Instrument Expert
Original factory packaging
www.dorgean.com

NINOX 1280

Model: NX1.7-VS-CL-1280

USER MANUAL

CONTENTS

1.   INTRODUCTION

1.1   Scope

This manual covers the Ninox 1280 digital camera and all applicable components. Raptor recommends that this manual be used to optimize camera operation.

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 Specification

The Ninox 1280 VIS-SWIR is designed for high resolution applications requiring visible to SWIR imaging (400-1700nm). The camera uses an InGaAS sensor with a resolution of 1280 x 1024. High-speed low-noise electronics provide linear response and sensitivity for rapid image capture.

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

Raptor works closely with EPIX, whose frame grabbers we offer with our cameras. If, using their frame grabbers, we offer their Software Development Kit (SDK) for interfacing with custom software. If using another companies frame grabber of your choosing, then you will have to obtain their SDK.

3.2 Specification Table

SPECIFICATION	
Sensor Type	InGaAs PIN-Photodiode
Active Pixel	1280 x 1024
Pixel Pitch	10µm x 10µm
Active Area	12.8mm x 10.24mm
Spectral response[1]	0.4µm to 1.7µm
Readout Noise (RMS) LG = Low Gain HG = High Gain	LG: <190 electrons (160 electrons typical) HG: <50 electrons (47 electrons typical)
Quantum Efficiency	>80% @ 1.55µm
Full Well Capacity	LG: 450ke- HG: 10ke-
Pixel Operability	>99%
Digital Output Format	12 bit Camera Link (Medium Configuration)
Dark Current (e/p/s)	<4,000 @ 15°C (2,000 typical)
Exposure time[2] LG = Low Gain HG = High Gain	LG: 300µs to 10s HG: 600µs to 86.5ms
Frame Rate[3]	10 to 60Hz
Dynamic Range	LG: 69dB, HG: 47dB
Optical Interface	C-mount (selection of SWIR lenses available)
Trigger interface	Trigger IN and OUT – TLL compatible
Power supply	12V DC ± 0.5V
TE Cooling	Cooled to -15˚C (ΔT = 35˚C)
Non-Uniformity Correction (NUC)	3-point NUC (offset, gain & dark current) + pixel correction
Functions Controlled by Serial Communication	Exposure, Intelligent AGC, NUC , Gamma, Pk/Av, ROI
Camera Power Consumption[4]	<3W with TEC OFF, NUC ON <5W with TEC ON, NUC ON
Operating Case Temperature[5]	-20°C to +55°C
Storage Temperature	-30°C to +60°C
Dimensions (L*W*H)[6]	87.30mm x 78.86mm x 79.30mm
Weight	550g

Note 1: Optional filters available: Low, High or bandpass.

Note 2: For exposure times up to 10s, the camera will have to be switched to long exposure mode. This mode only operates in low gain and there is no NUC. When in normal mode and in low gain, the maximum exposure time is 90ms with an active NUC. In high gain in normal mode, the NUC is also active for the full exposure time range up to the maximum 80ms exposure.

Note 3: Frame rates lower than 10Hz are achievable when in the long exposure mode discussed in note 2.
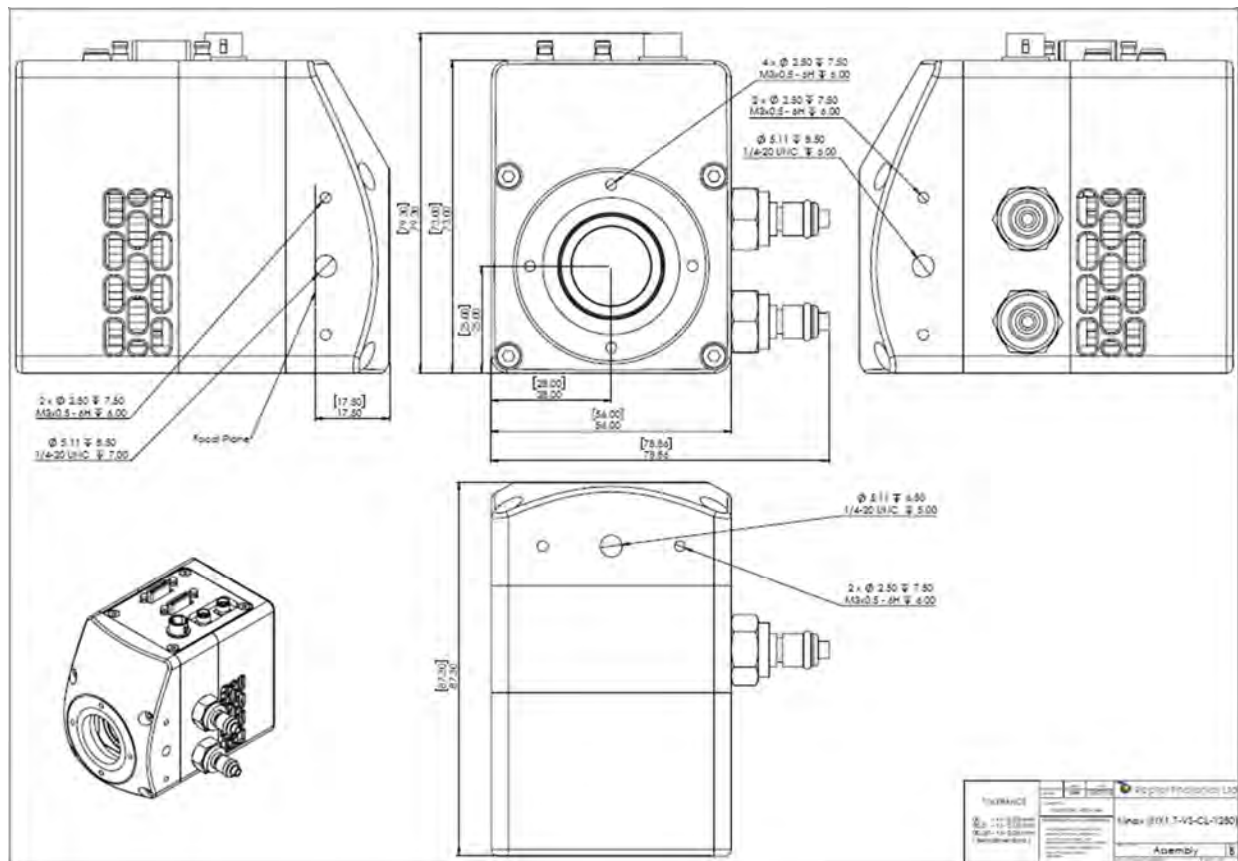
Note 4: Measured in an ambient of 25˚C with adequate heat sinking.

Note 5: Extended Operating Temperature range on request.

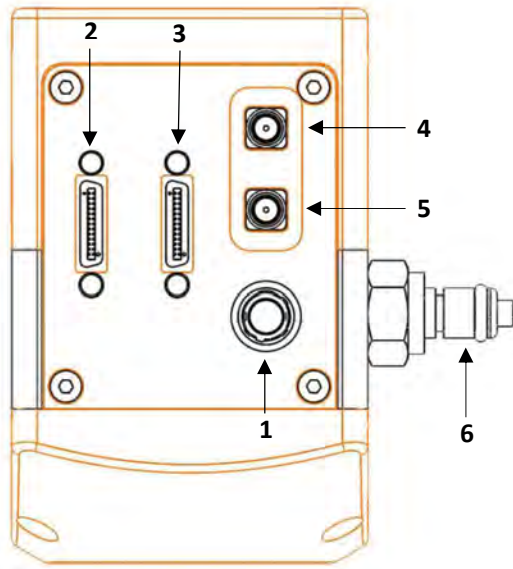**Note 6:** Dimensions include all connector parts on camera.

