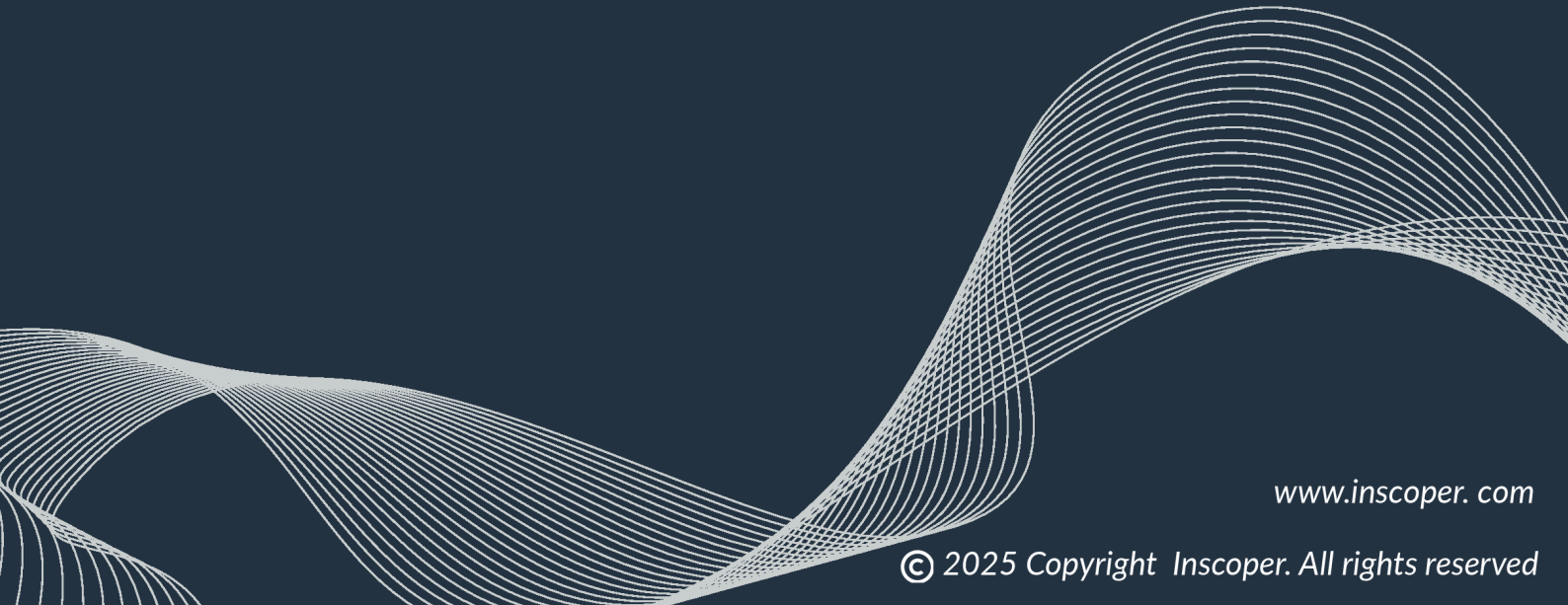
INSCOPER

User Guide
Configurator

v. 1.1.9



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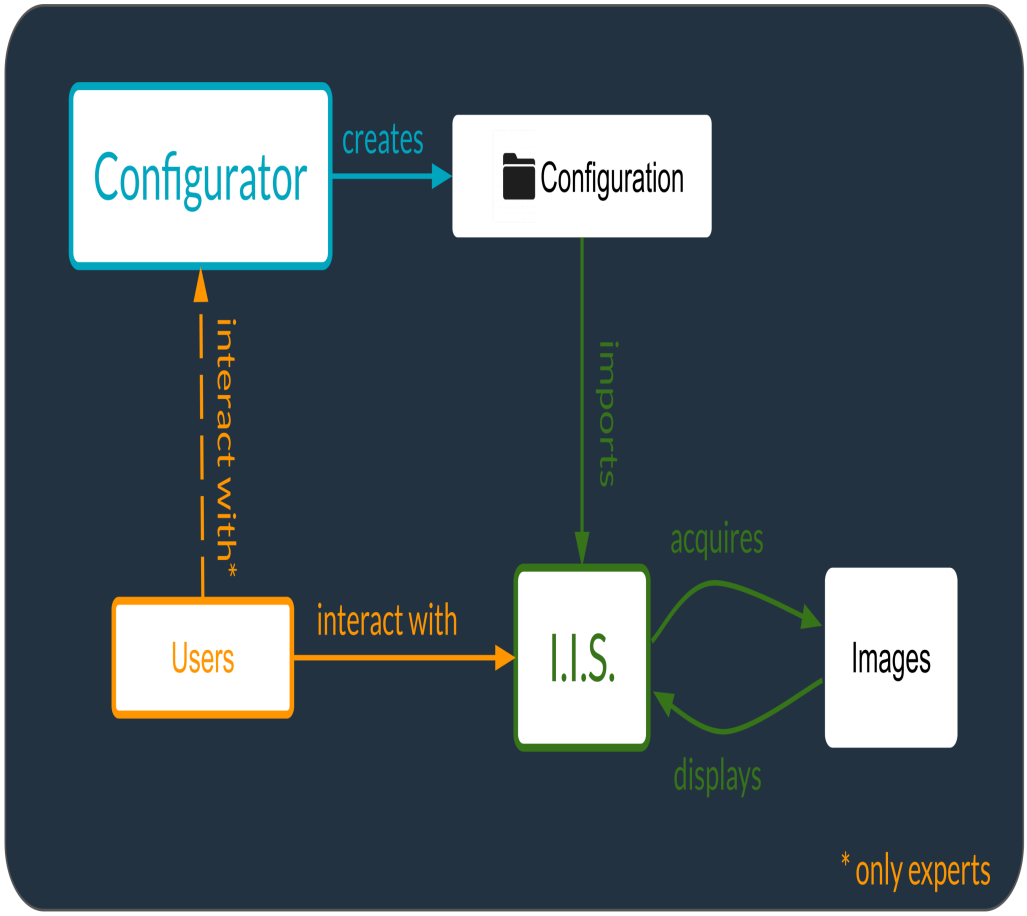
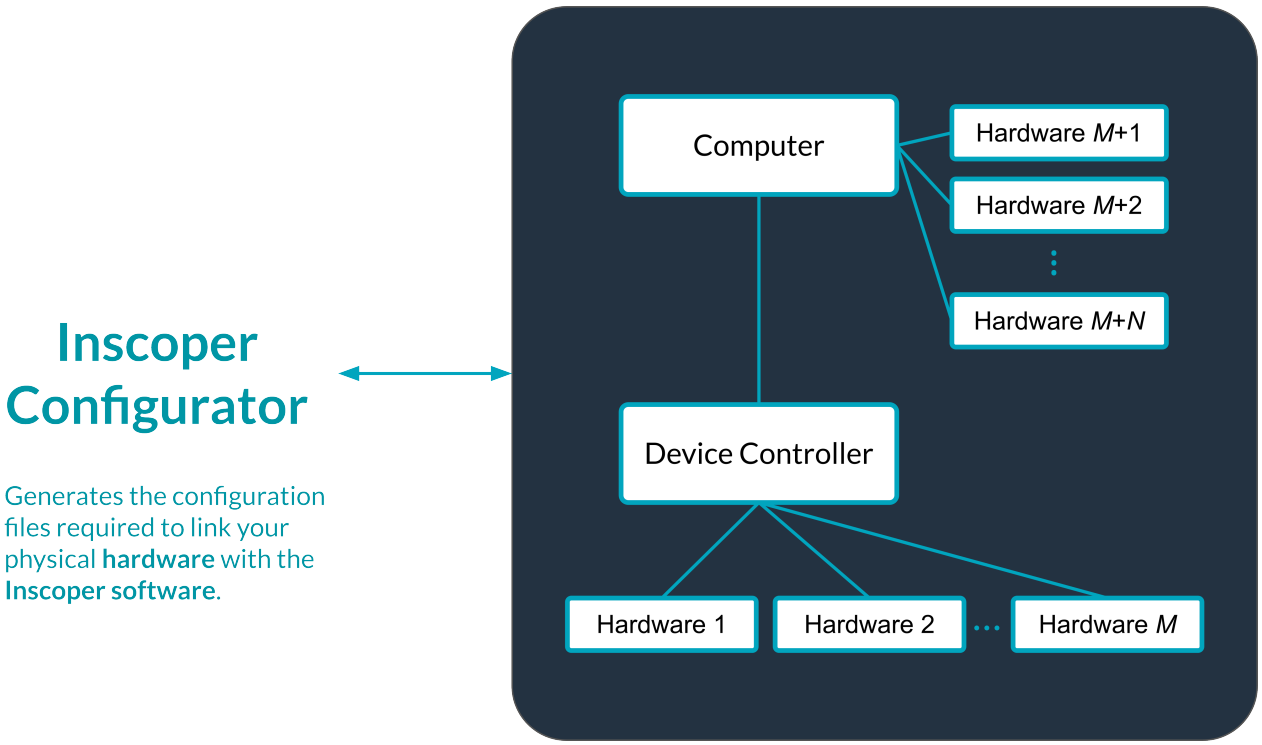
1. INSTALLATION

Once a certified installer has set up the Inscoper hardware, connected all components, and installed both software tools (Inscoper Imaging Software and the Inscoper Configurator),together, these elements form the operational basis of the Inscoper system.

User Interactions and Software Workflow: The diagram below shows how users interact with the Imaging Software and the Configurator. It highlights how these tools work together to produce images. The goal is to clarify the functional workflow from user input to image generation.



Hardware Structure and Configurator Integration: The diagram below presents the physical hardware setup and how each component is connected. It illustrates how the Configurator interprets this hardware layout. Its role is to convert the material structure into a configuration usable by Inscoper software.



1.1. Inscoper Configurator

The Inscoper Configurator is a powerful tool that simplifies the setup of complete microscopy systems built around the Inscoper Device Controller. It lets you define, connect, and manage all system devices to create a fully operational configuration tailored to your research needs.

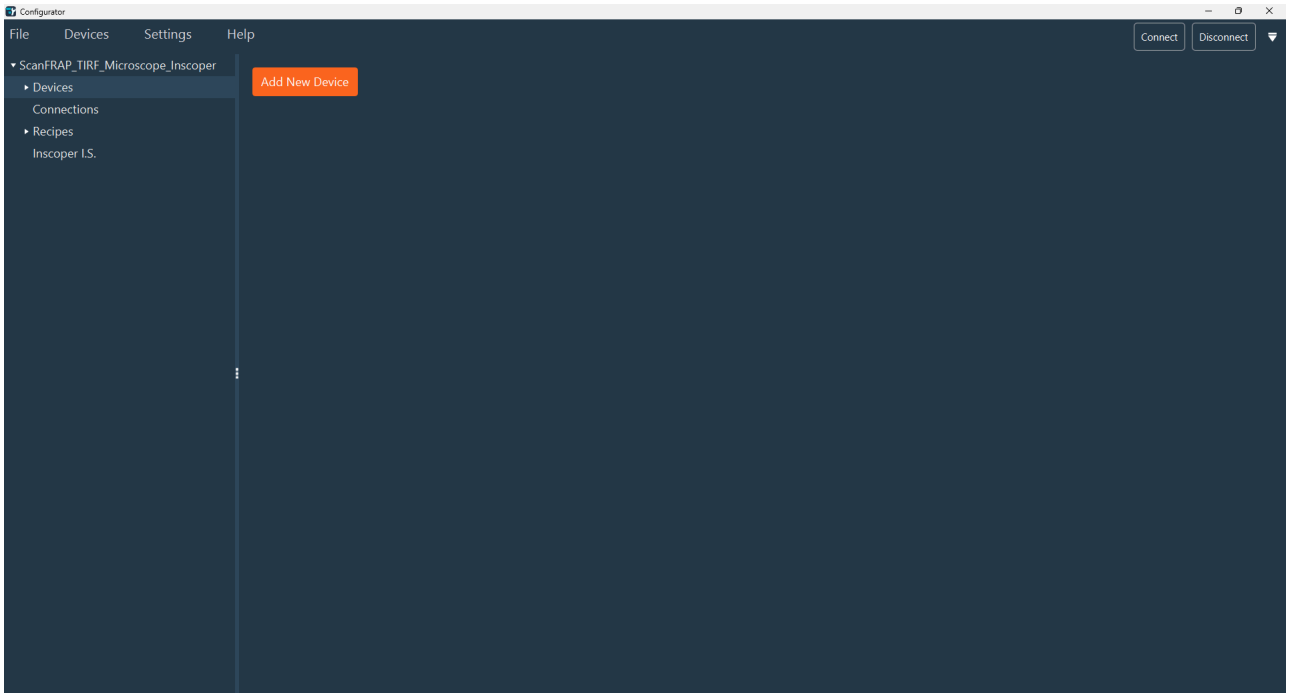
The Configurator outputs a ready-to-use system configuration compatible with the Inscoper Imaging Software (Inscoper I.S.) and the standalone Inscoper API.

Who is it for?

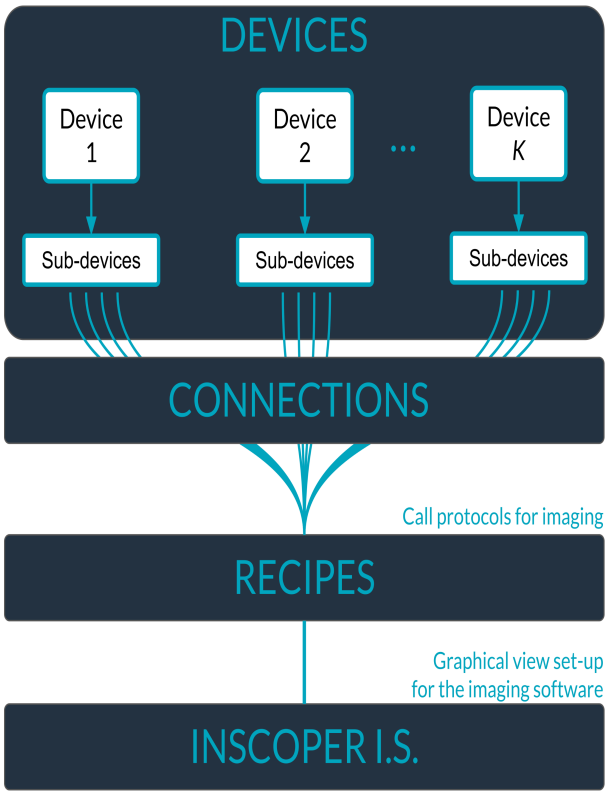
- System integrators installing microscopy systems controlled by the Inscoper Device Controllers.
- Advanced users performing hardware updates or adjustments (with appropriate precautions).

What will you find here?

This documentation offers step-by-step guides to help you perform key configuration tasks, from defining connected devices to pre-configuring the IIS.



Main Steps for Creating a Configuration:The diagram below shows the key stages involved in creating a configuration with the Configurator. It outlines the typical user workflow from start to finish. The goal is to provide a clear overview of the essential steps in the configuration process.



1.1.1. Getting started

The main interface is divided into three sections:

I - Toolbar

II - Configuration section (detailed here)

III - Device Controller (DC) status & actions

1. **File** allows to:
    - # **New:** Create a new configuration
    - # **Open:** Open an existing configuration
    - # **Save:** Save current configuration
    - # **Exit:** Close the Configurator window.
2. **Devices** options are:
    - # **Reload Devices:** Reload devices information from the DC and external drivers (micromanager drivers and custom drivers).

> NB: When the checking is done, a popup window appears in the bottom of the Configurator window indicating you the number of found/loaded devices (Inscoper, Micromanager or custom [which is no inside the DC])
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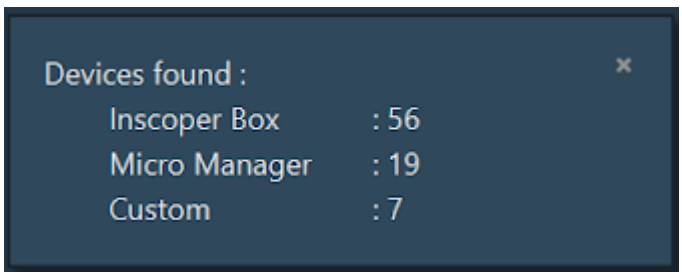
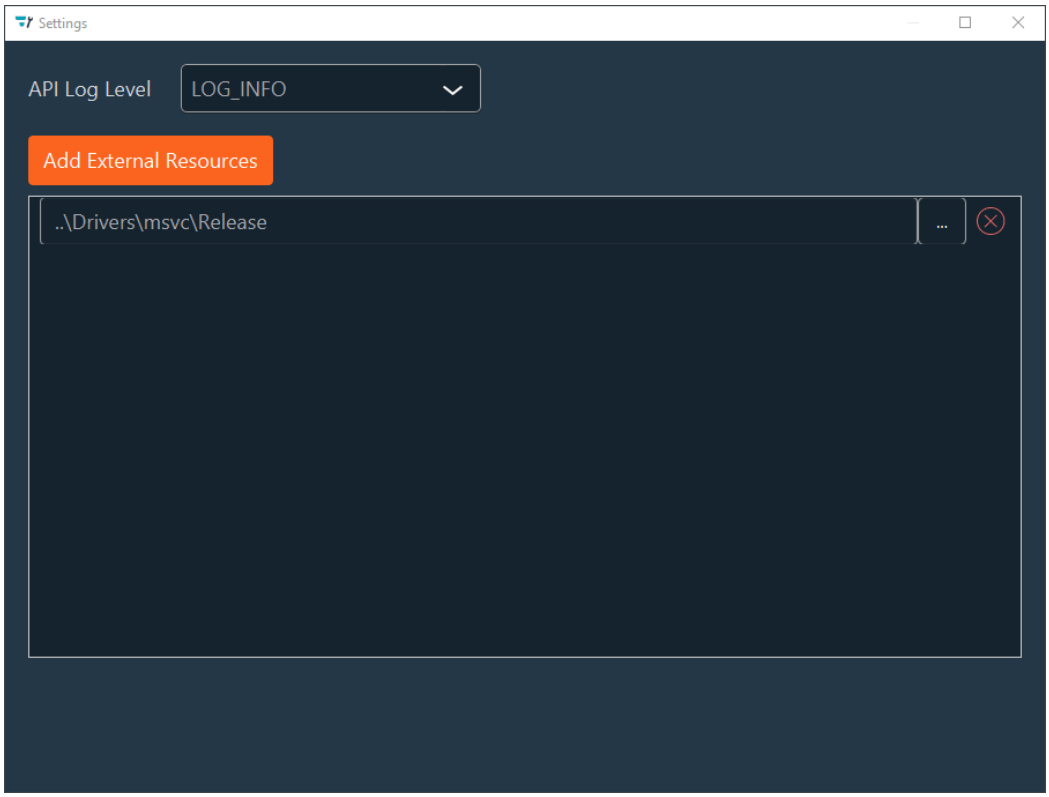
> 
>

    - # **Load Devices from File:** read and import the devices information (settings, configuration, etc.) from stored file.

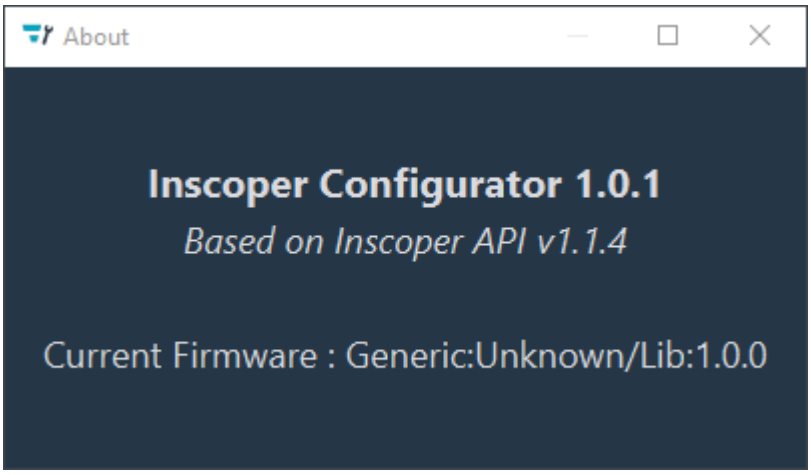
- **Save Devices to File:** export the devices information to a new local file.
- **Display Devices:** Display of the previously mentioned popup window.

3. **Settings**: You can specify the directory where the Micromanager and custom drivers are stored on your computer. You can add several directories by clicking **Add External Resources** and delete them by clicking on  . You can specify the **API log level** used by the configurator in the drop-down menu. When you are done, you can close the window and all the information will be saved automatically.



4. In the **Help** menu, you have the following options:
   - **Update Firmware:** Open explorer window to upload the firmware file
   - **Online Help:** Open the Configurator or Inscoper User Guides
   - **Visite Website:** Open the Inscoper website

About: Open popup window with all information about the Configurator (Configurator version, API number, Firmware Version)

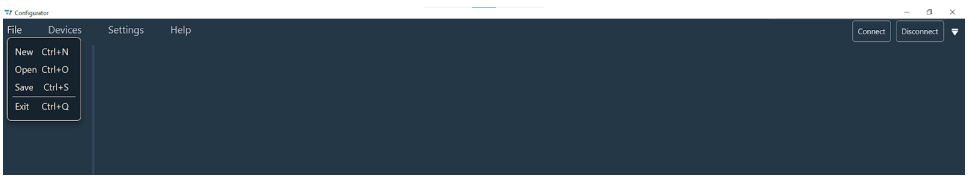


The **DC actions section** allows you the following actions:

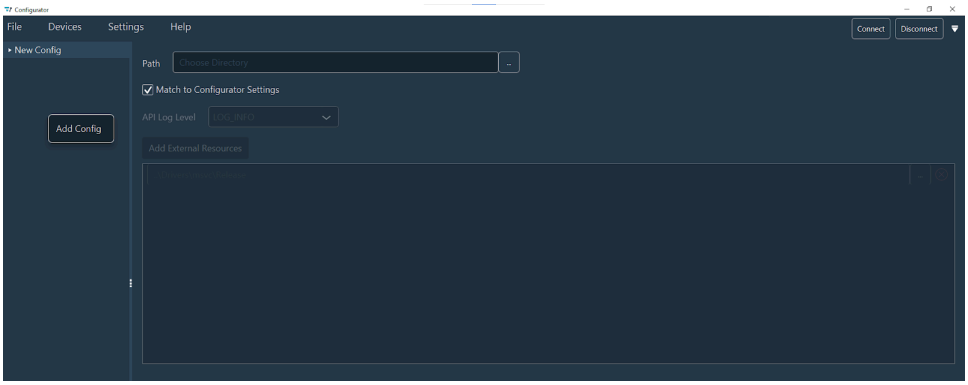
1. **Connect:** Connection of Device Controller
2. **Disconnect:** Disconnection of the Device Controller
3. **Restart Firmware:** Restart the Firmware
4. **Reset Inscoper Box USB view:** Triggers the Inscoper Box to rescan all USB devices connected to its ports. For example, if a device is plugged in while the Configurator is open, this action updates the detected USB devices within the DC.

1.1.2. Create configuration

1. There are three ways to create a configuration:
   # Click on **File** and **New**.

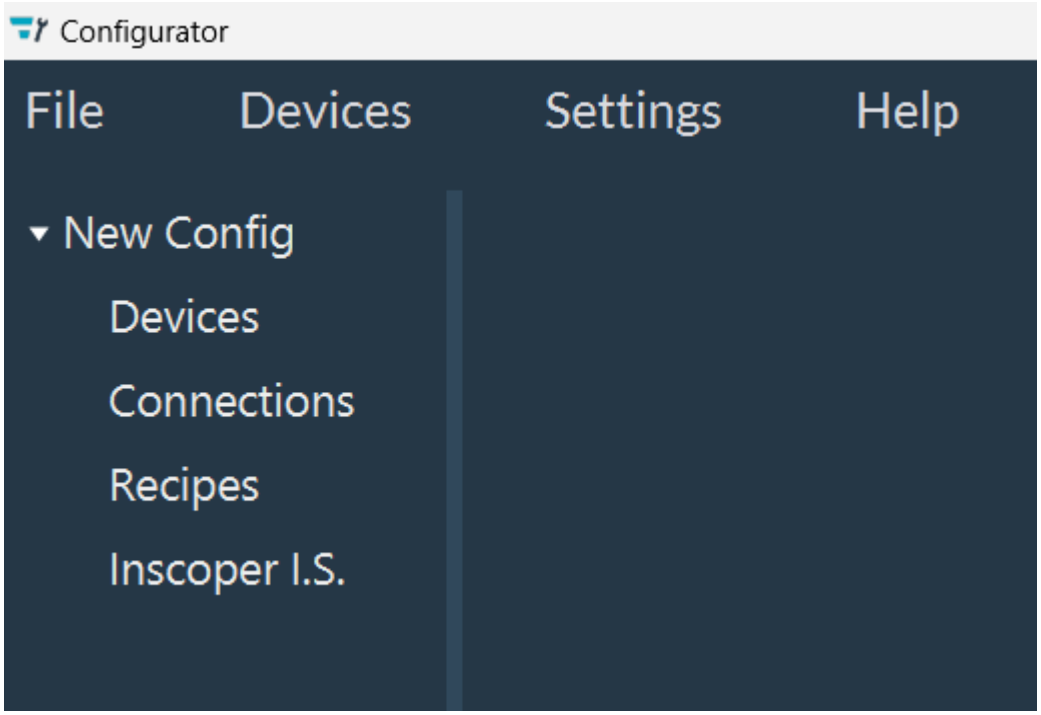


   # Right click inside the Configuration section (left part of the window) then click **Add Config**.



Use the key combination: **Ctrl + N**.

When a new configuration is created, it will appear in the Configuration section with a default name **New Config**.



