



USER MANUAL

THERMAL IMAGERS
KT-560 • KT-650 • KT-670



USER MANUAL

THERMAL IMAGER KT-560 • KT-650 • KT-670

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Santa Clara, Ca USA**

**SONEL S.A.
Świdnica, Poland**

Version 1.12 04.08.2021



KT-560, KT-650 and KT-670 Thermal Imagers comply with current EU directives related to electromagnetic compatibility and safety.

All products of Sonel S.A. are manufactured in accordance with Quality Management System which is approved to ISO9001:2008 for the design, manufacturing and servicing.

Due the continuous development of our products, we reserve the right to introduce changes and improvements in the thermal imaging camera and in the software described in this manual without prior notice.

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1 Safety

Before you proceed to operate the camera, acquaint yourself thoroughly with the present manual and observe the safety regulations and specifications defined by the manufacturer.

- Any application that differs from those specified in the present manual may result in a damage to the device and constitute a source of danger for the user.
- The camera must not be used in rooms where special conditions are present e.g. fire and explosion risk.
- It is forbidden to use damaged or malfunctioning camera and is partially or fully out of order.
- In case the camera is not used for a long time, its batteries should be removed.
- It is not allowed to use the camera with half-closed or opened battery cover and do not use any other power adapter than the one supplied with the camera.
- Repairs may be carried out only by an authorised service point.

KT series Thermal Imagers are designed to measure and record the images in the infrared. The camera is constructed in a manner which gives you maximum performance and safe-ty at work, however the following precautions must be adhered to at all times (in addition to any advised precautions applicable at the relevant work-site or work area):

- Keep the camera steady during operation.
- Do not use the camera in ambient temperatures exceeding its operation and storage temperature ranges.
- **Do not direct the camera toward very high intensity radiation sources such as the sun, lasers or welding arcs etc.**
- Do not expose the camera to dust and moisture. When operating the device near water, ensure that it is adequately guarded against splashes.
- When the camera is not in use or is to be transported, ensure that the unit and its accessories are stored in the protective carry case.
- Do not obstruct the speaker holes in the camera's body.
- Do not re-switch on the imager before 30 seconds after switching it off and do not remove the battery when the imager is on.
- Do not throw, knock or shake intensely the camera and its components in order to avoid the damage.
- Do not attempt to open the imager's body, as this action will void the warranty.
- Keep the SD memory card for the exclusive use of the camera.
- During operation, if the camera is to be moved from hot/cold place to cold/hot place, e.g. from inside/outside to outside/inside of a room, switch the imager off and leave it in the new workplace for 20 minutes, then turn it on and start normal operation with an accurate temperature measurement. Sudden and rapid changes in ambient temperature may cause fault temperature measurement and even damage camera's IR detector.

- FPA calibration (FPA - Focal Plane Array): in order to ensure accurate temperature measurement, the FPA detector was calibrated in different temperature points. After switching the imager on, it performs auto calibration procedure every once in a while. During the calibration, for about 1 second, **the device does not respond to user's activity**, during this time the sound of a shutter clicking twice is heard. Calibration can be performed manually at any time. In order to do that, the 'C'(2) button needs to be programmed into 'Calibration' mode (the 'C' button programming process is described in chapter 11.1). Then, while in real time mode press 'C'(2) button and the calibration procedure will be carried out..
- During imager operation its housing temperature increases and it's a normal phenomenon.

NOTE!
KT-670 (KT-560, KT-650) Thermal imager has no parts that could be repaired or modified by its user. Never attempt to dismantle or modify the device. Opening up the unit invalidates the warranty.

NOTE!
Laser locator installed in the camera may be dangerous to eyes, in case of direct contact!
DO NOT DIRECTED THE LASER BEAM TOWARDS OTHER PERSONS OR ANIMALS!
Please note that the laser beam may reflect off shiny surfaces.
AFTER TURNING THE CAMERA ON, IT PERFORMS INTERNAL TEST, DURING WHICH, FOR FEW SECONDS, LASER POINTER IS BEING TURNED ON AS WELL. AFTER TURNING THE CAMERA ON, UNTIL IT REACHES THE POINT OF BEING FULLY OPERATIONAL IT IS FORBIDDEN TO AIM IT AT HUMAN AND ANIMALS!!

NOTE!
Use only standard and additional accessories, listed in "Equipment" section. Using other accessories does not ensure proper operation of the camera and may cause its damage.

NOTE!
Due to the continuous development of the device, the design of the display and its certain features may be slightly different than presented in this manual.

2 Description of the camera

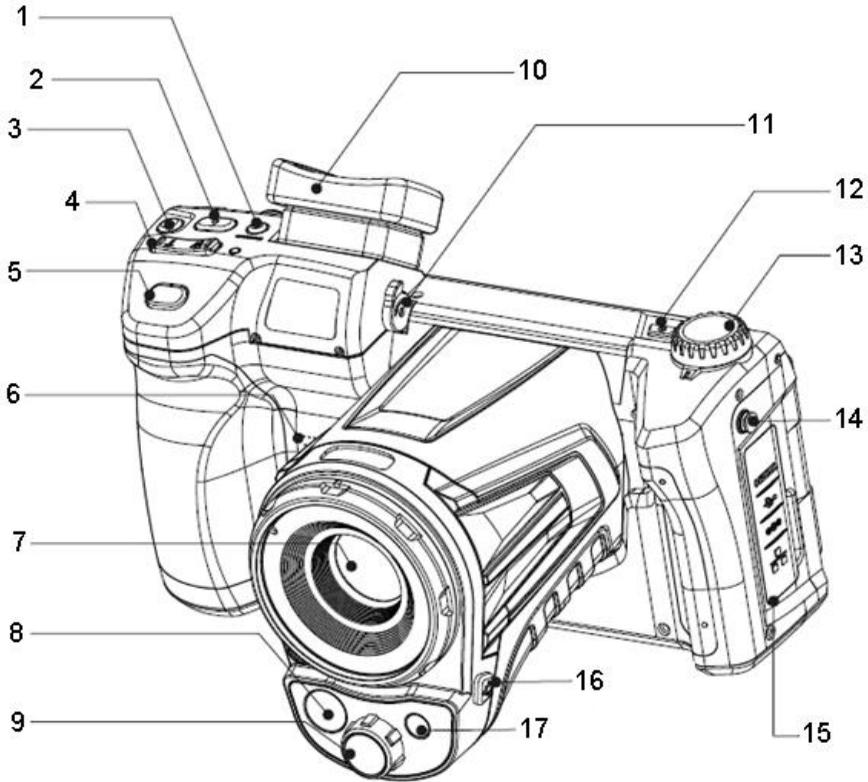
Thank you for purchasing our thermal imager.

KT series imagers are modern, high-quality, easy and safe to use measuring devices. Based on infrared, 640 x 480 (KT-560: 384 x 288) pixel detector allow to capture high-quality, fully radiometric thermal images. Our products combine high-quality measurement parameters with an innovative and intuitive interface, based on a new operating system, to create an intelligent solution in the field of thermal imaging. The camera operation, with a large, movable, touch screen is very comfortable. Together with the pivoting part of the camera body, where the high grade lens is located, these set of features create an ideal solution that brings the camera's ease of use to a new level, especially in places that require difficult angle shots. Thanks to the built-in viewfinder, bright outdoor lighting is not an issue. In addition to standard modes like IR (infrared), visual and PIP (picture in picture), the camera has a new mode for mixing images, overlapping and blending outlines of the visual image on the infrared image. User can take and store static images or record and save video clips. The available range of software tools allows an image analysis on the go, also in the live mode. Each infrared image can have a text note, voice annotation and/or sketch attached to it. With the provision of built-in GPS and compass, the camera automatically tags the locations where the pictures are being taken. On site reports are possible with the embedded PDF report editor. The camera provides a number of ways to connect with external devices, both wired (LAN, USB, HDMI) and wirelessly (Wi-Fi, KT-670: Bluetooth).

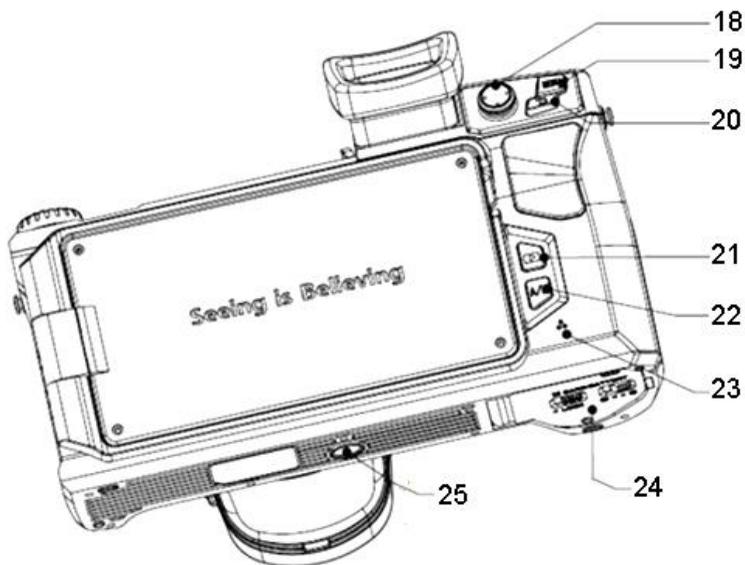
Please acquaint yourself with this manual to improve your daily work with the device, and to avoid measuring errors and prevent possible problems related to operation of the imager. The camera operation and available options may vary, depending on the camera model. This manual describes the operation based on the highest specs model available.

2.1 The camera body

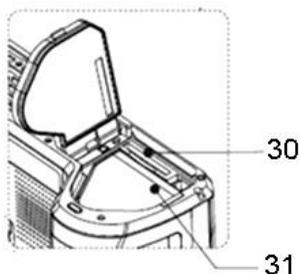
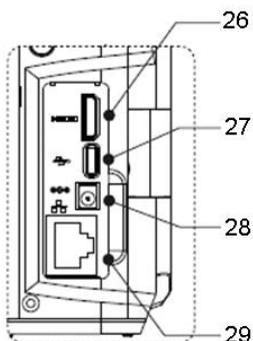
External parts of the camera body:



1	Display/View Finder switch button	9	Visual image lens
2	„C“ button (programmable)	10	Viewfinder
3	IR video capture button	11	Viewfinder Focus adjustment
4	Focus adjustment buttons (T – zoom in, W –zoom out)	12	Power On/Off button
5	Trigger button (freeze / save image)	13	Image mode selection dial
6	Speaker	14	Body of the camera
7	IR lens	15	connector cover (connectors described in following section)
8	LED flashlight	16	Laser pointer On/Off button
		17	Laser pointer



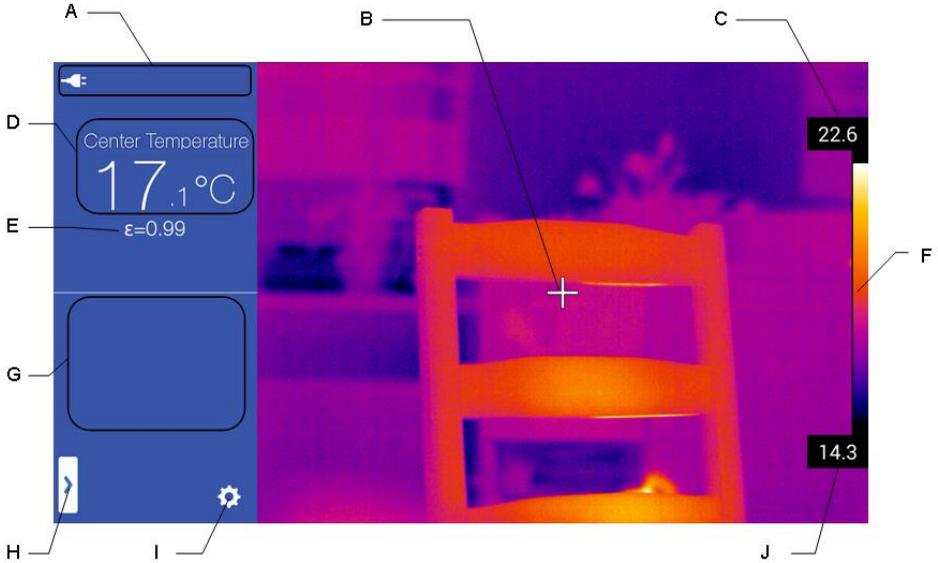
18	Joystick	22	Auto/Manual temperature range selection button
19	MENU button	23	Microphone
20	Return button	24	Battery/SD card chamber cover (description in following section)
21	View stored photos/videos	25	Tripod socket



26	HDMI (mini) connector	29	LAN (RJ45) connector
27	USB (micro) connector	30	SD card slot
28	Power supply connector	31	Battery chamber

Further on in this document, every reference to '[number in brackets]', refers to the camera description presented in the table and drawings above.

2.2 Arrangement of information on the screen



A	camera status information area	F	Palette
B	Central point (cursor)	G	Additional information field
C	The maximum temperature of presented range	H	Pop-up menu
D	Central point temperature	I	The camera's setup menu
E	Emissivity	J	The minimum temperature of presented range

Further on in this document, every reference to '[letter in brackets]', refers to the elements/buttons description presented in the above picture and table.

3 Operation Instructions And The Camera Adjustment

Camera operation and available options may vary depending on the version of the camera. This manual describes the operation based on the highest available camera configuration.

3.1 *Turning the camera on/off and the standby mode*

To switch on the camera, press and hold on/off button [12] for around 2 seconds.

A splash screen will be displayed, followed by the self-test procedure of the device. When the procedure is completed, the camera is ready to be used, and real time infrared image mode is on.

Short pressing the On / Off button [12] at working camera will turn off the screen and the camera will switch into a power saving mode (standby mode). A second press of on / off button [12] will resume the camera to its normal operation.

To switch off the camera completely, press and hold down on/off button [12], until following information appears on the screen: (POWER OFF?). The camera will then be switched off.

Press "OK" to turn off the camera or "Cancel" to cancel the switch off procedure.

3.2 *Displaying image on screen/viewfinder*

During the camera operation in real time mode the image can be displayed on either the LCD screen or in the viewfinder. Toggle between these two display modes with Display/View Finder switch button [1].

3.3 *Focus adjustment*

Focus can be adjusted in manual or in auto mode. Focus can be adjusted in manual or in auto mode. In manual mode aim the lens at the target and then move the joystick [18] up or down. For very precise focus setting move the joystick [18] left or right – focus will be adjusted automatically.

Another way to adjust the focus automatically is programming the 'C' (2) button into auto focus mode (the 'C' button programming process is described in chapter 11.1). Press it and the camera will focus, provided that the object, which the camera is being set to focus on, has a large enough thermal contrast. In case the auto focus results are dissatisfying, use the manual focus mode.

.

3.4 Enlarging the image – ZOOM

Image enlargement can be controlled. In order to do so, after aiming the camera on the measured object, use the zoom button [4]. Press the right side of the button (T) to enlarge the image (up to x4.0 or x10, depending on the camera model), press the left side of the button (W) to zoom out to the default size (x1.0).

Image magnification allows accurate focusing. It should be remembered that zooming is performed digitally. Despite the image magnification on the screen, the image that is saved into the memory is always of a default size (magnification x1.0).

3.5 Temperature range

The temperature range selection mode is selected by A/M (22) button or by the use of the touch screen, when the camera is in the real time mode, and when a real time infrared image is being displayed on screen.

Press A/M (22) button or click on the top or the bottom temperature value of the temperature bar on the right hand side of the touch screen, to switch from the automatic temperature mode into the manual mode. The shift will be indicated by the padlock icon

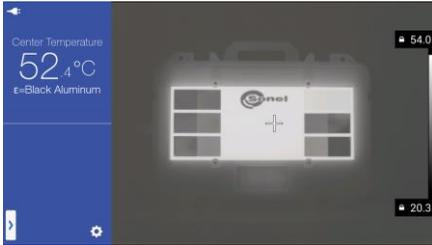
 appearing next to the top and the bottom values of the temperature range bar. Press on the selected temperature field (the top or the bottom of the temperature range bar) to get a window appear on the screen, that allows to change the selected temperature value. Move the displayed numbers up or down, to change the temperature value (the selected value is the one between the two horizontal lines).



After selecting desired value, close the temperature selection window by clicking anywhere outside its outline. Moreover moving the joystick [18] up or down sets both temperature range values. Clicking the joystick activates the focus adjustment (chapter 3.3). Press A/M (22) button to switch into automatic temperature selection mode.

3.6 Selecting the colour palette

Image palette selection is made by clicking the palette bar (F) on the screen. A window with a palette selection options will open. The currently selected palette is indicated by a check mark . Available palettes: (the choice may vary depending on the camera model):



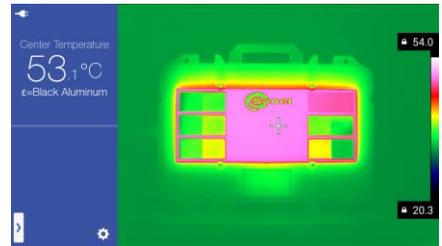
White Hot



Fulgurite



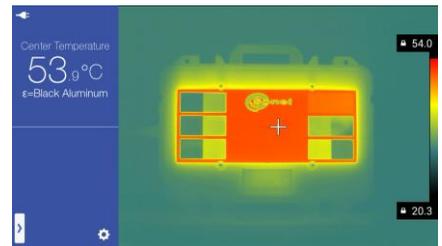
Brightness



Rainbow



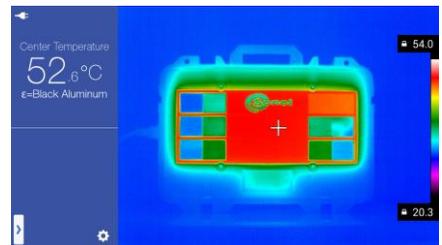
Arctic



Hot Iron



Layer



Medical

3.7 Manual Calibration

- During operation the camera performs auto calibration procedure every once in a while. During the calibration, for about 1 second, **the device does not respond to user's activity**, during this time the sound of a shutter clicking twice is heard. Calibration can be performed manually at any time. In order to do that, the 'C'(2) button needs to be programmed into 'Calibration' mode (the 'C' button programming process is described in chapter 11.1). Then, while in infrared real time mode press 'C'(2) button and the calibration procedure will be carried out.

3.8 Laser Pointer

Laser pointer can be activated, while being in real time mode, by pressing (16) button.

NOTE!
The laser beam may damage your eyes in case of contact, therefore DO NOT DIRECT YOUR EYES TOWARD THE LASER BEAM, and do not direct the laser beam toward people and animals! Pay particular attention, as the laser beam can reflect off the shiny surfaces.

3.9 Image modes

The camera captures both the thermal and the visual images. Use the knob [8] to select the displayed image mode. There are four modes available:

- IR – infrared image:



- VL – visual image:



- MIF- infrared image combined with visual image:



- PIP – picture in picture – both infrared and visual images are displayed:

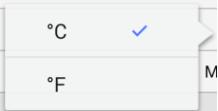


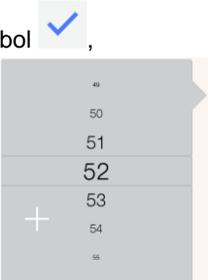
The infrared image can be moved to any place of the screen window. Click and press IR image and move it to the desired location:

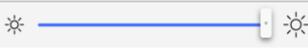


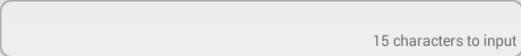
3.10 General rules for using on-screen menu

-  - button disabled,
-  - button enabled,

- selection window:  - select by clicking the desired value (parameter), the currently selected value is indicated by check mark symbol ,

- selection window with a circular scrolling list of values:  - Select by moving through the list up and down (the selected value is the one between the two horizontal lines). After selecting desired value, close the selection window by clicking anywhere outside its outline,

- slider:  - change the parameter by sliding left (decreasing value) or right (increasing value),

- text field:  - type values/characters by clicking the field and use the on-screen keyboard.

