



# WORKSWELL SMARTIS

## USER MANUAL

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# Contents

<b>1. Introduction</b>	<b>4</b>
1.1 Legal Disclaimer . . . . .	4
1.2 Copyright . . . . .	4
<b>2. Help and FAQ</b>	<b>5</b>
2.1 General Instructions . . . . .	5
<b>3. User Information</b>	<b>6</b>
3.1 Typographic Conventions . . . . .	6
3.2 Help and Community Forum . . . . .	6
3.3 Updates . . . . .	6
3.4 Firmware . . . . .	6
<b>4. Warning and Cautions</b>	<b>7</b>
4.1 Warnings . . . . .	7
4.2 Notifications . . . . .	7
<b>5. Revision History</b>	<b>8</b>
<b>6. System assembly</b>	<b>9</b>
6.1 Connection . . . . .	9
6.1.1 Power Supply . . . . .	9
6.1.2 Digital Triggers . . . . .	9
6.1.3 Digital Outputs . . . . .	10
6.1.4 Analog Outputs . . . . .	11
6.2 Mounting the system . . . . .	12
<b>7. General usage overview</b>	<b>13</b>
7.1 Controlling SMARTIS . . . . .	13
7.1.1 Web server . . . . .	13
7.1.2 Login control . . . . .	13
7.1.3 Users . . . . .	13
7.1.4 Admin and Operator Modes . . . . .	14
7.2 Products overview . . . . .	14
7.2.1 Measurement Modes . . . . .	14
7.2.2 ROI . . . . .	14
7.3 Measurement overview . . . . .	15
7.3.1 Measurement session . . . . .	15
7.3.2 Digital and analog inputs and outputs . . . . .	15
<b>8. Login</b>	<b>16</b>
8.1 No measurement in progress . . . . .	16
8.2 Measurement in progress . . . . .	17
<b>9. Administrator Mode</b>	<b>18</b>

9.1	System . . . . .	18
9.1.1	Basic Settings . . . . .	18
9.1.2	Network Settings . . . . .	19
9.1.3	Time and Date Settings . . . . .	20
9.1.4	User Settings . . . . .	20
9.1.5	Log Files Settings . . . . .	21
9.2	Products . . . . .	22
9.3	Radiometry . . . . .	23
9.4	Modes . . . . .	23
9.4.1	Frame Measurement and Evaluation . . . . .	24
9.4.2	Start-Stop Measurement and Evaluation . . . . .	25
9.4.3	Continuous Evaluation . . . . .	25
9.4.4	Non-Trigger Evaluation . . . . .	26
9.5	ROI . . . . .	27
9.5.1	ROI shapes . . . . .	27
9.5.2	Zoom . . . . .	28
9.5.3	Range and Palette . . . . .	28
9.5.4	Settings panel . . . . .	29
9.5.5	Edit ROI panel . . . . .	29
9.5.6	Sequence panel . . . . .	29
9.6	Table . . . . .	31
9.6.1	Statistic . . . . .	31
9.6.2	Value . . . . .	31
9.6.3	Extreme . . . . .	31
9.6.4	Operator . . . . .	31
9.6.5	Extreme val. . . . .	31
9.6.6	Digital . . . . .	32
9.6.7	Analog . . . . .	32
9.6.8	Copying ROI settings . . . . .	32
9.7	Outputs . . . . .	33
9.7.1	Analog Outputs . . . . .	33
9.7.2	Digital Outputs . . . . .	34
9.8	Visualization . . . . .	35
9.9	Finish . . . . .	36
<b>10.</b>	<b>Operator Mode</b>	<b>37</b>
10.1	Graphical interface . . . . .	37
10.1.1	Individual parts . . . . .	37
10.1.2	Measurement types differences . . . . .	40
10.2	Work-flow . . . . .	42
10.3	Measurement session . . . . .	42
10.3.1	Web server during measurement session . . . . .	42
10.3.2	Power cut during measurement session . . . . .	42
<b>11.</b>	<b>Ethernet</b>	<b>43</b>
11.1	Communication Protocol . . . . .	43

<b>12. Data Transfer</b>	<b>46</b>
12.1 FTP Server . . . . .	46
12.1.1 Restrictions and warnings . . . . .	46
12.1.2 Software for accessing FTP . . . . .	47
<b>13. Firmware update</b>	<b>48</b>
13.1 Firmware update . . . . .	48
<b>14. Workswell CorePlayer</b>	<b>49</b>
14.1 General Description . . . . .	49
<b>15. Environment Conditions</b>	<b>50</b>
15.1 Environment Conditions . . . . .	50
<b>16. Infrared camera behaviour</b>	<b>51</b>
16.1 Infrared camera warm-up . . . . .	51
16.2 Non-uniformity correction . . . . .	51
<b>17. Maintenance</b>	<b>52</b>
17.1 Cleaning the SMARTIS head and cables . . . . .	52
17.2 Cleaning the infrared lens . . . . .	52
<b>18. Troubleshoot</b>	<b>53</b>
18.1 Turning ON . . . . .	53
18.2 Connection error . . . . .	53
18.3 Factory Default . . . . .	53
18.4 LED status . . . . .	53
18.5 System Update . . . . .	54

## 1 Introduction

### 1.1 Legal Disclaimer

All products (software, hardware or firmware) manufactured by Workswell s.r.o. are warranted against defective materials and workmanship for a period of twelve (12) months, provided such products have been under normal storage and use in accordance with herein instructions.

The warranty extends only to the original purchaser and is not transferable. It is not applicable to any product which has been subjected to misuse, neglect, accident or abnormal conditions of operation.

In the case of a defect in a product covered by this warranty the product must not be further used in order to prevent additional damage. The purchaser shall promptly report any defect to Workswell s.r.o. or its authorized distributor or this warranty will not apply.

Workswell s.r.o. will, at its option, repair or replace any such defective product free of charge if, upon inspection, it proves to be defective in material or workmanship and provided that it is returned to Workswell within the said twelve-month period.

Nobody but Workswell s.r.o. is allowed to open or modify such product.

Workswell s.r.o. has no other obligation or liability for defects than those set forth above. No other warranty is expressed or implied. Workswell s.r.o. shall not be liable for any direct, indirect, special, incidental or consequential loss or damage, whether based on contract, tort or any other legal theory.

### 1.2 Copyright

© Workswell s.r.o. All rights reserved worldwide. No parts of the software including source code may be reproduced, transmitted, transcribed or translated into any language or computer language in any form or by any means, electronic, magnetic, optical, manual or otherwise, without the prior written permission of Workswell s.r.o.

Names and marks appearing on the products herein are either registered trademarks or trademarks of Workswell s.r.o. All other trademarks, trade names or company names referenced herein are used for identification only and are the property of their respective owners.

## 2 Help and FAQ

### 2.1 General Instructions

While looking for a solution of any technical problem we recommend following these steps:

- try to find an answer by searching this User Manual
- contact your dealer
- search Workswell s.r.o. website at <https://workswell.cz/termokamera-smartis/>
- log in and send an email to [support.workswell.eu](mailto:support.workswell.eu)

## 3 User Information

### 3.1 Typographic Conventions

Following typographic conventions are used in this User Manual:

- UPPER CASE is used for the names of keys, buttons and menu items
- COURIER is used for filenames and paths
- *Italic* is used for important information and document names
- **bold** is used for the links to other sections, for function names or internet sites

### 3.2 Help and Community Forum

For technical questions that were not answered in this User Manual feel free to contact your dealer or visit the product website at <https://workswell.cz/termokamera-smartis/>. Try to find an answer by searching the Community Forum and if there is not such answer please log in and send an email on [support.workswell.eu](mailto:support.workswell.eu).

### 3.3 Updates

The primary aim of Workswell s.r.o. company is to supply their products in a way to meet the current needs of its users and at the same time to remove all the weaknesses that were found in their use as soon as possible. For this reason, Workswell s.r.o. regularly releases updates for all their products.

### 3.4 Firmware

Firmware is the „internal“ control program of the device. From the user's point of view, only the official firmware released by Workswell s.r.o. company can be used for update of the device.

## 4 Warning and Cautions

### 4.1 Warnings

Before using the product, please check that there is no visible damage or malfunction. If there are any visible signs of damage or other defect on the device, then on no account should it be installed or put into operation.

Any interference and non-certified service operations into the product leads to an automatic loss of warranty.

### 4.2 Notifications

Do not use or store the device in conflict with the storage and operating conditions laid down in this manual (only for hardware).

- Do not point the infrared camera (with or without the lens cover) at strong energy sources, for example, devices that cause laser radiation, or the sun. This can have an unwanted effect on the accuracy of the camera. It can also cause damage to the detector in the camera.
- Plug the camera to its own power source. Do not plug the camera into the same power source as drone's motors.
- Do not use the Workswell SMARTIS system in temperatures higher than +50°C (+122°F). High temperatures can cause damage to the camera.
- Do not use the Workswell SMARTIS system in temperatures lower than -15°C (+5°F). Low temperatures can cause damage to the camera.
- Do not apply solvents or equivalent liquids to the cameras, the cables, or other items. Damage to the items can occur.
- Be careful when you clean the infrared lens. The lens has an anti-reflective coating which is easily damaged. Do not use too much force to clean the infrared lens. This can cause damage to the anti-reflective coating.
- The encapsulation rating is only applicable when all the openings on the all components of the system are sealed with their correct covers, hatches, or caps.



## 5 Revision History

### 1.0.0

- Initial Release

### 210127

- Added new support contact and version numbering.

## 6 System assembly

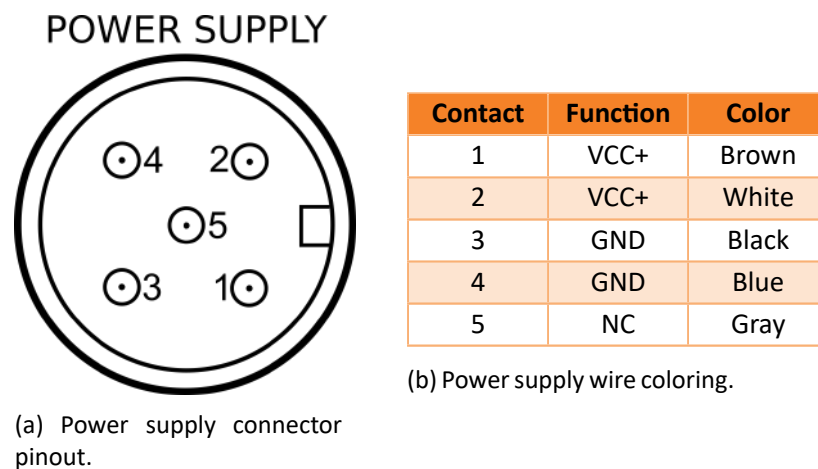
### 6.1 Connection

For fully controlling the SMARTIS you need:

- Ethernet Cable
- 1x M12 5-pin cable for power supply
- 3x M12 8-pin cables for Digital Triggers, Digital Outputs and Analog Outputs

#### 6.1.1 Power Supply

You can power your SMARTIS with M12 5-pin cable. Voltage between VCC and GND pins must be within range **18VDC - 32VDC**. You can see the power connector pinout in the Figure 6.1a.

