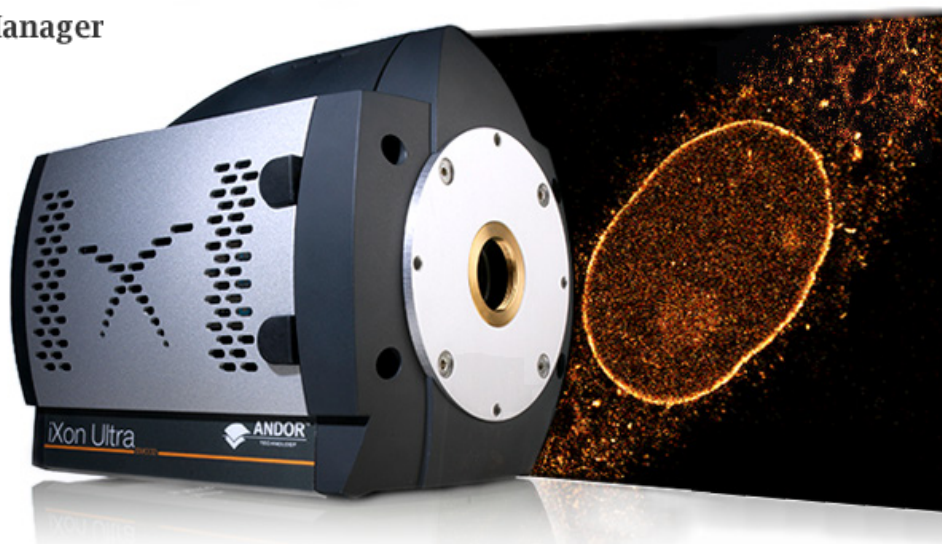


μManager Software Guide

Version 1.5 rev 19 Jan 2015

μManager



for the iXon EMCCD Cameras

(covering iXon3, Ultra 897 and 888 models)

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INTRODUCTION

This document explains how to install and setup µManager for use with the iXon EMCCD Cameras (iXon₃, Ultra 897 and iXon₃ 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

Andor®, the Andor logo, iXon Ultra and iXon₃ EMCCD and Solis are trademarks of Andor Technology. Andor is an Oxford Instruments company. µManager is an open source application developed at UCSF and is funded by an NIH grant R01-EB007187 from the National Institute of Biomedical Imaging and Bioengineering (NBIB). ImageJ is a freely available public domain Java image processing program. All other marks are property of their owners.

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

REVISION HISTORY

Version	Released	Description
1.0	31 Oct 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 3.4-3.6.
1.3	13 May 2014	Added Software feature Matrix (Section 3.7) Updated presentation (All Sections)
1.4	21 May 2014	Correction to Andor weblink (Section 1.1)
1.5	19 Jan 2015	Updated for iXon Ultra 888

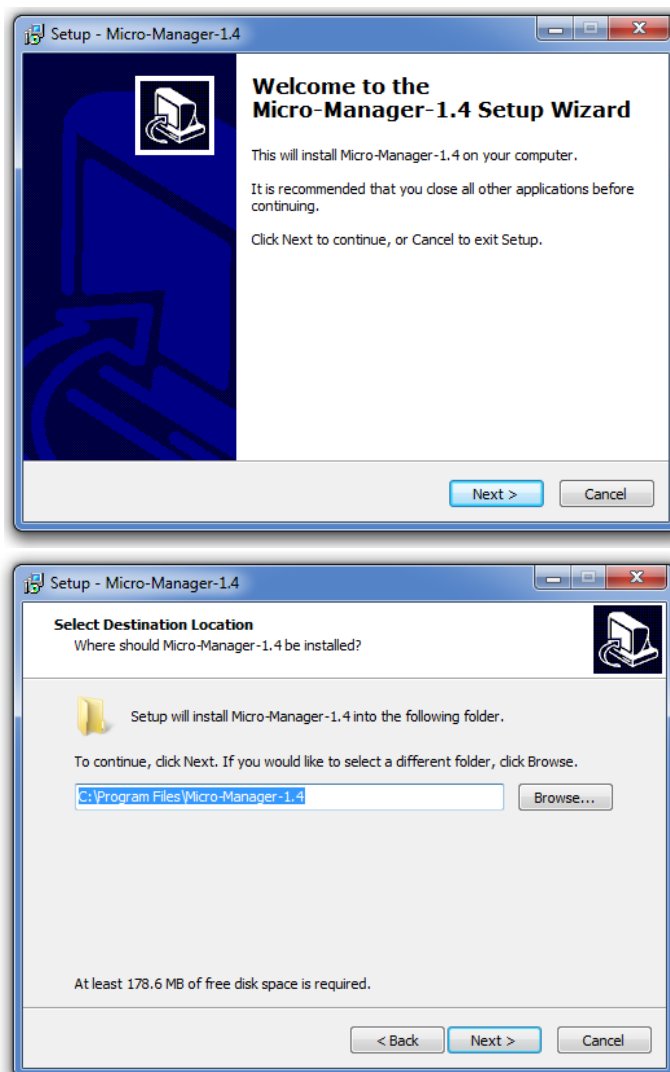
SECTION 1: INSTALLATION

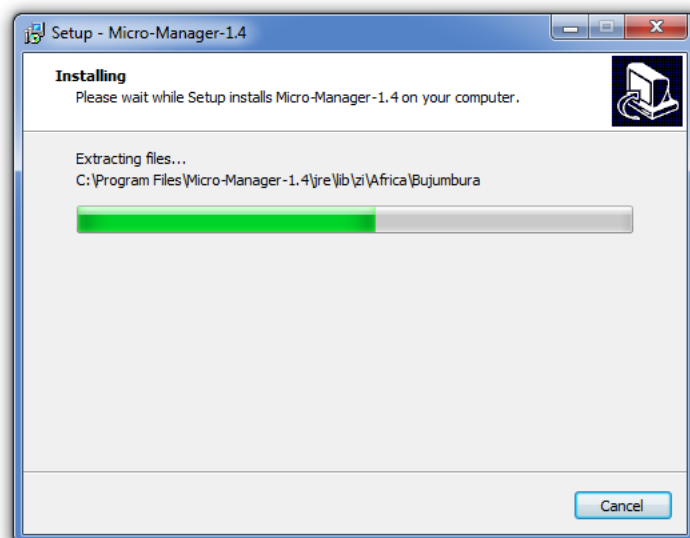
This section outlines how to install µManager on your PC for use with the iXon EMCCD cameras (iXon₃, Ultra 897 and 888).

