INSCOPER

User Guide

Configurator

v1.2

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1. Configurator

1.1 Overview

After a certified installer sets up the Inscoper hardware, connects all components, and installs both the Inscoper Imaging Software and the Inscoper Configurator, these elements form the operational basis of the system.

The **Inscoper Configurator** is a robust tool for setting up microscopy systems integrated with the **Inscoper Device Controller**. Use this tool to define, connect, and manage hardware components to generate a configuration tailored to specific research requirements.

The diagram below illustrates the physical architecture of a typical system. The computer communicates with hardware through two paths: via the **Inscoper Device Controller**, which manages hardware connected to its physical ports, or directly via external drivers such as Micro-Manager or a custom driver.

Mermaid Diagram

The Configurator produces a system configuration file that the **Inscoper Imaging Software (IIS)** and the standalone Inscoper API load to initialize and operate the connected hardware. The diagram below shows each tool's role and the users who interact with it.

Mermaid Diagram

Target Audience

- **System integrators** who install microscopy systems controlled by Inscoper Device Controllers.
- **Advanced users** who perform hardware modifications or adjustments (with appropriate precautions).

Contents

This documentation provides step-by-step guides for key configuration tasks, including defining connected devices and pre-configuring the IIS.

Support

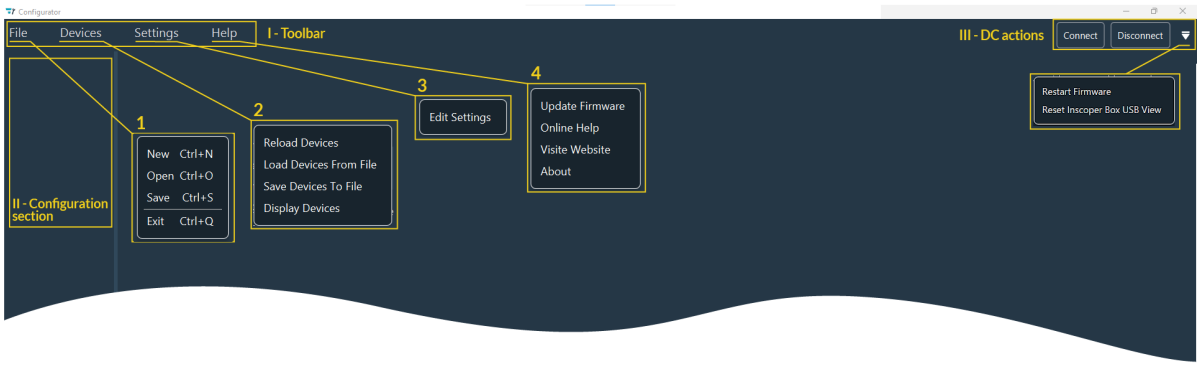
If you encounter issues during configuration, please contact Inscoper Support.

1.2 Guide

1.2.1 Getting Started

The main interface consists of three primary sections:

1. **Toolbar**
2. **Configuration Section** (detailed here)
3. **Device Controller Status & Actions**



Toolbar

1. FILE

Use the **File** menu to perform the following actions:

- **New**: Create a new configuration.
- **Open**: Open an existing configuration.
- **Save**: Save the current configuration.
- **Exit**: Close the Configurator window.

2. DEVICES

The **Devices** menu includes commands to manage device communication:

- **Reload Devices**: Reload device information from the device controller and external drivers (Micro-Manager, and custom drivers).

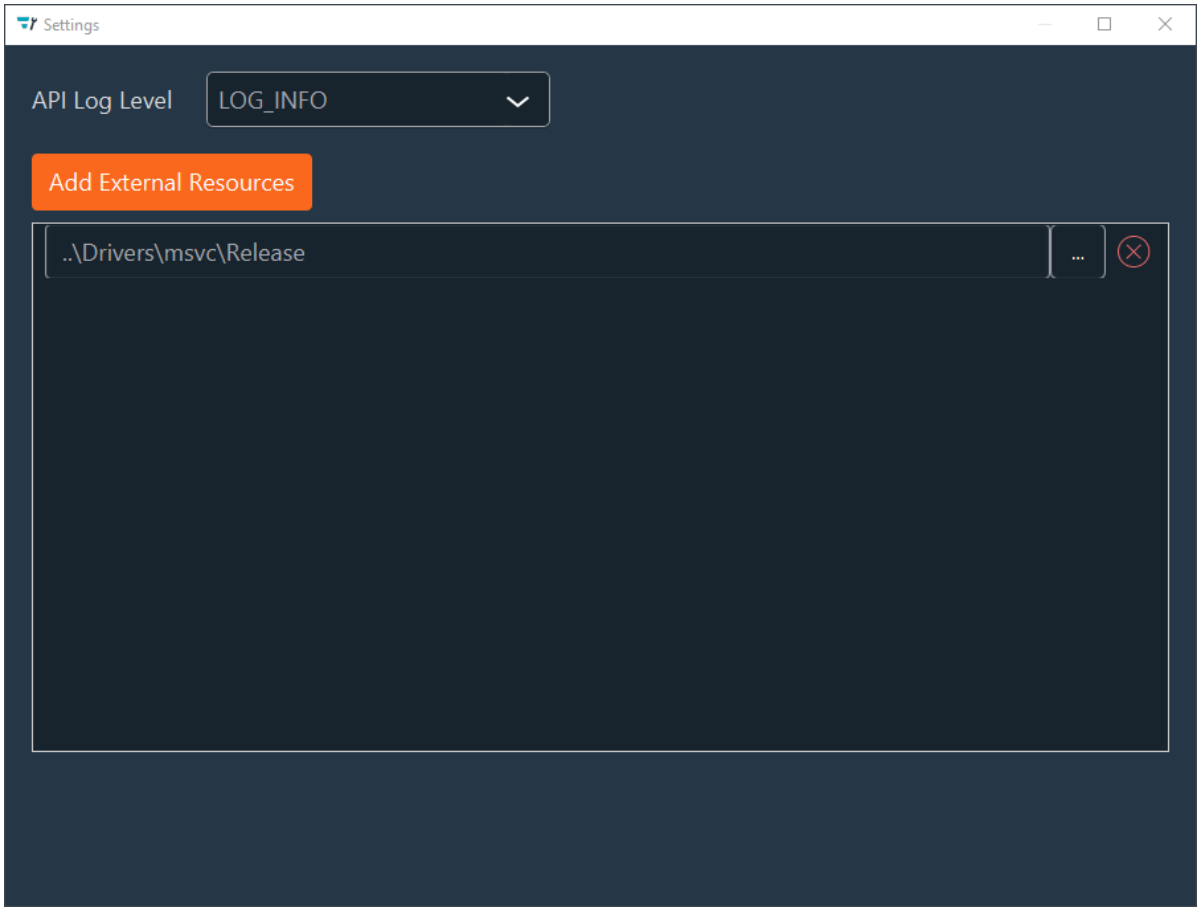
> **Note**
>
> When the check is complete, a popup window appears at the bottom of the Configurator window to indicate the number of devices found and loaded.
>
> 
>

- **Load Devices from File**: Read and import device information (settings and configuration) from a stored file.
- **Save Devices to File**: Export device information to a new local file.
- **Display Devices**: Redisplay the device status popup window.

3. SETTINGS

Use the **Settings** menu to specify the directories where Micro-Manager, and custom drivers are stored.

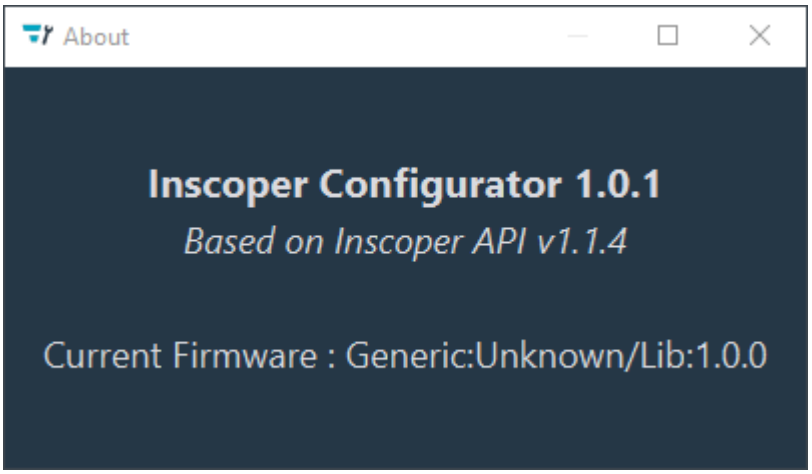
- **External Resources**: Add directories by clicking `Add External Resources` or delete them by clicking the **Red Cross**.
- **API Log Level**: Specify the log level used by the Configurator via the drop-down menu.
- **Note:** Changes save automatically upon closing the window.



4. HELP

The **Help** menu provides the following options:

- **Update Firmware**: Open an explorer window to upload a firmware file.
- **Online Help**: Access the Configurator or Inscoper User Guides.
- **Visit Website**: Open the official Inscoper website.
- **About**: Display a popup with versioning information (Configurator, API, and firmware).



Device Controller Actions

The Device Controller (DC) actions section provides the following operations:

1. **Connect**: Establish a connection with the Device Controller.
2. **Disconnect**: Terminate the connection with the Device Controller.
3. **Restart Firmware**: Reboot the firmware.
4. **Reset Inscoper Box USB View**: Trigger the Inscoper Box to rescan all USB devices.

> **Example**
>
> Use this command if a device is connected while the Configurator is open to update the detected hardware inventory.

1.2.2 Creating a Configuration

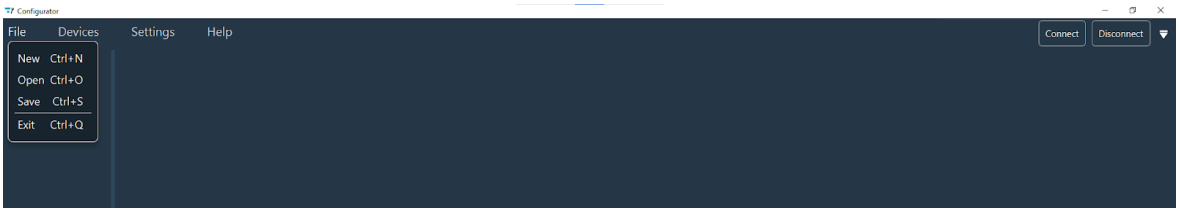
A configuration defines your entire system. It lists all devices, sub-devices, and drivers, and maps their connections to the device controller. It also determines the operation sequence (recipes) for sub-devices. Creating a configuration is a prerequisite for using your microscopy system with the Inscoper ecosystem.

The interface offers several ways to create and manage your configurations.

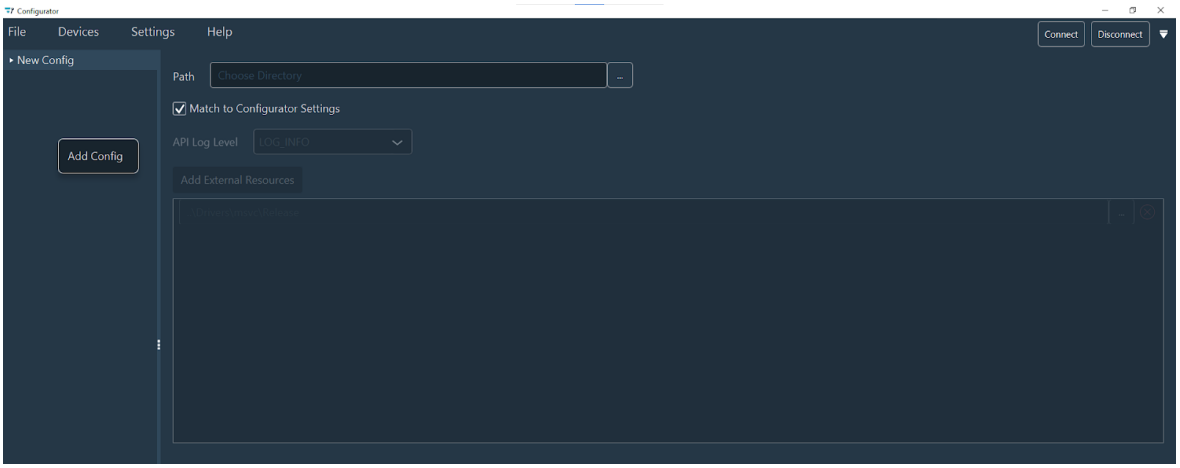
Creating a New Configuration

You can create a new configuration using any of the following three methods:

- **Top Menu Bar**: Go to *File* > *New*.

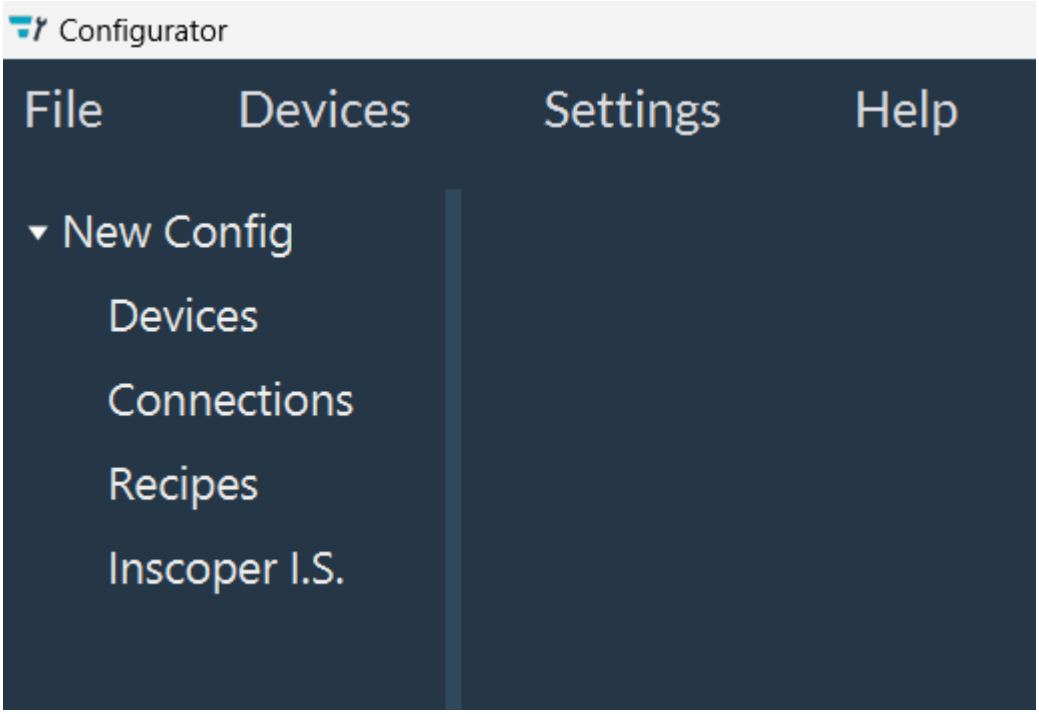


- **Left Config Menu**: Right-click inside the left-hand configuration menu and select the option *Add Config*.



- **Keyboard Shortcut**: Press `^ Ctrl` + `N` .

The newly created configuration is added to the left-hand configuration menu with the default name `New Config`.



Setting up the Configuration

Click the `New Config` item in the left-hand menu to open the main configuration settings in the central workspace. From here, you can:

- **Define the Save Path**: Choose the destination folder for your configuration.
- **Customize Environment Settings**: Uncheck *Match to Configurator Settings* to:
  - Set a specific API log level.
  - Point to custom resource folders for driver DLLs.

Saving a Configuration

SAVING METHODS

To save your work, you can use one of these three methods:

- **Top Menu Bar**: Go to *File* > *Save* to select a destination folder.

> **Note**
>
> The configuration automatically adopts the name of the folder you select.

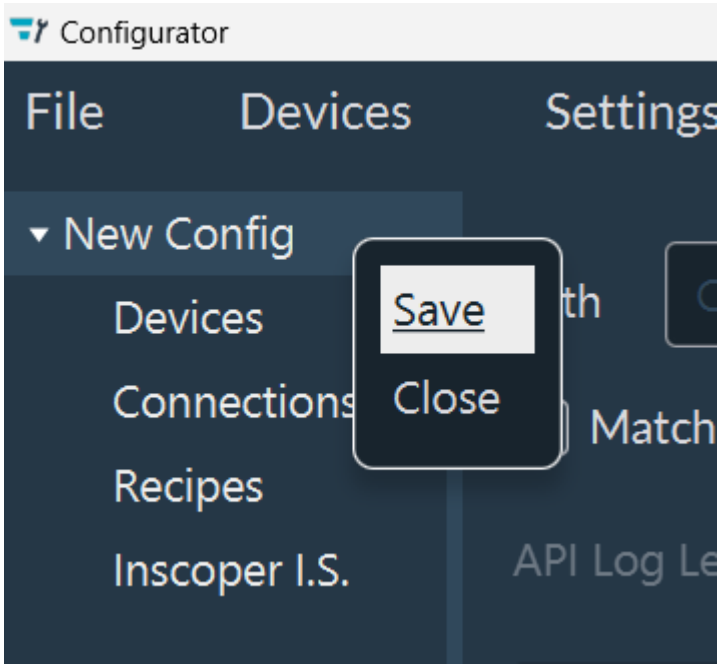
- **Left Config Menu**: Right-click the configuration name (e.g., `New Config`) and select the option *Save*.
- **Keyboard Shortcut**: Press `^ Ctrl` + `S` .

SAVING LOGIC

Folder Selection & Path

The save action depends on whether a target directory is already assigned:

- **Undefined Path**: A file explorer opens, allowing you to choose a directory. The configuration is saved upon confirmation.
- **Defined Path**: The configuration saves directly to the specified directory without further prompts.



Creating a configuration automatically provisions the system structure in the left-hand menu, namely: *Devices*, *Connections*, *Recipes*, and *I.S. Inscoper*.

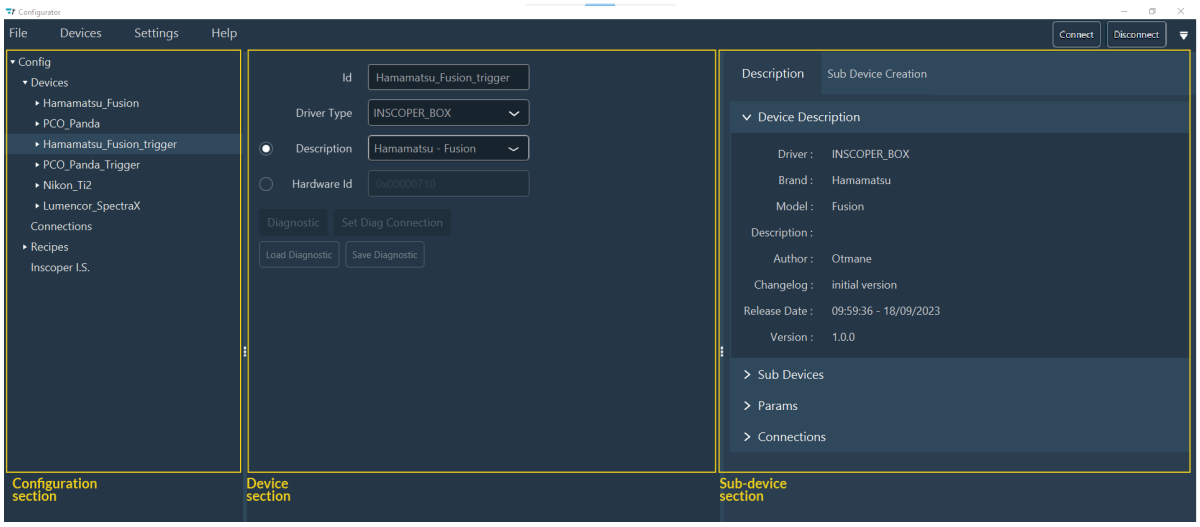
With the configuration saved, you are ready to begin adding devices to build your instrument.

1.2.3 Setting up a Device

This guide details the process of adding devices to your configuration. This step follows the creation of a configuration and is a prerequisite for defining connections and creating recipes.

The **Devices** interface is organized into three distinct regions:

1. **Left-hand Configuration Menu**: Displays the hierarchical tree of your system configuration.
2. **Central Device Parameters**: The main workspace for defining primary drivers and device settings.
3. **Right-hand Sub-Device Parameters**: Dedicated to managing sub-devices and viewing their technical details.

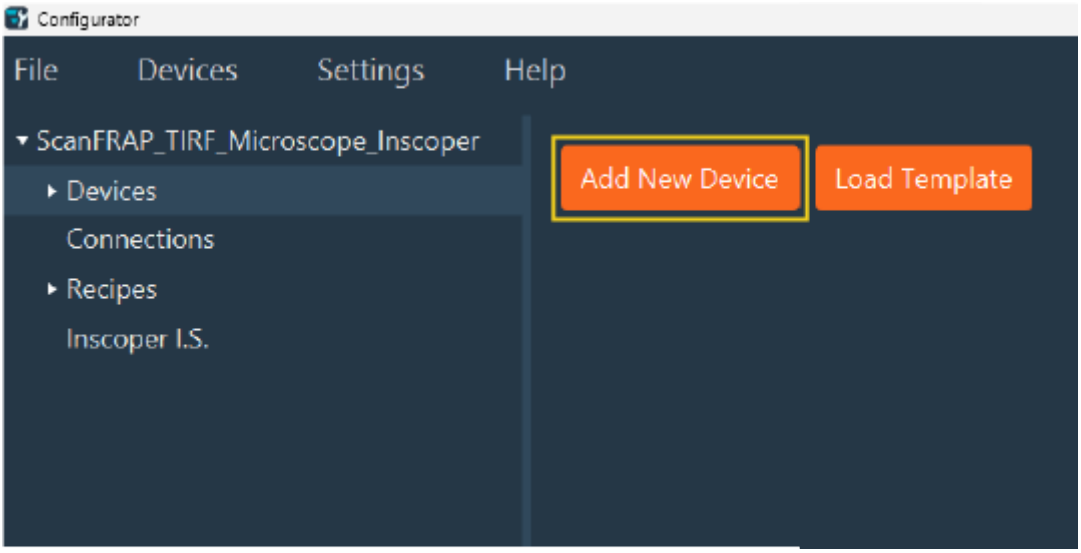


Adding a Device

Start by grouping your device components into the configuration tree.

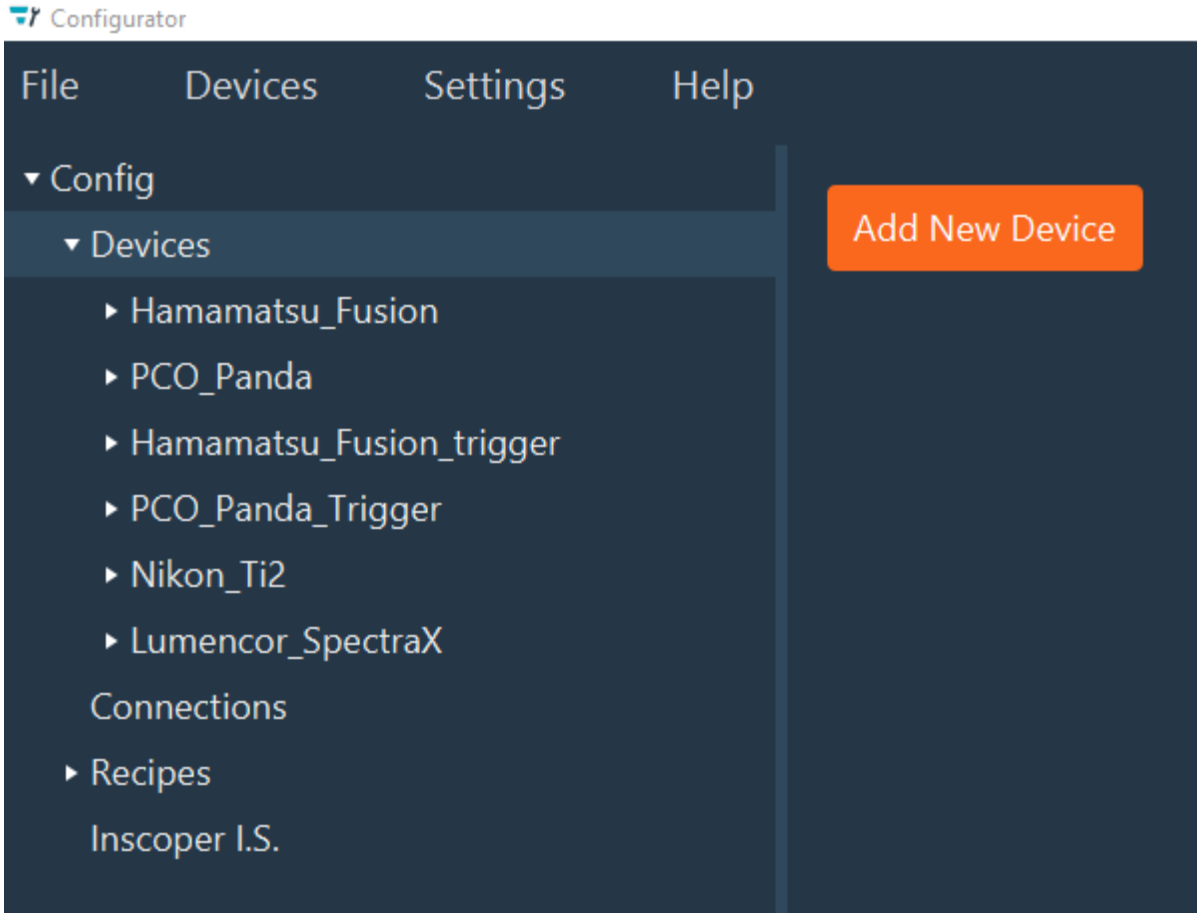
To add a device to your configuration, use one of the following methods:

- Click the **Add New Device** button.