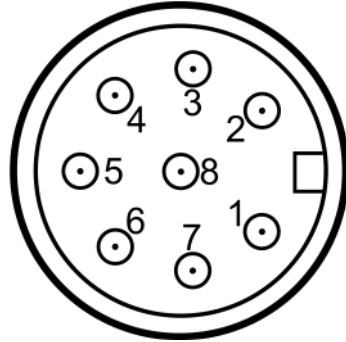


**Note:** Exceeding the input power range may cause damage to the SMARTIS.

#### 6.1.2 Digital Triggers

You can trigger your SMARTIS with M12 8-pin cable. Trigger level of each trigger is within range **8VDC - 36VDC**. You can see the trigger connector pinout in the Figure 6.2a.

### DIGITAL TRIGGERS



(a) Connector pinout.

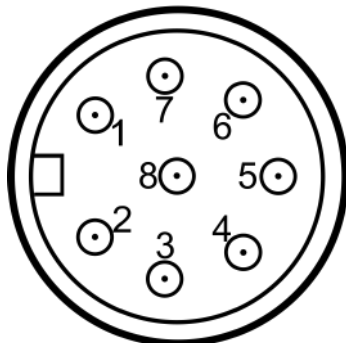
Contact	Function	Color
1	LATCH+	White
2	GND_T	Brown
3	START+	Green
4	GND_T	Yellow
5	STOP+	Gray
6	GND_T	Pink
7	NUC+	Blue
8	GND_T	Red

(b) Digital triggers wire coloring.

### 6.1.3 Digital Outputs

You can use 7 Digital Outputs of your SMARTIS with M12 8-pin cable. Each Digital Output is set as an open collector circuit. You can see the Digital Outputs connector pinout in the Figure 6.3a and output's schematics and example circuit in the Figure 6.4.

### DIGITAL OUTPUTS



(a) Connector pinout.

Contact	Function	Color
1	D0	White
2	D1	Brown
3	D2	Green
4	D3	Yellow
5	D4	Gray
6	D5	Pink
7	D6	Blue
8	GND	Red

(b) Digital outputs wire coloring.

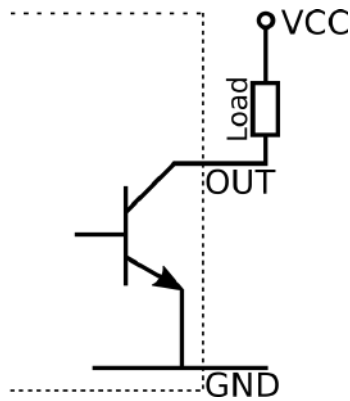


Figure 6.4: Output pin scheme.

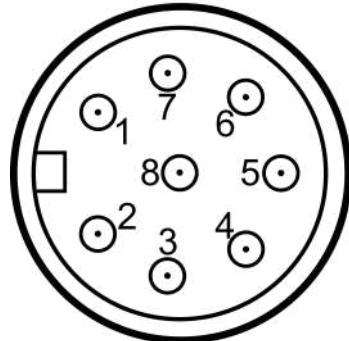
### 6.1.4 Analog Outputs

You can use 7 Analog Outputs of your SMARTIS with M12 8-pin cable. Each Analog Output can be set as voltage or current loop:

- **Voltage**
  - $\pm 12V$
  - 0V - 12V
  - 0V - 6V
- **Current**
  - $\pm 24mA$
  - 4mA - 24mA

You can see the Analog Outputs connector pinout in the Figure 6.5a.

#### ANALOG OUTPUTS



(a) Connector pinout.

Contact	Function	Color
1	A0+	White
2	A0-	Brown
3	A1+	Green
4	A1-	Yellow
5	A2+	Gray
6	A2-	Pink
7	A3+	Blue
8	A3-	Red

(b) Analog outputs wire coloring.

### 6.2 Mounting the system

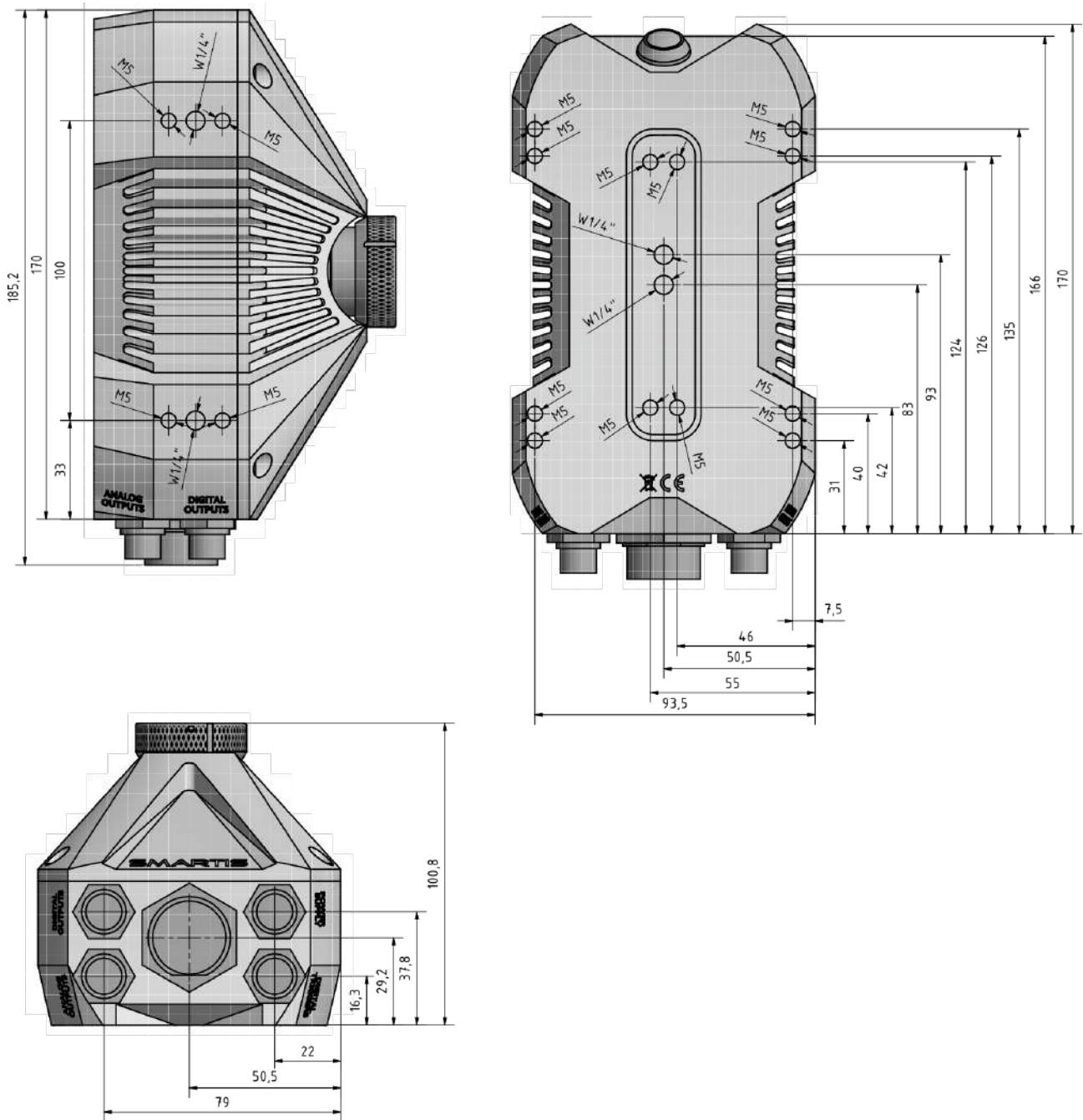


Figure 6.6: SMARTIS mechanical drawings and dimensions.

## 7 General usage overview

This chapter should provide the reader basic usage information for understanding SMARTIS functions, the logic behind it and basic terminology.

### 7.1 Controlling SMARTIS

The SMARTIS is intended as all-in-one solution featuring a thermal camera, control unit, I/O card, as well as a TPC/IP interface integrated within a single casing including an in-built web server allowing for communication with a superior system, including any PLC with this interface.

#### 7.1.1 Web server

After powering the SMARTIS up and connecting it to Ethernet network, the device should be available on default IP address **10.0.0.225**. This IP address could be changed later.

All the user needs for configuring and controlling the SMARTIS is computer or tablet with at least 10" screen with web browser. The built in web server should be running few seconds after the SMARTIS boots up.

The web server is available on the standard web port 80.

#### 7.1.2 Login control

The inner logic of SMARTIS does not allow more users to log into the web server simultaneously. This should prevent unexpected settings changes from administrator or operators.

The current user logged in must be firstly disconnected before another user can use the SMARTIS web server. This can be done through special web pages described in chapter 8.

#### 7.1.3 Users

There two types of users: administrator and operators.

##### Administrator

Administrator (or "Admin") is a unique user that can not be created nor deleted. Administrator has the highest privileges, he/she can creates unlimited number of operators.

Administrator should configure the SMARTIS and prepare it for operators to perform measurement sessions.

The default password for administrator "Admin" is "1234".

## Operators

Operators are users with the privilege to control measurements sessions. Operators can change products (a set of settings) and start or stop the measurement sessions.

They should watch over the measurements and progress.

### 7.1.4 Admin and Operator Modes

As with the two kind of users, there are two basic modes with different web pages on SMARTIS web server.

If administrator logs in to web server, the "Admin Mode" starts. If operator logs in, the "Operator Mode" starts.

#### Admin Mode

Admin mode takes the administrator through several tabs and web pages with settings. The administrator should follow these tabs and create one or more operators and products.

Please refer to chapter 9 for further details.

#### Operator Mode

Operator mode is just a single web page. Upon operator logging, he can select some of his products and starts or stops measurement sessions.

Please refer to chapter 10 for further details.

## 7.2 Products overview

For the broadest range of usage administrator can create several operators with their own settings.

Each operator can have several products - a set of settings. The operator can select whatever of his products starts the measurement with this settings.

There are just a few general settings like language, units, date, time etc. The rest is encapsulated in its own product.

### 7.2.1 Measurement Modes

Measurement modes are a basic settings for each product. Again, to cover all kind of applications, several modes can be chosen.

### 7.2.2 ROI

One of the most important settings is so called Regions Of Interests, or ROIs.

ROI is a point or an area of a thermocamera image upon which the measurement computations and evaluations are performed. Each product can have several ROIs.

For further information, please refer to chapter 9.5.

## 7.3 Measurement overview

When operator logs in, he should select the product. The SMARTIS will not evaluate any digital signal nor do any measurement until the operator starts the measurement session.

### 7.3.1 Measurement session

When measurement session starts, the SMARTIS will perform an image calibration and will react to digital inputs and produce digital and analog outputs according to product settings.

It will do individual measurements and evaluate the results. Each single measurement can consist of data collecting from incoming thermal images.

The SMARTIS will continue a measurement until the operator stops the measurement session.

### 7.3.2 Digital and analog inputs and outputs

During the measurement session, the SMARTIS will react to digital inputs and produce the analog outputs according to product settings.

These signals should be connected to PLC unit. The PLC should signal the SMARTIS when to start individual measurements and control the outputs from SMARTIS.