1.1 INSTALLING µMANAGER

NOTE: The driver required to run the iXon Ultra and iXon₃ range of cameras in µManager is already included in µManager and therefore you do not need Andor SDK.

1. To ensure that everything is correct it is advisable to download the latest Andor Driver Pack for iXon EMCCD from the following link: <http://www.andor.com/downloads>
2. Start the installation and install to the Micro-Manager directory
Note: This is very important. If the Andor Driver Pack is not installed to this directory the iXon EMCCD camera will not be detected in the Configuration set-up.
3. Complete the installation steps and click 'Finish'.
4. Select 'Yes Restart the computer now'.
5. Download the latest full version of µManager from the 'Downloads' section of www.Micro-Manager.org.
6. Run the executable when it downloads and follow the steps in the setup wizard through until µManager is installed.



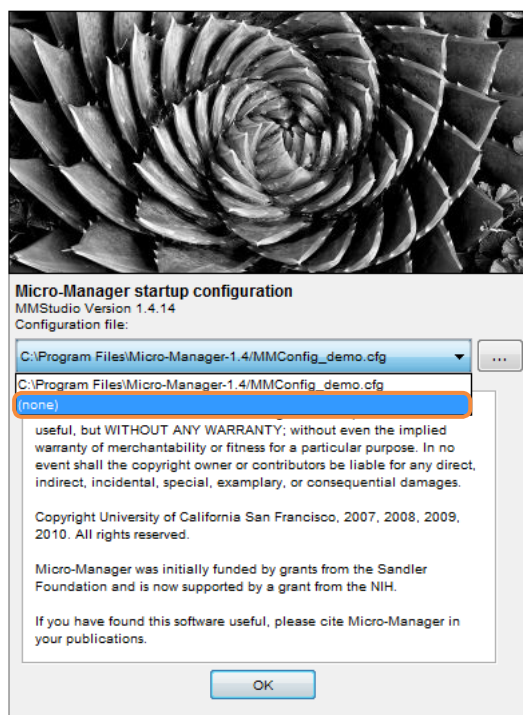


7. Once μManager has been installed, uncheck the box that says 'Launch Micro-Manager' and click 'Finish'.

SECTION 2: CONFIGURING µMANAGER

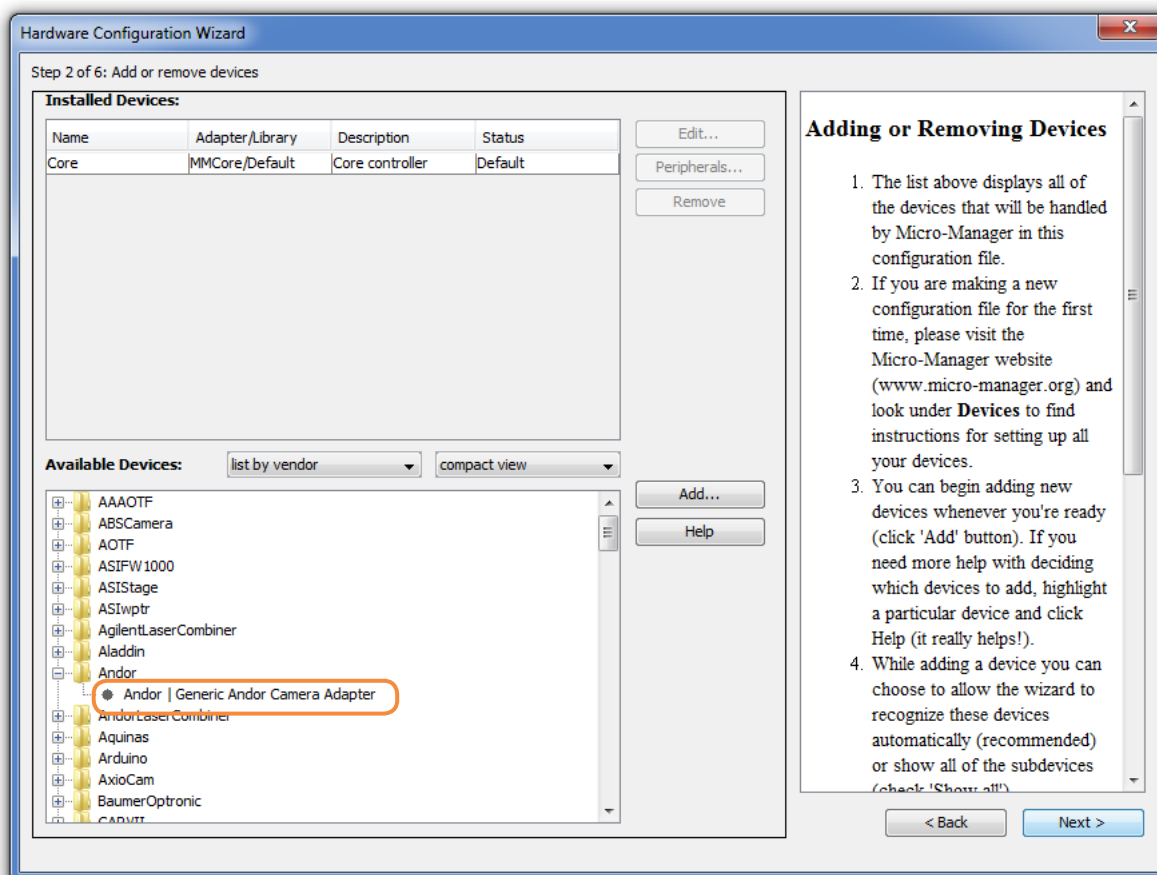
