Operating Video Spectral Comparator

Regula 4308/4308M/4308S

with Regula Forensic Studio

RFS Version 5.6

User Guide

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2 GENERAL INFORMATION

The video spectral comparator Regula 4308/4308M/4308S is designed for verifying the authenticity features of passports, driver's licenses, identity cards, technical and transport documents, visa stamps, banknotes, securities, and other documents with special anti-counterfeiting protection. It is also used for conducting forensic examinations and document analysis to detect alterations, erasures, photo substitutions, and other document manipulations, as well as for examining stamp impressions and performing spectral characteristic analysis.

Device operation is exclusively controlled via the Regula Forensic Studio (RFS) software. The device does not operate autonomously. For detailed information on operating the software, refer to the **Regula Forensic Studio User Guide**.

2.1 Differences Between Models 4308, 4308M, and 4308S

The video spectral comparator models Regula 4308, 4308M, and 4308S differ in the configuration of cameras used for examinations.

Parameter	**4308**	**4308M**	**4308S**
Basic top camera	✓	✓	✓
Basic bottom camera	✓	✓	—
Camera with autofocus	✓	✓	—
Auxiliary top camera designed for use with a coaxial light source	—	—	✓
Coaxial module	—	✓	—

This user manual describes the operation of the RFS software **using model 4308 as an example**.

For information about the available features of a specific device, please refer to the technical documentation provided with the equipment.

3 BEFORE YOU START

In the standard configuration, the comparator comes with a built-in computer that already has all the necessary software components installed.

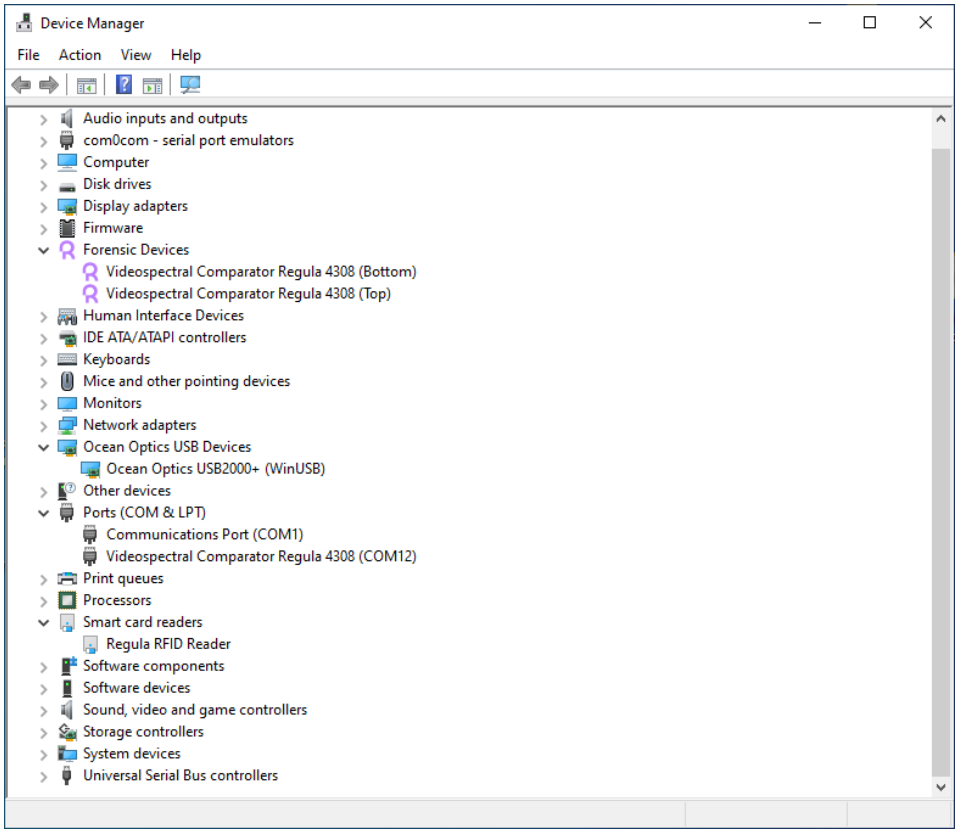
If you are using an external computer, to start working with the device, connect it to a USB 3.0 port, turn on the power switch on the back panel, and briefly click the button on the front panel (the indicator should change color from red to green).

4 INITIALIZATION

To install Regula Forensic Studio, run the installation program and follow the instructions.

To start using the device, connect it to a USB 3.0 port on your computer.

Once the initialization is successful, in the Device Manager, you will see the individual components of the device:

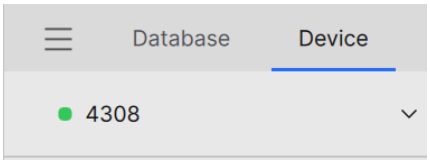


- **Videospectral Comparator Regula 4308 (Top)** and **Videospectral Comparator Regula 4308 (Bottom)** under **Forensic Devices**
- **Spectrometer Ocean Optics USB2000+ (WinUSB)** under **Ocean Optics USB Devices**
- **Videospectral Comparator Regula 4308** under **Ports (COM and LPT)**
- **Regula RFID Reader** under **Smart card readers**

5 GETTING STARTED

To start using the video spectral comparator Regula 4308/4308M/4308S:

1. Connect the device to a USB 3.0 port on your computer.
2. Set the power switch on the device to the **ON** position.
3. Launch **Regula Forensic Studio.**
4. Open the **Device** tab and select the device from the drop-down list. The connected device state will look like this:



To disconnect the device, click the **4308** icon again.

During the connection process, the device initializes its internal mechanical components, such as the optical systems of the cameras, the filter system, the coordinate stage, the oblique light sources, and the transmitted light table. The first connection after powering on may take about 1 minute. Subsequent connections are significantly faster.

Note. If Regula 4308/4308M/4308S is not listed among the available devices or if connection errors occur, check the correctness of the device connection and the installation of software components.

6 DEVICE TAB STRUCTURE AND TOOLS

The **Device Tab Structure and Tools** section describes the **Device** tab, panels, and controls available in the application workspace. This section explains how the application interface is organized and where to find the tools for working with the device.

Note. The screenshots in this guide are provided as examples and may differ slightly from the interface of your software version.

Main program window, **Device** tab, the **top camera** is active:

1	**Control and settings menu**	Provides access to the program's basic functions and settings.
2	**Main sections**	Provide access to the main sections of the program: • **Database** – working with the database, managing the list of documents and objects. • **Device** – work with the **Regula** device using the tools available on this tab. • **Comparison** – comparison of data (images, video, and other data). • **Examination** – examination of data with saving the results. • **Processing** – modification of data using a set of processing tools. • **Report** – viewing and editing of reports based on comparison, examination, and processing results using the built-in text editor. The report can be printed or saved in DOCX or PDF format. • **External Database** – working with the information reference system (IRS), which contains images of banknotes, passports, identity cards, visas, driver's licenses, etc. **Note**. All tabs and unctions except the **Device** tab are described in the **Regula Forensic Studio User Guide**.
3	**Device connect**	Here you can select a device to connect to from the drop-down list.
4	**RFS database**	Contains a list of graphic and composite data related to the current examination object and provides quick access to them.

5 Toolbar

This panel contains:

- Tools for different camera modes:
  -  Standard
  -  Long exposure
  -  HDR
  -  Glare compensation
  -  Multifocus
  -  Super resolution
- Tools for working with machine-readable document:
  -  Automatic authenticity verification
  -  Barcode
  -  MRZ
- Additional tools:
  -  M-tag
  -  Remaining banknote area calculation
  -  Spectral examination

For more tool details listed above, see below.

6 Main workspace

The central part of the **Device** tab displays the camera view from the device.

7 Video and script

Video – this tool allows you to record:

- **Screen** – everything that happens on the screen will be recorded as a video.
- **Camera video** – everything captured by the device camera will be recorded as a video.

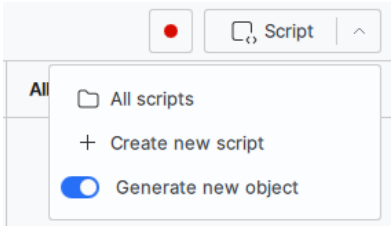
To start video recording, follow these steps:

1. Click the icon. A dialog pop-up window opens where you can enter a name and choose a storage location for the video file.
2. Enter the video file name.
3. Select the folder where the video file will be saved.
4. Close the dialog pop-up window. An REC indicator appears, showing that video recording has started.

To stop video recording, click the icon again.

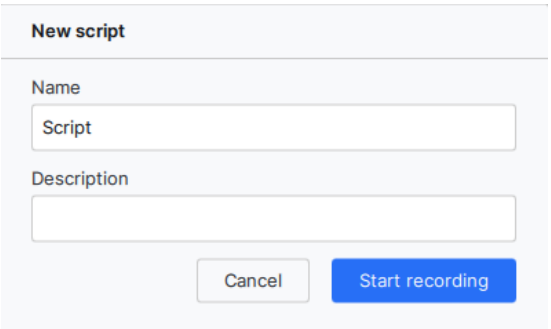
Script – this feature allows you to create, record, and manage scripts on the **Device** tab. By following these steps, you can capture a sequence of actions, save them as reusable scripts, and organize them for future use. The process includes creating a new script, recording actions, and managing saved scripts.

1. On the toolbar of the **Device** tab, find the **Script** button in the top right corner and click the drop-down icon. Select **+ Create new script**:

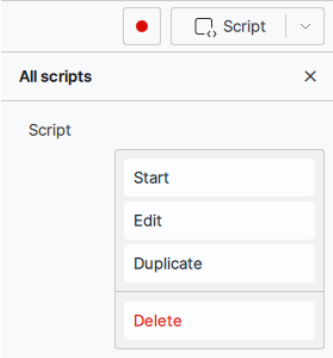


To save the outcomes of actions within the scenario as a separate object on the **Database** tab, select the **Generate new object** radio button.

2. Fill in the **Name** and **Description** fields and click the **Start recording** button:



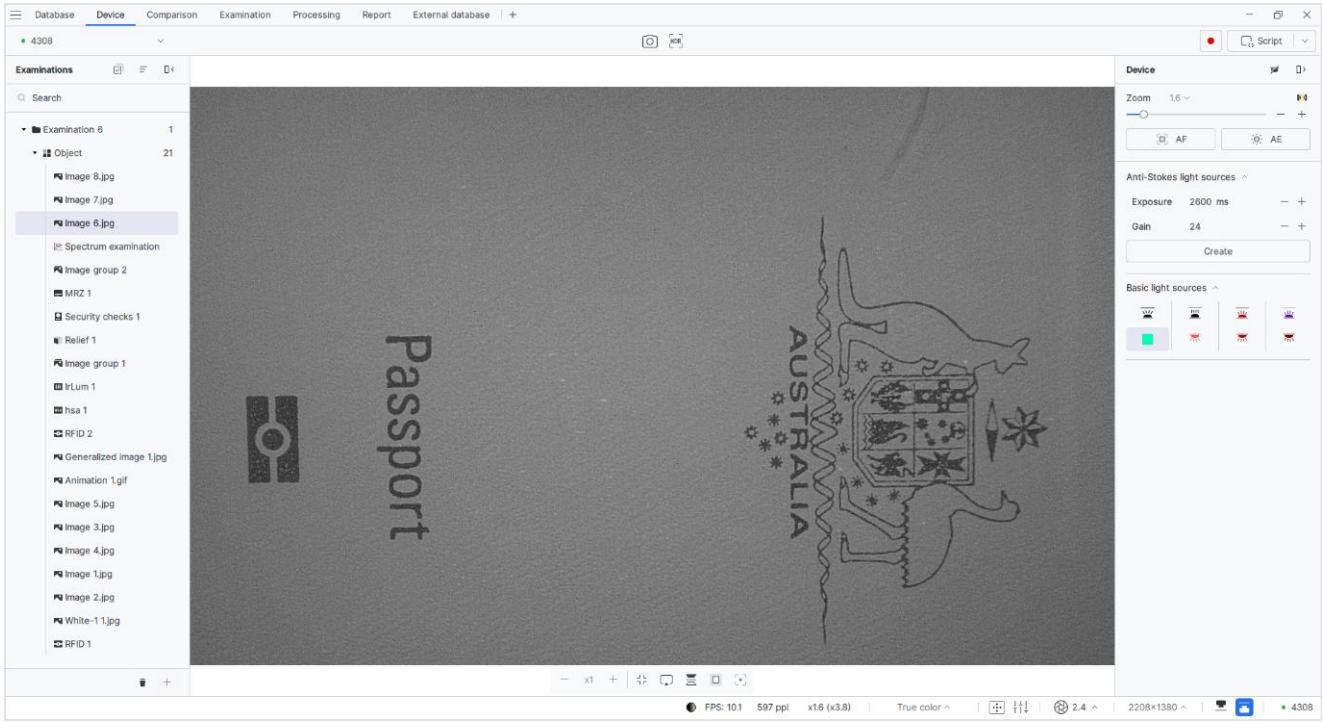
3. During script recording, the program window will be outlined in red. Perform the necessary actions in sequence; they will be saved in the list on the right. When finished, click the **Stop** button.
4. The script will be added to the **All scripts** list. To run, edit, duplicate, or delete the script, right-click on it:



8	**Right-side device control panel**	This panel contains the following device control sections: • Zoom • Autofocus • Auto-exposure • Filter • Camera module position • Basic light sources • Oblique light sources • Hologram (OVD) • Narrowband light sources • Polarization light sources • 3D visualization • Hyperspectral analysis

		• Bottom light sources For a detailed description of the sections listed above, see below.
9	**Bottom device control panel**	This panel contains the following device control sections: • Color profile • Coordinate table • Adjustment • Aperture • Camera display mode • Switching between the top and bottom cameras For a detailed description of the sections listed above, see below.
10	**Device camera image controls**	The main workspace also contains controls for the device camera image: • **Zoom** – allows you to zoom in or out on the area under examination in the image. • **Fit to screen** – adjusts the image display size to fit the Main Workspace. • **Actual size** – restores the image to its original size. • **Horizontal and vertical mirroring** – flips the image along the horizontal and vertical axis. • **Mask on/off** – allows you to select and take a screenshot of a selected viewing area. • **Frame center** – indicates the center of the current viewing area.

Main program window, **Device** tab, the **bottom camera** is active:



For the bottom camera, the main panels are similar to those used for the top camera. The additional sections in the **Device control panel** are listed below:

- **Anti-Stokes light sources**
- **Basic light sources**

A more detailed description of the bottom camera sections is provided in the corresponding sections of this manual below.

6.1 Cameras

The Regula 4308 video spectral comparator is equipped with two digital video cameras for the **top** and **bottom** optical paths.

When working with both optical paths, a two-coordinate stage with image stitching capabilities is available.