## 8 Login

If you power up the SMARTIS, log-in screen appears. There are two types of log-in screen, one if there is not any measurement in progress and one if there is.

### 8.1 No measurement in progress

For logging in, follow these steps:

1. Select the user you want to log-in. For opening the SMARTS settings mode, select the "Admin" user. For opening the operator mode, select appropriate user from the combo-box menu
2. Type in the correct password.
3. Press Log In



Figure 8.1: Main log-in screen - no measurement in progress.

## 8.2 Measurement in progress

If the measurement is in progress and you try to log-in you have two options.

1. Log-in to operator mode with the password of the currently logged user.
2. Stop measurement with the Admin password and log to the main log-in screen.



Figure 8.2: Main log-in screen - measurement in progress.

## 9 Administrator Mode

In Administrator mode, you can configure the SMARTIS for correct measurement. For correct settings, you have to go through all of the settings tabs.

### 9.1 System

In this part, you can set:

- Basic Settings,
- Network Settings,
- Time and Date Settings,
- User Settings,
- Log Files Settings.

#### 9.1.1 Basic Settings

In this part, you can see:

- Serial number,
- Camera resolution,
- Firmware version.

You can set

- **Units** - Celsius, Fahrenheit, Kelvin,
- **Language** - English, Czech.

You can upload update file with new firmware version. For more details about the update process, please read the section 13.

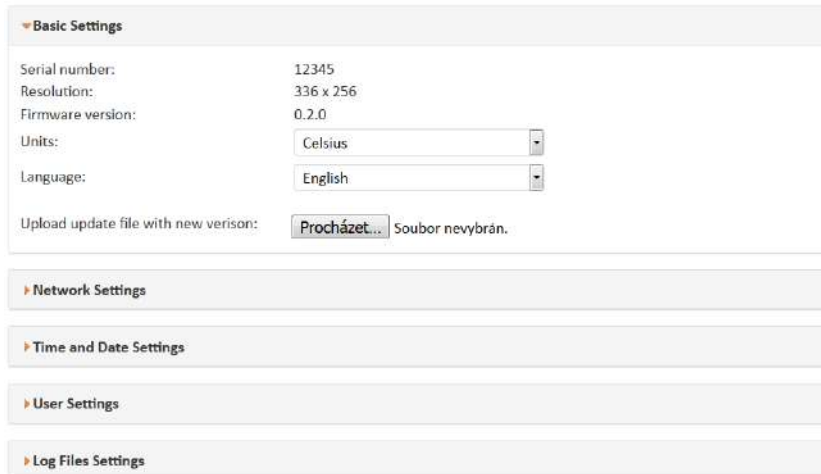


Figure 9.1: System - Basic settings.

### 9.1.2 Network Settings

In this part, you can see:

- Current IP address,
- Current Subnet mask.

You can set

- IP address,
- Subnet mask.

For setting the new IP address or subnet mask, fill the numbers and press the *Set Network* button. After that, SMARTIS will reboot and start with the new IP address. You have to change the address in your web browser to the new one for connecting to the SMARTIS.

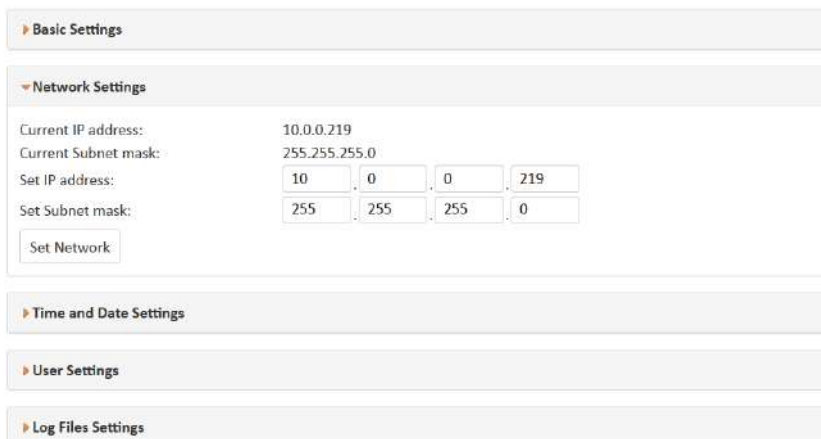


Figure 9.2: System - Network settings.

### 9.1.3 Time and Date Settings

In this part, you can set:

- Current date,
- Current Time.

For setting the new date and time, fill the numbers and press the *Set Date* or *Set Time* button.



The screenshot shows a web interface with several settings sections: Basic Settings, Network Settings, Time and Date Settings (expanded), User Settings, and Log Files Settings. In the 'Time and Date Settings' section, there are two buttons: 'Set Date' and 'Set Time'. To the right of 'Set Date' are three input fields containing '2017', '06', and '12' separated by slashes. To the right of 'Set Time' are three input fields containing '11', '14', and '07' separated by colons.

Figure 9.3: System - Time and Date settings.

### 9.1.4 User Settings

In this part, you can:

- edit user password,
- delete user,
- create new user.

For editing user password:

1. Select the desired user from the combo-box.
2. Type in the new password.
3. Type in the password again for confirmation.
4. Press the *Edit* button.

For deleting an user:

1. Select the desired user from the combo-box.
2. Press the *Delete* button.

**Note:** You can not delete the Admin user.

For creating new user:

1. Type in the new User name.

2. Type in the new password.
3. Type in the password again for confirmation.
4. Press the *Create* button.

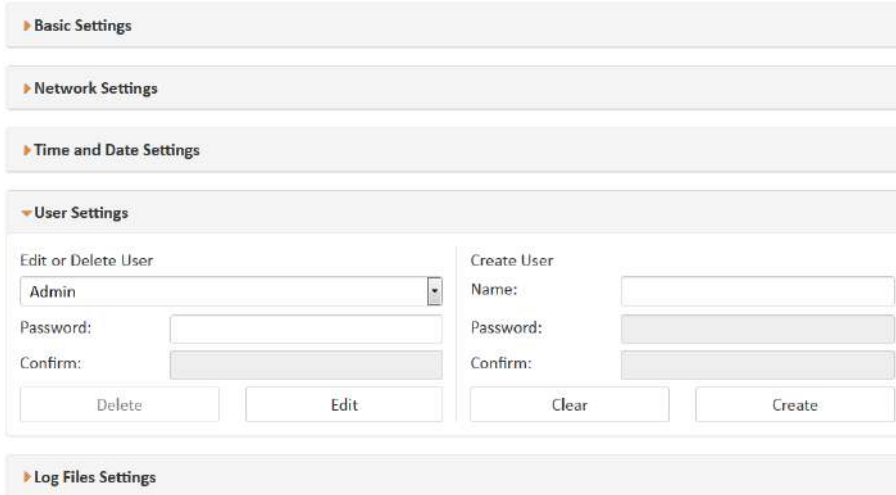


Figure 9.4: System - User settings.

### 9.1.5 Log Files Settings

In this part, you can:

- see the current used memory,
- erase Log files,
- select Auto erase Log files. If this option is set, old log files and images are erased when the memory is full.

'." data-bbox="217 636 782 826"/>

Figure 9.5: System - Log Files settings.

## 9.2 Products

In this part you can create and edit products. All the subsequent settings will be applied to selected product.

For creating a product:

1. Select user for whom you want to create a product.
2. Type in the Product name.
3. Press the *Create* button.

**Note:** After creating a product, you have to go through all of the settings tabs and set up your product.

If you want to edit an existing product, select it from the table below and click the *Edit* button.

**Note:** For editing a product, you have to go through all of the settings tabs and set up your product.

If you want to delete an existing product, select it from the table below and click the *Delete* button.

For copying a product with all of its settings:

1. Select product you want to copy from the combo-box.
2. Select user to whom you want to copy the product.
3. Type in a name of the new desired product.
4. Press the *Copy* button.

You can see the new copied product in the product table.

Tester

Create Product:

---

Copy product  to user

New name:

#	Name	Mode	No. of ROIs	Edit	Delete
0	Product01	Frame	1	<input type="button" value="Edit"/>	<input type="button" value="x"/>
1	Product02	Start-Stop	6	<input type="button" value="Edit"/>	<input type="button" value="x"/>
2	Product03	Continuous	13	<input type="button" value="Edit"/>	<input type="button" value="x"/>

Figure 9.6: Products settings.

### 9.3 Radiometry

In this part, you can set:

- Camera emissivity,
- Atmospheric temperature,
- Reflected temperature,
- Camera temperature range,
- Synchronous image correction limit.

Emissivity:	<input type="text" value="0.95"/>
Atmospheric temperature:	<input type="text" value="20.0°C"/>
Reflected temperature:	<input type="text" value="20.0°C"/>
Camera temperature range:	<input type="text" value="-25°C to +150°C"/>
Synchronous image correction limit:	<input type="text" value="10 min"/>

Figure 9.7: Radiometry settings.

### 9.4 Modes

In this part, you can set input triggers and modes for controlling the measurement. You can select one of the four measurement modes:

- Frame Measurement and Evaluation,
- Start-Stop Measurement and Evaluation,
- Continuous Evaluation,
- Non-Trigger Evaluation.

For each triggered mode, you can select one of the two trigger options:

1. **Latch trigger** - One trigger signal, measurement during high level of the signal.
2. **Start and Stop** - Two trigger signals - one for starting and one for stopping the measurement.



Figure 9.8: SMARTIS trigger options - Latch or Start-Stop triggers.

For each trigger signal, you can select the steady-state and ON-state logical level to either:



1. **Logical High** - Trigger activates if it is changed from Low to High level.
2. **Logical Low** - Trigger activates if it is changed from High to Low level.

You can see an example in the figure 9.9

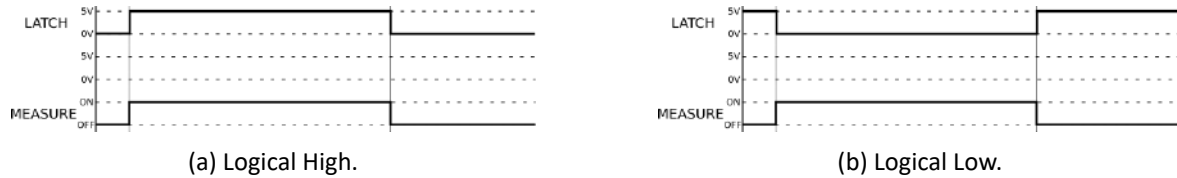


Figure 9.9: SMARTIS trigger level options - logical High or logical Low with the Latch trigger example.

If you do not have any triggers available, you can control the SMARTIS via Ethernet commands. For this, check the *Ethernet triggers* checkbox. You can find more information about the Ethernet commands in the chapter 11.

### 9.4.1 Frame Measurement and Evaluation

In this mode, you can start the measurement with one trigger. The measurement stops after defined sequence length.

You can specify:

- **Sequence length** with number of frames to take.
- **Sequence length** in milliseconds.
- **Start Delay** - delay after the start-trigger in milliseconds .

