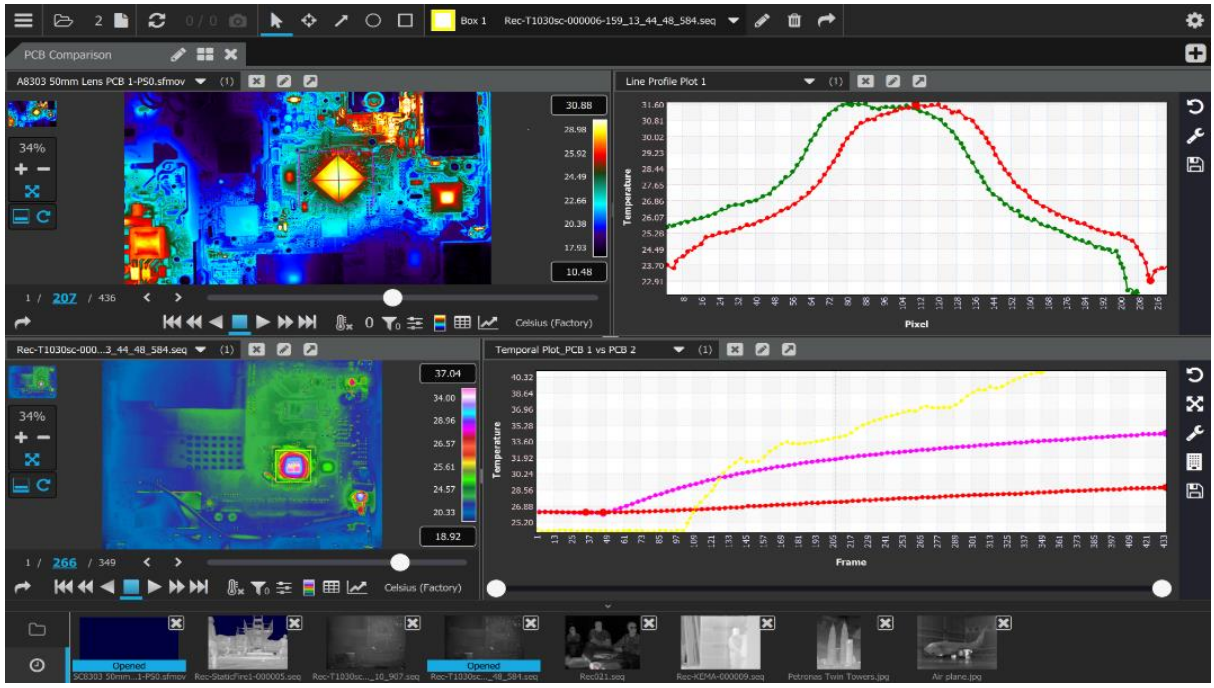
FLIR Research Studio

User's Manual



Document Number: 4217871

Version: 2.1

Issue Date: March 15, 2022

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Version	Date	Initials	Changes
1.0	9/18/2018	AAR	Initial Release for beta
1.1	4/3/2019	RIM	For initial product release (v1.0)
1.2	APR 8, 2019	RIM	Added system requirements, supported cameras
1.3	01/29/2010	AAR	Refreshed screen shots
1.4	03/02/2020	AAR	Added Hotkeys and Precision
1.5	3/06/2020	RIM	Final for v1.1 release
2.0	05/28/2021	MGH	V2.0 release
2.0.1	07/12/2021	MGM	Added EULA
2.1	03/15/2022	RIM	Updated for v2.1 release. Updated export control marking.

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1 Introduction

FLIR Research Studio works the way you work, while providing the robust recording and analysis capabilities expected from a premium thermal analysis software. The stream-lined, intuitive Connect – View – Record – Analyze – Share workflow makes it easy to quickly characterize important thermal data to support critical decisions. While the ability to working in native languages improves collaboration, increases efficiency, and helps reduce the potential for misunderstanding critical thermal data.

- The **Standard Edition** provides users with the basic, core software functionality required for thermal analysis. Please see datasheet on FLIR.com for Edition feature comparisons.
- The **Professional Edition** gives users an expanded set of visualization and analysis tools as well as features that help streamline the recording and export processes.
- The **Research Studio Player** is a free software application which allows teams to share recorded data for analysis across their team. With a Professional Edition License of Research Studio, the user can export a .FRS file which is readable in the FRS Player. The FRS Player has the same analysis capability as Research Studio Professional; it just cannot record or stream thermal data from a camera.

1.1 Key Features

Research Studio works the way you work

Enjoy working in your own language. Research Studio allows you to work in your preferred language by supporting a multitude of languages.

FLIR Research Studio runs on Window, MacOS and Linux so user can work on the OS they are comfortable using.

Research Studio's streamlined, intuitive software interface saves time

The simple Connect -> View -> Record -> Analyze -> Share workflow is easy to comprehend and allows for the thermal measurement system to be passed on to colleagues, without the need for extensive training

Easily share data and reduce analysis time during repeated events through the creation, saving and sharing of workspaces.

Reduce the time required to set up experiments or performing analysis with FLIR Research Studio's quick plug-n-play camera connection.

Quickly review and recall previously opened files using the available quick collect strip.

Research Studio has the recording and analysis capabilities you need

Quickly visualize and understand thermal characteristics thanks to flexible regions of interest, isotherms, and unique color palettes.

Pick one of the many image analysis tools that allow you to perform measurements on objects of any shape or size

Generate line profile and time versus temperature plots simultaneously from multiple connected cameras or recorded data

Understand thermal impact and drift by looking at temperature differences using the Frame Subtraction functionality

Export data into commonly used file and image formats

Research Studio promotes collaboration and increasing efficiency

Share important thermal data quickly and easily with colleagues across multiple operating systems and languages

Increase efficiency and reduces the potential for misinterpreting thermal measurement by working in your preferred language

Enhance collaboration without the need for additional licensed software copies thanks to the free Research Studio Player application

1.2 Installation

The installation process will depend on the operating system, but the steps should be typical for an application in that environment. For example, installation under Windows uses a wizard that guides the user through the install. For Linux .RUN file is provided. For MacOS, a .DMG file is provided. Because FRS is not distributed through the App Store, it must be side loaded. MacOS users should be careful to read any security dialogs that pop up to avoid accidentally blocking the FRS installation. For more detailed installation instructions, please refer to the Research Studio Installation Guide, which is a separate document that can be found at: https://support.flir.com/researchstudio.

1.3 System Requirements

Operating Systems Supported:	**Windows 10 (64-bit only)**
	Linux: Ubuntu 16.04, RHEL/CentOS 7, Fedora 31, Mint 19.3
	MacOS High Sierra through Catalina
Hardware requirements	i3, 4GB RAM, USB2/3, GigE (camera dependent), 32-bit color for computer monitor settings, 1280x800 minimum native video resolution

1.4 End User License Agreement (“EULA”) for FLIR Systems, Inc.

NOTICE TO USER: This is a Contract.

End User License Agreement (“EULA”) for FLIR Systems, Inc.

NOTICE TO USER: This is a Contract.

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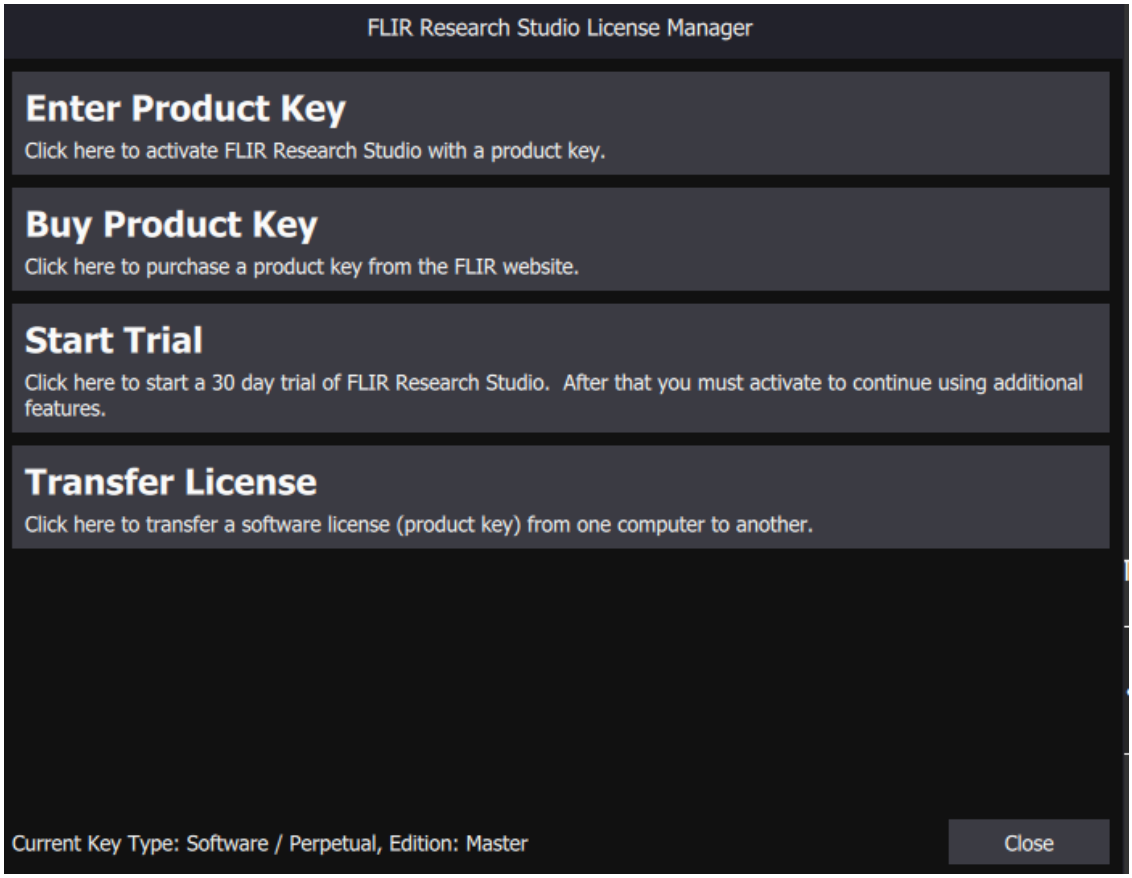
1.5 Activation

Research Studio does require a license activation. The default license period is one year. When the license is close to expiring the software notify the user through a series of banner messages in the program window that will provide a link to renew the license. The activation key will either be provided on a card or in an email (depending on your purchase method).

When the program is launched for the first time, an activation dialog will appear. You can either choose to enter your key, buy a key, start a 30-trial, or transfer a license from another computer. The normal activation process requires an internet connection to register the key. After the registration is complete an internet connection is not required to launch the program.



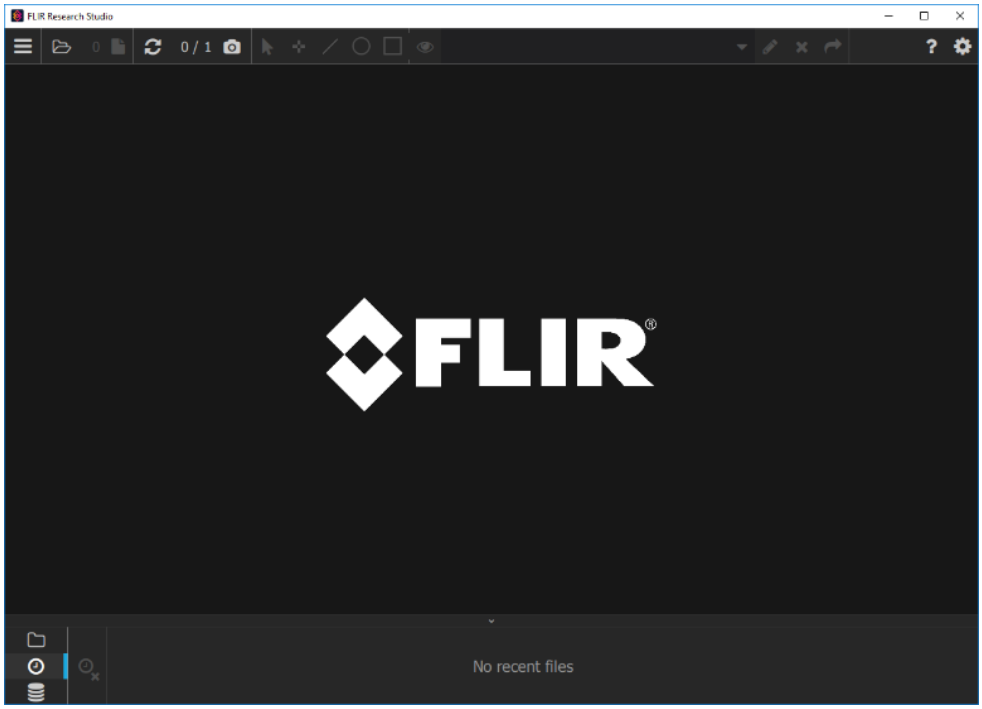
If your computer does not have internet access, there is a process to do an “offline” activation For more detailed installation instructions, please refer to the Research Studio Installation Guide, which is a separate document that can be found at https://support.flir.com/researchstudio.

2 Connect

2.1 Launching FLIR Research Studio

To launch FRS, double-click on the desktop icon, task bar icon (shown below) or start menu icon:

The application will open:

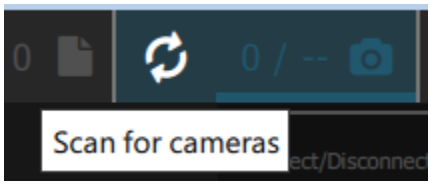


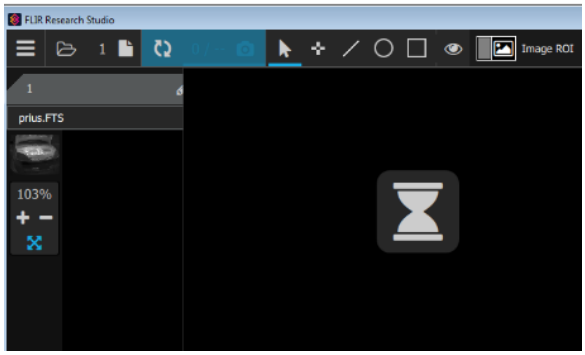
The place to start using the software is the top bar of the application:

2.2 Camera Detection & Connection

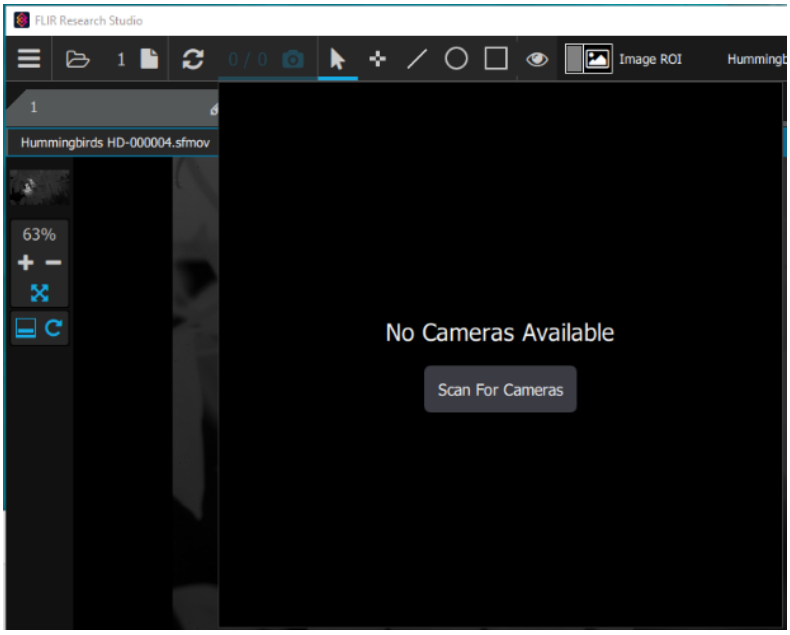
The user can scan for cameras and display available cameras from this menu, but these functions are also available on the main toolbar. This shows the user how many cameras are connected and how many have been detected and are available for connection. The numbers next to the camera icon indicate the number of connected/detected cameras. In example below, zero cameras are connected, but one has been detected.

If the user presses the two arrows icon, the scan process begins and the control pulses with a blue shade to it. An hourglass appears as well.

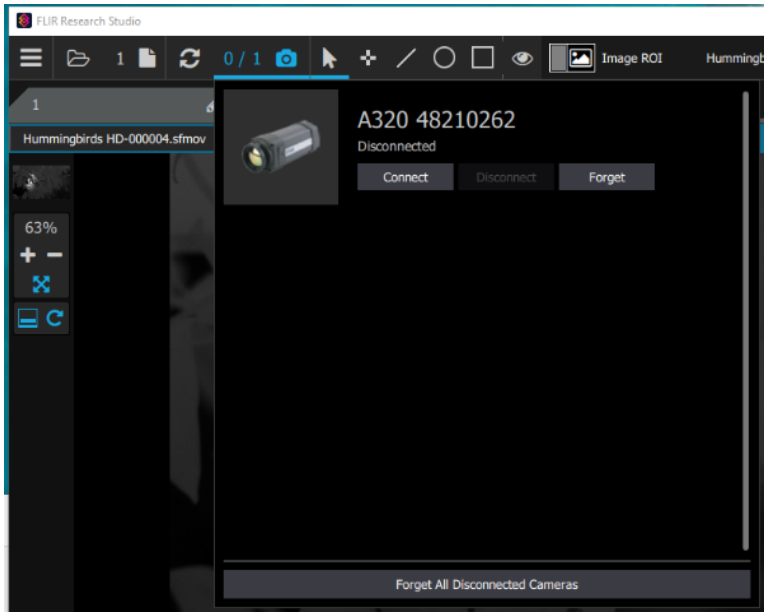




If no camera is found, then this message will be displayed:



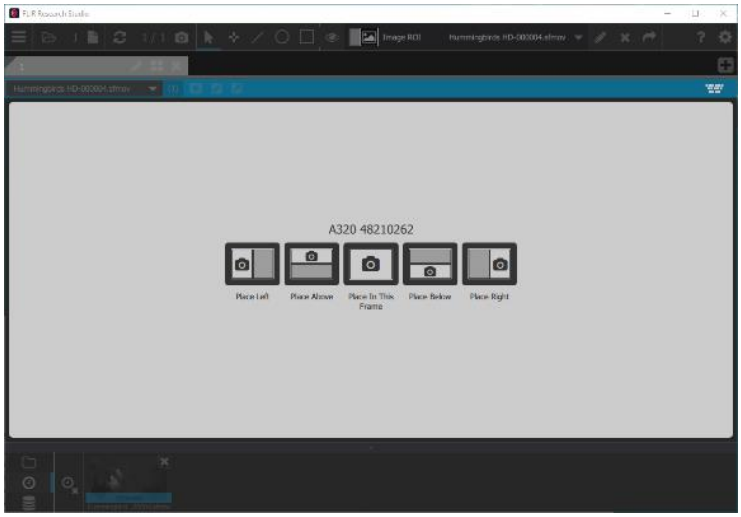
If a camera is then connected, and the Scan for Cameras button is pressed, the software should find the camera and display a message like this:



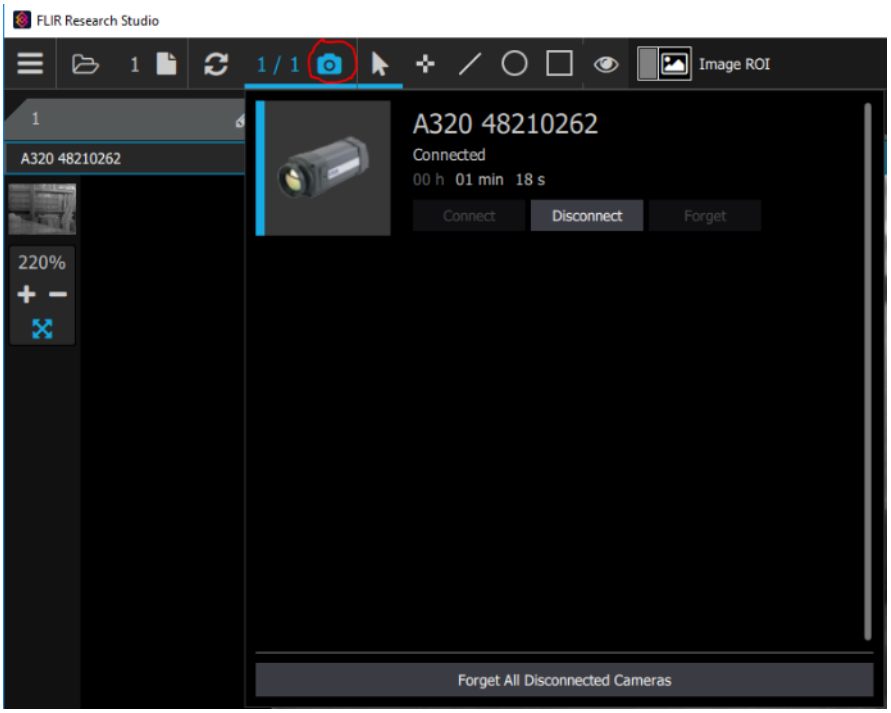
The screen shows the type and serial number information for the camera with a Connect button and a Forget button below. The Connect button is pressed to initiate the connection of the camera. Forget will make it so this camera will not be listed in the list of available cameras.

Note: At the end of the scanning process, if no camera is found, but there have been cameras connected previously, then this window will show what cameras have been previously connected. Clicking on the Connect button will initiate an attempt to connect to the camera.

When one clicks the Connect button, the software will ask the operator where the camera image should be placed:



Once the camera is connected, pressing the Camera icon (circled in red) will make this window appear:



The Disconnect icon can be pressed to disconnect from the camera. The status window also shows the duration of the connection to the camera.

2.3 Supported Cameras

Uncooled:

A50, A70, A400, A500, A700
GF77a
A35sc, A65sc, ETS320
C2, C3
E53, E75, E85, E95
T5xx (T530, T540), T8xx. T865
T6xx (T600/610, 620, 630sc, 640, 650sc, 660)
T1k (T1010, 1020, 1030sc, 1040, 1050sc, USB only, no HSI support)
A3xx (A300, A305sc, A310, A315, A320, A325sc, A615, A645sc, A655sc)

Cooled:

A-series (A6260, A67x0, A6780, A8200, A8300, A8580)
SC-series (SC6100, SC6200, SC6700, SC8200, SC8300)
X-series (X6800, X6900, X8500, X6980, X8580)
RS-series (RS6700, RS6780, RS8200, RS8300, RS8500)

2.4 Camera Link and CoaXPress (CXP) Frame Grabbers

Research Studio supports a limited selection of frame grabber models that can be used to connect to cameras with Camera Link and CXP interfaces. Research Studio can use these interfaces for both control and digital video. For help installing these devices, please refer to the FLIR Research Studio Frame Grabber Installation Manual at:

Support.FLIR.com

The following frame grabber models are supported:

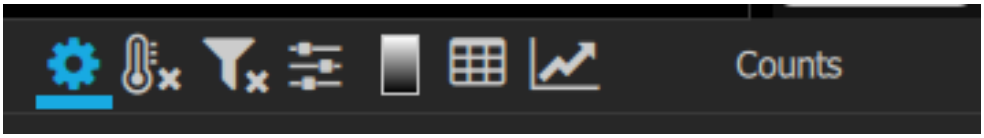
Frame Grabber	Interface	Operating System	Firmware Version
Euresys Coaxlink Quad G3	CoaXPress	Windows and Linux	eGrabber 15.0.3.586
DALSA Xtium2-CXP PX8	CoaXPress	Windows only	SaperaLT 8.60 + Xtium2-CXP PX8 1.00
IO Industries Core2 CXP High Speed Data Recorder	CoaXPress	Windows only	Firmware – CoaXPress Plus x4 Version 4.9 Software - IO Coreview 2.1.0.38
Euresys Grablink Full XR	CameraLink	Windows and Linux	MultiCam 6.18.1.4670
DALSA Xtium-CL MX4	CameraLink	Windows only	SaperaLT 8.60 + Xtium-CL MX4 1.30
DALSA Xcelera-CL PX4	CameraLink	Windows only	SaperaLT 8.60 + Xcelera-CL PX4 1.41
IO Industries Core2 CL High Speed Data Recorder	CameraLink	Windows only	Firmware – Camera Link Base x4 Version 4.6 Software - IO Coreview 2.1.0.38

Note: Other frame grabbers in the DALSA Xtium, DALSA Xcelera, and Euresys Grablink product lines may work, but are not tested.

The High Speed Data Recorder accessory recorder system acts like a frame grabber and brings image data into Research Studio through an eSATA to USB 3.0 converter cable connected to the PC. The HSDR is available in either Camera Link or CoaXpress varieties.

2.5 Camera Controller

When a camera is connected and is in the active displayed window, a new tool appears to the left of the Object Parameters tool in the Image Module Toolbar. It looks like a gear. This is the camera controller.



The camera controller windows are different for different cameras, depending on their capabilities and features. Because FRS works with so many different cameras, it is not practical to explain all the camera control functions in this manual. The detailed explanation of the camera control function for a particular camera can be found in the camera user manual.

In general, the controller will have a number of tabs to organize the controls. Each page may be vertically scrollable.

X-series RAM/SSD Data Transfer

Research Studio v2.1 adds support for downloading data directly to the PC from the X-series on-board DV-IR recording system. This is accessed through the SSD page of the camera controller. See the X-series user manual for more details.

3 View

3.1 Main Menu

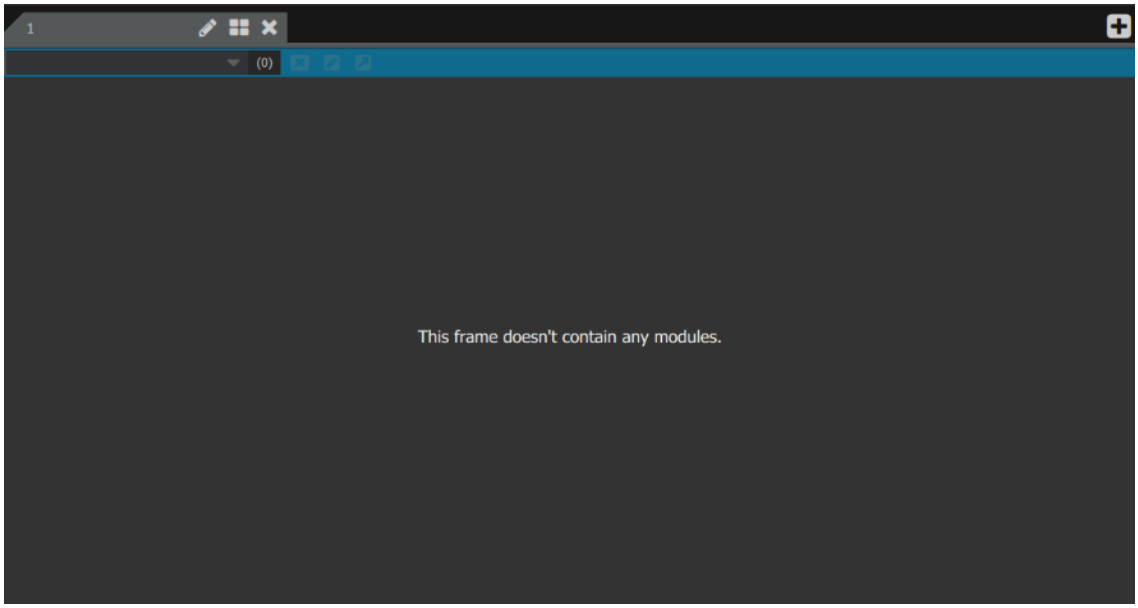
The first icon in the top left corner is the “hamburger menu”, which contains controls for workspaces, opening files and connecting to cameras.

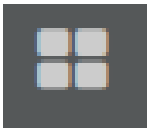
3.2 Workspaces (Tabs, Layouts & Frames)

The design of FRS makes it possible to open multiple files, live cameras, and plots all at once. These different items can be displayed within the same window using Tabs, Layouts, Frames, and Modules.

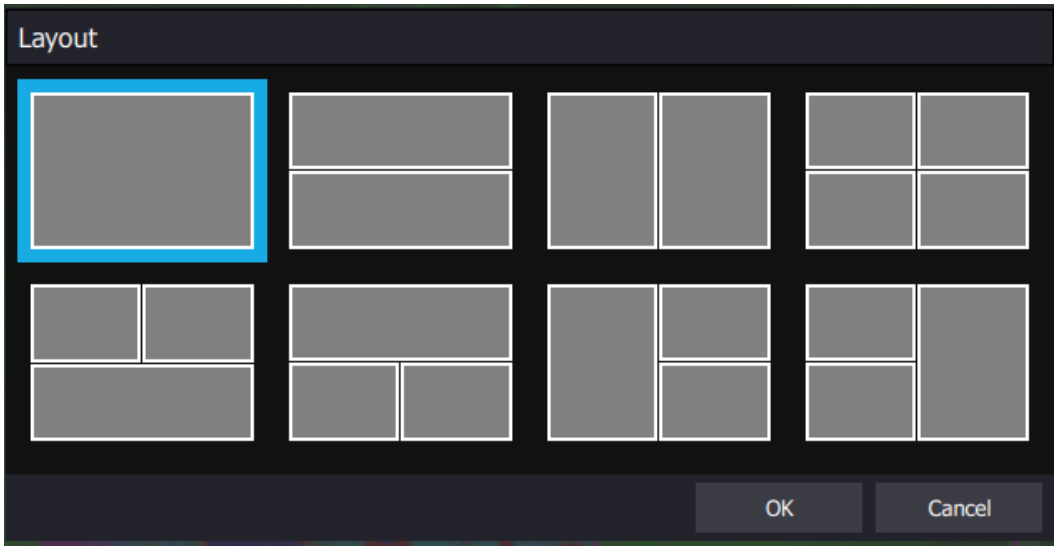
3.2.1 Overview

When the program is first launched, the default layout contains a single tab, with a single frame and no modules.



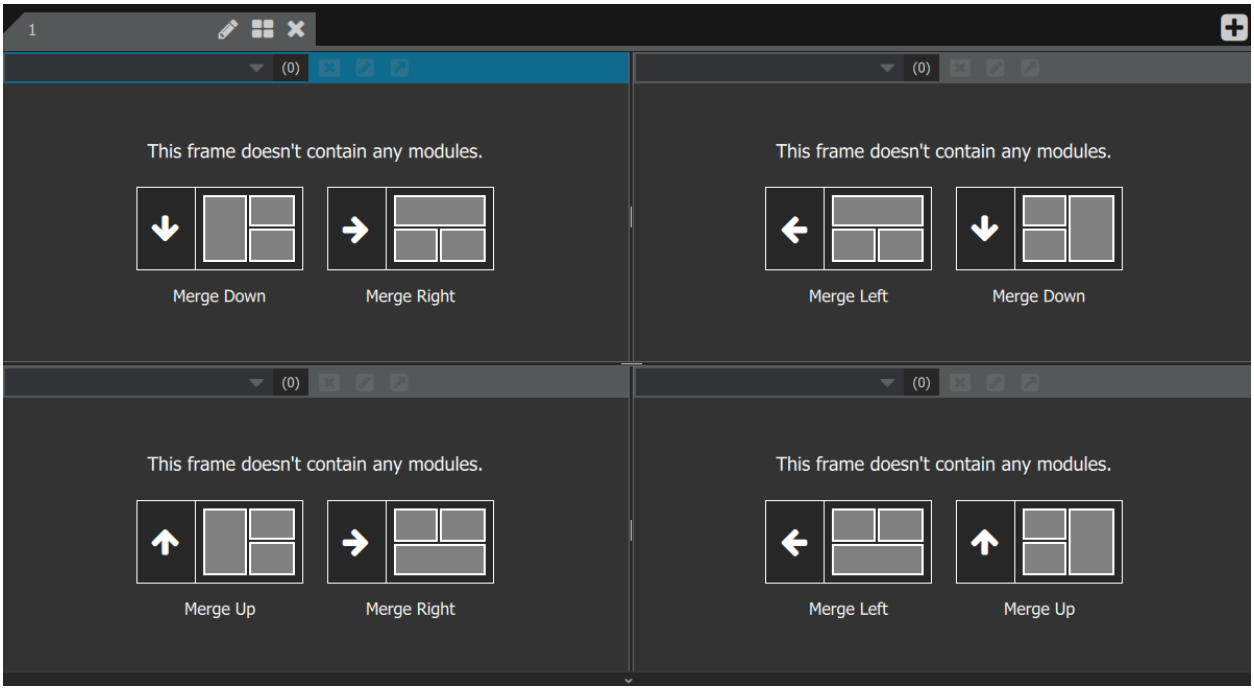
The Tab can be reconfigured to show multiple frames using the Layout button. 

This button brings up the following window:

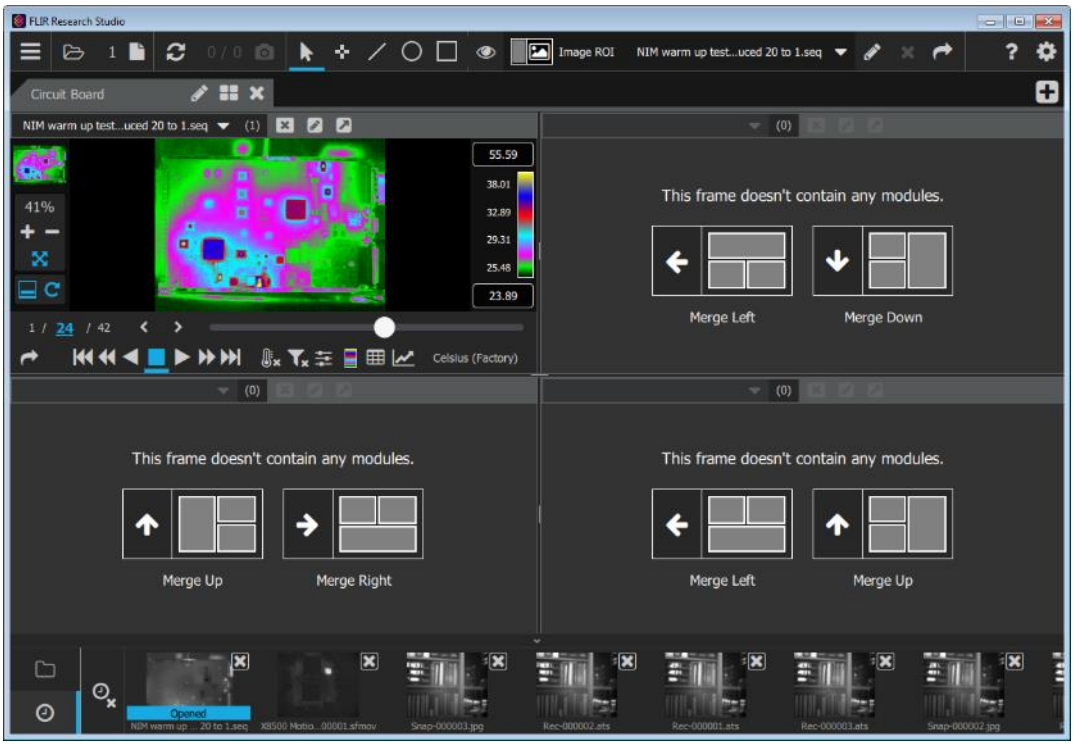


The user can select a layout with up to four frames.

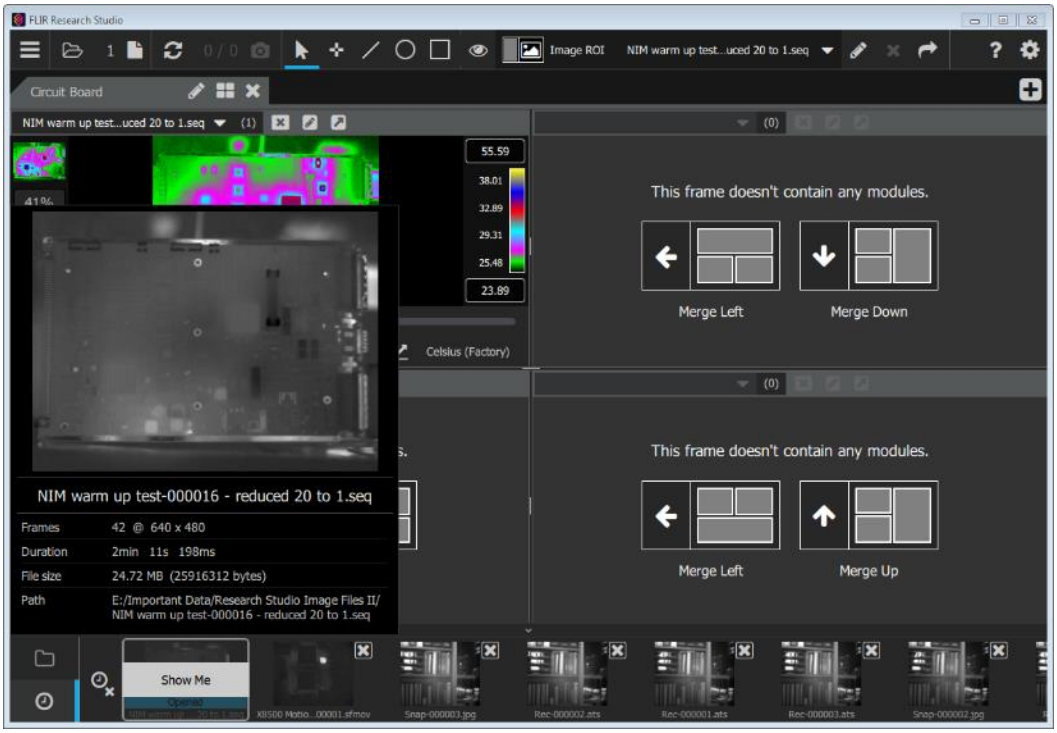
Here is an example of a four-frame layout. At this point the frames are empty.



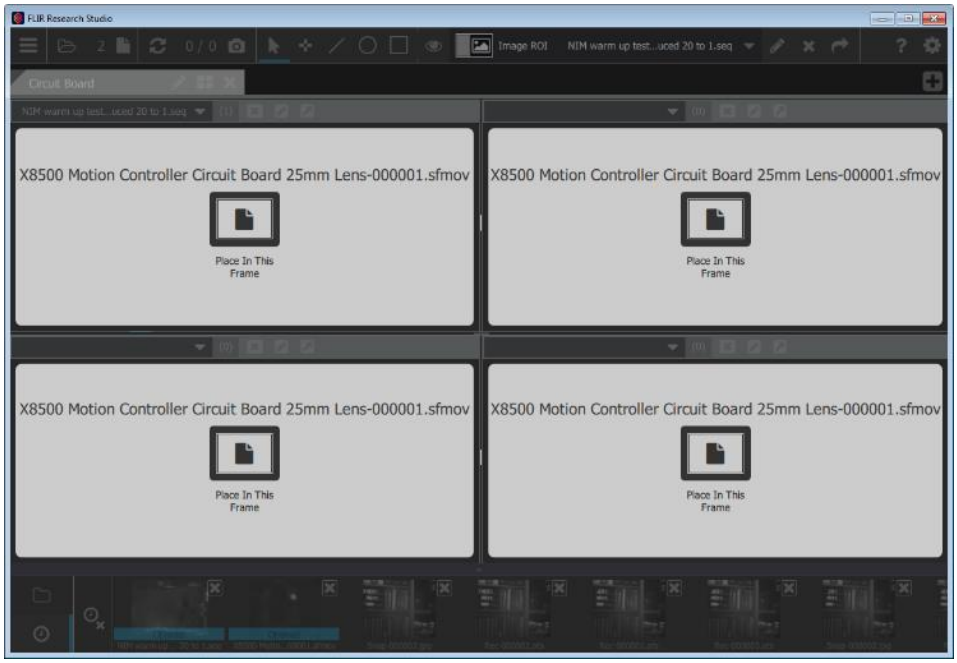
When a file is opened or a camera is connected it can be placed in any frame on any tab. The same frame can contain multiple modules that will be stacked on each other. Stacked modules can be selected using the drop list in the upper left corner of the frame.