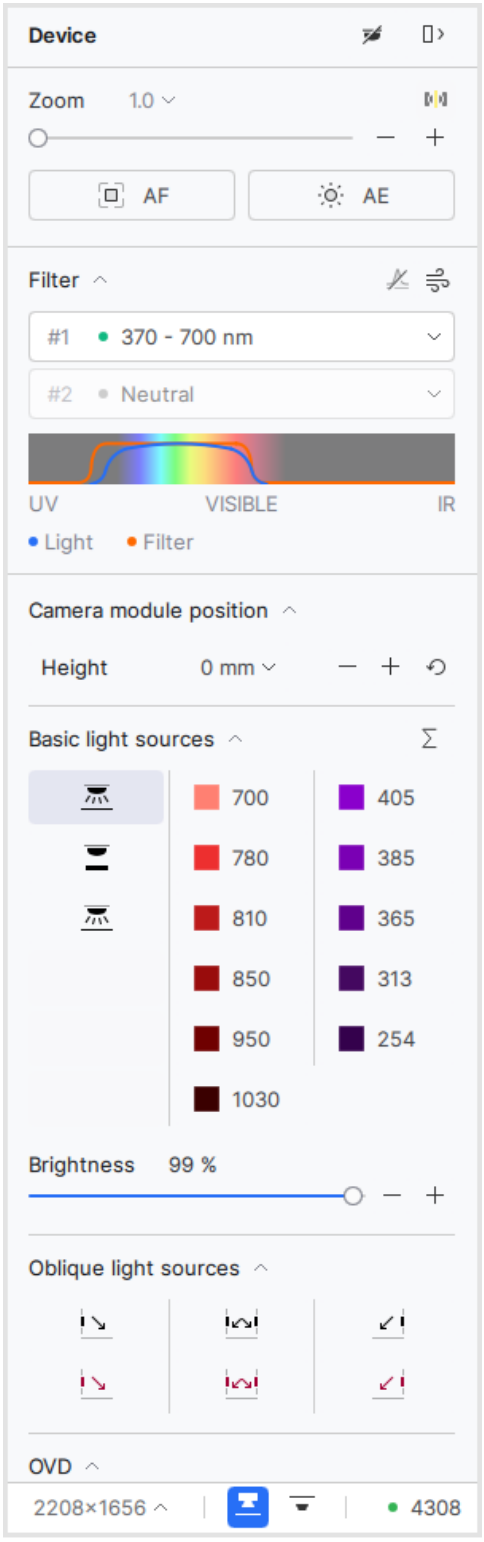
During operation of the comparator, the following optical and electronic camera subsystem parameters are automatically applied:

- Aperture
- Focus
- Exposure
- Color balance
- Light filter

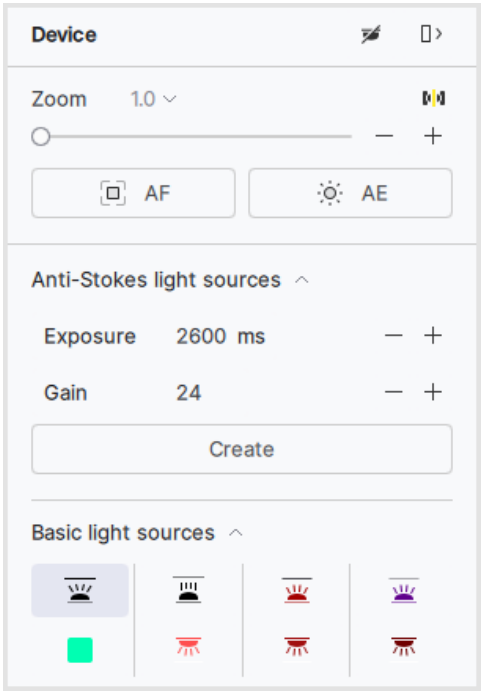
These parameters are set as optimal for specific operating modes during factory calibration. They can be manually adjusted. Any new parameter value (except for the type of light filter and focusing) will be saved as the working setting for the current light source configuration and will be applied during the current session of using the device.

On the **Right-side device control panel**, you'll find tools to control the optical subsystem of the camera, such as **Zoom**, **Autofocus**, **Auto-exposure**, **Filter**, and **Camera module position**:

Top camera

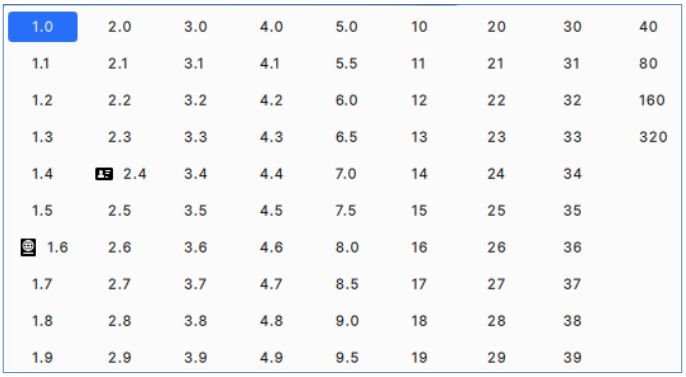


Bottom camera



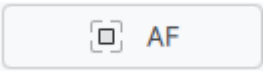
- **Zoom**

  In the **Zoom** menu, special icons indicate the gradations recommended for working with the machine-readable zone reading tool for ID-2 and ID-3 format documents (passports, ID cards) and ID-1 (ID cards):



  When the camera reaches the maximum optical zoom 15-17X, it automatically switches to the digital zoom mode. Camera zoom control does not influence the operating modes of the light sources.

- **Autofocus**

  Autofocus 

 is used to adjust sharpness automatically.

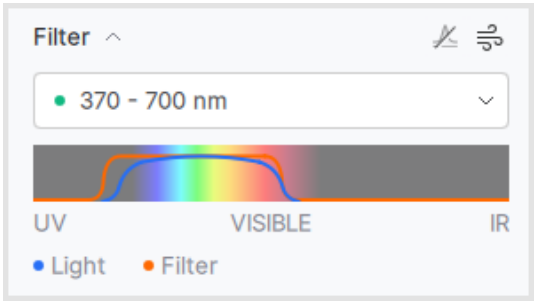
- **Auto-exposure**

  Auto-exposure 

 is used to automatically adjust the image brightness.

- **Filter**

  To select a filter value, click the drop-down list in the **Filter** section. The selected light filter range is displayed on the graph.

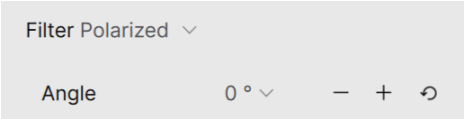


  Click the  icons to show or collapse the graph.

  When changing the active light source, the necessary filter for its operation is set automatically.

- **Polarizer**

  When the **Polarizer** filter is selected, an additional control subgroup for the **Polarizer Filter** appears in the instrument control panel:

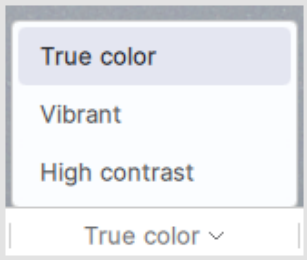


- **Camera module position**

  You can move the top camera optical module, upper light sources, and spectrometer vertically using the **Camera module position** tool on the control panel.

The **Bottom device control panel** contains tools for controlling the camera's optical subsystem, such as **Color profile**, **Coordinate table**, **Adjustment**, **Aperture**, **Camera display mode**, and **Cameras**.

- **Color profile**



Select the device color rendering mode:

- **True color** — displays the data with natural color reproduction.
- **Vibrant**— makes the data more saturated and vivid.
- **High contrast** — enhances the differences between light and dark areas of the data.

- **Coordinate table**

The two-coordinate table within the Regula 4308/4308M/4308S comparator is designed for precise positioning of the examined object. It allows capturing images of areas that do not entirely fit into the camera's field of view by stitching individual video frames together.

To display the **Coordinate table** controls, click the icon located on the bottom device control panel of the **Device** tab.

Use the , , , buttons for precise step-by-step movement of the table in the specified direction within the range of 110 mm along the X-axis and 70 mm along the Y-axis. The step (from 0.01 to 1 mm) is set in the drop-down menu by clicking in the **Step** line.

To return the table to its initial position (X=0 and Y=0), use the **Turn on preview** button.

To return to previously set values, click the **Turn off preview** button.

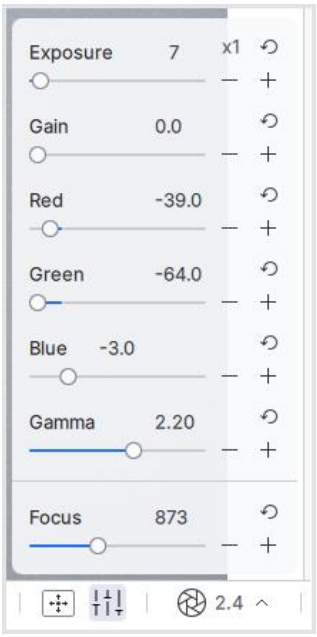
You can also move the table using the mouse: press and hold the left mouse button, then drag the position to the desired area of the image.

To position the table in the center of the available movement area, click the **Reset** button. If part of the examined object does not fit into the camera's field of view at the current magnification, but its complete image is required, you can use the procedure of stitching individual video frames. To do this, click the **Stitching** button.

Note. The stitching procedure is available for both optical paths of the device, when working with all light sources, and for any magnification, **except for magnifications of 80 and 160 times for the top camera**.

After the capture is completed, the table returns to its initial position from which the stitching procedure began. The resulting composite image is automatically placed in the **Database** but is not displayed in the image view window.

- **Adjustment**



Adjustment of the red, green, and blue color balance is performed within the range of -64.0 to 255.0, based on the object positioned in front of the camera lens.

Also, in the **Adjustment** group there are:

- **Focus**

  Each time the Focus is adjusted (in manual or automatic mode), the focus parameters are corrected based on the calibration data of the top camera, considering the thickness or height of the object. These parameters are then applied automatically during subsequent operation.

  For more accurate calculation of the thickness/height of the object under examination, it is recommended to perform automatic or manual Focus adjustment at magnifications of 35-40x.

- **Exposure**

  The numerical Exposure value is set within the range of 0.0 to 400.0 milliseconds.

- **Aperture**

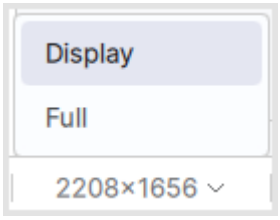
Using **Aperture**, you can adjust the opening in the camera lens through which light reaches the sensor.

The smaller the number, the wider the aperture opens, allowing more light into the camera and creating stronger background blur. The larger the number, the narrower the opening, allowing less light in, while keeping more objects in the frame sharp.

Note. After changing the aperture, you may need to readjust the exposure.

- **Camera display mode**

You can select the camera operating mode on the toolbar at the bottom of the screen:



- **Display** mode shows a smaller-sized image.
- **Full** mode expands the camera frame for a wider view.

- **Cameras**

To switch between optical paths, use the respective buttons in the **Camera** group:

  -  — selecting the top camera.
  -  — selecting the bottom camera.

6.2 Light Sources

Controls for the light sources (illuminators) are located on the main screen of the program under the **Device** tab on the right.

When using the top and bottom optical paths, different sets of light sources are available.

When working with the top camera, the **Hyperspectral Analysis** module is used as a separate light source.

The brightness of the light sources is adjusted using a slider and buttons [− +].

- **Basic light sources: Top camera**

Note. When working with the ultraviolet light sources of 313 nm and 254 nm, it is necessary to tightly close all protective screens of the device. Otherwise, the light sources will not activate or will be disabled, and the control button on the panel will be locked and displayed with a warning icon [313].

White (with **brightness** regulation)

Halogen (used when operating the spectrometer)

White D50 (used when operating the spectrometer)

700 Infrared 700 nm

780 Infrared 780 nm

810 Infrared 810 nm (for Regula 4308M only)

850 Infrared 850 nm

950 Infrared 950 nm

1030 Infrared 1030 nm

405 Violet 405 nm (for Regula 4308M only)

385 Violet 385 nm (for Regula 4308M only)

395 Violet 395 nm (for Regula 4308 and 4308S only)

365 Ultraviolet 365 nm

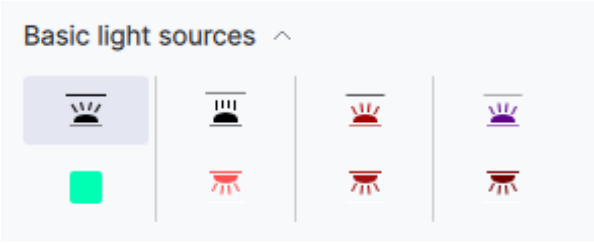
313 Ultraviolet 313 nm

254 Ultraviolet 254 nm

You can use two light sources at the same time—one white and one IR:

1. Select the **White light source**  from the list.
2. Click the dual light sources icon  .
3. Select an **IR light source**.

- **Basic light sources: Bottom camera**



White (used for anti-Stokes luminescence analysis)

Coaxial white (retroreflective protection analysis)

IR 850 nm

Ultraviolet 365 nm

Blue-green 505 nm (observation of IR luminescence)

IR 780 nm transmitted

IR 850 nm transmitted

IR 950 nm transmitted

- **Oblique light sources**

The angle of incidence of the beam on the focusing plane changes depending on the height of the light source.

White Left

White Left-Right

White Right

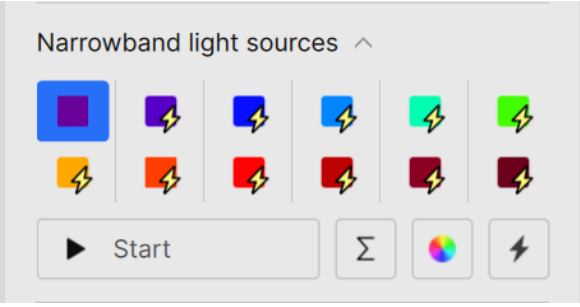
IR 850 Left

IR 850 Left-Right

IR 850 Right

- **Narrowband light sources**

  When turning on a narrowband light source, the recommended filter for observing infrared fluorescence at the specified wavelength is automatically set.



You can combine narrowband light sources in any configuration. For this, before turning on the sources, click the Σ button. The emission spectra of the sources will be summed, while maintaining the filter automatically set for the first source.

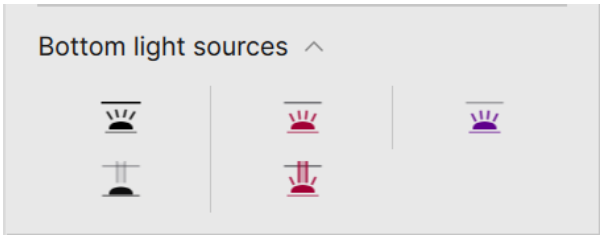
To capture a sequence of images in automatic IR luminescence examination mode, click the **Start** button.

Pseudo-color mode enhances spectral details by mapping different intensity levels to distinct colors, improving contrast and visibility.

High intensity mode boosts the brightness of the selected narrowband light source, enhancing weak infrared luminescence.

