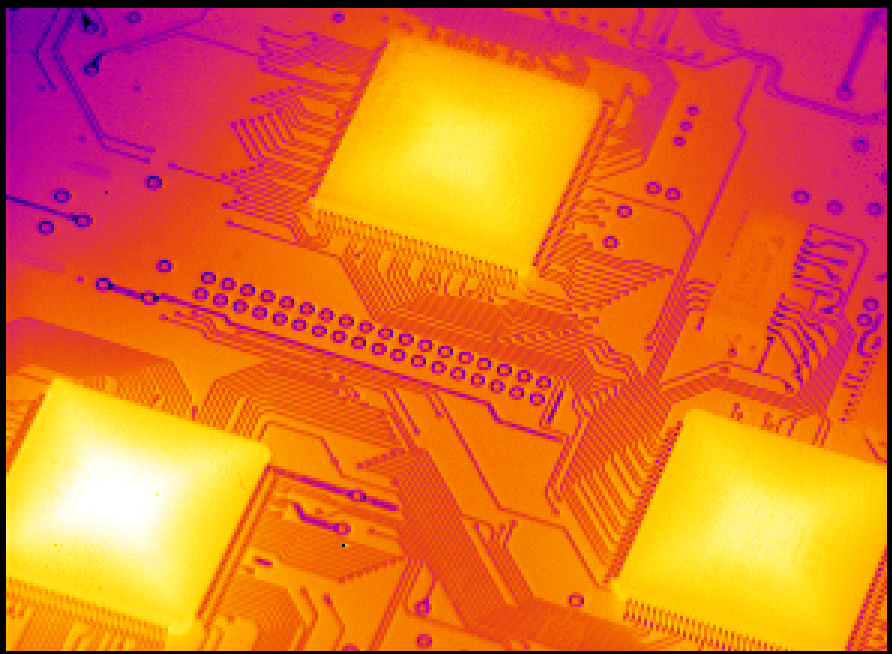
ThermaCAM™

Researcher 2001

Operating Manual

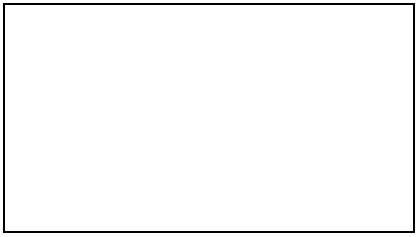


FLIR SYSTEMS

ThermCAM™ Researcher 2001

Operating Manual

Your license number is:



FLIR Publication number: 1 557 488 version A

Contents

1. General

1.1 Introduction

This is the user's manual of ThermaCAM™ Researcher 2001. We are convinced that this program will be a useful tool when you explore the fascinating world of Infrared Imaging and Measurements.

ThermaCAM™ Researcher has two hardware configurations, a PC Card camera interface and a Parallel camera interface. Both interfaces are used for several types of cameras. The manual covers both configurations and all cameras. Please make sure that the information you read is about the right camera with the right type of camera interface.

In the manual, you should be able to find detailed answers to these three types of questions:

- What kind of hardware and software is used? How is it to be installed?
- What is the software and Thermography like, in general?
- How should I use ThermaCAM™ Researcher, to get some particular result?

Since this is more like a reference manual than a tutorial, there will be rather detailed answers to those questions. It means that you probably only will study the manual in parts from time to time.

If you need the manual, but cannot find it, you can rely on that the same information is available as the help text of the program.

1.2 News in ThermaCAM™ Researcher 2001

Major new features, compared to ThermaCAM™ Researcher 2000 March Edition:

- The **PC Card Interface** can now be used **on Windows™ 2000 and Windows Millennium.**
- The images produced when connected to a new **ThermaCAM SC 2000 will not be leaning** strongly to the right.
- You can now set a **default session**. (A session which is read when the program starts.) See Session files on page 42.
- **Bendable lines now exist as a measurement tool on the IR images.** See The line tool on page 84.

- **Object signal** presentation can now be selected from the IR Image Settings. See Units of measure on page 39 and Measurement output and units, page 94.
- Images can now be saved in a **FLIR Public Image Format**, described in this manual. See The FLIR Public image format on page 97.
- Images saved in the **Matlab file format**, will now also have **information about the image**, in addition to the point values. See Studying whole images with Matlab on page 96.
- Temperature or Object signal **Subtraction of selected image files** is now available in the Recording menu. **Two new** special purpose **palettes** exist, intended for difference images. (midgreen and midgrey) See Subtracting selected images on page 77.
- A new **palette tool button** has been added to the standard tool bar.
- The **image replay rate** can be set via the new "*1" control on the play images toolbar. See The play images tool bar on page 72.
- **Trig counts** stored in the images are now displayed on the play images tool bar and in the result table. They are also available as OLE links. Plotting on stored trigs is also possible. See The Replay Settings dialogue on page 73 and How to trigger ThermaCAM Researcher from outside on page 63.
- **Formulas** can be applied to analysis results. An "f(x)" button has been added to the analysis tool bar. See The Formula tool on page 84.
- The **IR image** now has **menus** brought up by clicks on the right mouse button, through which its settings can be changed. The area symbol in focus will now highlight when the mouse cursor is moved in the IR-image.
- The mathematics that corrects for the effects of emissivity and atmospheric attenuation can now also handle **external optics.** See External optics transmission and temperature on page 38.
- For ThermaCAM SC 3000 cameras with **a high-speed option**, the image speed can be set from the camera control. See

The THV 500 Camera Control on page 54.

- **Striped burst volumes** can be **moved** between Windows 2000 computers. See Windows 2000 striped volumes on page 29.

1.3 Copyright

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2. PC Card Interface configuration

2.1 System parts ThermaCAM™ SC - PC Card Interface

This configuration is used for the following camera models:
Thermovision 550, Thermovision 570, AGEMA 550, AGEMA 570, ThermoVision Alert, ThermaCAM SC 500, ThermaCAM SC 2000 and ThermaCAM SC 3000.

Note: It is not used for ThermaCAM SC 1000.

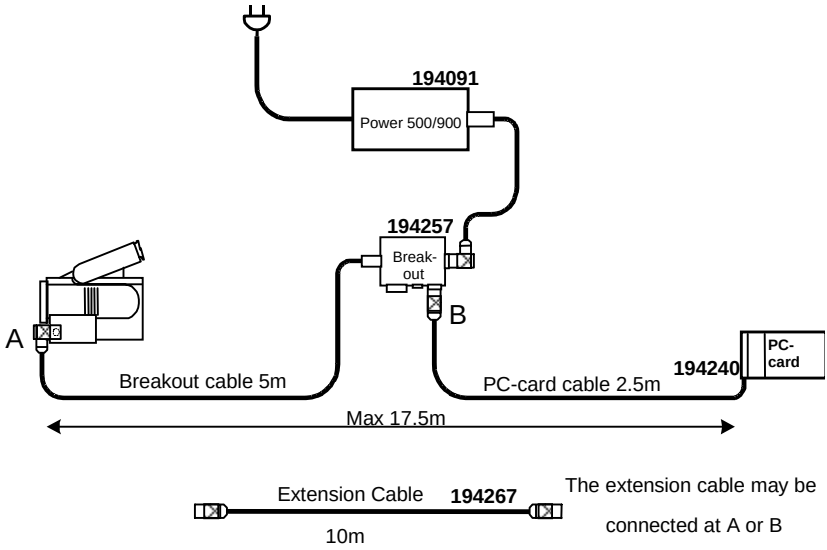


Figure 1: ThermaCAM™ SC - PC Card Interface system parts

- A **BreakOut Box** (194 257).
- A **PC Card Interface 500** (194 240). A PCMCIA-standardised card with a cable that fits into the "Remote" connector on the BreakOut Box.
- A **Power Supply 500/900** (194 091).
  (A ThermaCAM 5xx battery pack can also be used.)
- An optional **Extension cable.**
- The **ThermaCAM Researcher CD-ROM** (not shown) including PC driver software.

Note: For ThermaCAM SC 3000, the **BreakOut Box** can be omitted. Instead, connect the power supply cable to the Power inlet of the camera and plug the PC Card Interface into the Data connector of the camera, like this:

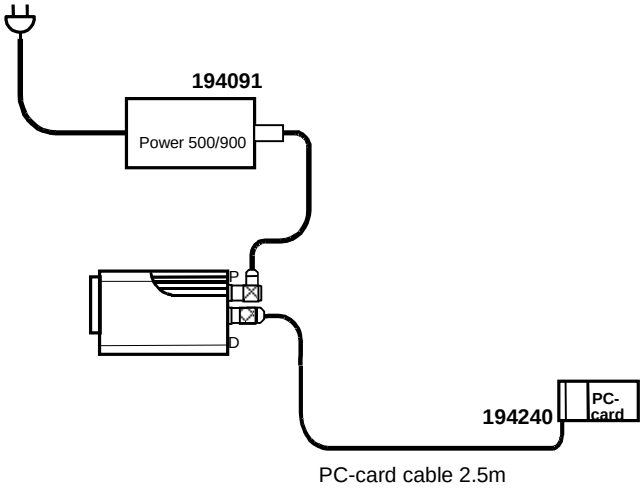


Figure 1a: ThermaCAM™ SC 3000 - Alternative configuration

Please make sure that the cables are connected in the right way. The connectors are of the same type, so you might make mistakes when connecting these cables. That cannot, however, harm the hardware.

Beware: You must not use the serial port connector (DSUB) of the Break-Out Box while the PC Card Interface is connected to it. That could harm the camera.

The computer side of the PC Card Interface has to be treated with care, since it is quite vulnerable to damage.

Please read Installing the driver software for the PC Card interface on page 16 as well.

2.2 System parts ThermaCAM™ SC 1000 - PC Card Interface

This configuration is used for only one camera model: ThermaCAM SC 1000.

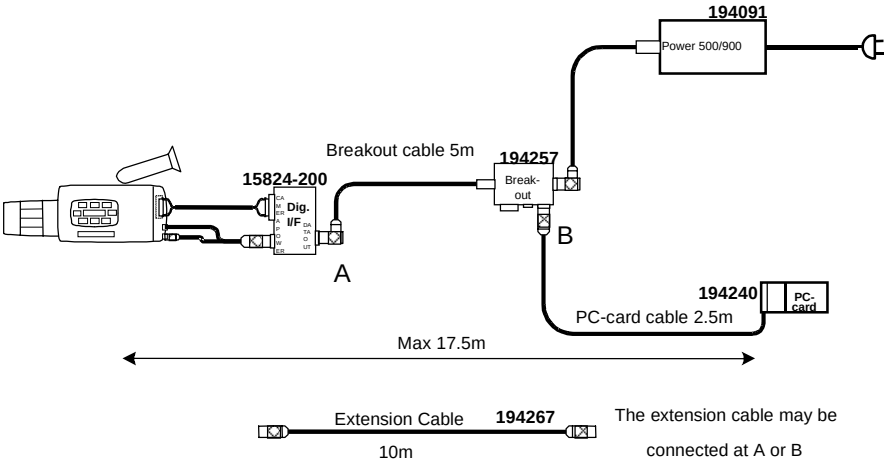


Figure 2: ThermaCAM™ SC 1000 - PC Card Interface system parts

- A **SC 1000 Digital Interface Box** (15824-200) with cables that connect to the SC 1000 battery connector, digital output connector and remote connector.
- A **BreakOut Box** (194257) with a cable that fits into the SC 1000 Interface box.
- A **PC Card Interface 500** (194240). A PCMCIA-standardised card with a cable that fits into the "Remote" connector on the BreakOut Box.
- A **Power Supply 500/900** (194091).
  (A ThermaCAM 5xx battery pack can also be used.)
- An optional **Extension cable** (194267).
- The **ThermaCAM Researcher CD-ROM** (not shown) including PC driver software.

Please make sure that the cables are connected in the right way. The connectors are of the same type, so you might make mistakes when connecting these cables. That cannot, however, harm the hardware.

The computer side of the PC Card Interface has to be treated with care, since it is quite vulnerable to damage.

Please read Installing the driver software for the PC Card interface on page 16 as well.

2.3 System parts Thermovision® 900 PC Card Interface

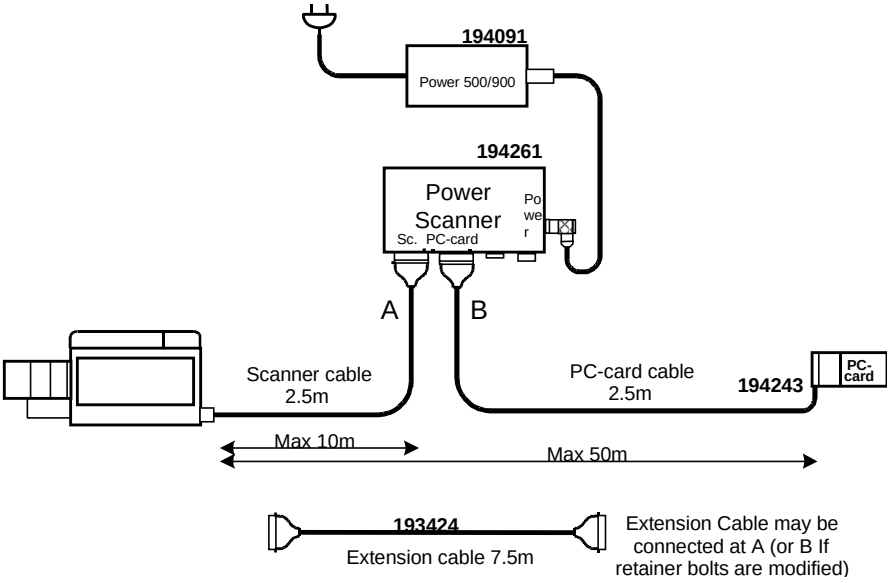


Figure 3:Thermovision® 900 PC Card Interface system parts

- A **PC Card Interface 900** (194243): A PCMCIA-standardised card with a cable that fits into the side of the Power Scanner box.
- A **Power Scanner 900** box (194 261).
- A **Power Supply 500/900** unit (194 091).
- An optional **Extension cable** (193424)
- The **ThermaCAM Researcher CD-ROM** (not shown) including PC driver software.

The computer side of the PC Card Interface has to be treated with care, since it is quite vulnerable to damage.

Please read Installing the driver software for the PC Card interface on page 16 as well.

2.4 System parts Thermovision® 1000 PC Card Interface

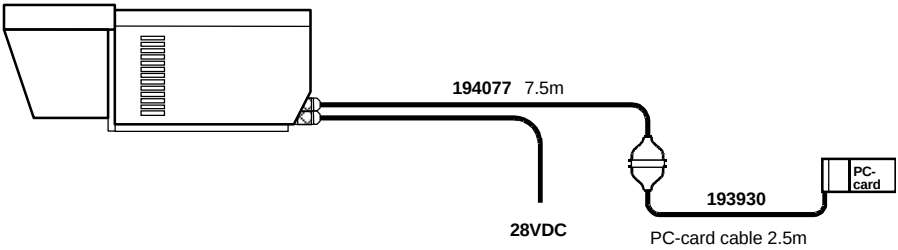


Figure 4 Thermovision® 1000 PC Card Interface system parts

- A **PC Card Interface 1000** (193930): A PCMCIA-standardised card with a cable that fits to the Thermovision 1000 scanner.
- The **ThermaCAM Researcher CD-ROM (not shown)** including PC driver software.

The computer side of the PC Card Interface has to be treated with care, since it is quite vulnerable to damage.

Please read Installing the driver software for the PC Card interface on page 16 as well.

2.5 Hardware limitations

Due to hardware and software driver limitations only one PC Card Interface 500/900/1000 can be inserted and functional at the same time. If you try to insert a second PC Card Interface, a hardware resource conflict will occur and the second card will not be configured correctly, which is indicated with a single low pitch beep.

2.6 Software limitations

The PC Card Interface configuration works on Windows 95, Windows 98, Windows Millennium, Windows NT 4.0 (with service pack 3 or higher) and Windows 2000. You might need a service pack on Windows 2000 to get your PC Card Adapter to work properly.

2.7 PC recommendations

To get a reasonably high performance you should have a Pentium desktop or laptop computer with a clock rate of 200 MHz or more. It should also have a fast display adapter and a fast hard disk.

Our recommendation is to set the Colour palette to 256 Colours. True Colour gives a lower frame rate, but better colour fidelity.

2.8 Installing the driver software for the PC Card interface

2.8.1 Windows NT 4.0

Please log in as Administrator during this installation.

First, install CardWare 6.00.007 (or higher), that allows you to insert and remove PC Cards while Windows NT 4 is running.

Then, insert the ThermaCAM Researcher CD-ROM into your CD drive. The CD-ROM will show a window of its own from which you can select to install Windows NT drivers. Start that installation utility and select "PC Card Interface" drivers only. Do not select any other drivers!

The installation utility will copy some files and update the Windows Registry.

2.8.2 Windows 2000

How to install the driver

Insert the PC Card Interface into the card adapter.

Windows™ 2000 will now detect the new hardware and display a **New Hardware Found** message together with a wizard dialogue. Insert the ThermaCAM Researcher CD-ROM into your CD drive. The CD-ROM will show a window of its own, but just remove that by clicking Exit. Follow the wizard instructions. When the wizard asks for search locations, check the **CD-ROM drives** option. In the last wizard step you should hear a double beep from the computer indicating that the resource allocation was successful.

Windows™ 2000 will then continue to install a second device, which is the imaging device. During the installation of this device, Windows™ 2000 will display a sign saying **Digital Signature Not Found.** Answer Yes here.

The third and last device installed is the communications port.

How to update an existing driver

Insert your PC Card Interface and your ThermaCAM Researcher CD-ROM. Remove the appearing CD-ROM window.

Go to the **Control Panel** and open the **System** icon and select the **Hardware** tab. Click on the **Device Manager** button:

> Open **Imaging devices** and double click on the **PC Card Interface** and then select the **Driver** tab. Click on **Update driver**.

Follow the instructions and when the wizard asks you what to do, select the **Display a list…** option and then click on the **Have disk…** button to make Windows read the driver from the CD-ROM. Select the appropriate driver from the list.

2.8.3 Windows 95/98/Millennium

How to install the driver

Insert the PC Card Interface into the card adapter. Windows™ 95/98/ME will now detect the new hardware and display a **New Hardware Found** message together with a dialogue. Insert the ThermaCAM Researcher CD-ROM into your CD drive. The CD-ROM will show a window of its own, but just remove that by clicking Exit. (If you have Windows™ 95 version A then select the alternative *Driver from disk provided by hardware manufacturer* and click OK, otherwise follow the wizard guide.) You should hear a double beep from the computer indicating that the resource allocation was successful.

Windows™ 95/98/ME will then continue to install the second device, which is the communications port. Windows™ 95/98/ME will display a sign saying **Unknown device**, which is quite all right. During the installation of the second device, Windows™ 95/98/ME may ask if you want to overwrite the communications port driver software provided by Microsoft. Please do not replace the existing one.

During the installation of the third and final device, the image device, Windows 95/98/ME will again display a sign saying **Unknown device**.

How to update an existing driver

If you have previously installed a device driver for a PC Card Interface, you may now need to update your driver.

Insert your PC Card Interface and your ThermaCAM Researcher CD-ROM. Remove the appearing CD-ROM window. Go to the **Control Panel** and open the **System** icon and select **Device Manager:**

Open **Multi-function adapters** and double click on the **PC Card Interface** and then select the **Driver** tab. Click on **Update driver**. Follow the instructions to make Windows read the driver from the CD-ROM. It takes a while for Windows to install the driver.

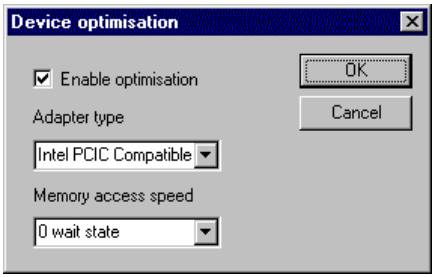
It may well happen that Windows does not find any new driver to load on the CD-ROM. This is quite OK, if you already have the most recent drivers.

2.9 Optimising the driver installation

The optimising option is only available if the PC Card interface is used under Windows 95/98/ME. The PC Card adapter in your system is initialised by the operating system. Three additional wait states are added to each memory access by default. Memory accesses are used by ThermaCAM Researcher to transfer images from the PC Card interface to the system memory.

If you have an Intel PCIC compatible controller in your PC Card adapter you can try to optimise the image transfer speed by reducing the number of PC Card memory wait states. Before you try this, make sure you have a PCIC compatible controller. This information can be found in the System Device Manager (Control Panel), under PCMCIA socket device properties. If you have a PCIC compatible controller from Cirrus Logic, it will require a different kind of optimisation compared to controllers from other vendors.

After you have installed ThermaCAM Researcher, select Optimise from the camera control panel. This dialogue box will then appear:



Check the "Enable optimisation" check box. Select the appropriate adapter type. The most common type is "Intel PCIC Compatible". Try with 0 wait states first. If you still have a live image the optimising is successful, otherwise go back to the dialogue and increase the number of wait states. Repeat this until you have a live image again.

2.10 Troubleshooting the PC Card installation

Problems with the PC Card Interface and its installation don't always show up immediately. You might not notice them until you try to get a live image from the camera.

Our experience is that hardware installations do not always run smoothly. A number of detailed suggestions on how to overcome known difficulties are available in an "InstHints" document on the ThermaCAM Researcher CD-ROM.

To work properly, the PC Card Interface configuration needs:

- A correct "Type of camera" and "Type of connection" setting in the Select Camera dialogue.
- One of the fixed I/O space range (3f8-3ff, 2f8-2ff, 3e8-3ef or 2e8-2ef).
- Interrupt request (IRQ) 3,4,5,7,9,10,11,12 or 15.
  An ISA-type interrupt is required, even for PCI bus adapters.
- A 4 kByte window in the computer memory.
- The fix addresses 380 to 387 in the computer I/O space.
- CardWare 6.00.007 (or higher) on Windows NT 4.0 installed by an administrator.
- Software for the three device drivers in Windows 95/98/ME/2000, just one on Windows NT 4.0.
- A successful installation of ThermaCAM Researcher.
- A functional PC Internal Card Reader on an ISA or PCI bus.
- A functional PC Card Interface.
- Reliable cables and electrical connections.
- A camera equipped with digital output.

The most frequent difficulties occur on laptop computers with lots of fancy equipment that occupy the scarce computer resources. Installation problems, such as only partly successful device driver installations are also rather frequent. Not to mention plain cabling problems.

This fairly simple troubleshooting scheme may help you locate your problem:

- When you insert the PC-Card Interface, you should hear a “happy” sound. If you don’t hear any sound at all or a “sad sound” there migh be something wrong with the PC Card Adapter (or its BIOS settings) or the installation of the drivers or a resource conflict.
- If you get a “happy” sound but ThermaCAM Reserarcher says Disconnected, one might still suspect the device driver installation. Only the presence of the first (out of three) device drivers is required to get a “happy” sound. Other possibilities are a resource conflict or that another instance of ThermaCAM Researcher already is connected to the camera.
- ThermaCAM Reserarcher does try to establish a connection with the camera using the serial communication port before trying to capture any images. If you get the Connecting… status text without any reply from the camera, there could be cabelling problems or problems with the BIOS settings for the PC Card Adapter or, simply, the wrong type of camera or connection type.
- If you get a serial connection to the camera (ThermaCAM Researcher says “Connected”) but no image, there might be some problem with the camera (such as insufficient cooling or hardware) or problems with the image flow (i.e. cabelling problems) or a computer memory window resource conflict.