- Right-click **Devices** in the left-hand configuration menu and select the option **Add Device**.

As a result, additional fields will appear, prompting you to fill in the parameters for this device and its sub-devices.



The device is now created in the interface. To make it functional, you must select the appropriate driver.

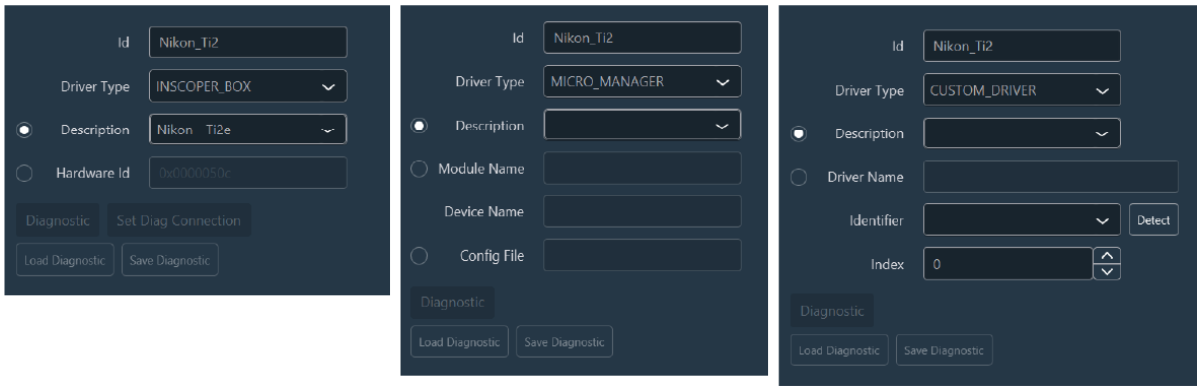
Configuring Device Details

Define the driver source and identification parameters for the new device.

In the **Device Section**, define the following:

- **Id**: Rename your device to a unique identifier.
- **Driver Type**: Select the appropriate driver source:
  - **Inscoper Box**: Drivers residing on the hardware box.
  - **Custom Driver**: External or user-defined drivers.
  - **Micro-Manager**: Drivers from the Micro-Manager library.
- **Driver Identification**:
  - **For Custom Drivers**: Enter the **Description** or **Driver Name** and the **Identifier**. Use the **Detect** button to find the identifier automatically. If using multiple identical devices, specify the **Index** (starting at 0).
  - **For Inscoper Box**: Provide the **Description** or the **Hardware ID**.
  - **For Micro-Manager**: Provide the **Description** (preferred) or the **Module Name** and **Device Name**.
- **Description**: For the Description, find your device in the drop-down menu.

> **Identifier vs. Index**
>
> In practice, the **Identifier** and **Index** fields are only required when multiple units of the same device model are connected. Typically, only one of these fields needs to be utilized.



With these details entered, the system can now attempt to communicate with the hardware.

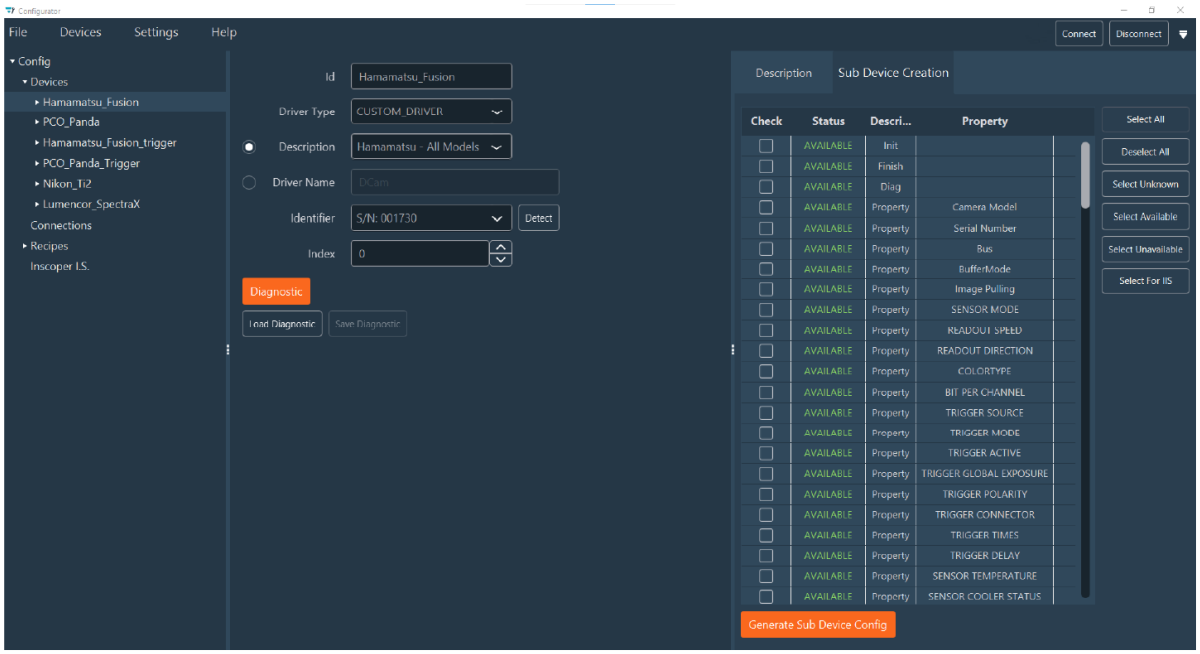
Running Diagnostics

Establish a connection to verify the device and retrieve its capabilities.

Before clicking **Diagnostic**, ensure the device is physically connected to the computer or the Inscoper Box.

The **Diagnostic** function performs the following actions:

1. Retrieves metadata (Brand, Model, Author, Changelog).
2. Requests a list of properties (for Custom and Micro-Manager drivers).
3. Updates the status of sub-devices to **Available**, **Unavailable**, or **Unknown**.
4. Refines associated constraints.



Successful diagnostics populate the list of available sub-devices, ready for selection.

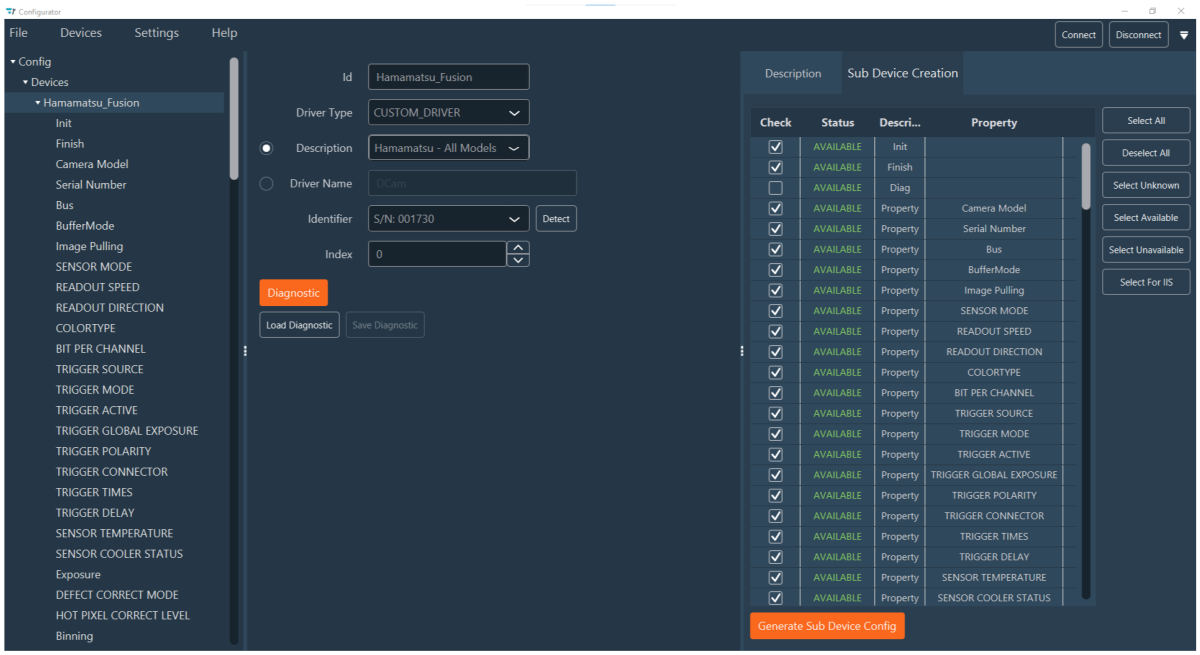
Generating Sub-Device Configurations

Select which specific functions (sub-devices) to include in your active configuration.

After running the **Diagnostic**, navigate to the **Sub Devices** tab.

THE SUB-DEVICE TABLE

Column	Description
Check	Checkbox to include the sub-device in the configuration.
Status	Indicates whether the sub-device is **Available**, **Unavailable**, or **Unknown**.
Description	The functional name of the sub-device.
Property	(Custom/Micro-Manager only) The specific property associated with the sub-device.



SELECTION

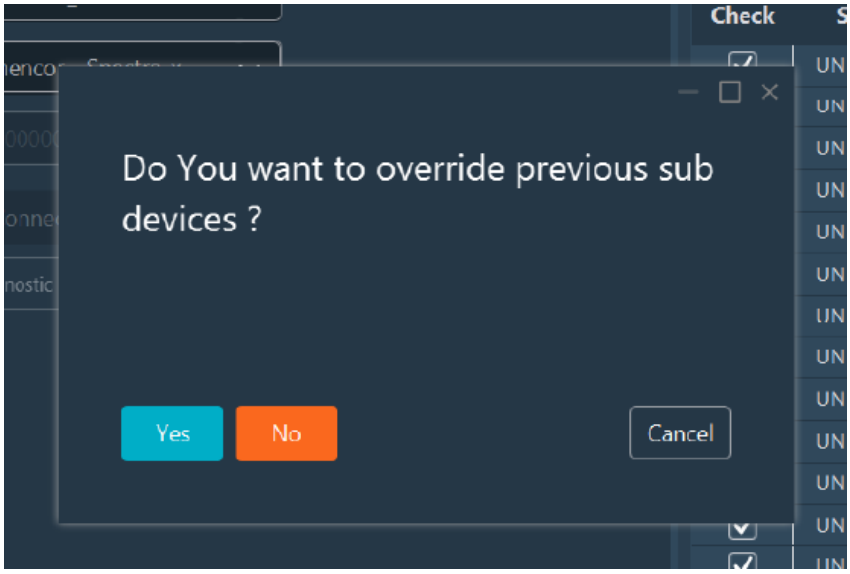
Use the buttons on the right to filter your selection:

- **Select All / Deselect All**: Selects or deselects every item in the list.
- **Select Unknown / Available / Unavailable**: Selects items based on their status.
- **Select for IIS**: Specifically for camera devices; selects all sub-devices required for the Inscoper interface.

Once selected, click **Generate Sub Device Config**.

> **Overriding Configurations**
>
> If you regenerate a configuration for a device that already has sub-devices, the system prompts you to choose an override option:
>
> - **Yes**: Replaces the existing sub-device list with your new selection.
> - **No**: Appends the new selection to the existing list.

Repeat these steps for each device in the microscopy system. Once all devices are added, you can proceed to the connection mapping.



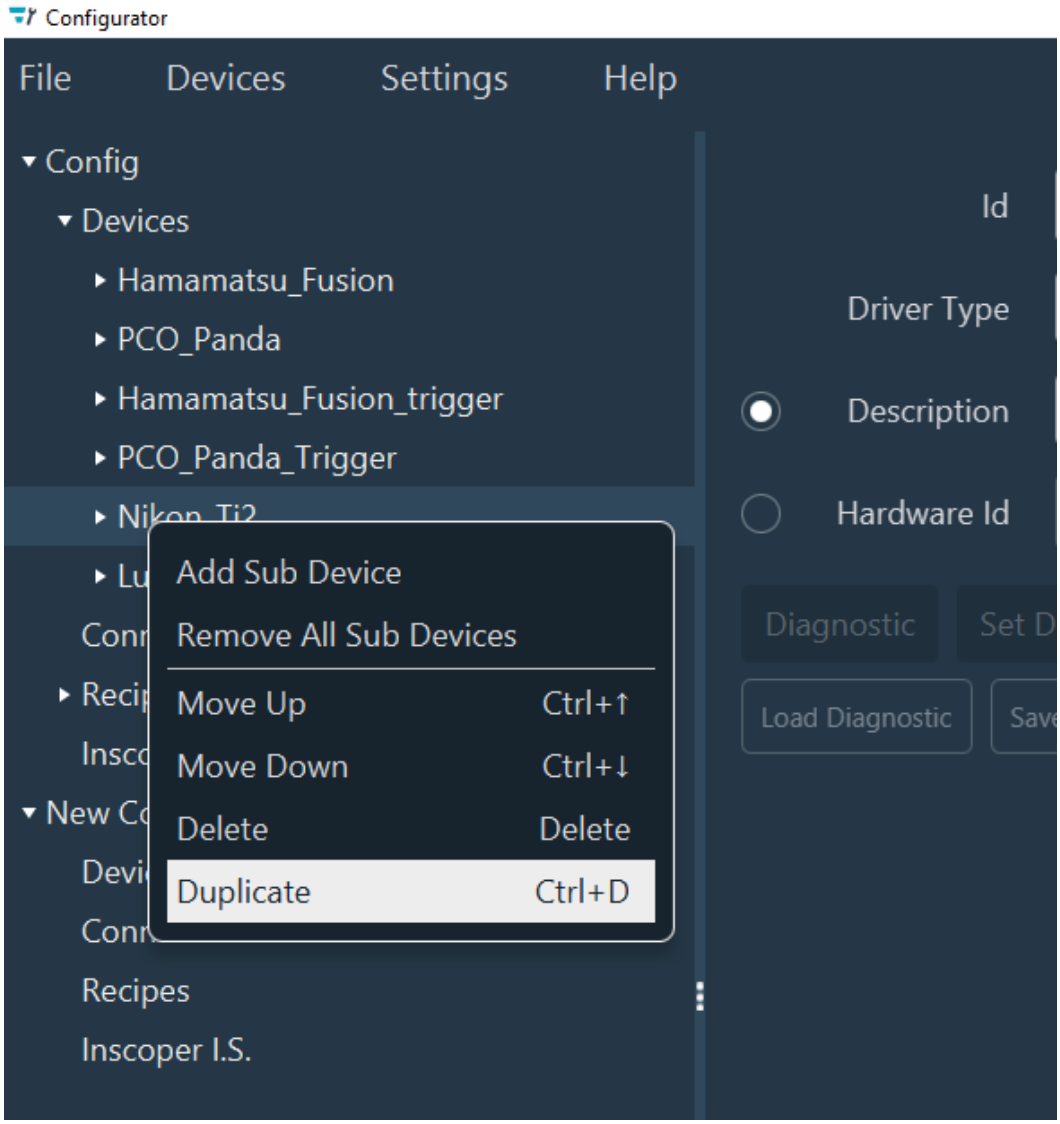
Manual Management & Advanced Options

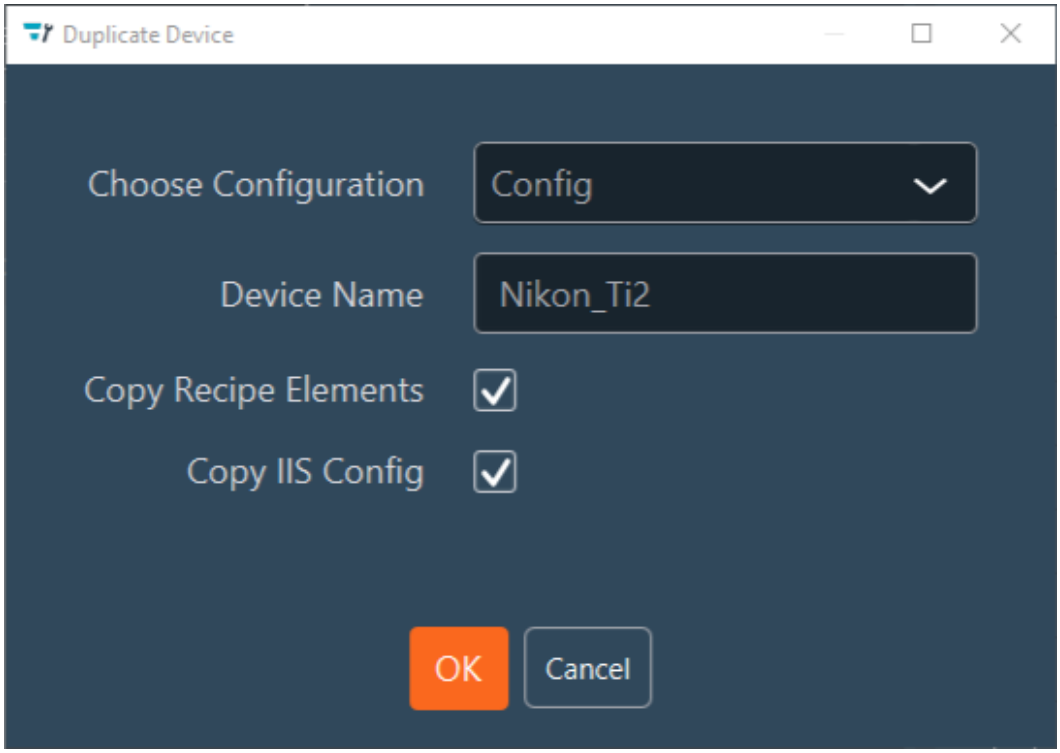
Manage existing devices or manually refine configurations for advanced control.

CONTEXT MENU ACTIONS

Right-click a device in the **Configuration** section to perform the following actions:

- **Duplicate**: Copy a device and its complete configuration.
  - **Note:** You cannot duplicate a device with the same name into the same configuration.
- **Move Up / Down**: Reorder devices in the tree view.
- **Delete**: Remove the device and all associated sub-devices.





MANUAL SUB-DEVICE SETUP

If you add a sub-device manually using the **Add Sub Device** function, configure the following fields:

1. **Id**: Assign a unique name to the sub-device.
2. **Description / Tag**: Define the functional identifier or tag for the sub-device.
3. **Recipe Id (Optional)**: Group multiple sub-devices under a single identifier (e.g., assigning "Shutter" to all shutter sub-devices). This allows you to create one Recipe Element that controls all associated hardware simultaneously.
4. **Post Init (Optional)**: If checked, the sub-device is ignored by the **Create Recipe**, **Initialize**, and **Update Display Data** functions. This also forces the sub-device to be called during initialization if the associated SET function has no parameters.

Click any sub-device to view its details, including **Description**, **Function**, and **Parameters**, in the right-hand panel.

PARAMETERS

If a sub-device includes one or more parameters, click **Add Param** to define default behaviors. **Note:** The **Add Param** button is only visible if the sub-device supports parameters.

To configure a parameter: 1. Select the parameter or the corresponding tag from the drop-down menu. 2. Check **Fixed** to prevent user modifications during operation. 3. Define the **Default Value**.

In many cases, a sub-device should only carry one editable parameter. If multiple parameters exist, fix the static values to ensure only the intended field remains editable.

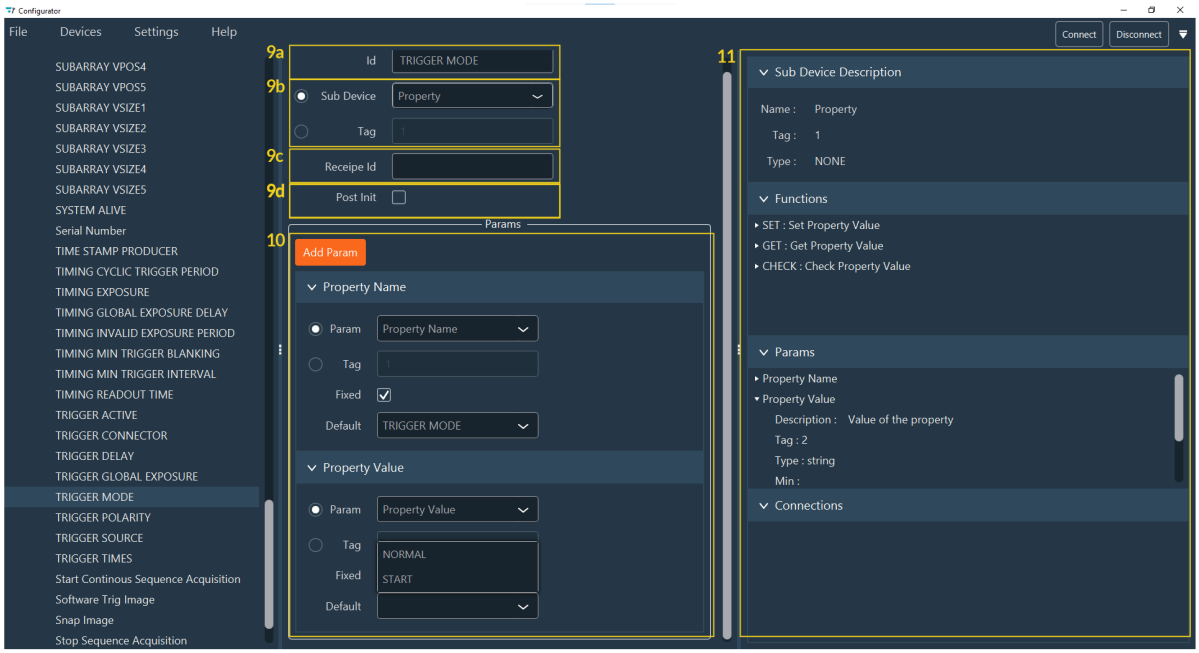
Parameter Logic (Custom and Micro-Manager Drivers)

Property sub-devices typically have two parameters: **Property Name** and **Property Value**.

- In the **Device** section, the **Property Name** is usually fixed (e.g., set to "Exposure").
- By fixing the name, the **Property Value** becomes the single editable field for the user.

If a required **Property Value** is missing from the list, click **Add Param** to select the property and define its non-fixed default value.

Advanced setup provides fine-tuned control over device behavior and restricts user access to critical parameters.



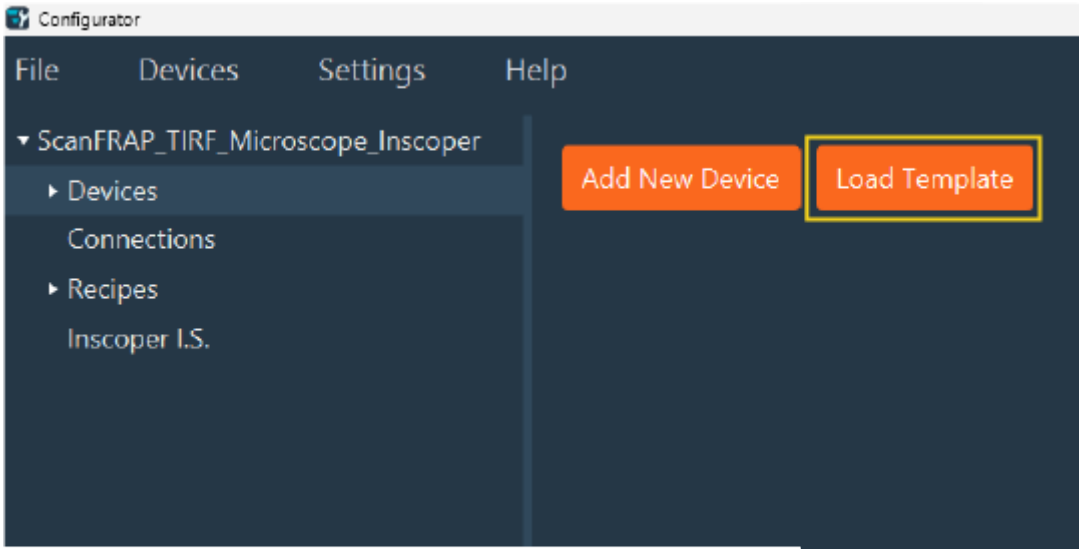
Next Step: Once all devices are configured, proceed to the Connections step.

