Multi Modal LED Illuminator User Guide

Contents

Installation Instructions

Option 1 - Manual

- Download the required files from the Github Repo (INSERT REPO LINK HERE WHEN)
- Extract the folder
- There are 2 DLL files and a JAR file, take both the mmgr_dal_LEDController.dll and the IlluminatorControl.dll files and place them in the root directory of your Micromanager installation location.
- Take the JAR file Plugin_Test and navigate to your micromanager installation location and open the plugins directory, in this directory open Micro-Manager directory and place the Plugin_Test JAR in this directory.

Option 2 – Automatic

- Run the Install_Firmware.exe file which will carry out the steps outlined in option 1 but done automatically.

Usage Overview to Control Multi-Modal LED Illuminator

The firmware is split into two sections a micromanager plugin and a device driver. The workflow is that the user can use the plugin to easily and intuitively create LED configurations and allow manual control of the illuminator. If the user just wants to manually control the illuminator and doesn't need to use micromanager features such as the multi-dimensional acquisition (MDA), or have the device act a shutter etc.

The device driver facilitates the use of micromanager features such as the MDA and ability to act as a shutter to provide more precise timing and with the MDA the ability to make light sequences based off of the configurations made by the user in the plugin

First steps once Installed

Opening the Plugin

After the steps have been followed in the Installations Instructions then:

- open micromanager and look for Plugins in the toolbar as shown in Figure 1

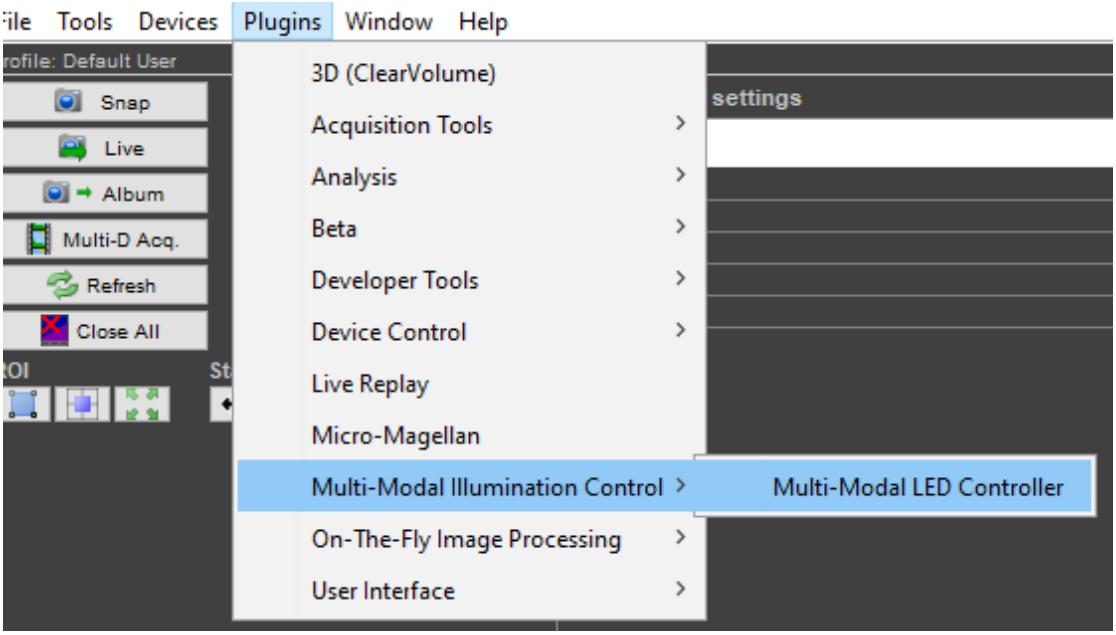

Figure 1: Where to access the Multi-Modal LED Controller Plugin

Connecting to the Plugin and Layout Overview

- After opening the plugin, you will see the plugin open and will look like shown in Figure 2. And as we want to use and control the LEDs from the plugin, we need to press the reconnect Plugin Control button in the bottom left-hand corner. After pressing this the Set Selected Colours and Turn All Off button will become available to press.
- The diagram on the right of the image represents how the LEDs are configured on the PCB. This diagram is interactive so you can click on any of the black circles where each one represents an LED on the LED PCB.

Selecting LEDs, Colour and brightness

- On the left side provides a tool bar which allows to actually set the LEDs to any configuration they want. Starting at the top left there is a drop-down menu which has the colour options, so first choose one from the drop-down menu.
- After selecting a colour from the drop-down menu there are quick select buttons for selecting all LEDs in the inner ring, middle ring or outer ring. When an LED is selected it will appear in the diagram as yellow.
- Next enter a brightness value for the selected LEDs (which appear as yellow) and then press the Confirm Colour/off button. This will now update the diagram so that the LEDs you had selected (which were yellow) now appear as the colour you selected. This gives a visual view from the PC of how the LEDs will look before turning them on to give the user chance to check they entered the correct configuration.

