
DAWN-FC

DAWN - Framing Camera

Dawn FC DC048 Report

DA-FC-MPAE-RP-304

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1 General aspects

1.1 Scope

This document contains the operations reports as well as the results of the analysis of the data acquired by both Framing Cameras during the DC048 operational slot. The scope of the activities was exclusively engineering, so no associated science report will be released.

1.2 Introduction

This report is structured in several parts.

Section 2 describes the conducted operations, including the different activities and a brief description of each.

Section 3 includes the activity log of the operational slot.

Section 4 reports on the general health status of the cameras.

Section 5 explains the evolution of the sensors since launch and analysis their change in performance.

The conclusions are covered in section 6.

1.3 Applicable Documents

no.	document name	document number, Iss./Rev.
AD1	DC048 Walkthrough	DC048_Walkthrough_r3.ppt
AD2	FC Semi-Annual Checkout Sequence	DA-FC-MPAE-TN-076, 2/-

1.4 Reference Documents

no.	document name	document number, Iss./Rev.
RD1	Dawn FC DC041 Report	DA-FC-MPAE-RP-295, 1/-
RD2	Dawn FC DC038 Report	DA-FC-MPAE-RP-290, 1/-
RD3	Dawn FC DC034 Report	DA-FC-MPAE-RP-285, 1/-
RD4	DC018 Report	DA-FC-MPAE-RP-286, 1/-
RD5	DC014 Report	DA-FC-MPAE-RP-287, 1/-
RD6	Framing Camera ICO Report	DA-FC-MPAE-RP-268, D/c

2 Description of the activities

2.1 Overview

The operations of the Framing Cameras within the frame of DC048 were planned to be conducted between March 15th 2011 (DOY 074) and 16th (DOY 075). There were two activities:



- FC1 non-pointed semi-annual checkout and flight software 3.05.01 upload
- FC2 non-pointed semi-annual checkout and flight software 3.05.01 upload

The telemetry passes were scheduled as follows:

DOY 073 1610 to 0025. Scheduled for uplink of FC2 LLSW upload files.

DOY 074 1615 to 0350. Scheduled for FC2 activities and uplink of FC1 LLSW upload files.

DOY 075 1610 to 0405. Scheduled for FC1 activities.

2.2 FC1 non-pointed semi-annual checkout and flight software 3.05.01 upload

The background of this activity is the need for the mechanisms on the cameras to be operated twice a year for maintenance. FC1 was due for this maintenance because its last operation had been during DC041 in July 2010. The details of the activity are described in AD2. A total of 65 images were acquired during this activity.

Prior to the execution of the checkout, a new version of the Framing Camera flight software was uploaded to the camera. During the planning of the Vesta phase, it was found that, during LAMO operations, and at least for the blue filter (F8), it would be necessary to bin the images 2×2 to increase the signal-to-noise ratio, so this feature was implemented in the new software.

Additionally, some minor bugs were fixed to improve the reliability of the operations, increase the visibility on the conditions of the image acquisition and reduce the amount of message sent to ground. The success of the FSW upload was verified by the subsequent non-pointed semi-annual checkout

2.3 FC2 non-pointed semi-annual checkout and flight software 3.05.01 upload

The scope of the activities for FC2 was the same as for FC1. The flight software upload installed into the cameras the most current version and the non-pointed checkout allowed the verification of the health status of the mechanisms and the electronic components.

3 Operations summary

All the sequences were uploaded to the spacecraft without incidence. The execution of FC2 activities was smooth enough that it allowed the execution of FC1 LLSW update on DOY 704, gaining valuable time for the spacecraft team to perform other maintenance activity on the day after.

These are the transcripts of the activity logs.

2011-03-15 (DOY 074)

14:50:00

FC on console on two sites.

14:55:17

Telemetry connection to Dawn-EGSE-Srv initiated by DSC and established.

14:58:29

Radiation of di4317 (llsw part 0). ERT is 15:42:21



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15:46:00

The camera is on per the S/C HK and not delivering HK packets (llsw upload mode). Waiting for the camera to boot to confirm that the correct software version is in place.

