User's Manual for

ThermaCAM® RDac™

IR Imager Data Acquisition Program

VERSION 2.4

FLIR Systems, Inc.

Software Part Number: 419-0015-00
Document Number: NVL000017
Revision Number: 2.4.0
Date: September 29, 2006

Table of Contents

1 Overview

ThermaCAM® RDac™ (RDac) is part of FLIR Systems' ThermaCAM® RTools™ Imaging Analysis Tools Suite (RTools). RDac is a data acquisition program that can be used to preview, acquire and store digital data from infrared (IR) imagers. File output is in the USAF Standard Archive Format (SAF) created at Arnold Engineering Development Center in Tennessee. It works in conjunction with the ThermaCAM® RCal™ (RCal) image calibration module and ThermaCAM® RView™ (RView) image analysis module. If properly setup, RDac™ will display or store data in real-time in either raw or engineering units (Radiance or Temperature). For the purposes of this document, ThermaCAM® RDac™ will be referred to as RDac, ThermaCAM® RCal™ will be referred to as RCal, ThermaCAM® RView™ will be referred to as RView, and ThermaCAM® RTools™ will be referred to as RTools. Note that the terms 'camera' and 'imager' are used throughout this document. For the sake of clarity, the difference in the terms is ignored since either a camera or an imager can be interfaced and applied with the RTools software suite.

2 Copyright

3 Installing RDac

RDac is installed using the setup utility on the RTools Installation CD. The setup utility will install the RTools programs the user selects. The RDac executable will be located in the folder selected by the user during the installation process. Sample data files will be located in the “\Program Files\RTools\Common\Demo” subfolder.

4 Typical Setup of RDac for the First Time

Following are the steps for bringing up RDac on a PC for the first time with a FLIR Systems or FPA IR camera in a manual setup/configuration for a new install of RTools. If you encounter any problems, email: rtools@flir.com.

1. Install the Win2K/WinXP operating system and all relevant non-acquisition drivers without any of the acquisition hardware in the system (frame-grabber, IRIG card, etc.). This includes video drivers, network (NIC) drivers, mouse drivers, and other standard PC hardware drivers.
   - Win2K must be updated to at least SP6 or later
   - WinXP must be updated to at least SP2 or later
   - The latest Matrox video card drivers should be applied if a Matrox video card is in the system.
   - If using a Matrox frame-grabber ensure that the Plug and Play Operating System setting in the BIOS is set to no. Most acquisition hardware and IRIG cards are plug and play unaware and will not be recognized properly by their associated drivers.

2a. Installation of a Matrox Meteor frame-grabber card.
   - If installing a Meteor II/Digital or Meteor II/CL card, install Mil-Lite 7.5 library using the defaults on all options except for the memory allocation.
   - Leave approximately 256 Meg of ram for Win2K/WinXP usage and give the rest to the Matrox memory subsystem handler. Typical example: 512 Meg of physical ram in the PC with 256 Meg to the Matrox memory subsystem and 256 to Win2K/WinXP. If 1 Gigabyte or more of ram is installed, it is recommended that the OS should have at least 512 Meg of ram. Note that the Matrox memory manager can only manage 1.5 Gig of ram for its own usage.

2b. Installation of a National Instruments frame-grabber card. Skip id installing Matrox frame-grabber.
   - Install NI-IMAQ version 2.6. Version 2.6 is required if a Phoenix camera is being used and full Preset Sequencing support is desired. NI-IMAQ 3.0 will work but is not optimal for high-speed acquisition with the Phoenix camera.

2c. Installation for GigE: See Phoenix DTS or SC6000 User's manual for detailed steps for installation.

3. Install IRIG card (Truetime, Datum, Brandywine, Meinberg and KSI are supported – KSI and Datum are preferred) and its drivers.
   - You do not need the Truetime server app.
4. Install RTools software and select desired options.
5. Power up and cool down the camera.
6. Camera initial startup: See associated camera user's manual
7. RDac initial startup.
   - If the Select a Header Include File Dialog appears, select the default.inc file in the default inc folder.
   - If the Imager controller module Dialog appears, select the appropriate camera controller exe file in the ".\RTools\RDac" folder.
   - If the LAST.* File Dialog appears, select the last.* file in the ".\RTools\RDac" folder.

- If the Select a Configuration File Dialog appears, select the appropriate Merlin (either MWIR or LWIR) dcf file (for Matrox), icd file (for NI), or xml file (for GigE) in the ".\RTools\RDac" folder.
- The main RDac window should appear.
- Select a Target Data Folder (optional).
- Under Options/Properties Display Rate Tab, do the following (optional):
  - Move the Display Refresh Rate Slider all the way to the left unless GigE is the acquisition platform. If GigE then set the slider to approximately 16.
  - Check the Display Rate Box.
- Under Options/Properties Camera Specific Tab, do the following:
  - Check the Save Camera header Info Box.
  - Check the Use Normalization Features.
- All other settings should be set as desired.

9. Exit and restart RDac to save all settings. Camera is ready for use.

5 User Interface

The RDac user interface is shown in Figure 1. A complete description of all menu items and buttons on the toolbar is presented in the sections that follow.

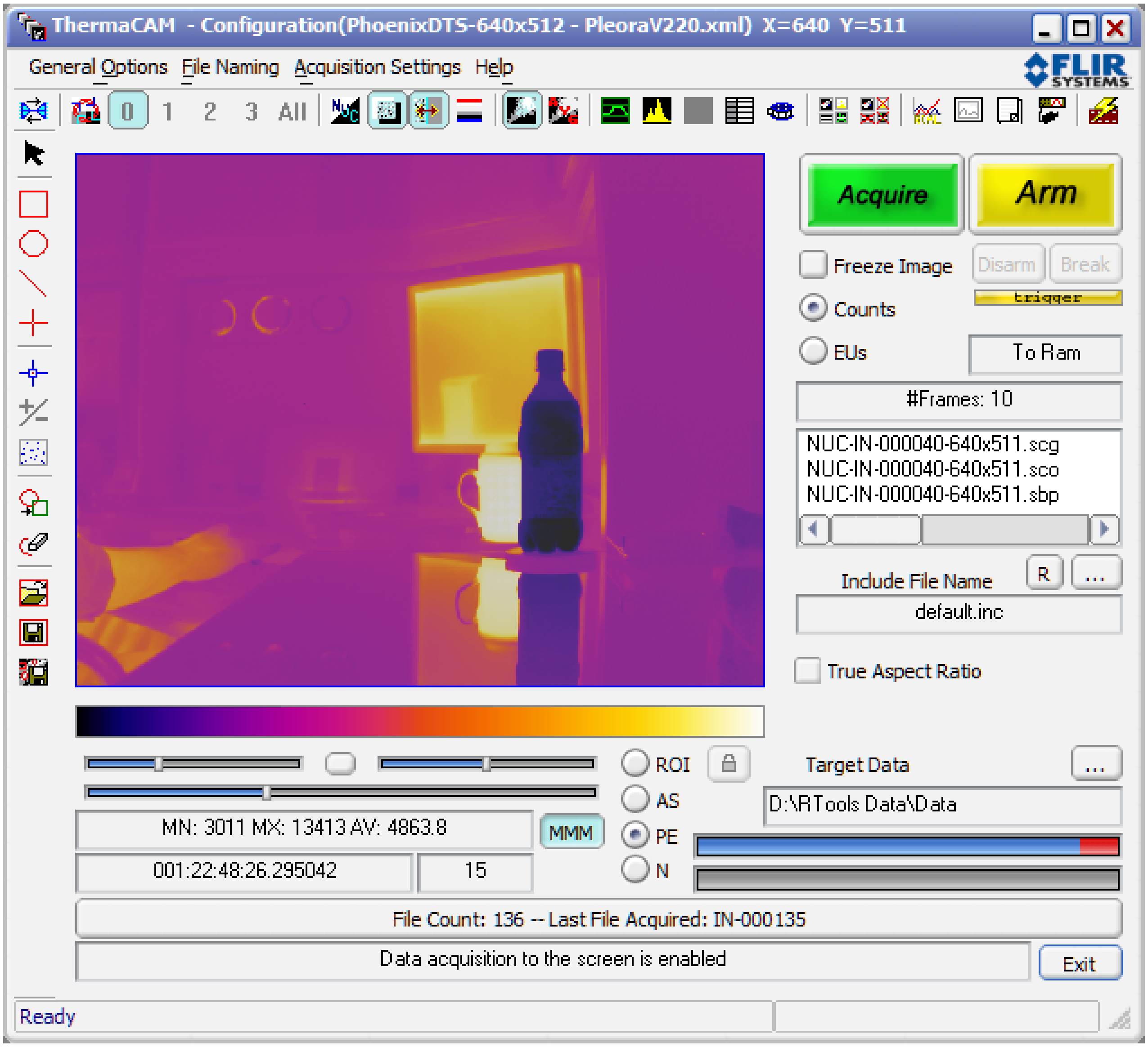
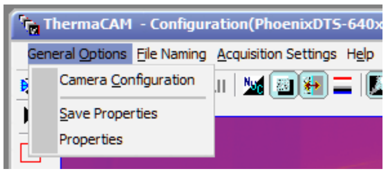


Figure 1 – RDac main user interface

The main user interface can be broken up into several different functional groups. A summary of each group follows.

- **Main Menu**



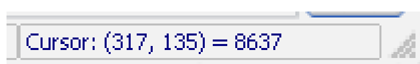
The main menu allows access to various options including camera configuration files and general properties for RDac setup, display and operation. 'File Naming' and 'Acquisition Settings' are available both from the front menu and the properties pages under 'General Options.'

- **Main Toolbar**

The main toolbar allows access to the most commonly used commands for image display modes, normalization, imager control, super-frame selection, movie playback, statistical information, external module spawning and starting the HSDR module.

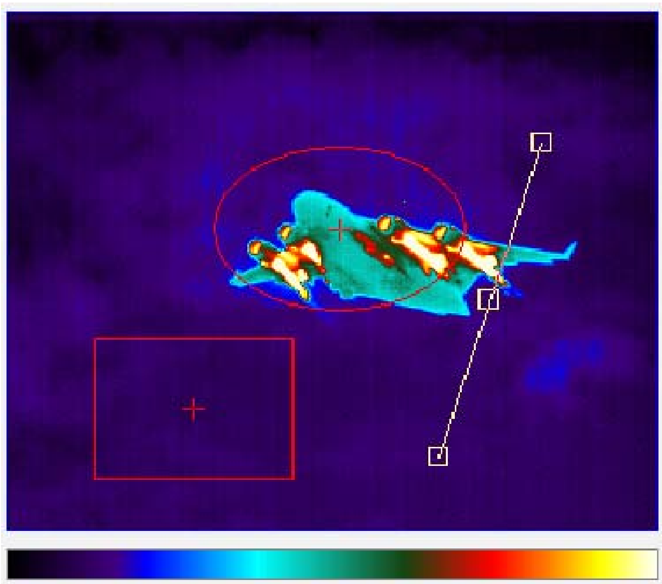
- **ROI and BP Mask Toolbar**

The ROI and BP Mask toolbar allows a variety of simple shapes to be drawn on the main image display from which statistical information is calculated based on the ROI mappings and output on the secondary Statistics grid window. Also, The bad pixel mask can be edited at the pixel level. For ROIs, one to for cursors, rectangles, ellipses and lines can be drawn in any combination with the image. Resizing and repositioning of each ROI are also supported. The actual button commands are: Selection, Rectangular Area Mode, Elliptical Area Mode, Profile/Line Mode, Cursor Mode BP Edit Mode, Add/Subtract BP, Show/Hide BP Mask, Select next ROI, Erase/Clear ROIs, Open ROI file, Save ROI file and Save Image to file



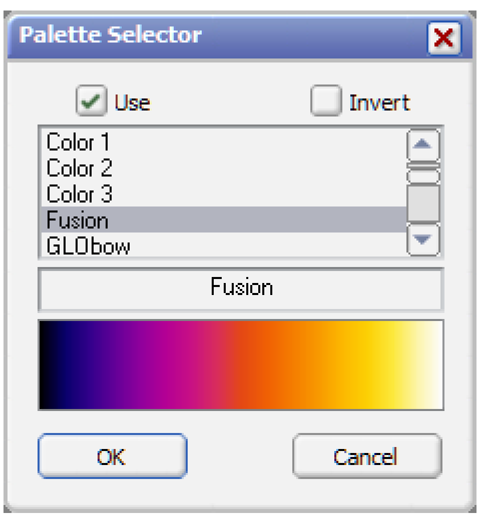
When the mouse cursor is over the image, the current pixel value is supplied.

- **Image Display and Controls**



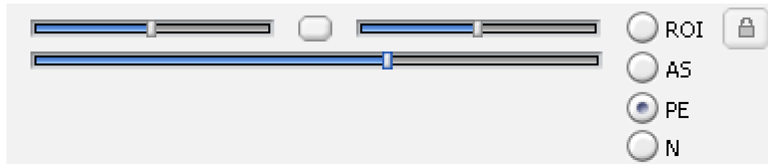
The image display is the primary informational tool for all RDac related tasks. Various display modes can be selected from the main toolbar, ROI's can be drawn with the mouse, and contrast and brightness can be varied with multiple functions. Note the gradient displayed at the bottom of the primary display. This is used to determine color scaling for both the default gray-scale and user defined color palettes in relation to the real-time image display. The keyboard command "Alt-Enter" will place RDac in a full screen, image only mode. Press "Alt-Enter" again to exit this mode.

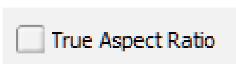
A freeze live image button is available. All ROI and stats functions can be performed while the image is frozen.



To change the display palette click on the color bar to open the window at left. The default palette is a gray-scale gradient. To select an alternate palette check "Use" and highlight the desired palette. Check "Invert" to reverse the diection of the desired palette gradient. Press "Okay or "Cancel" when done.

Manual contrast & brightness controls can be used in each mode. ROI is a lockable scaling version that uses an ROI to determine scale limits. AS is a linear scaling technique. Plateau Equalization can be used to enhance detail in a low contrast image. The display controls in general allow the user to control contrast and brightness of the image either manually or through automatic means.

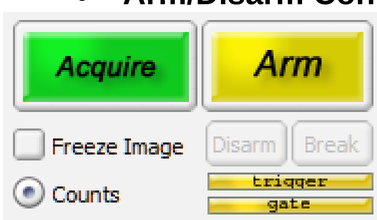




True aspect ratio or arbitrary image display size is supported with this switch acting as a toggle between the two modes.

The main display panel can be resized and the window state is stored for a user specified size upon restart of RDac.

- **Arm/Disarm Controls**

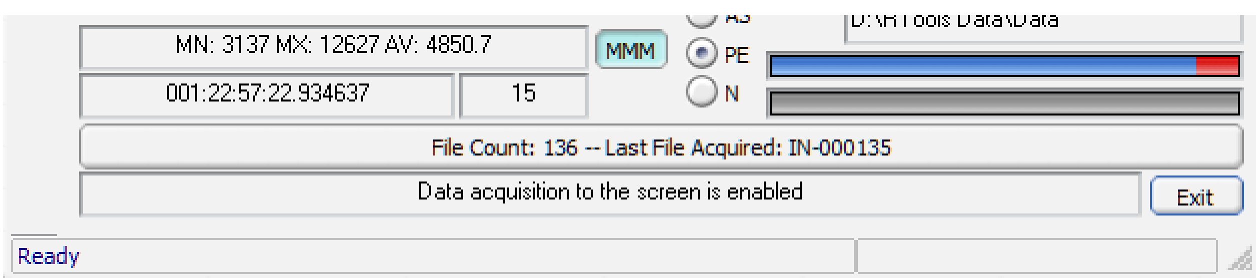


The group of buttons in the top right corner of the main interface window allows arming and disarming of RDac for remote trigger operation. Also, an acquisition can be triggered by pressing the Acquire button. Alternatively, “Alt-c” can be pressed to initiate an acquisition when not armed.

This is an example of how the RDac arming controls look in an armed and ready for remote trigger condition. Note the two long green ”LEDs”. These show the status of the remote start signal. Yellow is disabled, Green signifies ready or off. Red signifies triggered or on. See the acquisition section for remote start details.

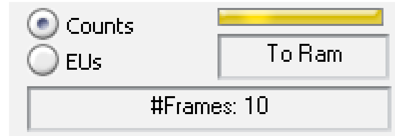
- **Status and Statistics Windows**

There are a variety of status and informational windows arranged around the image display.

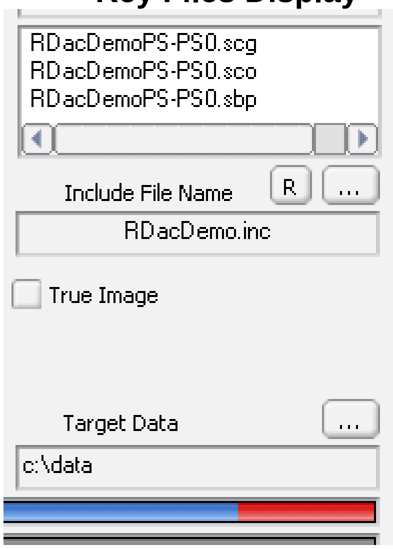


At the bottom of the main panel are areas displaying time stamping, display refresh rate, minimum, maximum and mean values for the entire image, collection time stamping, and cursor position.

At the top right section of the main panel is the EU/Counts toggle, data collection type and storage mode displays.



- **Key Files Display**



The key files display windows and controls set and show several key files and paths relevant to the creation of each data set. If the normalization functions are enabled, the norm file list will be displayed. Target data folder and include file name set and show the current active settings for each.

- **Help and Exit**

The help button spans a compiled help version of this document. Also, note that the majority of controls are tool-tipped with short phrases for quick functional identification. Exit stops and exits RDac.

5.1 Main Menu Command Description

The main menu contains configuration commands 'General Options,' 'File Naming,' and 'Acquisition Settings.'

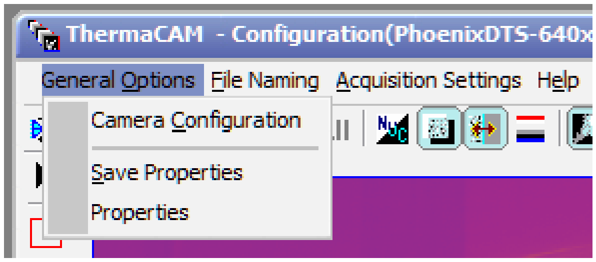


Figure 2 – Main menu options

'General Options' includes all settings and modes that are only occasionally set or configured. This includes imager configuration file selection, general RDac state saves, and all other general properties as listed in the following sub-sections. 'File Naming' and 'Acquisition Settings' give more direct access to the corresponding properties pages available under 'Properties.' Help selects the help and about menu items. The following sections give greater detail to each menu option.

5.1.1 Select Camera Configuration File

The select camera configuration menu option allows RDac to be configured for multiple imagers.

Note that this menu option is not available in the GigE or HSDR installations for FLIR Phoenix DTS & FLIR SC6000 cameras. The FLIR Phoenix DTS and FLIR SC6000 are configured through the RDac System Configurator utility described in the appendix. The generalized version of the GigE installation still includes this menu option to support cameras connected via an external iPORT.

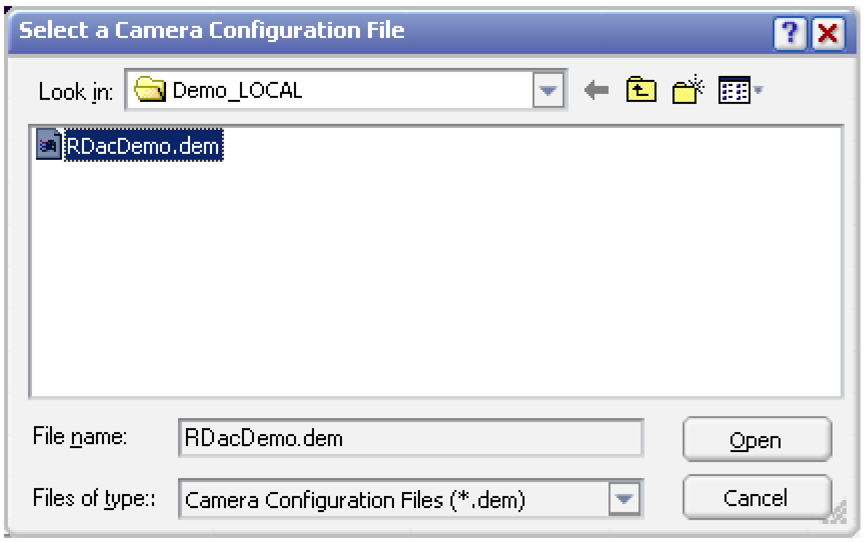


Figure 3 – Pick a new imager configuration file selector

Several imager configuration files are supplied with the RTools setup program based on the imager the user has selected to install. Alternatively, the configuration file can be created by the appropriate frame-grabber imager setup program. See the OEM frame-grabber help file for additional information. Using this method, user defined camera configuration files can be used for special cameras or camera modes. For instance the FLIR Phoenix line of focal-plane imagers can be configured in multiple row and column counts. The user can define a camera configuration file which best suites their needs and use RDac to acquire data in that mode. After selecting a file using the open button, RDac will restart using the newly selected camera file.

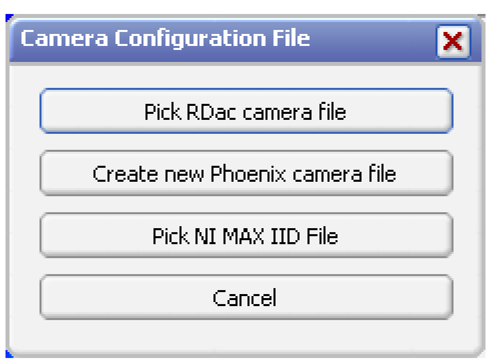


Figure 4 – Pick or create an NI ICD file

When RDac has been installed for a National Instruments 1422/1424 frame-grabber and the camera type selected is Phoenix, the above dialog is displayed. This allows the user to either pick an existing NI ICD file or create a new file for the FLIR Phoenix camera.

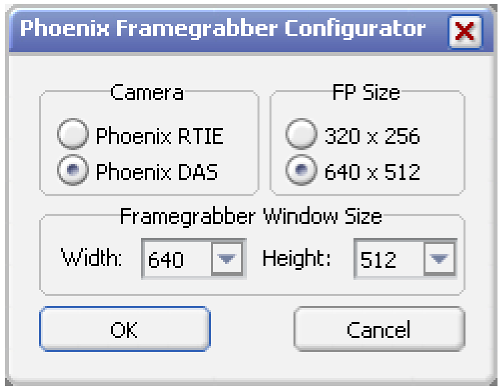


Figure 5 – Create a new Phoenix configuration file

If the create new ICD file option is selected, the above dialog is displayed. This dialog allows the creation of a custom Phoenix ICD file with different frame sizes. Note that the available frame sizes allowed are those supported by the appropriate Phoenix camera. To use, select the camera type and size. Next, select the desired number of rows and columns. Then select OK to create the file and RDac will automatically restart with the new ICD file selected.

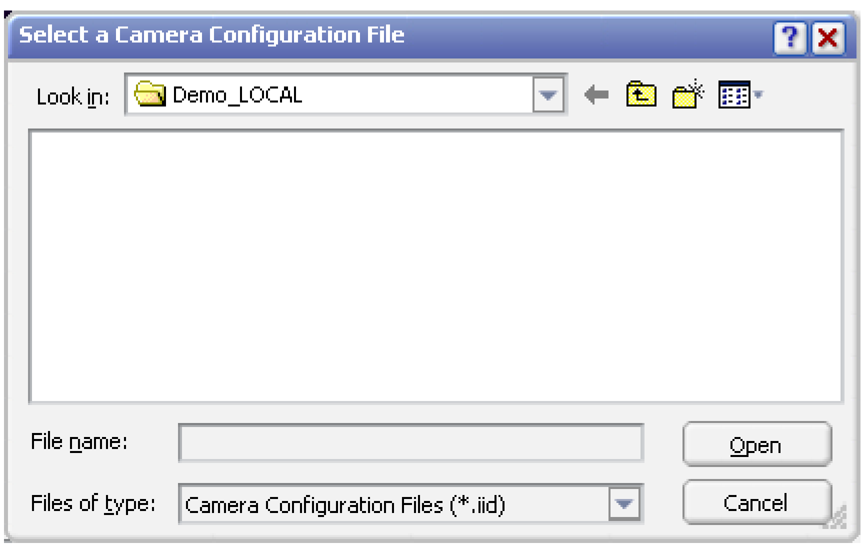


Figure 6 – Pick an NI IID file

When RDac has been installed for a National Instruments 1422/1424 frame-grabber and the camera type selected is Phoenix, the above dialog is displayed. This allows the user to either pick an existing NI ICD file or create a new file for the FLIR Phoenix camera.

5.1.2 Save Global State and Properties to File

The save global state and properties to file menu option is used to save the state of RDac to a text file.

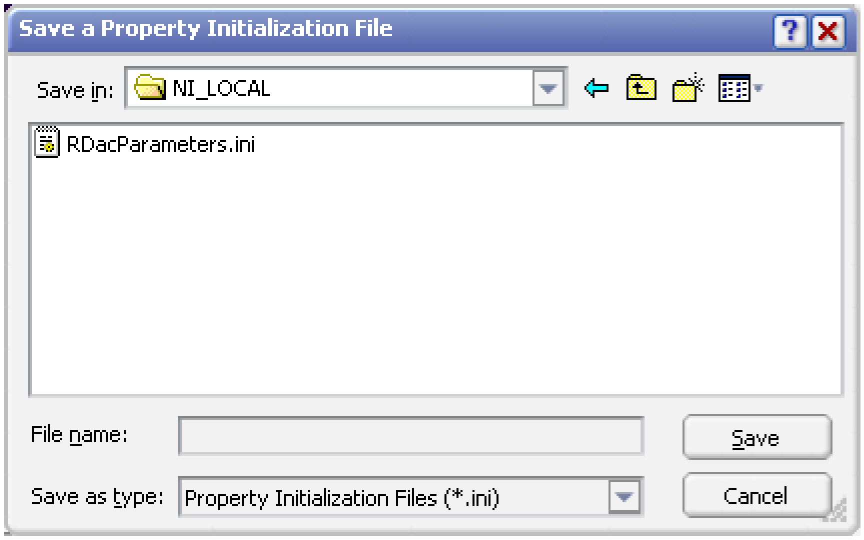


Figure 7 – Save system state selector

These files can be used to configure RDac on startup by specifying the appropriate initialization file on the command line of RDac. RDac will ignore its previous default startup state and configure itself based on the initialization file. See the appendices for an example ini file. Usage is simple. From a command line prompt, go to the RDac folder. From that location, run RDac with the desired properties initialization file.

5.1.3 Properties

The properties menu option opens a Windows style property sheet dialog with various pages devoted to specific options and switches to better tune RDac to the attached imager and allow the user to select configurations to meet a multitude of data monitoring and acquisition requirements.

5.1.3.1 Color Options

This panel contains color options for both the real-time display plot windows and the movie playback plotting windows. Following is a detailed description of each feature.

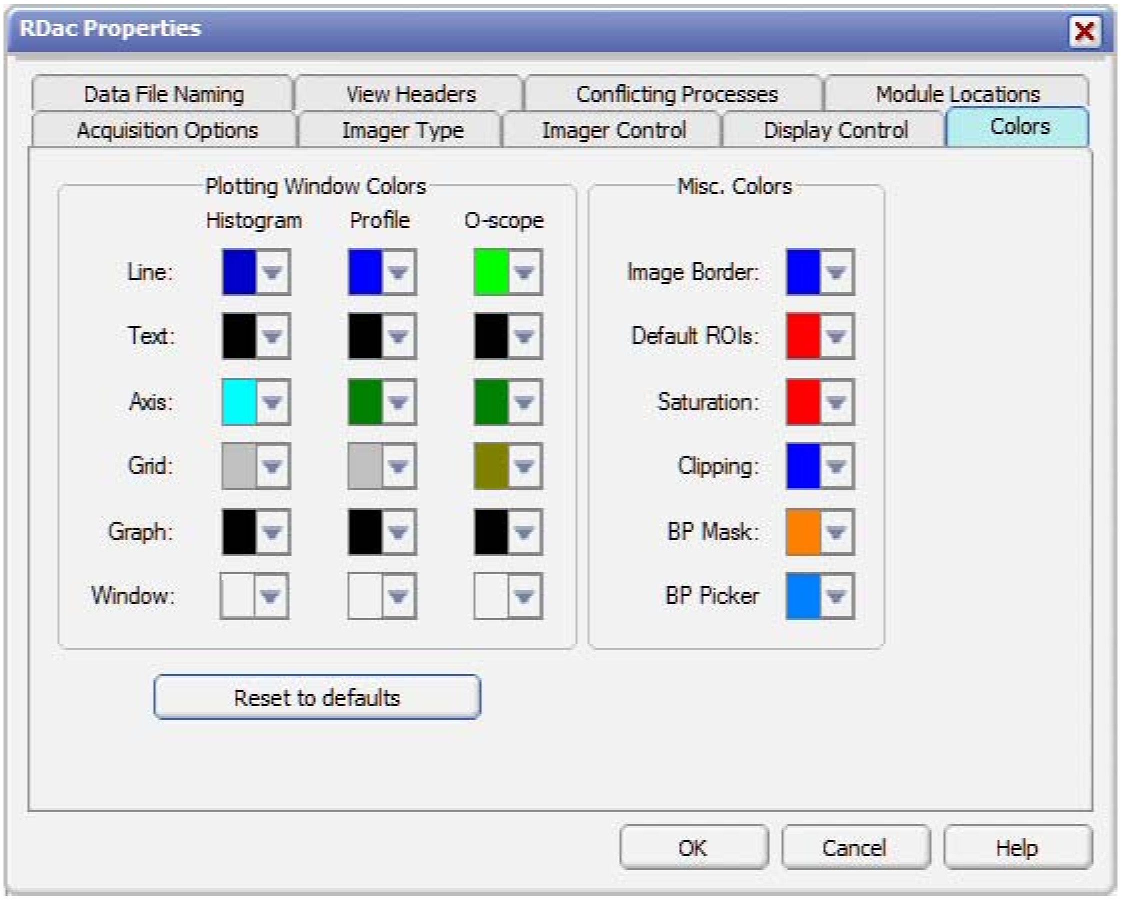


Figure 8 – Properties relating to color

Each of the plot window types can be configured as follows: Line is the actual plotting line, Text is any legend and scale text on the plot window, Axis is the horizontal and vertical zero base lines, Grid is the horizontal and vertical scale lines, Graph is the graph background, and Window is the background of the overall plot border.

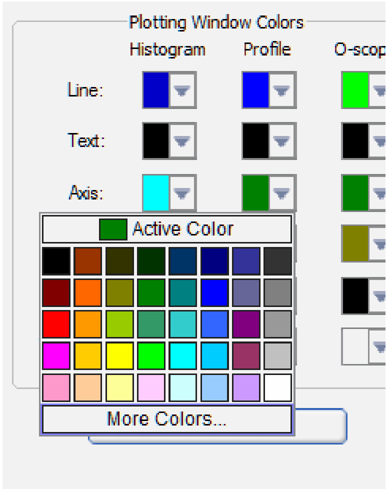


Figure 9 – Color pick selection

Other user definable color options are: image border, default ROI color (note that individual ROI colors can be controlled by right clicking an ROI), saturation, and clipping colors. The BP mask and picker colors are ste here as well.

System default colors can be reset by using the 'Reset to defaults' button.

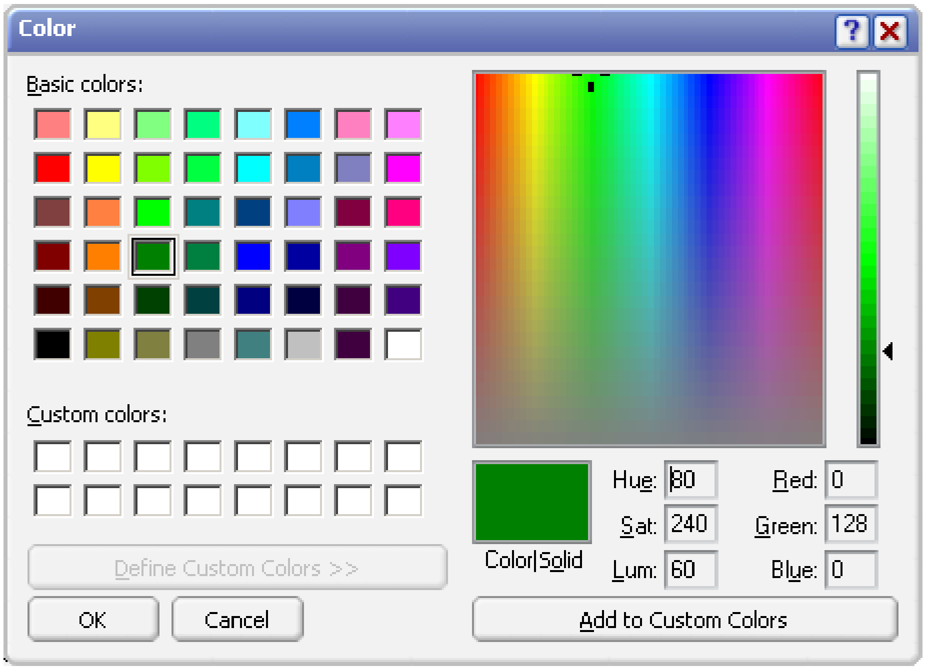


Figure 10 – Custom color pick selection

Each color can be redefined by clicking on the color which will show the above dialog. The color picker is a standard Windows common dialog used to select colors.

