AnalyzIR Venus

Professional Thermal Image Analysis Software

Operation Manual

CONTENTS

1. Legal Disclaimer

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To the fullest extent permitted by law, our liability will not exceed the amount paid for the Product.

After the product is connected to the Internet, it may face risks including but not limited to network attacks, hacker attacks, virus infections, etc. For the problems caused by the product working abnormally, information leakage, etc., the Company is not responsible, but will provide the user with technical support in a timely manner.

The product can sense motion detection and fire events when properly installed and configured, but cannot prevent accidents or resulting personal injury or property damage.

Thermal imaging products are classified by the U.S. Department of Commerce as an export-controlled product under Export Control Classification Number (ECCN) 6A003.b.4.b. This product contains a focal plane array under Export Control Classification Number (ECCN) 61002.a.3.f. This product is not to be used in a controlled country (e.g., North Korea, Iran, Syria, Cuba, Sudan, etc.) Do not bring the product into, or use it in, a controlled country. Any loss or liability arising from the above behavior will be at your own risk.

When using this product, you are requested to comply strictly with applicable laws. You agree that this product is for civilian use only and shall not be used for infringement of third-party rights, medical/safety equipment or other applications in which a product failure could result in life-threatening or personal injury, and fog of mass destruction, biological/chemical weapons, nuclear explosions, or any unsafe use of nuclear energy or uses that are dangerous or contrary to

humanitarianism. Any loss or liability arising from such use will be at your own risk.

In the event of a conflict between the above and the applicable law, the provisions of the law shall prevail.

2. About

This manual is intended for instructional use. Photographs, graphics, icons and illustrations provided in this manual are for explanation and illustration purposes only, and may differ from the specific product, so please refer to the actual product. Due to product version upgrade or other needs, we may update this manual without prior notice.

3. Safety Information

！ WARNING: Represents a dangerous situation or behavior that could result in personal injury or death.

! CAUTION: Represents a situation or behavior that could result in damage to the camera or permanent loss of data.

! Note: Represents a prompt message that is useful to the user.

4. Operating Environment

4.1 Operating systems

- ✧ Microsoft Windows 7, 32-bit (requires .NET Framework 4.6 to be installed, otherwise the program will not run properly).
- ✧ Microsoft Windows 7, 64-bit (requires .NET Framework 4.6 to be installed, otherwise the program will not run properly).
- ✧ Microsoft Windows 10, 32-bit Pro or above (requires .NET Framework 4.6 to be enabled in windows features, which is on by default).
- ✧ Microsoft Windows 10, 64-bit Pro or higher (requires .NET Framework 4.6 to be enabled in windows features, which is on by default)

4.2 Hardware Configuration

- ✧ PCs with Intel 2G Hz Pentium processors (dual-core), AMD Opteron, AMD Athlon64 or AMD Athlon XP processors (dual-core).
- ✧ At least 2GB RAM or more (4GB recommended).
- ✧ 20GB of available hard disk space.
- ✧ Super VGA (1024 x 768) monitor (or higher resolution).
- ✧ Audio Output.
- ✧ It is possible to connect to the Intelnet network and perform the necessary installation of plug-in upgrades.
- ✧ Keyboard and Microsoft mouse, or pointer-compatible devices.

5. Software Introduction

AnalyzIR is the professional thermal image analysis software that comes standard with our thermal imaging cameras.

The following functions are available in AnalyzIR Professional Thermal Image Analysis Software:

- ✧ Supports associating folders, viewing information about files, etc.
- ✧ Supports connection and communication between camera and PC for real-time display, transmission, recording, and analysis of full-radiation thermal video streams
- ✧ Supports secondary analysis of thermal image files by adding, deleting, renaming, moving, and resizing measurement tools on a thermal image or a full radiometric thermal image video.
- ✧ Supports modification of temperature measurement parameters of thermal image files, including emissivity, reflected temperature, atmospheric temperature, relative humidity, target distance, external optical temperature, external optical transmittance, and so on.
- ✧ Supports partitioned emissivity settings for measurement tools to improve the accuracy of temperature measurement.
- ✧ Supports the function of presenting, exporting, saving and overlaying the time-temperature curve of any measurement tool.
- ✧ Supports histogram, 3D graph, and line temperature distribution graph display on thermal files.
- ✧ Supports combining and splitting specified thermal images or full radiometric thermal videos.
- ✧ Supports editing personalized inspection report templates, batch processing of thermal image files, batch generation of word version of thermal image inspection reports.
- ✧ Supports I/O externally triggered recording.
- ✧ Supports DB, TCP/IP Modbus, RS232 Modbus serial communication protocols for data transmission with external systems.

✧ Comes with a lens calculator that automatically calculates parameters such as measuring range, measuring distance, lens field of view angle, image pixel size, etc.

6. Software Installation

! Note: Before installing AnalyzIR, please close all programs on the PC.

To install AnalyzIR, please follow instructions below.

6.1 Precautions before Installation

1. Ensure that the operating system is Windows 7, Windows 8, Windows 10, or Windows 11, with .NET Framework 4.6 installed. Additionally, confirm whether the operating system is 32-bit or 64-bit to match the installation of the corresponding USB interface driver file.

2. Installation requires administrator privileges. After installation, set the program to run with administrator privileges. Locate the AnalyzIR.exe file in the installation directory, right-click, select Properties > Compatibility > Run this program as an administrator, and save..

3. During installation, the user may encounter warnings from Microsoft ® about the software not passing the Windows ® logo test. In such cases, select "continue" or "always trust." If prompted by antivirus software, select "always allow" to run, and choose to trust the software.

4. The installation process includes several sub-program installations, some from third-party vendors. Do not terminate these installations, as they are essential for a complete installation.

5. To connect the software to the thermal imaging camera, it is recommended to disable the firewall and antivirus software on the PC. Failure to do so may result in connection issues or image loss. Close the Windows firewall, disable antivirus software, or add the program to the trusted list.

6. To utilize the report and data export function, install Office Word, Office Excel, or WPS

Word, WPS Excel office software on the PC

7. For our 220/220s/220RD series products, the Windows 7 operating system typically installs the USB interface driver file automatically during AnalyzIR software installation. However, for Windows 8 or Windows 10, the user must set "disable driver mandatory signature" before separately installing the USB interface driver file.

8. For our 280/360/350 series products, the user must separately install the USB interface driver file to connect to the PC for full radiometric thermal image video streaming. For Windows 8, Windows 10, or Windows 11, set "Disable Driver Forced Signature" and then install the USB driver file separately.

6.2 .NET Framework 4.6 Installation

Windows 7/8 requires the installation of .NET Framework 4.6 (Windows 7 defaults to .NET Framework 3.5). The user can search for .NET Framework 4.6 on Google and download it for self-installation.

The .NET Framework version included with Windows 10/11 is also compatible.

6.3 AnalyzIR Installation Procedure

To install AnalyzIR Professional Thermal Image Analyzer on the PC, please perform the following steps:

1. Windows operating system log on with an administrator account and close all applications.

2. Double-click on the AnalyzIR installation file.

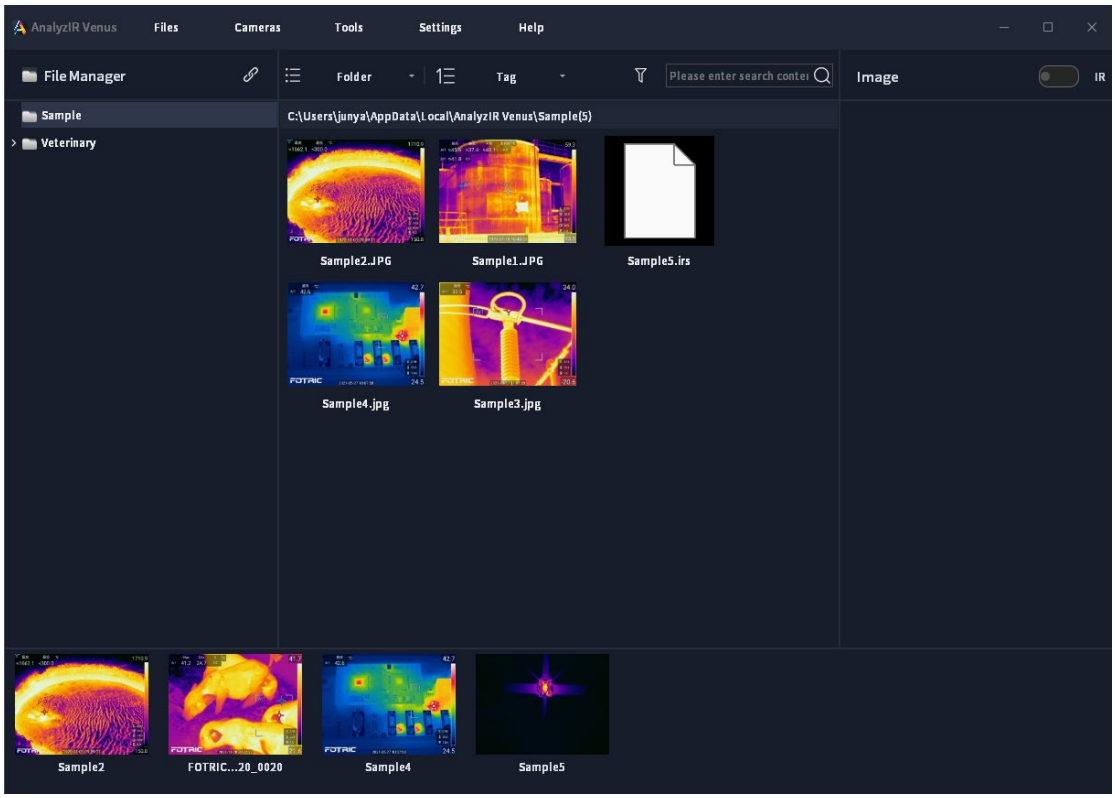
3. Follow the instructions on the installation wizard step by step.

4. Find the AnalyzIR.exe file in the installation directory, then right-click Properties - Compatibility - Run this program as administrator and save.

5. Double-click on the PC desktop AnalyzIR Professional Thermal Image Analyzer shortcut button to enable the software.

7. Software Operation

7.1 Introduction to Interfaces and Functions



1. File Manager: This section encompasses functions such as folder association, grouping, sorting, filtering, and information display.

2. Files: This section features the Thermal Image Workspace tab, facilitating the analysis of captured thermal images and videos, alongside other functionalities.

3. Cameras: This section incorporates the Camera Workspace tab, enabling the connection of the camera to the AnalyzIR software and the real-time display of the full radiometric video stream within the camera workspace.

4. Tools: This section includes tabs for report templates, data interfaces, and lens calculator functions.

5. Settings: Here, the user will find system configuration and other functional settings for common use, display, storage, synchronization, trigger, unit, and language.

6. Help: This section contains the user manual and About.

7. Software Interface Control Buttons: These buttons include options to minimize, maximize, and close the software window.

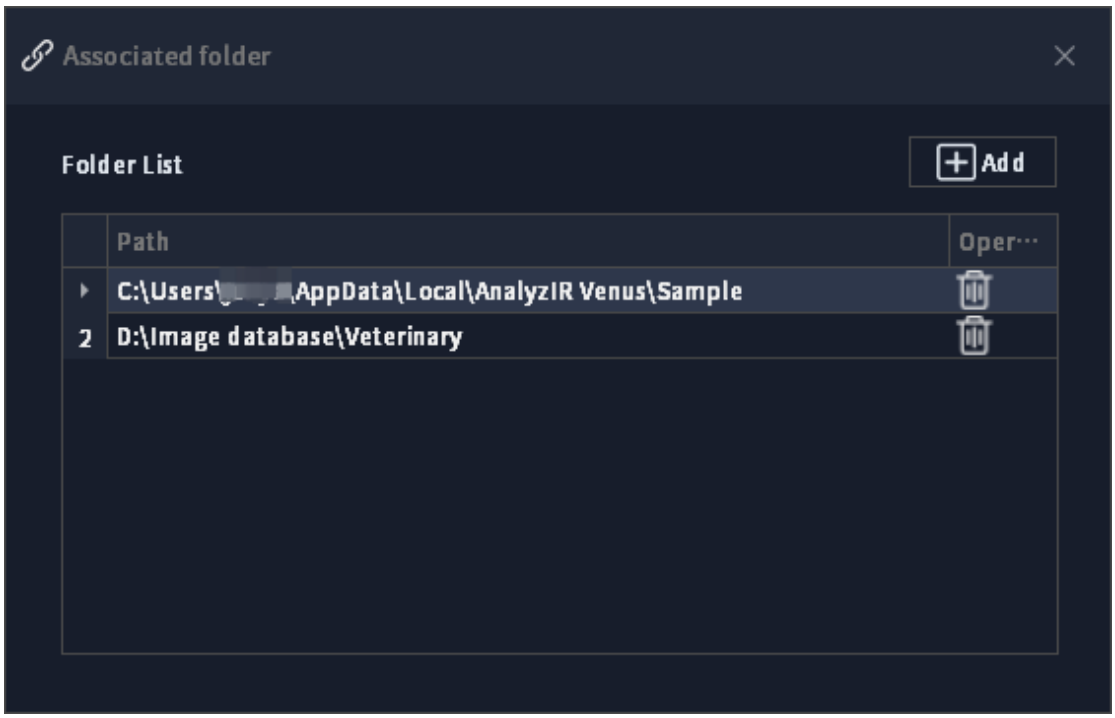
8. Quick Access: This feature allows the user to save recorded or captured thermal image files. The user can drag and drop thermal image files from the PC's local hard disk into the Quick Access bar. Double-clicking on thermal image files in the Quick Access bar opens them for analysis. The user can also remove files from the bar or open them in their file location.

7.2 Document Manager

7.2.1 Document Management

7.2.1.1 Associated folders

Click in the upper left corner of the home page of the software to associate folders.



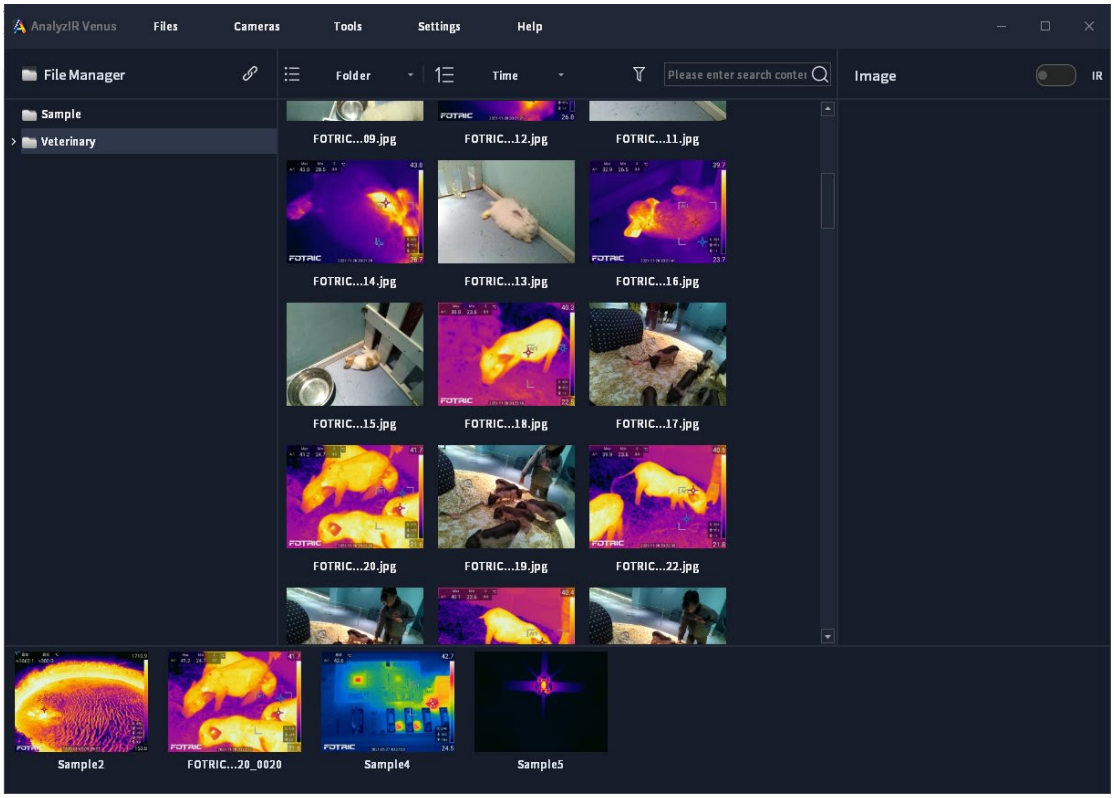
In the associated folder pop-up window, click the "Add" button, select the folder the user want to associate, and then click OK. The added folder will then appear in the tree structure on the left side of the home page.

7.2.1.2 Cancel association

In the associated folder pop-up window, click the "Delete" button behind the folder to cancel association, and then the pop-up window to determine the deletion can be asked, at this time the tree structure on the left side of the home page no longer show the folder.

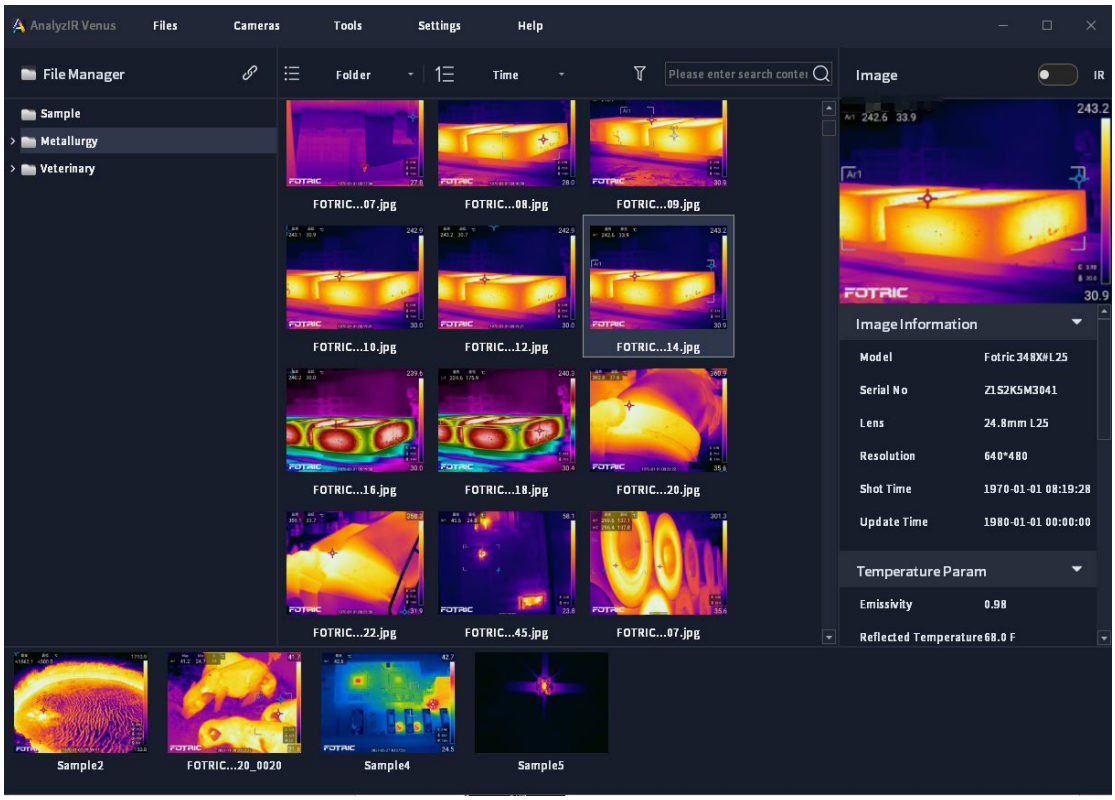
7.2.1.3 Document structure

The tree structure on the left side of the software's home page displays all associated folders. Clicking on a parent folder or subfolder reveals all the files contained within that folder on the right.



Right-clicking on a parent folder or subfolder brings up the menu option "Open the folder location." This feature enables the user to quickly locate the storage location of a folder.

7.2.2 Document Information



The file information comprises two main parts, outlined below:

1. Icon information encompasses voice notes, text notes, label notes, favorites, and label content.

2. For thermal image files, additional file information includes the image itself (with support for infrared/visible map switching if visible light information is available), temperature measurement parameters, geographic location information, image details, and notes. Clicking on a file in the file display area will prompt the display of this information on the right side of the software.

7.2.3 Grouping, Sorting and Filtering

7.2.3.1 Grouping

is to group the files inside the selected folder in the tree structure on the left with different attributes. Clicking on the drop-down reveals the attributes: Folder, Time and Tag.

7.2.3.2 Sorting

is to sort the already grouped files in different types of ascending/descending order, click on the drop down to bring up the options including: time, name and tag, and toggle button for ascending and descending order.

7.2.3.3 Screening

Document screening consists of two ways:

1、  Filter buttons, including whether or not it is a favorite and whether or not it has tagged information;

2、 

Fill in the specific information to enter a search.

7.2.4 File Menu

Select single/multiple hot image files in the file area and right-click to bring up the menus: Favorites, Unfavorites, Add Text Note, Batch Processing, and Open in Folder (**! Note:** only appears when a single file is selected).

7.2.4.1 Favorites

Support for quick file favorites.

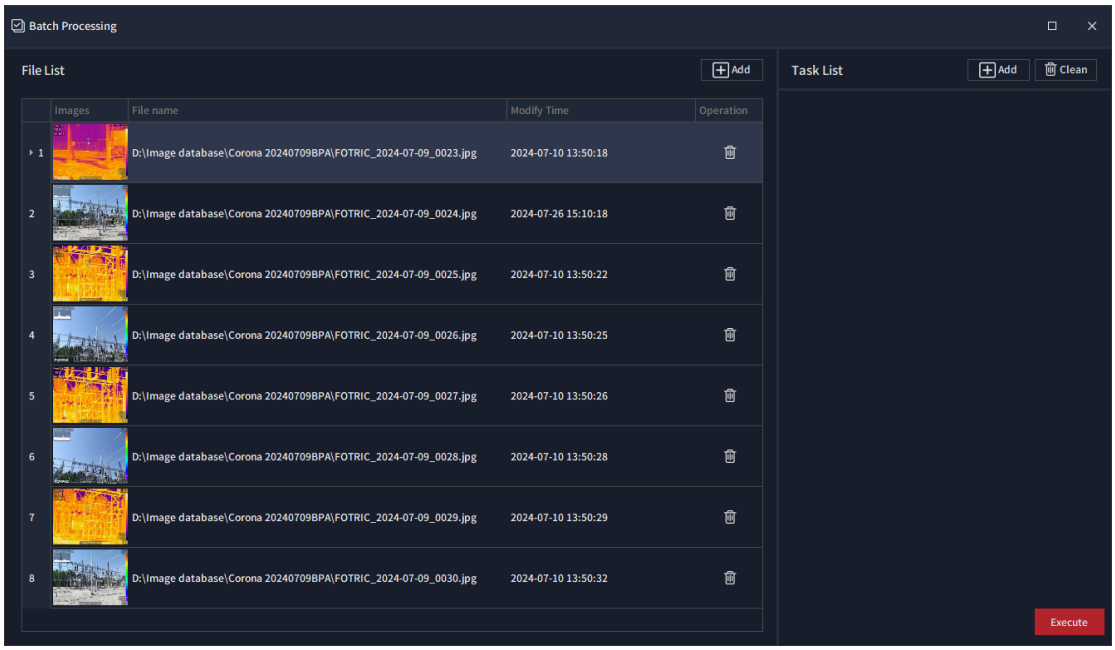
7.2.4.2 Canceling Favorites

Supports quick unfavorite files.

7.2.4.3 Adding Text Notes

Support for quickly adding text note information to documents.

7.2.4.4 Batch processing



Clicking Batch Processing opens its submenu, which contains the following functions:

✧ Convert images

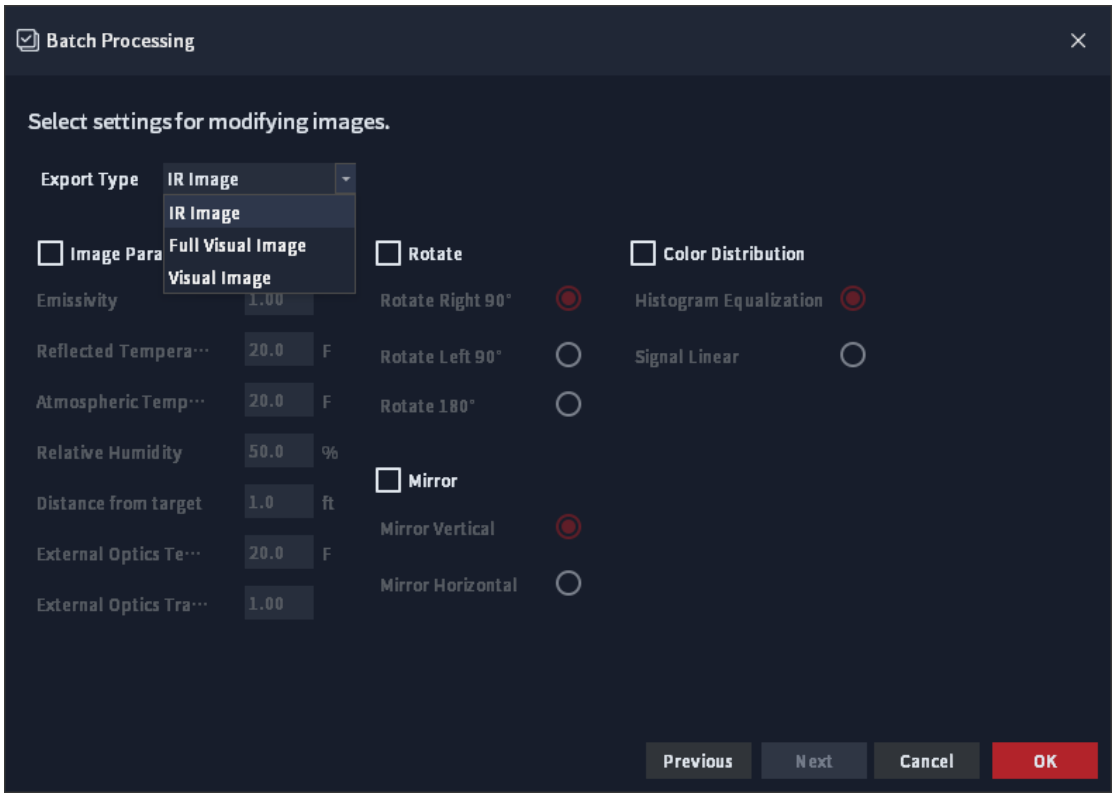
: Add a thermal image file, multiple selections are possible (visible images cannot be added individually);

: Move the thermal image position order up;

: Move the thermal image position order down;

: Delete the added thermal image file.

After adding the files, select "Next" to enter the following interface:



1. Export types: thermal image, visible image (the visible image saved in association with the thermal image file will be saved separately) and full visible image (the full visible image saved in association with the thermal image file will be saved separately).

2. Image parameters: Refer to section 7.3.3 of this manual for description.

3. Rotate: Refer to section 7.3.4 of this manual for description.

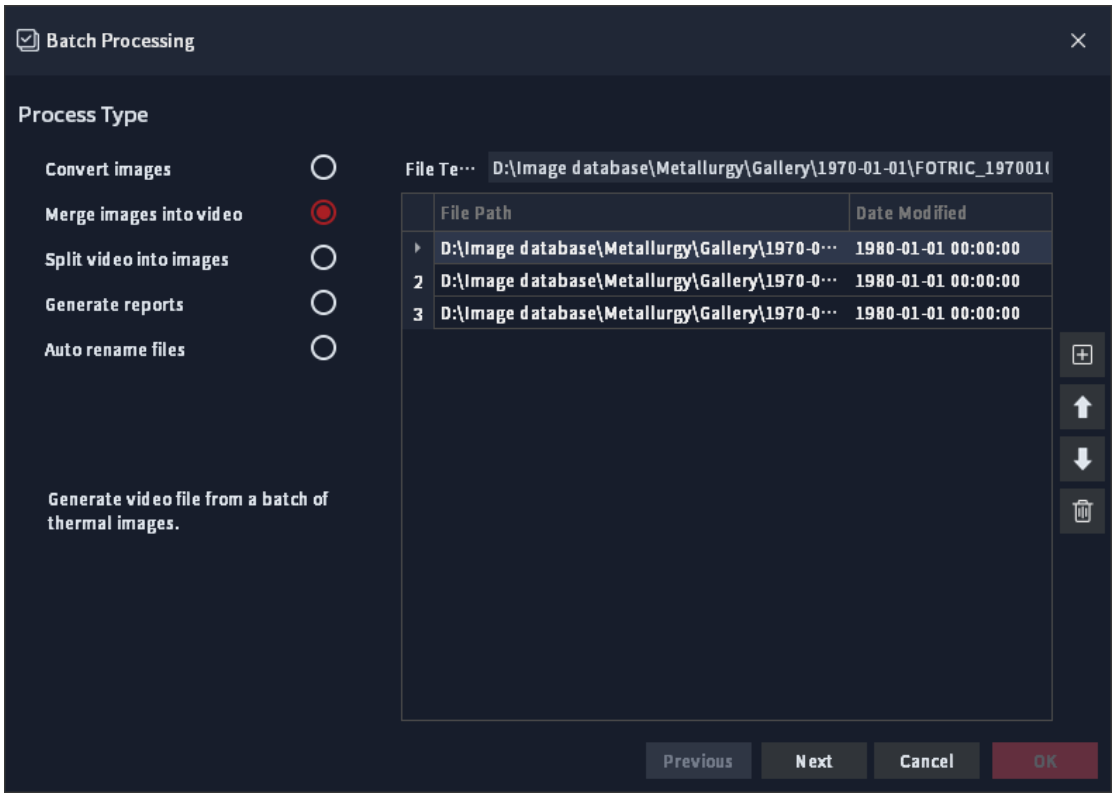
4. Mirror: Refer to section 7.3.4 of this manual for description.

5. Color Distribution: Refer to Section 7.3.6 of this manual for description.

Users only need to select the type of export, and then adjust other parameters, and finally click "OK", the user can complete the image conversion batch processing.

✧ Merge images into video

It is possible to combine multiple thermal photos or full radiometric videos taken by the same thermal imaging device (with the same serial number) into a single radiometric video.



File Template: Select the video start file (thermal image picture or full radiometric thermal image video), the thermal image file added later can only be selected from the thermal image file generated by the same serial number device.

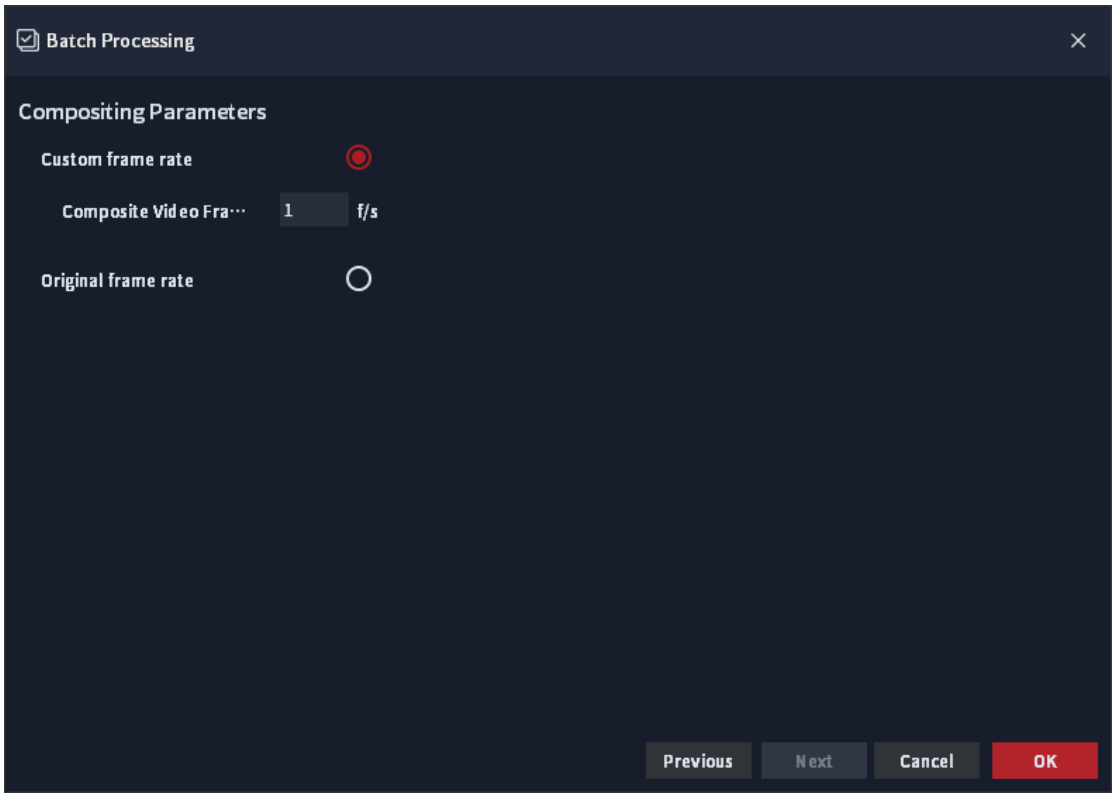
: Optionally add files in thermal image and full radiometric thermal image video formats;

: Moves the thermal image position order upwards, affecting the order in which the synthesized video is played;

: Moves the order of thermal image positions downward, affecting the order in which the synthesized video is played;

: Delete the added thermal image file.

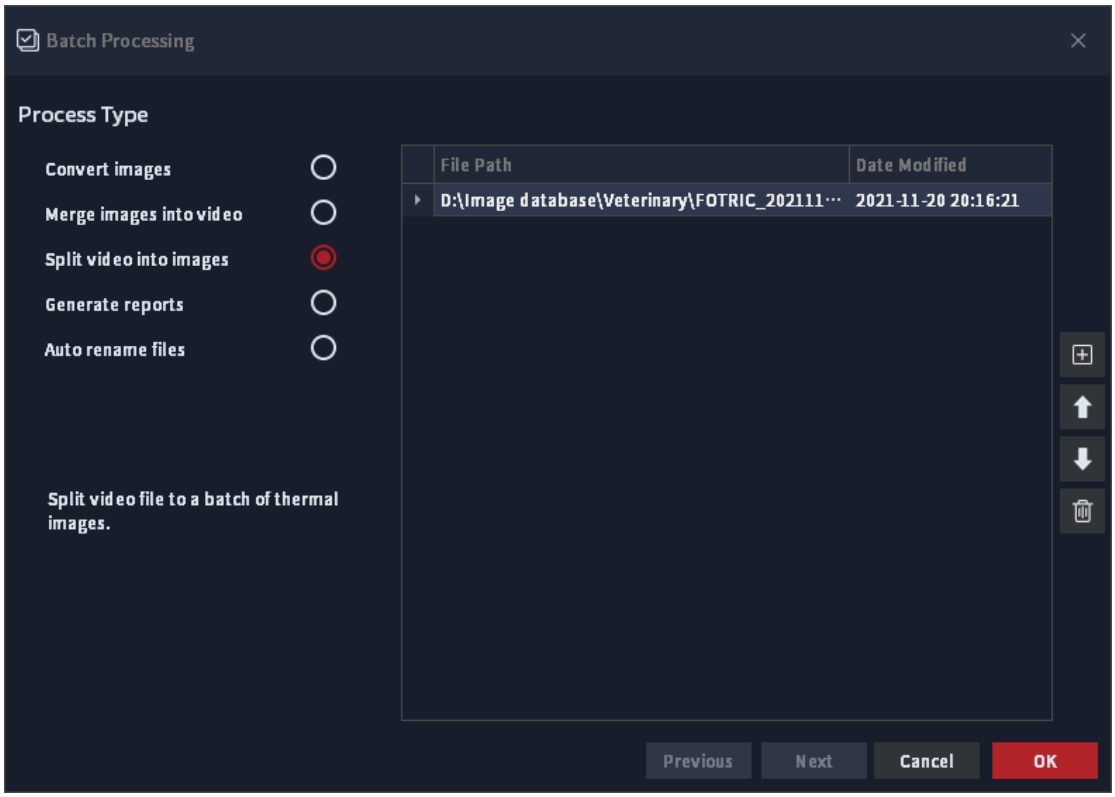
Finish adding the thermal image file and click Next, the following figure will appear:



The user can choose to customize the frame rate, enter the appropriate frame rate, or select the original frame rate, click "OK" to complete the batch generation of thermal image video.

✧ Split video into images

It is possible to break down a full radiometric thermal image video file into single thermal image pictures.



: Add video files of full radiometric thermal images;

: Move the thermal image file position order up;

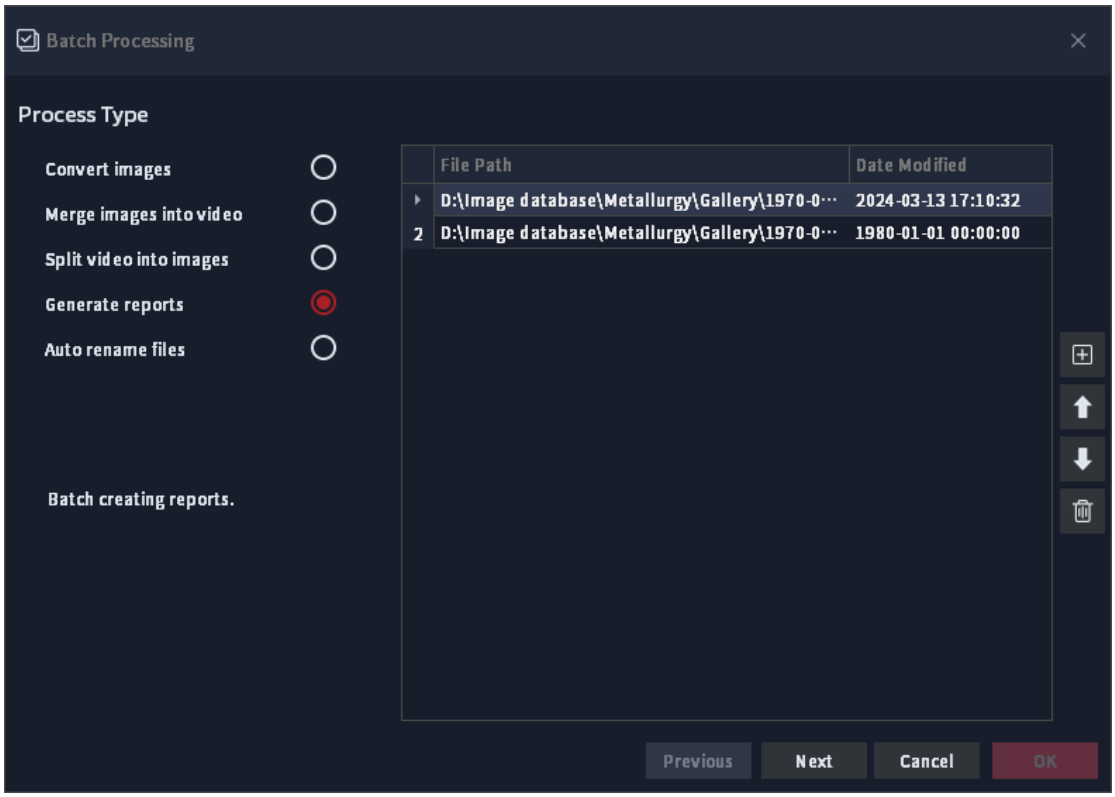
: Moves the thermal image file position order down;

: Delete the added thermal image file.

After adding the radiometric video file, click "OK", select the location where the user want to save it, and click "OK" to start and complete the decomposition of the radiometric video.

✧ Generate reports

The user can batch generate a word version of the inspection report, supporting a single generation of 200 thermal image inspection reports, which can be batch generated in a word file, or generate a separate word file for each thermal image photo.



