak (dB)
Y (degs)
X (degs)
Measured: Mon 2011-01-31 19:02:37 Plotted: Mon 2011-01-31 19:54:27 SW Ver. 4.9 2010-02-08
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