

# Mad City Labs Micro-Manager Tutorial

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## Getting Started

This guide will take you through the steps of setting up Micro-Manager (<http://micro-manager.org/>) to use your Mad City Labs device. This guide will not cover everything Micro-Manager has to offer, but will show everything that can be used with a Mad City Labs device. For more information on how to use Micro-Manager, check out the Micro-Manager user guide at:

[https://micro-manager.org/wiki/Micro-Manager\\_User%27s\\_Guide](https://micro-manager.org/wiki/Micro-Manager_User%27s_Guide)

## Downloading Micro-Manager

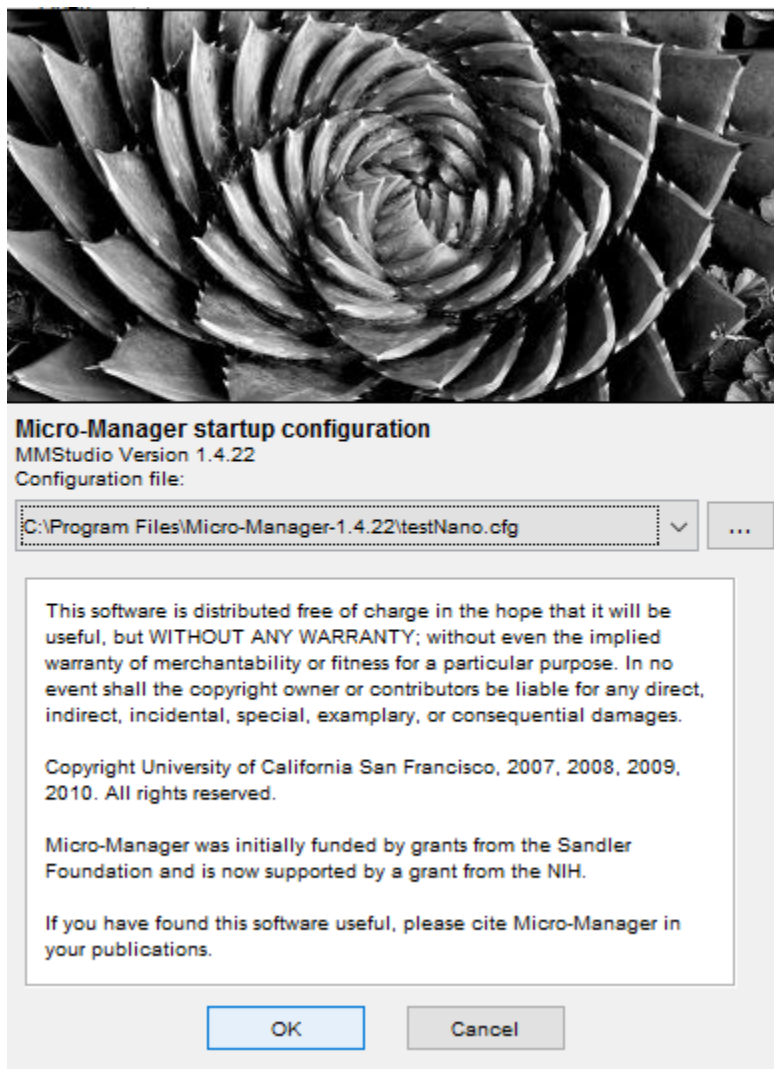
Micro-Manager can be downloaded from the Micro-Manager downloads website:

[https://micro-manager.org/wiki/Download%20Micro-Manager\\_Latest%20Release](https://micro-manager.org/wiki/Download%20Micro-Manager_Latest%20Release)

This guide was written to work with Micro-Manager version 1.4.22.

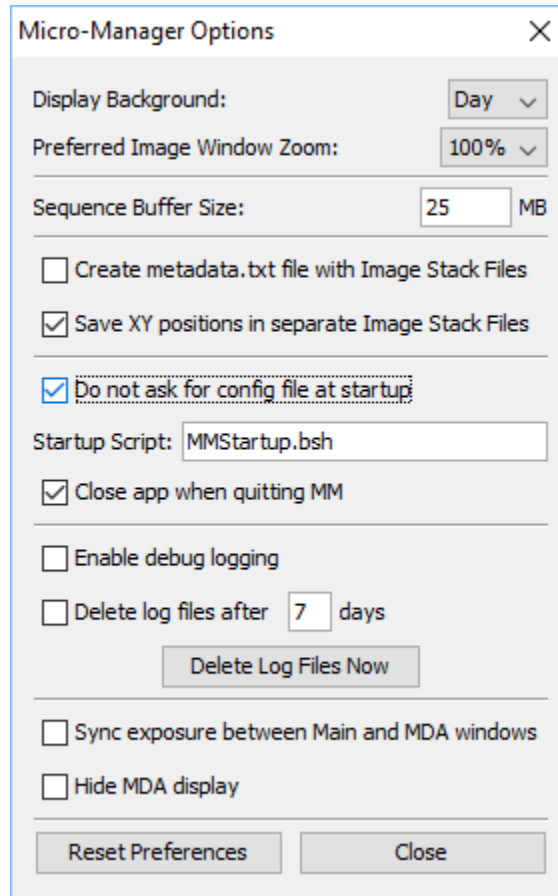
## Running Micro-Manager

When you run Micro-Manager, two screens pop up. One is the ImageJ program and the other is the Micro-Manager plugin.



Micro-Manager loads the Micro-Manager Startup screen after being run. From here, a configuration file can be loaded (for more information see **Configuration Files**). The most recently used configuration file will be shown (or the demo configuration file if Micro-Manager is being run the first time). Clicking “OK” will take you to the Micro-Manager main screen.

The Micro-Manager Startup window can be shut off in the Options window (choose Tools->Options from the main menu). In the Options window, check “Do not ask for config file.” If this box is checked, Micro-Manager will automatically load the most recently used configuration file.



