DAWN-FC

DAWN - Framing Camera

DC014 Report

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1 General aspects

1.1 Scope

This document reports the results of the operation of the Dawn Framing Cameras in the frame of DC014.

1.2 Introduction

The Framing Camera test slot within DC014 was intended to replace the onboard software for both cameras and perform a minimal functional checkout afterwards.

To this end, both cameras were operated one at a time, first replacing the software and then performing the set of operations known as “CCD mini cal”. This set includes some image acquisitions aimed at the detection and evaluation of extra charge.

Operationally, the test was a success: the software of both cameras was replaced and all 72 images were retrieved from each of the cameras. There was a minor hiccup when the camera was commanded to get ready for power down while the mechanisms were off, but the problem was later solved and the lesson learnt for further occasions.

About the content of the images, it is remarkable that several streaks were found, even more than one in some images. A detailed account is reported on section 2.4.

Section 3 includes the operational log from the FC team.

1.3 Applicable Documents

no.	document name	document number, Iss./Rev.
AD1		

1.4 Reference Documents

no.	document name	document number, Iss./Rev.

2 Results

2.1 General

The main result obtained from the DC014 operation slot was the update of the flight software of both FC1 and FC2 to version 3.03.02. As a side bar, the operations served as additional monitoring point of the condition of the cameras by the execution of the CCD mini cal, reporting below. A general remark is that all images were received successfully on ground for both instruments. Additional, it is worth mentioning that in this un-targeted activity the solar elongation was close to the exclusion zone, causing a visible amount of out-of-field stray light in most of the images.

Also during the operation slot, several streaks were found and reported hereafter.

Finally, an operation error was found in the FC sequences. The nominal power-down sequence, which includes FCPrepPowerDown shall not be used immediately after flight software update. The usual procedure of changing the LLSW and the UDP library together results in the UDP library not booting spontaneously after upload. This results in the MCU not being powered on during the whole on-phase of the UDP library upload (the UDP library switches on the MCU during the boot). As a consequence, if FCPrepPowerDown is sent, the UDP library will find a non-responsive MCU and will flag the mechanisms as failed, preventing their operation until maintenance is conducted for clearing the flag. This operational work around shall always be regarded when replacing the flight software of the cameras.

2.2 FC1 performance

2.2.1 Extra charge

As already detected earlier the extra charge on FC1 could be verified to be still present and not having changed significantly.

The extra charge measurements during DC014 where done with different pre illumination times, allowing the extra charge to accumulate prior to the exposure. Figure 1 shows the accumulated frequency of DNs all the 1024x1024 pixels. The six different graphs show the level of extra charge for six different illumination times (from bottom to top: 1.3 s, 2.3 s, 3.3 s, 4.3 s, 6.3 s, 11.3 s). The most effected pixels show extra charge of up to 200 DNs.