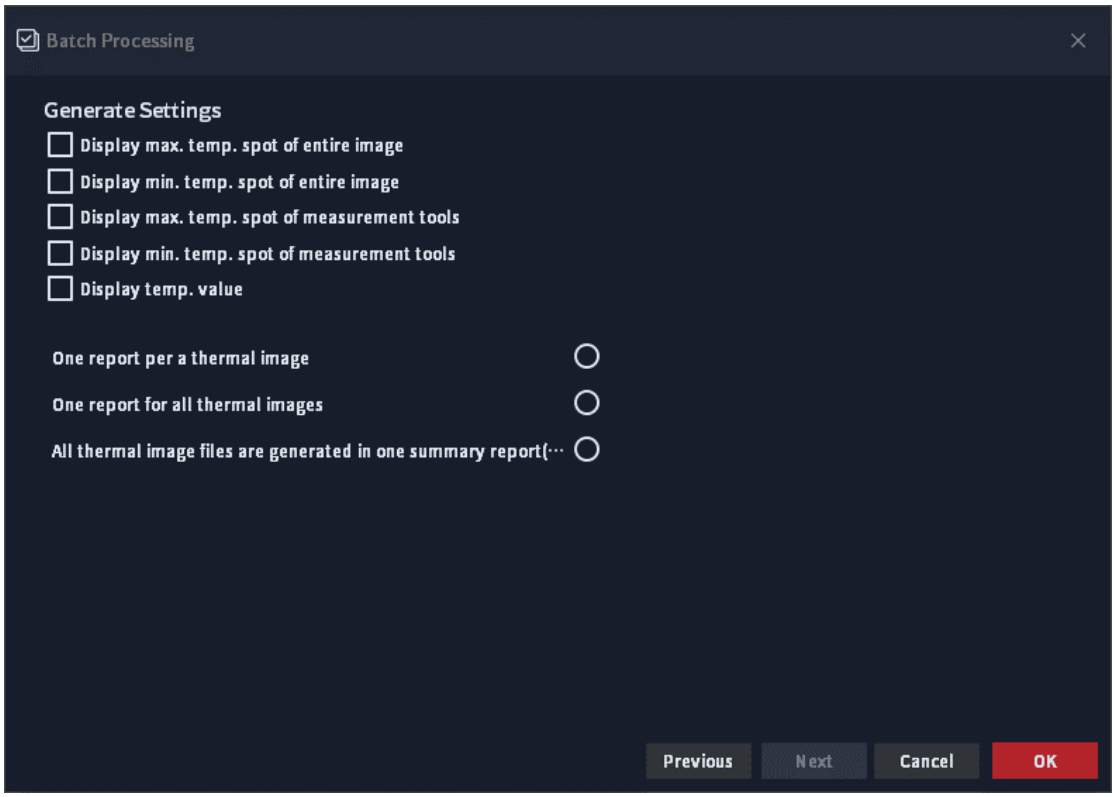
: Add the thermal image files needed to generate reports in batches of up to 200 thermal images per batch;

: Move the thermal image file position order up;

: Moves the thermal image file position order down;

: Delete the added thermal image file.

Click "Next" to enter the following interface:



1. Display max. temp. spot of entire image: Displays the highest temperature point of the entire thermal image in the report;

2. Display min. temp. spot of entire image: Displays the lowest temperature point of the entire thermal image in the report;

3. Display max. temp. measurement tools: Displays the highest temperature point within the temperature measurement area on the thermal image in the report;

4. Display min. temp. measurement tools: Displays the lowest temperature point within the temperature measurement area on the thermal image in the report;

5. Display temp. values: Displays the temperature values on the thermal image (highest point on the screen, lowest point on the screen, highest point on the marker, lowest point on the marker) in the report;

6. One report per thermal image: Generate a separate word version of the report for each thermal image file;

7. One report for all thermal images: all added thermal image files are generated in a word version

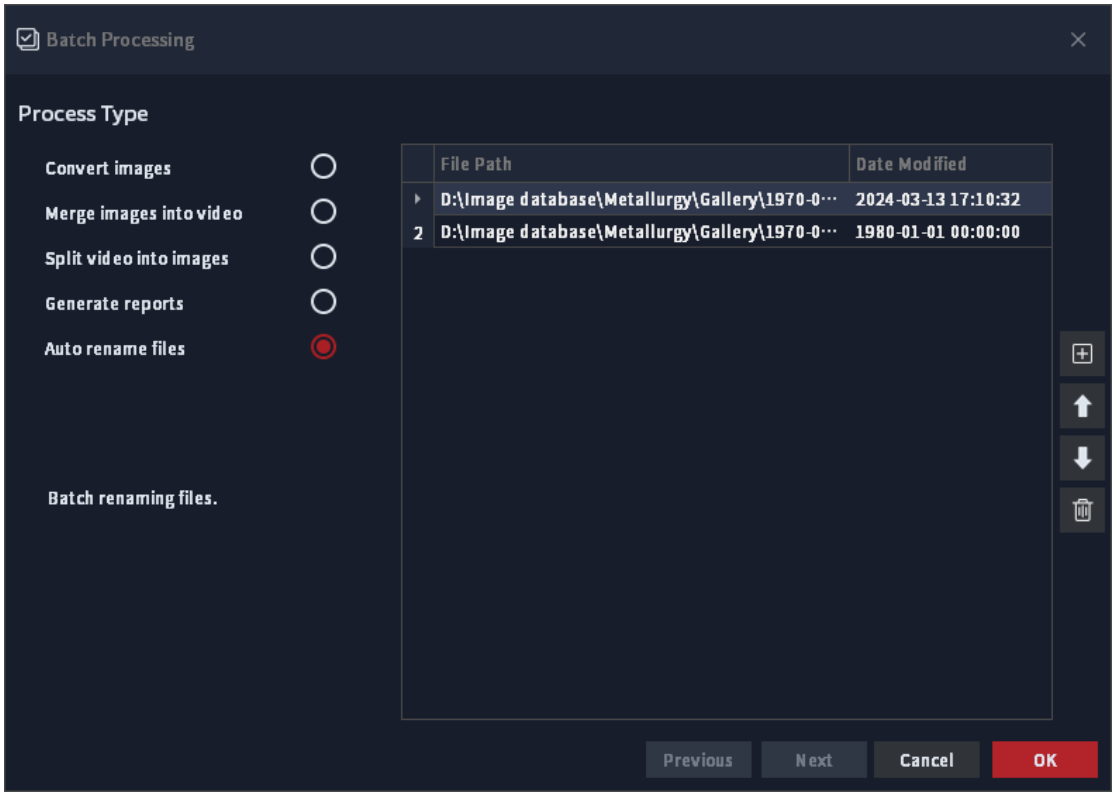
of the report

8. All thermal images files are generated in one summary report: A summary version of the report is generated for all added thermal images.

After the selection is completed, click "OK" to select the location to save the report; enter the file name and click "OK" to complete the batch processing of the report.

✧ Auto rename files

Supports renaming files with the following format: ‘filename_tag’.



: Add a thermal image file;

: Move the thermal image file position order up;

: Moves the thermal image file position order down;

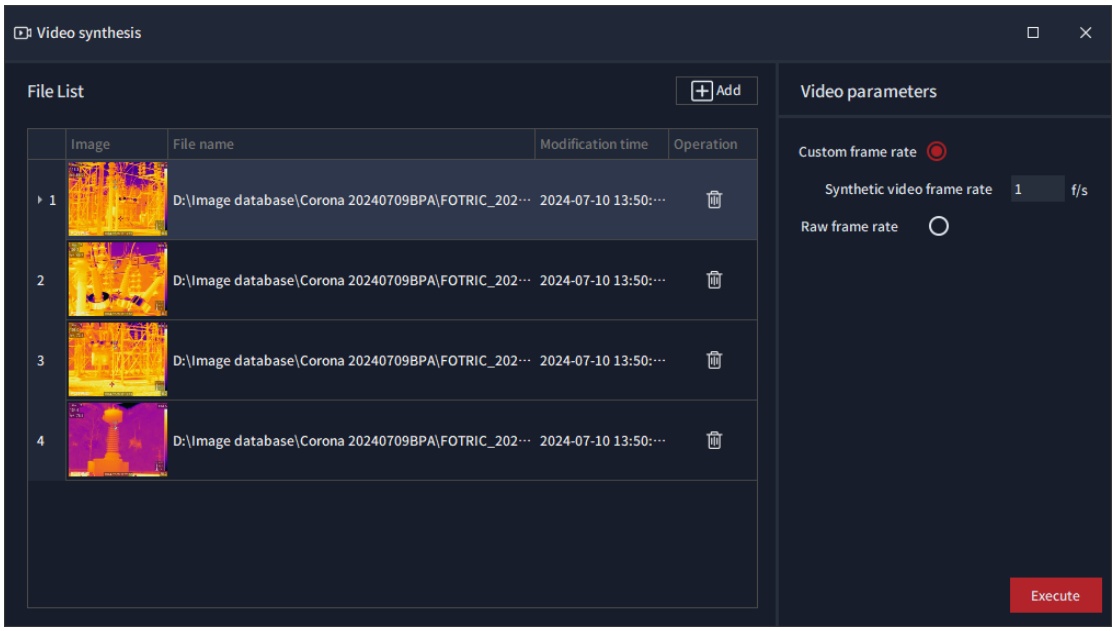
: Delete the added thermal image file.

After the above files are added, click "OK" to select the save location; enter the file name and click

"OK" to complete the batch processing of auto renaming.

7.2.4.5 Composite videos

Users may compile a series of thermal images into one radiometric video, provided all the images were captured by the same thermal camera with the same serial number.



On this interface, users may add or delete thermal images and change frame rate of the video. Click on ‘Execute’, select the path for video storage and click ‘confirm’ to finish the composition.

7.2.4.6 Open the located folder

Support for quickly locating where associated files are stored.

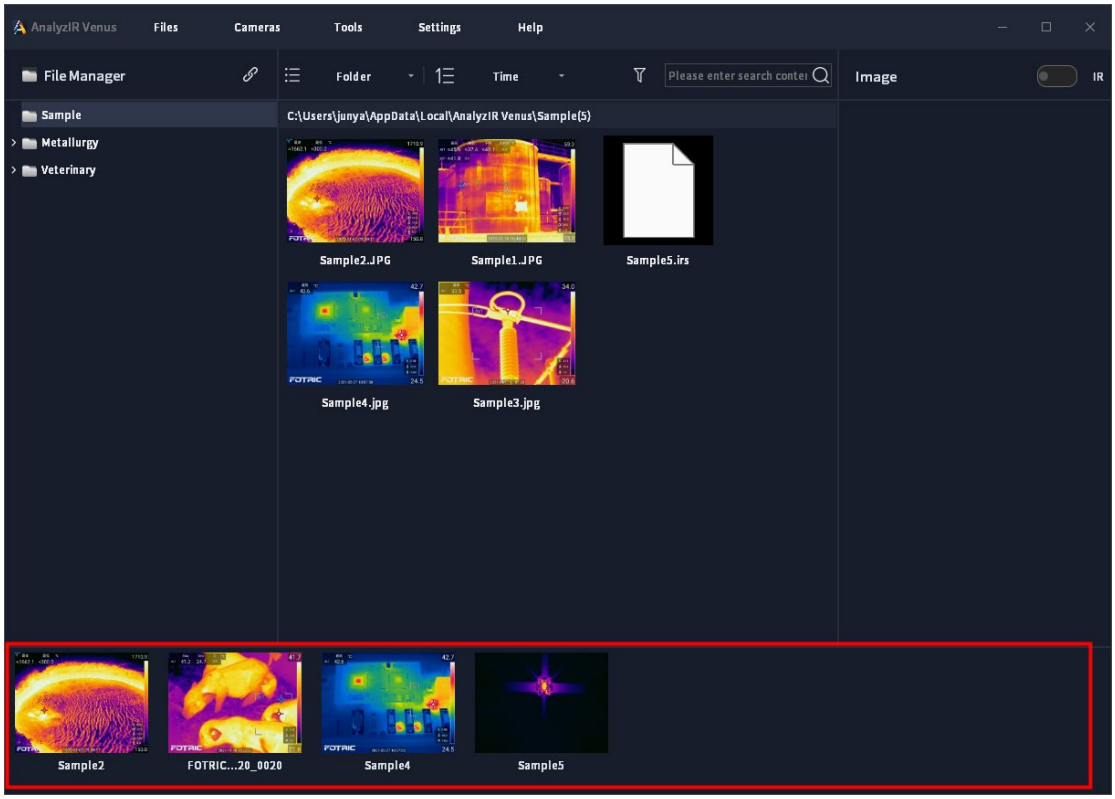
7.2.5 Quick Favorites Bar

The red box in the figure below shows the Quick Favorites section of the software. The user can double-click to open a thermal image file in the Quick Favorites section to quickly access the thermal image workspace for data analysis.

- ✧ The captured thermal photos and thermal videos are displayed in the Quick Favorites bar;
- ✧ Locally saved thermal image files can be added to the Quick Favorites bar for quick opening and analysis;
- ✧ Right click on the empty space of the Quick Favorites bar, the user can choose to add files to the Quick Favorites bar;

✧ The user can hold down the Ctrl or shift keys on the keyboard to batch delete the thermal files in the Quick Favorites bar;

✧ Support for locating where the thermal files are stored in the Quick Favorites bar.



7.3 Documentation

7.3.1 Thermal File Workspace

7.3.1.1 Opening a thermal image file

AnaylzIR Thermal Image Professional Analysis Software can open thermal image files in three ways;

✧ **Method I:**

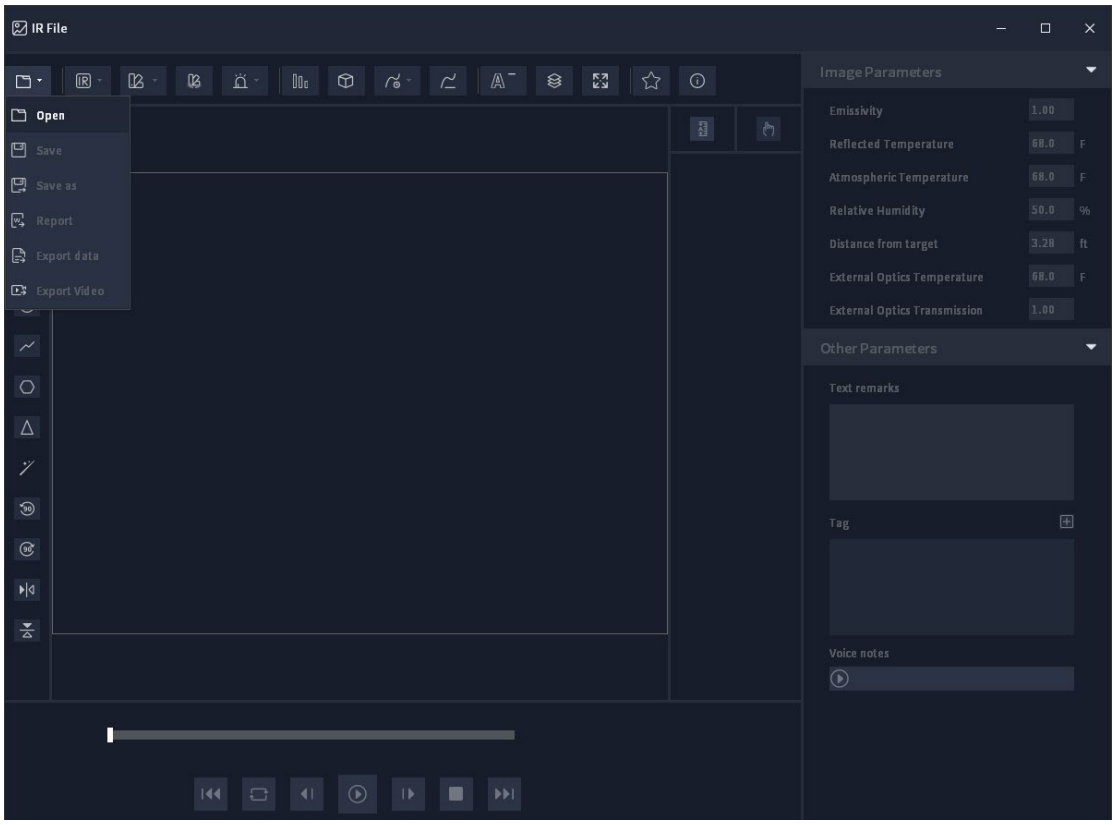
Select the thermal image file in the Quick Favorites column and double-click the left mouse button to directly open the thermal image file for analysis;

✧ **Method II:**

On the home page of the software, select the associated folder and double-click directly in the file list area to open the thermal image file for analysis;

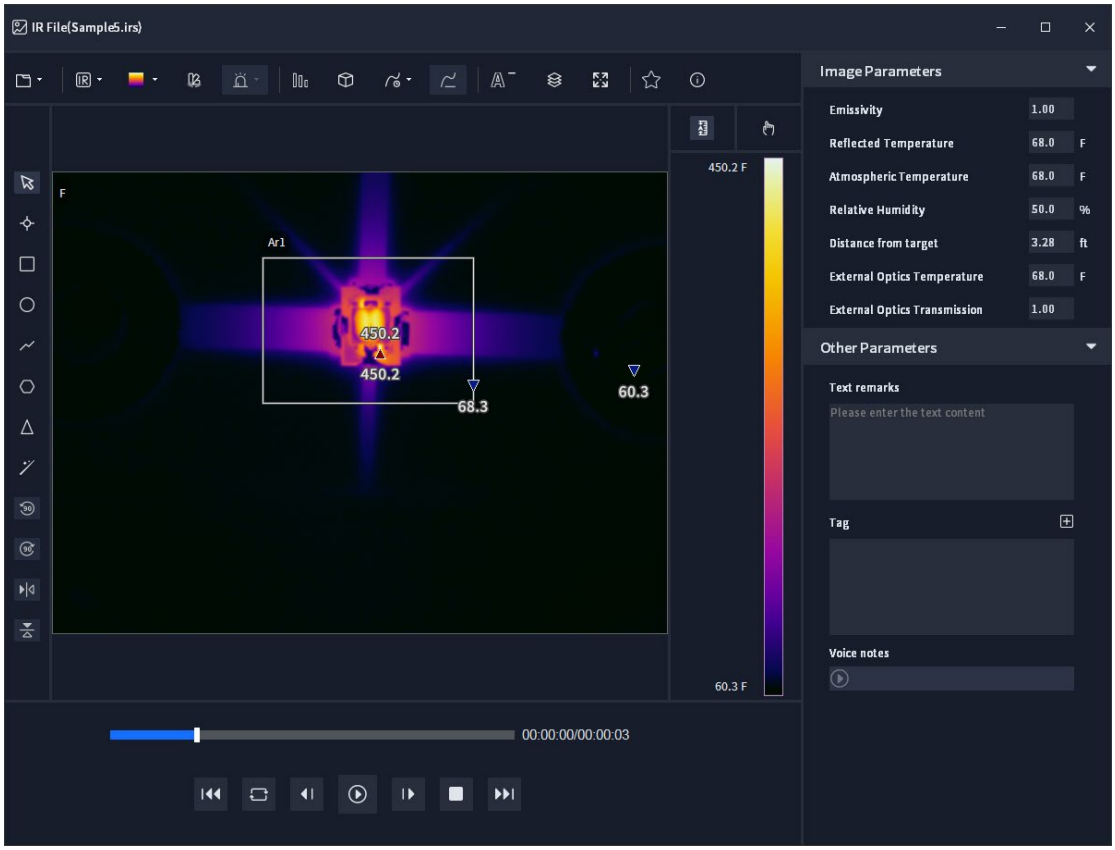
✧ **Method Three:**

Click on "File" - "Thermal Image Workspace" - select "Thermal Image", automatically jump to the thermal image workspace, as shown below. Click "Open", select the file the user want to analyze and click "OK".



7.3.1.2 Functions and buttons

7.3.1.2.1 Introduction to the IR file workspace interface



The thermal image workspace comprises of the following sections:

1. The middle screen of the software is the image or video display area.
2. 

The function buttons in the above figure are described in details below:

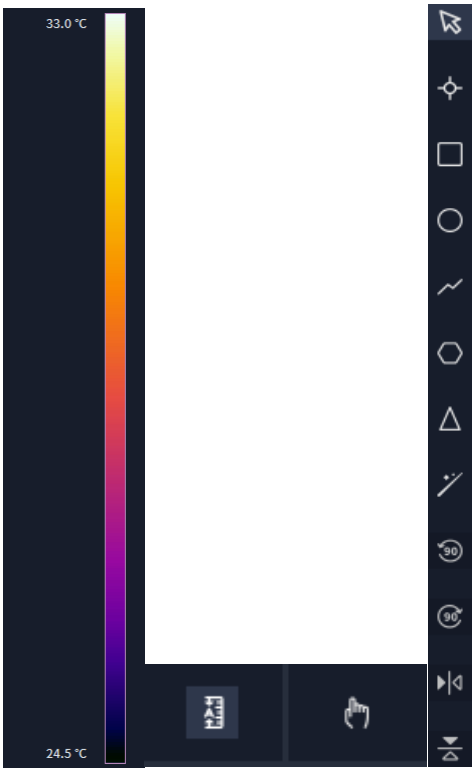
✧ File: Support Open, Save, Save As, Export Report, Export Data and Export Video. Please refer to section 7.3.2.2 of this manual for detailed operation procedures.

✧ Image Mode: Support Thermal Image, Picture-in-Picture (adjustable IR size and position), Blending (adjustable transparency) and Fusion (adjustable threshold) functions. For detailed operation procedures, please refer to section 7.3.2.3 of this manual for description.

✧ Palette: After clicking, a drop-down color menu appears, including 16 built-in color palettes and local color palettes, which can be selected arbitrarily according to needs and preferences;

usually, warm colors correspond to high temperatures and cold colors correspond to low temperatures.

- ✧ Inverted Palette: When clicked, the correspondence between the warm and cold colors and the high and low temperatures will be reversed; reversed to warm colors corresponding to low temperatures and cold colors corresponding to high temperatures.
- ✧ Alarm Type: Support regular, above, below, between and beyond function. For detailed operation procedures, please refer to the description of 7.3.2.4 in this manual.
- ✧ Histogram: For detailed procedure, please refer to section 7.3.7 of this manual for description.
- ✧ 3D Graph: For detailed operation procedures, please refer to the description of 7.3.8 in this manual.
- ✧ Time-Temperature Profile: For detailed operation procedure, please refer to the description of 7.3.9 in this manual.
- ✧ Line Temperature Distribution Curve: Please refer to section 7.3.10 of this manual for detailed operation procedures.
- ✧ Font size: When clicked, it will cycle through the font sizes, i.e., small, normal, and large fonts.
- ✧ Character Overlay: Please refer to section 7.6.4 of this manual for detailed operation procedures.
- ✧ Image Expansion: Click on the live video display area, slide the mouse wheel to zoom out and zoom in, clicking on this button will directly fill the entire thermal image window.
- ✧ Favorites: Supports file favorites/unfavorites function.
- ✧ Camera information display: When clicked, information about the camera is displayed, including camera model, serial number and resolution.

3. 

The function buttons in the above figure are listed below:

- Palette display, which displays the color of the current thermal image screen in relation to the temperature. The user can click on the ribbon area with the mouse and drag the mouse up and down to adjust the maximum and minimum temperature values for the entire screen and the effect of the display.
- Switch between temperature span mode: the default is the automatic temperature span , which automatically displays the color distribution of the thermal image in a linear fashion according to the highest and lowest temperatures on the screen; is the manual temperature width, which allows the user to set the minimum and maximum temperature values on the screen as needed.
- Temperature measurement tool: For detailed operation procedure, please refer to the description of section 7.3.4 of this manual.

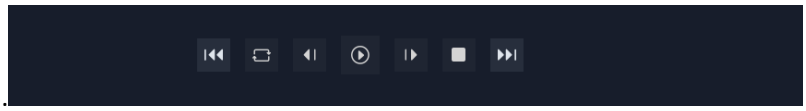
4. 

The first number represents the current time stamp during playback of the thermal imaging video, while the second indicates the total duration of the video. These can be displayed as absolute time,

relative time, or current frame count. Simply click here to toggle between the three display options.

The Time Cursor button allows the user to select and hold the cursor, enabling the user to drag it along the time axis for fast forward or rewind effects during video playback. As the user move the cursor, the thermal imaging video in the workspace will synchronize with the cursor's playback position.

! Note: This section is automatically hidden when the analyzed thermal image file is a thermal image.

5. 

The function buttons in the above figure are described in order as follows:

- Previous Button: Clicking this button automatically switches to the previous thermal image file.
- Playback Button: Clicking this button repeats playback of the current full radiometric thermal video.
- Previous Frame Button: Clicking this button plays the current full radiometric thermal video frame by frame in reverse.
- Play Button: Clicking this button plays the current full radiometric thermal video; switches to pause button during playback.
- Next Frame Button: Clicking this button plays the current full radiometric thermal video frame by frame forward.
- Stop Button: Stops playback of the current full radiometric thermal video.
- Next Button: Clicking this button automatically switches to the next thermal image file.

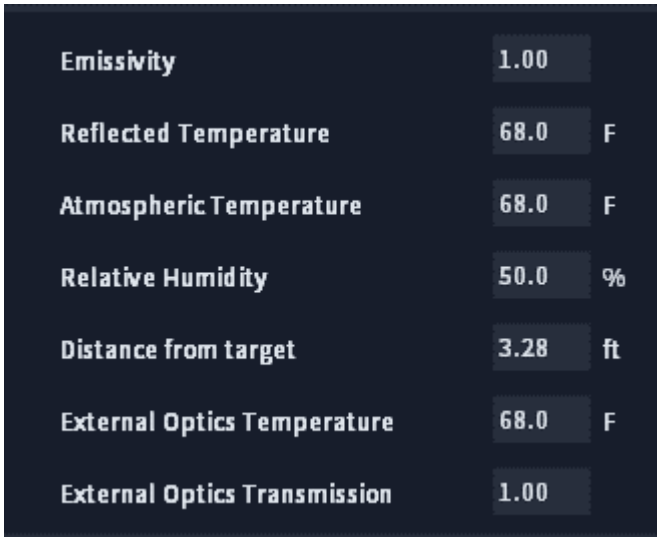
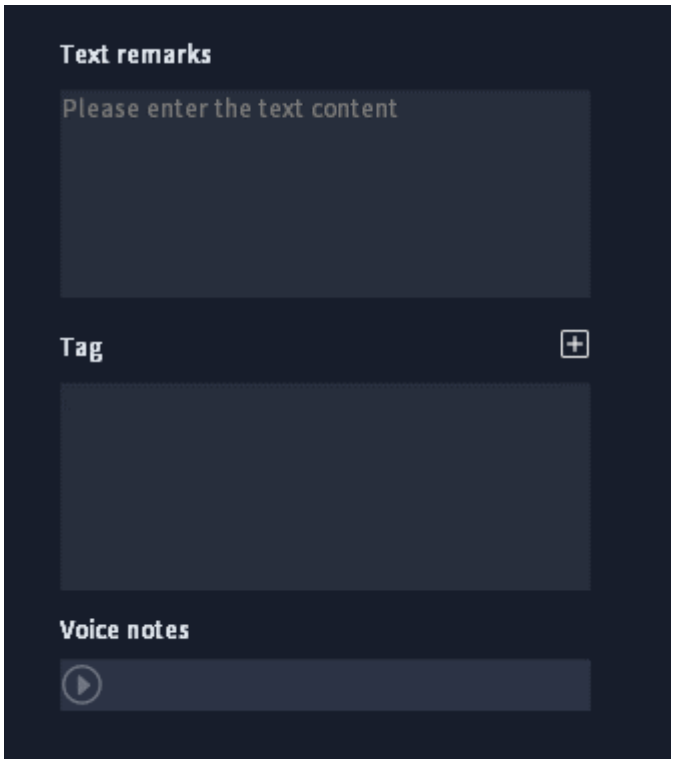
6. 

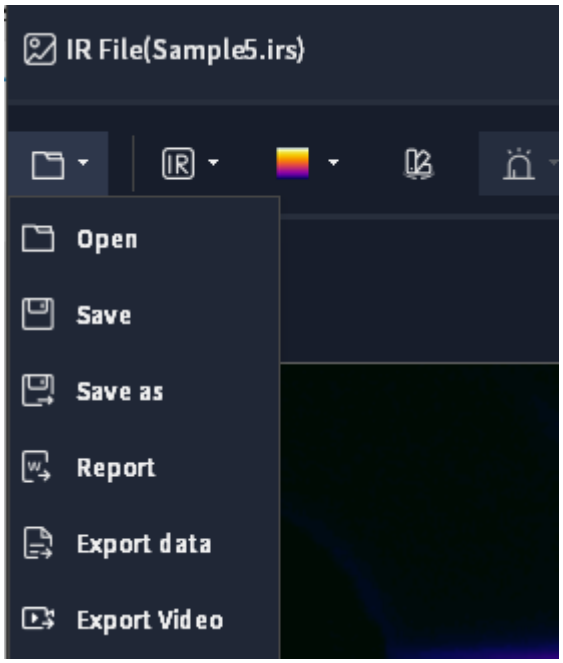
Image target parameter setting: It contains emissivity setting, reflection temperature setting, atmospheric temperature setting, relative humidity setting, target distance setting, external optical temperature setting, and external optical transmittance setting. For detailed operation steps, please refer to section 7.3.3 of this manual.

7. 

Other parameters of the image: support for adding, deleting, changing and checking text notes, labels (clicking on the plus sign will allow the user to edit a new label), as well as clicking on the voice note playback button will automatically play the contents of the voice notes saved in the

thermal image file.

7.3.1.2.2 File operations



Supports open, save, save as, export report, export data and export video.

✧ Open: Click this button to open the thermal image file.

✧ Save: When clicked, the current hot image file will be automatically updated and saved.

✧ Also for: when clicked, it will automatically save the analyzed and processed thermal image file as a new thermal image file.

! Note: When the object analyzed in the thermal image workspace is a '.irsx' full radiometric thermal image video, the Save As button can be used as a full radiometric thermal image video edit function as follows:

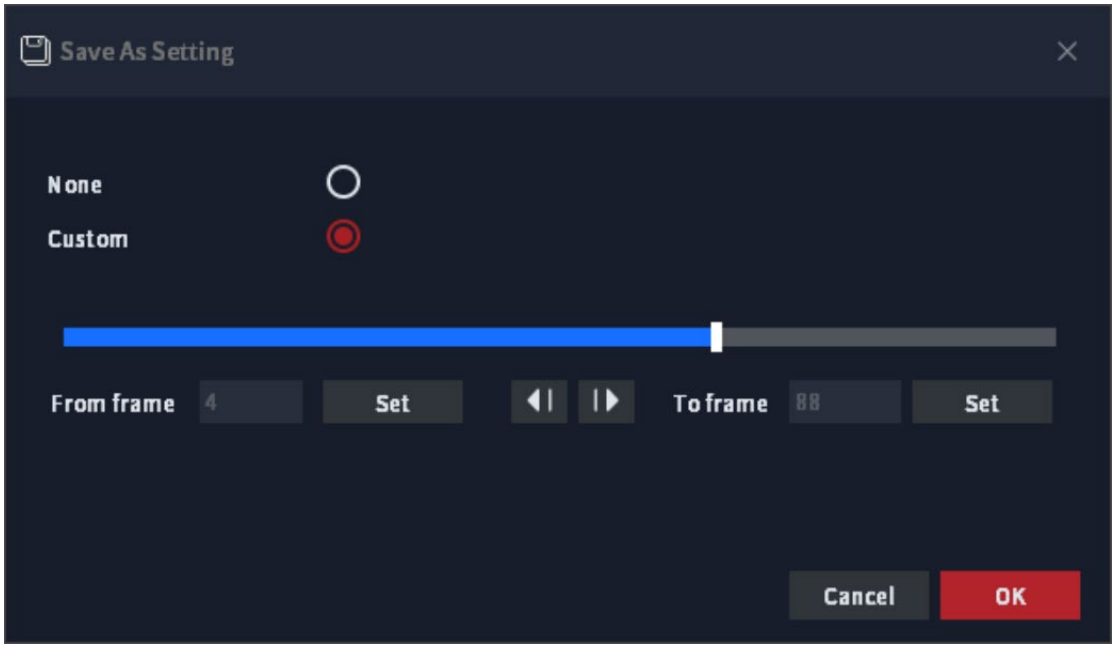
1. Open the full radiation thermal image video file, click the file Save As button to enable the Save As Settings tab, click "None", and then click "OK" can be;

2. Or click the checkbox for 'Custom';

3. Drag the bottom of the timeline cursor, select the radiation thermal image video files need to intercept the start frame, click "Set", the number of frames in the display column to the right of the start frame will be automatically displayed as the current number of frames of the radiation

thermal image video; continue to drag the timeline cursor, select the radiation thermal image video files need to intercept the end of the frame, click Set, the number of frames in the display column to the right of the end frame will be automatically displayed as the current number of frames of the radiation thermal image video. The number of frames on the right side of the end frame will be automatically displayed as the current number of frames of the thermal imaging video; frame-by-frame back button, frame-by-frame forward button, similar to the function of dragging the timeline cursor.

4. As shown in the example below, select frame 4 as the start frame of the new video, click the setup button, the right display bar of the start frame will automatically show 4; Select frame 88 as the end frame of the new video, click the setup button, the right display bar of the end frame will automatically frame 88;



5. Click the "OK" button, enter the file name, save as a new thermal image of the whole radiation video file.

✧ Export Report: Click on this button to automatically generate a professional report of the currently analyzed thermal image according to the default report template, continue to click on "OK", enter the file name and click on "Save" to generate a word version of the thermal image report;

! Note: For the setup of the report template, please refer to the detailed text description of the report template in Section 7.5.1 Report Template of this manual for execution.

✧ Export Data: Click this button to export and save the currently analyzed thermal image file as a temperature data matrix file in Excel format.

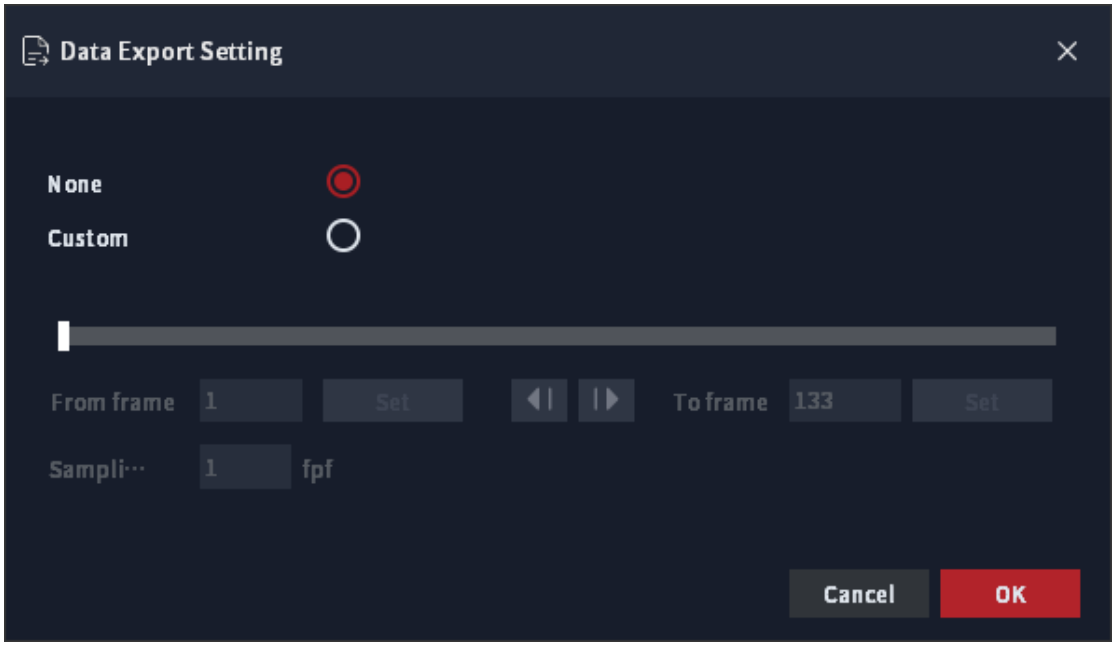
If the user need to export the temperature data matrix file within the thermal image file, the user should follow the steps below:

1. Open the thermal image file, click the Data Export button, enable the Data Export Settings tab, click "None", and then click "OK";

2. Click the checkbox for ‘Custom’;

3. Drag the timeline cursor below, select the thermal image file needs to export the temperature data of the starting frame, click on the setting, the number of frames in the display column to the right of the starting frame will be automatically displayed as the current number of frames of the thermal image file; continue dragging the timeline cursor to the need to intercept the thermal image of the file's end frame, click on the setting, the number of frames in the display column to the right of the ending frame will be automatically displayed as the current number of frames of the thermal image file;  frame-by-frame backward buttons,  frame-by-frame Forward button, similar to dragging the timeline cursor.

4. As shown in the example below, select frame 3 as the start frame for exporting temperature data from the thermal image file, click the Set button, the right side of the start frame will be displayed as 3 automatically; select frame 7 as the end frame for exporting temperature data from the thermal image file, click the Set button, the right side of the end frame will be displayed as 7 automatically;



5. In the sampling frequency of the right side of the blank column, enter the appropriate sampling frequency, 1fpf means export all the frames, 2fpf means every 1 frame export, 3fpf means every 2 frames export, and so on; set the appropriate sampling frame frequency is conducive to further streamlining of the temperature data need to be exported.

6. Click ″OK″ button, enter the file name, the selected thermal image file will be exported to Excel format temperature data matrix file.

✧ Export Video: Click this button to export the currently analyzed thermal image file to a video file in .MP4 format.

If the user need to export the full radiometric thermal image video to a video file in MP4 format, please follow the steps below:

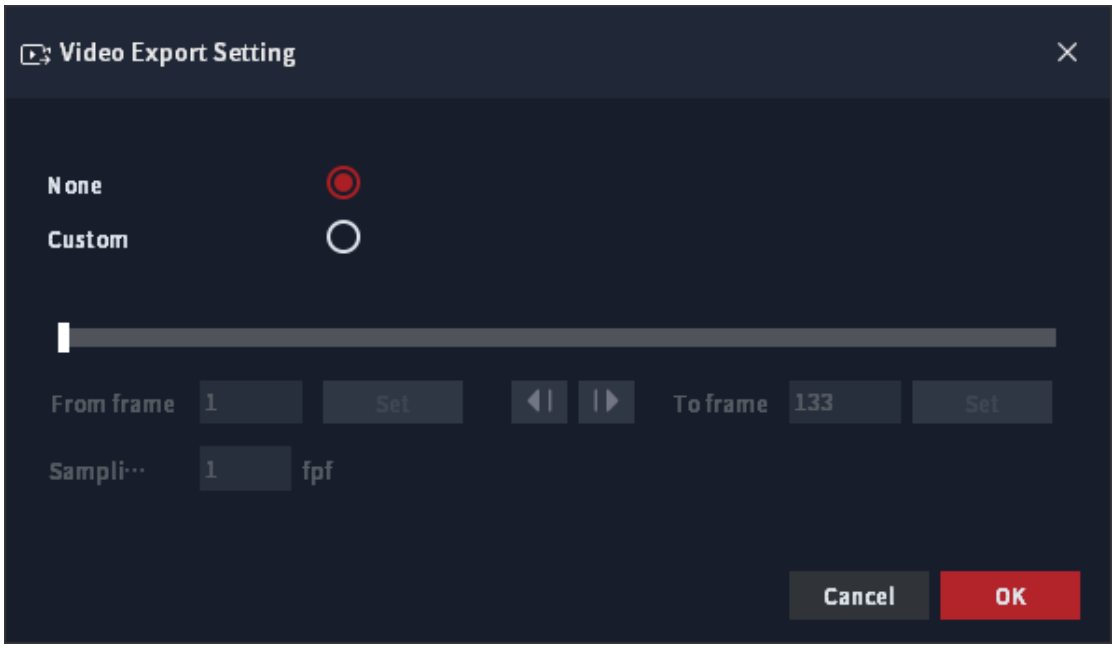
1. Open the hot image file, click the video export button, enable the video export settings tab, click "None", and then click "OK";

2. Click the checkbox ‘Custom’;

3. Drag the timeline cursor below, select the video file needs to be exported to the start frame, click on Settings, the number of frames in the display column on the right side of the start frame will be automatically displayed as the current number of frames of the radiation thermal image

video; continue to drag the timeline cursor, select the video file needs to be exported to the end of the frame, click on Settings, the number of frames in the display column on the right side of the end frame will be automatically displayed as the current number of frames of the radiation thermal image video; frame-by-frame backward buttons Frame-by-frame forward button, the function is similar to dragging the timeline cursor.