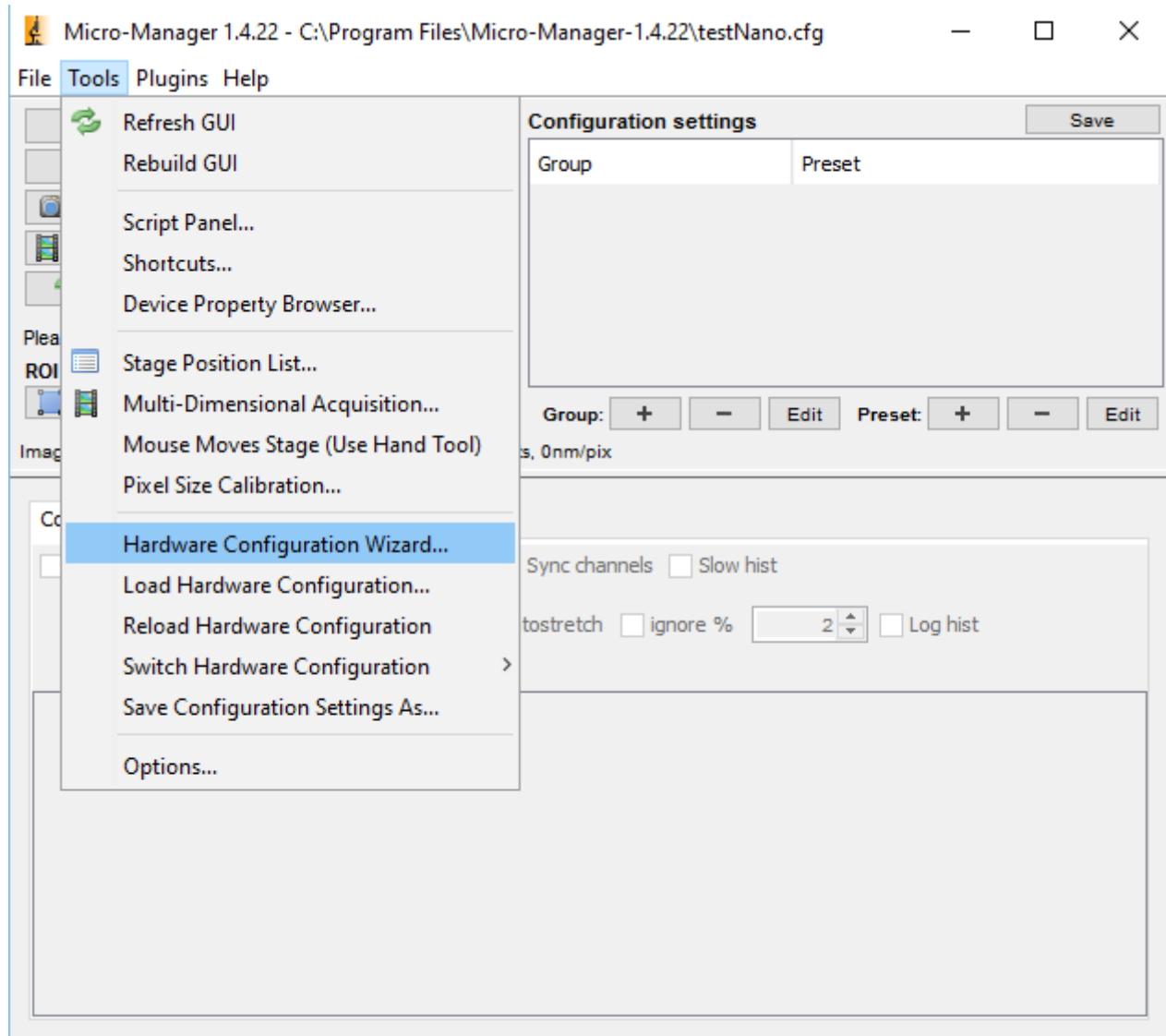
## Hardware Configuration

In order to get your Mad City Labs device working with Micro-Manager, Micro-Manager needs to be correctly configured. Users may use the **Hardware Configuration Wizard** or load a user generated configuration file. Both methods will successfully load your Mad City Labs Device. Using the Hardware Configuration Wizard will result in a saved configuration file.

## Hardware Configuration Wizard

The Hardware Configuration Wizard allows you to manually load devices through Micro-Manager. The Hardware Configuration Wizard takes you through six steps. This tutorial will highlight the steps that will involve a Mad City Labs device. If you are new to Micro-Manager, it is recommended that you setup your device through the Hardware Configuration Wizard since it is an easy way to make sure your device will be correctly setup in Micro-Manager.

To access it, choose Tools->Hardware Configuration Wizard from the main menu.



*Step 1: Select the configuration file*

If you already use other devices with Micro-Manager and have a configuration file, choose “Modify or explore existing configuration” and load the configuration file you wish to use. Otherwise, choose “Create new configuration.”

The screenshot shows the 'Hardware Configuration Wizard' window, titled 'Step 1 of 6: Select the configuration file'. The window is divided into two main sections. The left section contains two radio buttons: 'Create new configuration' (unselected) and 'Modify or explore existing configuration' (selected). Below these is a 'Browse...' button and a text field containing the file path 'C:\Program Files\Micro-Manager-1.4.22\testNano.cfg'. The right section is a sidebar with a title 'Welcome to the Micro-Manager Configuration Wizard'. It contains a paragraph: 'The Hardware Configuration Wizard will help you setup Micro-Manager software to work with your hardware.' followed by two bullet points: '● In this first step you can choose whether to create a new hardware configuration or modify an existing one.' and '● At the end of the wizard sequence, or any time you quit the wizard, you will be given a chance to give the configuration file a name.' At the bottom right of the window are two buttons: '< Back' and 'Next >'. The 'Next >' button is highlighted with a blue border.

Hardware Configuration Wizard

Step 1 of 6: Select the configuration file

☐ Create new configuration

☒ Modify or explore existing configuration

Browse...

