4 RECEIPT Comm Inspection

36-01510.020

ACIS Verification Summary Report

Specification:	ACIS Contract End Item Specification
Requirement Number/Title:	3.1.3.2a Event Modes (VRSD 3.1.3.2a-9)

Requirement Statement: The bias and dark current removal processing shall accommodate frame-to-frame variation of detector bias level.

Verification Method:	Analysis of Test Data

Procedure Number:

Configuration:

Cycle Time:

Verification Discussion/Results:

See ACIS memo 138

20 June 97

ACIS Cognizant Engineer Date

ACIS Memo # PS - 138

DATE: June 20, 1997

TO: ACIS Science Team

FROM: Beverly LaMarr

RE: Comparison of XRCF Flat Field High Speed Tap and Telemetry Data.

CC: file

By comparing the flight software telemetry with the high speed tap data it can be shown that the x-ray event information telemetered by the flight software preserve the spectral, time, and position information from the raw data frames. Both the pixel by pixel and the frame by frame bias variations are accounted for in the telemetry.

During flat field calibration operations at the XRCF in May of 1997, telemetry data and high speed tap data were taken simultaneously for a number of sources for all ten of the flight devices.

The standard procedure was to begin a science run, then use the high speed tap to collect raw data frames for each of the chips being operated.

After some processing, the event list generated from the raw high speed tap data frames can be directly compared with the events telemetered by the flight software.

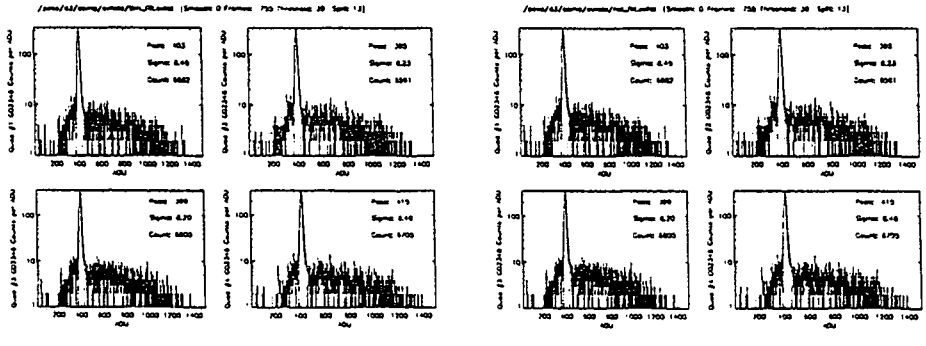
Event List Comparison

Both of the event lists in the comparison contain events from 755 frames. The average number of events per frame in the 56 rows of the comparison is 56.6 events per frame. The total number of events in the filtered telemetry event list is 42738. There are 42768 events in the filtered high speed tap event list.

Spectral Resolution Comparison

After subtracting the average bias and delta-overclocks, the event amplitudes in the two event lists can be directly compared. The spectra for grades 0, 2, 3, 4, and 6 for both the high speed tap and telemetry event lists are shown below.

Telemetry	High Speed Tap

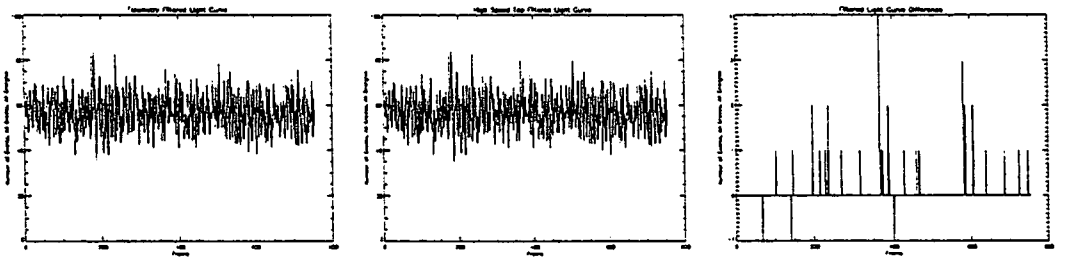


The peak and sigma fit to the data for each of the four quadrants is the same for each of the event lists.