2. To **save** your configuration, there are three ways:

Click **File** then by clicking on **Save**.

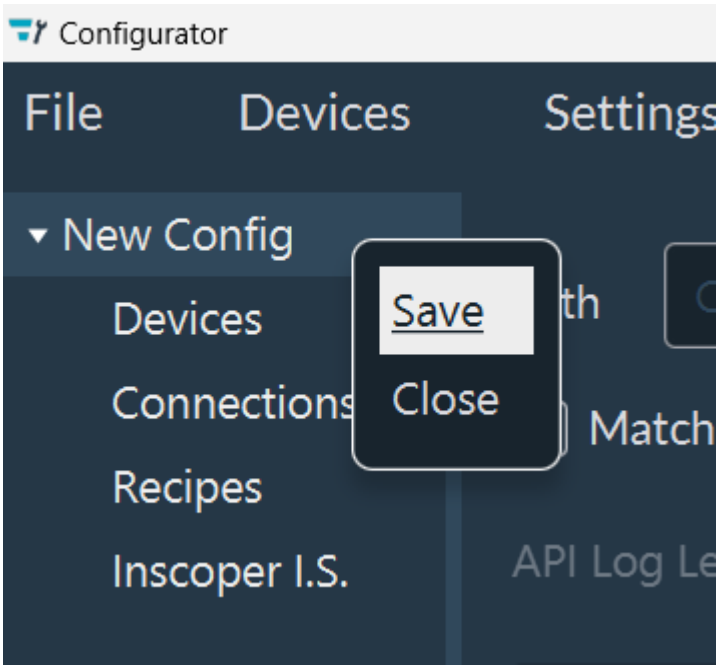
to select the folder. The name of your configuration will be the name of the folder.

Right click on **New Config** (or renamed config) then click on **Save**.

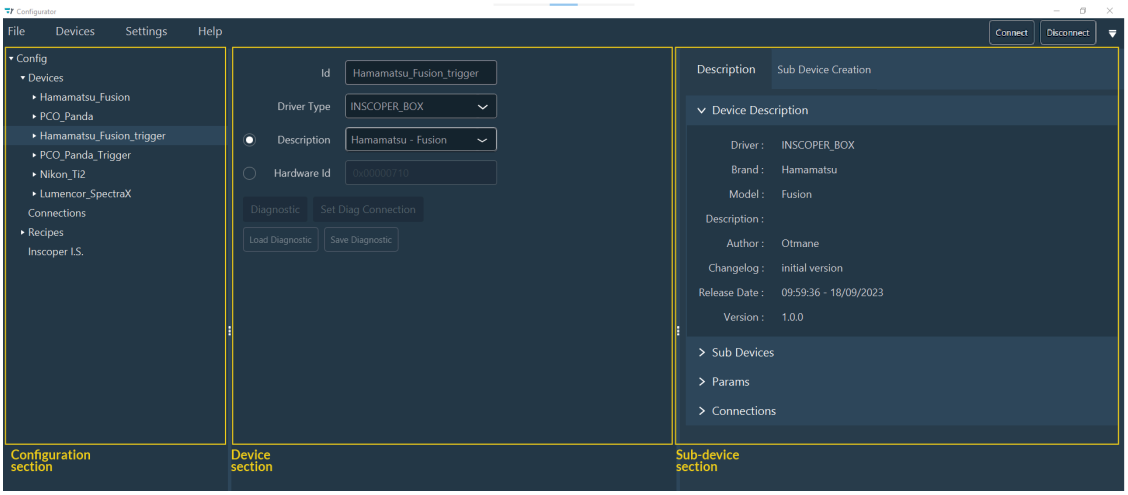
Use the key combination: **Ctrl + S**.

NB: If the **Path** field is not filled in, a file explorer opens to allow the user to choose a save directory. Upon confirmation, the configuration is saved.

NB: If the **Path** field is filled in, the configuration is automatically saved in the specified directory.



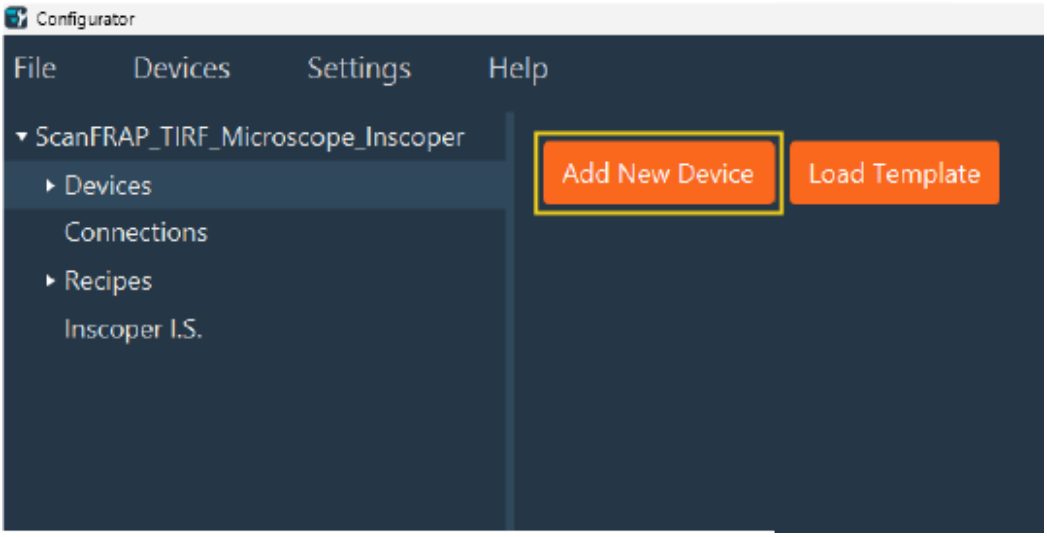
1.1.3. Devices setup



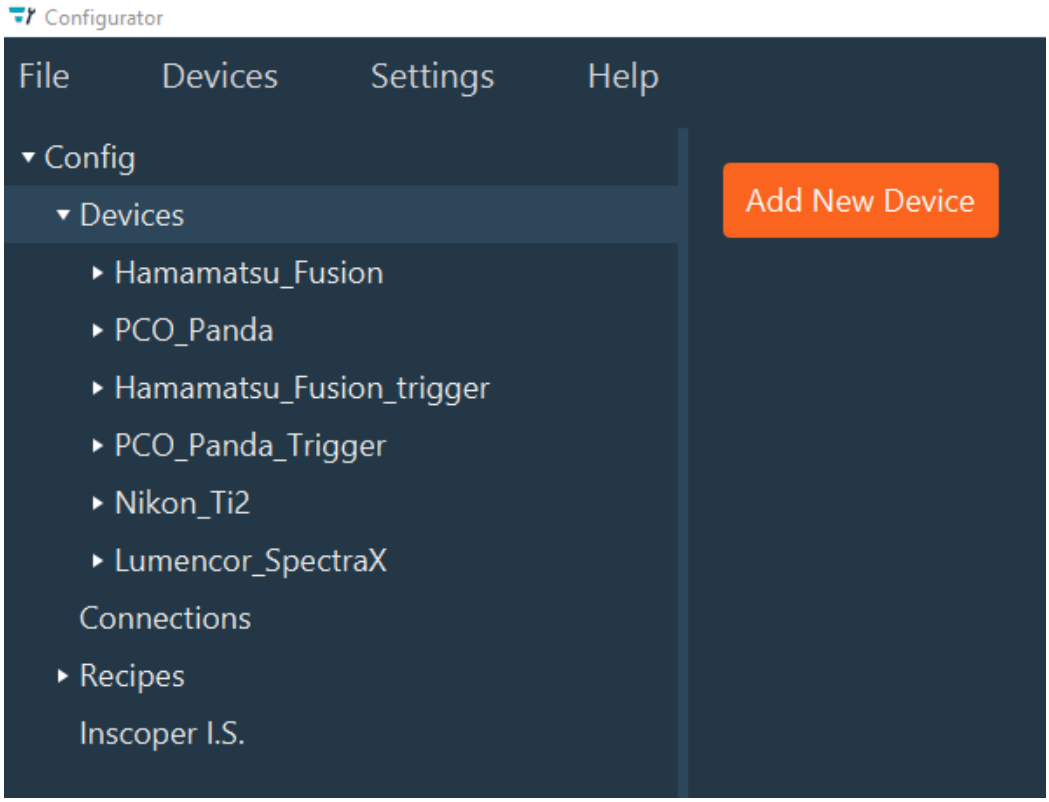
When you create your configuration, all the subsequent levels are automatically created [Devices, Connections, Recipes, I.S. Inscoper] in the configuration section.
In this stage, the main Configurator window is divided into 3 parts:

- **Configuration** section (already explained here)
- **Device** section: where you will configure all the devices
- **Sub Device** section: where you will create Sub Devices for the device. This section has two tabs: one for creating Sub Devices and the other for the device description.

1. Add Devices to Your Configuration
   For this, click the **Add New Device** button OR right-click on the **Devices** in the Configuration section and click **Add Device**.



   As a result, you'll see additional fields appear with the parameters to be filled in for this device and its Sub Devices.



2. Configure your device. Here, you can:

   a. Rename your device in the **Id field**.

   b. Specify the **Driver type** in the Driver Type field. For example : driver in Inscoper Box, custom driver or micro_manager.

   c. Depending on the chosen Driver type, fill in

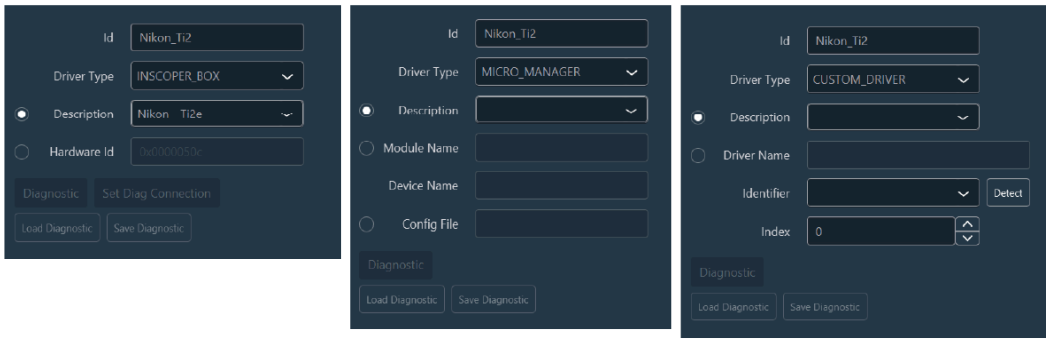
      # **For Custom Driver**: Enter the device **Description** or **Driver Name**, along with the device Identifier. You can click **Detect** to automatically find the device identifier. If multiple devices of the same type are present, add the device Index (starting from 0).

      > NB: In practice, the Identifier and Index fields are only useful when the same device is used multiple times, and only one of them should be used.

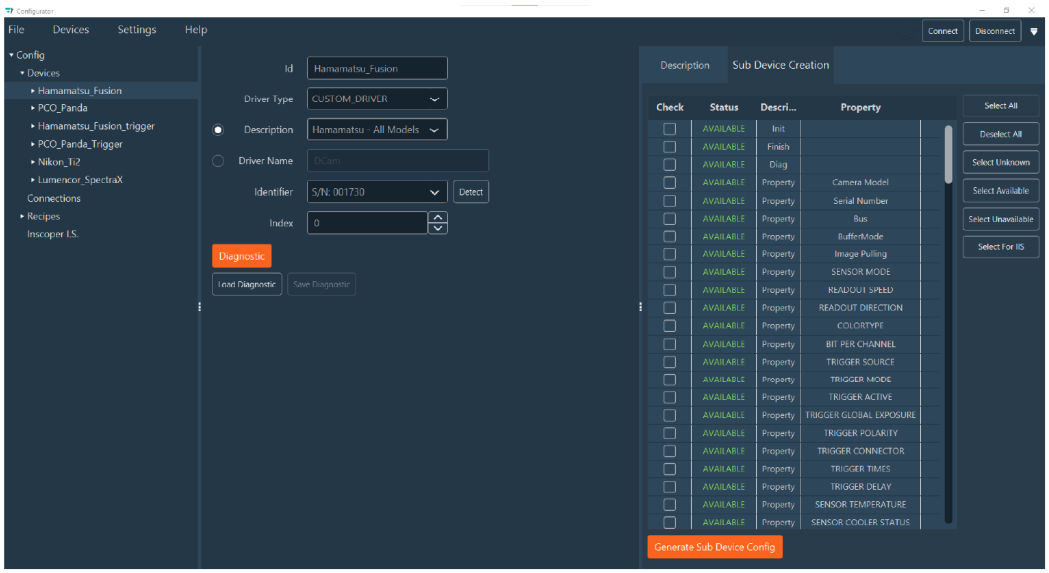
      # For **Inscoper Box**: Fill either the **Description**or the **Hardware Id** (using the Hardware ID requires knowing the exact identifier of the device to be added).
      # For **Micro manager**: Fill either the **Description** (preferred) or the **Module Name** and **Device Name** or **Config File** (rarely needed).

d. For the **Description**, find your device in the drop-down menu.

> NB: Items are listed in alphabetical order, but you can also search by typing the beginning of a word.

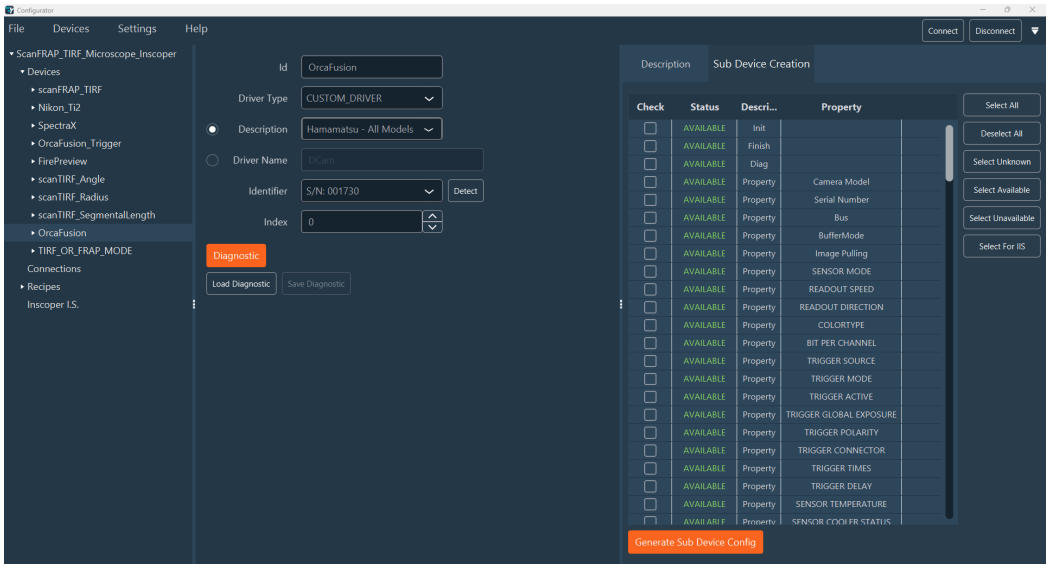


3. Before clicking on **Diagnostic** be sure that the device is connected to the system (either to the computer or the Inscoper Box). This function retrieves additional information beyond the initial description loaded via **Reload Devices** (brand, model, author, changelog). For Custom and Micro-Manager drivers, Diagnostic requests the device to provide its list of properties. It also updates the status of Sub Devices (Available, Unavailable, or Unknown) and may refine associated constraints.
   All the information about the device will be found in the **Description tab** of the **Sub Device section**.

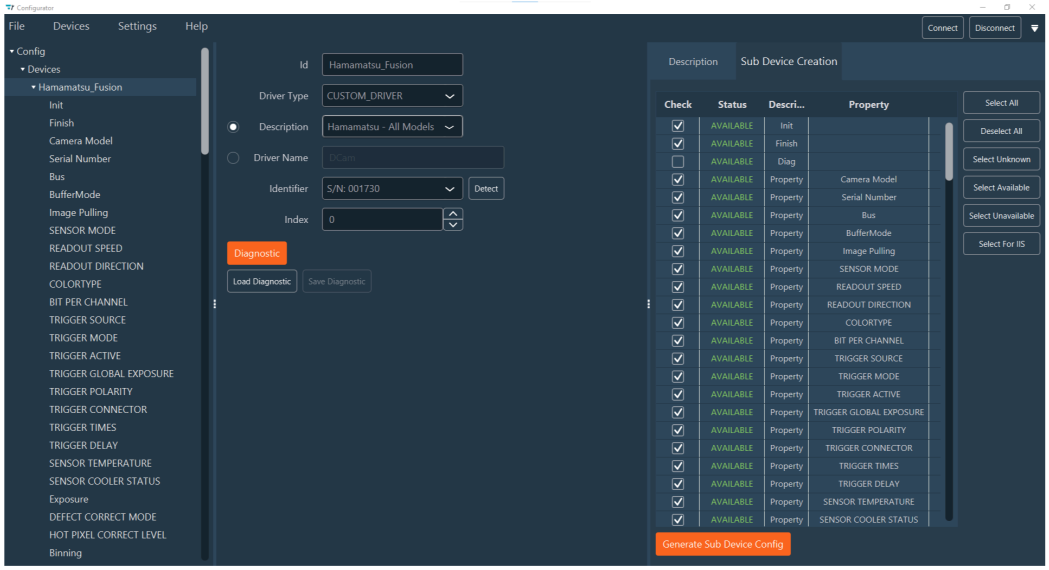


4. After running the Diagnostic, you can check the status of each Sub Device in the Sub Devices tab of the Sub Devices section. The table contains four columns:

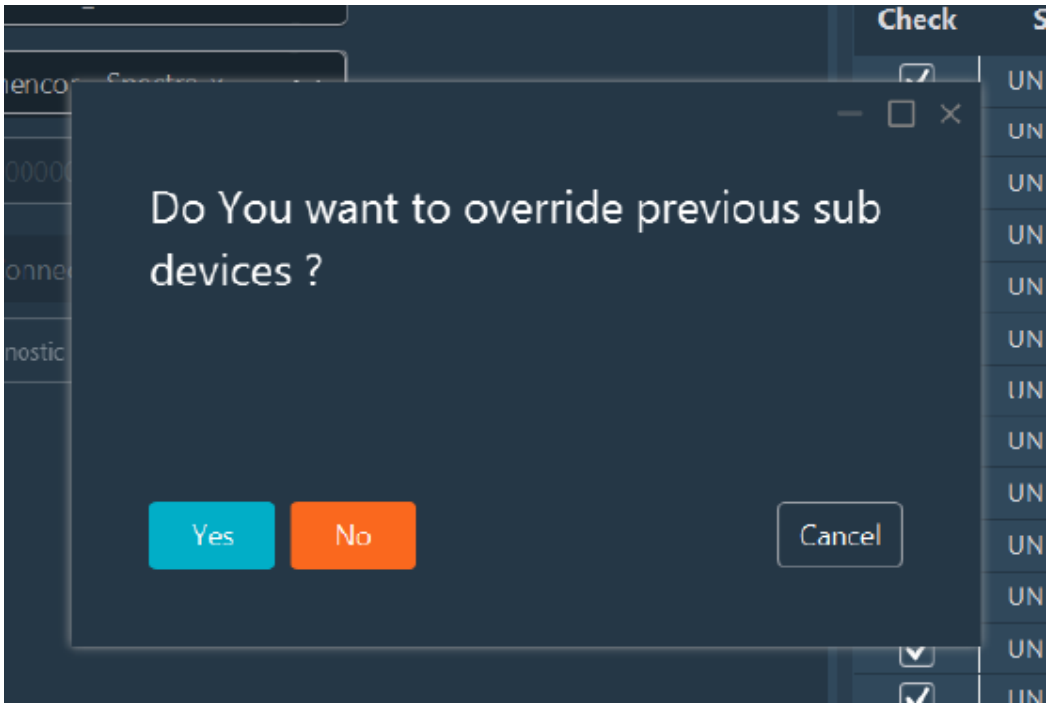
- **Check:** checkbox to select the Sub Devices.
- **Status:** indicates if the Sub Device is **available**, **unavailable** or **unknown** (after the diagnostic the driver could not verify the status).
- **Description:** indicates the name of the Sub Device.
- **Property** (Custom and Micromanager only)**:** property of the Sub Device.



5. To the right of the window, you have access to different buttons to interact with the Sub Devices list:
   - **Select All:** Select all Sub Devices
   - **Deselect All:** Unselect all Sub Devices
   - **Select Unknown:** Select all Sub Devices where the status is UNKNOWN
   - **Select Available:** Select all Sub Devices where the status is AVAILABLE
   - **Select Unavailable** Select all Sub Devices where the status is UNAVAILABLE
   - **Select for IIS (only for camera devices):** Select all Sub Devices needed for your Inscoper interface
6. When you have selected all Sub Devices needed, you can add them in the configuration by clicking on the **Generate Sub Device Config** button. All Sub Devices will be inserted below the Device Name on the Configuration section.



7. If some Sub Devices are missing, you can select them and click the **Generate Subdevice Config** button. A pop-up window will appear asking you if you want to override the previous Sub Devices. If you answer **Yes**, your selection will replace your previous Sub Devices, if you click **No**, your Sub Devices selection will be added to your previous Sub Devices list.

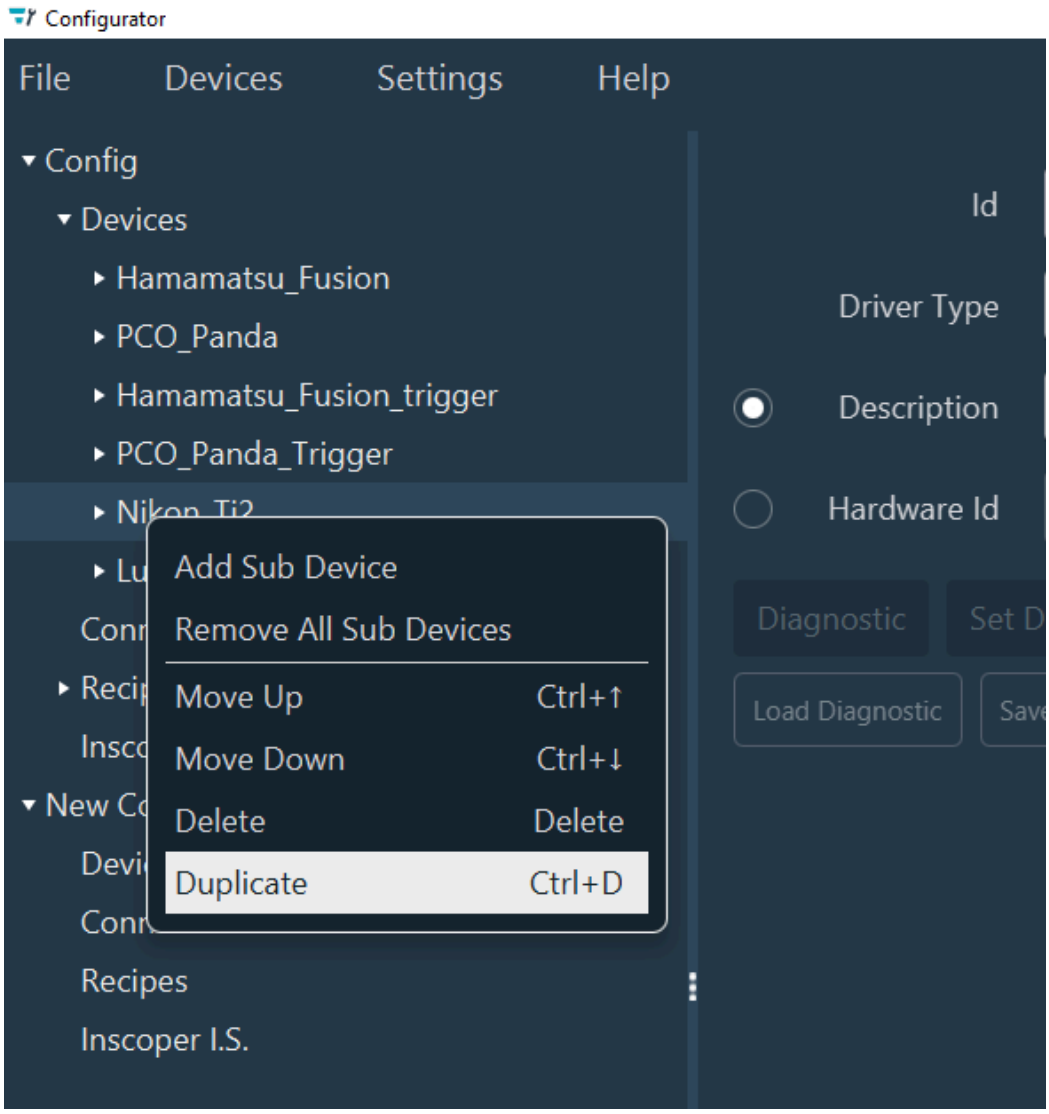


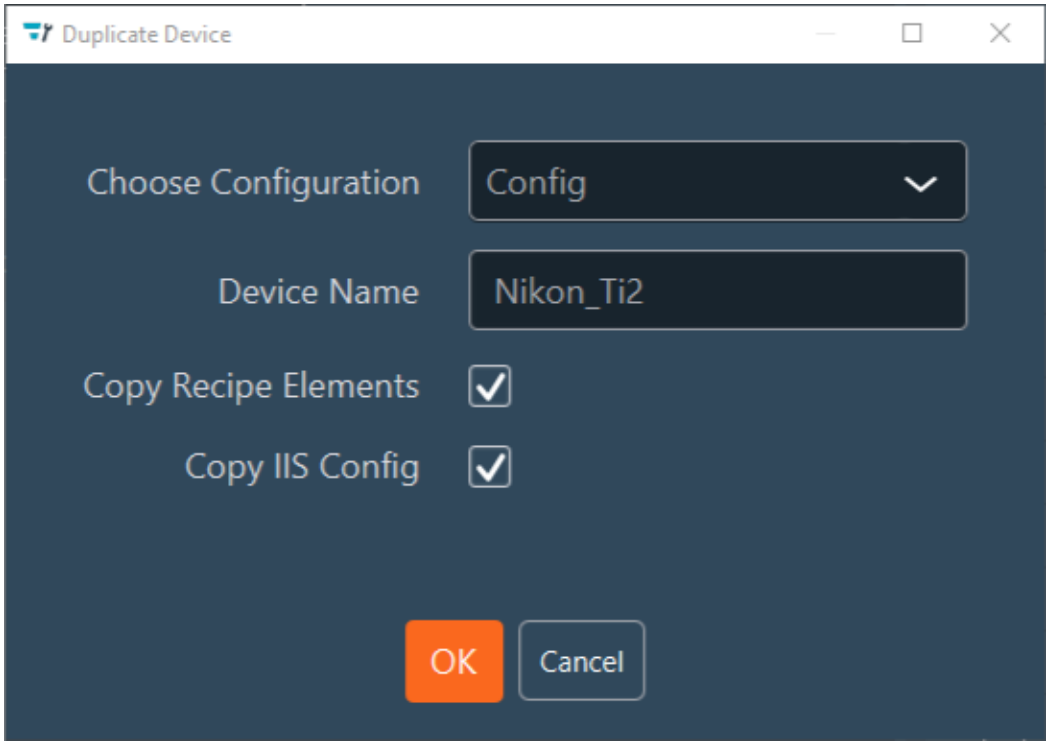
8. Right clicking on the device will allow you to:
    - **Add Sub Device:** Add a subdevice to the device
    - **Remove All Sub Devices:** Remove all subdevices from the device
    - **Move up:** Move the device up
    - **Move Down:** Move the device down
    - **Delete:** Delete the device and all its Sub Devices

Duplicate: Allows you to fully copy a device within a given configuration. This is useful, for example, if you have multiple identical devices or if you want to reuse an already configured device in a new configuration.

