Version

4.8

IRcameras, Inc.

Infrared Software

Thermography Suite

User's manual

IRcameras, Inc

Thermography Suite Manual

IRcameras, Inc.
1600 Providence Hwy.
Walpole, MA 02081
1 (877) 472-2637
IRcameras.com
mailto:support@ircameras.com

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Chapter 1

Installation and the first experience

Welcome

Welcome to IRcameras Thermography Suite, the professional infrared image analysis and reporting tool. Thermography Suite delivers a comprehensive environment for professional thermographic engineers to create accurate detailed analysis and quickly generate eye-catching reports. Moreover, Thermography Suite provides an integrated communication option for real-time image acquisition, analysis and process control.

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Why Thermography Suite?

Ircameras Thermography Suite is based on a simple idea: a powerful tool, but comprehensive and easy to use. You need to be quick to be efficient!

Easy to use workspace

- The program is fully *integrated* in one workspace
- Includes a built-in *Thermography Explorer* with thumbnail preview to browse your disks and find infrared images and related files
- Convenient *image zooming* with *view finder* allows to see every detector
- Collection files to remember analysis workspace and windows placement
- *Navigation panel* to have all the instruments right at your hand
- Bright, flexible diagrams
- Close link to *Microsoft Office*
- All the features are accessible at *any time*, even in real-time
- And more …

Powerful features

- Full range of *analysis tools*: spots, lines, free form areas, rulers and measures
- On image *annotation* tools
- All kinds of *diagrams*: profiles, histograms, envelope profiles
- *Trend analysis*: point, profile, area and box-line trends
- *Hot/cold spots* detection
- Quick template-based *report generation system* based on Microsoft Word documents
- Statistics
- Image enhancement filters
- *Real-time analysis* for process control with direct connection to the camera
- Variety of *export* options
- Sequence *aggregation*
- And many more …

System requirements

Protection

Thermography Suite requires a **hardware key** (Sentinel SuperPro) for execution, otherwise it can be run in the *trial mode* for 30 days. After this period, Thermography Suite has to be deleted from the system or you have to apply to GORATEC for getting the license.

Software

Thermography Suite has been designed to work with the following **operation systems**:

- Microsoft Windows 95/98/ME
- Microsoft Windows NT 4.0 (with Service Pack 6 or later)
- Microsoft Windows 2000/XP or more

To use reporting features of Thermography Suite you will also need Microsoft Word 2000/XP/2003 on your computer.

Hardware

Minimum:

- Pentium II class PC, 128 MB RAM, approx. 100 MB of free space on HDD.
- Video board with at least 16b (65536) colors.
- 800x600 monitor resolution.

Recommended:

- Pentium III 1GHz (or higher), 256 MB RAM
- Video board with at least 16b (65536) colors.
- 1024x768 or better monitor resolution.

To use the sound recording feature a soundboard with a microphone is required.

Installation notes

Important

Before installing Thermography Suite we strongly recommend to uninstall previous versions, including GORATEC PE 3.1x and PE 4.00.

You must have *administrative privileges* in order to successful install Thermography Suite on Windows NT/2000/XP. This is because Thermography Suite installation requires access to areas of the registry that are available only to those with administrator access privileges.

Administrative privileges are not required to use the software.

Installation procedure

Place Thermography Suite installation CD into your CD-ROM drive. The installation will start automatically. If not:

- Open your CD-ROM drive
- Double click on IRTSSetup.exe
- Follow the instructions on the screen.

Warning: the installation program might ask you to restart your computer.

First start

Insert the provided hardware key into the printer or USB port. Double click on Thermography Suite icon on the desktop.

IMPORTANT NOTICE FOR PE-USERS

This note concerns you if your PE package includes **Image Database** option.

Thermography Explorer changed the way in which images were stored in the database. Because of that, your active database has to be converted into the new format and Thermography Explorer will suggest you to do so during the first start.

You will get a question similar to this:

"E:\Documents and Settings\ andrei\ Application Data\ GORATEC\ PE\ ImageDB\

Image database is created by a previous version of the Explorer. In order to continue, you have to convert it into a new format. In this case, it will be NOT accessible by older versions of the Explorer. Proceed?"

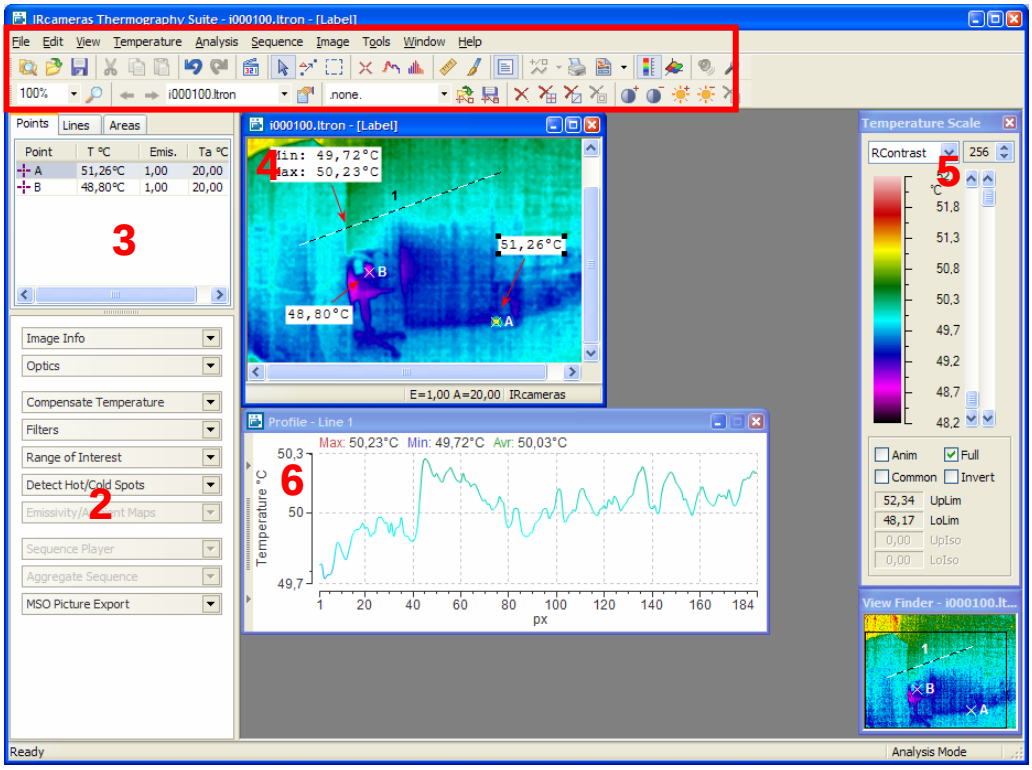
Before selecting YES, **we strongly recommend you to make a copy of the shown image database folder.**

In case an error occurs during the conversion, you can use "Restore Database" option of Thermography Explorer, see corresponding article in this manual.

Getting started

Thermography Suite application contains the following items:

- Main menu bar and toolbars (❶)
- Navigation panel (❷): contains list of dialogs and information windows allowing to change active item properties or perform some action
- Statistics view (❸): contains information about all analysis objects, such as spot values, average, minimum, maximum values and others
- Image analysis view (❹): contains image being analyzed
- Temperature scale (❺): shows dependency between color and temperature value, allow to change color palette
- Diagram (❻): displays a curve for the active object



First steps:

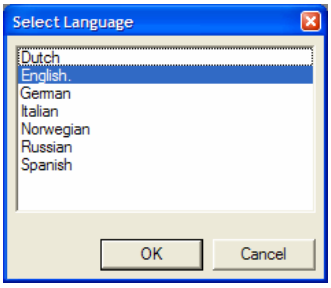
1. Open an image by choosing **File/Open** and selecting an image filename.
2. Move mouse cursor over the image: under the image, you can read pixels temperature and position.
3. Choose **Analysis/Point** and click on any part of the image. You have created an analysis point object and can see its value in the statistics view (❸).
4. Choose **Analysis/Profile**, move the mouse cursor to the image, press left mouse button, holding it move the mouse pointer to another place and release the button. You have created an analysis line object and a profile diagram (❻).

Chapter 2

Thermography Suite workspace

Interface language

- Choose **File/Language**
- Select preferred language from the list and click OK.
- You will be prompted to re-run the application, because newly selected language can be applied only during the start.



Open images

There are two principal ways of storing images: "one file - one image" and "one file – many images". The second type files are called *sequence files*.

Thermography Suite can open images in two modes: *preview* and *analysis*. First you should open an image or sequence in the *analysis mode* (only infrared images), after you can additionally open several images (infrared or visual) in the *preview* mode.

Quick reference

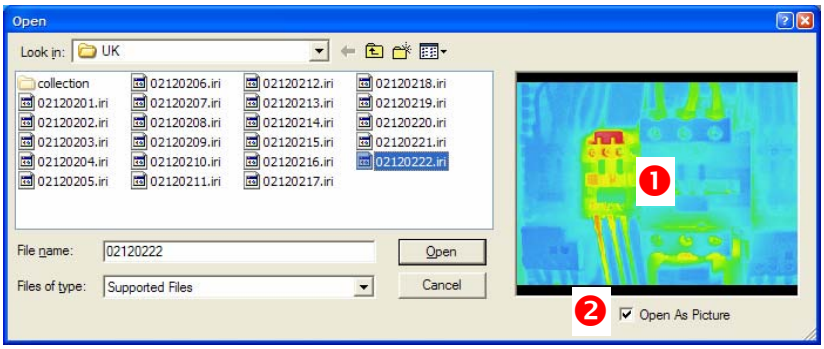
Menu: **File/Open**

Toolbar:

Keyboard: Ctrl+O

In the dialog, select one or more images, or select one sequence file and push **Open**.

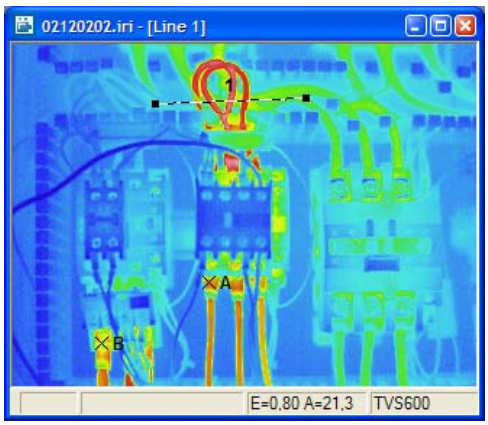
The Open dialog consists of the standard file dialog plus preview (❶). The preview part shows content of the selected file. If



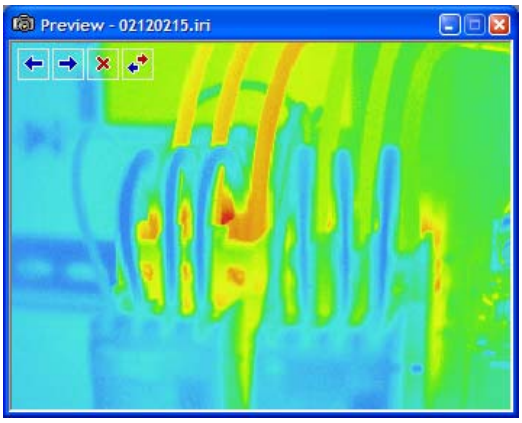
the file does not contain an image in a supported format or more than one image is selected, nothing is displayed.

To open images in preview mode, check "Open as Picture" (❷).

An image in **analysis** mode (main image window)



An image in **preview** mode: no analysis possible (has to be activated first).



If you want to open several images in a sequence, they have to have similar file format (origin from similar source) and their size has to be same.

Image in preview mode

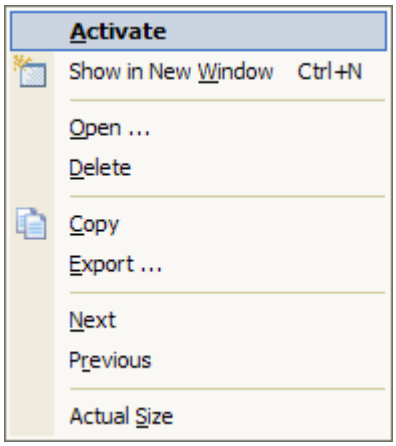


Image preview mode is designed to serve as a temporary place for images, which you want to analyze. You can activate the previewed image and it will replace the active image, keeping all the analysis objects unchanged.

To activate the image choose **Activate** from the context menu.

You can open several images in preview mode: choose **Open** in context menu.

To navigate through the opened images push corresponding buttons at the top of the image or choose **Next** or **Previous** in the context menu.

There are several restrictions when activating a previewed image: the previewed image must have same size and format as the currently active image; activation does not work when a *sequence file* is analyzed.

Image in analysis mode

All the analysis functionality of Thermography Suite is made with images opened in the analysis mode. Such an image, which is displayed in the main image window, called *active image*.

Diagrams and property windows display values, which they take from or calculate by the active image.

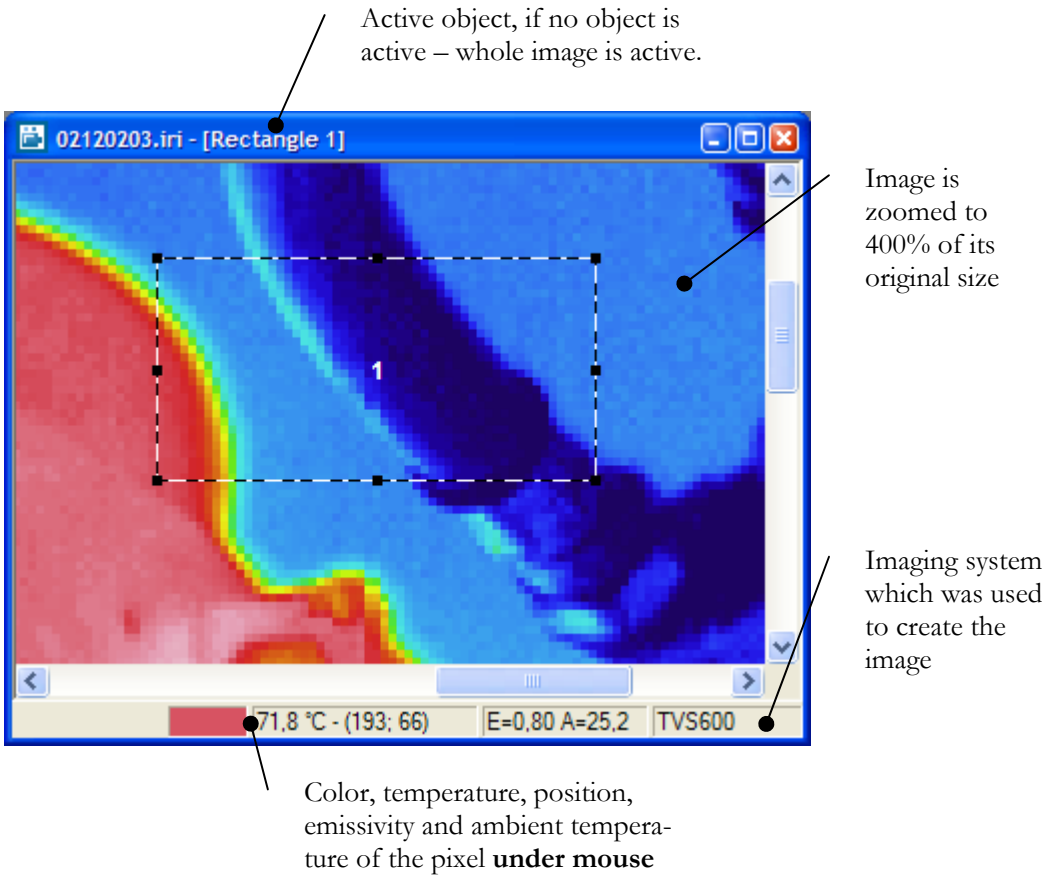
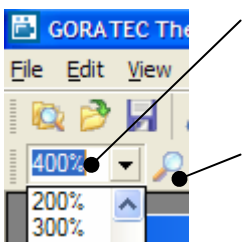


Image scaling and orientation

Thermography Suite has tools to scale an image and to change its orientation.

Scaling is important when you want to position some analysis object more accurate.

Changing orientation includes rotation and mirroring.



Quick reference

Zoom:
Menu: **View/Zoom In(Out)**
Keyboard: Plus, Minus

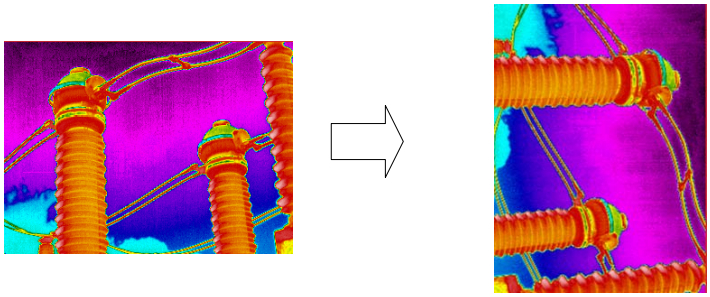
Rotate:
Menu: **View/Rotate 90° CW (90° CCW)**
Keyboard: Ctrl+Right, Ctrl+Left

Mirror:
Menu: **View/Flip Horizontal (Vertical)**

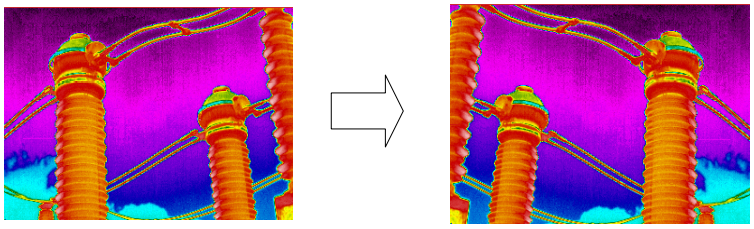
To return to the original, choose **View/Original Orientation**.

When an image is zoomed to such size that it does not fit to the window, additional **View Finder** window is displayed to help you to see where the zoomed part is located.

Rotation



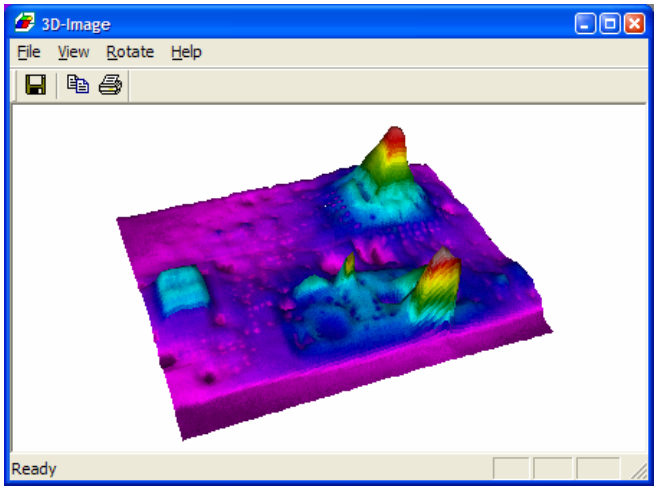
Mirroring



Changing image size and orientation does not change image pixels; only the way the image is displayed on the screen is affected. Because of this, even if you save the rotated image it will keep its original size and orientation.

3-dimensional view

Choose **View/3D View** to display active image in three dimensions.



Temperature to color correspondence

Color of every image pixel depends on its temperature. Thermography Suite has means to adjust this correspondence to make visual appearance of the image better and to intensify important details.