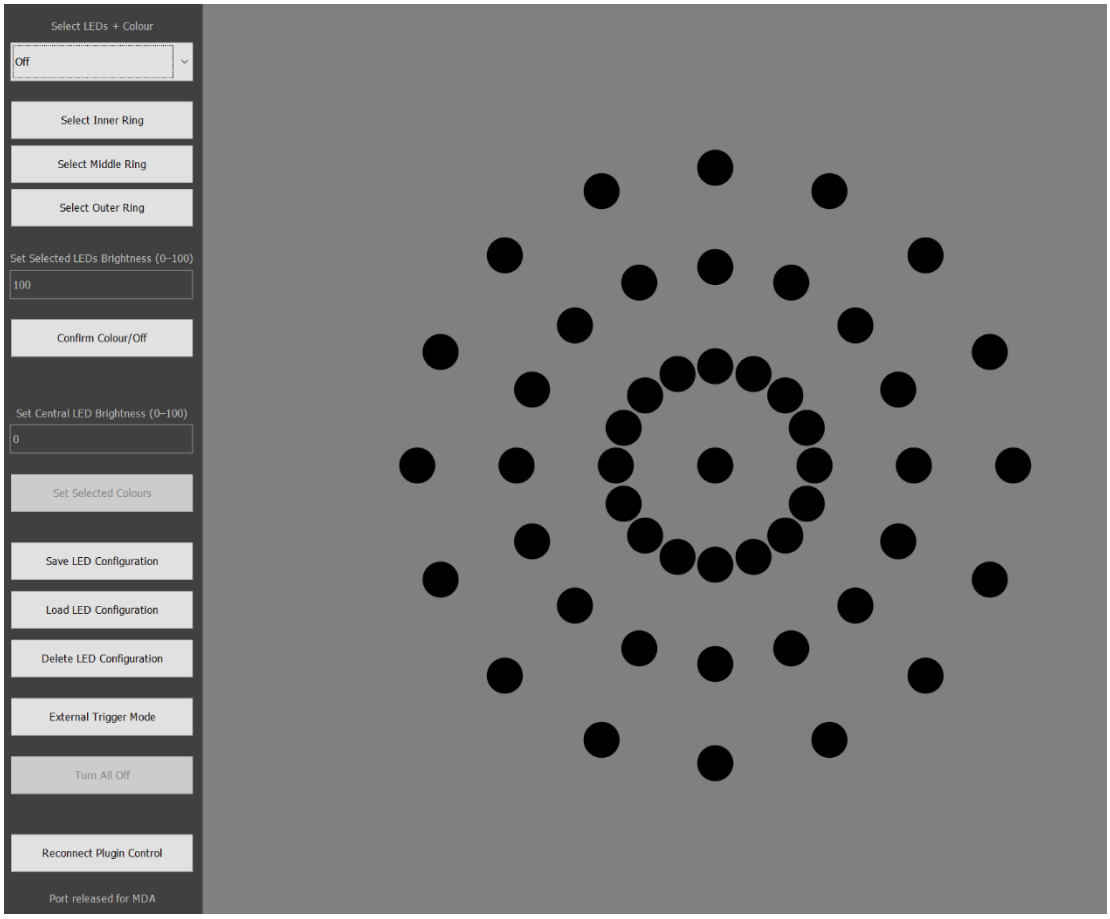

Figure 2: Plugins main page

- As an example, shown in Figure 3 the inner and middle rings were set to blue at 100% brightness.
- To actually set the LEDs once you have set them to the configuration you want then press the Set Selected Colours button and this will then send the configuration to the illuminator and the LEDs you selected should turn on.

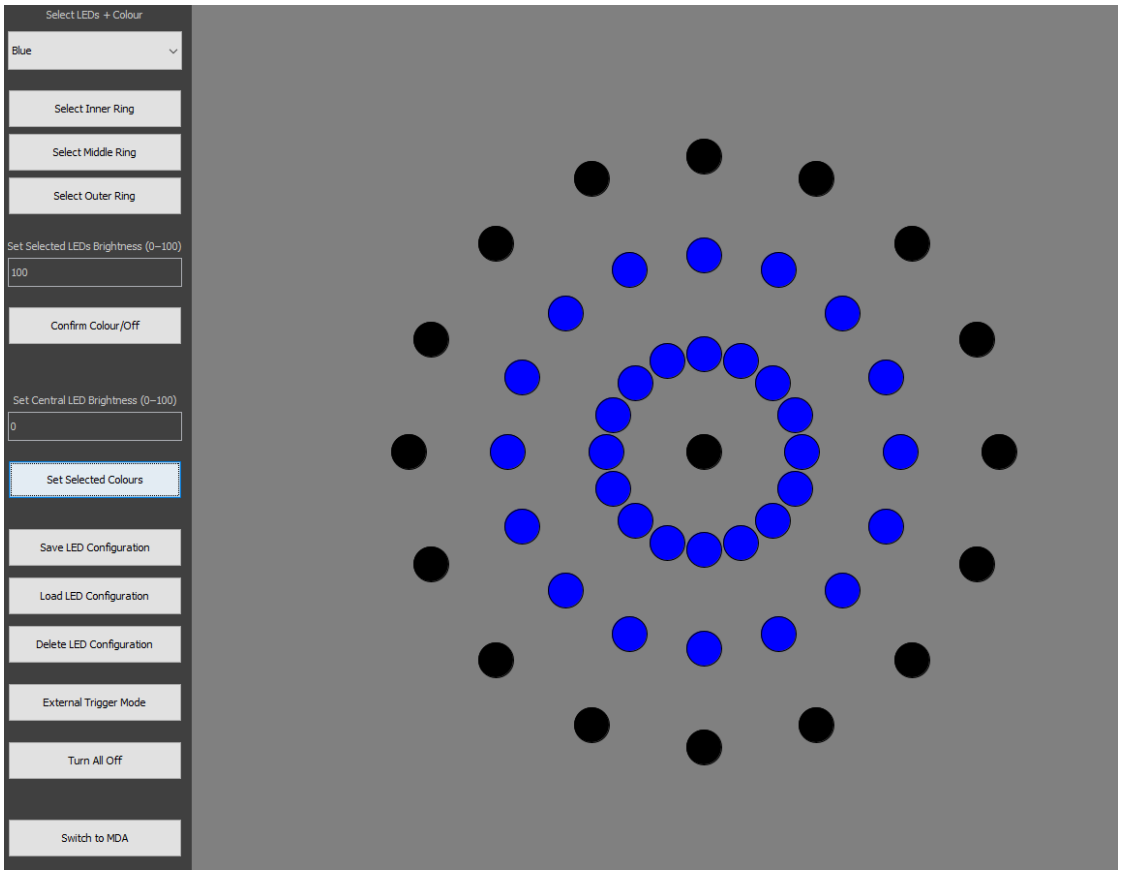

Figure 3: Example of setting the inner and middle LED rings to blue.

Turn All Off

- This is self-explanatory, and simply when the Turn All Off button is pressed it will turn off all currently on LEDs and just provides a quick way to do this rather than having to select all the LEDs and selecting Off from the Colour drop down menu.

Configuration Features

- The above are the basic features to start controlling the illuminator from just the plugin. Now there are 3 buttons related to configurations, these are:
    - Save LED Configuration
    - Load LED Configuration
    - Delete LED Configuration
- These configurations are what allows the user to do more advanced control of the illuminator such as using the MDA and also makes using the manual control in the plugin quicker as can load your configurations once saved so no need to manually set each LED again.

Save LED Configuration

- To save an LED configuration first follow the steps above to set the LEDs you want in your saved configuration to be actually turned on.
- Once the LEDs you want to save as a configuration are turned on the press the Save LED Configuration button. This will cause a pop-up box to appear as shown in Figure 4 prompting the user to enter a name for the configuration, once entered a name press ok.

