Memorandum

To: Dan Koller, Tony Kerr, John Webber, Kamaljeet Saini, Dave Schmitt, Mike Reynolds, Mike Shannon, Casey Litton, Matt Morgan, Neil Horner

From: John Effland

Date: 2009-02-03

Revisions: 2009-02-03 jee Initial

Subject: Changes in Cross-Pol Isolation of Band 6 Cartridges with Different OMTs and Horns

This memo presents recent measurements of cartridge and OMT polarization isolation and we solicit comments on how to determine the source of the cartridge cross-pol problem.

Polarization isolation in Cartridge B6-012 changed significantly when OMT6-020 (Figure 4) was replaced by OMT6-035 (Figure 5), despite both OMTs having measured polarization isolation sufficiently high that OMT contributions should be small.

Feedhorn manufacturing was also checked by measuring polarization isolation using the same feedhorn design as built by Custom Microwave and General Dynamics. When the feedhorn built by Custom Microwave (Figure 1) was replaced with the same model built by General Dynamics (Figure 4), significant polarization isolation changes also occur, because changes at the 14-16 dB level imply the feed horns contribute at a relatively high level. Both measurements had OMT6-020 installed in the cartridge. Also note that all cartridge measurements in this memo are over a limited frequency range constrained by the lack of a broadband BeaST, but all cartridge measurements use the same frequencies.

The first table below presents cartridge data in the left column and measurements of the installed OMT in the center and right columns. Figure 5 is cartridge polarization isolation when OMT6-020 was replaced by OMT6-035 with no other changes made to the cartridge. Measurements of Pol 0 at 265 GHz (18.5 dB) were confirmed by re-nulling the polarization angle for maximum polarization isolation, and the results were the same.

Figure 2 and Figure 3 are OMT polarization isolation measurements of OMT6-020 and Figure 6 and Figure 7 are similar measurements for OMT6-035. The table in Figure 8 compares all the other measurements of the OMTs with OMT6-035 data in the left column.

The following are possible causes of the cartridge measurement discrepancies when using different OMTs:

1. Flange alignment between OMT and horn
2. Flange alignment between OMT and mixer-preamps
3. OMT cross-pol differs from measured values

We are currently installing the broadband BEasT and will remeasure at the band edges and two other frequencies for a total of 7 measurements for each polarization. To determine the sensitivity of flange alignment between the OMT and horn, we plan to remeasure this cartridge after removing the horn and reinstalling it onto the same OMT. Also, a cascade analysis is planned to quantify feedhorn and OMT contributions.