5.1.3.2 Camera Type and Imager Control Options

This panel contains imager specific setup information and imager related options. Following is a detailed description of each feature.

Note that these two property pages are not available in the GigE or HSDR installations for FLIR Phoenix DTS & FLIR SC6000 cameras. The FLIR Phoenix DTS and FLIR SC6000 are configured through the RDac System Configurator utility described in the appendix. The generalized version of the GigE installation still includes these pages to support cameras connected via an external iPORT.

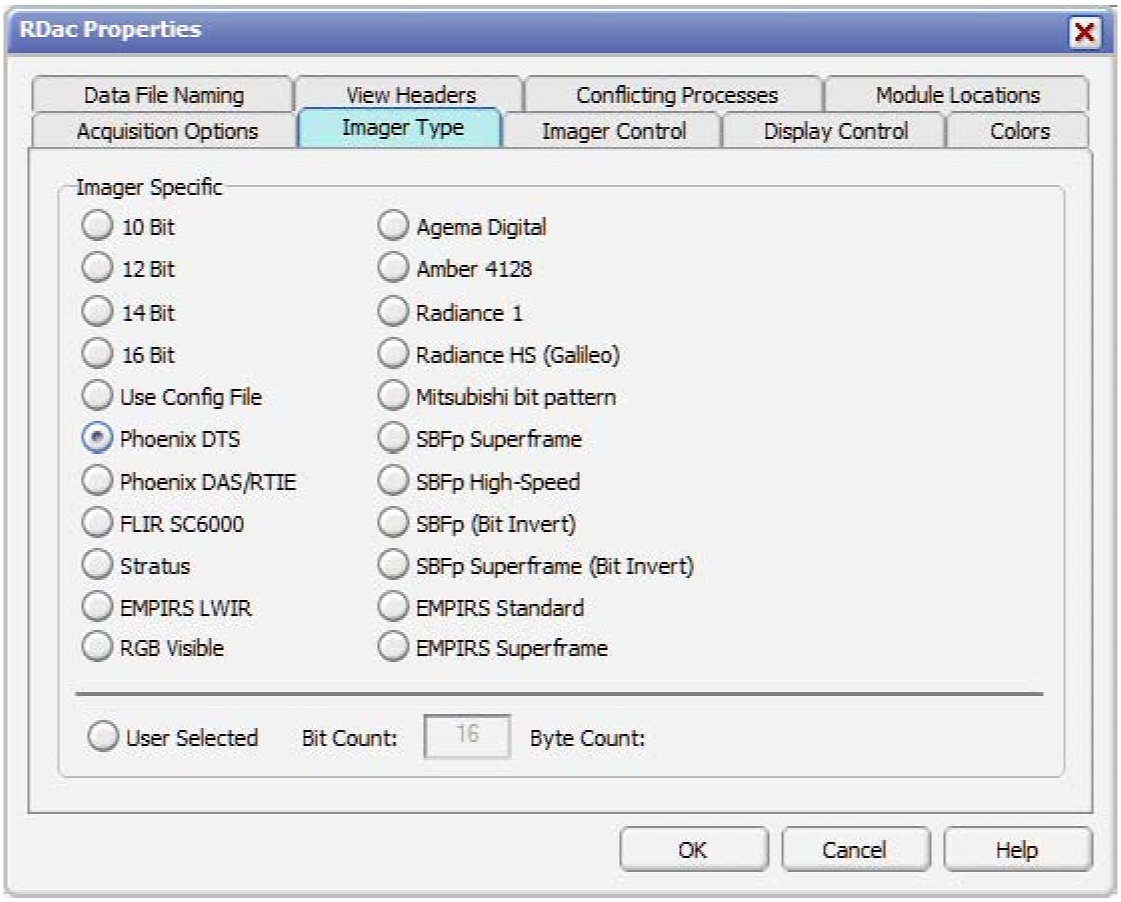


Figure 11 – Properties relating to imager specific setup

The Camera Specific options allow RDac to be tuned to a particular imager bit size, bit pattern or mode. The available options are as follows:

- **10 Bit: Set to a generic 10 bit imager interface.**
- **12 Bit: Set to a generic 12 bit imager interface.**
- **14 Bit: Set to a generic 14 bit imager interface.**
- **16 Bit: Set to a generic 16 bit imager interface.**
- **Use Config File: Use selected default camera configuration file for the imager interface.**

- **Phoenix DTS: Set to use the Phoenix DTS attached to a traditional frame-grabber**
- **Phoenix DAS/RTIE: Set to use FLIR Phoenix special features such as Preset Sequencing.**
- **FLIR SC6000: Set to use the FLIR SC6000 attached a traditional frame-grabber**
- **Stratus: Set to use the FLIR Stratus special features**
- **EMPIRS LWIR: Set to use the EMPIRS LWIR special features**
- **RGB Visible: Set to use/display RGB visible cameras**
- **Agema Digital: Used to support custom digital converter for Agema cameras.**
- **Amber 4128/41256: Set to decode Amber pixel ordering scheme.**
- **Radiance 1: Used to support Radiance 1 bit pattern.**
- **Radiance HS: Used to support Galileo/Radiance HS bit pattern.**
- **Mitsubishi bit pattern: Used for some Mitsubishi digital outputs.**
- **SBFp Super-frame: Used to support SBFp superframing.**
- **SBFp High-Speed: Used as a workaround on some 320x256 4ch cameras.**
- **SBFp DRS LW: Used to support DRS based SBFp camera.**
- **EMPIRS Standard: Used to support SBFp EMPIRS normal mode.**
- **EMPIRS Super-frame: Used to support SBFp EMPIRS Superframing.**
- **User Selected: Use user defined bits per pixel for the imager interface.**

Other specialty options are available for custom camera interfaces. Note that the Phoenix option is the preferred method for using the FLIR Phoenix camera in both normal and Preset Sequencing mode (this is similar to Super-frame mode in operation).

An imager controller module can be selected in the Controller Module area. Use the Set button to select a controller module and use the None button to select no module.

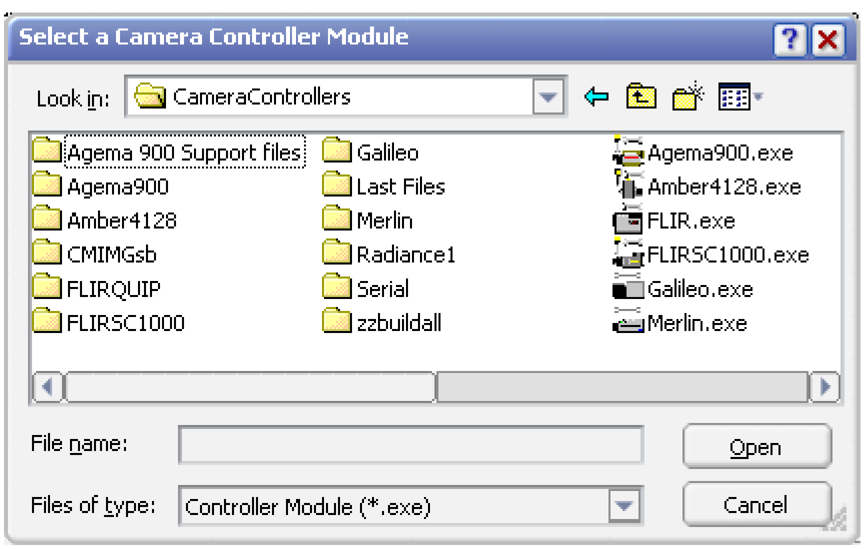


Figure 12 – Select camera controller module

Other options include the ability to store camera specific information in each data collection by selecting Save camera controller header info. This will vary depending upon the imager controller module selected. See the specific imager controller module manual for details.

Also, the Use Normalization Features switch allows the enabling or disabling of the application of imager normalization functions. When this switch is off, no normalization files are generated for a data collection set. It is highly recommended that normalization files are created and maintained by RDac during any data collection process.

The Use IRIG card (if installed) option allows the user to enable/disable IRIG time card support.

The Use Phoenix calculated time switch is a specialized switch designed to take advantage of the Phoenix RDAS's built-in frame counter to precisely time-tag per frame data when using the NI frame grabber. Time is referenced using an initial IRIG/System time call immediately prior to the first frame acquisition and a post time call immediately after the last frame acquisition. Post processing after the collection generates a time reference based on the embedded frame counter in each Phoenix frame's header row. This reference is used to compute an artificial precision time stamp for each frame and output to the pod file.

The Show Agema field number is used to allow display of digital Agema header information. Only available if the Agema Digital option is selected.

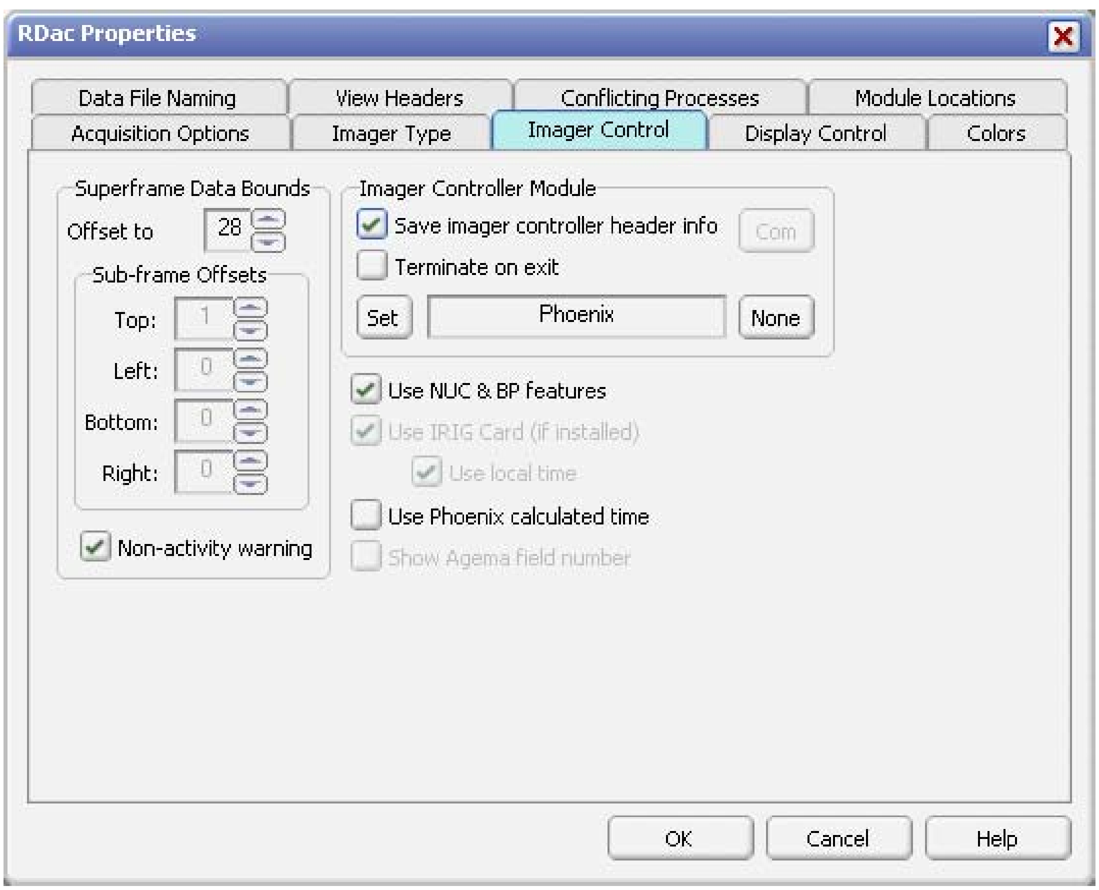
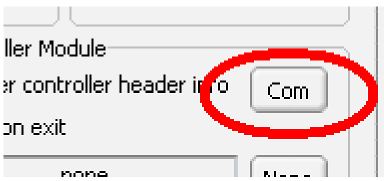


Figure 13 – Properties relating to imager specific setup

The Offset to FC determines where to look for the position of the sub-frame counter. Typically, this is at positions 2, 4, 6, or 8. Note that the full frame counter can be displayed by checking the Show Frame Counter box; otherwise, only the sub-frame counter will be displayed along with the refresh rate on the main display. These can be used to help find the right offset setting. The Sub-frame Offsets tell RDac where in the primary data frame the active image is located. Top is the offset in pixel rows from the full frame top edge to the top edge of the active image area. Left is the offset in pixel columns from the full frame left edge to the left edge of the active image area. Bottom is the offset in pixel rows from the full frame bottom edge to the bottom edge of the active image area. Right is the offset in pixel columns from the full frame right edge to the right edge of the active image area.



The Com button selects the Pleora Serial Port Configuration dialog. See the Pleora tech note 'RDac/Pleora GigE configuration procedure' in the appendix concerning usage. Note that this is only supported when communications with a camera is being directed through a 3rd party virtual serial port.

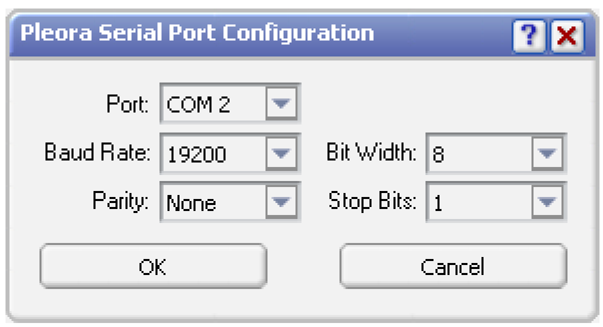


Figure 14 – Setup Pleora serial port communication parameters

5.1.3.3 Display Control Options

This panel contains customization features relating to the real-time display that enhance RDac's real-time display. Following is a detailed description of each feature.

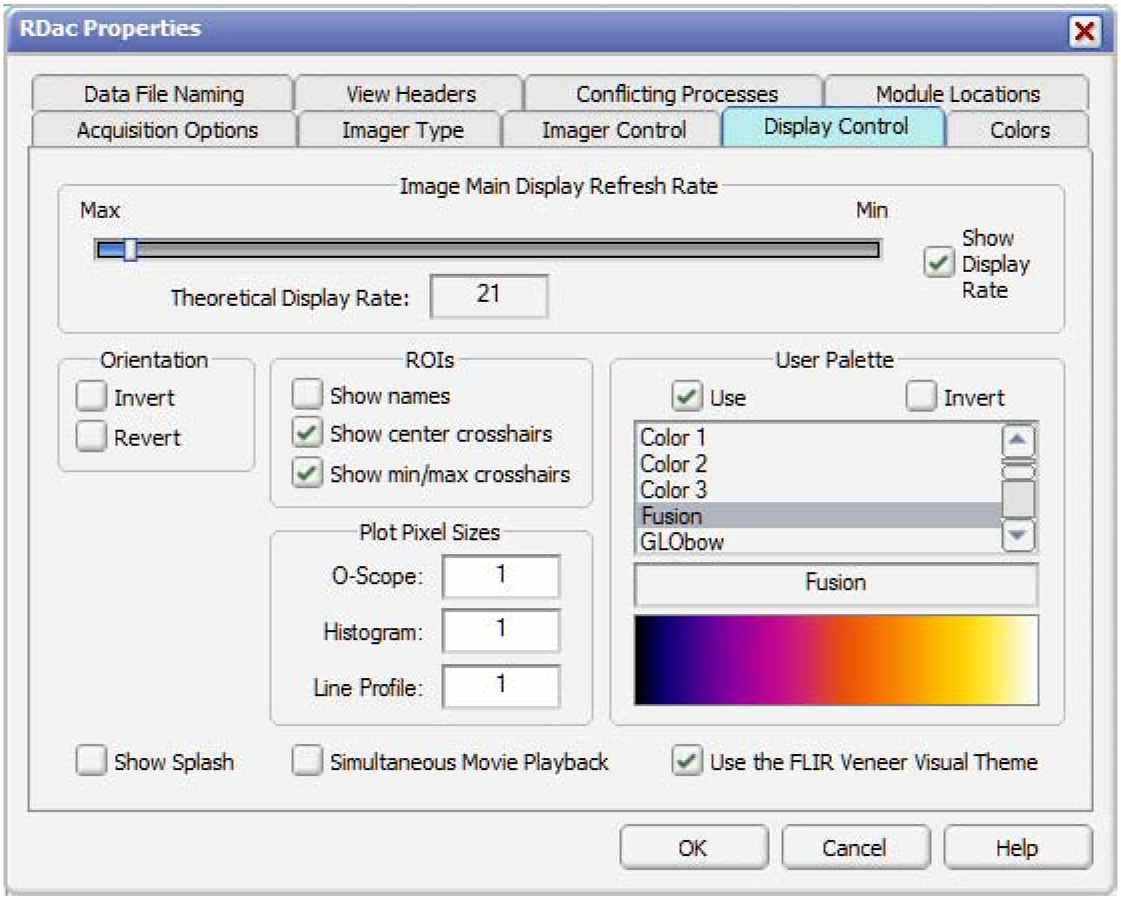


Figure 15 – Image display options

The Image Main Display Refresh Rate section controls the approximate display refresh rate that the image is updated. The slider bar can be used to speed up or slow down the display rate. Note that the fastest rate possible is dependent upon computer and video card performance. The Display Rate check box enables and displays the refresh rate on the main panel of RDac.

Image Orientation (Invert/Revert) allows the rows and/or columns of an image to be swapped or reversed in both the real-time image display and the data collection disk write.

Global ROI switches allow whether names, center crosshairs, and/or min and max crosshairs are visible on the display window.

Global Plot pixel sizes are defined here. Note that each plot's pixel size can be controlled via a right click accessed window on the plotting surface.

User palettes are supported when a false color or other palette gradient is desired over the default gray-scale built into RDac. Each of thes palettes can be reversed/inverted by selecting the “Invert” box. All contrast/brightness options are supported with any user palette in both the real-time and playback display. New palettes can be created in RView using the gradient palette option.

The startup splash screen can be enabled/disabled with the Show Splash option.

Simultaneous playback can be shown while the real time display is being refreshed. Note there will be performance degradation for both operations.

The FLIR Veneer visual theme can be disabled in RDac with this switch. Restarting RDac is required whenever the stat is changed for the desired operation to go into effect.

5.1.3.4 File Naming Options

This panel contains options for determining the file-naming template for collected data sets. Following is a detailed description of each feature.

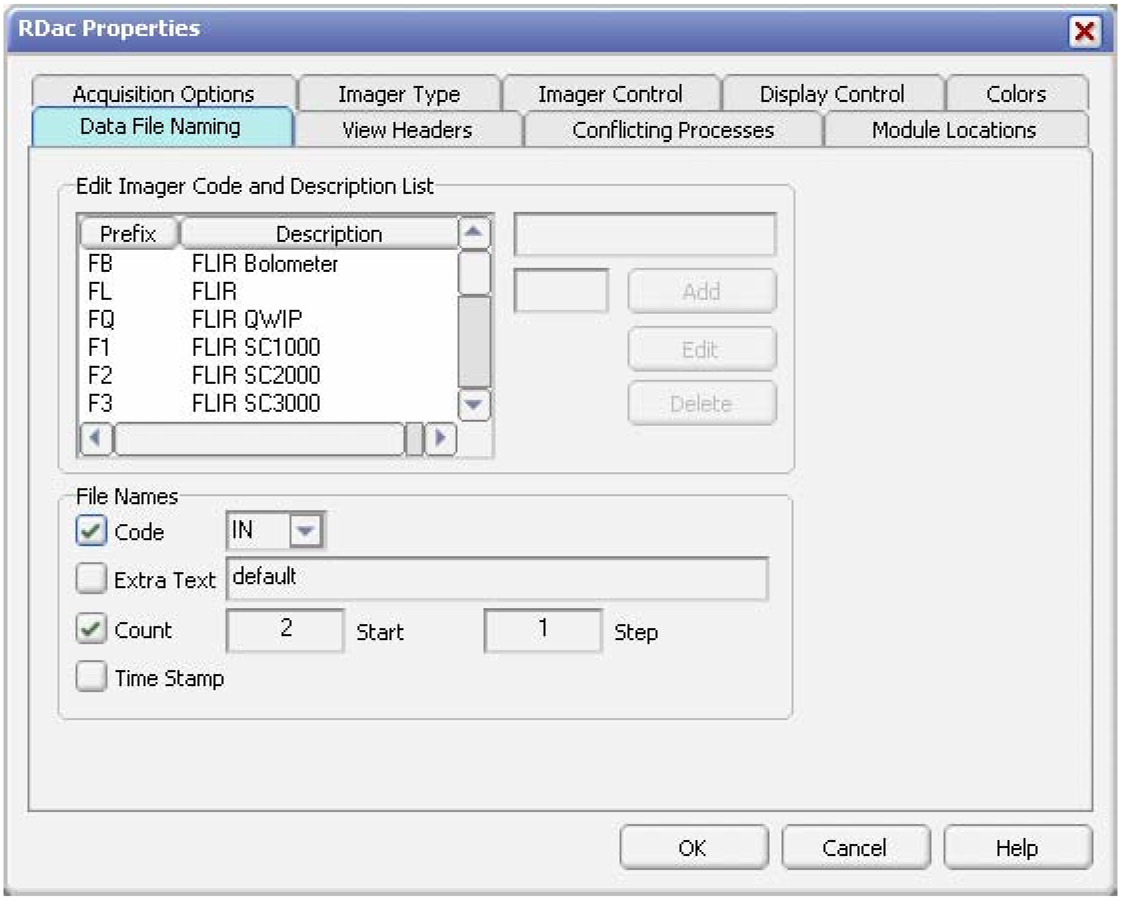


Figure 16 – File naming options property page

The Edit Imager Code and Description List area allows the user to create, edit or delete new two character camera codes and associated descriptions. To add a camera code, type in a description in the top edit box, a two-character code in the smaller edit box and press the 'Add' button. To edit a code, highlight a code in the list box on the upper left corner, modify to taste and select the 'Edit' button. To delete a code, highlight the desired code and press the 'Delete' button.

File Names defines the data set base name format. Each field is optionally selected by checking the appropriate box. The Code is a two-character code descriptor for an imager. Extra Text can be any user defined text string. Count is a sequential increment value used to give data sets successive number IDs. The count can be controlled by the start and step values. Start is the first number in a series and step is the increment value. Time Stamp uses the first IRIG time in a data collection as part of the base name. If no file naming options are selected, the default base name is 'default_file.'

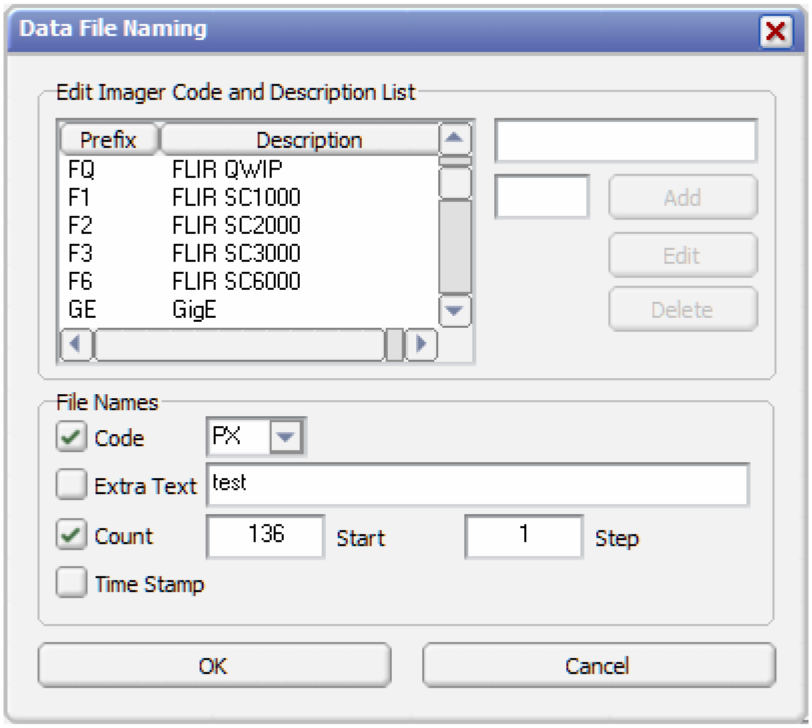


Figure 17 – File naming options from main menu

The 'Data File Naming' dialog is directly accessible from the main panel menu of RDac. All functionality is the same as its corresponding properties page.

5.1.3.5 Processes Options

This panel contains options for setting up a list of processes that may conflict with proper operation of RDac. Following is a detailed description of each feature.

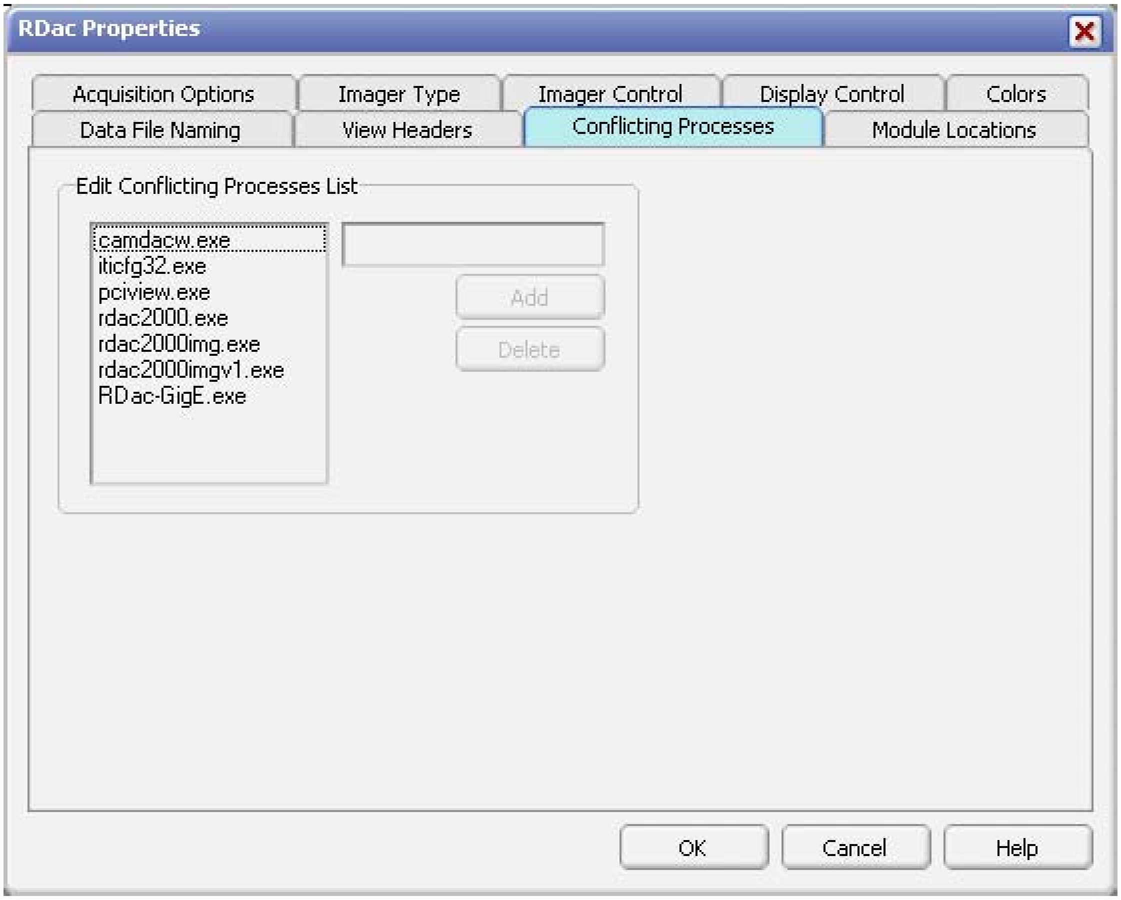


Figure 18 – Conflicting processes setup

The Edit Conflicting Processes List allows the user to add or delete processes that can conflict with RDac operation. On startup, RDac checks for the existence of each of these processes and, if found, exits with a warning message. To add a process, type in the name with extension and press the 'Add' button. To delete a process from the list, highlight the process and press the 'Delete' button.

Note: Because of its real-time nature, RDac consumes a significant amount of the computer's memory and processing resources. It is strongly recommended that as many other processes as possible be shut down during RDac operation.

5.1.3.6 View Headers Options

This panel contains a window and toggles to display the various core data headers for a data set. Following is a detailed description of each feature.

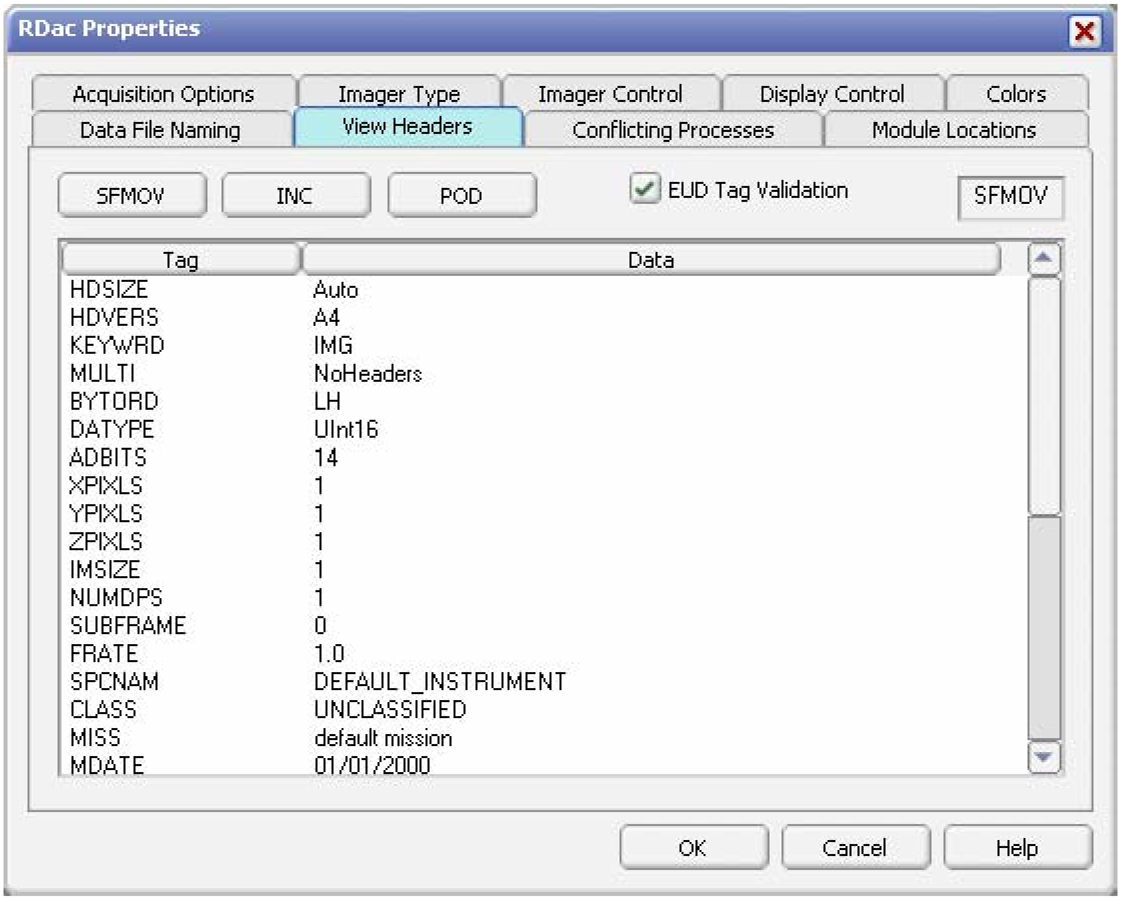


Figure 19 – View core data headers

The View Headers property page allows the user to view the three main SAF data file headers. Press the desired button to view the movie header, the include header and the pod file header. The SAF data file headers cannot be directly edited with RDac. The user should use REdit to edit SAF headers.

5.1.3.7 Collection Options

This panel contains the various collection modes and options relating to data acquisition and storage. Following is a detailed description of each feature.

