Memorandum

To:	Wes Grammer	Andrea Vaccari	Skip Thacker	Eric Bryerton
	Christian Holmstedt	Antonio Perfetto	Kamaljeet Saini	
cc:	Dan Koller	Alex Grichener	John Webber	
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From: John Effland

Date: 2004-05-21

Subject: Problems with PLL Attenuators in Production LO

1. Summary

We have been unable to phase lock the production LO for the Band 6 cartridge and the problem has been traced to setting of the attenuators for the phase lock loop (PLL) assembly. The problem appears to be either a LabVIEW software error or a firmware error in the temporary LO monitor and control (M&C) chassis.

Rapid resolution of this problem is important so we can begin measuring gain stability of a complete (except for warm IF amps) Band 6 cartridge.

2. Nature of Problem

Attempts last week to phase lock the production LO failed and the problem was traced to the inability to correctly set the attenuators in the PLL box in the Warm Cartridge Assembly (WCA). When the commanded attenuator value is changed from 4 dB to 5 dB, the read-back attenuator value jumps from 4 dB to 25 dB. The detected power in this case is consistent with the attenuator actually being set to 25 dB. The read-back attenuator value continues increasing by increments 20 dB greater than the commanded value until the commanded value changes from 9 dB to 10 dB when the read-back value jumps from 29 dB to 25 dB. The read-back vs. commanded attenuator values are graphed in Figure 2.

Alex and I spot checked Christian's LabVIEW software routine that converts from a single commanded attenuator value input on the LabVIEW screen to two commanded values required for each attenuator in the PLL box. For our spot check, a value of 20 dB input into the LabVIEW screen was correctly converted by the code so that one attenuator is commanded to 20 dB and the other to 0 dB. However, the read-back value is 25 dB.

Note that the LO group was never able to check this function using the temporary M&C chassis because the software provided was limited to an 11 dB maximum value for both attenuators.

We also confirmed that the problem exists with either of the temporary LO M&C chassis.

3. Equipment Configuration

The cartridge test system was configured to use the CAN bus to control the temporary LO M&C chassis, and the temporary LO M&C chassis was connected to the back of the Warm Cartridge Assembly. The LabVIEW software included Christian's latest Virtual Instrument code that was provided this week.

Figure 1 is the block diagram of the PLL circuit[1] in the Warm Cartridge Assembly. To independently test the PLL assembly, K. Saini recommended injecting a 30 MHz, -20 dBm signal into the "IF Input" port shown in the figure and commanding the attenuators with Christian's LabVIEW program while examining two responses:

1. The read-back attenuator value, which apparently is stored in the AMBSI board on the temporary LO M&C chassis, and
2. The detected PLL IF power, which is from a crystal detector in the PLL box located after the second amplifier in Figure 1 but not drawn in that figure.

Both the read-back attenuator value and the detected IF power are returned to the LabVIEW screen.

4. Test Data

Figure 2 is a graph of both the read-back attenuator value and the detected power *vs*. the commanded attenuator value. This graph shows how the read-back attenuator value jumps at 5 dB boundaries of the commanded attenuator value and how the detected voltage is consistent with the read-back attenuator value.

Further evidence that the PLL attenuators are being set according to the read-back attenuator values is shown in Figure 3. This graphs the detected power as a function of the read-back attenuator value superimposed on data taken by K. Saini. Saini actually measured detected power vs. input power level, but his data was converted to an equivalent attenuation and plotted on this graph.

5. Recommendations

Christian Holmstedt, Andreas Vaccari, and Wes Grammer should work with both the LO group and the Band 6 Cartridge group to check the following functions:

1. Does the LabVIEW software convert the commanded attenuator value to the correct string to send over the CAN bus?
2. Does the AMBSI firmware in the temporary LO M&C chassis decode the CAN string into the proper format for sending to the M&C box in the WCA?
3. Does the M&C box in the WCA correctly decode the attenuator command string to set the proper attenuator lines for the PLL box?

[1] K. Saini, "First Local Oscillator Driver Assembly for Band-6, User Documentation, FEND-40.10.00.00-021-C-MAN, on ALMA EDM at http://almaedm.tuc.nrao.edu/forums/alma/dispatch.cgi/iptfedocs/showFile/100605/d20040427155547/No/FEND-40.10.00.00-021-C-MAN.pdf

