FLUKE
Process Instruments

# DTDP Software

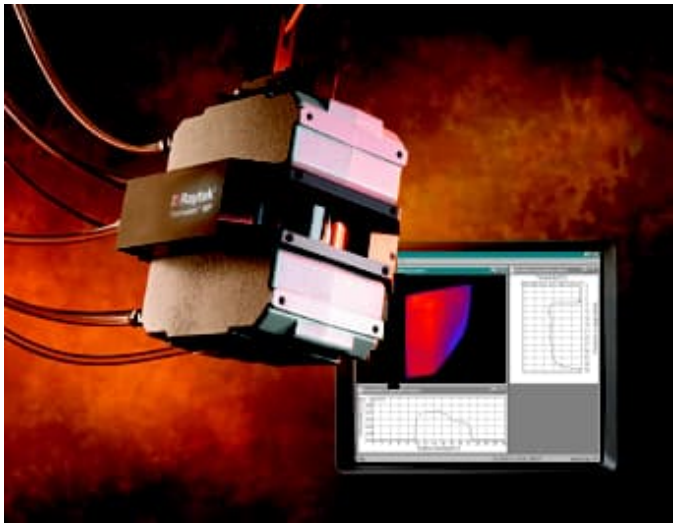
## For Infrared Linescanner

**TF**
Thermoforming

**GS/GSLE**
Glass / Low-E Glass

**ES**
Continuous-Web Processes

**EC**
Extrusion Coating



## Users Manual

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*Note*

*This document is part of the operating instructions for the linescanner. All tips and notices regarding acceptable operation and safety must be read in addition!*

This manual is available in different languages. In case of differences between the language versions, the English manual is binding.

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# 1 Description

The infrared temperature measurement system is designed for use in industrial heating applications where the continuous monitoring and control of temperature is critical to productivity. The infrared linescanner monitors the material's temperature distribution allowing the system to help improve product quality and part uniformity. The early detection of heater or cooler problems results in better operating efficiency by reducing scrap rates and saving energy.

The measurement system is used for monitoring of both, continuous web processes and discrete processes.

Web processes are characterized by a continuous material flow (e.g. coating of paper) whereby the scanner is operated in a continuous manner sending line by line to the computer. A dedicated portion of a scanned line is called a Sector.

In discrete processes separate sheets are observed (e.g. bending of separate glass sheets). Thus, the recording of temperature lines by the scanner is to synchronize to the flow of the separate sheets. For that the scanner is started by a starting signal (trigger) in case of detecting a new sheet in its field of view. Depending on the size and the velocity of the sheet the scanner must record an adequate number of temperature lines for a complete acquisition of the sheet. The totally of the lines is named snapshot. A dedicated portion of a snapshot is called a Zone.

The system allows the visualization of the temperature distribution by a diagram (horizontal or vertical profile) or a color-coded thermal image. It is possible to output temperature values as a current or a voltage by means of additional hardware output modules. In case of a thermal defect, the system triggers an alarm. The alarm time is saved in an alarm file. For later analysis, the thermal image is automatically stored in a separate file. The alarm can also be output with an optional digital output module.

This manual describes functionality and installation of the system. It is directed to the process engineer who must know the background of the process, the capabilities of the scanner, and to learn how to configure and use the software.

This manual does not cover the linescanner itself; for further information please refer to the linescanner user manual.

The DTDP software as light version comes with limited functionalities and is intended to be used for monitoring purposes only. The DTDP software light is delivered with each linescanner shipment.

**Table 1-1: DTDP Light versus System Software**

| **Feature** | **DTDP light** | **System Software: TF, GS/GSLE, ES, EC** |
|---|---|---|
| Configuring the linescanner (scan frequency, temperature range, pixel count, communication, etc.) | X | X |
| Configuring of sectors | X | X |
| Scanner internal sectors (device sectors) | X | X |
| OPC Server | | X |
| DDE connectivity | | X |
| http Server | | X |
| Analog/digital Output Modules | | X |
| Forwarding of results via Ethernet/COM port | | X |
| Saving of snapshots | max. 5 snapshots | unlimited |

The DTDP is the system software for the application specific system packages TF, GS/GSLE, ES, and EC providing a comprehensive set of input and output capabilities for process control. Similarities and differences between the system packages are elaborated in that manual.

**Table 1-2: Feature Comparison for System Software**

| | **EC** | **ES** | **TF** | **GS/GSLE** |
|---|---|---|---|---|
| Process | continues | continues | discontinues (discrete) | discontinues (discrete) |
| Area of interest | sector | sector | zone | zone |
| Specialty | Automatic Sector | Generic Sector | | |

# 2 System Functions

## 2.1 System Components

The system consists of the following components:

- System software
- Industrial power supply
- Documentation

## 2.2 System Requirements

Minimum requirements for the PC (provided by the user):

- Clock speed: ≥ 2 GHz
- Main memory: ≥ 2 GB RAM
- Hard disk: ≥ 20 GB for data (1 GB for the program)
- Ethernet communication: Ethernet, TCP/IP protocol, 10/100 Mbit/s
  It is recommended to consider a second Ethernet ports for additional network communications.
- Graphic: 1280 x 1024 pixel (for displaying 1024 scanner pixel per line)
- Operating system: Windows 7 / 10

*Note*

*It is strongly recommended to run the linescanner software in the latest version exclusively on the PC. Other applications could affect function and performance! A permanent CPU usage above 80% can affect the functionality of the whole system!*

## 2.3 System Interfaces

For interfacing to other control systems, the system provides a lot of interfaces to transfer temperature, alarm and system information.

**Table 2-1: Outputs**

| Output | Interface | Remark |
|---|---|---|
| Sector/Zone Results | File / Network | ASCII-Text Format<br>5.8.2.3 Context Menu of the Snapshot View, page 69 |
| | Analog Output Module | Current or Voltage<br>4.7 Input/Output , page 47 |
| | Serial via Ethernet/COM-Port | ASCII Protocol<br>7.1.4 Forwarding of Results, page 91 |
| | DDE Connection | 4.6.1 Software Sector/Zone Button, page 36<br>11.1 DDE with Microsoft Excel, page 108<br>11.2 DDE with LabVIEW, page 108<br>11.3 DDE with DASYLab, page 109 |
| | OPC | 10.5 OPC Items, page 105 |
| | Analog Output at Scanner | Current<br>4.8 Device Sector Page, page 56 |
| Sector/Zone Alarm | Digital Output Module | 0/1 Signal<br>4.7 Input/Output , page 47 |
| | OPC | 10.5 OPC Items, page 105 |
| Snapshot | File / Network | Binary Format or ASCII-Text Format<br>5.8.2.3 Context Menu of the Snapshot View, page 69 |
| Snapshot Counter | OPC | 10.5 OPC Items, page 105 |
| Actual Temperature Line | OPC | 10.5 OPC Items, page 105 |
| Automatic Sector | Serial via Ethernet/COM-Port | ASCII Protocol<br>7.1.4 Forwarding of Results, page 91 |
| | OPC | 10.5 OPC Items, page 105 |
| Generic Sectors | OPC | 10.5 OPC Items, page 105 |
| Alarm and System Information | File / Network | ASCII Text-Format<br>5.10.1 Alarm File (Logbook), page 83 |
| Scanner Internal Temperature | Analog Output Module | Current or Voltage<br>4.7 Input/Output , page 47 |
| | OPC | 10.5 OPC Items, page 105 |
| | Analog Output at Scanner | Current<br>4.8 Device Sector Page, page 56 |
| Alarm for Scanner Internal Temperature | Digital Output Module | 0/1 Signal<br>4.7 Input/Output , page 47 |
| | OPC | 10.5 OPC Items, page 105 |
| | Relais Output at Scanner | 0/1 Signal<br>4.8 Device Sector Page, page 56 |

**Table 2-2: Inputs**

| Input | Interface | Remark |
|---|---|---|
| Capturing a Snapshot | OPC | 10.5 OPC Items, page 105 |
| | Trigger Input at Scanner | 0/1 Signal<br>4.5.2 Trigger Source, page 33 |
| Saving a Snapshot | Digital Input Module WAGO | 0/1 Signal<br>5.8.2.3 Context Menu of the Snapshot View, page 69 |
| Providing a Snapshot Description | File / Network | ASCII-Text Format<br><Add a Note>, page 71 |
| | OPC | 10.5 OPC Items, page 105 |
| Saving a Data Stream | Digital Input Module WAGO | 0/1 Signal<br>5.8.1 Scroll View, page 66 |
| Gating the whole Measurement | Digital Input Module WAGO | 0/1 Signal<br>4.7 Input/Output , page 47 |
| | OPC | 10.5 OPC Items, page 105 |
| Stop all Alarms | Digital Input Module WAGO | 0/1 Signal<br>4.7 Input/Output , page 47 |
| Emissivity | OPC | 10.5 OPC Items, page 105 |
| | Voltage Input at Scanner | 4.2.2 Emissivity via Voltage Input, page 23 |
| | Digital Input Module WAGO | List of Emissivities in a Table<br>4.7 Input/Output , page 47 |
| Path to Configuration File | OPC | Path to Configuration File<br>10.5 OPC Items, page 105 |
| | Digital Input Module WAGO | List of Configuration Files in a Table<br>4.7 Input/Output , page 47 |
| Alarm threshold for Sector / Zone | OPC | 10.5 OPC Items, page 105 |
| Temperature range | OPC | 10.5 OPC Items, page 105 |
| Synchronization to Process Speed | OPC | 10.5 OPC Items, page 105 |
| | Voltage Input at Scanner | 4.7 Input/Output , page 47 |

# 3 Software Installation

Complete the following steps to install the software on a PC:

- Insert the installation - CD into the CD-ROM drive, follow the steps below:
- Click on the <Start> button on the Windows Desktop, then select <Run>.
- Type <D:\ProgramFiles\setup.exe> (assuming D is your CD-ROM drive).
- Click <OK>.

Follow the Installation Wizard's instructions on the screen. Choose the software configuration you want to install, e.g. <TF – Thermoforming>. Afterwards select the requested language for the Configurator and the scanner software. The installation program creates a new program group in the start menu, e.g. it is called <DataTemp_TF>. The start menu includes the icons for the scanner software and the Configurator. Also, corresponding icons on the Windows desktop are created.

Clicking on the <TF Configurator> symbol invokes the configuration program. With that program the initialization file can be edited.

Clicking on the <TF> symbol will automatically start the program with the preset initialization file.

*Note*

*Each installation generates a new initialization file. For existing installations, the existing initialization file is saved separately and renamed to <FileName>.lastInstallation.<TimeStamp>.ini.*

*Note*

*Do not run several instances of the scanning program simultaneously! To configure more than one scanner one program instance is only required, see section 4.1.5 Configuration Group, page 21.*

# 4 Configurator

Every call-up of scanner software relates to an initialization file. Each initialization file contains a parameter list corresponding to the specific requirements of an application. Use the Configurator to edit and create new initialization files.

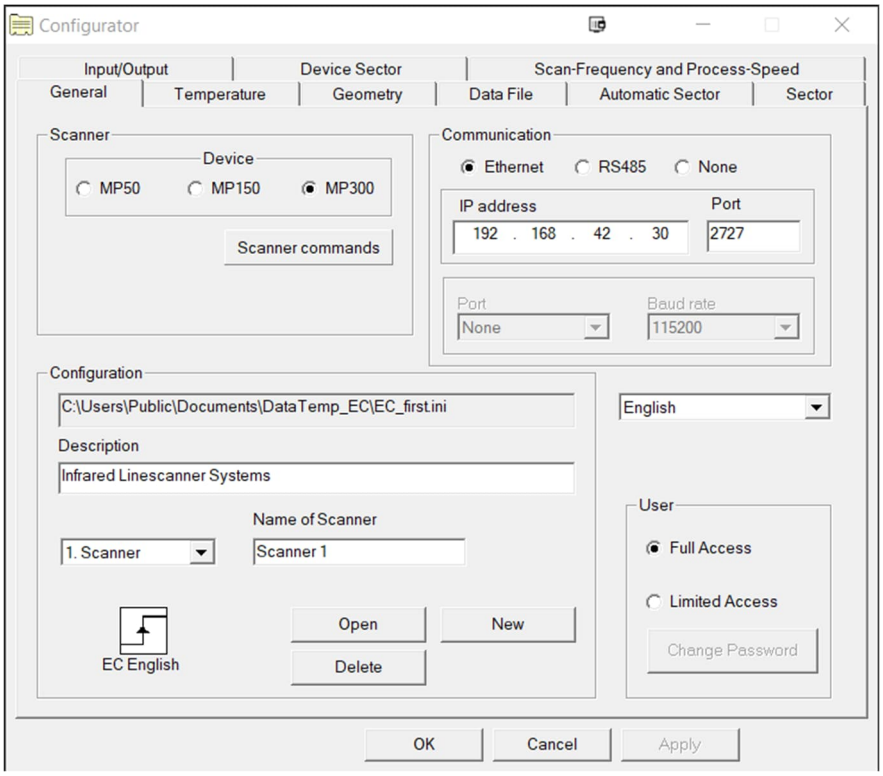
*Note*

*All changes must be saved! This is the only way for changes to be valid for the next program startup!*

The Configurator consists of a few pages, which are following described in detail.

## 4.1 General

**Figure 4-1: General Page**




### 4.1.1 Scanner Group

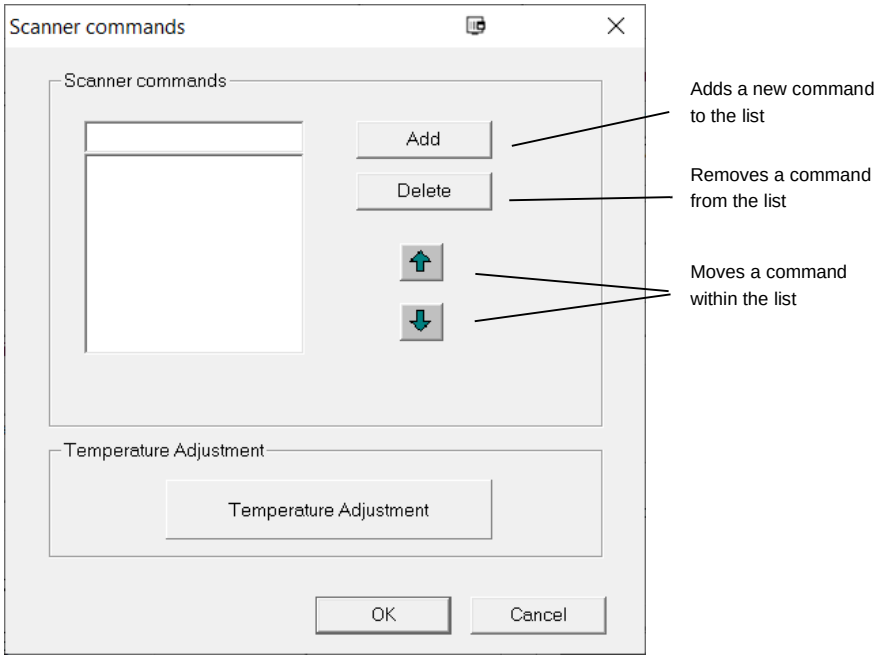
In this parameter group, specific commands for the scanner can be defined.

**<Device>** selects between a MP50 or a MP150/300 linescanner. The <MP50> option ensures backward compatibility to the old MP50 linescanner. With <MP150> and <MP300> the system runs with the full set of advanced features like high scan frequencies and higher pixel counts.

**<Scanner commands>** Optional commands for additional initialization of the scanner can be set here. Normally this feature is not used but in case of use you must be very carefully!

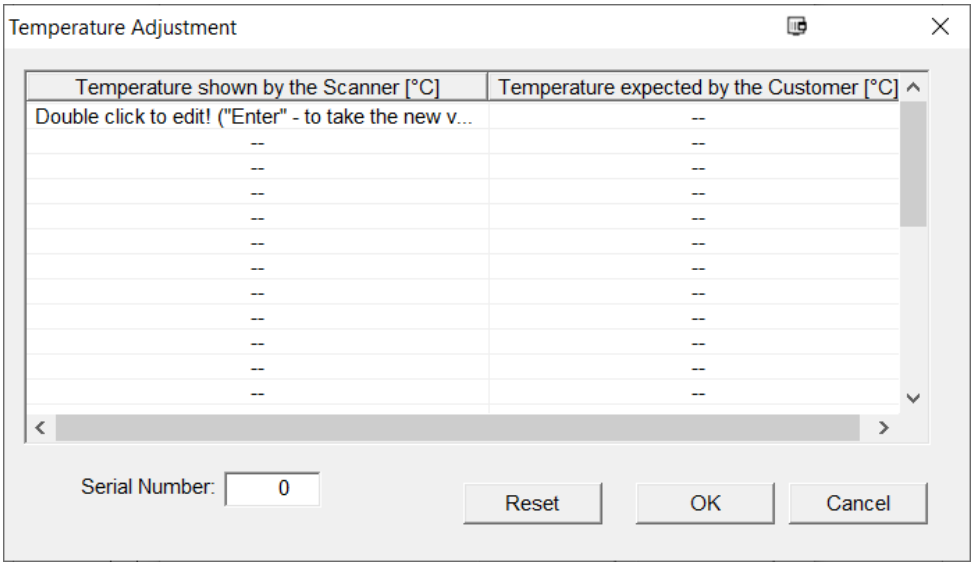
*Note*
*Changed command list can suspend the whole scanner system!*

**Figure 4-2: Scanner Commands**




The scanner's command list will be executed after all other parameters set in the Configurator. Further information for scanner commands is found in the Protocol Manual of the scanner.

**Figure 4-3: Temperature Adjustment**




The dialog box <Temperature Adjustment> allows the user to make a field-side adjustment of the temperature values of the scanner. For this, the user specifies one, two or more temperature points at which the adjustment is made. The temperature displayed by the scanner at this point will now be corrected to match the temperature expected by the user. For all temperatures between the given temperature points, the scanner performs a linear approximation.

Please note:

- The temperature adjustment is made on the temperature side of the scanner and not on the energy side.
- Therefore, the adjustment only applies to one emissivity value. If the emissivity value has changed, the adjustment must be carried out again.
- By specifying the serial number of the scanner, the adjustment is written to the nonvolatile memory of that scanner. Thus, the adjustment is carried out even after loss of voltage on the scanner and is also independent of the scanner software.
- A click on the <Reset> button deletes all temperature points in the table and writes one line with zeros. This means that the scanner will be reset and will not carry out any adjustments any more.
- The temperature adjustment requires the scanner firmware in revision 3.46 (or higher).

### 4.1.2 Communication Group

The linescanner can communicate via Ethernet interface or RS485. During system configuration the user will define either Ethernet or RS485 via a selection box. Be aware, that Ethernet communication is not possible for old MP50 devices.

**Ethernet**

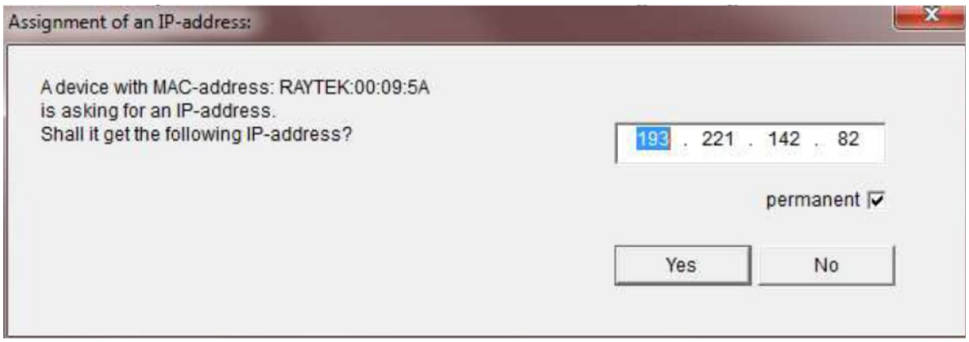
**<IP address>** Reflects the IP address set in the linescanner. The factory default IP address is 192.168.42.30. Make sure, that the network adapter on the PC side is set to an appropriate IP address, see linescanner manual for detailed information!

*Note*
*Setting of <IP address> in the Configurator does not change the scanner's IP address. It only tells the software to use this IP address to find the scanner!*

*Note*
*Make sure that a possible firewall does not block the set TCP port!*

The scanner also supports the BootP protocol (requires firmware revision 3.44 and scanner software revision 3.9.0.10 or higher). BootP is activated by factory default on the scanner but can also be switched manually via the <BootPClient> terminal command. In the case of an IP address conflict or an interrupted communication, the scanner software uses the BootP protocol to assign the scanner the IP address set in the configurator.

**Figure 4-4: IP Address Assigning using BootP during Software Start Up Phase**




**RS485**

**<Port>** Sets the serial COM port of the PC, where the scanner is plugged in. In a multi-scanner system, every scanner needs a dedicated, free COM-port.

**<Baud rate>** Defines the baud rate for scanner and computer. A data transmission rate of higher than 115200 Baud is normally not supported by the PC standard interface card. For that case a special high-speed interface card is required.

**None**

Allows the run of the runtime software without having a scanner connected.

### 4.1.3 Description

In the description, a text is definable that is stored with every saved snapshot. For the text, a maximum length of 256 characters is allowed. The description can be changed while running the scanner software by means of the context menu of the Snapshot and the Scrolling view.

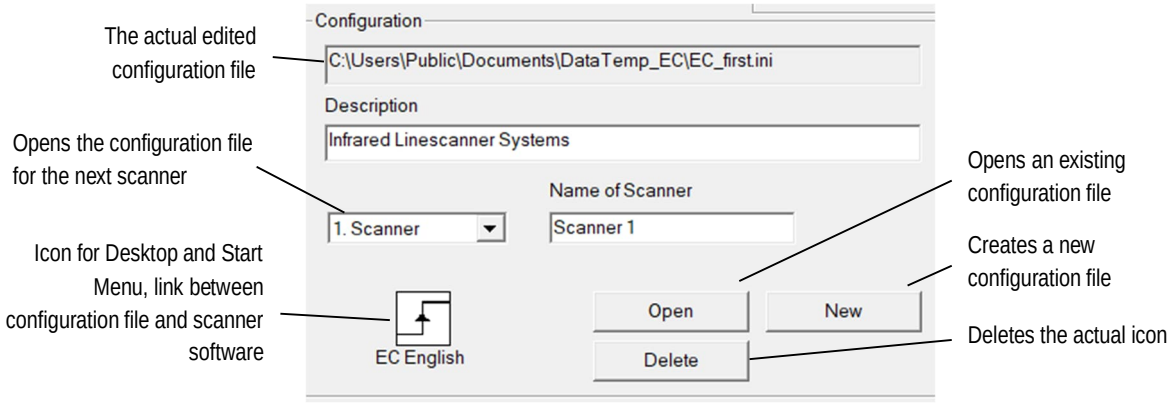
### 4.1.4 Name of Scanner

By means of that menu, you can give a description for each scanner. While running the scanner software you can see this description in the title bar of each scanner's window.

### 4.1.5 Configuration Group

In the Configuration Group, some common settings for configuration files can be defined.

**Figure 4-5: Configuration Group**




The scanner software allows operation with several scanners simultaneously (a system with 8 scanners is well proven by the manufacturer, even more scanners are thinkable). Each scanner needs its own configuration file. By clicking on the proper combo box, the configuration file for the next scanner is opened and editable. In case of missing that file, you are asked for creating it. In the example above, the file name for a second scanner is determined with EC_first.ini.1, for the third scanner EC_first.ini.2 and so on. In the scanner software, the next scanner can be called up with the menu <Scanner> <New Scanner>.

By preparing different configuration files in advance, you can easily execute the desired configuration later by simply clicking on the corresponding desktop icon:

Product 1

(Configuration containing recipe 1)

Product 2

(Configuration containing recipe 2)

### 4.1.6 User Group

It may be desired to restrict access to configuration files and various operating parameters. The software allows users to restrict the permission granted to access configuration files and configuration parameters of the scanner software.

Using the Windows operating system, the configuration of the scanner software can be protected against unauthorized modification, e.g. by setting the configuration file to read-only status.

Additionally, some functions of the scanner software itself can be changed by using one of the following “buttons”:

**<Full Access>** Defines the user as administrator with full permission to access files.

**<Limited Access>** Defines the user as the operator with limited permission to access files.

If the user is set to <Limited Access>, the following functions are affected or restricted:

- The switching to other applications by means of the <Alt> <Tab> buttons is not allowed.
- The software starts always with a maximized window.
- The opening of a window is not allowed.
- The closing of the current scanner window is not possible.
- The <Terminal View> is not accessible.
- The menu <Scanner Setup> is not accessible.
- The context menu <Auto-save Conditions> for Scroll View and Snapshot View are not accessible.
- The changes of the display are not saved; the software will always start up with the same display. This allows the administrator to set up a display (including the auto-save conditions), which will be saved in a file called display.0. The program takes this file for users and administrator/operator, to build-up the display, but the operator cannot change it.

If the user is set to <Limited Access>, the exiting of the scanner software can be protected by a definable password.

### 4.1.7 Language

This box allows the language of the Configurator to be defined. The corresponding vocabulary is to be found in an ASCII text file named <language>.txt, e.g. “English.txt”. The file is in the installation folder.

Entries in the language file are structured page by page. All pages are numbered. This number is only used for software internal purposes. In the following example page 1 is the General page detectable by means of the keyword “Title_Page “=General. In the following the labels of all buttons, boxes, tool tips, and messages are to be found. To make changes in the vocabulary, open the language file with the standard Windows Editor.

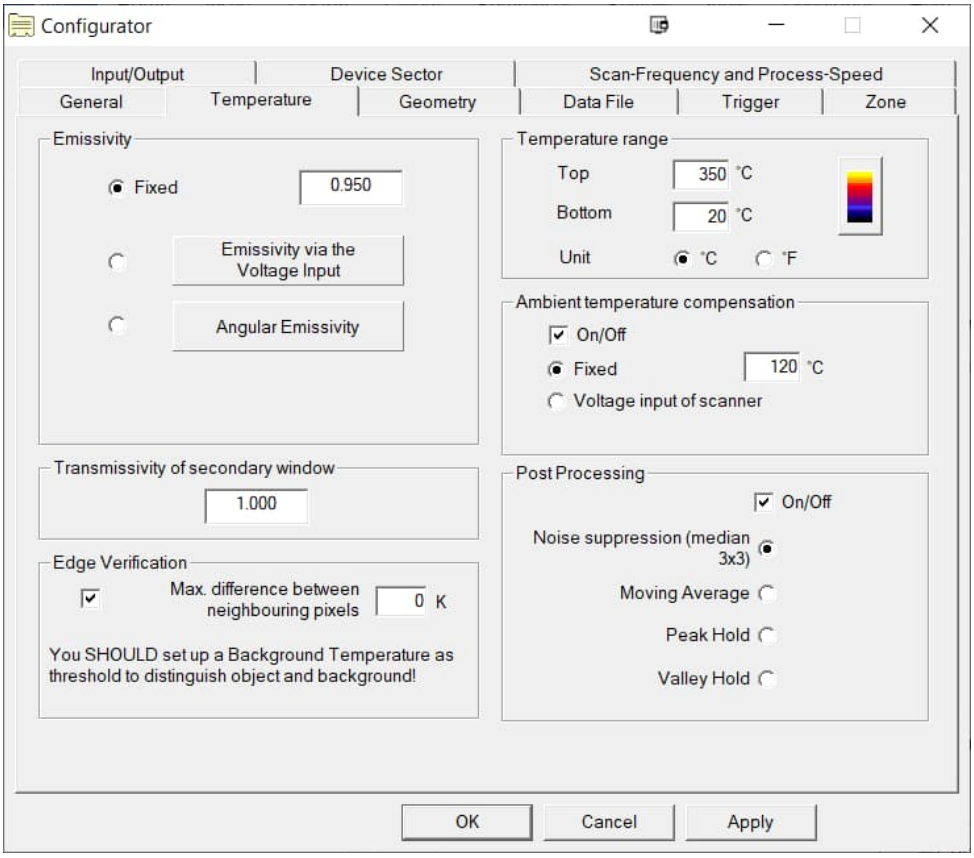
*Note*

*The text in the brackets and to the left of the equal sign must not be changed! Only the text to the right of the equal sign is changeable!*

```
[Page1]
Title_Page=General
Label_Scanner=Scanner
Button_Scanner_Commands=Scanner commands
Label_Configurator_Settings=Configuration
…
```

## 4.2 Temperature

**Figure 4-6: Temperature Page**



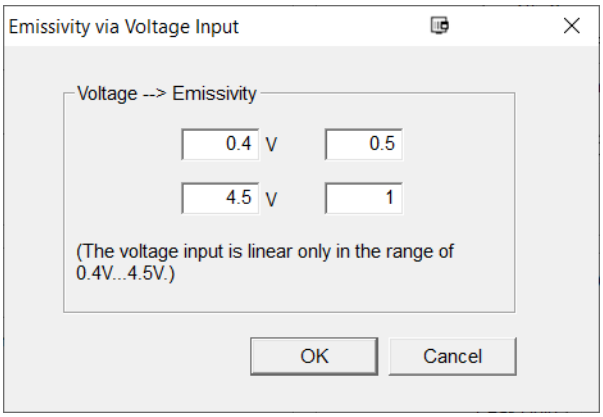

### 4.2.1 Emissivity

Defines the emissivity of the scanned material. The minimal setting for the emissivity is 0.01

### 4.2.2 Emissivity via Voltage Input

The voltage input of the scanner (see 6-pin connector at the scanner rear side) can be configured to accept an analog voltage signal to provide real time emissivity setting.

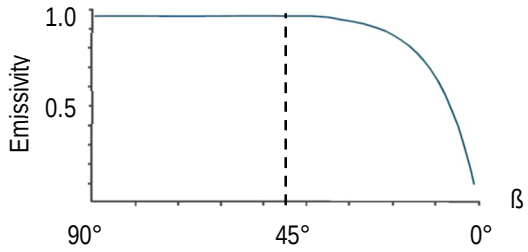
**Figure 4-7: Emissivity Setting via Voltage Input**



### 4.2.3 Angular Emissivity

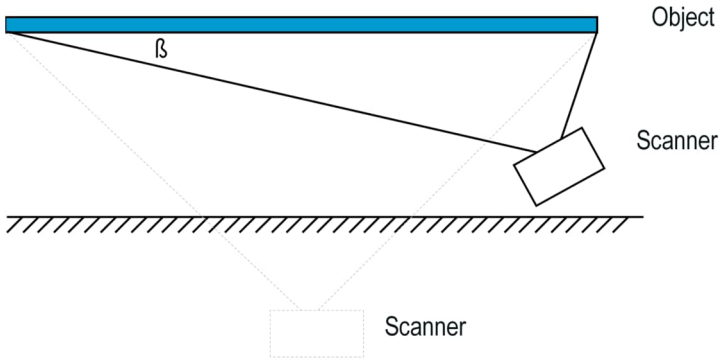
In case of difficult mounting environments, it is sometimes not possible to mount the scanner perpendicular over/under the measured object. A non-perpendicular mounted scanner could cause the need to consider the effect of an angular emissivity meaning the emissivity value is not constant anymore but changes over the emission angle.

**Figure 4-8: Emissivity Change over Emission Angle ß**



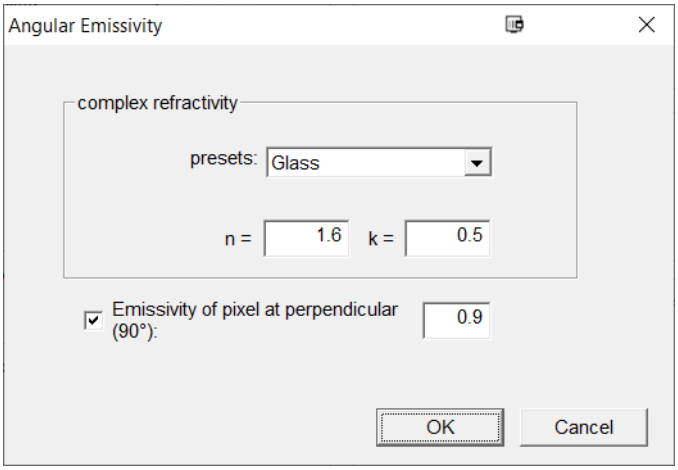

The problem of an angular emissivity comes up (e.g. for float glass) if the infrared radiation is being emitted under an angle less than 45°. The angular emissivity can be compensated by using different refractive indexes changing over different object materials whereby each pixel of the scanned line gets its own individual emissivity value.

**Figure 4-9: Space Limitation Preventing Scanner from Perpendicular Mounting**




For the angular emissivity correction, you must give the <complex refractivity> with its real portion <n> and imaginary portion <k>. The <complex refractivity> comes as default for float glass and pure iron.

**Figure 4-10: Angular Emissivity Setting**




The angular emissivity correction requires also the configuration of the scanner's turning angle as precise as possible, see section 4.3.1 Alignment Group, page 28.

### 4.2.4 Transmissivity of a Second Window

Defines the transmission factor for a second or a dirty scanner window.

### 4.2.5 Edge Verification

*Note*
*<Edge Verification> is only available for TF and GS/GSLE systems!*

The temperature value of a pixel is the result of the infrared radiation emitted of a certain area, the measurement spot. If the measurement spot is located on the edge of the measurement object, measurement object and background are scanned simultaneously. As the result, the edge pixel has a temperature value between the temperature of the measurement object and the background temperature. With the option <Edge Verification> the described effect can be corrected.

**<Maximal Difference between neighboring Pixels>** Defines the maximal expected temperature difference within the measuring object. In case of detecting a pixel with a greater temperature difference to the neighboring pixel, the pixel must be a wrong edge pixel. This edge pixel will be corrected with the temperature of the warmest neighboring pixel.

**<Background>** The correction of an edge pixel is done only for pixels warmer than the background temperature. The background temperature can be defined on the Configurator's page <Zone>.

### 4.2.6 Temperature Range

This group defines the minimum and the maximum temperature of the material to be scanned.

