Raptor photonics

NINOX 640 SU

Model: NXU-CL-640

USER MANUAL

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1. INTRODUCTION

This document provides detailed instructions for the operation of the Ninox 640 SU camera. Raptor Photonics Limited reserves the right to change this document at any time without notice and disclaims liability for editorial, pictorial or typographical errors.

1.1 Scope

This manual covers the Ninox 640 SU digital camera and all applicable components. The Ninox 640 SU is the lowest noise camera available. With an ultra-low typical readout noise (rms) of 30e- and a typical dark current reading of <300e-/p/s at -80°C, the Ninox 640 SU improves even further on its noise performance. Raptor recommends that this manual be used to optimize camera operation. Details of the camera's mechanical and electrical interfaces are provided. Important precautions to be taken when using the camera are also stated.

Detailed information is also provided on each of the cameras control parameters. Each camera control is discussed and explained with the use of XCAP Imaging software, which is the core plug and play software package that is offered with Raptor cameras. An image of the camera is shown in Figure 1.

Figure 1: Complete Camera Module.

2. CAMERA CARE

2.1 Cleaning the Sensor Window

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). Use optical grade isopropyl to clean this window. A cotton swab can be used, but may leave some fibres on the window, so be careful. To avoid this, you could also use a lens tissue or a cleaning swap such as a texwipe. Forced air can be applied to remove any loose particles. Should any other issues occur please contact your local agent.

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

CAUTION — Do not use acetone.

3. SPECIFICATION

3.1 Camera Overview

The Ninox 640 SU is a 16-bit deep cooled SWIR camera. The camera has a response in the SWIR region from 0.9µm to 1.7µm.

The Ninox 640 SU is an ultra-high sensitivity camera, offering a low dark current of <300 e/p/s with a typical readout noise of 30e-. The camera has a high intra-scene dynamic range for simultaneous capture of light and dark regions of a scene.

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

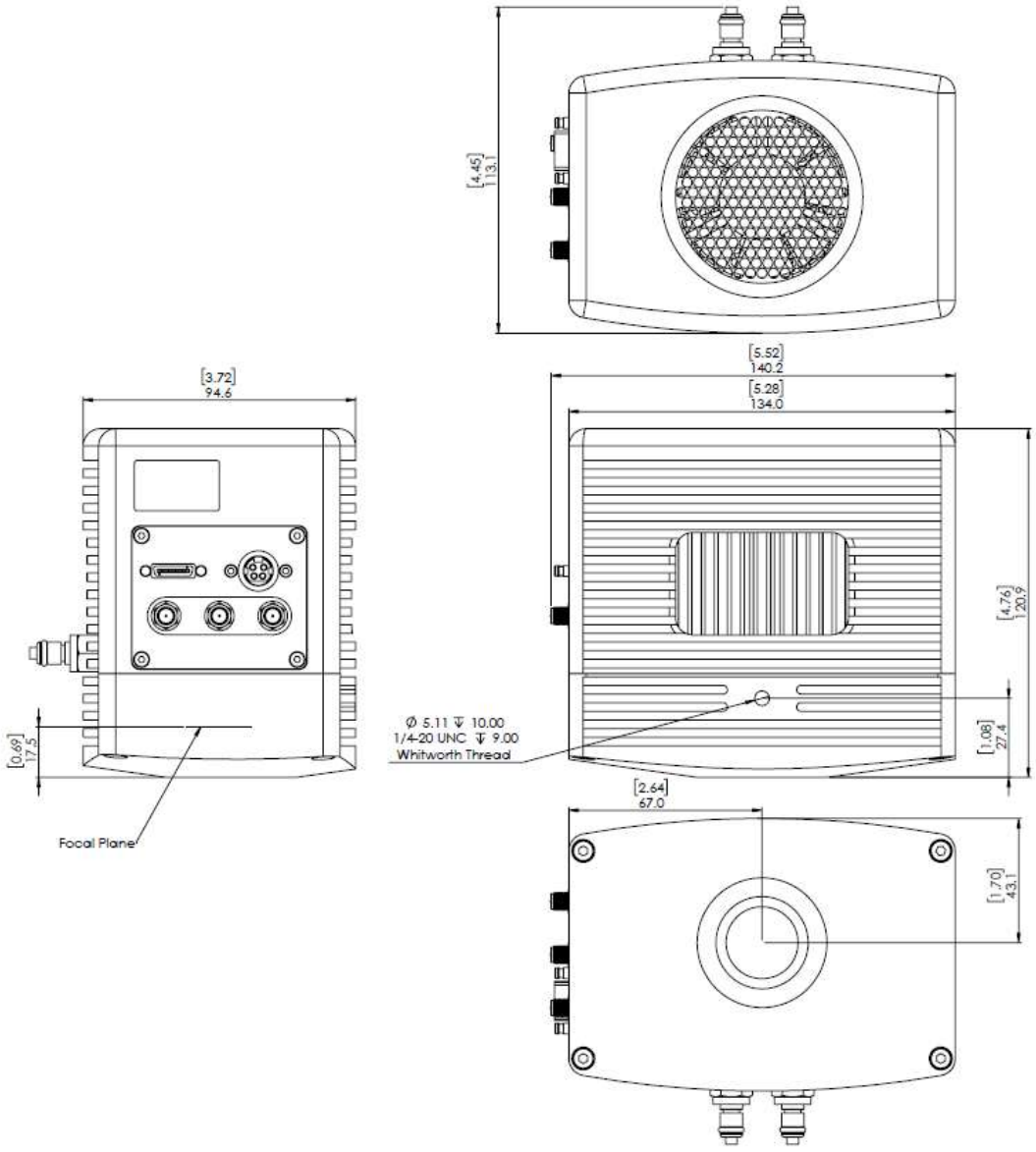
3.2 Datasheet

For the full specification of the Ninox 640 SU, the datasheet for the camera can be downloaded from the Raptor Photonics website using the link below:

https://www.raptorphotonics.com/products/ninox-640-su/

4. DESIGN OVERVIEW

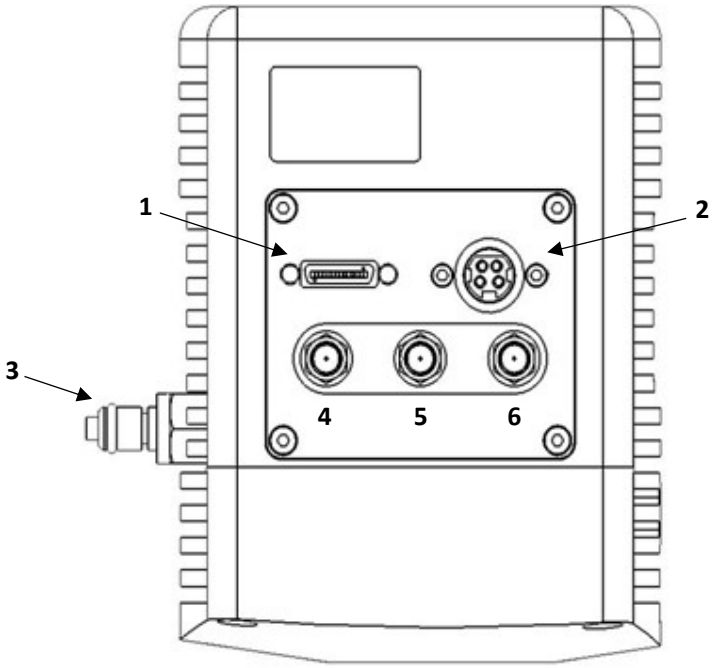
4.1 Mechanical Model



Units shown in mm and inches [in]

PDF of mechanical model available from our website:
https://www.raptorphotonics.com/products/ninox-640-su/

4.2 Physical Interface



1. **3M CameraLink connector**
   Part #: 12226-1150-00FR
2. **Power Connector**
   Part #: KPJX-PM-4S
3. **Water Taps**
   Part #: CPC; MCD2402
4. **SMA Connector:** Trigger Out (Frame) Single ended, termination impedance = 51Ω, capable of sinking and sourcing 32mA and will have an output voltage of 3.3V i.e., TTL compatible.
5. **SMA Connector:** Trigger In. Single ended, termination impedance = 510 Ω, captive load = 200 pF, TTL compatible.
6. **SMA Connector:** Trigger Out (Exp). Single ended source impedance = 51 Ω, capable of sinking and sourcing 32mA and will have an output voltage of 3.3V i.e,., TTL compatible.

4.3 Power Consumption

Unit input power specification is +12V +/- 0.5V with a maximum of 6W power dissipation with the cooling fan switched on and the thermoelectric cooler (TEC) switched off. Additional current is required when the TEC is enabled. The total maximum power dissipation is <110 Watts.

4.4 Mounting to a Microscope

The camera has a standard C-mount that should easily screw onto any microscope port.

4.5 Mounting to a Tripod or Optical Table

The camera has a ¼-20 BSW (Whitworth) threaded hole to mount to a tripod or an optical table.

5. SOFTWARE COMPATIBILITY

This section outlines the options relating to software that are available for the Ninox 640 SU.

5.1 XCAP Compatibility

Raptor works closely with EPIX who integrate all Raptor camera models into their XCAP Imaging Software package. XCAP is the core plug and play software package that is offered with the Ninox 640 SU.

5.2 LabView Compatibility

Raptor can supply a LabView .icd file which can be used to control the camera on National Instruments imaging tools such as NI MAX. The file may also be useful if attempting to create your own LabView VI.

5.3 Custom Software Interfacing

Raptor works closely with EPIX Inc, who integrates all Raptor cameras into their software package, XCAP. The EPIX frame grabbers are the models that we offer with our cameras. We offer their Software Development Kit (SDK) for interfacing with custom software (XCLIB). If using a frame grabber from a different company, then you will have to obtain their SDK. Raptor can provide an ICD which includes a list of all serial commands to control the camera. This would be required along with the SDK from the frame grabber device to integrate the camera.

6. CAMERA AND CHILLER SETUP

This section will give instruction on connecting the frame grabber to the camera, as well as outlining important frame grabber and PC requirements.