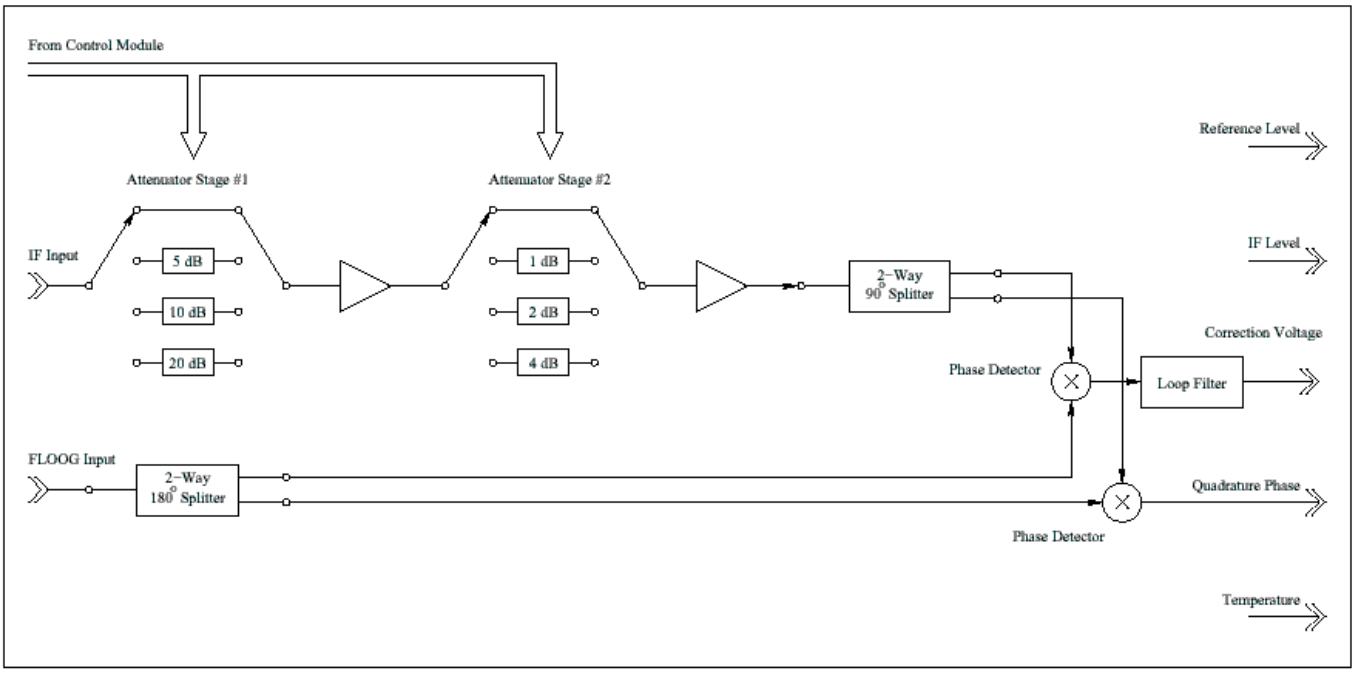

Figure 1: Block Diagram of PLL Circuit

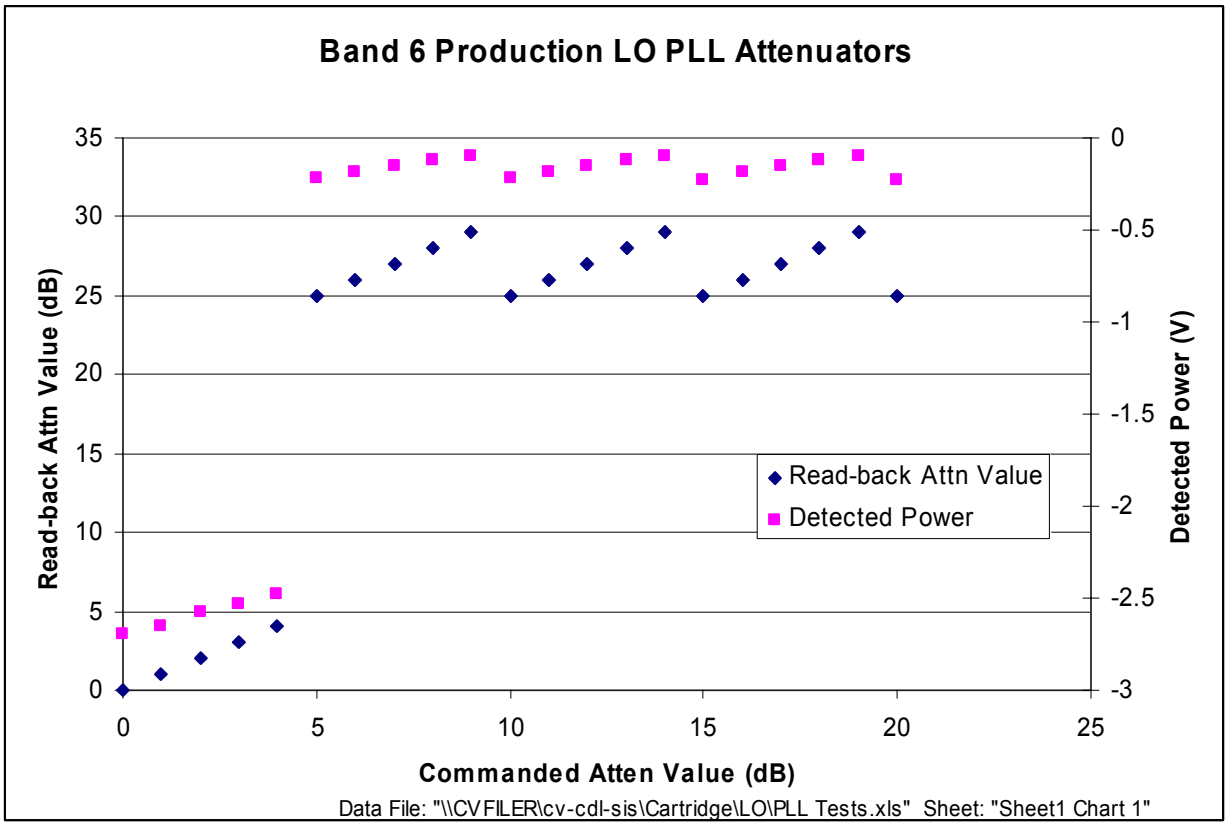

Figure 2: Read-back vs