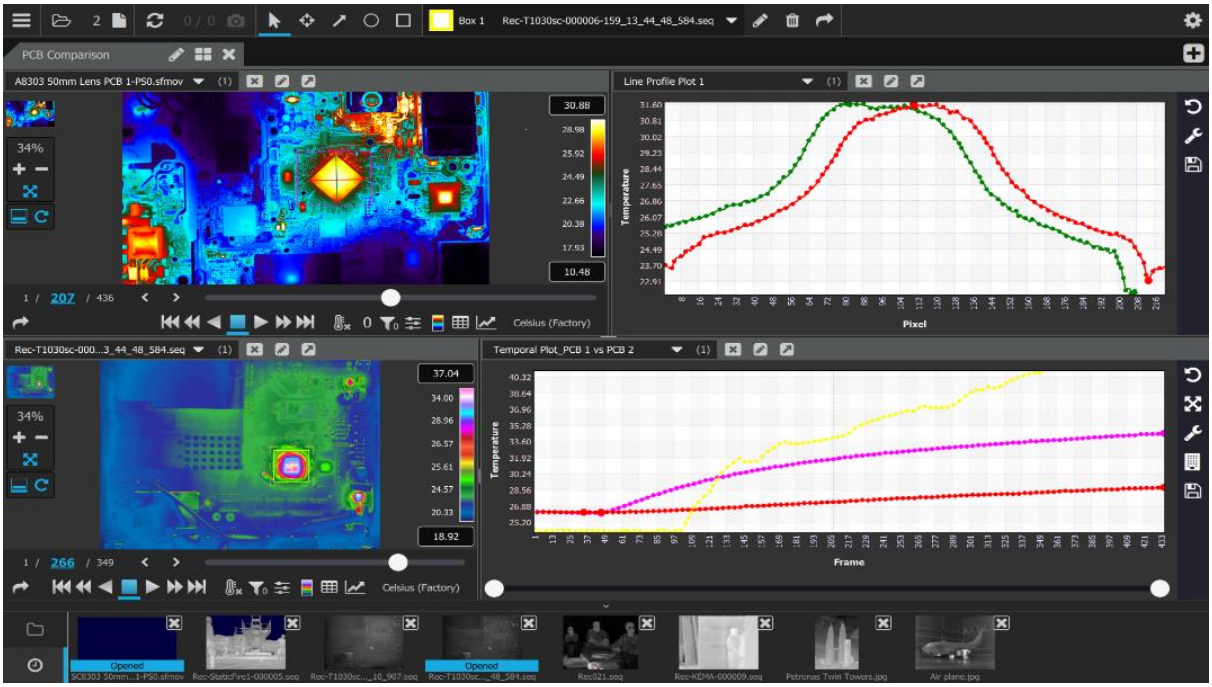
FLIR Research Studio

User's Manual



Document Number: 4217871

Version: 2024.07

Issue Date: July 19th, 2024

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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	04/08/2019	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.
3.0	3/15/2023	RAW	Updated for v3.0 release
3.1	08/01/2023	RAW	Added *2.2 Check for Updates, 3.4.6.4 MSX/Fusion*, and *5.1.8 ROI Import and Export Actions* Updated *3.2.3 Saving and Opening Workspaces* to reflect workspace file “drag and drop” and relative paths
3.2	09/28/2023	JAT	Added sections *1.6 Check Your License* and *1.7 Customer Support*. In *2.5* and *4.4.1*, removed references to old documents and updated wording. Added FLIR Ignite Sync as new *section 8* and updated wording and images for changes to the Collections/Thumbnail Bar.
2024.03	02/16/2024	JAT	Added and updated sections 3.4.3 through 3.4.5 for the new Playback Bar configuration.
2024.05	05/23/2024	JAT	Updated section 4.1.3 with new recording abort and terminate buttons.
	6/4/2024	DNW	Added PRO icon and CSV note to 6.1.2 Export Multiple Images. Changed Export Single Image text to Export Current Image.
2024.07	7/19/2024	RAW	Updated User Registration information, added support for the X/RS-HS camera models, fixed a connection issue with the Dalsa Xtium CL Framegrabber, added support for the Euresys Quad CXP-12 framegrabber

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

Table of Contents

1 Introduction 8
1.1 Key Features 8
1.2 Installation 10
1.3 System Requirements 10
1.4 End User License Agreement (“EULA”) for FLIR Systems, Inc. 10
1.5 Activation 17
1.6 Check Your License 17
1.7 Customer Support 19
2 Connect 20
2.1 Launching FLIR Research Studio 20
2.2 Check for Updates 21
2.2.1 Software Update Window 22
2.3 Camera Detection & Connection 23
2.4 Supported Cameras 26
2.5 Camera Link and CoaXPress (CXP) Frame Grabbers 27
2.6 Camera Controller 28
3 View 30
3.1 Main Menu 30
3.2 Workspaces (Tabs, Layouts & Frames) 30
3.2.1 Overview 30
3.2.2 Naming and Adding Tabs 35
3.2.3 Saving and Opening Workspaces 37
3.3 Files 39
3.4 Frames and Modules 42
3.4.1 Image Modules 42
3.4.2 Zoom Control 43
3.4.3 Basic Playback Controls 44
3.4.4 Playback Bar 44
3.4.5 Inline Editing of Playback Start, Current, and End 47
3.4.6 Image Enhancement 49

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

3.4.6.1 Level and Span 49
3.4.6.2 Plateau 53
3.4.6.3 Scaling Mode 54
3.4.6.4 MSX/Fusion 55
3.4.7 Image Filters 58
3.4.8 Palettes 62
3.4.9 Display Units 64
3.4.10 Image Flipping 67
4 Record 68
4.1 Recording Controls 68
4.1.1 Prepare/Unprepare RAM Button 68
4.1.2 Arm/Disarm Recording Button 68
4.1.3 Record / Stop / Abort / Terminate Buttons 69
4.1.4 Pause Button 70
4.1.5 Snapshot Button (Radiometric JPEG) 70
4.1.6 Record Settings Button 70
4.1.7 Record Info Button 71
4.2 Record Settings 71
4.2.1 File Handling 71
4.2.2 Start, Stop, & Periodic Options 75
4.2.3 Record Once to a Single File 76
4.2.4 Record periodically using intervals PRO 76
4.2.5 Performance 77
4.2.6 Pre-Trigger Buffer PRO 78
4.2.7 Post-trigger Buffer PRO 80
4.2.8 Computer RAM Dashboard 80
4.3 Record Info Dashboard 81
4.4 HSDR (High Speed Data Recorder) PRO 82
4.4.1 Install and Setup 83
4.4.2 Pairing 85
4.4.3 Recording 86
4.4.4 Quick Look and File Browser 87

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

4.4.5 Batch Extract 89
5 Analyze 91
5.1 Region of Interest (ROI) 91
5.1.1 Controls 91
5.1.2 Available ROIs 92
5.1.3 Select/Move 93
5.1.4 Image Zoom 94
5.1.5 Editing an ROI 97
5.1.5.1 Emissivity Calculator 99
5.1.6 Deleting an ROI 99
5.1.7 ROI Settings 99
5.1.8 ROI Import and Export Actions 100
5.2 Opening Recorded imagery 102
5.2.1 File Open Button 102
5.2.2 Collections Gallery 102
5.2.2.1 Quick Collection Files 103
5.2.2.2 Recent Files 103
5.2.2.3 HSDR/SSD Files 104
5.2.2.4 Ignite Sync Files 104
5.2.3 Drag and Drop 105
5.3 Object Parameters 106
5.4 Superframing 107
5.5 Spatial Calibration 108
5.6 Table-Based Modules 109
5.6.1 Source Info Module 109
5.6.2 Metadata Module 110
5.6.3 Statistics Module 111
5.6.3.1 Delta Measurements 113
5.6.4 Measurement Functions Module PRO 114
5.6.4.1 Adding a Measurement Function 116
5.6.4.2 Measurement Functions List 116
5.7 Frames – Plot-Based Modules 118

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

5.7.1 Line Profile Plot 119
5.7.2 Temporal Plot 123
5.7.2.1 Temporal Plot Tools 125
5.7.2.2 Temporal Plot Display Range 126
5.8 Color Bar 127
5.8.1 Segmentation PRO 128
5.8.2 Isotherms PRO 129
6 Share 131
6.1 Export 131
6.1.1 Export Current Image 132
6.1.2 Export Multiple Images 134
6.1.3 Export Movie 134
6.1.4 Export for Research Studio Player PRO 135
6.1.5 Extract File 136
6.2 Export ROI Data 136
6.3 Export Plot 138
7 User Correction and Calibration PRO 139
7.1 User Correction 140
7.1.1 Toggle User Correction On/Off 141
7.1.2 Toggle Bad Pixel Correction On/Off 141
7.1.3 User Correction Functions 141
7.1.3.1 Correction vs Correction Pack 142
7.1.3.2 Perform New Correction… 142
7.1.3.3 Edit Bad Pixels… 146
7.2 User Calibration 149
7.2.1 Calibration vs Calibration Pack 150
7.2.2 User Calibration Window 150
7.2.2.1 Camera Spectral Response Tab 152
7.2.2.2 Atmospheric Compensation (MODTRAN) Tab 154
7.2.2.3 Additional Spectral Response 155
7.2.2.4 Calibration Points 156
7.2.2.5 Coefficients 159

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

7.2.2.6 SAF Tags 162
8 FLIR Ignite Sync Compatibility 163
8.1 What are Ignite and Ignite Sync? 163
8.2 Installation 163
8.3 Hamburger Menu Integration 163
8.4 Record Settings Integration 164
8.5 Gather Information Integration 164
8.6 Collections/Thumbnail Bar Integration 165
9 General Program Settings 167
9.1 Help Icon 167
9.2 Program Settings 167
9.2.1 Application Settings 167
9.2.1.1 Global Settings 168
9.2.1.2 Workspaces Settings 168
9.2.1.3 ROIs 168
9.2.1.4 Hardware Settings 168
9.2.1.5 Hotkey Settings 169
9.2.1.6 Precision Settings 173
9.2.2 Performance Global 174
9.2.3 Gather Information 175
9.2.4 Manage License 176

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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, 11 (64-bit Intel/AMD only)
	Linux: Ubuntu 20.04, 22.04; Fedora 37, 38 (64-bit Intel/AMD only)
	macOS 11 Big Sur, 12 Monterey, 13 Ventura, 14 Sonoma (Intel and Apple Silicon)
Hardware requirements	i3, 8GB 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.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

NOTICE TO USER: This is a Contract.

FLIR is willing to license the Software identified as FLIR Research Studio to You only on the condition that You accept all of the terms and conditions contained in this License Agreement. Please read the terms and conditions carefully before installing or using the software. By installing or using the software, You are indicating Your acceptance of this Agreement. If You do not agree to the terms of this Agreement, FLIR is unwilling to license the software to You. In that event, You should not install or use the Software.

1. Scope of Permitted Use: In this Agreement, "Software" shall mean the machine readable software programs and associated files identified as FLIR Research Studio, any modified version, upgrades or other copies of such programs and files, and any associated media and printed materials. You have a limited, nonexclusive, and non-transferable right to install and use the Software on a single central processing unit, machine, or instrument. Only one copy of Your licensed Software may be made by and for You for backup or archival purposes only. You may not make or distribute any other copies of the Software, nor does this license permit You to allow multiple users access to a single copy of the Software via a computer network. You may not resell or redistribute the Software.

You will not assign or transfer this Agreement without the prior written consent of FLIR and any attempted assignment or transfer in violation of the foregoing will be null and void. Assignment or transfer shall only be permitted, provided such transfer or assignment otherwise complies with the requirements of this Agreement, and the Transferee agrees to be bound by the restrictions contained in this Agreement. The Transferee shall not have any rights under this Agreement and shall not be a third-party beneficiary for any purpose. Additionally,(a) You must comply with any and all transfer terms imposed and deliver all copies of the Software in all forms to the transferee along with this EULA; (b) the transferee accepts the terms and conditions of this EULA as a condition to any transfer; and (c) Your license to use the Software/Product terminates upon transfer.

2. Proprietary Rights: The Software is owned by FLIR and/or its suppliers and You acknowledge that the structure, organization and/or code to the Software is/are the valuable trade secret(s) of FLIR. You agree to hold such trade secret(s) in confidence. You further agree not to translate, decompile, disassemble, modify, reverse engineer, or otherwise attempt to discover the source code of the Software, in whole or in part. The Software is protected by United States Copyright Law and International Treaty provisions. This EULA does not transfer any ownership interest by FLIR Systems to the User and/or Recipient of this software.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

You are prohibited from: (a) copying the Software or any of its integrated code/software onto any public or distributed network; (b) using the Software to operate in or as a time-sharing, outsourcing, service bureau, application service provider or managed service provider environment; (c) using any of the integrated code/software as a standalone application or any other purpose than as integrated into the Product; (d) changing any proprietary rights notices which appear in the software or the Product; or (e) modifying the Software.

3. No Other Rights: FLIR retains title and ownership to any and all copies of the Software whether transmitted electronically or recorded as diskette copies and all subsequent copies of the Software, regardless of the form or media in or on which the original and other copies may exist. Except as expressly stated, this Agreement does not grant You any rights to patents, copyrights, trade secrets, trademarks or any other rights with respect to the Software.

4. Term: The Agreement is effective until terminated. This Agreement shall terminate automatically upon failure by You to comply with any of its terms. FLIR also has the right to terminate Your license immediately at any time. Upon any such termination, You must destroy the original and any copies of the Software as well as any of the source code or integrated software. However, any terms of this Agreement which can reasonably be construed to protect FLIR will survive its termination.

5. NO WARRANTY: This Software is being delivered to You AS IS and FLIR makes no warranty as to its use or performance. FLIR AND ITS SUPPLIERS DO NOT AND CANNOT WARRANT THE PERFORMANCE OR RESULTS YOU MAY OBTAIN BY USE OR INABILITY TO USE THE SOFTWARE OR THE DOCUMENTATION. FLIR MAKES NO WARRANTIES, EXPRESS OR IMPLIED AS TO NON-INFRINGEMENT OF THIRD PARTY RIGHTS, MERCHANTABILITY, OR FITNESS FOR ANY PARTICULAR PURPOSE.

6. WARNING: THIS SOFTWARE IS NOT DESIGNED NOR TESTED FOR A LEVEL OF RELIABILITY SUITABLE FOR USE IN THE DIAGNOSIS OR TREATMENT OF HUMANS OR AS CRITICAL COMPONENTS IN ANY LIFE SUPPORT OR OTHER INFORMATION SYSTEMS THE FAILURE OF WHICH CAN REASONABLY BE EXPECTED TO CAUSE PERSONAL INJURY. THE SOFTWARE CONTAINS BUGS AND INACCURACIES. WHEN YOU USE IT, YOU CAN EXPECT INCORRECT RESULTS, ERRORS, OR ANOMALIES. YOU AGREE TO TAKE PRECAUTIONS TO OFFSET SUCH RISKS, SUCH AS TO MAINTAIN FULL BACKUPS OF STORAGE MEDIA AND TO NOT USE THE SOFTWARE WHERE PERSONAL INJURY OR PROPERTY DAMAGE MAY RESULT.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

7. LIMIT OF LIABILITY: IN NO EVENT SHALL FLIR BE LIABLE TO YOU FOR ANY CONSEQUENTIAL OR INCIDENTAL, INDIRECT, SPECIAL, OR PUNITIVE DAMAGES, INCLUDING ANY LOST PROFITS OR OPPORTUNITIES, EVEN IF A FLIR REPRESENTATIVE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. Your sole remedy for any claim is to obtain one (1) replacement copy of the Software from FLIR for each copy You have lawfully obtained and which You return to FLIR. YOU AGREE THESE ARE YOUR ONLY REMEDIES EVEN IF THEY FAIL OF THEIR ESSENTIAL PURPOSE(S).

NOTWITHSTANDING ANY OTHER PROVISION OF THIS AGREEMENT, FLIR'S MAXIMUM LIABILITY FOR ANY REASON OR IN CONNECTION WITH ANY CLAIM WILL NOT EXCEED THE AMOUNTS PAID IN THE YEAR IMMEDIATELY PRECEDING THE YEAR IN WHICH IT IS ASSERTED THE LIABILITY AROSE OR $50,000 (UNITED STATES DOLLARS), WHICHEVER IS LESS, AND SUCH LIABILITY WILL TERMINATE ONE YEAR FROM THE DATE OF THE EVENT WHICH GAVE RISE TO THE CLAIM. Some states may not allow the above exclusion or limitation of warranties, remedies or damages, so the above exclusions or limitations may not apply to You. This warranty gives You specific legal rights. You may have other rights which vary from state to state or province to province. For further warranty information, contact FLIR.

8. Governing Law and Venue: This Agreement shall be construed in accordance with, and all disputes hereunder shall be governed by, the laws of the State of Oregon, excluding its conflict of laws rules. The United Nations Convention on Contracts for the International Sale of Goods is hereby excluded in its entirety from application to this Agreement. If any term of this Agreement is inconsistent with any provision of Uniform Computer Information Transactions Act ("UCITA"), as UCITA may be enacted in Oregon or any other state whose law is applicable, such term will be enforced to the full extent allowed by law. Both Parties agree to submit to the exclusive jurisdiction and venue of either the state or federal court in Oregon. No other court in any other country or state will have jurisdiction or venue as to any legal action brought to enforce, interpret, or recover damages for a breach of this Agreement.

9. Compliance With Laws. You agree that the Software will not be shipped, transferred, or exported into any country or used in any manner prohibited by the United States Export Administration Act or any other export laws, restrictions, or regulations. Without limiting the foregoing, the Software may not be exported to Iran, Iraq, Libya, Syria, Cuba, or North Korea, or any nation with which the U.S. Government has embargoed trade. To gain access to the Software, You are certifying that You are not a national of one of these nations and will not permit anyone who is a citizen of one of these nations to have any access to the Software whatsoever.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

9.1 General Obligations. You will comply, and will cause your directors, officers and employees (and any third-parties whose services are employed in furtherance of this Agreement) to comply with all laws, regulations and executive orders of the U.S. and all other countries applicable to its performance of this Agreement, including in connection with the sale, resale, delivery, or re-delivery of the Products and information hereunder, including but not limited to the requirements of Arms Export Control Act (22 U.S.C. 2751-2794), the International Traffic in Arms Regulations ("ITAR") (22 C.F.R. 120 et seq., the Export Administration Act of 1979 (50 U.S.C. 2401-2420), the Export Administration Regulations ("EAR") (15 C.F.R. 730-774), the Office of Foreign Assets Control ("OFAC") regulations (31 C.F.R. Chapter V), the International Emergency Economic Powers Act ("IEEPA") (50 U.S.C. 1701-1706), the Trading with the Enemy Act ("TWEA") (50 U.S.C. 5, 16), Anti-Bribery Laws (as defined below), laws related to the protection of personal data, and all other applicable laws and regulations (collectively, "Laws"). FLIR shall not be liable if any government export authorization is delayed, denied, revoked, restricted or not renewed despite reasonable efforts by FLIR. Additionally, such delay, denial, revocation or non-renewal shall not constitute a breach of this Agreement. FLIR shall have no obligation to deliver any Products or information to You under this Agreement, except as permitted under Laws. FLIR reserves the right, in its sole discretion, to decline or to cancel the unshipped balance of any or all orders for any reason, including if appropriate authorization is not obtained from any governments exercising export authority, or for any violation or suspected violation of the terms of this Agreement or the Laws, and FLIR shall have no liability to You in any way for any such cancellations.

9.2 Export, Import and Related Obligations. You understand that the Products (i.e. Software) and FLIR information provided under this Agreement may be subject to export regulations by the United States or other governments, and agree that you will not provide nor assist in providing the Products or such information to a customer or potential customer, without ensuring clearance from FLIR for the purpose of compliance with the EAR, ITAR and other applicable Laws. You shall comply with the Laws as well as all laws and regulations in your jurisdiction and any other jurisdiction related to the import, export, re-export, transfer, shipping, sale, re-sale and/or use of the Products and information. You agree that you will not export, reexport, sell, distribute, disclose, release or otherwise transfer any Product or information provided under this Agreement to any country, person, or entity prohibited under Laws, including but not limited to parties and entities: (i) located, organized, or ordinarily resident in a country or territory that is, or whose government is, the target of comprehensive U.S. trade sanctions, including the Crimea Region, Cuba, Iran, North Korea, and Syria, (ii) located, organized, or ordinarily resident in a country designated as a "State Sponsor of Terrorism" by the U.S. Department of State, or (iii) identified on the Specially Designated Nationals and Blocked Persons List, the Denied Persons List, the Entity List, the Unverified List, or the Debarred List, or any other applicable prohibited party list of the U.S. Government, without U.S. Government authorization. This clause applies regardless of the legality of such a transaction

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

under local law. You shall screen all potential customers against applicable restricted persons lists prior to any direct or indirect transfer of Products or information subject to this Agreement. This clause will apply regardless of the legality of such a transaction under local law. Neither the country of shipment nor Product country of origin (manufacture) denoted on shipping documentation are confirmation of Free Trade Agreement ("FTA") eligibility. Rules of origin for each specific FTA differ. FTA eligibility will be certified by Buyer's trained and qualified FTA specialist and will only be certified as eligible if Products meet the qualification requirements.

9.3 Restriction on Military Use. Except as permitted, You shall not use any Products sold by FLIR for any military end-use or to a military end-user, or resell them for such purpose, especially for sales made into China, Russia and Venezuela.

9.4 Anti-Bribery Laws. You understand the requirements of the U.S. Foreign Corrupt Practices Act of 1977 ("FCPA"), the UK Bribery Act 2010 and all other applicable laws related to anti-bribery and corruption (collectively, the "Anti-Bribery Laws") and agree to strictly comply therewith. You certify that you have not and will not engage in the bribery of Foreign Officials by directly or indirectly paying money or giving anything of value to any Foreign Official or offering the same in order to influence any action or decision for the purpose of obtaining or retaining business or securing any competitive advantage. You further agree that you will maintain and enforce a policy that prohibits the bribery of Foreign Officials. You may view the FCPA in its entirety at: www.usdoj.gov. If required, You have disclosed to FLIR during the due diligence process the identity of your owners, chief executive officer, senior sales official and other personnel who will be involved in the proposed relationship with FLIR. Company will promptly notify FLIR in writing of any changes in the individuals holding these positions, and provide curriculum vitaes (resumés) upon FLIR's request

9.6 Government Interests; Foreign Officials. Except as otherwise disclosed to FLIR in the due diligence questionnaire submitted to FLIR, (a) You are not and will not be directly or indirectly Government-owned, in whole or in part, and none of your officers, directors or personnel who will be performing work in connection with this Agreement is a Foreign Official and (b) if the company is a non-public business entity, You also represent, warrant and covenant that none of its owners, partners or shareholders is a Foreign Official.

10. Entire Agreement: You acknowledge that You have read this Agreement, understand it and that it is the complete and exclusive statement of Your agreement with FLIR which supersedes any prior agreement, oral or written, between FLIR and You. No variation of the terms of this Agreement will be enforceable against FLIR unless FLIR gives its express consent, in writing signed by an officer of FLIR.

11. Notice to Government End Users: If this Software is acquired by or on behalf of any unit or agency of the United States Government, this provision applies. This Software (a) is a trade

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

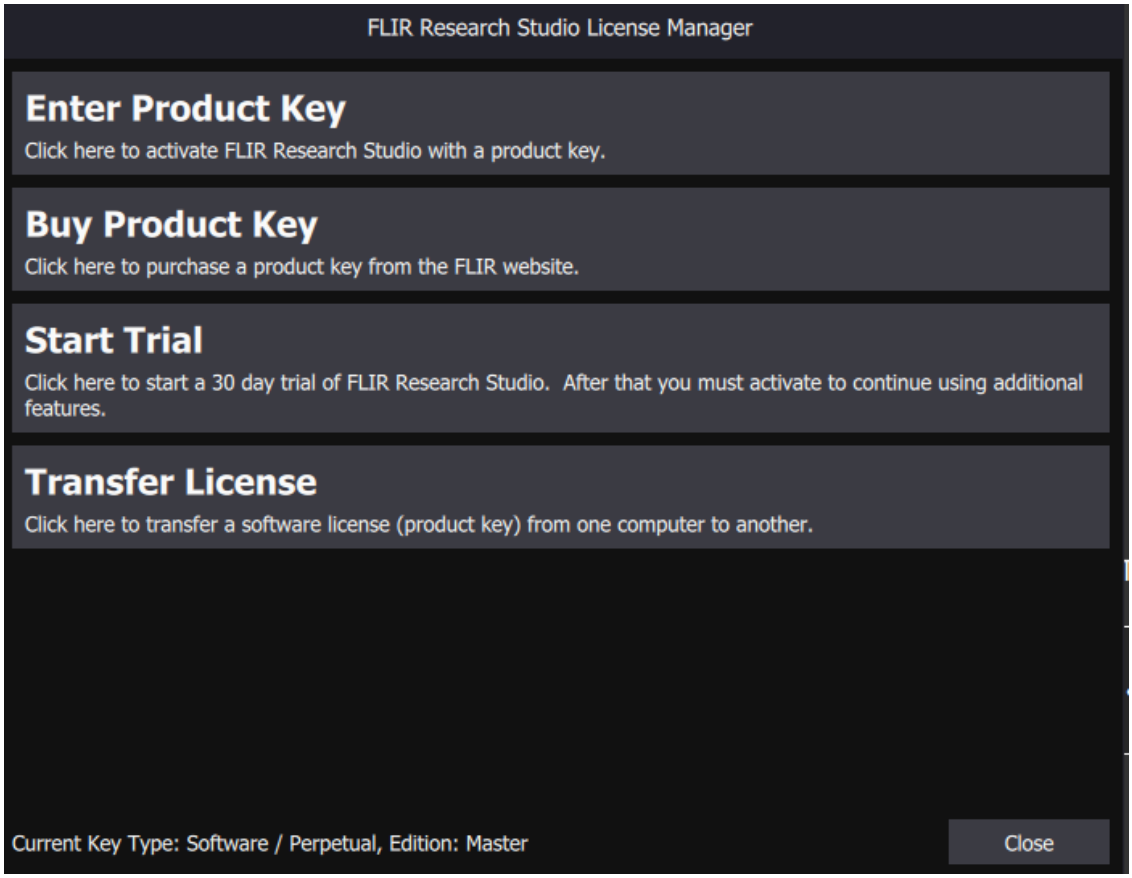
secret of FLIR for all purposes of the Freedom of Information Act, (b) is provided with RESTRICTED RIGHTS in accordance with subparagraphs (c)(1) and (2) of the Commercial Computer Software-Restricted Rights Clause at 48 CFR 52.227-19, (c) in all respects is proprietary data belonging solely to FLIR, and (d) all rights are reserved under the copyright laws of the United States. For units of the Department of Defense (DoD), this Software is licensed only with "Restricted Rights" as set forth in subparagraph (c)(1) (ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.227-7013 and 7014. Government users other than under a DoD or GSA contract are notified that use of this Software is subject to restrictions that are the same as or similar to those set forth above, and FLIR are trademarks of FLIR. Unauthorized use prohibited.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.

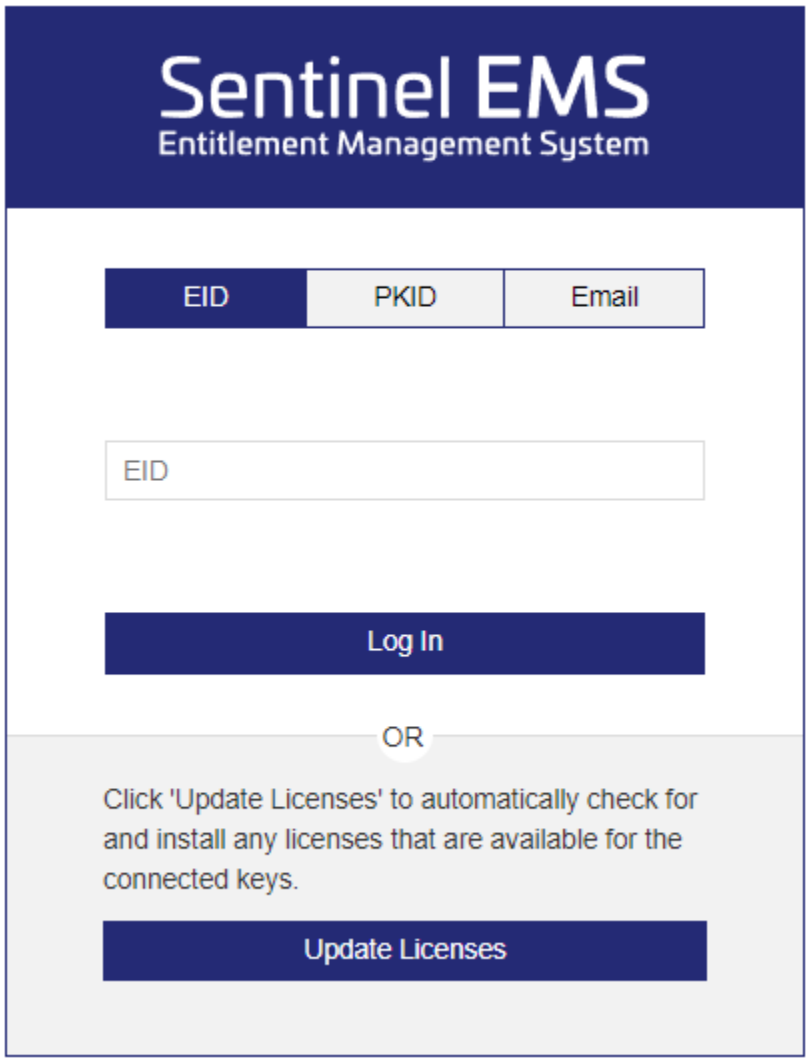
1.6 Check Your License

You can check the status of your license key here on our license server:

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

https://teledyneflir.prod.sentinelcloud.com/ems/customerLogin.html

On this page, enter your EID, which is also known as your product key:



If your key has been previously activated, you will see information about the number of activations and the amount remaining.

If you see a screen asking for registration information, this indicates that the product has never been activated.

For further information on activating your license, either online or offline, please reference the installation guide which can be downloaded from here:

https://support.flir.com/researchstudio

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

1.7 Customer Support

If you need assistance with licensing, installation, or have found an issue with the application, please open a ticket on our support website:

http://flir.custhelp.com

Be sure to include information in your problem description and any error codes or messages that were displayed. If you can reach the Gather Information dialog and save off the text file, please submit this as well. This will provide the support agent with more details that can be used to troubleshoot your problem.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

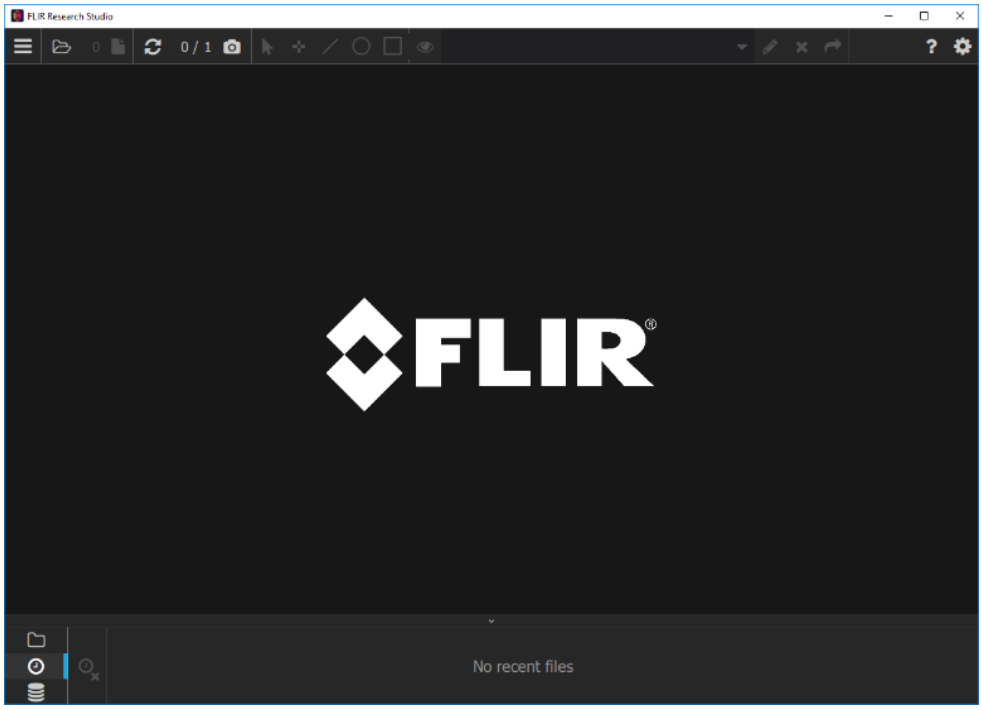
2 Connect

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:



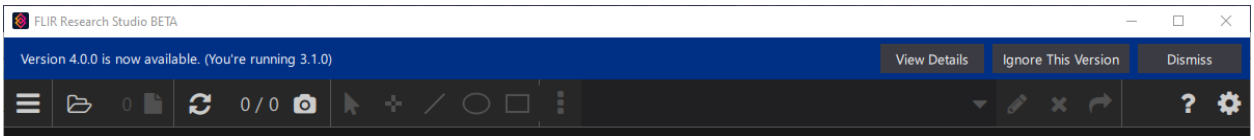
The place to start using the software is the top bar of the application:



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

2.2 Check for Updates

If connected to the internet, Research Studio will automatically look to see if a newer revision is available on the FLIR download page. If so, a blue banner across the top of the window will inform the user of the newer version, as seen below.



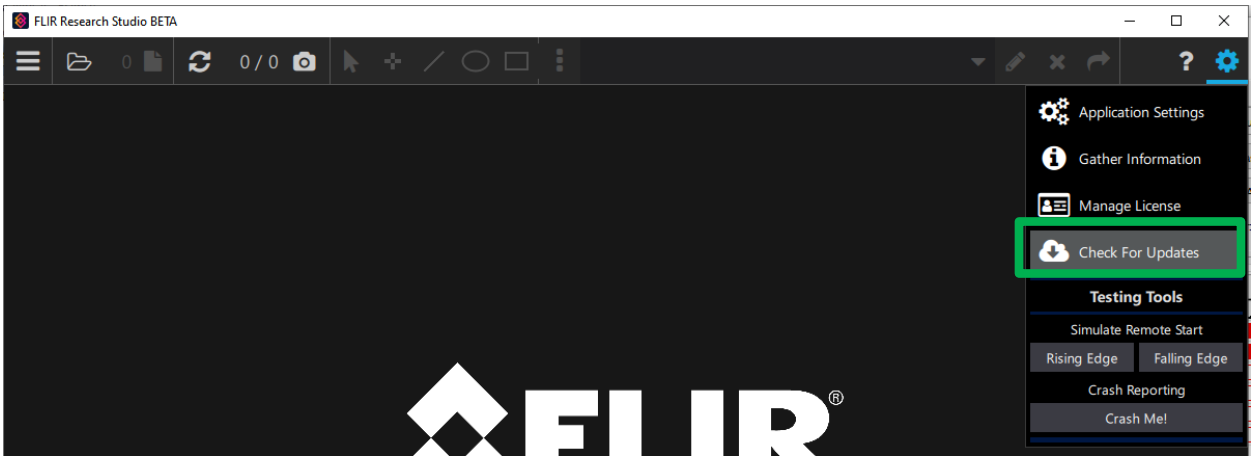
The banner has three options:

View Details - Brings up the Software Update window (see *2.2.1 Software Update*).

Ignore This Version – Clears the warning banner. Will continue checking for the latest version on start-up but will no longer inform the user of this current version if it's the latest one.

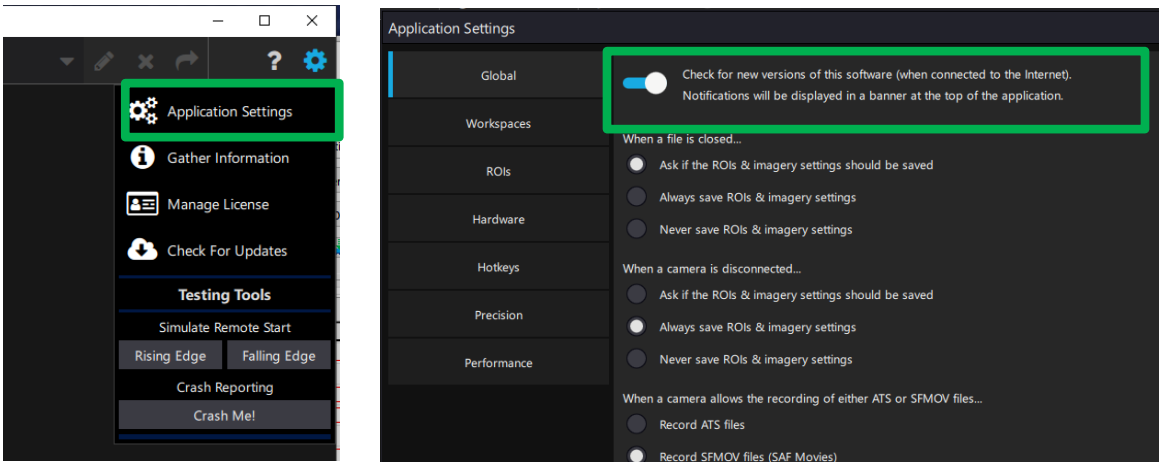
Dismiss – Clears the warning banner. Will continue checking for the latest version on start-up and will inform the user of this version on next start-up.

The user can manually check for updates by clicking the Check For Updates option under the Settings, located on the right of the top tool bar. This will bring up the Software Update window (see *2.2.1 Software Update*).



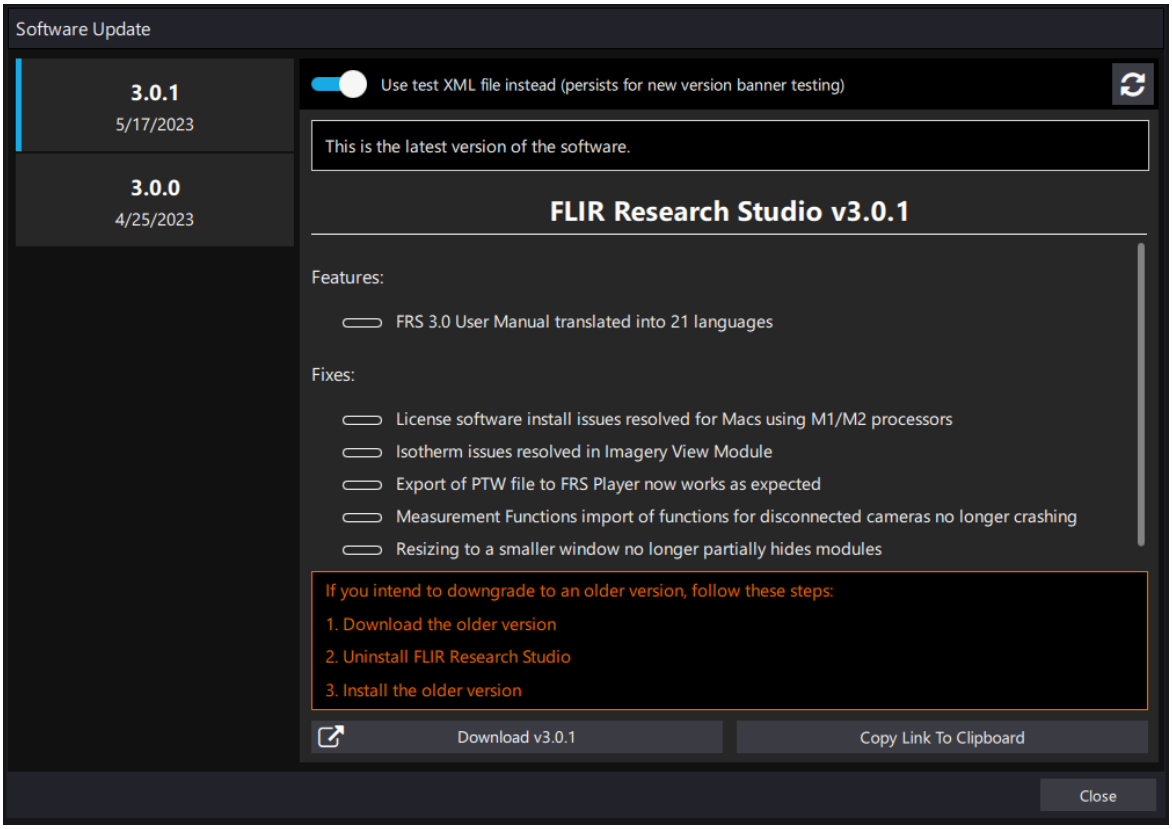
To disable automatic checking for the latest software revision, disable the *Check for new versions of this software…* selection located in the Application Settings window. To access this window, select the Application Settings choice under the Settings on the right of the top menu bar.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



2.2.1 Software Update Window

The Software Update window is accessed either from the View Details button on the New Revision Banner or by the Check For Updates option under the Settings pulldown, located on the right of the top tool bar.



The left side of the window lists all the revisions available for download. The latest revision will have a blue bar on the side (in this case, revision 3.0.1 is marked as the latest). In the middle of the window is a short description of the Features and Fixes (bug fixes) notable for this release. Features marked with PRO require the PRO version of the Research Studio license to access.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

To download a revision, select the desired revision on the left of the window and then click the Download button on the bottom of the screen. The Copy Link To Clipboard button will copy the download link that can then be pasted in a web browser to manually download the revision. This feature is for firewalls that block applications from downloading.

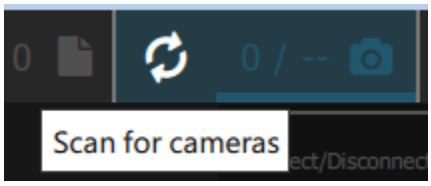
Once the download is complete, refer to *1.2 Installation* on how to install the new version.

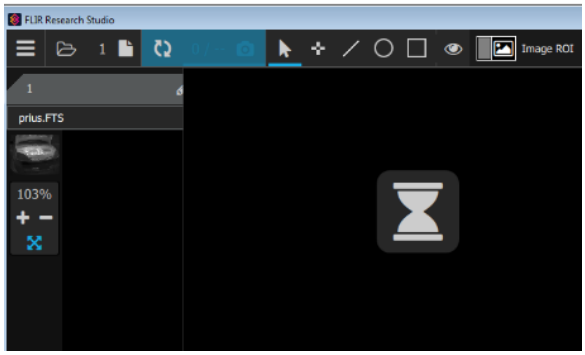
2.3 Camera Detection & Connection

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.



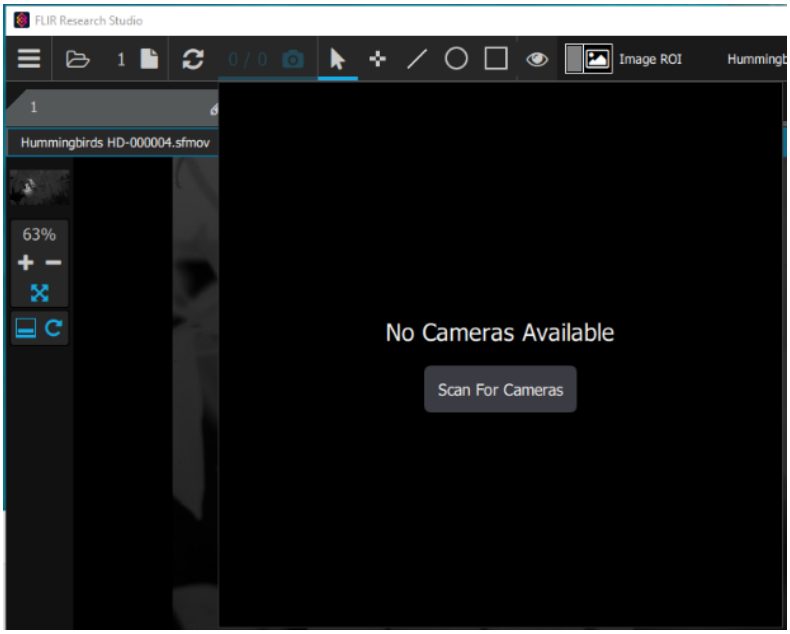
If the user presses the two arrows icon, the scan process begins and the control pulses with a blue shade to it. An hourglass appears as well.





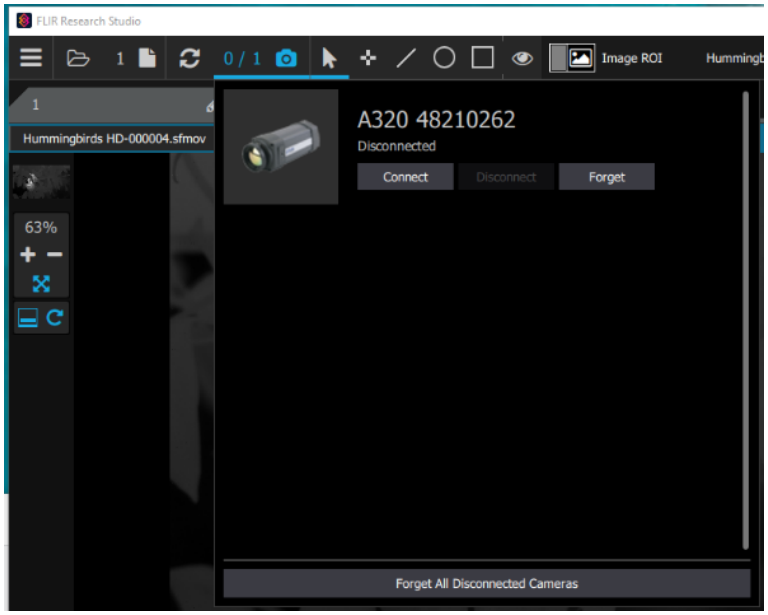
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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:

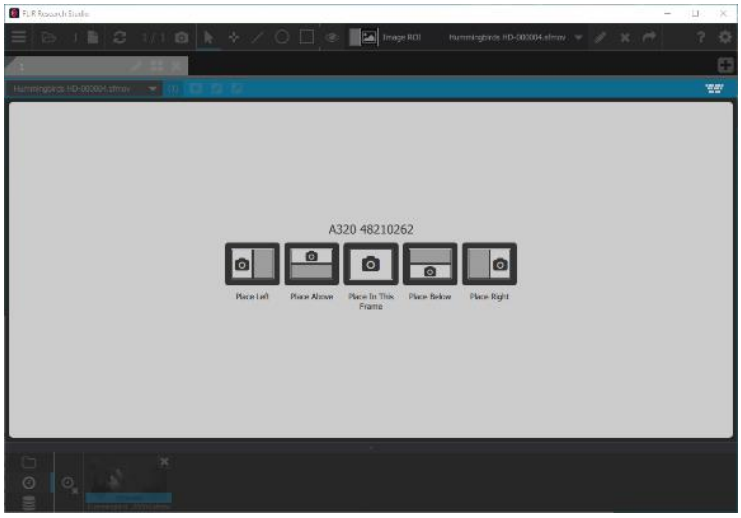
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



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.

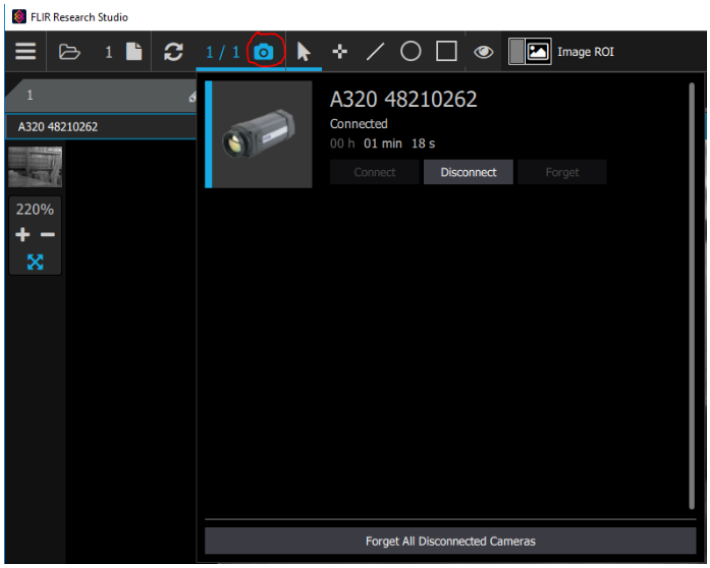
Note: At the end of the scanning process, if no camera is found, but there have been cameras connected previously, then this window will show what cameras have been previously connected. Clicking on the Connect button will initiate an attempt to connect to the camera.

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:

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



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

2.4 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)
X-HS-series (X6980HS, X8580HS)
RS-HS-series (RS8500HS)

*USB connection and streaming not supported on macOS 11 Big Sur and above

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

2.5 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. Be sure to follow the manufacturer's installation process for each frame grabber.

The following frame grabbers are supported in Research Studio. The IO Industries Core2 must use the exact version of CoreView listed for Research Studio to work with it. The other frame grabber versions are what was last tested, other versions may or may not work.

Frame Grabber	Interface	Operating System	Firmware Version
Euresys Coaxlink Quad G3	CoaXPress	Windows, Linux, and macOS	eGrabber 23.8.0.10 or 23.8.0.11
Euresys Coaxlink Duo	CoaXPress	Windows, Linux, and macOS	eGrabber 23.8.0.10 or 23.8.0.11
Euresys Coaxlink Quad CXP-12	CoaXPress	Windows, Linux, and macOS	eGrabber 24.04.0.2
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 Duo	CameraLink	Windows, Linux, and macOS	eGrabber 23.8.0.10 or 23.8.0.11
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

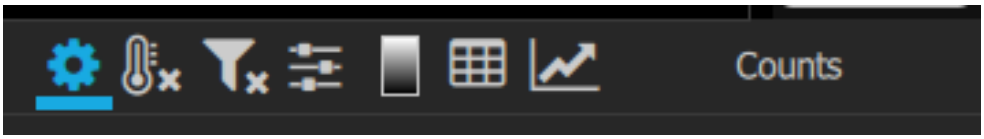
Note: Other frame grabbers in the DALSA Xtium, DALSA Xtium2, DALSA Xcelera, Euresys Coaxlink, and Euresys Grablink product lines may work, but are not tested.

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.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

2.6 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

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

SSD page of the camera controller. See the X-series user manual for more details.

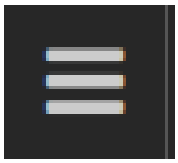
* SSD direct movie reading is not supported in macOS 10.15 Catalina and above.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.

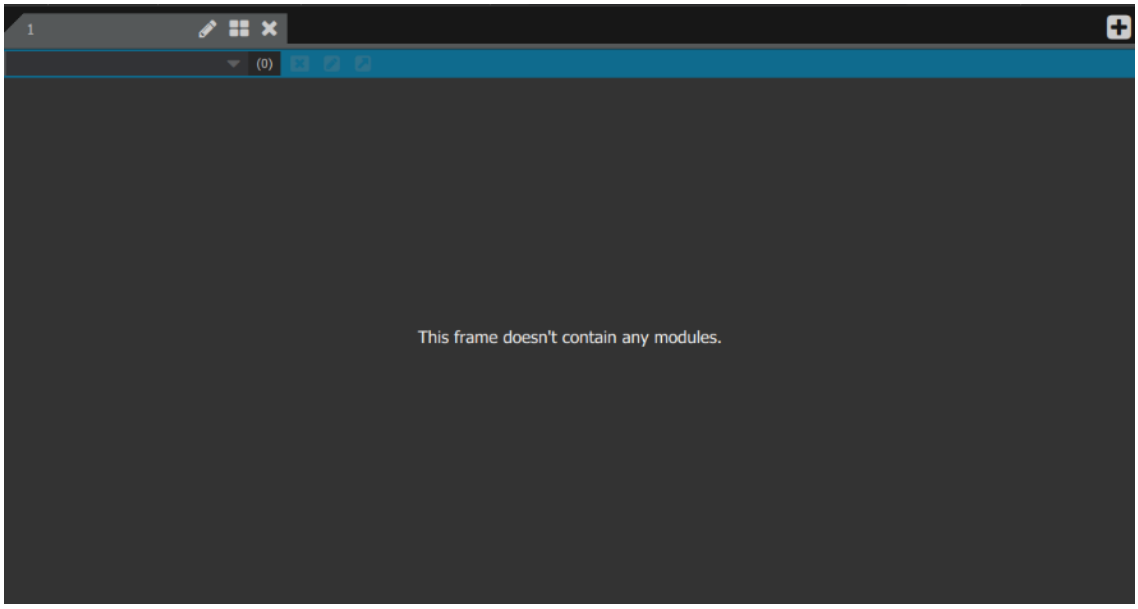


3.2 Workspaces (Tabs, Layouts & Frames)

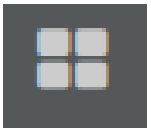
The design of FRS makes it possible to open multiple files, live cameras, and plots all at once. These different items can be displayed within the same window using Tabs, Layouts, Frames, and Modules.

