REVISIONS

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ACIS SW Continuous Clocking CCD Options Verification Procedure

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List of Undetermined Items

1.

1.0 Introduction

1.1 Identification

FileName: `CcOpt.book, rev A`

1.2 Objective

The objective of this test procedure is to verify those items in the Software Requirements Specification (Ref. 1) listed in Table 1.

Table 1: Extract from Software Requirements Traceability Matrix

#	SRTM #	SRS Reference 36–02406–01	SRS Table	Software Requirements Verification Matrix Description	Comments
1	192	3.2.3.3.1 Continuous Clocking Parameter Block	T27-3	Number of Rows to Sum	Verify at 0, 1, 9
2	194	3.2.3.3.1 Continuous Clocking Parameter Block	T27-4	Numbered of Columns to sum	Verify at 0, 1, 6
3	194.1	3.2.3.3.1 Continuous Clocking Parameter Block	T27-5	Output register Clocking CCDs	Verify at Full, AC, BD, Diag - 5 cases, need working CCDs
4	195	3.2.3.3.1 Continuous Clocking Parameter Block	T27-6	Number of overclocking pairs	Verify at 0, 1, 15, need working CCDs
5	196	3.2.3.3.1 Continuous Clocking Parameter Block	T27-7	Video Chain Response	Verify with hi/lo gain for alternating CCDs, need working CCDs
6	226.3	3.2.3.3.6 CC Pixel Bias Map Determination	T11-9	On chip summing	Ensure that summed CC bias produces expected number of pixels

1.3 Method

The objective of this procedure will be accomplished by using the "test" method of verification.

1.4 Overview

In each case, verification shall consist of performing a Continuous Clocking Mode science run on engineering or flight hardware attached to cold CCDs viewing X-rays. This procedure assumes that the test conductor is familiar with ACIS, and is capable of building and issuing commands to power on and off the DPA and DEA, power on and off the FEPs and CCD video boards, and starting and stopping science runs, and is capable of unpacking the telemetry stream and analyzing the telemetered event data.

Most of the options are easy to verify, however, determining whether or not on-chip row summing is being performed is a little awkward. The scheme used in this procedure relies on using the measurement of X-ray charge which is split across rows (i.e. "vertical splits") to determine if x2 row summing is being performed. For larger numbers of summed rows, this procedure only verifies that the system accepted the parameters, and produced data at

a rate which is consistent with the selected row summing parameter. The formula used to determine the frame rate in CC mode is:

```
512 * ((rowSum * 4 pixel clocks/transfer) + (4 underclocks
  + n)/m pixels + 4 + number of overclocks + 1 end of row
  marker) / 100,000 pixel clocks/second)          (Eq. 1)
```

where: "n" is 256 if **output register mode** in FULL or DIAG mode and
"n" is 512 if the **output register mode** is AC or BD mode.

and: "m" is 1 if not performing **column summing**, and
"m" is 2 if performing **column summing**.

2.0 Applicable Documents

	Documents	Titles
1	MIT 36-01103 Rev H	ACIS Software Requirements Specification
2	MIT 36-01202 Rev A	Product Assurance and Safety Plan for ACIS
3	MIT 36-01215-01	ACIS Software Test Plan
4	MIT 36-02104 Rev C	DPA Hardware Specification & System Description
5	MIT 36-53200 Rev 01	ACIS Software Detailed Design Specification
6	MIT 36-53204.0204 I	ACIS IP&CL Structure Definition

3.0 Resources

- 1 BEP
- 6 FEPs
- 6 Video Boards
- 1 DEA Interface Controller Board
- 6 CCDs (in a vacuum, below -60 °C, with X-rays)
- DPA and DEA Power Supplies
- CTUE/RCTU or LRCTU and 1 GSE workstation

4.0 Test Cases

4.1 Test Case 1. Verify Diag. Mode, No Overclocks and Video Gain

4.1.1 Objective

This test case verifies Continuous Clocking (CC) Mode operates in Diagnostic clocking mode, with no overclock pixels, and verifies that CC Mode properly assigns the video gain parameters to the correct CCDs. Since the Flight software does not contain SRAM primitives to perform both Diagnostic Clocking, and Attenuated Gain, the CCDs assigned attenuated gain will not execute during this run. This behavior is used to determine that the instrument has assigned the gain parameters to the correct set of CCDs.

4.1.2 Test Setup

1. Ensure that DPA sides A and B are on
2. Ensure that DEA side A is on
3. Ensure that BEP A is selected and is running version 1.5 of the flight software (start-up version code 11)
4. Ensure that all 6 FEPs are on
5. Ensure that all imaging array CCD video boards are on (I0..I3, S2, S3)

4.1.3 Test Steps

1. Load a Continuous Clocking Parameter Block `ccopt_diag_oc0_vr.cc` into slot 4, which has the following options set: rowSum := 0, columnSum := 0, overclockPairsPerNode := 0, outputRegisterMode := DIAG, and ccdVideoResponse := 0 1 0 1 0 1.