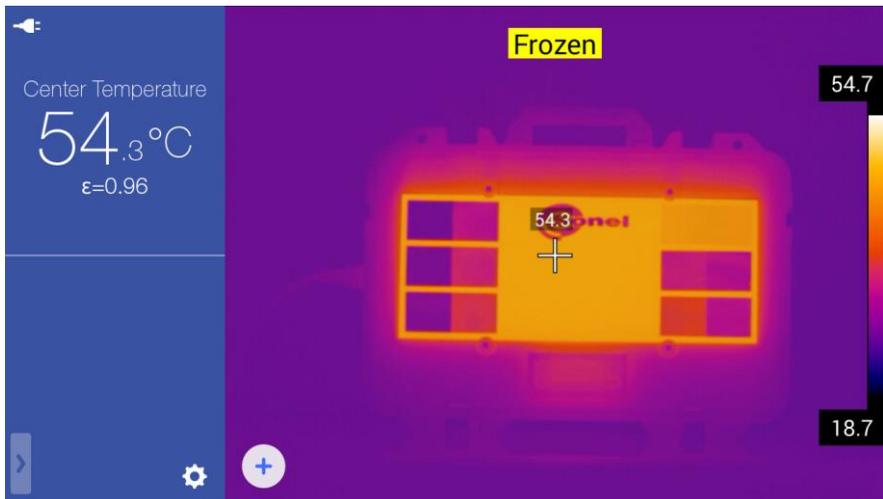
4 Capturing and saving images

Remarks:

1. Thermal image is saved in "extended jpeg format". Thanks to that it can be viewed in all image browsers and graphics softwares (stored preview image will be viewed in those cases). In addition to that all the information related to the thermogram is stored in one single extended jpeg file as well: temperature of each and every pixel of thermal image, voice annotation and image marks.
2. Editing thermal image in software other than Sonel ThermoAnalyze2 will result in losing all the thermographic data.
3. If there is not enough space to save a file on SD card or when a saving error occurs, proper information will be displayed on screen.
4. Saved thermal image file name is IR1xxxx.jpg (where xxxxx are digits). Additionally a separate file with a visual image is saved (as VISxxxx.jpg, where xxxxx is the same number as in its corresponding thermal image file name). Both files must be placed in the same folder if the visual image is to be used for an analysis in Sonel ThermoAnalyze2 program.

4.1 Manual mode for capturing and saving images

The camera displays image continuously. To capture an image, press trigger button [5] (its operation depends on the settings for the trigger button – description in chapter 11.1), which, with default settings for trigger button (freeze/take picture), will freeze an image and will display additional menu on screen. At the same time 'Freeze' mode indication will be displayed at the top of the screen, and the additional options icon  will appear at the bottom.



At this point:

- press the trigger button [5] again to save the thermal image along with its corresponding visual image into internal memory or into SD card.

- Clicking the additional options icon  will save an image and will proceed to the memory, where it is possible to edit the image, add annotation, create report and send it via the internet. Further proceeding is described in details in a following chapters of this manual.

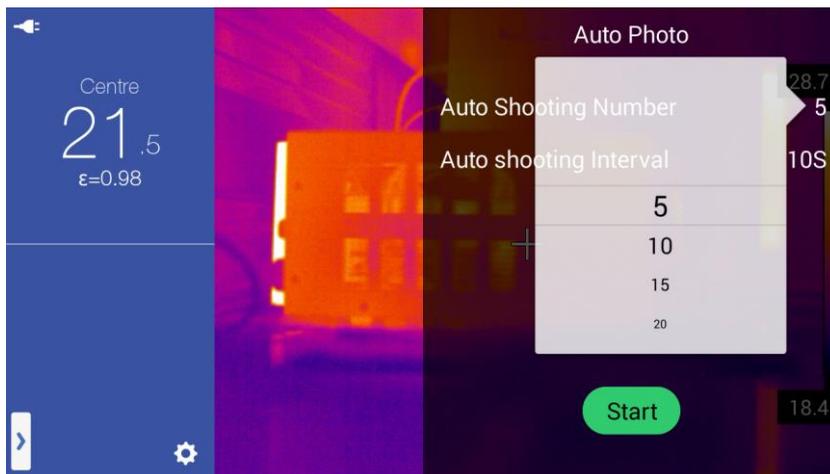
4.2 Automatic mode for capturing and saving images (KT-670)

KT-670 Thermal Imager allows capturing and saving images into both internal and external (SD card) memory automatically. This option is available through pop-up MENU upon

clicking its icon  [H] while in infrared mode.



Press Auto Photo icon  to open up a menu that allows to set a number of images to be taken and the time interval between them. To change these parameters click the value of each parameter individually.



After setting the parameters, start the automatic capture of images by pressing on-screen START button. The camera will then take predefined number of images and will store them into memory, resuming its operation in real time mode afterwards.

4.3 Saving images directly to PC hard drive.

Saving images on a hard drive requires connecting the camera with a PC, as described in chapter 16 of this manual, and following instructions provided in Sonel ThermoAnalyze2 user manual.

5 Recording and storing infrared videos

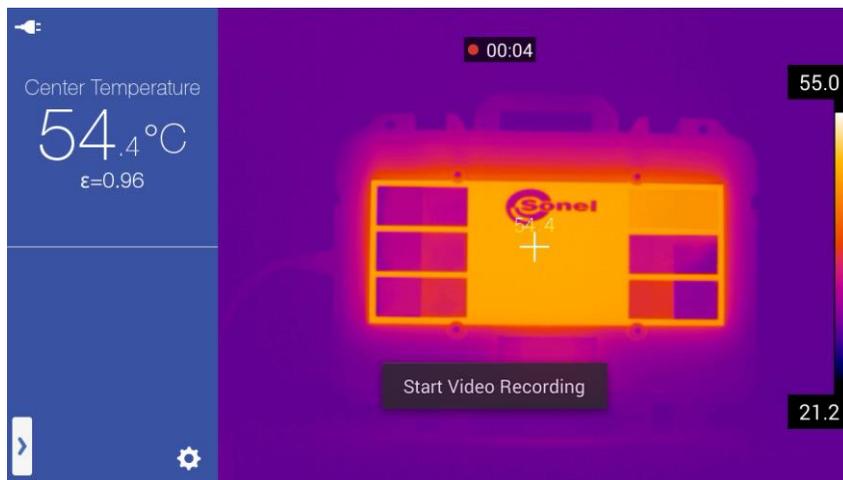
The camera allows to record infrared video in every available image mode:

- Infrared: knob [8] set on IR function;
- Visual: knob [8] set on VL function;
- MIF mode: knob [8] set on MIF function;
- PIP mode: knob [8] set on PIP function.

IR and VL video can be stored on both internal memory (or on SD card), and also directly on PC hard drive, using SoneI ThermoAnalyze2 program supplied with the camera. The recording can be performed in both manual and automatic(KT-670) modes. For infrared videos, whether recording on internal memory (or SD card), or directly on PC's hard drive, all information is being stored - each video frame is a thermogram, for which the temperatures of each point are stored and recorded independently (just like for the static images).

5.1 Manual mode for video recording

Recording video to internal memory or to SD card. Video recording starts after pressing IR video capture button [3]. The commencement of video registration is confirmed by the following notification displayed on the bottom of the screen: 'Start Video Recording'. Additionally, on top of the screen, an icon indicating video registration is displayed, with the recorded video duration next to it. .



Press IR video capture button [3] again to stop recording. The video file will then be stored, which will be confirmed by the following on-screen notification: 'Video is saved'. Stored IR video files can be browsed in the camera or played on a PC.

5.2 Automatic mode for video recording (KT-670)

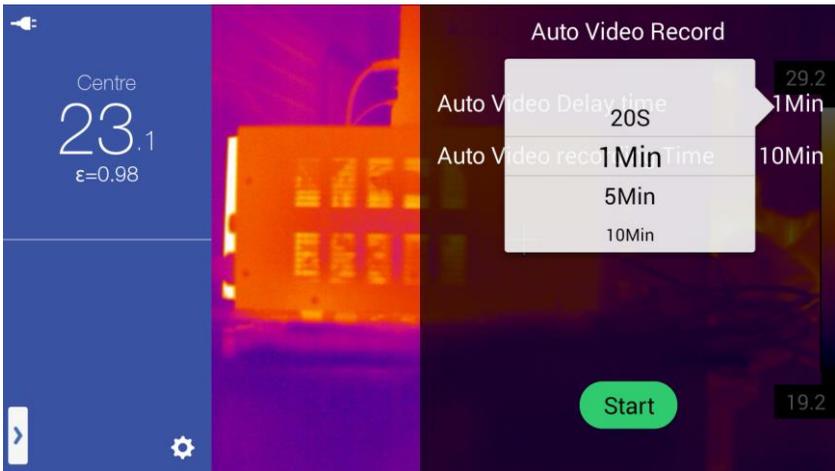
KT-670 Thermal Imager allows recording and saving video into both internal and external (SD card) memory automatically. This option is available through pop-up MENU.



Click the Auto Video Record icon  to open up a menu that allows to set:

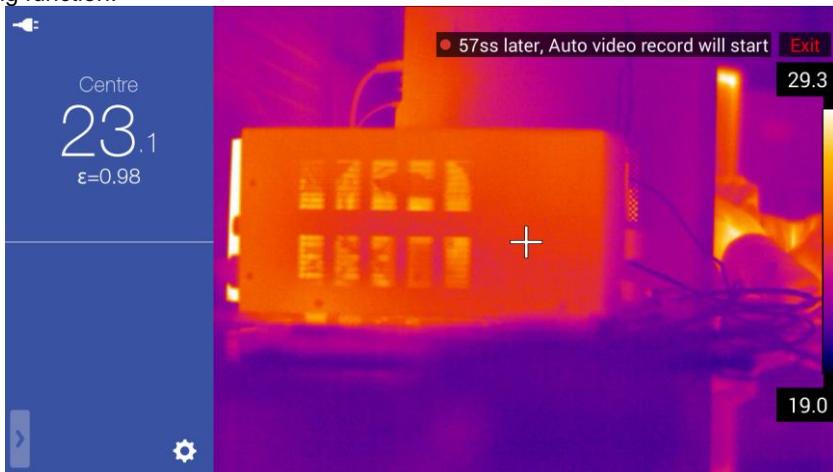
- Video Delay Time – the time that will pass before the actual video recording will commence, after pressing the START button. ;
- Video Recording Time – the time from the start till the end of the video recording.

To change these parameters click the value of each parameter individually.



After setting the parameters, start the video recording by pressing on-screen START button. In the upper right corner of the screen the camera will display notification on its readiness to commence video capturing, along with the information on the time that left before

starting video recording. ● 57ss later, Auto video record will start. Press Exit button in the upper right corner of the screen to cancel the countdown and exit auto video recording function.



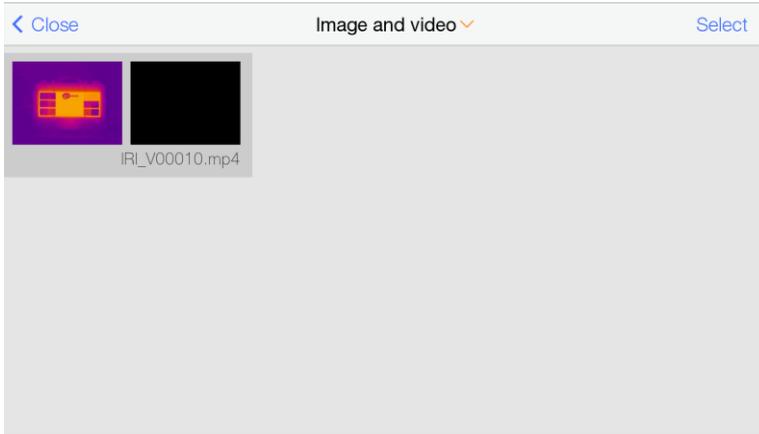
After the countdown is finished, the camera will start recording video, with the entire procedure and the screen layout during the process being the same as in the manual mode. After the video recording, with predefined time, is finished, the camera will automatically end the recording procedure, save the video into the memory, and will resume its operation in real time mode.

5.3 Recording video on hard drive

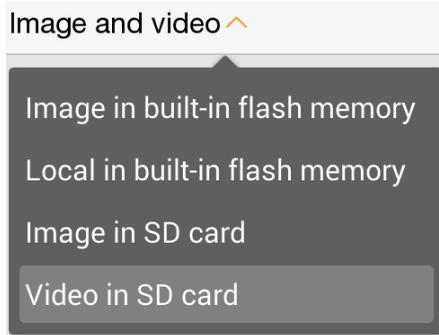
Recording videos into a hard drive requires connecting the camera with a PC, as described in chapter 16 of this manual, and following instructions provided in Sonel ThermoAnalyze2 user manual.

6 Memory browsing

Click the view stored photos/videos button [21] to switch into a viewing and editing mode of pictures stored in the internal memory (or on SD card). That will open a thumbnail preview window of the stored files. The list can be scrolled by touching and holding a finger on the screen and moving it up and down.



Click the 'Image and Video' (or) button to open up a selection menu that allows to select the file type to be displayed: IR images or IR videos (click the desired option to select it, and then close the window by clicking anywhere on the screen outside the window's outline).



Select 'Image in built-in flash memory' or 'Image in SD card' to display IR images stored in the memory. Click a thumbnail of an image to open it up in a preview mode, that also allows to preview its corresponding visual image. Additionally, a voice, text or a graphics

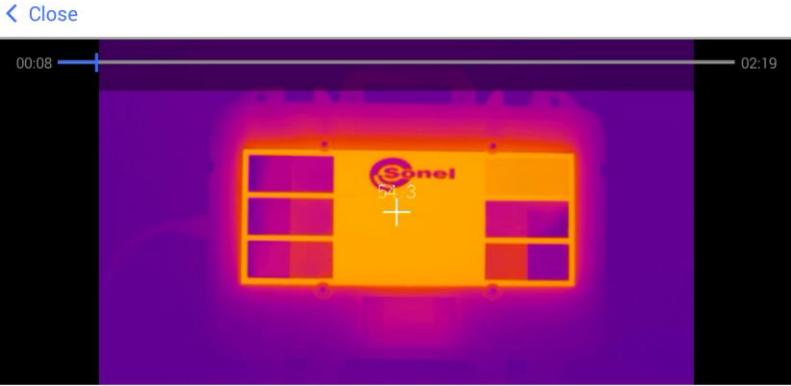
annotation can be added (click the on-screen button  to open up an annotation submenu - available options are described in Chapter 9), and perform the thermogram

analysis (Press on-screen 'Edit' button to open up an analysis submenu - options for an image analysis are described in Chapters 7 and 8).

Select 'Video in built-in flash memory' or 'video in SD card' to display IR videos stored in the memory. Click on a thumbnail of a video to open in up in a preview mode, that allows to:

- delete stored video file by clicking the trash bin icon  (a confirmation window will open: press OK to delete the file, or press Cancel to close the window without deleting it)

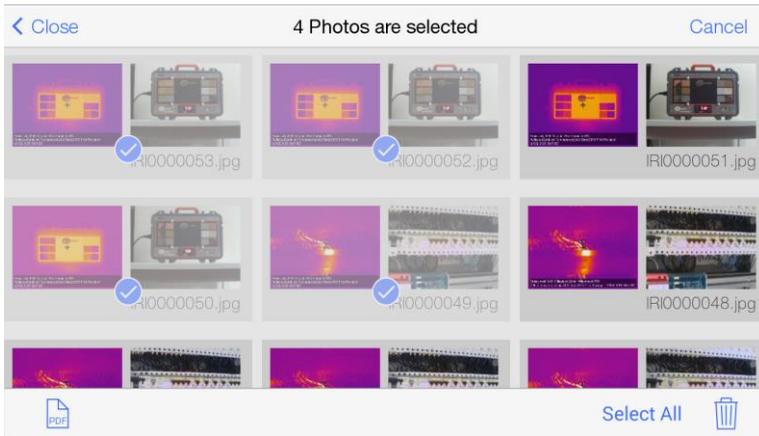
- play the recorded video by pressing play button icon . In video playback mode, after touching a screen while a video is being played, the player menu will open:



Stop the video by pressing pause button  or jump to any part of the video by pressing at the desired place on the playback progress bar:



It is possible to select multiple images or videos. In order to do that click the 'Select' button in the thumbnail preview window. That will open a bottom command bar. Now the multiple images or videos can be selected by clicking their thumbnails. Selected files are indicated by the check mark symbol :



The bottom command bar allows to switch into PDF report editor by clicking the  button (this option is available for IR images), to select all files by pressing **Select All** or to delete all files by pressing the trash bin button .

Press **< Close** or Return button [20], to return to the previous screens and to the real time mode.

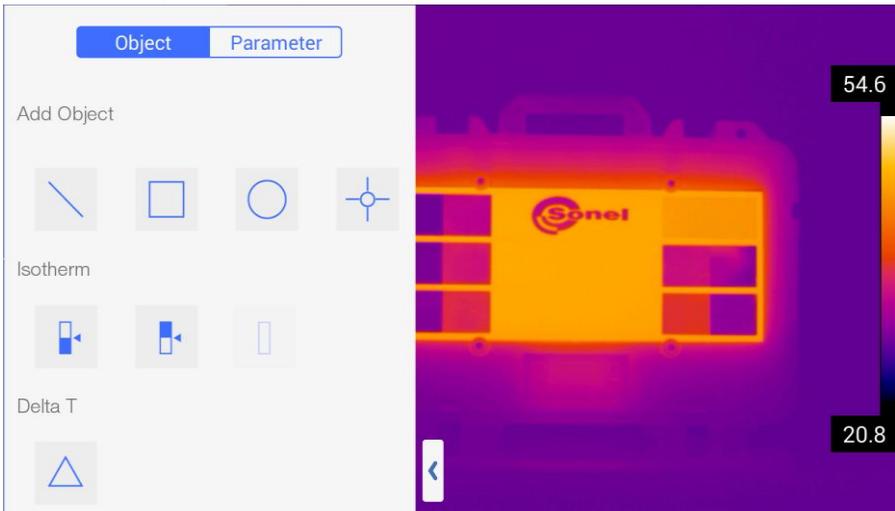
7 Thermal image analysis

Thermal image analysis is possible in every image mode - real time, frozen and for images stored in the memory.

Activating expanding analysis toolbar:

- in real time mode by clicking the pop-up menu icon  [H] and selecting 'Object' in selection bar: ;
- in Freeze mode by clicking the additional options icon ;
- for saved images, in browsing mode by selecting 'Edit' option.

A menu containing analysis objects will open up:



Delete analysis objects (all of them) by clicking the trash bin icon  in pop-up menu, and confirm your action by pressing OK.