3.2.1 Overview

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

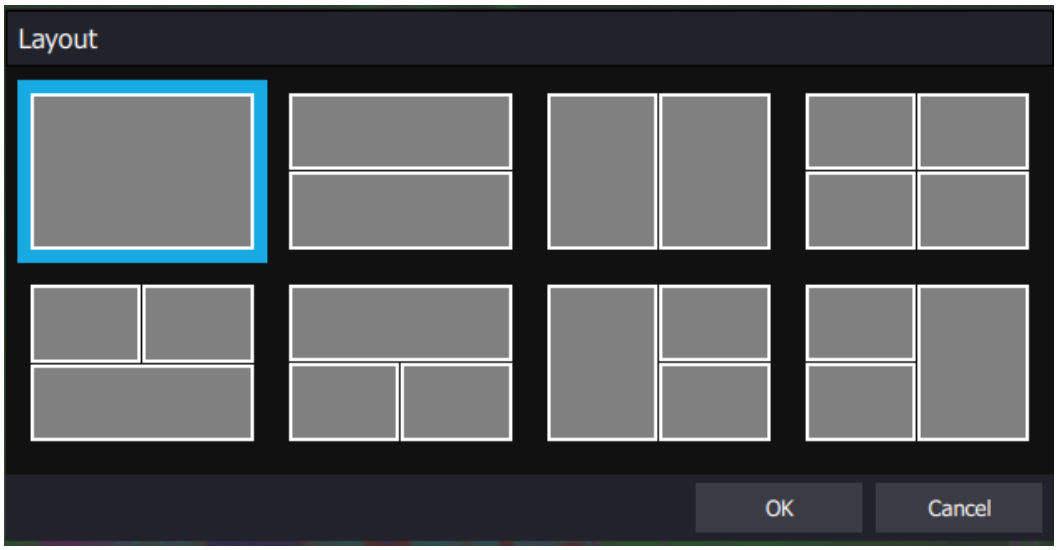


The Tab can be reconfigured to show multiple frames using the Layout button.

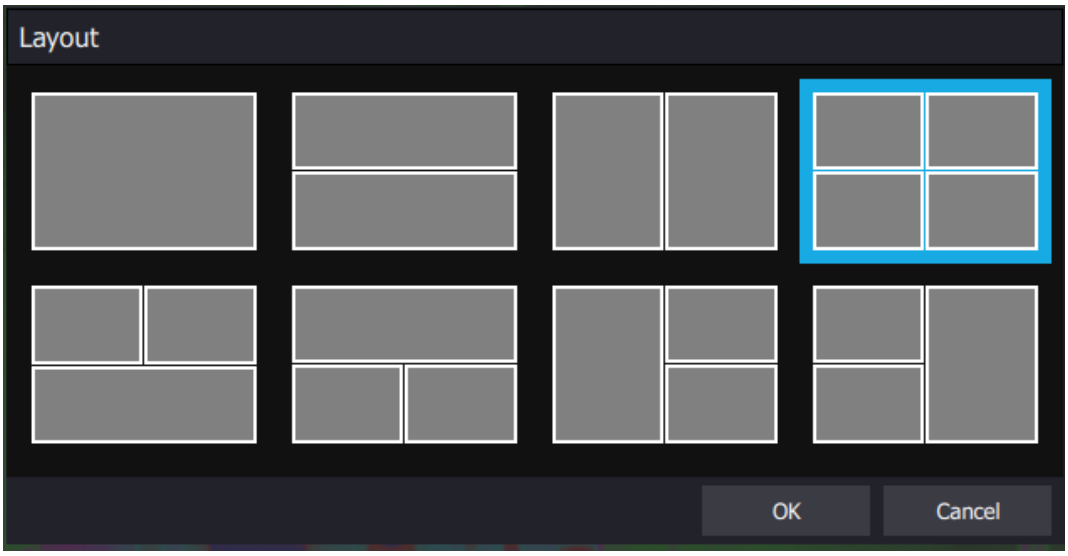


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

This button brings up the following window:

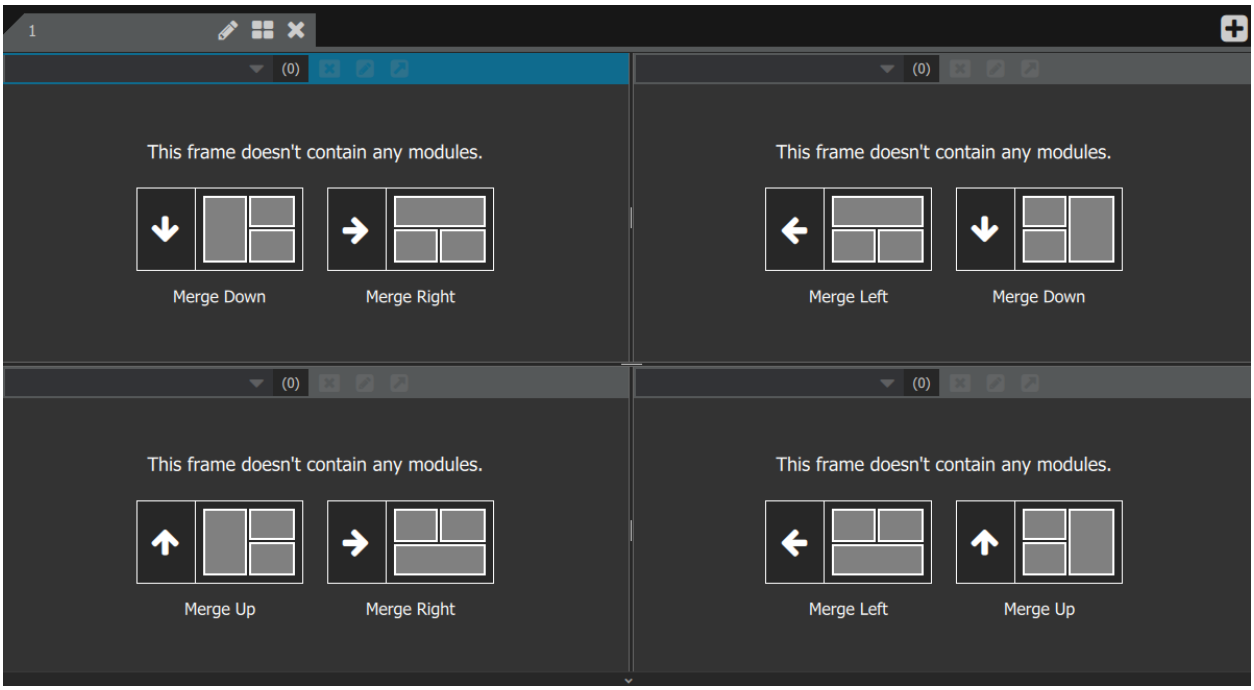


The user can select a layout with up to four frames.



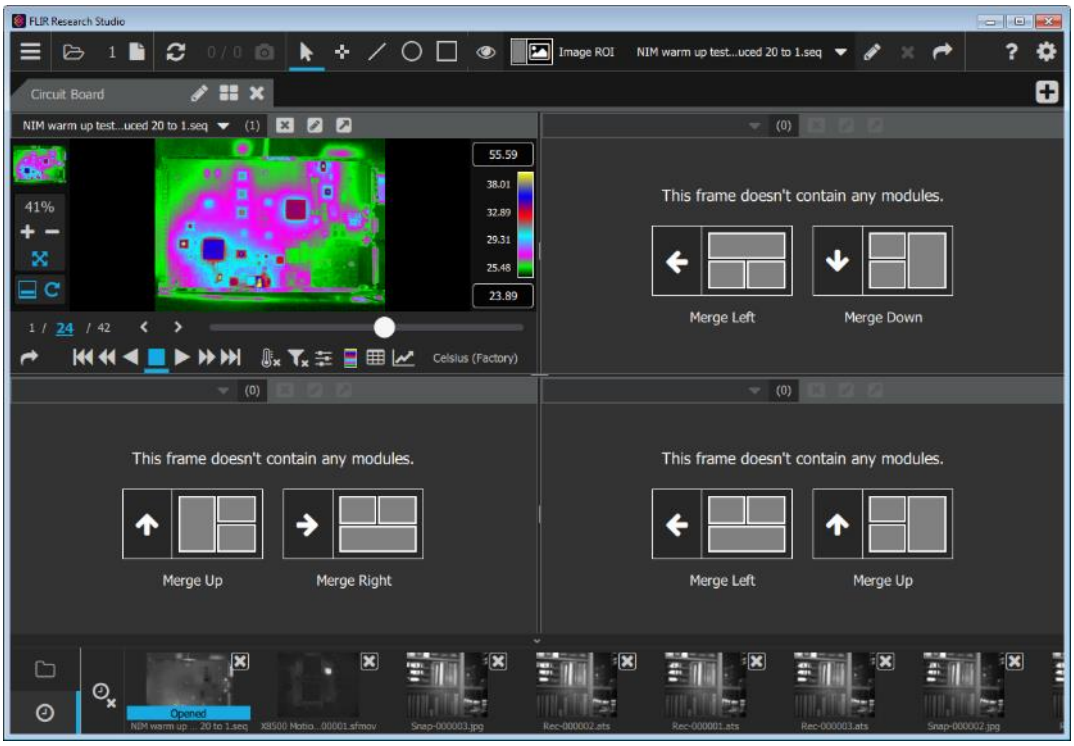
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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

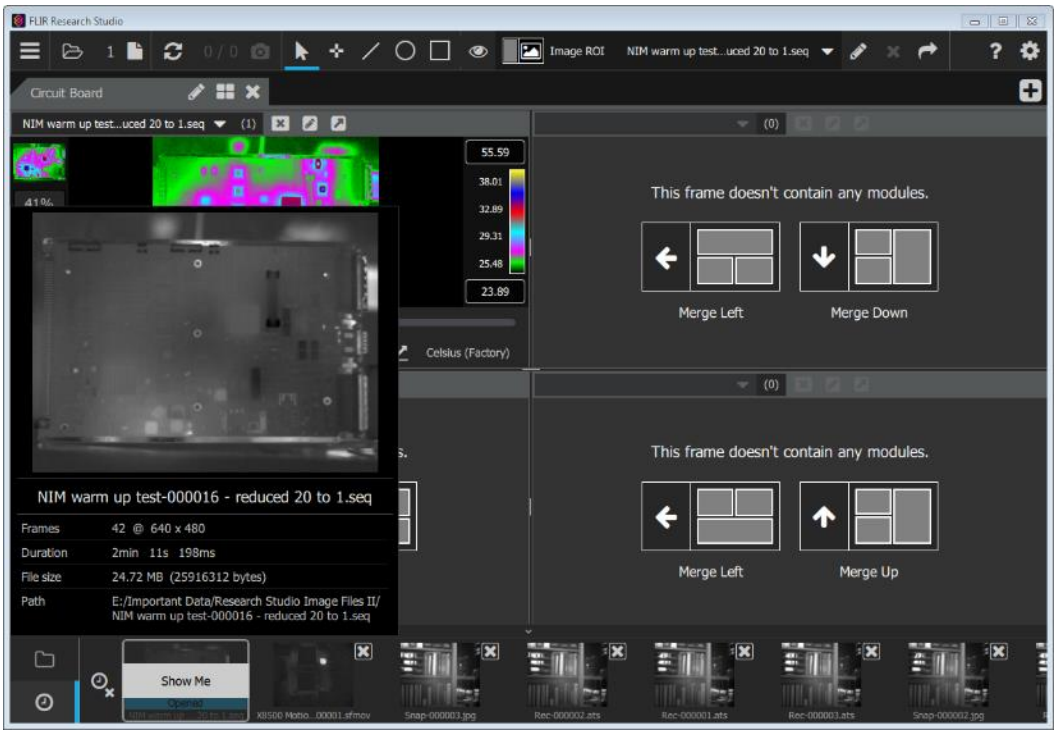


When a file is opened or a camera is connected it can be placed in any frame on any tab. The same frame can contain multiple modules that will be stacked on each other. Stacked modules can be selected using the drop list in the upper left corner of the frame.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

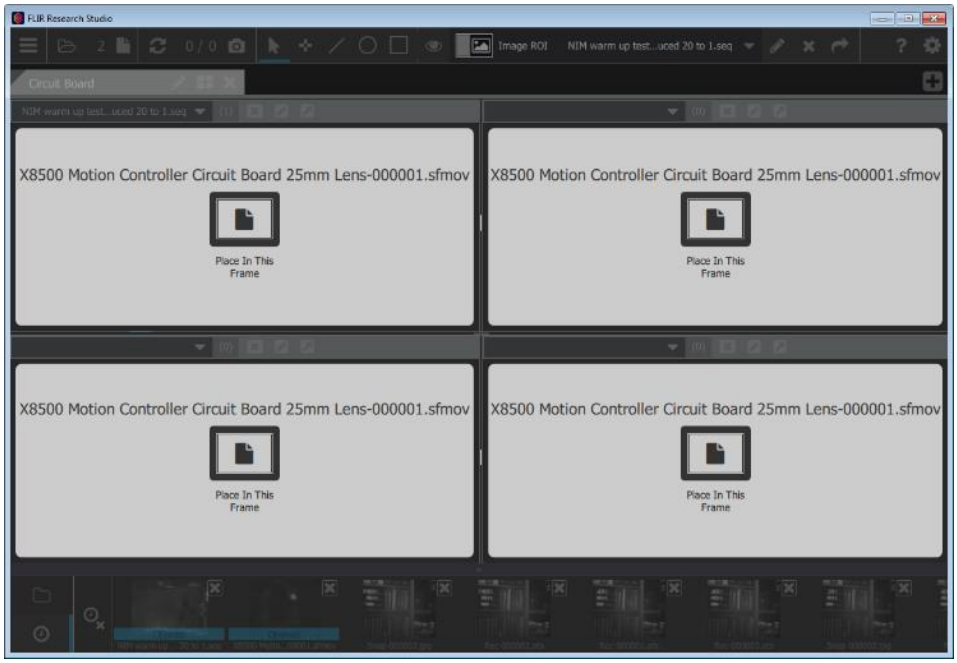


Note the circuit board movie shows as “Opened” in the preview thumbnail view on the bottom bar. The user can now open more files into the blank modules. Clicking once on the thumbnail brings up a larger view of it, and information about the file.

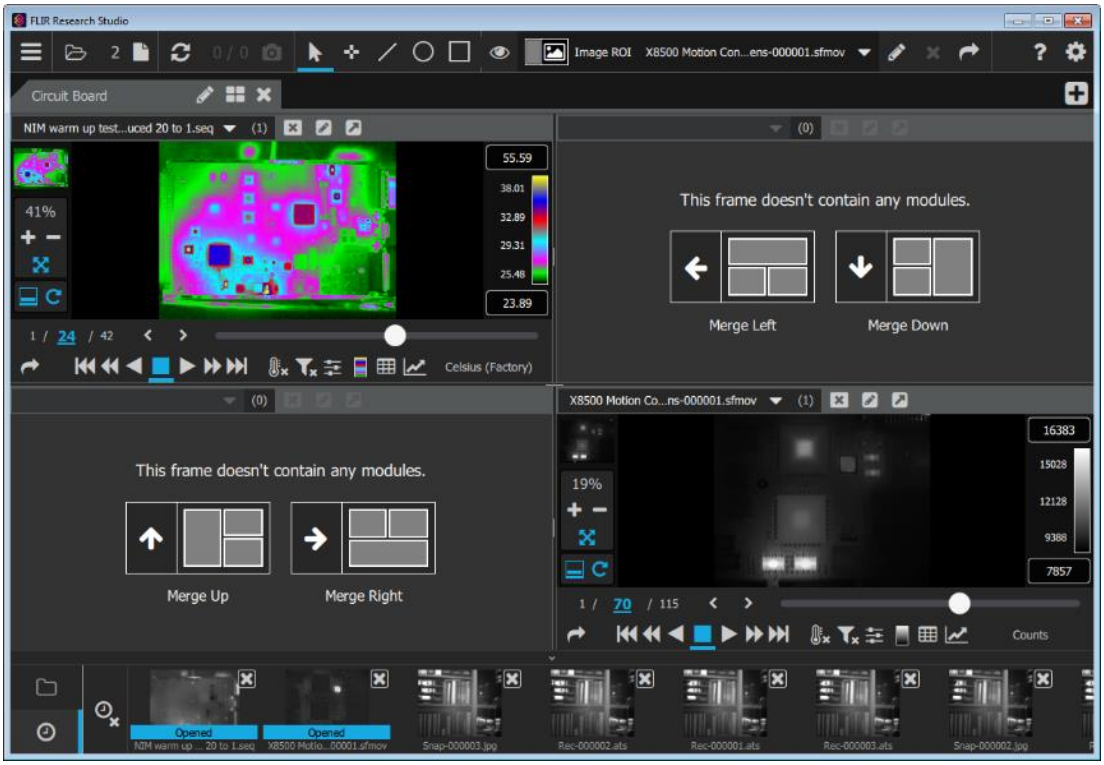


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.

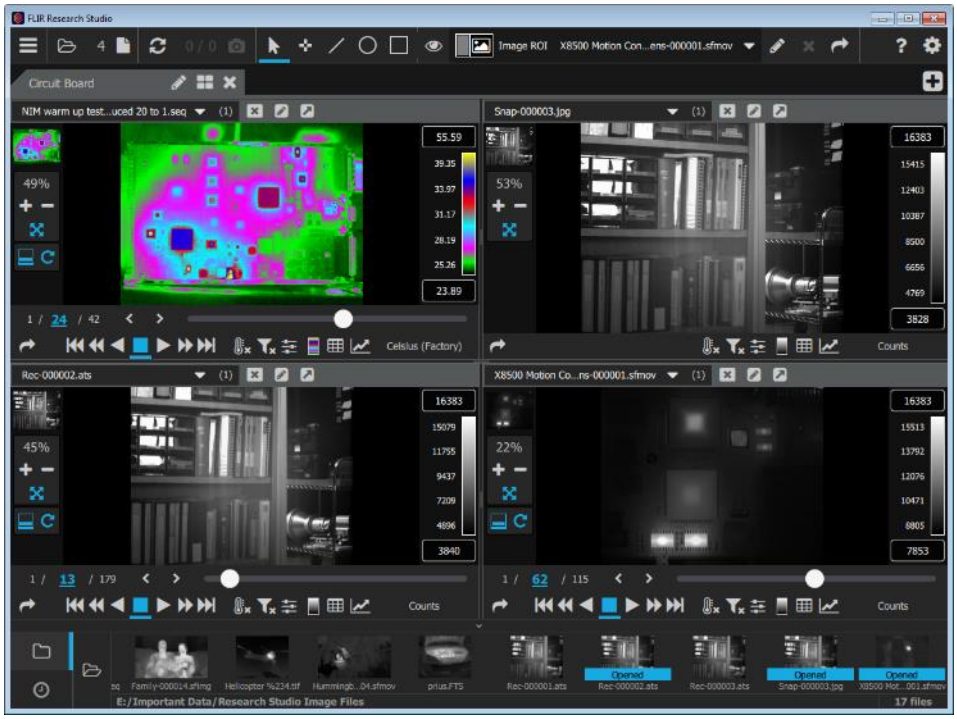


In this case, the new image was placed in the lower right corner:



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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:



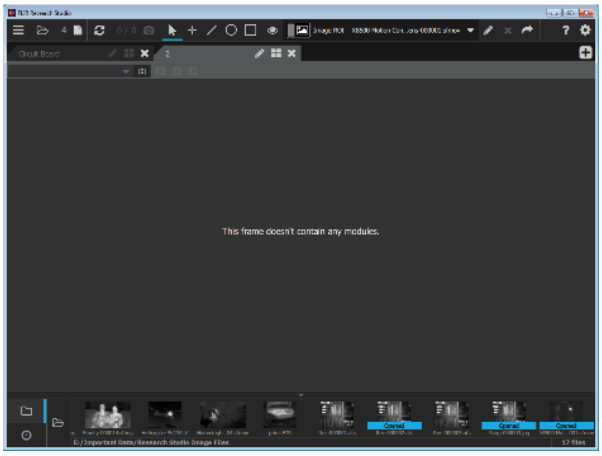
3.2.2 Naming and Adding Tabs

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:



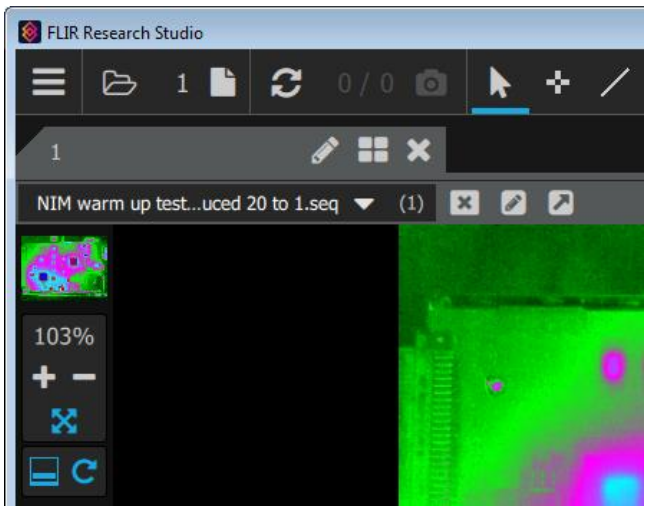
Each tab can have its own layout of frames and modules:

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



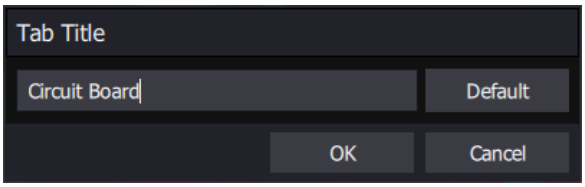
If multiple Tabs are being opened, it is a good idea to give them names that are more informative than the default names 1, 2, etc.

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:



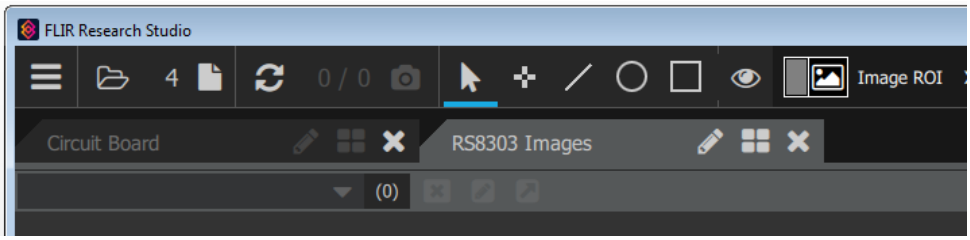




WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

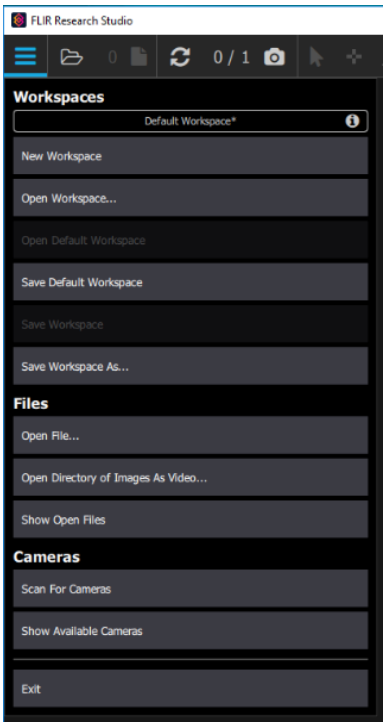
These names do not persist over a restart of the software, unless they are saved in a workspace file. The option to save a workspace is found in the Main Menu

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

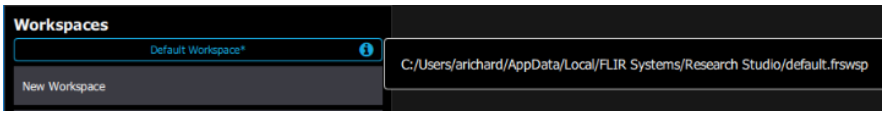


3.2.3 Saving and Opening Workspaces

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.

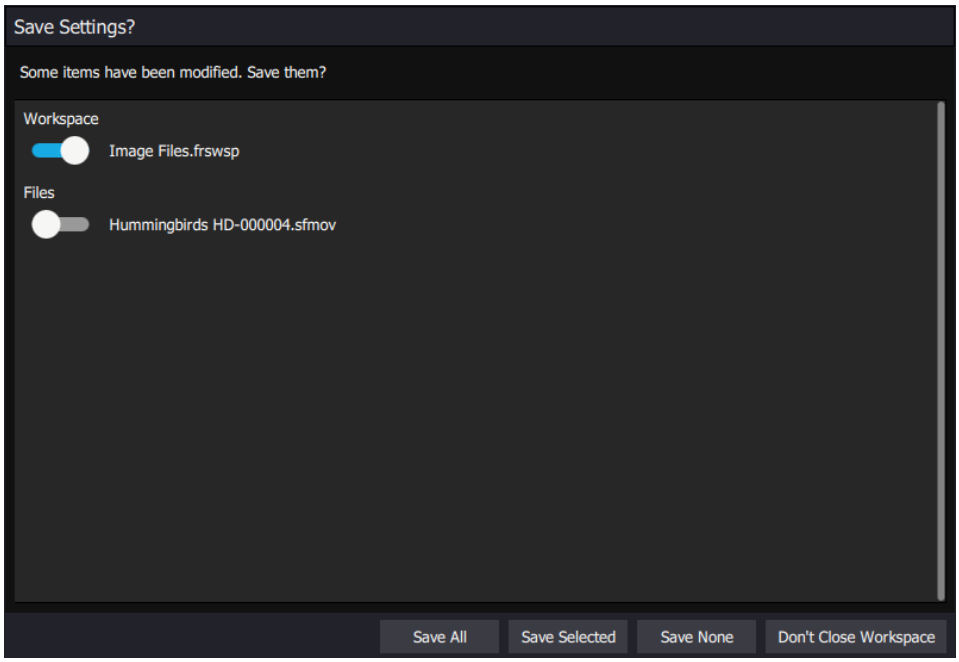


The default workspace path is shown in the top of the screenshot above when the user “mouses” over the little “i” in a circle. There is always a default workspace and it is always in the same place. In the case of the computer used for writing this manual, it is here:

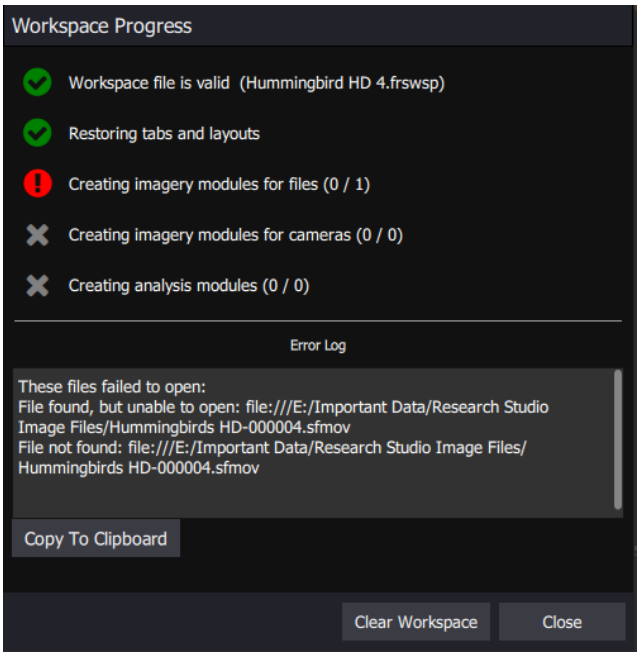


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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 saved (optionally, you can drag and drop a workspace file into the application), 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:

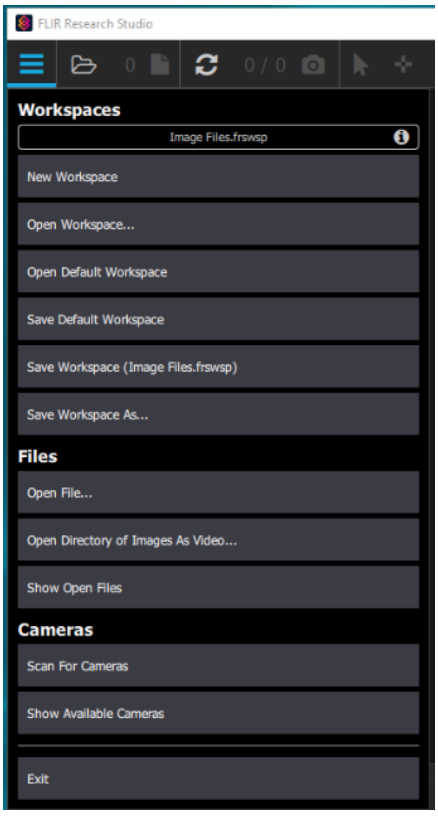


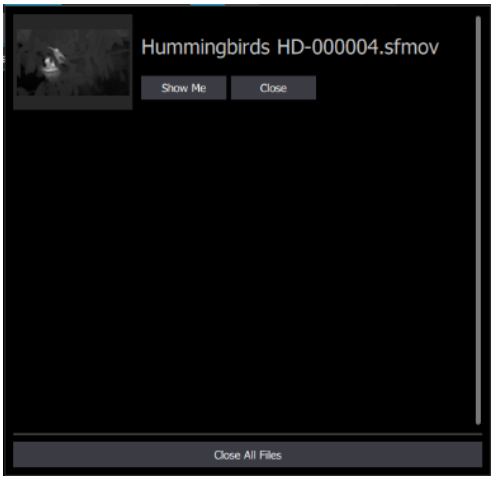
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

Research Studio 3.1 and later supports relative paths in workspaces. So if one saves the workspace and all associated files in a single folder, that folder can copied to another computer/directory and the workspace can still be opened.

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:



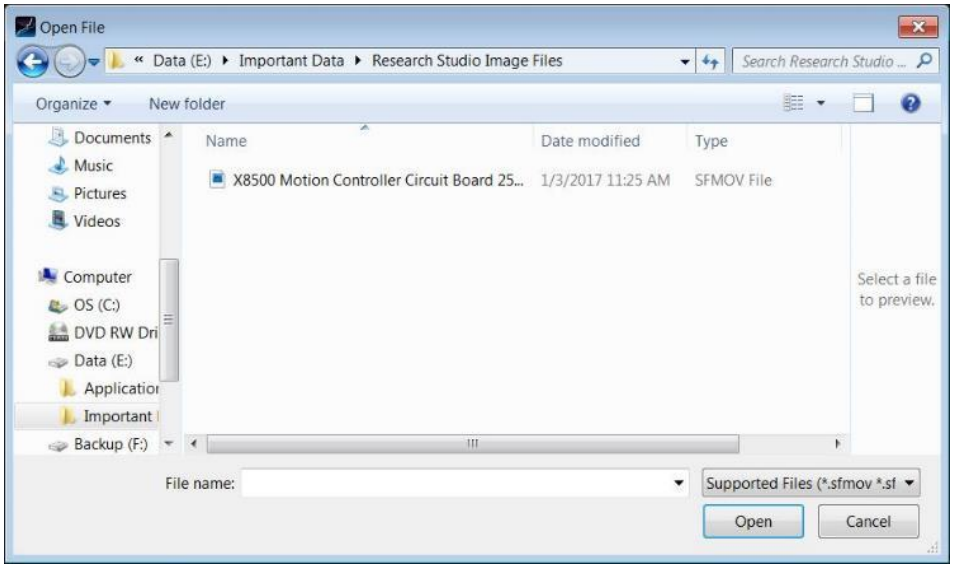


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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



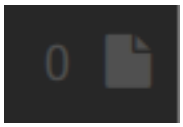
Clicking on this icon brings up a file explorer window:



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.

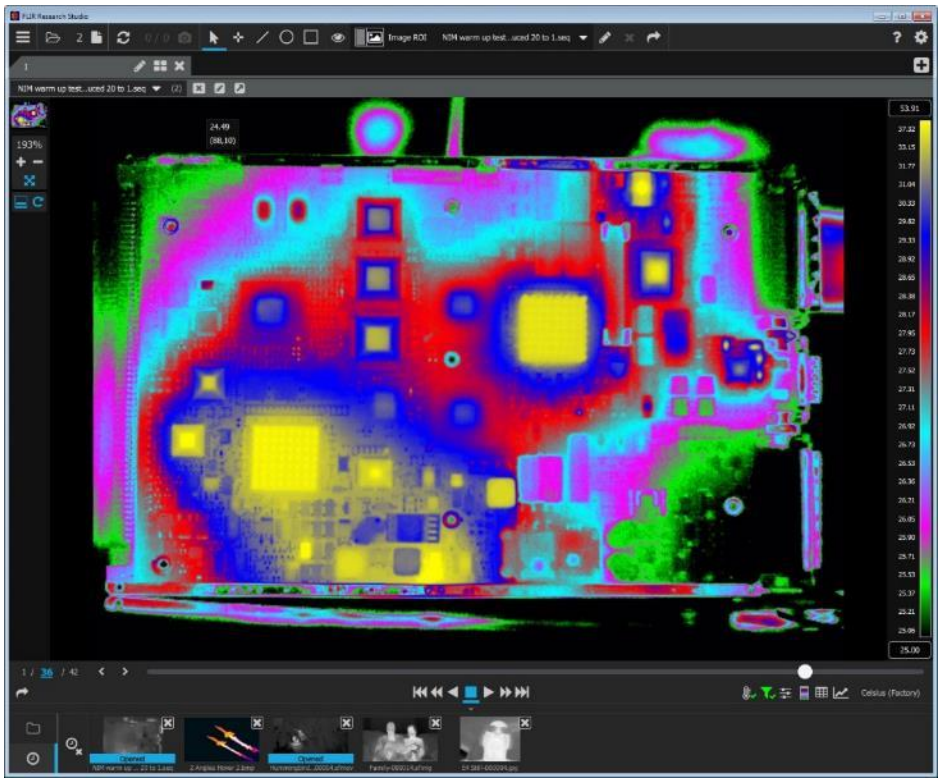


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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

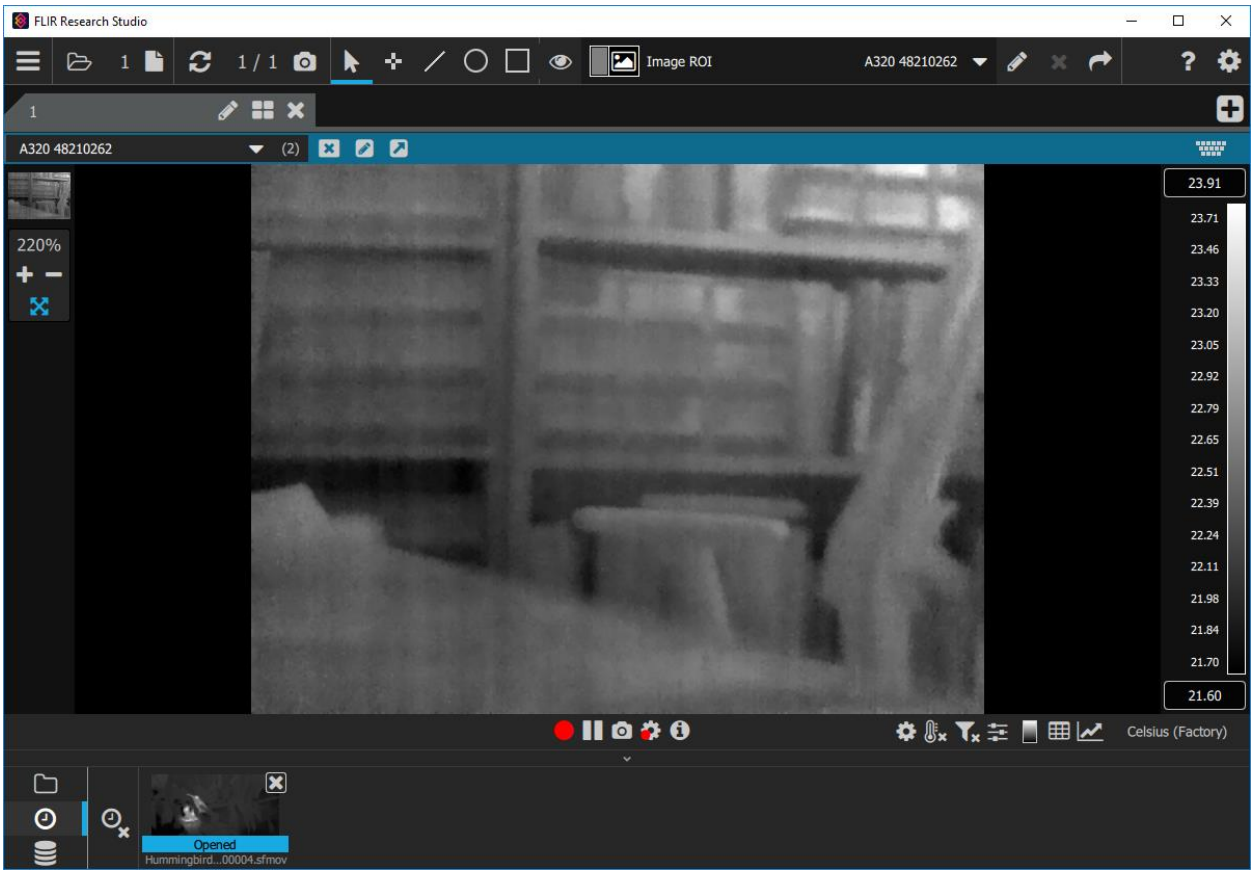
Table modules (Discussed in the analysis section): Can contain Source Information, Metadata, or Statistics

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:

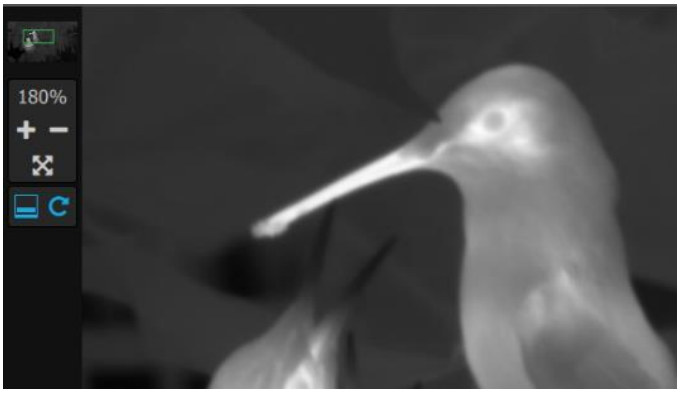


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

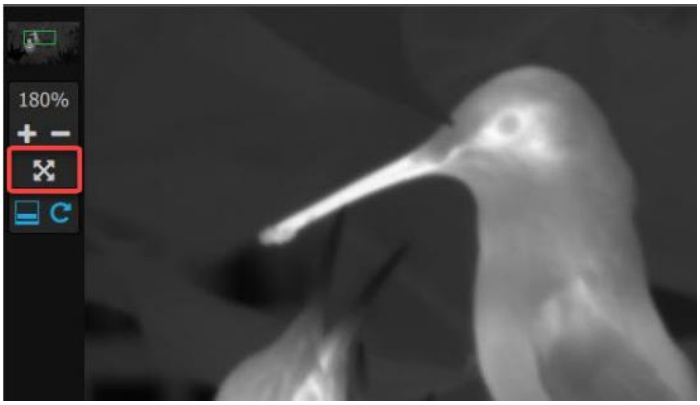
3.4.2 Zoom Control

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.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

3.4.3 Basic Playback Controls

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



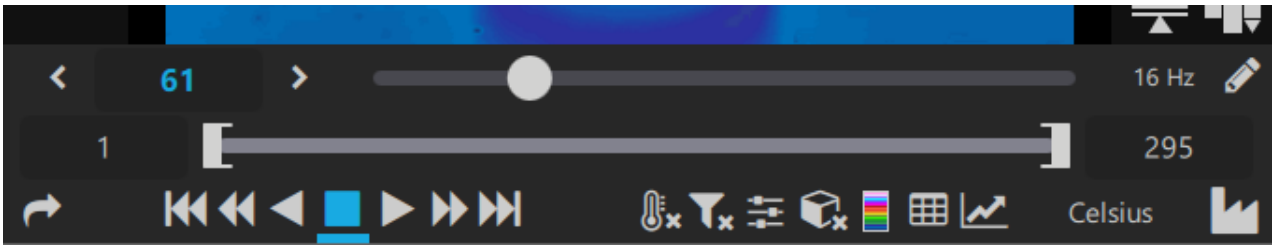
The center button is stop, then there is play forward/backward, fast forward/fast backward (10 times the target frame rate) and skip to the end/beginning of the movie file. When the control is active, it turns blue.

The left side panel contains the sliders visibility toggle and the playback loop toggle.

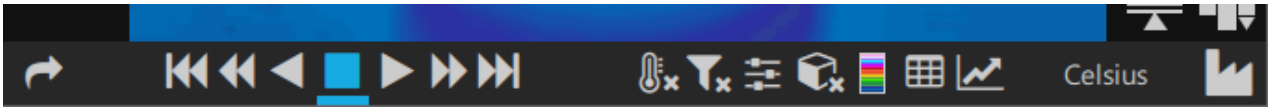


The sliders visibility toggle is useful when you want to reclaim some space for your image or don't need to interact with the frame number or time fields.

When the toggle is on, the sliders will be visible:



When the toggle is off, the sliders will disappear:

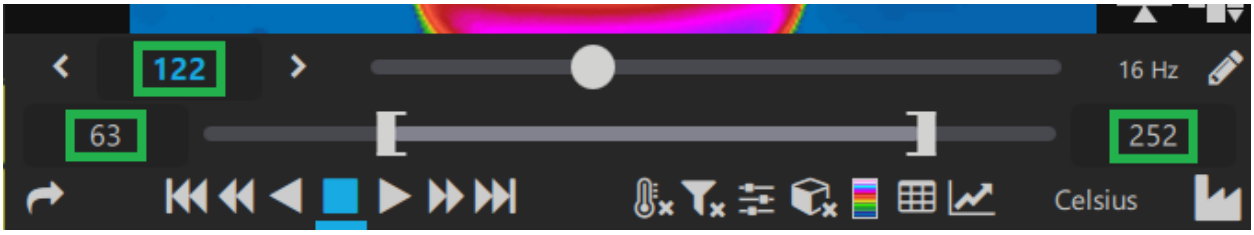


The next button is the playback loop toggle. When on, it will loop the playback back to the beginning after it reaches the end. When off, the playback will stop when the end of the file is reached.

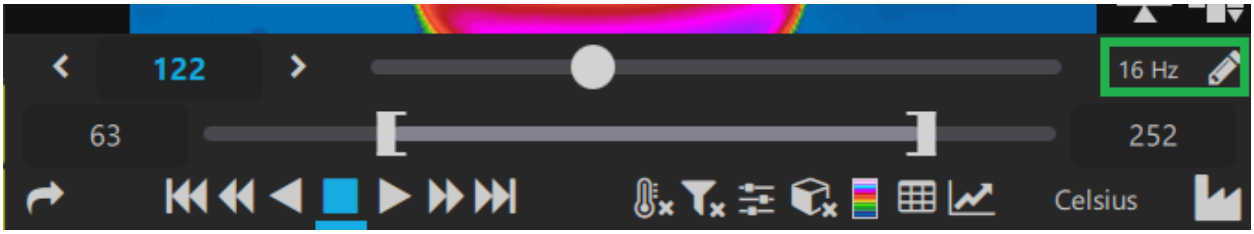
3.4.4 Playback Bar

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

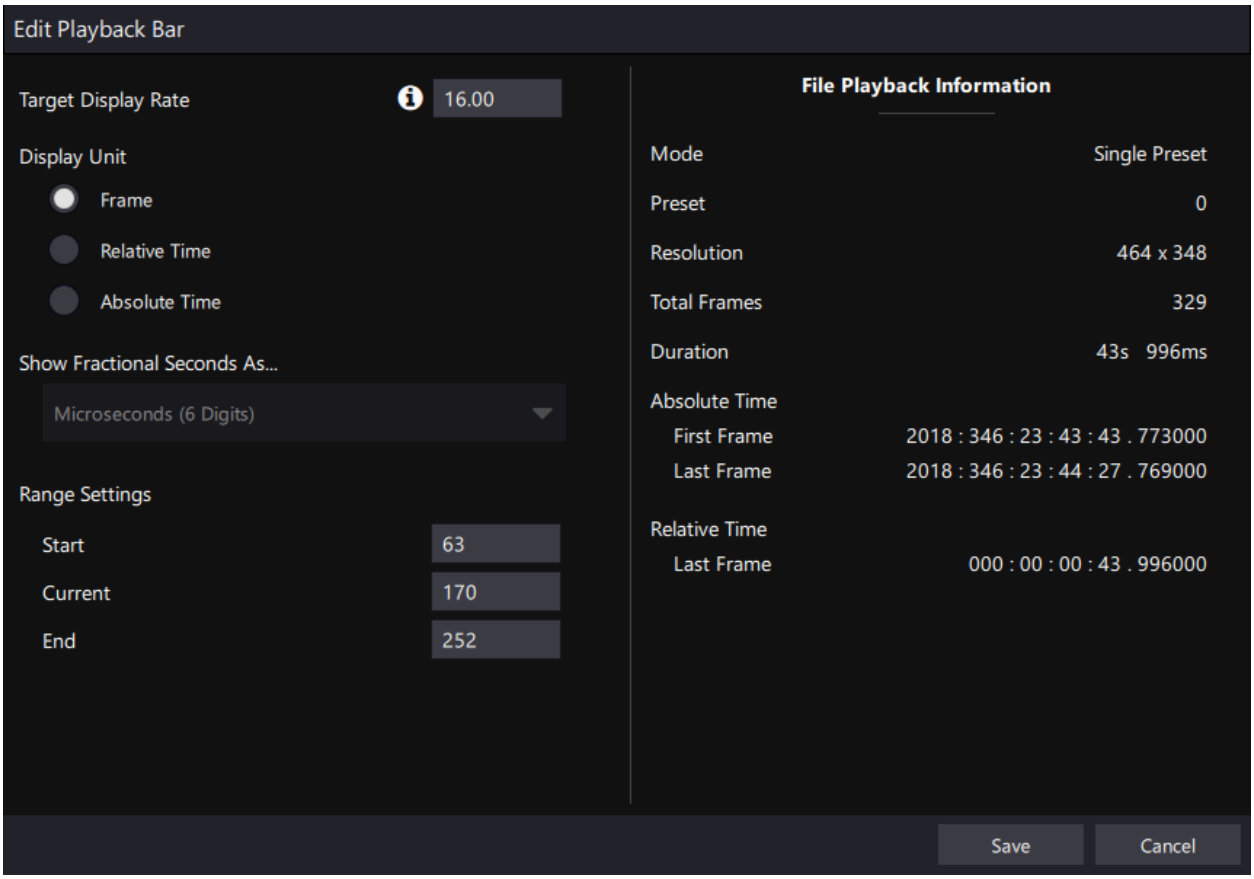
When a movie is opened, a set of frame controls opens beneath it. These allow the user to select which frame of the movie is displayed and the playback bounds for looping. The user can select the frame to display by clicking the frame number (or time) to type in a value or by using the scroll bar. The playback bounds can each be clicked to edit in the same way, or the range slider can be used to set the values. Setting the bounds also trims the clip for the extract and export features.



The Edit Playback Bar button shows the target frame rate for playback. When clicked, it shows a dialog to configure how the file is played. It also presents a summary of information about the file itself.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



The playback configuration allows the user the change the following:

Target Display Rate	This is the rate at which the application will attempt to playback the file at. The range is between 0.01 Hz and 60 Hz, and the default is 16 Hz. The speed and hardware of the system will determine if the rate entered is actually possible.
Display Unit	This determines which unit is used for the start, current, and end frames on the Playback Bar. The default for a newly opened file can be set in the Application Settings, but when a workspace is saved, the last setting will be retained there. When selecting one of the time options, the times are shown using the IRIG format: Day of year, Hours, Minutes, Seconds, and either Milliseconds or Microseconds, depending on the next item
Show Fractional Seconds As…	When a the time option is chosen for the Display Unit, this determines how many digits of precision will be used for the fractional part of the seconds. Either Milliseconds (3 digits) or Microseconds (6 digits) can be chosen for display. When editing time, Microseconds (6 digits) of precision will always be used.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

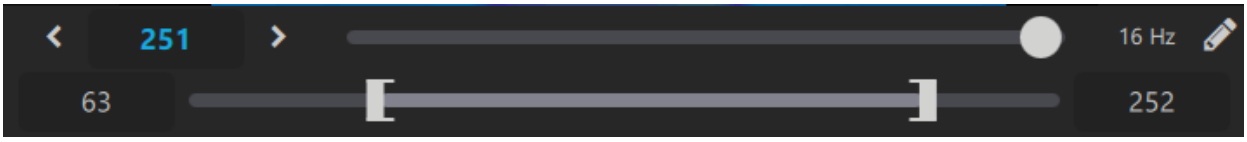
Range Settings	These define the start, current, end points of the playback, as set by frame or time, depending on the chosen display unit. Changes to the Display Unit will update these fields automatically.

The File Playback Information fields are the following:

Mode	The camera mode that the file was recorded with. This can be Single Preset, Superframing, or Preset Sequencing.
Preset(s)	The preset number(s) the camera was using when the file was recorded. For Single Preset Mode, this will be only one preset, while the other modes can contain more than one.
Resolution	The pixel width and height of the image.
Total Frames	The number of frames in the file, regardless of mode
Duration	The time duration of the file, as calculated from the first and last times in the file.
Absolute Time	The first and last absolute times in the file using the IRIG time format. If the file's time information contains a year, then it will be shown in the Absolute Time's first and last frame line items. However, the only time the year will be present in the editable fields will be when the file contains data that spans one year to the next.
Relative Time	The last frame in relative time. This is different way of displaying the duration.

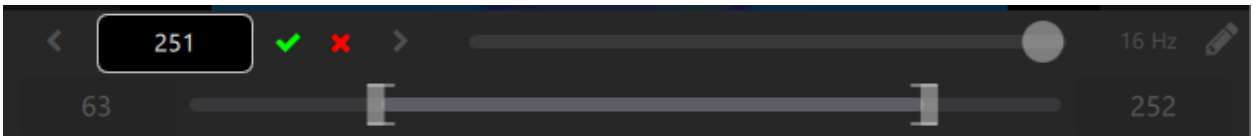
3.4.5 Inline Editing of Playback Start, Current, and End

After setting the display unit on the dialog, that unit will be used in the start, current, and end fields on the Playback Bar.



You can click on the current field to edit which frame will be displayed.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



You can also click on the start and end fields to set the bounds. The bracket button will set the current frame to the bound that is being edited. The reset button will set the start to the first frame or the end to the last frame.

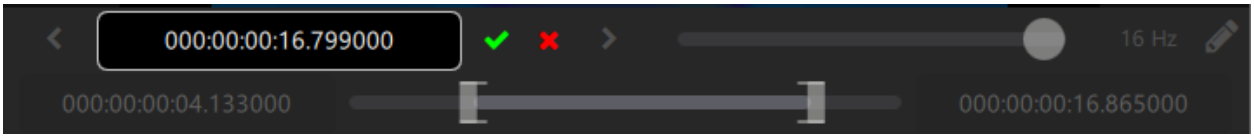




These work the same way when Relative Time and Absolute Time are displayed. When you enter a time, keep in mind that the time entered will not likely match a time in the file. When you click the checkmark or type enter to commit your entry, the frame with the nearest time will be selected.