4.   MECHANICAL DESIGN

4.1   Mechanical Model

PDF of mechanical model available from our website.

4.2   Physical Interface

1. **4 Pin Hirose Connector**
2. **SDR Camera Link Connector**
3. **SDR Camera Link Connector**
4. **SMA Connector: Trigger OUT**
    Single ended, source 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 = 510Ω, capacitive load = 200pF [TTL compatible].
6. **Liquid cooling IN/OUT valve coupling (x2 IN/OUT)**

4.3   Mounting to Microscope

The Ninox 1280 has a standard C-Mount that should easily screw onto any microscope port.

4.4   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
5.1   Compatibility Table

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

5.2 XCAP Compatibility

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

5.3 Micromanager Compatibility

There is a selection of Raptor cameras integrated into the free open source imaging software Micromanager. The cameras currently supported can be seen in the table outlined in section 5.1.

5.4 LabView Compatibility

Raptor can provide LabView Interface Control Document files (.icd) to image and control the camera on National Instruments Software such as NI MAX. Contact a Raptor Sales employee to obtain this file.

6. CAMERA SETUP

This section will talk through setting up the camera, including connecting to the frame grabber and chiller (if applicable). Below is an image of a normal setup of the camera, computer and chiller. For most applications, the chiller may not be necessary to use with the Ninox 1280, as the fan is normally adequate at dissipating heat from the device. If imaging the camera in a high ambient temperature environment, water cooling may be required to keep the PCB temperature low enough in order to hit the optimum -15°C TEC set point. The maximum delta between the PCB and sensor temperature is discussed in section 7.7.3.

6.1   Connecting Camera to Chiller

If using a chiller, the water tubing simply needs connected from the camera water connectors to the chiller connecters, as shown in the image below. You will hear a click which indicates a solid connection. The polarity of the tubing connections does not matter.

Please consult the Ninox 1280 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 Ninox 1280 camera, 20°C is preferred.

WARNING: 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.
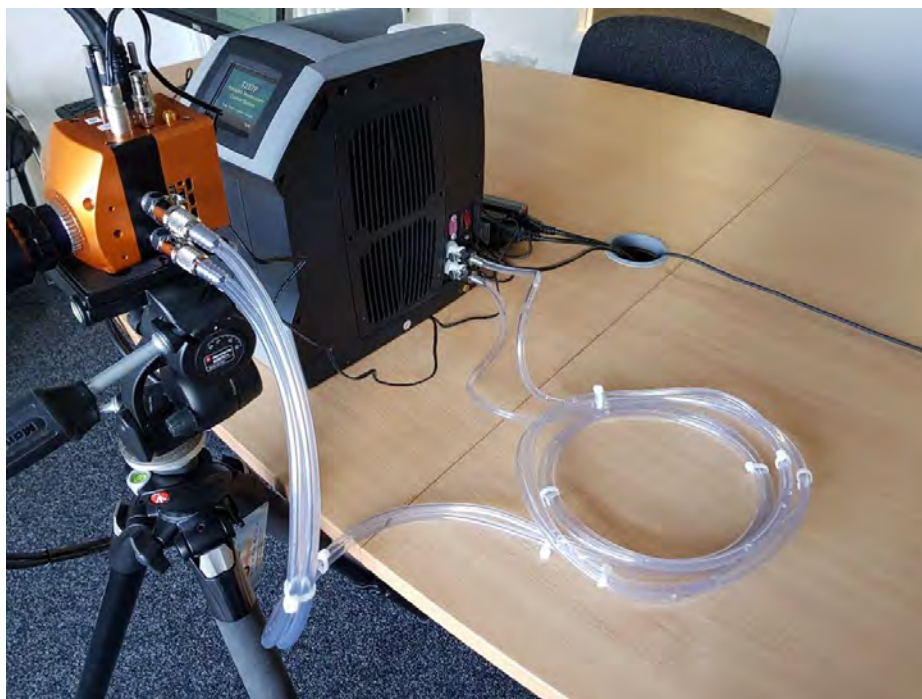
6.2   Connecting Camera to Frame Grabber

All demo cameras and PC units should be marked with an A and B symbol, which indicates the polarity required for connecting the two frame grabber ports to the Camera Link MDR ports on the camera head. This is shown in the two pictures below. Another way to distinguish which ports connect together, is that the MDR port closest to the power connector on the camera head needs to be connected to the frame grabber port nearest to the PCIe slot.
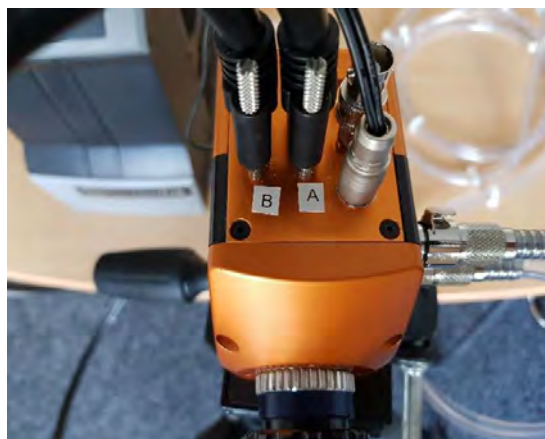
7.   XCAP IMAGING SOFTWARE

7.1   Computer System Requirements

Contact EPIX Inc. for the latest information regarding minimum computer specification requirements to run the XCAP Imaging Software.

7.2   Frame Grabber Requirements

With the Ninox 1280, it is a minimum requirement to use an PIXCI E8 frame grabber. If using a frame grabber from another company, the spec requirements of this frame grabber must meet those supplied by the PIXCI E8 model.

7.3   Downloading and Installing 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.

7.4   Opening 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 1 below:
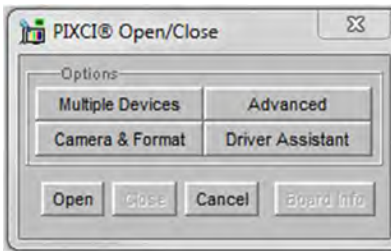

Figure 1: PIXCI Open/Close.

