Eagle

Models: EA4240-CL and EA4710-CL

USER MANUAL

Raptor photonics

CONTENT

1. INTRODUCTION

1.1 Scope

This manual covers the Eagle V digital camera and all applicable components. Raptor recommends that this manual be used to optimize camera operation.

1.2 Camera Care

Raptor cameras require no regular maintenance except occasional external cleaning of the sensor window (the glass window between the camera sensor and the microscope or lens). Should any other issues occur please contact your local agent.

To clean the sensor window: gently wipe the face of the sensor window with a small amount of optical grade isopropyl alcohol and lens paper. Apply forced air again to remove any loose particles.

CAUTION — The camera's sensor, and circuits are sensitive to static discharge. Ensure you are using a static strap or are completely grounded at all times to release any static energy before you clean the window.

CAUTION — Do not use acetone.

2. SPECIFICATION

2.1 Camera Specification

The EAGLE V digital camera is designed for high-resolution applications requiring visible imaging (300-1050nm). The EAGLE V camera uses a choice of back-illuminated CCD sensors with a resolution of 1024x1024 or 2048x2048, both with 16-bit digital outputs. Low-noise electronics provide linear response and sensitivity. Vacuum based cooling to a delta of greater than 110°C (using both TEC and liquid) the Eagle V reduces dark current to 0.0001 e-/pixel/second, allowing longer exposures.

The Camera Link digital interface provides the most stable platform for data transfer and the camera will work on any Camera Link standard card.

A Software Development Kit (SDK) is available for interfacing with custom software.

SPECIFICATION		
Sensor (Front and Back Illuminated)	e2v CCD42-40	e2v 47-10
Active Pixel	2048 x 2048	1024 x 1024
Pixel Pitch	13.5µm x 13.5µm	13µm x 13µm
Active Area	27.65mm x 27.65mm (39.10 diagonal)	13.3mm x 13.3mm (18.81mm diagonal)
Readout Noise (RMS)	<3.5e- @ 75kHz (2.3e-typical) <12e- @ 2MHz (9.0e-typical)	
Binned Readout Noise (RMS)	16x16 binning: <5.0e- @75kHz	
Peak Quantum Efficiency	>90% @ 550nm	
Full Well Capacity	Minimum: 80ke- Typical: 100ke-	
Non-linearity	<1%	
Digital Output Format	16 bit Camera Link (Base Configuration)	
Dark Current (e/p/s)	<0.0001 @ -90°C	
Dynamic Range	81dB (2MHz pixel readout rate) 93dB (75kHz pixel readout rate)	
Shutter	Mechanical, aperture φ = 45mm	
Trigger interface	Trigger IN and OUT – TLL compatible	
Power supply	12V DC ± 10%	
TE Cooling	Active, ΔT > 110°C	
Image Correction	3 point NUC (offset, gain & dark current) + pixel correction	
Functions Controlled by Serial Communication	Exposure, Intelligent AGC, Non-Uniformity Correction, Gamma, Pk/Av, ROI	
Camera Power Consumption[2]	<20W with TEC OFF <100W with TEC ON (Steady State)	
Operating Case Temperature	0°C to +55°C	
Storage Temperature	-30°C to +60°C	
Dimensions[3]	140.89mm x 173.36mm x 110mm	
Weight	3.0kg	

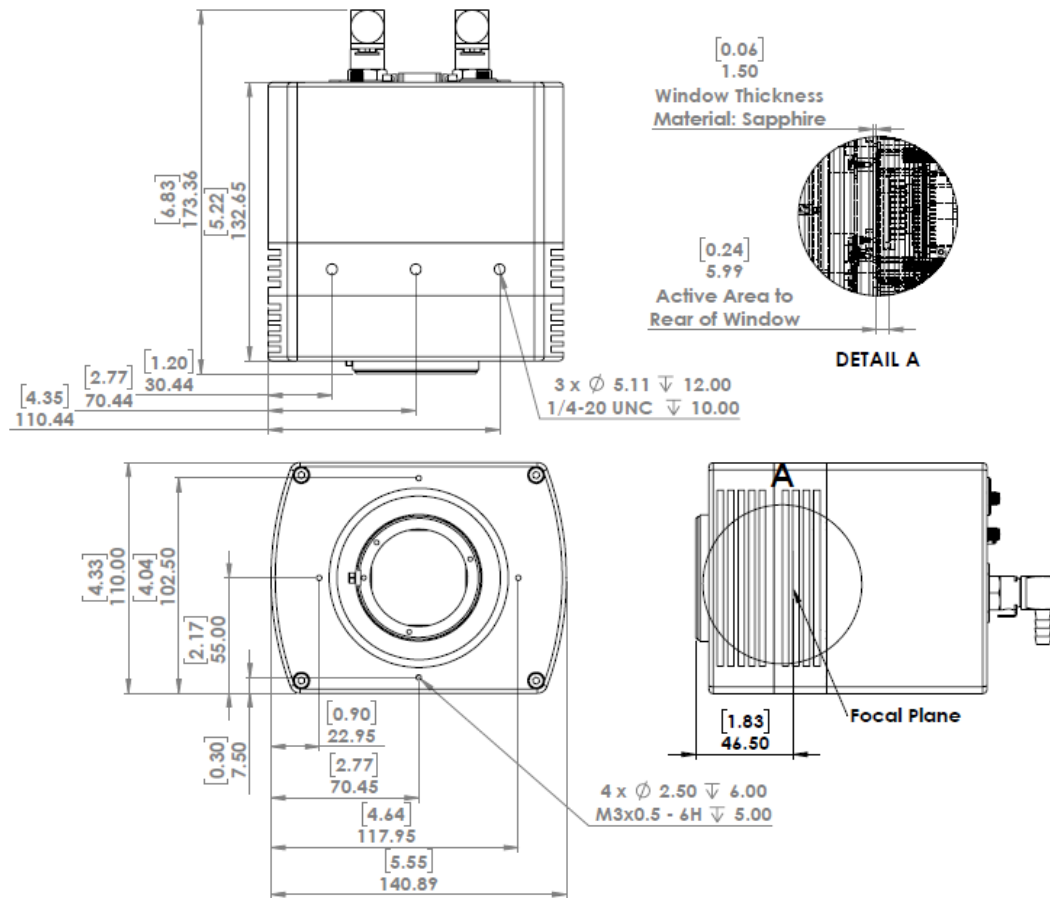*Latest version available on www.raptorphotonics.com*

Note 1: Optional filters available: Shortpass, Longpass or Bandpass
Note 2: Peak power consumption is <120W with the TEC on
Note 3: Dimensions include all connector parts on camera interface
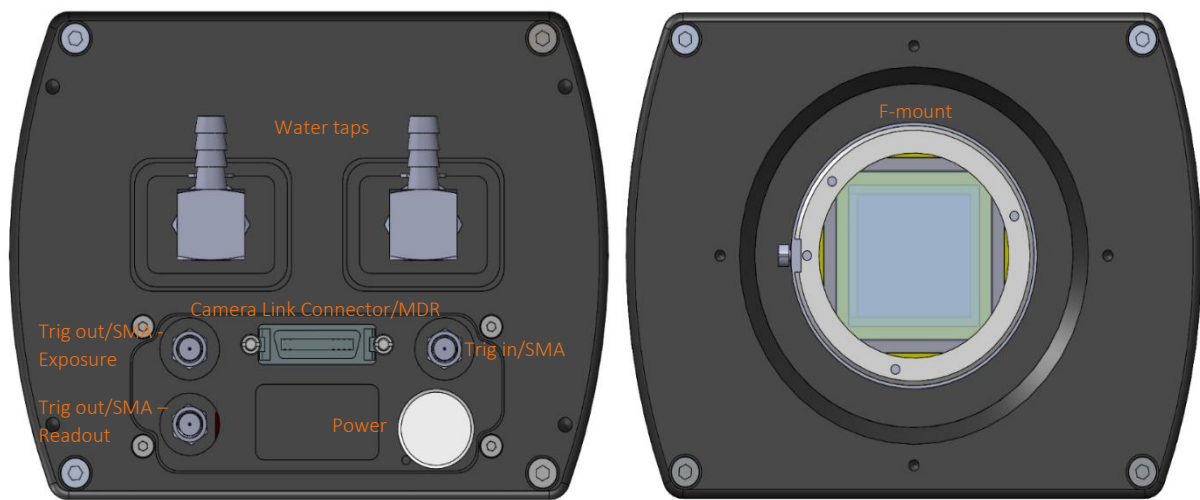
2.2   Mechanical Outline

3D drawings (STEP) are available upon request.

## 3.   GETTING STARTED

3.1   System Overview

3.2   Lenses

The EAGLE V has a standard Nikon F-Mount for standard lenses. It features a three-lug bayonet mount with a 44 mm throat and a flange to focal plane distance of 46.5 mm.