7.1 Spot Analysis

Press  button on Pop-up menu to add an additional spot for temperature measurement on screen. The spot can be moved to any place on the screen (click and hold down the spot and move it to desired place). Depending on the camera model, from 5 to 10 spots can be added to the screen. The temperature readout for every spot is displayed on the left side of the screen, in the additional information field [G]. The points are marked with 'P' letter with subsequent number.

The spot parameters can be edited. Press on and hold the spot, without moving it, to open a menu with the spot parameters:

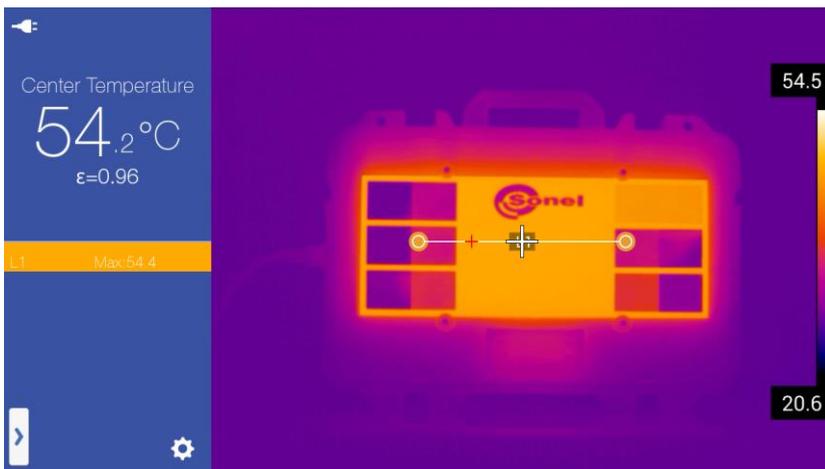


The 'Marking' option turns on/off a description of the spot marker. The 'Center' option moves the spot to the center of the screen.

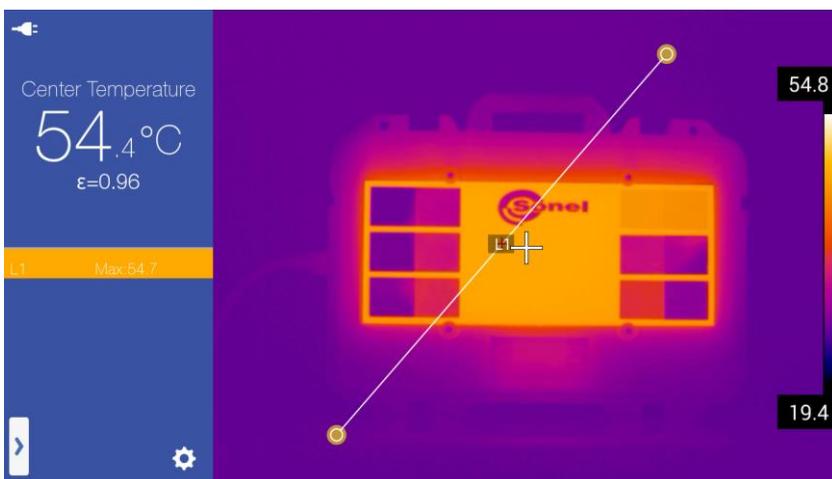
Remove the spot by clicking the  symbol.

7.2 Line Analysis

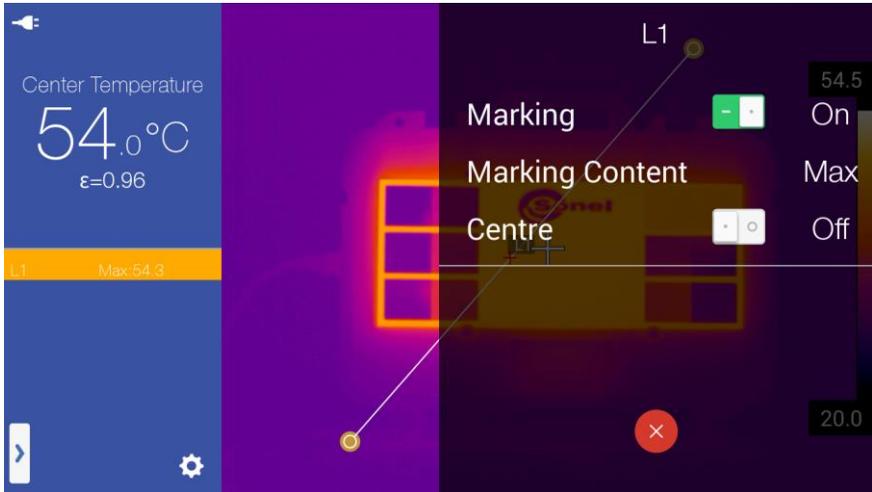
Press  button on pop-up menu to add a line on screen. When added, the line appears in the center of the screen. The line can be moved to any place on the screen (click and hold down the center part of the line and move it to a desired place on screen). Depending on the camera model, from 2 to 10 lines can be added to the screen. The temperature readouts for every line (min, max or average) is displayed on the left side of the screen, in the additional information field [G]. The lines are marked with 'L' letter with subsequent number.



The shape and the position of the line can be modified (rotate, lengthen, shorten). This can be done by changing the position of its endpoints. This can be done by pressing and holding the selected end of the line (marked ) and move it to the desired location on the screen.



The line parameters can be edited. Press on and hold the center part of the line, without moving it, to open a menu with the line parameters:



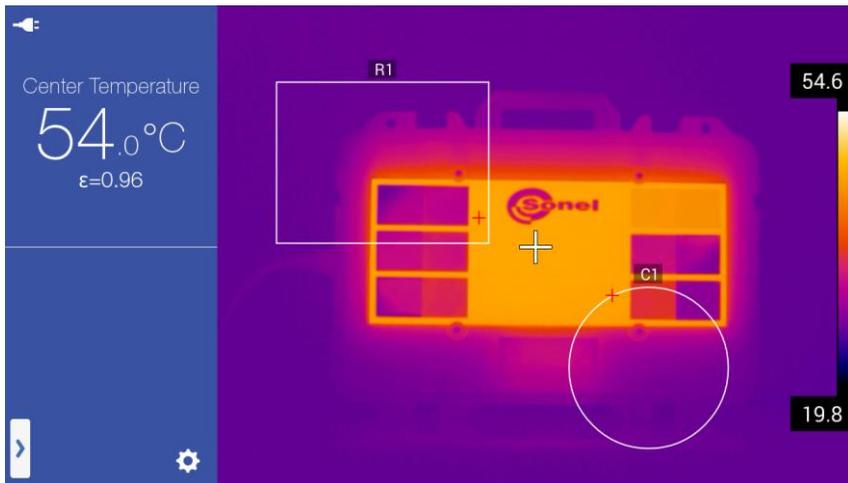
The 'Marking' option turns on/off the temperature points displayed on the line. The 'Marking Content' option allows to select the displayed temperature value for the line: minimum, maximum or average. The 'Center' option moves the line to the center of the screen.

When the maximum temperature is selected, then the displayed temperature spot for given line is rendered as red cross. For the minimum temperature it's rendered as blue cross, and for average both crosses are visible.

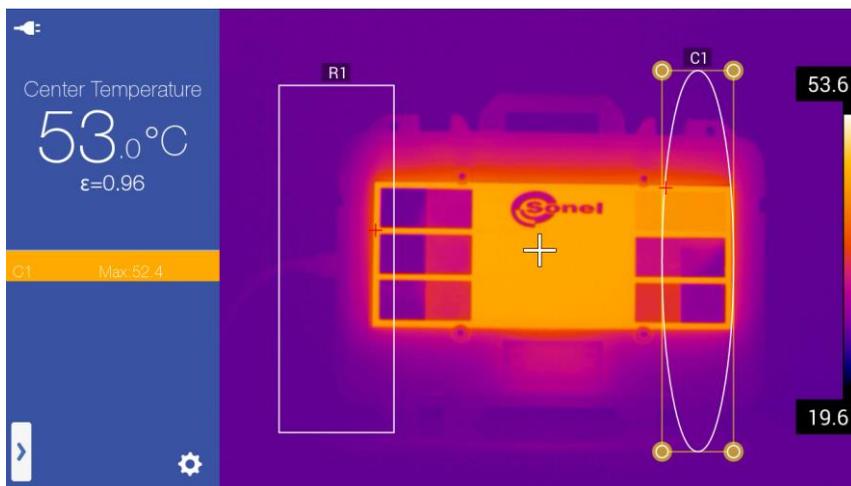
Remove the line by clicking the  symbol.

7.3 Area Analysis

Press  or  button on pop-up menu to add an analysis symbol of, respectively, a rectangle or a circle on screen. When added, the object appears in the center of the screen. The object can be moved to any place on the screen (click and hold down the center part of the object and move it to a desired place on screen). Depending on the camera model, from 5 to 10 objects of each type can be added to the screen. The temperature readouts for every object (min, max or average) is displayed on the left side of the screen, in the additional information field [G]. The rectangle objects are marked with 'R' letter with subsequent number, while the circle objects are marked with 'C' letter with subsequent number.



The shape and the position of the object can be modified (rotate, lengthen, shorten). This can be done by changing the position of its defining points. Press and hold the selected defining point (marked ) and move it to the desired location on the screen.



The object parameters can be edited. Press on and hold the center part of the object, without moving it, to open a menu with the object parameters:



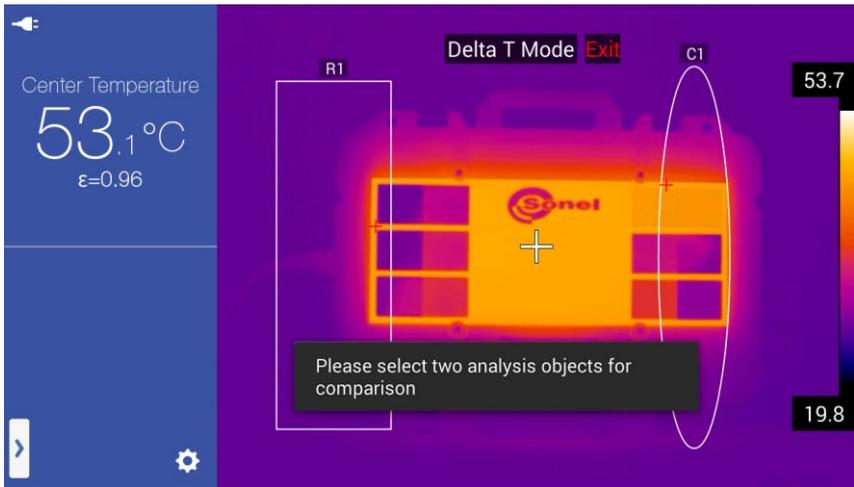
The 'Marking' option turns on/off the temperature points displayed on the line. The 'Marking Content' option allows to select the displayed temperature value for the object: minimum, maximum or average. The 'Center' option moves the object to the center of the screen.

When the maximum temperature is selected, then the displayed temperature spot for given object is rendered as a red cross. For the minimum temperature it's rendered as a blue cross, and for average both crosses are visible.

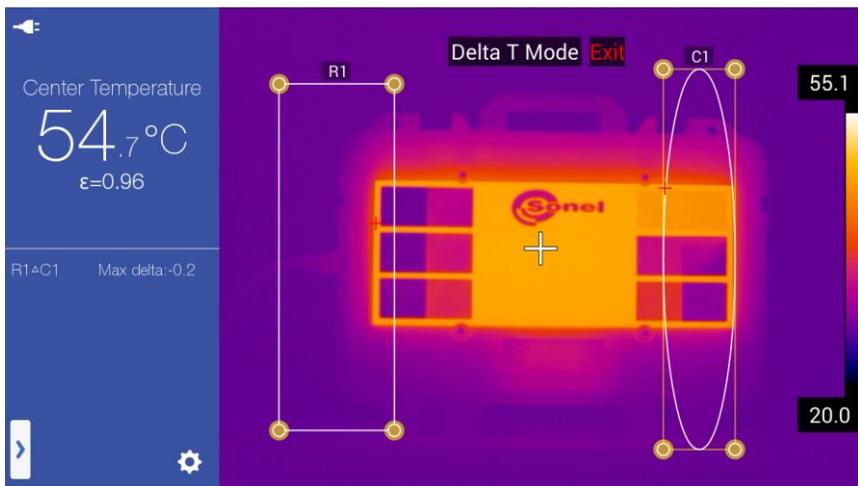
Remove the line by clicking the  symbol.

7.4 Differential measurement and Delta T mode

It is possible to measure the temperature difference of a two objects of analysis. To do this, there must be at least two objects of analysis added on screen. Additionally, these two objects must be set to indicate the temperatures of the same type. It means that when the first object is set to show the maximum temperature, the second one must also be set to show the maximum temperature. The camera can compare two maximum, minimum or average temperatures, never mixed ones. To activate this option press  button on the pop-up menu:



Select the two objects, for which the temperature difference will be calculated. This is done by clicking any area of the first object and then any area of the second one.

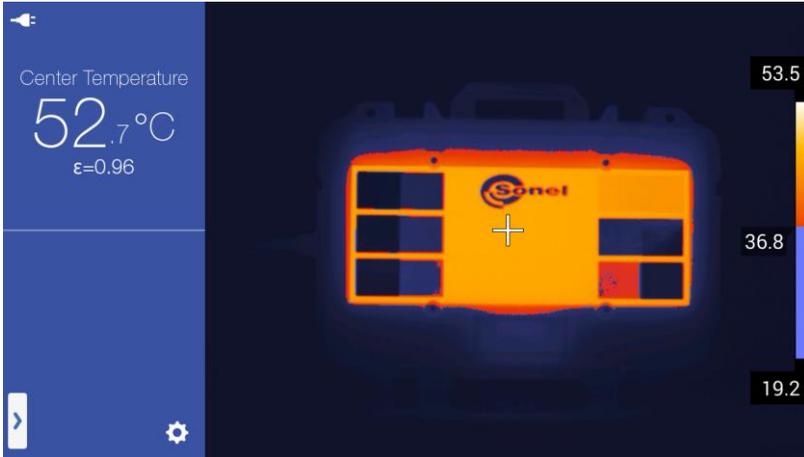


The calculated temperature difference is displayed on the left side of the screen, in the additional information field [G]. If the difference is for the maximum temperatures, the result is described as Max Delta, for the minimum temperatures as Min Delta and for medium temperatures an Average Delta. The calculation method is always the same, and the description alone indicates only the type of the temperatures for which the difference was calculated.

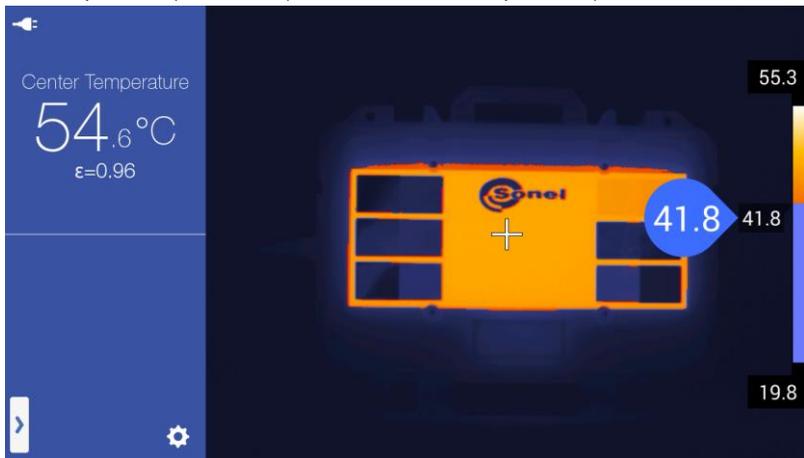
Disable this function by clicking the **Exit** icon at the top of the screen.

7.5 Isotherm analysis

Press  or  button on the pop-up menu to initiate isotherm analysis mode for selected image. In this mode the camera will mark the temperature ranges of below (for ) or above (for ) the selected temperature, with a single, uniform colour (depending on the isotherm settings - see chapter 11.1). The boundary temperature is displayed on a temperature bar, between the maximum and minimum temperatures.



The boundary temperature change is possible by pressing and holding down the boundary temperature tag on the temperature bar. A speech bubble, with the temperature value, will appear on screen. Select the desired temperature by sliding the marker up (to increase the temperature) or down (to decrease the temperature).

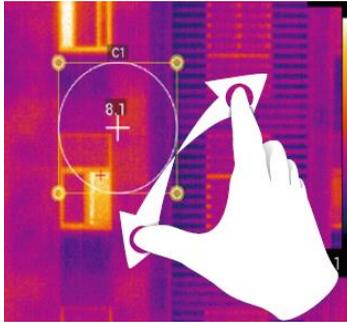


Delete isotherm by pressing  icon on the pop-up menu.

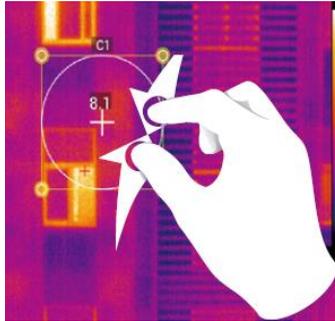
7.6 Enlarging an image in edit mode

In edit mode, frozen or stored images can be enlarged, downsized and repositioned on screen:

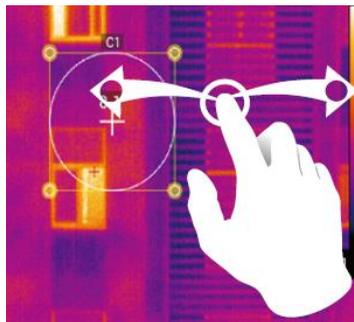
- to enlarge an image place two fingers on the screen and spread them apart:



- to downsize an image place two fingers on the screen and pinch them close:



- to slide an enlarged image within the screen, place one finger on the screen and move it in the desired direction:

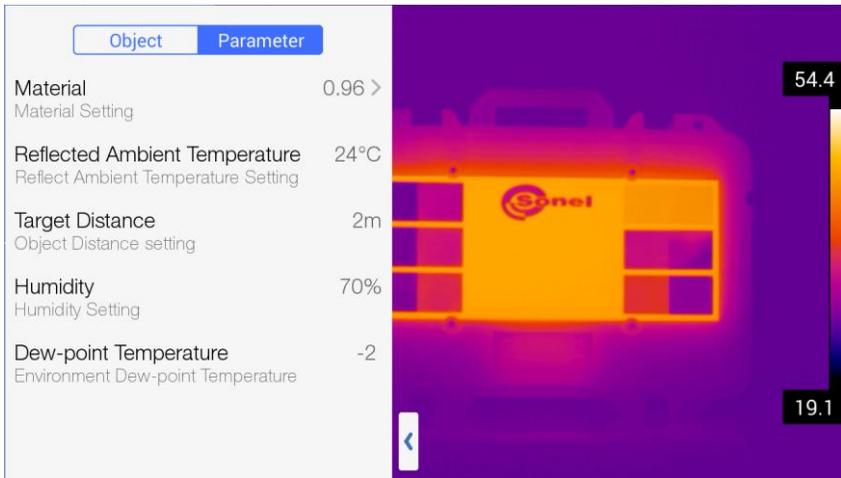


8 Measurement parameters (object, environment)

The parameters of the objects and the environment can be changed in every IR image mode, ie. real time, frozen and for files stored in the memory. An expandible analysis toolbar can be accessed:

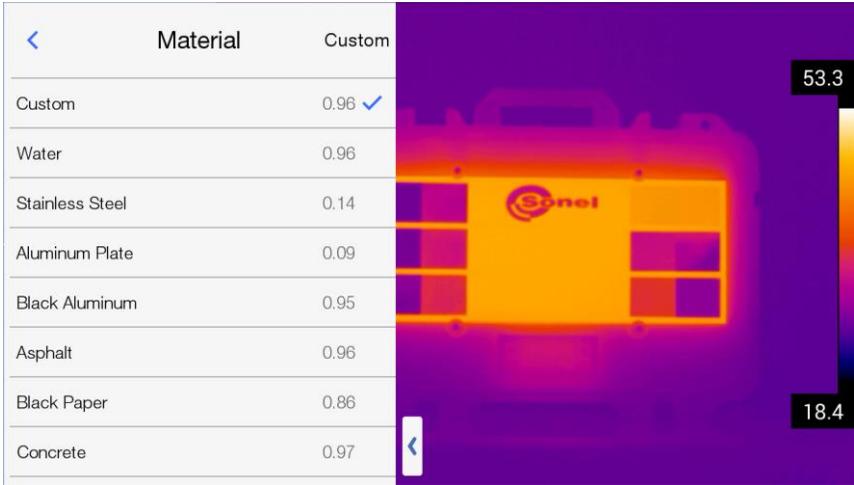
- in the real time mode by pressing the pop-up menu button  [H] and choosing „Parameter” from the selection bar: ;
- for frozen image by pressing on an additional options icon ;
- in the preview mode for stored or frozen image by pressing 'Edit' and then 'Parameter' in the upper part of the side menu.