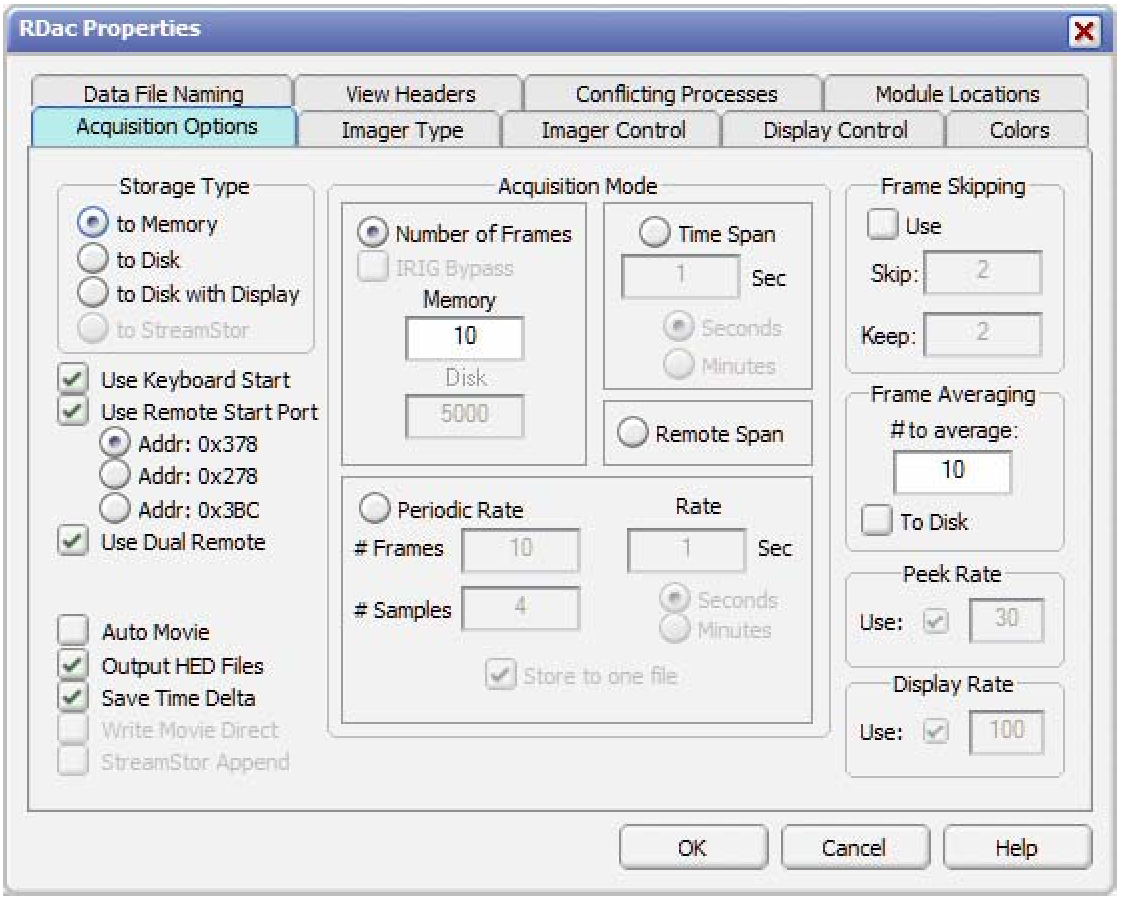
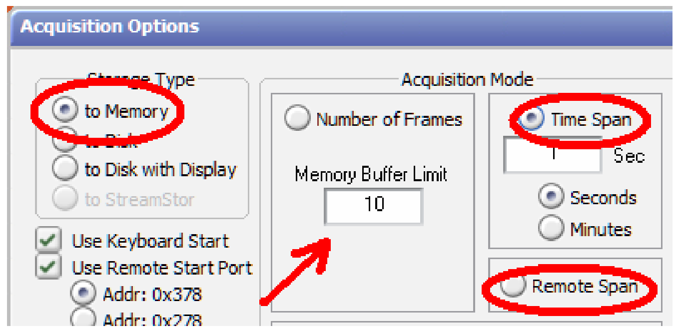


Figure 20 – Various collection modes and options property page

The Storage Type area selects the primary temporary storage location for data acquisition. To Memory uses physical ram to store the collection. Note that Number of Frames is the only collection mode available with this storage type. To Disk temporarily stores data to disk. This option and the next option are highly dependent on system optimization and hard drive speed. High speed, high bandwidth SCSI hard drives are highly recommended. The To Disk with Display writes data directly to disk with a periodic screen refresh. This mode is useful for excessively long collections where obtaining every frame is less important than a real-time screen display update. To StreamStor is a special collection mode that allows data collection to a StreamStor device. Note that a StreamStor device must be installed and properly configured for this option to be available.

The Acquisition Mode area selects the type of collection performed. Number of Frames allows the user to select the specific number of frames to acquire. Note that two different values are maintained: Memory is the number to collect in memory and Disk is the number of frames to collect to non-memory devices. Time Span allows a specified time span of data to be collected regardless of number of frames or frame rate. The time span can be specified in either seconds or minutes. Remote Span allows the collection to be controlled via a remote trigger. As long as the trigger is engaged, RDac will continue to collect and store data. Periodic Rate allows the collection of periodic subgroups or bursts of data over an extended period of time. To use, specify the number of frames to collect per period, specify the interval to collect each subset in either seconds or minutes, and finally specify the number of subsets of data to collect to span the overall time period. Select the Store to one file box to store all periodic rate acquisitions to one file.

To memory mode allows the user to acquire data via the time span, remote span and periodic rate modes for the highest possible frame rates. When not in number of frames mode the value of Memory Buffer Limit is used to determine how many buffers can be acquired in the other acquisition modes. When an acquisition occurs either the time span/remote span/periodic rat or the buffer limit will determine the end of the acquisition – which ever ending condition occurs first.



Frame Skipping allows the collection to skip X number of frames and keep Y number of frames collected. The Use box must be checked to use this feature.

Frame Averaging allows a sliding window average to be applied to the data collected. This can be demonstrated in the main toolbar average button. The window can be varied from 2 to 30 in size. To apply averaging to data collections, check the To Disk box.

Use Keyboard Start enables/disables the ability to start an acquisition using the keyboard and mouse.

Use Remote Start Port enables/disables the ability to trigger off the printer port interface. Figure 23 describes the parallel port interface trigger adapter. Note that this trigger interface operates on a switch closure type of trigger. Warning: Any voltage applied to the BNC connector of the trigger adapter will result in damage to the printer port and possibly the computer motherboard.

Note that there are 3 options for the printer port address. 0x378 is traditionally assigned to printer port on and is the most commonly used port on a PC. 0x278 is traditionally assigned to printer port 2 and may be available on some PCs. 03BC is an alternate address that can be found on many laptops such as those made by IBM and Dell. If the remote start fails to trigger, first check all physical connections. Next try each of these address settings. If the trigger still is not being recognized please check that the printer port is functional as a printer port.

Use Dual Remote activates the dual remote start trigger/gate mode. This mode allows the user to acquire multiple acquisitions to a single file in number of frames, time span and remote span modes.

When Auto Movie is activated, the playback window is automatically opened with the last data collection set after a triggered collection has been completed. See the 'Image Movie Playback' section for additional information on movie playback within RDac.

Output HED Files creates an information file that contains a copy of all the header information that is embedded in the sfmov file in an ASCII text readable format. The file extension will be 'hed.'

Save time delta saves the delta between two frames. It creates a column of delta time per frame in the pod file.

The Write movie direct switch is a performance option which allows the direct writing of data to disk without the use of an intermediate file. This can result in a very fast turn-around for long disk collections. *Note that not all camera type and modes are supported and this option will be disabled for those camera types and modes. Note that using the RDac Invert/Revert switches will disable this option. When reversal of the rows and/or columns of a camera is desired, use the native camera controller settings if available. Note that due to a bug in the Matrox Meteor, 14 bit cameras are not supported (Phoenix RDas is an exception). Special grounding requirements in the frame-grabber cable must be performed for bits 15 & 16. See Customer Services for additional information.*

StreamStor Append is used to allow multiple data collections to be maintained on a StreamStor device. For each collection on a StreamStor device, an sslog file is generated so that later offloading and conversion to a standard file format can be accomplished.

Following is a short explanation of the comma delimited sslog file:

- **record number - int - a simple counter**
- **camera type - key word - this will reflect the camera type selected in the Camera Specific page**
- **hed name - file name - the header for our movie file format**
- **inc name - file name - the include file**
- **use norms - boolean - TRUE or FALSE, TRUE if you are using the RDac Normalization**
- **scg name - file name - either the norm gain file or NULL**
- **sco name - file name - either the norm offset file or NULL**
- **sbp name - file name - either the norm bad pixel file or NULL**
- **irg name - file name for the IRIG times**
- **ss start - int 64 - the StreamStor starting address for the data set**
- **ss size - int 64 - the StreamStor size for the data set**

The Write Movie From Raw is used primarily in StreamStor mode to enable/disable writing a SAF movie file from the StreamStor device directly after acquisition.

The Save Raw File and Temporary Folder options are not implemented yet.

The Peek Rate is a value that determines how often the collection loop checks for a keyboard abort. The value is defined as the number of frames of data to collect before looking for an abort.

The Display Rate is a value that determines how often the collection loop displays a frame of data to the screen. The value is defined as the number of frames of data to collect between frame displays to the screen. This option is only valid when the storage type is set to: to Disk with Display.

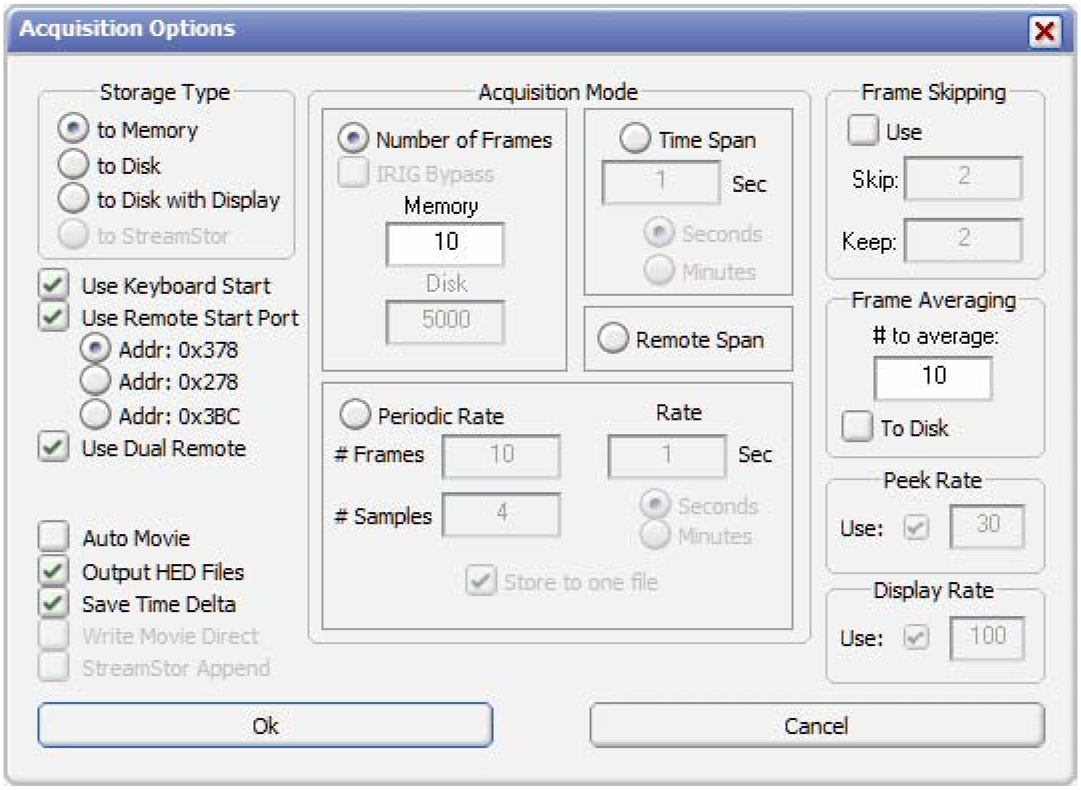


Figure 21 – Various collection modes and options from main menu

The 'Acquisition Options' dialog is directly accessible from the main panel menu of RDac. All functionality is the same as its corresponding properties page.

Following is a diagram for the parallel port adapter used for a switch closure (**NO VOLTAGE**) single style of trigger.

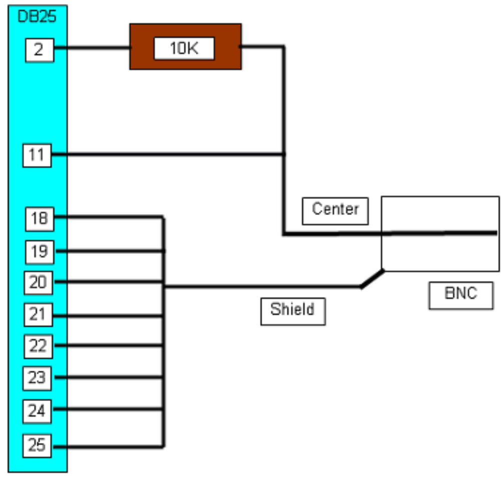


Figure 22 – Parallel port interface for remote trigger

Following is a diagram for the parallel port adapter used for a switch closure (**NO VOLTAGE**) dual style of trigger. Note that this trigger can be used in the same way as the single trigger style via the "Trigger" BNC.

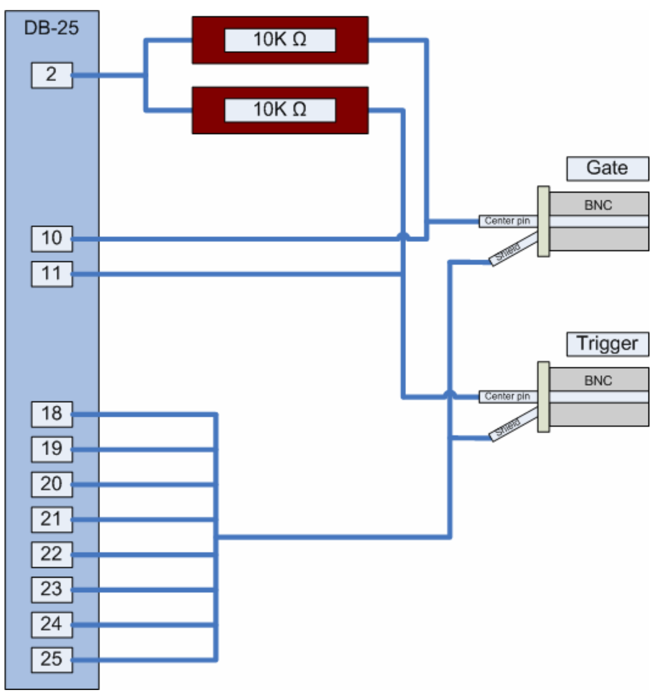


Figure 23 – Parallel port interface for dual remote trigger

5.1.3.8 Module Location Options

This panel is used to specify the various paths for spawning other modules from RDac. Following is a detailed description of each feature.

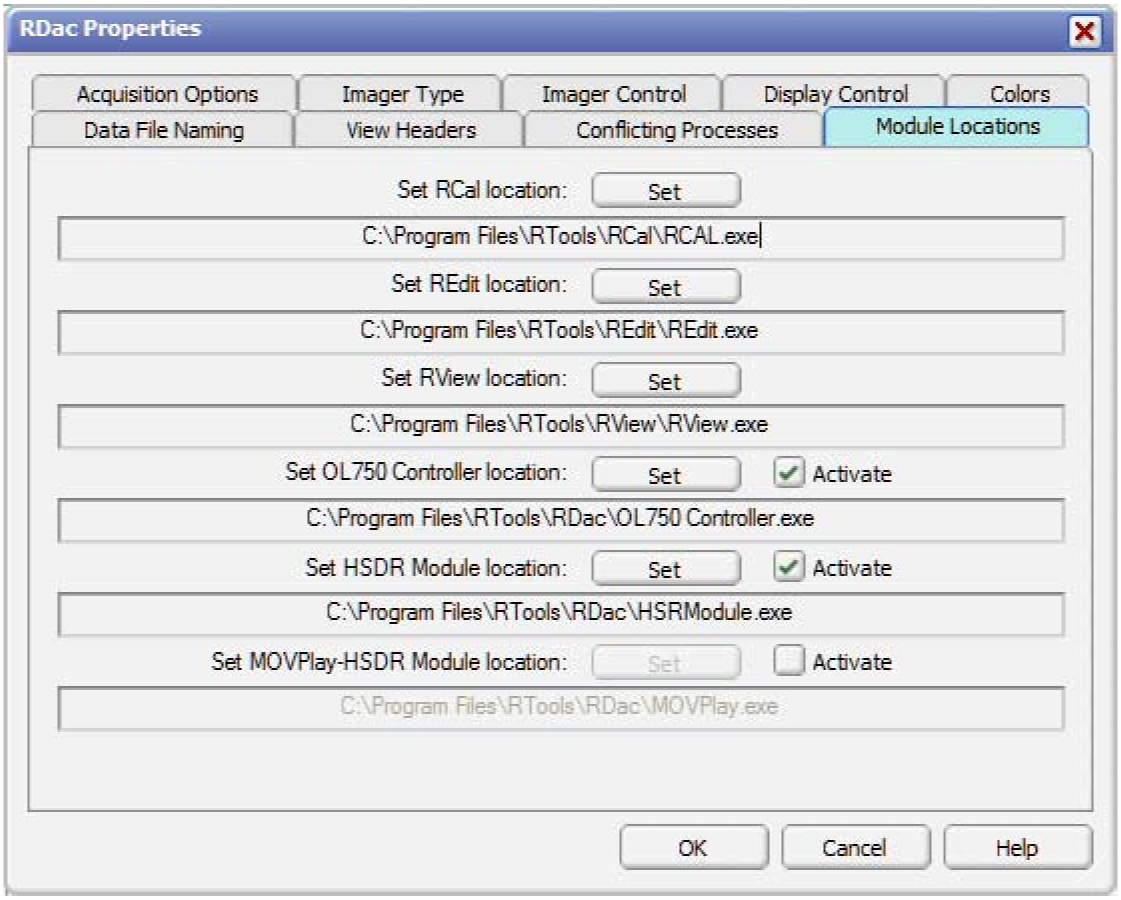


Figure 24 – Various collection modes and options

The ‘Set RCal location’ specifies the location of the RCal module used to derive calibration coefficients. When set, the RCal toolbar button will launch RCal. See the RCal module manual for a detailed discussion of its functions.

The ‘Set REdit location’ specifies the location of the REdit module used to edit, modify and/or maintain header tag information. When set, the REdit toolbar button will launch REdit. See the REdit module manual for a detailed discussion of its functions.

The ‘Set RView location’ specifies the location of the RView module used to analyze collected data sets. When set, the RView toolbar button will launch RView. See the RView module manual for a detailed discussion of its functions.

The ‘Set OL750 Controller location’ specifies the location of the controller module developed for the optional spectral response system from Optronic Laboratories. When set, the OL750 toolbar button will launch the OL750 controller. See the OL750 controller module manual for a detailed discussion of its functions. The Activate switch enables/disables the OL750 toolbar button.

The ‘Set HSDR Module location’ specifies the location of the HSDR module used for the high speed digital recorder option. When set, the HSDR toolbar button will launch the HSDR module. See the next section for a detailed discussion of its functions. The Activate switch enables/disables the HSDR toolbar button. Note that normally this field is configured by the RTools HSDR installation process and the user should not have to set this module up.

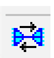
The ‘Set MOVPlay-HSDR Module location’ specifies the location of the MOVPlay-HSDR module used by the HSDR module for data display and processing of HSDR recorded data. When set, the Playback button in the HSDR module will launch the MOVPlay-HSDR module. See the MOVPlay-HSDR user’s manual for a detailed discussion of its functions. The Activate switch enables/disables the HSDR toolbar button. Note that normally this field is configured by the RTools HSDR installation process and the user should not have to set this module up.

5.2 Top Tool Bar Description

The toolbar consists of the most common controls to use during image monitoring, calibration and acquisition.

Figure 25 – Main toolbar controls

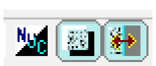
Following is a short description of each toolbar button's assigned command. See the detailed description later in this section for additional information on each command.



Activate imager control module: The imager can be setup via its corresponding control module. This option will be disabled if no control module is required or not setup in the properties section of RDac.

Toggle a Phoenix camera in and out of Preset Sequencing (Suberframe) mode.

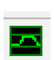
Preset Sequencing/Super-frame sub-frame selectors: 0, 1, 2, and 3 select the appropriate preset/sub-frame to display; 'All' displays all presets/sub-frames as they occur. These buttons are only enabled when RDac is configured for a multi-integration imager setup in Phoenix or Super-frame mode in the properties section.



Normalization functions: The 'NUC' button brings up the normalization setup dialog. The other two buttons allow toggling off and on the normalization and bad pixel correction. These buttons are disabled if the use norm features switch is turned off under the 'Camera Type' tab of the Properties section.

Toggle min/max range display: Show pixels outside the min/max range – blue for clipping and red for saturation. The ranges are setup under the 'Display Control Options' tab within the Property section.

Select current Display mode: Either display the image or display the average image.



Open an oscilloscope plot window for the imager or active ROI.

Open a histogram plot window for the imager or active ROI.

Open a line profile plot window for an active ROI.

Show statistics window: This is used with ROI commands to display various statistical information describing the region of interest. This can be used for both calibration and real-time data reporting.

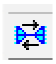
Movie file playback: This allows the playback of any previously collected data set.

Arrange all windows in a tiled format.

Close all windows except the primary display window.

Module spawning. These are used to launch RCal, RView, REdit , the OL750 controller module and the HSDR module.

5.2.1 Imager Controller Module



The imager controller module command allows easy access to an imager specific control program. Following are several examples of imager specific modules:

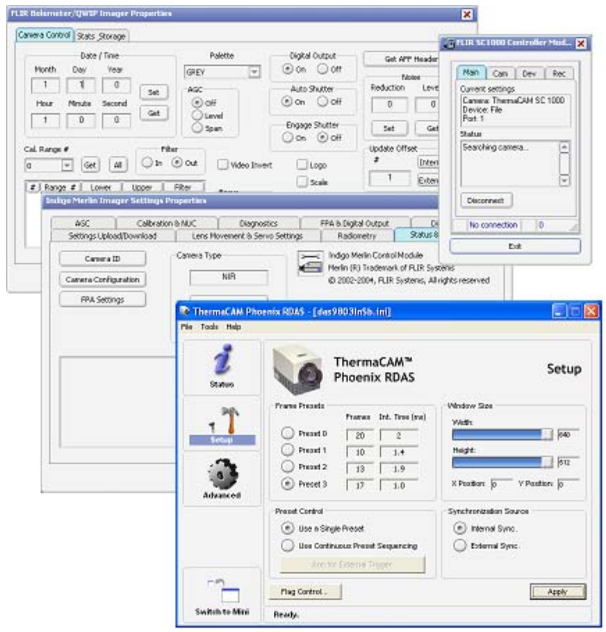


Figure 26 – Example imager controller modules

If configured and enabled, the controller button will spawn the Controller Module and allow real-time imager adjustments such as integration time selection, offset control and any other imager specific commands. Configuration and setup of the appropriate imager controller module is accomplished under the 'Camera Type' tab in the properties section. If the save camera information option is selected under the 'Camera Type' tab in the properties section, various important imager settings are saved into each data collection set. This is only true if a camera has an external settings module. Generally, any RTools or third party camera control module can be configured. Note that the camera control module should not access the frame-grabber directly. Also note that some cameras on initial power-up may need initialization by a camera control module before the camera data can be properly acquired using RDac. Check the specific controller module or camera manual for details.

5.2.2 Preset Sequencing/Super-frame Selectors

The preset/super-frame selectors allow the user to quickly step through and display each preset/sub-frame of an imager that has been setup to use preset sequencing/super-frame mode.

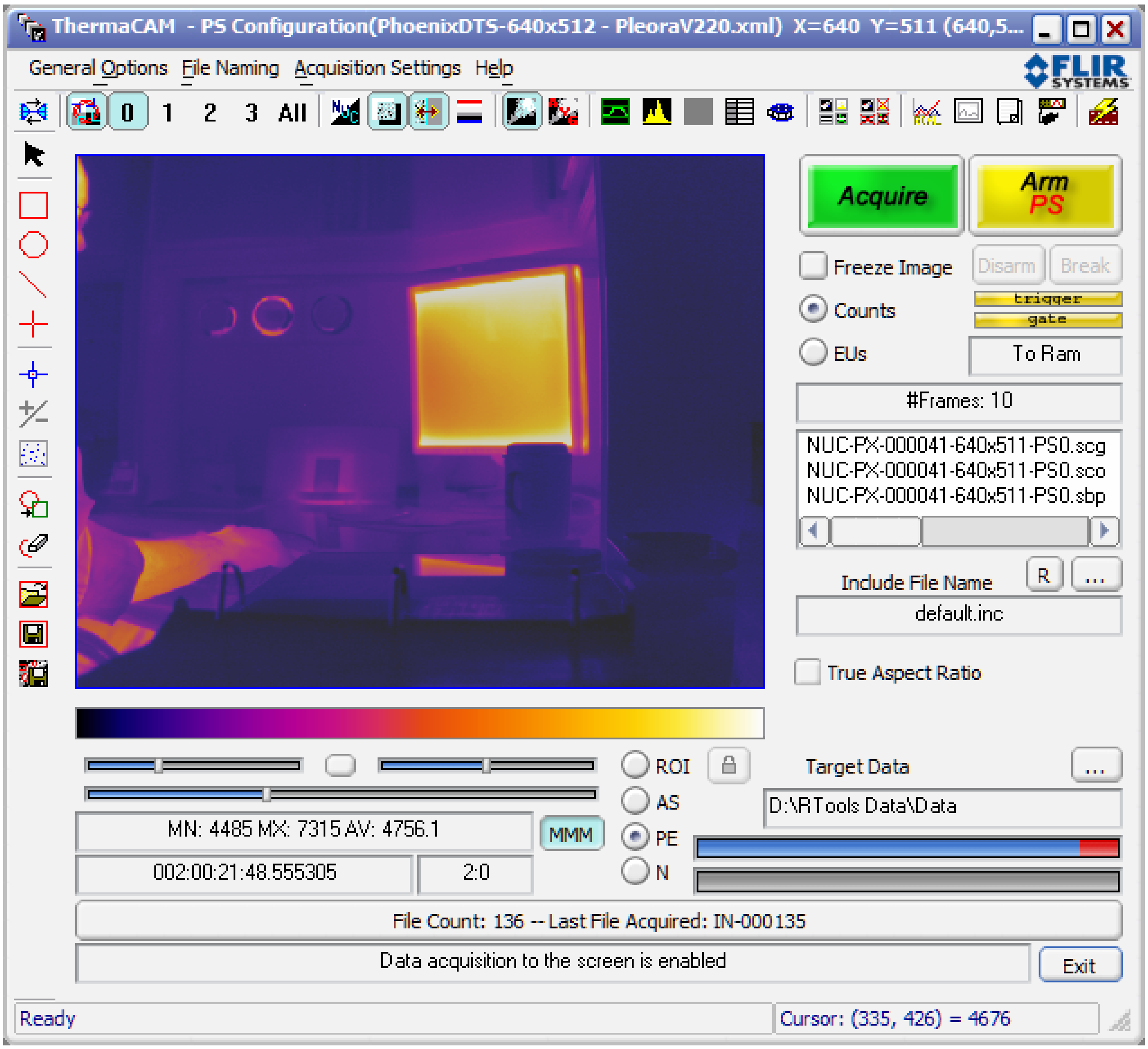


Figure 27 – Preset sequencing/super-frame selectors

Note that when performing normalization on a preset/sub-frame, the desired preset/sub-frame must be active in the display. Another useful mode is to select all ‘All’ and display the oscilloscope mode when setting up an imager’s video offsets, global gains and integration times while using the camera specific controller module.

5.2.3 Perform Non-uniformity Correction (NUC)

The NUC command (the GOB button) brings up the following dialog. This is the setup window for performing, adjusting and selecting non-uniformity corrections. Note that the terms normalization, non-uniformity correction and NUC are used interchangeably here. The purpose is to correct the imager field to respond equally across the plane with minimal artifacts and maximum uniformity.

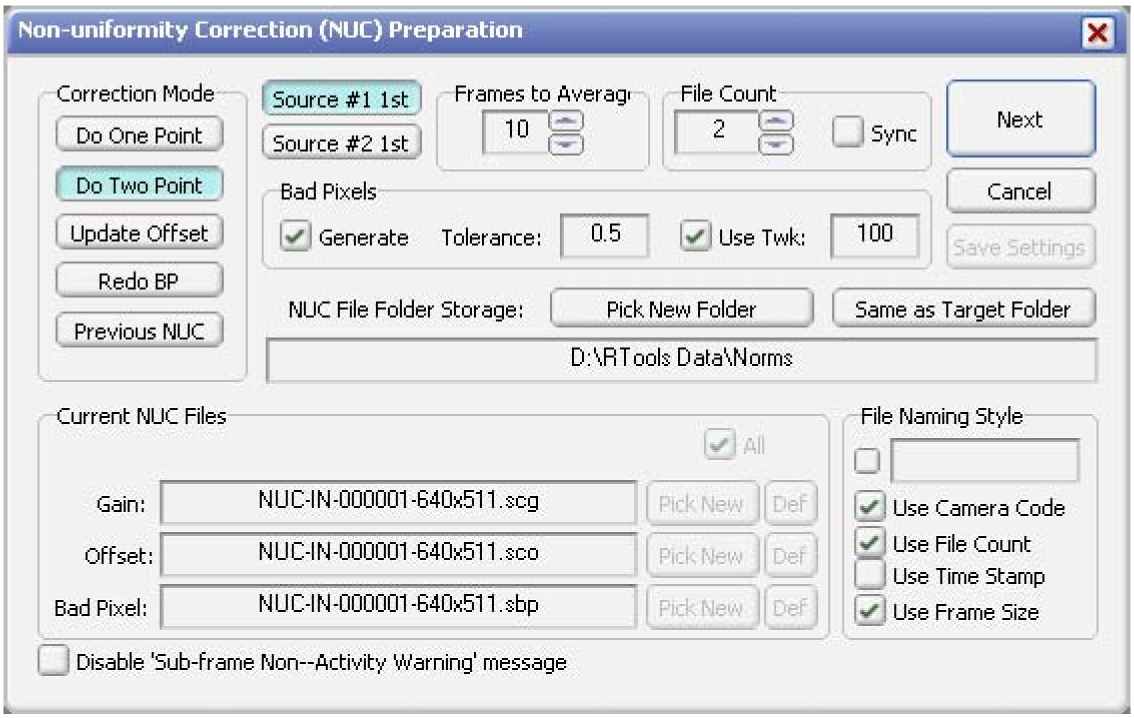
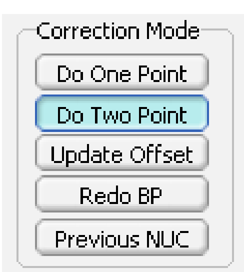


Figure 28 – Main NUC dialog

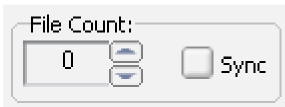


Several different NUC techniques are supported in RDac. 1-point corrections are desirable as a ‘quick and dirty’ image cleanup when there is little gain error and very few bad pixels. Note that a gain of one is used and no bad pixel correction is performed. Two-point correction is the most precise NUC technique but requires two different uniform sources at two different temperatures. This is the baseline operation for doing bad pixel correction. Update offset correction is used when a good two-point has been performed and the pixel offsets have drifted while the pixel gains have held stable. The original bad pixel correction is carried forward from the original two-point. Redo bad pixel correction is used when the NUC is acceptable but not all bad pixels have been found. This only redoes the bad pixel correction based on the calculations from the existing NUC. No new data is acquired. Previous NUC is used to load a previous NUC file set or individual gain, offset or bad pixel files.

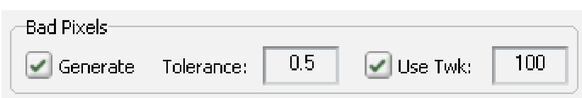
No new data is acquired in this operation.

The source #1/Source #2 1st selector allows the user to select what source is prompted for first during the two-point NUC process.

The frames to average control determines the number of frames to acquire and average for NUC calculations. This number does not affect the data collection mode being used by the RDac main user interface.

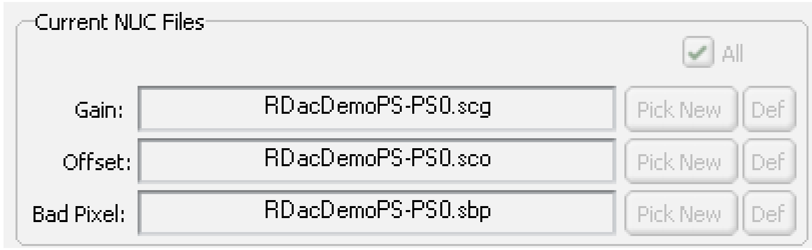


The file count is the sequential number used in the file naming style for the NUC file set. The sync switch allows this number to be automatically synchronized with the main data file name number sequence.

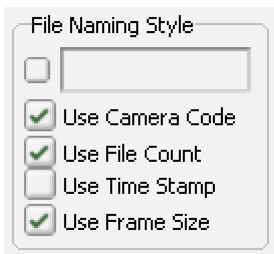


Bad pixel tolerance is a value used in the determination of bad pixels based on slope change. Adjust this number as needed to remove desired bad pixels and use the Redo BP option to check the results. Valid values are greater than 0.0 and less than 2.0. The Use Twk: or twinkler option allows the user to attempt to trap pixels which vary rapidly on response. The value entered is the maximum count level that a pixel can vary over the NUC acquisition process before an average value is determined. The Generate bad pixel switch allows the user to either force a new bad pixel map to be created or allow the user to keep a previous bp map. Note that the edit bad pixel mask functions available on the main display are still allowed. Typically after a bad pixel map is generated and later edited through the bp mask editing process, the user would turn off the generate switch to preserve the bp map through later two-point NUCs.