3.3   Mounting to a tripod or optical table

The camera has three (x3) ¼-20 BSW (Whitworth), threaded holes to mount to a tripod(s) or an optical table. The image below shows an optical table mount with the ¼-20 BSW threads.
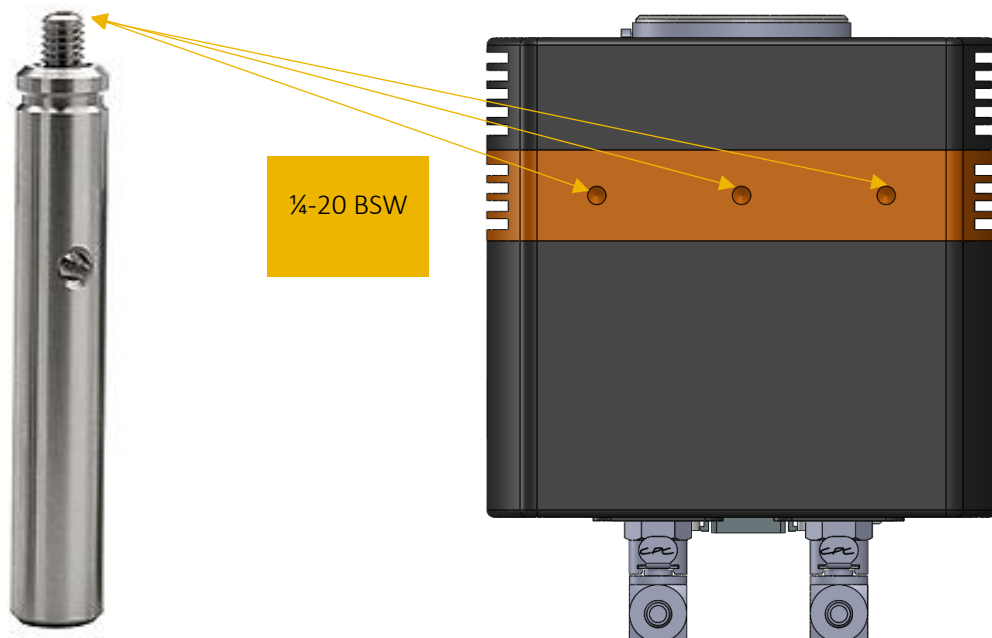
3.4 3rd PARTY SOFTWARE

Raptor supports a range of 3rd party software packages as per the matrix below.

	XCAP	XCLIB	NI Labview	Micromanager
Hawk 252	☑	☑		
Falcon III	☑	☑		
Eagle	☑	☑	☑	☑
Owl 320 High Speed	☑	☑		
Owl 'Mini'	☑	☑	☑	☑
Owl 640	☑	☑	☑	☑
Ninox 640	☑	☑	☑	☑
Owl 1280	☑	☑	☑	

☑ - Software tested by Raptor Photonics

☑ - Software tested by other companies

Blank - The camera has not been tested or is not supported by this software

In this guide, there is a quick overview of XCAP (http://www.epixinc.com/support/files.php) and Micro-Manager (https://micro-manager.org). Should you have other software support specific needs, please do not hesitate to contact our sales team on sales@www.raptorphotonics.com.

3.5 Connecting your camera to a computer

- If using a laptop insert the Express Card to Camera Link adapter while the PC is switched off and make sure it is secure. If using a PC, insert the EPIX controller card into the correct slot of your PC. You can visit http://www.epixinc.com for further support issues.
- Insert EPIX software key dongle into a USB port (the red light on the dongle should light up).
- Boot up the computer.
- Use the Camera Link cable to connect the camera to the computer.
- Connect the other end of the Camera Link cable to the camera.
- Carefully thread the F-mount lens onto the camera's lens ring until it is securely fastened. Use the lens controls to adjust focus. We suggest that the camera be mounted on a tri-pod or an optical bench.
- The Eagle V has its own custom 12V power supply module and camera power cable. Connect a mains lead to the power supply module and the power cable to the camera through the LIMO connector. A red guide dot on the cable and camera highlights where to insert the connector.

The Eagle V camera is compatible with all types of Camera Link frame grabber. However, our cameras are extensively tested using Epix Inc. equipment's XCAP, for this reason we recommend XCAP software.

3.6   Using a liquid re-circulator

The TEC and fan will allow the Eagle V to cool but if you want to run the camera at its optimum of -90C, you will need to use a Liquid Re-circulator unit or Chiller. This will help dissipate the heat from the hot side of the sensor. A typical set-up is shown in Figure 1.
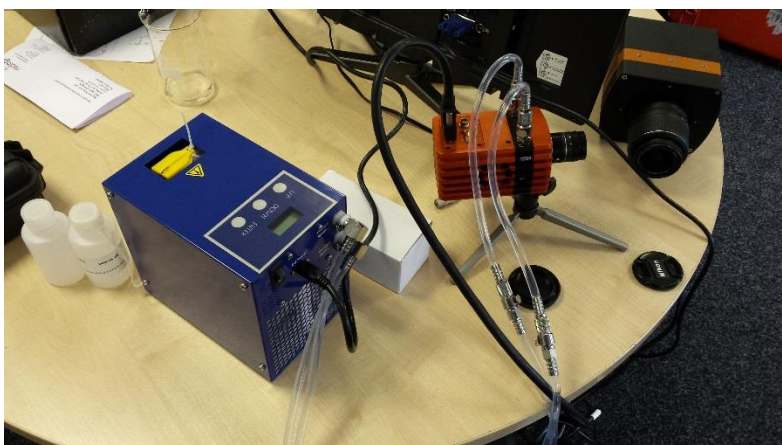

Figure 1: Liquid re-circulator set-up

Please consult the Eagle V data sheet for a list of recommended re-circulators and tubing accessories required. The set-up is as follows:

- Connect the cooling pipes and tubes to the from the Chiller to the camera.
- Fill the chiller with the liquid, filling to the bottom of the neck.
- Switch on the circulator; you will now see bubbles traveling along the tubing.
- Wait for the bubbles to bleed into the reservoir, top up the reservoir as required. You should tilt the camera side to side to ensure there are no bubbles remaining in the camera.
- Click "Start" to begin circulating water.
- Now set the Temperature set point on the circulator. For the Eagle camera, 20°C is preferred.
- *Please ensure the temperature set point of the re-circulator is above your ambient dew point, otherwise condensation can form around the sensor package and cause damage.*

Disassembly and draining

- Disconnect all the tubing from the camera and re-circulator.
- The camera and tubes should be drained by holding the adaptor with the tubing above the camera, as per Figure 2.

Figure 2: Drain the camera after use (left) and drain tubes (right)

4. EPIX XCAP

For minimum computer system requirements, please contact Epix for the latest information.

4.1 Download and Install XCAP

Using the following link, http://www.epixinc.com/support/files.php, please select the appropriate version of XCAP for your computer. Please ensure you are downloading from the section labelled. *Pre-release version with support for the latest cameras and latest PIXCI® imaging boards.* Open the downloaded file when complete and follow the onscreen instructions. Be sure to accept the board driver installation.

4.2 Operating your camera using XCAP

1. Open XCAP from within your operating system enabling administrative privileges.

2. Select PIXCI dropdown menu and select PIXCI Open Close, Figure 3 should appear.
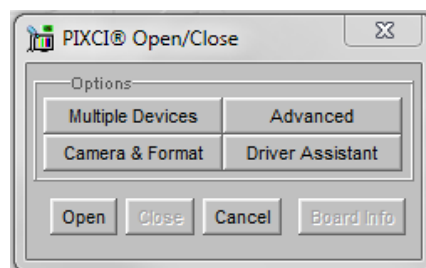
Figure 3: Open / Close

3. Select Close, and then Click on the Camera & Format button.

4. Using the dropdown menu scroll down and select Raptor Photonics Eagle V-from the list (Figure 4). Selecting OK when done.
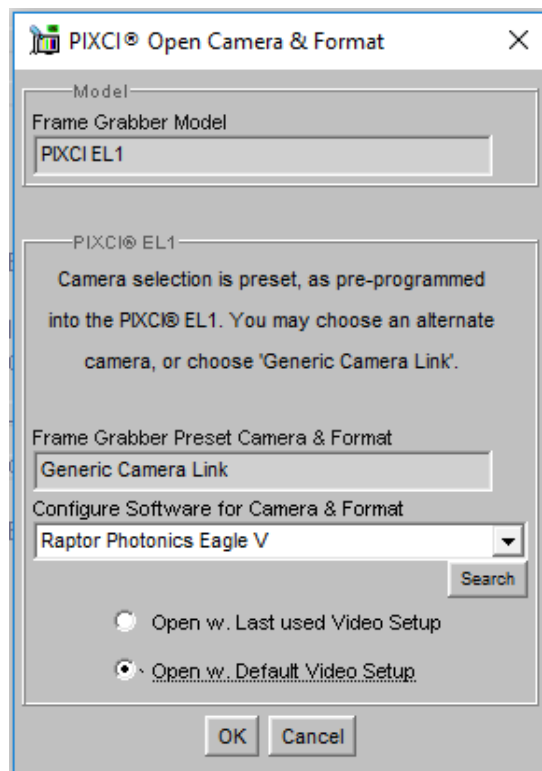
Figure 4: Camera Selection