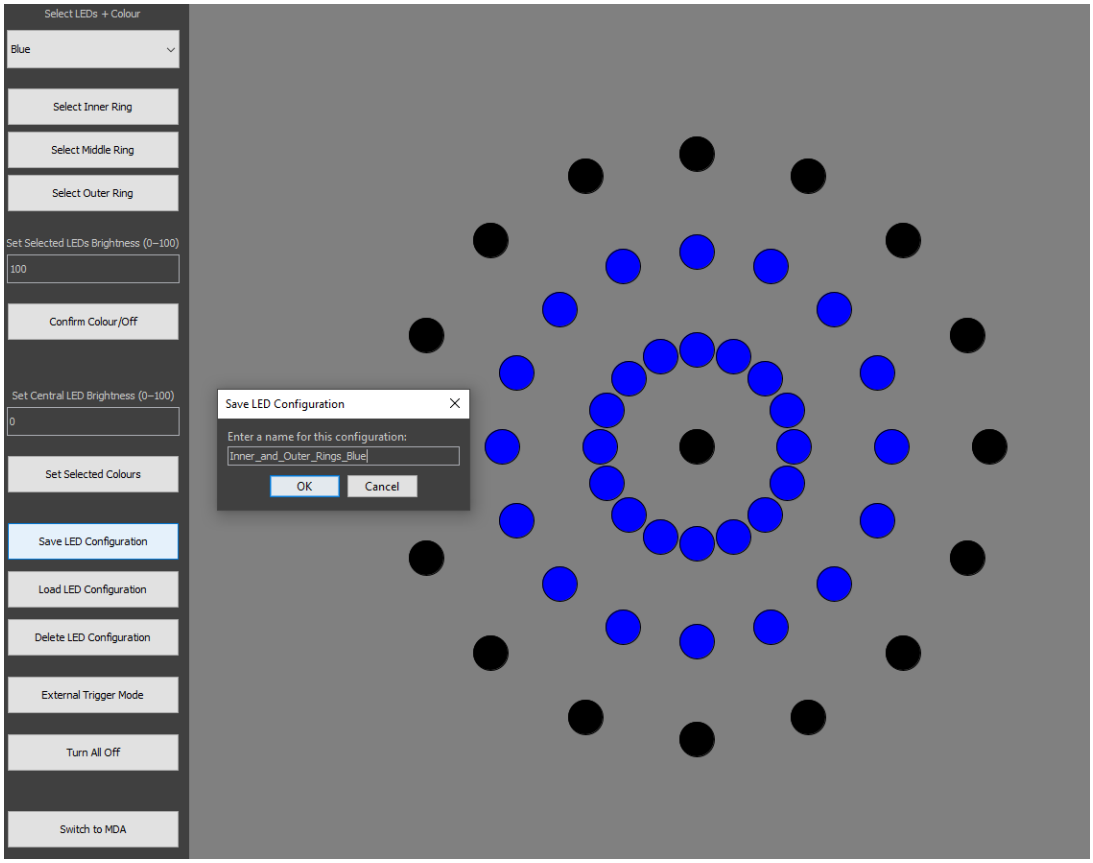

Figure 4: Example showing the Save LED Configuration feature

- These configurations get stored in C:\Users\username\.mm_led_configs.

Load LED Configuration

- Once the steps in the Save LED Configuration section have been followed, to load an LED Configuration it is as easy as pressing the Load LED Configuration and selecting your LED Configuration from the dropdown menu such as shown in Figure 5 and pressing ok.

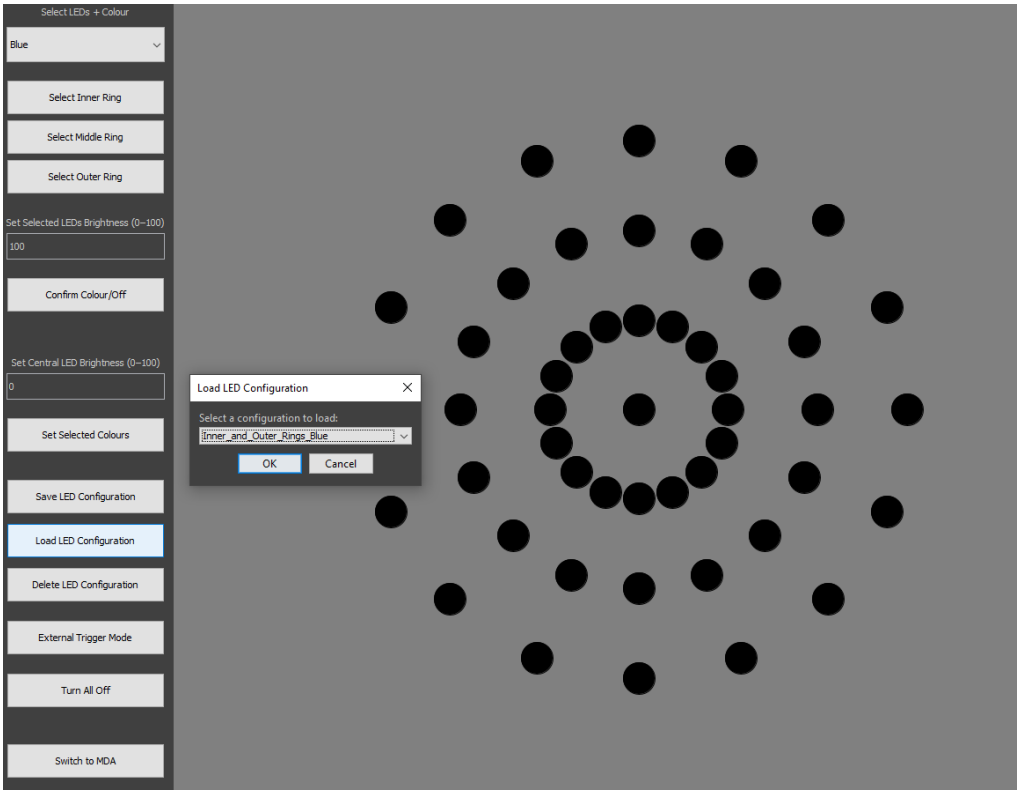

Figure 5: Example showing the Load LED Configuration feature

Delete LED Configuration

- As the final part of the configuration section is the Delete LED Configuration feature. This as it sounds allows the user to delete configurations they no longer want or need. Like the load LED Configuration to delete a configuration it is as easy as just pressing the button and selecting the configuration you want to delete from the drop-down menu and then press ok.