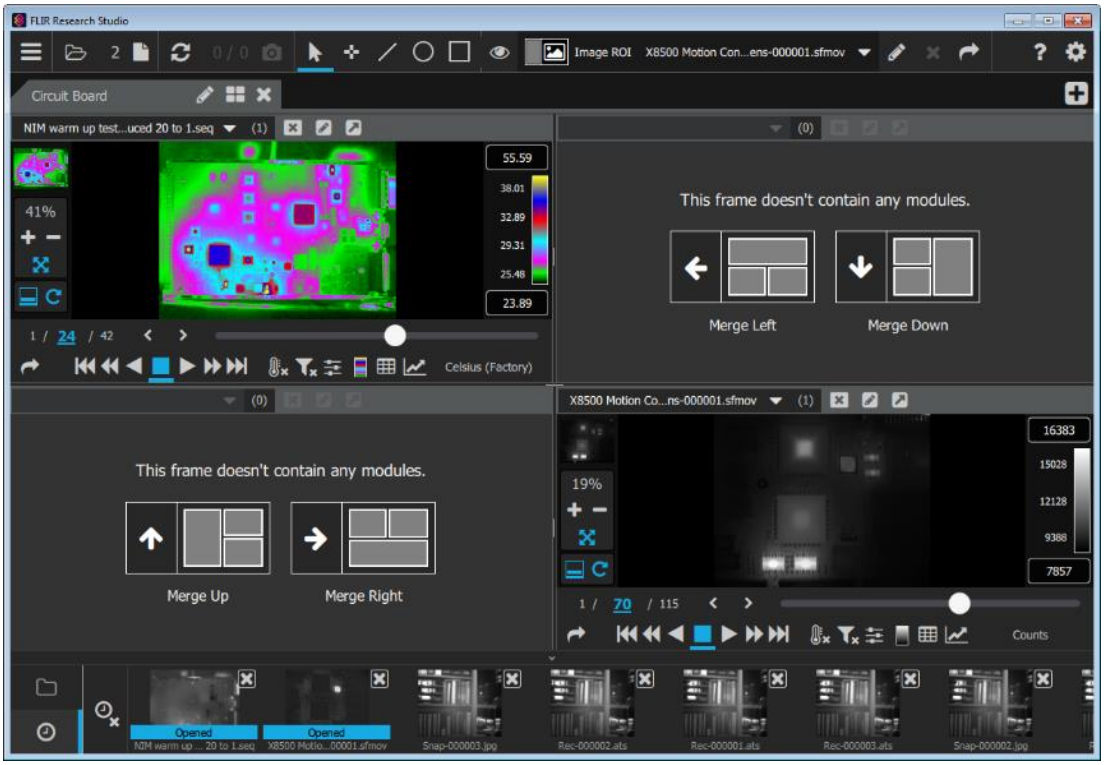
Note the circuit board movie shows as “Opened” in the preview thumbnail view on the bottom bar. The user can now open more files into the blank modules. Clicking once on the thumbnail brings up a larger view of it, and information about the file.



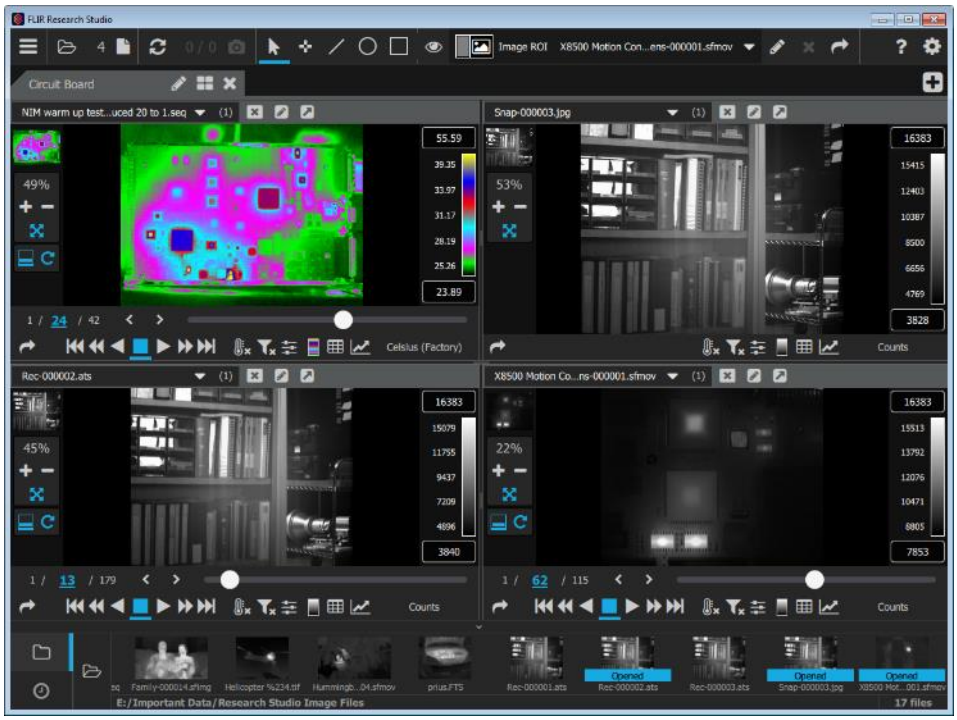
Clicking a second time on a thumbnail preview presents the user with a choice of where to place the file in the “quad window” pattern selected in this example.



In this case, the new image was placed in the lower right corner:



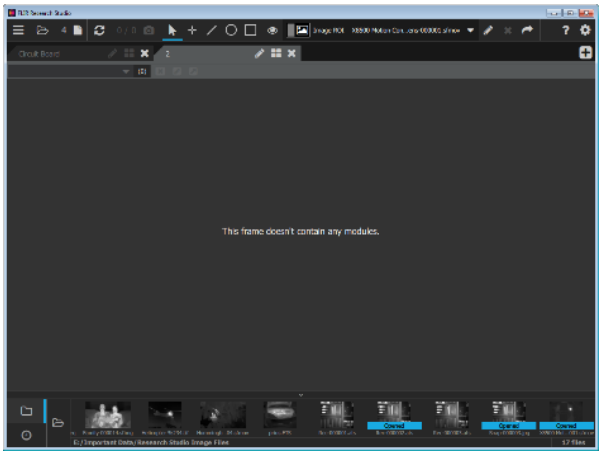
Now the user can now open two more files in the other two modules and then the user will see this view of the main window:



3.2.2 Naming and Adding Tabs

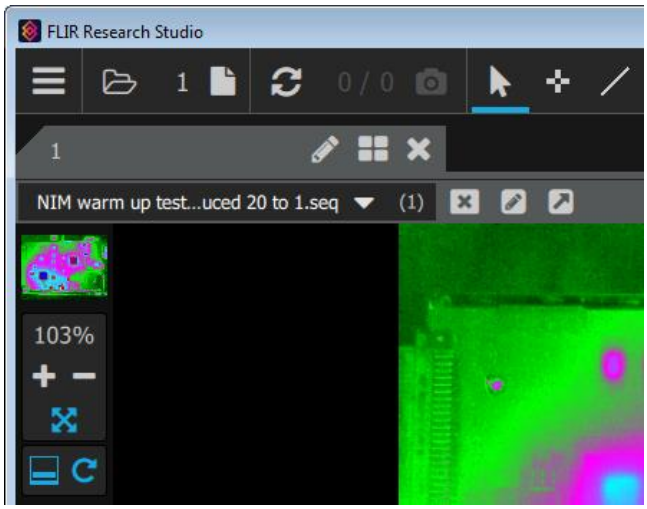
If more than four frames are needed, it is possible to create additional tabs by clicking on the “+” button in the upper right corner of the main window:

Each tab can have its own layout of frames and modules:

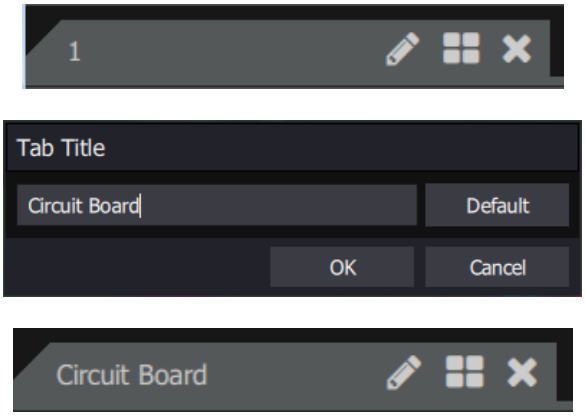


If multiple Tabs are being opened, it is a good idea to give them names that are more informative than the default names 1, 2, etc.

By default, tabs are numbered, but the user can give them any desired name.

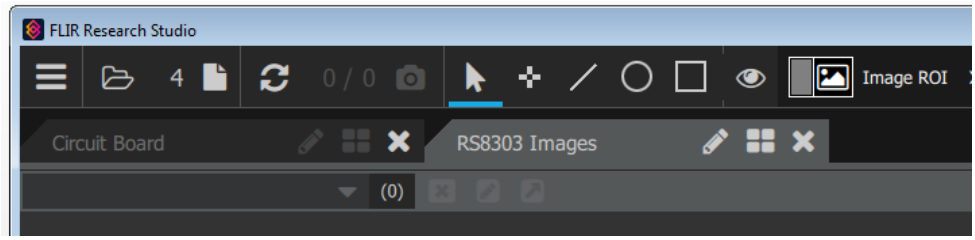


Use the pencil icon to edit the name of the Tab:



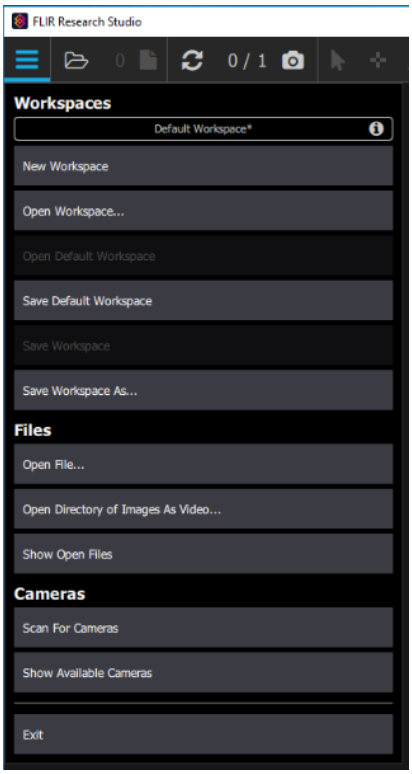
These names do not persist over a restart of the software, unless they are saved in a workspace file. The option to save a workspace is found in the Main Menu

Here the Tab names were changed to represent what is in the Tabs:



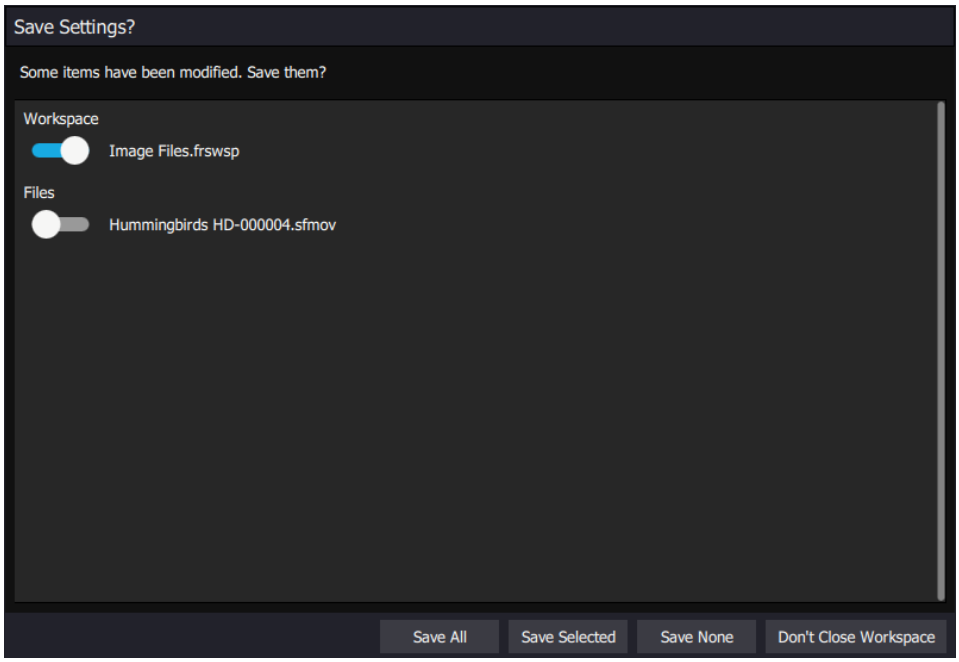
3.2.3 Saving and Opening Workspaces

A workspace is a file that preserves the state of FRS, including which files are open and the configuration of tabs. The user can create a new workspace, open an existing workspace file, save a workspace (the last saved one is shown in parentheses), and Save Workspace As. The Workspace file extension is *.frswsp.

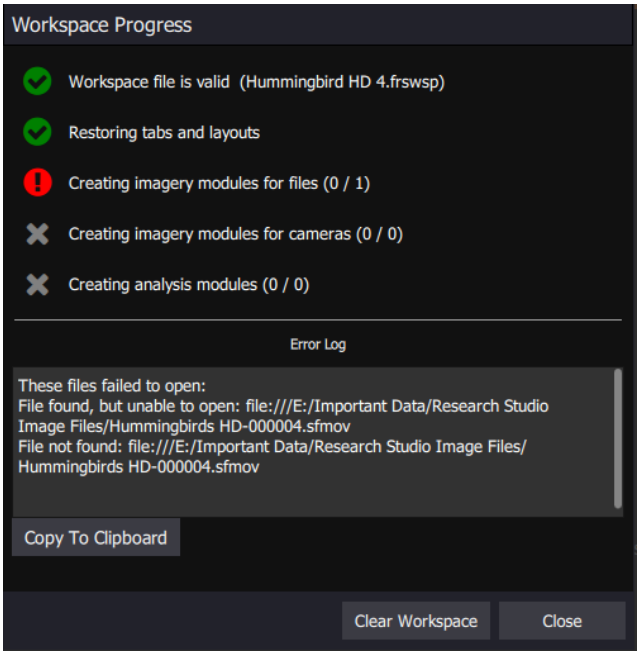


The default workspace path is shown in the top of the screenshot above when the user "mouses" over the little "i" in a circle. There is always a default workspace and it is always in the same place. In the case of the computer used for writing this manual, it is here:

When the New Workspace button is selected, the application asks the user to save modifications to existing opened files. Here are the options:

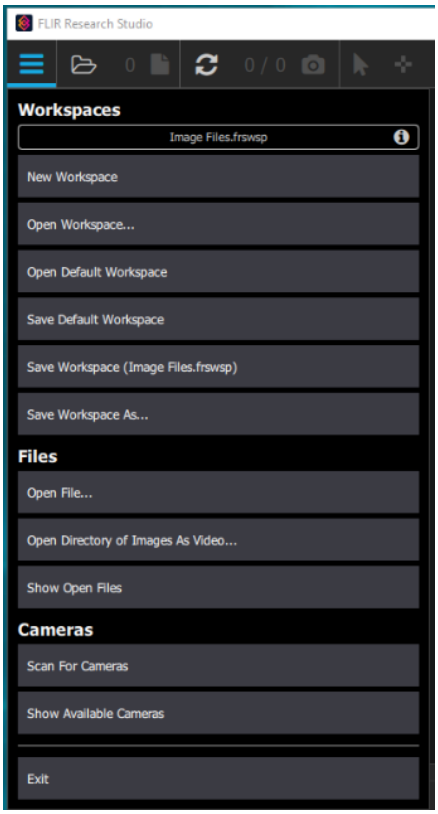


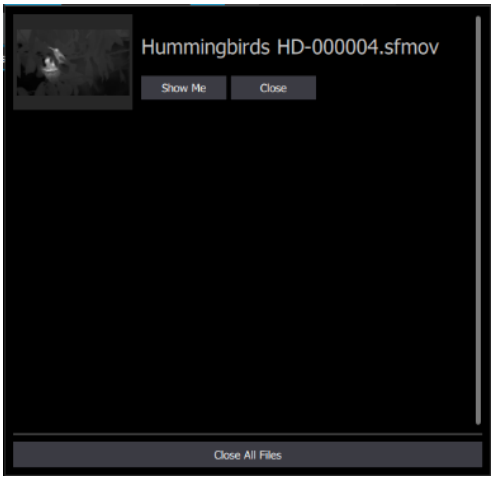
Opening a workspace using the Open Workspace… option will restore the application to the condition it was in when the workspace was saves, assuming that the files it references are still in the same place in the directory they were in when the workspace was last saved. In the example below, the file was renamed, which “breaks” the workspace:



3.3 Files

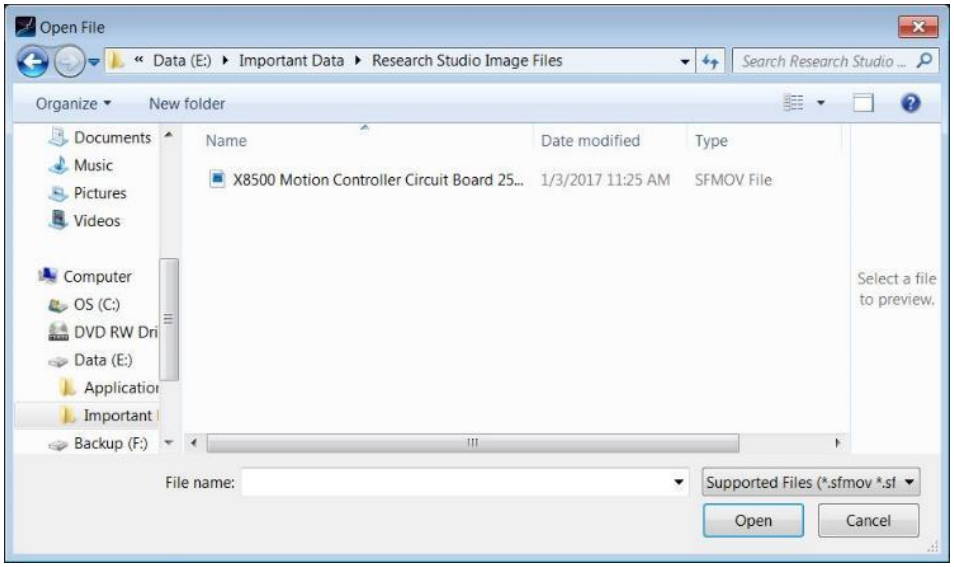
The next group of controls below the workspace controls enables the user to open a file, open a directory of images as video, and show open files. Opening a directory of images as a video makes a short video with all the images in the folder, so that one can rapidly browse the folder. The Show Open Files command brings up a window showing all open files:





The next icon in the top ribbon of the main GUI window is for file opening:

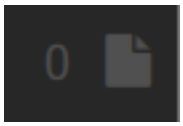
Clicking on this icon brings up a file explorer window:



The user can then browse for a file to open. The allowable file types include the following types that are used in other FLIR products, as well as some that are industry standards:

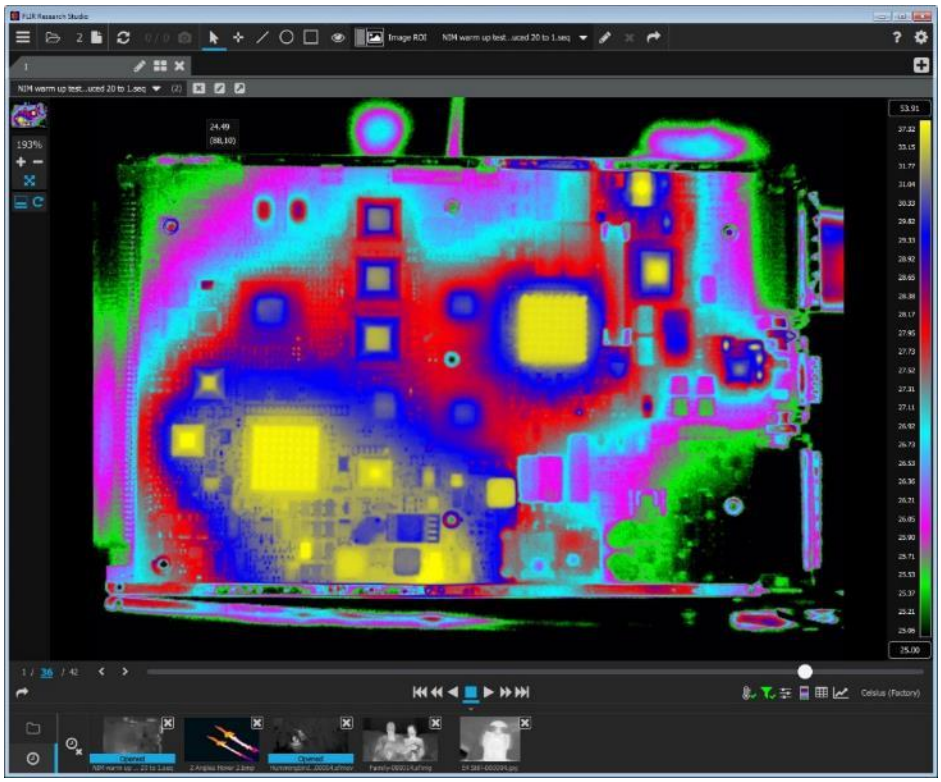
Supported Files: .sfmov, .sfimg, .seq, .csq, .img, .png, .bmp, .jpg, .jpeg, .tif, .tiff, .fts, .ats, .fcf, .frs

The next icon over shows the number of files that are open. Right after launch, the number of files open will be zero, and both the zero and the file icon will be greyed out.



Once a file is opened, the zero changes to a “1” and the file icon is no longer greyed out:

Here is a view of the main GUI window with a file open, in this case a movie of a circuit board heating up. We will see how to manipulate the controls for movie playback a bit later. For now, we will continue our tour of the top bar.



3.4 Frames and Modules

There are four types of modules that can be placed inside of a frame:

Image Modules: Can contain live or recorded imagery

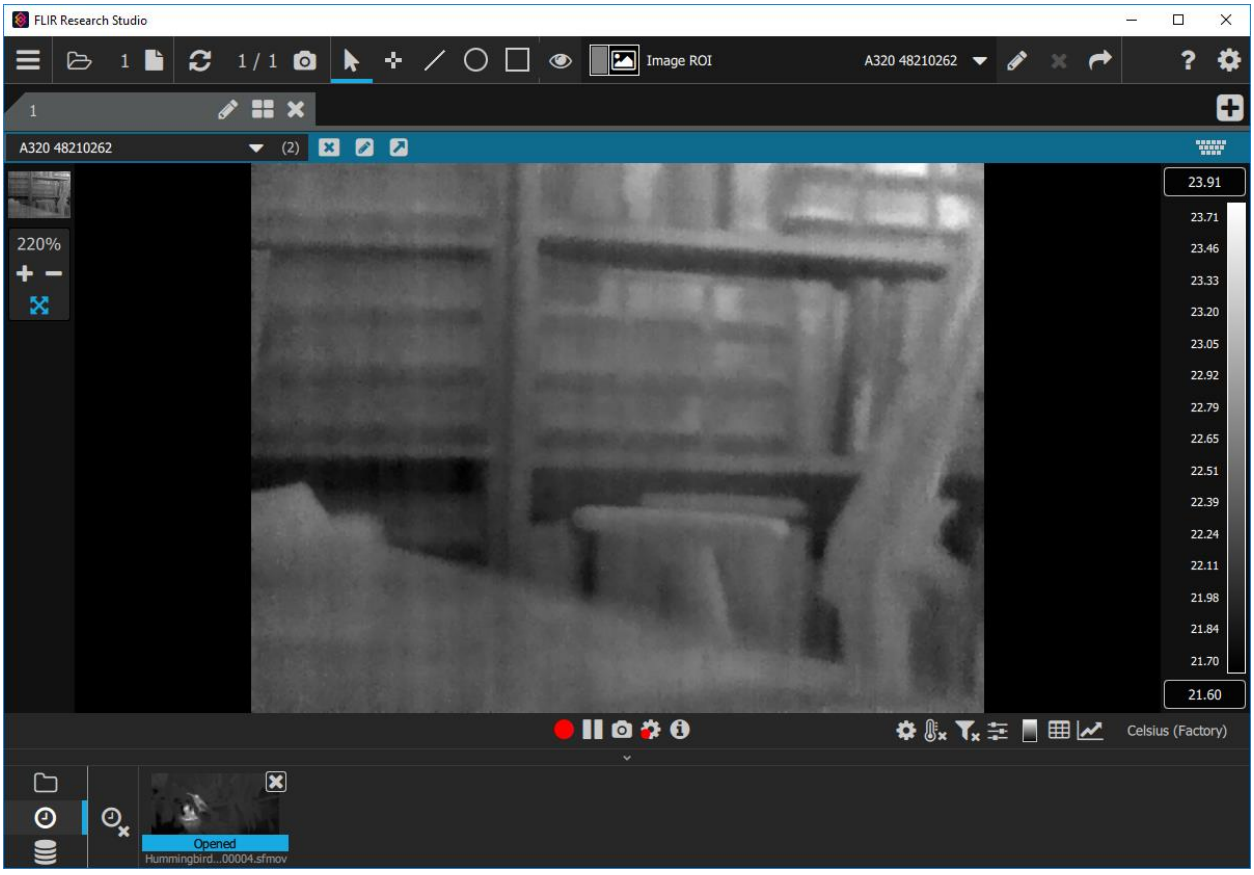
Table modules (Discussed in the analysis section): Can contain Source Information, Metadata, or Statistics

Plot modules (Discussed in the analysis section): Can contain profiles plots or temporal plots

3.4.1 Image Modules

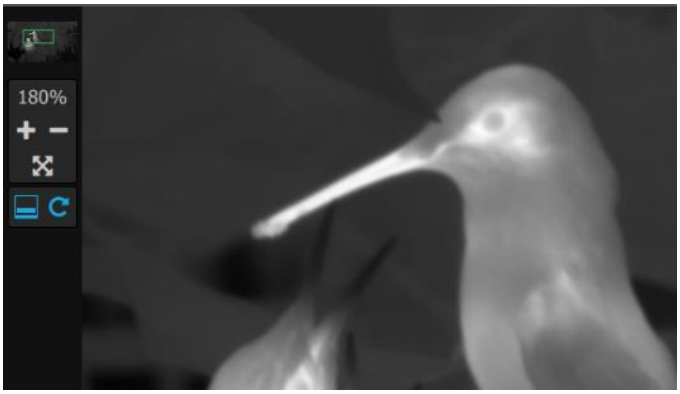
The image module is the most central of the module type as all other types of modules are connected to an imagery module. Image modules can display either images from a live camera stream or from a file.

When a camera is connected, a live image will be shown, along with a group of camera controls, as shown below:

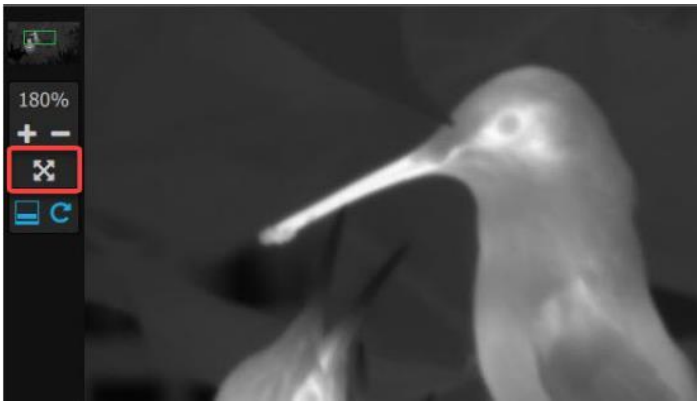


3.4.2 Zoom Control

The zoom control is on the upper left side of the main window. The zoom range goes from 10% to 1000%. There is a small mini-map displayed above the zoom control that puts a green box around the displayed portion of the image. The zoom factor can be adjusted in a continuous fashion using the arrow keys on the tool, the mouse scroll wheel or using the pinch gesture on the screen or touchpad.



The cross arrows icon resets the zoom factor to best fit the window.



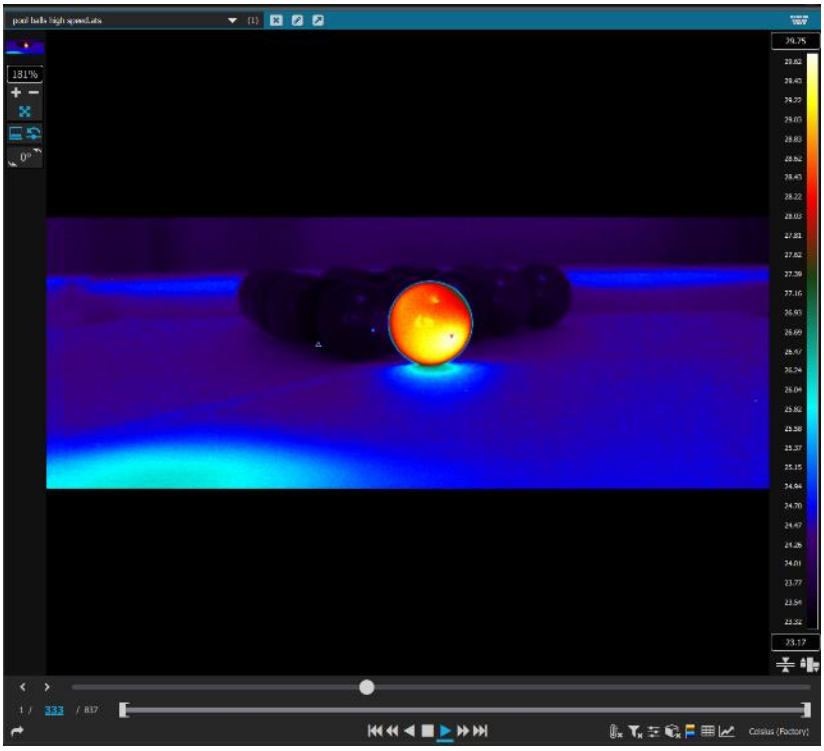
3.4.3 Playback Control Group

The playback control group has all the standard controls used all over the video camera industry for playback of video.

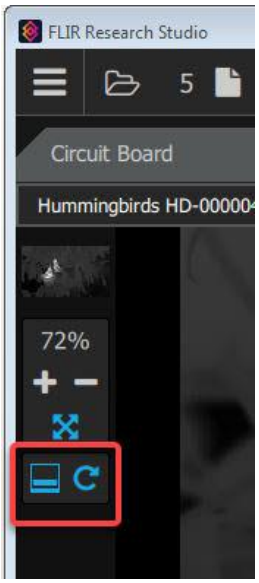
The center button is stop, then there is play forward/backward, fast forward/fast backward and skip to the end/beginning of the movie file. When the control is active, it turns blue.

3.4.4 Frame Selection Controls

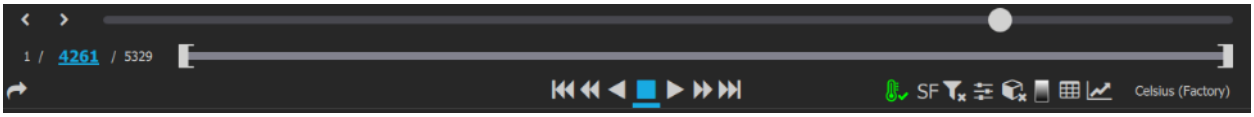
When a movie is opened, a set of frame controls opens beneath it. These allow the user to select which frame of the movie is displayed. In the example below, the currently displayed image is frame 333 out of 837 frames. The user can select the frame to display by clicking the blue frame number entering a new number or by using the scroll bar. There also playback bounds beneath the playback bar that allows the user to select a portion of the entire clip to play. This also trims the clip for the extract and export features.



The left button below the zoom control on the left side of the GUI window toggles the playback slider bar from being visible to being hidden. The right button controls looping of the playback.



The default condition is that the slider bar is made visible and the icon is shaded blue. Here the slider bar is made visible.

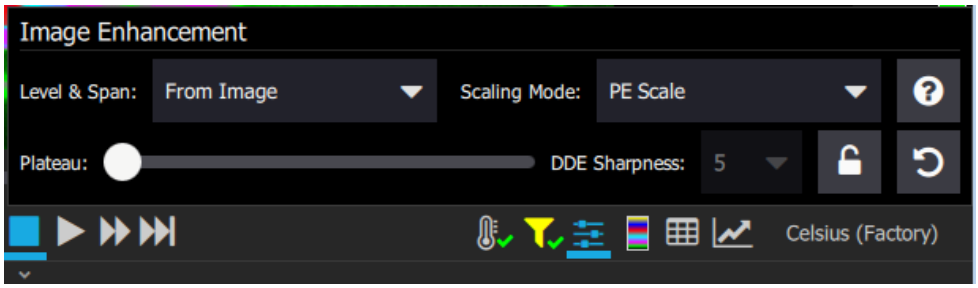


And here it is hidden:

The right control button looks like a loop with an arrow. This control toggles looping of the video in playback, and it is enabled by default for files that the user just opens. When it is enabled, it turns blue. FRS remembers the state of this control for that specific movie file during the session.

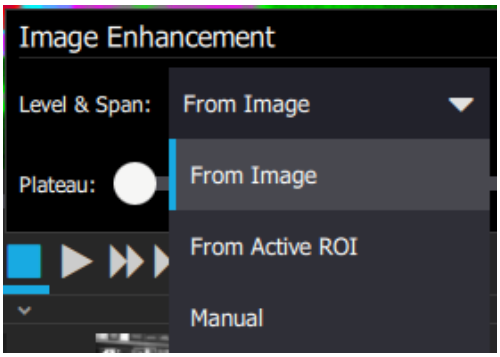
3.4.5 Image Enhancement

The slider bar icon represents the image enhancement tool, which affects the appearance of the image data as it is displayed. It does not affect the underlying data.



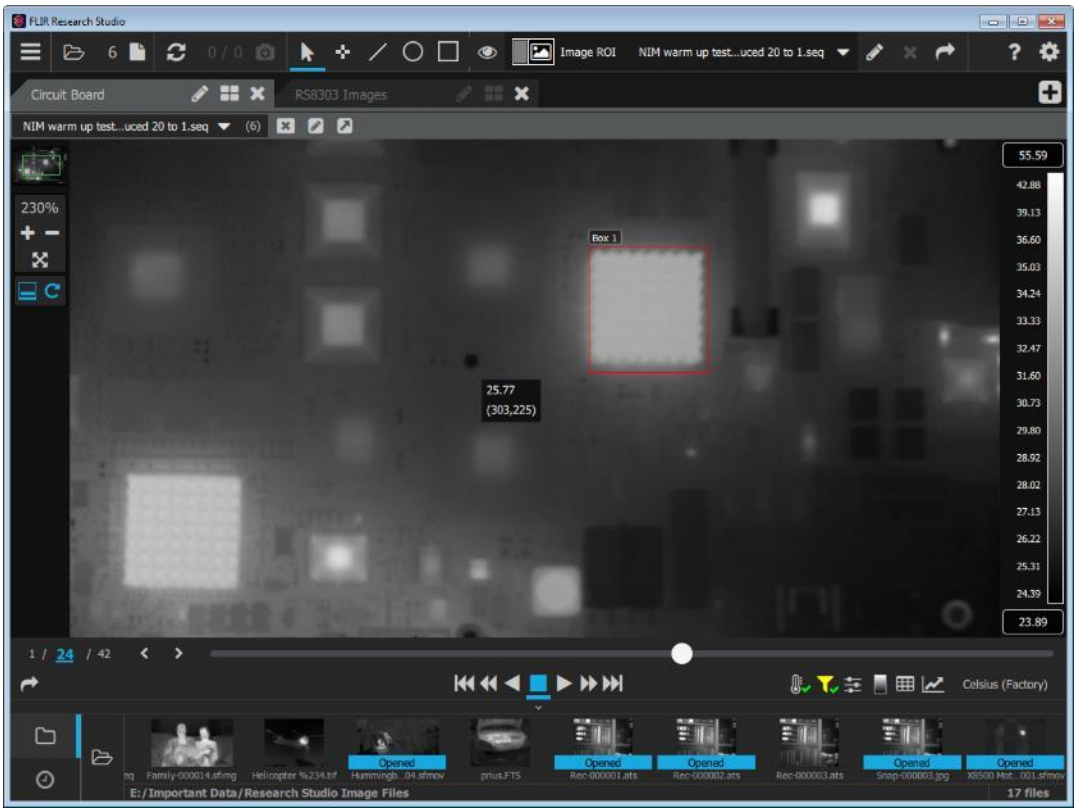
3.4.5.1 Level and Span

The level and span pull-down menu options control the range of digital data used in the image enhancement algorithm. The first option, From Image, uses statistics from all the pixels in the image as an input to the algorithm. The next option, From Active ROI, will only use statistics from a region of interest. The Manual option allows the user to determine the range of digital data counts as the input.

