NSLS-II CSX Beamline Docs Documentation

Release 0.1

Stuart B. Wilkins

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CONTENTS

Contents:

CHAPTER

ONE

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

Contents:

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 x 960 pixels of 30 µm x 30 µm and is arranged into two halves of 960 rows by 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 chanel is shown in the *LBNL fCRIC Circuit Diagram*.

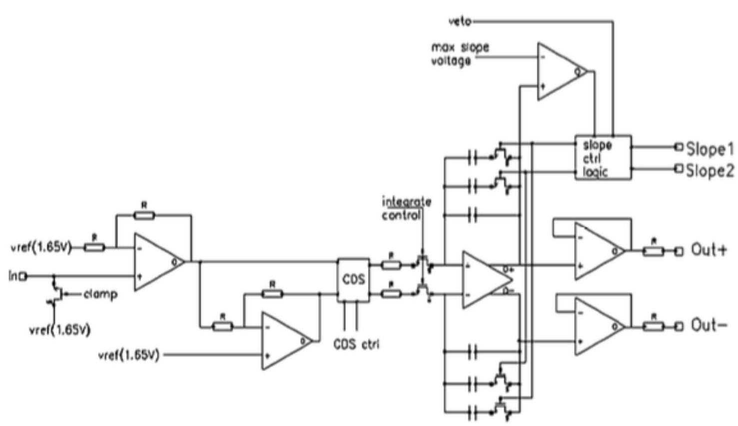


Fig. 1.1: LBNL fCRIC Circuit Diagram

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^- / 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:

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

where A_{corr} is the corrected intensity, A_{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

CHAPTER

TWO

INDICES AND TABLES

- genindex
- modindex
- search

CHAPTER

THREE

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            | IOC             | USER            |  PORT | EXEC
/epics/iocs      | apcupsd         | root            |  5000 | /epics/iocs/apcupsd/st.cmd
/epics/iocs      | cam-diag1       | softioc         |  4202 | /epics/iocs/cam-diag1/st.cmd
/epics/iocs      | cam-diag6       | softioc         |  4300 | /epics/iocs/cam-diag6/st.cmd
/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
/epics/iocs      | ct-eps          | softioc         |  4002 | /epics/iocs/ct-eps/st.cmd
/epics/iocs      | es-dg645        | softioc         |  5013 | /epics/iocs/es-dg645/st.cmd
/epics/iocs      | es-K2611        | softioc         |  4302 | /epics/iocs/es-K2611/st.cmd
/epics/iocs      | es-tctrl1       | softioc         |  5010 | /epics/iocs/es-tctrl1/st.cmd
/epics/iocs      | es-vortex       | softioc         |  4301 | /epics/iocs/es-vortex/st.cmd
/epics/iocs      | mc11            | softioc         |  5001 | /epics/iocs/mc11/st.cmd
/epics/iocs      | mc12            | softioc         |  5002 | /epics/iocs/mc12/st.cmd
/epics/iocs      | mc13            | softioc         |  5003 | /epics/iocs/mc13/st.cmd
/epics/iocs      | omegaM4061      | softioc         |  5012 | /epics/iocs/omegaM4061/st.cmd
/epics/iocs      | simdetector     | softioc         |  4203 | /epics/iocs/simdetector/st.cmd
/epics/iocs      | simmotor        | softioc         |  8001 | /epics/iocs/simmotor/st.cmd
/epics/iocs      | timestamp       | softioc         |  6001 | /epics/iocs/timestamp/st.cmd
/epics/iocs      | va-bakeout-01   | softioc         |  4001 | /epics/iocs/va-bakeout-01/st.cmd
/epics/iocs      | zebra           | softioc         |  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] + ]` 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
```

CHAPTER

FOUR

CONTROLS ACCOUNT SETUP GUIDE

CHAPTER

FIVE

INSTALLING A PERSONAL CONDA ENVIRONMENT

5.1 Installing Miniconda

Install the latest *miniconda*. This can be done by downloading the latest miniconda binary installer from conda.pydata.org.

Once the file is downloaded make the file executable and run the installer and answering all the default questions. However **DO NOT** let the installer change your `.bashrc` file.:

```
[swilkins@xf23id1-srv2 ~/Downloads]$ chmod u+x Miniconda3-latest-Linux-x86_64.sh
[swilkins@xf23id1-srv2 ~/Downloads]$ ./Miniconda3-latest-Linux-x86_64.sh
```

To add the *miniconda* to yor path, edit your `.bashrc` file with your favorite editor and add the following lines.