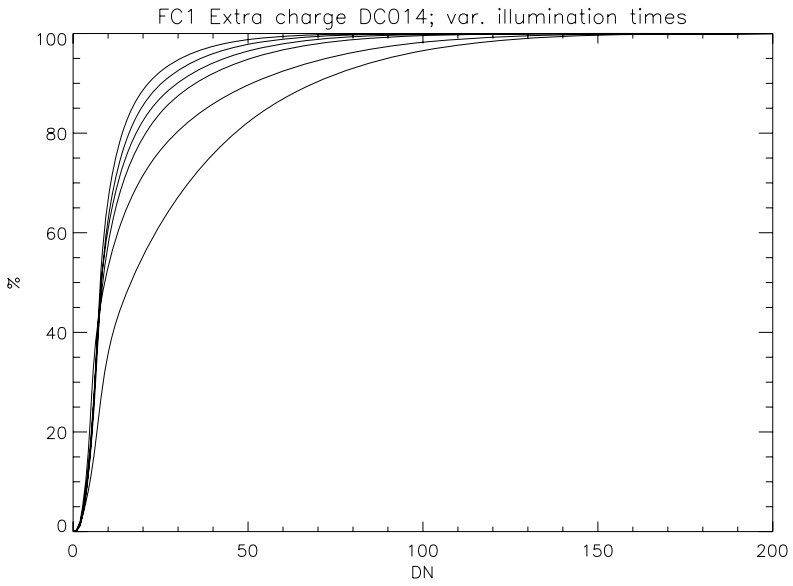

Figure 1: Accumulated histogram of pixels showing extra charge on FC1

2.3 FC2 performance

2.3.1 Extra charge

No traces of extra charge could be found on FC2 during DC014. Figure 2 shows only the up to 5 DNs noise consisting of readout noise and photon noise.

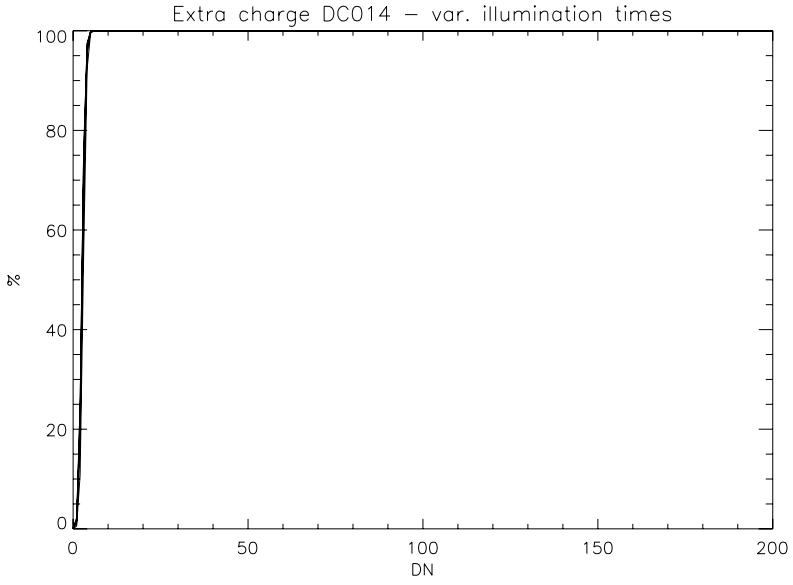

Figure 2: Accumulated histogram of pixels does not show any extra charge on FC2

2.4 Streaks

Several streaks were identified in the images taken during this operational slot. The following table identifies the images where one or more were found.

Table 1: Relation of the streaks found in the DC014 images

Image	Streak location
FC2_2008-04-03T02.39.12.707Z_ID10_0000000882_F1	- One in the upper center - One at the bottom left - One at the bottom right
FC2_2008-04-03T02.39.27.845Z_ID10_0000000883_F1	- One in the upper center - One at the bottom left - One at the bottom right
FC2_2008-04-03T02.39.38.025Z_ID10_0000000884_F1	- One in the upper center - One at the bottom right
FC2_2008-04-03T02.40.17.810Z_ID10_0000000885_F1	- One in the upper left - One at the bottom center
FC2_2008-04-03T02.49.17.694Z_ID10_0000000897_F7	- One long streak in the upper center and right

