Infrared camera

MICRO-EPSILON

Operators manual

thermoIMAGER TIM 160

CE-Conformity

The product complies with the following standards:

EMC:	EN 61326-1
Safety Regulations:	EN 61010-1:1993/ A2:1995

The product accomplishes the requirements of the EMC Directive 2004/108/EC.

Read the manual carefully before the initial start-up. The producer reserves the right to change the herein described specifications in case of technical advance of the product.

Warranty

Each single product passes through a quality process. Nevertheless, if failures occur, please contact the customer service at once. The warranty period covers 24 months starting on the delivery date. After the warranty is expired the manufacturer guarantees additional 6 months warranty for all repaired or substituted product components. Warranty does not apply to damages, which result from misuse or neglect. The warranty also expires if you open the product. The manufacturer is not liable for consequential damage. If a failure occurs during the warranty period the product will be replaced, calibrated or repaired without further charges. The freight costs will be paid by the sender. The manufacturer reserves the right to exchange components of the product instead of repairing it. If the failure results from misuse or neglect the use has to pay for the repair. In that case you ask for a cost estimate beforehand.

Contents

1. Description

The thermoIMAGER TIM calculates the surface temperature based on the emitted infrared energy of objects [► Basics of Infrared Thermometry]. The two-dimensional detector (FPA - focal plain array) allows a measurement of
160 x 120 pixels and will be shown as thermographic image using standardized palettes. The radiometric processing of the picture data enables the user to do a comfortable detailed analysis with the software TIM Connect.

The thermo IMAGER is a precise instrument and contains a sensitive infrared detector and a high-quality lens. The alignment of the camera to intensive energy sources (high power laser or reflexions of such equipment, e.g.) can have effect on the accuracy of the measurement or can cause an irreparable defect of the infrared detector.
The mounting should be made only via the mounting threads or tripod connection the housing is providing.

1.1 Scope of Supply

- thermo IMAGER TIM inclusive one lens
- USB cable (1 m)
- Process interface cable
- Table tripod
- Thermo graphic software TIM Connect
- Operators manual

1.2 Maintenance

Lens cleaning: Blow off loose particles using clean compressed air. The lens surface can be cleaned with a soft, humid tissue moistened with water or a water based glass cleaner.

PLEASE NOTE: Never use cleaning compounds which contain solvents (neither for the lens nor for the housing

1.3 Cautions

Avoid static electricity, arc welders, and induction heaters. Keep away from very strong EMF (electromagnetic fields). Avoid abrupt changes of the ambient temperature.
In case of problems or questions which may arise when you use the infrared camera, please contact our service department.

1.4 Factory Default Settings

The unit has the following presetting at time of delivery:

Temperature range	-20...100 °C
Emissivity	1.000
Process interface (PIF)	inactive
Interprocess Communication (IPC)	inactive
Measurement function	Rectangle measure area

2 Technical Data

2.1 General Specifications

Environmental	
Environmental rating	IP 67 (NEMA-4)
Ambient temperature	0...50 °C
Storage temperature	-20...70 °C
Relative humidity	10...95 %, non condensing
Material (housing)	aluminum, anodized
Dimensions	45 mm x 45 mm x 65 mm
Weight	250 g (inclusive lens and 1 m USB cable)
Cable length (USB 2.0)	1 m (Standard), 5 m, 20 m
Vibration	IEC 68-2-6: 3 g, 11 – 200 Hz, any axis
Shock	IEC 68-2-27: 50 g, 11 ms, any axis
EMC	EMC Directive 2004/108/EC

2.2 Electrical Specifications

Power Supply	5 VDC (powered via USB 2.0 interface)	
Current draw	max. 500 mA	
Output Process Interface (PIF out)	0-10 V (TObj, TInt, Flag status or Alarm status)	
Input Process Interface (PIF in)	0-10 V (Emissivity grad, ambient temperature, reference temperature, Flag control, triggered video or triggered snapshots	
Digital Input Process Interface	Flag control, triggered video or triggered snapshots	
Digital interface	USB 2.0	[► TIM Interface]

2.3 Measurement Specifications

Temperature ranges	-20...100 °C 0...250 °C 120...900 °C
Spectral range	7.5...13 µm
Lenses	64 ° x 50 °/31 ° x 23 °/ 9 ° x 7 °
System accuracy [1)]	±2 °C or ±2 %
Temperature resolution (NETD)	0.1 K at 31 ° and 64 ° FOV / 0.3 K at 9 °FOV
Frame rate	TIM 160: 100 Hz TIM 160/9: ≤ 9 Hz (export version)
Warm-up time	10 min
Emissivity	0.100…1.000 (adjustable via software)
Measurement functions	Measure points (1x1, 3x3 or 5x5 pixels); free adjustable location Measurement rectangle; Size scalable; free adjustable location Both of these functions can be combined with the signal processing features: Average, MAX, MIN value.
Software	TIM Connect

[1)] at ambient temperature 23 ±5 °C; whichever is greater

3 Mechanical Installation

The TIM is equipped with two metric M4 thread holes on the bottom side (6 mm depth) and can be installed either directly via these threads or with help of the tripod mount (also on bottom side).

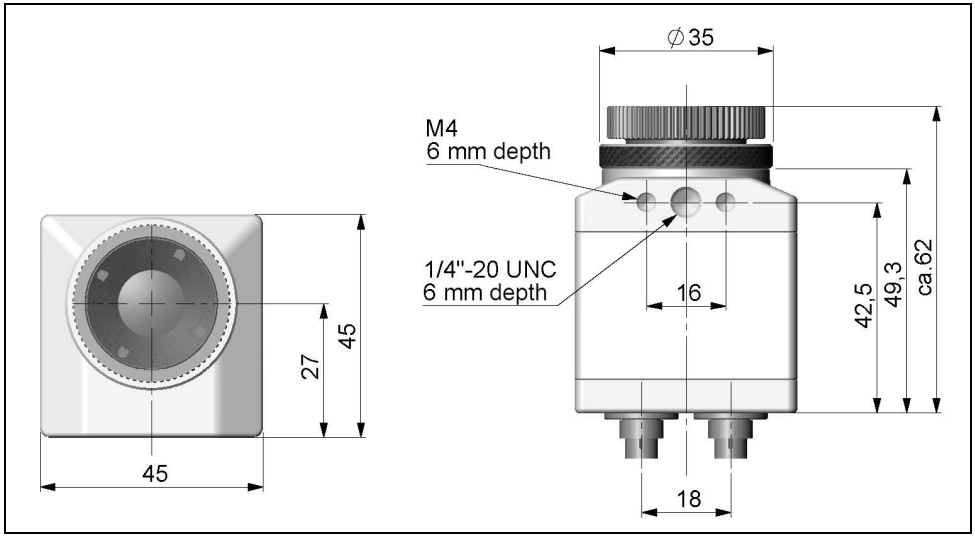


Fig. 2.1: thermo IMAGER TIM – drawing

3.1 Mounting Accessories (Optional)

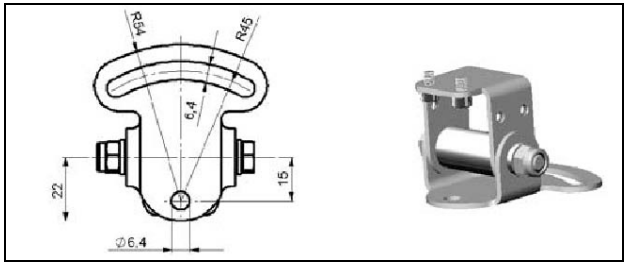


Fig. 2.2: Stainless steel mounting base, adjustable in two axes, part number: TM-MB-TIM

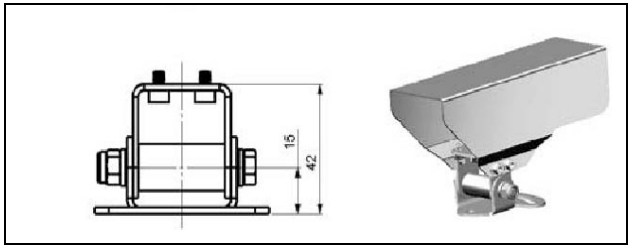


Fig. 2.3 Stainless steel protective housing, inclusive mounting base, part number: TM-PH-TIM

4 Electrical Installation

At the back side of the TIM you will find two connector plugs. Please connect the supplied USB cable with the right plug. The left connector plug is only used for the process interface.

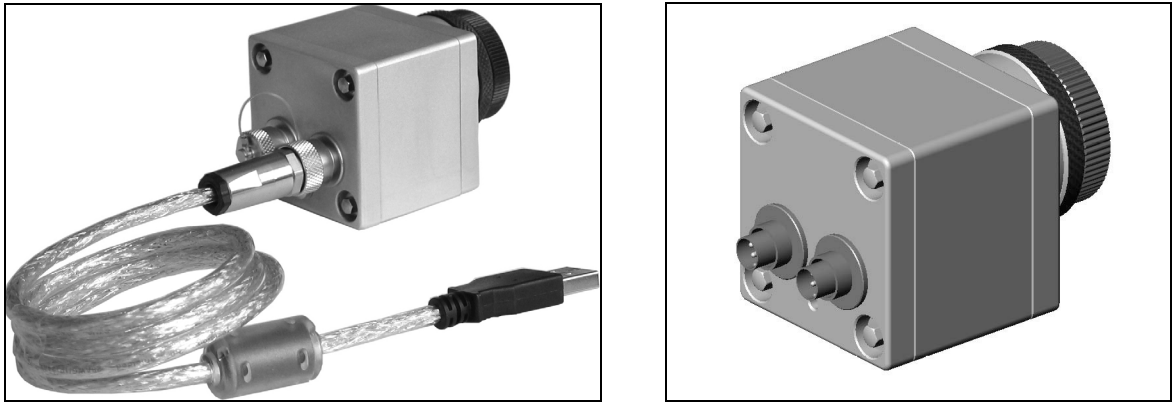


Fig. 4.1 Backside of camera with connectors

5 Process Interface

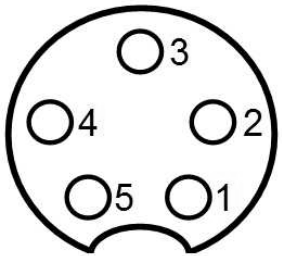
The TIM is equipped with a process interface, which can be programmed via the software as analog input **(PIF IN)**, and digital input **(DIG IN)** (to control the camera) or as analog output **(PIF out).**

PIF in	PIF out	PIF (digital input)
Emissivity	Main area temperature	Flag control
Ambient temperature	Internal temperature	Triggered recording
Reference temperature	Flag status	Triggered snapshots
Flag control	Alarm	
Triggered recording		
Triggered snapshots		

The signal level is always 0-10 V.