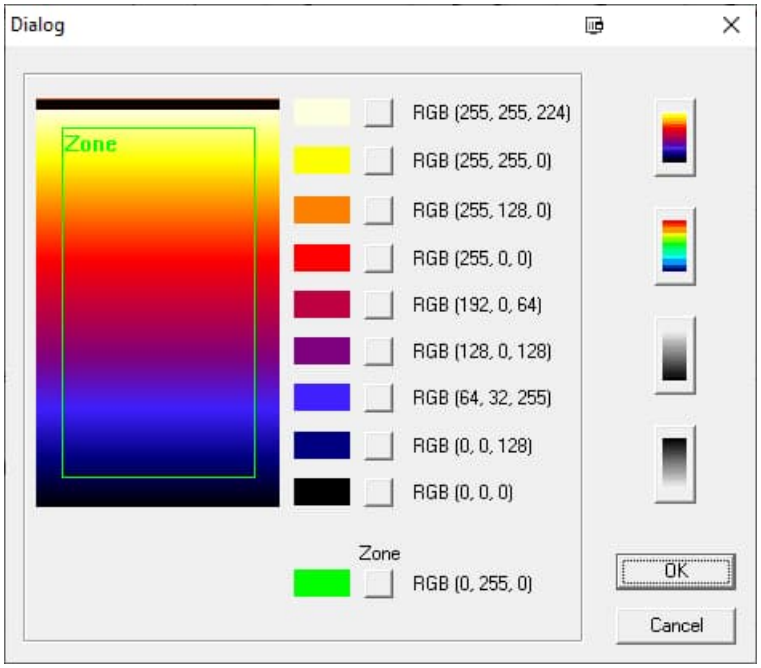
<Temperature Range> changes the displayed temperature range in the software. The temperature range in the scanner remains always unchanged to full range.

For MP50 only: <Temperature Range> changes the set temperature range in the scanner.

The temperature units, Celsius or Fahrenheit, are changeable. The selected unit is valid for all other temperature parameters (e.g. background temperature, zone thresholds, etc.). The conversion from one temperature unit to the other is performed automatically.

By clicking on the colored button, the dialog for changing the color palette appears. The user may create his own individual color palette. Alternatively, a predefined color palette is can be selected (iron palette, rainbow palette, gray palette, gray palette inverse).

**Figure 4-11: Color Palette and Zone Color**




### 4.2.7 Ambient Temperature Compensation

The scanner is capable to improve the accuracy of target temperature measurements by considering the ambient or background temperature. This feature is useful when the target emissivity is below 1.0 and the background temperature is significantly hotter than 25°C (77°F). For instance, the higher temperature of a furnace wall could lead to hotter temperatures being measured especially for low emissivity targets.

Ambient background temperature compensation compensates for the impact of the reflected radiation in accordance to the reflective behavior of the target. Due to the surface structure of the target, some amount of ambient radiation will be reflected and therefore added to the thermal radiation that is collected by the sensor. The ambient background temperature compensation compensates the result by subtracting the amount of ambient radiation measured from the sum of thermal radiation the sensor is exposed to.

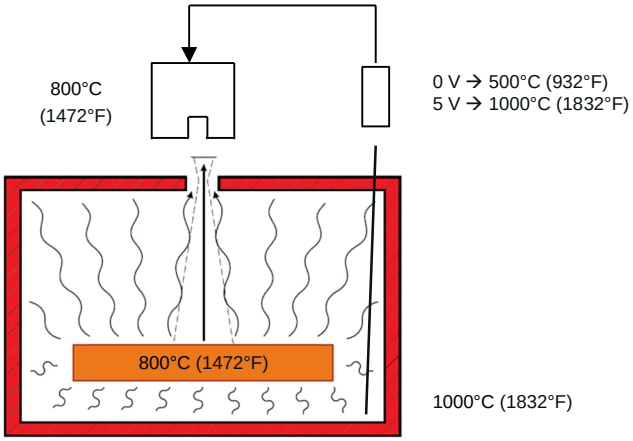
*Note*
*The ambient background temperature compensation should always be activated in case of low emissivity targets measured in hot environments or when heat sources are near the target!*

The following possibilities for ambient background temperature compensation are available:

**<Fixed>** If the background ambient temperature is known and constant, the user may give the known ambient temperature as a fixed temperature value.

**<Voltage input of scanner>** Ambient background temperature compensation from a second temperature sensor (infrared or contact temperature sensor) ensures extremely accurate results. The voltage output of that second sensor could be connected to the voltage input of the scanner (see 6-pin connector at the scanner rear side) is utilized for real time compensation, whereby the second sensor and the scanner's voltage input must be set on the same temperature range.

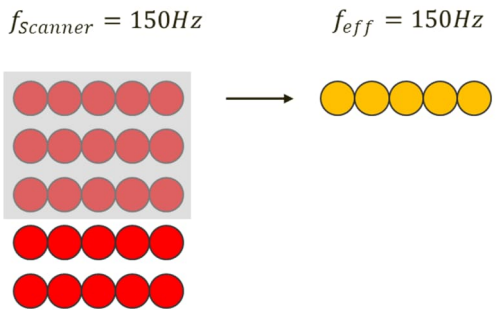
**Figure 4-12: Ambient Background Temperature with a Second Temperature Sensor**




### 4.2.8 Post Processing

Defines the post processing mode for the scanned lines. The calculation is done on the PC side (not in the scanner itself). The effective scan frequency remains is identical to the scanner's scan frequency. The following algorithms are applied line by line for pixels at the same position.

**Figure 4-13: Processing of Scanned Lines (here in blocks of 3 lines)**




**<Noise suppression>** Applies a median 3x3 filtering technique to remove noise from the thermal image by trying to preserve the image edges.

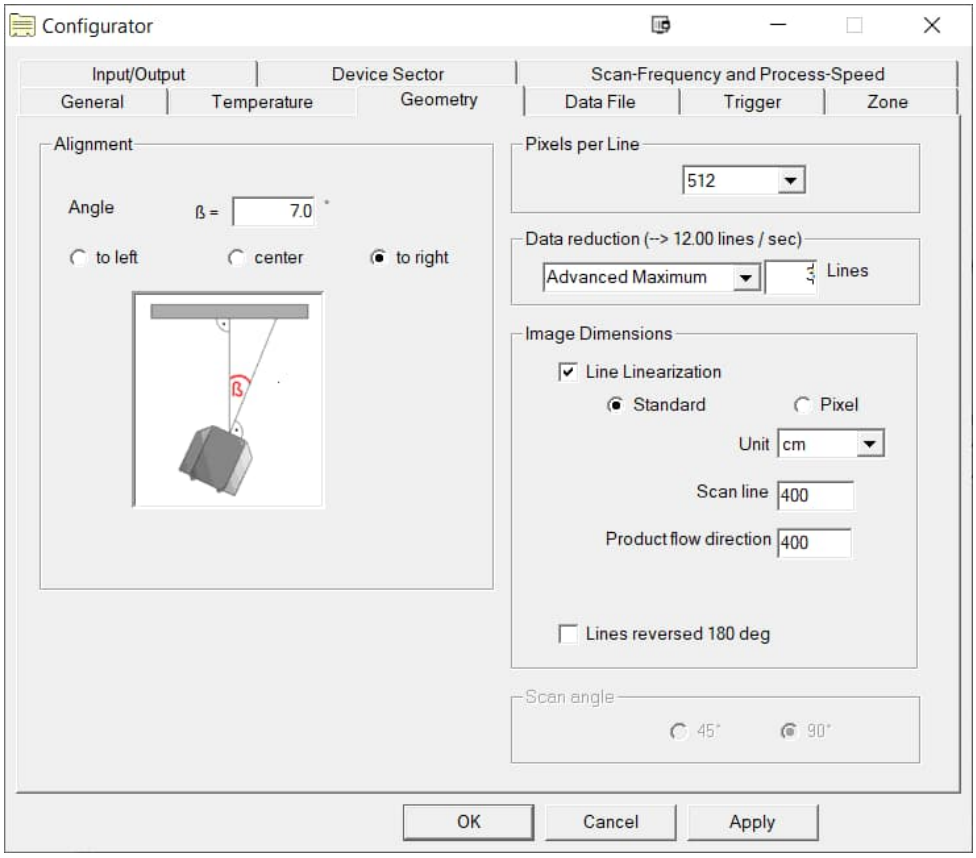
**<Moving Average>** Provides a gliding average over the given number of lines. The result is a significant reduction of noise but a slower response for temperature changes.

**<Peak Hold>** Holds the maximum value of the pixel-to-pixel comparison between the lines. The hold reset is realized over the given number of lines. The result is the elimination of temporary disturbing effects (like water steam) but a loss of sensitivity for temperature valleys.

**<Valley Hold>** Holds the minimum value of the pixel-to-pixel comparison between the lines. The hold reset is realized over the given number of lines. The result is the elimination of temporary disturbing effects but a loss of sensitivity for temperature peaks.

## 4.3 Geometry

**Figure 4-14: Geometry Page**




### 4.3.1 Alignment Group

If the scanner is not mounted perpendicularly to the material being scanned, the angle ß defines the angular deviation from the perpendicular position. The input field accepts angles up to 44° but an angle greater than 25° causes high non linearities in the thermogram. In that case, a message box with a warning appears.

It is possible to turn the scanner to the right or left (always as viewed from the top of the scanner). The Alignment Group is available only if the box labeled “Line Linearization” is checked.

### 4.3.2 Pixel per Line

That function selects the number of pixels per scan line. A high number of pixels compromises the available maximal scan rate:

For models up to 150 Hz:

- 1024 pixel → max. 40 Hz
- 512 pixel → max. 80 Hz
- 256 pixel → max. 150 Hz

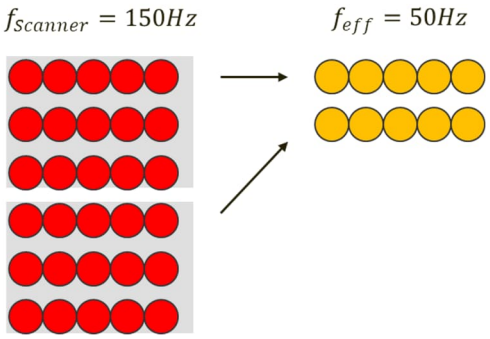
For models up to 300 Hz:

- 1024 pixel → max. 80 Hz
- 512 pixel → max. 160 Hz
- 256 pixel → max. 300 Hz

### 4.3.3 Data Reduction

Defines the number of recorded lines to be processed into one line. With e.g. 3 defined as parameter, 3 lines are buffered in the scanner and processed into one line to be transferred to the PC. The effective scan frequency is by the given number of lines lower than the scanner's scan frequency. The following algorithms are applied line by line for pixels at the same position.

**Figure 4-15: Data Reduction of Scanned Lines (here in blocks of 3 lines)**



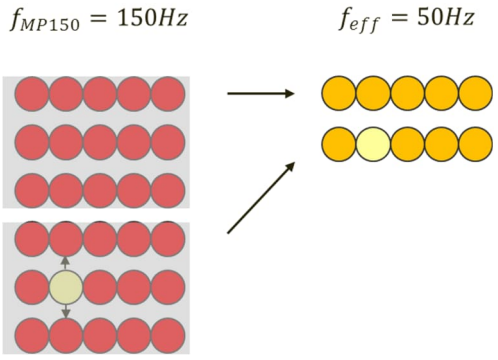

**<Average>** Provides an average over the given number of lines. The result is a significant reduction of noise but a slower response for temperature changes.

**<Maximum>** Holds the maximum value of the pixel-to-pixel comparison between the lines. The hold reset is realized over the given number of lines.

**<Minimum>** Holds the minimum value of the pixel-to-pixel comparison between the lines. The hold reset is realized over the given number of lines.

**<Advanced Maximum>** Provides an average over the given number of lines. For a pixel with > 10 K temperature difference to its neighbors, the averaging is stopped and a peak hold is applied instead of. The result is a reduction in noise due to the averaging by keeping a sensitivity for temperature peaks.

**Figure 4-16: Data Reduction with <Advanced Maximum> and a pixel with > 10 K difference to its neighbors**




### 4.3.4 Image Dimensions

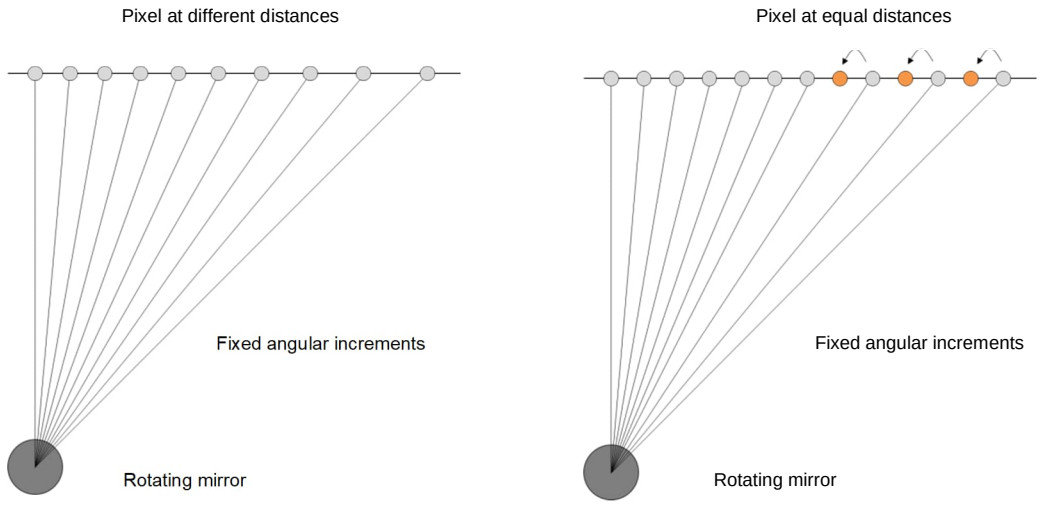
**<Line Linearization>**

Most all applications require selection or activation of this feature. The scanner's internal mirror continuously sweeps across the field-of-view. As the mirror rotates, up to 1024 temperature readings are recorded at fixed angular increments resulting in the display of a nonlinear temperature distribution (i.e., non-linear with respect to

the horizontal axis of the thermogram). This nonlinear display results in the physical distance between two adjacent points at the edges or extremities of the thermal image to be larger than that in the middle of the thermal image.

To avoid this nonlinearity, click the check box for <Line Linearization>. This causes the system's software to properly correct for measurement geometry by copying and pasting of adjacent pixels to display measured temperatures linearly.

**Figure 4-17: Non-linear Line (left)**
**Linear Line by pasted Pixels (right, principle schematic)**




**<Standard>**

Defines the dimensions of the measured object and the units of length. Changing length units causes all length-related parameters (e.g., size of sectors) to be converted automatically after user confirmation. However, the software only processes whole (integer) numbers for dimensions. Converting from a smaller length unit to a larger length unit may cause loss of dimensional data. (e.g. 850 cm → 9 m). In that case a message box appears.

*Note*
*The image dimensions are mapped to the scanner's field-of-view independent from the mounting distance of the scanner! For that reason, any change on the image dimensions does not affect the scanned image size or the pixel resolution. For further information on scaling the image, see section 5.8.4 Horizontal Profile, page 74.*

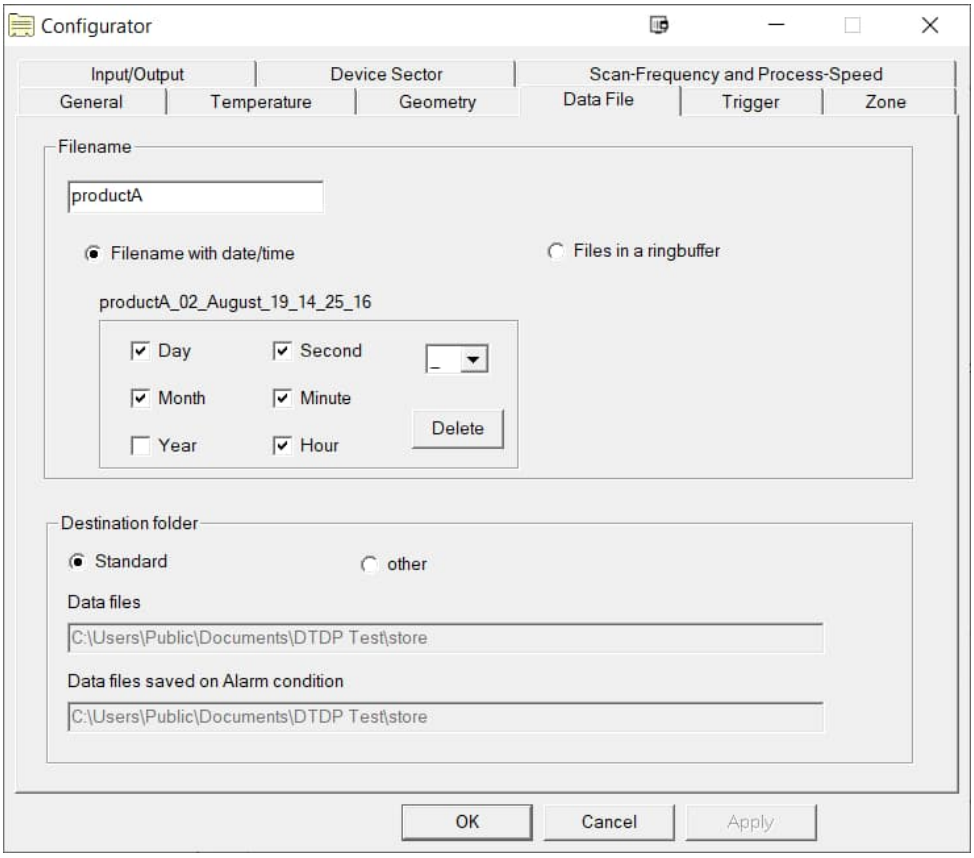
By selecting the option **<other>** the axes are labeled in pixel and lines. In that mode, sectors are not supported.

**<Lines reversed 180°>**

This allows the display of temperature lines to be mirrored by 180° (i.e., left-right reversal). As a result, the left-edge of the displayed screen is transformed to the right-edge, and vice versa. This option is helpful if the left-edge of the material scanned and the left-edge of the displayed image should be the same to the user even though the scanner is not mounted in the appropriate manner.

## 4.4 Data File

**Figure 4-18: Data File Page**




### 4.4.1 Filename

Defines the file format for labeling files with images automatically saved. First, a basic filename without any extension is input. Based on this basic filename, two different options are offered:

**<Filename with date/time>** Enlarges the basic filename with a free, definable combination of a date or time. In case of an alarm, the filename will be created as the basic filename plus the actual date/time combination according to the setting of the PC. In the example given above, the created filename could be: productA_02_August_19_14_25_16

**<Files in a ring buffer>** A ring buffer provides a counter to name the files. When the last counter value is reached, the ring buffer starts again from the beginning, overwriting previous files. A ring buffer of 100 creates a ring buffer with running file names: Product_A_000, Product_A_001, ..., Product_A_099

The save conditions must be set in software by launching the context menu in the activated view. See section 5.8.2.3 Context Menu of the Snapshot View on page 69, to define conditions for storing files.

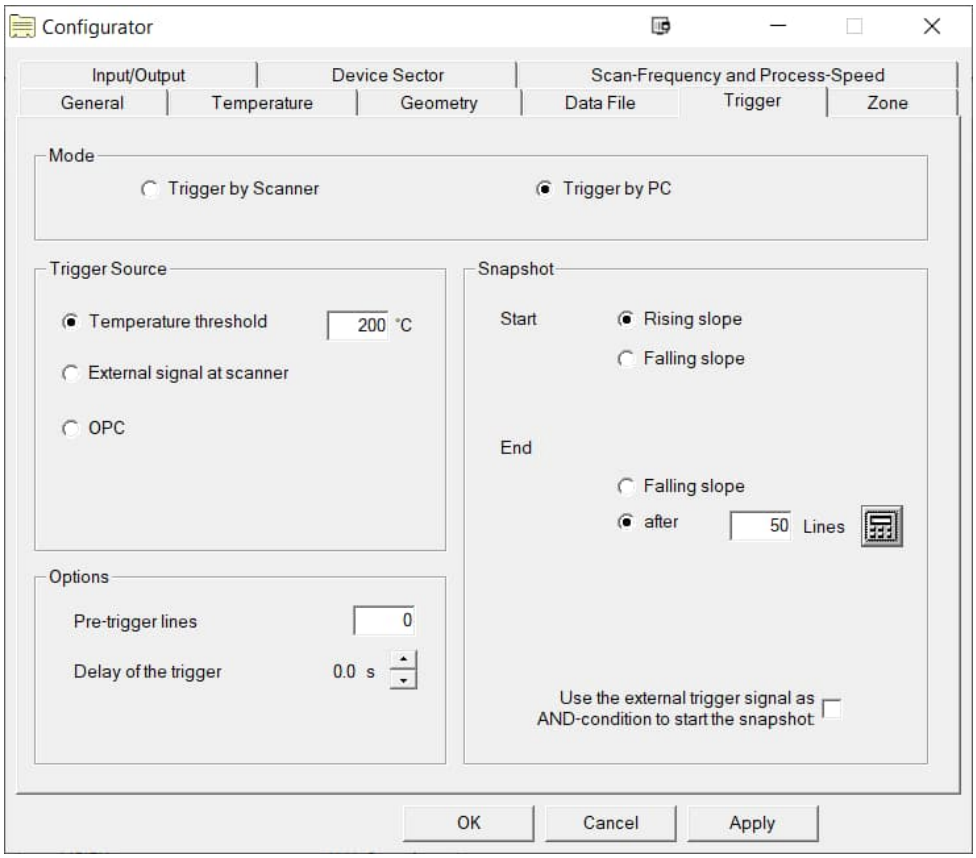
### 4.4.2 Destination Folder

Defines the directories where the automatically saved files are stored separated for the normal and the alarm condition.

## 4.5 Trigger

*Note*
*The <Trigger> page is only available for TF and GS/GSLE systems!*

**Figure 4-19: Trigger Page**




### 4.5.1 Mode

**<Trigger by Scanner>** A trigger (i.e., start signal) orders the scanner to record a specified number of temperature lines. While scanning an image, existing lines are already buffered in the scanner. A “snapshot” is the totality of all temperature lines. In the waiting time until the next trigger, the snapshot is transferred to the PC via the serial interface. In that mode, the trigger condition is evaluated by the scanner.

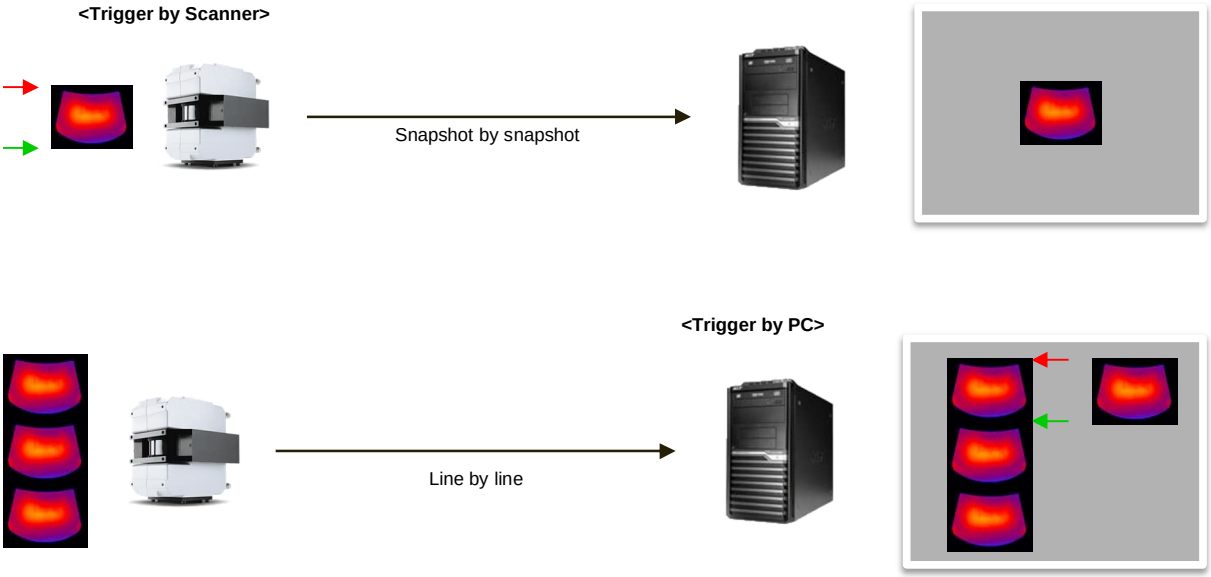
Finally, the number of lines for a snapshot is fixed.

**<Trigger by PC>** In this mode the PC evaluates the trigger condition. The scanner sends temperature lines to the PC permanently. In case of a valid trigger, a certain number of lines are “cut” from the continuous line flow and selected as a “snapshot” image.

Finally, the number of lines for a snapshot is variable. This permit scanning objects of different sizes or different line speeds without losing a significant number of lines.

*Note*
*<Trigger by PC> is the preferred mode with Ethernet communication!*

**Figure 4-20: Recording of Snapshots**




### 4.5.2 Trigger Source

For generating a trigger signal different trigger types are available:

**<Temperature threshold>** Triggering by exceeding of the specified temperature threshold. Additionally, the temperature threshold can be AND wired with the external trigger signal at the scanner.

**<External signal …>** Triggering by an external signal at scanner's trigger input connector, see linescanner manual for further information.

**<OPC>** Triggering by a corresponding OPC item, see section 10.5 OPC Items, page 105. <OPC> is only selectable with the activated OPC server, see section 4.7 Input/Output , page 47.

**<Cyclical trigger>** Self-triggering of the scanner after the given time (only in the <Trigger by Scanner> mode selectable).

### 4.5.3 Snapshot

**<Start>** The starting point for triggering a snapshot can be a rising slope (from lower to higher trigger levels) or a falling slope (from higher to lower trigger levels). Available only for a <Temperature Trigger>, <External Trigger>, or <OPC>.

**<End>** The end of a scanned snapshot can be a constant number of lines. The set line count per snapshot is determined according to scan-frequency, velocity and length of sheet, and calculated to:

$$n = \frac{f \cdot l}{v}$$

*n* ... count of lines

*f* ... scan rate of scanner (with attention to averaging)

*l* ... length of measurement object

*v* ... velocity of measurement object

Example: f = 20 Hz, l = 1 m, v = 0.5 m/s → n = 40

In the <Trigger by PC> mode, the end of a snapshot can be defined by the inverse trigger condition for the start of a snapshot. The number of lines in the snapshot is variable compared to snapshots with a fixed number of lines.

A snapshot can be started and ended with the same trigger edge (e.g. start and end set to <Rising slope>). In that case the snapshot end is the start of the next snapshot.

### 4.5.4 Options

**<Pre-trigger lines>** (in the <Trigger by PC> mode) number of lines inserted prior to the snapshot's trigger event.

**<Delay of the trigger>** Time between trigger signal and the start of a snapshot.

## 4.6 Sector/Zone

**Figure 4-21: Sector/Zone Page**

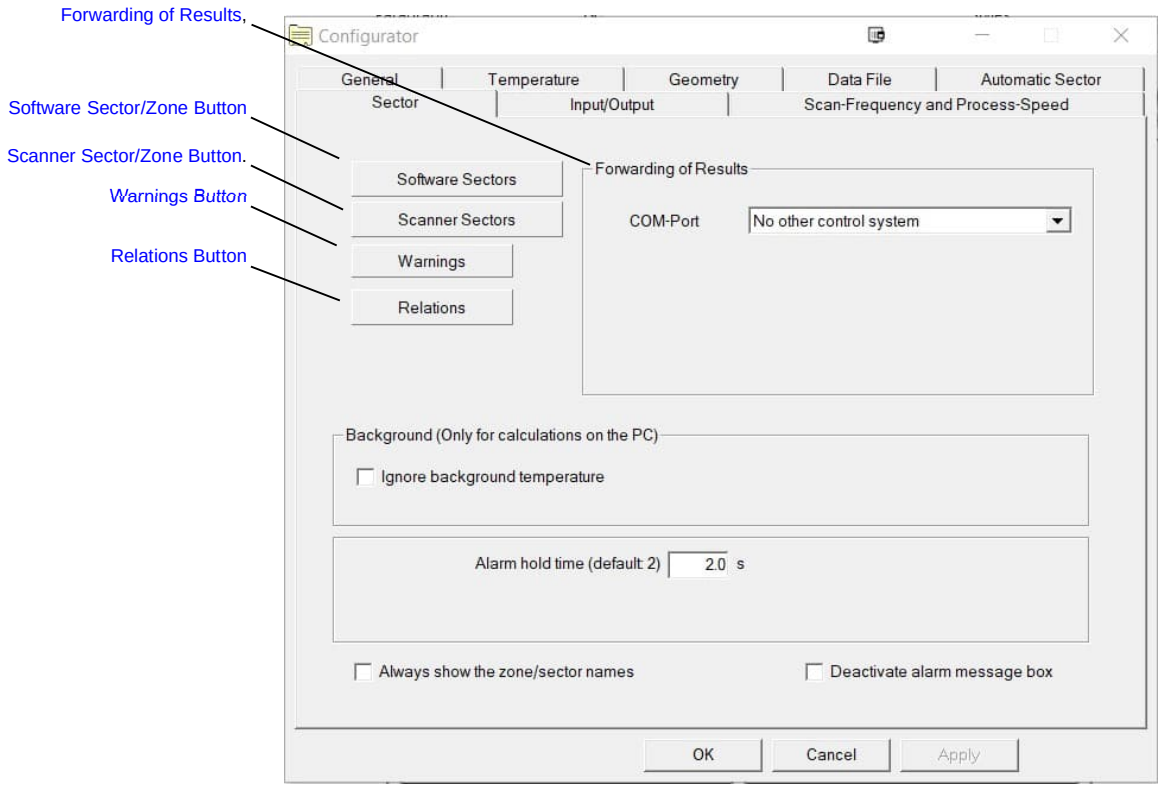
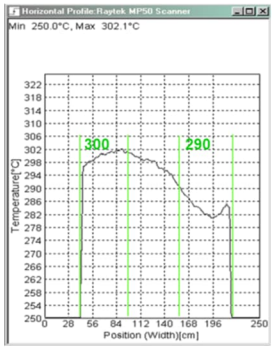


**Figure 4-22: Comparison to Sectors and Zones**

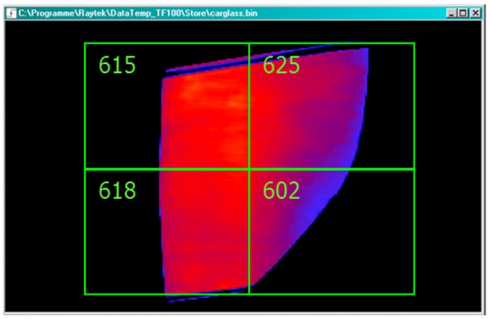
**Sector**

- for continuous processes
- 1-dimensional portion of a line
- Calculation with each new line
- Software Sector: controlled by the software, unlimited number of sectors but real time behavior is not guaranteed
- Scanner Sector: sector controlled by the scanner, limited number of sectors but real time behavior is guaranteed




**Zone**

- for discrete/discontinuous processes
- 2-dimensional zone grid
- Calculation with each snapshot
- Software Zone: controlled by the software, unlimited number of zones but real time behavior is not guaranteed
- Scanner Zone: zone controlled by the scanner, limited number of zones but real time behavior is guaranteed, trigger mode needs to be set to <Trigger by Scanner>



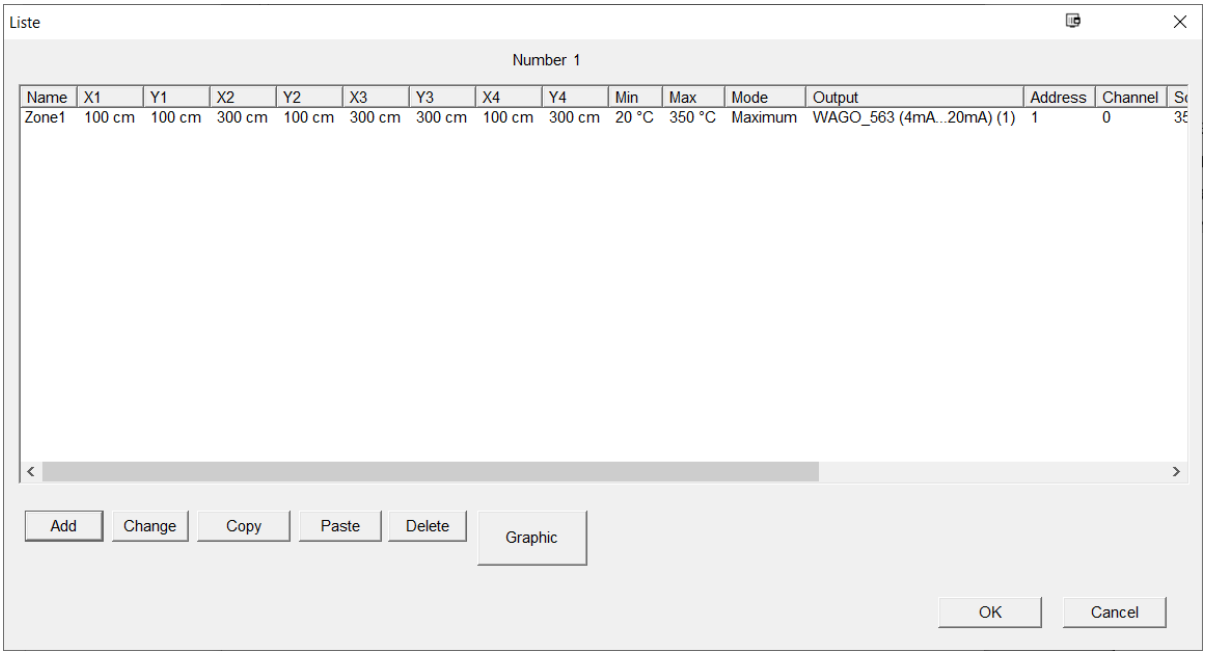

Please note, sectors/zones controlled by the software are shown in the views using continuous lines.

### 4.6.1 Software Sector/Zone Button

Defining software sector/zones makes it possible to monitor specified areas. Software sector/zones are evaluated via the software on the PC.