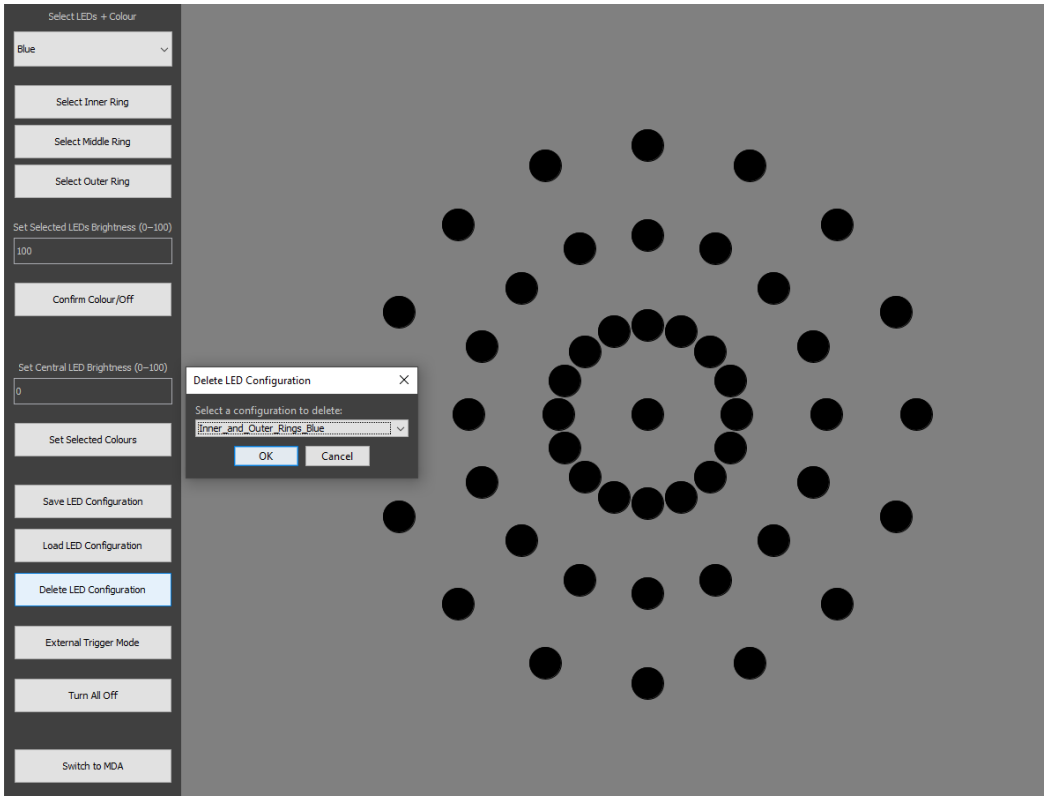

Figure 6: Example showing the Delete LED Configuration feature

External Trigger Mode

- The external trigger mode is implemented in the plugin so that the user can control the illuminator from an external trigger input from within the plugin if they don't want to go to using the device as a shutter as an example. The trigger input works for a 3V3 or 5V input signal and the device can function up to 250Hz at a 50% duty cycle.
- This trigger signal can come from any device such as a camera or a function generator, microcontroller etc.
- To actually set up the External Trigger Mode this relies on the user made configurations as laid out in the Save LED Configuration section. Once you have your configuration made that you want to use in the external trigger mode then again it very simple just press the External Trigger Mode button and select the configuration you want the system to turn on at the rising edge of the trigger signal, example shown in Figure 7.
- To stop or exit the External Trigger Mode just send any command to the illuminator, easiest way is to just press the Turn All Off button which is underneath the External Trigger Mode button.

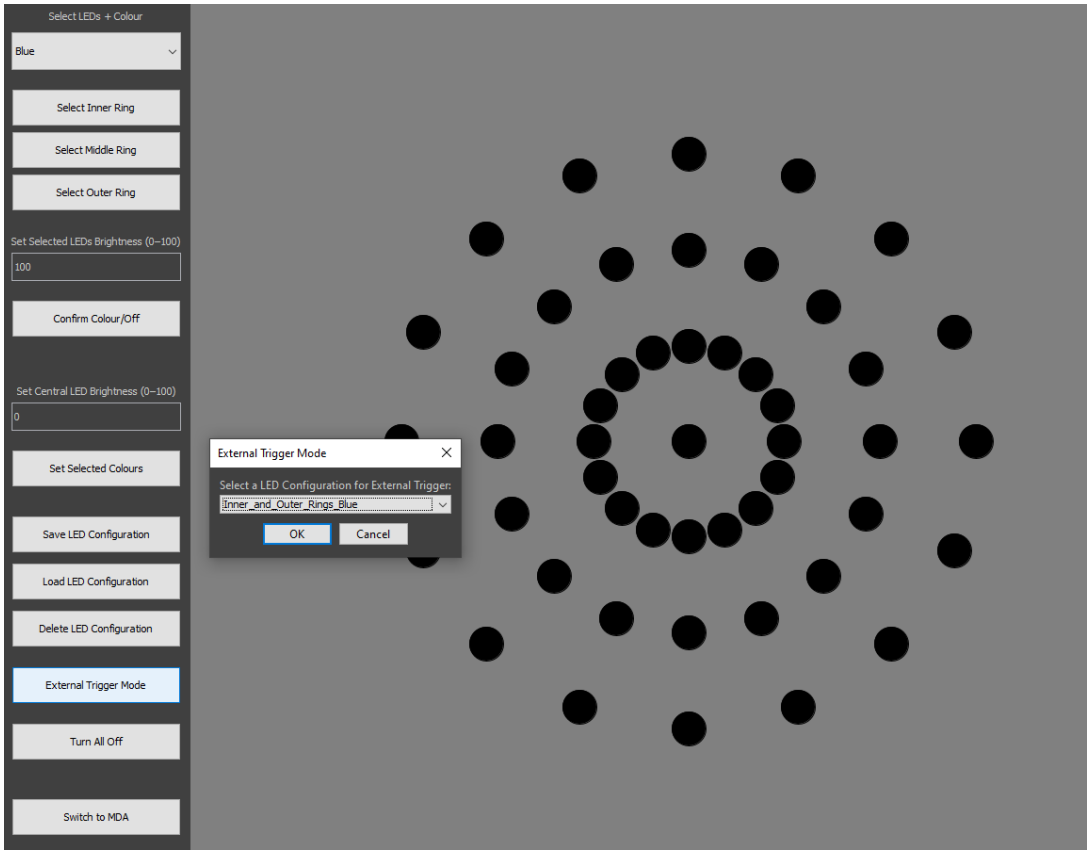

Figure 7: Example showing the External Trigger Mode feature

Controlling the Illuminator through existing micromanager methods

Switching from the Plugin Control to Micromanager Control

- To be able to switch from controlling the illuminator from the plugin to controlling the illuminator through standard micromanager ways such as using the MDA. The user needs to press the Switch to MDA button, once pressed a pop-up window will appear saying that you can now control the Illuminator through the MDA as shown in Figure 8.
- If you open the plugin when in the MDA control mode, then the Switch to MDA button will instead show Reconnect Plugin Control and this would need to be pressed to switch back to controlling the illuminator from the plugin.