Pin configuration Process Interface (PIF) (outside view)

1 DIGITAL IN
2 10 V OUT
3 GND
4 OUT
5 IN



[►TIM Interface]

6 Start Up

Please install at first the software TIM Connect from the CD, as described in the next chapter. The CD contains the software application as well as the unit specific calibration data. These data will be installed also automatically.
Now you can connect the infrared imager to a free USB port (USB 2.0) of your PC.
After the software has been started, you should see the live image from the camera inside a window on your PC screen.
In case you are using more than one TIM simultaneously go to Devices to select required TIM from the list.
The sharpness of the image can be adjusted by turning the exterior lens ring.

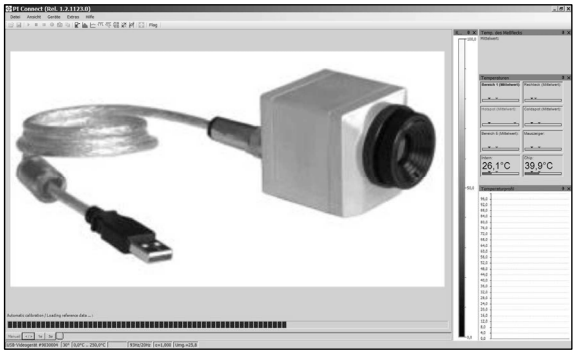


Fig. 6.1 Initiating phase after starting TIM Connect software

7 Software TIM Connect

7.1 Installation

Insert the installation CD into the according drive on your computer. If the auto run option is activated the installation wizard will start automatically.
Otherwise please start **setup.exe** from the CD-ROM. Follow the instructions of the wizard until the installation is finished.

The installation wizard will place a launch icon on the desktop and in the start menu:
[Start]\Programs\Micro-Epsilon Messtechnik GmbH u Co KG\TIM Connect.

If you want to uninstall the software from your system please use the **uninstall icon** in the start menu.

The TIM Connect software can be started with additional starting parameters using the command line:

Command the parameters	
/?	Opens this help dialog
/Minimized	Application starts minimized
/Maximized	Application starts maximized
/FullScreen	Application starts in full screen mode
/Invisible	Application starts invisible
/Name=Instancename	Application starts with an instance name

To start multiple instances of imager.exe you need to start any instance with an unique name.

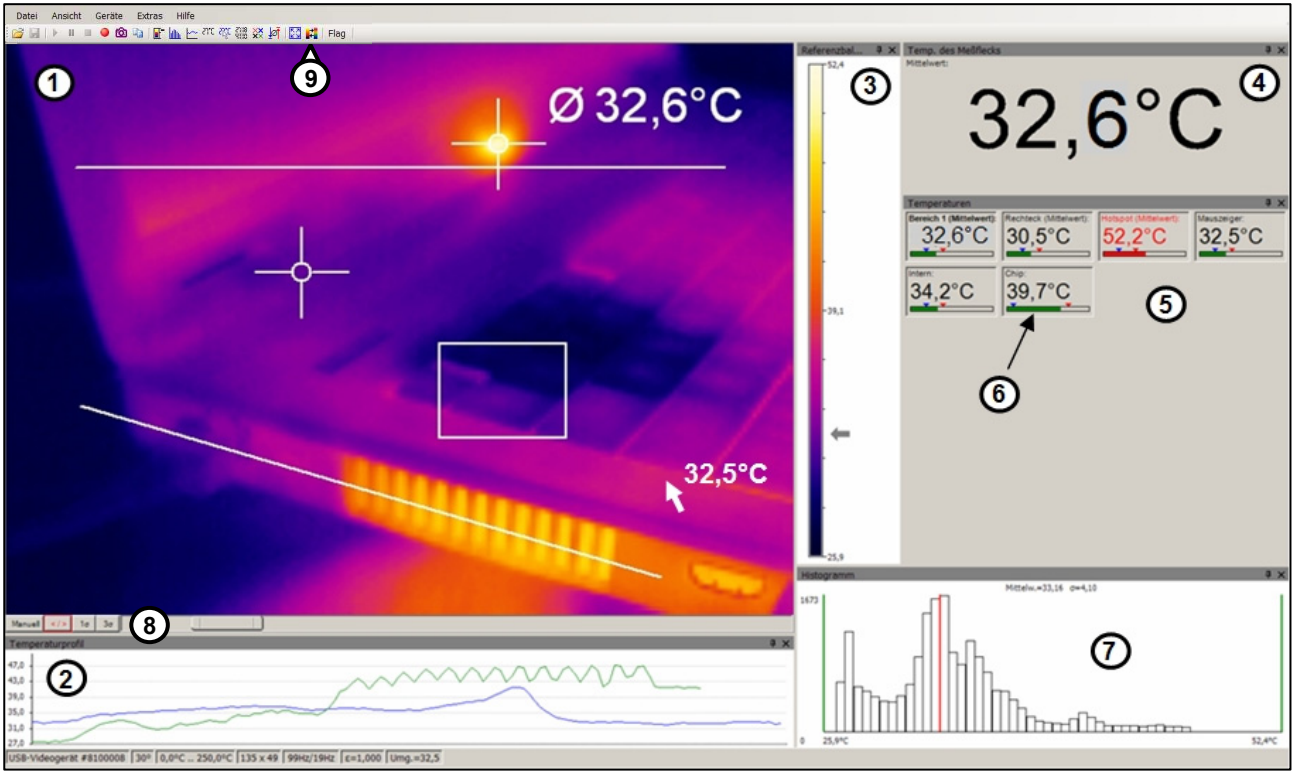
7.2 Minimum System Requirements:

- Windows XP (Service Pack 3)
- Hard disc with at least 30 MByte free space
- CD-ROM-drive
- USB 2.0-interface
- At least 256 MByte RAM

7.3 Main Features:

- Display of the thermal image in real time (100 Hz) with a wide range of measurement functions
- Analysis and post processing of infrared images/ videos
- Recording function (video, radiometric video, snap shot)
- Complete set up of parameters and remote control of the camera

7.4 Overview


Datei
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Temperaturen
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30,5°C
52,2°C
32,5°C
34,2°C
39,7°C
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2
7
Temperaturprofil
Histogramm

1	IR-Live picture from the camera	
2	Temperature profile:	Shows the temperatures along max. 2 lines, which can have any size and position inside the picture.
3	Reference bar:	Shows the scaling of the palette.
4	Temperature of measure area:	Shows the temperature according to the selected measurement function (example in the picture: average temperature in the measure points area. This value is shown also inside the IR picture (right top corner)
5	Control displays:	Enables displaying of all temperature values in the defined measure areas, Cool Spots, Hot Spots, temperature at cursor, internal temperature and chip temperature
6	Alarm displays:	Diagram of defined temperature scale showing low alarm value (blue arrow) and high alarm value (red arrow). The color changes to red (when temperature above the high alarm value) and to blue (when temperature below the low alarm value).
7	Histogram:	Shows the statistic distribution of single temperature values.
8	Automatic/ Manual scaling of displayed temperature range:	</> : Min, Max 1 **σ**: 1 Sigma 3 **σ**: 3 Sigma
9	Icon enabling switching between palette colors	

8 Menus

The most important features of the software can be activated directly via the toolbar:

8.1 File Menu

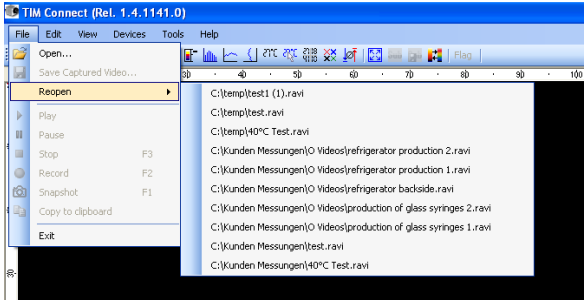


Fig. 8.1 File menu

Fig. 8.2 A current recording is designated by a red notice bar at the lower screen border.

Open is used for opening of all thermographic files (IR pictures in the radiometric JPG format, IR videos). Save captured video is used for saving of thermographic video files (standard AVI format or radiometric RAVI format). Reopen shows a list of recently opened files. Play, Pause, Stop and Record are controlling the recording and play back of video files. Snapshot is used for saving of single pictures (JPG).

8.2 Edit Menu

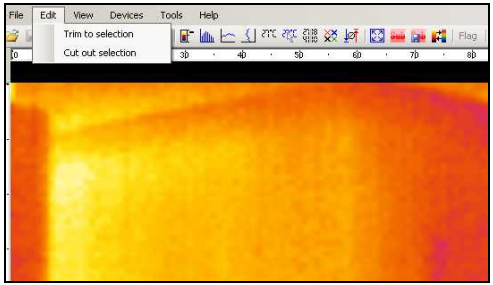


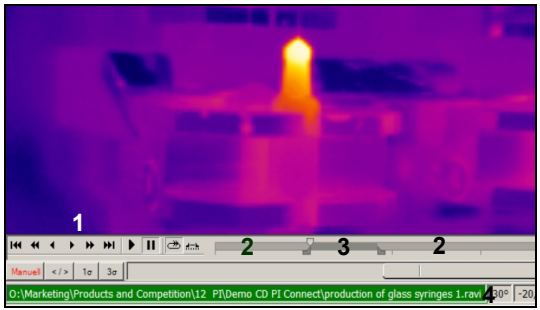
Fig. 8.3 Edit menu

Selected video can be edited by using Trim to selection and Cut out selection options in the **Edit** menu. A time bar tool is shown on the bottom of the image.

Set the position marks on the time bar to select beginning and end of the video sequence you want to be edited.

“Trim” means that the selected video sequence will remain whereas not selected parts will be deleted. “Cut out” means that the selected video sequence will be deleted.

Menus



1	Video control pane contains: Start, Rewind, Previous image, Next image, Forward, End, Play, Pause, Play in loop, Play selection only
2	Time bar: Not selected video sequences will be deleted by choosing Trim to selection option
3	Time bar: Selected video sequence will be deleted by choosing Cut out selection option
4	Green colored notice bar showing the video file name being edited

8.3 View Menu

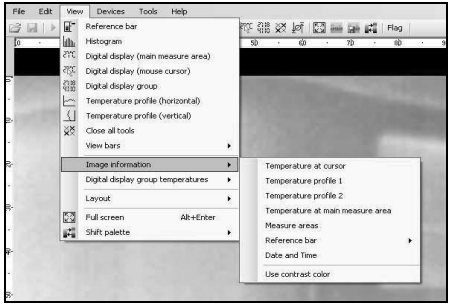


Fig. 8.4 View menu

This menu controls displaying or fade-out of the different software functions.