1.2.4 Using Templates

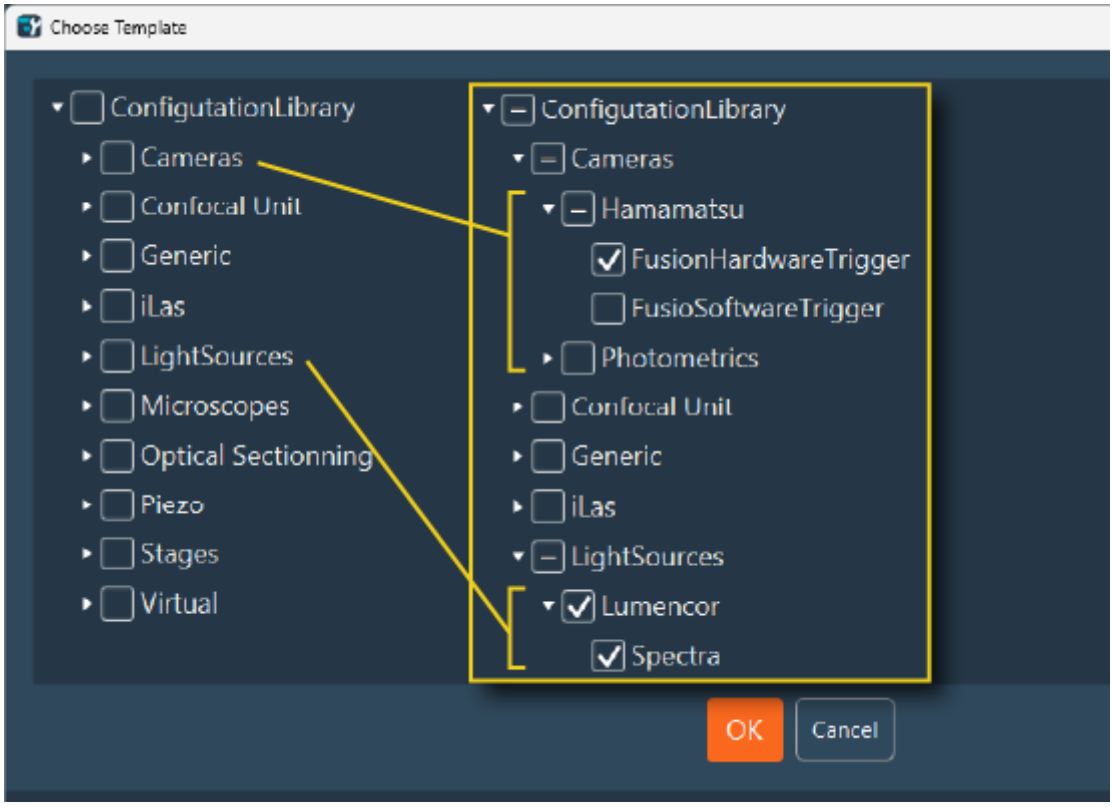
Templates provide a pre-validated starting point for system configurations. By importing pre-configured devices, you can rapidly establish a baseline setup that requires only minor adjustments to match your physical hardware connections.

Authorized Inscoper representatives have configured and validated these templates to ensure operational reliability.

1. Click **Load Template**.

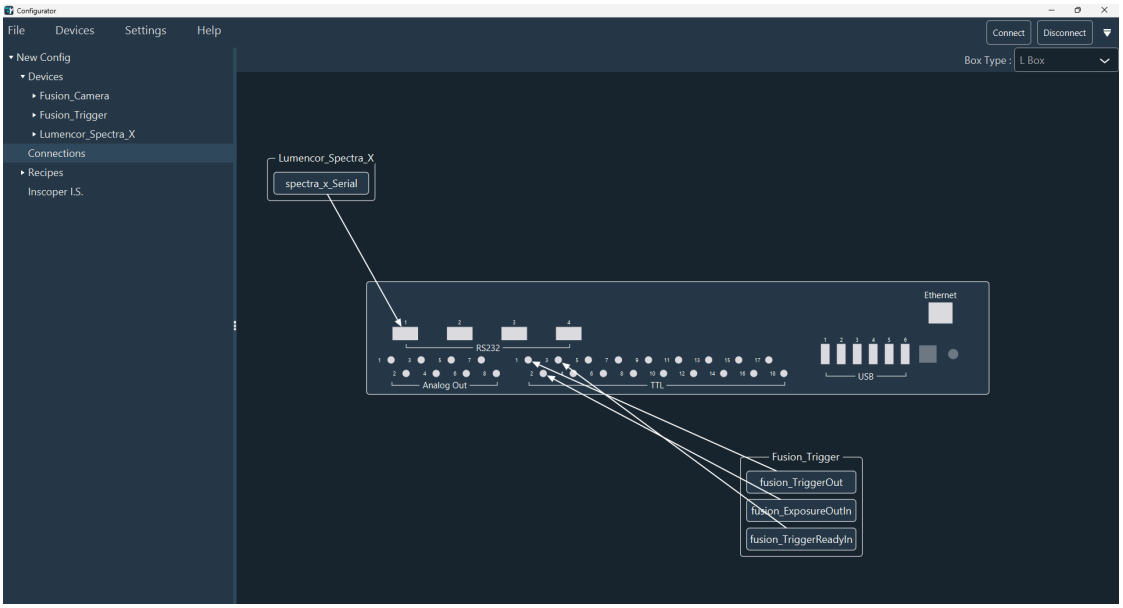


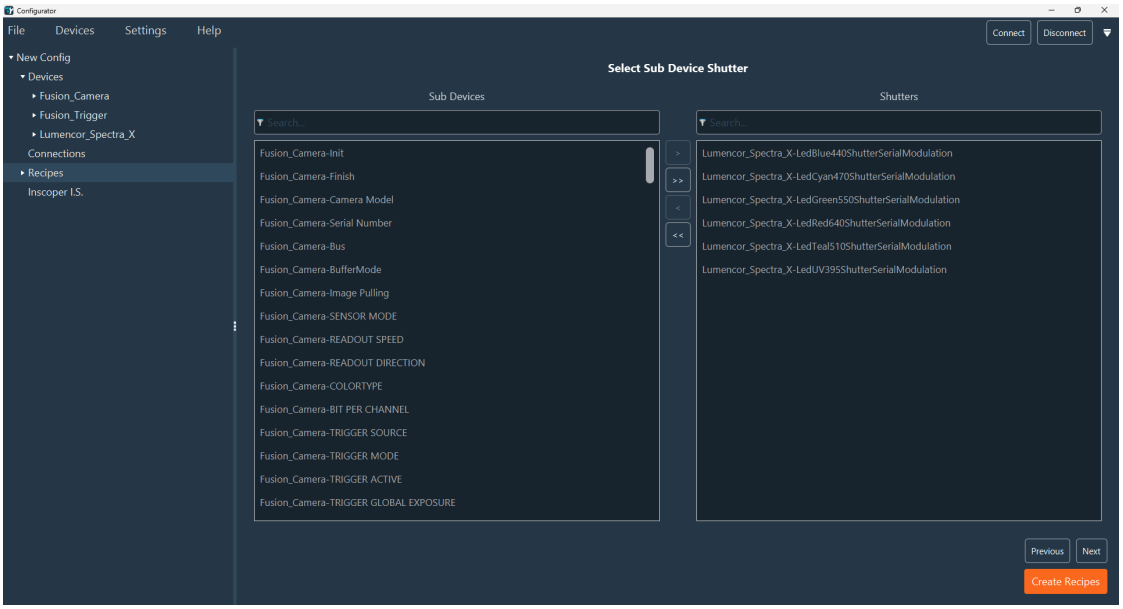
2. Expand the directory tree to browse devices grouped by type. Select the devices to import by checking the box next to each device name.



3. Click **OK** to import the selected devices into the configuration.
4. Adjust the physical connections to match the hardware setup. Review the imported recipes and key settings.

> **Warning**
>
> Templates provide generic connection settings. You must update these settings to match the actual ports and controllers used in the physical architecture.





5. Verify and modify the device configurations in the **Inscoper Imaging Software (IIS)** tab. This tab groups all parameters for controlling and validating devices. For full customization details, refer to the Inscoper Imaging Software Configuration section.

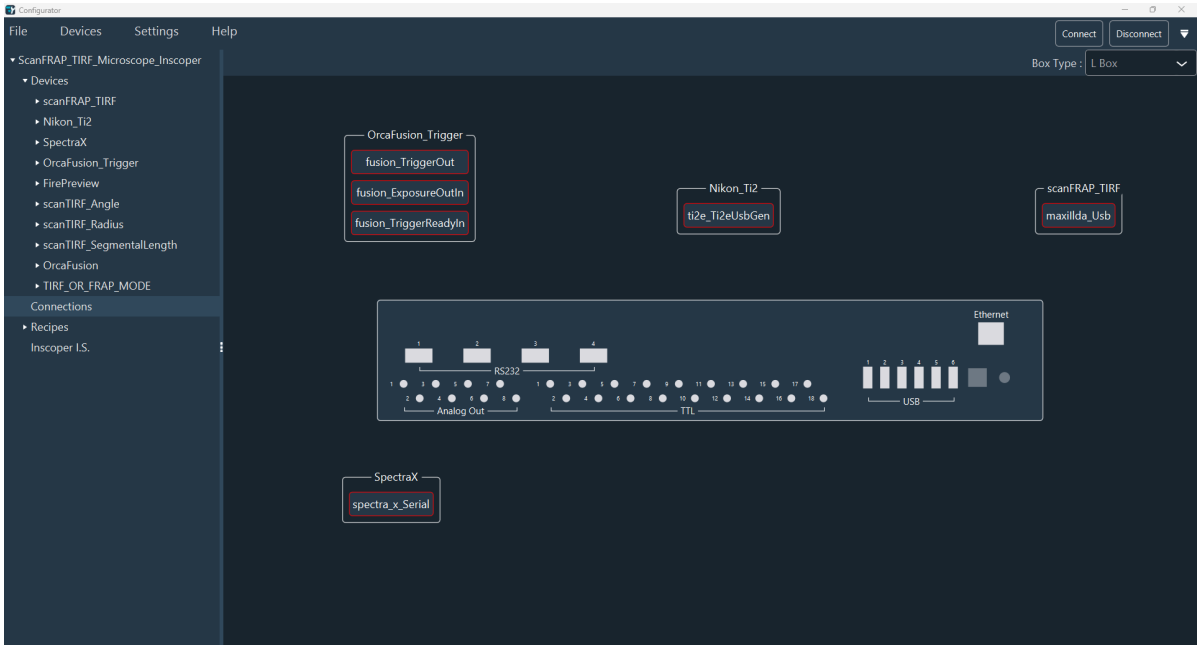
The devices are now ready for fine-tuning. Proceed to customize specific parameters or define experimental protocols.

1.2.5 Setting up Connections

The **Connections** stage establishes the logical link between configured devices and the physical ports on the Device Controller (DC). This mapping ensures the software sends commands to the correct hardware interfaces.

Accessing the Connections View

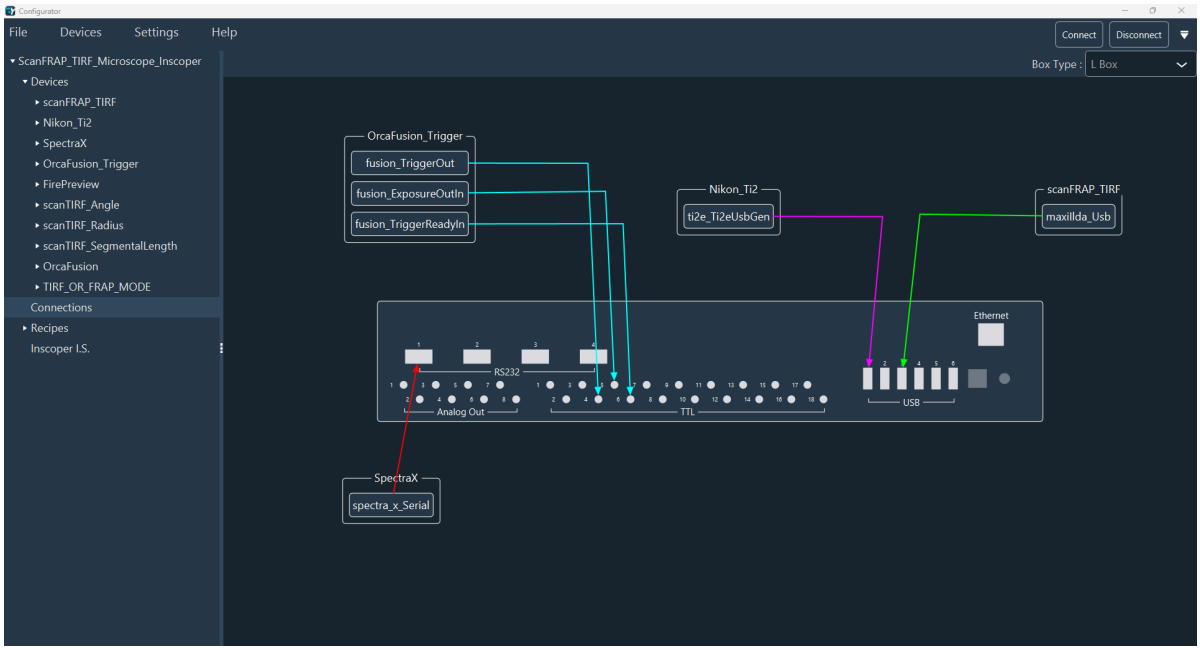
Click **Connections** in the **Configuration** section to view the controller and the devices requiring connection.



Defining the Box Type

The system automatically detects the box type (S, M, L, or XL). To override this selection manually:

- Use the **Box Type** drop-down menu in the top-right corner.
- The diagram updates automatically to reflect the port layout of the selected model.



Managing the Diagram

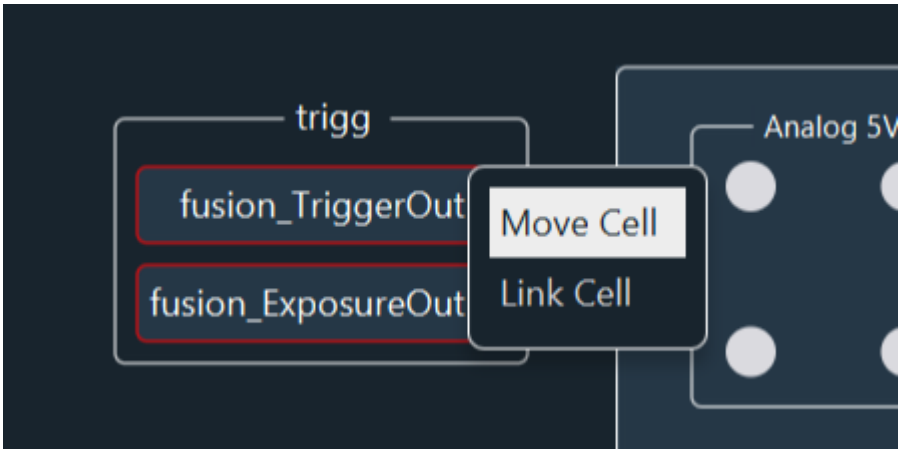
Organize the workspace to facilitate easier connections before linking ports. Use the following controls to navigate the diagram:

Action	Control
Move Device	Ensure the device is in **Move Cell** mode (right-click to toggle).
Move Box	Click and drag the DC box diagram.
Pan Workspace	Click and hold the mouse button on the background to move the entire diagram.
Zoom	Use the **scroll wheel** to zoom in and out.
Reset View	**Double-click** the scroll wheel to reset the zoom and center the diagram.

Linking Devices to the DC

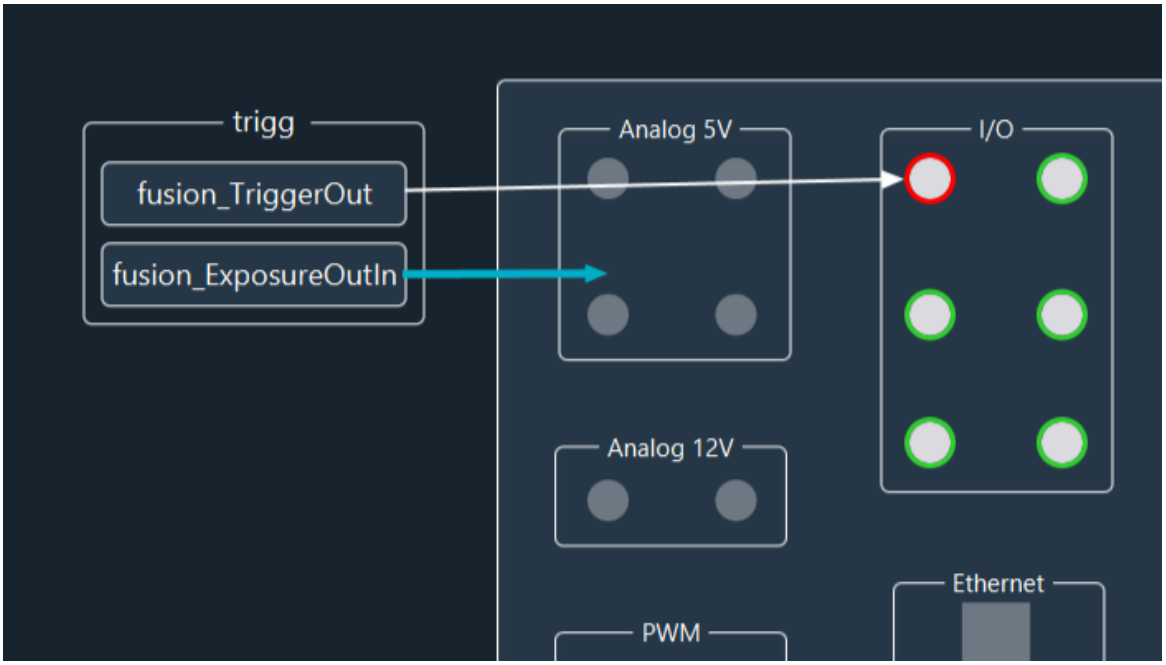
To create a physical link between a device and the controller:

1. Right-click the device and switch from **Move Cell** to **Link Cell** mode.
2. Click and hold the connection point of the device, then drag the line to the target port on the DC.
3. Repeat this process for all device connections.



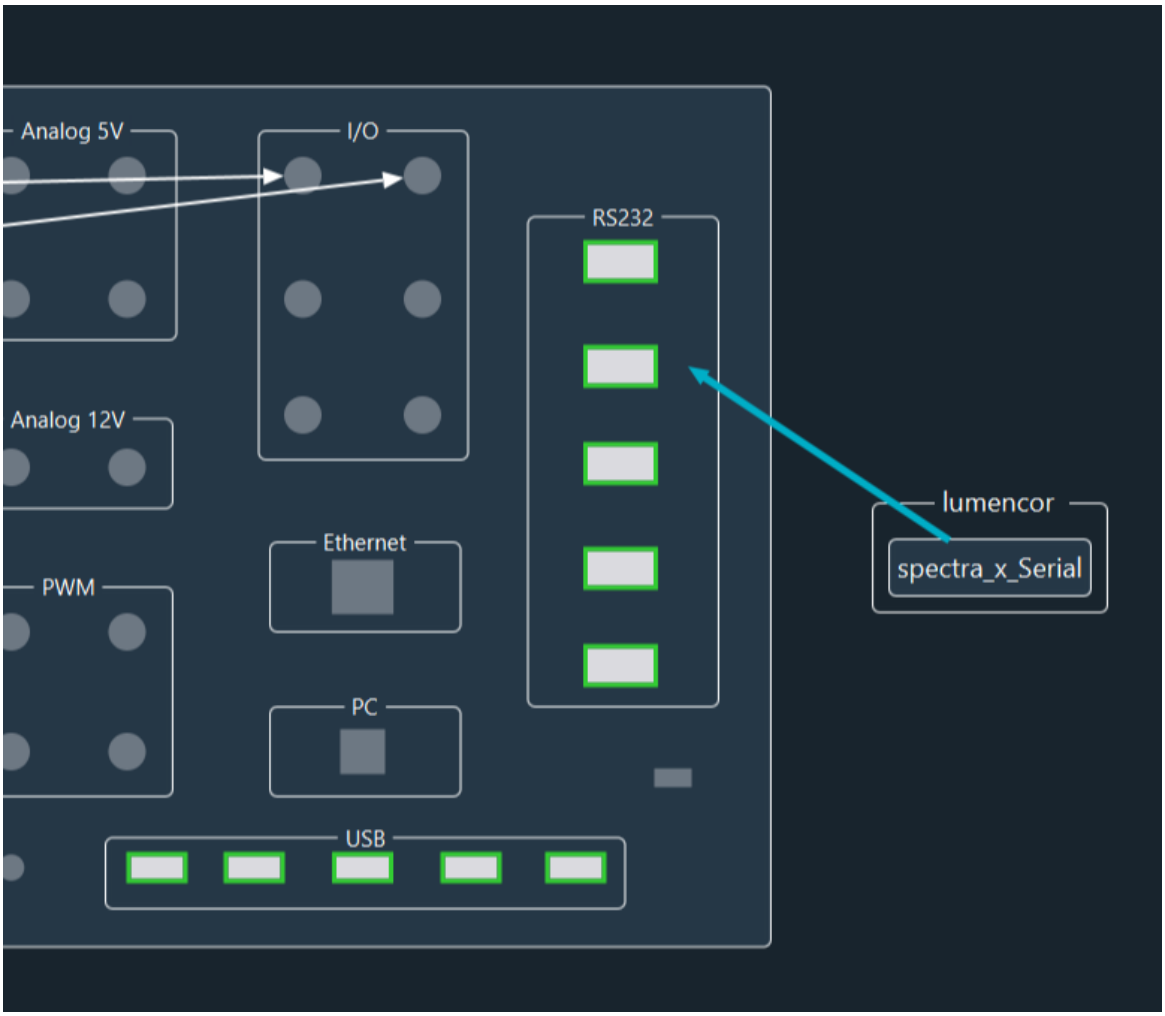
Port Highlighting

Available ports are highlighted in green. Occupied connectors are highlighted in red.

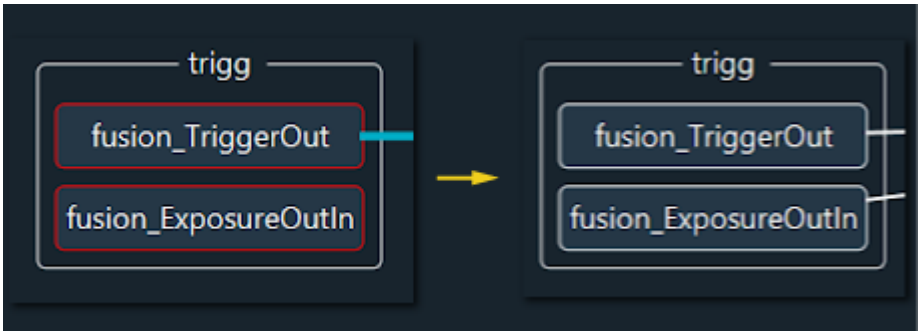


Automatic Recognition

Connectors are automatically recognized based on the connection type. For example, the *Lumencor Spectra X* light source connects to the Device Controller via RS232 or USB.



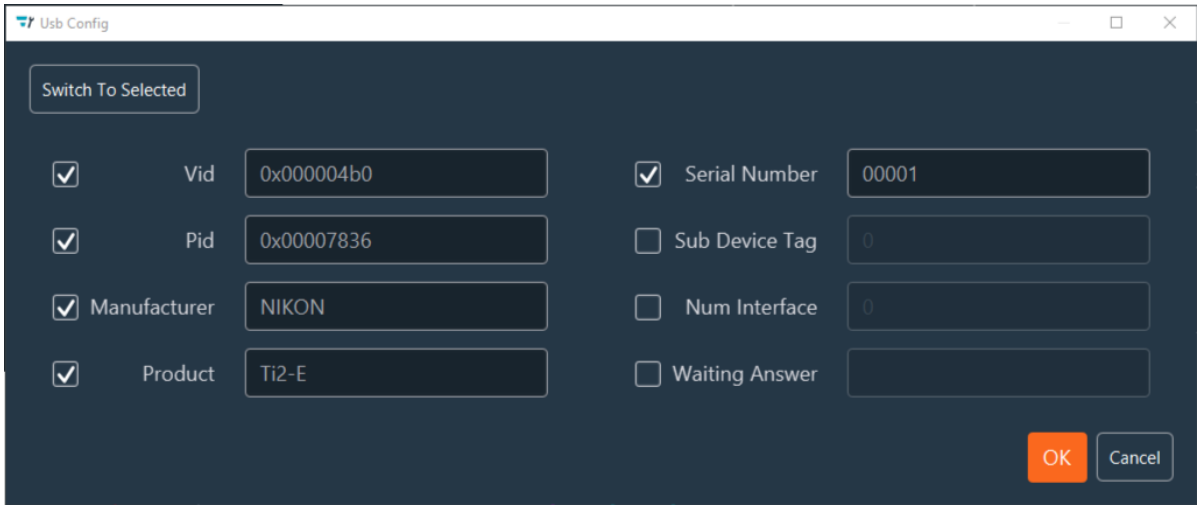
Connection Status: When a connection is successfully linked, the border surrounding the sub-device name changes from **Red** to **White**.



