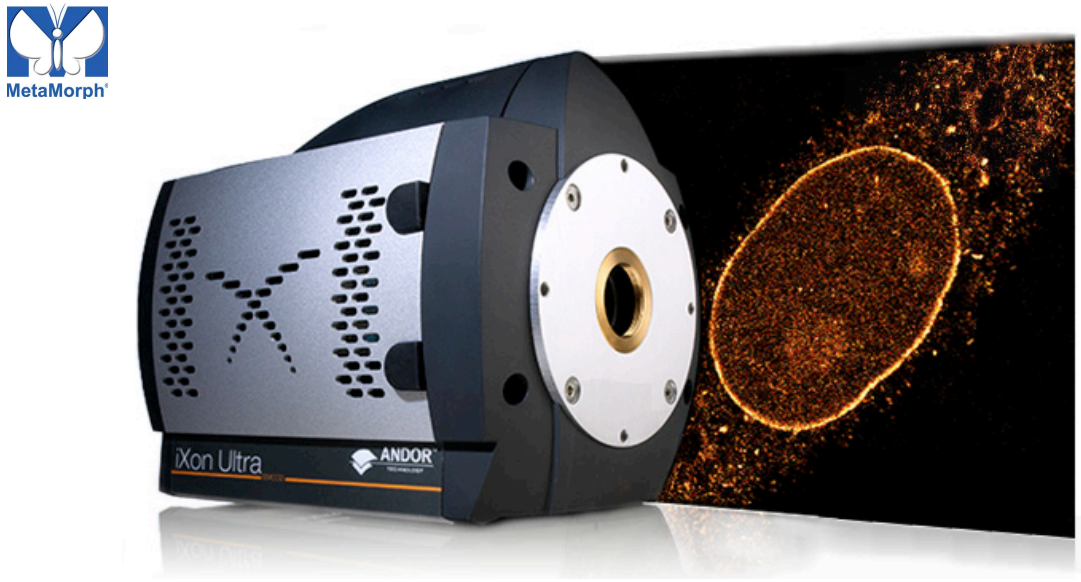
ANDOR
an Oxford Instruments company

MetaMorph
Software Guide

Version 1.7 rev 22 Jun 2015



for the iXon EMCCD

(covering iXon$_3$, Ultra 897 & 888 models)

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INTRODUCTION

This document explains how to install and setup MetaMorph for use with the iXon EMCCD Cameras (iXon3, Ultra 897 & 888). In order for the camera to work to its full specification it is necessary to perform the installation as described in this document.

Trademarks and Patent Information

Front page image courtesy of Prof. Jan Liphardt and Dr. Alan Lowe, University of California, Berkeley, USA

Revision History

Version	Released	Description
1.0	27 Sep 2012	Initial Release
1.1	28 May 2013	General updates to improve presentation and procedures throughout. Updated Minimum Exposure and Frame Rate data in Section 3.3-3.5.
1.2	17 Oct 2013	Updated MetaMorph installation procedure (Section 1.1) and Andor Driver pack installation procedure, (Section 1.3). Included iXon3 897 camera model.
1.3	13 May 2014	Added Software feature Matrix (Section 3.6) Updated presentation (All Sections)
1.4	21 May 2014	Minor edit to text in table for consistency (Section 3.6)
1.5	12 Aug 2014	Added content to cover the iXon Ultra 888 model (All Sections)
1.6	19 Sep 2014	Updated Driver Installation steps (Section 1.3)
1.7	22 Jun 2015	Added clarification on software version supporting for iXon Ultra 888 (Section 1.1)

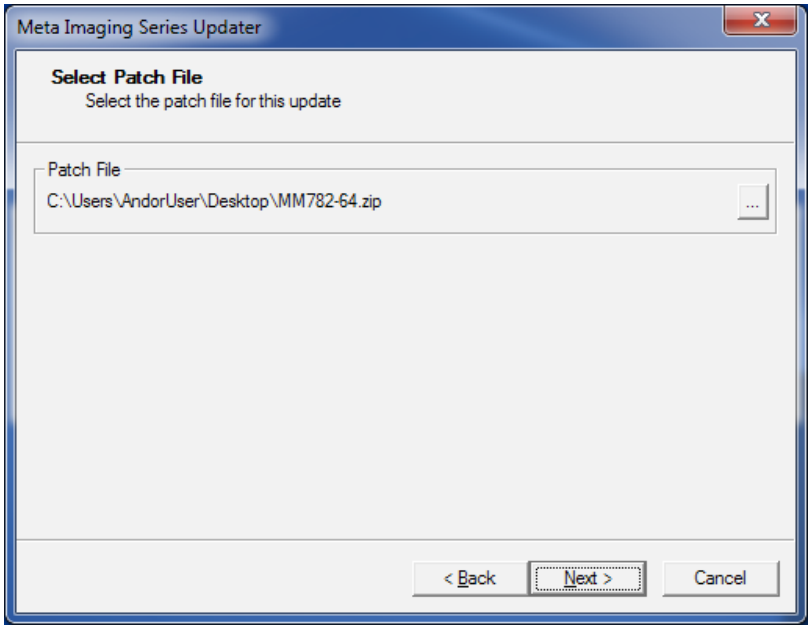
SECTION 1: INSTALLATION

This section outlines how to install MetaMorph on your PC for use with the iXon EMCCD Cameras (iXon3, Ultra 897 & 888).