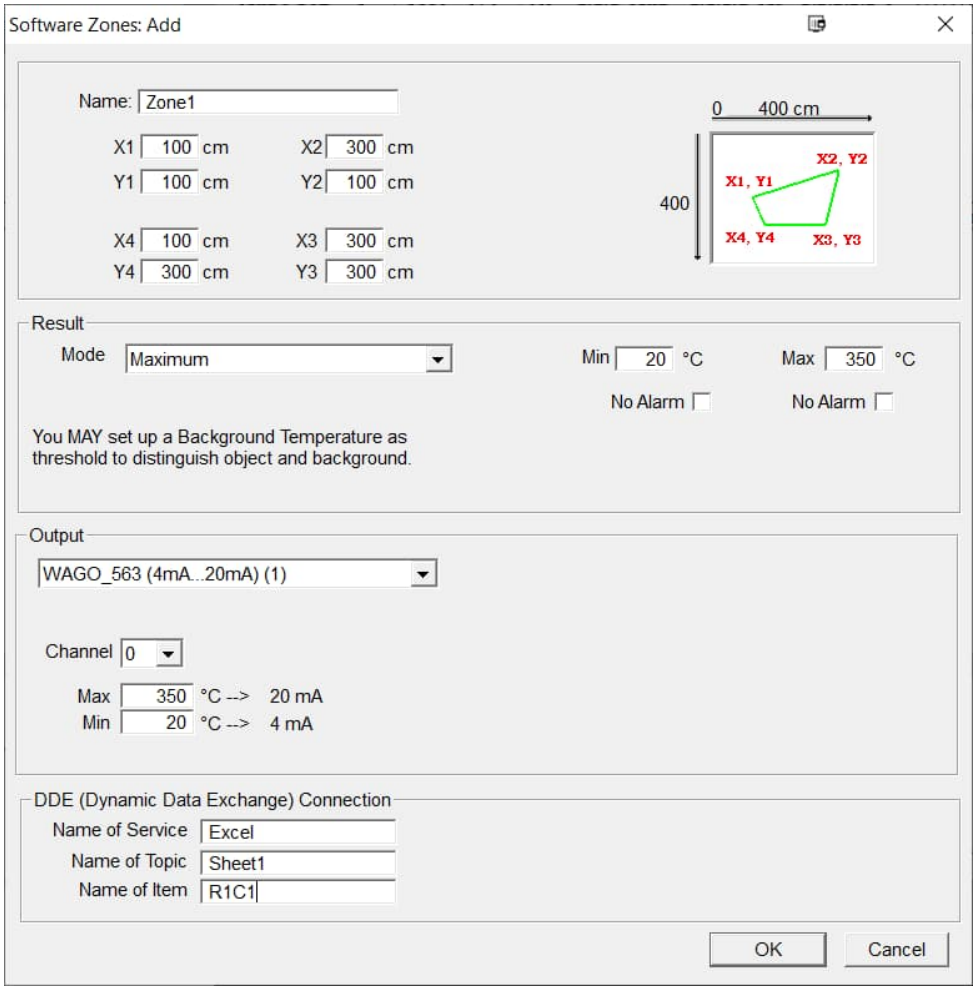
Sector/zones are defined with their name, their size and position, and their result based on available math functions (maximum, minimum, … etc.). For the result, one can define a lower and an upper threshold. An alarm is triggered when the threshold is exceeded or violated. Additionally, the result can be output as a hardware signal from an optional output module.

**Figure 4-23: Exemplary Zone Table**



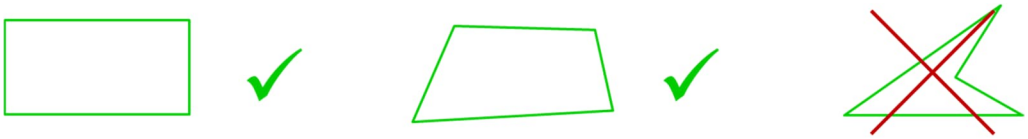

The table above indicates zones (sectors alternatively) defined for a particular configuration. For actual production operations, a meaningful name should be selected for each desired sector/zone. It is possible to add additional items and change or edit existing items. Alternatively, the <Change> button allows one to “double click” on the requested item name for changing it. For copying and deleting items, one can select multiple zones. Names of items “pasted” into the table are incremented numerically with a running number. The following shows the exemplary dialog for changing zone parameters.

**Figure 4-24: Setting of Zones**




**<Name>** Input desired item name without any spaces.

**<X, Y>** There are coordinate pairs that define the size and position of each sector/zone relative to object dimensions defined in section 4.3.4 Image Dimensions, page 29.
A sector is a 1-dimensional portion of the scanned line, defined via two edges.
A zone is 2-dimensional portion of a snapshot. A zone is always defined via 4 edges building a right-angled or a convex rectangle, a concave rectangle is not allowed.



right-angled rectangle | convex rectangle | concave rectangle

**<Result>** calculation modes for the item result, the following modes are available:

| | |
|---|---|
| Maximum: | result is the pixel with the highest temperature.<br>The mode can be used to detect hot spots. |
| Average: | result is the temperature average of all pixels.<br>The mode can be used to control process devices like coolers and heaters. |
| Minimum: | result is the pixel with the lowest temperature.<br>The mode can be used to detect temperature holes. |

Median: result is the median, a kind of middle value separating the higher half from the lower half of the temperature values within a sector / zone. For example, in the temperature set {10, 30, 30, 60, 70, 80, 1000}, the median is 60, the fourth largest and the fourth smallest number in the sample. The advantage of the median compared to the average is that it is not skewed so much by a small proportion of extremely large or small temperature values, and so it may give a better idea of a typical value. Thus, the temperature value 1000 in the example above does not matter for the median result.

Most occurring value: In a first step, this function divides the entire range of occurring temperature values within the sector/zone into a serios of intervals of 1 K width. Subsequently, the function counts how many temperature values fall into each temperature interval. The result is the temperature of the interval with most temperature values.

Maximum-Average: result is the difference between maximum and temperature average.

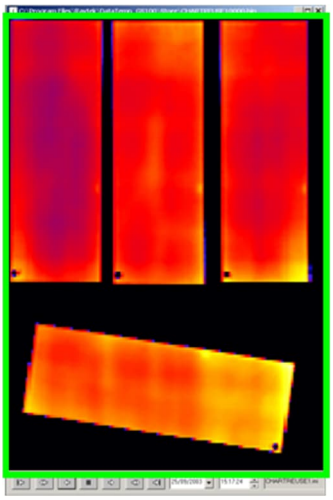
Average-Minimum: result is the difference between temperature average and minimum.

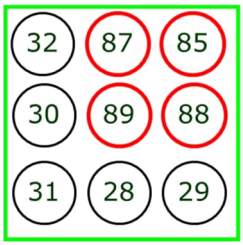
Maximum-Minimum: result is the difference between maximum and minimum.

Greater Value: (Max-Avg) or (Avg-Min):
In this mode the „Average-Minimum“ and the „Maximum-Average“ is calculated. The result is the greater value of both.

Standard Deviation: the result is the standard deviation over all pixels within a sector/zone. The standard variation shows how much variation exists from the average. A possible connected digital output modules alternates permanently the level from 0 to 1 or vice versa.

Covered Area [%]: The result is a percentage of all pixels which are warmer than the background temperature. By means of that function the capacity of heating ovens can be monitored. The following example demonstrates the calculation for an area covered with glass whereby one zone overlays a snapshot completely (left). The exemplary calculation is to be seen on the right for a zone containing 3 by 3 pixel. The temperature for 4 pixels is above the set background temperature of let’s say 80°C. Those 4 pixels are now related to the total amount of 9 pixel which corresponds to a covered are of 45% as the zone result.






Covered Area [cm²]: The result is the area of all pixels which are warmer than the background temperature. The principle calculation follows the description of Covered Area [%], see above.

Gradient: result is the maximum gradient (rising or falling) whereby gradient represents the steepness of a temperature curve.

Positive Gradient: result is the maximum rising gradient (rising: in direction from left to right).

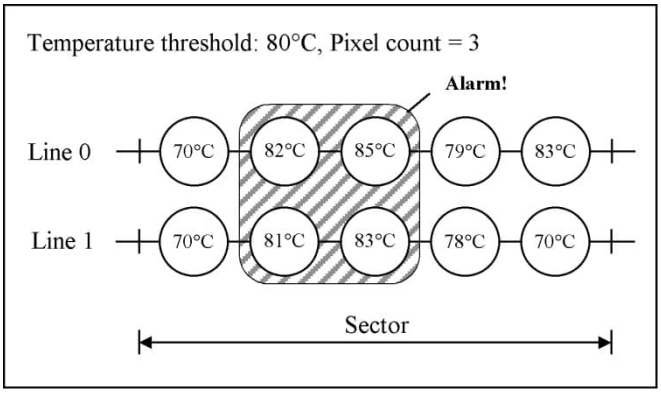
Negative Gradient: result is the maximum falling gradient (falling: in direction from left to right).

Max of minimum Area: (mode for sectors only)
Sector result is the temperature of the pixel with the highest temperature within the minimum area. Two thresholds are given to check this result:

- an upper temperature threshold
- a count of adjacent pixels (in the line and the previous lines!) which must have a temperature greater than the upper temperature threshold. These adjacent pixels form the minimum area.

An alarm is generated if more than the given count of pixels has a temperature greater than the upper temperature threshold, see the following example:

**Figure 4-25: Alarm Generated by the "Max of minimum Area" Function**




Min of minimum Area: (mode for sectors only)
Sector result is the temperature of the pixel with the lowest temperature within the minimum area. The principal functionality is identical to the Max of minimum Area mode, see above.

Snapshot Counter: (mode for zones only)
result is increased by one with each new captured snapshot.

Cold Bubble: (mode for zones only)
result is the size of the detected cold bubble. Each bubble detected generates an alarm.

Warm Bubble: (mode for zones only)
result is the size of the detected warm bubble. Each bubble detected generates an alarm.

Displacement to the Reference: (mode for zones only)
result is the shift between the current snapshot and the snapshot reference. Location and size of the zone are irrelevant for this function.

Crack Detection: (mode for GS/GSLE systems only)
the result is the number of pixels belonging to a detected crack.

**<Min, Max>** Defining of thresholds for the result.

**<No Alarm>** Sector/zone results are displayed on the screen, but the alarm generating is switched off.

**<Output>** Defining of a module output for the result. Analog modules output the result as a current or a voltage in a certain range. For the current output the current can be scaled to user defined temperature

thresholds. Digital modules set an output in case of an alarm caused of a threshold violation. Modules can be configured under the <Input/Output> page, see section 4.7 Input/Output , page 47.

**<DDE Connection>** The DDE connection provides a continuous transfer of sector/zone results to another target application. In the target application, further analyses can be realized. For the data transfer a text format is applied, a dot is always used for the marking the fractional portion.

*Note*

*For establishing a DDE connection, the target application must be started before the scanner software!*

<Service> Name of the target application, which is able to communicate via a DDE connection. Normally, Service is the name of an executable application file (without the extension .exe) based on Microsoft Windows.

<Topic> Specific parameter according to the target application.

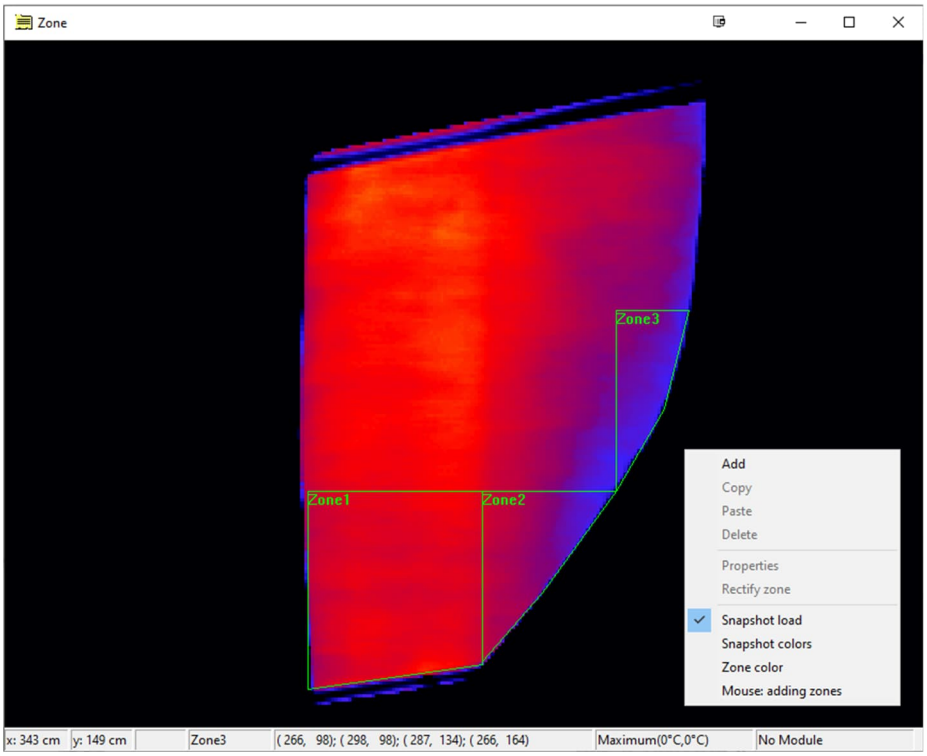
<Item> Specific parameter according to the target application.

The actual use of the parameters <Service>, <Topic>, and <Item> is described in the documentation material of the target application. Some examples are to be found in section 11 DDE, page 108.

**Graphical Editor (for zones only)**

It is also possible to edit zones by using a graphical editor. For that click on the <Graphic> button on the zone table page and the following window appears.

**Figure 4-26: Graphical Editor for Editing of Zones**




The window consists of an area for displaying the zones. The basic operations for the zones (moving, stretching, deleting and so on) are supported by using the mouse or the cursor keys. Zone operations are only valid for marked zones. A multi-selection of zones is possible.

The graphical editor also contains a status line, where all parameters of a zone are displayed accordingly to the actual mouse position. Furthermore, a context menu is provided which is accessible by clicking the right mouse button. Depending on the number of selected zones, the following menus are available:

| | |
|---|---|
| <Add> | Adds a new zone by using a dialog. |
| <Copy> | Copies all selected zones. |
| <Paste> | Pastes all previous copied zones. |
| <Delete> | Deletes all selected zones. |
| <Properties> | Opens the dialog for changing zone parameters such as alarm thresholds, output modules and so on. |
| <Rectify zone> | Sets a zone back to a rectangular shape. |
| <Snapshot load> | Opens a dialog for selecting a snapshot, previously stored in the scanner software. For a better alignment of zones, the snapshot is put into the background of the graphical editor. Accordingly, to the actual mouse position, the snapshot temperature is displayed in the status line. |
| <Snapshot color> | Opens a dialog for selecting the colors of a snapshot. |
| <Zone color> | Opens a dialog for selecting the color of a zone. |
| <Mouse> | The mouse can be used in two different modes: for adding zones and as marking tool for the simultaneous catching of several zones. |

### 4.6.2 Scanner Sector/Zone Button

Defining scanner sectors/zones makes it possible to monitor specified areas. In contrast to software sectors/zones, scanner sector/zones are evaluated on the linescanner itself independly from a PC. Thus the scanner is also able to directly control output modules to output sector/zone results.

The number of scanner sectors/zones is limited to 10. The names are automatically numbered. Sector/zone 0 always covers the full field of view of the scanner.

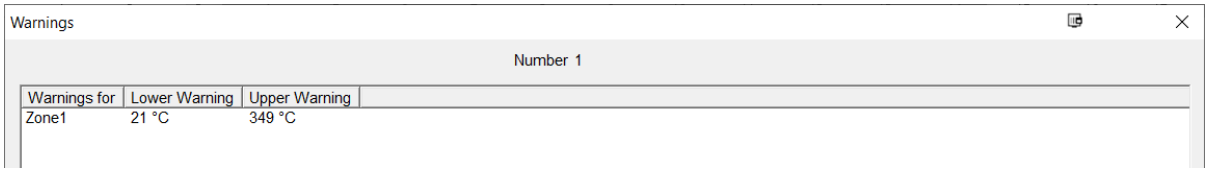
The main settings for a scanner sector/zone are similar to the settings for a software sector/zone, see section 4.6.1 Software Sector/Zone Button, page 36.

In contrast to software controlled sectors/zones, monitoring of the internal temperature of the scanner can be configured for the scanner controlled sectors/zones.

### 4.6.3 Warnings Button

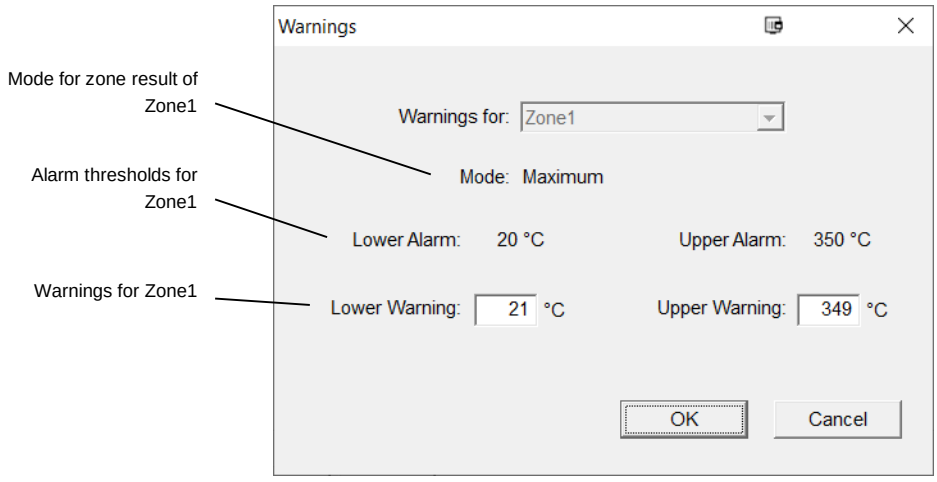
Based on sectors/zones already defined, it is possible to create warning thresholds for the result of a particular sector/zone (in addition to the alarm thresholds of the sector/zone). A warning causes a warning message on the screen before a the actual sector/zone alarm is triggered. Warnings are defined with their name, a lower warning, and an upper warning.

**Figure 4-27: Warning Table**




The following shows the dialog for changing parameters for warnings. The warnings must be within the range of the alarm thresholds.

**Figure 4-28: Configuring a Warning Exemplary Shown for a Zone**




### 4.6.4 Relations Button

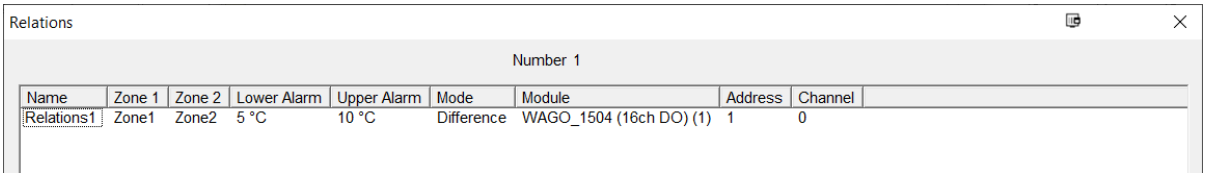
Based on sectors/zones already defined, it is possible to create “relations” between them. The result of the first sector/zone can be compared with the result of the second sector/zone, whereby a relation is the difference between these two results.

Relations can be also defined between a zone in the taken snapshot and the zone in the reference at the same position.

Every relation is managed like a common sector/zone:

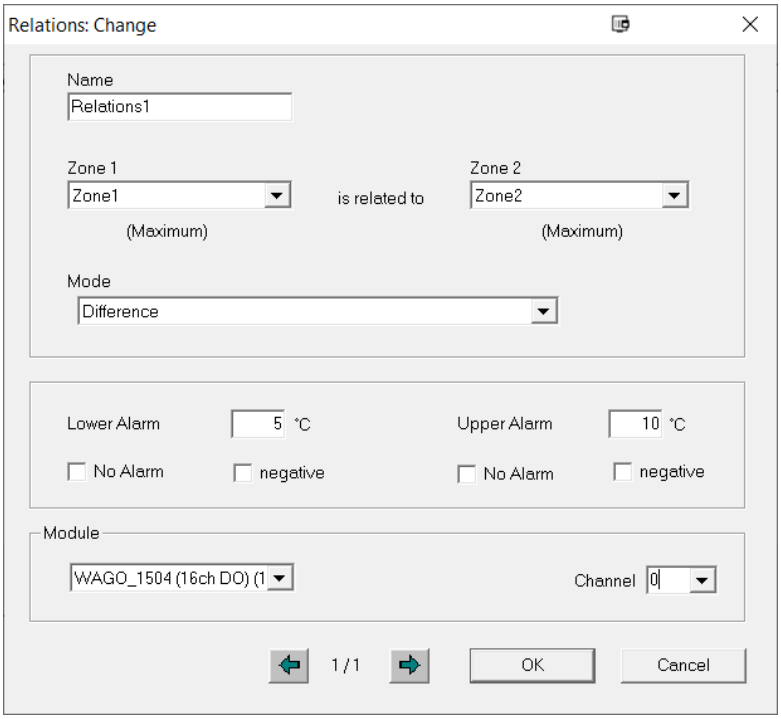
- it has a name,
- it contains the names of the two sectors/zones to be compared,
- it can be observed with alarm thresholds,
- it will be displayed on the screen like a sector/zone result,
- it can drive a channel of an output module.

**Figure 4-29: Relations Table Exemplary Shown for Two Zones**




The following shows the dialog for changing parameters for relations. In the given example, the name of the relation is “Relation1”. The result of that relation is the difference between the zone result of “Zone1” (Maximum) and the zone result of “Zone2” (Maximum). An alarm is generated if the difference is less than 5°C (Lower Alarm) or greater than 10°C (Upper Alarm). If you want to suppress an alarm, the check box “No Alarm” can be enabled. In that case, the relation is only displayed on the screen. In the given example, the result of the relation is output as hardware signal at channel 0 of the digital output module.

**Figure 4-30: Specifying Relations Exemplary Shown for Two Zones**



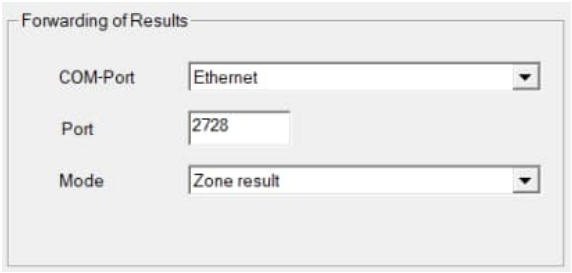

### 4.6.5 Forwarding of Results (Ethernet)

With that option, temperature data can be output via the Ethernet socket of the PC.

**<Port>** defines the Ethernet socket number. Make sure that a possible firewall does not block the set TCP port!

**<Mode>** defines the output format for the temperature data. Additionally, to the format <Sector result> you can select the format <Lines> which provides the unprocessed temperature line containing the raw data.

**Figure 4-31: Forwarding of Results via Ethernet**




The data transmission to forward the temperature data via a socket connection is structured in two parts: Head and body. The head is sent once after connection and is followed by a continuous flow of temperature data.

**Format of the Head**

The head starts with <head> and ends with <\head>. Parameters are given in between these markers. Up to now the following parameters are defined:

```
TemperatureRange: <Tmin> <Tmax> °C
PixelPerLine: <pixelPerLine>
```

Example:

```
<head>
TemperatureRange: 20 350 °C
PixelPerLine: 652
</head>
```

**Format of the Body**

The scanned lines are built up of pixels; its count of pixels per line is given in the head.

The pixel data contains temperatures which are built up of two bytes (the most significant byte first). They give the temperature scaled to 16 bit:

$T = DataWord * (T_{max} - T_{min}) / FFFF_{hex} + T_{min}$

$T_{min}$ is given in the head with: <$T_{min}$>

$T_{max}$ is given in the head with: <$T_{max}$>

The DataWord $FFFF_{hex}$ is reserved as a key word and in conjunction with $0001_{hex}$ it defines the start of a line.

Structure of line:

$FFFF_{hex}$ $0001_{hex}$ <$data_1$><$data_2$>...<$data_{PixelPerLine}$>

### 4.6.6 Forwarding of Results (Serial COM Port)

Alternatively, to Ethernet it is possible to send the information from the sector/zone calculation as ASCII text characters via a serial port to another device. This makes it easy to get the temperature information to a PLC for controlling heaters or any other system to post-process the data.

**Output format exemplary for the <Sector result> protocol:**

```
STX
Scanner tab <Nummer> \n
<name of first sector> tab <result of first sector> \n
...
<name of last sector> tab <result of last sector> \n
checksum tab <value of checksum (hexadecimal)> \n
ETX
```

In multi scanner systems the results can be forwarded to a separate COM-port or a common used COM-port. Every sector/zone list is marked with preceding specific scanner number. The <name of sector> is the name for the sector (or zone) given by the user. If sector/zone name is longer than 8 characters, it will be truncated to 8 characters. The checksum is the sum of all characters but the ETX.

The output rate could be decreased by limiting the forwarding of the results to a certain number of lines.

Example:

| | |
|---|---|
| Forwarding results every: | 100 lines |
| Scan frequency: | 20 Hz |
| Forwarding results every: | 5 s (interrupted in case of a possible alarm) |

### 4.6.7 Background Group

**<Ignore Background Temperature>** Checking this box allows the measured object's temperature to be distinguished from that of the background. The user can determine a temperature threshold. A value outside of this temperature threshold (above or below) is considered background. Warm or cold backgrounds are definable.

If a sector/zone contains temperature values of the background, these values are ignored for the calculation of the result (on PC only). If all temperature values of a sector/zone are pixels of the background, then the sector/zone is marked on the screen with the character „X".

**<Alarm hold time>** Determines the minimal alarm hold time for continues applications addressed by the EC and ES system. For discontinues applications addressed by the TF and GS/GSLE system this configuration parameter defines the maximal alarm hold.

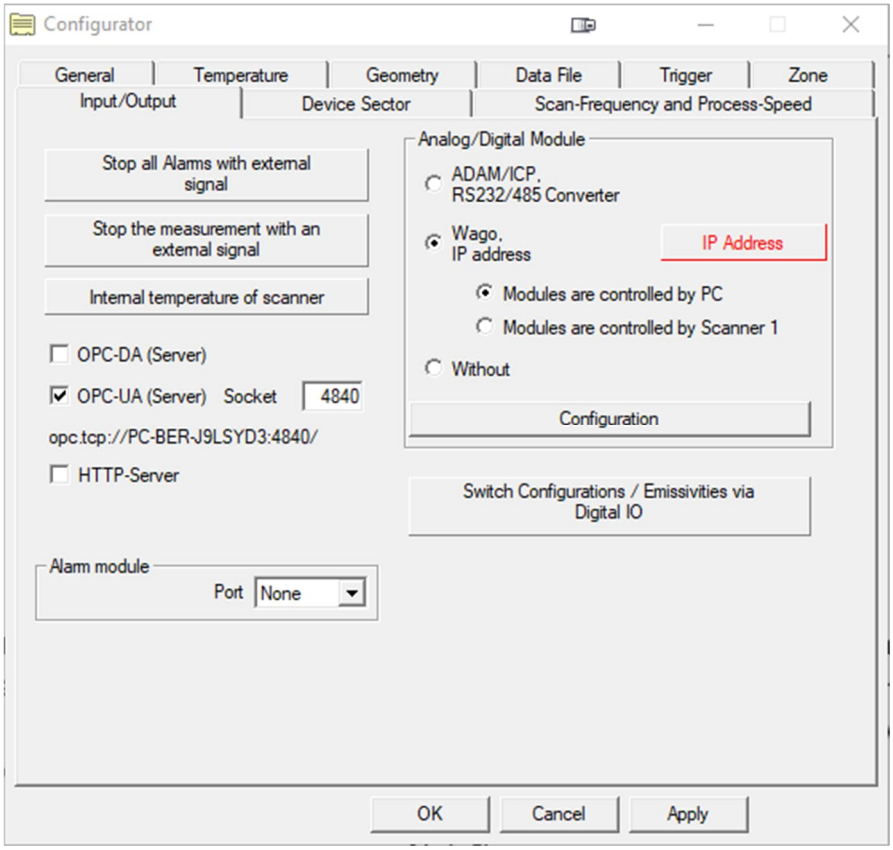
**<Alarm delay over snapshots>** Delays the triggering of an alarm to a specified number of snapshots. This is useful to tolerate measurement objects to be out of order when the machine runs in. The option is only available for TF and GS/GSLE systems.

**<Always show the zone/sector name>** Enable this check box to display the zone/sector name always (instead of zone/sector results).

**<Deactivate alarm message box>** Enabling this check box, the system ability to generate alarms is furthermore active, but the display of alarm message windows in the scanner software is suppressed.

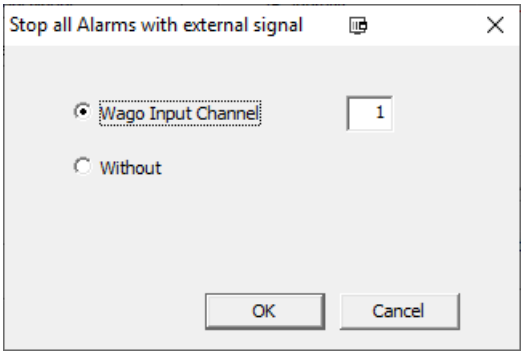
## 4.7 Input/Output

**Figure 4-32: Input/Output Page**




**<Stop all Alarms with external signal>** Click that button and the following dialog appears allowing you to assign a digital input channel of a Wago module to stop all alarms.

**Figure 4-33: Stopping all Alarms via a Digital Input Channel**



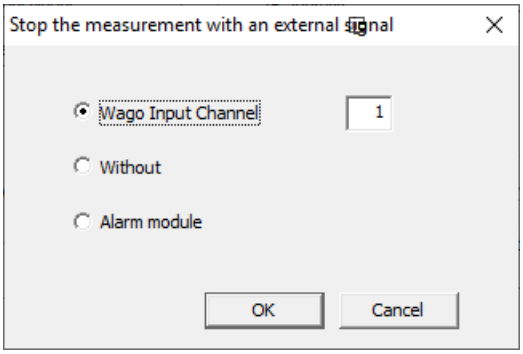

**<Stop the measurement with an external signal>** Determines an external trigger as a measurement gate via a digital input channel of a Wago module or the Alarm Module. If the input is detected as low, data

acquisition proceeds. If not, data acquisition stops. This is helpful for machine down-time/maintenance to prevent alarms or to shut down the program.

*Note*

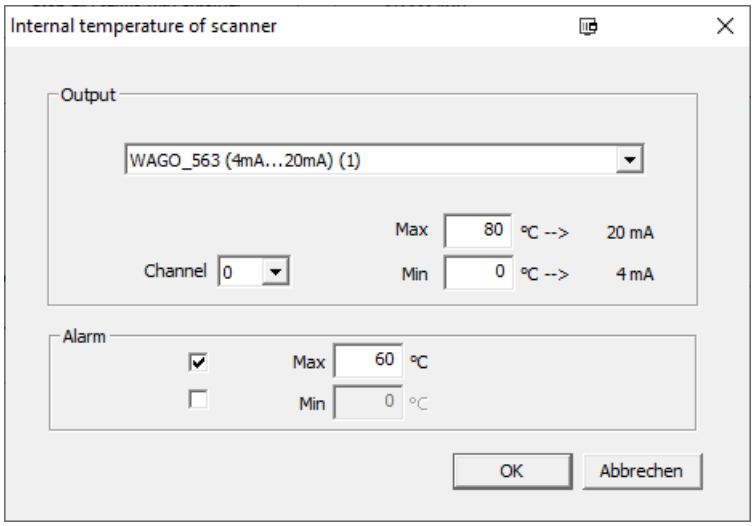
*The external trigger of the gating (the whole measurement) is not identically to the external trigger of the scanner starting/stopping a single snapshot!*

**Figure 4-34: Stopping the Measurement with an External Signal**




**<Internal temperature of scanner>** Click that button and the following dialog appears allowing you to configure a digital or analog output for the scanner internal temperature.

**Figure 4-35: Outputting the Scanner Internal Temperature**




**<OPC-DA (Server)> <OPC-UA (Server)>** By labeling one of these checkboxes, the scanner software runs as OPC server for one or more OPC clients within a network in accordance to the specification OPC Data Access or OPC Unified Architecture. For interfacing to other control systems this option allows the remote monitoring of the process and the remote configuring of the scanning system. It is recommended to use OPC UA as the more modern interface.

Further information for the OPC technology, available OPC items and the configuration of OPC connections you can find in see section 10 OPC, page 102.

**<http-Server>** By activating the check box, the scanner software runs as a server for one or more client computers based on a http-protocol within an Intranet. The intranet address built from the server‘s computer name and the socket number is to use as address information for the client’s explorer.

This option allows the remote monitoring of the process on other networked PC's.

A Java capable internet browser must be installed on the client computer. Additionally, the Java-Runtime-Environment it its latest version must be available on the client computer.

*Note*

*The use of MS Internet Explorer is recommended. Newer browsers like MS Edge, Mozilla Firefox, or Google Chrome do not work.*

*Note*

*In the Java Control Panel under <Security>, add the http address of the client computer as an exception site.*

In case of running more than one http-server on the computer, the standard socket number of 8080 must be changed. In multiple scanner systems a separate socket number must be used for each individual scanner.
The client's explorer shows only temperature data. Sector/zone and alarm information are not displayed.
A remote configuration of the system from the client's computer is not possible.

*Note*

*In case of any connection problems try to switch off the possible existing fire wall temporally!*

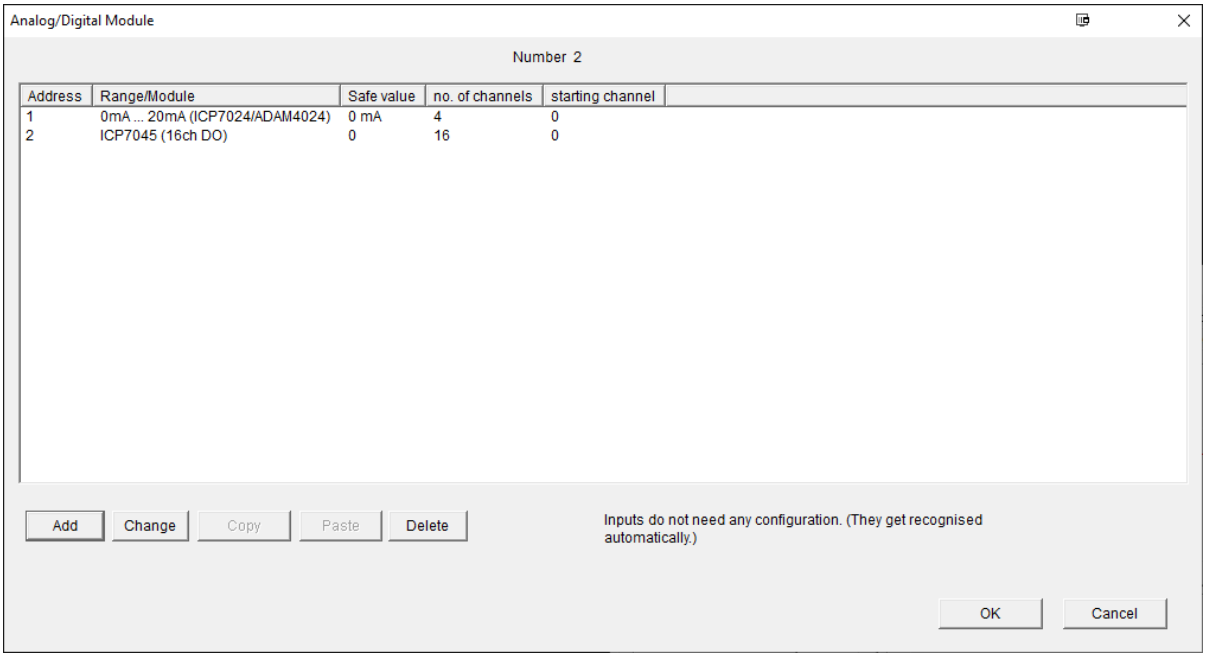
**<Alarm module>** If the scanner communicates via Ethernet, you can select a COM port for the Alarm Module. The Alarm Module allows the output of one digital alarm signal and the input of an trigger signal to stop the measurement. The alarm module is supported in the software only for backward compatibility with older installations.