Click on *"Camera & Format"* that is highlighted in Figure 1 and a *"PIXCI Open Camera & Format"* box will appear, as shown in Figure 2 below:
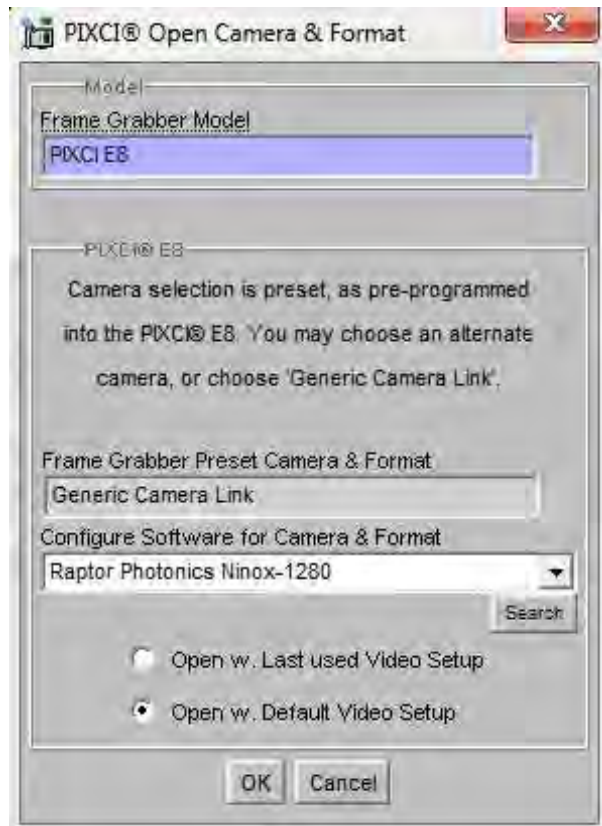

Figure 2: PIXCI Open Camera & Format.

Using the dropdown menu highlighted, search for *"Raptor Photonics Ninox 1280".* Alternatively, you can use the search button and typing Ninox 1280 will bring you to the correct file. 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 1).

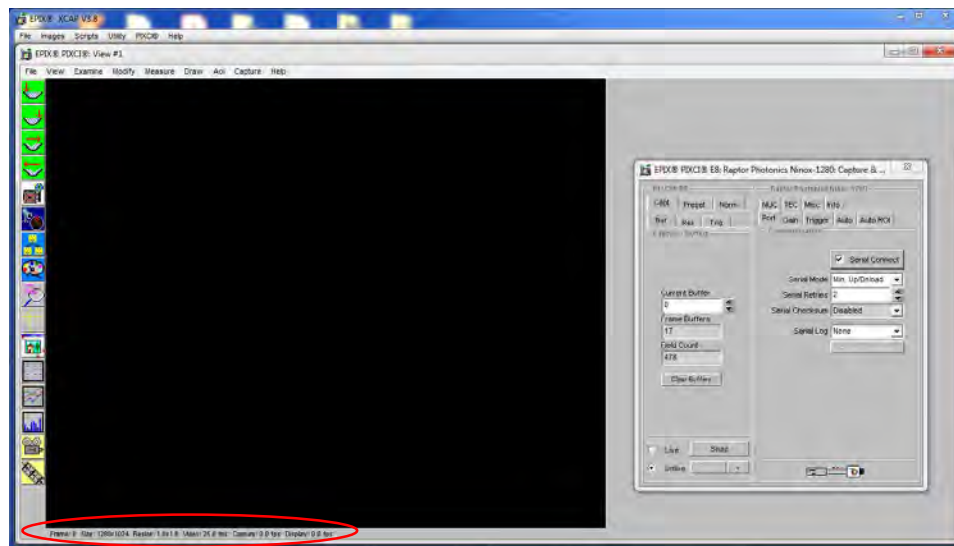Two windows will now open in XCAP, and imaging window and control panel, as shown in Figure 3 below:

Figure 3: Imaging Window & Control Panel.

7.5   Ensuring the Camera is Connected

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 means that you are obtaining video data from the camera.

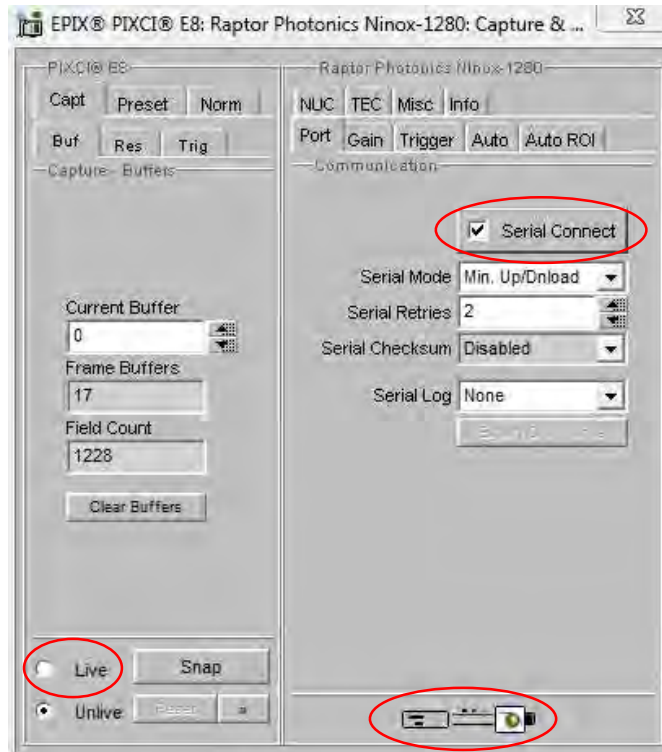Both symbols are highlighted in Figure 4 below:

Figure 4: Port Tab – Checking Camera Connection.

7.6   Acquiring a Live Image Sequence

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, also highlighted in Figure 4, will grab a live image sequence which you will now see in the imaging window.

Live imaging statistics are shown below the imaging window (resolution & frame rate), highlighted in Figure 3.

7.7   Controlling the Camera

The XCAP control panel provides full control over the camera. The below sections will go through each control tab, giving a description on how to use them on XCAP and their effect on the camera's performance.