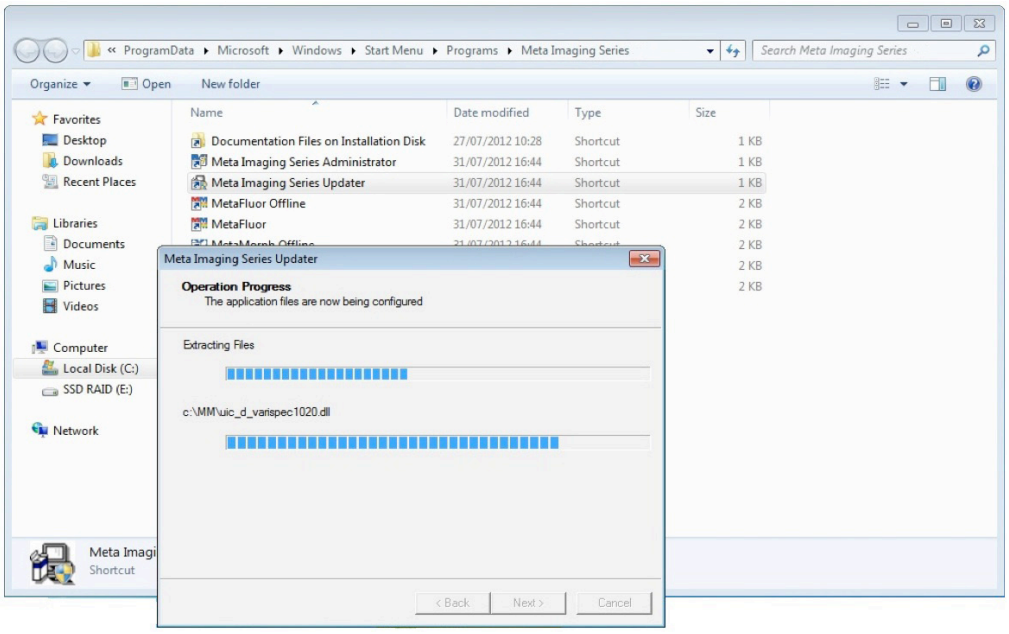
1.1 Installing MetaMorph for the first time

1. Install MetaMorph from the CD-ROM supplied. Please note: MetaMorph 7.7 is the first version which supports Windows 7.
2. To get the latest MetaMorph updates please visit http://www.meta.moleculardevices.com/updates/

   Note: iXon Ultra 888 is supported by MetaMorph version 7.8.11 onwards.
3. Download the latest update and save the Zip file to the desktop.
4. In order to update the full release of MetaMorph, go to the Meta Imaging Series folder which contains the Updater program. Select the Updater and browse for the MetaMorph zip file just downloaded.



5. Follow the steps in the Updater menu until all the files are extracted and the application files are configured.



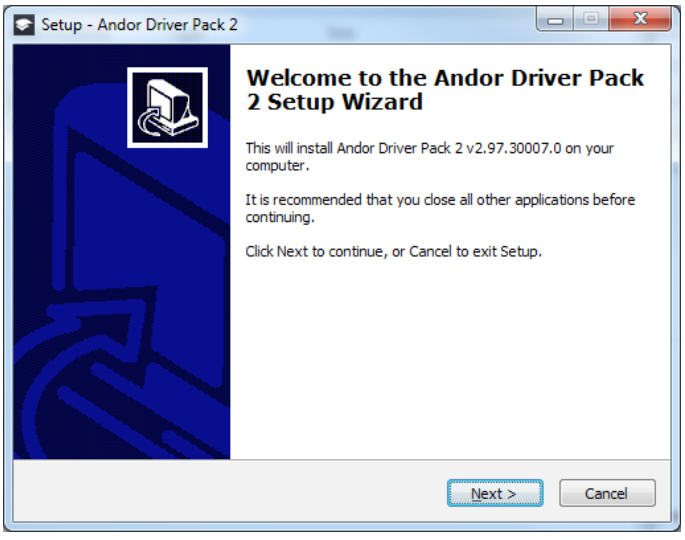
6. The software is now updated to the latest release.

1.2 MetaMorph already Installed

1. If MetaMorph is installed already on your PC, ensure that it is the latest version available.
2. If you need to update to the latest version download the latest version of MetaMorph from the following site: http://www.meta.moleculardevices.com/updates/ and use the Updater program as shown in **Section 1.1**.

1.3 Installing the Andor Driver Pack

1. Install Andor Driver Pack 2.97.30005.0 (minimum version) from **MyAndor>Software>Drivers & 3rdParty**.
2. If you don't have an account, please register to access the latest driver pack and documentation.



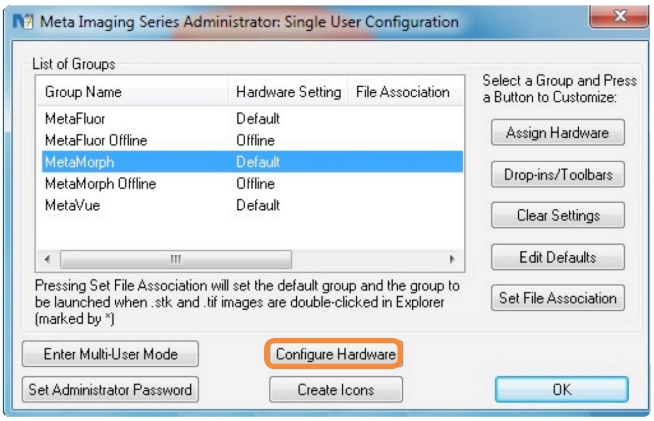
3. **Important** - install the Andor Driver Pack to the MetaMorph vinput folder (**c:\MM\vinput\Andor**)
4. Complete the installation steps and click 'Finish'
5. Select 'Yes, Restart the computer now'.

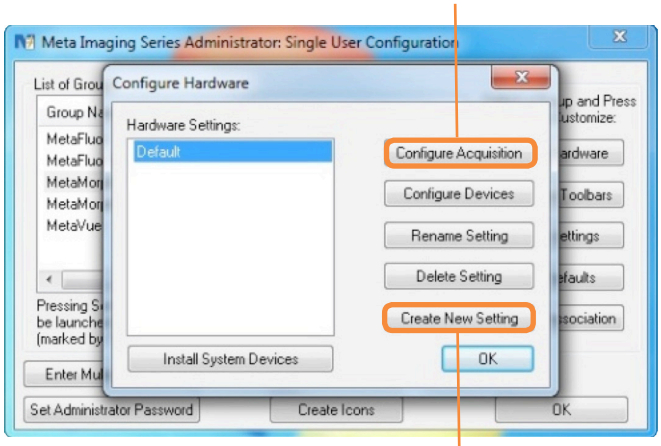
SECTION 2: CONFIGURING METAMORPH

2.1 Configuring MetaMorph

1. Power on the iXon EMCCD Camera.
2. Run the Meta Imaging Series Administrator to set up the configuration for acquisition.
3. Select MetaMorph-Default and then click ‘Configure Hardware’.
4. Click ‘Create New Setting’, to create a new setting, and call this setting ‘iXon Ultra’.