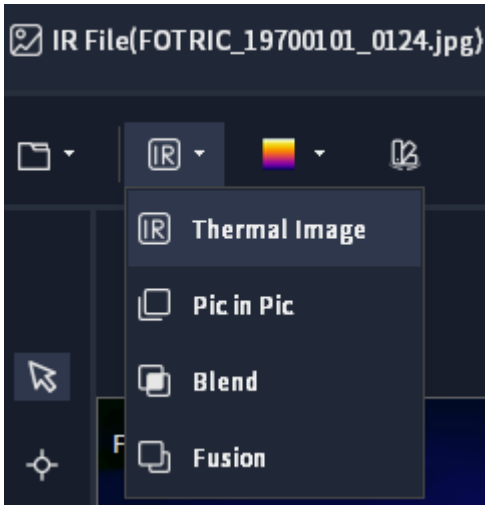
4. As shown in the example below, select frame 3 as the start frame of MP4 video, click the Set button, the right display bar of the start frame will automatically display 3; select frame 7 as the end frame of MP4 video, click the Set button, the right display bar of the end frame will automatically display 7;



5. In the sampling frequency of the right side of the blank field to enter the appropriate sampling frequency, 1fpf means to save all the frames, 2fpf means every 1 frame to save, 3fpf means every 2 frames to save, the subsequent figures and so on; set the appropriate sampling frame rate is conducive to reducing the size of the AVI format video files.

6. Click the "OK" button, enter the file name, saved as MP4 format video files.

7.3.1.2.3 Image mode



For thermal images containing visible light information, the thermal image, picture-in-picture, blending and fusion functions can be switched.

- ✧ Thermal Image: When clicked, the thermal image workspace displays the radiometric thermal image.
- ✧ Picture-in-Picture: When clicked, the thermal image workspace displays the thermal image in Picture-in-Picture format.

In PICTURE-IN-PICTURE display mode, the lock button for adjusting the position and size of the thermal image in the PICTURE-IN-PICTURE image; This state is locked and the position and size of the thermal image in the PICTURE-IN-PICTURE image cannot be adjusted. means the picture is up for edition. The user can drag the corners of the thermal image in the picture-in-picture image to resize it or select and drag the center of the thermal image to move the position of the image.

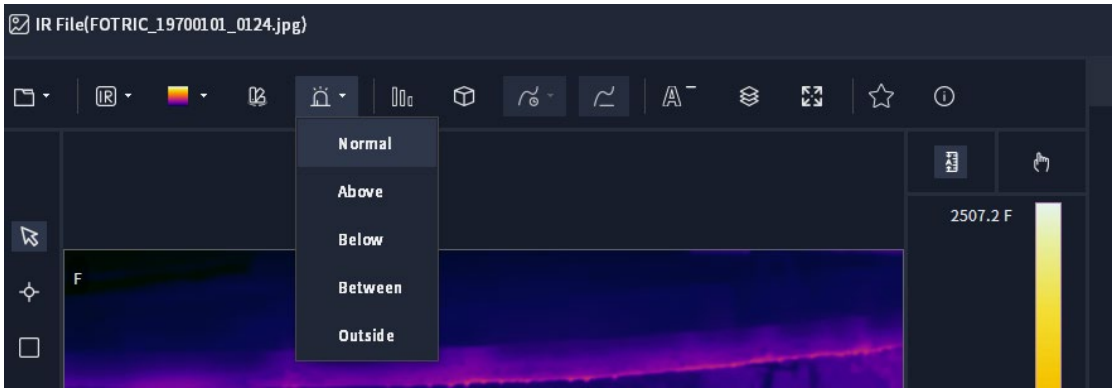
- ✧ Blend: 

Select and hold the cursor and drag left and right to adjust transparency of the thermal image screen in the image.
- ✧ Fusion: 

Adjust the threshold to decide the portion of the thermal image display of the image. For example, if the user enter 20° C-40° C, the area in the 20° C-40° C range will automatically be displayed as a

thermal image on the image, and the rest of the temperature range will be displayed as a visible image.

7.3.1.2.4 Types of alarms



Supports Normal, Above, Below, Between and Outside.

- ✧ Normal: When clicked, there is no alarm.
- ✧ Above: Clicking this option displays the alarm type on the right side of the workspace, allowing adjustment of the alarm color and upper limit. Whenever a pixel's temperature value on the thermal image exceeds the upper limit, the area will be shown in the alarm color.
- ✧ Below: Selecting this option reveals the alarm type on the right side of the workspace, enabling adjustment of the alarm color and lower limit. Whenever a pixel's temperature value on the thermal image falls below the lower limit, the area will be displayed in the alarm color.
- ✧ Between: Choosing this option shows the alarm type on the right side of the workspace, where the alarm color and upper and lower limits can be adjusted. If the temperature value of a pixel on the thermal image falls within the specified upper and lower limits, the area will be displayed in the alarm color.
- ✧ Outside: Opting for this feature displays the alarm type on the right side of the workspace, allowing adjustment of the alarm color and upper and lower limits. If the temperature value of a pixel on the thermal image is either inside or outside the specified upper and lower limits, the area will be shown in the alarm color.

7.3.1.3 Image Parameter Settings

For detailed operation procedures, please refer to the description of 7.4.3 in this manual.

7.3.1.4 Adding temperature measurement tools

Rotate 90° to the left: When clicked, the thermal video or thermal image is automatically rotated 90° to the left.

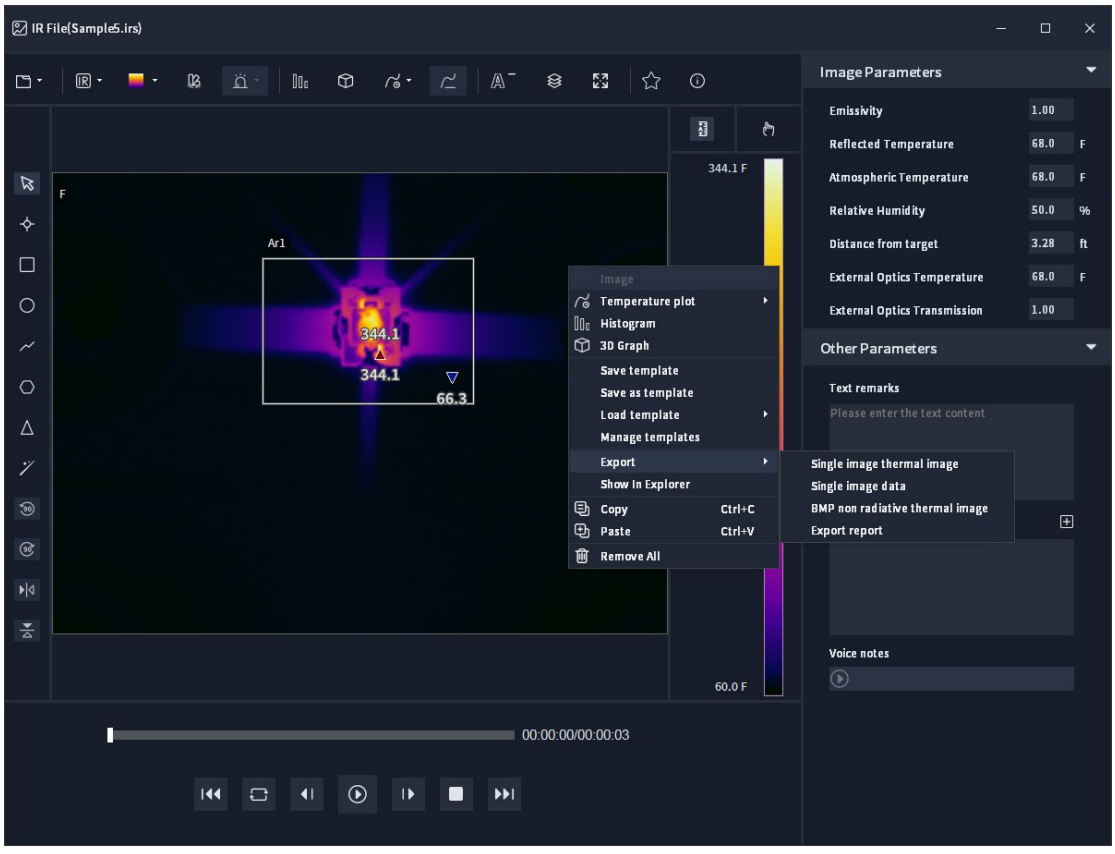
Rotate 90° to the right: When clicked, the thermal video or thermal image is automatically rotated 90° to the right.

! Note: For other settings of the temperature measurement tool, please refer to the description in section 7.4.4 of this manual.

7.3.1.5 Measurement tools parameter settings

For detailed operation procedures, please refer to the description of section 7.4.5 of this manual.

7.3.1.6 Hidden function menu



Select the thermal image file or select the temperature measurement object in the thermal image file and click the right mouse button to bring up its hidden function menu containing the following functions **! (Note:** some menu items only appear in certain scenarios):

✧ **Time-temperature curve**

For detailed operating procedures, please refer to the description in Section 7.3.9 of this manual.

✧ **Line temperature distribution curve**

For detailed operation procedures, please refer to the description of section 7.3.10 of this manual.

✧ **Histogram chart**

For detailed operation procedures, please refer to the description of section 7.3.7 of this manual.

✧ **3D graph**

For detailed operating procedures, please refer to the description in Section 73.8 of this manual.

✧ **Color distribution**

Click on Color Distribution and it will be divided into Histogram Equalization and Signal Linearity. Choose different, the imaging effect is different.

✧ **Reference temperature difference**

Click on the reference temperature difference and the following figure appears:

Enable the reference temperature difference, select the reference object as temperature, then the user can enter a fixed value; or select the reference object as a temperature measurement standard or select the reference object as a temperature measurement standard, click OK, and the result of the reference temperature difference appears in the screen.

✧ **Save template**

Click ‘Save Template’, the save menu will appear, enter the template name and the measurement template will be saved as set named.

✧ **Save as template**

Click ‘Save As Template’, the Save As menu will appear, enter the template name and the measurement template will be saved as set named.

✧ **Load template**

Clicking on ‘Load Template’ will bring up the saved template options, which can be freely selected as needed.

✧ **Manage templates**

Clicking on ‘Manage templates’ will bring up a list of saved templates, and clicking the Delete button will automatically delete the template.

✧ **Export**

Options are available to export single-image thermal image, single-image data, BMP non-radiometric thermograms, extract visible light image, extract full visible light image, and export reports.

✧ **Show in file explorer**

Directly opens the folder where the current hot image file is located.

✧ **Copy/"Ctrl+C"**

The current thermal image can be copied directly.

✧ **Paste/"Ctrl+V"**

The user can directly paste the copied thermal image into Word, Excel, PPT and other office software.

✧ **Delete all**

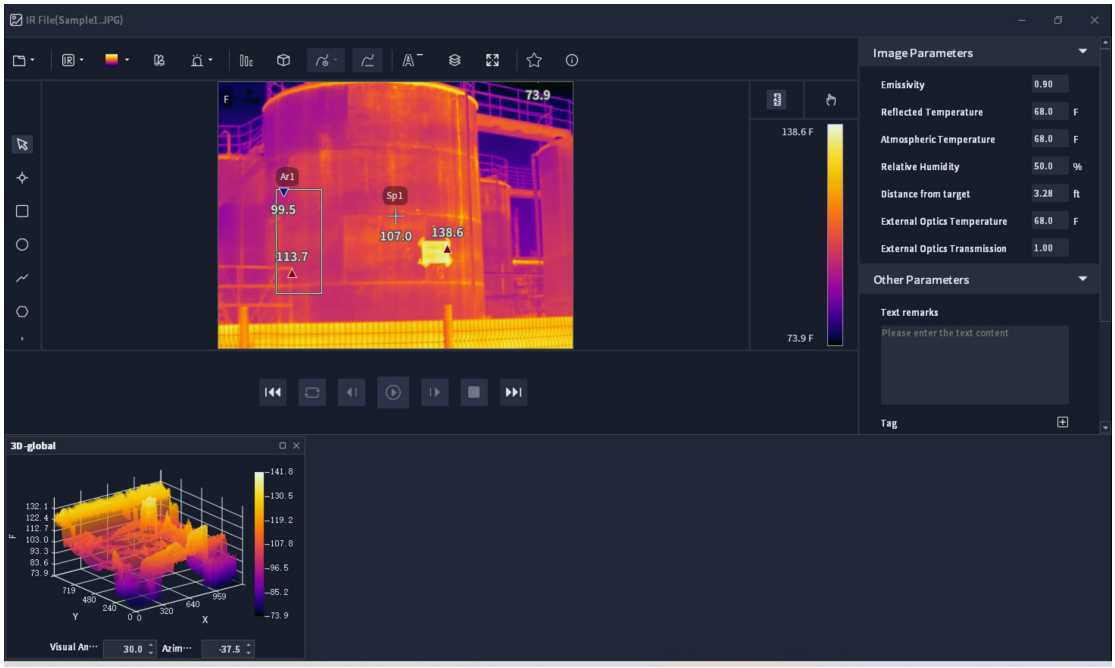
Delete all temperature measurement markers directly from the thermal image.

7.3.1.7 Generating a Histogram

! Note: If the user need to use the Histogram function, please refer to Section 7.4.8 of this manual for description.

7.3.1.8 Generating a 3D graph

7.3.1.8.1 3D graphs based on global temperature distribution



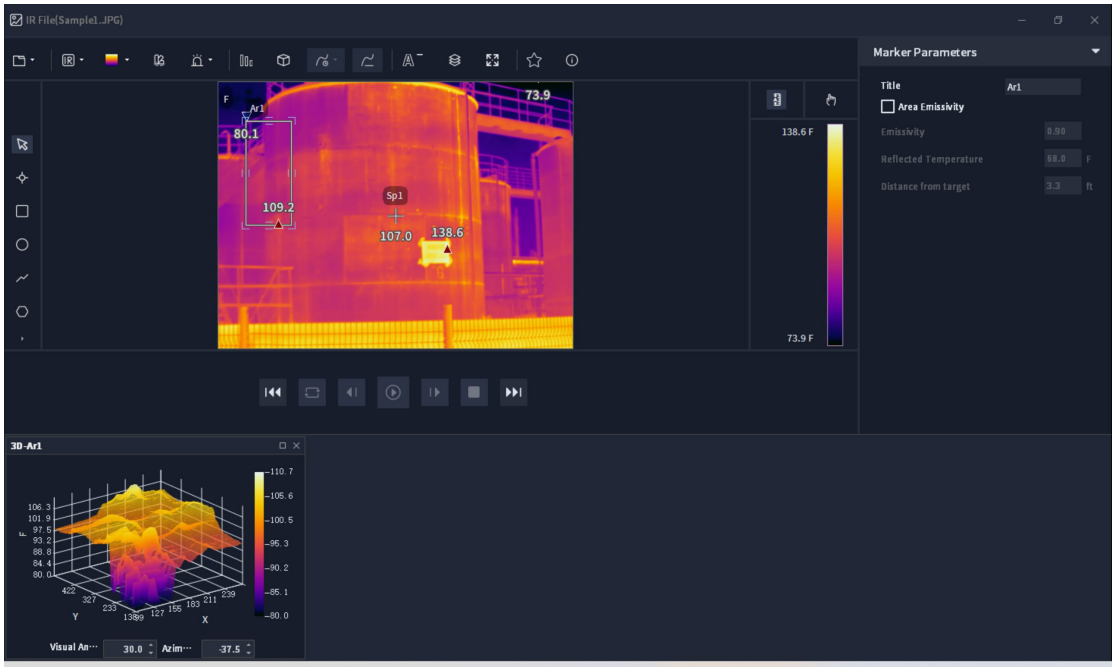
To add the Global 3D graph, the user should perform the following steps:

1. Click on the 3D image icon in the toolbar on the top, or move the mouse to the right button on the thermal image to bring up the hidden menu;

2.Select the 3D graph option, the software will automatically render a 3D graph based on the overall thermal image;

3. User may insert appropriate values in the view input field and azimuth input field to achieve the best 3D map display.

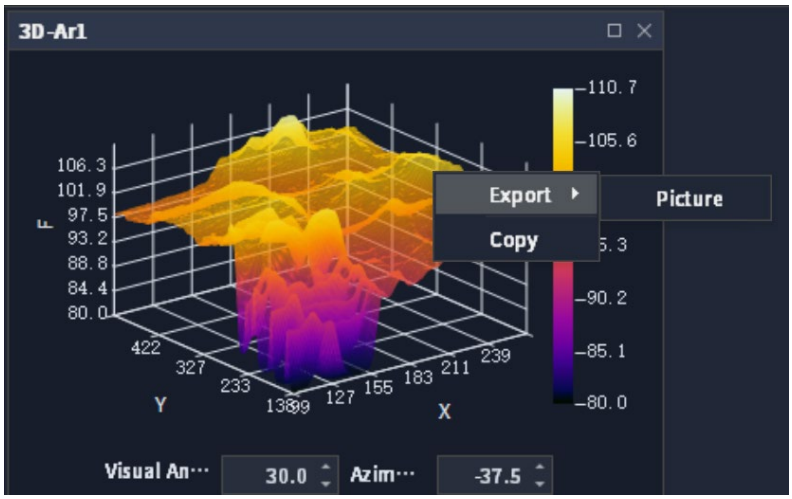
7.3.1.8.2 3D graph based on ROI



If the user need to add an ROI 3D graph, follow these steps:

1. Hover the mouse over the thermal image and select an existing measurement area (circle, polygon, rectangle). Alternatively, click directly on the 3D graph icon in the toolbar above the software, or right-click to access the hidden menu.
2. Choose the three-dimensional graph option to automatically generate a 3D graph based on the **ROI** temperature distribution.
3. In**sert** appropriate values in the view input field and azimuth input field to achieve the best 3D graph display.

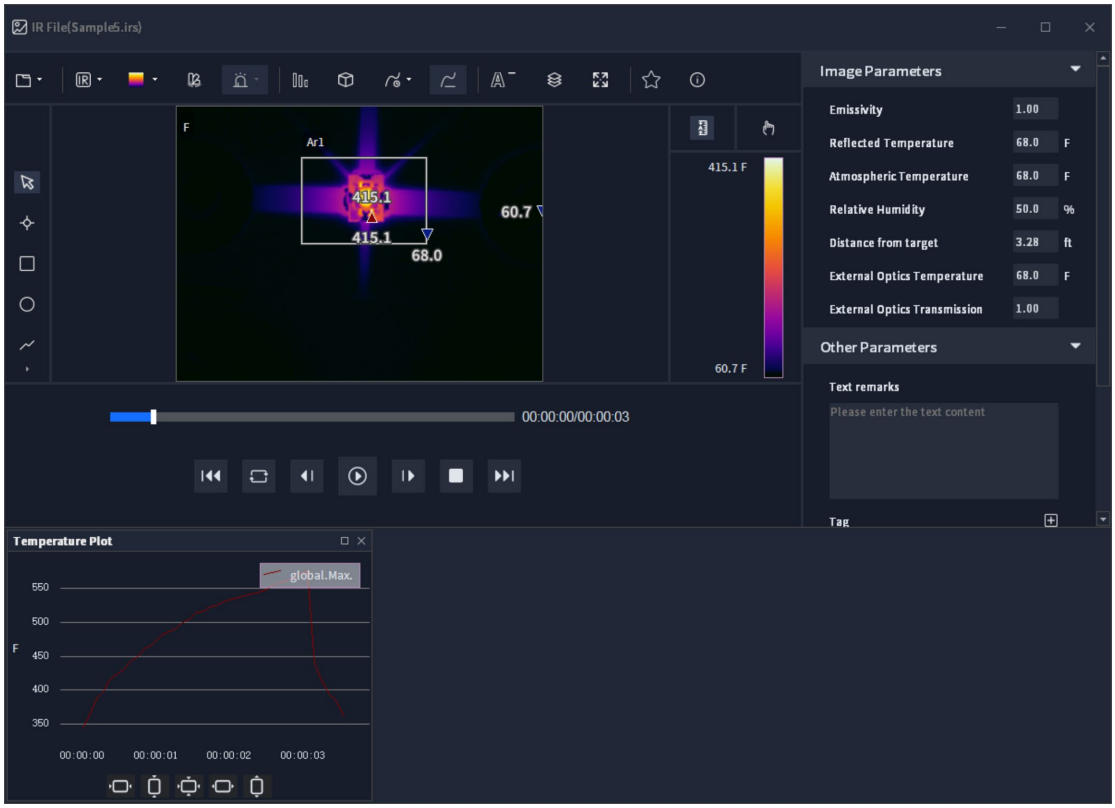
7.3.1.8.3 3D graph hidden function menu



✧ Click "Export" - "Picture" - "Input file name" to save as BMP/JPG format Save as a BMP/JPG image.

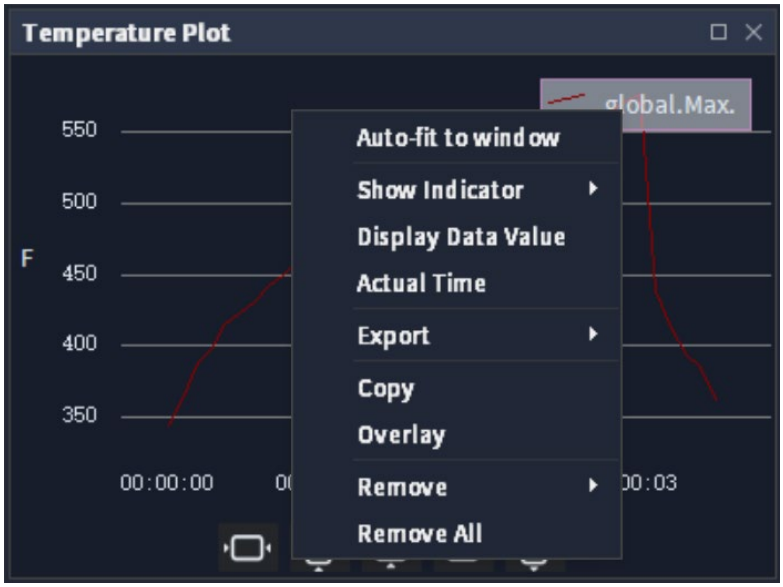
✧ Choose copy or shortcut key "Ctrl+C", directly paste the 3D drawing in picture format into word/excel/PPT and other office software.

7.3.1.9 Adding a Time-Temperature Profile



! Note: If the user need to add the Time Temperature tab, please refer to the description in 7.4.9 of this manual.

7.3.1.9.1 Time-Temperature Profile Hidden Functions Menu



! Note: If the user need to use the hidden function menu of the Time Temperature Profile option, please refer to the description in 7.4.9.3 of this manual.

Show indicator: After clicking, the drop-down menu appears on the right side, the user can choose the cursor to display the temperature value according to that time-temperature curve, and the user can drag the cursor arbitrarily along the left and right directions on the time-temperature curve graph to realize the fast-forward and fast-reverse functions of the video.

Overlay: When clicked, brings up the Overlay Function tab, which allows the user to display the time-temperature profiles of other thermal image workspaces superimposed on the time-temperature profile tab of the current thermal image workspace.

7.3.1.9.2 Overlay display of time-temperature curves

1. Enter the thermal image workspace and click to open the two thermal image files;

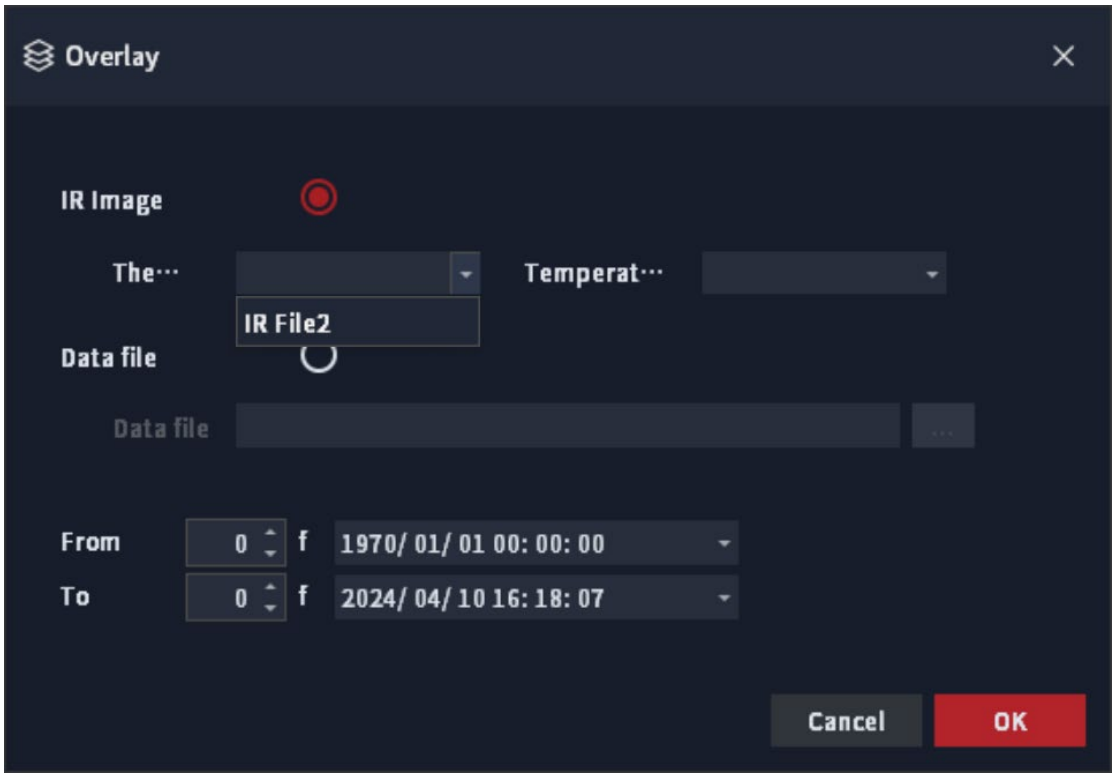
2. The Time Temperature Profile tab is enabled for both thermal image files;

3. will need to pay attention to the temperature measurement area or temperature measurement point to generate time temperature curve;

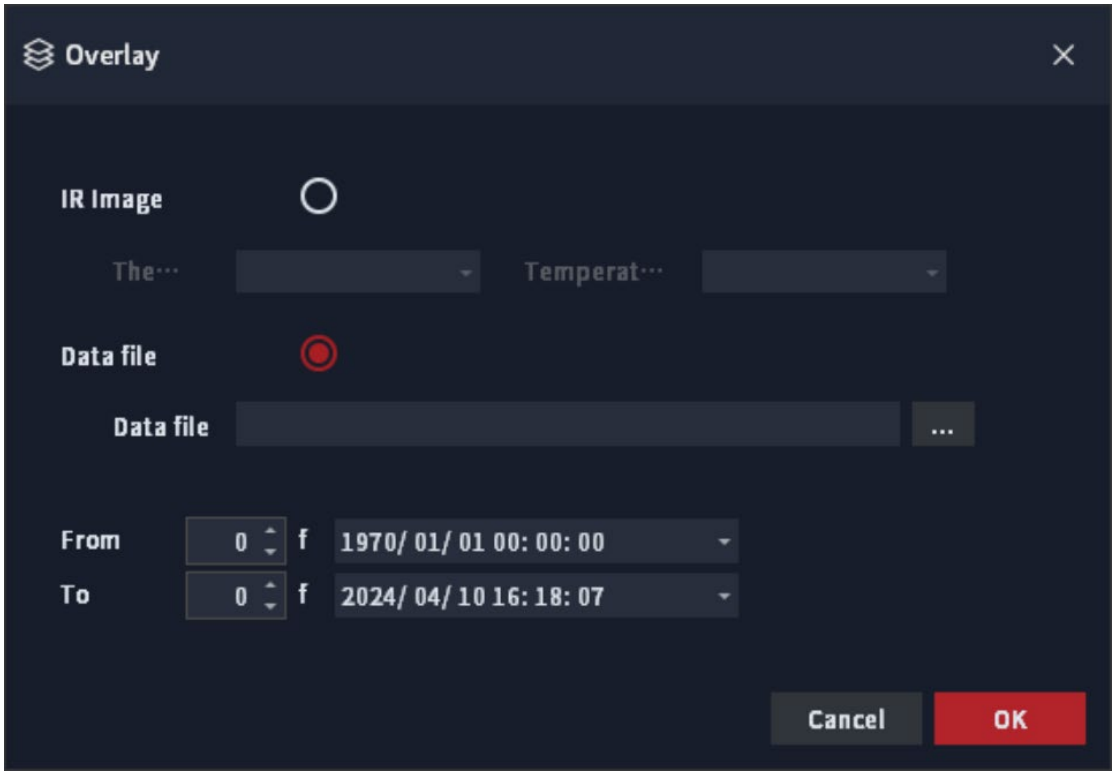
4. Click the right mouse button on the Time Temperature tab of one of the thermal image files to open the Hidden Functions menu;

5. Click the Overlay button to bring up the Overlay function submenu;

6. Select Thermal Image, click the Thermal Image drop-down menu, and select IR File 2;



7. Click on the time and temperature curve of the drop-down menu, select the appropriate logo; or the user can also select the data file, click on the right side of the selected data file "Browse" button, import the CSV format time and temperature curve file for the superposition of the display;



8. ‘From’, the user can enter the specific number of frames (example input 30 frames), superimposed on the starting point of the time-temperature curve will be 30 frames ahead of the starting point of the current display curve;

9. ‘To’, the user can enter the specific number of frames (example input 100 frames), the superimposed time temperature curve will start 100 frames later than the start of the source time;

10. Click "OK" to complete the time and temperature curve of the superposition of the display.

7.3.1.10 Adding a Line Temperature Distribution Curve Tab

! Note: If the user need to use the Line Temperature Distribution Curve tab function, please refer to the description in Section 7.4.10 of this manual.

7.3.1.11 Resetting the window layout

For detailed operating procedures, please refer to section 7.4.12 of this manual for description.

7.3.2 Acoustic File Workspace

7.3.2.1 Opening acoustic image and video files

AnalyzeIR Professional Thermal Image Sound Analysis Software provides three methods to open sound files:

✧ **Method I:**

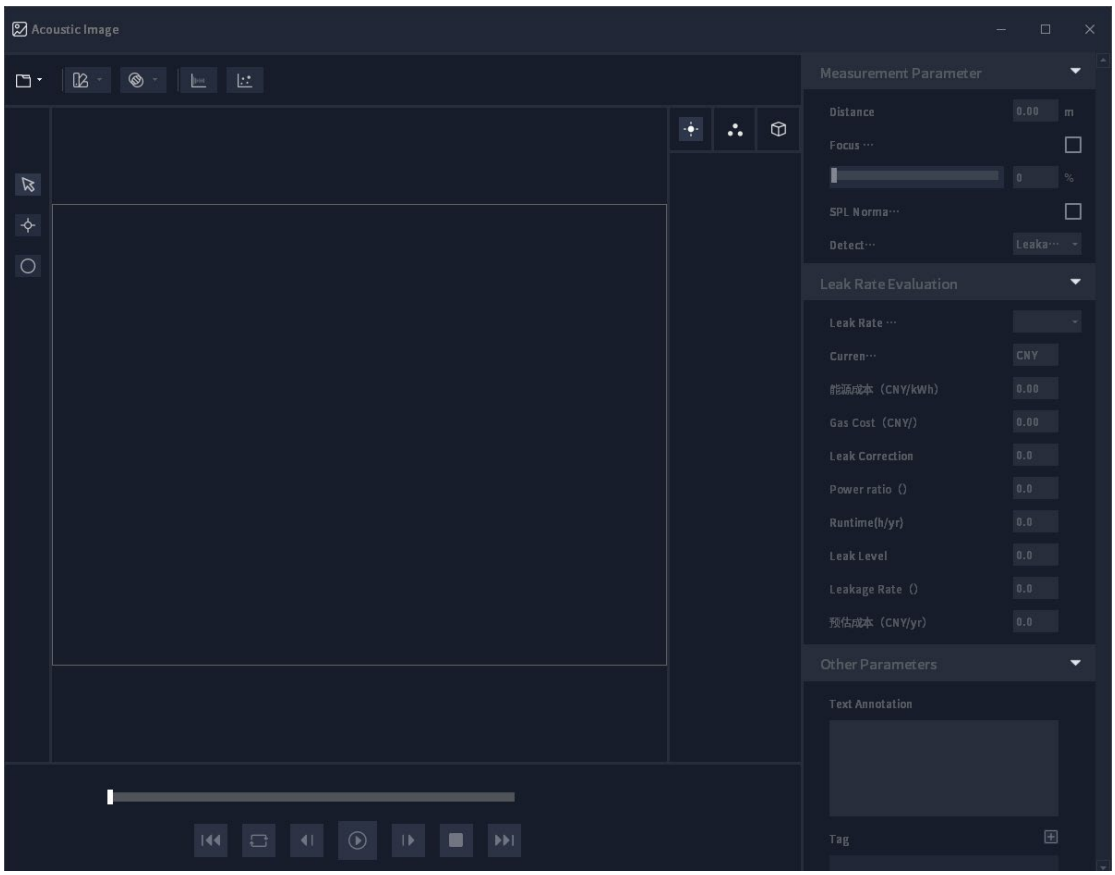
Navigate to the Favorites column, select the desired sound file, and double-click the left mouse button to open it directly for analysis;

✧ **Method II:**

From the software's home page, choose the associated folder and double-click on the file list area to open the sound and video files for analysis;

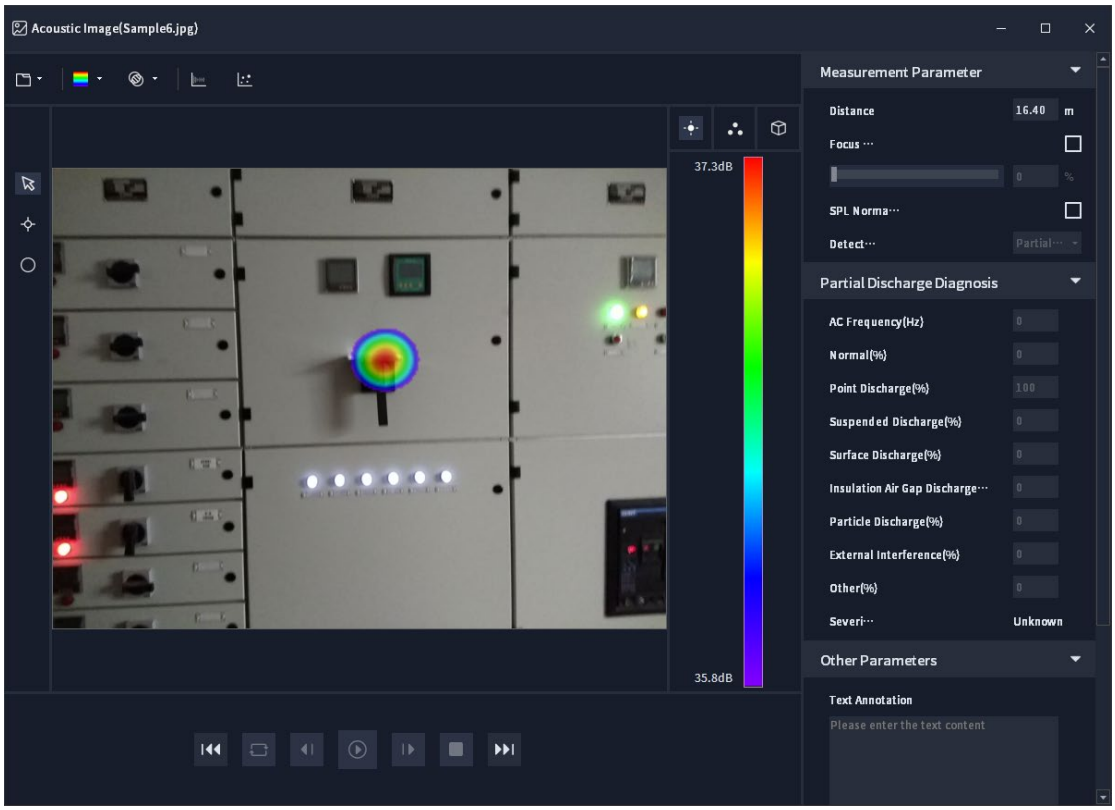
✧ **Method Three:**

Click on "File" > "Sound and Image Workspace" > select "Sound and Image". This action will automatically switch to the sound and image workspace. Then, click "Open" to select the file you wish to analyze and click "OK".


Acoustic Image
Measurement Parameter
Distance
0.00
m
Focus ···
0
%
SPL Norma···
Detect···
Leaka···
Leak Rate Evaluation
Leak Rate ···
Curren···
CNY
能源成本（CNY/kWh）
0.00
Gas Cost（CNY/）
0.00
Leak Correction
0.0
Power ratio（）
0.0
Runtime(h/yr)
0.0
Leak Level
0.0
Leakage Rate（）
0.0
预估成本（CNY/yr）
0.0
Other Parameters
Text Annotation
Tag

7.3.2.2 Introduction to the Functions and Keys of the Acoustic File Workspace

7.3.2.2.1 Introduction to the Acoustic File Workspace Interface



The acoustic file workspace interface can be divided in the following sections:

1. The middle screen of the working area is the image or video display area.

2. 

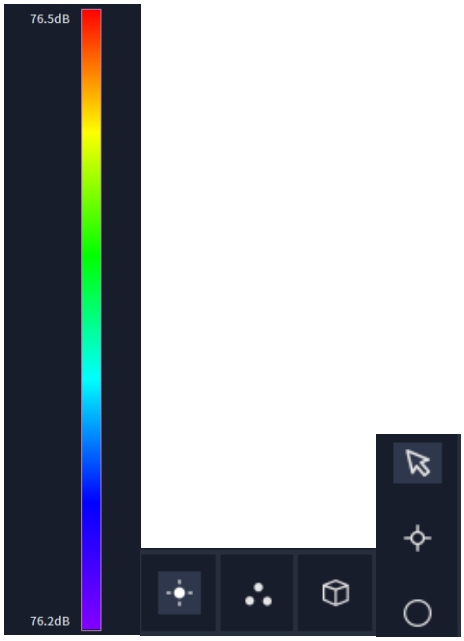
The function buttons in the above figure are described in order as follows:

- ✧ File button: supports open, save, save as and export report. For detailed operation steps, please refer to section 7.3.2.2.2 of this manual for description.
- ✧ Palette button: After clicking, a drop-down color menu appears, including 3 built-in color palettes and a custom color palettes.
- ✧ Palette Transparency Button: After clicking, the user can click on 

to select and hold the cursor, the user can drag it back and

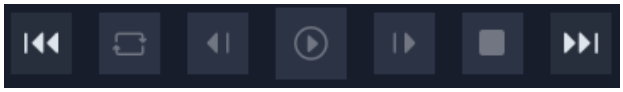
forth along the axis to adjust the transparency (the value ranges from 0 to 100%).

- Sound amplitude graph: For detailed operation procedures, please refer to the description of 7.3.2.8 in this manual.
- PRPD graph: For detailed operation procedures, please refer to section 7.3.2.9 description of this manual.

3. 

The function buttons in the above figures are described in order as follows:

- Palette ribbon: Displays the color of the signal sound and image screen in correspondence to the sound pressure level.
- Display mode selection: For detailed operation procedures, please refer to the description in Section 7.3.2.2.3 of this manual.
- Measurements tools: Please refer to section 7.3.2.4 of this manual for detailed operating procedures.

4. 