7.7.1   Gain, Exposure & Frame Period

The gain, exposure time and frame period can be controlled from the *"Gain"* tab. By default, the auto exposure is enabled, which will automatically control the exposure time and digital gain. Toggling the "Auto Level Control" box will disable the auto exposure control and the user will now be able to manually adjust these settings. The user can manually change the gain setting of the camera between high and low gain. High gain has a smaller pixel full well capacity but offers lower noise. The camera will be set in low gain by default. If imaging a very weak signal or for night-time imaging, high gain would be more optimal. These controls are illustrated in Figure 5 below.
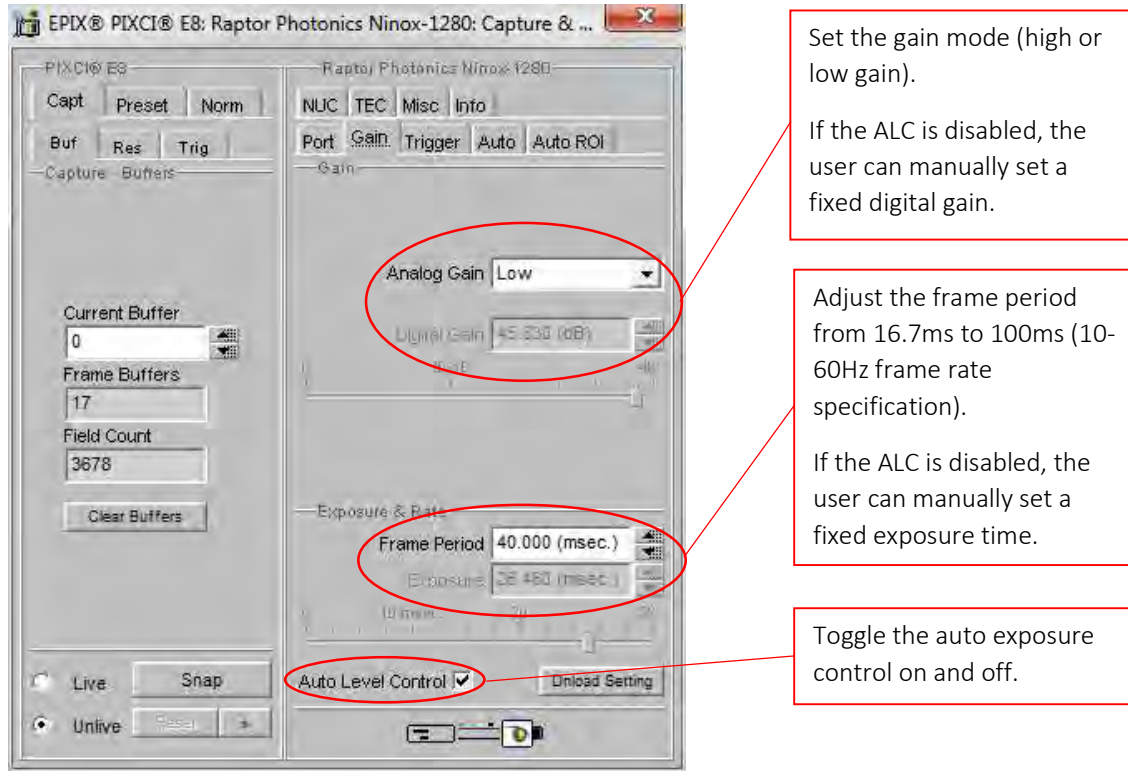
12

The following callout boxes appear connected to the figure:

Set the gain mode (high or low gain).

If the ALC is disabled, the user can manually set a fixed digital gain.

Adjust the frame period from 16.7ms to 100ms (10-60Hz frame rate specification).

If the ALC is disabled, the user can manually set a fixed exposure time.

Toggle the auto exposure control on and off.

Figure 5: Gain, Exposure and Frame Period Controls.

Exposure times can be selected that are possible under the current frame period selected. The default frame period is 40ms (25Hz). From Figure 6 below, you can see that for this frame period, XCAP enables the user to select exposure times in the range of 0-32ms in low gain and 0-26.5ms in high gain.

Figure 6: Frame Period and Exposure Time Controls (Low Gain left, High Gain right).

This is due to the readout time in both gain modes. The relationship between the frame period, exposure time and readout time is stated below, which applies for all frame periods set:

Frame period = Exposure Time - Readout Time

Therefore, the maximum possible exposure time with a 40ms frame period is:

LOW GAIN: Max. Exposure Time = 40ms - 7.5ms (readout time in low gain)
= 32.5ms

HIGH GAIN: Max. Exposure Time = 40ms - 13.5ms (readout time in high gain)
= 26.5ms

Minimum and Maximum Exposure Times:

The minimum and maximum exposure times in both gain modes are stated in the table below for the Ninox 1280:

	Low Gain	High Gain
Minimum Exposure[1]	20μs	40μs
Maximum Exposure[2]	92.498ms	81.91ms

[1]Subjective to customers application. Image scene needs sufficient illumination to achieve pixel well fill above the camera noise floor. What is defined as a useable image will also vary between applications.

[2]The maximum exposure of 10s in low gain mode stated on the datasheet is not yet officially released or implemented into XCAP.

7.7.2 Triggering Modes

The cameras triggering mode can be toggled from the "Trigger" tab, shown in Figure 7. By default, the camera will be using the internal trigger, which is the "Live" option in the "Readout Mode" dropdown bar. This can be changed to external trigger if wanting to externally trigger the camera.

Enabling the external trigger will open the trigger polarity and trigger delay options. You can choose rising or falling edge trigger polarities, as well as set trigger delays.

There is also a frame rate dropdown menu in this tab which gives discrete frame rate options (25Hz, 30Hz, 50Hz and 60Hz).
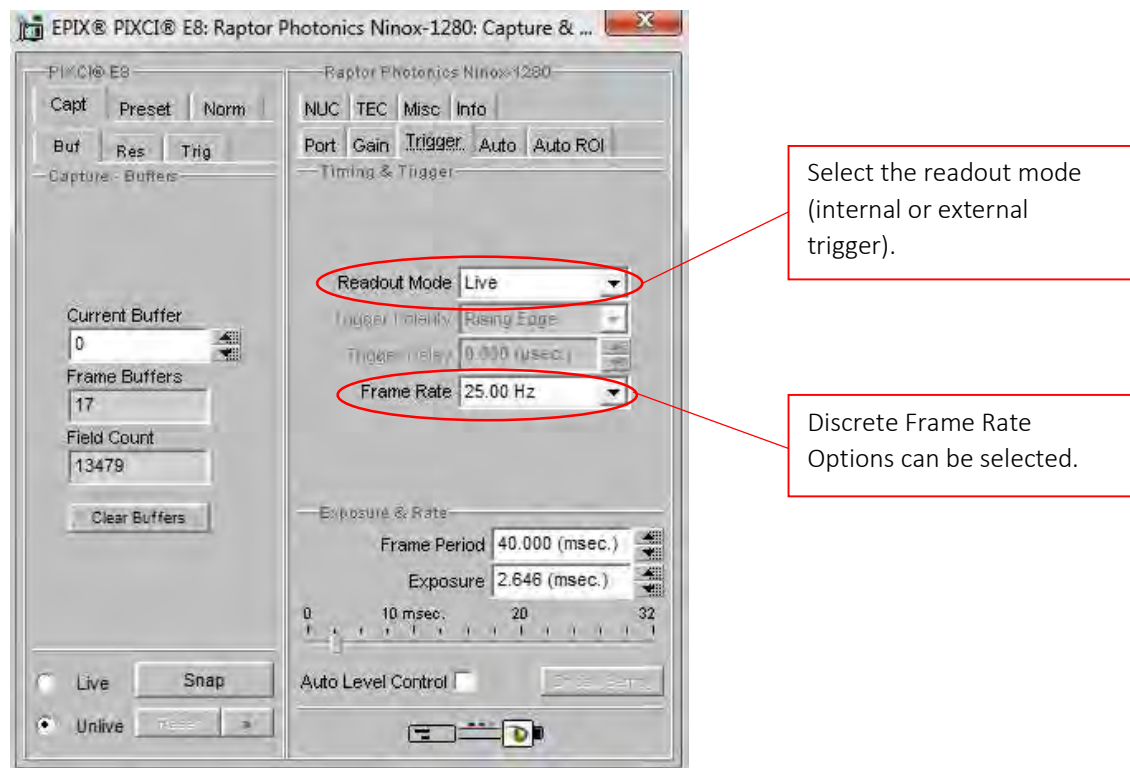

Figure 7: Trigger Tab.

7.7.3   Thermoelectric Cooler (TEC)

The "TEC" tab in the GUI gives the user control over the TEC and fan. The minimum and optimum cooling temperature is -15˚C. This is what the TEC set point will be by default, as highlighted in Figure 8. The fan will also be enabled by default, as the fan is required for the TEC to be able to hit   -15˚C. The sensor can also be read from this tab.