- Purple 395
- Purple 420
- Blue 450
- Cyan 470
- Blue-green 505
- Green 530
- Golden 590
- Amber 615
- Red 635
- Dark red 660
- IR 700
- IR 735

- **Bottom light sources**



 – White

 – White pinpoint

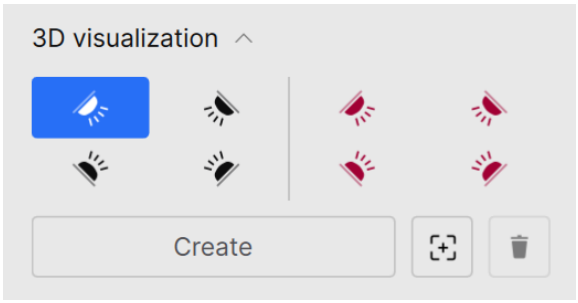
 – IR 780 nm

 – IR 860 nm

 – IR pinpoint 860 nm

 – UV 365 nm

- **3D visualization light sources**



 White rear left

 White rear right

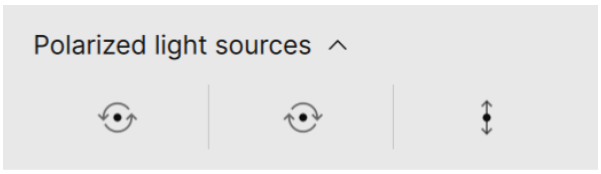
 White front left

 Infrared 850 nm rear left

 Infrared 850 nm rear right

 Infrared 850 nm front left

- **Polarized light sources**



 White with left circular polarization

 White with right circular polarization

 White with linear polarization

6.3 Hologram Examination

To examine objects with variable optical properties (OVI/OVD), such as holograms, it is necessary to capture a sequence of images of the object. In the **Device** tab, find the **OVD** tool and expand the toolbar:

Horizontal rotation

Vertical rotation

Horizontal and vertical rotation

Once you select the rotation type, an additional control panel will appear, allowing you to adjust the rotation angle relative to the center of the specimen stage.

Click the **Start** button to activate the automatic cycling mode for switching light source positions. This mode is designed for previewing changes in the optical properties of the examined object.

The **Stop** button will appear immediately after activating the mode and will allow you to stop the cycling.

In the image view window, you will see images of the object with the light source positioned at the specified angle.

To save the hologram examination, click the **Create** button. The data generated during this procedure will be saved as an Image group4 entry in the database.

6.3.1 Light sources control (only for Regula 4308M)

The Regula **4308M** device enables hologram examination by switching specific light sources on the **OVD Light source control panel**.

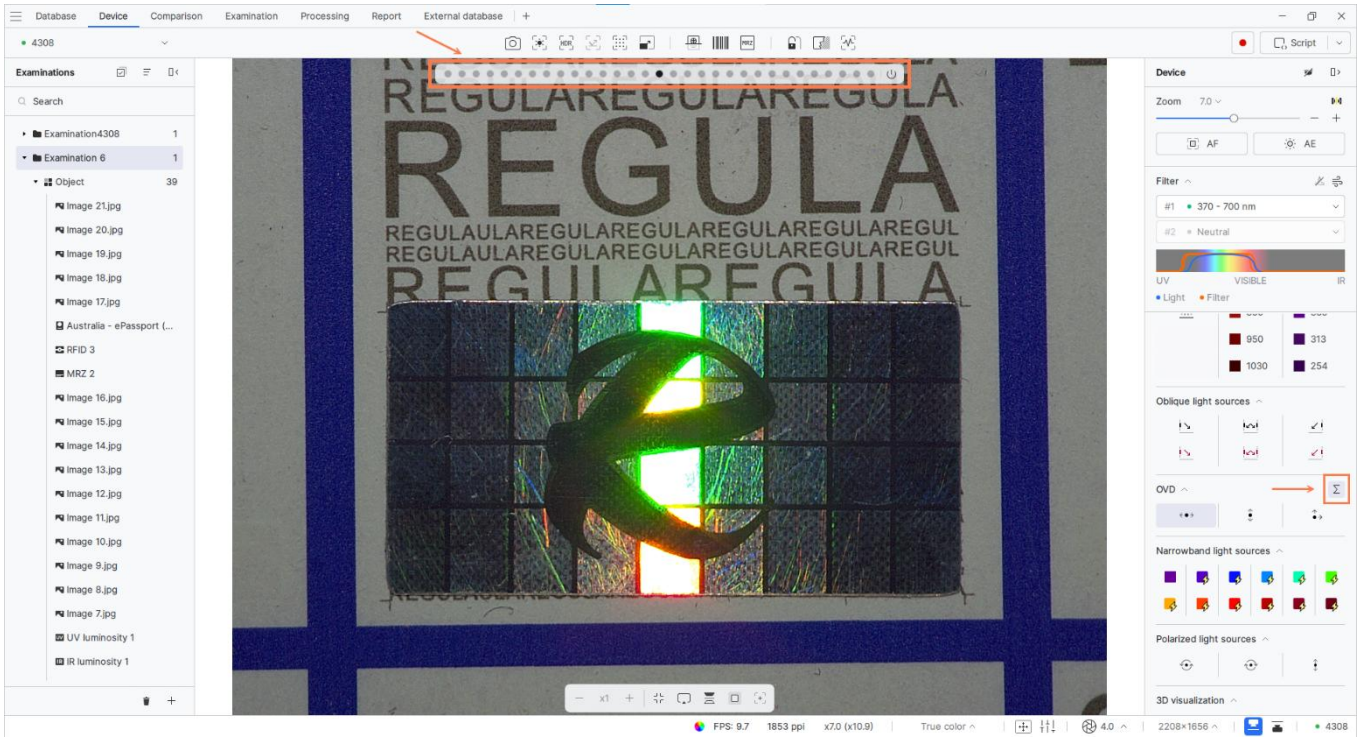
Click the  icon to open the **OVD Light source control panel**.

You can turn any light source on or off by clicking it on the panel.

To turn off all OVD light sources, click the  icon.

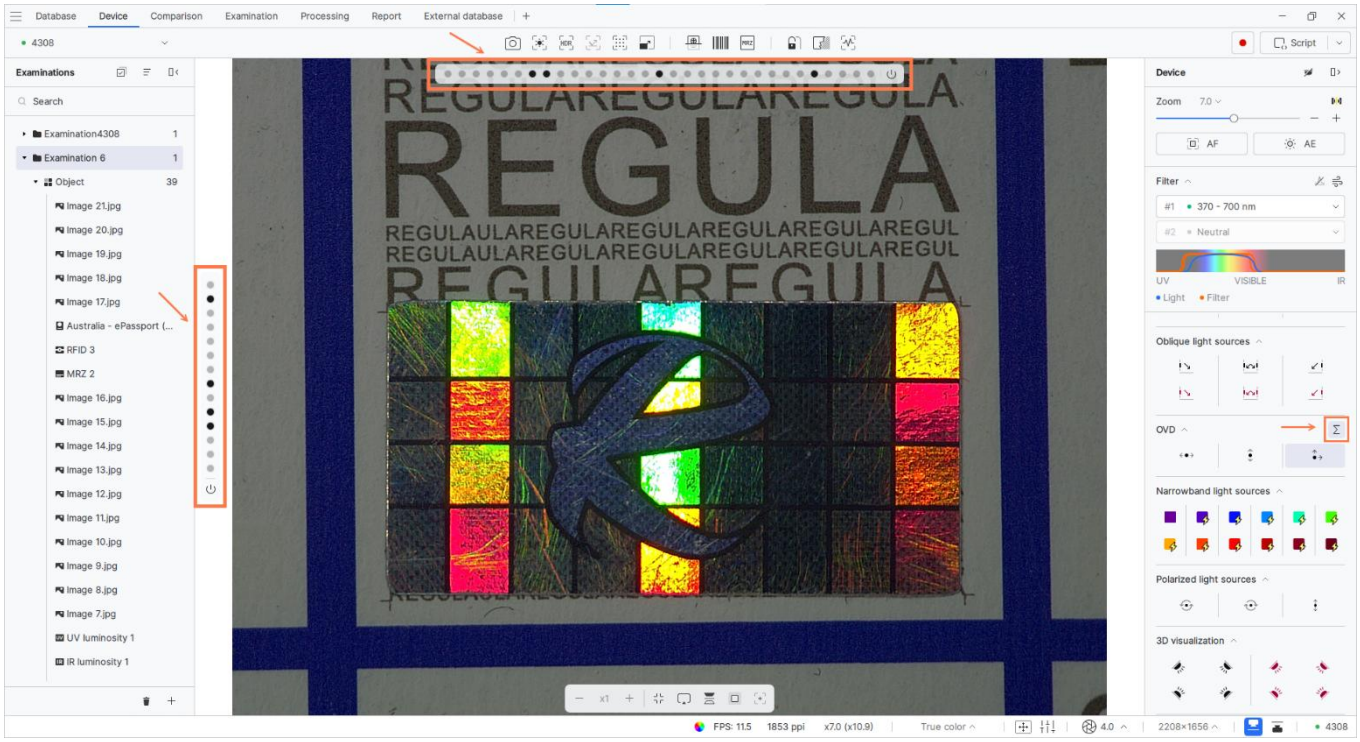
Depending on the rotation type, the **OVD Light source control panel** is located as follows:

- **Horizontal** rotation: at the top of the **Main workspace**.



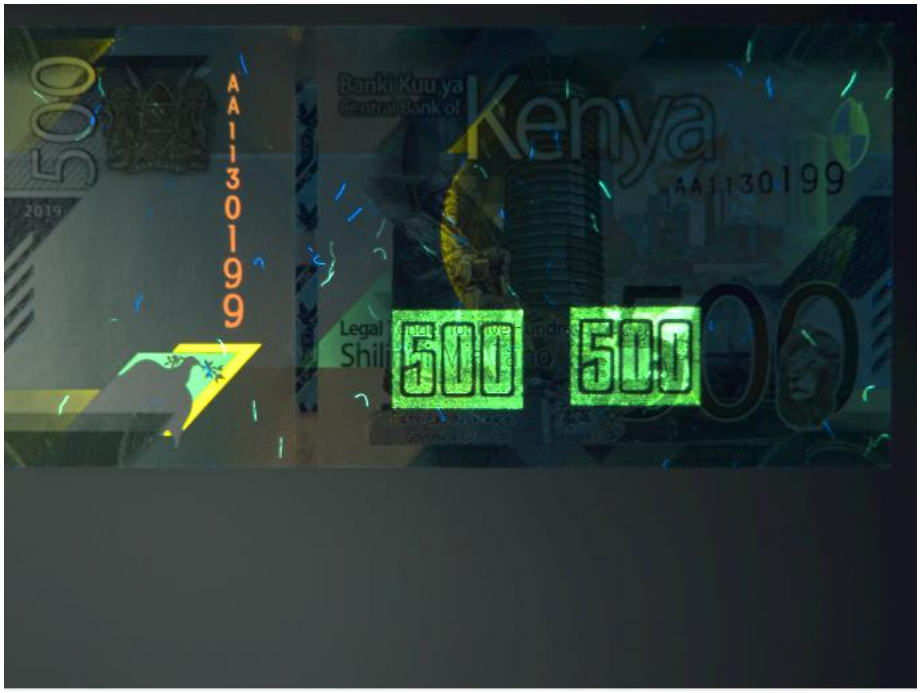
- **Vertical** rotation: on the left side of the **Main workspace**.

- **Horizontal and vertical** rotation: at the top and on the left side of the **Main workspace**.



6.4 Post-Exposure UV Examination

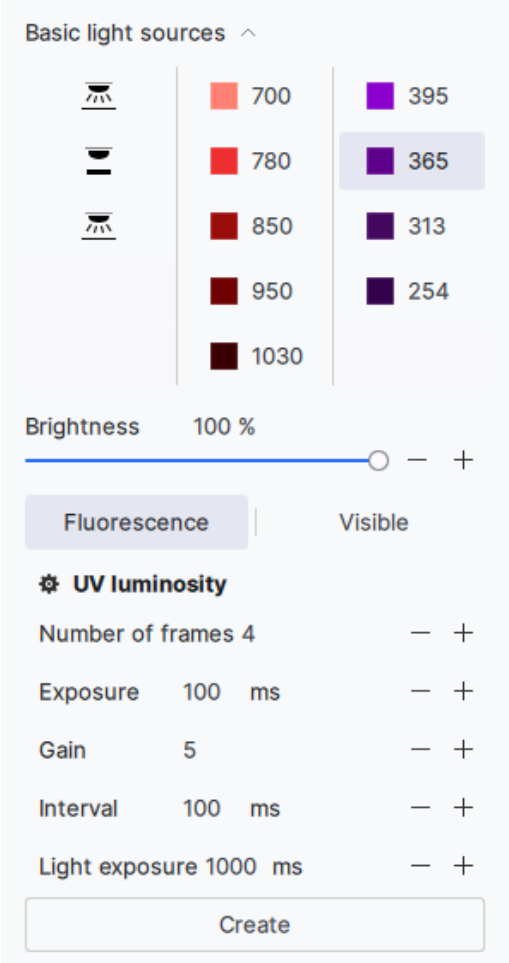
1. Click on the light source  icon in the **Basic light sources** group. An image of the examined object (for example, currency with fluorescent areas) will appear in the image view window:



2. A group of parameters for different UV luminescence examination modes will appear on the control panel:

- **Fluorescence** — uses a filter to visualize fluorescence in the inspected object.
- **Visible** — displays all luminescent elements of the inspected object.

The following parameters can be set for each UV luminescence mode:

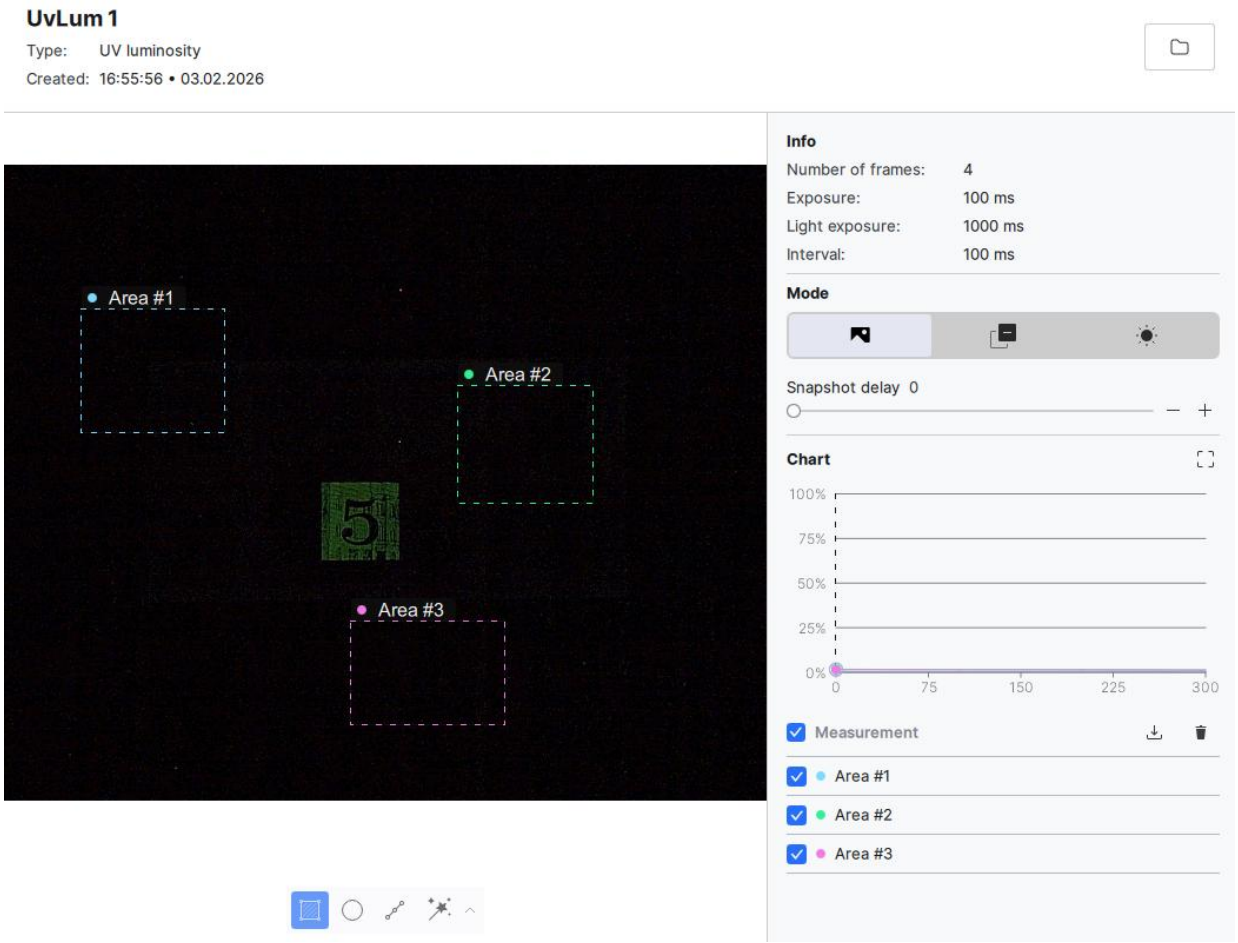


- **Number of frames**
- **Camera exposure**
- **Gain**
- **Interval** between frames
- **Light exposure** time: duration of continuous operation of the light source before image capture.