Event Timing Comparison

The total number of events in each frame is shown below for both the telemetry event list and the high speed tap event list as well as the difference between the two.

Telemetry	High Speed Tap	Difference



Position Comparison

Subtracting the event list images for the two files shows that there are 124 pixels for which the total number of events is different.

Ninety-six of the differences are due to split events which, because to differences in the biases or processing order, have a difference in the position of one row or column.

The following is an example of an event found in the exposure taken at 22:45.558 GMT (frame 502 for the high speed tap, frame 5075 for the telemetry). Due to the 3 ADU difference in the bias levels, the peak of this split event was found at two different positions.

	Telemetry Event				High Speed Tap Event				Bias Difference			
r/c	169	170	171	172	169	170	171	172	169	170	171	172
9		1	1	4	2	2	3		-2	-1	-2	+2
10		124	125	-4	2	127	126		+1	-3	-1	-3
11		65	96	-3	1	66	97		-2	-1	-1	+2

The remaining events which don't appear in both lists are events which are, due to the variations in the bias, either below the threshold, or are no longer the local maximum.

The Data Set

The data set chosen for this comparison is TRW ID I-IAS-EA-2.017. The chip is s4 (aka. w457c4). The anode is silicon. The data set was captured on 09 May 1997 at 22:12 GMT.

This set was chosen because there were no dropped high speed tap frames, there were no bad high speed tap frames, and the telemetry event list is currently available in Cambridge.

The Telemetry Data Processing

The telemetry event list is from Science Run 72, which began on 09 May 1997 at 17:48 GMT as TRW ID I-IAS-SG-2.008.

The parameter block used was xfaint_win_s.te. xfaint_win_s.te is full frame, faint telemetry, trickle bias, with a window.

The window block used was xsik56b50.2d. For the s4 chip, this has two windows. The first window begins at row 9 (counting from 0) and is 28 rows high. The second window begins at row 972 and is 28 rows high. All 1024 columns were telemetered.

The first event for the science run was on 09 May 1997 at 18:03 GMT. The last event for the science run was on 09 May 1997 at 23:49 GMT.

An ERV event list and fits format average bias frame for this science run were created from the ACIS telemetry using PSCI. For a description of PSCI and the ERV format see http://acis.mit.edu/ttools/psci.html.

The ERV format event list was converted to ACIS RV format using an IDL program which combines the fits format average bias file and the ERV format event list. For a description of the ACIS RV format see http://acis.mit.edu/ttools/acis-analysis.html.

To directly compare the telemetry event list with the high speed tap event list, events which the telemetry includes but the high speed tap does were removed. There are three types of events that the high speed tap event list does not include; events on quadrant boundaries, events taken before (22:17 GMT) or after (23:00 GMT) the high speed tap data were captured, and events in frames that the high speed tap dropped.

The High Speed Tap Data Processing

The high speed tap event list used was taken as TRW ID I-IAS-EA-2.017, which began on 09 May 1997 at 22:12 GMT. The first event was at 22:17 and the last event was at 23:00 GMT.

An RV format event list was created from the fits format bias frames (taken with the gate valve shut, immediately prior to the data) and the fits format data frames using "xrcf_find_events".

To directly compare the high speed tap event list to the telemetry event list the high speed tap times and coordinates were converted to telemetry times and coordinates, and events not included in the telemetry event list were removed.

The times had to be converted because the telemetry times are given in seconds from the beginning of 1997 while the high speed tap times are given in seconds from the beginning of 1994.

The coordinates needed to be converted because the telemetry row and column coordinates are given in chip coordinates while the high speed tap coordinates are given in readout coordinates.

There are two types of events that the high speed tap event list includes that the telemetry event list does not; events that occur outside of the telemetry window, and events in frames that the telemetry dropped.