Figure 3: Three streaks on FC2_2008-04-03T02.39.12.707Z_ID10_0000000882_F1

Figure 4: Three streaks on FC2_2008-04-03T02.39.27.845Z_ID10_0000000883_F1

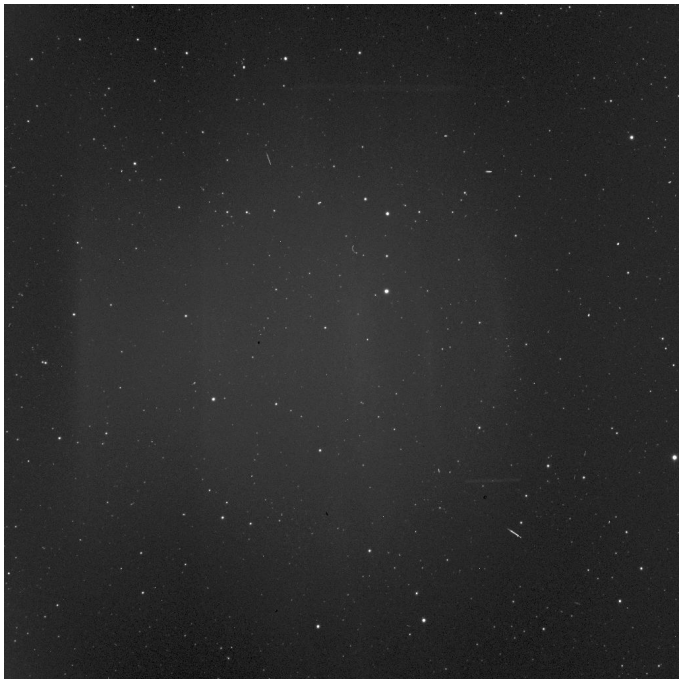

Figure 5: Two streaks on FC2_2008-04-03T02.39.38.025Z_ID10_0000000884_F1

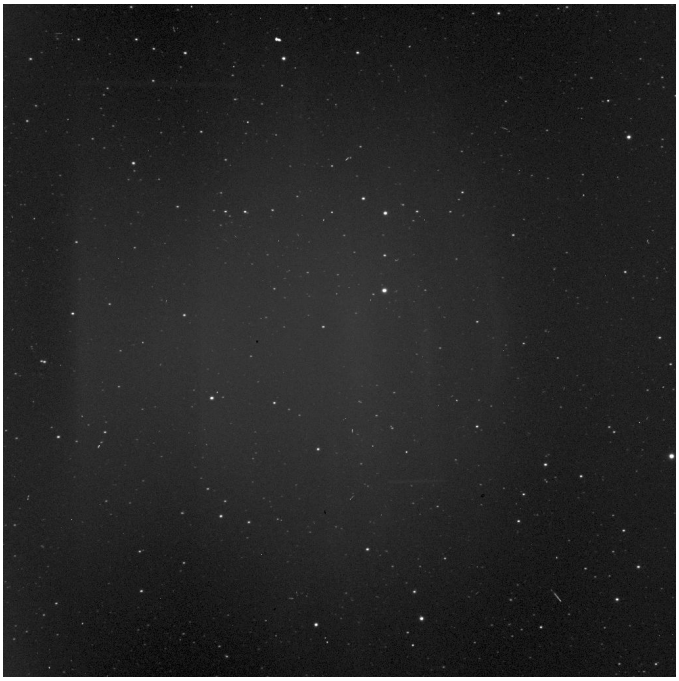

Figure 6: Two streaks on FC2_2008-04-03T02.40.17.810Z_ID10_0000000885_F1

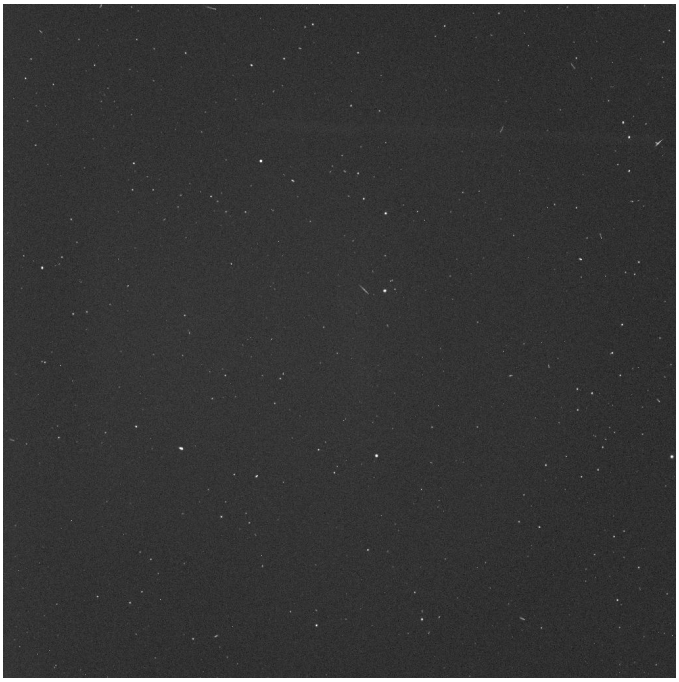

Figure 7: One streak on FC2_2008-04-03T02.49.17.694Z_ID10_0000000897_F7

3 Operational log

3.1 2008-093 (2008-04-01)