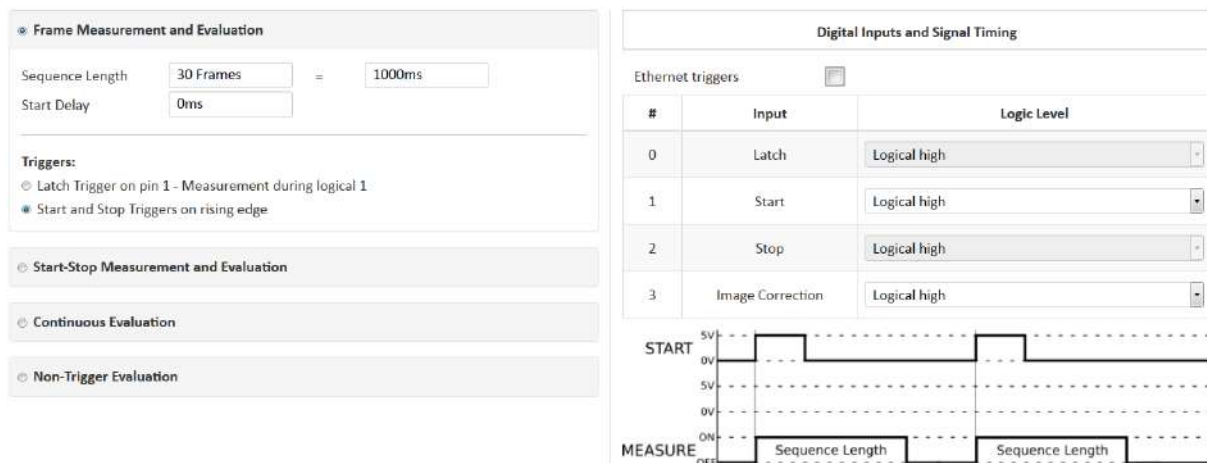


Figure 9.10: Frame Measurement and Evaluation example.

### 9.4.2 Start-Stop Measurement and Evaluation

In this mode, you can trigger the measurement in two ways:

1. **Two triggers** - start with one Start trigger and with one Stop trigger.
2. **One trigger** - start with Latch trigger in logical high state and stop with Latch trigger in logical low state.

You can specify:

- **Start Delay** - delay after the start-trigger in milliseconds.

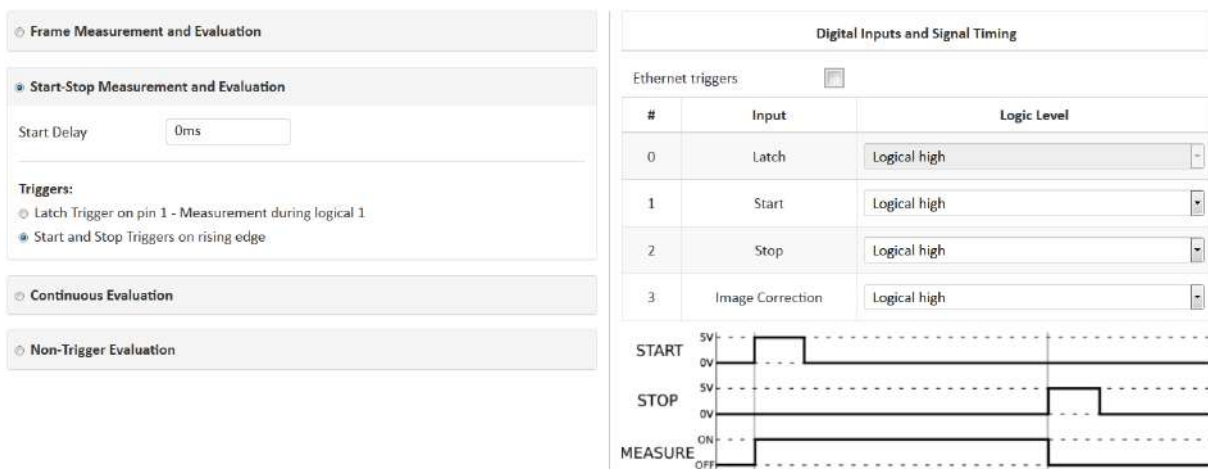


Figure 9.11: Start-Stop Measurement and Evaluation example.

### 9.4.3 Continuous Evaluation

In this mode, you can trigger the measurement in two ways:

1. **Two triggers** - start with one Start trigger and with one Stop trigger.
2. **One trigger** - start with Latch trigger in logical high state and stop with Latch trigger in logical low state.

When the measurement is active, SMARTIS takes and evaluates one frame repeatedly with *Sample interval* period.

You can specify:

- **Sample interval** - time between captured images.
- **Start Delay** - delay after the start-trigger in milliseconds.
- **Save Image** - saves image with log file which can be downloaded and evaluated later.

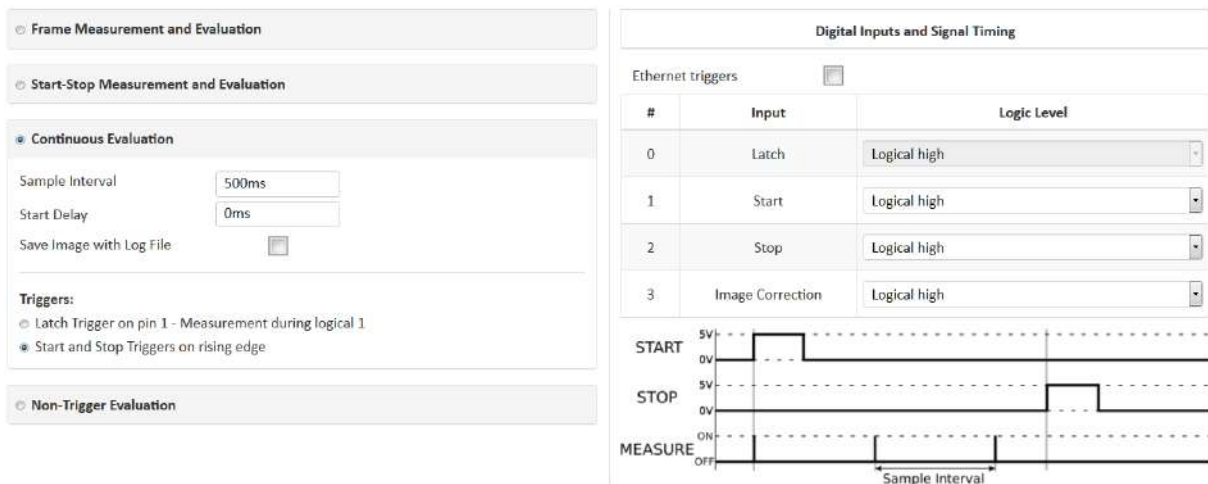


Figure 9.12: Continuous Evaluation example.

### 9.4.4 Non-Trigger Evaluation

In this mode, there are no triggers needed and each frame is evaluated.

You can specify:

- **Hysteresis**
- **Save Image** - saves image with log file which can be downloaded and evaluated later.

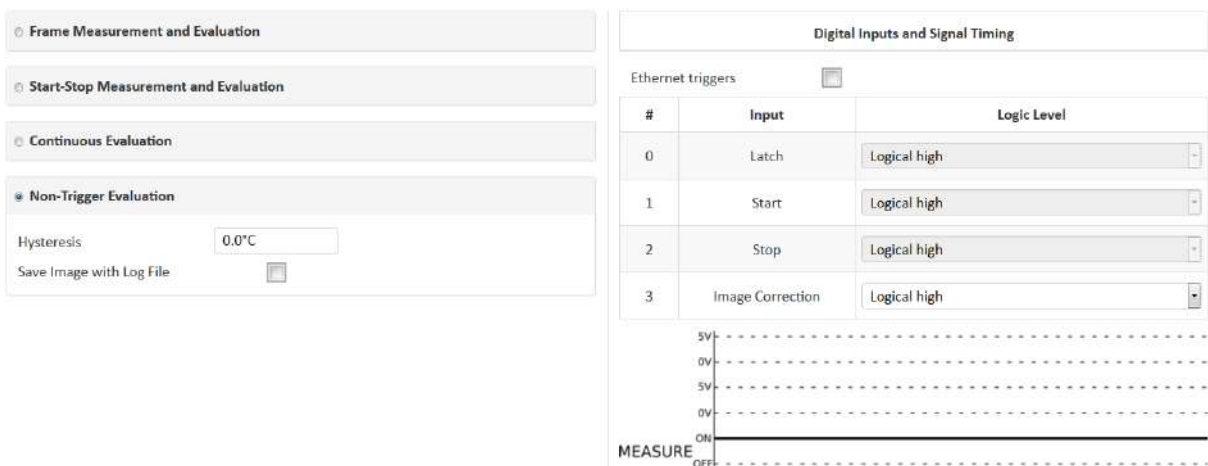


Figure 9.13: Non-Trigger Evaluation example.

## 9.5 ROI

### 9.5.1 ROI shapes

In this part, you can set your ROIs. You can select several shapes:

- **Point** - click on the *Point* symbol and then anywhere into the image you want to place your Point.
- **Line** - click on the *Line* symbol and then anywhere into the image you want to place the first Line point. Then click the second Line point.
- **Poly-line** - click on the *Poly-line* symbol and then anywhere into the image you want to place the first Poly-line point. Then click the next points of your Poly-line. You can end the Poly-line by double-click or by clicking to any shape button.
- **Rectangle** - click on the *Rectangle* symbol and then anywhere into the image you want to place the first Rectangle point. Then click the second Rectangle point.
- **Circle** - click on the *Circle* symbol and then anywhere into the image you want to place the center of the Circle. Then click any other Circle point.
- **Polygon** - click on the *Polygon* symbol and then anywhere into the image you want to place the first Polygon point. Then click the next points of your Polygon. You can end the Polygon by double-click or by clicking to any shape button.

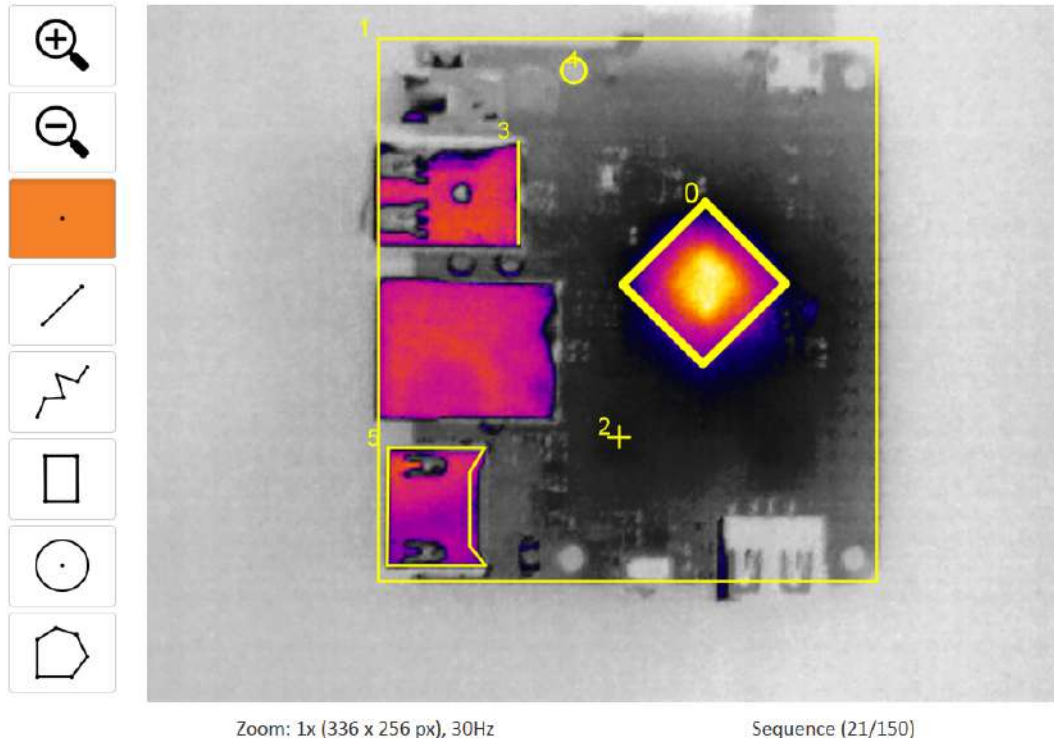


Figure 9.14: ROI shapes icons.