5. Select Open and the viewing and control screens, Figure 5, will now open. Two windows should open (Figure 5), a viewing window (Left) and a control window (Right).
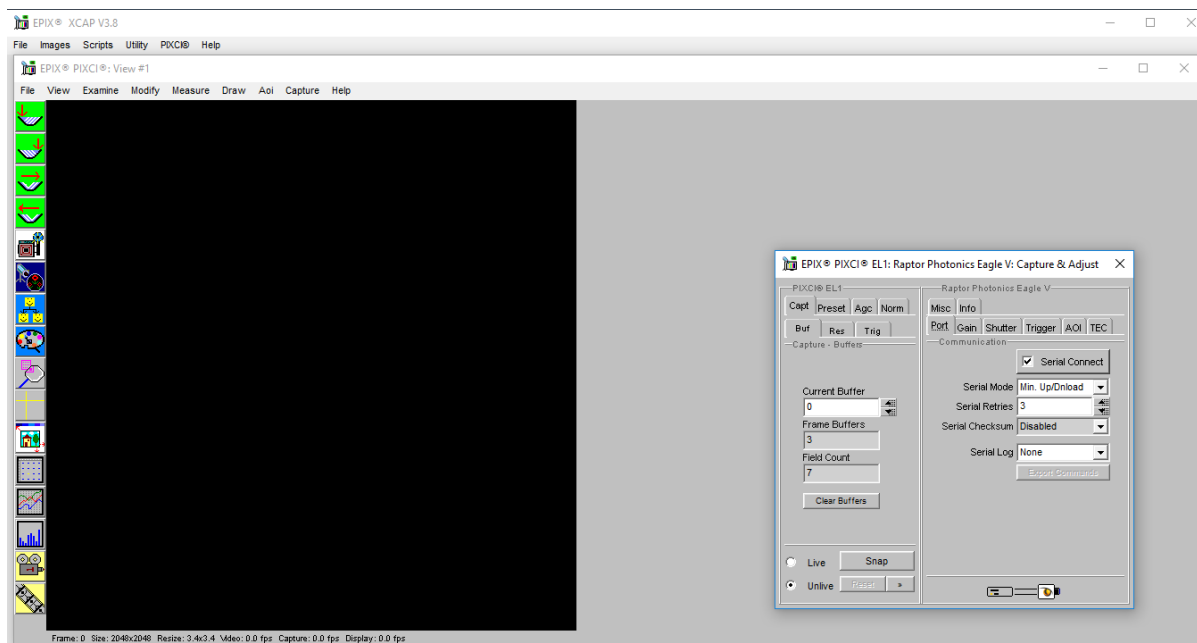
Figure 5: XCAP Camera Control Screen

6. The camera controls are pre-configured in EPIX.

7. The control window on the right should reflect your chosen camera. For example, for the Eagle V, it should read - EPIX PIXCI E8DB: Raptor Photonics Eagle V. If not, you need to select a different camera.

8. Check that the camera is communicating, see animated icon (Figure 6) on bottom right of control screen.

Figure 6: Active Communication

9. You are now configured and connected, ready to acquire an image.

10. Check the Serial Connect box (to establish serial communication to the camera). This should contain a tick (as circled in Figure 7).

11. Check the live button (as circled in Figure 7).
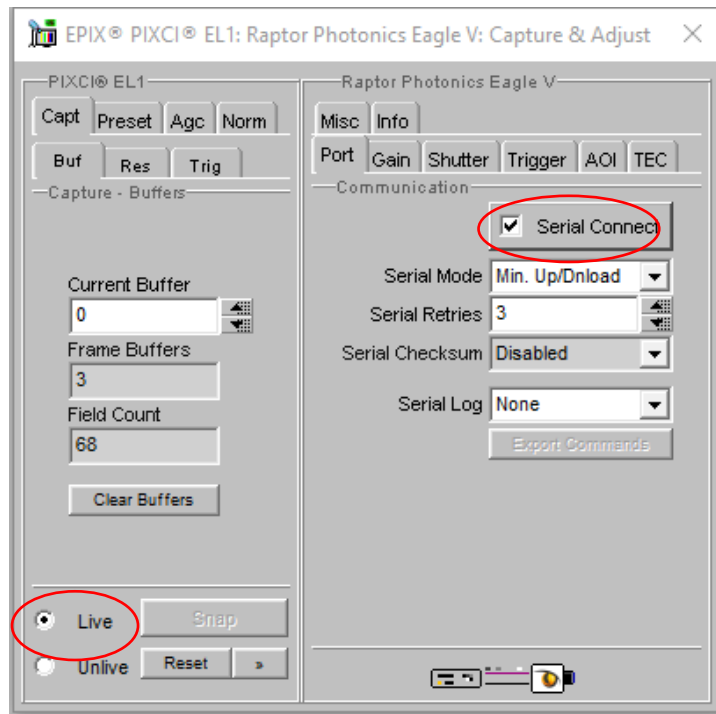
Figure 7: Image Capture

12. You should now see an image. On the bottom of the screen, you should see something similar to the following: *Frame: 0 Size: 2048 x 2048 Resize 3.4x3.4 Video: 0.4 fps Capture: 0.4 fps Display: 0.4fps.*
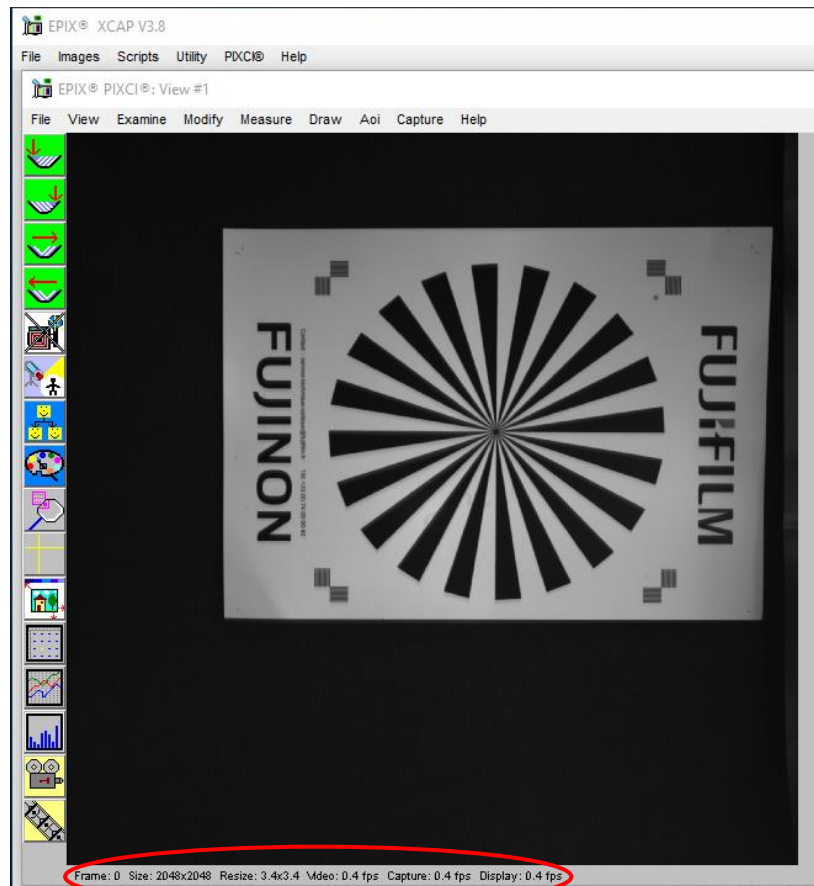

Figure 8a: Live Image Capture Window

To adjust the image to upright, go to Resolution tab on the left and select left B-T from the drop down menu. Then click on buffer tab again.
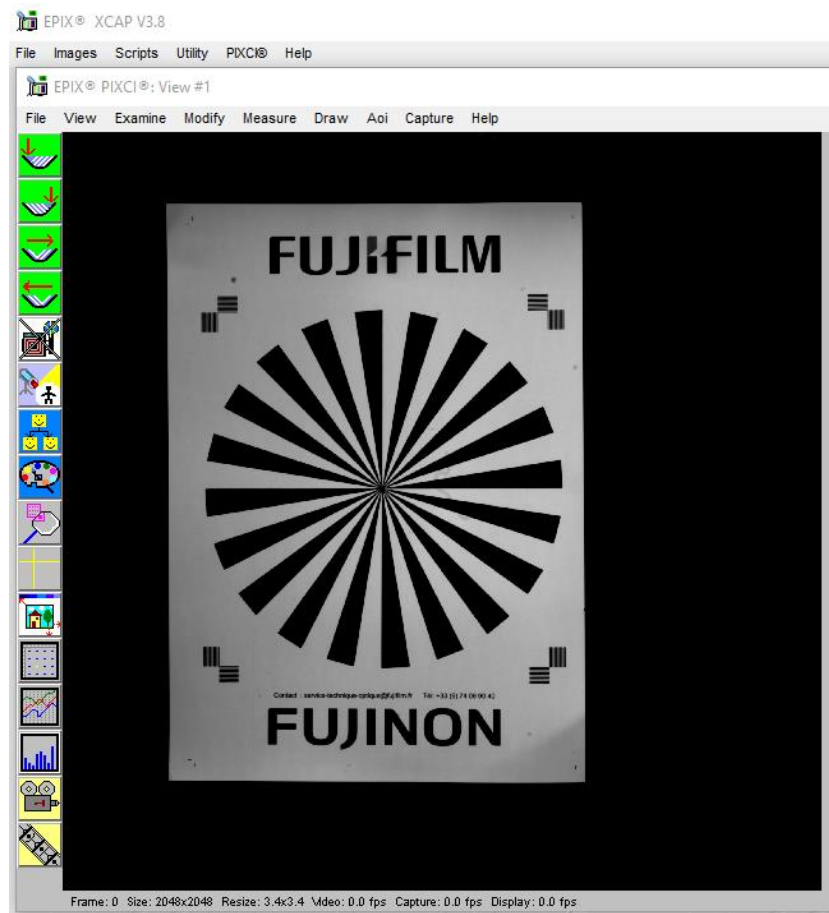

Figure 8b: Adjusted Live Image Capture Window

4.3   Changing the settings on XCAP

You have the ability to change several settings to control the camera through the tabs in the control window of the EPIX software.

