



2105 West Cardinal Drive
Beaumont, Texas 77705

IR Flash

Professional Thermal Image Analysis Software

Manual Version 2.0

**Infrared Cameras, Inc.
2105 W. Cardinal Drive,
Beaumont, TX 77705**

USER GUIDE

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This warranty does not apply to any component that has been disassembled, tampered with, or altered in any way or to any other component which has been subject to misuse, negligence, abnormal conditions of operation, or accident.

Infrared Cameras, Inc. will, at its option, repair or replace any such defective product free of charge if, upon inspection, it proves to be defective in material or workmanship and provided that it is returned to Infrared Cameras, Inc. within the said one-year period.

The user shall determine the particular use to which the product shall be applied and Infrared Cameras, Inc. excludes and disclaims any warranty that the product is fit for that use. Infrared Cameras, Inc. accepts no liability in the use and application of the camera.

An infrared camera system generates an image based on the heat (energy) signature of the target scene with all the error associated with non-contact radiometric measurements. A thermal infrared camera cannot determine or diagnose faults, problems, or ailments in any form. That determination must be made by the technician applying the camera technology in his/her specific application.

It is the responsibility of the user to obtain proper training in the use of the camera for their particular application including a working knowledge and understanding of any inaccuracy that is typically attributed to radiometric measurements.

ANY SOFTWARE APPLICATION PROVIDED IN THIS PACKAGE IS PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EXPRESSED OR IMPLIED. THE ENTIRE RISK LIES WITH THE USER FOR THE ACCURACY AND PERFORMANCE OF THE PROGRAM.

The original registered purchaser of this system is granted a limited, non-exclusive

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The Infrared Cameras, Inc package is self-contained and requires no maintenance beyond maintaining the viability of cabling etc. Ensure that the lens glass is protected from finger smudges and any object that can scratch the lens surface. This warranty does not include any damage done to the surface of the lens. To clean the lens, simply use a soft dry cloth.

WARNING

The camera is controlled by the software application and should never be unplugged from the computer while the software is running. The user should exit the software program normally before the camera is unplugged. This will safely shut the camera down. This is analogous to turning your computer off through the Windows software versus just hitting a switch to turn it off.

Failure to follow this process may result in the need for the manufacturer to re-calibrate the camera system and this failure is not covered under this warranty.

Technical support is offered free of charge to all registered users of Infrared Cameras, Inc. system for one year from date of invoice. Whenever you require technical support you may be asked to provide the serial number of your package before support is granted.

We suggest you thoroughly read the User's Manual before you call for assistance. If the User's Manual does not answer your questions please call Infrared Cameras, Inc. If you are having problems with the software please note any errors messages you receive and have them available at your call.

User support is available by phone, email or in person at the offices of Infrared Cameras, Inc. office during normal working hours.

User support is free of charge on issues relating to interpretation of the help files, the proper operation of the software, routine maintenance and warranty service. Consultation is generally not available through this user support service on computer and operating system problems, image interpretation problems, fault diagnosis, system modifications or application specific issues, particularly those outside the field of this program.

Infrared Cameras, Inc. reserves the right to determine, at its sole discretion, the extent of user support made available to any user.

Section 2:

System and Camera Introduction

2.1: Introduction

The Infrared Cameras, Inc package includes a state of the art thermal infrared imaging radiometer that is unique in design offering an integrated process monitoring imaging system that includes the camera unit, and a dedicated software program. The core technology used in the system is the latest in thermal imaging technology using a microbolometer 320×240/640×480 focal plane array, Vanadium Oxide technology base ensuring the best thermal and spatial resolution in the industry. All control functionality is built into the software making sure that the Infrared Cameras, Inc package as versatile as can be developed for any and all process monitoring and control applications.

The data signal and communications is accomplished via the USB 2.0 port on the host computer. Camera configuration and operation control is accomplished via this line by the IR Flash software package. Both the data stream and the communication protocol is a proprietary format developed and controlled by Infrared Cameras, Inc.

The following information is for the ICI 9320P, the most common camera model at the time of writing. For information about other models, please contact your sales or technical representative.

Base IR Camera	Model ICI 9320 P
Manufacturer	Infrared Cameras, Inc.
Technology	Microbolometer
Material	Vanadium Oxide
Spectral Response	7-14 um
Contrast/Brightness	Software Controlled
Data Output	Digital USB 2.0
Thermal Time Constant	14 ms
Thermal Sensitivity	<30 mK
Frame Rate	30 fps
Pitch Size	17 um
Optics	25mm with 22° FOV
Array size	320×240 array
Focus	Manual Controlled

Camera Specification

The standard 25mm lens is a high quality F1.0 optic ensuring the highest image quality possible. The lens was chosen with a field of view that optimizes the general process control application. We also have a variety of optional of lenses that can be substituted in specific applications.

The system complies with UL/IEC 60601-1, CSA C22.2 No. 601.1, IEC 60601-1-1 only when used with a Computer and power supply that comply with the UL/IEC 60950 standard (i.e. A UL Safety Mark), and the Tripp-Lite model IS250HG isolation transformer with a rated supply voltage, Frequency, Power (from Isolation Transformer) of: 120 V, 60 Hz, 2.2 A.

It is recommended that the camera system be returned to Infrared Cameras, Inc, at minimum, once every six months and, at maximum, of every twelve months for recalibration.

2.2: Before You Begin

- 1 Examine the items for shipping damage. If damage is found, before proceeding, contact the delivering carrier's agent and proceed under his/her instructions.
- 2 Have the insurance agent inspect the damage and arrive at an agreement to repair or replace the damaged item.
- 3 If replacement or repairs are required, call the engineering office of Infrared Cameras, Inc. as soon as possible for return authorization. In the case of damage, be sure to repackage it in the original shipping carton before shipping.

2.3: Software Installation

The installation of this software program is made easy with the use of the installation program "INSTALL" provided on the program disk or USB flash drive. Place the program disk into your CD or DVD drive in your computer (or plug the USB into a USB port) and the installation program will automatically start if the auto-run feature of your drive is enabled. If the install does not automatically start or you are using USB, go to "My Computer" and double-click on the letter of the drive that contains the installation CD or USB. Next, find and double-click on the Install program icon. Once the install program has started, you will be guided through installation process.

When the INSTALL is done the program will be completely installed and a note will appear

telling you that the installation is complete. Hit any key and you are ready to begin running the **IR Flash** program.

2.4: System Set-Up:

There is one main connector and mating cable supplied as part of the Infrared Cameras, Inc. camera system package. That cable is a standard USB 2.0 cable and must be connected to the back plate of the camera unit before operation.

In order for the camera and software to connect properly, the camera must be connected to the PC before starting the software. Please wait for the camera to be recognized by the PC and then open IR Flash.

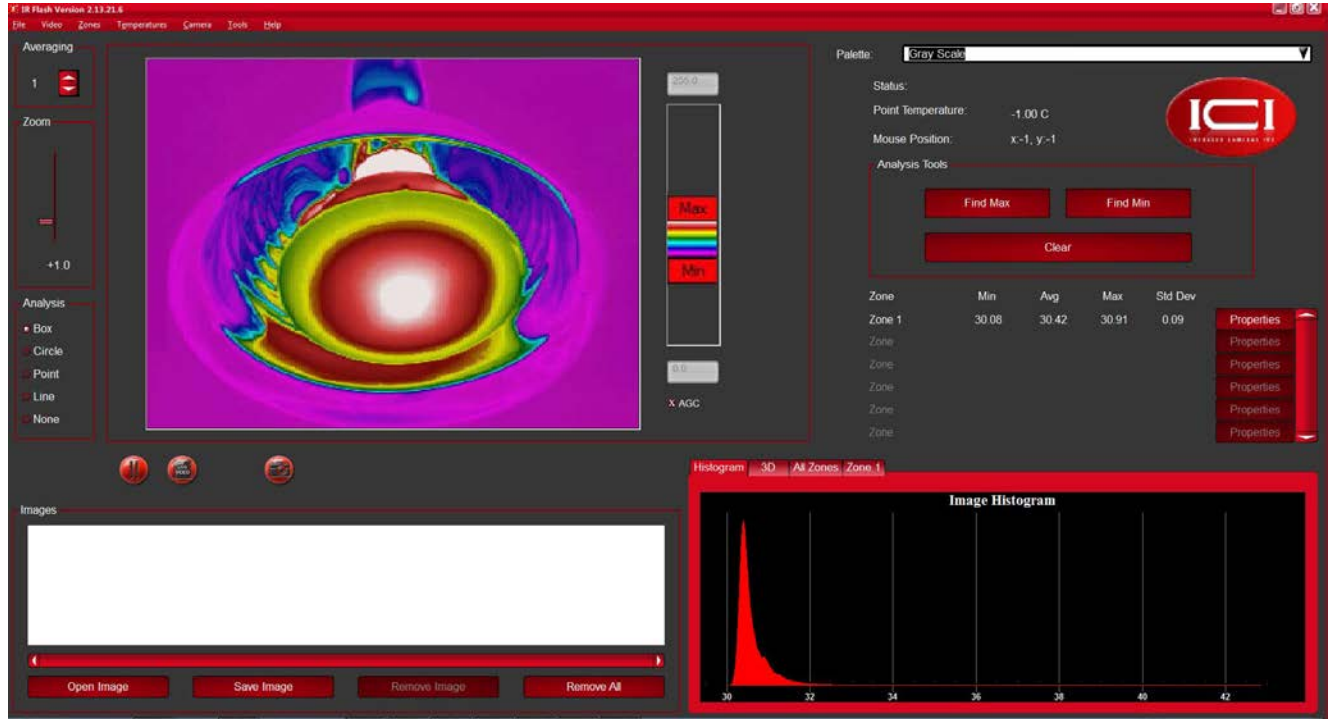
Section 3:

GENERAL OUTLINE

3.1: General Operation

The main operating screen will be referred to as the “Main Menu Screen” throughout this manual. This screen is the first permanent screen that appears when entering the program and is where all user activity will originate. The Main Menu and Control Bar options were organized to break the program into several logical functional groups. These groups will be introduced in detail in subsequent chapters. There is a chapter devoted to each Main Menu choice or an appropriate Control Bar option.

First note that before a complete menu presentation is available, you must load an image into the software system or have the camera running in live video mode. Once the camera is plugged into the USB port on the computer this live video should commence. To load an image simply select the LOAD option from the File Main Menu selection and make a file choice as discussed in the File Chapter.



3.2: Layout

The layout of the software is based on one main screen shown above. The main image display area is located in the top left quadrant of the screen with control features found in the main menu line main screen and appropriate sites within the main screen. To view the image shown on the main screen at full-screen resolution, double click the left mouse button while on the image. To return to the normal main screen display, again double click the left mouse button on the image.

Section 4:

Miscellaneous Features

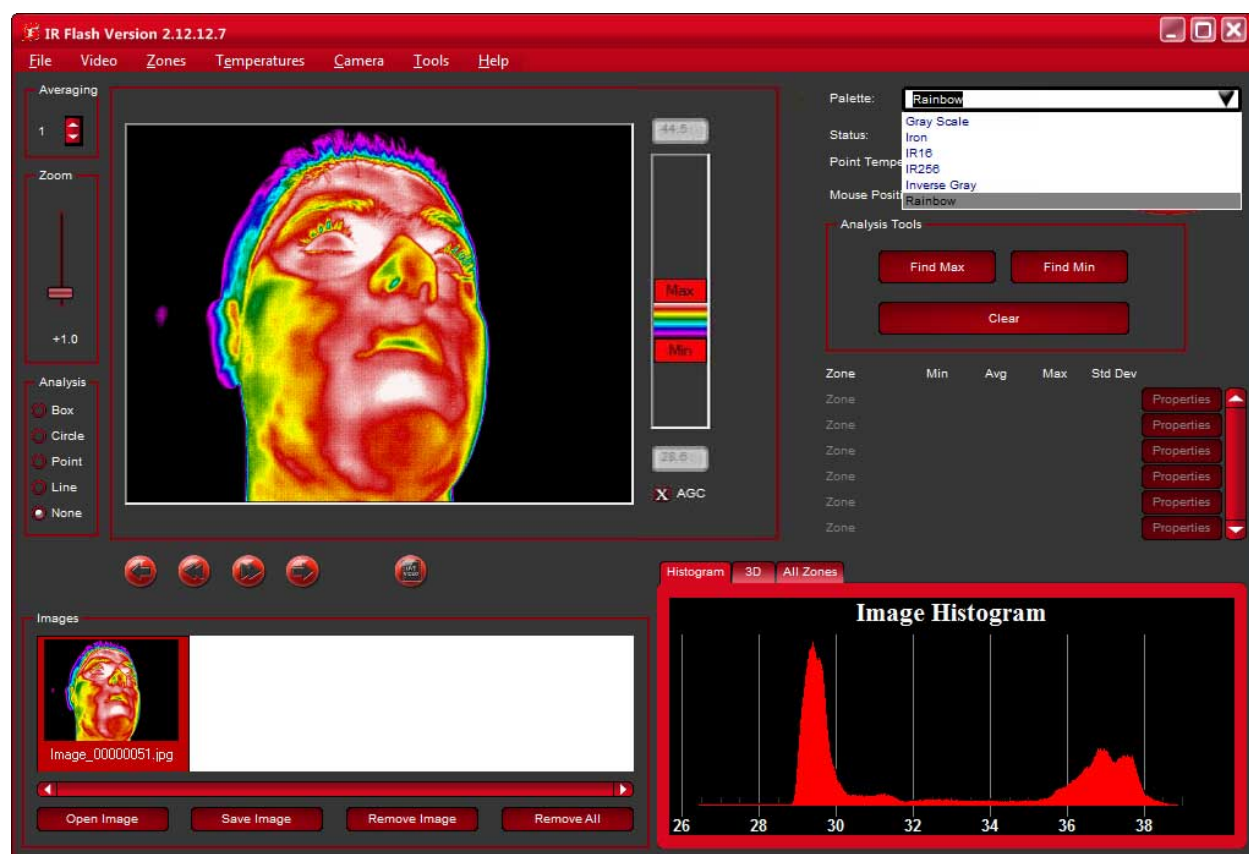
4.1: Introduction

The following is a listing of several features found in IR Flash that do not require a separate chapter to describe. The Miscellaneous Chapter lists these features as you might find them on the main screen.

4.2: Select IR Color Map

In many situations, it is advantageous to view black and white images in the color scale. In fact, many image processing users select their equipment specifically based on its ability to add false color to black and white imagery.

The Color Palette section allows you to completely control the color palette by which the current image is displayed, saved, and printed. The Color palette selection control is a drop down menu located to the top and right of the image display area as shown below.

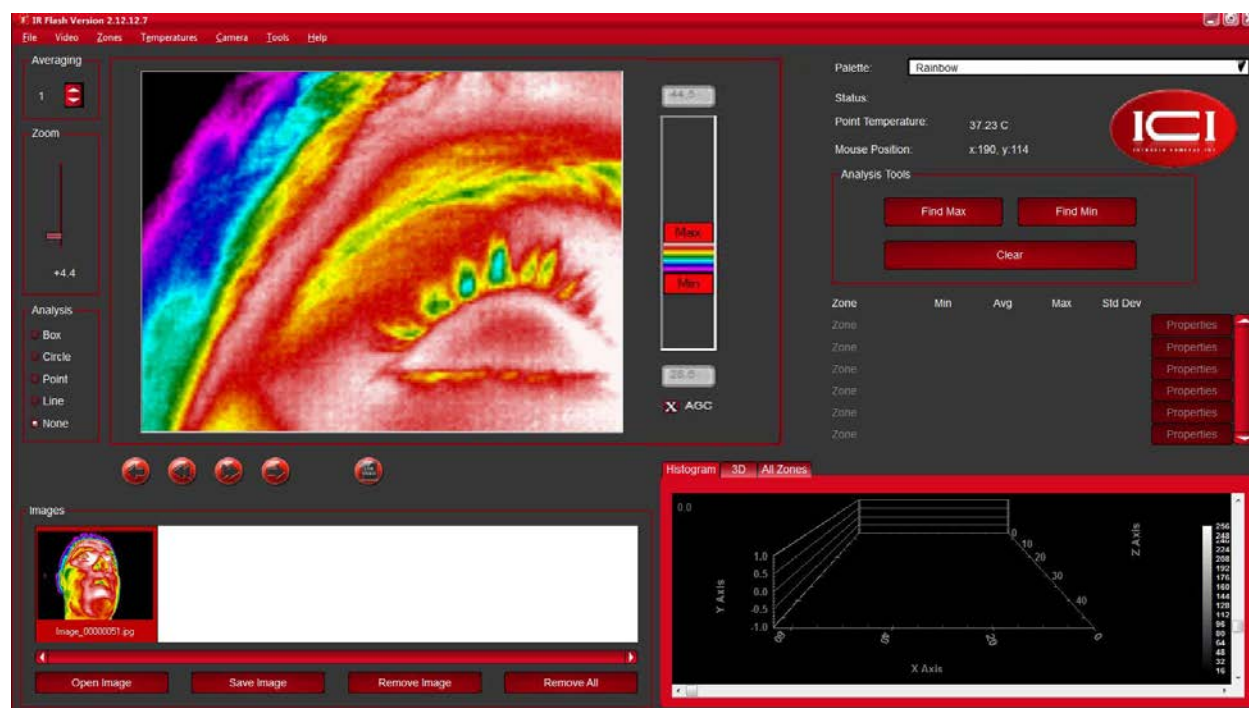


4.3: Image Averaging

The Image Average button will average all the images from the camera into a single displayed image. The Image Averaging control is located at the top left of the main image display area. Adjust the number of frames you want averaged.