Handling Missing Parameters

If a connection box appears **Yellow**, required communication parameters (e.g., PID/VID numbers) are missing.

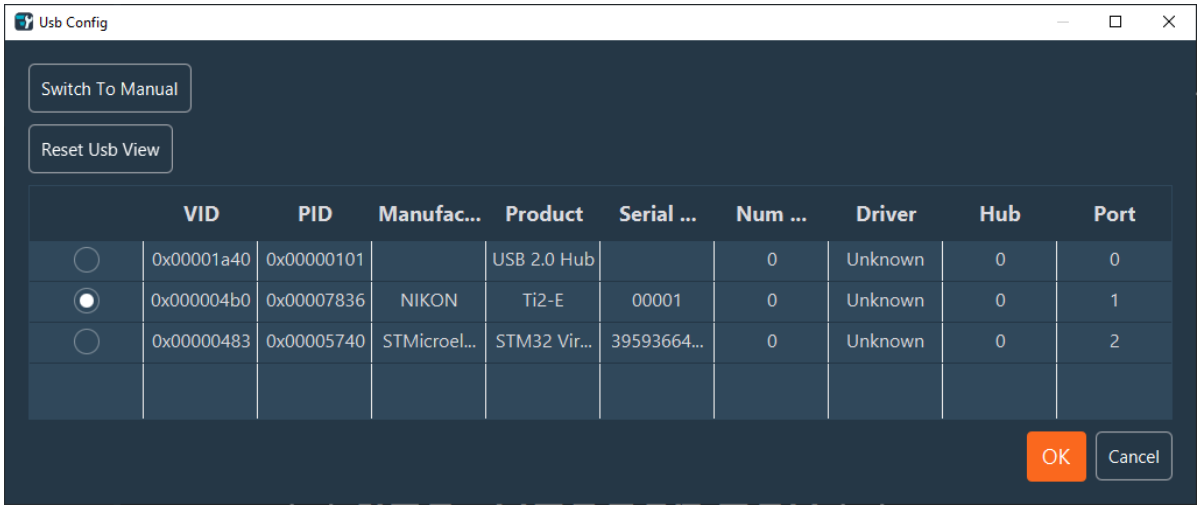
1. Double-click the connection name.
2. In the popup window, fill in the required fields. For a *Microscope Stand Ti2*, select the checkboxes for **Pid** and **Vid** to enable auto-detection, or enter them manually.



USB Detection and Management

Automate port assignment or refresh the hardware view using the USB management tools:

- **Reset USB View**: Triggers a scan of all connected USB hardware.
- **Switch To Manual / Switch To Selected**: Grants granular, manual control over port assignments if automatic detection is insufficient.



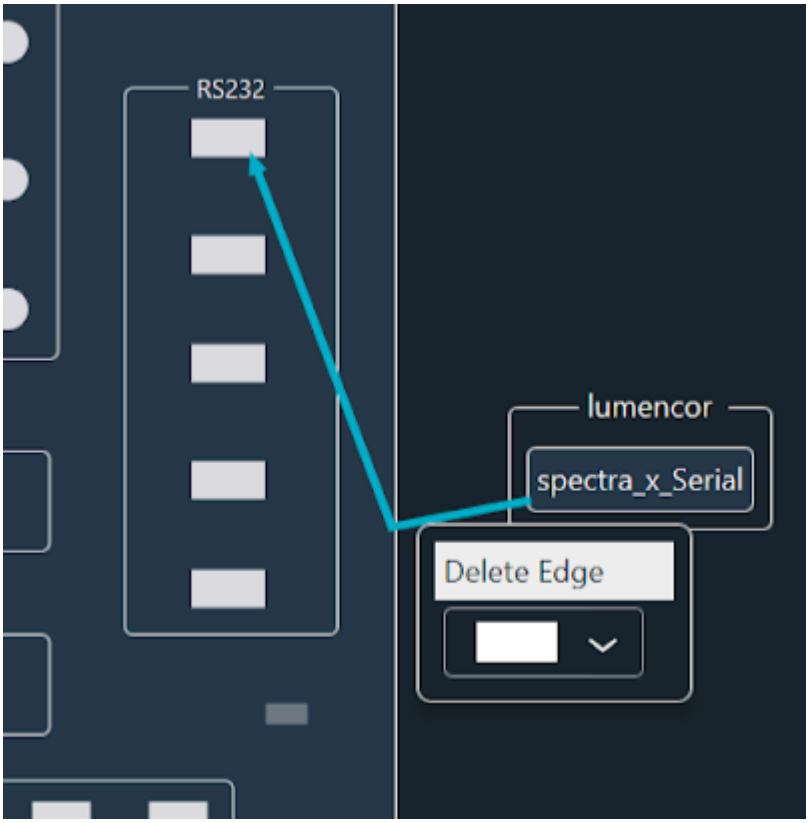
USB Hub Info

The first line in the USB port list typically represents the internal USB hub of the box (except for Type S). This line is used for diagnostic purposes to ensure internal communication is functional.

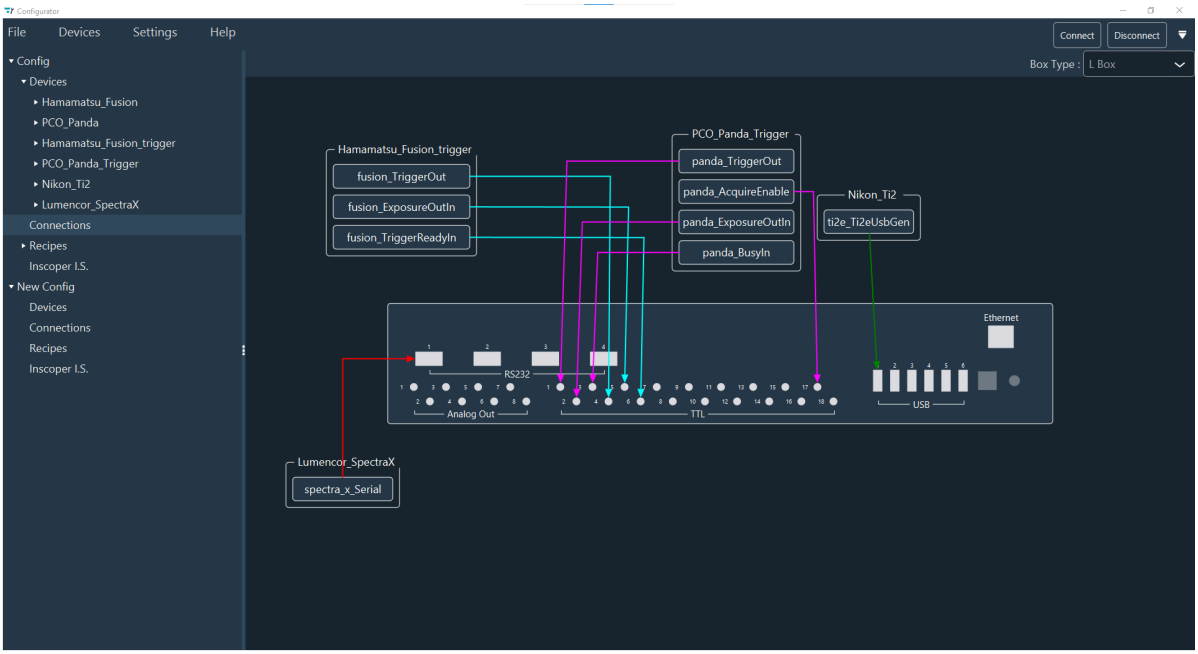
Customizing the Diagram

To improve the readability of complex diagrams:

- **Adjust Lines**: Click a connection arrow to create an anchor point. Drag the anchor point to create logical angles and route cables clearly.
- **Remove Angles**: Right-click an anchor point to delete it.
- **Styling**: Right-click an arrow to change the **Color Box** for visual separation, or select **Delete Edge** to remove the connection.



Once all devices are correctly linked, the diagram displays all devices with white borders, indicating valid connections.



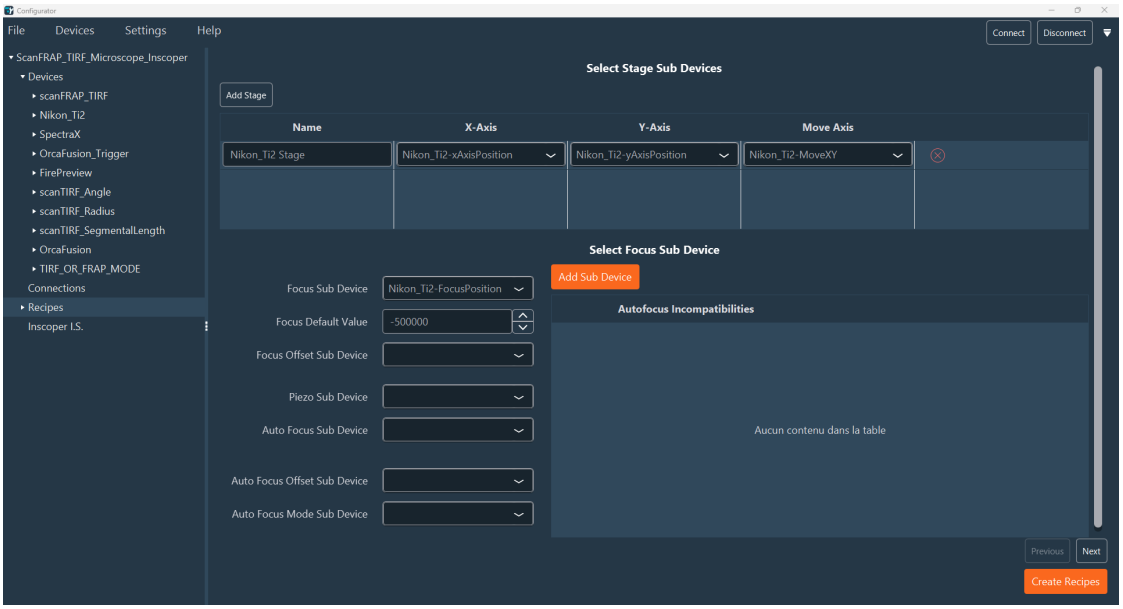
All logical devices are now physically mapped to the controller. Proceed to the next step: defining acquisition recipes.

1.2.6 Generating Recipes

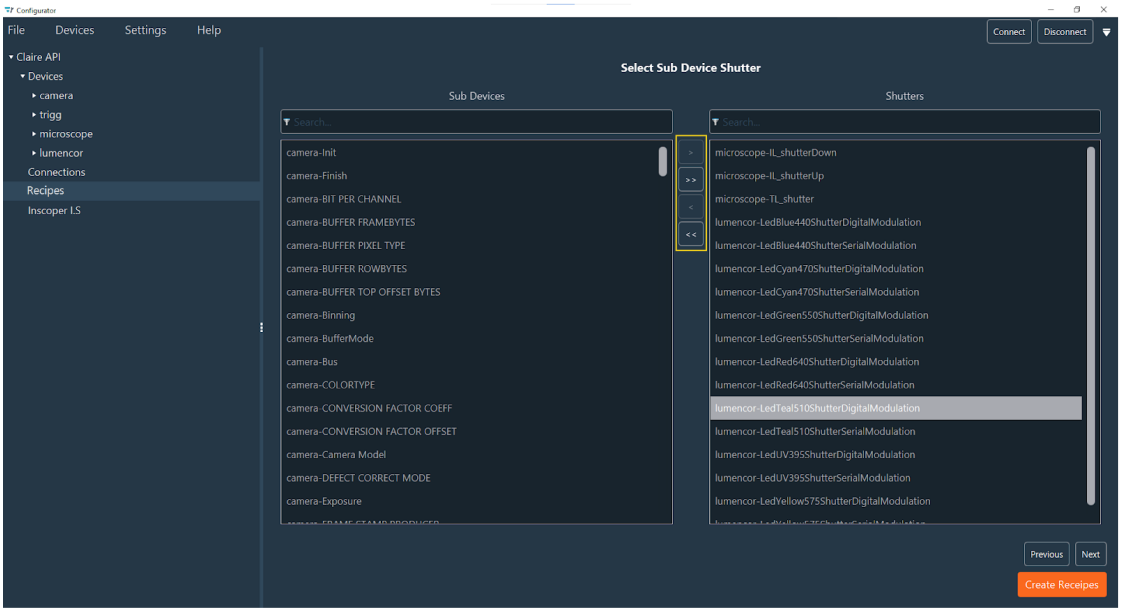
Automatic Recipe Creation

This section guides you through the automated generation of standard recipes derived from your device configuration. Completing this step ensures that all core microscope functions are correctly mapped and ready for operation.

1. After configuring and connecting your devices, navigate to the **Recipes** tab on the left sidebar. Verify that the correct sub-device is assigned to each function (e.g., Stage X, Stage Y, Focus). While these fields are pre-filled, you must confirm that they accurately reflect your current configuration.
2. In the **Select Stage Sub Devices** section, a table defines the components (X, Y, Move) for each stage. Enter a descriptive name for the stage and map the appropriate sub-device for each row. You can add new stages using **Add Stage** or remove them using the **Red Cross**.
3. Configure the focus device properties, including any piezo or autofocus sub-devices. Click **Next** to proceed.



4. Configure the shutter list. The panel on the right displays the shutter sub-devices currently identified in your configuration. Review this list carefully: add any missing shutters from the available list on the left, and remove any incorrect entries (false positives). Ensure that the right-hand list contains **all and only** the valid shutter sub-devices for your system. Use the arrow buttons to move items between the lists:
    - **>>**: Move all sub-devices to the shutters list (Right).
    - **>**: Move only the selected sub-device to the shutters list (Right).
    - **<<**: Remove all sub-devices from the shutters list.
    - **<**: Remove only the selected sub-device from the shutters list.



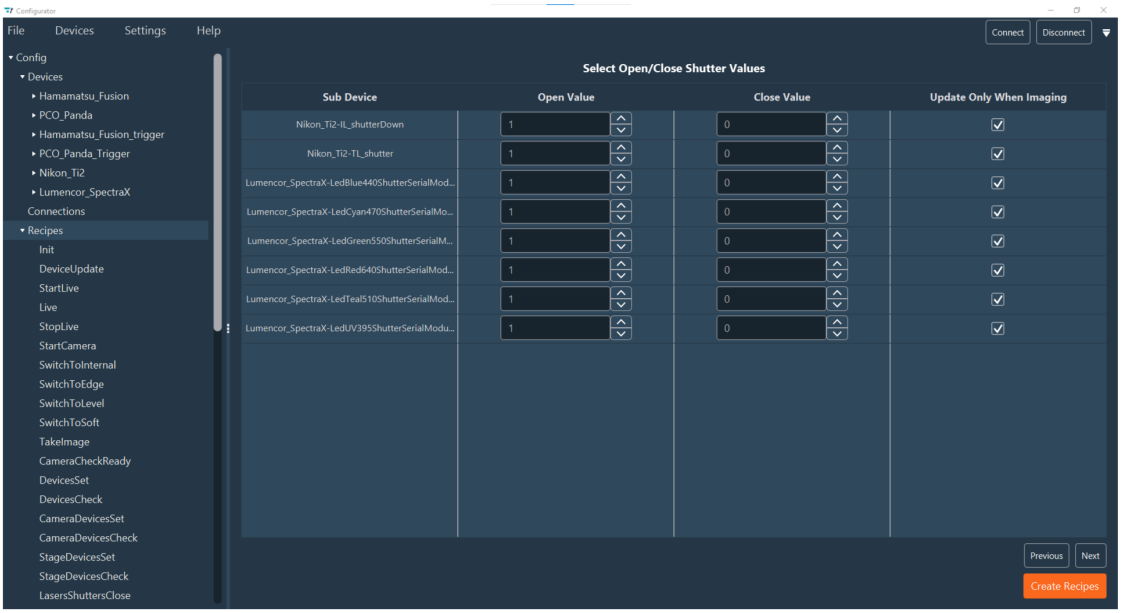
> **Tip**
>
> Use the search bar to quickly locate specific elements.

Click **Previous** to return to the prior step. Once your shutter list is correct, click **Next** to continue.

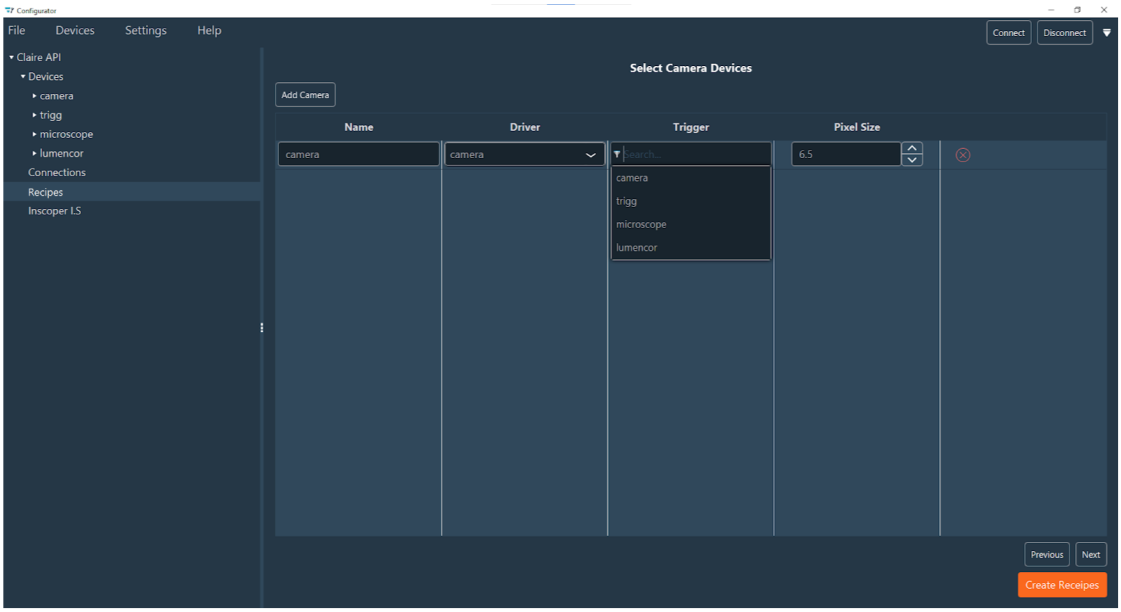
5. Verify the configuration for each shutter sub-device listed in the rows. For each shutter, check the columns:
    - **Open Value**: Enter the value that opens the shutter (typically **1**).
    - **Close Value**: Enter the value that closes the shutter (typically **0**).
    - **Update Only When Imaging**: Check this box to restrict shutter status changes to Live or Acquisition modes only. Uncheck it to allow manual control of the shutter status at any time.

> **Note**
>
> Ensure you verify whether your hardware requires a **0** or **1** to open/close the shutter, as this can vary.

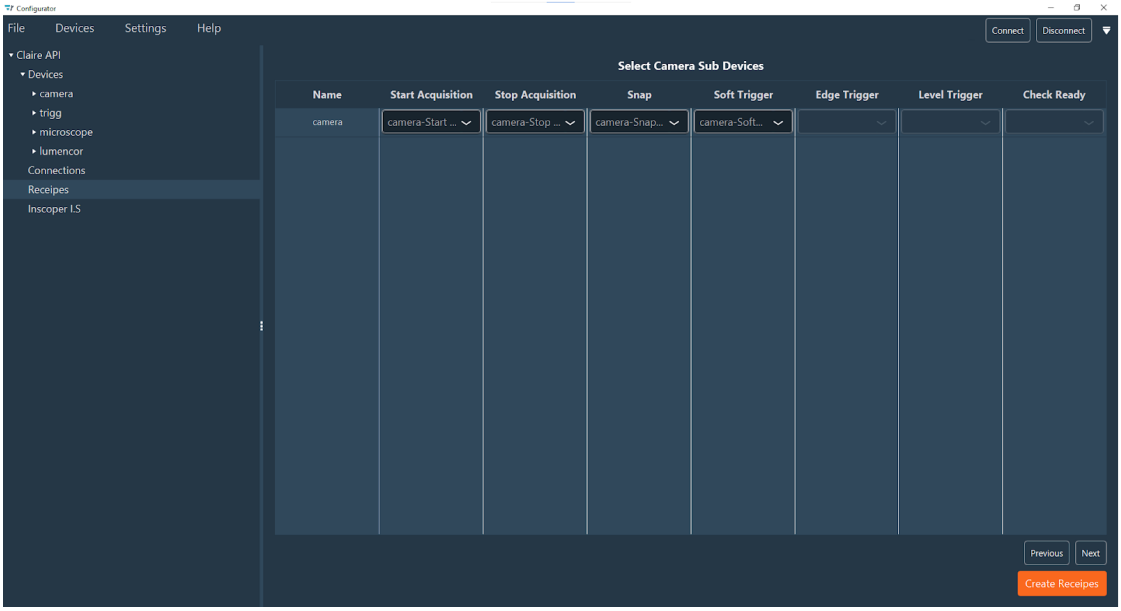
When verification is complete, click **Next**.



6. Configure your cameras. Detected cameras will appear automatically in the table, where each row represents a camera device. You can manually include additional cameras by clicking **Add Camera** or remove them using the **Red Cross**. For each camera row, specify the **Name**, **Camera Driver**, **Trigger Device** (optional), and **Pixel Size**. When finished, click **Next**.



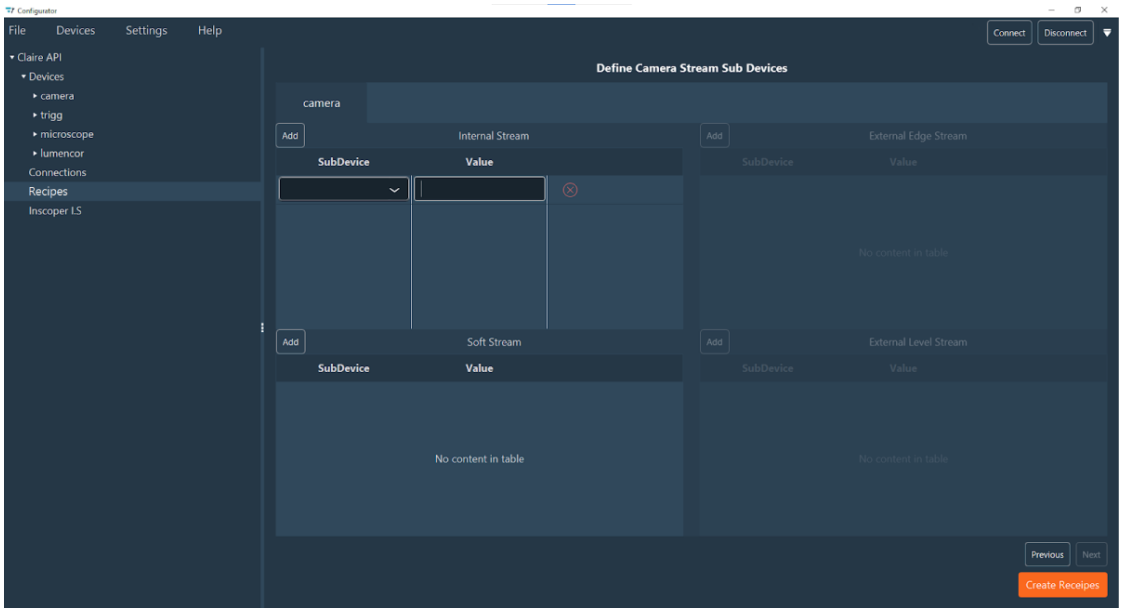
7. Review the pre-filled sub-devices (`Start Acquisition`, `Stop Acquisition`, `Snap`, `Soft Trigger`). These are sub-devices of the **Camera Device**. If a **Trigger Device** was selected in the previous step, `Edge Trigger`, `Level Trigger`, and `Check Ready` fields will also be available. Click **Next** to proceed.