2.1 CONFIGURING µMANAGER

1. Power on the iXon EMCCD camera.
2. Run µManager from the **Start Menu>Programs**.
3. A dialog box allows the user to load a camera from a configuration file on start-up. Initially you won't have any configuration files so select '(none)' and click 'OK'.

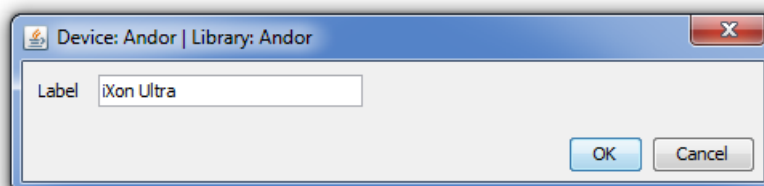


4. To load a camera open the Hardware Configuration Wizard by clicking **Tools->Hardware Configuration Wizard**
5. In the first screen select 'Create new configuration' and click 'Next >'.

6. In Step 2 expand the 'Andor' folder, select 'Generic Andor camera Adapter' as shown and click 'Add...'.



7. Confirm the camera name is 'iXon Ultra' and click OK to return to the Hardware Configuration Wizard.



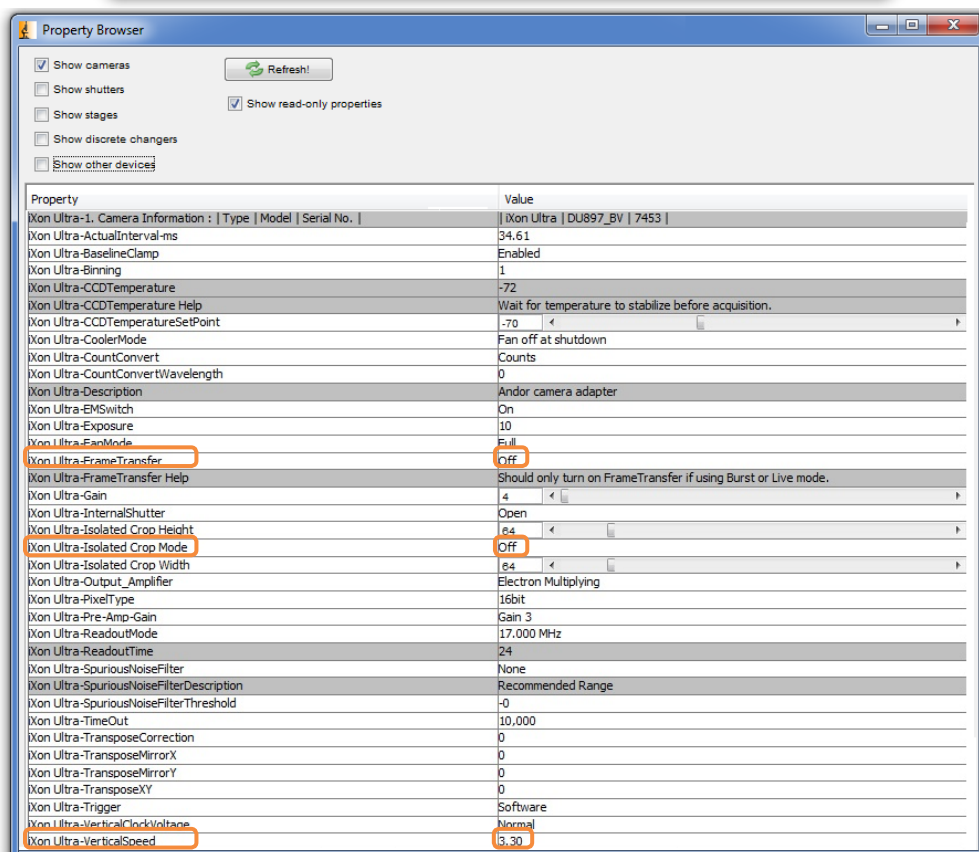
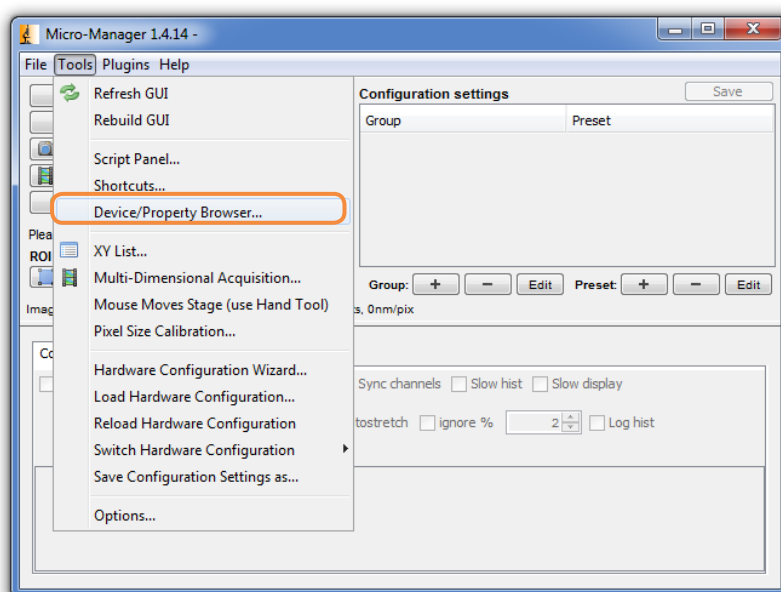
Installed Devices:

Name	Adapter/Library	Description	Status
Core	MMCore/Default	Core controller	Default
iXon Ultra	Andor/Andor	Generic Andor Cam...	OK

8. Continue to click 'Next >' until Step 6 of 6.
9. Enter a configuration filename to save these settings.
10. Click 'Finish'.