4.4: Zoom

The Zoom function allows the zooming of the image data currently on screen and is set by the employing the Zoom Slider control. This control is found to the left of the image display area just below the Image Averaging control.



4.5: Manual Capture

Along the bottom of the Image display screen you will find a Pause button and a Capture button. The Pause button will simply Pause continuous image display and show the image where the Pause button was pressed. In contrast, the Capture button will capture an image from the Live display and move it to the captured image group shown to the right center of the main screen. You can capture as many images as needed and save them once your imaging activity is complete. You can move through the captured images using the slider controls located to the bottom of the capture image group display. Additionally, you can move an image in the captured group to the main image display by moving the cursor over the desired image and clicking the left mouse button. To return to live video, select the Live Video Icon at the bottom of the main image display.

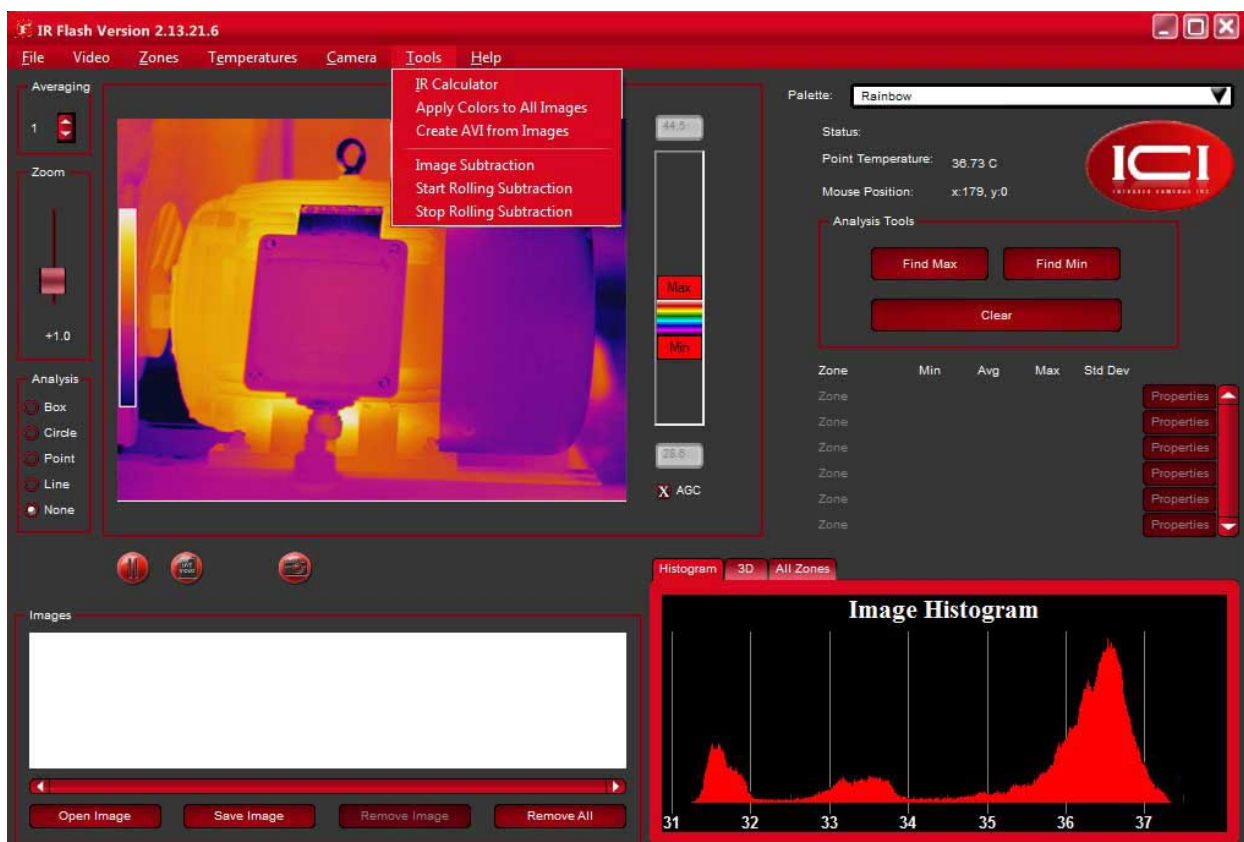
4.6: Image Display Control

To the right of the image display area are a group of controls used to fine-tune the way the images are presented on screen. At the bottom of these controls is an AGC radio button (Automatic Gain Control). If this button is marked, the display will occur in the AGC mode. If not set, the Center and Span Slider controls will activate. The user will then have complete control of how this image is displayed. The temperature numbers will not change however, how these temperature are represented in the image will change (the color or shade of grey used for a particular temperature may change).

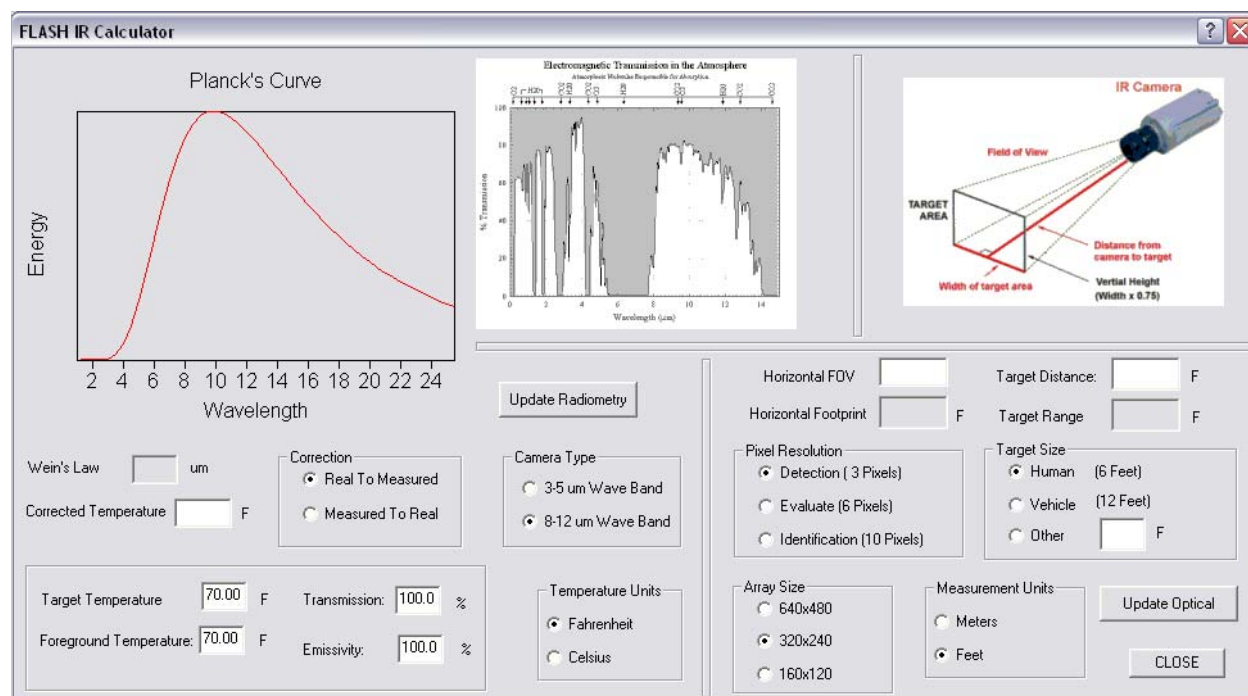
4.7: IR Calculator

IR Flash includes a calculator that provides the specialist a resource to determine the theoretical radiometric effects of Emissivity, Reflection, and Transmission on radiometric temperature values. Additionally, the second half of the Calculator allows the user the ability to adjust imaging parameters from an optical point of view.