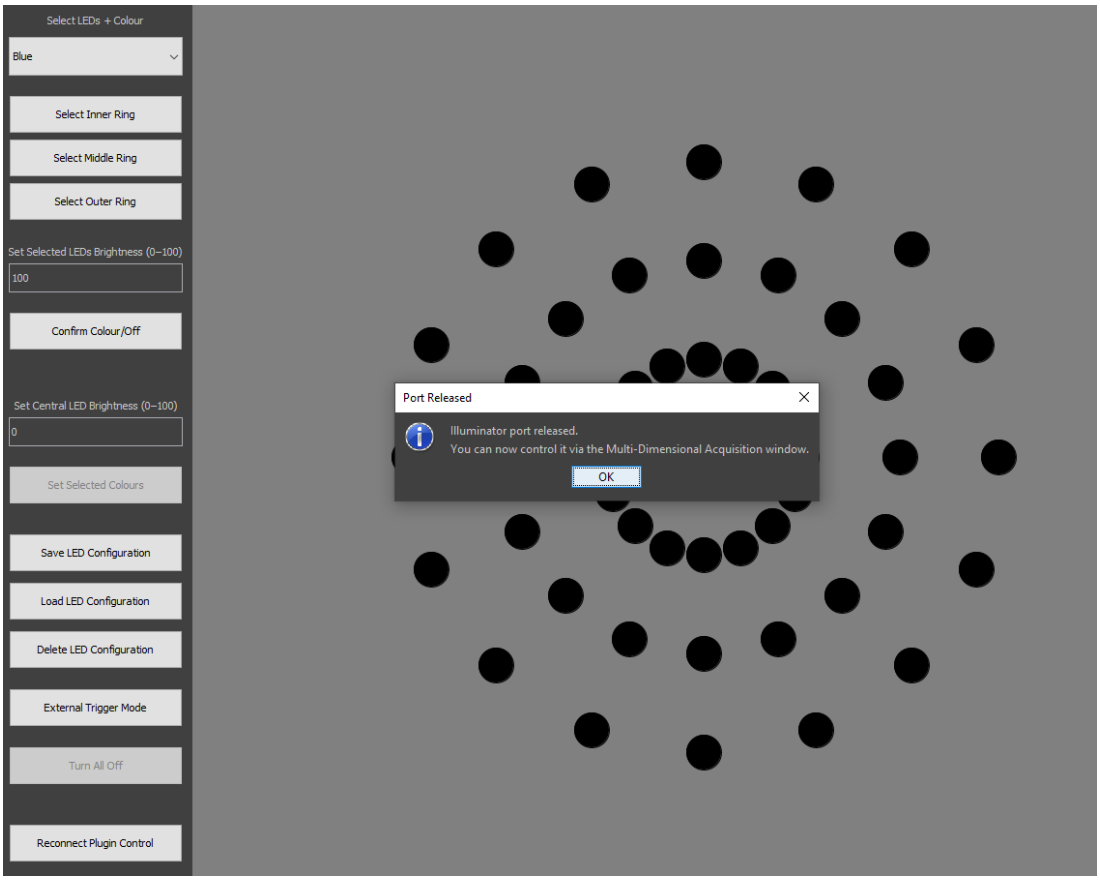

Figure 8: Showing how the Switch to MDA button.

Hardware Configuration Wizard Setup

- Go to devices in the top tool bar and click Hardware Configuration Wizard as shown in Figure 9.

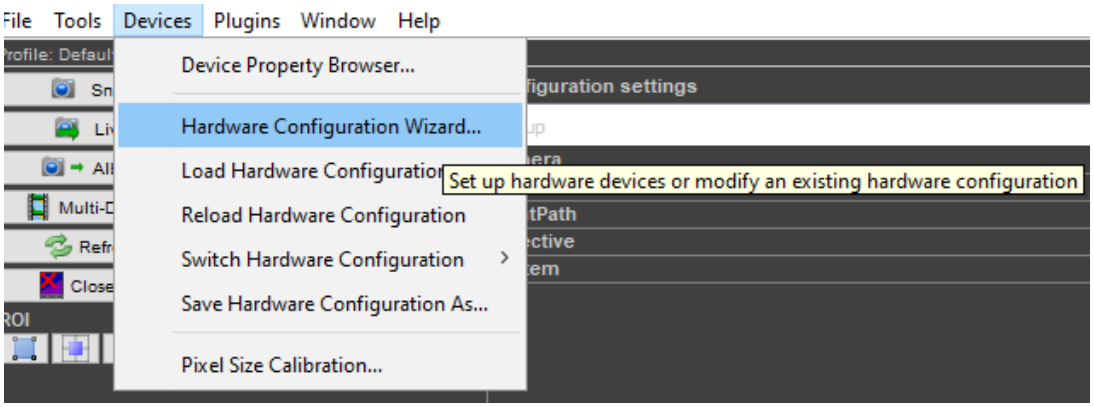

Figure 9: Where to access the Hardware Configuration Wizard

- Once pressed the hardware configuration you will see the pop-up shown in Figure 10, for this example we are modifying the example configuration that comes with micromanager, if you have a custom configuration then browse to your custom configuration.

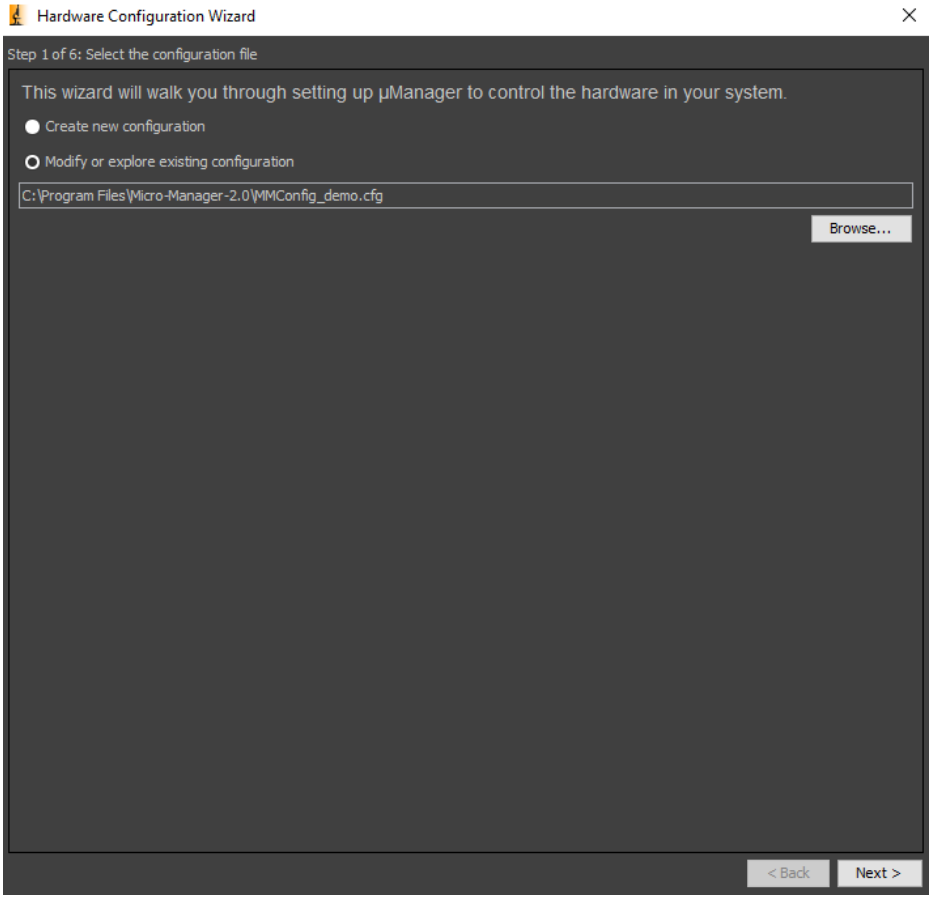

Figure 10: Showing the 1st step of the Hardware Configuration Wizard

- Press next and in the bottom half of the next pop up you will see available devices and a list of modules. Scroll down in this section until you see the LEDController and press the + to the left of the name as shown in Figure 11.
- Select the LED-Controller: RP2040 LED Controller and then press the Add button

Figure 11: Step 2 Hardware Configuration Wizard, selecting the LED Controller

- Now in under the installed Devices in the top of the same pop-up you should see LED-Controller added at the bottom of the installed devices list, shown in Figure 12. Now press the Next button in the bottom right corner.

