DCR Stability Monitoring of Ku-band Receiver Project TBASErdn030114 January 14, 2003

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1 Setup

The DCR was used to record the total power from the Ku-band (Rcvr12-18) receiver, as detected in the IF Rack. The center sky frequency was 12GHz, and front-end IF 500MHz wide IF filters were selected. IF Rack 3000/320MHz filters were selected. DCR $tau = 1s$, $ScanTime = 300s$, $BlankingTime = 2mS$, and switching mode Total Power with Cal were used. However, because of a misset local control switch in the receiver room, the front-end noise cal was not switching during these tests. Weather conditions were light snow, temperature 21F, and winds of 5-10mph. M&C version 3.9 was active.

2 Measurements

2.1 GBT Stationary

The system was configured so that the receiver IFs were connected to Optical Driver modules 2, 3, 6, and 8. The corresponding Optical Receiver outputs were then connected through two independent Converter and Sampler/Filter module paths. Data from detectors in the ODM and SF modules was recorded by the DCR.

Connections:
Ku-L1 → ODM2 → OR2 → CM1-2 → SF1-2 → DCR ch9-10
Ku-R1 → ODM3 → OR3 → CM5-6 → SF5-6 → DCR ch13-14
Ku-L2 → ODM6 → OR6 → CM11-12 → SF3-4 → DCR ch11-12
Ku-R2 → ODM8 → OR8 → CM15-16 → SF7-8 → DCR ch15-16

The GBT was moved to Elevation 50, Azimuth 44 and held stationary.

Scan 25 st@ 00:39:11 → Scan 27 fi @ 00:54:19.

Discussion: Figure 1 shows the total power during scans 25-27. Channel R2 has an obvious stability problem. Note also the correlated changes in the other three channels. Following scan 27, the GBT was set to tracking mode to see if the variations were caused by sources drifting through the beams.

2.2 GBT Tracking

The GBT was set to tracking RA 06:52:01 Dec 56:52:05

Scan 28 st @ 00:55:57 → Scan 30 fi @ 01:11:15.

Discussion: Figure 2 shows total power from scans 25-30. There is no obvious change in behavior when the GBT was set to tracking.

2.3 Fast Sampling of R2

A one-minute scan was done with $tau = 0.1s$, to better characterize the fluctuations in channel R2.

Scan 31 st @ 01:12:10 → Scan 31 fi @ 01:13:12.

Discussion: Figure 3 shows the total power from R2 and, for comparison, L2. The irregularly spaced dips in R2 total power are most likely due to a intermittant contact in the front-end, perhaps affected by refrigerator vibrations. Figure 4 shows FFTs of the total power.

3 Summary

Total power data was recorded for thirty minutes for all four channels of the Ku-band receiver. Channel R2 exhibits short-term fluctuations of several percent, and requires service. The other three channels show simultaneous fluctuations of $2 - 3\%$, regardless of whether the GBT is stationary or sidereal tracking. Could this be atmosphere? Figure 5 shows the receiver cryogenic temperature during the time of these tests. The temperature sensor bit level is 0.7K, and is logged at 1 minute intervals, so the receiver would have to be quite sensitive to temperature to account for the total power variations seen.

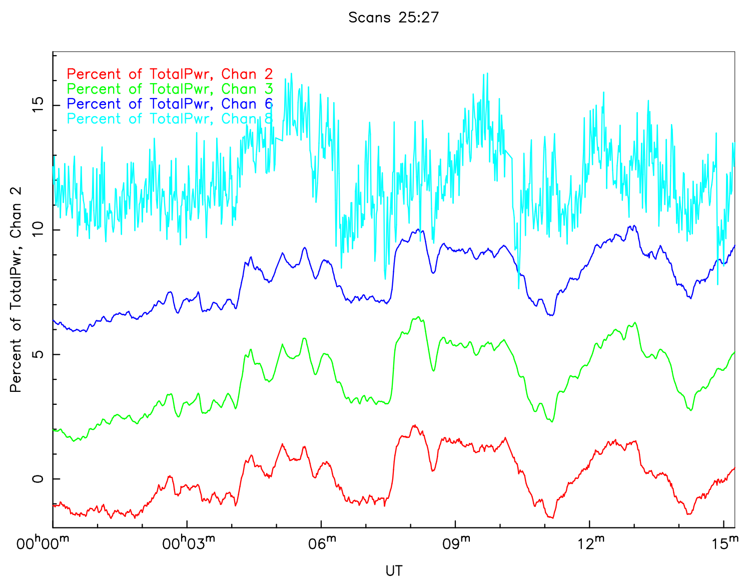

Figure 1: Total Power from Ku-Band channels (from the bottom trace) L1, R1, L2, and R2, as measured at detectors in ODM 2, 3, 6, and 8. The GBT was stationary at El 50, Az 44.

