# NSLS-II CSX Beamline Docs Documentation

Release 0.1

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## **CSX-1 (23-ID-1) BEAMLINE DOCCUMENTATION**

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#### 1.1 Fast CCD Detector

#### 1.1.1 Introduction

The FastCCD installed in the endstation at CSX-1 is of the LBNL Fast CCD design. The sensor contains  $1920 \times 960$  pixels of  $30 \, \mu m \times 30 \, \mu m$  and is arranged into two halves of  $960 \, columns$  with the columns parallel to the long CCD axis. There is one output for each  $10 \, columns$  (a "super column") which results in  $192 \, individual$  outputs and analogue to digital converters (ADC). The CCD camera can either be used in a traditional CCD with an x-ray shutter exposing the full chip, or in a framestore (frame transfer) mode by covering two quarters of the CCD with a light (x-ray) block effectively exposing half the chip along the column direction.

The analogue CCD signal is digitized by a custom designed fCRIC. Each fCRIC has 16 analogue inputs and digitizes with 13 bit precision and had 16 bit dynamic range. This is accomplished by having 3 gain ranges of 8x, 4x and 1x with an auto gain feature. In order to allow negative charge injection. The ADC is biased at a value of approximately 4096 (0x1000 in hex) with the exact value dependent on the ADC channel. The gain settings are stored in the two most significant bits of each ADC reading. The schematic of a single fCRIC channel is shown in the LBNL fCRIC Circuit Diagram.



Fig. 1.1: LBNL fCRIC Circuit Diagram

The specifications of the CCD are summarized below:

• Pixel Size: 30 μm x 30 μm

• Active Area: 1920 pixels (column) x 960 pixels (row)

• 192 super columns = 192 outputs (480 rows x 10 columns)

· Back illuminated

• 250 µm - 350 µm thickness

• Full well: ~900k e per pixel

• Sensitivity: 6 e<sup>-</sup> / ADU for 8x gain (max gain)

• Pixel readout time: 500 µs

Digitization time: 2 µs at 120 Hz
100 Hz maximum data collection

#### 1.1.2 Data Format

In treating the raw CCD data from the FastCCD there are a few important considerations related to the multi-gain behaviour of the fCRIC amplifier and digitizer. The raw 16 bit values that are recorded in the data file follow the *16 Bit fCRIC Data Format* shown below with the two gain bits following the *fCRIC Gain Setting*.

Table 1.1: 16 Bit fCRIC Data Format

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
G1	G0	ERR	D12	D11	D10	D09	D08	D07	D06	D05	D04	D03	D02	D01	D00

Table 1.2: fCRIC Gain Setting

G1	G0	Gain	Pre-factor
0	0	x8	x1
1	0	x2	x4
1	1	x1	x8

Here the two most significant bits record the gain setting for the encoded value. The least significant 13 bits hold the measured analogue value. The actual value is therefore related to the measured value by:

$$A_{\rm corr} = G(A_{\rm meas} - O)$$

where  $A_{\text{corr}}$  is the corrected intensity,  $A_{\text{meas}}$  is the measured value by the ADC, G is the gain of the ADC and O is the bias offset.

#### 1.1.3 Dark Image Subtraction

Due to the multi gain nature of the fCRIC it is therefore necessary to take 3 dark images at different gain settings to obtain the different ADC offsets under these modes. As the lower gain settings are not subject to considerable contribution due to dark current it is usually justifiable to measure only the highest gain dark image repeatedly. Given 3 dark images for the different gain settings the images the following python pseudo code can be used to correct for dark current and gain:

```
import numpy as np

def subtract_background(image, dark_image, gain = [1, 4, 8]):
    gain_mask_8 = (image & 0xC000) == 0xC000
    gain_mask_4 = (image & 0xC000) == 0x8000
    gain_mask_1 = (image & 0xC000) == 0x0000
```

```
cor_image = image.astype(np.float16)
cor_image -= gain_mask_8 * dark_image[2]
cor_image -= gain_mask_4 * dark_image[1]
cor_image -= gain_mask_1 * dark_image[0]

gain_image = (gain_mask_8 * gain[2]) + (gain_mask_4 * gain[1]) + (gain_mask_1 * gain[0])

return (cor_image * gain_image), gain_image
```

#### 1.1.4 Useful Links

- LBNL Fast CCD Site
- csxtools python analysis routines
- libcin low level c driver
- areaDetector Driver

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# **INDICES AND TABLES**

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#### HELP!! THE %\$^\$#@% JUST CRASHED