6.1 Connecting the Camera to the Frame Grabber

The camera has the shrunk SDR port on the interface. The main frame grabber that Raptor offer with this camera has the normal MDR port (EPIX EB1). Therefore, one MDR – SDR Camera Link cable is required to connect the camera to this frame grabber.

If demoing the camera with the Mini PC system that Raptor provides, you should connect to the left port of the frame grabber in the Mini PC. This should be stated on the Mini PC.

6.2 Connecting Camera to Chiller

Raptor uses a Chiller from Thermotek, the T257P Precision Chiller. For the datasheet and full user manual from Thermotek, please contact Raptor and we can provide this. The instructions to set up the chiller are as follows:

1. Connect the T257P chiller to the Ninox 640 SU using the tubing provided. You will hear a click which indicates a solid connection. The polarity of the tubing connections does not matter.
2. Keep the chiller horizontal and on a level surface.
3. Make sure there is a minimum 12” clearance and free path for flow of air entry and exit at the left side and right side of the T257P chiller prior to operation.
4. Remove the reservoir cap and add coolant to the reservoir until the fluid reaches the bottom of the neck. Please refer to section 6.3 for recommended coolants.
5. Close the cap securely to the reservoir. Make sure not to overfill the reservoir.
6. Install the appropriate end of the power cord into the unit and connect to the mains electricity.

If using another chiller model, please refer to it’s manual for start-up instructions.

6.3 Recommended Coolants for Chiller

The recommended coolants are:

Option 1: Distilled Water
Option 2: 95% distilled water and 5% isopropyl alcohol mixture prevents bio growth.
Option 3: 80% distilled water and 20% inhibited Glycol mixture for set temperatures below 5C.

Raptor recommends using option 3. If purchasing the Thermotek model from Raptor or using a demo kit provided by Raptor, there will be inhibited Glycol mixture provided to mix with water.

6.4 Setting the Coolant Temperature for Re-circulation

When powering up the chiller, the screen will immediately give the option to set the temperature of the coolant. It is recommended to set a 20˚C set point. After the set

point has been configured, selecting start will initiate the coolant re-circulation. For more detailed information on all the operating modes of the T257P Precision Chiller, please refer to the Thermotek user manual.

WARNING: Please ensure the temperature set point of the chiller is above your ambient dew point, otherwise condensation can form around the sensor package and cause damage.

6.5 Draining the Chiller, Camera and Tubing

If using the Thermotek T257P Precision Chiller, it is recommended that a coolant change be implemented at a minimum, every six months, to keep the system in working order. Based on the amount of use, you may need to perform this more frequently. For more detailed information, please refer to the Thermotek user manual. If using another model of chiller, please refer to its user manual for the recommended time frame for coolant changes.

If finishing the testing of a demo kit, please disconnect the tubing and drain all of the camera, chiller and tubing before sending the equipment back to Raptor. Shorter draining tubes will be supplied with the demo kit. Two draining tubes (with the appropriate mating connectors) need to be connected to both connecters on each of the camera, chiller and tubing to drain each individually.

7. FRAME GRABBER AND SYSTEM REQUIREMENTS

7.1 Computer/Laptop System Requirements

The basic requirement is that the PCIe bus of the system must provide sufficient bandwidth to handle video rate transfers. The amount of bandwidth required depends on the camera in-hand. The Falcon III uses a Base Camera Link interface which can be handled with a x1 PCIe bus and PIXCI EB1, providing roughly 200MB/sec maximum bandwidth. Contact EPIX Inc. for further information regarding minimum computer/laptop specification requirements to run the XCAP Imaging Software.

7.2 Frame Grabber Requirements

If using a computer, it is a minimum requirement to use an PIXCI EB1 frame grabber. If using a frame grabber from another company, the specification requirements of this frame grabber must meet those supplied by the PIXCI EB1 model.

If using a laptop, EPIX offers base Camera Link frame grabbers for a laptop system, such as the ECB1/ECB1-34.

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8. XCAP IMAGING SOFTWARE

This section will discuss downloading and installing XCAP, as well as acquiring an image using the software package.

8.1 Downloading XCAP

The latest version of XCAP can be downloaded from the link below:
http://www.epixinc.com/support/files.php

please select the appropriate version of XCAP for your computer. Ensure that you download 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 in the installation wizard. If a pop-up message appears asking whether to install the PIXCI driver, ensure that you click yes.

8.2 Opening the Camera Configuration

After opening XCAP, select *"PIXCI Open/Close"* from the *"PIXCI"* tab from the top menu bar in the main window. A PIXCI Open/Close pop-up box will open as shown in Figure 2.

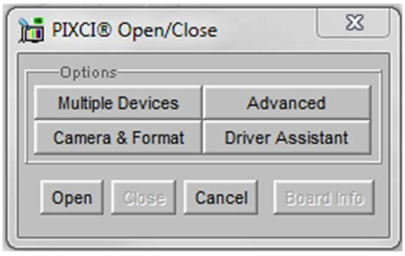

Figure 2: PIXCI Open/Close.

Click on *"Camera & Format"* that is highlighted in Figure 2 and a *"PIXCI Open Camera & Format"* box will appear, as shown in Figure 3.