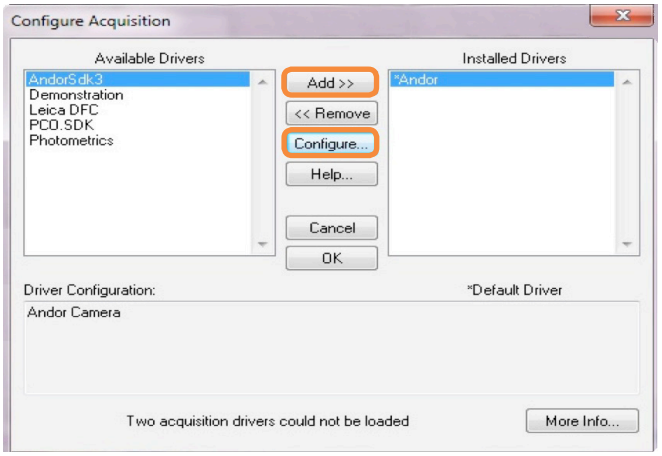
Click ‘Configure Acquisition’ after the new setting has been created





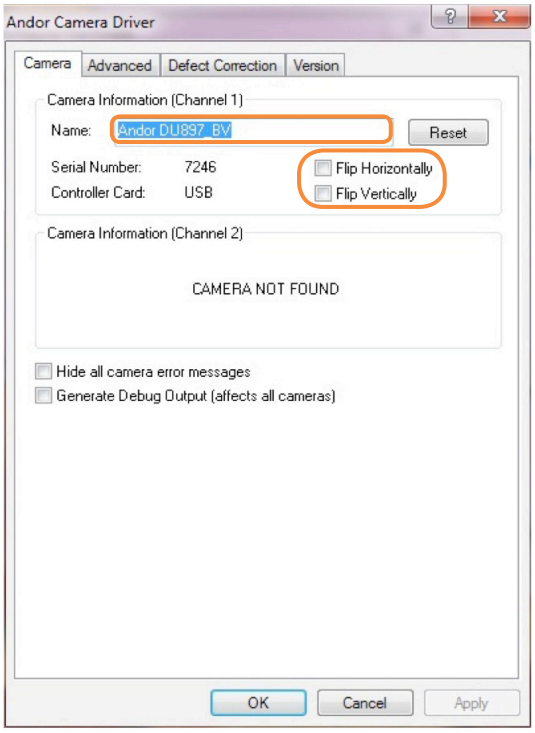
Click ‘Create New Setting’ first

5. Click ‘Configure Acquisition’.
6. Select the ‘Andor’ driver from the list of Available Drivers.

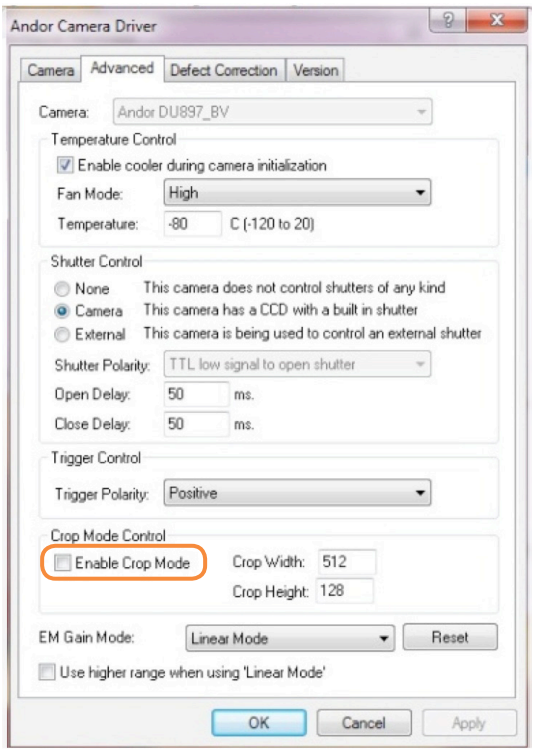


7. Click ‘Add >>’.
8. Then click ‘Configure...’.

9. The camera serial number is shown in the **Camera** tab. You can also set the image orientation by selecting 'Flip Horizontally' or 'Flip Vertically' as required.



10. In the **Advanced** tab the Temperature, Fan Mode and Shutter Control parameters can be set as required.



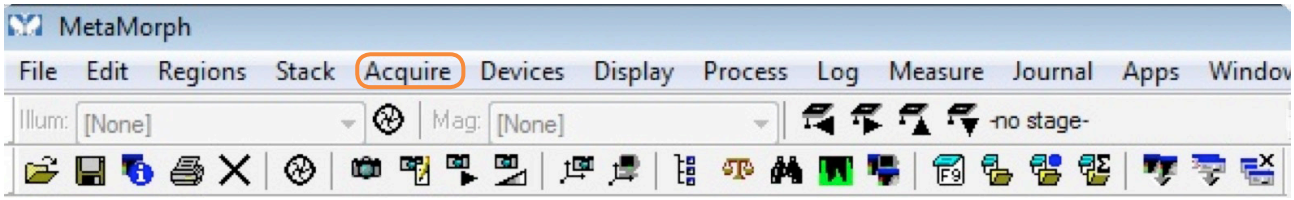
NOTE: If the Optomask will be used for cropping the sensor to achieve even faster speeds select 'Enable Crop Mode'.

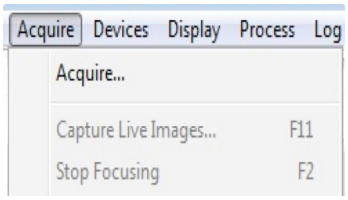
11. Once the configuration is complete, click 'OK' to leave the Meta Series Administrator and go to the MetaMorph Application.