There is roughly a 35˚C delta between the sensor and PCB temperature. Therefore, to be able to maintain the -15˚C set point, the PCB temperature will have to remain around room temperature. The PCB temperature can be read in the "Misc" tab which is discussed in section 7.7.6.
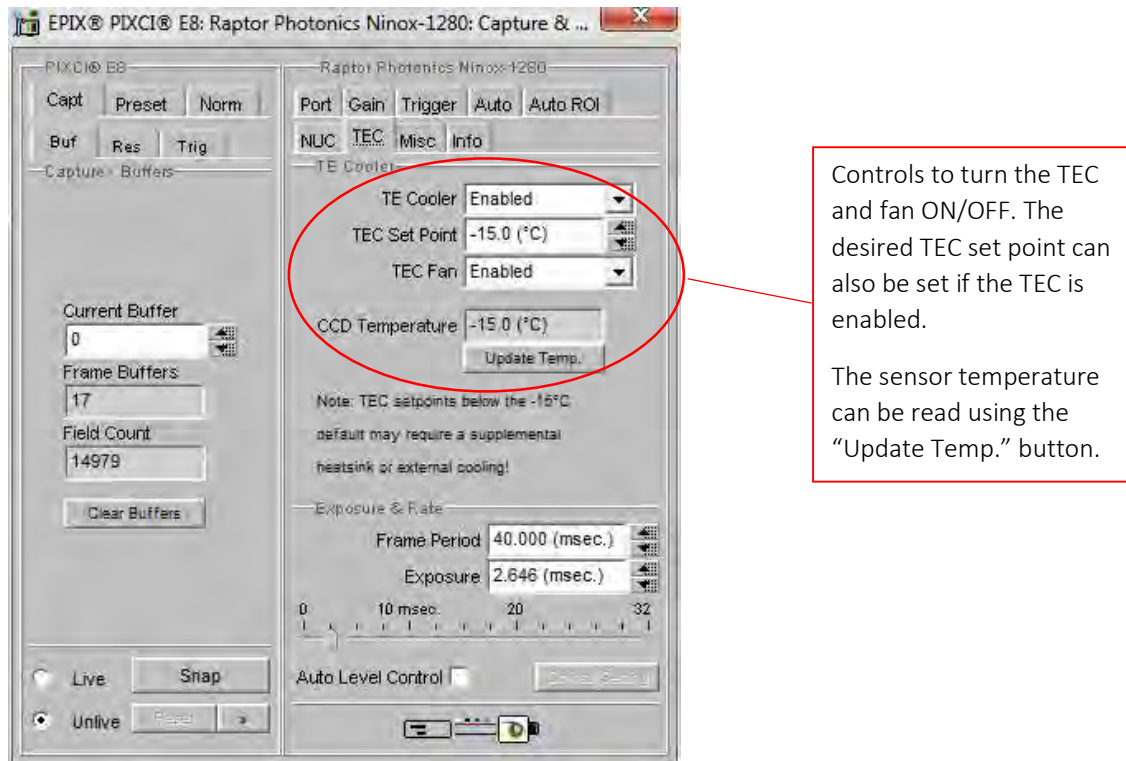

Controls to turn the TEC and fan ON/OFF. The desired TEC set point can also be set if the TEC is enabled.

The sensor temperature can be read using the "Update Temp." button.

Figure 8: TEC Tab.

7.7.4   Non-Uniformity Correction (NUC)

The "NUC" tab gives the user control over the NUC that is performed live on-board the FPGA chip in the camera. The Ninox 1280 offers a 3-point NUC (offset, gain & dark current) and a bad pixel correction. XCAP gives the option to apply each state of the NUC. In practice, the user will want to have either the NUC completely disabled (Normal) to receive the raw data from the sensor, or the 3-point NUC enabled (Offset+Gain+Dark) & bad pixel corrections.

The ramp test pattern image can also be enabled from this tab, which will consist of a fixed ramp pattern that will start with a value of 0 on the first pixel read from the camera and increment by one for each subsequent pixel read from the camera.
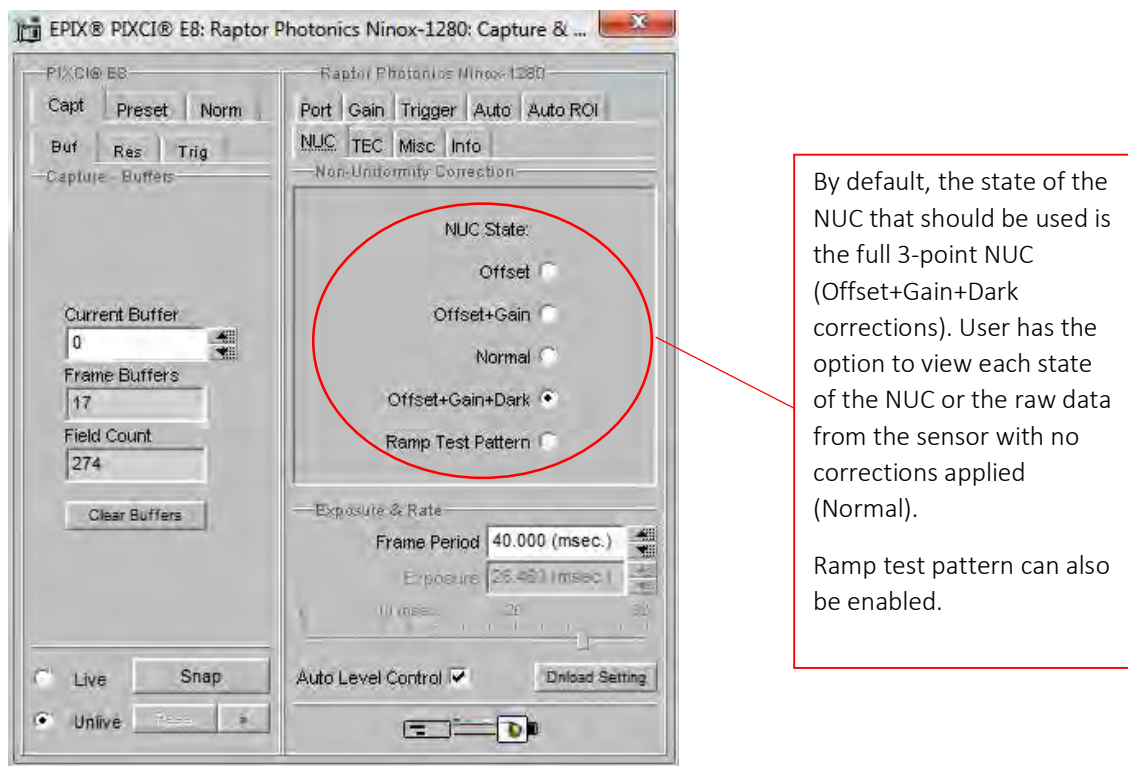
These controls can be seen from Figure 9.

By default, the state of the NUC that should be used is the full 3-point NUC (Offset+Gain+Dark corrections). User has the option to view each state of the NUC or the raw data from the sensor with no corrections applied (Normal).

Ramp test pattern can also be enabled.

Figure 9: NUC Tab.