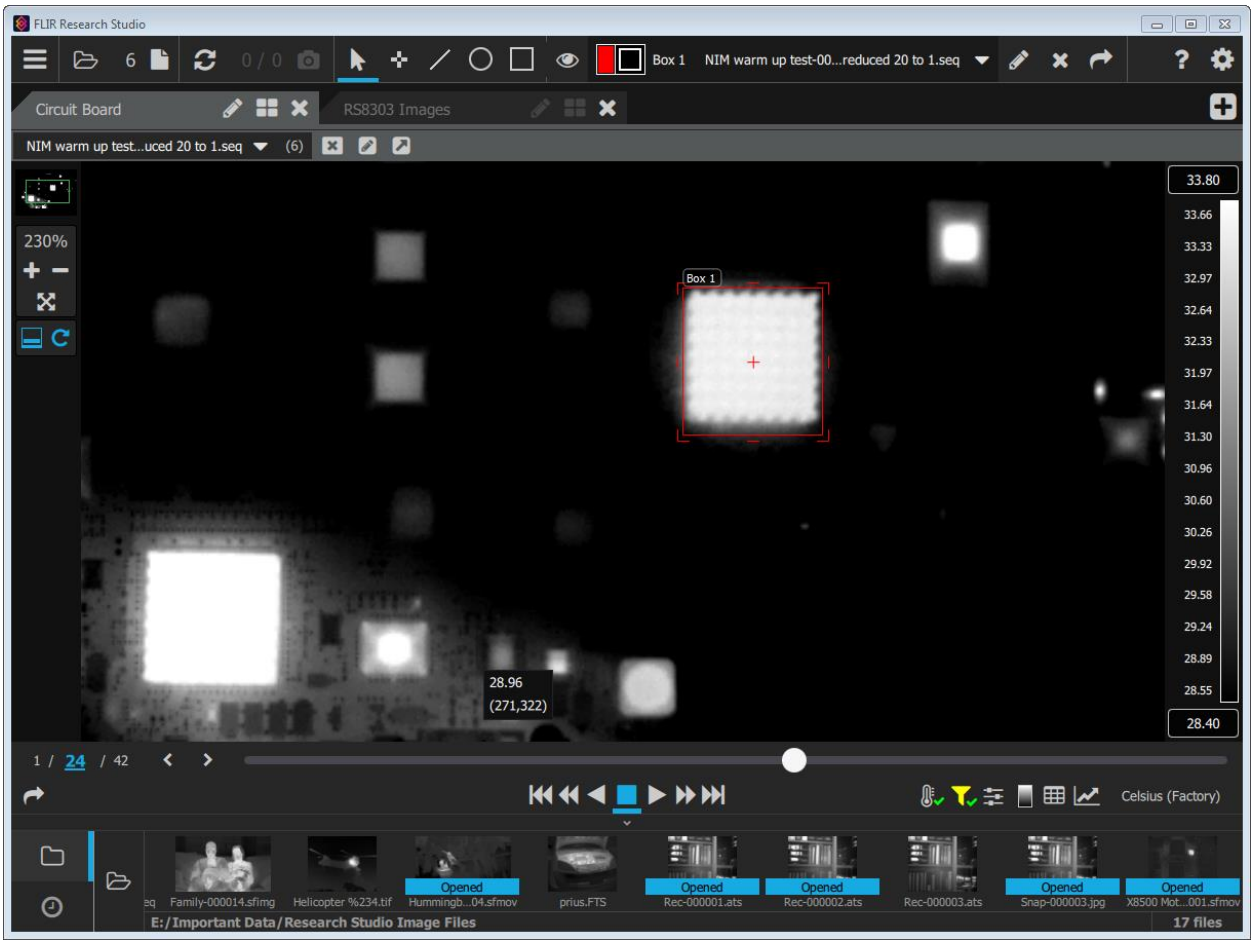


Some examples will make all this clearer:

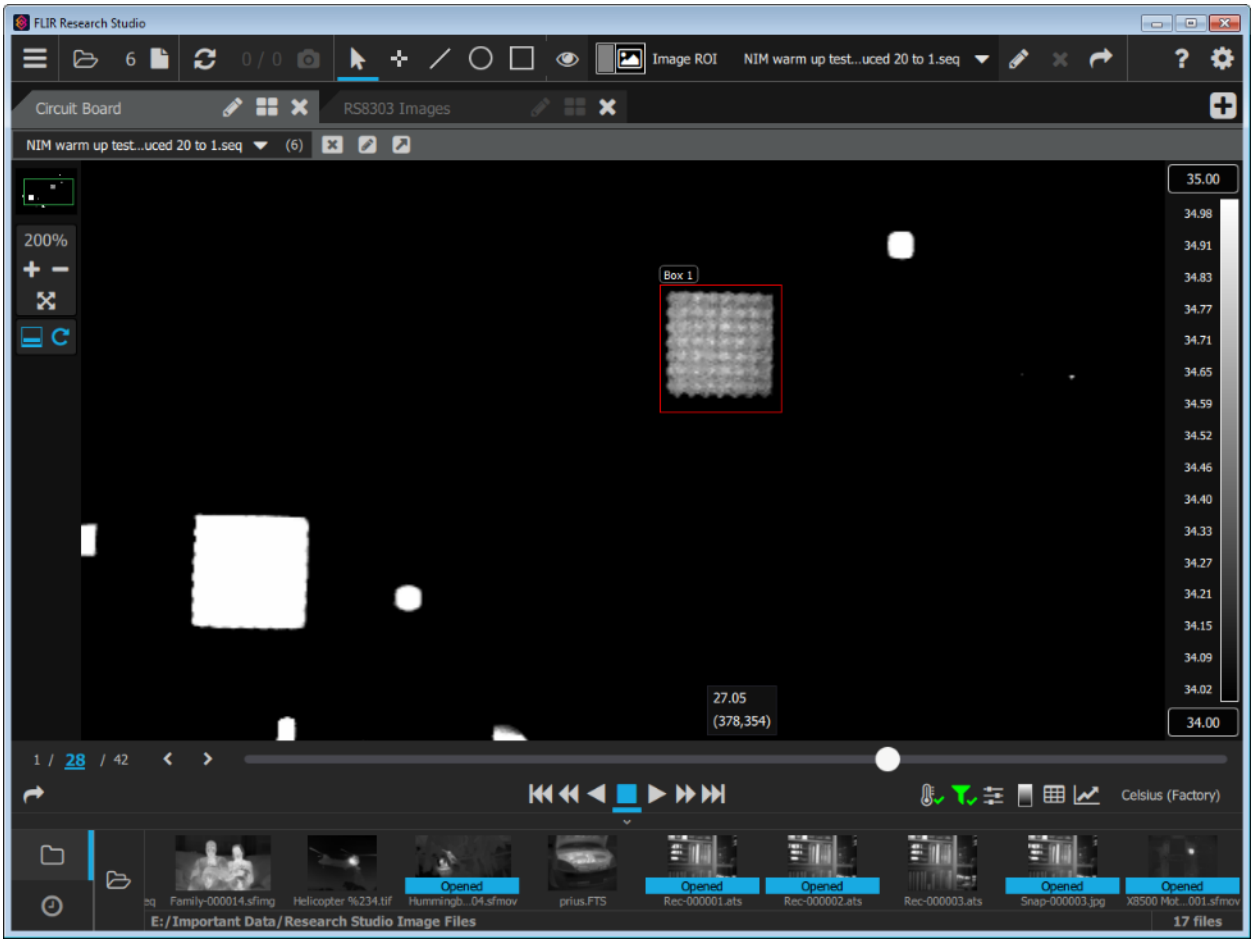
This circuit board image is processed using the PE Scale scaling mode (more on that shortly) and the level and span is determined by the whole image. The counts range from 23.89 C to 55.59 C, as shown in the color bar on the right side of the image.



The next image uses the statistics from the pixels within the blue ROI to determine level and span. Notice that the image within the ROI is displayed with good contrast, and the hotter ICs are blown out. The “focus” of the image enhancement is just that part of the image inside the ROI. The range of temperature values now is restricted to the pixel temperature values in the ROI, which range from 28.40 degrees C to 33.80 C.

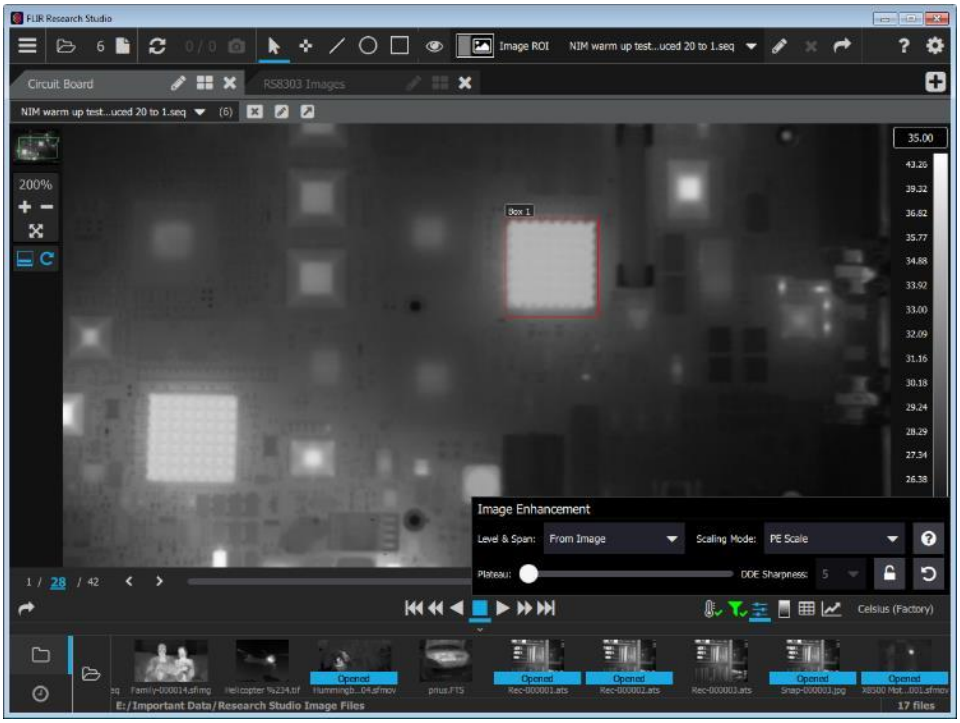


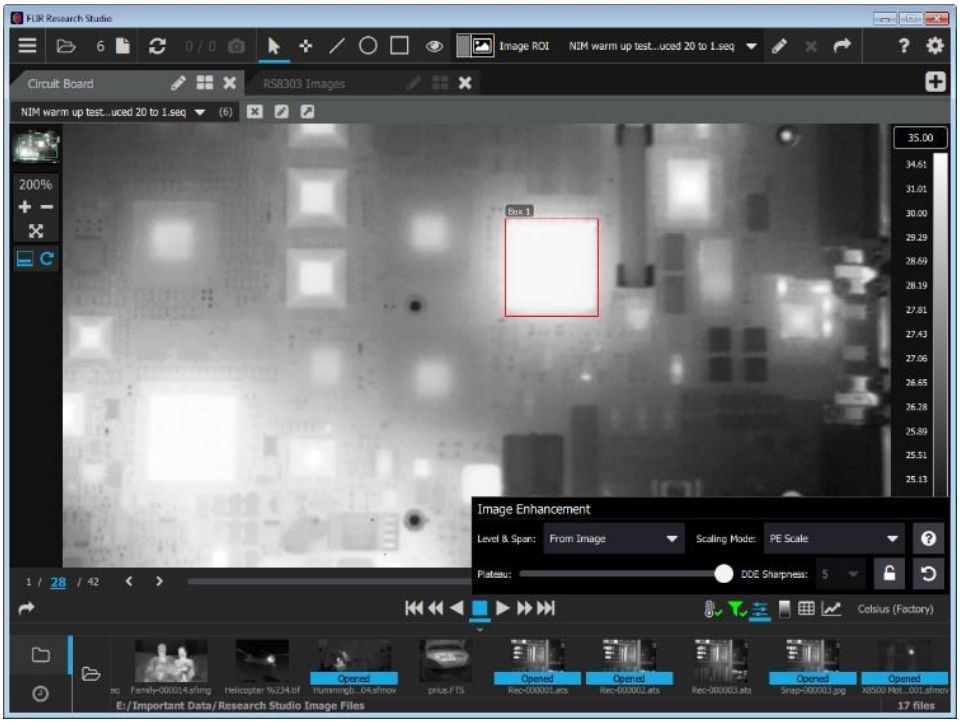
In this last image, the temperature range was set from 34 C to 35 C. Every pixel in that range of counts is displayed with a grey level. Pixels colder than 34 C are displayed in black, and pixels above 35 C are displayed in white. This manual method is very useful for enhancing a specific range of pixels across the whole image, not just in an ROI. In this case, only the pixels on the big square waffle-looking IC are displayed correctly in shades of grey. Everything else is either black or white.



3.4.5.2 Plateau

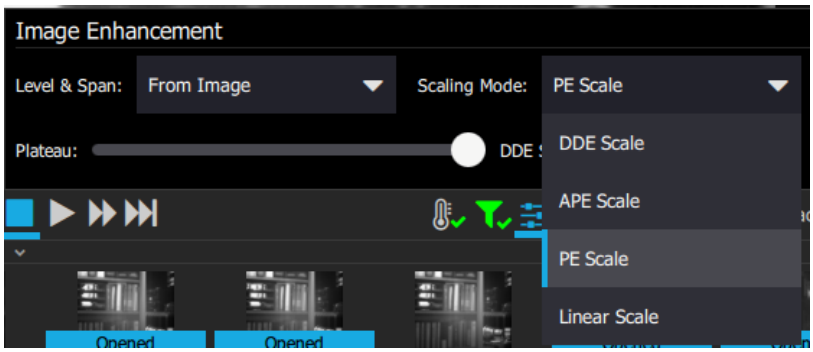
The plateau slider controls the mapping of the PE scaling. As the user slides the slider to higher values, the image contrast will tend to get more evenly distributed over the image. Here is the same image with the slider all the way to the left and then all the way to the right:





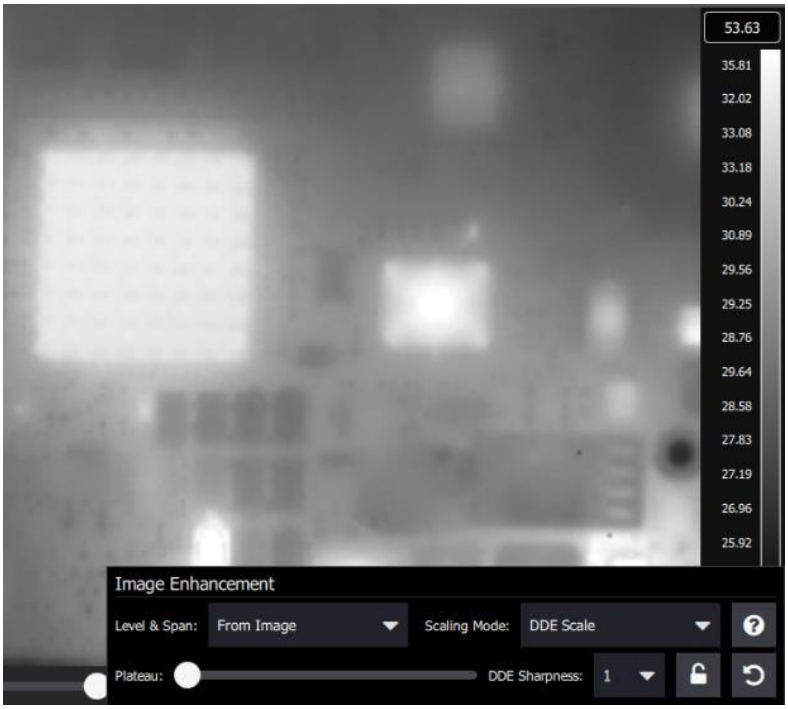
3.4.5.3 Scaling Mode

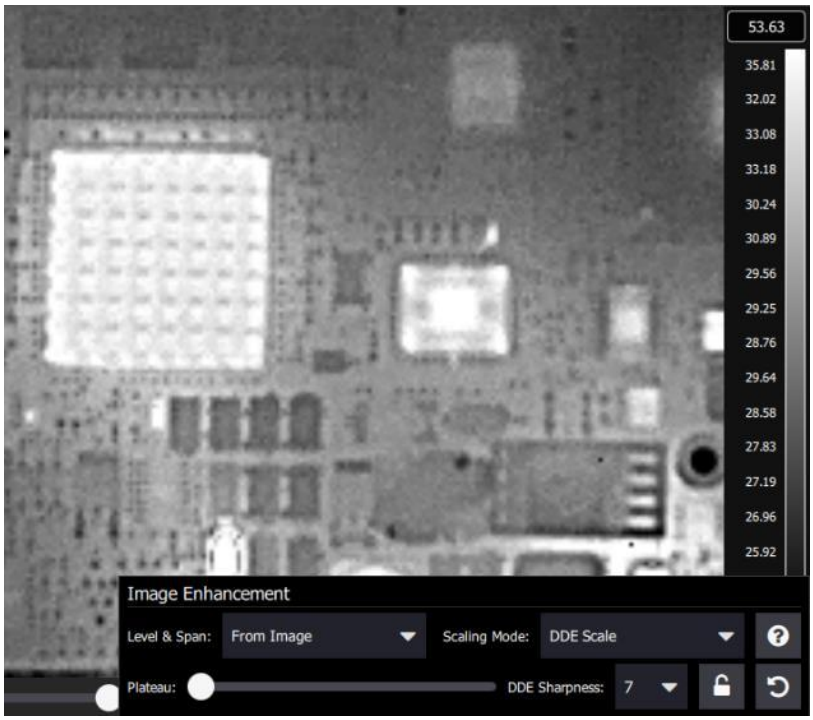
The scaling modes in FRS are: PE Scale, APE Scale, Linear Scale, and DDE Scale.



The default mode is always PE Scale. PE stands for plateau equalization, which refers to a histogram-based mapping of digital counts to the 256 display levels. The Plateau slider affects all the modes. DDE Scale refers to digital detail enhancement, a FLIR image processing algorithm that enhances edges. APE is adaptive plateau equalization, where smaller regions within the image have their histograms computed and used to enhance contrast in local areas. It is a very strong image enhancement tool and generally only looks decent on low-contrast images. Linear Scale just maps the digital counts in a range directly to display levels in a linear fashion. It usually gives the lowest image contrast, especially if there are some very hot objects in the scene.

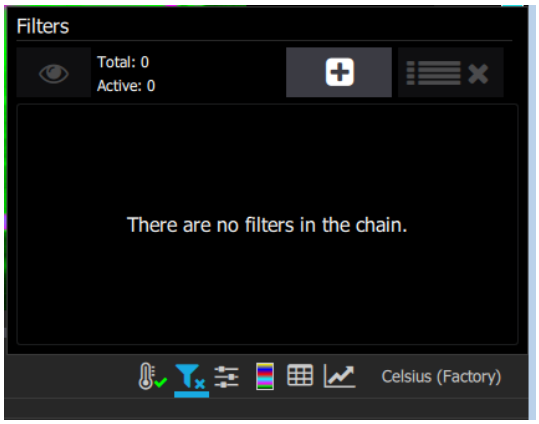
When DDE Scale is selected, a control called DDE Sharpness is enabled. This controls the amount of edge enhancement. Here are two images of an IC in the circuit board image. The first image has DDE Sharpness set to 1, the second with it set to 7:





3.4.6 Image Filters

The funnel icon represents the image filter tool. This tool allows the user to apply filters to the image during playback. These filters are available depending on the edition of the software.

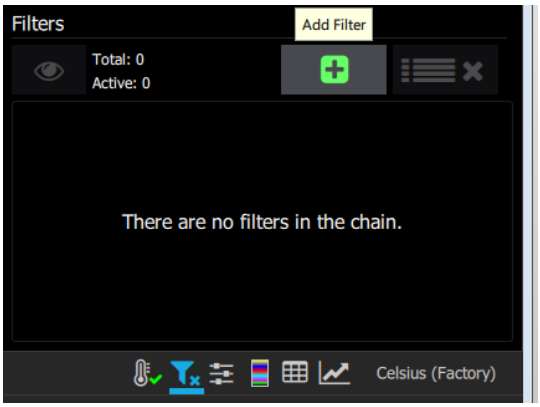


Here is a list of the available filters depending on software edition.

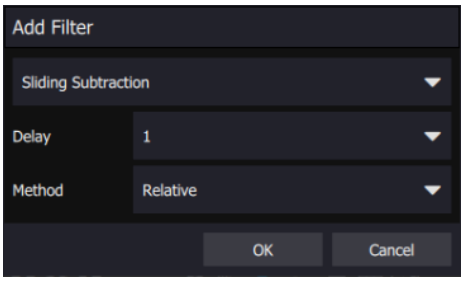
Filter Name	Operates On	Description
Gain	Pixel	Multiply each pixel by the gain value
Offset	Pixel	Add the offset value to each pixel
Absolute Value	Pixel	Compute the absolute value of the pixel
Natural Logarithm	Pixel	Compute ln(pixel value)
Square root	Pixel	Compute square root (pixel value)
Exponential	Pixel	Compute exp(pixel value)
Gaussian	Pixel	Compute a Gaussian blur (smoothing) to the image
Window average	Pixel	Make each pixel the average of the selected kernel
Median	Pixel	Make each pixel the median of the selected kernel
Frame Average	Image	Make current image the average of the last n frames. Relative mode shows the actual delta values. If this output will be fed into another filter that cannot accept

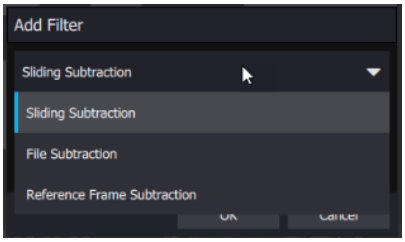
		negative numbers, the absolute mode will add the min value of the image in order to make all pixels >0
Min – Continuous	Pixel	Make each pixel the temporal minimum until reset
Min – Frame interval	Pixel	Make each pixel the temporal minimum over the last n frames
Max – Continuous	Pixel	Make each pixel the temporal maximum until reset
Max – Frame interval	Pixel	Make each pixel the temporal maximum over the last n frames
Sliding subtraction	Image	Subtract the previous nth frame from the current frame. Relative mode shows the actual delta values. If this output will be fed into another filter that cannot accept negative numbers, the absolute mode will add the min value of the image in order to make all pixels >0
File Subtraction	Image	Subtract a selected file from the current frame. Relative mode shows the actual delta values. If this output will be fed into another filter that cannot accept negative numbers, the absolute mode will add the min value of the image in order to make all pixels >0
Reference Frame Subtraction	Image	Subtract a frame that is captures with the “Grab Reference” button from the current frame. Relative mode shows the actual delta values. If this output will be fed into another filter that cannot accept negative numbers, the absolute mode will add the min value of the image in order to make all pixels >0
HSM Mode	Image	Emulates the HSM mode found in GF-series cameras

Hovering over the Plus sign button makes it turn green. Clicking it brings up an Add Filter dialog.

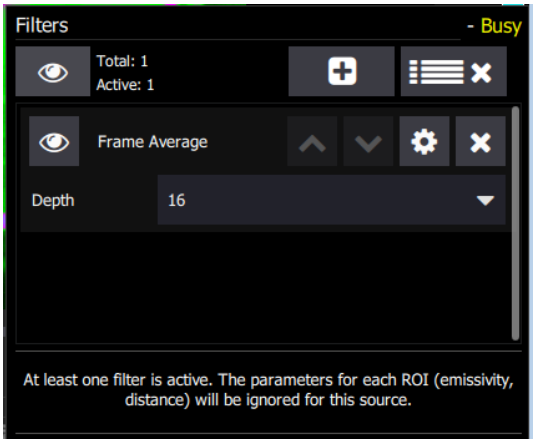


Use the pulldown menu to choose the filter. The available choices will depend on the edition of the software.





The “Eye” button is used to enable or disable individual filters or all the filter at once. The order of filters matters in some cases. The gear-like button is used to edit the settings for a particular filter. The X button will delete the filter.

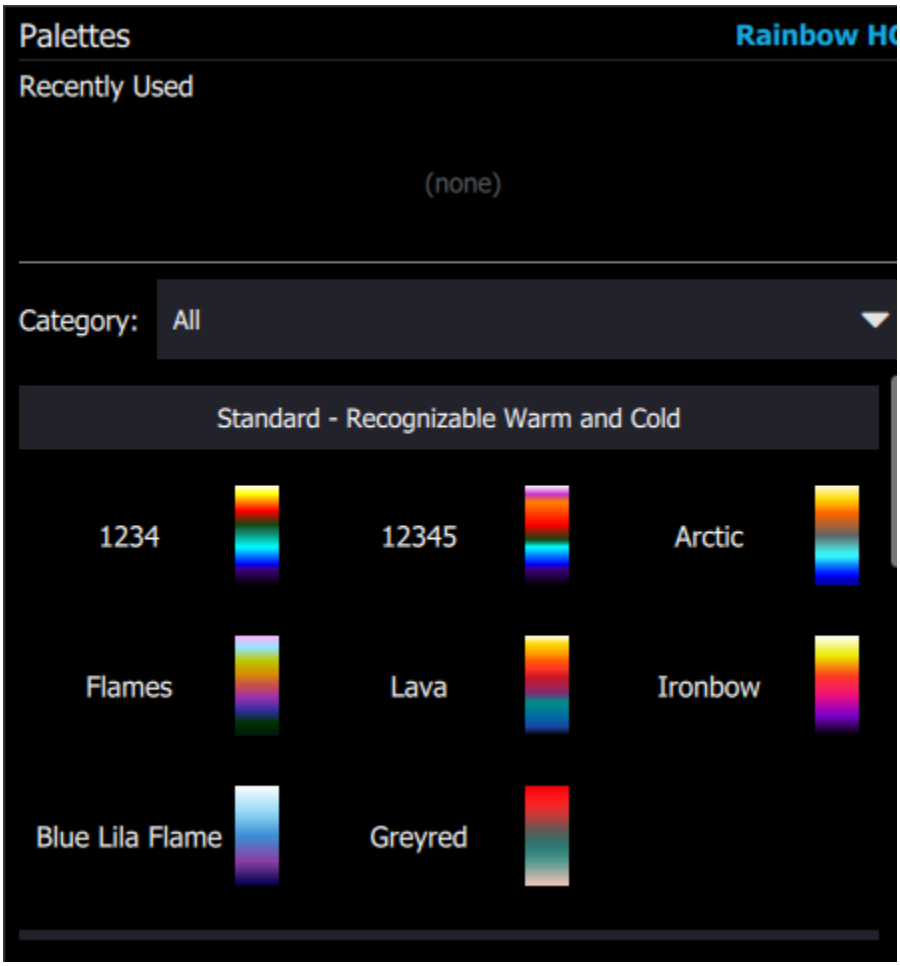


When a filter is active, the filter button changes its appearance like so:

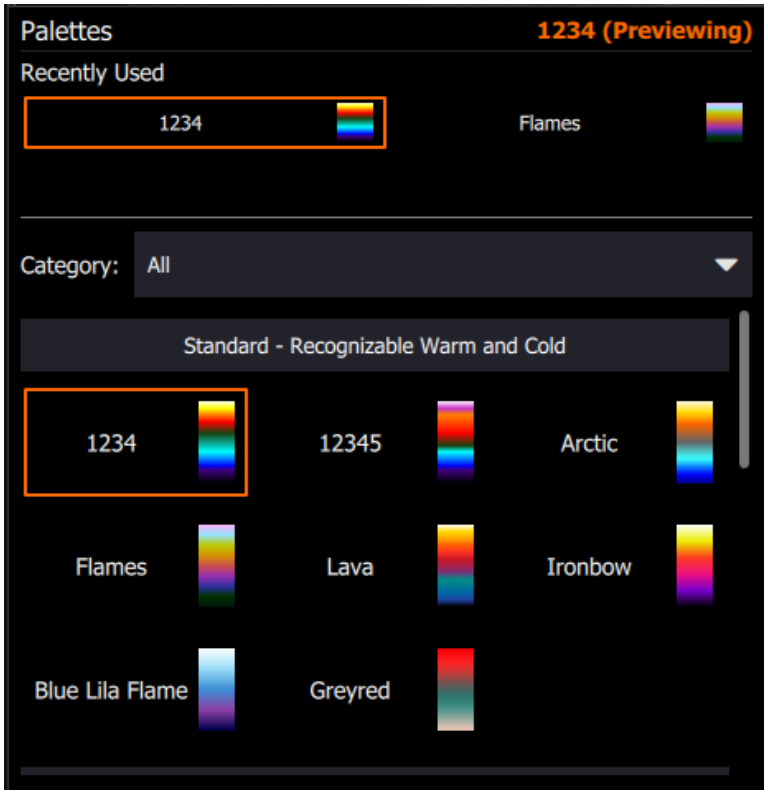
3.4.7 Palettes

Research Studio offers the user the ability to apply color palettes to the images on the screen. These color palettes are applied to exported images and movies as well. The color palette menu is here:

The palette selector tool utilizes select by category, recently used, and user supplied palettes. The palettes in FRS are unique because they allow the user to dynamically preview how the image will change before selecting the palette. The software will now remember the last 4 palettes used (for the entire program, not per camera). User supplied palettes can be added via a directory on the local computer. Once added they will show up in a user category.



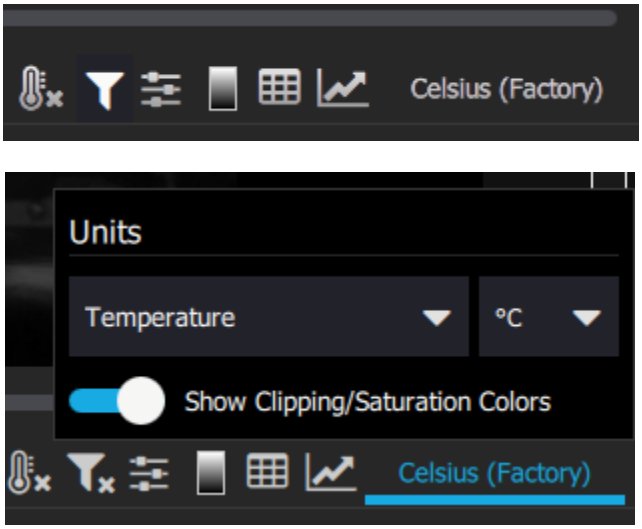
The currently selected palette is shown with an orange outline around it and the name is displayed. The other color bars are the available palettes and one can immediately see the effect of the palette on the image if one “mouses” around the color bars.



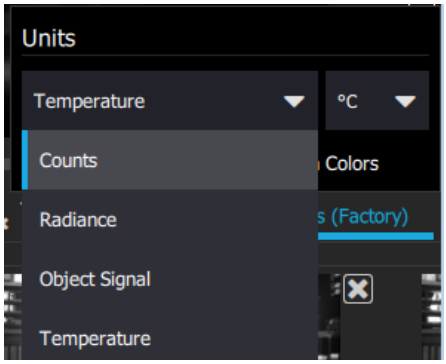
There are four palette categories to enable easy navigation of the palettes. See the screenshot below.

3.4.8 Display Units

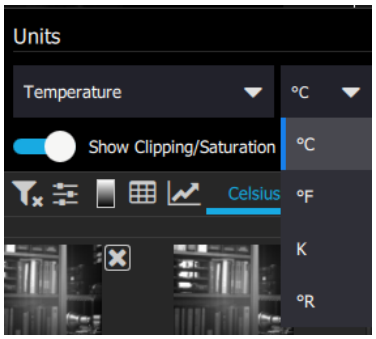
At the bottom right of the imagery module is the control for the selection of the display units. In this example, it is set to Celsius (Factory). This indicates that the camera has a factory calibration in it.



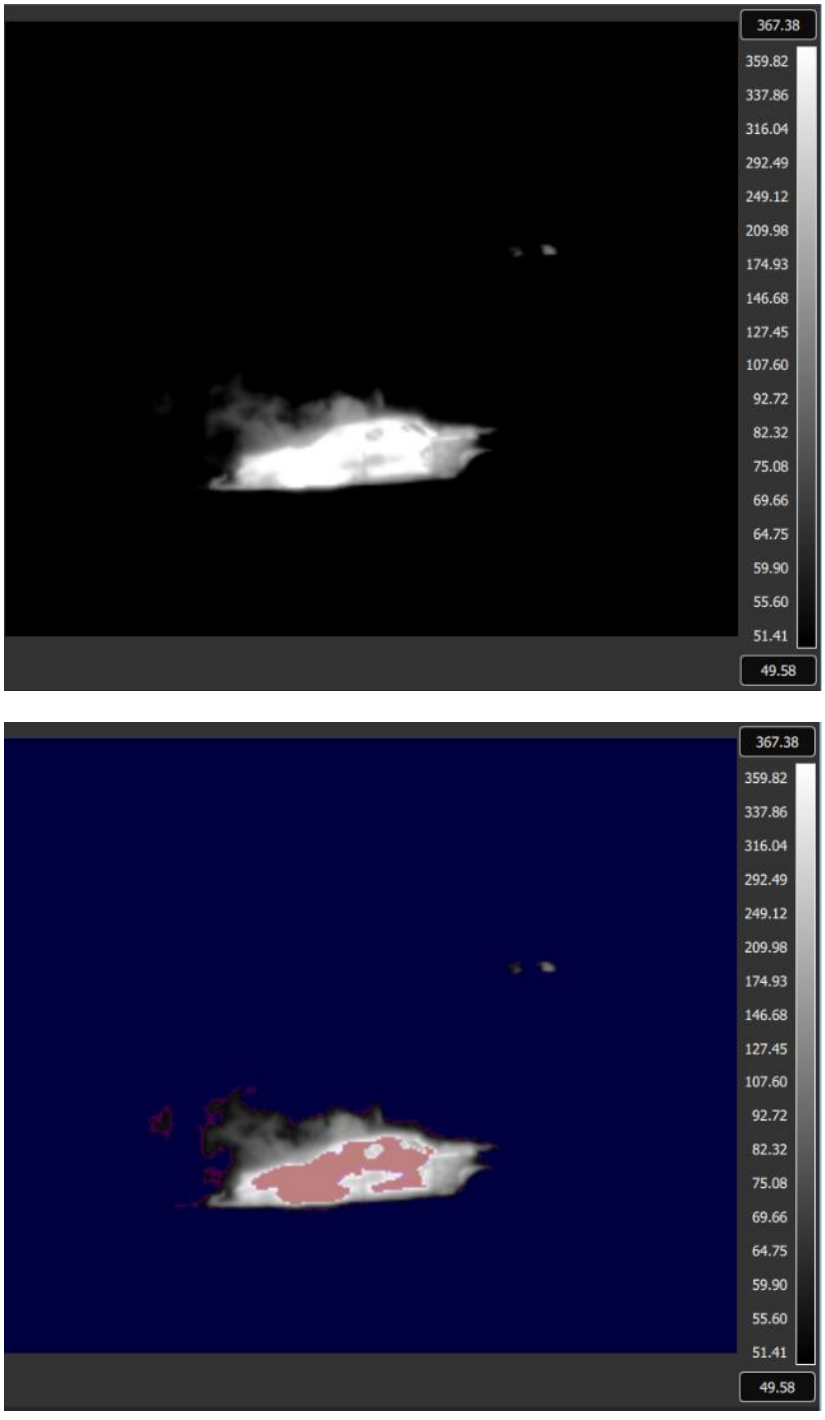
The units can also be changed to Radiance (Factory) or counts using the pulldown menu. The radiance units are watts/square cm/steradian. Object Signal is a unit used by the factory for certain cameras. Digital counts are dimensionless.



The temperature units that are available are Celsius, Fahrenheit, Kelvin and Rankin.



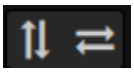
Clipping/Saturation colors are set up so that for cameras with factory calibrations, any pixels that are saturated. i.e. too hot for the calibration will be shaded pink. Any pixels that are too cold for the calibration will show in dark blue. The image below of a car on fire shows the effect of this control.



3.4.9 Image Rotation

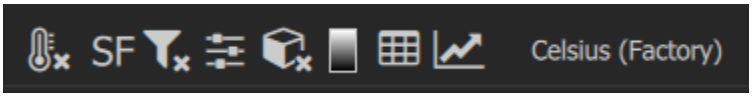
Clicking this button will cause the image to rotate by 90-degrees counter-clockwise. Each additional click will rotate another 90 degrees. The icon will show the amount of rotation applied.

3.4.10 Image Flipping



Clicking these buttons will flip the image vertically (invert) and horizontally (revert). They can be used independently but are most often used together when the use of a lens caused the image to be flipped. These controls are similar to controls that are found in some of the camera controllers, but in the camera controller you are flipping the image at the camera sensor level but in Research Studio you are flipping the data on the PC-side.

Each image module has a toolbar in the lower right corner. This toolbar allows the user to adjust object parameters, activate superframing (only if the recorded file was superframed), apply filters, adjust scaling, apply spatial calibration, choose palettes, launch additional analysis modules, and change the units displayed.



4 Record

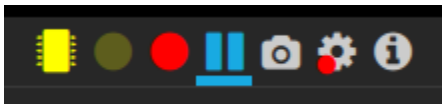
When a live camera is connected the recording control section is located at the bottom of the live imagery view module.

4.1 Recording Controls

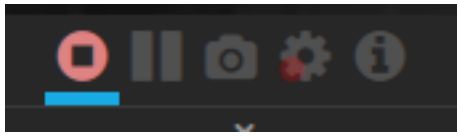
The controls are from left to right, Arm for Recording, Record/Stop, Pause, Take Snapshot (Radiometric JPEG), Record Settings, and Record Info.

The first button on the left that is yellow is to Arm the Recording. This is optional for Pre-Trigger recordings. This button pre-allocates memory; otherwise, memory is allocated at the time the recording is triggered. When requesting a large memory buffer this can add a delay to the start of recording. If you are triggering off a header flag, then it is best to Arm the recording so you can be sure the first flagged frame is captured.

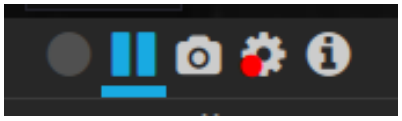
The record/stop button is a red circle. It will initiate and stop video recordings.



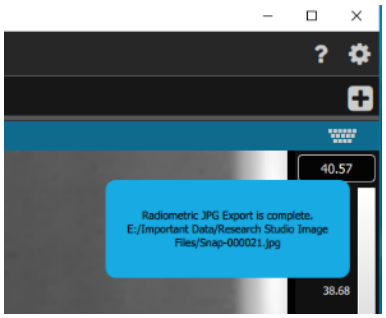
When it is stopped, it is solid red. When it is recording, it gets a black square in the center and the icon pulses slowly.



When the pause button is pressed during a recording, nothing happens. This button cannot be used to pause an active recording – it only freezes the live video.

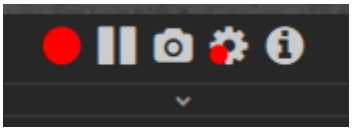


The camera icon to the right of the pause button enables the user to take a still frame. One can turn off the Snap prefix and add a text prefix instead in the Record settings menu.



4.2 Record Settings

The Recording Settings button looks like a gear with a red dot on it. The settings in this menu should always be set appropriately before recording videos or stills. We discuss this menu in the sections below.



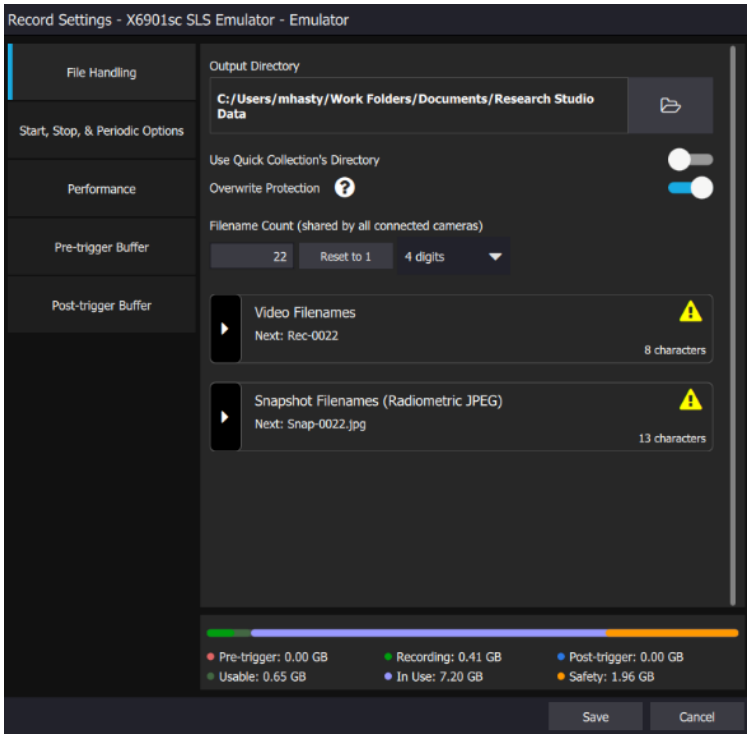
4.2.1 File Handling

The first tab in the record settings menu is File Handling. The user has options for choosing the location to store recording as well as file naming options.