4.4   TEC

Thermoelectric Cooling (TEC). Use this tab to set and read back the sensor temperature. To operate the camera for long exposures you will need to adjust the temperature of the Eagle V to deep cooling using a combination of the TEC and a water re-circulator. The camera is capable of cooling to -90C.

Ensure that the camera is connected to the circulator and that the temperature is set to 20°C. Make sure to rock the camera to ensure that the coolant is flowing evenly through the camera with no air bubbles.

Then click on the TEC tab. On the TE Cooler drop down, select Enabled, and then set the TEC to -90°C. This will take several minutes for the camera to reach the temperature. Click on the update temp button every few minutes to check on the sensor temperature.
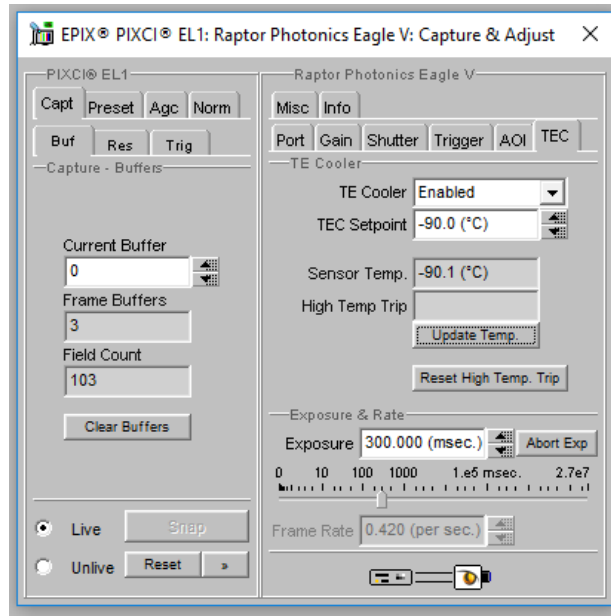
Figure 9: TEC Tab

4.5   Exposure
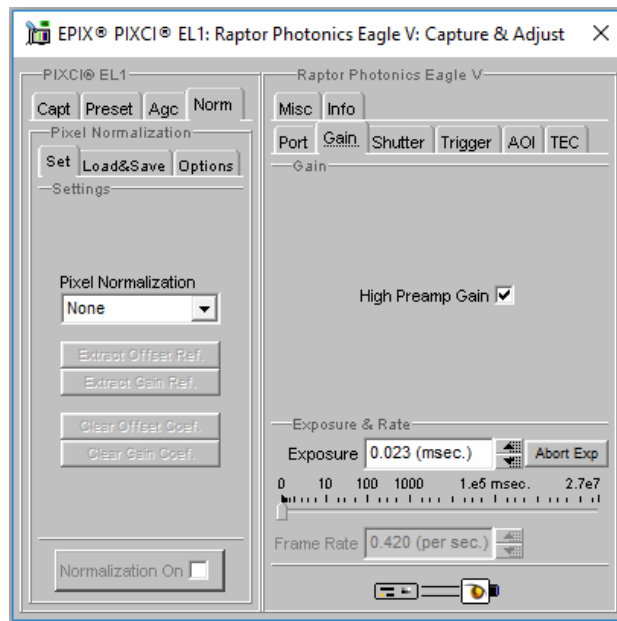
Click on the Gain Tab.

Figure 10: Gain Tab

There is an option for high preamp gain, which is already pre-selected, offering the lowest noise. If you have a bright signal, then there is the option to deselect, offering more signal albeit with about x5 less counts.

You can also adjust the exposure from 0.023msec through to 2.7^7msec. You should adjust it to 300 msec. at the start while setting up.
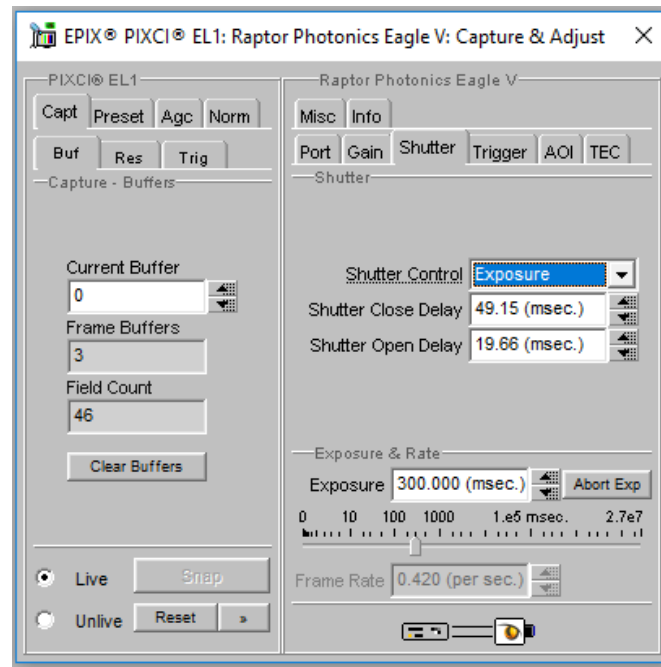
4.6   Shutter

Click on the shutter tab (as per Figure 11).

Figure 11 Shutter Tab

There are three options in the shutter control; closed, open or exposure. If you select exposure, you have to determine the shutter close delay and shutter open delay. A good test set-up to begin with is go to live, set exposure to 300msec and shutter control to exposure. Then set closed to 49.15 and Open to 19.66 and set Read-out mode to Normal.
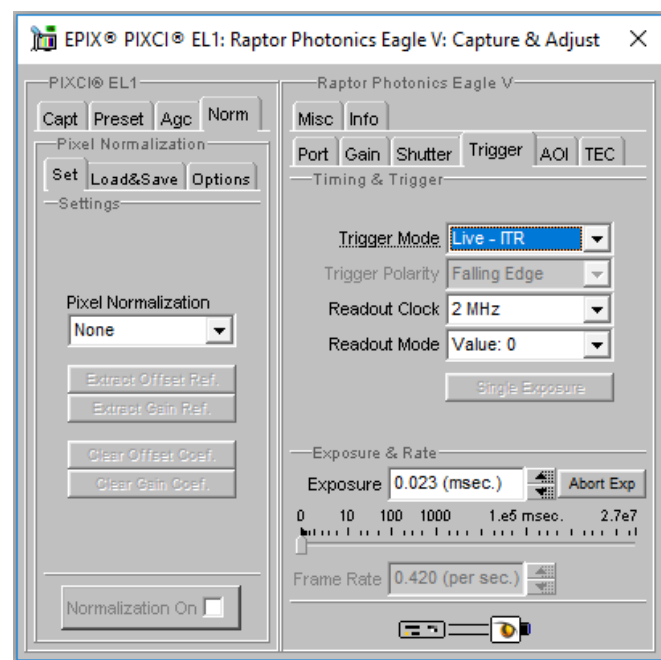
4.7   Trigger

Click on the trigger tab (as in Figure 12).

Figure 12: Trigger Tab

Use this tab to select the Trigger Mode (Live – ITR, Live - FFR, External Triggered or Button Triggered). If you select one of the triggered options, you then get a trigger polarity option (Falling edge or raising edge). To acquire a single image you use the button trigger. Click on unlive and hit the reset button. Then click on snap and then single exposure. You can save this fie and open later in a program such as Image J.

You can operate the Eagle V at two speeds by adjusting the readout clock, either 2MHz or 75kHz.

There is also a readout mode where you can select Normal data or a Test Pattern option.

4.8   AOI

Click on the AOI tab (as in Figure 13). Use this tab to set the binning options, which are as follows:

1x1	2x2	2x1	4x1	8x1	16x1	32x1
1x2	4x4	2x4	4x2	8x2	16x2	32x2
1x4	8x8	2x8	4x8	8x4	16x4	32x4
1x18	16x16	2x16	4x16	8x16	16x8	32x8
1x16	32x32	2x32	4x32	8x32	16x32	32x16