2008-093T00:00:30Z EGSEs at MPS and DSC up and running. Telemetry if flowing from the s/c.

On the phone Carol pointed out that technically it would be possible to run the whole FC2 activity in today's pass, but we have to be very careful to avoid colisions with absolutely timed activities that are scheduled to start close to the end. Pending a more careful revision of the time available, the decision has been to start with the SW update and reconsider the options once it is clear

00:11:28Z Radiation of dz109a to switch of FC2 CCD heaters

001506Z Radiation completed of di3280

002022Z Radiation started of di3281

002400Z Radiation completed

002548Z Radiation started of di3282

002952Z Radiation completed

003000Z The CCD heaters are off and the temperature is sinking

003124Z Radiation started of di3283

003520Z Radiation completed

Flight reports that the T/C speed today is 2kbps, so the transimission time is approximately 3 min 20 s per file.

It has been agreed that, for safety reasons, the UDP library upload will not start until confirmation is recieved that the LLSW completed successfully and FC2 is off.

003624Z Radiation started of di3284

FC2 CCD Temp -20.0

004032Z Radiation completed

FC2 CCD Temp -28.6

004145Z Radiation started of di3285

Flight confirms that two files are loaded on buffers 4 and 5

004834Z Radiation completed

FC2 CCD Temp -38.2

004935Z Radiation started of di3286

005245Z Confirmation of 4 files on buffers

005412Z Radiation completed

005623Z Radiation started of di3287

FC2 CCD Temp -44.3

Flight reports that mission has decided to stay with FC2 SW upload today and leave FC2 CCD minical for tomorrow.

At this time the commanding will wait for confirmation that all 8 files are in their corresponding buffers.

Confirmation of 5 files in the buffers.

010325Z Confirmation of 6 files in the buffers.

010903Z Telemetry problem with GSEOS. Session restarted

011412Z Confirmation of 8 files in the buffers.

011531Z Radiation started of di3279

012002Z Radiation completed

013300Z FC2 CCD Temp -57.9

013700Z FC2 is up and the LLSW is being uploaded

014211Z Starting the third sequence

014439Z Starting the fourth sequence

014716Z Starting the fifth sequence

015501Z Starting the last sequence

015744Z Camera is on and reports the right LLSW version

020708Z Camera is off and ready for the UDP library upload

Starting transmission of di3245

Expected power up at 022330Z ERT

022519Z Camera is on again and reports 3.03 LLSW

ResetUDPManager executed successfully

022716Z Radiation started of di3246

023132Z Radiation completed
Expected feedback at 024800Z ERT

023328Z Radiation started of di3247
023630Z Radiation completed
Expected feedback at 025300Z ERT

024159Z Radiation started of di3248
024450Z Radiation completed
Expected feedback at 030100Z ERT

025022Z Radiation started of di3249
025338Z Part 1b is executing
025455Z Radiation completed
Expected feedback at 031100Z ERT

025536Z Part1b is done and camera reports 221 UDPs loaded

025828Z Radiation started of di3250
030204Z Part 2a is executing
030214Z Radiation completed
Expected feedback at 031916Z ERT

030420Z Part2a is done and camera reports 82 UDPs loaded

030617Z Radiation started of di3251
031029Z Radiation complete
Expected feedback at 032720Z ERT

031229Z Part 3a is executing
032146Z Part 3b is done and camera reports 135 UDPs loaded