Commanded Attenuator Values and Detected Power

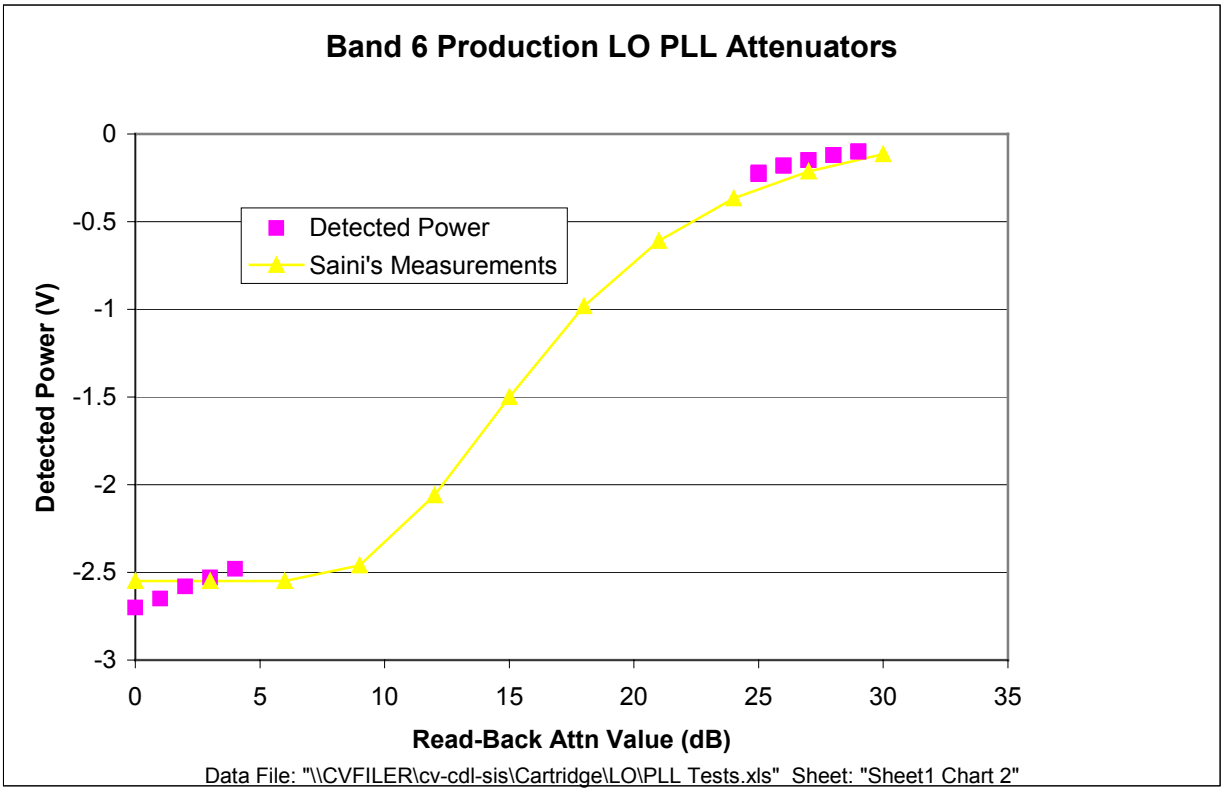

Figure 3: Detected Power vs. Read-Back Attenuator Value