Figure 1: Cross-Pol with OMT 020, Feedhorn Custom 114

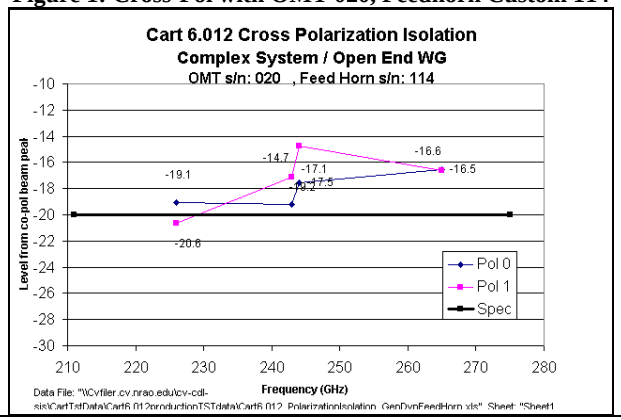


Figure 2: OMT 020 Measured Cross-Pol, Side Arm

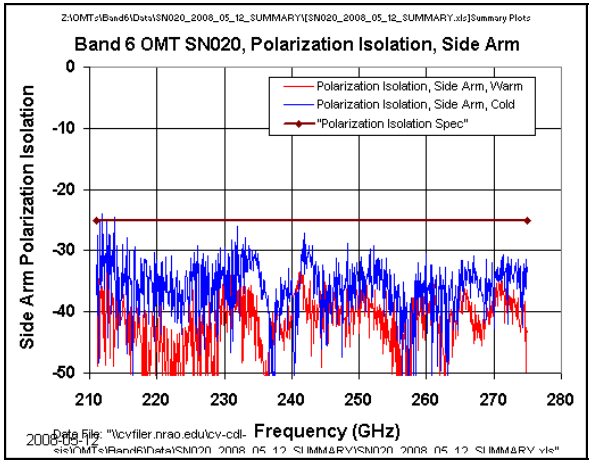


Figure 3: OMT 020 Measured Cross-Pol, Main Arm

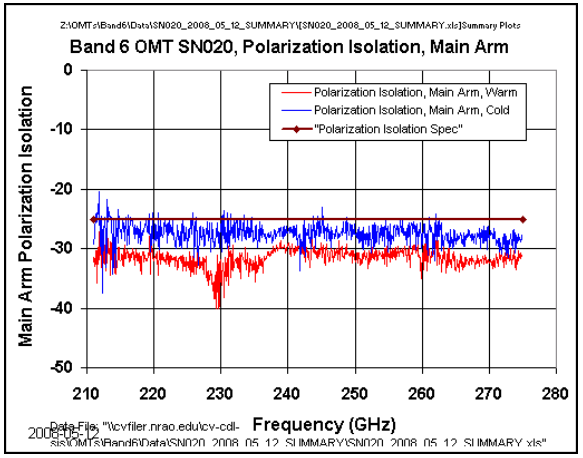


Figure 4: Cross-Pol with OMT 020, Feedhorn GD 302

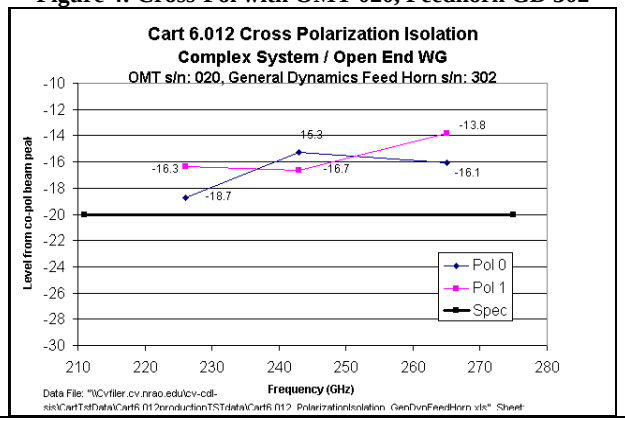


Figure 5: Cross-Pol with OMT 035, Feedhorn GD 302