7.7.5   Auto Exposure Control (ALC)

The "Auto" tab gives control over the ALC. Adjusting the parameters shown in Figure 11 will fine tune the ALC to the users liking, which will depend on factors just as signal strength, the users application etc. A description of what these control parameters do is stated below:

ALC from Peak & ALC from Mean:
Peak video is determined from a rolling average of 4 pixels. Current pixel + 3 previous pixels are used to derive the peak value. This peak value is monitored for the ROI (Region of Interest) and latched at the end of frame.

An average video level is calculated for the active ROI. This value will be calculated in real time, i.e. as pixel data in the ROI is captured from the sensor it is fed directly to an Accumulator. At the end of frame, the Accumulator is divided to give a true average.

The user can adjust the percentage they want to take from the peak & average to drive the ALC. Taking a greater percentage from the peak value will result in smaller exposure times being set. Taking a greater percentage of the average to drive the ALC will result in larger exposure times being set.

ALC Level & AGC+ALC Speed: Adjusts the "level" of the ALC. Making the level and speed set points higher will drive the ALC to set larger exposure times.

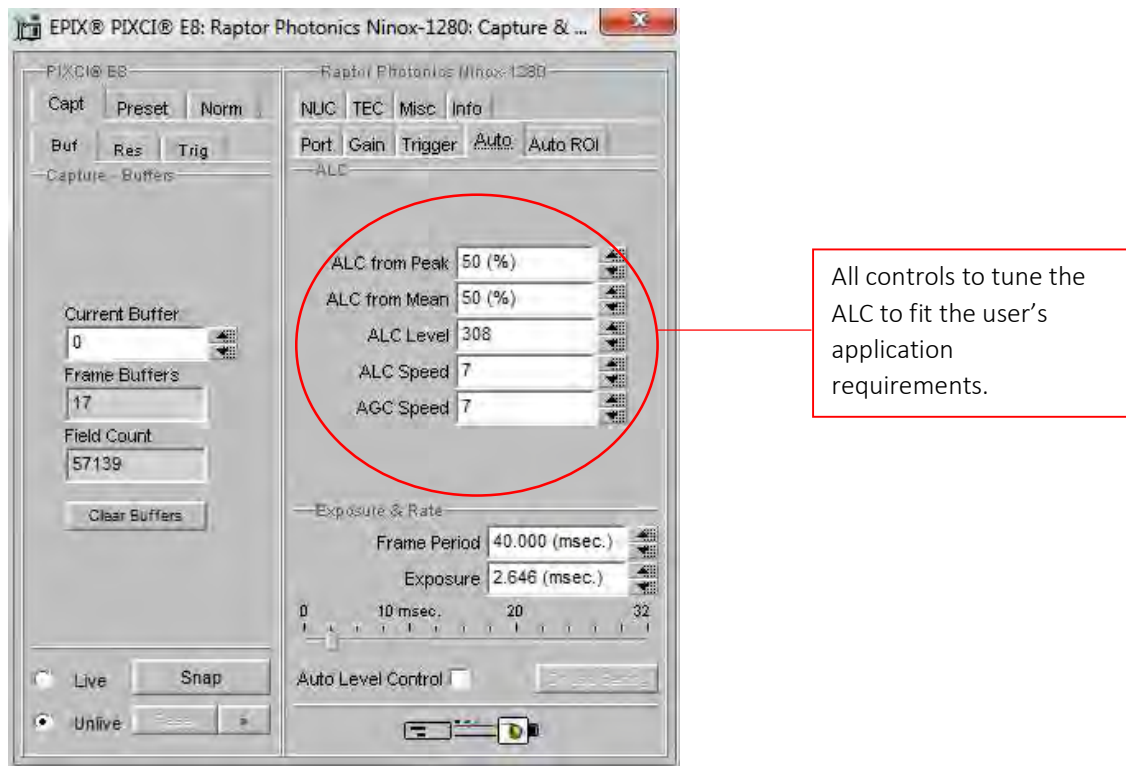All controls to tune the ALC to fit the user's application requirements.

Figure 10: ALC Tuning.

7.7.6   Auto Exposure ROI Control

The pixel values used in the accumulator that drives the ALC can be selected from the "Auto ROI" tab. By default, the whole pixel array will be selected for this (1280x1024) as shown in Figure 11.
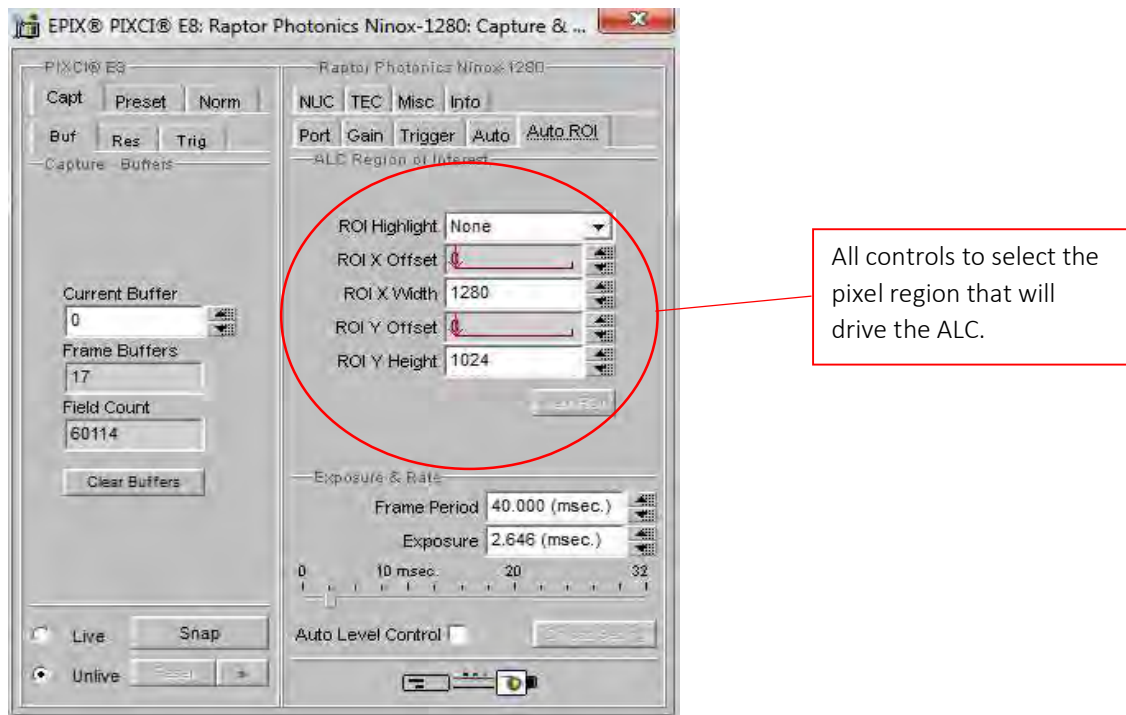

All controls to select the pixel region that will drive the ALC.

Figure 11: Auto ROI.

The ROI can be made smaller and moved around the image array by adjusting the width and height and offset controls. Selecting "ROI Box" from the "ROI Highlight" drop down box will outline the ROI on the imaging window that is currently set.