AXAF-I Verification Requirement Compliance Data Submittal

Element: ACIS

Requirement Number: 3.1.3.2

Verification Item: 3.1.3.2a-9

Evaluators: CHE, DMS, IN&C, SAO

Type of Review:
- ☐ Verification Item Closure
- ☒ Requirement Closure

Requirement Title: Event Modes

Compliance Data/Location: MA-282/36-01510.020/Rm 522 Bldg 4200 (Closure Report)

Verification Method: Test

Comments:

SAO/COJ - APPROVED, 6-25-97

IN&C - Disapprove: Data provided (Memo 138) does not seem to address the test described in the VRSD.

See attached memo of 7/25 to show compliance with frame-to-frame detector bias subtraction.

This step was done automatically in the data analysis set of memo #138, but the detailed demonstration was not shown or discussed.

William Mayer
7/25/97

Status: Open 6/24/97

Recommendation:
- ☐ Approve
- ☒ Disapprove
- ☐ Other (Explain)

Action Required for Closure: Provide data from test proposed in ACIS CEI Spec Matrix, 36-01403, pg 7.

MSFC Evaluator:	Date:	Organization:	Phone Number:
Ken Reed	7/9/97	EJ32	4-8560

Disposition:
- ☐ Approve
- ☒ Disapprove
- ☐ Other (Explain)

Action Required for Closure: Assuming req't 3.1.3.1a-2 is approved, the necessary thing to show here is that from frame to frame the bias level compensation changes. The memo PS-138 does not show evidence of compliance to this req't. .

Chief Engineer:	Date:
Anthony R. Lavoie	7/14/97

DATE: July 25, 1997

TO: ACIS Science Team

FROM: Beverly LaMarr

RE: XRCF Flat Field Telemetry Bias Subtraction.

CC: file

The ACIS flight software telemeters enough information to create spectra that have been corrected for both pixel by pixel bias variations and frame by frame bias variations.