Use View bars option to display Menu bar, Tool bar, Status bar, Temperature range bar and Rulers on the screen individually or show/hide all of them.

You can individually change the positions of the display windows within the desktop area (drag & drop).

Fig. 8.5
Position fields

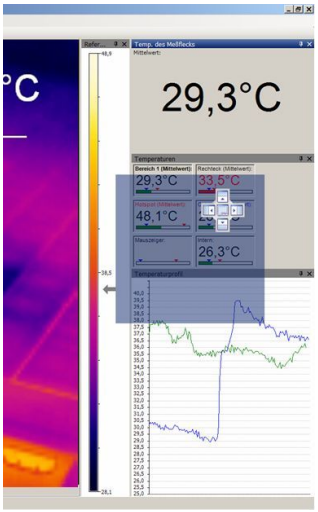


Fig. 8.6 Relocating of display windows
(example: control displays)

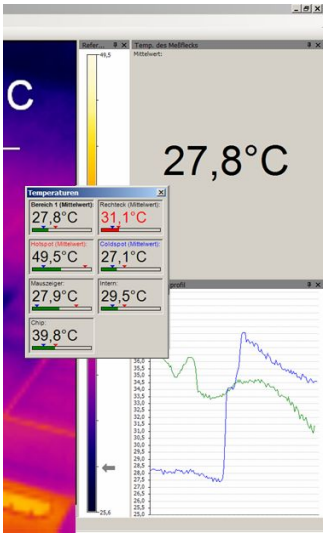


Fig. 8.7 Relocating of display windows
(example: control displays)

Using the Image Information submenu item you can decide, which information you would like to see inside the infrared image window.
Via Reference bar you can set the position of the temperature scale within the infrared image window.

The menu item Use contrast color can be used for highlighting particular information by choosing different color.

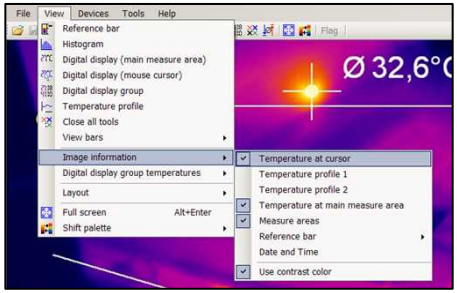


Fig. 8.8 View menu – information in image

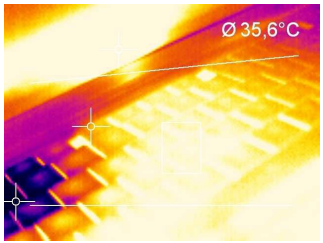


Fig. 8.9 Infrared image without using the contrast color

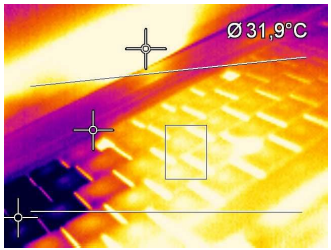


Fig. 8.10 Using contrast color for better visibility of the information within the infrared image

Digital display group temperatures menu option allows user to define which temperature control displays will be shown in the application window.

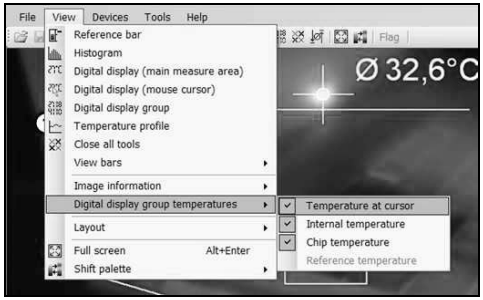


Fig. 8.11 View menu Digital display group temperatures

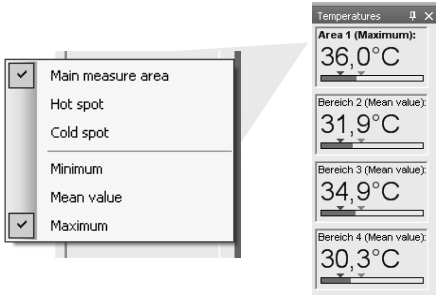


Fig. 8.12 Digital display group

A fast change of the window layout can be achieved due to a right click on the context menu.

In the menu item Layouts you can manage the pre-designed or your own image layouts.

You can save these layouts under user-defined names or delete existing layouts.

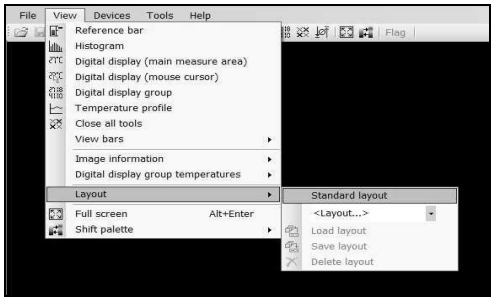


Fig. 8.13 Menu view - layouts

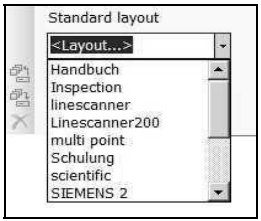


Fig. 8.14 Pre-designed layouts help the user to select ideal visualization for his application

Examples of pre-designed layouts:

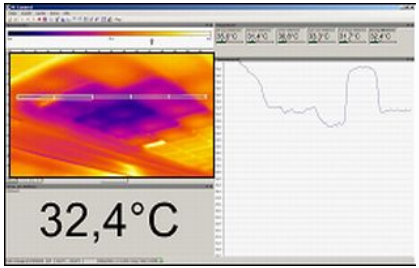


Fig. 8.15: Line scanner layout

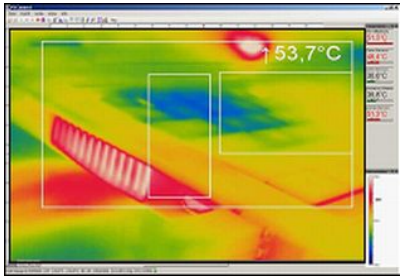


Fig. 8.16: Multipoint layout

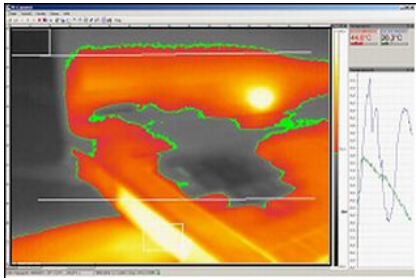


Fig. 8.17: Scientific layout

8.4 Menu Devices

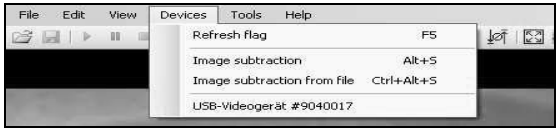


Fig. 8.18: Devices menu

Fig. 8.19: Subtraction button on the toolbar

In the Devices menu option the Flag (Shutter) can be refreshed.
Once the Image Image subtraction function is on an image is saved in the background and temperature difference is calculated and displayed for all the following images. You can also load a previously saved image (.jpg or .tiff) to be used as a template for the image subtraction.

Fig. 8.20: Image subtraction is not activated.

The current averaged temperature of the measure area is displayed in the right top corner.

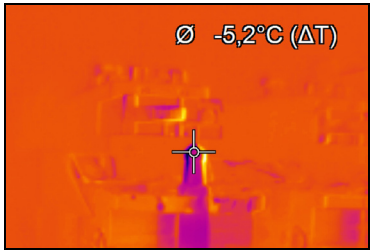


Fig. 8.21: After activating the image subtraction

The current temperature difference compared to the previous image is displayed.

8.5 Tools Menu

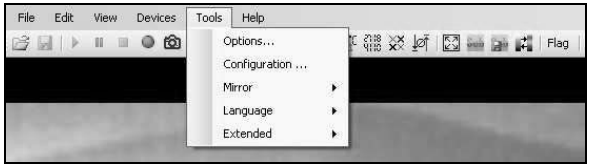


Fig. 8.22 Tools menu

The menu item Tools opens a selection screen for extensive settings for the camera parameters as well as for the display of the infrared images. Using Mirror you can mirror the camera view horizontally or vertically. In the Language section you can choose from all installed languages. Extended enables to boot the calibration data for the currently connected TIM.

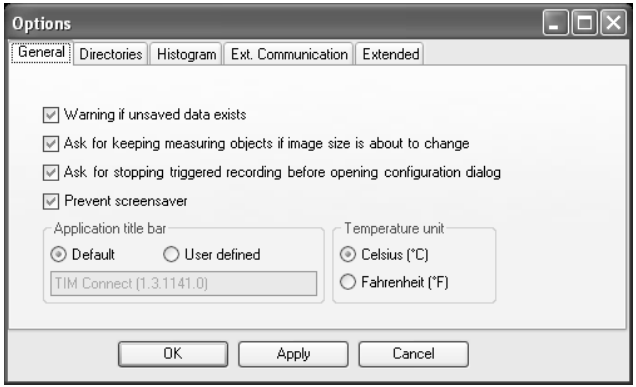
8.6 Help Menu

Fig. 8.23 Help menu

In the Info submenu you will find the version name of TIM Connect software you are currently running.

9 Options

9.1 Options: General



Warning if unsaved data exists:
If activated a reminder will appear to warn you on unsaved data or setups before shutting down the software.

At image size changing ask, if targets are to keep preserved:
Here can be decided, if the applied targets are to keep preserved at a changing of the image size.

Fig. 9.1 Option: General

Ask before configuration dialog, if triggered video is to be interrupted:
At opening of configuration dialog a notice window asks, if the triggered video is to be interrupted.

Prevent screensaver: Deactivates the screensaver

Application title bar: In this field it is possible to rename the title bar shown in the program window (TIM Connect by default).

Temperature unit: Option between Celsius (°C) or Fahrenheit (°F)

9.2 Options: Directories

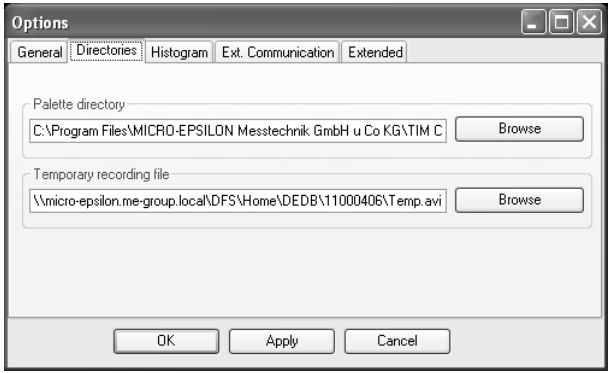


Fig. 9.2 Option: Directories

Palette directory:
Path leading to your folder where your color pallets are saved.

Temporary recording file
Choose directory for saving your temporarily recorded video file.
Every new record will overwrite the previous one!