   `Record the cmdResult:` _____

   Is the cmdResult == `CMDRESULT_OK`?

   ___`Yes` ___ `No`

2. Start a Continuous Clocking run, using slot 4.

   `Record the cmdResult:` _____

   Is the cmdResult == `CMDRESULT_OK`?

   ___`Yes` ___ `No`

3. Wait until at least 5 exposures have been produced from each CCDs S3, I1 and I3, and the stop the run and wait for the scienceReport.

   Record the number of exposures from each FEP/CCD:

   `FEP 0/CCD S3:` _____

   `FEP 1/CCD I0:` _____

   `FEP 2/CCD I1:` _____

   `FEP 3/CCD I2:` _____

   `FEP 4/CCD I3:` _____

FEP 5/CCD S2: _____

Record the termination code from the report:

terminationReason: _____

Did FEPs 0, 2 and 4 produce at least 5 exposures, and FEPs 1, 3, and 5 fail to produce any exposures?

___Yes ___ No

Is the terminationReason == SMTERM_STOPCMD?

___Yes ___ No

4. Examine the initial overclocks from the telemetered bias maps, and the delta-overclocks from the exposure records, which should be 0.

   Are any initial overclocks or delta-overclocks non-zero?

   ___Yes ___ No

5. Examine telemetry for any events. No events should be reported in Diagnostic Mode.

   Were no events reported during the run?

   ___Yes ___ No

4.2 Test Case 2. Verify 2 Overclocks and Video Gain

4.2.1 Objective

This test case verifies that Continuous Clocking (CC) Mode operates in Full clocking mode, with 2 overclock pixels (1 pair) and the correct video response assignments.

4.2.2 Test Setup

1. Ensure that DPA sides A and B are on
2. Ensure that DEA side A is on
3. Ensure that BEP A is selected and is running version 1.5 of the flight software (start-up version code 11)
4. Ensure that all 6 FEPs are on
5. Ensure that all imaging array CCD video boards are on (I0..I3, S2, S3)
6. Ensure that all CCDs are seeing X-rays

4.2.3 Test Steps

1. Load a Continuous Clocking Parameter Block *ccopt_full_oc1_vr.cc* into slot 4, which has the following options set: rowSum := 0, columnSum := 0, overclockPairsPerNode := 1, outputRegisterMode := FULL, and ccdVideoResponse := 1 0 1 0 1 0.

   Record the cmdResult: _____

   Is the cmdResult == CMDRESULT_OK?

   ___Yes ___ No

2. Start a Continuous Clocking run, using slot 4.

   Record the cmdResult: _____

   Is the cmdResult == CMDRESULT_OK?

   ___Yes ___ No

3. Wait until at least 5 exposures have been produced from each CCD, and the stop the run and wait for the scienceReport.

   Record the number of exposures from each FEP/CCD:

   FEP 0/CCD S3: _____

   FEP 1/CCD I0: _____

   FEP 2/CCD I1: _____

   FEP 3/CCD I2: _____

   FEP 4/CCD I3: _____

   FEP 5/CCD S2: _____

   Record the termination code from the report:

   terminationReason: _____

Did all FEPs produce at least 5 exposures?

___Yes ___ No

Is the terminationReason == SMTERM_STOPCMD?

___Yes ___ No

4. Examine the initial overclocks from the telemetered bias maps, and the delta-overclocks from the exposure records.

   Are all of the initial overclocks greater than zero?

   ___Yes ___ No

5. Analyze the bias maps and events reported from each CCD. Determine a rough measure of the gain by histogramming the corrected event amplitudes and choosing an easily identifiable peak in the spectra. Record the amplitude position of this peak for each CCD. The gain response from CCDs S3, I1, and I3 must be at least 4 times lower than the response from CCDs I0, I2, and S2.

   Record the approximate gain from each CCD:

   FEP 0/CCD S3: _____

   FEP 1/CCD I0: _____

   FEP 2/CCD I1: _____

   FEP 3/CCD I2: _____

   FEP 4/CCD I3: _____

   FEP 5/CCD S2: _____

   Is the gain from CCDs S3, I1 and I3 at least 4 times lower than I0, I2 and S2?

   ___Yes ___ No

6. Examine telemetry for any events. Given the setup, some events should be reported during the run. Save the event data for comparison with data to be taken in §4.3 Test Case 3.

   Record the number of reported events:_____

   Were events reported?