The first selection is if the user wants the Snapshot or Video to be placed in the Quick Collection Directory. The quick collection is located at the very bottom of the application.

The second selection enables the software to detect if the currently specified file name will overwrite a file name already in the directory. If necessary, the program will append a number to make the filename unique. If the user turns this off important previously recorded files could be overwritten.

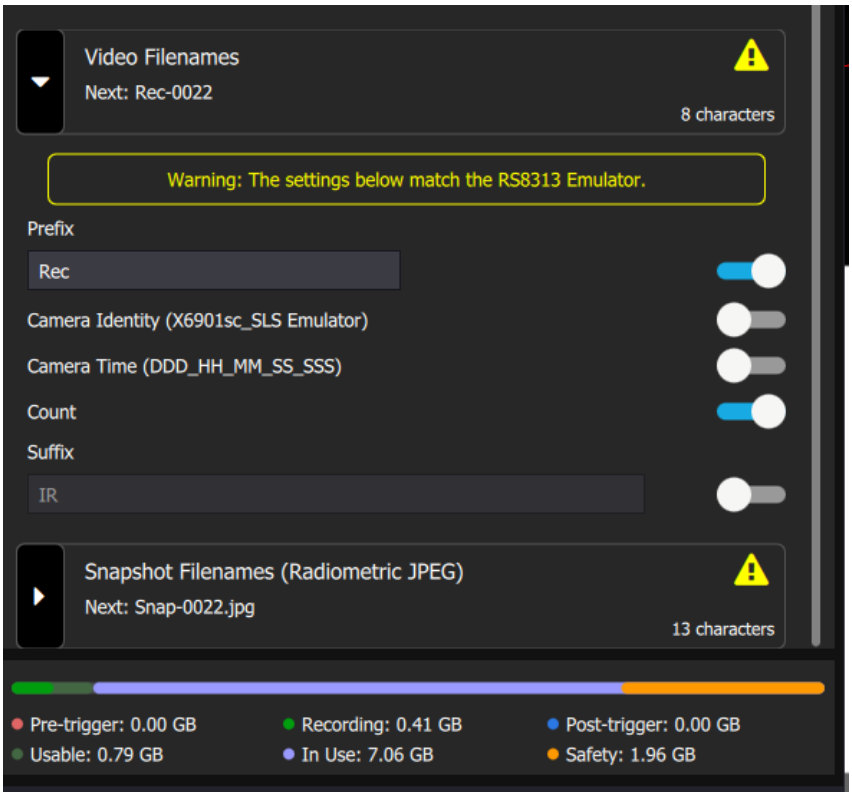
The third is a global setting to add a count at the end of the file name. This will start at the designated number and continuing to count by 1 as multiple recordings or snapshots are performed.



The next section is Video Filenames. In this section the user is able to add a prefix, toggle the camera identity, toggle the camera time, toggle the count, and add a suffix. In the example below, the first video file recorded would be named REC-0022.ats

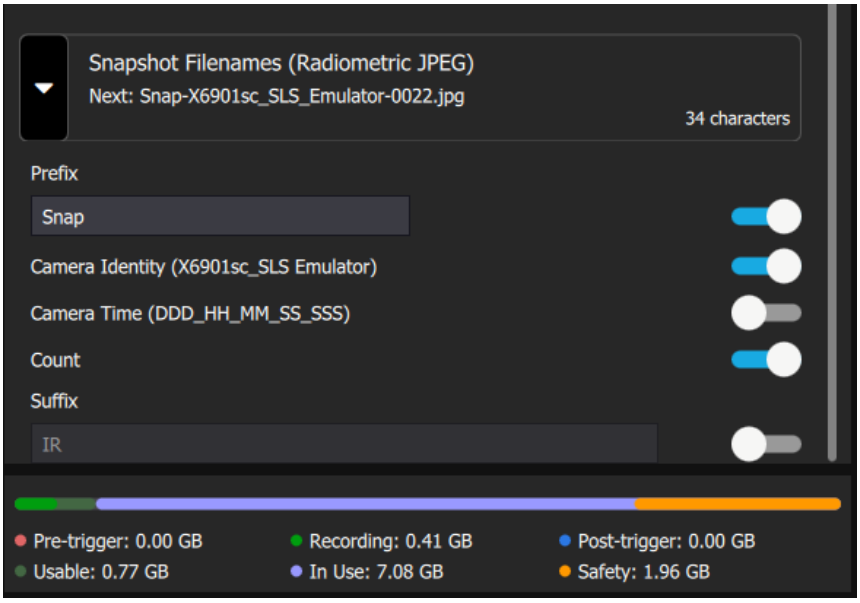
You can also see a warning designated by the yellow triangle and the yellow framed note. Currently there are two cameras connected to Research Studio and if the user recorded with each camera the names would be the same. This warning is letting the user know they may want to add a unique identifier to the file name to distinguish from other recordings.

You will notice in the section heading the file name preview is displayed and is dynamic based on the selections.



The next section is Snapshot Filenames seen below. In this section similar to video file names the user is able to add a prefix, toggle the camera identity, toggle the camera time, toggle the count, and add a suffix. Also, notice the warning is no longer visible. This is because I enabled the Camera Identity as part of the name. This identity will make the file name unique from other cameras.

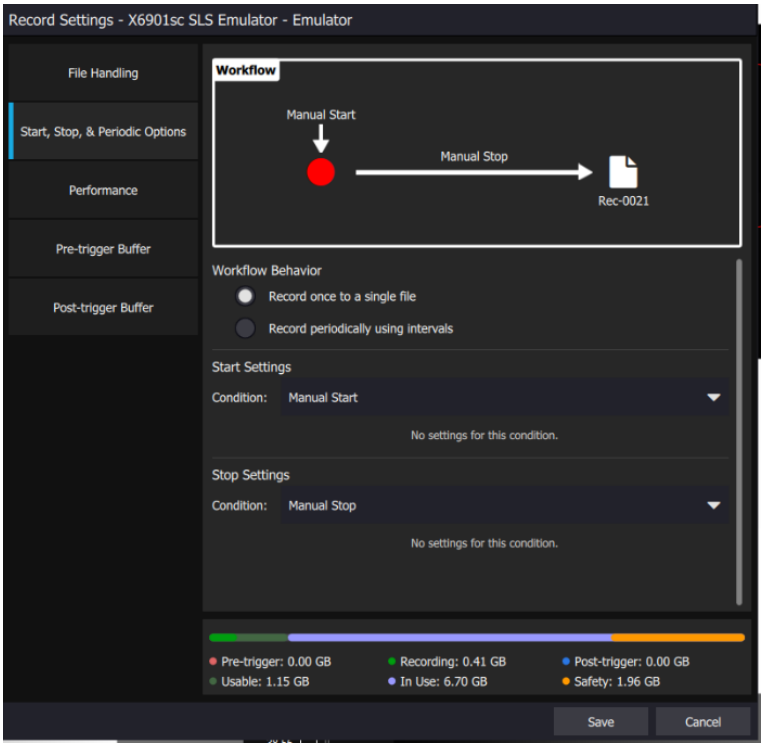
You will notice in the section heading the file name preview is displayed and is dynamic based on the selections.



4.2.2 Start, Stop, & Periodic Options

The next tab in the menu is Start, Stop, & Periodic options. This dialog gives the user the ability to set the start and stop conditions for recording, or to set periodic recording. The user will see the workflow dynamically change as changes are made to the recording setup.

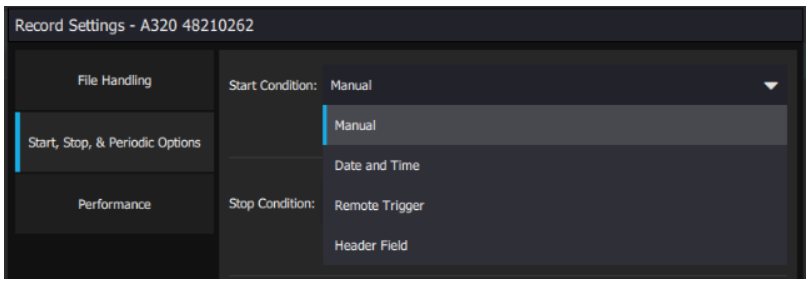
There are two main options selectable by radio buttons – Record once to a single file or Record periodically using intervals to multiple files.



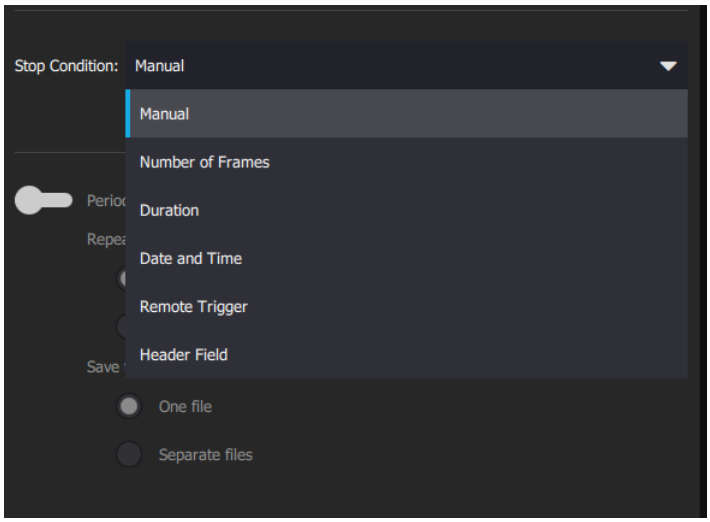
4.2.3 Record Once to a Single File

If Record once to a single file is chosen, the user will see settings to choose the Start and Stop conditions.

The start condition can be selected from the pulldown menu:



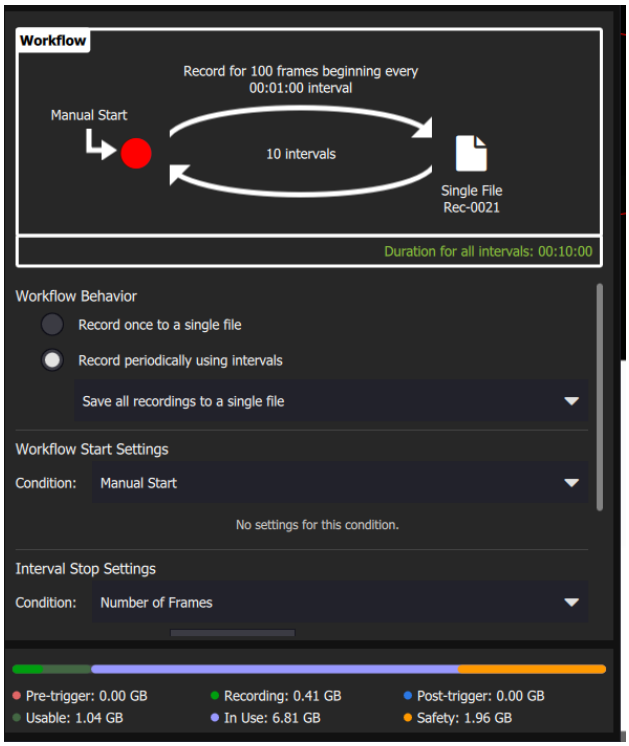
The stop condition can also be selected from the pulldown menu:



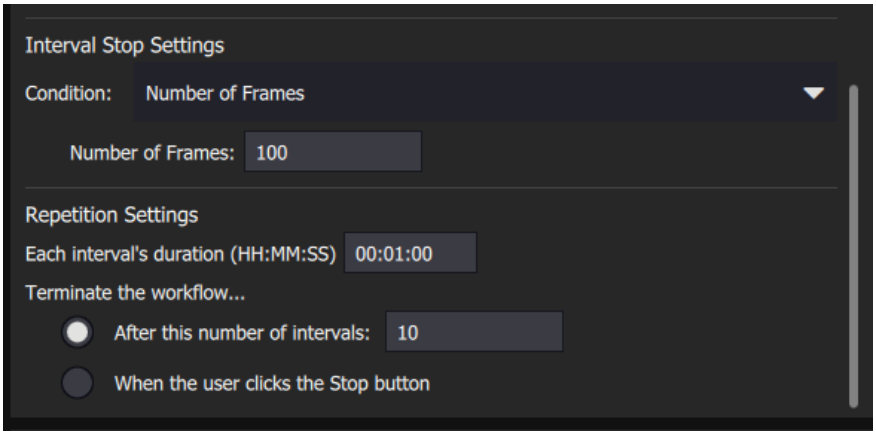
4.2.4 Record periodically using intervals

The Periodic option allows the user to set a pattern for recording frames. This option requires that the Stop condition be something other than Manual. The default duration is a one-minute interval recording, repeated 10 times, with the results placed in a single file, as shown below. The workflow diagram at the top also updates to reflect the recording settings.

The periodic recording can be recorded to single file or to multiple separate files for each period.



The Workflow Start Setting options are the same for periodic. However, the Stop condition and repetition can be different. The user can choose to stop at Number of Frames or Duration. The repetition settings allow the user to choose how long to wait until between recordings, and how many intervals to record. This can also be set to a manual stop for the intervals.



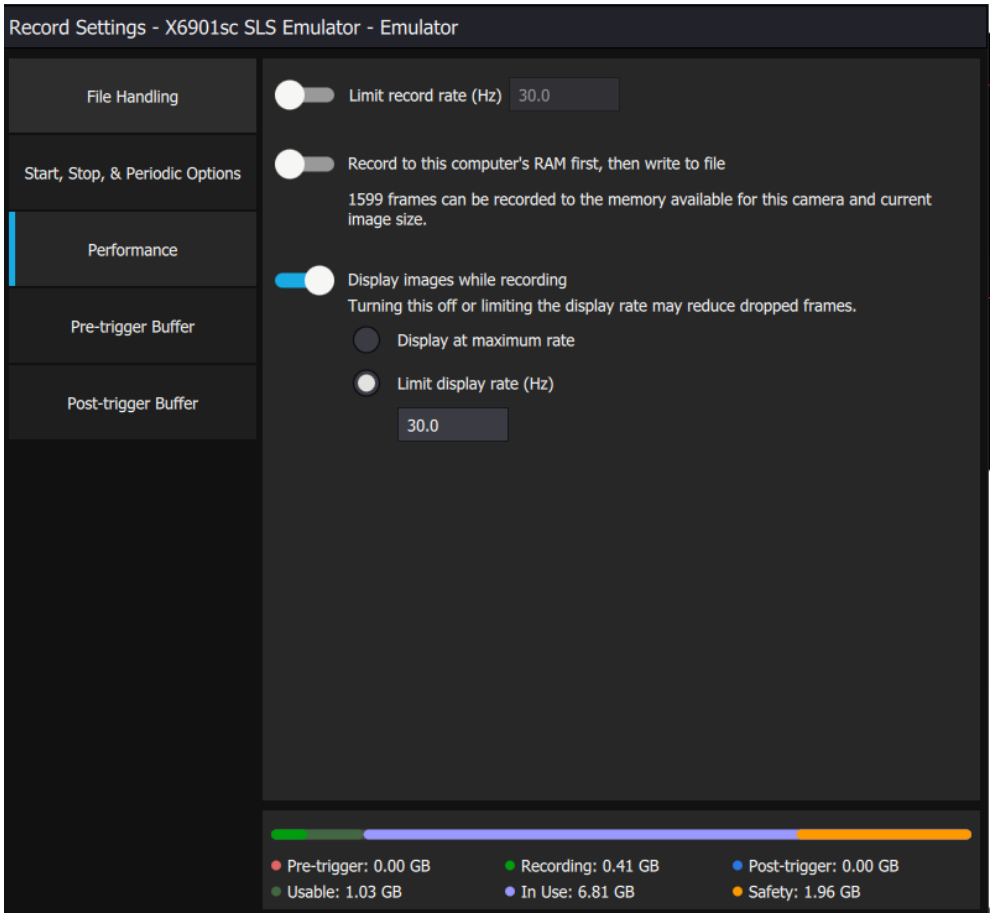
4.2.5 Performance

The next tab is Performance and allows the user to choose certain parameters that affect the recording performance of the computer. Global performance settings can also be edited in the Application Settings menu mentioned at the end of the manual.

The user can limit the recording frame rate to a selected lowered rate by sliding the slider to the right and then entering the desired frame rate. The limit record rate is typically used with uncooled cameras because this type of camera may not have a frame rate control. Research Studio tries to achieve the selected rate by dropping frames.

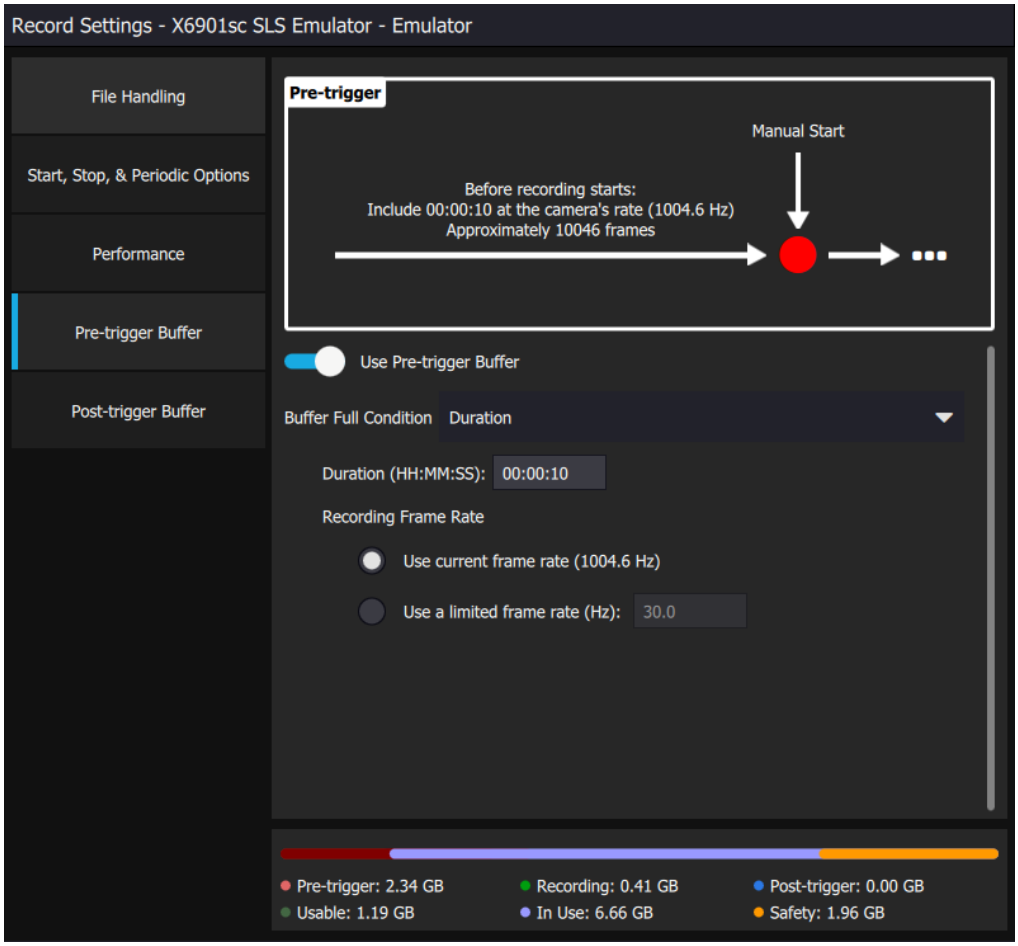
The user can also choose to record to the computer RAM first and then write to hard drive. Recording to computer RAM is the fastest recording mode, but the time is limited by available physical RAM (does not use virtual RAM). Below this option the program displays the number of frames that can be recorded to RAM memory for the currently chosen camera.

Finally, the user can choose to display images while recording. If this is toggled on the user can choose to Display at maximum rate or to limit frame rate displayed while recording. Turning this off can help the user reduce dropped frames.



4.2.6 Pre-Trigger Buffer

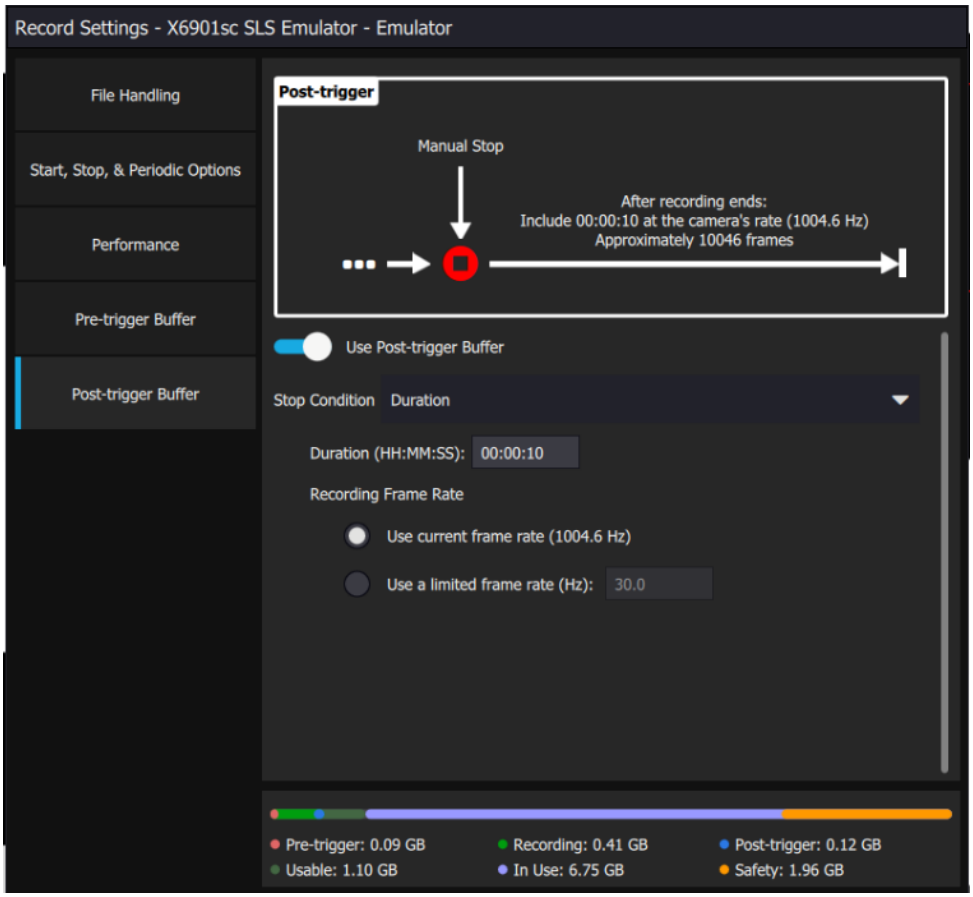
User can setup a circular buffer where data is continually captured. When a recording is initiated the frames in the buffer allow the user to see data before the recording was started. The user can set the buffer size based on number of frames or duration.



The rate limiter options allow the user to slow down the rate of data recorded prior to the trigger. This is useful for extending the time span of the pre-trigger buffer. There is also the option for the software to set the frame rate to fill the specified number of frames inside the time duration.

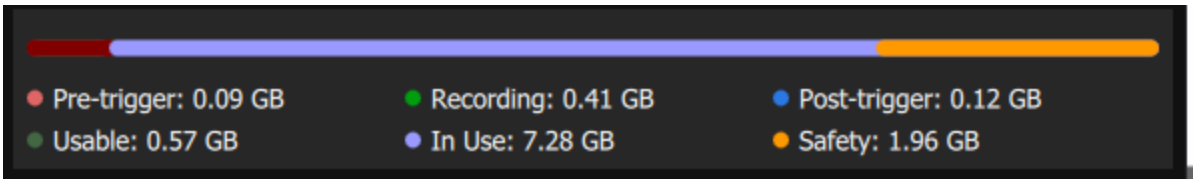
4.2.7 Post-trigger Buffer

The user can also setup a post-trigger buffer. The software will record a specified duration or number of frames after the recording is over. The recording frame rate can also be limited in the post-trigger to save computer RAM.



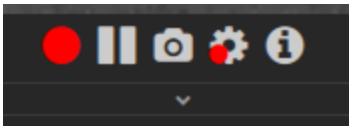
4.2.8 Computer RAM Dashboard

At the bottom of the record settings menu there is a chart that shows RAM allocation. This lets the user know where memory is being allocated and how to adjust to improve the recording performance. This menu is dynamic based on the user changing settings in various menus.

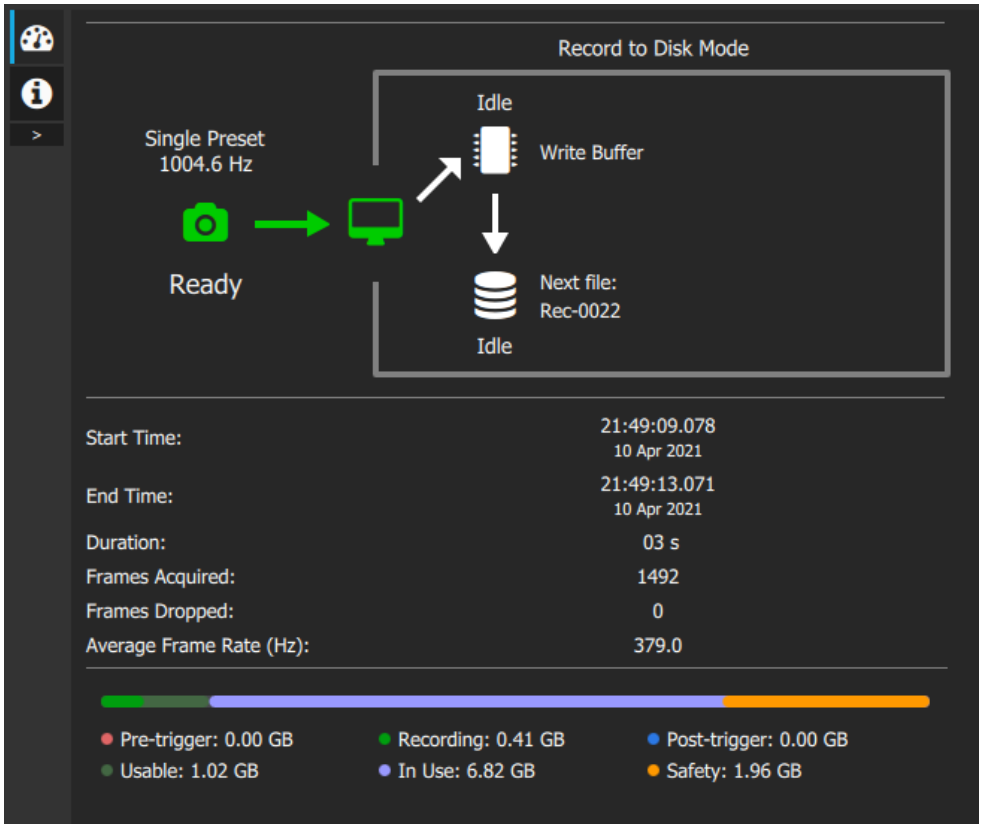


4.3 Record Info Dashboard

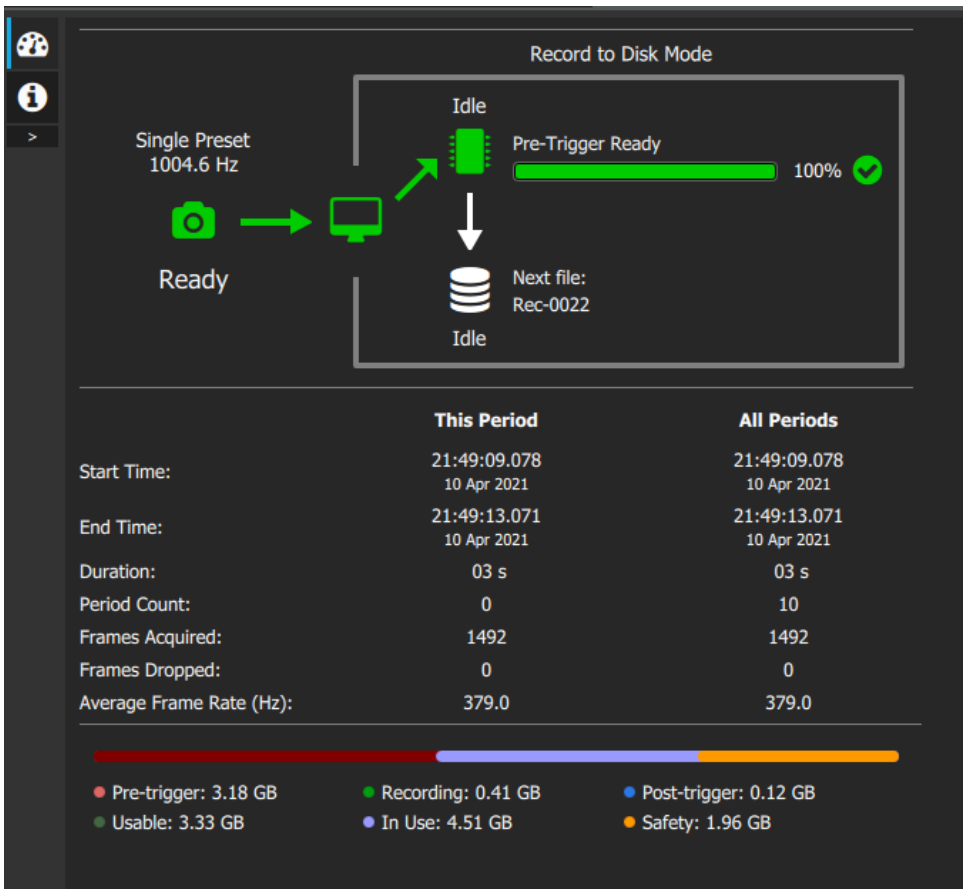
The record info dashboard can be accessed via the info button



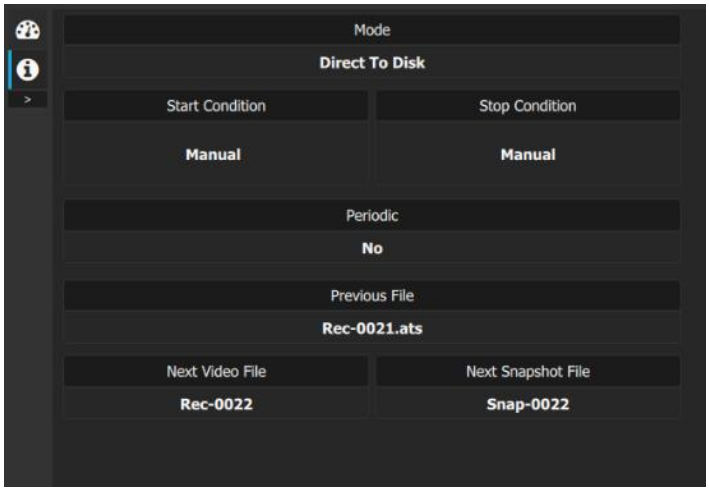
This dashboard allows the user to dynamically monitor recordings while in progress. It can be displayed as popup or docked into a module. The user can see the Start Time, End Time, Duration, Frames acquired, Frames dropped, and the Average Frame Rate in Hertz.



This menu also reflects the record settings. If a periodic recording is setup there will be a column for the current period and all periods. It is useful to dock this dashboard in a frame next to the camera livestream so the user can monitor performance during the recording.



There is also an info field in this menu. This field summarizes the record setting workflow.



4.4 HSDR (High Speed Data Recorder)

FLIR's Portable High Speed Data Recorder (pHSDR) solves the traditional performance limitations of recording to a computer by offering extended, high speed recording with zero dropped frames. At the same time, you can view the infrared imagery live, perform analyses, and control the camera. The removable solid-state hard drive shuttle provides quick, secure access, while the download module offers easy file access and data reduction at your desk.

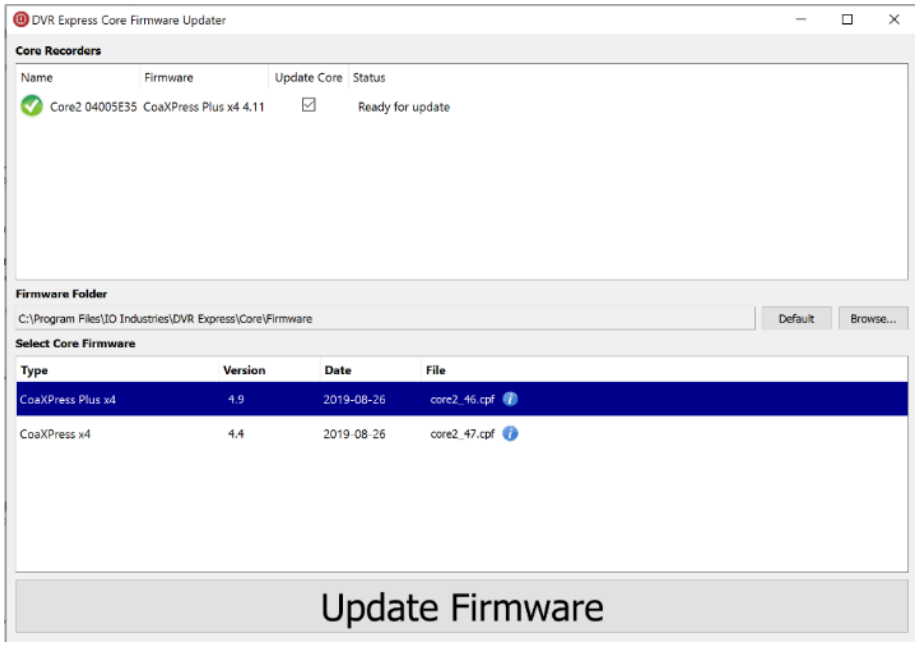
The High Speed Data Recorder accessory recorder system acts like a frame grabber and brings image data into Research Studio through an eSATA to USB 3.0 converter cable connected to the PC. The HSDR is available for purchase on the FLIR Pricelist in either Camera Link or CoaXpress varieties.

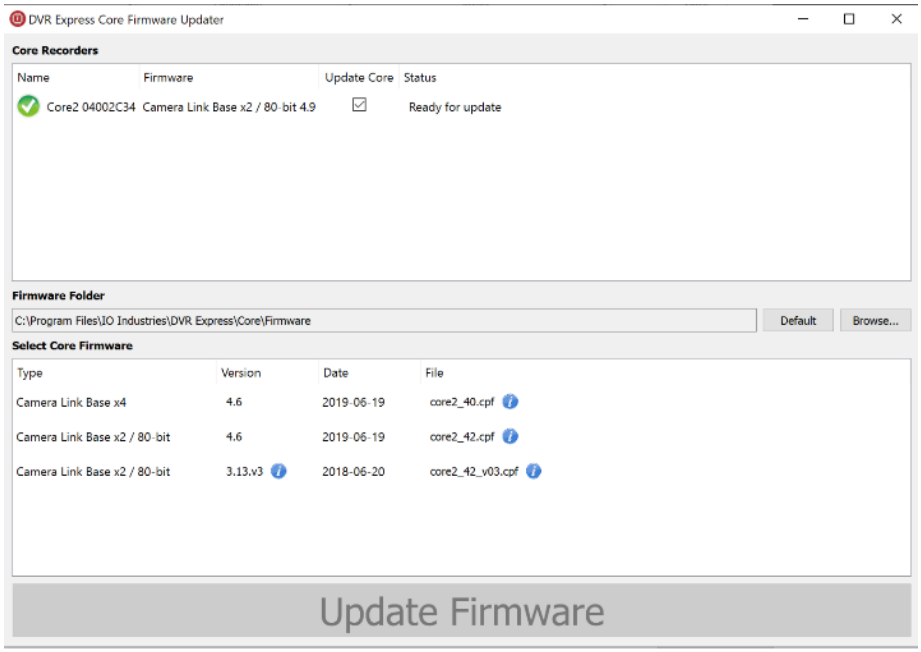
4.4.1 Install and Setup

"IO Industries DVR Core Express Software" v 2.1.0.38 is required for FLIR Research Studio Pro to connect to a FLIR HSDR unit (IO Industries DVR Core1 and Core2). If you do not have one of these units, you don't need to install the drivers. Note that its only supported on Windows OS. If you are installing FLIR Research Studio on a PC that previously had Research Max+HSDR installed, you must manually uninstall the existing "IO Industries DVR Core Express Software" and then install version 2.1.0.38. This will disable ResearchIR HSDR functionality. While both ResearchIR and Research Studio can be installed on the same computer, only one at a time can have HSDR support.

If using the HSDR Core2 hardware, the host PC must have a USB 3.0 port on it for the eSATA to USB 3.0 converter cable. If you have a pHSDR, the "core" software can be found on a CD that came with the unit. It can also be downloaded from: https://support.flir.com/researchstudio/hsdr. Just run the "core.exe" program.

Once the install is complete, reboot the PC. Then open the IOI Firmware Updater to make sure that the firmware on the HSDR hardware is correct. See below. If the firmware needs to be updated choose - CoaXPress Plus x4 version or Camera Link Base x4 version and click "Update Firmware".





See the table below for firmware and Coreview version info.

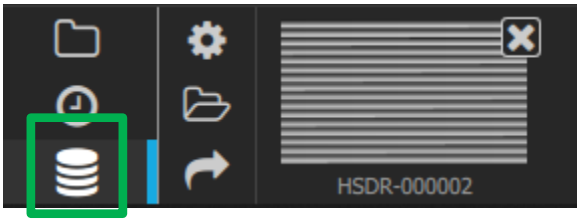
Frame Grabber	**Interface**	**Operating System**	**Firmware Version**
IO Industries Core2 CXP High Speed Data Recorder	CoaXPress	Windows only	Firmware – CoaXPress Plus x4 Version 4.9

			Software - IO Coreview 2.1.0.38
IO Industries Core2 CL High Speed Data Recorder	CameraLink	Windows only	Firmware – Camera Link Base x4 Version 4.6 Software - IO Coreview 2.1.0.38

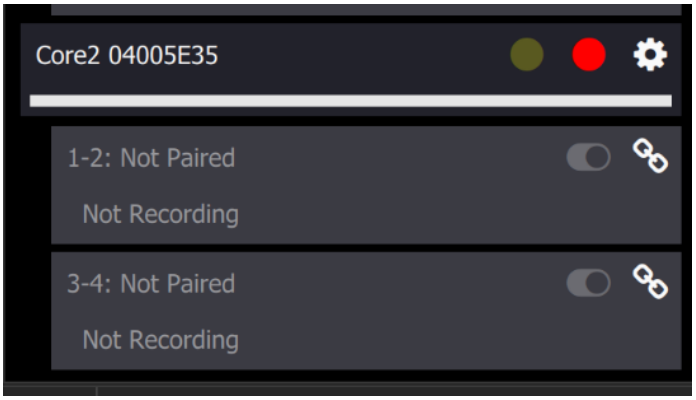
Once the firmware is updated the user can start the connection process. Make sure that all of the cables between the camera, HSDR, and computer are connected. Next, make sure Research Studio is closed. Power on the camera until a ready light is visible. Once the ready light is visible power on the HSDR. Wait 20 seconds for the HSDR to boot and then open Research Studio.