Here are some Relative Time examples:

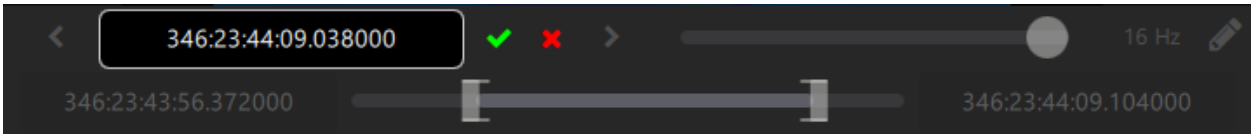






And some Absolute Time examples:







WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

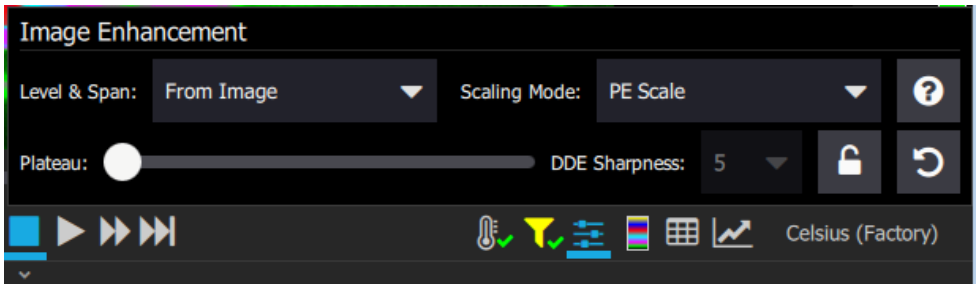
The only instance in which the year will be displayed on the Playback Bar is when Absolute Time units are chosen and there is a case of year rollover within the recording.



3.4.6 Image Enhancement

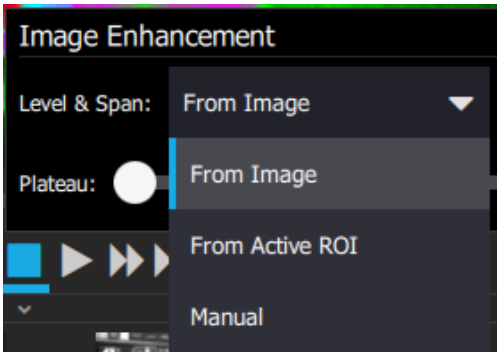


The slider bar icon represents the image enhancement tool, which affects the appearance of the image data as it is displayed. It does not affect the underlying data.



3.4.6.1 Level and Span

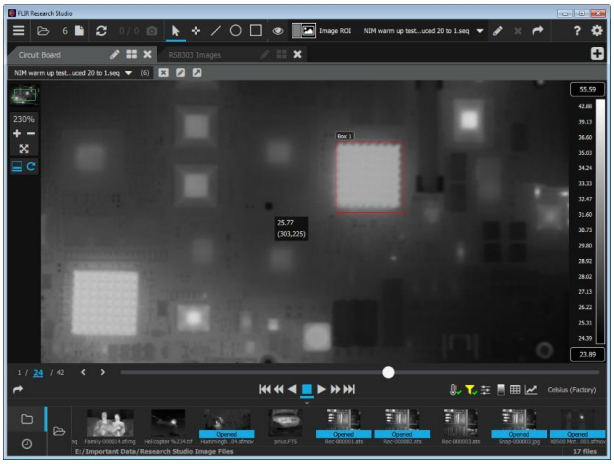
The level and span pull-down menu options control the range of digital data used in the image enhancement algorithm. The first option, From Image, uses statistics from all the pixels in the image as an input to the algorithm. The next option, From Active ROI, will only use statistics from a region of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



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

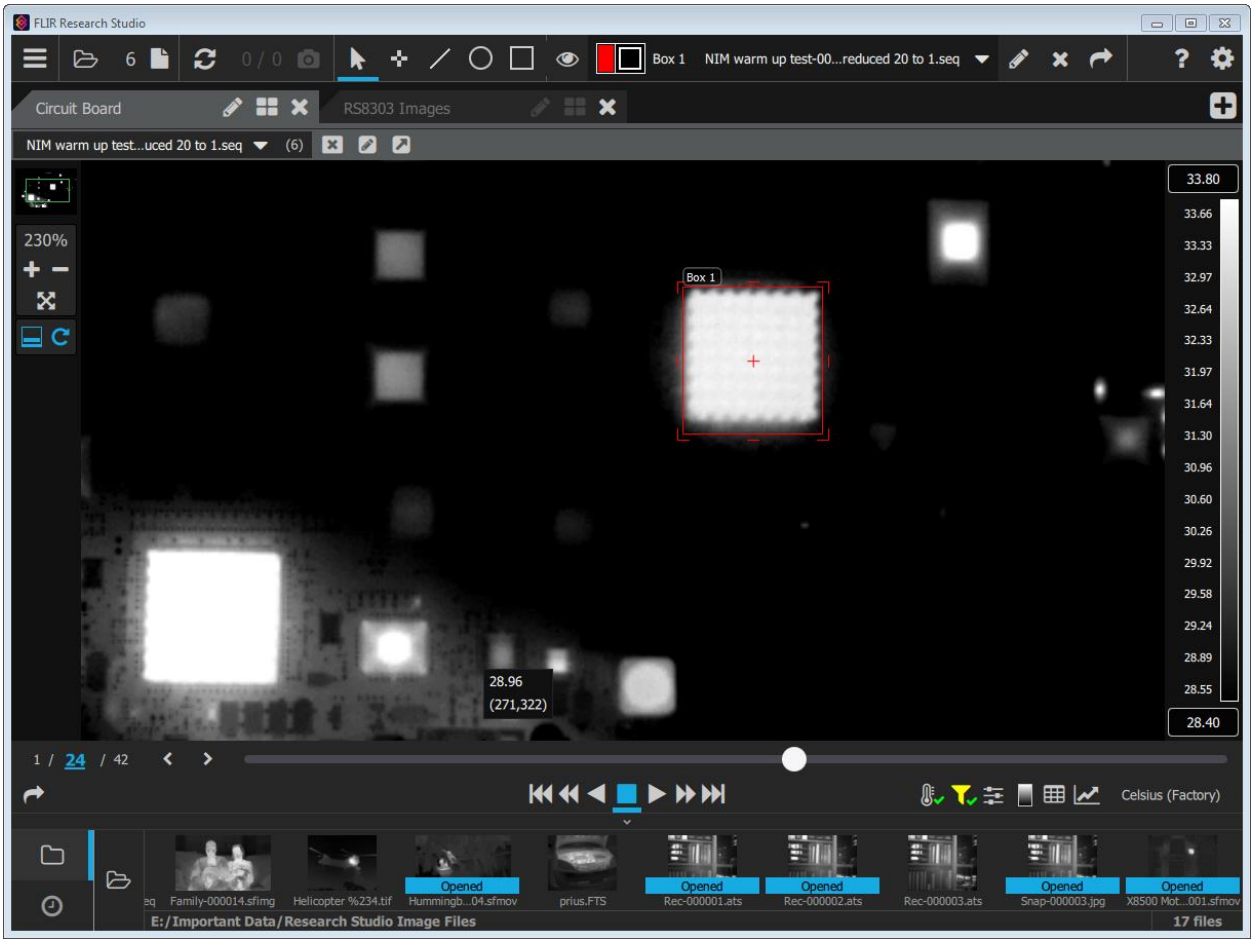
Some examples will make all this clearer:

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.



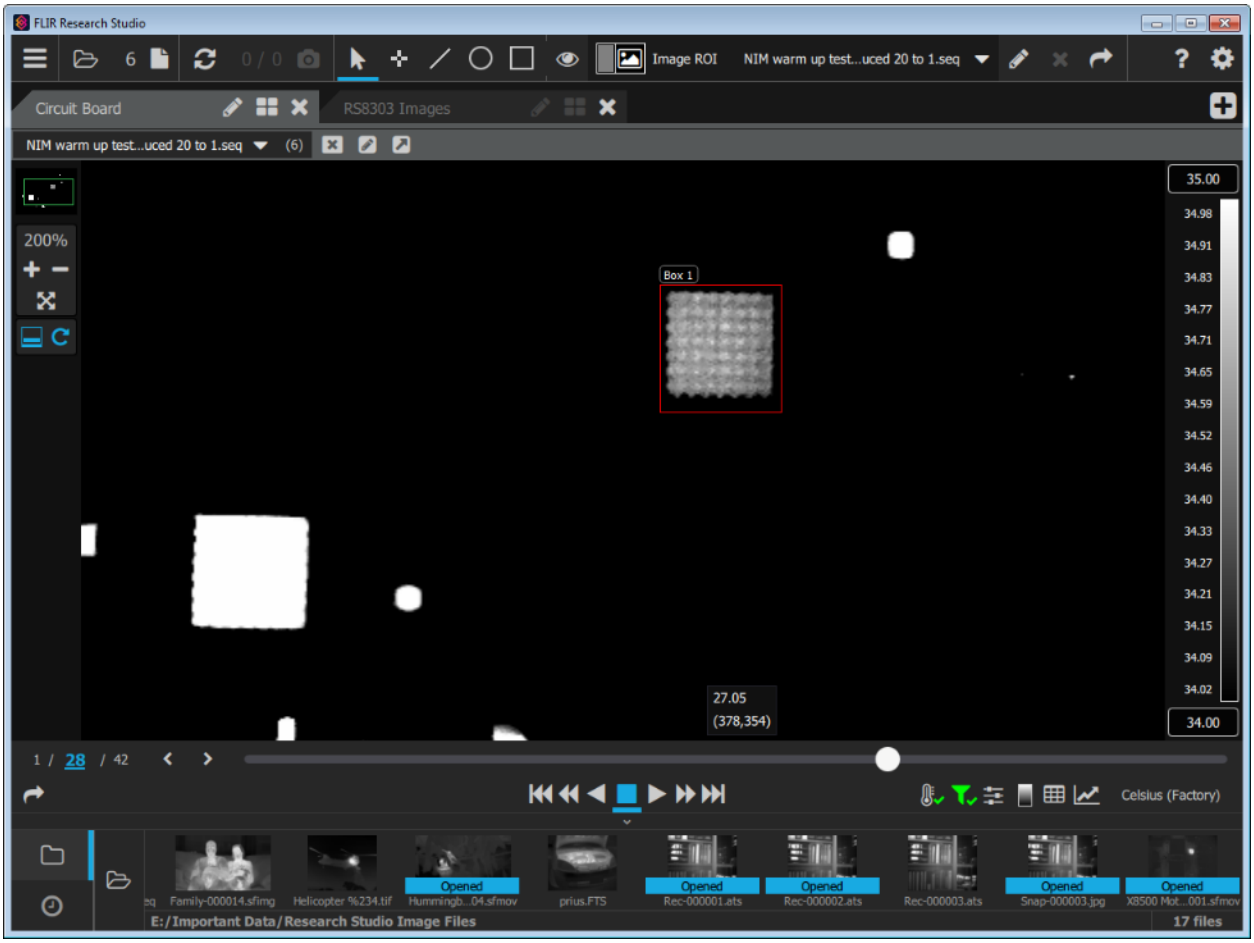
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

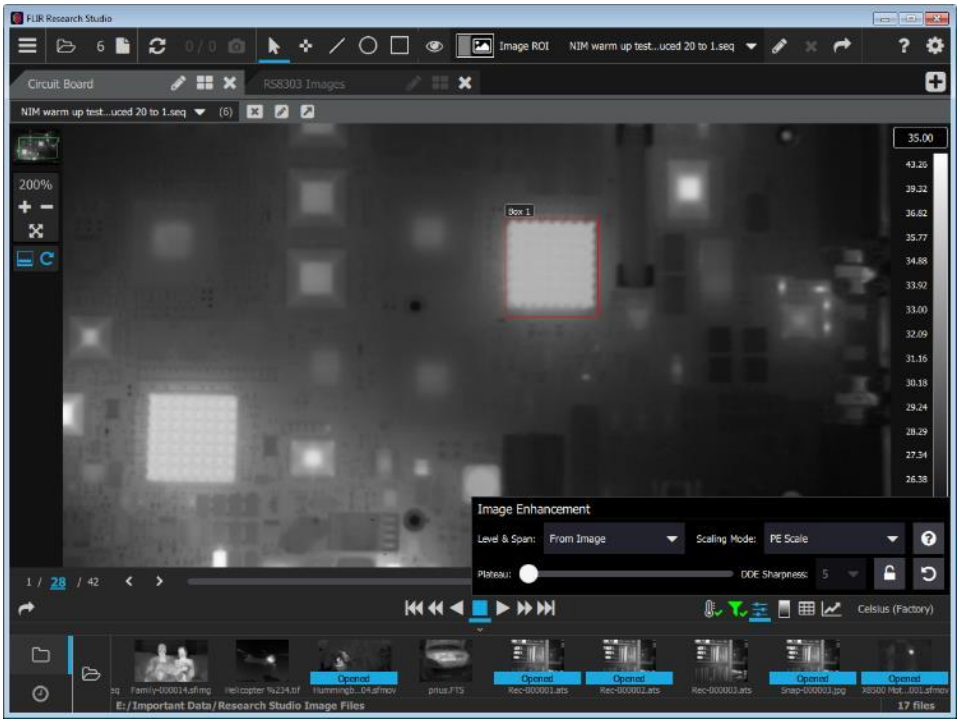
In this last image, the temperature range was set from 34 C to 35 C. Every pixel in that range of counts is displayed with a grey level. Pixels colder than 34 C are displayed in black, and pixels above 35 C are displayed in white. This manual method is very useful for enhancing a specific range of pixels 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.

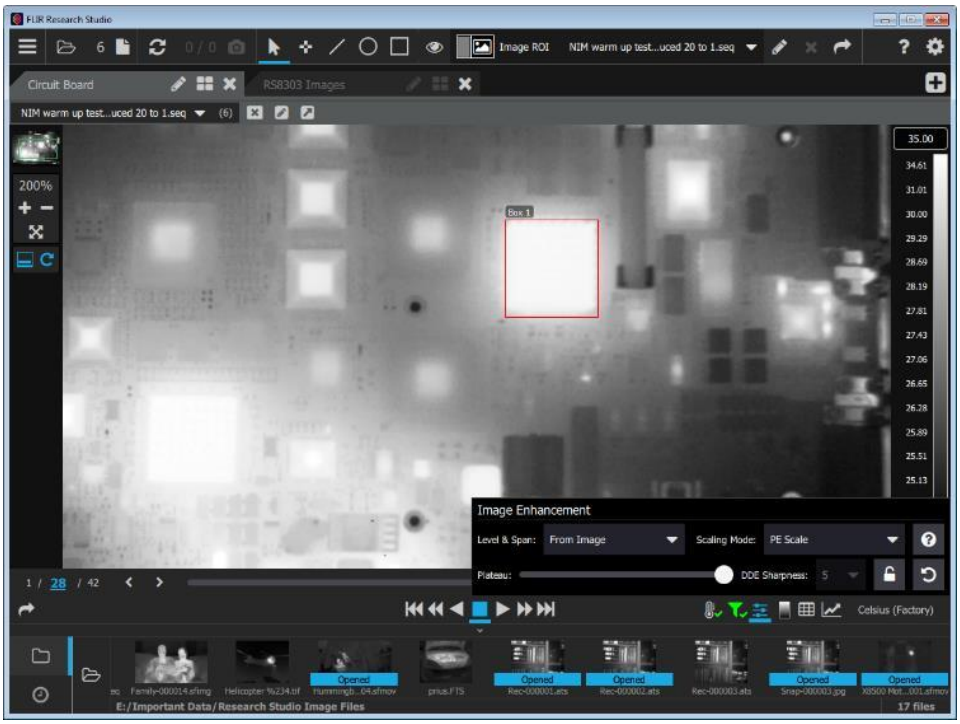


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

3.4.6.2 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:

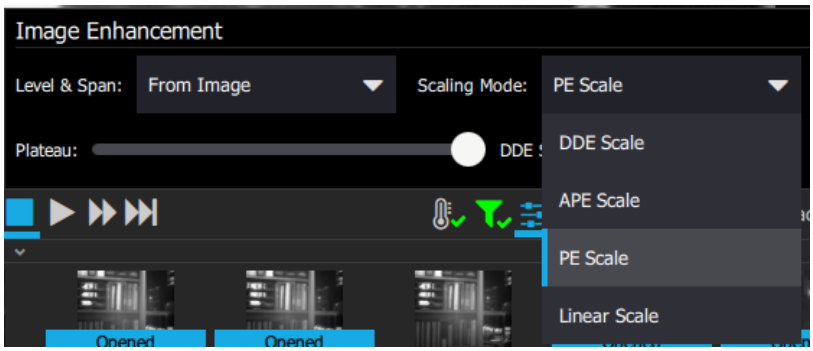




WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

3.4.6.3 Scaling Mode

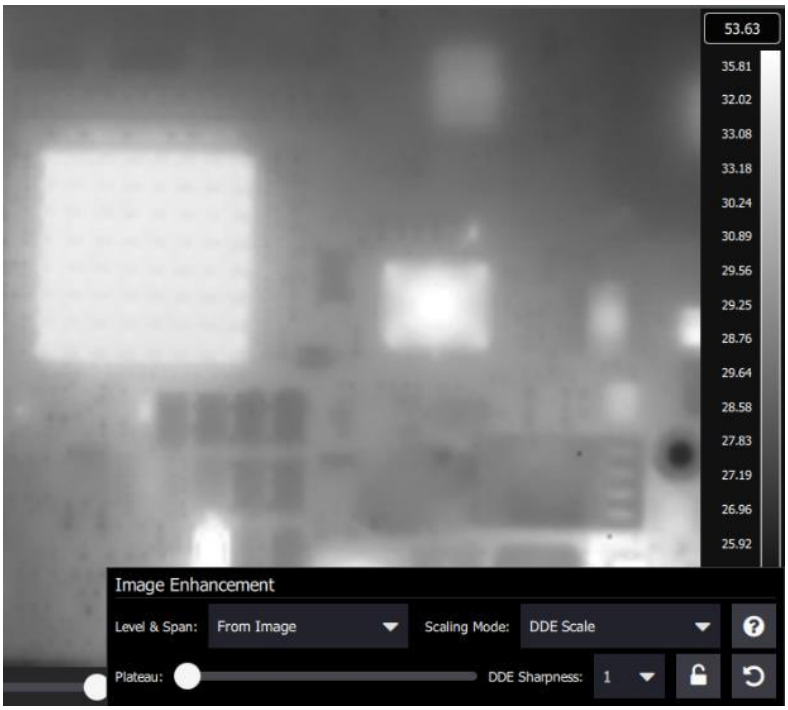
The scaling modes in FRS are: PE Scale, APE Scale, Linear Scale, and DDE Scale.

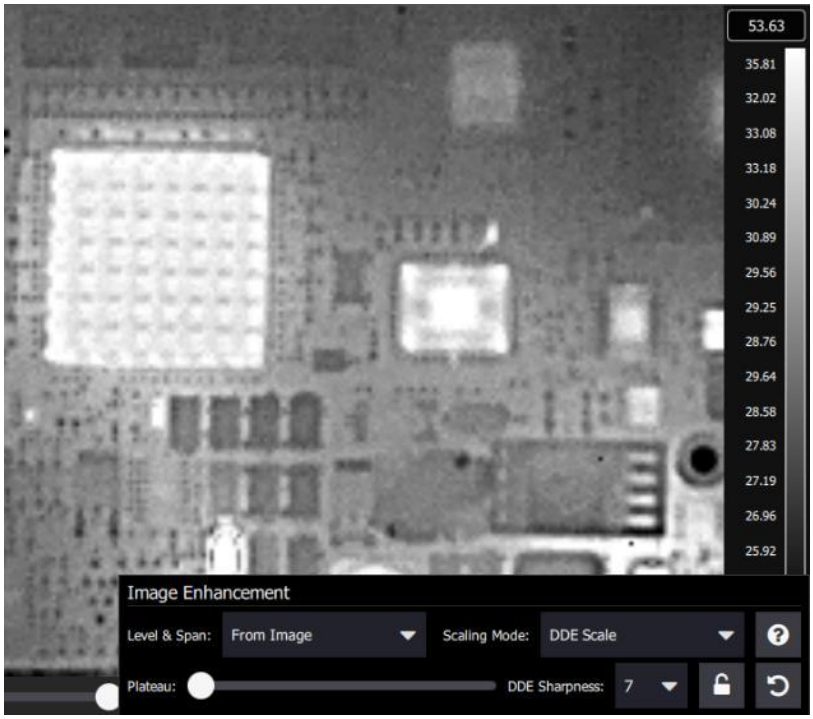


The default mode is always PE Scale. PE stands for plateau equalization, which refers to a histogram-based mapping of digital counts to the 256 display levels. The Plateau slider affects all the modes. DDE Scale refers to digital detail enhancement, a FLIR image processing algorithm that enhances edges. 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:

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.





3.4.6.4 MSX/Fusion

MSX/Fusion functions are available when connected to a compatible camera, such as the A700.

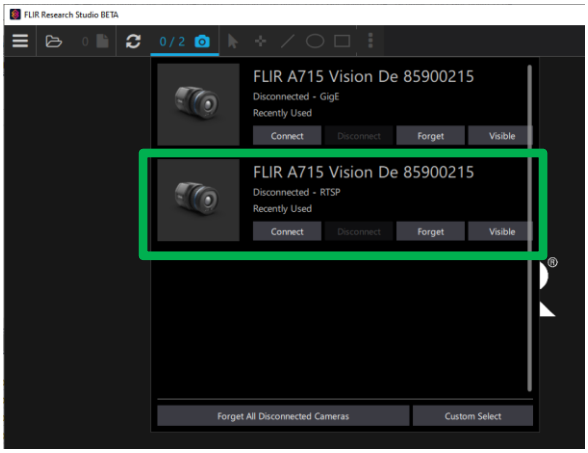
> **NOTE:** *When saving images, only the Snapshot mode will save an RJPEG file that contains both the IR and visual images which can later be opened and used with the*

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

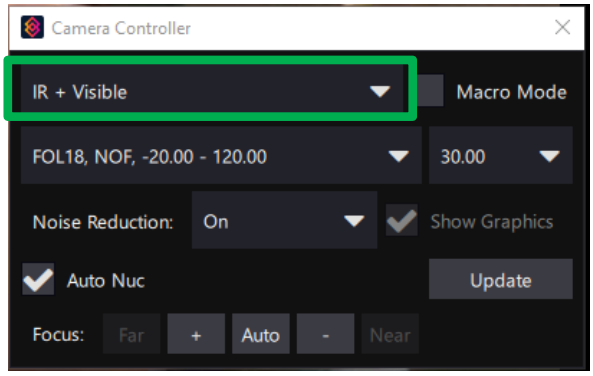
MSX/Fusion functions. Saving a movie file only saves the IR image and will not allow for the MSX/Fusion Image Enhancements.

NOTE: *To use the MSX/Fusion enhancements, both the visual and IR images must be in focus or the results of the enhancement functions will be off.*

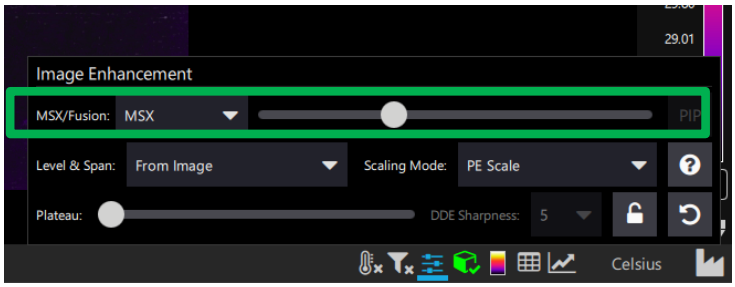
Using the Scan for Camera function, select the RTSP connection link to the camera. The RTSP link supports dual streaming, allowing the camera to send both the visual and IR images to Research Studio. The GigE connection does not allow for dual streaming and therefore does not support MSX/Fusion.



Once connected to the camera, set the output to IR + Visible (via the Camera Controller).



The MSX/Fusion function will now be available in the Image Enhancement window.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

The MSX/Fusion control consists of a pull down menu to select the image mode and a slider bar to adjust the image (if applicable).

MSX/Fusion Image Modes	
Thermal *– Displays the camera's thermal image only*	
Blend *– Blends the visible and thermal images by scaling (controlled via the slider bar)*	
Fusion *– Displays the visible image as the base layer and replaces the portions of the visible image with the thermal image based on the thermal image's values.* *Thermal image values max and min to replace are set by the slider bar*	
PIP – Replaces a portion of the visual image with the thermal image. The area to replace can be changed by pressing the PIP button to the right of the slider bar.	
MSX *– Multi Spectral Dynamic Imaging – Displays the thermal image with details of the visual image added.*	

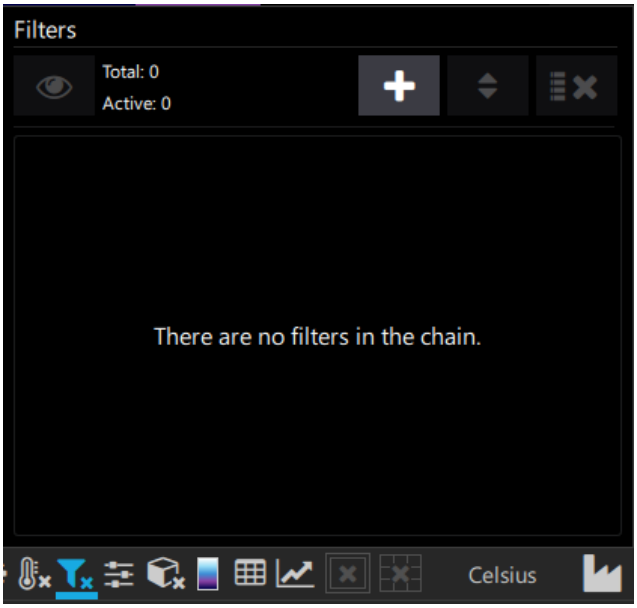
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

Visual *– Displays the camera's visible image only.*	

3.4.7 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
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

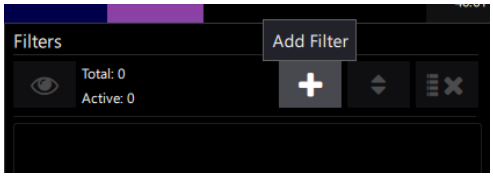
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

		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
Additional Filters Available with PRO		
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)
Power	Pixel	Compute $pixel^N$
Square root	Pixel	Compute square root (pixel value)
Exponential	Pixel	Compute exp(pixel value)

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

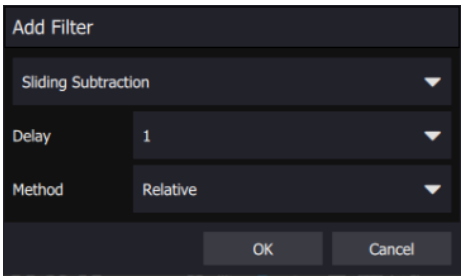
Gaussian	Pixel	Compute a Gaussian blur (smoothing) to the image
Window average	Pixel	Make each pixel the average of the selected kernel
Median	Pixel	Make each pixel the median of the selected kernel
Frame Average	Image	Make current image the average of the last n frames. Relative mode shows the actual 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
HSM Mode	Image	Emulates the HSM mode found in GF-series cameras

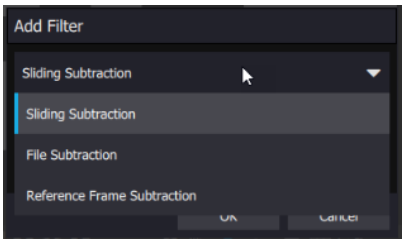
Clicking the Plus button brings up an Add Filter dialog.



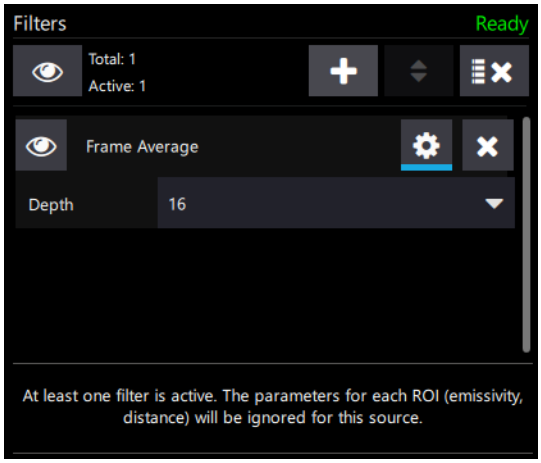
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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



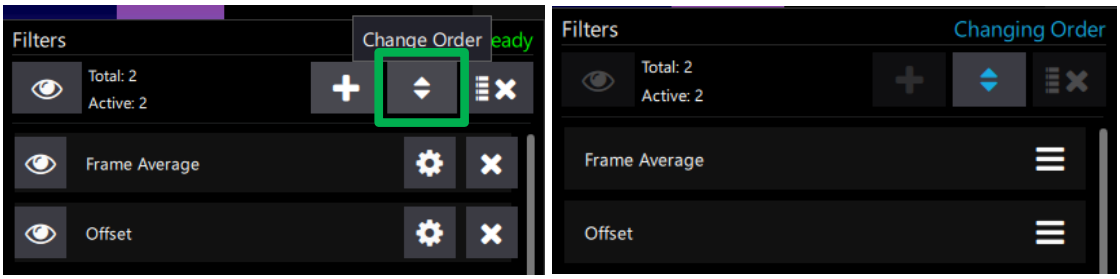


The “Eye” button is used to enable or disable individual filters or all the filter at once. The order of filters matters in some cases. The gear-like button is used to edit the settings for a particular filter. The X button will delete the filter.



If the user wants to change the order of the filters in the chain, the up-down button can be clicked to put this popup into a reorder mode. In this mode, the user can drag and drop the filters into their desired order. When done, click the up-down button again to save that new order.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



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



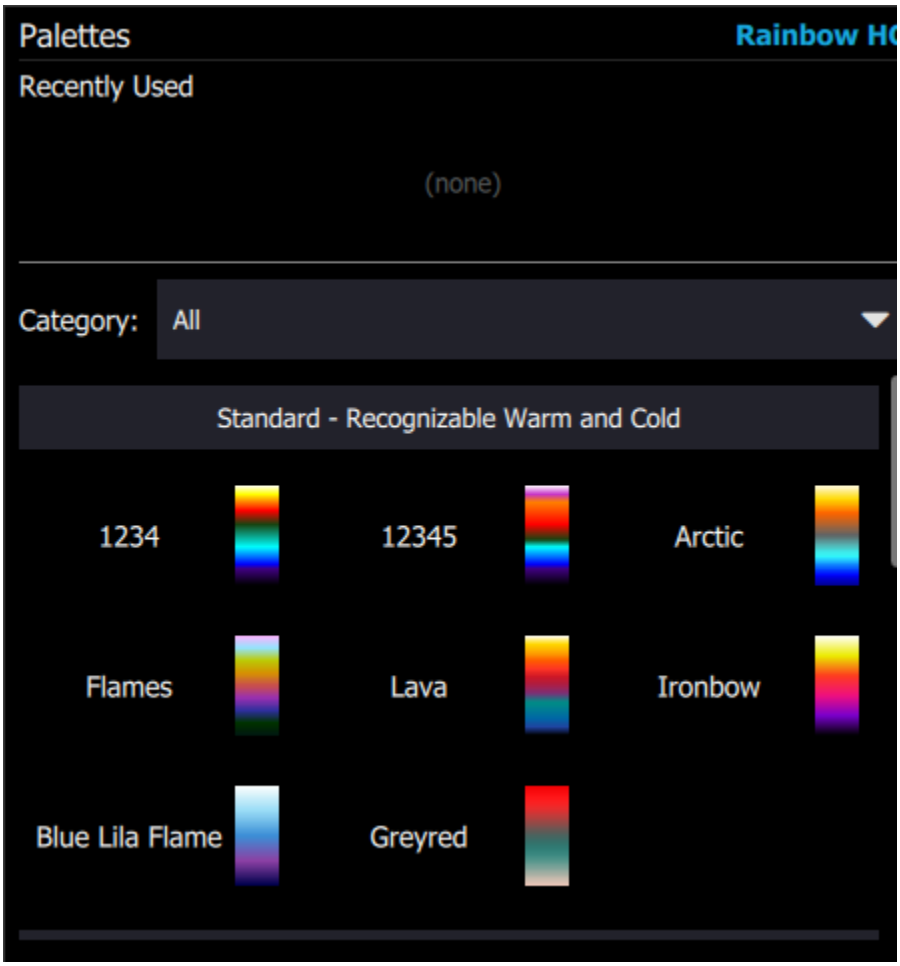
3.4.8 Palettes

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.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



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.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



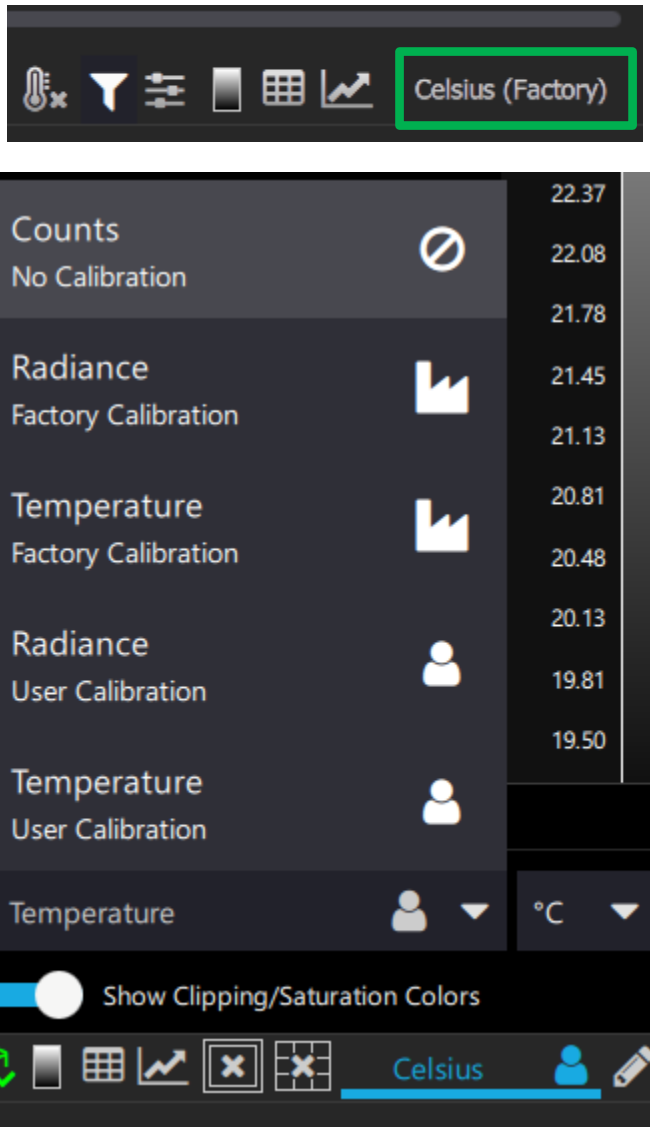
There are four palette categories to enable easy navigation of the palettes. See the screenshot below.



3.4.9 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.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



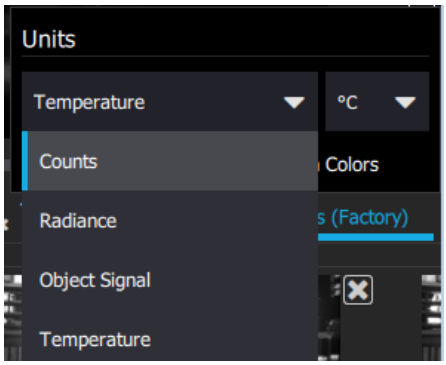
The units can also be changed to Counts, Radiance or Temperature using the pulldown menu. If a camera has a calibration on it and is enabled, there will be a Radiance and Temperature *Factory Calibration* selection. If a User Calibration has been created (see **7. User Correction and Calibration** PRO) then there will be a Radiance and Temperature *User Calibration* selection.

User Calibrations, which are calibrations created by a user in FRS, can be identified by the person icon,.

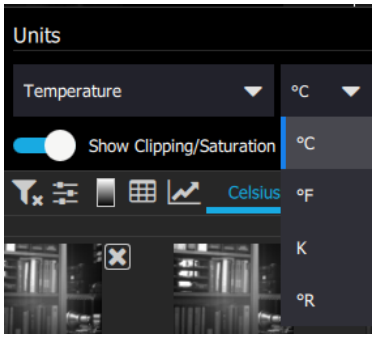
 Factory Calibrations, which are calibrations on the camera itself, can be identified by the factory icon,.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

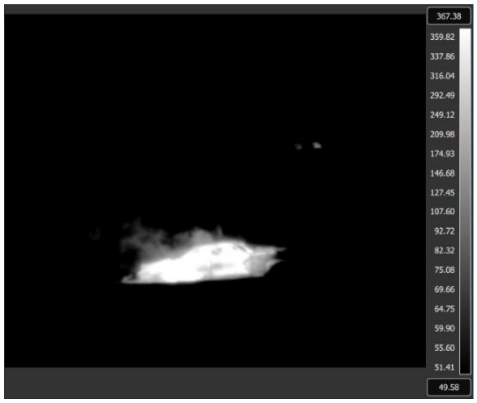
The radiance units are watts/square cm/steradian. Object Signal is a unit used by the factory for certain cameras. Digital counts are dimensionless.

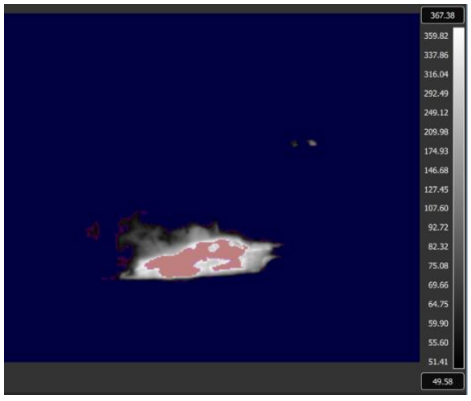


The temperature units that are available are Celsius, Fahrenheit, Kelvin and Rankin.



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.



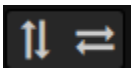




Clicking this button will cause the image to rotate by 90-degrees counter-clockwise. Each additional click will rotate another 90 degrees. The icon will show the amount of rotation applied.

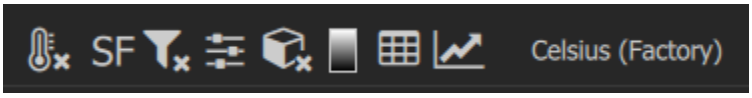
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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, Prepare/Unprepare RAM, Arm/Disarm for Recording, Record/Stop, Pause, Take Snapshot (Radiometric JPEG), Record Settings, and Record Info.



4.1.1 Prepare/Unprepare RAM Button

This button pre-allocates memory for an upcoming recording, regardless if the recording is initiated by the user or by a triggered start condition. By allocating the memory in advance, this reduces the time it takes to start recording.

The left shows the unprepared state, and on the right is the prepared state. Note that the Record Settings button is disabled whenever the RAM has been prepared.





4.1.2 Arm/Disarm Recording Button

If you are triggering off a Start Condition in the Record Settings, then you will need to arm the recording so that the condition will be caught and the recording automatically started.

If no Start Condition is set in the Record Settings, the Arm button will be disabled:



When there is a Start Condition selected, the Arm button will be enabled:



When the recording is armed, the Arm button will become the Disarm button:



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

4.1.3 Record / Stop / Abort / Terminate Buttons

These buttons will manually start, stop, abort, and terminate video recordings. They handle other conditions where Research Studio may not be ready to stop recording immediately, but still allows the user to force the application to stop recording.

This the Record button. The record button will start a recording. It is shown when the camera is ready to start a recording.



This is the Stop button icon. The stop button will stop a recording. It is shown when the camera is currently recording.

The stop button acts as stop trigger. When the stop condition is Manual, the stop button is the primary stop trigger. With other stop conditions the stop button is an additional stop trigger. For example, if the stop condition is set to duration, and the duration is 5 minutes, you can use to stop button to stop the recording earlier, say after 1 minute. If the record settings include a post-trigger, clicking the stop button will stop the normal portion of the recording and start the post trigger portion of the recording. If there is no post-trigger, the stop button will stop the recording.



This is the Abort button. It lets the user perform a graceful abort of the recording. It is shown after the stop button is pressed and there is still a post-recording task.

The abort button stops the recording even if there are more frames expected. For example, if the post-trigger duration is 5 minutes, you can use the abort button to stop the post-trigger portion of the recording earlier, say after 1 minute. Another example is if the camera is in external sync mode and the external sync clock was stopped while Research Studio was recording, the abort button will tell Research Studio to stop waiting for frames that the camera will never output.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

This is the Terminate button. It tells Research Studio to stop recording immediately, discarding any frames that were acquired but not yet written to disk. It is shown when the user has pressed both the Stop and the Abort buttons.

Normally you would not want to use the terminate button, since you could just wait for Research Studio to finish writing frames to disk. An example of when you may want to use the terminate button is if you have accidently set your record destination to a slow disk like a network share or old USB2 external hard drive and you decide that you would rather redo your experiment than wait for the recording to finish writing.



4.1.4 Pause Button

This button freezes the live video stream on the computer. It does not stop the camera from sending video to the computer. As noted above, it is disabled while recording.



4.1.5 Snapshot Button (Radiometric JPEG)

This button saves a Radiometric JPEG single frame of the live video. Click on the Record Settings to configure the destination and naming of this file.



4.1.6 Record Settings Button

This button brings up the Record Settings dialog for this camera. More information is available in the Record Settings section.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

4.1.7 Record Info Button

This button opens the Record Info Dashboard popup and allows the user to create a separate module. More information is available in the Record Info Dashboard section.



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

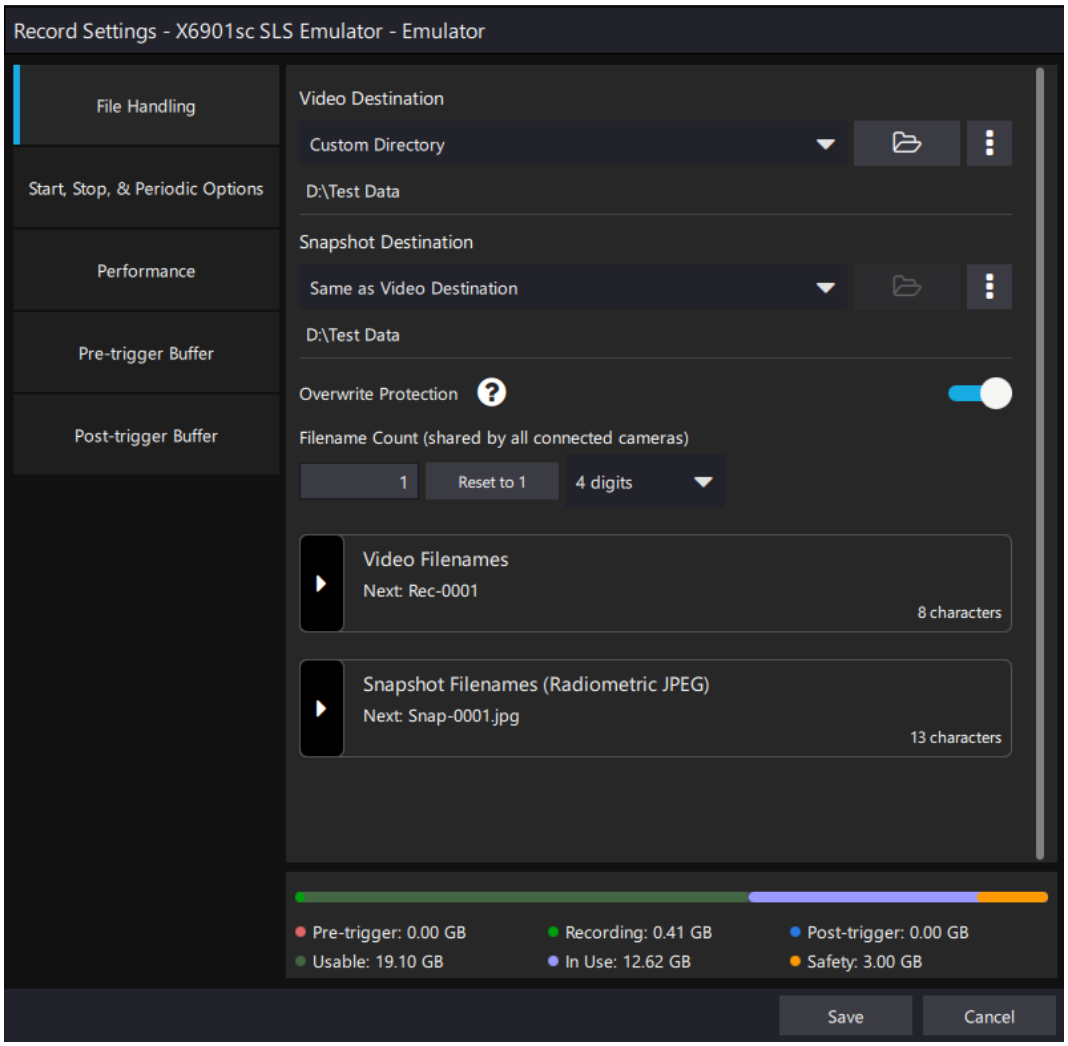
The first tab in the record settings menu is File Handling. The user has options for choosing the locations to store video recording and snapshots as well as file naming options.

The first section lets the user choose the destinations for both the videos and snapshots. These can be a custom directory selected by the user, the quick collection directory, or the Ignite Sync directory. The quick collection and Ignite Sync collection are located at the very bottom of the application. The snapshot destination can also be set to the same location at the video's destination.

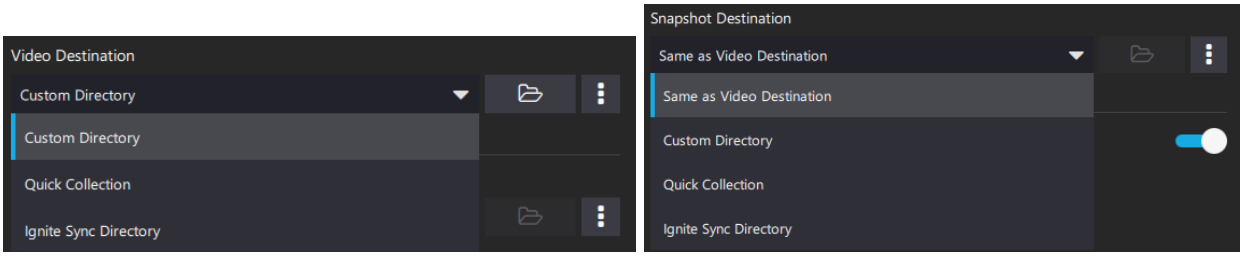
The second selection enables the software to detect if the currently specified file name will overwrite a file name already in the directory. If necessary, the program will append a number to make the filename unique. If the user turns this off important previously recorded files could be overwritten.

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.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



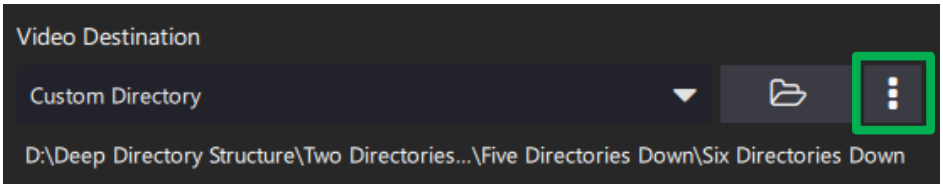
Here are the options for the Video Destination and Snapshot Destination:

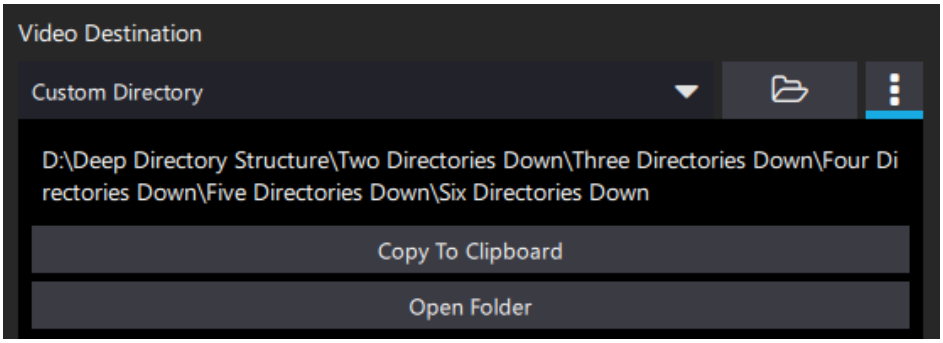


If the directory path is too long on either of the destinations, it will be shortened in the middle. However, the user can click the ellipsis button to show the full directory. This popup also allows

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

the user to copy the path directory to the clipboard or open that folder in the operating system's native file explorer.



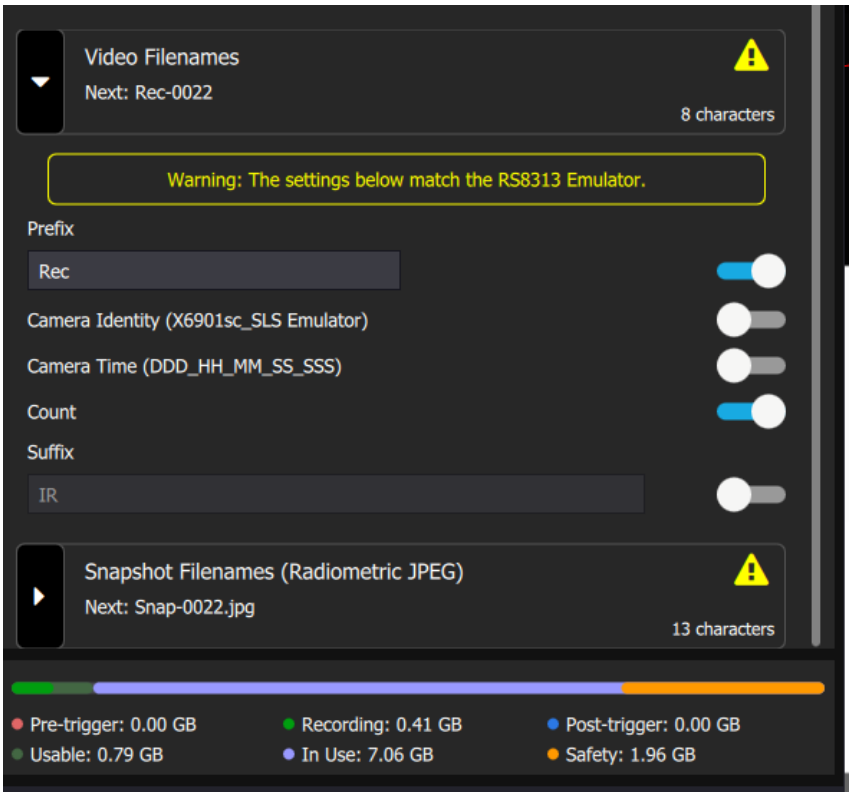


The next section is Video Filenames. In this section the user is able to add a prefix, toggle the camera identity, toggle the camera time, toggle the count, and add a suffix. In the example below, the first video file recorded would be named REC-0022.ats

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.

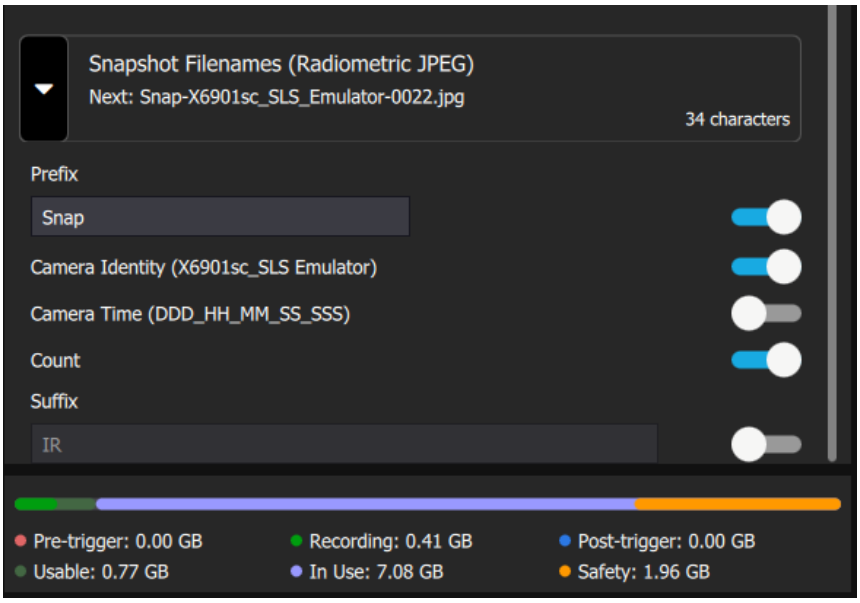
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



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.