An example of this feature in action is shown in Figures 12– 13. The images were taken using our Owl 640 camera, but the exact same principle applies for the Ninox 1280, as both cameras have these identical control feature.

In Figure 12, you can see that the ROI is 146x146 and is active over the carpet of the floor, which is setting a good exposure time for the carpet region. However, the suitcase is very dark and under exposed.
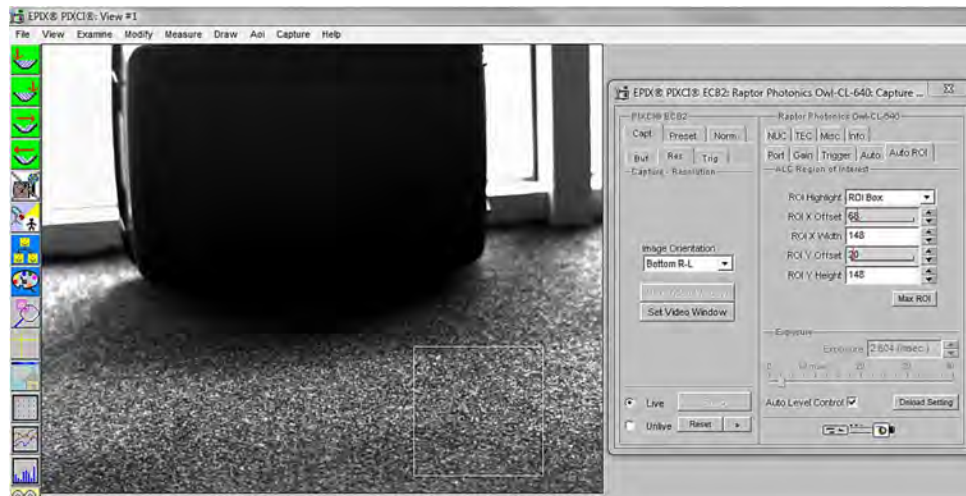

Figure 12: Auto ROI Example.

If the ROI is moved to an area on the suitcase, the pixels in this region will now drive the ALC. This can be seen in Figure 13.
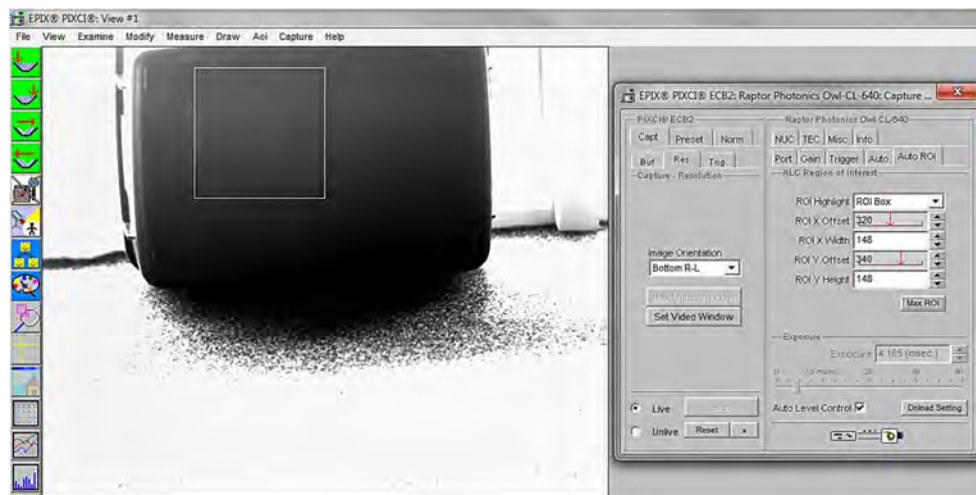

Figure 13: Auto ROI Example.

You can see from Figure 13 that the exposure value being set by the ALC is larger due to lower pixel values driving the ALC. The suitcase is now better exposed. However, the exposure is still always changed for the whole image array, saturating the rest of the image.

7.7.7   Miscellaneous Section

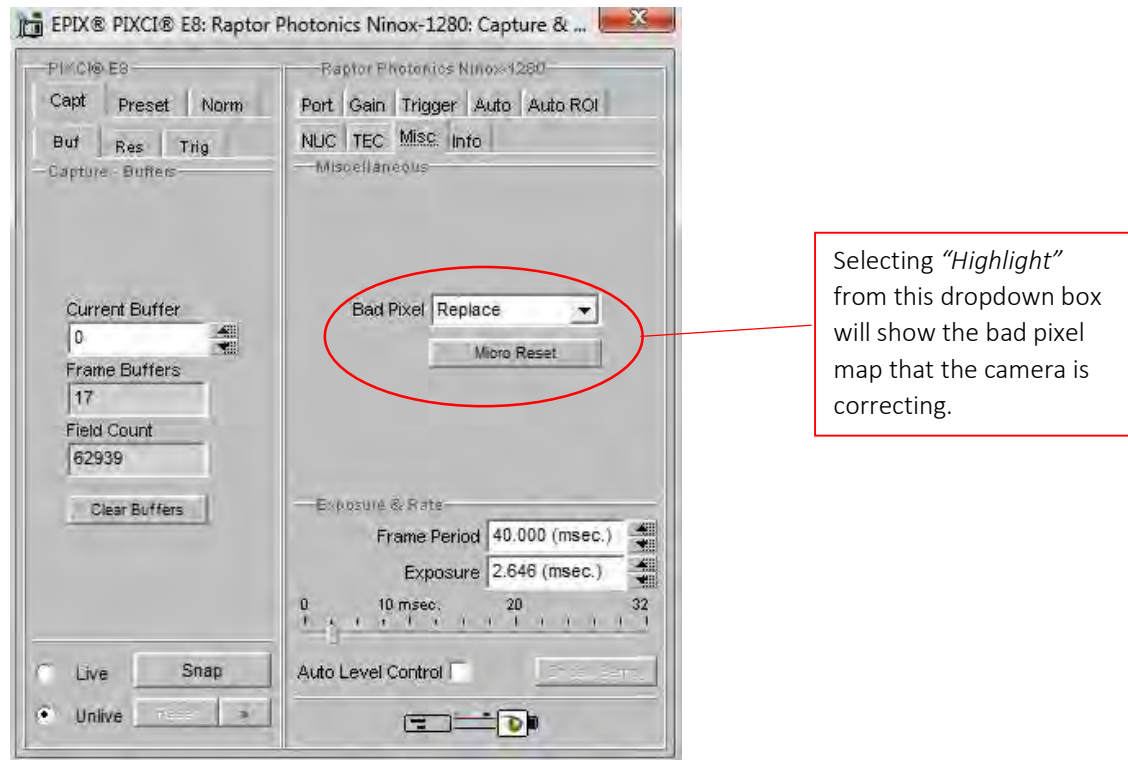The "Misc" tab highlights the bad pixels that the NUC is correcting for, seen in Figure 14.

Selecting *"Highlight"* from this dropdown box will show the bad pixel map that the camera is correcting.

Figure 14: Miscellaneous Tab.

7.7.8   Manufactures Data Information

The "Info" tab displays information about the camera such as the manufactures data:

FPGA & Micro Version: The current firmware version of the camera is displayed.

Serial #: States the serial number of the camera.

Build Date & Code: Gives the date that the camera was built.