Temperature range

The temperature range defines visible temperatures of the image.

Pixels with temperatures below the lower range limit are shown with the **darkest** palette color; pixels with temperatures above the upper range limit are displayed with the **brightest** palette color; pixels with temperatures in between have corresponding intermediate palette color.

Quick reference

Menu: **Image/ Temperature Range**

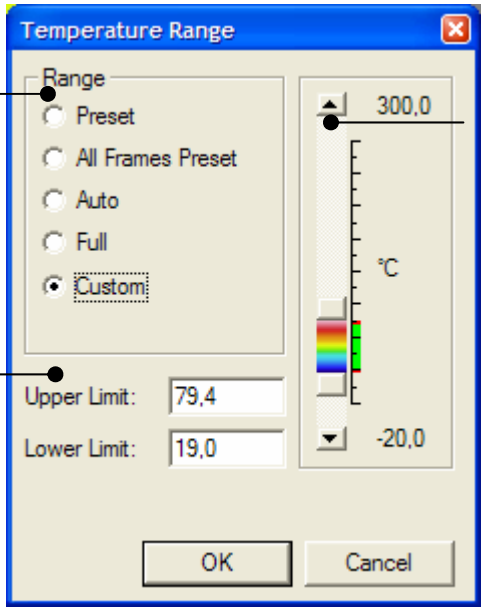
Keyboard: F4

Additional: using palette window - double click or select Range in the context menu.

In the displayed dialog, select one of the predefined ranges or adjust range manually with the scroll bar or the edit fields.

Predefined range selection

Custom range: available only when "Custom" is activated



Special scroll bar to adjust custom

Predefined ranges:

- *Preset*: thermal imager display range when the image was taken.
- *All Frames Preset*: generalization of *Preset* for several images: the minimum range that includes *Preset* ranges of all analyzed images.
- *Auto*: [minimum - maximum] of active image temperatures.
- *Full*: thermal imager working range (if this information is not stored with the image – *Preset* range is used).
- *Custom*: allows entering custom upper and lower limit values, the special scroll-bar can be used as well.

Color palette

Another possibility to enhance image coloring is to change and adjust palette.

Temperature Scale dialog displays current palette and temperature mapping. In this dialog you can select one of supplied color palettes and adjust its properties.

Palette is defined by its name, number of colors, high and low temperature limits (palette range). With palette range you can additionally shrink the temperature range.

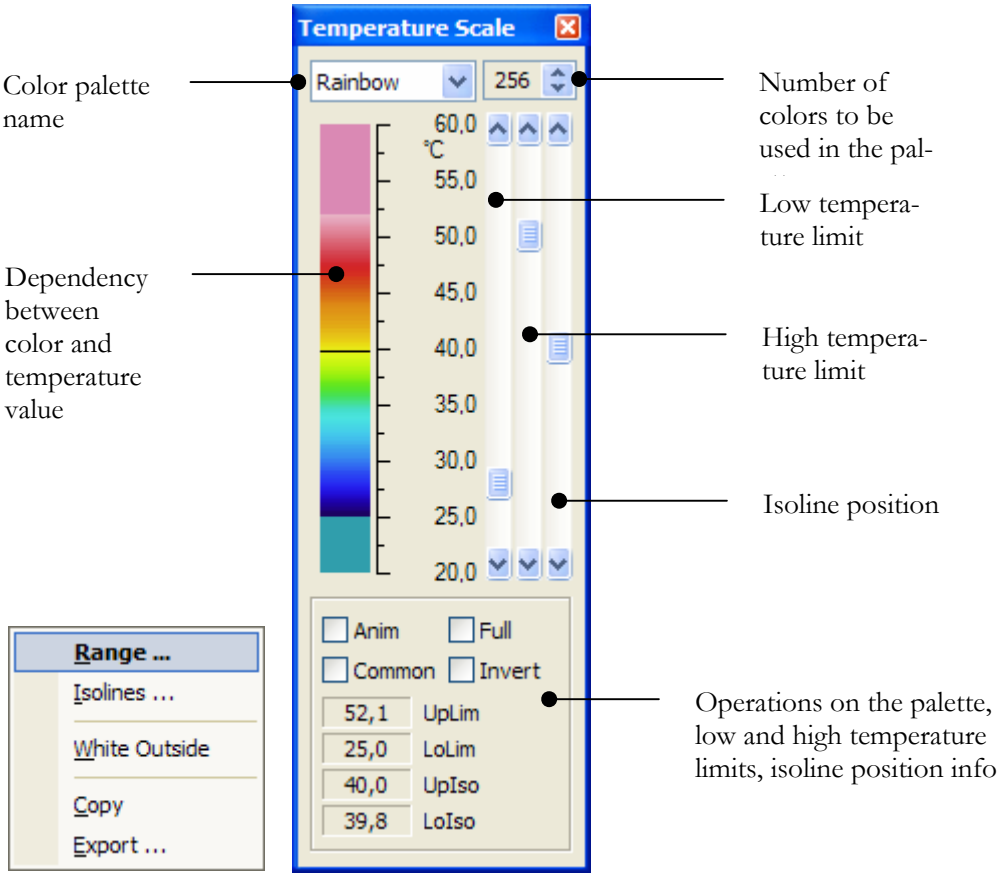
Quick reference

To hide or to show Temperature Scale dialog choose **View/ Temperature Scale**.

Toolbar: ,

Keyboard: Ctrl+G

Temperatures that fall outside palette range are displayed with special colors. It is possible to set these special colors to white by choosing **White Outside** in the context menu.



With the help of ***Anim (animation)*** check box the color palette can be shifted. ***Invert*** check box will turn palette upside down. These options might help to see hidden structures on the image.

Common Temperature Scale (Temperature Scale Lock)

Some images may store individual temperature scale settings. These images are the images from **Report folders** of the Image Database and also the images saved in GTSI Analyzed image format.

To make images with individual temperature scale settings use the same common temperature scale – mark ***Common*** check box.

To lock some particular temperature range values use the combination of Custom temperature range and marked ***Common*** check box.

Isolines

Quick reference

Choose **Image/Isolines** or choose **Isolines** in the context menu of color palette.

Select isoline mode, color, width and, in multi mode, distance.

Thermography Suite has a possibility to mark some temperature sub range with a color (black, white or red).

Isoline modes

You can choose from the following isoline modes:

- *Off:* not to display isolines.
- *Single:* one range isoline, width of the range is selectable.
- *Multi:* isolines for several ranges, you can set up the width of each range and the distance between ranges.

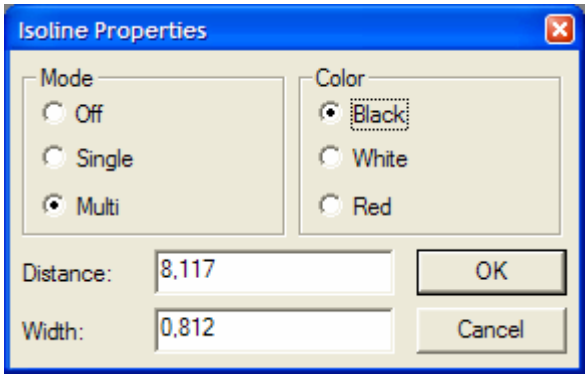


Image information

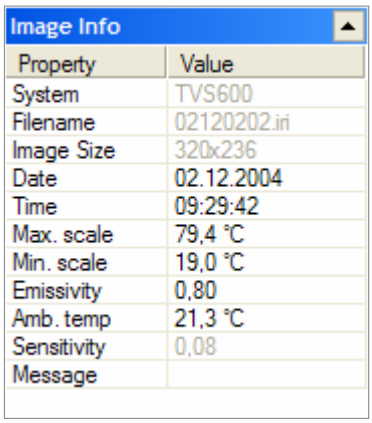
Quick reference

Menu: **Image/Image Info**

Keyboard: F3

Located in the *navigation panel*.

You can read and modify information tags stored by thermal imager with an image. These values and common image properties are displayed in the *Image Info* window, which is located in the *navigation panel*.



Items marked with gray are read only and cannot be modified.

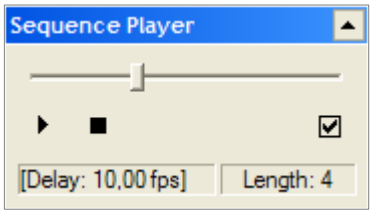
Length of *Message* field is limited by format specifications.

After changing some value, you can save your modifications. Choose **File/Save**.

Image sequences

Usually an image sequence contains some continuous process recorded by a thermal imager. But it is not necessarily the case; you can build up a sequence from any kind of images. Moreover, when you need to analyze images made during plant inspection, for example, it is convenient to open them in one sequence and, going through them, make the required analysis.

As was mentioned before, there are two ways of storing image sequences: all the images in one file and one file for every image. Thermography Suite handles both these ways. In File Open dialog select one sequence file (usually it is *.irs) or select several stand alone images.



When you open a sequence of images, automatically Sequence Player pops up in the navigation panel. Sequence Player allows to playback the sequence, with selectable speed and direction (forward or backward). Moving the slider, you can manually select any frame.

As you can see on the image, Sequence Player has three buttons: *play*, *stop* and *options*. *Options* button allows modifying the described properties of the player (speed and direction).

Sequence navigation is also accessible from the main menu and toolbar.

More flexibility in handling sequences is available in Sequence Editor.

Sequence Editor

In addition to sequence navigation and playback, Sequence Editor allows accomplishing basic editing functionality. You can **add** images to the sequence; **delete** images from the sequence; change sequence **order** and, finally, **save** the result in a new sequence.

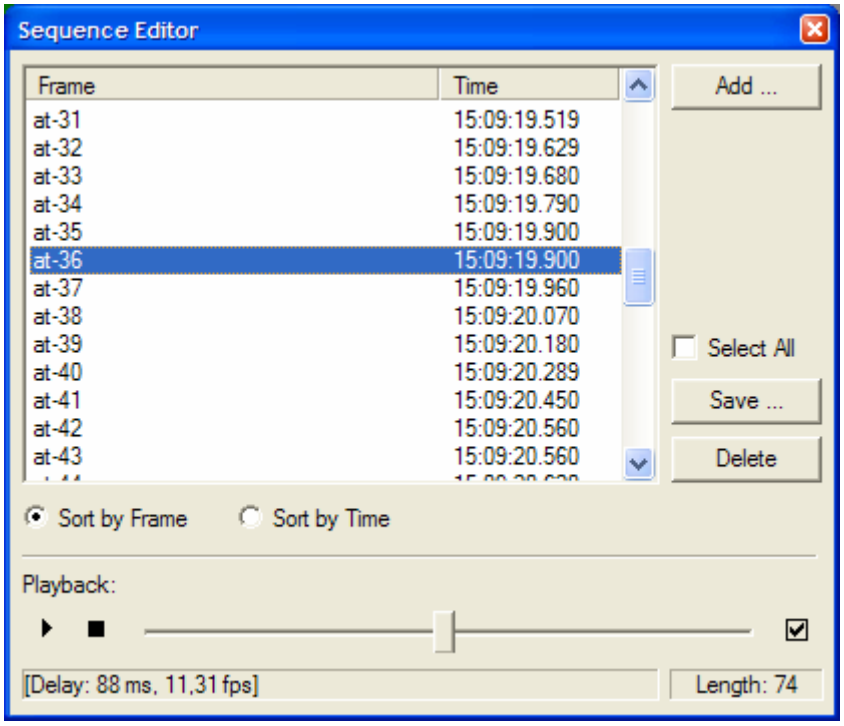
Sequence Editor can store images in one file in IRS format or separately in their native format. In that way, you can convert your separated images into one sequence file and vice versa.

Quick reference

Menu: **Sequence/Edit Sequence**

Toolbar:

Add, delete, sort and save the resulting sequence in one IRS file or each frame separately.



Playback part is same as in sequence player described above.

Sequence order

There are two ways to change order of the sequence: to sort images by *frame name* (**Sort by Frame** option) and to sort them by *time* when they were made (**Sort by Time** option). Sorting order is important for trend analysis.

Add frames to the sequence

To add frames to the sequence push **Add** button and select new sequence. This new sequence must contain images of the same size and format as the already opened ones.

New images will be inserted in accordance with the sorting order. This means you cannot insert the new sequence after a pre-selected frame, to do so you should consider special naming strategy.

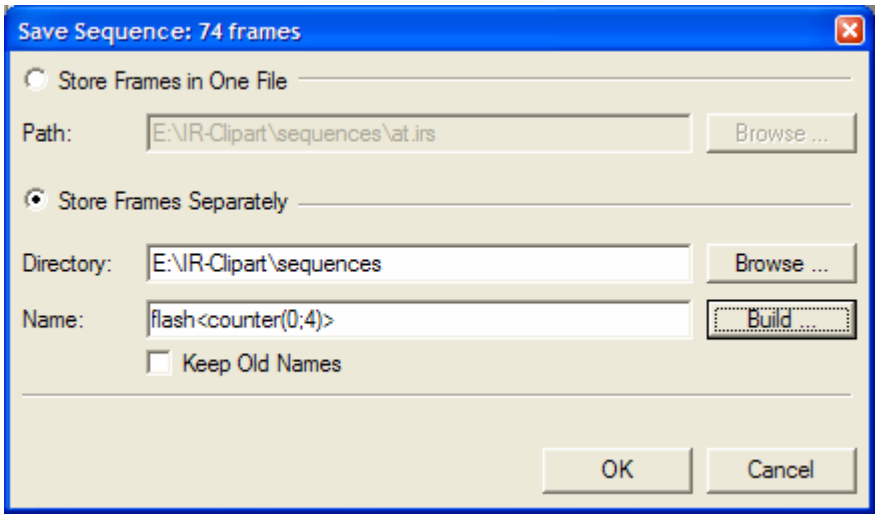
Delete frames from the sequence

Select one or more frames you want to delete and push **Delete** button. Selected frames will be removed from the computer memory, but not from the disk.

Save the resulting sequence or its part

Select frames you need to save in the list (or select "Select All" check box to save all frames) and push **Save** button. You will be asked where to save the sequence and how to give names.

If you want to save the sequence in one file, you simply have to specify a name for the file, but if you want to store every frame separately – you have to define a naming rule to give unique names to every frame in the sequence.



To **store frames in one file**:

- first select the correspondent option,
- then push **Browse** and specify a filename and a location,
- finally, push **OK** to store.

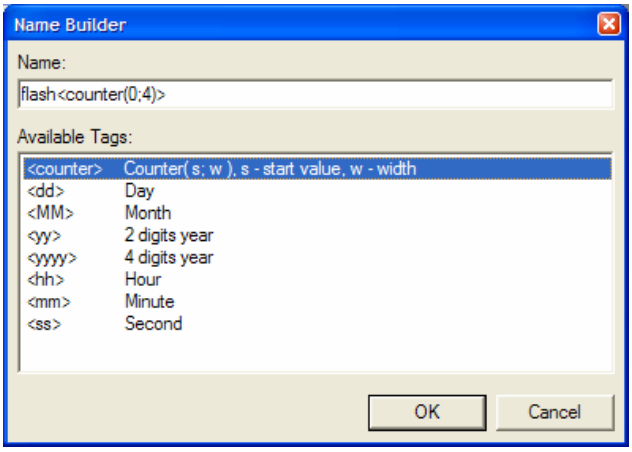
To **store frames separately**:

- select the correspondent option,
- then push **Browse** to specify a directory which is going to receive images,
- push **Build** to create *naming rule* for generating names for every saved frame or select **Keep Old Names** check box to keep the existing names.
- finally, push **OK** to store.

Name Builder dialog simplifies naming rule creation. Naming rule consists of usual name string; additionally it must contain special tags, which are replaced with some information taken from the frame being saved. This allows creating unique names for every frame automatically.

Available Tags list shows all the tags you can use in the naming rule. Double click on a tag and it will be inserted into the name field at the cursor position.

As you can see from the picture, a name may consist from some arbitrary text and a counter.



Naming rule "**flash<counter(0;4)>**" will create the following sequence of names: flash0000, flash0001, flash0002, … First digit means from which index to start – in the example from zero; second – how many digits to use – in the example four.

You can also use time and date in the name creation, but you have to be careful, because in contrast to counter tag, date-time tags do not guarantee name uniqueness.

Save your workspace

To save your current work Thermography Suite uses *collection* files.

Collections store the following information:

- image properties (zoom factor, emissivity, ambient temperature, applied correction filters)
- analysis objects and their properties (positions, emissivity values, filters and so on)
- temperature scale (palette, temperature range)
- windows and diagrams placement
- diagram cursors and their positions

This allows you to interrupt your work at any time and continue it afterwards from the very same point.

A **reference to a collection file** can be stored with an image and loaded whenever the image is opened.

If a collection is attached to the active image (to attach a collection you should load an existing collection or save your current workspace in a collection) Thermography Suite will asks a question about storing the reference when you close an image. Choose **Yes** do link collection to the image.

Quick reference

Menu: File/Collection/Open, Save, Close

Toolbar:

Saves and restores your analysis layout and windows placement

You can access recently used collections selecting them from the collection combo box in the toolbar. Using the same combo box you can disconnect a collection from the image selecting ".none.".

Choosing **File/Collection/Close** from the menu also removes link to the collection.

Sound message

This function is available if your computer has a sound card and a microphone.

Recorded sound file is saved under the image path in WAV format.

Quick reference

Menu: Tools/Play Sound, Record Sound

Toolbar:

Records and plays sound file attached to the image.

Chapter 3

Thermographic analysis

Thermography Suite uses so-called *analysis objects* to present thermal information contained by an image.

Objects belong to five groups:

- Points (spots)
- Lines
- Areas
- Measures
- Annotations

Each analysis object can have its own emissivity, ambient temperature, averaging factor, software filters and other parameters. You can create one or more diagrams and associate them with an object: for lines - profiles, for areas – histograms, area- and box-line trends, for points – points statistics window and point trends.

Objects

To create an object you should use corresponding object tools from the toolbar.

Tools in the order as on the picture:

- *Selection tool.* Select, move, resize and activate objects.
- *Connection tool.* Connect two or more objects to compare them.
- *Clip rectangle tool.* Mark some part of an image to copy it to the Clipboard.
- *Point tool.* Create point object.
- *Line tool.* Create line object.
- *Area tool.* Create area object.
- *Measure tool.* Create ruler, measure or angle object.
- *Drawing tool.* Create annotation object.

For line, area, measure and drawing tools, you should additionally select tool sub-type. For example, for lines there are vertical, horizontal, polygonal and crossing sub-tools.

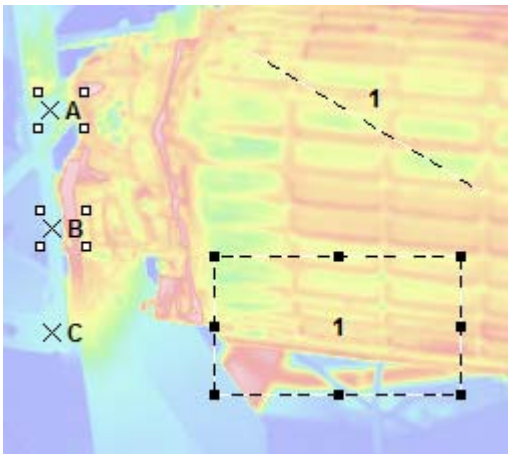
For complex objects, like polygonal lines, you should consequently click on the image to add segments. To close current object creation click on any tool in the toolbar.