The NUC file storage folder is displayed in the above window. A new or different folder can be selected using the ‘Pick New’ button. The NUC folder can also be changed to the target data storage folder on the RDac front panel by pressing the ‘Same as Target’ button.



The current gain, offset and bad pixel correction files are displayed in this area of the dialog window. When the previous NUC mode is selected, the button controls are activated so that previously acquired individual gain, offset, or bad pixel files can be selected. Also, any of these can be set to the default file. For the default gain file, each pixel gain is 1.0. For the default offset file, each pixel offset is 0.0. And for the default bad pixel file, each pixel is assumed as good. By selecting the all switch, if a pick new button is selected, a complete gain, offset, bad pixel file set is loaded all at once.



These switches control the naming of the normalization files' base names. The top switch allows user defined text to be in the file name. The camera code switch uses the code selected under the 'File Naming' tab in the properties area. Use file count adds the sequential file count described earlier. Use Time inserts the monitored and acquired time sample of the normalization collection average. Use frame size adds the imager's x and y frame dimensions.

Enables/disables the no sub-frame found warning message used to avoid trying to NUC a non-existent sub-frame.

These buttons control the next step in the normalization process. The 'Next' button will go to the next step. 'Cancel' exits the normalization process. 'Save Settings' saves the current state and settings in this dialog so that the next execution of this dialog will have those settings. The 'Save Settings' button will be active when a settings change occurs

5.2.3.1 NUC Storage Folder

The NUC folder storage selector is used to choose where to store normalization files that will be later duplicated with each data collection set.

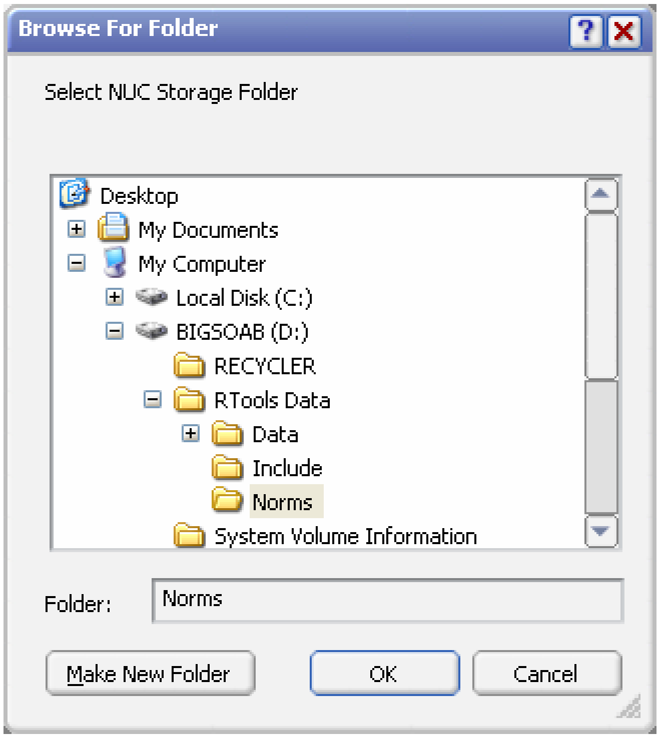


Figure 29 – NUC storage folder selector

To use, select the 'Pick New' button located above the NUC storage folder window. Locate or create the desired folder and press 'OK' to change.

5.2.3.2 Perform 1-Point Correction

To perform a one-point correction, the user should have a uniform source that is at the lower end of the imager's A/D band or desired measurement range. A lens cap can serve the same purpose if nothing else is available. Press the 'Next' button and the following message box will appear. Place the source directly in front of the imager optics – ensuring that the complete field of view is filled uniformly. Note that the user can toggle between the various display modes while in this message box. When ready, press the 'Acquire' button. Tip: It is recommended that the imager's focus be set to infinity during the normalization process.

Figure 30 – Source prompt

After collection is complete, the one point correction will be temporarily applied to the image for review and the following message box will be displayed. Answer as appropriate. If 'Accept' is pressed, this will make the one point correction the new default NUC to use for display and data collection. If 'Abort' is pressed, the previous NUC will be restored.

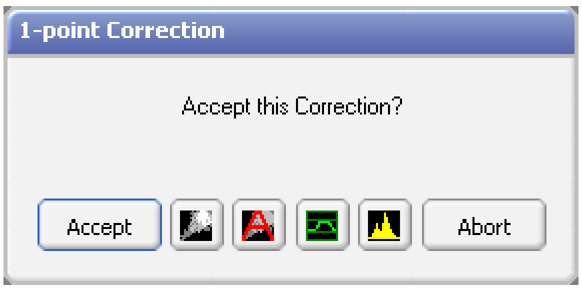


Figure 31 – One point correction acceptance prompt

Upon completion, RDac will resume in the mode prior to NUC but with the normalize display and apply bad pixel correction commands applied.

5.2.3.3 Perform 2-Point Correction

To perform a two-point correction, the user should have a uniform source that is at the lower end of the imager's A/D band or desired measurement range. A lens cap can serve the same purpose if nothing else is available. Also, the user will need a uniform source which is at the upper end of the imager's A/D band or desired measurement range. A hot plate will do if nothing else is available. Press the 'Next' button and the following message box will appear. Place the 1st source directly in front of the imager optics – ensuring that the complete field of view is filled uniformly. Note that the user can toggle between the various display modes while in this message box. When ready, press the 'Acquire' button. Tip: It is recommended that the imager's focus be set to infinity during the normalization process

Figure 32 – 1st source prompt

Press the 'Next' button and the following message box will appear. Place the 2nd source directly in front of the imager optics – ensuring that the complete field of view is filled uniformly. Note that the user can toggle between the various display modes while in this message box. When ready, press the 'Acquire' button.

Figure 33 – 2nd source prompt

After collection is complete, the two-point correction will be temporarily applied to the image for review and the following message box will be displayed. Answer as appropriate. If 'Accept' is pressed, this will make the two-point correction the new default NUC to use for display and data collection. If 'Abort' is pressed, the previous NUC will be restored.

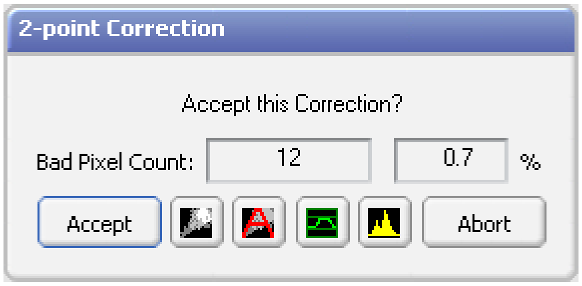


Figure 34 – Two-point correction acceptance prompt

Upon completion, RDac will resume in the mode prior to normalization but with the normalize display and apply bad pixel correction commands applied.

The bad pixel correction is applied in this way: For the overall image plane, if a bad pixel is found, the pixel directly above it is used to replace it. If the pixel is located on the top row, the pixel to its immediate left is used to replace it. If the pixel in the top-left corner of the image is determined as bad, the pixel to the right is used to replace it. Note that this bad pixel correction algorithm can be switched off and on with the 'Bad Pixel Command' button on the main toolbar of the main display.

5.2.3.4 Perform Offset Correction

To perform an offset correction, the user should have a uniform source that is at the lower end of the imager's A/D band or desired measurement range. A lens cap can serve the same purpose if nothing else is available. Press the 'Next' button and the following message box will appear. Place the source directly in front of the imager optics – ensuring that the complete field of view is filled uniformly. Note that the user can toggle between the various display modes while in this message box. When ready press the 'Acquire' button. Tip: It is recommended that the imager's focus be set to infinity during the normalization process

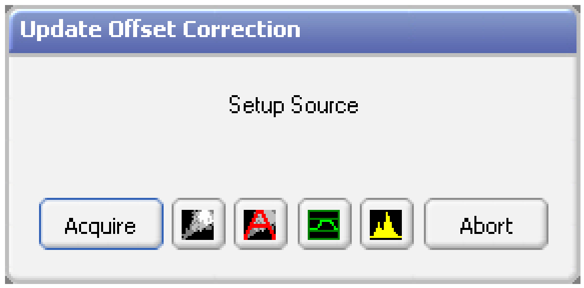


Figure 35 – Source prompt

After collection is complete, the offset correction will be temporarily applied to the image for review and the following message box will be displayed. Answer as appropriate. If 'Accept' is pressed, this will make the offset correction the new default NUC to use for display and data collection. If 'Abort' is pressed, the previous NUC will be restored.

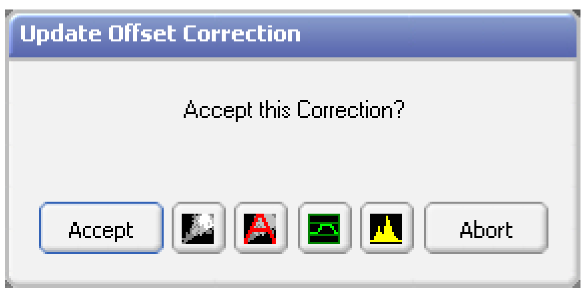


Figure 36 – Offset correction acceptance prompt

Upon completion, RDac will resume in the mode prior to normalization but with the normalize display and apply bad pixel correction commands applied.

5.2.3.5 Redo Bad Pixel Correction

Redo bad pixel correction allows the user to update the bad pixel correction of a current two point or offset correction without needing to perform a completely new normalization. Press 'Next' after adjusting the bad pixel tolerance to try a new calculation.

After recalculation is complete, the new bad pixel correction will be temporarily applied to the image for review and the following message box will be displayed. Answer as appropriate. If 'Accept' is pressed, this will fold the new bad pixel correction into the existing NUC to use for display and data collection. If 'Abort' is pressed, the previous bad pixel correction will be restored.

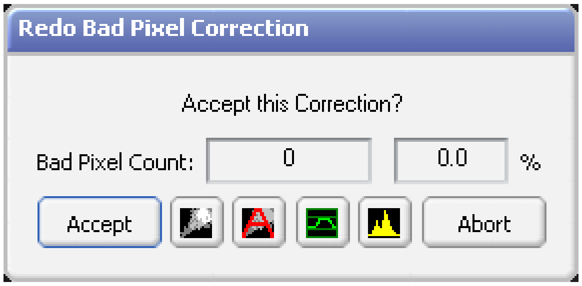


Figure 37 – Bad pixel correction acceptance prompt

Upon completion, RDac will resume in the mode prior to normalization but with the normalize display and apply bad pixel correction commands applied.

The bad pixel correction is applied in this way: For the overall image plane, if a bad pixel is found, the pixel directly above it is used to replace it. If the pixel is located on the top row, the pixel to its immediate left is used to replace it. If the pixel in the top-left corner of the image is determined as bad, the pixel to the right is used to replace it. Note that this bad pixel correction algorithm can be switched off and on with the 'Bad Pixel Command' button on the main toolbar of the main display.

5.2.3.6 Load Previous NUC

Select an existing camera gain file here. This will replace the current active NUC gain table after the 'Load' button is pressed.

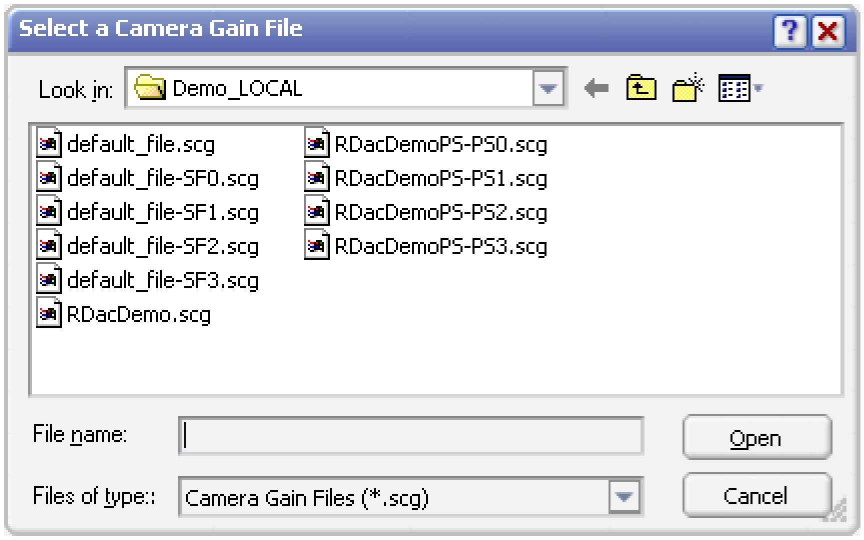


Figure 38 – Load existing camera gain file selector

Select an existing camera offset file here. This will replace the current active NUC offset table after the 'Load' button is pressed.

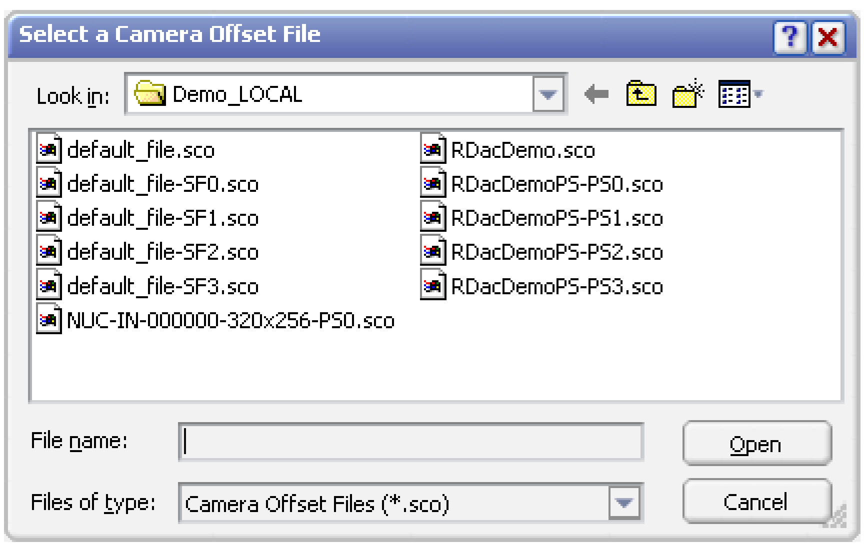


Figure 39 – Load existing camera offset file selector

Select an existing camera bad pixel file here. This will replace the current active NUC bad pixel table after the 'Load' button is pressed.

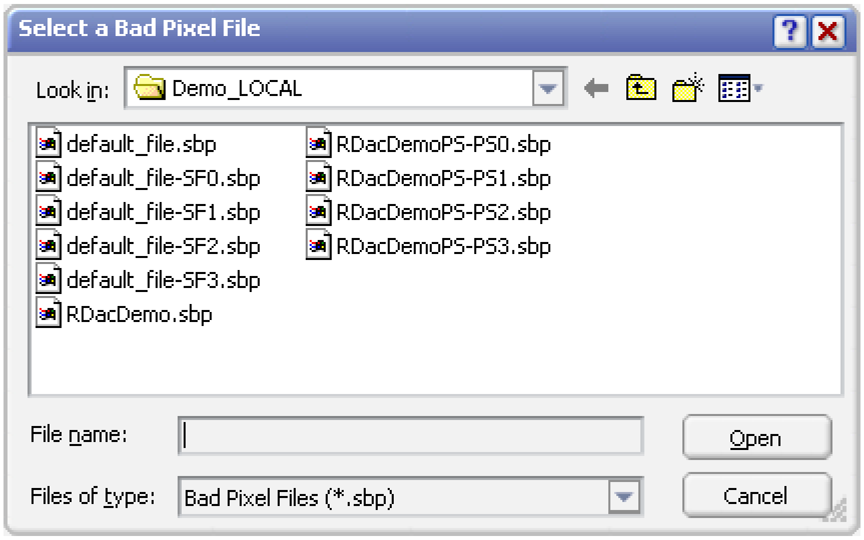
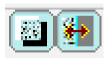


Figure 40 – Load existing camera bad pixel file selector

Upon loading, RDac will resume in the mode prior to normalization but with the normalize display and apply bad pixel correction commands applied.

5.2.4 NUC Selectors



The NUC selectors allow the user the ability to turn off and on the non-uniformity and bad pixel correction in the display.

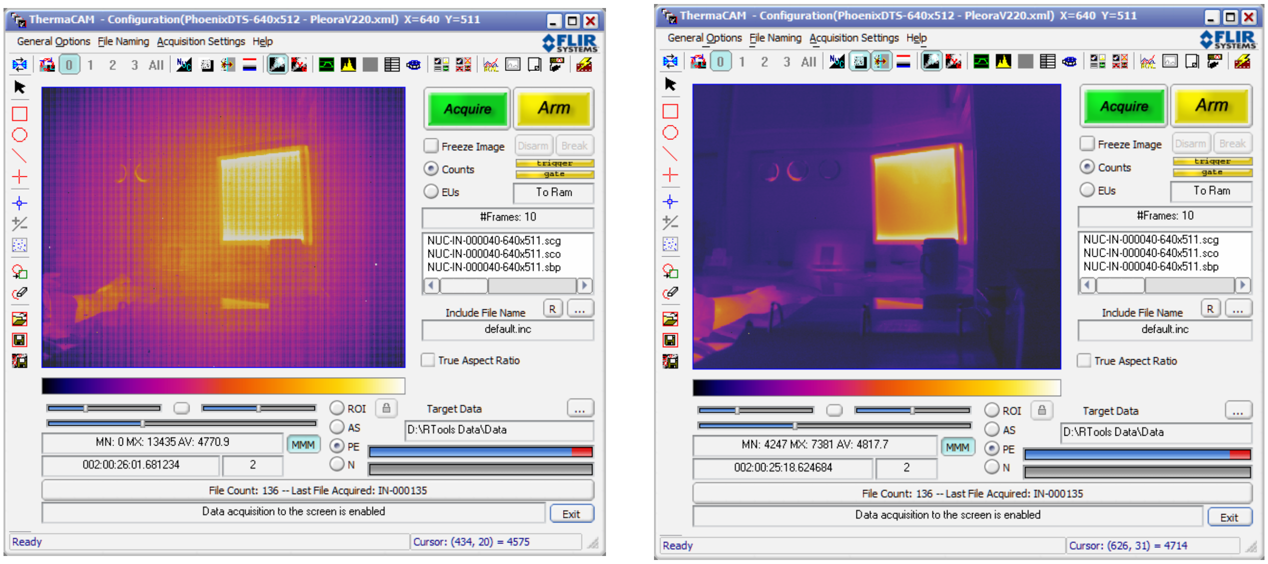


Figure 41 – Display normalization selectors (without NUC/with NUC)

The application of the bad pixel correction can only be toggled when the NUC button is active. Note that the state of these buttons does not affect the data collection process. The currently active NUC files will always be copied with any data collection performed and the appropriate associations will be performed automatically.

5.2.5 Image Display

This is the primary display mode for RDac. Most of the secondary display features and commands are active in this mode.

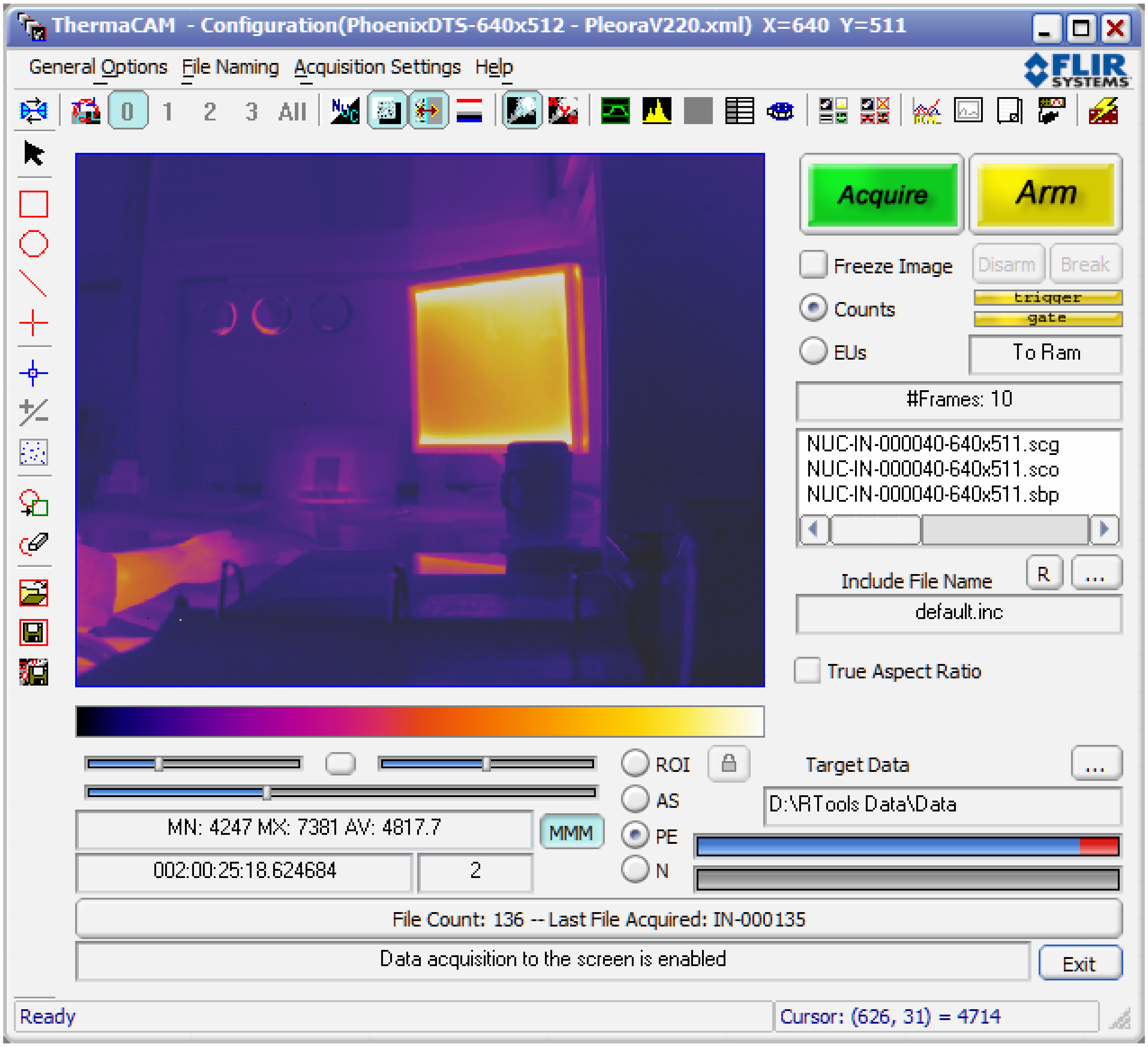


Figure 42 – Image display mode

The image display can be resized with a pull-tab located at the bottom-right corner of the window. Adjustable aspect rations can be set using this feature. A true image size can be selected at any time. Various contrast/brightness modes can be selected to supply a suitable display image.

5.2.6 Average Image Display

The average image display command has all the functionality and features as the display image command.

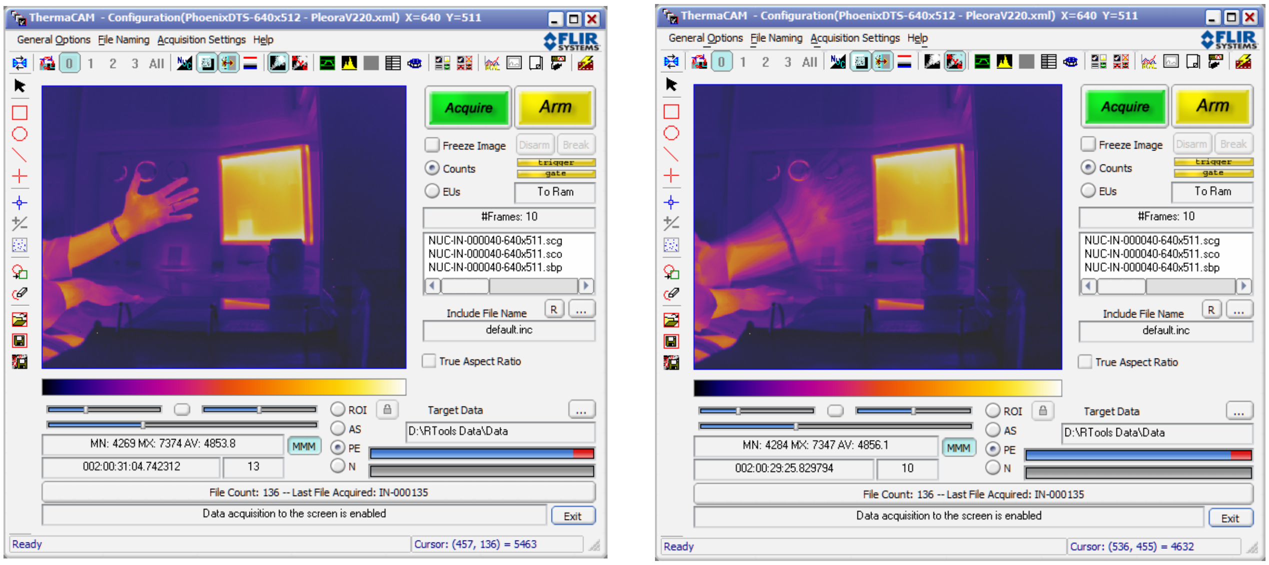


Figure 43 – Image average display mode

In addition, this display mode supports the use of a sliding window average that is controlled in the properties section. This mode is useful during calibration to generate a real-time mean value via an ROI for use in RCal calibration coefficients generation. Also, the higher signal to noise ratio can be used to generate a more refined 'quick look' answer in static measurements. Note the blurring of the image in the above figure.

5.2.7 Clipping and Saturation

This option allows the user to display a warning level for both saturation and clipping conditions.

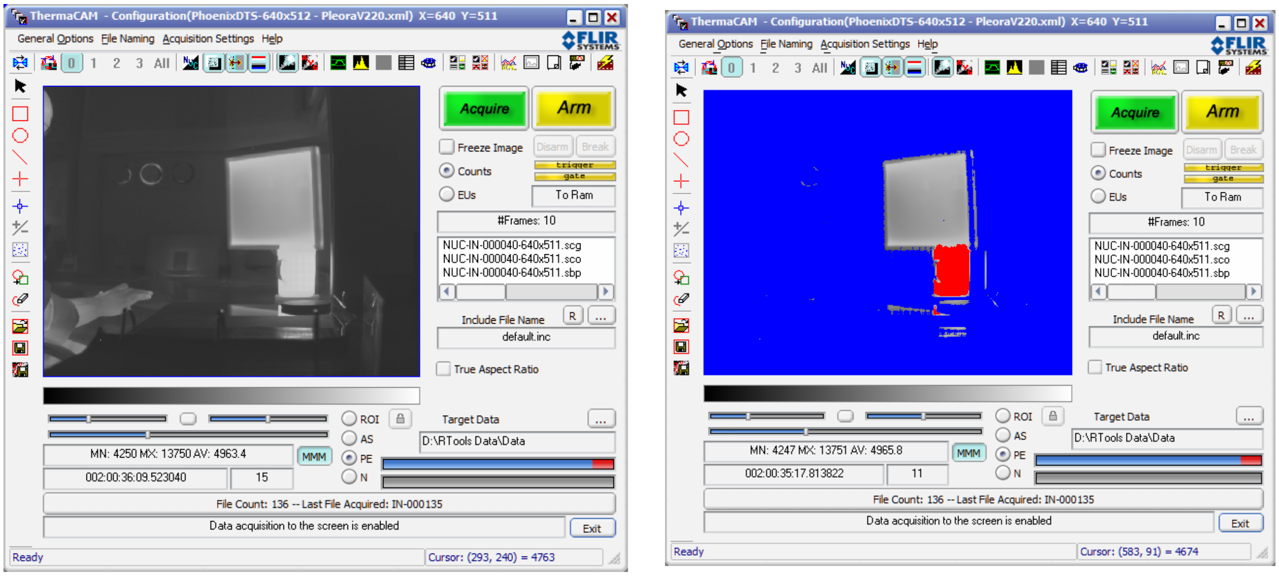


Figure 44 – Example of saturation and clipping display

To use this mode, the maximum and minimum range under the 'Display Control' tab in the Properties section must be set to values that can occur in the A/D of the imager. Blue signifies clipping and red signifies saturation. The trigger values can be set to greater than zero or less than the A/D width to allow the user to monitor the target and make sure that imager levels do not fall outside the desired range. One possible use would be if an imager is non-linear in the upper 10 percent of its range then the saturation level could be set at 90 percent of the A/D width.

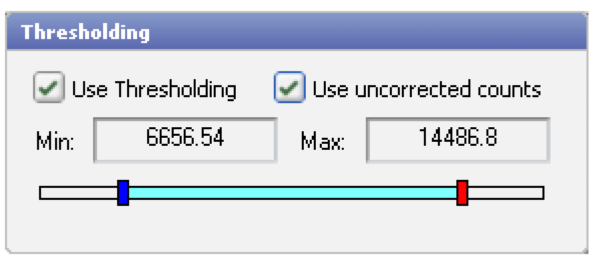


Figure 45 – Thresholding control

Use thresholding can be toggled off and on by the 'Use Thresholding' switch. The 'use uncorrected counts' switch allows the user to set a thresholding value that is true raw counts (no NUC) to determine known saturation and clipping levels (either A/D or focal plane). The min and max values for thresholding are controlled by either sliding the grabs on the cyan bar or typing in a value in the edit boxes. Note that the scale will switch between counts and engineering units based on the Counts/EUs man display control.

5.2.8 Plot Windows

Each of the plot windows has a common look, feel and functionality for display, color control, function control and zoom control.

By right-clicking on the active ROI, the following dialog will appear. The ROI name, position and whether it is visible can be defined here. Specific size and position coordinates can be defined. Also, an individual color for the ROI and name text can be selected.

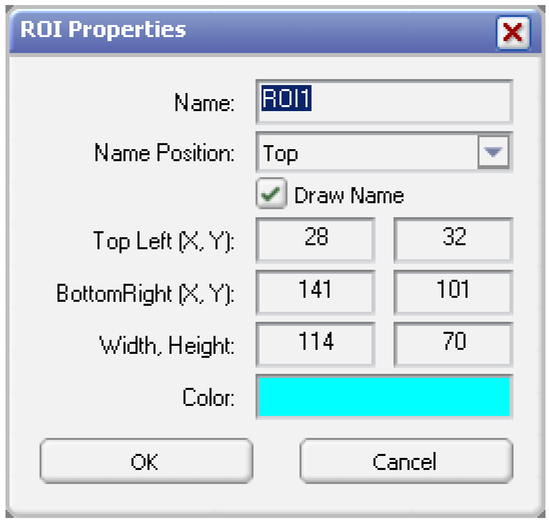


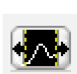
Figure 46 – ROI properties

Zooming options are represented by the following tool bar.

Figure 47 – Plot zooming toolbar

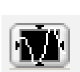
Reset zooming and panning.

Pan plot in x and y directions.



Box zoom in x direction.

Box zoom in y direction.

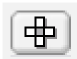


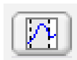
Box zoom in x and y directions.

Magnify in the x direction.

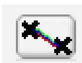
Magnify in the y direction.


Magnify in the x and y directions.


Cursor reading (use Plot properties/plot/cursor to display values


Range selection


Adjust data point. (Not in real-time)


Adjust range of data points. (Not in real-time)

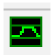

Lock y scale to a fixed position.

Print the plot window

Save a bitmap of the plot window

The properties of the plot can be selected/set by right-clicking on the plot surface. See the separate RDac Player Help or the RDac Player PDF file located in the RTools\docs folder for details.

5.2.8.1 Image Oscilloscope Display



The image oscilloscope display mode is a digital video representation of the imager plane looking edgewise with the pixel values plotted as amplitude.

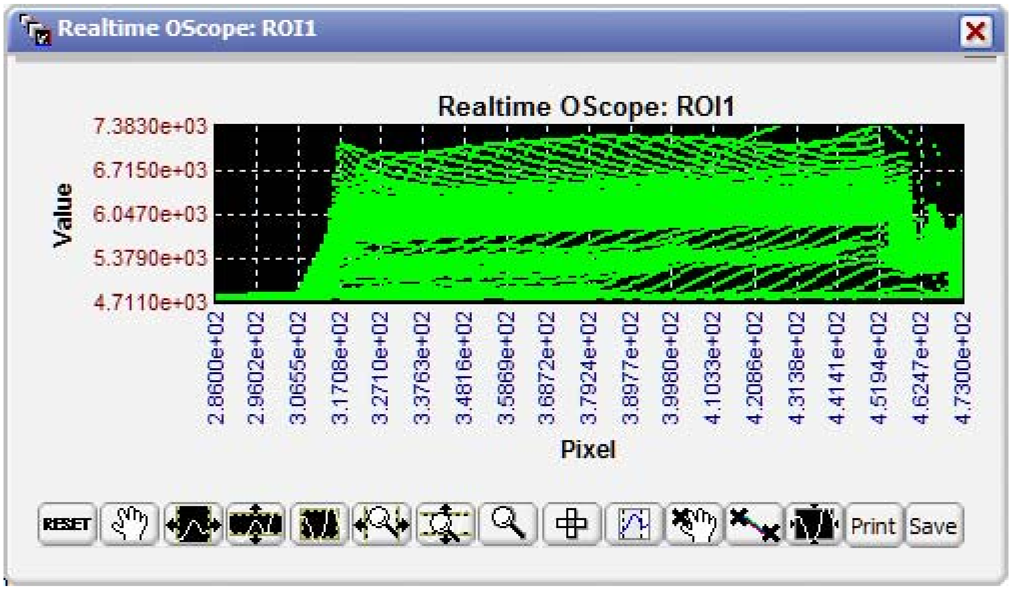


Figure 48 – Oscilloscope display mode

This mode is particularly useful in imager setup via the associated controller modules. Signal saturation and clipping can be quickly detected and corrected. Observing the slope of the signal can quickly set the imager focus when setting up on an aperture blackbody source. The default y-axis represents the A/D width of the imager. For example, a 14 bit imager would have a y-scale of 0-16383 or a 12 bit imager would have a y-scale of 0-4095. Zooming and rescaling of the plot is fully supported. Note that the y scale lock is only available in this style plot.