3. Click the **Create** button. This will start the UV afterglow examination procedure of the examined object with the light source activated and data automatically saved.

The file saved in the database is denoted by the UvLum icon. To view the saved results of the UV afterglow examination and generate intensity decay graphs, navigate to the **Database** tab.

Here is the **UvLum** window for the saved UV afterglow examination result of the original image of the object under examination (mode – **Original**):



The examination area on the object's image can be selected using the buttons located at the bottom of the **UvLum** window.

Rectangle

Oval

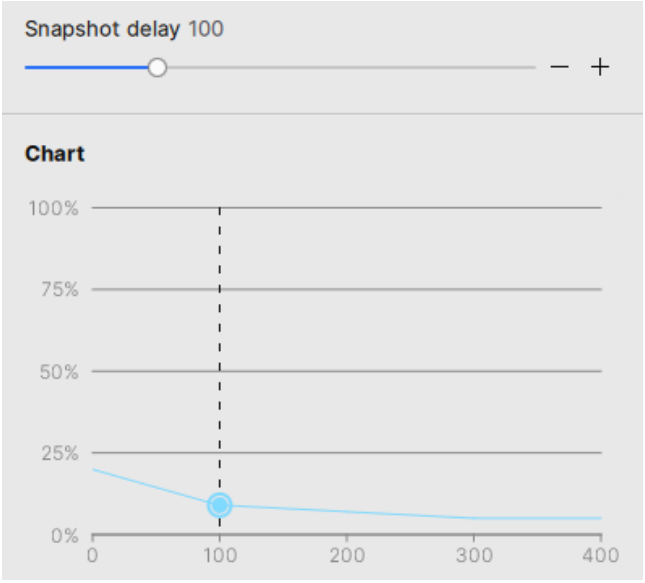
Polyline

Magic wand

When the examination area is selected, a graph of the afterglow intensity decay (average brightness of the points in the area) is generated on the left.

To rename or delete the selected area, hover over the row **Area #1** and click the corresponding icon.

The **Exclusion**  mode allows you to see the difference between images taken at the current and next positions when the capture delay is changed by one step. This helps to detect short-term changes in the afterglow of the objects under examination:



The **Full UV Luminescence**  mode allows you to view the image of the object under examination with the 

and white basic light source activated.

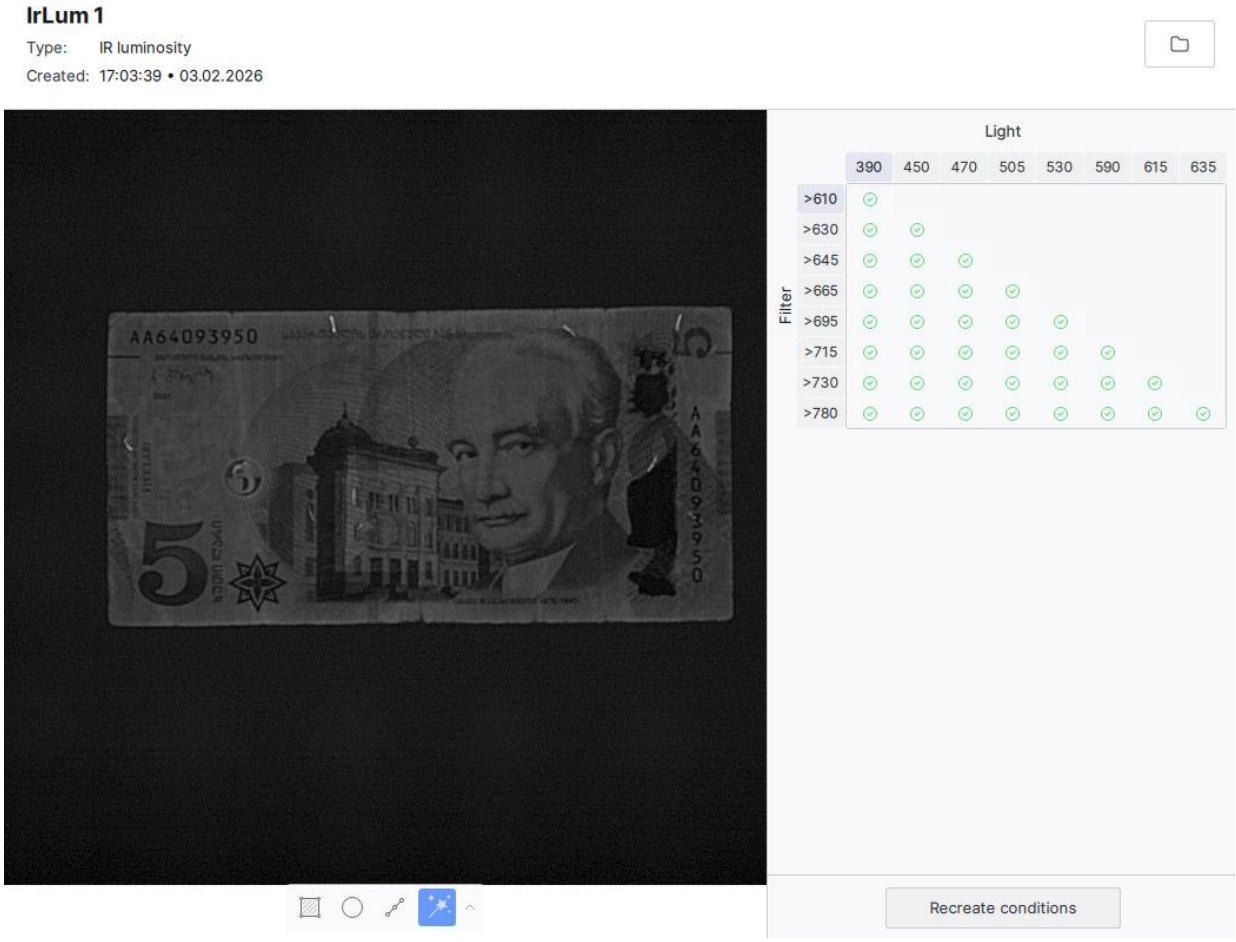
6.5 Automatic Examination of IR Luminescence

The procedure of automatic examination of IR luminescence involves capturing a sequence of images of the examined object using all valid operational combinations of the basic set of narrowband luminescent light sources and camera filters.

To start the automatic examination of IR luminescence, click the **Start** button in the **Narrowband light sources** group.

The data generated during the procedure is automatically saved as an element in the **IrLum** database. The corresponding file is indicated by the IrLum icon .

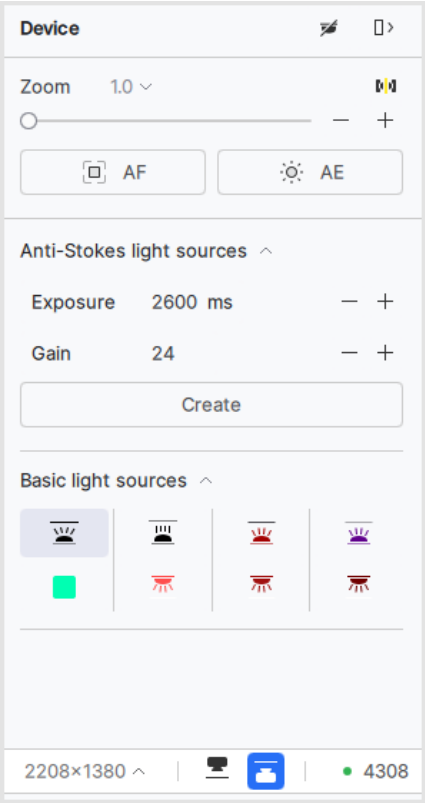
When selecting this data item in the **Database** tab, the **IrLum** window opens:



If there is a marker in the **Light/Filter** cell of the table, it means that the corresponding image is available. To obtain this image, click on the marker at the intersection of the required **Light** and **Filter** values.

6.6 Anti-Stokes Luminescence Examination

To examine anti-Stokes luminescence, the bottom optical path of the Regula 4308 device is equipped with a pulsed IR emitter.



To conduct the examination, follow these steps:

1. Activate the **bottom camera** in the **Device** tab: The **Anti-Stokes light sources** pane will appear on the toolbar.
2. Set the **Exposure** and **Gain** values.
3. Click the **Create** button to capture an image.

The maximum heating temperature of anti-Stokes sources is 60 °C.

Note. At excessively high temperatures, the anti-Stokes source may shut down.

Note. The camera gain and flash duration affect the brightness of the luminescent object in the image.

6.7 Hyperspectral Analysis

To conduct research on the spectral characteristics of examined objects (reflection spectra) in a continuous range of wavelengths from 395 to 1000 nm, the device is equipped with a hyperspectral analysis module. This module consists of a comprehensive light source that provides radiation in the specified wavelength range with a 1 nm step. A digital video camera of the device is used as the recording device.

The research involves obtaining a sequence of images of the examined object for each wavelength within the specified range with a defined step increment. These images can then be used for visual assessment of the visibility of object elements and for creating a reflected signal spectrum for the selected area.

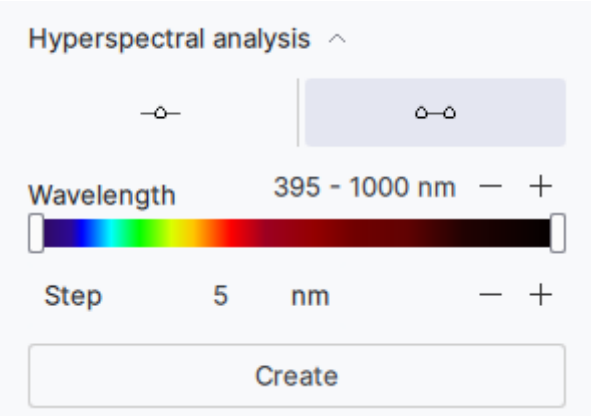
Control of the hyperspectral analysis module is located in the **Hyperspectral analysis** section and includes two modes:

- **Preview**

  In the **Preview** mode, the spectral ruler helps determine the current wavelength of the light source. Select the desired position on the ruler within the range of 395 to 1000 nm by moving the cursor using the left mouse button.

- **Range**

To conduct the examination, switch to the **Range** mode and set the parameters for capturing the sequence of images:



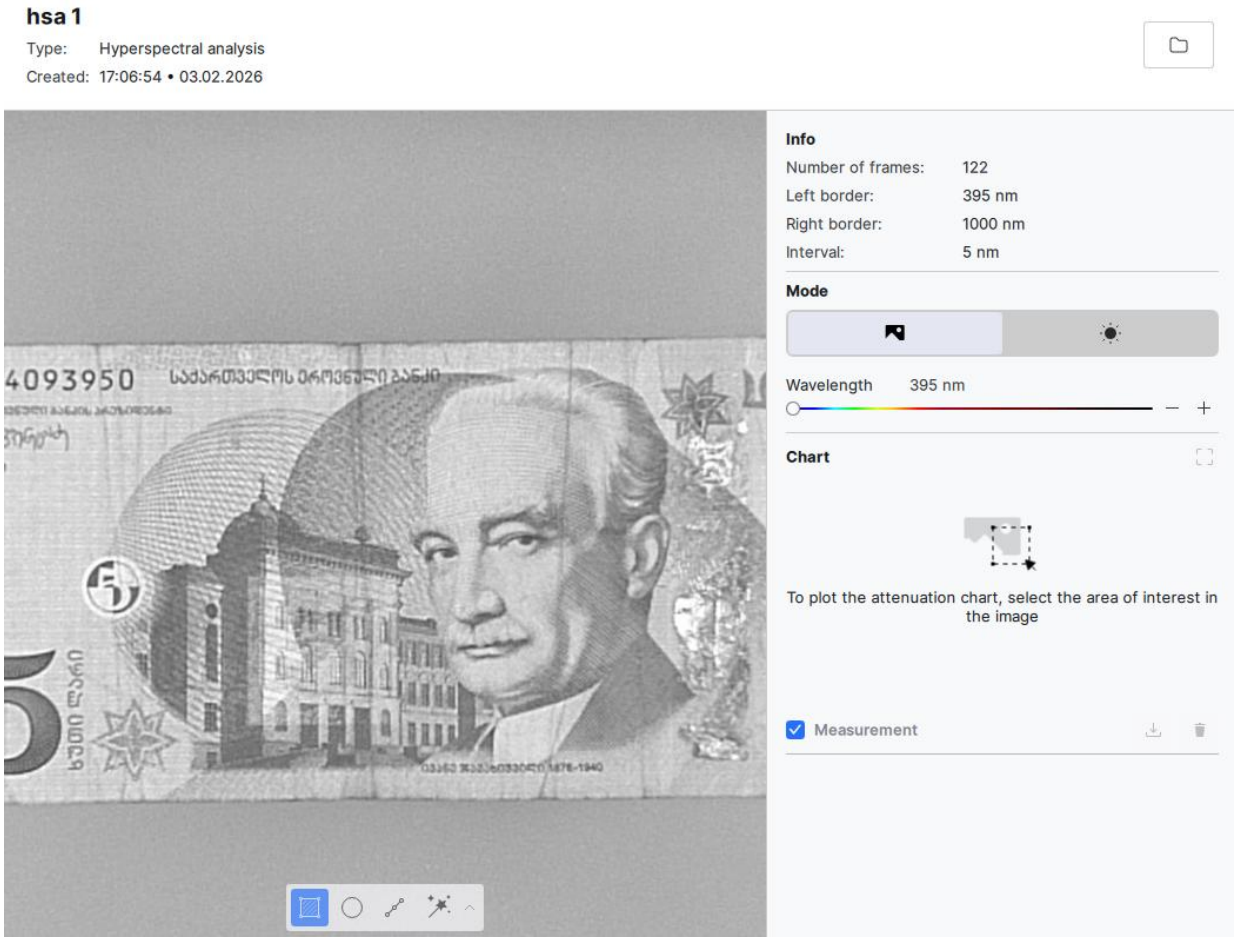
Wavelength range of the light source.

Step increment within the specified range.