For more information on how to deal with these matters, please check the InstHints document on the ThermaCAM Researcher CD-ROM.

3. Parallel Interface configuration

3.1 System parts ThermaCAM™ SC Parallel Interface

This configuration is used for the following camera models:
Thermovision 550, Thermovision 570, AGEMA 550, AGEMA 570, ThermoVision Alert, ThermaCAM SC 500, SC 2000 and SC 3000.

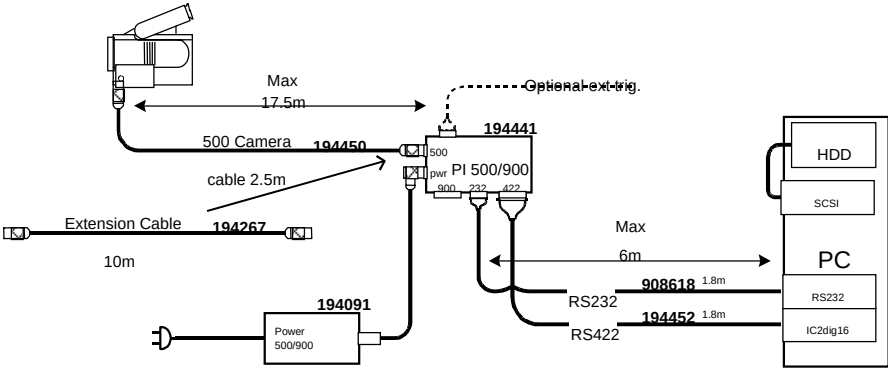


Figure 5 ThermaCAM™ SC parallel interface system parts

- **IC2-DIG16 frame grabber** (in the PC) from Imaging Technology Inc. in USA: A PCI-standardised card with a 44-pin DSUB cable that fits into the side of the **Parallel Interface (PI)**. A standard RS 232-C cable that connects a serial port in the PC with the Parallel Interface.
- A **Parallel Interface (PI) 500/900** box (194 441).
- **Camera cable 500** (194 450). For ThermaCAM SC 3000, plug this cable into the Data connector of the camera (not into the power inlet).
- A **Power Supply 500/900** unit (194 091).
- An optional **Extension cable** (194 267)
- The **ThermaCAM Researcher CD-ROM (not shown) including PC driver software.**
- A desktop computer with two striped SCSI disk for image storage.

Please read Installing the driver software for the IC2-DIG16 on page 30 as well.

3.2 System parts ThermaCAM™ SC 1000 Parallel Interface

This configuration is used only for one camera model: ThermaCAM SC 1000.

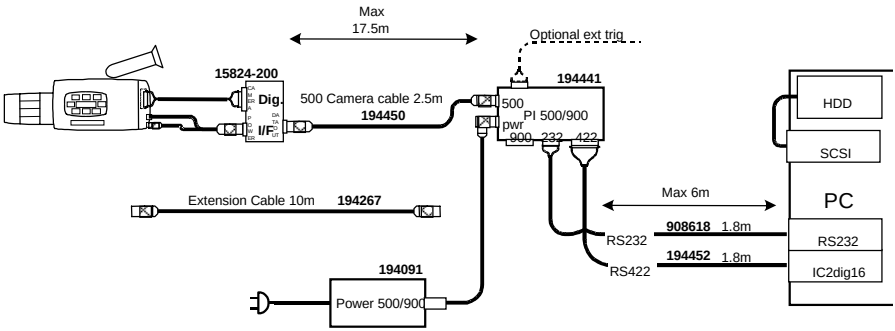


Figure 6 ThermaCAM™ SC 1000 parallel interface system parts

- A **SC 1000 Digital Interface Box** (15824-200) with cables that connect to the battery connector, digital output connector and remote connector of the SC 1000.
- **IC2-DIG16 frame grabber** (in the PC) from Imaging Technology Inc. in USA: A PCI-standardised card with a 44-pin DSUB cable that fits into the side of the **Parallel Interface (PI)**. A standard RS 232-C cable that connects a serial port in the PC with the Parallel Interface.
- A **Parallel Interface (PI) 500/900** box. (194 441)
- **Camera cable 500** (194 450).
- A **Power Supply 500/900** unit (194 091).
- An optional **Extension cable** (194 267).
- The **ThermaCAM Researcher CD-ROM (not shown) including PC driver software.**
- A desktop computer with two striped SCSI disk for image storage.

Please read Installing the driver software for the IC2-DIG16 on page 30 as well.

3.3 System parts Thermovision® 900 Parallel Interface

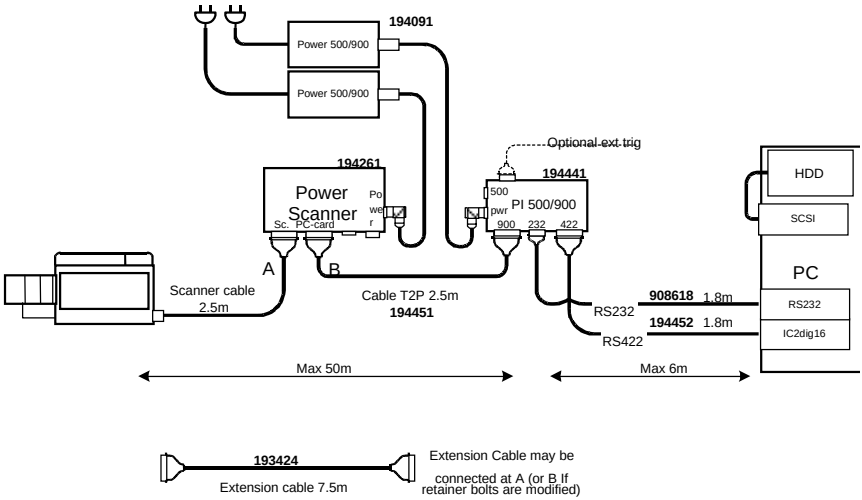


Figure 7 Thermovision® 900 parallel interface system parts

- **IC2-DIG16 frame grabber** (inside the PC) from Imaging Technology Inc. in USA: A PCI-standardised card with a 44-pin DSUB cable that fits into the side of the **Parallel Interface (PI)**. A standard RS 232-C cable that connects a serial port in the PC with the Parallel Interface.
- A **Parallel Interface (PI) 500/900** box. (194 441)
- A **Power Scanner cable** (194 451)
- A **Power Scanner 900** box (194 261).
- Two **Power Supply 500/900** units (194 091).
- An optional **Extension Cable** (193 424).
- The ThermaCAM Researcher **CD-ROM (not shown) including PC driver software.**
- A desktop computer with two striped SCSI disk for image storage.

Please read Installing the driver software for the IC2-DIG16 on page 30 as well.

3.4 System parts Thermovision® 1000 Parallel Interface

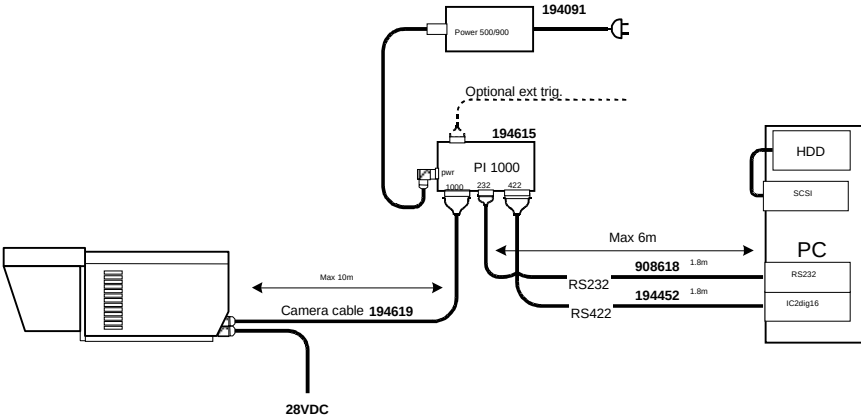
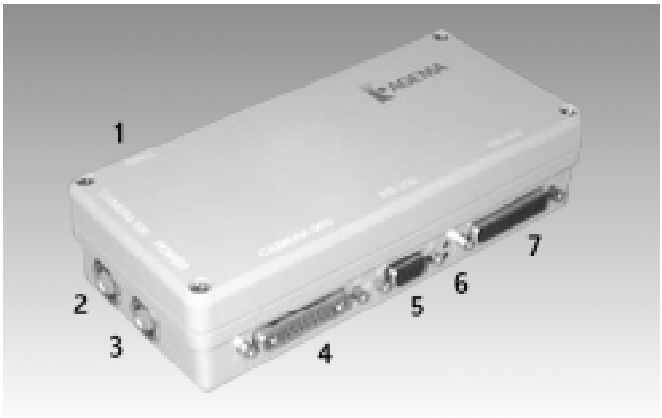


Figure 8 Thermovision® 1000 parallel interface system parts

- **IC2-DIG16 frame grabber** (in the PC) from Imaging Technology Inc. in USA: A PCI-standardised card with a 44-pin DSUB cable that fits into the side of the **Parallel Interface (PI)**. A standard RS 232-C cable that connects a serial port in the PC with the Parallel Interface.
- A **Parallel Interface (PI) 1000** box (194 615).
- A **Power Supply 500/ 900** unit (194 091).
- A **Thermovision 1000 Power Supply 28 VDC**
- The **ThermaCAM Researcher CD-ROM (not shown) including PC driver software.**
- A desktop computer with two striped SCSI disk for image storage.

Please read Installing the driver software for the IC2-DIG16 on page 30 as well.

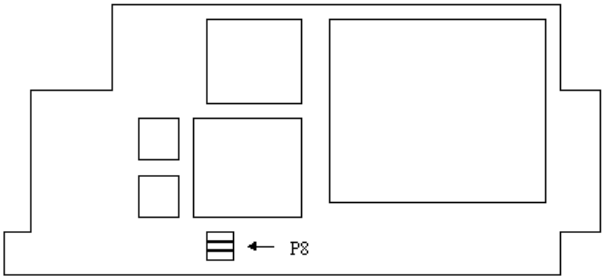
3.5 The parallel interface (PI)



There are two green LED's (6) between the RS232 connector (5) and the RS422 connector (7). When power is applied to the parallel interface, the bottom LED will flash for approximately 15-20 seconds indicating a boot phase. The parallel interface is ready when the bottom LED stops flashing. If the flashing continues a boot error has occurred. The top LED will start flashing (camera frame frequency divided by 8) when it detects an input signal on either Camera 900 or Camera 500 connector. If an input signal is detected on both connectors, then the Camera 900 input has priority.

The Parallel Interface is equipped with a trig input connector (DSUB-9 Male) which can be configured by modifying jumpers on the interface circuit board. The trig inputs are not debounced. The easiest way to test the TTL trig input is simply to ground the TTL input pin, which will create at least one negative flank and a trig signal.

Top view of the parallel interface circuit board.



Jumper	P8:1 Trig type	P8:2 Trig slope	P8:3
ON	TTL input *)	Negative *)	Not used
OFF	OPTO coupled	Positive	Not used

*) default setting

Pin description for the TRIG connector

Pin	Name	Direction	Description
1	OPTO+	Input	OPTO isolated trig input. Threshold 0.1 mA at 1.4 V >10 µs duration 1.5 mA at 5V / 15 mA at 24V Max 24 V cont. Used together with pin 6.
2	TTL	Input	TTL trig input. Threshold 1.2 V >1 µs duration Max 24 V cont. (12 mA)
3	VSYNC	Output	TTL synch. output. Pulse on first image pixel to frame grabber. 0 - 5V max 5 mA. Pulse width 62.5 ns (THV 500) or 125 ns (THV 900)
4	EXSYNCB	Output	TTL buffered synch. signal from THV 900 scanner. 0 - 5V max 5 mA
5	EXSYNC	In/Output	Synch. signal to/from THV 900 scanner
6	OPTO-	Input	OPTO return
7	GND		Ground for TTL signals
8	GND		Ground for TTL signals
9	RESERVED		

3.6 Software limitations

The frame grabber configuration works on Windows 95 (OS/R1), Windows 98, Windows NT 4.0 (with service pack 3 or higher) and Windows 2000 operating systems.

In Windows 95/98/ME, due to file system limitations you cannot get full burst recording rate for the cameras.

In Windows NT 4/2000, full burst rate recording of the cameras is only available when the target disk is equipped with a striped NT file system (NTFS).

Images can be stored on PC Card hard disks. Windows NT 4.0 will not allow you to insert or remove such disks at will. To access them you will have to restart the computer. Unicore Software Inc. (www.unicore.com) and SystemSoft Corporation (www.systemsoft.com) have released software packages (CardWare/CardWizard), which add PC Card hot swapping functionality to Windows NT 4.0. If you intend to use the PC Card Interface on NT 4, you have to install CardWare 6.00.007 (or higher) from Unicore.

3.7 PC recommendations

To get a reasonably high performance you should have a Pentium desktop computer with a clock rate of 200 MHz or more. To achieve burst recording it should have an internal or external SCSI striped disk set with the NT file system (NTFS).

The manufacturer of the IC-PCI frame grabber card does not recommend computers marketed for home use from Packard Bell, Compaq and Acer.

Our recommendation is to set the Colour palette to 256 Colours. True Colour gives a lower frame rate, but better colour fidelity.

3.8 Creating stripe sets and formatting NTFS disks in Windows

This applies to Windows NT 4 / 2000 only.

You must have Administrator privileges to carry out this work.

A stripe set (in Windows 2000 called striped volume) makes two or more physical disks appear as one single hard disk to the user. Data is written evenly across the physical disks. The usage of concurrent operations increases the speed of the disk I/O, and that is very important for burst recordings.

3.8.1 Windows NT 4.0 stripe sets

Note: Information about a stripe set is kept in binary format in the Registry of your computer. **You cannot move the Windows NT 4.0 striped disks to any another computer** and retain the data without moving this information as well. (Very difficult.)

Partition the Burst disks in Windows NT 4.0:

- Click on *Start, Programs, Administrative Tools, and Disk Administrator*. If Windows NT 4.0 asks if you want a disk *Signature,* click on the *Yes button.*
- When the disk administrator has started, click on SCSI *Disk 1*, press the Ctrl-button and click on SCSI *Disk 2*. (This will mark both disk 1 and disk 2. Make sure that no other disks are marked!) Open the *Partition* menu and select *Create Stripe Set.*
- On the *Create Stripe Set* dialogue, click on the OK button. Open the menu again and select *Commit Changes Now*... On the *Confirm* dialogue, click on the *Yes* button and press *Yes* again when asked to restart the computer.

Format the Burst disks in Windows NT 4.0:

Start the *Disk Administrator* again and click on SCSI *disk 1* (both *disk 1* and *disk 2* should now be highlighted). Open the *Tools* menu, select *Format...* On the dialogue change the *File System* selection to *NTFS*, mark *Quick Format* and click on the *Start* button. On the *Format* dialogue, click on the *OK* button. When the disks are formatted, select *Close*. Leave the *Disk Administrator*.

3.8.2 Windows 2000 striped volumes

Creating and formatting striped volumes in Windows 2000:

- Click on *Start, Settings, Control Panel.* Double-click on the *Administrative Tools* and *Computer Management* icons.
- When the Computer Management window has started, click on *Storage* and *Disk Management* in the left view. The two SCSI disks will now appear as basic disks, each one with a separate drive letter and a separate number, normally Disk 1 and Disk 2. If other numbers appear, please use them instead in the description below.
- Click with the right mouse button on the text "Basic" below the text "Disk 1". Select *Upgrade to dynamic disk* from the menu. *Mark the proper two SCSI disks* in the dialogue that appears. Click *OK*.
- From the same menu for Disk 1, select *Create Volume.* If the entry isn't active, you may have to select *Delete Volume* first.
- Press *Next* to skip the Welcome dialogue. In the next dialogue that appears, select *Striped Volume* as the volume type. Press *Next.*
- *Select the other SCSI* disk and press *Add*. Press *Next.*
- *Assign a drive letter* to the striped volume. Press *Next.*
- *Select the NTFS file system* for the new volume. Press *Next.*
- Check that the information on the last dialogue is correct. Press *Finish*. The formatting of the new volume will now begin.

Importing striped volumes in Windows 2000:

- To import a volume, striped on one Windows 2000 computer into another Windows 2000 computer, click on *Start, Settings, and Control Panel.* Double-click on the *Administrative Tools* and *Computer Management* icons.
- When the Computer Management window has started, click on *Storage* and *Disk Management* in the left view. The two SCSI disks will now appear as foreign disks, each one with a separate number, normally Disk 1 and Disk 2. If other numbers appear, please use them instead.
- Click with the right mouse button on the text "Foreign" below the text "Disk 1". Select *Import foreign disks* from the menu. *Mark the right two SCSI disks* in the dialogue that appears. Click *OK.*
- On the next dialogue, select an appropriate drive letter and click *OK.*

3.9 Installing the driver software for the IC2-DIG16

Note: When you start to use the IC2-DIG16 card, after having installed these drivers, it may happen that the computer does reprogram the prom of the IC2-DIG16 card and order you to restart the computer immediately. That is part of the normal installation routine for this card, and nothing to worry about, unless it happens more than once. You will have to be logged in as Administrator in NT for this reprogramming to be possible.

3.9.1 Windows NT 4.0

Insert the IC2-DIG16 frame grabber into a free PCI bus slot.

Please log in as Administrator during this installation.

Insert the ThermaCAM Researcher CD-ROM into your CD drive. The CD-ROM will show a window of its own from which you can select to install Windows NT drivers. Start that installation utility and select "Frame grabber" drivers.

The installation utility will copy some files and update the Windows Registry.

3.9.2 Windows 95/98/ME/2000

Insert the IC2-DIG16 into a free PCI bus slot. Windows™ 95/98/ME/2000 will detect the new hardware and display a **New Hardware Found** message (or **Multimedia Video Controller Found**) together with a Wizard dialogue. Insert the ThermaCAM Researcher CD-ROM into your CD drive. The CD-ROM will show a window of its own, but just remove that by clicking Exit. If you have Windows 95 version A then select the alternative *Driver from disk provided by hardware manufacturer,* otherwise follow the wizard guide.

3.10 Troubleshooting the frame grabber installation

Problems with the frame grabber and its installation don't always show up immediately. You might not notice them until you try to get a live image from the camera.

Our experience is that hardware installations do not always run smoothly. A number of detailed suggestions on how to overcome known difficulties are available in an "InstHints" document on the ThermaCAM Researcher CD-ROM.

To work properly, the frame grabber configuration needs:

- A correct "Type of camera" and "Type of connection" setting in the Select Camera dialogue.
- A standard serial port.
- Appropriate BIOS settings.
- Software for the device drivers on Windows NT/2000.
- A functional IC2-DIG16 frame grabber.
- A successful installation of ThermaCAM Researcher.
- A number of fix computer memory slots.
- An interrupt request (IRQ) of the right (PCI) type
- A Parallel Interface to convert the camera output.
- Reliable cables and electrical connections.
- A camera equipped for digital output.

The most frequent problem with the frame grabber installation are no doubt plain cabling connection difficulties.

This fairly simple troubleshooting scheme may help you locate your problem:

- If you get a message in the system event log on Windows NT 4 from the mvcntp device (= the frame grabber) or a warning symbol for the Imaging Device in the Device Manager on Windows 2000, then the BIOS settings for the frame grabber resources aren't OK. Check the interrupt types and make sure that the BIOS PnP OS flag is set to NO. Moving the frame grabber to another PCI slot might also help.
- If ThermaCAM Researcher says Disconnected, there is something wrong with the selected serial port or its settings. The serial port may also be occupied by another instance of ThermaCAM Researcher.
- ThermaCAM Reserarcher does try to establish a connection with the camera using the serial communication port before trying to capture any images. If you get the Connecting… status text without any reply from the camera, there could be cabelling problems or, simply, the wrong type of camera or connection type.
- If you get a serial connection to the camera (ThermaCAM Researcher says "Connected") but no image, there might be some problem with the camera (such as insufficient cooling or hardware) or problems with the image flow (i.e. cabelling problems) or the wrong type of interrupt for the frame grabber or a computer memory window resource conflict. Other PCI cards in the computer might be interfering with the frame grabber.

For more information on how to deal with these matters, please check the InstHints document on the ThermaCAM Researcher CD-ROM.

4. Application software installation

4.1 Installing ThermaCAM Researcher

ThermaCAM Researcher is designed to run on Windows™ 95/98, Windows™ NT 4, with service pack 3 or higher, Windows™ 2000, or Windows™ Millennium.

When you insert the ThermaCAM Researcher CD-ROM into your computer, a window will appear, from which you can start the installation of the application and of the NT 4.0 drivers.

(You may already have installed the NT 4.0 or Windows 95/98/2000/ME drivers, else see Installing the driver software for the PC Card interface on page 16 or Installing the driver software for the IC2-DIG16 on page 30.)

If you have Windows™ NT 4.0 or Windows 2000, log in as Administrator during the installation.

Click on ThermaCAM Researcher to start the installation. It is made by a utility program, which will guide you through the installation steps, and do most of the work for you. If you are asked to restart Windows, please do that before continuing with the installation.

During the installation of ThermaCAM Researcher, you will be asked to type in your license number. The license number is unique, and can be found on the first page of the manual.

The directory structure of ThermaCAM Researcher is pre-set. The only adaptation you can make during the installation is to change the name of the directory in which the program is installed.

After the installation, you will be able to start ThermaCAM Researcher from the Programs entry of the Start button menu. Until you have installed the PC Card Interface or the frame grabber and their drivers, you will however not be able to connect to the camera, only to work with disk images.

4.2 Where do the installed files go?

On all Windows™ systems, the installation program builds a new directory tree, normally at C:\Program Files\ThermaCAM Researcher XXXX, containing the following files:

Researcher XXXX\	Executable files, help file, OLE type library.
…\Examples	Sample Excel files with their session files.
…\Images	Sample Image files
…\Palettes	Palette files (scale colour definitions).

The installation also adds some executable files into the main Windows directories.

On Windows™ 2000, which is a multi user system, only administrator users may create and update files in the common Program Files directory. Ordinary users are not permitted to do that. Ordinary users have a place of their own where they can keep the data files of their programs. It is called “My Documents”.

On Windows™ 2000, the \Examples, \Images and \Palettes files are copied to a ThermaCAM Researcher XXX subdirectory of the “My Documents” directory of each user when he, or she, starts to use the software. Then each user easily can modify them separately.

(These “My Document” files are not removed by an un-installation.)

5. About Thermography

5.1 Introduction to Thermography

The infrared camera measures and images the emitted infrared radiation from an object. The fact that radiation is a function of object surface temperature makes it possible for the camera to calculate and display this temperature.