9.3 Options: Histogram

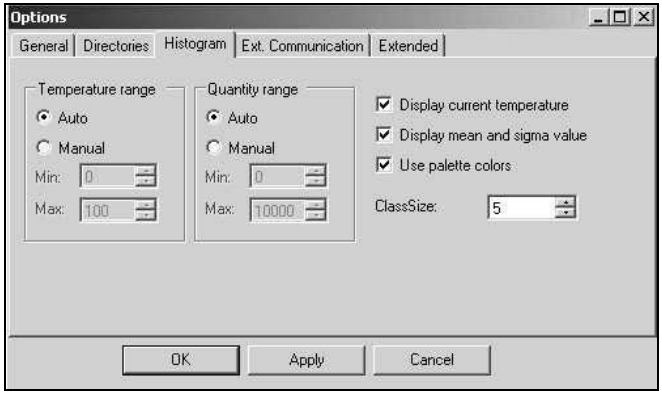


Fig. 9.3 Option: Histogram

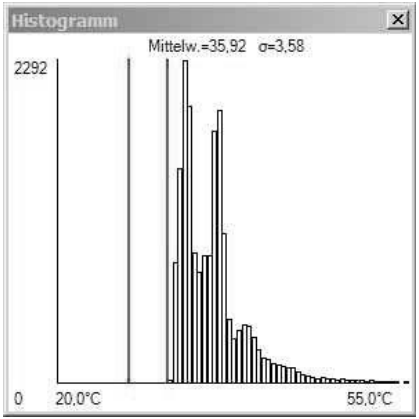


Fig. 9.4 Histogram

Temperature range /Quantity range:
The given temperature range and frequency range can be generated by the software or by the user by defining the minimum/maximum temperature value respectively minimum/maximum frequency.

Display the actual temperature:
If activated red line showing the current temperature will appear in the graph.

Display mean and sigma value:
Average temperature and variance (statistical dispersion) can be displayed.

Use palette colors:
You can choose between a colored or a black-and-white image.

Class size:
Number of values measured which should be affiliated to one class.

9.4 Options: Ext. Communication

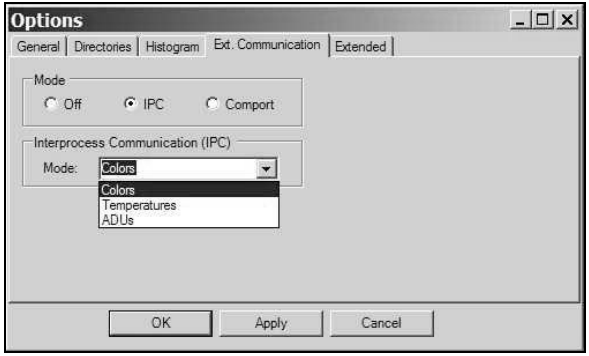


Fig. 9.5: Options: Ext. Communication IPC

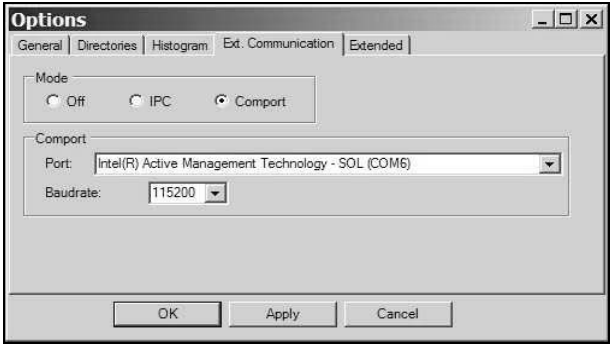


Fig. 9.6: Options: Ext. Communication Comport

Interprocess Communication (IPC):
This function enables embedding of color, temperature or ADU values into other applications using Dynamic-link Library (DLL).

Comport:
If selected the data values sent out by the camera can be transmitted via specified COM-port. The baud rate can be changed accordingly.
[►You will find more details on using IPC und Comport on the CD provided]

9.5 Options: Extended

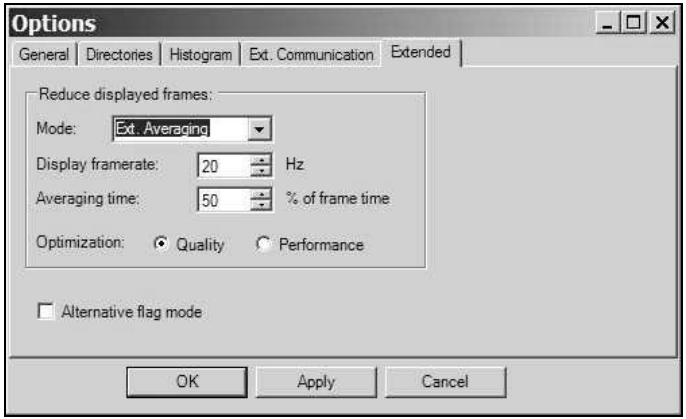
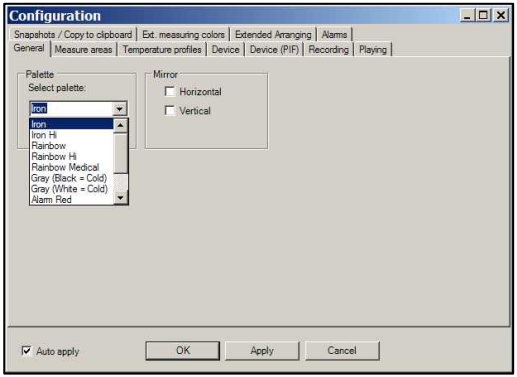


Fig. 9.7: Options: Extended

Display frame rate: Display frame rate can be defined in this tab. You can choose whether average, minimum or maximum values should be displayed or whether skipping of values within specified frame rate should be used. For less powerful computers might be useful to choose Performance optimization.

10 Configuration

10.1 Configuration: General



Select palette: Choose from the list of color pallets to achieve the ideal displaying of the infrared image.

Mirror: Sometimes, depending on the fitting position of the TIM, it is useful to mirror the camera image horizontally or vertically.

Avoid distortion: The width-to-height-ratio of the infrared image is retained.

Fig. 10.1: Options: General

Available color pallets:


Iron


Iron Hi


Rainbow


Rainbow HI


Rainbow Medical


Gray (Black = Cold)


Gray (White = Cold)

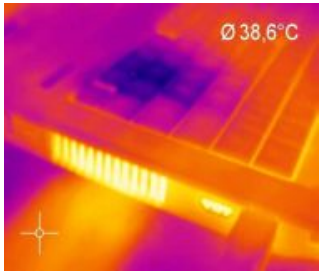

Alarm Red


Alarm Green

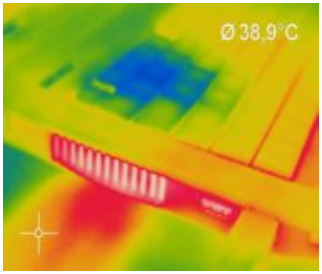

Alarm Blue


Blue Hi

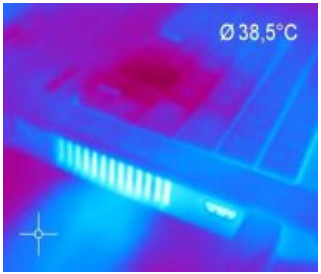
Examples of various color pallets:



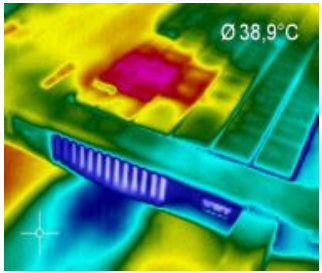
Palette Iron



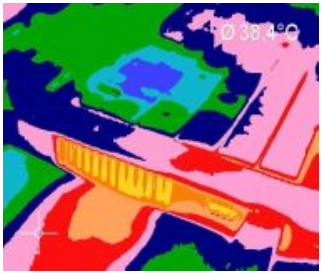
Palette Rainbow



Palette Blue Hi



Palette Rainbow Hi



Palette Rainbow Medical

Palette Gray (Black = Cold)

Using this tool bar button you can easily switch from one color palette to another.

10.2 Configuration: Measure Areas

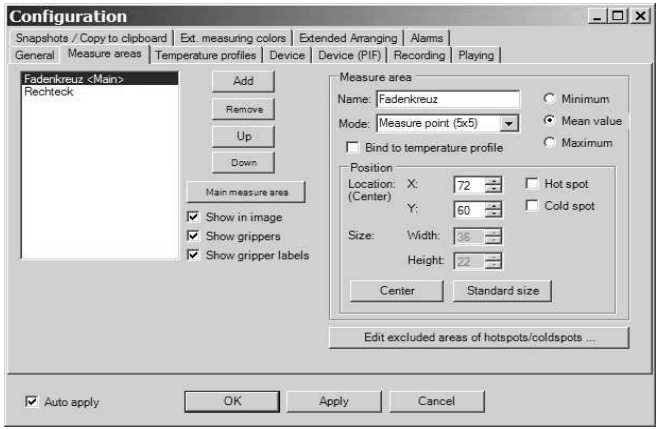


Fig. 10.2: Configuration: Measure area

Available measure areas (modes)

Rectable Measure points (1x1) Measure points (3x3) Measure points (3x3)

Using New / Delete buttons you can create a new measure area (measure points/rectangle) or delete existing measure area. Press Up/Down to position individual measure areas within the list.
One measure area from the list can be appointed as the Main area (temperature of the main area converted) into electrical signal can be also transmitted via Process Interface (PIF).
By selecting Show in image measure areas can be displayed in the infrared image.
Ticking off the Show grippers/gripper labels enables you to change the position or the size of defined measure areas by using the mouse.
Use the Name field to rename each measure area. Mode allows you to define the type of area (measure points or rectangle).
Specify what temperature value - minimum, mean value or maximum - should be shown. Using Bind to profile you can assign each measure area to specified temperature profile.
In the Position section the exact position of the measure area within the camera image can be defined. If desired the area can represent a hot spot (spot with highest temperature in the image) or a cold spot (spot with lowest temperature in the image).