## 3.1 Managing IOCs

Soft IOCs are managed through the manage-iocs script. To obtain a list of softiocs running on a NSLS-II computer use the command manage-iocs report an example is shown below for xf23id1-ioc3:

```
[swilkins@xf23id1-ioc3 ~]$ manage-iocs report
nBASE
                                                 | PORT | EXEC
               | IOC
                                l USER
                                | root
                                                 | 5000 | /epics/iocs/apcupsd/st.cmd
/epics/iocs
               | apcupsd
/epics/iocs
              | cam-diag1
                                                   4202 | /epics/iocs/cam-diag1/st.cmd
                               | softioc
                                                 4300 | /epics/iocs/cam-diag6/st.cmd
/epics/iocs
              | cam-diag6
                               | softioc
                                                /epics/iocs
              | cam-dif1
                               | softioc
                                                   4204 | /epics/iocs/cam-dif1/st.cmd
                                                /epics/iocs
              | cam-dif2
                               | softioc
                                                | 4205 | /epics/iocs/cam-dif2/st.cmd
/epics/iocs
              | cam-dif3
                               | softioc
                                                | 4206 | /epics/iocs/cam-dif3/st.cmd
/epics/iocs
              | cam-dif-beam | softioc
                                                | 4201 | /epics/iocs/cam-dif-beam/st.cmd
                                                | 4002 | /epics/iocs/ct-eps/st.cmd
/epics/iocs
              | ct-eps
                               | softioc
/epics/iocs
              | es-dq645
                               | softioc
                                                | 5013 | /epics/iocs/es-dg645/st.cmd
/epics/iocs
              | es-K2611
                               | softioc
                                                | 4302 | /epics/iocs/es-K2611/st.cmd
                               | softioc
/epics/iocs
              | es-tctrl1
                                                | 5010 | /epics/iocs/es-tctrl1/st.cmd
/epics/iocs
                                                | 4301 | /epics/iocs/es-vortex/st.cmd
              | es-vortex
                               | softioc
              | mc11
                               | softioc
                                                | 5001 | /epics/iocs/mc11/st.cmd
/epics/iocs
                               | softioc
                                                | 5002 | /epics/iocs/mc12/st.cmd
/epics/iocs
              | mc12
/epics/iocs
              | mc13
                               | softioc
                                                | 5003 | /epics/iocs/mc13/st.cmd
                                                | 5012 | /epics/iocs/omegaM4061/st.cmd
/epics/iocs
              | omegaM4061
                               | softioc
              | simdetector
/epics/iocs
                               | softioc
                                                   4203 | /epics/iocs/simdetector/st.cmd
                                                /epics/iocs
              simmotor
                                                | 8001 | /epics/iocs/simmotor/st.cmd
                               | softioc
/epics/iocs
               | timestamp
                               | softioc
                                                   6001 | /epics/iocs/timestamp/st.cmd
/epics/iocs
               | va-bakeout-01
                               | softioc
                                                   4001 | /epics/iocs/va-bakeout-01/st.cmd
                               | softioc
/epics/iocs
               | zebra
                                                   5011 | /epics/iocs/zebra/st.cmd
```

To connect to the IOC console, telnet to localhost at the port that is shown in the table. For example to connect to the mc12 console issue the command:

```
[swilkins@xf23id1-ioc3 ~]$ telnet localhost 5002
Trying ::1...
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
@@@ Welcome to procServ (procServ Process Server 2.6.0)
@@@ Use ^X to kill the child, auto restart is ON, use ^T to toggle auto restart
@@@ procServ server PID: 10584
@@@ Server startup directory: /epics/iocs/mc12
@@@ Child startup directory: /epics/iocs/mc12
@@@ Child "mc12" started as: /epics/iocs/mc12/st.cmd
@@@ Child "mc12" PID: 28044
```

```
@@@ procServ server started at: Tue Oct 20 17:35:25 2015
@@@ Child "mc12" started at: Fri Nov 13 12:49:49 2015
@@@ 0 user(s) and 0 logger(s) connected (plus you)
```

In order to reboot the IOC, type [CTRL] + X. To leave the console type [CTRL] + J and type close at the telnet> prompt

To start all IOCs configured on the system issue the command sudo manage-iocs startall and if needed to stop all IOCs issue the command sudo manage-iocs stopall

# 3.2 OLog Glassfish Server

To reboot the glassfish server on xf23id-ca.cs.nsls2.local execute:

```
swilkins@xf23id-ca:~$sudo su - glassfish
glassfish@xf23id-ca:~$cd glassfish3/bin/
glassfish@xf23id-ca:~/glassfish3/bin$ ./asadmin stop-domain domain1
glassfish@xf23id-ca:~/glassfish3/bin$ ./asadmin stop-domain domain2
glassfish@xf23id-ca:~/glassfish3/bin$ ./asadmin start-domain domain1
glassfish@xf23id-ca:~/glassfish3/bin$ ./asadmin start-domain domain2
```

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# **UNIX ACCOUNT SETUP**

# 4.1 Bash Shell Setup

The BASH shell is initialized by two main files .bashrc and .bash\_profile. These are executed by the shell differently depending on how the shell is executed. This is often a source of confusion. These files are summarized below:

• .bashrc : This is run by **interactive** shells

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# **DOWNLOADS**

Download the CSX Documentation as a PDF

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