The function buttons in the above figure are described in order as follows:

- ✧ Previous button: When clicked, automatically switches to the previous image or video file.
- ✧ Playback button: When the button is clicked, the current sound and video will be played back repeatedly.
- ✧ Previous Frame Button: Click to play the current sound and video backwards frame by frame.
- ✧ Play button: When clicked, plays the acoustic video; Automatically switches to pause button during play.
- ✧ Next Frame Button: Click to play forward the current sound and video frame by frame.
- ✧ Stop button: Stops of the current sound and video.
- ✧ Next button: When clicked, automatically switches to the next sound and video file.

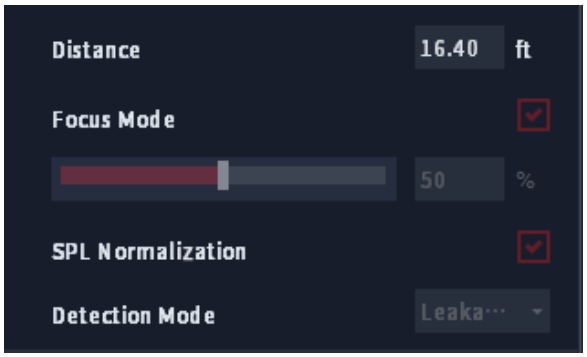
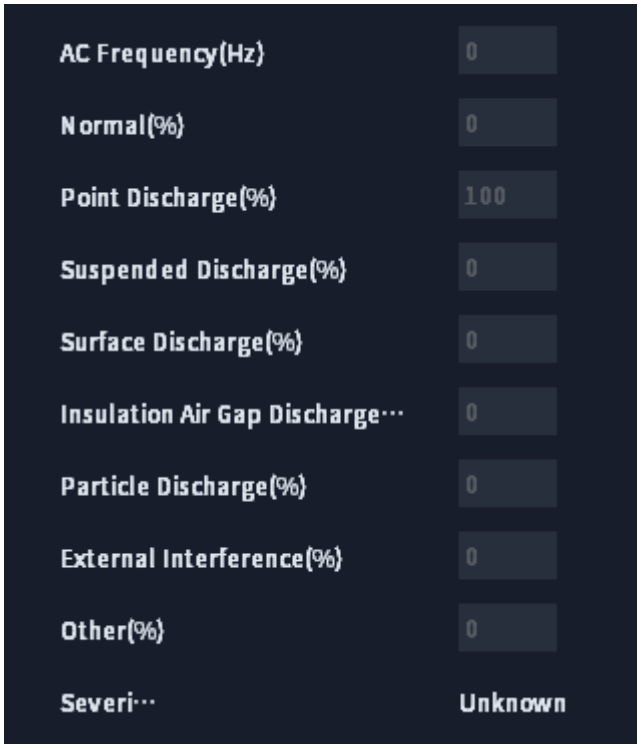
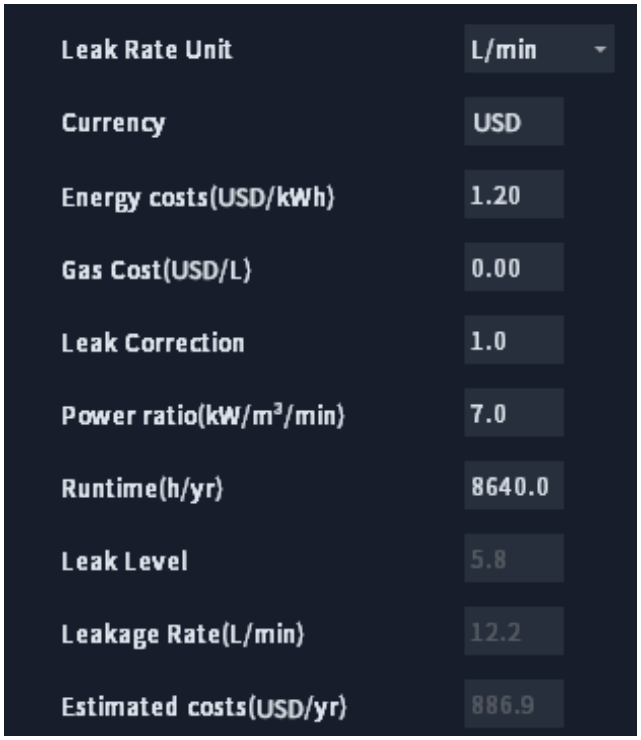
5. 

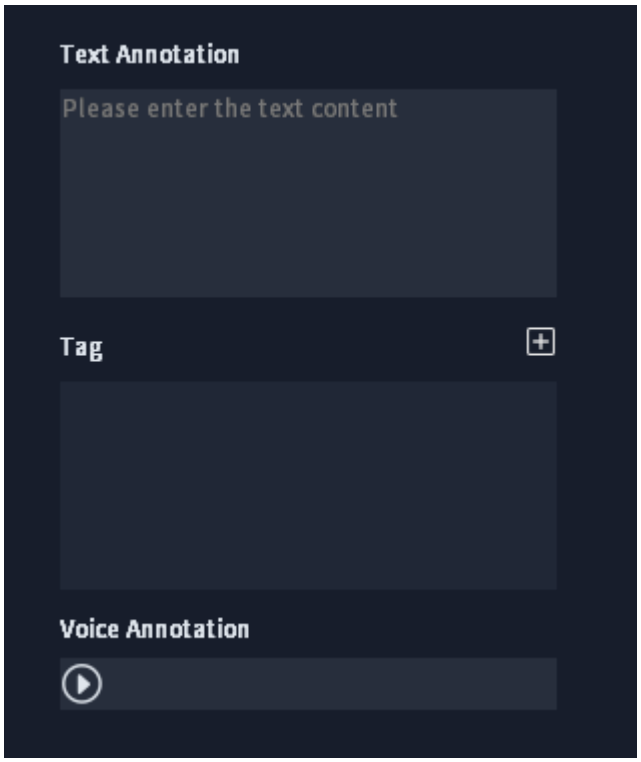
Image parameter setting: For detailed operation procedures, please refer to the description of section 7.3.2.3 of this manual.

6. 

Open the acoustic file under Partial discharge detection mode to show the discharge evaluation panel, please refer to section 7.3.2.5 of this manual for detailed procedure description.

7. 

Open the acoustic image under the leakage type to show the leakage assessment, for detailed procedure please refer to section 7.3.2.6 of this manual.

8. 

Other parameters of the image: support for adding, deleting, and editing annotations, tags (click on the plus sign to edit a new label), as well as clicking on the voice note playback button, it will automatically play the content of the voice notes saved in the sound and image files.

7.3.2.2.2 File operations

 Supports opening, saving, saving as, and exporting reports.

- ✧ Open: Click this button to open the acoustic file to be analyzed.
- ✧ Save: When clicked, it will automatically save the current acoustic file update.
- ✧ Save as: when clicked, the analyzed and processed file is automatically saved as a new sound and video file.
- ✧ Export Report: Click on this button to automatically generate a professional report based on the default report template for the currently analyzed audio/video images, continue to click on "OK", enter the file name and click on "Save" to generate a word version of the audio/video report;

! Note: For the setup of the report template, please refer to the detailed text description of the

report template in Section 7.5.1 Report Template of this manual for execution.

7.3.2.2.3 Display Mode

Display mode includes single-source, multiple-source, and holographic modes.

- ✧ **Single source:** Does not display any signal when the signals are uniform, and display the highest point when they are not uniform.
- ✧ **Multiple sources:** Does not display any signal when the signals are uniform, display sound pressure at certain threshold when it is not uniform.
- ✧ **Holographic:** Automatic/manual control of upper and lower limits to control the sound pressure display range.

7.3.2.3 Image parameters

7.3.2.3.1 Target distance

The target distance is the distance from the device to the measured sound source. The target distance value can be entered manually and determined by clicking the Tab key on the keyboard.

7.3.2.3.2 Focus mode

Focus mode is where the acoustic view shows only the center area, excluding signals from its surrounding.

Focus Mode Setting: Tick the blank checkbox to the right of Focus Mode to open the setting function, click to select and hold down the cursor, you can drag it back and forth along the axis to achieve the effect of a larger or smaller focus circle (the value range is adjustable from 0 to 100%).

7.3.2.3.3 Sound pressure level normalization

Sound pressure level normalization means that the display of sound pressure level is normalized to assume the sound source is at 1m distance.

Sound Pressure Level Normalization Setting: Tick the blank checkbox to the right of Sound Pressure Level Normalization to enable this setting function, otherwise it is off.

7.3.2.3.4 Detection modes

There are two types of detection modes. Leakage mode detects gas leakage and partial discharge mode detects partial discharge.

! Note: The detection mode on the acoustic image is read-only information and cannot be changed.

7.3.2.4 Adding measurement tools

7.3.2.4.1 Mouse pointer

 Mouse pointer buttons.

7.3.2.4.2 Point measurement tools

 Point Measurement Button: When activated, it adds a movable measurement point to the acoustic image. Here's how to use it:

1. Click on the Point Measurement button.
2. Use the left mouse button to select the desired point for measurement on the acoustic image.
3. Then, click on the acoustic image with the left mouse button to generate a measurement point.

4. Hold down the left mouse button to move the measurement point freely, adjusting its position vertically and horizontally as needed.

7.3.2.4.3 Circular measuring tools

 Circle Measurement Button: When activated, it adds a movable and resizable measurement circle to the sonogram. Here's how to use it:

1. Click on the Circle Measurement button.
2. Use the left mouse button to select the desired circular measurement area on the sonogram.
3. Then, click on the acoustic image with the left mouse button and drag diagonally downwards to the right. This action will automatically generate a circular measurement

area.

4. You can adjust the size of the circular measurement area by moving the mouse up and down or left and right while holding down the left mouse button.

5. To reposition the circular measurement area, select it and then press and hold the left mouse button to move it around within the acoustic image.

7.3.2.5 Partial Discharge Assessment

Depending on the partial discharge type, the camera can display their AC frequency.

The software can AI-diagnose different types of partial discharge, providing diagnostic probabilities for each discharge type, including: normal, tip discharge, suspended discharge, surface discharge, insulation gas discharge, particle discharge, external interference, and other types.

In addition, the software can also diagnose the severity of the discharge, including: unknown, normal, attention, general defect, serious defect, and critical defect.

7.3.2.6 Leakage assessment

The leakage assessment parameters include:

- ✧ **Leakage Units:** This unit can be adjusted to display leakage estimates, including L/min (liters per minute) and CFM (cubic feet per minute).
- ✧ **Currency unit:** displays the currency of the leakage cost estimate, which can be selected by you.
- ✧ **Energy costs:** To estimate the cost of a compressed air leak, it is necessary to know the energy costs. The unit is kWh (kilowatt hour).
- ✧ **Cost of gas:** Price of special gas (price per liter or cubic foot, varies by unit of leakage).
- ✧ **Leakage correction:** Since leakage depends on many different factors, if there is a discrepancy between the leakage estimate and the observed results, it can be adjusted by setting a leakage correction factor (a value greater than 0).
- ✧ **Specific power:** Specific power measures how much energy is required to produce a given

amount of compressed air. The unit can be kW/m^3 /min or kW/100CFM. varies depending on the leakage unit selection. The default value is 7kW/m^3 /min. 7kWh compresses 60m^3 of air.

✧ **Running time:** The running time of the air compressor in a year, in hours.

The results of the leakage assessment are as follows:

✧ **Leakage level:** The leakage level assessed by the camera.

✧ **Leakage rate:** The amount of leakage evaluated according to the assessment, either in L/min or CFM.

✧ **Estimated cost:** Estimated cost per year should the leakage is ignored.

7.3.2.7 Hidden Function Menu

Selecting an acoustic file or selecting a measurement object in a sound file and right click to bring up its hidden function menu, which contains the following function(s):

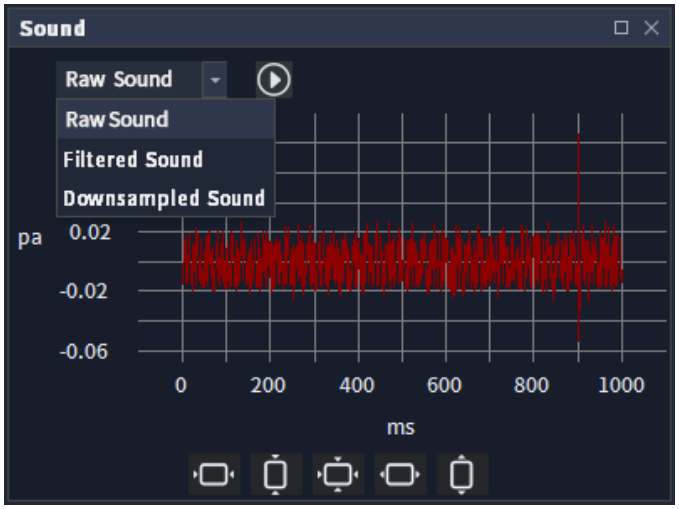
✧ **Delete all**

Delete all measurement markers directly on the image.

7.3.2.8 Sound

To generate a sound waveform graph, click the button in the toolbar at the top of the software.

The following image will be generated:



There are three available modes:

Raw Sound: is the raw sound data obtained by the acoustic image sensor.

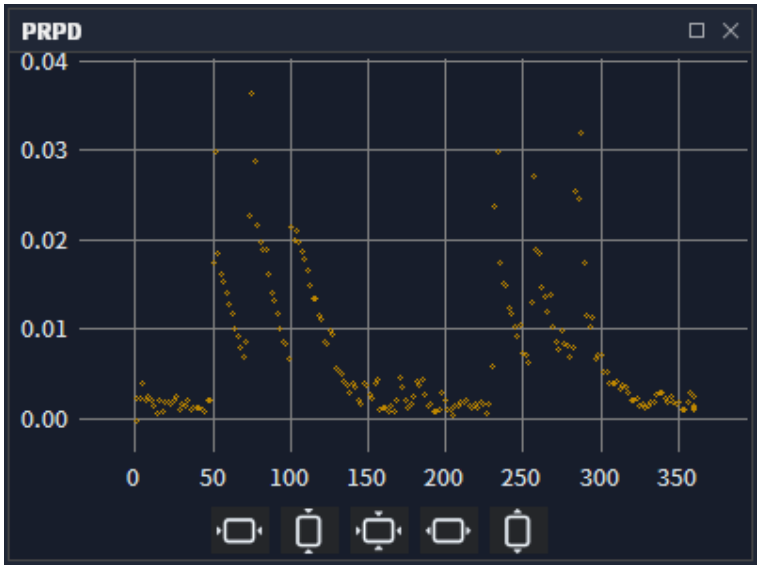
Filtered Sound: is the sound data filtered by the acoustic image sensor.

Down sampled Sound: is the sound data after down sampling of the acoustic image sensor.

is the sound playback button, clicking this button plays the corresponding of sound.

7.3.2.9 PRPD

To apply a PRPD diagram, please click the PRPD button directly on the toolbar at the top of the software . The following diagram will be generated:



7.3.2.10 Resetting the window layout

For detailed operating procedures, please refer to section 7.4.12 of this manual for description.

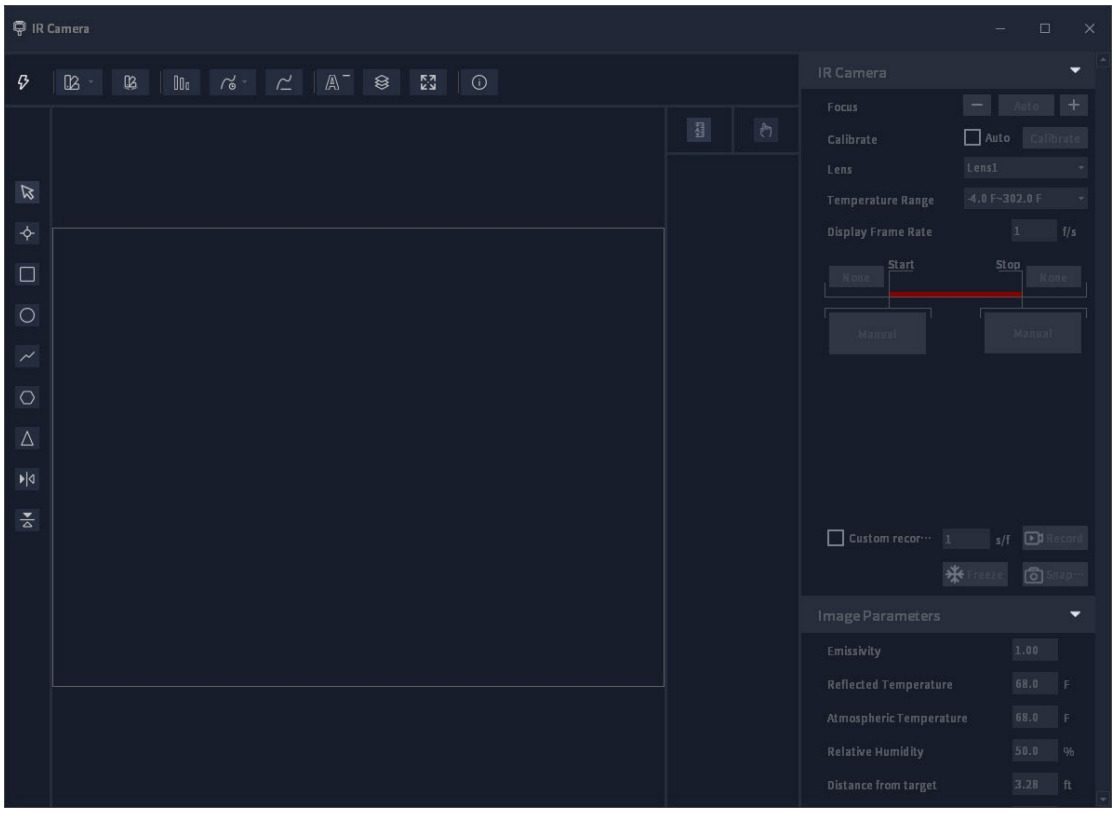
7.4 Real Time Connection

Users can connect the camera to AnalyzIR Professional thermal analysis software and display the full radiometric video stream in real time in the camera's workspace. Once the camera is connected, the user can add or remove measurement tools, change parameters, create plots, and more.

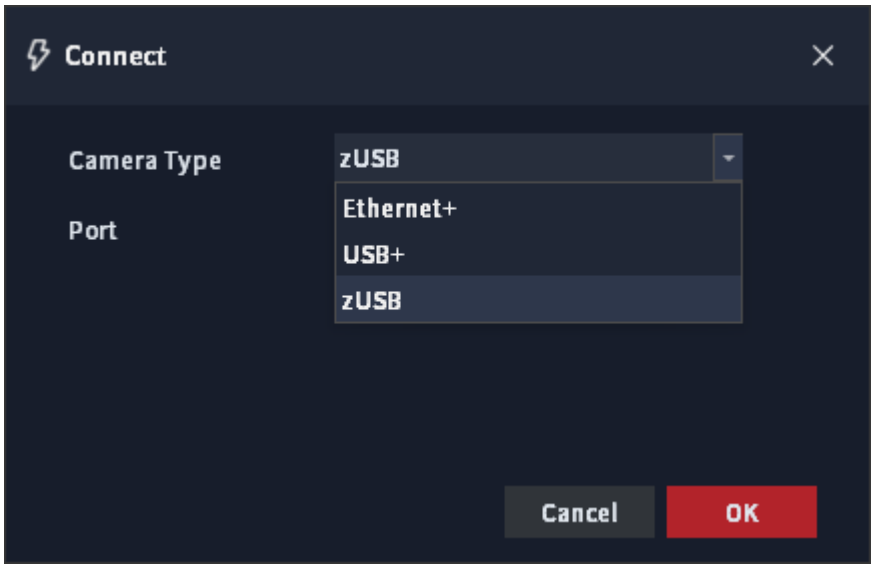
7.4.1 Connect Thermal Camera to the AnalyzIR

1. Click on "Cameras" - "IR Camera Workspaces" - select "Camera 1" or "Camera 2";

2. Clicking on "Camera 1" or "Camera 2" automatically takes the user to the camera workspace as shown below:



3. Click on the "Connect" button and select the camera to be connected according to the device type;



a. The ‘Ethernet+’ camera type is used for the connection of our 600 series cameras, and enter the IP address of the camera. Click on the "OK" button to connect the camera and start transmitting the full radiometric video in real time.

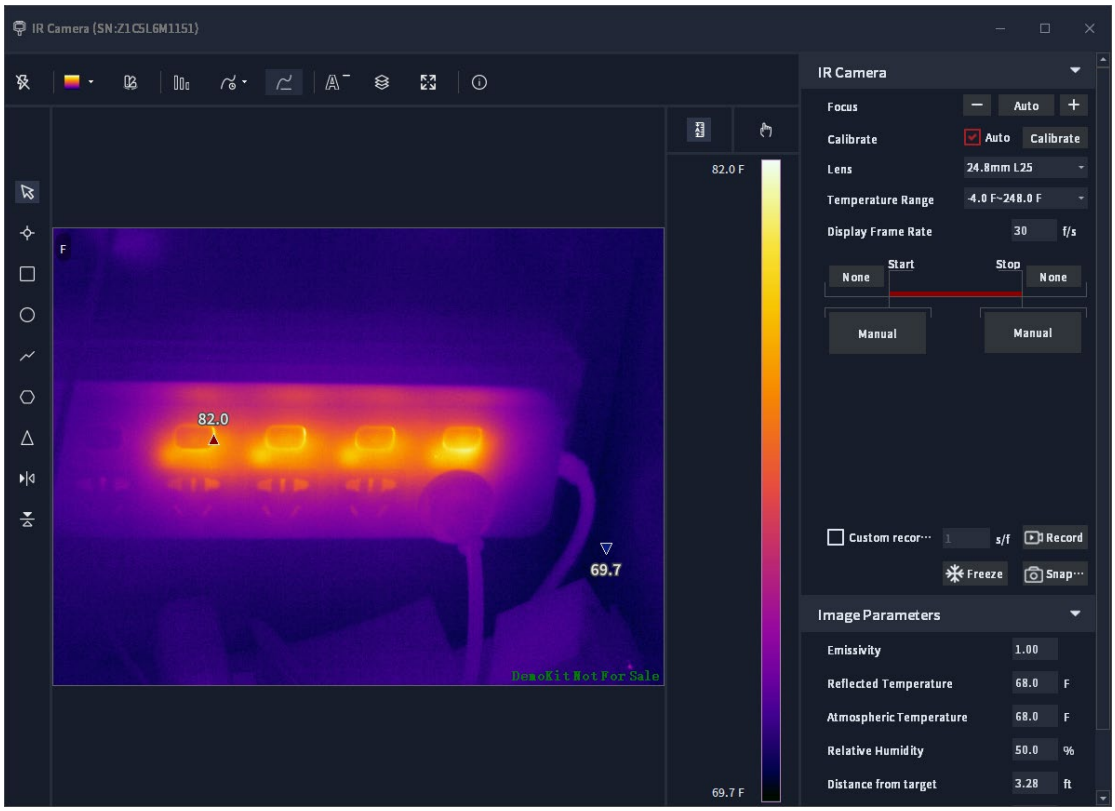
b. The ‘USB+’ is for the connection of our 220s series cameras, the user need to select the port

number for the USB connection. Click on the "OK" button to connect the camera and start transmitting the full radiometric video in real time.

c. ‘zUSB’ is for the connection of our 320/340/P series cameras, the user need to select the USB connection port number, which is by default ‘zUSB’. Click on the "OK" button to connect the camera and start transmitting the full radiometric video in real time.

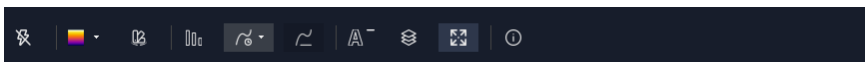
4. After successful connection, real-time transmission of radiometric thermal image video will start.

7.4.2 Functions and Keys of the IR Camera Workspace



The IR Camera Workspace interface contains the following sections:

1. The main body of the screen is a radiometric video streaming display area.

2. 

The function buttons in the above figure are described in order as follows:

✧ Connected/Disconnected button: There are two operating states: connected and disconnected.

- ✧ Palette button: After clicking, a drop-down color menu appears, with 16 built-in color palettes, which can be selected arbitrarily according to needs and preferences; usually, warm colors correspond to high temperatures and cold colors correspond to low temperatures.
- ✧ Inverted palette button: When clicked, the correspondence between the warm and cold colors and the high and low temperatures will be reversed; reversed to warm colors corresponding to low temperatures and cold colors corresponding to high temperatures.
- ✧ Histogram: For detailed procedure, please refer to section 7.4.8 of this manual for description.
- ✧ Time-temperature profile: For detailed operation procedure, please refer to the description of 7.4.9 in this manual.
- ✧ Line temperature distribution curve: Please refer to section 7.4.10 of this manual for detailed operation procedures.
- ✧ Font size setting button: When clicked, it will cycle through the font sizes, i.e., small, normal, and large fonts.
- ✧ Character Overlay: Please refer to section 7.6.4 of this manual for detailed operation procedures.
- ✧ Expansion button: Click on the live video display area, slide the mouse wheel to zoom out and zoom in, clicking on this button will directly fill the entire thermal image window.
- ✧ Camera information display: When clicked, information about the camera is displayed, including camera model, serial number and resolution.

3. 

The function buttons in the above figure are described in order as follows:

- Palette ribbon, which displays the color of the current thermal image screen in relation to the temperature. The user can click on the ribbon area with the mouse and drag the mouse up and down to adjust the maximum and minimum temperature values for the entire screen and the effect of the display.
- Switching keys for the temperature span: the default is the automatic temperature span , which automatically displays the color distribution of the thermal image in a linear fashion according to the highest and lowest temperatures on the screen; is the manual temperature width, which allows the user to set the minimum and maximum temperature values on the screen as needed.
- Temperature measurement tool (ROI): For detailed operation procedure, please refer to the description of section 7.4.4 of this manual.

4. 

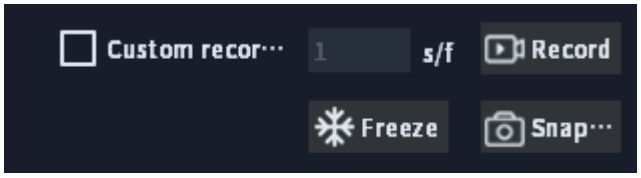
The function buttons in the above figure are described in order as follows:

- ✧ Focus: Controls the focus of the camera, including the Manual Focus +- button and the Auto Focus button.
- ✧ Calibration: enables the camera to conduct automatic Non-uniform Calibration(NUC) and manual activation.
- ✧ Lens: The lens of the thermal imaging camera is selected, usually automatically recognized, but can also be selected manually to ensure accurate temperature measurement.
- ✧ Temperature Range: The temperature range of the thermal imaging camera is selected by clicking on the drop-down menu to select different temperature ranges to meet the test requirements.
- ✧ Frame Rate: A setting for the frame rate of the thermal imaging video recording. The frame rate can be set from 0.1 f/s to the maximum frame rate supported by the camera.

5. 

The function buttons in the above figure are described in order as follows:

- ✧ Recording trigger selection buttons: start trigger setting and stop trigger setting.
- ✧ Trigger type selection button: a drop-down menu will appear when clicked. Start/Stop Trigger can be selected from a total of 5 trigger recording methods: Manual, Date and Time, Duration, Conditional, and External Trigger. For detailed operation steps, please refer to section 7.4.6 of this manual for description.

6. 

The function buttons in the above figure are described in order as follows:

- ✧ Customized video interval: Support customized video interval setting, the interval setting range is from 1s/f to 10000s/f (the interval value is automatically rounded to the nearest integer).
- ✧ Freeze button: The Freeze button automatically freezes the current screen and puts it in a paused state.
- ✧ Record button: The record button will record the current thermal image video with temperature data, which can support secondary analysis.
- ✧ Snapshot button: The snapshot button will automatically capture and save the current thermal image with temperature data, which supports secondary analysis.

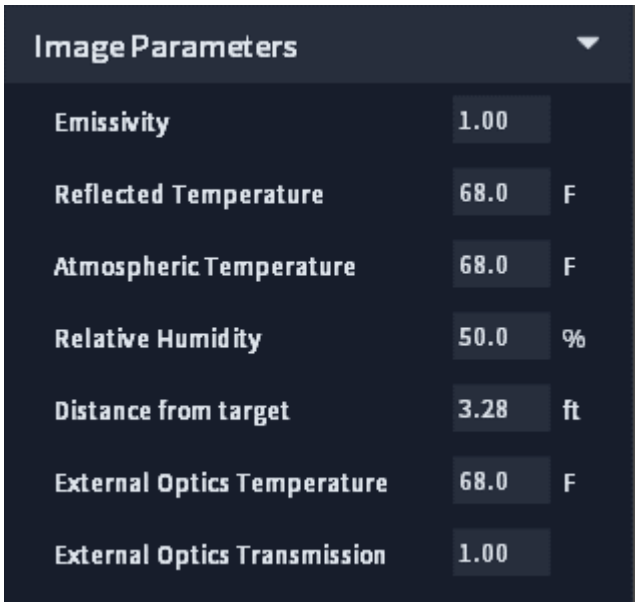
7. 

Image parameter setting: It contains emissivity setting, reflected temperature setting, ambient temperature setting, relative humidity setting, target distance setting, external optical temperature setting, and external optical transmittance setting. For detailed operation steps, please refer to section 7.4.3 of this manual.

7.4.3 Image Parameter Settings

7.4.3.1 Emissivity setting

Emissivity is the ratio of the energy radiated outward from the object being measured to the energy radiated from a blackbody at the same temperature and wavelength, with a value between 0 and 1.

! Note: The emissivity of a material is one of the most important parameters that affects the ability of a thermal imaging camera to accurately measure the temperature of the object being measured.

The emissivity settings in AnalyzIR Professional Thermal Image Analysis Software are divided into two types: global (full screen) emissivity correction and regional (partial) emissivity correction.

Global Emissivity Correction Setting: Click on the thermal image and in the Emissivity Setting area of the Image Parameter Setting field, enter the emissivity value (the value range is adjustable from 0.01 to 1.0) and click on the Tab key on the keyboard to confirm.

7.4.3.2 Reflected temperature setting

Reflected temperature is used to compensate or correct for thermal radiation reflected on the target being measured.

If the emissivity of the target to be measured is relatively low and the actual temperature is much lower relative to the temperature of its reflective source, it is very important to set this parameter correctly and compensate for the reflected temperature for accurate temperature measurement.

If the user need to set the reflected temperature, please perform the following steps:

1. First test the actual temperature of the reflective source near the target with a thermal imaging camera;

2. Click on the thermal image and fill in the Reflected Temperature setting area in the Image Parameter Settings column with the actual temperature value of the reflection source as measured by the thermal imaging camera;

3. Click the keyboard Tab key to confirm.

! Note: If on-site testing conditions allow, avoiding reflective interference as much as possible can dramatically improve measurement accuracy.

7.4.3.3 Ambient temperature settings

Ambient temperature is the temperature of the air between the thermal imaging camera lens and the target object.

If the user need to set the ambient temperature, please perform the following steps:

1. First, use a thermometer to test the actual temperature of the air near the target;

2. Click on the thermal image and fill in the actual temperature data in the Ambient Temperature setting area of the Image Parameter Settings field;

3. Click the keyboard Tab key to confirm.

! Note: The value of the ambient temperature is usually the system default, and the parameter needs to be set only if the ambient temperature is higher than the actual temperature of the target

to be measured.

7.4.3.4 Relative humidity setting

The thermal imaging camera compensates for the localized effects of the relative humidity of the air on the transmission of thermal radiation. Therefore, please set the relative humidity to the correct value.

If the user need to set the relative humidity, please perform the following steps:

1. First, use a hygrometer to test the actual humidity of the atmosphere near the target;

2. Click on the thermal image and fill in the actual humidity data in the Relative Humidity setting area of the Image Target Parameter Setting field;

3. Click the keyboard Tab key to confirm.

! Note: At short distances and normal humidity, the relative humidity is usually set to the default value of the thermal imaging camera.

7.4.3.5 Target distance setting

Target distance refers to the distance between the measured target and the thermal imaging camera lens. This parameter is used to compensate for the following two situations:

- Thermal radiation from the target under test that is absorbed by the atmosphere between the target and the camera lens.

- Thermal radiation that comes from the atmosphere itself and is detected by a thermal imaging camera.

If the user need to set the measurement distance, please perform the following steps:

1. First, use a rangefinder to test the distance value from the target object to the thermal imaging camera lens;

2. Click on the thermal image and fill in the actual distance data in the Target Distance setting area of the Image Target Parameter Setting column;

3. Click the keyboard Tab key to confirm.

! Note: At short distances or distances less than the farthest accurate temperature measurement of the camera, the measuring distance is usually set to the default value of the camera.

7.4.3.6 External optical temperature setting

The external optics temperature setting is used to compensate or correct for the effect of the temperature of the external optics itself on the measurement target.

If the user need to set the external optical temperature, please perform the following steps:

1. First, use the contact temperature measurement tool to test the actual temperature of the surface of the external optics;

2. Click on the thermal image and fill in the External Optical Temperature setting area in the Image Target Parameter Setting column with the actual temperature value of the external optics surface as measured by the contact temperature measurement tool;

3. Click the keyboard Tab key to confirm.

! Note: This function is only considered to be set if the temperature of the external optics is higher than the temperature of the measured target. Normally, the external optics temperature is set to the default value of 20° C.

7.4.3.7 External Optical Transmittance Settings

External Optical Transmittance is the transmittance of any external lens or infrared window used in front of the thermal imaging camera lens.

If the user need to set the external optical transmittance, please perform the following steps:

1. Measure the actual transmittance of the external lens or external infrared window (usually tested by our after-sales service department or qualified partners authorized by FOTRIC, accurate testing requires the use of a measurement standard source);

2. Click on the thermal image and fill in the actual external optical transmittance data in the External Optical Transmittance setting area of the Image Target Parameter Setting field;

3. Click the keyboard Tab key to confirm.

! Note: If the optional external optics have been calibrated at the factory, or if there is no external IR window, the external optical transmittance is usually set to the camera's default value.

7.4.3.8 Image Parameter Defaults

If the user are not sure which values to use for the parameters the user want to measure, the following values are recommended:

Emissivity: 0.9

Reflection temperature: 20℃

Atmospheric temperature: 20° C

Relative humidity: 50%

Target distance: 1.0m

External optical temperature: 20° C

External optical transmittance: 1.0

7.4.4 Adding a Temperature Measurement Tool

7.4.4.1 Mouse pointer

 Mouse pointer buttons.

7.4.4.2 Point temperature measurement tools

 Spot Temperature Measurement button; when selected, adds a movable temperature measurement point to the thermal image video or thermal image.

Procedure:

First use the left mouse button to click on the selected point temperature measurement button, and then use the left mouse button to click on the thermal image, in the thermal image will automatically generate a temperature measurement point, selected and hold down the left mouse

button can be moved up and down, left and right to change the location of the temperature measurement point.

7.4.4.3 Rectangular temperature measurement tools

 Rectangular Area Temperature Measurement button; when selected, adds a movable and resizable temperature measurement area to the thermal image video or thermal image.

Procedure:

First use the left mouse button to select the rectangular temperature measurement area button, then use the left mouse button to click on the thermal image and hold down the left mouse button to the right diagonally below the drag, will automatically generate a rectangular temperature measurement area; selected rectangular temperature measurement area, the user can up and down, left and right to adjust the size of the rectangular temperature measurement area; the user can also select a rectangular temperature measurement area, long pressed the left mouse button to move in the thermal image to change the position of the rectangular temperature measurement area.

7.4.4.4 Circular temperature measurement tools

 Circular area thermometry button; when selected, adds a movable and resizable thermometry area to the thermal video or thermal image.

Procedure:

First, use the left mouse button to select the circular temperature measurement area button, then use the left mouse button to click on the thermal image and hold down the left mouse button to the right side of the diagonal bottom of the drag, will automatically generate a circular temperature measurement area; selected circular temperature measurement area, the user can adjust the size of the circular temperature measurement area up and down, left and right; the user can also select the circular temperature measurement area, and then long-press the left mouse button to move in the thermal image arbitrarily to change the location of the circular temperature measurement area.

7.4.4.5 Linear temperature measurement tools

 Line Temperature Measurement button; when selected, adds a movable and adjustable size and direction temperature measurement line to the thermal image video or thermal image.

Procedure:

First use the left mouse button to select the line temperature measurement button, and then use the left mouse button to click on the thermal image, select the starting point of the line temperature measurement area; then move the mouse along the area to be measured, and then click the left mouse button again on the thermal image screen, it will form a section of the node of the line temperature measurement area, if the user repeat the steps mentioned above, the user can draw a continuous and any direction of the line temperature measurement area; double-click on the left mouse button, the user will Double-click the left mouse button, will exit the linear temperature measurement function, double-click the left mouse button position for the end of the linear temperature measurement region. The user can use the mouse to select the nodes in the linear region, drag to change the position, length and direction of the linear temperature measurement region.

7.4.4.6 Polygonal temperature measurement tools

 Polygonal Temperature Measurement Area button; when selected, adds a polygonal temperature measurement area to the thermal image video or thermal image that can be moved and adjusted in size and shape.

Procedure:

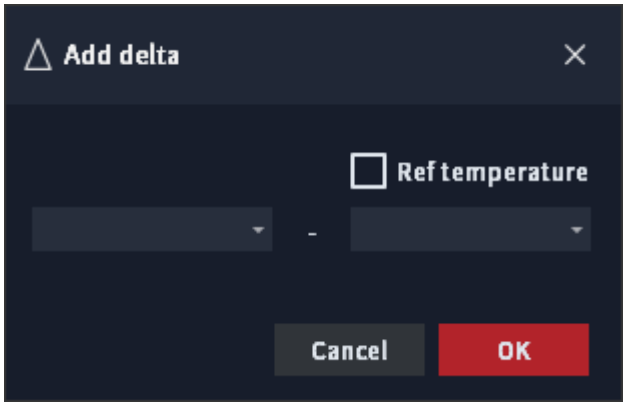
First, use the left mouse button to select the polygonal temperature measurement area button, and then use the left mouse button to click the thermal image, select the starting point of the polygonal temperature measurement area; then move the mouse along the area to be measured, and then again click the left mouse button in the thermal image screen, a polygonal temperature measurement area will be formed in the node, if the user repeat the above steps, the user can draw an irregular, arbitrary shape of the polygonal temperature measurement area; double-click on the left button, will exit the polygonal temperature measurement area function, the left mouse

button double-click position is the end point of the polygonal temperature measurement area. Double-click the left mouse button, will exit the polygonal temperature measurement area function, double-click the left mouse button position for the end of the polygonal temperature measurement area. The user can use the mouse to select the nodes in the polygonal temperature measurement area and drag them to change the position, size and direction of the polygonal temperature measurement area.