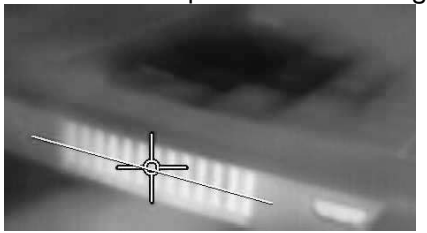


Fig. 10.3: Measure area assigned to a temperature profile (measure point)

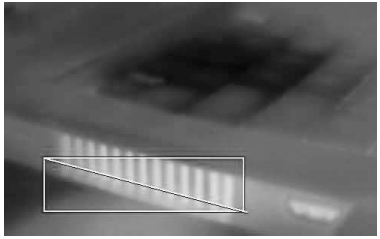
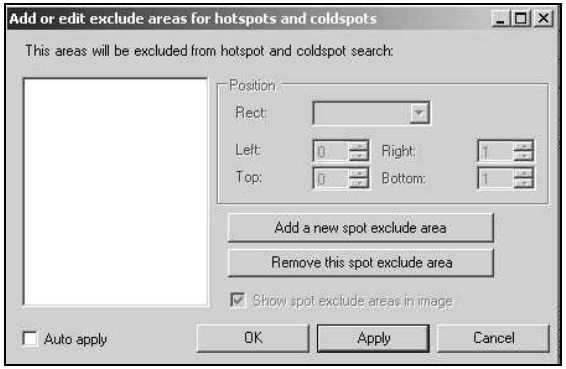


Fig. 10.4: Measure area assigned to a temperature profile (rectangle)

Add or edit excluded areas Hot or Cold spots button:



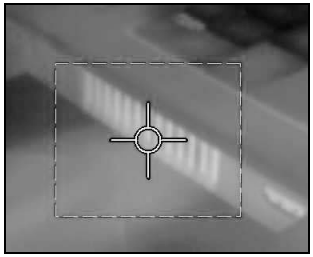


Fig. 10.5: Example of an excluded area

In case that you are using the Cold spots or Hot spots search function here you can define areas which will be from the search excluded. This means that in here defined area/areas will not be searched for Cold or Hot spots. These areas can be positioned anywhere within the camera image.

10.3 Configuration: Temperature Profile

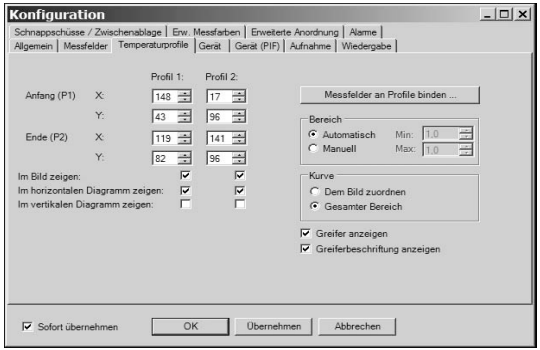


Fig. 10.6: Configuration: Temperature profile

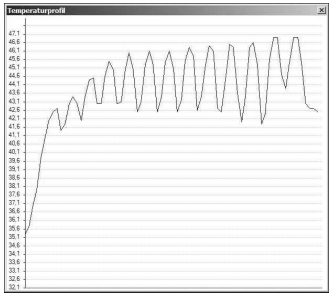


Fig. 10.7: Temperature profile

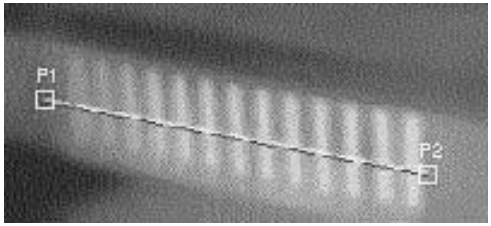


Fig. 10.8: Coordinate designation

Up to 2 temperature profiles graphically reproducing the temperature development can be generated. The profiles are labeled as Profile 1 and Profile 2. Position of the profiles can be defined via coordinates (P1, P2) or by dragging the grippers directly in the image.

Select Show in picture / Show in diagram if you want the profiles to be displayed in the infrared picture or in the diagram. Range allows you to choose between automatic or manually set temperature ranges.

There are two possibilities of displaying the profile curves in the profile diagram:

1. Profile curve fills out the whole profile diagram independent from the size of the profile/s (Fig. 10.9).
2. Profile curve fills out only parts corresponding with the actual length of the profile/s within the camera image (Fig. 10.10).

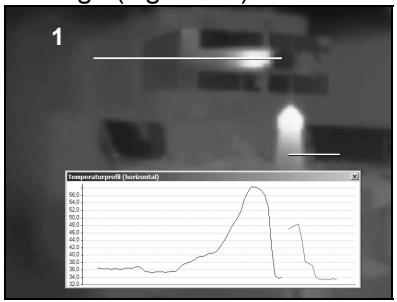


Fig. 10.9: Profile curves which are allocated to the picture (shown in the bottom window) The actual length of the profile is shown.

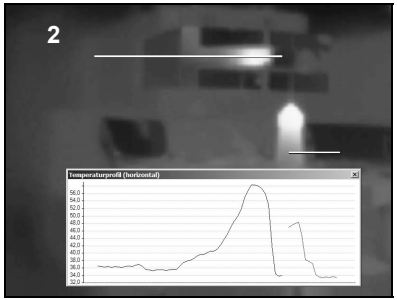


Fig. 10.10: Profile curves for the whole picture area (shown in the bottom window) Profile curve fills out the whole profile diagram independent from the size of the profile/s.

Bind to temperature profile options:

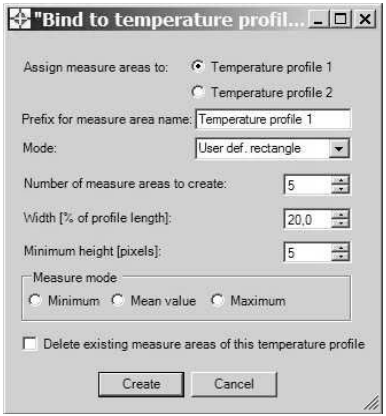


Fig. 10.11: Bind to temperature profile options

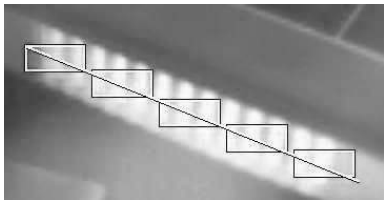


Fig. 10.12: 5 measure areas (rectangles) assigned to temperature profile

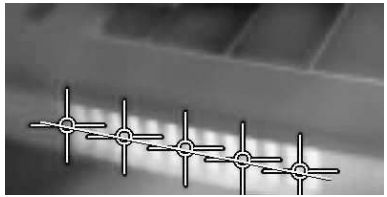


Fig. 10.13: 5 measure areas (rectangles) assigned to temperature profile

Use Bind to temperature profile to assign various measure areas to the temperature profile
Number of areas as well as the mode (measure area type) can be defined by the user. You may also specify the width and height of the areas.
Save the settings by pressing the Create button.

10.4 Configuration: Device

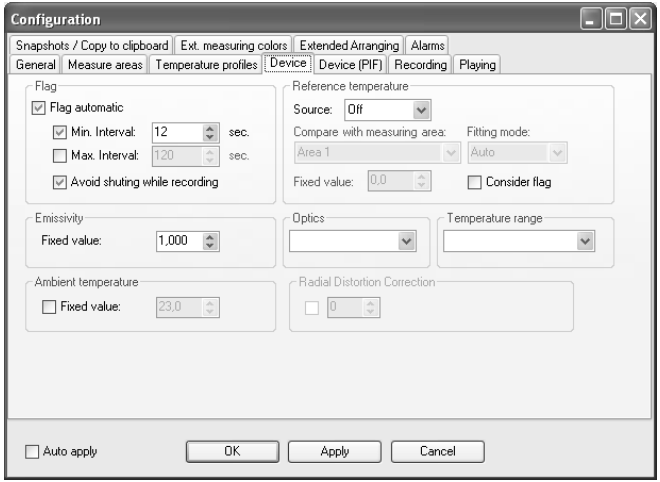


Fig. 10.14 Configuration: Device

Fig. 10.15 Flag

Flag function (shutter) can be also operated with the tool bar button.

Note: This function is not available, if the flag is externally controlled via process interface input.

Flag:
Each pixel of the detector array emits its individual signal level depending on the ambient temperature. In order to calculate these individual levels the detector has to be exposed to a surface with a homogenous temperature. Therefore a shutter (or flag) is released in regular intervals.
The flag can be also used to protect the detector from potentially dangerous radiation (for example laser radiation).
Min. interval controls that the flag will not be released before given time period even thought it might be required by the imager. If the Max. interval is defined the flag will be always released after certain time period even if not required by the imager.

Emissivity / **Ambient temperature:**
You may enter fixed emissivity/ambient temperature value.
By default the ambient temperature value is delivered by the camera's internal sensor
In case that the values are controlled through Process Interface (PIF) the here defined values will be ignored. [► Emissivity]

Reference temperature
There are two options available to define the reference temperature – by entering fixed value or using the Process Interface input (PIF in).
Using comparisons of reference temperature source automatic or user-defined adjustments of object temperature can be carried out.

Temperature range
Temperature range from 20 °C to 100 °C, from 0 °C to 250 °C or from150 °C to 900 °C are available.

Lenses
According you your requirements the TIM camera can be supplied with 64 °, 31 ° or 9 ° lens/lenses.

Objective 64° x 50° wide angle; focal distance 5.7 mm; min distance 0.02 m												
HFOV	m	0.019	0.119	0.369	0.619	1.494	2.49	4.5	7.5	12.5	37.5	125
VFOV	m	0.015	0.09	0.277	0.464	1.121	1.87	3.7	5.6	9.4	28.1	94
IFOV	mm	0.121	0.746	2.308	3.871	9.338	15.6	31.2	46.8	78	234.3	781
Distance in m		*0.02*	*0.1*	*0.3*	*0.5*	*1.2*	*2*	*4*	*6*	*10*	*30*	*100*

Objective 31° x 23° wide angle; focal distance 10 mm; min distance 0.02 m												
HFOV	m	0.006	0.05	0.16	0.27	0.67	1.11	2.3	3.4	5.6	16.8	56
VFOV	m	0.004	0.04	0.12	0.21	0.50	0.84	1.7	2.5	4.2	12.6	42
IFOV	mm	0.03	0.30	1.00	1.70	4.20	7	14	21	35	105	350
Distance in m		*0.02*	*0.1*	*0.3*	*0.5*	*1.2*	*2*	*4*	*6*	*10*	*30*	*100*

Objective 9° x 7° wide angle; focal distance 35.5 mm; min distance 0.3 m												
HFOV	m	-	-	0.04	0.07	0.18	0.31	0.6	1	1.6	4.8	15.8
VFOV	m	-	-	0.03	0.05	0.14	0.23	0.5	0.7	1.2	3.6	11.9
IFOV	mm	-	-	0.30	0.50	1.20	2	4	6	10	30	99
Distance in m		*0.02*	*0.1*	*0.3*	*0.5*	*1.2*	*2*	*4*	*6*	*10*	*30*	*100*

FOV = Field of view; HFOV = Horizontal field of view; VFOV = Vertical field of view; IFOV = Indicated field of view

Tab. 10.1: Optical parameters of the lenses

31 ° lens 9 ° lens

Fig. 10.16 Lenses

The wide-angle-lens has a macro adjustment allowing thermo graphic analysis in close-up ranges combined with an excellent detailed resolution.