However, the radiation measured by the camera does not only depend on the object temperature but is also a function of its emissivity. And, radiation that originates from the surroundings becomes reflected in the object. Moreover, radiation from the object and the reflected ambient radiation are influenced by the absorption in the atmosphere and in any external optics it passes through.

To measure temperature accurately, it is therefore necessary to compensate for the effects of a number of different radiation sources. The following object parameters must be supplied:

- Emissivity
- Ambient temperature
- Atmospheric temperature
- Distance
- Relative humidity of the air
- External optics transmission and temperature

5.2 Emissivity

The most important object parameter to set correctly is the emissivity, which, in short, is a measure of how much radiation is emitted from the object compared to that if it were a perfect blackbody.

Normally, object materials and surface treatments exhibit emissivities ranging from approximately 0.1 to 0.95. A highly polished (reflective) surface falls below 0.1, while an oxidised or painted surface has much higher emissivity. Oil-based paint, regardless of colour in the visible spectrum, has an emissivity over 0.9 in the infrared. Human skin exhibits an emissivity close to 1. Non-oxidised metals represent an extreme case of almost perfect opacity and high specular reflectivity, which does not vary greatly with wavelength. Consequently, the emissivity of metals is low - only increasing with temperature. For non-metals, emissivity tends to be high, and decreases with temperature.

Typical emissivities for a variety of common materials are listed in the table below. The values are meant to be used only as a guide and can vary depending on many different factors.

Metals and their oxides		Temp°C	Emissivity
Aluminium:	foil (bright)	20	0.04
	weathered	20	0.83 - 0.94
Copper:	polished	100	0.05
	heavily oxidised	20	0.78
Iron:	cast, oxidised	100	0.64
	sheet, heavily rusted	20	0.69 - 0.96
Nickel:	electroplated, polished	20	0.05
Stainless steel (type 18-8):	polished	20	0.16
	oxidised	60	0.85
Steel:	polished	100	0.07
	oxidised	200	0.79

Other materials		Temp°C	Emissivity
Brick:	common red	20	0.93
Carbon candle soot:		20	0.93
Concrete:	dry	35	0.95
Glass:	chemical ware	35	0.97
Oil:	lubricating	17	0.87
	film thickness 0.03 mm	20	0.27
	film thickness 0.13 mm	20	0.72
	thick coating	20	0.82
Paint:	oil, average of 16 colours	20	0.94
Paper:	white	20	0.07 - 0.90
Plaster:		20	0.86 - 0.90
Rubber:	black	20	0.95

Skin:	human	32	0.98
Soil:	dry	20	0.92
	saturated with water	20	0.95
Water:	distilled	20	0.96
	frost crystals	-10	0.98
	snow	-10	0.85
Wood:	planed oak	20	0.90

5.3 Finding the emissivity of an object

We need to know the emissivity of an object in order to be able to calculate its temperature. If, on the other hand we know the temperature of the object, and it is far above or below the ambient temperature, then the emissivity can be calculated from the shown (faulty) value of, for instance, a measurement area.

One way to measure the temperature is to use a thermocouple.

Another way is to put a piece of tape or paint of a known emissivity onto the object and make the camera measure the temperature in that way.

Use the emissivity calculation function of ThermaCAM Researcher to calculate and apply the new emissivity, see Emissivity calculation on page 91.

5.4 Ambient temperature

This parameter is used to compensate for the radiation reflected in the object.

In some cameras, it is also called Background temperature.

If the emissivity is low and the object temperature relatively close to that of the ambient it will be very important to set and compensate for the ambient temperature correctly.

5.5 Atmospheric temperature, humidity and distance

These parameters are used to correct for the fact that radiation is being absorbed in the atmosphere between the object and the camera and the fact that transmittance drops with distance.

If the humidity of the air is high, the distance very long and the object temperature relatively close to that of the atmosphere it will be important to set and compensate for the atmosphere correctly.

The distance is the distance between the object and the front lens of the camera.

The transmittance is heavily dependent on the relative humidity of the air. To compensate for this, set the relative humidity to the correct value. For short distances of air with normal humidity, the relative humidity can usually be left at a default value of 50 %.

If you have a better estimate of the properties of the atmosphere than the built-in model has, you can enter your estimated transmission value instead.

To avoid applying this type of compensation, please set the estimated transmission to 1.0.

5.6 External optics transmission and temperature

Sometimes, the radiation from the object also has to pass through some optical accessory, such as a heat shield or a macro lens, before reaching the camera. Then that optics, external to the camera, will absorb some of the radiation. To correct for this effect, enter the transmittance and temperature of the optics.

Ambient reflections in the external optics are not taken into consideration mathematically, so the optics either has to have a non-reflective coating or have the same temperature as the ambient (on the camera side) to make the correction work properly.

Please avoid ambient reflections. Do, for instance, make sure that the camera cannot see itself mirrored in the external optics.

To avoid applying this type of compensation, please set the external optics transmission to 1.0.

5.7 Infrared spectral filters

Any object, with a temperature above 0 Kelvin, will emit electromagnetic radiation over a wide spectrum. The hotter the object, the stronger and wider the radiation, and the shorter its wavelength. Infrared detectors are only sensitive in parts of the infrared waveband. This means that the temperature calculations in infrared cameras make assumptions about the amount of radiation present in other wavebands.

Infrared cameras are calibrated with a set of standard blackbodies at various temperatures. Any object in air, behaving like a blackbody, can thus be treated

properly by the camera. Sometimes, there are different conditions. Hot gases, for instance, emit radiation only at discrete wavelengths, “stripes”. Cold gases absorb radiation in stripes. To be able to make accurate measurements under such circumstances, you have to use the right spectral filters.

5.8 Units of measure

Thermography really means making images of thermal surface property variations of objects. The most natural property to measure is of course temperature, which has the units Celsius, Fahrenheit and Kelvin in ThermaCAM Researcher.

Another interesting property is the total amount of radiation emitted from the object but, since the infrared camera is sensitive only to parts of the spectrum, no accurate such measurement can be made. Hence no standardised unit is available for radiation display. Instead, the non-calibrated unit “Object Signal” (abbreviated OS) has been invented. Being approximately proportional to the amount of radiation sensed by the camera detector, it can be used for comparative radiation measurements within the same measurement range for the same camera. If you intend to use it in some other way, you have to provide a calibration of your own.

Some measurements, such as the standard deviation, produce a result which best could be described as a “Difference Temperature” (or “Difference Object Signal”). They involve a subtraction, which cancels out the existing absolute level. A standard deviation of 2.5 at 25 °C is the same thing as a standard deviation of 2.5 at 50 °C. In such cases, the units DeltaCelsius (dC), DeltaFahrenheit (dF), DeltaKelvin (dK) and DeltaObjectSignal (dOS) apply.

6. About the program

6.1 Basic principles for ThermaCAM Researcher

The main purpose of this program is to deal with live IR images arriving through a Camera interface. It can also receive IR images from other media, such as PC Card hard disks from ThermaCAM cameras.

The program can make studies on high/medium/slow speed thermal events depending on the hardware configuration. It can show IR images, record them on disk and analyse them afterwards during their replay. It can provide measurement result values directly from the live stream of images too, but only for the images you decide not to record.

The measurements are made with the following analysis tools: isotherm, spotmeter, area and line. The results produced by these tools can be displayed within the IR image, in the profile window, in the histogram window, in the result table window, or in the plot window. Formulas can be applied to the results.

The program uses a set of predefined screen layouts, one for each type of work that you could have in mind.

You can also extract information from ThermaCAM Researcher by using OLE (which is an automatic way of transferring information between programs running under MS Windows) to bring the information into for example Excel or Word. The IR image can be transferred in the same way.

Images can also be transferred to ThermaCAM Reporter for analysis and report generation. The clipboard functions **copy** and **paste** are used for this purpose.

Several copies of ThermaCAM Researcher can run at the same time, but only one at a time can be connected to the camera interface.

6.2 Working with ThermaCAM Researcher

A typical user of the PC Card Interface configuration of ThermaCAM Researcher would probably install it both on a laptop computer, which easily can be brought along to the site where the data is to be collected, and on a stationary computer connected to a network with printers and disks on it.

A typical user of the Parallel Interface configuration of ThermaCAM Researcher would install it on a fast desktop computer, which permanently is located at the site of some important experiment. The Parallel interface cannot be installed on a laptop.

At the site, the user would set up the camera, connect it to the computer and start recording.

Some users will record images, lots of images, and go back home in order to study them. Others will immediately make measurements and simply record a few values on paper or in a spreadsheet and forget about the images on which they are based. Some users are satisfied with the temperature measurements as such, others want mathematical functions of temperature or to correlate the measurements to something else, like pressure or vibration or the incidence of some event.

Being careful when setting up the camera will normally improve the measurement results. This could mean measuring the object parameters carefully, avoiding creating images containing reflections from strong heat (or cold) sources in the neighbourhood, using a spectral IR-filter which is appropriate for the application and so on.

Before studying the recorded images, one has to pick out and examine the really interesting ones. Then one normally finds that something has to be done to them before the actual analysis begins. The emissivity factor might be wrong, or the temperature scale limits or the analysis tool is missing or whatever. (The images recorded by ThermaCAM Researcher do not contain any analysis; it has to be added on.)

In this preparatory step, the user will scan through all the images, noting the interesting ones, grouping them and preparing them for analysis. This involves either applying a correction to each individual image, actually changing the file, or using a standard correction replacing some parameter of the images but not changing the images themselves.

The standard correction is, in this program, often indicated by the word “lock”. It is possible to lock the temperature scale, lock the object parameters the analysis functions and lock the zoom factor. This means for instance that you can apply your favourite temperature scale to an image by locking the scale and setting it to your favourite values. The current image, and the ones that follow, will be **presented** with your favourite scale despite having another scale stored inside them. When you unlock the scale, the original scale of the image will reappear.

The actual analysis involves playing through the images once more, taking values from the analysis tools of the images and comparing them to what was expected.

The analysis might be preceded by a conversion of some kind, such as image subtraction.

The results of the study might become an important part of a research report, a graph or a set of images supporting some vital conclusion.

6.3 The list of current image files

When you store images with ThermaCAM Researcher you can either store them one by one, giving each image a characteristic file name, or store them as a sequence thus indicating that they have something in common.

Such a sequence of IR images is recorded in an image directory either as separate files or in a single file. This is a decision you take when you set the recording parameters.

When the recording is finished, the sequence recording function assumes that you would like to replay and analyse the new images. It creates a list of the image files concerned and keeps it until the next recording.

This list, a group of names of image files in the same directory, is what still keeps the sequence together. You may change the list at will, adding or removing file names, but then the sequence concept is lost.

You can actually group any images you like into a fake sequence. The only restriction is that they have to be stored in the same directory on the disk. You do not have to include all the images of the directory.

Single file image recordings are normally quite large. ThermaCAM Researcher has functions that will let you edit these files. Then you are supposed to first open all images and then mark the images to be removed or copied as a selection.

6.4 The image directory

All the images of the same recording are placed in the same directory on disk. We call it the image directory. The full path name of the image directory is displayed in the program title bar. You should set it when you determine the conditions for image recording (or when you create a new image list out of pre-recorded images).

6.5 Session files

You often need to be able to recreate particular situations (such as an experiment) during your work. ThermaCAM Researcher uses session files for this purpose. It stores for example the names of the currently open images in its session files. They do however not contain the images themselves. (You will notice this, if you save your session while looking at a frozen live image. When the session is recreated, the former live image is gone.)

The full path name of the image directory is also stored in the session file.

If you move the images (or try to reach them from another computer in which the image directory has another path), you will have to correct this path in order to be able to see the images again.

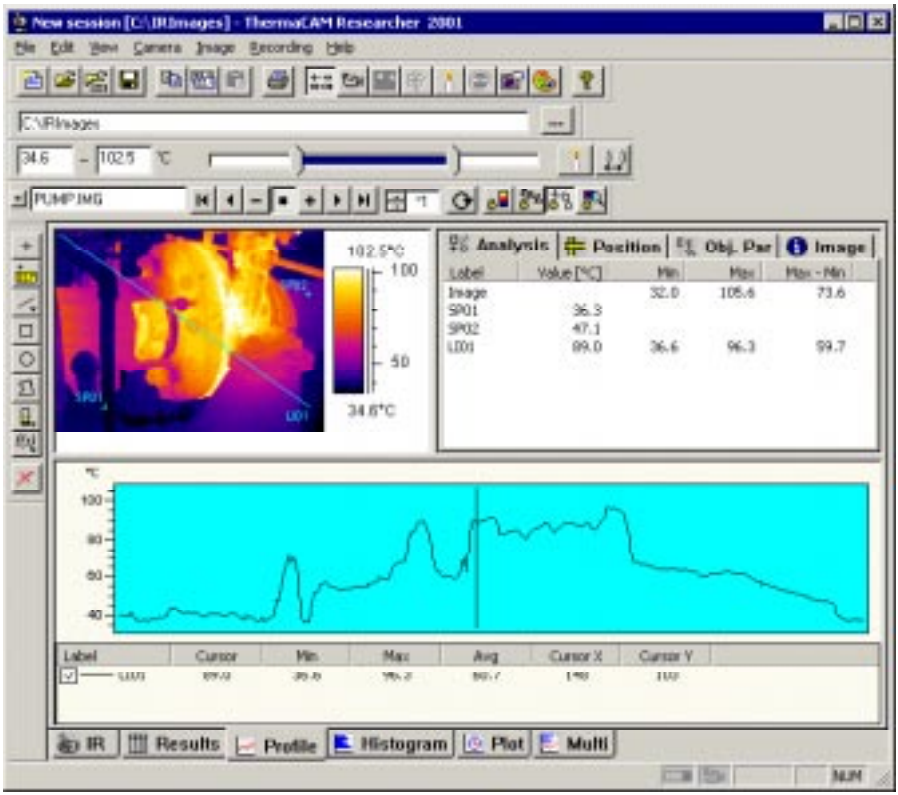
Normally, every recording of images would be ended with the creation of a session file. It would usually be placed in the same directory as the images, but that is not a requirement. Later, when you start analysing the images, you pick up the session file, add analysis tools or other settings to it and save it to disk again. The session files do not contain any images or analysis results, only file names and information about the program settings.

You may select a session file to become the default session. This means that every time you start ThermaCAM Researcher or order a brand new session, the default session settings and images will be fetched. The Set Default Session command is in the File Menu.

Should you wish to avoid reading the default session, please press the keyboard shift button while ThermaCAM Researcher starts.

You deselect the default session by opening the default settings dialog and pressing the Cancel button.

6.6 Program screen layout



There are several layout options available. These are controlled by tabs in the bottom part of the ThermaCAM Researcher window. You can see combinations of the IR image, the profile, the histogram, the plot and the result table windows. All tabs have an IR image with a temperature scale in the top left corner.

You cannot reposition the windows within the tabs, but you can catch and move the splitter bars that separate the windows, thus increasing or diminishing the relative size of each of the windows.

You can copy the whole program window to the clipboard by pressing the Alt + PrintScrn key buttons. You can also save the current tab as a bitmap by the command "Save Tab As" in the File Menu

The program can only show one image at a time. On the image, the analysis tools are displayed. The results of the analysis tools can be displayed in the histogram, profile, plot or result table window.

The main layout of the program is pretty much like any other Windows program. On the top line of the program window, there is a title containing a session name, the image directory and the three buttons, minimise, maximise and close, from left to right. The same functions are available on the right mouse button menu of the top line.

Below the top line, there is a set of drop-down menus by which you can select functions related to session/image filing (File), the Clipboard (Edit), the screen layout (View), the camera (Camera), the display and analysis of the image (Image) and the recording/playback of images (Recording).

There is also a large number of toolbar buttons. There are tool buttons for almost every function of the program. Every tool button has a short yellow description that will pop up if you hold the mouse cursor still for a while on top of it.

The tool bars are normally docked to the borders of the program window, but can be undocked and placed anywhere on the screen. Just double-click on them.

There is also a floating camera control panel that can not be docked to the program window. Use it to change the camera measurement range and affect how the live image is generated.

At the bottom of the program window, on the status line, a more detailed description of the menu items and tool bar buttons will be shown while you sweep through menus and over the tool buttons by the mouse cursor. Towards the right of this status line, there are indicators of the Interface status and the Camera status as well as keyboard indicators for Caps Lock and Num Lock. You can click on the Interface and Camera indicators and get further information about the interface and the camera.

The following buttons exist on the standard tool bar:

- Create a new session.
- Open an existing session.
- Open/Add images to the current session.
- Save the current session using the current name.

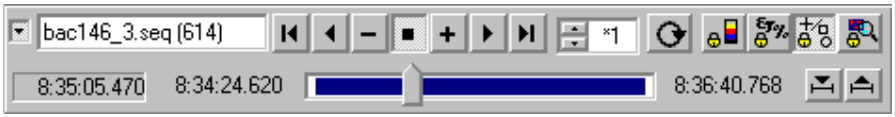
- Copy the session file and the current image to the Clipboard
- Copy values, such as analysis results, as text to the Clipboard.

- Paste a copied session into ThermaCAM Researcher. The name of the session is not pasted.
- Print the current image.

- Select disk images as the image source.
- Select the live camera as the image source. This button is “down” indicating that a camera image is being shown.
- Move the camera focus towards infinity.
- Move the camera focus towards the lens.
- Switch on the function Automatic adjustment of the image scale.
- Freeze the live stream of images from the camera.
- Bring up the image settings dialogue window.
- Bring up the palette selection dialogue.

- Bring help from the manual.

The following functions exist on the play images tool bar:



Top row:

- Show second row: on/off.
- Name of the current image. (You may type a name or number in this field.)
- 7 VCR style playback buttons. Stop in the middle.
- A control by which the replay rate is controlled.
  ”*1” means full speed from disk.
  “*2” means twice full disk speed (i.e. every other image is not shown) and
  “÷2” means half full speed.
- Auto rewind button.

- The “lock temperature scale” button.
- The “lock object parameters” button.
- The “lock analysis tools” button.
- The “lock zoom factor” button.

The “lock” buttons will, when pressed down, let you keep the same temperature scale / object parameters / analysis tools / zoom factor for all images being replayed, regardless of what is stored inside the images. When you “lift” these buttons, the information of the images will be used instead.

Second row:

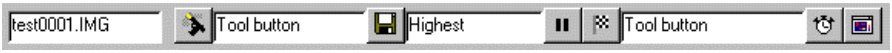
- Current image time/frame/trig count.
- First image time/frame/trig count.
- Slider. Move fast within your image sequence. The first image is to the left.
- Last image time/frame/trig count.

The time/frame/trig count field depends on the Presentation selection in Replay Settings in the Recording menu. It is either absolute image time, relative time to first frame, frame number or trig count.

- Set selection start.
- Set selection end.

"Start" is always to the left of "end". The slider will highlight the selected area within the sequence with a blue colour.

The following functions exist on the recording tool bar:



- Name of the next image to be recorded.
- Start button.
- Start condition field.
- Record one image button.
- Recording condition field.
- Pause button.
- Stop button.

- Stop recording condition field.
- Bring up the recording conditions dialogue window.
- Replay the recorded sequence in a separate copy of ThermaCAM Researcher.

The following functions exist on the image directory tool bar:

- The image directory. (You may edit this field to change it.)
- Browse existing directories.

The following analysis tools exist:

- Spot meter.
- Flying spot meter. (Uses the mouse cursor.)
- Line, with cursor.
- Box area.
- Circle area.
- Polygon area.
- Isotherm (above, below, interval).
- Formulas
- Removal tool.

The following functions exist on the scaling tool bar:

- Scale max temperature field. Editable.
- Scale min temperature field. Editable.
- Current measurement unit indicator.
- Slider for the scale max and min temperature. Drag with mouse. Min is to the left.
- Automatic adjustment of the scale to the image: on/off.

- Lock span: on/off. (Changes apply only to the level.)

The highlighted region in the sliders indicates the span of temperatures in the image. By selecting Auto Adjust, you will place the slider markers close to the ends of the highlighted area, but still inside it. A small part of the span is thus "wasted".

6.7 Shortcut keys

Menu selections can be made from the keyboard. Press Alt + the key indicated on the menu line by an underscore. This brings up the menu. Then press the key indicated in the menu by an underscore to select that item.

In addition to the tool bars, there are a number of shortcut keys on the keyboard by which important functions can be reached:

Ctrl + A	Auto adjust image
Ctrl + C	Copy session and image
Ctrl + D	Play recorded sequence
Ctrl + F	Freeze/Unfreeze image
Ctrl + I	Open disk images
Ctrl + L	Show live images
Ctrl + N	New session
Ctrl + O	Open session
Ctrl + P	Print
Ctrl + V	Paste session
Ctrl + S	Save session
Ctrl + R	Autorewind mode on/off
Ctrl + T	Show the camera control
Ctrl + Tab	Next main tab
Ctrl + Shift + Tab	Previous main tab
Home	First disk image
End	Last disk image
F2	Play backwards

F3	Stop playing
F4	Play forwards
Ctrl + F2	Step backwards
Ctrl + F4	Step forwards
Shift + F2	Fast backwards
Shift + F3	Stop
Shift + F4	Fast forwards
Ctrl + Shift + F4	Set selection end (within sequence)
Ctrl + Shift + F2	Set selection start (within sequence)
Page up/down	Changes min scale temperature
Ctrl + Page up/down	Changes max scale temperature
F5	Image recording keyboard trig
F8	Freeze/Unfreeze image
F11,F12	Camera focus
Alt + F4	Exit

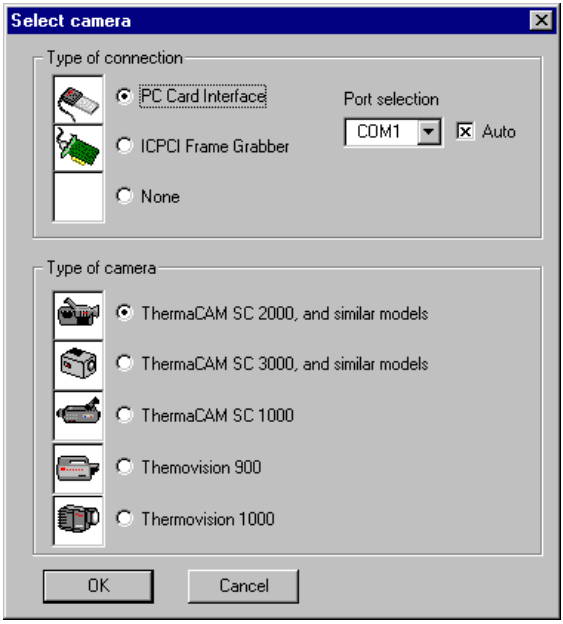
(All shortcuts do not work in OLE embedded mode.)

7. How to....

7.1 How to begin using a camera

We recommend that you connect the cables, insert the PC Card Interface or power up the parallel interface and start the camera before starting the ThermaCAM Researcher program. The computer may play a little tune, often a double beep, when the PC Card is inserted or removed.

The first time you run ThermaCAM Researcher, you will have to indicate which type of camera you have got and how it is connected physically. This dialogue automatically shows up:



You do have to bring up this dialogue yourself (from the Camera menu), if you want to change the selected camera type or connection.