SECTION 3: USING METAMORPH TO CONTROL THE IXON EMCCD CAMERA

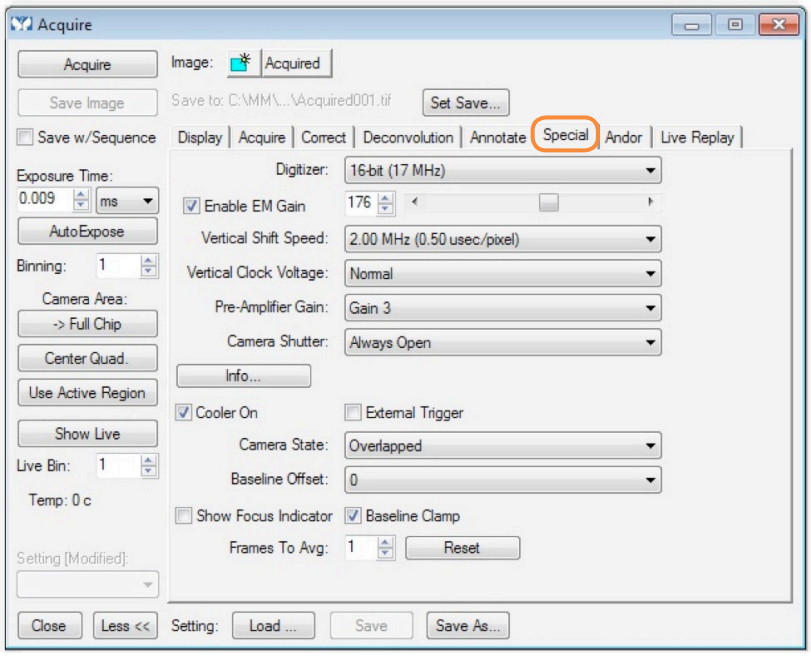
3.1 Setting the Acquisition Parameters

1. Open the MetaMorph application.
2. Open the '**Acquire**' window which can be accessed via the **Acquire** tab or the **Acquire** icon.





3. Set the Readout Speed, EM Gain settings, Vertical Shift Speed, Vertical Clock Voltage, Pre-Amplifier Gain, Shutter and Trigger parameters in the '**Special**' tab of the '**Acquire**' window.



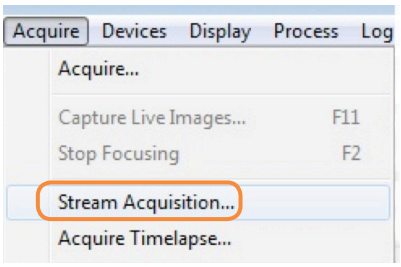
4. For a continuous live view press '**Show Live**' in the '**Acquire**' window or the '**Live**' icon on the toolbar. To acquire a snapshot press the '**Acquire**' button on the '**Acquire**' window or the '**Snap**' icon on the toolbar.

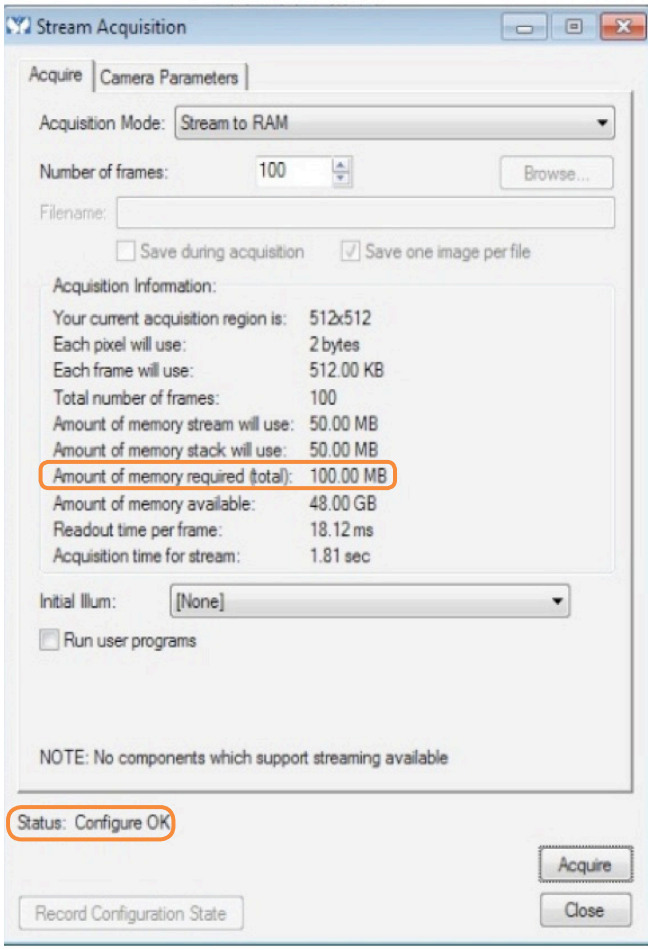
Acquire Acquire a Snapshot Image

Live Continuous Live View/Video Mode

3.1.1 Setting up a Kinetic Series

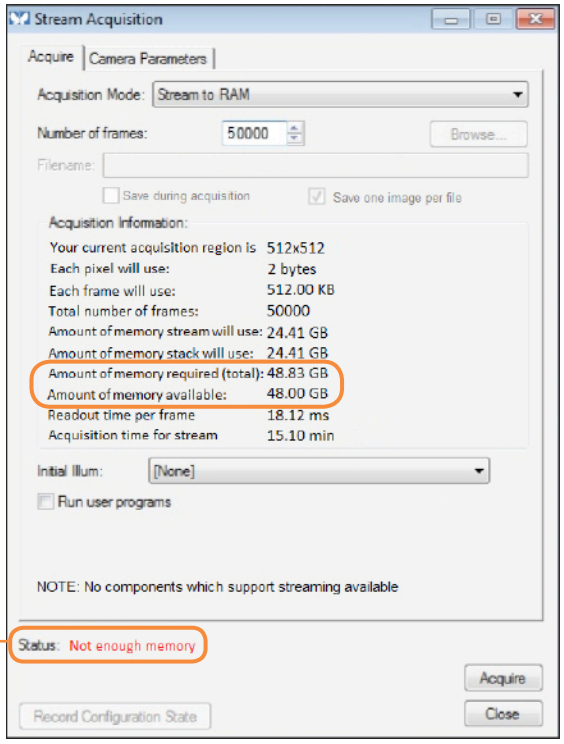
To set up a kinetic series go to the **Acquire** tab on the main MetaMorph toolbar and choose 'Stream Acquisition...'. In the **Stream Acquisition** window the number of frames/time-points to be acquired can be selected as well as where the data will be streamed to i.e. RAM/Hard Disk.