You also have the option to choose an Area of Interest within the main active region of 2048 × 2048. The user must ensure that X offset + ROI width is ≤ 2048 and similarly the Y offset + ROI height is ≤ 2048. Also, AOI width and AOI height must be > 0. (See Figure 13a).
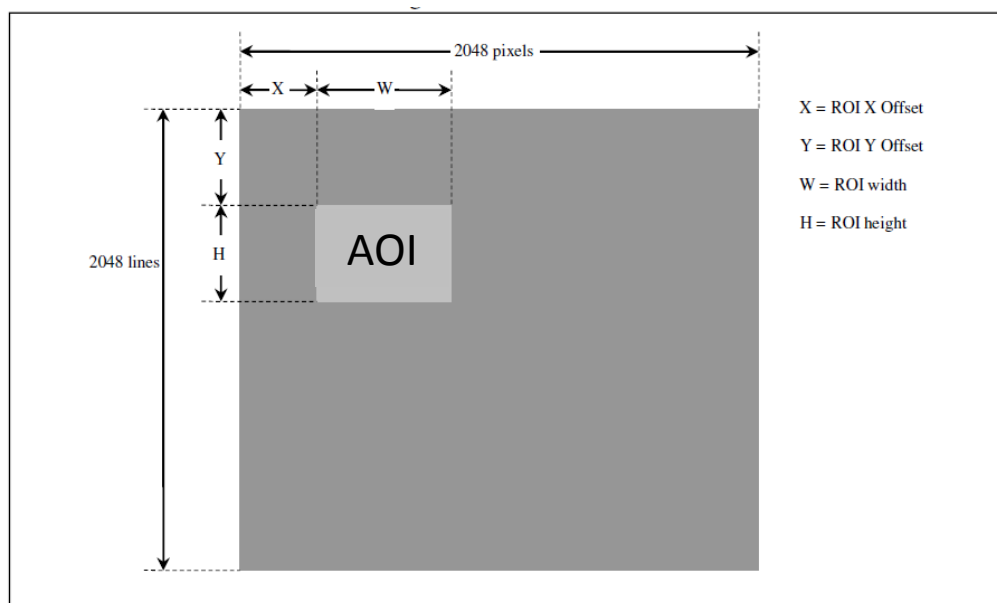

Figure 13a: AOI size and offset

In the example in Figure 13b we have chosen a point 200 left and 200 from the top. We have then defined the AOI width as 512 and the height as 512.
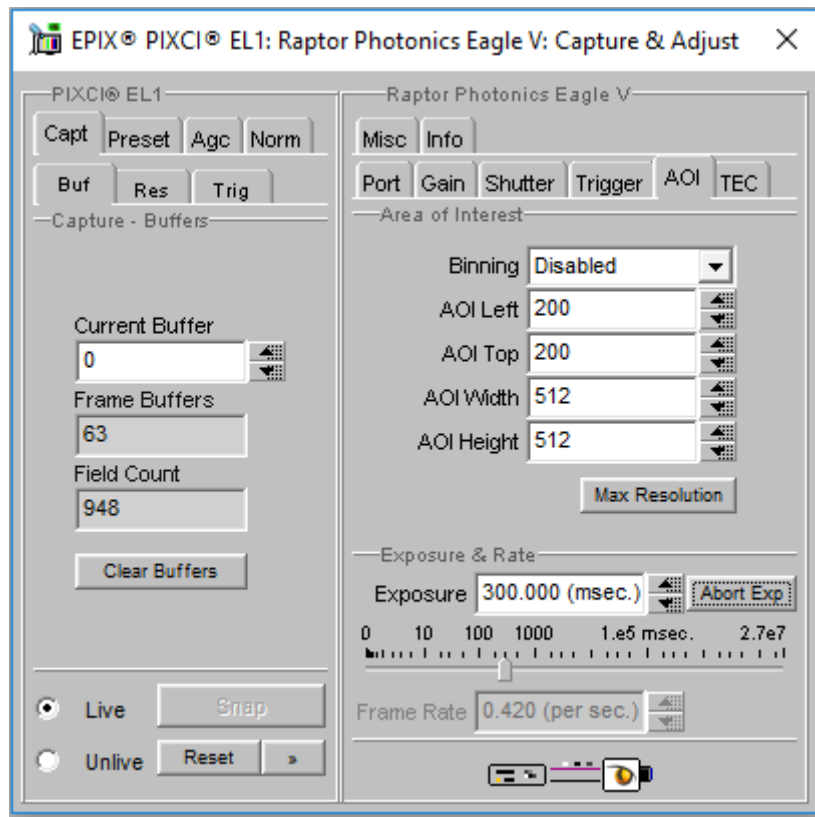
Figure 13b: AOI settings

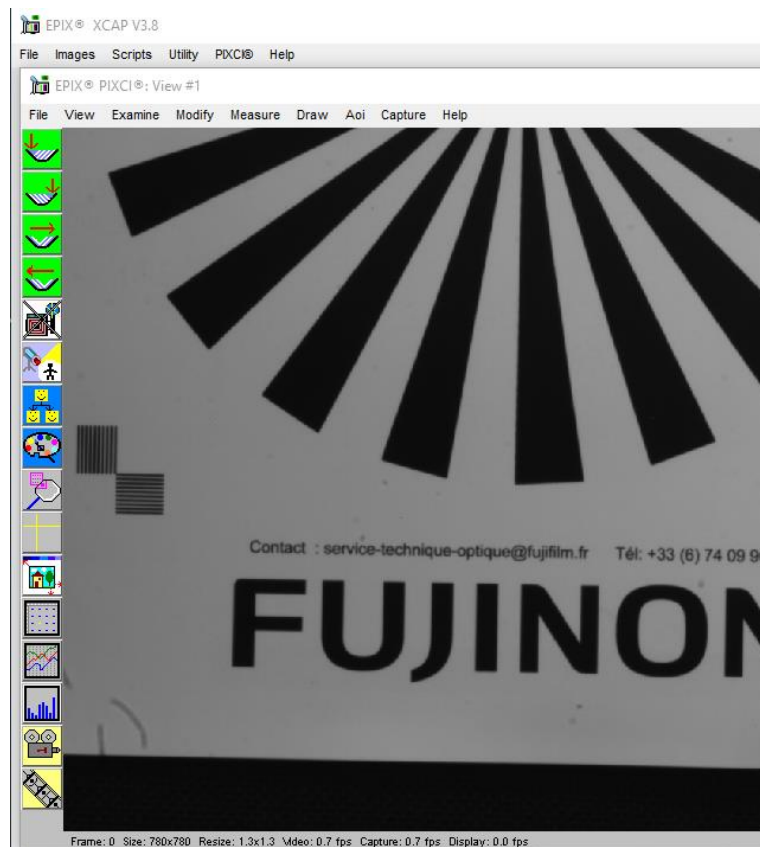You can see how the image have focused on this particular area of interest in Figure 13b.

Figure 13c: AOI Example Image

4.10   Information

Click on the Info tab (show in Figure 14) to view the cameras manufacturer data, for example Build date and serial number.
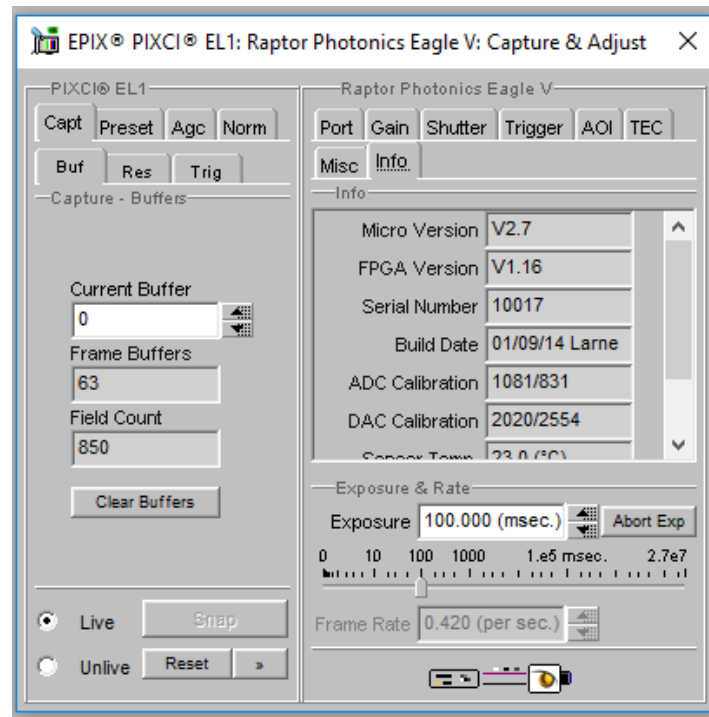

Figure 14: Information Tab

4.11   Adjusting the image display (With XCAP Std only)

The Viewing Pallet is not automatically adjusted in the XCAP software.

This needs manually configured to give the best display of the RAW image data from the camera.