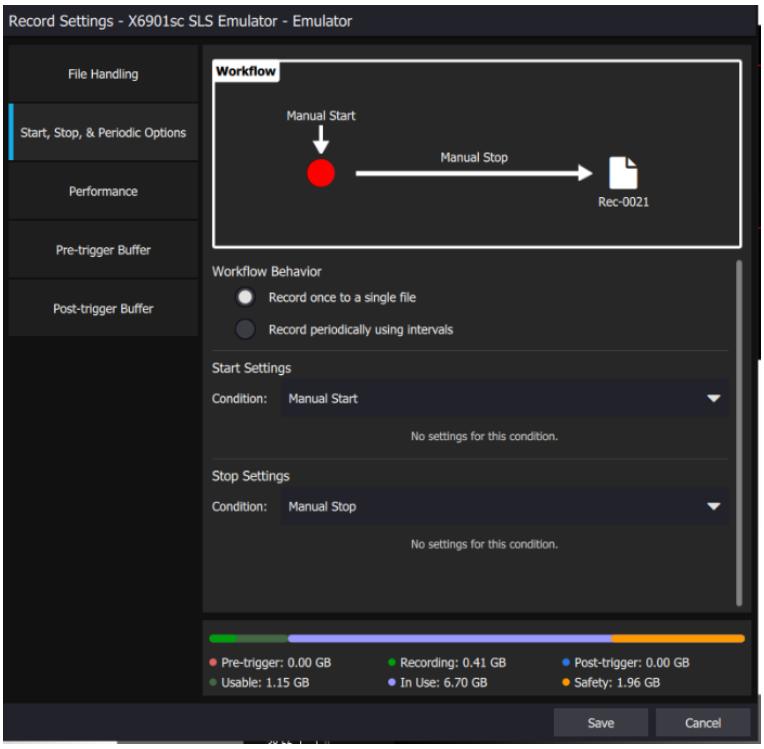
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



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.

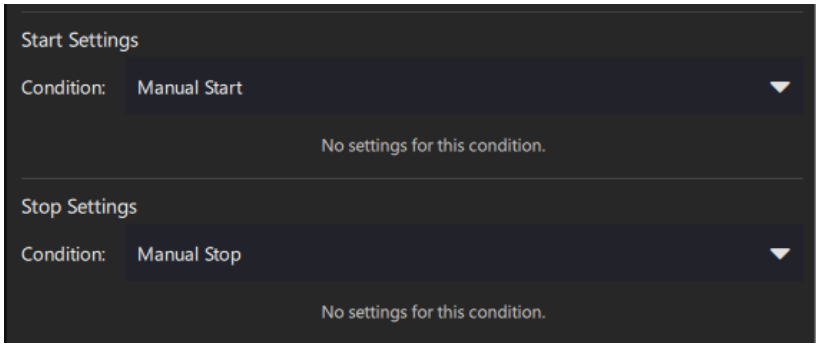


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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 and stop conditions can be selected from the pulldown menus:



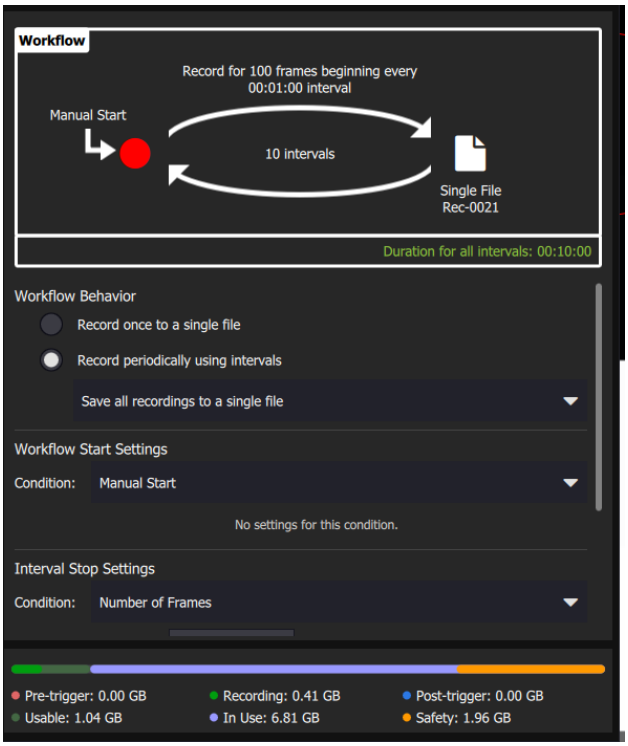
Start/Stop Condition	Function
Manual Start	Starts recording via Record/Stop button
Date and Time	Starts recording via a given date and time
Remote Trigger	Starts/Stops recording via an external trigger connected to the computer. See 9.2.1.4 Hardware Settings
Header Field	Starts/Stops recording via fields in the image's header (metadata). Note: available fields are camera specific.
Measurement Field PRO	Starts/Stops recording via logic measurement functions
Manual Stop	Stops recording via Record/Stop button
Number Frames	Stops recording after N number of frames has been collected
Duration	Stops recording after a given time period

4.2.4 Record periodically using intervals PRO

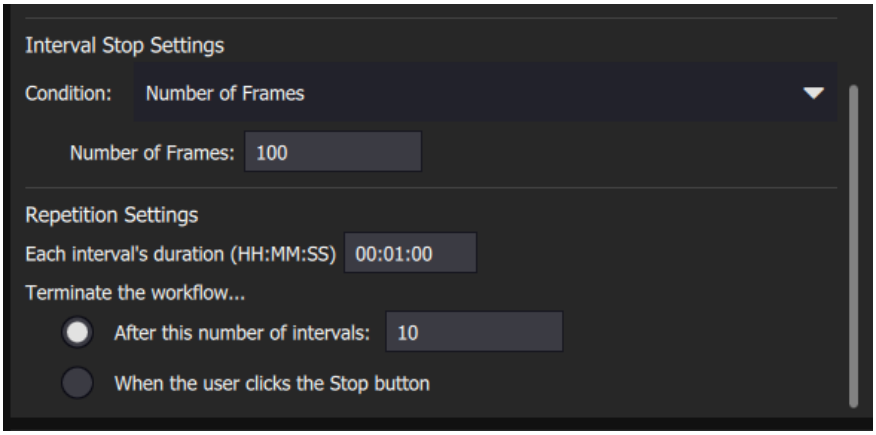
The Periodic option allows the user to set a pattern for recording frames. This option requires that the Stop condition be something other than Manual. The default duration is a one-minute interval recording, repeated 10 times, with the results placed in a single file, as shown below. The workflow diagram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

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



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.

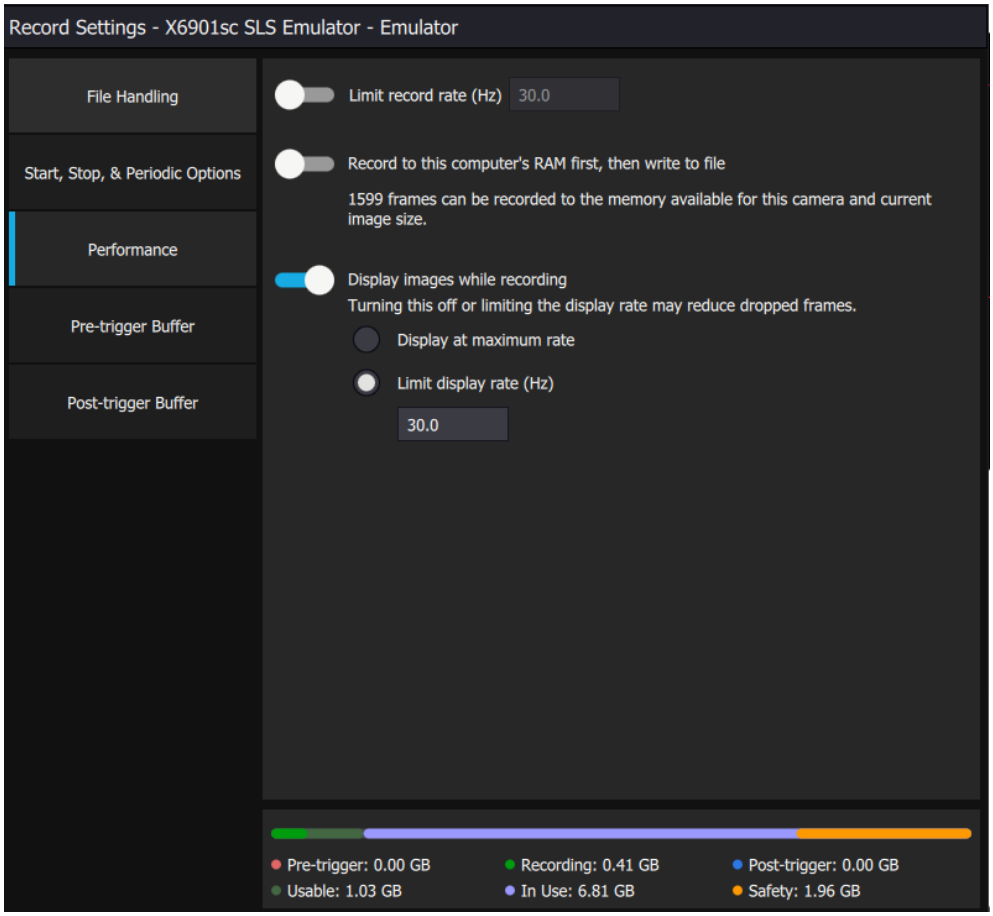
The user can limit the recording frame rate to a selected lowered rate by sliding the slider to the right and then entering the desired frame rate. The limit record rate is typically used with

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.

FRS PRO users 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.

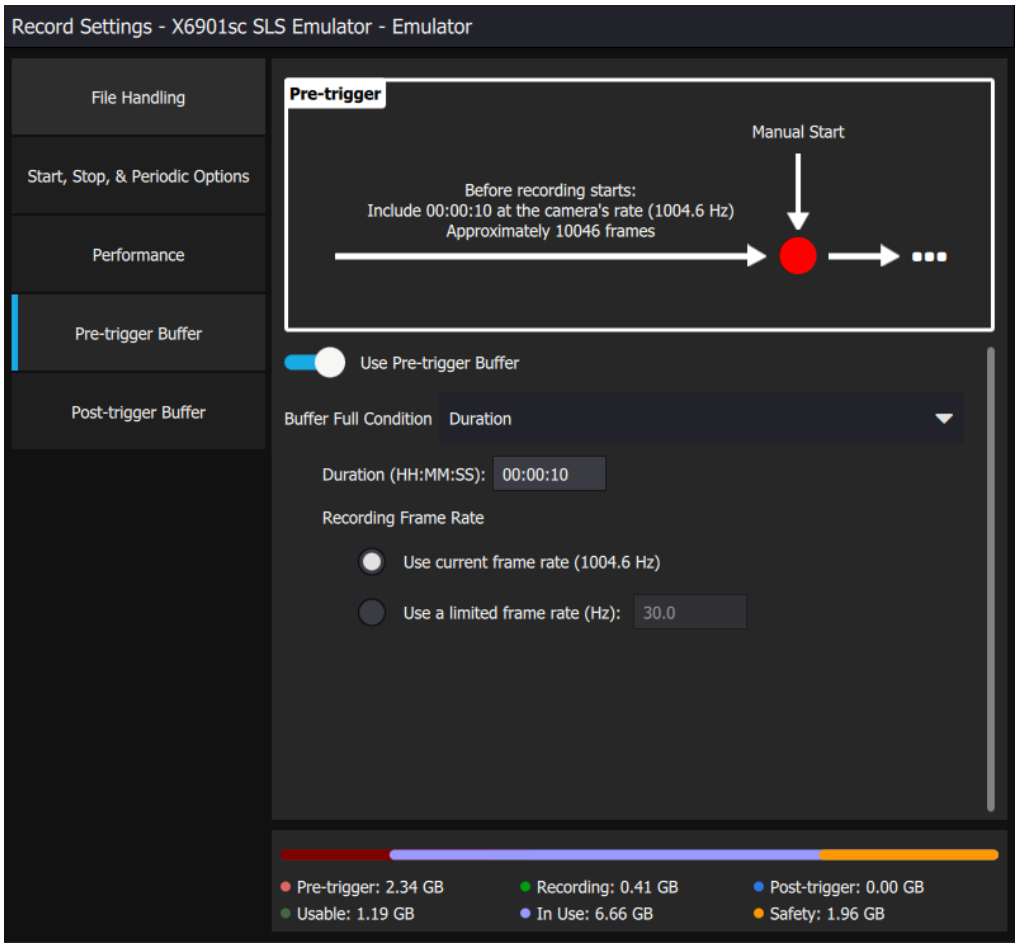
Finally, the FRS PRO users can choose to display images while recording. If this is toggled on the user can choose to Display at maximum rate or to limit frame rate displayed while recording. Turning this off can help the user reduce dropped frames.



4.2.6 Pre-Trigger Buffer PRO

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.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



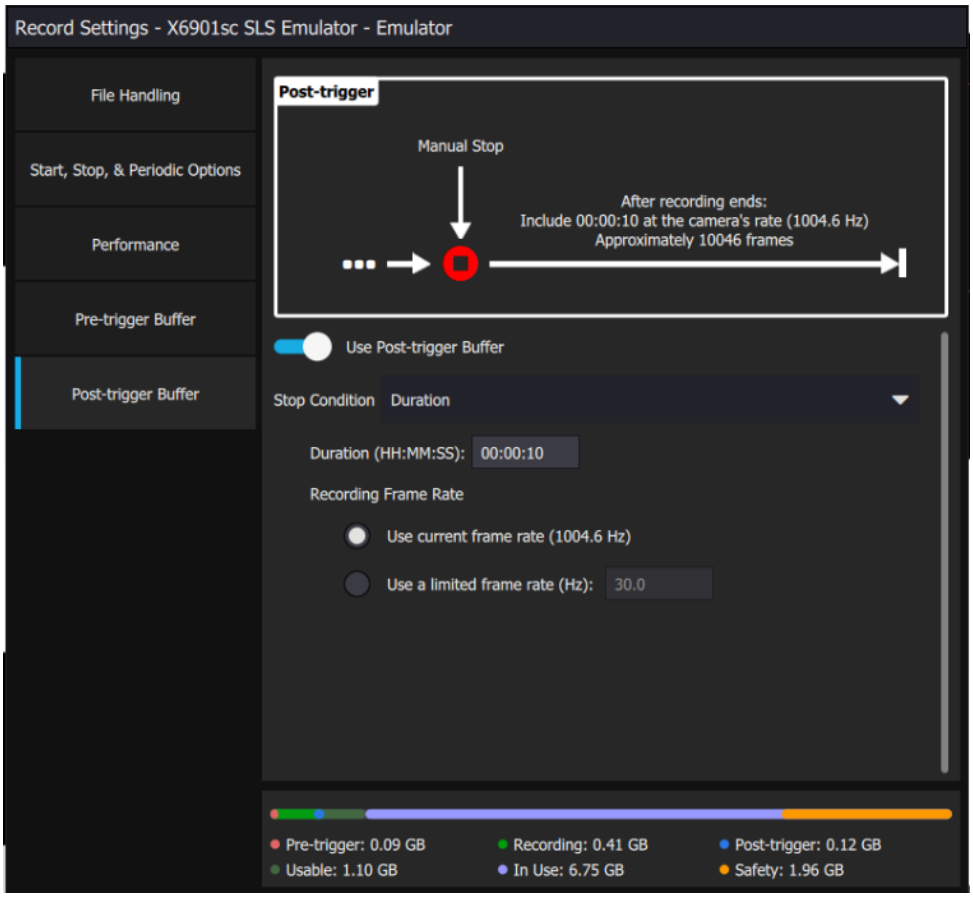
The rate limiter options allow the user to slow down the rate of data recorded prior to the trigger. This is useful for extending the time span of the pre-trigger buffer. There is also the option for the software to set the frame rate to fill the specified number of frames inside the time duration.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

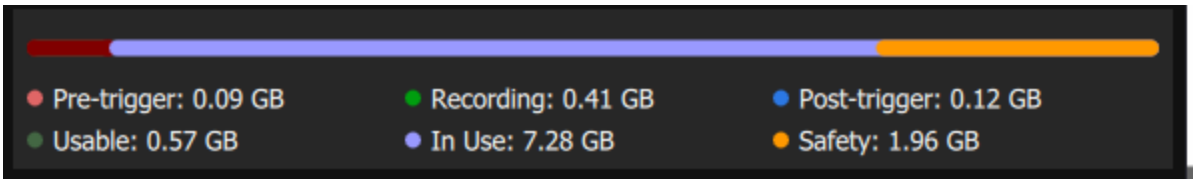
4.2.7 Post-trigger Buffer PRO

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

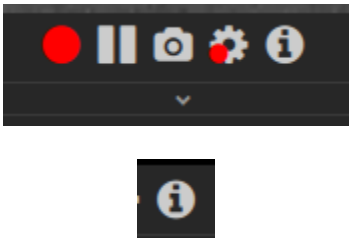
At the bottom of the record settings menu there is a chart that shows RAM allocation. This lets the user know where memory is being allocated and how to adjust to improve the recording performance. This menu is dynamic based on the user changing settings in various menus.



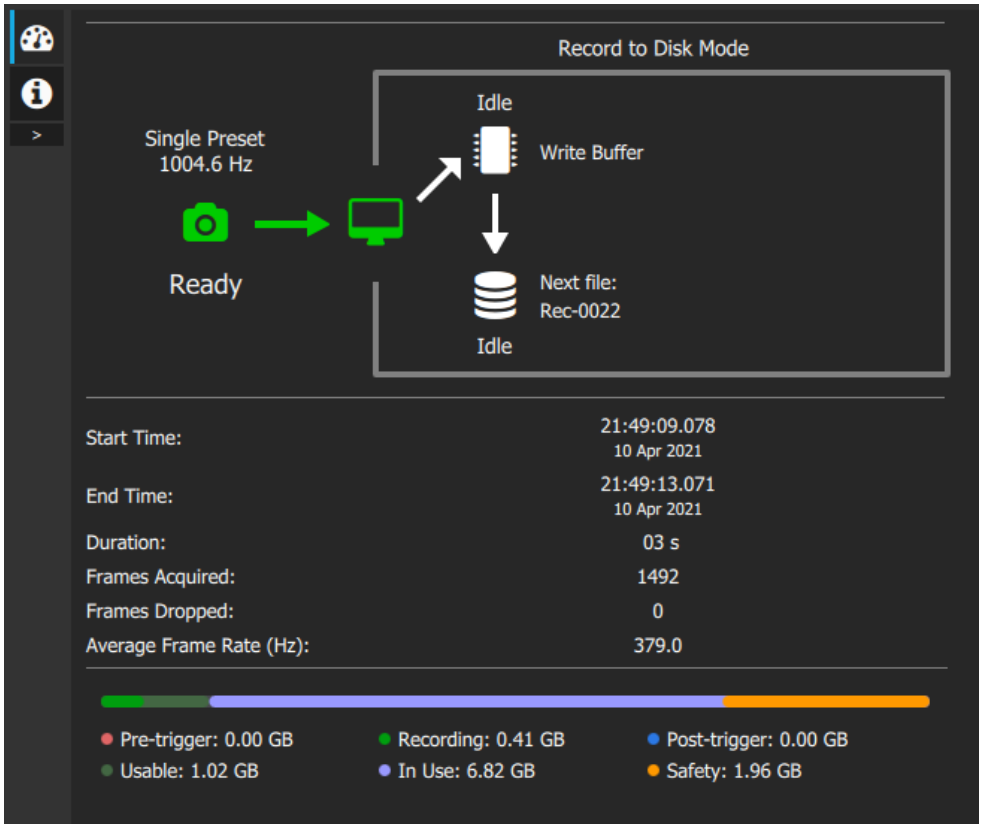
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

4.3 Record Info Dashboard

The record info dashboard can be accessed via the info button

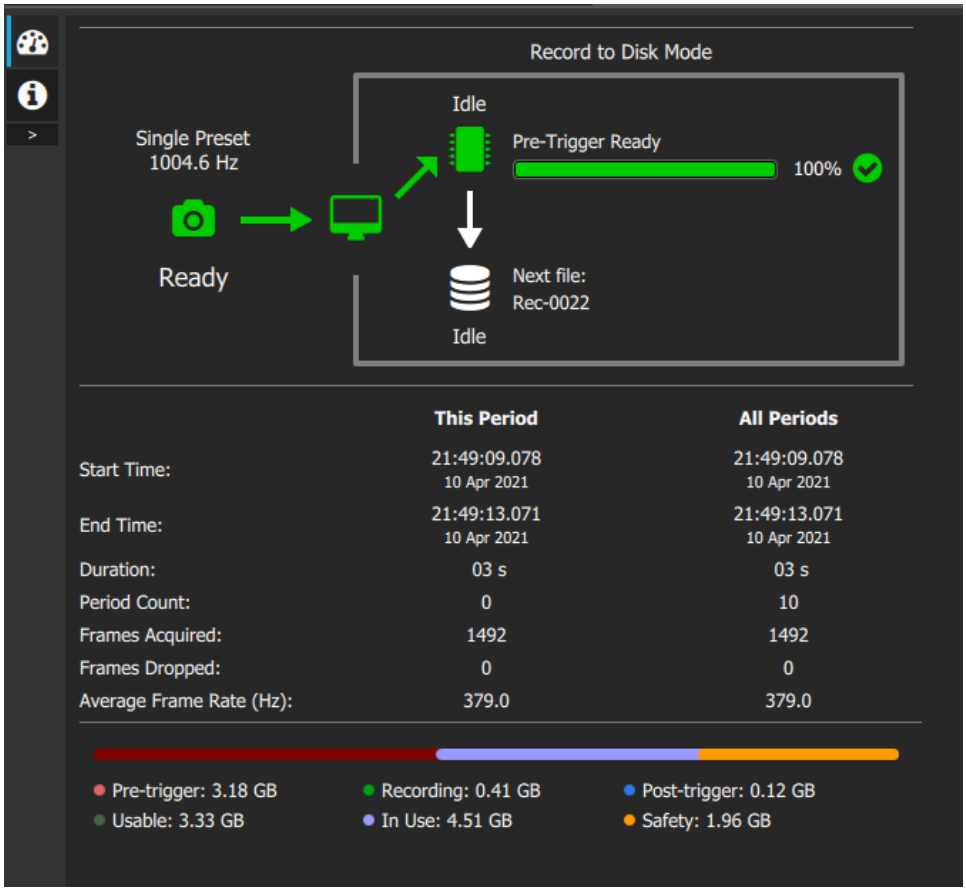


This dashboard allows the user to dynamically monitor recordings while in progress. It can be displayed as popup or docked into a module. The user can see the Start Time, End Time, Duration, Frames acquired, Frames dropped, and the Average Frame Rate in Hertz.



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.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



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



4.4 HSDR (High Speed Data Recorder) PRO

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.

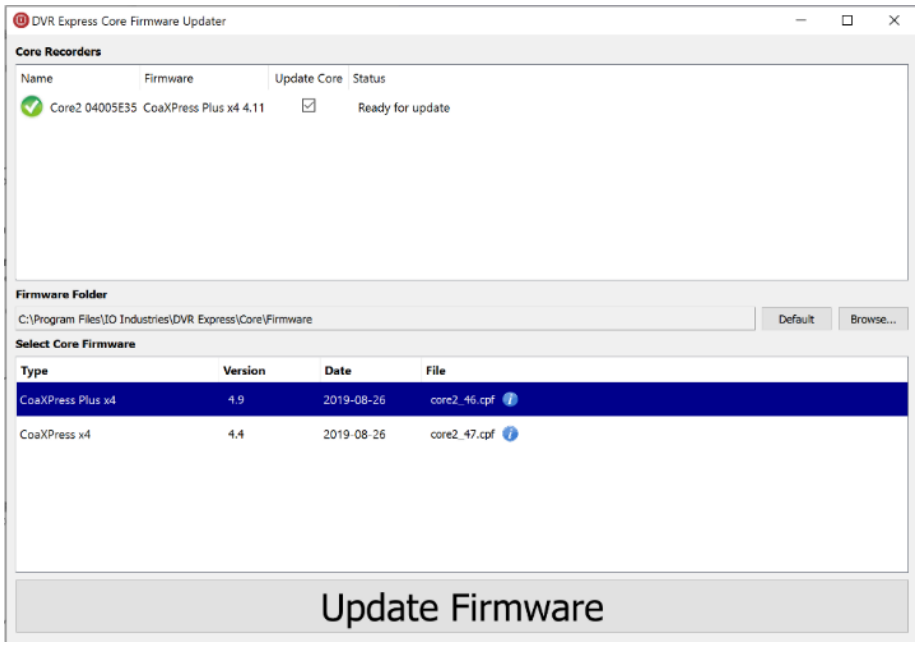
4.4.1 Install and Setup

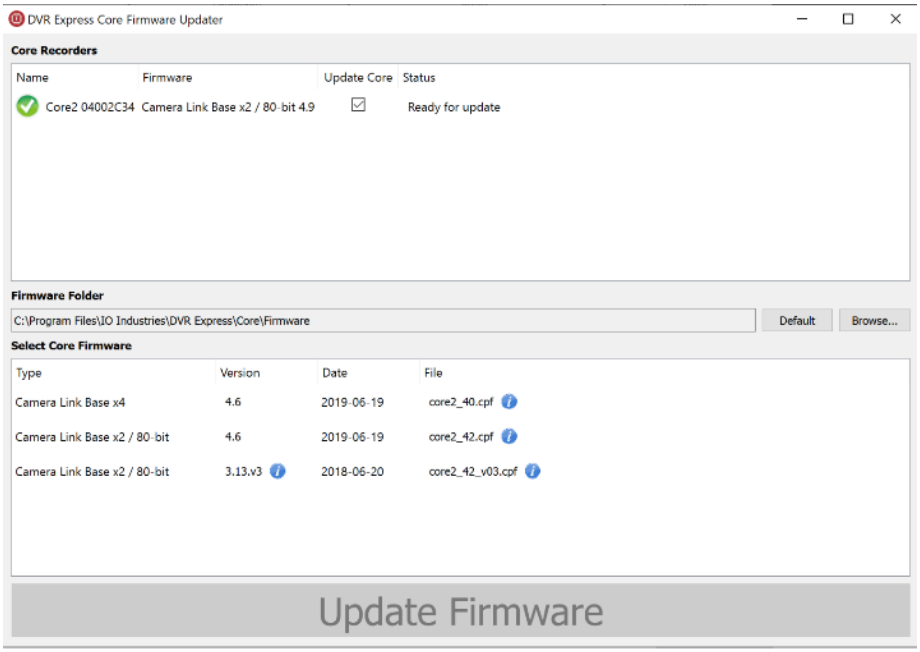
The "IO Industries DVR Core Express Software" v 2.1.0.38 is required to connect to a FLIR HSDR unit (IO Industries DVR Core1 and Core2). If you do not have one of these units, you don't need to install the drivers. Note that its only supported on Windows OS and by the Professional edition of Research Studio. 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. After downloading, unzip the file and 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".

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.





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

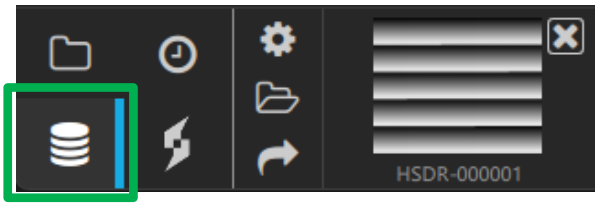
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

			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

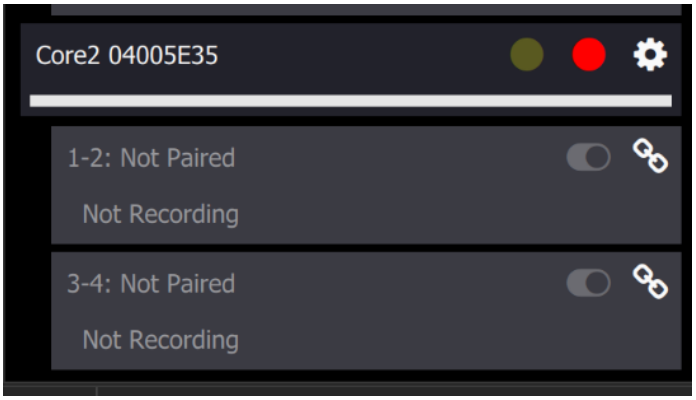
Once the firmware is updated the user can start the connection process. Make sure that all of the cables between the camera, HSDR, and computer are connected. Next, make sure Research Studio is closed. Power on the camera until a ready light is visible. Once the ready light is visible power on the HSDR.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

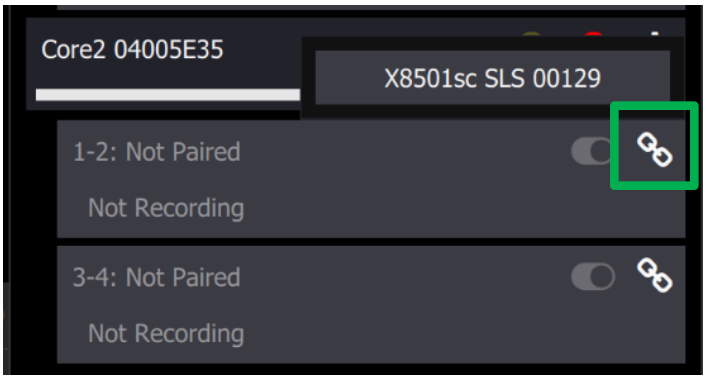


Clicking the gear icon will bring up the HSDR controller. In the controller is a record button, settings button, and the controls to pair the HSDR. Each time a new camera is connected to an HSDR, the two devices must be paired.

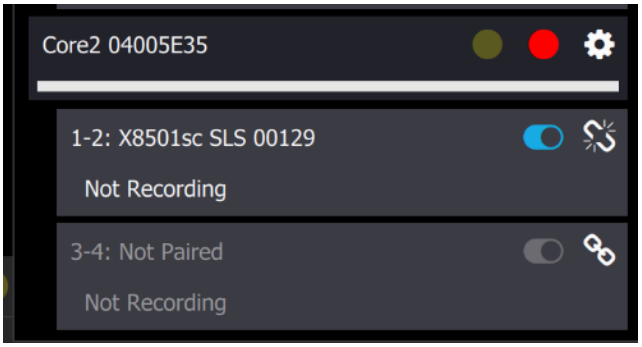


The button outlined is the pair button. When the user clicks on this the available cameras to pair will be visible.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



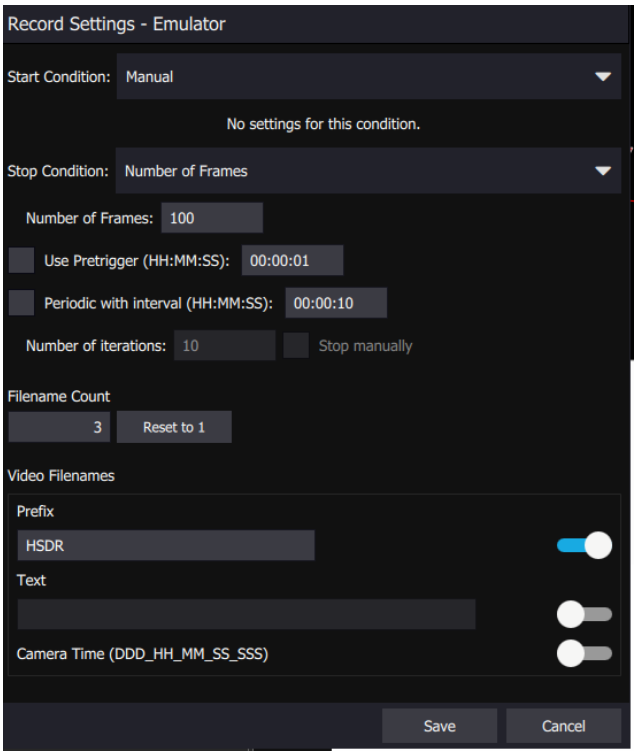
After pairing the camera and HSDR the window will look like this below. The pair icon will change to have light rays showing off of it reflecting that clicking the button again will unpair the HSDR from the camera.



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.

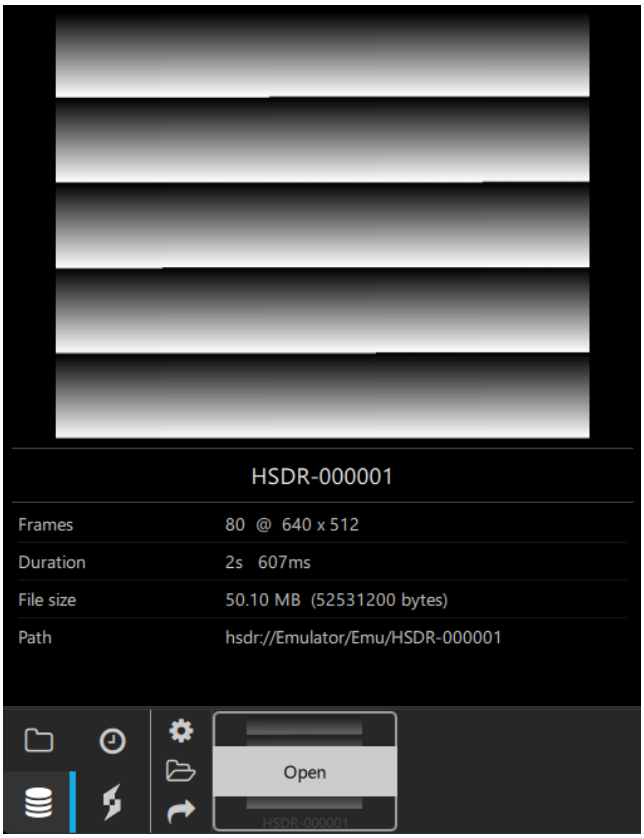
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



4.4.4 Quick Look and File Browser

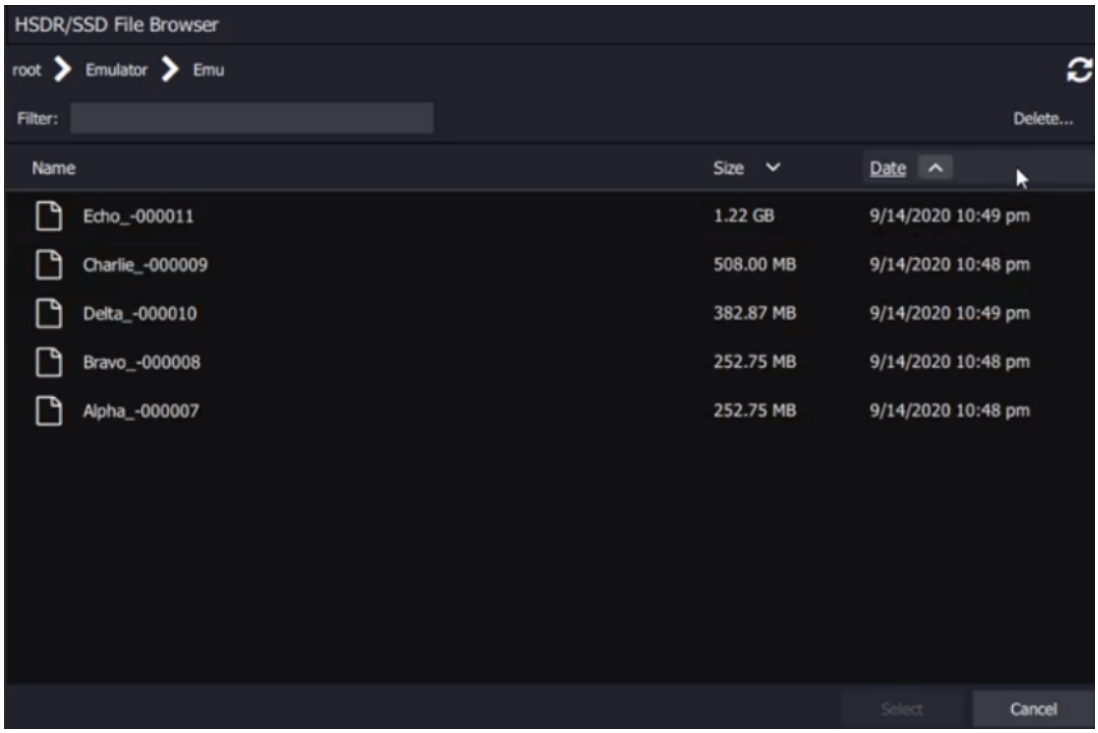
The HSDR tab in the Quick look menu allows the user to access data that has been recently recorded or opened in the HSDR but has not been extracted to the PC hard drive. Just double-click the movie you wish to play.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



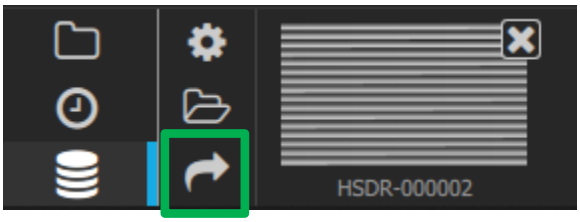
There is also a File Browser to allow the user to see all the files on the HSDR. This file menu allows the user sort by Name, Size, and Date.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



4.4.5 Batch Extract

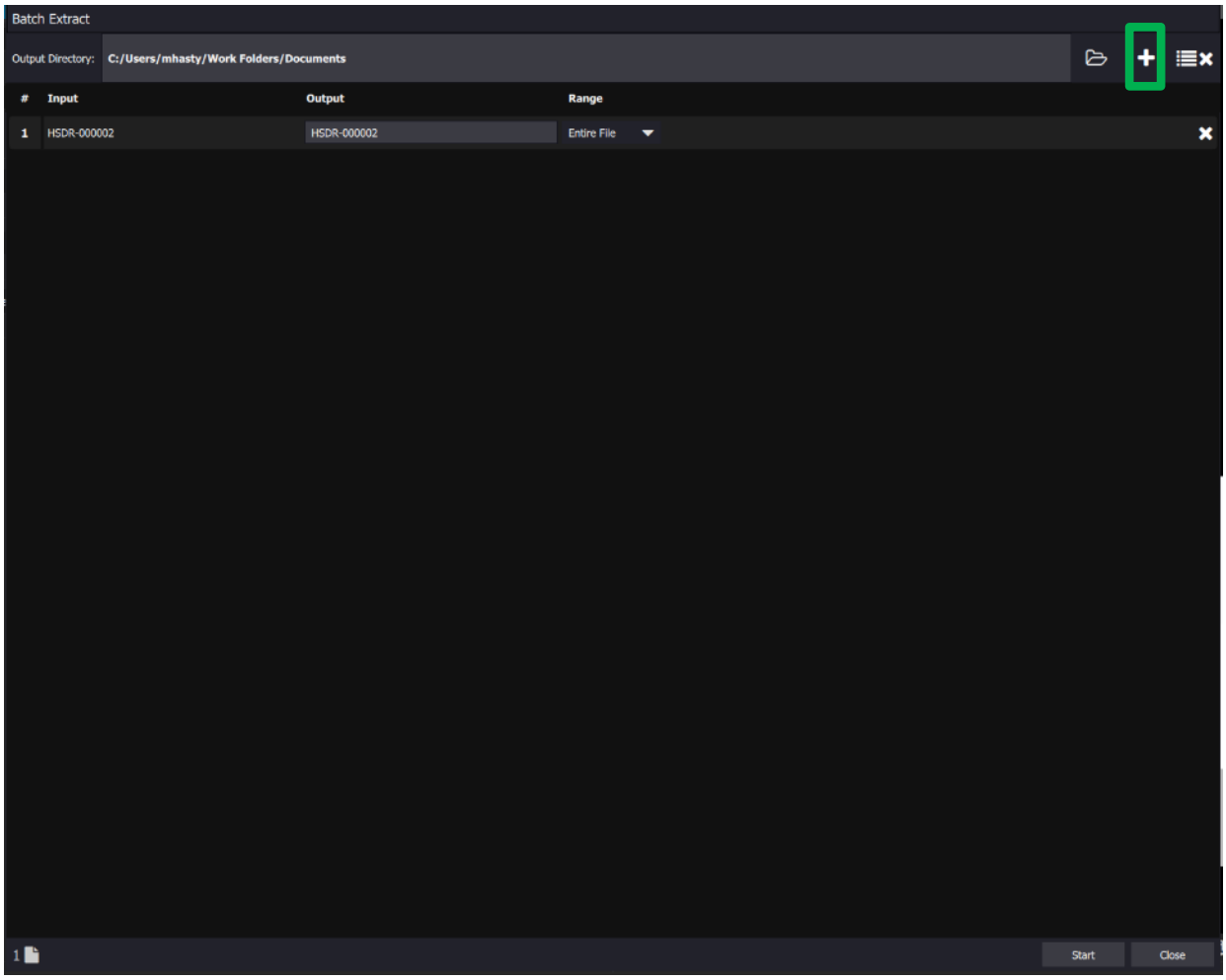
There is also a separate menu to batch extract from the HSDR into a .ATS format that is saved on the computer. The HSDR is only accessible via Research Studio. The only way to retrieve data off the HSDR is to use the Extract feature. It is IMPORTANT that you extract data you want to keep as soon as possible. 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.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.
	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.
	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.
Additional ROIs Available with PRO		
	Square ROI	This ROI reads the values inside a square. Height and width stay equal during resizing.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

	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

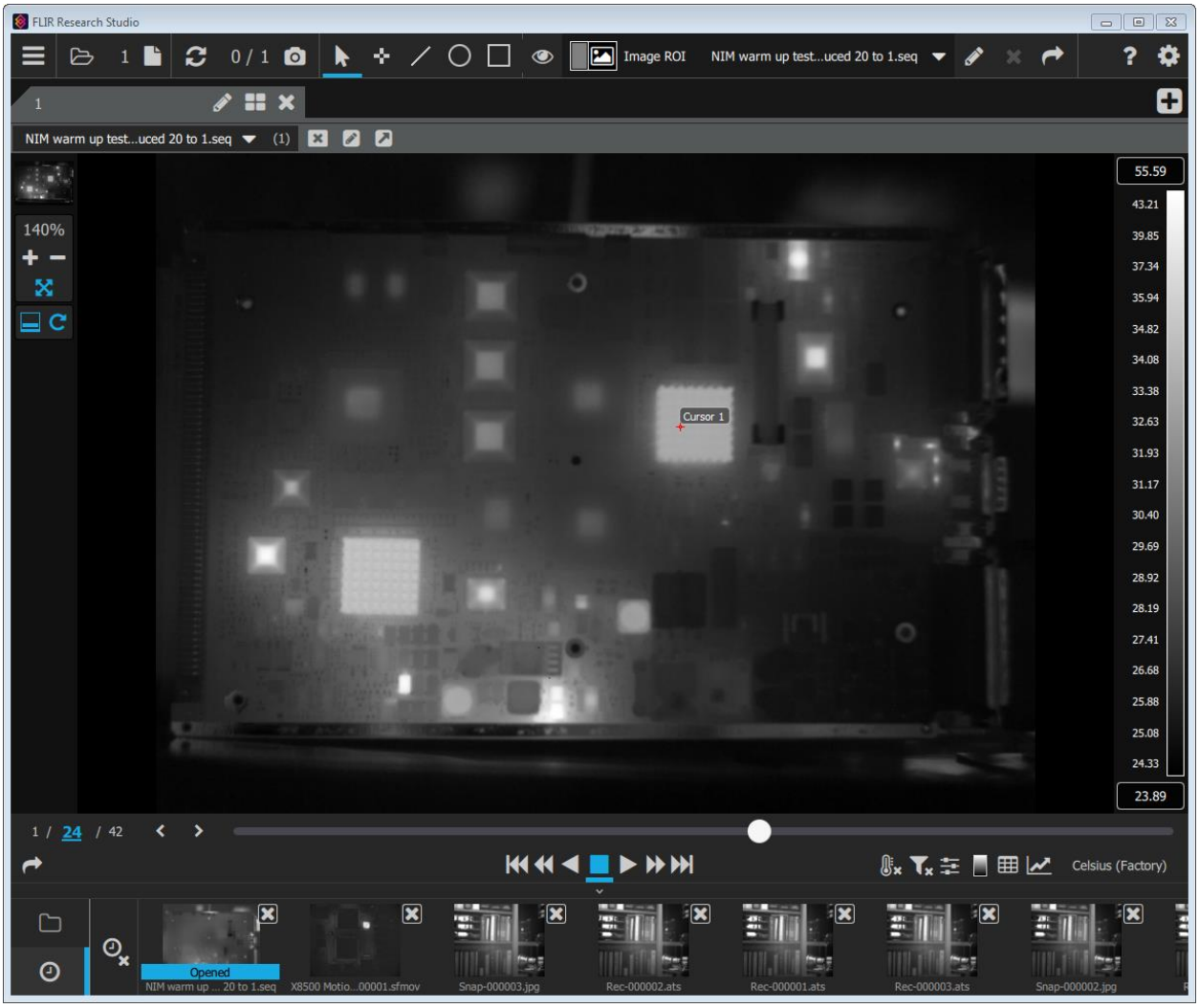
Until the user has drawn an ROI, the Select/Move ROI control does not do anything. Open a file and then click on the Draw Cursor ROI control. It will now look like this, indicating that it is active:



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

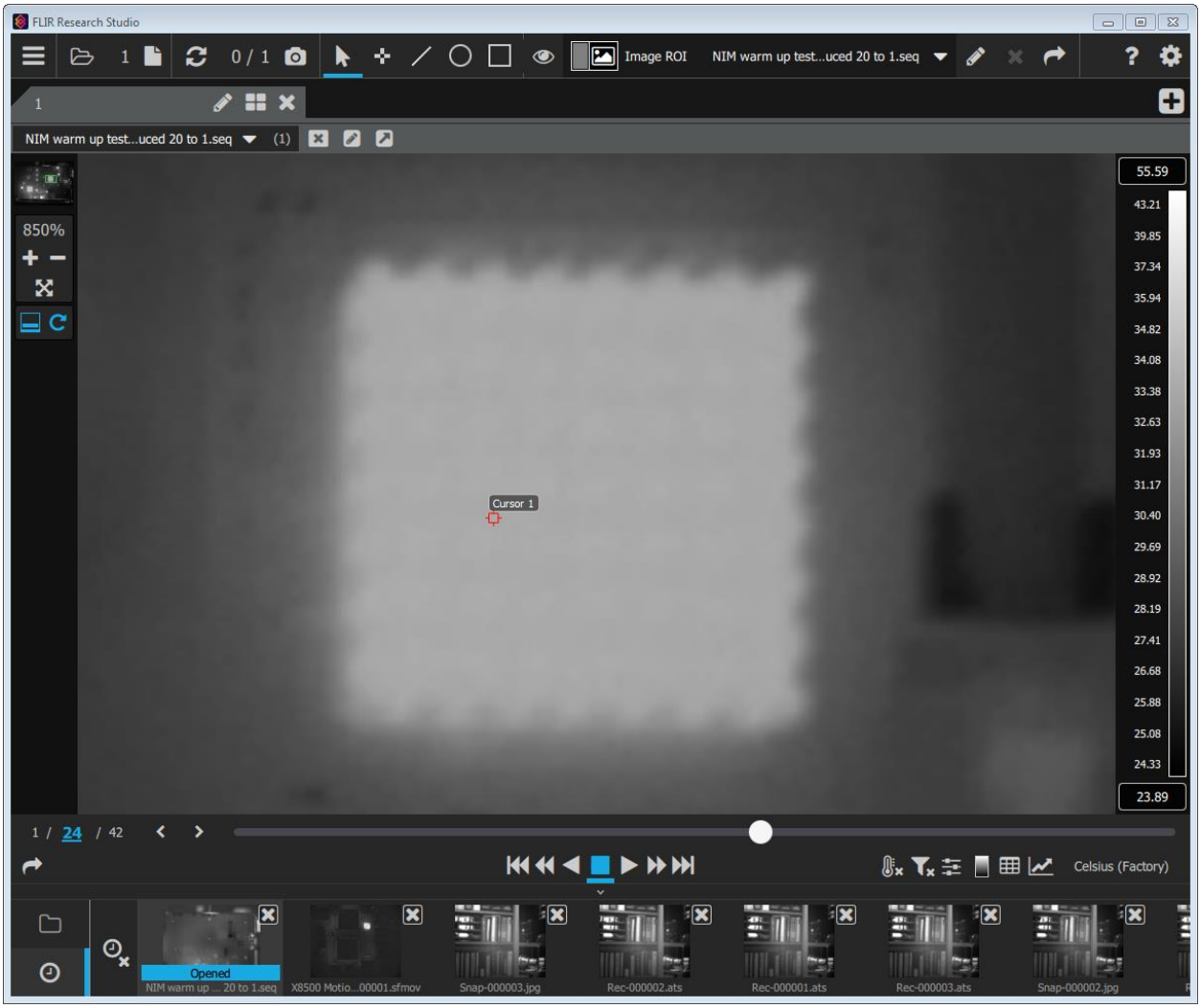
5.1.4 Image Zoom

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.



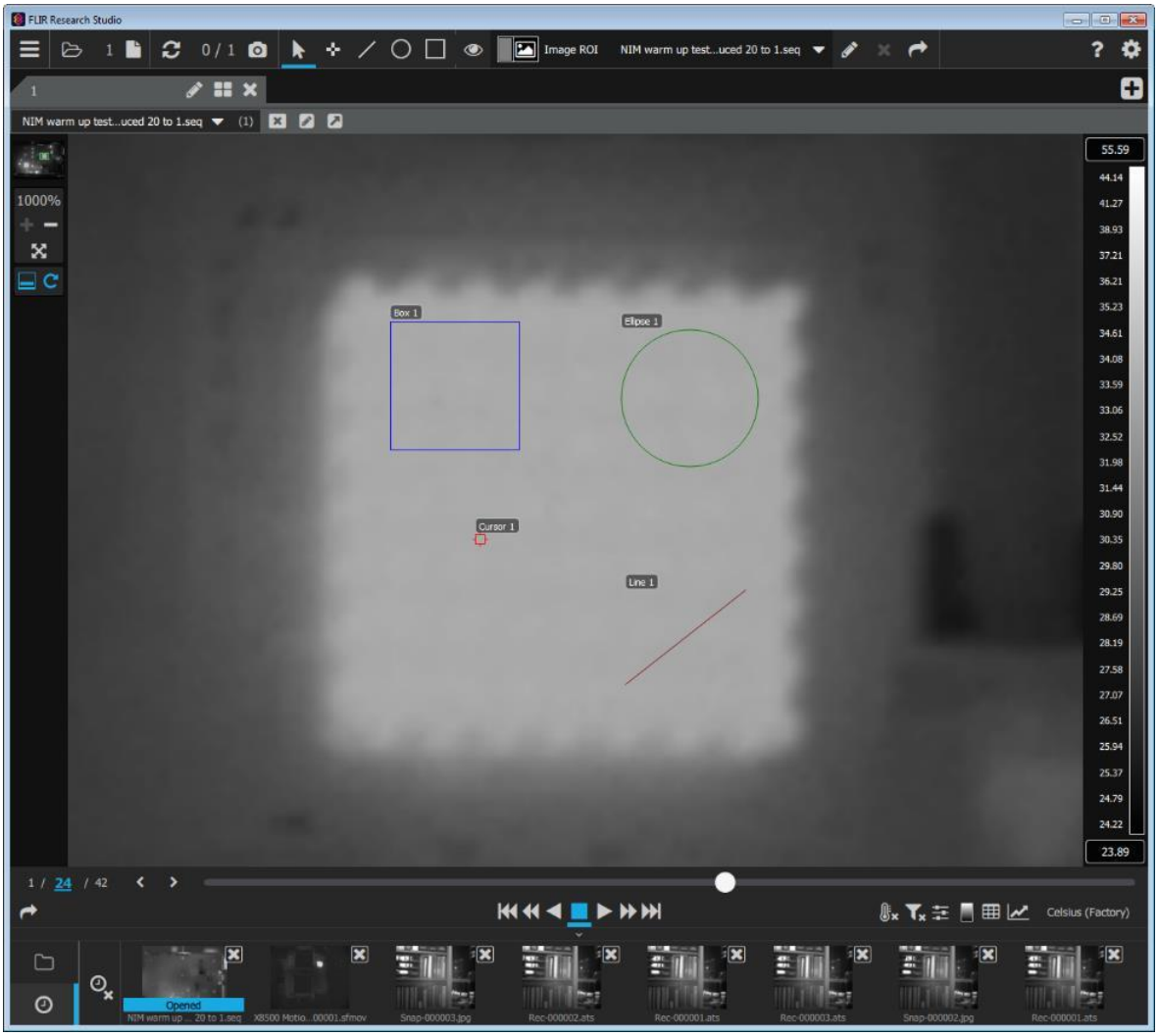
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.