5.2.8.2 Image Histogram Display

The histogram display mode represents the number of pixels at each count level across the digital width of the imager's A/D module.

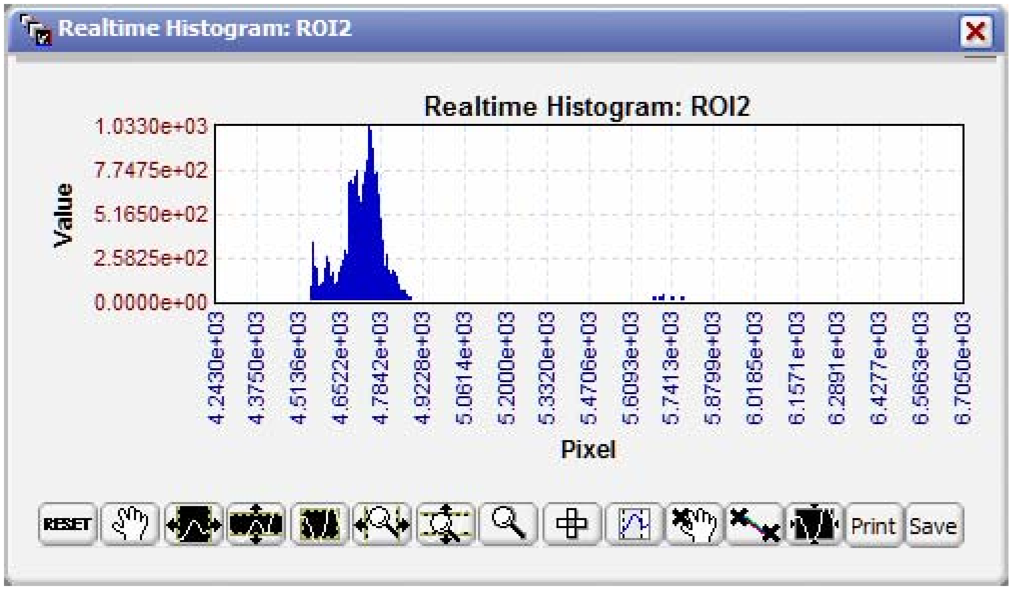


Figure 49 – Image histogram display mode

This mode is useful in quickly determining how much of the imager A/D is being used and the general spread of the image in sensitivity. The default x scale is the A/D width of the imager. For example, a 14 bit imager would have a y-scale of 0-16383 or a 12 bit imager would have a y-scale of 0-4095. The y scale is an arbitrary auto-scale with the maximum level at a particular level determining the scale. Zooming and rescaling of the plot is fully supported.

5.2.8.3 Line Profile Display

Shows a profile representation of a line drawn across the image.

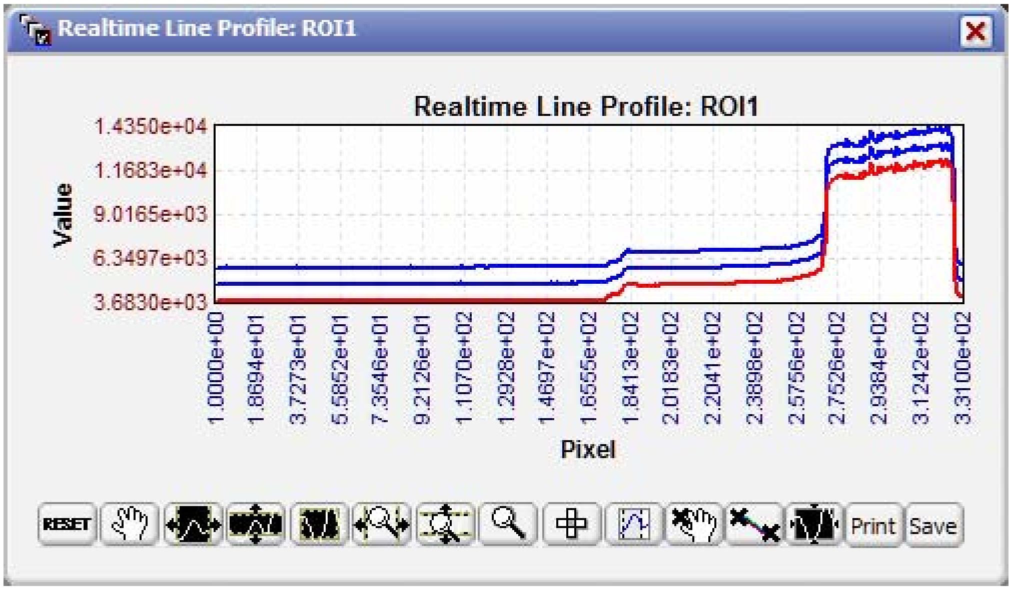


Figure 50 – Line profile plot window

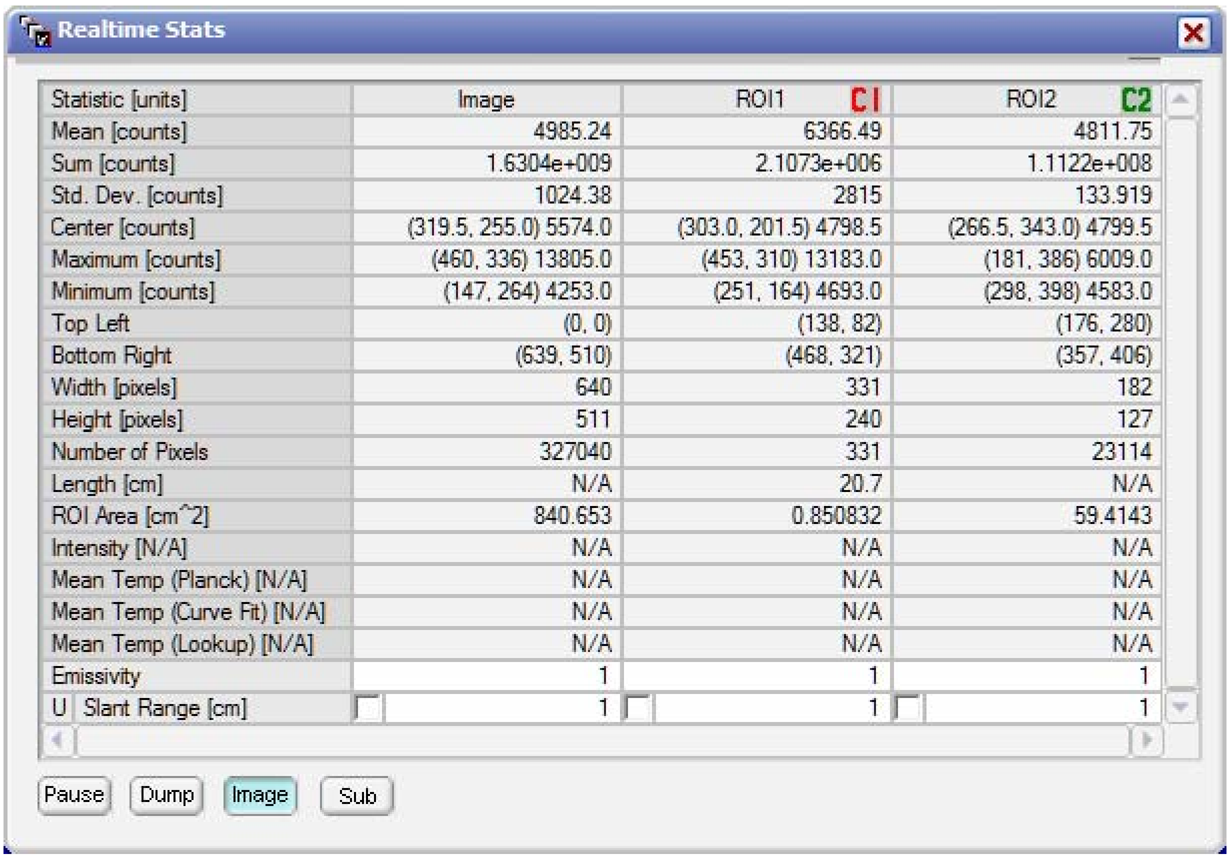
This is a special plot available only when a line style profile ROI is drawn on the image. Zooming and rescaling of the plot are fully supported.

5.2.9 Statistics Grid

The Image Statistics grid window provides real time raw counts or calculated engineering unit values based on ROI selections.

5.2.9.1 Raw Counts Mode

When the main display is in Counts mode, the Image Statistics window will display raw counts information for, optionally, the full image and any active ROI drawn on the real time image.



Statistic [units]	Image	ROI1 C1	ROI2 C2
Mean [counts]	4985.24	6366.49	4811.75
Sum [counts]	1.6304e+009	2.1073e+006	1.1122e+008
Std. Dev. [counts]	1024.38	2815	133.919
Center [counts]	(319.5, 255.0) 5574.0	(303.0, 201.5) 4798.5	(266.5, 343.0) 4799.5
Maximum [counts]	(460, 336) 13805.0	(453, 310) 13183.0	(181, 386) 6009.0
Minimum [counts]	(147, 264) 4253.0	(251, 164) 4693.0	(298, 398) 4583.0
Top Left	(0, 0)	(138, 82)	(176, 280)
Bottom Right	(639, 510)	(468, 321)	(357, 406)
Width [pixels]	640	331	182
Height [pixels]	511	240	127
Number of Pixels	327040	331	23114
Length [cm]	N/A	20.7	N/A
ROI Area [cm^2]	840.653	0.850832	59.4143
Intensity [N/A]	N/A	N/A	N/A
Mean Temp (Planck) [N/A]	N/A	N/A	N/A
Mean Temp (Curve Fit) [N/A]	N/A	N/A	N/A
Mean Temp (Lookup) [N/A]	N/A	N/A	N/A
Emissivity	1	1	1
U Slant Range [cm]	1	1	1

Figure 51 – Statistics in raw counts mode

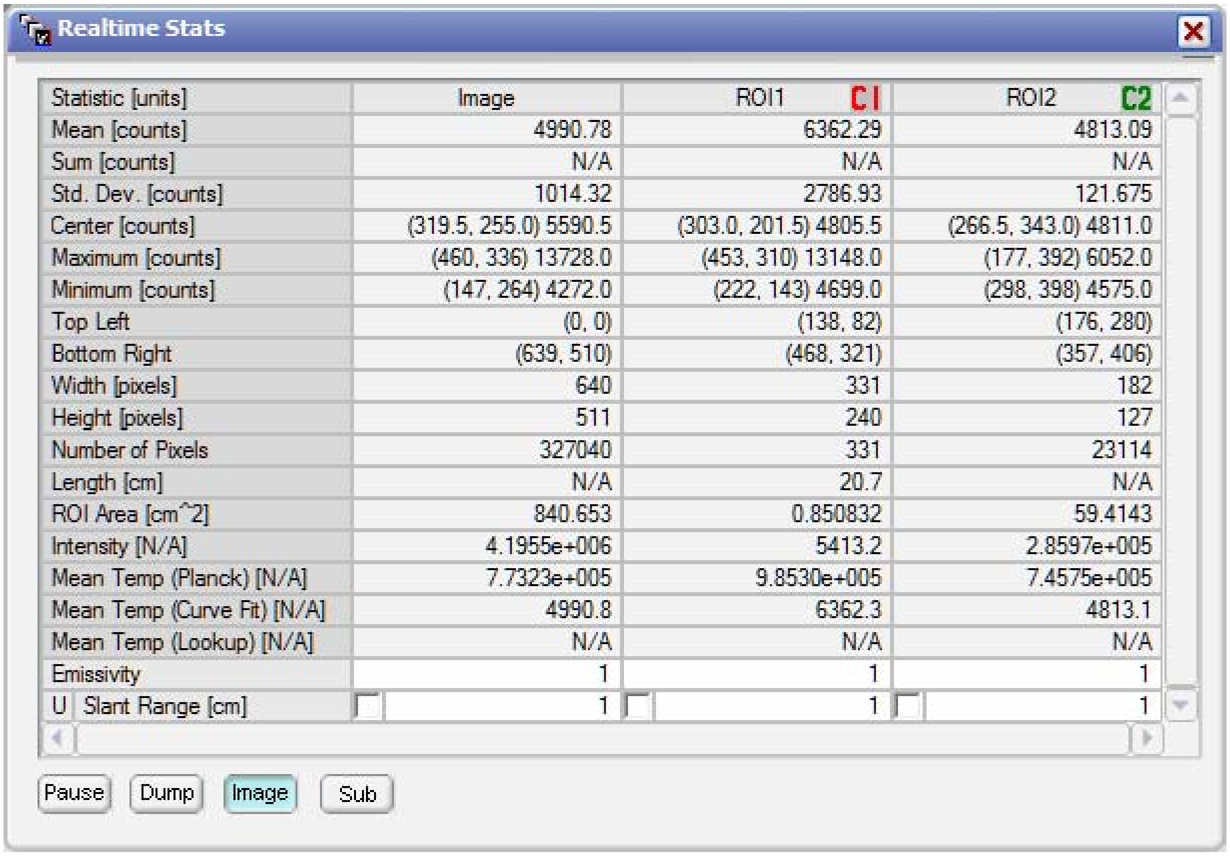
Functions available are the ability to set emissivity for temperature calculations for each ROI, the ability to pause the real-time stats update, and the ability to dump a tab delimited text file with all the current values. Any value can be copied to RCal or any other program supporting copy/paste text strings. To copy a value, first press the 'Pause' button to freeze the display. Next, move the mouse over the desired values and right-click to bring up the copy menu. Select copy and the values are stored in the standard Windows clipboard ready to paste into the program of the user's choice. RCal has a special function where it can load the first two ROI mean values via the RCal value input column. C1 and C2 are the values that are passed on to RCal when one or more ROIs are active in RDac. Note that these values will always be from the first column. Slant range can either be used from the include file or a local value can be entered directly in the table. The check box in the input cell allows the desired slant range values to be toggled.

Note that the C1 and C2 values supplied to RCal are always passed to RCal as corrected counts.

Note that values will only be displayed when an active ROI is on the main display screen. Bounding box coordinates are zero based which means that a 320 by 256 image with a full image ROI would have a top-left coordinate of (0, 0) and a bottom-right coordinate of (319, 255). Note that Area, Intensity, and the temperature calculations are not available in Counts mode.

5.2.9.2 EUD Mode

When the main display is in EUD mode, the Image Statistics window will display engineering units information for any active ROI drawn on the real-time image.



Statistic [units]	Image	ROI1 C1	ROI2 C2
Mean [counts]	4990.78	6362.29	4813.09
Sum [counts]	N/A	N/A	N/A
Std. Dev. [counts]	1014.32	2786.93	121.675
Center [counts]	(319.5, 255.0) 5590.5	(303.0, 201.5) 4805.5	(266.5, 343.0) 4811.0
Maximum [counts]	(460, 336) 13728.0	(453, 310) 13148.0	(177, 392) 6052.0
Minimum [counts]	(147, 264) 4272.0	(222, 143) 4699.0	(298, 398) 4575.0
Top Left	(0, 0)	(138, 82)	(176, 280)
Bottom Right	(639, 510)	(468, 321)	(357, 406)
Width [pixels]	640	331	182
Height [pixels]	511	240	127
Number of Pixels	327040	331	23114
Length [cm]	N/A	20.7	N/A
ROI Area [cm^2]	840.653	0.850832	59.4143
Intensity [N/A]	4.1955e+006	5413.2	2.8597e+005
Mean Temp (Planck) [N/A]	7.7323e+005	9.8530e+005	7.4575e+005
Mean Temp (Curve Fit) [N/A]	4990.8	6362.3	4813.1
Mean Temp (Lookup) [N/A]	N/A	N/A	N/A
Emissivity	1	1	1
U Slant Range [cm]	1	1	1

Figure 52 – Display in engineering units mode

All the functions described in the raw counts mode section are available in EUD mode. All units are engineering units and calculations are based on information retrieved from the current active SAF include file. For the values to be meaningful in EUD mode, a good NUC must be performed and active, a calibration must be performed using RCal, and the include file must be refreshed within RDac. Refreshing the include file values can be accomplished by simply toggling between EUD and Counts mode and back to EUD mode. Slant range can either be used from the include file or a local value can be entered directly in the table. The check box in the input cell allows the desired slant range values to be toggled.

Note that the C1 and C2 values supplied to RCal are always passed to RCal as corrected counts.

For the EUD mean, minimum and maximum values to be meaningful, the following fields must be valid. This can be accomplished by performing a good NUC, if required, and a radiometric calibration via RCal.

POLYORDER	Polynomial calibration type
COEFF#_#	Polynomial calibration coefficients
BGTYPE_#	Background type: NONE, FIX, FILE
BGVALU_#	Background constant to subtract off
BGFILE_#	Background file to subtract off
TPFACT_#	Transmission path factor

In the movie file, the following tags are used if a NUC is being used:

CGFILE	Camera gain NUC file
COFILE	Camera offset NUC file
BPFILE	Camera bad pixel correction file

For area and intensity to be active and meaningful, the following tags should have valid values before using EUD mode:

SLTRNG	Slant range in meters
IHFOV	Horizontal field of view of a single pixel in micro radians
IVFOV	Vertical field of view of a single pixel in micro radians
EURAW_#	This tag must be set to 'Raw;' i.e., the real-time imager data are raw counts
STDUNIT_#	This tag must be set to '17' for radiance. If this tag is set to '16' for irradiance, mean temperature values will not be displayed. When reduced data is in irradiance, mean temperature does not particularly make sense

For mean temperature calculated using Planck's function to be active and meaningful, the following tags plus the previously described tags should have valid values:

SBPLO	System band pass, lower wavelength in microns
SBPUP	System band pass, upper wavelength in microns

For mean temperature calculated using coefficients function to be active and meaningful, the following tags plus the previously described non-temperature tags should have valid values:

TEMPPOLYORDER_#	The number of temperature coefficients
TEMPCOEFF#_#	The temperature coefficient values

For mean temperature calculated using the temperature lookup table calculations to be active and meaningful, the following tag plus the previously described non-temperature tags should have valid values:

CAFILE	The value of this tag provides the filename of the file that contains the temperature lookup table.

Refer to the appendix of this document for explanation of the various EUD calculations.

5.2.9.3 ROI# Minus ROI# Selection

The stats window allows any ROI to be subtracted from any other ROI and the resulting values displayed as a new column.

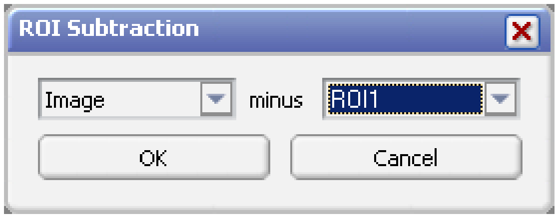
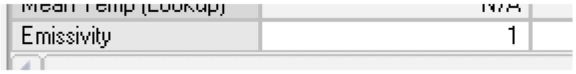


Figure 53 – ROI# minus ROI# selector

To use, press the ‘sub’ button for the desired ROI located at the lower part of the Image Statistics window. Select two ROIs to generate a column of stats showing ROI_X-ROI_Y.

5.2.9.4 ROI Emissivity Selection



The Emissivity selectors are used to dynamically change the emissivity for temperature calculations for each ROI. The buttons on the left activate this option and displays the result.

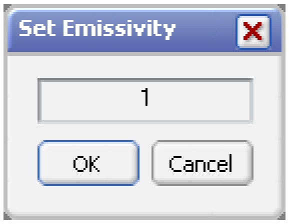


Figure 54 – Emissivity factor selector

To use, edit the desired ROI emissivity field located at the lower part of the Image Statistics window. Alternatively, right-clicking on a ROI column will show the set emissivity dialog for new emissivity entries. These values will be saved internally so that all future temperature calculations will have these values available. Valid values are from 0.000001 to 1.0.

5.2.9.5 Stats Snapshot

This is the statistics snapshot output file selector. The button on the left activates this option.

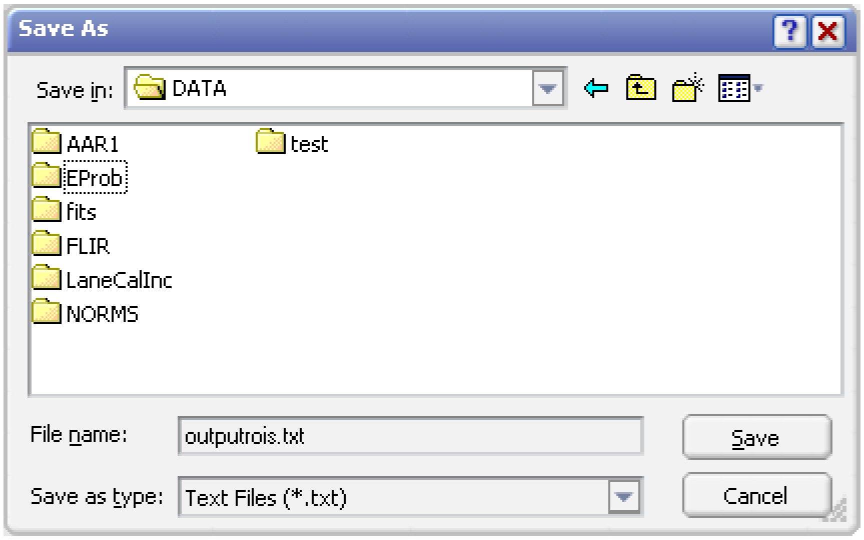


Figure 55 – Statistics output to a text file selector

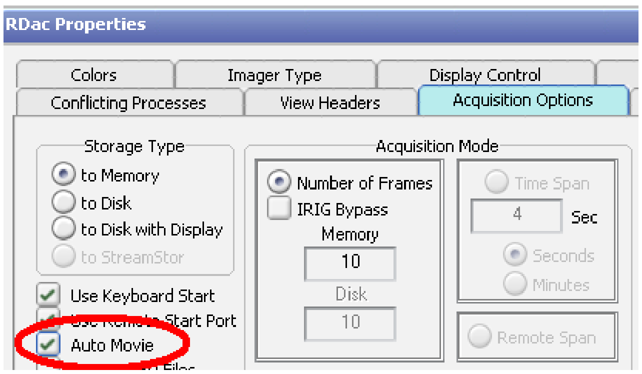
To use, press the ‘Dump’ button on the Image Statistics window. If the statistics window is not paused, the display will be auto-paused until the file is created. Type in the desired file name, press ‘Save’ and a tab delimited text file will be created. See below for an example output file:

Statistic	Image	ROI1	ROI2
Mean	9848.64	9317.18	10937.4
Sum	8.06801e+008	3.81539e+007	5.82525e+007
StdDev	1444.21	302.319	2252.24
Center	(160.0, 128.0) 10232	(62.5, 64.5) 9251	(219.0, 180.5) 9468.5
Minimum	(206, 4) 8706	(39, 66) 9008	(246, 157) 9137
Maximum	(135, 177) 16468	(86, 93) 10858	(196, 164) 16383
TopLeft	(1, 1)	(31, 34)	(179, 140)
BottomRight	(320, 256)	(95, 96)	(260, 222)
Width	320	65	82
Height	256	63	83
Num Pixels	81920	4095	5326
Length	N/A	N/A	N/A
ROI Area	7.40232e-007	3.70026e-008	4.81259e-008
Intensity	0.00729028	0.00034476	0.000526371
Mean Temp (Planck)	1.52438e+002	1.44221e+002	1.69273e+002
Mean Temp (Curve Fit)	1.96973e+002	1.86344e+002	2.18748e+002
Mean Temp (Lookup)	Out of range	Out of range	Out of range
Emissivity	1	1	1

5.2.10 Image Movie Playback

The Image movie playback function allows the user to playback and review any previously collected data set.

5.2.10.1 Optional Sub-frame Selection



The sub-frame selector is used to pick a super-frame file when the display last movie option after a data collection is selected and RDac is in preset sequencing/super-frame mode.

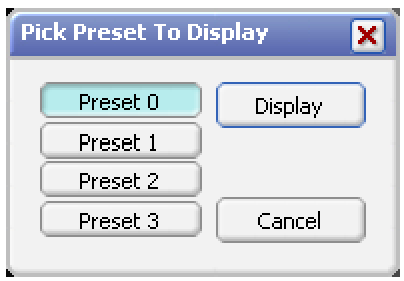


Figure 56 – Sub-frame movie file selector

The sub-frame selector will reappear each time a movie is played until the ‘cancel’ button is pressed to escape the loop.

5.2.10.2 Movie File Selection

The movie file selector is used to load and playback a previously collected imager data set.

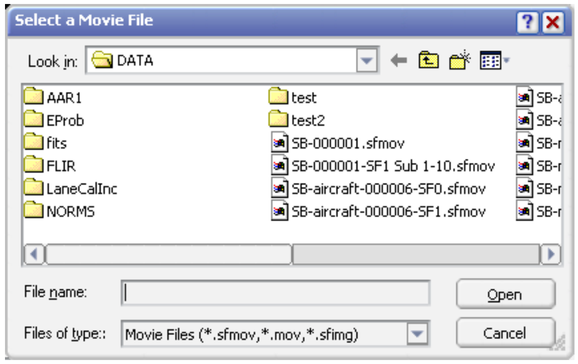


Figure 57 – Movie file selector

Note that mov files are not the same as the QuickTime movie type.

5.2.10.3 Movie Playback Display

The movie playback display window is a video display for reviewing previously collected data sets. See the separate RDac Player Help or the RDac Player PDF file located in the RTools\docs folder for details.

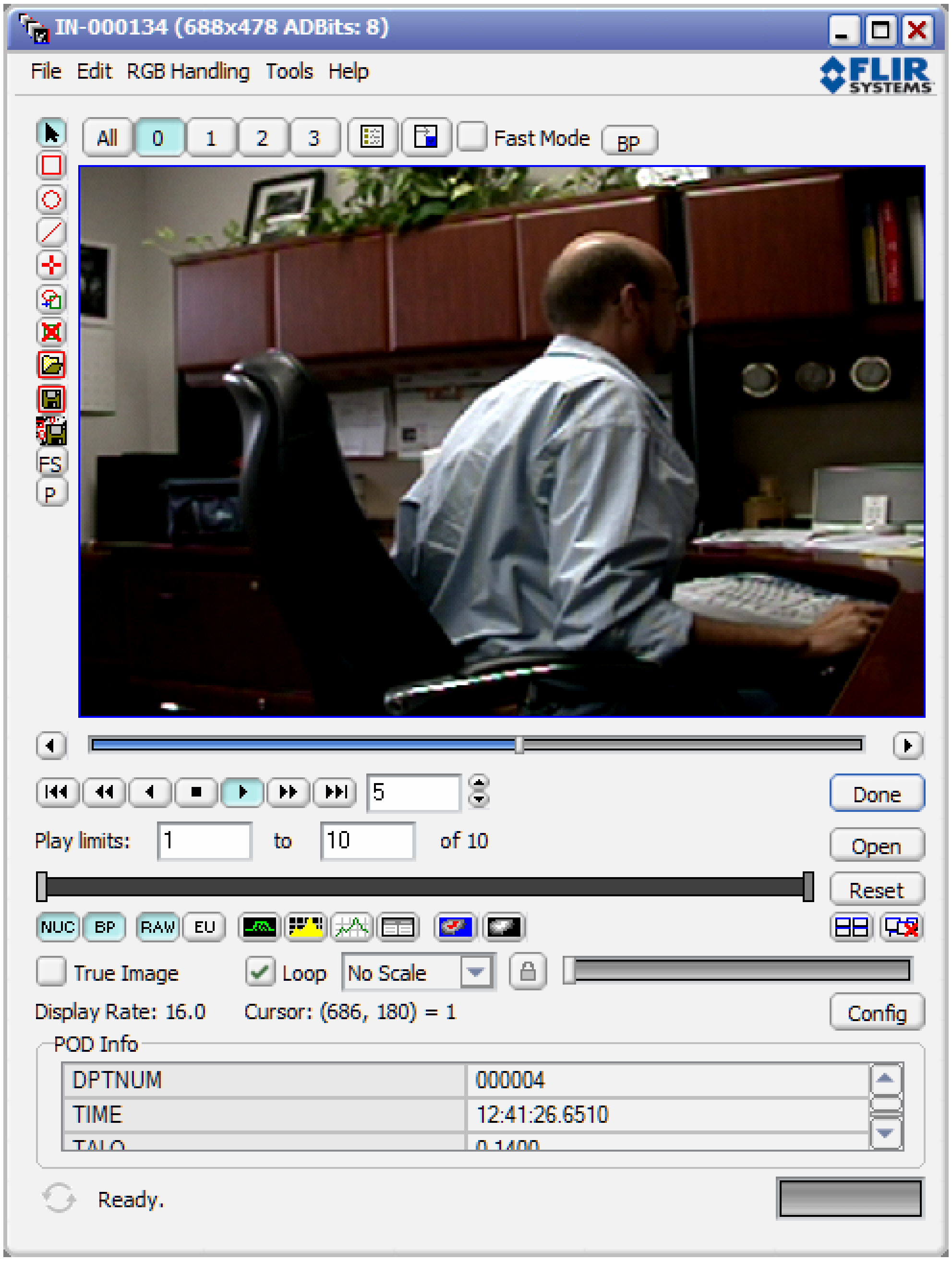


Figure 58 – Movie file playback window

5.2.11 Organize Windows (Main Display)

Press to tile all open windows to fill the screen.

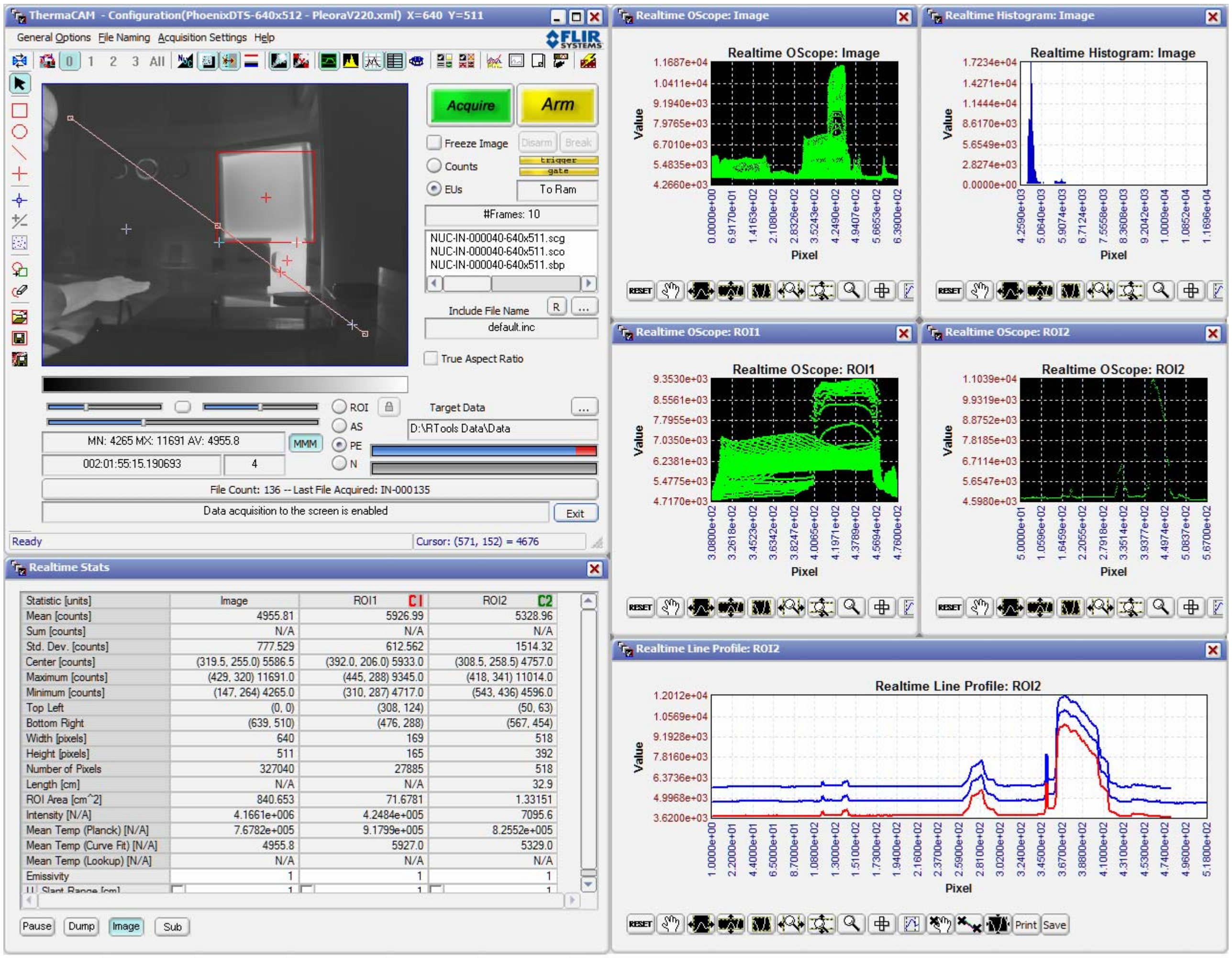


Figure 59 – Tiled windows

5.2.12 Clear Extra Windows (Main Display)

Press to remove all plot and stats windows.