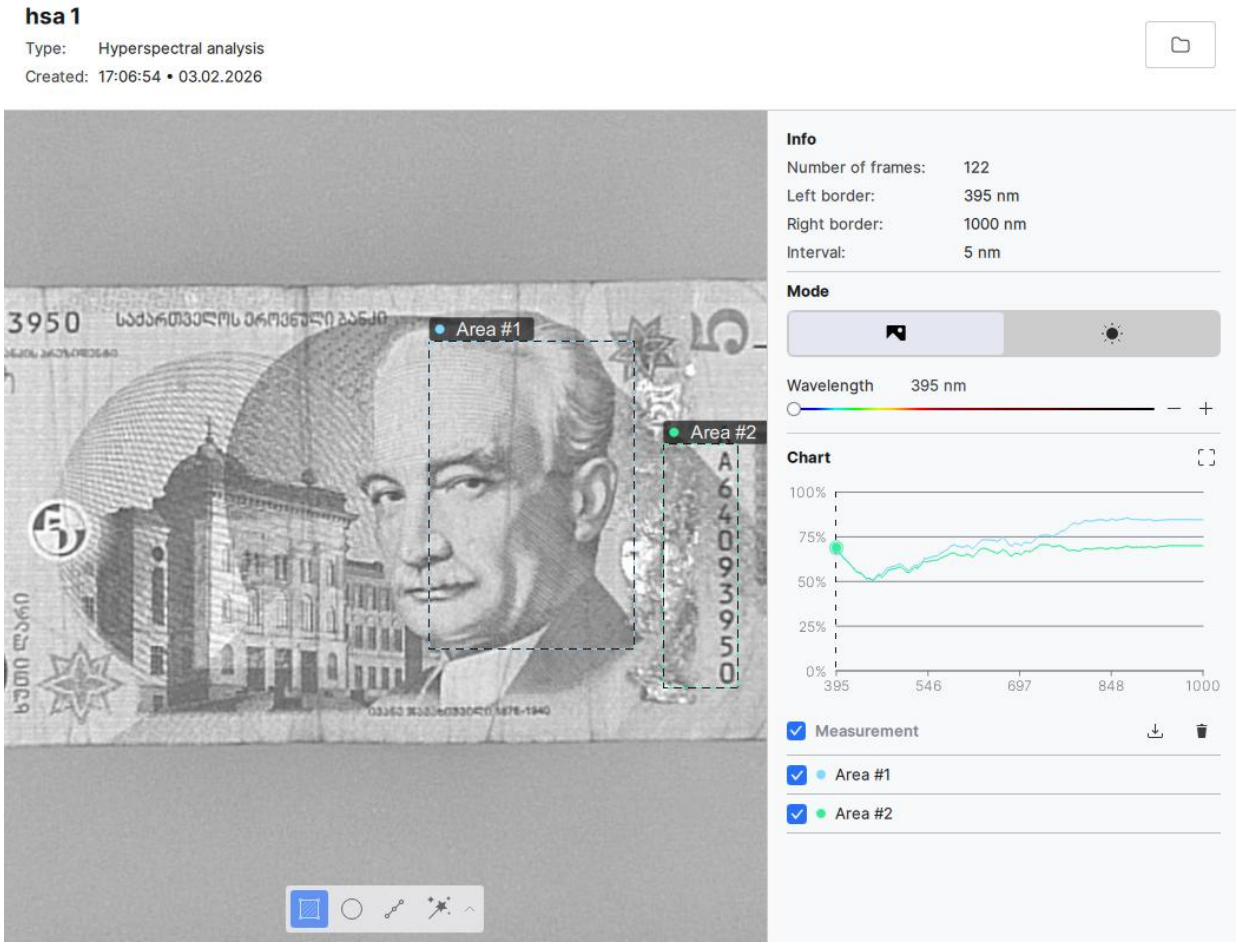
To begin capturing a sequence of images, click the **Create** button.

The data generated during the procedure is automatically saved as an hsa entry in the database. The corresponding file is indicated by the HSA icon in the database.

To view the saved results of the hyperspectral analysis and generate the spectrum of the reflected signal for a specific image area, navigate to the **Database** tab and select the desired item in the navigation panel. The contents of the data item will be displayed in the image view window. On the instrument control panel, you can set the **Wavelength**:



To create a graph of the level/magnitude of the reflected signal, select an area in the image. To select the required area in the image, click the left mouse button, move the pointer to the desired distance, and click the left mouse button again:



The control panel will automatically generate a graph of the level/magnitude of the reflected signal (the average brightness of the points in the area) based on all available images.

To view the image of the examined object in the visible spectrum range, click the **Visible Range** button. The image will be captured with the active white light source.

6.8 Working with Machine-Readable Documents

The devices Regula 4308/4308M/4308S read information from machine-readable documents and perform subsequent analysis. This information includes:

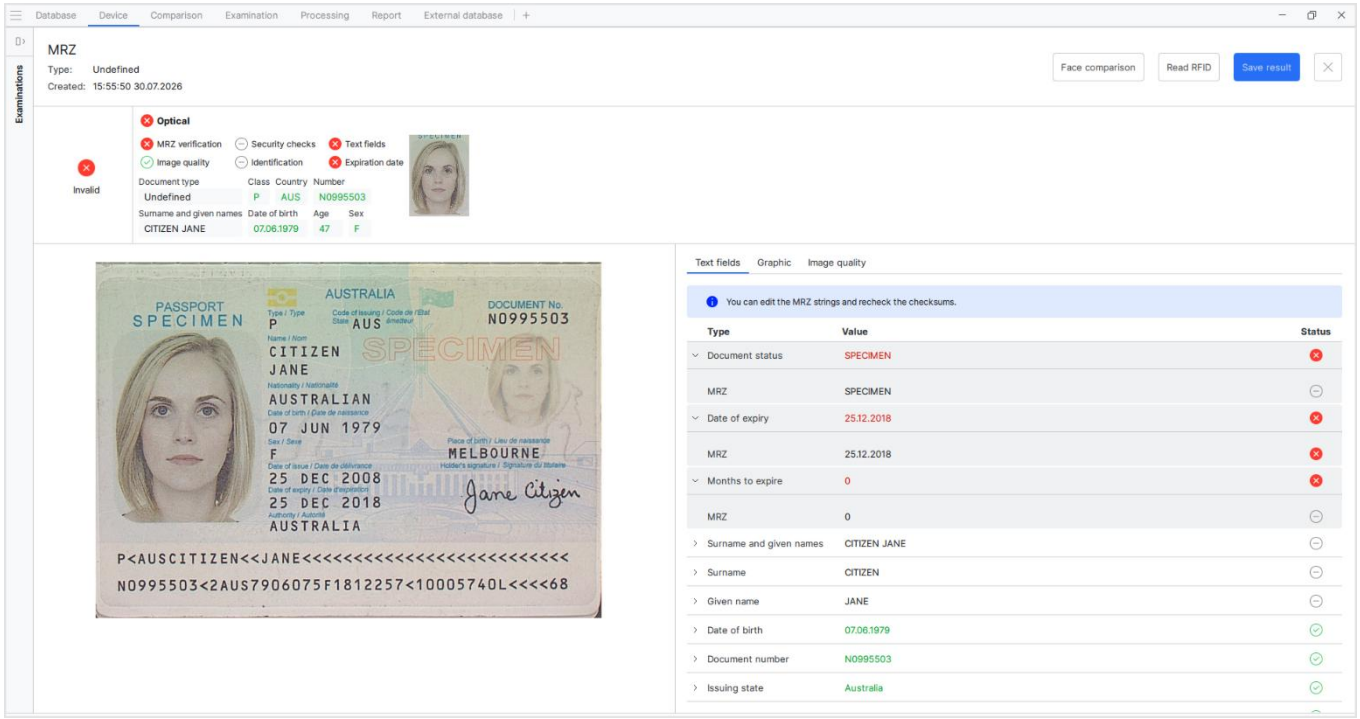
- Content from the machine-readable zone (MRZ) of the document
- Barcode content
- Data from the RFID chip

Tools for machine-readable documents examination are located in the **Device** tab:

6.9 Reading MRZ

1. Click the **Upper white**  button on the **Basic light sources** panel.
2. Place the document page with the MRZ into the field of view of the device camera.
3. Adjust the camera zoom so that the page fits completely within the camera's field of view, occupying most of the frame, with the edge of the document containing the printed MRZ almost touching the bottom or top edge of the frame.
4. Click the  button.
5. Skip the RFID chip reading step.

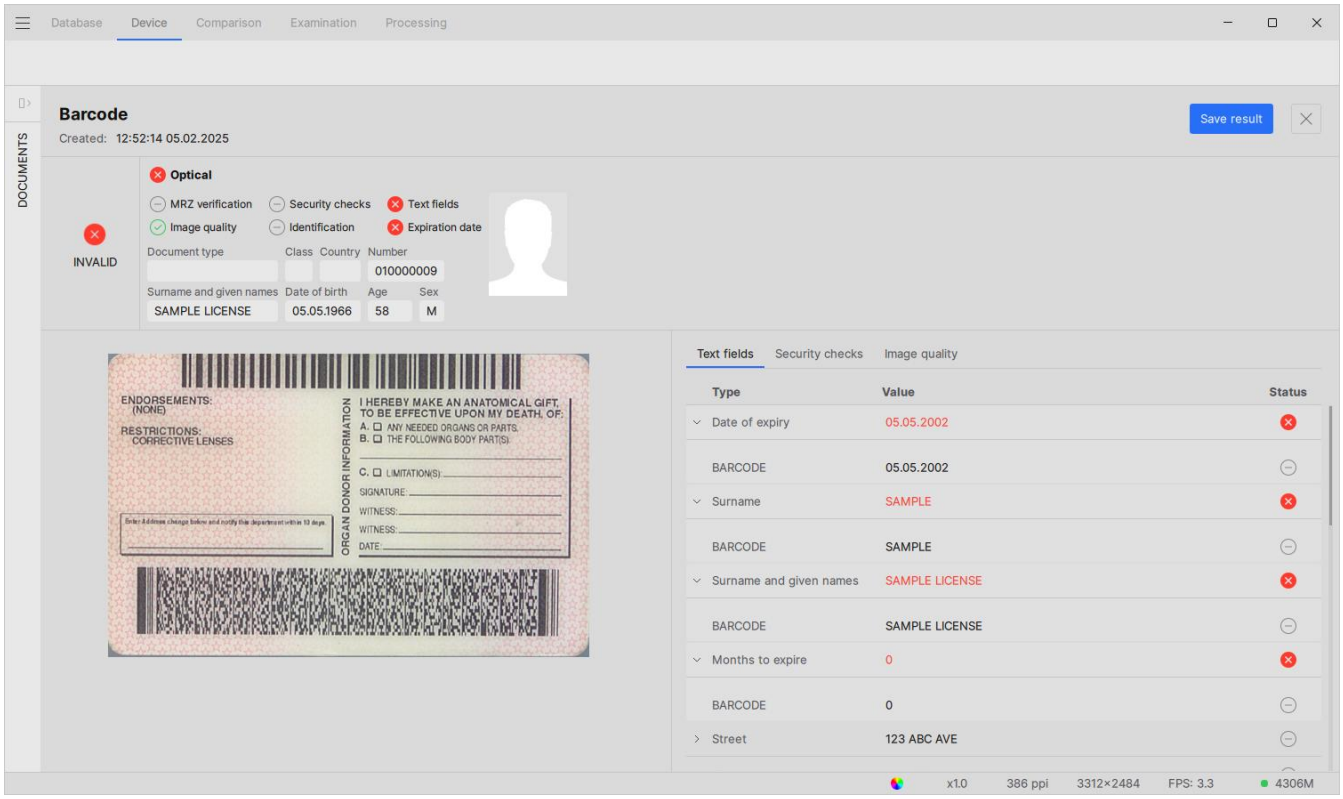
If the MRZ is successfully detected, the recognized text result will be displayed in a separate **MRZ** window:



6.10 Reading Barcode

1. Click the **Upper white**  button on the **Basic light sources** panel.
2. Place the object with the barcode within the camera's field of view. Adjust the camera zoom so that the object is fully visible within the frame, occupying most of the frame, with the edge of the document containing the barcode nearly touching the top or bottom edge of the frame.
3. Click the  button.

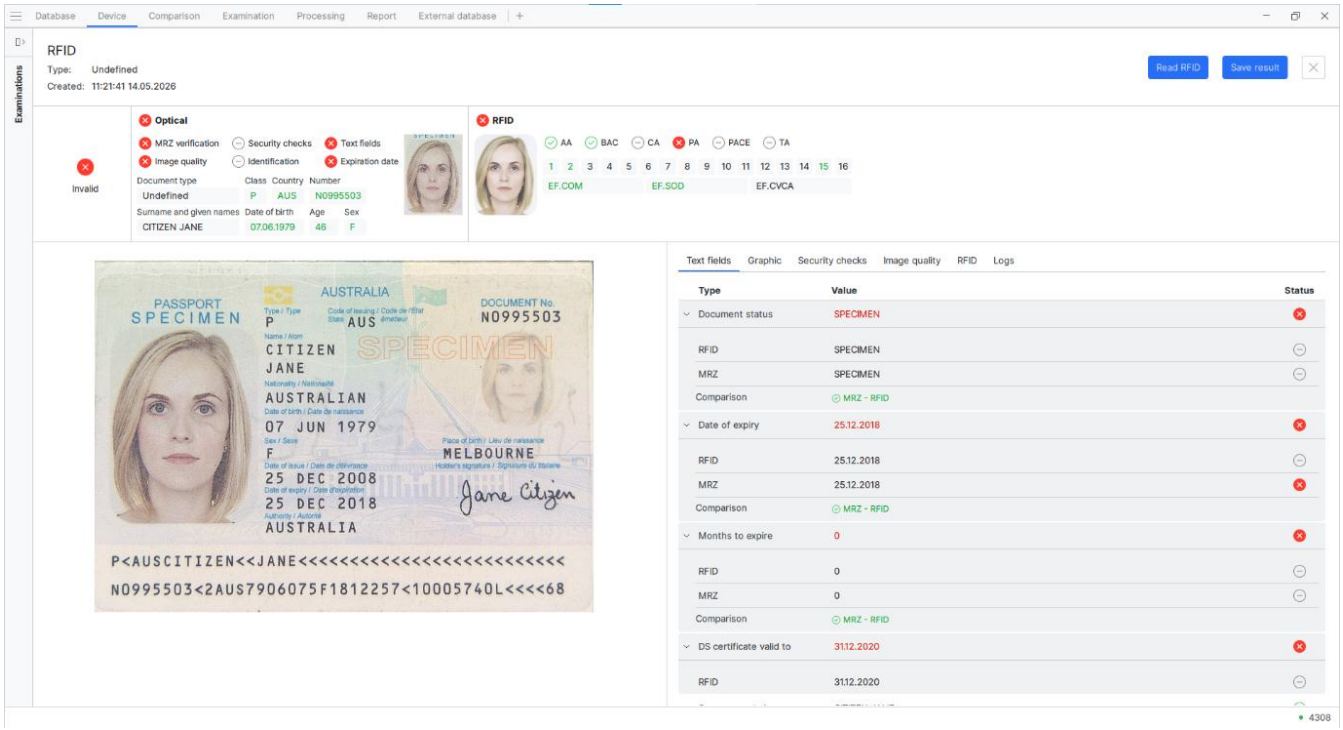
If the barcode is successfully detected and read, the recognized text result will be displayed in a separate **Barcode** window:



6.11 Reading RFID chips

1. Place the document with an RFID chip and MRZ within the camera's field of view.
2. Click the MRZ button.
3. Position the part of the document with the embedded RFID chip within the area of the reader antenna, which is specially marked.

