GPIO boards in pressure systems

These are the serial numbers of the Diamond GPIO-MM-12 cards used in each pressure system, along with the clock rates that were determined for each card. Following the tables is a discussion of the clock rate calibration procedure. Plots of the clock calibrations are viewable as attachments, under the **Too ls** menu.

Pressure1

board	SN	corrected clock rate (Hz)
0	302859	20,000,292.73
1	302828	20,000,450.67
2	302832	20,000,284.66
3	302871	20,000,072.66
4	302835	20,000,242.86

Pressure2

board	SN	corrected clock rate (Hz)
0	302821	20,000,314.13
1	302829	20,000,364.39
2	302826	20,000,354.37
3	302874	20,000,342.21
4	302842	20,000,346.47

GPIO-MM Clock Calibrations

Prior to AHATS, a calibration of the 20 MHz clocks on each of the diamond GPIO-MM-12 cards was performed using the rubidium referenced signal generator in the NCAR EOL sounding lab.

The reference frequency was stepped in 10 KHz increments from 110 to 300 KHz approximately every 10 seconds. The GPIO cards were configured to count the number of tics from the onboard 20 MHz clock while counting 10,000 cycles of the reference input, which is the same manner that the frequencies of the ParoScientific temperature transducers are sampled. These counts are repeated every 0.1 seconds. The resulting frequency measurements were then compared against the reference frequencies.

See the attachments to this blog for plots of the calibrations.

The upper left plot shows the linear relation between the mean error in the frequency measurement and the reference frequency.

The slope of the least squares linear fit to the data is a correction for the 20 MHz clock on the GPIO-MM:

corrected clock frequency = 20 MHz / (1 + slope)

The upper right plot is the measurement error after applying the corrected 20MHz clock rate to the data.

Lower left is a plot of various measurement errors. The top black points are the frequency discretizaion due to a difference of one 20 MHz clock tic. As you can see, below a 200 KHz input frequency the resolution is better than 1 part in 10^6, which is the target accuracy for sampling the ParoScientific 202BGs. The temperature signal from a 202BG is around 170 KHz and the pressure signal is around 40 KHz, so a 20 MHz clock is able to provide this accuracy.

*max(abs(fcor-fref))*is the maximum absolute difference of the measured, clock corrected frequency from the reference frequency for the 100-300 samples at each reference frequency. This maximum error seen in the test stayed below the 1:10^6line except for some points at frequencies over 200 KHz. Board 3 in pressure2 was the exception and did have some points over the line. We should repeat the calibration after the project.

The maximum error also generally stayed below the frequency discretization level, suggesting that after the clock is corrected, almost all of the remaining error is due to the discretization. Boards 1,2 and 3 however do show some errors above the discretization level.

mean(fcor-fref) are the mean measurement error points at each frequency.

The lower right plot shows the number of samples at each frequency. The tests were sometimes performed more than once, or with more than one input pulse counter, hence we usually have more than the 100 samples expected over 10 seconds.

The effect of temperature on the on-board 20 MHz clock is not known.