Active and selected objects

Each object can be in one of the following states:

- active and selected (only one)
- selected (several is allowed)
- not selected

The picture beside shows objects in all three states: *Area 1* is active (black squares around), *Points A* and *B* is selected (white squares), *Line 1* and *Point C* is neither active nor selected.



As you already know, the selection tool makes selection. To select several objects hold **Shift** key and click on the objects you want to select. The active object is always the last clicked one.

Thus, we can say that selecting objects in Thermography Suite is similar for example to selecting icons on the desktop.

To switch quickly to the selection tool after an object is created, click with the right mouse button somewhere on the image.

The concept of **active object** is very important, because, when not additionally mentioned, operations are made taking exactly the active object. This is why the name of the active object is show in the caption of the image window. When there is no active object, whole image is active. To activate the image, click outside objects with the selection tool.

Several selected objects are needed when one object is not enough. For example, you can move the entire group of selected objects altogether, keeping relative positions unchanged.

To select all objects press Ctrl+A.

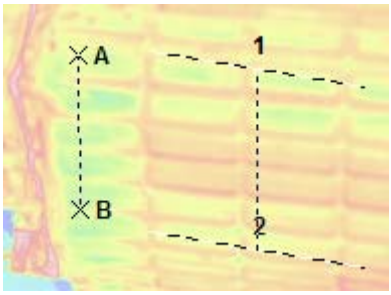
Object groups

You can group several objects together. Grouped objects are similar to selected objects with the difference that when you select one object, other objects in the group are selected automatically.

Grouping of two area objects does not union their areas. They are still two separate objects and can be displayed in a histogram separately.

To group several objects, select them, click with the right mouse button on one of them and choose **Group**. To ungroup objects do the same thing, but choose **Ungroup**.

Connected objects



To connect two objects, use the connection tool: click on one object with the left mouse button and, holding it, move mouse pointer to the second object, and then release the button. If you made it properly, you will see a dash line connecting the objects.

Only objects of same type connect to each other: points to points, lines to lines, areas to areas.

The effect of connecting two objects is, of course, depends on the objects type. If it was points you will see temperature difference if the statistics window for points. Emissivity difference and ambient temperature difference is calculated as well.

For lines and areas, beside difference calculation, you will see two and more profiles or histograms in one window.

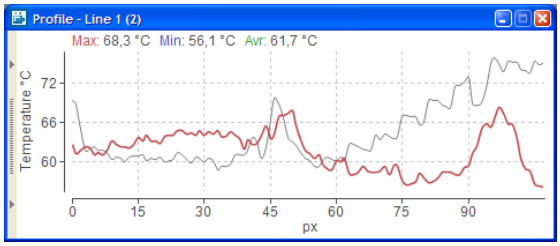
Very convenient way of creating connected objects is to use the selection tool. Using this tool and the **Control** key on the keyboard you can create exact copy of an object, which in addition will be connected to its twin. Choose the selection tool and, holding the Control key, move the desired object to another place.

Two connected points

Points | Lines | Areas

Point	T °C	Emis.	Ta °C
A	60,1	0,95	24,5
B	55,7	0,95	24,5
Δ A - B	4,4	0,00	0,0

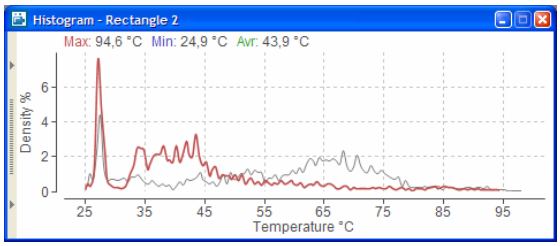
Two connected lines



Points | Lines | Areas

Line	Min °C	Max °C	Avr °C
1	56,1	68,3	61,7
2	58,8	75,8	64,7
Δ 2 - 1	2,7	7,5	3,0

Two connected areas



Points | Lines | Areas

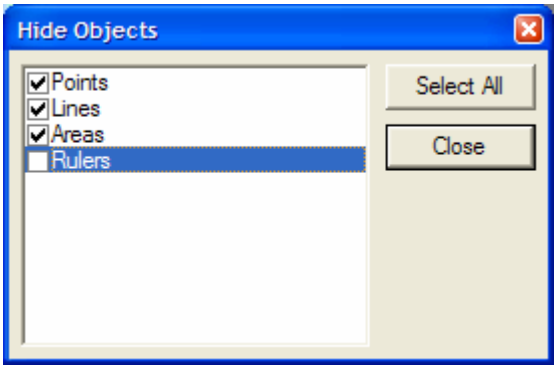
Area	Min °C	Max °C	Avr °C
1	25,3	98,1	56,7
2	24,9	94,6	43,9
Δ 1 - 2	0,4	3,5	12,8

Hidden objects

Sometimes you do not need to have all the objects visible at the same time. Especially this is actual for the ruler objects (described later).

To hide an object click on it with the right button and in the context menu choose **Hide**. The object will disappear, but you can be sure – it is not deleted.

To show an object back choose **View/Hide Objects** in the main menu or the same item in the context menu of the image. A dialog will appear, where you can select which type of object to make visible or invisible.



Temperature calculation

As you should now from infrared thermography, temperature can be calculated only when the right **emissivity** value is known. In most cases, an infrared imaged contains objects with different emissivity values. The **ambient** (background) temperature also affects scanned temperature value.

Thermography Suite allows adjusting both of these parameters for the entire images and for every individual analysis object. Therefore, you can analyze images containing objects from different materials.

Emissivity and ambient temperature

As was mentioned before, Thermography Suite can assign emissivity and ambient temperature values for image and for every object individually. One menu command is used to change both these parameters: **Temperature/ Emissivity** or same item in the context menu of an object or an image.

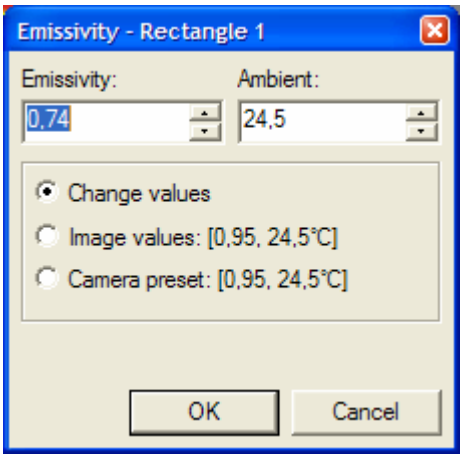
After an object is created, it inherits emissivity and ambient values from the image.

Quick reference

Menu: **Temperature/ Emissivity**

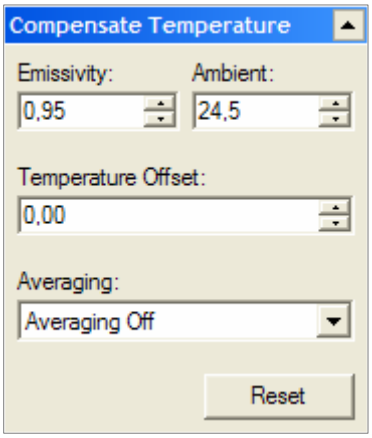
Keyboard: Ctrl+E

Double click on an object or image to change its Emissivity or ambient temperature.



In the emissivity dialog, you can change the values manually or select one of the suggested options (to make same as image values or to take original values recorder by the thermal imager).

Temperature offset



You can add or subtract some value from image or object temperatures. Click with the right mouse button on an object or image and select **Temperature Offset**. Then enter positive or negative value.

Averaging

Averaging is used when an image is too noisy and you want to get more reliable values, which do not affected by noise at individual pixels (especially this is true for points and profiles).

Averaging here is **spatial** averaging. This means, to calculate some pixel value, it takes values from its neighbors and take their average.

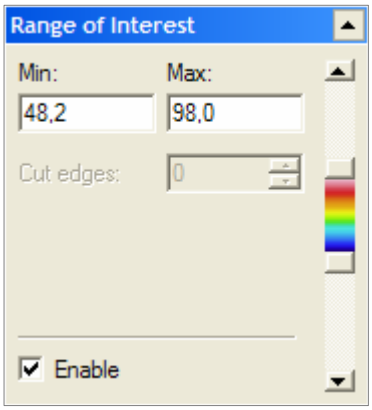
To change averaging of an object or image click on it with the right mouse button and choose **Averaging/3x3 or 5x5**. 3x3 or 5x5 is the size of the neighborhood which is used during averaging.

To remove averaging, choose **Averaging 1x1** from the context menu.

For the convenience, emissivity and ambient correction, temperature offset and averaging are summarized if the **Compensate Temperature** dialog (at the picture), which can be easily located in the *navigation panel*.

In addition, please take a look at Thermography Suite advanced features – software filters and emissivity/background compensation maps, which are described later in this manual.

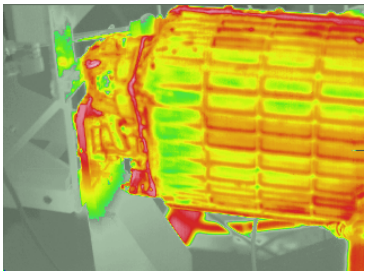
Range of interest



Range of Interest dialog is located in the navigation panel. Range of interest applies to an image or to an area object (if it is currently active) and its behavior depends on this.

Image Range of Interest

Range of interest when applied to an image changes its visual appearance: pixels outside the range lose their colors to black and white. This gives you additional option to emphasize visually some area on the image.



In addition, some of Thermography Suite features use image range of interest for their own needs (Hot/cold spot detection).

Range of interest for areas is described in the "Analysis Areas" section below.

Analysis points

Points are the most simple and, at the same time, time the most used analysis objects.

As for other analysis objects in Thermography Suite, you can assign individual emissivity and ambient temperature for a point.

Temperature values at points can be found in the statistics window at the bottom-left part of the application.

To make values more reliable, consider using *Averaging*, described above.

Quick reference

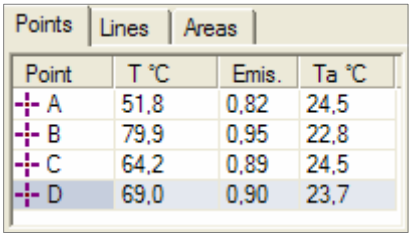
Menu: **Analysis/Point**

Toolbar:

Select the point tool from the toolbar and click on the spot of interest in the image. Information for the newly created point will be added to the statistics window.

Emissivity by temperature

Sometimes (for example, by using a thermocouple) you know the temperature value at a point, but not the emissivity. Thermography Suite gives you the possibility for the reverse calculation.



Click with the right mouse button on a point, choose **Temperature** in the context menu and, finally, enter the known temperature value. Emissivity of the point will be recalculated.

Hot/cold spot detection

Thermography Suite can automatically detect hottest and coldest spots on an image. A hot/cold spot is a local extremum or, in other words, pixel on the image having the highest or the lowest temperature value among all its neighbors (in some adjacent area).

You should first define *image range of interest* to narrow the area where Thermography Suite looks for hot/cold spots.

Second step will be the selection whether to find only hot, only cold or both types of spots. After that, you should define the maximum number of spots to find (*Spots number*) and minimum allowed distance between found spots (*Minimum distance*).

Spots number – how many spots of each type is allowed to find.

Minimum distance defines the check area around every pixel. Pixel is an extremum if it has the highest (lowest) value in the neighborhood. This rule automatically leads to the situation,

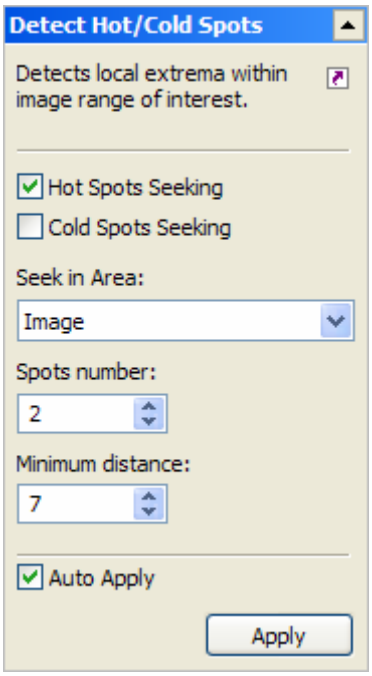
Quick reference

Menu: **Analysis/Detect Hot/Cold Spots**

The dialog is located in the navigation panel.

If needed, define image range of interest, then select whether to find hot, cold of both types of spots, enter how many spots is allowed to find (Spots number) and the Minimum distance, finally, push **Apply** to begin the search.

when, if two hot spots are located closer than the Minimum distance, only one is detected (with the highest value).



To detect hot spots push **Apply** button.

A hot/cold spot object is an object similar to a point object. This difference is that its caption is a small letter and Thermography Suite does not allow moving it.

There are not that many things you can do with a hot/cold spot object - for example, you cannot use it in a point trend. To be able to do more, convert the hot/cold spots into normal points: choose **Convert to Points** from the context menu of a hot/cold spot object.

To mark the hottest and the coldest spots on an image set Spots number to one.

Analysis lines and profiles

Line objects in Thermography Suite include segments (arbitrary, horizontal, vertical), polygonal lines and crossing lines.

As for the points and other analysis objects, you can assign individual emissivity and ambient temperature for every line. The averaging is also a helpful option.

Line profile visualizes primary analysis information about a line. A profile is a curve showing temperatures of every line point.

Quick reference

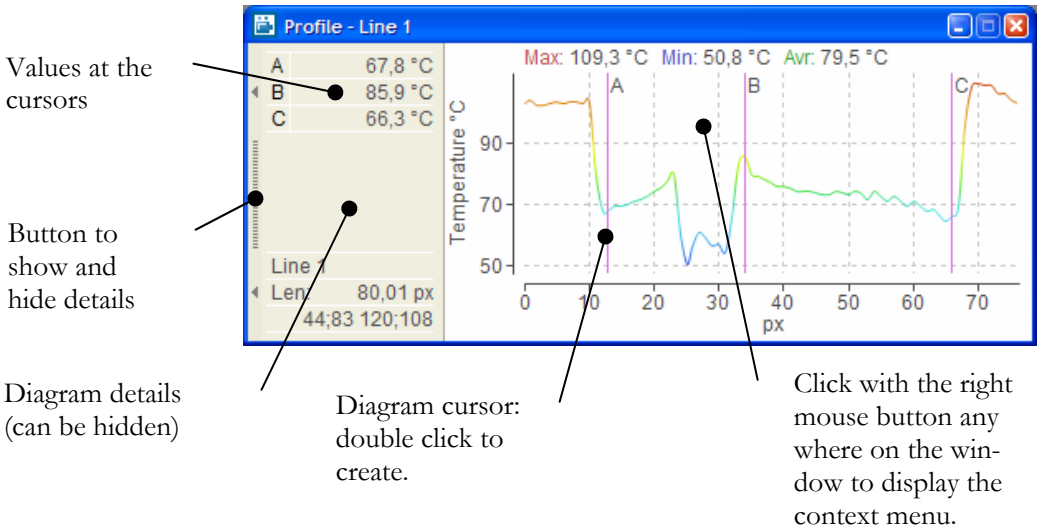
Menu: **Analysis/Profile**

Toolbar:

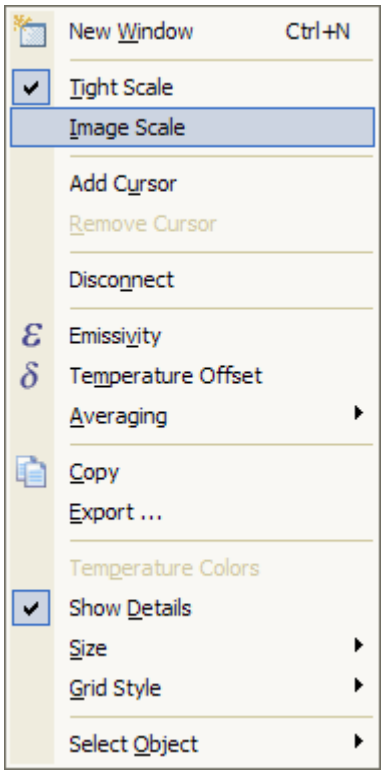
Select the profile tool from the toolbar and draw a line on the image. A corresponding profile diagram will be created automatically and displayed in a separate window.

The profile curve is displayed on a standard Thermography Suite diagram window, which now will be examined more detailed.

As you can see from the picture, a diagram window consists of the diagram itself



and its details that can be hidden. Details part usually shows values at the diagram cursors and additional information about the object. To change diagram appearance use its context menu (click with the right mouse button).



Let us go through the menu items:

- **New Window**: Opens additional diagram window of the same type (in our case additional profile diagram). If you have two lines, this new window will show profile for the second line.
- **Tight Scale/Image Scale**: All diagrams display values, which they take from an infrared image. Therefore, they have a temperature axis. Start and end value for the axis is selected automatically. In the tight scale case, it is the minimum and the maximum value at the diagram; in the image scale case, it is the limits taken from the temperature scale dialog.
- **Add Cursor/Remove Cursor**: Adds a new cursor to the diagram or removes the cursor you have clicked on.
- **Disconnect to Averaging**: These items are taken from the context menu of the object and applied to the object properties.
- **Copy**: Copies the diagram into the clipboard.
- **Export**: Exports the diagram data.
- **Temperature Colors:** When selected, diagram uses "temperature colors" to draw the curve. This means, color of every pixel depends on its value and taken from the active palette. When not selected, all pixels have same color.
- **Show Details:** Shows and hides the details part of the window.
- **Size:** Here you have a selection of three sizes – small, normal and large. Choose one which better fits to you screen resolution and preferences.
- **Grid Style:** On window background, diagram draws lines from axes ticks, which create grid. In this menu, you can delete these lines or choose their style.
- **Select Object:** Allows you to change the object by which the diagram is calculated.

When you delete an object, all diagrams taking values from this object are closed automatically. Reverse is not true: when you close a diagram, the object is not destroyed. To show the diagram for the object again, click corresponding tool in the menu or, if you already have a diagram window, choose **Select Object** from its context menu.

Analysis areas and histograms

There are four types of areas in Thermography Suite: rectangle, ellipse, circle and polygon.

Again, you can apply individual emissivity and ambient temperature for every area object.

Thermography Suite calculates minimum, maximum, average, area size and radiation power values for all area object. The statistics window displays all these values.

Quick reference

Menu: **Analysis/Histogram**

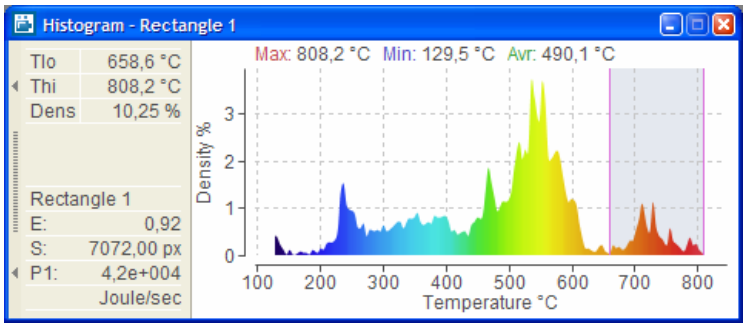
Toolbar:

Select the histogram tool from the toolbar and create an area on the image. A corresponding histogram diagram will be created automatically and displayed in a separate window.

Histograms

Area histogram presents more thermal information about an area. Histogram is a diagram showing temperature distribution in an area. In other words, for every temperature range you can see percentage of pixels falling into this range.