If you have set the number of frames too high for 'Stream to RAM' a warning will appear at the bottom of the window. If this happens, lower the number of frames or switch to 'Stream to Hard Disk' to resolve the issue.

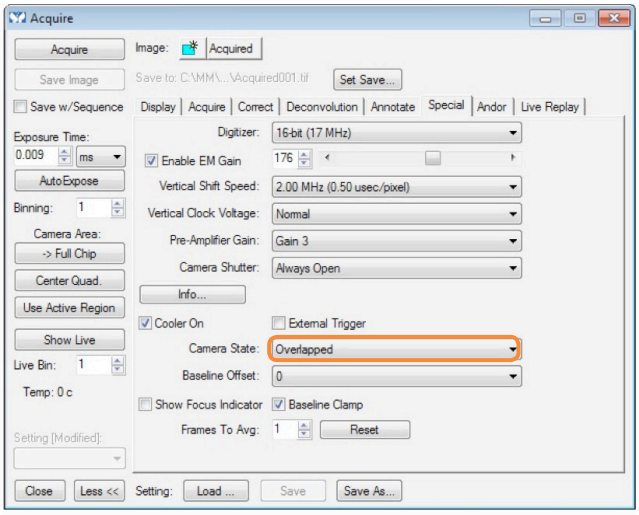
Insufficient memory warning message

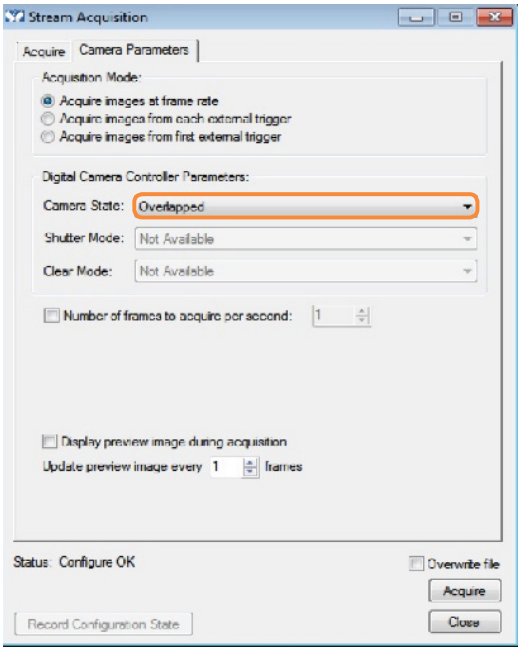


3.1.1.1 Obtaining the Fastest Acquisition Speeds (Overlapped Mode)

To achieve the fastest speeds with the iXon EMCCD Cameras (iXon$_3$, Ultra 897 & 888) in MetaMorph set the camera state to **Overlapped mode**.

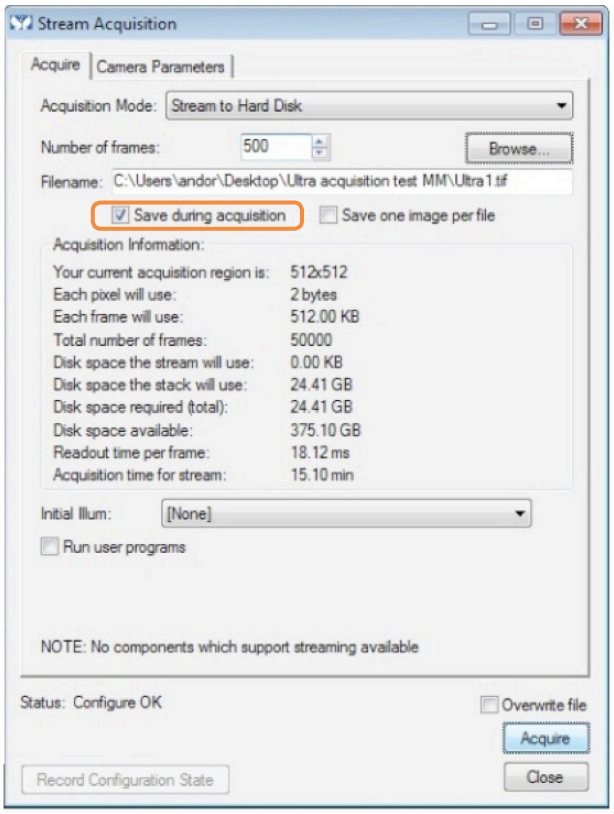
- Overlapped mode is where the sensor is reading out and exposing simultaneously i.e. frame-transfer mode, hence the faster speeds in this mode.
- This can be selected from the '**Acquire**' window (below left) as well as the '**Stream Acquisition**' window (below right).





3.1.2 Saving your Image Data

When 'Stream to Hard Disk' is selected you have the option to save the images during the acquisition by ticking the 'Save during acquisition' box in the Stream Acquisition window. This should always be ticked as you want to guarantee that all your data will be saved if there is a crash during the acquisition. You can also indicate where you want the files saved to.

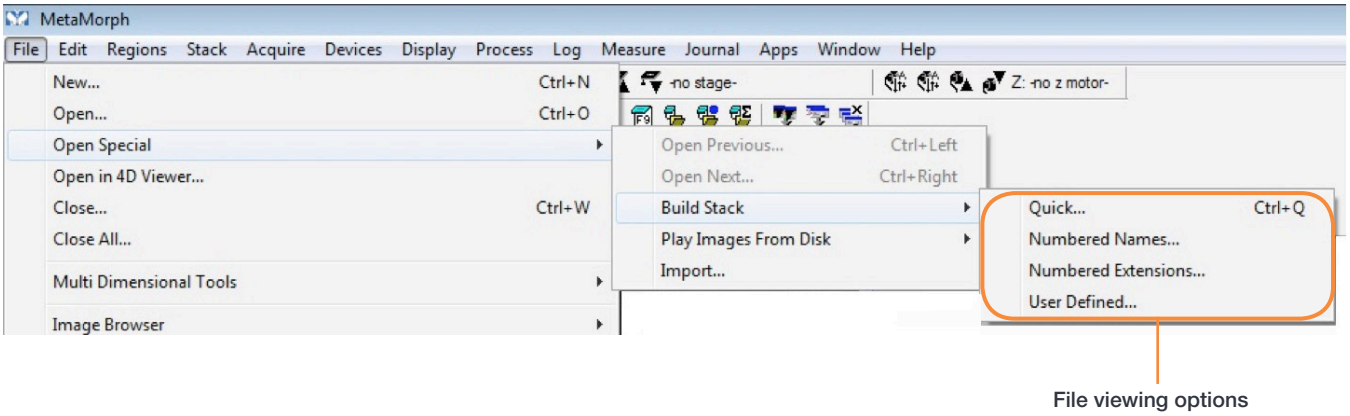


Once you are happy with your settings press the '**Acquire**' button and acquisition will begin.