A menu with parameters of object and environment will open:



Available options:

- **Material** – opens up a menu with value settings of emissivity coefficient of the measured object (the type of a material of which the external surface is made of):
-



There is a choice of selection from the list of a predefined materials, or the custom emissivity coefficient value can be set by pressing 'Custom' button (in the upper part of the opened menu).

- **Reflected Ambient Temperature** – allows to set an ambient temperature (reflections of objects that reflect in the object being measured).
- **Target distance** – allows to set object's distance from the camera.
 - **Humidity** – absolute humidity of the air in which the tested object is placed.
- **Dew-point Temperature** – dew point temperature indication. This option is available only in real time mode.

9 Annotations

It is possible to add following annotations for every image stored in the camera:

- sketch;
- text annotation;
- voice annotation.

Adding annotations is possible in the image preview window, that can be opened, when the image is frozen, by pressing on an additional options icon  or when viewing images, after clicking the selected thumbnail.



To enter the annotation mode in the image preview mode press the paperclip  button.

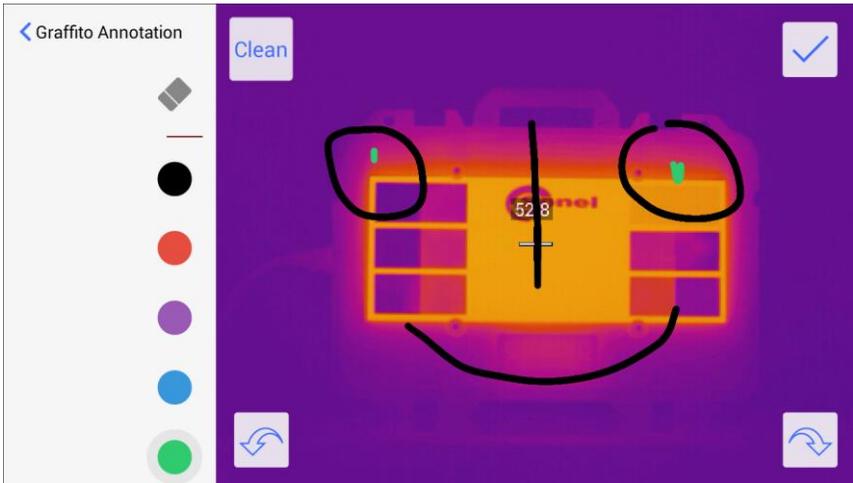
The annotation menu will open.

9.1 *Sketch note*

Start this mode by pressing  followed by pressing .



In this mode any drawing with coloured strokes can be made.

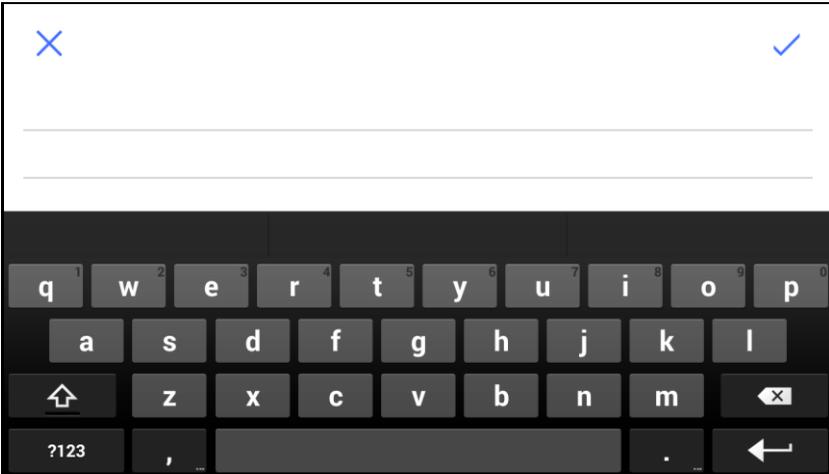


Function buttons:

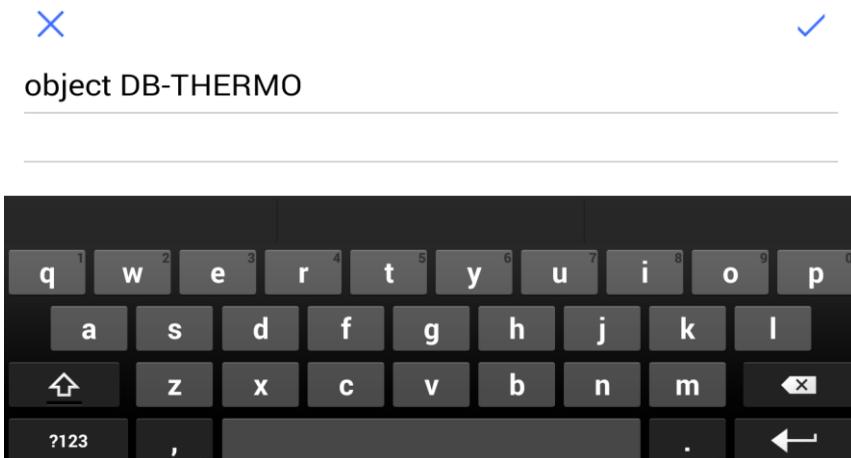
-  go back to the previous screen;
-  drawing mode, allows to draw lines over IR image,
-  eraser mode, allows to erase parts of lines,
-  - colour palette, change the colour of the drawn lines by clicking selected dot,
-  remove all the changes applied to an image,
-  save changes applied to an image,
-  go back,
-  repeat.

9.2 Text annotation

Start this mode by pressing  followed by pressing .



In this mode a text note can be added using an on-screen keyboard.

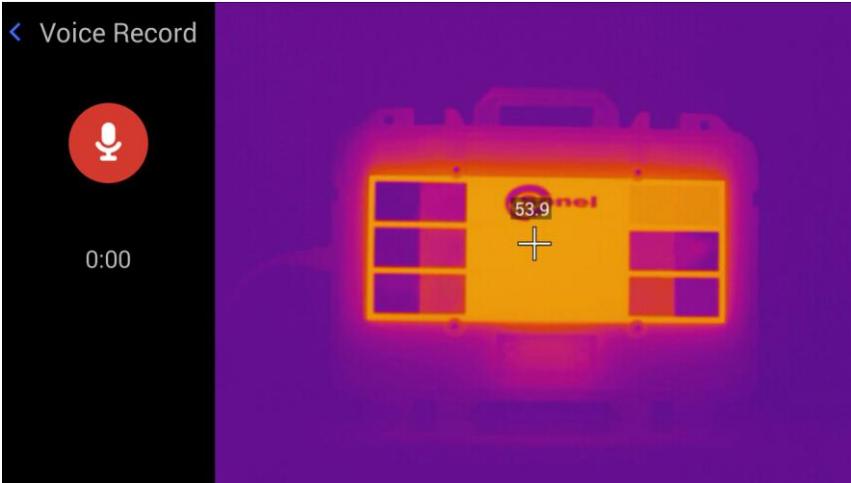


Function buttons:

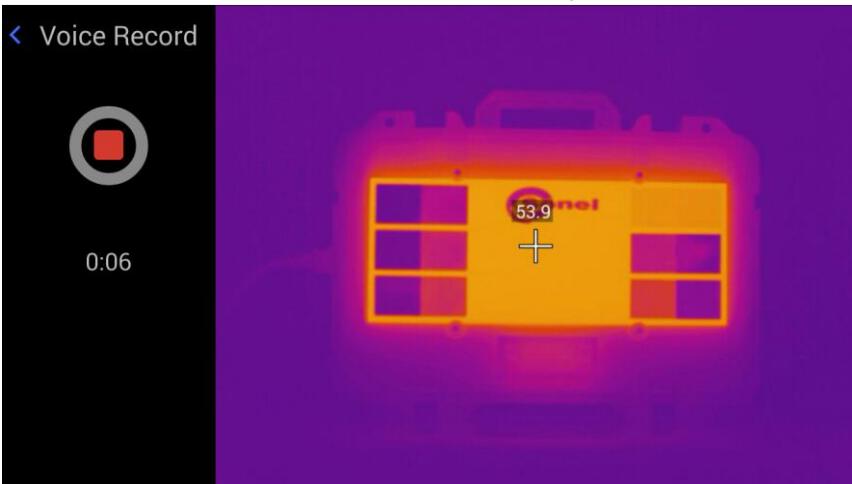
-  Save changes and return to the previous screen,
-  exit without saving changes.

9.3 Voice annotation

Start this mode by pressing  followed by pressing .



This mode allows to add (or play stored) voice annotation. Press  to start recording. The timer below shows elapsed time of the voice being recorded.



Stop recording by pressing  button. Play the recorded annotation by pressing  button.

Other control buttons:

-  The track (progress) slider. To change the current playing position, drag the track slider left to rewind or right to forward the track being played.

-  - pause recording,

-  - delete recorded annotation (press OK to confirm deleting),

-  - return to the previous screen.

10 Report

10.1 Creating report

The camera allows to create reports. The report wizard is available:

- in the real time mode by pressing the additional options icon ;
- in the thumbnail preview mode for stored images by pressing the PDF report icon ;
- in the preview mode for saved or registered image by pressing the PDF report icon .



The report wizard box will open:



Swipe your finger up/down to view the entire document.



The text fields marked with a blue frame can be filled in:



. The following fields can be edited:

- field in the document header,
- the description field at the bottom of the document,
- field in the document footer.

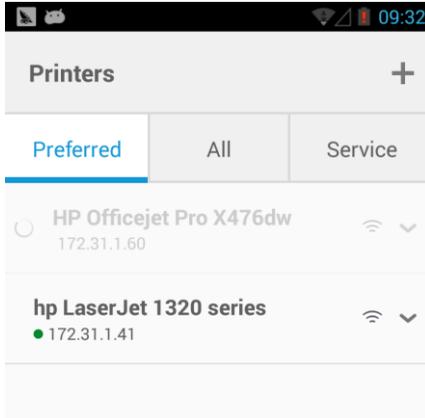
After filling in the report, a ready document can be created by pressing 'Generate' in the upper right corner of the screen. A new window with a document preview will open. Following options are available upon clicking anywhere in the screen:

- Print – Print out the document with a wireless printer that is paired with the camera (HP make).
- Close – close the preview.



- Selecting printer:

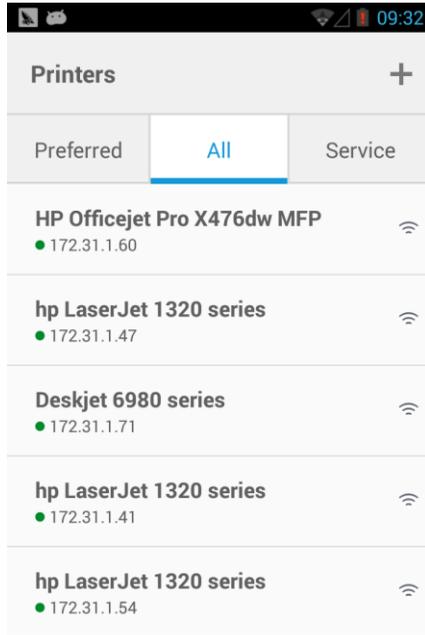
Press  to open the printer selection window:



Available tabs:

Preferred – the list of printers defined for connection as preferred.

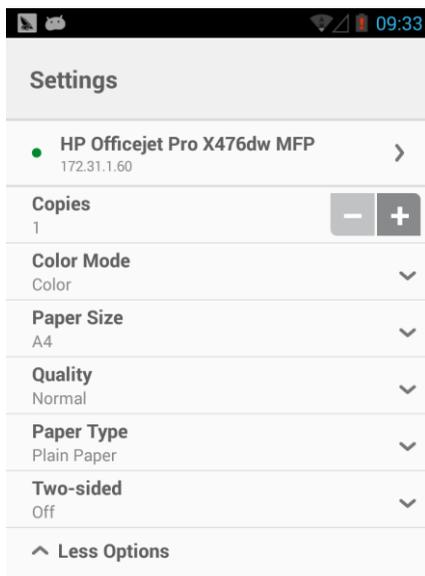
All – all available printers in the camera's range, or the Wi-Fi networks to which the camera is connected to:



Select printing device by clicking its name twice. The camera will then return to the main screen of the printing wizard.

- Printing settings.

Press  to open printing settings window (the complete list of settings is available in More Options tab):



Available options:

Copies – select the number of copies to be printed.

Color Mode – select between printing in color or in a grayscale.

Paper Size – choose the printout paper size.

Quality – select the printout quality.

Paper Type – select the type of paper for printing.

Two-sided – two-sides prints.

- Printing.

Press  button to start printing.

Press Return button [20] to exit (return to previous window).

11 The camera's setup menu

The camera settings and parameters can be adjusted by pressing the camera setup menu button [!] .

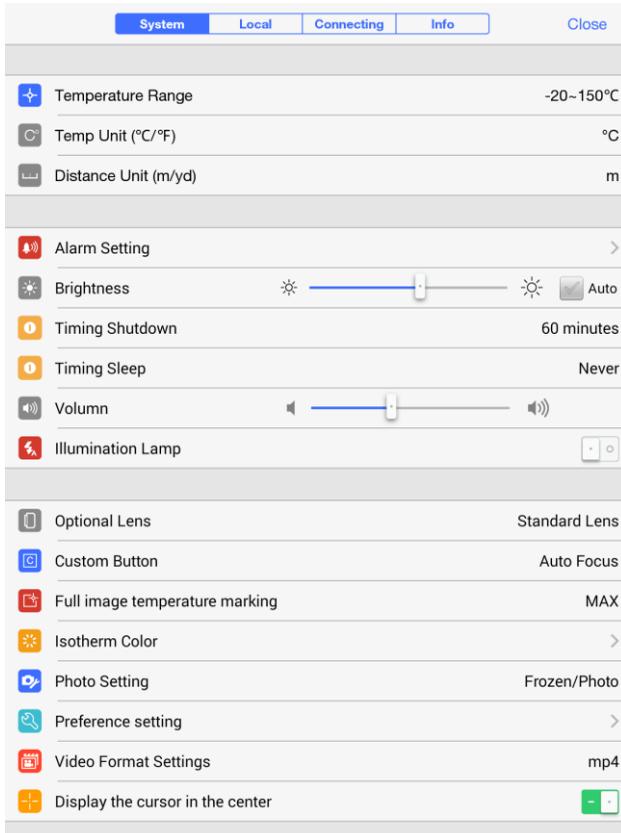


The setup menu is divided into four categories: 'System, Local, Connecting, Info'. Access the selected category by clicking the desired tab. Leave the setup menu by clicking the

Close button in the upper right corner of the screen.

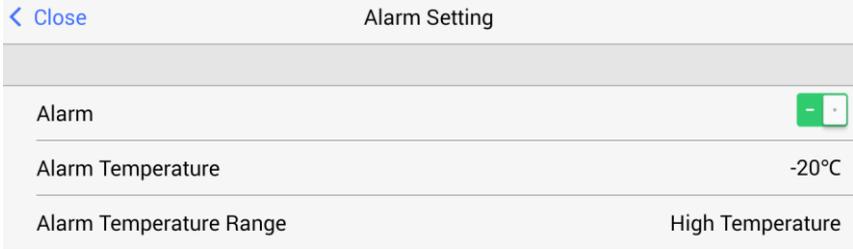
11.1 System

After opening the setup menu and selecting the 'System' tab, the system settings window will open. Swipe the screen up and down to access more settings.



The following parameters can be set in the system tab:

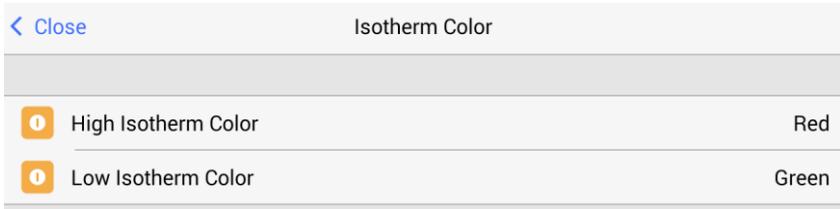
- **Temperature range** – operating temperature range of the camera, the three subranges can be selected: -20~150°C (-4~302°F); 150~800°C (302~1472°F); 800~2000°C (1472~3632°F) – optional range – requires high temperature filter.
- **Temp unit (°C/°F)** – choose between °C and °F.
- **Distance unit (m/yd)** – choose between meter and yard.
- **Alarm setting** – alarm setting window will open. Enable the alarm with  button.



Upon activating the alarm, the **Alarm Temperature** can be set – the temperature value that triggers the audible alarm when exceeded. **Alarm Temperature Range** – Selecting "Low" will trigger the alarm when the temperature drops below selected "Alarm Temperature". Selecting "High" will trigger the alarm when the temperature exceeds selected " Alarm Temperature.

- **Brightness** – LCD brightness adjustment is done sliding the marker on the brightness slider. When the 'Auto' mode is on, the brightness is automatically set by the camera.
 - **Timing shutdown** – set the time to turn off the camera. Following options are available: 'Never' to disable the auto off function, 5 minutes, 10 minutes, 30 minutes or 60 minutes.
 - **Timing sleep** – set the time to put the camera into the sleep mode. Following options are available: 'Never' to disable the sleep mode, 1 minute, 5 minutes or 15 minutes.
- **Volume** – move the cursor to adjust the volume of the camera.
- **Illumination lamp** – enable built-in LED light (flashlight).
- **Optional lens** – optional lens selection – this option is only available upon request.
 - **Custom button** – allows to choose a response of the camera (activated function) at the press of the 'C' button [2]. The available options are:
 - Illumination Lamp – press the button to turn on the built-in flashlight.
 - Palette Switch – every single press of the button will consecutively change the palette colour.
 - Auto focus – press the button to set the focus of IR image automatically.
 - Voice – establish connection with the headset.
 - Compensation – press the button to perform the detector calibration (this feature is described in chapters: 1 and 3.7).