When you create an area object, Thermography Suite automatically creates a histogram and shows it in an available diagram window.



As you can see on the picture, histogram window looks similar to the profile window and for sure, you can expect similar behavior. Same as for profile, you can hide and show the details part, resize the window, select the grid style, copy and export diagram data, change axes scale and select which object to use.

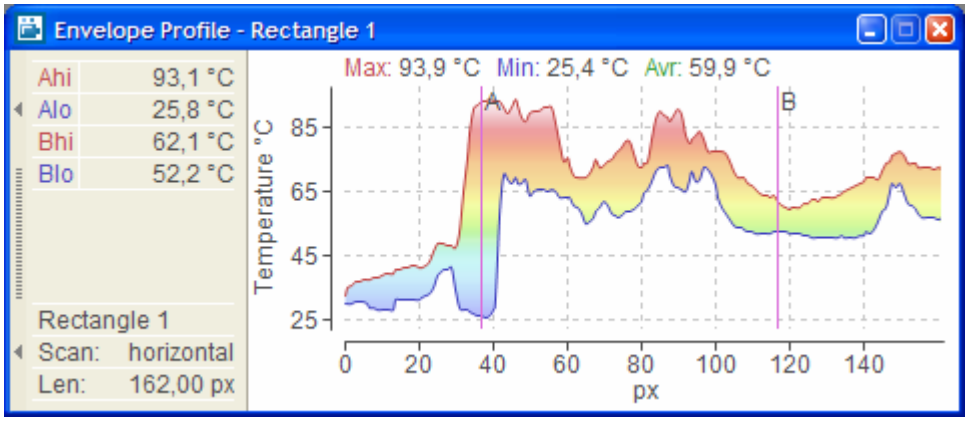
The histogram cursor differs from profile cursors. It defines a temperature range with parameters shown in the details part. There is only one cursor allowed for a histogram.

The details part shows the following information:

- **Tlo** – cursor defined lower limit.
- **Thi** – cursor defined upper limit.
- **Dens** (density) – percentage of pixels falling into the cursor range.
- **E** – emissivity of the object.
- **S** – area of the object.
- **P1** (<P1>) – radiation power.

Box envelope profiles

Envelope profile is a diagram created by a rectangular area. Envelope profile consists of two curves: first shows the minimum value for every vertical (horizontal) line of a rectangle, second shows the maximum.



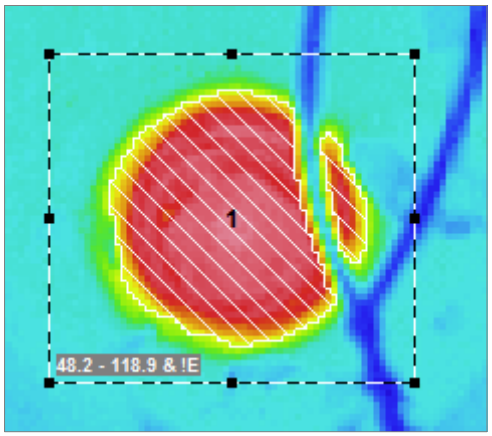
This diagram is very similar to usual profile. You can add several cursors to it and their values will be shown in the details part.

By default, the rectangle is scanned from left to right (horizontal scan). You can change this to the vertical scan and it will be scanned from top to bottom. To do so, choose **Vertical Scan** from the context menu.

Range of Interest for areas

Range of interest, if set for an area, defines pixels which belong to that area. For example, you have created a rectangle. If you assign some temperature range to it, Thermography Suite will take into account only those pixels of the rectangle that fall into the defined range – the rest does not belong to the object.

Only the crosshatched pixels at the picture belong to the area and only they are taken when the histogram or object area is calculated. It is also true for other operations with areas – min, max, average calculation, trend analysis, region where the filters are applied and so on.



Range of interest is defined in the image temperatures, which are different to the object temperatures because, as you know, it is possible to assign object's own emissivity value. This is done in order to prevent object shape changing when you change its emissivity.

The "Range of Interest" dialog has **Cut Edges** parameter. This parameter is only active when range of interest is applied to an area. As you can see from the name, it finds edges inside the area and removes them from the resulting region. The bigger this parameter is the bigger tolerance for the edge detection algorithm (more edges detected). Usually edges (because of spatial resolution of camera detector) do not show real temperature values, so they can be removed.

Radiation power

Quick reference

Menu: **Image/Radiation Units**

The dialog allows changing the formula and units for radiation power calculation.

Thermography Suite calculates the radiation power value for every area object. It can be seen in the details part of the histogram window and in the statistics window.

$$P1 = \frac{\sigma \varepsilon T^4}{S}$$

$$P2 = \frac{\sigma \varepsilon (T^4 - T_0^4)}{S}$$

$$P3 = \frac{\sigma \varepsilon (T^4 - T_0^4) + hm(T - T_0)^{\frac{4}{3}}}{S}$$

$P1$ — absolute radiation power.

$P2$ — radiation energy.

$P3$ — radiation energy plus energy loss by convection energy.

$< P1 >= S \cdot P1,\ < P2 >= S \cdot P2,\ < P3 >= S \cdot P3$

T_0 — ambient temperature.

ε — emissivity.

σ — Stephan-Bolztmann constant.

hm — heat transfer coefficient. By default $hm = 1.73 \frac{Kcal}{m^2 hK}$

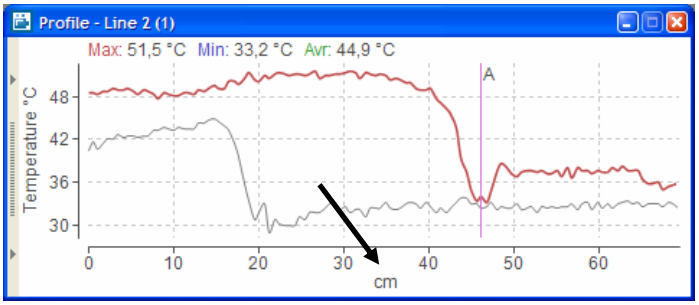
It is possible to select units to display above values: $\frac{Joule}{ms^2}$ or $\frac{cal}{ms^2}$

Values of <P> can be calculated only when the coordinate system is defined for the image (by optics or by ruler objects).

Real image size

The real size of objects displayed on infrared images depends on many parameters: optics configuration of the imager, distance from the objective to the objects, tilt angle and others. If you know optics on your camera and distance to the object, you can use the "Optics" dialog; if you do not know the optics, but know the size of some object on the image – use the ruler object to define coordinate system for the image.

When you have defined the coordinate system for the image in real units, Thermography Suite can show more comprehensive values at diagrams, which, at the end, might help to locate problem zone.



Optics, lens calculator

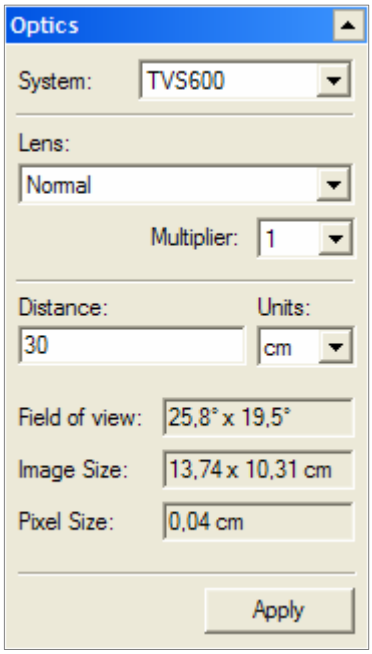
In addition to setting up the coordinate system for an image, you can use optics dialog as lens calculator.

Quick reference

Menu: **Image/Camera Optics**

Location: navigation panel

Select optics from the list, specify distance to the object and push **Apply** to setup the coordinate system for the image.



From **System** combo box select the system you are interested in and specify its optics configuration: dialog will display the corresponding field of view.

If you additionally specify distance to the object, you can estimate what resolution you can achieve with different lenses.

Rulers and measures

Second chance to set up coordinate system for an image is to use rulers.

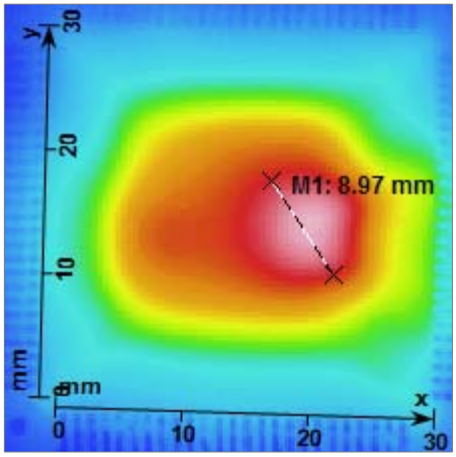
If you define length in real units for a segment, Thermography Suite, assuming that the object on the image is flat and the camera was looking on it at an angle of 90°, can recalculate sizes of other image parts.

Quick reference

Menu: **Analysis/Measure**

Toolbar:

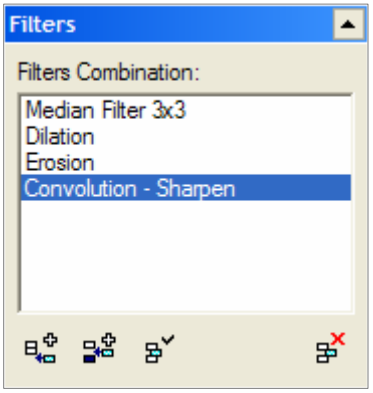
Select measures tool and a subtool from the toolbar. Draw one or two rulers on the image, **double click** on each ruler and specify their length in real units.



Thermography Suite also supports the case of not right angle, but here you have to define real length of **two segments**. However, it is still assumed that the camera is looking at a plane.

After the coordinate system is defined, you can use distance and angle objects.

Software filters



Besides averaging, an image and objects can have more sophisticated filters. Thermography Suite gives you wide choice of different software filters.

Activate an object or image (filters can be added only to points, lines and areas, not to rulers and annotations) and change the filter list using "Filters" dialog:

Adds a filter to the list end.

Inserts a filter before the selected one.

Changes parameters of the selected filter.

Deletes the selected filter.

Filters apply to the object or image one after another, in the order they are listed. Averaging and temperature offset added through the menu or "Compensate Temperature" dialog apply before.

Mathematical morphology filters (erosion and dilation)

Fundamental definitions

The fundamental operations associated with an object are the standard set operations *union*, *intersection*, and *complement* {$\cup$, $\cap$, ^{c}} plus *translation*:

Definition

Given a vector **x** and a set ***A***, the *translation*, ***A*** + **x**, is defined as:

$$A + x = \{\alpha + x | \alpha \in A\}$$

Note that, since we are dealing with a digital image composed of pixels at integer coordinate positions (Z^2), this implies restrictions on the allowable translation vectors **x**.

Now we can define the basic *Minkowski set operations* - addition and subtraction. First we note that the individual elements that comprise ***B*** are not only pixels but also *vectors* as they have a clear coordinate position with respect to [0, 0]. Given two sets ***A*** and ***B***:

Minkowski addition $$A \oplus B = \bigcup_{\beta \in B} (A + \beta)$$

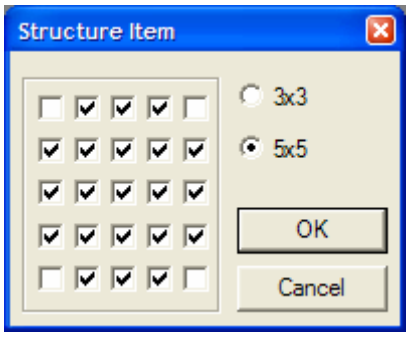
Minkowski subtraction $$A \ominus B = \bigcap_{\beta \in B} (A + \beta)$$

Dilation and Erosion

From these two Minkowski operations, we define the fundamental mathematical morphology operations *dilation* and *erosion*:

Dilation $D(A,B) = A \oplus B = \bigcup_{\beta \in B} (A + \beta)$

Erosion $E(A,B) = A \ominus (-B) = \bigcap_{\beta \in B} (A - \beta)$ where $-B = \{-\beta | \beta \in B\}$.



Implementation in Thermography Suite:

Set **A** is the whole image or some area of an image. Set **B** has center in [0, 0] and defined by the "Structure Item" dialog.

Median filter

Here we set the pixel level to be the *median* of the pixel values in the neighborhood of that pixel.

Definition

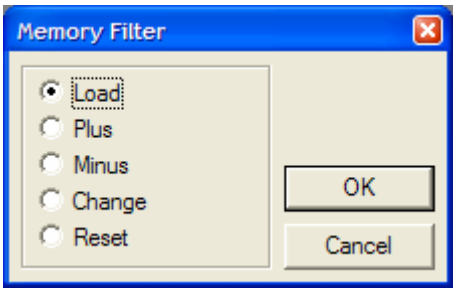
The *median m* of a set of values is such that half the values in the set are less than m and half are greater.

For example, suppose the pixel values in a neighborhood are (10, 20, 20, 15, 20, 20, 20, 25, and 100). If we sort the values we get (10, 15, 20, 20, |20|, 20, 20, 25, 100) and the median here is 20.

The outcome of median filtering is that pixels with outlying values are forced to become more like their neighbors, but at the same time, edges are preserved.

Implementation in Thermography Suite: the neighborhood is always square and its size is selectable 3x3, 5x5 or 7x7.

Memory



This is not a real filter. It behaves like the memory function of a usual calculator.

Load: puts the area into the memory in its current state.

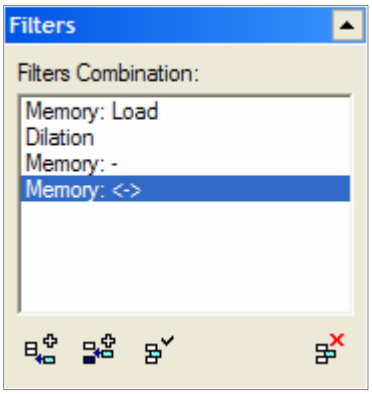
Plus: adds the current area to the area already in the memory.

Minus: subtracts the current area from the area already in the memory.

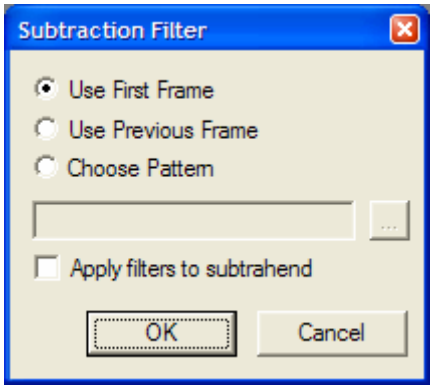
Change: swaps the current area and the memory area.

Reset: resets the memory area to zeros.

The filter combination at the right outlines edges.



Subtraction



This filter can be applied only to the image, not to objects.

As follows from the name, it subtracts some image from the image it is applied to. This is convenient to use with sequences when you want to see the difference to the start conditions. Such option sometimes is called "Subtraction mode".

To define which image to use as a subtrahend, Subtraction filter uses the following options:

- Use First Frame. The filter takes the first frame of the loaded sequence.
- Use Previous Frame. The filter takes the previous frame in the sequence and subtracts it from the active image.
- Choose Patter. You can specify any image, which of course has to have same format and size.

Apply filters to subtrahend check box, when selected, applies averaging to the subtrahend image before using it in the subtraction.

You should consider using this filter with trend analysis, as it allows you to create the difference trends.

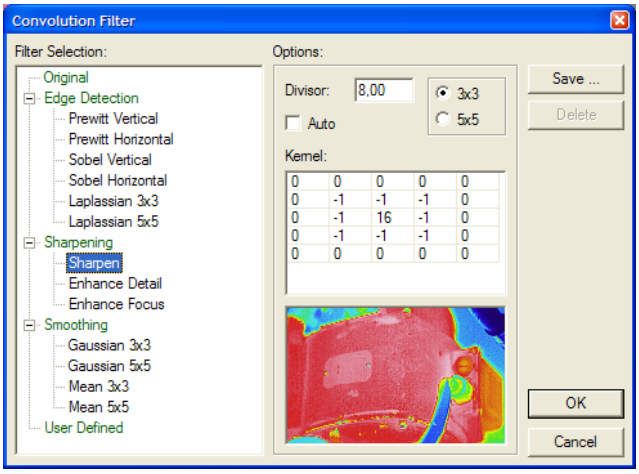
Convolution

The 2D convolution is a versatile image processing primitive which can be used in a variety of image processing operations; for example, edge detection, blurring, noise removal, and feature detection. It is also known as mask convolution or spatial convolution.

For 2D convolution, a rectangular kernel is used. The kernel is a matrix of signed integers. The kernel could be a single row (a row filter) or a single column (a column filter) or composed of several rows and columns. There is a cell in the kernel called the "anchor," which is the geometric center of the kernel. For each input pixel, the kernel is placed on the image such that the anchor coincides with the input pixel. The output pixel value is computed as

$$y_{m,n} = \sum_i \sum_k h_{i,k} x_{m-i,n-k}$$

where $x_{m,n}$ is the input pixel value and $h_{i,k}$ denotes the kernel. Optionally, the output pixel value may be scaled (by the divisor).



Thermography Suite provides a set of predefined kernels, namely: Prewitt (vertical and horizontal), Sobel (vertical and horizontal), Laplas-

sian, Gaussian, Mean, Sharpen kernel and kernels to enhance focus and details. These kernels organized in groups by their effect on image pixels.

In addition, you can specify your own kernel using the table at the left part of the "Convolution Filter" dialog. Your custom kernels can be remembered for future use.

Emissivity and background maps

With this function, you can try to eliminate the effects of different emissivity and ambient temperature values at different points on an object so that real temperatures can be calculated from an infrared image.

For example, this method may be applied to the thermal analysis of circuit boards, which consist of parts with different emissivity values.

Thermography Suite gives you the option to calculate the emissivity and ambient temperatures across the image area, and then apply these measurements to other images to calculate their true temperatures. The resulting corrected image can be instantly used for detailed analysis using the wide range of other tools provided by Thermography Suite.

A bit of theory

The intensity of infrared radiation coming from a point on an object is the sum of the radiation emitted by the object itself and the ambient radiation reflected by the object:

$$I = \varepsilon I_{object} + (1-\varepsilon) I_{ambient}$$

Where,

I_{object} is the intensity of radiation coming from the object.

$I_{ambient}$ is the intensity of radiation coming from the object's environment.

ε is the emissivity of the surface of the object.

I is the intensity of detected radiation.

Note: The emissivity is in general a function of both the object temperature and the frequency of the radiation, but in practice, it is regarded, to a good approximation, as independent of these factors for the materials and temperatures that are likely to be encountered. We also assume that the contributions from atmospheric absorption and emission are insignificant.

Equation above shows that in order to calculate the true temperature of a point on the object from the detected intensity, you have to know the values of emissivity and ambient temperature at that point.

If you know the value of the intensity of radiation coming from each point for two different uniform temperatures T_1 and T_2, you can calculate the values of emissivity and ambient temperature at each point on the surface of the object. If to assume that the effect of the environment is uniform across the surface of the object, a single image at a single uniform temperature (but different from the ambient temperature) is sufficient to calculate the emissivity at each point on the surface of the object.

Thus, to create an emissivity/background map for an object you can:

- Take two infrared images of the object at two different uniform temperatures, to calculate both the emissivity and background maps.
- Assuming a uniform environment, take a single infrared image at a uniform temperature (different from the ambient).