4.4.2 Pairing

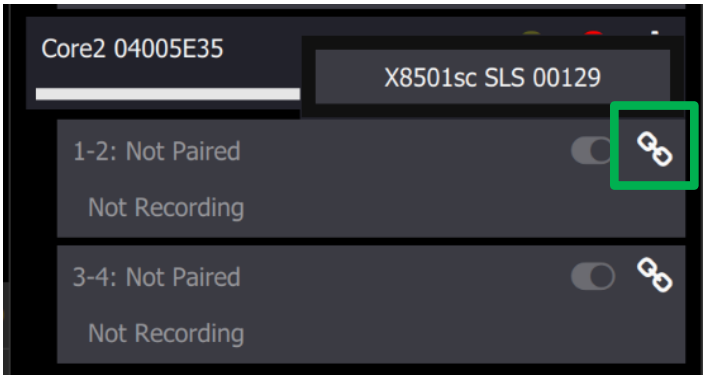
The HSDR menu is at the bottom left of the screen and is only accessible if you have an HSDR connected. Clicking the stacked disks will change to the HSDR quick access menu.



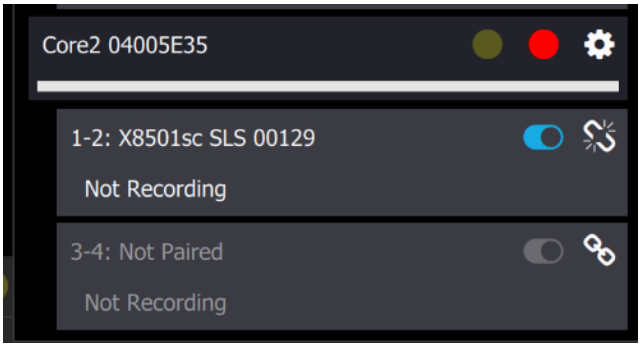
Clicking the gear icon will bring up the HSDR controller. In the controller is a record button, settings button, and the controls to pair the HSDR. Each time a new camera is connected to an HSDR, the two devices must be paired.



The button outlined is the pair button. When the user clicks on this the available cameras to pair will be visible.

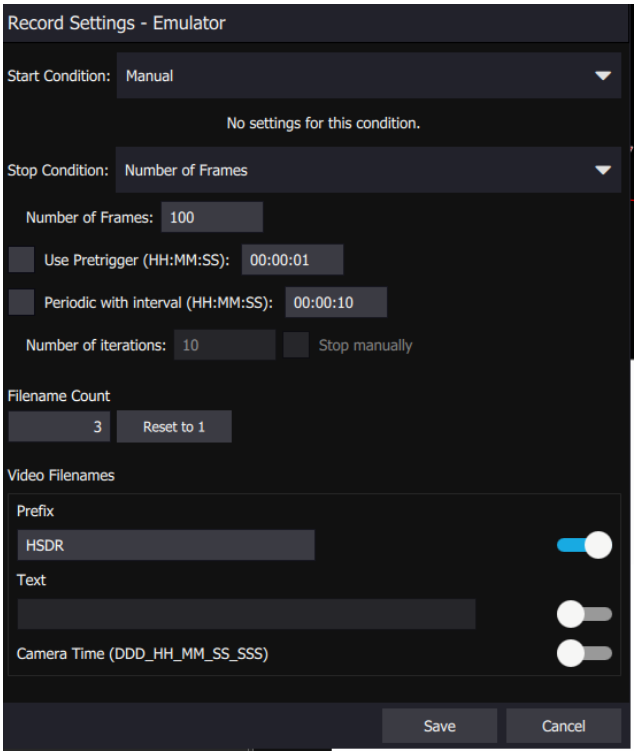


After pairing the camera and HSDR the window will look like this below. The pair icon will change to have light rays showing off of it reflecting that clicking the button again will unpair the HSDR from the camera.



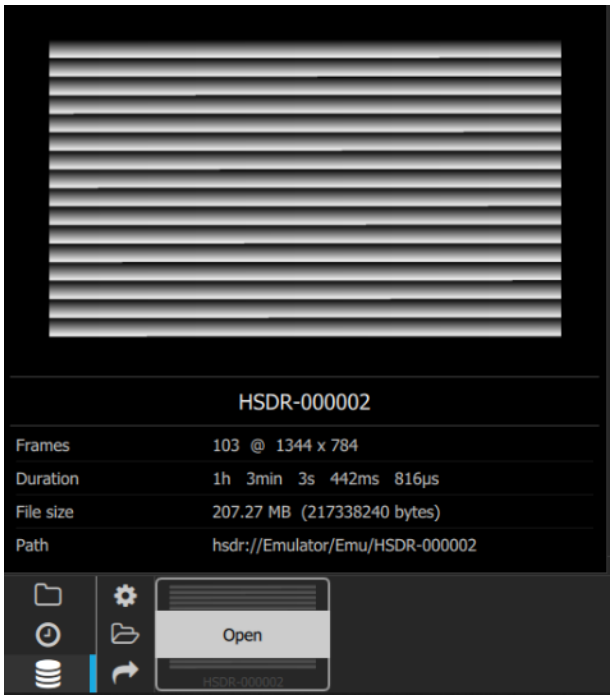
4.4.3 Recording

The record settings for the HSDR are similar to the PC-side record settings in Research Studio. Please see the recording section to see descriptions of Pre-Trigger, periodic, start conditions, start conditions, and file naming.

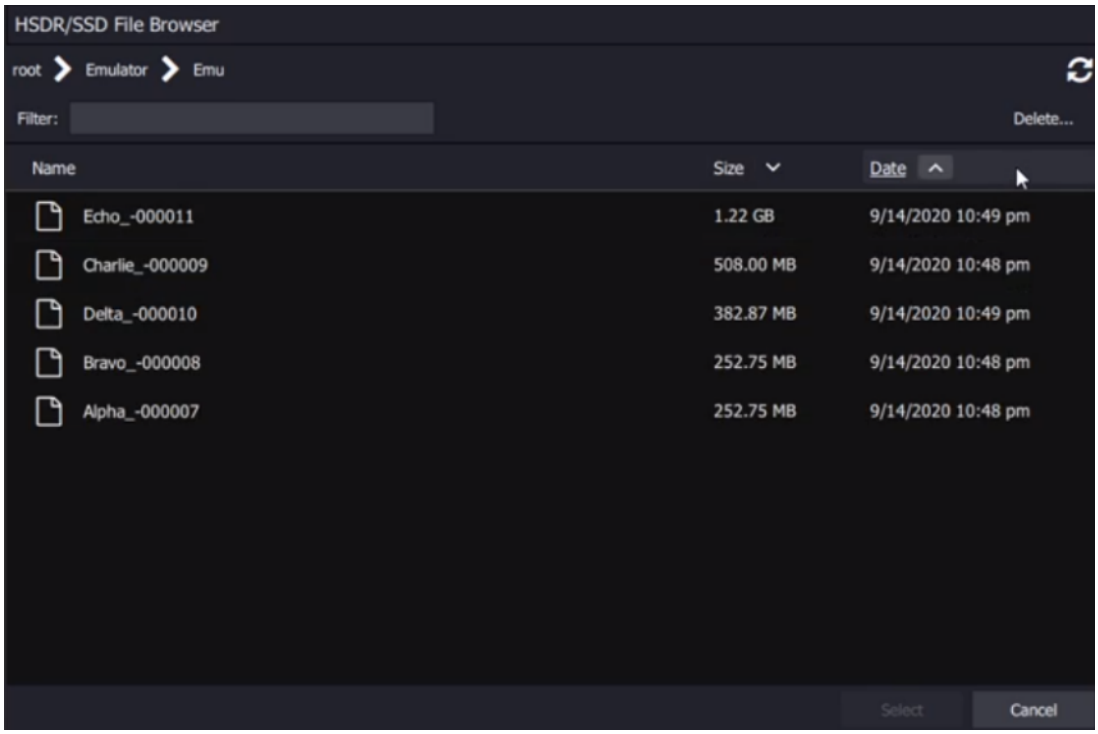


4.4.4 Quick Look and File Browser

The HSDR tab in the Quick look menu allows the user to access data that has been recently recorded or opened in the HSDR but has not been extracted to the PC hard drive. Just double-click the movie you wish to play.

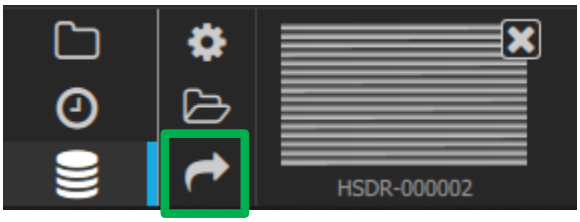


There is also a File Browser to allow the user to see all the files on the HSDR. This file menu allows the user sort by Name, Size, and Date.

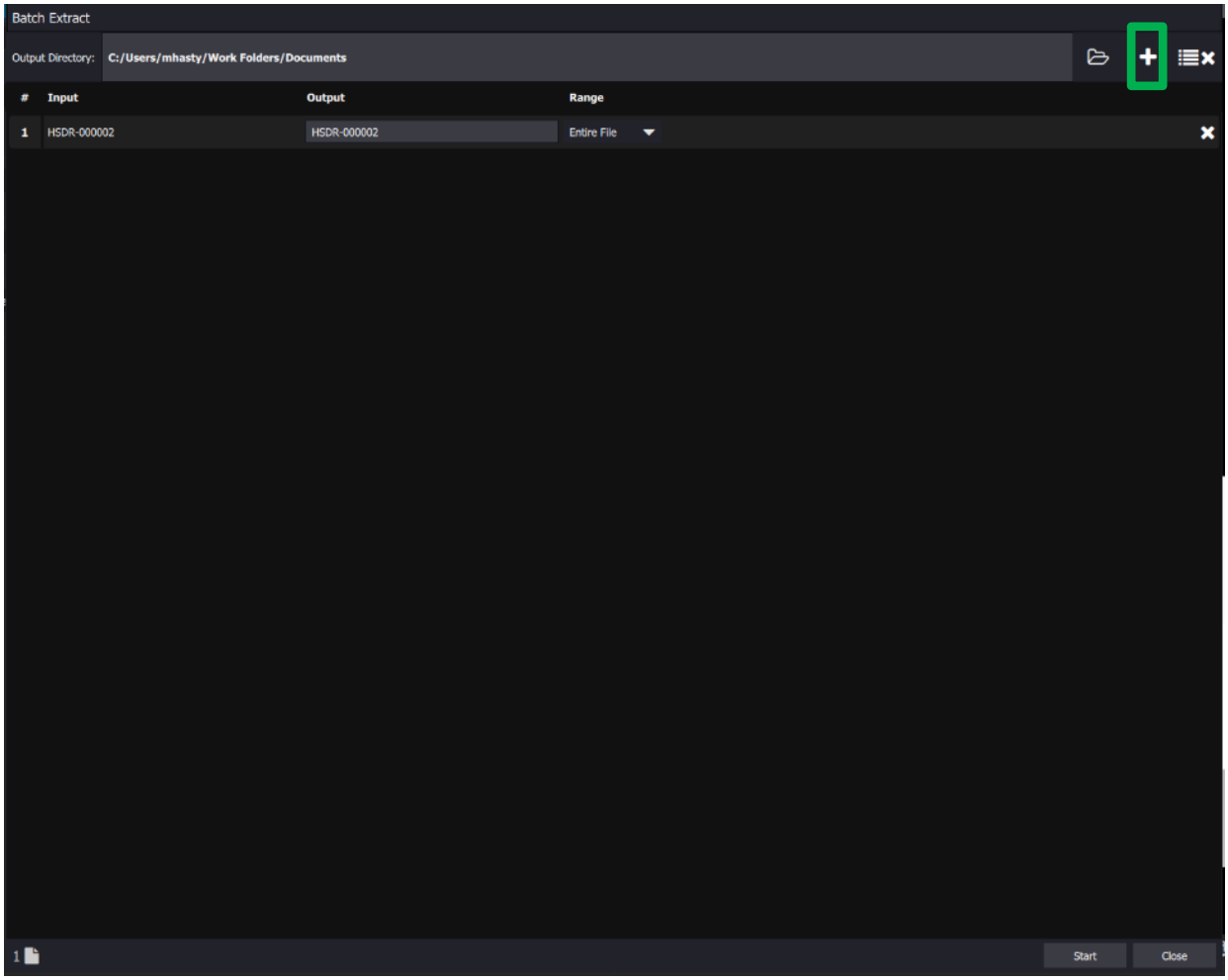


4.4.5 Batch Extract

There is also a separate menu to batch extract from the HSDR into a .ATS format that is saved on the computer. The HSDR is only accessible via Research Studio. The only way to retrieve data off the HSDR is to use the Extract feature. It is IMPORTANT that you extract data you want to keep as soon as possible. Certain actions such as pairing a new camera or changing the camera window size can trigger a reformat of the HSDR drives, possibly causing this data to be permanently lost.



If you have a lot of data that needs to be extracted from the HSDR, this can be a time-consuming process. The batch extract dialog allows the user to setup a list of files to extract. Only one file can be specified per row in the table. Clicking the plus button at the top right allows the user to browse and add files from the HSDR to batch extract dialog.



5 Analyze

The next step in our standard workflow is analysis. The next section describe various tools within Research Studio that enable the user to perform in depth analysis on live or recorded data.

5.1 Region of Interest (ROI)

Regions of Interest are a critical part in the analysis of infrared data.

5.1.1 Controls

This group of controls in the top bar relates to regions of interest (ROIs). ROIs are areas of the images whose pixels are contained in a shape that can be analyzed as a group. These controls will be greyed out until a file or live image is opened:

Once a file or live image is opened, the group will look like this. The blue underline under the arrow icon indicates that this is the active control. Once a ROI type is selected the user can draw it on a visible module.

In the ROI Toolbar when a user selects an ROI type from a column/class, and that ROI type is not currently what's in the toolbar, we'll replace it. This allows for quick access to recently used ROIs.

5.1.2 Available ROIs

These robust ROIs listed below, and ROI settings change the user's ability to extract only the data they need.

Icon	Name	Description
	Select/Move ROI	With this tool selected, the user can mouse over an ROI. The ROI can be dragged to move it or the user can grab a "handle" to resize the ROI. The ROI can also be updated with the circular arrow.
	Cursor ROI (1 pixel)	This ROI reads the value of a single pixel.
	Line ROI	This ROI reads the values across a single line segment 1-pixel wide.
	Ellipse ROI	This ROI reads the values inside an ellipse. Height and width are independent.
	Rectangle ROI	This ROI reads the values inside a rectangle. Height and width are independent.
	Show/Hide All ROIs	Allows user to turn on/off the display of all ROIs without having to delete and add them. This is forced on when a new ROI is added.
	Square ROI	This ROI reads the values inside a square. Height and width stay equal during resizing.
	Circle ROI	This ROI reads the values inside a circle. Height and width stay equal during resizing.

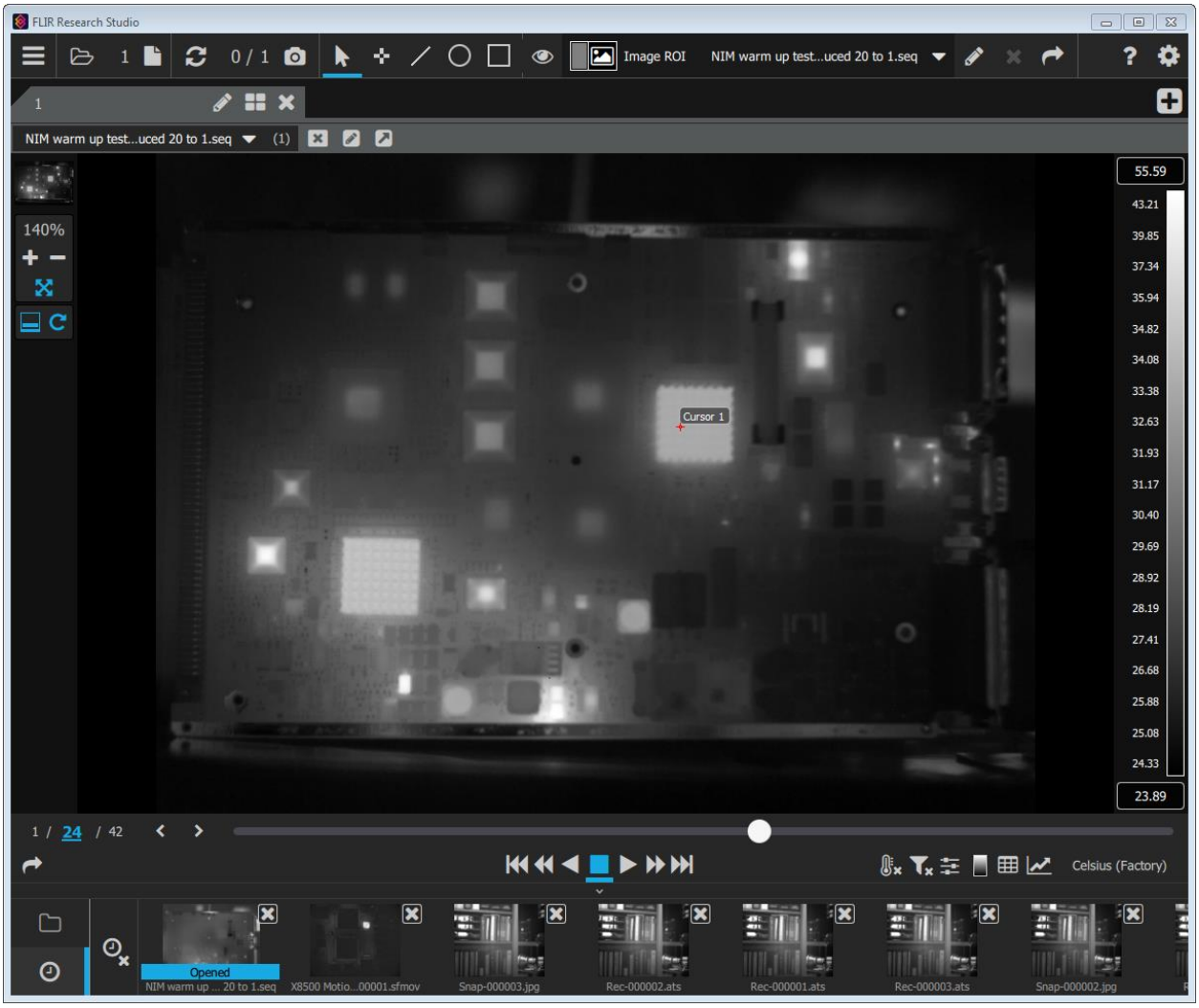
	Freehand ROI	Hand drawn shape. Left click, hold, and drag to draw. Release to finish.
	Measurement Cursor	3x3 pixels in a square
	Crosshairs cursor	1-pixel measurement. Shown as the intersection of two lines across the entire view.
	Multi-segment line	Multiple line segments 1-pixel wide. Left click to create new segments, and right click to finish.
	Add/Remove Points	For polygon and multi-segment line. Toggle the editing of points. To add a point, click on the shape and drag. To remove a point, click on it.
	Polygon	Custom polygon. Left click and drag to add first vertex. Right click to finish.

5.1.3 Select/Move

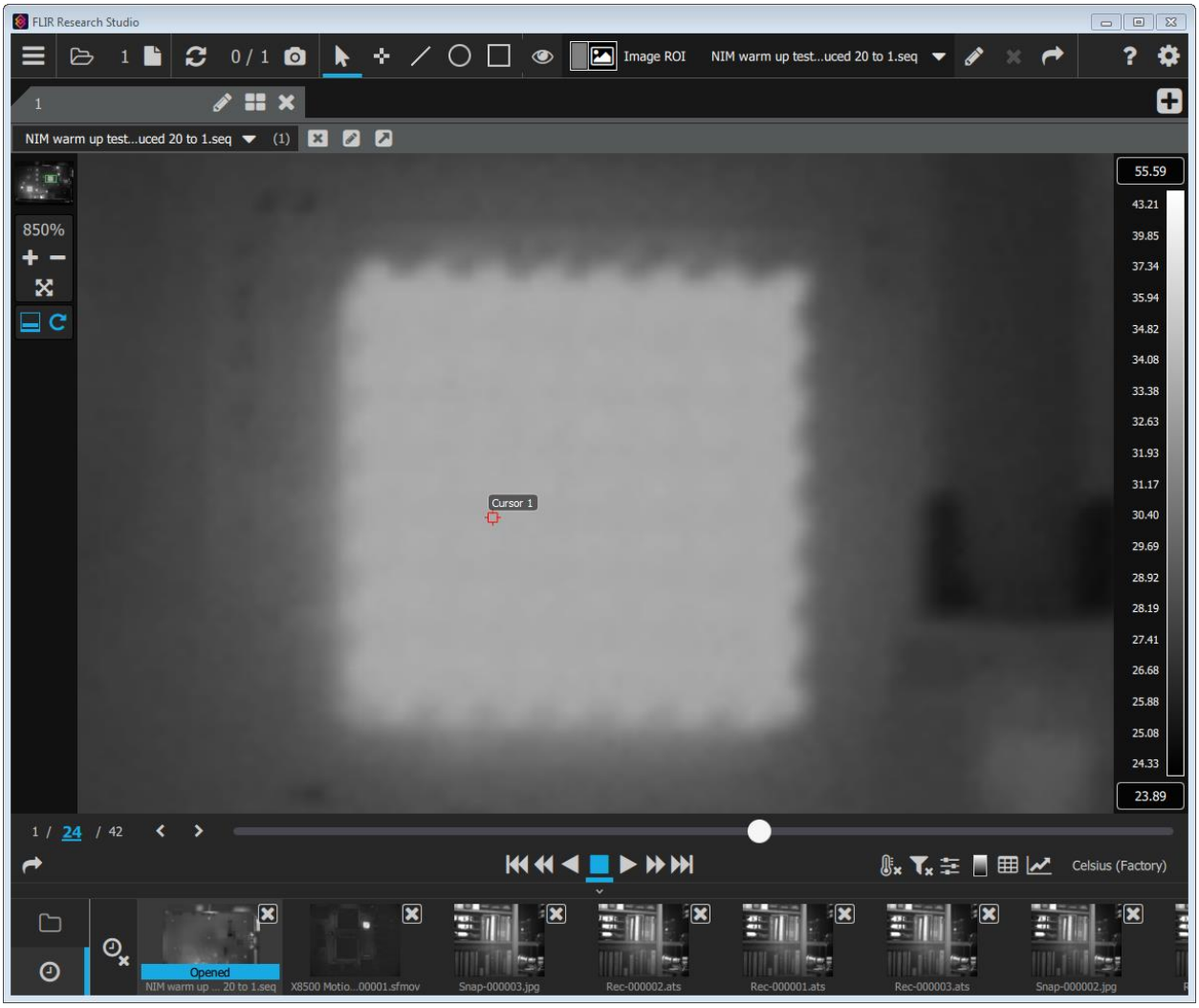
Until the user has drawn an ROI, the Select/Move ROI control does not do anything. Open a file and then click on the Draw Cursor ROI control. It will now look like this, indicating that it is active:

5.1.4 Image Zoom

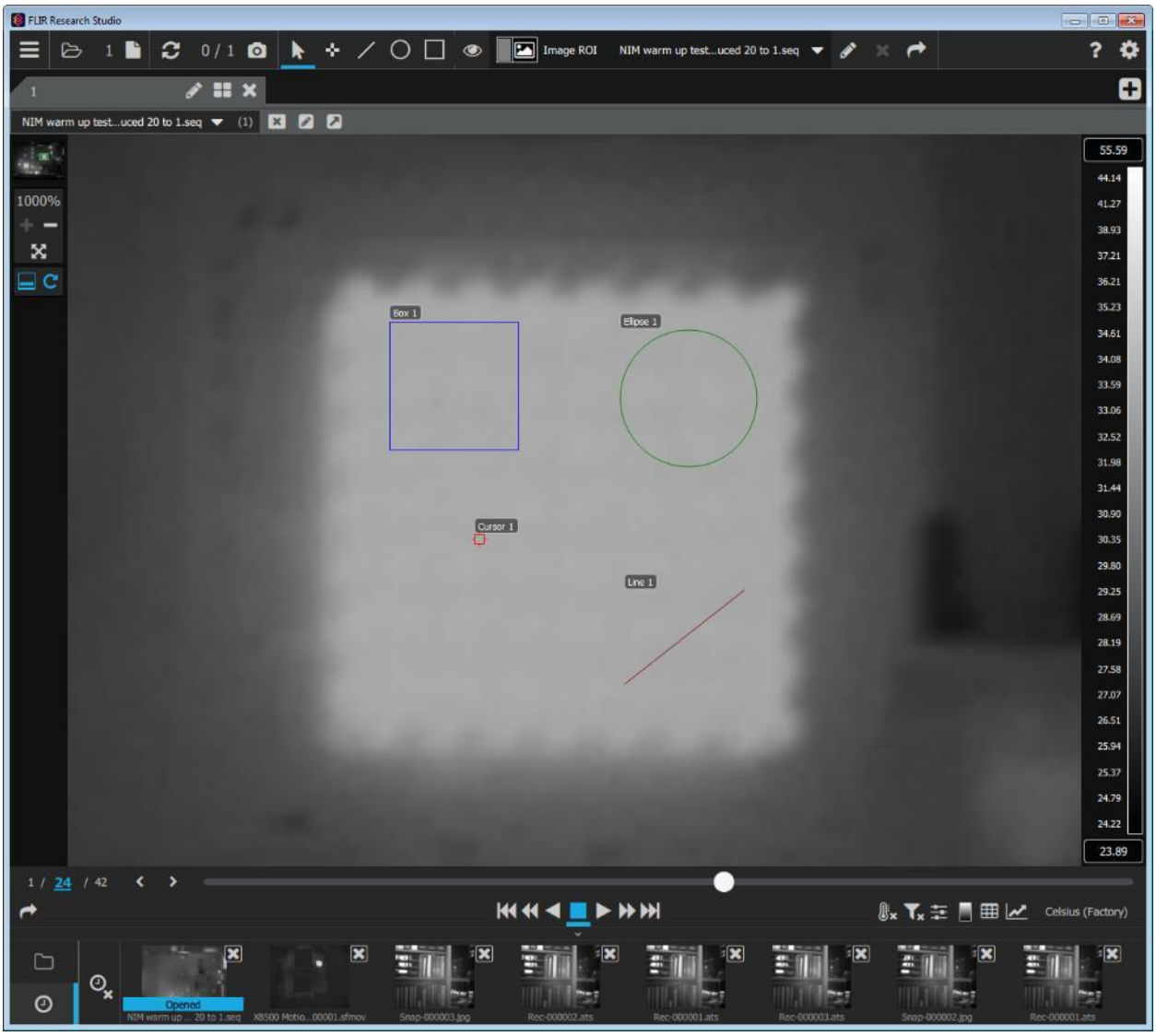
The user can now place an ROI on the image. Here is a Cursor ROI placed on the image of a hot circuit board. The image is at a zoom level of 140%, which was determined by the size of the window on the screen and the size of the IR image.



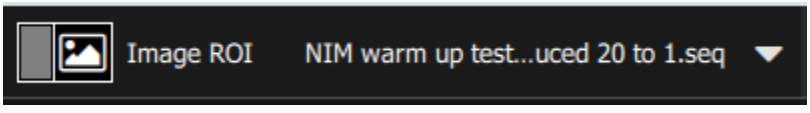
The ROI is very small on this image. One can use the zoom tool on the left side of the main window to zoom in up to 850%, which will show the Cursor ROI in closeup. The user can zoom using the mouse scroll wheel or using the +/- buttons on the zoom control. The crossed arrows button sets the zoom to fill the available space.



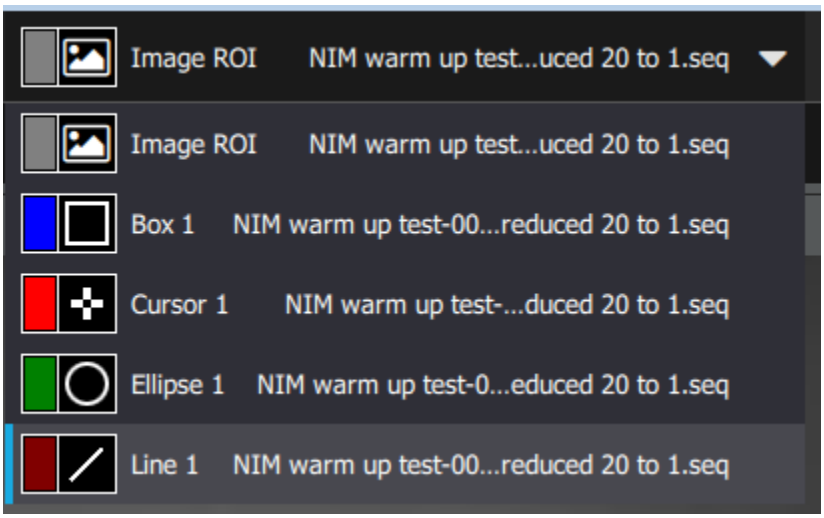
One can use the other ROI controls to draw lines, elliptical and rectangular ROIs, etc… on the image. Here the image was zoomed to 1000% to show the section of the image with the ROIs:



Now there will be a selection of ROIs available to choose from in the ROI selector pulldown menu in the top bar.



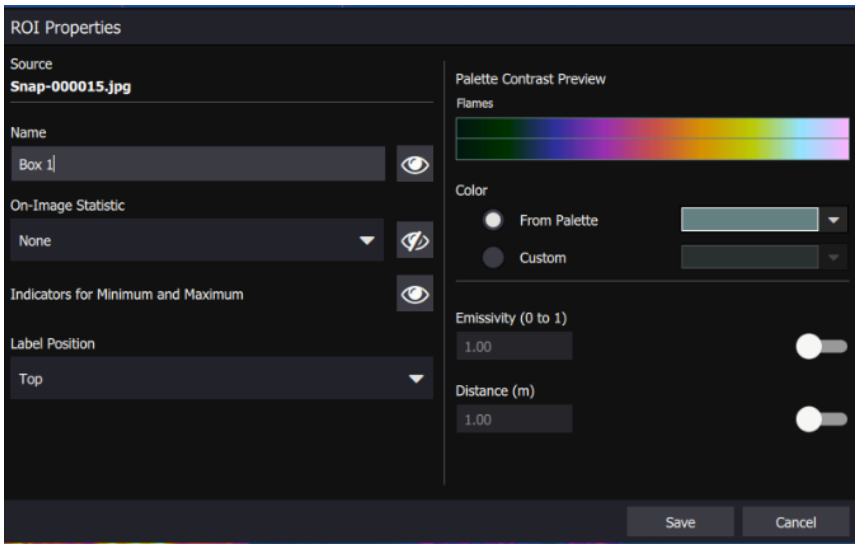
The image ROI is always available and always present in the list. The other ROIs are shown with their default names and the file with which they are associated:



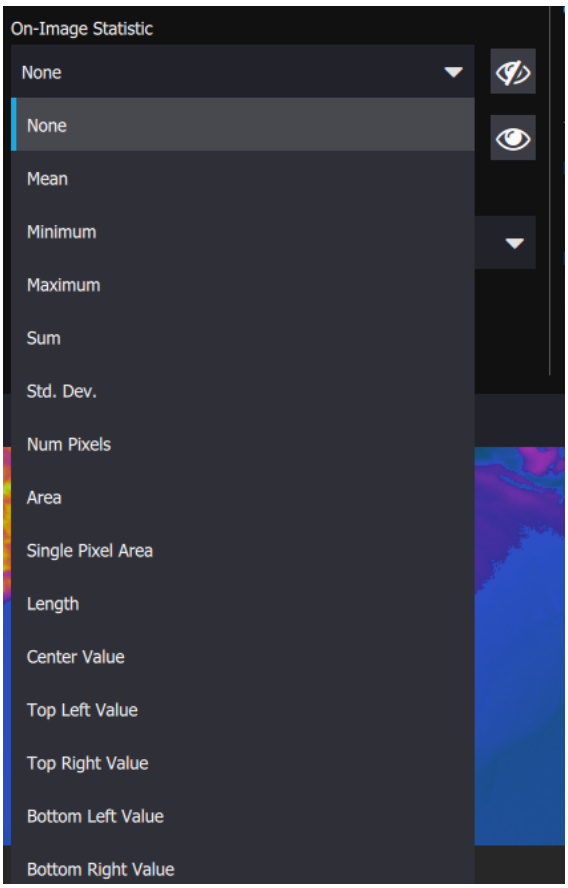
5.1.5 Editing an ROI

The pencil control in the top bar allows the user to change the settings of the ROI currently selected in the pulldown menu:

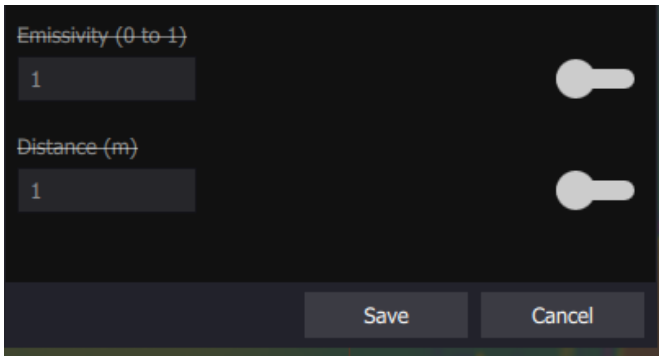
The ROI properties that can be changed include the name (which can be up to 30 characters long), the on-image statistic label, the color of the ROI outline, the emissivity and the distance of the target.



The user can choose from many different statistics to display in a label near the ROI. These are listed below. Indicators for minimum and maximum can also be toggled on/off. The user can also choose where the label will be placed in relation to the ROI.



If the camera is uncalibrated, then the emissivity and distance are crossed out:

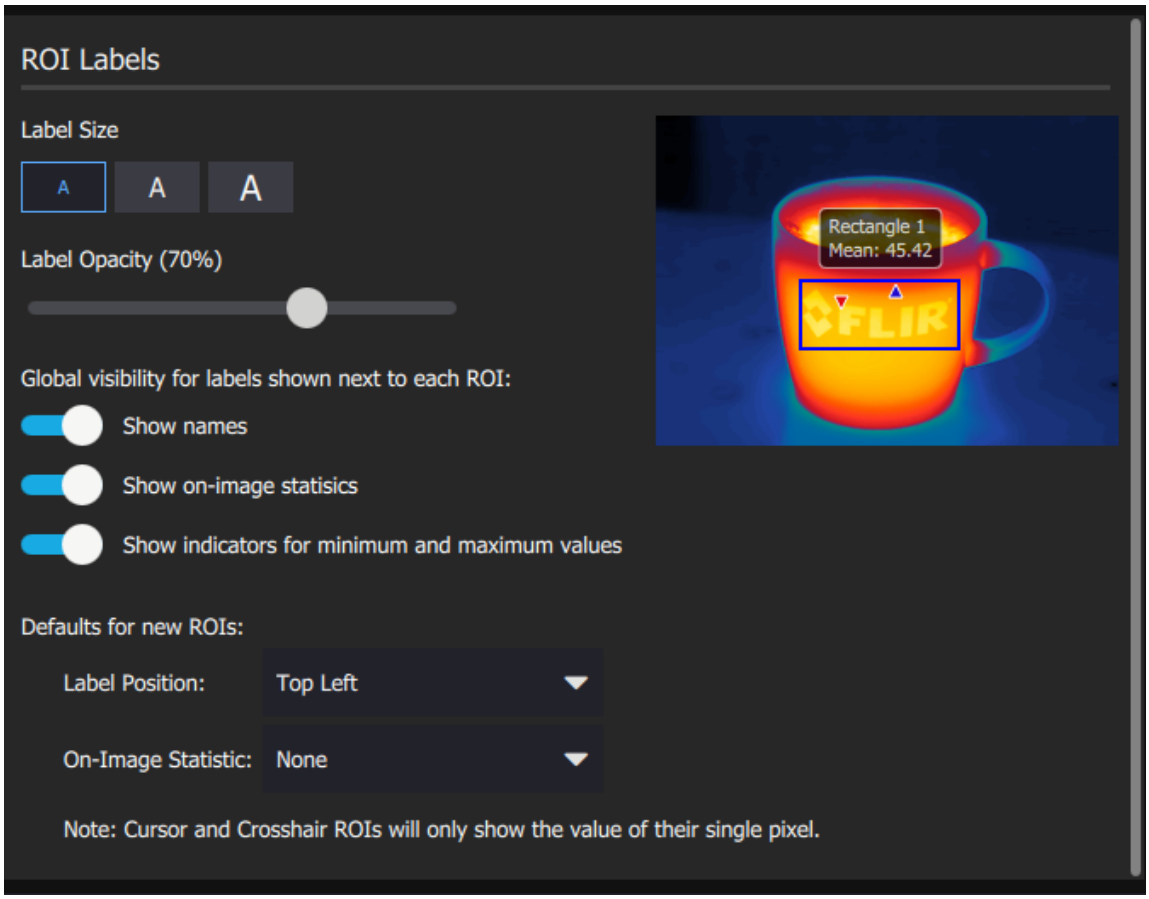


5.1.6 Deleting an ROI

An ROI can be deleted using this button, which is greyed out until there is at least one ROI other than the Image ROI:

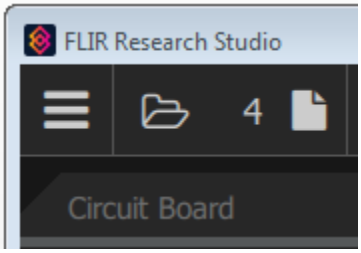
5.1.7 ROI Settings

This dialog allows the user to select global setting for all ROIs. These global setting will override individual ROI settings. There are controls for label size, opacity, and visibility for ROI labels. There is also the option to change default settings for when new ROIs are created.