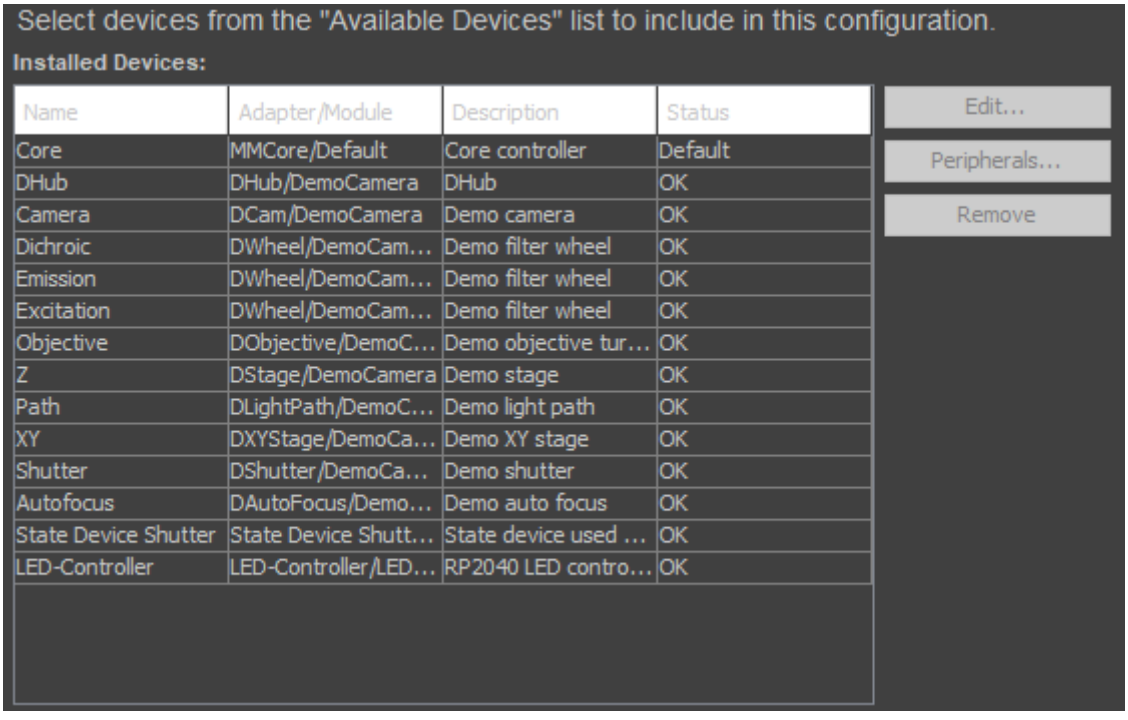

Figure 12: Showing the successfully added LED-Controller in the Installed Devices

- In step 3 of the hardware configuration wizard, change the default shutter in the drop-down menu to LED-Controller, and for the illuminator no other changes are required.

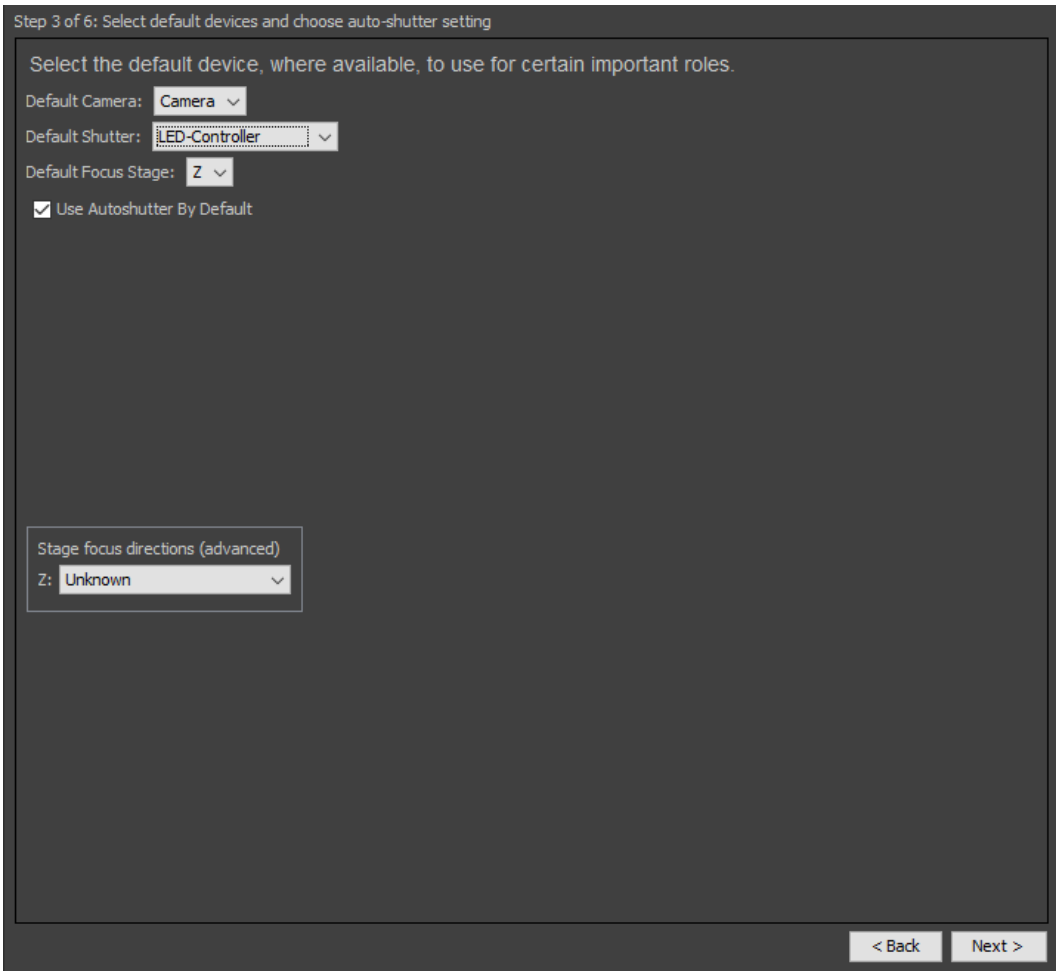

Figure 13: Step 3 of the Hardware Configuration Wizard, choosing the default shutter to LED-Controller

- For the rest of the steps, so steps 4-6 no changes are required and can just press next on each and then finish and now the hardware configuration is done the illuminator can be added to a group, as shown in the Making a Group for the Illuminator section.

Making a Group for the Illuminator

- To add a Group at the bottom of micromanager press the + next to Group as shown in Figure 14.