NB: It is possible to duplicate the device with all its recipe elements and elements related to the configuration of the Inscoper I.S.

NB: Impossible to duplicate the device with the same name to the same configuration (error message will appear).





9. If you manually add a Sub Device (with the Add Sub Device function), you will need to fill:
    a. The **Id** of the Sub Device
    b. Either the **Description** or the **Tag** of your **Sub Device**.
    c. [OPTIONAL] **Recipe Id**: Define a Recipe Id to group several Sub Devices in one unique Recipe Element.

    > NB: For example, if you define a Recipe Id "Shutter", you could apply it to all your shutter Sub Devices. Thus, you can later create a Recipe Element with this Recipe Id and all your shutter Sub Devices will be called with this Recipe Element.

    d. [OPTIONAL] **Post Init**: Check this if you want your Sub Device to be ignored by the Create Recipe function and the Initialize or Update Display Data. This also allows you to force the Sub Device to be called at initialization if the SET function has no param (for Sub Sevice with an editable param, a default value is required).

10. If your Sub Device has one or multiple parameters, you can add a default value to your parameterss by clicking on **Add Param**:
    a. Select either your param or the corresponding tag.
    b. Select if the param is fixed or not
    c. Define your default value

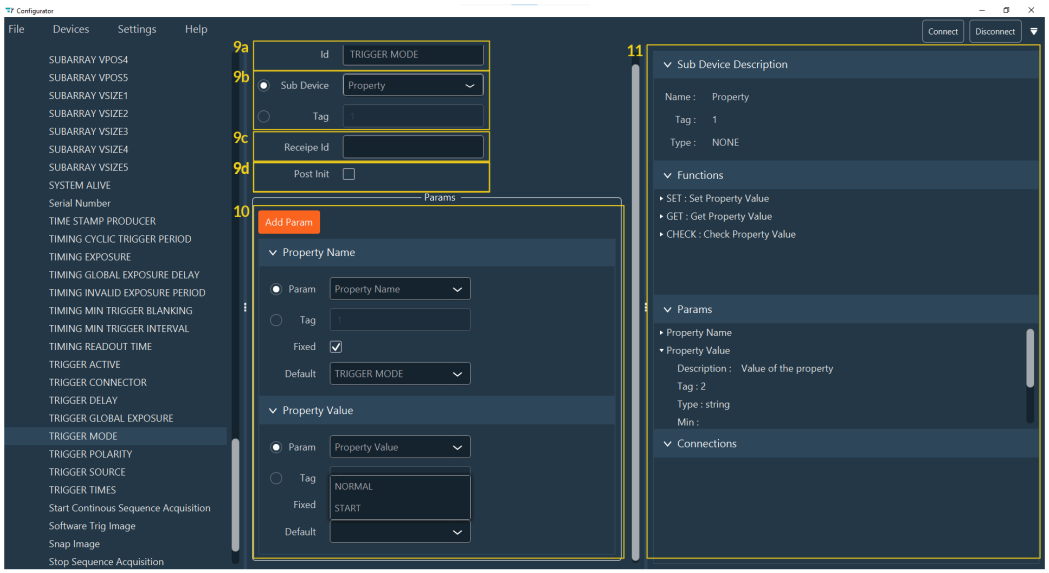
NB: In many cases, we want a Sub Device to carry one (or no) editable param. For Sub Devices with several params, you need to fix the value of several params to keep just one editable param.

Example: the Property Sub Device (defined for all external drivers) has 2 params : Property Name and Property Value. If you fix the Property Name value, the Property Value value will be the editable param of your Sub Device : Property Name = "Exposure" (fixed) -> never changes Property Value = Editable value

NB: If no param exists for your Sub Device, the Add Param button is not visible.

11. If you click on a **Sub Device**, you will get all information about it in the Sub Device part like **Description, Function, Parameters**.

NB: [FOR DRIVER_CUSTOM and MICRO_MANAGER ONLY] In Parameters (**Params**) you can see the **Property Name** and the **Property Value**. In the Device part you will always find the **Property Name**. This property is fixed. If you notice that a parameter (Property Value) is missing, you can add it by pressing the **Add Params** button. In the drop-down menu you can select the property that is not fixed. You can select the default value by selecting it in the drop-down menu.



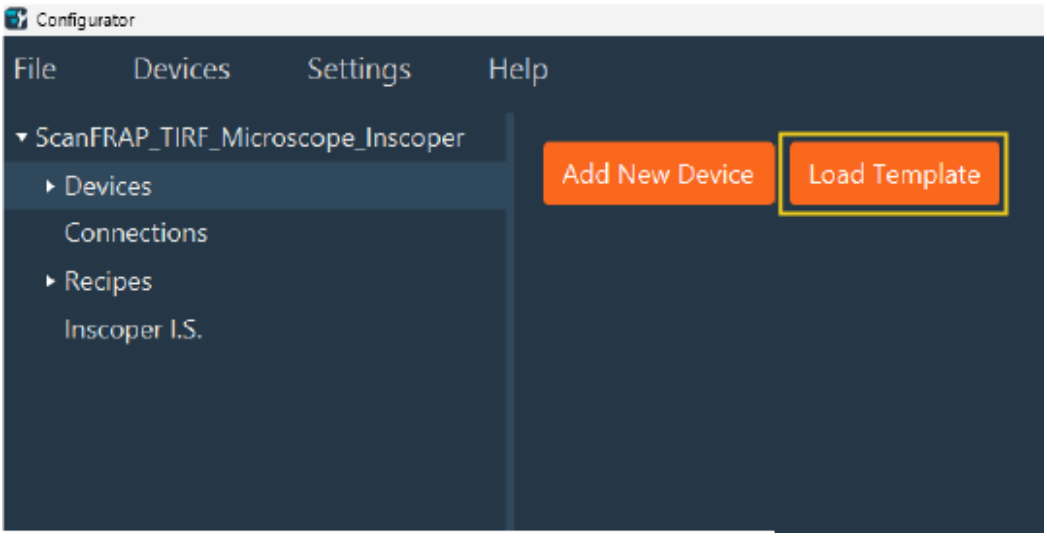
12. Repeat these steps for each device of your system.

When all devices are added to your configuration, you can go to the Connections step.

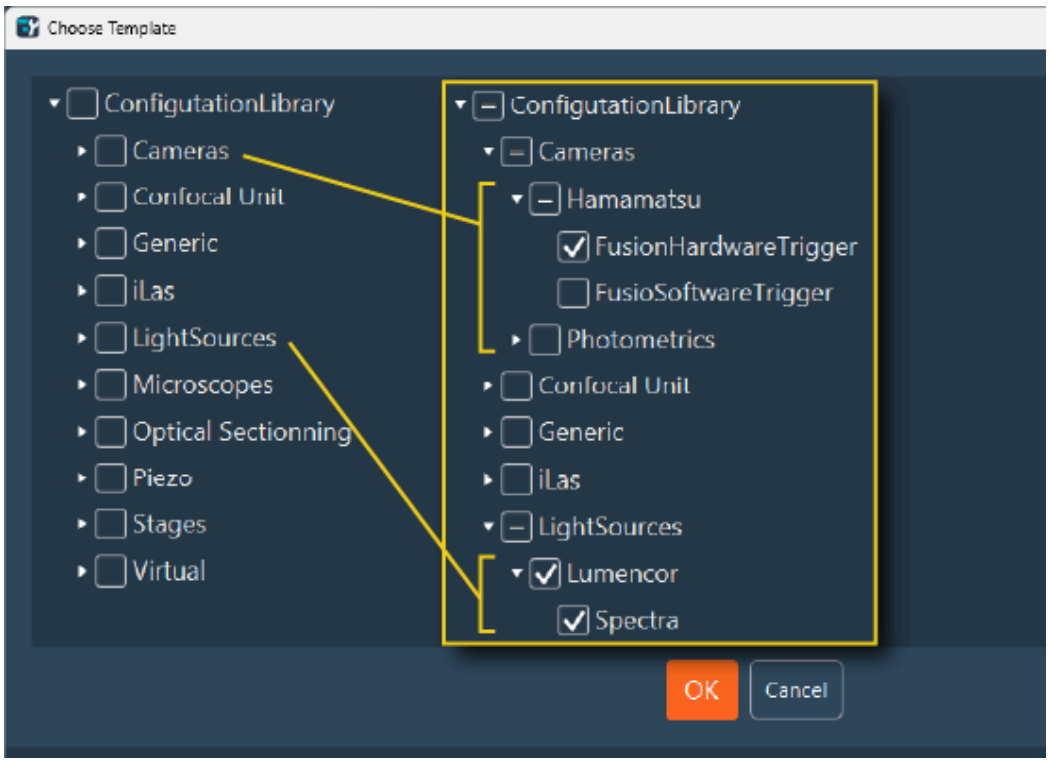
1.1.4. Template use

A quicker way to prepare your configuration and set up devices is to use templates: use devices that have already been added by our technical staff to the Configurator library. Templates are small configurations by device. Each configuration is tested and validated.

1. Click on **Load Template**.

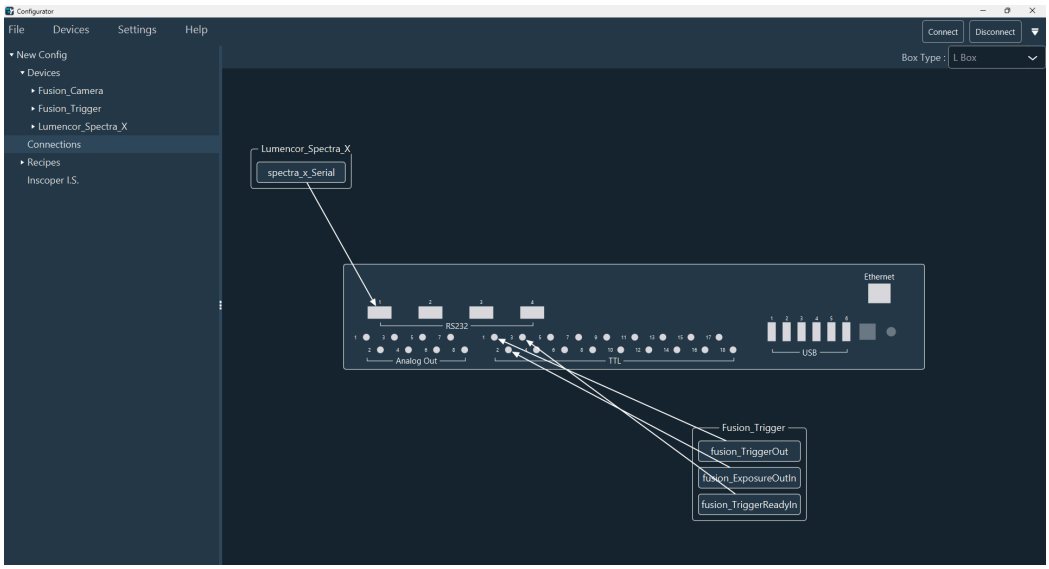


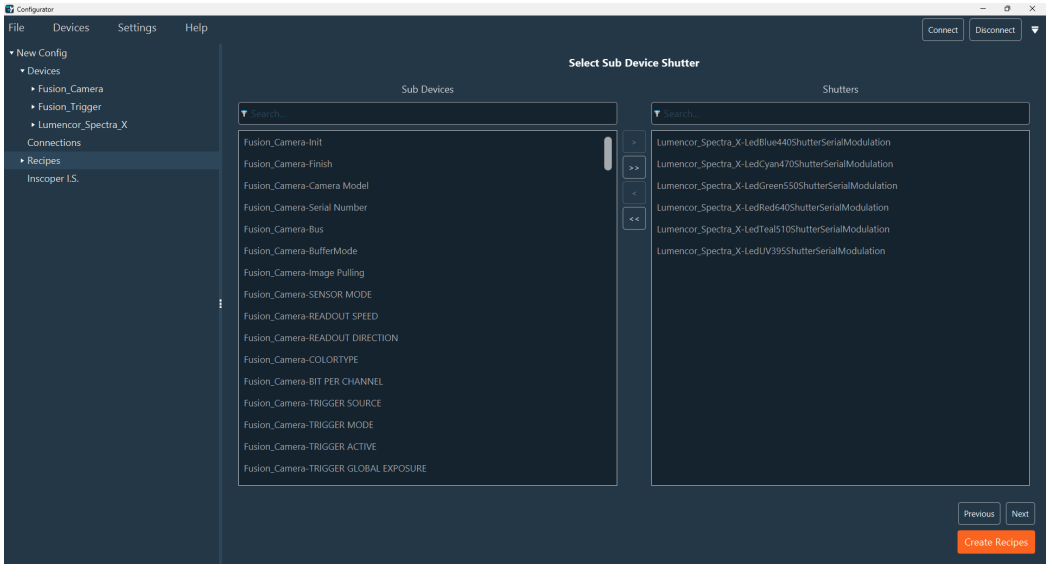
2. Select the devices in the library you want to load by checking the boxes.



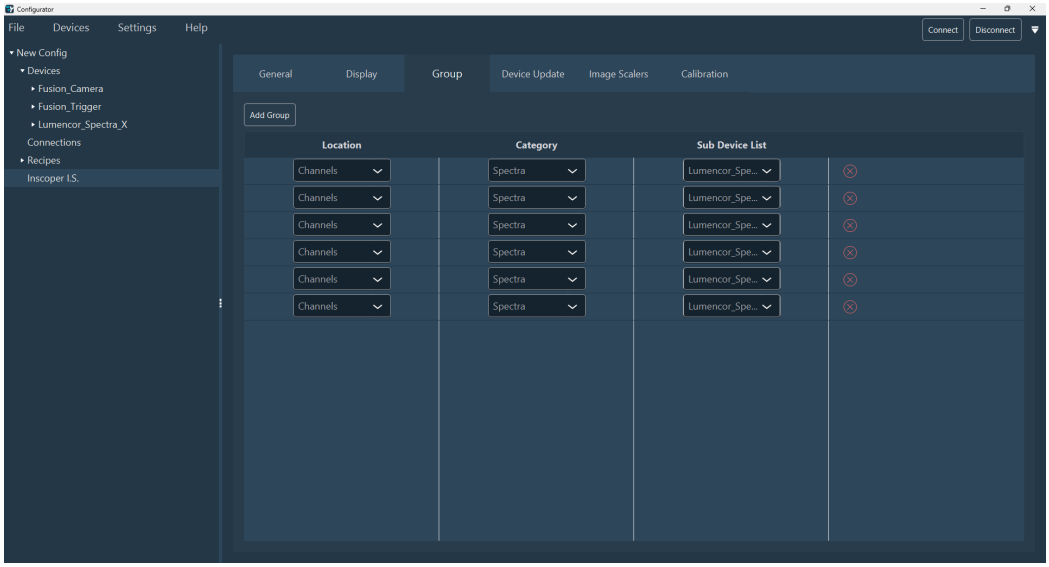
3. Click **OK** to load the devices into your configuration.
4. Check the connections and recipes of your devices and change them if necessary. The templates automatically import all the information.

> NB: In general it is necessary to modify the connections of the devices (especially if you do not have the same type of box and therefore not the same number of connectors).





5. You will then be able to check and modify the display of your devices within the Inscoper software by reviewing the Inscoper I.S. You will be able to modify all of the tabs by following steps described in Inscoper I.S. configuration.



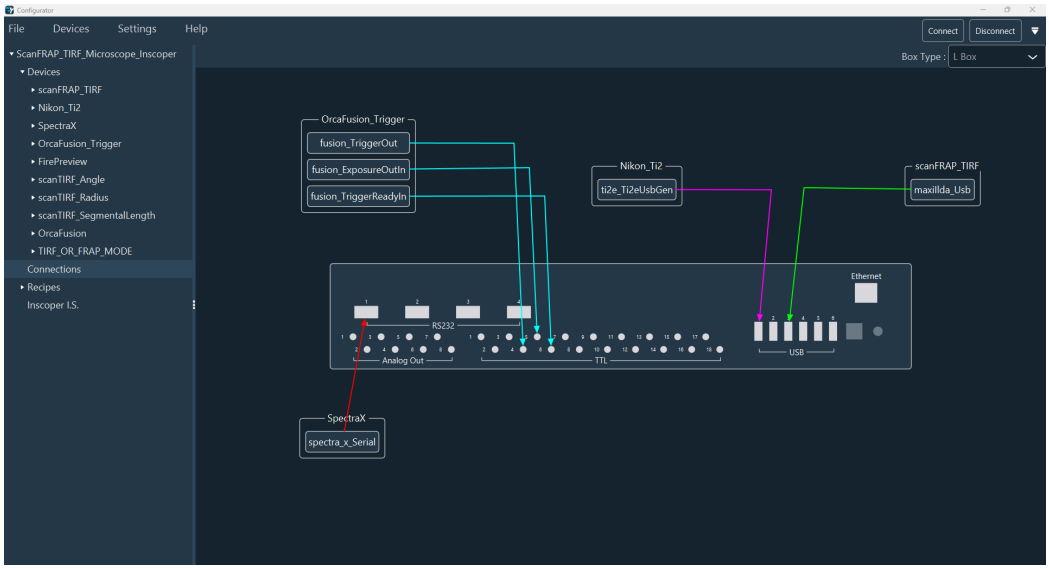
1.1.5. Connections setup

This stage is the link between the devices and the Device Controller (DC).

1. Click **Connections** inside the Configuration section, you'll get a view of the box and the devices that need to be connected to the DC.

2. The box type (S, M, L, XL) is recognized automatically. To select the box type manually, click on the **Box Type** drop-down menu in the top right-hand corner.

The drawing is automatically updated according to your choice.



3. Indicate where you have connected your device to the DC: right-click on the device you want to connect to change the mode from **Move Cell** to **Link Cell**.

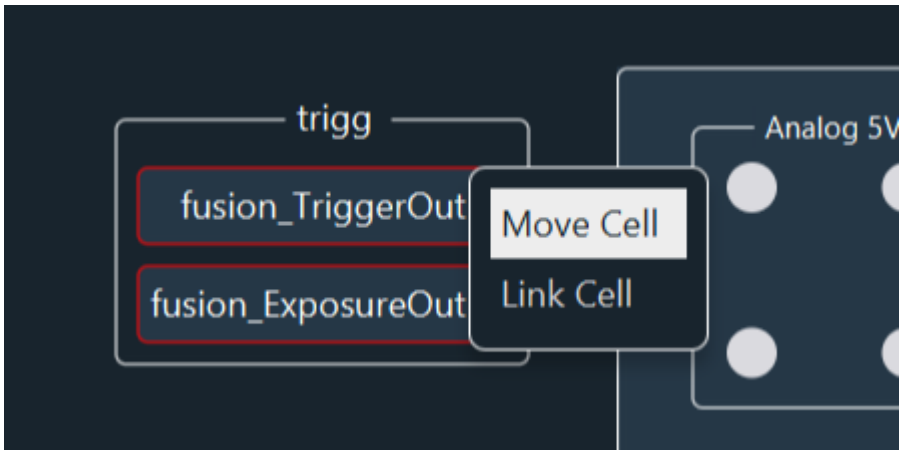
NB: **Move Cell** button allows to move the device on the diagram.

NB: The box diagram can be moved by simple click on it.

NB: Click and hold the mouse down to move the entire diagram (box and devices).

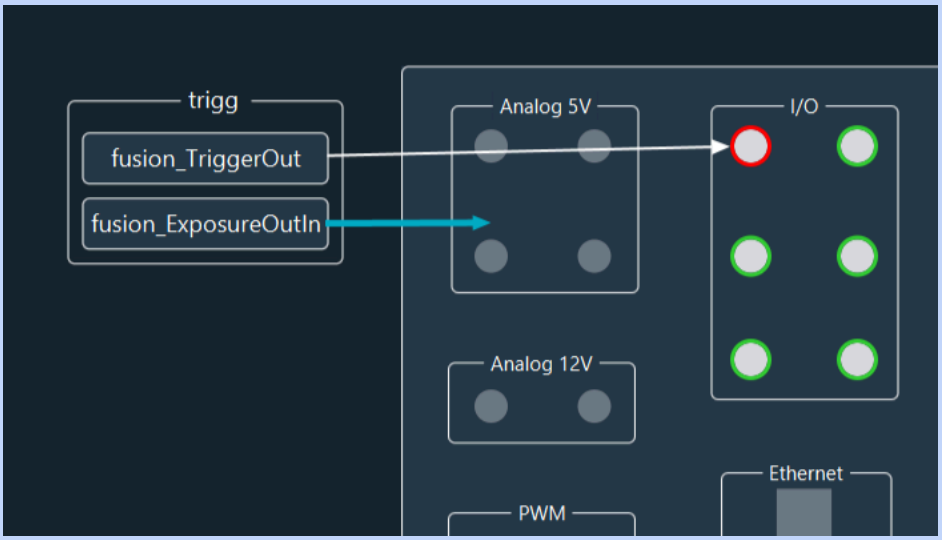
NB: Zoom in and out with the mouse wheel.

NB: double click on the mouse wheel resets the size of the entire diagram.

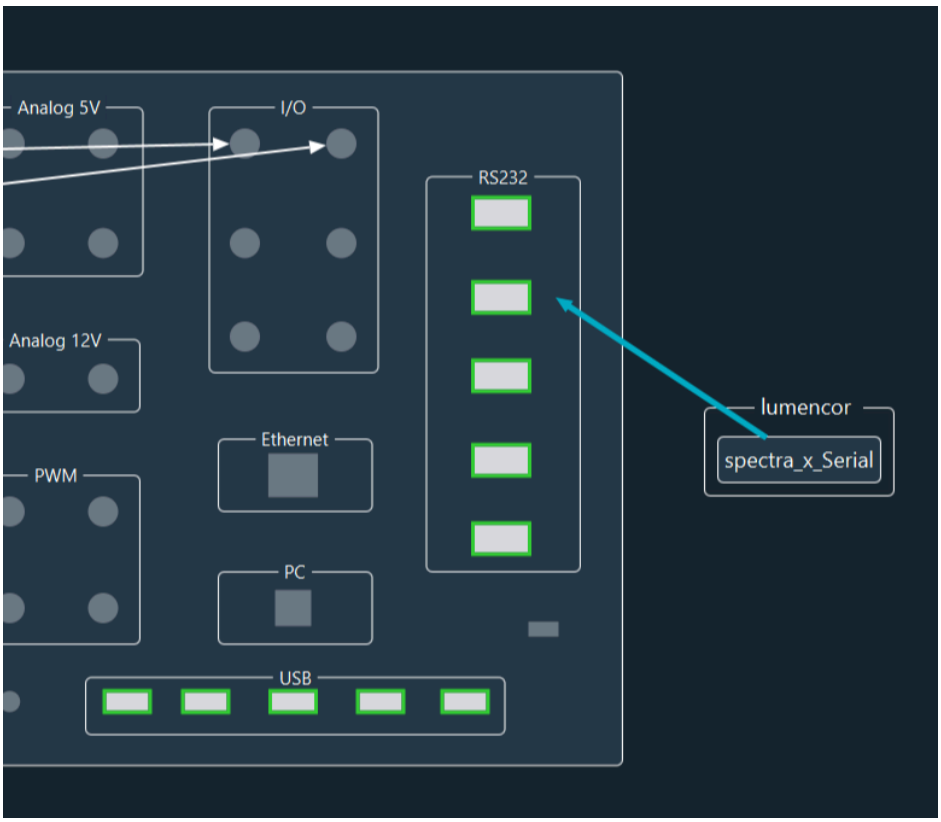


4. Link the connection by holding click from the connection to the DC. Repeat this step for each connection

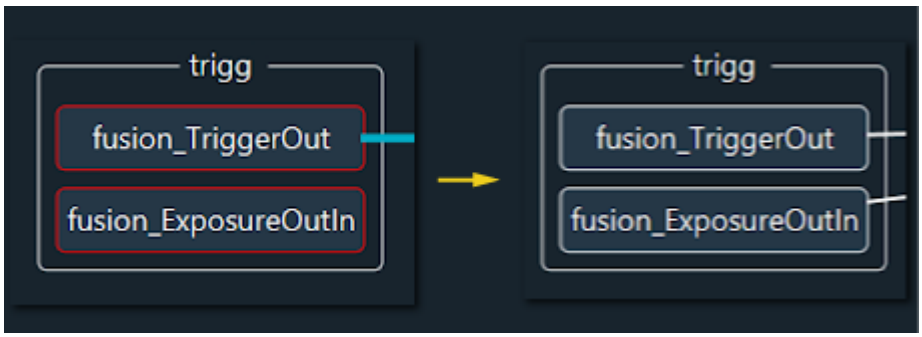
NB: The available ports for this connection are highlighted in green.When the connectors are occupied, it is surlight in red.