How to choose the object temperatures

Before creating an emissivity/background map for an object, you need to decide what temperature to use for the uniform temperature images. This temperature must be known and uniform.

One-image method

If you are using the one-image method for creating an emissivity map, the emitted radiation should be large compared with the reflected ambient radiation.

You should use a temperature higher than ambient.

Two-image method

If you are using the two-image method for creating an emissivity map, the calculations involve taking the difference between the two intensities to cancel out the effect of the ambient temperature. This means that the two temperatures should be distanced to make the intensity difference large enough.

One of the images should be at as high a temperature as possible and the other at as low a temperature as possible.

At the same time, the chosen temperatures should be not too far away from the ambient temperature (this concerns both methods).

Implementation in Thermography Suite

Thermography Suite has a possibility to create and apply emissivity/background maps not only to the whole image, but to some area as well. This area has to be marked with an area object.

How to create emissivity map

In order to create an emissivity / background map, select an area or an image that has a known uniform temperature. Click on it with the right mouse button and choose **Save Emissivity Map**.

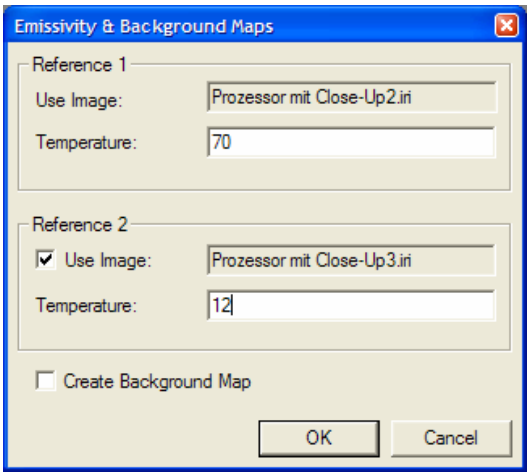
Quick reference

Menu: **Temperature /Save (Load) Emissivity Map**

Save: to create an emissivity / background map, open one or two images, specify the uniform temperature(s), select whether to create the background map.

Load: open an image to apply emissivity / background map to. The map will be loaded and applied.

As you already know, the emissivity calculations will be more accurate if to use the two-image method, the background map can be created only in this case. To use this method you should open a sequence consisting of two images beforehand.



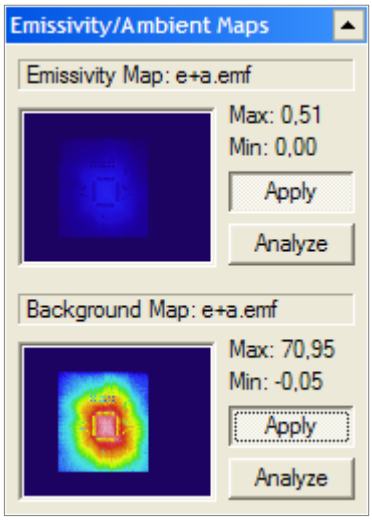
Enter the uniform temperature values for the first reference image and if needed – for the second. Select the "Create Background Map" check box if you want to create the background map.

Thermography Suite will make calculations, and if it is not possible to measure emissivity for some pixels, will show you how many such pixels present on the image in percentage terms.

After the emissivity map (background map) is created and saved, it will be loaded automatically for you to check the accuracy of calculations.

How to apply an emissivity map

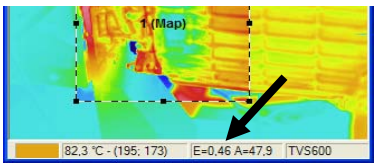
In order to load a previously saved emissivity/background map, choose **Temperature/Load Emissivity Map**. After the loading emissivity/background map will be applied to the active image. If it is a map of some region, corresponding area object will be created.



Image(s) of the emissivity/background map will be displayed in the navigation panel in the "Emissivity/Ambient Maps" dialog.

To learn the values for emissivity and ambient temperature at any pixel of the image, simply move the mouse cursor to that pixel. The values will be displayed in the status bar at the image bottom.

In addition, you can create a point object; it will take values from the emissivity/background map.



How to analyze an emissivity map

Emissivity and background maps can be regarded as images and Thermography Suite can open them in this nature. Use the usual **File/Open** or push **Analyze** button on the "Emissivity/Ambient Maps" dialog.

On an emissivity/background map image, you can do the very same operations as on infrared images. In particular, you can apply analysis objects and create diagrams.

Adaptive Emissivity

As known from the theory of infrared thermography, emissivity of an object may depend on object's temperature. In general, emissivity is a function of temperature: $\varepsilon = f(T)$.

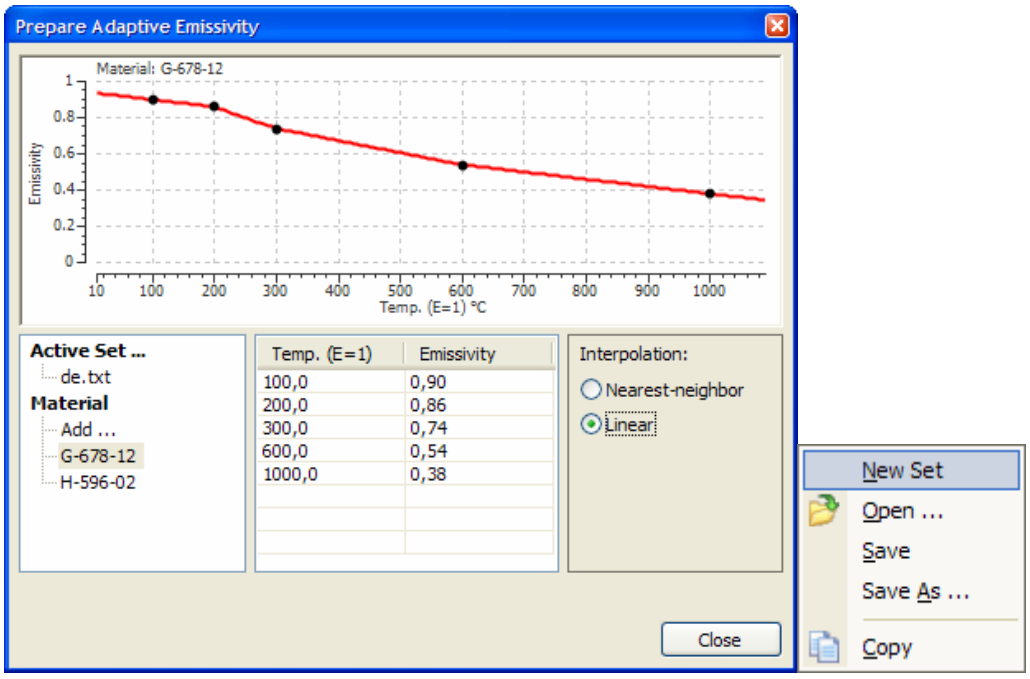
You can try to eliminate the effect of dependent emissivity by using Adaptive Emissivity function of Thermography Suite.

First, you should prepare a look-up table to describe the dependency function. For this, for several object's temperatures you need to know (or measure) object's real emissivity value and temperature measured by your infrared camera with emissivity set to 1.0. (To measure object's real emissivity value, use Emissivity by Temperature at a point function of Thermography Suite).

When you have the emissivity look-up table, you can apply it to some infrared image or image part. Thermography Suite will recalculate and assign personal emissivity values to every pixel of the selected object and will use these values to calculate object's temperatures.

Prepare Adaptive Emissivity

To show the dialog where you can enter the emissivity by temperature look-up table, click **Temperature/Prepare Adaptive Emissivity** item in the main menu.



You can create several sets of adaptive emissivity tables, each set can contain several materials, and for every material, you can define the emissivity by temperature dependency function. Every set is stored in a different file.

To **create a new set** of adaptive emissivity tables, right click on the dialog (in the graph part) and select **New Set** in the context menu.

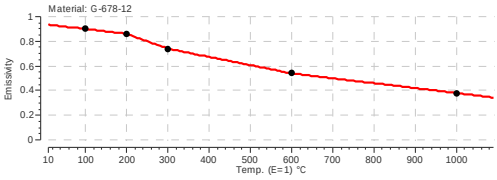
To **save a set** of adaptive emissivity tables to disk, right click on the dialog (in the graph part) and select **Save or Save As** in the context menu.

To **open an already saved set** of adaptive emissivity tables from disk, right click on the dialog (in the graph part) and select **Open** in the context menu.

To **add a new material**, click **Add** in the list of materials (under caption "Material"). To enter the look-up table – simply edit the table in the middle: in the first column enter object's temperature measured by the infrared camera with emissivity set to 1.0, in the second column enter the emissivity value that corresponds to this temperature. The order in which you enter values is not important.

Interpolation

To calculate emissivity values for temperatures which are not in the look-up table, Thermography Suite uses interpolation. There are two interpolation modes available: linear and nearest neighbor.



Apply Adaptive Emissivity

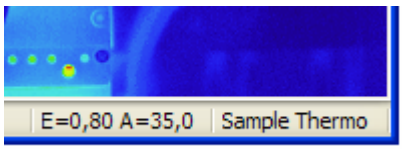
Adaptive emissivity can be applied to any analysis object: to whole image, to an area, to a line or to a spot.

Create an analysis object and make sure that it is active. Select **Temperature/Apply Adaptive Emissivity** in the main menu to display the Adaptive Emissivity dialog.

In the dialog, load or create new adaptive emissivity set and select the material that corresponds to the object on the infrared image. Press OK.

Thermography Suite recalculates and assigns personal emissivity values to every pixel of the selected object and from now on uses these values to calculate object's temperatures.

To see which emissivity value was applied to a pixel, point to this pixel with the mouse pointer: emissivity value will be shown in the status bar of the image.



Annotations

Quick reference

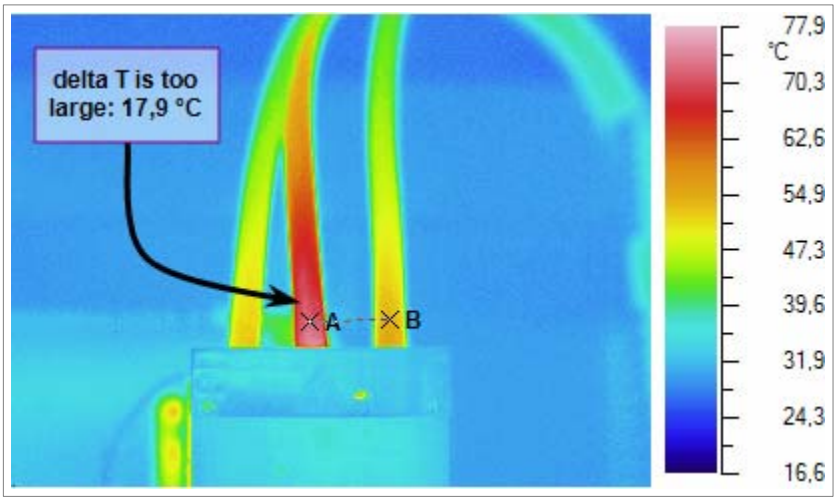
Menu: **Analysis/Drawing**

Toolbar:

Create the object and double-click on it, change the properties.

In order to draw attention or to put an emphasis on some region of an image you can use the drawing objects of Thermography Suite. They include the arrow object, rectangle and ellipse objects and annotation object, by which you can create text notices directly on the image.

In order to change the properties of drawing object, double click on it or choose **Properties** in its context menu. You can select such parameters as object color, frame color, background colors, transparency and, for the annotation object, text.



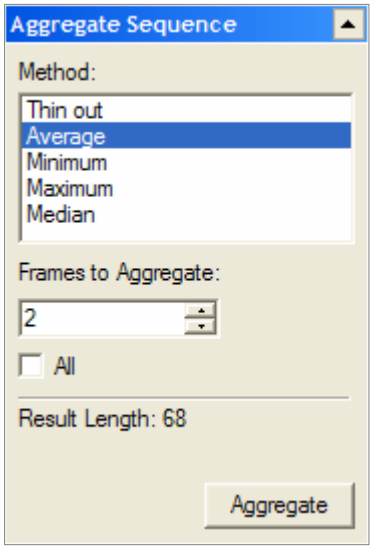
Chapter 4

Trend analysis

The functions, described in chapter 3, were applied to the single image. Possibilities and fields of thermal analysis application widen a lot if to examine sequences of infrared images. Thermography Suite has a number of features for acquisition and preconditioning, as well as for the analysis. The main instrument of sequence analysis is the building of diagrams that show the change of some parameters over the time.

Sequence aggregation

It is not always possible to record a sequence in the necessary quality and frame rate. For instance, quite often cameras allow to record images only at the maximum rate, at the same time, for the specific application, there is no need for that. In order to change the frame rate of an already recorded sequence, as well as for enhancement of imager sensitivity and other reasons, you can use "Aggregate Sequence" feature of Thermography Suite.



This function has several methods to compress the sequence. Each method takes specified number of frames (a block of frames) and, with the help of some algorithm, makes the single frame. Let us assume that the "Frames to Aggregate" parameter is equal to N.

- Thin out – throws away N-1 frame, leaving only the first one in every block.
- Average – each pixel of the resulting image is the average of corresponding pixels of all images in the block. This method allows enhancing the sensitivity of the imager in $\sqrt{N}$ times.
- Minimum, Maximum – each pixel of the resulting image is the minimum (maximum) of corresponding pixels in the block.
- Median – analogue of the spatial median filter, applied to the sequences. As well as its spatial counterpart, allows suppressing pixel noise.

You can aggregate the whole sequence to the single image. For this, select the "All" check box.

Point trend

As follows from the name, Point trend shows the temperature value change of one or more points (up to 6) with the time. It uses the standard Thermography Suite diagram window to display the results.

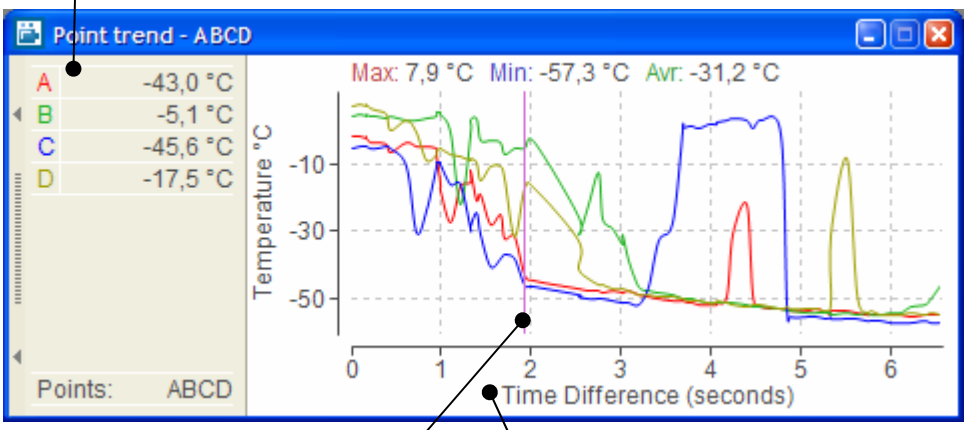
Quick reference

Menu: **Analysis/Point Trend**

Toolbar:

Create several point objects, click the menu item, in the "Trend points" dialog mark points to be present in the trend and push OK.

Temperature values for the active frame.



The cursor corresponds to the active frame.

Frame index or time difference, depending on the sequence sorting order. Double click to open the "Sequence Editor" dialog

In order to avoid dependency on the pixel noise, consider the possibility to apply averaging to the points.

To add and to remove points from the trend click **Select Points** in the context menu of the point trend window.

Area trend

An area trend can be built by an area of any shape and it shows the minimum, maximum and average temperature in this area for every frame in the sequence.

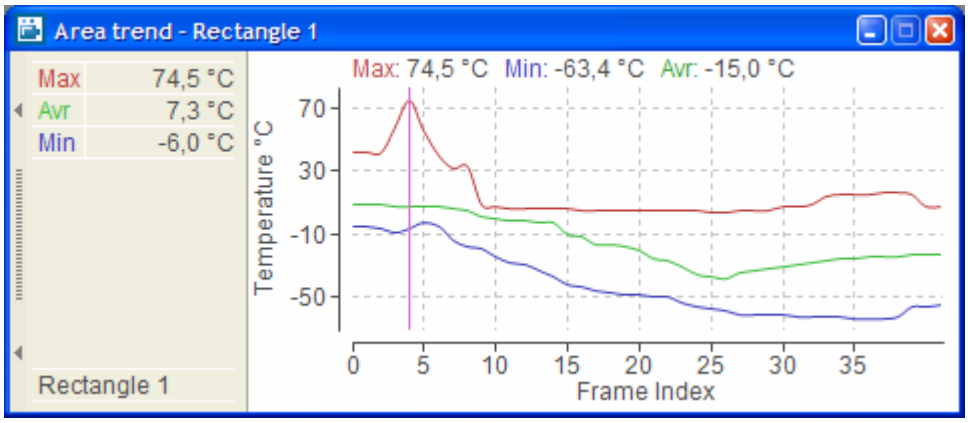
The rest is almost similar to the point trend.

Quick reference

Menu: **Analysis/Area Trend**

Toolbar:

First, create an area object and leave it active, then click the menu item.



Box-line trend

In contrast to the area trend, box-line trend can be only built by rectangular area object.

This diagram is not quite a usual trend, because the X-axis is not the time axis. In fact, box-line trend is an envelope profile generalization for the case of several frames.

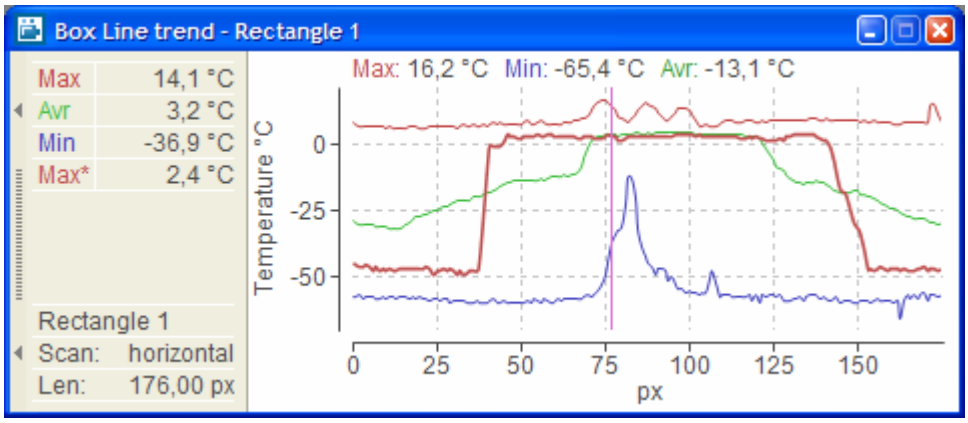
A box-line trend shows minimum, maximum and average temperature value for each vertical line of the rectangle, taken from all frames in the sequence.

Quick reference

Menu: **Analysis/Box-line Trend**

Toolbar:

First, create rectangular area object and leave it active, then click the menu item.



For comparison, on the box-line trend diagram one can show envelope profile values of the active frame. Choose **Frame Max, Frame Min or Frame Average** from the context menu.

Profile trend

A profile trend shows profile curves for every frame in the sequence in the three dimensional space.