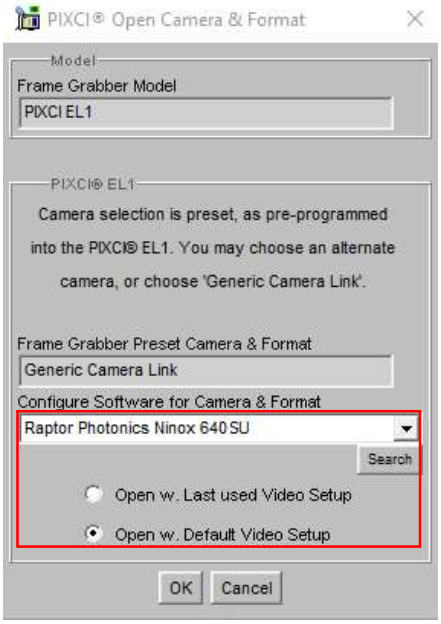

Figure 3: PIXCI Open Camera & Format.

Using the dropdown menu highlighted, search for *"Raptor Photonics Ninox 640 SU".* You will see the configuration for *"Raptor Photonics Ninox 640 SU".* Selecting *"Open w. Default Video Setup"* will open the control panel with all control parameters set to the default states. *"Open w. Last used Video Setup"* will open the control panel with all parameters set at the last known state. Once this option between the two has been selected, click *"Ok"*. To open the camera control panel and imaging window, click *"Open"* in the *"PIXCI Open/Close"* window (Figure 2).

Two windows will now open in XCAP, an imaging window and control panel, as shown in Figure 4.

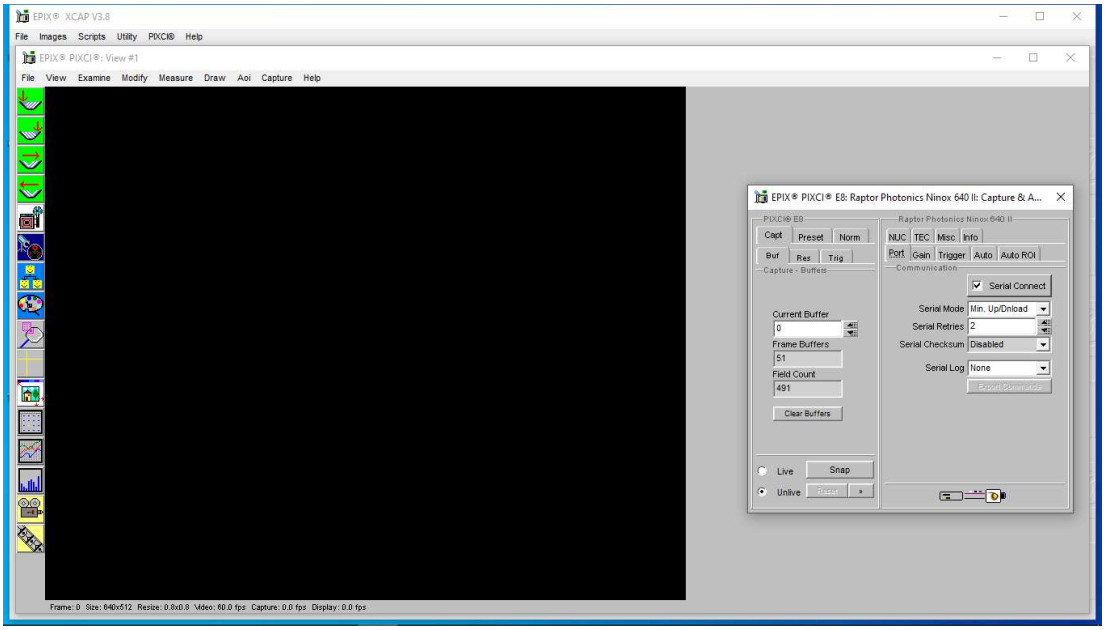

Figure 4: Imaging Window and Control Panel.

8.3 Acquiring a Live Image Sequence

There are two things to observe in the control panel that inform you that the camera is connected and ready to image.

The serial connect checkbox must be ticked in the control panel. This informs you that you have established a serial connection with the camera and can control the camera.

Secondly, the symbol near the bottom right of the control panel will have three moving dots. This indicates that you are obtaining video data from the camera. The imaging statistics displayed directly underneath the imaging window will also inform you if you are receiving a video feed from the camera.

Once you have established a serial connection with the camera and are receiving video data, you can now grab a live image feed. Clicking the *"Live"* button will grab a live image sequence which you will now see in the imaging window.

The symbols in the control app discussed above are displayed in Figure 5.