The IR Calculator is found under the Tools main menu choice:



The right half of the Calculator screen provides the input and output controls for Radiometry including Wiens Law values and the Planck Equation plot. The right side contains the input and output controls for the optics portion of the calculator.



4.8: “Apply Color to All Images”

Under the “Tools” menu option is “Apply Color to All Images.” This will apply any changes made with the Color Palette and the Max/Min range in the center of the window to all of the images in the Images window in the lower left of the window.

4.9: GPS Meta-Data

IR Flash software currently supports the USGlobalsat Corporate model BU-353S4 USB GPS receiver to record GPS meta-data (longitude, latitude, and altitude at the time the image is taken).

The BU-353S4 uses the SiRF Star IV chip for GPS communication. While other USB GPS devices with the same chip *may possibly* work, this model is the only one guaranteed to be compatible with IR Flash.

Recording the GPS meta-data is enabled as soon as the device is plugged in and recognized by the computer. When recognized, a notification will temporarily appear in the IR Flash window to confirm. Data recorded and added to the saved images includes the longitude, the latitude, altitude, and direction of travel.

North-Up Image Rotation

On the “Loading and Saving” tab of the “File >> Setup” menu option is “Automatically rotate images if GPS information is found.” When enabled, images that include GPS location data will automatically be rotated with North in the image up.

Section 5:

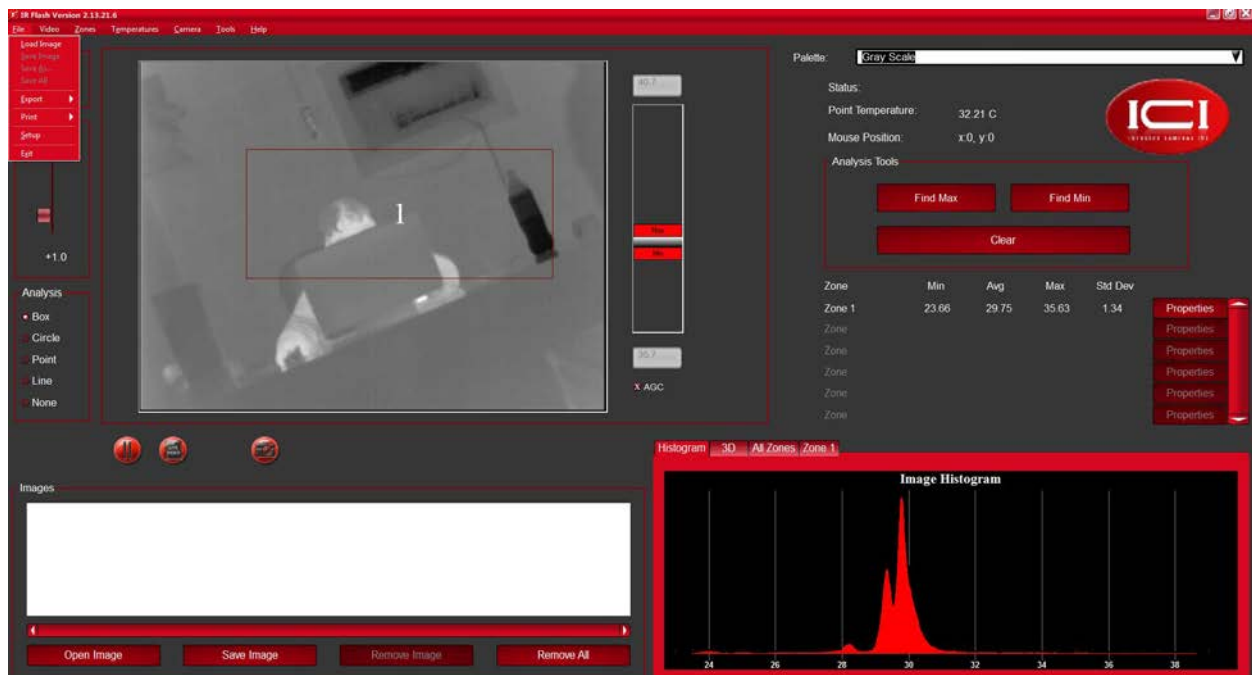
File Options

5.1: Introduction

The series of File Control functions that will be described below are provided to allow you to bring images into the system and manage their display. These File Control features are found in the first of the menu line items found at the top of the main screen page.

The File selection group consists of the following main sub-menu options:

- Load Image
- Save Image
- Save As
- Save All
- Export
- Print
- Setup
- Exit



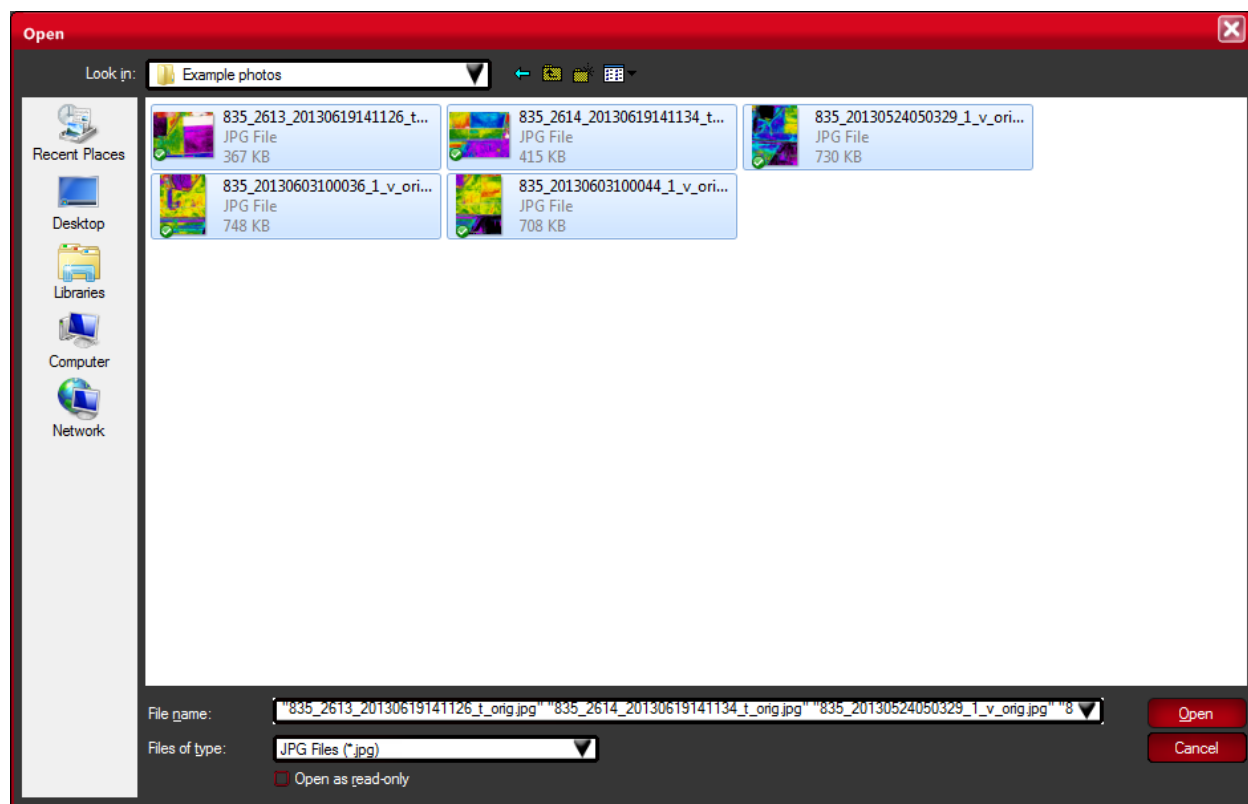
5.2: File Menu Choice: Load Image File

The Load selection is used to recall images that have previously been stored as digital data files on some storage media. The first step is to specify the file name of the image you wish to load into the program. A File Choice Window, as described below, will appear listing all files saved under the appropriate file format. Make your selection as described in the File Choice Window discussion. The Load function knows if the image you are loading is a single image or a series of images (See Series).