7.4.4.7 Temperature difference measurement tools

Set Measurement Temperature Difference Value button: when checked, the temperature difference can be added to the thermal image video or thermal image. Usage:

1. First, select the temperature measurement button with the left mouse button, then click on the thermal image with the left mouse button;



2. On the left side, the user can select the temperature measurement markers for which the user need to calculate the temperature difference, and on the right side, the user can select the temperature measurement markers for comparison;

3. If the user need to compare with a fixed temperature, calculate the temperature rise by checking the reference temperature and entering the value;

4. Click OK and the temperature difference measurement results appear on the screen.

7.4.4.8 Horizontal flip

Horizontal flip button: When clicked, the thermal video or thermal image is automatically

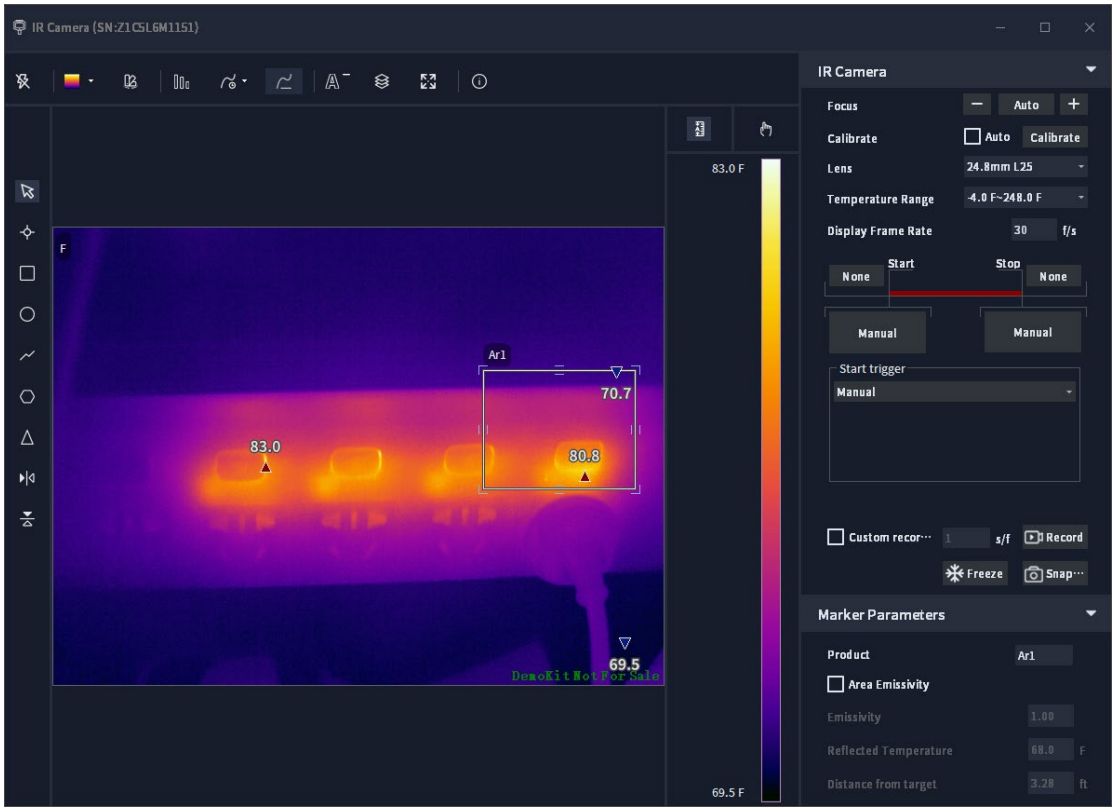
flipped horizontally.

7.4.4.9 Vertical flip

 Vertical Flip Button: When clicked, the thermal video or thermal image is automatically flipped vertically.

The camera will not operate if the camera itself supports this feature! Note: Horizontal flip and vertical flip cannot be operated unless the camera itself supports this feature.

7.4.5 Marker(measurement tool) Parameter Settings



When the user click on a marker(ROI) on the thermal image, the "Image parameters" setting field changes to "Marker parameters".

Rename: If the user need to rename a different marker measurement tool, please perform the following steps:

1. Move the mouse over the thermal image, select the existing temperature measurement tool,

and mark the target parameter field with the name modification area;

2. Click on the blank box with white background to the right of the name and enter the name the user need to set;

3. Click the Tab key on the keyboard to complete the renaming of the markers.

4. The user can rename any mark, just refer to the description of this section 1-3 to set up.

Regional(partial) emissivity setting: tick the blank checkbox to the left of the regional emissivity below to open the regional emissivity setting function, enter the emissivity value (the value range is adjustable from 0.01 to 1.0), click the keyboard Tab key to confirm; enter the value of the reflected temperature, click the keyboard Tab key to confirm; enter the distance to the target, click the keyboard Tab key to confirm; click the keyboard Tab key to confirm. keyboard Tab key to determine.

7.4.6 Recording of Full Radiometric Thermal Image Video

! Note: Before recording a full radiometric thermal image video, it is recommended to pre-set the frame rate for recording;

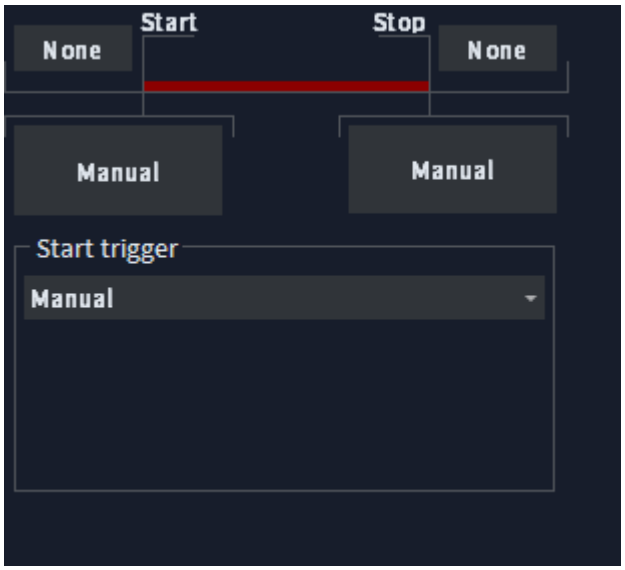
7.4.6.1 Setting the recording frame rate

There are two types of settings for recording frame rate:

1. If the recording frame rate is greater than 1 f/s, the user can change the recording frame rate value in the setting field of the recording frame rate of the thermal imaging video, the value ranges from 0.1 f/s to the fastest frame rate supported by the thermal imaging camera.

2、If the recording frame rate is less than 1f/s, the user can tick the checkbox of Custom Recording Interval on the left side of the Manually Trigger Recording button, and the value of Customize Recording Interval ranges from 1s/f to 10000s/f.

7.4.6.2 Manual recording



If the user need to use the manual recording mode, please perform the following steps:

1. Start the trigger and select Manual;

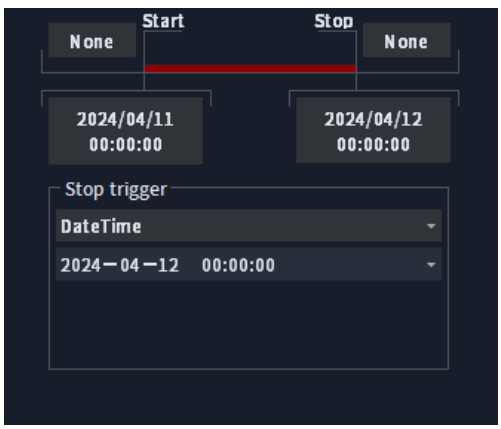
2. Stop the trigger and select Manual;

3. Click the record button to start recording of the radiometric video. The recording button automatically changes to the stop button;

4. Click the Stop button to automatically store the recorded thermal video file to the system-configured storage path.

5. Completion of manual recording of full radiometric thermal image video.

7.4.6.3 Date and Time Triggered Recording



1. Start the trigger, select the date and time, and set the start date and time within the drop-down menu;

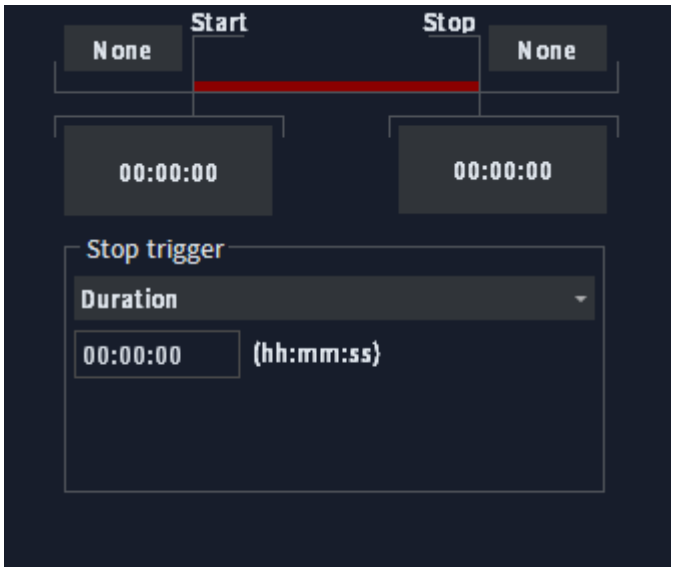
2. Stop the trigger, select the date and time, and set the stop date and time in the drop-down menu;

3. Click the ready button, if not to the start date and time, this time the ready button will change to release the button, click the release button, the user can re-trigger settings; if the user reach the date and time of the start of the recording, it will automatically record the radiometric video, the ready button will change to the stop button, the user can intervene humanely to stop the recording;

4. If the date and time to is reached, the system will automatically stop recording and store the recorded radiometric video files to the system-configured storage path automatically.

5. Complete the date and time triggered recording of the full radiometric thermal image video.

7.4.6.4 Duration-triggered recording



1. Start the trigger, select the duration by setting the 'hh:mm:ss' in the time bar below. The value in the time bar determines how long it will take before start the recording automatically;

2. Stop the trigger, select the duration by setting the 'hh:mm:ss' in the time bar below, the value in the time bar determines how long it will take before stop the recording automatically;

3. Click the ready button, if it is not time to start recording automatically, the ready button will change to release button, click the release button, the user can release the current trigger

recording state, reset; if the user have started recording automatically, the ready button will change to stop button, the user can intervene humanly to stop recording;

4. If it comes to the set stop time, the system will automatically stop recording and store the recorded thermal image video files to the system-configured storage path automatically.

5. Completion of the duration-triggered recording of the full radiometric thermal image video.

7.4.6.5 Condition triggered recording

1. Start trigger, select the 'Condition'. Below the drop-down menu appears, the user can choose to the trigger conditions, it can be the max / min temperature of the entire screen, the user can also choose to mark the region of the highest / lowest temperature trigger and so on;

2. The conditions for starting the trigger can be below the set temperature, above the set temperature, and between the set temperature thresholds;

3. Stop trigger, select 'Condition'. Below the drop-down menu appears, the user can choose to stop the trigger conditions, can be the highest / lowest temperature trigger of the full screen, can also be the highest / lowest temperature trigger to select the marking of the region, etc.;

4. The conditions for stopping the trigger can be below the set temperature, above the set temperature, and between the set temperature thresholds;

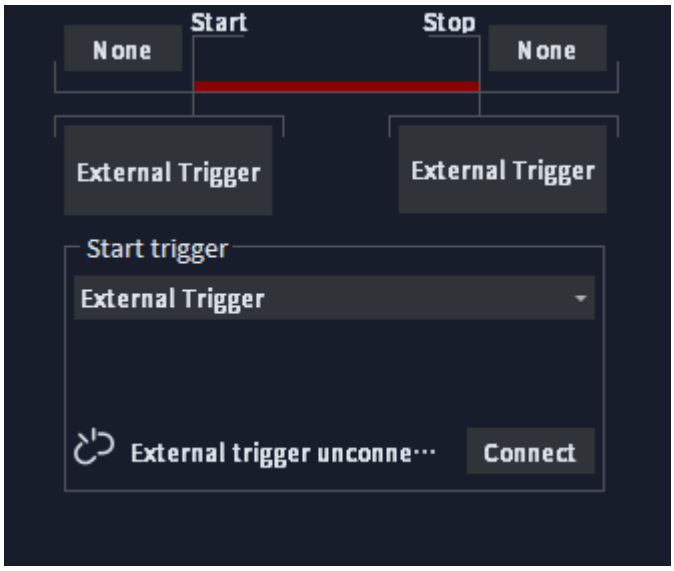
5. Click the ready button, if the temperature range of auto-trigger recording is not reached, the

ready button will change to release button, click the release button, the user can release the current trigger recording state, reset; if the user have already started to record automatically, the ready button will change to stop button, the user can intervene humanly to stop the recording;

6. If the temperature range to stop triggering recording is reached, the system will automatically stop recording and automatically store the recorded thermal image video file to the storage path configured by the system.

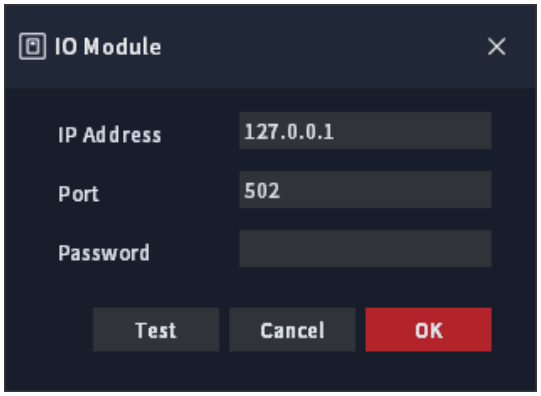
7. Completion of conditionally triggered recording of full radiometric thermal image video.

7.4.6.6 Externally triggered recording



1. Start trigger, and select External Trigger;

2. Click the Connect button to bring up the IO module setup menu and set the correct IP address, port number and password for the IO module;



3. Stop trigger, and select external trigger;

4. Click the Connect button to bring up the IO module setup menu and set the correct IP address, port number and password for the IO module;

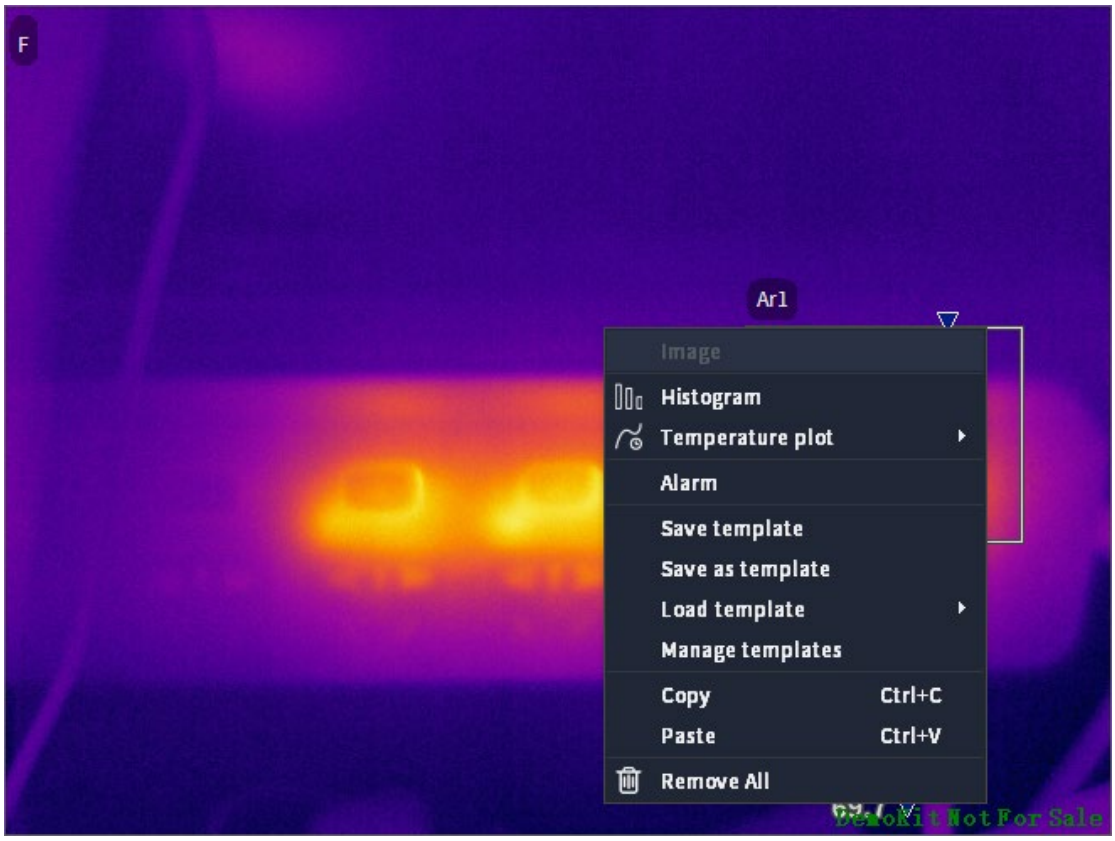
5. After successfully connecting the external trigger module, the red circular status icon will turn green;

6. click the ready button, if the user have not started the external trigger recording, this time the ready button will change to release button, click the release button, the user can release the current trigger recording state, reset; if the user have started the automatic recording, this time the ready button will change to stop button, the user can intervene humanly to stop the recording;

7. If the stop trigger is activated, the system will automatically stop recording and automatically store the recorded thermal image video file to the storage path configured by the system.

8. Completion of the externally triggered recording of the full radiometric thermal image video.

7.4.7 Video Hidden Function Menu



Select the live video or select the temperature measurement object in the live video and click the right mouse button to bring up its hidden function menu, containing the following functions (**! (Note:** some menu items only appear in certain scenarios):

✧ **Histogram**

Please refer to the description of 7.4.8 of this manual for detailed operation procedures.

✧ **Time-temperature profile**

Please refer to the description of 7.4.9 of this manual for detailed operation procedures.

✧ **Line temperature distribution curve**

Please refer to the description of 7.4.10 of this manual for detailed operation procedures.

✧ **Threshold alerts**

Please refer to the description of 7.4.11 of this manual for detailed operation procedures.

✧ **Save template**

Click Save Template, the save menu will appear, enter the template name and the measurement template will be saved as set named.

✧ **Save as template**

Click Save As Template, the Save As menu will appear, enter the template name and the measurement template will be saved as set named.

✧ **Load templates**

Clicking on Load Template will bring up the saved template options, which can be freely selected as needed.

✧ **Manage templates**

Clicking Load Template will bring up a list of saved templates, and clicking the Delete button will automatically delete the template.

✧ **Copy/"Ctrl+C"**

The current thermal image can be copied.

✧ **Paste/"Ctrl+V"**

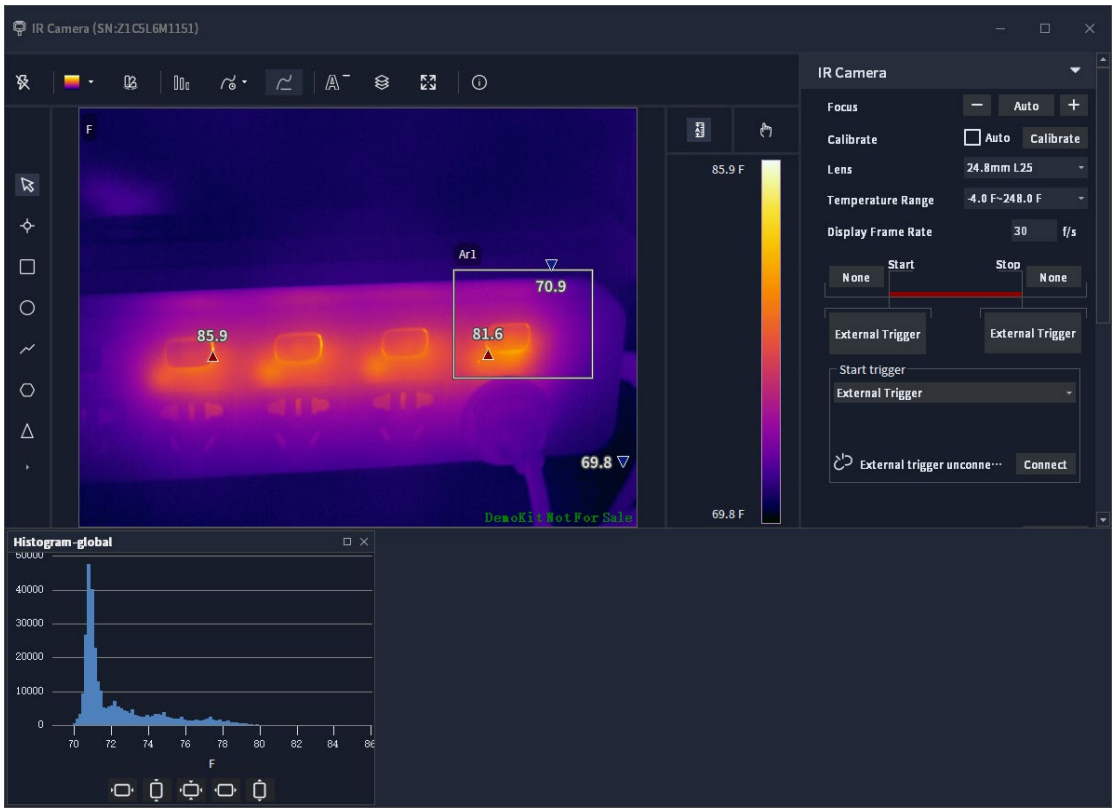
The user can paste the copied thermal image into Word, Excel, PPT and other office software.

✧ **Delete all**

Delete all temperature measurement markers directly from the thermal image.

7.4.8 Adding a Histogram

7.4.8.1 Histogram based on global temperature distribution

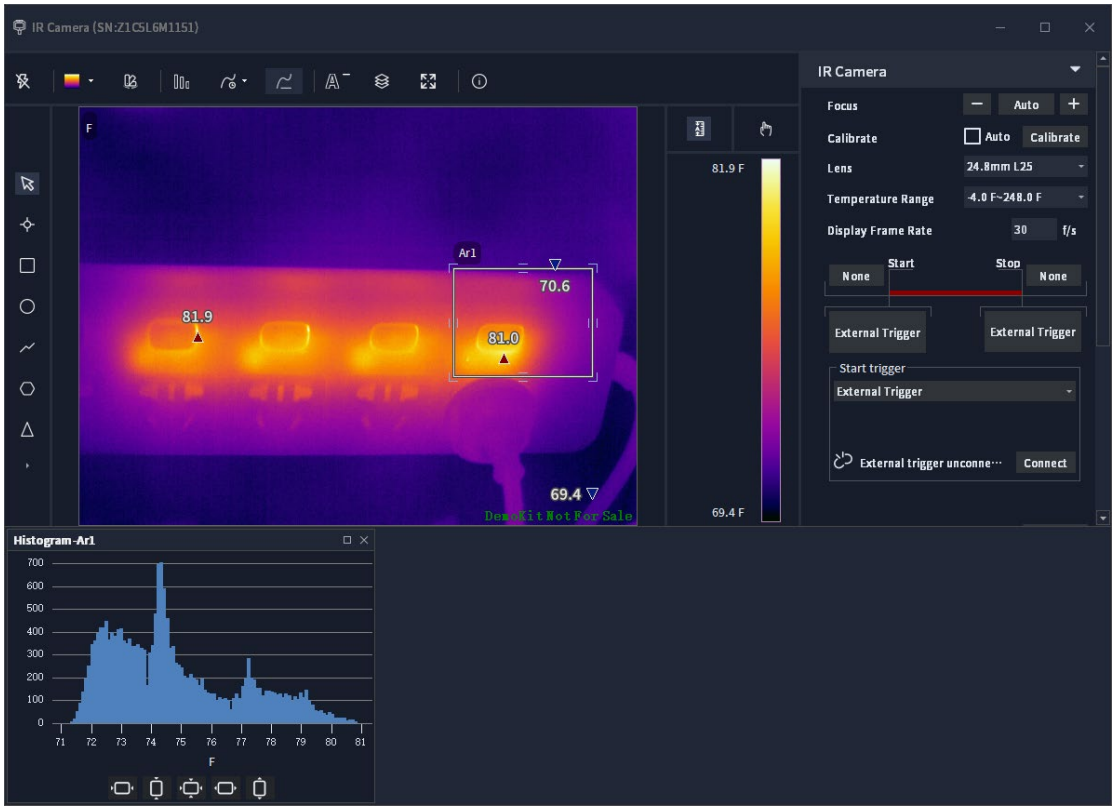


If the user need to add a full-screen histogram tab, please perform the following steps:

1. Click on the toolbar above the software histogram, or move the mouse to the thermal image, click the right mouse button, pop-up hidden menu, select the histogram;

2. Automatically generate a histogram based on the full-screen temperature distribution.

7.4.8.2 Histogram based on measurement tools (markers)

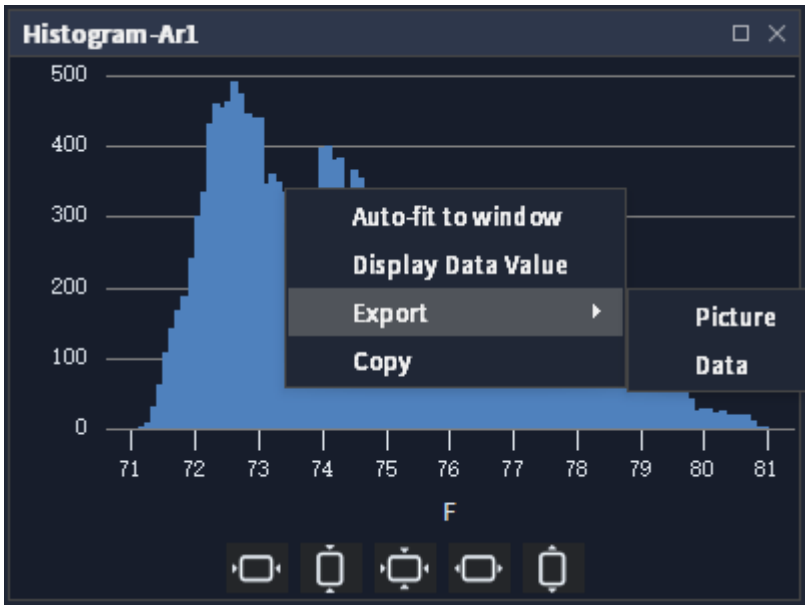


If the user need to add a marker's histogram tab, perform the following steps:

1. Move the mouse over the thermal image, select an existing measurement area (circle, polygon, rectangle), click the right mouse button to bring up the hidden menu, and select Histogram; or click on the Histogram in the toolbar directly above the software when the measurement area is selected;

2. Automatic generation of histograms based on the distribution of labeled temperatures.

7.4.8.3 Histogram tab hidden function menu



1. Auto-adaptation, after clicking, the histogram will automatically fill the tab window according to the suitable size and scale;

2. Display data labels, click, the histogram of the sampling point will increase the temperature value of the label, easy to visualize the temperature value of the sampling point;

3. Export, click, the histogram can be exported to save as a picture in .JPG/.BMP format or Excel file;

4. Copy, click, copy the contents of the current histogram tab, the user can press the picture format or text format directly pasted into word, PPT, EXCEL, TXT and other formats within the document;

5. Horizontal Axis Zoom Button, shortcut key Ctrl+←, to zoom out the scale value of the horizontal axis temperature distribution;

6. Vertical Axis Reduction button, shortcut key Ctrl+↓, reduces the scale value of the vertical axis pixel point distribution;

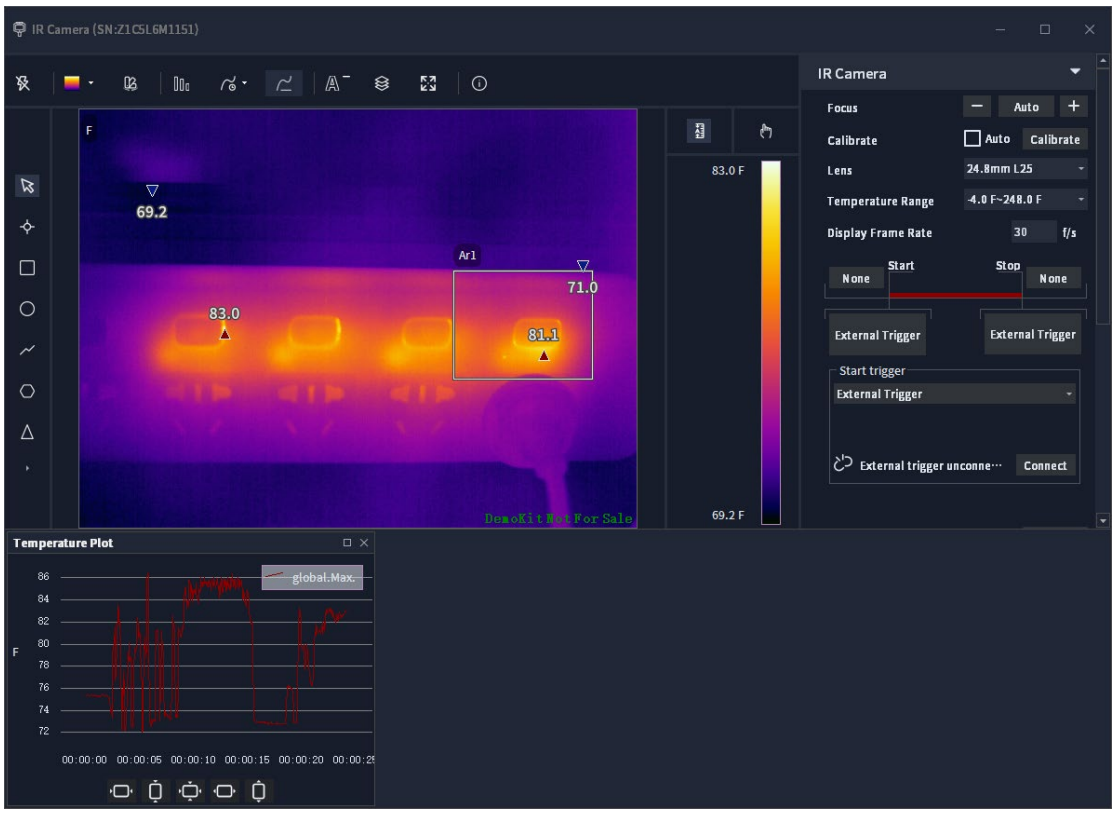
7. Automatically adapts to the keystrokes, and the histogram automatically fills the tab window at the appropriate size and scale;

8. Horizontal axis zoom button, shortcut key Ctrl+→, zoom in the scale value of the horizontal axis temperature distribution;

9. Vertical axis zoom button, shortcut key Ctrl + ↑, to zoom in on the scale value of the vertical axis pixel point distribution.

7.4.9 Adding a Time-Temperature Profile Tab

7.4.9.1 Global-based time-temperature profiles



If the user need to add a tab for time-temperature profiles, perform the following steps:

1. The mouse over the thermal image, click the right mouse button, pop-up hidden menu or directly view the software above the toolbar

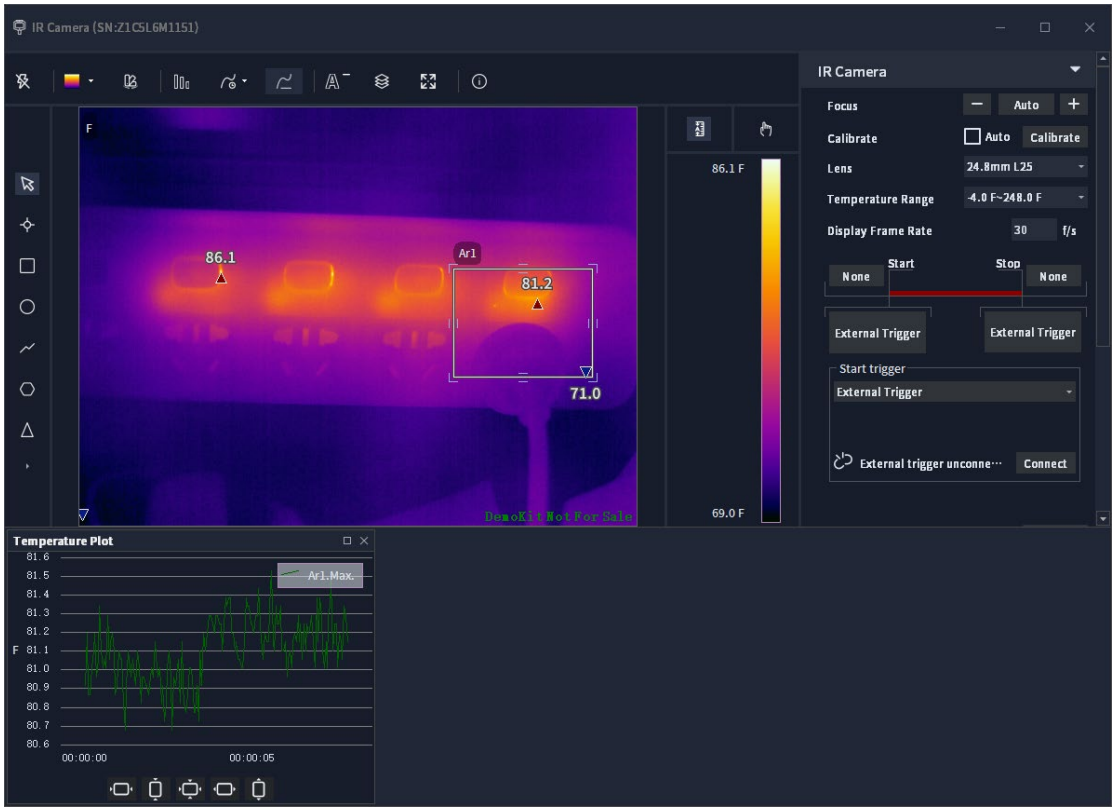
2. Select the temperature time curve, it will show the highest, lowest, formula three modes

3. Select Maximum Mode, and a graph of the full-screen maximum temperature over time will be displayed on the Time Temperature Profile tab;

4. Select Minimum Mode, and a graph of the full-screen minimum temperature over time will be displayed on the Time Temperature Profile tab;

5. Select the formula mode, will call up the formula settings menu, the user can select the contents of the drop-down menu, the operation symbols can choose ″−″ or ″+″, the automatic generation of the operation of the temperature change over time graph;

7.4.9.2 Marker-based time-temperature profiles



If the user need to add a tab for time-temperature profiles, perform the following steps:

1. Move the mouse over the thermal image, select the existing measurement area and click the right mouse button to bring up the hidden menu; or view the temperature and time curves in the toolbar at the top of the software directly when the measurement area is selected.

2. Select the temperature time curve, it will show the four modes: highest, lowest, average and formula;

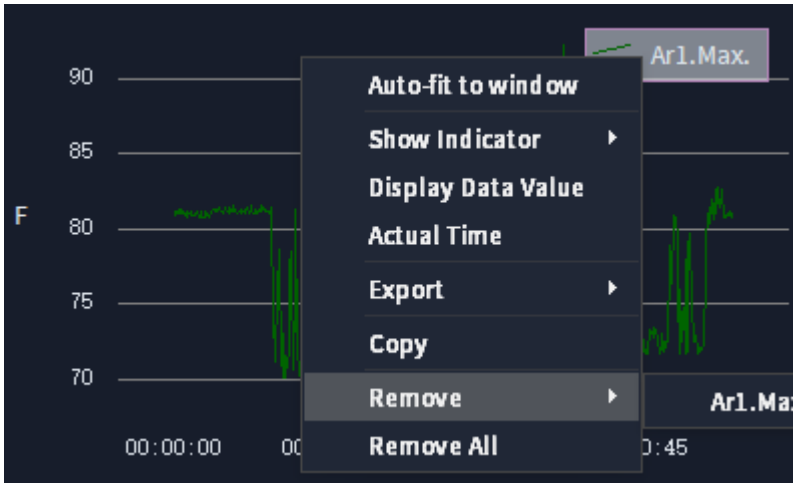
3. Select Maximum Mode and a graph of the labeled maximum temperature over time will be displayed on the Time Temperature Profile tab;

4. Select Minimum Mode and a graph of the labeled minimum temperature over time will be displayed on the Time Temperature Profile tab;

5. Select the average mode, the Time Temperature Profile tab will display a graph of the labeled average temperature over time;

6. Select the formula mode, will call up the formula settings menu, the user can select the contents of the drop-down menu, the operation symbols can choose "-" or "+", the automatic generation of the operation of the temperature with the time of the curve; the user can generate a number of markers of the temperature and time curve. The temperature time curve can be generated with multiple markers.

7.4.9.3 Time-temperature profile tab hidden functions menu



Right-click on the Time-Temperature Profile tab to bring up the hidden tab of the Time-Temperature Profile, containing the following function keys;

1. Auto-fit to window. When clicked, the time-temperature curve will automatically fill the tab window in the appropriate size and scale;

2. Show indicator. When clicked, the corresponding time and temperature are displayed;

3. Display data value. When clicked, time temperature line of the sampling point will increase the temperature value of the label, easy to visualize the temperature value of the sampling point;

4. Actual time, after clicking, the user can choose how to display the horizontal time axis (Beijing time/relative time/cumulative time);

5. Export, after clicking, the time-temperature curve can be exported and saved as a picture or Excel file in .JPG/.BMP format;

6. Copy, click, copy the current time temperature curve tab, the user can press the picture format or text format directly pasted to word, PPT, EXCEL, TXT and other formats within the file;

7. Click Delete and a drop-down menu appears on the right side, so the user can selectively delete the time-temperature curve;

8. Delete All, when clicked, will directly delete all temperature profiles within the Time Temperature Profile tab;

9.  Horizontal Axis Zoom Button, shortcut key Ctrl+←, to zoom out the scale value of the horizontal axis temperature distribution;

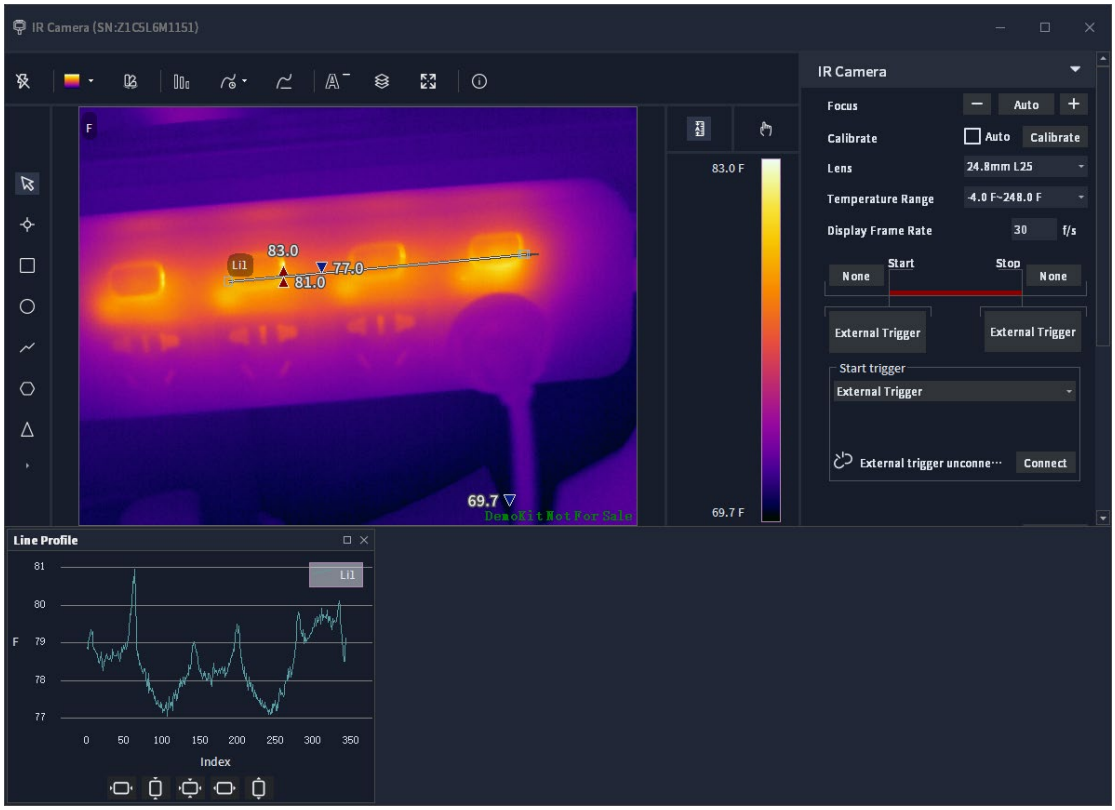
10.  Vertical Axis Reduction Button, shortcut key Ctrl+↓, reduce the scale value of the vertical axis pixel point distribution;

11.  Auto-fit button, the time and temperature curve will automatically fill the tab window in the appropriate size and scale;

12.  Horizontal axis zoom button, shortcut key Ctrl+→, zoom in the scale value of the horizontal axis temperature distribution;

13.  Vertical axis zoom button, shortcut key Ctrl + ↑, zoom in the scale value of the vertical axis pixel point distribution.