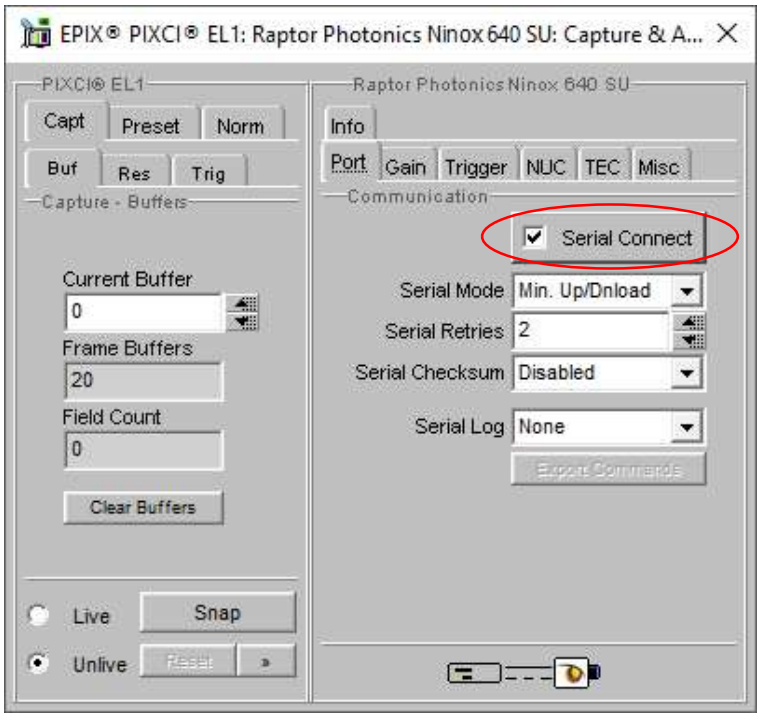

Figure 5: Checking Camera Connection and Acquiring a Live Image.

9. CONTROLLING THE CAMERA (XCAP)

The sections below will give information on using each control of the Ninox 640 SU, giving a description on how to use each control parameter and their effect on the camera's performance. The software used to illustrate the camera controls is XCAP.

9.1 Exposure Time and Frame Rate

The exposure time can be controlled under any camera control tab in the XCAP GUI and remains constant on the GUI.

The minimum and maximum exposure times that the camera can set are shown in the table below in Figure 6.

	High Gain	Low Gain
Min. Exposure Time	15µs	15µs
Max. Exposure Time	Frame Period (ms) – 10.2ms	Frame Period (ms) – 10.2ms
Exposure Resolution	13.89ns	13.89ns

Figure 6: Minimum and Maximum Exposure Times.

Frame Rate: The frame rate can also be set using the frame rate user input box located under the Trigger tab. By default, the frame rate is set to 25fps. The maximum frame rate of the camera is 100fps. If an exposure time is selected that exceeds the exposure time limit of the current frame rate set, then the exposure time will dominate, and the frame rate will be decreased. Alternatively, if the user selects a frame rate that is too fast for the current exposure time set, XCAP will decrease the exposure time.

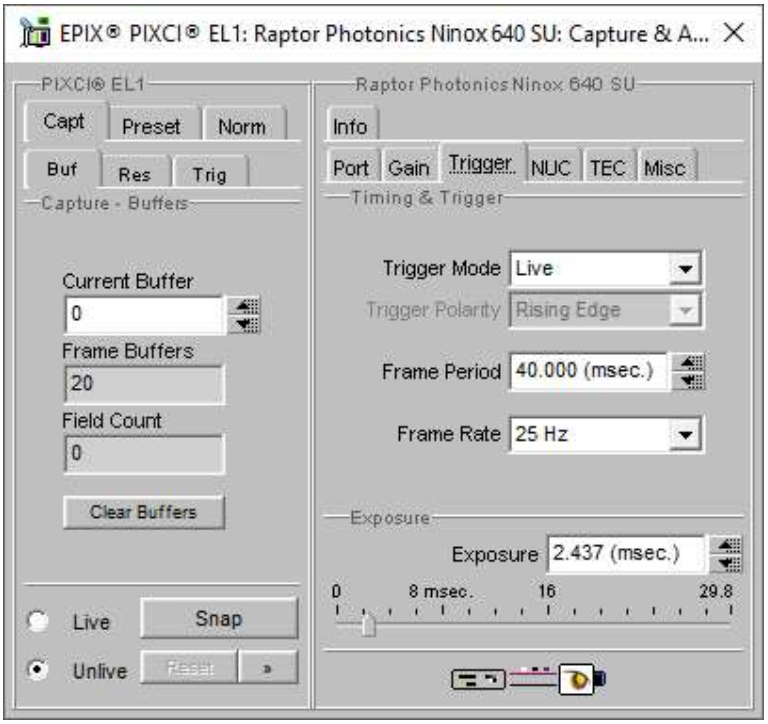

Figure 7: Exposure Time & Frame Rate Controls.

9.2 Gain Mode

The camera has two modes of operation, high gain mode and low gain mode (default). The gain mode of the camera can be toggled from the “Gain” tab on the GUI.

High gain mode provides the best noise performance and can provide better images for low scene illumination e.g. night imaging.

Low gain mode provides the best dynamic range and can provide better images for high scene illumination e.g. daytime imaging or using large exposure times.

The gain mode control is shown in Figure 10.