5.2 Opening Recorded imagery

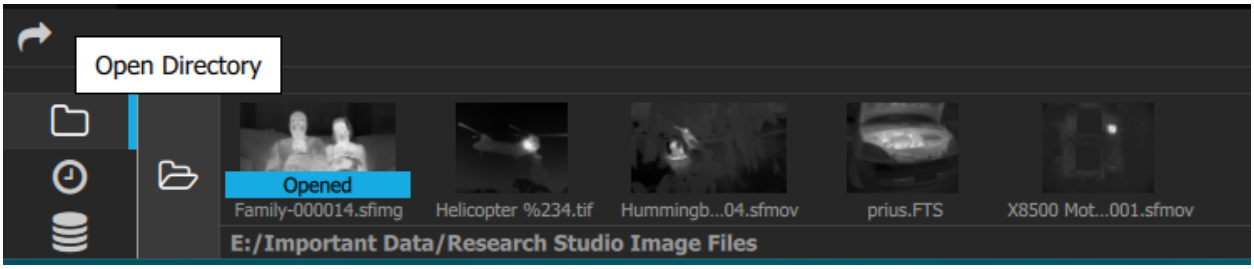
There are several ways to open a still image file or image sequence file in FRS. One method is to use the open file option next to the “hamburger menu” in the upper left corner of the main window:



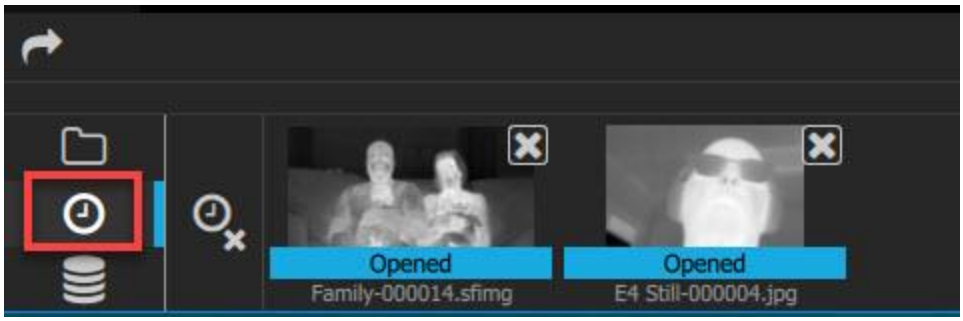
5.2.1 Quick Collection

Another method is to double-click on a thumbnail in the Quick Collection gallery along the bottom of the main window. The icons on the left side are used to select what view is shown in the quick collection.

The folder icon allows the user to see the contents of a specific folder. Clicking the opened folder icon allows the user to set the folder to be viewed.



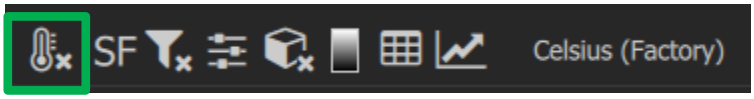
The clock icon allows the user to see all “recent” recordings or files that have been opened



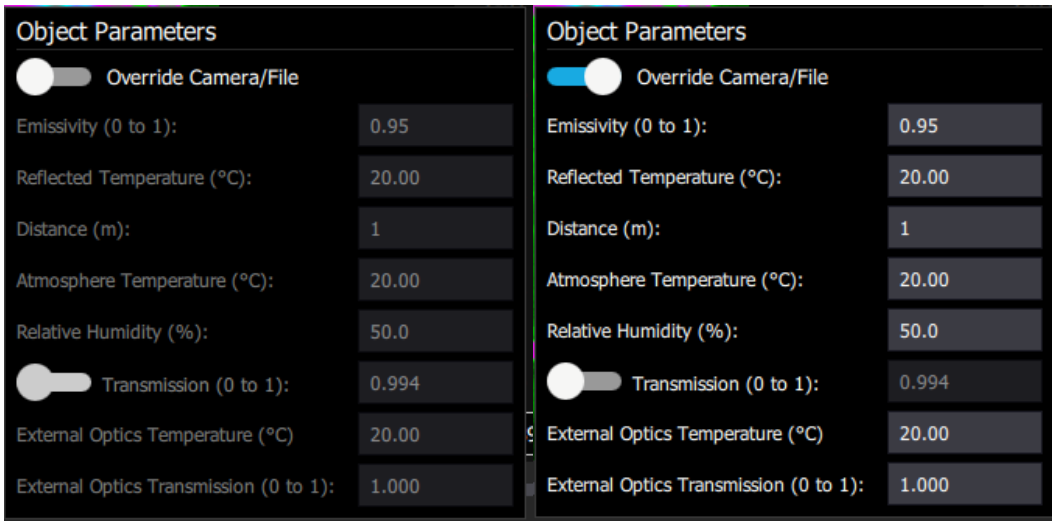
The recent files list persists until the user decides to clear the list. The user can clear individual files by click the “x” in the upper corner of the thumbnail. All files can be cleared from list by using the button that looks like a clock with an X next to it. **Clearing the recent list does not delete the files**.

If the user clicks once on a thumbnail, FRS brings up information about the file including the name, the frame size and number, the duration if it is a movie file, the file size, and the full file path. Here are two examples: the information for a still image file and a movie file:

5.3 Object Parameters

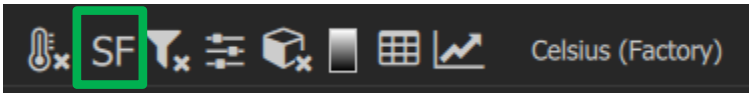


At the bottom of the image module the control on the far left that looks like a thermometer is the Object Parameters tool. The default is that the Override is off. For factory calibrated cameras, the movie file tells FRS what the global object parameters are. In the example below, the camera is a 3-5-micron mid-wave camera. The atmospheric transmission is calculated from the distance, the atmosphere temperature and the relative humidity. These input values can be overridden as shown in the image on the right below. One can also override the atmospheric transmission value that is calculated from the air path parameters.



When the parameters are overridden, the thermometer icon gets a green checkmark next to it:

5.4 Superframing

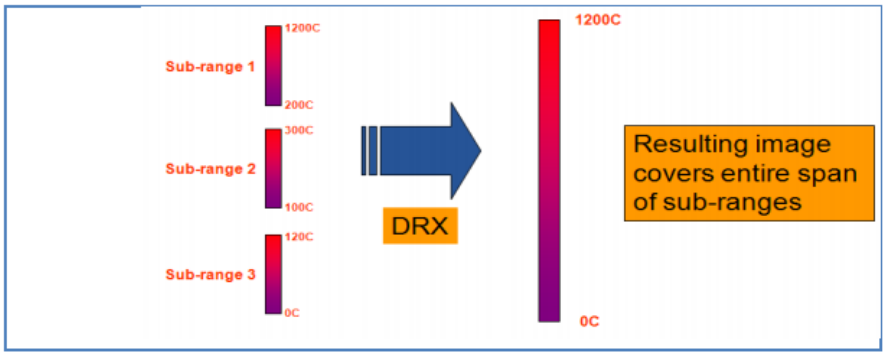


For cameras that support superframing, the Selector control allows the user to choose which preset to display.

- **All in Series** - Tells Research Studio to display all active presets in sequence. For general display purposes this mode is not very helpful because it can be quite "flashy" as the AGC adjusts from frame to frame. This mode is useful if you are trying to do a PC-side NUC with multiple presets. With this mode Research Studio will NUC all active presets at the same time, using the same NUC scenes. Depending on the integration times being used this may or may not produce optimal results.

- **Show single preset selection -** Tells Research Studio to filter out a particular preset for display. If a chosen preset is not active in the camera, Research Studio will display a message "Frame Not Available" in the image window.

- **Superframing -** Enables real-time Dynamic Range Extension (DRX). If a camera is calibrated (factory or user), with a different temperature range loaded in each preset, this option will apply the DRX algorithm. Using Preset Sequencing, DRX will take the best pixel data from each preset and combine the data to form a new image that spans all of the available calibration ranges. This allows the user to span a much larger dynamic range than could typically be covered with one integration time. DRX works best for static scenes.



5.5 Spatial Calibration

A spatial calibration allows Research Studio to compute lengths and areas of ROIs drawn on an image. The Spatial Calibration dialog allows the user to enter the data necessary to compute the camera's Instantaneous Field of View (IFOV). Each Imagery View Module has its own Spatial Calibration Button, represented as cube. The green cube represents an applied Spatial Calibration. The "x" on the cube represents that there is not an applied spatial calibration. IFOV is the field-of-view of a single pixel. Research Studio supports independent values for horizontal and vertical IFOV; however, modern cameras have square pixels so these values will be the same. The Spatial calibration dialog presents the user with five options for computing IFOV values. The results will be displayed in microradians.

There are now five methods to calculate.

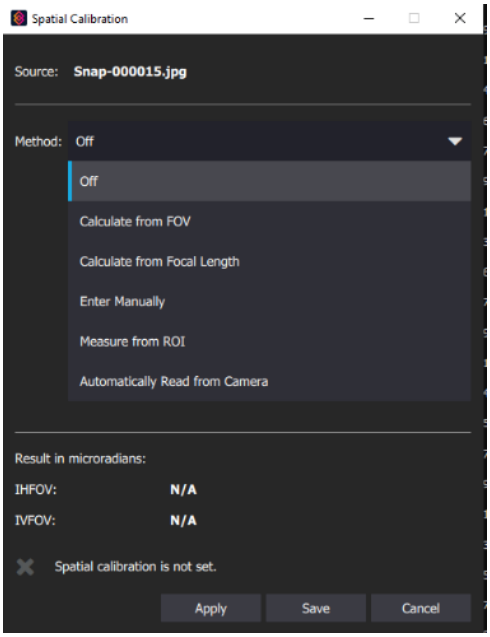
1. Calculate from FOV: Enter the FPA height and width in pixels and the Field-of-view (FOV) of the optics

2. Calculate from focal length: Enter the pixel pitch (size), and lens focal length

3. Manual: If you know the IFOV, just enter it manually

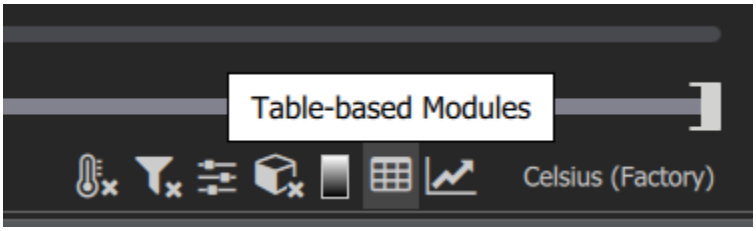
4. Measure Draw a line ROI on an object of known length in the image and enter the distance to the object from the front of the lens

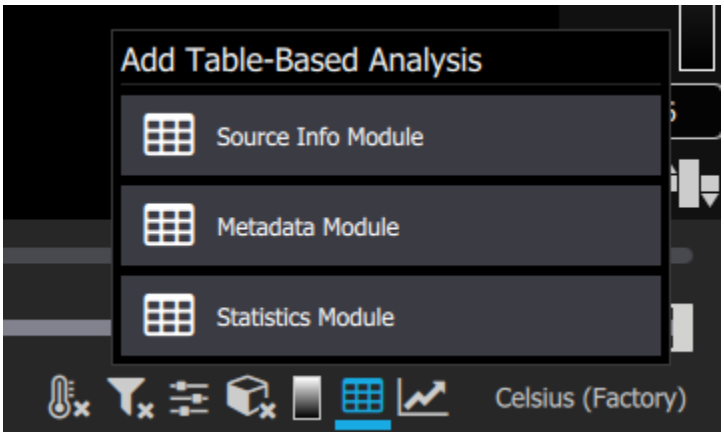
5. Automatically read from camera – Only available if the camera provides the calibration



5.6 Table-Based Modules

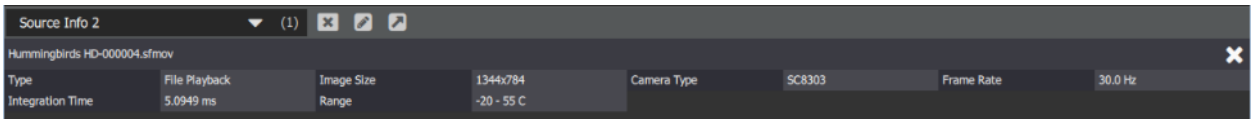
Further to the right on the control menu is the table-based modules which include source info, metadata and image statistics:



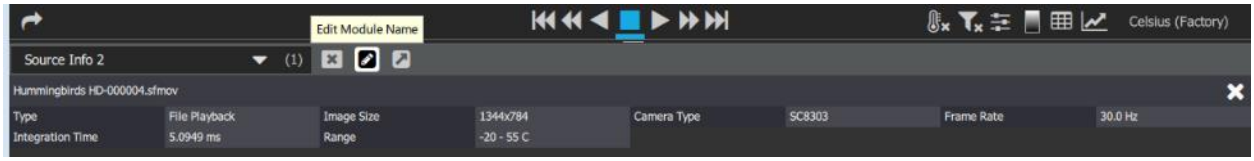


5.6.1 Source Info Module

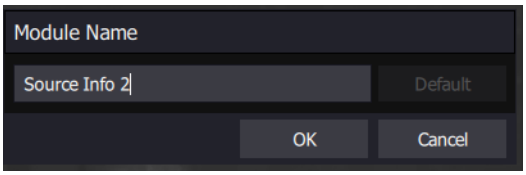
The Source Info module displays data about the image file:



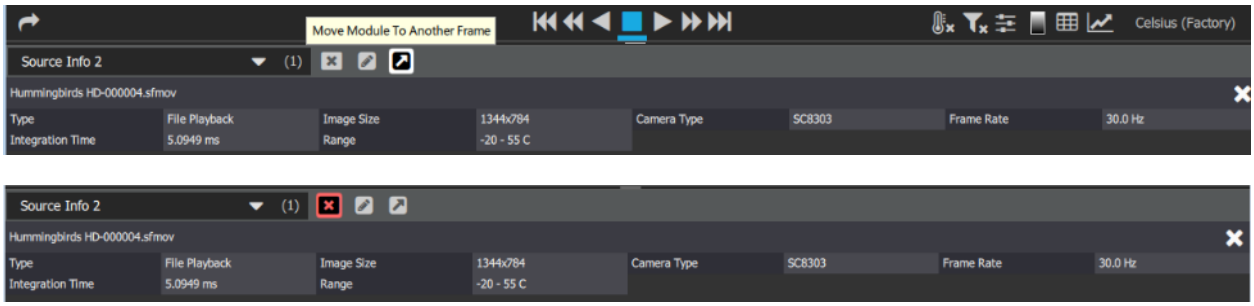
The user can edit the name of the module using the pencil button next to the module name:



It brings up this dialog box:

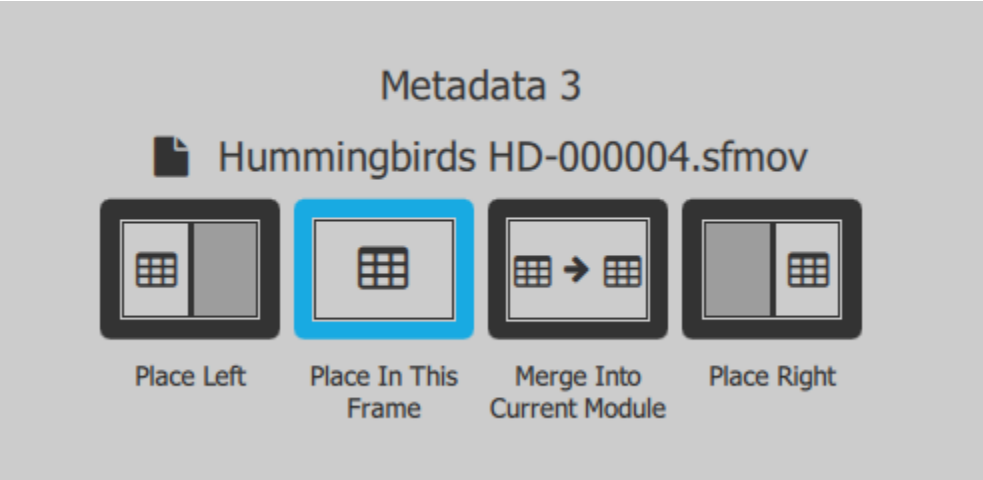


The arrow button allows the user to select a different position for the module data to be displayed and the X button closes the module:

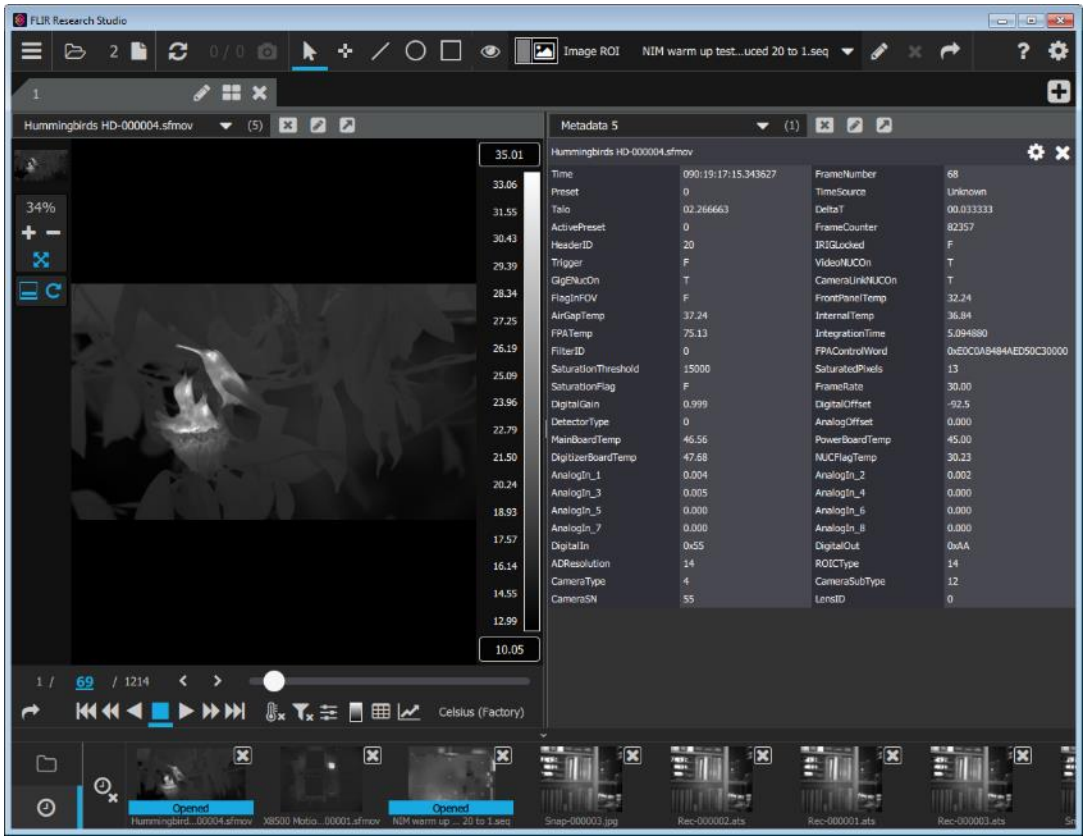


5.6.2 Metadata Module

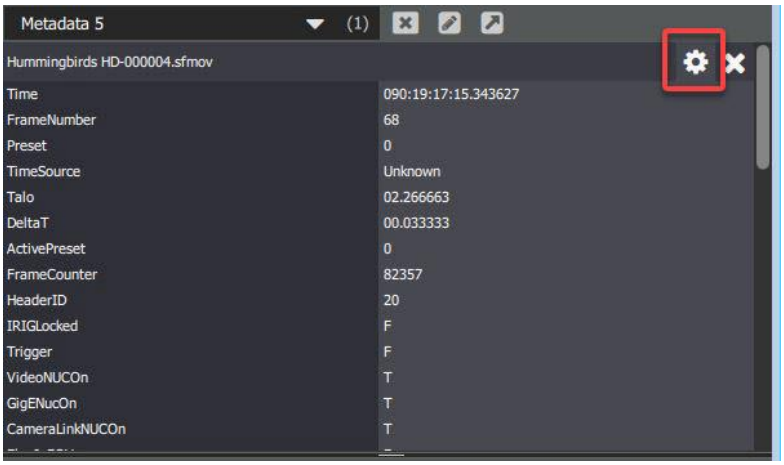
If the user selects the Metadata option, then the user chooses where to place the module data:

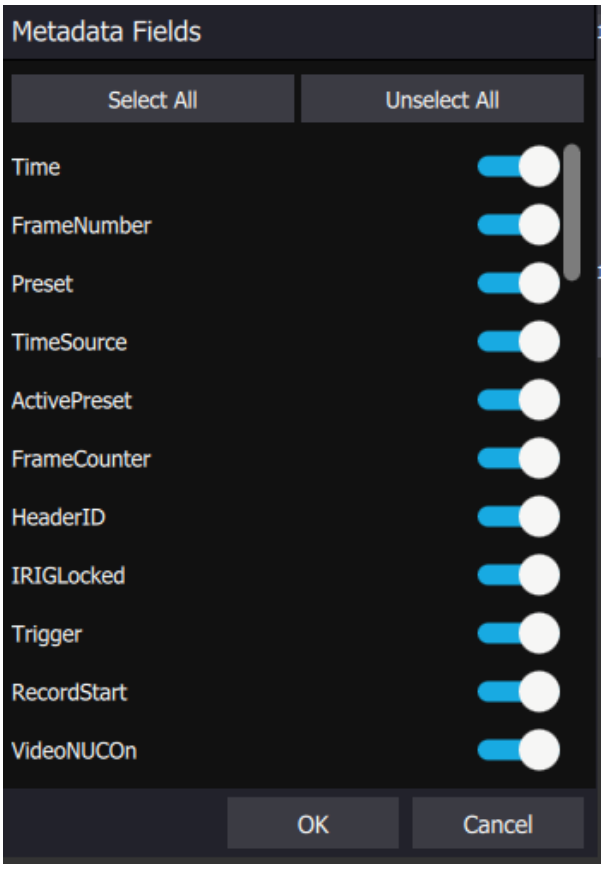


Here it was placed to the right, and one can see all the metadata tags associated with this image:



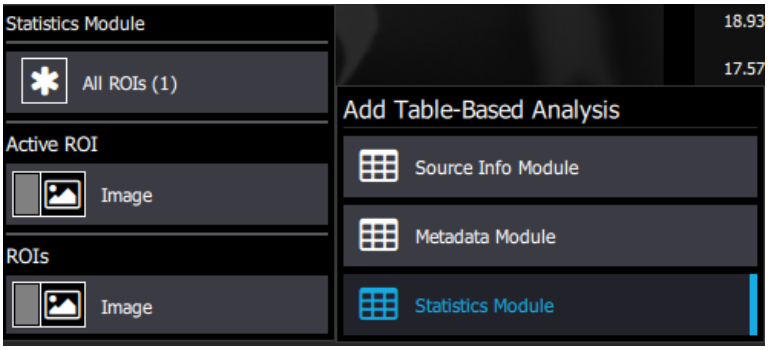
The gear button on the upper right corner of the metadata module opens a dialog box that lets the user select what metadata tags are displayed:



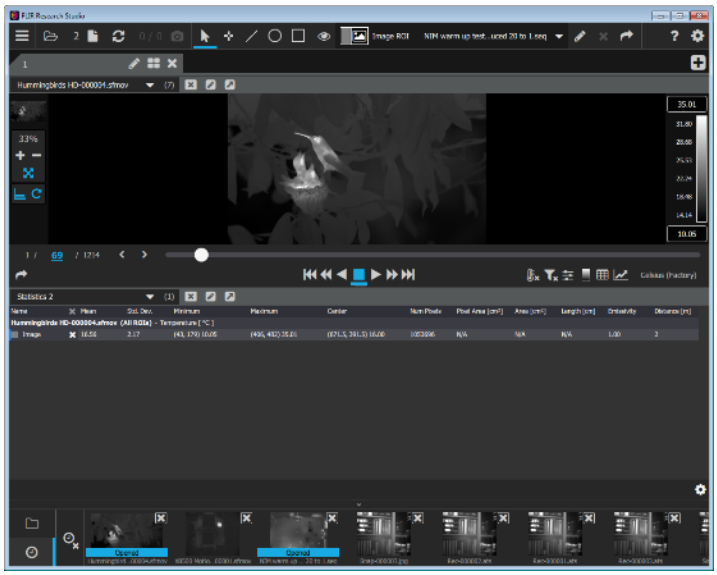


5.6.3 Statistics Module

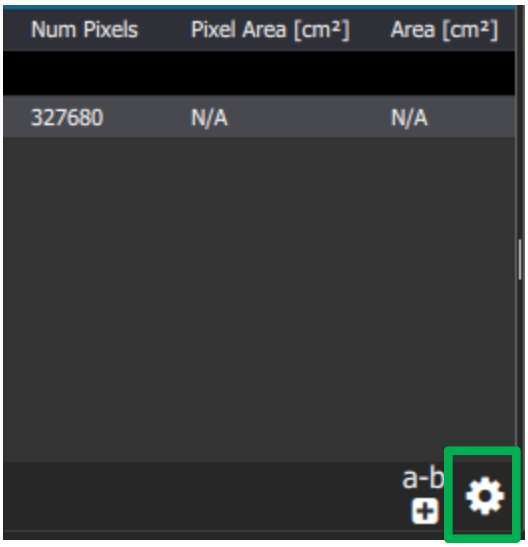
If the user selects statistics, FRS asks which ROI to use for the statistics computations. In this case, the only ROI is the Image ROI, so this is the only choice:



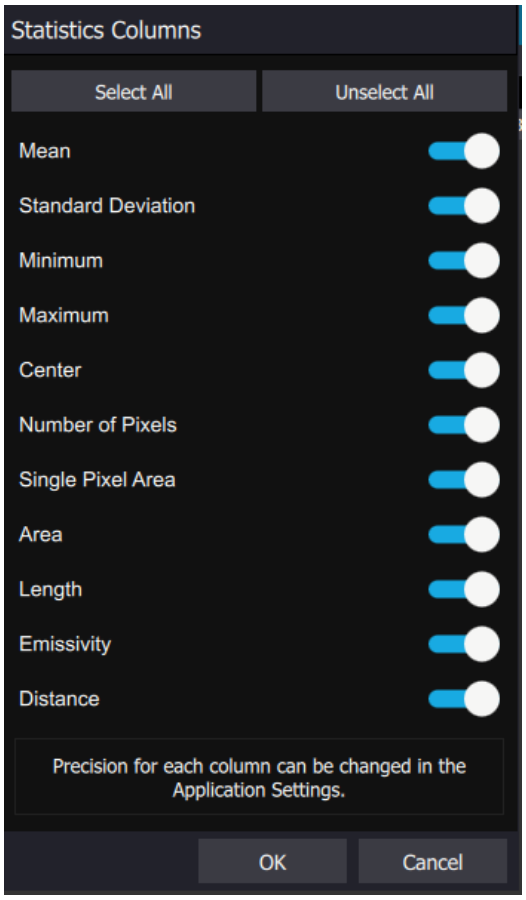
Here is the result with the statistics module placed below the image:



It is also possible to configure the variables that are displayed in the statistics window using the gear-shaped settings icon in the lower right corner of the Statistics window:

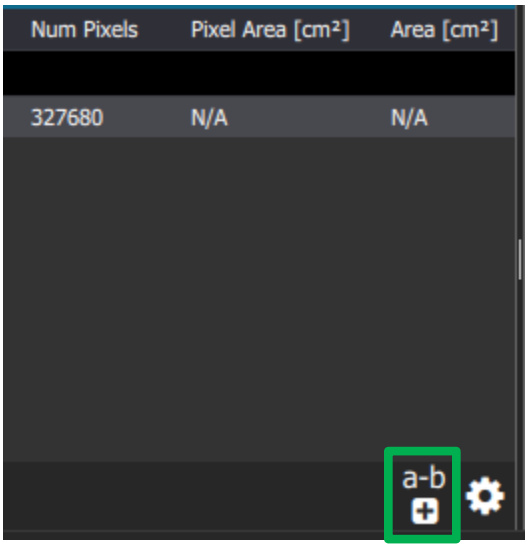


The user can deselect any of the variables displayed. The ones in blue are active, and the others are turned off:

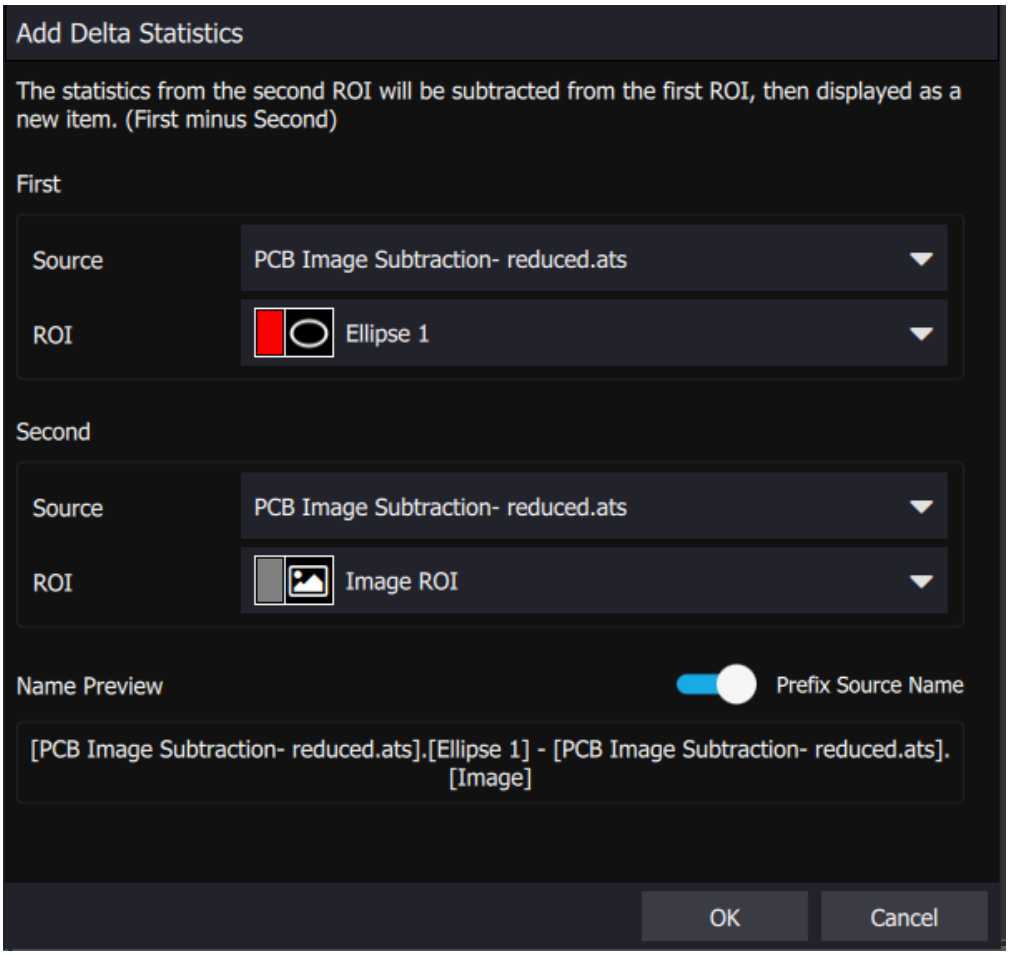


5.6.4 Delta Measurements

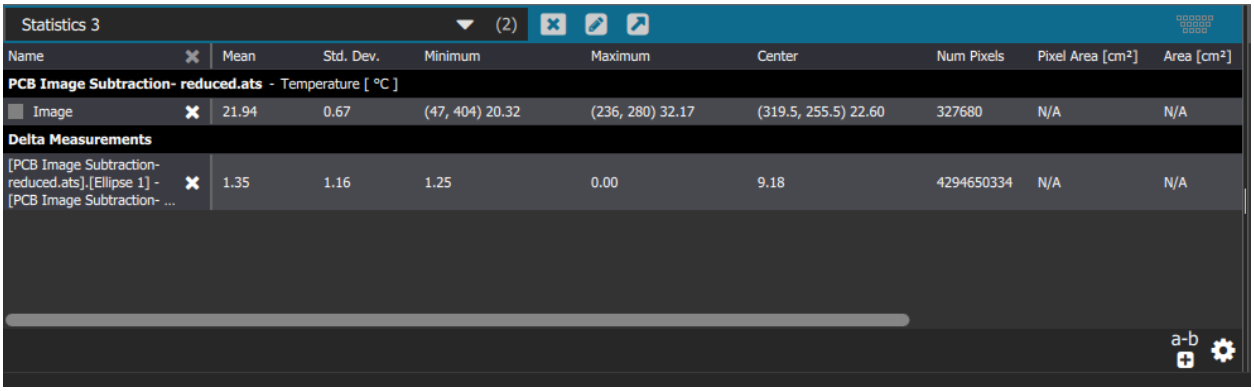
The user can also select the add delta measurements option.



This new menu allows the user to take the delta between two ROIs or measurements for all of the currently displayed statistics in the Stats module.

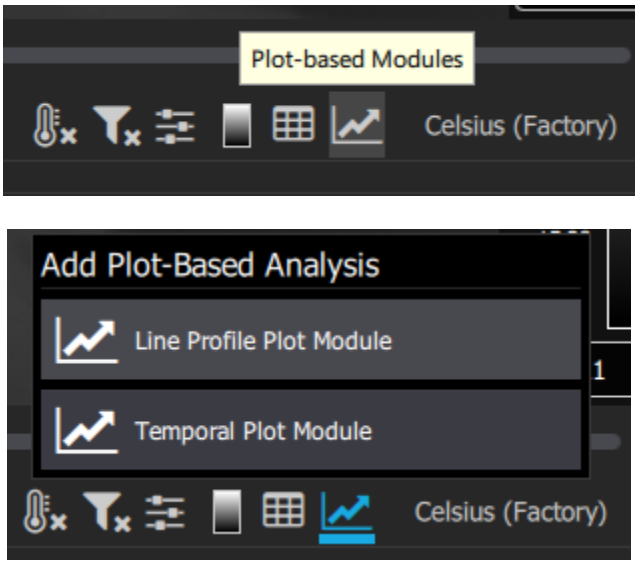


After applying the delta measurements, the statistics window will look like this.



5.7 Frames – Plot-Based Modules

The final control icon in the control group is for control of the plot-based modules, which include line profile plots and temporal plots.

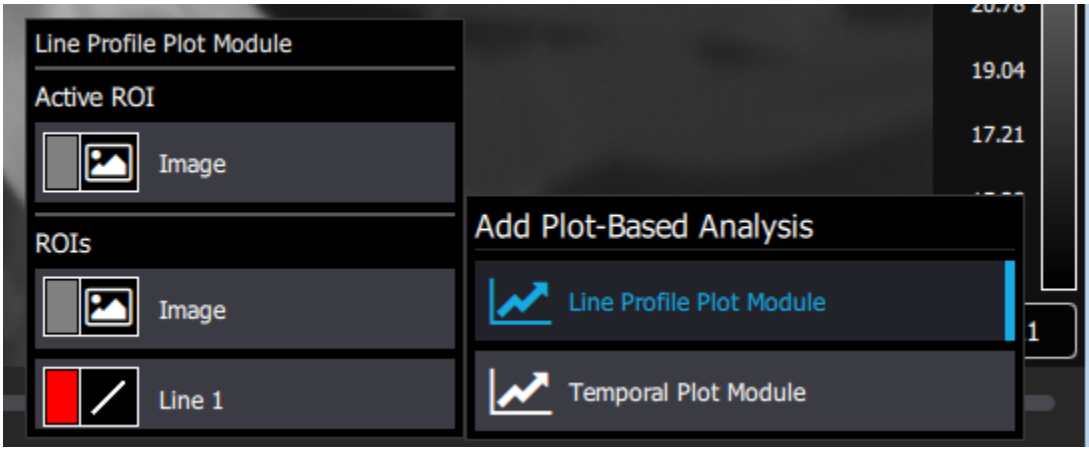


The Line Profile plot module shows a plot of the pixel values along a region of interest. The Temporal Plot module shows a plot of a statistical property as a function of time (frame number in a sequence).

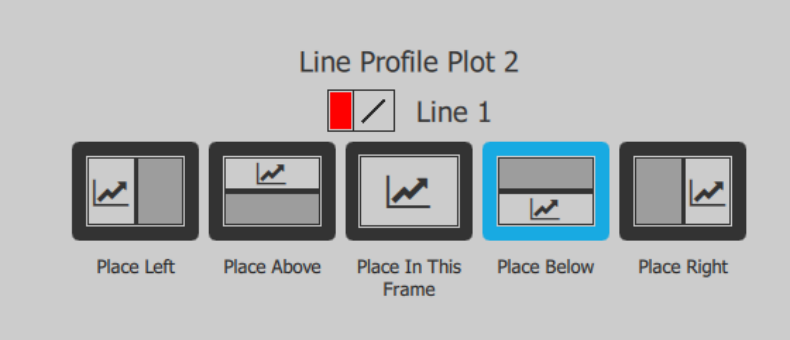
5.7.1 Line Profile Plot

Here is an example of a line profile. The user drew a red ROI called Line 1. The start of the line is denoted by the circle, and the end is denoted by the square.

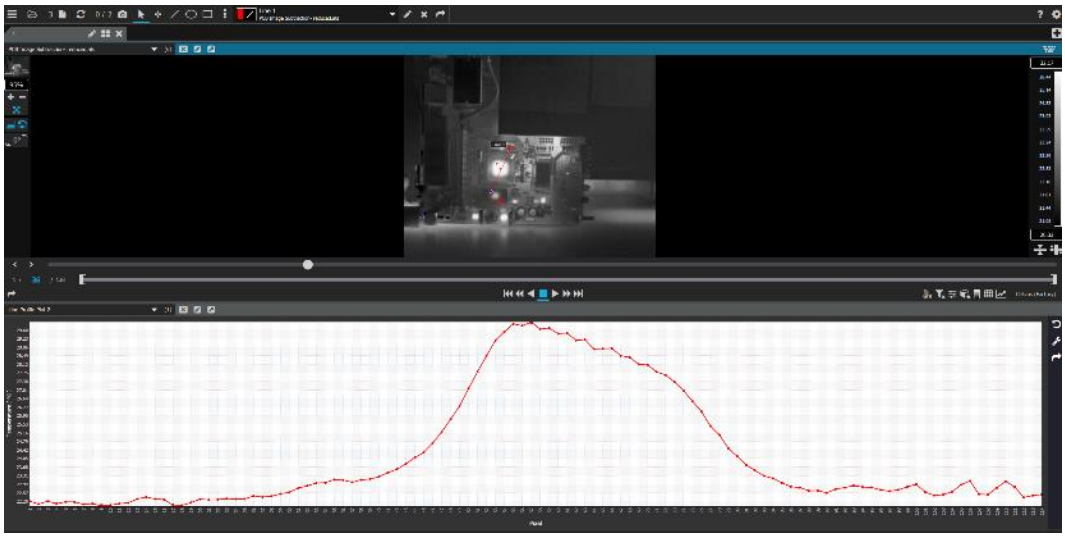
The “Line 1” ROI is selected off the line profile plot module selection:



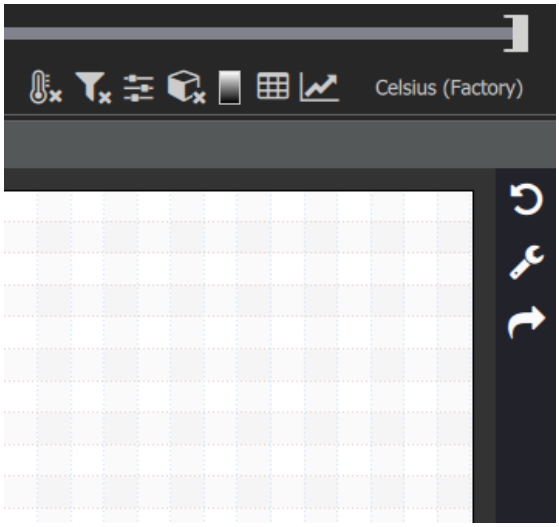
Then the user put the line profile plot below the hummingbird image.