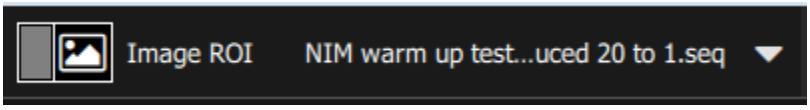


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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:

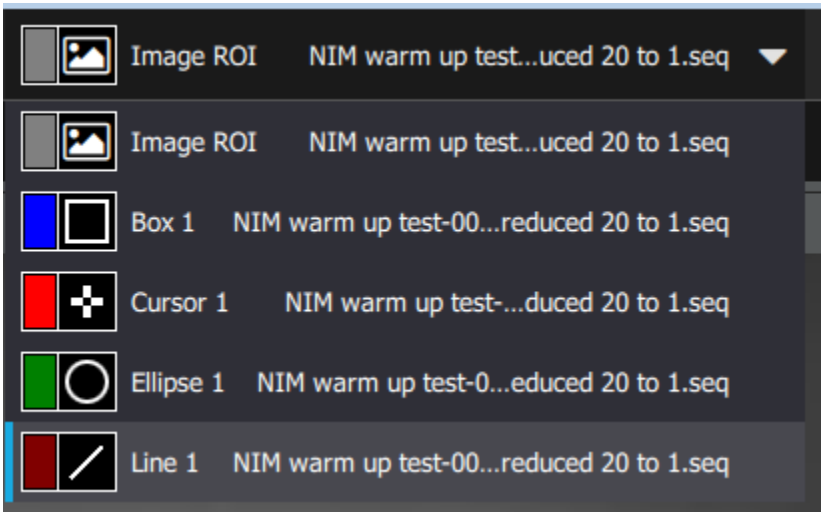


Now there will be a selection of ROIs available to choose from in the ROI selector pulldown menu in the top bar.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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:

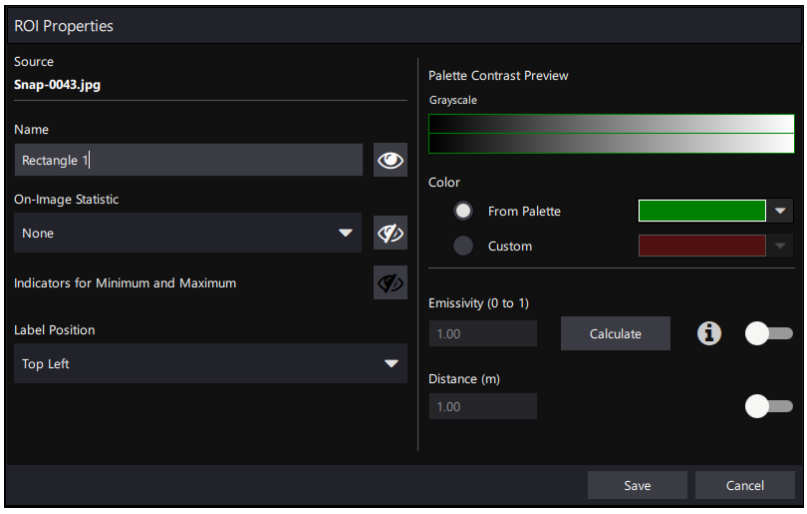


5.1.5 Editing an ROI

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

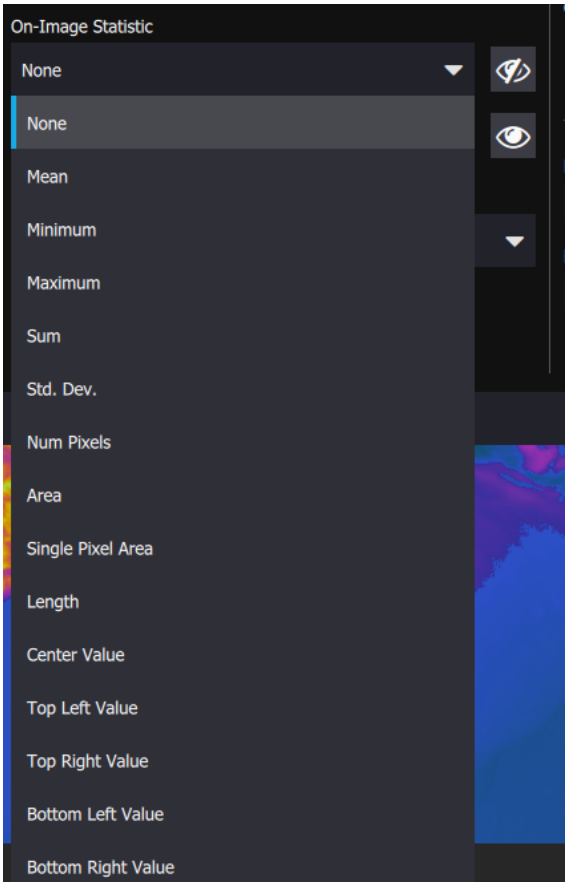


The ROI properties that can be changed include the name (which can be up to 30 characters long), the on-image statistic label, the color of the ROI outline, the emissivity and the distance of the target.

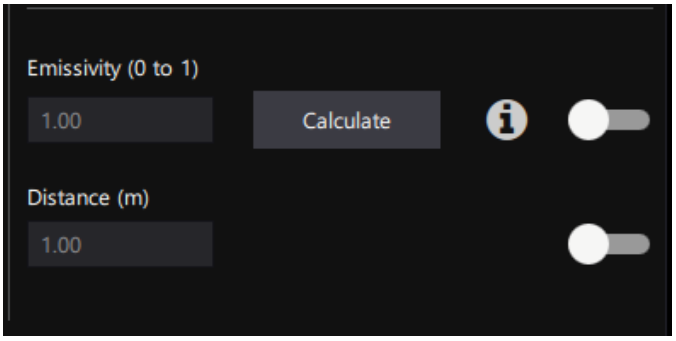


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.



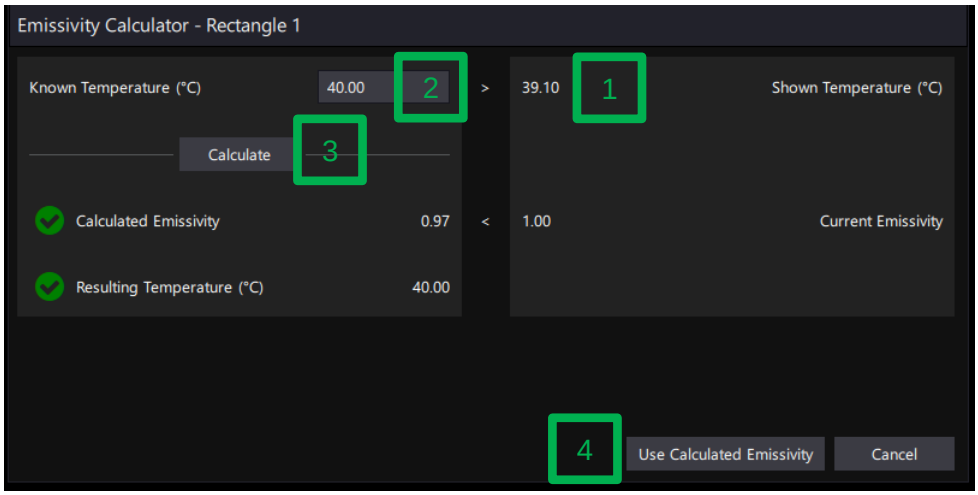
The Emissivity and Distance values are used for calibrated cameras or cameras with a User Calibration applied. To manually override the default values for Emissivity and/or Distance, enable with the slider and enter the desired value.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

5.1.5.1 Emissivity Calculator

Clicking the Calculate button brings up the Emissivity Calculator.



The Shown Temperature (1) is the temperature as derived from the calibration that the camera is seeing. Set the Known Temperature (2) to the actual temperature of the target and press Calculate (3). The Calculated Emissivity and Resulting Temperature are then displayed. To use this setting, click Use Calculated Emissivity (4).

5.1.6 Deleting an ROI

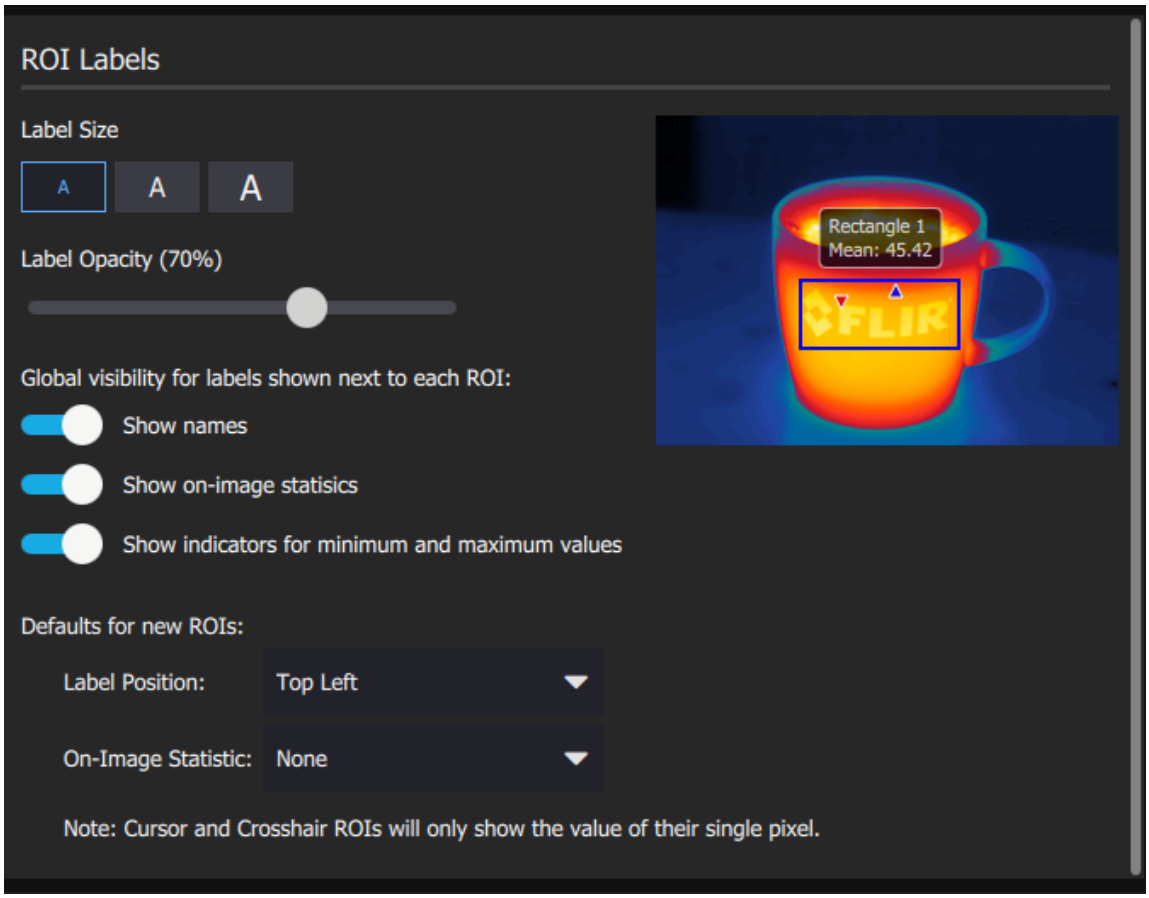
An ROI can be deleted using this button, which is greyed out until there is at least one ROI other than the Image ROI:



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.

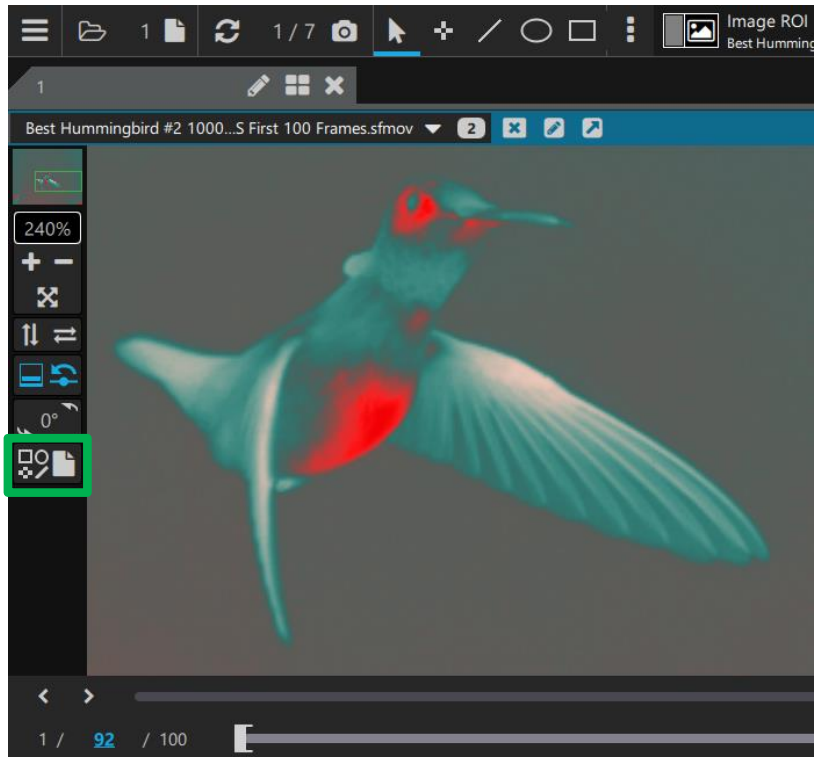
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



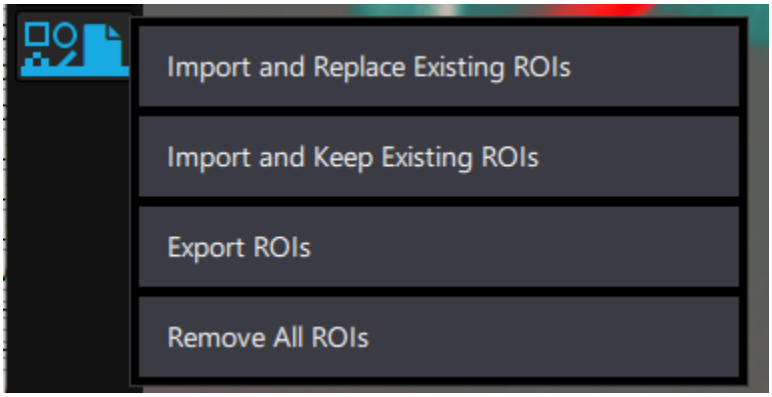
5.1.8 ROI Import and Export Actions

On the left side of the image module there is an ROI Import and Export Actions selection.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



This brings up options for importing and exporting ROIs.



Import and Replace Existing ROIs – Deletes the current ROIs and Imports (opens) previously Exported (saved) ROIs

Import and Keep Existing ROIs - Imports (opens) previously Exported (saved) ROIs and adds them to the image while keeping the existing ROIs. Imported ROIs will be appended with a number if there is a conflict in naming with the existing ROIs.

Export ROIs – Exports (saves) all ROIs in the module. This differs from the *6.2 Export ROI Data* function which exports the data collected by the selected ROI to a CVS file.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

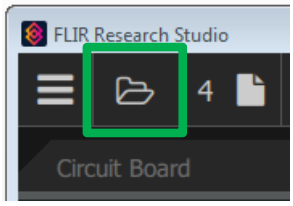
Remove All ROIs – Removes (deletes) all the ROIs in the module. To delete a single ROI refer to *5.1.6 Deleting an ROI*.

5.2 Opening Recorded imagery

There are several ways to open an image or video (image sequence) file in FRS.

5.2.1 File Open Button

One method is to use the open file option next to the “hamburger menu” in the upper left corner of the main window:



5.2.2 Collections Gallery

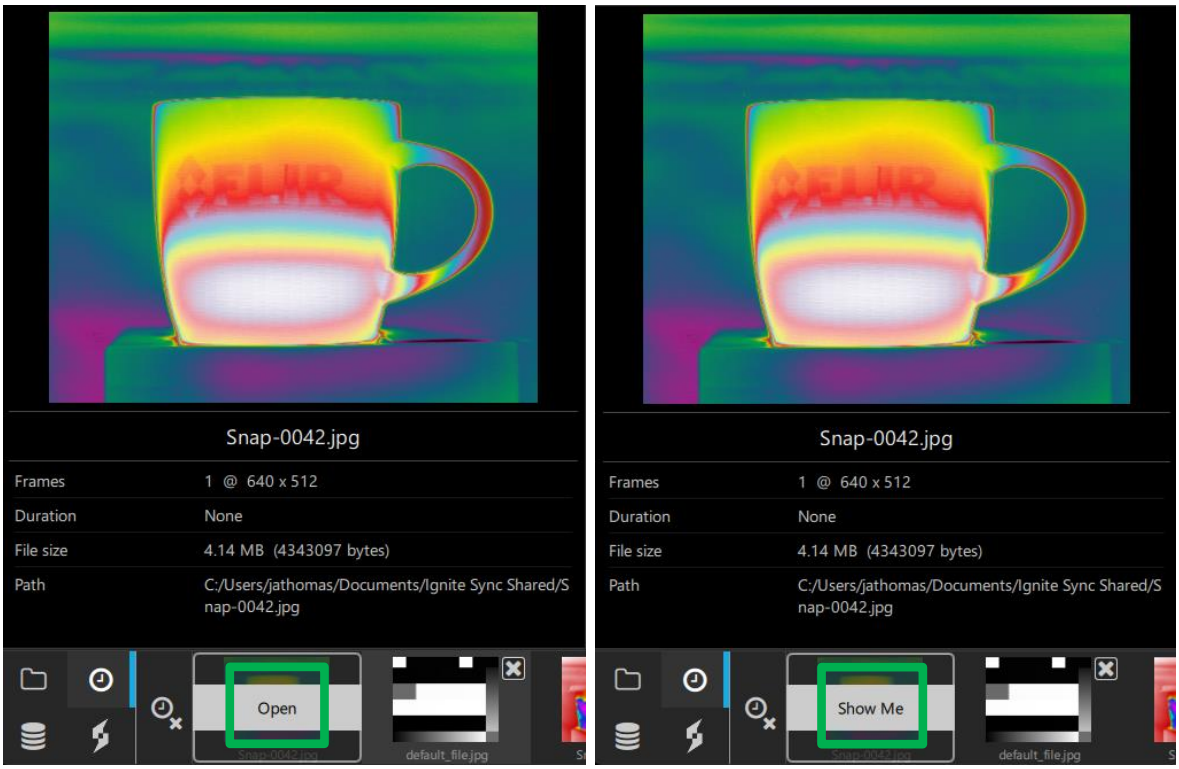
Another method is to double-click on a thumbnail in the Collections gallery along the bottom of the main window. The icons on the left side are used to select what view is shown in the list of thumbnails. Only files with extensions recognized by Research Studio will show in the list.



If the user clicks just 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.

However, if the file is already open within the workspace, the “Open” button will be replaced with “Show Me”. Clicking this will automatically select the tab, frame, and module where the file is already open.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



5.2.2.1 Quick Collection Files

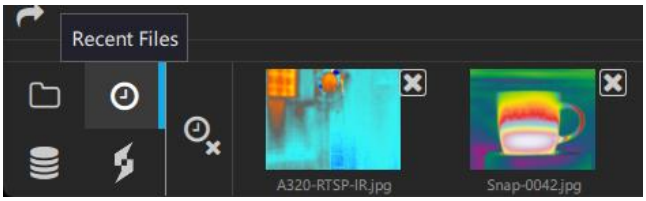
The folder icon button allows the user to see the contents of a specific folder. Clicking the opened folder icon allows the user to set the folder and display the files as thumbnails.



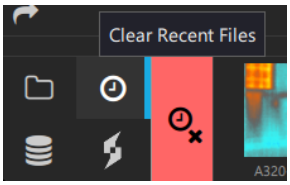
5.2.2.2 Recent Files

The clock icon button allows the user to see all recent recordings or files that have been recently opened.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

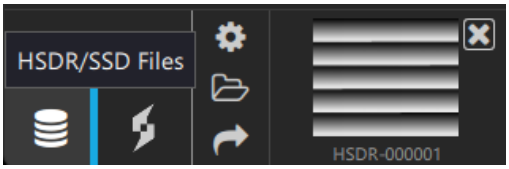


The recent files list persists until the user decides to clear the list. The user can clear individual files by click the “x” in the upper corner of the thumbnail. All files can be cleared from list by using the button that looks like a clock with an X next to it. **Clearing the recent list does not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



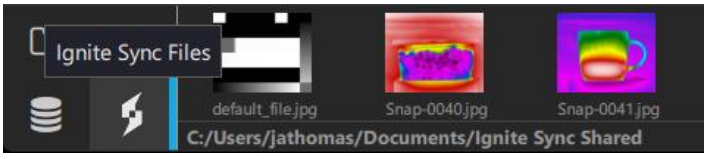
5.2.2.3 HSDR/SSD Files

The disk array icon button lets the user configure a connected HSDR or SSD and view their files as thumbnails.



5.2.2.4 Ignite Sync Files

If Ignite Sync is installed and configured properly, the double flame icon button lets the user view the files inside of their Ignite shared directory as thumbnails.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

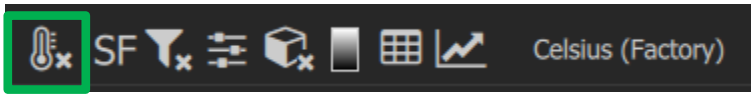
5.2.3 Drag and Drop

The user can also drag and drop a file or a folder of images to the application, and it will open them. This is the indicator the user will see if a file or a folder of still images in sequence are dragged near the center of the application.

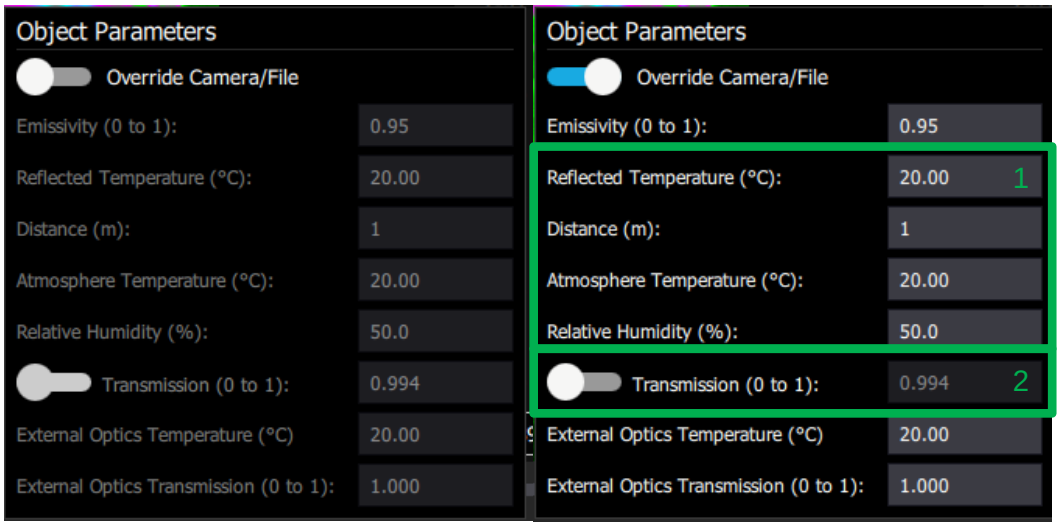


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.



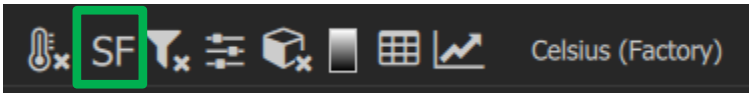
For factory calibrations, the Reflected Temperature, Distance, Atmosphere Temperature, and Relative Humidity values (1) are used to calculate the Transmission value (2) based on additional data stored with the camera. User calibrations do not have this data, so those values (1) are ignored and only the Emissivity and Transmission values are used. The Transmission value will be set to its default or the user can override it and enter the value the user calculates themself.

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



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

5.4 Superframing



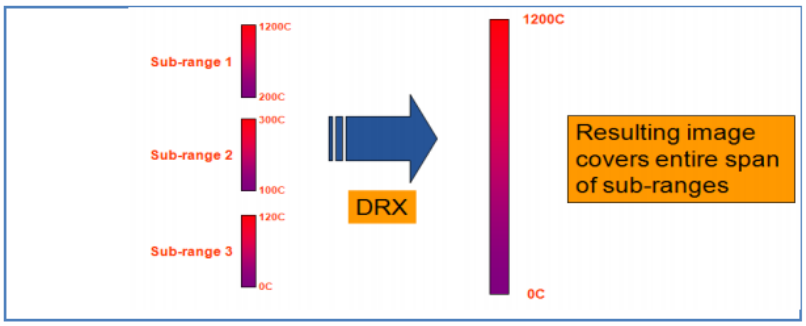
For cameras that support superframing, the Selector control allows the user to choose which preset to display.



- **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.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.

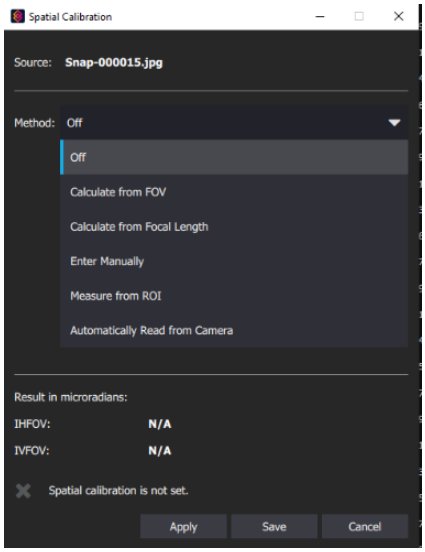
1. **Calculate from FOV** PRO: Enter the FPA height and width in pixels and the Field-of-view (FOV) of the optics

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

3. **Enter Manually** PRO: If you know the IFOV, just enter it manually

4. **Measure from ROI** PRO: 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

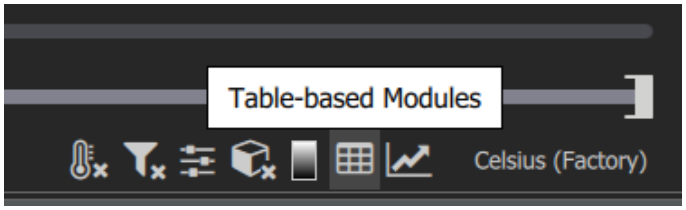
5. **Automatically Read from Camera:** Only available if the camera provides the calibration

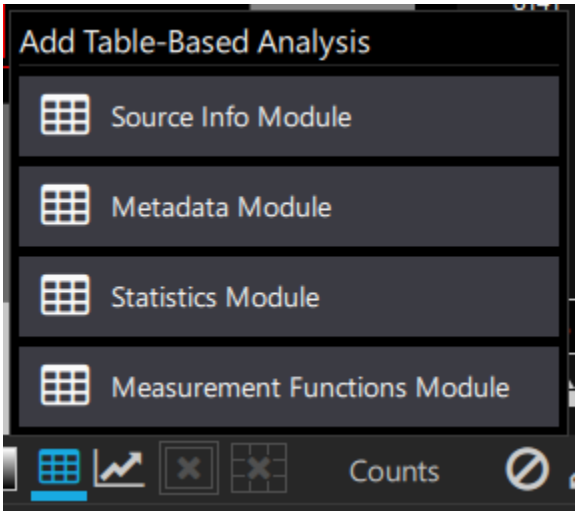


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

5.6 Table-Based Modules

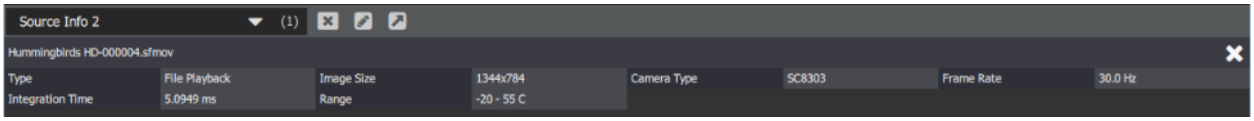
Further to the right on the control menu is the table-based modules which include source info, metadata and image statistics:



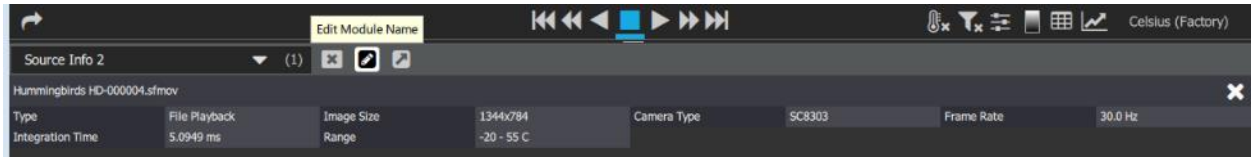


5.6.1 Source Info Module

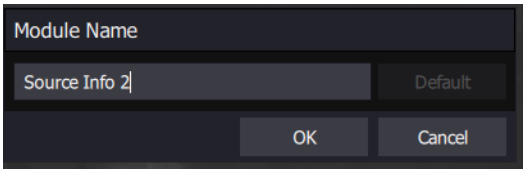
The Source Info module displays data about the image file:



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

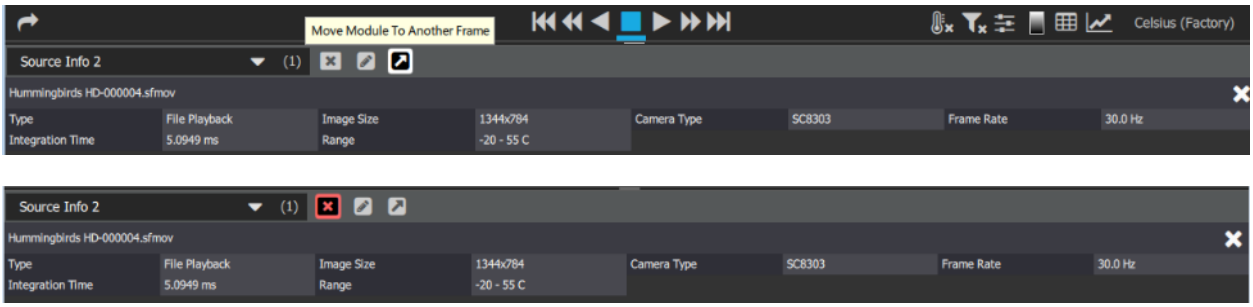


It brings up this dialog box:



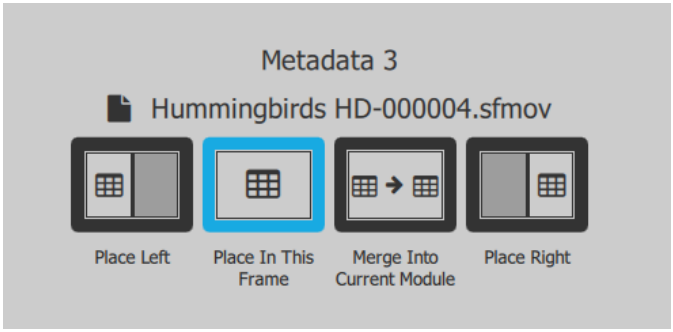
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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:

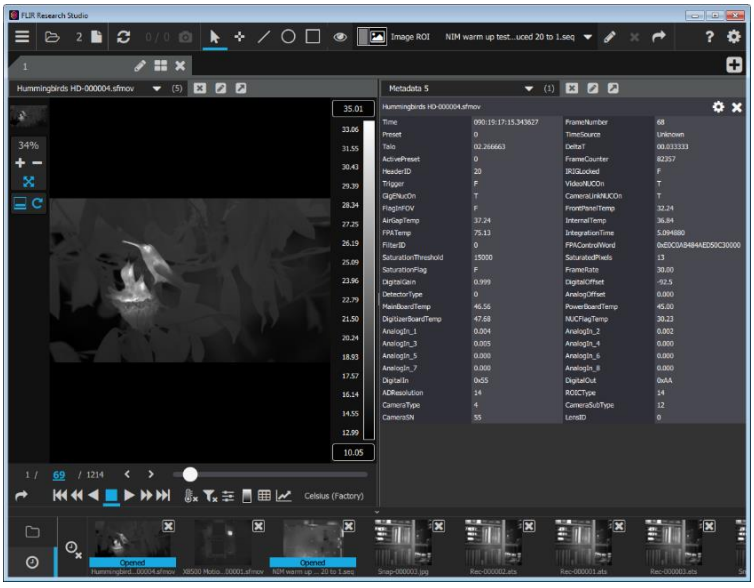


5.6.2 Metadata Module

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

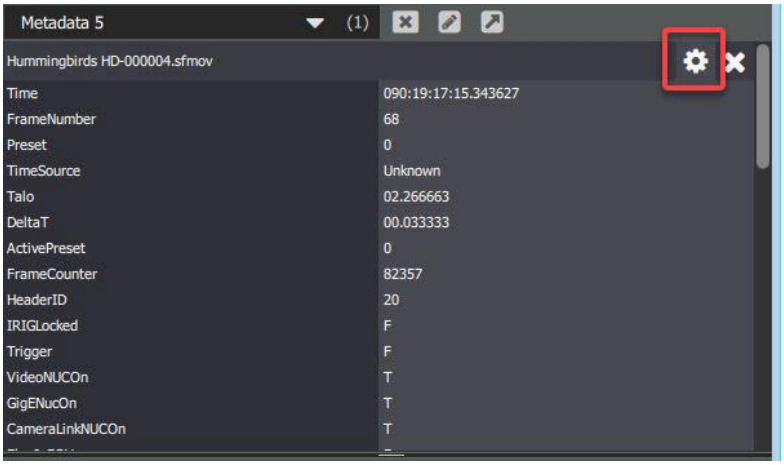


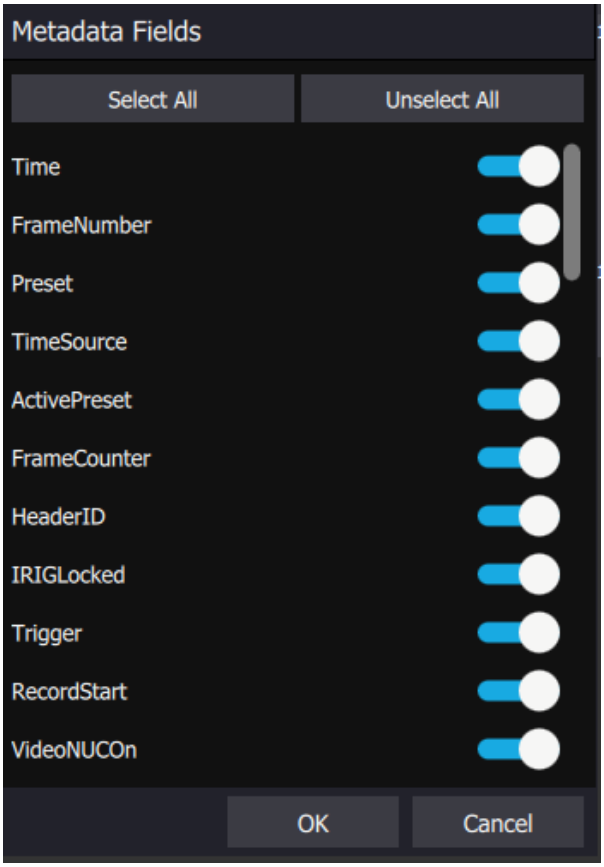
Here it was placed to the right, and one can see all the metadata tags associated with this image:



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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:

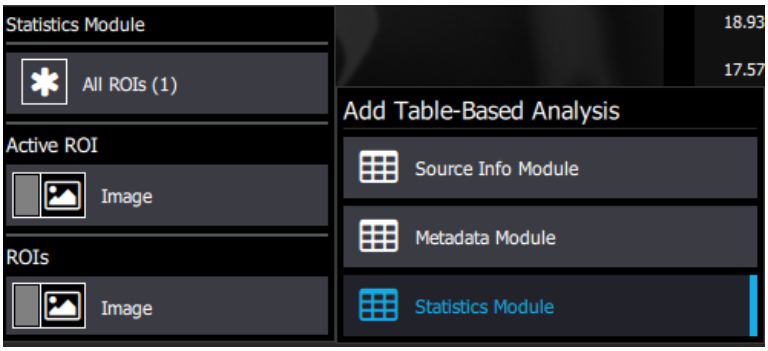




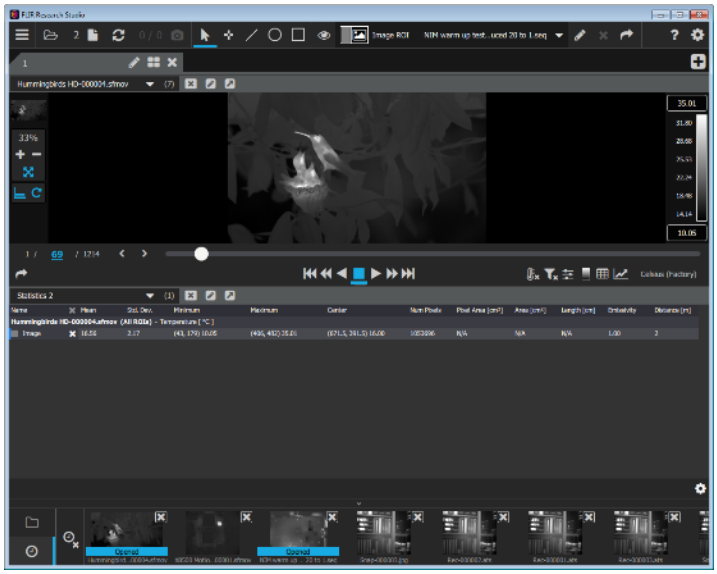
5.6.3 Statistics Module

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:

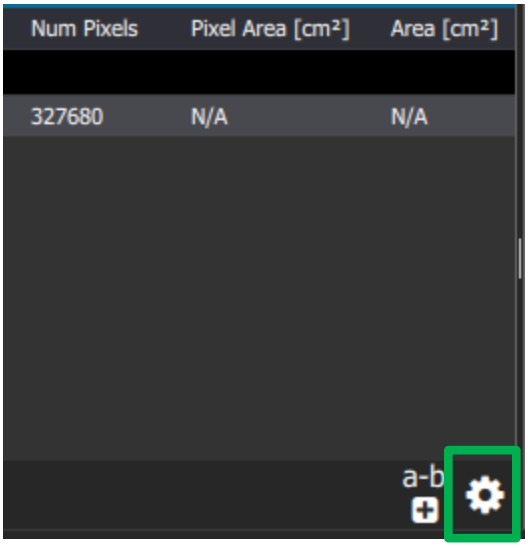
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



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

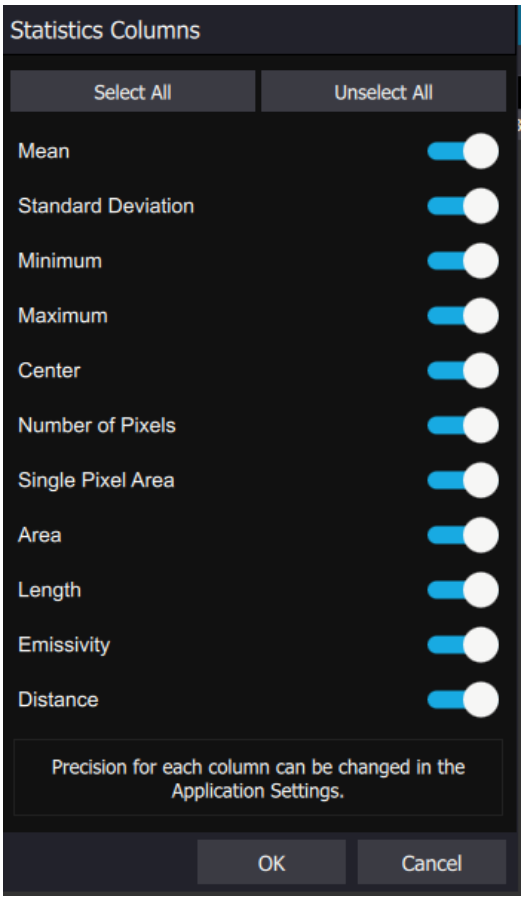


It is also possible to configure the variables that are displayed in the statistics window using the gear-shaped settings icon in the lower right corner of the Statistics window:



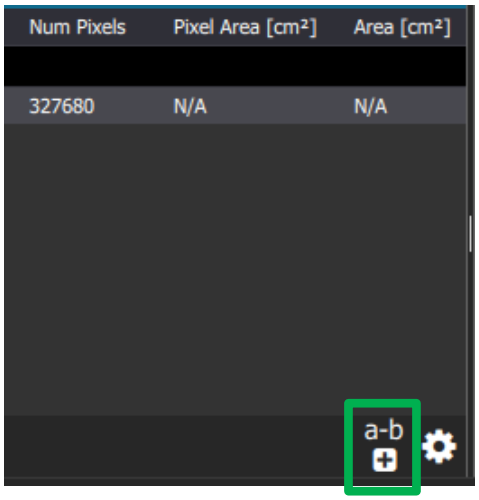
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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



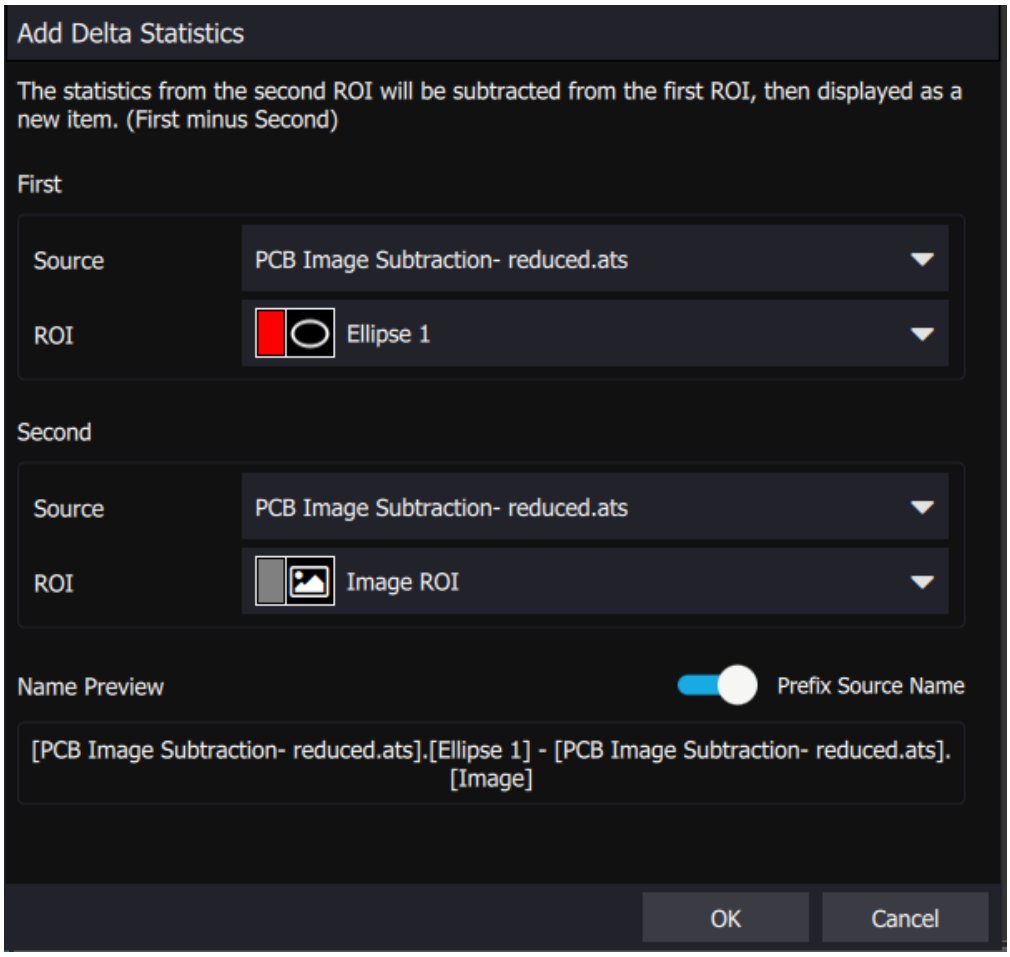
5.6.3.1 Delta Measurements

The user can also select the add delta measurements option.

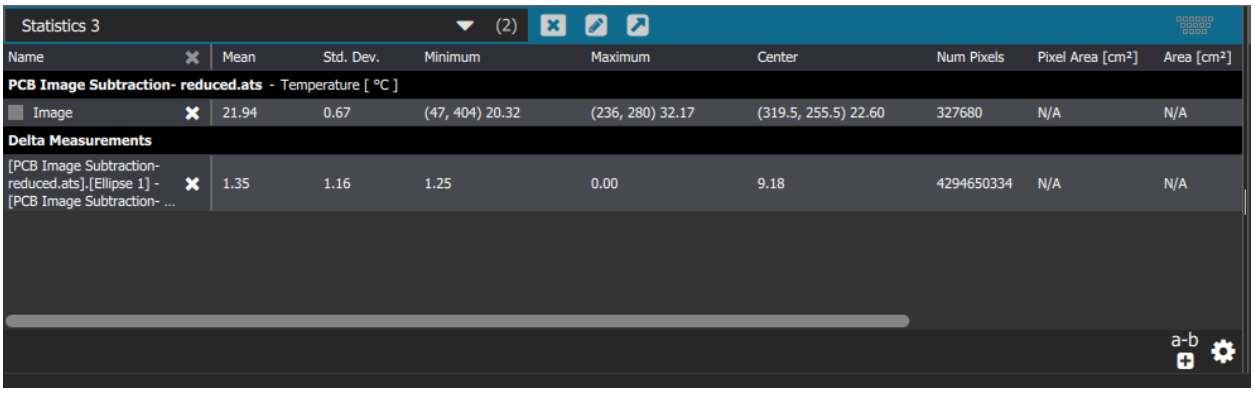


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.



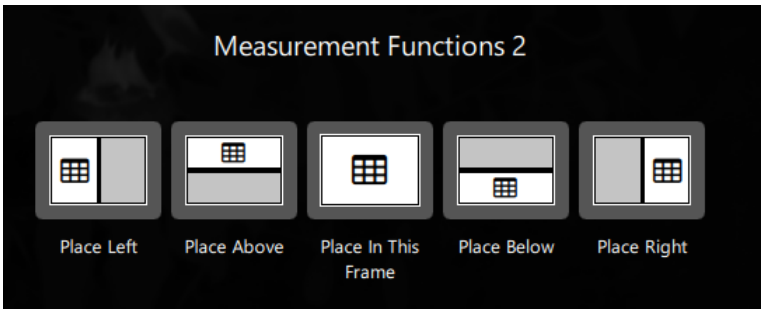
After applying the delta measurements, the statistics window will look like this.



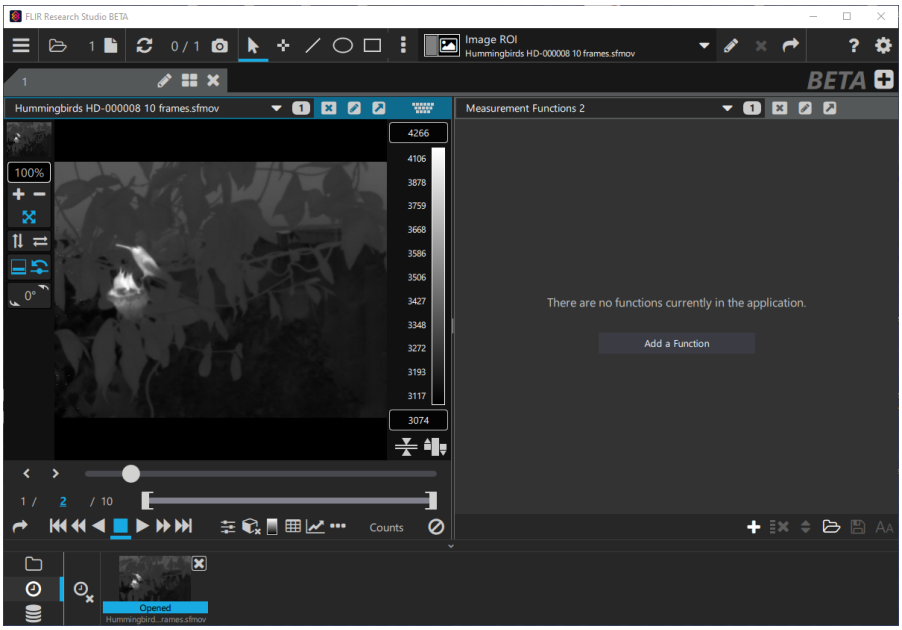
5.6.4 Measurement Functions Module PRO

When the Measurement Functions Module is selected, as with the other table-based modules, the user will first be promoted where to place the measurement module.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



Here it has been placed to the right and an empty Measurement Functions module can be seen.



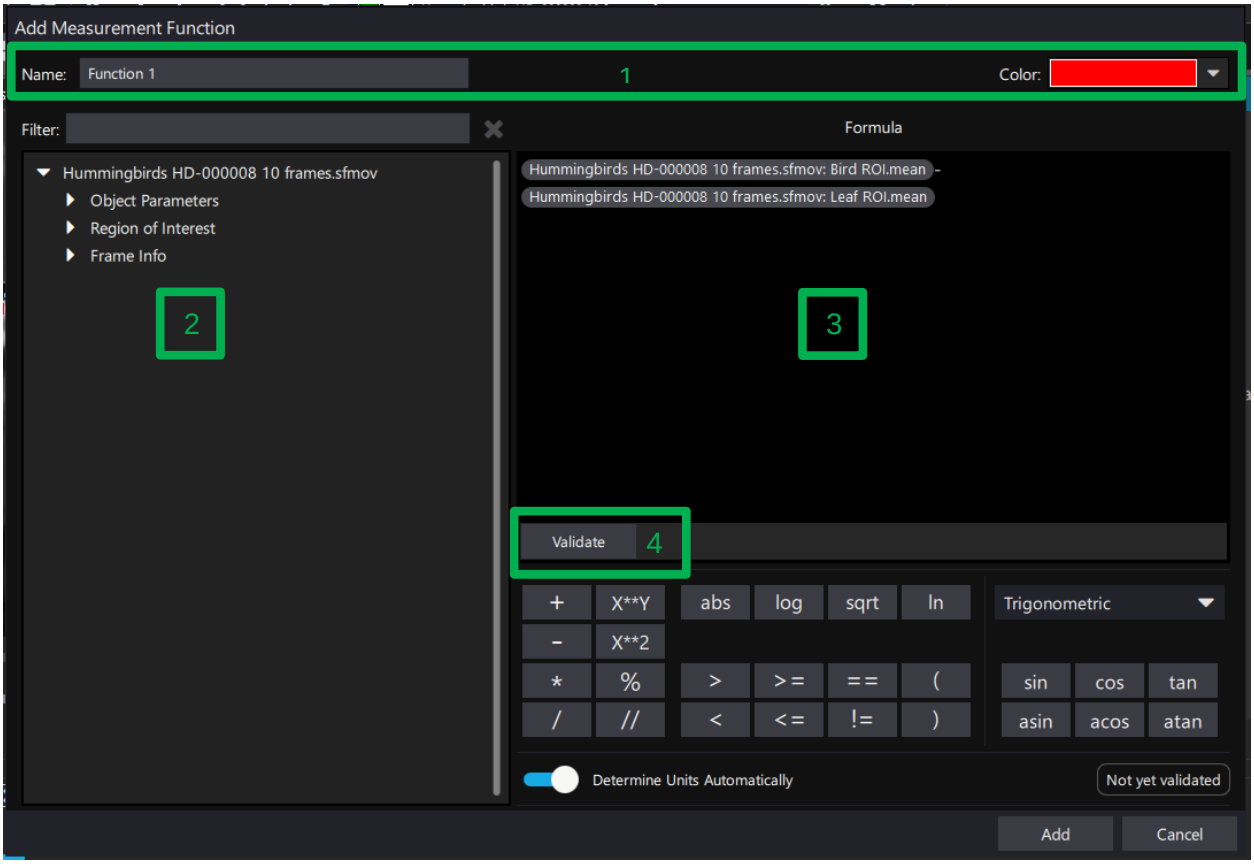
The module specific controls are as follows.