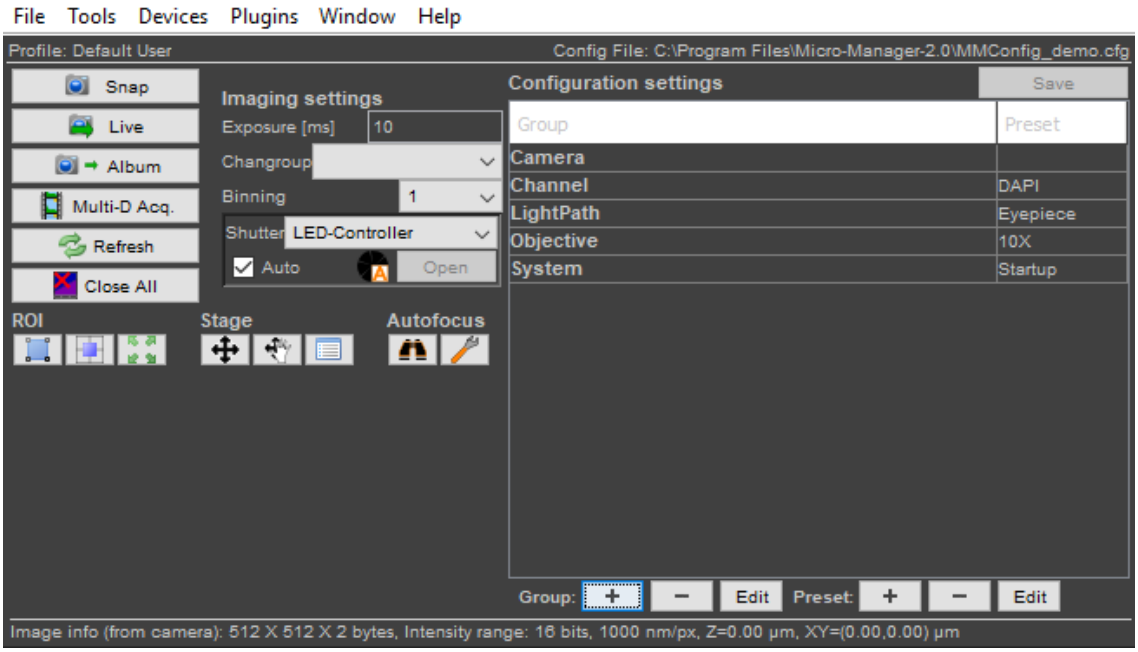

Figure 14: Showing where to add a new group for the illuminator

- To add the device uncheck on the left handside everything but shutters, the options should now look like whats shown in Figure 15. Just select the LED-Controller Configuration in the use as group section, and give a Group name at the top of the window for the example Multi-Modal LED Example was used. Then press the ok button in the top right corner.

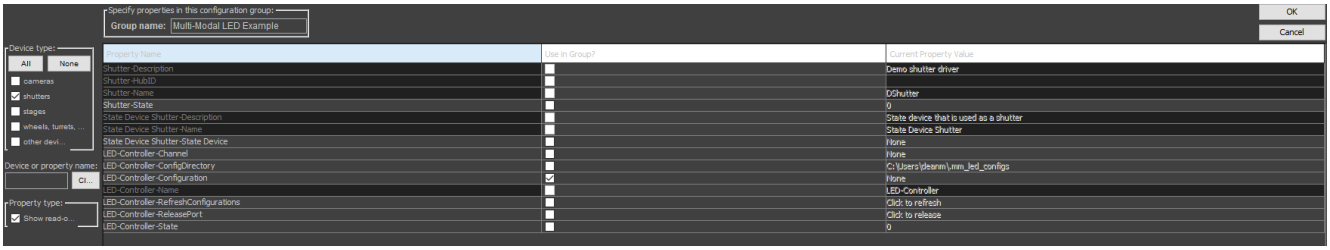

Figure 15: Showing which property name to select for the illuminator group

- The configuration settings should now look like this, specifically you should see the name you entered for the group appear and as shown in Figure 16 the drop down box for this group lists the configurations made in the plugin. It should be noted that you should make all the configurations you think you need before you add the group as if you make a new configuration in the plugin it wont auto update the group and thus a new group would have to be made to access the new configurations made in the plugin after the group was created.

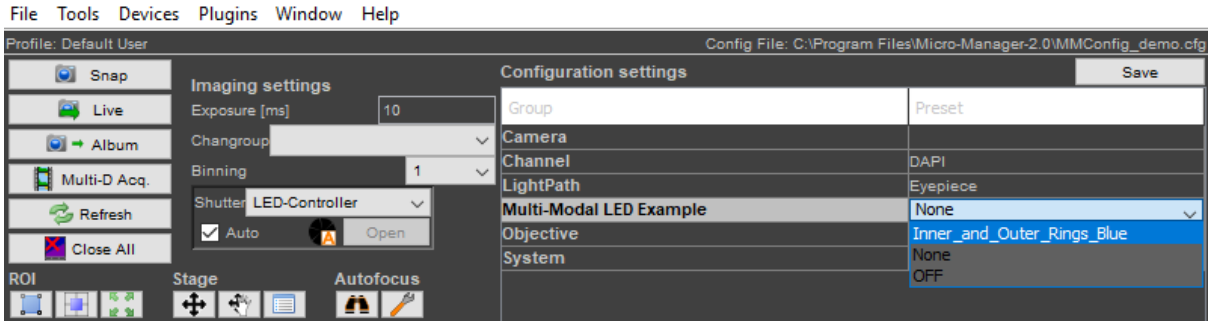

Figure 16: How the group should appear in the configuration settings if done correctly

How to use the Illuminator with the Multi-Dimensional Acquisition

- After opening the Multi-Dimensional Acquisition from the main micromanager screen the pop-up shown in Figure 17. First the drop-down box next to the Channel group text select this and select the name of the group that was just made.

