DCR Stability Monitoring of K-band Receiver
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1 Setup

The DCR was used to record the total power from the K-band (Rcvr18-22 and Rcvr22-26) receiver, as detected in the IF Rack and in the Analog Filter rack.

DCR $tau = 1s$, $ScanTime = 120s$, $BlankingTime = 2mS$, and switching mode Total Power with Cal were used. Weather conditions were clear, temperature 15F, and winds of 5-10mph. M&C version 3.10 was active.

2 Measurements

2.1 Lower K-band Channels

The center sky frequency was 20GHz. IF Rack 6000/1280 MHz filters were selected. Four circular polarizations were recorded.

The system was configured so that the receiver IFs were connected to Optical Driver modules 2, 4, 6, and 8. The corresponding Optical Receiver outputs were then connected through two independent Converter and Sampler/Filter module paths. 800MHz filters were selected in the SF modules. Data from detectors in the ODM and SF modules was recorded by the DCR.

Connections:
K-L1 → ODM2 → OR2 → CM1-2 → SF1-2 → DCR ch9-10
K-R1 → ODM4 → OR4 → CM5-6 → SF5-6 → DCR ch13-14
K-L2 → ODM6 → OR5 → CM9-10 → SF3-4 → DCR ch11-12
K-R1 → ODM8 → OR8 → CM15-16 → SF7-8 → DCR ch15-16

All sixteen DCR channels were recorded.

The GBT was arbitrarily set to track RA 05:00:31; Dec 25:00:00.

Scan 72 st @ 00:40:20 → Scan 81 fi @ 01:01:35.

Discussion: Figure 1 plots the total power from the IF Rack detectors during these scans. Obviously the R1 total power fluctuates wildly, several percent within a few seconds. This is investigated further below. Figure 2 omits the R1 data to allow examination of the other channels. It is clear that the dominate fluctuations (about one-half percent) are correlated across all three channels. Figure 3 shows T_{sys}/T_{cal} during this period. The blip in the L1 and L2 near minute 2 is curious and unexplained. Published T_{cal} values for L1, L2, and R2 are 5.1K, 5.3K, and 3.9K yielding T_{sys} values of 31K, 47K, and 35K respectively.

Figure 4 shows the total power from R1 as measured before and after the fiber link in channel 4. Note that the fluctuations measured downstream are smaller than those measured in the IF Rack. That too is curious and unexplained.

As ODM4 had not been used earlier this evening, the IF signal from R1 was now routed through ODM3 rather than ODM4. Figure 5 shows six minutes of data with this configuration. It appears that the R1 signal begins with large fluctuations and gradually settles down.

We then routed the IF Rack noise source to ODM4, and recorded another six minutes of data, shown in Figure 6. The R1 channel continues settle down. And, the Noise Source via ODM4 seems reasonably stable. To the eye, there appears to be short-term fluctuations that are correlated between the R1 channel (green) and noise source (blue) traces - this is quite unexpected.

2.2 Upper K-band Channels

The system was reconfigured to examine the upper K-band channels. The center sky frequency was 24GHz. IF Rack 6000/1280 MHz filters were selected, and four circular polarizations were recorded.

The system was configured so that the receiver IFs were connected to Optical Driver modules 2, 4, 6, and 8. The corresponding Optical Receiver outputs were then connected through two independent Converter and Sampler/Filter module paths. 800MHz filters were selected in the SF modules. Data from detectors in the ODM and SF modules was recorded by the DCR.

Connections:

K-L3 → ODM2 → OR2 → CM1-2 → SF1-2 → DCR ch9-10
K-R3 → ODM4 → OR4 → CM5-6 → SF5-6 → DCR ch13-14
K-L4 → ODM6 → OR5 → CM9-10 → SF3-4 → DCR ch11-12
K-R4 → ODM8 → OR8 → CM15-16 → SF7-8 → DCR ch15-16

All sixteen DCR channels were recorded.

The GBT continued to track RA 05:00:31; Dec 25:00:00.

Scan 88 st @ 01:21:22 → Scan 90 completed as the observing time came to a close.