Control	Function
	Add – Opens the Add Measurement Function dialog window.
	Delete All – Deletes all measurement functions.
	Change Order – Places the measurements function in a mode where an individual function can be selected and moved to a different place in the list
	Load – User can load a previous set of functions from disk.
	Save – User can save a set of functions for later use.
	Text Size – User can change the font size of the displayed measurement functions.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

5.6.4.1 Adding a Measurement Function

Clicking the Add icon brings up the Add Measurement Function dialog box allowing the user to create a new measurement function

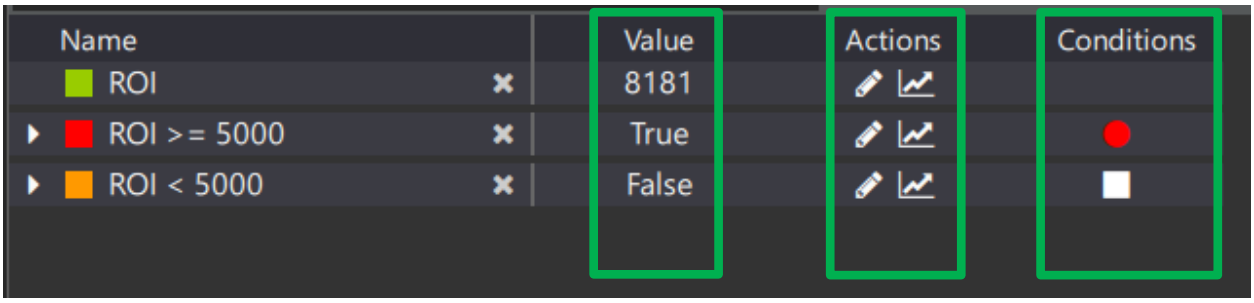


The top area (1) allows the user to set the name and reference color for the function. The left area (2) allows the user to choose an input variable. Possible choices include existing ROIs, data from the camera image header, or even other measurement functions. Click the arrows to expand the lists. The Filter box allows the user to filter the list to keywords. Area (3) shows the complete expression as a "formula". These formulas can be a combination of inputs and math functions from the "calculator" area. Boolean functions (True, False, etc) can be used to evaluate the function and this state can be used to trigger the start of data recording. (see 4.2.2 Start, Stop, & Periodic Options). The Validate (4) button is used to test the formula to make sure it's valid before adding. Click Add or Cancel appropriately when done.

5.6.4.2 Measurement Functions List

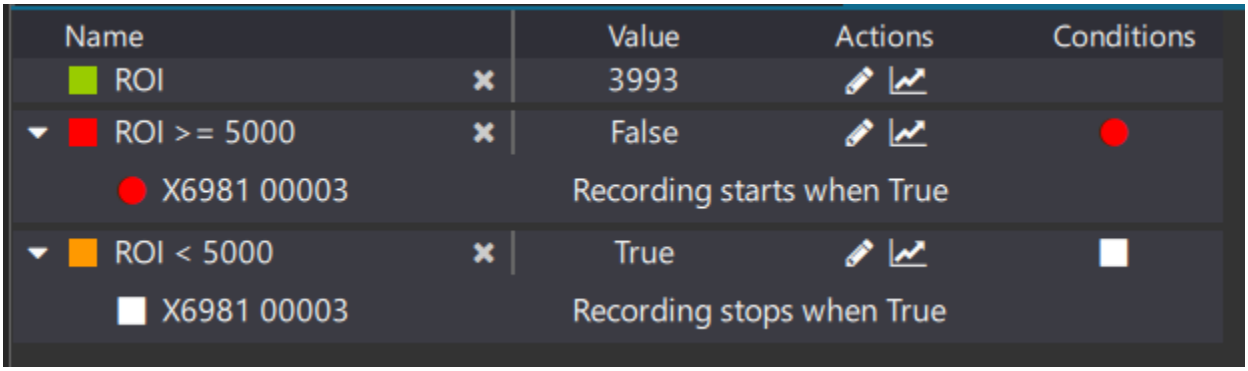
Multiple functions can be created and they will be listed in the measurements module list. In addition to the main module controls, there are individual controls for each function.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



Control	Function
✖	Delete – Deletes this function only
Value	The Value column lists the result of the measurement function.
Actions - ✎	Allows the user to edit the function
Actions - 📈	Allows the user to place a graph in a module
Conditions - ●	Indicates this function is used as a trigger to start a recording
Conditions - ☐	Indicates this function is used as a trigger to stop a recording

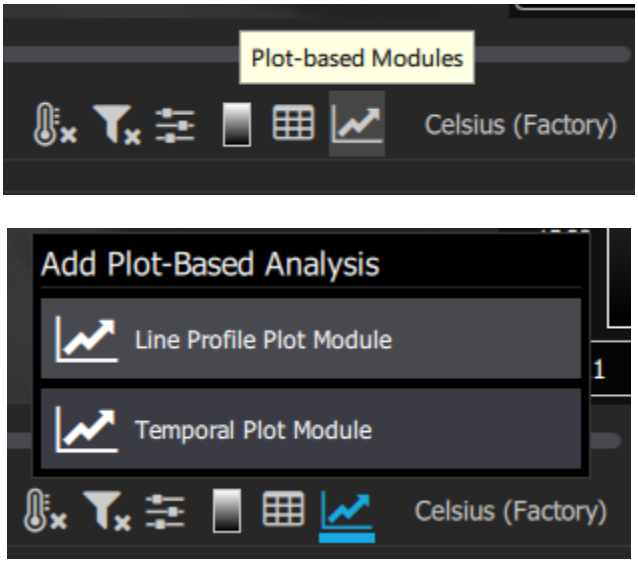
If a function is used to trigger a recording, an expander button will be shown in front of the function's name. Expand to get a detail of how the function is used to trigger a recording.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.

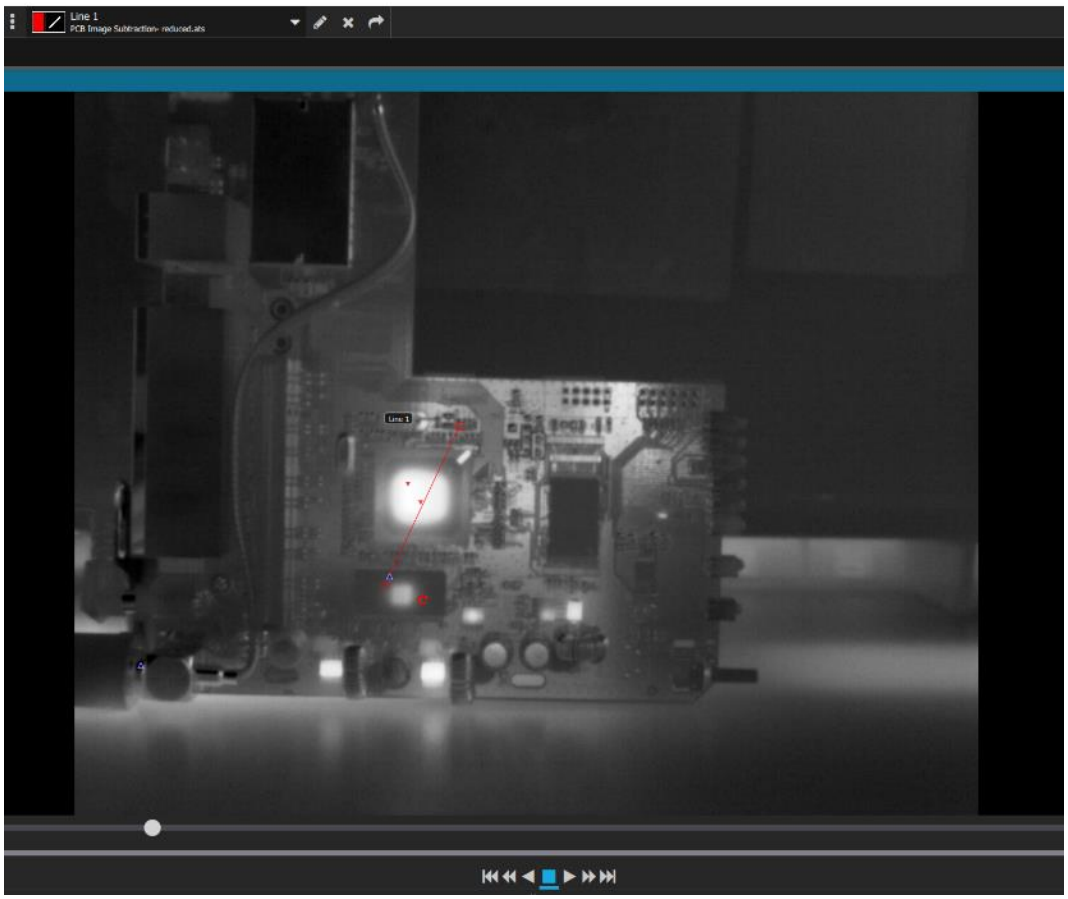


The Line Profile plot module shows a plot of the pixel values along a region of interest. The Temporal Plot module shows a plot of a statistical property as a function of time (frame number in a sequence).

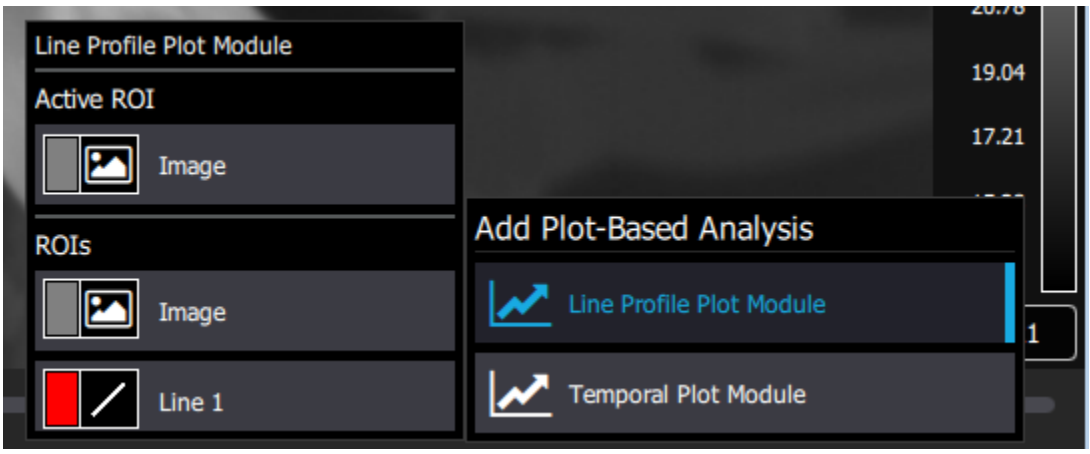
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.

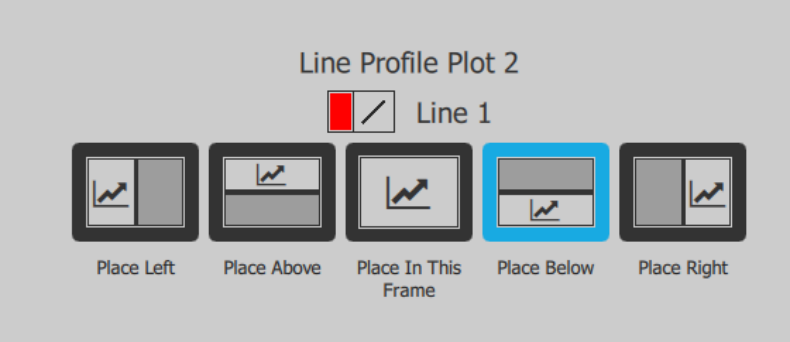


The “Line 1” ROI is selected off the line profile plot module selection:

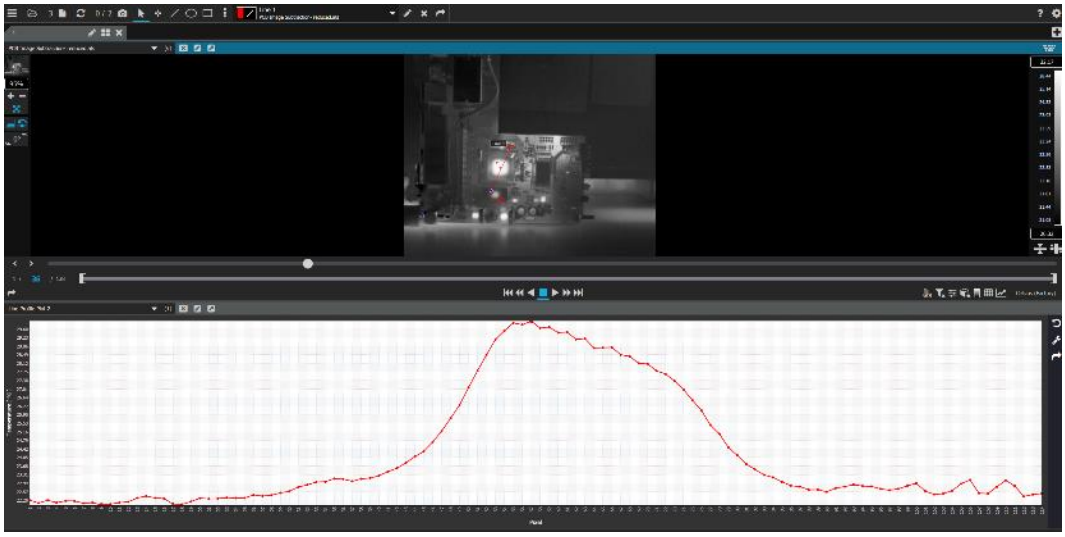


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

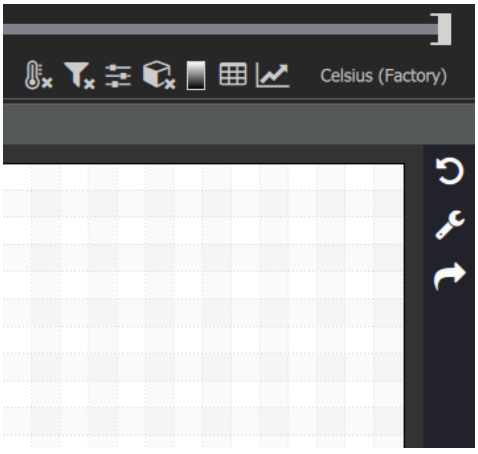
Then the user put the line profile plot below the hummingbird image.



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

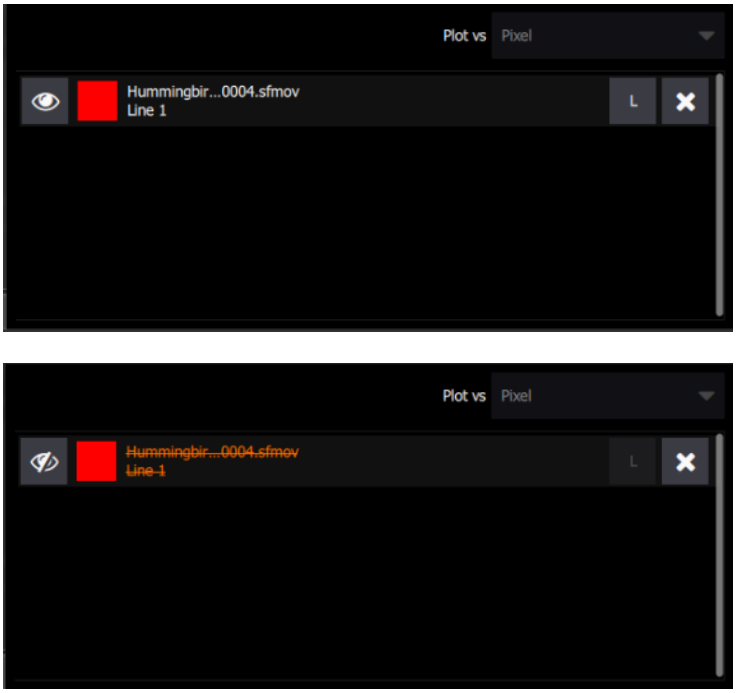


The line profile plot can be reconfigured using the settings icon that looks like a crescent wrench on the right side of the line profile plot:

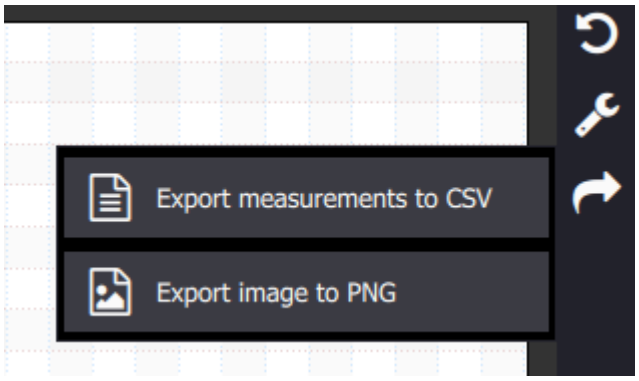


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

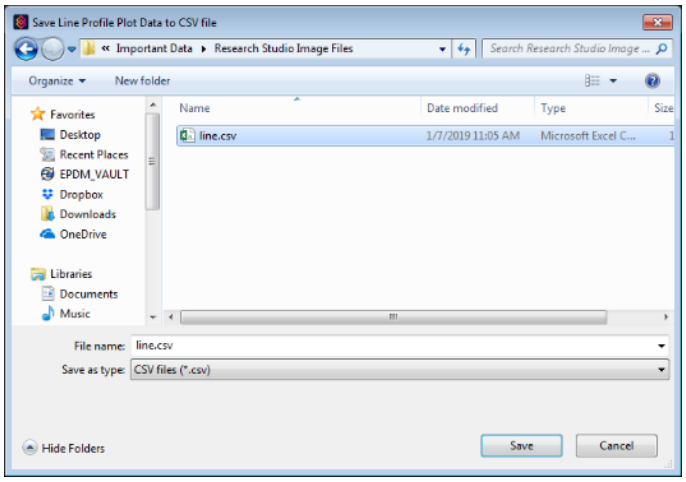
The L/R button can be used to move the Y axis label to the left or the right side of the plot. When it says L, the axis is on the left. Clicking it changes the button to an R and moves the axis to the right side of the plot. The Eye button can be used to turn the plot on or off.



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.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



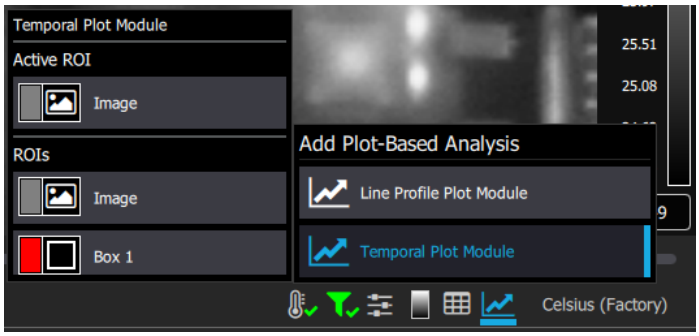
When the file is opened in Excel, the top lines look like this:

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

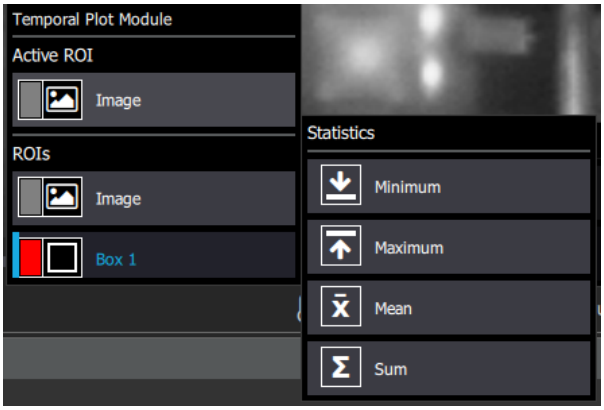
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

5.7.2 Temporal Plot

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

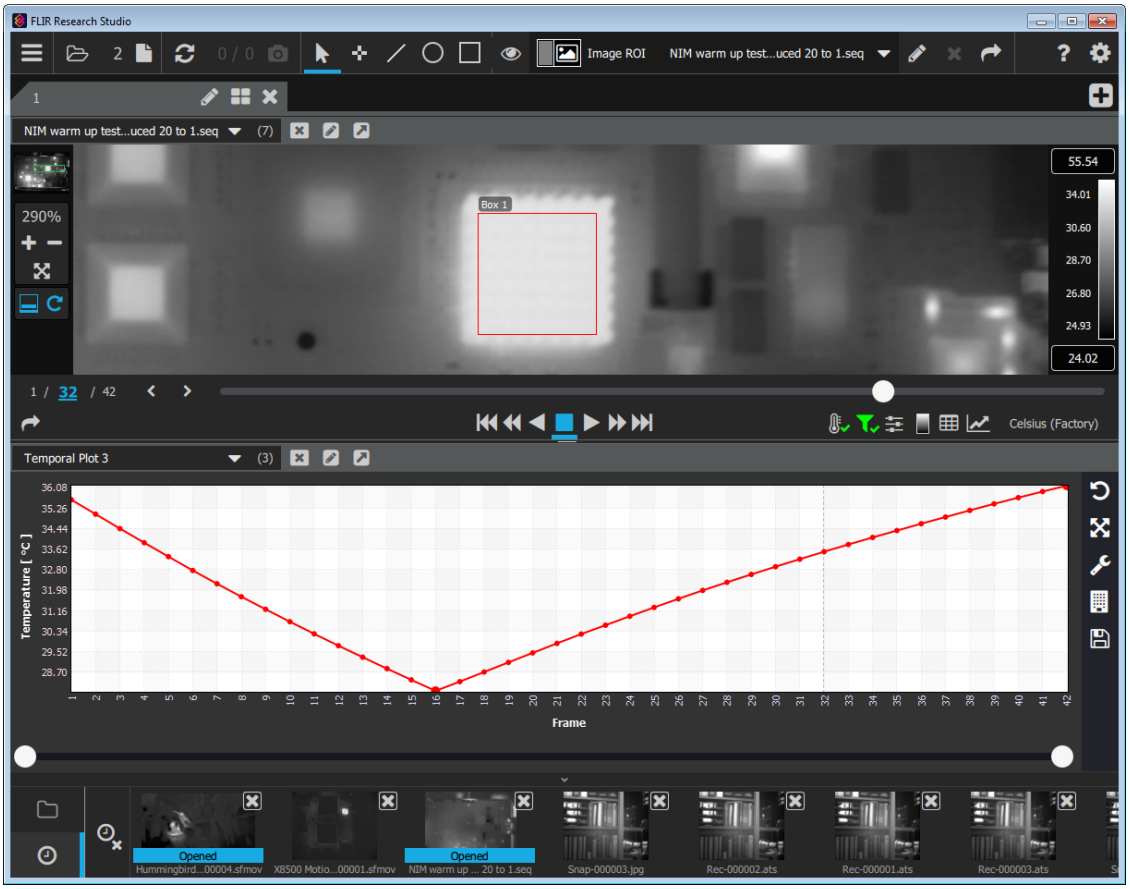


Most users will use the Mean value for a Box ROI, but there are these other options as well:



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.

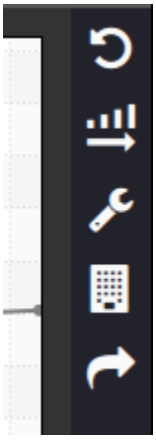


Note the vertical dotted line that sweeps along with the frame counter, showing the user where the playback is in the temporal plot.

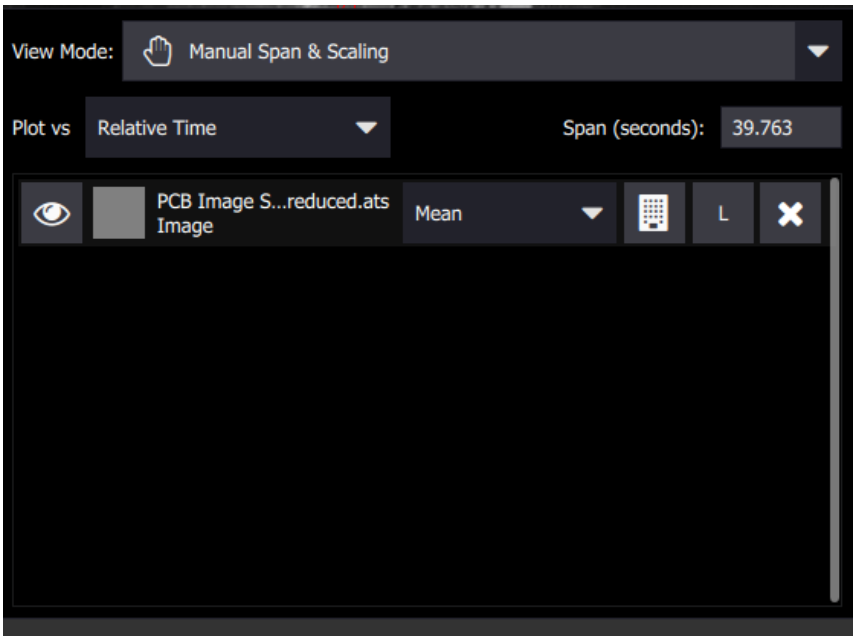
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.



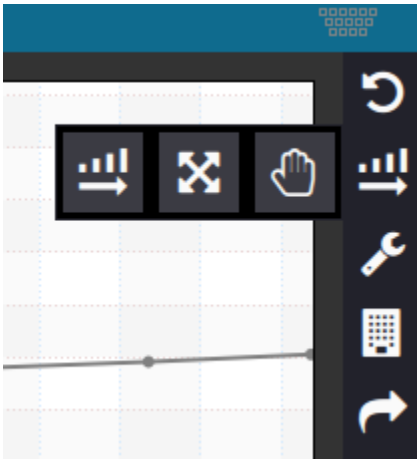
The crescent-wrench shaped icon has a pull-down menu for the selection of the variable to be plotted on the x axis. The default value is the frame number, which is the FrameCounter variable in the metadata, followed by the relative time (which is zero at the start of the image sequence), and finally 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.



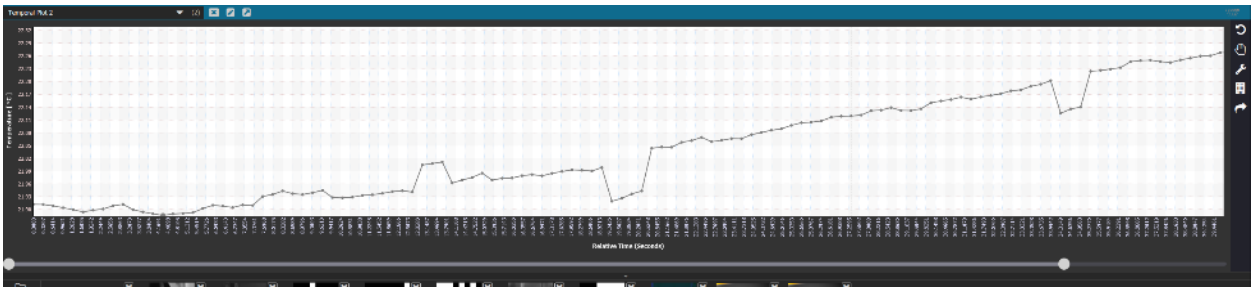
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.



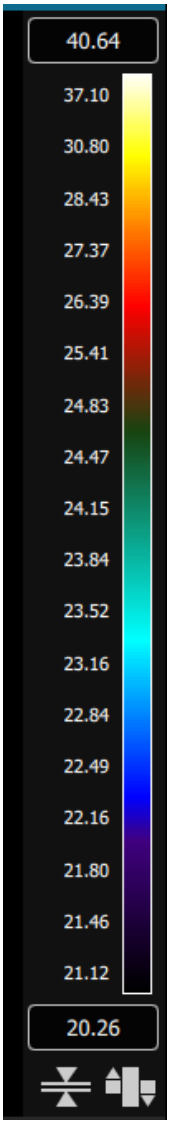
The change plot view mode icon (the horizontal arrow with the increasing bar graph) has three options after clicking. Follow with Manual Span, Fit with auto span and scaling, and Manual span and scaling. With the manual span and scaling the graph's resolution is controlled by the white circle-shaped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



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

5.8 Color Bar

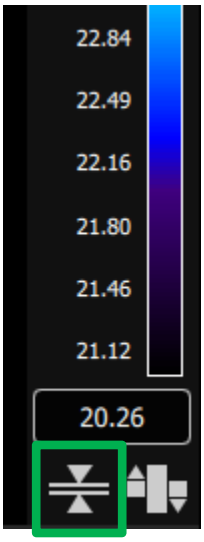
The Color bar shows the relationship between the color palette and the data values in the currently selected units. The palette can be changed by using the palette selector tool via the palette button. The scale limits and the color distribution are controlled by the Image Enhancement Tool.



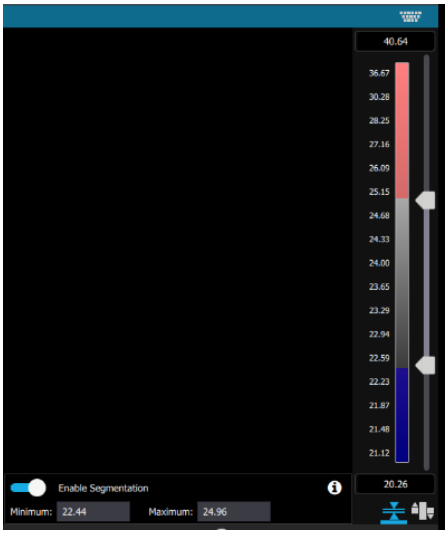
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

5.8.1 Segmentation PRO

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.

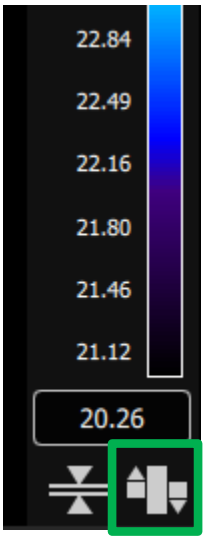


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

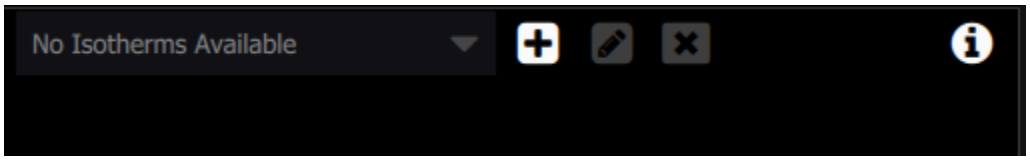
5.8.2 Isotherms PRO

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.



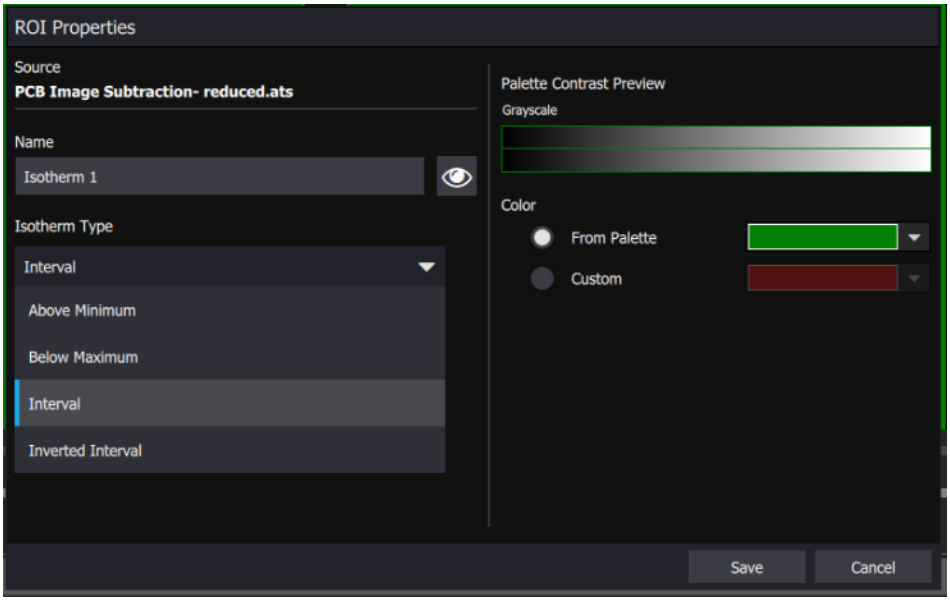
The isotherm button opens this menu to add isotherms via the plus button.

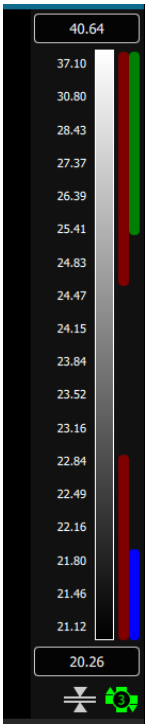


There are four types of Isotherms available to the user.

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.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.





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.

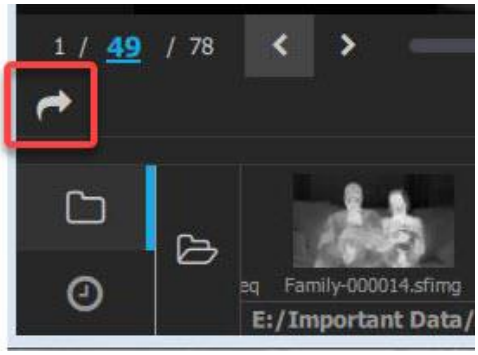
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

6 Share

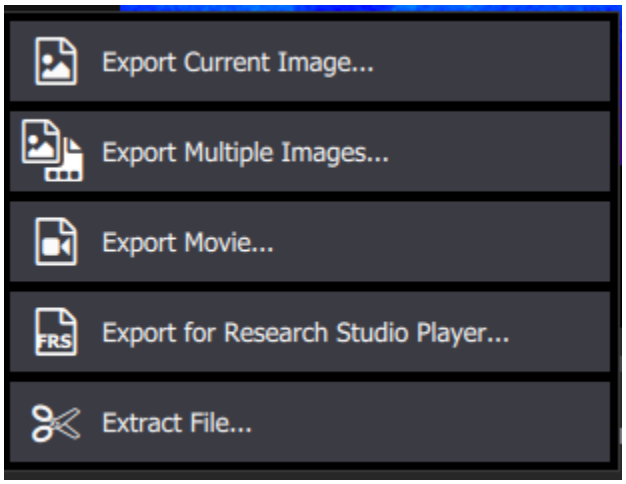
The final step in the standard Research Studio workflow is to share the data. There are a lot of options that assist the user in sharing their data to enable many use cases.

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.



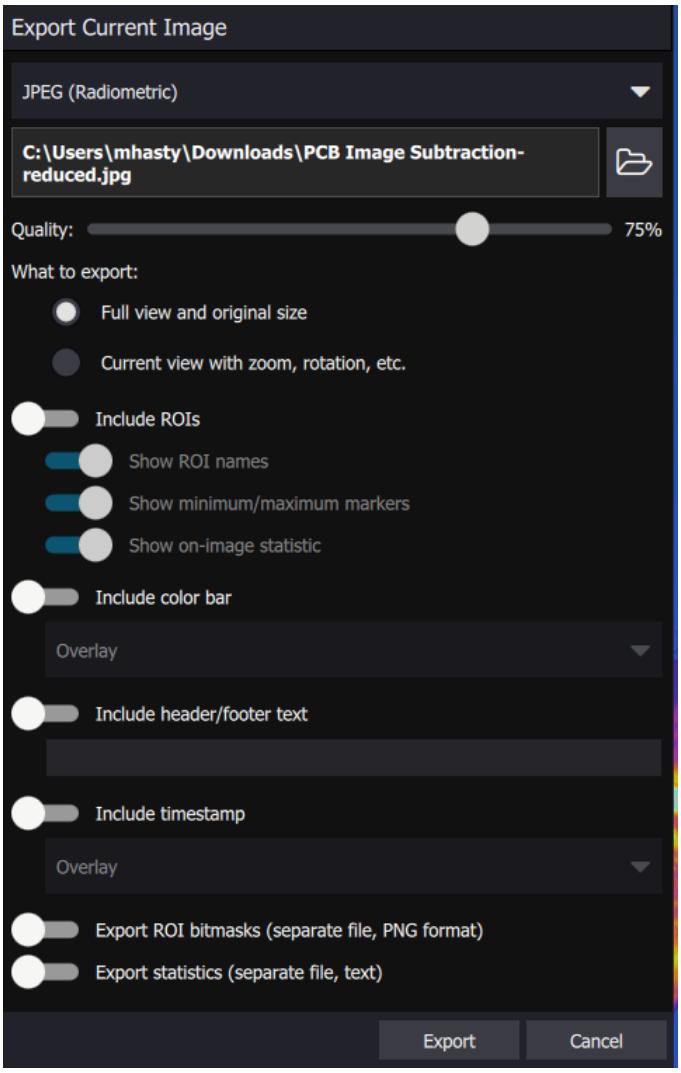
When that button is pressed, the following options come up. There are five main export options with different menus.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

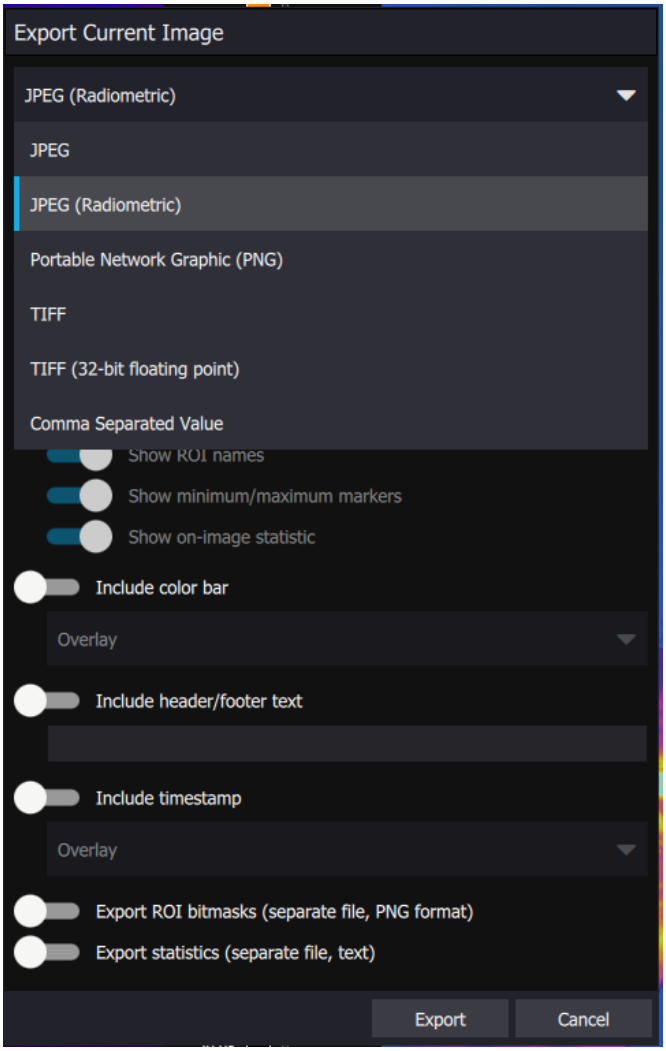
6.1.1 Export Current Image

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.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

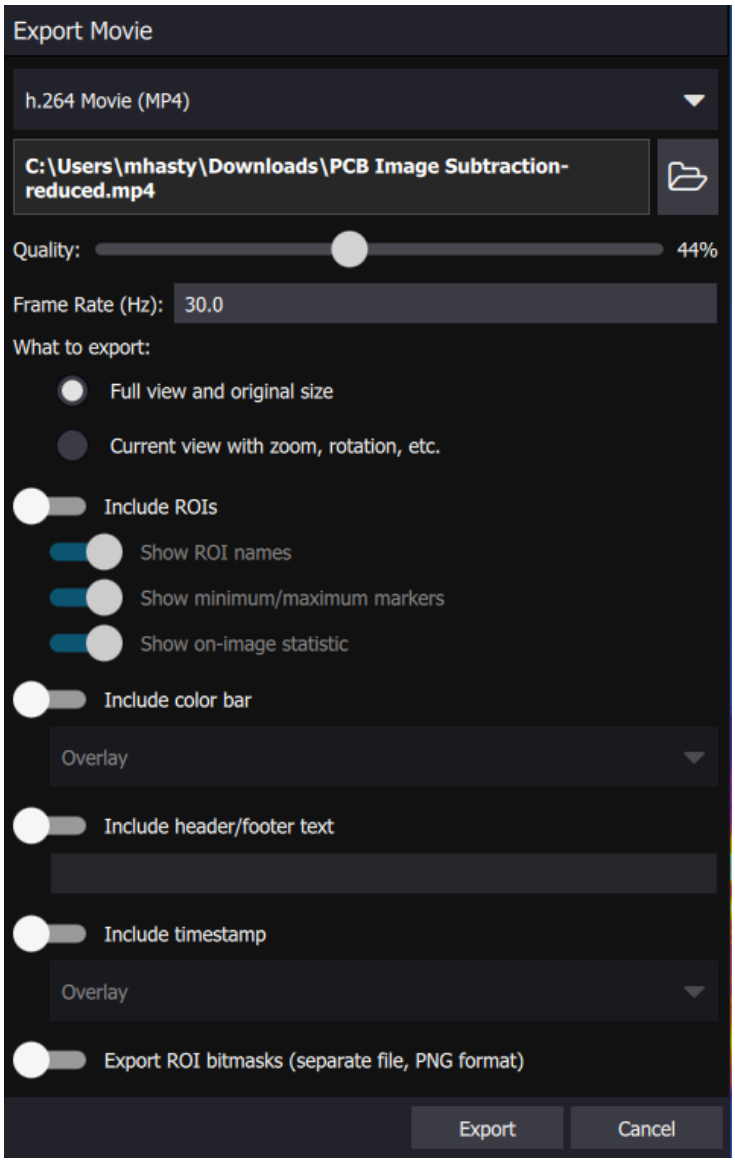
6.1.2 Export Multiple Images

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 Current Image Dialog. CSV, and some TIFF and PNG formats only available in PRO.



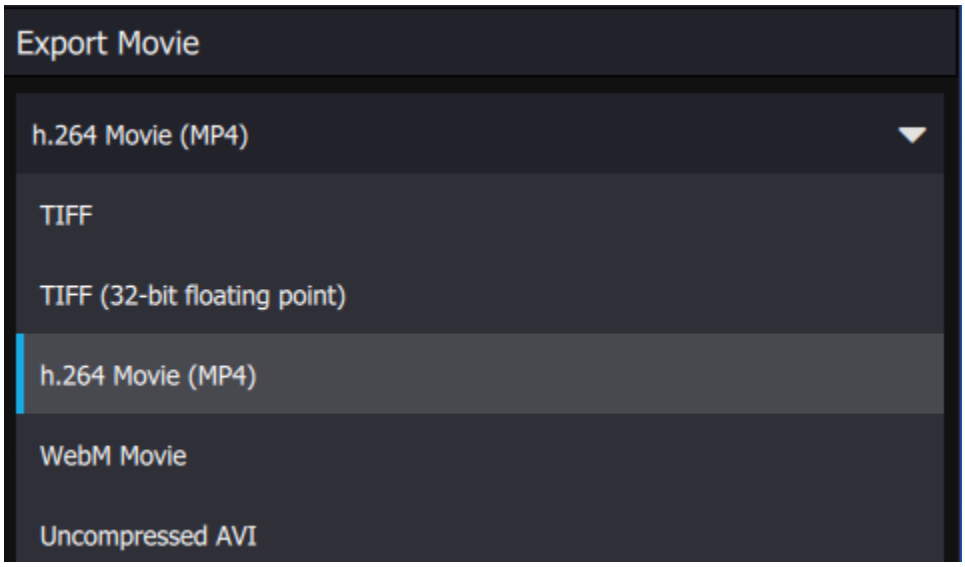
6.1.3 Export Movie

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.



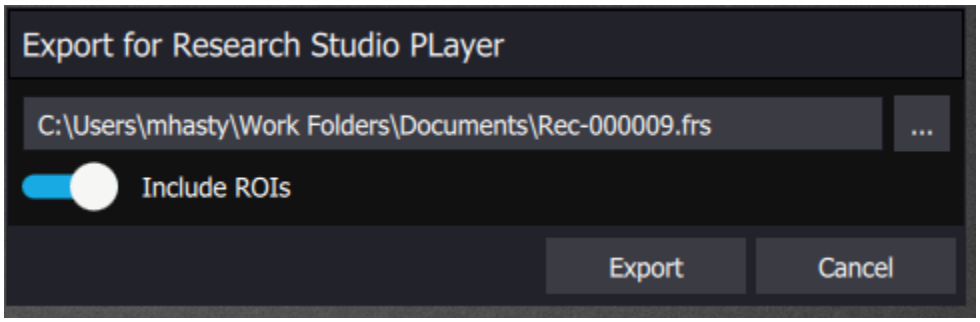
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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 PRO

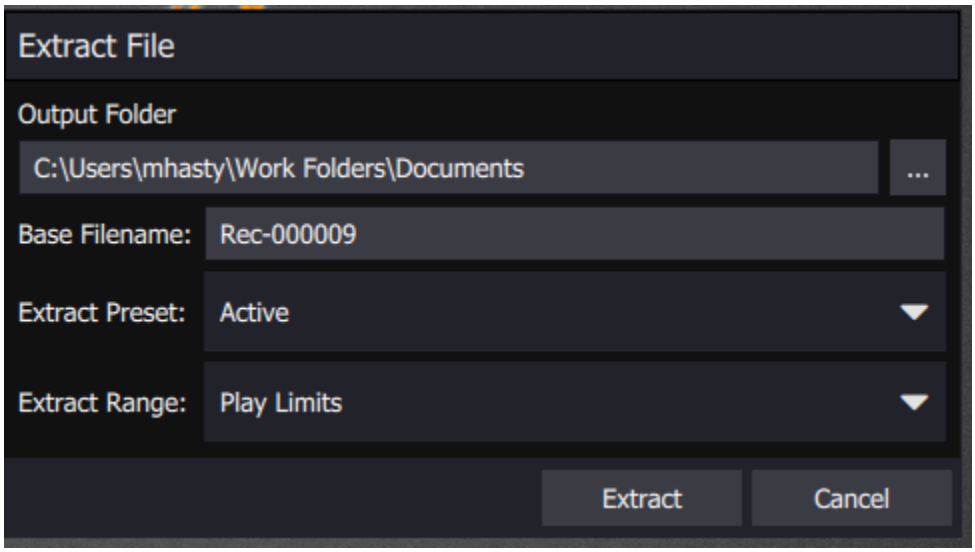
This option allows the user to export a .FRS File that can be loaded into the free FLIR Research Studio Player App. The FRS Player has all of the same functionality for viewing and analysis as Research Studio. The main difference is it cannot stream from a camera or record a file. The player application 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.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.

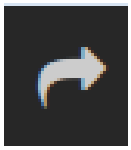


6.2 Export ROI Data

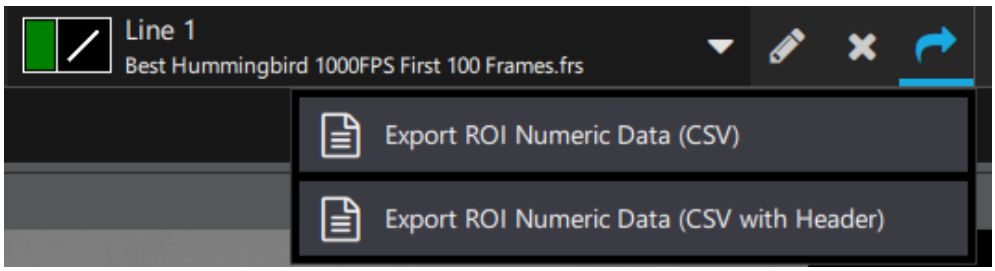
Another export option is the ability to export data from regions of interest. The menu for this is located at the top of program window.



The Export ROI Data pulldown button looks like this on the:

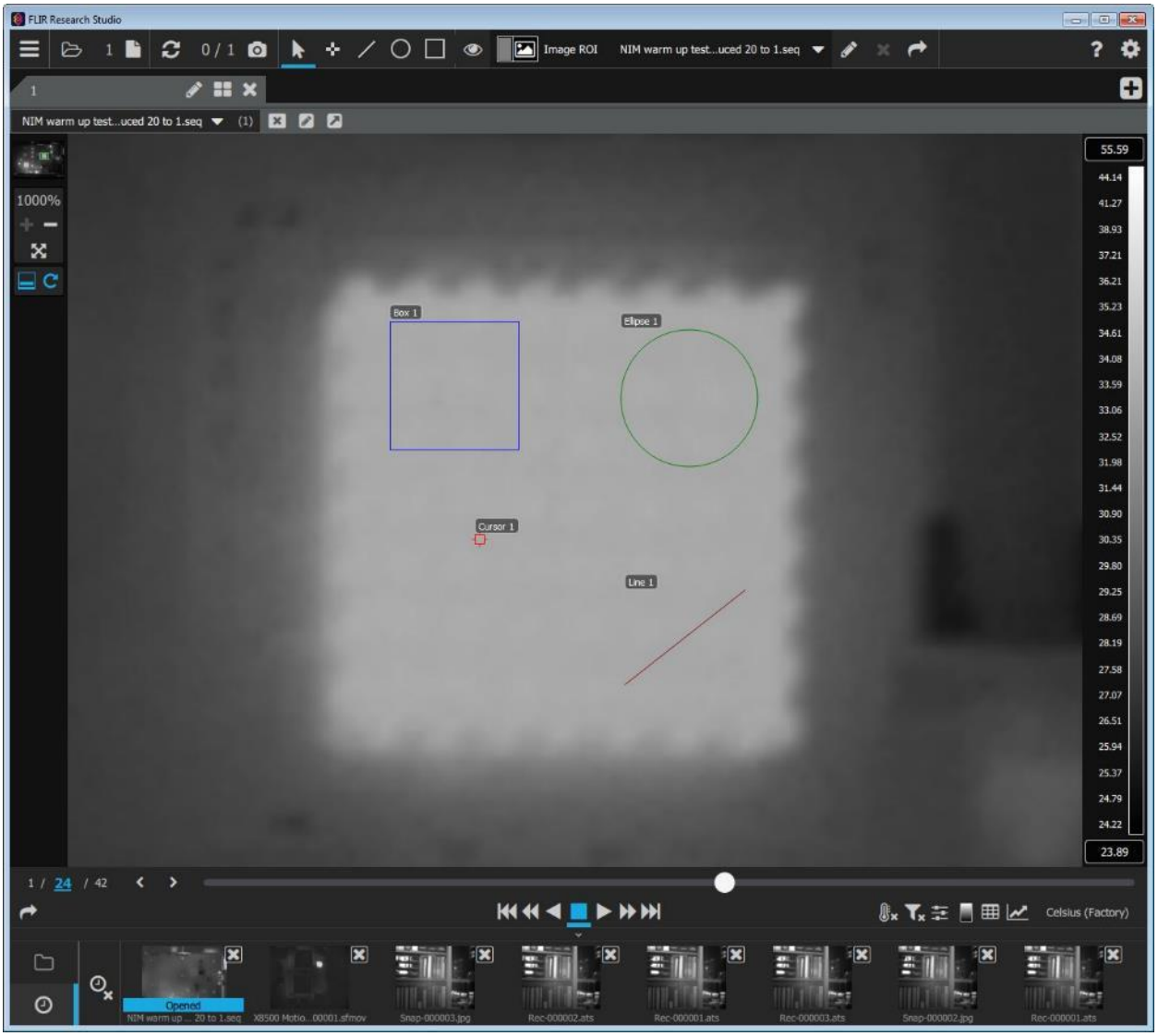


There are two options in the pulldown:



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.