032726Z Part 4 is executing
032902Z Part 4 is done and camera reports 48 UDPs loaded

033026Z Part 5 is done and camera reports 34 UDPs loaded

033143Z Part 6 is done and camera reports 10 UDPs loaded
All parts have been uploaded successfully, FC2 is ready

033312Z Starting radiation of di3252

Expected feedback at 035022Z ERT

044856Z The LLSW and UDP library upload went nominal, but the execution of FCPrepPowerDown with MCU off has probably resulted in flagging both mechanisms as failed. After discussion with the mission it has been agreed to power up FC2 for 5 minutes to get a confirmation that this is the case and prepare contingency products for both FC1 and FC2 to solve the situation.

051115Z FC2 is powered and shows the failed mechansim on. Powering down with nominal sequence. ERT 052752Z

053900Z FC2 is powered off. The anomaly description has been sent to Flight manager together with the contingency products to tackle it.

3.2 2008-094 (2008-04-02)

2008093T201000Z Connection established from FSTB3 to DSC for verification of the contingency products for clearing the Mechanism Failure flags

201700Z Power up and boot ok, patch ok, FCPrepPowerDown behaved nominal, Power down ok

201845Z Second power up ok, shows the failure flags cleared through the power cycle

202530Z FC2 is off. Reconfiguring camera and EGSE for FC1 run of the contingency products. As the flags have been corrected already, the sequence for FC1 will be power up, contingency file and power down. This will confirm that the commands are understood by the camera and the correctness of the parameters can be verified by inspection

203000Z FC1 is on. Booting completed nominal

203300Z FC1 has received and executed both commands on the contingency product. Proceeding to power down

203510Z FC1 is off

2008094T000000Z The Command Approval Meeting has been completed with agreement that 5 files will be sent to FC2 for fixing the Mechanism Failure Flags:

-power on

-flag change

-power off

-power on

-power off

The sequences will be 5 min apart except the last, that would require TWLT to confirm that the patch has worked.

001300Z Telemetry is flowing from the spacecraft.

FC2 CCD Temp -63.7

002400Z FC1 CCD heaters switched off

002700Z FC1 CCD Temp -12.9

003000Z FC1 CCD Temp -21.7

003300Z FC1 CCD Temp -28.0

003347Z Starting transmission of dz167a
ERT 005102Z

003600Z FC1 CCD Temp -32.6

003853Z Transmission of di3328
ERT 005610Z

003900Z FC1 CCD Temp -36.0

004200Z FC1 CCD Temp -39.4

004401Z Transmission of dz159a
ERT 010117Z

004500Z FC1 CCD Temp -41.6

004800Z FC1 CCD Temp -43.8

004908Z Transmission of 167a
ERT 010624Z

005100Z FC1 CCD Temp -46.0
FC2 is on and shows the mechanism flags on. They will be reset by subsequent commands

005400Z FC1 CCD Temp -47.6

005418Z Transmission of dz159a
ERT 011134Z

005618Z Mechanism Failure Flags patched

005700Z FC1 CCD Temp -48.7

010000Z FC1 CCD Temp -50.4

010300Z FC1 CCD Temp -51.4
FC2 is off

010600Z FC1 CCD Temp -52.5
FC2 is back on. Flags are off.

010900Z FC1 CCD Temp -53.6

011142Z Powering down FC2

011200Z FC1 CCD Temp -54.1

011252Z FC2 is off

011500Z FC1 CCD Temp -55.2

011800Z FC1 CCD Temp -55.8

011949Z Transmission of dz296b
ERT 013740Z

012100Z FC1 CCD Temp -56.3

012400Z FC1 CCD Temp -56.8

012700Z FC1 CCD Temp -57.4

013900Z FC2 is on again

014458Z FEE is on

014948Z CCD Minical is started

022528Z 19 basics acquired. 24 commands, 23 images. Starting Extra charge block

023636Z Flight confirms that the FC1 LLSW files can be uploaded at this point, posing less of a load to the s/c than during playback. ACE will enqueue the files 1 through 8 and confirm only after completion. If any file were missing at the time FC1 operations should start, it would be resent and confirmed prior to the beginning of FC1 operations.