The File Choice Window provides the opportunity to browse through the image files currently on disk and make the image file selection through menu control. Note that the File Choice Window is a standard Windows dialog box and operates accordingly. Of particular interest is the "List File Type" field. This section allows you to select which file formats you wish to access.

To make a file choice you must gain control over the appropriate File, Directory, and Drive sub-windows. This is simply done by placing the cursor within the sub-window and proceed with the selection process. Once in the File sub-window for example, scroll through the file names listed, by using the cursor on the scroll bar on the right side of the window. By making a selection on ".." in the Directory sub-window, additional directories will be listed. Upon selection of a new directory a corresponding list will appear for the image files in that directory. An alternate drive can also be accessed using the drive sub-window by pressing the appropriate designation such as "A".

When a file of interest has been found, place the highlight at the file name location and click the left mouse button. When the image file has been selected the name will appear in the current file field. By pressing the OK button the file will be loaded and displayed on the image screen. The Cancel button can be used to exit the window without making a file choice.



5.3: File Menu Choice: Save Image File

The Save function allows you to archive any image brought into the program by storing it on the storage media of your choice. When the Save selection is made, a File Choice Window will appear with a prompt to assist you in entering a filename for the new image file. At the prompt enter the filename without the extension. As with Load Image, you must select which one of the many file formats available the image will be saved under.

5.4: File Menu Choice: Save As

The Save As option allows you to save the current image under a new file name. This allows you to make duplicate files without disturbing the original data file.

5.5: File Menu Choice: Save All

The Save All feature will save the entire image package currently in service. This feature will save these as a series.

5.6: File Menu Choice: Export File

You can export image data to two file types. The first is a MS Excel spread sheet file at a resolution that is allowed by Excel. The second file type is a CSV file which is an ASCII text file with the image placed in 240 rows of data with each row containing 320 data temperature data points (pixels).

The screenshot shows a Microsoft Excel spreadsheet titled 'Template1 (Compatibility Mode) - Excel'. The spreadsheet contains a grid of numerical data points. The data is organized in rows and columns, with a logo in the top left corner. The data points are arranged in a grid that is 240 rows high and 320 columns wide. The data points are numerical values ranging from approximately 30.00 to 30.25. The spreadsheet is displayed in 'Compatibility Mode' and includes various toolbars and menus.

Image Data Exported to Excel

The screenshot shows a Notepad window titled 'test.csv - Notepad'. The window contains a grid of numerical data points, representing the image data exported to a CSV file. The data is organized in rows and columns, with a logo in the top left corner. The data points are arranged in a grid that is 240 rows high and 320 columns wide. The data points are numerical values ranging from approximately 18.00 to 18.25. The CSV file is displayed in a plain text format.

Image data Exported to CSV file

5.7: File Menu Choice: Printing

The Printing option allows you print the current active image. Printing will be accomplished using defined parameters specified in the configuration section for your printer. Printing will occur in the color palette set in the program and will be placed on the page as defined by you in the Print dialog box. Set the size and location parameters you wish the image printed with and depress the OK button.

5.8: File Menu Choice: Set Up

This feature allows you to fine tune the setup of the program including certain graphical presentations, the way Zones are saved, etc.

Section 6:

Video Options

6.1: Introduction

There are several sub-menu options found under the Video Main Menu choice. These functions are ordered by their ability to manage or manipulate the live video data. The choices found under this menu option is:

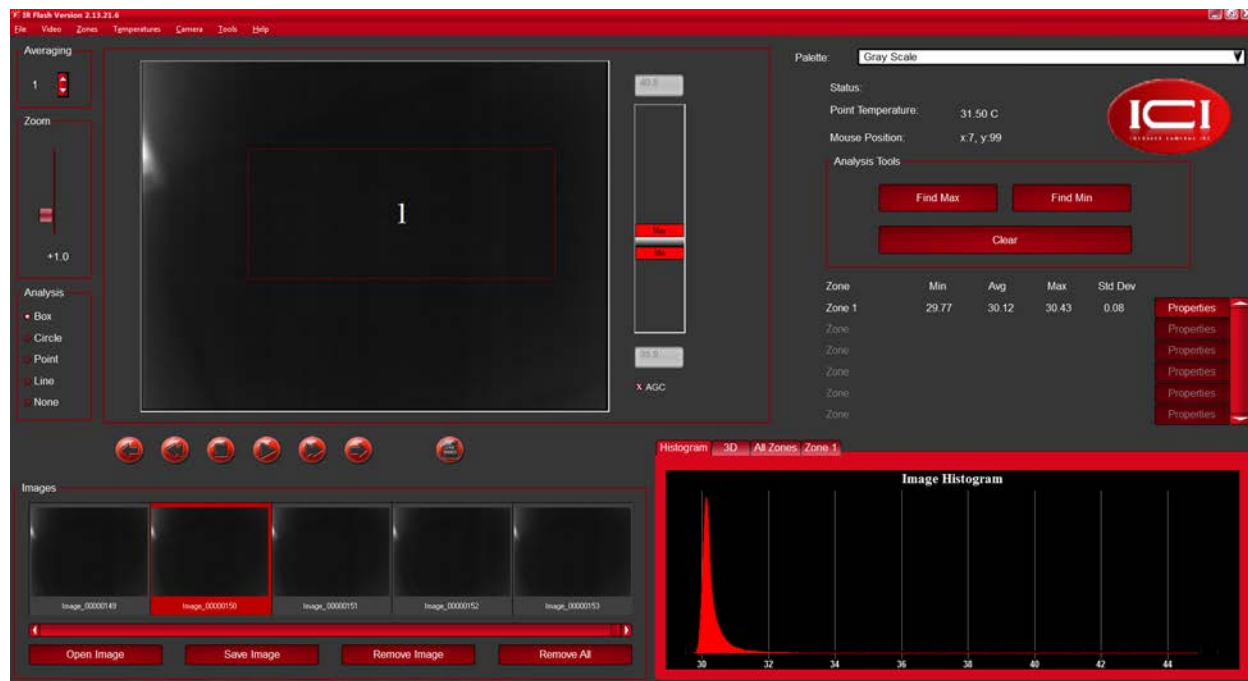
- Capture Single Image
- Capture Image Series
- Quad Resolution
- Real-time Filtering
- Standard Resolution
- Double Resolution

6.2: Video Menu Choice: Capture Single Image

This menu sub-option allows you to capture an image from the video display and place it in the Captured Image Group (labeled 'Images') shown at the lower left of the main image display.

6.3: Video Menu Choice: Capture Image Series

IR Flash allows the user to capture a **Series** of images. Whenever you wish to capture a new image data set click on the “Capture Image Series” selection from the “Video” main menu choice. Once this selection is made and live video is running a red Record Button is displayed under the main image display. When this button is depressed a series of images is captured to the Capture Image Group. When you are done simply depress the black Stop Button (also found at the bottom of the main image display).



The user can play back the Series as often as needed by selecting the “Playback” option button under the Series sub-menu choice. When the video is in the capture mode and control buttons are displayed at the bottom of the main image display, use these control buttons, as shown in the above image, to move through the series as desired.

6.4: Video Menu Choice: Real-Time Filtering

Often the best judge of image quality is the human eye. The development of image processing technology has provided the ability to manipulate an image to aid the observer in his or her judgment. The Real-Time Image Filtering features of the program offer the user a basic capability in Digital Image Processing. Convolutions are a special case of image enhancement techniques known as spatial filtering. Spatial filtering is typically used for edge or boundary enhancement, noise reduction prior to edge or object detection, or to simply make the image look better. When this sub-menu option is chosen a dialog box will be displayed from which you can pick what filters you want applied to the live video images.

- Low Pass
- Gaussian Smoothing
- Laplacian 1
- Median
- Laplacian 2

6.5: Video Menu Choice: Display Resolution

The resolution of the data coming from the camera is at an array count of 320 pixels stored in 240 lines. Under Standard Resolution the image display takes from the data directly from the camera.

The Double Resolution options converts the image to a 640x480 smoothed array. While the displayed image is still shown at 320x240, the display takes the data from an image array 4 times as large. This, in many cases, greatly improves the quality of the image display.

The Quad Resolution doubles the image array again.