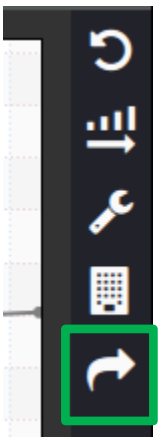
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.



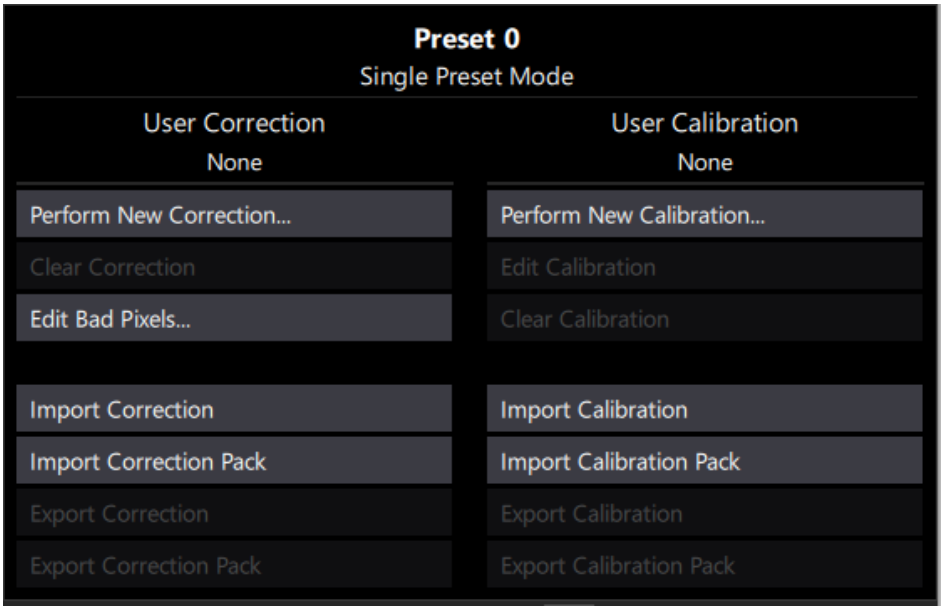
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

7 User Correction and Calibration PRO

New to FRS 3.0 is the ability for the user to create Non-Uniformity Corrections (NUCs) and User Calibrations on the PC instead of using the NUCs and Calibrations that are on the camera itself (Factory NUC / Factory Calibrations).



At the bottom of the image module on the menu bar, on the far right, the pencil icon brings up the Edit Correction and Calibration dialog box.



The left column of the dialog box contains the controls to create and edit a User Correction (NUC table). The right side contains the controls to create and edit a User Calibration

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

7.1 User Correction

The User Correction allows users to create, load, edit, and save their own Corrections, also called NUC Tables or PC-Side Corrections/PC-Side NUCs. They are similar to the camera-side NUCs, but there are a few differences in functionality as shown in the table below.

NUC Feature	PC-Side NUC	Camera-Side NUC
1-point correction (Compute offset, Gain =1)	√	
2-point correction (Compute Gain and Offset)	√	√
Update offset only (keep current gain, compute new offset)	√	√
Bad pixel detection	√	√
Use factory bad pixel map (eliminates more bad pixels and twinklers)	√	√
Can be applied to camera video output (SDI, HDMI ect)		√
Can use camera internal NUC flag		√
NUC data stored separately from raw digital data (NUC data can be changed in post-processing)	√	
Manual bad pixel tool	√	
NUC storage space	unlimited	limited



If desired, both types of NUCs can be used simultaneously. However, if you are using factory calibration it is STRONGLY recommend that you not use a PC-Side NUC as this can affect the calibration accuracy.

One exception to this recommendation is using the Bad Pixel Tool to mark additional bad pixels that are not masked by the automatic bad pixel detection algorithm

FLIR Research Studio keeps track of the last User Correction performed for each camera it connects to.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

7.1.1 Toggle User Correction On/Off



At the bottom of the image module on the menu bar, to the right of the Plot-Based Modules selection, there is the Toggle User Correction On/Off button. Click this button to enable/disable the User Correction. The status of the applied User Correction is given by the button colors as follows.


No User Calibration is loaded


A User Calibration is loaded but not applied


A User Calibration is loaded and applied correctly


A User Calibration is loaded and applied, as well as a Camera-Side NUC. Possible conflict may exist.

7.1.2 Toggle Bad Pixel Correction On/Off



To the right of the Toggle User Correction button is the Toggle Bad Pixel Correction On/Off. Click this button to enable/disable the User Correction's Bad Pixel map. The status of the applied Bad Pixel Correction is given by the button color as follows.

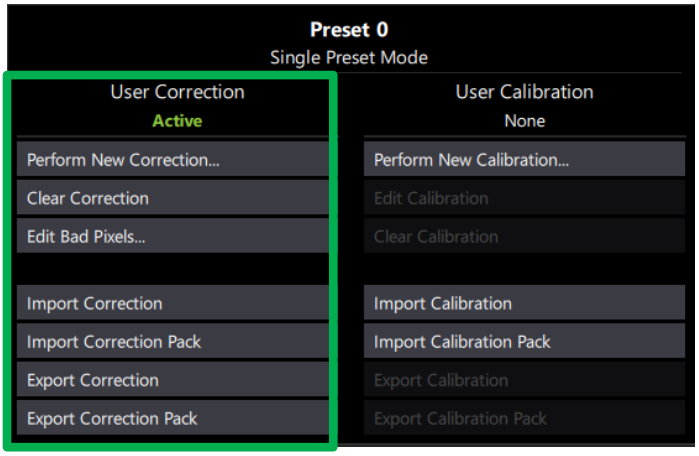

No User Calibration Bad Pixel Map is loaded


A Bad Pixel Map is loaded but not applied


A Bad Pixel Map is loaded and correctly applied

7.1.3 User Correction Functions

The User Correction functions are listed below.



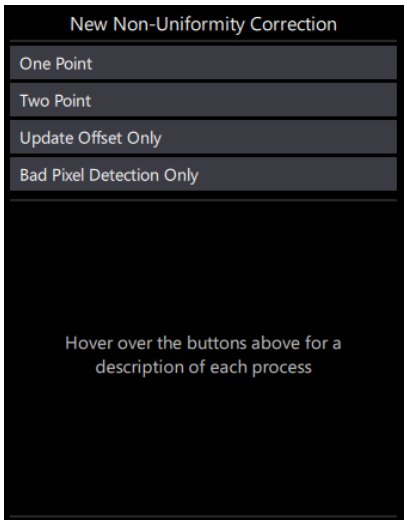
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

Control	Function
Perform New Correction...	See 7.1.3.2 Perform New Correction… for explanation
Clear Correction	Deletes the NUC table for the currently selected Preset. If the camera is in Preset Sequencing or Superframing, all presets are set to display, this will delete all the preset's NUC tables.
Edit Bad Pixels...	See 7.1.3.3 Edit Bad Pixels… for explanation
Import Correction	Imports a previously saved Correction.
Import Correction Pack	Imports a previously saved Correction Pack
Export Correction	Exports the current Correction
Export Correction Pack	Exports the current Correction Pack

7.1.3.1 Correction vs Correction Pack

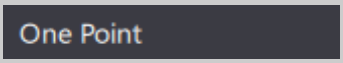
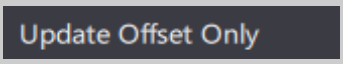
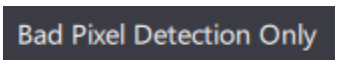
A Correction is a single NUC table that is not tied to a particular Preset. A Correction Pack is a set of NUC tables tied to specific Presets.

7.1.3.2 Perform New Correction…



After selecting Perform New Correction… a dialog box is brought up which allows the user to select the NUC action to perform. Hover over each selection for a brief description or reference the table below.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

Control	Function
	One Point – Sets the Gain to 1 and computes the Offset value of the NUC table using a single source. Very limited practical use as the source needs to be the same temperature as the imaged target. Limited Bad Pixel Detection.
	Two Point – Typical correction performed as it computes both the Gain and the Offset components. Uses two sources and can implement the Bad Pixel Detection fully.
	Update Offset Only – Also referred to as a Flat Field Correction (FFC) or Auto NUC. As the camera runs, its electronics and lens change temperature and thus the image degrades a bit. The Update Offset corrects for this by adjusting the Offset component of the NUC table while leaving the Gain and Bad Pixel Map the same. Uses a single source.
	Bad Pixel Detection Only – Creates a new Bad Pixel Map while leaving the Gain and Offset values untouched.

Select the desired action and Click Next to continue.

The workflow steps for all the selections are very similar, Setup, Acquire Images, Compute Coefficients, and Preview & Accept. This workflow will be shown at the top of the dialog box. What the user must do in each step does vary with the NUC action being performed. Follow the on-screen instructions for each step and click Next when ready to continue.

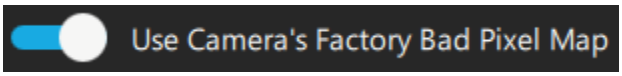
7.1.3.2.1 Setup

The Setup step will vary depending on the NUC action being performed.

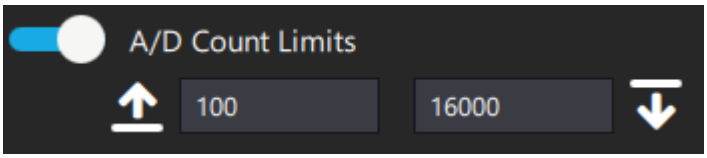
7.1.3.2.1.1 Number of Frames to Acquire



For each source, FRS collects and averages N number of frames to use in the NUC calculations. The typical value used is 16.Bad Pixel Detection Options

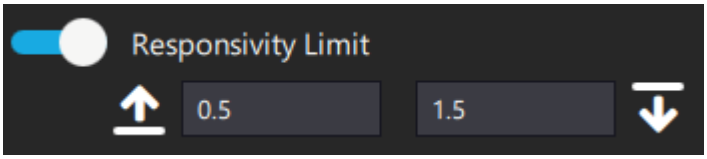


Cameras come with a Factory NUC table that includes a Factory Bad Pixel Map. If enabled, FRS will read that Factory Bad Pixel Map and apply it to the User Correction's bad Pixel Map

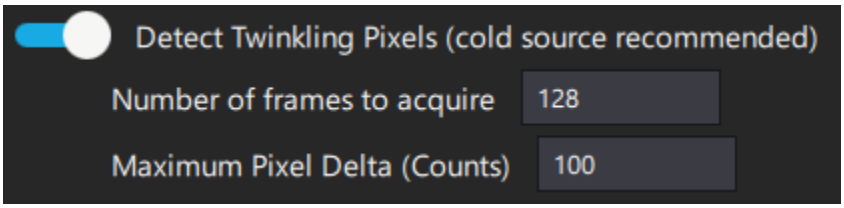


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

Some bad pixels are bad because they are “stuck” high or low. Any pixel for Source 1 or 2 that is outside these limits will be marked as bad.

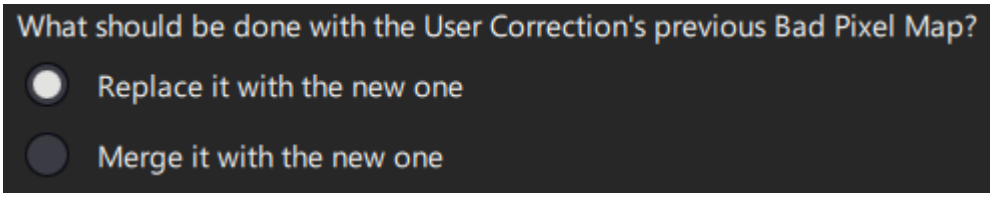


The NUC process first determines the gain of each pixel. The gain should normally be approximately 1. The Responsivity Limit sets the range the gain can be before being marked as bad.



FRS collects N frames (Number of frames to acquire) and computes the range of each pixel. If that range exceeds the Maximum Pixel Delta then that pixel is marked as bad.

7.1.3.2.1.2 What should be done with the User Correction’s previous Bad Pixel map



The user can tell FRS to create a new Bad Pixel Map from the currently performed NUC action or merge any newly found bad pixels to the existing applied Bad Pixel Map.

7.1.3.2.2 Acquire Images

The Acquire Images step may be implemented in a single step or two depending on the NUC Process action being performed. If implemented in two steps (such as a Two-Point NUC) then the first step is associated with Source 1 and the second step is associated with Source 2.

When two sources are required, the black body settings should consist of a “cold” and “hot” value. The cold and hot values should span the range of the image that the correction will be used. For a 14-bit A/D camera (count range of 0 – 16,383), best practice is for the cold value to be about 2,500 counts and the hot value to be about 12,000 counts

In theory, it does not matter which order the “hot” and “cold” temperatures are used. However, it is important to note that Source 2 is the source that will be used to collect the frames for twinkler pixel detection. Hot black bodies often create air turbulence which could cause the detection process to falsely identify a twinkler pixel. For this reason, best practice is to use Source 1 to collect the hot values and Source 2 to collect the cold values.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

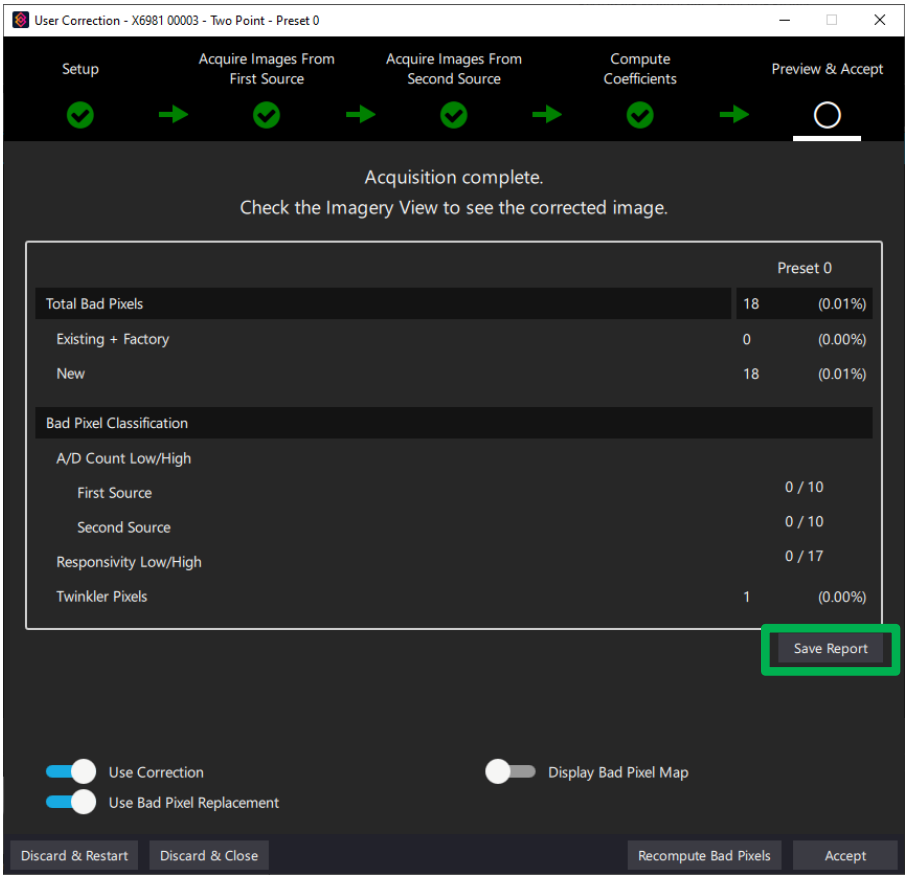
Regardless of using 1 or 2 sources, in this step fill the image completely with the black body and then press Acquire to continue.

7.1.3.2.3 Compute Coefficients

The Compute Coefficients step requires no user interactions.

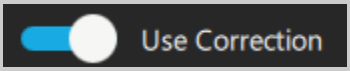
7.1.3.2.4 Preview & Accept

The Preview & Accept is the final step in the Perform New Correction workflow.

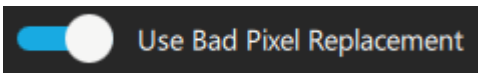
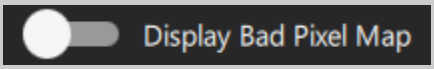
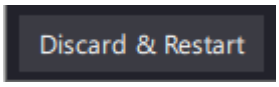
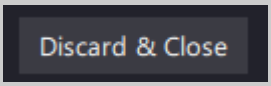
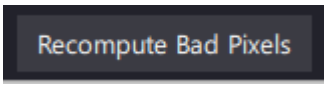
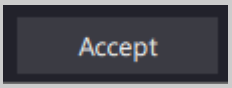


The middle portion of the dialog box gives the results of the bad pixel map. This data can be useful in adjusting the values in the Setup step to optimize the bad pixel picker routine. The Save Report button saves the data to an html file that can be reviewed later offline.

The controls on the bottom of the screen are explained below.

Control	Function
	Toggles the application of the Gain and Offset values on/off. Useful in evaluating the results of the NUC action before accepting.

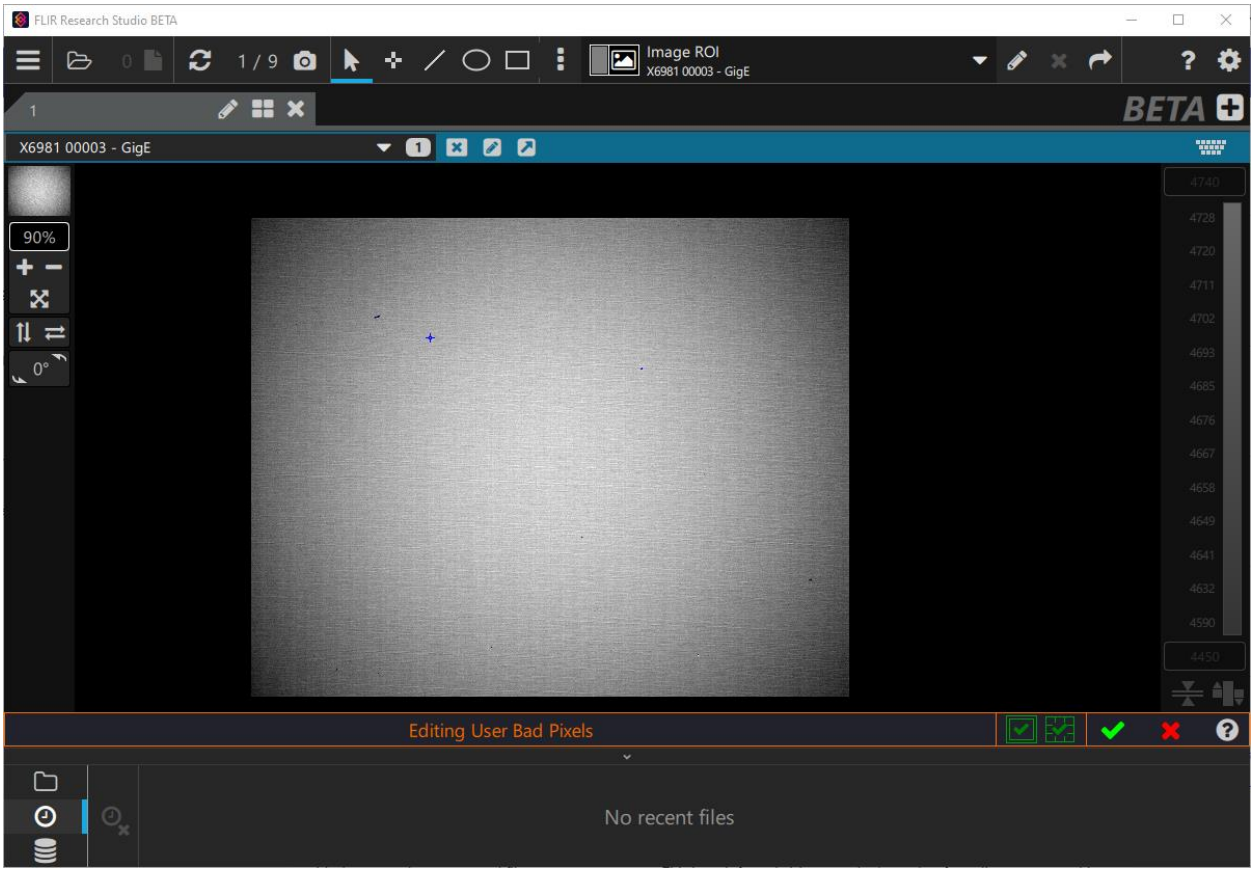
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

	Toggles the application of the Bad Pixel on/off. Useful in evaluating the results of the NUC action before accepting.
	Displays the bad pixels in the image. Bad Pixels will be colored white. Useful in evaluating the results of the NUC action before accepting.
	Discards the NUC action results and starts the process over
	Discards the NUC action results and closes the Perform NUC Correction window.
	Brings up the Recompute Bad Pixels dialog box. Allows user to readjust the bad pixel setup parameters. Useful in adjusting parameters to achieve the desired results without having to repeat the full workflow process (reacquire images).
	Accepts (saves) the NUC results.

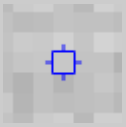
7.1.3.3 Edit Bad Pixels…

Selecting Edit Bad Pixels… from the Edit User Corrections function list allows the user to add and delete pixels from the Bad Pixel Map.

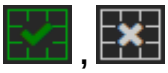
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



The controls/indicators are as follows.

Control / Indicator	Function
	Pixels are colored blue if the pixel is marked as bad in the currently selected preset's Bad Pixel Map
	Pixels are colored orange if the pixel is not marked as bad in the currently selected preset, but is marked bad in one of the other preset's Bad Pixel Map
	The blue cursor in the image is used to pick a pixel to add or delete from the Bad Pixel Map
<space bar>	Pressing the space bar toggles the pixel in the cursor as "bad" or "good"
	Toggle User Correction On/Off – toggling the correction on/off can be helpful with identifying bad pixels

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

	Toggle Bad Pixel Correction On/Off – toggling the bad pixel correction on/off can be helpful with identifying bad pixels
	Accept Changes - Accepts the changes made to the Bad Pixel Map and exits.
	Cancel – ignores the changes made to the Bad Pixel Map and exits.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

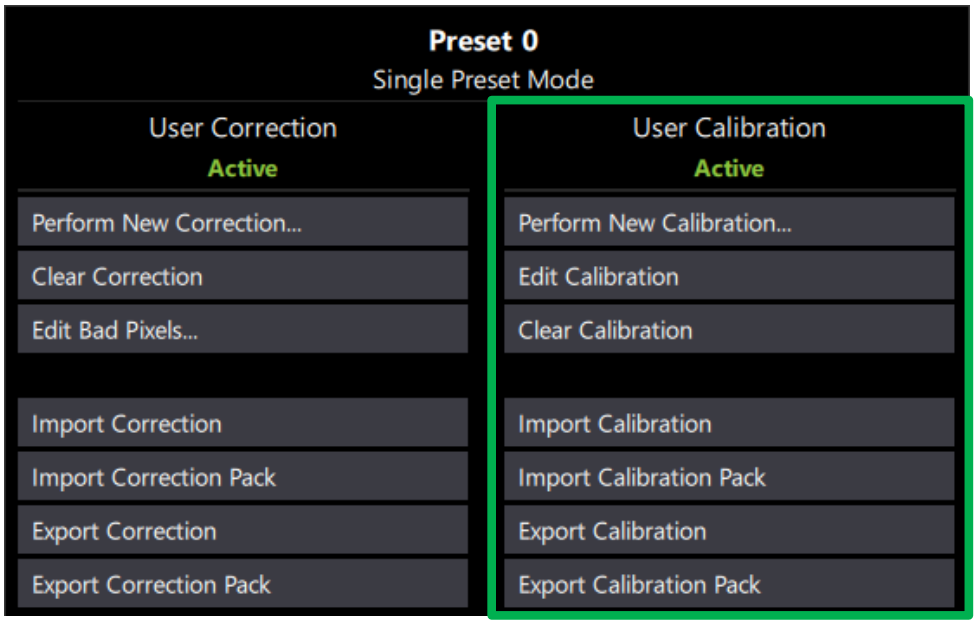
7.2 User Calibration

User Calibration allows users to create, edit, and save calibrations from within FLIR Research Studio while connected to a camera. FRS will remember the calibration created for the connected camera and will apply it to the data during future connections.

The Radiometric Calibration Tool (RCal), accessible via the hamburger menu at the top left corner of the FRS screen or through the Windows Start Menu, is a standalone application that allows the user to access the User Calibration functions offline. Note, saving User Calibrations via RCal does not update the FRS User Calibration file.

User Calibrations can be created using a Camera-Side or PC-Side Correction.

The Edit User Calibration functions are listed below.



Control	Function
Perform New Calibration...	Brings up the User Calibration Window (7.2.2) window with no previously created calibration information loaded. Used to create a new, clean calibration.
Edit Calibration	Brings up the User Calibration Window (7.2.2) window with current calibration information loaded. Used to edit the current calibration.
Clear Calibration	Clears (deletes) the User Calibration

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

Import Calibration	Imports a previously created User Calibration
Import Calibration Pack	Imports a previously created User Calibration Pack
Export Calibration	Exports the current User Calibration
Export Calibration Pack	Exports the current User Calibration Pack

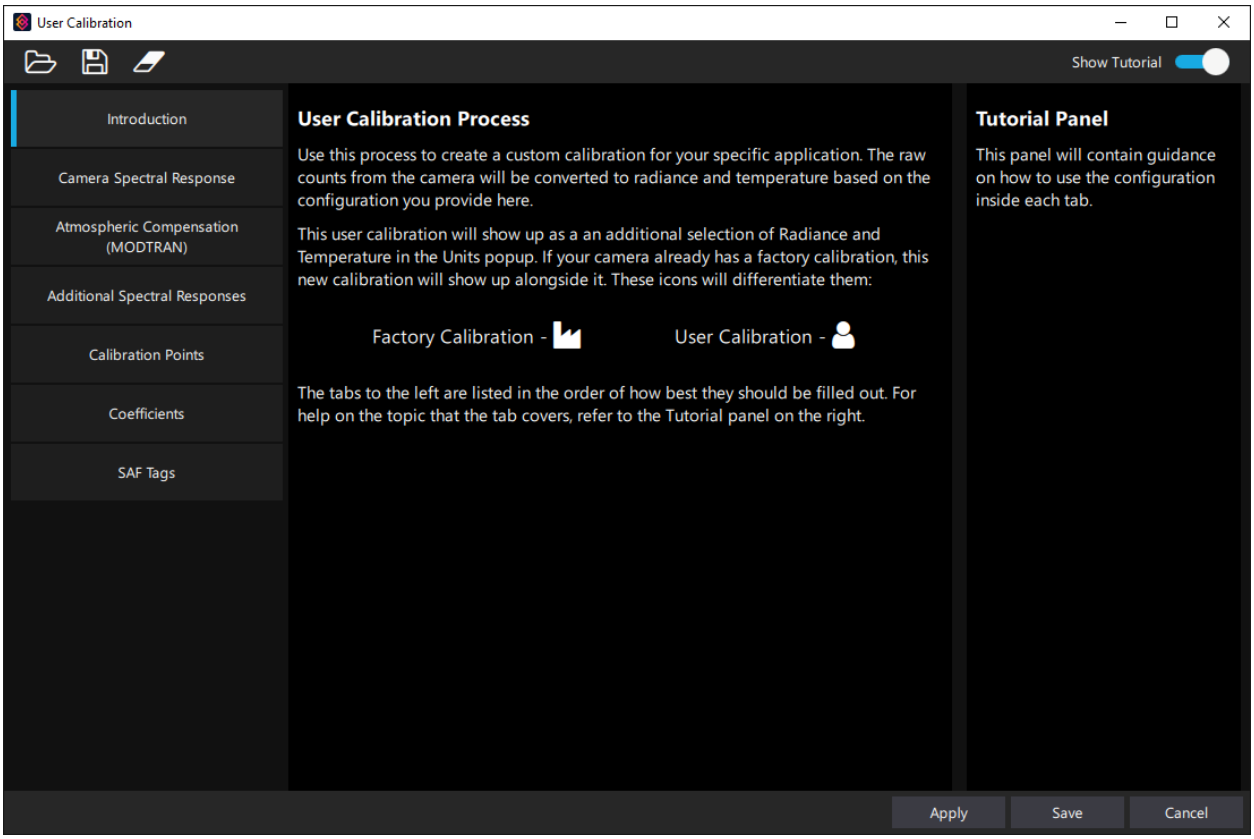
7.2.1 Calibration vs Calibration Pack

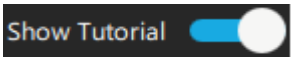
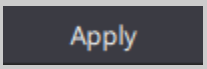
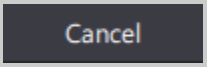
A Calibration is simply the calibration file. A Calibration Pack will include the calibration, the INC file, associated NUC files, and any other files that would go along with the calibration.

7.2.2 User Calibration Window

The User Calibration window allows the for creation of a new calibration (Perform New Calibration…) or allows the user to edit the current enabled calibration (Edit Calibration). The workflow steps are shown in the column on the left-hand side of the window. The workflow can be performed or edited in any order, but generally goes straight down the list. Each step's function is shown in the middle panel of the window. The right-hand side of the window is the Tutorial Panel (can be toggled on/off) and gives instructions on how to use each workflow step.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



Controls	Function
	Import Calibration Options – Imports a previously created Calibration or Calibration Pack
	Export Calibration Options – Exports the current calibration or exports the current calibration with no Cal points to use as a template for future Cals
	Clear Calibration – Clears the current calibration
	Toggles the Tutorial Panel on/off
	Applies changes to the currently load calibration, does not exit the User Calibration window.
	Saves changes to the currently loaded calibration and exits the User Calibration window.
	Ignores any changes and exits the User Calibration window

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

7.2.2.1 Camera Spectral Response Tab

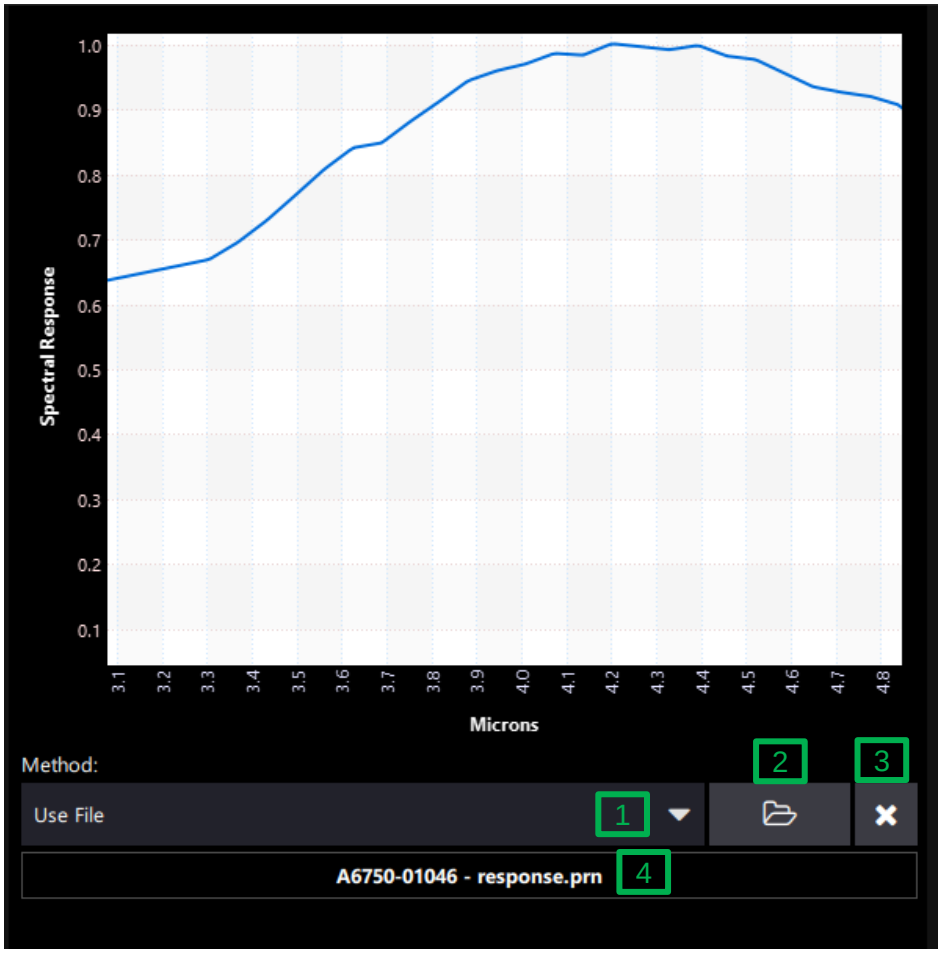
A camera spectral response is required and the user can choose either an ideal “top hat” response or provide a file with an actual response curve. FRS will display a graph showing the selected response curve.

An actual response file should be a **peak-normalized power spectral response** (not a photon response). A response file is a simple tab-delimited ASCII file with the wavelength in microns and normalized response values. See 7.2.2.1.3 Creating a Custom Spectral Response File for more information on how to create a response file.

7.2.2.1.1 Use File

Often times a spectral response has been performed on the actual camera being used, whether by the user or from the factory. If so, the results are stored in an .prn or .txt file which can be loaded by FRS.

- Pros – Best results as the spectral response is true for the actual camera selected.
- Cons – The spectral response file can be costly to obtain.



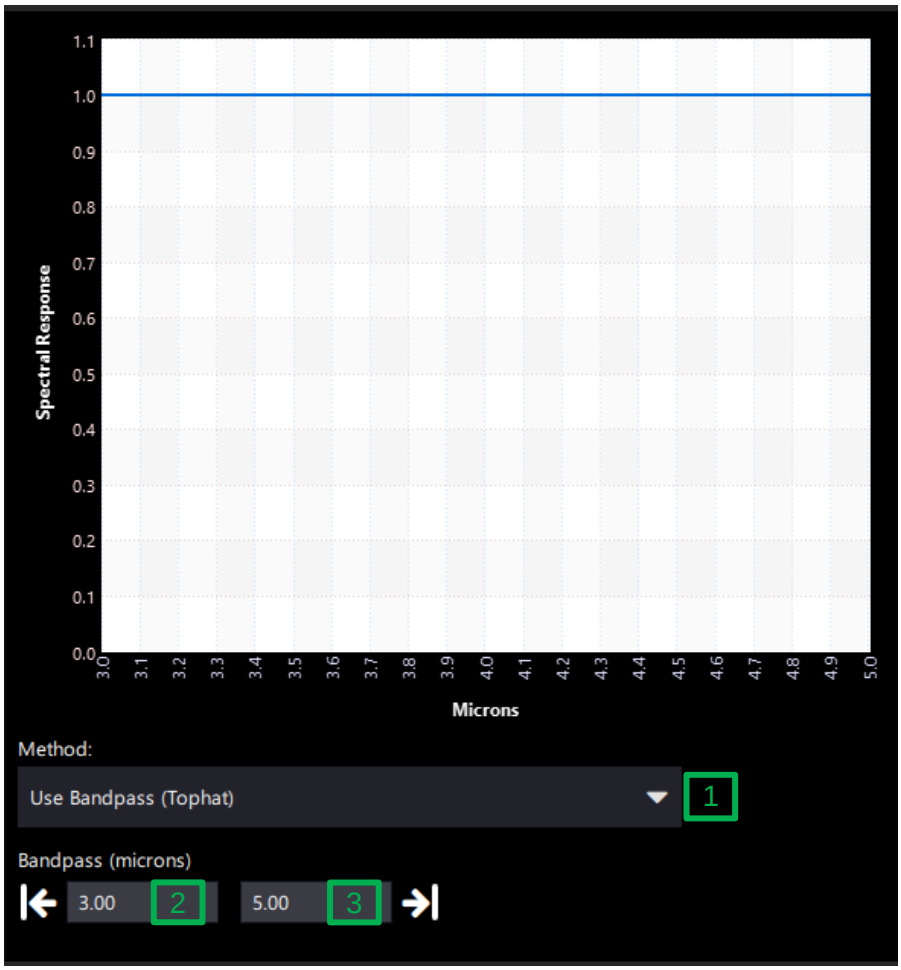
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

Control is to select Use File from the Method drop down menu (1) and then open the file (2) containing the response. The file can be removed by clicking Unload File (3). If a file is loaded the file name will be displayed on the bottom (4).

7.2.2.1.2 Use Bandpass (Tophat)

If the actual camera response is unknown, this option can be used. It assumes an "on/off" response with the lower and upper limits being user selected and should match the camera's response range.

- Pros – Allows RCal to be used even though the camera's response is unknown
- Cons – Suffers penalty due to assuming a perfect spectral response curve



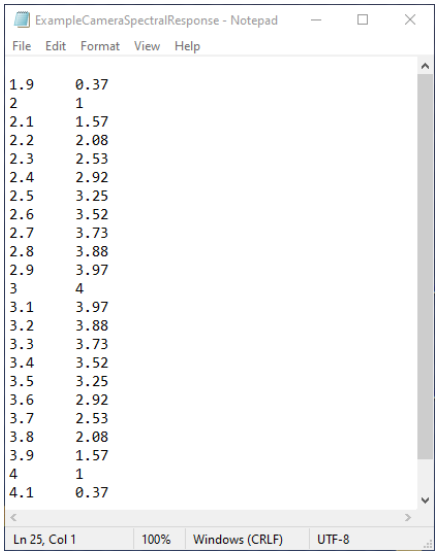
Control is to select Use Bandpass (Tophat) from the Method drop down menu (1) and then enter the lower (2) and upper (3) bandwidth limits (in microns).

7.2.2.1.3 Creating a Custom Spectral Response File

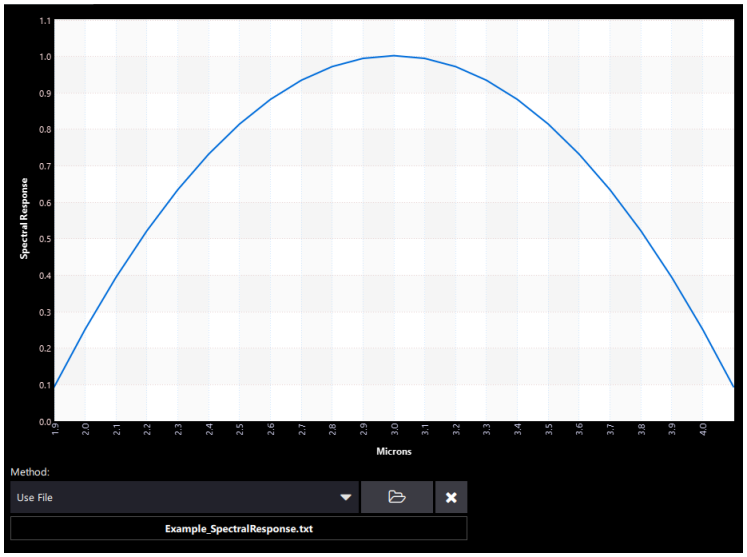
The file format for a *Camera Spectral Response* or *Additional Response* file is a simple tab-delimited ASCII file saved as a .txt or .prn. The first column is the wavelength in microns and the second column is the transmission value (0 to 1). The data increment does not have to

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

match any other files used as FRS will automatically interpolate the values. The response is assumed to be a value of zero leading up to the first point. The response is assumed to be zero after the last point and beyond.



Example_SpectralResponse.txt

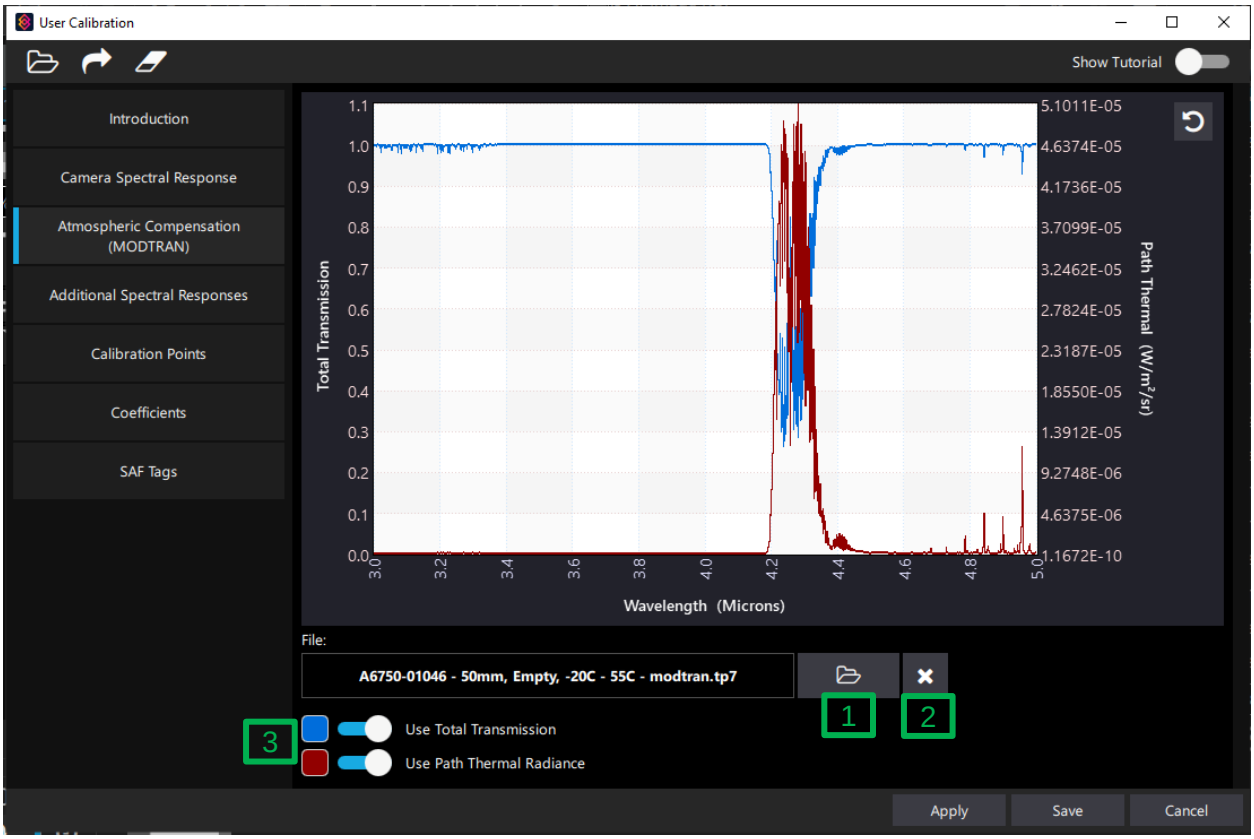


Graph Display of Loaded Example_SpectralResponse.txt

7.2.2.2 Atmospheric Compensation (MODTRAN) Tab

MODTRAN is a widely accepted model used to predict atmospheric transmission. The MODTRAN model has several output files. FLIR Research Studio is set up to read the TOTAL TRANSMISSION and PATH THERMAL data from the MODOUT2 files.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



To enter an Atmospheric Compensation, open the desired MODTRAN file (1). The Total Transmission and Thermal Radiance (3) can be toggled on/off as desired. Click Unload File (2) to remove the loaded MODTRAN file.

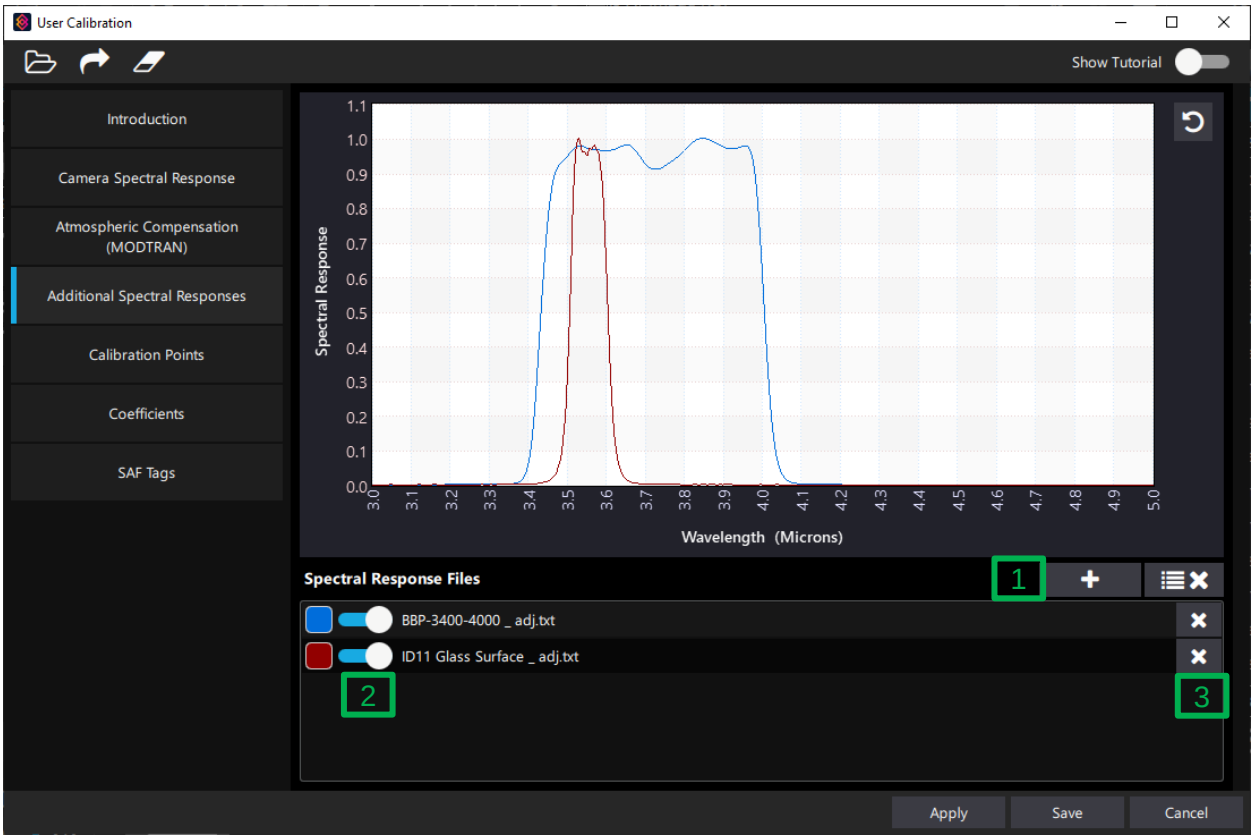
7.2.2.3 Additional Spectral Response

Additional responses can be used to account for other factors that can affect the path between the cal target and the camera that are not already accounted for by camera spectral response or atmospheric modeling. Such things might be a mirror reflectance curve or an additional filter.

See 7.2.2.1.3 Creating a Custom Spectral Response File for details on how to create a response file.

DO NOT include response files for any item that may have been used in the camera's spectral response file or Atmospheric Compensation or the response will effectively be counted twice by FRS.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



To add a response file click on the *Add File* (1). Multiple files can be added, one for each item in the transmission's path. Added files can be enabled/disabled in the calculations by using the slider bar associated with the file (2). Files can be deleted individually or all at once using the unload buttons (3).

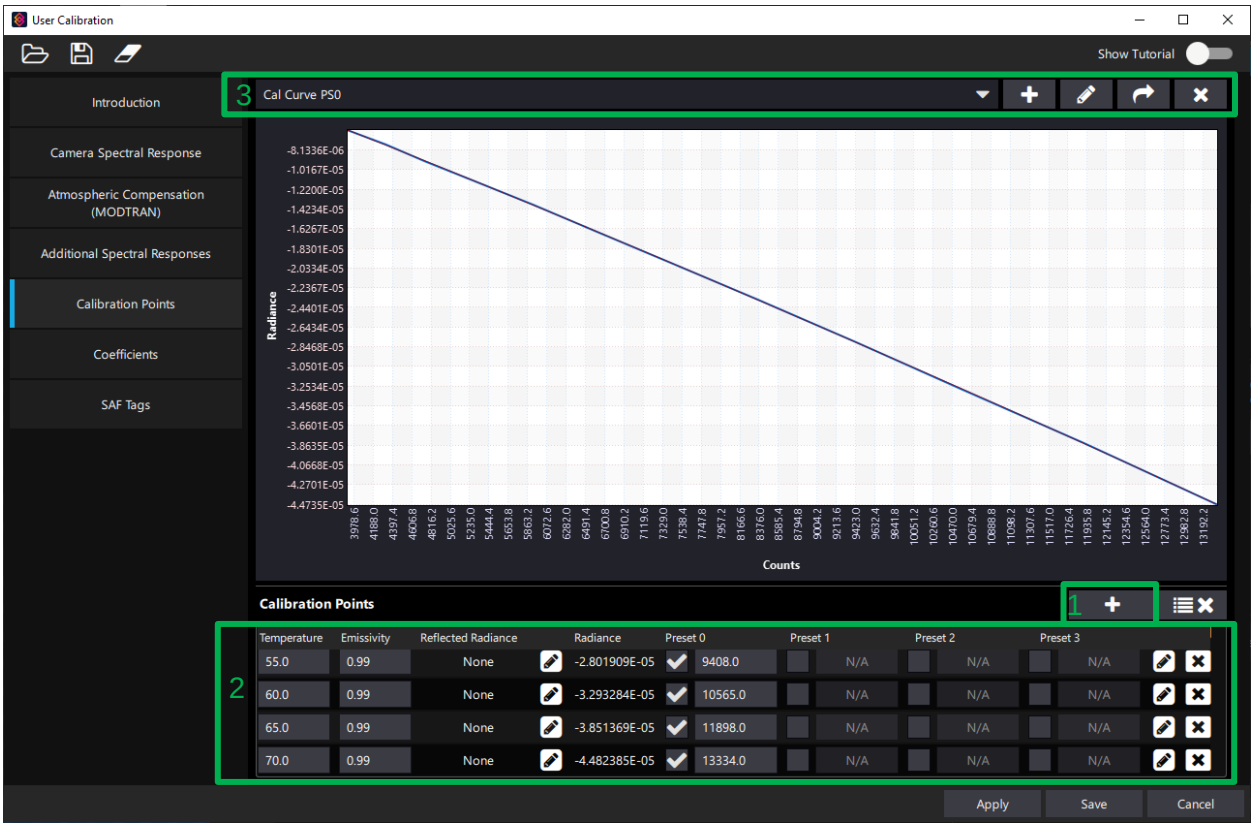
7.2.2.4 Calibration Points

The *Calibration Points* tab is where measured black body energy is recorded along with the black body's temperature setting. This is the data set used to calibrate the camera and great care should be taken when collecting the data.

Calibration requires at least two points, but more is better. Calibration points should include the max and min points in the desired calibration range

Points should be acquired from an ROI that completely encompasses the calibration source. Be careful to exclude the "blurry" edges of the source. FRS will use the mean of the ROI for the data point.