3.1.3 Viewing Acquired Image Files/Data Series

To view the acquired kinetic series/time lapse experiment go to **File>Open Special>Build Stack** and choose one of the four options available:

- The '**Quick**' option will allow you to select the first file of the series and will automatically open all of the frames sequentially.
- In '**Numbered Names**' and '**Numbered Extensions**' you can choose what the first and last frame will be and therefore you can limit the size of the series to open.
- In '**User defined**' you can select which frames you want to see by selecting them from a list.

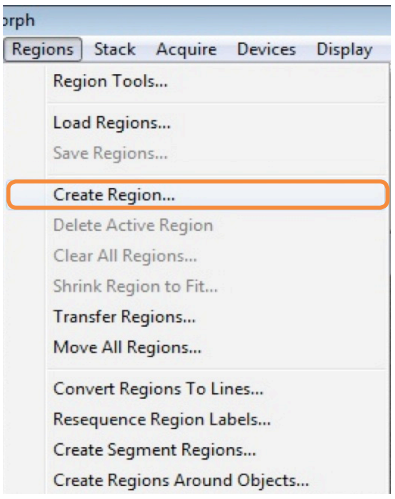


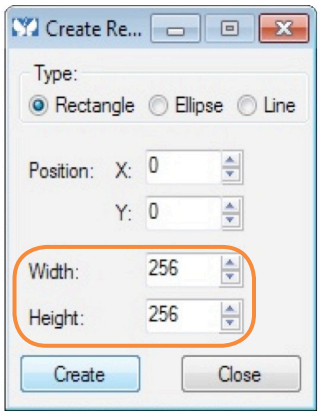
File viewing options

3.2 Setting a Custom Region of Interest (ROI) in MetaMorph

To define a custom ROI follow the instructions below:

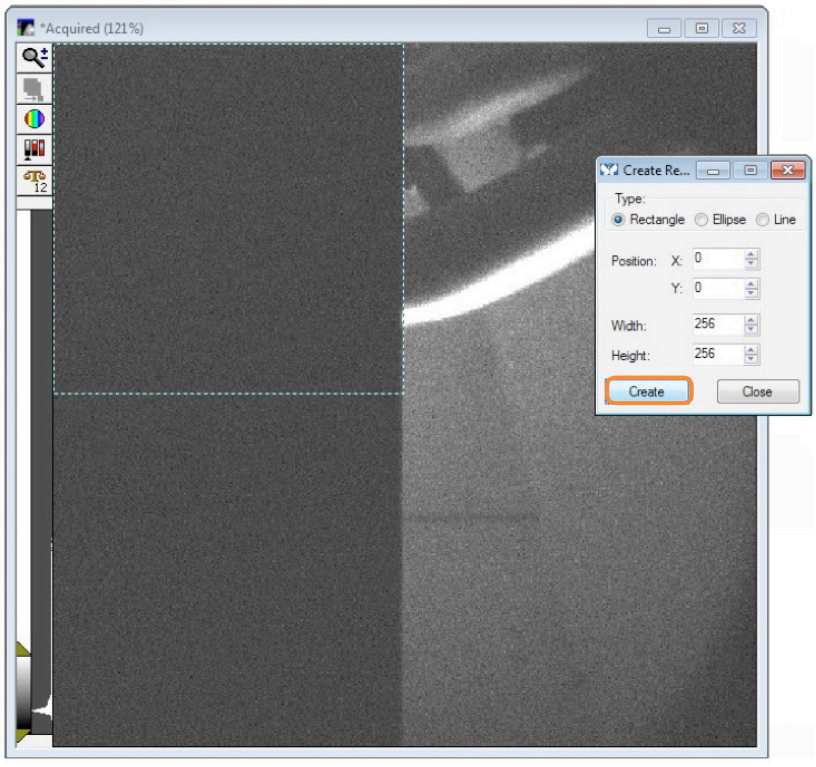
1. Select 'Go Live' to see the full field of view, and acquire an image.
2. To define the ROI, go to the main tool bar and select **Regions>Create Region**.
3. This opens a new window where you can set the height and width and x and y position on the sensor.



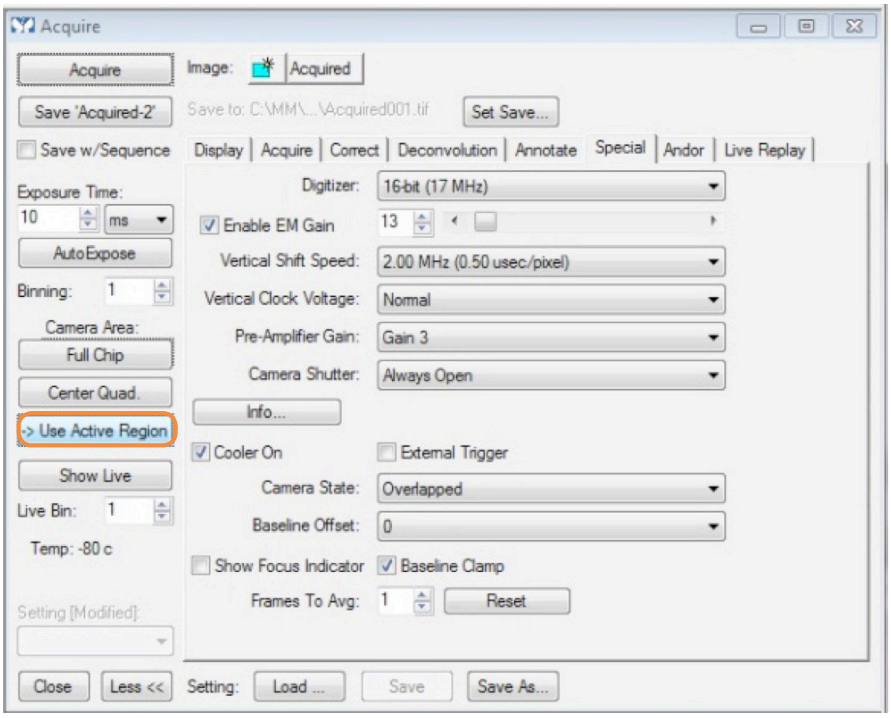


NOTE: It is not necessary to specify the x and y position of the ROI for the iXon EMCCD Cameras (iXon3, Ultra 897 & 888) in MetaMorph.