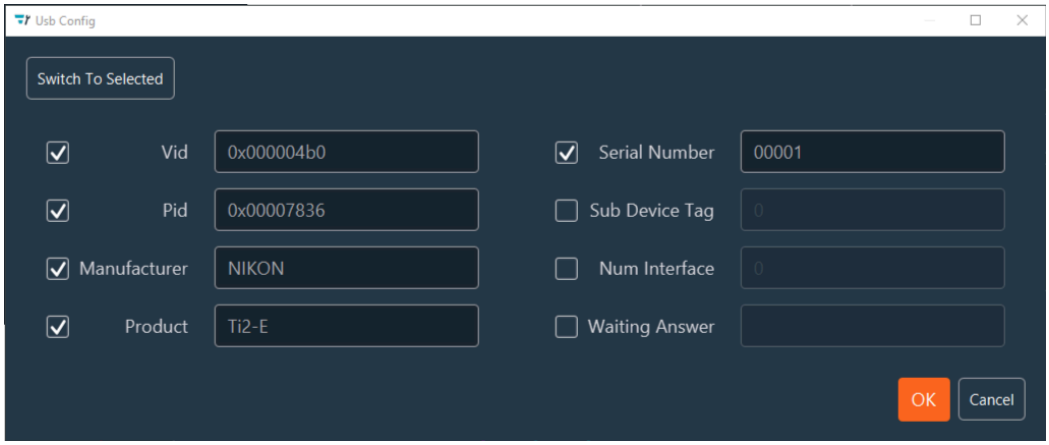
NB: Depending on the type of connection used, the connectors are automatically recognized. For example : the light source Lumencor Spectra X can be connected to the device controller by RS232 or USB connections.



When the connections are linked to the device controller (DC), the colour of the box around the Sub Device name changes from red to white.

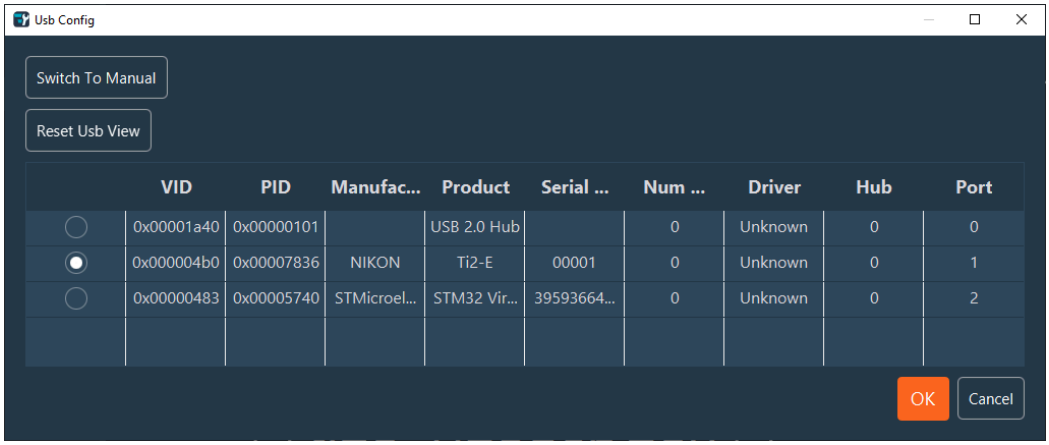


5. If the color of the box around the connection name is yellow, it means that a parameter is missing. To change it, double-click the connection name. A popup will appear and you can fill in the empty field. For example, for the Microscope Stand Ti2, you will get the window below and you need to enter the Pid and Vid numbers by checking the box of them.



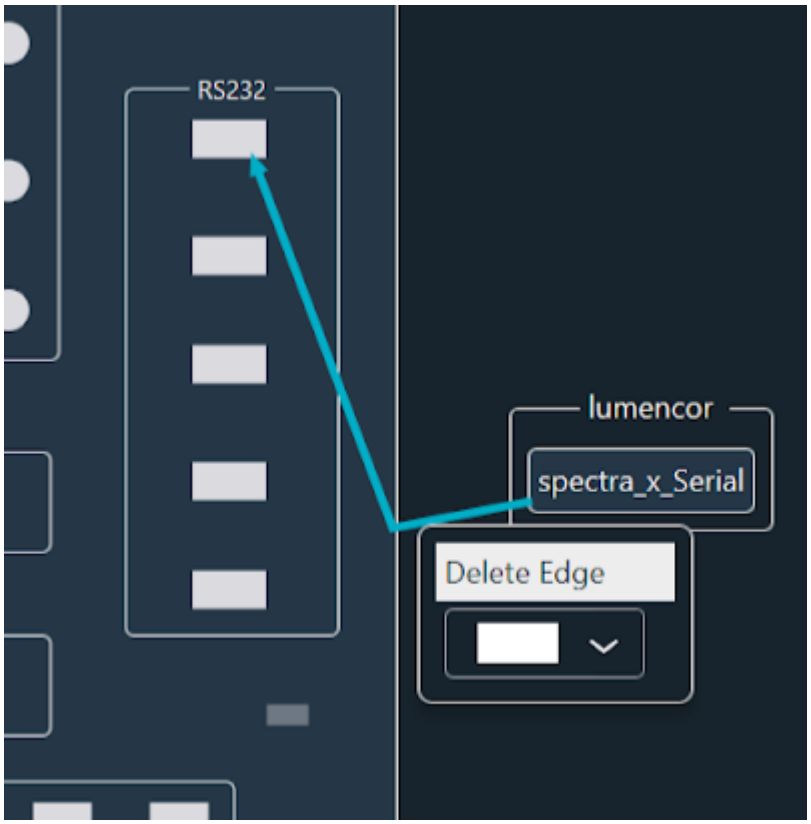
6. You can also detect all connected devices and select which port you need. **Switch To Manual** and **Switch To Selected**

   By clicking on **Rest Usb View**, The box will rescan all USB-connected devices.

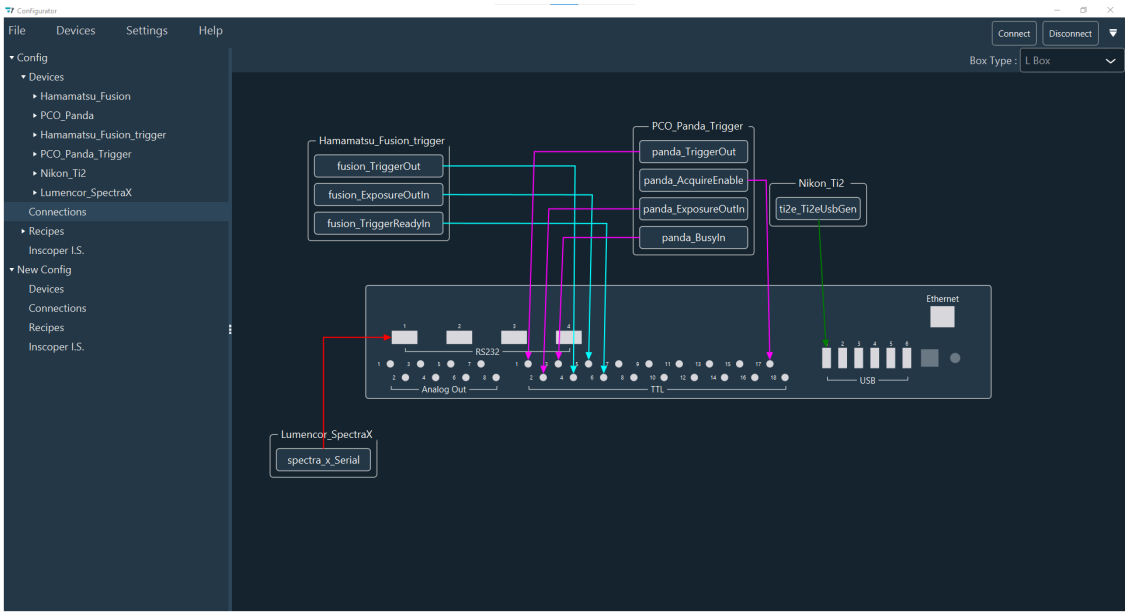


NB: In the list of USB ports, the first line corresponds to the USB hub inside the box (not valid for S type box). This is given for information only, to check that the box is working correctly.

7. You can modify the color of the arrow (**Color Box**) or delete it (**Delete Edge**) by a right click on it. If you click on the arrow you create a spot and you can move it to make an angle (like the example). To delete it, make a right click on the spot.



Once all your devices are connected to the DC, the diagram will look as follows:



After, you can go to the next step, which is the Recipe creation.

1.1.6. Recipe creation

There are two ways to create recipes:

1. Manual recipe creation
2. Automatic recipe creation

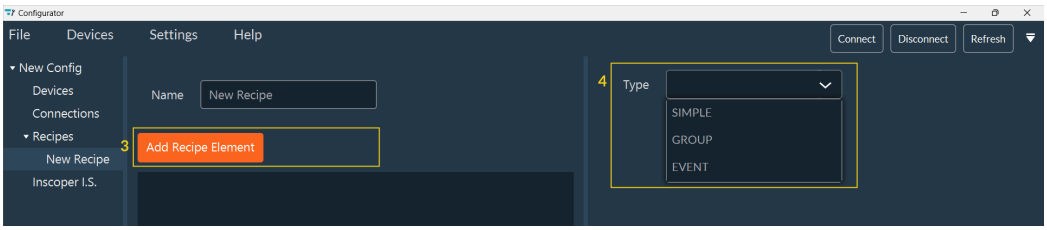
1.1.6.1. Manual recipe creation

1. Add recipe to your configuration
   For this, right-click on the **Recipes** in the Configuration section and click **Add Recipe**.

   NB: If you want to delete all the recipes, select **Remove All Recipes.**

   NB: You can duplicate the recipe by clicking on **Duplicate**, then select the Configuration and indicate the recipe name and validate.

2. If necessary, give this recipe a name in the **Name** field.
3. Then click **Add Recipe Element**.
4. Choose the **Type** of this recipe element:
   - **SIMPLE:** Recipe for a Sub Device (or a list of Sub Devices if recipe Id is selected)
   - **GROUP:** Recipe call another recipe
   - **EVENT:** Option that triggers a specific action at a defined moment in the acquisition sequence (e.g., stop or pause). This ensures, for example, that shutters are closed when the system is paused. This applies to both configurations with and without the device controller (DC).



5. If you choose **SIMPLE** option, you can:

   a. Modify the **Name** of this recipe element.

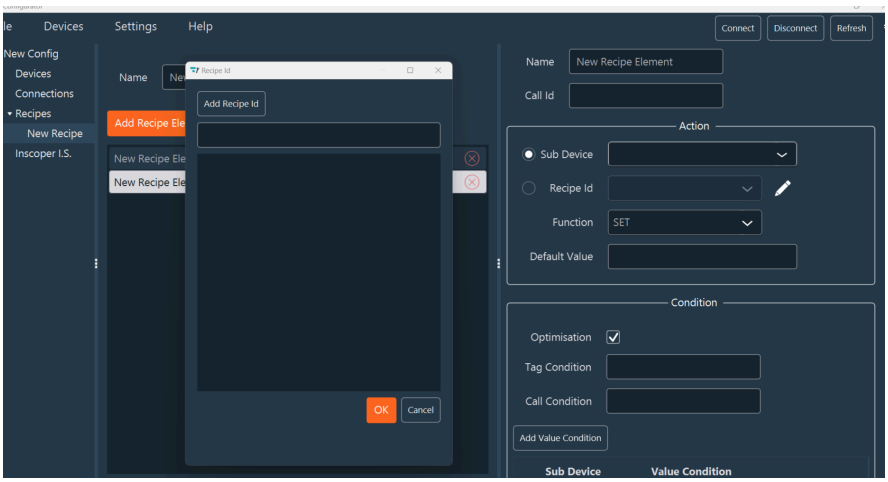
   b. Indicate the **Call ID** which is the ID of the recipe.

   c. In the **Action** part, you can:

      # Indicate the **Sub Device** involved in this recipe element or if you want to call the **Recipe Id** defined in the Sub Device during the configuration.

> NB: click on the pencil to open the pop-up window to **Add Receipe Id**

> NB: Recipe ID created at device level can not be removed or modified. All recipe IDs created at recipe level can be created, deleted, and modified.



      # Choose the **Function** that you want to call:

         # **SET**: send a value

         # **GET**: give the current value

         # **CHECK**: wait until the Sub Device is in the good status

      # Define a **Default Value**

   d. In the **Condition** part, you can:

Check the **Optimisation** box if you want to call the function only if the value changed

Define **Tag** and **Call Condition**:

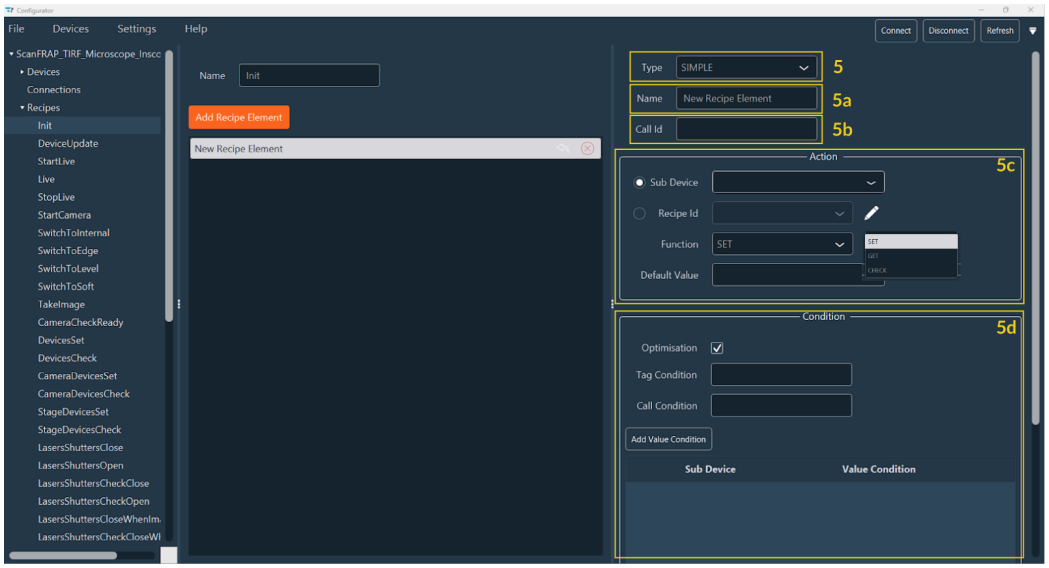
Tag Condition: Boolean expression about the presence or absence of a tag

Call Condition: Boolean expression to check if a recipe element with a specific callId has been called previously. For example : TI2xAxisPosition || TI2yAxisPosition

Add value condition by clicking **Add Value Condition**

Select a **Sub Device** and indicate the **Value Condition** for this Sub Device

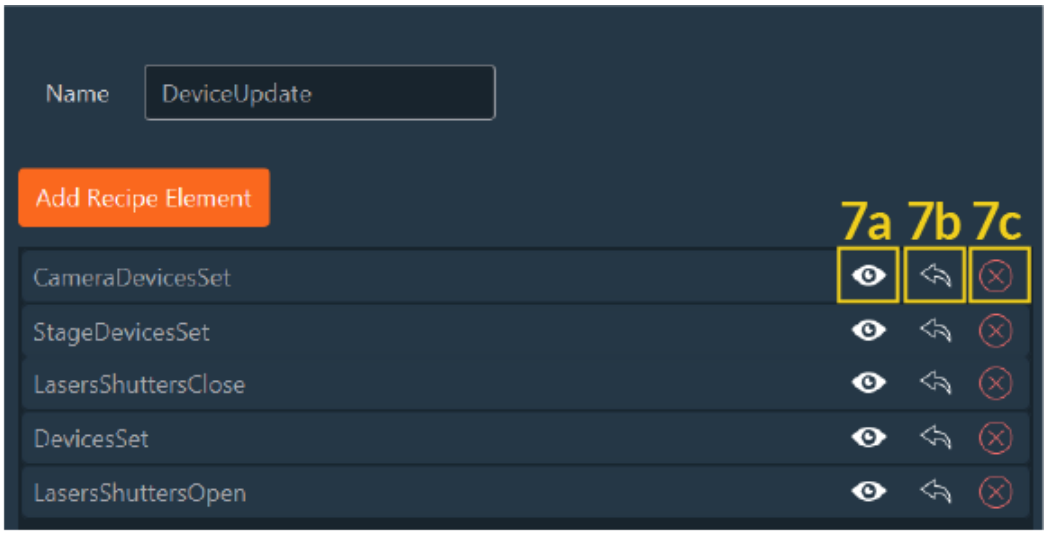
You can add several value conditions.



6. If you choose **GROUP**, you can add many recipe elements by clicking on **Add Recipe Element** and repeat the previous steps to configure them.rec
7. Recipe elements tools allow to:
   a. View details of this element (valid only for a Recipe Element Group).
   b. Move the Recipe element to another recipe.

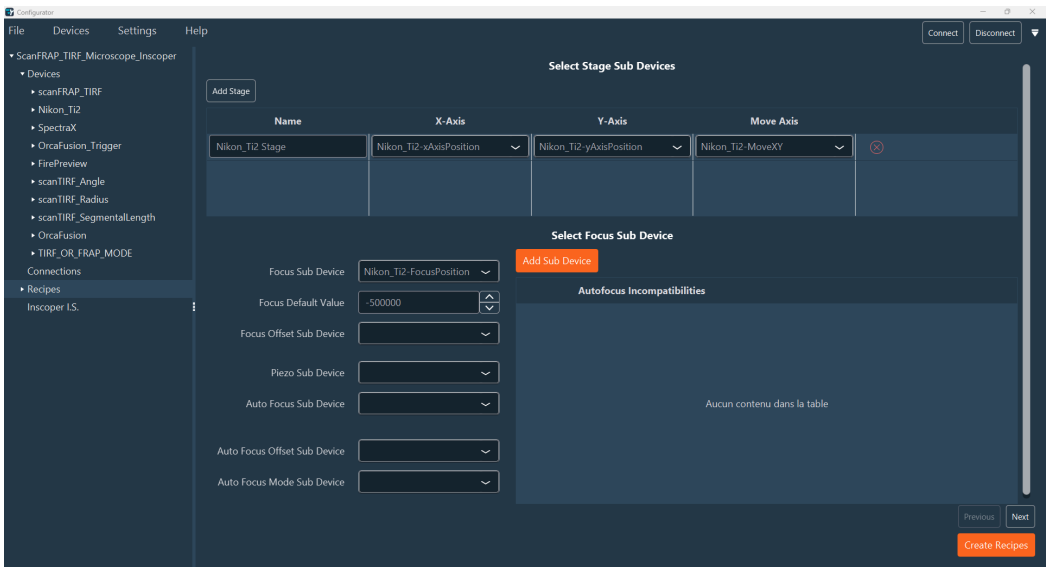
c. Delete this Recipe Element.

d. Drag and drop the Recipe Element to reposition it.



1.1.6.2. Automatic recipe creation

1. In the Configuration section, select the **Recipe** line. For each function, you must verify the details of the selected Sub Device. This Sub Device definition is required to generate the recipe. By default, the fields are prefilled.
2. For the **Stage Device**, you can enter the name of the stage, modify the Sub Devices.If you have multiple stages on your system, you can add a stage by clicking on the **Add Stage** button. You can delete a stage by clicking on the red cross.
3. You will find all properties for the focus device. You can enter the piezo and autofocus Sub Devices. When it's done, click on **Next**.



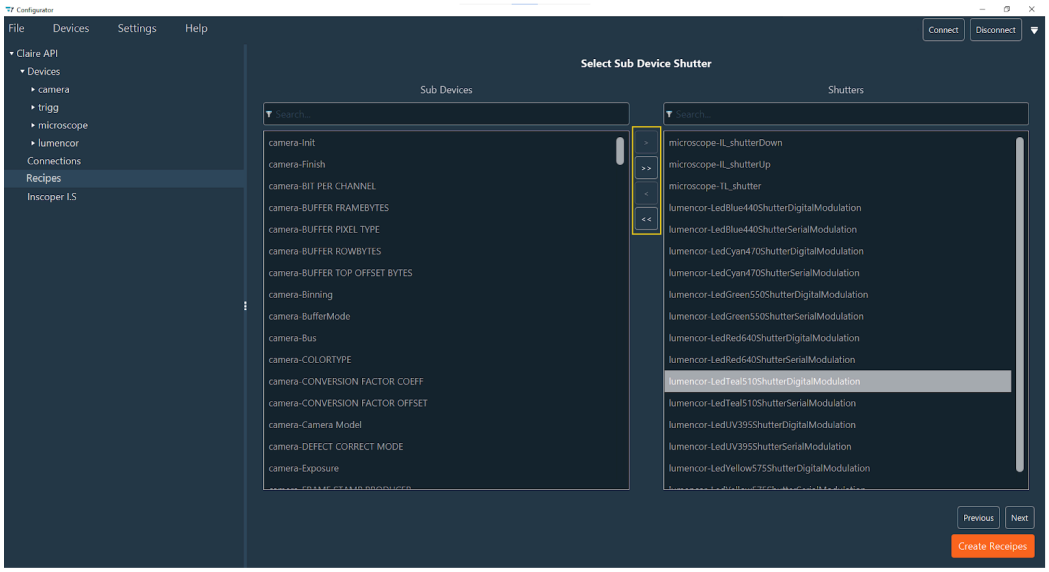
4. Enter all the shutters in your system. If one is missing, you can search for the name of the shutter in the search field of the left column and move to the right column by clicking the arrow.

   >> : All Sub Devices on the field are moved in the shutters list

   > : Only the selected Sub Device is moved in the shutters list

   << : All Sub Devices on the field are removed from the shutters list

   < : Only the selected Sub Device is removed from the shutters list

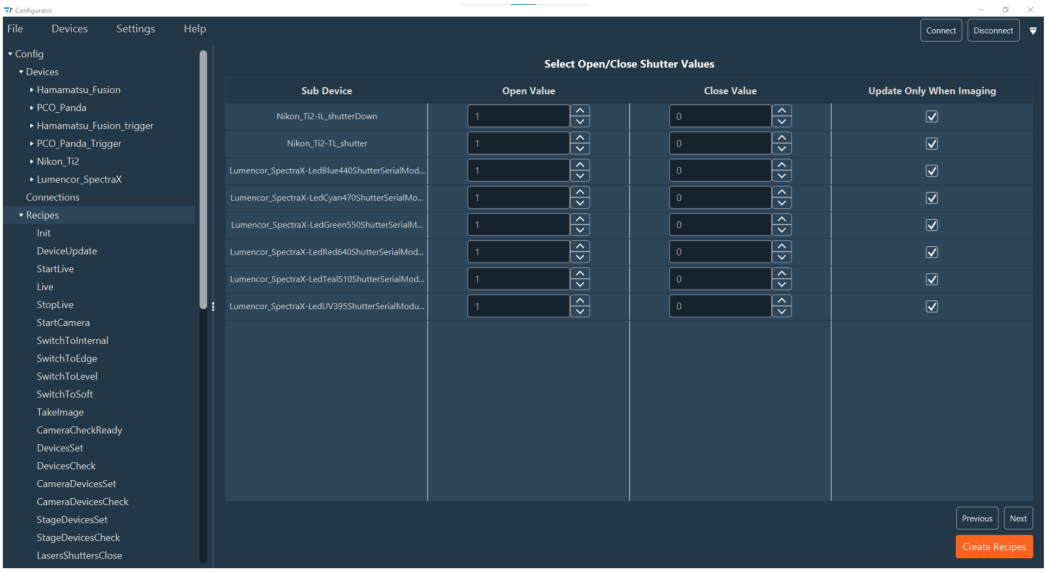


NB: Use the search line to find the needed element.

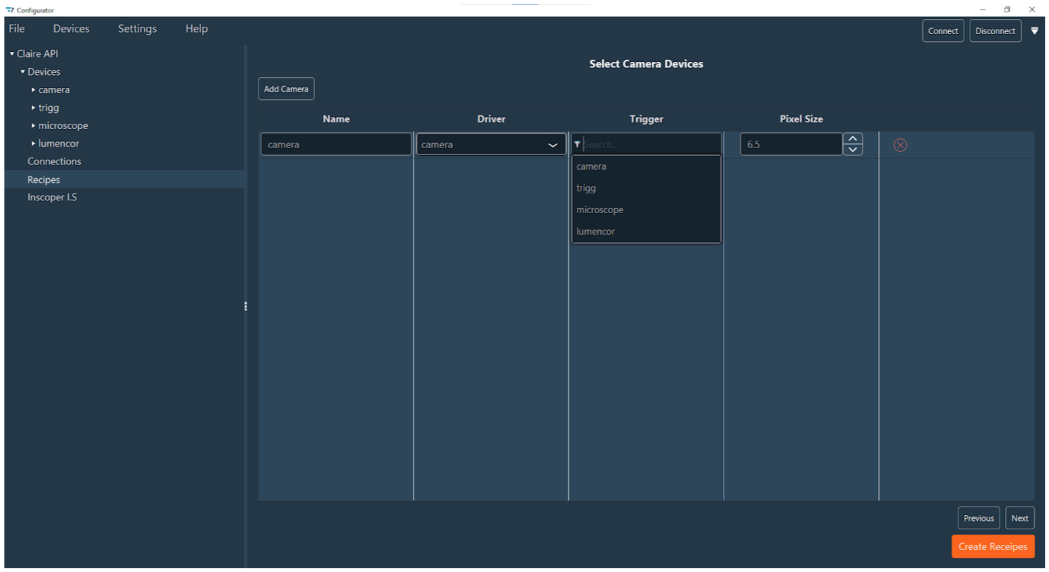
You can come back to the previous device by clicking on **Previous**. Once all your shutters are in the list, you can click **Next**.