Section 7:

Generating Zones

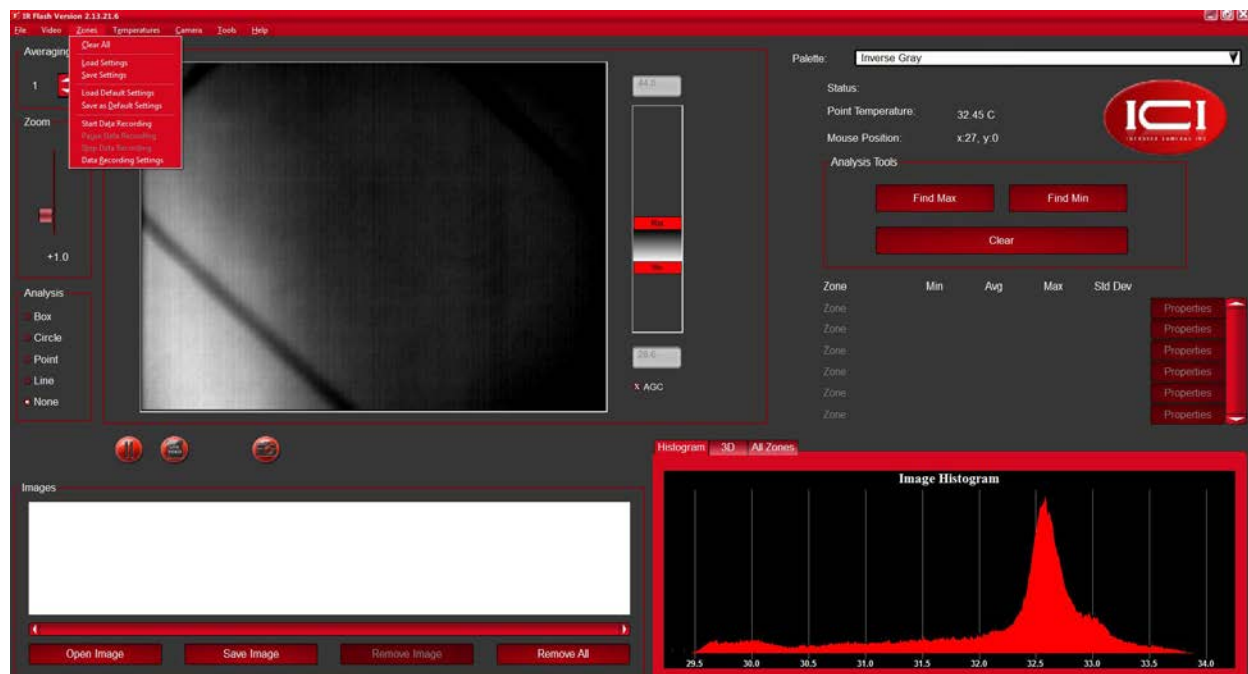
7.1: Introduction

Zones are regions of interest within or on your image data that are marked and configured by you. You can add, delete, and set-up each zone to function in variety of ways. The area at the bottom left of the screen provides the user interface for each zone for a total of 48 possible. The statistics are shown in this interface dialog as well as a “Properties” button. You can thumb through the zones in place by using the scroll bar next to the three Zone Display panels shown at the bottom left of the main screen.

7.2: Zones Menu Choices

The third main menu choice is the Zones selection which provides a series of sub-menu options to manage the Zones on the images as shown below.

- Clear All
- Load Default Settings
- Load Settings
- Save As Default Settings
- Save Settings



7.3: Zones Menu Choice: Clear All

The Clear All sub-menu choice simply clears all the Zones currently residing on the image.

7.4: Zones Menu Choice: Load Setting

The Load Settings sub-menu choice allows you to load the last Saved Zone settings.

7.5: Zones Menu Choice: Save Settings

The Save Settings sub-menu choice allows you to save the current Zones set-up parameters to a file for future retrieval.

7.6: Zones Menu Choice: Load Default Settings

The Load Default Settings sub-menu choice allows you to load the last Saved Default setup parameters. This is different than the Load Settings in that the Load Settings parameters are established local settings and not default. Default Settings will also load upon the startup of the new initiation of the program.

7.7: Zones Menu Choice: Save As Default Settings

The Save Default Settings sub-menu choice allows you to Save the current Zone set-up parameters as the Default parameters.

Section 8:

Zone Management

8.1: Introduction

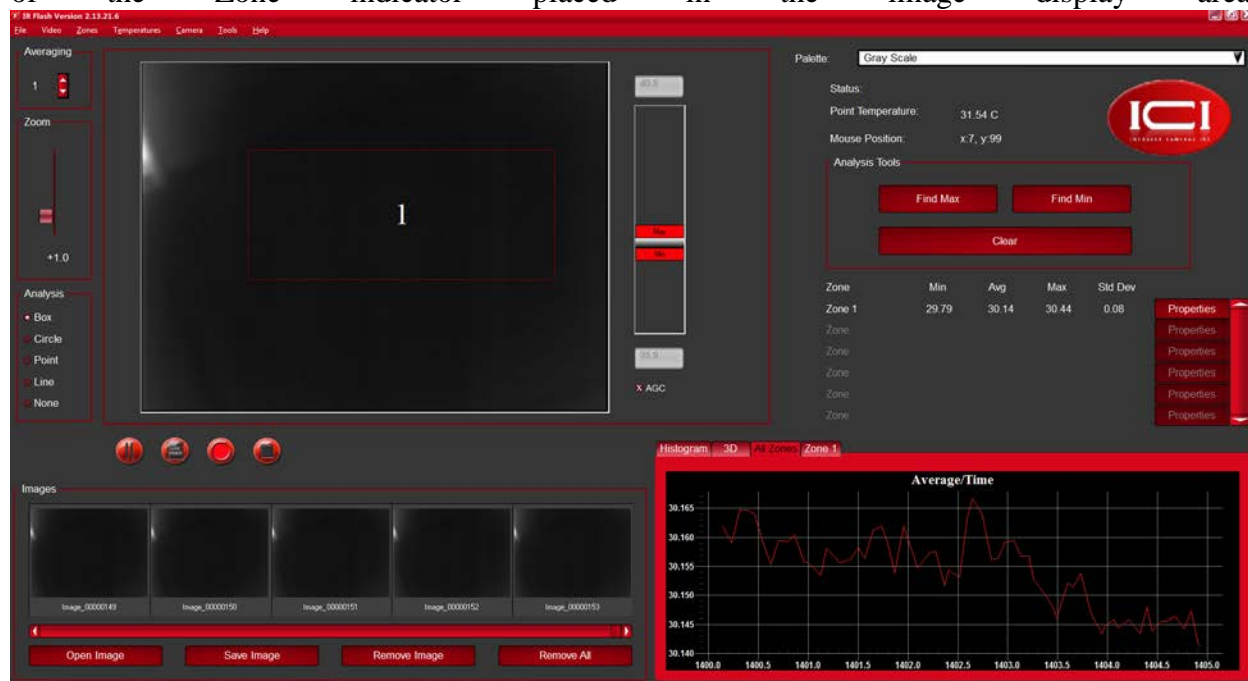
To add a zone to the image area click on the Zone type control located to the left bottom of the image display area. Move the mouse cursor to the starting position and set the location. You can grab the graphic control on the feature and re-size or move the Zone around the image. To remove a Zone indicator highlight the zone, mouse grab its center and slide it off the image. It will be deleted.

The Zone types are:

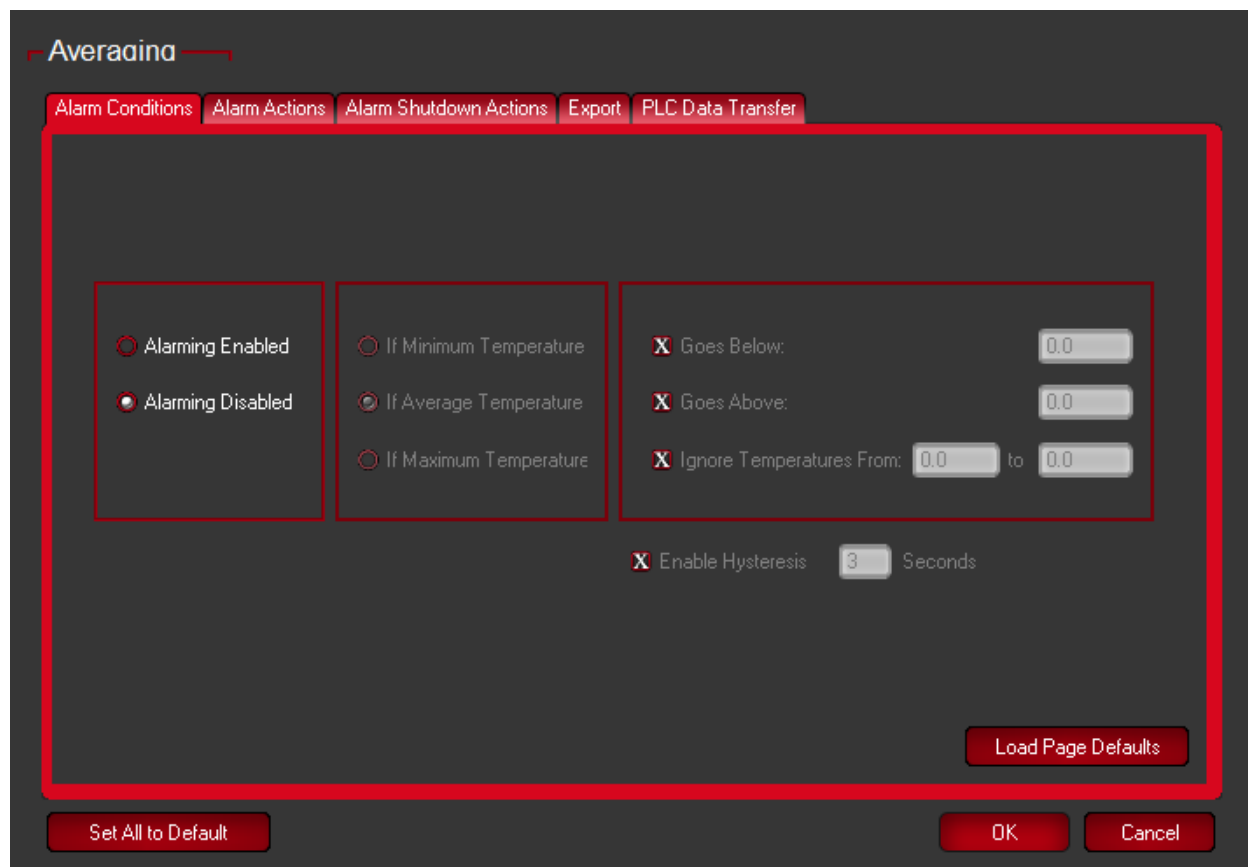
- Box
- Line
- Circle
- Point

The plotting area shown on the bottom right corner of the screen allows you to plot both full image information in the form of a 3-D plot and/or as an image histogram. It also allows you to plot the temperature data over time for any/all of the Zones placed on the image. The image below shows this plot for one of the two zones set.

The image illustration below shows both a box and a circle example of the Zone indicator placed in the image display area.



Once you have placed Zones on the image display, detailed management of the Zones in place can be accomplished using the “Properties” button found at the bottom of each active Zone panel. Once this button has been depressed a dialog worksheet will appear by which this management will be carried out.



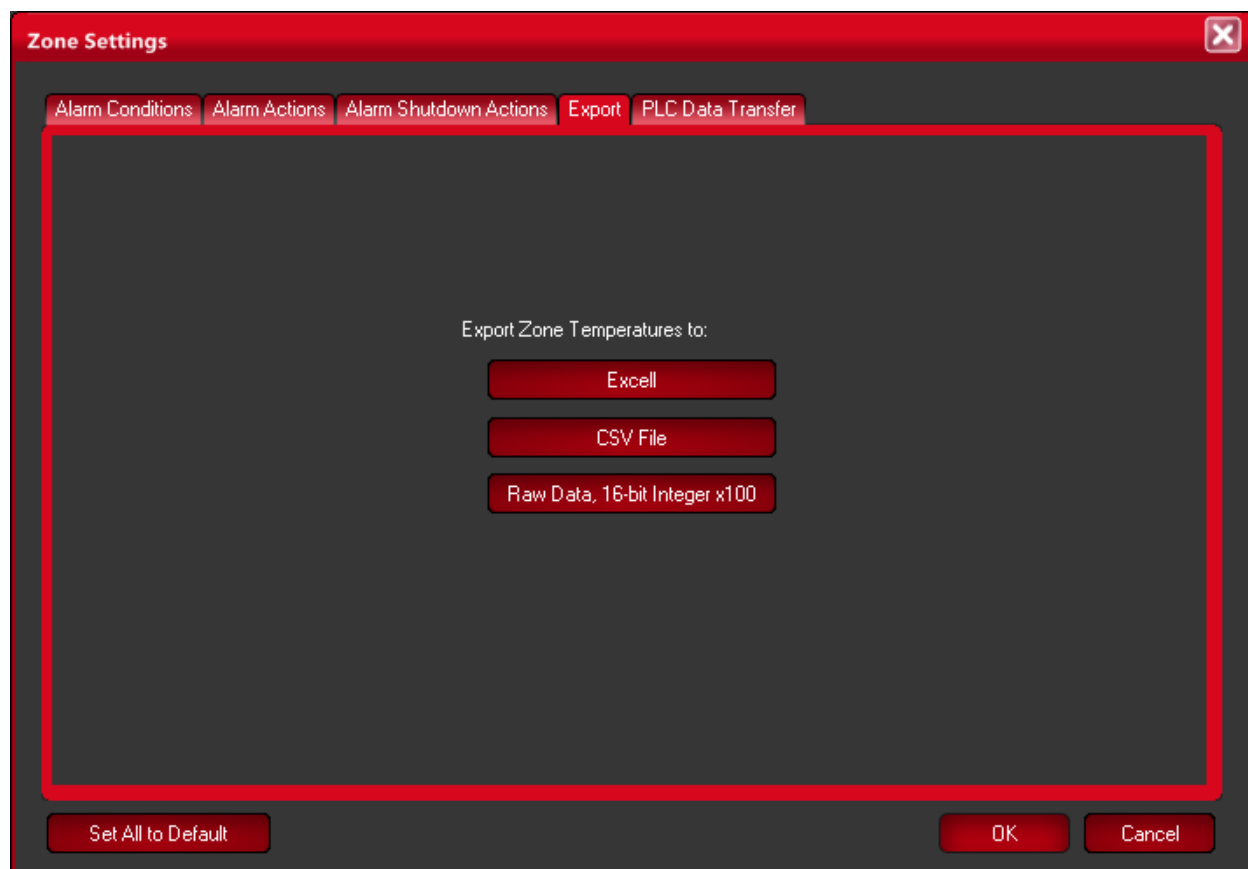
There are two main features that can be set from within this dialog; Alarm Setting and Export control

8.2: Alarms

The Alarms configuration for each Zone allows you to set up the system to continuously monitor the analysis points discussed for the Zones and alarm if any of the Zones' average temperature value exceed the temperature limits specified by you within this worksheet.

8.3: Export

Export allows you to export the data within a Zone in three different formats as shown in the graphic below. This dialog box is invoked through the Zone Properties button found in each Zone interface box.



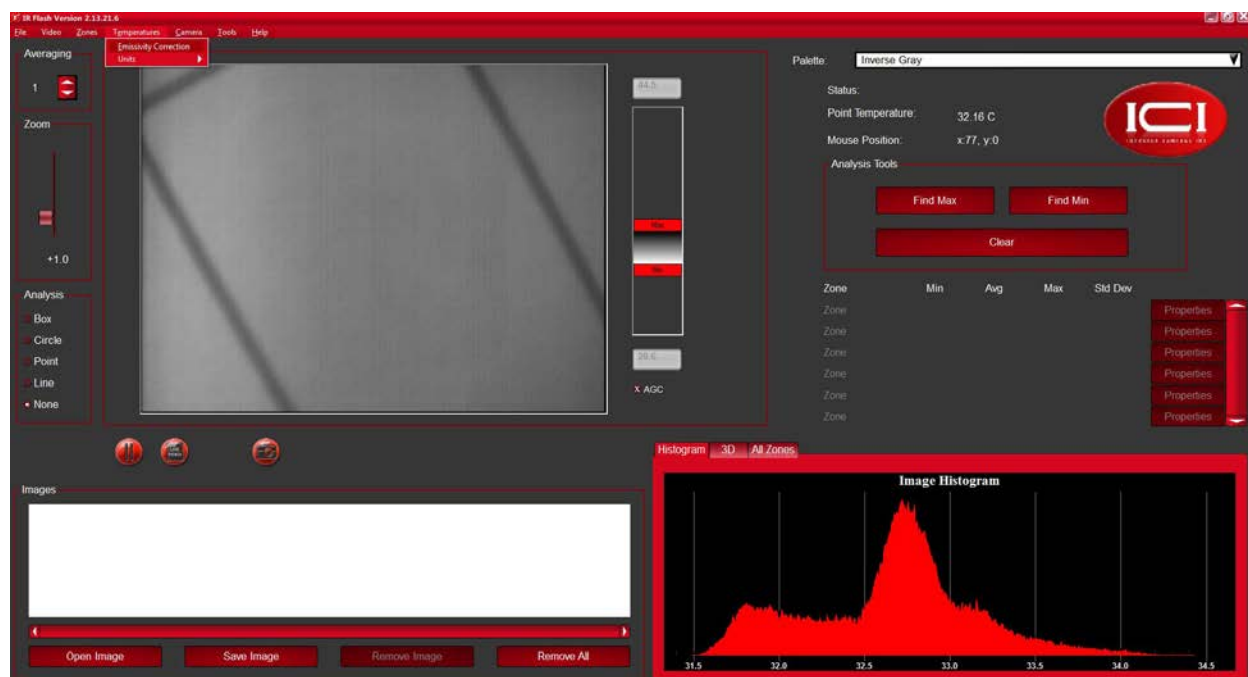
Section 9:

Radiometry

9.1: Introduction

Typically the very basic reason for employing image processing programs when analyzing IR images is to have an easy and fast, yet comprehensive means to determine the information content of an image in numerical terms. Radiometry is considered the "BASE" from which to conduct this analysis.

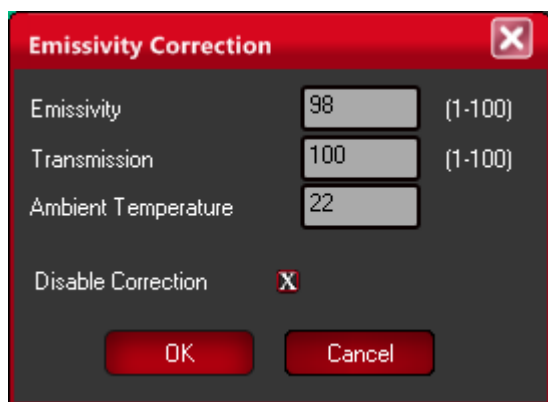
Typically, to convert the gray scale values to values of temperatures requires either a calibration of individual cameras, cameras that provide reference parameters using internal black-bodies, or by using field "ground truth" calibration data. The method for calibrating images provided in this program is camera dependent because temperature calibration data is provided by an advanced calibration process at the factory and installed in this software program. This program looks for a very specific file in its structure and mates that with the camera serial number automatically read by the program. If this software cannot match the camera to the calibration file, the user cannot perform temperature analysis on the data.



If your specific package includes additional optional lenses a separate calibration is required for each lens. See the Camera Menu chapter for selecting the lens you are currently using.

9.2: Radiometric Correction

Note that accuracy of temperature conversion is typically more dependent on the physics of the scene than on the detailed calibration/temperature model provided with the software. These physical properties include emissivity and reflection of the target, the transmission in the intervening atmosphere, and the background/foreground temperature within the scene. The work sheet shown below allows the user the ability to offset some of this error by defining these parameters as accurately as practical.



Parameter	Value	Range
Emissivity	98	(1-100)
Transmission	100	(1-100)
Ambient Temperature	22	

Disable Correction

OK Cancel

Enter the Target Emissivity: You are provided the capability to select any value of surface optical property of the target surface you deem appropriate to the analysis being performed. Simply move the cursor to the Target Emissivity field and click the mouse button. Once done enter the value from 1.0 to 100.0.

Transmission: This value is the percentage of energy loss due the transmission of the energy from the target surface to the camera. This loss can be a result of any intervening medium such as atmosphere, IR windows, etc. This loss is entered as a percentage value for 1.0 to 100.0.

Ambient Temperature: The Ambient Temperature, which is often referred to as the Background, is the temperature of the surfaces surrounding the imaged object. These surfaces are those whose energy will hit the face of the imaged object and reflect from it into the camera FOV.

Note: As the value of emissivity becomes lower the error between the actual surface temperature of the object and that shown by the camera becomes greater. A great deal of error can be introduced into the calculation process if you are not careful with the emissivity specification.

Section 10:

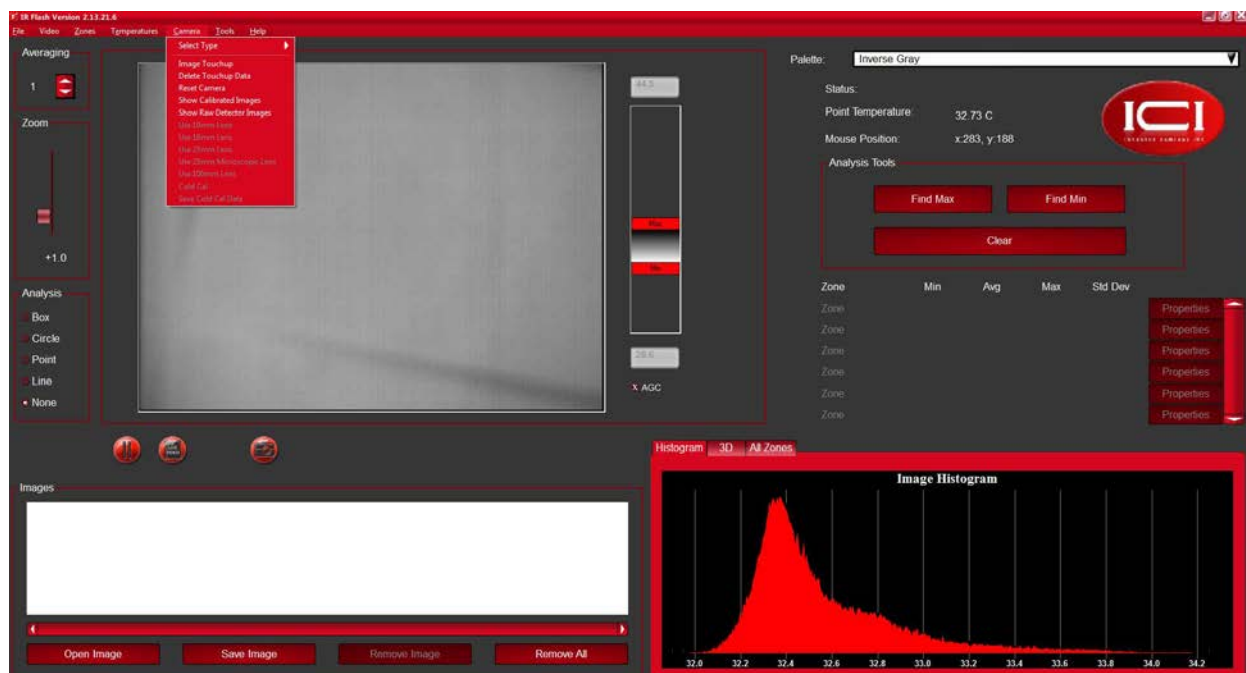
Camera Menu Choice

10.1: Introduction

The Camera Menu Choice is found on the fifth selection of the Main Menu Bar. This selection provides features that allow you control over the actual operation of the camera. There are three sub-menu choices found within this selection.

10.2: Camera Menu Choice: Image Touch-Up

The “Image Touch-Up” function performs a Non-Uniformity Correction (NUC), setting all pixels in the camera to the same average reading. In the 7000 series cameras (7320 and 7640), the camera needs to either have its lens cap placed back on or it needs to be looking at a surface with a consistent temperature (often, placing it looking down on a table to other solid surface). For the 9000 series cameras (9320 and 9640), there is an internal shutter that will automatically perform a NUC every three minutes; selecting the “Image Touch-Up” option manually triggers the shutter instead.



10.3: Camera Menu Choice: Delete Touch-Up Data

The Touch-Up function saves the Touch-Up data in a file and will be used at subsequent boot-up of the camera. This data file can be deleted by simply selecting the Delete Touch-Up sub-menu choice.

10.4: Camera Menu Choice: Reset Camera

If for any reason the computer's USB port is disrupted at any time and proper communication with the camera is disturbed, hit the Camera Reset sub-menu choice and the camera will reboot and reestablish USB communication, providing the USB port on the computer is functioning properly.

10.5: Camera Menu Choice: Lens Choice

Some models such as the 7000 series cameras (7320 and 7640) do offer multiple lenses; multiple calibration files are saved and selecting the appropriate lens option causes IR Flash to adjust accordingly. At this time, though, the 9000 series cameras (9320 and 640) do not.