Discussion: Figure 7 shows total power as measured at the IF Rack. The data recorded from the Analog Filter rack was also examined, but not printed,

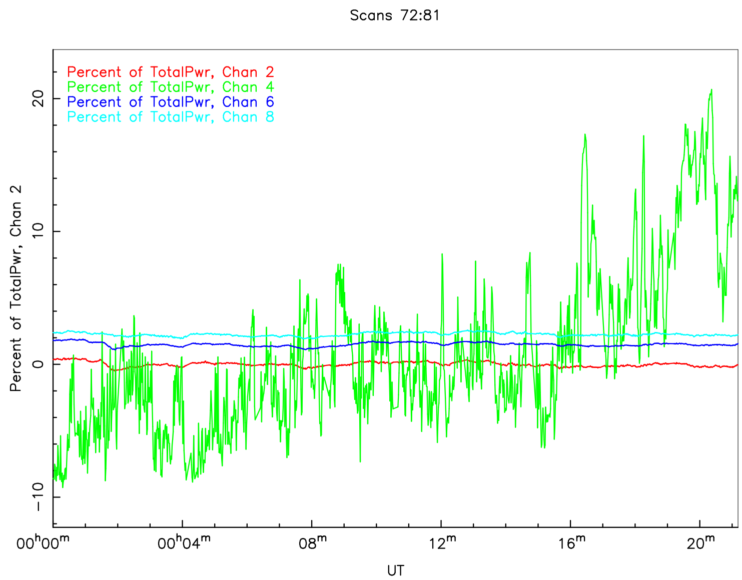

Figure 1: Total Power from K-Band channels L1 (red), R1 (green), L2 (blue), and R2 (cyan) as measured at detectors in the IF Rack. The traces are offset by 0.75% for clarity.

and found to track the IF Rack data quite closely. Figure 8 plots the T_{sys}/T_{cal} data for the high-band channels. Published T_{cal} values for L3, R3, L4, and R4 channels are 2.9K, 4.0K, 3.0K, and 3.9K yielding T_{sys} values of 46K, 50K, 38K, and 41K respectively.

3 Summary

All eight channels of the K-band receiver were tested using the DCR. It was found that one channel, R1, fluctuated by several percent in a few seconds in the early part of the test period, but gradually settled down. There seems to be an intermittant problem somewhere between the feed and the IF Router. A few other less significant phenomenon were noted and need further study.

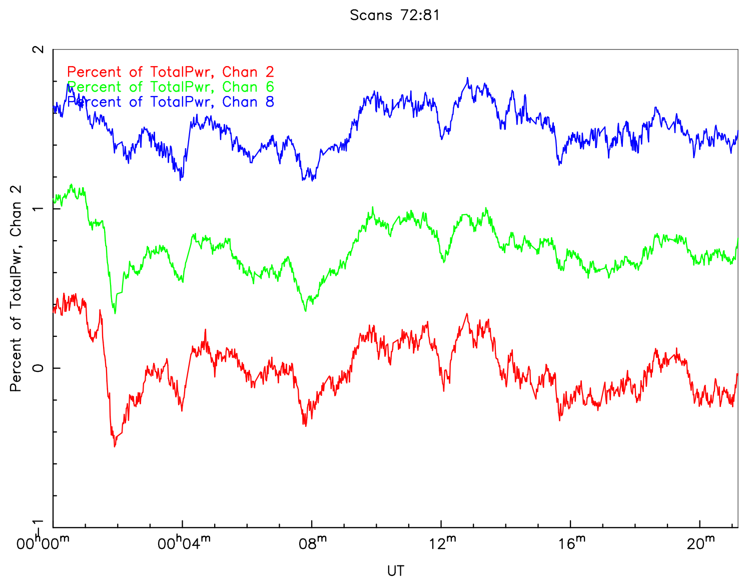

Figure 2: Total Power from K-Band channels L1 (red), L2 (green), and R2 (blue) as measured at detectors in the IF Rack, omitting the fluctuating R1 channel. The traces are offset by 0.75% for clarity.