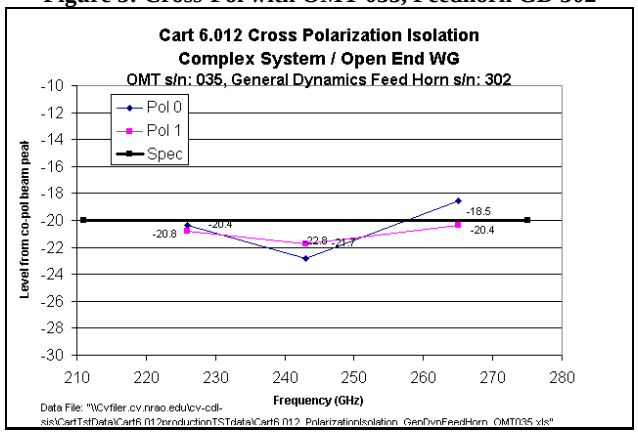


Figure 6: OMT 030 Measured Cross-Pol, Side Arm

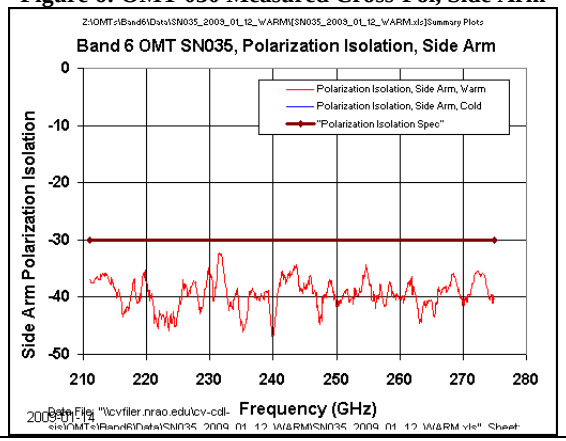


Figure 7: OMT 030 Measured Cross-Pol, Main Arm

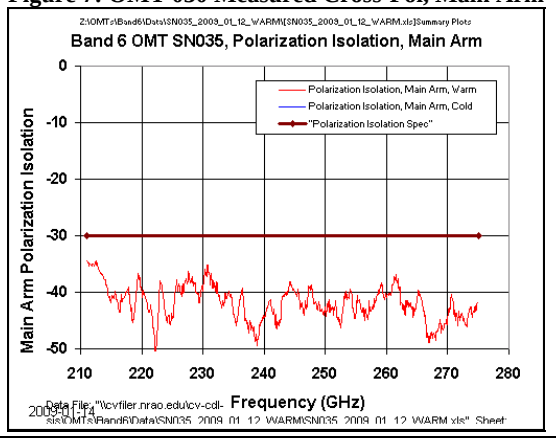
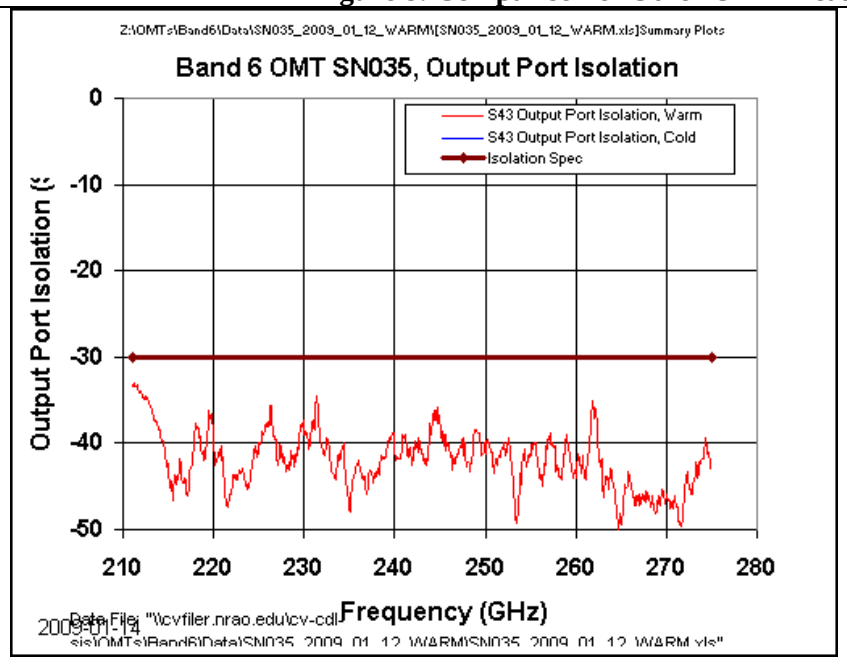
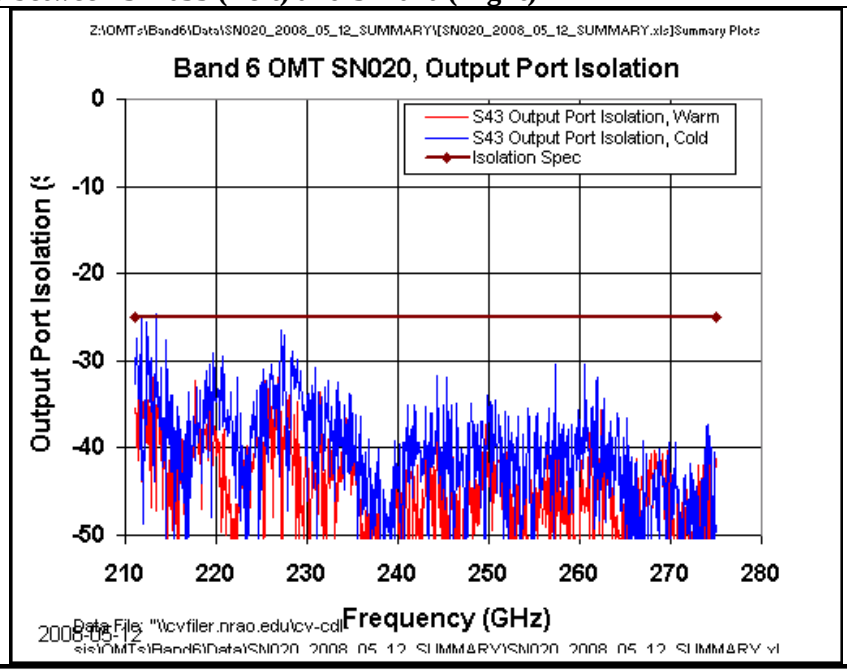
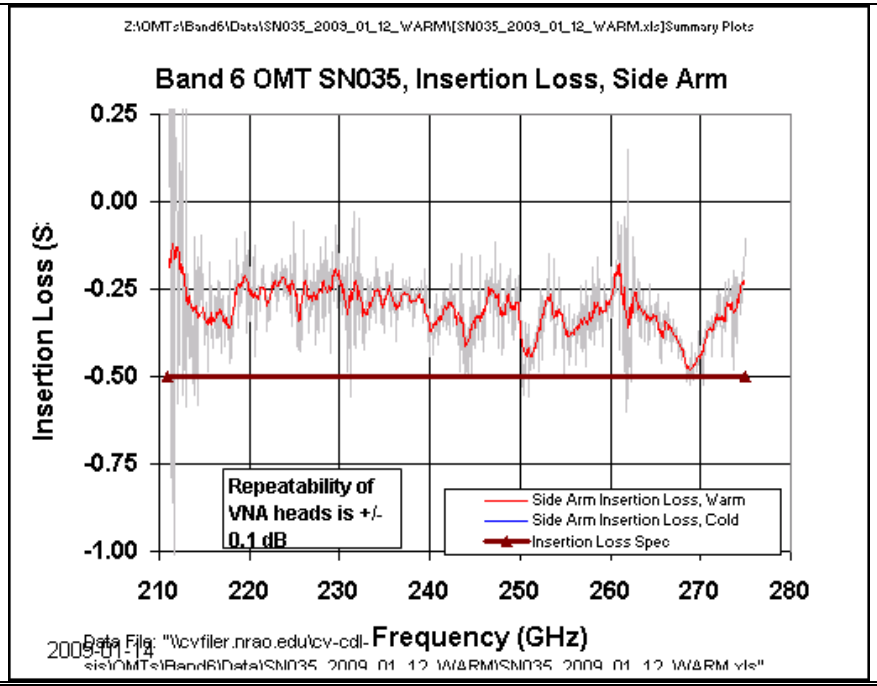
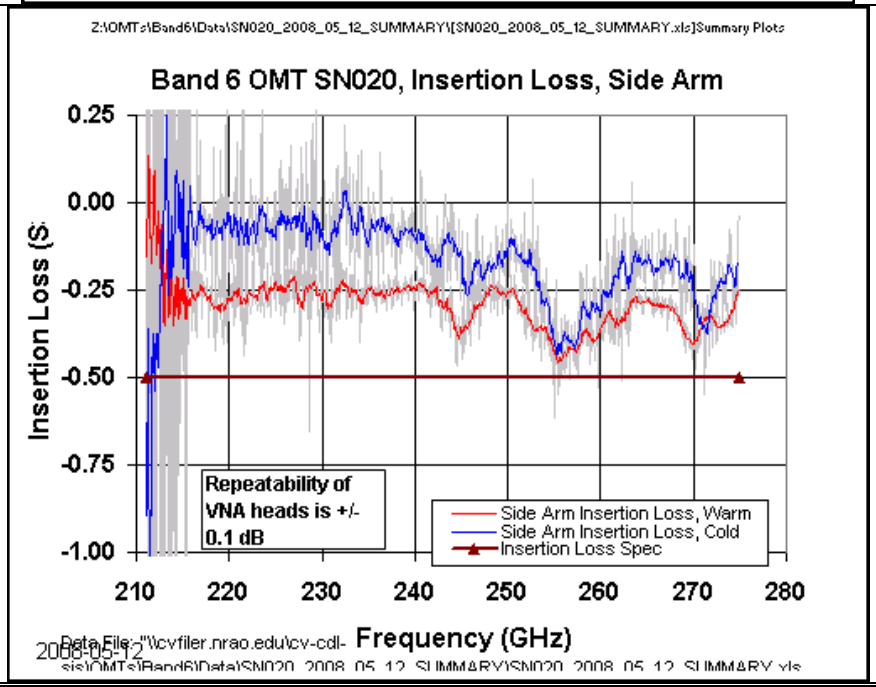