When you are using the ICPCI frame grabber, you must indicate to which serial port the cable from the parallel interface box is connected.

When you are using the Parallel Interface, you have the option of specifying the serial port or letting ThermaCAM Researcher find it for you (recommended).

7.2 How to connect and control the camera

In order to be able to show a live image, ThermaCAM Researcher has to establish a software connection to the camera. The status information of the Camera Control panel will reveal if the program is trying to connect to the camera or not. If it says Disconnected, you will have to order a new connection by selecting Connect from the Camera menu.

If ThermaCAM Researcher is showing a disk image, you will have to select Show Camera Image from the Camera menu or press Ctrl + L or push this tool button to make the program consider connecting to the camera and displaying its image.

The purpose of doing these soft connections/disconnections is that it enables you to run two or more copies of ThermaCAM Researcher. You can disconnect the camera from one copy and connect it to another instead.

After the connection is established, it may still take some time before the logo image disappears. The camera has to run for a while, before its detector is cool enough to produce a live image.

The first time a SC 1000 camera is connected, a large calibration file will be unloaded from the camera, before a live image can be shown.

If you get into connection difficulties here, see About connection difficulties on page 59 for more information.

Note: Do not remove the PC Card or switch off the camera while ThermaCAM Researcher is running unless you have selected Disconnect from the Camera menu first.

The Camera Information dialogue and the Camera Control panel are the two main ways by which you communicate with the camera.

Take a quick look at the Camera Information dialogue, which can be reached from the Camera menu or by clicking on the Camera symbol to the right on the status line below the image. It will probably show the name of the camera and that it is working. Otherwise the reason of failure is displayed here (or in the Device Status panel displayed if you click on the Interface symbol to the lower right of the program window).

Let’s OK the Information dialogue and take a quick look at the Camera Control panel. We will study it in more detail in the next sub-chapters.

Let's examine the Measurement Range list. Select a range, which covers the expected measurement temperatures. The range limits are blackbody temperatures, so if your measurement target has a shiny surface with a low emissivity, you will be able to make measurements above the range limits.

An image, which is probably blurred, is shown on the screen. Otherwise, press the candle tool button to get a better scale in the PC. Some cameras have their own ways of adjusting the image and improving its quality. See the appropriate camera control description below.

Aim the camera onto the target. Time to focus the camera! You can either use the focus buttons on the Camera Control panel or the two buttons below (found on the Standard Toolbar). You also have the option to use the F11/F12 keys.

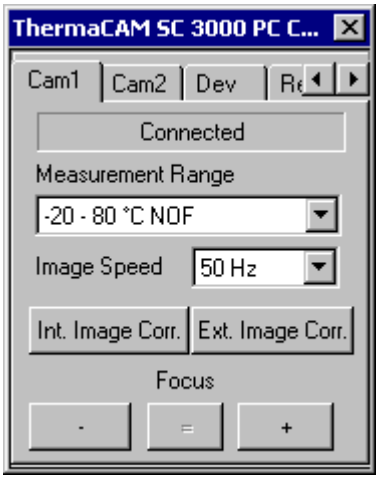
Hold down the button in order to run the focus motor of the camera towards infinity or towards the lens. Release the button when the focus is OK, or rather slightly before. There is a small delay before the focus motor stops.

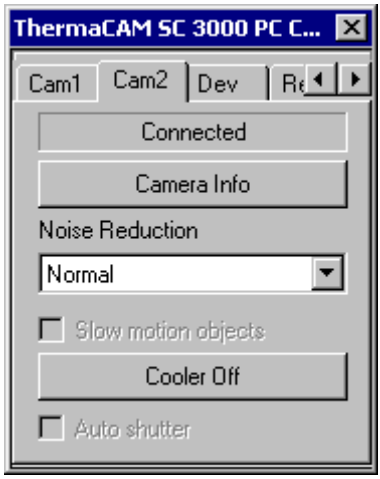
If you are satisfied with your image, you can freeze it by pushing this button on the standard tool bar or pressing Ctrl + F or F8:

If it is an interesting image, you had better save it on disk right now. If you leave the program without first recording the image, the image is lost. See How to record IR images on page 64.

7.2.1 The THV 500 Camera Control

This control panel is used for ThermaCAM SC 500, ThermaCAM SC 2000, ThermaCAM SC 3000 and similar camera models.





If some button is disabled on your camera control, it is because your particular camera does not support that function.

The selected Measurement Range should cover the expected measurement temperatures. The range limits are blackbody temperatures, so if your measurement target has a shiny surface with a low emissivity, you will be able to make measurements above the range limits.

The “Image Speed” control allows you to increase the speed by which images are captured in a high-speed camera. The speed by which they are grabbed by the PC frame grabber remains unchanged, however. This has the effect that the high-speed image size is reduced proportionally, so that each frame will contain more than one image. Only under one condition, when you record images at full speed into one single file, will you be able to retrieve all the captured high-speed images. In all other cases, you will only see the first image of each grab.

If you press the Int(ernal) Image Correction button on the Camera Control panel, the camera will respond by making a rather heavy clicking sound when the internal shutter is pulled and adjust its own temperature scale once to the current image. It is highly recommended to use the Int. Image Correction function now and then, since it improves the image quality. Check the **Auto shutter** checkbox if you want an automatic internal image correction.

Note: There is a related function in the Image menu, on the standard tool bar and on the scaling tool bar. That function is called Auto Adjust. It is “sticky” and will continuously adjust the scale to the image locally, within the PC.

If you try to study targets whose temperatures are close to or even outside the measurement range, it might happen that the image becomes noisy due to detector offset errors. That is when you should use the External Image Correction function. There is a button on the camera control panel and a camera menu item for this purpose. Aim the camera towards a surface with a flat temperature close to that of the target. Push the button. The image will now be subjected to an offset correction so that every part of the image will get the same value as that in the middle. Aim the camera towards the target again. This correction will last until the next time you internally correct the camera image, or run External Image Correction again.

At the bottom of the first tab, there are three focus buttons. Near focus (-), auto focus (=) and far focus (+).

Let’s move over to the second tab on the Camera Control panel.

High noise reduction will blur the image of moving objects.

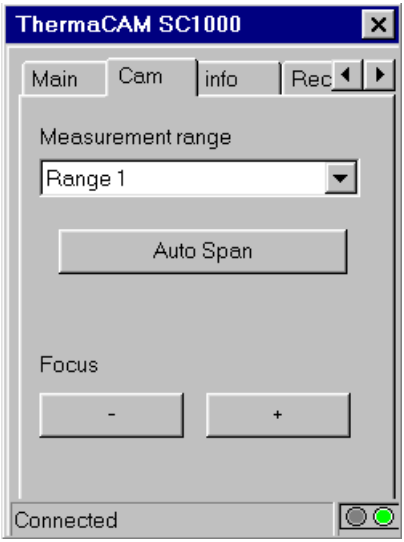
To improve image quality, you can check the **Slow motion objects** check box if you are viewing slowly moving or still targets.

The **Cooler** button will switch on/off the camera cooler.

The **Auto shutter** check box will switch on/off the automated internal image correction. This automated process can be disabled as it may affect the recording of images. When you switch it off, a warning will appear on the status field of the control. This warning will become red if you leave it switched off for a long time.

7.2.2 The SC 1000 Camera Control

This control panel is used for ThermaCAM SC 1000 only.



Select a Measurement Range that covers the expected measurement temperatures.

If you press the Auto Span button on the Camera Control panel, the camera will adjust its own temperature scale once to the current image.

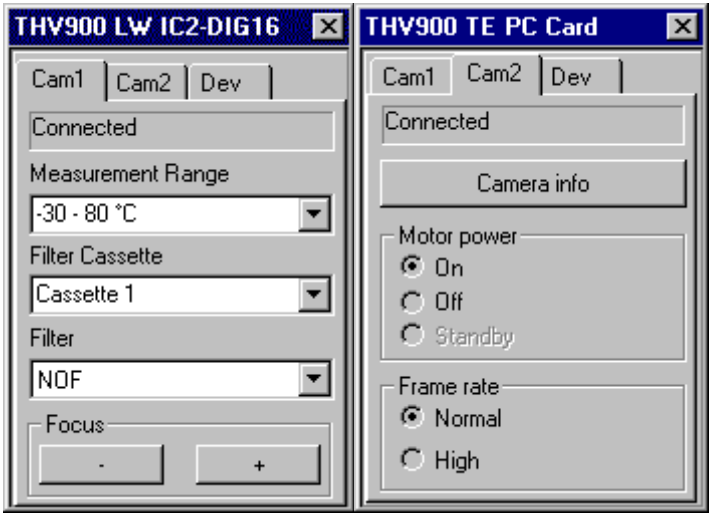
The focus function will only work if the focus motor switch by the lens socket is in the R position.

The SC 10000 camera also has a Non-Uniformity Correction (NUC) function, available only through its Set-up menus, that you can use to improve the image quality.

The SC 1000 has a calibration file, which will be unloaded from the camera, when it is connected for the first time. If you have the camera sent in for recalibration, you have to initiate the unloading of this file again, from the "Info" tab.

7.2.3 The THV 900 Camera Control

This control panel is used for Thermovision 900 Cameras.



There is a Cassette selection, which must be set to the number of the cassette actually installed in the camera, a Filter selection, which reflects the IR filters of that cassette, and a Measurement Range selection. The Measurement Range selection is tightly coupled to the two others. If you change them, the measurement ranges will change accordingly.

The range should cover the expected measurement temperatures. The range limits are blackbody temperatures, so if your measurement target has a shiny surface with a low emissivity, you will be able to make measurements above the range limits.

Ideally you should make your proper Cassette/Filter/Range selections immediately, but it is often easier to select a measurement range, which is well suited to the surroundings first and then set the proper range afterwards. It makes it easier for you to focus the camera.

The “Motor power” switches control the camera horizontal and vertical scanning mirror motors. On stirling cooled cameras you may also put the cooler in standby.

You can set the frame rate to 30 Hz by selecting the high frame rate option. The number of lines will decrease when the frame rate is high. The scanner use the high frame rate as long as the power is on, or until you select normal frame rate again. After a power on, the frame rate is always normal.

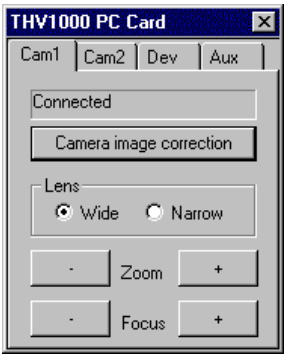
7.2.4 The THV 1000 Camera Control

This control panel is used for Thermovision 1000 cameras only.

Let us investigate some of the alternatives in the Camera Control panel.

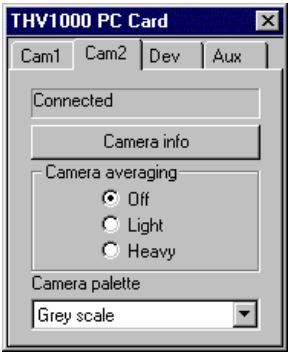
Camera image correction performs an internal Auto adjust.

Lens changes the camera field of view.



Camera averaging selects the level of noise reduction. Heavy averaging will reduce the noise for still or slow moving objects but will blur fast moving targets.

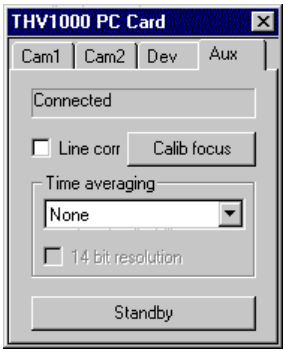
Camera palette selects the camera palette used for the camera video output. Don't confuse this control with the image palette option in the Image menu.



Line corr(ection). Correct each image for geometric detector differences. This will give you a better image quality but will decrease the image display rate.

Focus calibration: The focus has a tendency to drift as the temperature of the lens varies. Use this function to set the correct focus infinity position.

Time averaging. In order to reduce noise set the number of images to average from and then press Record One Image. You can't combine time averaging with sequence file recording.



14 bit resolution. Save time averaged images with 14 bits per pixels. To interpret the image correctly, you need special software.

Standby. Set the camera cooler and motors in standby mode. Press the button again to restart the camera.

7.2.5 About connection difficulties

At times, you may run into difficulties establishing a connection with the camera. Here are some suggestions on what you can do:

The program is having problems with the camera. It only works now and then.

Take care in inserting your PC Card Interface properly into the PC Card Adapter. Make sure that the card has been recognised and properly configured (is indicated with a little tune) before you start ThermaCAM Researcher. The same caution is required when the Interface is to be removed or switched off. Always exit the program or select Disconnect from the camera menu before you pull the Interface out or switch the power off.

The program refuses to establish a contact with the camera. The status information keeps saying Disconnected while the camera is running.

The camera may be connected to another copy of ThermaCAM Researcher. Switch over to that one and disconnect the connection. Now the new ThermaCAM Researcher can connect to the camera.

The status information says Connected, but no live image is shown.

If you are using a ThermaCAM SC 1000, please check that no “Maintenance Required” information is displayed in the camera viewfinder. If you accidentally have put the SC 1000 in Setup-mode, it can also cause this problem.

Further information.

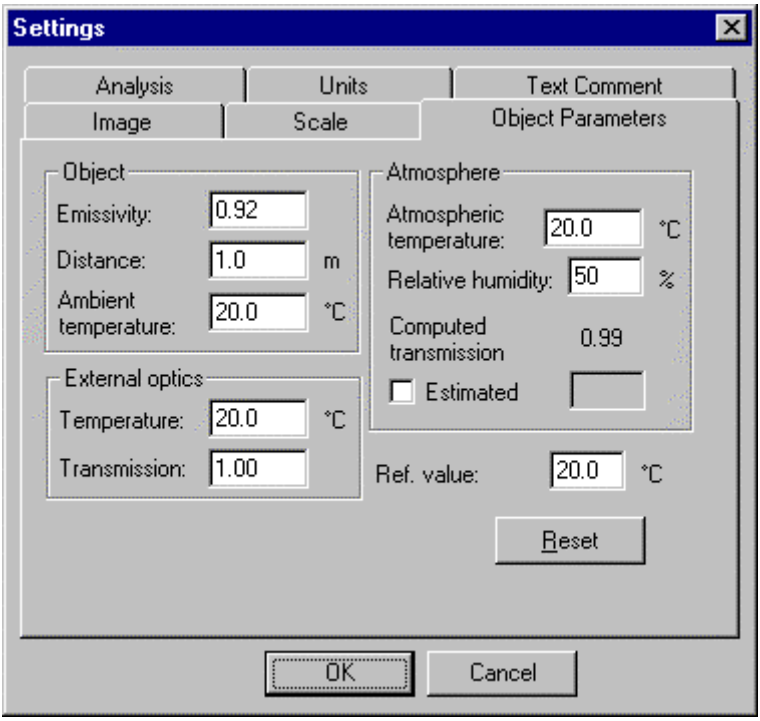
Your problems may be related to the hardware installation. Please read more about it in Troubleshooting the frame grabber installation on page 31 or Troubleshooting the PC Card installation on page 19.

7.3 How to display an IR image

7.3.1 Obtaining a good IR image

In order to get a good image from the camera, you should establish a connection, select an appropriate measurement range, auto adjust it, and focus it as described in the previous chapters.

No matter if you have a live image, a frozen image or a disk image, you should now consider the object parameters (emissivity, ambient temperature, atmospheric temperature, relative humidity of the air, the distance and the external optics transmission and temperature). They describe the physical properties of the body of interest and its environment and the atmosphere between the object and the camera. You can reach them via Settings in the Image menu or this button:



It is important that these parameter values become correct. Otherwise the scale temperatures and displayed colours will be wrong. The image parts for which the

object parameters are wrong will get incorrect temperatures and colours. (The measurement functions have object parameters of their own which are used to handle the case when there are two different targets in the same image.)

To calculate the emissivity of an object, see Emissivity calculation on page 91.

If the colours of the image are inappropriate, you can change them. The selection Palette tool button will bring up a dialogue window with the palettes available.

Contrary to what you might think, the **Show saturation colours** option enables specific colouring of image points, which are outside the current temperature scale. The **Show out of range colours** option enables specific colouring of image points, which are outside the detectable range of the camera.

You can change the temperature scale with this control bar:

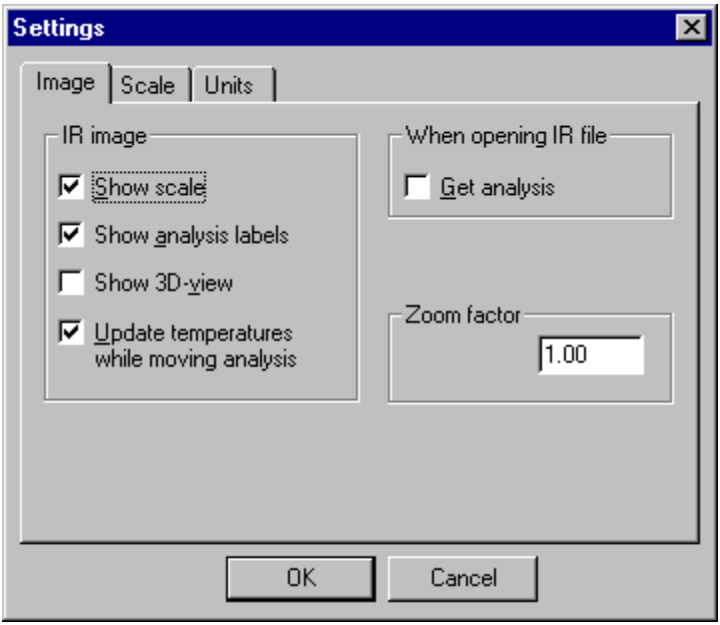
You can use the slider to search for a good scale or to set fixed limits. Remember that the maximum temperature always has to exceed the minimum temperature. Click on the input fields if you want to edit them and hit the Enter key afterwards. If you select Auto Adjust, you will find that an attempt to find the optimum scale is made for each new image. A small part of the temperature span of the image is however wasted, to minimise the effect of noise in the image.

(The measurement areas have a related auto adjustment function, which adjust the scale based on the area.)

The rightmost button will keep the distance between the slider controls fixed.

Sometimes, when a live camera image is shown, you can find it impossible to change the scale in ThermaCAM Researcher. This is when the camera has been set to continuously adjust the level or span of the image. Please switch that camera setting off.

Finally, in the Image tab of the Settings dialogue, there are a few more options you can explore:



The Show scale option switches the display of the temperature and colour scale on/off.

The Show analysis labels option will switch the display of the label texts on/off.

The Show 3D-view option will display a pseudo 3D version of the image.

The Update temperatures option has to do with the update of OLE links, profile, histogram and result table when analysis tools are moved around in the image.

The Get analysis option should not be used unless your images contain analysis tools that vary from image to image, which normally isn't the case.

The Zoom factor makes it possible to temporarily enlarge the centre of an image.

7.3.2 Transferring an IR image to ThermaCAM Reporter

You can easily move your IR image to ThermaCAM Reporter. Use the Copy session and image tool button or the same command of the Edit menu.

Then, open ThermaCAM Reporter and paste the image into it.

7.3.3 Transferring an IR image with OLE

If you want to display your image in a program not designed for IR images, you have to use OLE to make it visible. Use the Copy session and image tool button or the same command of the Edit menu.

Read more about this in OLE in brief on page 114.

7.4 How to trigger ThermaCAM Researcher from outside

If your target is active only on certain occasions, you might well want to tell the program when it should examine at the target. Two functions in ThermaCAM Researcher work under such conditions. The recording functions that collect images, and the plotting functions that collect measurement results.

They can conditionally record or plot not only at certain times, but also on external trig pulses. The parallel interface has a trig input connector, which is the default trig source. In addition, a free COM port or a LPT port can be used as the external trig source. These are mainly intended for usage with the PC Card Interface.

The external trig increments a trig counter which is stored with each image. The value of this counter can be displayed in the Play Images tool bar and the result table. For COM or LPT trigs, the counter only counts one trig pulse per image.

The source for the external trig is selected from the “Dev” tab (or the Recording Conditions dialogue) in the camera control panels.

External trig using the parallel interface

Please see The parallel interface (PI) on page 25.

External trig using the serial port

This trig source option uses the CTS input line on a free COM port. The COM port has an RS232 electrical interface.

Trig input using COM1, COM2, COM3 and COM4.	
DSUB-25 Pin 5: Trig Input.	Transition Low (<-3 V) to High (>+3 V) =trig. Close pin 4 and 5 to trig.
DSUB-9 Pin 8: Trig Input.	Transition Low (<-3 V) to High (>+3 V) =trig. Close pin 7 and 8 to trig.

Please review the RS232 specification for a more detailed description of the electrical interface.

External trig using the printer port

The printer port (LPT) option is only available on Windows 95/98/ME platforms. This trig source option uses a control signal on a free LPT port. The LPT port has a TTL electrical interface.

Trig input using LPT1 (or LPT2) DSUB 25 pin printer port.	
Pin 10: Trig Input.	Open circuit = high. (+2.4 V to + 5 V) Transition High -> low =trig.
Pin 22: Ground	Closing 10 - 22 = trig.

The LPT1 port is normally associated with the physical hexadecimal address 378 and the LPT2 port is associated with address 278. The camera control assumes that this is the case. Check your parallel port configuration in the Control Panel, System icon, to find out the physical address associated with the parallel port.

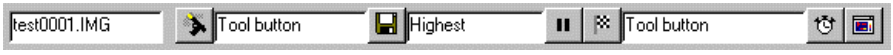
7.5 How to record IR images

You can only record images that come from the camera interface. The currently active measurement tools are not recorded with the images, but the current scale and object parameters are.

You have to push the camera button in order to get live images (or select Show Camera Image from the Camera menu or press Ctrl + L on the keyboard).

7.5.1 The Recording tool bar

When the camera becomes the image source, the following tool bar is displayed.



It is primarily associated with recording sequences of image files, but can also be used to record single image files. The leftmost field shows the name of the file that will be stored next. The name consists of a base part (TEST) to which a sequence number is added (0001) and extension is appended (.IMG or .SEQ). The base part is a text string, which you can change in the Recording Conditions dialogue

window hidden under the stopwatch button on the same tool bar. The sequence number is controlled by ThermaCAM Researcher and is increased by 1 for every image file or image sequence file.

A field showing the current condition for starting the recording follows the tool button with the start pistol.

A field showing the current condition for recording an image follows the tool button with the diskette. No matter what the field says, the diskette button will always record one image, even if the start condition is not fulfilled.

The next button will temporarily stop the recording: Pause.

A field showing the current condition for stopping the recording follows the tool button with the chequered flag. No matter what the field says, the flag button will always stop the recording.