Figure 60 – Prompt for closing all plot/stats windows

5.2.13 External Modules

Spawn RCal, RView, REdit and if installed the OL-750 controller. See their corresponding manuals or help files for details on operation and features.

Relevant manuals are located in the RTools\Docs folder:

RCal Manual.pdf

RView Manual.pdf

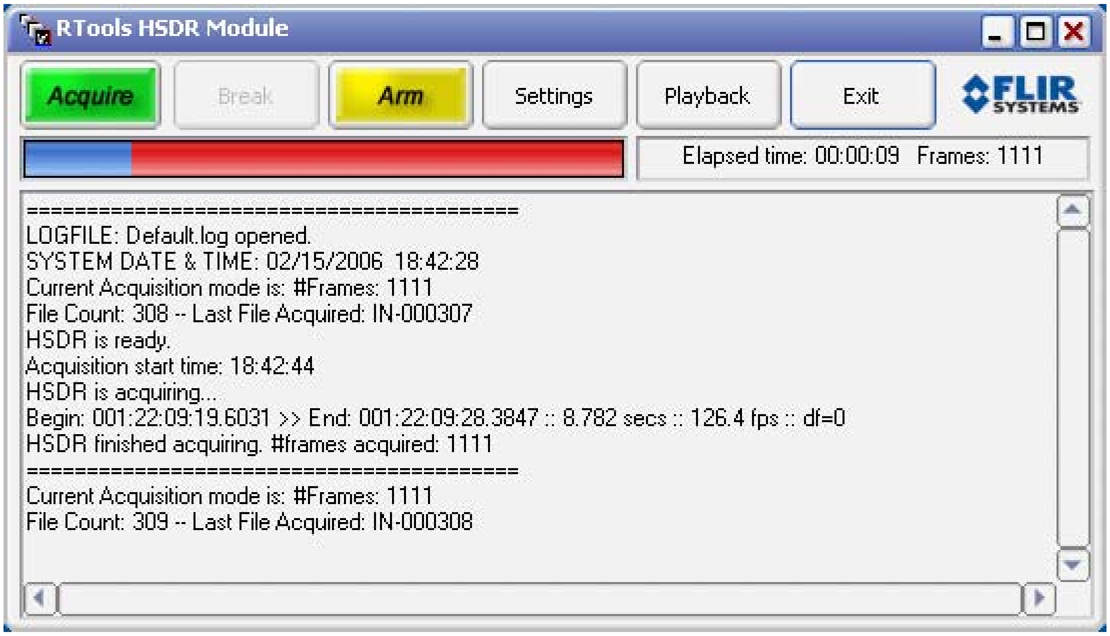
REdit Manual.pdf

OL-750 Controller Manual.pdf (if installed)

Also, the *RDac Manual.pdf* is located in the same folder.

5.2.14 HSDR Module

If installed, spawn the HSDR module. See section 6 for general operation and features



5.3 ROI Toolbar Description

The ROI toolbar allows a variety of simple shapes to be drawn on the main image display. Statistical information is calculated based on these ROI mappings and output to the secondary Statistics grid window.

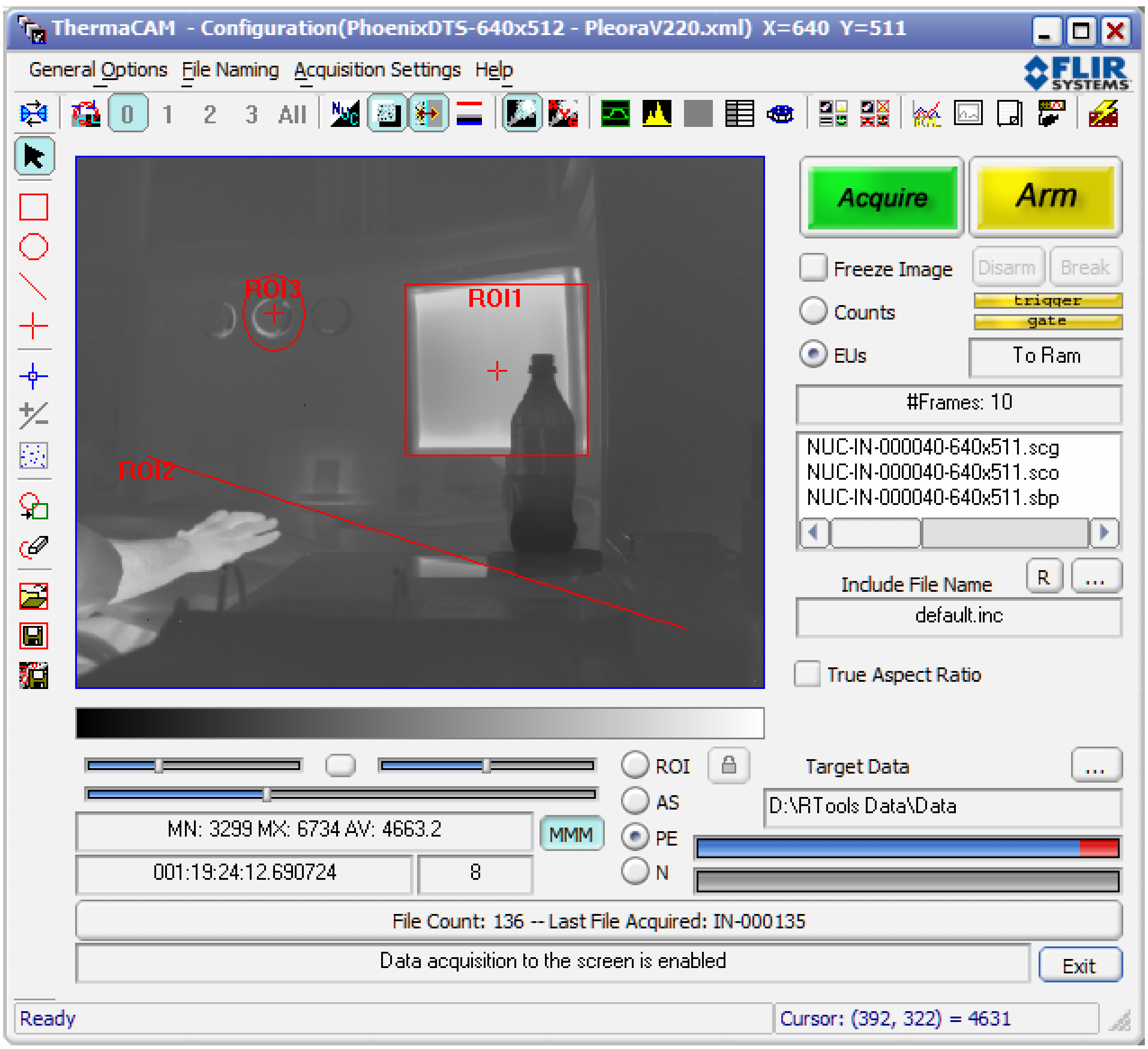


Figure 61 – ROI mode in action

ROI selection for mode changing, repositioning and/or resizing.

ROI rectangle creation.

ROI circle/ellipse creation.

ROI line profile creation.

ROI cursor creation.

The next 3 buttons are part of the bad pixel selection/editing tools

Step through each ROI.

Erase current ROI.

Load an ROI set.

Save an ROI set.

Save all images, bit masks, plots and stats to bitmap and text files.

A manual bad pixel picker has been added. Note the new buttons along the left edge in Figure 63 –Manual Bad Pixel Picker just below the ROI shape buttons. Three new buttons are available to manually edit the bad pixel map. The top button places RDac into and out of BP edit mode which both displays the targeting cursor and displays the BP mask. The targeting cursor can be controlled by either dragging it with the mouse or moving it via the cursor keys. The middle button will either add or remove a pixel centered inside the targeting cursor based on its current 'BP' state. If it is marked as good, pressing this button will add it to the BP map. If it is already on the BP map, this button will remove it from the map. The third button toggles on and off an overlay of all bad pixels. ***NOTE:*** *It is recommended that "True Image" should be on when performing BP picking. When the "True Image is not selected potential positional errors in what pixel appears to be masked can occur due to the image being distorted on the display.*

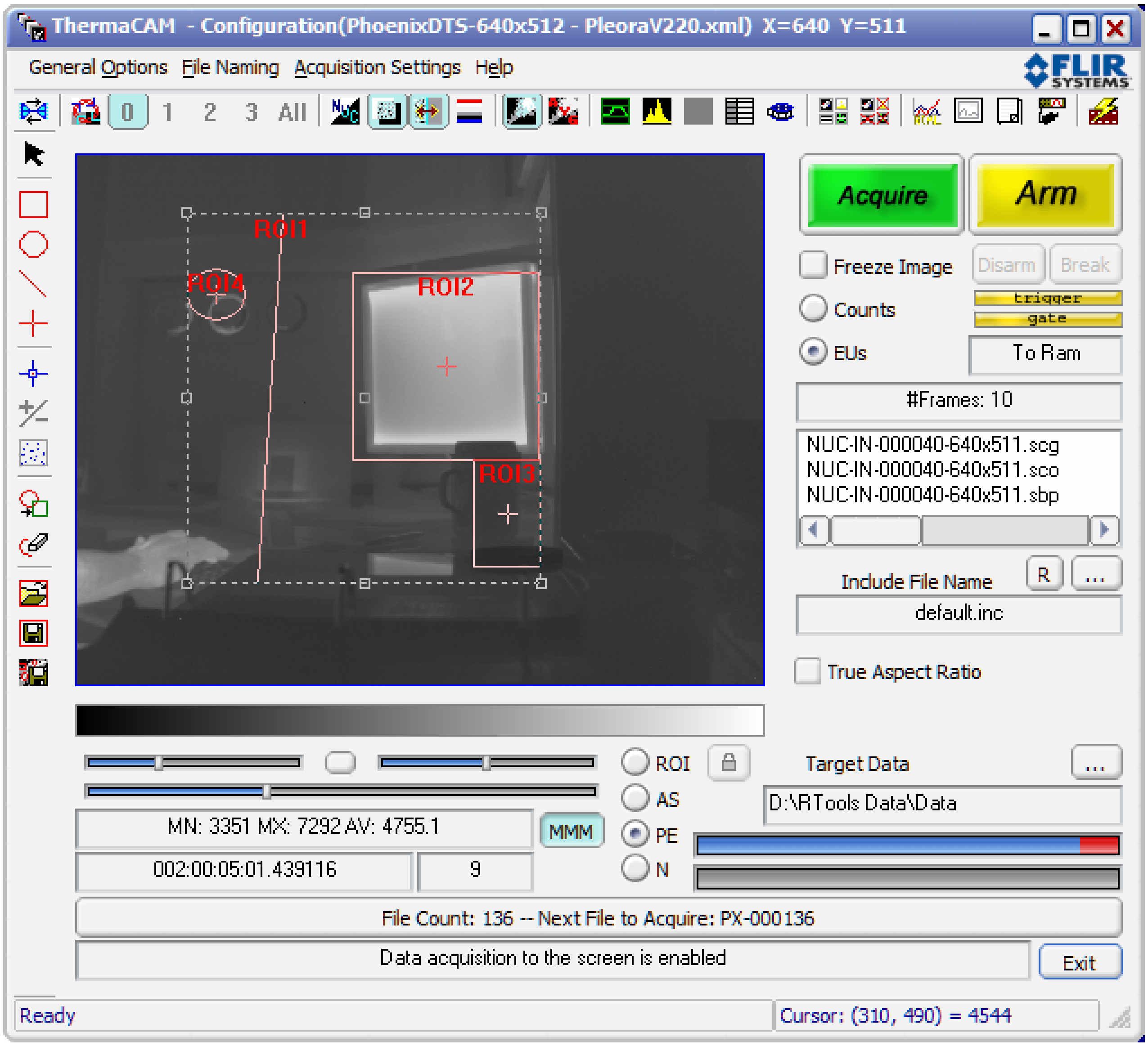


Figure 62 – ROI Grouping

Multiple ROIs can be grouped by selecting each ROI with a mouse click while the Control key is pressed. Grouping can also be accomplished by left click down and dragging the mouse cursor until a rectangle selects all the ROIs desired. Once the ROIs are selected, group control boxes for sizing and movement allow the overall group of ROIs to be sized or moved as a single unit.

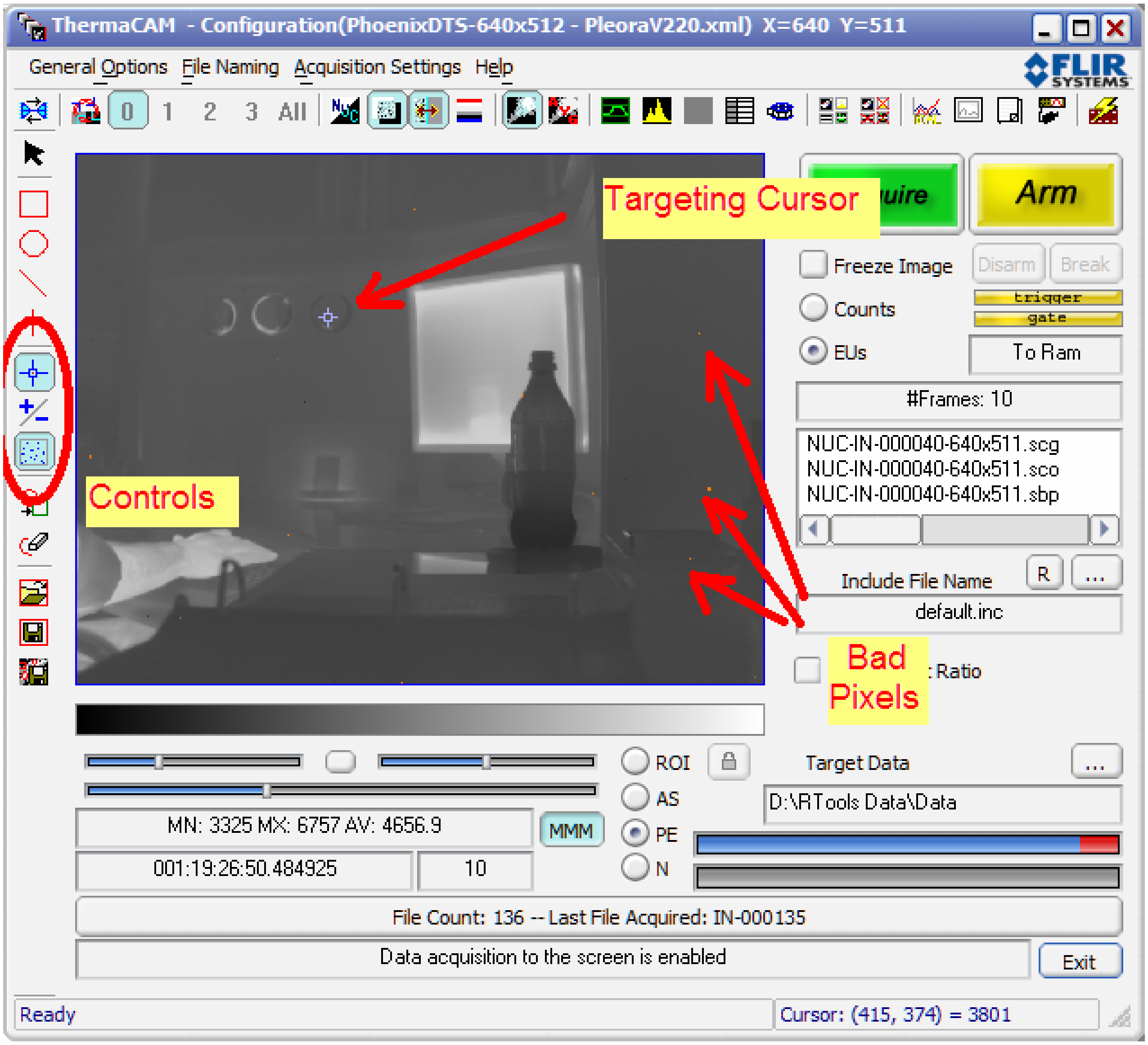


Figure 63 –Manual Bad Pixel Picker

In the NUC selection dialog a new switch called 'Generate' has been added to the bad pixel selection area. When this switch is selected then a new bad pixel correction file is generated during a Two-Point NUC operation. If it is not selected then the previous bad pixel correction file is sued in the NUC operation and future data acquisition operations.

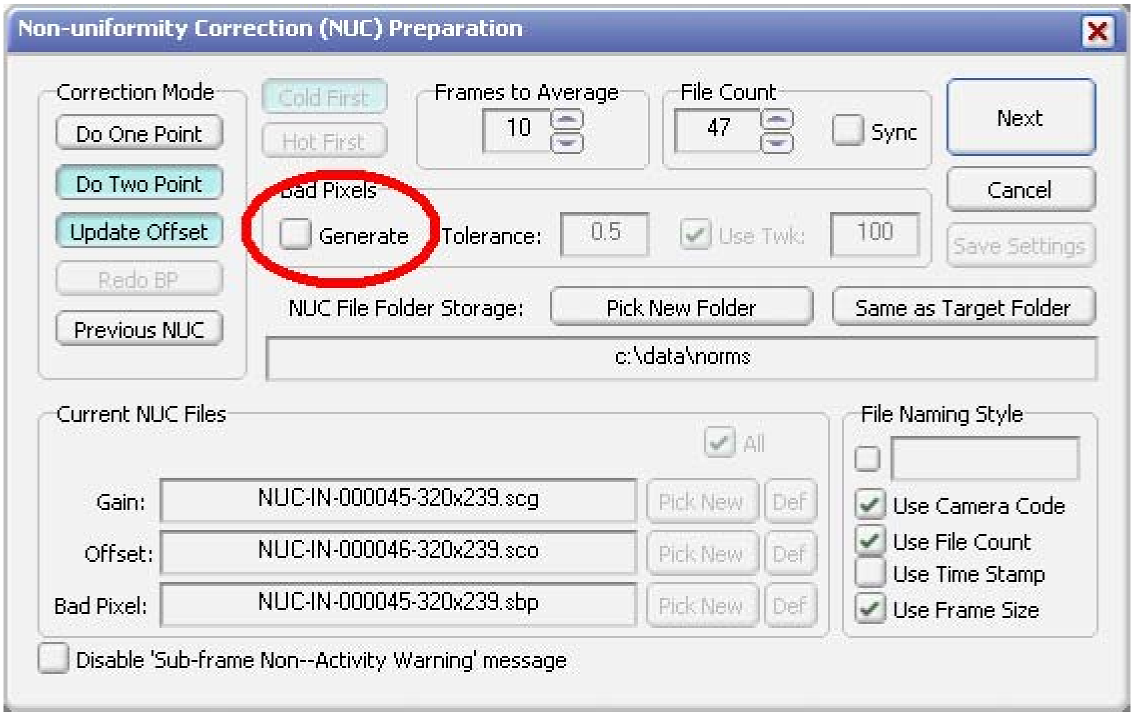


Figure 64 –NUC setup dialog

Optional color selection for both the targeting cursor and the bad pixel mask has been added to the color selection property page.

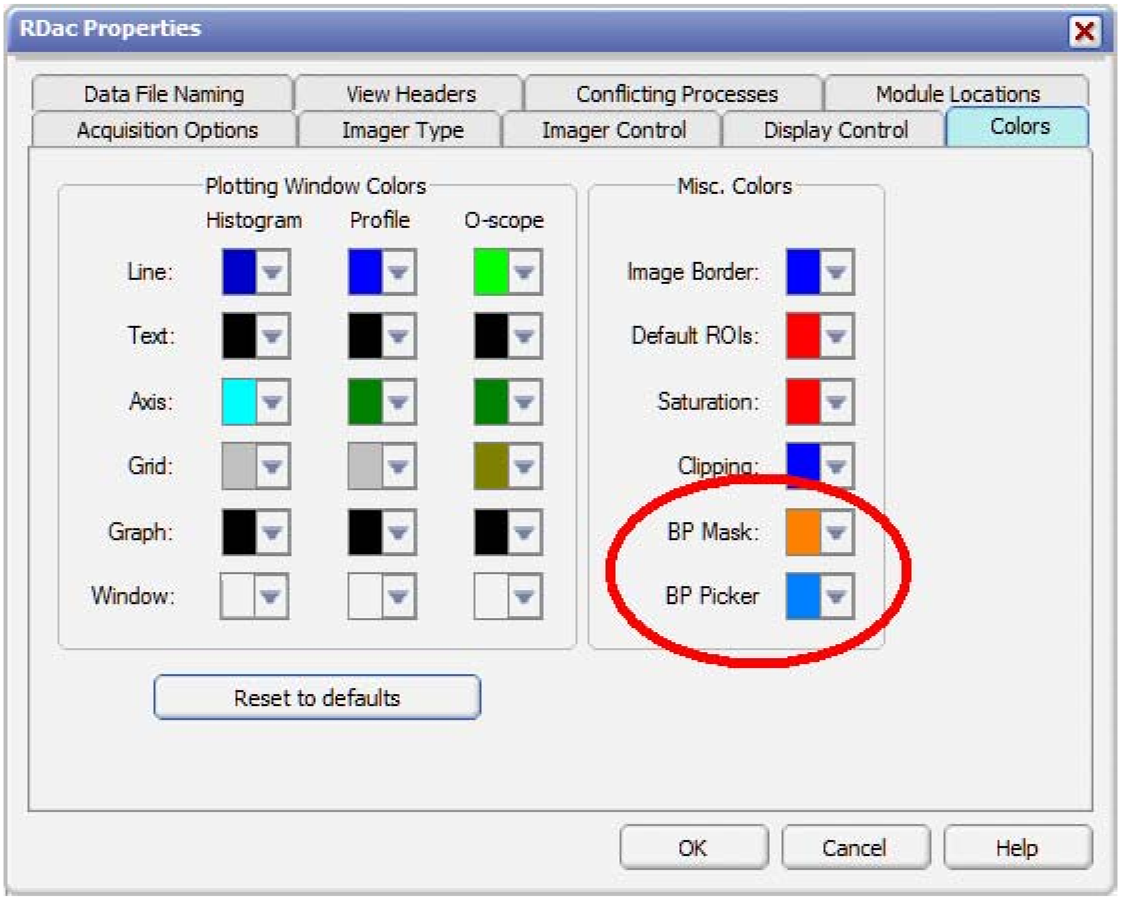


Figure 65 – BP Color Options

Several keys are available to move ROIs and the bad pixel target cursor around the screen:

- 'Shift' with the mouse allows the active ROI to be locked at a vertical position and moved left/right via the mouse.
- 'Ctrl' with the mouse allows the active ROI to be locked at a horizontal position and moved up/down via the mouse.
- 'Space' with the mouse allows the active ROI to be symmetrically resized by moving the mouse around the screen.
- 'Alt' with the mouse allows the active ROI to be moved around the image without the mouse being over the active ROI.
- 'Arrow' keys allow the active ROI to be nudged around the image.
- 'Del' key deletes the active ROI.
- 'Tab' key steps through the ROIs, activating each one in turn.

5.4 Image Display and Controls Description

The contrast and brightness of the imager display area can be adjusted through several control options located just below the image.

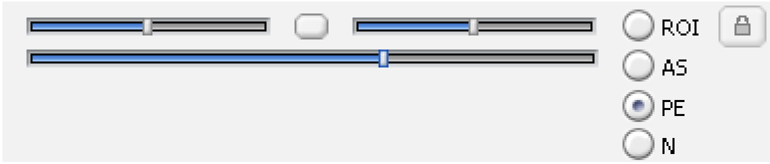


Figure 66 – Image enhancement controls

The 'N' selects no contrast/brightness adjustment. Image scaling is based on the A/D width of the imager.

The contrast and brightness slider bars are used to manually adjust the image display. The slider bars are available for all image scaling methods. The reset button resets the contrast and brightness controls to their default position.

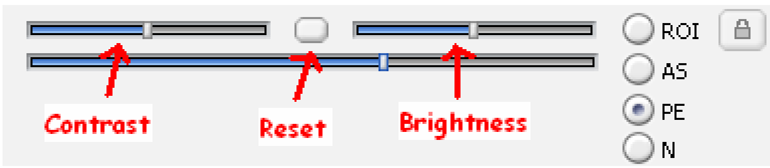


Figure 67 – Manual contrast and brightness controls

The 'PE' (plateau equalization) button selects a non-linear image enhancement style of contrast/brightness adjustment which is recalculated per each image frame displayed. The slider exposed in this mode allows adjustment in low contrast images. Also note that noisy images, where there is a fair amount of scaling flicker, can be dampened using this control.

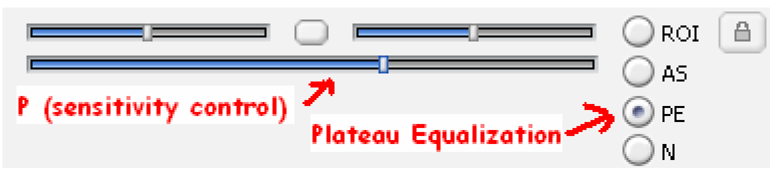


Figure 68 – Plateau equalization controls

ROI auto-scaling is an additional image visual enhancement technique modeled after the AS (Auto-scale) algorithm. To use, select the 'ROI' Auto-scale radio button and either create or select an ROI on the real-time image display. Note that if no ROI is selected or there are no ROIs on the image, the entire image will be used and functionality will be the same as 'AS' mode. To maintain a desired image scale, select the lock button to maintain that scaling for the display.

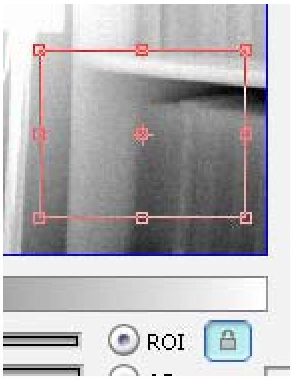


Figure 69 – ROI Scale lock

5.4.1 Stretch Window and Not Aspect Ratio

RDac supports a resizable main window with a true aspect ratio pixel-to-pixel representation of the imager display.

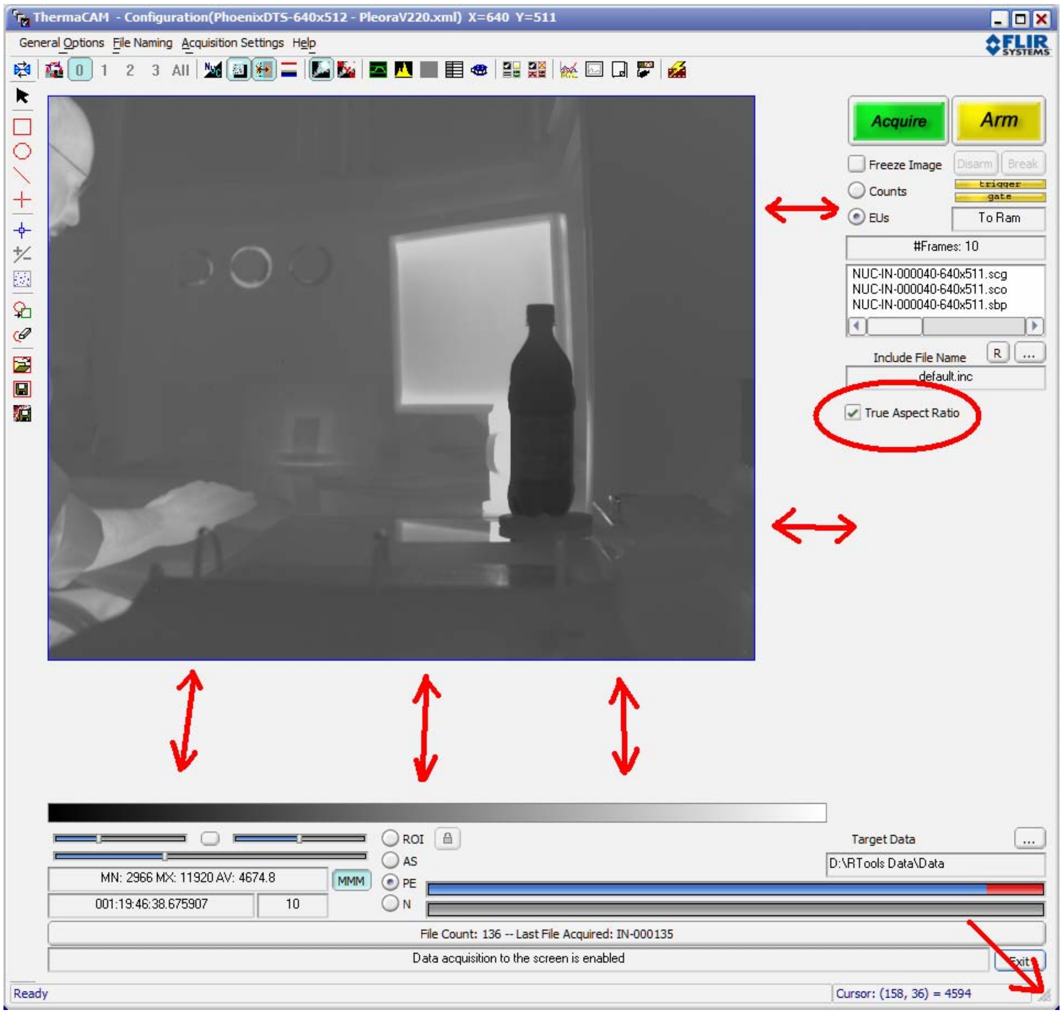


Figure 70 – Example of stretched window with true aspect enabled

To set RDac into true aspect ratio mode, check the True Image option in the middle right section of the main user window. The main window can be resized with the main image display holding its size and shape. Resizing of the user interface can be accomplished by sliding the mouse over an edge or corner, clicking, and dragging to achieve the desired size. The desired size will be 'remembered' from session to session.

5.4.2 Stretch Window and Aspect Ratio

RDac supports a resizable main window with an arbitrary aspect ratio pixel-to-pixel representation of the imager display.

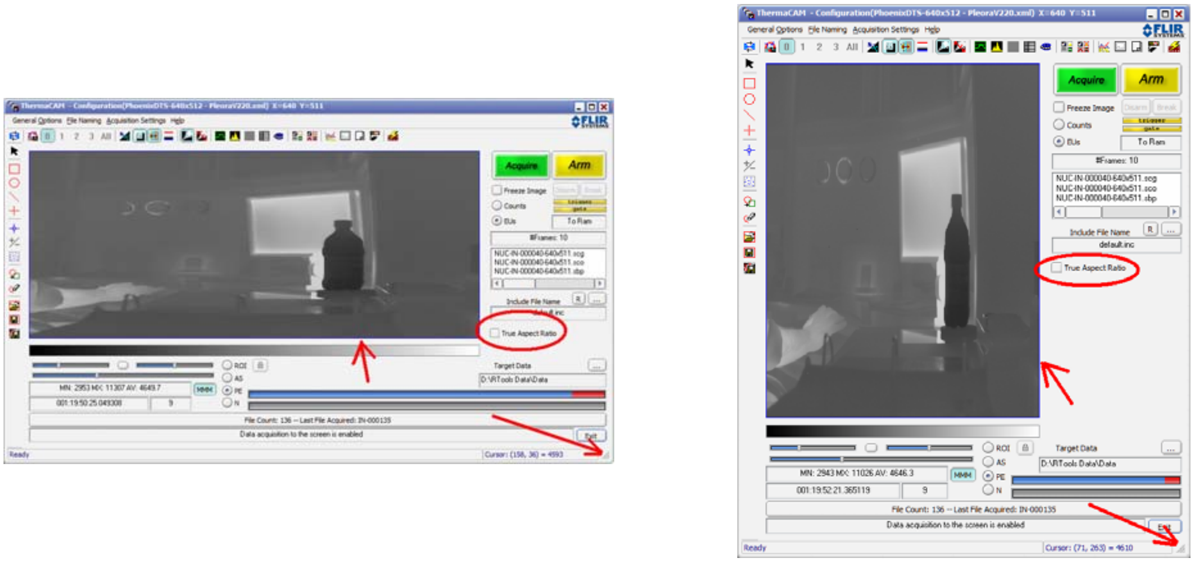


Figure 71 – Examples of arbitrary aspect ratio selected

To set RDac into arbitrary aspect ratio mode, uncheck the True Image option in the middle right section of the main user window. The main window can be resized with the main image display changing its size and shape to match. Resizing of the user interface can be accomplished by sliding the mouse over an edge or corner, clicking, and dragging to achieve the desired size. The desired size will be ‘remembered’ from session to session.