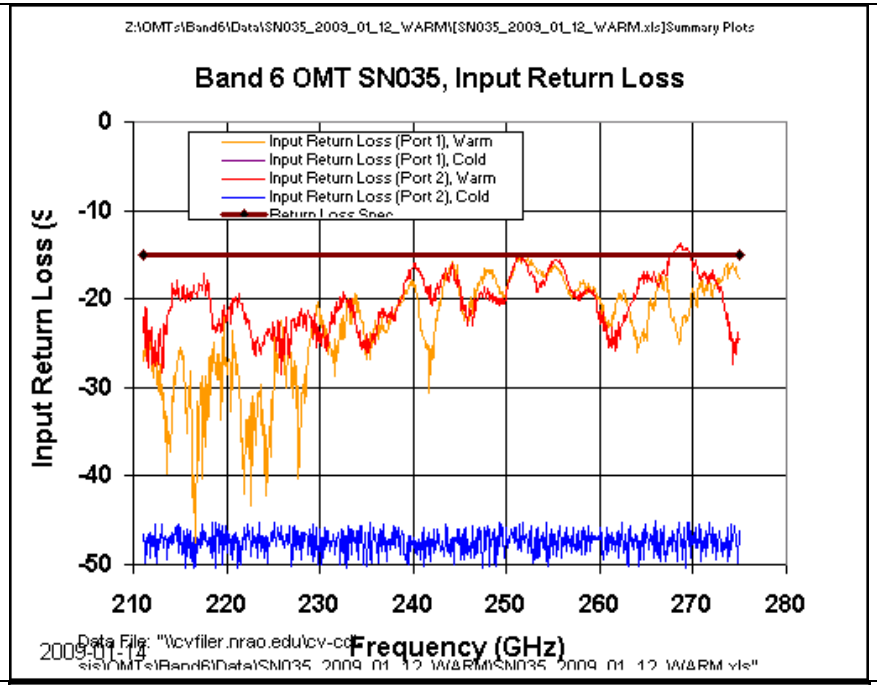
Figure 8: Comparison of Other OMT measurements between SN 035 (Left) and SN 020 (Right)