SECTION 3: USING µMANAGER TO CONTROL THE IXON EMCCD CAMERA

1. Open µManager
2. To access camera settings open the **Device/Property Browser** by clicking **Tools->Device/Property Browser**.
On start-up, µManager sets the values in the property browser by reading them from the camera's current state.



3. Once you have input the acquisition settings for your iXon EMCCD camera you can close the Property Browser window.
4. You are now in the main µManager window.

3.1 CONTINUOUS LIVE VIEW AND SNAPSHOT

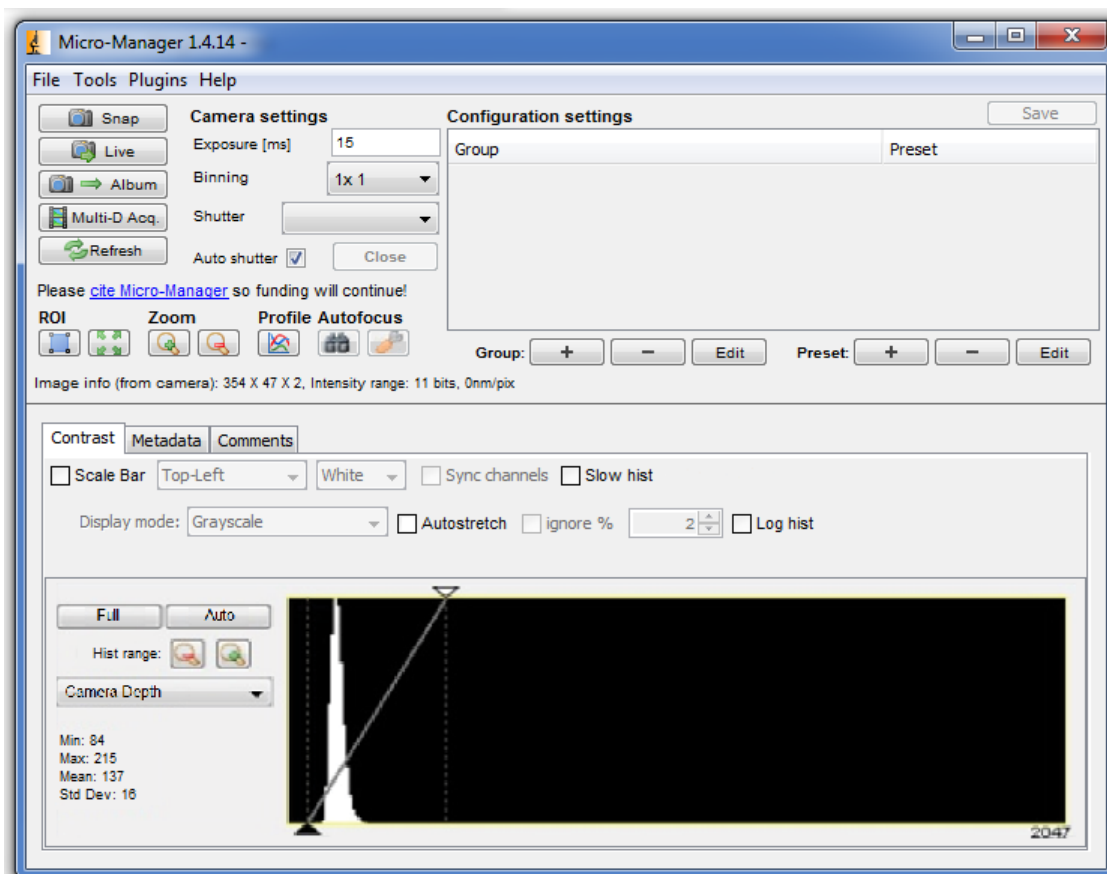


For a **continuous live view** click the '**Live**' button and ensure that the software trigger is selected in the Device/Property browser.

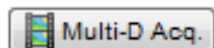


To **acquire a snapshot** click the '**Snap**' button on Acquisition/Live window.

If no image is visible when you select the live mode, auto-scale the image by pressing Auto on the main acquisition window (see below).