Pixel by Pixel and Frame by Frame Bias Corrected Spectra

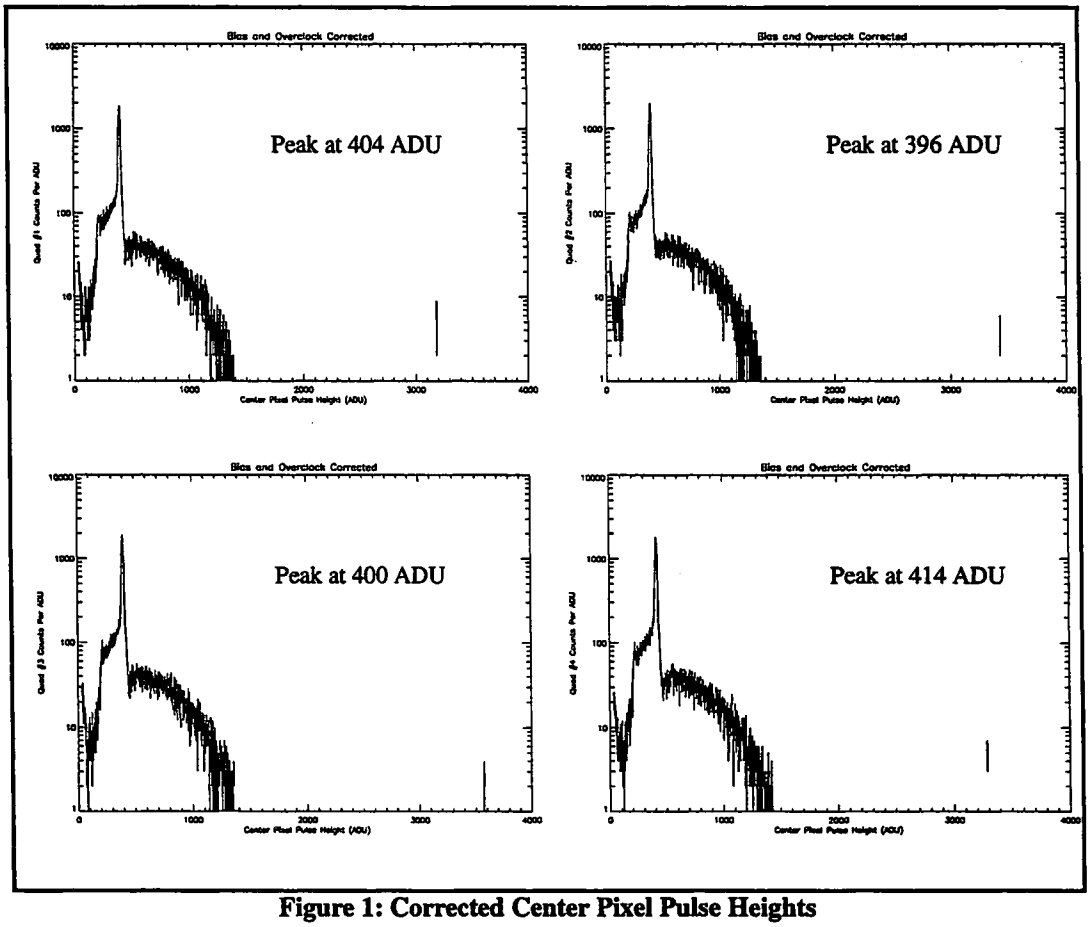


Figure 1: Corrected Center Pixel Pulse Heights

Figure 1 shows histograms of the corrected center pixel pulse heights for the data set. Each pulse height has been corrected for both the pixel by pixel variations in bias and dark current as well as the frame by frame variations in the average bias level for each quadrant.

This data set was taken in the Timed Exposure, faint telemetry mode. This means that:

- For each science run, the flight software telemeters an average bias value for each pixel of each chip being used. This is one of 1024 x 1024 pixel bias values in the average bias file.

- For each data frame, the flight software telemeters an average bias change for each quadrant of each chip being used. This is the delta overclock value.
- For each event, the flight software telemeters the position and pulse heights for the 3 x 3 pixel region of the event. This is a single row in the event list.

The corrected pulse height values in Figure 1 were created by subtracting the pixel bias value and the delta overclock value from each of the pulse heights in the event list.

Pixel by Pixel Bias Correction

At the beginning of the science run several frames were captured, x-ray events were discarded, and the frames were averaged, then the bias information was telemetered by the flight software. The resulting bias map has a single value used to correct each pixel.