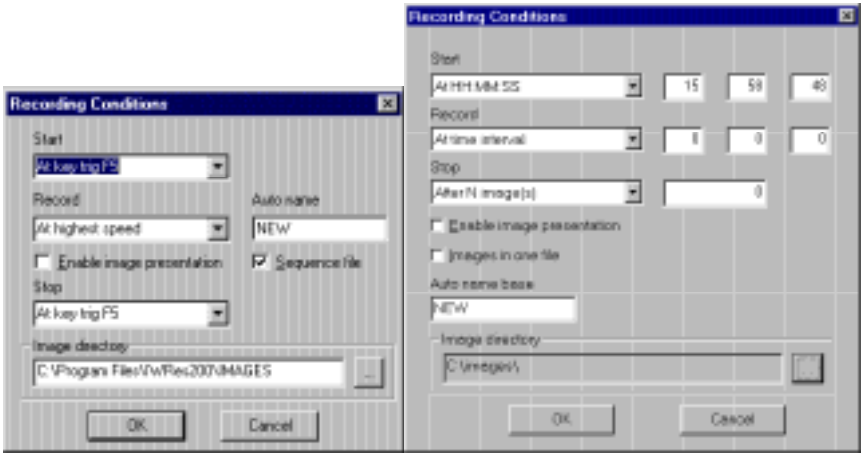
The second last button will bring up the Recording Conditions dialogue window.

The very last button will start the replay of the recorded images in another copy of ThermaCAM Researcher.

To start the replay of the recorded images in the current copy of ThermaCAM Researcher, just press this button in the standard tool bar:

7.5.2 The Recording Conditions dialogue

You can reach this dialogue from the Recording tool bar and the Conditions item of the Recording menu.



This dialog has two shapes, depending on the camera used. They are functionally the same.

Recordings are controlled by three conditions: Start, Record and Stop. In this dialogue you can set these conditions as well as the base part (Auto name) of the file names and the directory where the recording shall be made. If you select the Sequence file option, images will be recorded to a single file, which will reduce the number of files to handle and increase the recording speed. The dotted button beside the current directory field leads to a directory browser.

Sequence recordings can start at:

- Tool button
- At key trig F5
- At HH:MM:SS. Fill in a time within the next 24 hours like this: “11:23:45”
- External trig (plus a specified delay: for instance “00:00:05”)

Images can be stored either:

- At highest possible speed. This means that no images will be displayed during the recording, unless you select the Enable Image Presentation option. That will however reduce the recording speed.
- At HH:MM:SS interval. Example: “00:05:30”
- At key trig F5. This choice will disable the start or stop conditions
- Every N:th image

- At external trig

The recordings will stop when the stop condition is reached. The following possibilities exist:

- Tool button. (The flag button is always active during a recording.)
- After XX stored image(s). Fill in the number desired like this: “88”
- After time interval HH:MM:SS. Fill in a time like this: “00:10:00”
- At key trig F5
- At external trig (plus a specified delay: for example “00:00:05”)

For more information about how to connect an external trig, see How to trigger ThermaCAM Researcher from outside on page 63.

Recording on external trigs is very hard work indeed for ThermaCAM Researcher. Your computer may appear to respond slowly while these recordings are in progress.

You might find it a bit difficult to get your recording conditions right if your camera is capable of producing images at a higher speed than the 50/60 Hz set by the video standard. At the higher speeds, the camera puts several images into every normal speed image sent to the frame grabber. The frame grabber will still grab its images in the normal way, throwing away the extra information sent by the camera. You will only get hold of the high-speed images when using “at highest speed” recording and the “into one file” option.

If your recording will last for a very long time, it might be a good idea to control it by OLE Automation instead.

7.5.3 Full burst recording of images

Only when you are using full burst recording, can you grab, store and study every image captured by the camera (except for the old Thermovision 1000).

If you have the parallel interface configuration and suitable SCSI disks and software, see Software limitations on page 27, you should be able to get a full burst recording rate if you

- Check the Sequence File / Images in one file checkbox in the Recording Conditions dialogue.
- Do not run any program that consumes processor power at the same time, for example "fast find".

- Do not run any program that consumes lots of memory (such as the Office programs) at the same time.
- Do not let the local area network connection interfere. (Pull the plug!)
- Do not let the screen saver / lock screen software interfere.

In short, don't let the computer do anything else at the same time.

When you use an external trig to control the burst recordings, these restrictions have to be observed even before the actual start. ThermaCAM Researcher will capture all images in advance in order to be able to store the trigged image(s).

7.5.4 OLE Automation recording of images

If you intend to record images at a slow or irregular rate, or wish to do switch off/on the Stirling cooler or to perform an Internal Correction of the camera before each “shot”, then OLE Automation controlled recording will be your natural choice.

You need to have another program available with a Visual Basic for Applications (VBA) macro language capability that can give orders to ThermaCAM Researcher. Here is an example for Microsoft Excel, in which 20 images are recorded to disk using a 15-second time interval:

```
Sub SaveIR()
  Dim sess As Object
  Dim counter As Integer
  Set sess =
   GetObject("C:\Program Files\Research\Ole.irs")
  Counter = 0
  Do While counter < 20
    counter = counter + 1
    sess.RecordOneImage
    Application.Wait Now + TimeValue("00:00:15")
  Loop
End Sub
```

7.6 How to play back images

ThermaCAM Researcher does not only handle images recorded by the program. It is also possible to show images taken directly from Thermovision® 400, 550/570, 900 and 1000, AGEMA™ 550/570, Prism DS, ThermaSNAP, ThermaCAM PM 1X0, 2X0 and 3X0, UltraCAM PM X95, ThermaCAM PM 525, 545, 575, 595, 675, 695, ThermaCAM SC 1000, 2000 and 3000.

Such images are received by ThermaCAM Researcher on disk.

When ThermaCAM Researcher is showing disk images, the “Play recording” tool button on the standard tool bar is depressed:

There are several ways in which a playback of images can be initiated. When a recording is finished, you can press “Play recording” or, on the recording toolbar, press the button “Play in a new window”:

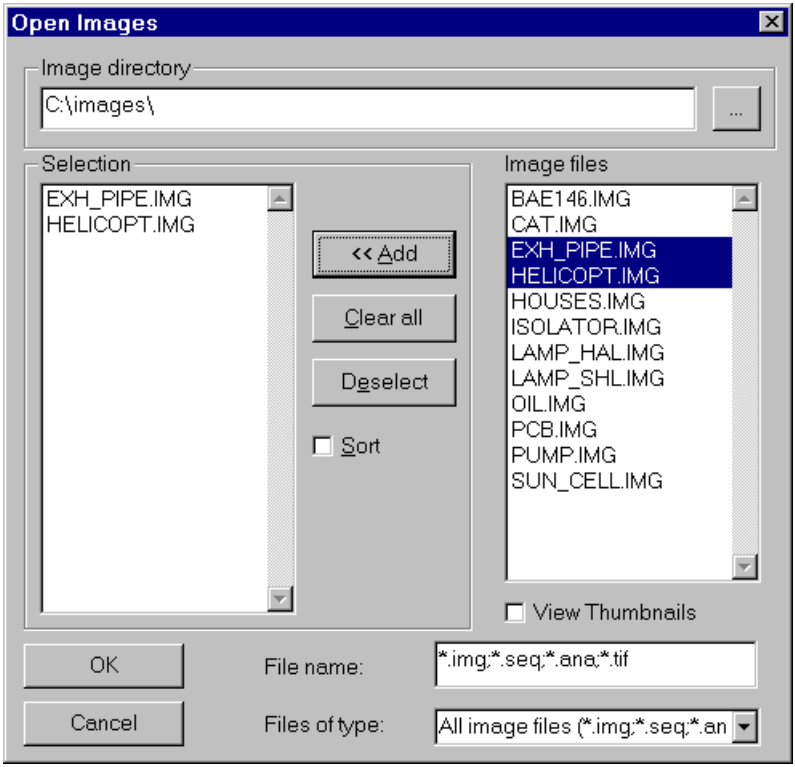
From the file menu, you can select Open Session, and read a session file from disk containing information from older, already stored sessions containing recordings. You can also copy and paste a recording session from one ThermaCAM Researcher window to another. Furthermore, you can drag and drop image files or a session file from the Windows Explorer onto a ThermaCAM Researcher window. Finally, you can use the Open Images function to put together a new selection of images (or change an existing one).

Let us examine that last method a little.

7.6.1 The open images dialogue

You start the dialogue with this tool button (or by pressing Ctrl + I keys or by the File and Image menus.)

It will bring up the following dialogue window:



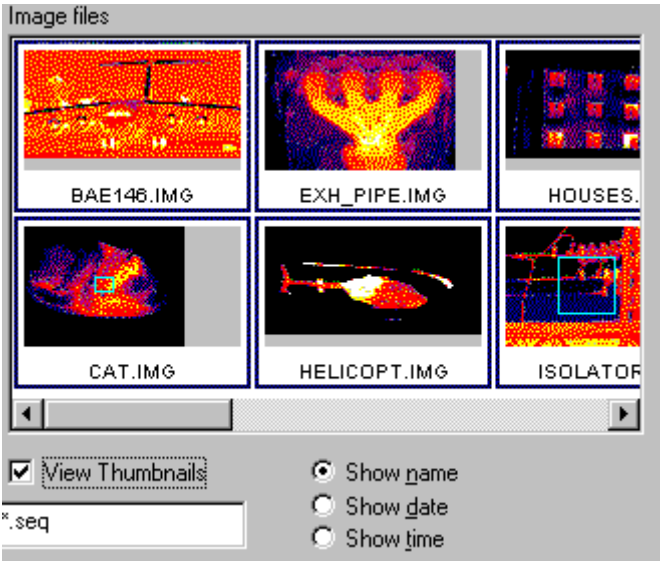
The top field of this dialogue permits you to edit the name of the directory where the images are stored. Press OK or the Enter key once after editing this text in order to refresh the dialogue. The dotted button leads to a directory browser.

The left half of the dialogue shows the list of images currently in use by this session.

The right half of the dialogue shows a list of image file names in the image directory. All the files in this list are highlighted by default.

There is a file name filter field by which you can affect the directory listing. You could for instance change *.img to t*.img to list files beginning with the letter t. Press OK or the Enter key once to refresh the list afterwards.

If you select the View Thumbnails option, the layout of the right half of the dialog will change drastically:



The list of files will become a list of images instead. The images with a blue frame are the highlighted ones. The images are always displayed with the iron palette and with their own scale, object parameter, analysis and zoom settings. As you can see, some of these images contain box area tools.

Using the three radio buttons below the images, you have the option of displaying the date or time instead of the image names.

The buttons in the middle of the dialogue manipulate the names of the list to the left. The << Add button will copy all highlighted file names from the right list to the left one. The Clear All button will clear the left list. The Deselect button will remove highlighted items in the left list. If no items are highlighted, nothing is removed. The image files are not deleted from disk by this operation, only their names in the list.

The Sort selection will rearrange the names in the left list. They become sorted in alphabetical order and duplicate names are removed.

This gives you the possibility to arrange the list of names, as you like.

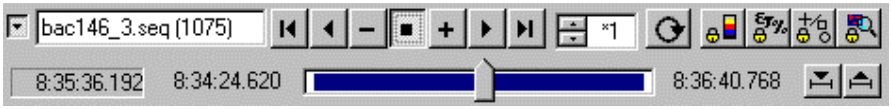
You should use mouse clicks in combination with holding down the Shift or Control keys in order to manipulate the highlighting of the lists.

You may add both single images and image sequence files to the left list at the same time, although it is probably not very common practice.

When pressing OK, you select all the image files in the list to the left for playback by ThermaCAM Researcher. This action activates the Play images tool bar.

7.6.2 The play images tool bar

When disk images are being replayed, this tool bar is displayed.



It resembles the controls found on ordinary video tape recorders quite a lot.

You can step forward and backward one image at a time. You can play your images in any direction fast or slowly or jump to the end/beginning of the images.

You set the replay rate by the “*1” control.

”*1” means full speed from disk.
“*2” means twice full disk speed (i.e. every other image is not shown) and
“÷2” means half full speed.

You can double-click on the control to make it return to ”*1” speed.

These two buttons let you select one part of the current images. Press the left one when you are looking at the first (leftmost) image to be selected. Press the right one when you look at the last (rightmost) image to be selected. A blue indicator will mark your selection in the control.

When you have marked a selection, the "to end/to beginning" buttons will instead jump to the next mark and the autorewind button will change its behaviour. Printouts can be made based to the selection and, in the case of a sequence file being displayed, editing of this file can take place.

You can remove the selection by choosing Clear Markers in the Recording menu

This button enables Autorewind mode. If a selection is made, it will be repeated continuously when replayed. If no selection is made, or AutoRewind mode is set to “All images”, the whole sequence is repeated.

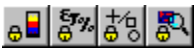
The text field to the left shows the name of the current image in the sequence. This field can be edited if you click in it. You may write:

- A file name, including the extension, present in the list.

- The number of a particular image. 1 signifies the first image.
- A relative number. “+5” means five images ahead. “-12” means twelve images back.

Hit Enter on the keyboard to finish the editing.

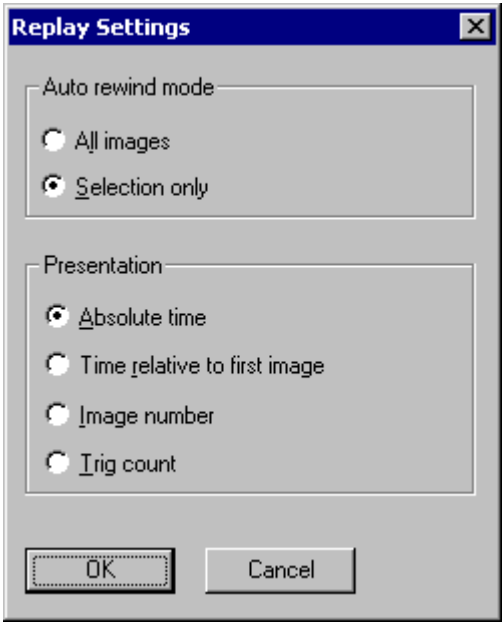
For information about associated shortcut keys, see Shortcut keys on page 49.



These four buttons control how the program behaves when you switch from one image to another. Read more about them in Making measurements in playback on page 101.

7.6.3 The Replay Settings dialogue

If you choose Replay Settings from the Recording menu the following dialogue will appear.



AutoRewind mode. In rewind mode you can chose between repeating the whole sequence or just the marked part.

Presentation. (What is presented on the play images tool bar.)
"Absolute time" shows the actual recording time.

"Time relative to first image" shows the time difference of the current image compared to the first image. If the current image is recorded earlier than the first image, ######## is shown instead.
"Image number" shows the image ordinal number.
"Trig count" shows the external trig count stored in the image.

7.7 How to edit/convert sequences

It will happen now and then that you record too many images and would like to extract the essential part of a sequence and/or convert it to some other image format, such as avi or bmp.

To edit a sequence of images, open it with the Open Images dialogue and use the Selection Start/Selection End buttons on the Play Images toolbar to mark some images. Step to the first image you intend to edit and press the left one of the buttons, then step to the last image to edit and press the right one. A blue ribbon will be shown in the Image Slider control.

7.7.1 Removing/Copying all selected images

Having selected some images, you can choose **Remove Selection** from the Recording menu. Then you will be prompted to confirm it is the right selection.

You cannot undelete images that become removed. Depending on the sequence size this operation may take several minutes. The frame numbers of the images following the removed part will be resequenced.

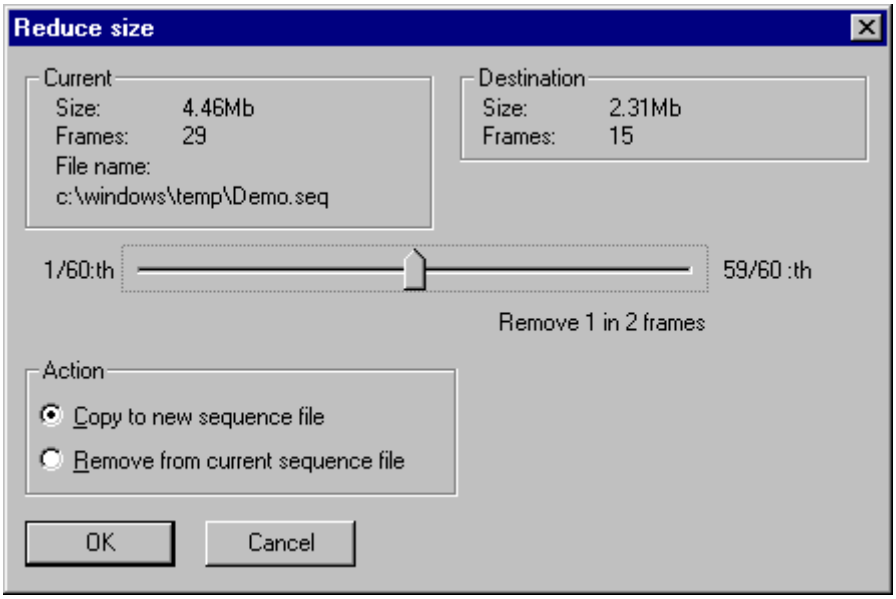
Removing images only works if all the images are in the same sequence file (.seq)

Instead, if you choose **Copy Selection** from the Recording menu, and then choose output format "Seq", you may select a directory and enter a file name for the new sequence file. Depending on the size of the selection this operation may also take several minutes.

Copying images in this way only works if all the images are in the same sequence file (.seq)

7.7.2 Removing/Copying some selected images

Having selected some images, you can also choose **Reduce Selection** from the Recording menu. This dialogue will appear:



If you move the slider in the centre of the dialogue to the right, more of the sequence file is kept. If you move it to the left, less is kept.

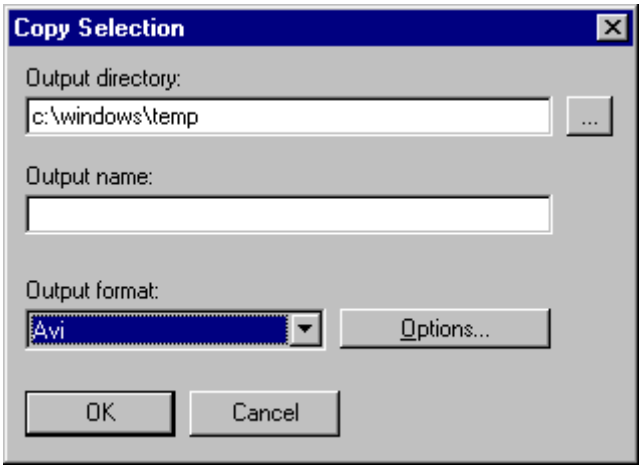
Select whether or not you wish to copy the sequence to a new file, and press OK.

You cannot undelete images that become removed. Depending on the sequence size this operation may take several minutes. The frame numbers of the images following the removed part will be resequenced.

The reduction works only if all the images are in the same sequence file (.seq)

7.7.3 Avi/Bmp/Matlab/FPF files from selected images

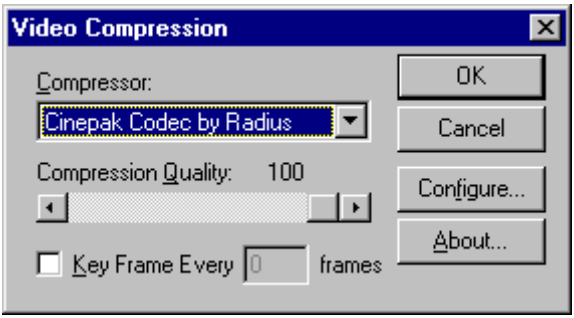
Having selected some images, you can convert them to other image formats by choosing **Copy Selection** from the Recording menu. This dialogue will appear:



Please set the output directory, output name and options of preferred output format and press OK to start the copy. Depending on the size of the selection this operation may also take several minutes.

You can read more about various output formats in Studying whole images on page 96.

If you press the options button when the output format is Avi, you will be able to set the Avi codec to "other". This, in turn, causes the Copy Selection dialogue to show the following dialogue when you press its OK button.



Here you can choose among the compressors installed in your computer and configure them. Please note that some of them might only be able to decompress avi files, not to compress the files.

Cinepak Codec is a fairly common compressor, but does not produce that good images. The MS Video 1 compressor makes better images, but is less common.

You should always check that the receiver of the avi file is able to decompress it.

7.7.4 Subtracting selected images

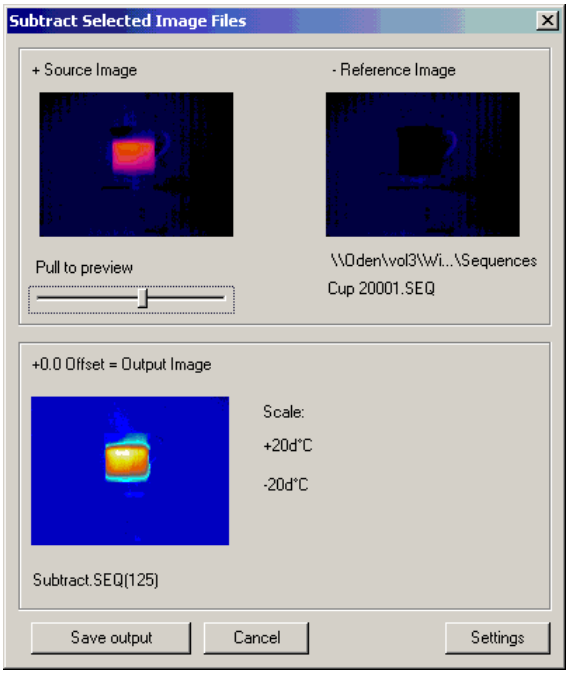
Regarding image subtraction as an image conversion function might seem strange, but that is really what this type of work is all about. You select some images out of a sequence, order them to be subtracted and get another sequence containing difference images as the result.

Why subtraction? Well, the most important usage of this function is for making comparisons. You can compare images of the same (or similar) object(s), taken at different times, in order to detect changes in temperature, position or shape.

Subtraction uses a reference image, taken when conditions are known to be good, in some sense, and subtracts the selected images with that reference. The subtraction is made in the current measurement unit, not in camera signal.

The reference image does not have to be located in the same directory as the selected images. The output images are put in the same directory as the selected ones, however.

To make a subtraction, select “Subtract Sel Images” from the Recording menu.

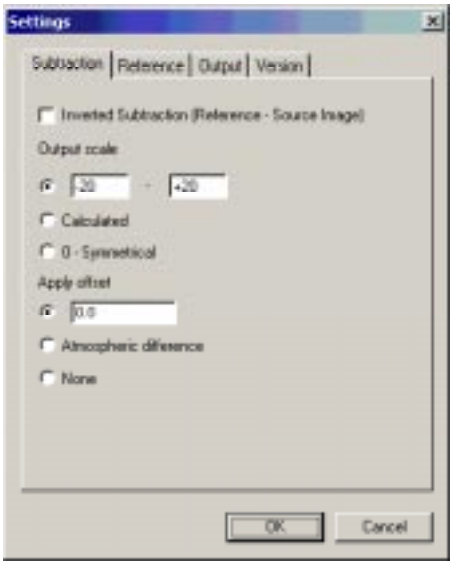


On the dialogue shown, you can see most of the settings of the subtraction function, and also preview the subtraction by (slowly) pulling the slider. No images will be saved on disk until you press the “Save output” button.

The Source Images shown in the upper left corner are the ones you selected before starting the subtraction. The Reference Image is displayed in the upper right corner and the resulting image in the bottom left.