In case of successful detection and reading of MRZ and RFID, the result of their comparison will be displayed in the **RFID** window. Errors in recognition and document violations are indicated in red with the icon:



To save the results as an item in the database, click on the **Save Result** button. The saved file in the database will be indicated by the rfid icon. To view the saved results, navigate to the **Database** tab.

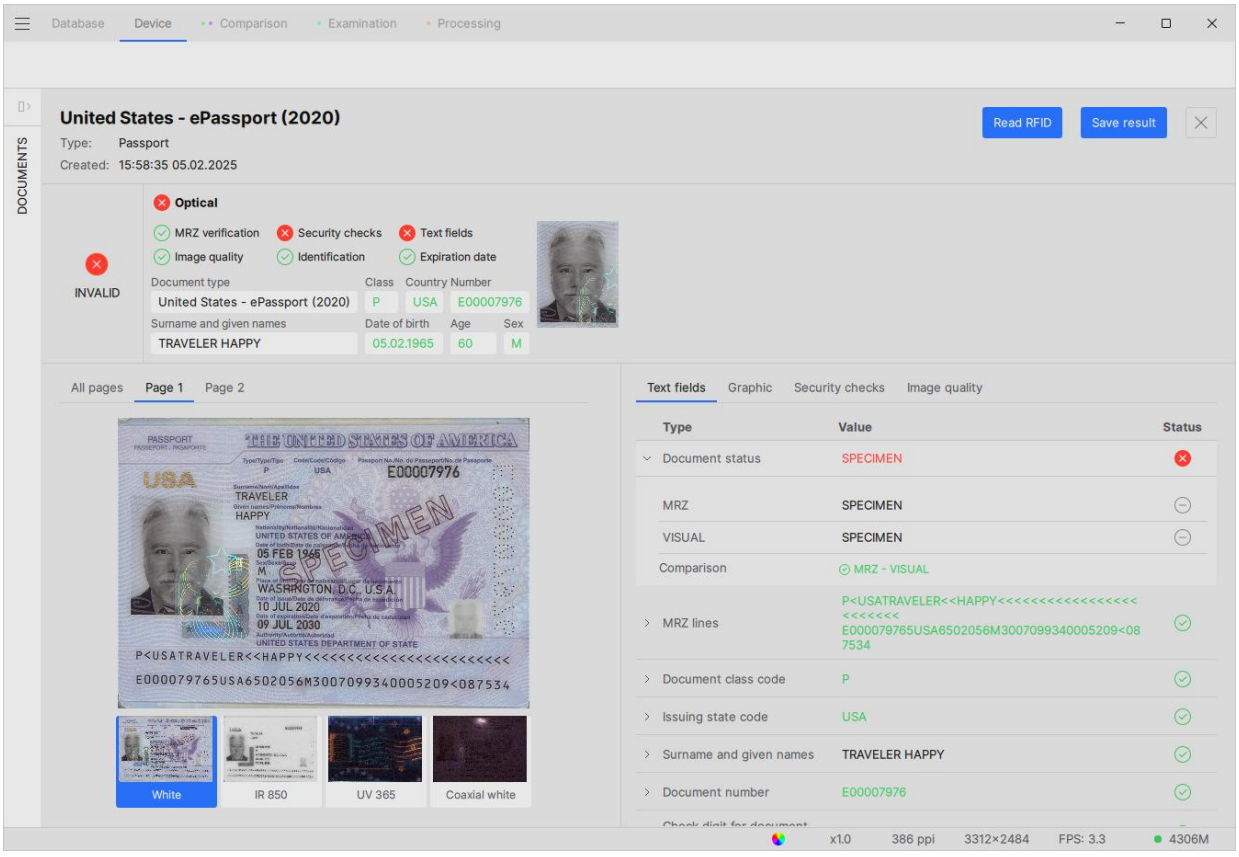
6.12 Automatic Authenticity Verification

Automatic authenticity verification allows for quickly obtaining all information about a document: document type, machine-readable zone recognition, visual zone and barcode recognition, as well as data from text fields.

Note: The functionality is available only with a special license.

Information is read using the following light sources: top white, coaxial white, ultraviolet 365, and infrared 850. The result can be saved in the database.

1. Place the examined document within the camera's field of view.
2. Click on the **Automatic verification** button. This will start the automatic verification process, display a progress indicator for capturing, and open a window showing the authenticity verification results:

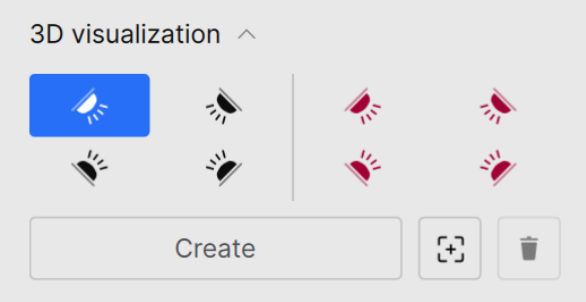


3. To save the results, click on the **Save result** button. The saved file in the database will be indicated by the icon.

6.13 3D Relief Reconstruction

The procedure of 3D relief reconstruction involves capturing a sequence of images using one of the specialized 3D light sources. Subsequently, a 3D surface model of the examined object is generated.

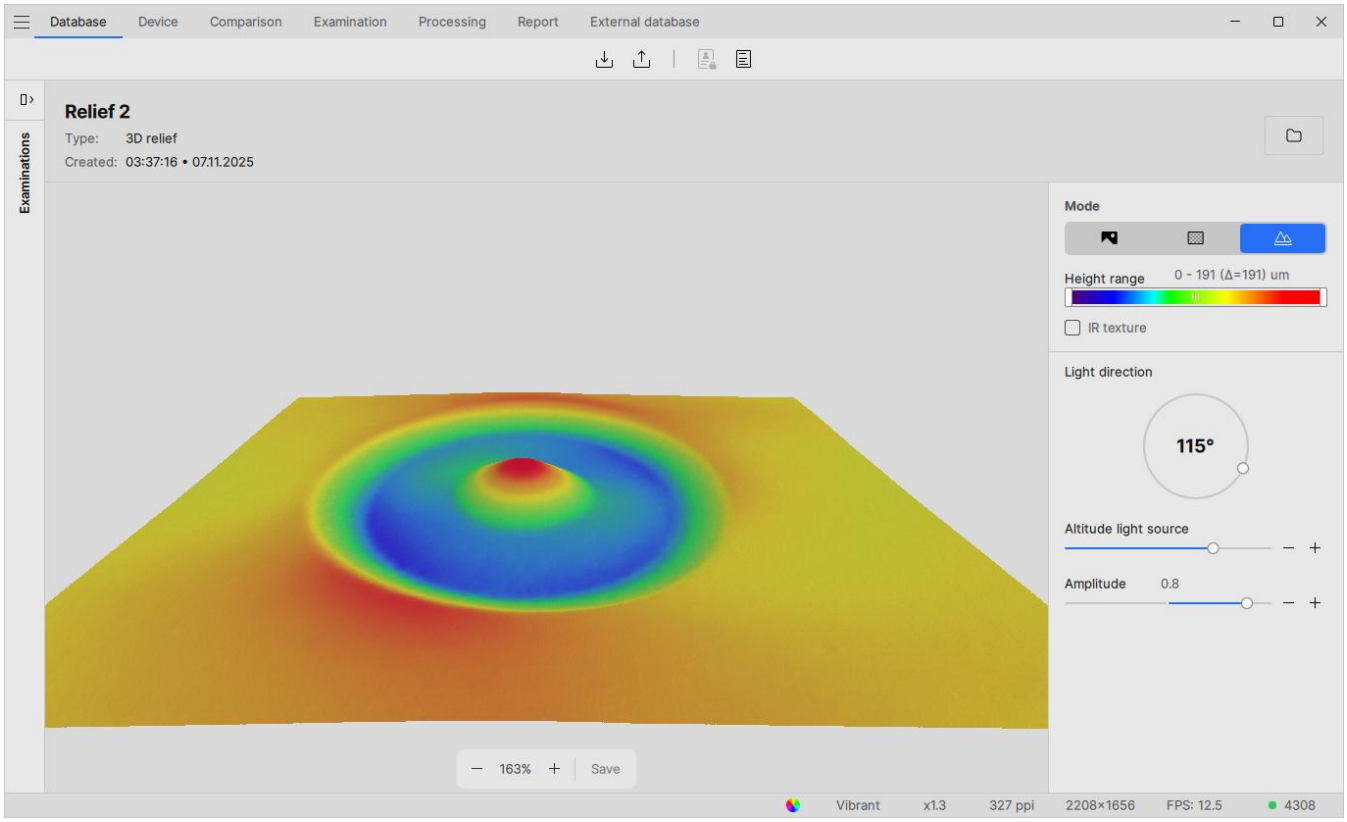
1. Place the examined object within the field of view of the device's camera.
2. Navigate to the **Device** tab, find the **3D Visualization** section, and click on the light source icon. You can choose either the white or IR (infrared) light source as the base.
3. The **3D Visualization** group will look like this:



4. Click on the **Create** button. This will initiate the procedure for creating a 3D surface model based on the set of images.

The results of the capture and formation of the 3D surface model are automatically saved as a database element with the **.Relief** extension and denoted by the icon  . To view and modify the saved relief reconstruction data, navigate to the **Database** tab and select the desired element in the explorer panel.

Here is the saved result example:



With the left mouse button, you can perform the following actions on the 3D model image:

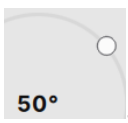
- By using the mouse wheel, you can zoom in or out of the view.
- By dragging the cursor while holding down the mouse button, you can rotate the model in different directions.

In the **Mode** section, you can set the following modes for examining the object:

-  – **Texture** mode: full activation of both 3D light sources.
-  – **Surface** mode: the 3D model is visualized without using texture.
-  – **Height map** mode: a texture is applied to the 3D model, where colors change according to the relative height of surface points – from the lowest (blue) to the highest (red).

To obtain an image of the object under infrared (IR) illumination, select the **IR texture** checkbox.

To obtain the relief of the object captured for different directions of illumination (azimuthal angle) by the basic 3D light source, set the height of the light source (distance to the surface) in the **Light direction** field



.

The **Altitude light source** option allows users to modify the elevation angle of the illumination, affecting how shadows and highlights form on the object's surface, thereby enhancing depth perception in the 3D model.

The **Amplitude** option regulates the intensity of the light source, influencing the contrast and depth representation of the relief model.

6.14 Obtaining Images with Glare Compensation

Obtaining images with glare compensation involves capturing a sequence of frames and forming a resulting image based on them. This image does not contain areas of overexposure caused by glare from lighting sources on glossy surfaces or holographic fragments.

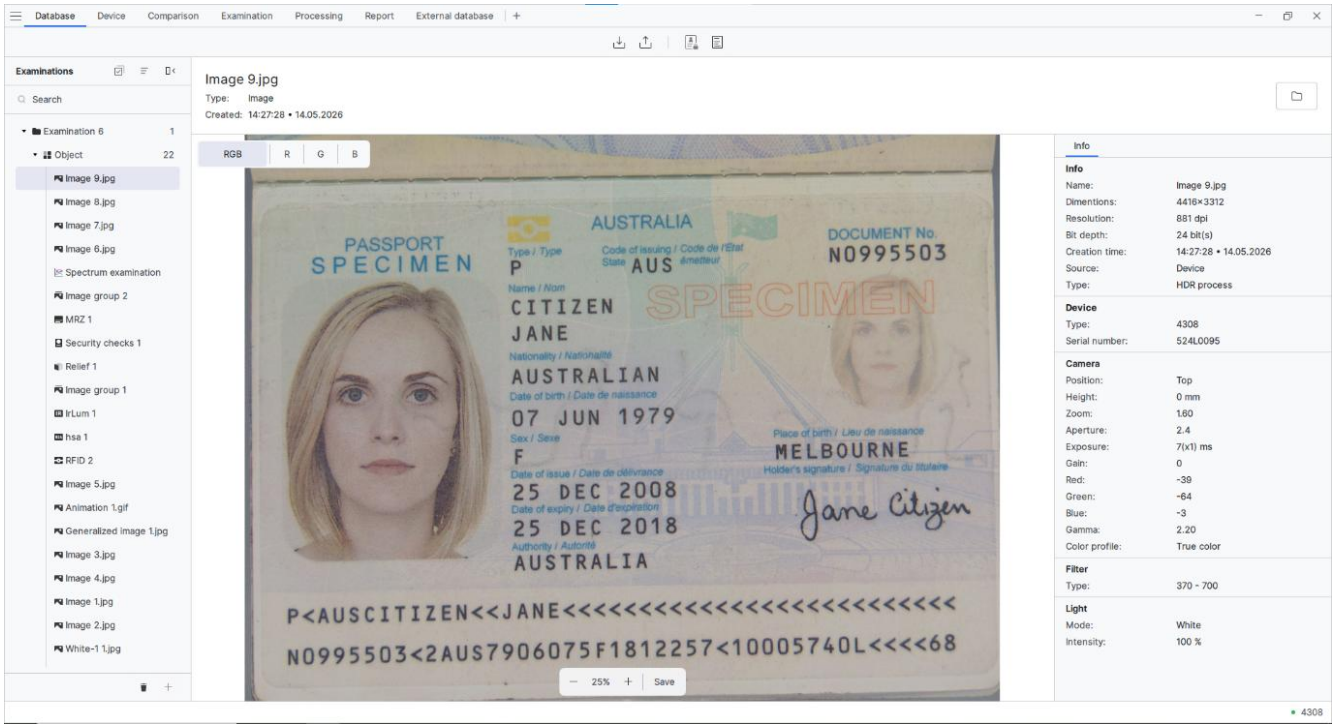
1. Place the examined object within the camera's field of view.
2. In the **Device** tab, find the **3D Visualization** section, and click on the icon for either the white or 850 nm IR light source.
3. Click the **Remove glares** button  .

6.15 Obtaining HDR Images

High Dynamic Range (HDR) imaging technology enables the creation of images with enhanced detail in high-contrast areas compared to images obtained in standard camera mode.