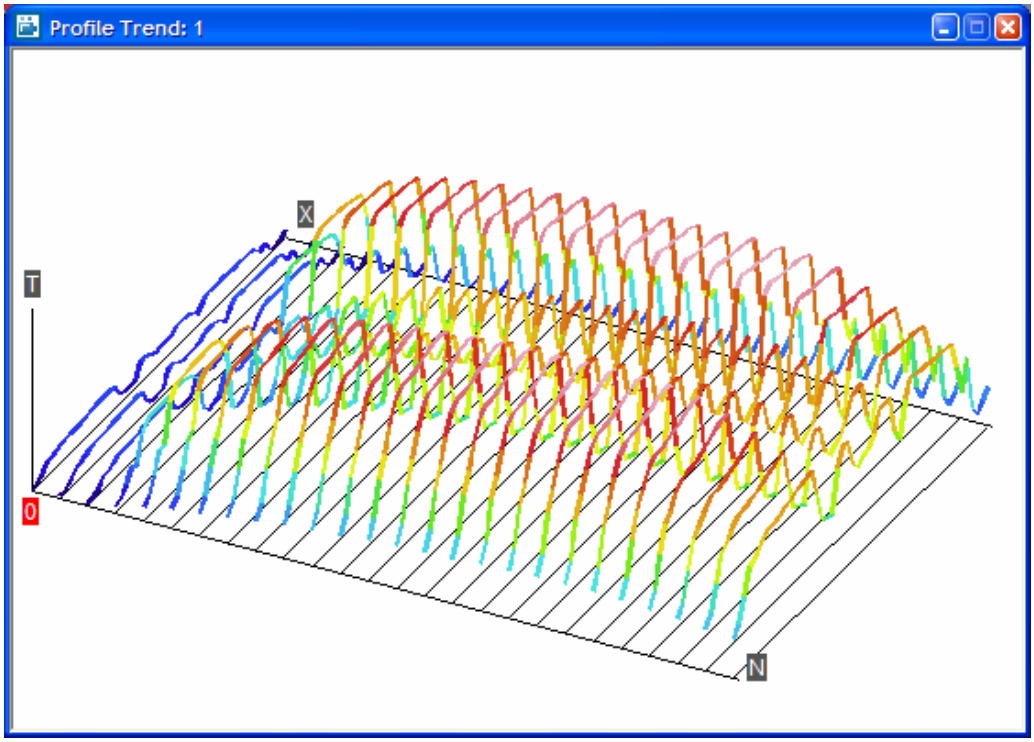
If you have Microsoft Excel installed on your computer, you can export a profile trend into Microsoft Graph, which gives you more options in the rotation and visualization. Choose **MSGraph** item from the context menu of a profile trend window.

Quick reference

Menu: **Analysis/Profile Trend**

Toolbar:

First, create a line object and leave it active, then click the menu item.



Profile trend envelope

A profile trend envelope shows aggregated minimum, maximum and average line profile of all frames in a sequence.

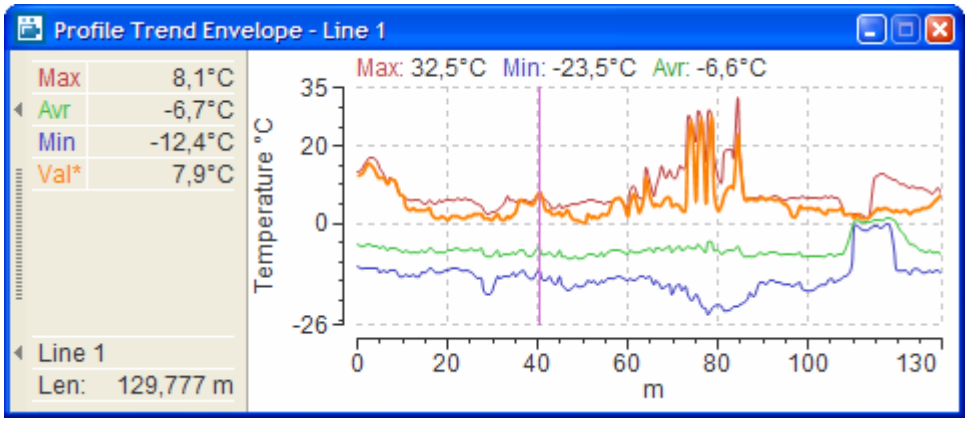
In other words: for every pixel of a line Thermography Suite calculates minumum, maximum and everage values among all frames in a sequence and displays them in a 2D diagram window.

Quick reference

Menu: **Analysis/Profile Trend Envelope**

Toolbar:

First, create a line object and leave it active, then click the menu item.



- The red curve shows the aggregated maximum profile.
- The blue curve shows the aggregated minimum profile.
- The green curve shows the aggregated average profile.
- The orange curve shows the profile of the active frame.

Chapter 5

Reports generation and data export

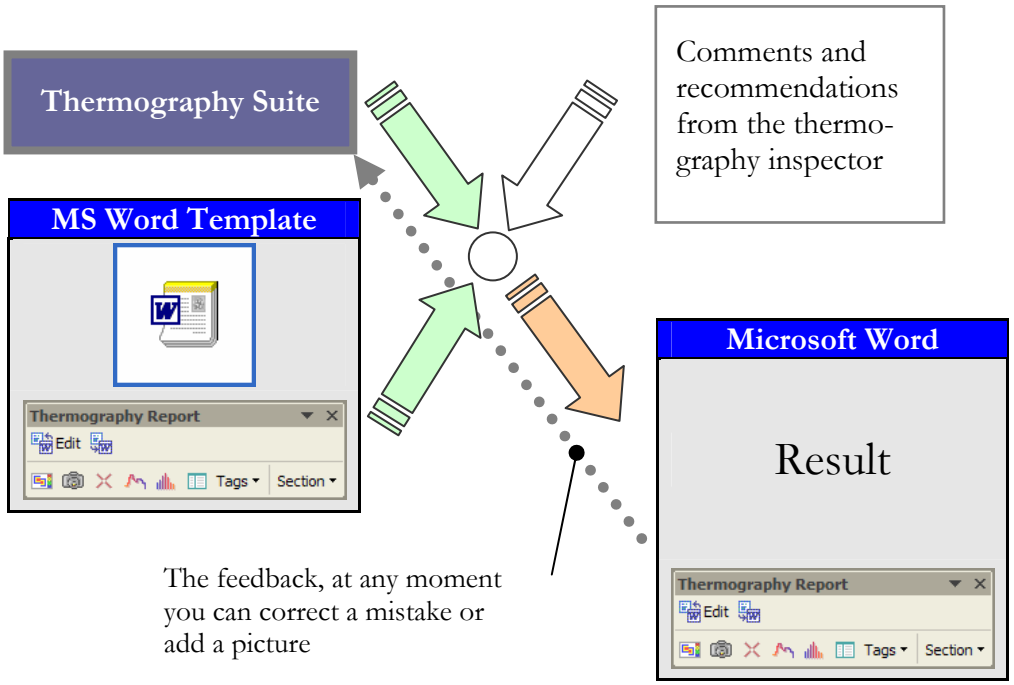
Thermography Suite has rich capabilities to analyze infrared images, but in the real practice it is not enough only to get the results on the computer screen, in addition, it is necessary to document them in printed or electronic form.

There are a number of variants to document obtained results in Thermography Suite, and they are flexible enough not to force a user to utilize some special working style. The simplest and the most often used method is the data exchange through the clipboard, while the automatic report generation system based on templates and working in pair with Microsoft Word makes the task of creating repots really easy and fast.

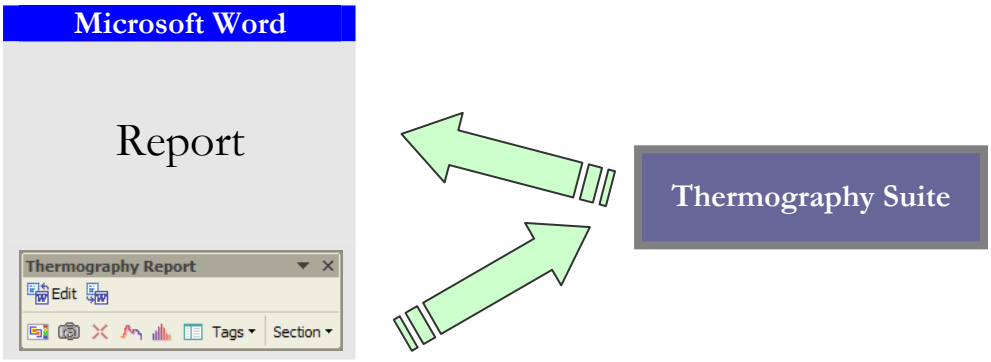
Reports in Microsoft Word

There are two different approaches to create a report in Microsoft Word and Thermography Suite reporter supports them both.

- Using the templates.



- Not using templates or an already created report revision

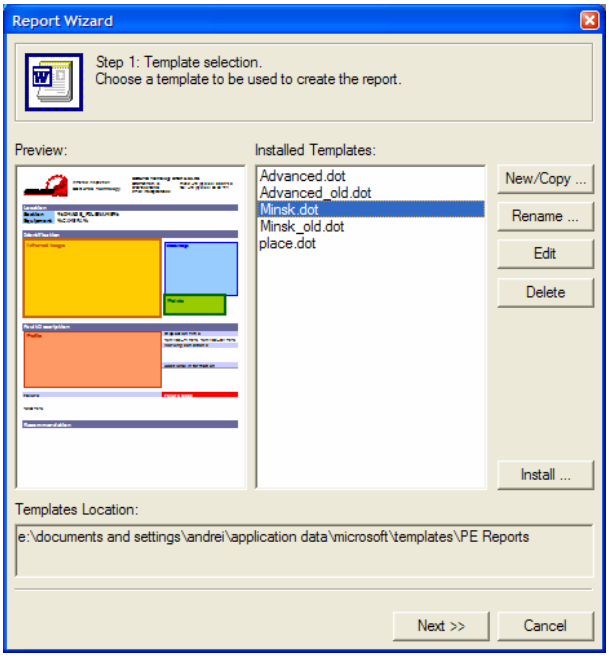


The advantages of such an approach are the following:

- The thermal analysis is made in the convenient and specially developed for the purpose workspace of Thermography Suite.
- Quick report creation: routine, oft-recurring jobs Thermography Reporter takes upon itself.
- A report is a single file in the widely spread Microsoft Word format, which can be easily sent to a customer.
- Pictures and diagrams in the document are **active**, this means that at any time if you find a mistake, you can return the picture with the analysis objects back to Thermography Suite and correct them.
- Easy template creation with the help of Thermography Report toolbar.
- Possibility to export not only the pictures, but also the data.

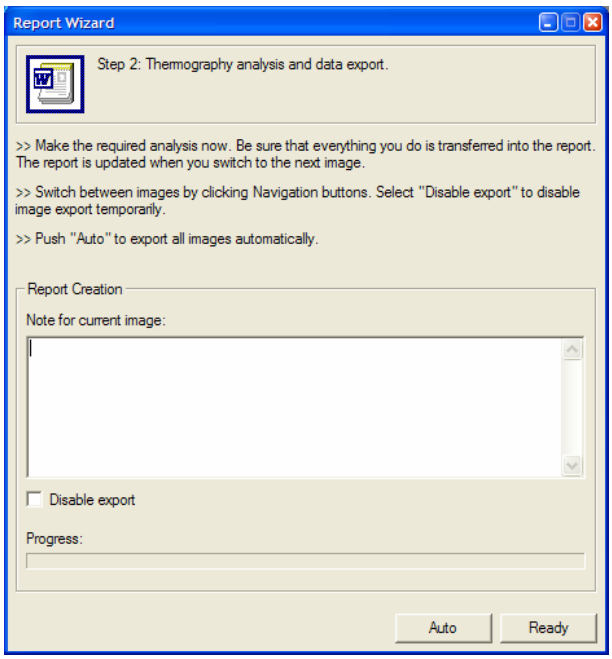
How to generate a report by a template

To create a report by an existing template, you should use the Report Wizard in Thermography Suite. Choose **Tools/Multi-Page Report** from the main menu.



Let us assume that we already have a template by which we are going to create a report. Select it from the "Installed Templates" list: the main page of the template will be previewed at the left.

Push **Next >>**. Thermography Suite will proceed to the second step and launch in an invisible mode Microsoft Word and will be waiting for your actions.



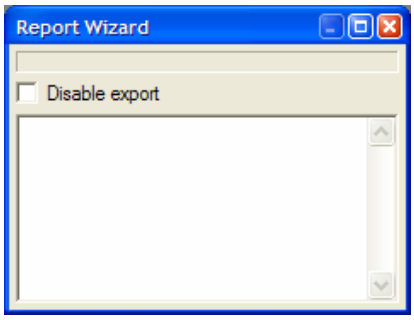
Minimize the "Report Wizard" dialog, so it does not disturb you – it will not disappear, but will take a small size, leaving the field for the comments input.

Now you can open images, make thermographic analysis and be sure that all you do is exported automatically into the report.

You can open both one image and several at once. The information is copied at the moment when you close an image or switch to the next one.

If you do not want the current image to be exported into the report, select the "Disable export" check box.

Field "Note for the Image"



For every image, you can make a comment and it will be written in a special field in the report. This field is defined during template creation and discussed more detailed in the article dedicated to the templates.

Because of this feature, in many cases you can avoid subsequent report editing in Word.

Button "Auto"

This button allows exporting the opened sequence automatically. The feature is used in the following situations:

- You have already made the necessary analysis and it is saved in the Image Database (in Thermography Explorer).
- The template designed in such a way that additional analysis is not needed. For example, it uses hot/cold spots, and Thermography Suite detects them automatically.
- All images use the very same analysis objects.

If you have pushed the "Auto" button, button "Ready" is not needed.

Button "Ready"

Push this button when you have finished the analysis of the last image. Thermography Suite will switch the focus to Microsoft Word where you can check and edit the newly created report.

How to edit a report

After Thermography Suite has generated the report, you, most likely, will want to check it and make additional comments. You should feel free here, as the generated report is a usual Word document and you can use all the provided features. For instance, you can draw an arrow connecting the problem zones at the infrared and visual image.

How to insert a visual image

A template can provide a place for a visual image; it is marked by a rectangle with "Visual Image" caption. Click once on this rectangle and push **Edit** button in Thermography Report toolbar (it is usually located at the bottom). In the displayed dialog, choose a visual image that corresponds to the infrared image.

What to do if you noticed a mistake

If you have noticed, that some of the information received from Thermography Suite is not correct and repeated analysis is required, do not worry, you do not need to recreate the complete report again. Links to the original images and corresponding analysis collections are stored together with the document.

To open an image or a diagram and edit it in Thermography Suite, click on it once and push **Edit** button in the toolbar. Thermography Suite will be opened with the image and corresponding analysis information. Correct the mistake and push button **Apply** (

) at the bottom, button **Cancel** will ignore the changes and return to Word.

How to add a new image

Choose a place where you want to insert a new image by placing there the cursor. Choose item **Section/Insert Main Section Copy** in Thermography Report toolbar to insert empty copy of the template. Then click once on the rectangle marked with caption "Infrared Image" and push the same **Edit** button. Thermography Suite will be launched. Open there the needed image, make the analysis and push **Apply** button in the toolbar at the bottom.

How to delete an image

Click once on the image you want to delete. In Thermography Report toolbar select item **Section/Delete**.

How to create a template

The templates of Thermography Report are usual templates of Microsoft Word and located together with other templates under the tab "PE Reports". Because of that, you can use the standard means to create templates in Microsoft Word, but we recommend you to use Thermography Suite.

Template organization

To begin, let us examine the basic rules of Thermography Report templates organization:

1. To mark places for images and diagrams special objects called placeholders are used. There are the following types of placeholders: infrared, visual, points, profile, histogram, image info and others.
2. A template must have at least one infrared placeholder.
3. A template can have any additional information, which will be copied into the resulting report afterwards.
4. You can use special fields, called *tags,* in a template. During report generation, these tags are replaced with actual information about an image or an analysis object. You can insert tags using **Tags** menu of Thermography Report toolbar.
5. To separate parts that will be copied for every inserted infrared image from those that will be not, Thermography Report uses *sections* conception of Word. Any Word document can consist of several sections, you insert them using **Section/Add Empty Section** (or **Insert/Section** item of the Word main menu).

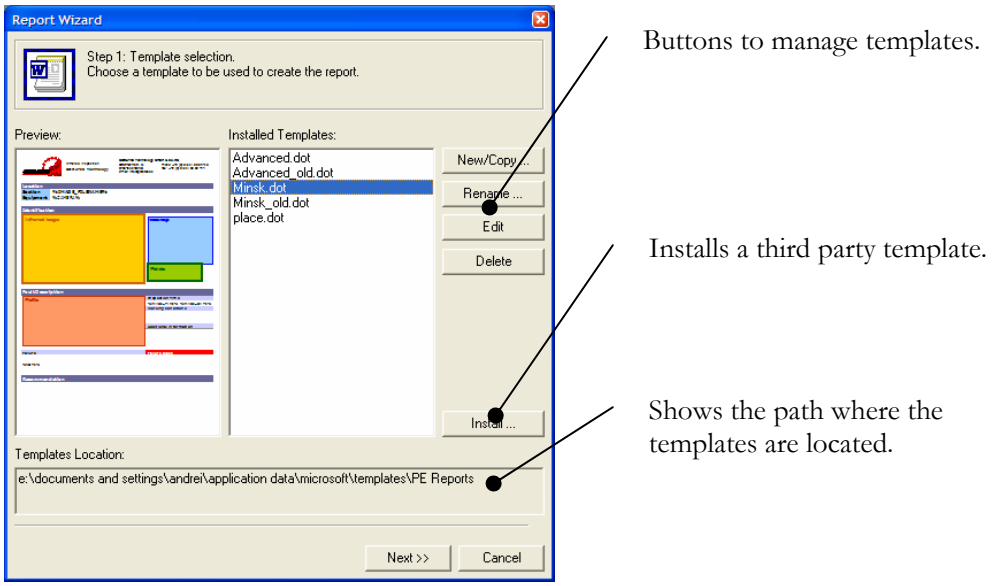
   The section that contains an infrared placeholder will be copied for every image received from Thermography Suite. This section is called *main section.* Other sections will remain unchanged in the result.

   In this manner, Thermography Report links an infrared image with diagrams and tags that correspond to the image and gives you the possibility to add a report header and footer (the first and the last pages).

   We recommend that the main section should contain an integer number of pages (one, two and so on), though this is not necessary.

How to copy an existing or create a new template

Thermography Suite uses the very same Report Wizard dialog to manage templates. Choose **Tools/Multi-Page Report**.



To create a new template, push **New/Copy** button. Thermography Suite will ask for a template name, enter it. The Microsoft Word new template dialog will open – here you have to define on which template to base your new one:

- Select **Blank Document** if you want to make a template from nothing.

- To make a copy of an existing template and update it, click on **PE Reports** tab and then select a template to be copied.

A new template will be created and installed in the Thermography Report templates folder. Make the necessary changes and click on **File/Save** to save them.

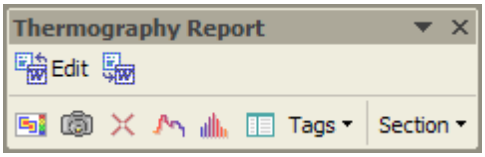
Other operations:

- To rename a template, select it in the "Installed Templates" list and push **Rename** button, enter a new name.
- To modify a template or to view it, select it and push **Edit** button. The template will open in Microsoft Word.
- To delete a template, select it and push **Delete** button.
- To install a template from any place, push **Install** button and select the template you want to install. Thermography Suite will copy the template to its templates folder and make it available for report generation.