Please press Settings, to view the settings dialogue.

The first tab contains settings for the actual subtraction algorithm. You can invert the result, force a particular output scale and apply an offset (in case your images were taken under very different atmospheric conditions).



The second tab contains settings for the reference image. You can either use the first selected source image as your reference or perform consecutive subtractions or use a separate reference image.

In the last case, use the open button to open your image and the slider to find it, if it is inside a sequence.

In the output tab you can set the name base for the output images. A number will be appended to the base, to make the name unique.

When the subtraction is finished, you can, at will, open and select the output images, close all previous source images and a new palette to the images.

There are two special purpose subtraction palettes. Midgrey and Midgreen. Since the 0-level of a difference image normally is in the middle of the scale, there has to be a neutral colour for that value.

Please press OK to return to the Subtraction dialogue. Now, press “Save Output” to get the subtraction going.

While the images are being subtracted, a progress bar is being displayed.

When the subtraction is over, and the output images are displayed, you may notice that the measurement units have changed. From °C to dC, for instance. This is because there is no longer any absolute temperatures in the real sense. Just differences indicating how much the temperature of the object has changed.

You may also notice that most of the object parameters have lost their meaning. Only the object distance is valid for difference images.

If you are very unfortunate, you may also notice that there was overflow in the subtraction. Subtraction has a limit, which normally is ±400 dC. You can use the offset to get around that limit, if it is disturbing.

Subtraction is an operation that can't be undone. This means that if you find out that something (an object parameter perhaps) of the source or reference image was wrong, then you have to change it and run the subtraction once again to get accurate results.

7.8 How to make single image measurements

Sometimes you just need to look at an IR image to measure it. You can look for anomalies, hot or cold areas and get an impression of their temperatures just by comparing the colours with those of the temperature scale. By choosing a suitable scale and palette, such things can be made to appear quite clearly. This chapter will, however, be devoted to something else: how to use the analysis tools to get numerical temperatures and statistical information out of a single image.

The analysis tools will show their results in the result table, plot, profile or histogram window or directly inside the IR image. Results are also available through the OLE functions, such as Copy Value.

Both absolute measurements (i.e. the result is a real temperature) and relative measurements (i.e. the result is a difference temperature) can be made. The relative measurements are made relative to the reference temperature that you can enter in the dialogue window Image Settings (in the Image menu), the Object Parameters tab. Relative measurements are only available for some camera types

The analysis tools work both with live images and recorded images.

The analysis tools are applied by activation of one tool button at a time. These are in this tool bar:

When you click on one of these buttons (except the formula button), it will stay depressed until you have "drawn" the analysis tool inside the IR image or the colour scale. If you change your mind, click on the button again, and it will pop up.

If you hold the Ctrl-button of the keyboard down while placing the tool on the image, the button will stay down and you will be able to continue adding another tool of the same kind. The removal button works in the same way.

Once the symbols have been drawn, you get the opportunity to bring up a menu for each symbol by "hovering" with the mouse cursor above the symbol and clicking with the right mouse button. The symbol will respond by changing its colour (and the mouse cursor) when you can catch it.

Formula results are not presented in the IR Image, instead they are available in the result table, plot and through OLE functions.

Three of the tool buttons are equipped with menus that you can activate by moving the mouse a little before releasing the mouse button. This is indicated with a small arrow facing downward on those buttons.

7.8.1 The isotherm tool

An isotherm is a marker in an infrared image that highlights areas where the radiation from the object is equal. The name isotherm can be misleading, since it implies that equal temperatures are highlighted. This is only true if the emissivity of the object is the same all over the image.

If you bring up the menu on this button, you will see that there are five types of isotherms in ThermaCAM Researcher. The most commonly used one is the interval isotherm. It will highlight a temperature interval with a certain (selectable) width. There is a marker in the colour scale to indicate the position of the isotherm. The temperature measurement value associated with the interval isotherm is taken at the top of the isotherm, regardless of how wide it is.

The Above isotherm will highlight all temperatures above a temperature value and the below isotherm the opposite.

Dual above and Dual below isotherms are an above/below isotherm attached to an interval isotherm with a different colour. The Dual isotherms highlight two temperature spans.

You activate the tool and set its level by clicking on the colour scale beside the image. If the scale has been switched off in the Image Settings dialogue, you have to switch it on again.

Isotherms can be viewed in a transparent mode: Select the Analysis tab from the IR objects settings dialogue, mark the transparent isotherm check box.

Transparent isotherm is best viewed with a grey palette, because the isotherm will always be presented in the image with red for above, green for interval and blue for below. If two isotherms of the same kind are present, the latest added isotherm will be shown in yellow.

It is possible to change the isotherm level after it has been created. You “catch” the level in the colour scale by pressing the left mouse button precisely on the level and pull it to where you want it to be. Then release the left mouse button. The interval isotherm can be changed in three ways. You can catch it in the upper and lower ends, changing them. You can also catch it in the middle and move both ends at the same time.

Isotherm limits cannot exist outside the maximum or minimum temperatures of the scale. Hence they will follow the scale limits, if the span of the scale is reduced.

You can use two isotherms with different colours at the same time.

The temperature values of the isotherm are shown in the result table window or through OLE. You can obtain the following values: Temperature, Width (interval isotherm only) and Temperature relative to the reference temperature.

The temperature value given for the interval isotherm, is that of the upper limit.

The isotherm always uses the object parameters of the IR image.

7.8.2 The spot meter tool

This tool measures the temperature in one spot on the image and shows the result in the result table or beside its symbol in the IR image. The results are also available through OLE. You can obtain the following values: Temperature, Temperature relative to the reference temperature, Emissivity, Object distance and the image co-ordinates of the spot meter.

Spot meters are called SP01, SP02...SP99.

You create a spot meter by first clicking on the spot meter tool button and then on the desired position in the image.

You move a spot meter by “catching” it with the mouse. You press the left mouse button on top of the cross hair and drag it into the place you want. The spot meter will then jump to that position.

7.8.3 The flying spot meter

This tool only measures the temperature at the mouse cursor and displays it beside the cursor in a tool tip window.

There is just one single flying spotmeter.

You can click with the left mouse button on the image to create fix spotmeters in that position, if you like.

7.8.4 The area tool

This tool measures the maximum, minimum, average and standard deviation temperature within a chosen part of the image and presents these values in the result table window or beside its symbol in the image. Results can also be displayed graphically in the histogram window. The results are also available through OLE.

You can obtain the following values: Minimum, Maximum, Average and Standard deviation temperature, the same relative to the reference temperature (except for the deviation), Emissivity, Object distance and the image co-ordinates of the area.

Areas are called AR01, AR02...AR99.

You create a box area by first clicking down the box button and then moving the mouse to one of the corners of the new box. Press the left mouse button down and drag the mouse to the opposite corner and release the button.

You create a circle area by first clicking on the circle button and then moving mouse to the centre of the new circle. Press the left mouse button down and drag the mouse to some place on the circle border and release the button.

You create a polygon area by first clicking on the polygon button and then moving mouse to the first corner of the new polygon area. Click the left mouse button for each new corner and double click or hit the Esc key to finish adding corners.

You move an area by “catching” it with the mouse. You press the left mouse button down inside the area and drag the whole area into the new position and release the button.

You reshape an area by catching the border or corner to be changed and dragging it along. Catching and dragging a polygon area border results in adding a new corner. You can remove a specific corner from a polygon area by using the analysis removal tool.

Areas can also be used to make Local Auto Adjustments. That means adjusting the scale of the whole image to the temperature span within that particular area. It is very useful, if you want to make detailed studies of some part of the image. This function is only available on the right mouse button menu of the areas.

7.8.5 The line tool

This tool measures the minimum, maximum, average and standard deviation temperature along a straight or bendable line within the image. The temperature in one spot, the line cursor, can also be measured. These values are presented in the result table or beside the line symbol in the image. The line temperatures can also be graphically presented in the profile window. The results are also available through OLE. You can obtain the following values: Cursor, Minimum, Maximum, Average and Standard Deviation temperature, the same relative to the reference temperature (except for the deviation), Emissivity, Object distance and the image co-ordinates of the line and a string with all the temperatures of the line.

Lines are called LI01, LI02...LI99.

You create a straight line by first clicking on the line button and then move the mouse to one of the ends of the new line. Press the left mouse button down and drag the mouse to the other end and release it.

You create a bendable line by first clicking on the line button, and then drag the mouse just a little. A menu will now appear. Select the “Bendable line” item and start clicking on the image wherever you want the corners to be placed. Double-click with the mouse or press the Escape key to finish the creation.

You create a line cursor by first pressing the left mouse button on the line tool button while dragging the mouse to bring up the menu. Select the “Cursor” item and move the mouse to the place on the line where you want to have the marker and click. You can see the temperature of the marker now in the profile window.

You move a line by “catching” the corners with the mouse. You press the left mouse button down on the corner and drag it away. Release the mouse button afterwards. You can move the whole line by catching it in the middle.

You move its cursor by “catching” it and dragging it along the line.

7.8.6 The Formula tool

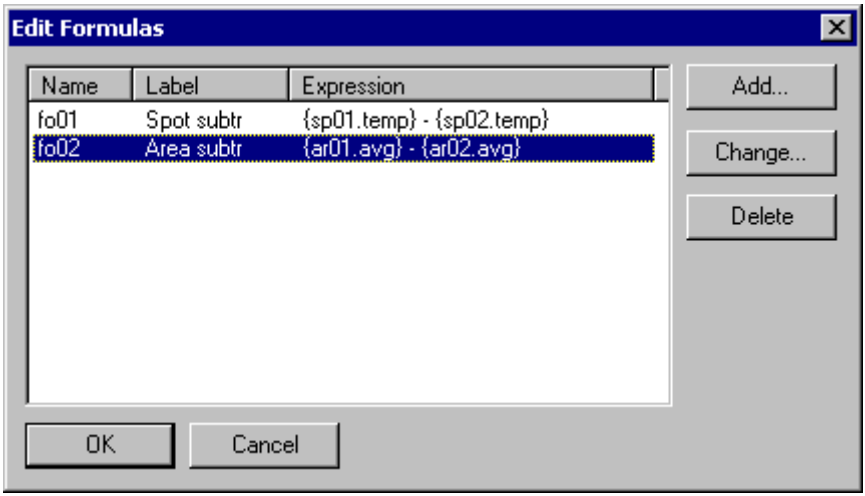
This tool is used for adding and editing formulas.

A formula can contain all common mathematical operators and functions, such as +, -, *, / square root, etc. Also, numeric constants such as 3.14 can be used. Most importantly, references to measurement results, formulas and other numerical data can be inserted into formulas.

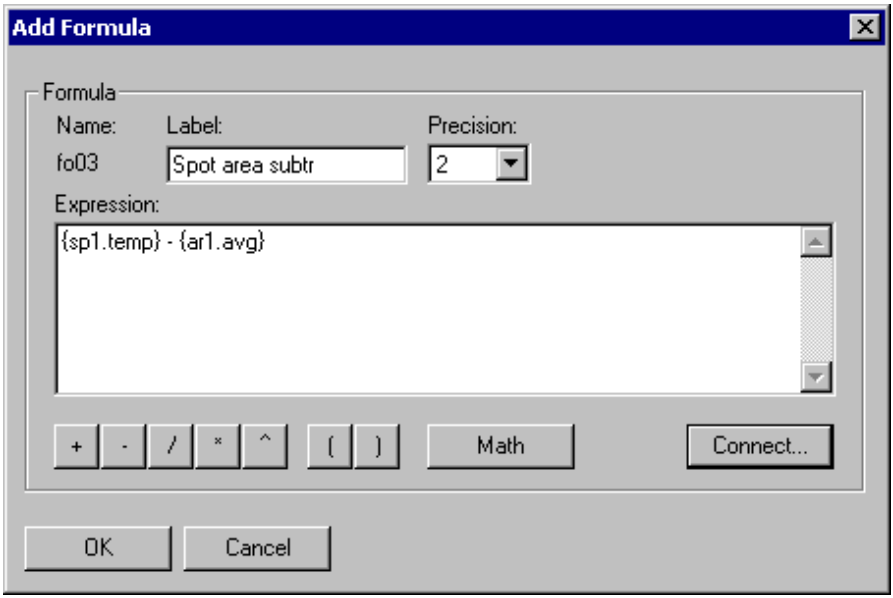
The formula button has a menu. If you bring up the menu you will find some frequently used formulas to add, in addition to entries leading to an add formula dialogue and an edit formulas dialogue.

The result of the formulas appears in the result table. You can also plot the result.

Please select the Formulas tool button. The Edit formulas dialogue box will appear.



Click Add, and another dialogue shows, in which you define your new Formula.



The formula name is generated automatically and identifies the formula uniquely.

In the Label field, type a text describing your formula. This label will appear in the result table window.

Now, enter the expression of the Formula. You may either type in the expression using the keyboard, or use the buttons in the dialogue box. When you click on any of the buttons, the corresponding operator will be inserted into the expression. Following are the operators that can be used.

Operator Button	Operator
	Plus operator
	Minus operator
	Division operator
	Multiplication operator
	Power operator
	Parentheses, used for grouping

If you want to use other mathematical operators, such as sinus, select the appropriate function by clicking the Math button. Following are the functions that can be used.

Function Name	**Function**
sqrt	Square Root
log	Natural Logarithm
log10	Base-10 Logarithm
sin	Sinus
cos	Cosinus
tan	Tangent
Asin	Arcsine
Acos	Arccosine
Atan	Arctangent

Typically, your Formula will contain references to other sources of data, such as measurement functions of IR images. To select a data source, click the Connect button. A dialogue will appear. Select the Object and Value, and click OK. This will insert a reference address into your expression. The address will be substituted with the actual value when the Formula is used.

For the example above, with the spot and area items, you would do the following to add a Formula that is defined as the subtraction of the spot temperature and the area's average temperature:

- Type a suitable label for the formula in the Label field, such as "Spot - Area"
- Click the Connect button. Select "Spot" from the Object list and "Temperature" from the Value list and click OK. This will insert the address "{sp1.value}" into your expression.
- Click the button labelled "-". This will insert a minus sign into your expression.
- Again, click the Connect button. This time, select the "Area" from the Object list and "Average temperature" from the Value list and click OK.

Your expression should now read "{sp1.temp} - {ar1.avg}".

You may also specify the precision of the formula, i.e. the number of decimals with which the result of the formula will be displayed. Do this by selecting the appropriate value from the Precision list. You can use 0 - 5 decimals.

Once finished, press the OK button. This brings you back to the Formulas dialogue. To add more formulas, repeat the procedure.

Another interesting formula you could try, is

```
"({sp1.temp}^4) * 5.57033e-8 / 3.141592 [W/m^2/sr]"
```

which calculates the blackbody radiance, when the temperature is in Kelvin. (5.57033e-8 means 5.57033*10^-8)

The command Change gives you the opportunity to change a defined formula. Selecting a formula is done by clicking on it. Double clicking it will open the Change Formula dialogue box directly. The Delete button removes the selected formula.

Note: Any text that follows the expression will be displayed, as is, in the field connected to the formula. For instance, your expression may be "{sp1.value} * {dobj} meters".

7.8.7 Removal of analysis tools

You remove analysis tools by pressing the removal tool in the analysis tool box down, i.e. the red X. You then move the mouse to an analysis tool and click to remove it. All analysis tools including line cursors and isotherms can be removed in this way.

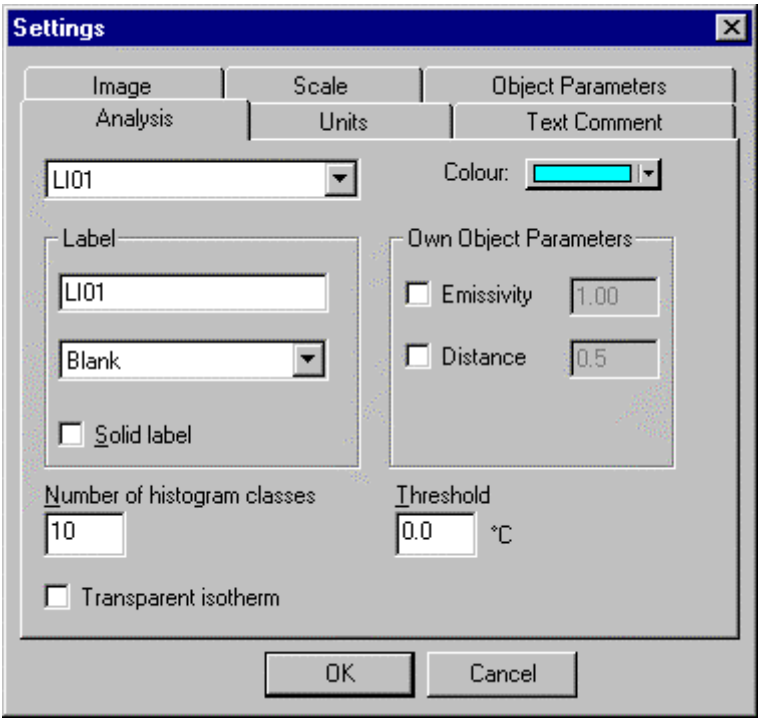
If you happen to press this button by mistake, click on it again to deactivate the function.

In the Image menu, there is a command that will remove all the active analysis tools (formulas excluded) at once. All the active formulas may be removed by a separate command in the Image menu.

7.8.8 Analysis tool styles and object parameters

You can affect the way in which analysis tools appear in the image. You can also change some of the object parameters used. Press this button to bring up the Image Settings dialogue window or select Settings from the Image Menu.

The Analysis tab looks like this:



First, use the list in the top left corner of the dialogue to select the appropriate analysis tool.

Then, write some short descriptive name in the text field below, unless you think that LI01 will do. This text will be shown beside the analysis symbol.

Further down the dialog, there is a list box that allows you to display one measurement result beside the analysis symbol.

If you click in the “Solid label” box, the text beside the symbol will be shown on a black background. This increases the visibility but hides more of the image.

You can also change the colour of the analysis symbol, in case it happens not to be visible enough.

Frequently, the object emissivity or distance is varying between different parts of the IR image. All analysis tools (except the isotherm) can be forced to use their own values on these object parameters. Click in the box to the left of the parameter to enable the function and fill in the desired value to the right. The value shown before was the corresponding value of the object parameters of the image.

The threshold temperature is described in Using a threshold on page 110.

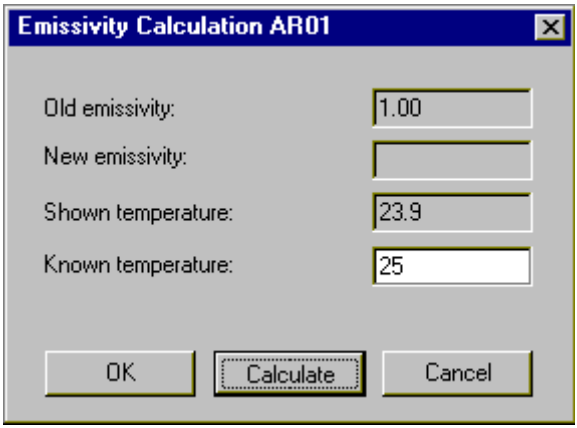
You may change more than one analysis function before clicking OK.

7.8.9 Emissivity calculation

The emissivity factor of an object can be calculated if you know its temperature and the temperature value is well above or below the ambient temperature.

Put for instance a box area on the object for which you know the temperature. Select "Emissivity Calculation" from the right mouse button menu of the area.

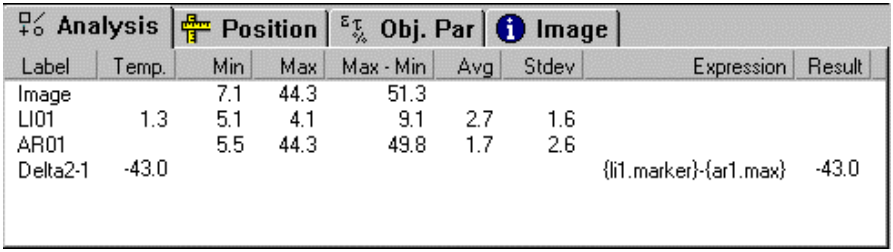
Enter the known temperature and click on "Calculate" to view the new emissivity. Press OK to accept and apply the new emissivity to the area.



7.8.10 The result table window

The result table presents measurement data from the IR image and from the analysis symbols. You can switch on/off the presentation of specific values from the settings dialogue reached by the right hand mouse button of the mouse.

The analysis tab



Label	Temp.	Min	Max	Max - Min	Avg	Stdev	Expression	Result
Image		7.1	44.3	51.3				
LI01	1.3	5.1	4.1	9.1	2.7	1.6		
AR01		5.5	44.3	49.8	1.7	2.6		
Delta2-1	-43.0						{li1.marker}-{ar1.max}	-43.0

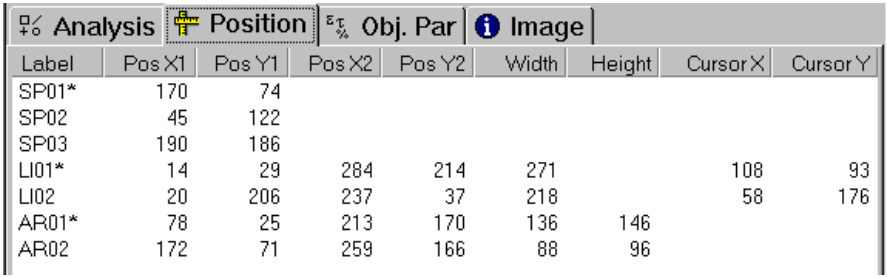
Analysis symbols having their own object parameters have their labels marked with an asterisk.

If the difference temperature option is available and checked in the settings dialogue, then the reference temperature is shown on the first line in the Temp. column. Results affected by the reference temperature are displayed on two lines, one line subtracted by the reference temperature and the other one as usual.

The expression and result columns present formulas and the result values.

The position tab

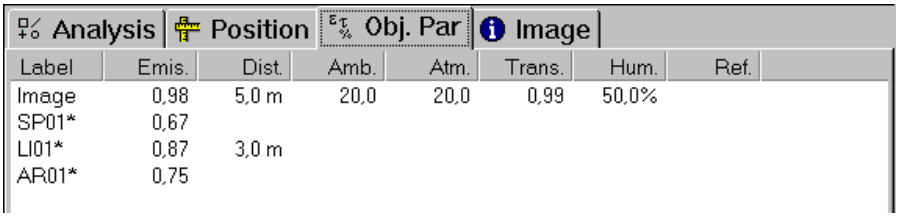
This tab shows the coordinates for spots, lines and areas. All coordinates are relative to the IR image top left corner. For a polygon area, the coordinates are those of a circumscribed rectangle.



Label	Pos X1	Pos Y1	Pos X2	Pos Y2	Width	Height	Cursor X	Cursor Y
SP01*	170	74						
SP02	45	122						
SP03	190	186						
LI01*	14	29	284	214	271		108	93
LI02	20	206	237	37	218		58	176
AR01*	78	25	213	170	136	146		
AR02	172	71	259	166	88	96		

The object parameter tab

The IR image object parameters are always shown according to the settings dialogue. Analysis symbols having their own object parameters are also shown. Their labels are marked with an asterisk.