5. Verify if the open and close values of the shutters are correct and click **Next**.

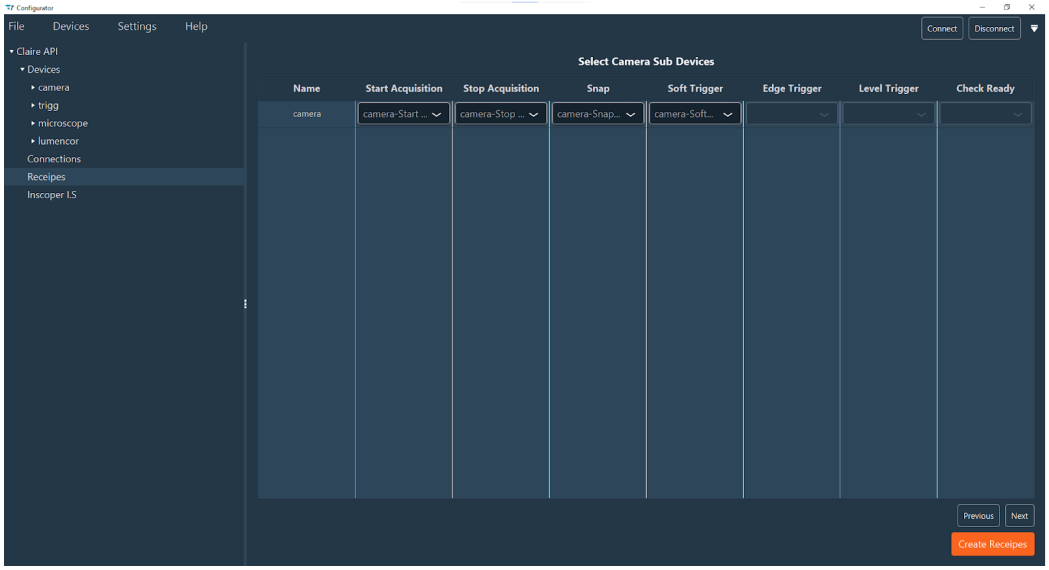
NB: By default 0 means close shutter and 1 means open shutter. Check if necessary "Update Only When Imaging". If you check the box of **Update Only When Imaging**, the status of the shutter will be only in **Live** or during the acquisition. If the box is unchecked, you can modify by yourself the status of the shutter.



6. Enter all your cameras. The camera is automatically detected. You can add many cameras by clicking on **Add Camera**. For each camera, you need to select or modify the **Name**, the **Camera Driver**, the **Trigger Device** (only if you want to trigger the camera with the device controller) and indicate the pixel size. You can delete the Camera by clicking on the red cross. Click on **Next**.

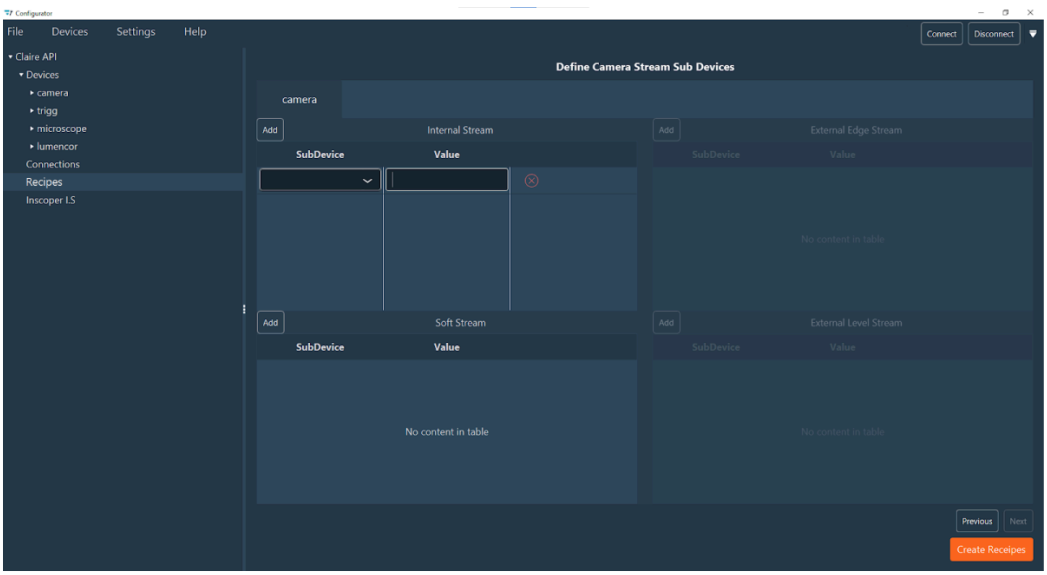


7. **Start**, **Stop**, **Snap** and **Soft Trig** Sub Devices are pre-filled. They are Sub Devices of the camera **Driver Device**. If the **Trigger Device** has been filled in, **Edge**, **Level** and **CheckReady** are available and pre-filled. Otherwise, the fields are disabled. Click **Next**.

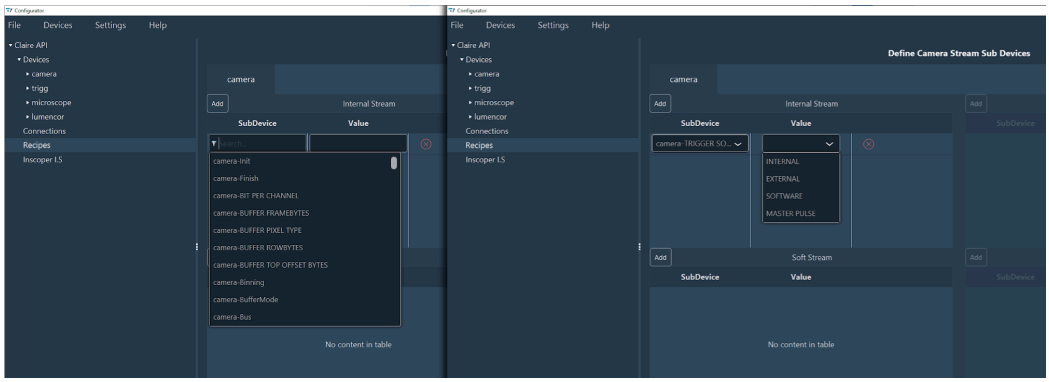


8. Define the **Camera Stream Sub Devices**: Indicate the parameters applied for the different modes of the camera. 4 fields need to be filled in:
    - **Internal Stream:** This mode I used for Live or Snap.
    - **Soft Stream:** In this mode, the camera is triggered via software by calling the previously defined Sub Device in the **Soft Trigger** field. This field is available only if **Soft Trigger** was specified in the previous view.
    - **External Edge Stream:** In this mode the camera is triggered by the DC with TTL. With this mode, you can't use different exposure times in one sequence. This field is available only if **Edge Trigger** was specified in the previous view.
    - **External Level Stream:**In this mode the camera is triggered by the DC with TTL. With this mode, you can use different exposure times in one sequence. This field is available only if **Level Trigger** was specified in the previous view.

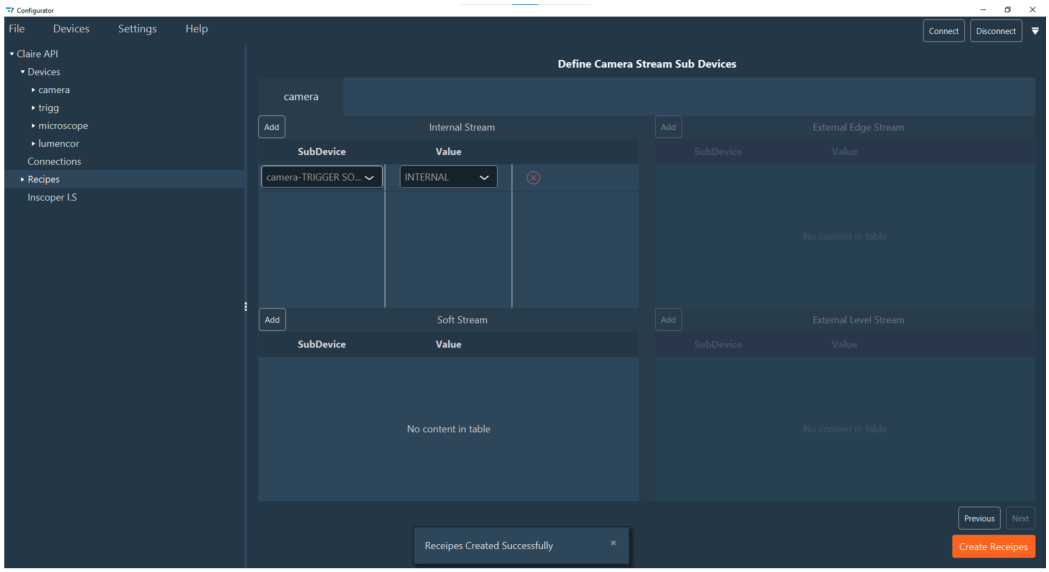
The Sub Devices responsible for those properties depend on your camera.



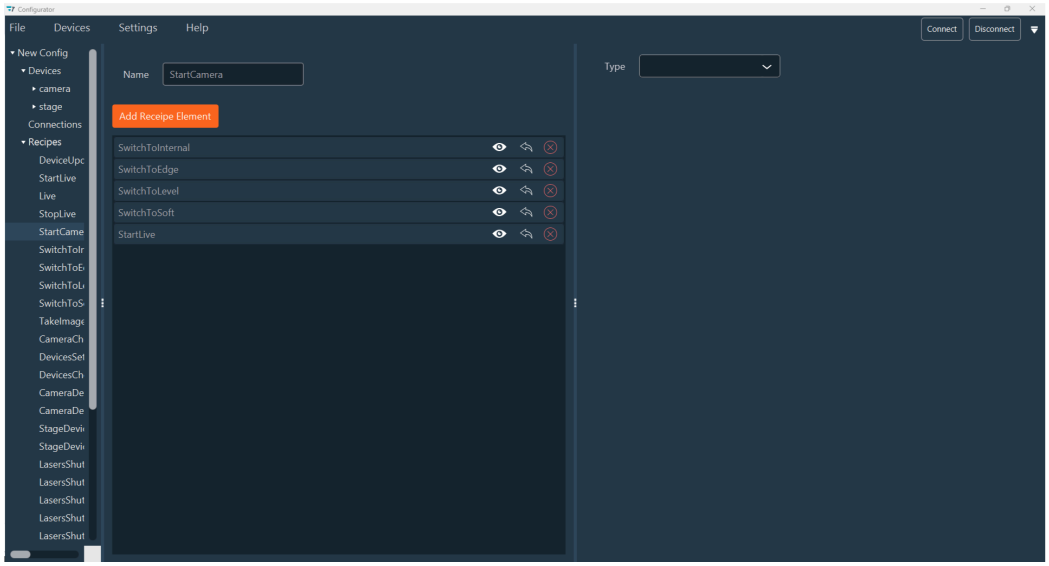
9. For each field, select the correct **Sub Device** and **Value** using the search box. Once your Sub Device is selected, you will get the values specific to this Sub Device in the Value drop-down menu.



10. [This is a optional step for all system with special techniques using ILDA connector (FRAP, TIRF) or FLIM option. If so, check ILDA functions]
11. When all the properties are filled in, click on **Create Recipe**. Once done, you will get a popup window "Receipes Created Successfully" and you will find your receipe in the configuration part (under Receipes line).

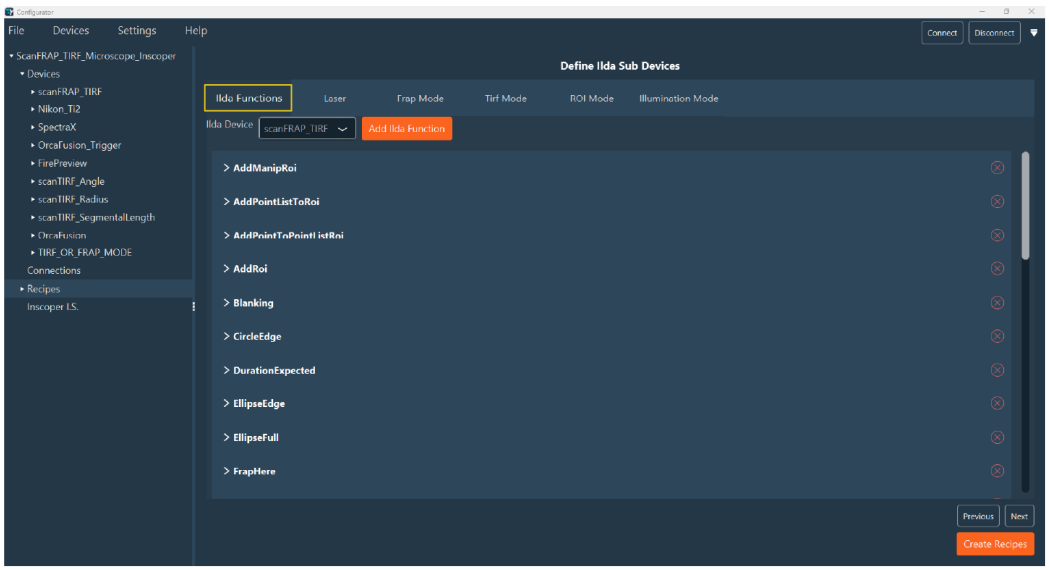


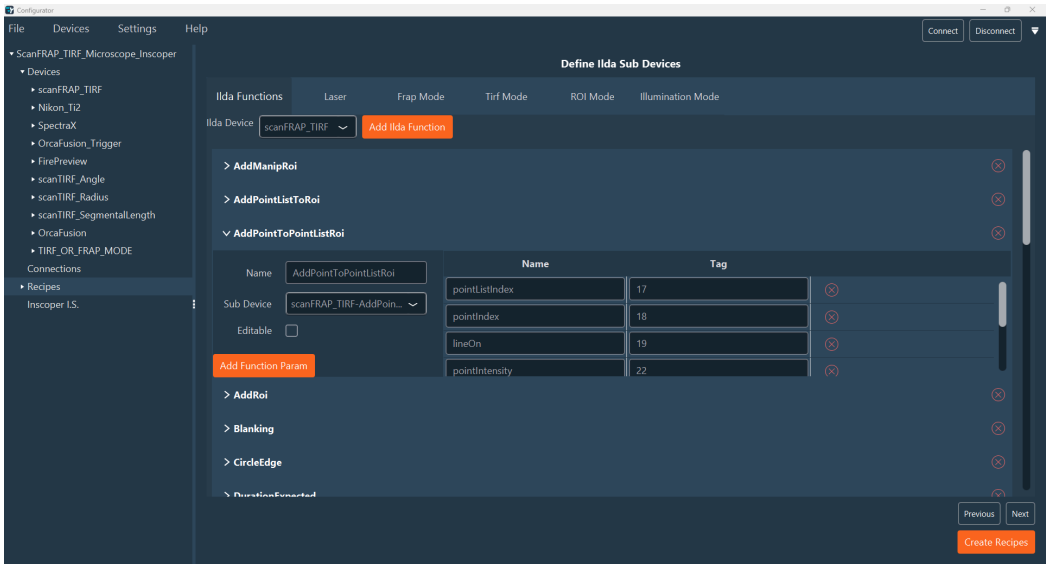
12. Normally you don't need to change the recipe, but if you want to, you can drag and drop the recipe function to change the order.



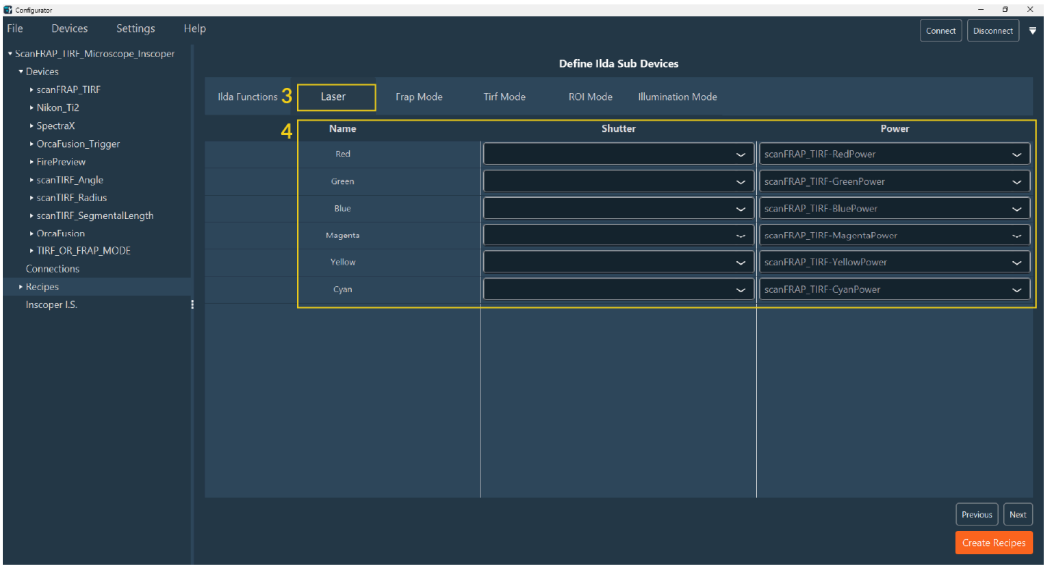
1.1.6.3. ILDA functions for FRAP, TIRF, FLIM modules

1. If you have an additional module such as a FRAP, TIRF or FLIM module, ILDA fuctions will need to be configured. You can continue setting up the recipe by clicking **Next**.
2. In the **Ilda Functions tab**, select your device connected to the Ilda connector (only available for the XL box type).





3. All Ilda functions and all parameters in each function are automatically loaded. Check if all functions and parameters are correct, then click on the **Laser tab**.
4. In the Laser tab, you will find a table where you must specify the shutter and power Sub Devices for each laser line. Select the Sub Devices by clicking on the drop-down menu in each column.



5. Then click on the **FRAP Mode tab**.
6. Select **Active Frap Mode** to access this option in the interface (if the box is unchecked, no FRAP parameters appear in the interface):

    a. Select the sub-device that determines the frap density and the scanRate.

    b. Specify the density index, which must match the FRAP diameter value set for the sub-device in the Device tab.

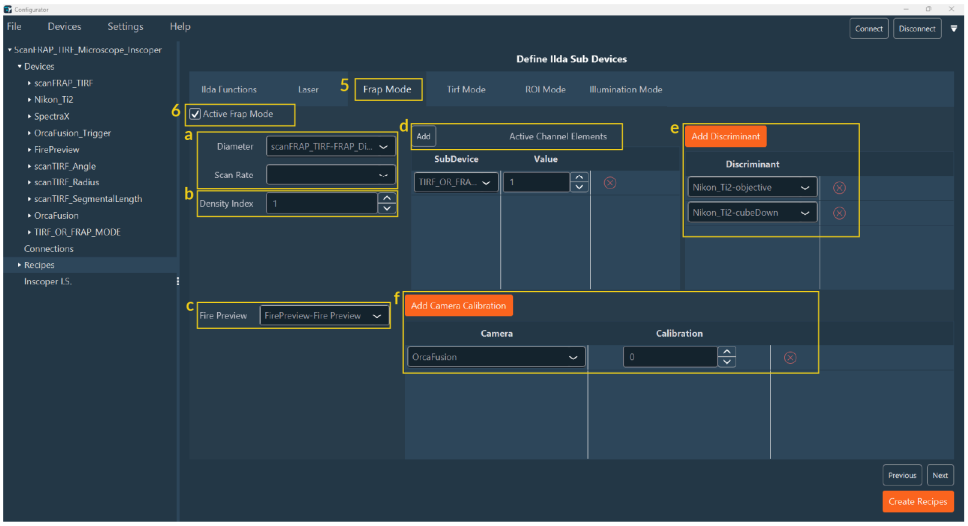
    c. Select the Sub Device that determines the Fire Preview.

d. Active Channel Elements shutter for FRAP (Allows to indicate which channel is a FRAP channel).

e. Add the discriminant for the frap calibration like Objective, filter cube.

f. Add camera calibration.

> NB: If you have several cameras indicate if you want to use the same calibration for all cameras or a different one. If you want to use the same calibration indicate the same number in the calibration column for all cameras



7. When it's done, then go to the **TIRF Mode tab.**
8. Select **Active TIRF Mode** to access this option in the interface (if the box is unchecked, no TIRF parameters appear in the interface):

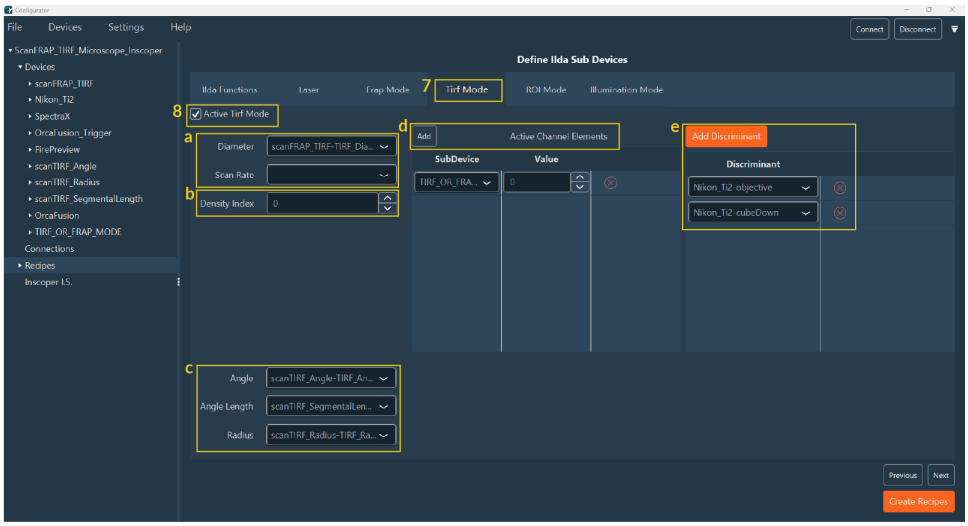
a. Select the Sub Device assigned to the TIRF density.

b. Specify the density index which need to be the same number than in the subdevice TIRF diameter in the Device tab.

c. Select the Sub Device responsible for the Angle, Angle Length and the radius. Those parameters will help you to configure as you want a TIRF experiment.

d. Active Channel Elements for TIRF (allows to indicate which channel is a TIRF channel).

e. Add discriminant for the TIRF calibration like Objective, filter cube, lasers.



9. If you have a lightsheet system, go to the **ROI Mode tab (for ROI scanning).**

a. Select **Active ROI Mode** to access to this option in the interface.

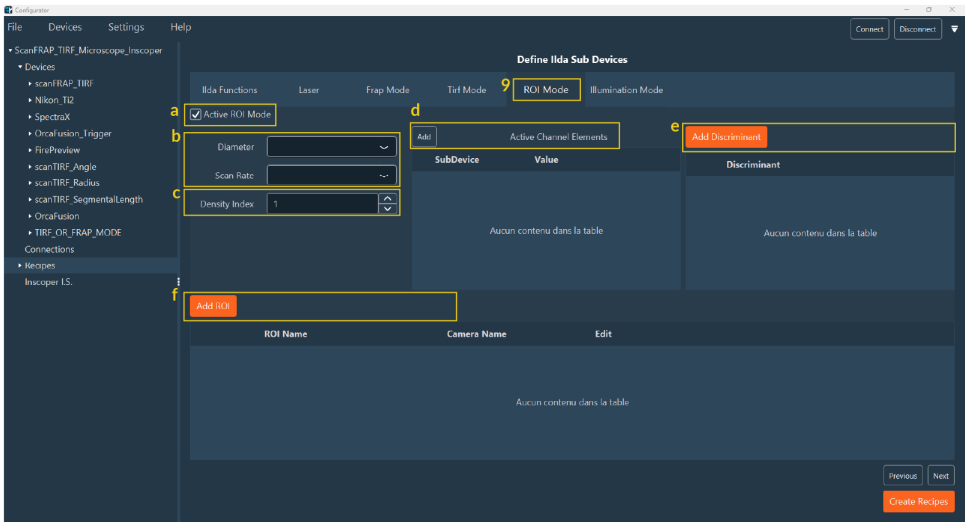
b. As with FRAP, select the sub-device that determines the density and the scanRate.

c. Specify the density index which need to be the same number than in the subdevice frap diameter in the Device tab.