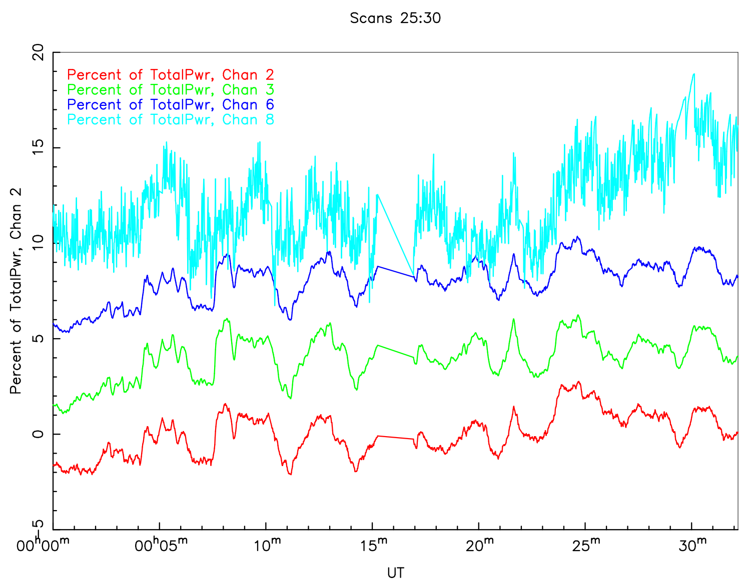

Figure 2: Total Power from Ku-Band channels (from the bottom trace) L1, R1, L2, and R2, as measured at detectors in ODM 2, 3, 6, and 8. The GBT was stationary for the first 15 minutes, and tracking fixed RA and Dec during the final 15 minutes.

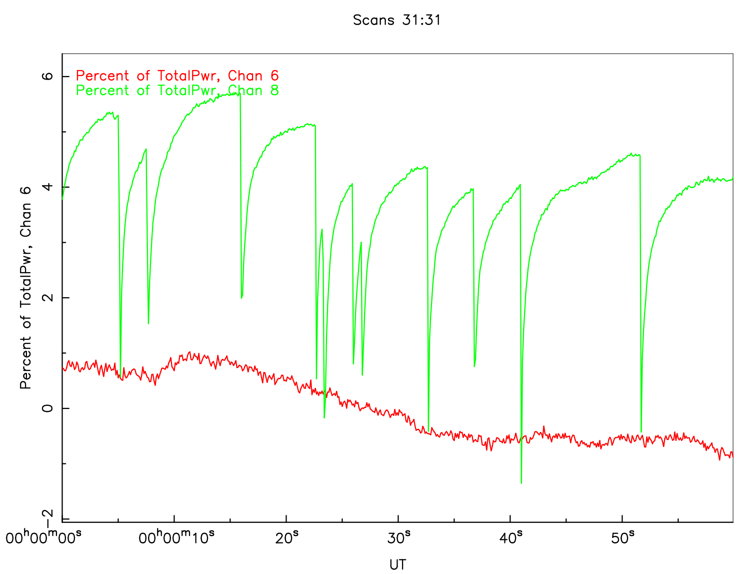

Figure 3: Total Power from Ku-Band channels L2 (red),and R2 (green), sampled at $0.1s$.

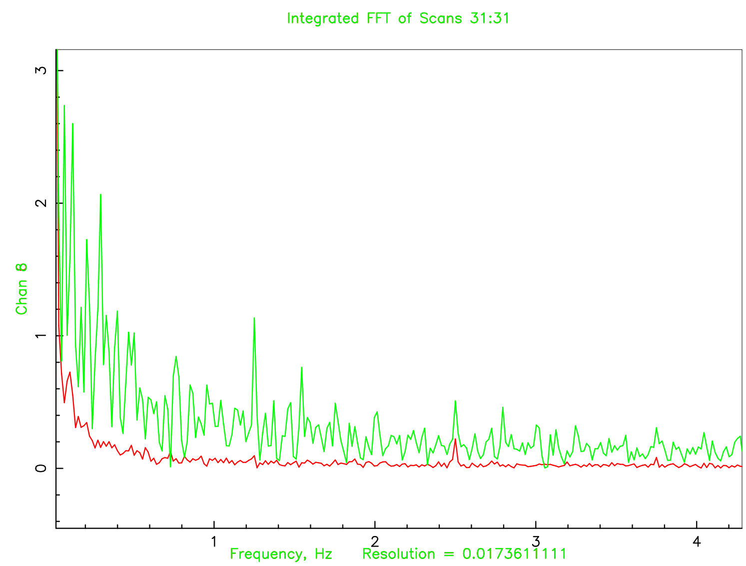

Figure 4: FFT of the total Power from Ku-Band channels L2 (red),and R2 (green), sampled at $0.1s$.

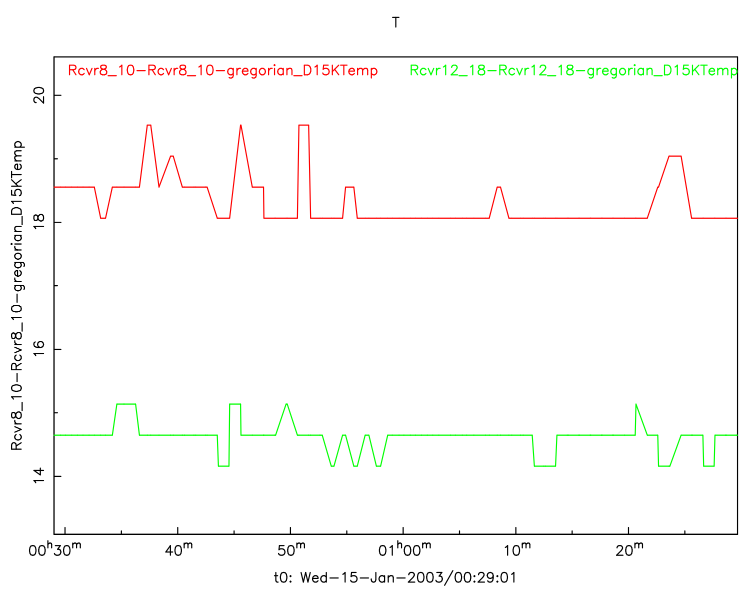

Figure 5: Cryogenic temperatures as measured near the receiver LNAs. Data discussed in this report was taken during the first 45 minutes of this plot.