1. Go to the Modify/Contrast Modification menu, Figure 21.

2. Select "Stretch Contrast, Histogram Percentile Endpoints" and "Preview" Figure 20: Stretch Contrast.

3. Adjust the "Low Percentile Endpoint" and "High Percentile Endpoint" to optimize the image display, defaults should be acceptable for most applications.
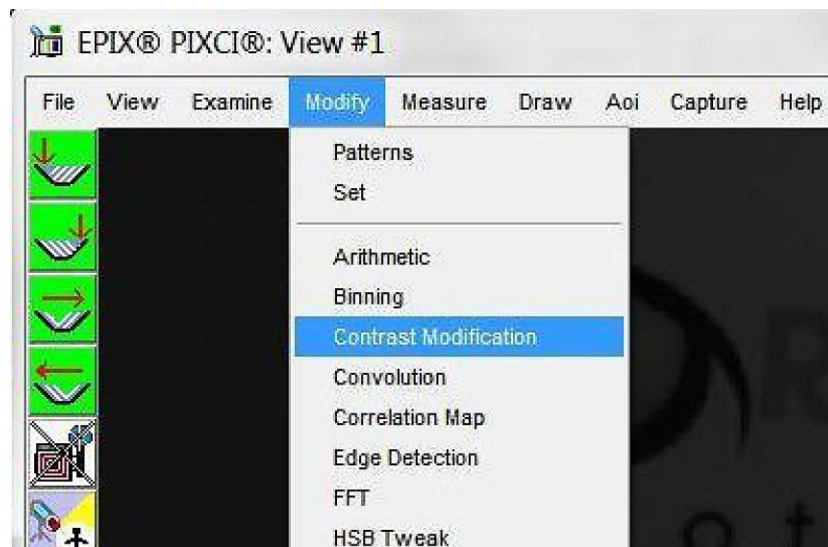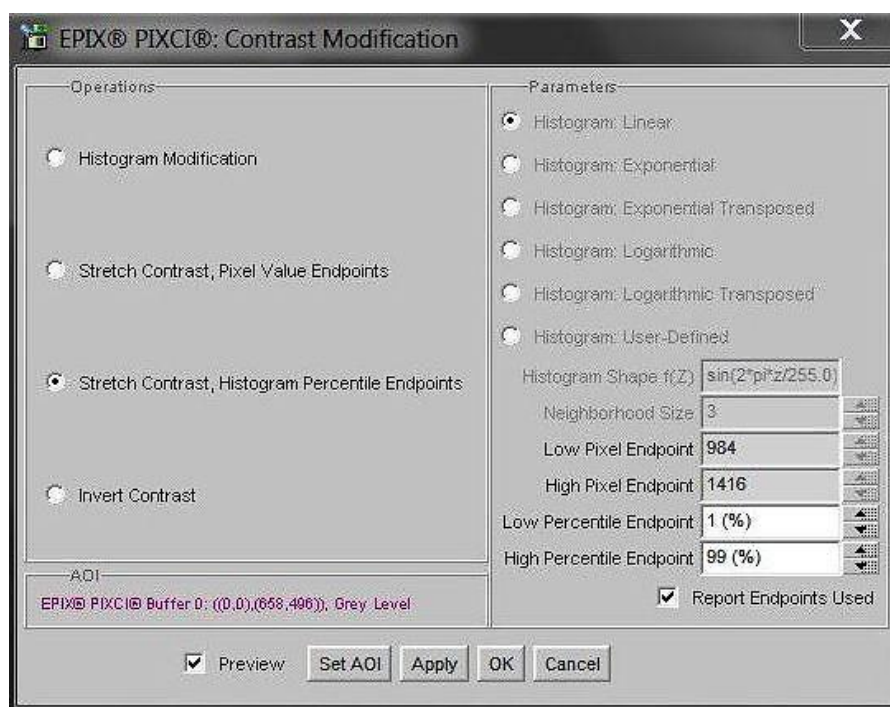
Figure 15: Contrast Modification

Figure 16: Stretch Contrast

5. MICRO-MANAGER

Micro-Manager is software for control of microscopes. It works with almost all microscopes, cameras and peripherals on the market, and provides an easy to use interface that lets you run your microscopy-based experiments. Micro-Manager runs as a plugin to ImageJ, is Open Source, and is free.

It is a complete image acquisition and microscope control package, available for Windows, Mac and Linux, it is easy to install and configure right "out-of-the-box", with built-in functionality and user interface for most common tasks performed in a Life Science laboratory. It also is a software framework for implementing advanced and novel imaging procedures, extending functionality, customization and rapid development of specialized imaging applications.

Micro-Manager has been developed at UCSF since the beginning of the project. Starting on October 1, 2015, Micro-Manager is developed and maintained by Open Imaging, a company founded by the Micro-Manager development team.

5.1 Download and install

Begin by installing the latest Micro-Manager. This can be done by going to the 'downloads' section of their website: www.Micro-Manager.org. You should select the latest nightly build for your operating system, found in the 'Download Nightly Builds' section. This will open a direct link to the Micro Manger FTP site where you can download most recently modified file.
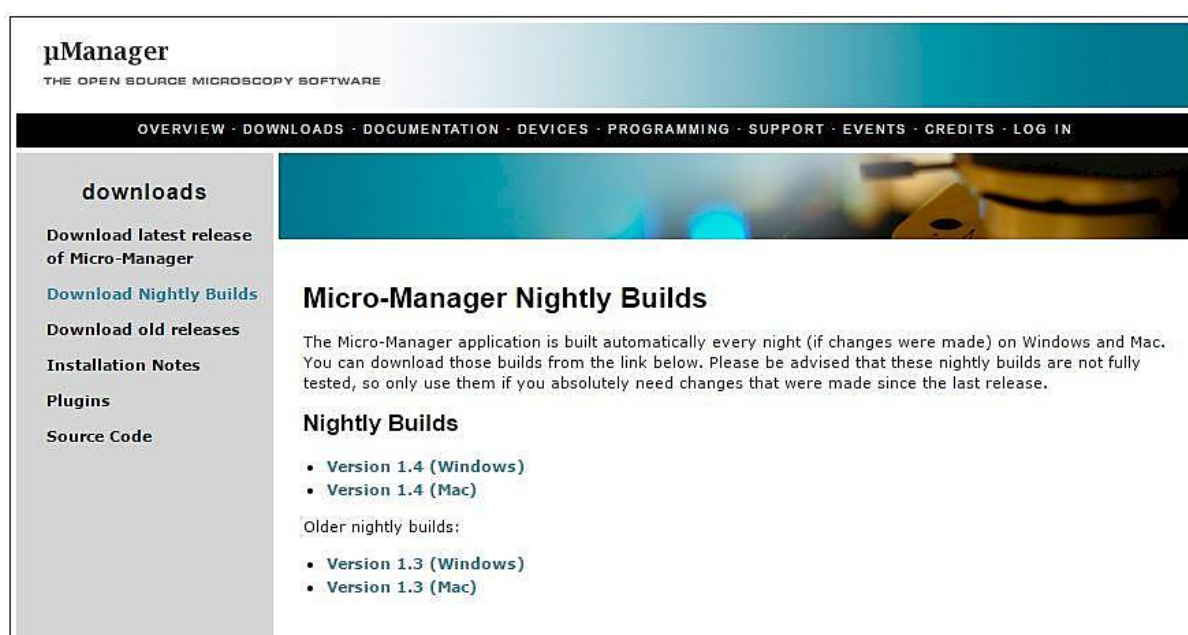

Figure 17: Micro-Manager Nightly Builds

5.2   Configuring Micro-Manager

When first opening Micro-Manager for the first time you will see the window shown in (figure 22). You need to make sure (none) is selected then click Ok.
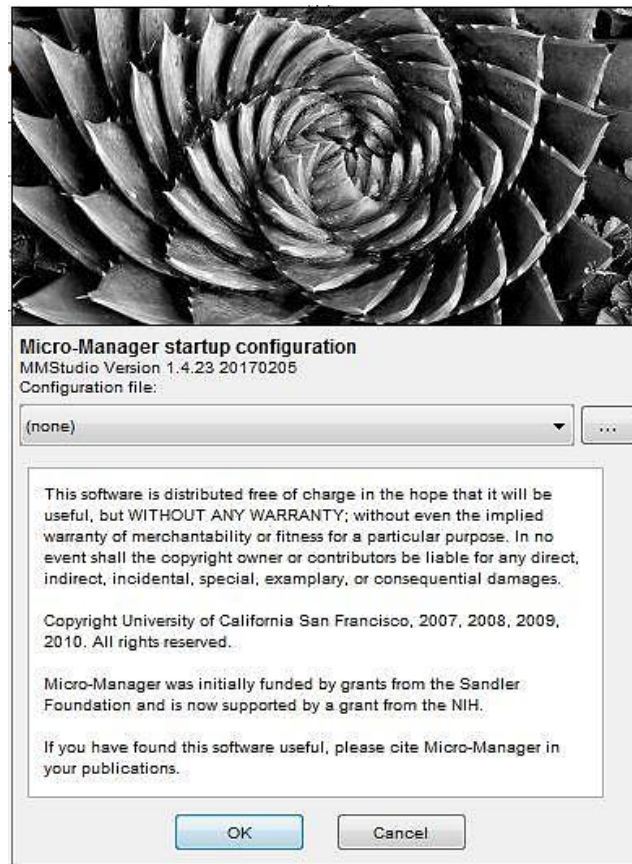

Figure 18: Hardware Configuration

1. Start the Hardware Configuration Wizard by going to tools then Hardware Configuration Wizard.
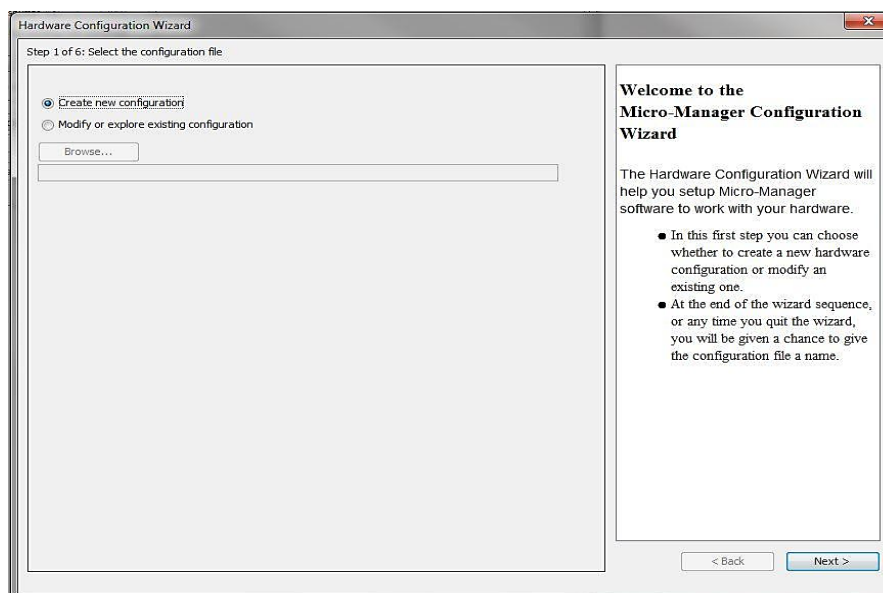