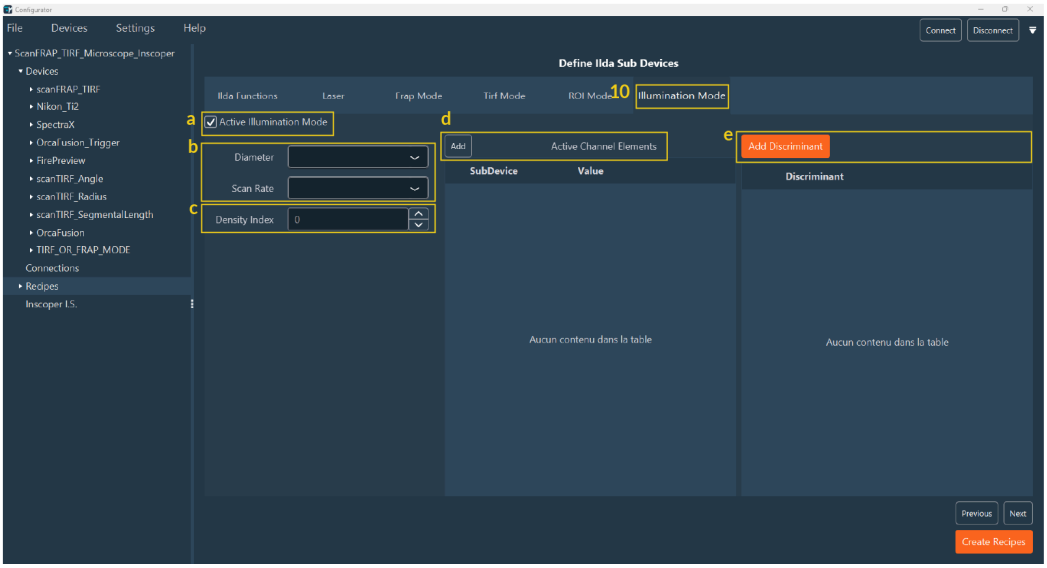
d. Add active channel elements (if you activate one element in the channel that means you are in the ROI mode).

e. Add discriminant.

f. Add ROI.



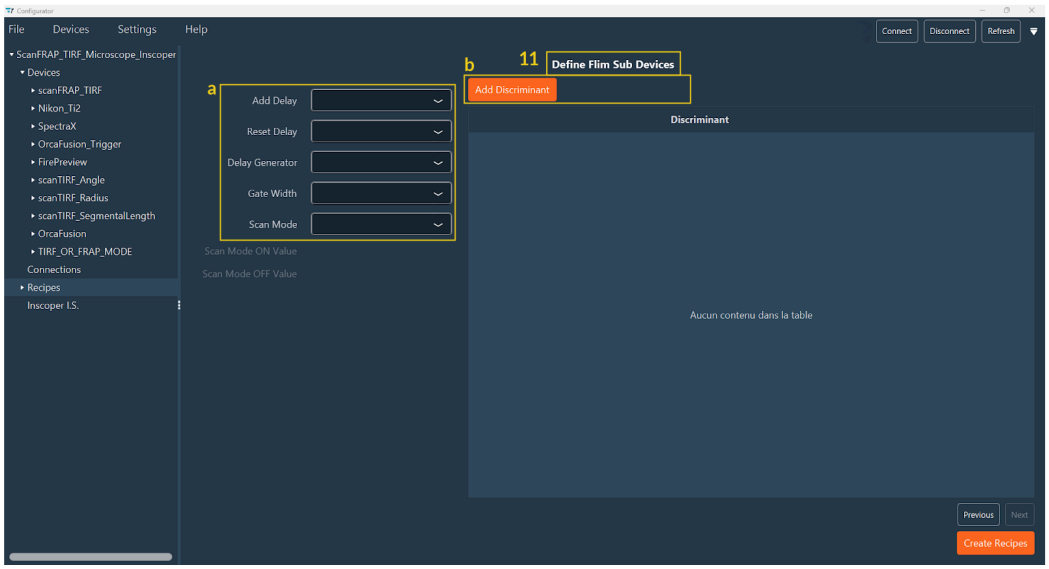
10. The **Illumination Mode** is used to add a virtual device to select the illumination mode (e.g. if you have a multimodal system with FRAP, TIRF, Spinning Disk).
    a. Select **Active Illumination Mode** to access to this option in the interface.
    b. As with FRAP, select the Sub Device that determines the density and the scanRate.
    c. Specify the density index which must to be the same number than in the Sub Device frap diameter in the Device tab.
    d. Add active channel elements.
    e. Add discriminant.



11. Click on **Next** to proceed to the last step, which is the **FLIM configuration**.

> NB: If you don't have the FLIM module, you can directly click on **Create Recipes**.

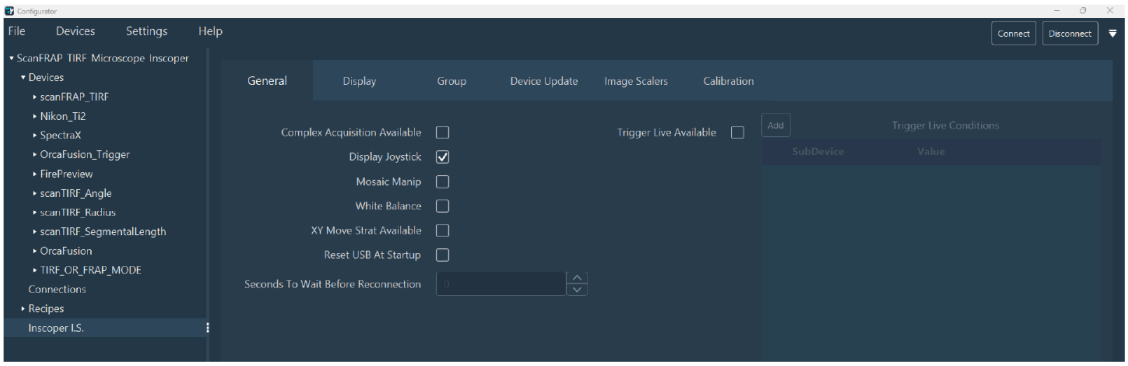
    a. Add all devices responsible for the Delay.
    b. Add discriminant.



12. Click on **Create Recipes**. Your recipe is created. You can now finalize your I.S. configuration.

1.1.7. Inscoper I.S. configuration

When the recipe is generated, the last action is to design the interface that you will use to control your system.



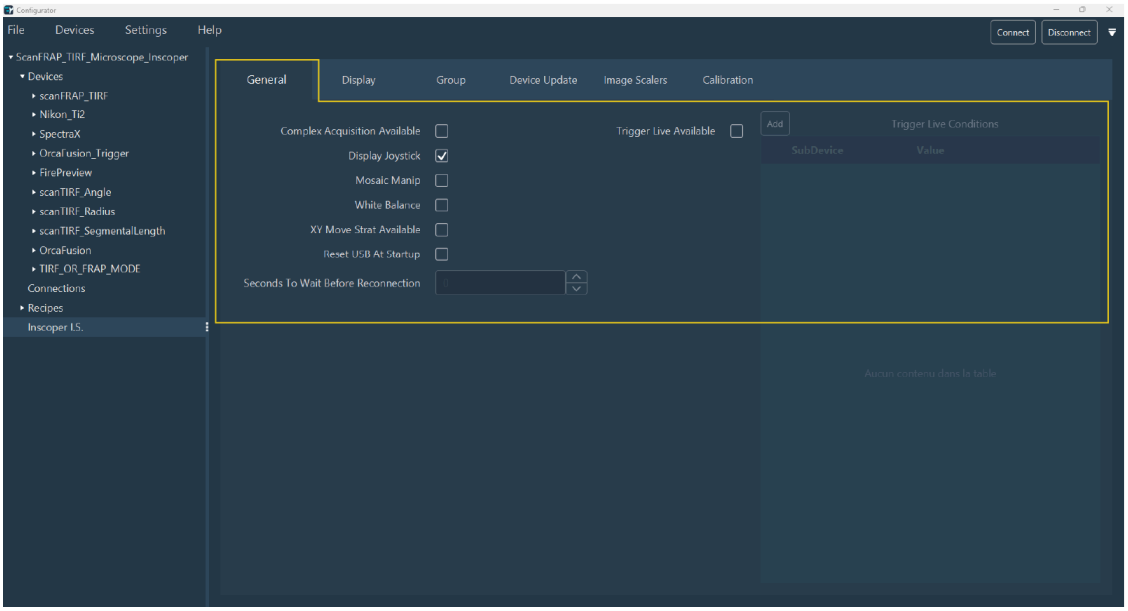
To configure Inscoper I.S. you have 6 steps to review:

- General
- Display
- Group
- Device Update
- Image Scalers
- Calibration

1.1.7.1. General

General tab allows you to select what kind of elements/options you want to have on your interface by checking boxes:

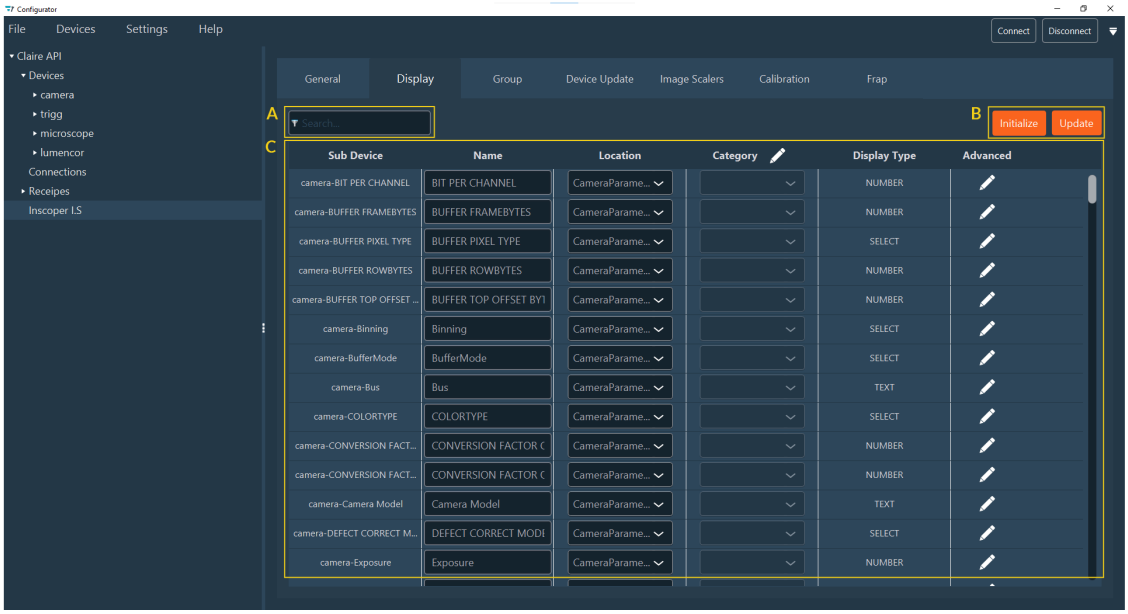
- **Complex Acquisition Available:** Option to create several acquisition sequences depending on some dimensions
- **Display Joystick**: Virtual joystick with blue arrows
- **Mosaic Manip:** Tiling calibration and experiment option
- **White Balance:** If you have color camera in your system
- **XY Move Strat Available:** Stage moving options when there is a significant distance between two positions
- **Reset USB At Startup:** Some devices need you to scan all the USB devices connected to the box, otherwise they won't be found
- **Seconds To Wait Before Reconnection:** waiting time between rescanning and reconnection (some devices may take a little longer)
- **Trigger Live Available:** allows to synchronize the Live with another device via a small sequence in the DC. You need this option if you are constrained in image capture. If you check this box you can add **Trigger Live Conditions**



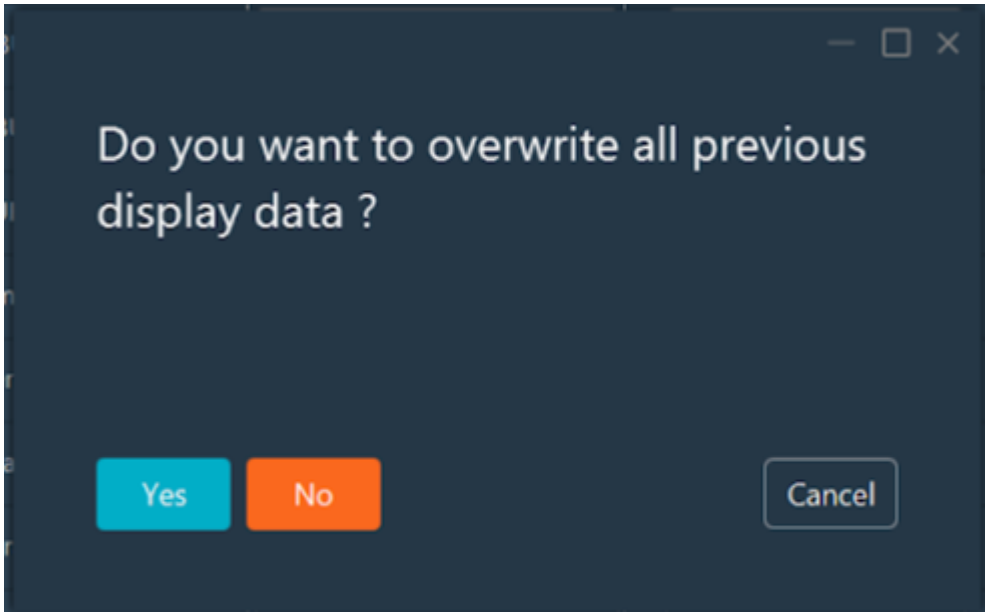
1.1.7.2. Display

Display: This tab allows you to configure the layout (**Display**) of your interface. It can be divided into different sections (**Location**) and different categories in the location (**Category**). There are 3 important points in this tab :

- A- Sub Device search field (lets you perform a quick search among items in the list)
- B- Buttons to interact with the Sub Devices
- C- The display setting table



1. Click on **Initialize** to create all Display Data (if this step has already been done but you want to add another device, click on **Update**). If you click on **Initialize** when you have already initialized your devices, you will get a message to know if you want to overwrite your current display or not.



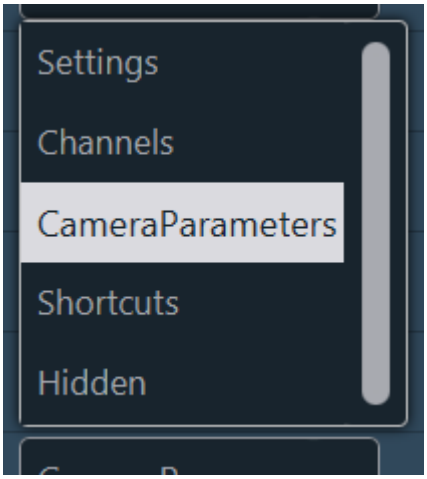
NB: After the initialization, you will get a table with all sub devices and their Location, Category, Name, Display type by default and advanced settings.

Sub Device: Sub Device bound to the display Data

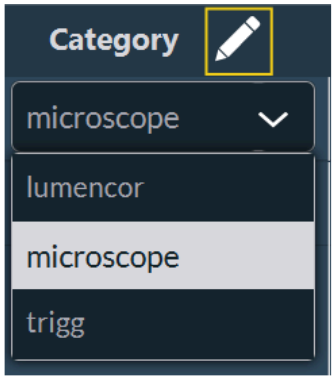
Name: name by default in the interface

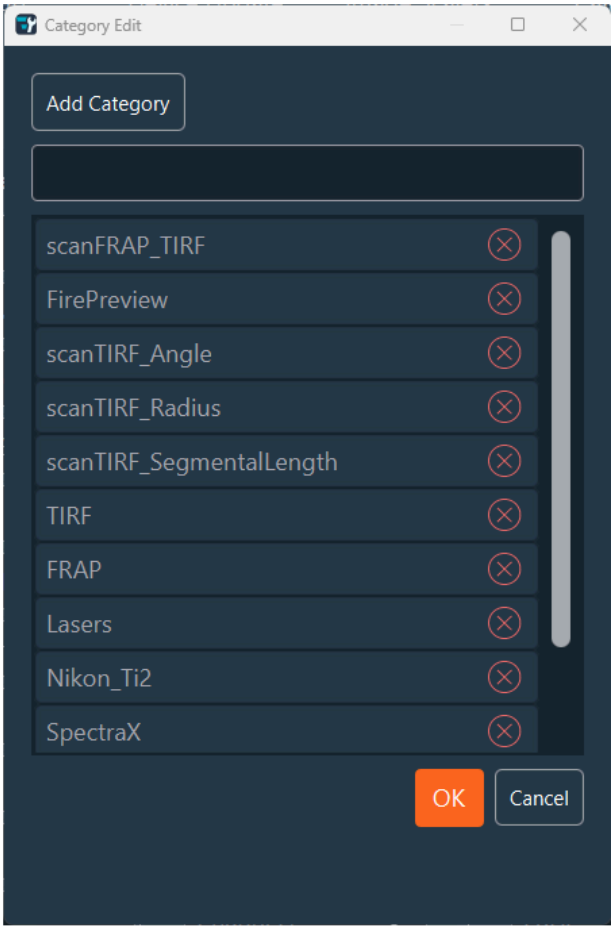
Location: in which section you want to place and display the Graphic Field.
Category: in the location you can organize sub devices by category
Display type: which kind of UI-elements it will be (for example, switcher will be a on/off button). Generated by default but you can change it by clicking on Advanced parameters.
Advanced: go to advanced parameters.

2. You can modify all the parameters directly by clicking on each column (or you can go to **Advanced**)
   # **Name**: You can change the name by editing the field.
   # **Location**: by clicking on the drop down menu you can choose another location. Depending on your system, you will find : Setting, Channel, Shortcut, CameraParameters, Hidden.



   # **Category**: You can add a category by clicking on **Edit** (pen). Write the name and click on **Add Category**, then click on **OK** to close the window. You will find the new category on the drop-down menu.

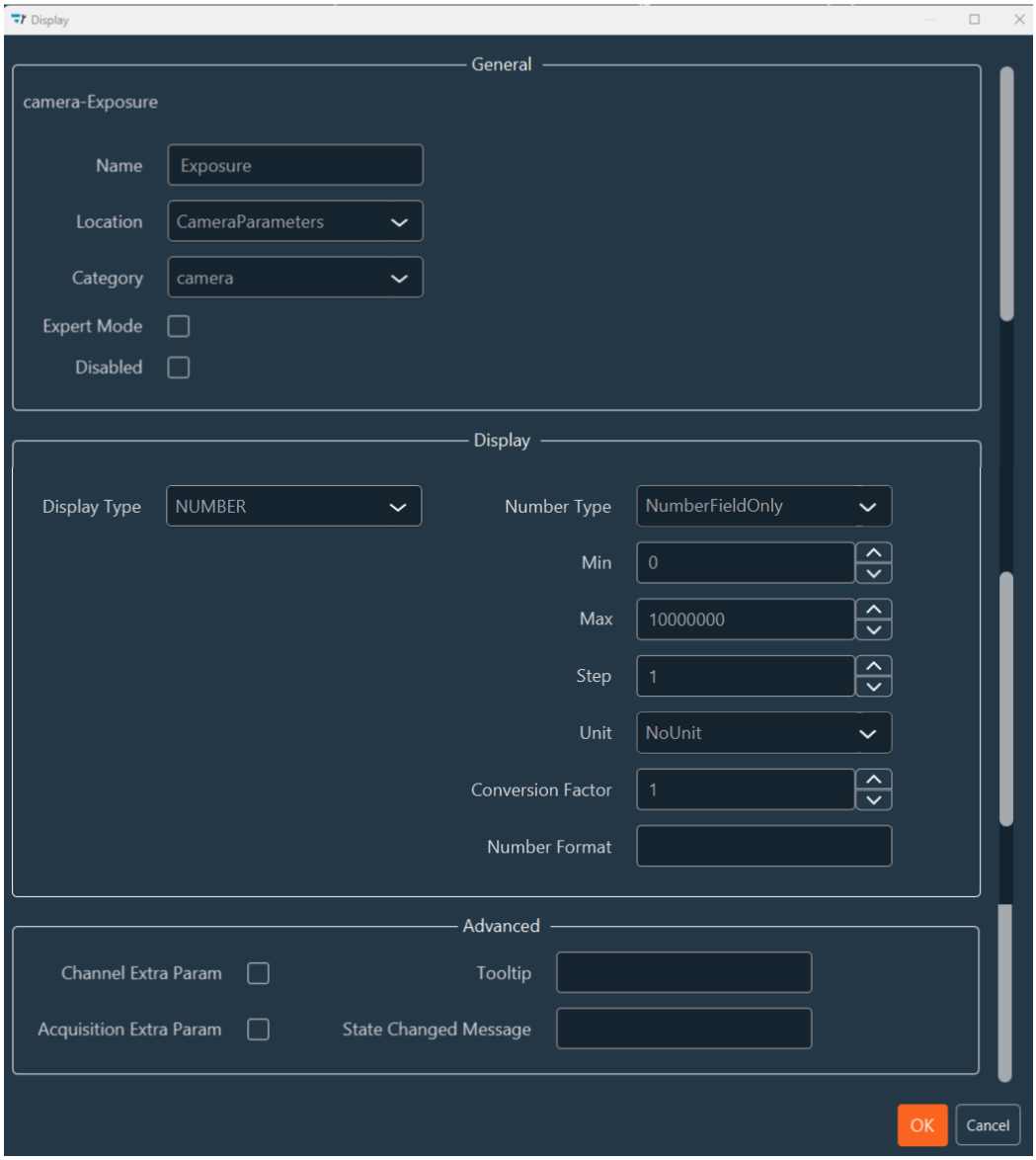




Display type: Depending on the Sub Device the display type will be by default but you can modify it by clicking on **Advanced** parameters.

Advanced Parameters.

3. **Advanced** Tab groups all previous display parameters together. Click on **Edit** (pen). You will find 3 sections to navigate by scrolling:



a. **General**:

Name: text field.

Location: drop-down list.

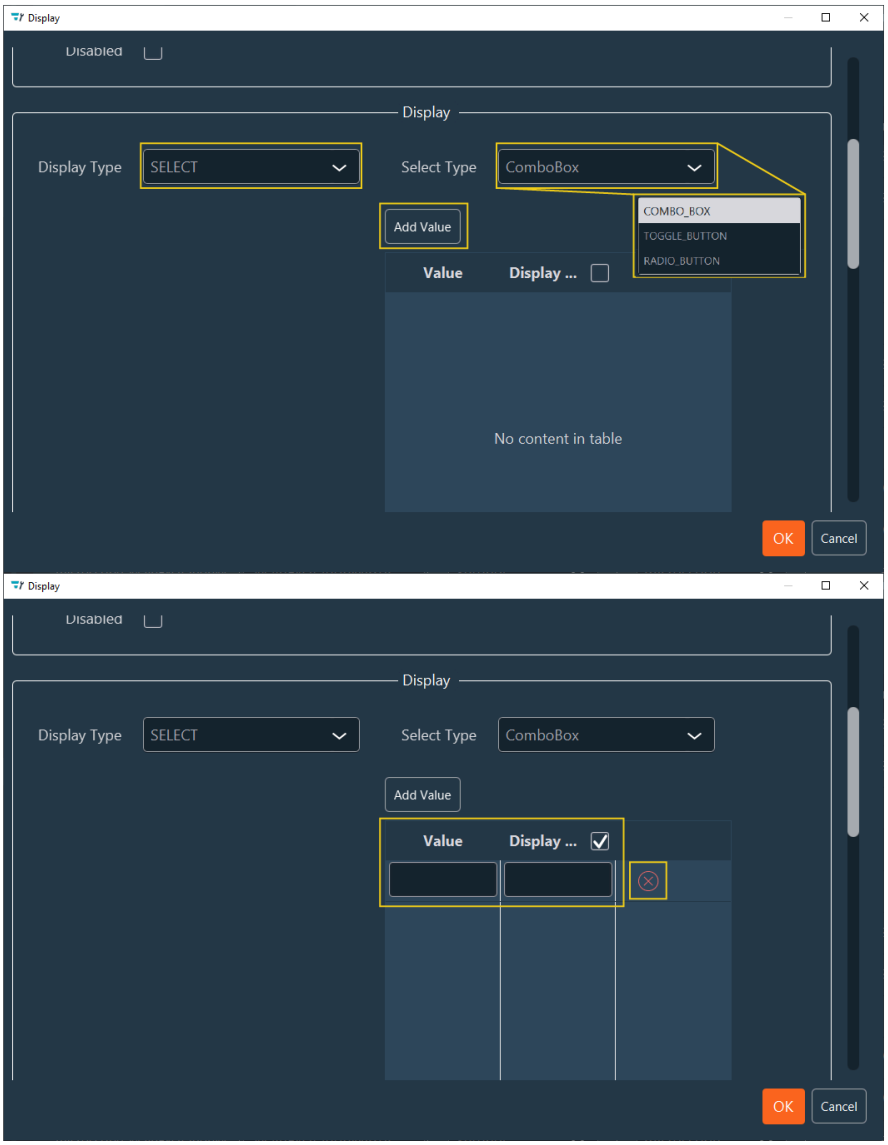
Category: drop-down list.

If you want to see this parameter in **Expert mode**, you should check the box (Expert mode allows unrestricted access to all settings and parameters of the system). If you don't check the box, the parameter will appear in **User mode**. User mode allows restricted access to some settings and parameters. The restrictions are fully customizable, from the basic channel configuration to the most advanced settings of the camera(s) or other devices.

If you check the **Disabled** box, the setting cannot be changed. It is possible to switch from User Mode to Expert Mode at any time. A password can be set to access the Expert Mode. These authorization levels are optional, depending on the use of the system.

b. Display Type:

SELECT - Select either **Combo_Box** (drop-down list), **Toggle_Button** (switching between two states) or **Radio_Button** (multiple button but one choice). Then click on **Add Value** and fill in required values. You can delete them one by one by clicking on the red cross.