### 4.7.1 Analog/Digital Module ADAM/ICP

**<RS232/485 Converter>** Determines the serial port for the RS232/485 converter of the analog/digital modules from the ADAM/ICP series.

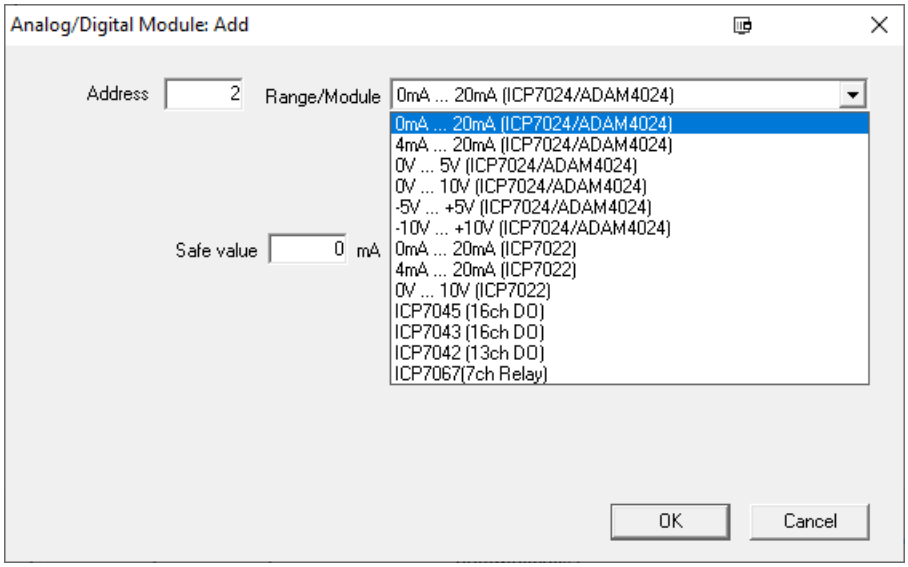
Clicking the <Configuration> button the following dialog appears:

**Figure 4-36: Analog/Digital Modules Table**



Clicking the <Add>/<Change> button the following dialog for setting the modules appears:

**Figure 4-37: Setting of Analog/Digital Modules**




**<Address>** Defines the address of the analog or digital output module. The address is programmed in the module. See the linescanner manual for the address programming.

**<Range/Module>** Selects the desired modules. Defines the output range for an analog module. Current and voltage ranges are available. The technical data of all supported analog and digital modules are to be found in the linescanner manual.

**<Safe value>** To increase the system reliability, the analog and digital output modules monitor the status of the system with the following possible problems:

- Crash of the PC
- Disconnected networks
- Communication error to the scanner (time between two snapshots longer than 60 min.)

In the error case all output modules will default to their predefined safe value. This function is realized by a watchdog timer, which is built in to every output module. These watchdogs are initialised by launching the program and must be updated (by the program) at least every 25 seconds. After 25 seconds without update, they will go to their safe state. The safe value can be evaluated by the following network to send an error message to a central processing unit.

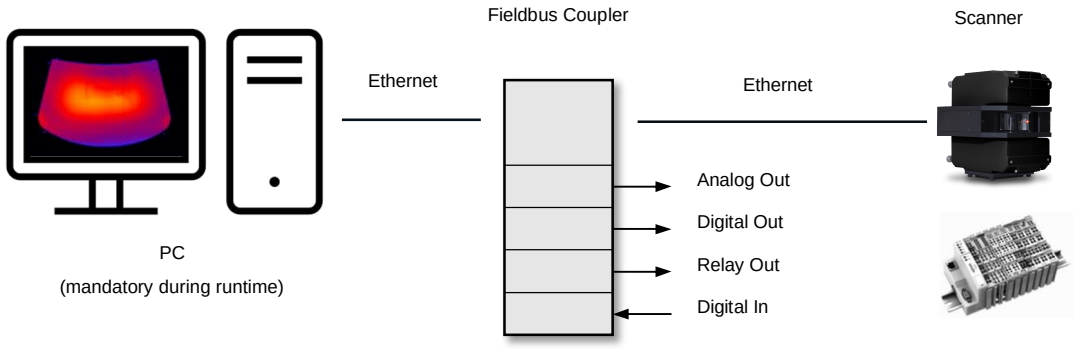
### 4.7.2 Analog/Digital Module WAGO

*Note*
*The software supports maximal 64 analog outputs and 64 digital outputs.*
*Although the software supports multiple linescanners but in a network only one bus coupler for controlling the WAGO modules is allowed!*

The following modes are available for selection for the WAGO modules:

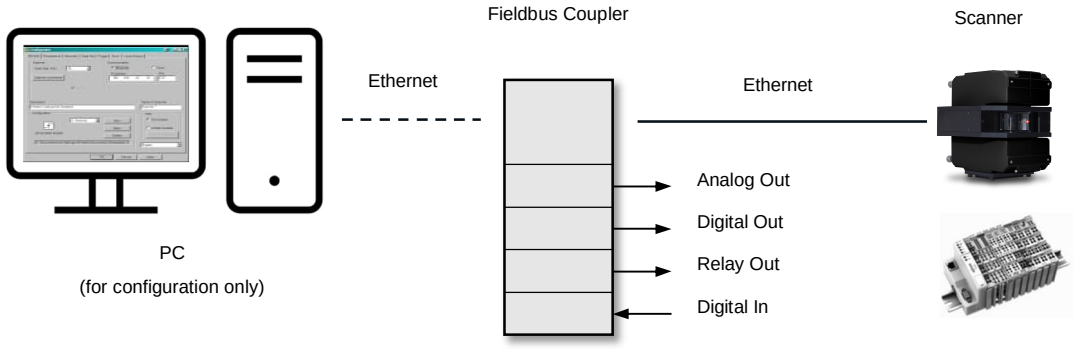
**<Module werden vom PC gesteuert>** In this mode, the modules are controlled via the scanner software. At runtime, the modules must therefore be permanently connected to the Windows PC. In this mode, the number of available sectors/zones is not restricted. However, Windows is not a real-time operating system, which means that the switching behavior of the modules is not determined by time.

**Figure 4-38: Modules Controlled by PC**



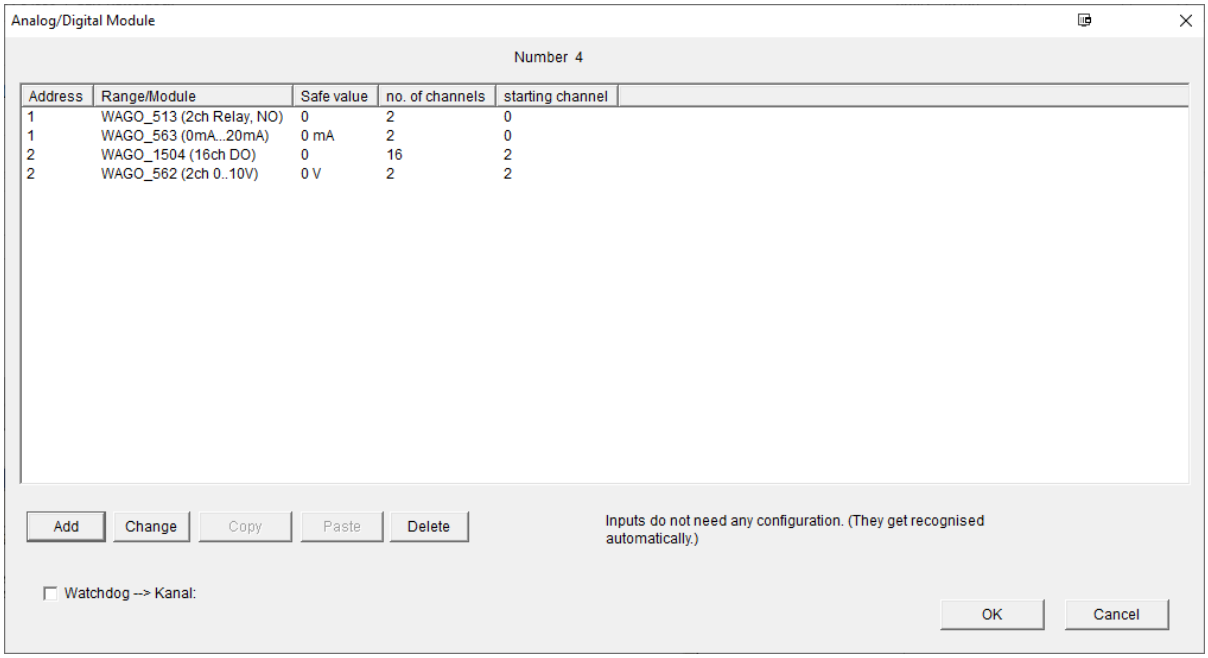

**<Modules are controlled by the scanner n>** In this mode, the modules are configured via the PC but controlled directly via the scanner. Therefore, the modules must be connected to the scanner but not to the Windows PC at runtime. In this mode, the number of available sectors/zones is limited to 10. The direct control by the scanner guarantees a timed switching behavior of the modules.

**Figure 4-39: Modules Controlled by the Scanner**



**<Configuration>** Clicking on that button and the following dialog appears:

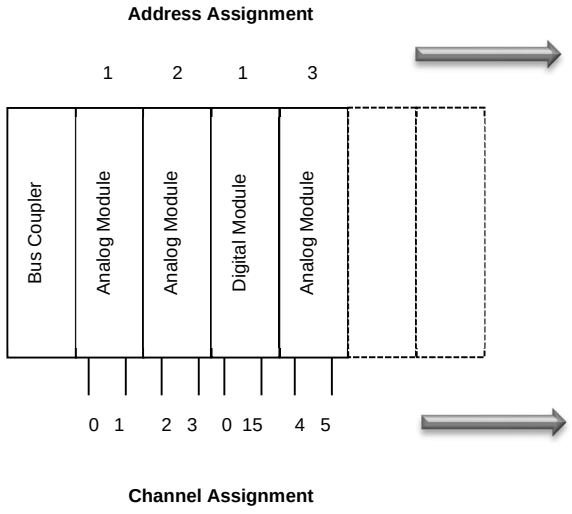
**Figure 4-40: Analog/Digital Modules in a Table**




The addressing of the input/output modules follows specific rules to be considered:

- The addresses for the modules are assigned ascendingly from left to right for the installed modules (whereby left is the position for the bus coupler).
- There are two groups of modules: analog modules and digital modules. Both groups follow their own separated addressing system. A group starts always with address 1. Each module next to the right gets an address incremented by 1.
- The channels for the modules are counted within each group over all modules. For example, the module with address 1 starts with the channels 0 and 1, the next module at address 2 continues with the output channels 2 and 3.

**Figure 4-41: Exemplary Address/Channel Assignment for Modules**



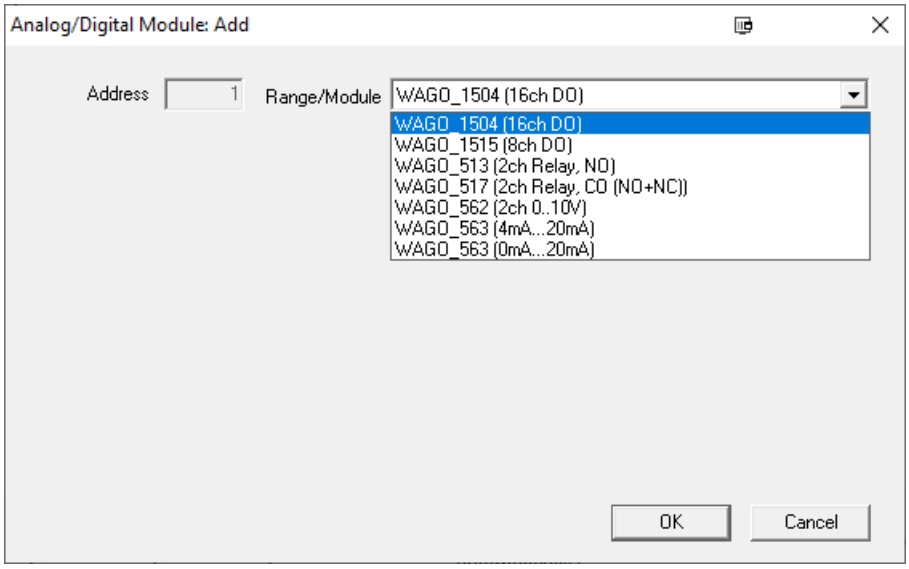
**<Watchdog>** To increase the system reliability, the analog and digital output modules monitor the status of the system by a watchdog timer. The watchdog is initialised by launching the scanner software and must be updated (by the software) at least every 25 seconds. During normal operation, the specified watchdog channel is set permanentely to high. The channel number is to be considered over all digital output modules. After 25 seconds without update, a computer malfunction is detected and all analog/digital output modules will default to zero.

The following possible problems are recognized:

- Crash of the PC
- Disconnected networks
- Communication error to the scanner

Clicking the <Add>/<Change> button the following dialog for setting the modules appears:

**Figure 4-42: Setting of Analog/Digital Modules**



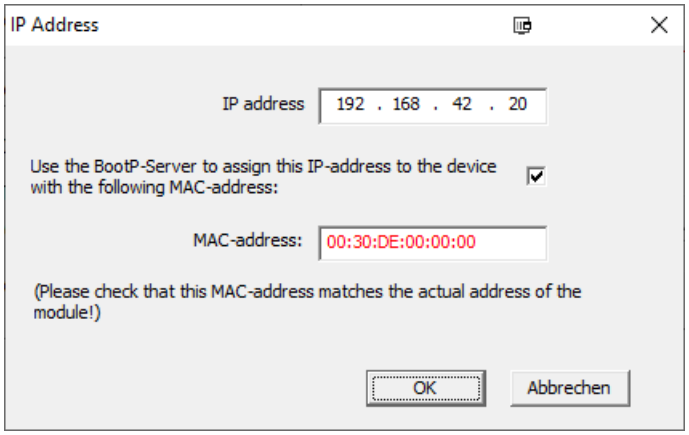

**<Range/Module>** Defines the output range for an analog module. Current and voltage ranges are available. The technical data of all supported analog and digital modules are to be found in the linescanner manual.

**<Address>** The address for a module is assigned by the software automatically following specific rules. See the linescanner manual for further information.

#### 4.7.2.1 BootP Server

**<IP Address>** Manages the IP address setting for the fieldbus coupler necessary for the WAGO modules.

**Figure 4-43: IP Addressing for the Fieldbus Coupler**




<IP address> specifies the IP network address for the fieldbus coupler. The fieldbus coupler is used to manage the WAGO modules. Please note, the WAGO modules itself do not have individual IP addresses.
If <BootP server> is not highlighted then <IP address> tells the software to use this IP address to find the fieldbus coupler.
If <BootP server> is highlighted then <IP address> forces the software to assign this IP address to the field bus coupler.

<BootP server> capability is used by the software to assign the desired IP address to the field bus coupler by using the correct <MAC address>. The <MAC address> must be noted from the side of the WAGO module.

*Note*

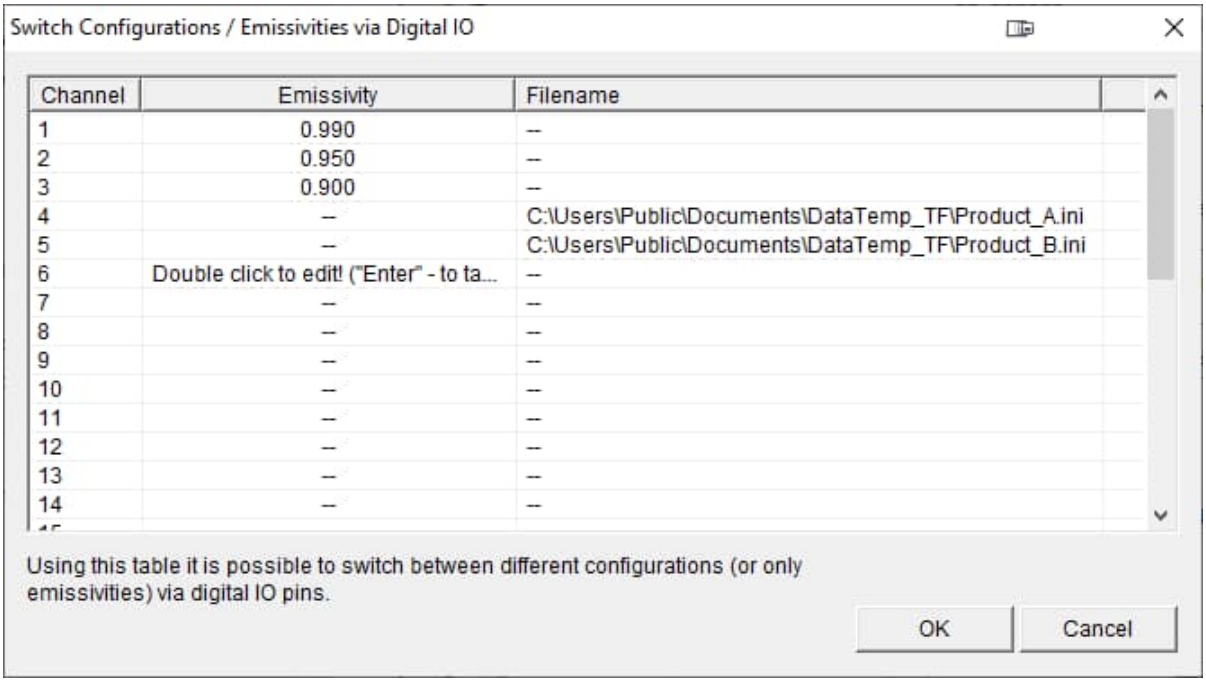
*The WAGO fieldbus coupler will not respond to a ping command until the software is started one time!*

*Note*

*For more detailed information on the WAGO modules, see the comprehensive “I/O Module System” handbook!*

**<Switch Configurations / Emissivities via Digital IO>** Click that button and the following dialog appears allowing you to assign digital input channels of a Wago module to switch between configurations or emissivity values.

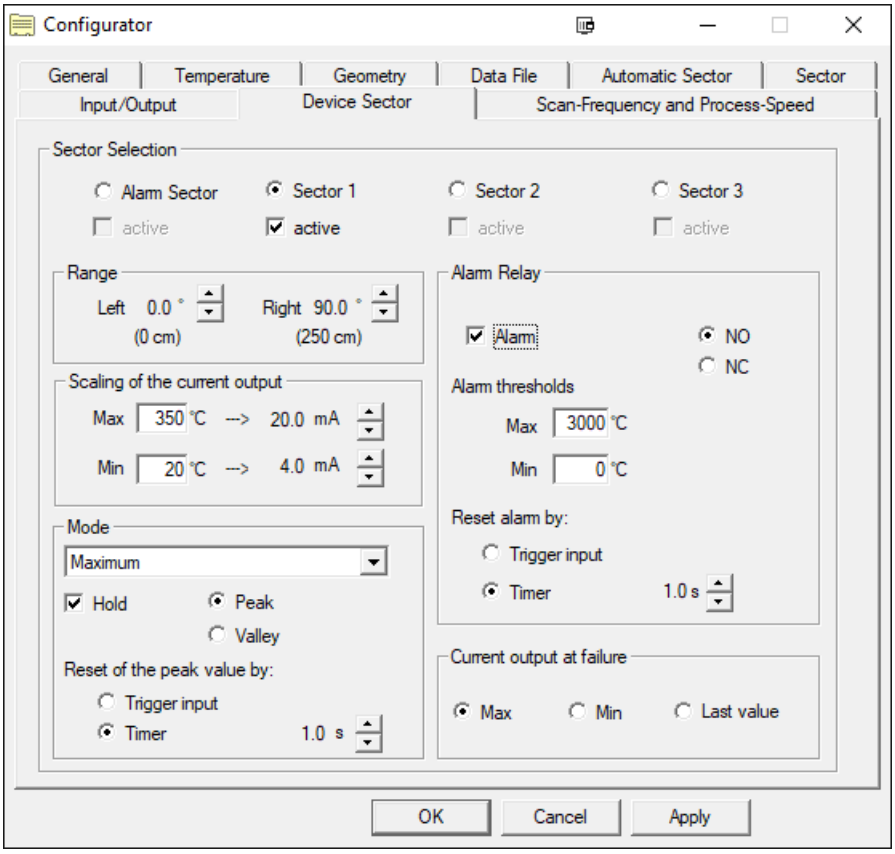
**Figure 4-44: Digital Switching of Configurations or Emissivities**



## 4.8 Device Sector Page

*Note*
*Device sectors are not available if Wago modules have been defined that are controlled directly by the scanner!*

**Figure 4-45: Device Sector Page**




The <Device Sector> dialog allows the direct setting of the scanner internal sectors. For each of the three sectors, the type of output (maximum, minimum, or mean value) can be selected. The output range is selectable for either 0 ... 20 mA, 4 ... 20 mA, or custom configured by user settings.

An additional alarm sector can be used to monitor the internal temperature of the scanner. This sector is assigned to the alarm relay only and does not provide a current output.

**<Alarm Sector> <Sector 1> <Sector 2> <Sector 3>** Displays the settings of the selected sector.

**<active>** Sets the corresponding sector to an active one.

**<Range>** Each sector's size can be adjusted by defining the left and the right edge for the sector's field of view. Sectors can overlap.

**<Scaling>** For each sector you can change the minimum and maximum temperature to be scaled to the minimum and maximum milliamp current output.

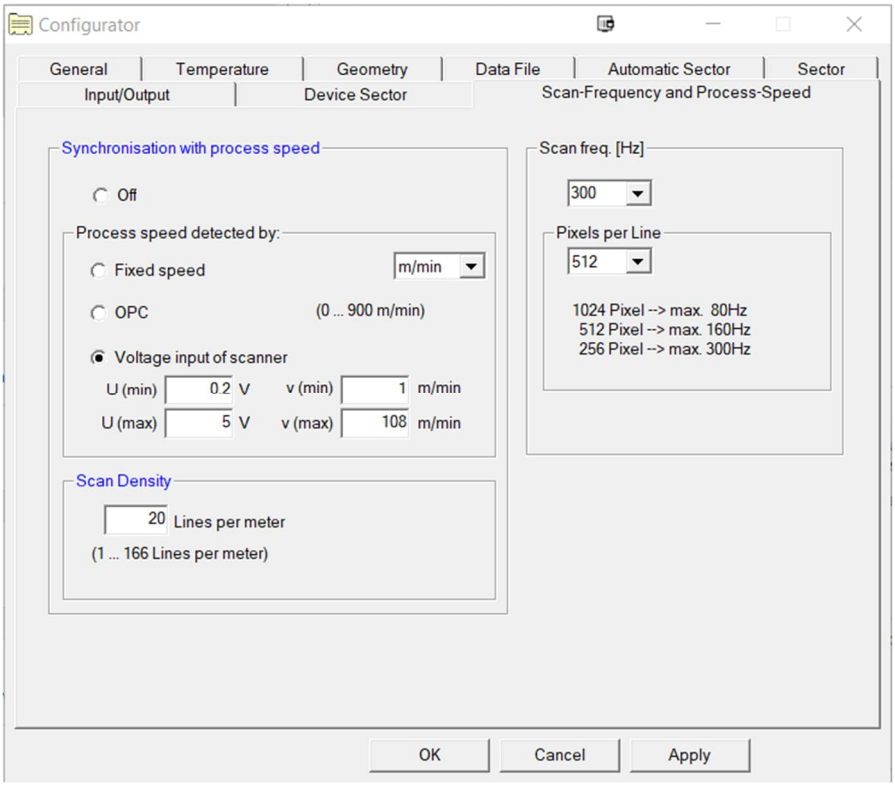
**<Mode>** You can set the sector mode for calculating the sector result to <Maximum>, <Minimum>, <Average> or <Internal temperature of scanner>. The sector result is calculated with each new scanned temperature line. By activating the <Hold> check box, the sector result can be held over more than one temperature line following the <Peak> (maximum over temperature lines) or <Valley> function (minimum over temperature lines). The hold reset can be done either by an external trigger (at the linescanner) or by a timer (hold time).

**<Alarm Relay>** The alarm relay contacts can be set either for NO (normally open) or NC (normally closed). Each sector can be adjusted for minimum and maximum temperature thresholds. Violating these thresholds with the sector result generates an alarm at the scanner internal alarm relay. You can designate a reset performed by an external trigger (at the linescanner) or by a user-defined timer (hold time).

**<Current output at failure>** In case of an scanner internal failure the current output can be set either to <Max>, <Min>, or <Last value>.

## 4.9 Scan-Frequency and Process-Speed

**Figure 4-46: Scan-Frequency and Process-Speed Page**




**<Synchronization with process speed>** Activating this function causes switching from a scanner-oriented view, according to which the lines are scanned per second, to a process-oriented view, according to which the scanning is set in "lines per meter". This gives correct length information in meters for the process direction; snapshots get the correct length. It is possible to work with variable snapshot length. <Scan Density> sets the desired number of lines per meter. The lines that the scanner delivers more are averaged with the positive side effect of noise reduction.

The process speed can be changed at runtime, even within snapshots. The change must then, of course, be communicated synchronously to the program.The actual process speed is fed via <Fixed speed>, a corresponding OPC item (see section 10.5 OPC Items, page 105) or via the voltage input at the scanner (see 6-pin connector at the scanner rear side).

**<Snapshot>** Defines the snapshot dimension in production flow direction.

**<Scan freq. (Hz)>** The scan frequency determines the number of temperature lines per second captured by the scanner. Alternatively, the frequency can be entered manually in 1 Hz steps. The maximum number of pixels per line depends on the selected scan frequency.

# 5 System Operation

## 5.1 Software Start

The scanner software is started by means of the <Start> menu or by double-clicking on the desktop symbol icon .

## 5.2 Continuous Mode

*Note*
*The continuous mode is applicable primary for EC and ES systems!*

For monitoring of continuous processes, the scanner has to record temperature lines permanently. The recording is performed according to the scanner's scan frequency. All recorded temperature lines are transferred to the PC immediately via the serial or the Ethernet interface. These lines can be viewed assembled to a scrolling temperature image or as profile line by line.

Sectors can be used to split the continuous process in several areas. All pixels within a sector contribute to a single calculated value (the sector "result"), which can be output to a channel of an (optional) Output Module.

Different "Views" are implemented to extract and display the temperature lines of interest:

- Display as a colored thermographic image (temperature variation over all lines)
- Display as a horizontal diagram (temperature variation over one line)

## 5.3 Discontinuous Mode

*Note*
*The continuous mode is applicable primary for TF and GS/GSLE systems!*

A trigger (start signal) orders the system to record a given number of temperature lines according to its scan frequency. A snapshot is the totality of these stored temperature lines.

Zones can be used to split the snapshot in several areas. All pixels within a zone contribute to a single calculated value (the zone "result"), which can be output to a channel of an (optional) output module.

Different views are implemented to extract and display the temperature lines of interest:

- Display as a colored thermal image (temperature variation over all lines and columns of a snapshot)
- Display as a horizontal diagram (temperature variation over one line)
- Display as a vertical diagram (temperature variation over one column)

These views are described in the following sections.

## 5.4 Main Screen

After the successful starting the program, the main screen appears. The availability of menu entries depends on the running mode (continuous or discontinuous). The contents of the main screen depend on the number and the position of opened windows during the last program exit.

The number of the visible windows can be matched to individual preferences. The desired size of the windows is adjustable from minimum to maximum. The arrangement of the opened windows is adjustable by means of the item <Window> and the options <Overlap>, <Tile Horizontal> or <Tile Vertical>.

In the bottom bar of the main screen the status line is arranged. This line contains information about the program status and the scanner's internal temperature.

**Figure 5-1: Main Screen for Systems in Discontinuous Mode**

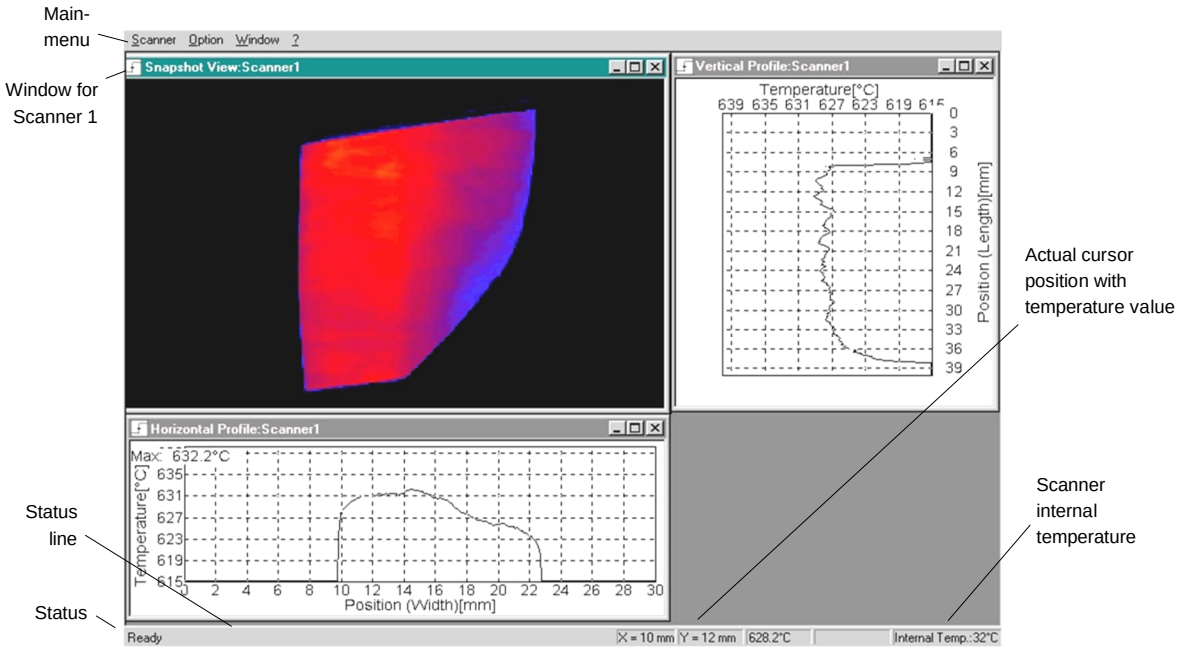
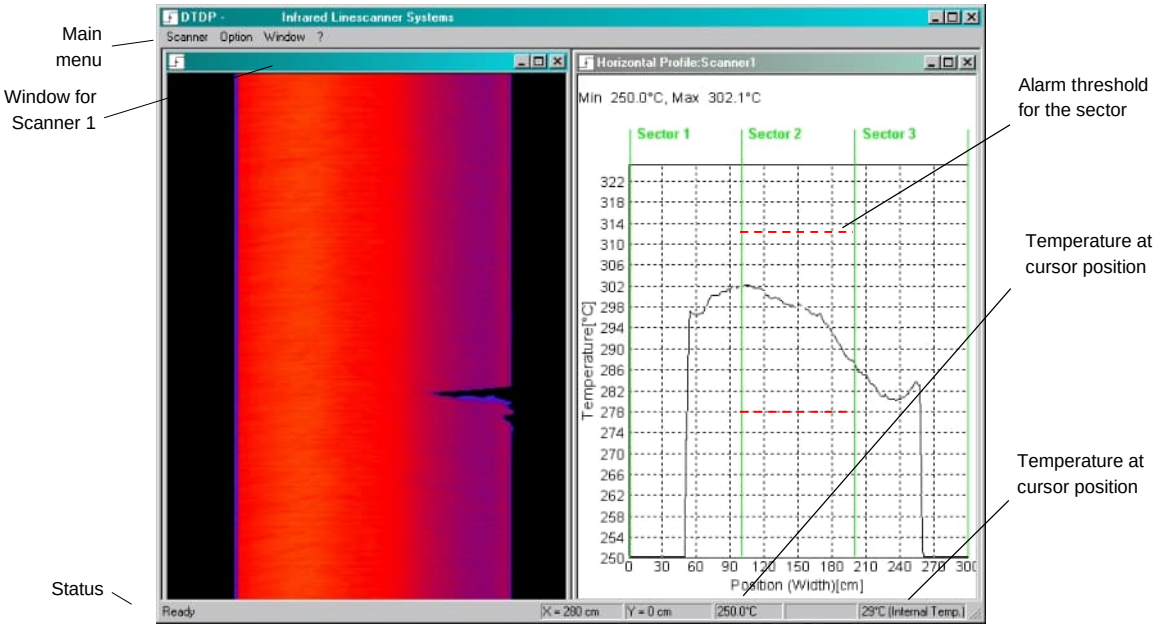


**Figure 5-2: Main Screen for Systems in Continuous Mode**



## 5.5 Menu Overview

The following figure shows an overview of all available menus. All menus are described later in this manual.

**Figure 5-3: Menu Overview**

| Scanner | Option | Window | Configuration | ? |
|---|---|---|---|---|
| Additional Scanner | Magnifier | Scroll View | Open a different configuration | Info |
| Start/Stop | Status Bar | Snapshot View | Configure the current configuration | |
| Switch Laser on/off | Chain Up History View | Difference View | Close | |
| Scanner Parameter | Unregister the OPC DA Server | Horizontal Profile | | |
| Transmissivity of the scanner window | | Vertical Profile | | |
| Reset of the Scanner | | Zones in a Table | | |
| Save as ... | | | | |
| Close (Scanner) | | Terminal | | |
| Exit | | Snapshot History | | |
| | | Reference | | |
| | | Zone History | | |
| | | Data Stream View | | |
| | | Log-File View | | |
| | | Cascade | | |
| | | Tile Horizontal | | |
| | | Tile Vertical | | |
| | | 1 Scroll View:Scanner1 | | |

## 5.6 Scanner Menu

**<Additional Scanner>**

It is possible to run two or more scanners simultaneously. To choose an additional scanner, the menu <Scanner> <New Scanner> must be selected. For each additional scanner, a separate initialization file is necessary. This additional initialization file must be created in the Configurator before the scanner software starts, see section 4.1.5 Configuration Group, page 21. An attempt to activate another scanner without a corresponding initialization file creates an error message. The menu <Scanner> <New Scanner> can also be used to open an initialization file of a closed scanner without exiting the program.