Figure 19: Hardware Configuration Wizard

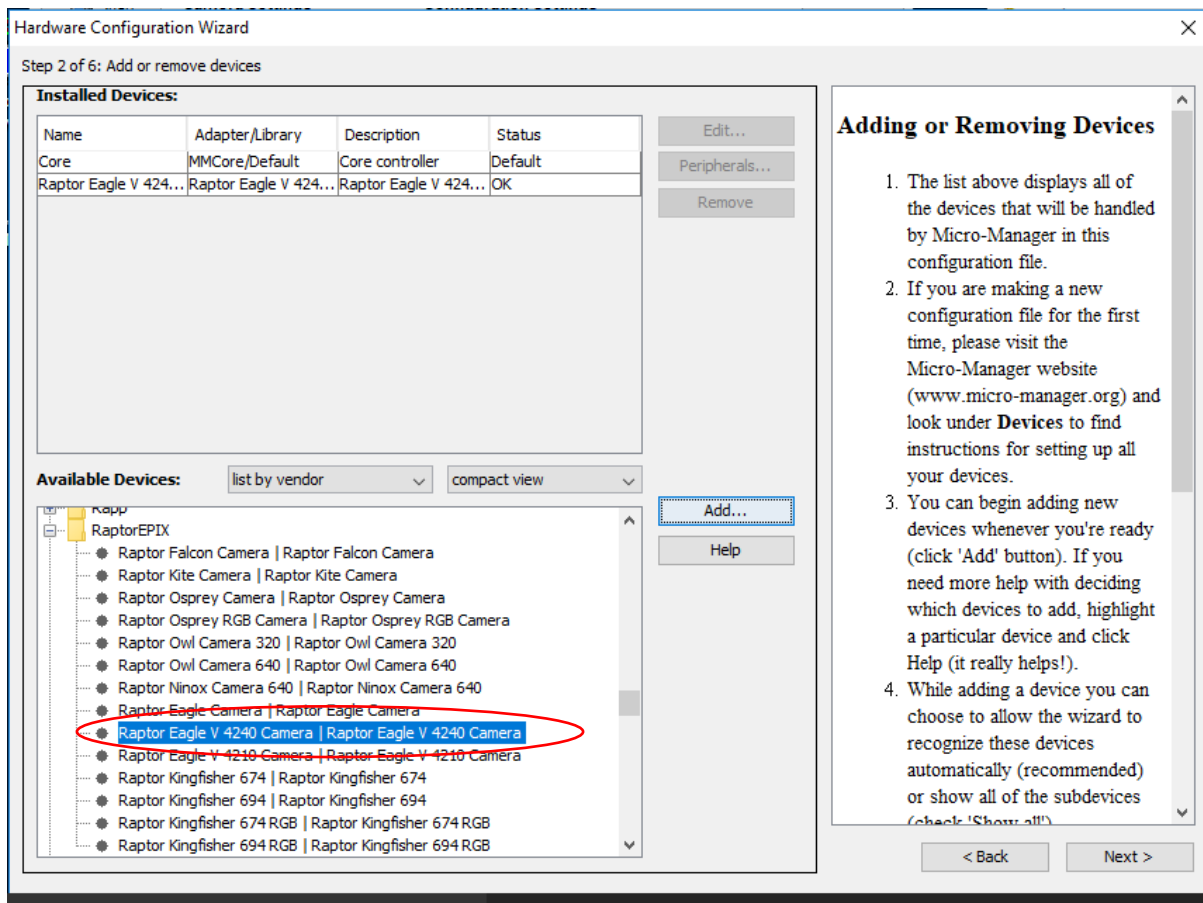2. Create a new configuration and add the raptor adapter from the list (shown in Figure 20), now click Next.

Figure 20: Add a New Device

3. Continue to click Next until you are faced with the screen shown in Figure 20.

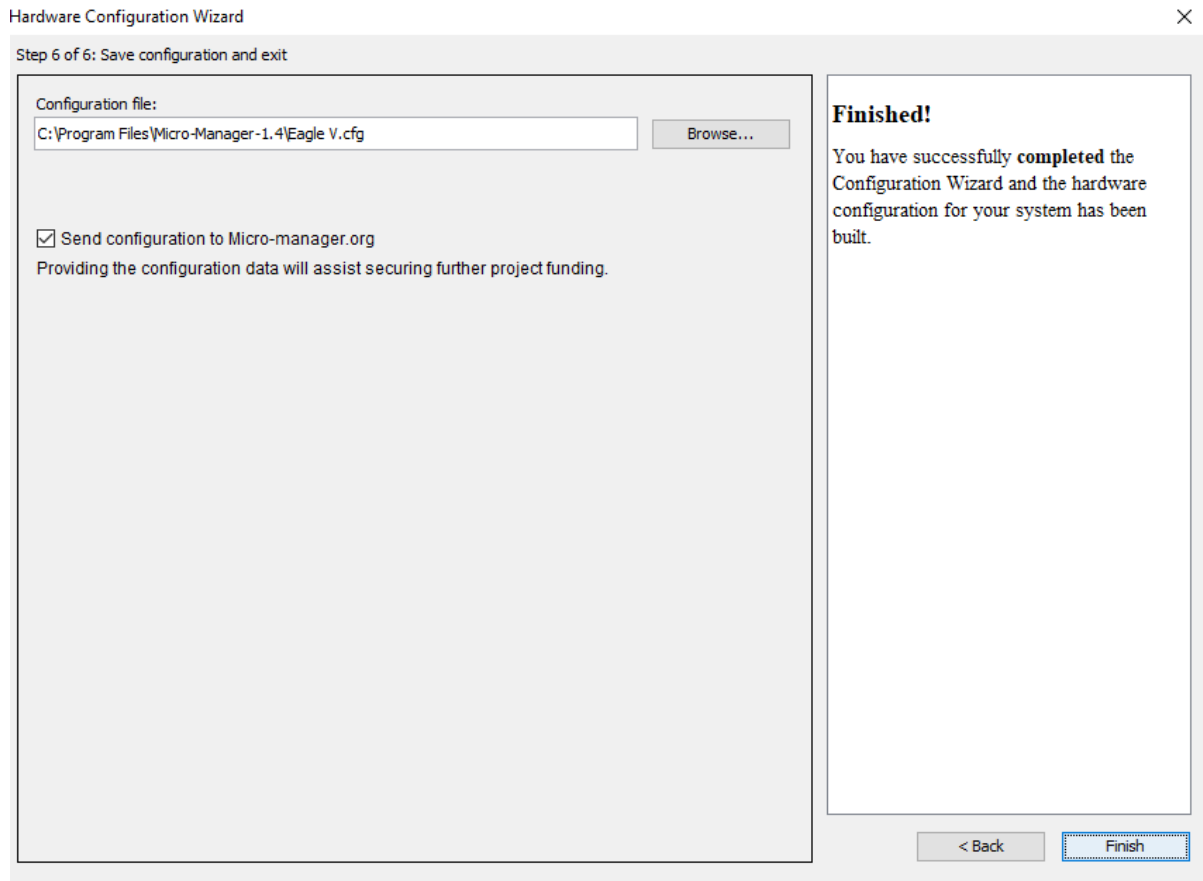4. Rename and save new configuration (e.g. "Eagle V" as shown in Figure 21).

Figure 21: Save Configuration

The connected camera should now be recognized.

Next time you open Micro-Manager you can simply select the saved Raptor Eagle V.cfg from the drop down menu (figure 22) then click Ok.
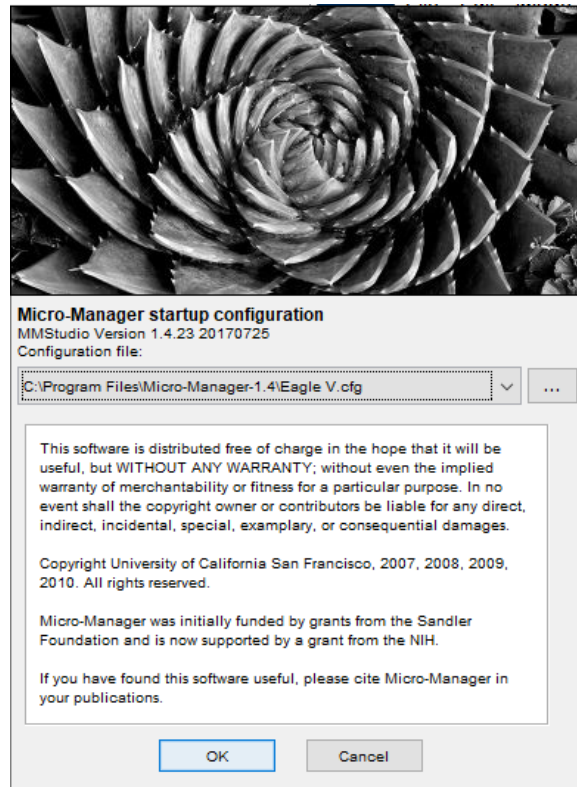
Figure 22: Selecting Saved Camera Configurations

