

MRO FTT/NAS & FLC

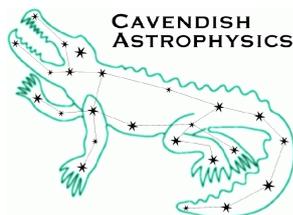
FLC Quick Start Guide

MRO-MAN-CAM-1210-0182

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Change Record

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0.1	2016-04-22	EBS	Initial version

Objective

To briefly describe installation of the Andor camera and associated electrical components, sufficient to perform image acquisition.

Scope

This document describes how to connect the FLC camera to its host computer and perform an initial acquisition test. It does not describe software installation, nor software use beyond acquisition of an initial image and adjustment of some parameters. Some familiarity with Linux, in particular the issuing of linux commands from a terminal, is assumed.

Reference Documents

- [RD1] J. Young, *Software Release Notes*, rev 1.5, Feb. 2016, ID: MRO-MAN-CAM-1160-0163.
- [RD2] J. Young, *Software User Manual*, rev 1.0, Apr. 2016, ID: MRO-MAN-CAM-1160-0165.
- [RD3] Andor Technology plc, *Hardware Guide, Andor Technology, iXon EM+*, rev 1.2, Aug. 2008.

Acronyms and Abbreviations

EMCCD Electron Multiplying Charge Coupled Device	MROI Magdalena Ridge Observatory Interferometer
FTT Fast Tip-Tilt	NMT New Mexico Tech
FLC First Light Camera	NAS Narrow-field Acquisition System
GUI Graphical User Interface	

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1 Introduction

This document is part of the MROI FTT/NAS software release, and describes how to connect the FLC camera to its host computer and perform some initial acquisition tests, such that the acquired data can be sent to Cambridge for assessment.

This document assumes that:

- The FLC/FTT software has already been installed on the host computer.
- Emulation tests (software tests that do not require camera hardware to be present) have been run successfully.

If this is not the case, please complete those tasks before proceeding. Software installation is covered in the software release document [RD1] and software use is described in the user manual [RD2].

2 Preparation

This work should be done in a room that can be easily and reliably darkened.

The following information will be needed:

- A user account name and password for the host computer.
- The root password for the host computer.
- The location of the software source code tree on the host computer's hard drive. The location will have been chosen by the person who installed the software, so if in doubt, consult them.

The following parts are required:

- The Andor camera and associated parts, as delivered from Andor.
- The host computer, an Amplicon Impact-R 3018 rack mount computer.
- The FLC camera mounting bracket.
- A "C" mount camera lens with manual focus and a manual iris, for example a Kowa LM35JC (available on Amazon for USD120). "CS" mount lenses are not suitable (they have a focal length which is too short).
- A target. This should be an easily recognised, high contrast object such as a coffee mug, that can be placed across the room from the camera in its field of view.
- A USB stick, or a network connection, or some other means of getting data off the host computer so that it can be sent to Cambridge.

The following preliminary steps are required:

- Remove the Andor camera from its packaging. Take care not to remove the protective cap from the C mount bush on the camera's front faceplate.
- Attach the camera front face to the FLC camera mount with the four supplied M5 bolts. The mount should be stable with the camera attached (Figure 1).

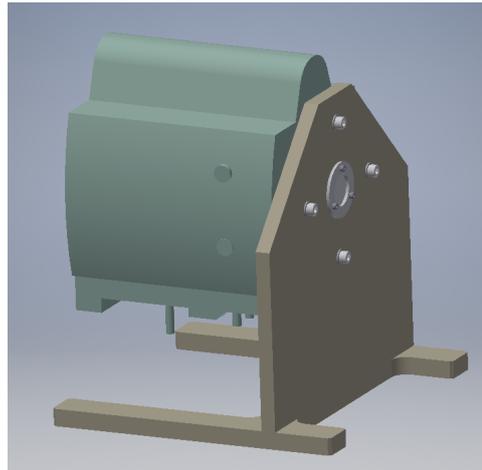


Figure 1: The camera shown attached to the FLC camera mount.

3 Electrical connections

Firstly install the PCI card in the host computer according to the following steps. Background information can be found in the Andor iXon EM+ hardware guide [RD3].

- Turn off the host computer.
- Remove the lid of the host computer.
- Install the PCI card in the slot labeled “PCI1” of the host computer (Figure 2).
- Install the supplied inline Molex power lead as described in the hardware guide.
- Replace the host computer lid.
- Ensure that any USB devices (mouse, keyboard) are connected at the rear of the host computer in the position shown in Figure 3.