5.5 System Arm/Disarm Controls Description

When the arm button is pressed, the RDac package responds to remote triggers from the parallel port. Alternatively, “Alt-c” can be pressed to initiate an acquisition when not armed.

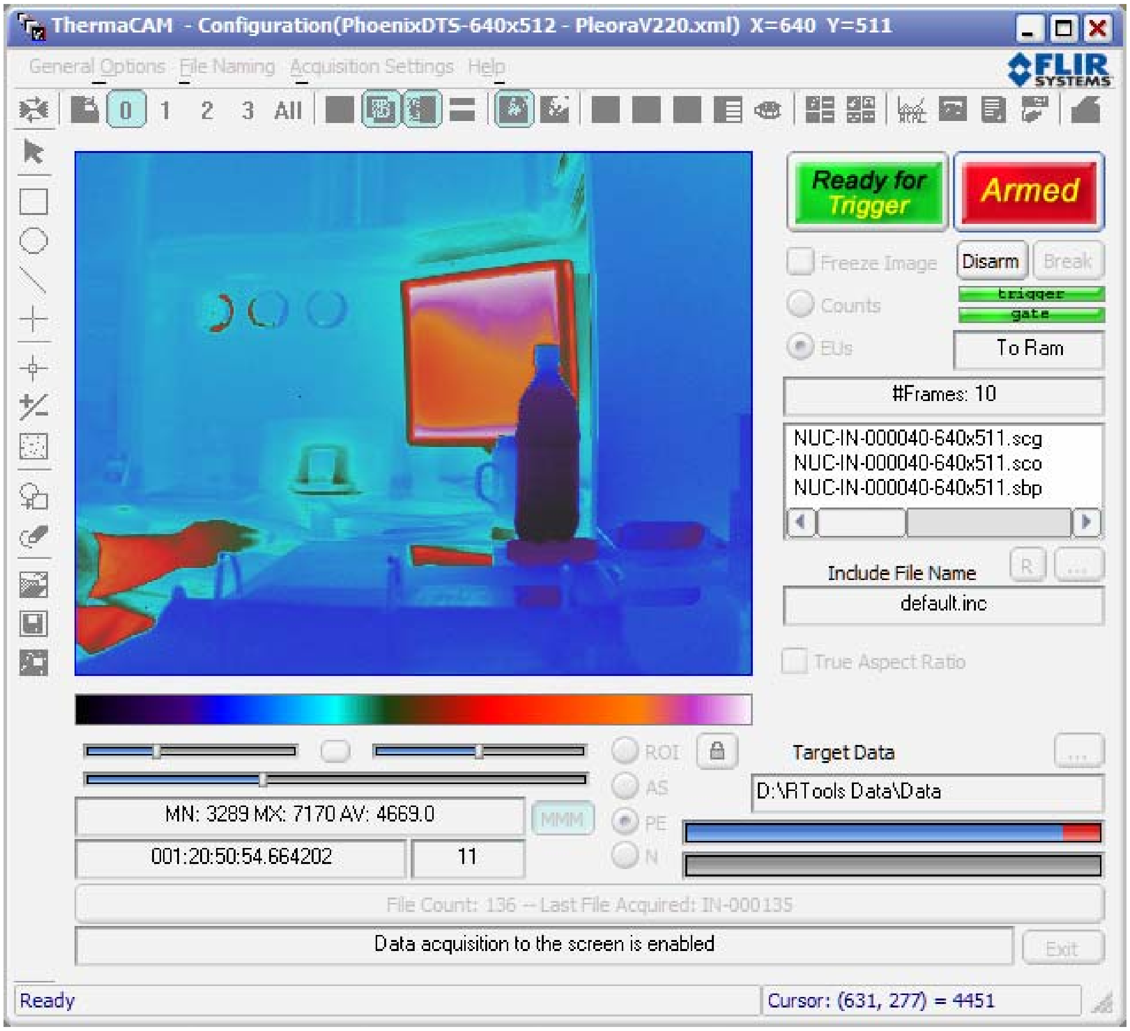


Figure 72 – RDac in armed configuration

When pressed, the system will enter an armed state where almost all controls are disabled. This reduces the possibility of inadvertent program changes while waiting for an external trigger event. Note that the disarm button must be depressed to move the system out of the armed state. If a data collection is started, the break button is enabled. By pressing the break button while collection is in progress, the collection period will be stopped and all acquired data up to the break point will be saved to disk. Note also that the green indicator will be red during the complete remote trigger. When the data is being saved to disk, a disk file write progress indicator will be displayed below the include file name box.

5.6 Status and Statistics Display Description

There are a variety of status and informational windows arranged around the image display.

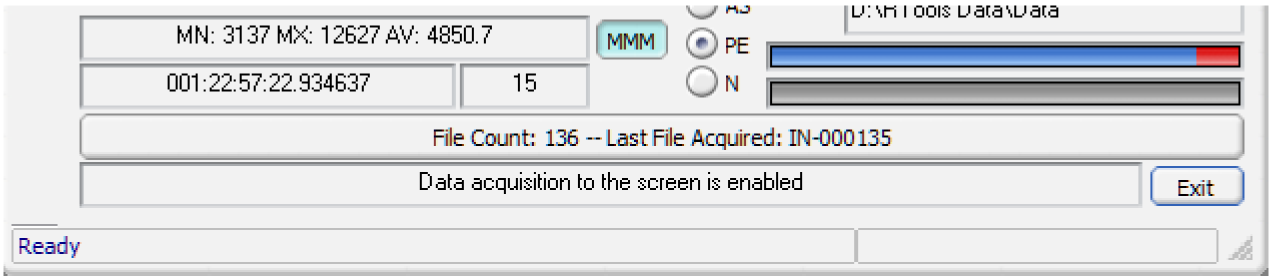


Figure 73 – General statistics and information displays

At the bottom of the main panel are areas displaying time stamping, display refresh rate, minimum, maximum and mean values for the entire image, collection time stamping, and cursor position. The top display window has the current time stamping information. The window to the right contains the display refresh rate and, if in super-frame mode, the current sub-frame number. The next window down displays the minimum, maximum and mean values for the entire image if the 'MMM' button in depressed. If the 'MMM' button is off, specialty information is displayed based on what imager RDac is configured for. For example, gain and offset values are shown when RDac is configured for an Agema 880. The large window displays the start collection time, the stop collection time, time span of collection and approximate frames per second after each triggered data collection. The small window to the right displays the current mouse coordinates converted to image-pixel coordinates. The progress bar above the cursor info window is used to show progress of the disk file write after a collection.

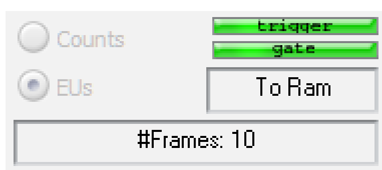


Figure 74 – Collection mode display

At the top right section of the main panel are the current file start id number, EUD/Counts toggle, data collection type and mode.

5.7 Key Files Description

The key files display windows and controls set and show several key files and paths relevant to the creation of each data set.

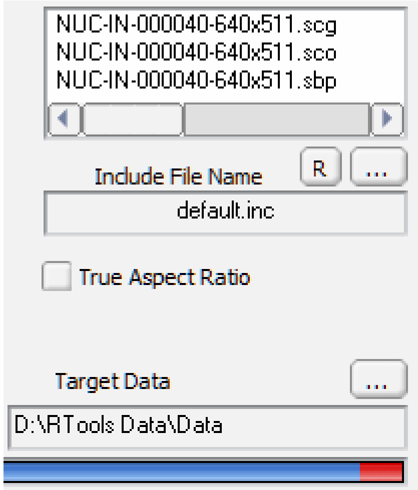


Figure 75 – Key files setting and display windows

If the normalization functions are enabled, the norm file list will be displayed. Target data folder and include file name set and show the current active settings for each. The blue and red bar gives a general indication of the drive space left on the target data folder drive. The more blue that is shown, the more free space is available. The more red that is shown, the more the drive is filled.

5.7.1 Pick Data Storage Folder

This is used to choose a data storage drive and folder.

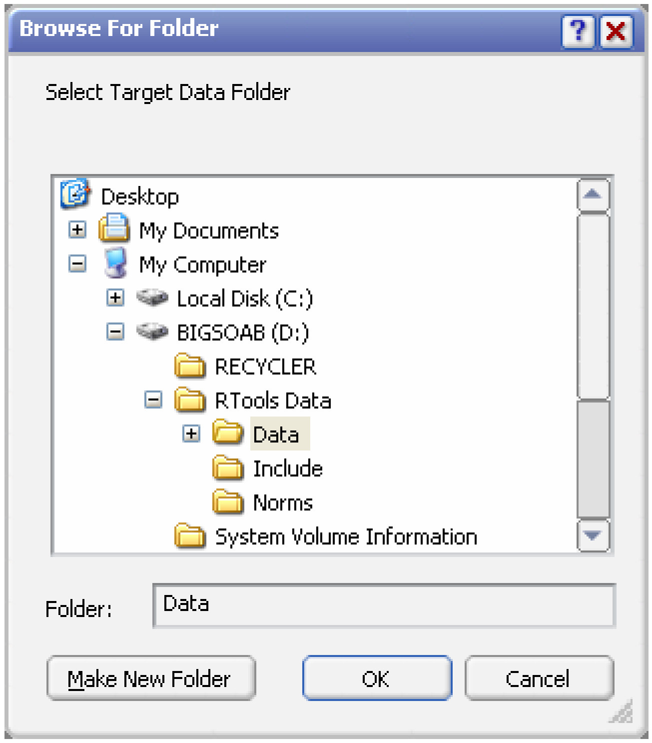


Figure 76 – Data storage folder selector

To use, press the […] button above the target data folder display window and the above dialog box will appear. To select a folder for data storage, select the desired drive and pick a folder in the folder tree window. To create a subfolder, go to the folder where the subfolder is to be created, type the desired name in the top edit box, and press the 'OK' button.

5.7.2 Pick Include File

This is used to pick a default SAF include file.

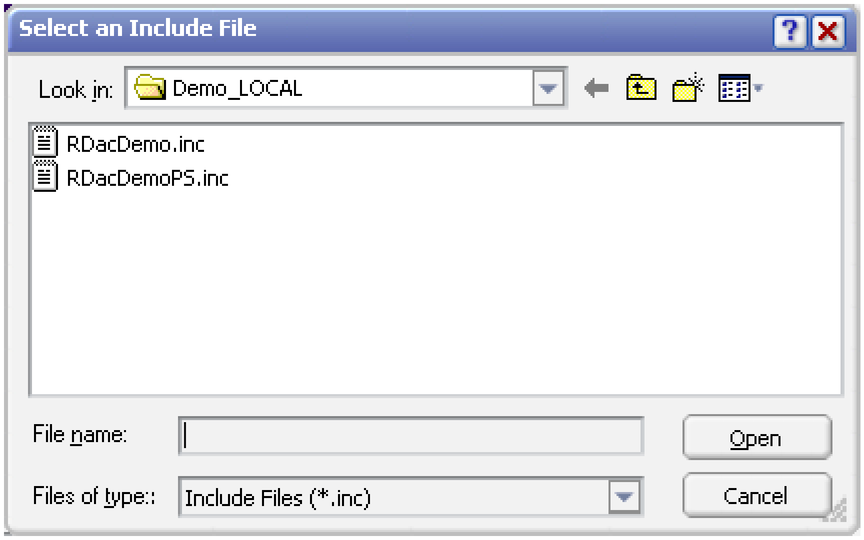


Figure 77 – Active include file selector

To use, press the ellipsis […] button above the include file display window and the above dialog box will appear. Pick the desired SAF include file and press the ‘OK’ button.

5.7.3 About Box

The ‘About Box’ displays a variety of legal and contact information for RDac.

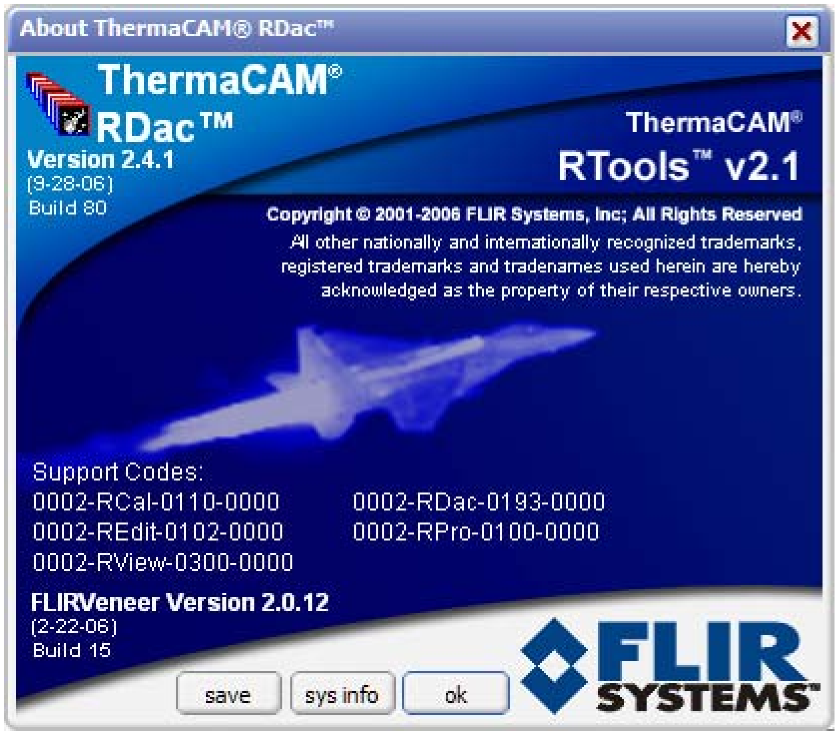


Figure 78 – About box

The basic about box has several buttons for additional information. The ‘save’ button allows the support codes to be saved in a text file for support issues requiring e-mail correspondence. The ‘sys info’ displays system resource information. ‘Ok’ exits the about box.

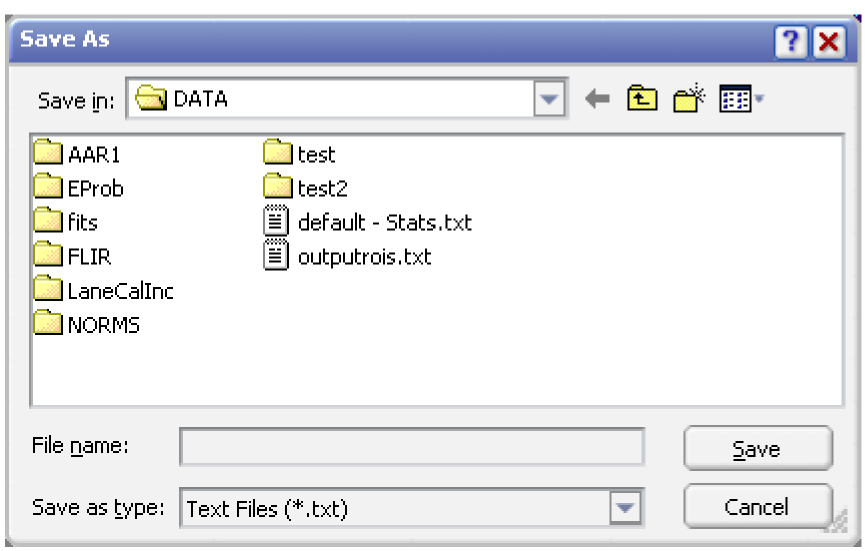


Figure 79 – Save dongle and serial number information

This is the standard file save name box for the dongle and serial number information text dump.

Example RTools serial number info file:

Support Codes:

0002-RCal-0110-0000 0002-RDac-0193-0000

0002-REdit-0102-0000 0002-RPro-0100-0000

0002-RView-0300-0000

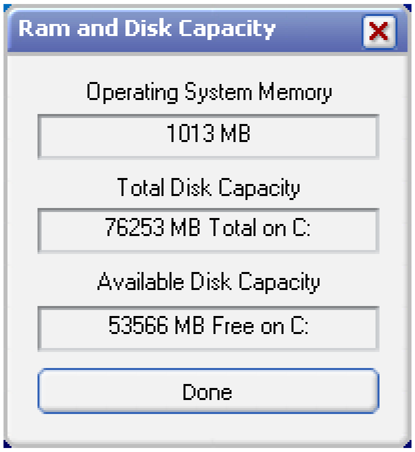


Figure 80 – System information

The system information gives a basic glimpse of available system resources. Operating system memory is memory available to Windows. This may not include memory managed by software such as the non-paged memory managers used by Matrox or Coreco. Use their supplied utilities to better gage memory usage by their memory managers. The disk capacity sections display current disk resources for the selected data drive.

6 RDac HSDR Module

The RDac HSDR module is a high speed, long duration acquisition option which will allow the user to acquire imager data at very high frame rates for extended periods of time to a custom disk array. This module is well suited to acquiring the FLIR SC6000 and FLIR Phoenix DTS data stream in all modes of operation.

Note that there are two distinct levels of acquisition available. All the normal RDac acquisition modes and options in the RDac main panel are still available and are separate from the HSDR module. Simultaneous acquisitions can be performed. For example, the HSDR can be set up to record a 30 minute continuous acquisition to the disk array while snapshots are taken using the main RDac panel via GigE.

The data from each is stored in separate folders. Data acquired from the primary RDac panel is stored in the default “RTools Data\<…>\Data” folder whereas the HSDR output and MOVPlay-HSDR output is stored in the “RTools Data\<…>\Data\HSDR-Database” folder.

6.1 Primary HSDR panel

The RDac HDSR module is activated from the toolbar button at the top/right corner of RDac. This module contains independent acquire, break, arm, settings and playback buttons from the primary RDac display. A data capacity bar (currently shown as blue) shows how much of the system storage space is used. Blue represents free space and red represents data. Beside the capacity bar is a window which shows the number of frames acquired. This window is periodically updated during an acquire with time as (minutes : seconds) since the start of an acquisition and frames acquired since start the start of an acquisition . Below the capacity bar is a status window which displays HSDR events during usage of the module

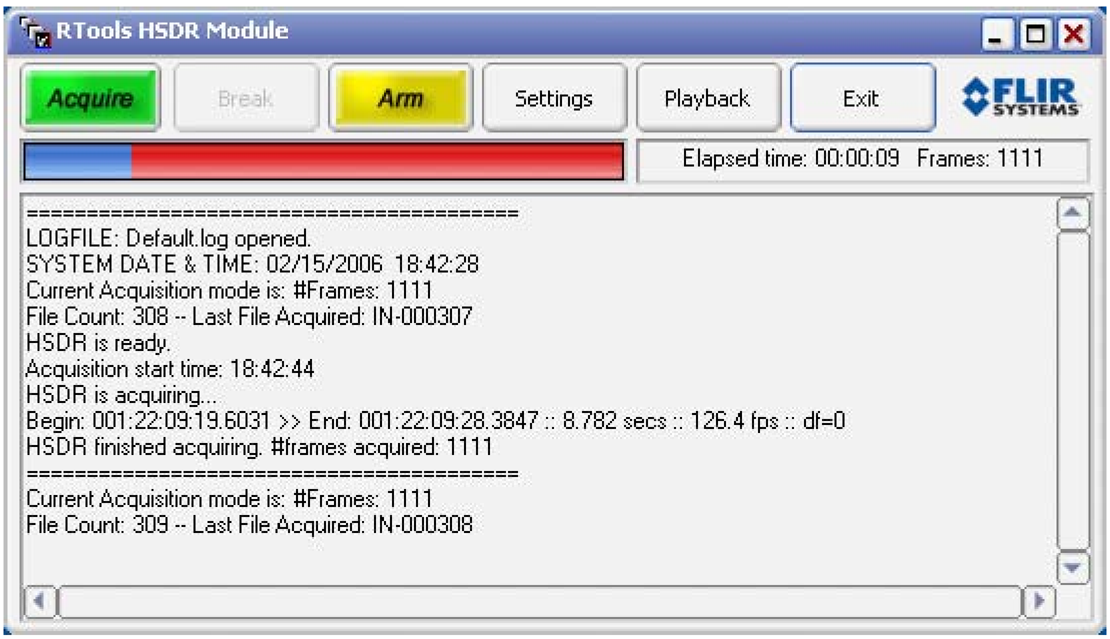


Figure 81 – HSDR module

6.2 Basic Acquisition and Break Command

When the module is acquiring, the command buttons change state to reflect acquisition in progress. Note that the Settings, Playback and Exit buttons are temporarily disabled. Time, frames acquired and the disk array progress bare are periodically updated.

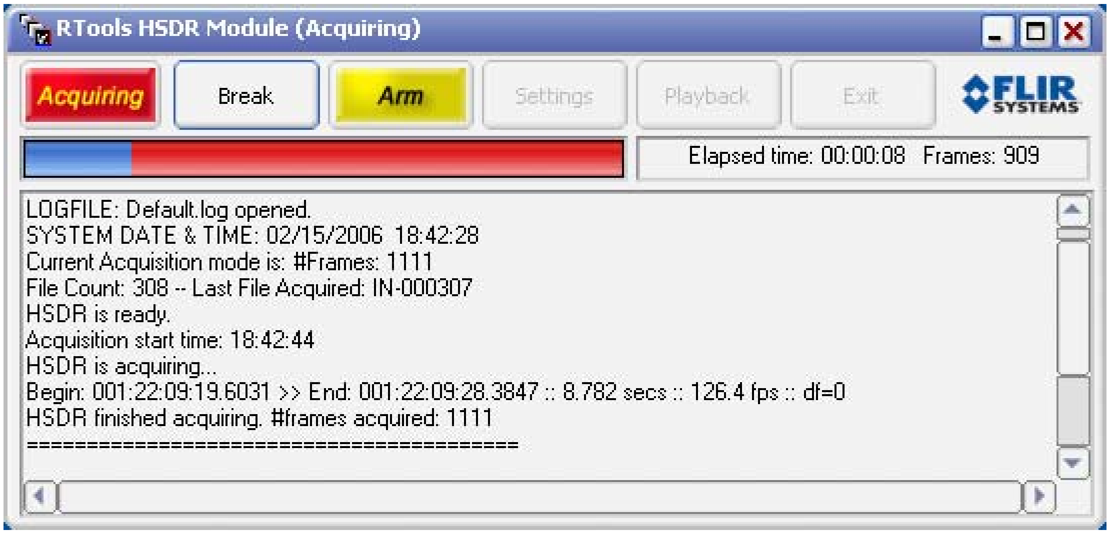


Figure 82 – HSDR module acquiring

During acquisition, the break button is active. This command button will break out of an acquisition and return the module to its ready state. For example, a 1 hour long acquisition is 20 minutes from completion. The ‘Break’ button is pressed. The module stops the current acquisition at approximately 40 minutes and returns the module to the ready state. A 40 minute data acquisition is now stored on the disk system.

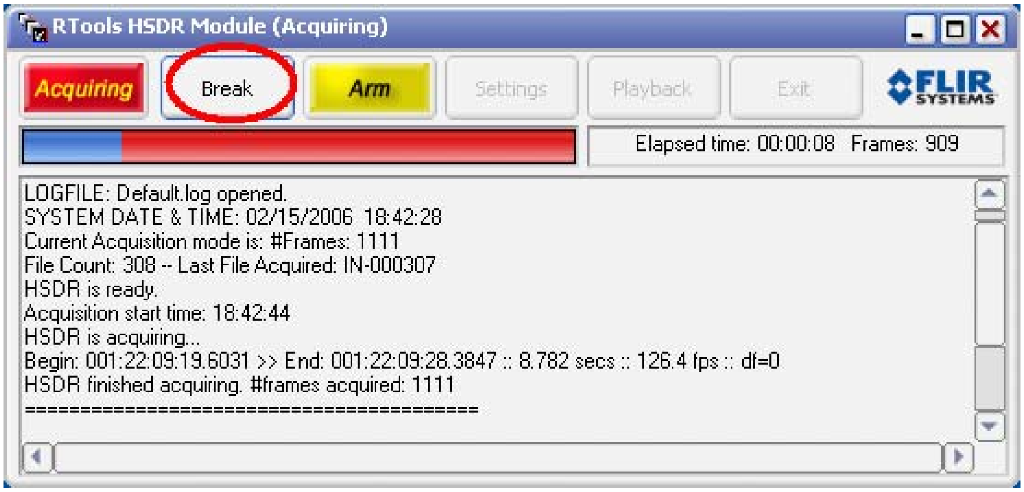


Figure 83 – Acquisition break button

6.3 Arm/Armed Command Button

Just like the main RDac panel, the HSDR module can be triggered via a remote start. Pressing the 'Arm' button places the module in an armed & ready for trigger mode. Press the 'Armed' button to disarm the module. See the section describing the remote start for more details about the remote start trigger hardware

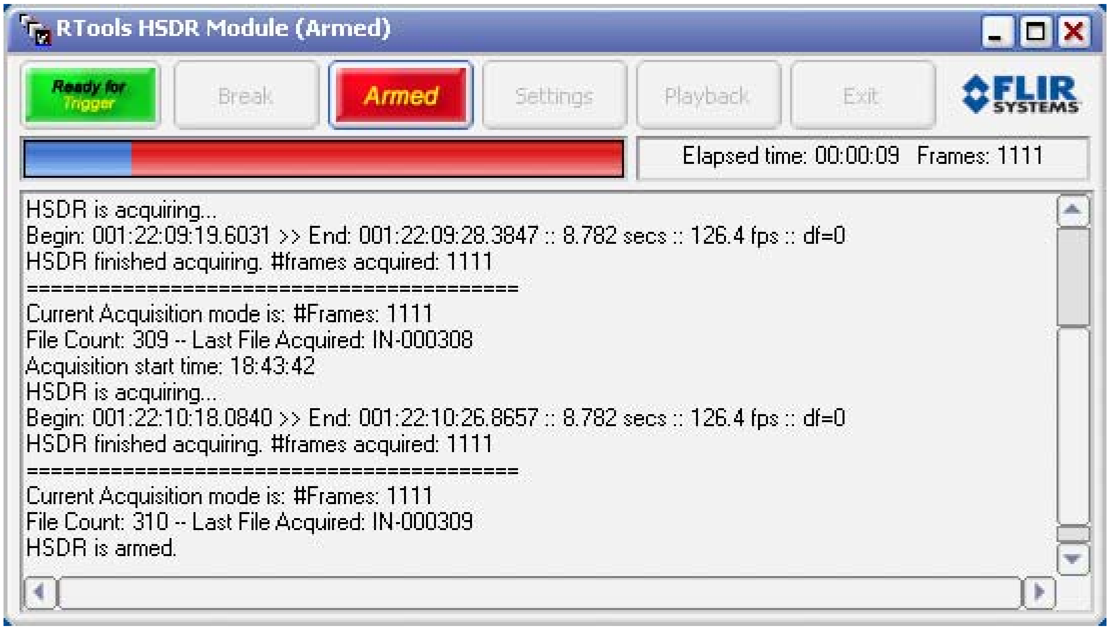


Figure 84 – HSDR module in Armed mode

6.4 HSDR Settings

While most relevant settings are reached and maintained through the main RDac panel, some module specific settings are accessed via the ‘Settings’ button. Module specific settings include data file naming, acquisition options’, a system log file, clear the system status window, launching the help file and the about box. Each option can be accessed by pressing the appropriate command button.

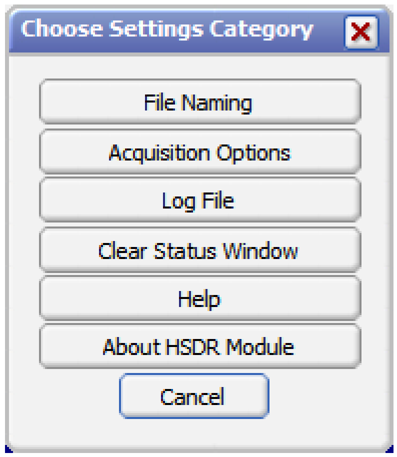


Figure 85 – Settings selector

6.4.1 HSDR Data File Naming

The data file naming settings are much the same as the primary RDac panel. The Edit Imager Code and Description List area allows the user to create, edit or delete new two character camera codes and associated descriptions. To add a camera code, type in a description in the top edit box, a two-character code in the smaller edit box and press the 'Add' button. To edit a code, highlight a code in the list box on the upper left corner, modify to taste and select the 'Edit' button. To delete a code, highlight the desired code and press the 'Delete' button.

File Names defines the data set base name format. Each field is optionally selected by checking the appropriate box. The Code is a two-character code descriptor for an imager. Extra Text can be any user defined text string. Count is a sequential increment value used to give data sets successive number IDs. The count can be controlled by the start and step values. Start is the first number in a series and step is the increment value. Time Stamp uses the first IRIG time in a data collection as part of the base name. If no file naming options are selected, the default base name is 'default_file.'

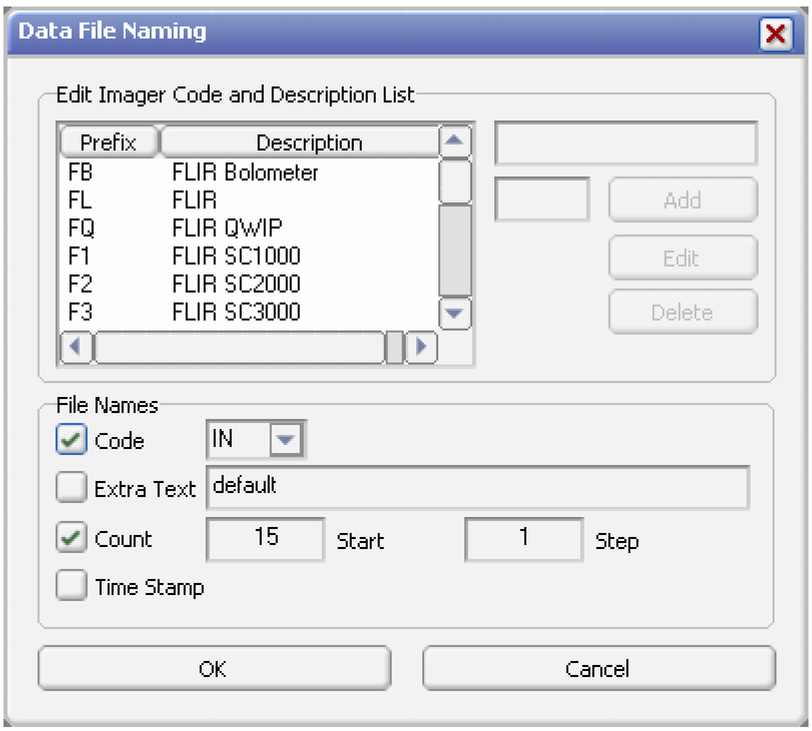


Figure 86 – Data file naming

6.4.2 HSDR Acquisition Options

The acquisition options duplicate the core acquisition modes normally available via the RDac main panel.

The Acquisition Mode area selects the type of collection performed. Number of Frames allows the user to select the specific number of frames to acquire. Note that two different values are maintained: Memory is the number to collect in memory and Disk is the number of frames to collect to non-memory devices. Time Span allows a specified time span of data to be collected regardless of number of frames or frame rate. The time span can be specified in either seconds or minutes. Remote Span allows the collection to be controlled via a remote trigger. As long as the trigger is engaged, RDac will continue to collect and store data. Periodic Rate allows the collection of periodic subgroups or bursts of data over an extended period of time. To use, specify the number of frames to collect per period, specify the interval to collect each subset in either seconds or minutes, and finally specify the number of subsets of data to collect to span the overall time period.

Note that remote start triggering is fully supported in both the HSDR module as well as the Main RDac-HSDR program.

The break button can be disabled with the 'Activate Break button' check box.

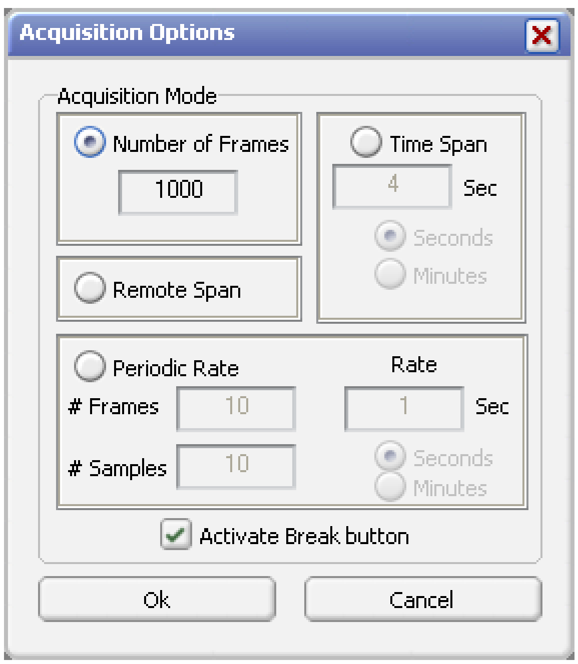


Figure 87 – Acquisition options

6.4.3 HSDR Event Log File

An event log file can be enabled to log actions performed in the HSDR module such as each acquisition with stats on number of frames acquired, time of start and time of end. Settings changes are also recorded. To use select the ‘Use Log File’ check box and enter a log file name. The extension .log will be added automatically. To reset a log file, just press the reset button.