5.3   Operating your camera using Micro-Manager
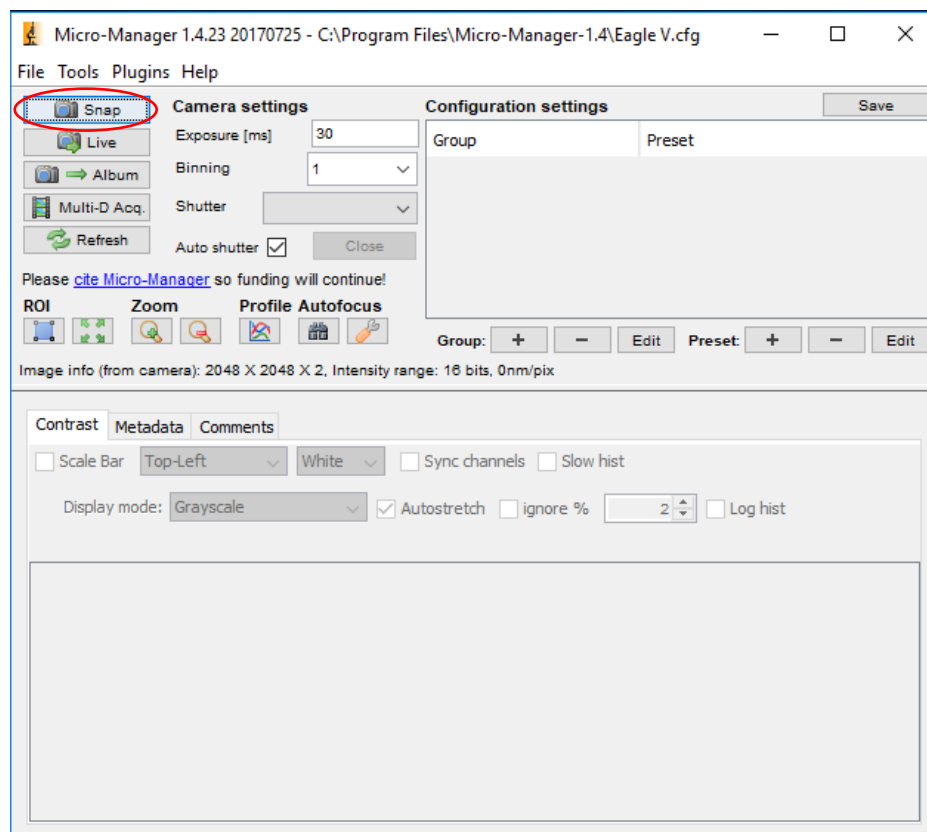
Figure 23: Opening Screen

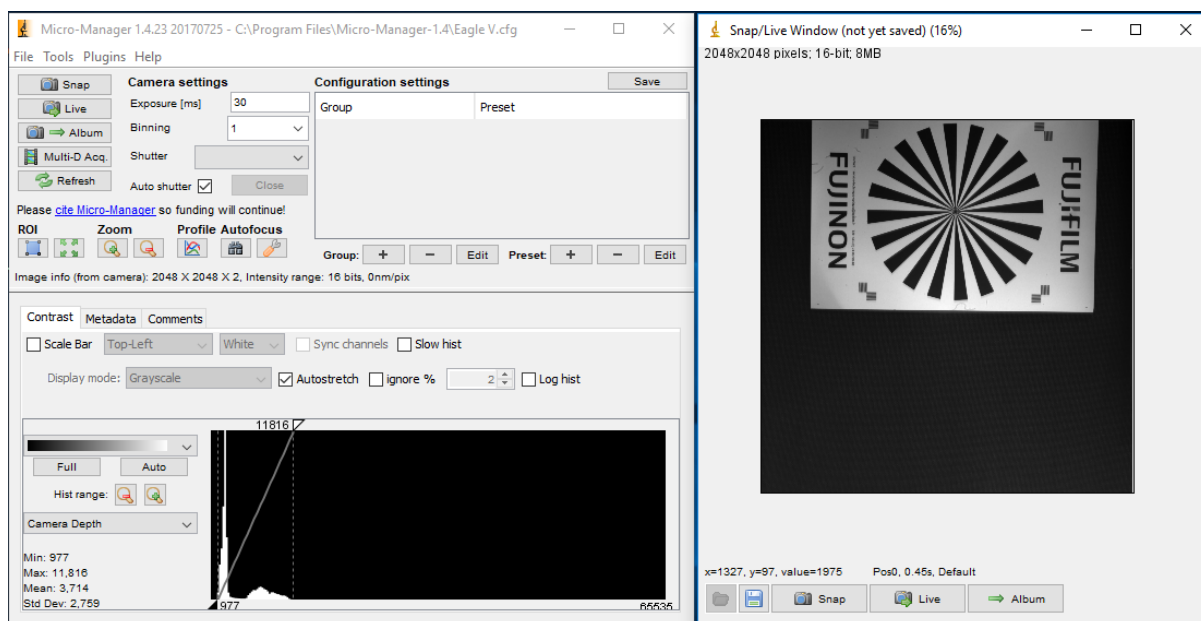1. Click on snap (Figure 23) for Micro-Manager to open the viewing window as shown in Figure 24.

Figure 24: Viewing Window

5.4   Changing Camera settings

All of the camera parameters are controlled within the Device/Property Browser; this can be accessed by selecting Tools from the menu bar then Device Property Browser…
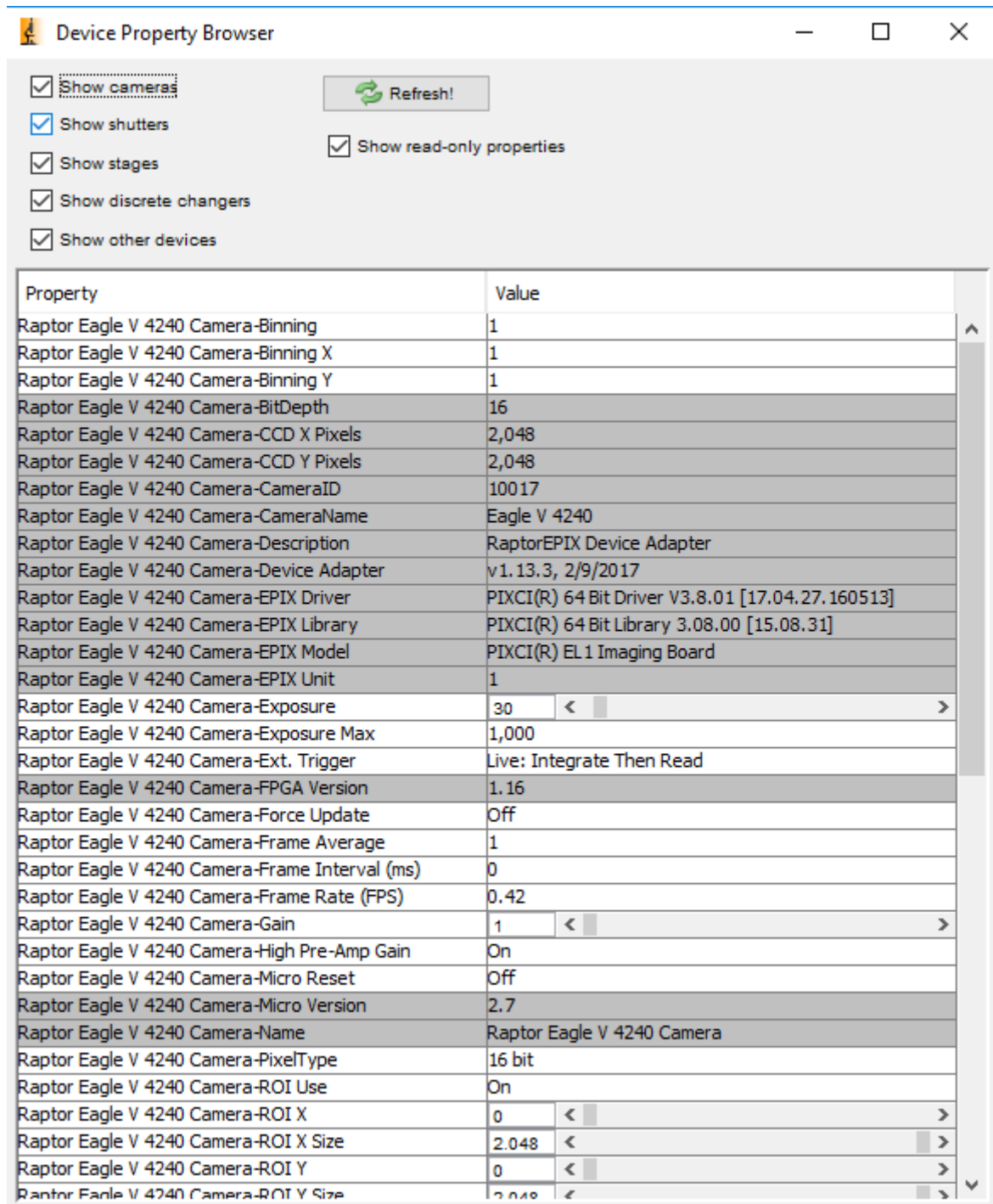

Figure 25: Camera Control Options

From here, you can access all the camera settings.

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