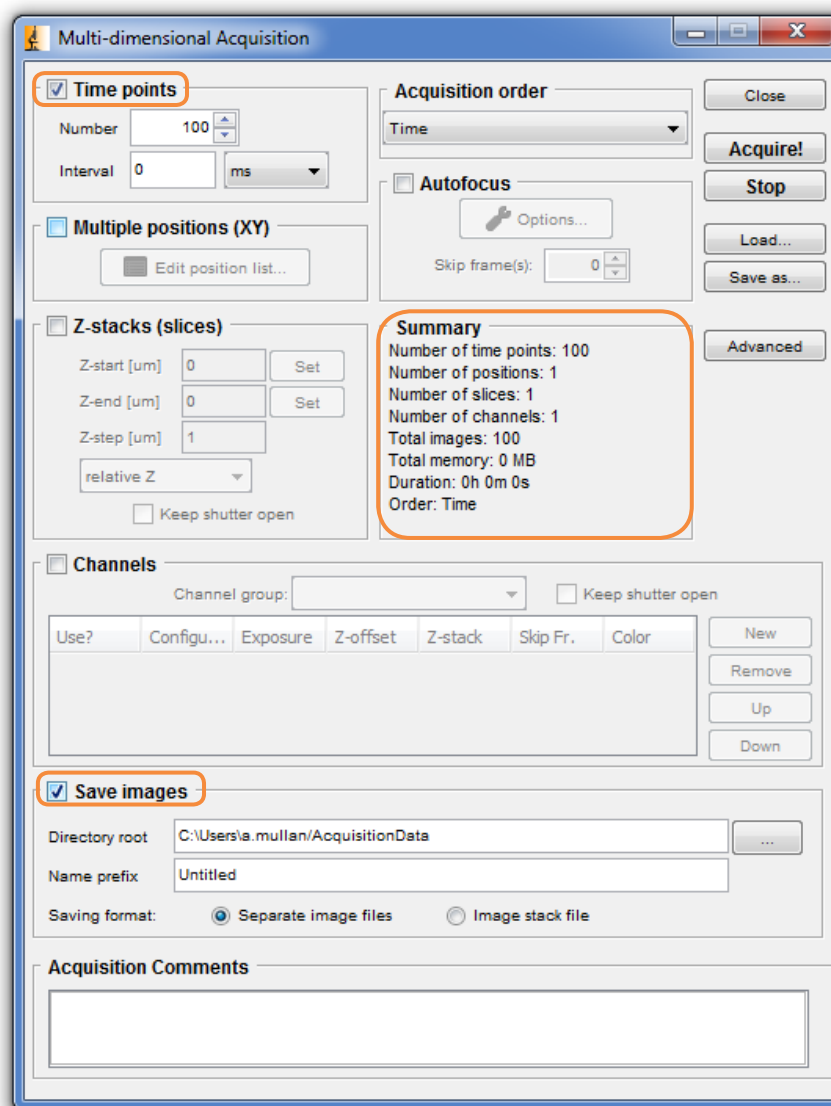
3.2 SETTING-UP A KINETIC SERIES/TIME-LAPSE EXPERIMENTS



To set up a kinetic series/time-lapse experiment using **Multi-D Acq**

In the **Multi-Dimension Acquisition** window you will only use the **Time points** and **Save images** tabs to control the iXon EMCCD camera, the other controls are for other devices. The summary section of the Multi-D Acquisition window provides information as to the number of images/frames in the acquisition and the total memory required to store these.

1. Click the **Multi-D Acq** button.
2. Select **Time points** and input the number of frames/time points you want to capture and set the **Interval** between frames. If the interval is set longer than the exposure time, µManager will acquire images at its own rate via software triggers. If the interval is less than the exposure time then µManager calls the camera to do a sequence acquisition and therefore the interval time is ignored and the camera acquires images at the frame rate set up through the Device/Property Browser.



3. Select the **Save images** option at the bottom of the window. The kinetic series/time-lapse can be saved as single image files, where each frame/time point is an individual file or as a multi-image file where all the frames/time points will be contained in one file. Both file formats can be imported into ImageJ after acquisition in µManager and processed.
4. Once you are happy with your settings press the **Acquire!** button and acquisition will begin.

3.2.1 VIEWING AN ACQUIRED KINETIC SERIES/TIME-LAPSE EXPERIMENT

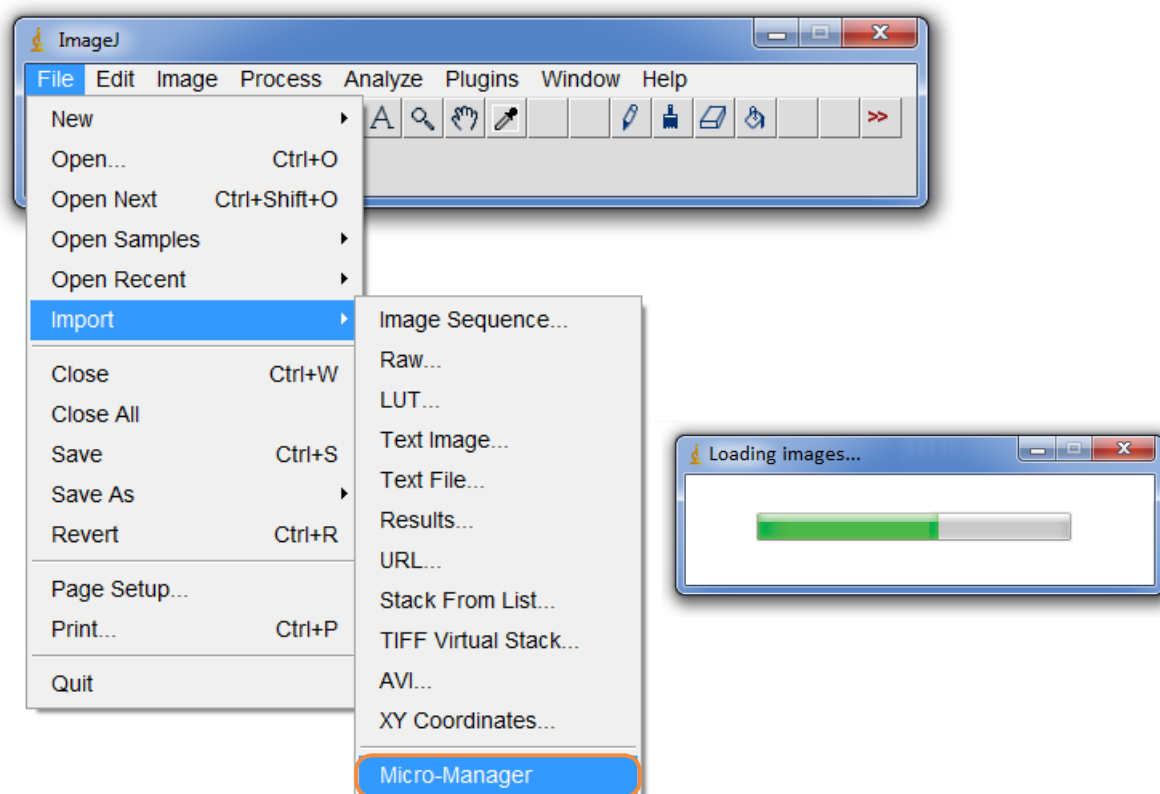
To view the acquired kinetic series/time-lapse experiment, the latest version of Image IO for ImageJ needs to be downloaded.