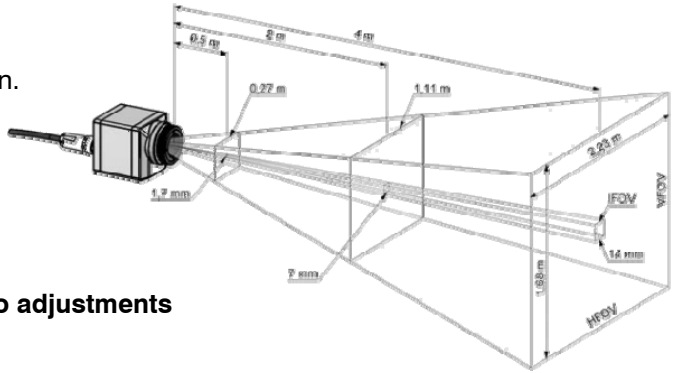


Fig. 10.17 Wide-angle-lens (31 ° x 23 °) with macro adjustments

10.5 Configuration: Device (PIF)

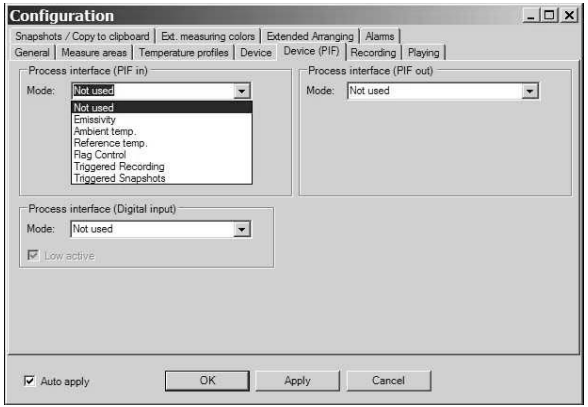


Fig. 10.18 Configuration: Device (PIF in)

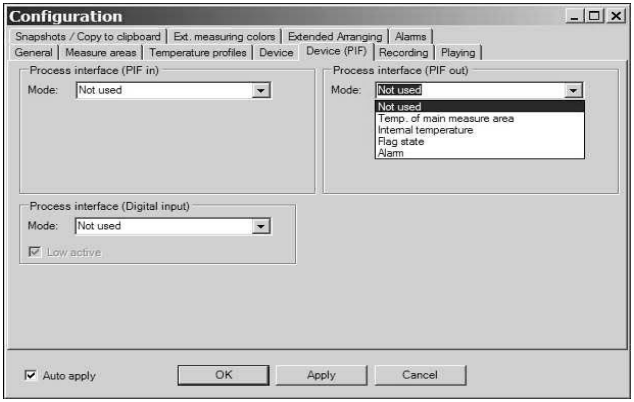


Fig. 10.19 Configuration: Device (PIF out)

The TIM is equipped with a process interface, which can be programmed via the software as Input [PIF in] (to control the camera) or as Output [PIF out] (to control the process).

Process interface (PIF in): Programming of the PIF as input (0-10 V) to control the emissivity setting, ambient temperature value, reference temperature value or flag remotely. Moreover recording and snapshots can be triggered using this input.

Process interface (PIF out): Programming of the PIF output (0-10 V) in order to supply measured values (temperature of main area, internal camera temperature, flag state and alarm statuses).

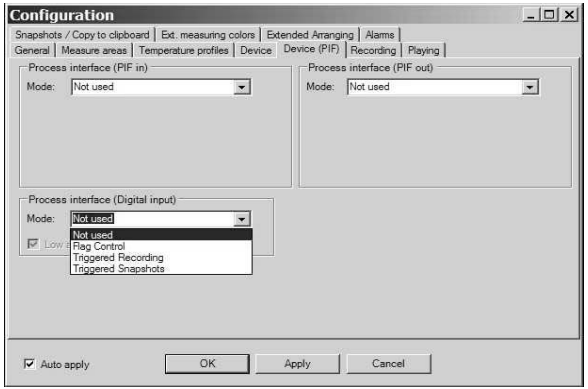


Fig. 10.20 Configuration: Device (digital input)

Process interface (digital input):
Process Interface can be also defined as a digital input.
Via this input (low or high level can be specified) flag function, recordings or snapshots can be controlled remotely.

10.6 Configuration: Recording

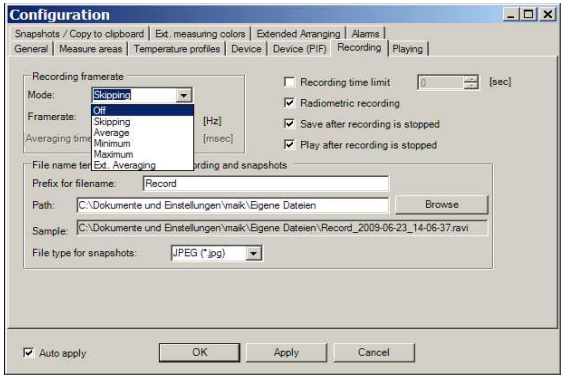


Fig. 10.21: Configuration: Recording

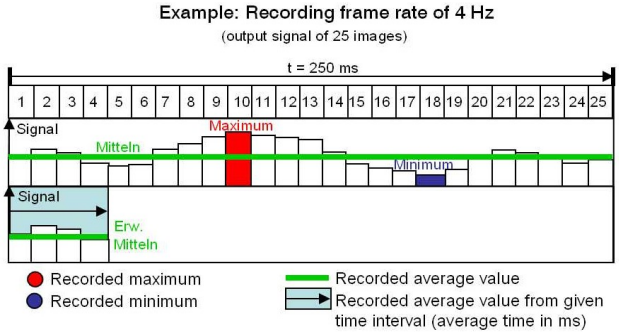


Fig. 10.22 Recording frame rate of 4 Hz

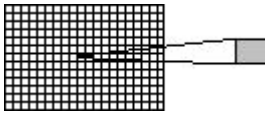
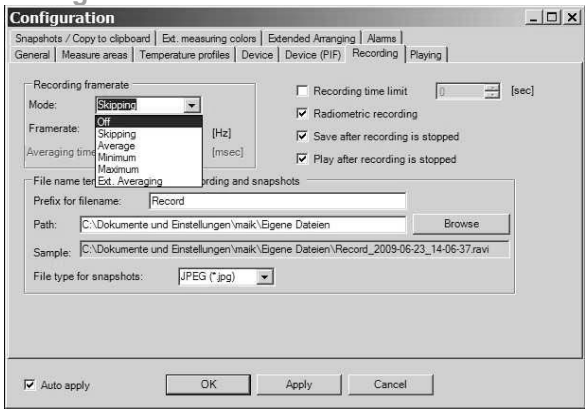


Fig. 10.23 Recording frame rate referring to 1 pixel

Recording frame rate: Mode defines which values should be recorded within particular frame rate. Should you select the Extended averaging option averaging time can be set additionally.

Recording time limit: Definition of fixed recording time (in seconds)



Radiometric recording:
If activated temperature value of each pixel as well as information on defined measure areas is recorded. These data allows user to carry out a detailed post-analysis anytime later. Moreover new measure areas and alarms can be created in addition to recorded data when doing the analysis.

Fig. 10.24 Configuration: Recording

Note: Later conversion of a .ravi file into a .avi file -and vice versa- is not possible.

Template for triggered recording and snapshots:
In the provided text field you can define prefix for recorded videos or snapshots.
In the Path text field you can specify the destination folder you wish to save your records to.
Your snapshots can be saved as JPG, TIFF or CSV file format.

10.7 Configuration: Playing

10.8 Configuration: Snapshots / Copy to clipboard

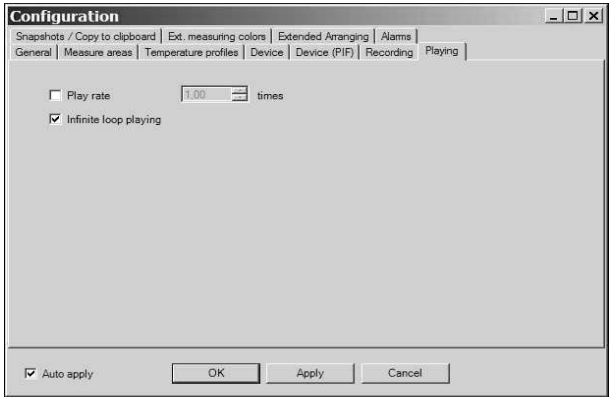


Fig. 10.25 Configuration: Playing

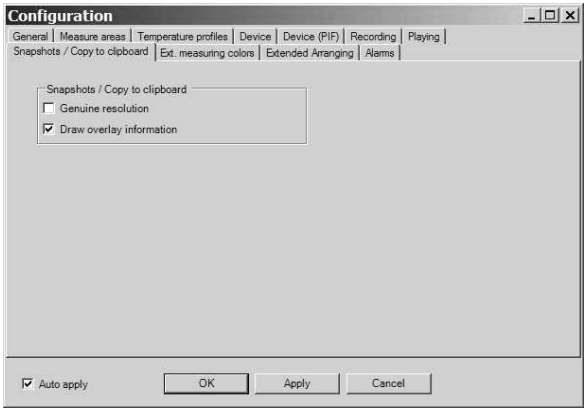
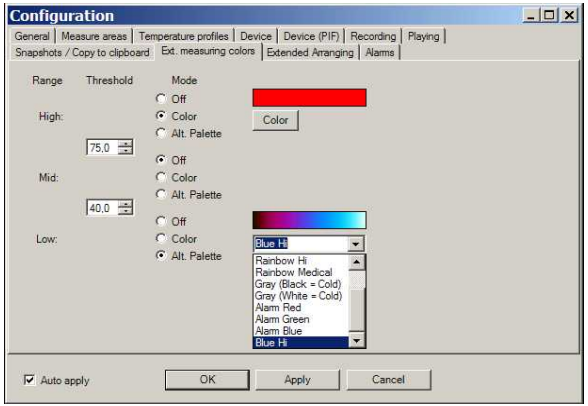


Fig. 10.26 Configuration: Snapshots / Copy to clipboard

Playing tab offers you to modify the play rate of recorded videos. Replaying of recorded videos in a loop is also possible.
Snapshots/Copy to clipboard tab allows you to decide if you want to keep the genuine resolution of recorded snapshot copied to clipboard and whether the overlay information in the image should be also saved.