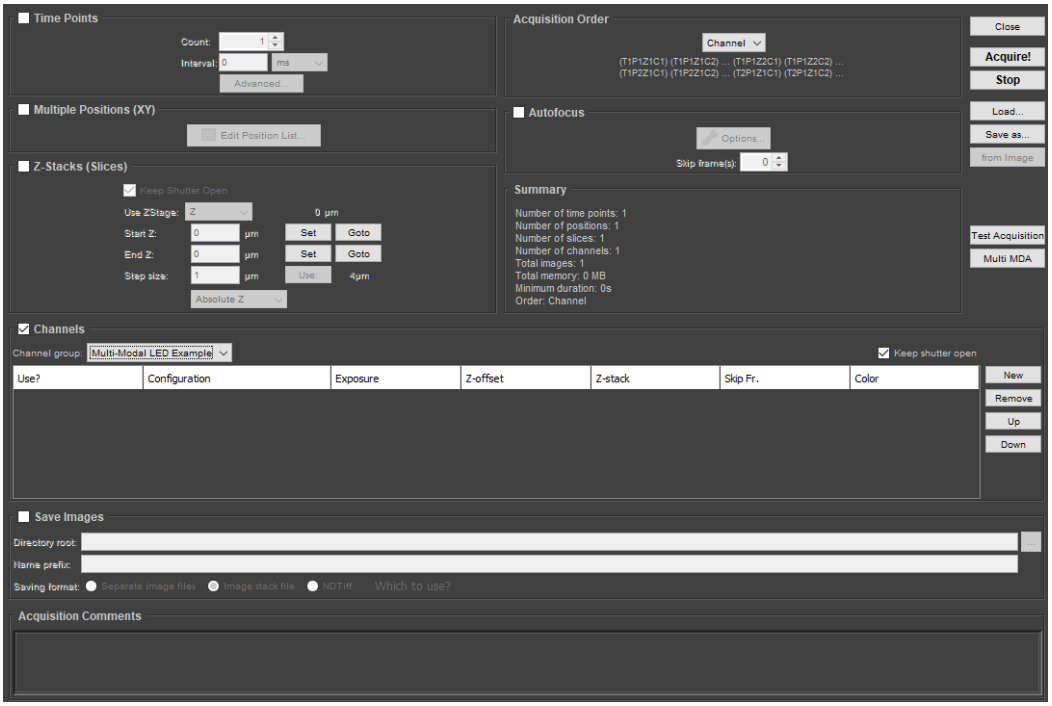

Figure 17: Shows first step to setup the MDA which is to set the channel group to the group that was just made for the illuminator

- Now press the New button and this will add a row to the table under channel group as shown in Figure 18, and it will automatically populate the Configuration section to one of the user's saved configurations but this can be changed by clicking in the configuration which is a drop down menu and then the user can select any of the configurations they have already made in the plugin.

- Now like any other use for the MDA the time the LED configuration will be on for is set by the Exposure time in ms e.g set to 1000 to be on for 1 second.

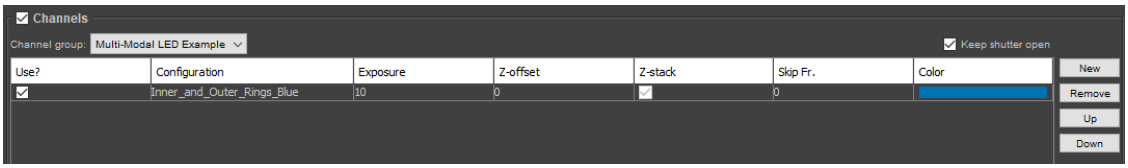

Figure 18: Showing adding one of the LED configurations to the MDA

- Usage not for the MDA to ensure the LEDs don't remain on after the MDA process has completed ensure that in the configuration settings that the preset is set to none or if you have a configuration made for OFF it can also be set to this for it to work.

Using Shutter with the Illuminator#

Manual Control

- In the top left corner of the micromanager main page under imaging settings ensure the shutter is set to LED-Controller which it should be automatically as in the hardware configuration wizard it was set as the default shutter.
- To test the manual control of the shutter un-check the Auto box for the shutter as shown in Figure 19. And ensure that the configuration you want to come on when you are manually operating the shutter is set for the group in the configuration settings same as in Figure 16.

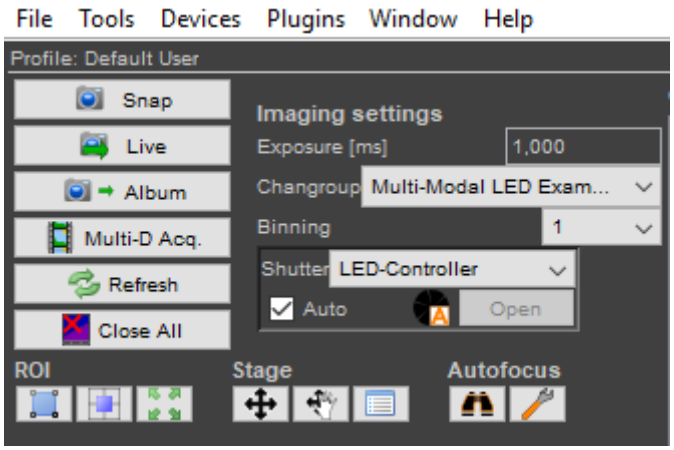

Figure 19: Showing location of the shutter

- Once the auto is unchecked for the shutter and configuration set in the configuration settings then pressing the open and close button for the shutter should control the illuminator to be on when open and off when closed.

Auto Control

- The auto control is for using the snap functionality, so the opposite to in the manual control the auto check box needs to be checked and the time you want the illuminator to come on is set by the exposure time in ms in the imaging settings. Like with the manual control the configuration you want to come on automatically need to be set for the group that was made for the illuminator in the drop-down menu, the same as shown in Figure 16.
- Then to test this press the snap button that can be seen in Figure 19 in the top left corner. This will then open a pop-up window and all that's needed to do to test the illuminator is working is press the snap button and the illuminator should turn on in the configuration the user set for the group and for the time set in the exposure time.

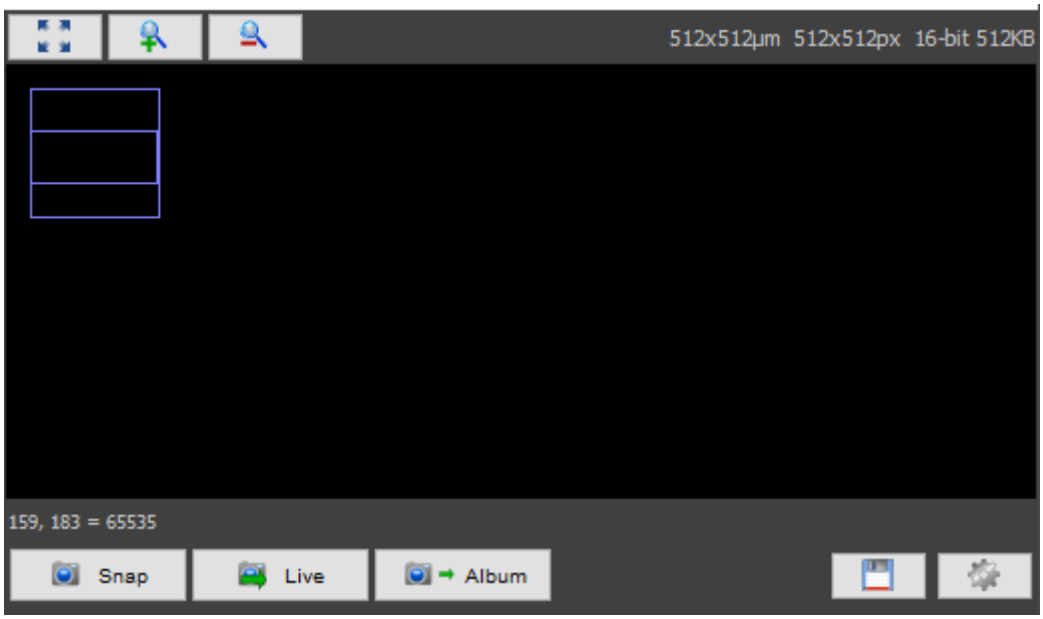

Figure 20: Showing the snap window to test the automatic shutter control of the illuminator