023832Z Extra charge block completed with 28 commands and 51 images. Starting pre-imaging darks

024359Z Pre-imaging darks completed with 31 commands and 54 images. Opening door. Door is open nominally. 32 commands and 54 images

024656Z Starting image acquisitions

025911Z Starfield observation completed with 58 commands and 72 images. Closing door

030023Z Door closed with 59 commands and 72 images.

030449Z Fee is off, 60 commands and 72 images.

031608Z 6 images recieved OK

033348Z Systems reports that files 1 through 8 are in their corresponding buffers.

All images have been transmitted to VR 8

034155Z All serials down

035300Z All images down except the final packet of the last image

044109Z Back to real-time. Starting power down.

044200Z Camera is off. CCD Heaters are back on.

FC CCD Minical sequence completed with 61 commands, 72 images, 5463 HK packets and 6319 events generated.

044652Z Playback completed, all images received. That completes FC2 activities for DC014.

045039Z Starting transmission of di3270

ERT 051146Z

051203Z FC1 is on. After 1 min it is still on the consumption of LLSW update

053328Z FC1 LLSW update is completed and the camara has booted into 3.03.

In prevision of a station hand-over comming up between 0555 and 0615, all commanding will be suspended from 0550 until re-acquisition of commanding capability. Systems is verifying that the transmitter of the next station is in green.

053834Z FC1 is off. Proceeding with UDP library upload

054105Z Starting transmission of di3261
ERT 055824Z

060054Z FC1 is on again and the prologue has executed nominally.

061131Z Starting transmission of di3262
ERT 063239Z

061836Z Starting transmission of di3263
ERT 063849Z

062539Z Starting transmission of di3264
ERT 064541Z

063608Z di3262 (part 1a) executed successfully

063308Z Starting transmission of di3265
ERT 065416Z

064155Z di3263 (part 1b) executed successfully

064155Z Starting transmission of di3266
ERT 070244Z

064807Z di3264 (part 2a) executed successfully

064858Z Starting transmission of di3267
ERT 071003Z

065727Z di3265 (part 3a) executed successfully

070550Z di3266 (part 3b) executed successfully

071132Z part 4 executed successfully

```
071342Z part 5 executed successfully

071431Z part 6 executed successfully

071611Z Transmission of di3268
        ERT 073332Z

073415Z Executing epilogue

074247Z Epilogue completed with the known result

074744Z FC1 is off

075308Z Transmission of dz141a

075811Z Transmission of di3326

080318Z Transmission of dz133a

081130Z Transmission of dz141a
        FC1 is booting

081329Z Transmission of dz133a

082045Z FC1 is off after patching

082633Z FC1 is booting for verification

083100Z FC1 is powered down and ready for CCD minical
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3.3 2008-095 (2008-04-03)

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2008094T201000Z Connection established from S/C Master OPS to DSC and Lindau

172508Z Transmission of dz286f
        ERT 174232Z

174416Z FC1 is on

175025Z FEE is on

175515Z DLR Extra charge block started
```

180138Z DLR Block finished with 5 commands and 4 images

181015Z Starting basic 19

183215Z Darks block finished with 24 commands and 23 images.
Starting extra charge images

184339Z Extra charge block finished with 28 commands and 51 images.
Starting pre-imaging darks

184715Z Pre-imaging darks completed.
Opening door

184752Z Door opened successfully. 32 commands and 54 images.

190515Z Star field observation completed with 58 commands and 72 images.
Closing door

190553Z Door closed successfully with 59 commands and 72 images.

191018Z FEE is off

191606Z S/C is in playback mode

191640Z Playback has started

200440Z Playback has completed, waiting for the last packet of the last images.
71 images received successfully.

204210Z Back in real-time mode

204618Z Initiating power down sequence

204730Z FC1 is off

205223Z The last image is down