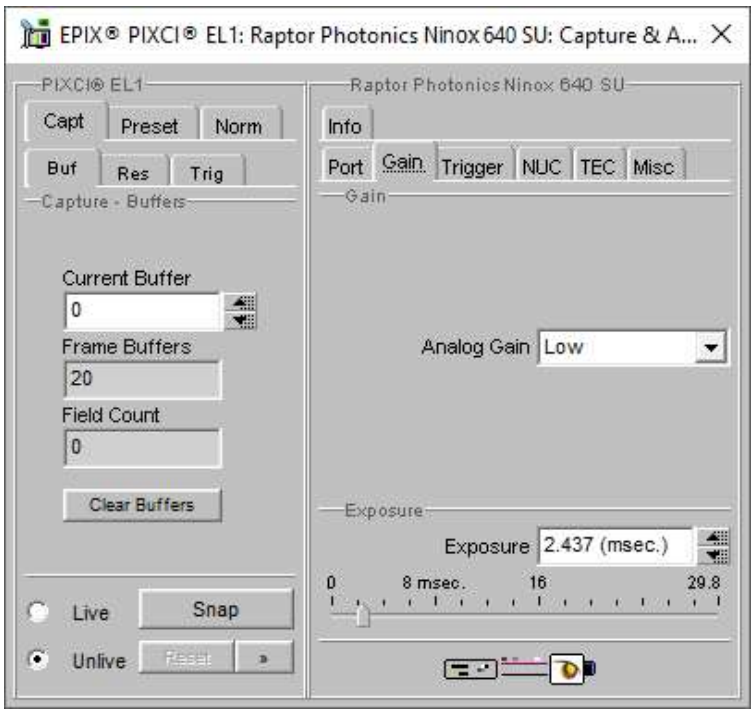

Figure 10: Gain Mode Control.

9.3 Trigger Mode

The trigger mode of the camera and additional trigger controls can be controlled from the *"Trigger"* tab in the GUI, shown in Figure 11.

The trigger mode of the camera can be toggled from the *"Readout Mode"* dropdown box. By default, the camera will be set to internal trigger. This mode is indicated by the *"Live"* option in the dropdown box.

The camera can be switched to external trigger mode by selecting the *"Ext. Triggered"* option. When this mode is enabled, the *"Trigger Polarity"* (rising or falling edge) dropdown input box will become available. By default, the camera will run with a rising edge trigger polarity. A trigger delay can also be set when external trigger mode is enabled.

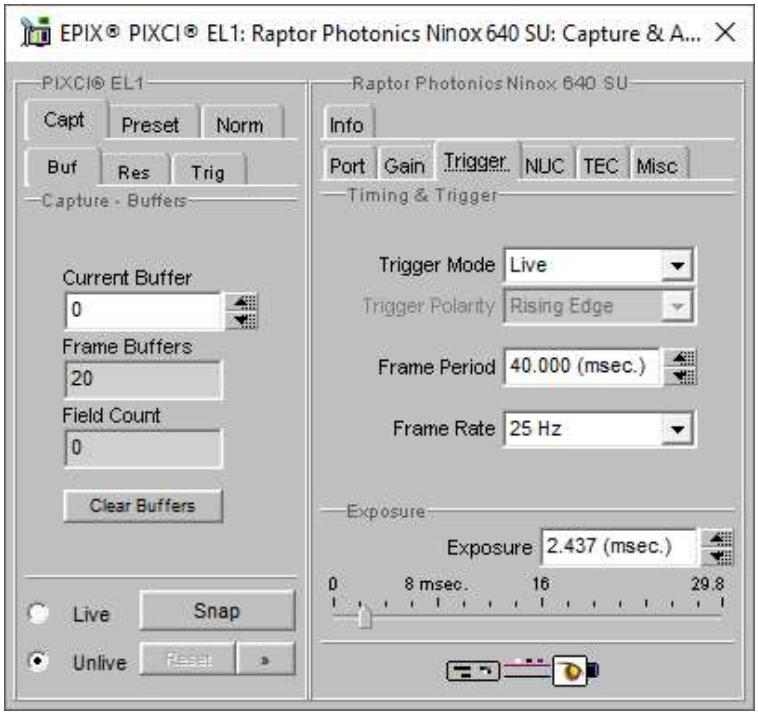

Figure 11: Trigger Mode.

9.4 Thermoelectric Cooler (TEC)

The Ninox 640 SU uses a TEC to cool the sensor temperature of -80˚C. The TEC status is shown in the “TEC” tab of the XCAP GUI, shown in Figure 13.

The TEC control can be enabled/disabled from this tab. By default, the TEC will be enabled and set to a -80˚C set point. Raptor recommends keeping the set point at this temperature, as the camera is tested at this temperature under QC, and this is the specification TEC set point of the camera.

To achieve a sensor temperature of -80˚C, liquid cooling is required. For more information on this, please refer to section 6.2. If the camera is in a room temperature environment, the TEC set point of -50˚C should be achievable using only the fan. By default, the fan is enabled.

The sensor temperature can also be read back from this tab. Clicking *“Update Temp.”* will read the current sensor temperature.