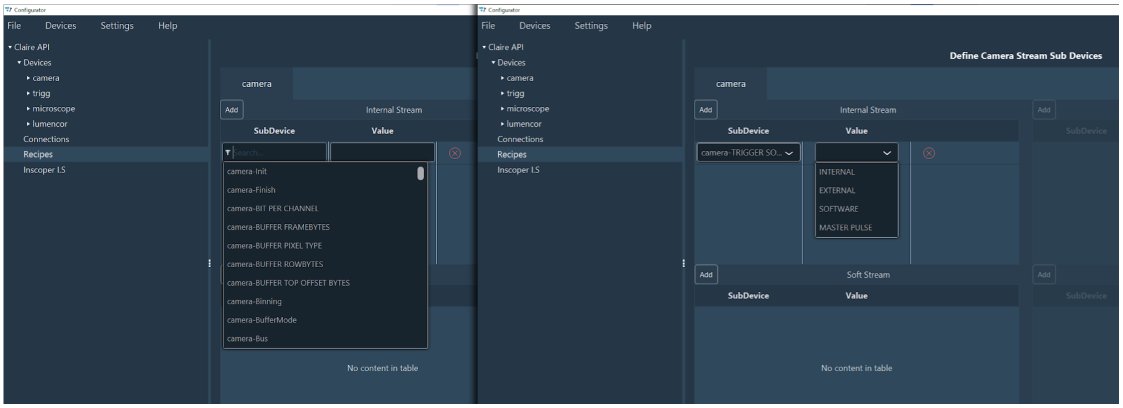
8. Define the **Camera Stream** parameters for different modes. This section contains four tables, one for each stream type. In each table, every row represents a sub-device and its corresponding value. You can add or remove rows using the **Red Cross**.

    - **Internal Stream**: Configurations for Live or Snap modes.
    - **Soft Stream**: Configurations for software-triggered modes (via `Soft Trigger`). Available only if **Soft Trigger** was specified.
    - **External Edge Stream**: Configurations for DC-triggered modes via TTL (fixed exposure). Available only if **Edge Trigger** was specified.
    - **External Level Stream**: Configurations for DC-triggered modes via TTL (variable exposure). Available only if **Level Trigger** was specified.

    The specific sub-devices required depend on your camera model.

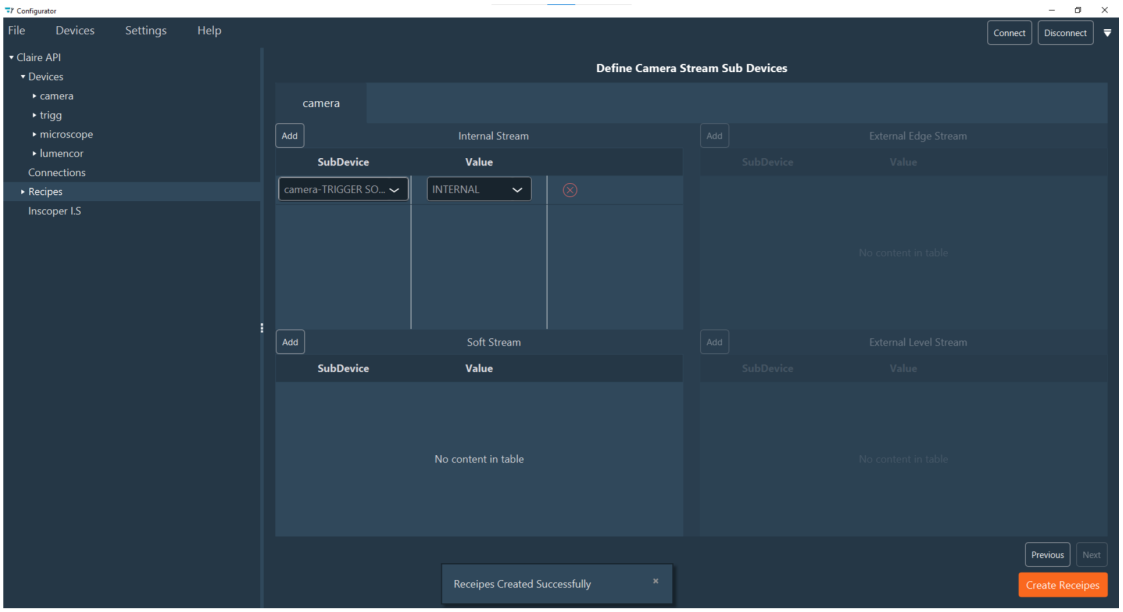


9. Select the appropriate **Sub Device** and **Value** for each field using the search box. Once selected, the specific values for that sub-device will appear in the **Value** drop-down menu.

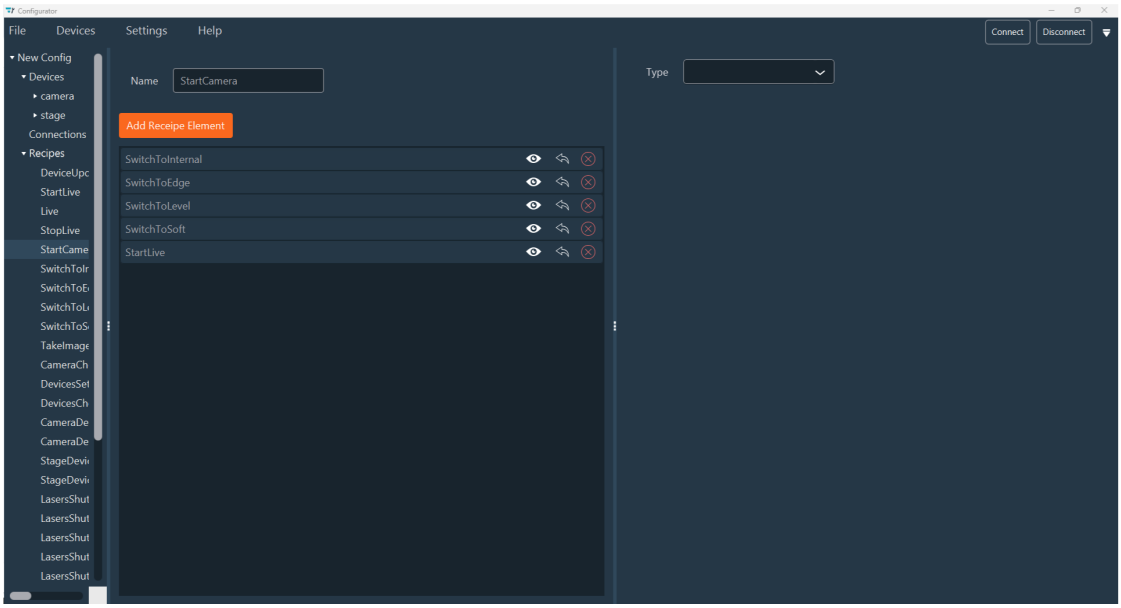


10. *(Optional)* For systems using special techniques like FRAP or TIRF (via ILDA connector) or FLIM options, check the **ILDA functions** box.

11. When all properties are configured, click the orange **Create Recipe** button at the bottom right corner. A confirmation popup "Recipes Created Successfully" will appear. The new recipe will then be listed as a sub-element under the **Recipes** section in the left-hand configuration menu. You can click these recipes to modify them if needed.



12. Typically, recipes do not require modification. However, you can drag and drop functions to reorder them if necessary.



The automatic generation is now complete, and your system is equipped with the essential recipes for standard usage. You may now review these recipes or proceed to add custom functions.

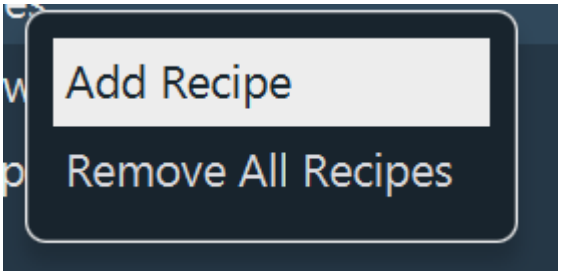
Manual Recipe Creation

For specific requirements beyond standard automation, this section explains how to manually create and configure custom recipes. This process provides precise control over individual sub-devices and acquisition sequences.

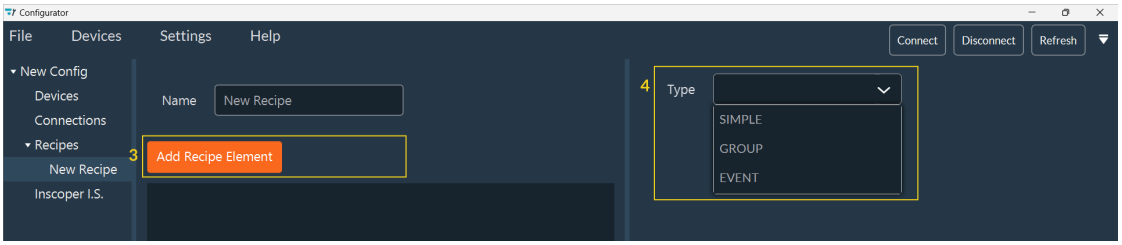
1. To add a new recipe, right-click the **Recipes** section in the left-hand configuration menu and select **Add Recipe**.

> **Note**
>
> To delete all existing recipes, select **Remove All Recipes**.

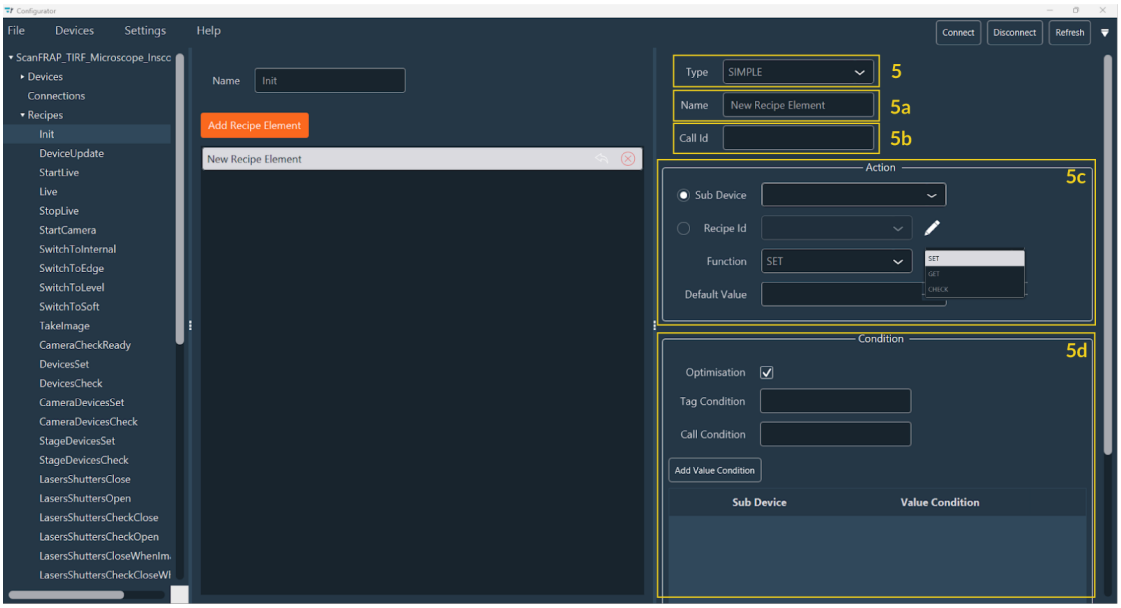
> **Note**
>
> To duplicate an existing recipe, click **Duplicate**, select the target configuration, enter a name for the new recipe, and validate.



2. Enter a descriptive name for the recipe in the **Name** field.
3. Click **Add Recipe Element** to begin configuring the recipe.
4. Select the **Type** of recipe element:
   - **SIMPLE**: A recipe for a single sub-device (or a list of sub-devices if a Recipe ID is selected).
   - **GROUP**: A recipe that calls another recipe.
   - **EVENT**: Triggers a specific action at a defined moment in the acquisition sequence (e.g., stop or pause). This is useful, for instance, to ensure shutters close when the system pauses. This type works for configurations with or without a Device Controller (DC).

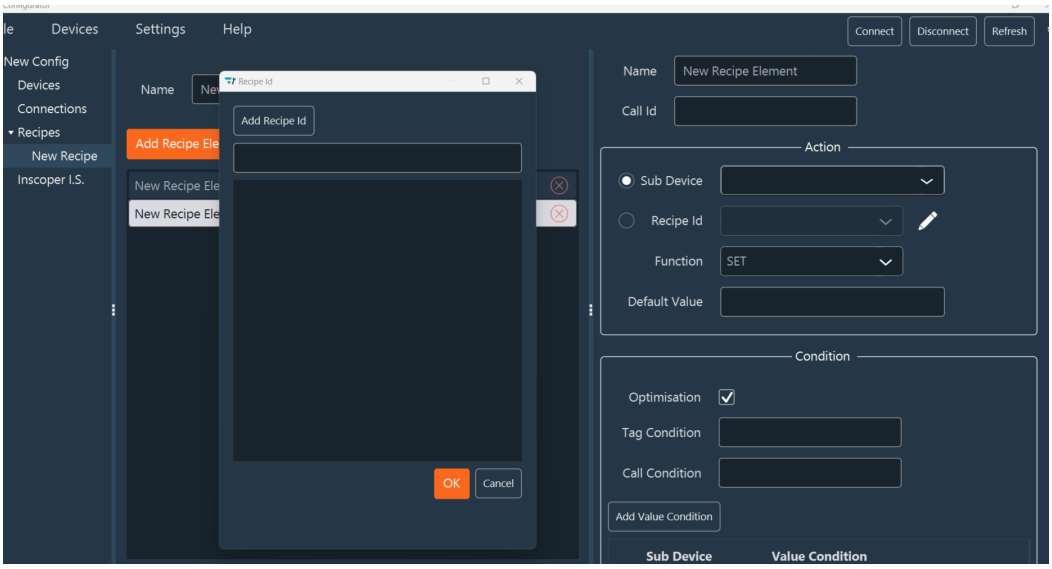


5. If you select **SIMPLE** (5), configure the following options:



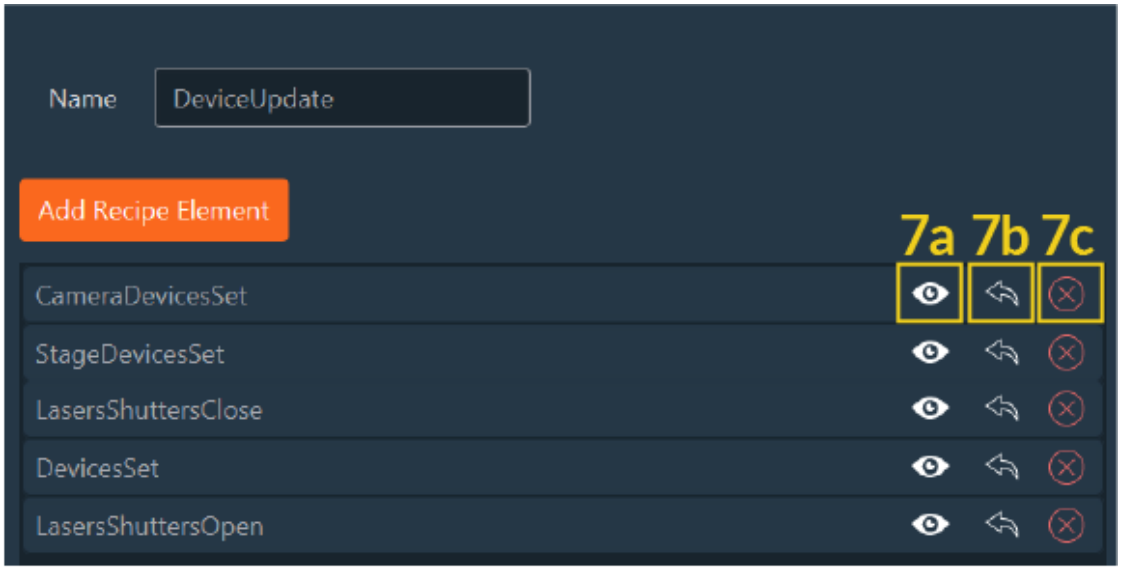
- **Name** (5a): Modify the name of the recipe element.
- **Call ID** (5b): Specify the unique ID for the recipe.
- **Action** (5c):
  - **Sub Device / Recipe ID**: specific the sub-device involved or the Recipe ID to be called. Click the pencil icon to open the **Add Recipe ID** popup.

> **Note**
>
> Recipe IDs created at the device level cannot be removed or modified. However, Recipe IDs created at the recipe level can be fully managed (created, modified, or deleted).



  - **Function**: Choose the function to execute:
    - **SET**: Sends a value to the sub-device.
    - **GET**: Retrieves the current value from the sub-device.
    - **CHECK**: Waits until the sub-device reaches a specific status.
  - **Default Value**: Define a default value for the action.
- **Condition** (5d):
  - **Optimisation**: Check this box to execute the function only if the value has changed.
  - **Tag and Call Condition**:
    - **Tag Condition**: A boolean expression based on the presence or absence of a specific tag.
    - **Call Condition**: A boolean expression to check if a recipe element with a specific `CallID` has been executed previously (e.g., `TI2xAxisPosition || TI2yAxisPosition`).
  - **Value Condition**: Click **Add Value Condition** to add logical constraints.
    - Select a sub-device and define its **Value Condition**.
    - You can add multiple value conditions as needed.

6. If you select **GROUP**, you can include multiple recipe elements. Click **Add Recipe Element** and repeat the steps above to configure each one.
7. Use the recipe element tools to manage your configuration:
   - a. **View Details**: View configuration details (valid only for **GROUP** elements).
   - b. **Move**: Transfer the recipe element to another recipe.
   - c. **Delete**: Remove the recipe element.
   - d. **Reposition**: Drag and drop the recipe element to change its order in the list.

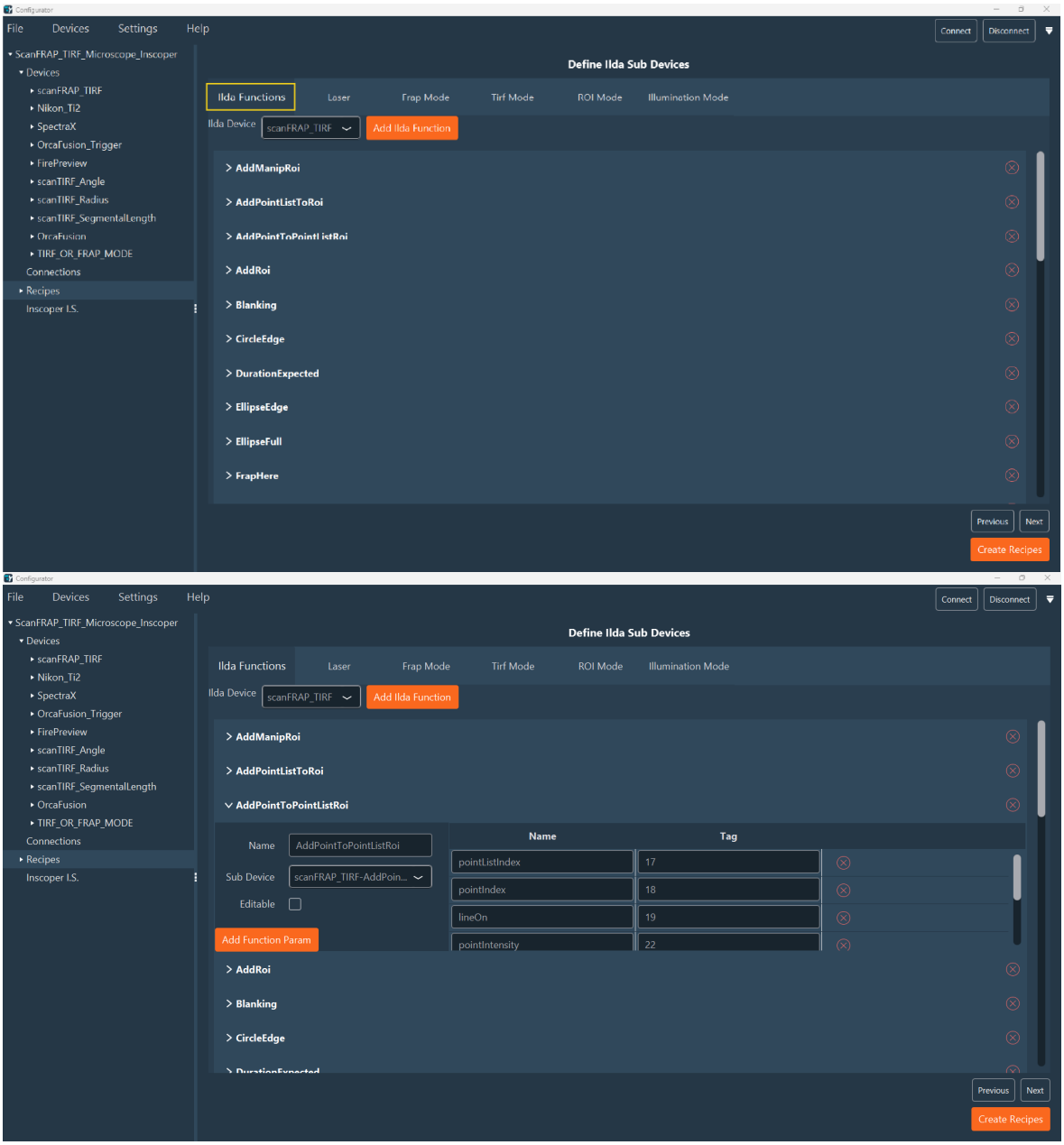


Your custom recipe is now fully configured and saved. It allows for tailored control of your system and can be utilized in your experimental workflows.

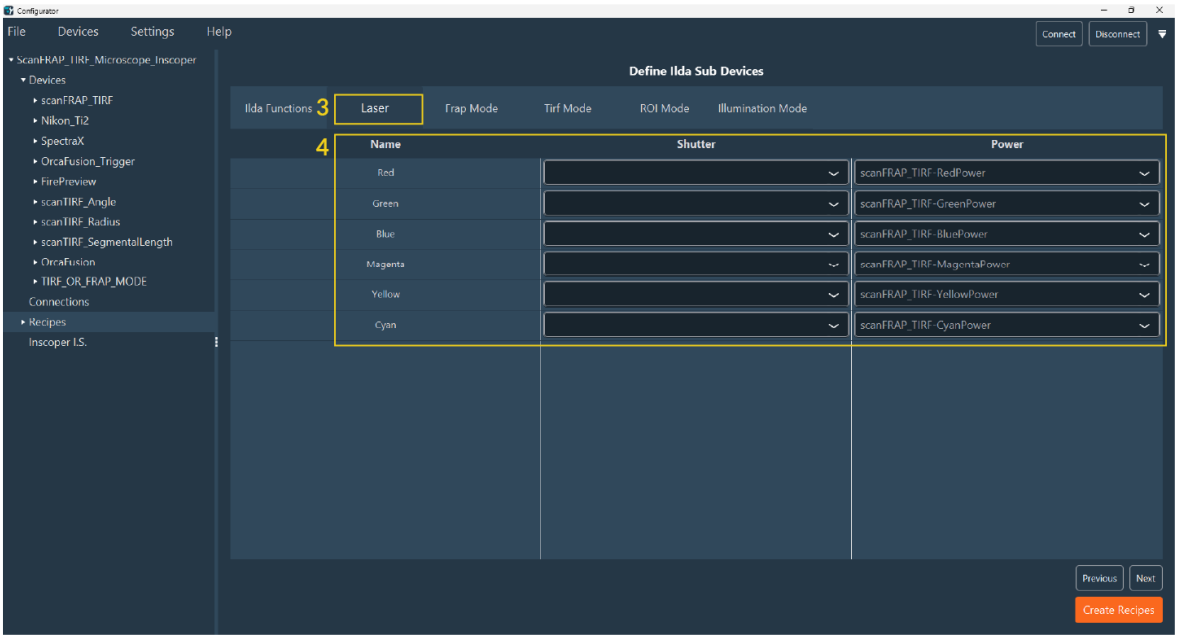
ILDA Functions for FRAP, TIRF, and FLIM Modules

If the system includes additional modules such as FRAP, TIRF, or FLIM, you must configure the ILDA functions.