   ___Yes ___ No

7. Sanity check the assignments and gain estimates. Repeat Steps 1 - 6, with the complement ccdVideoResponse := 0 1 0 1 0 1.

   Is the gain from CCDs S3, I1 and I3 at least 4 times greater than the corresponding estimates in the first pass of Step 5?

   ___Yes ___ No

   Is the gain from CCDs I0, I2 and S4 at least 4 times lower than the corresponding estimates in the first pass of Step 5?

   ___Yes ___ No

4.3 Test Case 3. Verify 2 Overclocks, 2 Rows, and Video Gain

4.3.1 Objective

This test case verifies that Continuous Clocking (CC) Mode operates in Full clocking mode, with 2 overclock pixels (1 pair), and can sum 2 rows. In order to be able to compare the events from this test case with those in §4.2 Test Case 2, the test case only varies the rowSum parameter.

4.3.2 Test Setup

1. Ensure that DPA sides A and B are on
2. Ensure that DEA side A is on
3. Ensure that BEP A is selected and is running version 1.5 of the flight software (start-up version code 11)
4. Ensure that all 6 FEPs are on
5. Ensure that all imaging array CCD video boards are on (I0..I3, S2, S3)
6. Ensure that all CCDs are seeing X-rays

4.3.3 Test Steps

1. Load a Continuous Clocking Parameter Block *ccopt_full_rs_oc1_vr.cc* into slot 4, which has the following options set: rowSum := 1, columnSum := 0, overclockPairsPerNode := 1, outputRegisterMode := FULL, and ccdVideoResponse := 1 0 1 0 1 0.

   Record the cmdResult: _____

   Is the cmdResult == CMDRESULT_OK?

   ___Yes ___ No

2. Start a Continuous Clocking run, using slot 4.

   Record the cmdResult: _____

   Is the *cmdResult* == CMDRESULT_OK?

   ___Yes ___ No

3. Wait until at least 5 exposures have been produced from each CCD, and the stop the run and wait for the scienceReport.

   Record the number of exposures from each FEP/CCD:

   FEP 0/CCD S3: _____

   FEP 1/CCD I0: _____

   FEP 2/CCD I1: _____

   FEP 3/CCD I2: _____

   FEP 4/CCD I3: _____

   FEP 5/CCD S2: _____

   Record the termination code from the report:

   terminationReason: _____

Did all FEPs produce at least 5 exposures?

___Yes ___ No

Is the terminationReason == SMTERM_STOPCMD?

___Yes ___ No

4. Examine the initial overclocks from the telemetered bias maps, and the delta-overclocks from the exposure records.

   Are all of the initial overclocks greater than zero?

   ___Yes ___ No

5. Analyze the bias maps and events reported from each CCD and determine the approximate gain of each CCD. The gain response from CCDs S3, I1, and I3 must be at least 4 times lower than the response from CCDs I0, I2, and S2.

   Record the approximate gain from each CCD:

   FEP 0/CCD S3: _____

   FEP 1/CCD I0: _____

   FEP 2/CCD I1: _____

   FEP 3/CCD I2: _____

   FEP 4/CCD I3: _____

   FEP 5/CCD S2: _____

   Is the gain from CCDs S3, I1 and I3 at least 4 times lower than I0, I2 and S2?

   ___Yes ___ No

6. Examine telemetry for any events. Given the setup, some events should be reported during the run.

   Record the number of reported events:_____

   Were events reported?

   ___Yes ___ No

7. Compare histograms of the bias-corrected pulse heights from the events from this test case and those from §4.2 Test Case 2. Since the row summing from this test case should have combined charge from some events which split across rows, the spectral lines from this test case should shift slightly to higher energies.

   Did the spectra shift to higher energies with respect to §4.2 Test Case 2?

   ___Yes ___ No

   NOTE: If the check above fails to produce a conclusive result, a more exact check is to compare the total number of ASCA q2 events to the total number of events. At 5.99ev, the ratio should be 18% on 1 row and less than 10% in 2-rows.

4.4 Test Case 4. Verify AC, 30 Overclocks, 64 Rows, 2 Columns

4.4.1 Objective

This test case verifies that Continuous Clocking (CC) Mode operates in AC clocking mode, with 30 overclock pixels (15 pairs), and can sum the 64 rows while summing 2 columns.

4.4.2 Test Setup

1. Ensure that DPA sides A and B are on
2. Ensure that DEA side A is on
3. Ensure that BEP A is selected and is running version 1.5 of the flight software (start-up version code 11)
4. Ensure that all 6 FEPs are on
5. Ensure that all imaging array CCD video boards are on (I0..I3, S2, S3)
6. Ensure that all CCDs are seeing X-rays

4.4.3 Test Steps

1. Load a Continuous Clocking Parameter Block *ccopt_ac_rs_cs_oc.cc* into slot 4, which has the following options set: rowSum := 7, columnSum := 1, overclockPairsPerNode := 15, outputRegisterMode := AC, and ccdVideoResponse := 0 0 0 0 0 0.