ADC & DAC Calibration Values: These are calibration values that are used to set the TEC set point and read back the sensor and PCB temperatures. They are not needed for the user as the XCAP GUI has simple buttons to set and read back these temperatures, discussed in earlier sections.

CCD & PCB Temperature: The current sensor and PCB temperature of the device can be read by clicking "Update Temp".
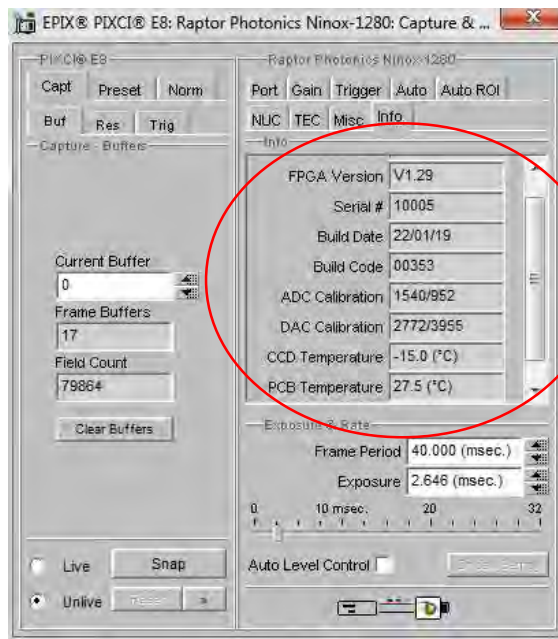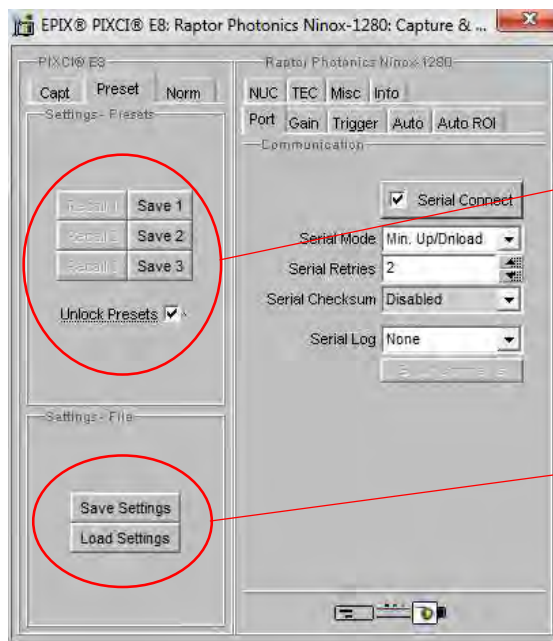
Figure 15: Manufactures Data Information.

7.7.9 Saving Preset Settings

Different camera and frame grabber settings can be saved in the "Preset" tab under the PIXCI E8 section of the GUI, shown in Figure 16.

Figure 16: Presets.

Up to three different presets can be saved per settings file. Once the camera is set to the desired state, click "Save 1". 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 is the maximum number that can be saved in a settings file.

7.7.10 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. Where to find this control feature is shown in Figure 17. The contrast modification may not be required for the application at hand.
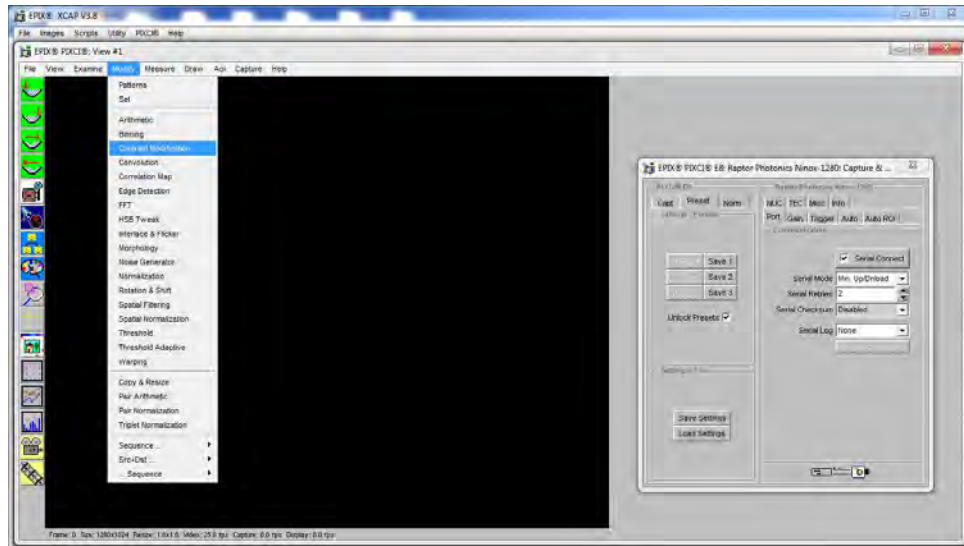

Figure 17: Contrast Modification Location on Toolbar.

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.

NOTE: This control feature is only applicable with XCAP Std.
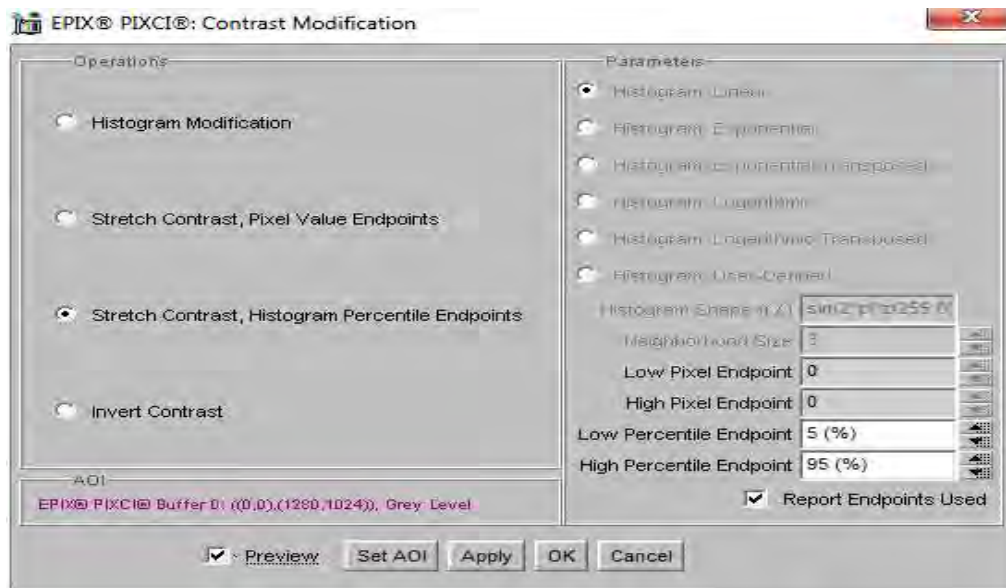

Figure 18: Contrast Modification.

Instrument Expert
Original factory packaging
www.dorgean.com

CORPORATE HEADQUARTERS

Raptor Photonics LTD
Willowbank Business Park
Larne, Co Antrim
BT40 2SF
Northern Ireland
PH: +44 2828 270141

www.raptorphotonics.com