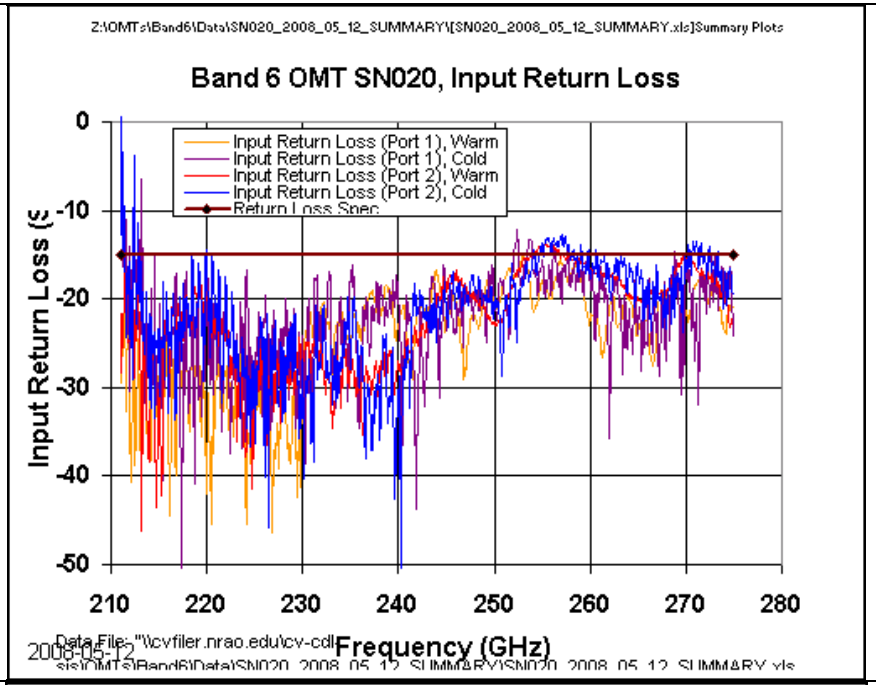


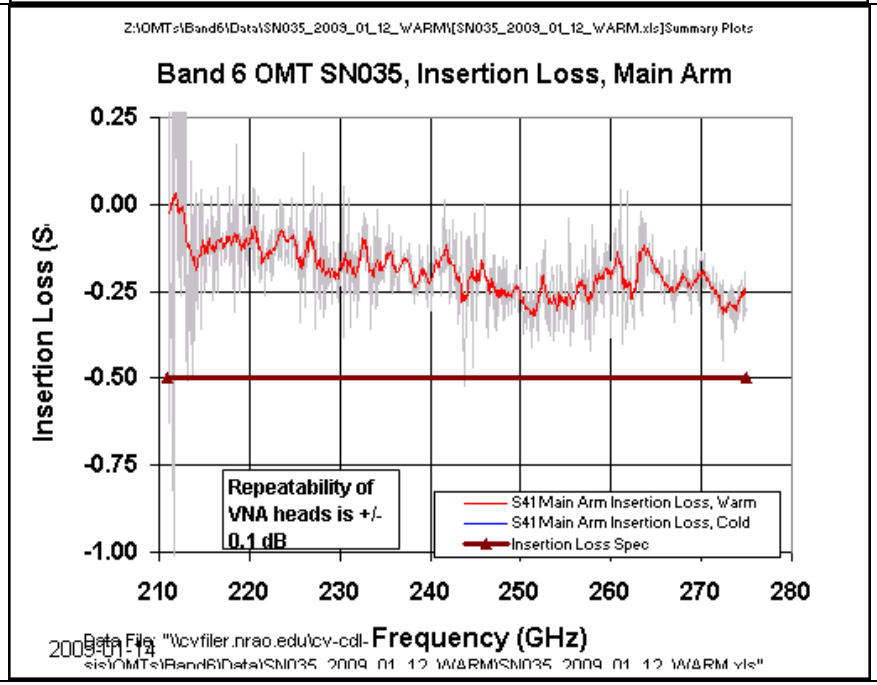


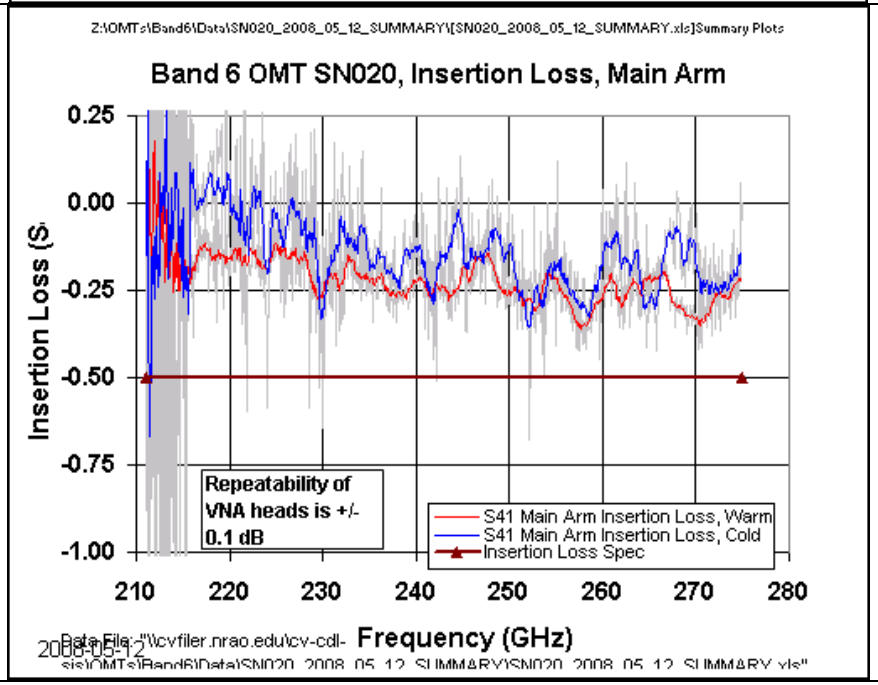


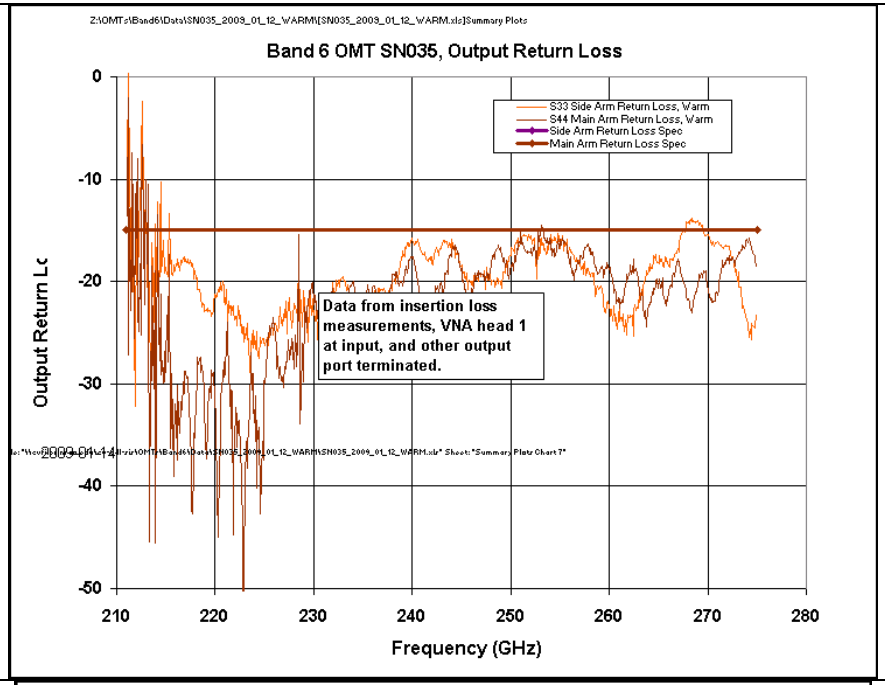


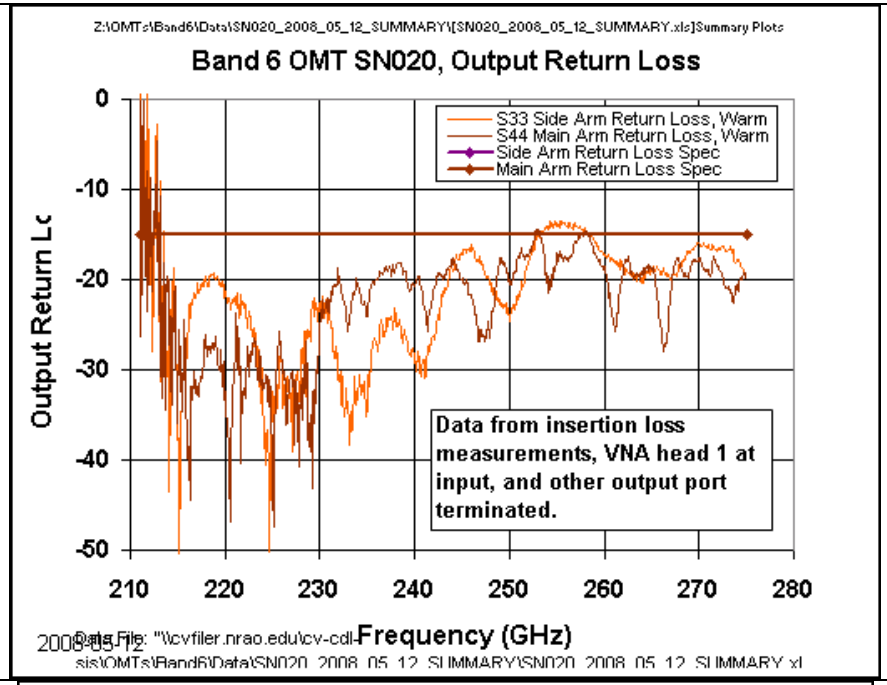

Z:\OMTs\Band6\Data\SN035_2009_01_12_WARM\[SN035_2009_01_12_WARM.xls]Summary Plots
Band 6 OMT SN035, Input Return Loss
Input Return Loss (Port 1), Warm
Input Return Loss (Port 1), Cold
Input Return Loss (Port 2), Warm
Input Return Loss (Port 2), Cold
Return Loss Spec
Input Return Loss (S
0
-10
-20
-30
-40
-50
210
220
230
240
250
260
270
280
Frequency (GHz)
2009-01-14