C:\Program Files\Micro-Manager-1.4.22\testNano.cfg

**Welcome to the  
Micro-Manager Configuration  
Wizard**

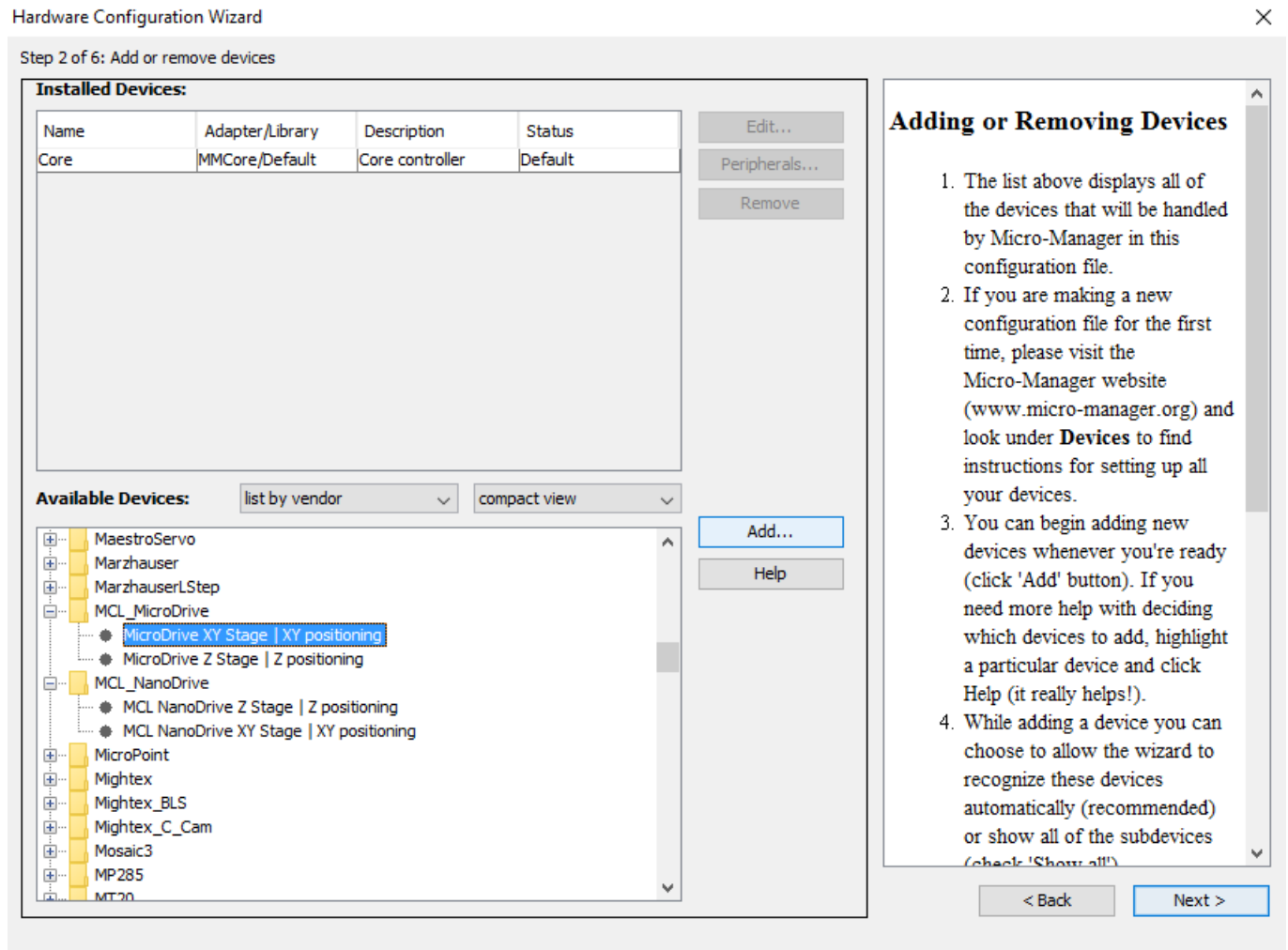
The Hardware Configuration Wizard will help you setup Micro-Manager software to work with your hardware.

- In this first step you can choose whether to create a new hardware configuration or modify an existing one.
- At the end of the wizard sequence, or any time you quit the wizard, you will be given a chance to give the configuration file a name.

< Back    Next >

*Step 2: Add or remove devices*

This window will show which devices Micro-Manager is already connected to. If you are creating a new configuration file, the only device that will appear is Core, which cannot be removed. Search the list of available devices for MCL\_NanoDrive. Expand the tree heading. Select the type of stage you wish to add. Finally press “Add..”. When you press “Add,” it will prompt for a device name. This name is arbitrary. It allows Micro-Manager to keep track of multiple devices of the same type. Note that if you have an XYZ stage you may add both a XY stage and a Z stage device. After adding all of the desired devices click next.



*Step 3: Set default devices and choose auto-focus setting*

If your Mad City Labs device has a Z axis, you need to tell Micro-Manager that you want it to be the default focusing device. Choose the device from the “Default focus stage” drop down menu.

Hardware Configuration Wizard ✕

Step 3 of 6: Select default devices and choose auto-shutter setting

Default camera

Default shutter

Default focus stage  
MCL NanoDrive Z...   
MCL NanoDrive Z Stage

Stage focus directions (advanced)

MCL NanoDrive Z Stage:

### Default Device Roles

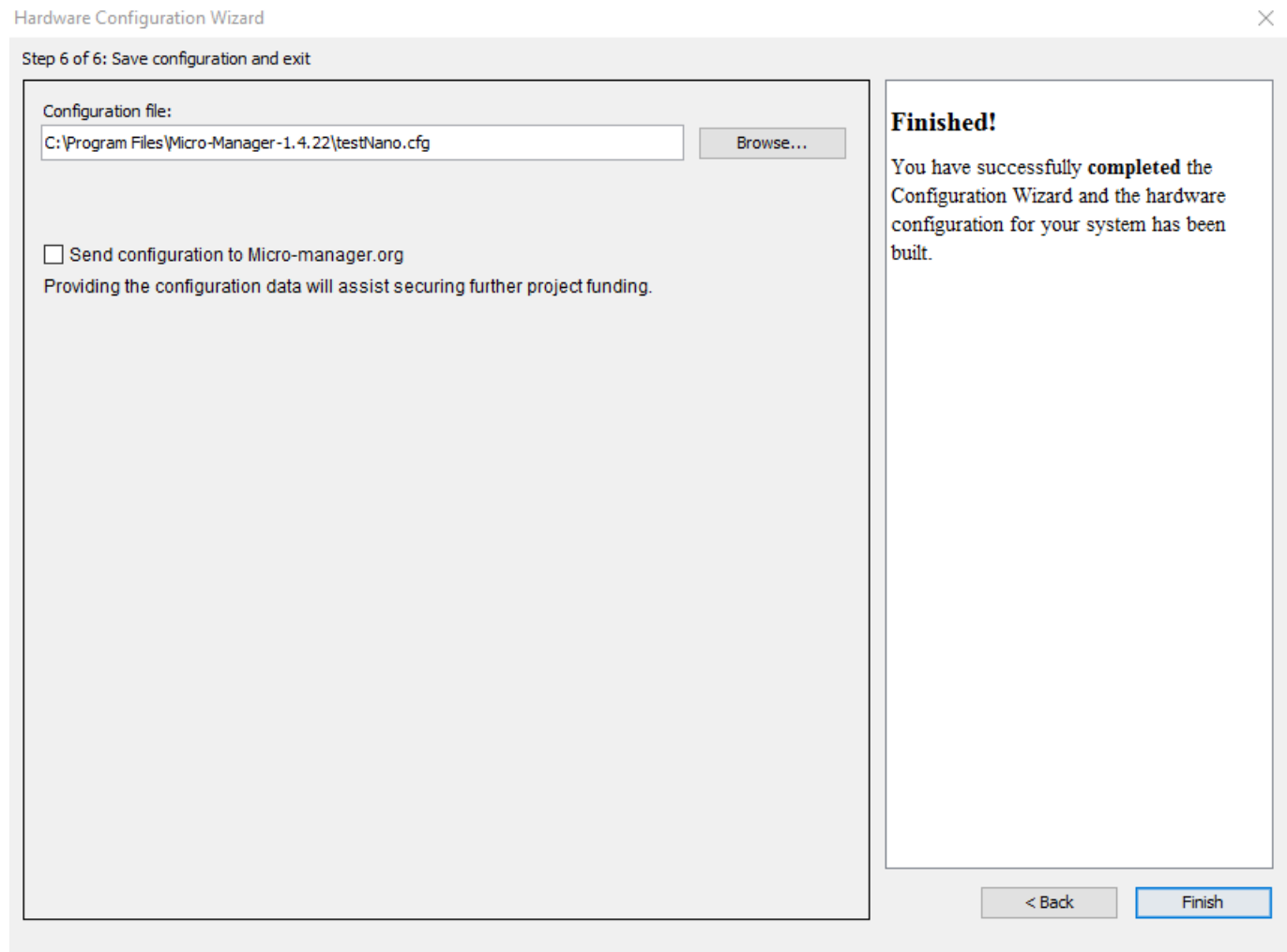
- Micro-Manager treats one camera, shutter and focus stage as defaults for the main control window.
- Here you can choose the defaults for Micro-Manager startup.
- These default roles can be changed at any time while Micro-Manager is running through the Device Property Browser (as properties of the Core).

### Autoshutter

- Choose whether or not the shutter, by default, should automatically open and close when acquiring images.
- This setting can be changed in the main control window at any time.

*Step 6: Test configuration, save, and exit*

This is the final step in the Hardware configuration wizard. Enter the path and name of the configuration file you just created. Configuration files must have a .cfg file extension. Click “Finish” to save the configuration and exit the wizard.




## Configuration Settings

In order to see and change the properties of your Mad City Labs device, you have to look at the **Device Property Browser** found in the **Tools** menu. However, properties that will be changed quite frequently (i.e. change position) can be placed on the Micro-Manager main screen under Configuration settings. Note that read-only properties cannot be loaded into a configuration settings.

In this example we will add presets that allow you to change the position on the X,Y, and Z axes. To add a new group of presets, click on the Group “+” button.

The Group Editor will be launched. Set a name for the group. In this example we chose “Set position X axis (um)”. Check the “Use in group?” box corresponding to MCL NanoDrive XY Stage Set position X(um) and then press ok.



 **Group Editor** ✕

Here you can specify the properties included in a configuration group.