NB: Example : you have 5 positions in the filter wheel (from 0 to 4 [you can find this information in the property of your Sub Device]). The display type will be SELECT and ComboBox. To configure these 5 positions you need to add 5 Values (see the example table below):

Val-ue	Dis-play
O	DAPI
1	GFP
2	YFP
3	Cy3
4	Cy5

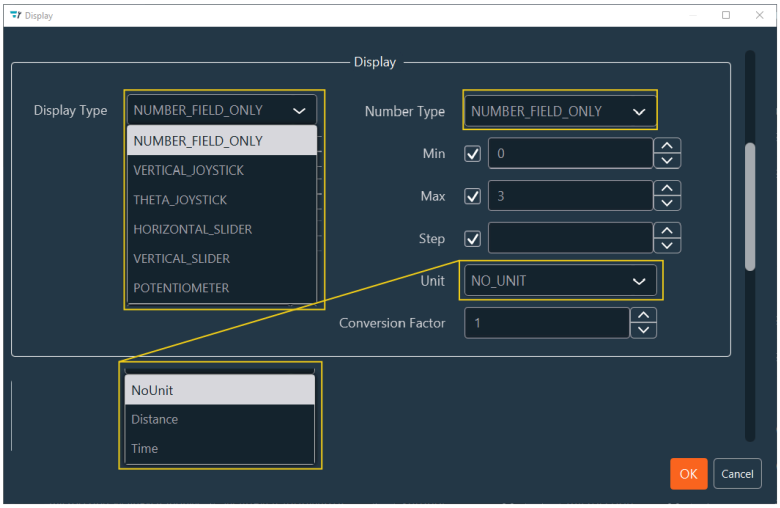
NUMBER - Select Number Type in the drop-down list:

- # Number field only
- # VerticalJoystick
- # ThetaJoystick
- # Horizontal Slider
- # Vertical Slider
- # Potentiometer

For each number type, you need to indicate:

- # Minimal and the maximal value
- # Step to change the value
- # Unit of this value: it can be **Distance**, **Time** or **No unit**
- # Number Format: decimal, the number of decimal or no decimal
- # Conversion Factor: decimal
- # For the VerticalJoystick and the ThetaJoystick, you can add a JoystickName

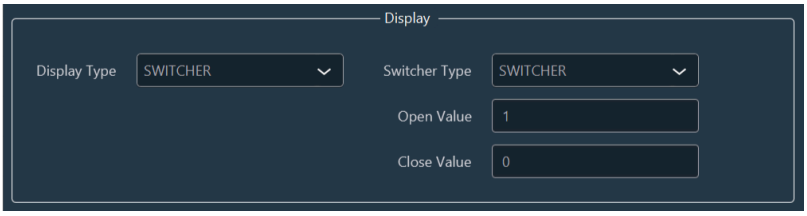
NB: Example: used for stage.



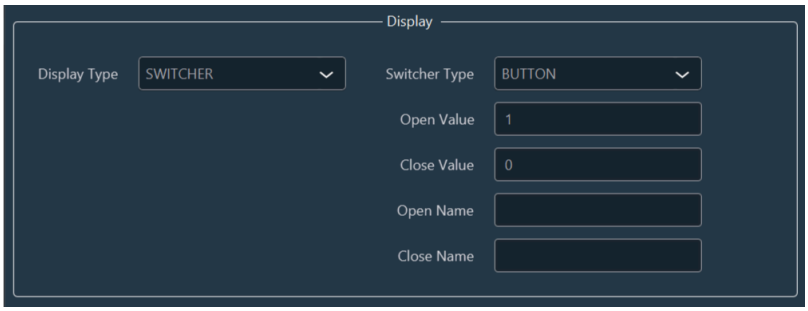
SWITCHER - Select **Switcher Type** between **Switcher** or **Button** in the drop-down menu:

If **Switcher**, indicate the **open** and **close** value.

> NB: For Inscoper, 0 is for close value and 1 is for open value.



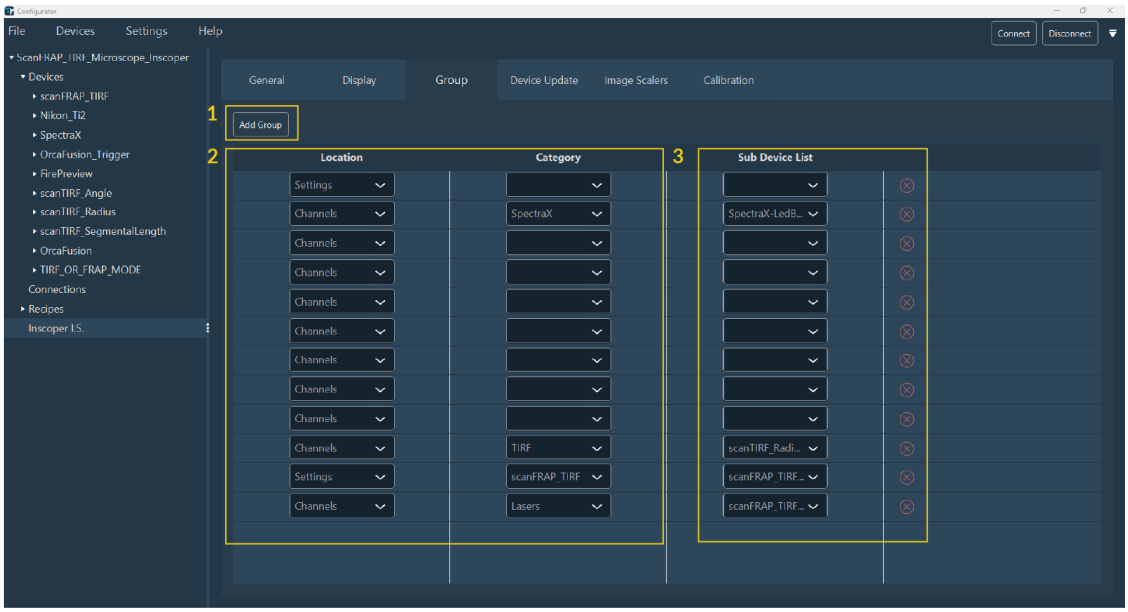
If **Button**, indicate the open and close value, open and close name.



TEXT - Text display type requires no action from your part.

1.1.7.3. Group

This tab allows you to group the display of several settings.

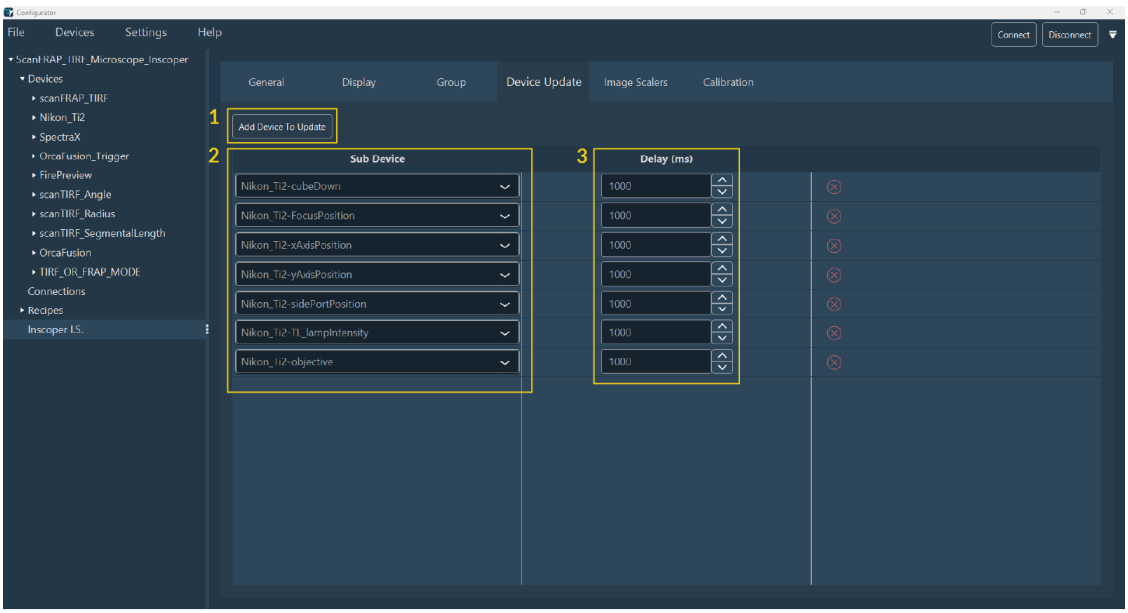


1. Click on **Add group**.
2. Find the sub devices you need to group by filtering by **Location** and **Category**.
3. Select them in the **Sub Devices** drop-down list.
4. Repeat the previous steps if you need to group more items.
   If necessary, you can delete the group by clicking on **Delete** (red cross).

1.1.7.4. Device Update

This tab allows you to select the devices whose values are to be updated automatically. The interface will query the drivers (DC, custom and Micromanager) to update the device value.

Example: it is important to update the values because the stage can be moved manually with the joystick.

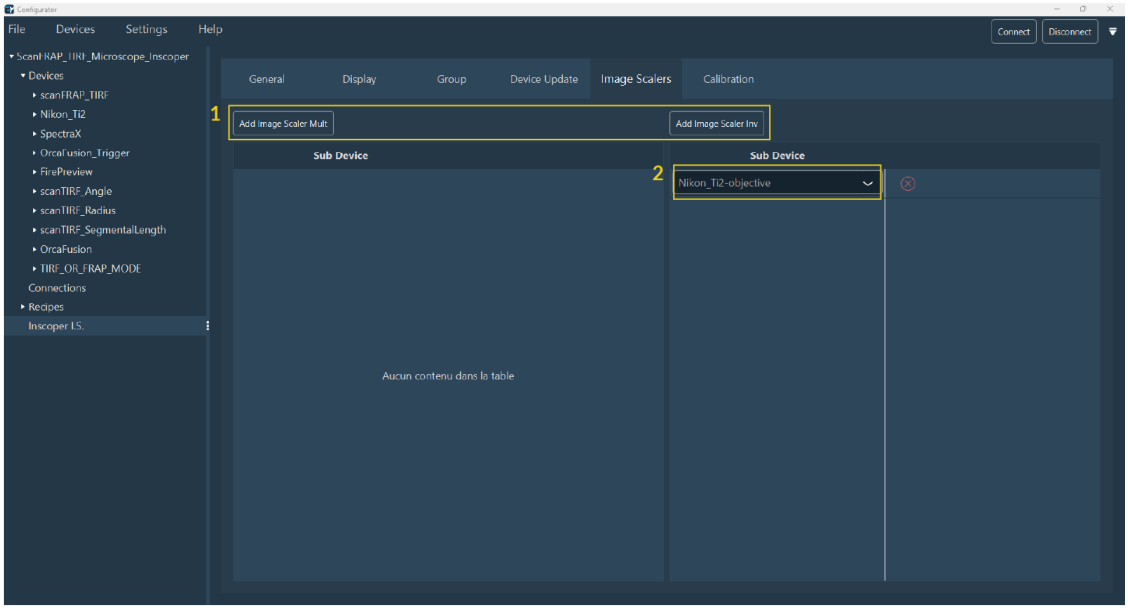


1. Click on **Add Device to Update**.
2. Use the search form to select the devices you need.
3. Indicate the delay of the update.
4. Repeat these steps if needed.
   If necessary, you can delete the device by clicking on **Delete** (red cross).

1.1.7.5. Image Scalers

All devices that can change the pixel size of the image should be specified in this tab. Example: objective.

This is very important for tile calibration and experiment, scale bar, and metadata.

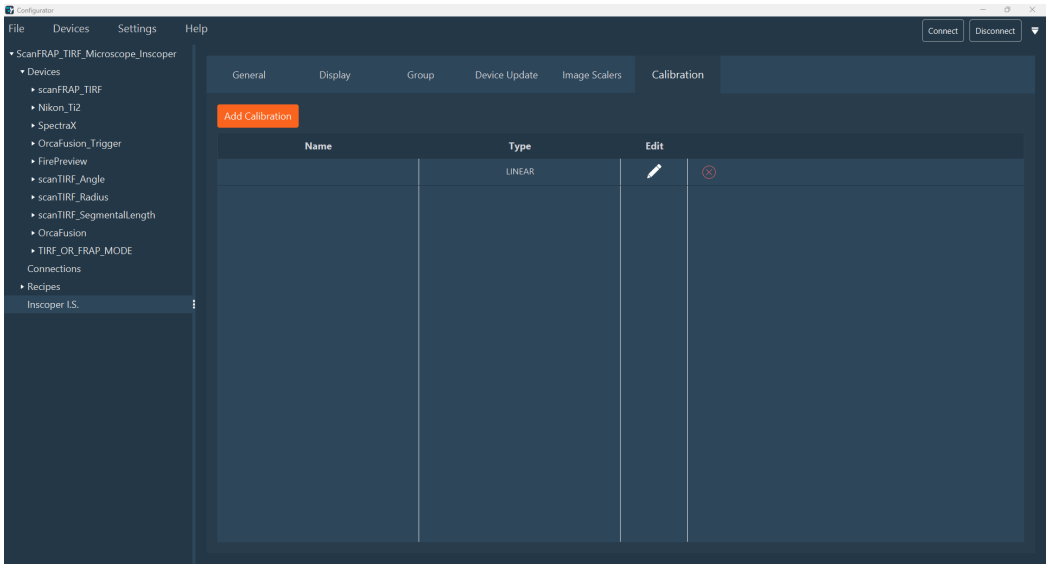


1. Click **Add Image Scaler Mult** or **Add Image Scaler Inv** to specify the Sub Device that enlarges or reduces the image size respectively.
2. Select the Sub Device of interest from the drop-down menu.
3. Repeat these steps if needed.
   Click on **Delete** (red cross) to delete the Sub Device.

1.1.7.6. Calibration

Calibration means putting a dependency link between 2 sub devices. Allows to set up different calibrations for your application.

1. Click on **Add Calibration** to create a new one.
2. Once you add it, you can edit it by clicking on the **pen**. You can delete it by clicking on the red cross.



3. In the Calibration Edit window, you can:

    a. Indicate the **name** of your calibration.

    b. Select the **type** of calibration (which formula you want to use to move the device). You can find several type like :

        # **Linear:** Linear formula (ax+b);
        # **Linear delta:**
        # **Bilinear:** representing a 3D plane (ax+by+c);
        # **Linear piece wise:** allows a curve approximation;
        # **Constant:** applying a fixed parameter between 2 devices;
        # **Formula:** you can enter a formula that you need

    c. **Auto Update:** If you check this box, you will get a button in your interface to deactivate the calibration. If this box is checked, you will have to specify the name of the button and its location (Category).

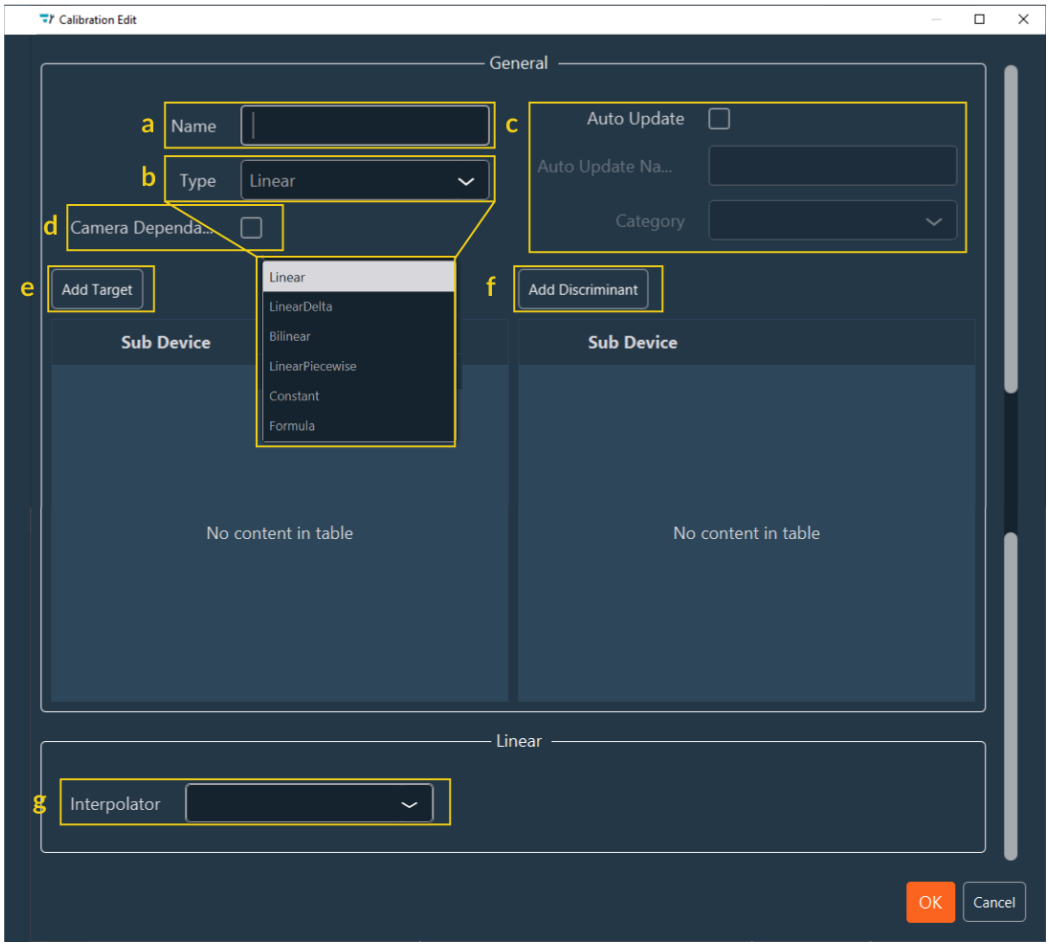
    d. **Camera Dependant:** Check this box if your calibration depends on the camera (example: Tiling and FRAP).

    e. **Add Target:** Add the target device, i.e. the device to be modified.

    f. **Add discriminant:** The discriminant is a Sub Device or device if you modify one of these Sub Devices, you must make the calibration again. For example, for FRAP calibration, if you change your objective or filter, you need to do another calibration.

NB: The discriminants will be filters and objectives.

g. **Interpolator:** select the Sub Device that is not the objective. For example, with the bilinear formula, you will have 2 interpolators.



4. Click **OK** to save the calibration.

1.2. Glossary

1.2.1. References

1.2.2. Devices

A device refers to a peripheral that can be either physical (hardware) or virtual. Each device is controlled by a driver and includes a sub-device responsible for its initialization (Init) and shutdown (Finish). A device may contain multiple sub-devices that perform various functions or actions. These

can be either mechanical (e.g., moving a motor) or informational (e.g., retrieving values or version data). A hardware device can be connected either to the Inscoper Device Controller (DC) or directly to the PC (e.g., a USB camera).

1.2.2.1. Device Description

The device description is a structure summarizing all known information about a device. It is stored either in the firmware or within the driver, if applicable. The information includes:

Field	Description
Driver	The type of driver used to control the device (see Driver Type).
Brand	The hardware manufacturer of the device. Example: Nikon for a Nikon microscope.
Model	The model(s) compatible with this device description. Example: Ti2 for a Nikon Ti2 microscope. Example: All models for Hamamatsu cameras that can be operated using the same driver.
Description	A short text describing the driver.
Author	The author of the device description.
Changelog	A manually maintained log of changes (no specific content convention).
Release Date	The date and time when the driver version was tagged.
Version	The version number of the driver.

1.2.2.2. Detect

The Detect function scans all hardware connected to the computer that are compatible with the selected driver and retrieves their serial numbers. It allows the user to select the serial number corresponding to the device being added, ensuring the correct module is identified. This is particularly critical when multiple devices using the same driver (e.g., two Hamamatsu cameras) are present on the system. The Detect function is available only for custom drivers .

1.2.2.3. Diagnostic

The Diagnostic function performs two main tasks:

1. It verifies that the device is properly connected to the device controller.
2. It retrieves all sub-devices associated with the device, indicating whether each is available or unavailable.

Each sub-device can have one of three possible statuses:

Status	Meaning
Available	The sub-device is detected and operational.
Unavail-able	The sub-device is detected but not functional.
Unknown	The system cannot automatically determine the presence or absence of the sub-device.

For custom drivers and Micro-Manager drivers, the function returns the list of device properties (equivalent to the list of available sub-devices).

For all drivers, the Diagnostic function updates parameter constraints such as minimum, maximum, and allowed values (list).

1.2.2.4. Camera

A Camera is a specialized device responsible for acquiring image data. In the Inscoper API, cameras are treated as high-level devices that manage image buffers, acquisition parameters, and triggering modes.

Trigger Device

A Trigger Device is used to provide precise control of a camera through triggering (TRIG) with the device controller. When installing a camera, two devices may be required:

1. A Camera Device, which retrieves all camera functions and properties.
2. A Trigger Device, which enables fine control and synchronization of the camera through hardware triggering by the DC.

If a camera is connected only via USB to the computer and not through the DC, only the camera device needs to be created, as trigger control is not handled by the Inscoper hardware in this case.

Camera Stream

A Camera Stream defines the method used to trigger image acquisition and control exposure timing. It determines whether the camera operates autonomously, responds to software commands, or synchronizes with external hardware signals.

Stream Mode	Description
Internal	Used for Live or Snap operations (but not triggered Live). Also used for acquisitions not requiring specific hardware driving.
Soft-ware	The camera is triggered by a software command; exposure time is handled by the computer.
Exter-nal Edge	The camera is triggered by an external TTL edge; exposure time is internal to the camera. Exposure cannot vary within a single sequence.
Exter-nal Level	The camera is triggered by an external TTL level; exposure lasts as long as the trigger is asserted. Allows multiple different exposure times within one sequence.

Start Acquisition

A function that sets the camera to image acquisition mode. Unlike "Snap," which captures a single image, this starts continuous image acquisition (Live). This is useful when a continuous stream of images is required. Note that images may not be acquired immediately, depending on the camera's trigger mode (Internal, Software, Edge, Level).

Stop Acquisition

A function that stops the current acquisition mode of the camera.

Snap

A function to capture a single image.

NB: For specific cameras like Maico or PcoFlim, a "Snap" may acquire multiple images (e.g., different selected wavelengths for Maico, or different phases for PcoFlim).

Camera Stream Definitions

Software Trigger

The sub-device used for image capture in software stream mode. The image capture signal is sent via software rather than an electronic signal.

Edge Trigger

The sub-device used for image capture in external edge stream mode. A short electronic signal is sent to start image capture.

Level Trigger

The sub-device used for image capture in external level stream mode. An electronic signal with a duration equal to the exposure time is sent to start image capture and control the exposure duration.

Check Ready

A sub-device that waits for the camera to signal it is ready to take the next picture. It waits for an electronic signal from the camera (often called "Trigger Ready") or uses a timer delay if the camera does not provide such a signal. This ensures the system waits until the camera is ready before sending the next trigger signal.

Is Controlled

A function used when the camera's external triggers are controlled by a device other than the Inscoper Controller (DC).

NB: Confocal.nl hardware.

1.2.2.5. Select For IIS

Automatically selects the subset of sub-devices/functions that are useful for controlling the camera with the Inscoper software (IIS). This is available only for custom drivers.

1.2.2.6. Shutter

A motorized element in the microscope or an external component that allows the light source beam to pass through or be blocked.

NB: The specific values (0/1, True/False) depend on the implementation.

Update Only When Imaging

When enabled for a shutter, the "Open" status is sent only while the camera is actively acquiring images, even if the shutter is set to "On" in the software. Otherwise, it remains closed to preserve the sample.

1.2.3. Device Controller

1.2.3.1. Firmware

Software operating within the Device Controller (DC) that enables the execution of sequences sent by the IIS. While the firmware offers many functionalities (providing device descriptions, restarting the box, etc.), its primary role is to execute pre-received sequences.

1.2.4. Drivers

1.2.4.1. External Resources

Path to the directory on the computer where Micro-Manager and custom drivers (DLL files) are stored.

1.2.4.2. Drivers Type

Custom

Custom driver

Drivers that have been integrated directly via their SDK and are controlled on the computer. This primarily applies to cameras.

µManager

Drivers for controlling devices using Micro-Manager.

Module Name

"Module Name" and "Device Name" are concepts specific to Micro-Manager.

Inscoper Box

Drivers that operate inside the Device Controller (DC).

Hardware ID

A unique identifier for a given hardware model.

1.2.5. Sub Devices

A sub-device is a functional component within a device that represents a controllable property, capability, or action. Sub-devices are the fundamental building blocks that allow the Inscoper system to interact with hardware at a granular level.

Core Concept:

While a device represents an entire piece of hardware (e.g., a motorized stage, a camera, or a filter wheel), a sub-device represents a specific aspect or function of that hardware. This modular approach allows complex devices to be controlled through simple, well-defined interfaces.

Categories of Sub-Devices:

1. Property Sub-Devices (State/Value Access)

Represent readable or writable properties of the hardware:

- Camera exposure time
- Stage X, Y, or Z position
- Filter wheel position
- Shutter open/closed state
- Objective turret position
- Device firmware version number

2. Action Sub-Devices (Commands/Operations)

Represent operations or commands that don't necessarily correspond to a single property:

- `MoveXY` - Triggers coordinated movement of both X and Y axes
- `StartAcquisition` - Initiates camera image capture
- `StopAcquisition` - Halts ongoing acquisition
- `Initialize` - Performs device initialization sequence

3. Virtual Sub-Devices (Software-Defined)

Exist purely in software without direct hardware correspondence:

- Calculated values derived from multiple hardware readings
- Software-managed state flags

- Version information and metadata
- Diagnostic status indicators

Examples:

A motorized XY stage device might contain these sub-devices:

- `XPosition` (property) - Current X-axis position in micrometers
- `YPosition` (property) - Current Y-axis position in micrometers
- `XResolution` (property) - Step size for X-axis movement
- `YResolution` (property) - Step size for Y-axis movement
- `MoveXY` (action) - Command to execute coordinated movement
- `Version` (virtual) - Firmware version string

A camera device might contain:

- `Exposure` (property) - Exposure time in milliseconds
- `Binning` (property) - Pixel binning factor
- `ROI` (property) - Region of interest coordinates
- `StartAcquisition` (action) - Begin capturing images
- `StopAcquisition` (action) - End image capture
- `Snap` (action) - Capture a single image

1.2.5.1. Properties

1.2.5.2. Status

Indicates whether a sub-device is present or not for a device.