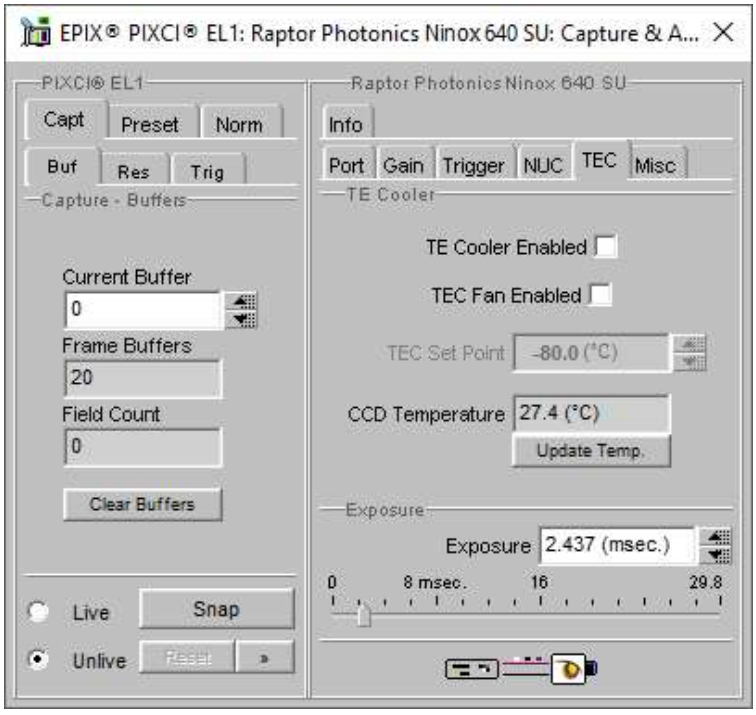

Figure 13: Thermoelectric Cooler (TEC) Control.

9.5 Manufacturers Data

The *"Info"* tab displays the manufacturers data of the camera, such as the firmware version and serial number etc. The PCB and sensor temperature can be read back from this tab by clicking *"Update Temp."* The *"Info"* tab is shown in Figure 15.

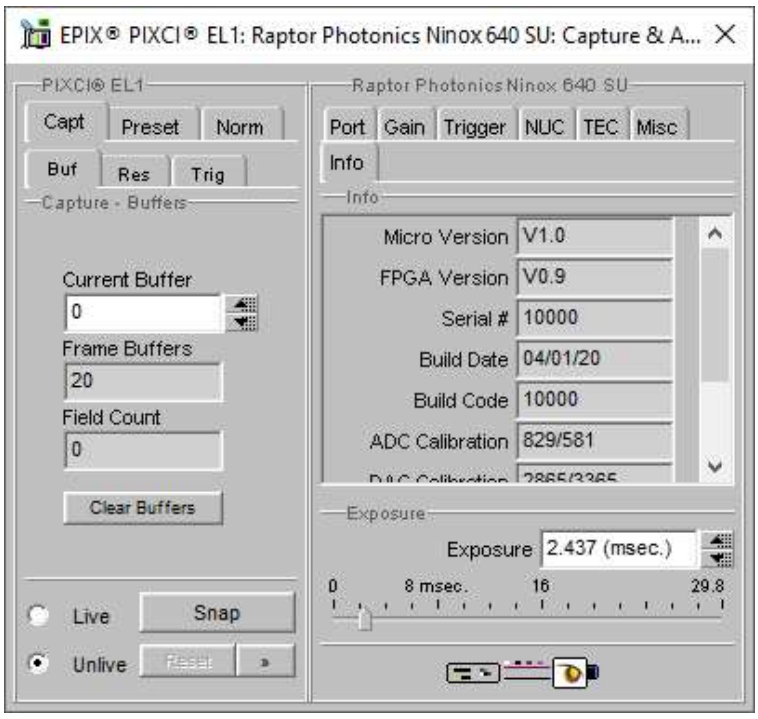

Figure 15: Manufacturers Data.

10. XCAP CONTROL FEATURES

XCAP has many different control functions and analytical tools that can be used when imaging the camera. For the full XCAP user guide, please refer to the link below:

http://epixinc.com/manuals/pixci_e14el/index.htm

This section will discuss in detail a few features on XCAP that Raptor thinks would be of immediate use when using the camera.

10.1 Saving Preset Configuration Settings

Different camera and frame grabber settings can be saved in the *"Preset"* tab under the *"PIXCI *Frame Grabber Model*"* section of the GUI, as shown in Figure 16.

Up to three different presets can be saved per settings file. If the camera is set to a desired state outside of the default parameters, clicking *"Save 1"* will save all the current parameter states that have been set. This can be done a further two times. These camera states can be recalled at any time by using the recall buttons. The overall settings file can then be saved and loaded in this tab also. Three preset states are the maximum number that can be saved in a settings file.