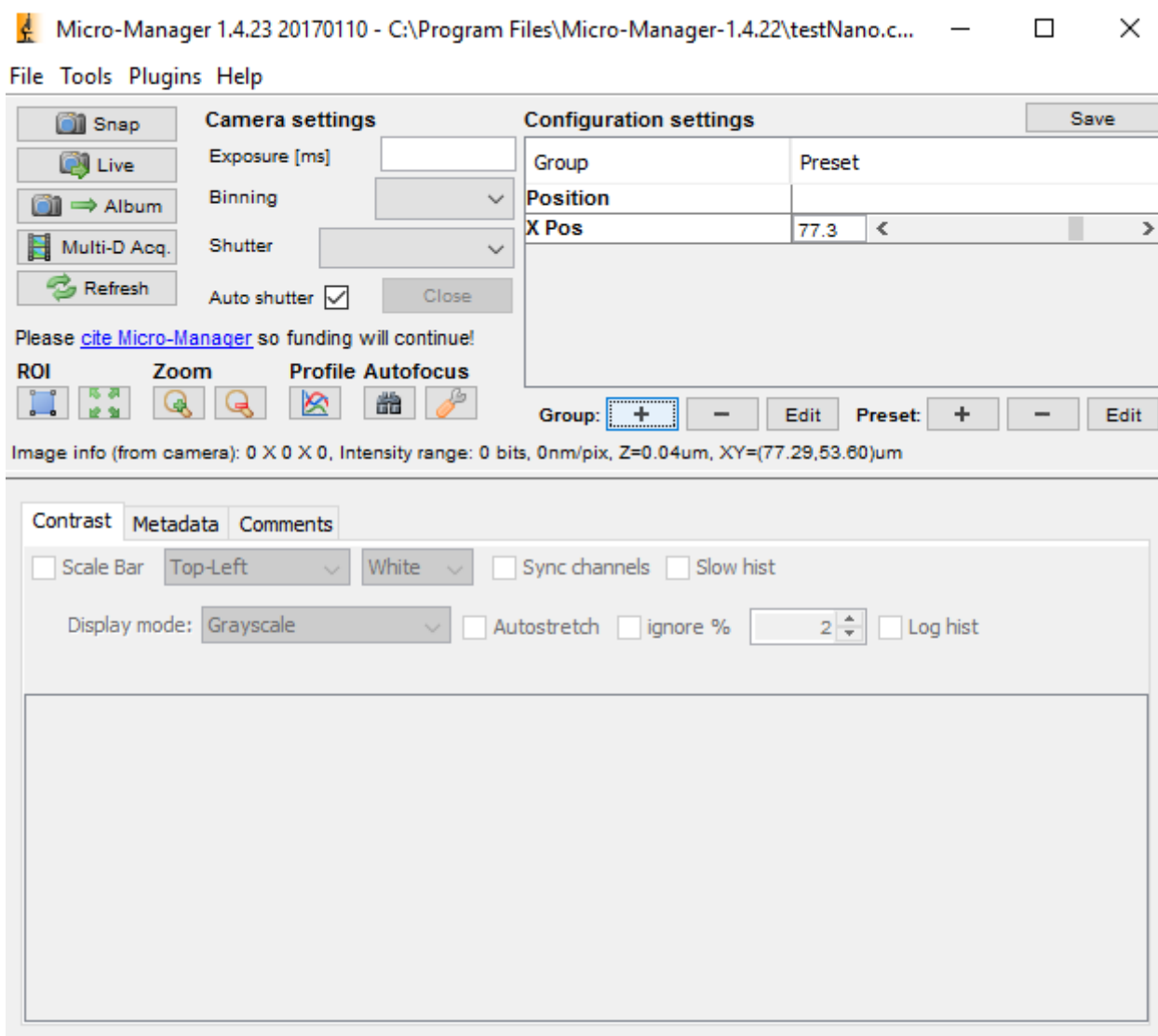
☐ Show read-only properties

**Group name:**

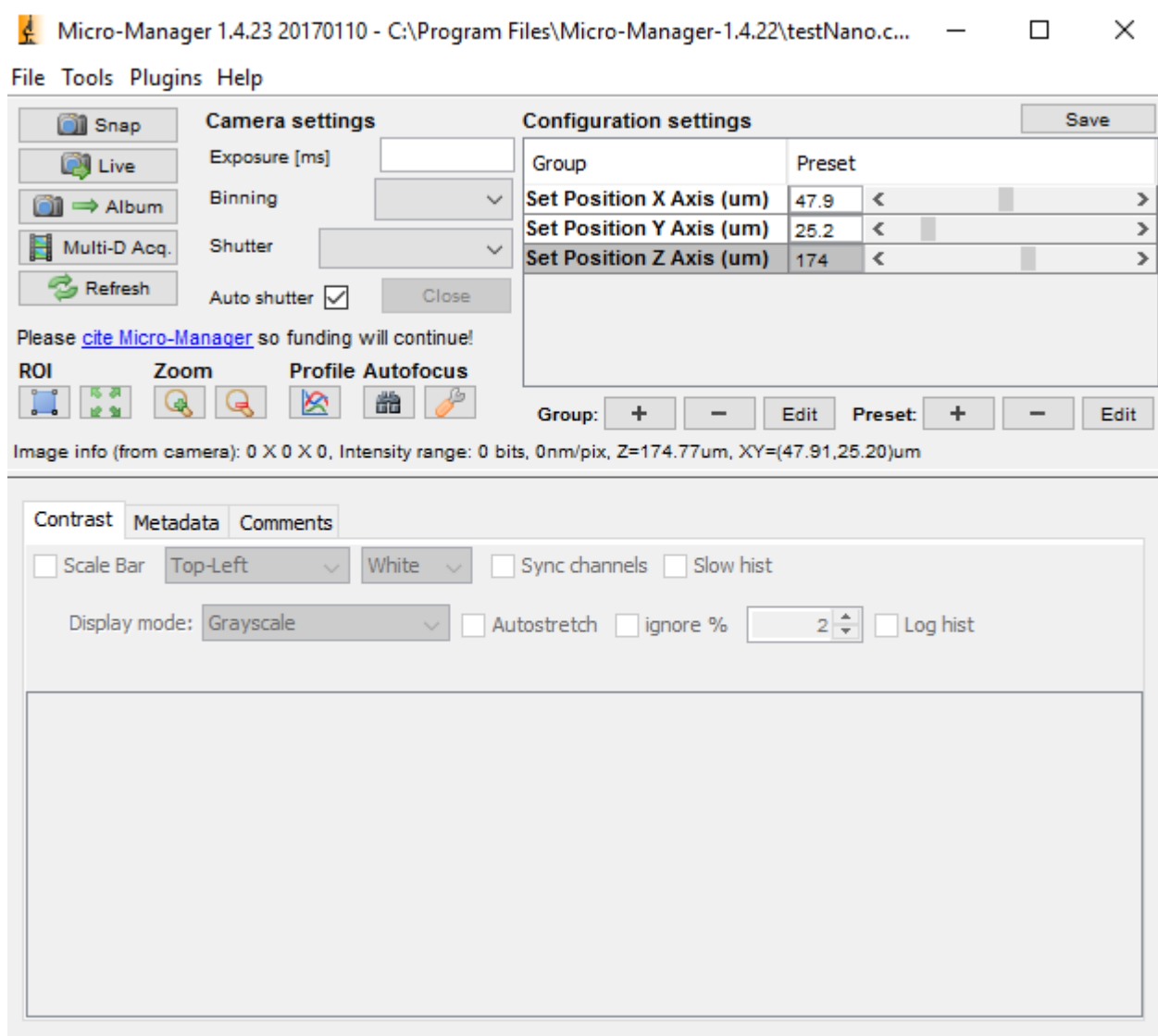
**Show**

- ☒ cameras
- ☒ shutters
- ☒ stages
- ☒ wheels, turrets, etc.
- ☒ other devices

Property Name	Use in Group?	Current Property Value
MCL NanoDrive XY Stage-Set origin here	<input type="checkbox"/>	No
MCL NanoDrive XY Stage-Set position X (um)	<input checked="" type="checkbox"/>	77.3 < >
MCL NanoDrive XY Stage-Set position Y (um)	<input type="checkbox"/>	53.6 < >
MCL NanoDrive XY Stage-Settling Time X axis (ms)	<input type="checkbox"/>	100
MCL NanoDrive XY Stage-Settling Time Y axis (ms)	<input type="checkbox"/>	100
MCL NanoDrive XY Stage-TransposeMirrorX	<input type="checkbox"/>	0
MCL NanoDrive XY Stage-TransposeMirrorY	<input type="checkbox"/>	0
MCL NanoDrive Z Stage-Set origin here	<input type="checkbox"/>	No
MCL NanoDrive Z Stage-Set position Z (um)	<input type="checkbox"/>	0.0002 < >
MCL NanoDrive Z Stage-Settling time Z axis (ms)	<input type="checkbox"/>	100
Core-AutoFocus	<input type="checkbox"/>	
Core-AutoShutter	<input type="checkbox"/>	1
Core-Camera	<input type="checkbox"/>	
Core-ChannelGroup	<input type="checkbox"/>	
Core-Focus	<input type="checkbox"/>	MCL NanoDrive Z Stage
Core-Galvo	<input type="checkbox"/>	
Core-ImageProcessor	<input type="checkbox"/>	



The newly created configuration preset should now be seen on the Micro-Manager main screen. We repeated these steps and added similar presets for the Y and Z axes.




Changes can be made by clicking on the “Edit” button. The rightmost set of “+” and “-” buttons allow you to add or remove specific configurations from a group. Click on the “Save” button on the top right. This will save the presets just created to your configuration file, so you don’t have to recreate these presets every time you start Micro-Manager.

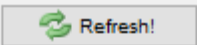
## Micro-Manager Tools




The following sections go over various tools and features of Micro-Manager. The tools can be found by selecting Tools from the main menu. Some of the tools also have buttons you can click on the left side of the main page.