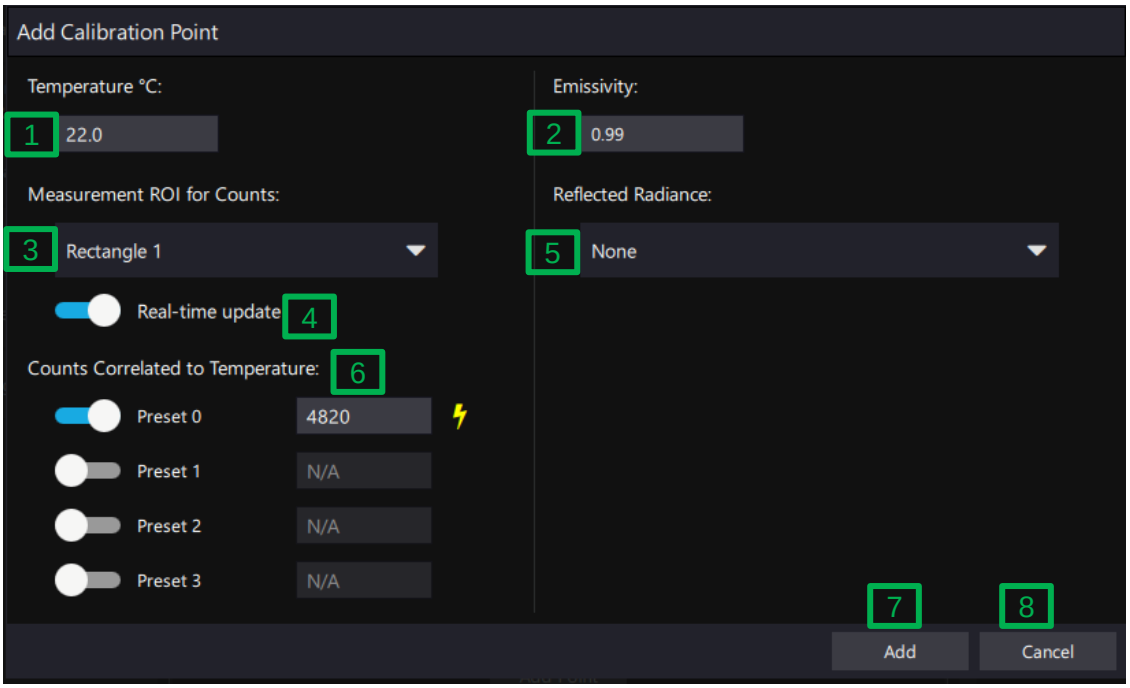
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



To add a calibration point, click the Add Point button (1) to bring up the Add Calibration Point window. Calibration points are displayed in table at the bottom of the window (2) and each point can be edited, enabled/disabled, and deleted from here. Graphical controls are located at the top of the window (3).

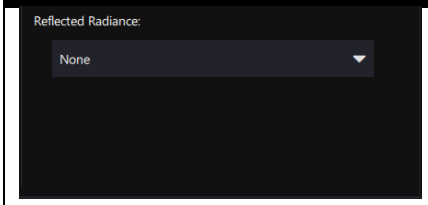
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

7.2.2.4.1 Add Calibration Point Window

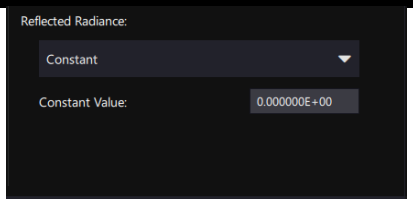


To add a Calibration Point, enter the black body's Temperature (1) and Emissivity (2). To automatically pull in the count value from an ROI, select the ROI to use from the Measurement ROI for Counts drop down menu (3) and enable the Real-time update (4). To manually enter a point then disable the Real-time update (4). Finally, select the appropriate reflected radiance from the Reflected Radiance drop down menu (5) and enter the required data.

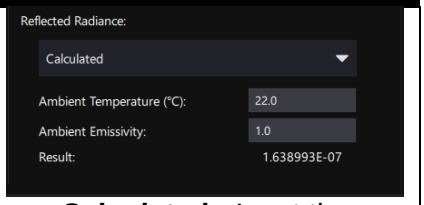
Reflected Radiance Correction Selection



None - Default and typical selection



Constant - Input the Radiance value



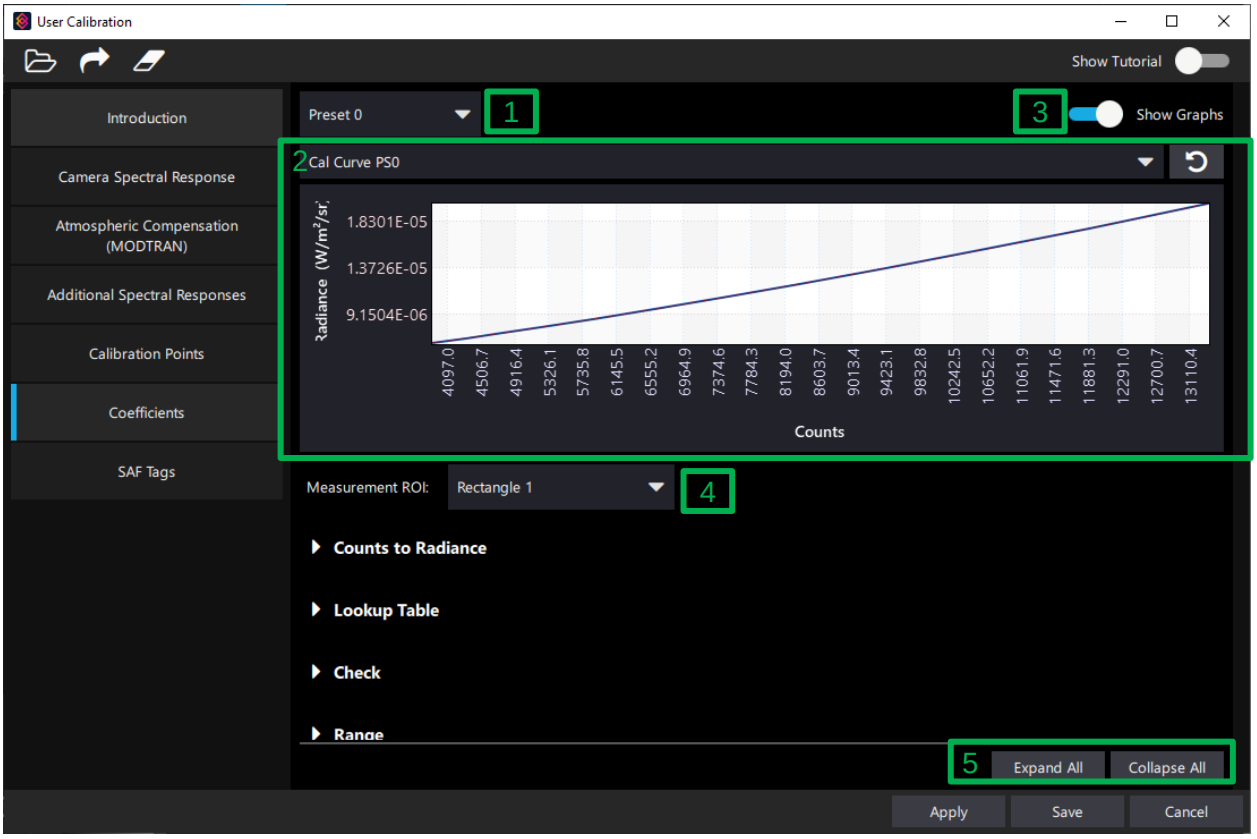
Calculated - Input the ambient temperature and emissivity and the reflected radiance is calculated

The value in counts of the black body (selected ROI mean value) is displayed in Counts Correlated to Temperature (6) as read by FRS from the selected ROI if Real-time update is enable, otherwise enter counts manually in this field. To keep this point, select Add (7). Cancel (8) ignores this point and closes the Add Calibration Point window.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

7.2.2.5 Coefficients

The *Coefficients* tab allows the user to review/edit the calibration results. This is considered "advanced" level and does not require user input.

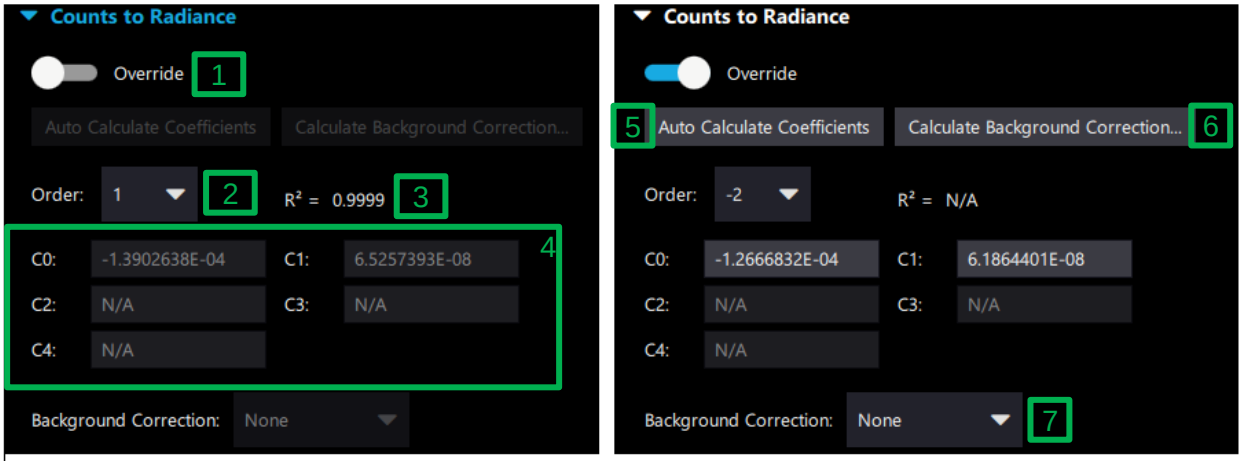


Controls	Function
1	Preset Selection – drop down menu to select which preset's results to review.
2	Graph displaying results. The drop down menu selects what results to display
3	Enables/disables the graph display
4	Measurement ROI – Selects the ROI to use to import data where necessary
5	Expand or Collapses all the accordion sections

7.2.2.5.1 Counts to Radiance

Displays and controls the coefficients used to convert digital counts to radiance.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

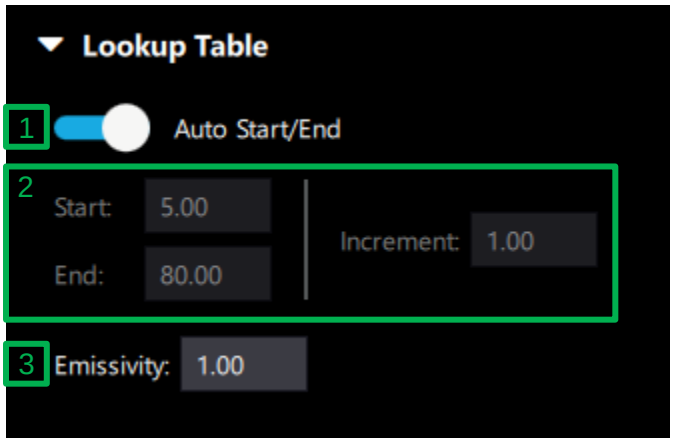


Controls	Function
1	Override Coefficients control. Default is off. When on, the coefficients, C0 – C4, can be manually adjusted
2	Order of the Counts to Radiance equation. An order of 1 is typical, but higher orders can be used. When Override is enabled, the range is -2 to 4 with orders -2 and -1 used for background offset correction.
3	R2 is a figure of merit for the quality of the curve fit. A value > 0.9995 is typical for a good calibration. Only valid when Override is disabled
4	The Counts to Radiance coefficients. When Override is enabled, these values can be manually changed.
5	When Override is selected, pressing Auto Calculate Coefficients updates the coefficients with the auto calculated values. These are the same values used if Override is off. This gives the user a set of values to start from when manually adjusting. Also away to “reset” the values.
6	Brings up the Calculate Background Correction window. Only valid for orders of -2 or -1
7	Drop down menu to select the source of the Background Correction value. Only valid for orders of -2 or -1

7.2.2.5.2 Lookup Table

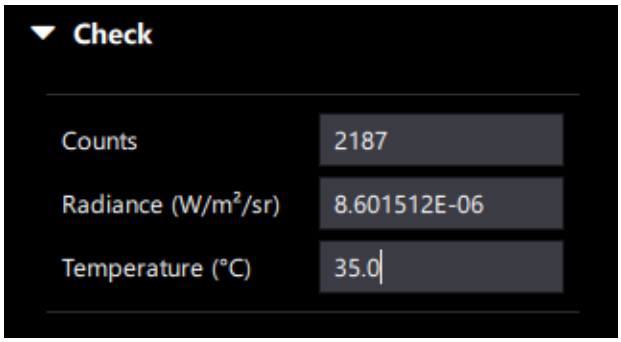
Controls the generation of the lookup table that converts radiance to temperature.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



Controls	Function
1	Auto Start/End enable slider. Default is enabled
2	Start, End, and Increment values of the lookup table. If Auto Start/End is enabled, the Start/Stop values will be 10°C below/above the lowest/highest calibration point. The Increment will be 1.0 If Auto Start/End is disabled, the user can adjust the Start, Stop and Increment values.
3	It is generally best to leave the Emissivity value set to 1.

7.2.2.5.3 Check

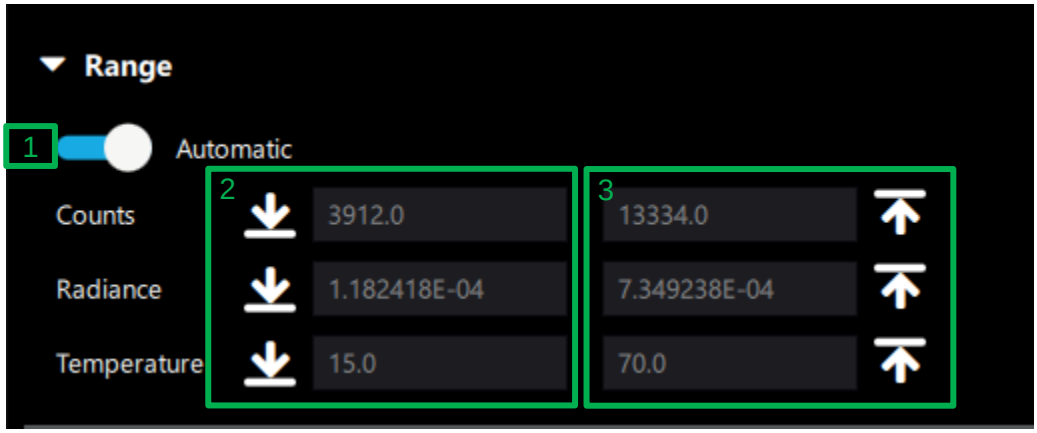


Allows the user to compute a value of counts, radiance, or temperature using the coefficients. Enter any values and the other two will be computed. Temperature is computed using the lookup table.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

7.2.2.5.4 Range

The Range tab allows the user to specify an appropriate range for the units in this calibration



Controls	Function
1	When enabled, the ranges will be computed automatically based on the calibration points list
2	Sets the lower limit of the calibration range for each unit
3	Sets the upper limit of the calibration range for each unit

7.2.2.6 SAF Tags

The SAF Tags tab allows the user to edit tags that will be part of the INC file for the calibration. The commonly used tags are listed individually, and, if enabled, will be applied to all presets. The user can also add additional tags linked to all the presets or on a preset basis.

Editing/using tags is not required and does not effect the calibration results.



Controls	Function
1	Allows user to import the tags created from a previously created calibration. (uses the *.inc file)
2	Exports the current tag list to an *.inc file
3	Removes all tags from the all and individual preset lists

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

8 FLIR Ignite Sync Compatibility

8.1 What are Ignite and Ignite Sync?

FLIR Ignite is an online image library than can be viewed from the web. Simple reporting and editing can be performed on the site.

FLIR Ignite Sync is a separate Windows application that synchronizes your Ignite library with Research Studio on your PC. This allows you to take snapshots in Research Studio and have them automatically uploaded. Ignite can also be synchronized to Thermal Studio where advanced reporting can be performed.

Research Studio has had a few features modified to simplify the flow when interacting with the Ignite Sync directory.

Note: Currently, Ignite Sync is only available for Windows.

8.2 Installation

To start using Ignite Sync, follow these instructions:

1. Sign up for a free Ignite account at https://ignite.flir.com
2. Download and install Ignite Sync from https://ignite.flir.com/sync
3. After running Ignite Sync for the first time, it should ask you to set a directory to share as your online library.
4. If you're still running an instance of Research Studio, close it and restart
5. Research Studio will then recognize that Ignite Sync has been installed

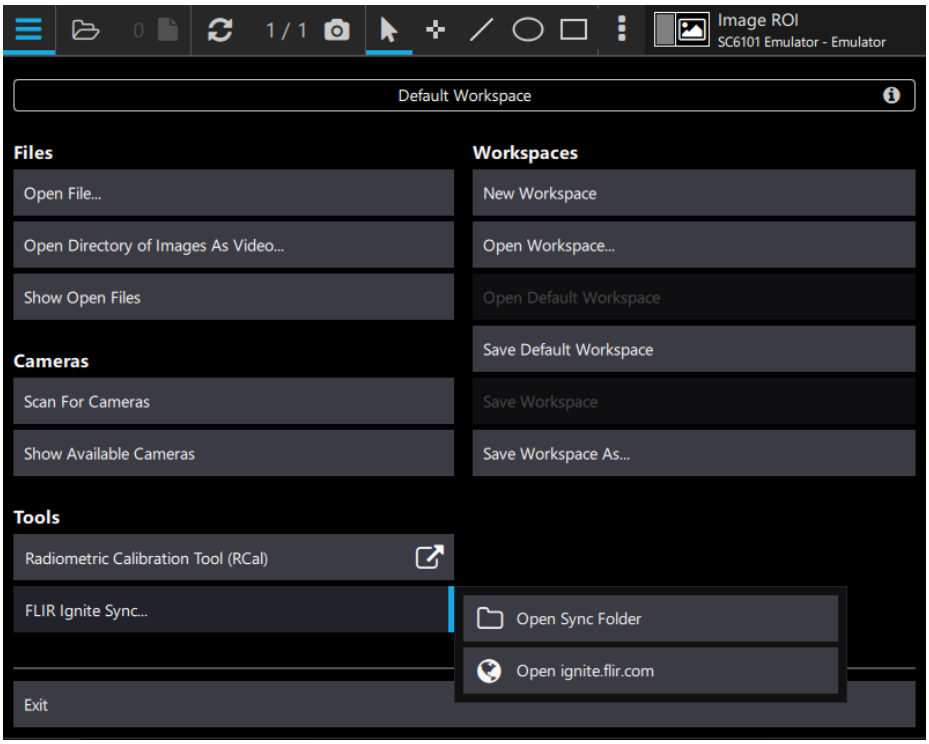
8.3 Hamburger Menu Integration

When installed and configured, the Hamburger Menu will show a split button containing two more buttons. These mimic the same context menu options as the Ignite Sync tray icon.

- Open Sync Folder
  - This will open up a File Explorer window showing the contents of the Sync folder

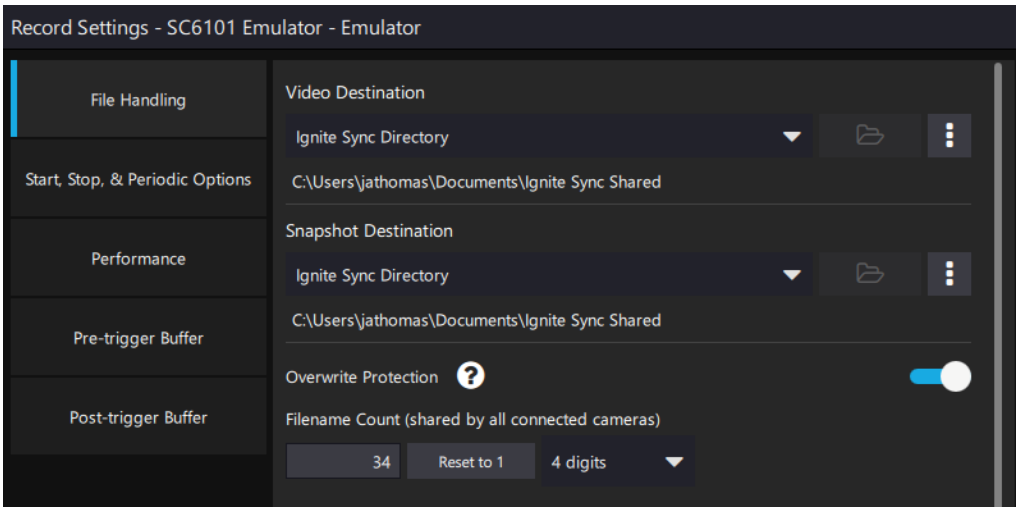
- Open ignite.flir.com
  - This will open a web browser to the Ignite Sync site where the user can interact with their synchronized folder items from the web application

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.



8.4 Record Settings Integration

For a camera's Record Settings, under the File Handling tab, there is an "Ignite Sync Directory" option under the Video Destination and the Snapshot Destination dropdowns.



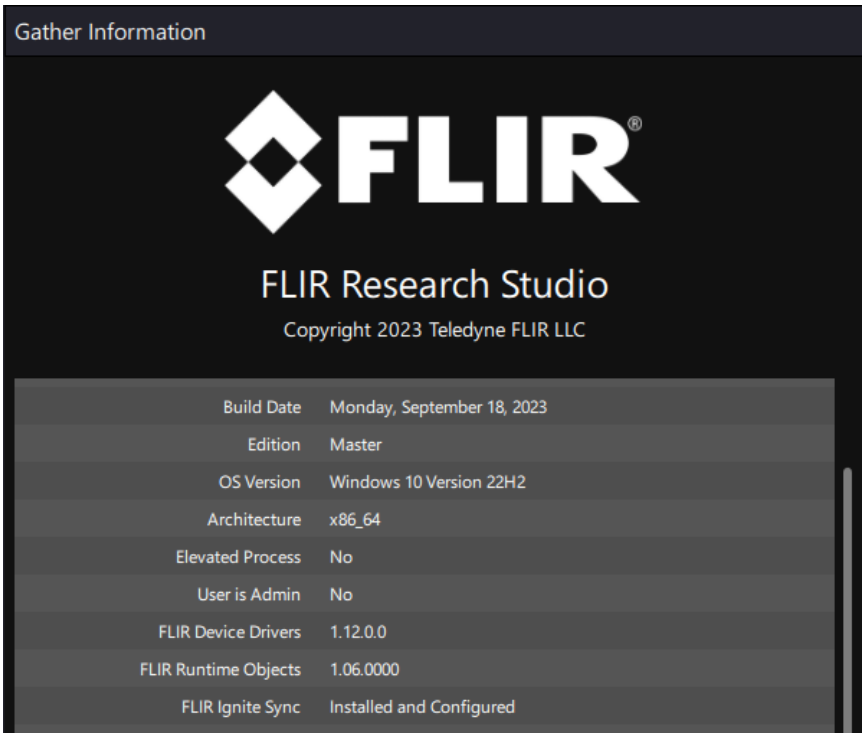
8.5 Gather Information Integration

One of the items in the information listing is the FLIR Ignite Sync availability. It can be one of these five states:

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

Ignite Sync State	Operating System or FRS Edition
Not Installed	Windows
Installed, But Not Configured	
Installed and Configured	
Not Supported on OS	Linux and Mac
Not Supported by Player Edition	All OSes, FRS Player Edition

One of these will be shown on the information listing:

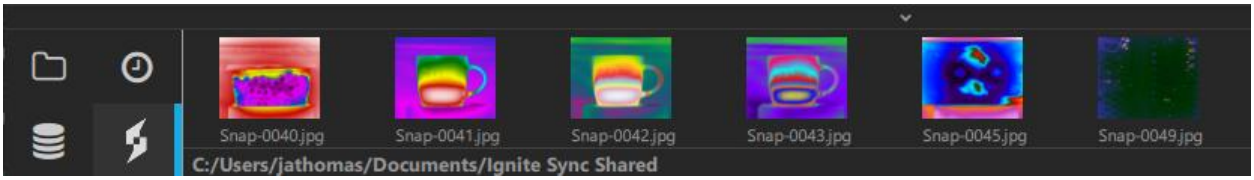


8.6 Collections/Thumbnail Bar Integration

The bar at the bottom of the application contains a tab for the user's Ignite Sync shared directory. When the user saves a snapshot to their shared directory, it will immediately show up here.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

It looks similar to the Quick Collection tab, which also has the directory listed underneath. The main difference is that the directory used by Ignite Sync tab is the shared directory to Ignite, and set by that application, not Research Studio.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

9 General Program Settings

9.1 Help Icon

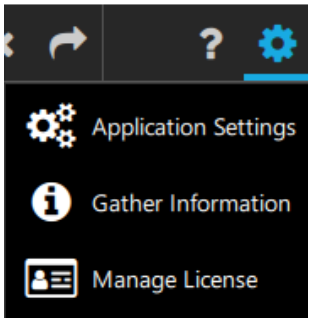
The question mark icon on the top ribbon opens a PDF of the user's manual.



9.2 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.





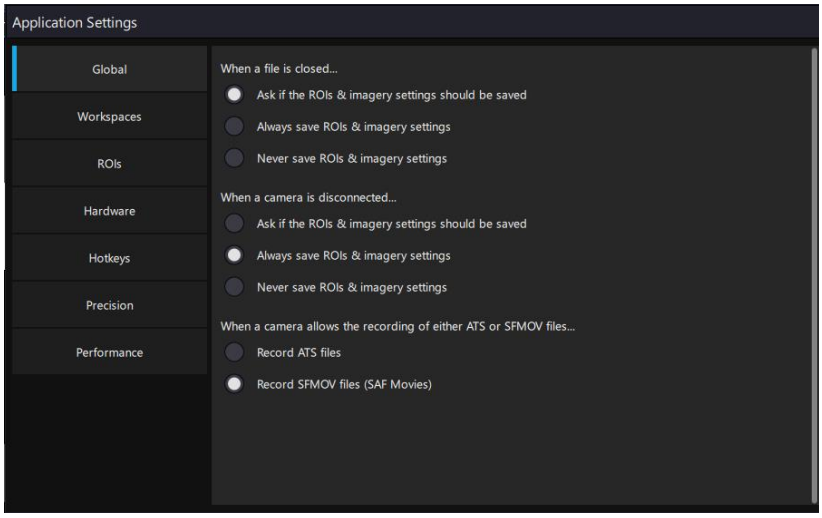
9.2.1 Application Settings

The tabs in this menu are described below.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

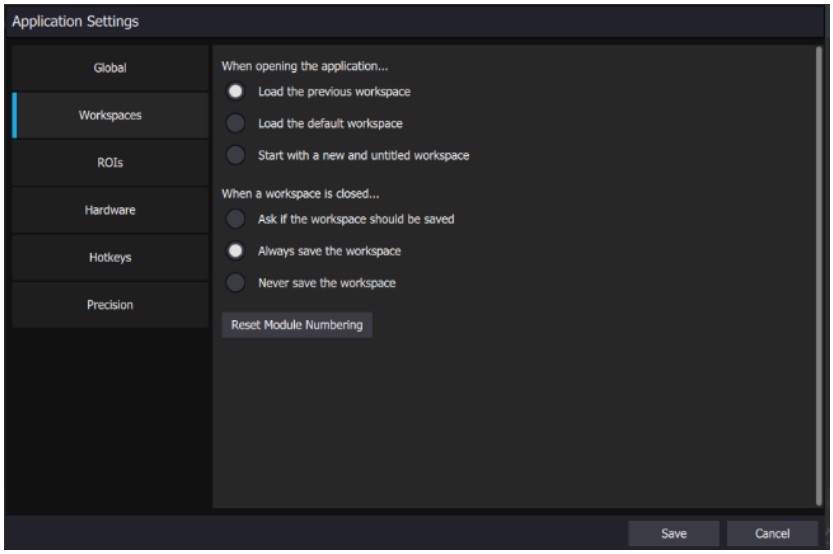
9.2.1.1 Global Settings

This dialog allows the user to choose options for what happens when a file is closed or a camera is disconnected and the file format to use when recording (ATS or SFMOV).



9.2.1.2 Workspaces Settings

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



9.2.1.3 ROIs

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

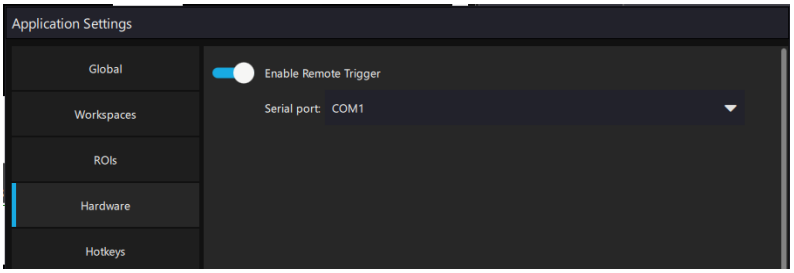
9.2.1.4 Hardware Settings

Settings for hardware controlled by FRS, other than normal frame grabber and camera interfaces.

WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

9.2.1.4.1 Enable Remote Trigger

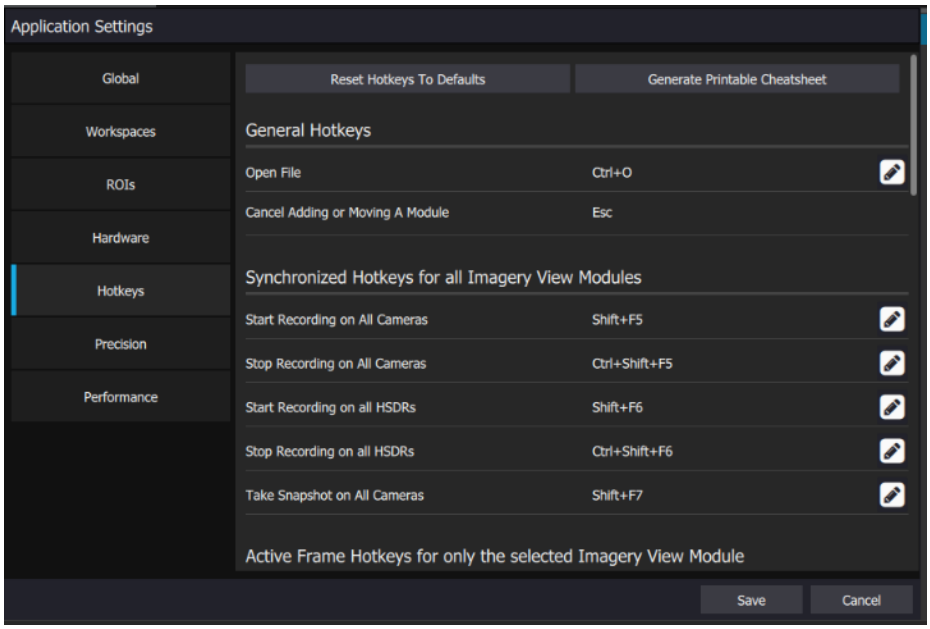
The remote trigger is performed by shorting pins 7 and 8 together of a serial port on the computer (RS232 signals CTS and RTS); typically via a momentary pushbutton switch. The com port FRS should monitor is set here:



Research Studio supports serial ports and standard USB to RS-232 converters. The user must provide their own button for switch closure.

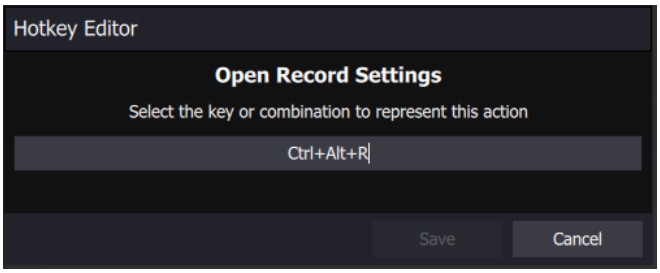
9.2.1.5 Hotkey Settings

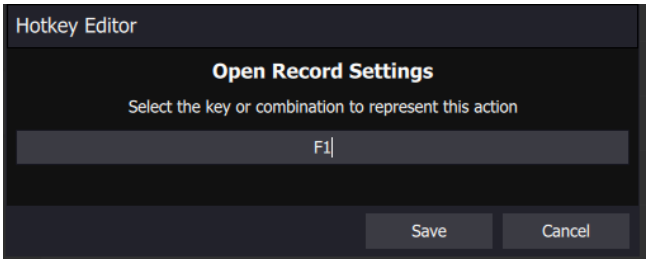
The hotkeys are there to save the user time by making combinations of keystrokes do functions that would otherwise have to be accessed by mouse movements and clicks. If the user modifies these hotkeys using the edit button, the changes are saved over restarts of the application. The user can also generate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



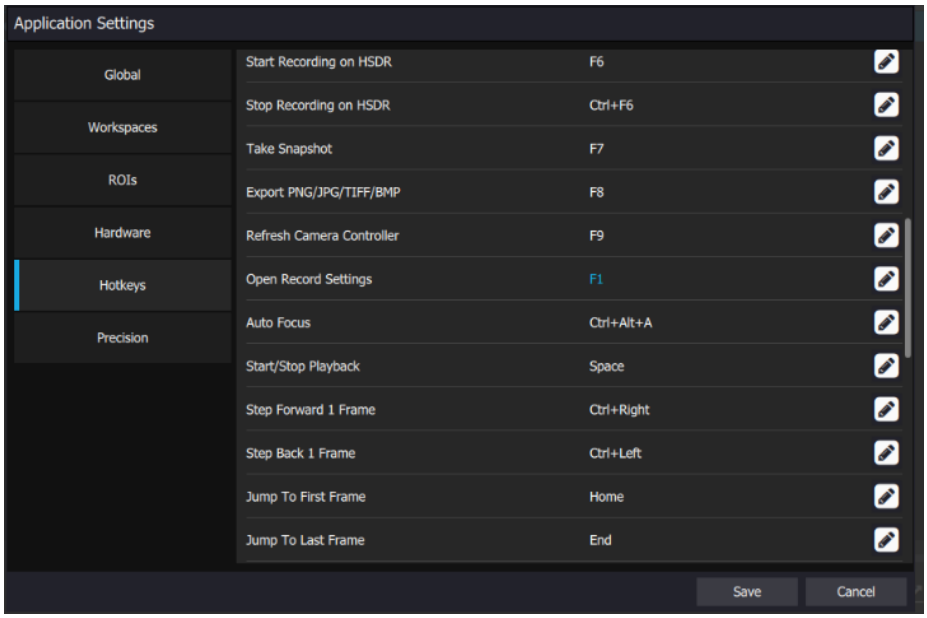
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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



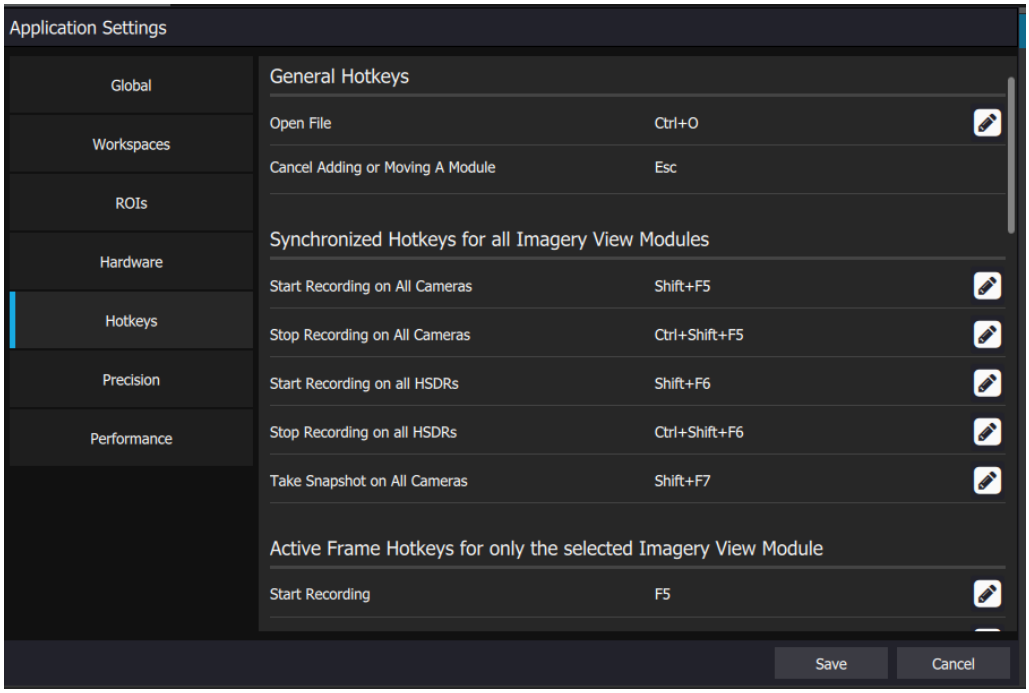


Once the list has been changed, the modified entry is now shown in blue text until the Save button is hit, at which point the Hotkey change is saved. The user can always revert to the factory hotkey settings when needed.

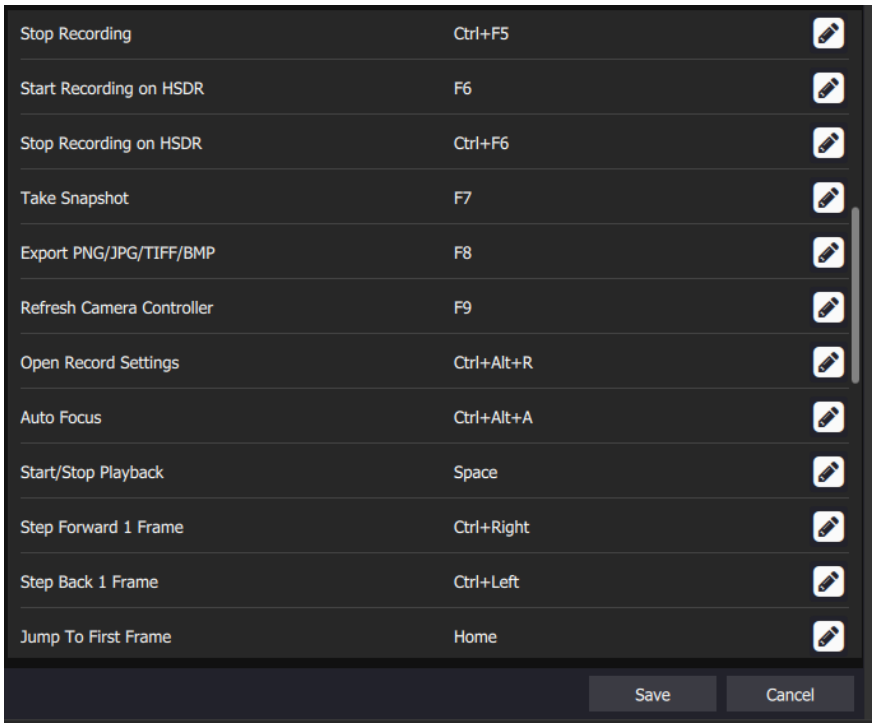


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

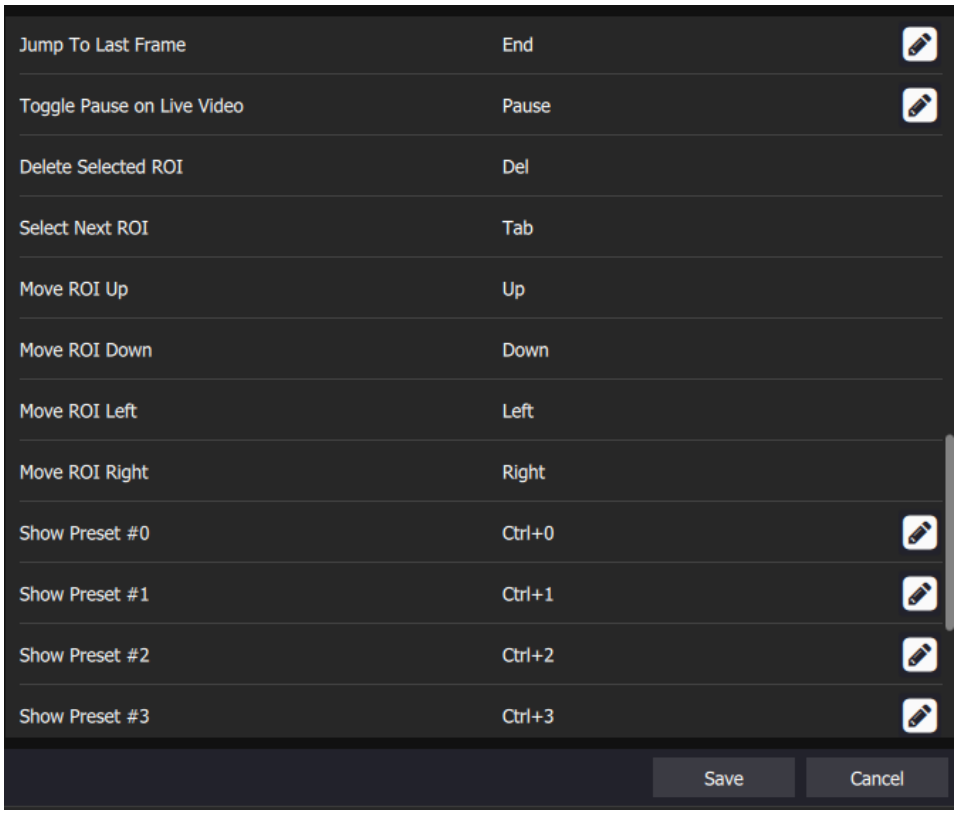
There are some hotkeys that apply to all Imagery View Modules. These are clearly labeled and would activate the action on all Imagery View Modules. The other hotkeys only affect Active Frames or Selected Frames.



Here are the remaining hotkeys:



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

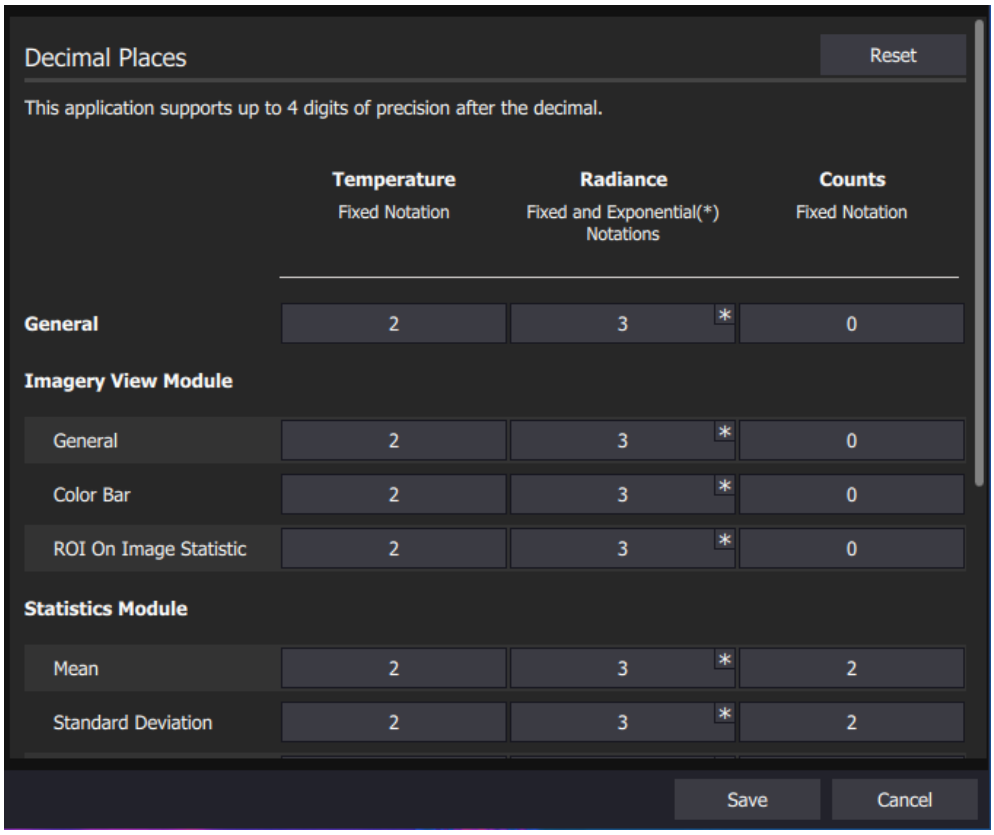


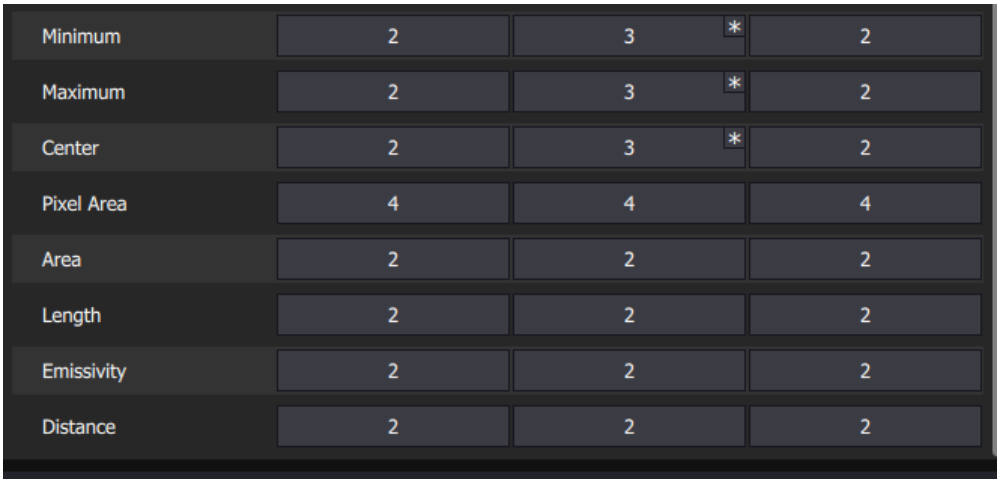


WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

9.2.1.6 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.

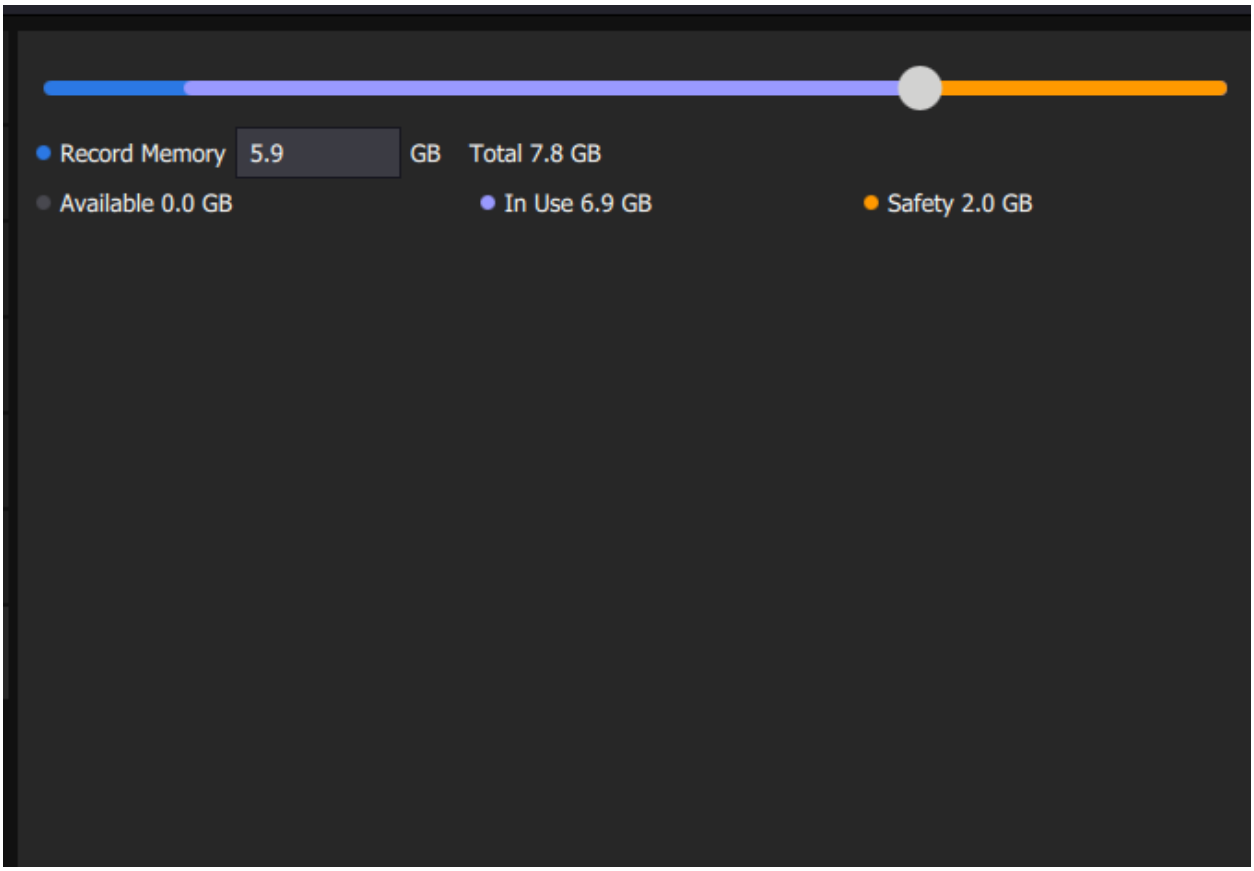




WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

9.2.2 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.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

9.2.3 Gather Information

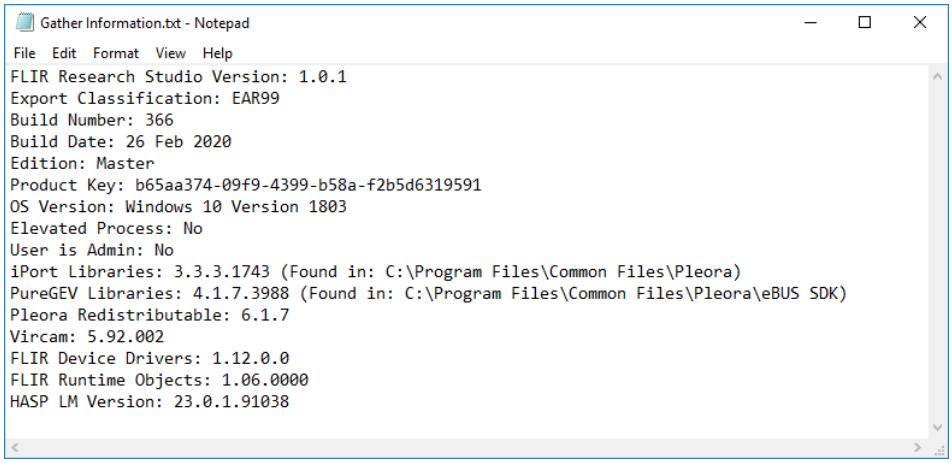
The Gather Information choice gives this window. The user can scroll down on the side bar to see more of the data.





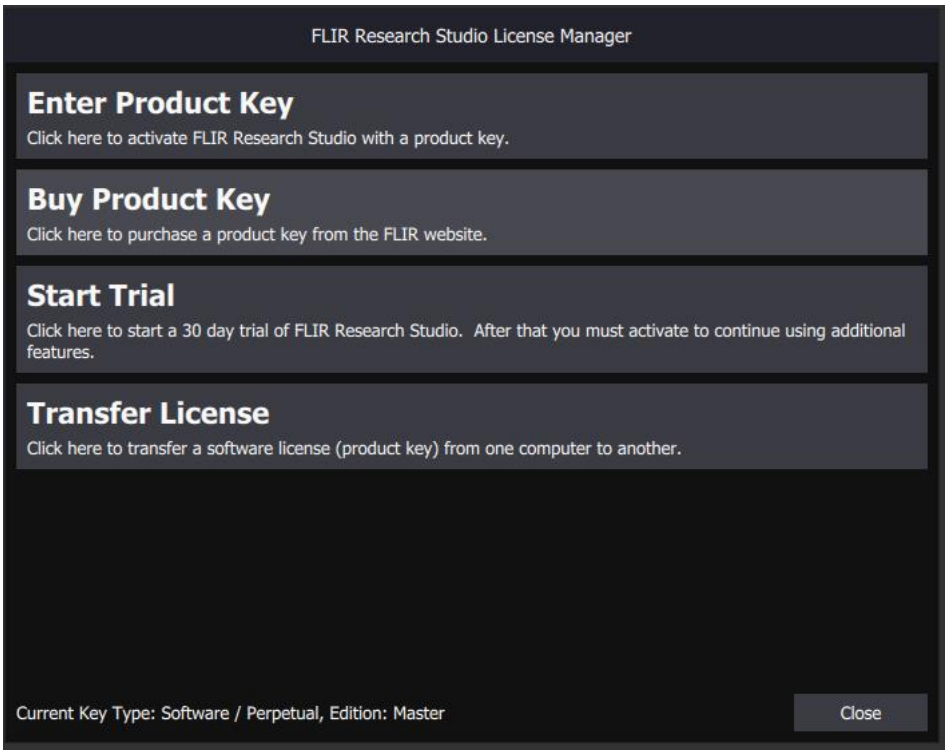
WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.

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.



9.2.4 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.



WARNING: Information contained herein is classified as EAR99 under the U.S. Export Administration Regulations. Export, reexport or diversion contrary to U.S. law is prohibited.