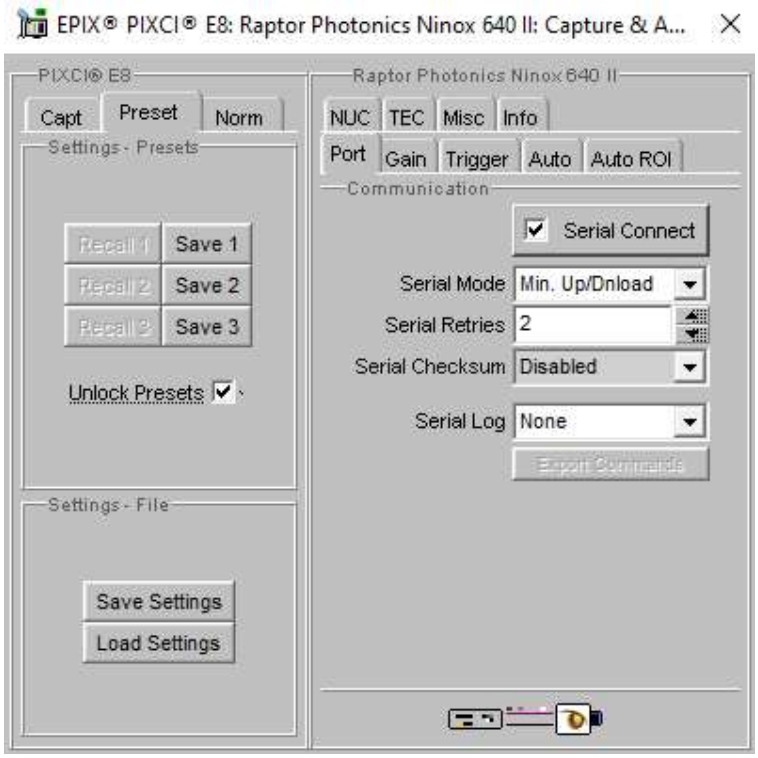

Figure 16: Preset Configuration Settings.

10.2 Contrast Modification (XCAP Std. Only)

The image contrast can be modified from the *"Contrast Modification"* section under the *"Modify"* tab in the XCAP imaging window. The location of this control feature is shown in Figure 17.

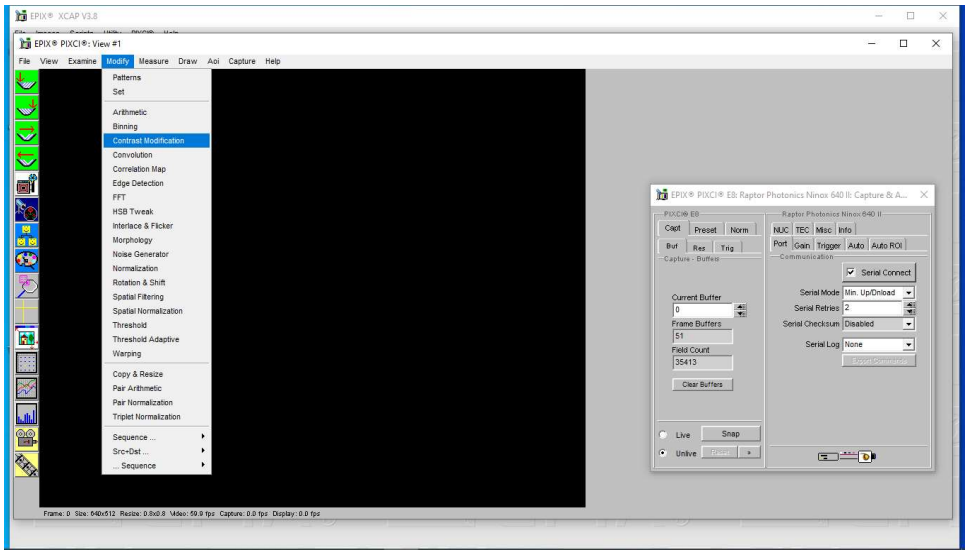

Figure 17: Contrast Modification Location on Toolbar.

In the contrast modification box, that can be seen from Figure 18, select *"Stretch Contrast, Histogram Percentile Endpoints"* and click *"preview"*. The contrast modification will now be applied over the live image feed. The contrast can be adjusted using the low and high end percentile point controls. The default settings are usually adequate for most applications.

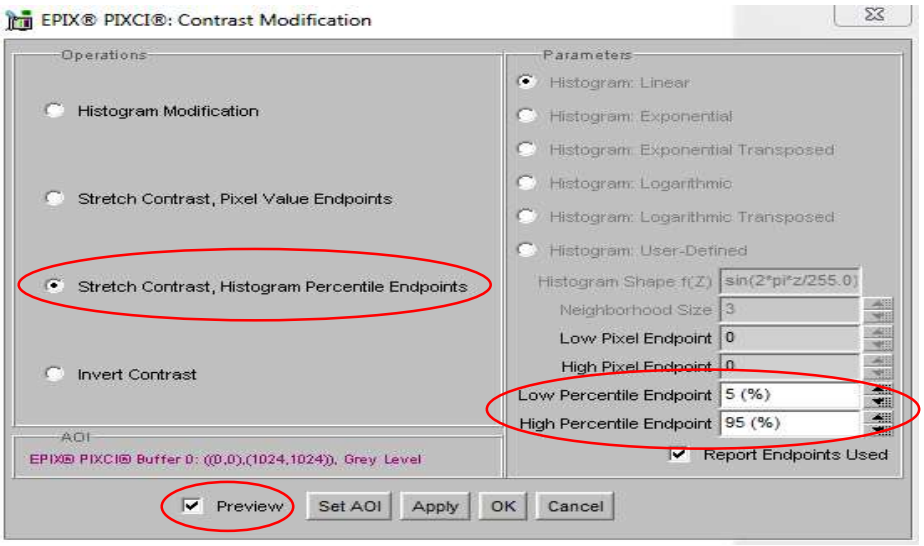

Figure 18: Contrast Modification.


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