16:32:00

After some problems with the connection between DSC and MPS, we can confirm that the loaded version of the llsw is 3.05. FC is go for radiation of di4326

16:32:31

Radiation of di4326 (UDP library prolog). Waiting TWLT for confirmation that the UDP manager has been successfully reset. ERT is 17:12:44

17:13:38

Received first HK packets from the prolog.

17:14:54

Received event that all UDPs were deleted. FC is go for radiation of di4327

17:16:38

Radiation of di4327 (UDP library part 1a). Standard procedure is 5 minutes separation between the last bit of one file and first bit of the next. This shall allow several minutes of margin for the execution of each sequence.

17:26:50

Radiation of di4328 (UDP library part 1b).

17:37:57

Radiation of di4329 (UDP library part 2a).

17:44:35

Radiation of di4330 (UDP library part 3a).

17:54:00

Radiation of di4331 (UDP library part 3b).

18:03:00

Radiation of di4332 (UDP library part 3c).

18:11:00

Radiation of di4333 (UDP library part 4a).



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18:19:00

Radiation of di4334 (UDP library part 5a).

18:26:00

Radiation of di4335 (UDP library part 6a). Waiting for confirmation of the upload of all UDPs. ERT is 19:07:37

19:09:00

Confirmed upload of all parts.

19:09:52

Radiation of di4336 (UDP library epilog). Waiting for confirmation that the UDP library save has been successful. ERT is 19:49:52

20:00:40

Radiation of dz296e (FC2 semi annual checkout). Waiting for power up to confirm that the camera boots to the correct version of the software.

20:48:00

Confirmed boot of FC2 for semi annual checkout to the correct version of the software. Playback expected to start in approximately 4 hours and last for 1 hour more. FC1 LLSW files will be uploaded in the meantime. FC will be back on console ~0120 UTC for verification of the images and provide the GO to FC1 activities.

02:00:00

65 images acquires successfully downloaded. Delphi logs look fine. The inspection of the images reveals a set of tracks moving across the CCD. Discussion with Flight reveals that, given that we are in RCS-controlled pointing, the accuracy is significantly worse than sub-pixel, so the tracks must be those of the stars, while the single points are cosmic hits.

02:03:41

Radiation of di4381 (FC1 llsw part 0). The llsw will take about one hour to complete including the TWLT. FC team will review the data coming out of this activity in the morning and report for continuation of the activities before 1500 UTC.

Activities conclude for the day. Consumables used in the activities

Power cycles: 3

FW cycles: 12

Door cycles: 2

=====

14:58:56

Radiation of di4390 (UDP library prolog). Waiting TWLT for confirmation that the UDP manager has been successfully reset. ERT is 15:39:03



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15:41:13

Confirmed boot of FC1 and UDP manager reset.

15:43:23

Radiation of di4391 (UDP library part 1a)

15:53:00

Radiation of di4392 (UDP library part 1b)

16:02:14

Radiation of di4393 (UDP library part 2a). A station hand-over will make us lose the uplink capabilities between 1615 and 1625. The next file will be uploaded after the hand-over.

16:24:55

Radiation of di4394 (UDP library part 3a)

16:29:00

First sequence starts to execute on board.

16:32:52

Radiation of di4395 (UDP library part 3b)

16:44:22

Radiation of di4396 (UDP library part 3c)

16:50:29

Radiation of di4397 (UDP library part 4a)

16:58:16

Radiation of di4398 (UDP library part 5a)

17:05:56

Radiation of di4399 (UDP library part 6a). Waiting for TWLT to confirm that all the UDP uploads have been successful.

17:47:39

Execution of the UDP part 6a is confirmed. FC is go for the upload of di4400 (UDP library epilog).

17:51:38

Radiation of di4400 (UDP library epilog). Waiting for TWLT to confirm that the saving of the UDP library has been successful.



UDP saving confirmed. FC team is GO to proceed with the non-pointed checkout without the supervision of the FC team. Execution will be assessed in the morning

The execution of FC1 non-pointed checkout was confirmed to be successful on the day after. All images were received as expected and without incidents.

4 Health status assessment

During the operational slot the camera performed nominal from the engineering point of view. All the images were acquired as scheduled and received without any missing packet.

5 Image analysis

The images acquired during the operational slot were analyzed in four aspects. First, the correctness of the exposure times was assessed as per AD2. Second, the dark current was analyzed to evaluate the evolution of bulk dark current and the warm pixel generation rate. Third, the status of the extra charge was assessed. Finally, the images were examined for the presence of streaks caused by particles slowly drifting away from the spacecraft.