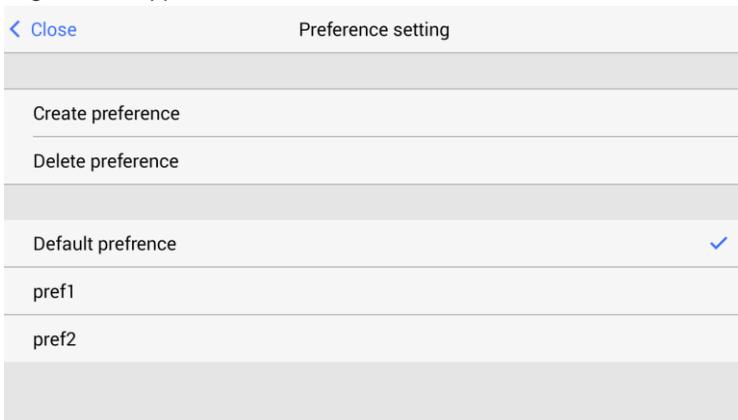
- **Full image temperature marking** – The camera can mark the hottest 'MAX' or the coldest 'MIN' point on the screen. Press 'No Display' to disable this option.
- **Isotherm color** – opens a window with isotherm color settings.



Select the colors for high isotherms and for low isotherms.

Photo setting – allows to set the camera's reaction for pulling the trigger button.

- „Frozen/Photo” – the camera will freeze an image after single button press, and will save it to memory when pressed again.
- „Photo” – the camera will save an image to memory after single button press, and will return to the live mode.
 - „Frozen” – the camera will freeze an image after single button press, and will return to the live mode when pressed again.
- **Preference setting** – allows to create a number of various camera presets. Preference setting window appears.



Options available:

- „Create preference” – creating a new preference preset.
- „Delete preference” – deleting an active (✓) preset.
- Enabling a chosen preset (✓).
- Changing preferences in a chosen preset – in order to do that, activate a preset (✓), press „Close” to get back to the System menu and change the preferences.

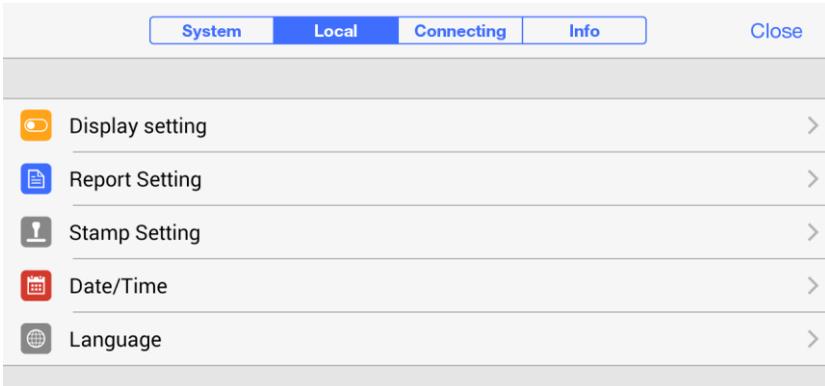
If other presets than „Default preference” exist in the camera, after turning the device

on it will ask for choosing the desired preset.

- **Video Format Settings** – here it is possible to set the video file format: mp4 or irgd.
- **Display the cursor in the center** – here it is possible to show/hide the cursor on the display [B].

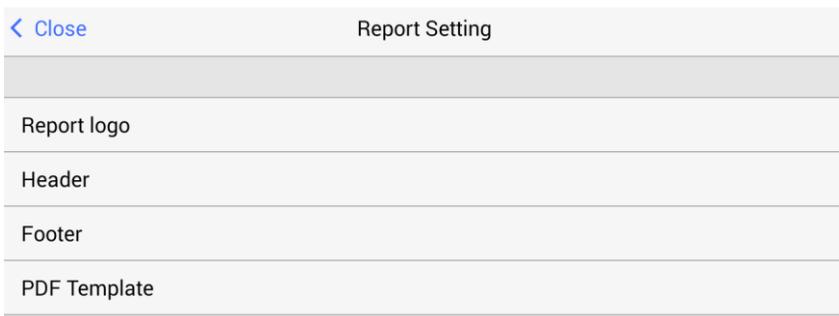
11.2 Local

After opening the setup menu and selecting the 'Local' tab, the Local settings window will open.



The following parameters can be set in the Local tab:

- **Display setting** – here it is possible to set data displayed on the camera screen:
 - „Display GPS information” – displays the GPS coordinates of the camera
 - „Display compass information” – displays the internal compass' readings
 - „Display date” – displays the current date
 - „Display time” – displays the current time
- **Report Setting** – opens the report settings window:

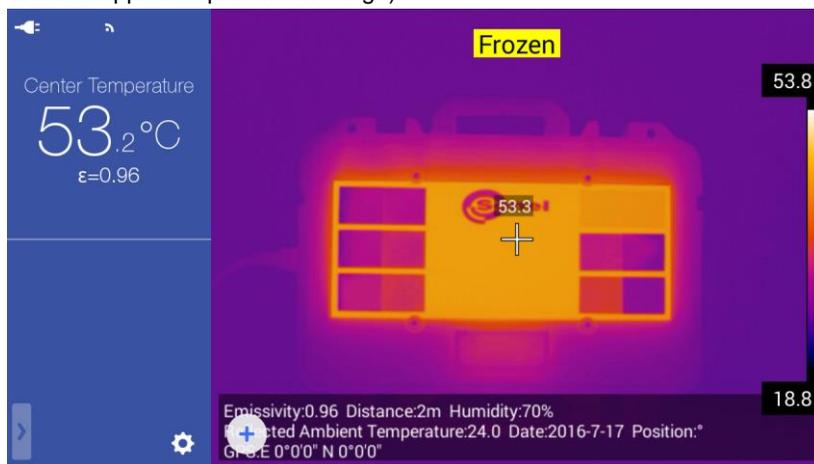


- 'Report Logo' – opens a window that allows to select the image that will be used as a logo in the report. To select, click the desired image and press 'Done'. The

files should be placed manually in the following directory: **Internal memory \ DCIM \ GCamera \ externalPdf \ pdfExternalLogoPic**

- 'Header' – opens a window (with an on-screen keyboard), for entering a text that will be used as the report's header.
- 'Footer' – opens a window (with an on-screen keyboard), for entering a text that will be used as the report's footer.
- 'PDF Template' – opens a window that allows to select a template that will be used for generating the report. To select, click the desired template and press 'Done'.
- **Stamp setting** – select markers, which, when activated, will be added to images:
 - 'Date Stamp Setting' – the date.
 - „Time watermarking” – image creation time.
 - 'Emissivity Stamp Setting' – the values of selected emissivity.
 - 'Distance Stamp Setting' – the distance to the object set in the camera.
 - 'Humidity watermark' – the values of selected humidity.
 - 'Reflectivity temperature stamp setting' – the values of selected ambient temperature.
 - 'GPS watermark' – the GPS coordinates that were registered when taking picture.
 - 'Electronic compass stamp setting' – compass data.
 - „Analysis of object temperature watermark” – temperature data for analysis markers set in chapter 7.

Once activated, the markers will be saved into an image file and will be put at the bottom part of an image as its description (except the LOGO watermark, which will be placed in the upper left part on an image).



- **Date/Time** – opens a window for setting the date and the time. After setting date and time press 'Done' to save changes.
- **Language** – opens a window for the camera interface language selection.

11.3 Connecting

After opening the setup menu and selecting the 'Connecting' tab, the network connection settings window will open.

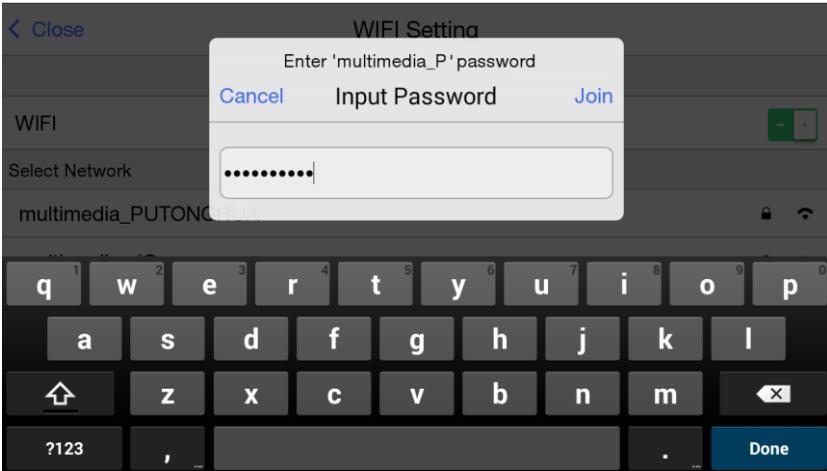


The following parameters can be set in the Connecting tab:

- **WiFi** – Opens a window for WiFi network settings. After enabling this function with  button, the camera will search for the available WiFi networks and will display them as a list:

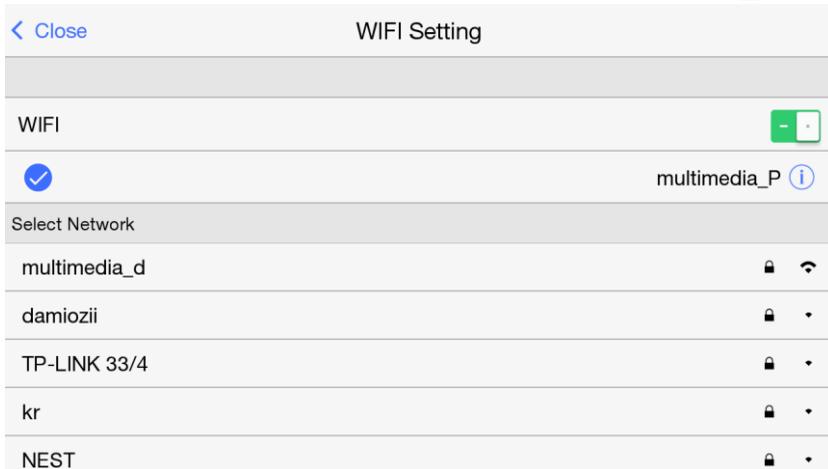


To connect, click the selected WiFi network, and click the password field in the window that will open. Type the password using the on-screen keyboard.

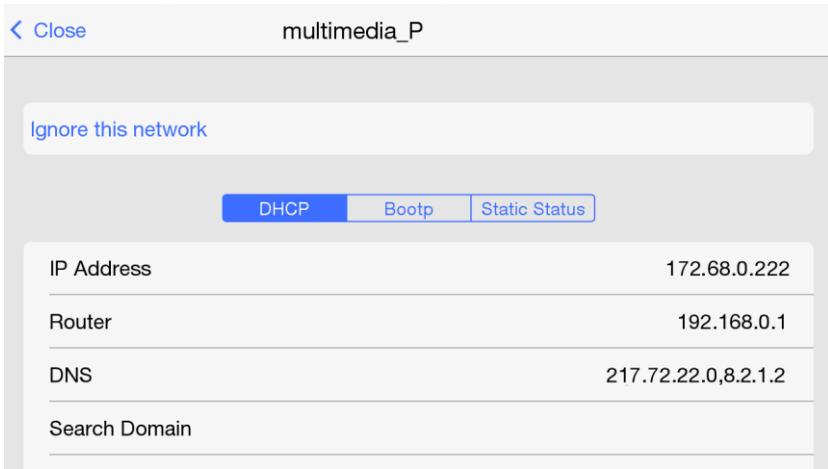


Confirm the password by pressing the OK button on the on-screen keyboard, followed by pressing 'Join' in the Input Password window. Press 'Cancel' to close the window without saving changes. After establishing connection the camera will return to the screen with available networks. A network with established connection is

moved to the upper list and is indicated by the check mark symbol  :

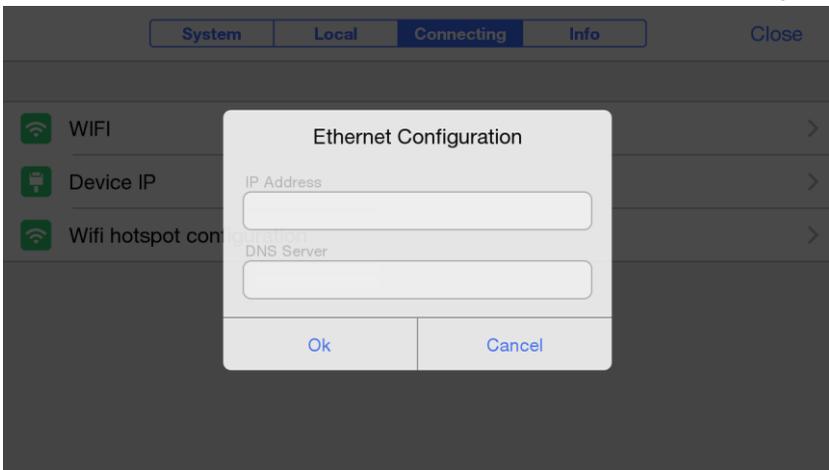


Press  to go to the detailed network parameters:

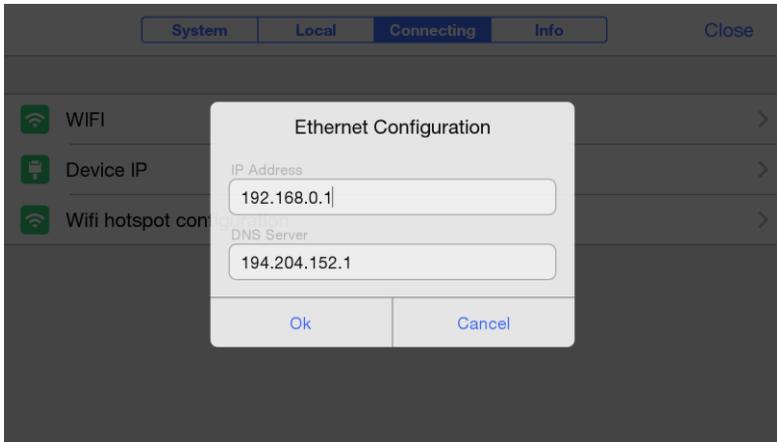


Specific network settings are available under three tabs: DHCP, Bootp and Static Status. Press 'Ignore this network' to disconnect from the selected network, and to make the camera ignore a connection attempt with this network in future.

- **IP Address** – press to open a window with the camera's Ethernet configuration.



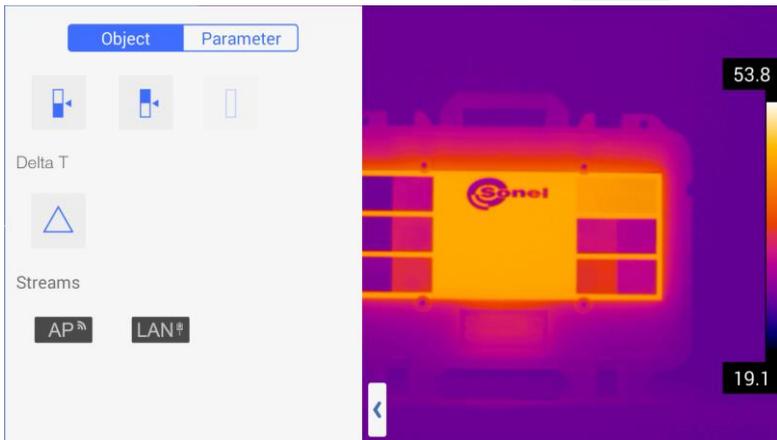
Set the connection parameters by typing in the IP address and the DNS Server address with the on-screen keyboard. The camera will be visible in the network at this address (sample data below).



Confirm by pressing the OK button on the on-screen keyboard, followed by pressing 'OK' in the Ethernet Configuration window. Press 'Cancel' to close the window without saving changes. LAN settings are completed. Close the configuration menu.

To start the camera in the LAN mode, open the menu activated with the pop-up, on-screen menu button [H] (the camera must be in the IR real time mode). Go to

'Streams' section at the bottom part of the menu and press **LAN** button:



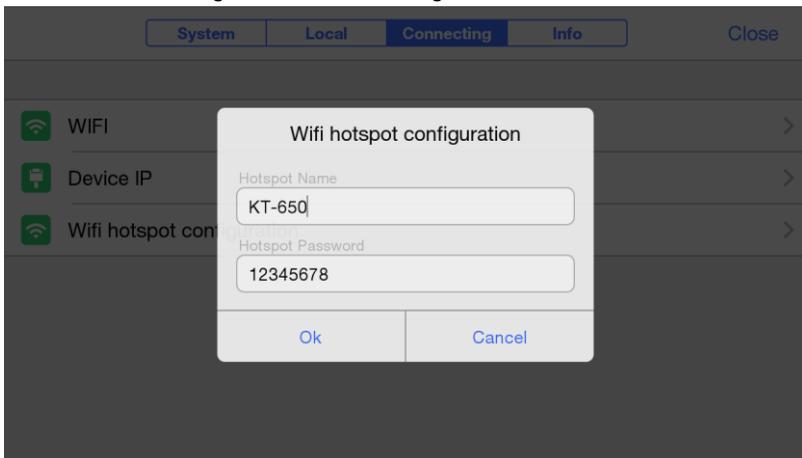
The camera working in the LAN mode is indicated by the LAN button being highlighted in blue **LAN**. Deactivate this mode by pressing the **LAN** button again.

Note: the camera can work only in one mode at a time: LAN or AP.

- **WiFi hotspot configuration** – press to open a configuration window for the WiFi network access point. The camera can work in the WiFi network hotspot mode (Access Point - AP), which allows devices, that have built-in WiFi, to connect directly to the camera. Press it to open up a configuration window:

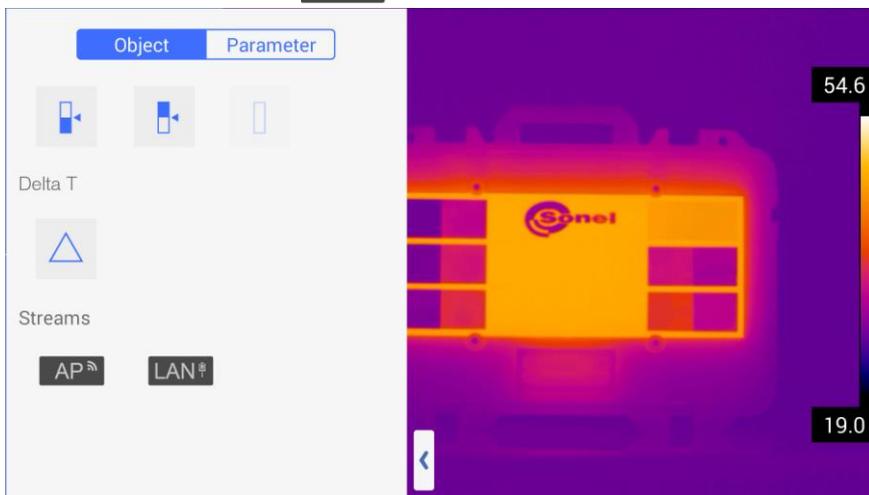


To set the parameters, click the text box and enter the hotspot (access point) name – this will be the name under which the camera will be visible, as a wireless network, to other Wi-Fi devices. Next type in the hotspot password. The password will be required when connecting to the camera using WiFi devices.