Do not turn the computer on yet.

The reason for specifying the PCI card and USB connector locations is to prevent the PCI card from sharing its interrupt line. This is a requirement for hard real time operation.

From this point on, do the following, in order. Again, further general information can be found in the Andor hardware manual [RD3]:

- Connect the controller cable between the PCI card and the camera.
- Connect the Peltier cooler power supply block to the power input jack on the camera.
- Connect the Peltier cooler power supply block to the mains, but do not switch it on yet.
- Remove the protective cap from the C mount on the camera faceplate.
- Attach the C mount lens to the camera.
- Look at the lens iris from the front of the lens and adjust the iris to its minimum diameter.
- Adjust the focus to (approximately) infinity using the marks on the lens barrel — the correct position should be marked with an “∞”.

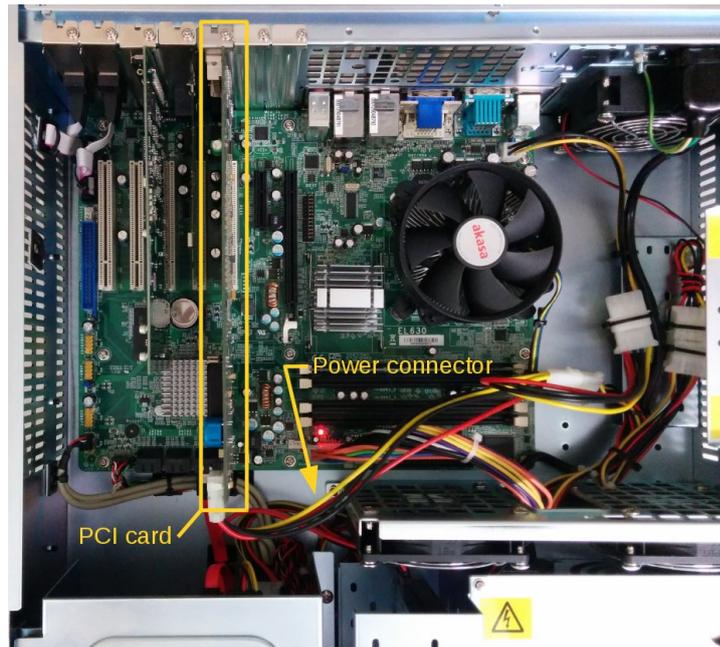


Figure 2: The host computer motherboard, showing the installed Andor PCI card and power connector.



Figure 3: Ensure that any USB devices use the rear USB connectors in the yellow rectangle.

4 Running the software

Power up the system as follows:

- Turn on the Peltier cooler power supply block at the mains.
- Turn on the host computer and wait for it to boot.
- Darken the room. It is OK if there is still enough light to see by, for this test the camera will initially be run with the lowest possible electron multiplying gain.

Log in as an ordinary user and find the location of the software source tree on the host computer's hard drive (here denoted [source]).

Next, do the following:

4.1 Load the drivers

The procedure for loading drivers is documented in the release notes [RD1]. For the FLC system, only the camera drivers are needed, so as root issue the following commands:

- `$ cd [source]/systems/drivers/linux/`
- `$./andordrvlx_manual_load`

- `$ insmod ../../xenomai/camera/ftt.ko`

If you get an error message during one of these steps, please send the output of

```
$ dmesg
```

to Cambridge.

4.2 Modify the configuration file

As an ordinary user, copy the example configuration file to a convenient location (which we will denote as [location]) and edit it to use real camera hardware:

- Issue the following command:

```
$ cp [source]/systems/FTTCamSystem/test/property.txt [location]
```
- Edit the copy, so that the first item on the list, `UseCamera`, is `true` instead of `false`.
- Make sure that the second item, `CameraAirCooling`, is `true` (this should only be set `false` when water cooling is in use).
- Save the modified copy.

4.3 Perform a trial acquisition

Run the software, as described in the user guide [RD2]:

- `$ mkdir /tmp/SCRATCH`
- `$ start_FTTCamSystem_ucamcontrol [location]/property.txt`
- `$ flcgui` (from a new terminal window)

The user interface should appear (Figure 4). There will also be a dialog warning about a connection failure, please drag this to one side and ignore it (it is because the environmental controller is not running for this test).