**<Start/Stop>**

By means of this menu, the scanner's data transmission can be started or stopped. An existing communication between scanner and program is marked through the ✓ symbol in the menu line. It is necessary to stop the scanner when using the terminal.

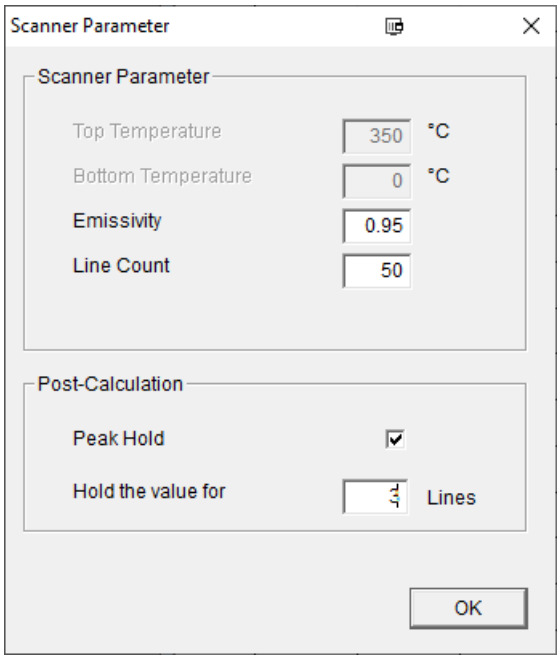
**<Switch Laser on/off>**

Switches the internal line laser of the scanner on/off. Alternatively, you may set the line laser to blinking (availability only with linescanner firmware version 3.40 or higher).

**<Scanner Parameter>**

This menu activates a dialog box to specify the requested temperature range, the emissivity, and the number of lines. The bottom (minimum) and the top (maximum) temperature are defined to the temperature range of the plugged scanner.

**Figure 5-4: Setting of Scanner Parameters**



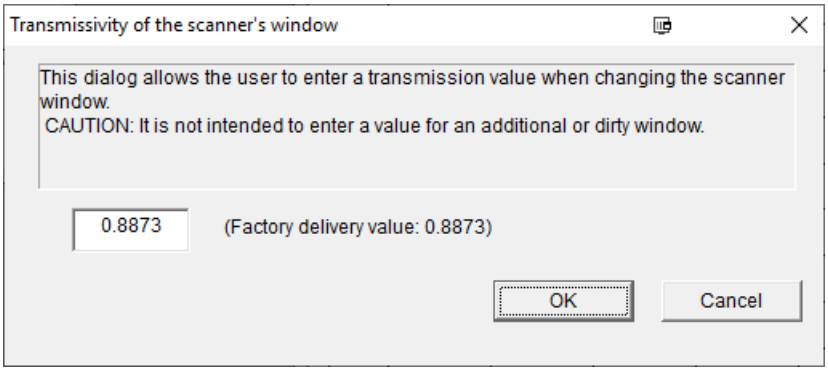

**<Transmissivity of the scanner window>**

That dialog considers the transmission factor for a scanner spare window.

*Note*

*The menu the software sends a <PS> command to the scanner automatically.*

**Figure 5-5: Setting Transmissivity After a Window Change**




**<Reset of the scanner>**

Initiates a reset of the scanner (warm start) by restarting scanner without resetting user defined parameters.

**<Save as ... >**

This menu opens the <Save as> dialog for saving a current snapshot.

**<Close (Scanner)>**

This menu closes the communication to the scanner.

**<Exit>**

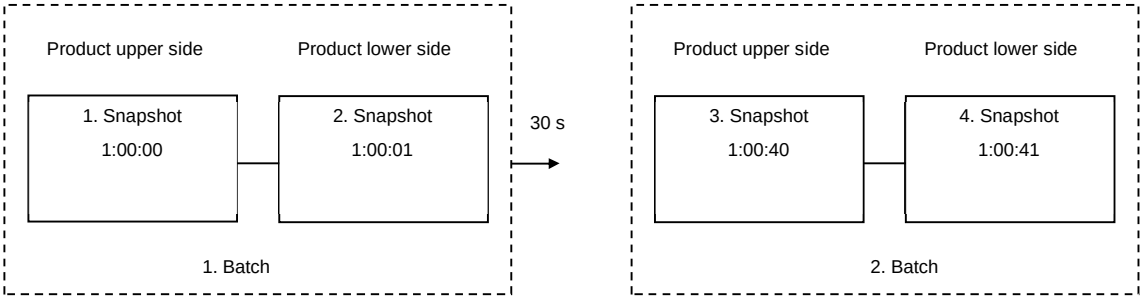
This menu allows the program to be ended. Prior to this, the size and the position of all opened windows are saved and subsequently recalled during the next program start.

# 5.7 Option Menu

## 5.7.1 Chain Up History View

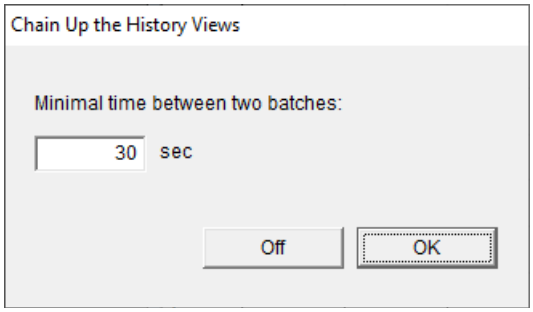
The function <Chain Up History View> allows the simultaneous display of multiple snapshots (e.g. product upper and lower side) in the history view. The assignment of snapshots, which belong together, is defined by the time when the images were saved. Connected snapshots are considered as one batch and the batches are separated from each other by defining the interval between batches.

**Figure 5-6: Minimal Time Between Two Batches**




In the scanner software, the function can be activated via the menu <Option> <Chain Up History Views>. The following dialog appears:

**Figure 5-7: Defining the Minimal Time Between Two Batches**




The chain up history view can be opened using the menu <Window> <Snapshot-History>. The first view contains the oldest snapshot of the batch.

As long as the interval between the saving time of the two images is within the given <Minimal time between two batches>, launching a second <Snapshot-History> view automatically connects (chain up) a second snapshot to the previous snapshot. The navigation bar can only be controlled via the history view for the first snapshot.

Setting of <Minimal time between two batches> to 1 s results in displaying only the predecessor snapshot.

**Chain up of history views for multiple scanners**

For each next scanner a separated saving folder for the snapshots must be defined. The first snapshot history of the next scanner is chained up automatically with the timely closest snapshot of the first scanner.

## 5.7.2 Unregister the OPC DA Server

This menu is used to unregister the OPC DA server from the registry of the operating system of the computer.

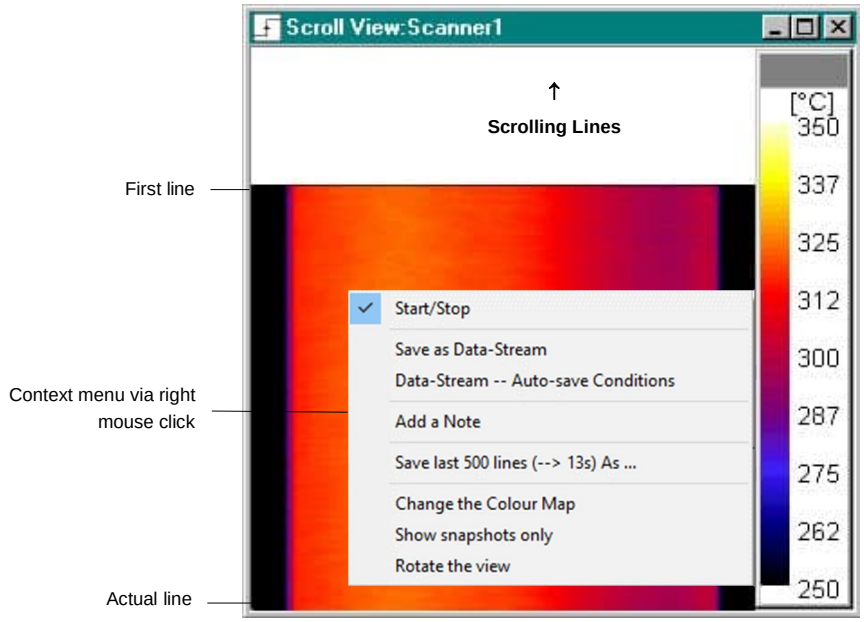
## 5.8 Window Menu

### 5.8.1 Scroll View

**<Scroll View>**

The <Scroll View> shows all recorded temperature lines continuously. The thermogram is built up line by line. If the last line of the window is reached, the whole content of the window is scrolled one line at a time.

**Figure 5-8: Example for a Scroll View**

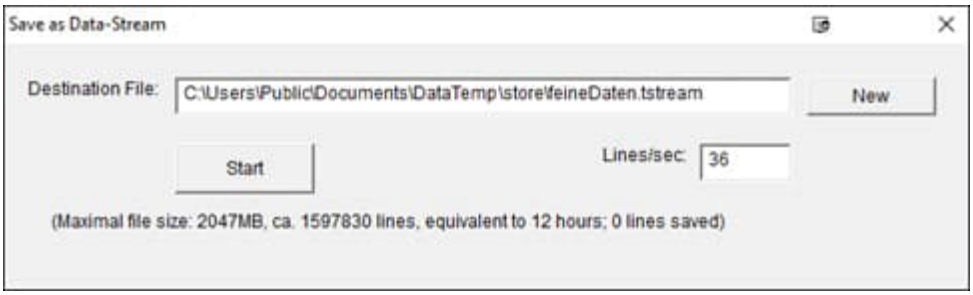



In the <Scroll View> a context menu is available. It is activated by clicking the right mouse button or by pushing the buttons <Shift> and <F10>:

**<Save as Data-Stream>** This menu opens a dialog box allowing the user to save a stream of temperature data line by line. The file is saved in a proprietary software format *.tstream. Via <Destination File> you can select a new destination folder in which to save the file. <Lines/sec> defines the recording speed.

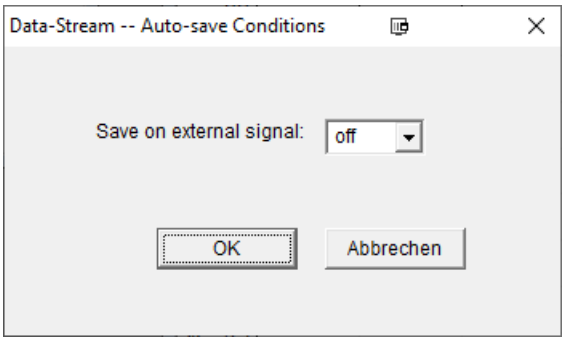
Upon reaching the maximum file size or when you press the <New> button a new file is created according to the naming convention agreed under <Data file> in the configurator.

**Figure 5-9: Saving a Data-Stream**




**<Data-Stream – Auto-save Conditions>** This menu allows the automatic storage of data streams triggered by an external signal via a digital input at a WAGO module.

**Figure 5-10: Auto-save Conditions for the Data-Stream**

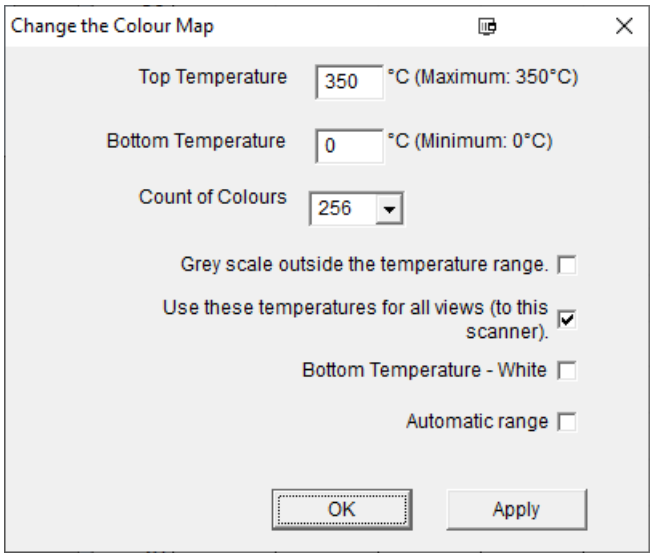



**<Add a Note>** This menu opens a dialog box to enter a note. The note length of the note is limited to a maximum of 500 characters.

**<Save last 500 lines As>** Saves the last 500 temperature lines as binary file or as ASCII file. The duration in time of 500 lines is determined by the scan speed and the averaging time of the scanner. Both are set with the Configurator. The resulting time is shown in the menu entry in brackets (e.g. → 13 s).

**<Change Color Map>** Opens a dialog box for setting the displayed colors.

**Figure 5-11: Changing Colors**




<Top Temperature> and <Bottom Temperature> define the thresholds for the displayed color map. The number of colors used is given with <Count of Colors>. By using only 2 colors for instance, the thermal image can be translated into a good-bad image.
<Grey scale outside the temperature range> colors the non-displayed temperatures in a grey color.
<Bottom Temperature – white> converts the black color corresponding to the minimum temperature to white color (suitable for an economical printing).
<Automatic range> sets the displayed color range automatically in accordance to the measured minimal and maximal temperature.

**<Show snapshots only>** When activated, the system will only display snapshots while in <PC Trigger> mode.

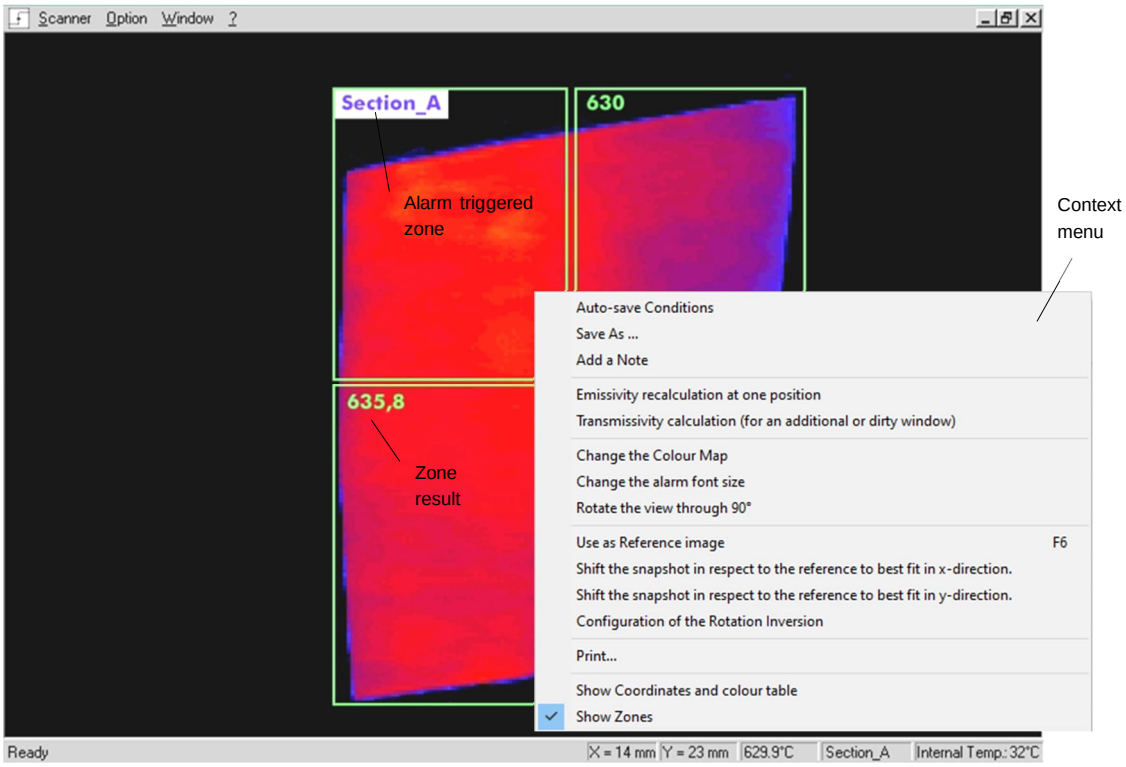
**<Rotate the view>** Rotates the view in a range from -180° to 180°.

### 5.8.2 Snapshot View

**<Snapshot View>**

The Snapshot View is the special view for discontinuous processes. In the Scroll View the temperature lines are displayed continuously. Opposite to that in the Snapshot View, the thermograph is recorded only from a “start trigger” for a constant number of lines or until the “end trigger” signal is valid. The temperature lines in the window always begin with the first line following “start trigger”. In case of same measurement objects, the Snapshot View creates a standing picture.

**Figure 5-12: Example for a Snapshot View**




With the standing picture of the Snapshot View, it is possible to perform operations with the measured object as described in the following sections.

#### 5.8.2.1 Display of Requested Pixels

In the Snapshot View the measurement objects can be analyzed very easily. For that the following functions are available:

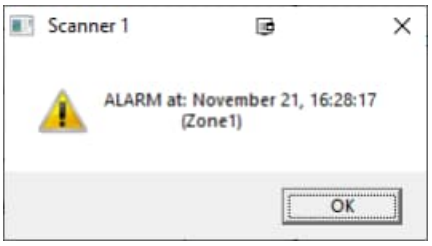
- The temperature values are shown directly with the cursor.
- The position of the actual pixel (in the unit line or column) and the corresponding temperature value (°C or °F) are displayed in the status line of the screen depending on the actual position of the mouse cursor.
- The chosen pixel can be fixed by a double-click of the left mouse button. This function is always helpful if the Snapshot View is displayed together with the Horizontal Profile and the Vertical Profile. The fixing of the pixel is removed with the next double-click of the left mouse button.

### 5.8.2.2 Display of Zones

In the Snapshot View, a zone appears on the screen as a green rectangle. The actual zone result is displayed in the left-top edge of the zone. If the zone area was positioned without containing valid temperature data, the zone result is marked with the character „X“.

In case of violating of the lower- or the upper-threshold for the zone result, an alarm is triggered. The zone in which the alarm was triggered is marked on the screen by the appearance of the particular zone name. Red characters indicate violation of the upper zone threshold, blue characterizes the violation of the lower zone threshold.

**Figure 5-13: Alarm Message with Alarm Time**




### 5.8.2.3 Context Menu of the Snapshot View

A context menu is available in the window <Snapshot View>. It is activated by clicking the right mouse button or by pushing the keyboard keys <Shift> and <F10>. The options of that context menu are described in the following paragraphs.

**<Start/Stop>**

Starts or stops the data transmission of the scanner.

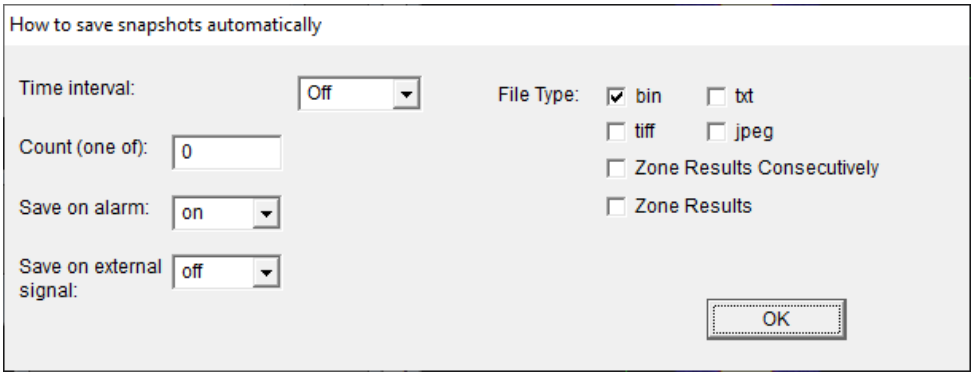
**<Auto Save Conditions>**

Snapshots can be saved automatically if certain conditions are complied. These conditions are set by means of a dialog box (see the following figure).

*Note*

*For saving of snapshots the Snapshot view and its saving conditions needs to be always opened or at least minimized (but not closed)! When saving of snapshots, the defined zone grid is not stored!*

**Figure 5-14: Dialog <Save Conditions>**




**<Time interval>**

After a certain time, a snapshot is saved automatically without any Alarm. This event is cyclical. To set the time units, seconds, minutes, hours or days are available.

**<Count (one of)>**

Every <Count>$^{th}$ snapshot is saved automatically without any Alarm.

**<Save on Alarm>**

In case of an alarm, a snapshot is saved automatically.

**<Save on external signal>**

A snapshot is saved in the event of an external signal from the digital input of a WAGO module.

All triggers mentioned above are combined via an OR-integration. This means one of the four trigger conditions must be true for saving a snapshot.

**<File Type> bin**

The binary format may be selected to save the alarm image for later analysis. The binary format is connected to the program specific to the software. The benefit of the binary format is the small storage requirement. A disadvantage is the difficulty to interface to other programs.

*Note*
*Only snapshots stored in a binary format can be recalled by means of the menu <Snapshot History>!*

**<File Type> tiff or jpeg**

The user can select a standardized format to save alarm images simplifying subsequent editing and file-sharing.

**<File Type> txt**

The ASCII-Text is used to interface to other programs (for example Excel or MathCad). This advantage offsets the possible disadvantage that files saved in ASCII-Text format require more storage space than files saved in binary format.

The ASCII-Text format is composed of a header containing information (the used program version, a note, the number of lines and pixels, the scanner's internal temperature and the temperature unit) and a body containing the lines of temperature points.

To get the first line of the temperature matrix, check `StartOfDataAtLine`. This allows one to add further information to the header without reprogramming.

Temperature values are given in tenths of degrees to avoid any trouble resulting from different decimal formats using commas or dot in different countries.

Example:

```
StartOfDataAtLine 9
Version 1.00
Note:
NumberOfLines 100
NumberOfPixels 256
InternalTemperature 40
Temperature in mC (°C * 10)
Orientation: row --> line
260 260 260 253 253 250 ... 247 250 250 250 250 250
260 260 260 260 260 253 ... 250 250 250 250 253 253
```

**<File Type> Zone Results Consecutively**

Le format <Zone Results Consecutively> est utilisé pour enregistrer les résultats de zone des instantanés dans un fichier consolidé. Un fichier commun nommé "Zones_consécutives.<NomScanner>.txt" (par exemple "zones_consécutives.Scanner1.txt") est créé pour toutes les zones et tous les instantanés consécutifs. Chaque

ligne de ce fichier contient les résultats de zone d'un instantané. À chaque nouveau cliché pris, le résultat de zone associé est inscrit sur une nouvelle ligne.

Example:

| Date | Zone_A | Zone_B |
|---|---|---|
| Tue Jul 15 13:01:09 2019 | 113.8 | 7.3 |
| Tue Jul 15 13:01:14 2019 | 113.7 | 7.7 |

**<File Type> Zone Results**

The <Zone Results> file type is used to save the zone results of a snapshot. For each snapshot, a separate file is created that contains the zone results for that snapshot. Its name is set in the configurator.

Example:

```
Note: Oven 27
ZoneA: 635.7
ZoneB: 610.3
ZoneC: 642.8
```

This format uses the ASCII-Code to store the information allowing an interface to other programs.

**<Save As>**

This option allows saving the actual snapshot in the binary or the ASCII-text format. The data transmission between scanner and program is not automatically broken. To do that, the communication must be stopped by means of the context menu <Start/Stop> before the menu <Save As> will be opened. That ensures saving of the actual snapshot instead of the following snapshot.

**<Add a Note>**

Use this menu entry to add further information (e.g., a note) to the snapshots. With the open dialog box, a text of maximum 500 characters can be input. This text will be added to all subsequently stored snapshots automatically or by hand. To initialise the note at start up time, the description of the <General> page of the Configurator is used.

In contrary to a static note it is also possible to add a note dynamically during the program's runtime via a:

**Text File**

A text file can be used to add to every saved snapshot some information from an external system automatically (for example a product number). If a file with the name note.0 will be found in the public document folder this file will be considered as a ASCII text file and read in as note to the snapshot.

**Bar Code Reader**

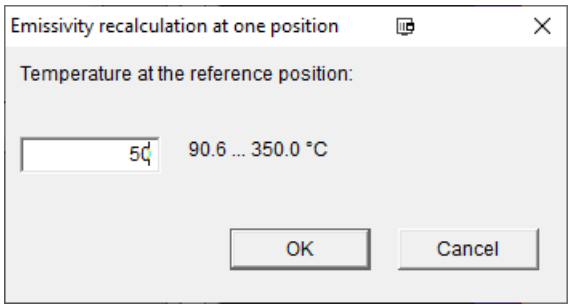
A PC connected bar code reader behaves like a computer keyboard. Open the <Add a Note> dialog. Any input from the bar code reader that ends with a <newline> (enter) will be taken as a new describing note for the following snapshot. The barcode-reader should add the <newline> sign automatically. The input focus will stay as long as the <Add a Note> dialog box is open.

**<Emissivity Recalculation at one position>**

Use this menu to recalculate the emissivity value for future measurements. Assuming that the object temperature is well known to the user, this function can be used to find the correct emissivity value for the object to be measured.

After selecting this menu, you have to fix one position within the current snapshot by double clicking the mouse. Afterwards, the known object temperature must be input to the dialog box below. Pushing the <OK> button will force the software to calculate a new emissivity value (based on the input temperature) to be used for the next captured snapshots.

**Figure 5-15: Dialog <Emissivity Recalculation>**

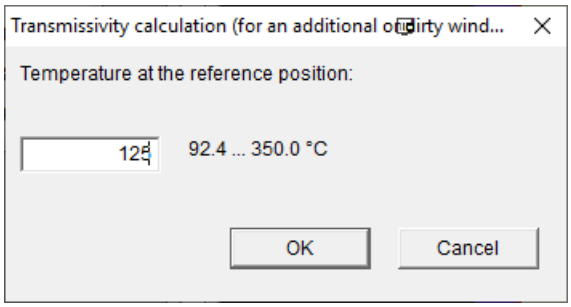



**<Transmissivity Calculation (for an additional or dirty window)>**

Use this menu to calculate the transmissivity value for an additional (second) or a dirty scanner window. Assuming that the object temperature is well known to the user, this function can be used to find the correct transmissivity value for the window to be used.

After selecting this menu, you have to fix one position within the current snapshot by double clicking the mouse. Afterwards, the known object temperature must be input to the dialog box below. Pushing the <OK> button will force the software to calculate a new transmissivity value (based on the input temperature) to be used for the next captured snapshots.

**Figure 5-16: Dialog <Transmissivity Recalculation>**



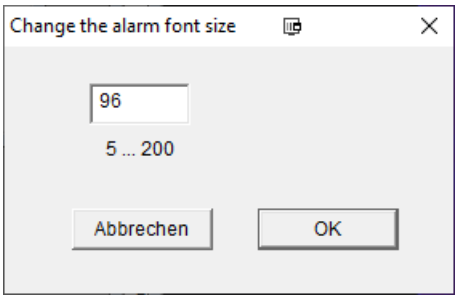

**<Change the Color Map>**

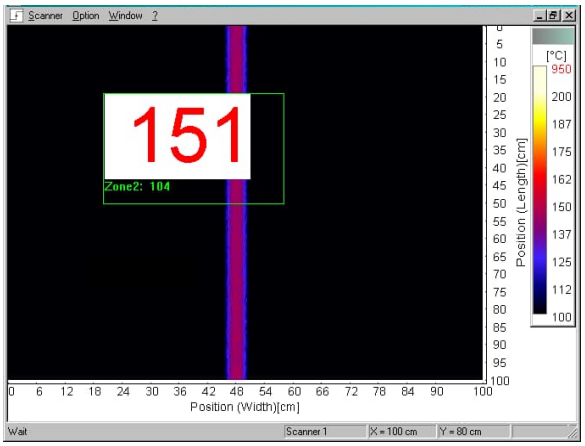
For detailed information see section 5.8.1 Scroll View on page 66.

**<Change the alarm font size>**

Use this menu to set the used character size for zone results in case of an alarm.

**Figure 5-17: Dialog <Change the alarm font size>**




**<Rotate the view through 90°>**

Initiates a counterclockwise rotation for the current snapshot view.

**<Use as Reference image>**

Use this menu (or alternative the hot key F6) to set the current snapshot as a reference snapshot. The reference snapshot is stored under the file name „reference.bin“ in the subfolder STORE. Only one snapshot can be set as a reference. The reference snapshot provides comparative analyses with current snapshots of the running measurement. The reference snapshot can be displayed or hidden by means of the menu <Reference> or the hot key F5.

**<Shift the snapshot in respect to the reference to best fit in x-direction>** Moves each new snapshot to the reference superimposable in horizontal direction.

**<Shift the snapshot in respect to the reference to best fit in y-direction>** Moves each new snapshot to the reference superimposable in vertical direction.

**<Configuration of the Rotation Inversion>** allows you to correct distorted thermal images, see section 9 TF Rotary Image Correction, page 100.

**<Print …>** Opens a dialog for printing the actual view.

**<Show Coordinates>**

This option allows the labeling of coordinates to be switched.

**<Show Zones>**

This menu allows the display of zones to be switched.

### 5.8.3 Difference View

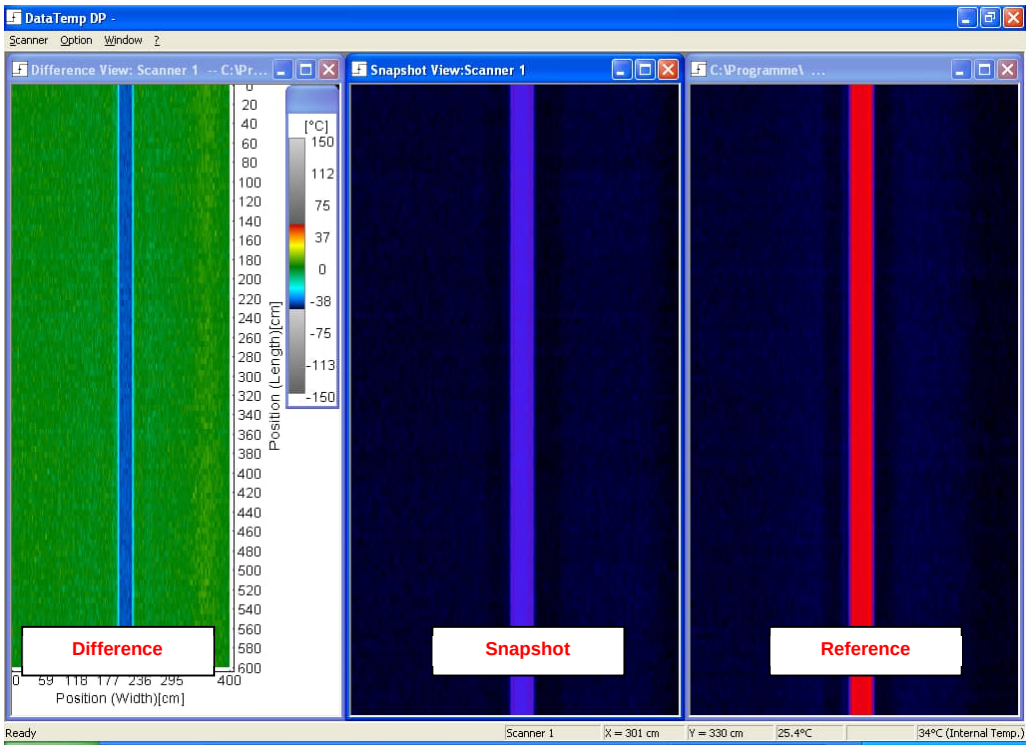
**<Difference View>**

The <Difference View> allows the temperature differences between snapshots of two scanners or the current snapshot and the reference image to be displayed. Before launching the <Difference View> you have to define a reference image.

The context menu entry <Shift the reference to best fit in x-direction> activates automatic horizontal correction of the reference image to improve the registration to the current snapshot.

The images, which are saved under the difference view, are created under this file name: <name>.diff.bin

**Figure 5-18: Difference View**

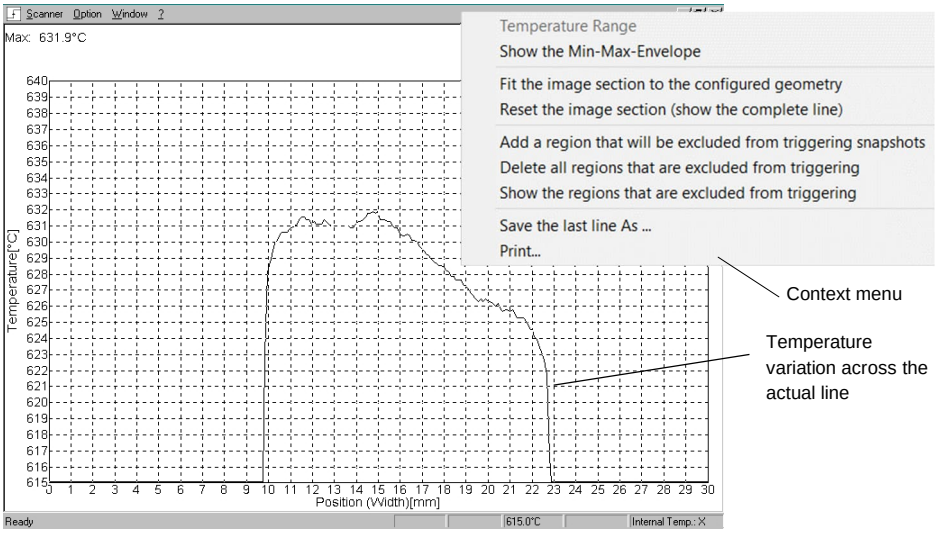



## 5.8.4 Horizontal Profile

**<Horizontal Profile>**

The <Horizontal Profile> allows the temperature variation across one line to be displayed. The displayed line depends on the actual position of the mouse in the window <Snapshot View>.