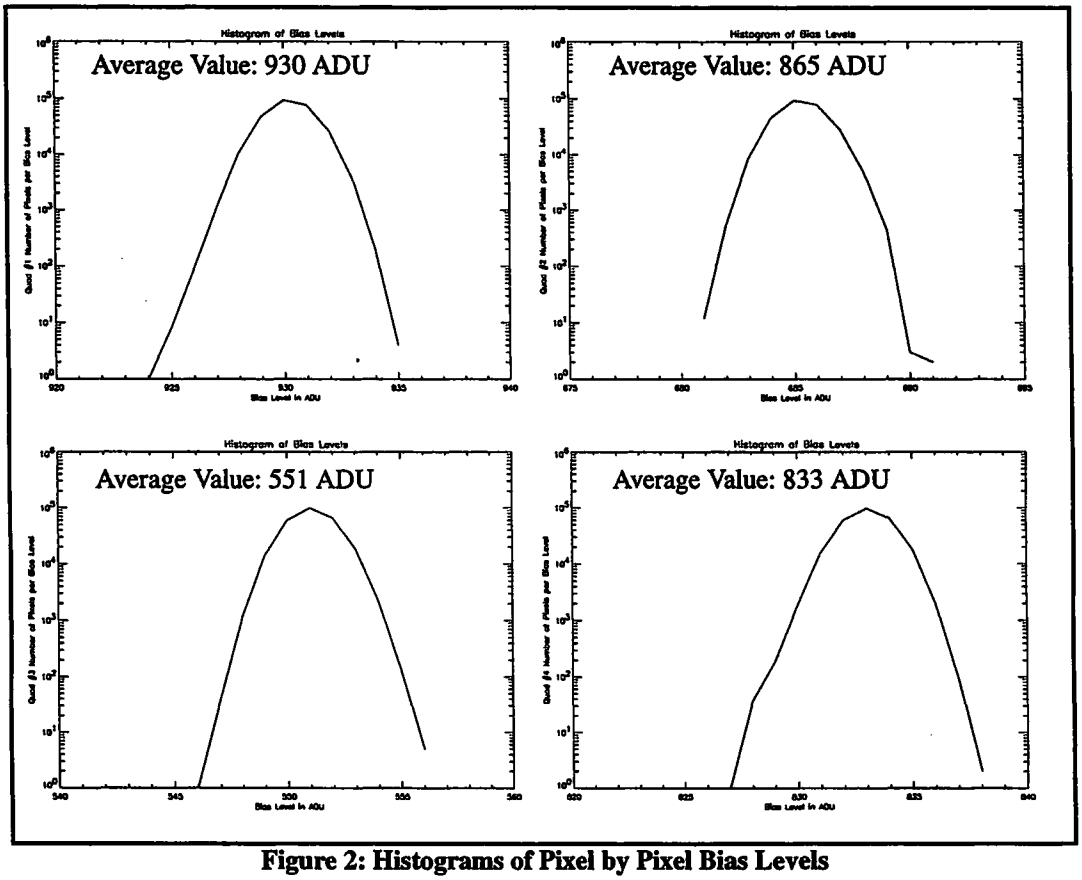


Figure 2: Histograms of Pixel by Pixel Bias Levels

Figure 2 shows the histograms of the pixel bias levels for each of the four quadrants.

Figure 3 shows the histogram of the center pixel pulse heights without the pixel bias correction applied. While the general shape of each of the curves is the same, the peak for each quadrant is shifted positive by the average of the bias level.