Status	Meaning
Available	The sub-device is detected and operational.
Unavail-able	The sub-device is detected but not functional.
Unknown	The system cannot automatically determine the presence or absence of the sub-device (e.g., after a diagnostic check failed to verify status).
Partially Available	Only some functions of the sub-device are available.

1.2.5.3. Param

- Property Name: The name of a configurable parameter for a sub-device (e.g., "Exposure" for a camera's exposure time). This is valid only for external drivers (Custom and Micro-Manager). It is always FIXED for IIS, though not necessarily for API use.
- Property Value: The value assigned to a property (e.g., "200ms"). Valid only for external drivers. The default value is set when IIS starts but can be modified by the user.
- Example: To start a camera in "Fast Mode" upon IIS launch, set Property Name = "Read Mode" and Property Value = "3".
- Default: The default value of the parameter.
- Fixed: If checked, the sub-device's value cannot be modified.
- Example: For a 3-axis controller, three sub-devices are created. The axis number (name) is marked as Fixed for each, while the position value remains editable.
- Note: There should never be two unfixed parameters in one sub-device.
- Min: The minimum allowed value. Defined by the device creator (based on the datasheet) or provided by the driver/Micro-Manager.
- Max: The maximum allowed value. Defined by the device creator (based on the datasheet) or provided by the driver/Micro-Manager.
- Step: Minimum increment for value update.
- The type of constraint can define the step; e.g. for integer constraint type, the default step is 1 (the step is induced by value type). If no step is provided by the firmware/drivers, IIS takes either step = 1 (if integer) or step = (max - min) / 1000 (for float).
- Type: (parameter type, among:), unsigned char, double, STRING

Description

Name

Name of the sub-device.

Type

Flags/tags to characterise the nature of a subdevice.

Lifecycle / System

Type	Description
NONE	No specific category or behavior associated with this sub-device.
INIT	Sub-device that triggers the device initialization sequence.
FINISH	Sub-device that triggers the device shutdown sequence.
DIAG	Sub-device that executes the diagnostic (DIAG) procedure.
USB_CHECK	Verifies that the USB device is connected and responsive.

Motion & Axis Control

Type	Description
X_AXIS	Represents movement or positioning along the X axis.
Y_AXIS	Represents movement or positioning along the Y axis.
MOVE_-AXIS	Generic movement command for an axis (X, Y, Z, or other).
FOCUS	Controls the focus mechanism (typically Z axis).

Optical / Hardware Components

Type	Description
SHUTTER	Controls opening and closing of a shutter.
OBJECTIVE	Selects or controls a physical objective lens.
CUBE	Controls filter cubes or optical paths.
FILTER_WHEEL	Selects filter positions using a rotating wheel.
MAGNIFI-CATION	Handles magnification settings (e.g., objective changer, zoom optics).
PROPERTY	Generic hardware property used for reading/writing vendor-specific parameters.

Triggering & Synchronization

Type	Description
TRIG_EDGE	Trigger based on a digital edge (rising/falling edge).
TRIG_LEVEL	Trigger based on a digital level (high/low).

Camera Operations

Type	Description
CAM_CHECK_READY	Checks whether the camera is initialized and ready for acquisition.
CAM_START_-CONTINUOUS	Starts continuous acquisition mode (Live).
CAM_START	Starts a single-sequence acquisition.
CAM_STOP	Stops acquisition (Live or sequence).
CAM_SNAP	Camera snap sub-device: performs a single image capture.
CAM_SOFTWARE_TRIG	Software-triggered image acquisition sub-device.

1.2.5.4. Functions (Set/Get/Check)

Functions

Func-tion	Description
Set	Assigns a new value to the device (e.g., moves an objective lens, opens a shutter).Example: Sending 0 or 1 to a shutter sub-device to close or open it.
Get	Retrieves the current value from the device.
Check	Verifies whether a SET function completed successfully by repeatedly calling GET until the retrieved value matches the expected target.Example: Waiting until a stage's X-axis position matches the requested position.

For each function, there are:

- Input Params: Parameters sent to the function.
- Output Params: Parameters returned by the function.

Connections

A Connection defines the physical or logical communication channel used to control a device and exchange commands with it. Connections establish the link between a device and the Inscoper Device Controller (DC), enabling the system to send control signals and receive status information.

Key Concepts:

- Each device is configured with one or more connections that specify how it communicates with the DC
- Sub-device functions (SET, GET, CHECK) are executed through these defined connections

- The connection type determines the protocol, signal characteristics, and data flow direction
- Different connection types support different capabilities (digital signals, serial communication, analog values, etc.)

NB: The "Connection" configuration field for sub-devices is only available when using INSCOPER_BOX drivers. Custom drivers and Micro-Manager drivers handle connections differently through their respective APIs. Connection Types:

Type	Signal Type	Direction	Description
TTL_IN_GEN	Digital (0-5V)	Input	Digital signal read by the Device Controller from external hardware. Used for reading trigger signals, limit switches, or sensor states.
TTL_OUT_GEN	Digital (0-5V)	Output	Digital signal sent by the Device Controller to external hardware. Used for triggering cameras, controlling shutters, or activating relays.
SERIAL	Serial Data	Bidirectional	RS232 or USB serial connection for command-based communication. Supports both sending commands and receiving responses.
USB_GENERIC	USB Protocol	Bidirectional	Standard USB connection requiring manufacturer-specific drivers. Used for devices with proprietary USB protocols.
USB_SERIAL	USB Serial	Bidirectional	USB connection emulating a serial port (Virtual COM Port). Combines USB convenience with serial protocol compatibility.
USB_HID	USB HID	Bidirectional	USB Human Interface Device protocol. Used for devices that present themselves as HID-class peripherals.
AIN	Analog	Input	Analog voltage input to the Device Controller. Used for reading sensor values, potentiometer positions, or other analog signals.
AOUT	Analog	Output	Analog voltage output from the Device Controller. Used for controlling variable-intensity light sources, motor speeds, or other analog-controlled devices.
UART	Serial Data	Bidirectional	Universal Asynchronous Receiver-Transmitter (RS232) connection. Low-level serial communication protocol.

Usage Example:

A motorized filter wheel might use:

- SERIAL connection for sending position commands and receiving status
- TTL_IN_GEN connection for reading a home position sensor
- TTL_OUT_GEN connection for triggering movement completion signals

1.2.6. Inscoper Imaging Software

This tab allows you to set up Inscoper Imaging Software (IIS). You can:

- Define and modify graphical elements.
- Activate modules such as tiling options or virtual joysticks.
- Configure advanced calibrations linking sub-devices.
- Set up the graphical representation of sub-devices in IIS (e.g., relabeling objectives, adding side ports/filter cubes, representing laser power with sliders).

This section is divided into: Display, Group, Devices Update, Image Scaler, and Calibration.

1.2.6.1. Display

The Display tab allows you to add, modify, and organize the graphical representations of sub-devices in IIS.

1.2.6.2. Initialize

The Initialize button adds all available sub-devices defined in the configuration to the device display list. This allows you to modify how a function is displayed in the software. Note: Upon configuration creation, the display data list is empty and must be initialized.

1.2.6.3. Update

If new devices are added to an existing configuration, the Update button automatically adds their associated sub-devices to the device display list.

1.2.6.4. Image Scaler

A sub-device that enlarges or reduces the image size.

- Image Scaler Mult: A sub-device that enlarges the image size (e.g., lenses or objectives that produce image reduction).
- Inv: A sub-device that reduces the image size (e.g., lenses or objectives that produce image magnification).

1.2.6.5. Calibration

A model used to link two or more sub-devices.

Type

Type	Description
Linear	`sd1 = a * sd2` or `sd1 = a * sd2 + b` (Linear formula).
Linear Delta	Same as Linear, but presented differently to expose the alpha parameter in IIS (used only for SoSPIM).
Bilinear	Represents a 3D plane (`ax + by + c`).
Linear Piecewise	Allows for curve approximation.
Constant	Applies a fixed parameter between two devices.
Formula	Allows entry of a custom formula.

Interpolator

Interpolators are the sub-devices used in formulas to compute new values (the sub-device that is not the objective). Example: In $sd1 = a * sd2 + b$:

- `sd1` is the target.
- `sd2` is the interpolator.
- `a` and `b` are computed during calibration.

Discriminant

A discriminant is a sub-device that, if modified, invalidates the current calibration. Each calibration is saved for a specific combination of discriminant values. Example: In a FRAP calibration, changing the objective or filter requires a new calibration.

Target

The sub-device that will be modified by the calibration. It is linked to an interpolator.

1.2.6.6. Complex Acquisition Available

Enables the "Complex Acquisition" / "Acquisition Designer" module if the customer has purchased the option. This module allows for advanced imaging workflows not possible with basic MDA. The module will not appear if the license does not include it, regardless of this checkbox.

1.2.6.7. Mosaic Manip

Activates Tiling options in IIS. The Tiling Dimension will appear in the graphical interface. A 5D license is required.

1.2.6.8. XY Move Strat Available

Adds an option to move the stage gradually during large movements. This reduces potential drift and prevents autofocus systems from losing track during motion.

1.2.6.9. Trigger Live Conditions

Associates a sub-device value with a condition, allowing other devices to be controlled during the camera's live trigger sequence. Example: Trigger live acquisition only if the fluorescence shutter is open, or apply a condition based on the side-port position.

1.2.6.10. Reset USB at Startup

If checked, USB connections are reset each time IIS is opened.

1.2.6.11. Device Update

This tab allows you to select devices to be updated automatically. The interface will query the drivers (DC, Custom, Micro-Manager) to update the device value by calling the GET function at the interval specified in the "Delay (ms)" column.

1.2.6.12. Connections

Link your device to the Device Controller. Available connections for a selected device are highlighted in green.

USB View

- Serial/Digital/Analog
- PID/VID: Product ID and Vendor ID. Any USB device provides these values, along with Manufacturer, Product, and Serial Number. They are used to identify and distinguish USB peripherals.

1.2.7. Recipe

A structured set of instructions defining system operation, including action order, execution conditions, and sequence optimization. It defines how statuses are applied.

1.2.7.1. Recipe Element

A single unit within a recipe that associates a sub-device with one or more actions.

Action

Defines which sub-device function to execute or which recipe ID to set.

- Sub-device / Recipe Id: The target sub-device or group.
- Function: The operation to perform (SET, GET, CHECK).
- Default value: Relevant only for SET. Usually left empty for user input, but can be set for specific recipes (e.g., "Close shutter" = 0).

Type

- Simple: Contains only one element.
- Group: Calls a combination of recipes.
- Event: A Recipe Element that allows for sequence interruptions. It handles user events such as Pause, Stop, or Restart during a sequence.

Call ID

An identifier used in `callConditions` to determine if a recipe has been executed.

Example (Motion Stages): `Recipe Set X -> callID = setX Recipe Set Y -> callID = setY Recipe MoveAxis -> callCondition = setX || setY`

Example (Shared Call ID): `Recipe Set X -> callID = axisMoved Recipe Set Y -> callID = axisMoved Recipe MoveAxis -> callCondition = axisMoved`

Recipe ID

An identifier assigned to one or more sub-devices. Historically used to group devices (e.g., all shutters), it is now mostly used for sub-devices created dynamically when IIS launches (e.g., timing devices, abstract sub-devices for scripting).

Tag

A label or identifier used to categorize and filter recipe execution based on the current system state or configuration. Tags are added to statuses and used in tag conditions to ensure that only relevant recipes are executed for the active devices or modes. Example: When using a specific camera model, its tag (e.g., "Fusion" or "Panda") is added to the status, ensuring only recipes with matching tag conditions are executed.

Condition

A graphical section grouping condition options for calling recipes.

Tag Condition

Ensures an action is executed only if a specific tag is present in the status. Example: If a sequence uses the "Fusion" camera, the tag "Fusion" is added to the status. Recipes requiring the "Panda" tag will not be executed, ensuring only the correct camera devices are used.

Call Condition

Ensures an action is executed only if a specific previous action has occurred.

Value Condition

Determines whether an action is executed based on a sub-device's value. Example: Change light source intensity only if the shutter is open. If the shutter is closed, the intensity change is skipped.

Optimization

Prevents reapplying a recipe if the sub-device value has not changed between two statuses. Example: Do not send XY coordinates again if they are identical to the previous position.

1.2.7.2. ILDA

Controls the Ilas and Starscan modules.

Mode

Describes the different illumination modes available in the system.

Illumination Mode

Adds a virtual device to select the illumination mode (e.g., FRAP, TIRF, Spinning Disk) in a multimodal system.

FRAP

- Scanrate: Controls the time between two points (galvo instructions).
- Diameter: Controls the distance between two points during a scan.
- Density Index: An index indicating the mode (FRAP, TIRF, WF, Spinning Disk) when sharing the scan rate sub-device. Must match the FRAP diameter value in the Device tab.
- Fire Preview: Enables the fire preview function (continuous scanning of an ROI).
- Active Channel Element: Indicates which channel is the FRAP channel. Must be activated for each illumination mode.

TIRF

- Angle (formerly Tirf Angle): The position of the point (or arc) on the circle traversed by the galvos.
- Diameter (formerly Interpoint Distance): Controls the distance between two points during a scan.
- Scanrate (formerly Pulse Time): Controls the time between two points.
- Density Index: (Obsolete after 9.3).
- Radius (formerly Penetration Depth): Corresponds to the laser angle at the lens outlet.
- Angle Length (formerly Tirf Mode): The length in degrees of the circle made by the galvos.
- Active Channel Element: Indicates which channel is the TIRF channel.

1.2.8. API

The Inscoper API (Application Programming Interface) is a comprehensive C++ library that enables external software to interact with and control the Inscoper system. It acts as a bridge between high-level applications (such as the Inscoper Configurator or third-party software) and the underlying hardware drivers.

Key Architectural Concepts:

- Bridge Pattern: The API exposes a single main entry point, the `Inscoper::Bridge` class, which simplifies interaction by abstracting the complexity of internal subsystems.
- Manager-Based: Core functionalities are handled by specialized singleton managers (e.g., `ConfigManager` for settings, `DeviceManager` for hardware, `SequenceManager` for acquisition workflows).
- Device Abstraction: The API provides a unified interface (`AbstractSystem`) for all devices, regardless of whether they are controlled by Inscoper hardware, Micro-Manager, or custom drivers.

Core Capabilities:

- Configuration: Loading and saving system states via XML files.
- Control: Direct manipulation of device parameters (SET/GET/CHECK).
- Acquisition: Execution of complex, multi-dimensional acquisition sequences and recipes.
- Imaging: Management of image buffers, metadata, and pixel formats.
- Events: A listener system (`SequenceListener`, `ImageListener`, `ErrorListener`) for real-time feedback and synchronization.

1.2.8.1. Log Level

Indicates the importance of a log message. Log levels are inclusive (e.g., enabling DEBUG also enables INFO, WARN, ERROR, FATAL).

Log Level	Description
LOG_-ALL	Enables all log levels.
LOG_-TRACE	The most fine-grained information, used only for deep debugging (e.g., annotating algorithm steps or individual queries).
LOG_-DE-BUG	Less granular than TRACE but more detailed than INFO. Useful for diagnosing issues and troubleshooting in test environments.
LOG_-INFO	Standard log level indicating normal application events (e.g., "Authorization successful"). Purely informative; missing these logs should not hide critical issues.
LOG_-WARN	Indicates an unexpected situation that does not stop the application (e.g., "Parsing error, document skipped"). The process continues, but the event is noteworthy.
LOG_-ER-ROR	Indicates an issue preventing specific functionalities from working (e.g., "Payment system unavailable"). The application may still run, but features are broken.
LOG_-FATAL	Indicates a critical failure where core functionality is lost (e.g., "Database connection failed"). The application cannot perform its primary business functions.
LOG_-OFF	Disables all logging.

1.3. Inscoper API

This page is under construction.

2. TECH SPECIFICATIONS

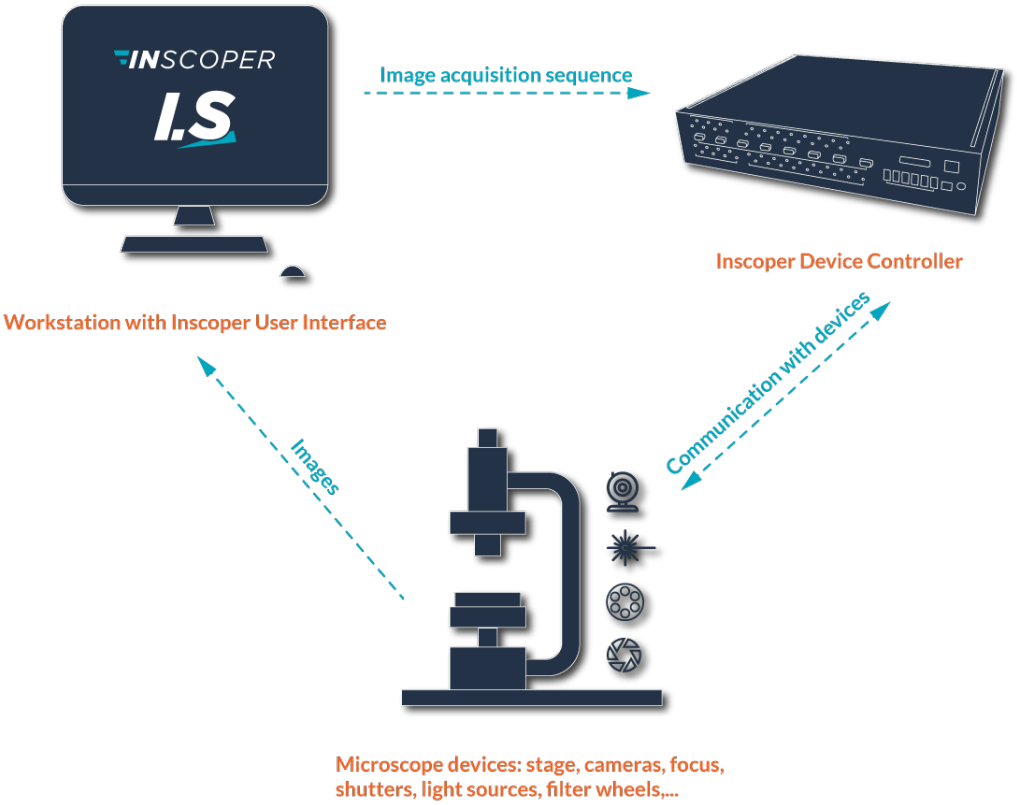
Operating specifications and parameters, input/output connexions, system requirements

2.1. Approach

Inscoper I.S. is a turnkey hardware solution that completely revolutionizes the way in which fluorescence microscopes are controlled in live cell imaging.

Inscoper's fundamental new approach involves dissociating the two functionalities managed by the acquisition software:

1. **User Interaction**: to configure the acquisition sequence, receive the acquired images, and display and save them;
2. **Device Control**: to communicate with the different devices in the microscopy system and run the acquisition sequence defined by the user.



This separation means that the Inscoper I.S. is free from hardware constraints. Therefore, regardless of the type of microscope, the Interface remains simple, easy to use and focused on user requirements rather than hardware issues.

2.2. Inscoper Device Controller

2.2.1. Warnings and cautions

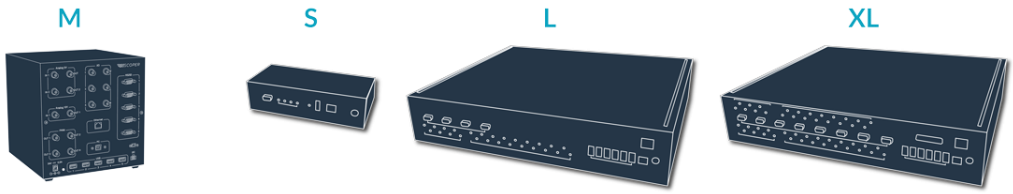
1. Always check that the Inscoper Device Controller is powered up before starting the computer. If in doubt, restart the computer.
2. The equipment can only be powered through Safety Extra Low Voltage that also complies with the limits of 6.3.1/6.3.2 of IEC 61010-1:2010.
3. Never use cables longer than 3 meters to connect devices (except for the Ethernet cable).
4. Please note that if the Inscoper Device Controller is used in a way that is not specified by INSCOPER, the protection provided by the device may be compromised.

2.2.2. Operating specifications

Parameter	Current Version	Next Versions		
Device Controller Model	M	S	L	XL
Weight	3.050 kg (6.724 lb.)	1.150 kg (2.20 lb.)	4.450 kg (8.82 lb.)	4.650 kg (8.88 lb.)
Dimensions (L*W*H)	230*230*230 mm (9.06*9.06*9.06 in.)	120*200*65 mm (4.72*7.87*2.55 in.)	420*434*84 mm (16.53*16.93*3.15 in.)	
Power input	24 VDC @ 2.5 A	24 VDC @ 3.75 A		
Operation temperature range	From 10 to 40 °C (from 50 to 104 °F)			
Altitude	Maximum 2000 m (6561,68 feet)			
Operating humidity range (non-condensing)	From 30 to 85 %			
Storage temperature range	From 0 to 50 °C (from 32 to 122 °F)			
Storage humidity range (non-condensing)	From 30 to 85 %			

NB: All there data are valuables for indoor use only.

2.2.3. Input / Output



<table>
<tr><td></td><td>Current Version</td><td colspan="3">Next Versions</td></tr>
<tr><td>TYPE</td><td>M</td><td>S</td><td>L</td><td>XL</td></tr>
<tr><td rowspan="2">ANALOG OUTPUTS</td><td>2x (0-5V)
1x (0-12V)</td><td>1</td><td>8</td><td>16</td></tr>
<tr><td>DAC resolution 12 bits
No Programmable Output range</td><td colspan="3">DAC resolution 14 bits
Sample rate 180 MS/s
Output range ±10 V, 0-5 V, +-5 V</td></tr>
<tr><td>ILDA</td><td>Via External Controller (MaxILDA)</td><td>-</td><td>-</td><td>1</td></tr>
<tr><td rowspan="2">ANALOG INPUTS</td><td>2x (0-5V)
1x (0-12V)</td><td>-</td><td>-</td><td>16</td></tr>
<tr><td>ADC resolution 12 bits
No Programmable Input range</td><td colspan="3">ADC resolution 16 bits
Sample rate 1 MS/s
Input range ±2.5 V, ±5 V, ±10 V, ±12.5 V</td></tr>
<tr><td>I/O</td><td>6</td><td>4</td><td>18</td><td>18</td></tr>
<tr><td>SERIAL PORTS</td><td>5</td><td>1</td><td>4</td><td>8</td></tr>
<tr><td>USB host</td><td>5</td><td>1</td><td>6</td><td>6</td></tr>
<tr><td rowspan="2">Computer</td><td colspan="4">Windows 7/10/11</td></tr>
<tr><td colspan="4">1920 x 1080 px</td></tr>
</table>

2.3. System requirements

	Minimum requirements	Optimum configuration
Operating system	Windows 7 / 10 32 bit / 64 bit MAC OSX 10.5	Windows 10 64 bit MAC OSX 10.5
RAM	4 Go	16 Go
Hard disk drive	4 Go	128 GB SSD drive for fast image saving
Processor	Pentium 2 266 MHz	Core i5 3.2 GHz
Graphics card		NVidia GeForce 8 and 100 series or higher ATI Radeon HD 2400, 3000, 4000, 5000 and 6000 series Intel GMA 4500 and GMA HD
Screen	Resolution 1920 x 1080	2 screens highly recommended

2.4. Installation

The Inscoper I.S. should only be installed by INSCOPER staff or appointed representatives. The customer and/or user can be involved in the installation process provided explicit consent has been given by an INSCOPER representative. In the event of intervention on the microscopy system with INSCOPER equipment or software without INSCOPER's consent, the company declines all responsibility for any consequences resulting from this intervention.

To **request installation** of Inscoper I.S. on a microscope, the following three steps are necessary:

1. Send a list of all your devices connected to the microscope to contact@inscoper.com or via the dedicated form available at www.inscoper.com.
2. Give INSCOPER team **three-day access** to install the microscope.
3. **Test out** the microscope with your team: acquire images of your research samples and compare them with previous ones.

3. CONTACT & LEGAL

Disclaimer, copyright, information about certifications, contact information.

Thank you for purchasing the INSCOPER product.

Please read this manual carefully before using the product. For future reference, please keep it in a safe place.

While every effort has been made to ensure the accuracy of this manual, some errors may remain. Please contact us if any points are unclear.

3.1. Contact

If you have any questions regarding the use of this product, please contact us by e-mail at: support@inscoper.com.

Please specify the following information about your system:

- Product serial number,
- Contact details,
- Any problem(s) you may have.

3.2. Copyright

INSCOPER products include technology protected by the following patents:

- US Patent No. US10330911
- EP Patent No. EP3123149
- FR Patent No. FR3019324

INSCOPER will update the product periodically, and such changes will be included in future editions of this user guide.

3.3. Disclaimer

The information in this manual is provided “as is”, without any warranties, conditions, or representations of any kind, whether express, implied, statutory, or otherwise. This includes, without limitation, any implied warranties of merchantability, non-infringement, or fitness for a particular purpose.

To the fullest extent permitted by law, INSCOPER shall not be liable for any loss or for any direct, indirect, special, incidental, consequential, or other damages arising from the use of this manual or the information contained in it, whether based on contract, tort, or any other legal theory.

3.4. FCC/IC certification

Any changes or modifications to this equipment not expressly approved by INSCOPER may cause, harmful interference and void the FCC authorization to operate this equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This device must be installed by a qualified professional.