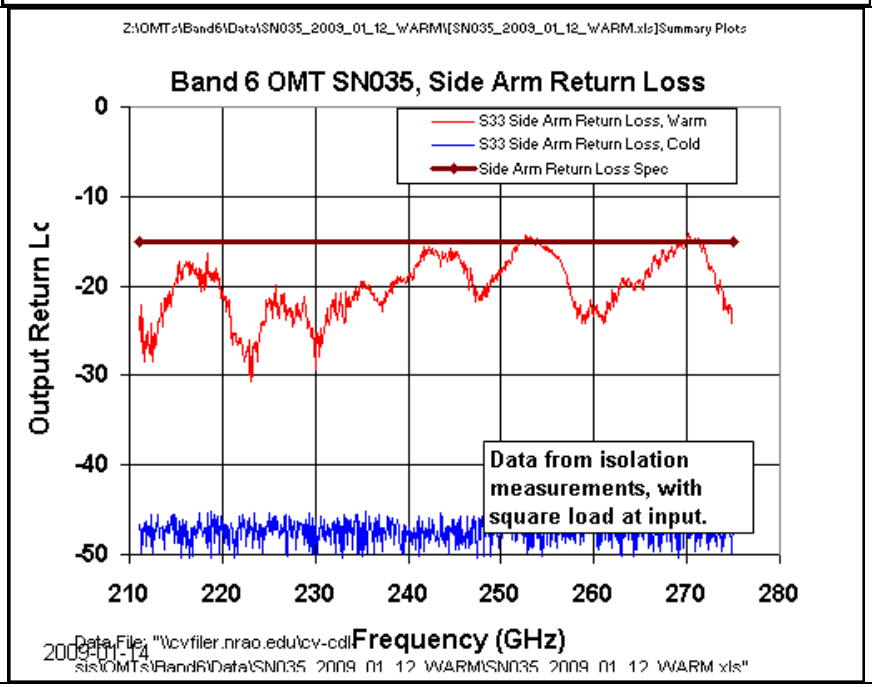

Z:\OMTs\Band6\Data\SN020_2008_05_12_SUMMARY\[SN020_2008_05_12_SUMMARY.xls]Summary Plots
Band 6 OMT SN020, Input Return Loss
Input Return Loss (Port 1), Warm
Input Return Loss (Port 1), Cold
Input Return Loss (Port 2), Warm
Input Return Loss (Port 2), Cold
Return Loss Spec
Input Return Loss (S
0
-10
-20
-30
-40
-50
210
220
230
240
250
260
270
280
Frequency (GHz)
2008-05-12

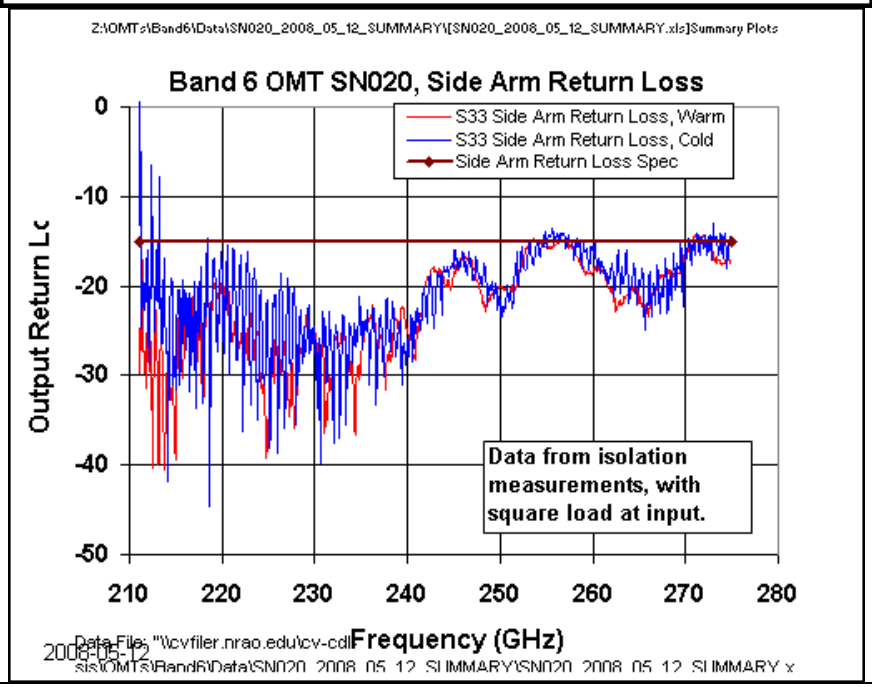

Z:\OMTs\Band6\Data\SN035_2009_01_12_WARM\[SN035_2009_01_12_WARM.xls]Summary Plots
Band 6 OMT SN035, Insertion Loss, Main Arm
Insertion Loss (S
0.25
0.00
-0.25
-0.50
-0.75
-1.00
Repeatability of
VNA heads is +/-
0.1 dB
S41 Main Arm Insertion Loss, Warm
S41 Main Arm Insertion Loss, Cold
Insertion Loss Spec
210
220
230
240
250
260
270
280
Frequency (GHz)
2009-01-14