How to edit a template in Word

To create a template in Thermography Report is as simple as to make a Word document and draw several rectangles on it.

For any operation, you would need, refer to the Thermography Suite toolbar, which is usually located at the bottom of the Word window.



If you cannot find the Thermography Report toolbar in your Word, there are two reasons for that:

- Thermography Suite is not installed or not properly installed.
- The toolbar was hidden. To show it back, click with the right mouse button anywhere on the toolbar area and select "Thermography Suite" from the list. In the same way, you can hide the thermography toolbar if you do not need it.

	Edits the active placeholder in Thermography Suite.
	Updates the active section with actual information from Thermography Suite.
	Creates Infrared Image placeholder.
	Creates Visual Image placeholder.
	Creates Points placeholder.
	Creates Profile placeholder.
	Create Histogram placeholder.
	Create Image Info placeholder.
Tags	Adds a tag to the cursor position. Tags are described below.
Section	As you know from the template organization rules, section is an important concept when making a report template. This menu helps to manage sections.

Thus, the Thermography Report toolbar has two groups of buttons.

- Used only when editing a report - Edit and Update,
- Used when creating a template – all the others.

The exception is **Section** menu that can be used both when making a report and when making a template.

Placeholders

Placeholders are ActiveX objects that during report generation replaced with actual pictures provided by Thermography Suite.

To add a placeholder to the document, click on the corresponding placeholder icon in the thermography toolbar. The placeholder will appear somewhere on the active page, after that you should position and resize it as you need – placeholders behavior is similar to any Word object behavior.

Every object in Microsoft Word has a property defining how it interacts with the text – it can be **inline** or **floating**. A floating object can be moved freely on the page, while an inline object is attached to some cursor position. The disadvantage of floating objects is that, as they are moved freely, their behavior is not that easy to predict – during report generation, they can jump somewhere.

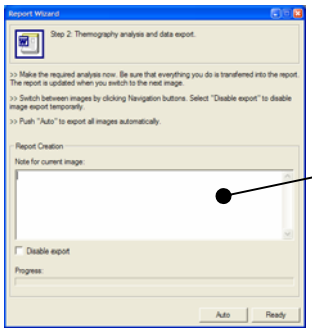
Therefore, we recommend using the inline objects. In order to define the position of an inline object, you have to use **tables** and insert placeholders to their cells.

By default, placeholders are floating. To make them inline, click with the right mouse button on a placeholder, choose **Format Object**, then select **Layout** tab, and finally, click on **In line with text** picture.

At the picture, you see an Infrared image placeholder. Different placeholders have different colors.

Tags

Tags are special fields, replaced with some information provided by Thermography Suite. They are similar to placeholders, with the difference that placeholders are replaced with pictures, while tags are replaced with text data.



Note for the image tag was already mentioned before. This tag is replaced with the text taken from the "Note for current image" edit box in the Report Wizard dialog.

Note for the image tag is replaced with text taken from here.

All tags are listed in the following table:

Tag name	Real name	Meaning
Note for the image	%NOTE%	The text from the edit box at Report Wizard step two.
Temperature Unit Sign	%U%	Temperature values are exported in the units selected in Thermography Suite. This tag is replaced by the unit sign.
Camera name	%CAMERA%	Camera used to make the image.
Image File Name	%IMAGE_FILENAME%	Image file name.
Image Date	%IMAGE_DATE%	Date when the image was made.
Image Time	%IMAGE_TIME%	Time when the image was made.
Emissivity	%IMAGE_EMIS%	Image emissivity.
Ambient Temperature	%IMAGE_AMBIENT%	Image ambient temperature.
Preset Range Min	%IMAGE_SCALEMIN%	Preset range minimum.
Preset Range Max	%IMAGE_SCALEMAX%	Preset range maximum.
Sensitivity	%IMAGE_SENSITIVITY%	Sensitivity.
Image Description	%IMAGE_MESSAGE%	Image message which was stored in the file.
Spot Temperature Value	%SPOT VALUE <ID>%	Spot temperature value (<ID> can be A, B, C, …)
Spot Emissivity	%SPOT EMIS <ID>%	Spot emissivity (<ID> can be A, B, C, …)
Area Minimum	%AREA MIN <ID>%	Area minimum (<ID> can be 1, 2, 3, …)
Area Maximum	%AREA MAX <ID>%	Area maximum (<ID> can be 1, 2, 3, …)
Area Average	%AREA AVG <ID>% or %AREA AVR <ID>%	Area average (<ID> can be 1, 2, 3, …)
Area Emissivity	%AREA EMIS <ID>%	Area emissivity (<ID> can be 1, 2, 3, …)

Sections

As was described before, Thermography Report uses *sections* to separated information that will be copied from not copied. Sections can be added using the thermography toolbar.

- **Next Section**: jumps to the next section (or infrared image).
- **Previous Section**: jumps to the previous section (or infrared image).
- **Mark Current Section as Main**: if you have more than one section with an infrared placeholder, you have to select which section will multiply for every reported image.
- **Insert Main Section Copy**: this item helps when you need to add an infrared image with analysis to an existing report. It will make a copy of the template's

main section and insert it at the cursor position. After that, you can click **Edit** to get a new image from Thermography Suite.

- **Add Empty Section**: you use this item to separate information copied for every infrared image from that, which is not.
- **Delete Current Section**: you can use this item to delete an infrared image with its analysis from a report.
- **Clear Placeholders**: clears all placeholders in the current section.

Quick reports in HTML

You can quickly create a report page containing diagrams and images you are working on at the time. Click **Report Page** in the **Tools** menu or in the toolbar.

The standard dialog for file saving will be shown, enter the file name and push **Save**. The report page will be saved and an application for viewing HTML documents (usually Internet Explorer or Netscape Navigator) will be displayed. From the application, you can print the report.

Exporting data, copying through the Clipboard

Thermography Suite has a number of features to make the data exchange between applications simpler:

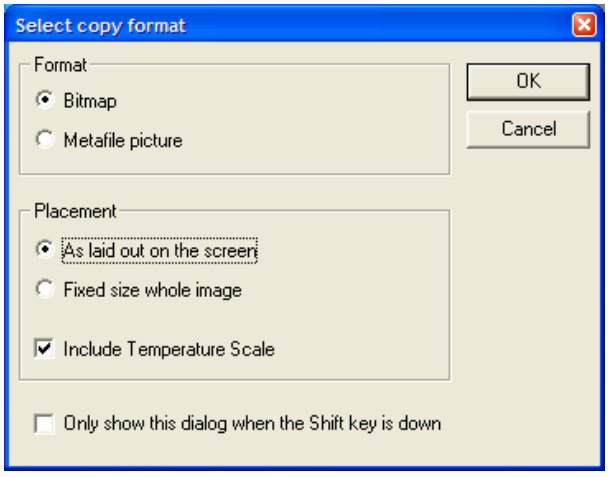
- You can copy images and diagrams into the Clipboard.
- Save them on the disk in commonly used formats.
- There is a special feature for quick copying to *Microsoft Office* documents.

How to copy an infrared image

To copy an infrared image into the Clipboard in a picture format, click on the image with the right mouse button and in the appeared context menu click **Copy**.

A dialog will show up where you should select an image format, the part of image to copy and whether to include the temperature scale or not.

Use the **Paste** function in other applications.



Quick reference

Menu: **Edit/Copy**

Toolbar:

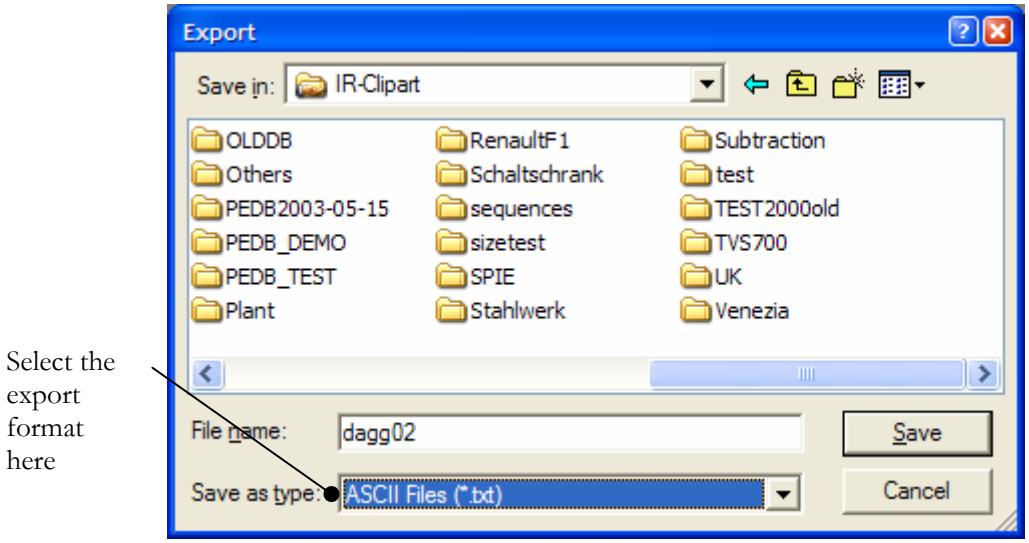
Keyboard: Ctrl+C

The active object or image will be copied into the Clipboard. In some cases, a dialog will show up allowing you to specify a copying style.

This dialog will pop up every time you use the copy function for an infrared image. By selecting "Only show this dialog when the Shift key is down", you tell Thermography Suite not to show the dialog every time, but to use the last input. If you will be holding the Shift button when selecting the copy function, the dialog will be shown again.

How to export an infrared image

To export an infrared image to the disk in a variety of formats, click **Export** in the context menu of the image. The standard dialog for saving will appear. To select the export format use the "Save as type" combo box.

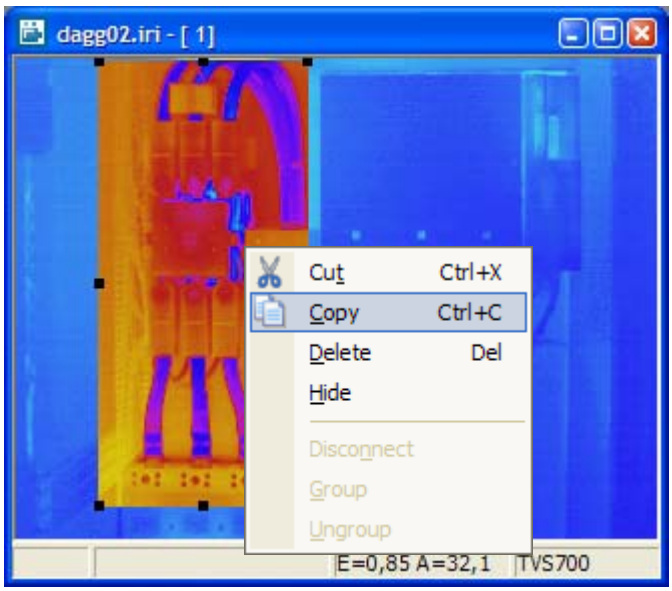


You have a selection of the following formats:

- Bitmap
- Jpeg
- Windows Enhanced Metafile (a kind of vector graphics)
- Text
- Comma-separated (CSV) – read by Microsoft Excel

Please note, that when an image is exported into a Text or CSV format, it is transposed – rows become columns and columns become rows.

Copying a rectangular part of an image



You can copy into the Clipboard some part of the image using the "Clip Rectangle tool" – activated by button on the toolbar or by **Edit/Clip Rect** in the menu. Outline the needed area and in the context menu of the object click **Copy**.

How to copy and export diagrams and data windows

The operation is similar for all diagram types as well as for **Image Info** dialog and **Statistics** window.

- To *copy* a diagram into the Clipboard click the right mouse button on a diagram window and select **Copy** in the context menu.
- To *export* the data or the image of a diagram to the disk, click **Export** in the context menu of a diagram. The standard dialog for file saving will be displayed. In the **Save as type** combo box select the format for the export.

How to export the complete sequence

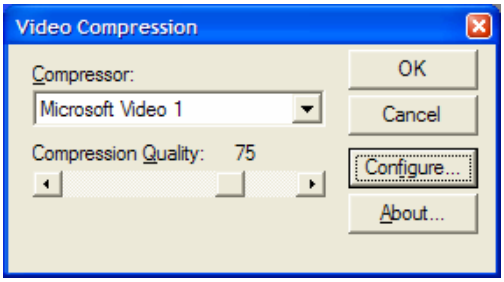
You can export all the images in the sequence to Jpegs, Bitmaps, Text or CSV files in a single step. Click on **Jpegs**, **Bitmaps, ASCII Text or Excel CSV** in the **Sequence/Export** menu. A dialog for folder selection will be displayed. Select a folder (this folder should already exist) and push **OK**. All images will be saved under original names with corresponding extensions.

How to make movie clips (AVI)

You can create a movie clip from a sequence of images or even a movie showing how a profile or a histogram is changing.

To create a movie clip from an image sequence:

- Open a sequence of images.
- Click **AVI Video** in the **Sequence/Export** menu.
- The standard file dialog for saving will be displayed. In the additional field **Speed (fps),** enter the playing speed for your movie in frames per second; type in a file name and push **Save**.
- Finally, a dialog to select a compression method will be displayed. It shows codecs installed on your system.



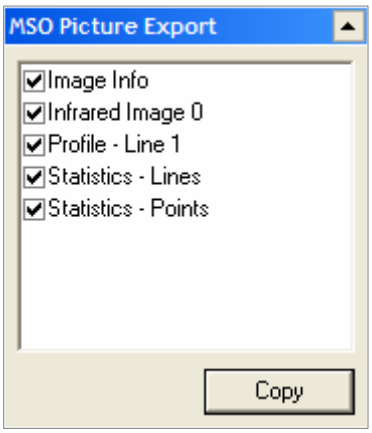
Codecs come from other developers (not from GORATEC) and usually installed with Microsoft Windows.

They differ in the resulting image quality and file sizes – you should find a compromise for the two parameters. By try and error, make your decision which codec suits you better. MPEG4 produces the best results, but it is quite often that it is not present on the system (also on a customer system). Thus, we recommend using Microsoft Video 1 if you are not sure.

To create a movie clip from a profile or a histogram:

- Open a sequence of images.
- Click **Export** in the context menu of a diagram. The standard file save dialog will be shown. Select "Avi Files (*.avi)" in the **Save as type** combo box, type in a file name and push **Save**.
- Enter speed for you movie in frames per second (fps).
- Select the compression method.

Copy into Microsoft Office



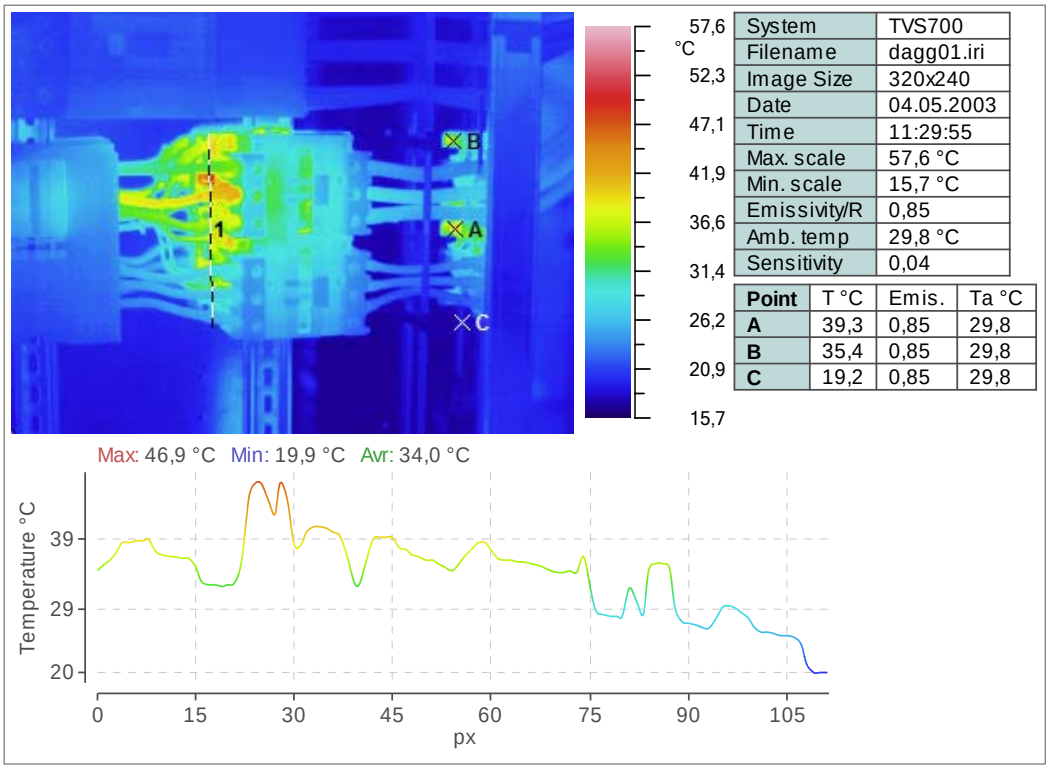
If you are using one of *Microsoft Office* members, you have an option of copying many images into the Clipboard at once.

Click **MSO Picture Export** in the **Edit** menu. The dialog will pop up in the navigation panel containing the list of all available exports.

Check the items you would like to copy and push **Copy**. After that, you can paste all the selected images to any of *Microsoft Office* documents.

Copy report

You can copy an image containing an infrared picture, points, image info, profile and histogram into the Clipboard. Choose **Edit/Copy Report** or press CTRL+R key combination. The image info window is only copied when visible.



System	TVS700
Filename	dagg01.iri
Image Size	320x240
Date	04.05.2003
Time	11:29:55
Max. scale	57,6 °C
Min. scale	15,7 °C
Emissivity/R	0,85
Amb. temp	29,8 °C
Sensitivity	0,04

Point	T °C	Emis.	Ta °C
A	39,3	0,85	29,8
B	35,4	0,85	29,8
C	19,2	0,85	29,8

Printing

You can print out the infrared picture, points, image info, profile and histogram displayed on the screen (the very same image as in Copy Report).

- Choose **File/Print** to print.
- Choose **File/Print Preview t**o see how it will look like on the page.
- Choose **File/Print Setup** to specify the page size and orientation.

Chapter 6

Real-time recorder

We tried to include in Thermography Suite all the operations you come across when working with infrared images on a PC. This is why Thermography Suite has the possibility to connect directly to an infrared imager and record images.

This is done with the Realtime Recorder feature of Thermography Suite designed to handle the following tasks:

- Real-time image analysis. You have live image on the screen with online thermal analysis.
- Sequence recording and conditional sequence recording. The conditions are defined with the help of triggers.