5.1 Exposure times

The exposure times used for the activities were inherited from DC041 and provided images of good exposure. However, the non-anticipated drift of the pointing due to the fact that the attitude control was performed by the RCS resulted in smeared images, in which stars appear as trails.

5.2 Dark current

The dark current generation rate was analyzed and compared with previous in flight measurements. The bulk dark current shown in Figure 1 is consistent with that determined during ICO (dotted line), and identical to that during DC041 [RD1]. To assess the generation rate of warm pixels, we compare the histograms for DC048 with DC041 in Figure 2. The number of warm pixels has increased slightly since DC041. Figure 3 shows the same plots for FC2. For both cameras, the hottest pixel has a dark current generation rate below 50 DN/s.

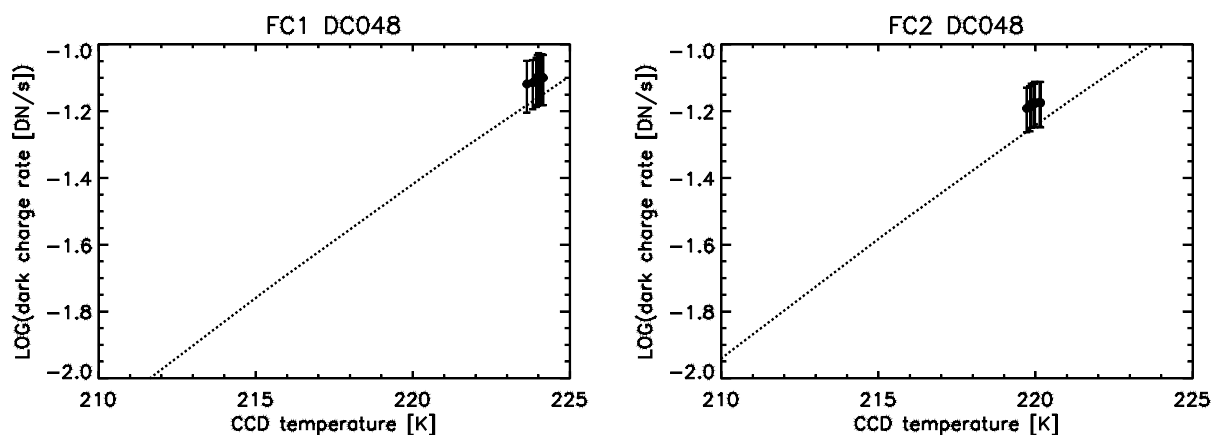


Figure 1: Bulk dark current for DC048. Left: FC1, right: FC2. The dotted line is the bulk dark current model derived from ICO observations.

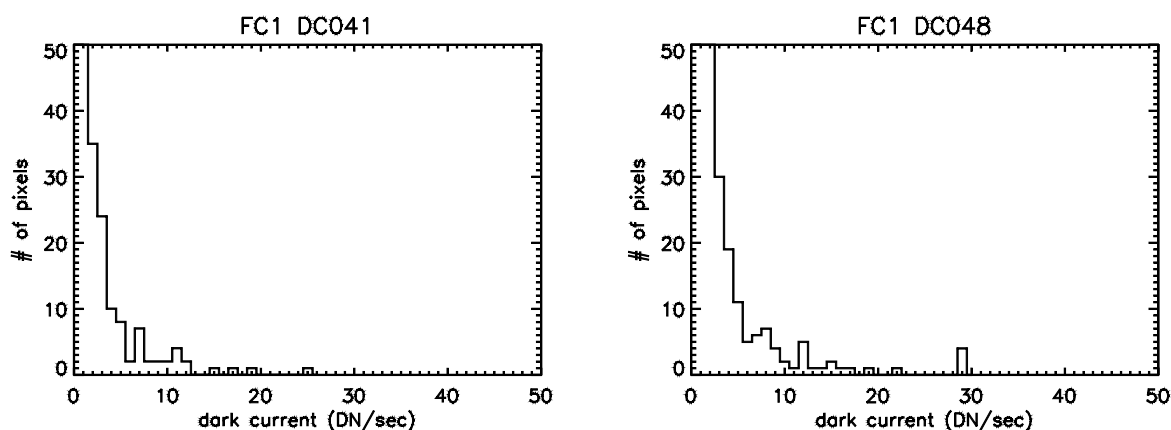


Figure 2: FC1 warm pixel histograms for DC041 and DC048.