### Device/Property Browser

The Device/Property Browser can be found by selecting Tools->Device/Property Browser from the main menu.


Device Property Browser
—
□
×

☒ Show cameras
 ☒ Show shutters
 ☒ Show stages
 ☒ Show discrete changers
 ☒ Show other devices
 ☒ Show read-only properties
  Refresh!

Property	Value
MCL NanoDrive XY Stage-CommandedX	47.8996
MCL NanoDrive XY Stage-CommandedY	25.1987
MCL NanoDrive XY Stage-Description	XY Stage Driver
MCL NanoDrive XY Stage-Handle	1
MCL NanoDrive XY Stage-Lower x limit	0
MCL NanoDrive XY Stage-Lower y limit	0
MCL NanoDrive XY Stage-Name	MCL NanoDrive XY Stage
MCL NanoDrive XY Stage-Serial number	555
MCL NanoDrive XY Stage-Set origin here	No
MCL NanoDrive XY Stage-Set position X (um)	47.908 <  >
MCL NanoDrive XY Stage-Set position Y (um)	25.202 <  >
MCL NanoDrive XY Stage-Settling Time X axis (ms)	100
MCL NanoDrive XY Stage-Settling Time Y axis (ms)	100
MCL NanoDrive XY Stage-TransposeMirrorX	0
MCL NanoDrive XY Stage-TransposeMirrorY	0
MCL NanoDrive XY Stage-Upper x limit	100
MCL NanoDrive XY Stage-Upper y limit	200
MCL NanoDrive Z Stage-Axis being used as Z axis	Z axis
MCL NanoDrive Z Stage-Calibration	300
MCL NanoDrive Z Stage-CommandedZ	173.9986
MCL NanoDrive Z Stage-Description	ZStage driver
MCL NanoDrive Z Stage-Device Handle	1
MCL NanoDrive Z Stage-Lower Limit	0
MCL NanoDrive Z Stage-Name	MCL NanoDrive Z Stage
MCL NanoDrive Z Stage-Serial Number	555
MCL NanoDrive Z Stage-Set origin here	No
MCL NanoDrive Z Stage-Set position Z (um)	174.01 <  >
MCL NanoDrive Z Stage-Settling time Z axis (ms)	100
MCL NanoDrive Z Stage-Upper Limit	300
Core-AutoFocus	
Core-AutoShutter	1
Core-Camera	
Core-ChannelGroup	
Core-Focus	MCL NanoDrive Z Stage
Core-Galvo	

This shows all of the properties for every device connected to Micro-Manager. Under the “Property” column, properties are listed as “Device adapter name – Device Property.” The “Value” column lists the current value associated with each property. White values can be changed, while grayed-out values cannot be changed since they signify read-only properties.