Confirm the settings by pressing 'OK' button on the on-screen keyboard, followed by pressing 'OK' in the hotspot configuration window. Press 'Cancel' to close the window without saving changes. The access point (AP) is now configured. Close the setup window.

To run the camera in access point (AP) mode, open the pop-up menu by pressing [H] on-screen button (while in the IR real time mode). Go to 'Streams' in the bottom part of the menu and press **AP** button to enable it:

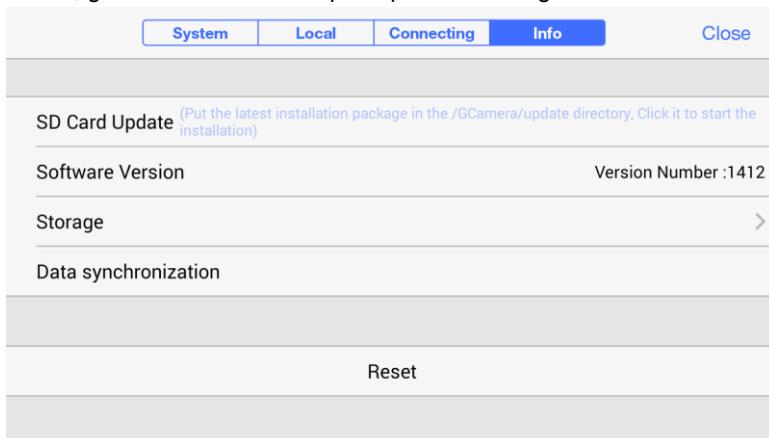


When the camera working in the AP mode, it is indicated by the **AP** button being highlighted in blue. Disable this function by pressing **AP** button again.

Note: the camera can work in one network mode at a time: AP or LAN.

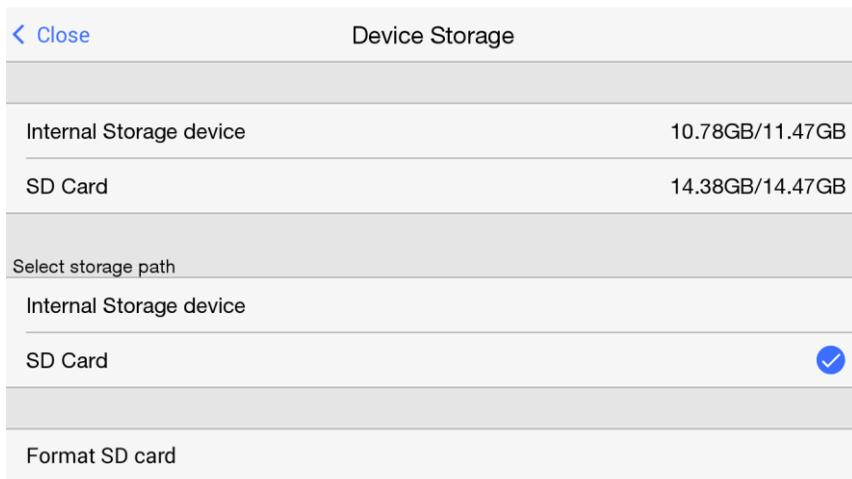
11.4 Info

On setup menu, go to 'Info' section to open up below settings menu:



Under 'Info' tab following options are available:

- **SD Card Update** – choose this option to go to camera's firmware upgrade mode. The complete procedure is described in chapter 18.
- **Software Version** – this section shows currently installed firmware version.
- **Storage** – chose this option to open device storage window, that allows to select data carrier:



At the top of the window the information on the availability of free space is presented, along with the total storage space on the internal memory and on the SD card (if it's inserted). The section below allows to select default data storage path. Selected path is



indicated by check mark icon  - the camera will save all data on this carrier. The 'Format SD card' option is used to format the SD card inserted in the camera. Press 'OK' in the dialog box that will open to format the SD card – all the data will be deleted.

- **Data synchronization** – click to synchronize the camera data.
- **Reset** – click and press OK in the displayed window to restore the default factory settings of the camera.

12 Accurate temperature measurement

Temperature measurement accuracy depends mainly on the below factors. During the measurements the camera undertakes corrections based on signals read from the sensors. In some situations and for some materials it may be necessary to the adjustments manually. It must be remembered that there are three basic measurement parameters, that can't be changed after capturing an image:

- **Focus** – images that are out of focus are not only blurred, but also they don't carry accurate temperature indications,
- **Framing** – it is essential that an image is properly framed, so the object and all its necessary parts are within the frame. Otherwise the picture may be of little or no use,
- **temperature range** – If the temperature of the object, or its part, exceeds the temperature range that is set in the camera, it may not be possible to later determine the exact temperature of this area.

When all the above parameters have been considered, then the next important step is to properly configure the measurement parameters. The following section is a simplified description of each parameter and their impact on the measurement results.

Emissivity. Infrared measurements base on receiving the infrared radiation emitted by objects. The amount of radiation energy is based on two main factors: surface temperature and emissivity of the object's surface. Considering that surrounding object are, in most cases, not transparent for infrared radiation, to simplify the measurements, it is assumed that the radiation that reaches the object is divided into:

- emitted - radiation emitted directly by the measured object,
- reflected - the ambient radiation reflected from the surface of the measured object.

For the camera, the sum of the emitted and reflected radiation equals 1. The ration of the reflected and the emitted radiation is described by the emissivity coefficient.

For example, if the emissivity is set to 0.2, then the camera (to put it in simple terms) assumes that 20% of the radiation coming from the measured object is emitted by the object itself, and 80% is the reflected radiation. Considering the above, a special algorithms calculate the correct surface temperature of the measured object.

Exemplary values of emissivity coefficient for selected materials are presented in the emissivity table. Poorly chosen value of the emissivity coefficient may cause significant temperature reading errors. And for that reason the camera allows to adjust the value of the coefficient in the range of 0.01 ... 1.00.

Measurement accuracy also depends on **the ambient temperature** (also known as the reflected temperature). By default, the temperature measured by the camera is used, however it should be remembered that ambient temperature is neither the temperature of the air surrounding the camera, nor the temperature of the measure object itself. The ambient temperature is the temperature of the object (the energy emitted by the object), which is reflected on the surface of the object being measured. In order to maintain accuracy of measurements, proper value of ambient temperature should be accounted for - **especially, if the emissivity coefficient is changed or these changes will be performed by processing a thermal image with computer program**. This value should be changed manually in order to determine proper relation of the examined object temperature and the surrounding temperature.

The influence **of the distance** from the object on the measurement accuracy may be significant, depending on the medium in which the object is located (air, fog, smoke ...) and its impact on the attenuation of thermal radiation. It is possible to adjust this value.

Relative humidity may also influence the accuracy of measurement, it is possible to change the default value for any value from the range of 0...100%.

Wind (air flow) is another factor influencing the measurement of the object's temperature, as it cools the surface of an object altering its temperature. Pictures should not be taken in strong wind.

Additionally, to achieve an accurate temperature readout, hold the camera steady. It is recommended to carry out the auto-calibration of the camera, before starting to capture images.

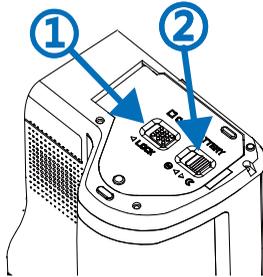
13 SD card

Static thermograms, files with their corresponding visual images and video files are stored on the removable SD card (with maximum 32GB capacity). The SD card must be formatted to FAT32 file system.

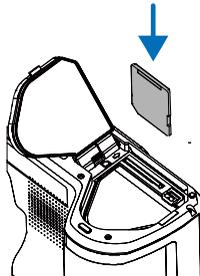
13.1 Installing SD card in the camera

Note! Turn off the camera before installing SD card.

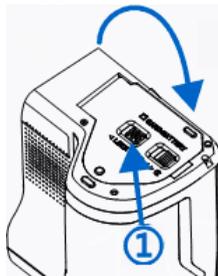
To install an SD card in the camera, unlock the security lid by sliding the latch on the compartment lid (1) and then open the lid by pulling the second latch (2):



Now insert the memory card into the SD card slot until a clicking sound is heard:



Close the lid and lock it with the latch (1):

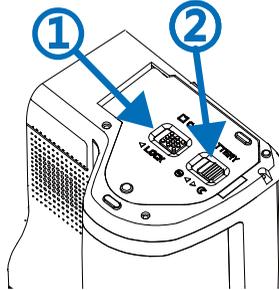


The card is now installed. The camera can be turned on.

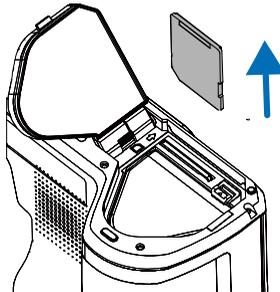
13.2 Removing SD card.

Note! Turn off the camera before removing SD card.

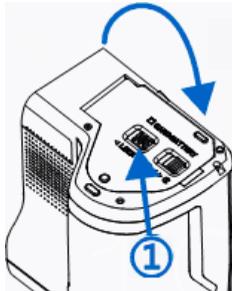
To remove SD card from the camera, unlock the security lid by sliding the latch on the compartment lid (1) and then open the lid by pulling the second latch (2):



Next, insert and press the SD card deeper into its slot, until it clicks and then release the pressure. The card is now partially ejected and can be removed:



Close the lid and lock it with the latch (1):

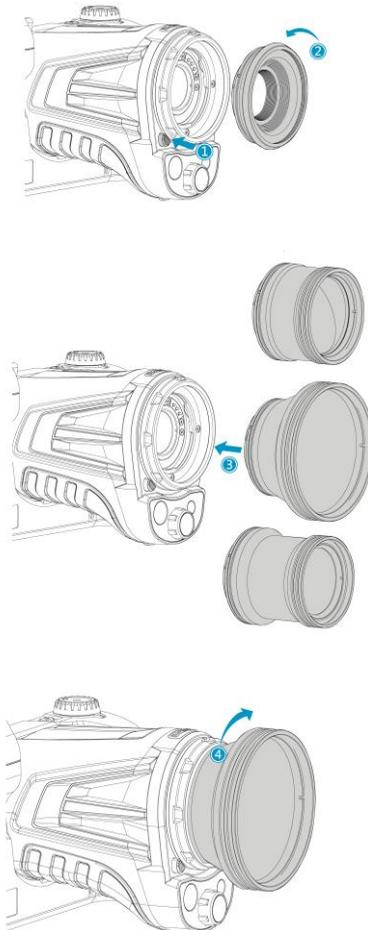


The card is now removed.

14 Replacing the lens

Note! It is advised to turn off the camera before replacing the lens.

In order to replace the lens, press and hold the lens-release button, which is placed next to the lens, then rotate the lens counter-clockwise to unmount it. To attach a lens to the camera body, position the lens in the camera's lens mount, and mount the lens by rotating the lens clockwise until it locks into place (which will be indicated by the clicking sound of a security lock).



Caution: Do not touch or expose the internal parts of the camera to prevent them from fouling.

15 Power Supply and battery charging

The camera is powered by Lithium-ion battery. It can also be powered from the mains through the AC adapter.

The battery can be charged while being inside of the camera. The device is also supplied with a spare battery.

Connect the AC adapter to the [28] socket to start charging procedure.

Charging can be performed only when the camera is not being used.

During camera operation, current power supply source indicator is displayed in the lower right corner of the screen:



- battery power supply



- mains power supply

15.1 Using AC adapter

The LED light, which is located on the on/off button [12], indicates when the AC adapter is connected. When the camera is turned on, the indicator shows battery charging status, flashing red while charging and lit green when fully charged.

15.2 Battery power supply

During camera operation the battery charge level is being shown in real time, in [A] information area, in upper left corner of the screen, as below changing symbol:

max.



min.

Additionally, low battery is indicated by following message displayed on screen:

Battery capacity is less than 20%, pls charge in time

15.3 Charging batteries

When the camera is turned off, connecting the AC adapter and starting the charging procedure is signaled by the LED charging indicator, embedded in the camera on/off button [12] - flashing red while charging and lit green when fully charged. When the battery is not being charged the indication is turned off.

Li-Ion battery does not require performing full charge-discharge cycles during exploitation, however it is advised to perform 3 full charge-discharge cycles when using it for the first time, and to perform one full charge cycle at least once in a several charge-discharge cycles.

The camera comes along with 2 batteries, which are advised to be used alternately. When using the second battery, the first one should be charged.

NOTE!

Use only the battery, AC adapter and the external battery charger supplied with the camera.

NOTE!

Do not remove the battery from the camera while it's being charged.

NOTE!

Battery charging should be performed in 32°F to 104°F / 0...40°C ambient temperature range.

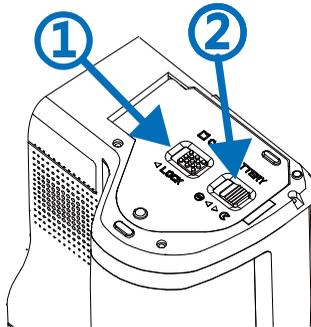
NOTE!

In order to maintain the proper parameters of the batteries, charging of unused batteries should be repeated every 3 months.

15.4 Charging the battery in the external battery charger

NOTE! Turn the camera off before removing the battery.

To remove the battery from the camera, unlock the security lid by sliding the latch on the compartment lid (1) and then open the lid by pulling the second latch (2):



Push the battery lock lever above the battery and the battery will partially slide out of the compartment, allowing to remove it.

Now the battery can be charged in the external battery charger (optional).

To put the battery back into the camera, follow the instructions for removing the battery in reverse order.

15.5 General rules of using Lithium (Li-Ion) batteries)

If the device is unused for an extended period, remove the battery and store it separately. The battery stored in state of deep discharge can get permanently damaged.

The battery should be stored in dry, cool and well-ventilated place and it should be protected from exposure to direct sunlight. If the battery is stored for an extended period at a location with high temperature in it, then the chemical processes occurring within it may shorten its expected life span.

Do not charge and use Li-On batteries in extreme temperatures (don't overheat and don't expose the batteries to very low temperatures). Extreme temperatures decrease battery life. Avoid placing devices powered with rechargeable batteries in very warm/hot places. Their nominal working temperature must be strictly observed.

Li-Ion cells are vulnerable to mechanical damages. Such damages can contribute to permanent damage of those type of batteries, and thus the ignition. Any interference in the structure of the battery may lead to its damage. Shorting poles (+ and -) of the battery may cause permanent damage and auto-ignition of the battery.

Do not immerse the Li-Ion batteries in liquids, do not store them in conditions of high humidity.

In case the electrolyte, that is filling the inside of the Li-Ion battery, makes direct contact with eyes or skin, rinse them with a large amount of water and contact your doctor immediately. The battery should be used in a way that makes it beyond access for random people. Keep it away from children.

Whenever any changes in Li-Ion battery is observed (different color, swelling, excessive temperature), it must cease to be used. Mechanically damaged, overcharged or deeply discharged batteries are not suitable for use.

Improper use of the battery can cause its permanent damage. It can lead to its spontaneous combustion. The seller and the manufacturer shall not be liable for any damages resulting from improper handling of the Lithium-Ion battery.

16 Connecting the camera to PC

16.1 Hardware requirements

Operating system: Microsoft® Windows 7 or higher

Processor: Pentium 4 2.4GHz or higher

RAM: at least 512MB

16.2 Sonel ThermoAnalyze2® Installation Guide

It is recommended to install Sonel ThermoAnalyze2 programme before connecting the camera to PC (the camera drivers will install automatically together with Sonel ThermoAnalyze2 software).

Installation procedure is identical on all computers regardless of the operating system.

It is recommended to close down all applications before installing the program. After inserting the CD containing the software (supplied with your camera) into CD-ROM drive, installation dialog box will appear. If the installation box doesn't appear automatically, double-click "autorun.exe" file in the CD's main folder. After selecting language new dialog box will appear. Choose "thermal cameras" and then "install ThermoAnalyze2":

The installation wizard will initiate. Necessary system modules (of Microsoft®) will get installed first, followed by Sonel ThermoAnalyze2 software. Follow the on-screen instructions.

NOTE 1: Without changing the default installation directory, the installation procedure will allow the program to be installed in C:\Program files\ Sonel ThermoAnalyze2. The installation procedure will add a shortcut icon Launch Sonel ThermoAnalyze to the Desktop and to the Start menu.

NOTE 2: When starting the program for the first time, with the camera connected and running in online mode, Windows Firewall alert may appear on screen. In that case, click allow to connect to private networks:

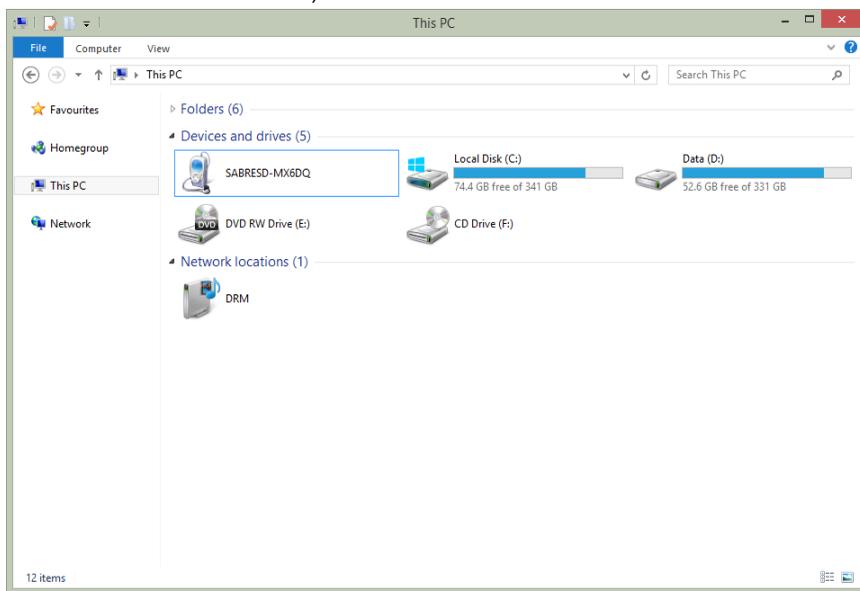
In case the original CD supplied with the camera is missing, the software can be installed after being downloaded from Sonel website: www.sonel.pl/en.

After the software has been installed, connect to the camera using one of the following means.

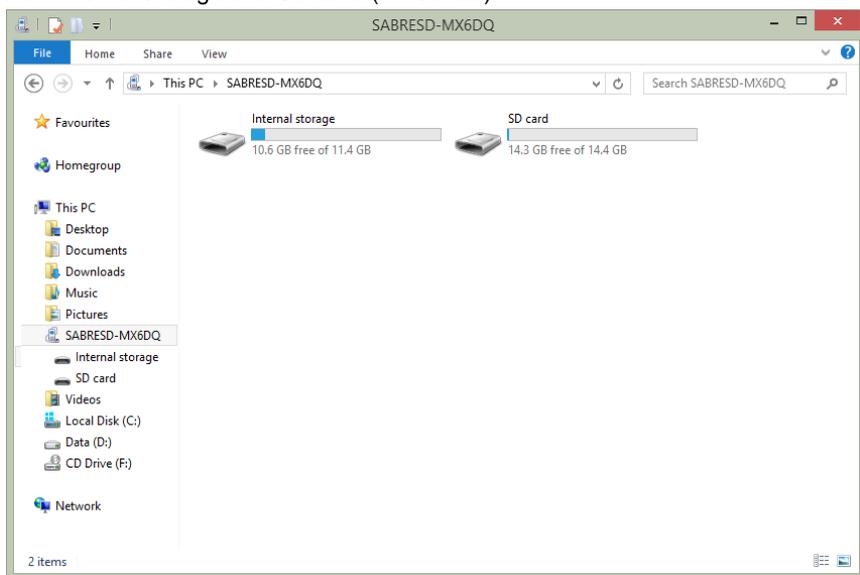
16.3 Reading data using USB

Turn on the camera. The USB connection can be used for browsing the data stored on the memory (built-in and SD card).