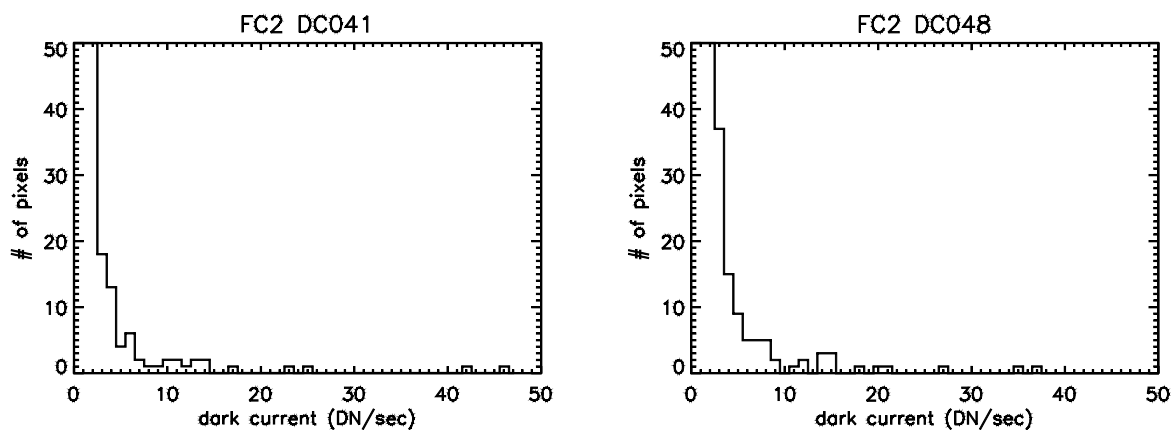


Figure 3: FC2 warm pixel histograms for DC041 and DC048.



5.3 Extra charge

An important part of the semi-annual checkout is monitoring the evolution of extra charge. FC1 is known to show extra charge, and it is found again in the DC048 images, as shown in Figure 4. The level of extra charge has not increased compared to DC041 (Figure 5). No extra charge has been detected in the past for FC2 at the illumination levels provided by the calibration lamp, and this is still the case in DC048. As the spacecraft approaches Vesta, there are a number of activities planned to conduct the same investigation for the much higher photon flux at the asteroid.