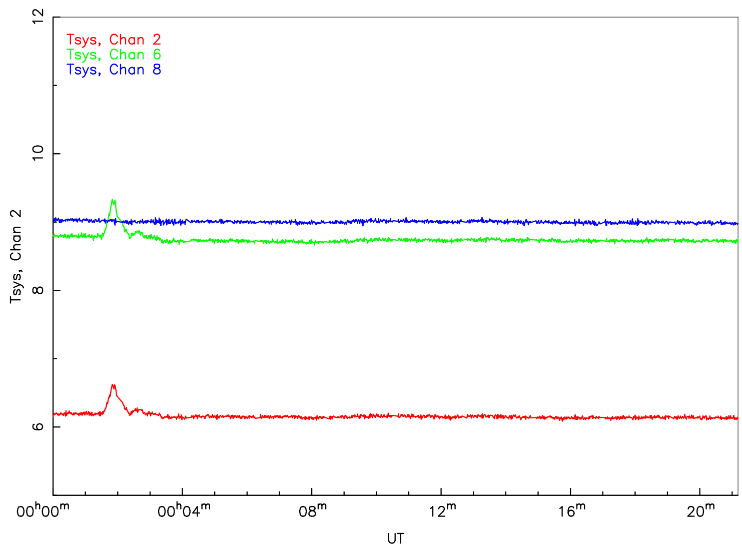

Figure 3: T_{sys}/T_{cal} from K-Band channels L1 (red), L2 (green), and R2 (blue) as measured at the IF Rack detectors.

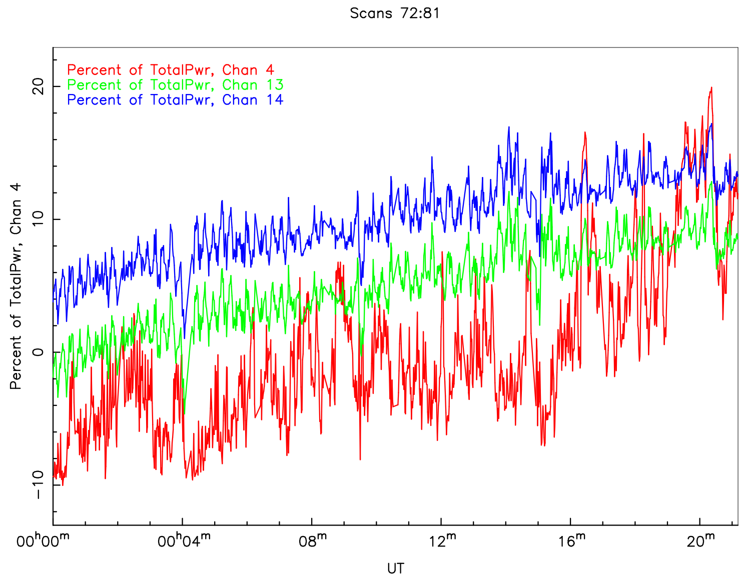

Figure 4: Total Power from the R1 channel as measured at the ODM 4 (red), SF5 (green), and SF6 (blue) detectors. The traces are offset by 0.5% for clarity.

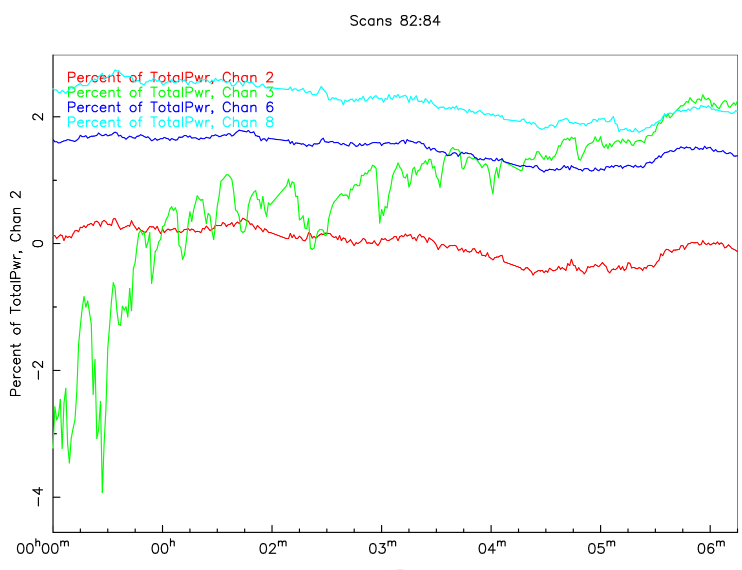

Figure 5: Total Power from channels L1 (red), R1 via ODM 3 (green), L2 (blue), and R2 (cyan) as measured at the IF Rack detectors.