4. When you have chosen the width and height for the ROI of interest, click '**Create**' and you will see an outline of the new ROI on the full chip.



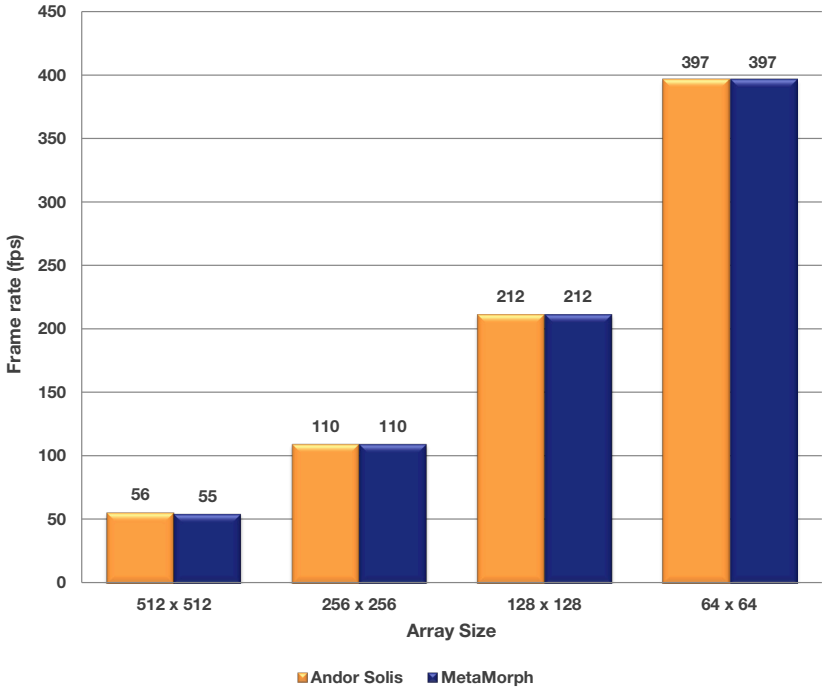
5. To select the new region select the ‘Use Active Region’ button in the ‘Acquire’ window and the new region you have defined will appear in a new window.



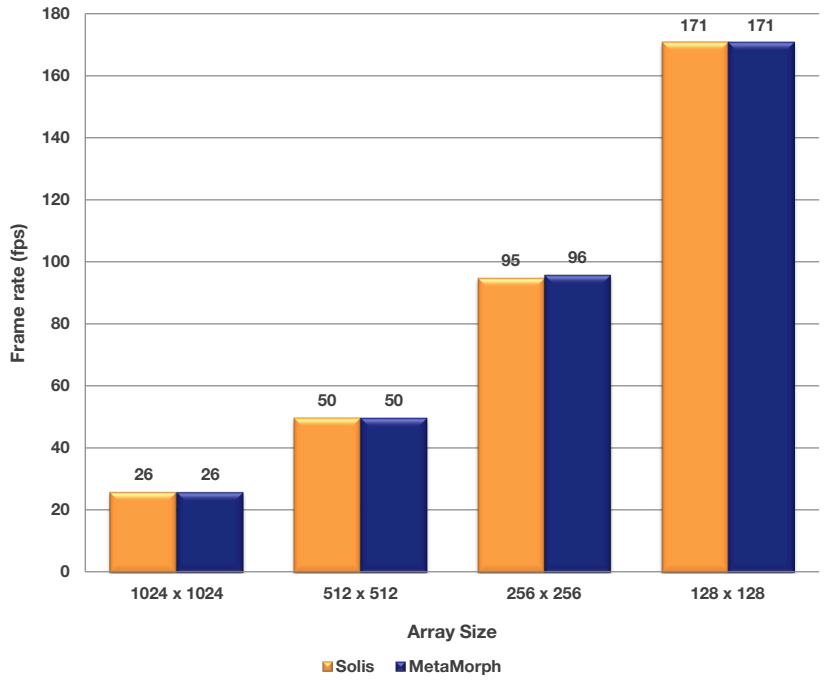
3.3 iXon Ultra Frame Rates in MetaMorph

The frame rates for the iXon Ultra in MetaMorph are consistent with Solis (refer to graph below).