- In the **ILDA Functions** tab, select the device connected to the ILDA connector. *Note: This option is only available for XL-type Device Controllers.*

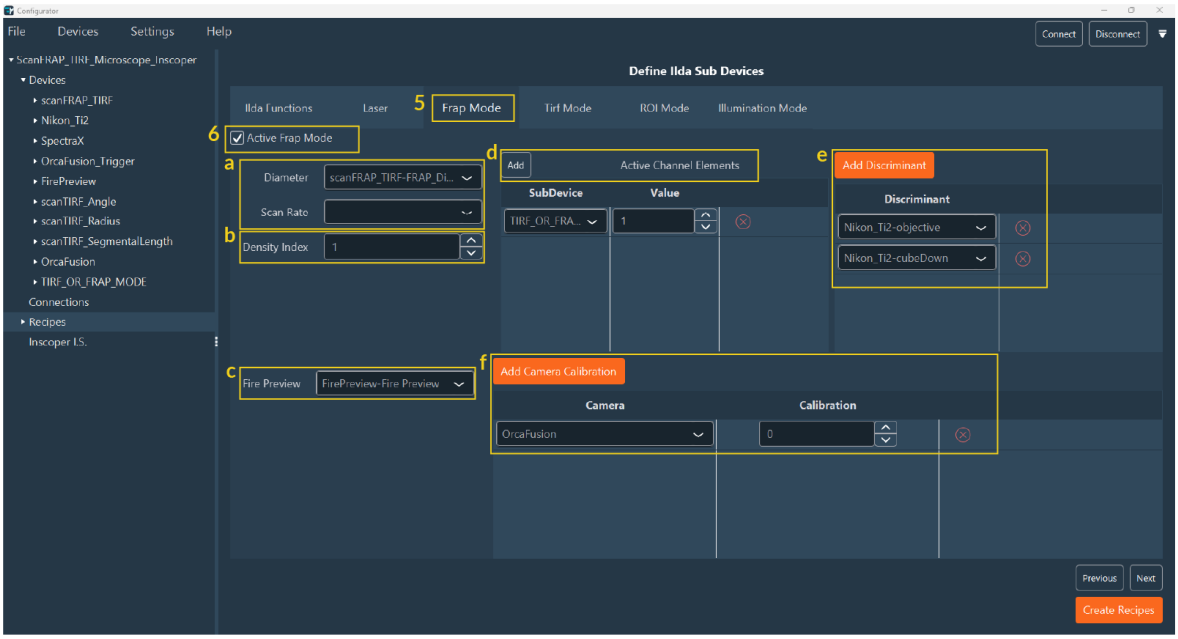


- The system automatically loads all ILDA functions and their associated parameters. Verify that the functions and parameters are correct, then navigate to the **Laser** tab (3).
- In the **Laser** tab (4), specify the shutter and power sub-devices for each laser line using the drop-down menus in the table.

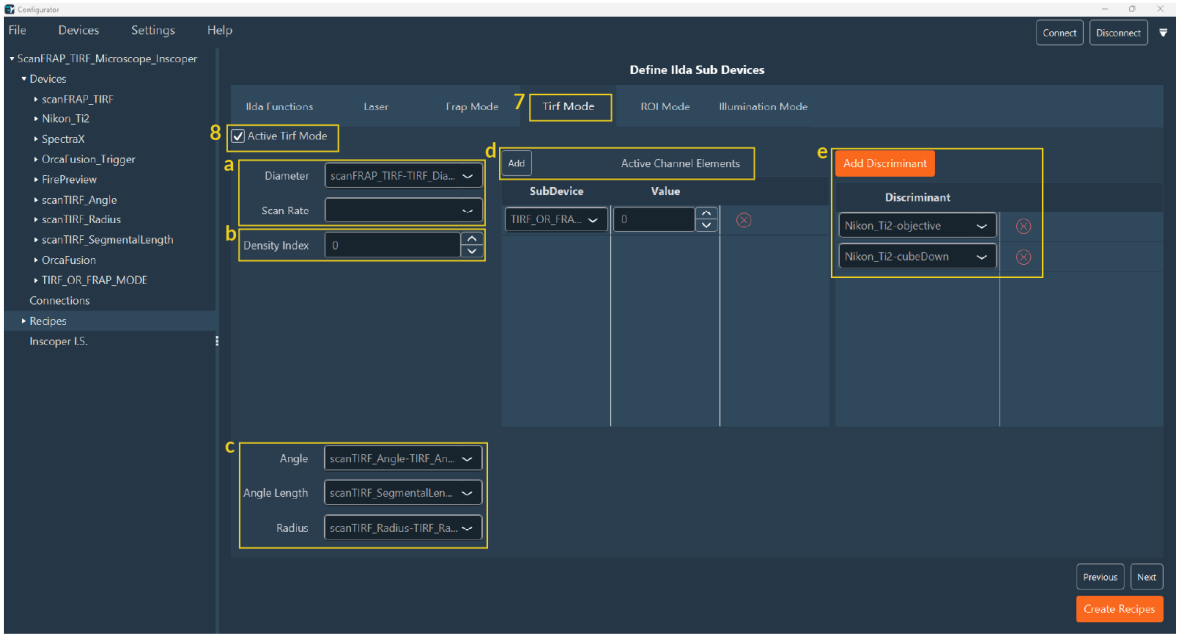


- Navigate to the **FRAP Mode** tab (5) and select **Active FRAP Mode** to enable these options in the user interface (6).
    - a. Select the sub-device that determines the FRAP density and scan rate.
    - b. Specify the **Density Index**, which must match the FRAP diameter value defined for the sub-device in the **Devices** tab.
    - c. Select the sub-device for the **Fire Preview**.
    - d. Enable the **Active Channel Elements** shutter for FRAP to identify the FRAP channel.
    - e. Add discriminants for FRAP calibration (e.g., Objective, Filter Cube).
    - f. Add the camera calibration.

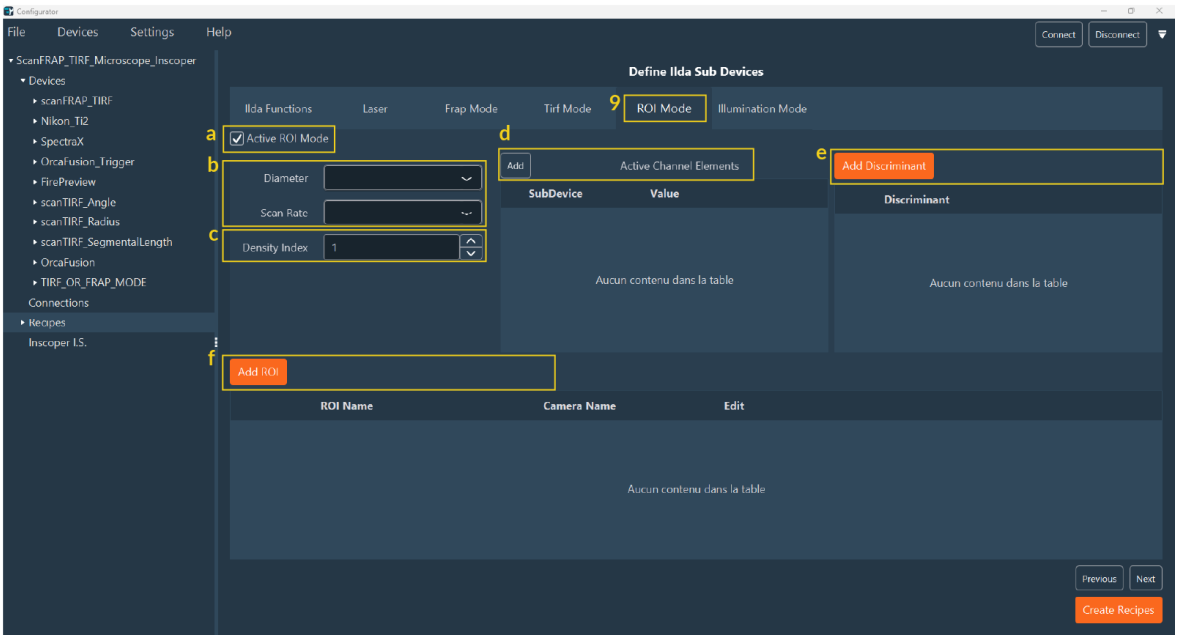
> **Note**
>
> If using multiple cameras, specify whether to use a shared calibration or unique calibrations for each camera.



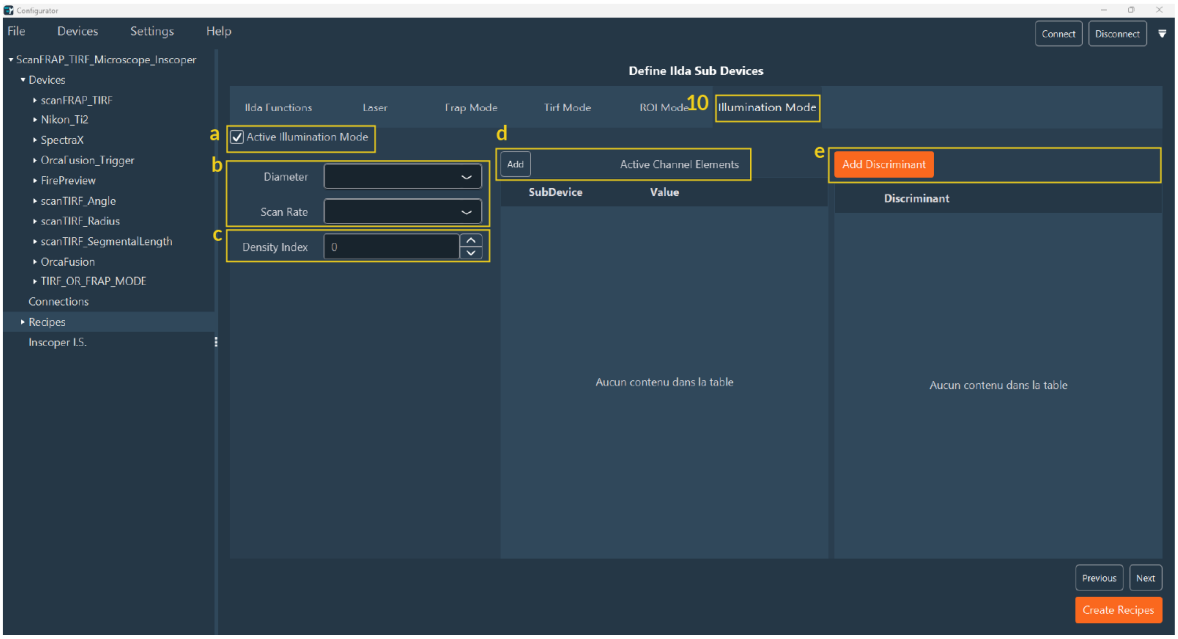
- Navigate to the **TIRF Mode** tab (7) and select **Active TIRF Mode** (8):
  - a. Select the sub-device assigned to the TIRF density.
  - b. Specify the **Density Index**, matching the TIRF diameter set in the **Devices** tab.
  - c. Select the sub-device responsible for **Angle**, **Angle Length**, and **Radius**.
  - d. Enable the **Active Channel Elements** for TIRF.
  - e. Add discriminants for TIRF calibration (e.g., Objective, Filter Cube, Lasers).



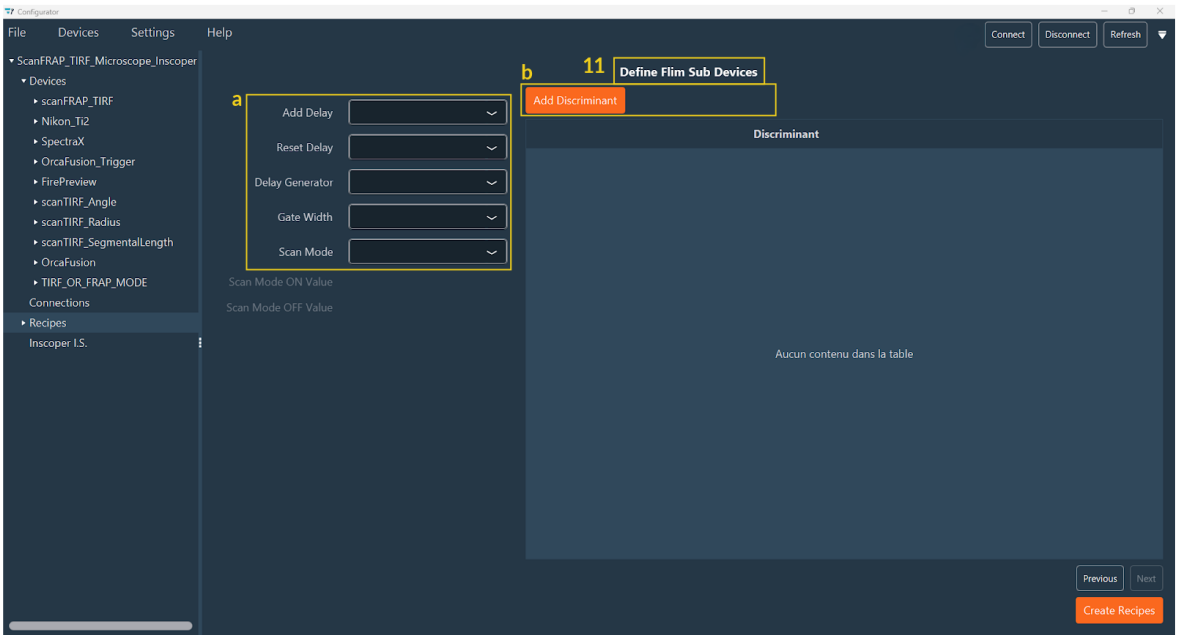
- For LightSheet systems, navigate to the **ROI Mode** tab (9).
  - a. Select **Active ROI Mode**.
  - b. Select the sub-devices for density and scan rate.
  - c. Specify the **Density Index**, matching the FRAP diameter set in the **Devices** tab.
  - d. Enable the active channel elements to activate ROI mode for that channel.
  - e. Add discriminants.
  - f. Add the ROI.



- Use the **Illumination Mode** tab (10) to add a virtual device for selecting illumination modes in multimodal systems (e.g., FRAP, TIRF, Spinning Disk):
  - a. Select **Active Illumination Mode**.
  - b. Select the sub-devices for density and scan rate.
  - c. Specify the **Density Index** (this **must** match the FRAP diameter in the **Devices** tab).
  - d/e. Add active channel elements and discriminants.



- Click on Next to proceed to the last step, the **FLIM** tab (11) for systems equipped with a FLIM module:
  - a. Add all devices responsible for the **Delay**.
  - b. Add discriminants.

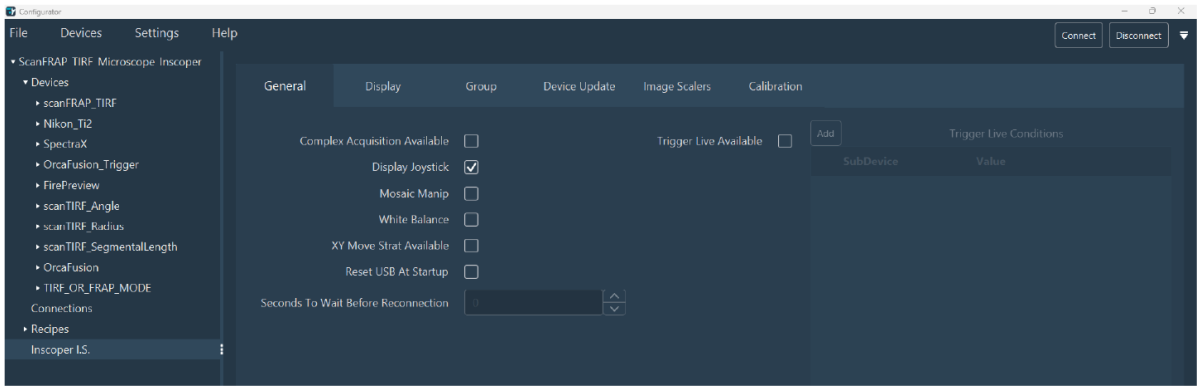


- Click **Create Recipes** to finalize the configuration.

Next Step: Your recipes are now created. You can finalize the Inscoper Imaging Software (IIS) Configuration to complete the setup.

1.2.7 Pre-configuring the Inscoper Imaging Software

Once the recipe is generated, the final step is to design the user interface (Inscoper I.S.) used to control the system. This step allows for the customization of the layout, controls, and available options for acquisition workflows.



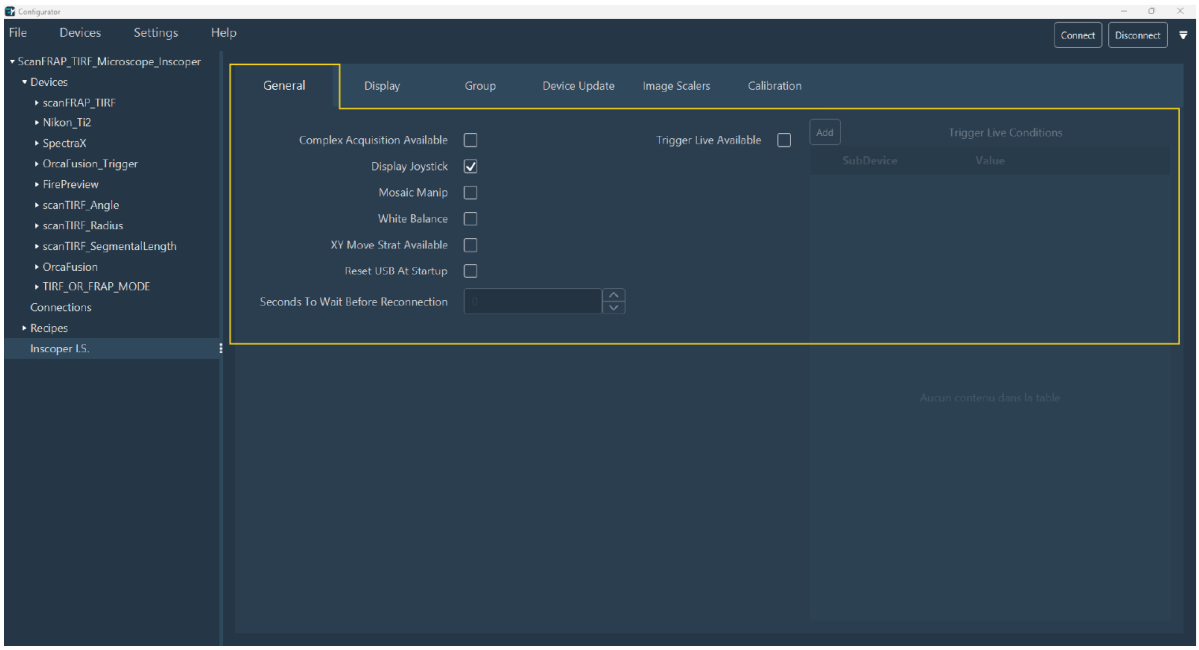
Review up to six configuration tabs to configure Inscoper I.S.:

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

General

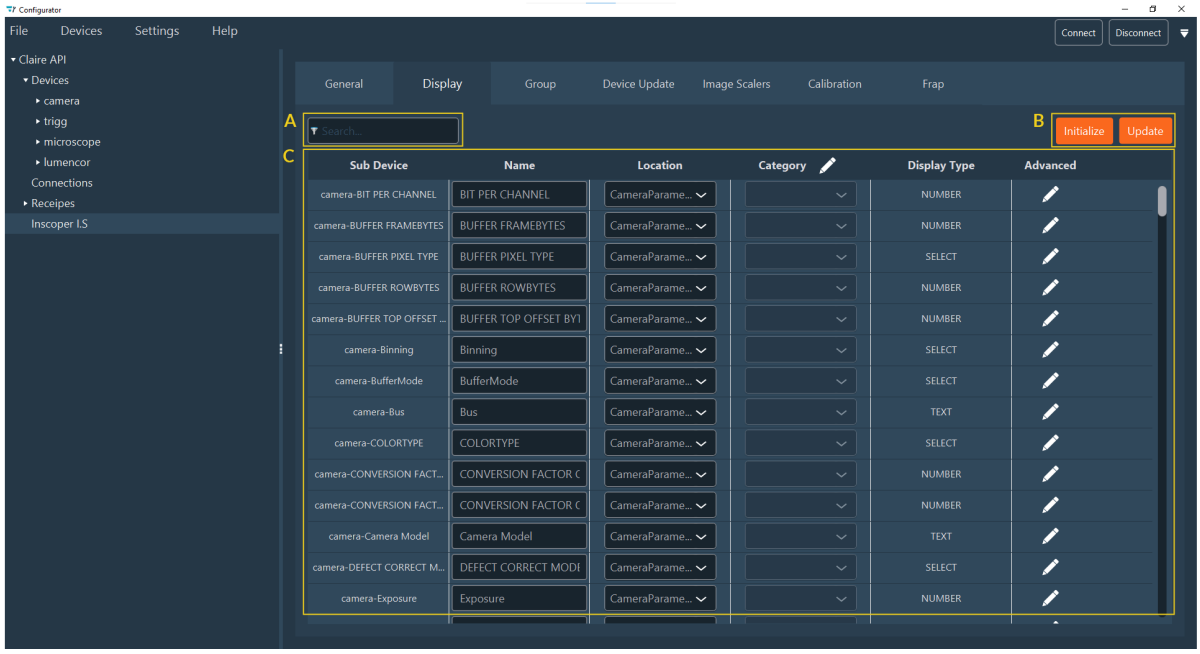
Use the **General** tab to select global elements or interface options:

- **Complex Acquisition Available**: Enable the creation of multi-dimensional acquisition sequences.
- **Display Joystick**: Add a virtual joystick with directional arrows for stage control.
- **Mosaic Manip**: Tiling calibration and experiment options.
- **White Balance**: Use if the system includes a color camera.
- **XY Move Strat Available**: Advanced stage movement options for optimizing travel between distant positions.
- **Reset USB At Startup**: Force a scan of all connected USB devices at startup (required for some devices to be detected).
- **Seconds To Wait Before Reconnection**: Specify the delay between rescanning and reconnection (useful for slow-initializing devices).
- **Trigger Live Available**: Synchronize the "Live" mode with another device via a DC sequence. Required for constrained image capture setups. Enabling this option activates **Trigger Live Conditions**.



Display

Use the **Display** tab to configure the interface layout. Organize controls into different sections (**Location**) and categories (**Category**).



Key elements of this tab include:

- (A) **Search Field**: For quickly locating sub-devices.
- (B) **Action Buttons**: For interacting with the list (Initialize, Update).
- (C) **Display Setting Table**: The main configuration area.

1. INITIALIZATION

Click **Initialize** to generate all Display Data.

- *Note*: If initialization has been completed but new devices were added, click **Update**.
- *Warning*: Re-initializing overwrites any existing custom display settings.

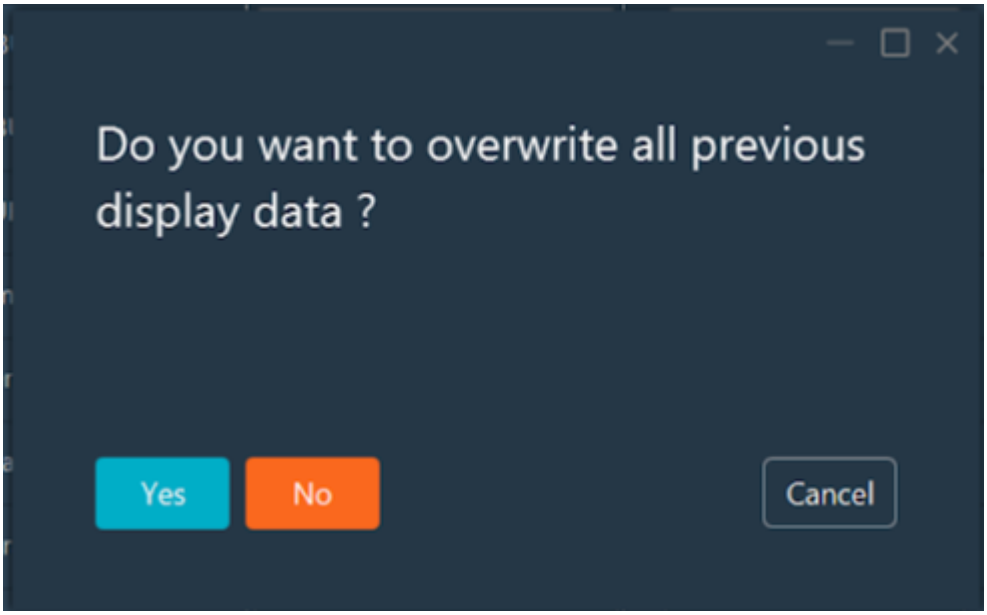


Table Columns

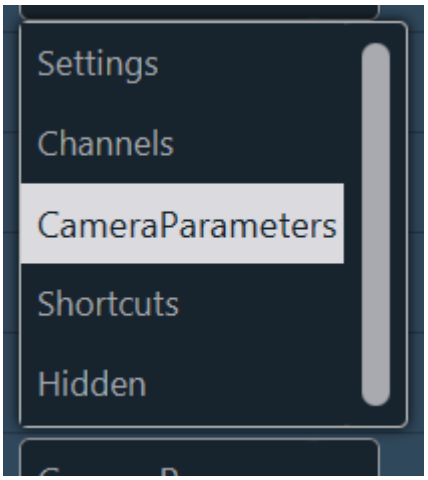
After initialization, the table displays the following for each sub-device:

- **Sub Device**: The sub-device bound to the display element.
- **Name**: The default label shown in the interface.
- **Location**: The section of the UI where the element appears (e.g., Setting, Channel, CameraParameters).
- **Category**: A sub-grouping within the Location.
- **Display type**: The type of UI control (e.g., Switcher, Slider). Generated by default; modifiable through customization.
- **Advanced**: Access to detailed parameters.