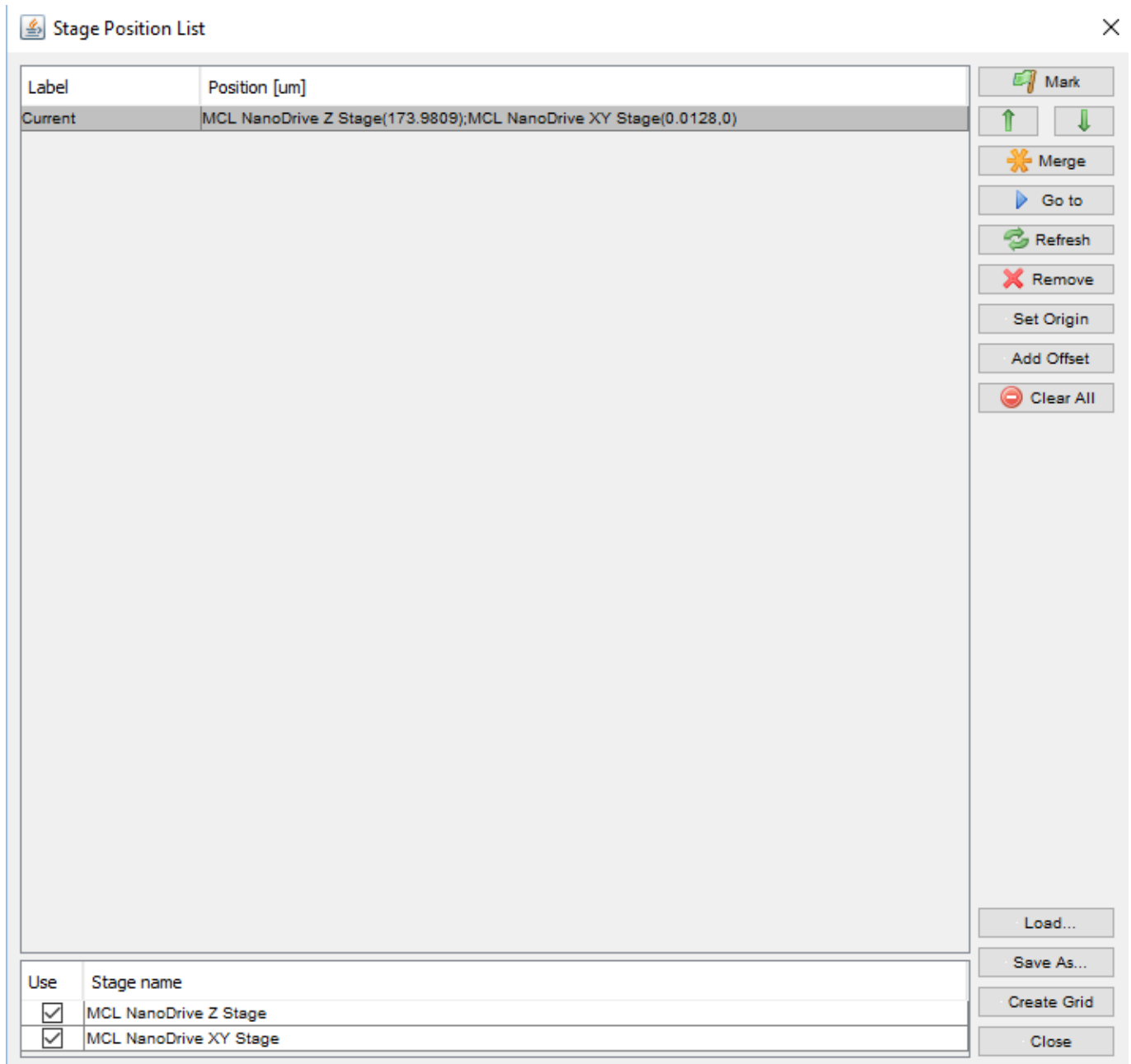
The following properties can be changed:

- Set position: Each of the X, Y, and Z axes have a slide bar that allow for movement along that axis.
- Set Origin here: Sets the current position as the origin.
- Settling Time: Sets the time (in ms) the Nano-Drive waits after moving before reading the current position. This value can be different for each of the three axes. The default time is 100ms. Please note that choosing an unreasonably small settling time will cause errors.
- “Core” is the Micro-Manager application. “Core-XYStage” and “Core-Focus” can be changed to tell Micro-Manager which XY and Z device it should currently use.

As seen in the **Configuration Settings** section, the non-read only properties can be added to the Configuration Presets box on the main screen so the Device/Property Browser doesn't need to be opened every time a value is changed.

## Stage Position List

Assuming you are connected to a Stage, the Stage Position List can be accessed through the main menu (Tools->Stage Position List). This will open the “Stage-position List” window. This allows you to create a list of positions you want the Stage(s) to move. To actually tell the device to move to all the positions, check the **Acquisition** section.