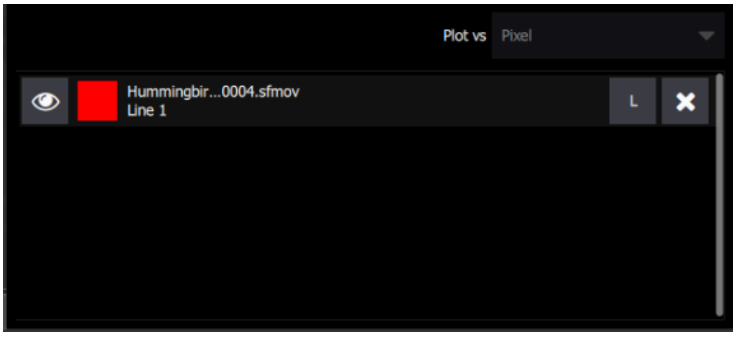
The plot is the temperature along the line as a function of position along the line as measured in pixel width units.



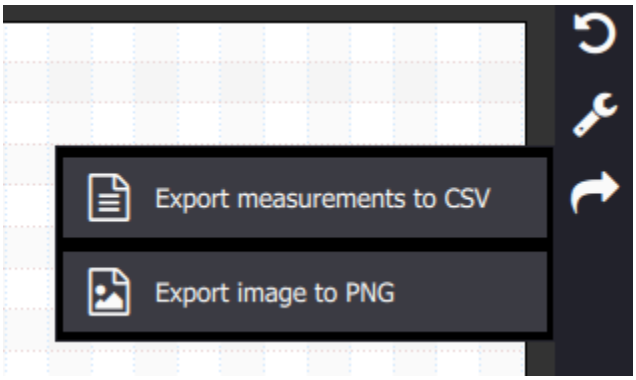
The line profile plot can be reconfigured using the settings icon that looks like a crescent wrench on the right side of the line profile plot:

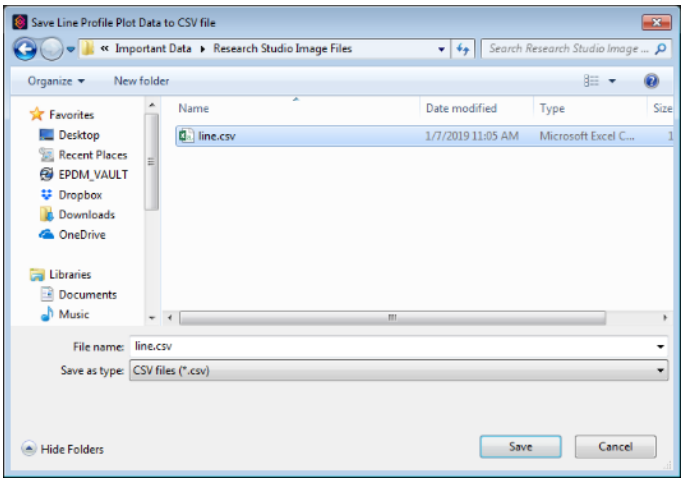


The L/R button can be used to move the Y axis label to the left or the right side of the plot. When it says L, the axis is on the left. Clicking it changes the button to an R and moves the axis to the right side of the plot. The Eye button can be used to turn the plot on or off.



The icon with the arrow is used to export the line profile to disc as a comma-separated variable file which can then be opened in Excel, or a .PNG image.



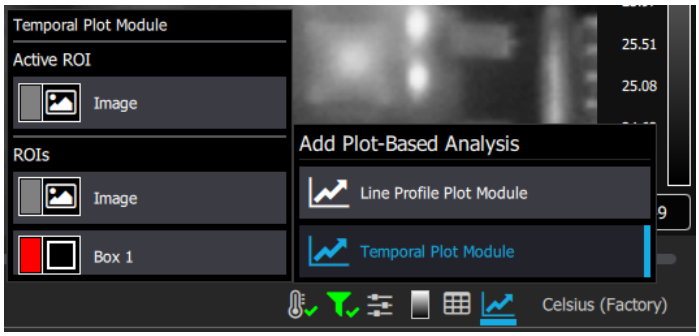


When the file is opened in Excel, the top lines look like this:

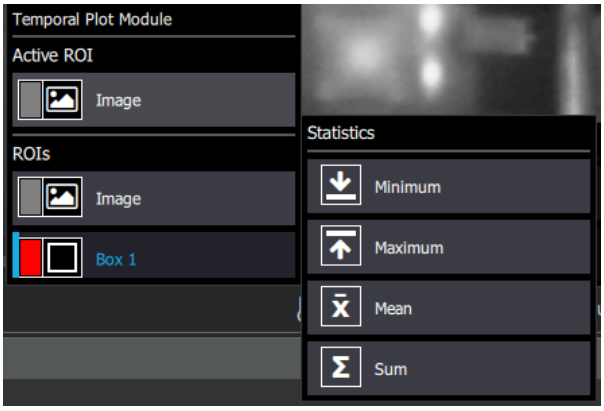
A	B
Pixel	Hummingbirds HD-000004.sfmov:Line 1 [C]:mean:horz
1	1.71E+01
2	1.71E+01
3	1.70E+01
4	1.71E+01
5	1.71E+01
6	1.71E+01
7	1.70E+01
8	1.71E+01

5.7.2 Temporal Plot

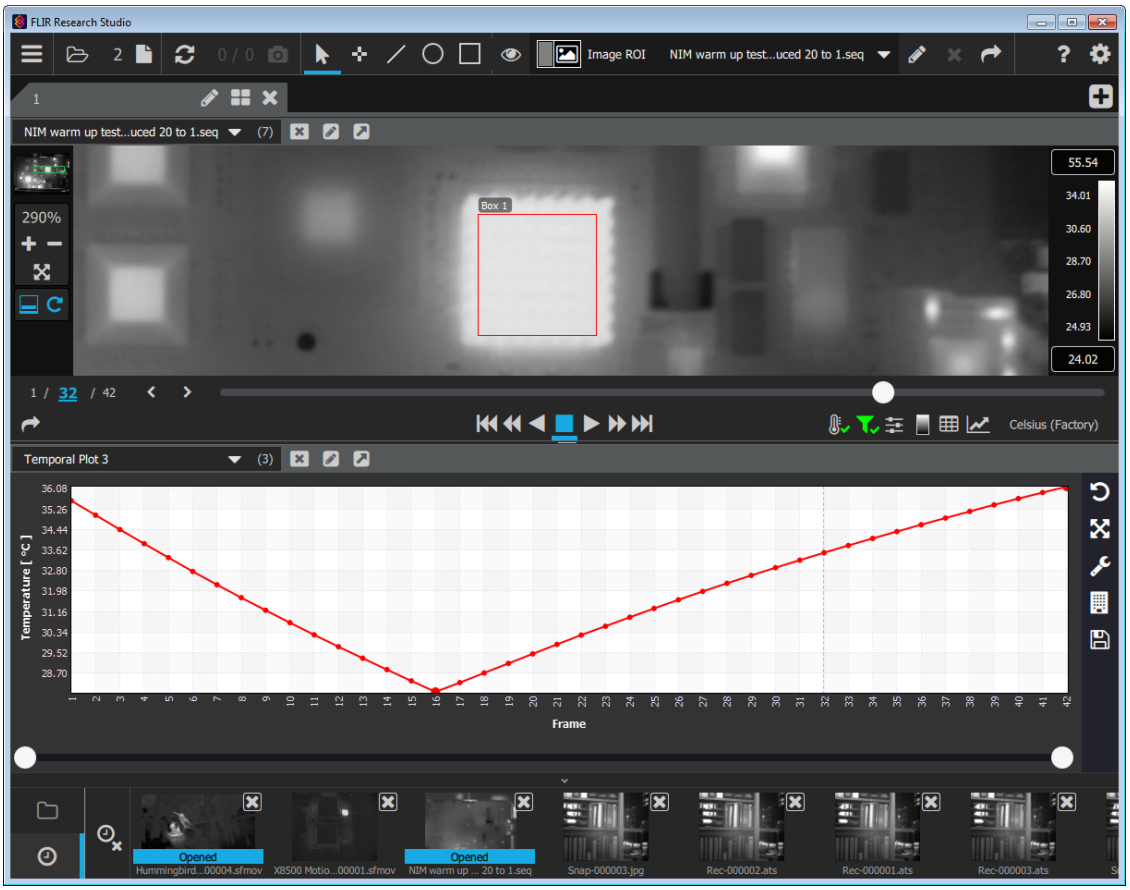
The temporal plot function takes an ROI and plots various values as a function of frame number.



Most users will use the Mean value for a Box ROI, but there are these other options as well:



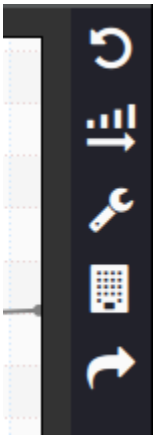
This Module only works for image sequences with greater than one image. The figure below shows a circuit board heating up over time after it is powered up starting right around frame 2.



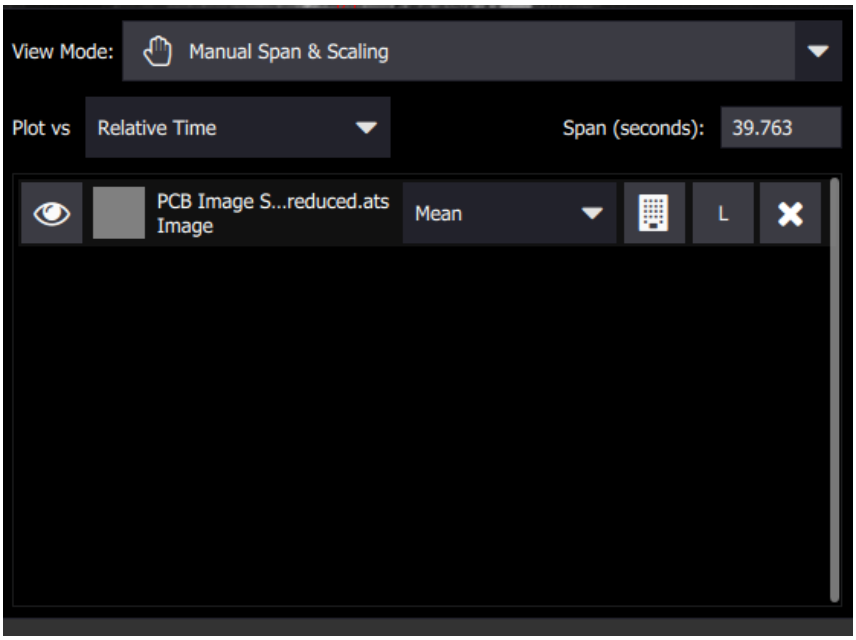
Note the vertical dotted line that sweeps along with the frame counter, showing the user where the playback is in the temporal plot.

5.7.2.1 Temporal Plot Tools

The tools to the right of the temporal plot are, from top to bottom, reset the plot view, plot view mode, change settings of the plot, build the plot, and save the plot data as a comma-separated variable file that can be opened in Excel or a .PNG image file.

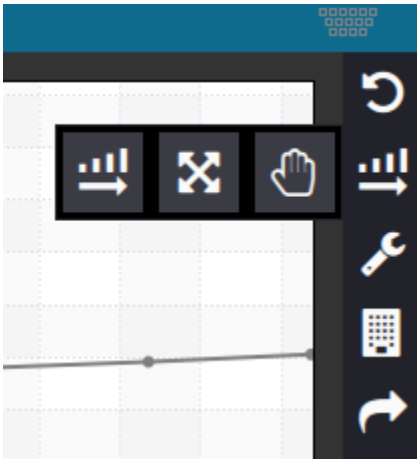


The crescent-wrench shaped icon has a pull-down menu for the selection of the variable to be plotted on the x axis. The default value is the frame number, which is the FrameCounter variable in the metadata, followed by the relative time (which is zero at the start of the image sequence), and finally Absolute Time, which is the Time tag in the metadata. The Follow slider, when enabled, puts the current frame in the center of the temporal plot.

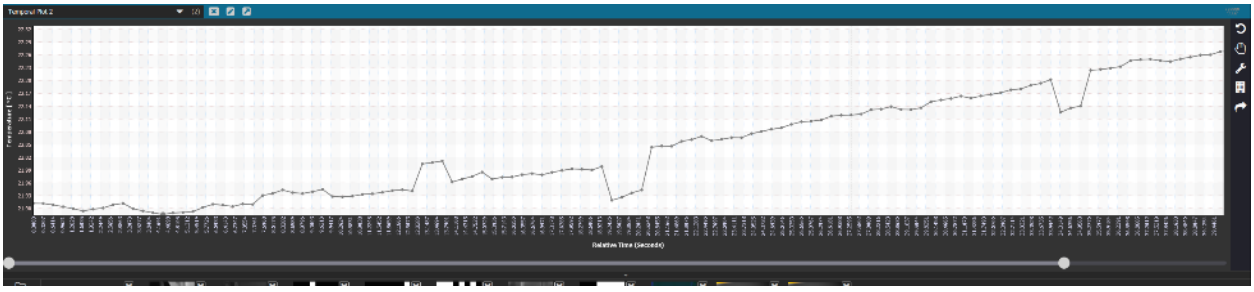


5.7.2.2 Temporal Plot Display Range

It is possible to restrict the range of the temporal plot that is displayed using the change plot view mode icon.

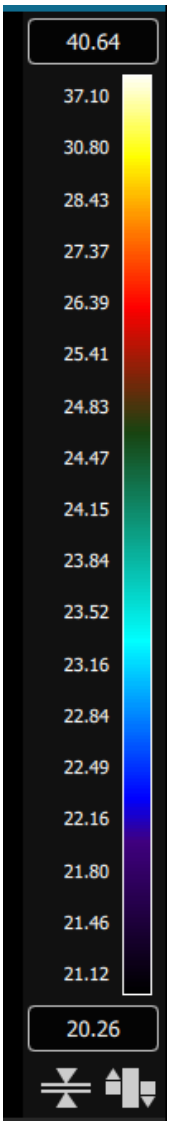


The change plot view mode icon (the horizontal arrow with the increasing bar graph) has three options after clicking. Follow with Manual Span, Fit with auto span and scaling, and Manual span and scaling. With the manual span and scaling the graph's resolution is controlled by the white circle-shaped sliders on the bottom of the temporal plot. These can be moved closer together to show a particular event in greater detail.



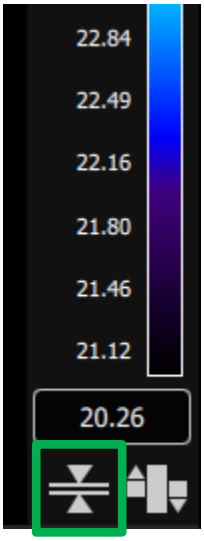
5.8 Color Bar

The Color bar shows the relationship between the color palette and the data values in the currently selected units. The palette can be changed by using the palette selector tool via the palette button. The scale limits and the color distribution are controlled by the Image Enhancement Tool.

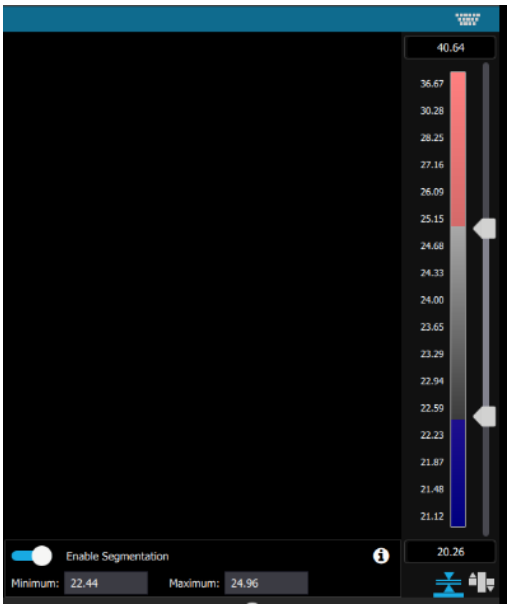


5.8.1 Segmentation

Segmentation defines a range of values that are considered valid in the image. For instance, if the segmentation min and max are 7000 counts and 9000 counts respectively then only the pixels in the image that have a value between 7000 and 9000 are considered valid. All other pixels are segmented out (ignored). Pixels that are segmented out are not included when computing statistics. The Number of Pixels statistic will reflect the number of valid pixels in the ROI. Pixels below the segmentation minimum are show as blue and pixels above the segmentation maximum are show as red. The segmentation range can be defined in terms of counts, radiance, or temperature units. The FRS implementation is powerful because the segmentation can be edited while seeing the results on the image and in the stats module. Segmentation can be turned on via the button below the color bar.



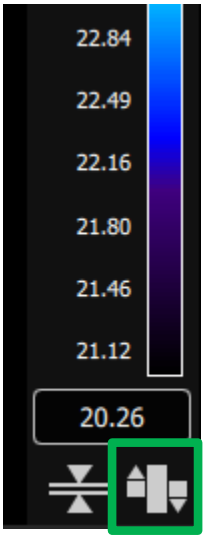
The values can be manually entered in the menu after clicking the segmentation button. The values can also be controlled via the arrows on the color bar.



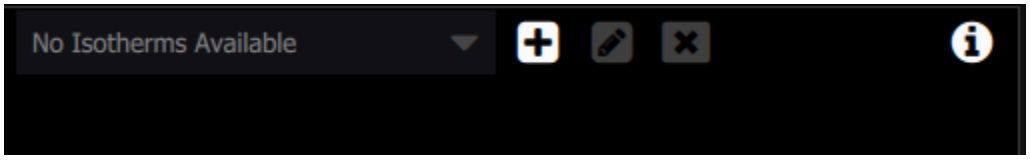
5.8.2 Isotherms

Isotherms are ROIs that track a specific range of measurements. They can be added to the statistics and plots like regular ROIs.

Isotherm ROIs are added by using the button below the color bar.

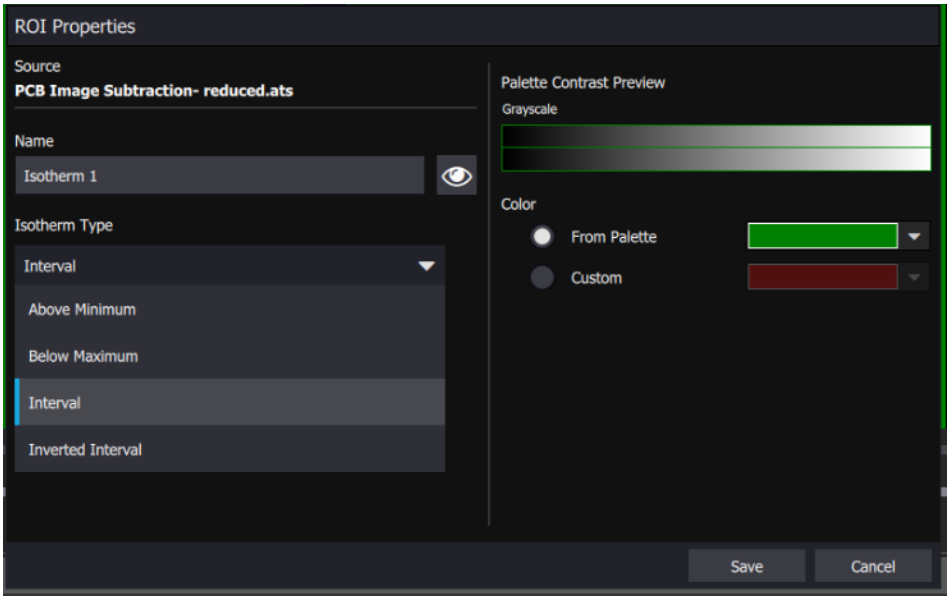


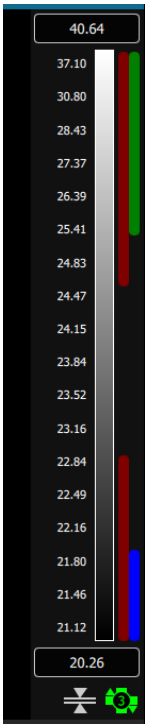
The isotherm button opens this menu to add isotherms via the plus button.



There are four types of Isotherms available to the user.

Type	Description
Interval	Removes everything Between two values.
Above Minimum	Removes everything Above a value.
Below Maximum	Removes everything Below a value.
Inverted Interval	Removes everything Above a value and removes everything Below a value. Leaving the range in between.





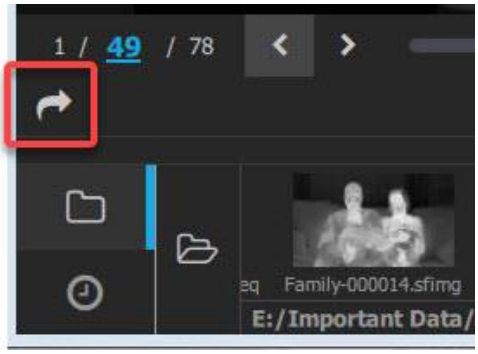
Active Isotherm ROIs are displayed as half width shaded regions. The half bars on the color bar represent the isotherms. These are clickable. When clicked, the range slider takes the values of that isotherm and allows the user to edit it. When the user clicks on any other part of the Imagery View or just the color bar the range slider would switch to controlling the segmentation. With this implementation the segmentation and isotherms can both be controlled with the range slider control shown full time and without a popup. Isotherms are considered ROIs so they can be edited, deleted, or exported. The software supports up to three (3) isotherms at a time. The number of active isotherms can be seen in the center of the Isotherm Icon.

6 Share

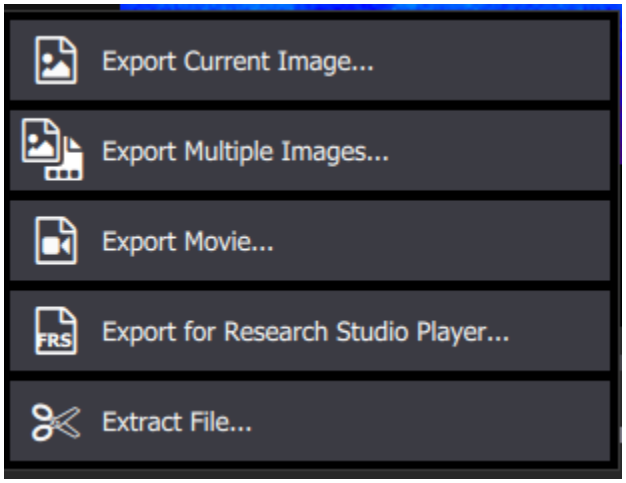
The final step in the standard Research Studio workflow is to share the data. There are a lot of options that assist the user in sharing their data to enable many use cases.

6.1 Export

Within the imagery view module the icon that looks like a bent arrow is for exporting of the movie or current image to a different file format.

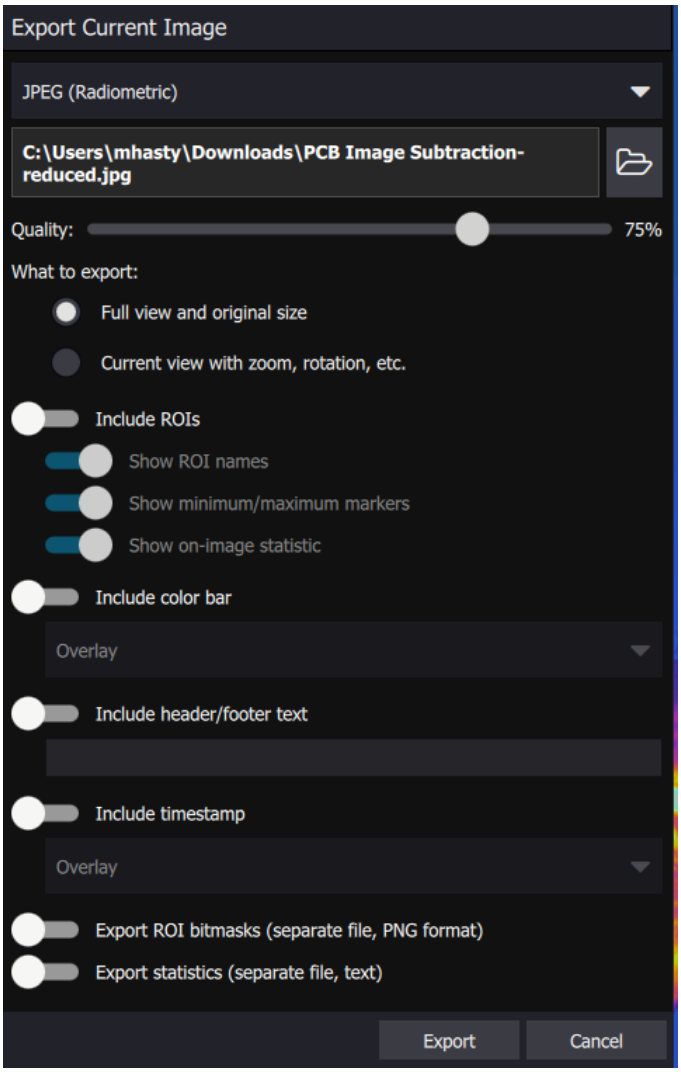


When that button is pressed, the following options come up. There are five main export options with different menus.

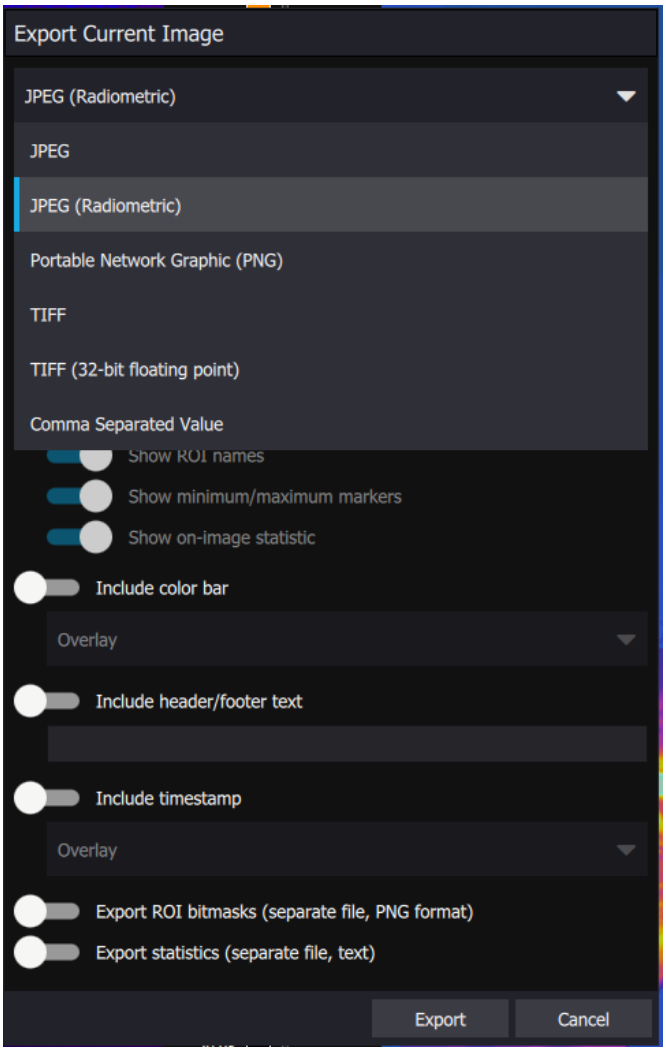


6.1.1 Export Current Image

The export current image dialog allows the user to export the currently displayed single image frame. The options of what to include on the export are extensive. Including quality setting, ROIs, color bar, header/footer text, timestamp, ROI bitmasks, and statistics. The application will remember the last selected type and options between sessions.



There are many different types of single frame exports in terms of file format. The TIFF and CSV will have fewer export configuration options.

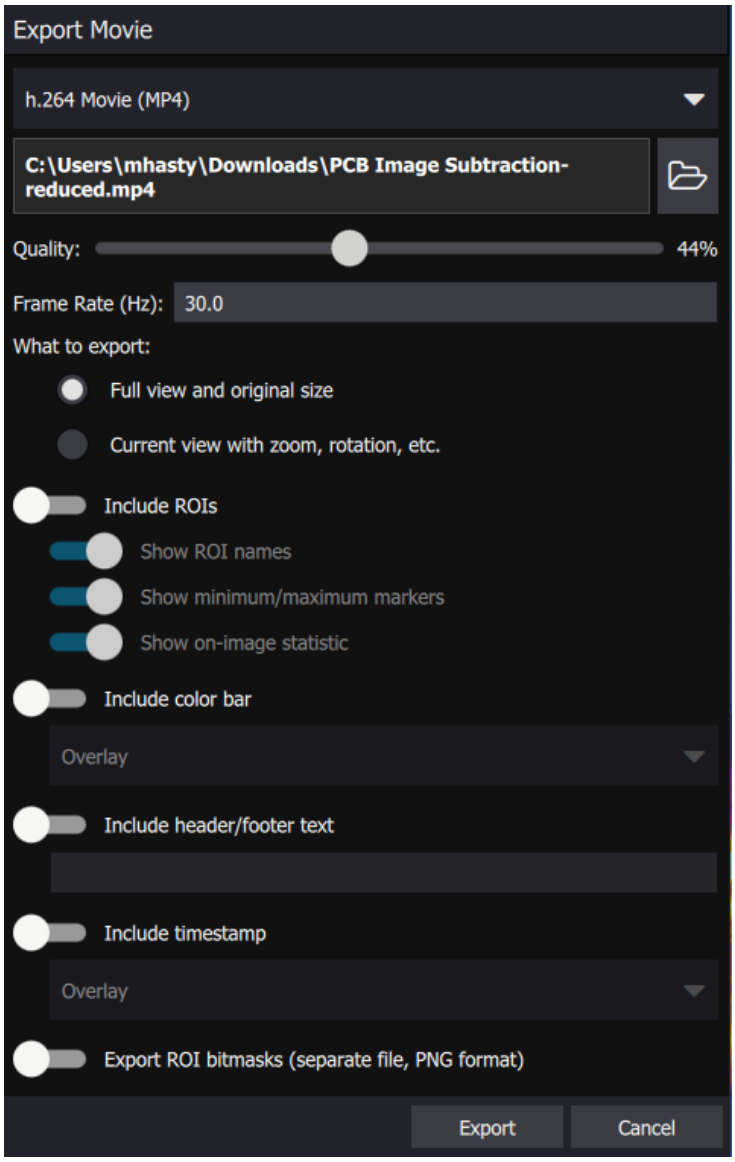


6.1.2 Export Multiple Images

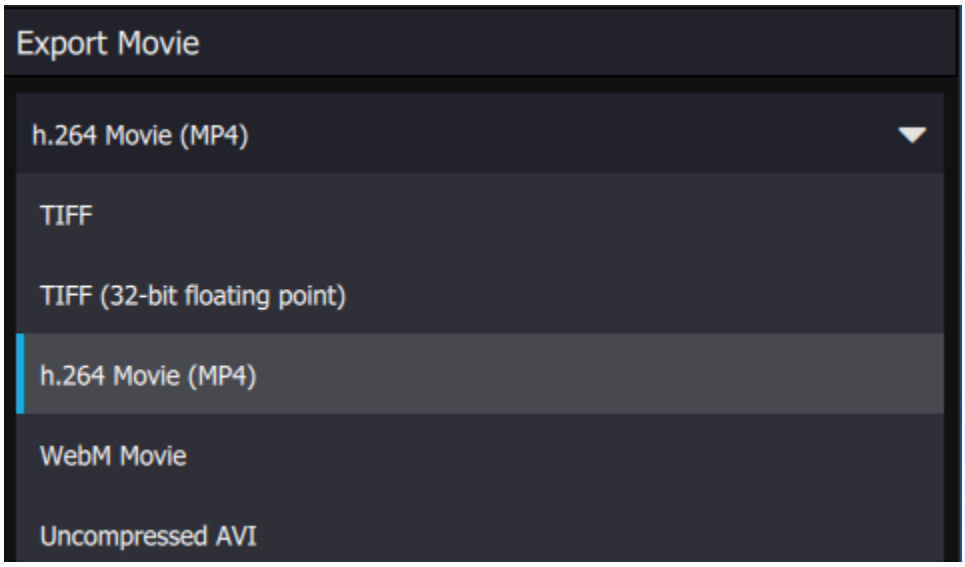
The next option is Export Multiple Images. Exports the selected range of frames, designated by the play bars, as a series of individual files. The selection options here are identical to the Export Single Image Dialog.

6.1.3 Export Movie

The third option is to export a movie. With this option the selected range of frames will be exported as a video. The options here are similar to the image options but a little different.

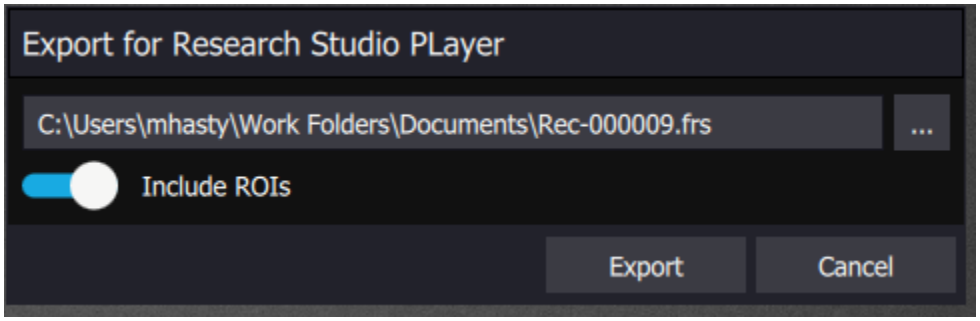


The video formats available are TIFF, TIFF (16-bit counts), TIFF (32-bit floating point), h.264 Movie (MP4), Uncompresed AVI, and WebM Movie.



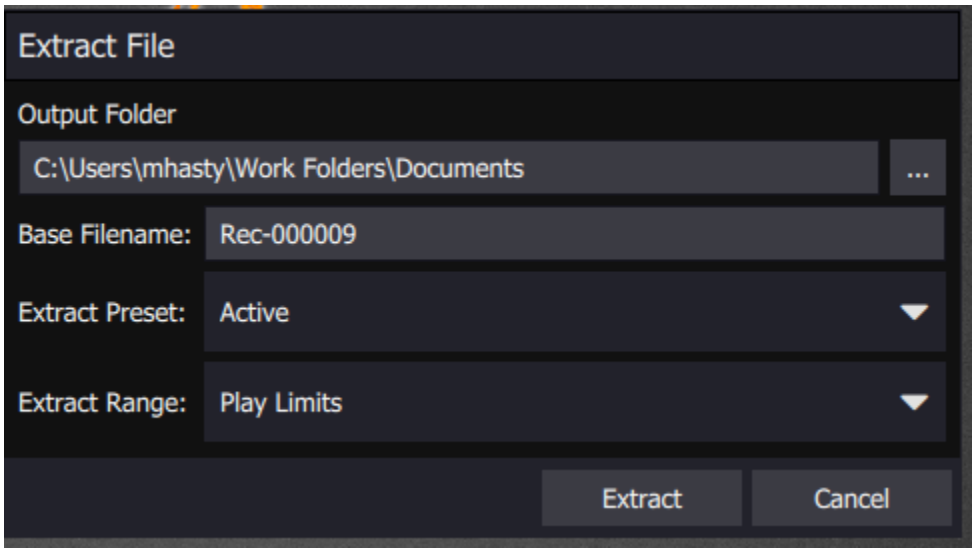
6.1.4 Export for Research Studio Player [Professional Edition only]

This option allows the user to export a .FRS File that can be loaded into the free FLIR Research Studio Player App. The FRS Player has all of the same functionality for viewing and analysis as Research Studio. The main difference is it cannot stream from a camera or record a file. The player application runs on Mac, Linux, and Windows. It also supports 21 languages. This is a powerful new tool for global research teams. Allowing teams to share recorded files, workspaces, and data without the need for numerous FRS licenses. The feature to export a .FRS file for the FRS Player is only available with a Professional Edition License.



6.1.5 Extract File

The final option extracts a .ats file based on play limits. This is useful to trim down recording files to save on file size. The user can trim to the important frames for analysis or viewing.

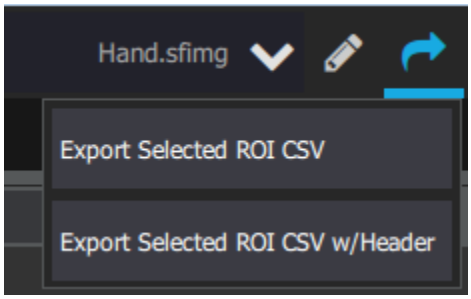


6.2 Export ROI

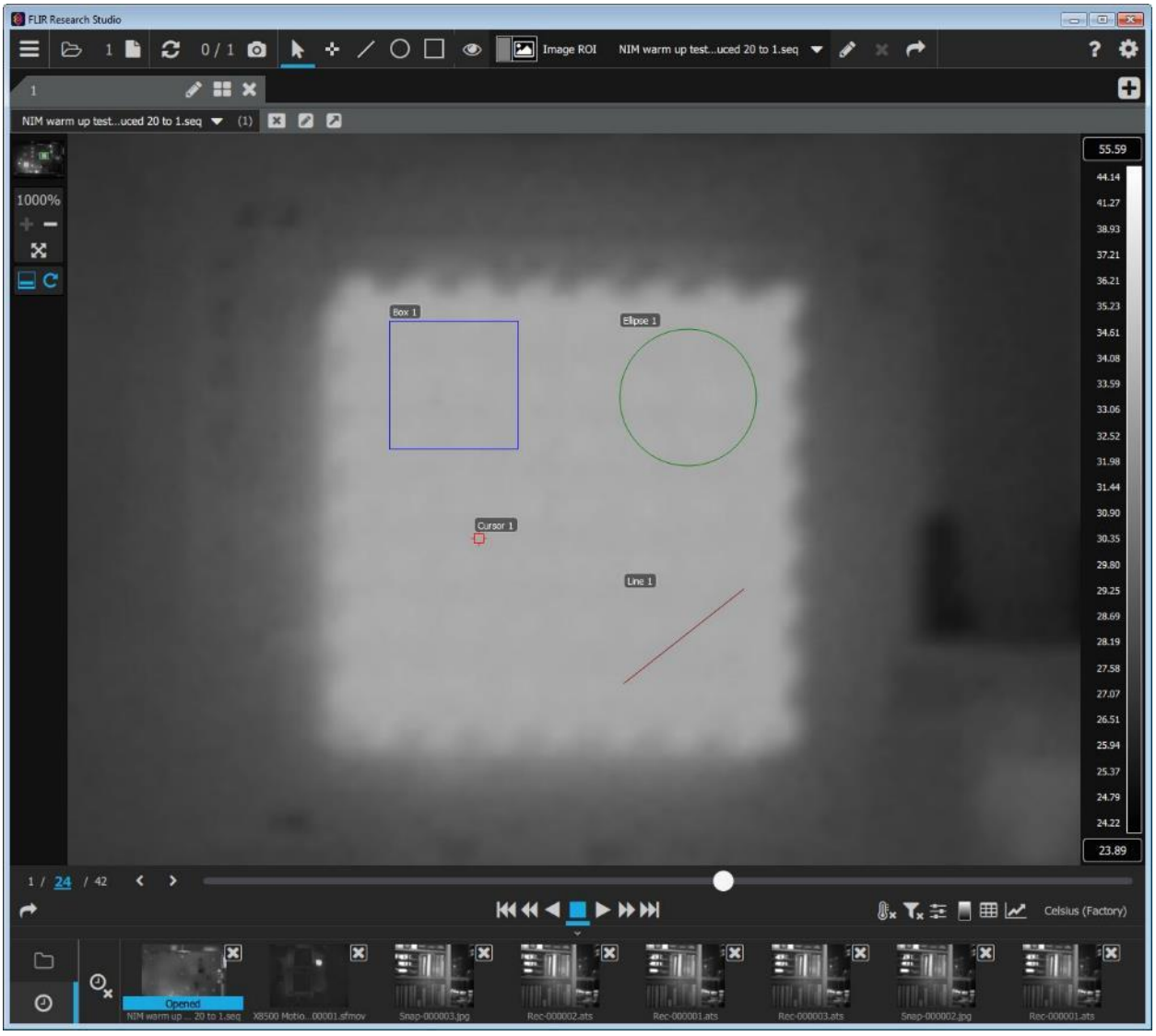
Another export option is the ability to export data from regions of interest. The menu for this is located at the top of program window.