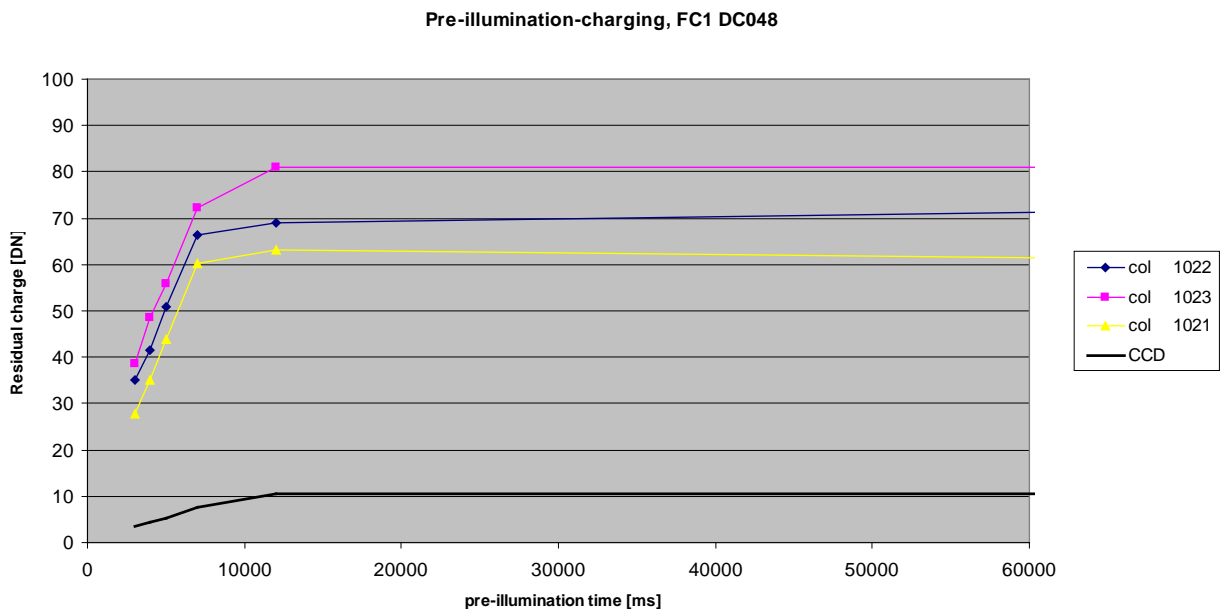


Figure 4: FC1 extra charge levels in DC048.

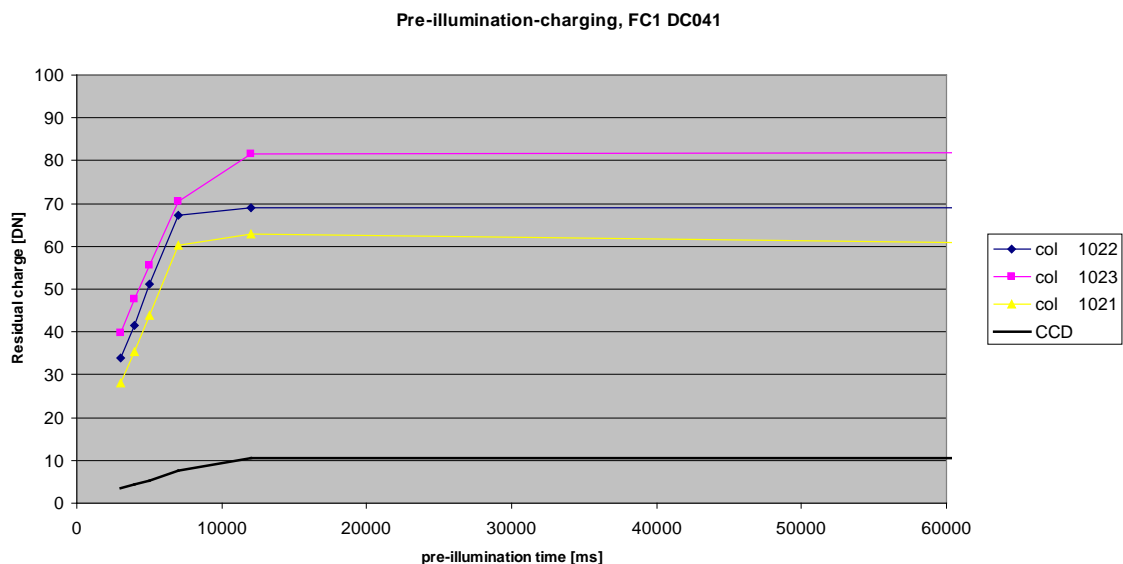


Figure 5: FC1 extra charge levels in DC041.



5.4 Image streaks

DC048 saw the return of image streaks, which had not been observed during DC041. These broad tracks of low brightness are caused by slowly moving particles in front of the camera. The particles are close enough to be out of focus, and originate from the spacecraft. Streaks were seen in several images by both FC1 and FC2. Figure 6 shows an example.