1. Place the examined object within the camera's field of view and activate any light source.
2. Click the  icon.

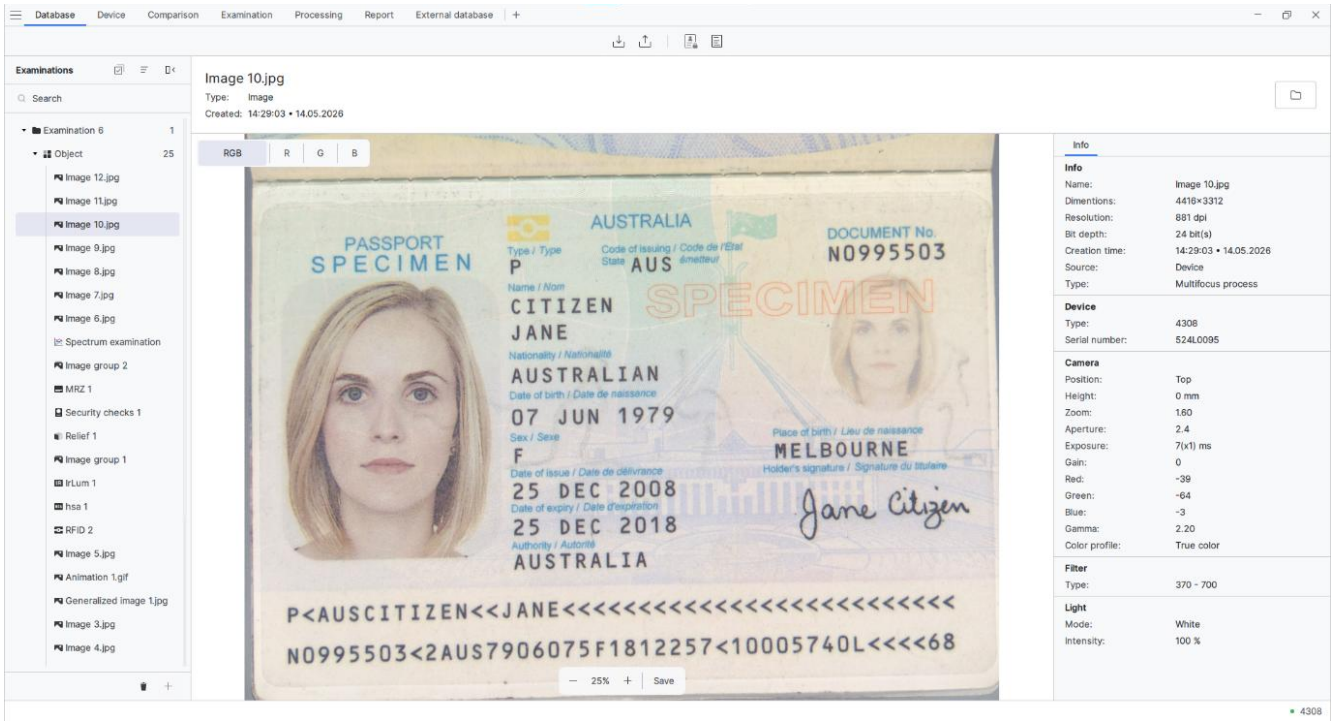
The HDR image will be automatically saved in the database:



6.16 Obtaining Multifocus Image

Obtaining a multi-focus image involves capturing a sequence of frames with different focus settings, followed by the formation of a resulting image with increased depth of field.

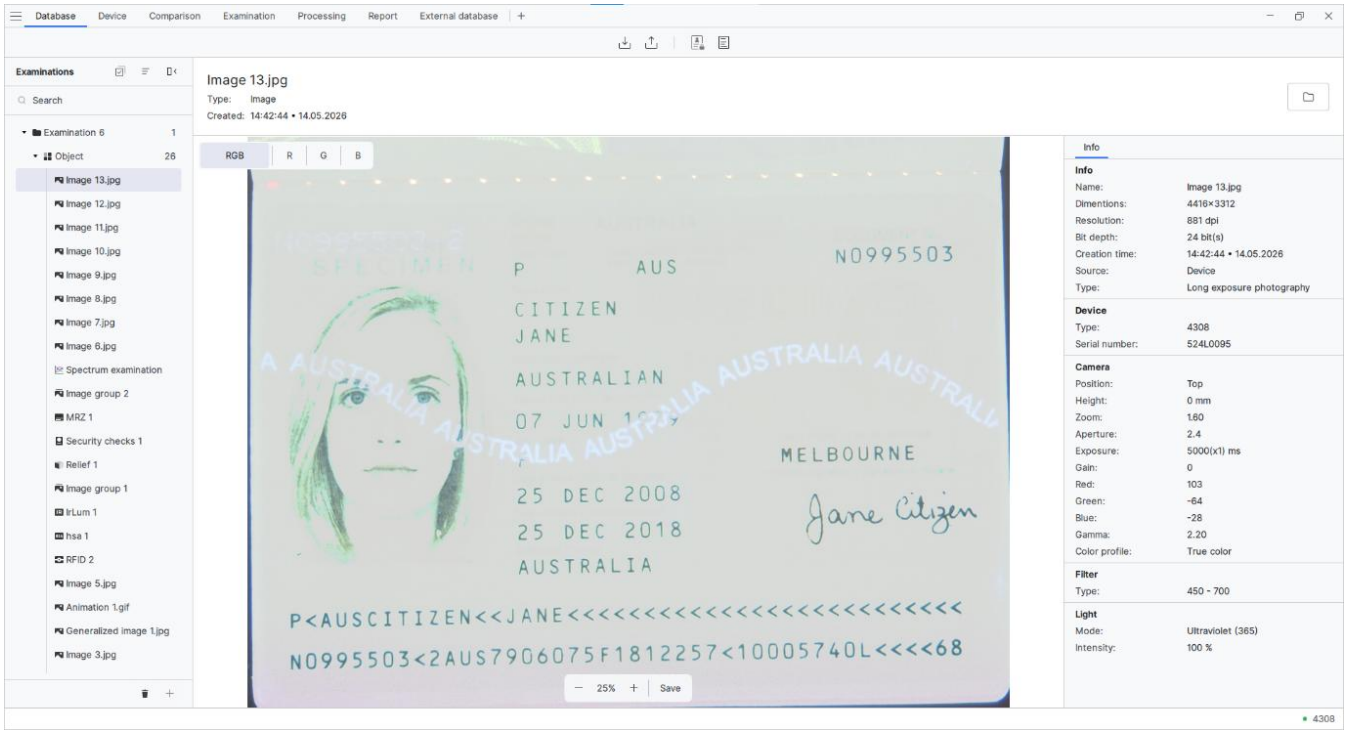
1. Place the examined object within the camera's field of view.
2. Click the **Upper white**  button on the **Basic light sources** panel.
3. Click the **Multifocus**  button on the toolbar.



6.17 Obtaining Long Exposure Photo

1. Place the examined object within the camera's field of view.
2. Select the desired light source.
3. Click on the **Long exposure photography**  button.
4. In the drop-down window, set the camera **exposure** value in seconds from 1 to 120.
5. Click the **Snapshot** button. The process of capturing a long exposure photo will start, and you will see a shooting progress indicator. The captured image of the object will be automatically saved in the database.

Evaluate the captured image in the image view window and adjust the exposure value if necessary:

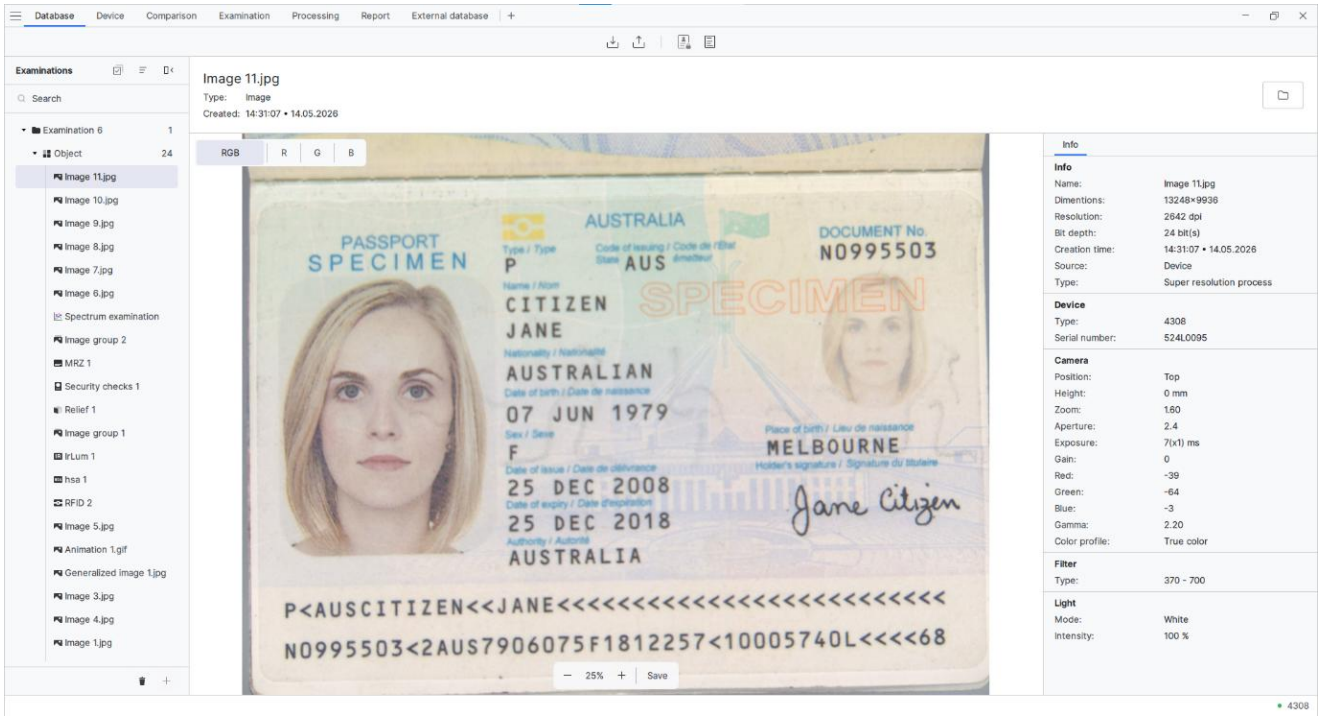


6.18 Obtaining Super Resolution Image

To get an image in a super resolution:

1. Place the examined object within the camera's field of view.
2. Select the desired light source.
3. Click on the **Super resolution** icon.

The resulting image will be automatically saved in the database.



6.19 M-tag

The M-tag mode is used to examine materials with different degrees of transparency to IR radiation at wavelengths of 870 and 950 nm. Alternating between the IR light sources makes it possible to detect differences in radiation absorption within the corresponding spectral ranges.

To enable the mode, click the  button. The 870 and 950 nm IR light sources will switch on alternately. An IR-pass filter will be automatically positioned in front of the camera for observation in the infrared spectral range.

6.20 Calculating Residual Area of Banknote

Calculating the remaining area of a banknote is supported whether you have an IRS connection or not.

When connected to the IRS information and reference system, you will simply select the banknote in the **External Database** tab, and its dimensions will be set automatically.

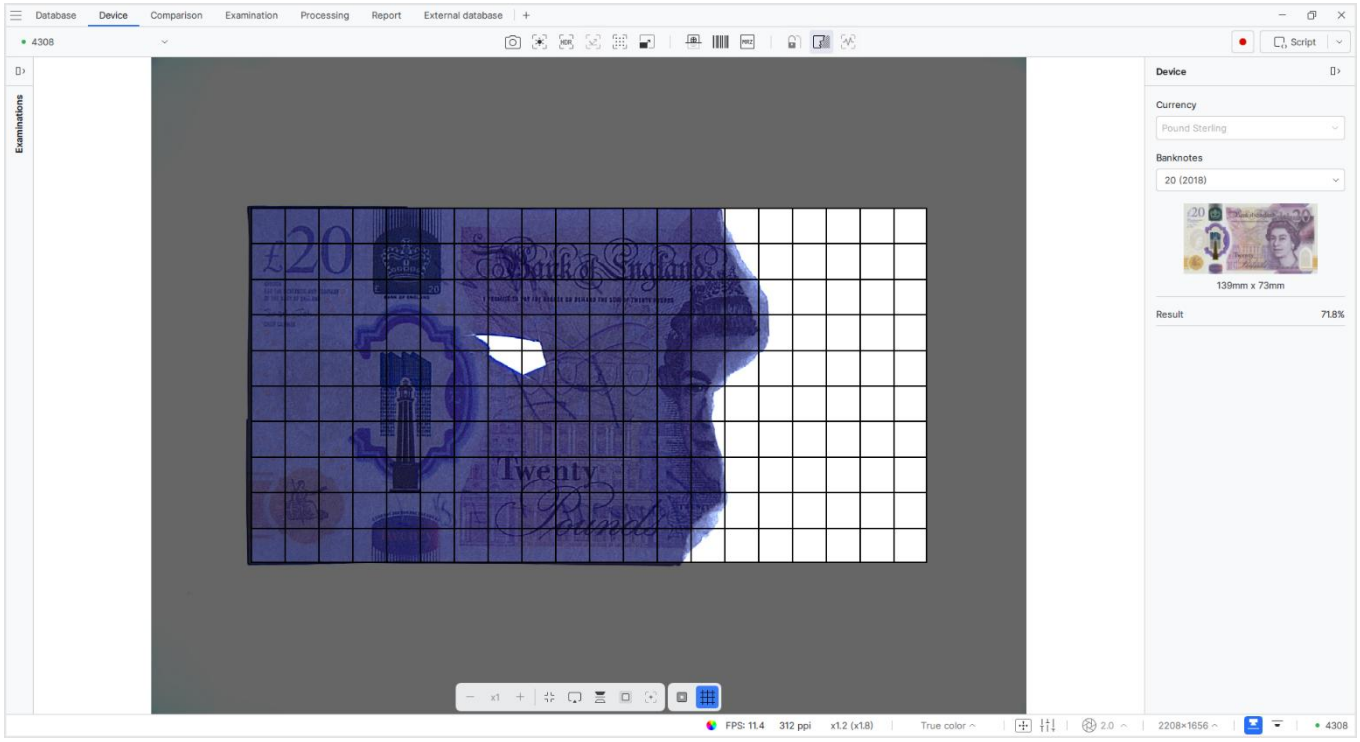
If you do not have an IRS connection, you can manually enter the banknote's size to perform the calculations.

1. Place the examined banknote within the camera's field of view.
2. Click the  button. A panel will appear on the right where you can select the type of banknote. You can also select a banknote on the **External Database** tab.

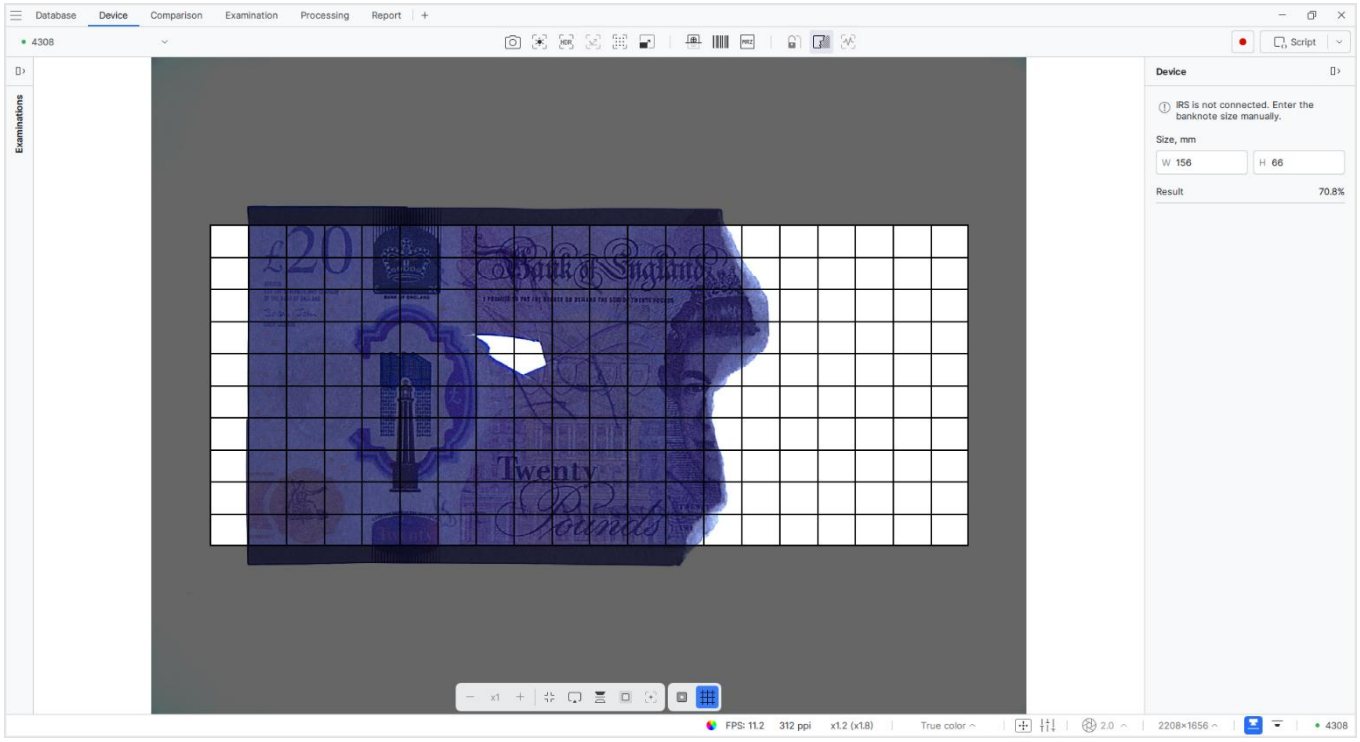
The residual area of the banknote (as a percentage) is calculated automatically and displayed on the right.