The export ROI pulldown button looks like this on the:

There are two options in the pulldown:



The first option will export the pixel values in the ROI to corresponding rows and columns in a comma-separated variable file which can then be opened in Excel. The second option gives the user the same data, with the addition of a header which contains information about the image and the ROI used for the export. What follows is an example of this. Below is an image of a circuit board with a blue rectangular ROI drawn on it, as well as other ROIs. The pixel values are in degrees Celsius.

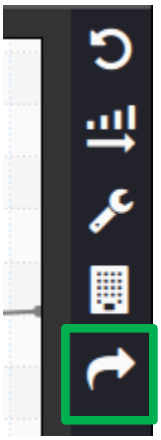


The image below is a screen capture of the *.csv file for this exported ROI opened in Excel.

Filename = E:/Important Data/Research Studio Image Files II/NIM warm up test-000016 - reduced 20 to 1.seq										
Units = Temperature (C)										
Time = 279:17:16:55.730000										
FrameNumber = 24										
Preset = 0										
TimeSource = Unknown										
3.34E+01	3.35E+01	3.34E+01	3.35E+01	3.35E+01	3.34E+01	3.35E+01	3.34E+01	3.36E+01	3.35E+01	3.35E+01
3.35E+01	3.35E+01	3.35E+01	3.36E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.36E+01	3.36E+01	3.35E+01
3.35E+01	3.36E+01	3.35E+01	3.35E+01	3.35E+01	3.34E+01	3.34E+01	3.34E+01	3.35E+01	3.35E+01	3.35E+01
3.37E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.34E+01	3.36E+01	3.34E+01
3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.33E+01	3.32E+01	3.34E+01	3.34E+01	3.35E+01	3.35E+01	3.35E+01
3.35E+01	3.34E+01	3.34E+01	3.33E+01	3.33E+01	3.34E+01	3.34E+01	3.35E+01	3.34E+01	3.34E+01	3.33E+01
3.34E+01	3.34E+01	3.35E+01	3.36E+01	3.34E+01	3.34E+01	3.34E+01	3.34E+01	3.36E+01	3.35E+01	3.34E+01
3.35E+01	3.34E+01	3.36E+01	3.36E+01	3.35E+01	3.36E+01	3.35E+01	3.34E+01	3.35E+01	3.36E+01	3.34E+01
3.35E+01	3.35E+01	3.36E+01	3.35E+01	3.34E+01	3.34E+01	3.34E+01	3.34E+01	3.37E+01	3.36E+01	3.36E+01
3.35E+01	3.36E+01	3.36E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.36E+01	3.35E+01	3.35E+01	3.35E+01
3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.36E+01	3.34E+01	3.34E+01	3.35E+01	3.35E+01	3.36E+01	3.35E+01
3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.34E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.34E+01
3.34E+01	3.35E+01	3.34E+01	3.34E+01	3.34E+01	3.34E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.34E+01
3.34E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01
3.35E+01	3.34E+01	3.34E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.36E+01
3.36E+01	3.35E+01	3.36E+01	3.36E+01	3.35E+01	3.34E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.37E+01
3.35E+01	3.35E+01	3.36E+01	3.36E+01	3.35E+01	3.34E+01	3.35E+01	3.35E+01	3.37E+01	3.36E+01	3.35E+01
3.36E+01	3.35E+01	3.35E+01	3.36E+01	3.34E+01	3.34E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01	3.35E+01

6.3 Export Plot

Research Studio also provides the ability to export analysis plots. The menu for this can be found next to a created analysis plot. The button is a similar arrow to the export options in FRS. This option will save the plot data as a comma-separated variable file that can be opened in Excel or a .PNG image file.



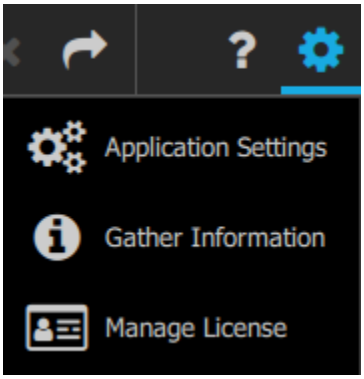
7 General Program Settings

7.1.1 Help Icon

The question mark icon on the top ribbon opens a PDF of the user's manual.

7.1.2 Program Settings

The last icon in the top ribbon looks like a gear. It is where the user can change application settings, gather information about the application and its installed components, and where the user manages the license for Research Studio.

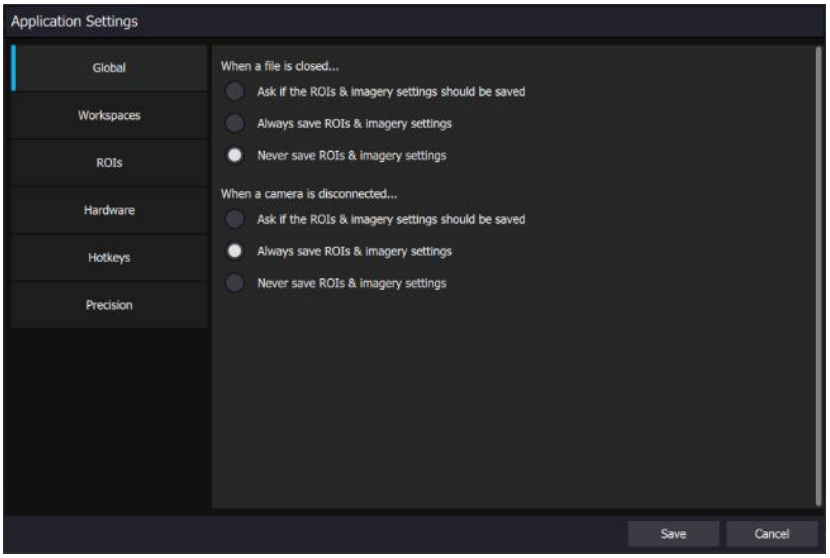


7.1.2.1 Application Settings

This group of settings allows the user to control what happens with ROI associated with data files, how data is loaded and displayed, among other things. The tabs in this menu are described below.

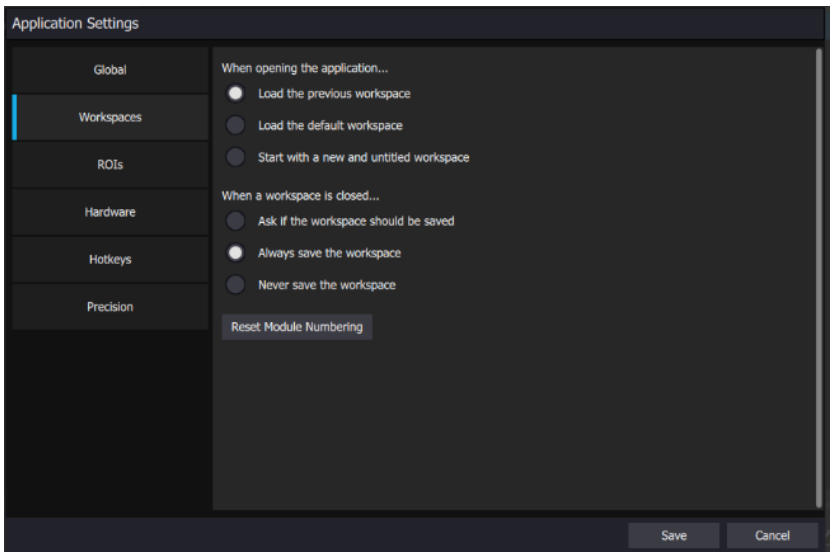
7.1.2.2 Global Settings

This dialog allows the user to choose options for what happens when a file is closed or a camera is disconnected.



7.1.2.3 Workspaces Settings

This dialog allows the user to choose how workspaces are saved and loaded.

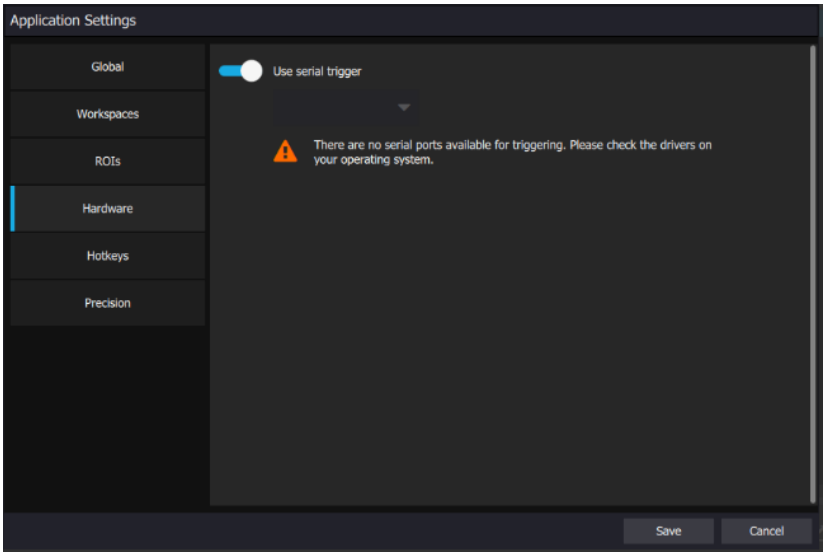


7.1.2.4 ROIs

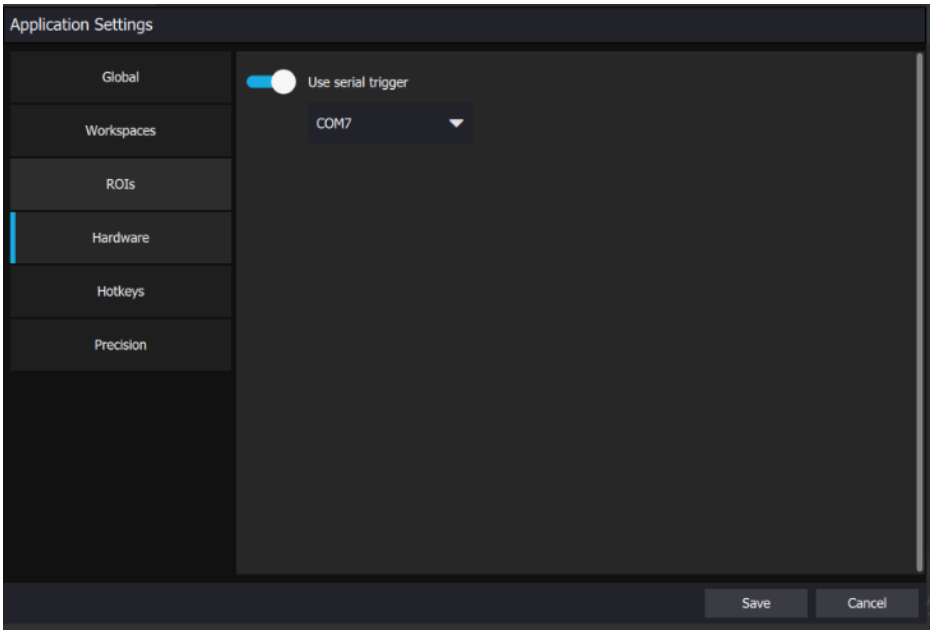
This global Region of Interest setting menu is described in the Analysis section of the manual under ROIs.

7.1.2.5 Hardware Settings

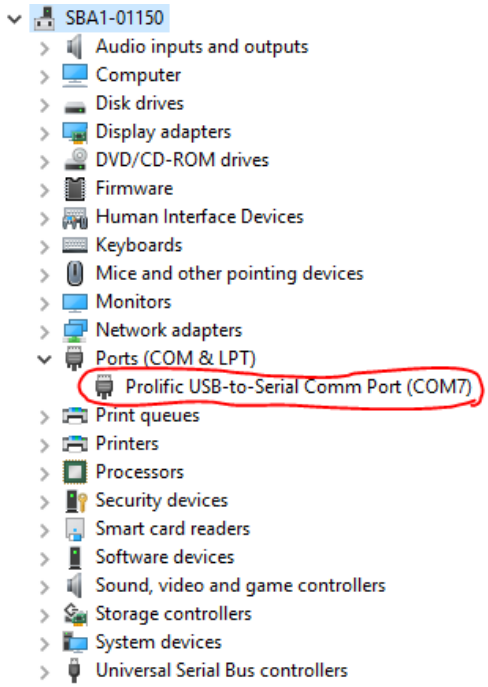
This dialog contains options for configuring a serial port trigger to start recording. The serial trigger is found when a USB to serial port converter is attached to the PC. Research Studio supports a standard USB to RS-232 converter. The user must provide their own button for switch closure. This is accomplished by shorting pins 7/8 (CTS/RTS). Here is the screen shot you see when no ports are found:



Here is the message you get when a port is found; in this case Window 10 is calling it COM7:

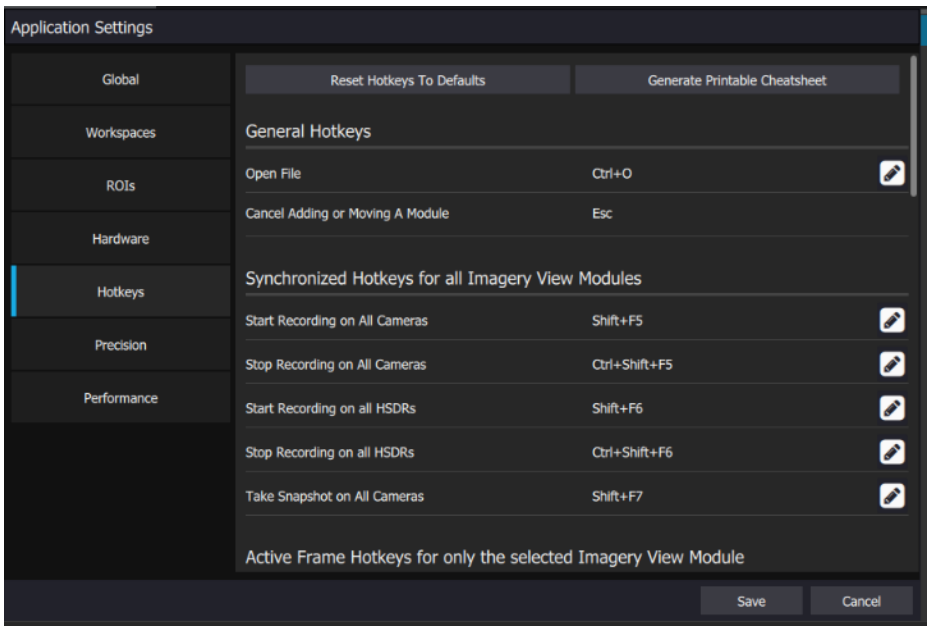


The COM7 port also appears in the Device Manager:

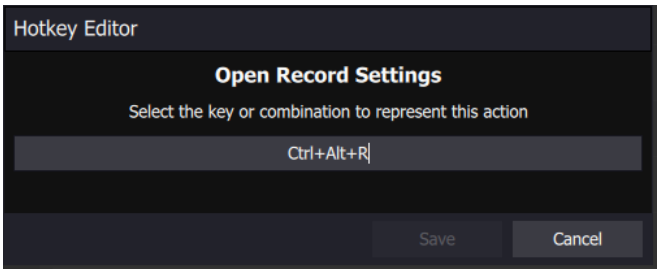


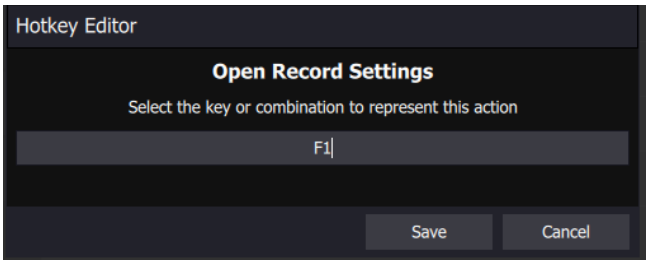
7.1.2.6 Hotkey Settings

The hotkeys are there to save the user time by making combinations of keystrokes do functions that would otherwise have to be accessed by mouse movements and clicks. If the user modifies these hotkeys using the edit button, the changes are saved over restarts of the application. The user can also generate an HTML file with the hotkeys in a “cheat sheet” table format.

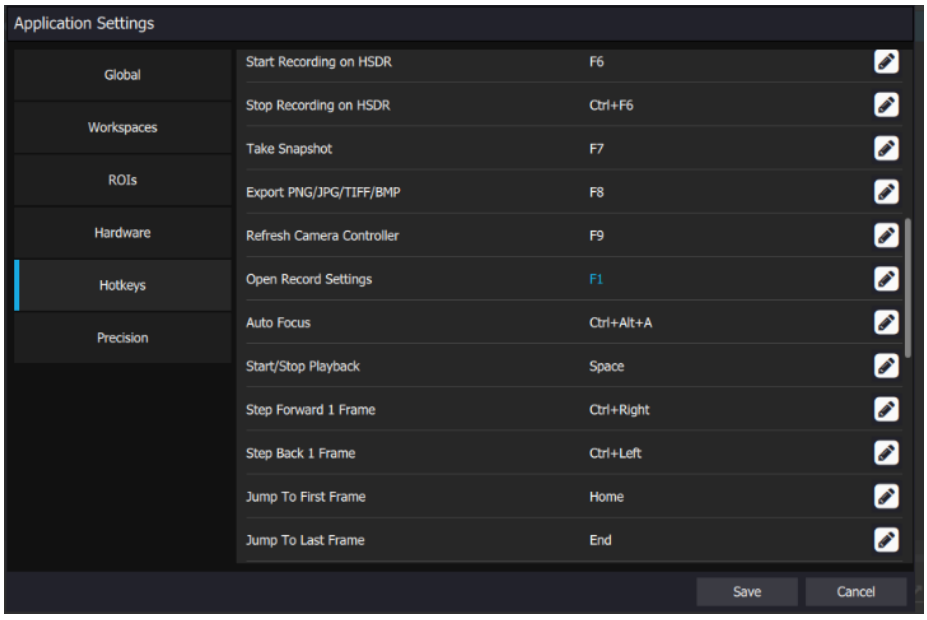


In this example, the default for Record Settings is Ctrl+Alt+R. Here the user changes it to F1, which is faster to enter:

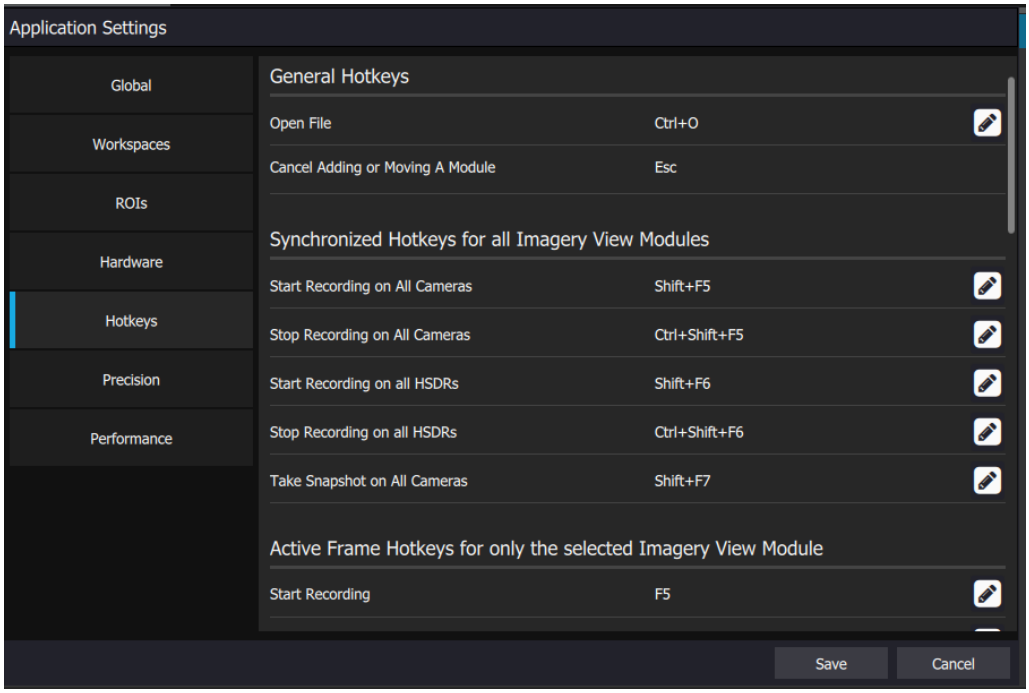




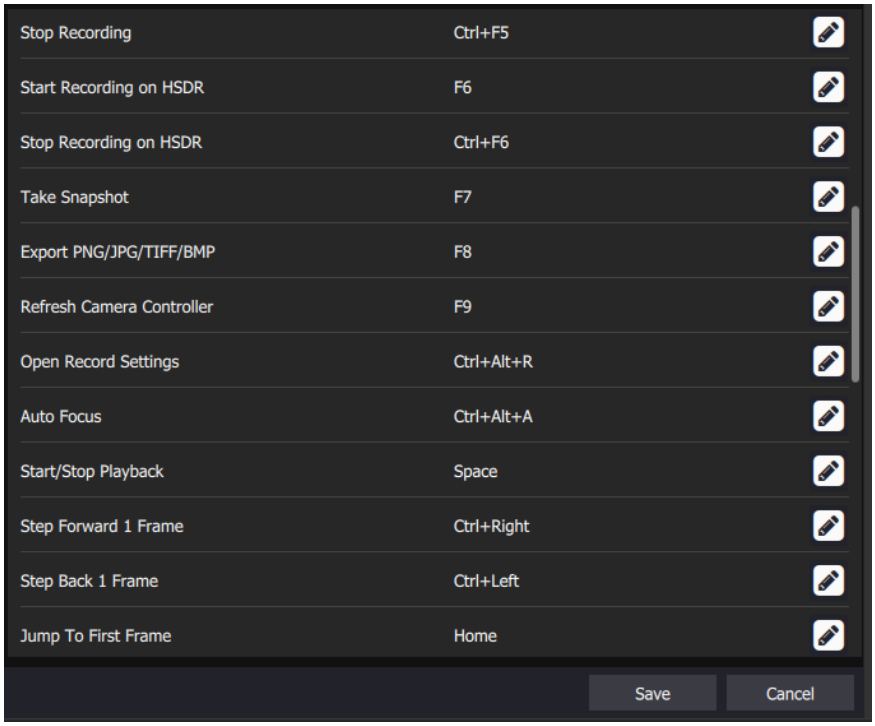
Once the list has been changed, the modified entry is now shown in blue text until the Save button is hit, at which point the Hotkey change is saved. The user can always revert to the factory hotkey settings when needed.

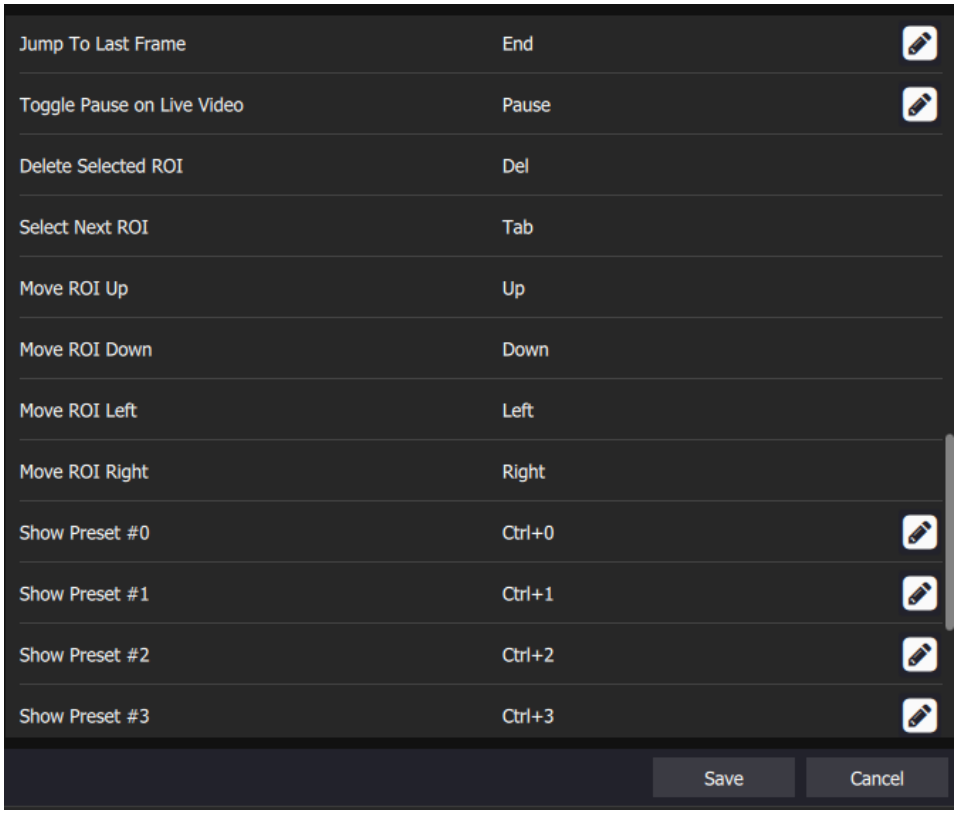


There are some hotkeys that apply to all Imagery View Modules. These are clearly labeled and would activate the action on all Imagery View Modules. The other hotkeys only affect Active Frames or Selected Frames.



Here are the remaining hotkeys:

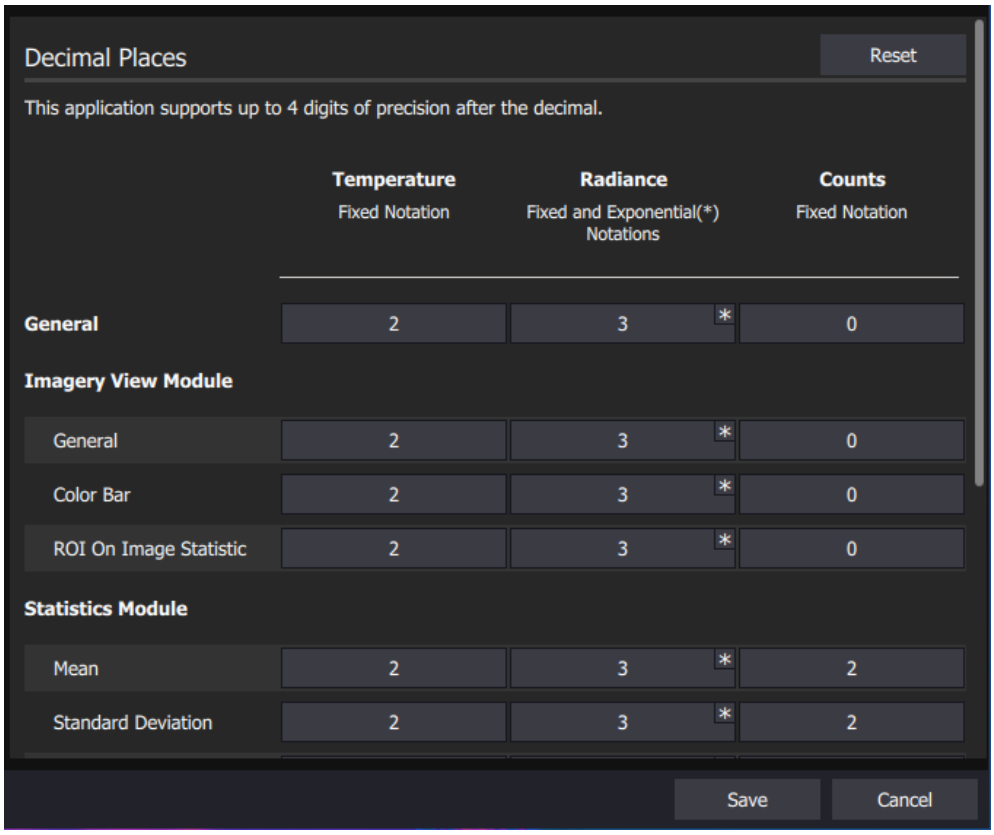


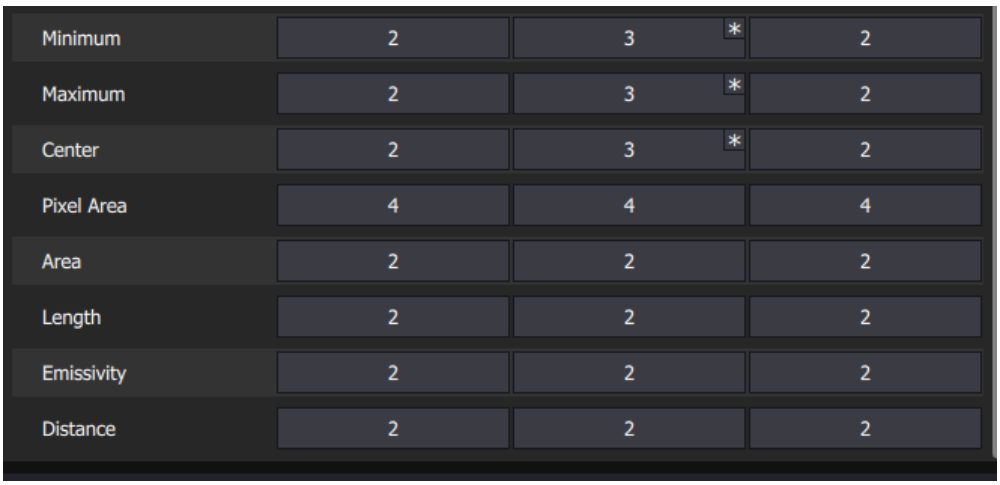

Jump To Last Frame
End
Toggle Pause on Live Video
Pause
Delete Selected ROI
Del
Select Next ROI
Tab
Move ROI Up
Up
Move ROI Down
Down
Move ROI Left
Left
Move ROI Right
Right
Show Preset #0
Ctrl+0
Show Preset #1
Ctrl+1
Show Preset #2
Ctrl+2
Show Preset #3
Ctrl+3
Save
Cancel

Show Preset #4
Ctrl+4
Show Preset #5
Ctrl+5
Show Preset #6
Ctrl+6
Show Preset #7
Ctrl+7
Show Superframes
Ctrl+8
Show All Presets
Ctrl+9

7.1.2.7 Precision Settings

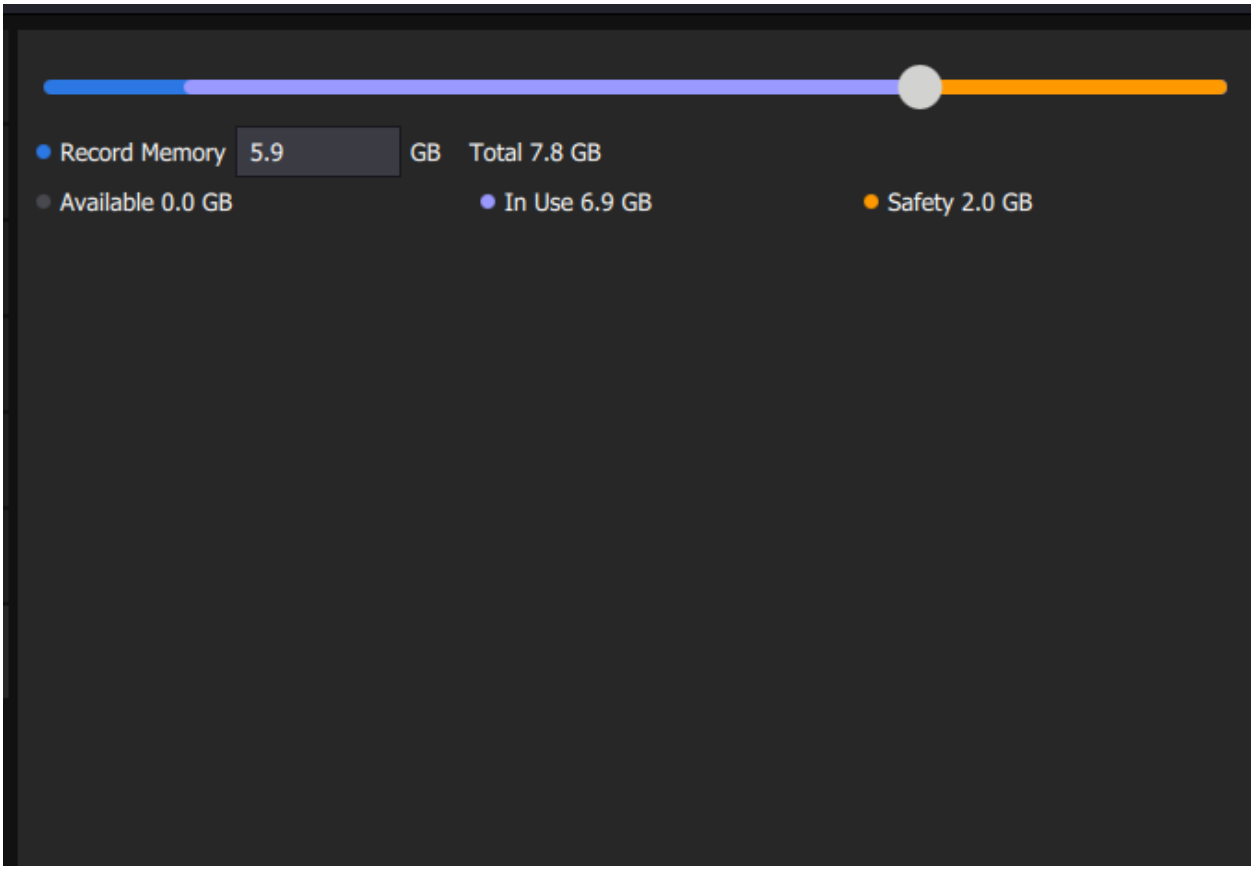
The Precision tab is where the user can select how many decimal places of data to display in the various statistics windows in FRS. This is useful to avoid conveying the erroneous impression to users that the systems are capable of 4 decimal place accuracy in radiometric measurements.





7.1.3 Performance Global

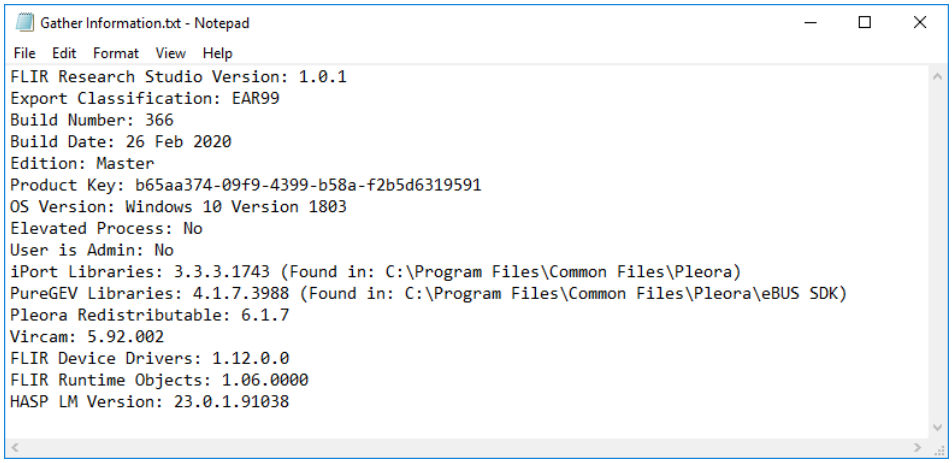
This performance settings tab is accessed from the Global Application Settings menu. This allows the user to choose how much RAM memory on the computer is allocated to Research Studio. It also lets the user see how much in-use is currently, reserved for safety, and available.

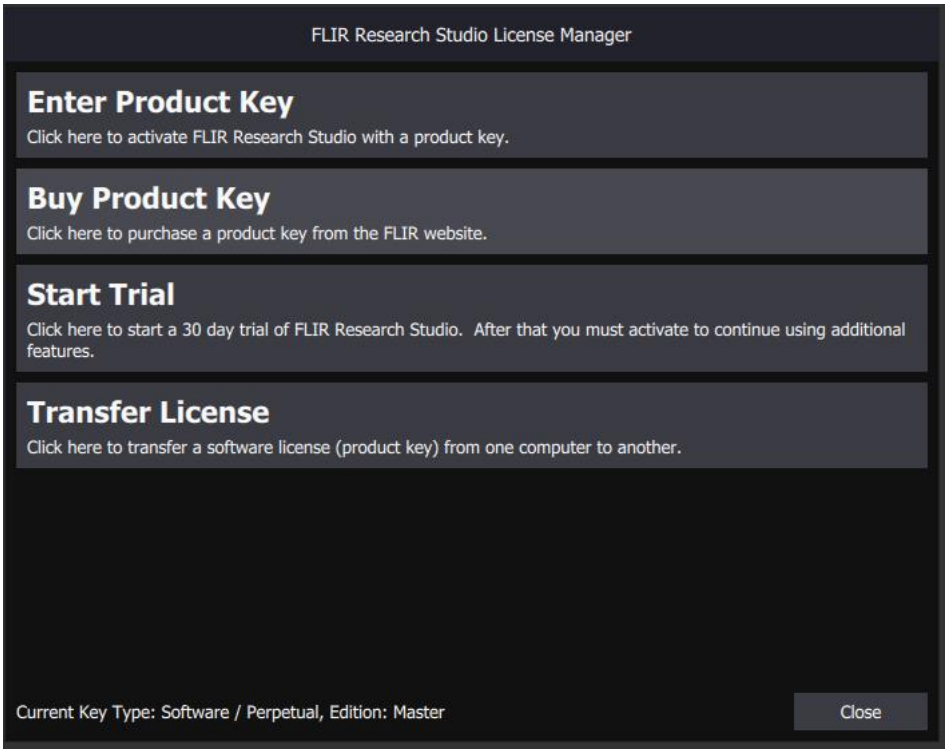


7.1.4 Gather Information

The Gather Information choice gives this window. The user can scroll down on the side bar to see more of the data.

One can also hit the Save… button and get a text file with the same information. Here is what the file looks like when opened in Notepad. Please provide this information when contacting customer support.



7.1.5 Manage License

This button brings up the same license/activation dialog that is presented when the program is launched for the first time. This dialog allows the user to update the license (for example to upgrade the edition), to start a trial license, or to transfer the license to another PC. At the bottom of the dialog the user can see the current type of license key and the Software edition.