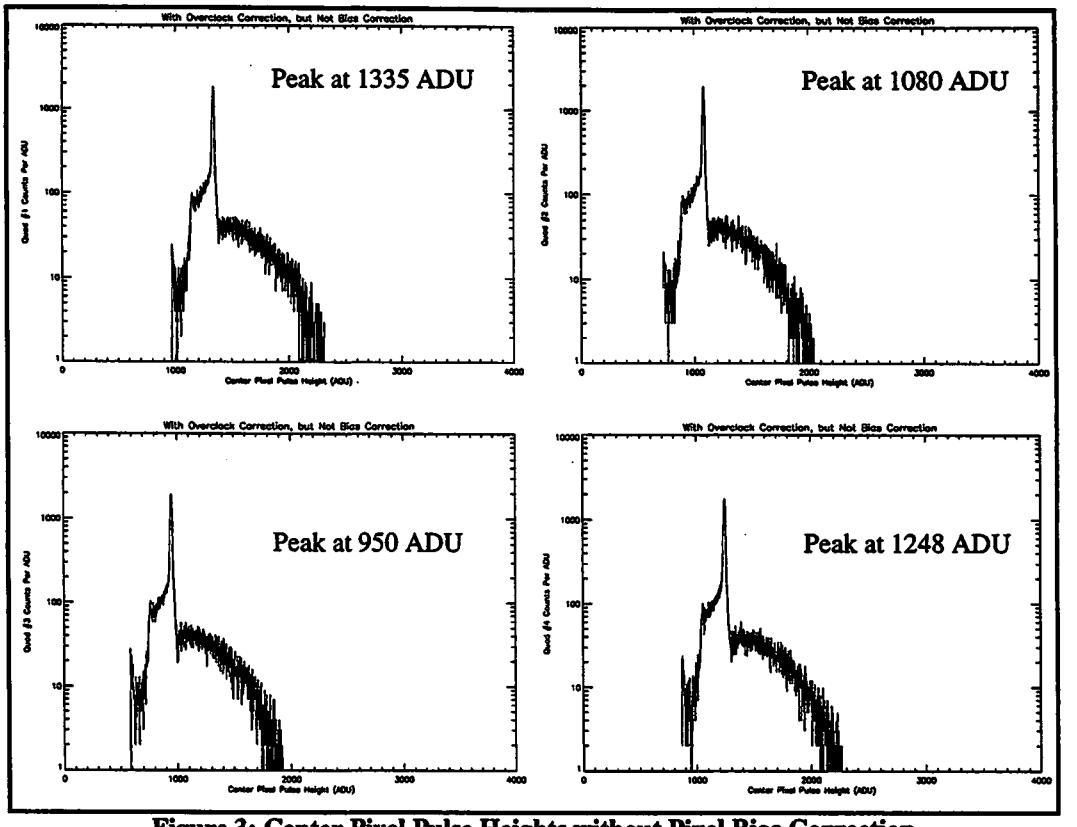


Figure 3: Center Pixel Pulse Heights without Pixel Bias Correction

Frame by Frame Bias Correction

The frame bias values are determined by taking average overclock values. At the end of each row in every frame the serial output shift registers are clocked additional times. The flight software computes an average overclock for each quadrant. The change of the overclock values from the beginning of the Science Run, delta overclock, is telemetered by the flight software for each data frame.

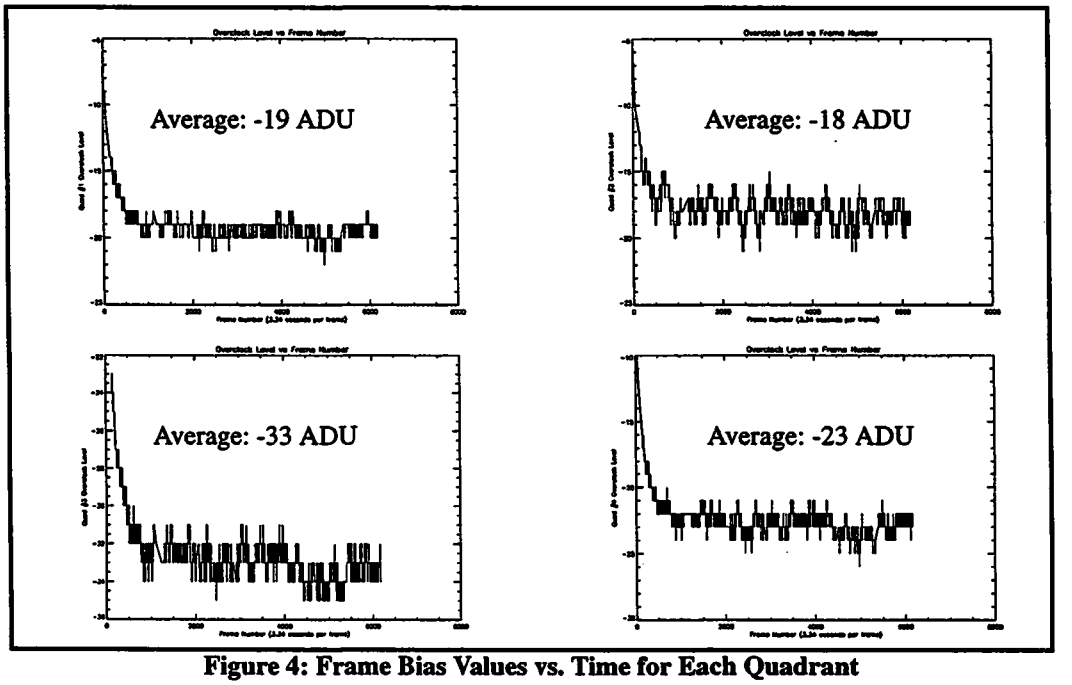


Figure 4: Frame Bias Values vs. Time for Each Quadrant

Figure 4 shows the frame bias values telemetered by the flight software for each data frame.