The image tab

The image tab shows IR image data. From the settings dialogue, select a set of data to be shown.

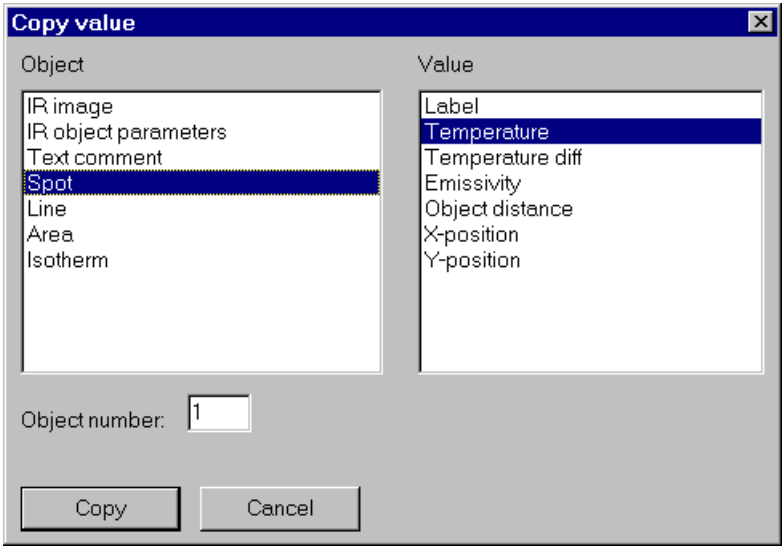
7.8.11 Interpretation of *>< values

Sometimes, when you accidentally make measurements almost outside the calibrated range of a camera, or when you enter extreme object parameters, you will get *s in front of or replacing the desired values. You may also get > or < characters in front of the values. In all these cases you are out of range.

7.8.12 Transferring single results with OLE

If you want to see result values not shown on the IR image or to process the values in other programs, then you should use OLE. First you press this tool button, or select Copy value from the Edit menu:

This will bring up the Copy Value dialogue window:



Then, click in the left column on the appropriate type of object and fill in the ordinal number in the text box below. SP01 corresponds to spot object 1. Click in the right column on the desired value.

Press "Copy" and this value can now be copied (or even linked) into other applications.

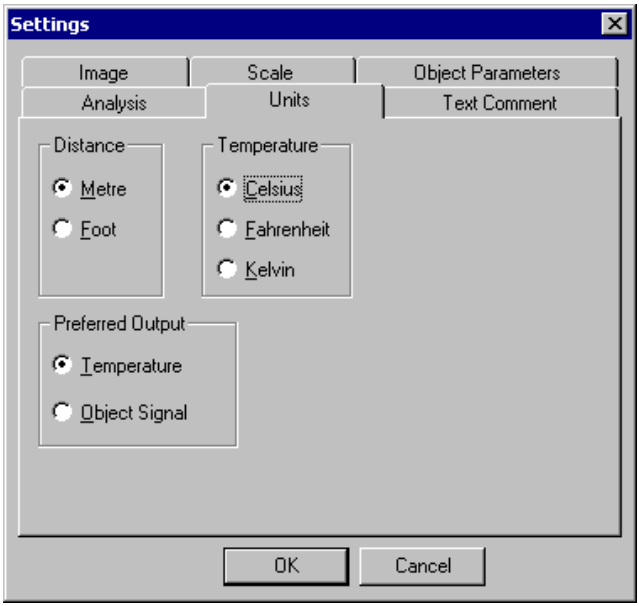
7.8.13 Transferring the result table with OLE

Click inside the result table window with the right hand mouse button and select **Copy**. In the receiving application, for example Excel, select Edit Paste. The whole result table is transferred.

7.8.14 Measurement output and units

You can select the temperature unit and distance unit you want the analysis tools to work with at the Units tab of the Image Settings dialogue that you bring up from the Image menu or with this button:

The temperature unit is also used in the temperature scale.



From the same dialog, you can also set the preferred measurement output:

- The temperature value is calibrated with a set of reference blackbodies.
- Object signal is a non-calibrated value approximately proportional to the amount of radiation sensed by the detector. It will change from camera to camera and between the measurement ranges.

See also: Units of measure on page 39.

7.8.15 Inheriting the analysis tools of cameras

Some versions of some cameras are equipped with analysis tools. When such a camera is electrically connected to ThermaCAM Researcher, none of them are transferred to the PC, only the image. However, if there is a PC Card hard disk in the camera, you can store images on it and move the PC Card disk to the PC, open the images and in some cases get the analysis tools transferred. You only need to **release** the following button on the “Play images” tool bar in order to see the analysis tools stored in each image:

7.8.16 Studying whole images

Users of MatLab or Excel will find it convenient to be able to study images themselves. The selection Save As in the Image menu leads to a dialogue in which the current image can be saved in various formats:

- MatLab format, with one double precision value for each element of the image (see Studying whole images with Matlab).
- FLIR Public Format File format, with one single precision value for each element of the image (see The FLIR Public image format).
- Bitmap format, with or without analysis. Can only be used to view the images.
- Csv format. The temperatures of the whole image is stored in a text format that Microsoft Excel can read. The character that separates the temperatures in the file is fetched from the Windows regional settings.

Note: There is also the "Save Tab As" command in the File Menu, which saves the current tab (i.e. both the image and the adjacent graphs) as a bitmap file.

7.8.17 Studying whole images with Matlab

ThermaCAM Researcher uses a simple Matlab matrix format. The binary file begins with five 4-byte integers structure. This is how it is described in C++:

```
typedef struct {  // MatLab file header (level 1.0)
   long type;     // 0 Intel type
   long mRows;    // Image height
   long nCols;    // Image width
   long imagF;    // 0 No imaginary part
   long namLen;   // Length of the matrix name + 1
} MatLabHeader;
```

This is followed by the name of the matrix, which corresponds to the name of the .mat file. **This name must begin with a letter and not contain any strange character for Matlab to be able to read the file**.

The name is followed by nCols*mRows 8 byte double precision float numbers, each containing the current value of one point in the image, column by column.

```
XXXX(1,1):              Top left corner of the image
```

The image value matrix is followed by four extra one column matrices containing data about the stored image. Example for image XXXX:

```
XXXX_DateTime(1,1):     Year
XXXX_DateTime(1,2):     Month
XXXX_DateTime(1,3):     Day
XXXX_DateTime(1,4):     Hour
XXXX_DateTime(1,5):     Minute
```

```
XXXX_DateTime(1,6):     Second
XXXX_DateTime(1,7):     Millisecond
XXXX_ObjectParam(1,1):  Emissivity
XXXX_ObjectParam(1,2):  Object distance
XXXX_ObjectParam(1,3):  Ambient Temperature
XXXX_ObjectParam(1,4):  Atmospheric Temperature
XXXX_ObjectParam(1,5):  Relative Humidity
XXXX_ObjectParam(1,6):  Computed atm. transmission
XXXX_ObjectParam(1,7):  Estimated atm. Transmission
XXXX_ObjectParam(1,8):  Reference Temperature
XXXX_ObjectParam(1,9):  External optics temperature
XXXX_ObjectParam(1,10): External optics transmission
XXXX_Scaling(1,1):      Blackbody range min
XXXX_Scaling(1,2):      Blackbody range max
XXXX_Scaling(1,3):      Type of output
                         0 = temperature
                         2 = difference temperature
                         4 = object signal
                         5 = difference object signal
XXXX_Scaling(1,4):      Camera scale min
XXXX_Scaling(1,5):      Camera scale max
XXXX_Scaling(1,6):      Calculated scale min
XXXX_Scaling(1,7):      Calculated scale max
XXXX_Scaling(1,8):      Actual scale min
XXXX_Scaling(1,9):      Actual scale max
XXXX_FrameInfo(1,1):    Image number
XXXX_FrameInfo(1,2):    Trig count
```

7.8.18 The FLIR Public image format

The "xxxx.fpf" files consist of a header followed by a matrix of single precision IEEE floating point values, each representing one point of the image.

A C-style description of the header layout can be found in the header file fpfimg.h, available in the Examples sub-directory of the installation.

The image point values are stored starting from the top left corner, row by row.

Fpf images can only be saved by ThermaCAM Researcher, not read again.

The basic data types are:

Char	8 bit	Often represents ASCII characters, may represent an 2's complement 8 bit integer (-128 - +127)
Unsigned char	8 bit	8 bit integer number (0 - 255)

Short	16 bit	16 bit integer (2's complement)
Unsigned short	16 bit	16 bit integer
Long	32 bit	32 bit integer (2's complement)
Unsigned long	32 bit	32 bit integer
Float	32 bit	IEEE floating point number, sign + 23 bit mantissa + 8 bit exponent, Representing numbers in the range +/- 10^{38}
Char[<len>]	Len * 8 bit	ASCII character string, most certainly terminated with the NUL character (=0)
Int	32 bit	32 bit integer (2's complement)

Multiple byte data types are stored with the least significant byte first.

The whole header data structure: (size 896 bytes)

```
typedef struct
{
   FPF_IMAGE_DATA_T  imgData;
   FPF_CAMDATA_T     camData;
   FPF_OBJECT_PAR_T  objPar;
   FPF_DATETIME_T    datetime;
   FPF_SCALING_T     scaling;
   long  spareLong[32];    /* = 0 */

} FPFHEADER_T;
```

The image data structure: (120 bytes)

```
typedef struct
{
   char fpfID[32];                /*  "FLIR Public Image Format" */
   unsigned long  version;        /*  = 1 */
   unsigned long  pixelOffset;    /*  Offset to pixel values from
                                      start of fpfID. */
   unsigned short ImageType;      /*  Temperature        = 0,
                                      Diff Temp          = 2,
                                      Object Signal      = 4,
                                      Diff Object Signal = 5, etc */
   unsigned short pixelFormat;    /*  0 = short integer  = 2 bytes
                                      1 = long integer   = 4 bytes
                                      2 = float          = 4 bytes
                                      3 = double         = 8 bytes*/
   unsigned short xSize;
   unsigned short ySize;
   unsigned long  trig_count;     /* external trig counter */
   unsigned long  frame_count;    /* frame number in sequence */
```

```
   long  spareLong[16];            /* = 0 */
} FPF_IMAGE_DATA_T;
```

The camera data structure: (360 bytes)

```
/*  String lengths    */
#define FPF_CAMERA_TYPE_LEN   31   /* Camera name string */
#define FPF_CAMERA_PARTN_LEN  31   /* Camera part number string */
#define FPF_CAMERA_SN_LEN     31   /* Scanner serial number string */
#define FPF_LENS_TYPE_LEN     31   /* Lens name string */
#define FPF_LENS_PARTN_LEN    31   /* Lens part number string */
#define FPF_LENS_SN_LEN       31   /* Lens serial number string */
#define FPF_FILTER_TYPE_LEN   31   /* Filter name string */
#define FPF_FILTER_PARTN_LEN  31   /* Filter part number string */
#define FPF_FILTER_SN_LEN     31   /* Filter serial number string */

typedef struct
{
    char camera_name[FPF_CAMERA_TYPE_LEN+1];
    char camera_partn[FPF_CAMERA_PARTN_LEN+1];
    char camera_sn[FPF_CAMERA_SN_LEN+1];

    float camera_range_tmin;
    float camera_range_tmax;

    char lens_name[FPF_LENS_TYPE_LEN+1];
    char lens_partn[FPF_LENS_PARTN_LEN+1];
    char lens_sn[FPF_LENS_SN_LEN+1];

    char filter_name[FPF_FILTER_TYPE_LEN+1];
    char filter_partn[FPF_FILTER_PARTN_LEN+1];
    char filter_sn[FPF_FILTER_SN_LEN+1];

   long  spareLong[16];            /* = 0 */
}FPF_CAMDATA_T;
```

The object parameters data structure: (104 bytes)

```
typedef struct
{
   float emissivity;        /* 0 - 1 */
   float objectDistance;    /* Meters */
   float ambTemp;           /* Ambient temperature in Kelvin */
   float atmTemp;           /* Atmospheric temperature in Kelvin */
   float relHum;            /* 0 - 1 */
   float compuTao;          /* Computed atmospheric transmission */
   float estimTao;          /* Estimated atmospheric transmission */
   float refTemp;           /* Reference temperature in Kelvin */
   float extOptTemp;        /* Kelvin */
   float extOptTrans;       /* 0 - 1 */
   long  spareLong[16];     /* = 0 */
} FPF_OBJECT_PAR_T;
```

The date and time data structure: (96 bytes)

```
typedef struct
{
   int Year;
   int Month;
   int Day;
   int Hour;
   int Minute;
   int Second;
   int MilliSecond;

   long  spareLong[16];            /* = 0 */
} FPF_DATETIME_T;
```

The scaling data structure: (88 bytes)

```
typedef struct
{
   float tMinCam;         /* Camera scale min, in current output */
   float tMaxCam;         /* Camera scale max */
   float tMinCalc;        /* Calculated min (almost true min) */
   float tMaxCalc;        /* Calculated max (almost true max) */
   float tMinScale;       /* Scale min */
   float tMaxScale;       /* Scale max */
   long  spareLong[16];   /* = 0 */

} FPF_SCALING_T;
```

7.8.19 Studying parts of images

If one part of image is particularly interesting, you can put a box area around it and save its temperatures in a text file that Microsoft Excel can read. (.csv format)

This command is called "Save area as…", and is available in the Image menu.

7.9 How to measure many images

The previous chapter was about measurements on single images. Much of what was said there is still valid and will not be repeated here. This chapter will deal only with questions arising when several images are involved. Typical examples are how a temperature varies with time or how two (or more) measurements vary together.

Two approaches can be used in achieving these measurements. Either you record images and extract the results while playing them back or you get the information directly from the live stream of images.

We recommend that you record images especially if the object you study is moving, since it can be a tedious task to track the moving object with the analysis tools. During the recording, you will have to aim and mind the camera focus as well.

7.9.1 Making measurements in playback

While recording, you often find that the conditions change. It is quite natural to improve the temperature scale or the ambient temperature value while the recording is in progress. This information is stored in the recorded images and can be retrieved during the playback.

Of course you can change the scale and the object parameters even when playing the images. Then you can choose among the following temperature scales:

- The original scale of the recorded image, the source scale.
- A calculated scale, automatically adjusted to the image.
- A fixed scale.

This is controlled by one button on the standard tool bar and one on the play images tool bar:

If you click on the candle, it will become depressed and a new scale will automatically be calculated for every new image as you play them. If you click again on the candle releasing it or, if you press down the lock scale button, the current scale limits will be locked (kept) for every new image. If you release the right button by clicking on it again, the original scale of the images is shown.

If you change the scale manually, and forget to press the lock scale button afterwards, you will be asked: “Do you want to use your new scale for all images?”

The following options exist for the object parameters:

- The original parameters of the recorded images.
- New, enforced object parameters.

This is also controlled from the play recording tools, using this button:

If it is depressed, the current object parameters are kept for all new images. If it is released, the original object parameters of the images are used.

If you change the object parameters manually, and forget to press the lock object parameters button afterwards, you will be asked: “Do you want to use your new object parameters for all images?”

The images recorded by ThermaCAM Researcher do not contain any analysis tools. Hence, you have to add them while playing the images. This is very well, as long as the object of interest stands still. You simply add the analysis and save it with the session file.

But, what if the object is moving?

Should that be the case, we recommend going through the images one by one, moving/reshaping the analysis tools for each image, and saving them under the same name. Thus, forcing each image to contain its own set of analysis tools. There is a Save As item in the Image menu that will do the job.

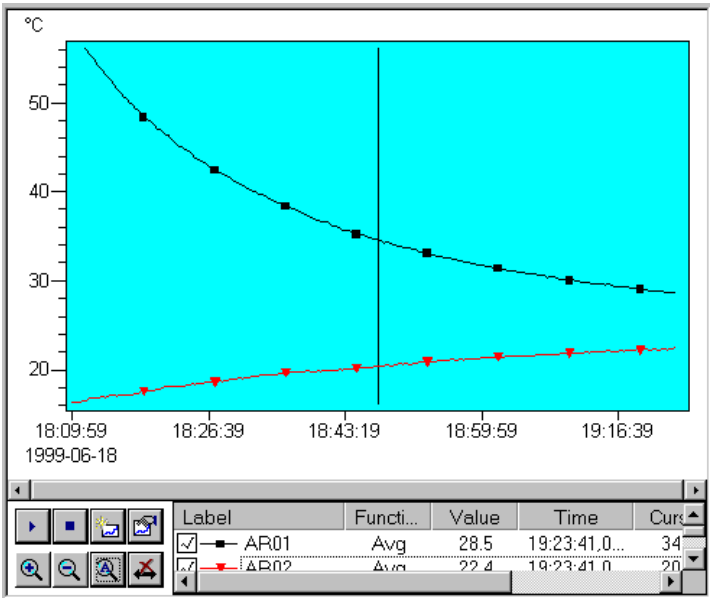
In order to make ThermaCAM Researcher bother about the analysis of these images in the future, you have to release the “Lock analysis symbols” button for this session.

It is also possible for you to “lock” the zoom factor, if you like. Each image can contain a different zoom factor. By pressing this button, you keep the same for all images.

If you change the zoom factor manually, and forget to press the lock zoom factor button afterwards, you will be asked: “Do you want to use your new zoom factor for all images?”

7.9.2 Plotting and logging measurement results

Plotting is useful when you wish to illustrate temperature variation over time. Just look at this graph which shows the temperature decline and increase of a hot and a cold cup of water.

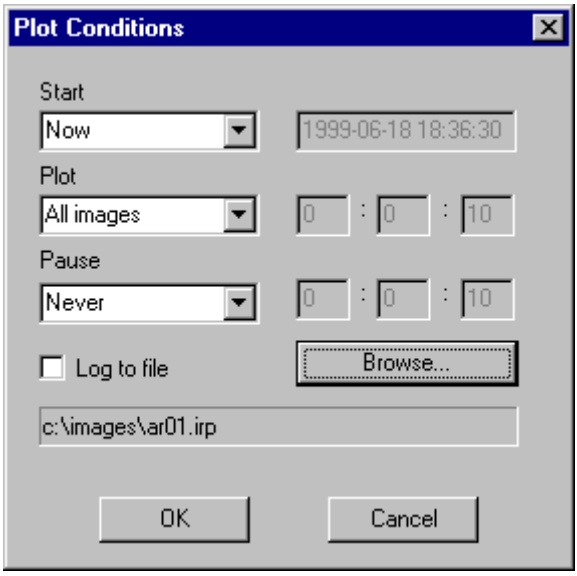


To get such a plot, you would add two areas to the live image, switch to the "Plot" tab and click on this button beside the plot table. Use it to add the average result of the two areas to the plot graph. Now you will find that the plotting starts immediately, and at a very high speed.

Press this button to stop the plotting.

When the plotting has stopped, you could start it again with this button, but never mind that for the moment.

Instead, click on AR01 in the plot table. The line highlights. If you click with right mouse button on the line, a menu appears from which you can select "Conditions". This is the dialogue that will appear:



Here you can control the way each result series is plotted. Set a starting time a few minutes ahead and an interval of 20 seconds for both areas. If you have connected an external trig, you might use that start condition instead. Press OK.

For more information about how to connect an external trig, see How to trigger ThermaCAM Researcher from outside on page 63.

(If you check-mark "Log to file, the results will be saved in a log file (.irp) too, in text format. You can read such files back into the plot window for examination later, if you like.)

Use the remaining seconds until the plotting starts to clear the graph by clicking with the right mouse button on it and by selecting "Clear" from the menu.

When the starting time arrives, the plotting will start and continue until you press the stop button again, unless you had set some condition that causes the plot to stop earlier.

To inspect the plotted results, place a cursor on the graph and read the results from the cursor column of the plot table. Click with the right mouse button on the graph and select "Cursor" from the menu. You can catch and drag the cursor with the left mouse button.

☑ If you have plotted many results at the same time, you will find it convenient to temporarily hide some of them by clicking on this symbol on the corresponding line of the plot table:

To inspect the graph in more detail, zoom in and out using these three buttons. The A-button auto-zooms so the data will fill most of the graph window. If a particular part of the graph is more interesting, you zoom into that part by "painting it" with the mouse. Hold the left mouse button down while you move the mouse over the interesting part of the graph.

To inspect the graph while plotting still is going on, press this button. It will prevent the plotting window from auto-scrolling to the end as soon as new results arrive.

The scaling of the axes and many other settings such as colours and line widths can be changed if you bring up the settings dialogue with this button:

To save plot data in text format either log it while it is being plotted (as described above) or click with the right mouse button on the line in the plot table and choose "Save" from the menu.

If you intend to make long plottings, there are a few things worth considering:

- Eventually, the plotting on the screen will slow down the computer. You can avoid this by switching off the auto-scrolling and have the function plot outside its window. Then, you won't see the whole graph until the plotting is finished.
- The temperature drift of the camera is important during long plottings. No camera will be perfectly stable, but you can improve the situation by running it until it reaches a steady state.

If you want to make plottings from images stored on disk, please do like this to get the first image included in the plot:

- Open the images via the Image Menu
- Place your analysis tools on the first image.
- Add the tools to the plot table.
- Set appropriate settings for this plot and clear the graph via the graph menu.
- Open the images once again.
- Forward play the images. (Backward plotting is not supported.)

7.9.3 Transferring plot data using OLE

You can also right click inside the plot window and select **Copy**. When pasting, choose either Text or Picture (Enhanced Metafile). The Text option copies the plot table contents and the Picture option copies the entire plot window in graphical format.

7.9.4 Transferring many image results with OLE

If you want to study really intricate things, like plotting the difference between two temperatures over time or correlating a temperature to some other entity, such as pressure, then you have to you use a spread sheet program capable of handling OLE. Assuming that you have access to Microsoft Excel, you should proceed like this.

Embed ThermaCAM Researcher in a spreadsheet (Insert => Object => ThermaCAM Researcher Session) and write an Excel macro in VBA (Visual Basic for Applications). It will open the right session file in ThermaCAM Researcher and, in a loop, read the desired measurement values from each image and put them in a pair of columns of cells. Then use the Chart Wizard of Excel to create a graphical presentation.