3.2.1.1 DOWNLOADING THE IMAGEJ I/O PLUGIN

1. You can download the latest plugin from the following link: <http://ij-plugins.sourceforge.net/plugins/imageio/>.
2. Follow the download link and then look for 'ij-ImageIO.jar' with the highest release number.
3. Copy this file into the plugins directory which you will find in the µManager folder in the program files in the C-drive.
4. Restart ImageJ to load the newly installed plugins.

3.2.1.2 VIEWING THE KINETIC SERIES/TIME-LAPSE

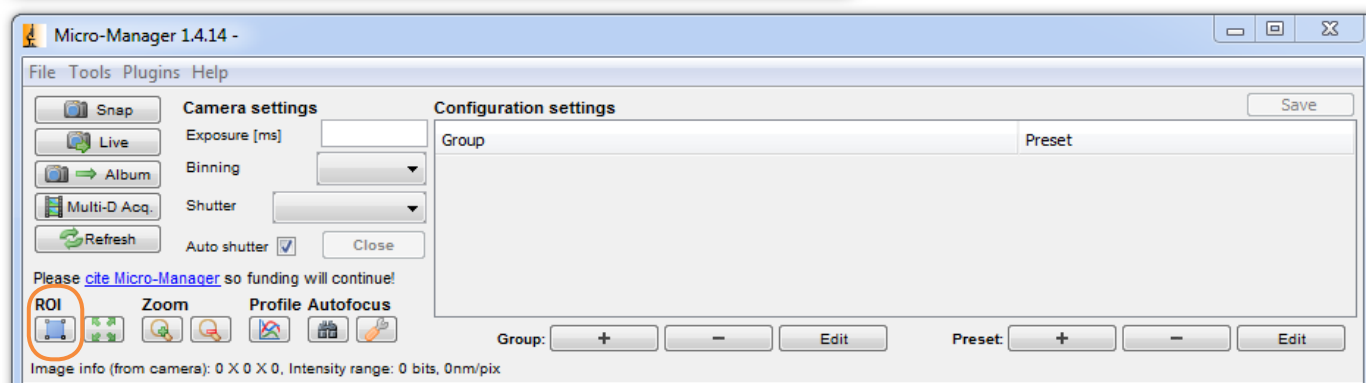
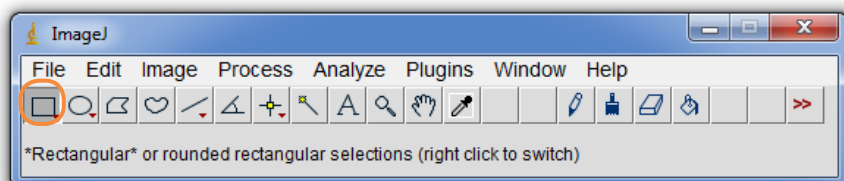
1. Once the plugins have been installed, open **ImageJ>File>Import>micromanager**.
2. Choose the folder where the kinetic series/time-lapse was saved to and select the first file of the single-image files or the multi-image file.