### 9.5.2 Zoom

By clicking on the *Zoom+* or *Zoom-* buttons, you can zoom or un-zoom your camera view by clicking anywhere into the image.

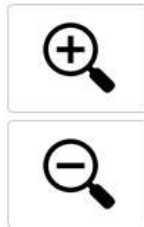


Figure 9.15: Zoom icons.

### 9.5.3 Range and Palette

You can switch camera temperature range from automatic to manual by clicking the *A/M* button. If you have selected the manual temperature range, you can set the appropriate Max/Min limits.

You can select one of several different temperature palettes for your camera image by clicking anywhere in the palette panel.

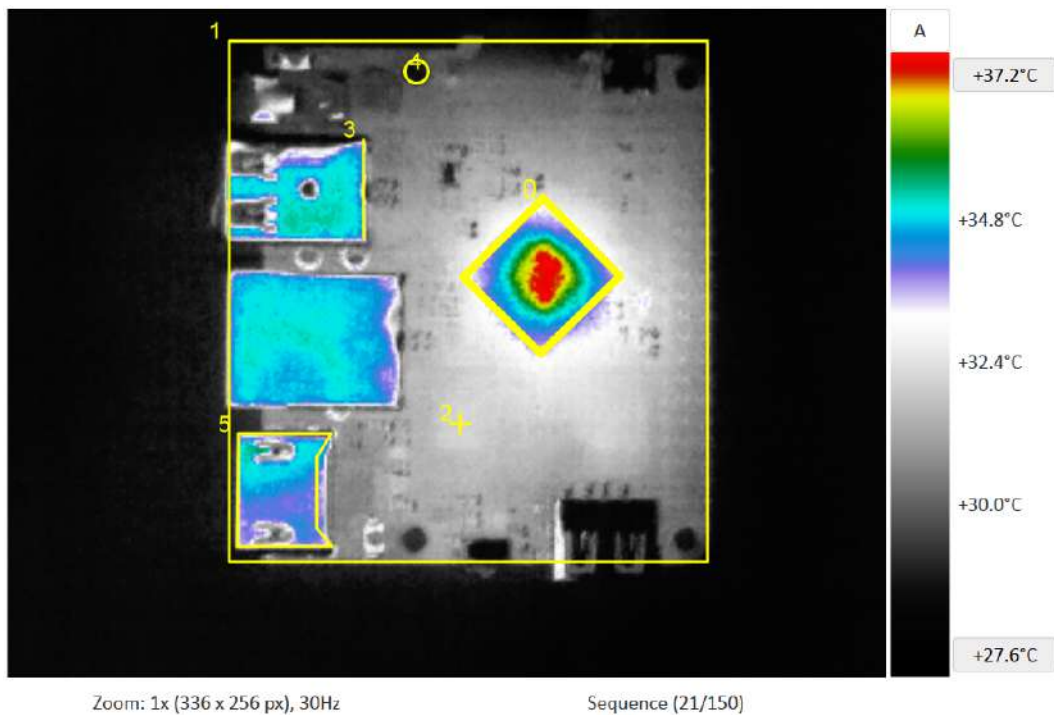


Figure 9.16: Palette selection.

### 9.5.4 Settings panel

You can select one of several different temperature palettes for your camera image by clicking anywhere in the palette panel or by selecting its appropriate name in the Settings panel. In the same panel, you can choose color of your ROIs and do camera image correction.

### 9.5.5 Edit ROI panel

You can edit already created ROIs in the Edit ROI panel. For editing ROI:

1. Select desired ROI from the *Select ROI* combo-box.
2. Select desired point of the ROI you want to move or you select the whole ROI.
3. Select number of pixels you want to move the ROI.
4. Click arrow in desired direction to move the ROI.

**Note:** Currently selected ROI gets highlighted.

In this panel, you can also:

- set ROI name,
- duplicate ROI - duplicates selected ROI,
- delete ROI - deletes selected ROI.

### 9.5.6 Sequence panel

You can record a video sequence by clicking the *Start* button or by switching ON your trigger you have set in the previous window. The recording will stop when you click the *Stop* button, switch OFF your trigger or after 5 seconds.

You can select your recorded sequence from the list where you can see all recorded sequences. With any sequence selected, you can:

- go through all of the frames by clicking arrows right or left,
- select number of frames you want to move forward or backward,
- delete sequence by clicking the *Delete* button.

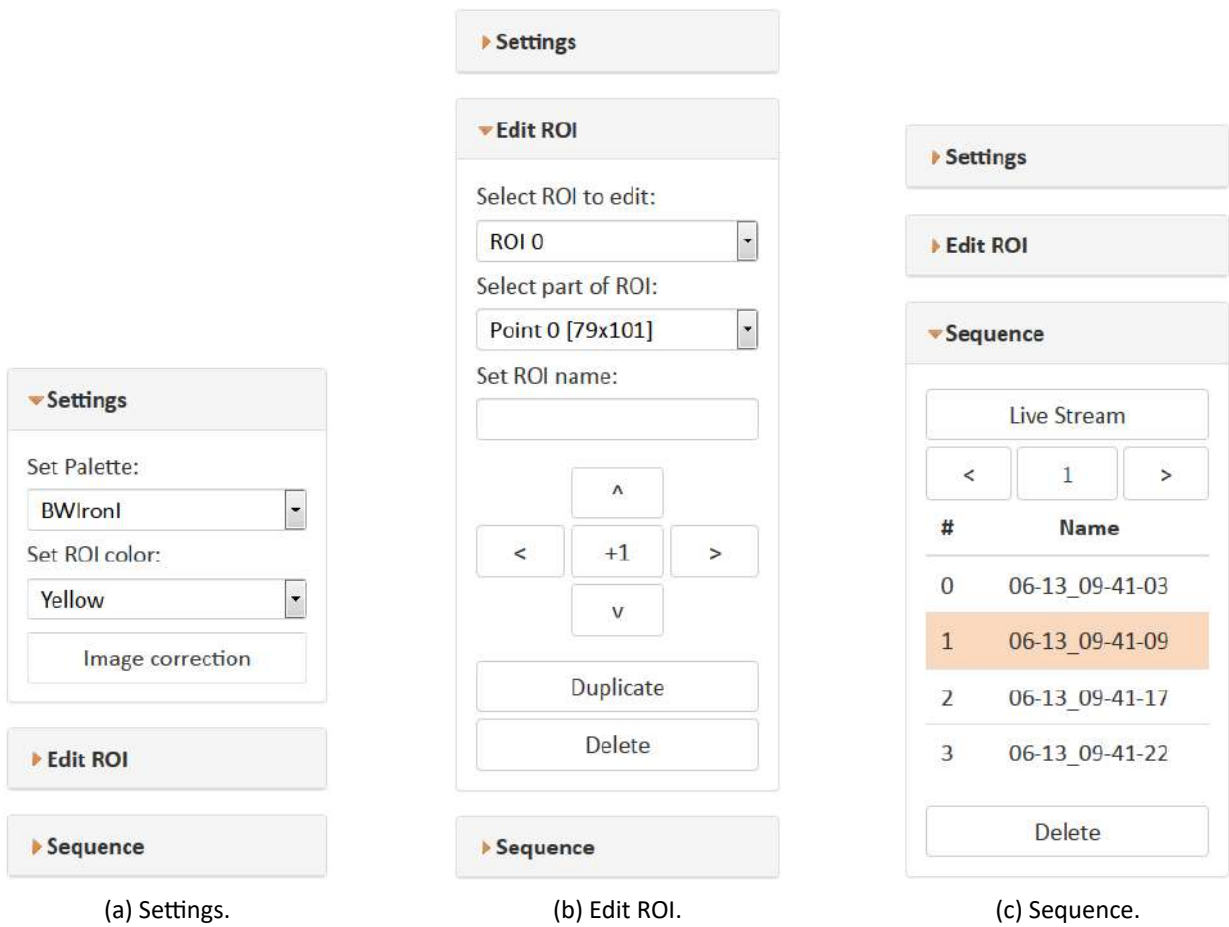


Figure 9.17: ROI settings panels.

## 9.6 Table

In this part, you can select statistic for each ROI, extreme and its critical value, operator, digital outputs with logic and analog outputs.

Each row in the table represents a ROI you have defined before.

### 9.6.1 Statistic

In each frame there is certain area depending on the size of the ROI. The area consists out of number of pixels, each with its own temperature. These pixels are used for calculating the statistical value. For each ROI, you can select:

- **Max** - Maximum value out of the ROI pixels.
- **Min** - Minimum value out of the ROI pixels.
- **Avr** - Average value out of the ROI pixels.
- **Dev** - Standard deviation value out of the ROI pixels.
- **Var** - Variation value out of the ROI pixels.

### 9.6.2 Value

This represents the current statistical result of the frame for the ROI

### 9.6.3 Extreme

The statistic value is calculated for each frame. In case of Frame or Start-Stop mode, the measurement can consist of several frames and thus several statistical results for each ROI.

The extreme selects either the lowest or the highest value from this sequence of statistical results.

### 9.6.4 Operator

The one value that comes out of the measurement sequence (or just from one measurement in case of sequence of one frame or Continuous or Non-trigger mode) is called measurement value. This value is compared to the extreme value.

The operator selects, whether the measurement value should be higher (>) or lower (<) than the extreme value.

### 9.6.5 Extreme val.

Specify the extreme value, that should be compared to the measurement value.



### 9.6.6 Digital

Each ROI has its own measurement result, either positive (pass, OK, condition were met) or negative (fail, NOK condition were not met). This depends on the critical value compared to measurement value.

Here administrator can select the digital output logic. There are seven digital outputs, each with either low or high signal. This signal is deduced out of the individual ROI measurement results.

The boolean logic is used to calculate the digital output among selected ROIs. If there is just one ROI checked for the digital output, the measurement result will apply directly to the digital output. If there are more ROIs checked for one digital output, the final result (positive or negative) is calculated with the boolean operations AND, NAND, OR, NOR.

ROI 0	ROI 1	AND	NAND	OR	NOR
0	0	0	1	0	1
0	1	0	1	1	0
1	0	0	1	1	0
1	1	1	0	1	0

Table 9.1: Summarizing table for boolean logic, 1 is positive result and 0 is negative.