**Figure 5-19: Horizontal Profile**




In the <Horizontal Profile, a context menu is available. It is activated by clicking the right mouse button or by pushing the keyboard buttons <Shift> and <F10>:

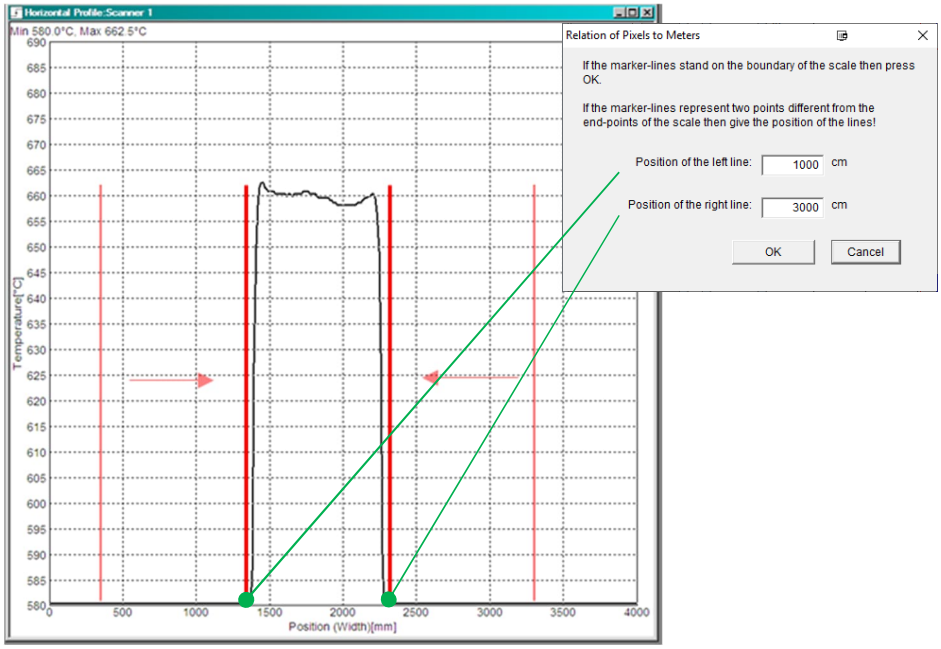
**<Show the Min-Max-Envelope>** shows an enveloping curve for the temperature profile.

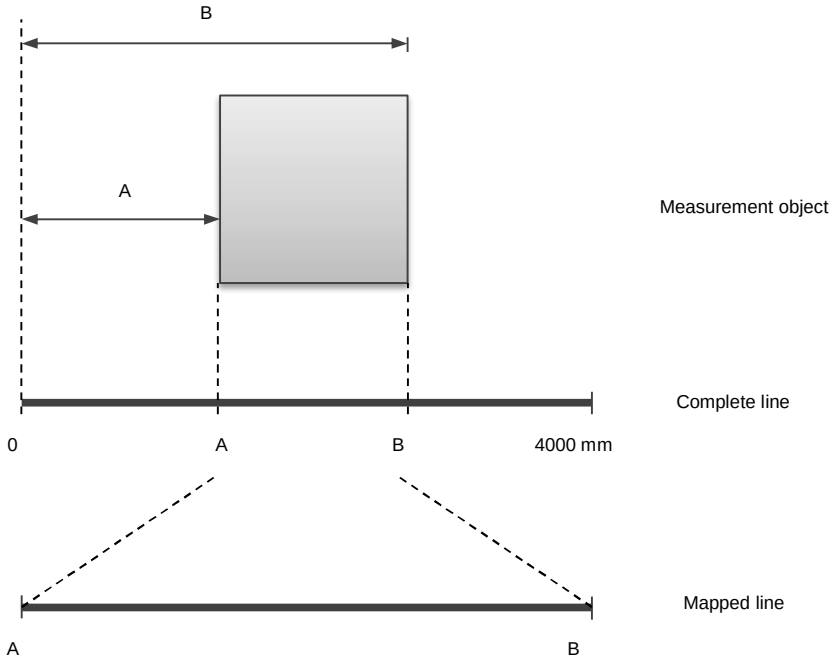
**<Fit the image section to the configured geometry>** With this option the configured geometrical dimensions are mapped to the scanner's field of view independent from the mounting distance of the scanner. Select the requested part of a temperature line by setting the left and the right edge. The new edge position is fixed by a double click of the left mouse button. The function is helpful to match the displayed screen to the width of the measured object.

Example: getting a glass sheet in its with of $W_{Object}$ = 2000 mm

1. Set the maximal process width under the <Geometry> page, e.g. 4000 mm
2. Physically measure the distance from the left edge of the process to the left edge of the glass, e.g. A = 1000 mm.
3. When prompted, enter the left edge A, here 1000 mm.
4. Calculate the right edge B with B = A + $W_{Object}$ and enter when prompted,
e.g. B = 1000 mm + 2000 mm = 3000 mm.

**Figure 5-20: Fitting the Image Section**



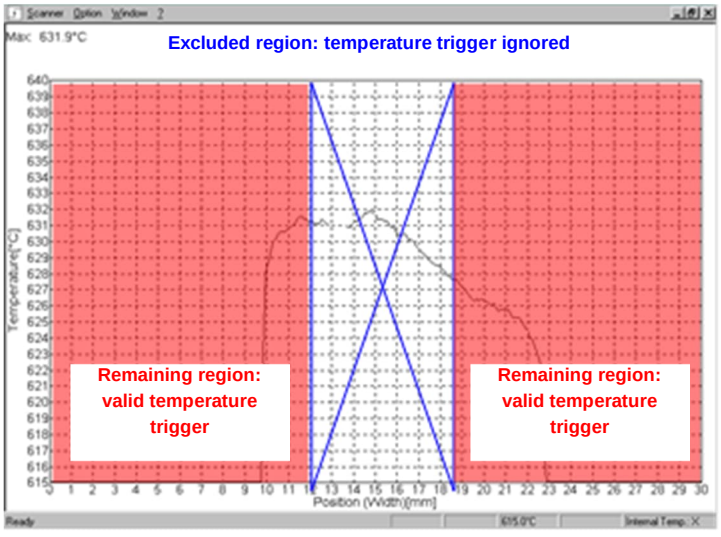



**<Reset the image section>** Resets the image to the complete line.

**<Add a region that will be excluded from triggering snapshots>** Select this menu to define a region where the trigger condition for a temperature trigger is not evaluated. You can define more than one excluded trigger region in the horizontal profile. The excluded trigger function is only available in <PC Trigger> mode.

The described function can be used for objects transported on big hot carriers to avoid a too early triggering of a snapshot.

**Figure 5-21: Horizontal Profile with Excluded Trigger Regions**




**<Delete all regions that are excluded from triggering>** Deletes all excluded trigger regions.

**<Show the regions that are excluded from triggering>** Displays excluded trigger regions on and off.

**<Save the last line As>** saves one line as bin/txt/jpg/tiff file by hand or time triggered.

**<Print …>** Opens a dialog for printing the actual view.

### 5.8.5 Vertical Profile

**<Vertical Profile>**

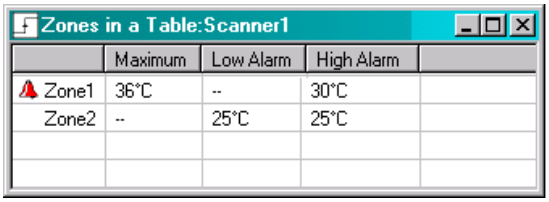
The <Vertical Profile> displays the temperature variation across one temperature column. The displayed column depends on the actual position of the mouse cursor in the window <Snapshot View>. When in that profile, only the printer dialog can be called.

### 5.8.6 Zones in a Table

**<Zones in a Table>**

The window <Zones in a Table> provides the display of zone results in a table. With every new snapshot, all zone results in the table are actualized automatically. A little red bell indicates the violation of the upper alarm threshold, a little blue bell indicates the violation of the lower alarm threshold.

**Figure 5-22: Displaying of Zone Results in a Table**

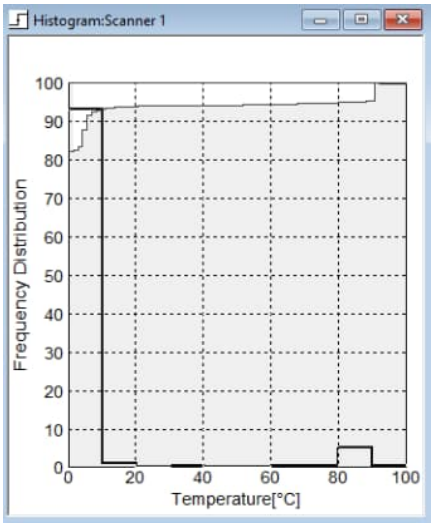



### 5.8.7 Histogram

The histogram displays the temperature distribution showing the number of temperature values falling within a certain temperature range. The grayed area in the background represents a cumulative histogram whereby all temperature numbers are added gradually from temperature range to temperature range.

The histogram is applicable for a current snapshot, for a snapshot from the history, or for a reference snapshot.

**Figure 5-23: Histogram**



### 5.8.8 Terminal

**<Terminal>**

The terminal gives direct access to the scanner via its command interface. The terminal function is only activated if the data transmission between scanner and program is stopped.

*Note*

*The scanner software does not monitor commands sent with the terminal - thus settings effected in this way may conflict with set-up settings of the scanner software. Access to the scanner via the terminal window is only possible with specific commands!*

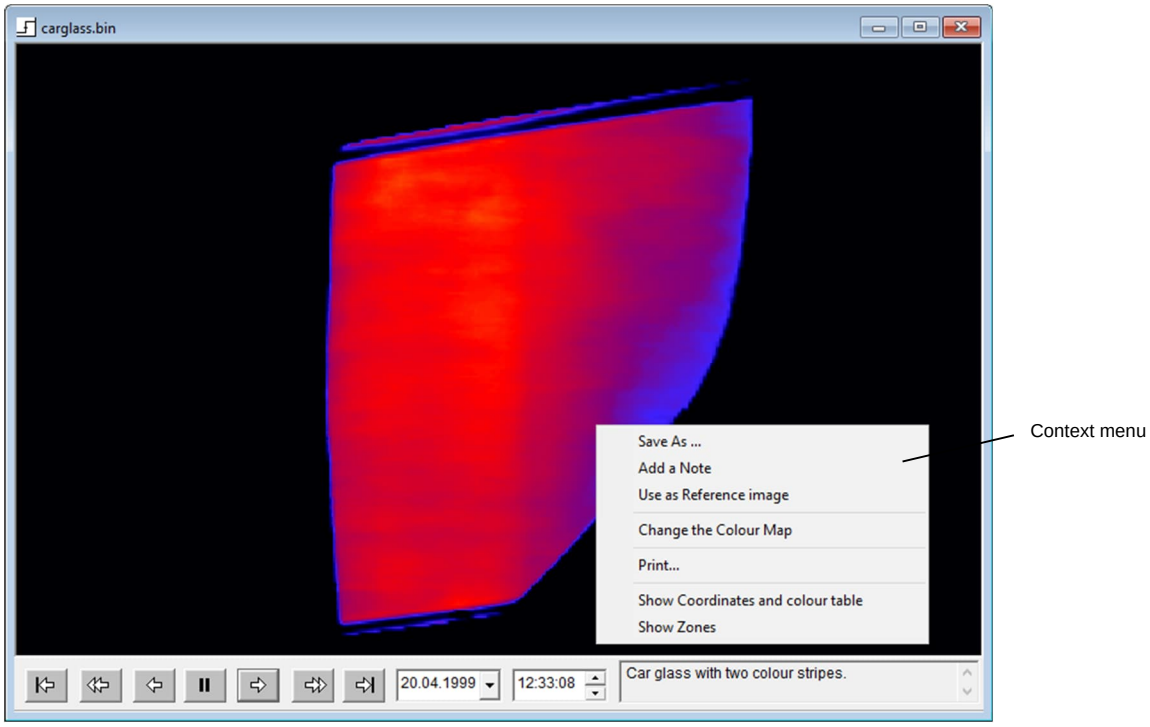
These commands are described in detail in the Protocol Manual, which is included with linescanner shipment.

### 5.8.9 Snapshot History

**<Snapshot History>**

The menu allows the running through the history of thermograms previously saved in binary format. This option is ideal when following process changes over a long time and having hundreds or thousands of thermograms. A specific thermogram can be displayed by selecting the corresponding saving date. Additionally, it is possible to run through the history step by step or continuously like the running of a video.

**Figure 5-24: Recall of a Thermogram by Means of the Menu <Snapshot History>**

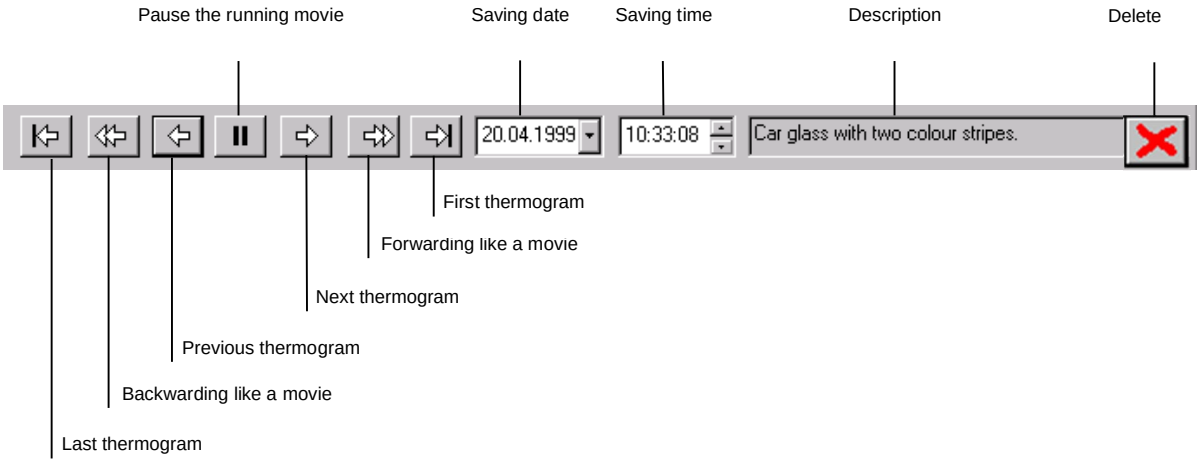



In dependency of the number of stored thermograms and the power of the used computer system, the loading of the history can take some time!

*Note*

*The scanner software installed on a remote PC working over a mapped drive allows the use as a simple viewer on the snapshot history.*

**Figure 5-25: Task Bar of the Snapshot History**




If the <First thermogramm> or the <Forwarding> button was pressed the view will automatically display new incoming snapshots.

In the <Snapshot History> a context menu is available. It is activated by clicking the right mouse button or by pushing the buttons <Shift> and <F10>:

| | |
|---|---|
| **<Save As>** | Saves a snapshot into another file format or under another file name. |
| **<Add a Note>** | Adding or changing of the note of a snapshot. |
| **<Use as Reference image>** | Sets the current snapshot to the reference snapshot, see <Use as Reference image>, page 73. |
| **<Change the Color Map>** | Opens a dialog box for setting the displayed colors. |
| **<Print …>** | Opens a dialog for printing the actual view. |
| **<Show Coordinates and …>** | Activating or deactivating the coordinates. |
| **<Show Zones>** | By means of this menu the display of zones can be switched. |

### 5.8.10 Reference

**<Reference>**

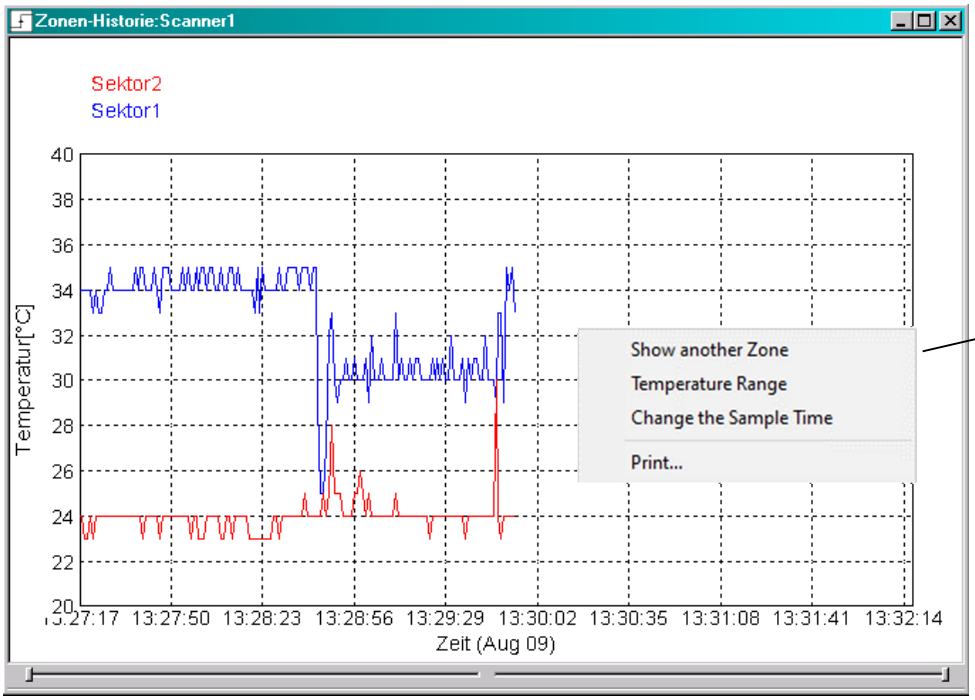
By means of this menu (or alternative the hot key F5) the reference snapshot can be displayed or hidden.

### 5.8.11 Zone History

**<Zone-History>**

The window <Zone History> provides a graphical view of sector/zone results or relations over a certain time. The displayed time interval is adjustable by using the sliders. The number of zones being presented is limited to 12. The <Zone History> does not show results from the Automatic Sector or the Generic Sectors.

**Figure 5-26: Displaying of Sector Results in the <Zone History>**




In the <Zone History> a context menu is available. It is activated by clicking the right mouse button or by pushing the buttons <Shift> and <F10>:

| | |
|---|---|
| <**Show another Zone**> | Selects a sector for graphical displaying. |
| <**Temperature Range**> | Changes the displayed temperature range |
| <**Change the Sample Time**> | Defines the time interval for taking zone results into the graph |
| <**Print ...**> | Opens the <Print> dialog for printing the current window. |

**Zone History as ASCII Text File**

The history is also available by accessing an ASCII file stored in the subfolder <Store> to be found in the installation directory. For every zone one file for the history is being used. The filename is created by using the zone name plus the extension ".zon".

```
<Number if seconds since 1.1.1970>  <zone result><date and time>
```

Example for "Zone1.zon":

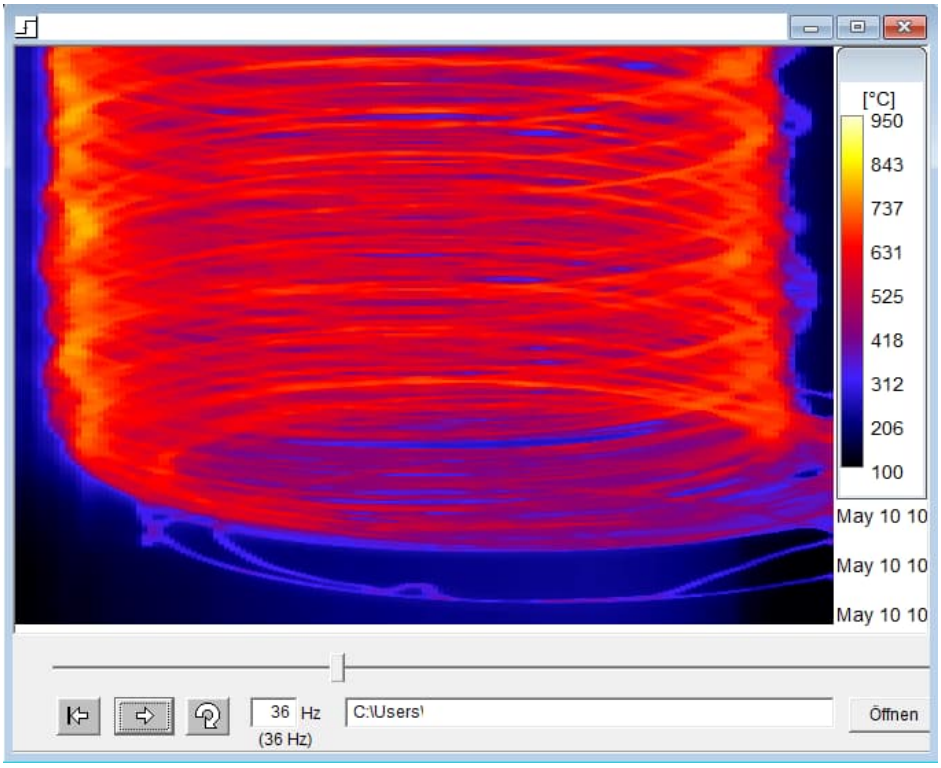
```
1045560325      28     Tue Feb 18 10:25:25 2003
```

### 5.8.12 Data Stream View

**<Data-stream View>**

The <Data-stream View> allows the user to display previously saved files in the *.tstream format, see the context menu in section 5.8.1 Scroll View, page 66. The displayed temperature line is adjustable using the slider. There are additional functions can be accessed via the navigation bar: <Start position>, <Play>, <Endless loop>, and playing speed <Hz>.

**Figure 5-27: <Data-Stream View>**

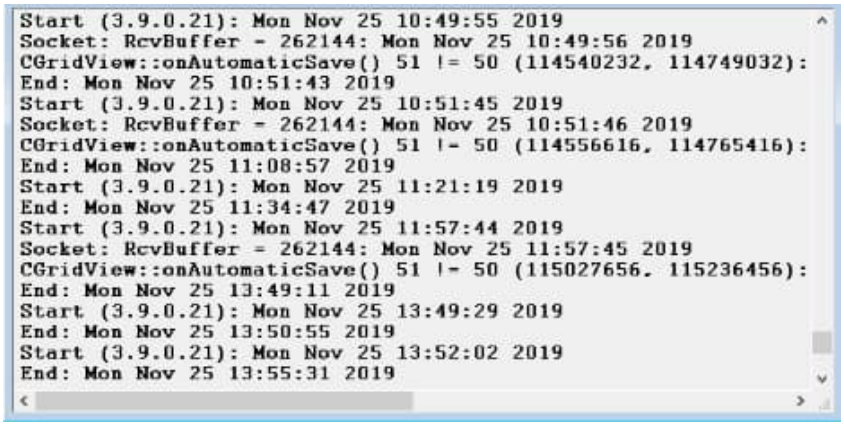



### 5.8.13 Log-File View

**<Log-File>**

This menu opens a view to the system's log file.

**Figure 5-28: <Log-File> View**



## 5.9 Configuration Menue

**<Open a different configuration>**

This menu opens the <File open> dialog for selecting another configuration file.

**<Configure the current configuration>**

This menu opens the <Configurator> for changing the current configuration.

**<Close>**

This menu closes the active scanner with all corresponding windows.

## 5.10 Alarms

Alarms are triggered by monitoring zone results. In case of violation, of the predefined zone thresholds the software responds with the following actions:

- Output of an alarm message on the screen
- Entry of the alarm time in the alarm file (logbook)
- Saving of an alarm image (auto-save condition in the snapshots context menu must be true)

To avoid a permanent alarm, a new alarm is only triggered if the recorded temperature data are within the given thresholds within a short period of time. A new alarm is also triggered if the previous alarm message on the screen is not acknowledged.

The software monitors also the internal temperature of the scanner. The preset threshold for triggering an alarm is at 60°C (140°F). In case of a more critical temperature the operator is informed by a screen message. To avoid a destroying of the scanner, the operator has to take appropriate corrective action.

### 5.10.1 Alarm File (Logbook)

The software contains a function to log program information automatically. For that the alarm file DTDP.0.log is made, it is found in the work directory. The number is used for the work with multiple scanners. Every line of this file contains a message with date and time of the entry. The following information is stored:

- beginning, end, and acknowledgement of alarms,
- beginning and end of the program.

Example:

```
Start: Wed Apr 14 12:12:31 2007
Alarm Begin: Wed Apr 14 12:12:49 2007
Alarm End: Wed Apr 14 12:13:00 2007
Alarm Acknowledge: Wed Apr 14 12:13:03 2007
End: Wed Apr 14 12:13:05 2007
```

## 5.11 Demo Mode

In case of no plugged-in scanner to communicate it is possible to run the software in demo mode. To avoid a long vain searching for a scanner, in the configurator's General the communication should be set to <None> scanner. The only meaningful feature of the scanner software in demo mode is the recalling of previous stored snapshots. The analyzing is supported by moving the mouse over the snapshot, whereby the actual position and the corresponding temperature value is to be seen in status line. Additionally, also the profile views are available to display the temperature variation of the actual line.

# 6 ES System

The ES System is an automated inspection system for detecting, measuring, and classifying thermal features and defects occurring in continuous web processes. In addition to the standard sectors, the ES systems provides the Generic Sector capability.

## 6.1 Generic Sectors

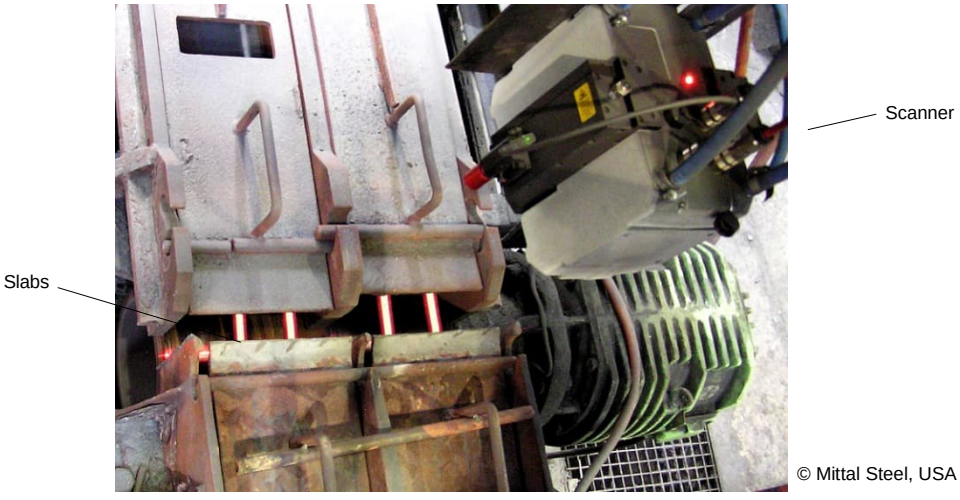
In some applications the web moves or is divided into a varying number of bars, e.g. the monitoring of ribbed steel bars which vary in number and their position. To follow these movements, stationary standard sectors with fixed locations cannot be used. With the so called generic sectors the ES system provides a dedicated feature to address this issue. Generic sectors are not fixed by a consistent position, but will be generated dynamically with each new line depending on the evaluated temperature plates within the scan. In this way, generic sectors are following the position of the web movement and permanently provide the desired sector results.

The need for a generic sector arises from strip coating applications that have a temperature profile with at least one plateau (i.e., stripe) characterized by comparatively sharp edges. Stripe coating is generally defined as alternating adhesive-coated stripes with non-adhesive stripes (coated in the web's machine-direction). Strip coating also includes stripe coating of silicone, emulsions and primers in addition to adhesives. The temperature information within the plateau (i.e., stripe) or plateaus (if there is more than one) is of interest and can be evaluated with the math functions of the standard common sector.

To meet this requirement, the generic sector extends the standard sector:

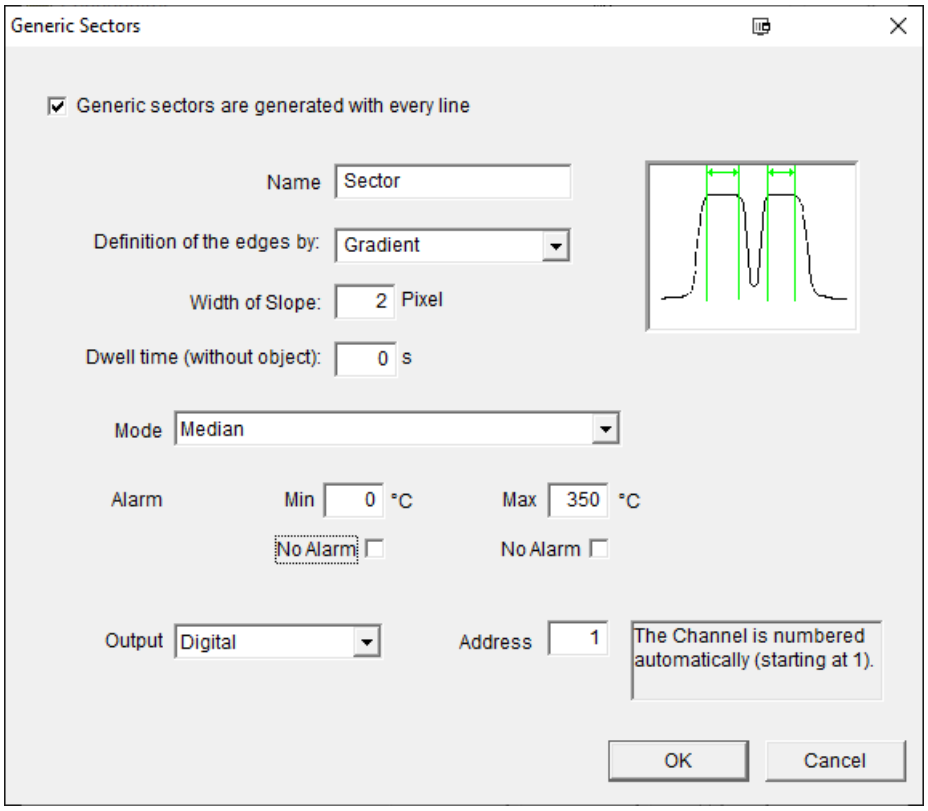
- its position can flow or extend within the edges of the plateau
- the count of sectors equals the count of plateaus and is allowed to vary at runtime.

**Figure 6-1: Monitoring of Ribbed Steel**




With the Configurator under the <Sector> page, the generic sector is defined as a rule to create sectors. Using the dialog box below, a set of characteristics have to be defined.

**Figure 6-2: Setting of the Generic Sector**




**<Name>** defines the basic name for all sectors. According to the number of generated sectors, the basic name will be extended by a running number during run time.

**<Definition of the edges by>** determines the method to search for generic sectors. The method <Gradient> expects to see the edges within the given <Width of Slope>. The method <Thresholds> assumes the edges to be on absolute temperature threshold.

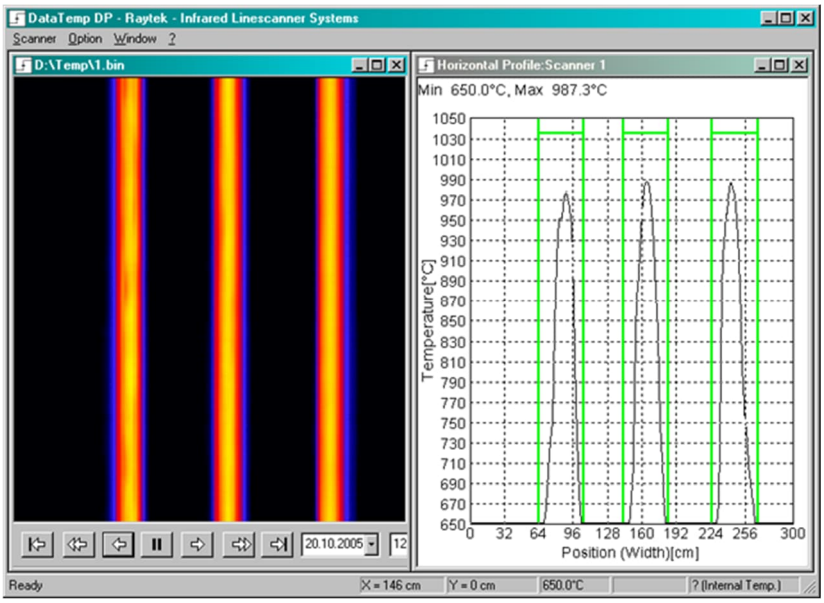
**<Dwell time (without object)>** defines the time for the generic sectors being present even without an object.

**<Mode>** the math function for the pixels of the sector. All functions of a standard sector are available, see section 4.6.1 Software Sector/Zone Button, page 36.
One extra function was added: as the width of the sector is not fixed it can be calculated and used as a raw measurement of the width. <Sector Width> increases the set of operations and determines the width of a sector relative to the dimension given in on the Configurator's <Geometry> page.

**<Alarm>** the minimum and the maximum threshold set to generate an alarm if the calculated value is out of limits. With activating the <No Alarm> check box you can disable the alarm generation.

**<Output>** defines a hardware output for the generic sector result. Analog Output Modules output the generic sector result as a current or a voltage in a certain range. Digital Output Modules set an output in case of a sector alarm caused of a threshold violation. The connection of a sector to a module is given by setting of the module's address. The output channel is counted up with every next sector that gets found. So the first sector is at channel 0, the second at channel 1 and so on.

**Figure 6-3: Temperature Profiles for 3 Steel Slabs Create 3 Generic Sectors**



# 7 EC System

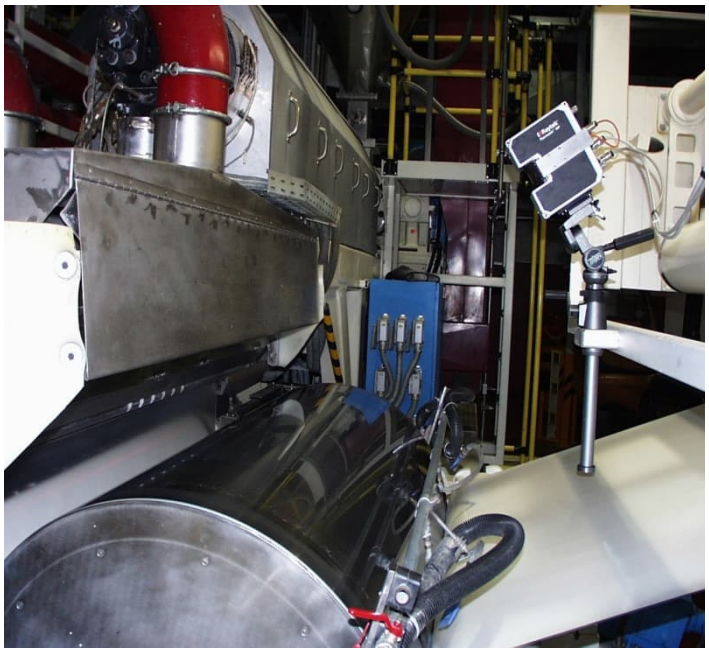
Consistent product temperature profiles are critical in continuous web applications such as lamination, extrusion coating, or float glass processing. Typically, process temperatures are adjusted in open-loop fashion without real-time product temperature feedback. But, infrared linescanners can provide edge-to-edge temperature measurement feedback on extrusion processes.

The EC system features a so-called Automatic Sector that detects and measures thermal defects on products manufactured. With continuous process control, the early detection of thermal defects (e.g., waving or running edges, temperature gaps) allows users to improve their processes and minimize scrap to approach a zero-defect standard of quality.