3.3 SETTING CUSTOM REGIONS OF INTEREST (ROI) IN µMANAGER

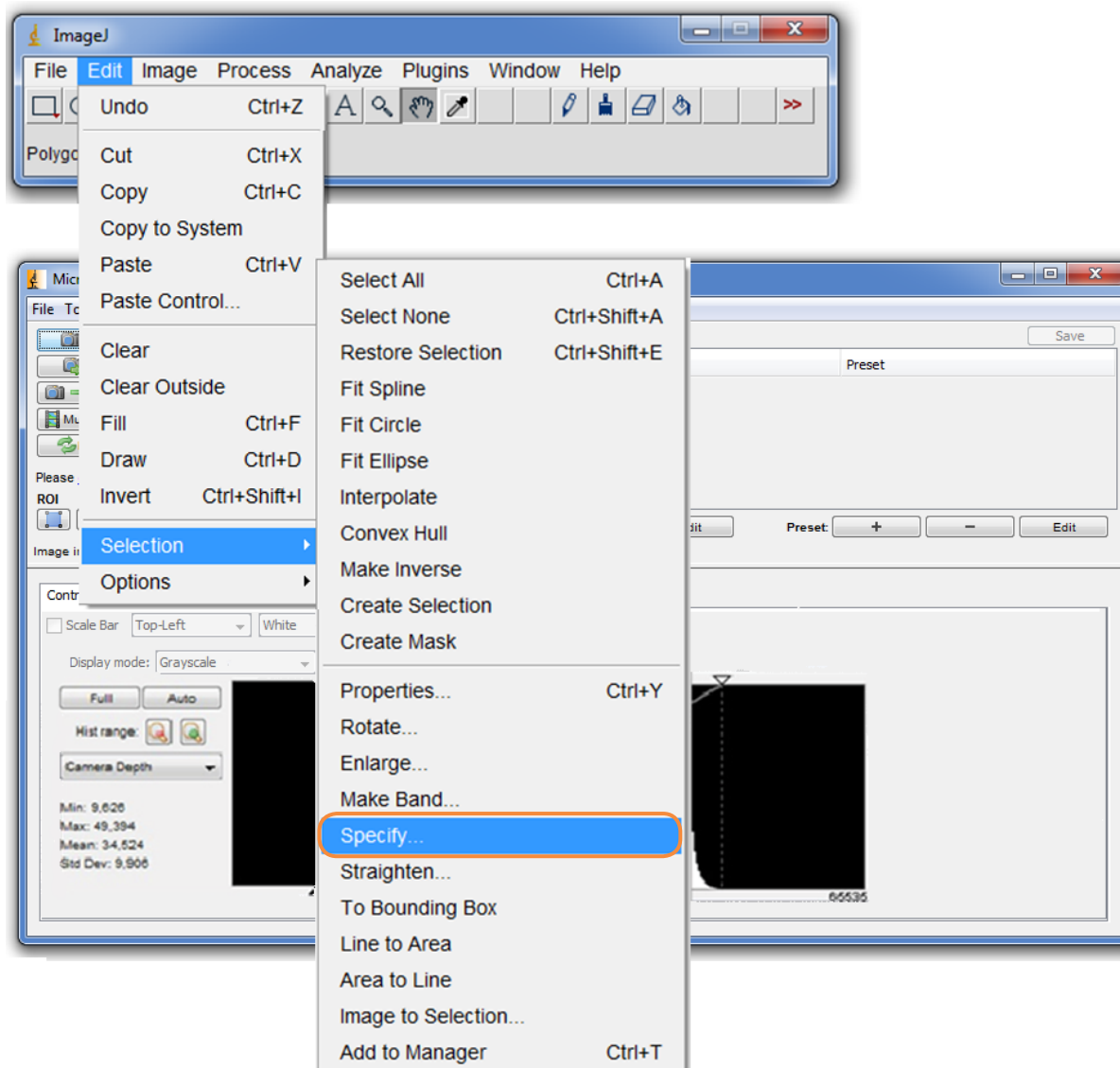
3.3.1 DEFINING A CUSTOM ROI

1. Go Live to see the full field of view and snap an image. To define the ROI use the rectangular drawing tool in ImageJ and draw a region onto the snapped image. Select ROI to define this as your new image size.



2. Select 'Live' to see new ROI.

- To further define the ROI with a specific width, height and position on the sensor, go to **ImageJ>Edit>Selection>Specify**



NOTE: Always remember to press the ROI button in the main μManager window after changing width and height in the 'Specify' window and this will instruct the software to choose the new edited region.

3.4 SETTING THE EXPOSURE FOR A ROI

In order to achieve the maximum frame rates for ROI, the minimum exposure must be set in μManager. In addition, ensure 'Frame Transfer' is ON and the minimum vertical shift speed is selected (see the Property/Device browser).

3.5 IXON ULTRA 897 AND 888 FRAME RATES IN μMANAGER

The acquisition speeds of the iXon Ultra 897 and 888 in μManager are consistent with Andor Solis (shown in the following graphs).

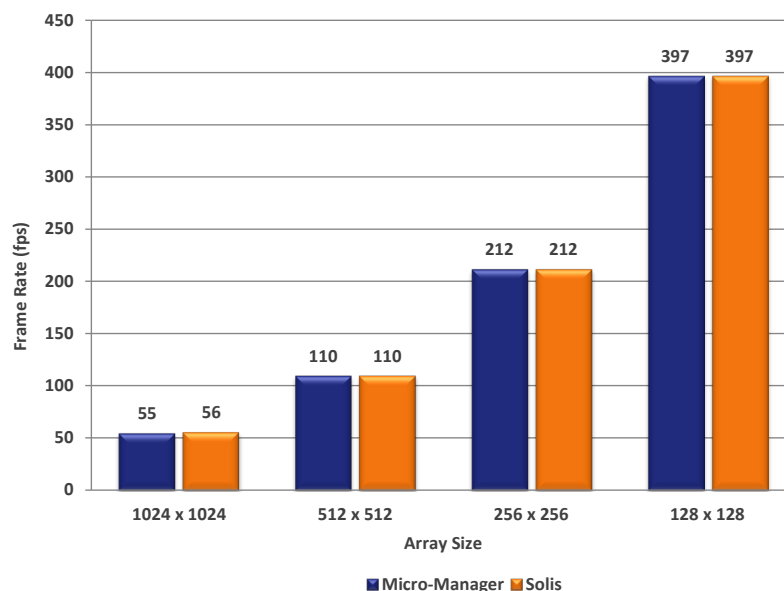


Figure 1: Comparison of Frame Rates (fps) in Micro-Manager and Solis for the iXon Ultra 897

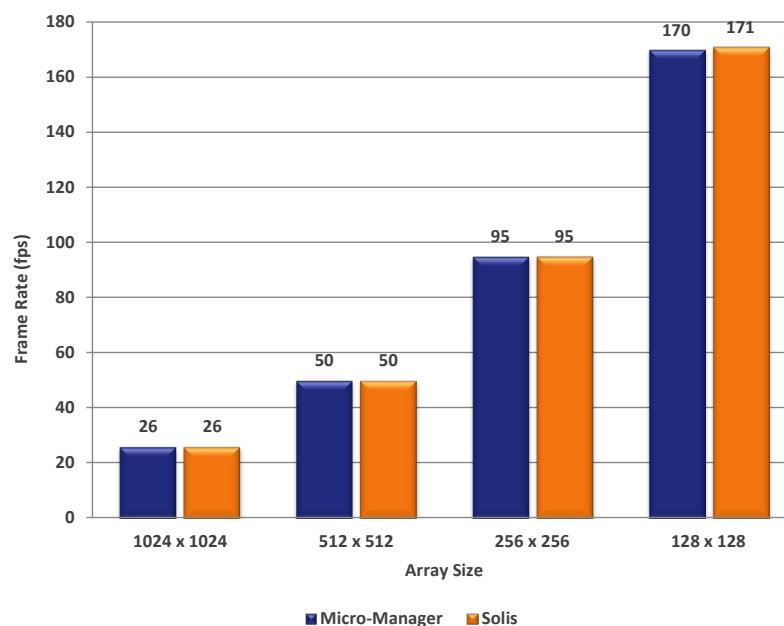


Figure 2: Comparison of Frame Rates (fps) in Micro-Manager and Solis for the iXon Ultra 888