This is the short summary of boolean operators:

- **AND** - Positive only if all measurement results of checked ROIs positive
- **NAND** - Opposite of AND, negative only if all measurement results of checked ROIs positive
- **OR** - Positive if at least one measurement results of checked ROIs positive
- **NOR** - Opposite of NOR, positive only if all measurement results of checked ROIs negative

### 9.6.7 Analog

Select which ROI should display it's current frame statistic value to which analog output.

### 9.6.8 Copying ROI settings

Administrator can copy the ROI settings to different ROI with the bottom table selection and "Copy settings" button.

## 9.7 Outputs

Here is the settings for digital and analog outputs. The settings are divided into two tables, the number of rows depends on the ROI's setting from tab Table.

There are up to 4 analog outputs and 7 digital outputs.

There is also special testing mode, that can be activated by clicking the button "Test mode".

Analog Outputs							Digital Outputs			
#	Type	Range	T <sub>MIN</sub>	T <sub>MAX</sub>	T <sub>TEST</sub>	U/I <sub>TEST</sub>	#	Pulse	Edge	Test
0	Voltage	0V to 12V	20.0°C	85.0°C	50.0°C	5.5V	0	250ms	Rising	Test
1	Current	-24mA to 24mA	0.0°C	120.0°C	80.0°C	8.0mA	1	500ms	Rising	Test
3	Voltage	-12V to 12V	0.0°C	150.0°C	0.0°C	-12.0V	2	750ms	Rising	Test
							3	250ms	Rising	Test

Test mode = OFF

Figure 9.18: Outputs settings.

### 9.7.1 Analog Outputs

#### Type

Select between electrical voltage or current as output.

#### Range

Select the appropriate range, that the output can achieve.

#### T<sub>MIN</sub>

Minimum temperature, any temperature lower than this value will be represented as the lower limit of the output range.

#### T<sub>MAX</sub>

Minimum temperature, any temperature higher than this value will be represented as the higher limit of the output range.

Any temperature between the minimum and maximum will be represented as linear mapping of these values.

### T TEST

Set the testing temperature and it will be recalculated to appropriate U/I TEST value. If test mode activated, it will also set the voltage or current to output.

### U/I TEST

Set the testing current or voltage and it will be recalculated to appropriate temperature test value. If test mode activated, it will also set the voltage or current to output.

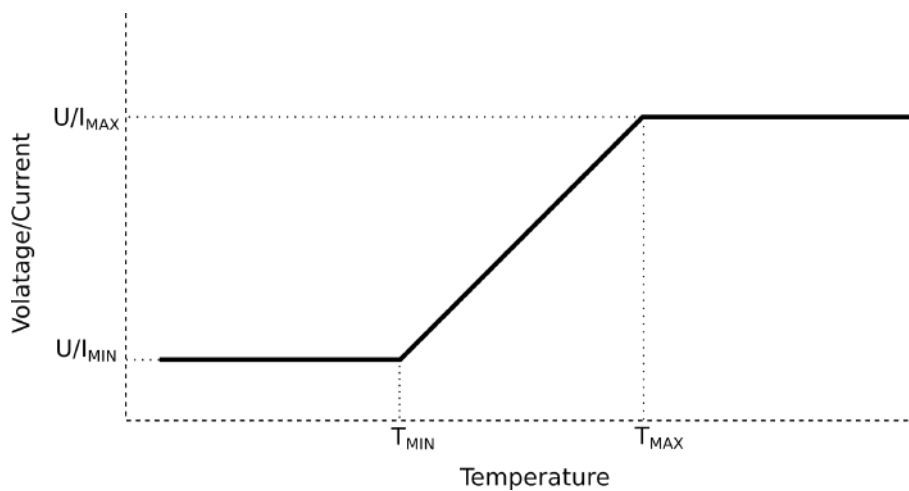


Figure 9.19: Analog output linear mapping example.

## 9.7.2 Digital Outputs

### Pulse

Set the length for the signal pulse in milliseconds.

### Edge

Select the edge of a signal. Either the edge is rising or falling.

Rising edge has the nonactive state at zero and the signal is a change between zero to the supply voltage, thus the voltage is rising.

Falling edge has the nonactive state at supply voltage and the signal is a change between supply voltage to zero, thus the voltage is falling.

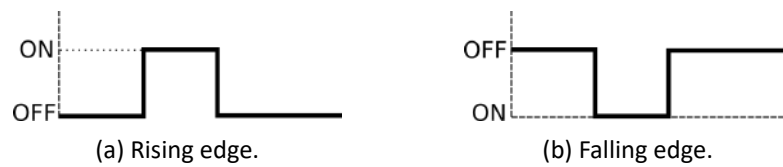


Figure 9.20: The difference between signals rising and falling edge.

## Test

Clicking the button in Test mode will produce the set signal according to its edge and length of pulse.

## 9.8 Visualization

Administrator can set the appearance of operator mode here. More settings may come with new firmware versions.

Number of numeric indicators:

Numeric Indicator 0	Numeric Indicator 1
Select ROI: <input type="text" value="0"/>	Select ROI: <input type="text" value="1"/>
Select indicator type: <input type="text" value="Current value"/>	Select indicator type: <input type="text" value="Fail/Pass"/>

Figure 9.21: Visualization settings.

## Numeric Indicators

The most important ROI and their values or result can be displayed in special panel in operator mode.

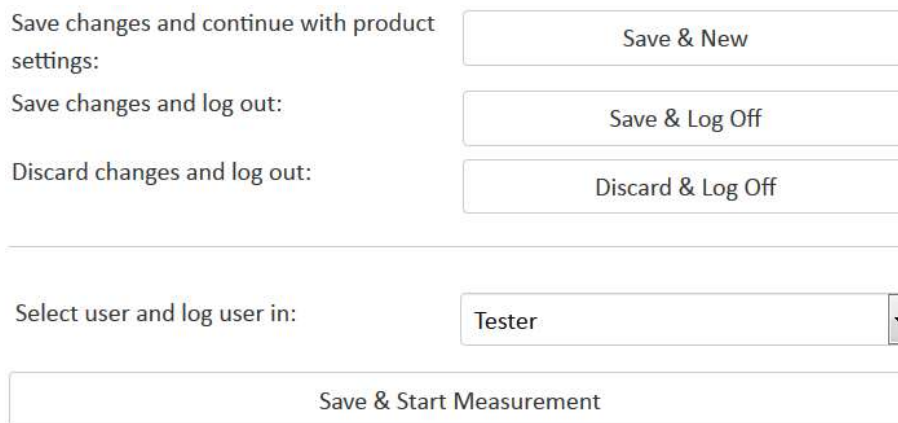
Just select the number of numeric operators, the ROI numbers and corresponding indicator types.

- **Current value** - The current ROI measurement, changes with each frame.
- **Last result** - The measurement value.
- **Fail/Pass** - The measurement result.

## 9.9 Finish

This is the last part of the SMARTIS settings. Administrator can choose one of the four possibilities:

- **Save & New** - Save changes and continue with new product settings.
- **Save & Log Off** - Save changes and log out.
- **Discard & Log Off** - Discard changes and log out.
- **Save & Start Measurement** - Select user you want to log in.



Save changes and continue with product settings:

Save changes and log out:

Discard changes and log out:

---

Select user and log user in:

Figure 9.22: Finish window.

# 10 Operator Mode

The second type of user, besides administrator, is operator. There can be limitless number of operators, each with his own products and settings.

Whereas administrator can create operators, products and set the measurements, the operator selects product and controls the measurement itself.

## 10.1 Graphical interface

On Log-in screen, select user, type password and log in. The basic layout of Operator Mode screen is the same for every measurement type.

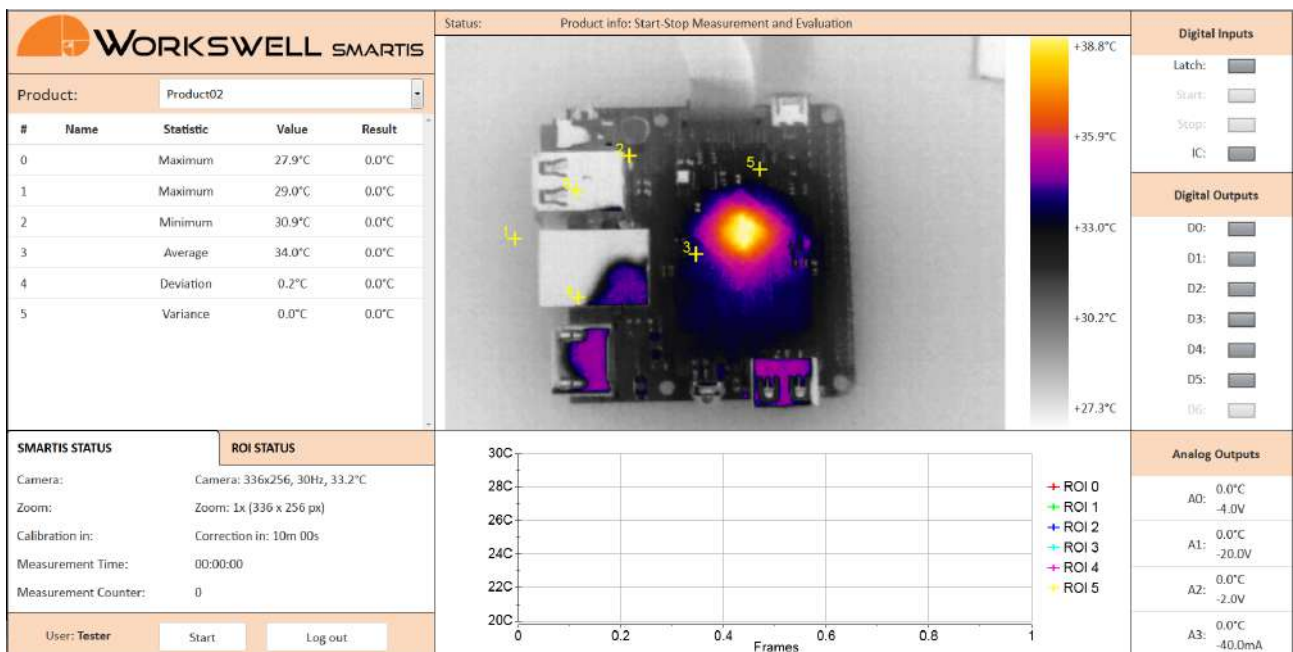


Figure 10.1: Operator Mode - Basic layout.

### 10.1.1 Individual parts

#### Product selection

The products can be selected from combo box. There are all the created products belonging to the logged in operator.

The selection of a product can take few seconds to load and apply.



Figure 10.2: Product selection combo box.

**Product ROI information**

Each product has its own ROIs. The summary of ROI info can be found in the ROI table.

After each measurement evaluation the ROIs are highlighted accordingly to its result.

When the result is positive (pass), the table line is highlighted green. When the result is negative (fail), the table line is highlighted red.

#	Name	Statistic	Value	Result
0		Maximum	28.3°C	33.9°C
1		Maximum	28.1°C	34.3°C
2		Minimum	28.2°C	33.9°C
3		Average	28.1°C	32.5°C
4		Deviation	0.2°C	0.2°C
5		Variance	0.0°C	0.0°C

Figure 10.3: ROI Table.