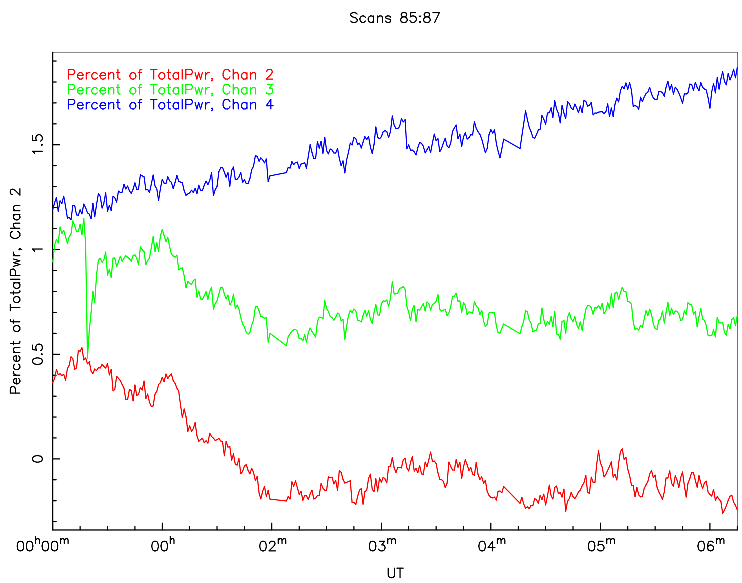

Figure 6: Total Power from channels L1 (red), R1 via ODM 3 (green), and the IF Rack noise source via ODM4 (blue), as measured at the IF Rack detectors.

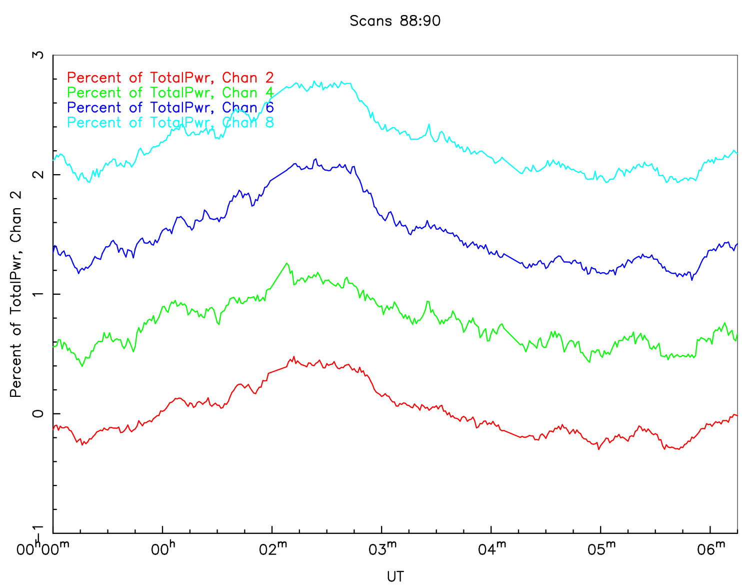

Figure 7: Total Power from channels L3 (red), R3 (green), L4 (blue), and R4 (cyan) as measured at the IF Rack detectors.

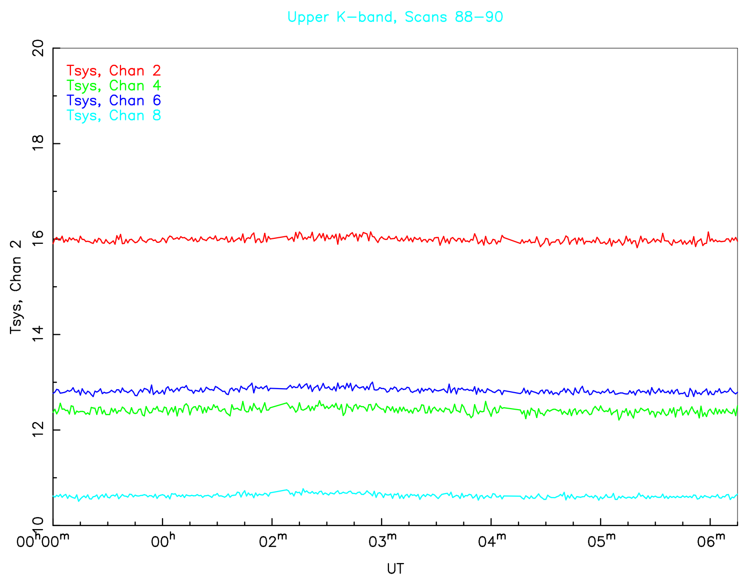

Figure 8: T_{sys}/T_{cal} from K-Band channels L3 (red), R3 (green), L4 (blue), and R4 (cyan) as measured at the IF Rack detectors.