```
if [ -e "$HOME/miniconda3" ]; then
    export PATH="$HOME/miniconda3/bin:$PATH"
fi
```

To enable the path, now source your `.bashrc` file:

```
[swilkins@xf23id1-srv2 ~/Downloads]$ source ~/.bashrc
```

Once miniconda is installed and in the path, configure conda to use the NSLS-II anaconda cloud server:

```
[swilkins@xf23id1-srv2 ~/Downloads]$ conda install anaconda-client conda-build --yes
[swilkins@xf23id1-srv2 ~/Downloads]$ conda config --add channels anaconda
[swilkins@xf23id1-srv2 ~/Downloads]$ conda config --add channels latest
[swilkins@xf23id1-srv2 ~/Downloads]$ conda config --add create_default_packages pip
[swilkins@xf23id1-srv2 ~/Downloads]$ conda config --add create_default_packages anaconda-client
[swilkins@xf23id1-srv2 ~/Downloads]$ anaconda config --set url https://conda.nsls2.bnl.gov/api
[swilkins@xf23id1-srv2 ~/Downloads]$ conda config --remove channels defaults --force
[swilkins@xf23id1-srv2 ~/Downloads]$ conda update --all --yes
```

Congratulations! You now have a personal installation of *miniconda* connected to the NSLS-II anaconda cloud server. Now you can create a new environment for doing your analysis. To create and activate the environment type:

```
[swilkins@xf23id1-srv2 ~/Downloads]$ conda create -n analysis python=3.5
[swilkins@xf23id1-srv2 ~/Downloads]$ source activate analysis
(analysis)[swilkins@xf23id1-srv2 ~/Downloads]$ conda install dataportal
(analysis)[swilkins@xf23id1-srv2 ~/Downloads]$ conda install ipython-notebook
```

To get your custom environment to work with the notebook server, you have to create a kernal file in your `.python/kernel` directory (where *my-analysis-kernel* can be any name you wish to know this kernel by):

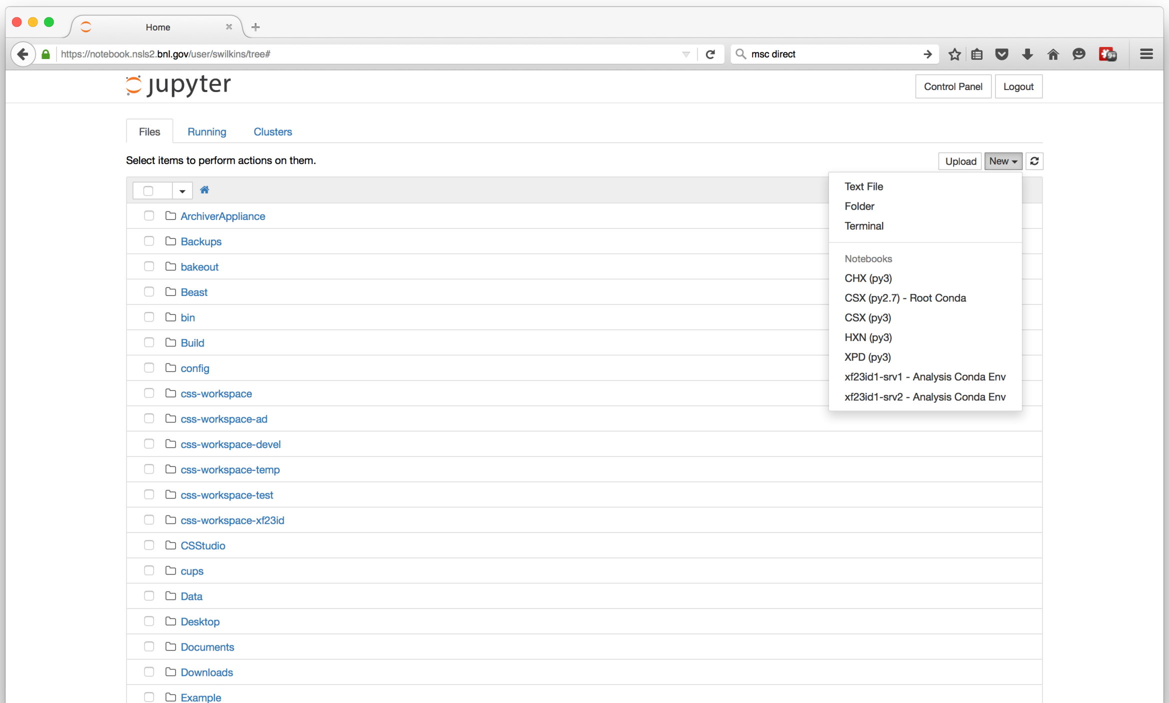
```
(analysis)[swilkins@xf23id1-srv2 ~]$ cd ~/.ipython/kernels/
(analysis)[swilkins@xf23id1-srv2 ~/.ipython/kernels]$ mkdir my-analysis-kernel
```

Now create a *kernel json file* to let the notebook server know how to run this kernel. Create a file `kernel.json` in the directory `my-analysis-kernel` with your favorite text editor such as:

```
{"argv":["/home/swilkins/miniconda3/envs/analysis/bin/python3.5",
        "-m", "IPython.kernel", "-f", "{connection_file}"],
  "display_name":"xf23id1-srv2 - Analysis Conda Env",
  "host":"xf23id1-srv2"
}
```

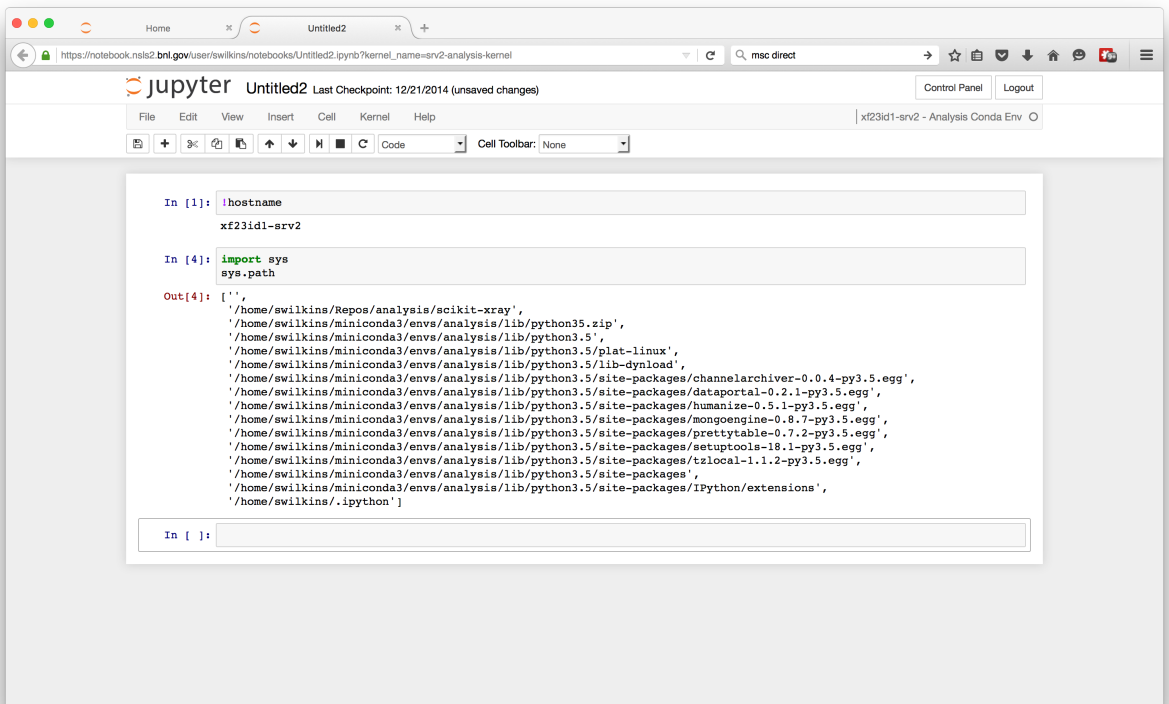
Where the path `/home/swilkins/miniconda3/envs/analysis/bin/python3.5` should point to the path of python in your home directory conda environment. `display_name` should be a nice name for this kernel, and the `host` is the computer on which the kernel should run.

If all works OK, the new kernel shouls show up in the kernel list on notebook.nsls2.bnl.gov



Running a new notebook from that option will now run a kernel in the new conda environment:

Congratulations!!


Home
Untitled2
https://notebook.nsls2.bnl.gov/user/swilkins/notebooks/Untitled2.ipynb?kernel_name=srv2-analysis-kernel
msc direct
jupyter Untitled2 Last Checkpoint: 12/21/2014 (unsaved changes)
Control Panel
Logout
File Edit View Insert Cell Kernel Help
xf23id1-srv2 - Analysis Conda Env
Code
Cell Toolbar: None
In [1]: !hostname
xf23id1-srv2
In [4]: import sys
sys.path
Out[4]: ['',
'/home/swilkins/Repos/analysis/scikit-xray',
'/home/swilkins/miniconda3/envs/analysis/lib/python35.zip',
'/home/swilkins/miniconda3/envs/analysis/lib/python3.5',
'/home/swilkins/miniconda3/envs/analysis/lib/python3.5/plat-linux',
'/home/swilkins/miniconda3/envs/analysis/lib/python3.5/lib-dynload',
'/home/swilkins/miniconda3/envs/analysis/lib/python3.5/site-packages/channelarchiver-0.0.4-py3.5.egg',
'/home/swilkins/miniconda3/envs/analysis/lib/python3.5/site-packages/dataportal-0.2.1-py3.5.egg',
'/home/swilkins/miniconda3/envs/analysis/lib/python3.5/site-packages/humanize-0.5.1-py3.5.egg',
'/home/swilkins/miniconda3/envs/analysis/lib/python3.5/site-packages/mongoengine-0.8.7-py3.5.egg',
'/home/swilkins/miniconda3/envs/analysis/lib/python3.5/site-packages/prettytable-0.7.2-py3.5.egg',
'/home/swilkins/miniconda3/envs/analysis/lib/python3.5/site-packages/setuptools-18.1-py3.5.egg',
'/home/swilkins/miniconda3/envs/analysis/lib/python3.5/site-packages/tzlocal-1.1.2-py3.5.egg',
'/home/swilkins/miniconda3/envs/analysis/lib/python3.5/site-packages',
'/home/swilkins/miniconda3/envs/analysis/lib/python3.5/site-packages/IPython/extensions',
'/home/swilkins/.ipython']
In [ ]:

CHAPTER

SIX

DOWNLOADS

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CHAPTER

SEVEN

INDICES AND TABLES

- genindex
- modindex
- search