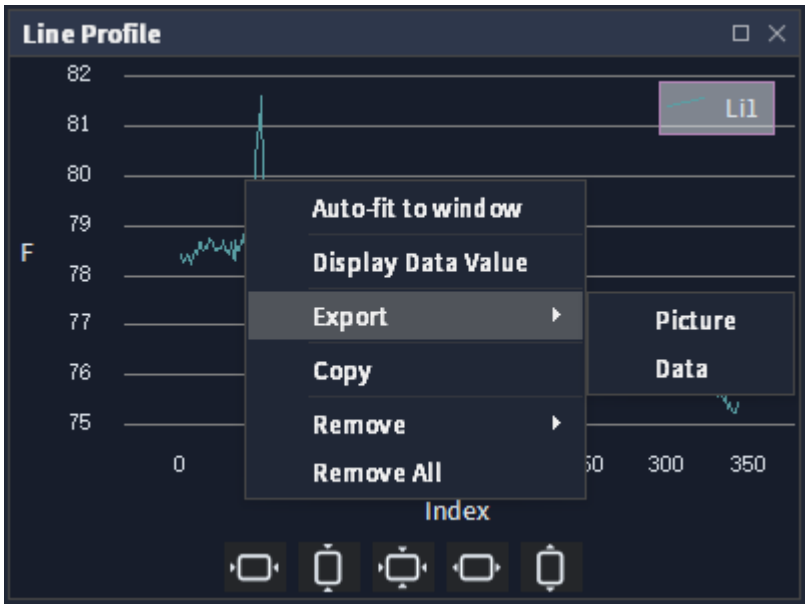
7.4.10 Adding a Line Temperature Distribution Curve Tab



If the user need to add the Line Temperature Distribution Curves tab, perform the following steps:

1. Move the mouse to the thermal image, select the existing line measurement tool, click the right mouse button to bring up the hidden menu, and select Line Temperature Distribution or click the Line Temperature Distribution button on the toolbar above the software when the user select the measurement line;

2. Automatically generate line temperature distribution graph; the user can add more than one line temperature distribution graph, just repeat the above 1-2 steps in this section.



Clicking the right mouse button on the Line Temperature Distribution Curve tab brings up the hidden function menu of the Line Temperature Distribution Curve tab, which contains the following function keys:

1. Auto-fit to window. When clicked, the line temperature distribution curve will automatically fill the tab window according to the suitable size and scale;

2. Display data value. When clicked, the line temperature distribution curve of the sampling point will increase the temperature value of the label, easy to intuitively display the temperature value of the sampling point;

3. Export. When clicked, line temperature distribution curve can be exported to save as a picture in .JPG/.BMP format, or Excel file;

4, Copy. When clicked, copy the current line temperature distribution curve tab, the user can press the picture format or text format directly pasted to word, PPT, EXCEL, TXT and other formats within the file;

5. Click Delete and a drop-down menu appears on the right side, so the user can selectively delete the line temperature distribution curve;

6. Delete All. When clicked, will directly delete all temperature profiles within the Line Temperature Distribution Profile tab;

7. Horizontal Axis Zoom Button, shortcut key Ctrl+←, to zoom out the scale value of the horizontal axis temperature distribution;

8. Vertical Axis Reduction button, shortcut key Ctrl+↓, reduces the scale value of the vertical axis pixel point distribution;

9. auto-fit button, the line temperature distribution curve will automatically fill the tab window in the appropriate size and scale;

10. Horizontal axis zoom button, shortcut key Ctrl+→, zoom in the scale value of the horizontal axis temperature distribution;

11. Vertical axis zoom button, shortcut key Ctrl + ↑, zoom in the vertical axis pixel point distribution of the scale value.

7.4.11 Setting Thresholds to Alert Alarms

7.4.11.1 Alarms based on global temperature threshold alerts

1. Move the mouse over the thermal image and click the right mouse button to bring up the Hide menu;

2. Select the 'Alarm';

3. Tick the checkbox to the left of the alarm ;

4.Select the alarm type, the user can choose the highest temp, the lowest alarm;

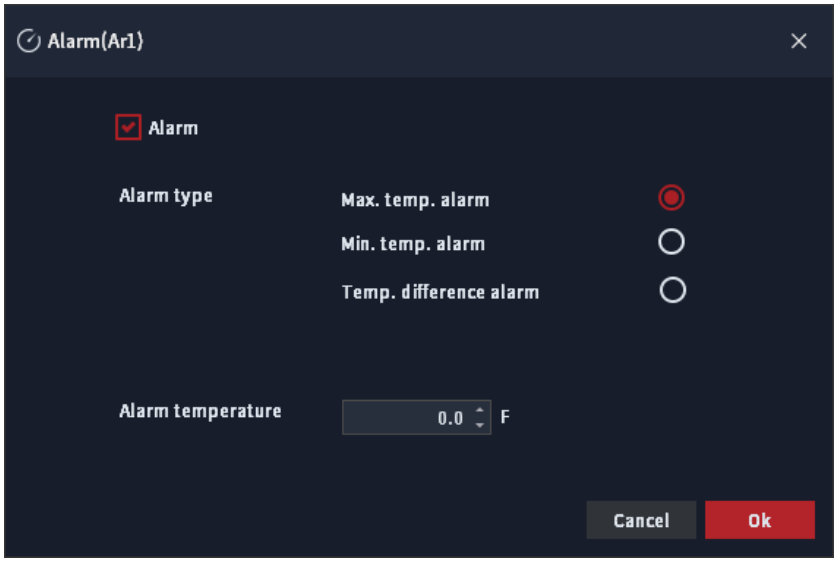
5. After selecting the alarm type, set the threshold and click the OK button;

6. Once the temperature in the full screen exceeds the set temperature threshold, it will display red color in the upper left corner of the thermal image, and the PC audio will emit the alarm sound of "Beep Beep Beep ....." at the same time.

7.4.11.2 Marker temperature threshold alerts

1. Move the mouse over the thermal image, select the existing temperature measurement tool, click the right mouse button to bring up the hidden menu;

2. Select the alarm;



3. Tick the checkbox to the left of the alarm ;

4.Select the alarm type, the user can choose the highest temp, the lowest temp and temperature difference alarm;

5. After selecting the alarm type, set the threshold and click the OK button;

6. Once the temperature in the marker exceeds the set temperature threshold, it will show red color in the upper left corner of the thermal image, and the PC audio will emit an alarm sound

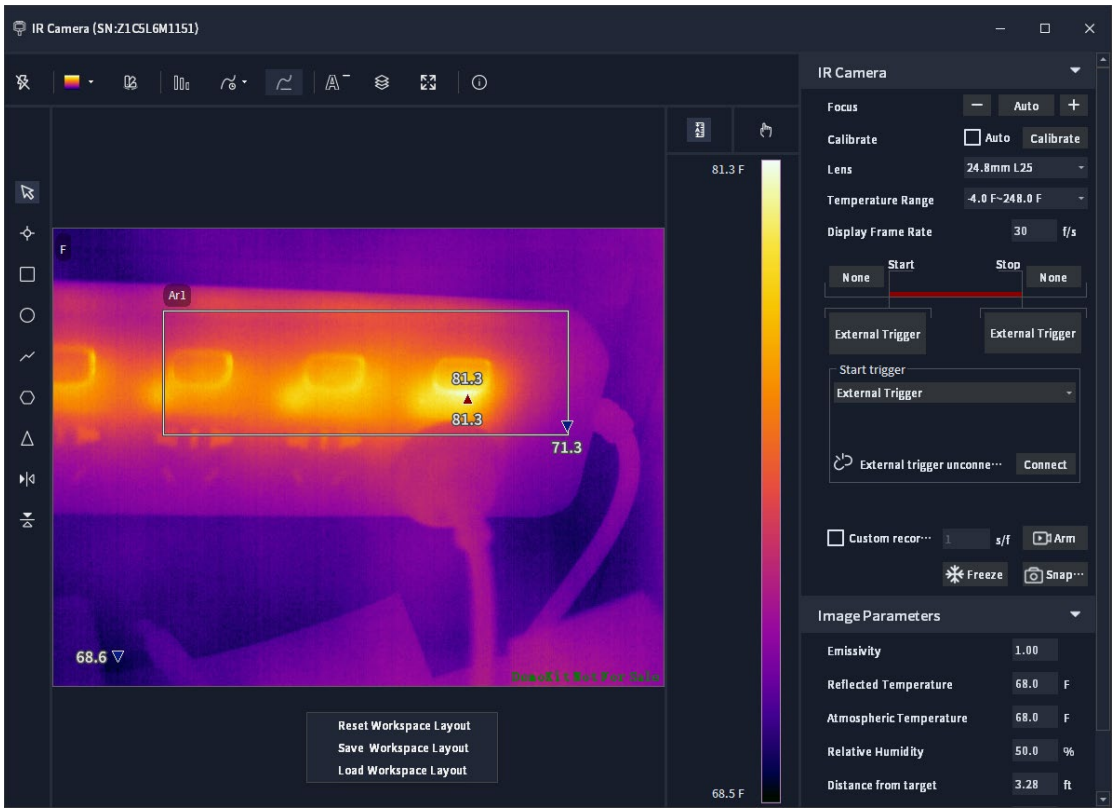
"beep beep beep ....." at the same time;

7. Temperature difference alarm can be set for multiple markers;

8. If the user need to set the temperature difference temperature threshold alarm, the user can first add the measurement of temperature difference measurement tool, and then select this measurement tool with reference to this section of the description of the above 1-5 can be set.

7.4.12 Resetting the Window Layout

If the user need to reset the window layout, please perform the following steps:



1. Right click on the mouse on an empty space on the IR camera workspace to bring up the Hide menu;

2. Click ‘Reset Workspace Layout’ and the tabs in the camera workspace will be automatically aligned;

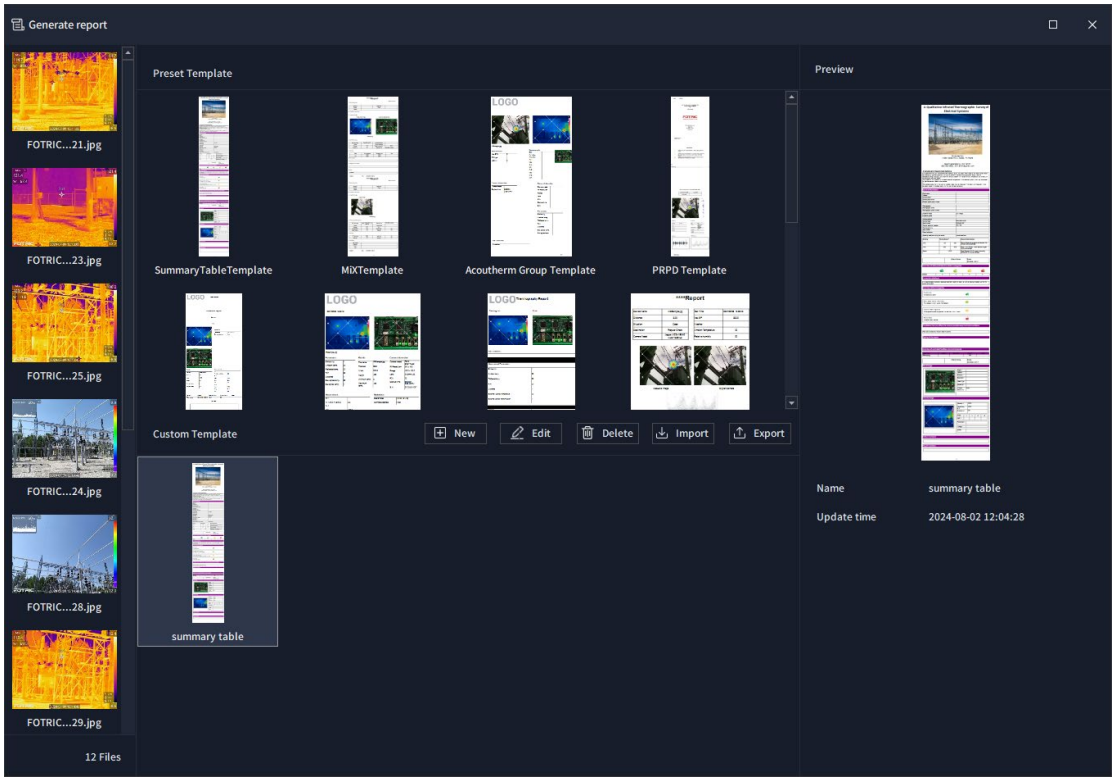
3. Click ‘Save Workspace Layout’ to automatically save the current window layout;

4. Click ‘Load Workspace Layout’ and it will automatically load the previously saved window layout.

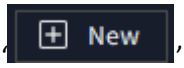
7.5 Report

7.5.1 Report Template Preview

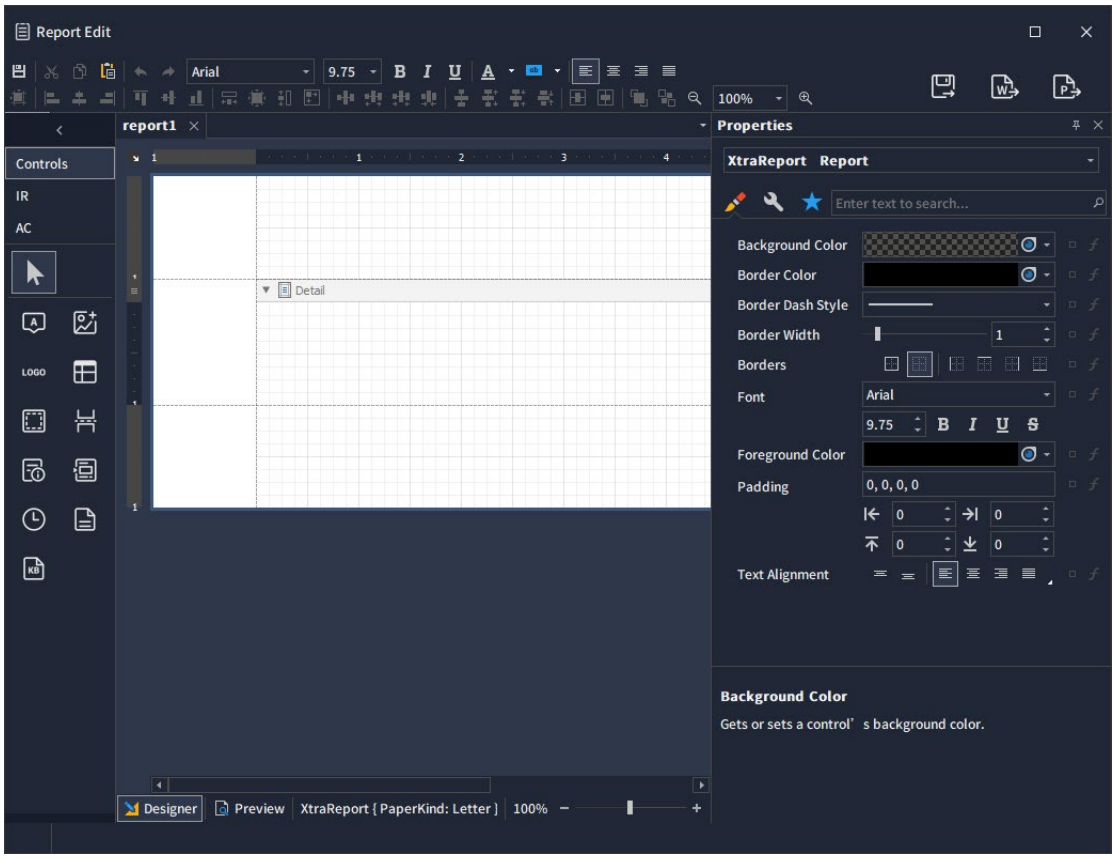
The layout of the template preview interface is divided into 4 sections: cover images for thermal and acoustic images (left), preset templates(mid-top), imported or user-created templates(mid-bottom), report preview(right).



7.5.2 Create Template

Click on the ‘ 

’ button on the template preview interface to enter the ‘repx’ report template interface, in which users can apply different report elements by drawing and typing.



The template creating/editing includes a menu bar(top), control area(left), template display area(middle), and property area(right):

- Menu bar: Cut, Copy, Paste, Undo, Redo, Change Font (font, font size, bold, italic, underline, font color, fill color, left align, center align, right align, justify align), Align Controls (left align, vertical center align, right align, top align, horizontal center align, bottom align, equal height, equal width, equal size), Control Spacing (equal horizontal spacing, increase horizontal spacing, decrease horizontal spacing, remove horizontal spacing, equal vertical spacing, increase vertical spacing, decrease vertical spacing, remove vertical spacing), Center Controls (horizontal center, vertical center), Control Position (bring to front, send to back), Design and Preview Interface (zoom in, zoom out), Save Template, Save As Template, Export to Word, Export to PDF.
- Control area: Divided into the following three parts:

    1. General Controls: Text, Image, Logo, Table, Panel, Page Break, Page Number, Table of Contents, Current Time, File Name, File Size;

    2. Thermal Imaging(IR) Controls: Thermal Image, Digital Camera Image, Temperature Measurement Parameters, File Information, Global Maximum Temperature, Global Minimum Temperature, Temperature Range, Direction, GPS, Text Notes, Tags, Lens Name, Lens Field of View, Resolution, Capture Time, Image Width, Image Height, Device Model, Device Serial Number, Reflective Temperature, Atmospheric

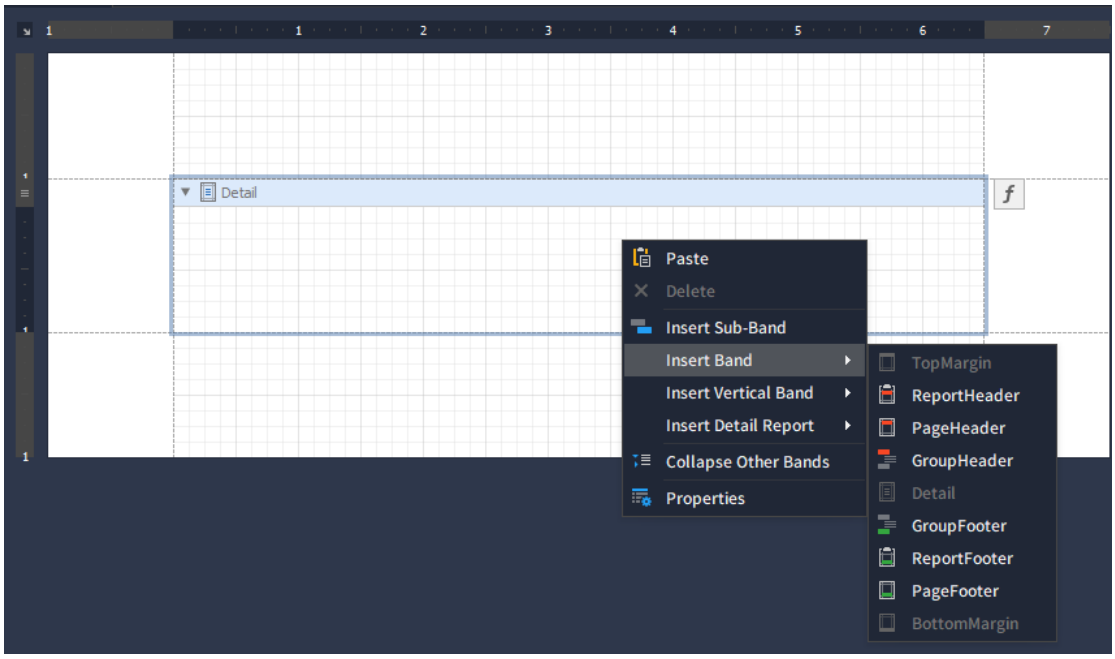
Temperature, Distance, Relative Humidity, Global Emissivity, External Optical Temperature, External Optical Transmittance, Region Name, Region Maximum Temperature, Region Minimum Temperature, Region Average Temperature, Region Emissivity, Measurement Values, File Summary Table, Specific Region Maximum Temperature, Specific Region Minimum Temperature, Specific Region Average Temperature, Functions;

3. Acoustic Imaging(AC) Controls: Acoustic Image, Digital Camera Image, Spectrum Graph, PRPD Graph, Waveform Graph, Acoustic Summary Table, Partial Discharge Table, Device Model, Shooting Time, Distance, Text Notes, Tags, Maximum Sound Pressure Level, Gas Leakage Cost, Energy Cost, Leakage Correction, Specific Power, Leakage Level, Estimated Leakage Amount, Estimated Cost, Partial Discharge Type, Running Time.

- Template display area: Displaying template design and preview.
- Property area: Dimensions, Position, Background Color, Border Width, Border Color, Font, Font Size, Font Color, Horizontal Alignment, Bold Font, Italic Font, Underline Font, Horizontal Text Alignment, Vertical Text Alignment.

7.5.2.1 Template display area layout

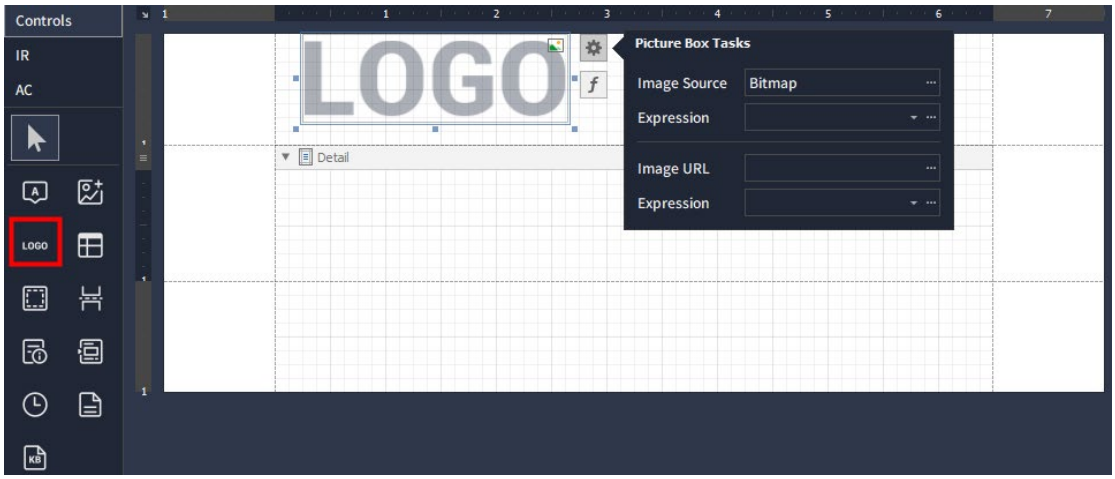
Right click on the template display area to summon the following menus:



- TopMargin: Corresponds to the header section of the document, where company logos, company names, etc., can be placed.
- BottomMargin: Corresponds to the footer section of the document, where copyright, page numbers, etc., can be placed.

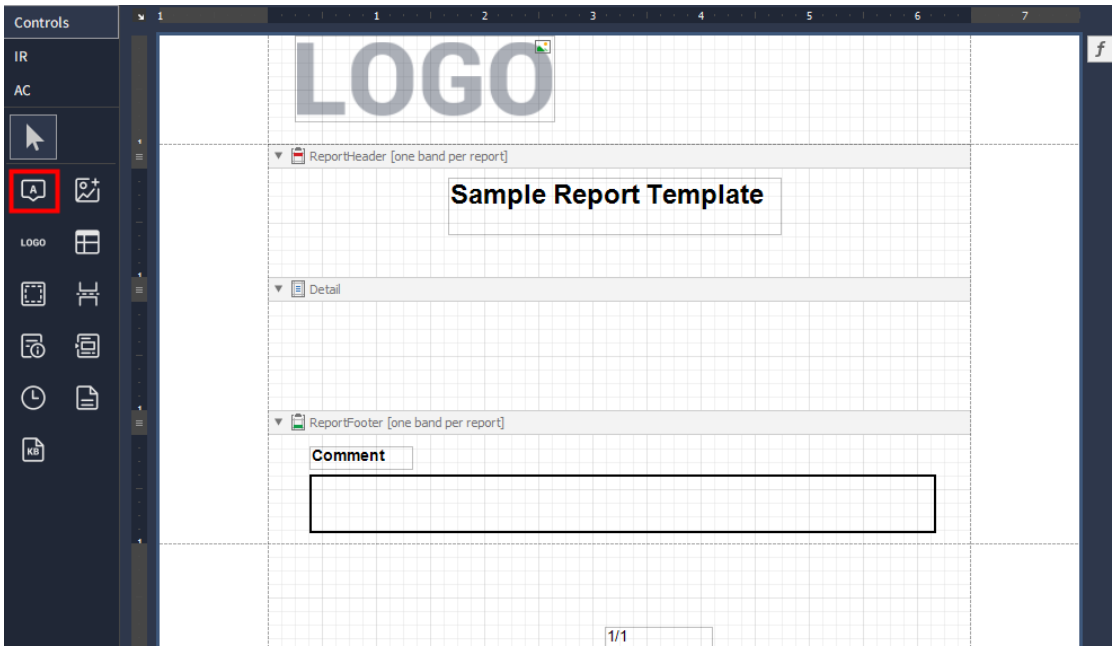
- ReportHeader: Appears once at the beginning of the report and can contain table of contents, cover page, title information, etc.
- ReportFooter: Appears once at the end of the report and can contain summary information.
- PageHeader: Displays at the top area of each page in the document, where website links, etc., can be placed.
- PageFooter: Displays at the bottom area of each page in the document, where contact information, etc., can be placed.
- GroupHeader: Displays at the beginning of a data table, where titles, etc., can be placed.
- GroupFooter: Displays at the end of a data table, where conclusions, etc., can be placed.
- Details: The system extracts and filters information to generate specific data from the selected file, thereby creating the content of the report.

7.5.2.2 Template creation demo

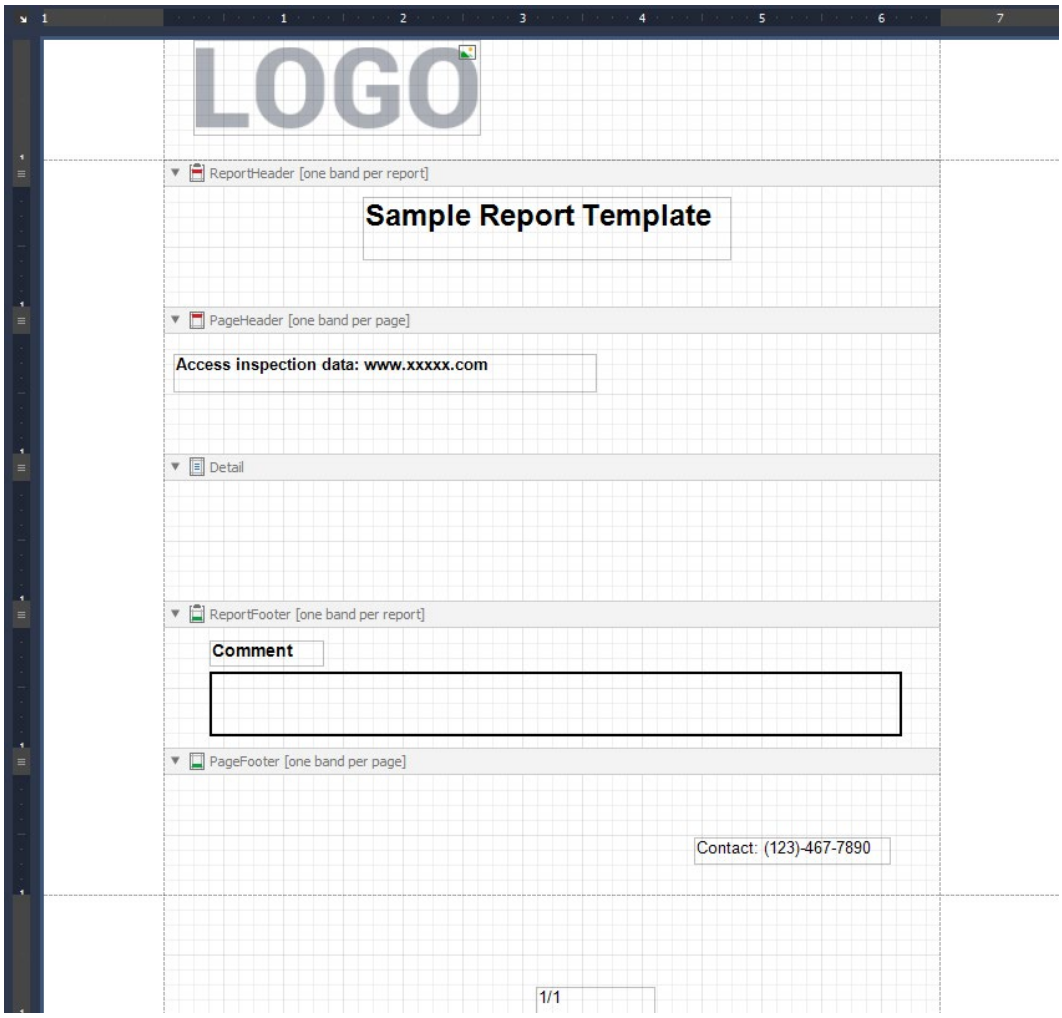


Drag the ‘Logo’ control to the TopMargin area (users may change the logo by Picture Box Tasks->Image Source)

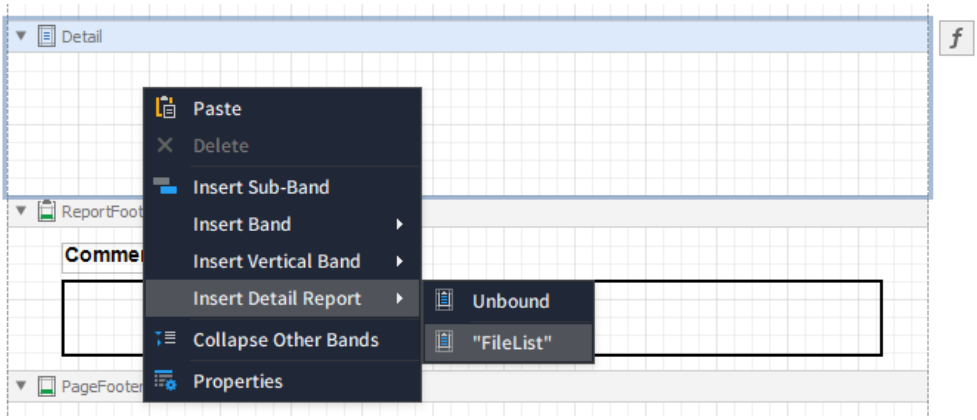
Drag the ‘Page number’ control to the BottomMargin area



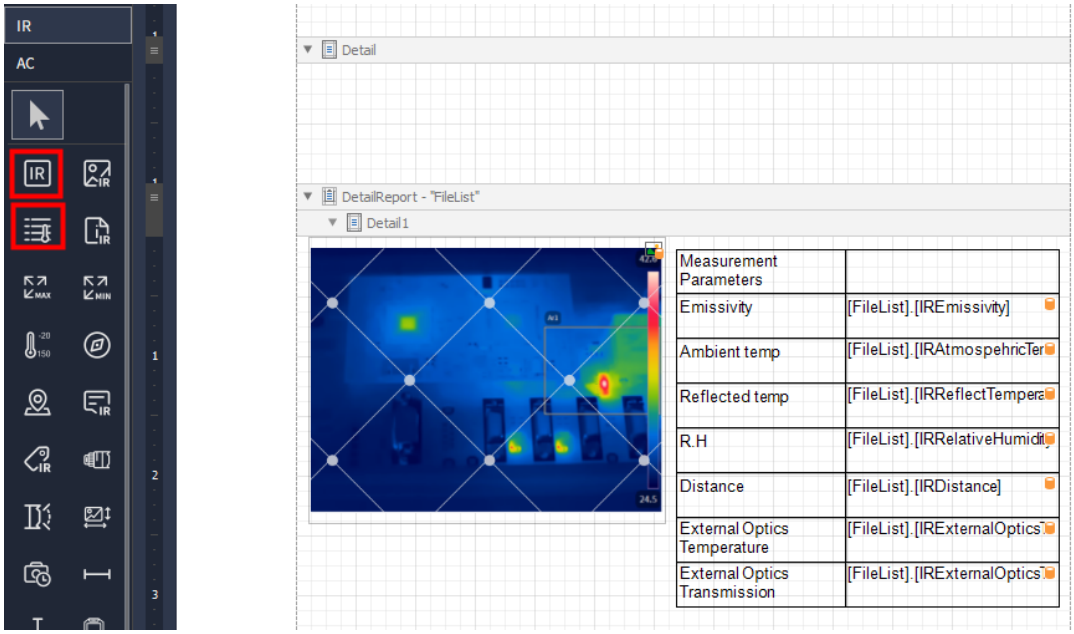
Apply ‘ReportHeader’ and ‘ReportFooter’ on the ‘Detail’ section, and fill in the sections respectively with ‘Text’ control.



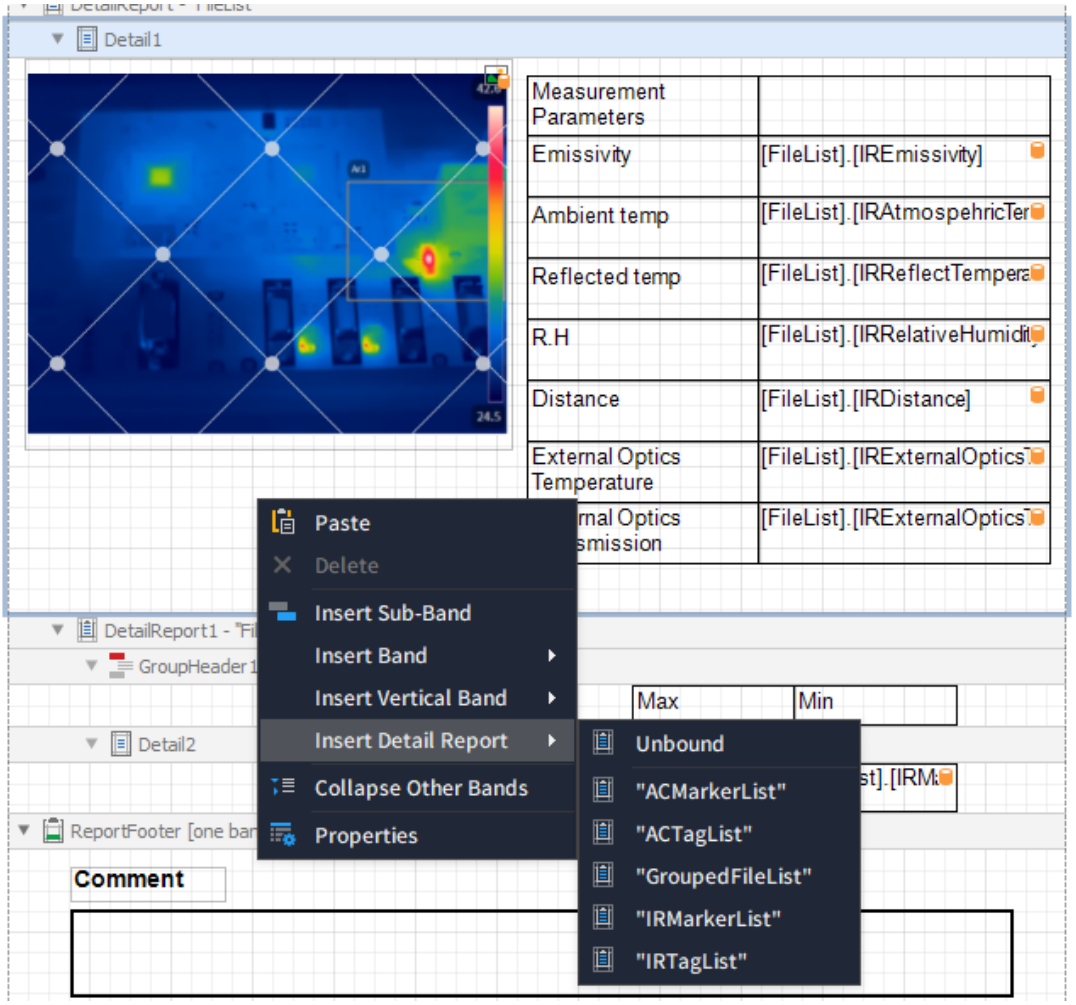
Apply ‘PageHeader’ and ‘PageFooter’ and fill in the content.



Right click on ‘Detail’ section, ‘Inset Detail Report’ and choose ‘FileList’. Doing so will enable the software to repeat unique information about each thermal or acoustic image in the report without repeating general information such as front page or summary table.



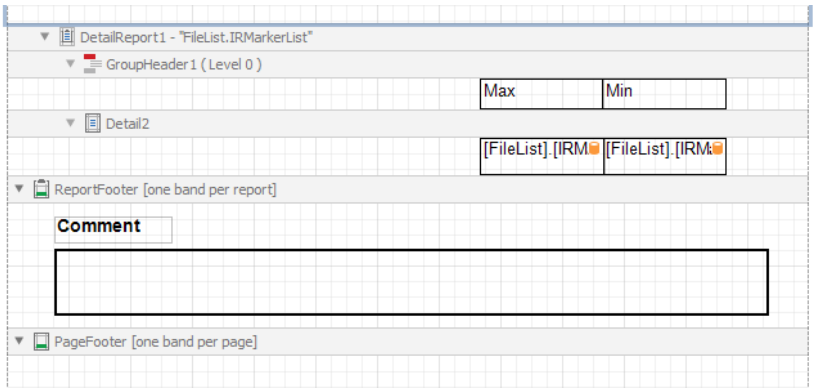
Apply necessary elements such as thermal image and measurement parameters for each image.



Right click and insert detail report again. The options are:

- ACMarkerList：Markers(ROIs) on acoustic image.
- ACTagList：Tags on acoustic image.
- GroupedFileList：File list of different images.
- IRMarkerList：Markers(ROIs) on thermal image.
- IRTagList：Tags on thermal image.