To monitor the temperature of the plastic-coated product and ensure precise temperature control, the linescanner is positioned immediately after the extruder, but before the chill rolls. Proper web temperature at this location is critical for strong plastic-to-paper-substrate adhesion. Cross-web temperature variation, a key determinant of coating thickness uniformity, can also be controlled by information from by the linescanner at the extruder's die zone heaters. Maintaining a consistent temperature profile improves the product's finished appearance, dimensional stability, and folding endurance. The EC software generates real-time process images for enhanced monitoring and control during start-up and operation. In case of extrusion defects, an alarm is triggered.

**Figure 7-1: Monitoring of Extrusion Processes**

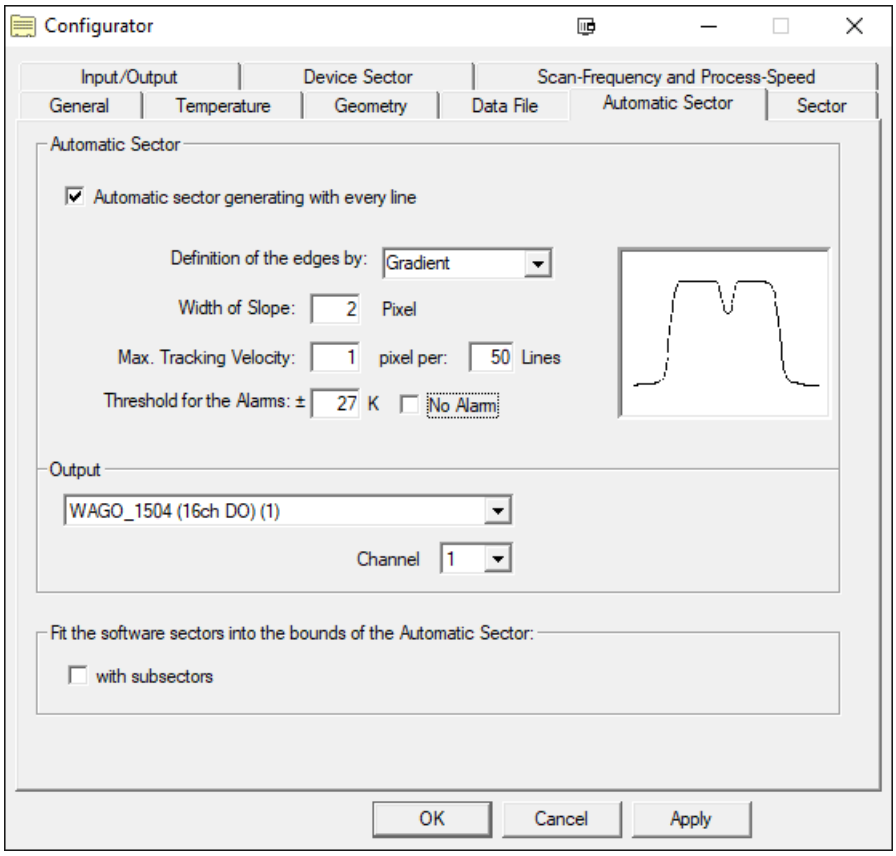
(Photo: Courtesy of SIG Combibloc GmbH, Wittenberg, Germany)



## 7.1 Automatic Sector

The “automatic sector” feature is very useful for monitoring the melt curtain coming from the extruder’s die. Temperature gaps or unacceptable “waving” or “edge running” is detected automatically. Within the “automatic sector”, temperature deviations are calculated. Unacceptable “edge waving” or “edge running” from one scanned temperature line to the next line can be detected. An alarm is triggered if a fault occurs. Alarm time and alarm position are automatically saved in an alarm file. For subsequent analysis, 500 temperature lines are stored in a separate file. Hardware alarm outputs are available using the Digital Output Modules discussed below. Hardware alarm outputs enable marking the machine-direction locations of the web corresponding to alarm occurrences. This feature is particularly useful in preventing use of off-spec packaging materials in food and beverage applications.

**Figure 7-2: Setting the Automatic Sector**




### 7.1.1 Automatic Sector Generating

A “sector” is defined as a specified portion of a temperature line. The sector’s starting-point and the end-point are calculated dynamically based on the actual measured temperature line. The criteria for setting these two points are either a temperature rise <Gradient> or a temperature limit <Threshold>. The edges of the sector are calculated concurrently with every new-recorded temperature line.

For setting specific parameters of the Automatic Sector, please refer to the figure above.

**<Gradient>:**

**<Width of Slope>** for evaluation of sector edges, the entire temperature line is analyzed point-by-point. To set a valid sector edge, the rising or falling edge needs some minimum increase or change. The parameter is specified in “pixels”. To understand the approximate physical length corresponding to 1 pixel, if the scanner’s entire field-of-view views the entire web width, there is the full pixel count spanning the width

of the web. For example, a web of width 60 inches corresponds roughly to about 4 pixels per inch. To detect a very sharp edge, the parameter should have a small value (e.g., 2 pixels).

**<Threshold>:**

**<Threshold for the Edges>** to set a valid sector edge, the considered edge needs a violation of the defined temperature threshold.

### 7.1.2 Edge Monitoring

**<Max Tracking Velocity>** with edge monitoring, it is possible to detect whether the "running" or variation of the temperature edges from one scanned line to the next occurs too rapidly. For that, the edge position of the actual line is compared with the edge position of the previous line. The user determines the acceptable "velocity" of edge variation.

**<pixel per x Lines>** the smallest selectable "velocity" is 1 pixel/line. This value is not adequate for monitoring edge velocities smaller than 1 pixel/line. That is why the comparison of one line to the next can be enlarged to a number of lines. The following table demonstrates the function of that parameter. In the example, the acceptable velocity of the edge positions is set to 1 pixel/line.

**Table 7-1: Velocity of Edge Positions**

| | **x = 1** | **x = 3** |
|---|---|---|
| Edge positions of the lines | Line $_{t-1}$: 10 | Line $_{t-3}$: 12<br>Line $_{t-2}$: 11<br>Line $_{t-1}$: 10 |
| Averaged edge positions | 10 | 11 |
| Edge positions of the actual line | 9,5 | 9,5 |
| Result | NO ALARM | ALARM |

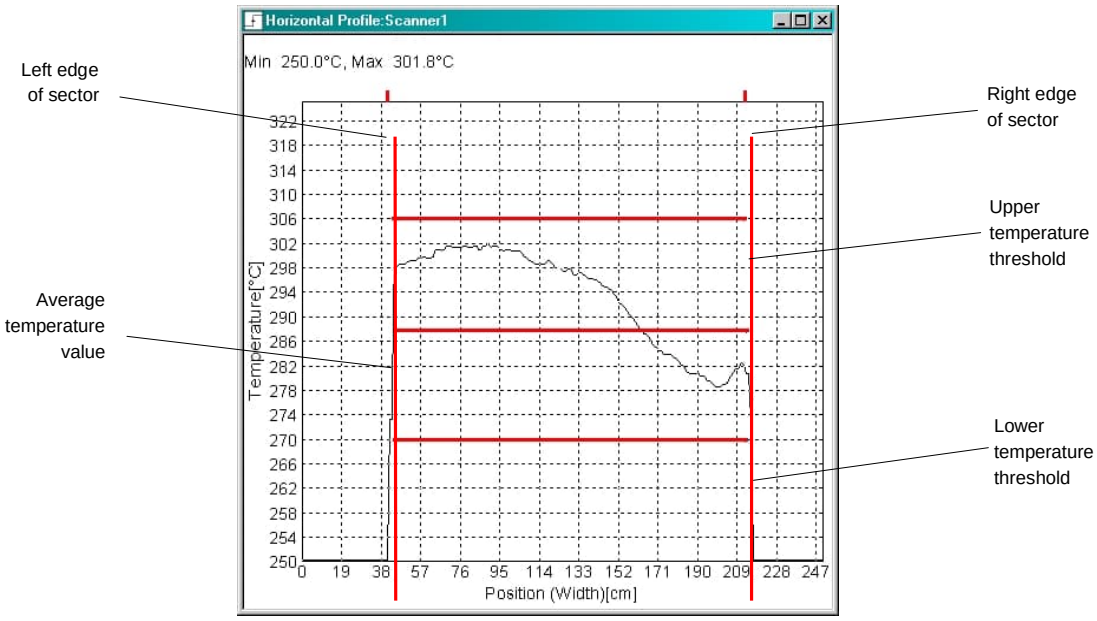
### 7.1.3 Temperature Monitoring

The Automatic Sector's temperature monitoring function provides a capability for checking the violation of definable temperature thresholds. All temperature values outside of the Automatic Sector are automatically ignored.

**<Threshold for the Alarms>** alarm levels are based on the upper and the lower temperature threshold. Temperature thresholds are calculated from the temperature average - increased or decreased by an absolute (referring to the average) temperature value. An alarm is always triggered with every violation of the top or bottom temperature threshold.

**<Output>** assigns an alarm to a digital output module (WAGO).

**Figure 7-3: Horizontal Profile with Temperature Monitoring within the Automatic Sector**




### 7.1.4 Forwarding of Results

The scanner program can forward the information of the Automatic Sector with every line to a serial COM-Port for processing the information in PLC's or other systems. The option must be activated on the Sector/Zone of the Configurator.

The following ASCII format is used:

**STX<scanner no><space><left edge><space><right edge><space><alarm><space><checksum>\r**

- the ASCII character STX (ASCII code 2) indicates the begin of a frame
- **<scanner no>**: every result line gives the scanner number to distinguish between scanners in multi scanner systems (in two digits beginning with 1).
- **<left edge>** 4 digits are giving the position of the left edge in relation to the defined (in the Configurator) width
- **<right edge**> 4 digits are giving the position of the right edge in relation to the defined (in the Configurator) width
- **<alarm>** [0|1] indicates if the Automatic Sector has detected an alarm
- **<checksum>** is the sum of the characters of <scanner no>, <left edge>, <right edge> and <alarm> without the spaces. It is given in two hexadecimal digits.
- the **\r** indicates the end of a frame

Example:

```
01     0100   0200   1      27
```

The actual position of the Automatic Sector of scanner 1 is 100 for the left edge and 200 for the right edge. The Automatic Sector has generated an alarm.

To localize the error, the following table should be used.

**Table 7-2: Localization of an Error with the Automatic Sector**

| | Position of left edge | Position of right edge | Alarm | Description |
|---|---|---|---|---|
| Previous line<br>Actual line | 100<br>105 | 200<br>200 | 0<br>1 | Error detection on the left edge |
| Previous line<br>Actual line | 100<br>100 | 200<br>205 | 0<br>1 | Error detection on the right edge |
| Previous line<br>Actual line | 100<br>100 | 200<br>200 | 0<br>1 | Error detection in the middle of the film |

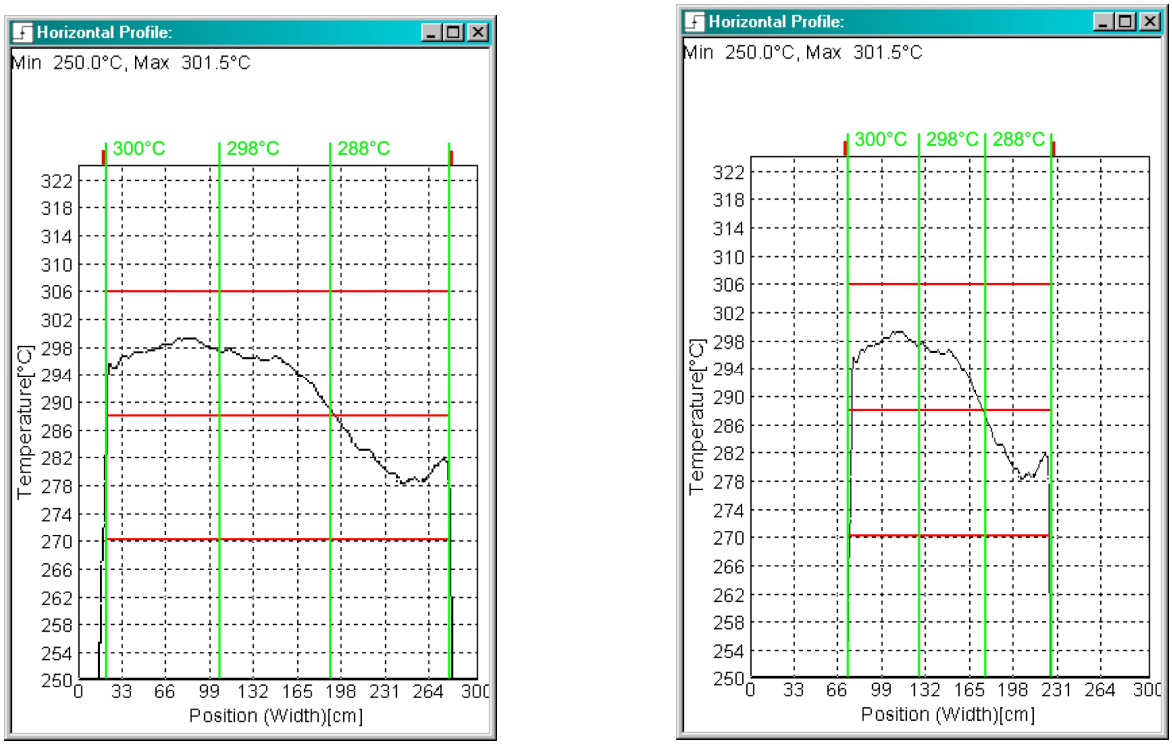
## 7.2 Automatic Sector with Subsectors

The Automatic Sector is only able to detect an error on the „Left edge“, on the „Right edge“ and an error „In the middle” of the film, see Table 7-2, page 92. For the last error, the Automatic Sector generates an alarm, but the position of the detected error is not output. The subdivision of the Automatic Sector by subsectors allows the exact localization of a possible error.

The number of subsectors is freely definable. In the case of a change in the width of the Automatic Sector, all subsectors will change their width accordingly. The subsectors come with the same functionalities as the standard sectors (calculation of a sector result and the output on output modules, OPC, DDE, ...)

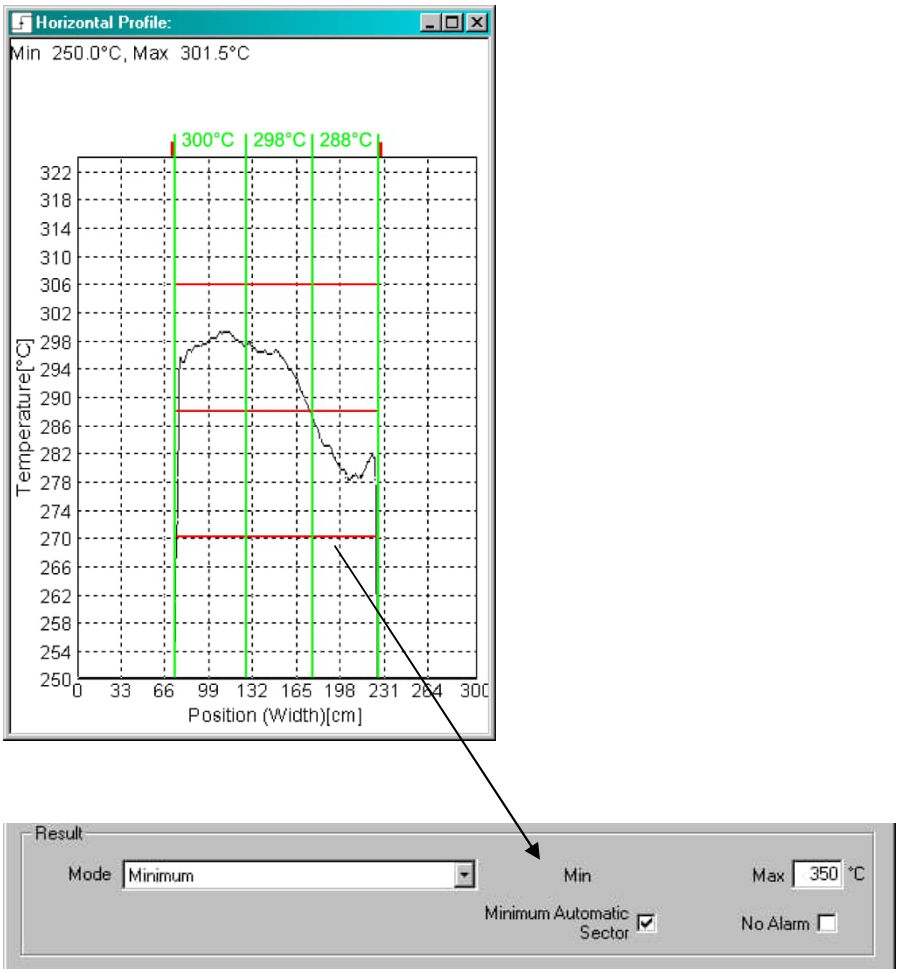
For subdividing the Automatic Sector, the option <with subsectors> must be activated, see Figure 7-2, page 89. The configuration of subsectors is the same as the configuring of the standard sectors, see section 4.6.1 Software Sector/Zone Button, page 36.

**Figure 7-4: Change in the Width: all 3 Subsectors are floating with the Automatic Sector**



Each new added subsector is preset to the sector result „Minimum“ whereby the minimum alarm is defined by the lower temperature threshold of the Automatic Sector.

**Figure 7-5: Sector Result for the Subsector**



# 8 GSLE System for Low-E Glass

## 8.1 Description

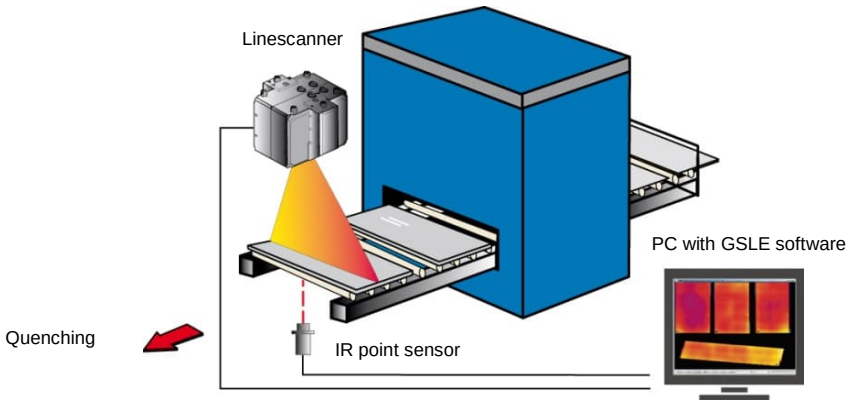
The GSLE is a Thermal Imaging System for Low Emissivity glass with automatic emissivity correction. The system was specifically designed to monitor and optimize the tempering process of one-side coated flat glass (Low-E glass). The GSLE incorporates all of the features of the proven GS System and can therefore be used for non-contact infrared temperature measurement also in other secondary glass-processing applications such as bending, forming, and annealing.

By design, Low-E glass has very low emissivity (high reflection) and the value is often unknown. Alternatively, the emissivity value specified by the supplier does not correlate to the actual emissivity at the process temperature. This presents a significant challenge to the process engineer, as correctly setting the emissivity value is essential for infrared temperature measurement. Simply scanning from the topside of the glass will provide erroneous readings, as the correct emissivity will not be factored into the temperature determination.

The GSLE system includes an IR point sensor that measures the temperature on the uncoated (bottom) side of the glass where the emissivity is known, the thermal image created by a linescanner can therefore be corrected. It can take up to three new glass loads before the automatic emissivity correction will occur.

By quickly detecting thermal irregularities within the glass and identifying defective heating elements, the GSLE allows glass processors to improve product quality and uniformity, and reduce scrap. If a fault or defect occurs, an alarm is triggered to allow for corrective action. Further, the GSLE system allows the user to set-up predefined recipes to accommodate frequent product changes.

**Figure 8-1: Basic Set-Up of the GSLE System**




The GSLE system has been developed specifically to correct the temperature distribution of a thermal image. Due to the low emissivity values, absolute temperature measurement of coated glass is not possible. For this reason, the system accuracy of the GSLE is not specified.

## 8.2 Scope of Delivery

The scope of delivery includes the following:

- GSLE system software
- Industrial power supply (100/240 VAC to 24 VDC)
- Specialized MI3 sensor with 8 m (26 ft) cable, Comm Box (metal), RS485 interface, air-purge jacket
- USB/RS485 adapter for MI3 sensor

## 8.3 Specification

The IR point sensor is a specialized MI3 sensor with air purge jacket, and Comm Box (metal) with RS485 interface.

| | |
|---|---|
| Temperature Range | 250 to 1650°C (482 to 3002°F) |
| Spectral Response | 5 µm |
| Optical Resolution | 30 : 1 (90% energy, focal distance 315 mm/12 in) |
| Ambient Temperature Sensing Head | max. 120°C (248°F) - without cooling |

**Figure 8-2: Specialized MI3 Sensing Head**

**Figure 8-3: Dimensions for Specialized MI3 Sensing Head**

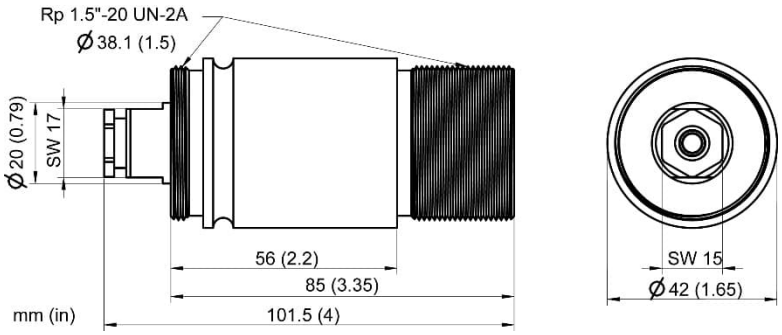
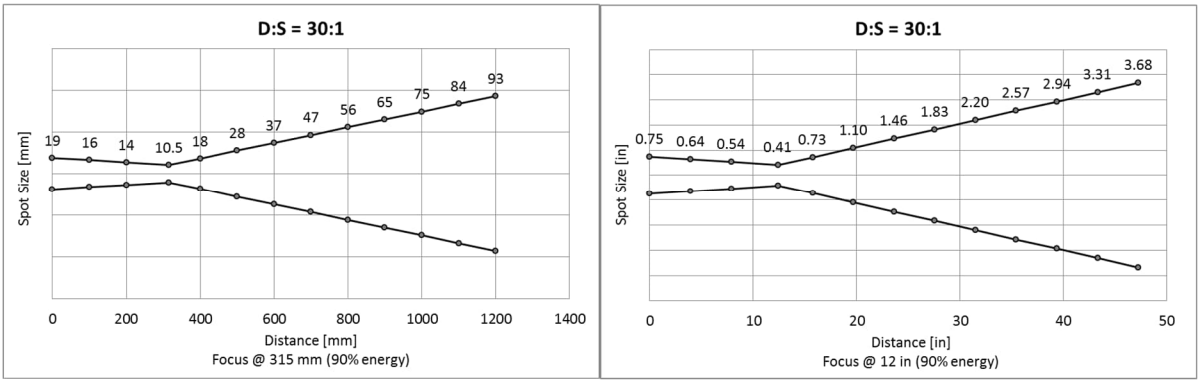



**Figure 8-4: Spot Size Chart for the IR Point Sensor**




For other technical data see MI3 operators manual.

For the linescanner specification, see the linescanner operators manual.

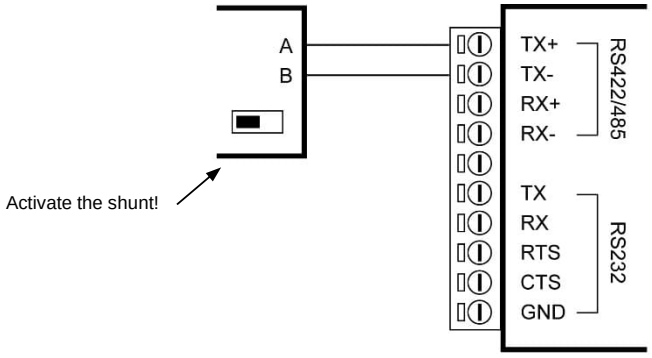
## 8.4 Installation

The IR point sensor requires a power supply from 8 to 32 VDC.

Connect the MI3 Comm Box to a PC via a COM port by using the USB/RS485 converter.

Connect the signal line as following shown:

**Figure 8-5: Wiring of MI3 Comm Box (left) and USB/RS485 Adapter (right)**




Make sure that the shunt resistor on the electronic board of the MI3 Comm Box is activated (only one sensor in the RS485 network), see figure above.

*Note*
*It is strongly recommended to use shielded and pair twisted cables (e.g. CAT.5)!*

For further installation instructions, see the MI3 manual!

**Figure 8-6: Installing the GSLE System**

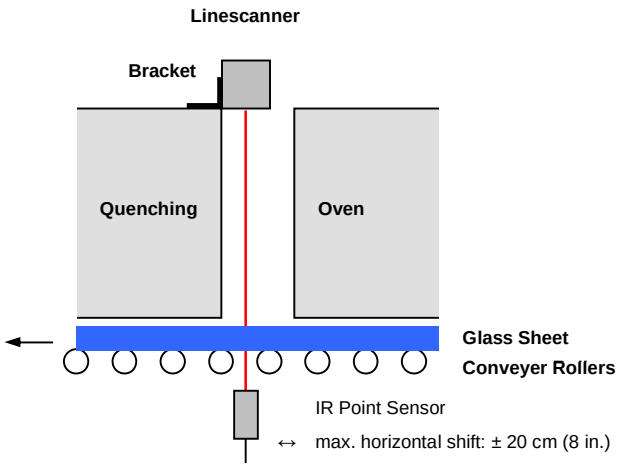
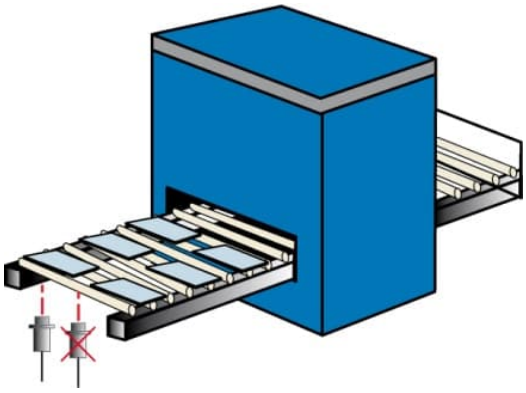


**Figure 8-7: Non-Centered Installation of the IR Point Sensor for Smaller Glass Sheets**



Before running the linescanner software, check the correct temperature readings for the IR point sensor by using the enclosed DataTemp Multidrop software!

*Note*

*To function properly, the optical path of the IR point sensor must be free from the conveyer rollers! Consider the sensor's optical resolution and the mounting distance!*

*The sensor's spot size at the given mounting distance needs to be a third (or smaller) of the distance between two conveyer rollers!*

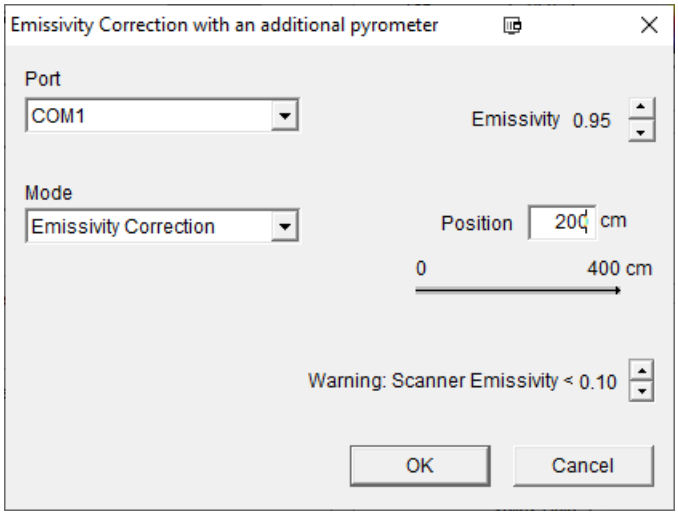
*Note*

*To function properly, the optical path of the linescanner must be not effected by the oven walls! Use the scanner laser sighting for a correct alignment!*

## 8.5 Configuration

To set up the IR point sensor, open the Configurator following the path: <Temperature> <Emissivity> <Correction with an additional pyrometer>.

**Figure 8-8: Configuring the IR Point Sensor**



| | |
|---|---|
| **<Port>** | COM port of a computer connected to the IR point sensor |
| **<Emissivity>** | Sets the emissivity for the bottom, uncoated side of the glass |
| **<Mode>** | Activates the emissivity correction for the top side of the glass |
| **<Position>** | Defines the position of the IR point sensor in relation to the width of the process, see Configurator on page <Geometry> <Image Dimensions> <Cross-direction>. |
| **<Warning>** | Defines the warning threshold for the corrected emissivity value. In the example, for a corrected scanner emissivity below 0.1 a warning message will appear in the running software. |

All settings must be applied by pressing the <OK> button.

*Note*

*A correct functioning of the system requires that the geometrical dimensions are mapped fittingly to the scanner's field of view using the function <Fit the image section to the configured geometry>, see section 5.8.4 Horizontal Profile, page 74.*

*Once the geometrical dimensions have been set correctly, they must not be changed later at runtime of the system!*

## 8.6 Operation

After starting the scanner software, emissivity correction will begin automatically. If necessary, this function can be disabled at any time by changing the selection on the <Option> <Emissivity correction> screen.

Both the IR point sensor and the linescanner can trigger the snapshot. To distinguish between the glass sheet temperature and the ambient temperature the background temperature defined in the Configurator under <Zone> <Background> <Ignore background temperature> is taken. If the background temperature is not defined, then the trigger temperature is taken, see the Configurator under <Trigger> <Trigger Source> <Temperature threshold>.

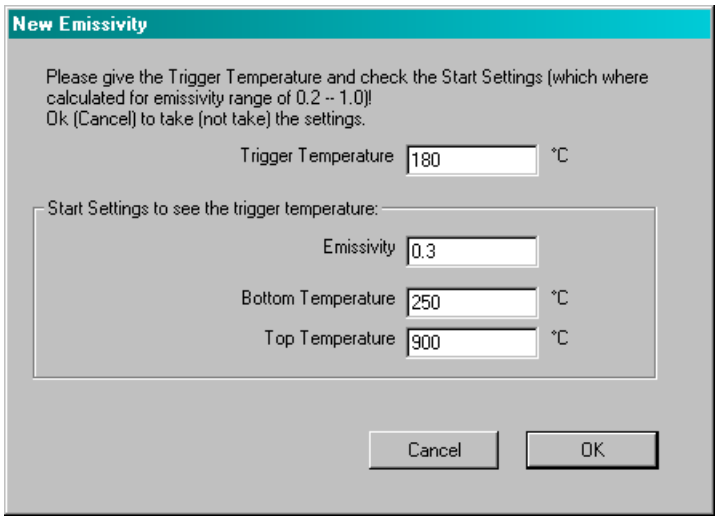
The temperature values of the IR point sensor are treated as zone results, this allows these temperature values to be viewed in either <Zone History> or <Zones in a Table> by making the appropriate selection in the <Windows> menu.

For a safe triggering of a snapshot, the following settings should be considered:

1. The emissivity value for the top coated side of the glass (Configurator: <Temperature> <Emissivity>) should be set as close as possible to the expected emissivity value to be corrected:
   Emissivity value of 0.95 for uncoated glass
   Emissivity value of 0.3 for coated glass
2. The current temperature range (Configurator: <Temperature> <Temperature range>) should be set as close as possible to the maximum temperature range given by the scanner (maximized span between top and bottom temperature range).

The menu <Option> <New Unknown Emissivity> in the scanner software supports you in setting the emissivity value and the temperature range in case of a failed triggering of snapshots as shown below:

**Figure 8-9: Dialog <New Emissivity> in the Scanner Software**




**<Trigger Temperature>** This is the temperature at which the system will detect the presence of a glass sheet in the field of view and therefore begin recording a snapshot image. This value should be set close to, but below, the estimated value of the glass sheet at this point in the process. Typically this value will be the same as entered in <Configurator> <Trigger> <Trigger Source> <Temperature threshold>.

**<Emissivity>** This value is the estimated value of the emissivity of the topside of the glass sheet. Although the system calculates emissivity automatically, it does so through an iterative calculation methodology. The more accurate that this value is the fewer iterations it will take for the system to provide the corrected emissivity.

**<Bottom Temperature / Top Temperature>** These values correspond to the upper and lower temperatures of the desired temperature range. The span between both should be maximized (for serial communication only). For Ethernet communication the upper and lower temperatures are always fixed to the maximum span.

*Note*

*To function properly, the optical path of both the IR point sensor and the linescanner must be clean and free from debris!*

*Note*

*The automatic emissivity correction feature will be enabled after the IR point sensor has captured data from one glass sheet!*

Coated glass sheets can have exceedingly low emissivity values. Emissivity values below 0.3 could cause erroneous temperature readings due to considerable reflection of the surrounding radiation. In the case of emissivity values below 0.3 a warning message will be displayed.

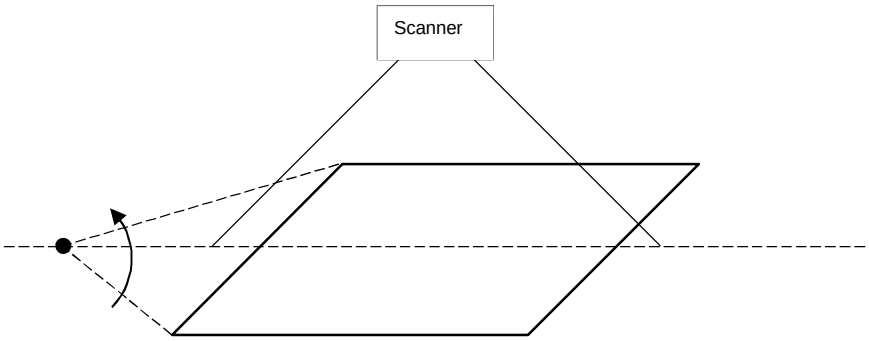
*Note*

*At low emissivity values we strongly recommend that the system be rigorously tested and if necessary, preventative measures should be taken such as moving heat sources or shadowing the linescanner to avoid excessive reflected energy!*

# 9 TF Rotary Image Correction

Measuring the temperature distribution of a sheet as it exits a thermoforming oven allows thermoformers to adjust the oven heating zone temperatures to achieve the desired sheet temperature uniformity. However, when a sheet indexes out of the oven, a shape distortion results on rotary thermoforming machines because the sheet traverses a curved path resulting in thermal images of non-rectangular shape and irregular dimension. The Rotary Image Correction corrects this distortion of the thermal image caused by non-linear sheet movement allowing accurate determination of heater zone average temperatures even with highly distorted thermal images.