You can use additional options by clicking on the icons below the image: **Mask** (binarization of the image) and **Grid** (overlaying a grid on the image).

Calculation of the remaining area of a banknote **with IRS connected**:



Calculation of the remaining area of a banknote **without IRS connected**:

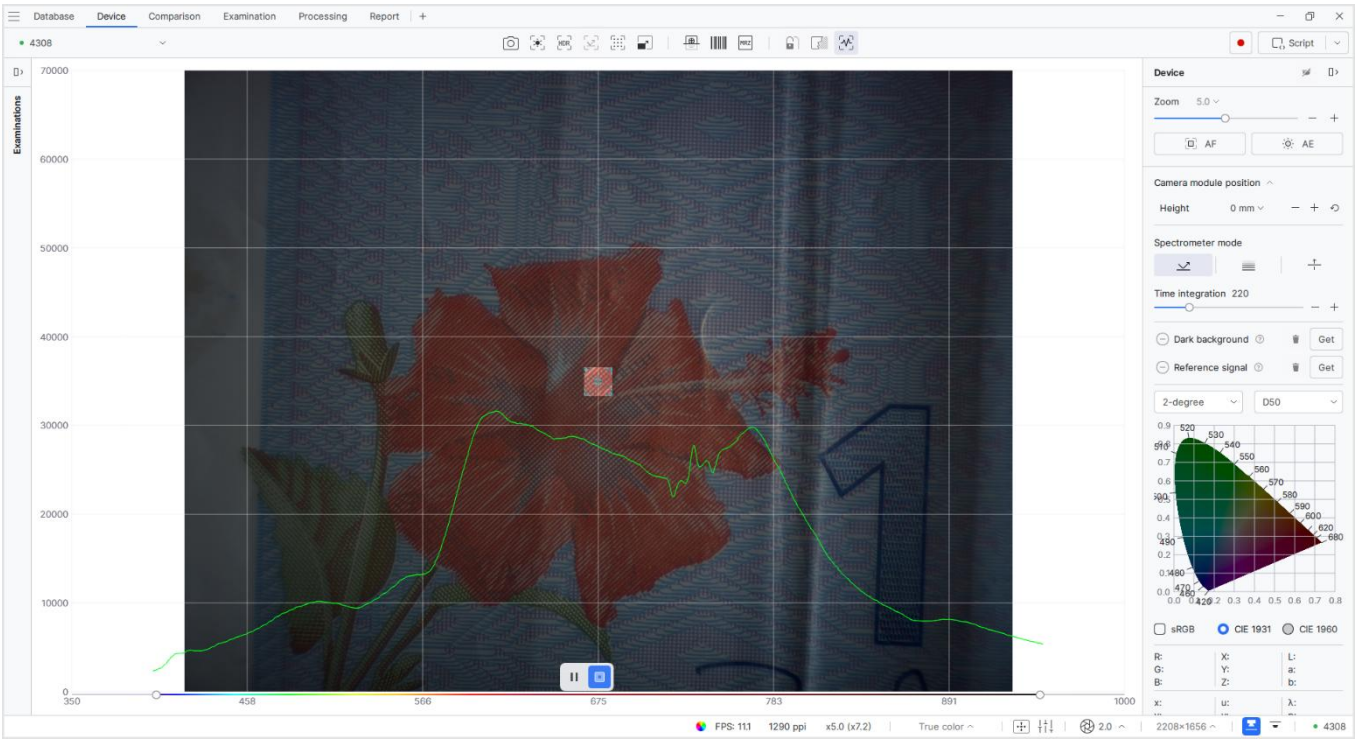


6.21 Using Spectrometer

The Regula 4308 comparator is equipped with a high-resolution spectrometer. Spectral characteristics of objects can be examined in **Reflection**, **Luminescence**, and **Transmittance** modes. Measurement results are accepted for the relative power signal within the wavelength range of 350–950 nm.

During spectrum measurement, the basic light source for the reflected signal is a Halogen light source combined with a D50 White light source from the Basic light sources group. For luminescence examination, the source is UV 365 nm, and for **transmittance** examination, a combination of White and IR Point Source 860 from the Bottom Sources group is used.

To conduct the examination, click the **Spectral examination**  button located on the toolbar of the **Device** tab. This initializes the spectrometer and activates the basic light source. The **Reflection** mode is activated on the instrument control panel, and the preliminary spectral characteristic of the selected area of the object is displayed without considering the **Dark background** and **Reference** measurements required for the automatic calculation of the **true** spectral characteristics of the object:



The spectrometer registers the signal using the optical system of the device. The working area of the spectrometer, when setting up the device, is positioned in the center of the optical system, corresponding to the center of the video image, and dynamically changes depending on the current magnification in the range from 2x2 mm (1x magnification) to 0.05x0.05 mm (40x magnification).

The horizontal axis of the drawing area corresponds to the wavelength in the spectrum of 350–950 nm. Absolute measurement values of the spectrometer (in the range from 0 to 60000) or values in % relative to the magnitude of the reference signal (in the range from 0% to 150%) are plotted on the vertical axis.

To adjust the amplitude of the signal values obtained, use the **Integration time** option.

To measure the spectrum of the image, it is necessary to obtain the **Dark background** (when the lighting is off) and **Reference** measurements. The Reference is the reference signal, the spectrum of the basic light source applied to the current examination mode.

For the **Reflection** examination mode, the reference is the reflection spectrum from any area of the reference white object.

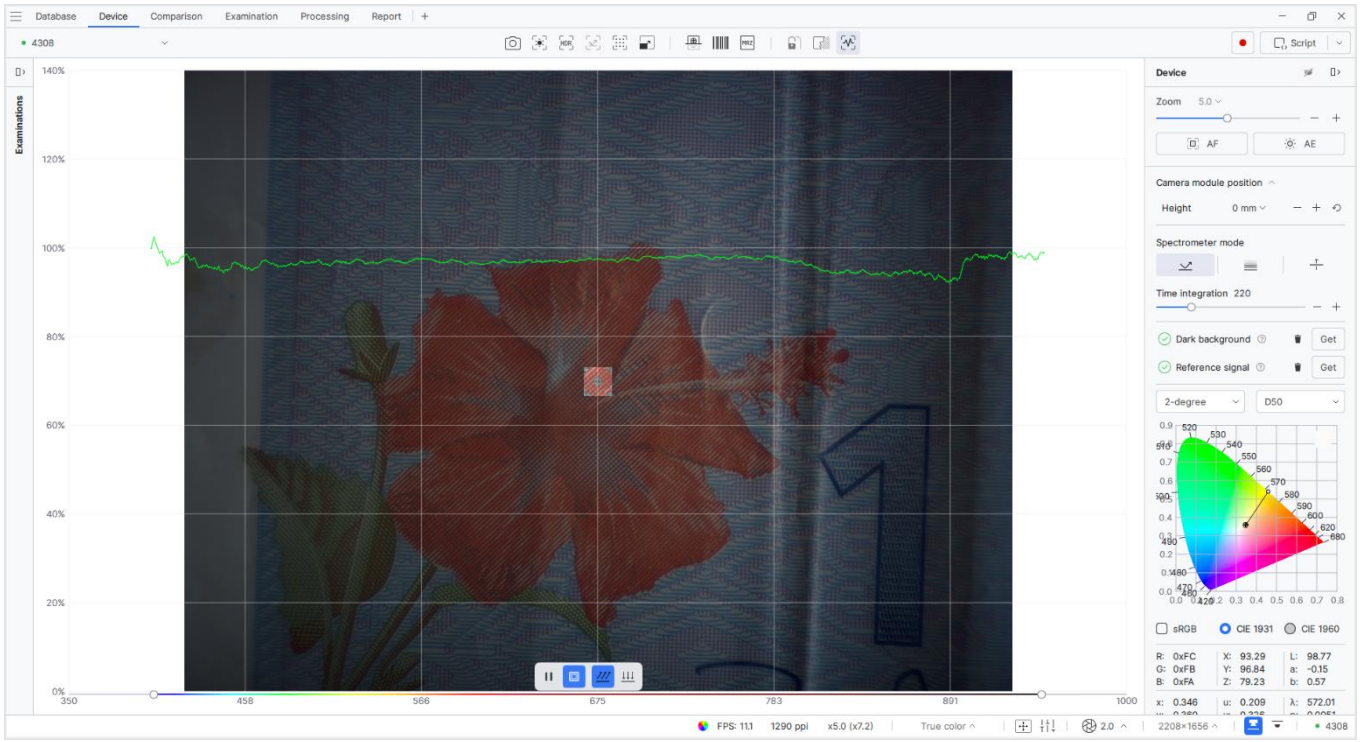
For the **Luminescence** examination mode, the reference is the reflection spectrum from the area of the object under examination, free from luminescent fragments.

For the **Transmittance** examination mode, the reference is the spectrum of the basic light source obtained in the absence of any object on the instrument's stage.

The procedure of using the spectrometer is the following:

1. Click the icon of the selected examination mode: **Reflection**, **Luminescence**, or **Transmittance**. The  button at the bottom of the image view window will change to  .
2. To obtain the Dark background data, click the **Get** button in the **Dark background** row.
3. To obtain the reference signal, click the **Get** button in the **Reference** row.
   Attention! For accurate measurement of color characteristics, it is necessary that the reference signal and the signal from the examined object are measured at the same integration time. Therefore, if the time changes, the data of the reference signal are reset and need to be obtained again. We recommend selecting an integration time so that the signal amplitude is maximized but the spectrometer does not enter the overexposure state.

Here are the spectral characteristics of the object in **Reflection** examination mode with consideration of **dark background** and **reference signal:**



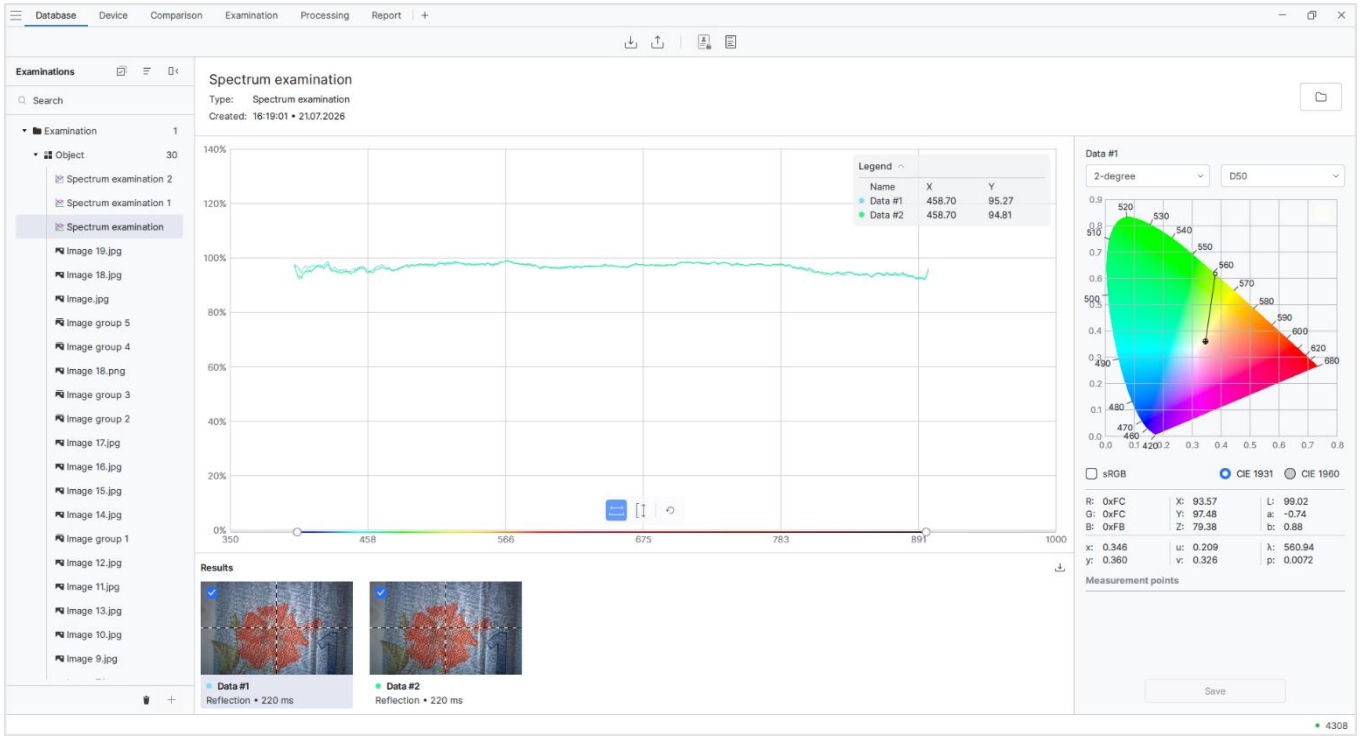
4 To save the measurement results in the **Measurements** list, sequentially click the **Stop** button and the **Add** button.

To delete or edit items in the **Measurements** list, hover the mouse over the desired row and use the and buttons.

To save the measurement as an item in the database, click the **Save** button. The file will be available in the **Database** tab as a Spectrum examination entry.

To save the spectral absorption characteristics of the selected area of the object in the database, click the **Absorption** button at the bottom of the image view window, then click **Add** and **Save**.

Here are the results of spectral examination in **Reflection** mode saved in the **Database:**



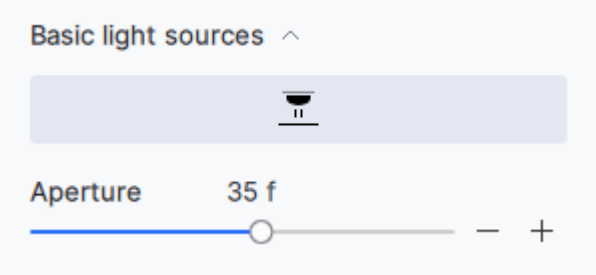
6.22 Coaxial Module (for Regula 4308M only)

The coaxial module is used to examine embossing and microrelief on plastic documents.

To use the coaxial module:

1. Install the coaxial module inside the Regula 4308M device.

   Note. On the Regula 4308M, when the coaxial module is in use, the top camera basic light sources are unavailable.



2. Click the  icon.
3. Set the **Aperture** value from 0f to 64f (by default is 27f).

When the coaxial module is connected, **Zoom** is automatically set to 6.0.