10.9 Configuration: Ext. Measuring Colors



This tab offers you the possibility to change the pixel color within the image if the temperature value reaches predefined low and/or high temperature values. List of colors and color pallets are available to find the right contrast.

Fig. 10.27 Configuration: Ext. measuring colors

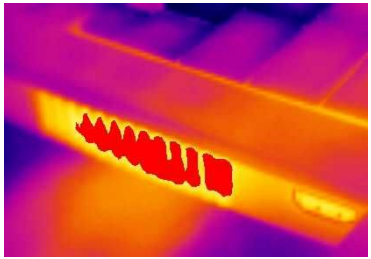


Fig. 10.28: Camera image using Iron color pallet option.
High alarm set on 75 °C so that pixels showing higher temperature will appear red.

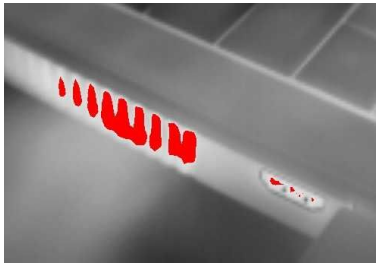


Fig. 10.29: Camera image using Gray color pallet option.
High alarm set on 75 °C so that pixels showing higher temperature will appear red.

10.10 Configuration: Extended Arranging

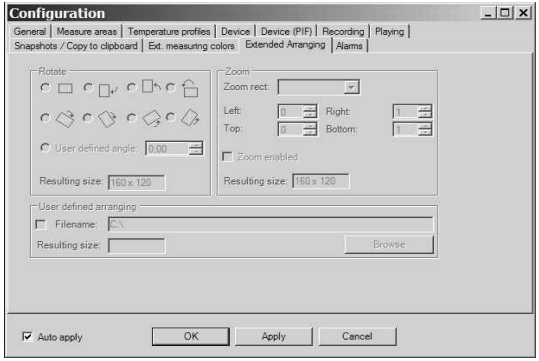
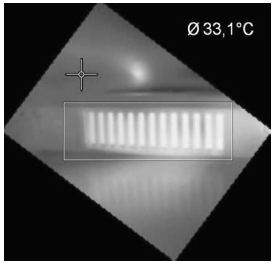
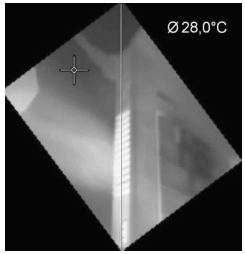


Fig. 10.30: Configuration: Extended Arranging





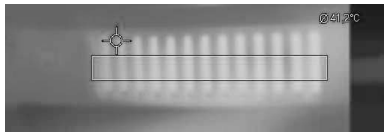


Fig. 10.31: Rotating and zooming of a rectangle measure area

Rotate:
This function enables rotating the camera image to a predefined of user-defined position. Size of the image you create using this tool will appear in "Resulting size" field (all predefined angle options from the second row have screen diagonal of 200 pixels).

Zoom:
In this section specified measure area can be zoomed.

User defined arranging:
In this field previously arranged files can be opened.

10.11 Configuration: Alarms

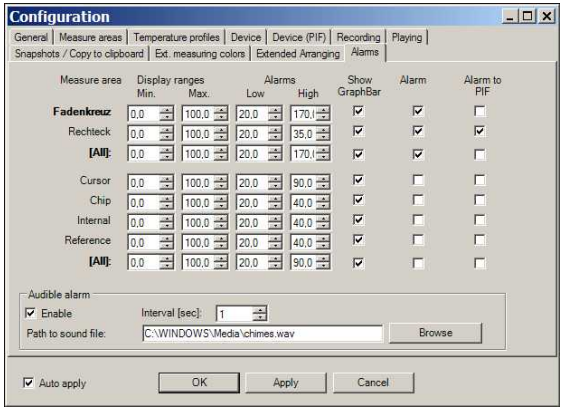


Fig. 10.32: Configuration: Alarms

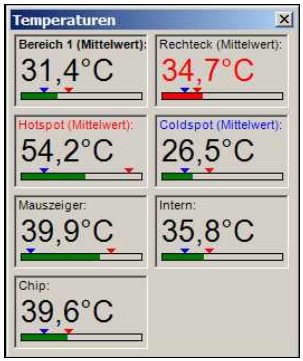


Fig. 10.33 Displayed alarm values as digits and in a bar graph

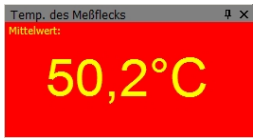
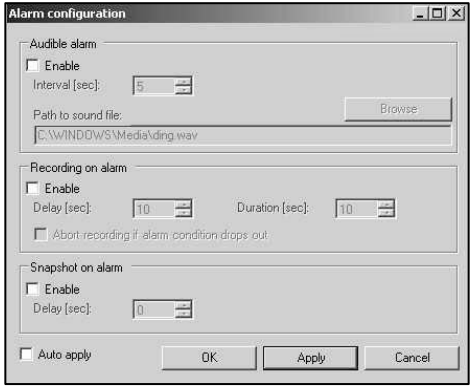


Fig. 10.34 The display background color will turn red after reaching or exceeding the set alarm value.

In the Alarm tab you can set low and high alarms to any defined temperature measure area. The alarm values can be displayed in form of digits or in a bar graph.
If the alarm value is reached the digit/bar color will change from green to red (high alarm) or blue (low alarm).
Display range for all alarms can be also defined.

By activating the alarm function a red alarm button will appear on the toolbar. You can deactivate the visual and acoustic alarm by clicking on the alarm button. The alarm will stay deactivated until the alarm value is reached again.

Alarms can be given out via Process Interface (PIF) by activating the provided tick box.
Also an acoustic alarm signalization is available. The setup options will appear after clicking the Alarm configuration button:



An acoustic alarm signalization can be repeated in defined intervals.
You can select any available .wav file to be defined as your alarm sound.
If you activate the Recording on alarm you can define delay and recording time in the fields provided. Optionally you can tick off that recording should be stopped automatically if the alarm condition no longer applies.
Taking (and saving) a snapshot image automatically every time that the alarm is activated is also possible.

Fig. 10.35 Alarm configuration

11 Basics of Infrared Thermometry

Depending on the temperature each object emits a certain amount of infrared radiation. A change in the temperature of the object is accompanied by a change in the intensity of the radiation. For the measurement of “thermal radiation” infrared thermometry uses a wave-length ranging between 1 μ and 20 μm.
The intensity of the emitted radiation depends on the material. This material contingent constant is described with the help of the emissivity which is a known value for most materials (see enclosed table emissivity).

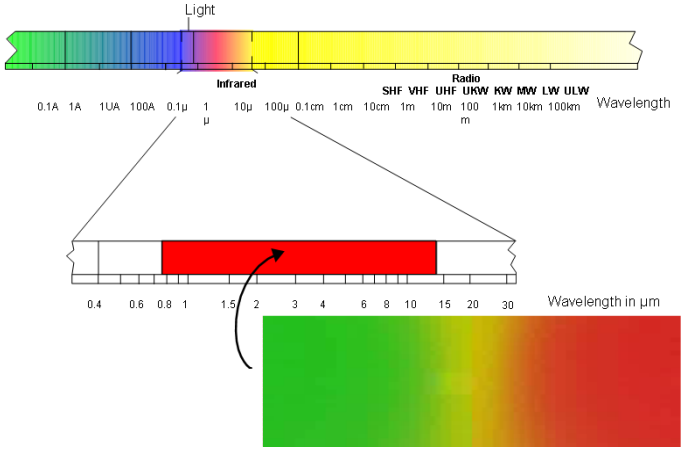
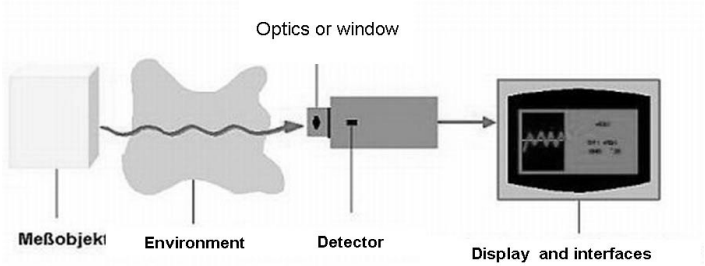


Fig. 11.1 The electromagnetic spectrum with for pyrometers used infrared area

Infrared thermometers are optoelectronic sensors. They calculate the surface temperature on the basis of the emitted infrared radiation from an object. The most important feature of infrared thermometers is that they enable the user to measure objects contactless. Consequently, these products help to measure the temperature of inaccessible or moving objects without difficulties. Infrared thermometers basically consist of the following components:

- lens
- spectral filter
- detector
- electronics (amplifier/ linearization/ signal processing)



The specifications of the lens decisively determine the optical path of the infrared thermometer, which is characterized by the ratio Distance to Spot size.
The spectral filter selects the wavelength range, which is relevant for the temperature measurement. The detector in cooperation with the processing electronics transforms the emitted infrared radiation into electrical signals.

12 Emissivity

12.1 Definition

The intensity of infrared radiation, which is emitted by each body, depends on the temperature as well as on the radiation features of the surface material of the measuring object. The emissivity (ε – Epsilon) is used as a material constant factor to describe the ability of the body to emit infrared energy. It can range between 0 and 100 %. A “blackbody” is the ideal radiation source with an emissivity of 1.0 whereas a mirror shows an emissivity of 0.1.
If the emissivity chosen is too high, the infrared thermometer may display a temperature value which is much lower than the real temperature – assuming the measuring object is warmer than its surroundings. A low emissivity (reflective surfaces) carries the risk of inaccurate measuring results by interfering infrared radiation emitted by background objects (flames, heating systems, chamottes). To minimize measuring errors in such cases, the handling should be performed very carefully and the unit should be protected against reflecting radiation sources.

Emission – (Absorption) – Reflection – Transmission

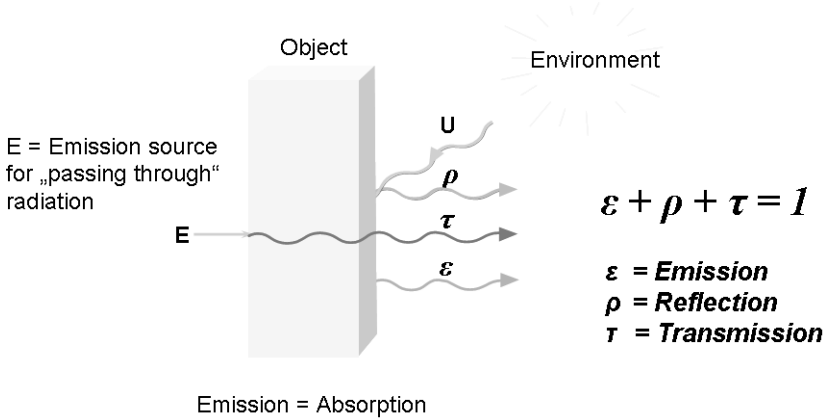


Fig. 12.1 Radiation ability of a target

12.2 Determination of Unknown Emissivities

►First, determine the actual temperature of the measuring object with a thermocouple or contact sensor. Second, measure the temperature with the infrared thermometer and modify the emissivity until the displayed result corresponds to the actual temperature.