Turn on the camera. Connect the camera to USB port on the PC. The drivers will install automatically. When completed, the camera will appear as a portable device (new disk drive named: **SABRESD-MX6DQ**):



Double-click the SABRESD-MX6DQ to open a window with available disk drives of the camera - internal storage and SD card (if inserted).



Thermogram files are stored in the following directories:

- on SD card in: SD card\SD\DCIM\
- on internal storage in: Internal storage\ DCIM\

Selected, or all, files must be copied to PC's hard disk drive before they can be opened in Sonel ThermoAnalyze2. Procedures for opening and editing images are described in the software manual.

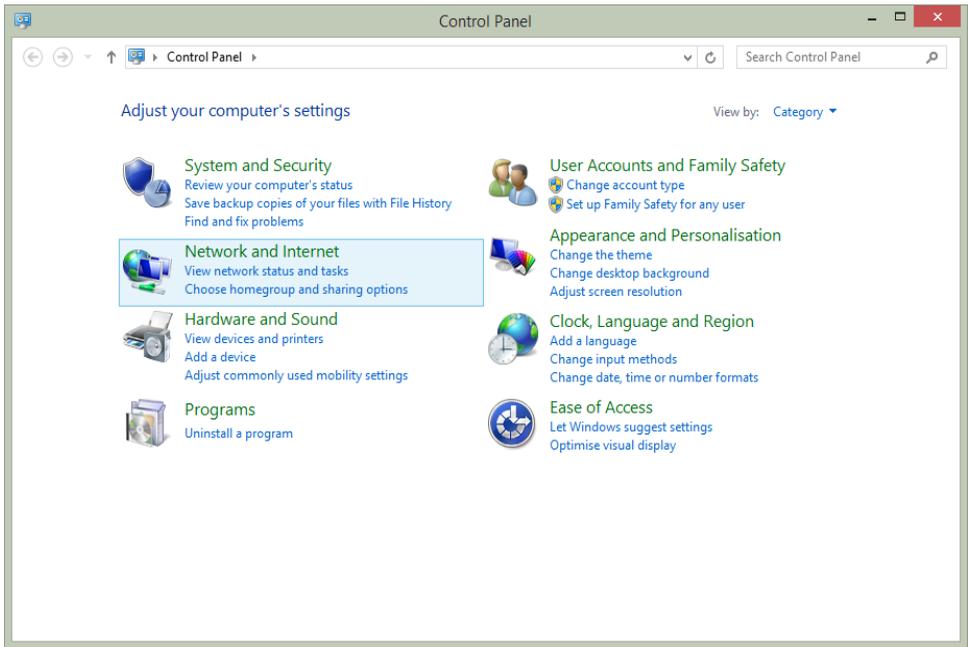
16.4 Reading data from the SD card using the external card reader

The content stored on the SD card can be read using SD card reader. To do so remove the SD card from the camera (as described in chapter 13) and then insert it into the SD card reader. After being automatically installed in your system, the card will be recognized as another drive on your PC (the name of the drive will be the same as the SD card's name). The thermogram files are located in the following directory: (the drive letter):\DCIM\...

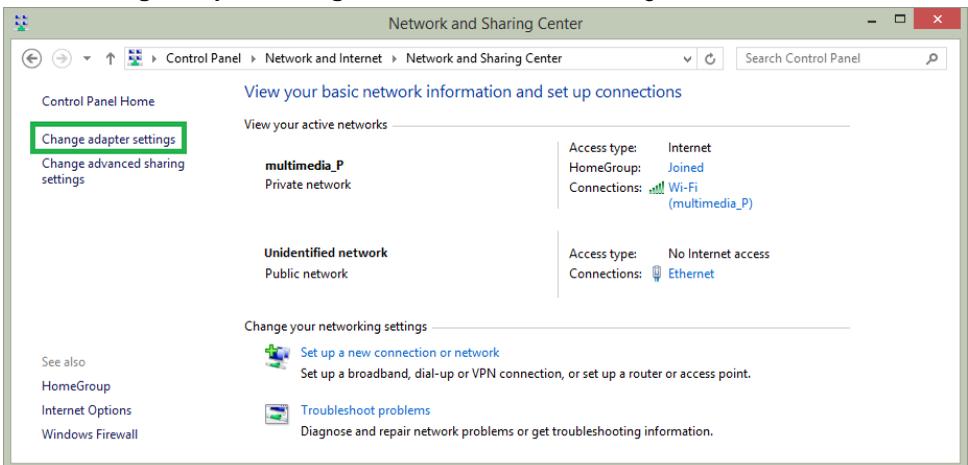
Copy selected, or all, files to your PC using Windows Explorer and then these files can be open in Sonel ThermoAnalyze2 software. The procedure of how to open and edit images is described in the user manual of the software.

16.5 LAN connection

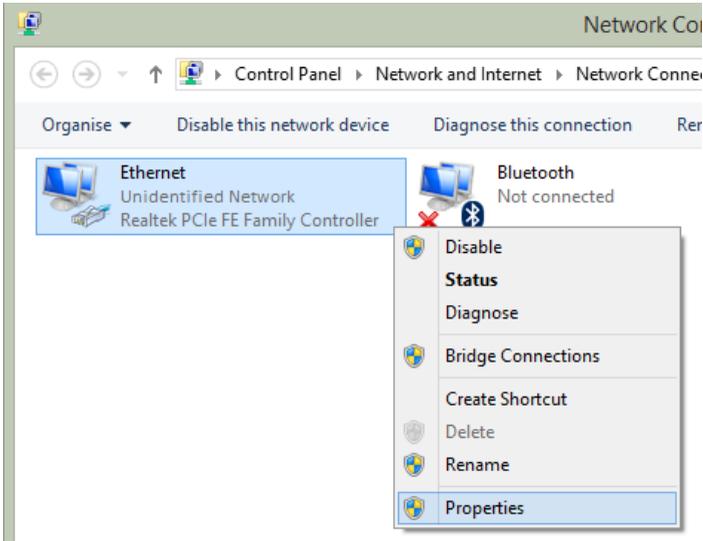
The camera can either be connected to PC directly or via existing LAN network. Turn on the camera and follow LAN connection instructions in chapter 11.3 to get the camera connected to PC through the LAN cable. The next step is to connect the camera (LAN[29] connector) to PC using LAN cable. This connection requires configuration of the PC's network adapter. While in Windows go to **START**, then select **Control Panel** and then click **Network and Internet**.



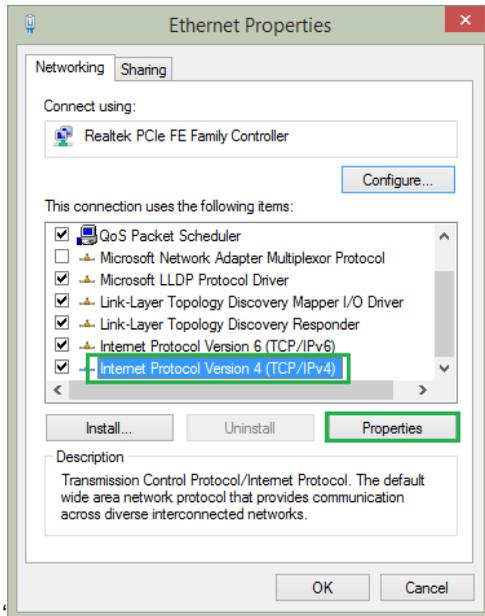
Select **Change adapter settings** in the Network and Sharing Center window.:



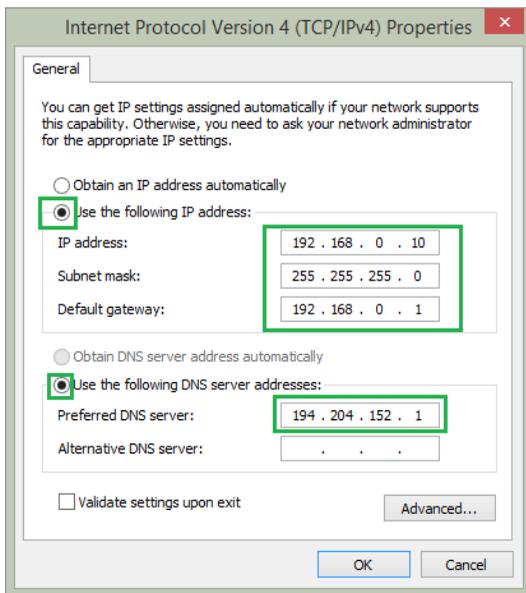
In the adapter settings window right-click on the **Ethernet** icon, and then select **Properties**:



The Ethernet Properties window will open. Select the Internet **Protocol Version 4 (TCP/IPv4)** from the list, and click **Properties**:

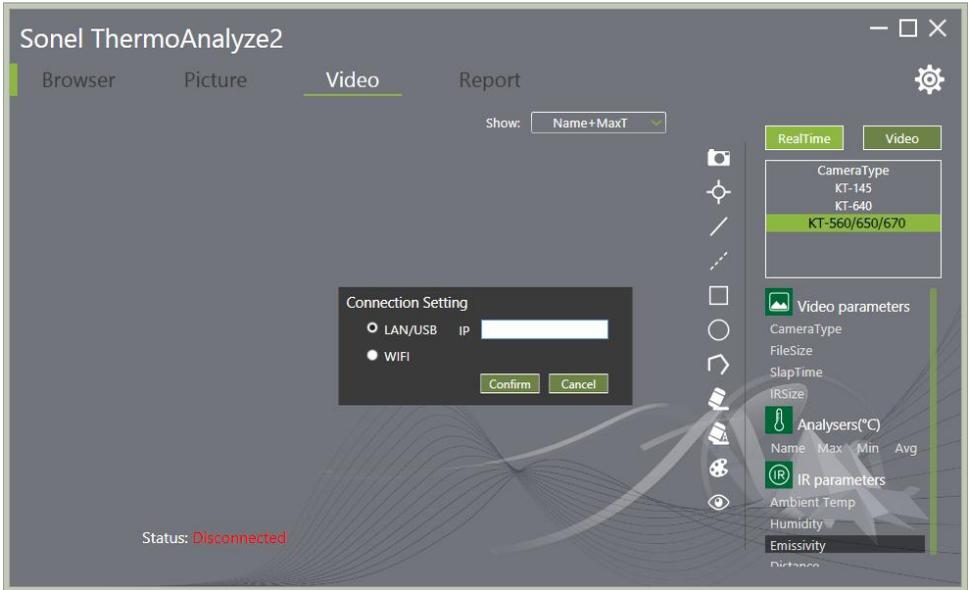


Chose **Use the following IP address** and fill in the IP address, Subnet mask and Default gateway fields. Then select **Use the following DNS server addresses** and enter the proper data. The data that you enter should match the settings of the camera (chapter 11.3) and the LAN network (if the camera and the PC are both connected to the existing LAN network):

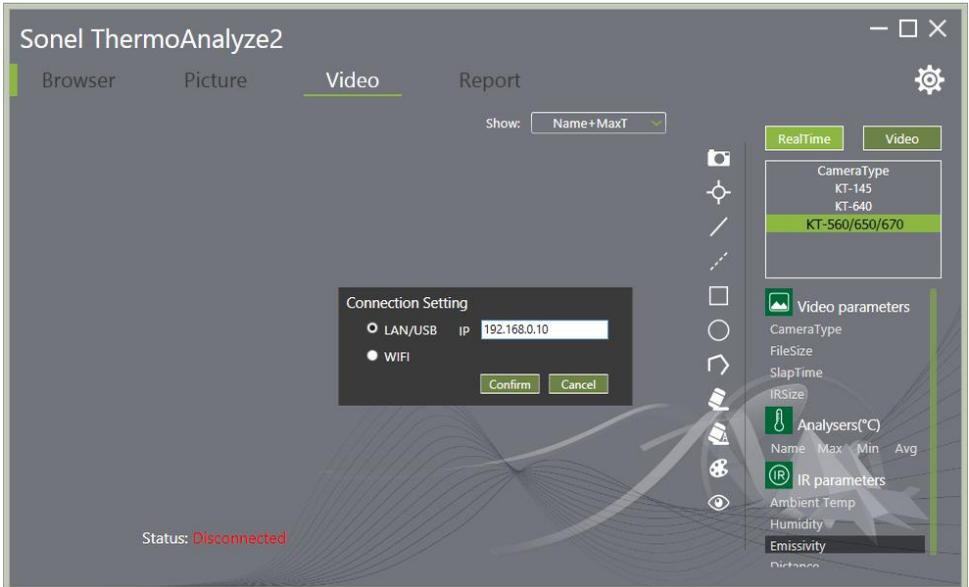


When the above parameters have been set press OK. The network connection will now restart and the selected parameters will be set.

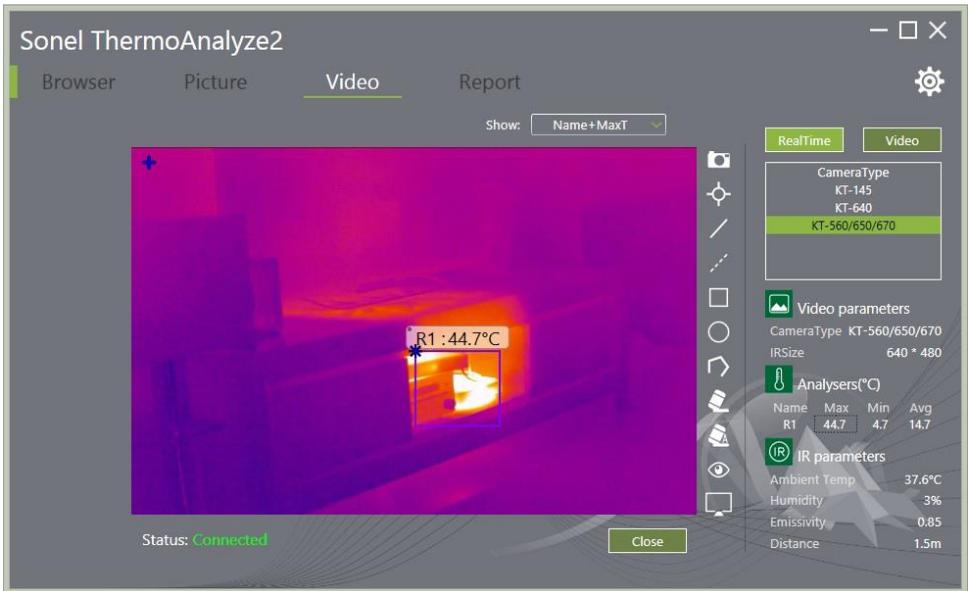
Run Sonel ThermoAnalyze2 software and go to **Video** tab. On the side menu click **RealTime** button, and double click on the **camera type** (one type for **KT-560/650/670**) in the table below. The **Connection Setting** window will open.



Click LAN/USB and enter IP address set in accordance to the description in chapter 11.3:



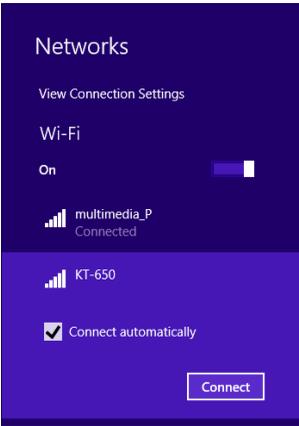
Press Confirm. The camera image is now transmitted live to your PC. In the bottom left corner of the screen the camera status has now turned into Connected.



Click Close at the bottom of the screen to disconnect. The camera's on-line operation, image capturing, saving and editing is described in the user manual of the Sonel ThermoAnalyze2 software.

16.6 WiFi connection – hotspot mode

The camera can be connected directly to PC via Wi-Fi network. Turn on the camera and configure the Wi-Fi hotspot connection as described in the chapter 11.3. The next step is to connect the camera to the PC. To do that, while in Windows, go to wireless networks control panel:

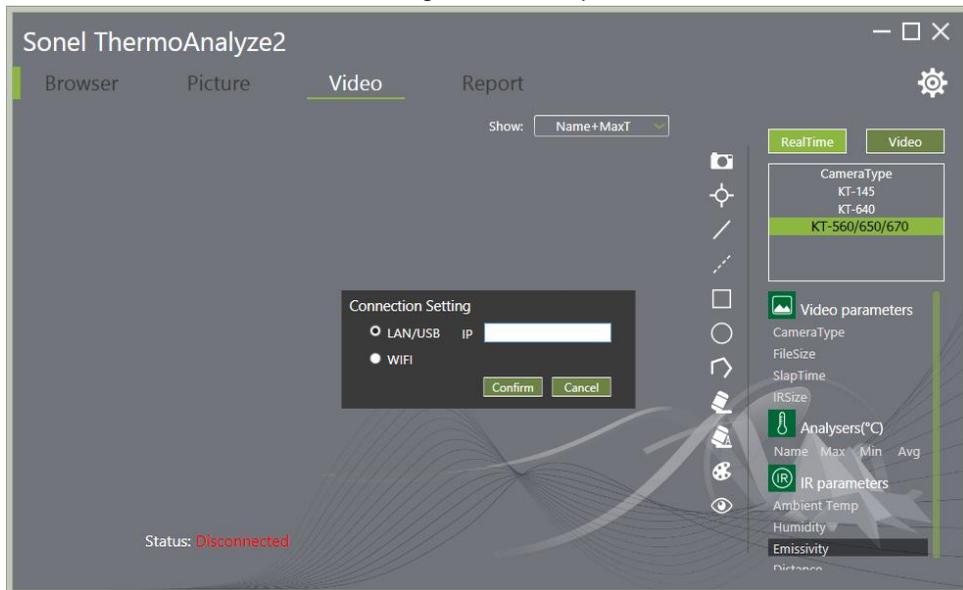


From the list of the available networks, select the camera, that goes by the name of the hotspot set in the chapter 11.3 (for example: KT-650) and click **Connect**. In the connection window enter the password set in the camera:

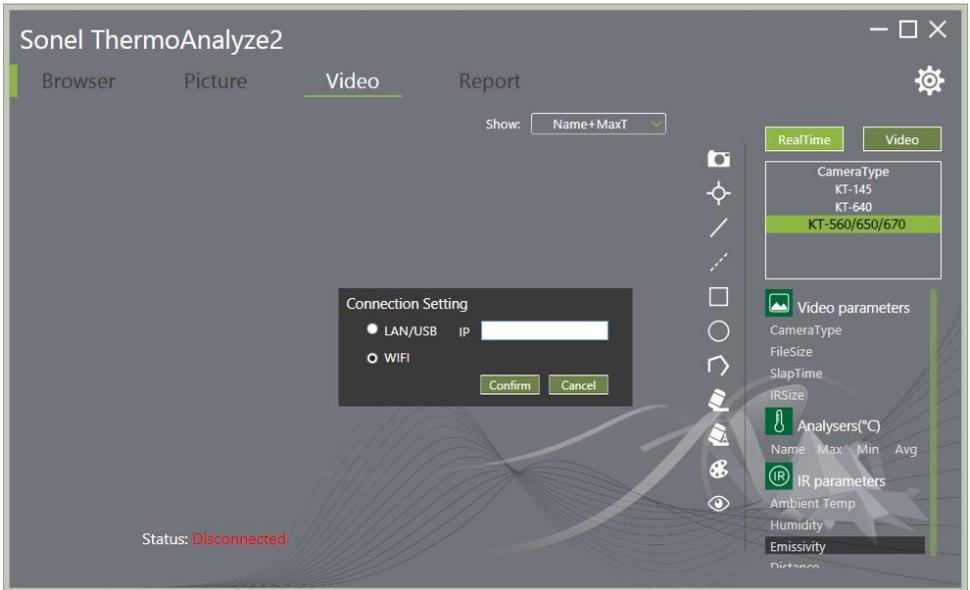


Press OK to save and the computer will establish the wireless connection with the camera.