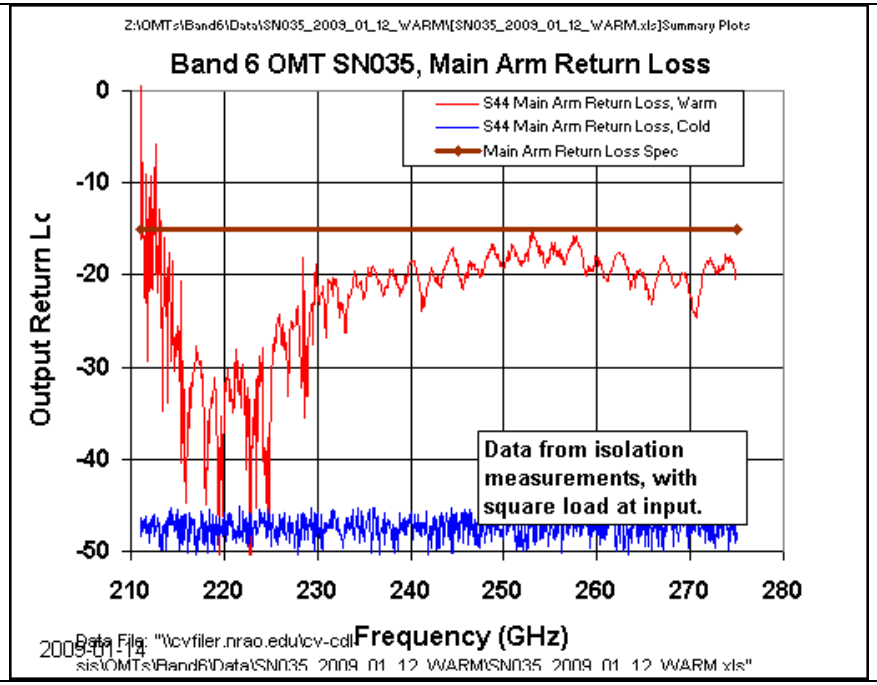

Z:\OMTs\Band6\Data\SN020_2008_05_12_SUMMARY\[SN020_2008_05_12_SUMMARY.xls]Summary Plots
Band 6 OMT SN020, Insertion Loss, Main Arm
Insertion Loss (S
0.25
0.00
-0.25
-0.50
-0.75
-1.00
Repeatability of
VNA heads is +/-
0.1 dB
S41 Main Arm Insertion Loss, Warm
S41 Main Arm Insertion Loss, Cold
Insertion Loss Spec
210
220
230
240
250
260
270
280
Frequency (GHz)
2008-05-12

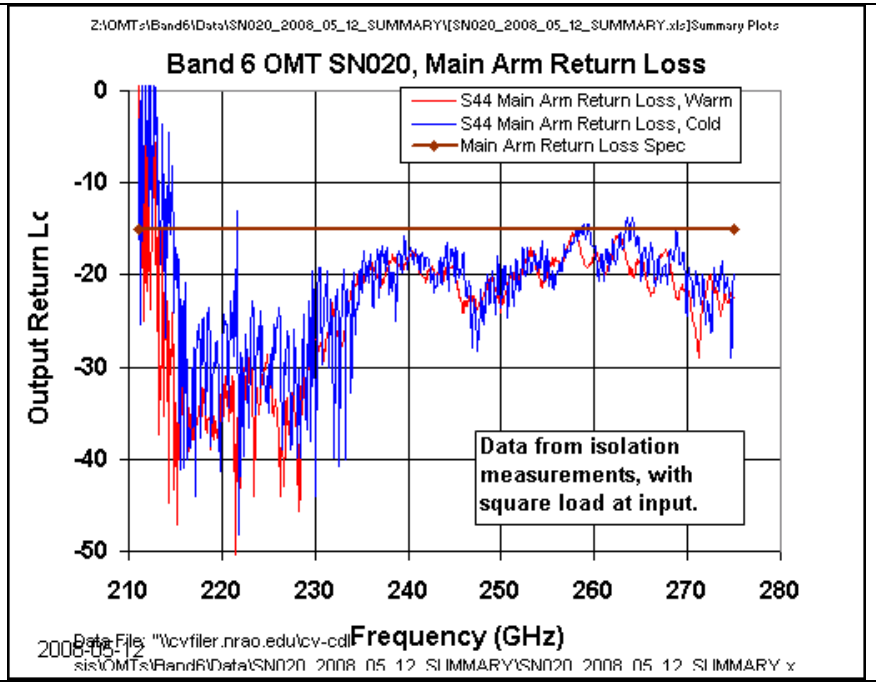

Band 6 OMT SN035, Output Return Loss
S33 Side Arm Return Loss, Warm
S44 Main Arm Return Loss, Warm
Side Arm Return Loss Spec
Main Arm Return Loss Spec
Data from insertion loss measurements, VNA head 1 at input, and other output port terminated.
Output Return Lc
Frequency (GHz)


Band 6 OMT SN020, Output Return Loss
S33 Side Arm Return Loss, Warm
S44 Main Arm Return Loss, Warm
Side Arm Return Loss Spec
Main Arm Return Loss Spec
Data from insertion loss measurements, VNA head 1 at input, and other output port terminated.
Output Return Lc
Frequency (GHz)


Band 6 OMT SN035, Side Arm Return Loss
S33 Side Arm Return Loss, Warm
S33 Side Arm Return Loss, Cold
Side Arm Return Loss Spec
Data from isolation measurements, with square load at input.
Output Return Lc
Frequency (GHz)


Band 6 OMT SN020, Side Arm Return Loss
S33 Side Arm Return Loss, Warm
S33 Side Arm Return Loss, Cold
Side Arm Return Loss Spec
Data from isolation measurements, with square load at input.
Output Return Lc
Frequency (GHz)


Z:\OMTs\Band6\Data\SN035_2009_01_12_WARM\[SN035_2009_01_12_WARM.xls]Summary Plots
Band 6 OMT SN035, Main Arm Return Loss
S44 Main Arm Return Loss, Warm
S44 Main Arm Return Loss, Cold
Main Arm Return Loss Spec
Data from isolation measurements, with square load at input.
Output Return Lc
Frequency (GHz)
0
-10
-20
-30
-40
-50
210
220
230
240
250
260
270
280
2009-01-14
Data File: "\\cvfiler.nrao.edu\cv-cdl


Z:\OMTs\Band6\Data\SN020_2008_05_12_SUMMARY\[SN020_2008_05_12_SUMMARY.xls]Summary Plots
Band 6 OMT SN020, Main Arm Return Loss
S44 Main Arm Return Loss, Warm
S44 Main Arm Return Loss, Cold
Main Arm Return Loss Spec
Data from isolation measurements, with square load at input.
Output Return Lc
Frequency (GHz)
0
-10
-20
-30
-40
-50
210
220
230
240
250
260
270
280
2008-05-12
Data File: "\\cvfiler.nrao.edu\cv-cdl