Here is an example of such a VBA macro:

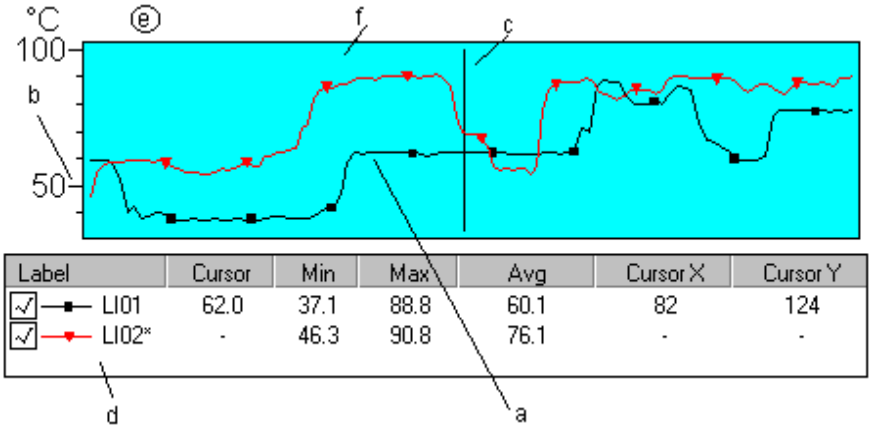
```
Sub PlaySequence_Click()
    Dim sess As Object
    Dim row As Integer
    Dim col As Integer

    row = 1
    col = 10

    ' Get a reference to the ThermaCAM Researcher object
    Set sess = _
       Worksheets("Sheet1").OLEObjects("Object 1").Object

    ' Move to the first image in the session
    sess.GotoFirstImage

    ' Start a loop that iterates through all images
    ' in the session
    Do While True

        ' Store IR image time and spotmeter temperatures
        ' in the cells
        Worksheets(1).Cells(row, col).Value = _
           sess.GetNamedValue("sp1.temp")
        Worksheets(1).Cells(row, col + 1).Value = _
           sess.GetNamedValue("sp2.temp")
        ' Leave col + 2 for the difference sp02 - sp01
        '
        Worksheets(1).Cells(row, col + 3).Value = _
           sess.GetNamedValue("time")

        If sess.IsLastImage Then
```

```
            Exit Do
        End If

        ' Load next image in the session and
        ' increment the row counter

        sess.StepForward
        row = row + 1

    Loop

End Sub
```

7.10 How to study temperature profiles

7.10.1 Obtaining a profile

Temperature profiles are useful when you wish to illustrate the temperature variation across or along an object in the image. You just have to put the line on the image and switch to the profile window in order to be able to see the profile. Below the graph, there is a table, in which you can get interesting information about each line.



a) Profile
b) Temperature scale
c) Line cursor
d) Profile table
e) Chart area
f) Plot area

If you would like to change the way in which the profiles are displayed, you can do this by the Settings dialogue, available on the right hand mouse button when you click on top of the profile.

The profile scale is normally connected to the IR image scale, but can be set independently or automatically.

The line presentation can be reversed, in case you happened to draw the line in the wrong direction.

Each line can have a cursor, which is displayed both in the profile window and the IR image. When you need to find the image position of a certain "bump" in the profile, add a cursor tool to the line and move it in the IR image until it hits the bump.

7.10.2 Transferring temperature profile data using OLE

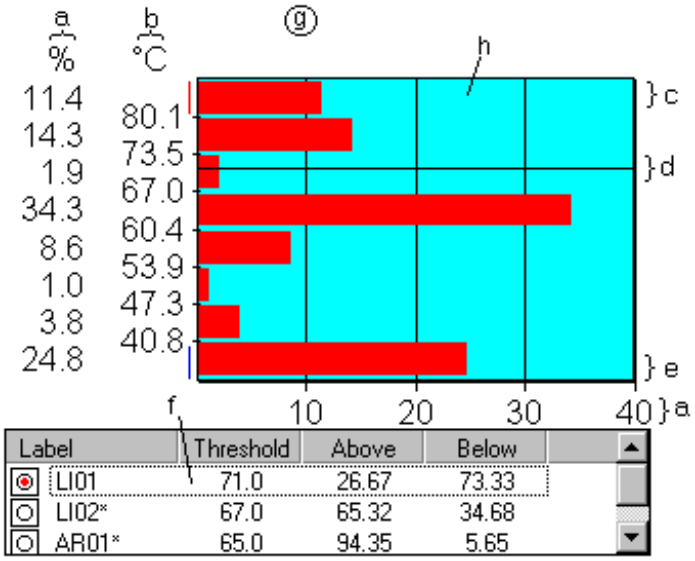
The profile of each line or area is available in table form if you select "String data" for a line from the Copy Value dialogue of the Edit Menu. In the receiving application, for example Excel, select Edit Paste Special.

You can also right click inside the profile window and select **Copy**. When pasting, choose either Text or Picture (Enhanced Metafile). The Text option copies the profile table contents and the Picture option copies the entire profile in graphical format.

7.11 How to study temperature distributions

7.11.1 Obtaining a histogram

The easiest way to assess the distribution of temperatures within an area or along a line on the image is to look at the histogram, which displays how much of the area/line that is occupied by a certain temperature interval. You simply put the area/line on the image and switch over to the histogram window and - there it is! Below the bar graph, there is a table, in which you select which analysis tool to display.



a) The percentage value for each class

b) Class temperature limits

c) Overflow class, marked by a red line by the scale

d) Threshold indicator

e) Underflow class, marked by a blue line by the scale

f) Histogram table, indicating the active histogram

g) Chart area

h) Plot area

If you would like to change the number of class intervals or the top/bottom limit of the histogram scale, this can be done by the Settings dialogue, available on the right hand mouse button when you click on top of the histogram. The permitted number of classes is 2 - 64.

The histogram scale is normally connected to the IR image scale, but can be set differently. Changing this does not, however, change the class interval limits that always are determined by the current IR image scale.

Those parts of the area/line that fall outside the IR scale are included in the overflow/underflow classes.

If you want to be able to see and compare two histograms at the same time you must switch the histogram window over to dual histogram mode. Afterwards, you can select two analysis tools for display at the same time.

7.11.2 Using a threshold

Let's suppose that you are not interested in the full temperature distribution of a line/area, just in getting to know how much of it that has been sufficiently heated or cooled. Then the threshold function will suit your purpose.

You can associate a threshold with a line/area from the Analysis Tab of the IR image settings or the General Tab of the Histogram Window Settings and obtain the desired percentage from the Result Table Window or the Histogram Window, if you switch on its presentation. The threshold can also be displayed in the histogram bar graph.

Temperatures that are equal to the threshold temperature are counted as below the threshold.

The threshold does not have to coincide with any class limit of the histogram window.

7.11.3 Transferring temperature distribution data using OLE

The histogram of each line or area is available in table form if you select "Histogram" from the Copy Value dialogue of the Edit Menu. In the receiving application, for example Excel, select Edit Paste Special.

You can also right click inside the histogram window and select **Copy**. When pasting, choose either Text or Picture (Enhanced Metafile). The Text option copies the histogram table contents and the Picture option copies the entire histogram in graphical format.

8. Menu commands

8.1 The File menu

This menu contains commands related to session files. See Session files, page 42. You can create new sessions, open existing session files, save the current session, select a default session, open/add images to the current session (see The open images dialogue, page 69), print an image and leave the program. You can also save the current tab as a bitmap file.

8.2 The Edit menu

This menu contains commands related to the clipboard. See Transferring an IR image to ThermaCAM Reporter, page 62, Transferring an IR image with OLE, page 63 and Transferring single results with OLE, page 93 or OLE on page 114. Pasting sessions into ThermaCAM Researcher is mentioned in How to play back images, page 68.

8.3 The View menu

This menu lists all the tool bars, the control panels and the status line of ThermaCAM Researcher. Use this menu to hide and unhide them as you please.

See Program screen layout, page 44, for a description of the tool bars.

8.4 The Camera menu

This menu contains a number of commands related to the connecting and controlling of the camera. All of them are described in How to connect and control the camera, page 52, and the following chapters about each camera control panel.

8.5 The Image menu

This menu leads to most commands related to the handling of single images. You can read about this in The image directory, page 42, The open images dialogue, page 69, Obtaining a good IR image, page 60, Measurement output and units, page 94, Studying whole images, page 96, Removal of analysis tools, page 89, Studying parts of images, page 100, and Emissivity calculation, page 91.

8.6 The Recording menu

This menu contains commands about the recording of images and the playback of recordings. This is described in How to record IR images, page 64, How to play back images, page 68 and How to edit/convert sequences on page 74.

8.7 The Help menu

This menu provides you with access to the ThermaCAM Researcher help file, which happens to correspond to this manual, and with version information about ThermaCAM Researcher and its components, the IR image control program and the camera control program.

8.8 The Play Images toolbar menu

This menu pops up when you click with the right mouse button on the play images tool bar. It contains some of the commands in the Recording menu. This is described in How to play back images, page 68 and How to edit/convert sequences on page 74.

8.9 The IR Image window menus

These menu pops up when you click with the right mouse button on the IR image.

If you happen to click near an analysis symbol, you will get a menu for that symbol. If you click anywhere else on the IR image, you will get a menu with some of the commands from the IR menu.

You can read about this in The open images dialogue, page 69, Obtaining a good IR image, page 60, Measurement output and units, page 94, Studying whole images, page 96, Removal of analysis tools, page 89, Studying parts of images, page 100, and Emissivity calculation, page 91.

8.10 The Results table window menu

This menu pops up when you click with the right mouse button on the Results table window. It contains settings for the Results table.

The result table is described in The result table window, page. 91.

8.11 The Profile window menu

This menu pops up when you click with the right mouse button on the Profile window. It contains settings for the Profile window.

The profile is described in How to study temperature profiles, page.107.

8.12 The Histogram window menu

This menu pops up when you click with the right mouse button on the Histogram window. It contains settings for the Histogram window.

The histogram is described in How to study temperature distributions, page 108.

8.13 The Plot window menu

This menu pops up when you click with the right mouse button on the Plot window. It contains settings for the Plot window.

Plotting is described in Plotting and logging measurement results on page 102.

9. OLE tricks and tips

9.1 OLE in brief

9.1.1 Copying information to other applications

If you want to copy information in ThermaCAM Researcher to another application you must first copy the data and put it on the clipboard. There are two commands on the Edit menu you can use: “Copy session and image” which will copy the session and the entire IR image and “Copy value” which will load a dialog where you can select the information you want to be copied.

You can also copy data from the result table, from the histogram window, from the profile window and from the plot window to the clipboard. Right click in the corresponding window and select “Copy”.

To control how information is pasted, use the Paste Special command on the Edit menu in the receiving application.

9.1.2 Linking into other applications

Create a link

- Start ThermaCAM Researcher as a standalone application.
- Save the session as an .irs file.
- On the Edit menu, click Copy session and image to copy the IR image to the clipboard.
- Alternatively, click copy value and select the value to copy.
- In the other application, click where you want the linked ThermaCAM Researcher Image to be placed.
- On the Edit menu, click Paste Special.
- To paste as a link, select the Paste Link option and Picture Object.
- Click OK.

9.1.3 Embedding into other applications

Create an embedded object

- Start the application in which you want to embed ThermaCAM Researcher.
- Click where you want to embed ThermaCAM Researcher.
- Open the dialog where you insert objects. It depends on the application how this dialogue is loaded. In Excel and Word you click Object in the Insert menu.
- In the Object Type box, click ThermaCAM Researcher Session.
- Click OK.

Edit an embedded object

Double-click the ThermaCAM Researcher Session object to open it for editing. The menus and toolbars in the application are replaced so that you can edit the embedded object in place.

9.1.4 Automation

By using OLE Automation, it is possible to manipulate ThermaCAM Researcher from the outside. You can instruct ThermaCAM Researcher to load images, query it about temperatures etc.

This interface is available from many programming languages such as Visual Basic for applications VBA (used in Excel), VB script (available in Windows 98, Me and 2000) and "ordinary" Visual Basic.

Some examples can be found in the Excel samples that are installed in the Example directory (a subdirectory to that ThermaCAM Researcher installation directory).

A full Visual Basic project is included in the VBDemo directory of the CD-ROM.

The on-line help texts of ThermaCAM Researcher describe the OLE Automation commands in detail.

There are many books on the market that describe VBA and how to use it in e.g. Excel.

9.2 OLE caveats

If ThermaCAM Researcher is embedded or linked to the Microsoft Office programs, e.g., Word or Excel there might be some strange behaviours you didn’t expect. The main reason for this is that the Office programs handle OLE in different ways and ThermaCAM Researcher cannot work perfectly in all

environments. This chapter describes some of the peculiarities and ways to work around them. ThermaCAM Researcher works better in Office 95 than in previous releases of the product. In Office 97 many problems seem to have disappeared.

9.2.1 Colours

Problem: In some applications, e.g. Microsoft Word, the image can be drawn using the wrong colours. Instead of using the colours in the selected palette (e.g. Rainbow) the image is drawn in randomly selected colours.

Solution: Change the settings for your video card so it uses more than 256 colours. Depending on your video card, use 32000, 64000 or TrueColour. Please refer to the documentation of your video card. Please note that this may affect the performance of the live image presentation.

9.2.2 Incorrect aspect ratio

Problem: When you change the size of the IR image it can get incorrect proportions, i.e. it becomes elongated either horizontally or vertically.

Solution: You have to avoid doing this. Different programs provide different means of resizing an embedded object with out changing the aspect ratio. In some cases you should catch the corners, in other cases you should press the shift button while resizing the object.

9.2.3 Links will not work for an embedded object

Problem: If you have an embedded ThermaCAM Researcher, linking to a value in it might not work.

Solution:

In Excel you can embed a ThermaCAM Researcher object and paste a link to a value in the object. The problem is that when you deactivate the object, any changes you have made to the image (added analysis etc.) will not be seen in the inactive object. The image will be updated when you save the Excel document. A solution to this problem is to link both the image and the value or to upgrade to Office ’97.

9.2.4 Multiple links do not update in Word

Problem: If you have more than one link from the same IR image (e.g. one link from the IR image and one link for a spot meter temperature) it might happen that only one of links will be updated when you modify the IR image.

Solution: The problem is that when the links shall be updated Word cannot handle more than one link. The easiest solution to this problem is to select all text in Word (press Ctrl + A) and then press F9 to update the entire document.

9.2.5 Word consumes lots of disk space for live images

Problem: If you embed ThermaCAM Researcher in Word and try to present a live image, Word will get busy slowly filling your hard disk. Sometimes, it proves impossible to do anything but restarting the computer.

Solution: Live image presentation in MS Word should be avoided. The lost disk space is recovered when the computer is restarted.

9.2.6 Excel does not accept our numerical values

Problem: Under some circumstances, the Excel cells will refuse to accept numeric values from ThermaCAM Researcher. This is due to the fact that ThermaCAM Researcher will "decorate" the values with "<", ">" and "*" signs, if the temperatures are out of range.

Solution: We recommend that you select a better measurement range in this case. If that proves impossible, there is a possibility for you to switch off these decorations altogether. Then, in the registry of your computer, set the following parameter to 0 instead of 1 and restart ThermaCAM Researcher.

```
My computer\
   HKEY_CURRENT_USER\
      Software\
         FLIR Systems AB\
            ThermaCAM Researcher XXXX\
               Settings\
                  IllegalTempIndicator = 0
```

9.2.7 Activate method gives run time error 1004 in Excel

Problem: When used on an embedded object in Microsoft Excel for Office 97, the Activate method under some circumstances gives runtime error 1004. This applies to many embedded objects, not only ThermaCAM Researcher objects.

Solution: We recommend that you either avoid activating the object or create the macro with an earlier version of Excel or update to Office 2000, which seems to work better.

10. Glossary

Ambient temperature

Ideally, all radiation received by the camera should come from the body you wish to study. Other bodies and the air around it will also emit radiation which by reflection can reach the camera, but it can be compensated for. The effect of this radiation is assumed to be the same all over the image. You should set this parameter to the average temperature of the surroundings.

Atmospheric temperature

The air between the body you wish to study and the camera absorbs some of the radiation passing through and adds some radiation due to its own temperature. This disturbs the measurements, but it can be compensated for. You should set this parameter to the average temperature of the atmosphere. The distance and relative humidity also have to be correct in order for the compensation to work.

Blackbody

A body, which absorbs all radiation falling upon it at any wavelength. Such objects do, despite their name, emit electromagnetic radiation due to their temperature. The spectral distribution of the radiation from a blackbody follows the so called Planck's Law.

Many ordinary bodies behave almost like blackbodies, emitting radiation in the same way, but less of it. Such objects are called greybodies.

See also: emissivity.

Camera interface

Name referring to the hardware through which the image passes before it reaches the image handling software in the computer.

CardBus PC Card

PC Cards that comply to the new 32-bit version of the PC Card Standard.

Clipboard

An area of storage, or buffer, where data objects or their references are placed when a user carries out a cut or copy operation. The data is then usually pasted into other applications.

Control panel

Windows with buttons, list selections, check boxes and so on with which you can control some particular thing, for instance a camera. Your actions you have an immediate effect.

Compound document

Or container document. A document within an OLE container application that contains data of different formats, such as sound clips, spreadsheets, text, and bitmaps. Each piece of integrated data (or compound-document object) can exist within the compound document as a linked item or an embedded item.

Computed transmission

The program will attempt to compute the transmission of the atmosphere, if it is air, based on facts about its temperature, humidity and the distance to the body being studied. The value is used in compensating for the effects of the atmosphere on the radiation passing through.

Dialogue window

A window meant for interaction with the user. It can be equipped with tabs, buttons, text input fields, list selections, check boxes and so on. There is an OK button, which you have to press in order to activate your changes and a Cancel button by which you can discard them.

Directory

A system file used to maintain the structure of a set of files.

Distance

The distance between the front of the lens of the camera and the thing being depicted.

Docking

Tool bars can be docked, i.e. be attached to the borders of the main window, following it as it is moved or resized. You double-click with the left mouse button on the tool bar to release the docking. The freely floating toolbar then created can be made to dock again by another double click with the mouse.

Embedded item

Or embedded object. A type of compound-document item in which all the information needed to manage the item is stored in the container document, but which is created and edited by an OLE server application. Embedded items can be edited or activated in-place. See also linked item and in-place activation.

Emissivity

A number between 0 and 1 describing the amount of radiation emitted from a body compared to if it was a perfect blackbody.

Estimated transmission

The program will attempt to compute the transmission of the atmosphere based on facts about its temperature, humidity and the distance to the body being studied. This value is used in compensating for the effects of the atmosphere on the radiation passing through.

If you are able to obtain a better value you can set this parameter to that value, thus improving the compensation. Set it to 0 to make the program use the computed transmission.

External Optics

An IR-transparent material through which the camera is looking at the body being studied. The program can compensate for the temperature and IR transmission properties of this material, but not for reflections that appear in its camera-side surface.

Frame grabber

Piece of hardware that captures images from an electrical stream of bytes.

In-place activation

Or in-place editing, visual editing. The ability to activate an object within the context of its container document, as opposed to opening it in a separate window.

IR

The infrared waveband in the electromagnetic spectrum. Roughly about 1 to 50 µm wave length.

IR image file (.IMG, .ANA, .TIF, .T?W, .SEQ)

Extensions for files containing an IR image in digital format. Most IR image files contain a substantial amount of information about the image in addition to the IR value of each pixel. The IR values are mathematically transformed to temperature, before any measurement or display is made. t?w stands for tmw, tgw and tlw.

ThermaCAM Researcher session file (.IRS)

File extension used for ThermaCAM Researcher session files, containing most of the settings related to a particular "run" of ThermaCAM Researcher. If you save your work in a session file, you should be able to come back to the same state when retrieving the file. The most important element of the session is its list of current image files and the name of their directory. The session files do not contain any images as such and no analysis results from the images.

Link

A connection between two documents.

Linked item

Or linked object. In OLE, an item in a compound document whose data is stored in a separate file rather than in the document's file. A linked item must be edited in a separate window. See also embedded item.

Object

A much too frequently used word meaning either the motif of the IR image, something in a screen window possible to activate by the mouse or a chunk of data that can be transferred between programs.

Object parameters

A group of values describing the body being investigated (the object) and its surroundings. The values are used in a calculation which computes the amount of radiation actually coming from the object. Compensations are made because the atmosphere between the object and the camera absorbs and emits radiation, and radiation being reflected in the object can reach the camera.

The object parameters are: Emissivity, Ambient temperature, Atmospheric temperature, Relative humidity, Distance, External optics temperature and External optics transmission.

In addition to these, there is also the Estimated transmission parameter, which mainly is used when atmosphere does not consist (only) of air.

OLE

Stands for Object Linking and Embedding. A way to transfer and share information between applications. Linking and embedding are two methods in OLE for storing items inside a compound document when those items were created in another application. An embedded item is stored as part of the compound document that contains it. A linked item stores its data in a separate file.

OLE Automation

A way to manipulate an application's objects from outside the application. OLE Automation is typically used to create applications that expose objects to programming tools and macro languages, to create and manipulate one application's objects from another application, or to create tools for accessing and manipulating objects.

OLE Automation object

An object that represents (some of) the data and functionality of an application. It can be changed by other applications using OLE Automation via "Properties" and "Methods". An application that exposes its OLE Automation objects is called an OLE server application. The application that accesses the object is called the OLE Controller application.

OLE Container application

An application that can incorporate embedded or linked items into its own documents. The documents managed by a container application are able to store and display OLE Visual Editing items as well as data created by the application

itself. A container application allows users to insert new items or edit existing items. See also OLE server application.

OLE Controller application

An application that can access and manipulate OLE Automation objects is called an OLE controller application

OLE item

An object that represents data, created and maintained by a server application, that can be seamlessly incorporated into a document so that the object appears to be a part of the larger document. The result is a compound document made up of the OLE item and a containing document.

OLE Server application

An application that can create OLE items for use by container applications. Data in a server application can usually be copied, using the Clipboard or a drag-and-drop procedure, so that a container application can paste the data as an embedded or linked item. Also the name of applications that expose their data and functionality for automation as OLE Automation objects.

OLE Server document

A document created by an OLE server application. See also compound document.

Palette

The set of colours used when painting the image.

Also, a text file with RGB colour codes. The extension is .pal.

PC Card

A memory or Input/Output card complying to the 16 bit PC Card Standard. Such cards can be plugged into PC Card adapters of laptop and desktop computers. They also fit into 32 bit PC Card adapters that are compatible with the same standard.

PC Card adapter

A device designed to connect PC Cards to an internal bus of a PC.

PCMCIA

An acronym for the Personal Computer Memory Card International Association which decides on the PC Card Standard.

Pixel

Short for picture element. The IR image is made up of a number of dots (pixels), each with its own temperature value and, consequently, colour. The pixel co-ordinates are 0:0 at the top left corner of the image and increase towards the right and downwards.

Relative humidity

A number between 0 and 99% which is used in the calculation of the computed transmission of air. Air will absorb parts of the radiation passing through it, but that can be compensated for.

Sequence of IR images

A set of IR images that have been recorded at the same time. Either in a number of different .img files or in one single .seq file.

Tool bar

A bar-shaped window frequently containing small buttons with pictures. Other types of controls can however also be used. Tool bar buttons issue a command when you click on them with the mouse. Some buttons stay depressed, indicating some kind of state, until you click again to release them or the state changes by itself. Tool bar buttons can sometimes hide menus, that will appear when you move the mouse during the click over the button. If you keep the mouse cursor still over a tool button, an explanatory text, the tool tip, will appear.

Transmission

See Computed transmission and Estimated transmission.

VBA

An acronym for Visual Basic for Applications, a language used when writing macro commands in modern Microsoft Applications.

Wait state

The number of clock cycles that the processor in a PC will wait before proceeding with the next operation towards a memory or Input/Output device.

11. Index

I

K

L

M

N

O

P

Q

R

S

T

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(November 17th, 2000)