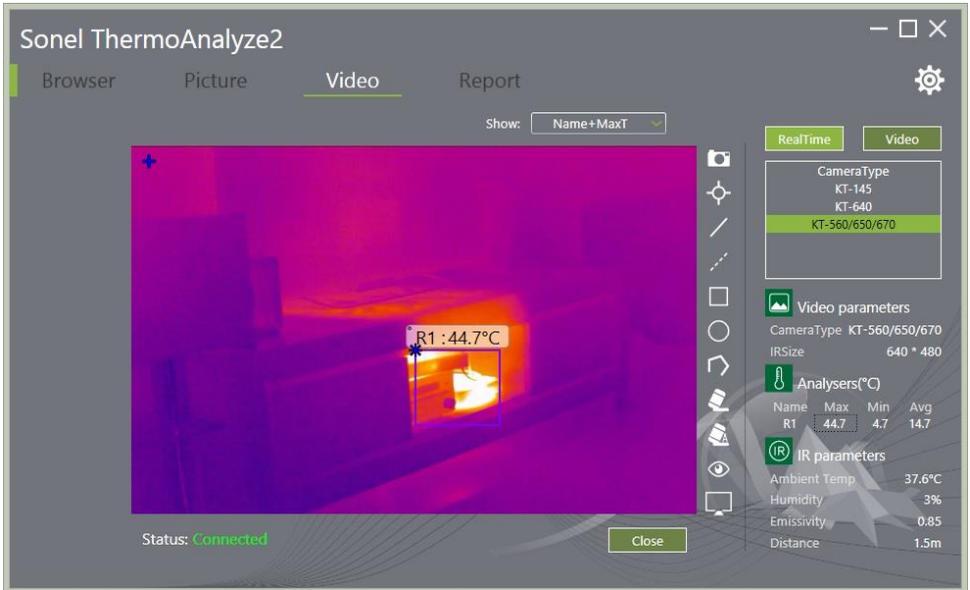
Run Sone! ThermoAnalyze2 software and go to **Video** tab. On the side menu click **RealTime** button, and double click on the camera **type** (one type for **KT-560/650/670**) in the table below. The Connection Setting window will open.



Select WiFi:



Press Confirm. The camera image is now transmitted live to your PC. In the bottom left corner of the screen the camera status has now turned into Connected.



Click Close at the bottom of the screen to disconnect. The camera's on-line operation, image capturing, saving and editing is described in the user manual of the Sonel ThermoAnalyze2 software.

16.7 Connection to WiFi network

The camera allows to connect to existing Wi-Fi networks. The connection procedure is described in the chapter 11.3.

17 HDMI connection

It is possible to transmit camera images live from the camera to audio/video devices with HDMI ports (monitors, TVs, projectors). To do so, turn on the camera and connect it to the HDMI signal receiving device, with HDMI cable connected to miniHDMI port [26] on the camera. As a signal port, select the HDMI port that has been used to connect with the camera on the signal receiving device.

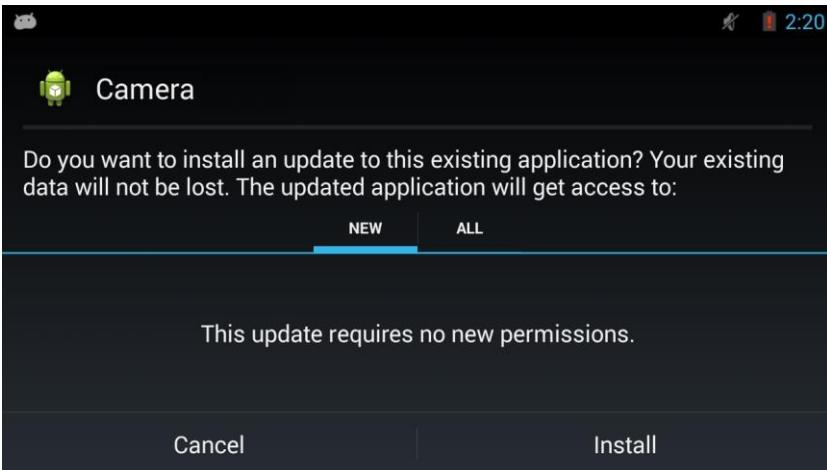
18 Firmware update

NOTE!

Do not switch off the camera's power supply, remove the batteries or SD card while the firmware upgrade is in progress.

Before commencing the upgrade procedure make sure the battery is fully charged.

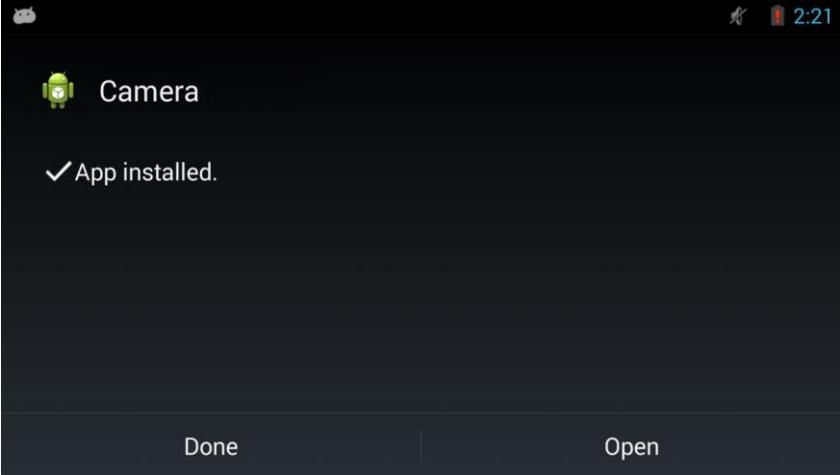
To update the firmware upload the latest version of it into the following folder on SD card: (driver letter):\GCamera\update\. Insert the card into the camera. Turn on the camera and go to setup Menu and 'Info' tab. Click SD Card Update. The firmware upgrade window menu will open:



Press '**Install**' to initiate the update procedure. During the update procedure following screen is displayed:



When the firmware has been installed, the following screen is displayed:



To complete the update procedure, press '**Done**' button. The camera will close the upgrade window menu and will resume its normal operation.

19 Specifications

Model	KT-560	KT-650	KT-670
Detector resolution	384 x 288	640 x 480	
Spectral range	7,5-14 μ m		
Thermal sensitivity	50 mK	40 mK	30 mK
Focus	Manual / Auto		
Lens (field of view/focal length)	21.7° x 16.4°/25 mm optional: 40.5° x 31.0°/13 mm 10.0° x 7.5°/55 mm 6.7° x 5.1°/85 mm	24.6° x 18.5°/25 mm optional: 45.4° x 34.9°/13 mm 11.3° x 8.5°/55 mm 7.3° x 5.5°/85 mm	
Display	5", 1280 x 720 high brightness, LCD touchscreen		
Viewfinder	1280 x 960 LCOS		
Image modes	IR / Visual / Infrarision MIF/PIp		
Digital Zoom	1...4		1...10
Temperature range	Range 1: -20°C...150°C / -4°F to 302°F Range 2: 150°C...800°C / 302°F to 1472°F Optional: 2000°C / 3632°F		
Accuracy (Ambient: 15°C / 59°F ...35°C / 95°F, object: >0°C / 32°F)	$\pm 2^\circ\text{C}$ or $\pm 2\%$ of reading		
Image analysis modes	5 points, 2 lines, 5 areas. Temperature indication: min, max, average. isotherm. Dew point. Temperature alarm.	8 points, 8 lines, 8 areas. Temperature indication: min, max, average. isotherm. Dew point. Temperature alarm.	10 points, 10 lines, 10 areas. Temperature indication: min, max, average. isotherm. Dew point. Temperature alarm.
Palettes	8		10
Emissivity coefficient	Selectable from 0.01 to 1.00 or from the list of materials.		
Measurement adjustment	Adjustable distance, relative humidity, ambient temperature (reflected)		
File format	JPG		
IR image annotations	voice (60 s), text, sketch.		voice (60 s), text, sketch, additional visual photos
Reports module	PDF reports, report printing through WiFi		
Video file format	AVI, IRV (including temp. informatio)		
Built-in features	Visual camera 5 MPix, LED flashlight, GPS, laser pointer, microphone, speaker, digital compass, light sensor.		
Wireless communication	Wi-Fi		Wi-Fi/Bluetooth
Interface	SD card slot, LAN 1 Gb/s, mini HDMI, micro USB 2.0		
Power Supply	Li-ion battery (over 4 h continuous operation), built-in charger, AC adapter 110-230 V, 50/60 Hz		
Operating temperature	-15°C...50°C / 5°F to 122°F		
Storage temperature	-40°C...70°C / -40°F to 158°F		
Humidity	10% ... 95%		
Shock/Vibration	25G, IEC 60068-2-29 / 2G, IEC 60068-2-6		
Encapsulation	IP54		
Weight	approx. 1.3 kg / 2.9 lbs (with battery)		
Dimensions	140 mm x 206 mm x 114 mm		

20 Exemplary emissivity coefficient values

aluminum	0.05	lead: polished.....	0.08
aluminum rough	0.07	lead: grey.....	0.28
aluminum oxidized.....	0.25	lead: oxidized.....	0.63
asphalt.....	0.90	paper white.....	0.90
asbestos board	0.96	paper black glossy.....	0.90
asbestos (fiber).....	0.78	paper black dull.....	0.94
akelite.....	0.93	paper: tarred.....	0.92
bronze: dull	0.22	plastic: black.....	0.95
bronze: polished.....	0.10	platinum.....	0.10
bronze: rough	0.55	porcelain: glazed.....	0.92
brick: glass.. rough.....	0.85	mercury.....	0.10
brick: fireproof. rough.....	0.94	lampblack.....	0.96
cement.....	0.54	silver.....	0.03
cement (concrete).....	0.90	steel: galvanized.....	0.28
chrome.....	0.15	steel: oxidized.....	0.88
chrome polished.....	0.10	steel: rolled freshly.....	0.24
tin.....	0.09	steel: rolled.....	0.56
zinc.....	0.05	steel: rough.....	0.96
brick red.....	0.93	steel: rusty red.....	0.69
paint: oil.....	0.94	steel nickeled.....	0.11
clay: fired.....	0.91	glaze.....	0.90
clay.....	0.40	glass.....	0.92
graphite.....	0.85	glass dull.....	0.96
ground: frozen.....	0.93	snow.....	0.80
rubber.....	0.93	tape insulation.....	0.95
cobalt.....	0.18	fabric.....	0.85
quartz.....	0.93	titanium.....	0.30
lacquer white.....	0.87	carbon.....	0.90
lacquer polished black.....	0.87	charcoal powder.....	0.96
lacquer dull black.....	0.97	tungsten.....	0.13
lacquer silver.....	0.31	tungsten: oxidized.....	0.11
ice.....	0.97	gold.....	0.02
magnesium.....	0.12	iron: glossy.....	0.16
copper: oxidized.....	0.65	iron: heat rolled.....	0.77
copper: oxidized black.....	0.88	iron: oxidized.....	0.74
copper: polished.....	0.07	iron: polished.....	0.23
copper: polished annealed.....	0.01.. 0.02	iron and steel: oxidized.....	0.85
brass.....	0.10	cast: raw casting.....	0.81
brass: oxidized.....	0.61	cast: polished.....	0.21
nickel : polished.....	0.05		

21 Cleaning and maintenance

NOTE!
Use the below specified methods of maintenance only.

Camera enclosure - all surfaces, except for optical elements of the camera, can be cleaned with a soft and moist cloth with generally available mild detergents. Do not use any solvents or cleaning agents that could scratch the enclosure (powder, paste, etc.). During cleaning, the camera must be turned off.

Due to the applied anti-reflective coating, optical lens are the most sensitive and at the same time the most expensive part of the camera (the lens is of key importance to radiometric capabilities of the infrared system). Therefore it is important to close the protective lens cover after each use of the camera. Optical surfaces should be cleaned only, when they are visibly fouled. Do not touch exposed surfaces of optical lens with fingers, because fouling left with fingerprints can be harmful to coatings and glass of the lens.

Chemical agents must not be used for cleaning the optical viewfinder, and particularly optics and accessories of the camera. Use a clean, dry and soft cloth for cleaning the body of the viewfinder; for cleaning the lens, use only the supplied lens cleaning cloth.

22 Service and storage

KT-560, KT-650 and KT-670 thermal imaging cameras don't comprise any parts serviceable by the user. Do not attempt to dismantle or modify the camera on your own. Opening the instrument voids the warranty.

NOTE:
Only the manufacturer is authorized to perform service repairs.

When storing the instrument, observe the following guidelines:

- make sure the camera and its accessories are dry,
- when storing the camera for a prolonged time, remove the batteries,
- allowed are storage temperatures specified in technical specifications,
- in order to avoid complete discharging of rechargeable batteries during prolonged storage, charge them once in a while.

23 Dismantling and disposal

Used-up electrical or electronic equipment must be collected selectively, i.e. must not be mixed with waste of other types.

Used-up electronic equipment must be delivered to an appropriate collection centre in accordance with regulations related to used-up electrical or electronic equipment.

Before delivering the equipment to the collection centre do not attempt to dismantle any of its parts.

NOTE:

Follow local regulations related to disposing of packaging, used-up batteries and rechargeable batteries.

24 Accessories

The current list of accessories can be found on the manufacturer's website.

24.1 Standard accessories

Standard bundle supplied by the manufacturer includes:

- Thermal imager
- Lens cover
- 2 x Li-ion battery 11.1 V 2.9 Ah for KT-670/650/560 – **WAAKU18**
- SD card 16 GB – **WAPOZSD16**
- Shoulder harness – **WAPOZPAS3**
- microUSB cable – **WAPRZUSBMICRO**
- HDMI cable – **WAPRZHDMI**
- LAN cable (RJ45) – **WAPRZRJ45**
- XL9 carrying case for KT-560/650/670 – **WAWALXL9**
- Power supply adaptor Z13 – **WAZASZ13**
- Power supply adaptor Z14 (KT-670 only) – **WAZASZ14**
- User manual
- Calibration certificate issued by an accredited laboratory

24.2 Optional accessories

- Power supply adaptor Z14 **WAZASZ14**



- Adapter – converter HDMI / RCA **WAADAHDMIXRCP**

- Lens

Tele IR lens 55 mm for KT-650/670 (11.3°×8.5°)

WAADAO55V650

Wide-angle IR lens 13 mm for KT-650/670 (45.4°×34.9°)

WAADAO13V650



- High temperature filter for KT-560/650/670 (up to 2000°C)

WAADAOF1



- M-11 carrying case

WAFUTM11



25 Manufacturer

The manufacturer and provider of warranty and post-warranty services for this instrument is:

In the US:

Sonel Test & Measurement
Santa Clara, Ca
Tel: 408 898 2215
Fax: 408 988 4869
e-mail: testsupport@soneltest.com
website: www.soneltest.com

International:

SONEL S.A.
58-100 Świdnica, Poland
Tel: +48 74 858 38 60
Fax: +48 74 858 38 09
e-mail: export@sonel.pl
website: www.sonel.pl

26 Laboratory services

SONEL Testing and Calibration Laboratory has been accredited by the Polish Center for Accreditation (PCA) - certificate no. AP 173.



AP 173

Laboratory offers calibration for the following instruments that are used for measuring electrical and non-electrical parameters.

● METERS FOR MEASUREMENTS OF ELECTRICAL PARAMETERS

- voltage meters,
- current meters (including clamp meters),
- resistance meters,
- insulation resistance meters,
- earth resistance and resistivity meters,
- RCD meters,
- short-circuit loop impedance meters,
- power quality analyzers,
- portable appliance testers (PAT),
- power meters,
- multimeters,
- multifunction meters covering the functions of the above-mentioned instruments,

● ELECTRICAL STANDARDS

- calibrators,
- resistance standards,

● METERS FOR MEASUREMENTS OF NON-ELECTRICAL PARAMETERS

- pyrometers,
- thermal imagers,
- luxmeters.

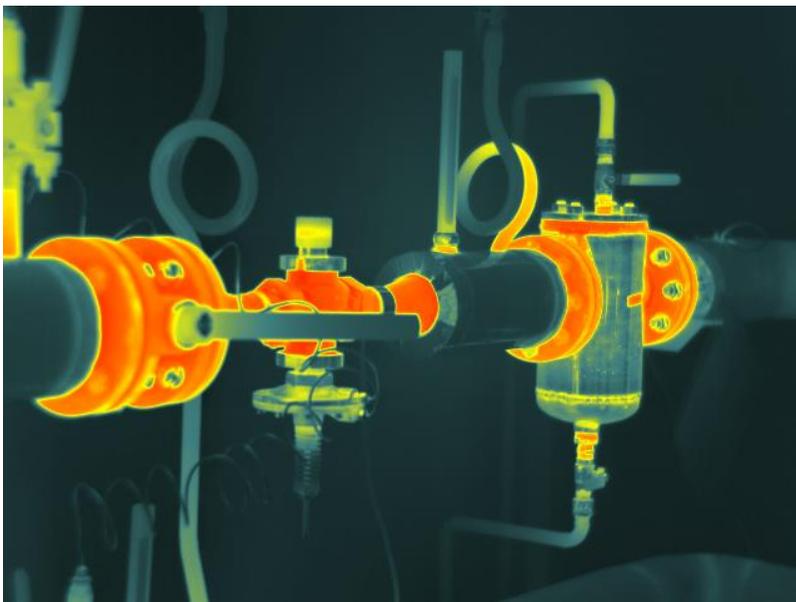
The **Calibration Certificate** is a document that presents a relation between the calibration standard of known accuracy and meter indications with associated measurement uncertainties. The calibration standards are normally traceable to the national standard held by the National Metrological Institute.

According to ILAC-G24 „Guidelines for determination of calibration intervals of measuring instruments”, SONEL S.A. recommends periodical metrological inspection of the instruments it manufactures no less frequently than once every **12 months**.

For new instruments provided with the Calibration Certificate or Validation Certificate at the factory, re-calibration should be performed within **12 months** from the date of purchase, however, no later than **24 months** from the date of purchase.

ATTENTION !

The person performing the measurements should be absolutely sure about the efficiency of the device being used. Measurements made with an inefficient meter can contribute to an incorrect assessment of the effectiveness of health protection and even human life.



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