**Figure 9-1: Arrangement of the Linescanner for Rotary Image Correction**




For the Rotary Image Correction, the following conditions need to be accomplished:

- The scan line has to run through the rotary center as shown with the red line in the figure above.
- The sheet has to move steadily, without any acceleration.

Please note, any deviation from these conditions will be appear as non-rectangularities in the resulting thermal image.

## 9.1 Configuration

Complete the following steps to configure the Rotary Image Correction.

- Take the distance D from the rotary point/center to the sheet's position
- Take the length L from the symmetry line to an edge which will be marked later in the snapshot.
- Open the context menu of the Snapshot view under the runtime software and enter the menu entry <Configuration of the Inverse Rotation>.
- Input the parameters L and D and mark the two points in the Snapshot view.

**Figure 9-2: Dialog <Configuration of the Rotation Inversion>**

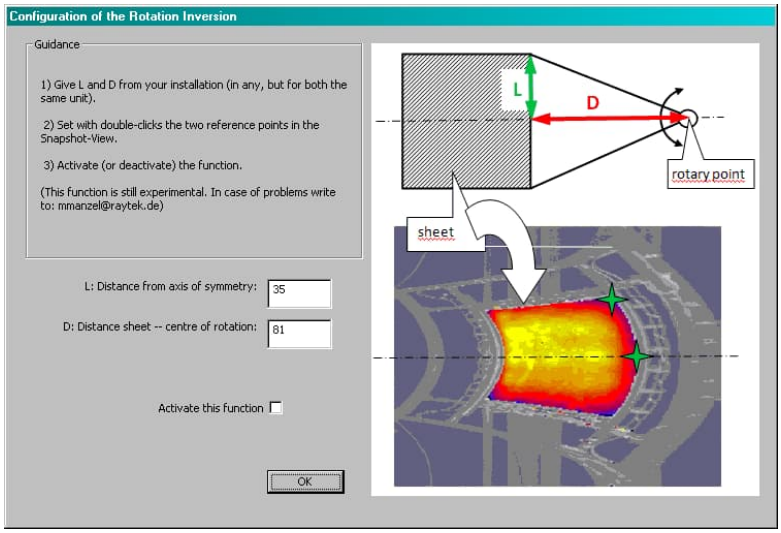



**Figure 9-3: Crossing points marking the endpoints for the distances L and D**

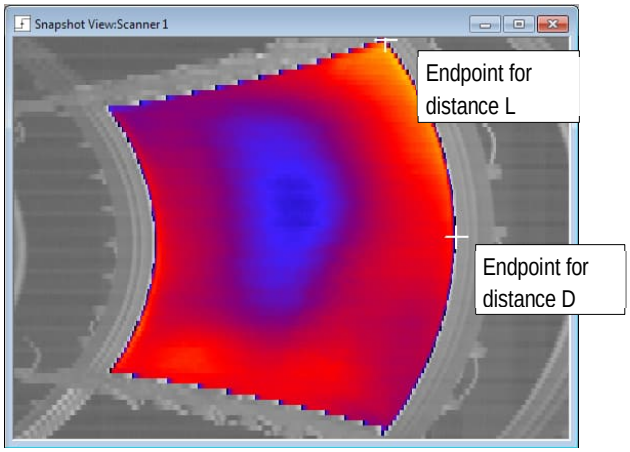
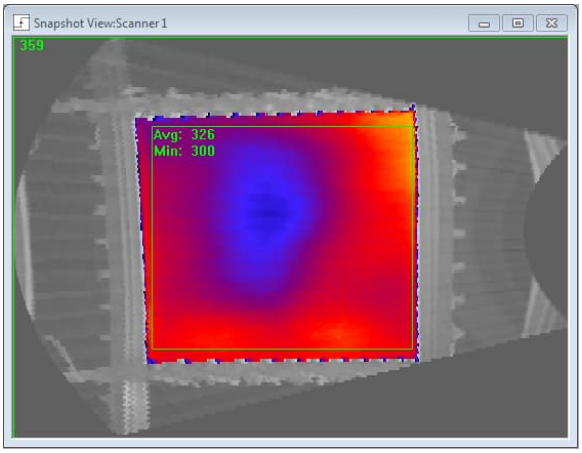



**Figure 9-4: Exemplary Thermal Image, finally corrected**



# 10 OPC

## 10.1 What is OPC?

OPC is an industry standard created through the collaboration of several leading worldwide automation and hardware software suppliers. This standard defines methods for exchanging real-time automation data among software clients. The organization that manages this standard is the OPC Foundation, for further information see http://www.opcfoundation.org/

OPC is a non-proprietary technical specification that defines a set of standard interfaces. The application of the OPC standard interface allows interoperability between automation/control applications, field systems/devices, and business/office applications.

Traditionally, each software or application developer was required to write a custom interface, or server/driver, to exchange data with hardware field devices. OPC eliminates this requirement by defining a common, high performance interface that permits this work to be done once, and then easily reused by HMI, SCADA, Control, and custom applications.

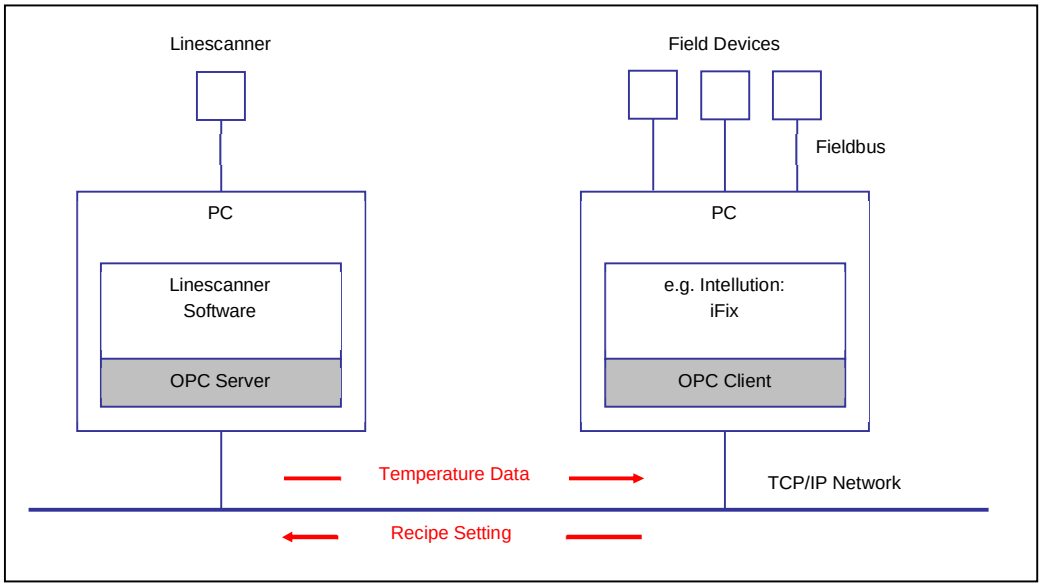
## 10.2 OPC Benefits

- Interoperability between field devices (e.g. Linescanner System), automation/control applications (e.g. Intellution iFix), and business/office applications (e.g. MS Excel). All relevant system data from the linescanner can be remotely read for process monitoring/controlling and for automated quality documentation (ISO 9000). Remote setting of complete configurations (recipes) allows the flexible adaptation of the linescanner system to product changes.
- Ease of software integration with Plug-and-Play connectivity. Traditionally, each software developer was required to write a custom interface to exchange data with hardware field devices. OPC eliminates this requirement by defining a standard software interface allowing interconnection of devices having OPC servers to computers, PLC's, DCS, or MMI/HMI machines.
- Time reduction through lower system integration efforts, because all software components adhere to a single standard interface. Once DTDP has been installed and the network has been set correctly, it only takes a few minutes to configure a OPC client to receive system data from DTDP.

## 10.3 OPC Server

The system offers an OPC software interface with its family of linescanners. The OPC server offers users flexibility of interfacing the linescanner directly with dozens of third-party MMI/HMI programs (e.g. Intellution, Siemens, and Matrikon).

**Figure 10-1: Principle Structure of Data Exchange via OPC Connectivity**




## 10.4 Verification of OPC Server

To facilitate testing of the OPC Server locally or in a network, an OPC demo client has been included along with the installation media of DTDP. This demo client is courtesy provided by the company Softing AG.

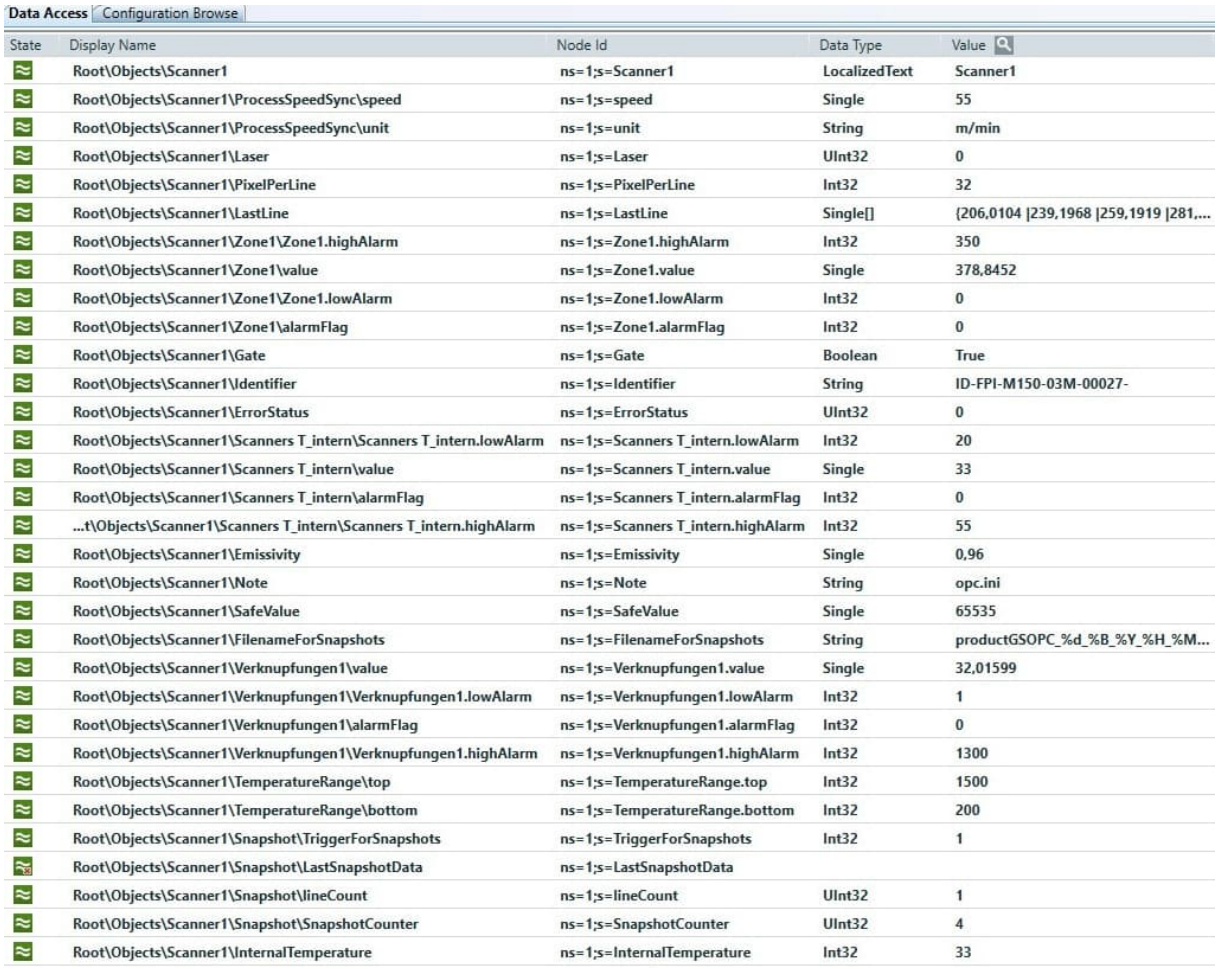
The manufacturer guarantees that DTDP software will work as an OPC server with the Softing Demo-Client when both are installed on the same computer. However, the customer is responsible for:

- Implementing OPC connections over their own networks / to their own clients
- Closing control loops and writing their own software for processing data from the OPC Server.

*Note*

*Problems connecting OPC clients and servers are almost never related to OPC. Such problems almost always relate to network access issues!*

**Figure 10-2: Exemplary Connection of the OPC Server to the Softing OPC UA Client**



Data Access | Configuration Browse

| State | Display Name | Node Id | Data Type | Value |
|---|---|---|---|---|
| | Root\Objects\Scanner1 | ns=1;s=Scanner1 | LocalizedText | Scanner1 |
| | Root\Objects\Scanner1\ProcessSpeedSync\speed | ns=1;s=speed | Single | 55 |
| | Root\Objects\Scanner1\ProcessSpeedSync\unit | ns=1;s=unit | String | m/min |
| | Root\Objects\Scanner1\Laser | ns=1;s=Laser | UInt32 | 0 |
| | Root\Objects\Scanner1\PixelPerLine | ns=1;s=PixelPerLine | Int32 | 32 |
| | Root\Objects\Scanner1\LastLine | ns=1;s=LastLine | Single[] | {206,0104 \|239,1968 \|259,1919 \|281,... |
| | Root\Objects\Scanner1\Zone1\Zone1.highAlarm | ns=1;s=Zone1.highAlarm | Int32 | 350 |
| | Root\Objects\Scanner1\Zone1\value | ns=1;s=Zone1.value | Single | 378,8452 |
| | Root\Objects\Scanner1\Zone1\Zone1.lowAlarm | ns=1;s=Zone1.lowAlarm | Int32 | 0 |
| | Root\Objects\Scanner1\Zone1\alarmFlag | ns=1;s=Zone1.alarmFlag | Int32 | 0 |
| | Root\Objects\Scanner1\Gate | ns=1;s=Gate | Boolean | True |
| | Root\Objects\Scanner1\Identifier | ns=1;s=Identifier | String | ID-FPI-M150-03M-00027- |
| | Root\Objects\Scanner1\ErrorStatus | ns=1;s=ErrorStatus | UInt32 | 0 |
| | Root\Objects\Scanner1\Scanners T_intern\Scanners T_intern.lowAlarm | ns=1;s=Scanners T_intern.lowAlarm | Int32 | 20 |
| | Root\Objects\Scanner1\Scanners T_intern\value | ns=1;s=Scanners T_intern.value | Single | 33 |
| | Root\Objects\Scanner1\Scanners T_intern\alarmFlag | ns=1;s=Scanners T_intern.alarmFlag | Int32 | 0 |
| | ...t\Objects\Scanner1\Scanners T_intern\Scanners T_intern.highAlarm | ns=1;s=Scanners T_intern.highAlarm | Int32 | 55 |
| | Root\Objects\Scanner1\Emissivity | ns=1;s=Emissivity | Single | 0,96 |
| | Root\Objects\Scanner1\Note | ns=1;s=Note | String | opc.ini |
| | Root\Objects\Scanner1\SafeValue | ns=1;s=SafeValue | Single | 65535 |
| | Root\Objects\Scanner1\FilenameForSnapshots | ns=1;s=FilenameForSnapshots | String | productGSOPC_%d_%B_%Y_%H_%M... |
| | Root\Objects\Scanner1\Verknupfungen1\value | ns=1;s=Verknupfungen1.value | Single | 32,01599 |
| | Root\Objects\Scanner1\Verknupfungen1\Verknupfungen1.lowAlarm | ns=1;s=Verknupfungen1.lowAlarm | Int32 | 1 |
| | Root\Objects\Scanner1\Verknupfungen1\alarmFlag | ns=1;s=Verknupfungen1.alarmFlag | Int32 | 0 |
| | Root\Objects\Scanner1\Verknupfungen1\Verknupfungen1.highAlarm | ns=1;s=Verknupfungen1.highAlarm | Int32 | 1300 |
| | Root\Objects\Scanner1\TemperatureRange\top | ns=1;s=TemperatureRange.top | Int32 | 1500 |
| | Root\Objects\Scanner1\TemperatureRange\bottom | ns=1;s=TemperatureRange.bottom | Int32 | 200 |
| | Root\Objects\Scanner1\Snapshot\TriggerForSnapshots | ns=1;s=TriggerForSnapshots | Int32 | 1 |
| | Root\Objects\Scanner1\Snapshot\LastSnapshotData | ns=1;s=LastSnapshotData | | |
| | Root\Objects\Scanner1\Snapshot\lineCount | ns=1;s=lineCount | UInt32 | 1 |
| | Root\Objects\Scanner1\Snapshot\SnapshotCounter | ns=1;s=SnapshotCounter | UInt32 | 4 |
| | Root\Objects\Scanner1\InternalTemperature | ns=1;s=InternalTemperature | Int32 | 33 |

## 10.5 OPC Items

**Table 10-1: Items for OPC UA and OPC DA**

| Item | Permission | Description |
|---|---|---|
| configfile | Read & write | Refers to the current used configuration file |
| Scanner1.Scanners T_intern.value | Read only | Internal temperature of scanner |
| Scanner1.Scanners T_intern.alarmFlag | Read only | Alarm status for internal temperature of scanner |
| Scanner1.Scanners T_intern.lowAlarm | Read & write | Low alarm threshold for internal temperature of scanner |
| Scanner1.Scanners T_intern.highAlarm | Read & write | High alarm threshold for internal temperature of scanner |
| Scanner1.Zone1.value<br>Scanner1.Sector1.value | Read only | Zone result<br>Sector result |
| Scanner1.Zone1.alarmFlag<br>Scanner1.Sector1.alarmFlag | Read only | Zone alarm status<br>Sector alarm status |
| Scanner1.Zone1.lowAlarm<br>Scanner1.Sector1.lowAlarm | Read & write | Zone low alarm threshold<br>Sector low alarm threshold |
| Scanner1.Zone1.highAlarm<br>Scanner1.Sector1.highAlarm | Read & write | Zone high alarm threshold<br>Sector low alarm threshold |
| Scanner1.Relations1.value | Read only | Result for Relation1 |
| Scanner1.Relations1.alarmFlag | Read only | Alarm status for Relation1 |
| Scanner1.Relations1.lowAlarm (OPC UA only) | Read & write | Lower alarm threshold for Relation1 |
| Scanner1.Relations1.highAlarm (OPC UA only) | Read & write | Upper alarm threshold for Relation1 |
| Scanner1.LastLine | Read only | Temperature line as discrete pixels |
| Scanner1.Snapshot.LastSnapshotData (OPC UA only) | Read only | Temperature array to transfer the last snapshot<br>Array size: pixel per line * lines per snapshot |
| Scanner1.Emissivity | Read & write | Emissivity value |
| Scanner1.SnapshotCounter | Read only | Life counter: increased by one with each new snapshot (discrete processes) or each new temperature line (continuous processes) |
| Scanner1.SafeValue | Read & write | Defines the value for the sector/zone result in case of invalid temperatures within the sector/zone exclusively (all pixel considered as background) |
| Scanner1.Note | Read & write | Description for the snapshot (e.g. batch number) |
| Scanner1.InternalTemperature | Read only | Internal temperature of linescanner |
| Scanner1.PixelperLine | Read only | Number of pixel per line |
| Scanner1.FilenameForSnapshots | Read & write | Defines the file name to be used in case of saving a snapshot |
| Scanner1.TemperatureRange.bottom | Read<br>(writing for MP50 models only) | Bottom temperature range of scanner |
| Scanner1.TemperatureRange.top | Read<br>(writing for MP50 models only) | Top temperature range of scanner |
| Scanner1.Gate | Read & write | Measurement gate for the whole system<br>0 = data acquisition stops; 1 = data acquisition proceeds<br><Scanner1.Gate> is only changeable with deactivated checkbox <Stop measurement with signal at external Alarm Module>, see <Input/Output> page of the Configurator |
| Scanner1.ProcessSpeedSync.speed | Read & write | Actual process speed in the given unit |
| Scanner1.TriggerForSnapshot | Read & write | Triggers the capturing of a snapshot |
| Scanner1.Snapshot.triggerTemperature | Read & write | Trigger temperature for the automatic capturing of a snapshot |
| Scanner1.GenericSector.sector0.value | Read only | Result of generic sector 0 |
| Scanner1.GenericSector.sector0.left | Read only | Left edge position of generic sector 0 in the current length dimension |
| Scanner1.GenericSector.sector0.right | Read only | Right edge position of generic sector 0 in the current length dimension |
| Scanner1.GenericSector.sector0.alarmFlag | Read only | Alarm status for generic sector 0 |
| Scanner1.AutomaticSector.left | Read only | Left edge position of automatic sector in the current length dimension |

| Item | Permission | Description |
|---|---|---|
| Scanner1.AutomaticSector.right | Read only | Right edge position of automatic sector in the current length dimension |
| Scanner1.AutomaticSector.avg | Read only | Temperature average within the automatic sector |
| Scanner1.AutomaticSector.min | Read only | Temperature minimum within the automatic sector |
| Scanner1.AutomaticSector.max | Read only | Temperature maximum within the automatic sector |
| Scanner1.AutomaticSector.alarmFlag | Read only | Alarm status for automatic sector 0 |
| Scanner1.AutomaticSector.leftAveragedBy32 | Read only | Averaged left edge position of automatic sector in the current length dimension |
| Scanner1.AutomaticSector.rightAveragedBy32 | Read only | Averaged right edge position of automatic sector in the current length dimension |
| Scanner1.Laser | Read & write | Toggles the scanner internal laser on/off |
| Scanner1.Identifier | Read only | Provides the identifier of the scanner device |
| Scanner1.ErrorStatus | Read only | Provides the error status for the scanner, see the linescanner manual for more information |

Notes:

- <Scanner1> stands for the name of the scanner, changeable under <Name of Scanner> on the <General> page of the Configurator.
- Automatic sectors are only available for EC systems.
- Generic sectors are only available for ES systems.
- The maximal number of generic sectors via OPC is limited to 7.
- The alarm flags can assume the following states:
  - -1 → alarm on violation of the lower alarm threshold
  - 0 → no alarm, within the alarm thresholds
  - 1 → alarm on violation of the upper alarm threshold

## 10.6 OPC UA and OPC DA

The current state for OPC is the specification OPC UA (OPC Unified Architecture). OPC UA is the successor of the still widely used but obsolete OPC DA, which is also known as OPC Classic. The disadvantage of OPC DA is that it is based on the Microsoft technology COM and DCOM and is therefore limited to Microsoft Windows operating systems and networks. The successor OPC UA pursues the goal of platform independence and thus enables OPC installations also under Linux or in web environments, for example. The OPC standard is based on fundamental web technologies such as TCP/IP and http.

## 10.7 OPC DA and DCOM

The DCOM protocol is the basis for OPC communication using OPC DA. DCOM (**D**istributed **C**omponent **O**bject **M**odel) is a Microsoft proprietary technology for software components distributed across several networked computers. However, to avoid DCOM configuration problems, experience has shown that it is neither practical nor easy to establish a DCOM connection between remote OPC applications. It is therefore recommended to use the OPC tunnel technology instead of DCOM.

*Note*
*OPC DA connections within a PC use the COM model instead of DCOM. COM can usually be used directly without special configurations!*

*Note*
*However, if DCOM is to be used anyway it is necessary to start the scanner software one times! This is needed to register the DCOM Server <dtdp>!*

*Note*
*On the data carrier you can find an OPC DA client[1] to test your OPC connectivity!*

*Note*
*As a general note, you would be wise to disable any firewalls for testing purposes - that is often the source of problems!*

On the data carrier you can find a white paper[2] how to configure DCOM and Firewall settings step by step. No responsibility is taken for the application or misapplication of the information presented.

## 10.8 OPC and DDE

The DTDP software comes already with DDE connectivity. However, OPC should be the interface of choice, because DDE is limited to the output of sector/zone results. OPC is much more robust in real-time data exchange in industrial environments. So, all data is marked with a quality flag and a time stamp. OPC tries automatically to re-establish disconnected communications. Changes in OPC settings can be done without a server shut down.

[1] © Softing AG
[2] © Kepware Technologies

# 11 DDE

The following examples describe the use of a DDE connection to another target application. It is shown how the DDE specific parameters <Service>, <Topic>, and <Item> are applied.

## 11.1 DDE with Microsoft Excel

<Service> To initiate a DDE connection with Microsoft Excel, "**Excel**" must be input as argument for <Service>.

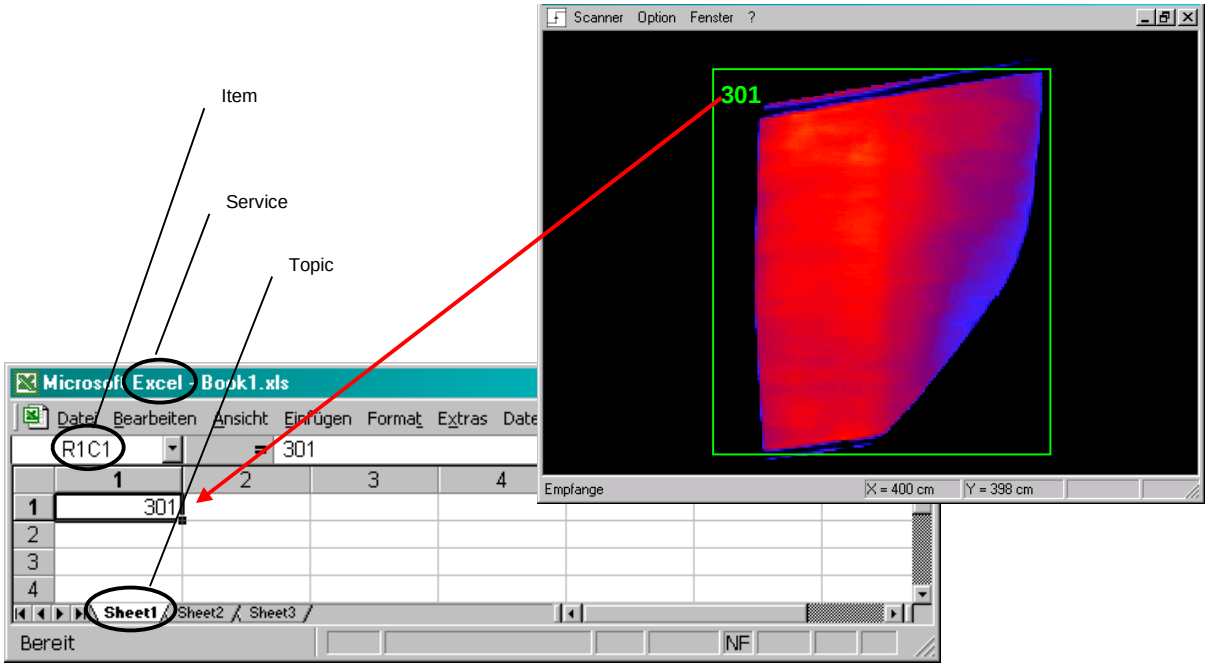
<Topic> <Topic> stands for the sheet name of an already opened Excel file. To initiate a DDE connection with that Excel file, e.g. "**Sheet1**" must be input as argument for <Topic>.

<Item> <Item> is the parameter to indicate a certain cell according to the row and column reference style in Microsoft Excel. The R1C1 reference style for cell addressing must be used. To initiate a DDE connection with the upper left cell of an Excel datasheet, "**R1C1**" must be input as argument for <Item>. Alternatively, a free defined cell name can also be used for the <Item>.

*Note*

*Microsoft Excel has set the A1 reference style for cell addressing as standard. A switching to the R1C1 reference style is possible (but not necessary) by means of the menu <Tools> <Options> <General> <Settings> and activating the checkbox <R1C1 reference style>.*

**Figure 11-1: Automatic Transfer of Zone Results to Microsoft Excel via DDE**

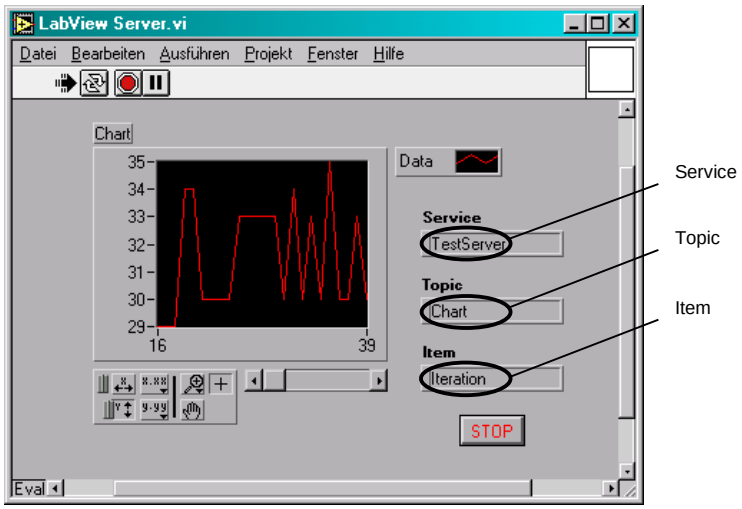



## 11.2 DDE with LabVIEW[3]

On the installation CD, there is the example libary „LabView Server.llb“ for LabVIEW 5.0. The library illustrates the DDE connection to the scanner software. After opening the library file (double click with the left mouse button), the file „LabView Server.vi“ must be selected in the launched file dialog. See following figure.

[3] LabVIEW is a product of DATATLOG, a National Instruments Company

**Figure 11-2: Automatic Transfer of Zone Results to LabVIEW via DDE**

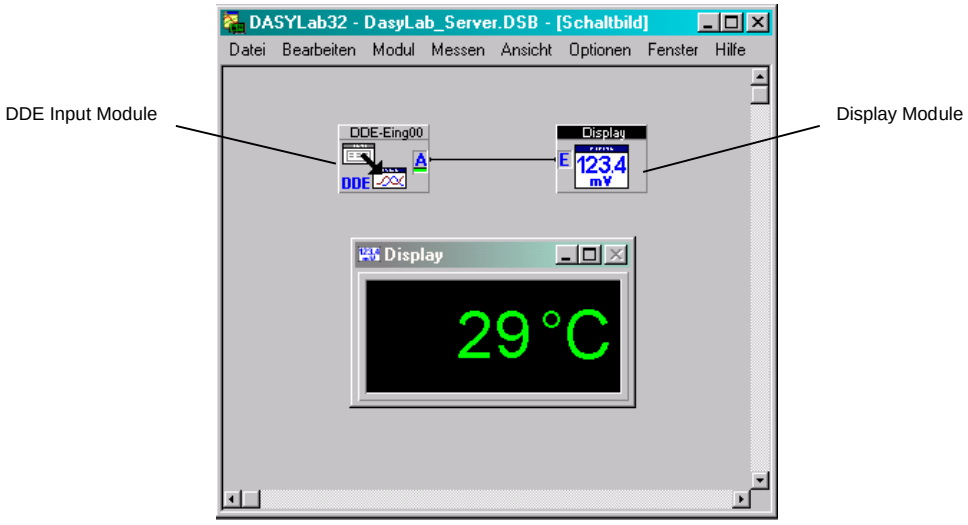



The DDE specific parameters <Service>, <Topic>, and <Item> are to be seen in the LabVIEW worksheet directly. If requested, the parameters are changeable in the according edit field.

## 11.3 DDE with DASYLab[4]

On the installation CD, there is the DASYLab example file „DasyLab_Server.dsb“. The file illustrates the DDE connection to the scanner software. The worksheet contains only two modules: the DDE Input Module and a Display Module, see following figure.

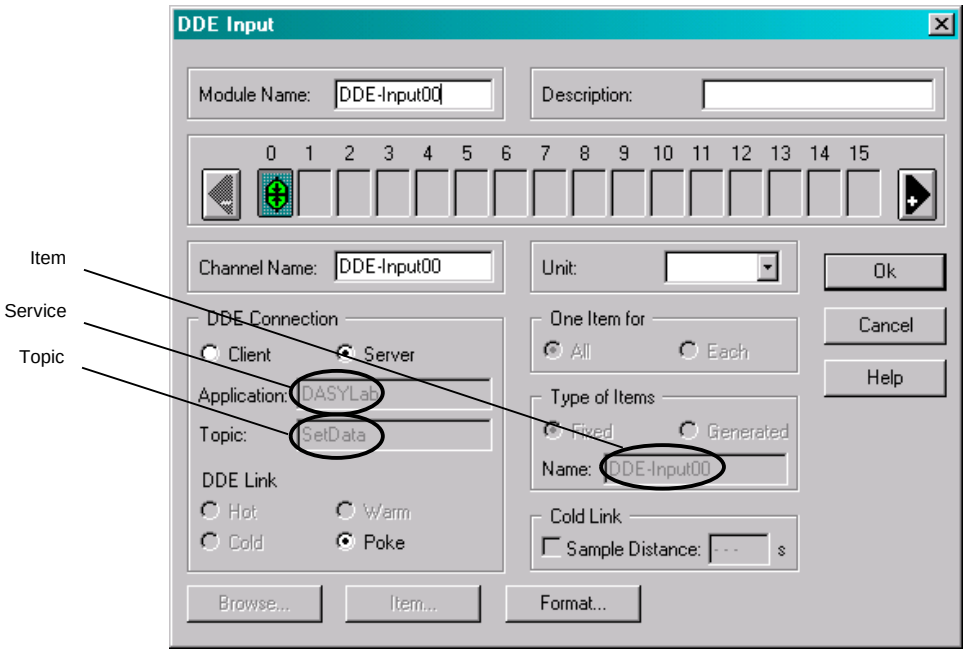
**Figure 11-3: DASYLab Worksheet for a DDE Connection with the Scanner Software**




The DDE specific parameters <Service>, <Topic>, and <Item> are to be seen in the property dialog of the DDE Input Module (double click with the left mouse button on the module). It must be ensured that in the parameter group <DDE Connection> the option <Server> is activated. See following figure.

[4] DASYLab is a product of National Instruments

**Figure 11-4: Property Dialog of DDE Input Module**




<Service> To initiate a DDE connection with the DASYLab, "**DASYLab**" must be input as argument for <Service>.

<Topic> "**SetData**" must be input as argument for <Topic>.

<Item> <Item> is the parameter to distinguish between more than one DDE Input Module in a worksheet. In the given example, "**DDE-Input00**" must be input as argument for <Item>, whereby the last two numbers stand for the number of the current DDE Input Module.

## 11.4 DDE with Microsoft Access

A DDE connection with Microsoft Access is not supported by the scanner software.

## 11.5 DDE with Mathcad[5]

The DDE functionality is supported by Mathcad only in Version 5 and 6.

[5] Mathcad is a product of MathSoft