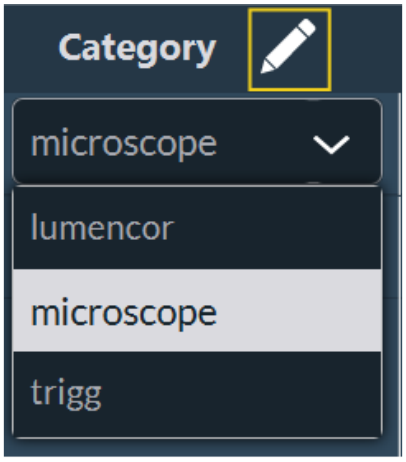
2. MODIFICATION

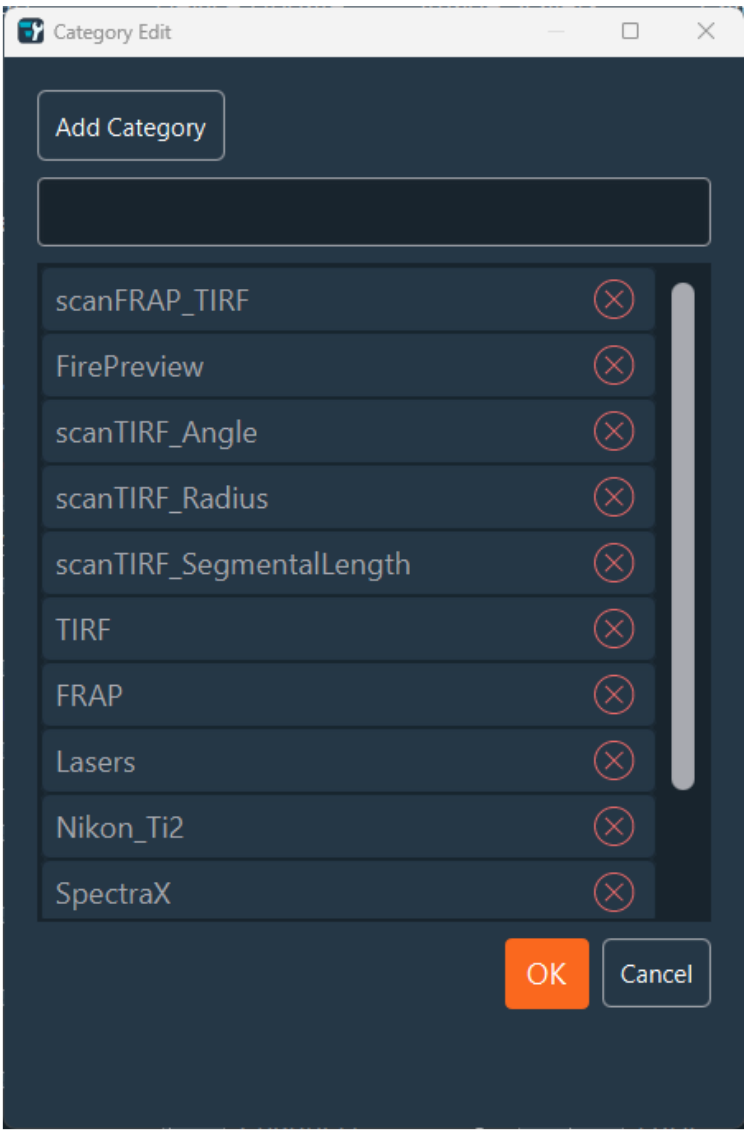
Modify parameters directly in the table:

- **Name**: Click and type to rename the element.
- **Location**: Select a new location from the drop-down menu. Common locations include *Setting*, *Channel*, *Shortcut*, *CameraParameters*, and *Hidden*.



- **Category**: Click the **Edit (pen)** icon to add a new category. Enter the name, click **Add Category**, and click **OK**. The new category then appears in the drop-down menu.

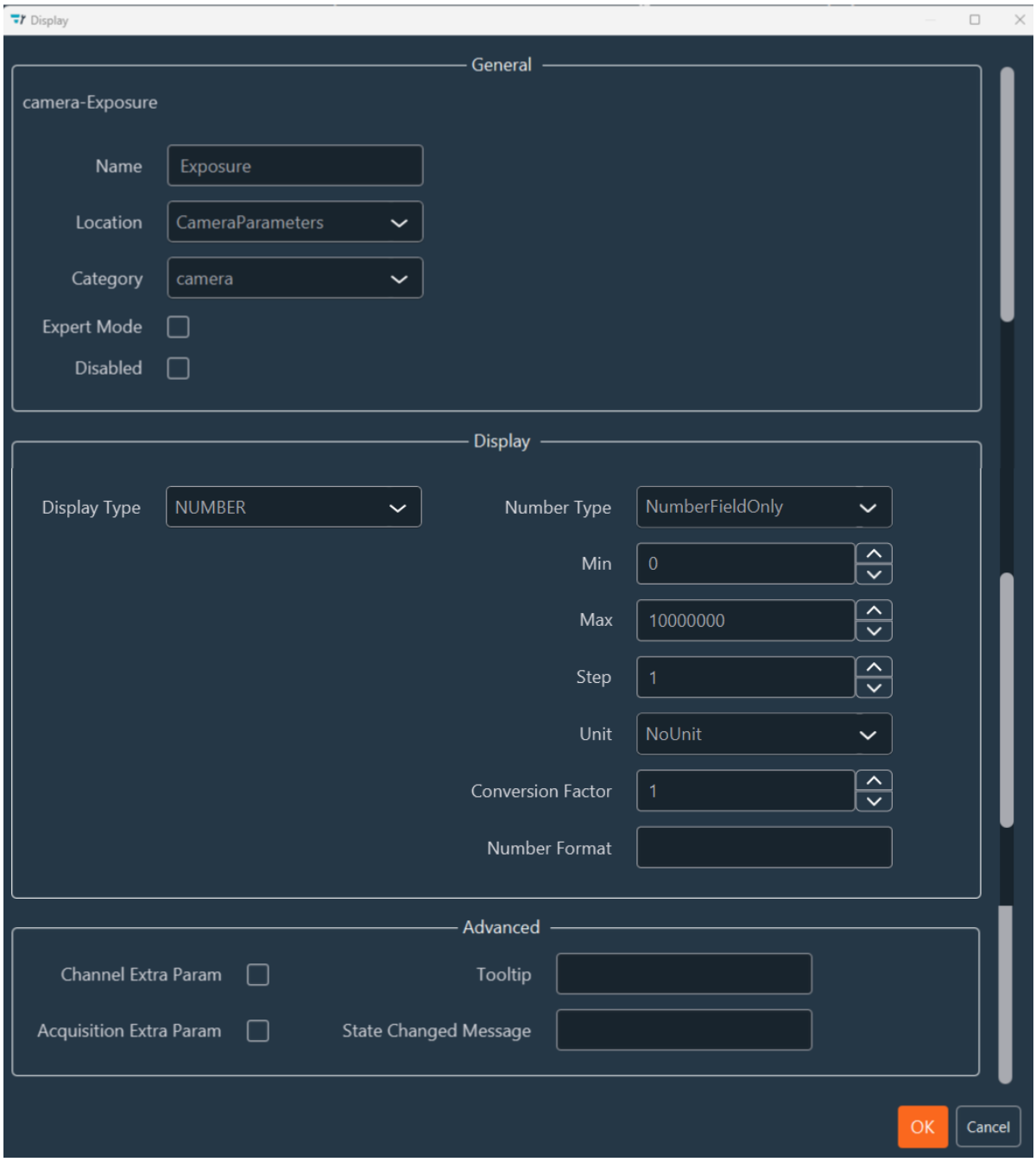




- **Display Type**: Modify the UI control type by clicking **Advanced parameters**.

3. ADVANCED SETTINGS

The **Advanced** tab aggregates all display parameters. Click the **Edit (pen)** icon for a sub-device to access three scrollable sections:



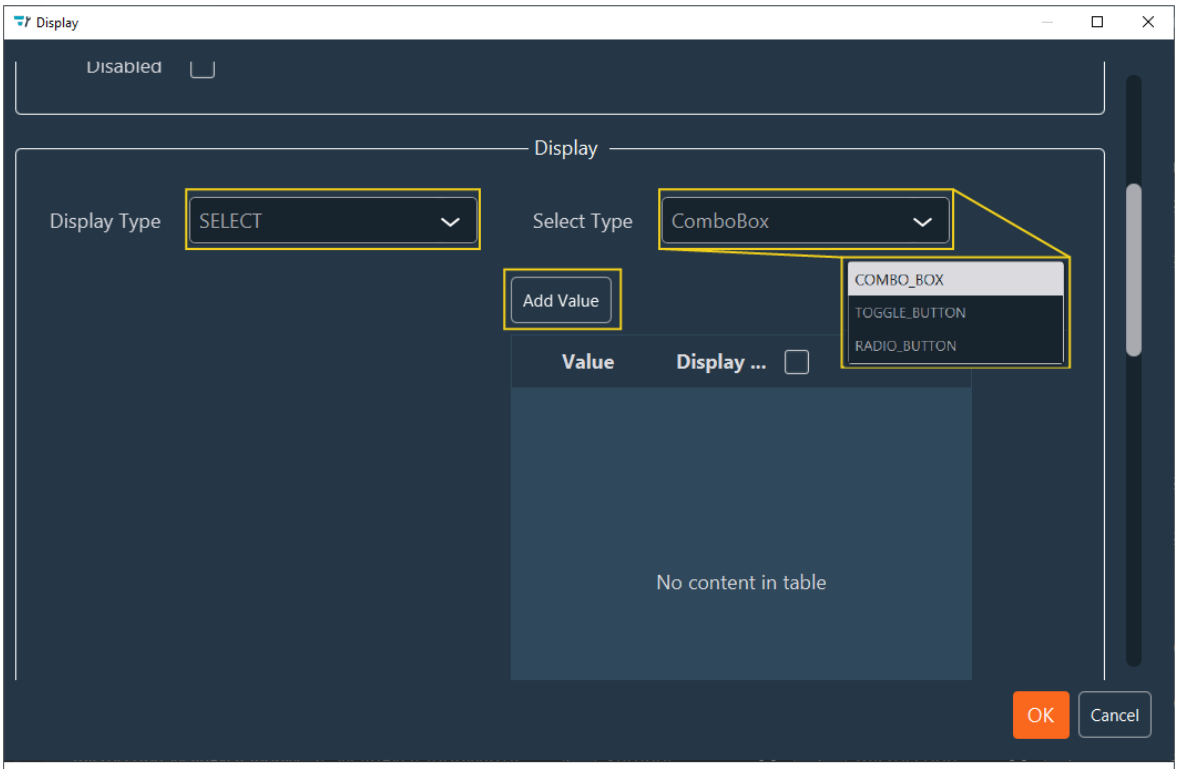
a. General

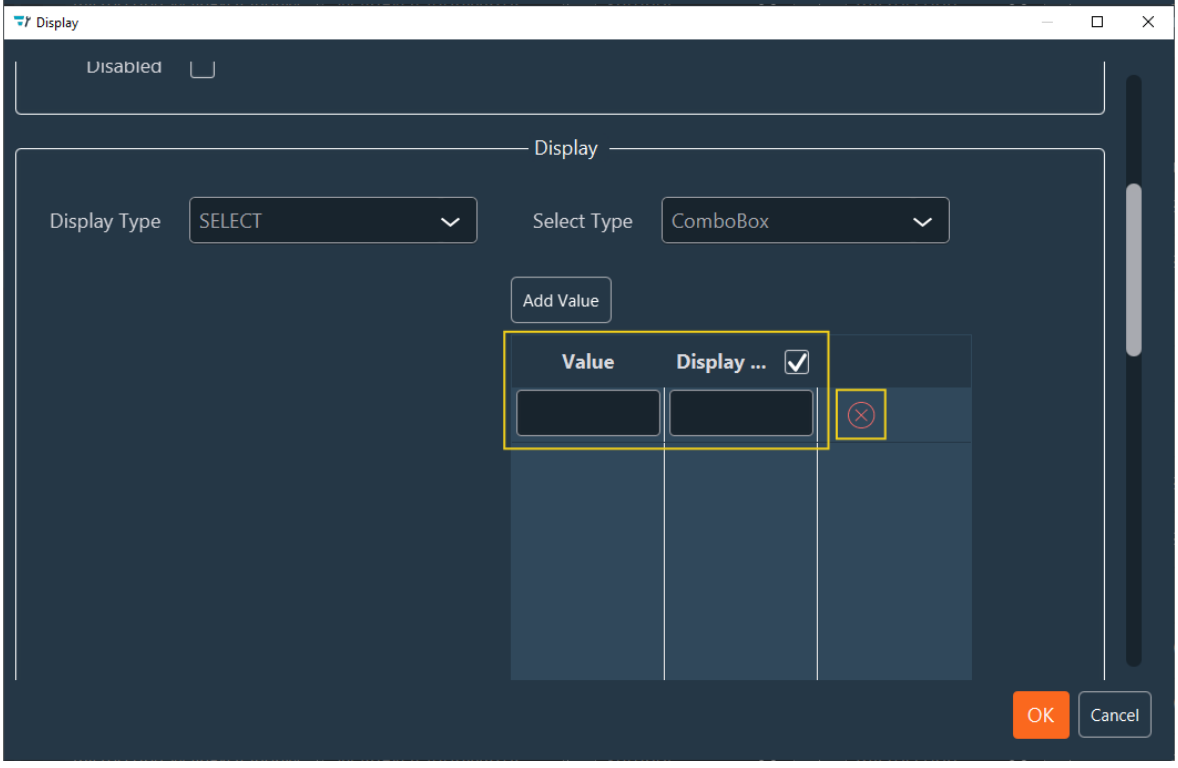
- **Name**, **Location**, **Category**: Standard identification fields.
- **Expert Mode**: Select this checkbox to hide the parameter in standard *User Mode*. *Expert Mode* grants unrestricted access, while *User Mode* provides a streamlined interface.
- **Disabled**: Prevents modifying the setting in the UI.

b. Display Type

Select the appropriate control type for the device property:

- **SELECT**: Choose from **Combo_Box** (drop-down), **Toggle_Button** (2-state switch), or **Radio_Button** (multi-choice).
    - Click **Add Value** to define options.
    - Use the red cross to remove values.





Filter Wheel Configuration

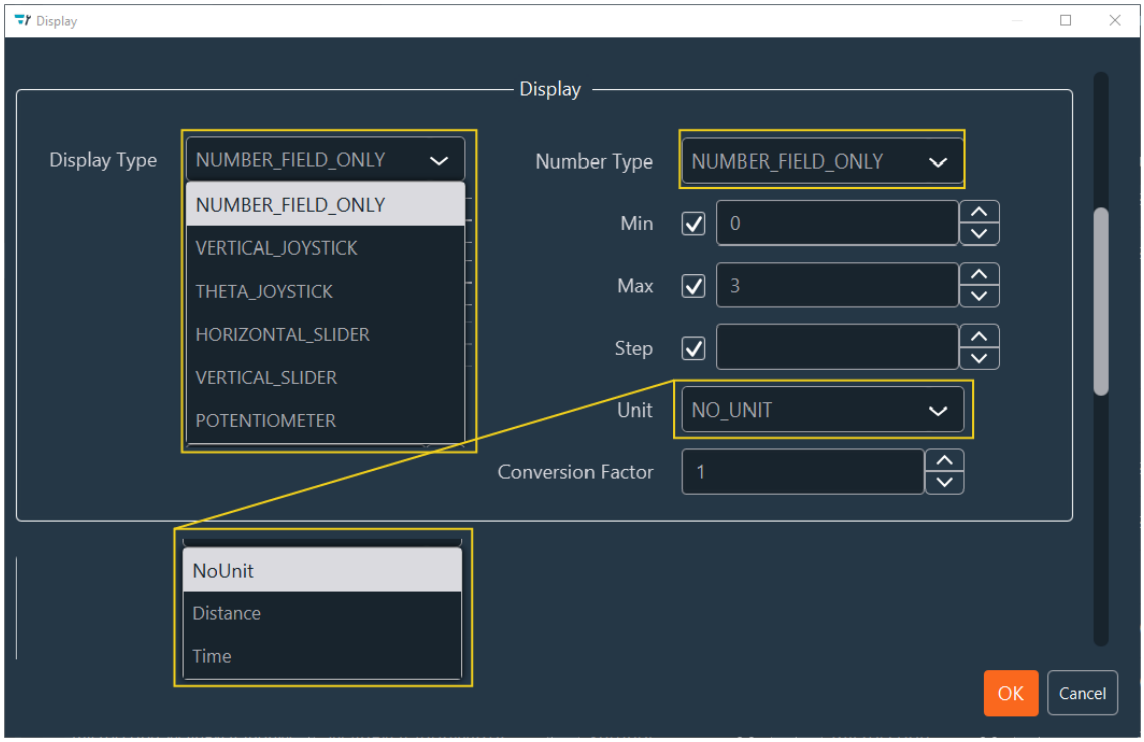
For a 5-position filter wheel (indices 0–4), configure a **SELECT** / **Combo_Box** with these values:

Value	Display
0	DAPI
1	GFP
2	YFP
3	Cy3
4	Cy5

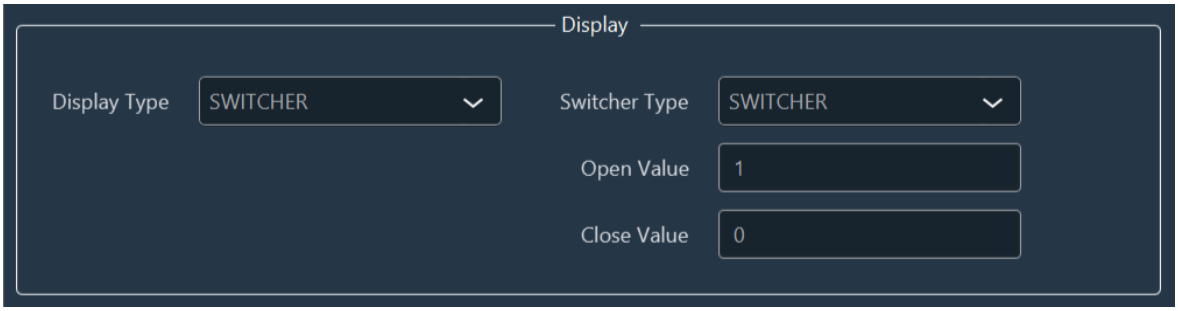
- **NUMBER**: Choose from **Number field**, **VerticalJoystick**, **ThetaJoystick**, **Horizontal/Vertical Slider**, or **Potentiometer**.
  - Required configurations: **Min/Max Value**, **Step**, **Unit** (Distance, Time, None), **Format** (decimal precision), and **Conversion Factor**.

Stage Control

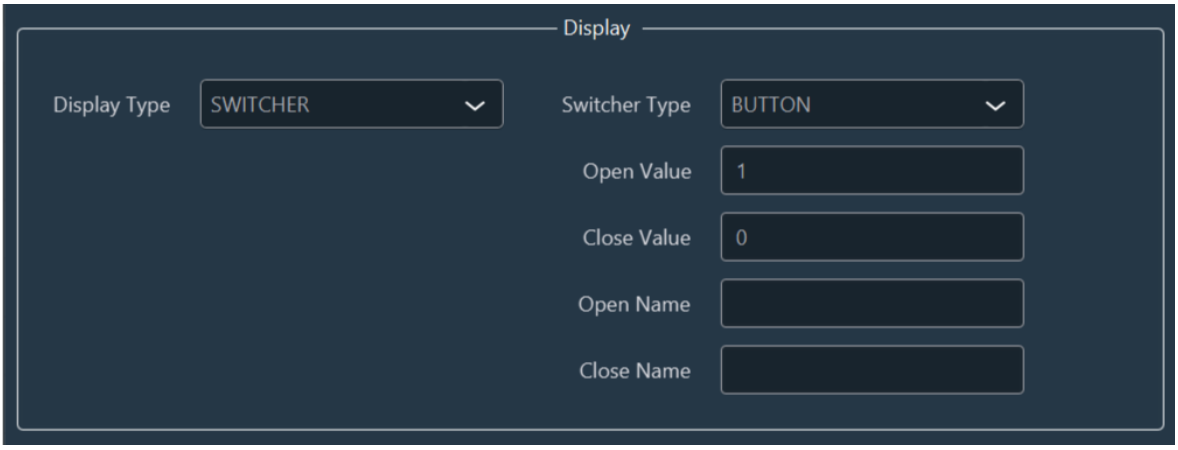
Commonly used for stage movement controls.



- **SWITCHER**: Choose between **Switcher** or **Button**.
  - Define the **Open** and **Close** values associated with the state change.



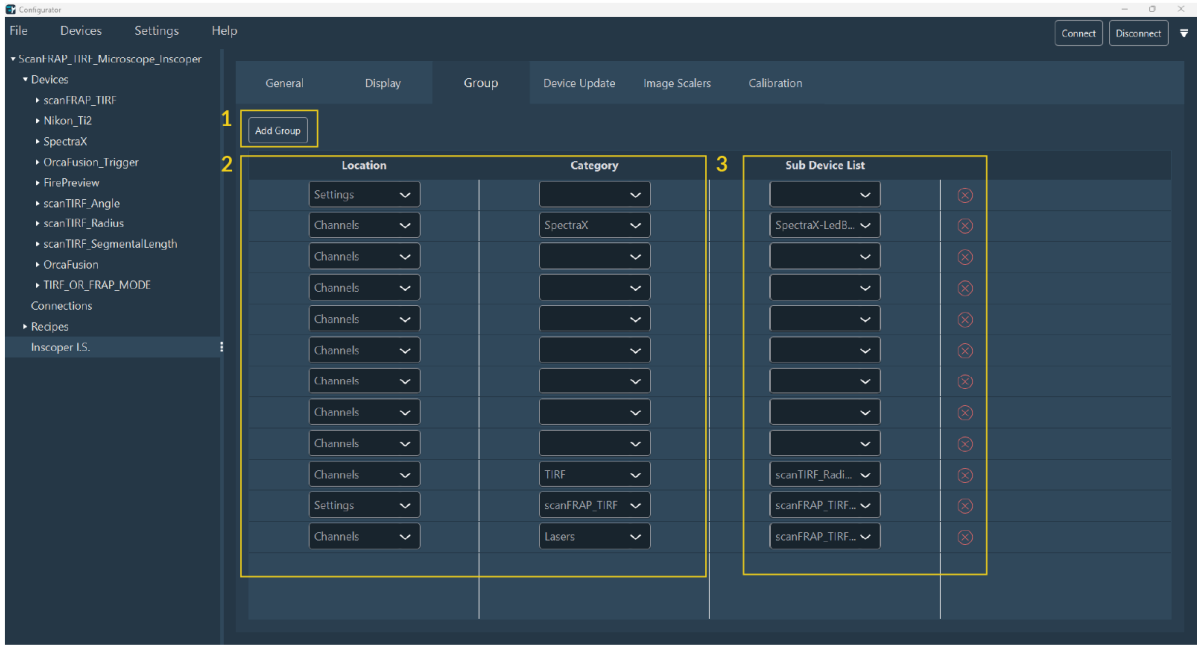
- For a **Button**, specify the open and close values and their respective display names.



- **TEXT**: The text display type requires no further action.

Group

Use this tab to group the display of multiple settings.