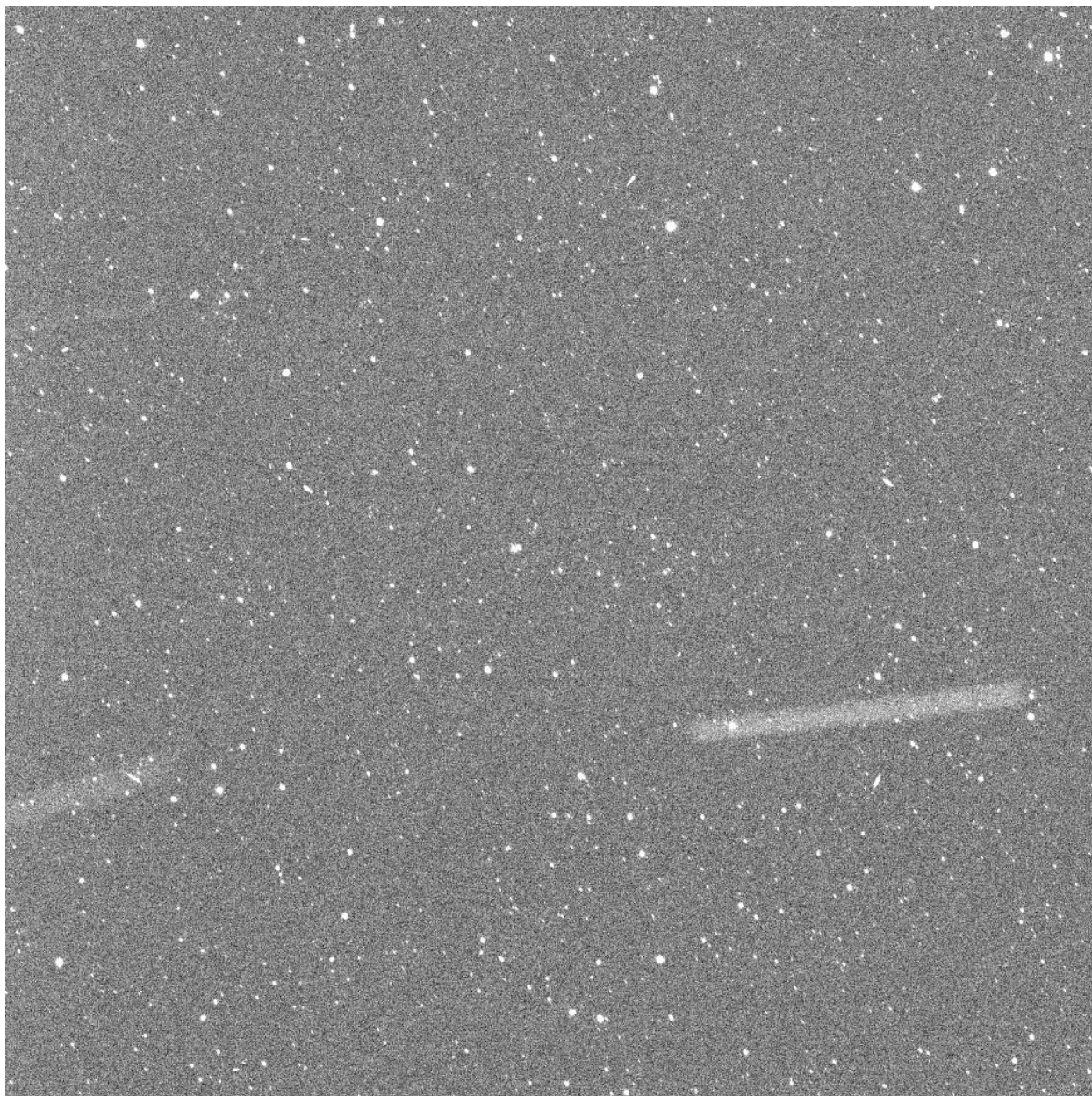


Figure 6: Three streaks in image FC21A0001869_11074224234F1A.IMG, a 15 sec clear filter exposure.

The table below includes a preliminary listing of all the images affected by the streaks and their exposure times.

**Table 1: Preliminary listing of the images affected by streaks**

Image name	# of streaks	Exposure (s)
FC11A0001161_11075212642F1A	1	15
FC11A0001162_11075212711F1A	1	15
FC21A0001869_11074224234F1A	3	15
FC21A0001870_11074224304F1A	1	15
FC21A0001871_11074224337F1A	1	15
FC21A0001872_11074224404F1A	1	15
FC21A0001873_11074224435F1A	1	15
FC21A0001875_11074224537F2A	1	37
FC21A0001876_11074224620F2A	1	37

6 Conclusions

Concerning the hardware and the software, the operational slot demonstrated that the camera is in good operational condition, including the mechanisms. With respect to the operational procedures, this slot demonstrated again an excellent performance of the instrument, spacecraft and mission teams. The command sequences for the non-pointed semi-annual checkout for both FC1 and FC2 meet the design criteria. At mission level, we note that several streaks were observed by both FC1 and FC2.