Vicor Power Supply tests at UIUC

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(with JJT and IK)

This is the summary of the tests power supplies performed at the Monsoon test stand at the UIUC. This file is accompanied by a set of plots in Plots.zip. In the Plots folder, file UIUC Vicor PS Tests contains the description of the plots.

The test used flat field readout that was written for a similar test stand at Fermilab in October 2005. Specifically, we used the Fermilab focal plane from October 2005, with the sequencer ReadType2a.asm.

We used the CCDACQ prototype card that Fermilab group used on the test stand before November 8, i.e. before the 8 channels' cards arrived. Sequencer ReadType2a reads a 2K x 4K pixels CCD. One CCD output goes to the ADC channel 0 and the other to the ADC channel 2. Instead of a CCD, the video input to channels 0 and 2 on the CCDACQ card was shorted at the far end of the input cable (several feet long).

We produced FITS files with this setup

- using linear power supplies
- using VICAR power supply

We then compared the noise in the fits files, and characterized the noise. We also looked at the noise as a function of ADCOffsets.

1. Linear Power Supply

We varied the ADC Offsets so the observed mean value of the ADC/Pixel covered the range of the ADCs, with the noise remaining approximately constant, σ between 22 and 24 ADUs. We did not observe any periodicity in the signal looking along a single row, or time dependence across the rows. We observe ADCs output which is a linear function of the offsets.

2. VICOR Power Supply

We replaced all power supplies in the Monsoon test stand with the VICOR. We observed a much broader signal, σ = 48.4. Closer inspection of the distribution of # of ADUs per pixel showed three overlapping peaks contributing to the width. Looking at the pixels along a single row we saw obvious periodic spikes whose top and bottom values corresponded to the two side-peaks . The spikes were clearly periodic and occurred every 54 pixels. The ReadType2a sequencer reads each pixel 48 us, so these oscillations were about 400Hz.

3. From Linear to VICOR Power Supply, one voltage at a time.

We went back to the linear power supply to introduce one switch supply at a time, and see its effect.

When we took data with the linear supply alone we observed a new feature in the image in the FITS file: bands of rows of different 'illumination'. The mean value at the bottom of each side (U/L, ADC0/ADC2) was about 40 ADUs higher than the mean value at the top. With the ReadType2a sequencer, it takes 48 msec to read out one row, and about 192 sec to read out the entire array. This broadened the noise from the intrinsic σ = 13.6 ADU at each band to the overall σ = 21.3 /19.7 ADU (for channel 2 and 0, respectively). We don't understand this time dependence of the signal.

We then replaced linear supplies with VICOR components:

- +15 V (for the analog circuits). We see
  NO multiple peaks in the overall pixel distribution.
  NO spikes in the pixels along each row.
  The difference between the means at top /bottom < 15

- -15 V (analog) and +15 V. We see
  some spikes in the pixels along each row but NO periodicity

The difference between the means at top/ bottom ~ 60

- -5 V (analog) and -15 V (analog), +15 V(analog). We see NO periodic oscillations
  The difference between the means at top /bottom 40-60 intrinsic width is narrow but this “vertical” slope yields σ = 21.6/18.3 (ADC0/ADC2)

- +5 V (analog) and -5 V, -15 V, +15 V(all analog). We see Strong periodic oscillations with the period of 100 pixels ~ 200 HZ along each pixel row
  The difference between the means at top /bottom 60

- 5 V and 3.3 V (Digital), and -5 V, -15 V, +15 V(analog) I.e., VICAR except for the linear supply for +5V (analog). We see:
  A lot of structure in the signal, pixel distribution has a double peak.
  Multiple periodic oscillations at +/- 150 ADU. Every 20 pixels (1 kHz), 60 pixels (300 Hz), 7 pixels (3 kHz) (lot’s of ratios of 3)

The oscillations seem to point to the +5V (analog) and 5 V and 3.3 V (Digital) VICOR supplies. As Peter Moore pointed out, the supplies are running under-loaded. We didn’t have the time to test the effect of adding a load on them, or to try to reduce radiation due to Eddies.