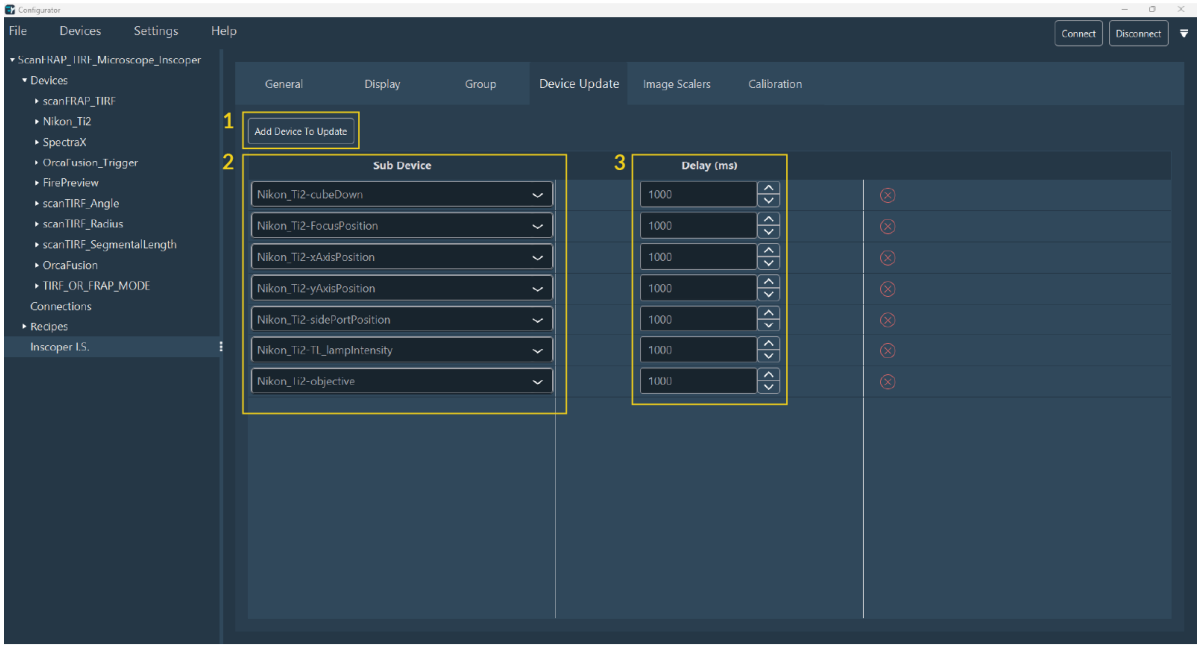


1. Click **Add group**.
2. Filter the sub-devices by **Location** and **Category**.
3. Select the required sub-devices from the **Sub Devices** drop-down list.
4. Repeat these steps if multiple groups are needed. Delete a group by clicking **Delete** (red cross).

Device Update

Use this tab to select devices for automatic value updates. The interface queries the drivers (DC, custom, and Micro-Manager) to update device values.

> **Example**
>
> Updating values is necessary when moving the stage manually via a joystick.

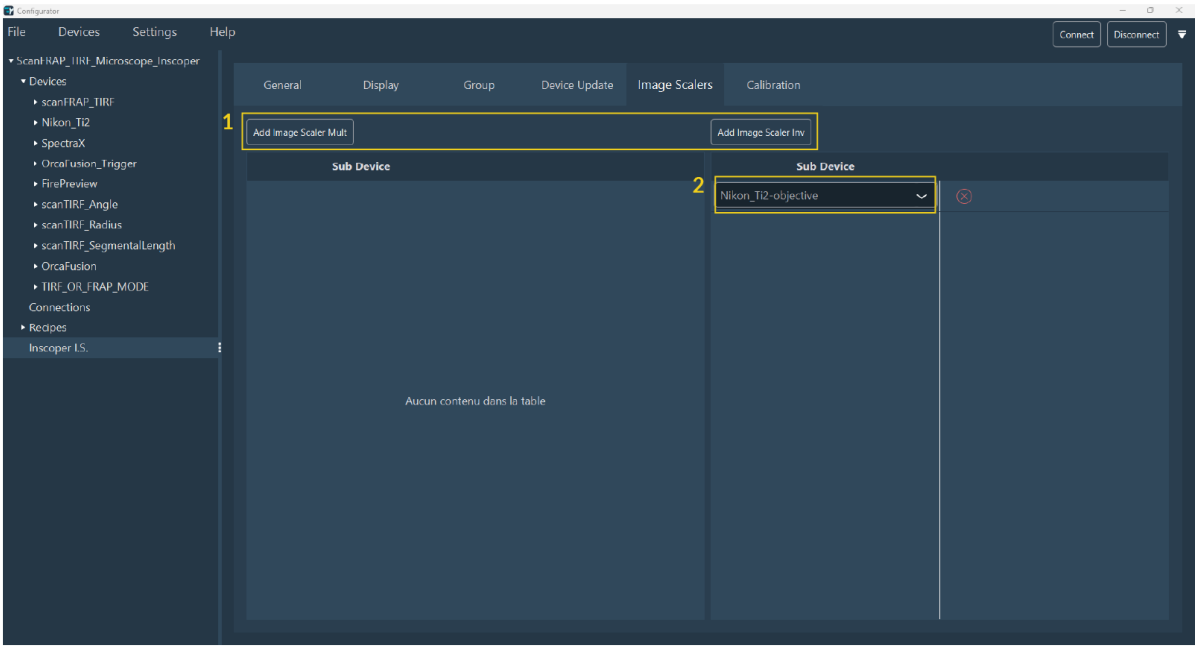


1. Click **Add Device to Update**.
2. Use the search form to select the required devices.
3. Specify the update delay.
4. Repeat these steps as needed.
5. Delete a device by clicking **Delete** (red cross).

Image Scalers

Specify all devices that alter the image pixel size (e.g., objectives) in this tab.

Correct specification is critical for tile calibration, experiment workflows, scale bars, and metadata.

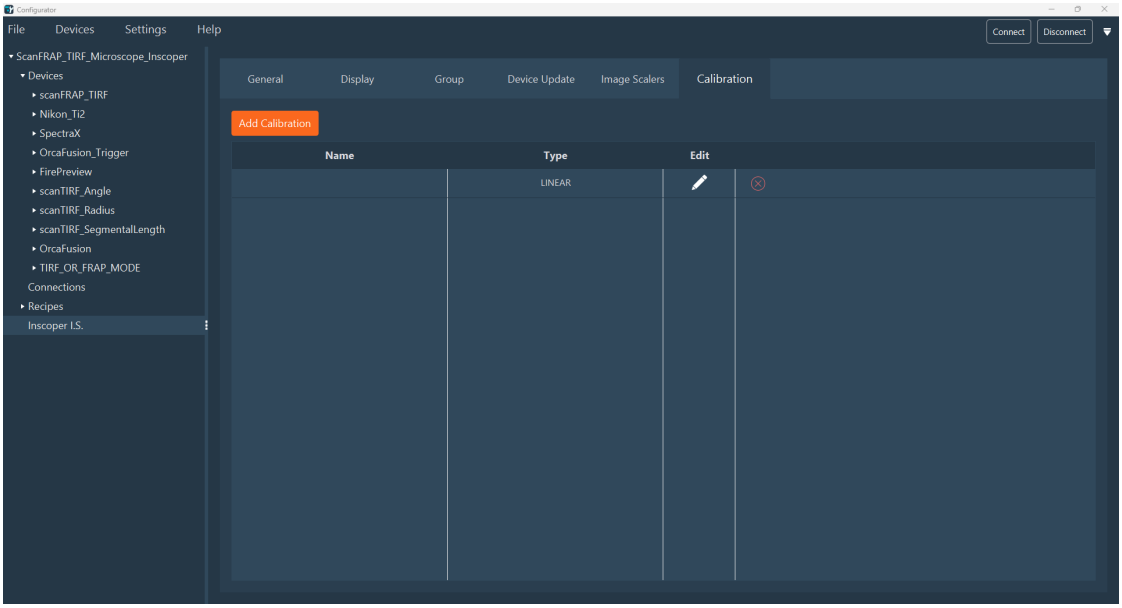


1. Click **Add Image Scaler Mult** or **Add Image Scaler Inv** to specify the sub-device that enlarges or reduces the image size, respectively.
2. Select the sub-device from the drop-down menu.
3. Repeat these steps as needed.
4. Click **Delete** (red cross) to remove the sub-device.

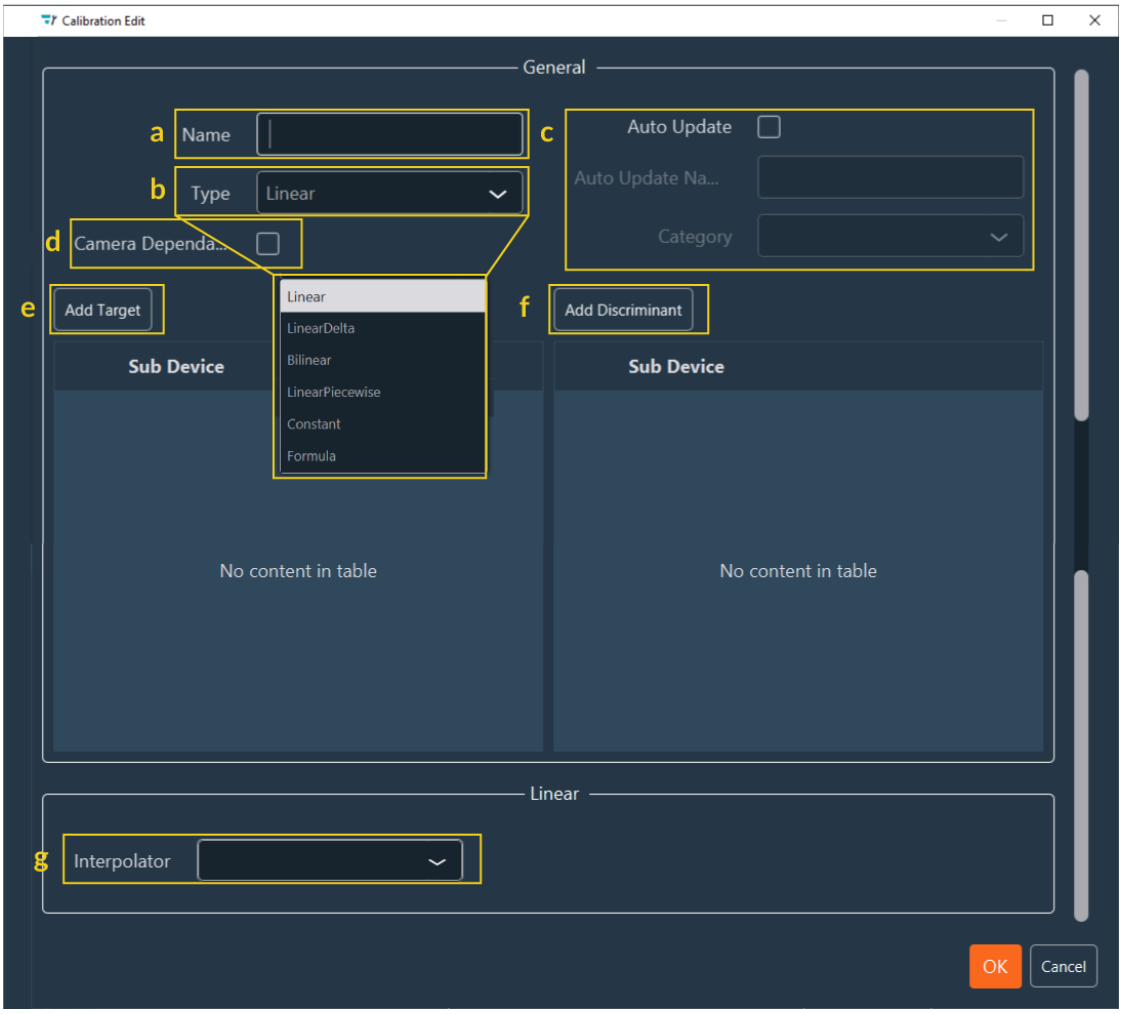
Calibration

Calibration establishes a dependency link between two sub-devices, enabling various application-specific setups.

1. Click **Add Calibration** to create a new entry.
2. Edit an entry by clicking the **Edit (pen)** icon or delete it using the **Delete (red cross)** icon.



3. Configure the following in the **Calibration Edit** window:



1. Specify the calibration **Name**.
2. Select the **Type** of calibration (the formula used for device movement). Available types include:
    - `Linear`: Linear formula (ax+b).
    - `Linear delta`: Delta-based linear formula.
    - `Bilinear`: Representing a 3D plane (ax+by+c).
    - `Linear piece wise`: Piecewise linear approximation.
    - `Constant`: Fixed parameter between two devices.
    - `Formula`: Custom user-defined formula.
3. **Auto Update**: Selecting this checkbox adds a button to the interface for deactivating the calibration. If selected, specify the button **Name** and its **Location** (**Category**).
4. **Camera Dependant**: Select this checkbox if the calibration is camera-dependent (e.g., Tiling and FRAP).
5. **Add Target**: Add the target device to be modified.
6. **Add discriminant**: A discriminant is a sub-device or device that, when modified, requires recalibration. For example, in FRAP calibration, changing an objective or filter necessitates a new calibration.

    > **Note**
    >
    > Discriminants typically include filters and objectives.

7. **Interpolator**: Select the sub-device other than the objective. For example, the **Bilinear** formula requires two interpolators.

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

The interface is now tailored to the specific experimental requirements. Launch the Inscoper Imaging Software to verify the layout and begin acquisitions.

1.3 Glossary

1.3.1 References

1.3.2 Devices

Device

A device is a peripheral that is either physical (hardware) or virtual (software-defined). 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 are either mechanical (e.g., moving a motor) or informational (e.g., retrieving values or version data). A hardware device connects either to the Inscoper Device Controller (DC) or directly to the computer (e.g., a USB camera).

Device Description

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. 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 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.

Detect

Detect

The **Detect** function scans all hardware connected to the computer that is compatible with the selected driver and retrieves the corresponding serial numbers. This allows the selection of the serial number corresponding to the device being added, ensuring the correct module is identified. Identification is 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.

Diagnostic

Diagnostic

The **Diagnostic** function performs two primary tasks:

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

Each sub-device has one of three possible statuses:

Status	Meaning
Available	The sub-device is detected and operational.
Unavailable	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).

Camera

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

Trigger Device

A Trigger Device provides precise control of a camera through triggering (TRIG) with the device controller. Installing a camera may require two devices:

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 connects only via USB to the computer and not through the DC, create only the camera device, as trigger control is not handled by the Inscoper hardware.

CAMERA STREAM

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	Use for Live or Snap operations (but not triggered Live). Also use for acquisitions not requiring specific hardware driving.
Software	The camera is triggered by a software command; exposure time is handled by the computer.
External Edge	The camera is triggered by an external TTL edge; exposure time is internal to the camera. Exposure cannot vary within a single sequence.
External Level	The camera is triggered by an external TTL level; exposure lasts as long as the trigger is asserted. This allows multiple different exposure times within one sequence.

START ACQUISITION

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). Use this when a continuous stream of images is required. Note that images may not be acquired immediately, depending on the camera trigger mode (Internal, Software, Edge, Level).

STOP ACQUISITION

Stop Acquisition

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

SNAP

Snap

A function to capture a single image.

> **Note**
>
> For specific cameras such as 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

Software Trigger

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

Edge Trigger

Edge Trigger

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

Level Trigger

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 transmitted to start image capture and control the exposure duration.

Check Ready

Check Ready

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

Is Controlled

Is Controlled

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

> **Example**
>
> Confocal.nl hardware.

Select For IIS

Select For IIS

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

Shutter

Shutter

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

> **Note**
>
> Values (0/1, True/False) depend on the specific implementation.

UPDATE ONLY WHEN IMAGING

Update Only When Imaging

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

1.3.3 Device Controller

Device Controller

The Inscoper hardware unit responsible for executing sequences and managing high-speed synchronization.

Firmware

Firmware

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

1.3.4 Drivers

Driver

Software that allows the operating system and Inscoper applications to communicate with specific hardware devices.

External Resources

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

Drivers Type

CUSTOM

Custom driver

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

MMANAGER

Drivers used to control devices through 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

Hardware ID

A unique identifier for a specific hardware model.

1.3.5 Sub-devices

Sub-devices

A **sub-device** is a functional component within a device representing a controllable property, capability, or action. Sub-devices are the modular building blocks allowing 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 hardware properties:

- 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 do not necessarily correspond to a single property:

- `MoveXY`: Trigger coordinated movement of both X and Y axes
- `StartAcquisition`: Initiate camera image capture
- `StopAcquisition`: Halt ongoing acquisition
- `Initialize`: Perform 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

Example

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

Example

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

Properties

Status

Indicates whether a sub-device is present for a device.

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

Param

- **Property Name**: The name of a configurable parameter for a sub-device (e.g., "Exposure" for a camera exposure time). This is valid only for external drivers (Custom and Micro-Manager). This name is **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 is modifiable.

> **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 selected, the sub-device value cannot be modified.

> **Example**
>
> For a 3-axis controller, three sub-devices are created. The axis identifier is marked as Fixed for each, while the position value remains editable.

  - *Note: Never use two unfixed parameters in one sub-device.*
  - **Min**: The minimum allowed value. Defined by the device manufacturer (based on the datasheet) or provided by the driver/Micro-Manager.
  - **Max**: The maximum allowed value. Defined by the device manufacturer (based on the datasheet) or provided by the driver/Micro-Manager.
  - **Step**: Minimum increment for value updates. The type of constraint can define the step; for example, for integer constraint types, the default step is 1 (the step is induced by value type). If the firmware or drivers do not provide a step, IIS uses either step = 1 (if integer) or step = (max - min) / 1000 (for float).
  - **Type**: Parameter type, including: unsigned char, double, STRING.

DESCRIPTION

Name

Name of the sub-device.

Type

Flags or tags used to characterize the nature of a sub-device.

Lifecycle / System

Type	Description
NONE	No specific category or behavior associated with this sub-device.
INIT	Sub-device triggering the device initialization sequence.
FINISH	Sub-device triggering the device shutdown sequence.
DIAG	Sub-device executing the diagnostic (DIAG) procedure.
USB_CHECK	Verify 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 the Z axis).

Optical / Hardware Components

Type	Description
SHUTTER	Controls the 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.
MAGNIFICATION	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 or falling edge).
TRIG_LEVEL	Trigger based on a digital level (high or low).

Camera Operations

Type	Description
CAM_CHECK_READY	Verify the camera is initialized and ready for acquisition.
CAM_START_CONTINUOUS	Start continuous acquisition mode (Live).
CAM_START	Start a single-sequence acquisition.
CAM_STOP	Stop acquisition (Live or sequence).
CAM_SNAP	Camera snap sub-device: perform a single image capture.
CAM_SOFTWARE_TRIG	Software-triggered image acquisition sub-device.

Functions (Set/Get/Check)

Functions

Function	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 searching for a match between the GET result and the expected target.

For each function, determine:

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

CONNECTIONS

Connections

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

Key Concepts:

- Configure each device with one or more connections specifying DC communication.
- Execute sub-device functions (SET, GET, CHECK) through these defined connections.
- Connection types determine the protocol, signal characteristics, and data flow direction.
- Different connection types support specific capabilities (digital signals, serial communication, analog values, etc.).

> **Driver-Specific Behavior**
>
> The "Connection" configuration field for sub-devices is available only when using `INSCOPER_BOX` drivers. Custom and Micro-Manager drivers handle connections 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 transmitted 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 commands and 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 or potentiometer positions.
AOUT	Analog	Output	Analog voltage output from the Device Controller. Used for controlling variable-intensity light sources or motor speeds.
UART	Serial Data	Bidirectional	Universal Asynchronous Receiver-Transmitter (RS232) connection. Low-level serial communication protocol.

Example

A motorized filter wheel might utilize:

- **SERIAL**: Transmit position commands and receive status information.
- **TTL_IN_GEN**: Read a home position sensor.
- **TTL_OUT_GEN**: Trigger movement completion signals.

1.3.6 Inscoper I.S.

Configure Inscoper I.S. (IIS) using this tab to:

- 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., relabel objectives, add side ports or filter cubes, represent laser power with sliders).

This section includes: Display, Group, Device Updates, Image Scaler, and Calibration.

Display

The Display tab allows adding, modifying, and organizing the graphical representations of sub-devices in IIS.

Initialize

The **Initialize** button adds all available sub-devices defined in the configuration to the device display list. This allows modification of how a function appears in the software. *Note: Upon configuration creation, the display data list is empty and requires initialization.*

Update

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

Image Scaler

A sub-device that alters 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).

Calibration

A model linking two or more sub-devices.

TYPE

Type	Description
Linear	`sd1 = a * sd2 + b` (Linear formula).
Linear Delta	Variant of the Linear formula exposing the alpha parameter in IIS (used for SoSPIM).
Bilinear	Represents a 3D plane (`ax + by + c`).
Linear Piecewise	Facilitates curve approximation.
Constant	Applies a fixed parameter between two devices.
Formula	Facilitates custom formula entry.

INTERPOLATOR

Interpolator

Interpolators are the sub-devices used in formulas to compute new values (the sub-device other than the objective).

Example

In `sd1 = a * sd2 + b`:

- `sd1`: Target.
- `sd2`: Interpolator.
- `a` and `b`: Computed during calibration.

DISCRIMINANT

Discriminant

A discriminant is a sub-device that invalidates the current calibration if modified. Each calibration is saved for a specific combination of discriminant values.

Example

In FRAP calibration, changing the objective or filter necessitates a new calibration.

TARGET

The sub-device modified by the calibration and linked to an interpolator.

Complex Acquisition Available

Enable the "Complex Acquisition" (Acquisition Designer) module if the license includes this option. This module facilitates advanced imaging workflows beyond basic MDA.

Mosaic Manip

Activate Tiling options in IIS. The Tiling Dimension will appear in the graphical interface. 5D licensing is required.

XY Move Strat Available

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

Trigger Live Conditions

Associate a sub-device value with a condition, allowing other devices to be controlled during the camera live trigger sequence.

Example

Trigger live acquisition only if the fluorescence shutter is open, or apply a condition based on the side-port position.

Reset USB at Startup

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

Device Update

Select devices to be updated automatically using this tab. The interface queries the drivers (DC, Custom, Micro-Manager) to update values by calling the GET function at the interval specified in the "Delay (ms)" column.

Connections

Link devices 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. These identifiers distinguish USB peripherals by providing Manufacturer, Product, and Serial Number details.

1.3.7 Recipe

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

Examples:

RecipeElement with an Action (set value 0):

```
<RecipeElement description="LightSource SET" callId="LightSourceShutter">
    <Action device="LightSource" subDevice="Shutter" function="SET" value="0" />
</RecipeElement>
```

Recipe with a single RecipeElement and a Tag Condition:

```
<Recipe recipeName="StartTimer">
    <RecipeElement description="StartTimerRecipeId SET" callId="">
        <Action recipeId="StartTimerRecipeId" function="SET" />
        <Condition tagCondition="SequenceStart && ResetRelativeTimer" />
    </RecipeElement>
</Recipe>
```

Recipe Element

Recipe Element

A single unit within a recipe associating a sub-device with actions.

ACTION

Define the sub-device function to execute or the 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.

TYPE

- **Simple**: Contains one element.
- **Group**: Calls a combination of recipes.
- **Event**: A Recipe Element facilitating sequence interruptions (e.g., Pause, Stop, or Restart).

CALL ID

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

Example

Example (Motion Stages):

```
Recipe Set X -> callID = axisMoved
Recipe Set Y -> callID = axisMoved
Recipe MoveAxis -> callCondition = axisMoved
```

RECIPE ID

An identifier assigned to sub-devices. Historically used for grouping (e.g., all shutters), it now typically identifies sub-devices created dynamically at IIS launch.

TAG

A label used to categorize recipe execution based on system state. Tags ensure only relevant recipes execute for active devices.

Example

If using a specific camera model, matching tags ensure only correct camera recipes execute.

CONDITION

A graphical section grouping condition options for calling recipes.

Tag Condition

Ensures an action executes only if a specific tag is present in the status.

Call Condition

Ensures an action executes only if a specific previous action has occurred.

Value Condition

Determines execution based on a sub-device value.

Optimization

Prevents reapplying a recipe if the sub-device value remains unchanged between statuses.

ILDA

Control 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.

1.3.8 API

API

The **Inscoper API** (Application Programming Interface) is a C++ library enabling external software to control the Inscoper system. It abstracts the complexity of hardware drivers for high-level applications.

Key Architectural Concepts:

- **Bridge Pattern**: The API exposes the `Inscoper::Bridge` class, simplifying subsystem interaction.
- **Manager-Based**: Core functions handled by singleton managers (e.g., `DeviceManager`).
- **Device Abstraction**: Provides a unified interface (`AbstractSystem`) for all devices.

Core Capabilities:

- **Configuration**: Loading/saving system states via XML.
- **Control**: Manipulation of device parameters (SET/GET/CHECK).
- **Acquisition**: Execution of multi-dimensional sequences.
- **Imaging**: Management of image buffers and metadata.
- **Events**: Listener system (e.g., `SequenceListener`) for real-time synchronization.

Log Level

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	Enable all log levels.
LOG_TRACE	Fine-grained information for deep debugging.
LOG_DEBUG	Detailed information for issue diagnosis.
LOG_INFO	Informative logs for normal application events.
LOG_WARN	Indicates an unexpected situation that does not halt the application.
LOG_ERROR	Indicates an issue preventing specific function operation.
LOG_FATAL	Indicates a critical failure where core functions are lost.
LOG_OFF	Disable all logging.

1.4 Legal

1.4.1 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 professionally installed.

1.4.2 Copyright

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INSCOPER and the INSCOPER logo are trademarks of INSCOPER Company (INSCOPER SAS - 3771 boulevard des Alliés, 35510 Cesson-Sévigné - France). INSCOPER includes technology covered by the following patents:

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

This product is updated periodically, and revisions will be incorporated into new editions of the user documentation.

1.4.3 Disclaimer

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