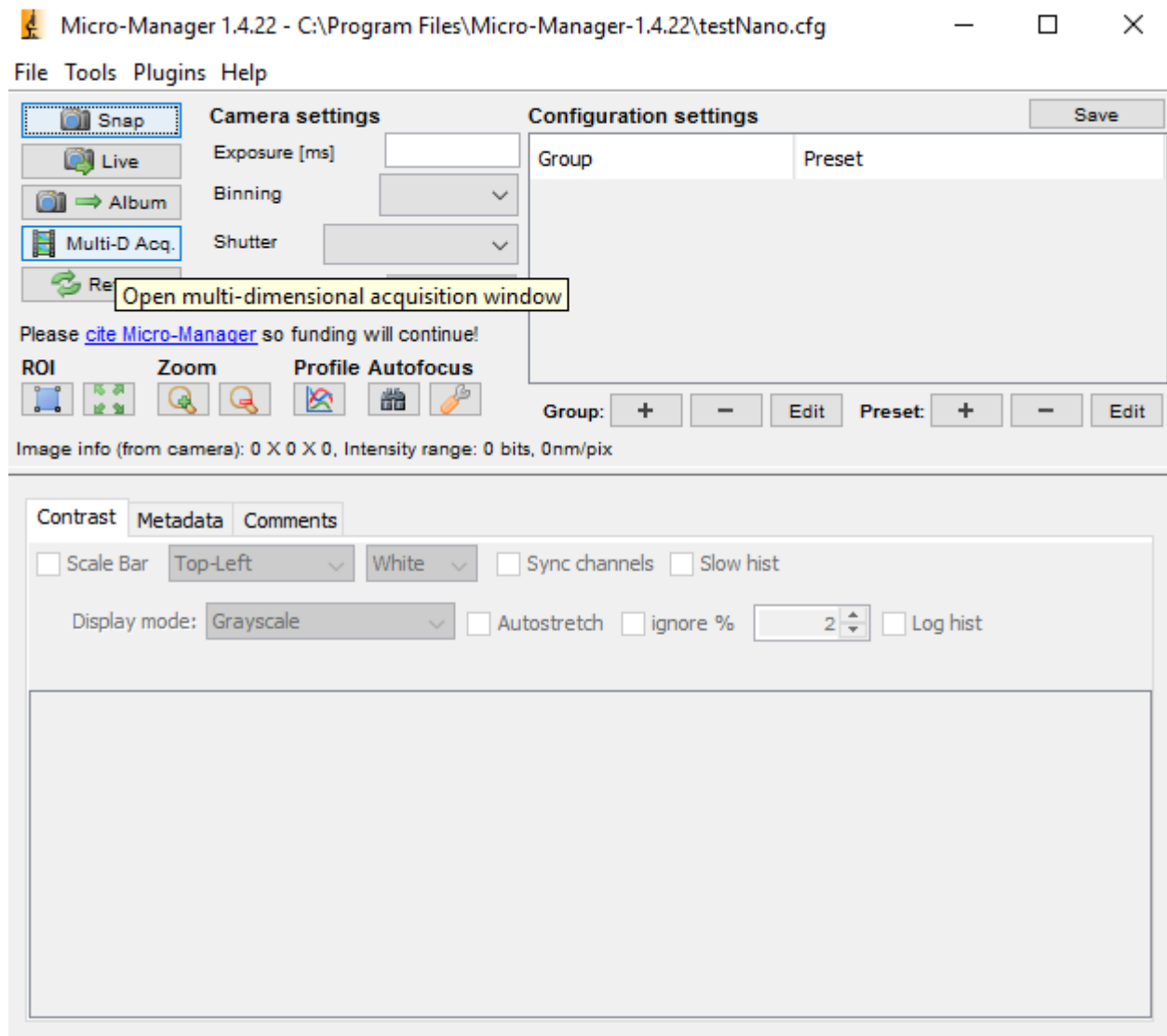
Overview of the buttons:

- Mark: Adds the current position of the XY Stage to the position list
- Up and Down Arrows: Move the selected position up or down in the list.
- Merge: Modify the selected position by using the current XY or Z position instead of the existing XY or Z position of the selected position.
- Go to: Moves the Stage(s) to the position selected on the position list
- Refresh: Reload the GUI
- Remove: Removes the selected position on the position list
- Set Origin: Sets the origin to be 0 for all stage axes. For calibrating the Micro-Drive, see the **Micro-Drive Specific Features** section.
- Add Offset: Create a new position by adding an offset in XY or Z to the current position.
- Clear All: Clears the position list
- Load: Load a position file (\*.pos) to the position list

- Save As: Save the current position list as a position file
- Create Grid: Create a square position list.
- Close: Return the Micro-Manager main screen

## Multi-Dimensional Acquisition

Assuming you are connected to a camera device through Micro-Manager, you can acquire multi-image stacks through the Acquisition feature. This can be accessed either through the main menu (Tools>Multi-Dimensional Acquisition) or by clicking on the “Multi-D Acq” button on the Micro-Manager main screen.



This will open the “Multi-dimensional Acquisition” window.

**Multi-Dimensional Acquisition**

☒ **Time points**

Number: 1

Interval: 0 ms

☒ **Multiple positions (XY)**

Edit position list...

☒ **Z-stacks (slices)**

Z-start [um]: 10.0001 Set

Z-end [um]: 40.0001 Set

Z-step [um]: 1

absolute Z

☐ Keep shutter open

☐ **Channels**

Channel group:

☐ Keep shutter open

Use?	Configu...	Exposure	Z-offset	Z-stack	Skip Fr.	Color

New

Remove

Up

Down

☐ **Save images**

Directory root: C:\Users\dev\AcquisitionData

Name prefix: Untitled

Saving format: ☒ Separate image files ☐ Image stack file

**Acquisition Comments**

Close

Acquire!

Stop

Load...

Save as...

Advanced

**Summary**

Number of time points: 1

Number of positions: 1

Number of slices: 31

Number of channels: 1

Total images: 31

Total memory: 0 MB

Duration: 0h 0m 0s

Order: Time, Position, Slice

Some key areas here:

#### Time Points

- Number: The number of times to go through the acquisition
- Interval: Time to pause in between each frame

#### Multiple Position (XY)

- Pressing the “Edit position list...” button launches a Stage Position List window which can be used to define multiple XY positions.
- Autofocus: Turn autofocus on/off

#### Slices (Z)

- Z-start (um) – The starting position in microns
- Z-end (um) – The ending position in microns
- Z-step (um) – The size of the steps in microns when going from Z-start to Z-end



- Relative or Absolute Z – Choose which type of positioning you want to use for the acquisition.

#### Save Images

- If you check “Save images” Micro-Manager will automatically save the acquisition files to the specified directory. Otherwise you must manually save the acquisition file after you finish acquiring it.

#### Acquire button

- Once everything is setup as desired, click on the “Acquire!” button to acquire your data. Micro-Manager will move the XY and Z Stages as specified and take pictures at each position

## Micro-Drive Specific Features

Going through this tutorial would have showed you how to correctly setup your Mad City Labs Device. The Micro-Drive, however, has a few additional properties that are not available to other devices, like the Nano-Drive.

These properties can be seen by opening the **Device/Property Browser** and can also be added as **Configuration Settings**.

- Calibrate: Selecting “Yes” will move the Micro-Drive to the X and Y forward limits and set this position as the origin. Then the Micro-Drive will move back to the original position where it was when it was told to calibrate. Selecting “Yes” here or clicking on the “Calibrate”
- Return To Origin: Selecting “Yes” will move the Micro-Drive back to the last location that was set as the origin.