Example: listing the max and min temperature of each ROI on the thermal image

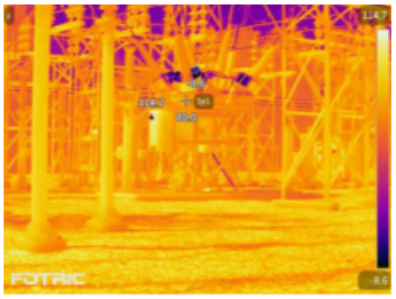


A preliminary report template is hence created:

LOGO

Sample Report Template

Access inspection data: www.xxxxx.com

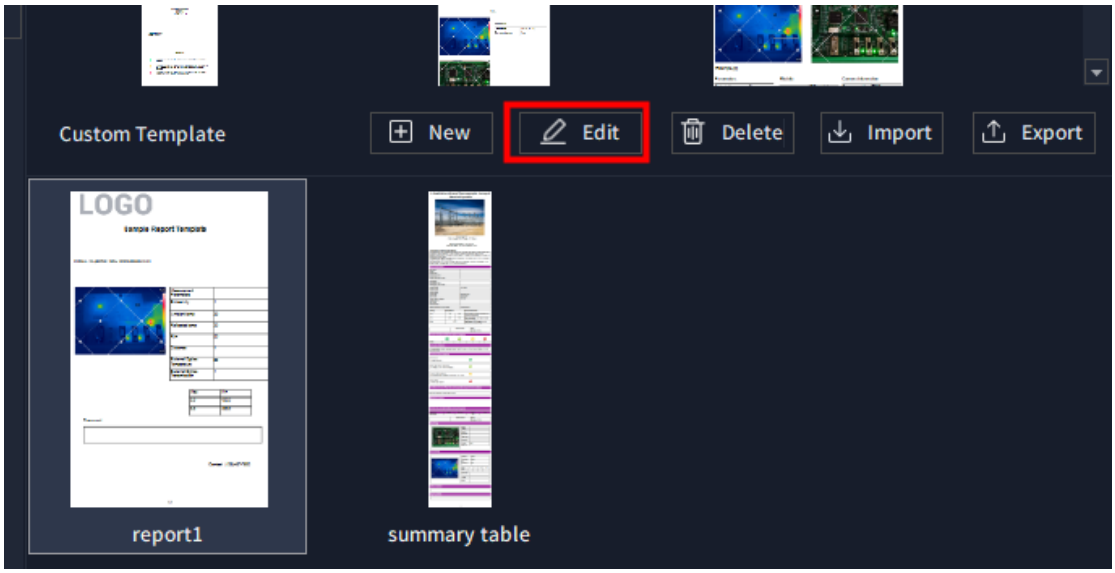


Measurement Parameters	
Emissivity	0.95
Ambient temp	68
Reflected temp	68
R.H	50
Distance	3.28084
External Optics Temperature	68
External Optics Transmission	1

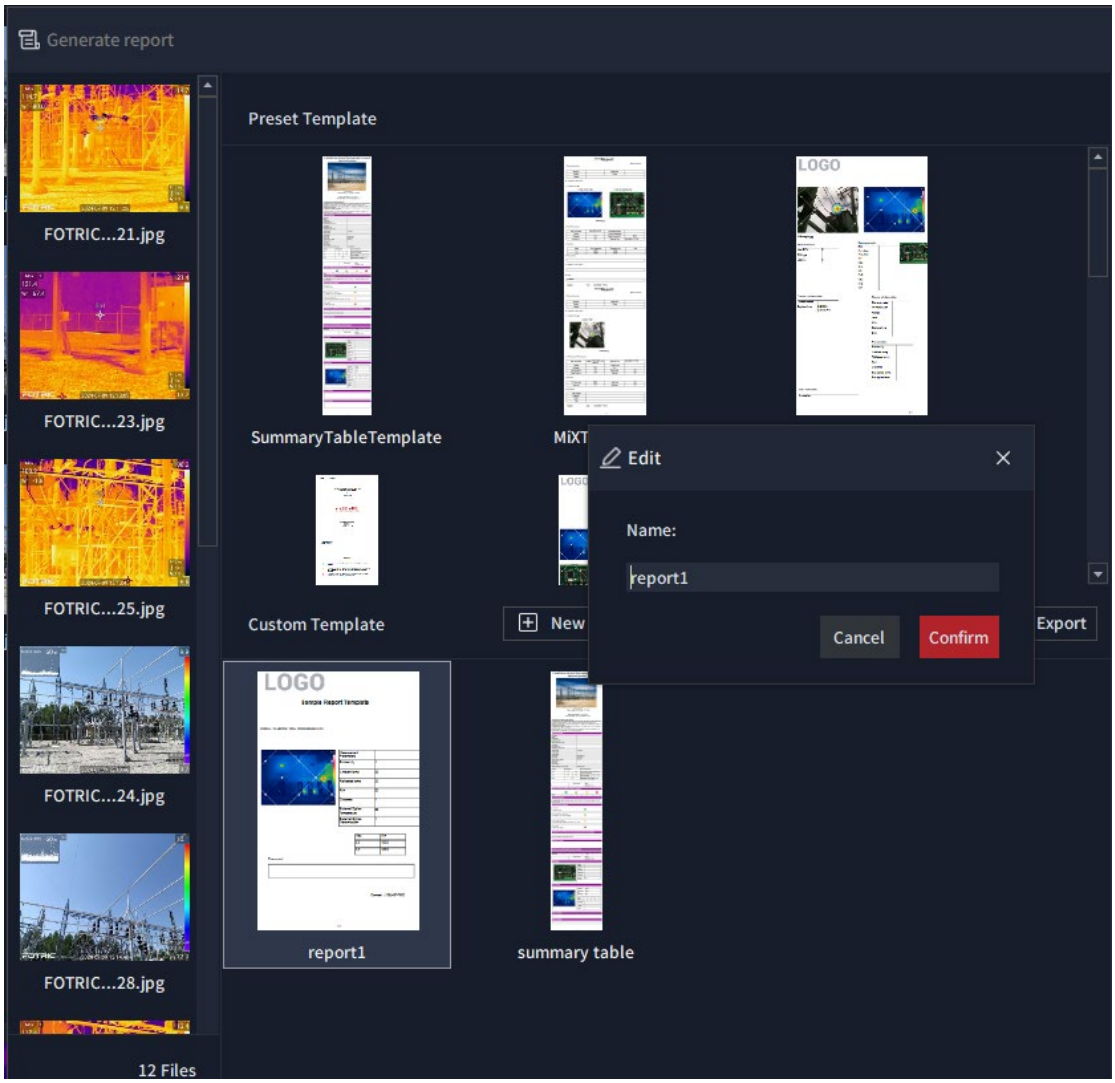
Max	Min
80.0	80.0

Contact: (123)-467-7890

7.5.3 Edit Template



Select a custom template and click ‘Edit’ to change its name.

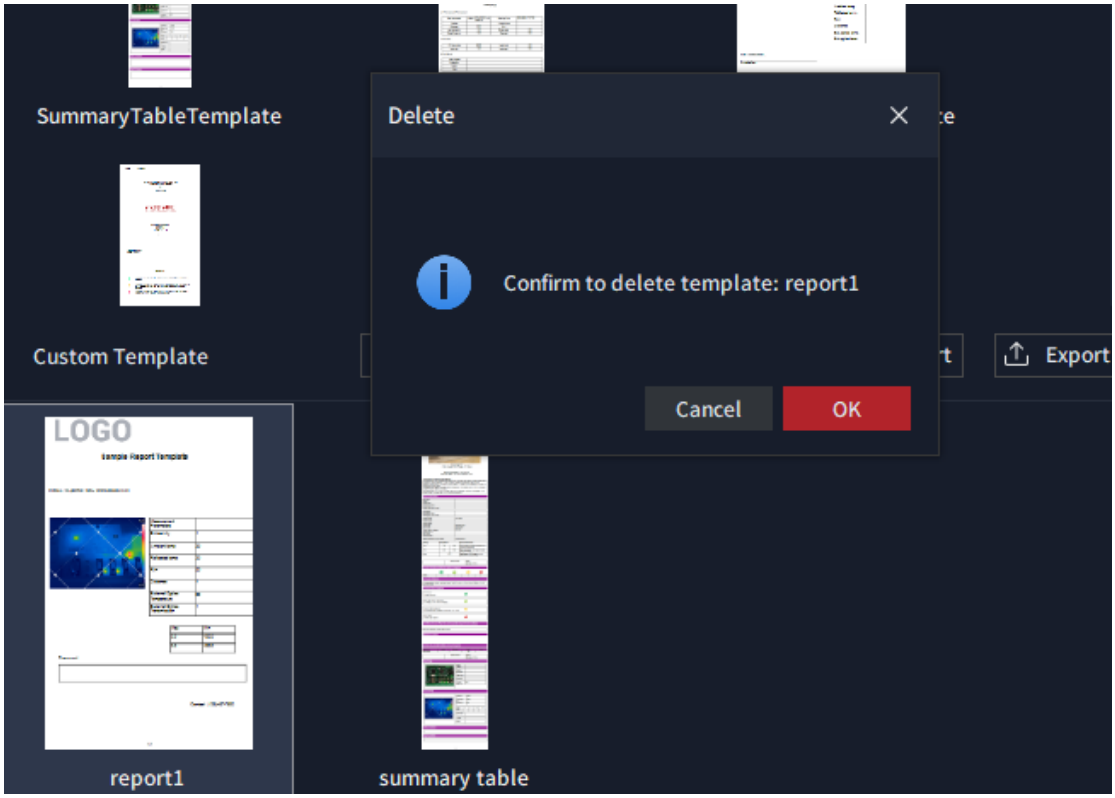


To edit the content of the template, double click on the template, make the changes and press ctrl+S.

!Note: users may not edit preset templates.

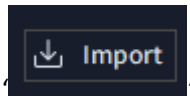
7.5.4 Delete Template

Select a custom template and click ‘Delete’ to delete it.



!Note: users may not delete preset templates.

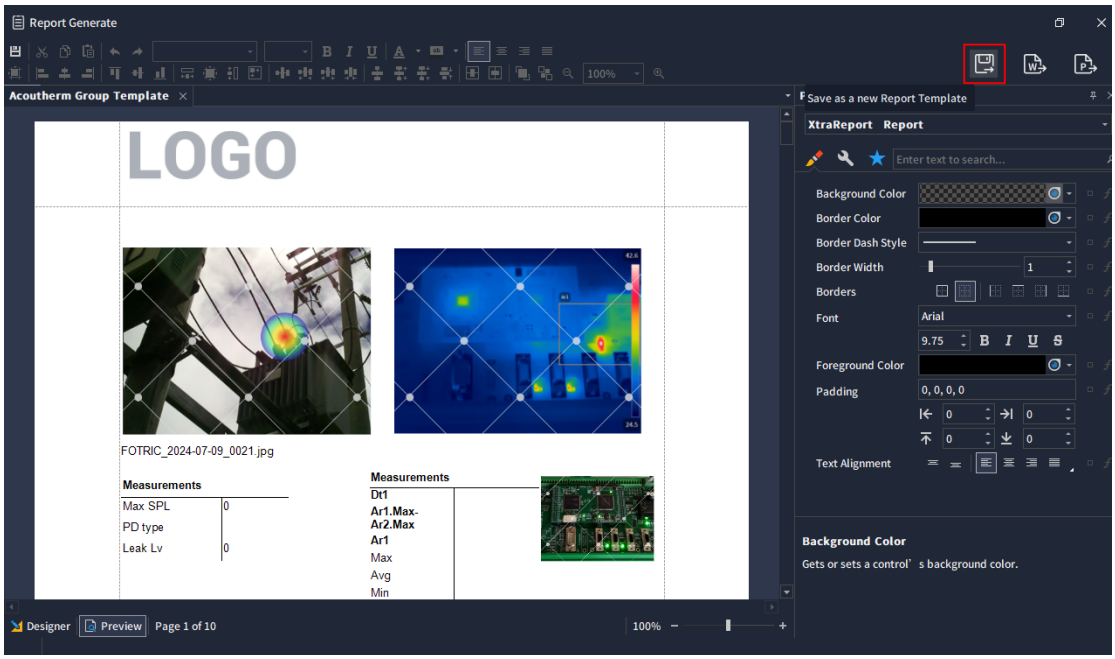
7.5.5 Import Template

Click on ‘ 

’ to import customized report template from others.

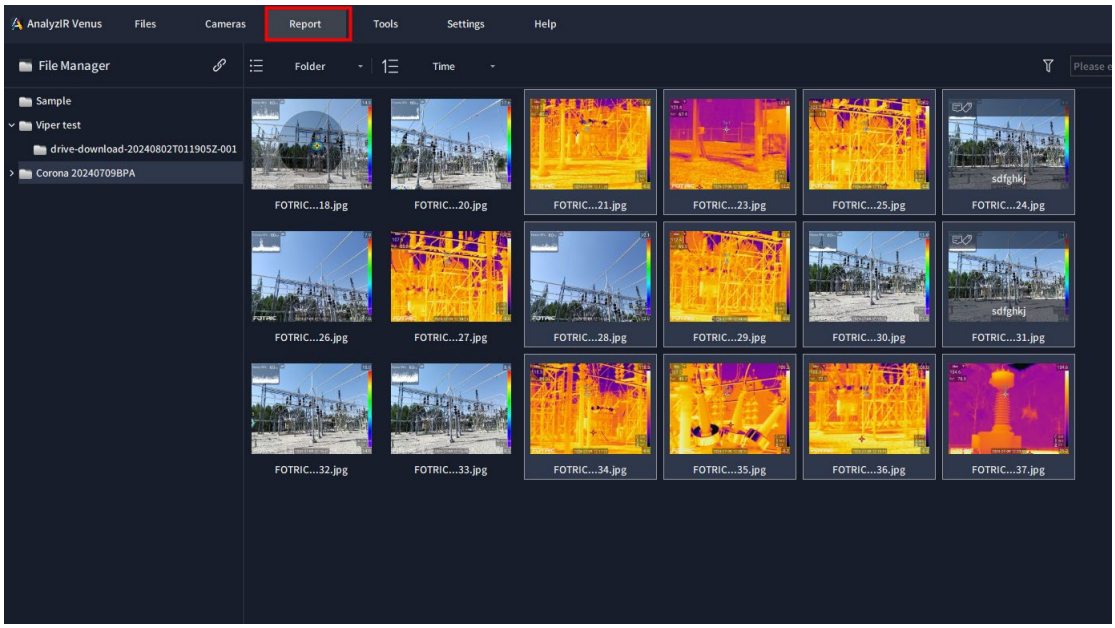
7.5.6 Export Template

To export a preset template for edition, double click on the template and click the ‘Save as template’ button on the top right.

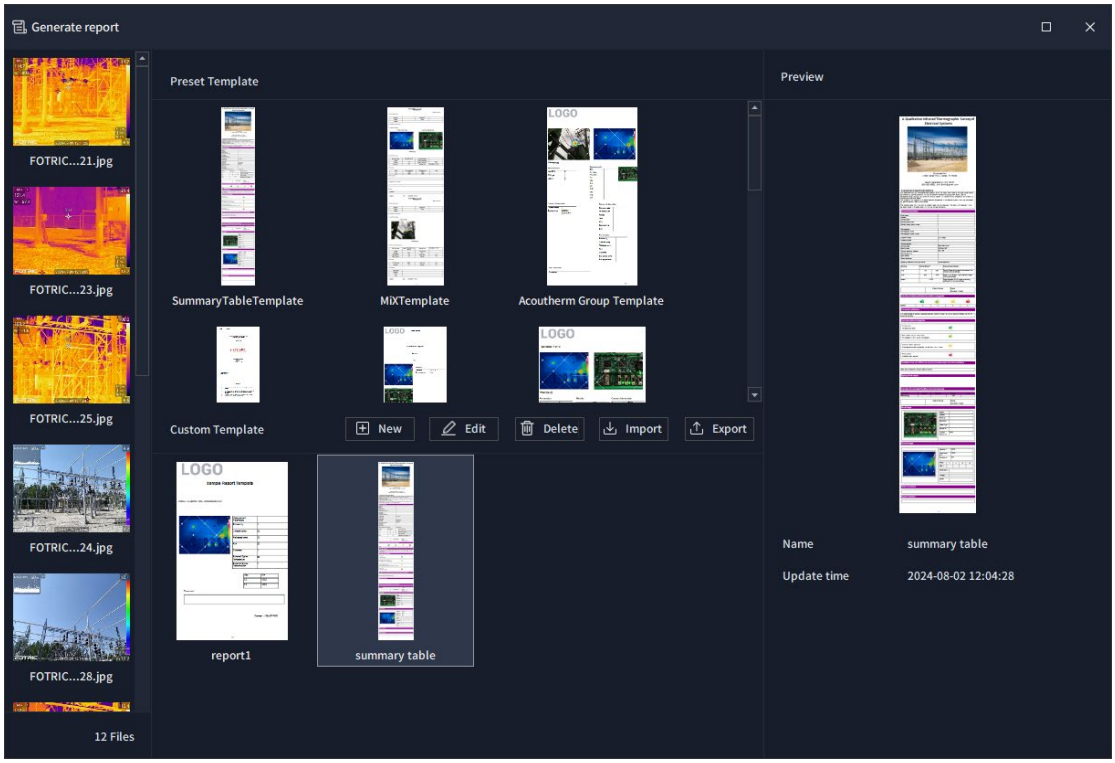


7.5.7 Generate a Report

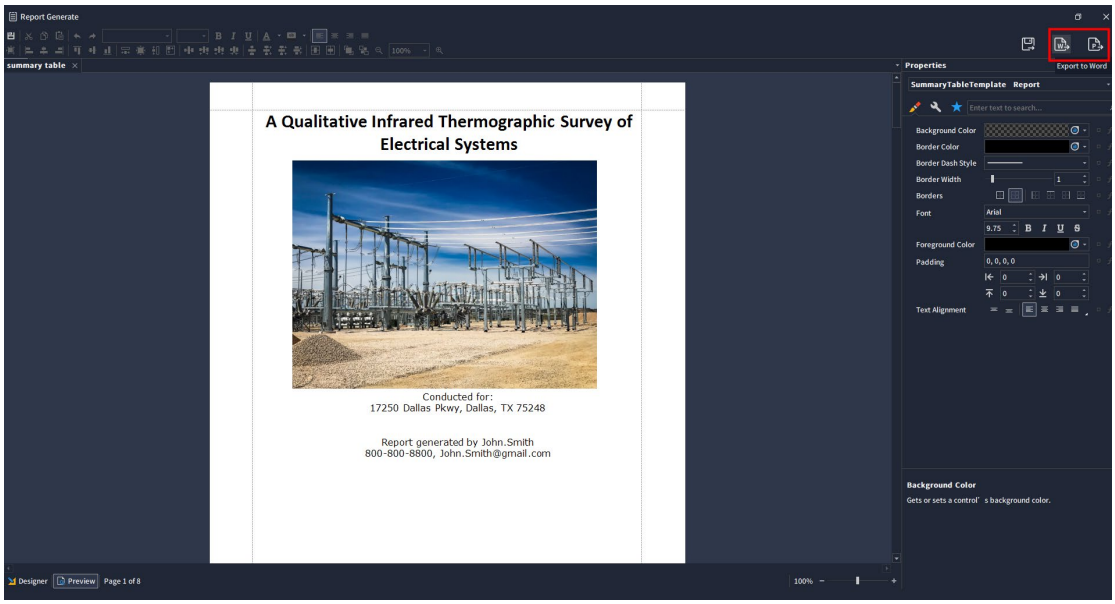
Select the folder or files for the report and click on the ‘report’ button.



Select a report template, double click to see the preview



Click the buttons on the top right corner to generate PDF or word report.



7.6 Tools

The tool contains batch processing, composite videos, data interfaces and lens calculator function tabs.

- ✧ Batch Processing.
- ✧ Composite Videos.

- ✧ Data Interface: Includes three data interface types: DB, TCP/IP Modbus, and RS232 Modbus.
- ✧ Lens Calculator: It can quickly and automatically calculate the measurement range, target distance, lens field of view, and pixel size to help users reasonably select the pixels, lenses, and test distances of the thermal imaging camera to improve the accuracy of thermal imaging tests.

7.6.1 Batch Processing

Please refer to section 7.2.4.4 for detailed introduction

7.6.2 Composite Videos

Please refer to section 7.2.4.5 for detailed introduction

7.6.3 Data Interfaces

7.6.3.1 TCP/IP Modbus Data Interface

1. For the area to be monitored, set up the ROI name;

2. Click on the measurement template selection button, select the drop-down menu of the "New" - click on the "Save" button - enter the name of the measurement template - Save the template;

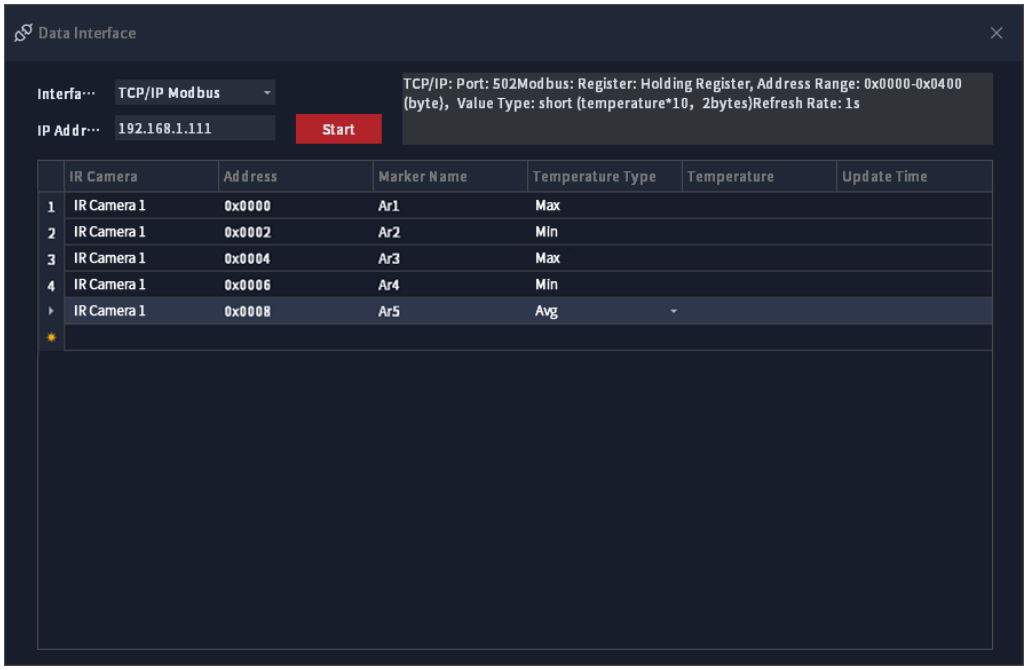
3. Enter the main interface of the software, open the "Tools" tab - click "Data Interface" - open the data interface tab;

4. Select TCP/IPC Modbus for the interface type;

5. Fill in the server IP address in the input box;

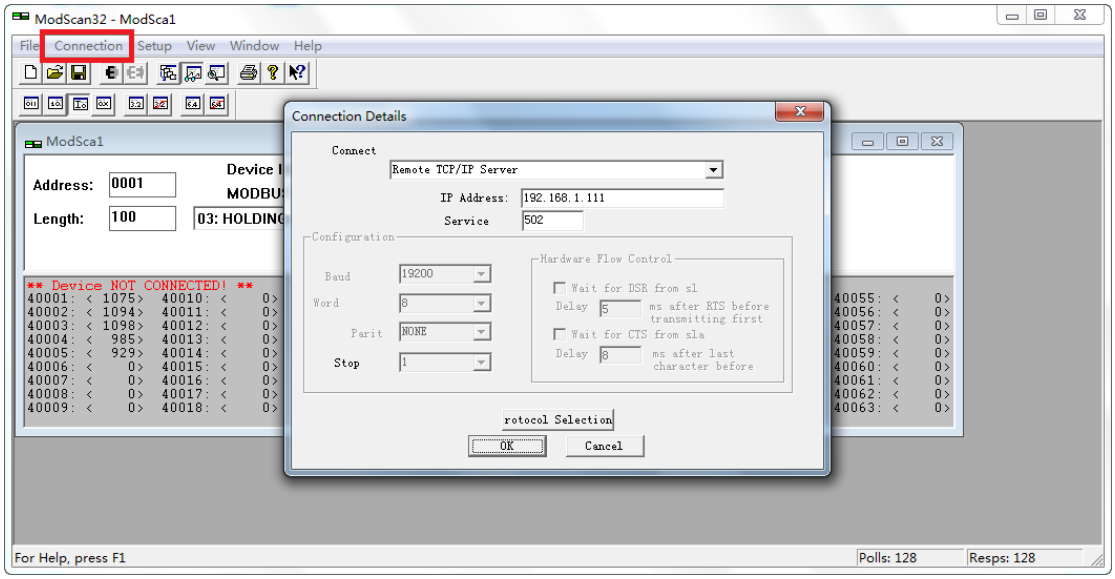
6. Select "Camera 1" or "Camera 2" in the Camera Options according to the actual situation;

7. The name of the marker(ROI) is the name of the marker(ROI) set up in step 1, the temperature type can be selected according to the needs of the "maximum value", "minimum value", "average value", each address should increment by 2 bytes;

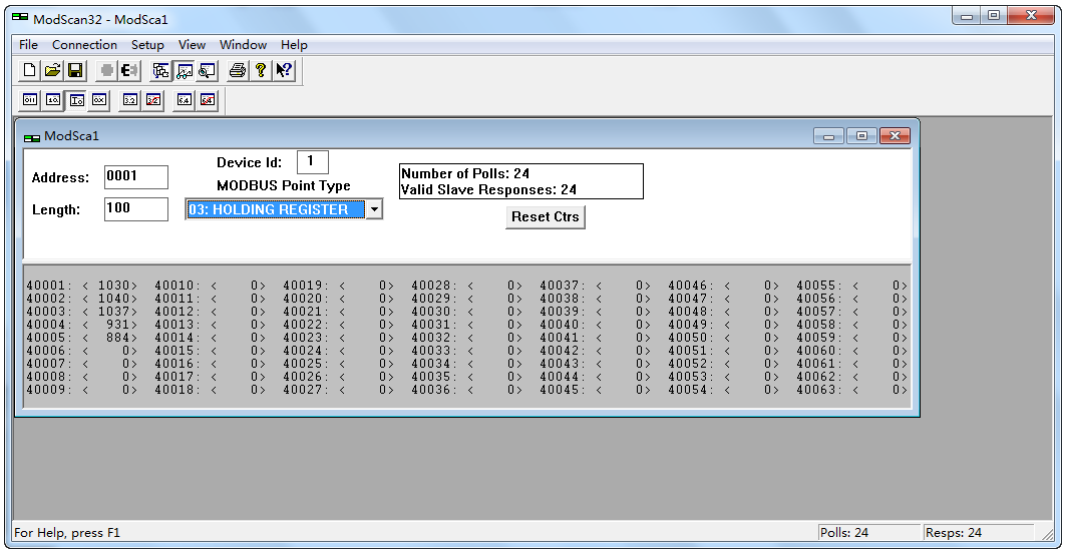


8. Click Start and the temperature data starts to be uploaded into the Modbus registers in real time;

9. Open the debugging software similar to Modscan32, select Connection, the connection type is Remote TCP/IP Server, the IP address is the server address, port 502, click OK.



10. select the HOLDING REGISTER register, the user can get the temperature value of the corresponding five regions.



7.6.3.2 RS232 Modbus Data Interface

1. For the area to be monitored, set up the ROI name;

2. Click on the measurement template selection button, select the drop-down menu of the "New" - click on the "Save" button - enter the name of the measurement template - save! Save the template;

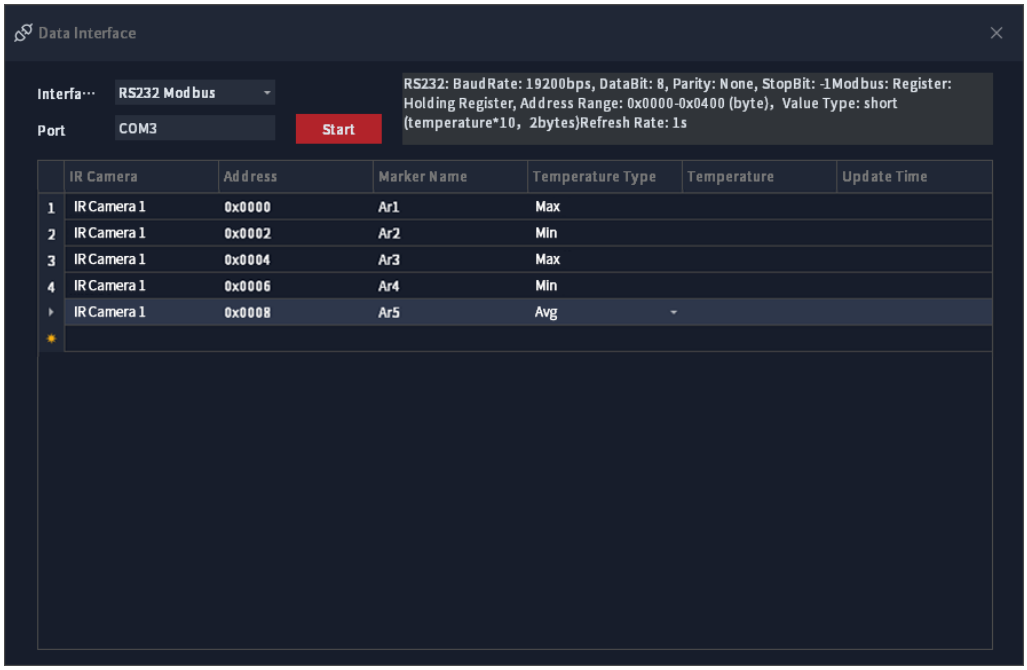
3. Enter the main interface of the software, open the "Tools" tab - click "Data Interface" - open the data interface tab;

4. Select RS232 Modbus for the interface type;

5. Open the server and PC computer management menu, select Device Manager, select USB Serial Port, right-click and select Port Properties, adjust the port settings and parameters;

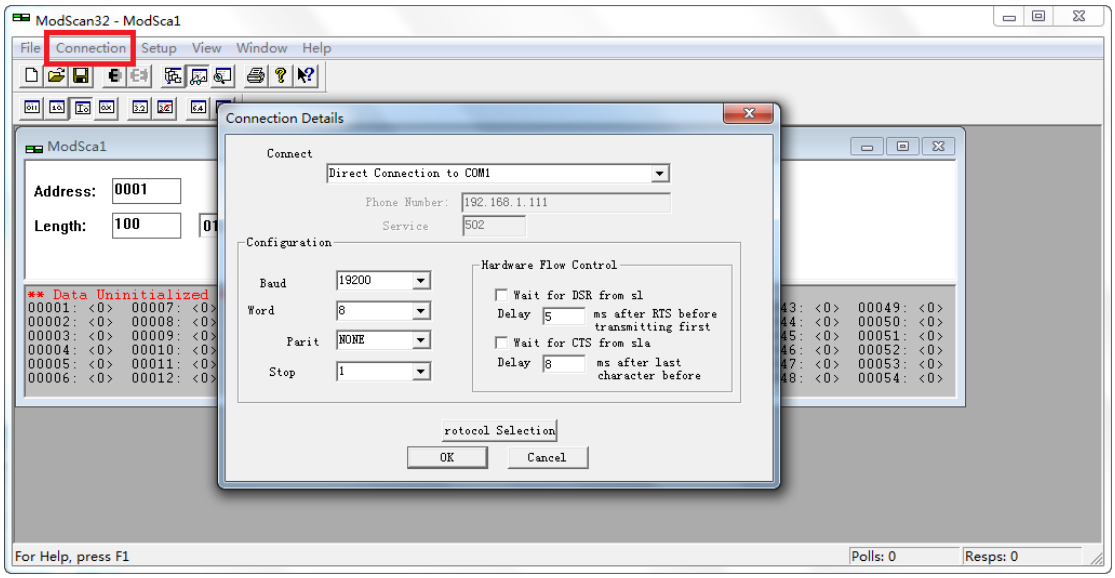
6. Fill in the port number;

7. In the 'IR Camera' option, select "IR Camera 1" or "IR Camera 2" according to the actual situation, the marker name is the set marker name, the temperature type can be selected according to the demand "maximum", "minimum", "average", the address increments by 2 bytes;

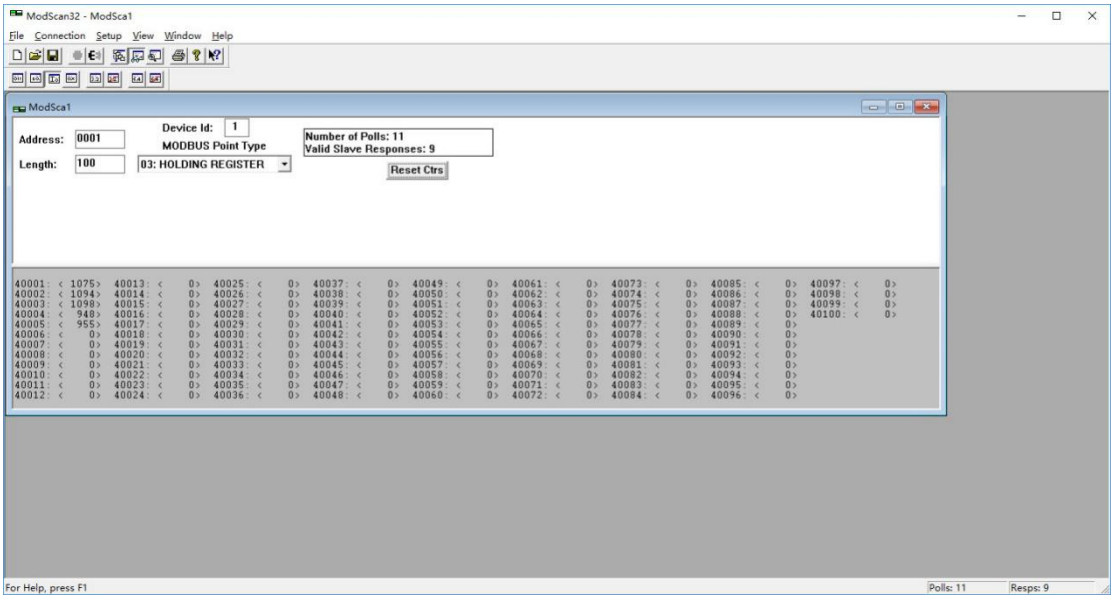


8. Click Start and the temperature data starts to upload to the Modbus register in real time;

9. Open a debugging software similar to Modscan32, select Connection, connection type: Direct Connection to COM1, baud rate: 19200bps, data bits: 8, parity: None, stop bit: 1, click OK.



10. select the HOLDING REGISTER register, the user can get the temperature value of the corresponding five regions.



7.6.4 Lens Calculator

7.6.4.1 Solving for measurement size

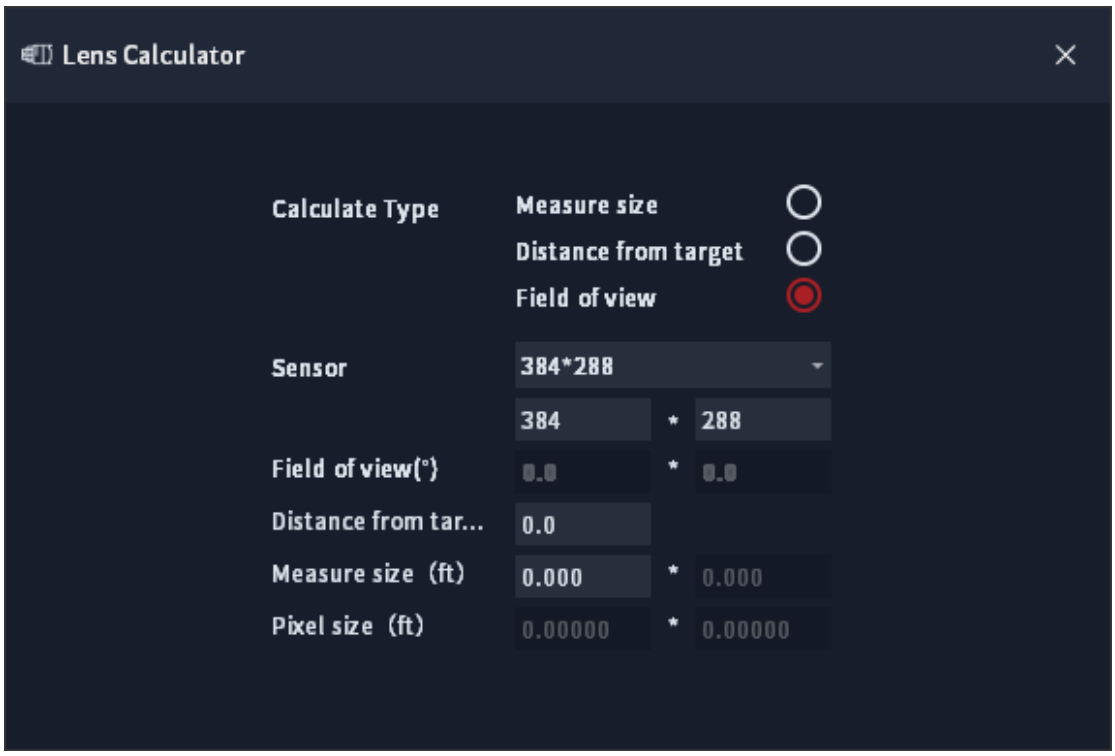
Select the thermal resolution of the thermal imaging camera from the drop-down menu, enter the lens field of view and target distance, and the measurement range and pixel size are automatically calculated.

7.6.4.2 Solving for target distances

Select the resolution of the thermal imaging camera from the drop-down menu, enter the lens field of view and measurement range, and the target distance and pixel size are automatically calculated.

7.6.4.3 Solving for the lens field of view

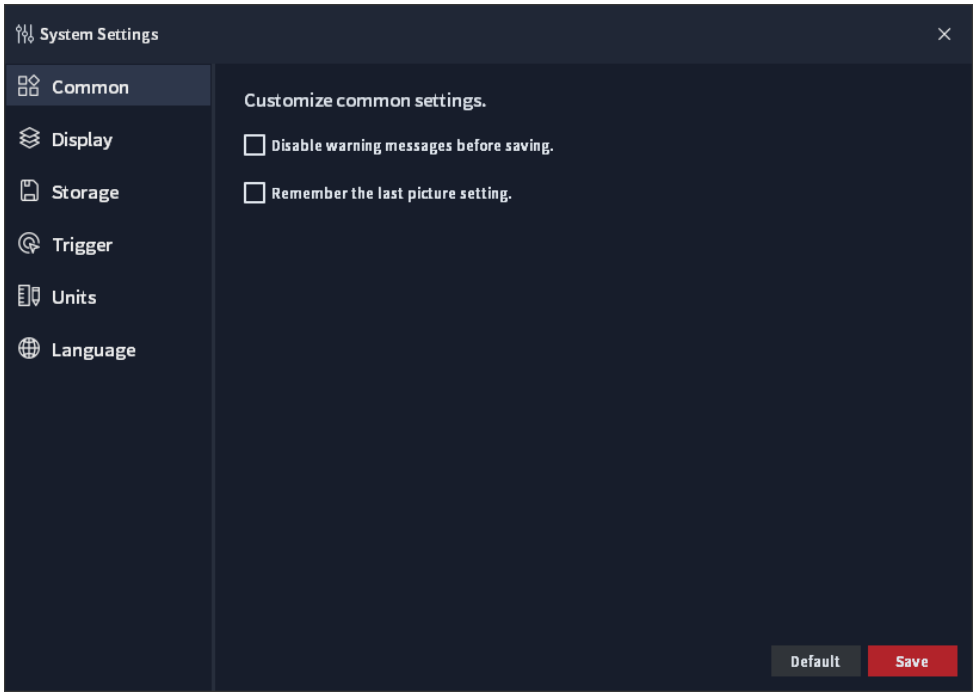
Select the resolution of the thermal imaging camera from the drop-down menu, enter the target distance and measurement range, the required lens field of view and pixel size are automatically calculated.



7.7 System Configuration

7.7.1 Common

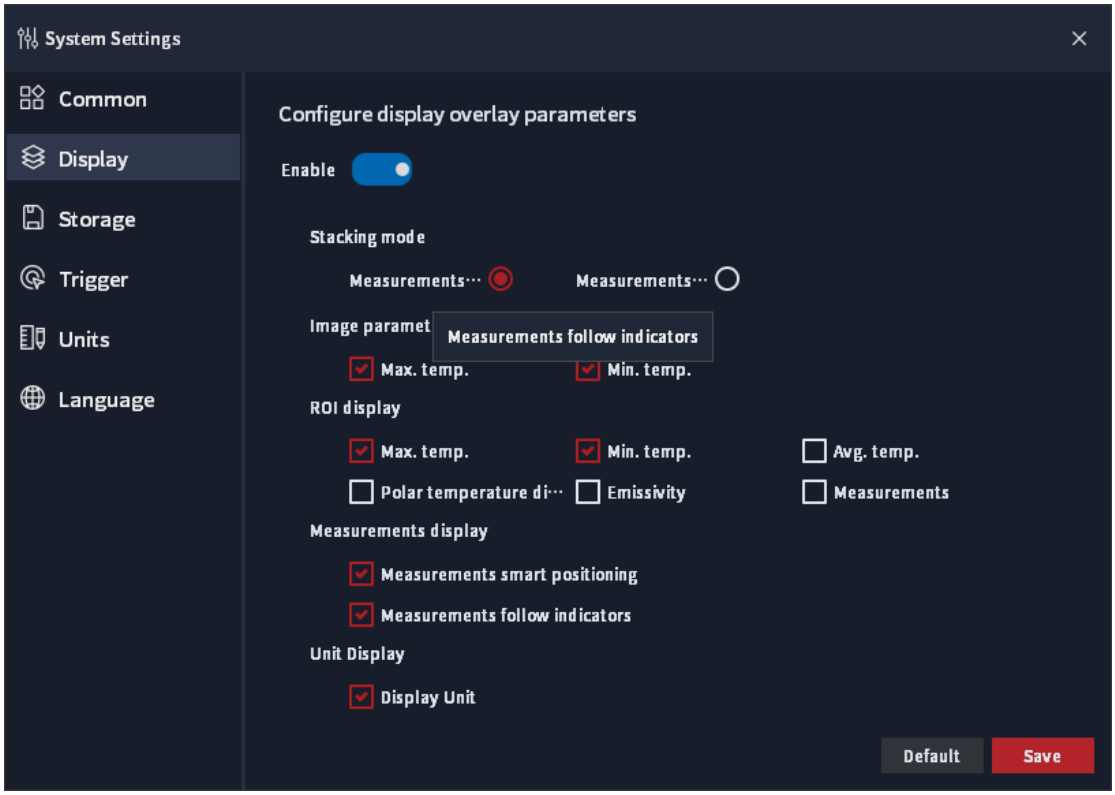
Configure common system parameters



- ✧ Default: The initial default setting in the system settings;
- ✧ Save: Saves the current settings;
- ✧ Disable Warning Message Before Saving: Check this box to prevent the system from displaying a warning message regarding saving changes to the picture (e.g., the prompt to save when closing the interface after adding a temperature measurement point).
- ✧ Remember the last image export settings: Saves the image size and width and height that were set when the image was exported previously.