iXon Ultra 897



iXon Ultra 888

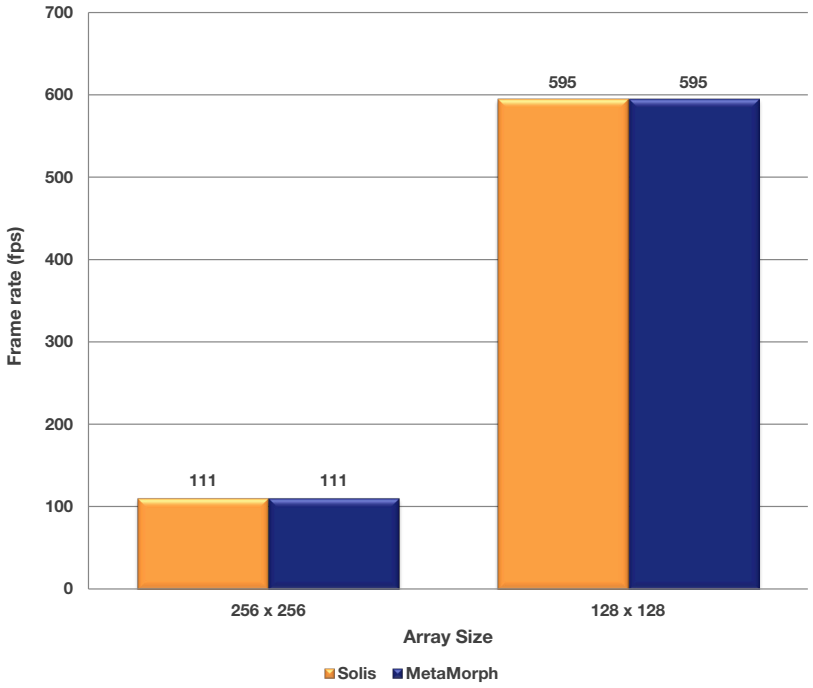


3.4 Crop Mode Frame Rates in MetaMorph

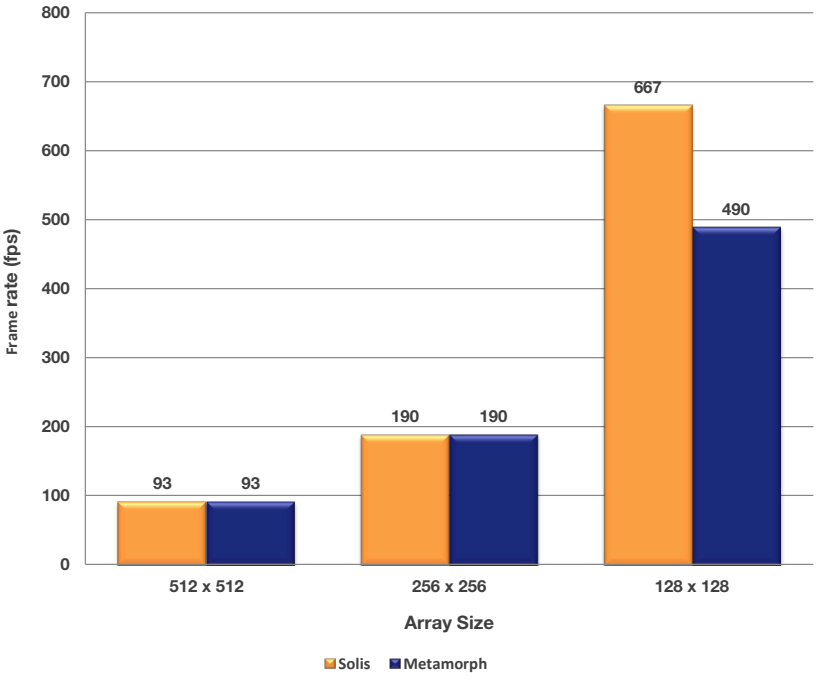
It is possible to achieve even faster speeds with the iXon Ultra using an Optomask to optically mask part of the sensor and fool it into thinking it is smaller than its actual size. For this to be effective, “Crop Mode” must be enabled in the **Meta Administrator** before going to the main MetaMorph application. MetaMorph currently supports Corner Tethered Crop Mode, Optically Centered Crop Mode is not yet supported.

The following graphs show the frame rates when using the ‘Corner Tethered Crop Mode’ in MetaMorph and Andor Solis.

iXon Ultra 897



iXon Ultra 888



* Metamorph is currently unable to sustain the camera maximum rates of ROI’s smaller than 128 x 128 in Crop Mode owing to the way that it retrieves data from the cameras (one frame at a time). This significantly impacts the maximum sustainable rate. This is a known issue which has been reported to Metamorph however the issue has yet to be resolved.

3.5 iXon Ultra 897 Feature Matrix in MetaMorph

	iXon Ultra 897
Trigger Modes	
Internal	✓
External	✓
External Exposure	x
Software Trigger	x
Fast External	x
External Start	✓
Acquisition Modes	
Single image	✓
Continuous - camera acquires until aborted	✓
Kinetic Series - Frame number and Rate Control	✓
Accumulate mode - specify number and rate to accumulate images	x
Fast Kinetics - Increase frame rate for user defined rows (requires masked area)	x
Readout Modes	
Imaging - Full Image Readout from Sensor	✓
Overlap - also called Frame Transfer (Selected modes only)	✓
Full Vertical Binning (FVB)	x
Multi Track - User defined depth of vertically binned rows at user defined spacings	x
Isolated crop mode - arbitrary size region but in bottom corner	✓
ROI - Arbitrary size region anywhere on sensor.	✓
Camera Binning - User Defined.	✓
Readout Parameters	
Exposure Time	✓
EM Pixel Readout Rate - 17MHz, 10Mhz, 5Mhz, 1MHz	✓
Conventional Pixel Readout Rate - 3MHz, 1MHz, 0.08MHz	✓
Pre Amp Gain - 1,2 and 4	✓
Vertical Shift Speed (3.3µS, 1.7µS, 0.9µS, 0.5µS and 0.3µS)	✓
Vertical Clock Amplitude (Normal, +1,+2, +3, and +4)	✓
Electron Multiplying Mode - Real gains from x2 to 300, - Real gains (x1000 in extended mode)	✓
Optaquire	
Enable Specific Mode	x
Add/Delete user defined mode	x
iCam	
Change Exposure Time during acquisition - (Limitations apply, see manual)	x
Change EM gain and control	✓

	iXon Ultra 897
Metadata	
Timestamp Clock (current timestamp reading on camera) +/- 10ns and time of subsequent frames	✓
For USB cameras FIFO fill level recorder in Meta data	✓
Image Processing	
Spurious Noise Filter (Median, Level above, Interquartile Range) - on camera correction	✓
Data Averaging Filter *	×
Shutter Control	
Open/Closed/Auto (open on power up)	✓
Fan Control	
High, Low, Off	✓
Operating System Support	
Windows 7 & 8, 32-bit & 64-bit	✓
Recommended Application Features	
Image Rotation - 90 degrees clockwise, 90 degrees anticlockwise	×
Image Streaming to disk at all sustained frame rates	×
Image Flip - Horizontal and Vertical (conventional and EM registers readout raw data in a different order by default)	✓
Supported File formats should contain all acquisition information in header	✓

*** MetaMorph uses custom averaging algorithms**