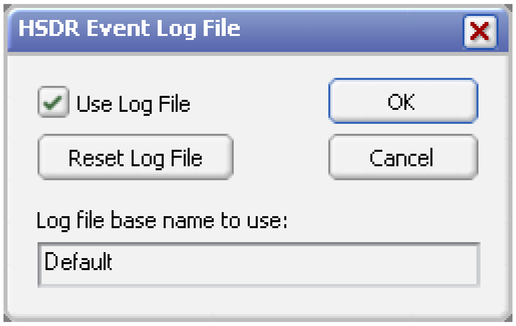


Figure 88 – Event log file dialog

6.4.4 HSDR Module About Box

The about box of the HSDR acquisition module.

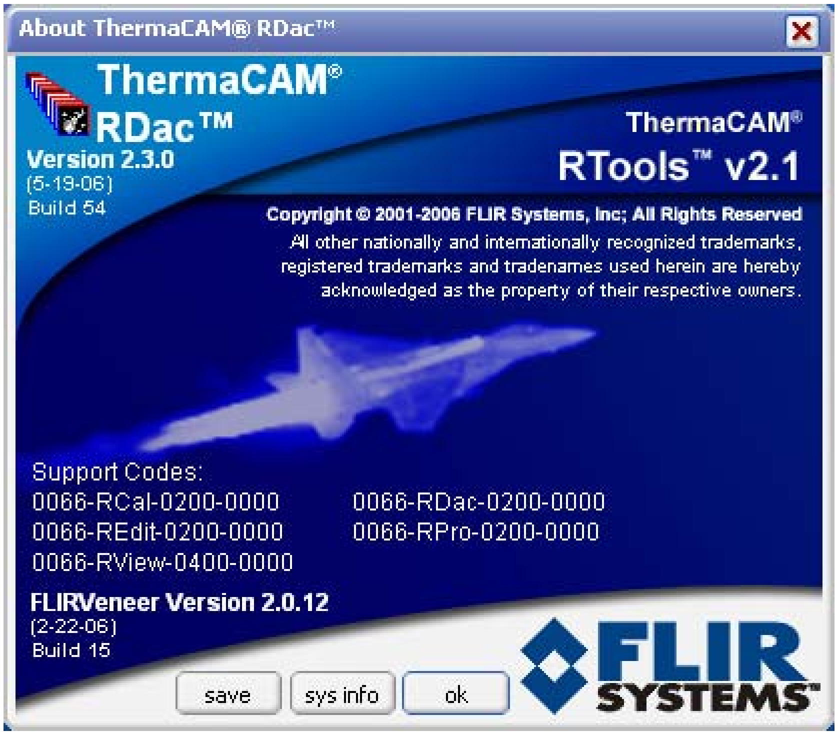


Figure 89 – About box

6.5 Playback

The MOVPlay/HSDR playback module is a separate program which is spawned from the Playback button. Note that it is not recommended to acquire data with the HSDR module while playback is occurring. For a more complete list of features and usage, please see the MOVPlay/HSDR user's manual.

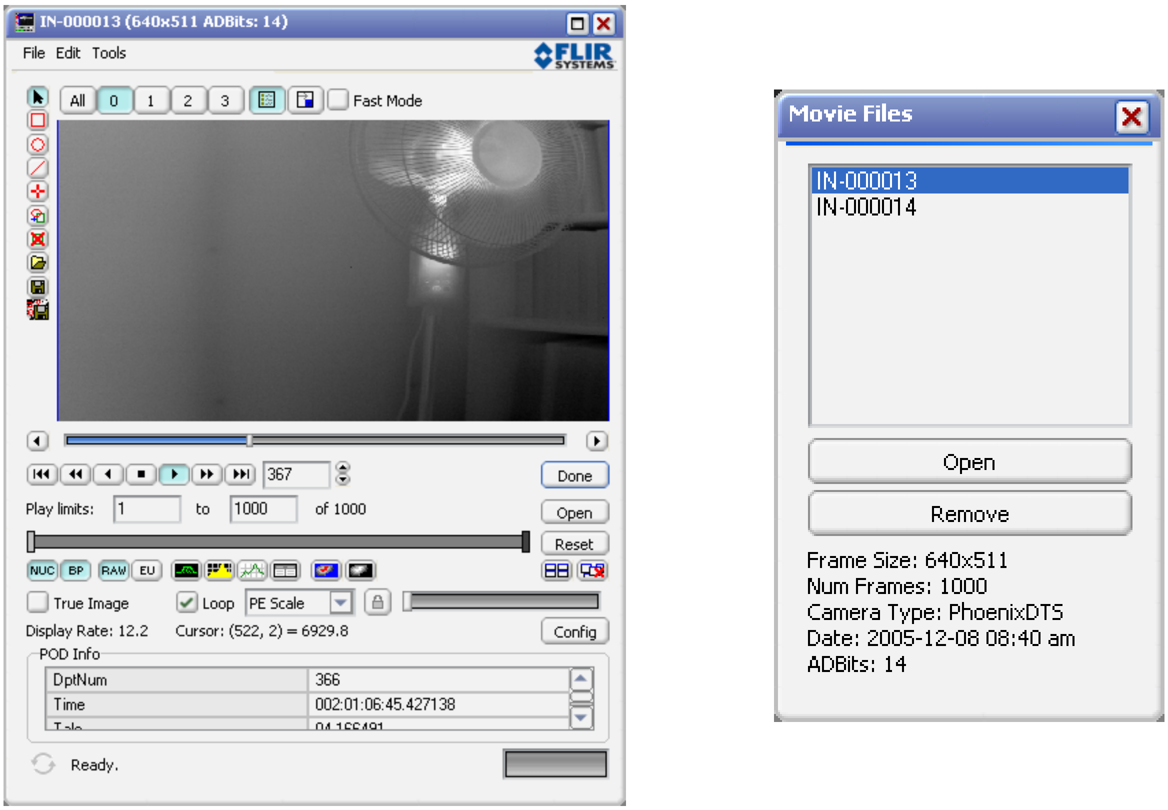


Figure 90 – MOVPlay/HSDR

7 RDac System Configurator

The RDac System Configurator is a separate module from RDac used to configure the RTools HSDR system to use either the FLIR SC6000 or the FLIR Phoenix DTS with either GigE or the HSRD system. It must not be run simultaneously with RDac-HSDR or MOVPlay-HSDR. Please exit out of both programs before running the Configurator.

The Configurator has 4 basic steps to select to reconfigure the system. Step 1 is the configuration to choose. Normally a system will have only one configuration installed. If more than one is installed, select the configuration to modify.

Step 2 is the GigE configuration. Again, normally only one system will be installed so the defaults should work fine. If more than one GigE device is present, select the appropriate 'device', 'adapter', and ip address. Note that the 'Refresh' and 'Test' buttons can be used in cases where devices are changed while the Configurator is running to update the settings display.

Step 3 is camera type. Currently only the FLIR SC6000 and the Phoenix DTS are supported. Note also that due to technical limitations, the system cannot acquire the last row of the Phoenix DTS. This limitation is handled automatically.

Step 4. Select window size. Select the desired window size. Please note that due to data clocking restrictions that the width should be a multiple of 4.

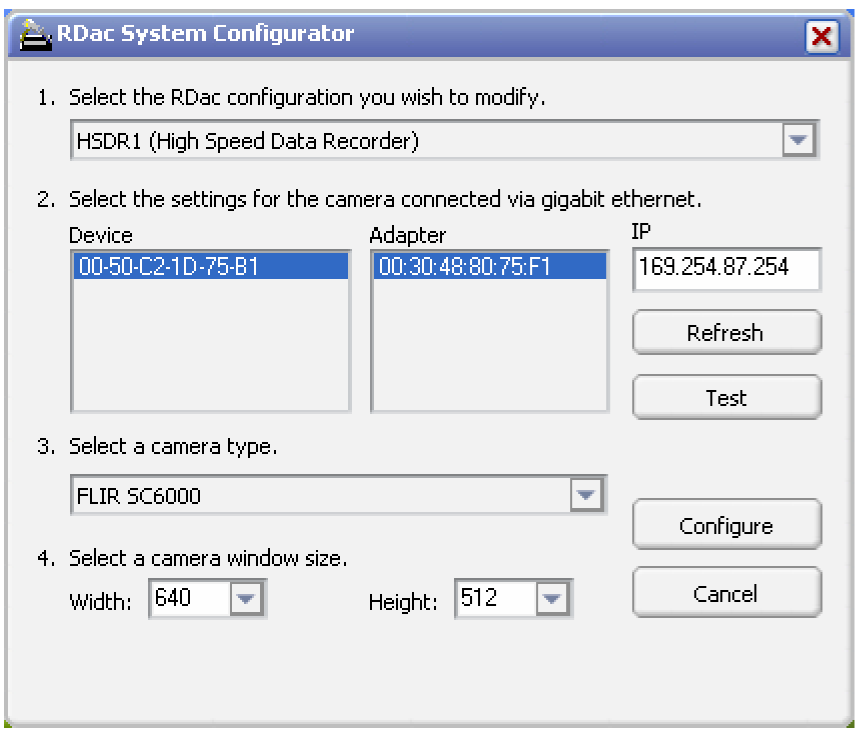


Figure 91 – RDac System Configurator module

Below is an example of the Configurator with the Phoenix DTS selected. Note the warning message concerning the last row limitation

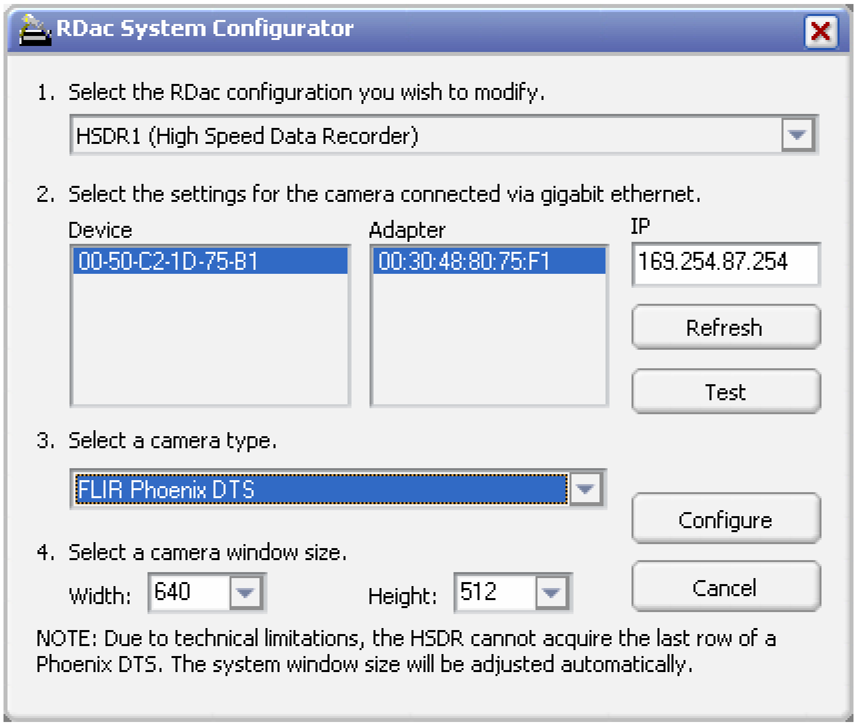


Figure 92 – Configurator with Phoenix DTS selected

After the desired settings are selected, press the configure button. The following warning will be displayed. ***Please make sure that all data previously acquired is backed up before continuing!*** This step permanently destroys any previous data acquired.

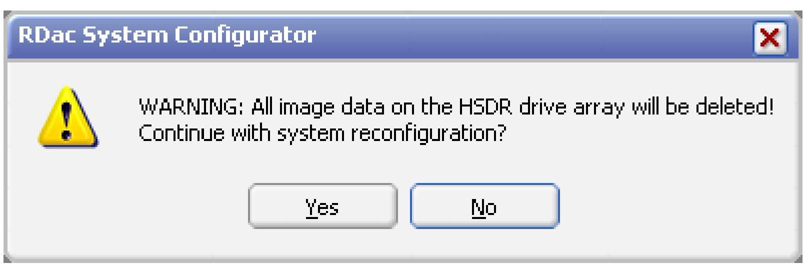


Figure 93 – Data erasure warning

Configuration can take up to a minute to perform. The following message will be displayed when done. At this point setup your camera to the desired settings using the camera controller software then restart RDac-HSDR and continue normally.

Figure 94 – Configurator is finished

8 Known Bugs

Software bugs: We attempt to ensure that the RTools software suite is as bug-free as possible, but – just like certain major operating system providers – we find it hard to be perfect. If you see a bug, please note the details of the problem, the circumstances leading up to the discovery of the problem, and email the information along with your contact information and a text dump from the about box screen to: rtools@flir.com. We will attempt to resolve the issue as soon as possible.

9 Appendices

9.1 Statistics and Calculation Algorithms

RDac works with SAF data files containing raw counts generated by the camera system. RDac is capable of converting Mean Raw to Mean Radiance and Mean Radiance to Mean Temperature in real-time. Temperature has three separate modes of calculation (Planck's equation, Curve fit, and Lookup table). General descriptions of the equations are described in the following sections. For further details, see the appropriate sections in the RView documentation.

Note: *All files must not include a path and must be located in the subfolder of the image movie.*

9.1.1 Adjusting Raw Counts

The raw counts are adjusted for NUC (Non-Uniformity Correction) and BP (Bad-Pixel) correction if those options are selected in the Control Panel (see user-interface for Control Panel). See the next Appendix section on details on how the Normalization/NUC arrays are derived from raw data collections.

9.1.1.1 NUC (Non-Uniformity Correction)

The header of the image movie needs to contain the following tags with valid filenames:

CGFILE (without the full path for the Gain file)

COFILE (without the full path for the Offset file)

Both files contain a two-dimensional array XPIXLS by YPIXLS (width and height of the image specified in header) that contains the gain and offset values for each pixel. If NUC is turned on, the pixel value is computed with the following formula:

$$CorrectedRawValue = RawValue \cdot Gain + Offset$$

9.1.1.2 BP (Bad-Pixel) Correction

Bad-Pixel files are generated by RDac using a normalized slope threshold algorithm to determine bad pixels in an image. The algorithm is described below:

To determine Bad Pixels:

Apply a programmable acceptance band (AB) to the Normalized Slope:

Min slope = normalized mean raw slope $\times \frac{1}{(1+AB)}$

Max slope = normalized mean raw slope $\times \frac{1}{(1-AB)}$

If slopes fall outside of this range, then consider them BAD pixels.

Example: If AB=0.25 then the bold and underlined values shown below would be bad pixels.

Normalized Slope to Mean Raw Slope

<u>0.63</u>	0.93	1.27
1.11	1.03	**<u>0.63</u>**
<u>0.71</u>	0.93	**<u>1.74</u>**

Bad Pixels are replaced by the first good pixel above them. In the case of bad pixels on the top row, an adjacent pixel is chosen to replace it. This method works satisfactory for larger images or Regions of Interest (ROIs). (See the next Appendix section for additional information.)

9.1.2 Converting Raw to Radiance

If the EURAW tag in the include file is set to ‘RAW,’ a conversion is needed to get radiance data values. If the EURAW tag is set to ‘EU,’ the data values in the image file are already converted to EUD.

Important Note *- Sub-frame information for the conversion formulas has been omitted for the sake of brevity. See the documentation on the FLIR SAF Addendum and the AMSC SAF specification for additional details on sub-frame use and detailed descriptions of tags and equations used below.*

9.1.2.1 Background Values

In order to subtract the background from the image, several tags need to be setup in the include file:

BGTYPE	None (no background assumed), Fix (a constant value), or File
BGFILE	Filename of Background file, used if BGTYPE = File
BGVALU	Constant value, used if BGTYPE = Fix

A Background file contains a two-dimensional array XPIXLS by YPIXLS (width and height of the image specified in header) that has a constant value to be subtracted in the EUD conversion for each pixel.

Note: *Background file must be the same size (XPIXLS by YPIXLS) as the foreground image.*

9.1.2.2 Conversion Formula

The following tags are required for the EUD conversion:

PolyOrder	Defines the polynomial order of the data reduction equation.
CoeffX	Floating point values used as coefficients for an nth-order polynomial equation. X=coefficient subscript used in the EUD conversion formula below.
TPFact	Transmission path factor, defaults to 1.0 if not present.

The formula is dependent on the value of PolyOrder:

PolyOrder = 0

Means raw data, i.e., no EUD algorithm applied

PolyOrder = -1

$$EUD = \left[\left(PixelValue - BackgroundValue\right) \cdot Coeff_1 \cdot TPFact\right] + Coeff_0$$

PolyOrder = -2

$$EUD = \left[\left(\left(PixelValue - BackgroundValue\right) \cdot Coeff_1\right) + Coeff_0\right] \cdot TPFac$$

PolyOrder > 0

$$EUD = TPFact \cdot \sum_{i=0}^{n} Coeff_i PixelValue^i$$

Example:

PolyOrder = 2

Pixel Value = 11300 counts

Coeff0 = 2.5e-004

Coeff1=5.2e-008

Coeff2=3.4e-007

EUD = 2.5e-004 + (5.2e-008*11300) + (3.4e-007*11300^2)

9.1.3 Temperature Algorithms

There are three algorithms for computing the temperature from radiance. There is the calculated method using Planck's equation, the curve fit using TempPolyOrder tags from the include file (generated by RCal), and the LookUp method using a table of temperature versus radiance.

9.1.3.1 Planck's Equation

The following equation is derived from Planck's equation using SBPUP and SBPLO from the POD file, or the include file.

Radiance ⇒ K (approximate):

$$\lambda = \frac{(SbpUp - SbpLo)}{2} + SbpLo$$

$$\delta = (SbpUp - SbpLo)$$

$$T_{emp} = \frac{1.43883E+4}{\lambda \cdot \ln\left[\frac{(1.191066E+4 \cdot \Delta \cdot \varepsilon)}{(L(\lambda) \cdot \lambda^5)} + 1\right]}$$

where ε is emissivity and L(λ) is replaced by the radiance for current pixel

The formula above will convert radiance into an approximate temperature in Kelvin. Celsius and Fahrenheit are calculated using the following formulas:

°C ↔ K:

$T_C = T_K - 273.15$, input either unknown and solve

°F ↔ °C:

$T_F = 9/5\, T_C + 32$, input either unknown and solve

9.1.3.2 Curve Fit

The following tags from the include file are required for Curve fit calculation:

TempPolyOrder	Defines the polynomial order of the temperature conversion equation.
TempCoeffX	Floating point values used as coefficients for an nth-order polynomial equation. X=coefficient subscript used in the temperature conversion formula below.

The formula follows the value of TempPolyOrder:

TempPolyOrder <= 0

No temperature algorithm applied

TempPolyOrder > 0

Pixel temperature (°C) $= \sum_{i=0}^{n} TempCoeff_i \cdot RadPixelValue^i$

In the equation above, RadPixelValue must already be reduced to Radiance [W/(sr · cm^2)]. The polynomial equation is derived from a curve of Temperature (°C) vs. Radiance using RCal.

Note: RadPixelValue is also divided by the Emissivity before running through this equation.

9.1.3.3 LookUp Table

RView will read in valid text files specified in the CAFILE tag in the include file to interpolate the temperature from radiance. These files must contain the line ‘Calibration Temps:’ and then have ‘Temperature(°C)   W/(sr·cm²)’ on some line after it. RView will then begin to read in the data in two-column format (temperature in the first column, radiance in the second).

Example CalFile:

Calibration Temps:	
Temperature(°C)	W/(sr·cm²)
15.000	1.192E-4
15.250	1.203E-4
15.500	1.215E-4
15.750	1.227E-4
16.000	1.239E-4
16.250	1.251E-4
16.500	1.263E-4
16.750	1.276E-4
17.000	1.288E-4

If radiance for a pixel is known, for example 1.231E-4, then the upper and lower bound is found for it in the radiance column. In this example, 1.231E-4 is between 1.227E-4 and 1.239E-4. A percentage is calculated to determine where 1.231E-4 is found in between 1.227E-4 and 1.239E-4:

$$Percentage = \frac{(RadPixelValue - RadLowerBound)}{(RadUpperBound - RadLowerBound)}$$

This is used to calculate the temperature:

$$Temperature = Percentage \cdot (TempUpper - TempLower) + TempLower$$

The temperature bounds are known by looking in the first column at the same row as the radiance bounds. So for the example:

$$Percentage = \frac{(1.231E-4-1.227E-4)}{(1.239E-4-1.227E-4)} = 0.3333$$

$$Temperature = 0.3333 \cdot (16.0 - 15.75) + 15.75 = 15.8333^{\circ} C$$

9.1.4 Statistics Table Formulas

Mean:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$, where x is pixel value (counts, radiance, …), number of pixels = n

Standard Deviation:

$$S = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}}$$

Sum of Pixels:

$$S_p = \sum_{i=1}^{n} x_i$$

ROI Statistics:

ROI Area (cm^2) = Single Pixel Area (cm^2) · n

Max. – return maximum pixel value (counts, radiance, …) in ROI

Min. – return minimum pixel value (counts, radiance, …) in ROI

Radiance Intensity formula:

$$Intensity = Area_{pixel} \sum_{i=1}^{n} L_i$$, where L is the pixel value in radiance

Single Pixel Area:

$$Area_{pixel} = [(IHfov \cdot SltRng) \cdot (IVfov \cdot SltRng)]$$

however, Area needs to be converted to cm^2

$$\Rightarrow [(IHfov \cdot 10^{-6}) \cdot (SltRng \cdot 10^{2})] \cdot [(IVfov \cdot 10^{-6}) \cdot (SltRng \cdot 10^{2})]$$

Note: This equation converts IHFO and IVFOV from μradians to radians and SLTRNG from meters to centimeters.

9.1.5 Line Profile Calculation

The line profile calculation uses the IHFOV, IVFOV, and SLTRNG tags found in the POD file or the include file (if not present in the POD file).

The distance of each pixel in the line segment to the endpoint is broken up into its horizontal and vertical components.

$$L_h = (x_1 - x_2) \cdot IHfov \cdot SltRng \cdot 0.000001$$

$$L_v = (y_1 - y_2) \cdot IVfov \cdot SltRng \cdot 0.000001$$

This converts IHFOV and IVFOV from *µrad*. to radians and finds the lengths in meters. The actual distance is found using the distance formula:

$$Length = \sqrt{L_h^2 + L_v^2}$$

Important Note: To calculate the length as an angle in radians, the same equation is used without SltRng.

9.2 Normalization/NUC Calculations

Assumption: *All NUC gain values=1.0 and NUC offset values=0.0 when starting this procedure.*

Collect Uniform Cold and Hot Sources (Average at least 10 of each)

Example data:

Raw Cold

4.00	6.00	7.00
8.00	6.00	3.00
4.00	5.00	9.00
	Raw Cold Mean =	5.78

Raw Hot

8.00	11.90	15.00
15.00	12.50	7.00
8.50	10.90	20.00
	Raw Hot Mean =	12.09

Determine Normalized Gain for NUC

Raw Hot - Raw Cold = Raw Slope

4.00	5.90	8.00
7.00	6.50	4.00
4.50	5.90	11.00
	Mean Slope =	6.31

Normalize Slope to Mean Raw Slope

0.63	0.93	1.27
1.11	1.03	0.63
0.71	0.93	1.74

NUC Gain (Gain File)

1.58	1.07	0.79
0.90	0.97	1.58
1.40	1.07	0.57

To determine Bad Pixels: (BP File)

Apply a programmable acceptance band (AB) to the Normalized Slope:

Min slope = normalized mean raw slope $\times \frac{1}{(1+AB)}$

Max slope = normalized mean raw slope $\times \frac{1}{(1-AB)}$

If slopes fall outside of this range, consider them BAD pixels. Example: If AB=0.25, the boxed values would be bad pixels.

Determine Offset for NUC

Raw Cold * NUC Gain = Gain Corrected Cold

6.31	6.42	5.52
7.21	5.83	4.73
5.61	5.35	5.16
Mean Gain Corrected Cold		5.79

NUC Offset (Offset File)

-0.52	-0.62	0.27
-1.42	-0.03	1.06
0.18	0.45	0.63

Note: For IR imagers, NUC offset values can be integers

Check: Raw * NUC gain + NUC offset

5.79	5.79	5.79
5.79	5.79	5.79
5.79	5.79	5.79

Check: Hot Raw * NUC gain + NUC offset

12.10	12.10	12.10
12.10	12.10	12.10
12.10	12.10	12.10

To update NUC offset after the fact, follow these steps:

1. Acquire another uniform raw cold source (at least an average of ten frames)
2. Apply original NUC gain and offset to raw cold image
3. Calculate mean of image created from step 2
4. Calculate new NUC offset correction terms to add to original NUC offset correction

New Cold RAW after NUC correction using gain and offset tables above

6.00	6.10	5.50
5.80	5.79	5.80
6.00	6.20	5.50
	Raw Cold Mean =	5.85

New NUC adjustment terms to be added to original NUC Offset table

-0.15	-0.25	0.35
0.05	0.06	0.05
-0.15	-0.35	0.35

9.3 Normalization File Formats

A camera normalization sequence will create three basic files: a gain file - *.SCG, an offset file - *.SCO, and a bad pixel file - *.SBP. All values are packed (no padding bytes). Each file type will have the following binary header and an associated data array as defined on page 2.

Name	Size	Description	File Vers.
Version	BYTE	File version # (current version = 2) This will be changed if this header is modified/revised	1
FileType	BYTE	File type: **0** = Basic Gain File **1** = Basic Offset File **2** = Basic Bad Pixel File • Other file types may be defined in the future. • New data types (32bit offsets for example) would require a new file type	1
NumX	WORD	Number of rows	1
NumY	WORD	Number of columns	1
Super frame #	WORD	Sub frame number = **0**, **1**, **2**, **3**. If non super frame, this is 0	1
IRIG	char[18]	Irig time string as *ddd:hh:mm:ss.mmmm* (null terminated)	1
CalType	BYTE	Calibration type: **0** = Basic 1 point **1** = Basic 2 point **2** = Update Offset **3** = defaults • Other calibration types may be defined in the future	2
NormAlg	BYTE	Normalization algorithm type **1** = Version 1 (04/17/00) • Other algorithms may be defined in the future	2
BPHandling	BYTE	Bad pixel handling algorithm type **1** = Basic pixel substitution • Other algorithms may be defined in the future	2
NumAvg	WORD	Number of frames averaged	2
BPTolerance	Float	Bad pixel tolerance, ± value based around normalized mean slope	2
OriginalName	char[128]	Original file name (null terminated) • This is the file name from the original normalization collection process	2
AverageFile	char[128]	Average data file name (null terminated) • This is the name of a file of averaged raw	2

		data as a SAF file • If the file type is a 1-pt, only a *.**CLD** will exist • If 2-pt, both *.**CLD** and *.**HOT** will exist • If update correction, only *.**UPD** • If this is blank, no external file exists	
PreviousFile	char[128]	Previous file, this one replaces (null terminated). Allows history tracking of normalization process	2
Gain File Data			
Gains	float[X*Y]	Gain array of values normalized to 1.0	1
Offset File Data			
Offsets	short[X*Y]	Offset array of signed values	1
Bad Pixel File Data			
BPFlag	BYTE[X*Y]	Boolean array where 1 = bad pixel and 0 = ok	1
BPSub	DWORD[X*Y]	Offset addresses for pixel substitution	2
BPsfSub	DWORD[X*Y]	Offset addresses for super frame pixel substitution	2

Example application of bad pixel file:

```
For pixel 1 to pixel n
    If (not bad pixel)
        data pixel = (int)(raw pixel * gain) + offset
    else
        do bad pixel algorithm
end for
```

9.4 FLIR Systems Addendum to SAF File Tags

The following is an addendum to the AMSC SAF format to reduce image data for ‘Super Frame’ imagers. In addition, it defines tags necessary to perform pixel temperature calculations given the appropriate polynomial coefficients and pixel radiance values.

New Tag	Type	Definition
EuRAW_Y	Text	Defined by AMSC SAF except the “_Y” denotes Sub-Frame starting w/ index 0
DaUnit_Y	Text	Defined by AMSC SAF except the “_Y” denotes Sub-Frame starting w/ index 0
StdUnt_Y	Int8	Defined by AMSC SAF except the “_Y” denotes Sub-Frame starting w/ index 0
CoeffX_Y	Float	Floating point values used as coefficients for an nth-order polynomial equation. X=coefficient subscript as defined by the EUD equation shown in PolyOrder tag description and Y=SubFrame value starting with index 0. ***Important:*** *Read Special Cases under the PolyOrder tag description below.*
PolyOrder_Y	Int8	8-bit signed integer that defines the polynomial order of the data reduction equation. For example, this value is equal to 1 if the user has provided Coeff0_Y and Coeff1_Y and wants the data reduced using a first order polynomial equation. _Y denotes sub-frame number Special Cases: • PolyOrder_Y = 0 means raw data, i.e. no EUD algorithm applied. • PolyOrder_Y = -1 means use the AMSC EUD equation defined in the SAF document. However, the following lists replacement tags: SclFac replaced by Coeff1_Y where Y=Sub-Frame number of a Super frame starting with 0 OffCor replaced by Coeff0_Y BgType replaced by BgType_Y BgValu replaced by BgValu_Y BgFile replaced by BgFile_Y EUD = [(PixelValue – BackgroundValue_Y)*Coeff1_Y*TPFact] + Coeff0_Y • PolyOrder_Y = -2 means use a modified version of

		the AMSC EUD equation defined in the SAF document. This version multiplies every term of the SAF EUD equation by TPFact. The original SAF EUD equation (shown above with PolyOrder=-1) doesn't multiply OffCor/Coeff0_Y by TPFact. The following shows the deviations from the SAF document: SclFac replaced by Coeff1_Y where Y=Sub-Frame number of a Super frame starting with 0 OffCor replaced by Coeff0_Y BgType replaced by BgType_Y BgValu replaced by BgValu_Y BgFile replaced by BgFile_Y EUD = [((PixelValue – BackgroundValue_Y)*Coeff1_Y) + Coeff0_Y] * TPFact • PolyOrder_Y > 0 follow this data reduction algorithm: EUD = (Coeff0_Y + Coeff1_Y*PixelValue + Coeff2_Y*PixelValue^2 + Coeff3_Y*PixelValue^3 + …) * TPFact_Y
BgType_Y	Text	Defined by AMSC SAF except the "_Y" was added to denote Sub-Frame
BgValu_Y	Float	Defined by AMSC SAF except the "_Y" was added to denote Sub-Frame
BgFile_Y	Text	Defined by AMSC SAF except the "_Y" was added to denote Sub-Frame
SubFrame	Int8	Defines the Sub-Frame of the Super frame. This tag is found in the movie data file header
TPFact_Y	Float	Transmission path factor is as defined by AMSC SAF with _Y denoting Sub-Frame number.
TempPolyOrder_Y	Int8	TempPolyOrder_Y less than or equal to 0: no Temperature algorithm applied TempPolyOrder_Y > 0 follow this data reduction algorithm: Pixel Temperature [oC] = TempCoeff0_Y + TempCoeff1_Y*RadPixelValue + TempCoeff2_Y*RadPixelValue^2 + TempCoeff3_Y*RadPixelValue^3 + …

		Notes: For Temperature calculations the 'RadPixelValues' in the 'Pixel Temperature' equation above must be already reduced to Radiance [W/(sr-cm2)]. It is assumed that the polynomial equation was derived from a curve of Temp. [oC] vs. Radiance. Also, the emissivity associated with each pixel is not accounted for using the equation above. The viewing or processing software must provide a means to adjust the pixel emissivity. The Pixel Temperature is defined as degrees Celsius. The viewing or processing software is responsible for creating other units such as deg. F or Kelvin. _Y denotes Sub-Frame number.
TempCoeffX_Y	Float	Floating point values used as coefficients for an nth-order polynomial equation. X=coefficient subscript as defined by the Pixel Temperature equation shown in TempPolyOrder tag description and Y=SubFrame value starting with index 0

9.4.1 Data Reduction Equation Examples

EUD:

PolyOrder_0 = -1, BgType_0=Fix, and SubFrame=0:

$$EUD = [(PixelValue - BgValu\_0) \cdot Coeff1\_0 \cdot TPFact\_0] + Coeff0\_0$$

PolyOrder_0 = -2, BgType_0=Fix, and SubFrame=0:

$$EUD = [((PixelValue - BgValu\_0) \cdot Coeff1\_0) + Coeff0\_0] \cdot TPFact\_0$$

PolyOrder_1 = -1, BgType_1=None, and SubFrame=1:

$$EUD = (PixelValue \cdot Coeff1\_1 \cdot TPFact\_1) + Coeff0\_1$$

PolyOrder_1 = -2, BgType_1=None, and SubFrame=1:

$$EUD = [(PixelValue \cdot Coeff1\_1) + Coeff0\_1] \cdot TPFact\_1$$

PolyOrder_3 = 2 and SubFrame = 3:

$$EUD = (Coeff0\_3 + Coeff1\_3 \cdot PixelValue + Coeff2\_3 \cdot PixelValue^2) \cdot TPFact\_3$$

Pixel Temperature:

TempPolyOrder_4 = 2 and SubFrame = 4:

$$Temp = TempCoeff0\_4 + TempCoeff1\_4 \cdot EUD + TempCoeff2\_4 \cdot EUD^2$$