3.6 CROP MODE FRAME RATES IN μMANAGER

In order to achieve even faster speeds with the iXon Ultra 897 an Optomask can be used to optically mask part of the sensor and fool it into thinking it is smaller than its actual size. For this option to be functional, the 'Isolated Crop Mode' must be enabled in the **Device/Property Browser** window. Crop mode works effectively in recent releases of μManager (see figures below) and it can be turned ON in the Property/Device browser.

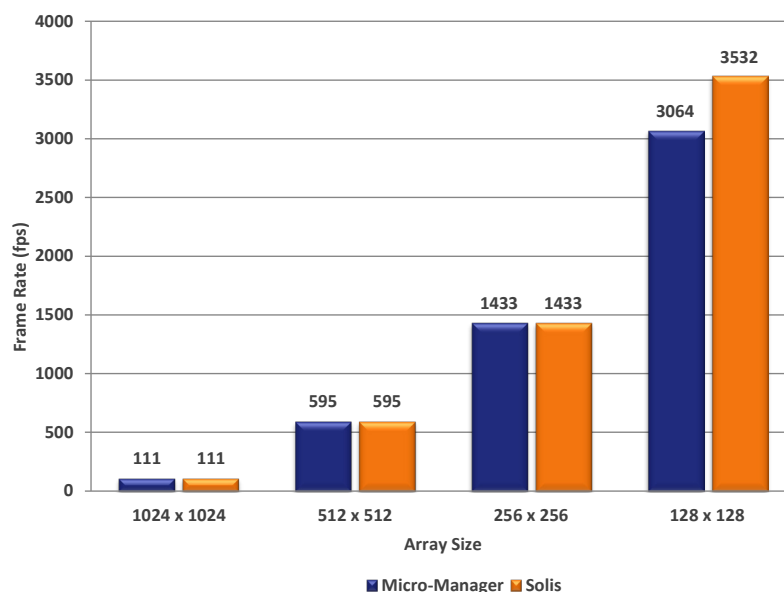


Figure 3: Comparison of Cropped Mode Frame Rates (fps) for the iXon Ultra 897

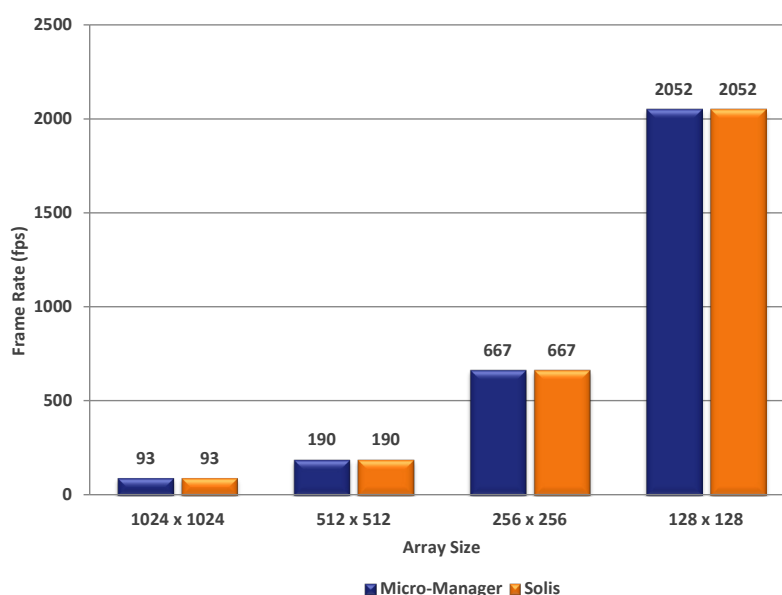


Figure 4: Comparison of Cropped Mode Frame Rates (fps) for the iXon Ultra 888

3.7 IXON ULTRA 897 AND ULTRA 888 FEATURE MATRIX IN μMANAGER

	Present
Trigger Modes	
Internal	✓
External	✓
External Exposure	✓
Software Trigger	✓
Fast External	✓
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	✓
Fast Kinetics - Increase frame rate for user defined rows (requires masked area)	✓
Readout Modes	
Imaging - Full Image Readout from Sensor	✓
Overlap - also called Frame Transfer (Selected modes only)	✓
Full Vertical Binning (FVB)	✗
Multi Track - User defined depth of vertically binned rows at user defined spacings	✗
Crop mode (Corner tethered and Optically Centered)	✓
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**	✓
Add/Delete user defined mode	✗
iCam	
Change Exposure Time during acquisition - (Limitations apply, see manual)	✗
Change EM gain and control	✓

	Present
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 Flip - Horizontal and Vertical (conventional and EM registers readout raw data in a different order by default)	✓
Image Rotation - 90 degrees clockwise, 90 degrees anticlockwise	✓
Image Streaming to disk at all sustained frame rates	✗
Supported File formats should contain all acquisition information in header	✓

* Fixed binning options 1, 2, 4 & 8 available

** 32-bit only