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FIRST READ ANOMALY TESTS

Peter Moore 22nd November 2001.

Summary

It has been noticed that the first readout of a 'multrun' command always seems corrupted. This corruption (usually) takes the form of an increase bias level without any additional noise increase. A series of multrun 4 integrations was performed using an increasing integration time (0.75 -> 250 sec.). These data were processed to analyse and quantify the effect. It was seen that:

1) At short integration times the effect is greatest (20 ADU equivalent at 0.75 sec.)
2) That the effect crosses over with an integration time greater than 50 seconds (i.e. for integrations greater than 50 sec. there is a decrease in the bias level).
3) For integration times greater than 200 sec. The effect is below the noise threshold of the measurements (2 ADU).
4) For the lowest integration time (i.e. 0.75 sec.) there is an additional increase in bias for all reads (not just the first). The increase is of order 10 ADU.
5) Quadrants 3 and 4 of the detector exhibit near zero influence from integration times greater than 0.75 sec. Quadrants 1 and 2 exhibit a residual linear increase in signal with increase in integration time. This may be caused by incorrect dark current correction to these quadrants.

Conclusions

It is concluded that the same micro thermal events during a read operation that cause the quadrant gradient (and for which flushing cycles were implemented) leads to a general increase in temperature to sensitive areas of the mux (Vbias structure). The localized heating during the first read would cause a temperature gradient within the device that would tend to go towards equilibrium during the integration period while at the same time the energy is being dissipated through the ceramic package to the cold finger. If the time to dissipate the extra thermal energy is greater than the integration time then the second read will begin with a higher bias value than the first. The reliance of bias value on temperature has been measured to be 123.5 ADU / ^{o}K. From this we can deduce that the temperature difference reached by this localized region during a read is approximately 162 milliK and the time constant to dissipate this extra thermal energy is 50 seconds.

Solution

I believe that the effect is only seen when the device is being read i.e. the channel outputs are enabled. This being so we should instigate a process that will maintain the temperature of the sensitive area at the maximum temperature attained during a readout. This would require that we read the device continuously at the same rate as that of a normal readout but without sending data to the acquisition host. Unfortunately the SDSU architecture does not allow for such a high overhead task to be run and still manage the communication and house keeping processes that are required. However, a close approximation could be attempted that would, if the conclusions are correct, significantly reduce the effect to below noise levels. This process would replace the currently used practice of flushing the array.