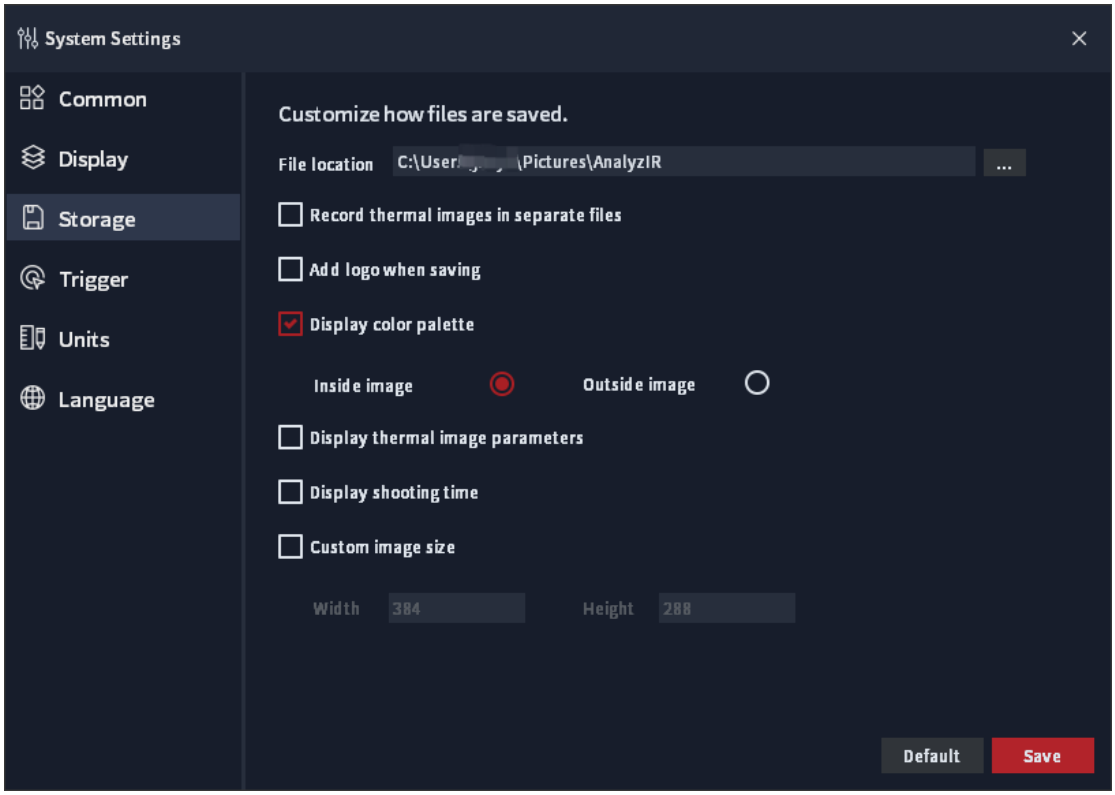
7.7.2 Display

On this interface, the user may configure image display parameters



- Enable: contains parameters to enable and disable the display overlay;
- Stacking Mode: Includes “measurements follow indicators” (overlay parameters are displayed next to the marker) and Global Top Left (overlay parameters are displayed in the top left corner of the entire screen);
- Image parameters: contain maximum and minimum temperatures;
- ROI displays: Contains the highest temperature, lowest temperature, average temperature, extreme difference, emissivity, and measured values;
- Measurement display: Includes character adaptive position (automatically adjusts the display position of temperature values according to the position of the temperature point to maximize the assurance of non-overlapping) and character following high and low temperatures (the value of the highest/lowest temperature is displayed next to the highest/lowest temperature point);
- Unit display: display units after measurement.

7.7.3 Storage

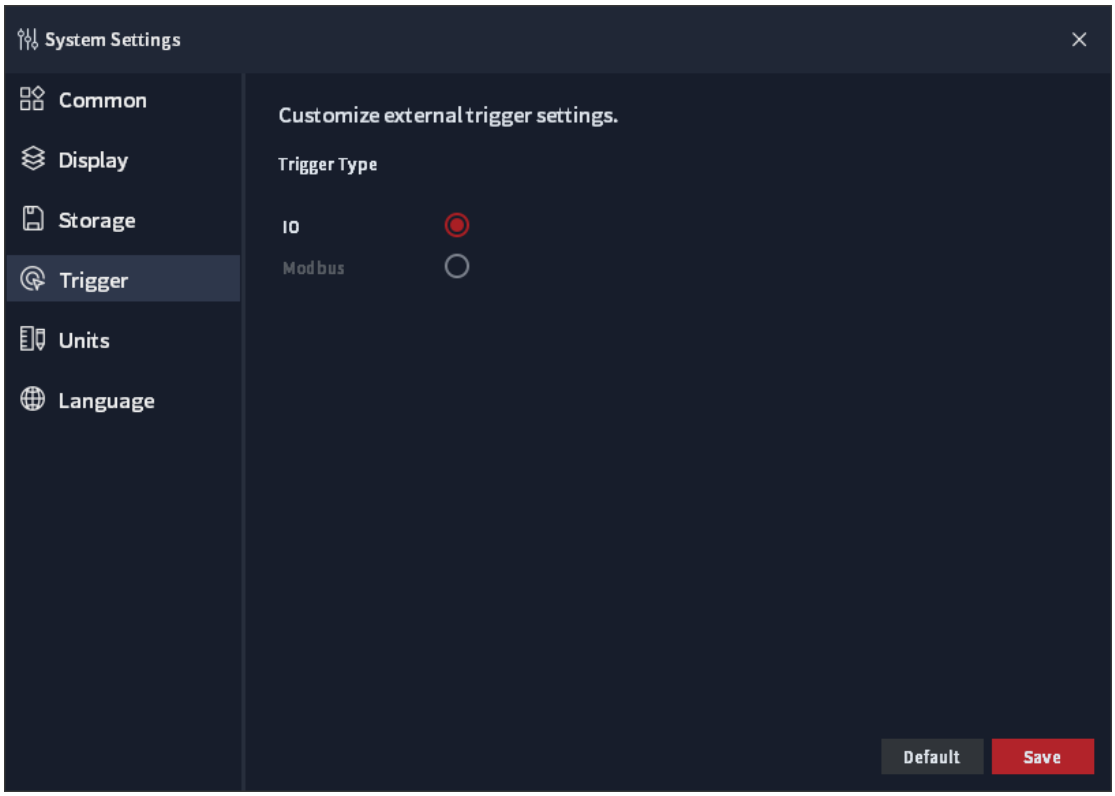


- File location: The path to the hard disk where the thermal image or full radiometric thermal image video is stored when it is taken;
- Record each frame of thermal video as a single file: when checked, the recording of a video becomes a series of snapshots;
- Add Logo when Save: Check the box to include a logo in the saved thermal image;
- Display color palette: hotshots saved after checking the box contain color bands for the palette;
- Inside: the palette ribbon is semi-transparent saved on the inside of the image;
- Outside: palette ribbons are saved outside the image and do not obscure the image;
- Display thermal image parameters: Check this box to display the temperature measurement parameters in the lower right corner of the image when the thermal image is saved;
- Display shooting time: when checked, saving a thermal image is a way to show the shooting time of the photo on the image;

- ✧ Custom image size: The user can customize the size of the image when saving the image. Customizing the width and height of the pixels in the thermal image will only change the size of the image display and will not affect the number of actual temperature measurement pixels.

7.7.4 Trigger

Configure external trigger parameters

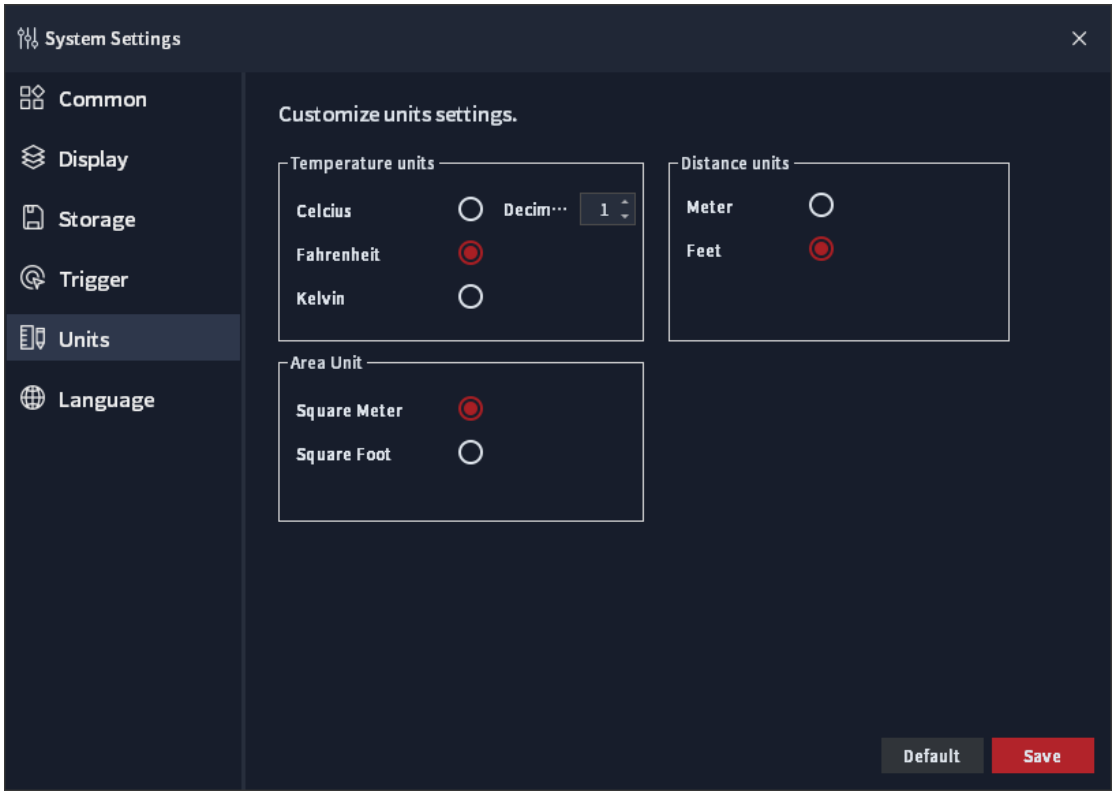


Trigger Type IO: Connects to an external I/O module via TCP/IP to control the recording/stopping of the full radiometric thermal video of the camera's working area;

Modbus: Modbus is a serial communication protocol that supports data communication with the host computer, and does not support external triggering.

7.7.5 Units

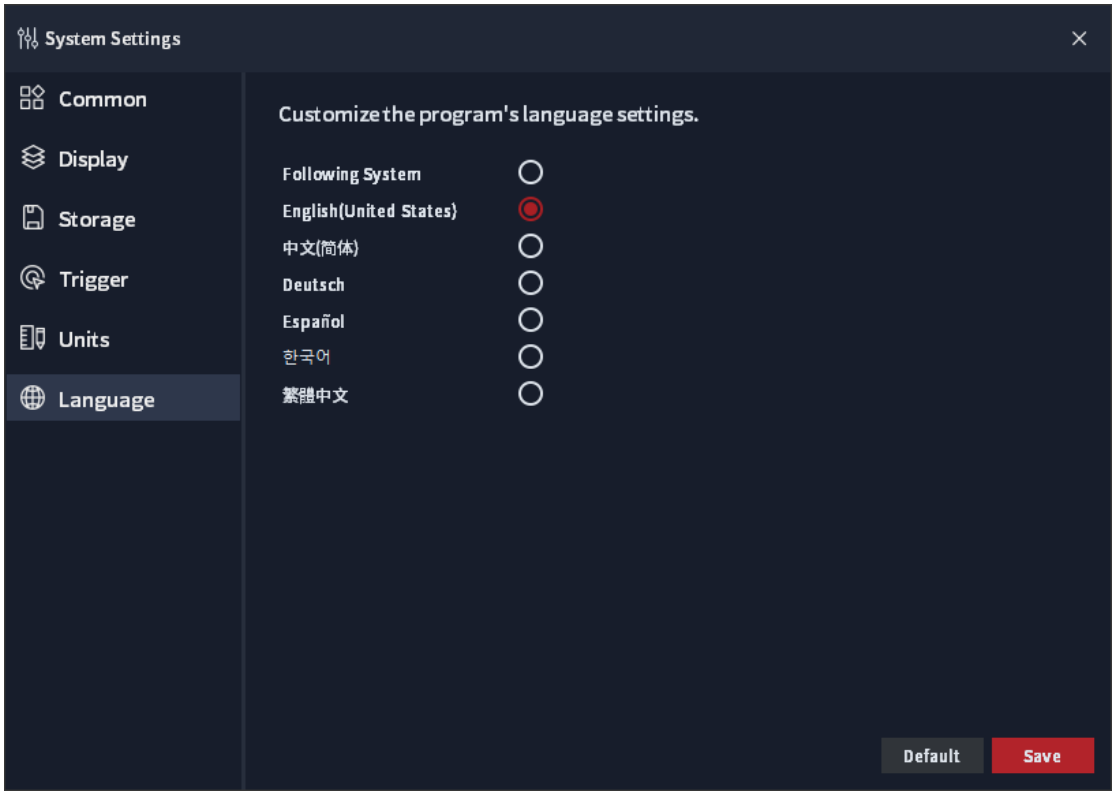
Configure unit of measurement parameters



- ✧ Temperature units: Celsius, Fahrenheit or Kelvin;
- ✧ Decimal digits: when displaying temperature data, the temperature is accurate well after the decimal point, available options are: 0, 1, 2;
- ✧ Distance units: meters or feet;
- ✧ Unit of area: square meters or square feet.

7.7.6 Language

Configure Software Language



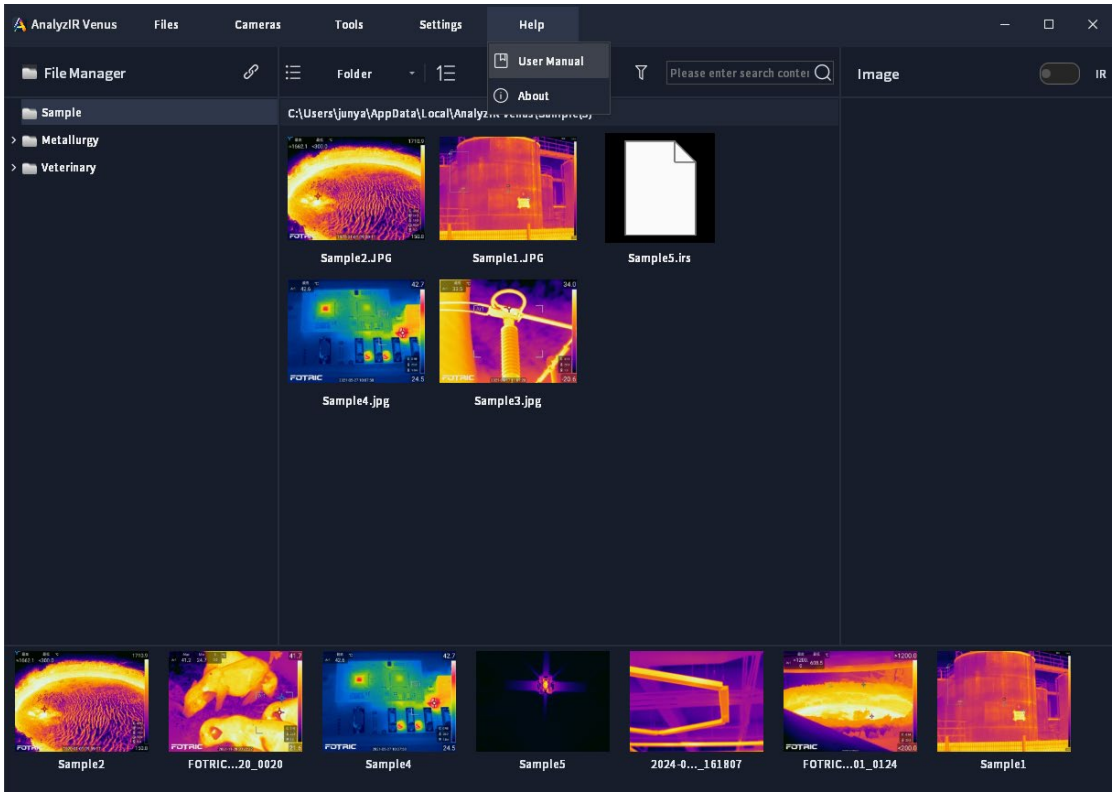
Languages can be selected as follows;

- ✧ Following System follows the system (Currently, for operating systems in languages other than English, the font of the software is displayed in Simplified Chinese.)
- ✧ English (United States)
- ✧ 中文（简体）
- ✧ Deutsch
- ✧ Español
- ✧ 한국어
- ✧ 繁體中文

7.8 Help

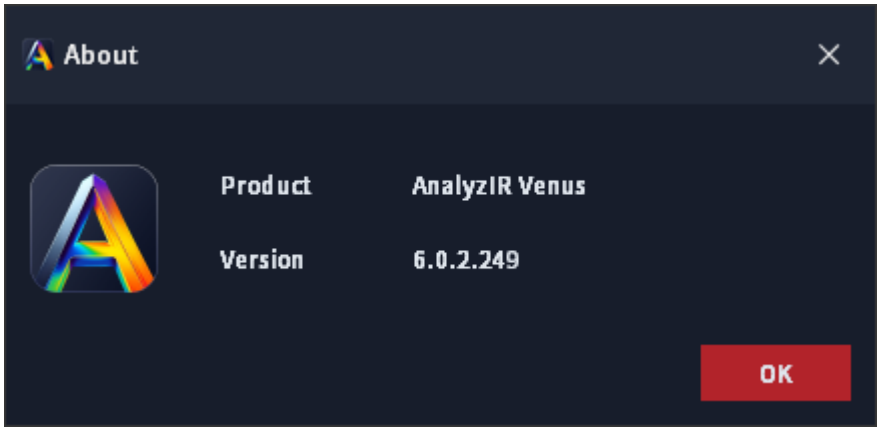
Help contains the user manual and About.

7.8.1 User manual



Click on User Manual to open the AnalyzIR Professional Analysis Software Operation Manual, which is this operation manual.

7.8.2 About



Click About to display information about the name and version number of the software.

7.9 File Formats Supported by AnalyzIR for Analysis

AnalyzIR Professional Thermal Image Analysis Software supports the analysis of thermal image files in the following formats:

1. Our thermal image in .JPEG format containing temperature data.

2. Our thermal image in .IR format containing temperature data.

3. Our full radiometric thermal image video files in .IRS or .IRSX format containing temperature data.

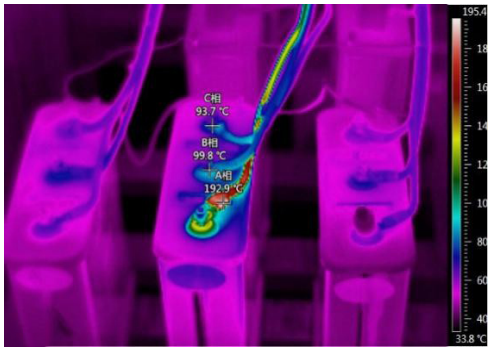
4. We contain thermal image files in .JPG format of temperature data and digital camera pictures.

8. Application Cases

8.1 Applications for Equipment Maintenance

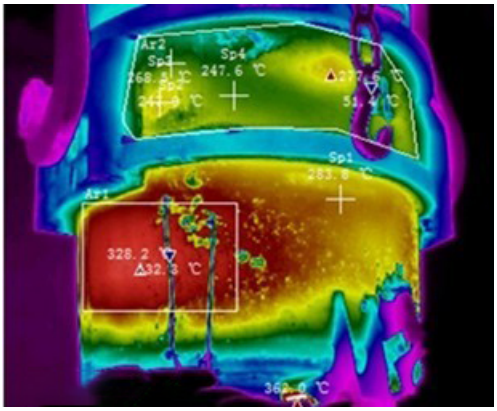
In industrial power transmission and distribution systems, numerous components such as contacts, switches, and casing clamps are prone to issues like poor contact, corrosion, or internal abnormalities. These issues can lead to abnormal overheating, significantly jeopardizing power supply safety. Utilizing an infrared thermal imaging camera enables precise detection of overheating spots, facilitating timely elimination of potential hazards and ensuring uninterrupted power supply.

For instance, it can detect poor contact in electrical connectors of capacitor compensation cabinets.



Motor coupling overheating

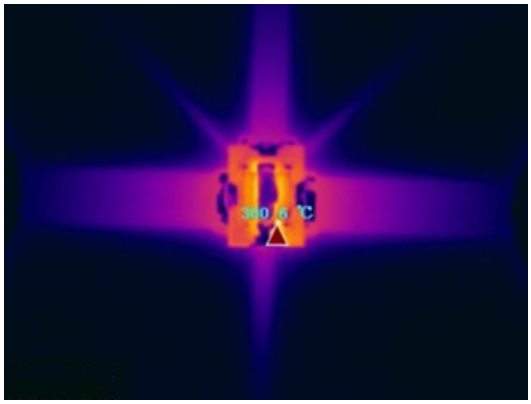
Compromised ladle refractory


Ar2
Sp4
247.6 ℃
Sp1
Ar1
328.2 ℃
Δ32.3 ℃

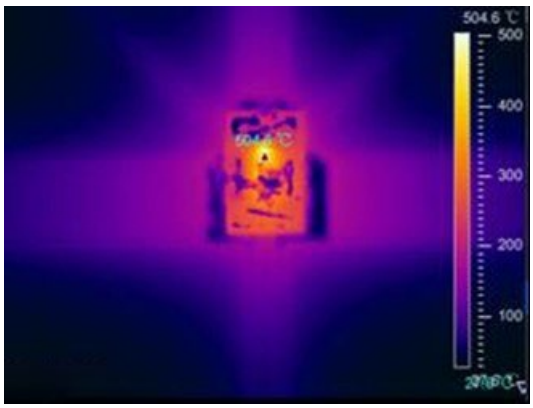
8.2 Applications for Research Development

Optimization study of chip fuse blowing process

Through the thermal imaging camera to observe the process of changes in the patch insurance and temperature changes to find the cause, to solve the problem of incomplete fusing and fusing irregularities, as follows:



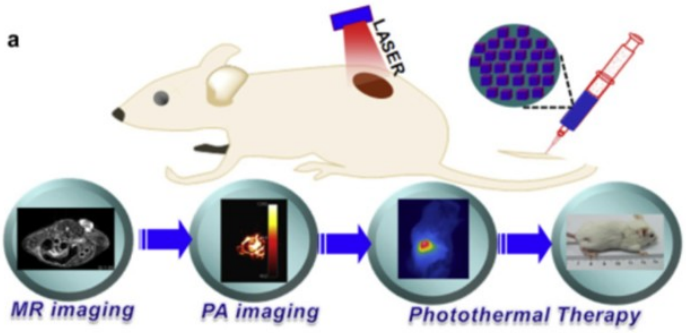
300℃Regular fusing



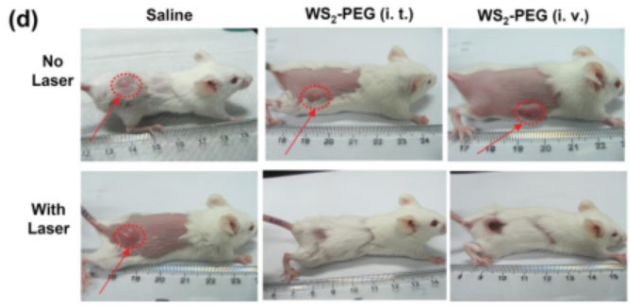
500 ℃ can not be regular fusion

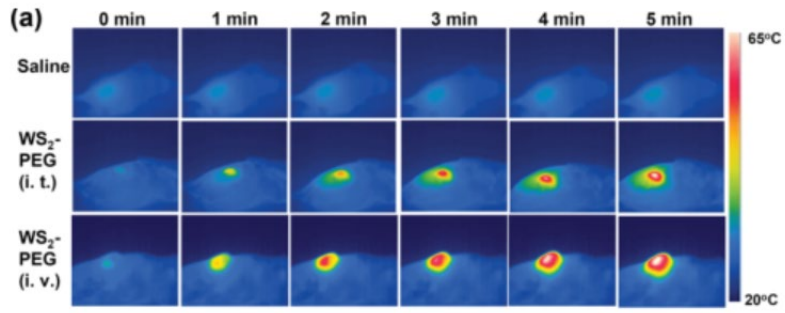
Photothermal therapy of tumors and materials research

During laser irradiation of the tumor site of a rat injected with a drug, a full radiation video is recorded using our thermal imaging camera with AnalyzIR software, and time-temperature trend analysis is used to observe and record the temperature change process and compare the performance of the drug with different concentrations and materials.



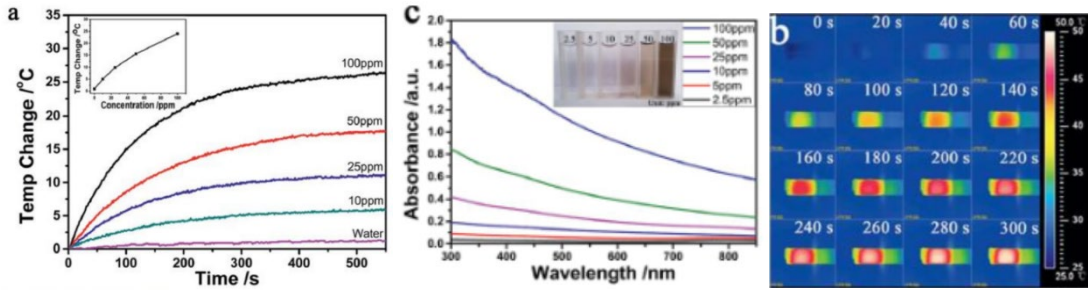
! Note: The above image is quoted from the paper "PEGylated Prussian blue nanocubes as a theranostic agent for simultaneous cancer imaging and photothermal therapy".





! Note: The above figure is quoted from the paper "PEGylated WS2 Nanosheets as a Multifunctional Theranostic Agent for in vivo" by Prof. Zhuang Liu's group in the Laboratory of Functional Nano and Soft Matter (Materials), College of Nanotechnology, SUU, published in Advanced Materials. Dual-Modal CT/Photoacoustic Imaging Guided Photothermal Therapy".

The camera supports full radiometric thermal image video streaming to connect to the AnalyzIR analysis software on the PC to compare and analyze the temperature rise of materials with different concentrations;



! Note: The above figure is quoted from the key laboratory of colloid and interface chemistry of the Ministry of Education, School of Chemistry and Chemical Engineering, Shandong University, published on

The Royal Society of Chemistry paper "Radar-like MoS2 nanoparticles as a highly efficient 808 nm

laser-induced photothermal agent for cancer therapy".

9. Glossary

Absolute zero.

means -273.15° C (0 Kelvin = 459.69° F). Absolute zero is a completely ideal state in which the motion of the atoms of an object stops completely, i.e., at this temperature the object is completely devoid of any energy.

Kelvin [K]

One of the internationally recognized temperature scales. 0 K corresponds to absolute zero (-273.15° C).

See the following conversion formula: 273.15 K = 0° C = 32° F. K = ° C + 273.15.

Celsius degrees Celsius [° C]

Degrees Celsius is a temperature scale that is currently more widely used in the world. Under 1 standard atmospheric pressure, the boiling point of water is defined as 100 ℃, and the freezing point of water is set at 0 ℃, between which it is divided into 100 equal parts, and 1 equal part is 1 ℃.

℃= (℉-32)/1.8 or ℃= K-273.15

Fahrenheit temperature [℉]

It is a temperature scale that is more widely used in North America. ℉ = (° C x 1.8) + 32.

Infrared radiation

It is a type of electromagnetic radiation. Any object above absolute zero emits infrared radiation.

Absorption

Any object has the ability to absorb infrared wavelengths to a greater or lesser extent, and the most direct reflection of the object after absorbing infrared light is an increase in temperature. Usually the object with relatively high temperature radiates more energy than

the object with lower temperature, while for the object itself, the absorbed infrared energy will be converted into its own energy and radiate to the outside, therefore, the emissivity of the object is related to the absorption rate of the object.

Radiation

In nature, all the temperature in the absolute zero degrees above the object, are in the form of electromagnetic waves constantly transmit heat to the outside, this way of transmitting energy is called radiation .

Conduction

Heat is always transferred from an object of higher temperature to an object of lower temperature in a process called heat conduction. Heat conduction is the main mode of heat transfer in solids.

Convection

The process of heat transfer that relies on the flow of the fluid (liquid, gas) itself is called thermal convection, or convection for short, and convection is caused by temperature inhomogeneity.

Atmospheric windows

When solar radiation passes through the atmosphere, the range of wavelengths of light radiation with high transmittance that are not reflected, absorbed or scattered is called the "atmospheric window". An atmospheric window also exists in the infrared wavelength range, where there is a stable atmospheric transmittance in the 7-14μm range. Therefore, measurements using infrared technology are particularly effective in this wavelength range.

Black body radiator

A blackbody radiator is an object that absorbs all of the incident electromagnetic waves and converts all of them into its own energy to radiate outward, with no reflection or transmission in the process. The emissivity of blackbody radiator $\varepsilon = 1$, there is no such absolute blackbody in the real nature, blackbody radiator is regarded as a kind of ideal

object, usually used as a standard object for thermal radiation research. Most blackbodies are also set to an emissivity of < 1 for calibration or alignment purposes, usually set to $\varepsilon >$ 0.95.

Grey body radiator (real body)

The vast majority of objects in nature are "gray radiators". Unlike black bodies, gray bodies cannot absorb so incident light waves, and usually reflect or conduct both at the same time. The emissivities of gray radiators are all values between 0.1 and 1.0.

Coloured body radiator

Colored emitters are materials whose emissivity varies with wavelength and temperature. This means that the same object has different emissivities. Most metals are colored emitters, e.g., aluminum increases in emissivity when heated.

Thermal Imager

A thermal imaging camera is a piece of inspection equipment that is capable of detecting radiation in the infrared band of the electromagnetic wave spectrum and turning the invisible infrared radiation into a visible picture. The most important functions of a thermal imaging camera today are temperature measurement and imaging.

Detector

The sensor of an infrared camera, which detects the infrared radiant energy of an object and converts it into an electrical signal. The smallest unit of the detector is the pixel.

Focal Plane array Non-cooling Focal Plane Infrared Detector (FPA)

FPA detectors were early refrigerated detectors and were large in size and used for measurements in the near-infrared band; nowadays, FPA detectors have been developed into uncooled types and are used for high-precision measurements in the far-infrared band. The detector receives the radiant energy from the object and causes the temperature of the sensor to rise, thus changing the resistance of the sensor, which is expressed by an electrical signal.There are two types of FPA sensors: optical readout uncooled focal plane

arrays and electrical readout uncooled focal plane arrays.

Refresh rate

Expressed in Hertz, this refers to the rate at which the camera updates the image per second. For example, 30Hz means that the camera can update 30 complete thermal images in one second.

Resolution

Resolution is a parameter used to measure how much data is within an image, and refers to how many dots (pixels) there are per unit length.

Lens

The lens determines the size of the visible field of view of the thermal imaging camera. Wide angle lenses are suitable for a large field of view of the temperature field distribution, while telephoto lenses are suitable for detailed measurements at long distances. Common lens materials used today are germanium (Ge), silicon (Si) and zinc selenide (ZnSe), which are excellent materials with good infrared transmission.

Field of view (FOV)

FOV is the horizontal and vertical angle at which an object is fully imaged in a thermal imaging camera.

MFOV Measurement of Field of View

MFOV is the smallest range of pixels over which a thermal imaging camera detector can accurately measure data. There are two main types: MFOV=1 and MFOV=3×3=9.

Thermography

Using an infrared camera displays a map of the surface temperature field by means of a non-contact measurement. The camera creates a visual image of the thermal distribution by detecting the amount of radiant energy of an object, converting it according to the relationship between radiant energy and temperature, and displaying the temperature

values in the field of view of the shot in different colors. Each pixel of a thermal imaging camera represents a temperature point on the surface of the object being measured.

Measuring range

The temperature measurement range is the band of temperatures that can be measured by a thermal imaging camera, indicating the amount of thermal radiation that can be measured and recorded by the instrument. Often a maximum and a minimum limit are defined, which are expressed as two bold temperature values limiting the current calibration. Outside the defined measuring range, the instrument usually fails to display or guarantee the accuracy of the measured values.

Thermal sensitivity NETD

NETD is the thermal sensitivity of the thermal imaging camera (also known as noise equivalent temperature difference), which describes the minimum temperature difference that can be detected by the instrument, and is directly related to the clarity of the camera's measurements. The smaller the value of thermal sensitivity, the higher the sensitivity and the clearer the image.

Accuracy

It refers to the degree of proximity between the observed results, calculated or estimated values and the reference values. For example, if the actual surface temperature is 100° C and the measurement accuracy is ±2° C, the difference between the measured value and the actual measurement result will not exceed ±2° C, i.e. 98° C-102° C.

Calibration

Calibration is the process of comparing the actual measured value of an instrument with the value of a standard, the result of which indicates that the measurement accuracy of the instrument is within the permissible limits. Calibration is different from calibration in that it is meant to record the deviation of an instrument's value, not to correct its measurement results. The calibration intervals and timeliness of an instrument depend on the measurement task and requirements.

Colour palette

Palette sets the color display of the image. Set the contrast of the image display colors according to different measurement tasks.

Isotherms isotherm

Temperature ranges can be set and all identical temperature points within this range are marked with the same color. This analysis function assists with on-site analysis.

Coldspot and Hotspot

In a thermal imaging camera, the point with the lowest temperature is called the "cold spot" and the point with the highest temperature is called the hot spot.

Emissivity (ε)

Emissivity: The emissivity is the ratio of the energy radiated outward by the object under test to the energy radiated by a blackbody at the same temperature and wavelength. The value of ε is a material property of the object under test, and is related to the properties of the surface of the object under test, as well as to the temperature and wavelength of the object under test. The value of ε is a material property of the object under test.

RTC (Reflected Temperature Compensation)

Some objects have quite high reflectivity, and in addition to taking care to adjust the emissivity of these objects under test when measuring, it is best to correct the measurement results by entering the temperature value of the high radiation source affecting the object under test in order to minimize the measurement error and improve the accuracy of the measurement results.

Condensation

It is the process of conversion from a gaseous state to a liquid state. When the surface temperature of an object is lower than the ambient temperature of the air, the moisture in the air will condense into water droplets on the surface of the object, and at a certain temperature, the original unsaturated water vapor contained in the air becomes saturated,

and this temperature point is also called the dew point.

Dewpoint

Dew point is short for dew point temperature, dew point temperature is the atmospheric pressure is unchanged, due to the cooling effect, the air originally contained in the unsaturated water vapor becomes 100% saturated temperature, known as the dew point temperature.

Relative humidity

The absolute humidity of air at a given temperature as a percentage of the saturation vapor pressure of water at the same temperature.

Specular reflection

Specular reflections usually occur on surfaces with high reflectivity or low emissivity. However, specular reflection does not mean that the object has a high reflectivity, e.g., painted surfaces, where a thermal imaging camera can reflect the specular reflection of other ambient emitters (e.g., measuring the image of a person) on a painted surface, which generally has a high emissivity ($\varepsilon \approx 0.95$). Conversely e.g. sandstone walls, which have lower emissivity ($\varepsilon \approx 0.67$), are unable to form specular reflections. Therefore, the surface structure of an object is an important factor affecting specular reflection. Specular reflection is the phenomenon that when the incident light is a parallel ray, it is reflected to a smooth mirror surface and goes out as a parallel ray. Its relative concept is diffuse reflection, which refers to the incident light is parallel to the light, reflected to the rough object, the reflected light in all directions out of the phenomenon. For example, when aluminum foil is flat, it is easy to produce specular reflection, but when the foil is crumpled and then unfolded, the uneven surface produces diffuse reflection, which is different in all directions on the surface of the object.

Reflectance coefficient (ρ) [rəʊ]

is the ability of an object to reflect infrared radiation. ρ depends on the type of material, the nature of the surface and the temperature and wavelength. In general, smooth and

polished surfaces have a higher reflection coefficient, while rougher and non-glossy surfaces have a lower reflection coefficient.

Transmittance Transmission coefficient (τ)

Refers to the ability of a substance to transmit infrared radiation. τ (tao): depends on the type and thickness of the material.

Coefficient of Convective Heat Transfer

Its size reflects the strength of convective heat transfer, which is defined as: when the temperature difference between the fluid and the solid surface is 1K, 1 square meter of surface area in the heat transfer per second, expressed in h. The heat transfer is the same as the convection heat transfer, which is the same as the convection heat transfer.

Kirchhoff's radiation law Kirchhoff's radiation law

is a well-known law of thermodynamics that describes the relationship between the emissivity and the absorption ratio of an object of a certain wavelength: under conditions of thermal equilibrium, the absorption ratio of an object to thermal radiation is constantly equal to the emissivity at the same temperature.

Planck's radiation law

Planck's Law of Radiation presents the idea that the intensity of the electromagnetic energy emitted by a blackbody depends on the wavelength and frequency. Planck's law was born in 1900 and is considered the fundamental theory of quantum physics. Currently Planck's constant is the most important physical constant in modern physics, and Planck's law is also the physical basis for the development of thermal imaging cameras. At the beginning of Planck's research, the assumption that the emission and absorption of light (i.e., later electromagnetic radiation) is not continuous, but a copy of a share of the process, the results of its calculations in order to match the results of the test, such a share of energy is called a quantum, each copy of the quantum is equal to hv, v for the frequency of the radiation of electromagnetic waves, h is a constant, called Planck's constant.

Stefan-Boltzmann-law Stefan Boltzmann's Laws

The famous law of thermodynamics, the law proposes that the total energy of electromagnetic waves of various wavelengths radiated per unit area of the surface of a blackbody per unit time is proportional to the fourth power of the thermodynamic temperature of the blackbody itself, T, with the formula Wb = σ - - T4

where s (sigma) = 5.67 × 10-8W/(m-2-K-4) is the Steffen-Boltzmann constant.

10. Material emissivity table

Aluminum (rough)	0.07
Aluminum (weathered)	0.83
brick	0.81
carbon (chemistry)	0.95
concrete	0.95
Copper (oxidized)	0.78
Copper (polished)	0.05
fiberglass	0.97
foundry iron	0.64
Iron (rust)	0.69
oaken	0.90
Oil film 0.03 mm	0.27
Oil film 0.13 mm	0.72
Oil (thick)	0.82
paintwork	0.94
classifier for documents, letter etc	0.90
plaster cast (for a broken bone)	0.86
Rubber (black)	0.95
human skin	0.98
dry soil	0.92
Soil (with saturated water)	0.95
Stainless steel (oxidized)	0.85
Stainless steel (polished)	0.14
Steel (oxidized)	0.79
Steel (polished)	0.07

distilled water	0.96
Water (cream)	0.98
Water (snow)	0.85