   `Record the cmdResult:` _____

   Is the cmdResult == CMDRESULT_OK?

   ___Yes ___ No

2. Start a Continuous Clocking run, using slot 4.

   `Record the cmdResult:` _____

   Is the cmdResult == CMDRESULT_OK?

   ___Yes ___ No

3. Wait until at least 5 exposures have been produced from each CCD, and the stop the run and wait for the scienceReport.

   Record the number of exposures from each FEP/CCD:

   `FEP 0/CCD S3:` _____

   `FEP 1/CCD I0:` _____

   `FEP 2/CCD I1:` _____

   `FEP 3/CCD I2:` _____

   `FEP 4/CCD I3:` _____

   `FEP 5/CCD S2:` _____

   Record the termination code from the report:

   `terminationReason:` _____

   Did all FEPs produce at least 5 exposures?

___Yes ___ No

Is the terminationReason == SMTERM_STOPCMD?

___Yes ___ No

4. Examine the initial overclocks from the telemetered bias maps, and the delta-overclocks from the exposure records.

   Are the initial overclocks for the A and C nodes greater than zero?

   ___Yes ___ No

5. Examine telemetry for any events. Given the setup, some events should be reported during the run.

   Record the number of reported events:_____

   Were events reported?

   ___Yes ___ No

6. Determine the exposure rate produced by the mode. The rate is a function of the number of pixels being clocked out of each serial register, the number of rows being summed. The exposure rate should be approximately 1 exposure/FEP every 2.8 seconds.

   Is the frame rate about 1 every 2.8 seconds per FEP/CCD?

   ___Yes ___ No

4.5 Test Case 5. Verify BD, 30 Overclocks, 64 Rows

4.5.1 Objective

This test case verifies that Continuous Clocking (CC) Mode operates in BD clocking mode, with 30 overclock pixels (15 pairs), and can sum the 64 rows with no column summing.

4.5.2 Test Setup

1. Ensure that DPA sides A and B are on
2. Ensure that DEA side A is on
3. Ensure that BEP A is selected and is running version 1.5 of the flight software (start-up version code 11)
4. Ensure that all 6 FEPs are on
5. Ensure that all imaging array CCD video boards are on (I0..I3, S2, S3)
6. Ensure that all CCDs are seeing X-rays

4.5.3 Test Steps

1. Load a Continuous Clocking Parameter Block *ccopt_bd_rs_oc.cc* into slot 4, which has the following options set: rowSum := 7, columnSum := 0, overclockPairsPerNode := 15, outputRegisterMode := BD, and ccdVideoResponse := 0 0 0 0 0 0.

   `Record the cmdResult:` _____

   Is the cmdResult == CMDRESULT_OK?

   ___Yes ___ No

2. Start a Continuous Clocking run, using slot 4.

   `Record the cmdResult:` _____

   Is the cmdResult == CMDRESULT_OK?

   ___Yes ___ No

3. Wait until at least 5 exposures have been produced from each CCD, and the stop the run and wait for the scienceReport.

   Record the number of exposures from each FEP/CCD:

   `FEP 0/CCD S3:` _____

   `FEP 1/CCD I0:` _____

   `FEP 2/CCD I1:` _____

   `FEP 3/CCD I2:` _____

   `FEP 4/CCD I3:` _____

   `FEP 5/CCD S2:` _____

   Record the termination code from the report:

   `terminationReason:` _____

   Did all FEPs produce at least 5 exposures?

___Yes ___ No

Is the terminationReason == SMTERM_STOPCMD?

___Yes ___ No

4. Examine the initial overclocks from the telemetered bias maps, and the delta-overclocks from the exposure records.

   Are the initial overclocks for the B and D nodes greater than zero?

   ___Yes ___ No

5. Examine telemetry for any events. Given the setup, some events should be reported during the run.

   Record the number of reported events:_____

   Were events reported?

   ___Yes ___ No

6. Determine the exposure rate produced by the mode. The rate is a function of the number of pixels being clocked out of each serial register, the number of rows being summed. The exposure rate should be approximately 1 exposure/FEP every 4.2 seconds.

   Is the frame rate about 1 every 4.2 seconds per FEP/CCD?

   ___Yes ___ No

5.0 Test Script(s)

This test is to be performed manually. There are no "pre-built" test scripts for this procedure.

6.0 Test Results

1	Run Date	
2	Test Conductor	
3	Software Version	
4	Number of tests passed	
5	Number of tests failed	
6	Number of tests not run	