**SMARTIS information and numeric indicators**

Some basic information about the SMARTIS and measurement can be found in the tab "SMARTIS STATUS".

The selected numeric indicators (selected ROI and measurement information) can be found in the tab "ROI STATUS".

SMARTIS STATUS	ROI STATUS
Camera:	Camera: 336x256, 30Hz, 33.2°C
Zoom:	Zoom: 1x (336 x 256 px)
Calibration in:	Correction in: 8m 08s
Measurement Time:	00:01:52
Measurement Counter:	11

Figure 10.4: Information tabs.

**Product ROI information**

The thermocamera image is showing either video stream or current measurement result, depending on selected measurement type.

The video stream has limited framerate and resolution caused by hardware and software limitation.

Status of measurement, product and other current information will be shown above the image from thermocamera.

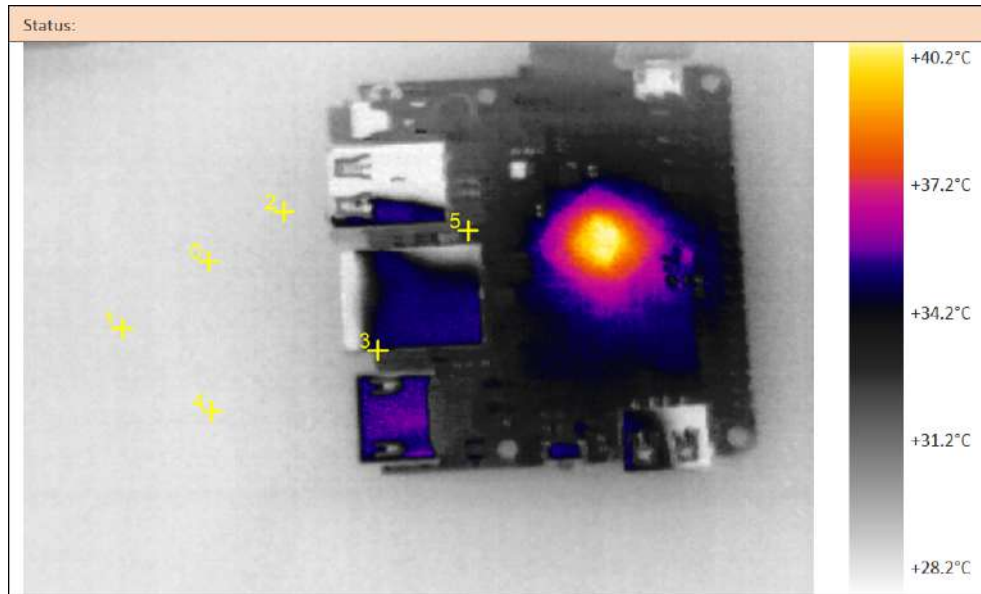


Figure 10.5: Camera image and status.

**Measurement graph**

The selected ROI statistic result values are displayed in the graph. The x-axis unit represents frames and y-axis unit represents either the degrees Celsius, degrees Fahrenheit or Kelvin.

The graph should provide additional information about the measurement progress. The graph differs according to selected measurement type.

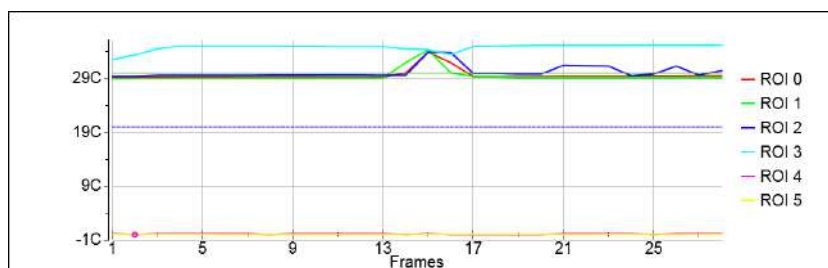


Figure 10.6: Measurement graph.



### Digital inputs, outputs and analog outputs

Digital outputs and inputs images show the current state of the signal - enabled or disabled. Analog outputs shows the current value of ROI and the corresponding electrical voltage or current.

In case of transparent output or input, it is not used. Either because of the product setting or the measurement type.

- Digital Inputs
  - Latch: Latch signal.
  - Start: Start signal.
  - Stop: Stop signal.
  - IC: Image correction signal.
- Digital Outputs
  - D0 - D7: Digital output signals.
- Analog Outputs
  - A0 - A3: Analog output values.

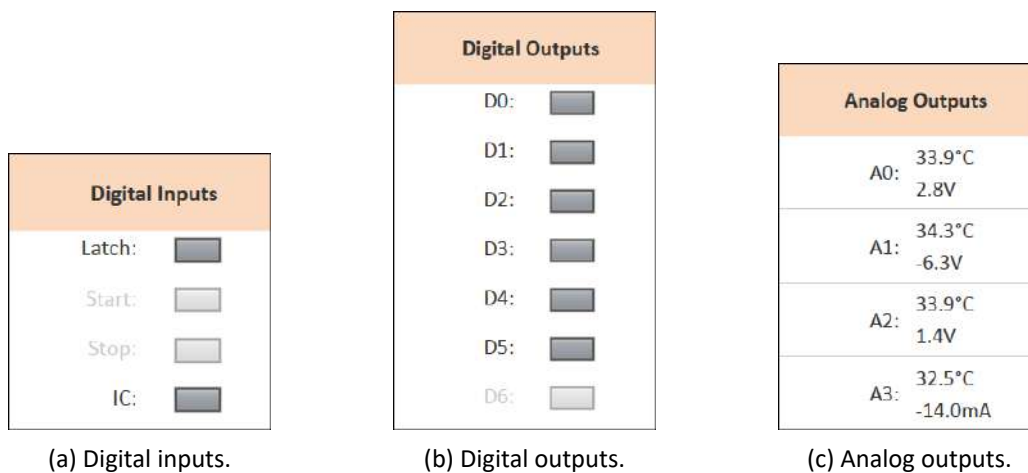


Figure 10.7: Digital inputs, outputs and analog outputs.

#### 10.1.2 Measurement types differences

Each measurement type differs in the displayed thermocamera image, graph and enabled digital inputs.

##### Frame Measurement

Frame measurement takes selected number of frames according to settings, from which it calculates the measurement results. It starts to grab the frames when either digital Latch or Start signal is detected.

Thus only the digital input Latch, Start and IC are enabled.

After the frame grabbing is finished and measurement is evaluated, the graph and thermocamera image are updated.

The thermocamera image shows the frame with the "worst" result - the biggest difference between the critical value and ROI frame statistic among all ROIs. This is the most important frame for evaluating fail states.

The graph shows all the selected ROI statistic results for all frames in the measurement. The displayed frame is marked with a dot in the graph.

Special case is when the measurement sequence consists only of one frame. Then the image displays this frame and the graph shows the development of frame statistic result value in time.

### Start-Stop Measurement

Start-Stop measurement takes number of frames according to digital input signals, from which it calculates the measurement results. It starts to grab the frames when either digital Latch or Start signal is detected and stops when Latch signal stops or the Stop signal is detected.

Thus the digital input Latch or Start-Stop and IC are enabled.

After the frame grabbing is finished and measurement is evaluated, the graph and thermocamera image are updated.

The thermocamera image shows the frame with the "worst" result - the biggest difference between the critical value and ROI frame statistic among all ROIs. This is the most important frame for evaluating fail states.

The graph shows all the selected ROI statistic results for all frames in the measurement. The displayed frame is marked with a dot in the graph.

### Continuous Measurement

Continuous measurement takes one frame at a time with selected period according to settings, from which it calculates the measurement results. It starts to grab the frame when either digital Latch or Start signal is detected and stops when Latch signal stops or the Stop signal is detected.

Thus the digital input Latch or Start-Stop and IC are enabled.

Since each measure sequence consists only of one frame, the image shows this frame and graph shows the ROI frame statistic results development. Each new result is added to the graph.

### Non-Trigger Measurement

Non-Trigger measurement takes each one frame from which it calculates the measurement results. It takes every frame regardless of digital inputs.

Thus only the digital input IC is enabled.

The image shows the video stream and graph shows the ROI frame statistic results development. Each frame result is added to graph.

## 10.2 Work-flow

The operator has just limited number of actions to do. Please, follow these steps to start and finish the measurement session:

1. Select the product from the combo box.
2. Wait few seconds for the settings to be loaded and applied.
3. If ready, start the measurement by clicking on the *Start* button.
4. When the session is finished, stop the measurement by clicking on the *Stop* button.
5. Confirm your action by clicking the *Ok* button.

## 10.3 Measurement session

When the measurement starts, the SMARTIS saves the state and continue the measurement until stopped by the operator or administrator.

### 10.3.1 Web server during measurement session

Even when the Internet browser is closed or the Ethernet connection fails, after reconnecting to the web server the user is informed about the ongoing measurement and only the operator who started the measurement, or administrator, can stop the measurement.

The SMARTIS will continue to evaluate the incoming digital inputs, calculate the measurements and set the according outputs independently on the state of graphical interface or web server.

Thus the web server is only visualization of the actions and measurement.

### 10.3.2 Power cut during measurement session

When the power is disconnected during the measurement session, the SMARTIS will continue the measurement on the next boot.

## 11 Ethernet

As an alternative to web server control we propose the TCP/IP communication. With simple TCP/IP text commands, user can control the SMARTIS device.

Parameter	Value
Protocol	TCP/IP
IP address	SMARTIS IP address
Port number	2240

Table 11.1: TCP/IP control parameters

### 11.1 Communication Protocol

The communication protocol is text based. You always send the request command and the server gives you an answer. The most common answers are OK in case of success and ERR in case of error. When parameters are given or returned, they are divided with one space.

#### Check connection

Command used for checking the connection.

- Request
  - HIS
- Answer
  - OK

#### Camera image correction

Performs camera image correction.

- Request
  - CIC
- Answer
  - OK

#### Change product

Change product to ABCD. User must be logged in.

Either product name must be specified or product order number as 2 for second product.

If measurement session in progress, the command will stop measurement, change the product and start the measurement again.

- Request
  - CHP ABCD
- Answer
  - OK

### Start measurement session

Starts measurement session for current product and user. User must be logged in.

- Request
  - SAM
- Answer
  - OK

### Stop measurement session

Stops measurement session.

- Request
  - SOM
- Answer
  - OK

### Get ROI measured value

Sends selected ROI current frame statistic value. Argument specifies the ROI order number.

- Request
  - GRM 5
- Answer
  - 25.54

### Get ROI result value

Sends selected ROI current measured statistic value - the result of a measurement. Argument specifies the ROI order number.

- Request

- GRR 5
- Answer
  - 25.54

### Get ROI active value

Sends selected ROI current result - positive (pass) as 1 or negative (fail) as 0. Argument specifies the ROI order number.

- Request
  - GAM 5
- Answer
  - 0

### Simulating triggers

Simulate digital triggers. Since there are four types of digital triggers, each has different message as in example. Latch trigger also need to specify the length in milliseconds.

- Request
  - TRG LATCH 1000
  - TRG START
  - TRG STOP
  - TRG CIC
- Answer
  - OK

## 12 Data Transfer

During the measurement data are collected and saved according to settings. This can be either Log files with history of measurements or thermal images.