►If you monitor temperatures of up to 380 °C you may place a special plastic sticker (emissivity dots – part number: TM-ED-CT) onto the measuring object, which covers it completely.

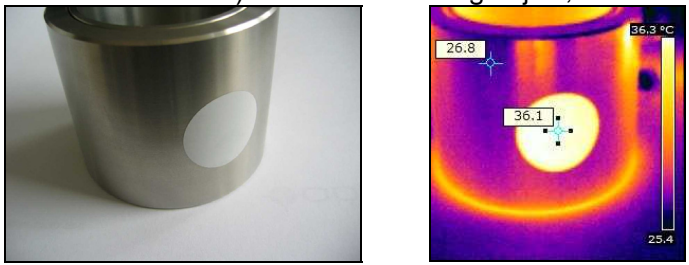


Fig. 12.2 Emissivity dots on a metal drum

Now set the emissivity to 0.95 and take the temperature of the sticker. Afterwards, determine the temperature of the adjacent area on the measuring object and adjust the emissivity according to the value of the temperature of the sticker.

► Cove a part of the surface of the measuring object with a black, flat paint with an emissivity of 0.98. Adjust the emissivity of your infrared thermometer to 0.98 and take the temperature of the colored surface.

Fig. 12.3 Blank metal surface

Fig. 12.4 Metal surface with black filled color

Afterwards, determine the temperature of a directly adjacent area and modify the emissivity until the measured value corresponds to the temperature of the colored surface.

CAUTION: On all three methods the object temperature must be different from ambient temperature.

12.3 Characteristic Emissivities

In case none of the methods mentioned above help to determine the emissivity you may use the emissivity tables ►Appendix A and B. These are average values, only. The actual emissivity of a material depends on the following factors:

- temperature
- measuring angle
- geometry of the surface
- thickness of the material
- constitution of the surface (polished, oxidized, rough, sandblast)
- spectral range of the measurement
- transmissivity (e.g. with thin films)

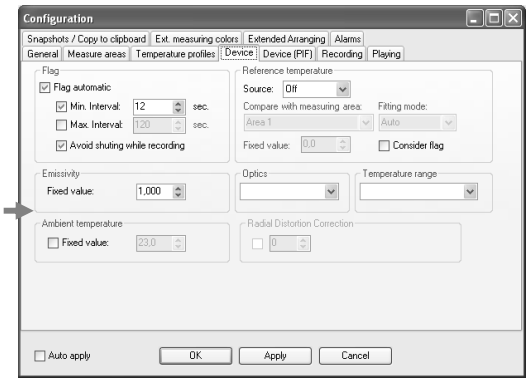


Fig. 12.5 Setting of the emissivity in the software TIM Connect under the menu configuration (device)

Appendix A – Emissivity Table Metals

Material		typical Emissivity
Aluminum	non oxidized	0.02-0.1
	polished	0.02-0.1
	roughened	0.1-0.3
	oxidized	0.2-0.4
Brass	polished	0.01-.05
	roughened	0.3
	oxidized	0.5
Copper	polished	0.03
	roughened	0.05-0.1
	oxidized	0.4-0.8
Chrome		0.02-0.2
Gold		0.01-0.1
Haynes	alloy	0.3-0.8
Inconel	electro polished	0.15
	sandblast	0.3-0.6
	oxidized	0.7-0.95
Iron	non oxidized	0.05-0.2
	rusted	0.5-0.7
	oxidized	0.5-0.9
	forged, blunt	0.9
Iron, casted	non oxidized	0.2
	oxidized	0.6-0.95
Lead	polished	0.05-0.1

Material		typical Emissivity
Lead	roughened	0.4
	oxidized	0.2-0.6
Magnesium		0.02-0.1
Mercury		0.05-0.15
Molybdenum	non oxidized	0.1
	oxidized	0.2-0.6
Monel (Ni-Cu)		0.1-0.14
Nickel	electrolytic	0.05-0.15
	oxidized	0.2-0.5
Platinum	black	0.9
Silver		0.02
Steel	polished plate	0.1
	rustless	0.1-0.8
	heavy plate	0.4-0.6
	cold-rolled	0.7-0.9
	oxidized	0.7-0.9
Tin	non oxidized	0.05
Titanium	polished	0.05-0.2
	oxidized	0.5-0.6
Wolfram	polished	0.03-0.1
Zinc	polished	0.02
	oxidized	0.1

Appendix B – Emissivity Table Non Metals

Material		typical Emissivity
Asbestos		0.95
Asphalt		0.95
Basalt		0.7
Carbon	non oxidized	0.8-0.9
	graphite	0.7-0.8
Carborundum		0.9
Ceramic		0.95
Concrete		0.95
Glass		0.85
Grit		0.95
Gypsum		0.8-0.95
Ice		0.98
Limestone		0.98
Paint	non alkaline	0.9-0.95
Paper	any color	0.95
Plastic >50 μm	non transparent	0.95
Rubber		0.95
Sand		0.9
Snow		0.9
Soil		0.9-0.98
Textiles		0.95
Water		0.93
Wood	natural	0.9-0.95

Appendix C - Serial Communication via Comport of the thermoIMAGER TIM Connect Software (a Brief Overview)

Introduction
One of the features of the thermoIMAGER TIM Connect software is he ability to communicate via a serial comport interface. This can be a physical comport or a Virtual Comport (VCP). It must be available on the computer where the TIM connect software is installed.

Setup of the interface
To enable the software for the serial communication open the Options dialog and enter the tab “Extended Communication”. Choose the mode “Comport” and select the port you want to use. Also select the baud rate that matches the baud rate of the other communication device. The other interface parameters are 8 data bits, no parity and one stop bit (8N1). This is mostly used on other communication devices too. The other station must support 8 bit data.

Now you have to connect the computer with your other communication device. If this is a computer too you will have to use a null modem cable.

Command list
You will find the command list on the CD provided.

Appendix D – Interprocess Communication (IPC) of the thermoIMAGER TIM Connect Software

The communication to the process imager device is handled by the thermoIMAGER TIM Connect software (Imager.exe) only. Micro-Epsilon supplies a dynamic link library (ImagerIPC.dll) that serves the interprocess communication (IPC) for other attached processes. The DLL can be dynamically linked into the secondary application. Or it can be done static by a lib file too.
Both Imager.exe and ImagerIPC.dll are designed for Windows XP/Vista only. The application must support call-back functions.

The ImagerIPC.dll will export a bunch of functions that are responsible for initiating the communication, retrieving data and setting some control parameters.

Init procedure

The description of the init procedure as well as the necessary command list you will find on the CD provided.

Appendix E – thermoIMAGER TIM Connect Resource Translator

Introduction

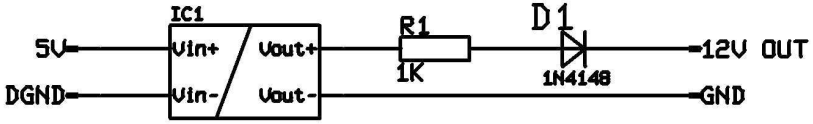
thermoIMAGER TIM Connect is a .Net Application. Therefore it is ready for localization. Localization as a Microsoft idiom means the complete adaption of resources to a given culture. If you want to learn more about the internationalization topics please consult Microsoft's developer documentation (e.g.: http://msdn.microsoft.com/en-us/goglobal/bb688096.aspx).
If needed the localization process can be very detailed. Also the resizing of buttons or other visible resources and the support of right-to-left-languages is supported. This can be a huge effort and should be done by experts who have the appropriate tools. To limit this effort and to enable anybody to translate the resources of the TIM Connect application Micro-Epsilon has developed the small tool "Resource Translator". This tool helps to translate any visible text within the thermoIMAGER TIM Connect application.

Step by step tutorial

You will find a detailed tutorial on the CD provided.

Appendix F – TIM Interface

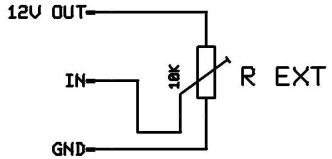
12 V output:



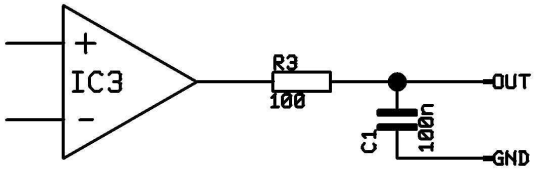
With no load the isolated output voltage is about 12 V.
Isolation voltage to USB power: >1000 VDC

You can drive as maximum 10 mA from the 12 V out (pin 2) or from the analog output (pin 4).
The 12 V output has a 1 KOhm resistor in raw. You can directly connect a LED as a “camera is working” indication.

Another possibility is the use of the voltage for the external emissivity setting:



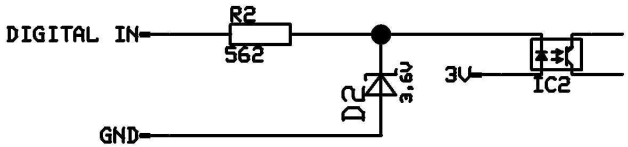
Analog output:



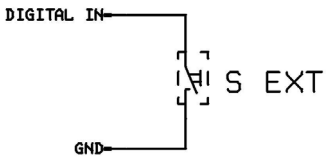
For voltage measurements the minimum load impedance should be 10 KOhm.

The analog output can be used as a digital output. The voltage for “no alarm” and “alarm on” can be set within the software.
The analog output (0 … 10 V) has a 100 Ohm resistor in raw. With a maximum current of 10 ma the voltage drop is 1 V.
Having an alarm LED with a forward voltage of 2 V the analog output value for “alarm on” should be 3 V as maximum

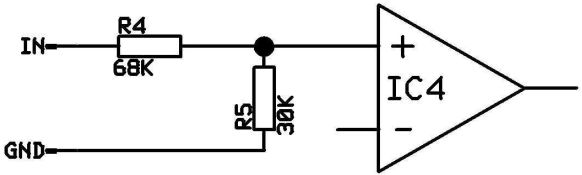
Digital input:



The digital input can be activated with a switch to the TIM GND or with a low level CMOS/TTL signal.



Analog input:



Useful voltage range: 0 … 10 V.

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