Quick reference

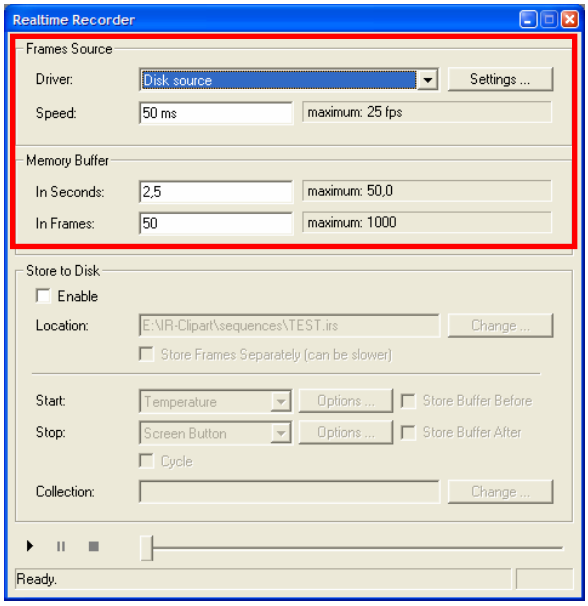
Menu: **Sequence/Realtime Recorder**

Toolbar:

Opens the Realtime Recorder dialog to make analysis on an online image or to record image sequences.

Setting up a connection

Thermography Suite uses its own drivers to connect to a camera. Select the driver, which corresponds to your device type and configure it by pushing **Settings**. Thermography Suite can handle images only from one device simultaneously.



Frame rate

The important parameter when recording images is the number of frames received in one second from an imager, because for some tasks it is important to have a fast frame rate, for others this is not necessary at all.

The frame rate is defined in field **Speed** in Realtime Recorder. You can enter a speed in frames per second (fps) or define a delay between consequent frames in milliseconds (ms), seconds (s), minutes (m) or hours (h). The defined frame rate

must not exceed the maximum value for the device, which is displayed in the filed beside.

Thus, to define a frame rate of two frames per second, you can type in one of the following values in the Speed field:

- "2 fps"
- "500 ms"
- "0.5 s"
- "0.00833 m"

Memory buffer

Images are always going through a memory buffer before being processed, even if the disk recording is on. In our case, the buffer is a usual sequence of images in Thermography Suite. When the buffer becomes full, it is shifted to the beginning so the first image is removed.

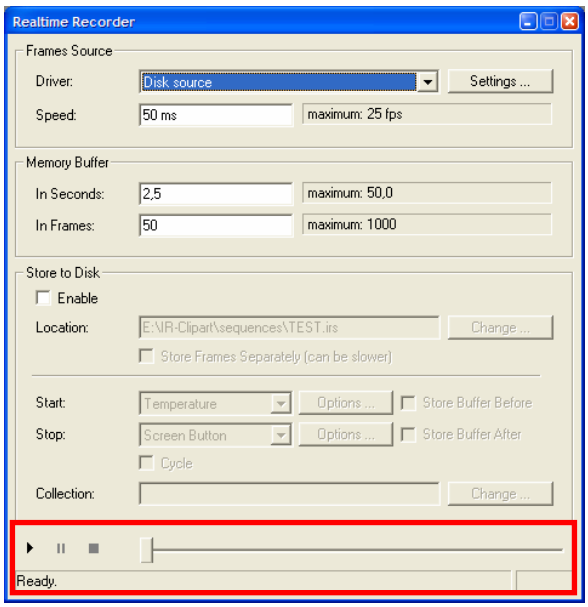
During the online analysis, the active frame is always the last received frame and the buffer frames serve as a kind of history. The maximum number of frames in a buffer is limited to 1000 frames. You can define the buffer size both in frames and in seconds, the Realtime Recorder has two fields for this.

Online analysis

The main concept of our Realtime Recorder implementation is that you are allowed to make the very same operations on an image in the real-time mode as on a static image loaded from a disk. The exceptions are the operations on sequences (open, add, aggregate, etc.) and the report generation.

Thus, to begin the online analysis, make the following:

- Setup the connection to the imager.
- Define the frame rate.
- Define the buffer size.
- To start to receive images push the *play* button ( ).



To stop the online mode push the *stop* button ( ). You can also utilize the *postponed stop* button ( ), which does not stop receiving images at once, but after half buffer size of images is received. This allows catching the necessary frame, frames before it and after.

The slider is used only when recording is stopped and give you the possibility to display frames in the buffer.

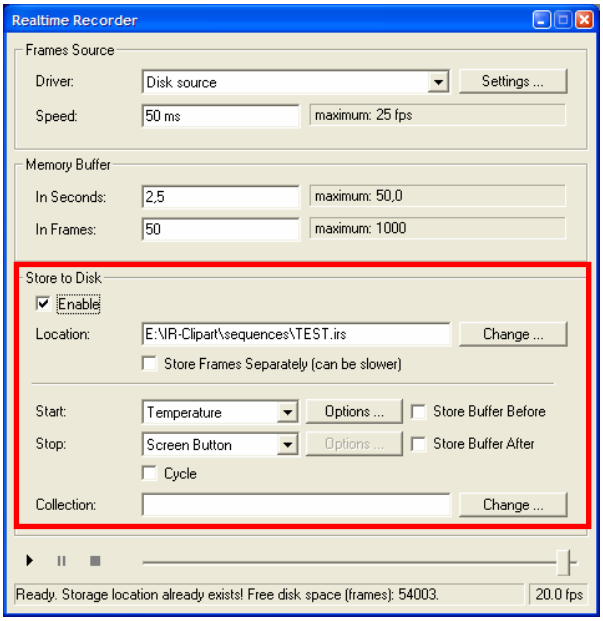
After the images begin to come, minimize the Realtime Recorder dialog, so it does not disturb you. Now you can create analysis objects, open diagrams, build trends and so on.

Recording to the disk

The simplest way is to record images to the buffer first and then, using the Sequence Editor, select the needed subsequence and save it on the disk.

This method cannot be used for very long sequences and at the case when you need to use the conditional recording. In these situations, you have to utilize the second method.

- To enable storage to disk select **Enable** check box.
- Define how and where to store images: separately or in one file. See the "Sequence Editor" article, part about saving a sequence. There you will find how to assign names to the sequence.
- Select a trigger, which will start the recording.
- Select a trigger, which will stop the recording.
- Push the start button to begin.



How triggers start and stop recording will be clear when they are discussed below.

Store buffer before/after

These options allow additionally storing the frames received before the start trigger is fired and the frames received after the stop trigger.

Cycle

If you select this option, Realtime Recorder stops recording when the stop trigger is fired and switches to the start trigger again, waits for the start trigger, and records the next subsequence and so on in the cycle. Images received on subsequent iterations are recorded to the end of the already recorded sequence.

Collection

In this field, you can assign a collection file, which will be loaded together with the first received image. The function is mainly useful for the temperature trigger, as it uses analysis objects and the objects cannot exist without an image.

Triggers

As was mentioned, triggers are used to define the start and the stop event for recording. Because of such structure, you can setup the Realtime Recorder in a way, that only the images you need are recorded while the others are filtered.

Immediate trigger

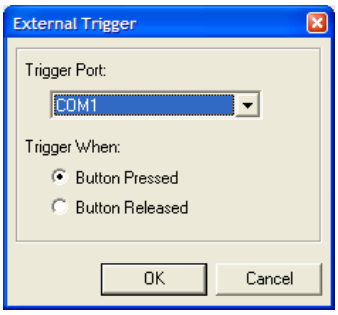
The trigger is fired right away with the first received image.

Screen button trigger

A small window with a button on the screen. The trigger is fired when you push this button.

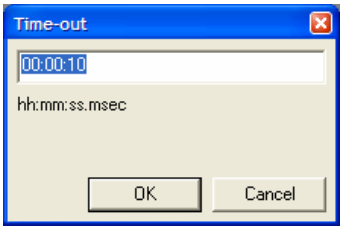
External trigger

In most cases, it is a button connected to a COM port of the computer. Depending on the setup, the trigger is fired when the button is pressed or when the button is released.



Time-out trigger

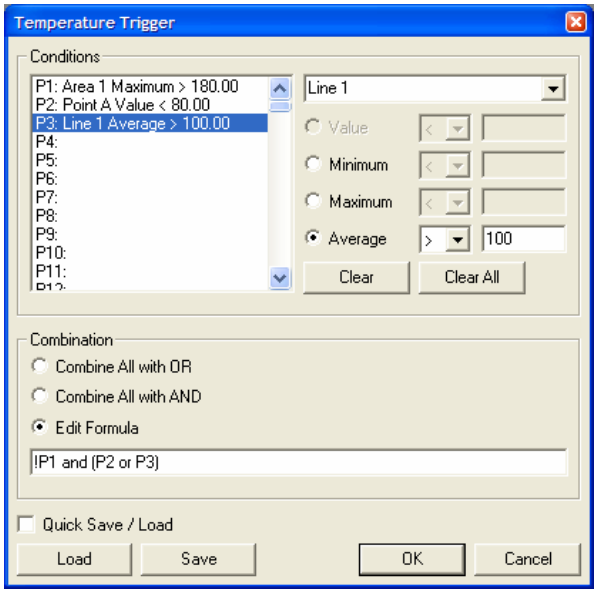
When enabled, the trigger is fired after a defined period of time. A start trigger is enabled after the play button is pushed (or after the stop trigger is fired, in case of cycling). A stop trigger is enabled right after the start trigger is fired.



Temperature trigger

This trigger checks the defined temperature conditions for every received frame and if the conditions are met – the trigger is fired.

The conditions are defined using the analysis objects: points, lines or areas. For points, a trigger can check their temperature value, for lines and areas – one of the three parameters: minimum, maximum or average. The simple conditions can be combined in one complex condition using logical NOT,



AND and OR. This complex condition is the condition that must result in true for the trigger to be fired.

Before defining conditions, open an infrared image and create the objects to be checked. If you do so, you will not have to enter the object names by hand, but simply select them from a list.

How to define simple conditions

- In the "Conditions" list select the condition to be created or changed (P1 – P256).
- Select the checked object from the combo box or type in its name: for points POINT A, POINT B, …; for lines LINE 1, LINE 2, …; for areas AREA 1, AREA 2, …
- Select the checked condition (< = >) and enter the limit value.
- Repeat these operations for every checked object.

How to create the complex condition

You have a choice:

- *Combine All with OR*: if at least one from the simple conditions is met, the trigger fires.
- *Combine All with AND*: the trigger is fired only when **all** conditions are met.
- *Edit Formula*: using the logical operations NOT (!), OR, AND and brackets, type in your own formula. For example: !P1 and (P2 or P3). AND operation has a larger priority than OR.

Chapter 7

Extras

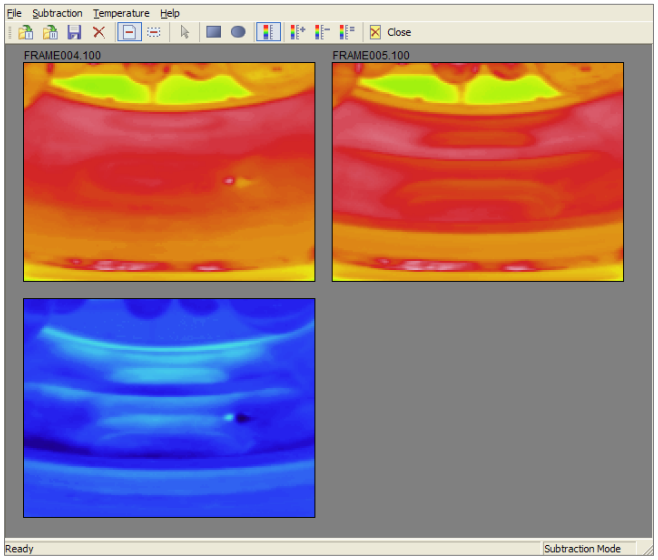
In addition to the analysis and real-time modes, Thermography Suite includes image composition and image subtraction modes.

GORATEC has developed a new software **iParallax,** an advanced image composition and subtraction tool, which greatly extends and improves the features discussed in this chapter. If you find that the image composition and subtraction features of Thermography Suite are not flexible enough to solve your task, please, visit www.goratec-engineering.de and contact GORATEC for more information about iParallax.

Picture subtraction

To switch to the subtraction mode click **Tools/Picture Subtraction** in the menu.

Load an image-minuend and an image-subtrahend using **File/Open First** and **File/Open Second**. The subtraction can be made in two modes: image subtraction and area subtraction.



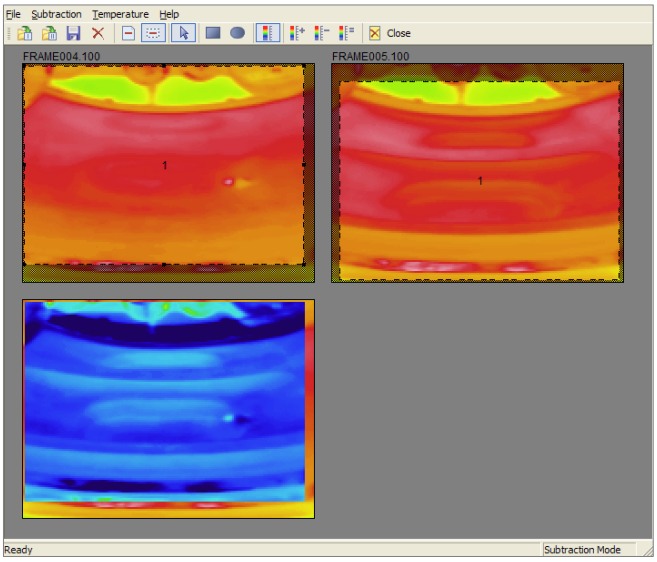
Subtracting whole images

To switch to the image subtraction mode, click **Subtraction /Image** in the menu or click on the corresponding button on the toolbar.

Aligning shifted images

If the object, which change you want to see, is shifted on one image if to compare to the other, you should use the subtraction by an area mode.

To switch to this mode, click **Subtraction /Area** in the menu or click on the corresponding icon in the toolbar. Using object tools in the toolbar, you can create an area on the left image. The same area will be created on the right image. Move and resize the two areas on both images until the objects on two images match.



Set up the temperature range and save the result

You can control the temperature range using items of **Temperature** menu or corresponding icons in the toolbar. The selected temperature range will be saved in the resulting image as the *preset* range.

To save the result, choose **File/Save** or **File/Save As**. To return to the analysis mode of Thermography Suite, choose **File/Close**.

Image composition

To switch to the image composition mode, choose **Tools/Compose Picture** in the menu.

- The standard dialog for loading images will appear. Select the images you want to compose and push **Open**. You can open only images of same format.
- The loaded images can be freely moved on the application screen with the mouse or pressing LEFT, RIGHT, UP, DOWN keys on the keyboard. To add new images choose **Compose/Open** or click the corresponding icon on the toolbar.
- To remove an image, choose **Compose/Delete Active Image** in the menu or press DEL.
- Change the zoom factor to make images smaller: use the Zoom combo box on the toolbar.
- To control the temperature scale use **Temp. Scale** item in the context menu of each image as well as **Compose/Temperature Range** in the menu.
- Choose **Compose/Save** or **Compose/Save As** to save the result.

The resulting composed image will always have the same default size that depends on the format. To save images in different sizes you have to use **iParallax** software.

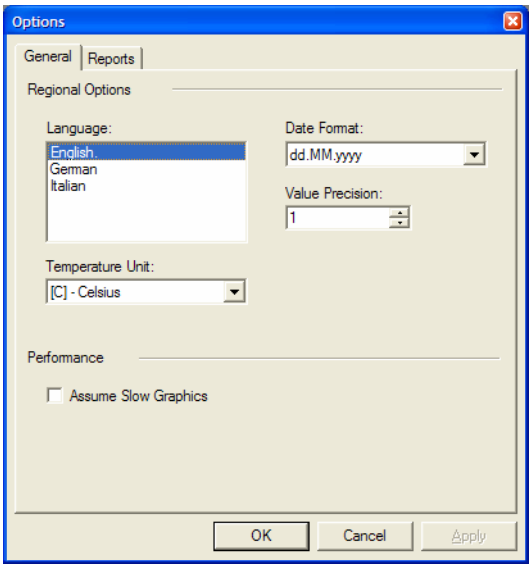
Appendix

A

Options

Thermography Suite has several global options that affect all other features of the software. To change these options, choose **Tools/Options**.

General



Language

User interface language: select a language you prefer from the list.

Temperature unit

You have a choice between Celsius, Fahrenheit and Kelvin temperature scales.

Date format

The choice is dd.MM.yyyy, MM/dd/yyyy and yyyy-MM-dd.

Value precision

This parameter defines the precision of temperature formatting everywhere in the software, or, in other words, how many digits will be displayed after the decimal comma. Can be zero (only the integer part is displayed), one or two.

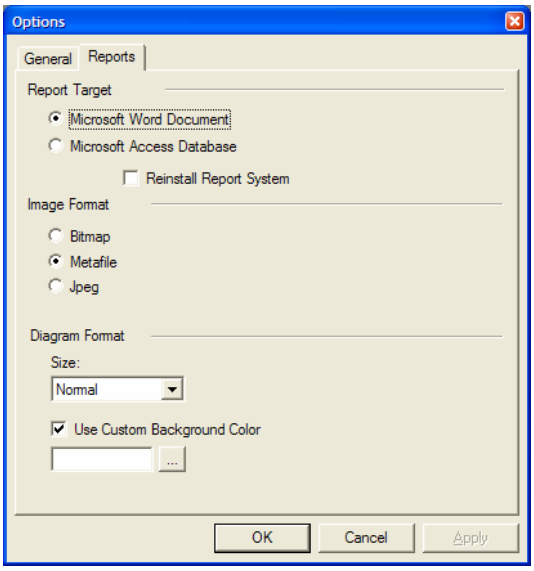
Performance

If your computer is quite slow, and you want to achieve better frame rates using the Realtime feature of Thermography Suite, try to select the "Assume Slow Graphics" check box.

Is this case Thermography Suite will use less processor time to draw diagrams and other graphics, though it will result in the quality loss (you may see flickering).

Reports

Report target



Select Microsoft Word to use the report generation system in Microsoft Word - recommended.

Select Microsoft Access to use the report generation system in Microsoft Access – not recommended.

Reinstall report system

If you experience some problems when working with the reports, select this check box and restart the application. During the next start report templates will be reinstalled and the Office part will be refreshed.

Image format

Select which format to use when exporting images into a Microsoft Office application. We recommend *Metafile*, but if you have problems with this format, try to use *Bitmap*.

Diagram format

Specify the size and the background color in which diagrams will be exported into Microsoft Office applications.

Appendix

B

Keyboard shortcuts

Thermography Suite has the following shortcuts for the frequently used operations:

Key combination	Action
Del	deletes selected objects
PageDown	switches to the next image of a sequence
PageUp	switches to the previous image of a sequence
Ctrl+E	modifies the emissivity value of an object or an image
F1	displays the help document
F3	displays the "Image Info" window
F4	display the "Temperature Range" dialog
Ctrl+A	selects all objects
Ctrl+C	copies the active object into the Clipboard
Ctrl+X	cuts the active object into the Clipboard
Ctrl+V	pastes an object from the Clipboard
Ctrl+R	copies an infrared image, spot measures, image information, profile and histogram diagram into the Clipboard in one bitmap
Ctrl+Shift+E	launches Thermography Explorer
Ctrl+O	displays the image open dialog
Ctrl+P	prints a report page
Ctrl+S	saves the active infrared image
Ctrl+M	switches into the *Image Subtraction* mode
Ctrl+T	switches into the *Image Composition* mode
Ctrl+Z	undoes the previous operation
Ctrl+Y	redoes the previously undone operation
Plus	zooms the image in
Minus	zooms the image out
Ctrl+Left	rotates the image 90° to the left
Ctrl+Right	rotates the image 90° to the right