It should now be possible to perform a trial acquisition and save some data for future analysis:

4.3.1 Initial test

- Change the file recording time (next to the `Record Next` button) from 100 seconds to 10 seconds.
- Wait for the camera CCD temperature to reach the set point (by default, -60°C).
- Click the `StartAcquireRun` button. You should hear the camera shutter open and a full-frame acquisition image should appear and update at 1 Hz. At this point it is unlikely that anything except system noise will be visible.
- Click the `Record Next` button and wait for the recording to complete.
- Point the camera at the target.
- Gradually open the lens iris until the object is visible on the computer display.
- Adjust the lens focus to bring the object into focus.
- Click `New Session` and then `Record Next`, and wait for the recording to finish.

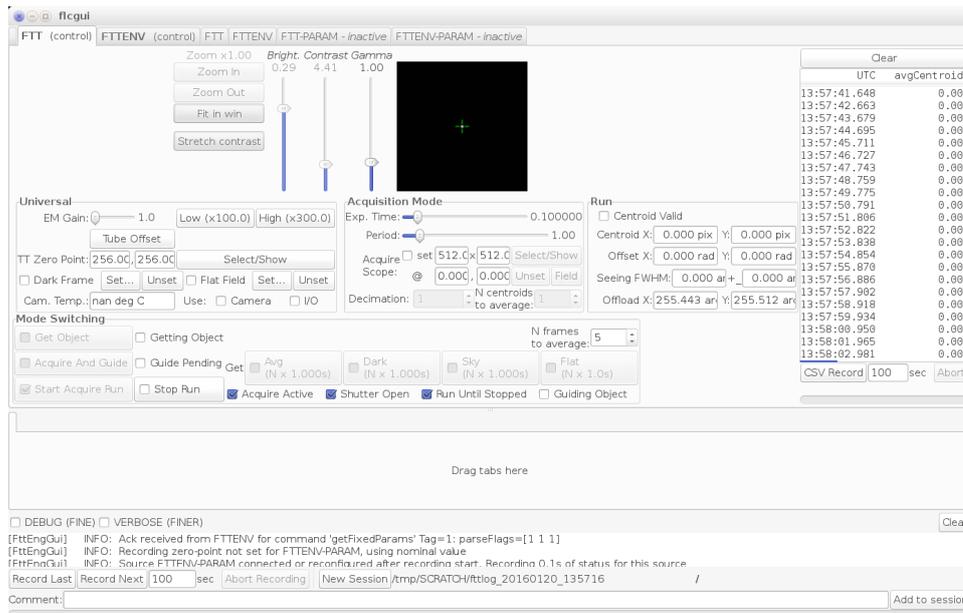


Figure 4: The FLC user interface. The image display and associated controls will only appear when an acquisition has been started.

- When done, stop the acquisition with the StopRun button. You should hear the camera shutter close.

4.3.2 Test change of exposure time

- Change the exposure time from 0.1 seconds to 0.2 seconds by adjusting the exposure time slider (or by using the cursor keys when the slider is selected).
- Click the StartAcquireRun button again and observe that images are once again being acquired. As the exposure time is twice as long, the image should have improved signal to noise and some parts of it might be saturated.
- Click New Session and then Record Next, and wait for the recording to finish.
- When done, stop the acquisition with the StopRun button.

4.3.3 Test electron multiplying gain

- Change the exposure time back to 0.1 seconds.
- Return the lens iris to its smallest possible diameter. *This is very important!*
- Next to the EM Gain slider is a button labelled Low (x100.0). Click on it.
- Click the StartAcquireRun button. Again, it is unlikely that you will see anything other than system noise.
- Click New Session and then Record Next, and wait for the recording to finish.
- Gradually open the lens iris until the object is visible on the computer display. Much less light should be needed than was previously required. Also, the images should be grainier than previously, as the electron multiplying gain introduces additional noise.

- Once again, click `New Session` and then `Record Next`, and wait for the recording to finish.
- When done, stop the acquisition with the `StopRun` button.

If it was possible to carry out these steps, then the hardware is correctly installed and most likely is working properly. There will be some new subdirectories in `/tmp/SCRATCH` containing the acquired data — please forward this to Cambridge for more detailed evaluation (see below). Note that files/directories in `/tmp` are automatically deleted when the computer is rebooted, so copy them immediately.

The recommended power down procedure is as follows:

- Stop any current acquisition.
- Stop the software: find the terminal windows from which the camera software and GUI were started, and in each one type `CTRL-C`.
- At this point it is safe to plug in a USB stick if this is your preferred means of getting data off the host computer. In any case, please copy the data in `/tmp/SCRATCH` elsewhere for transmission to Cambridge.
- Shut down the host computer.
- Turn off the Peltier cooler power supply block at the mains.