User may want to download the data. The internal memory is also limited and once in a while may require to delete outdated data.

The data are available through FTP server.

### 12.1 FTP Server

The FTP server can be accessed on the SMARTIS IP address on the standard port 21.

Parameter	Value
Protocol	Plain FTP
IP address	SMARTIS IP address
Port number	21
Loggin	Admin or users with their passwords
Permissions	Admin - RW, users - R

Table 12.1: FTP parameters

Administrator can log in as "Admin" and his/her password, users can log in with their user names and passwords. Administrator and users can copy files from FTP server, but only administrator can delete file on the FTP server.

#### 12.1.1 Restrictions and warnings

The FTP server is available even during measurements, when SMARTIS can be doing critical operations. Thus, following restrictions should be observe with caution:

- Do not delete current log folders during measurement session.
- Try to minimize the operations on FTP server during measurement session, since it can have negative impact on the overall performance.
- Folder "seqs" is containing sequences recorded during ROIs creation, so they should not be manipulated when administrator logged in.

If these restrictions are broken, it can cause unexpected behavior.

### 12.1.2 Software for accessing FTP

The server can be accessed with web browser (Firefox, Chrome, Opera, ...). For details please refer to the support of the browser.

The server was tested with the Filezilla software <https://filezilla-project.org/>.



## 13 Firmware update

The SMARTIS update is available at the web page <https://workswell.cz/termokamera-smartis/>.

We will inform our customers about new software releases whenever available.

### 13.1 Firmware update

Once you have obtained the update file, connect to the SMARTIS web server. The update file should have extension ".wsm".

Log in as administrator and on tab "System" on panel "Basic Settings" select the update file.

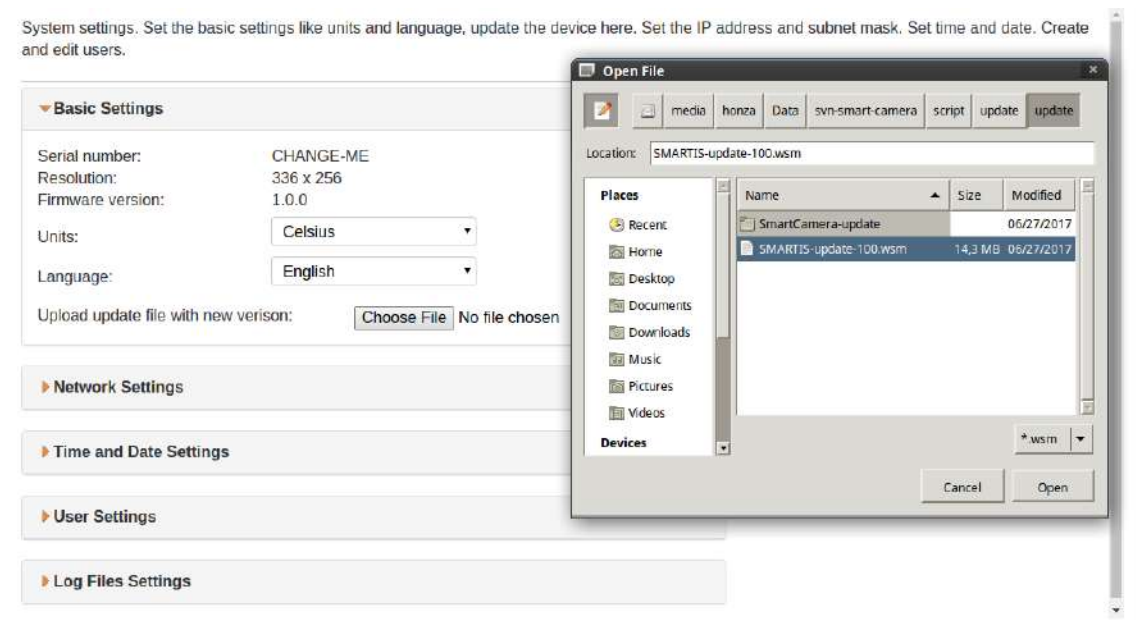


Figure 13.1: Update file selection.

The file will be uploaded to SMARTIS and checked for errors, which can take several minutes.

When ready, window with the result information shows up. To install the update, system will be rebooted and the connection to the SMARTIS web server will be lost for several minutes.

After finishing the operation, log in as administrator again and confirm the new firmware version number.

# 14 Workswell CorePlayer

## 14.1 General Description

The Workswell SMARTIS system can capture radiometric images compatible with Workswell CorePlayer (supplied with Workswell SMARTIS system). Workswell CorePlayer offers the user many functions for editing and processing radiometric images.

Workswell CorePlayer is available at <http://www.workswell.eu/CorePlayer>

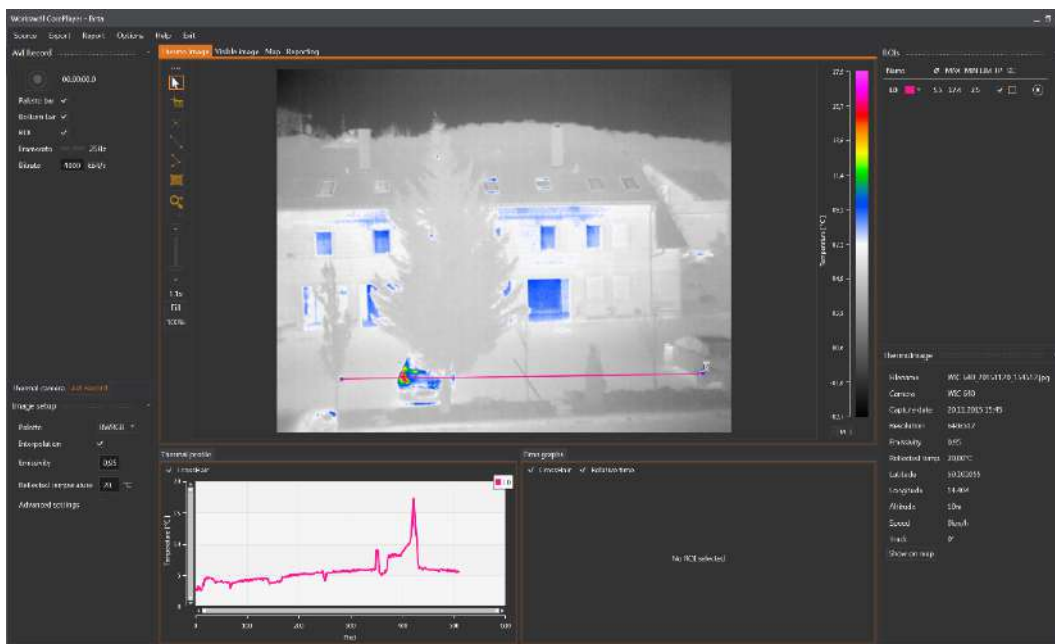


Figure 14.1: Workswell CorePlayer.

Workswell CorePlayer allows the user to

- Change measurement parameters (emissivity, ...)
- Change temperature range, colour palette
- Use multiple isotherms
- Use measurement functions in multiple ROIs (region of interest)
- Export images
- Generate PDF reports
- And much more...

## 15 Environment Conditions

### 15.1 Environment Conditions

You should follow these storage and operating conditions for proper function of the Workswell SMARTIS system:

Operation temperature range	from -15°C to +50°C
Storage temperature range	from -30°C to +60°C
Humidity	5-95%, noncondensing
Maximum irradiance	100W/cm <sup>2</sup>

If you use the product in conflict with these conditions, damage to the Workswell SMARTIS system can occur.

## 16 Infrared camera behaviour

### 16.1 Infrared camera warm-up

Modern infrared cameras are based on a sensor (microbolometer array) that needs to be warmed-up to the working temperature before it can be used. The sensor starts warming-up automatically when the user turns Workswell SMARTIS system on. The infrared camera is usually ready in less than 5 minutes.

During the warm-up process the accuracy of the measured temperature data is lower and various defects can appear in the thermal image. Therefore, we recommend to let the infrared camera warm before using it.

### 16.2 Non-uniformity correction

Infrared camera needs to be periodically calibrated in order to get reasonable measurement accuracy. This process is called Non-uniformity correction (NUC) and is done automatically.

It is recommended to use shorter periods (2 – 5 minutes) during camera warm-up process and longer periods (10 – 30 minutes) when the camera is already warmed-up.

**Warning:** Using only short periods (2 – 5 minutes) for a long time can cause early camera damage.

## 17 Maintenance

### 17.1 Cleaning the SMARTIS head and cables

**Liquids:** Use one of these liquids:

- Warm water
- A weak detergent solution

**Equipment:**

- A soft cloth

**Procedure:**

1. Soak the cloth in the liquid.
2. Twist the cloth to remove excess liquid.
3. Clean the part with the cloth.

### 17.2 Cleaning the infrared lens

**Liquids:** Use one of these liquids:

- A commercial lens cleaning liquid with more than 30% isopropyl alcohol.
- 96% ethyl alcohol (C<sub>2</sub>H<sub>5</sub>OH)
- DEE (= "ether" = diethylether, C<sub>4</sub>H<sub>10</sub>O)
- 50% acetone (= dimethylketone, (CH<sub>3</sub>)<sub>2</sub>CO)) + 50% ethyl alcohol (by volume). This liquid prevents drying marks on the lens.

**Equipment:**

- Cotton wool

**Procedure:**

1. Soak the cotton wool in the liquid.
2. Twist the cotton wool to remove excess liquid.
3. Clean the lens one time only and discard the cotton wool.

**Warning:** Make sure that you read all applicable MSDS (Material Safety Data Sheets) and warning labels on containers before you use a liquid: the liquids can be dangerous.

**Caution:**

- Be careful when you clean the infrared lens. The lens has a delicate anti-reflective coating.
- Do not clean the infrared lens too vigorously. This can damage anti-reflective coating. Re-applying anti-reflective coating is not possible and is required to change the lens.

## 18 Troubleshoot

### 18.1 Turning ON

When the ON/OFF button is pressed in order to start the SMARTIS and nothing happens, please check you power supply. A stable power supply is essential for correct SMARTIS behavior.

### 18.2 Connection error

When you can not connect to the SMARTIS via web-browser, check that you have typed in correct IP address. In case that you do not know the IP address of the SMARTIS, you can press and hold the *RESET* button for more than 5 seconds to reset the SMARTIS IP address to default *10.0.0.225*. After that Status LED starts to blink orange and the SMARTIS will reboot with the default IP address.

### 18.3 Factory Default

If you want to reset the SMARTIS to its Factory default state, press and hold the *RESET* button for more than 30 seconds.

**Note:** All of your saved data, settings and FW updates will be erased.

### 18.4 LED status

LED color	SMARTIS state
Green short blink	Log-in screen
Orange 2x blink	Administrator logged-in
Green 2x blink	Operator logged-in
Green still	Measurement in progress, operator logged-in
Green still / orange blink	Measurement in progress, log-in screen
Orange still	SMARTIS starting-up
Orange blink	SMARTIS IP-address reset

Table 18.1: LED status

## 18.5 System Update

Make sure that your SMARTIS version is up to date. You can find information about the current version on <https://workswell.cz/termokamera-smartis/>



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