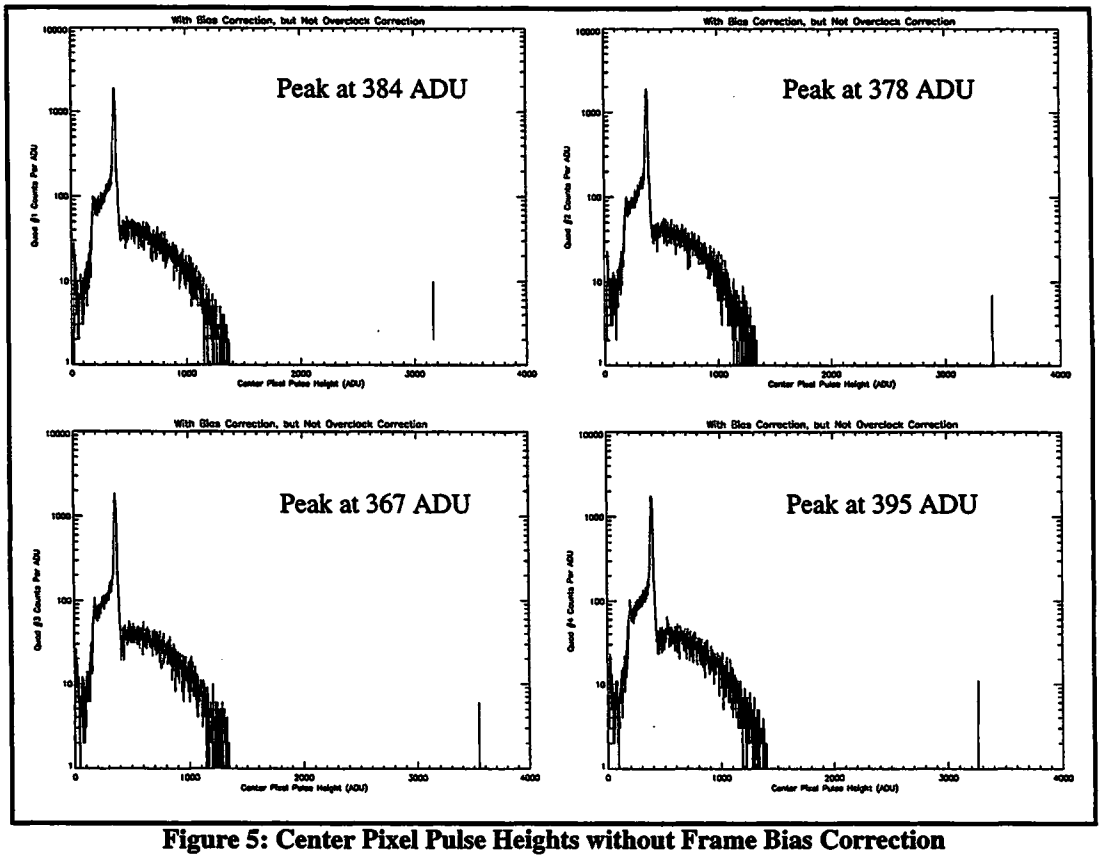


Figure 5: Center Pixel Pulse Heights without Frame Bias Correction

Figure 5 shows the histogram of the center pixel pulse heights without the frame bias (delta overclock) correction applied. While the general shape of each of the curves is the same, the peak for each quadrant is shifted by the average of the frame bias.

The Data Set

The data set chosen for this comparison is Science Run 72. The chip is s4 (aka. w457c4). The anode is silicon. The data set was captured on 09 May 1997 at 17:48 GMT.

The parameter block used was xfaint_win_s.te. xfaint_win_s.te is full frame, faint telemetry, trickle bias, with a window.

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