



Specim IQ User Manual

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1 Specim IQ and Spectral Imaging

The fundamentals of the Specim IQ system and spectral imaging.

Thank you for choosing Specim IQ!



Figure 1: Specim IQ Logo

1.1 Specim IQ Introduction

Specim IQ is a portable hyperspectral camera, where data capturing, data processing and result visualization are integrated into a one ready-to-use package. The camera is able to screen the imaging target and show the results on the camera display in just seconds. The weight of the camera, 1.3 kg containing a chargeable battery and a memory card for data storing, allows true portability for imaging in locations, where it has not been possible before.



Figure 2: Specim IQ

Specim IQ is accompanied with the Specim IQ Studio PC software. With Specim IQ Studio, you can develop and deploy your own applications, which can be loaded to the camera. In addition, IQ Studio allows you to import, export and manage hyperspectral data, manage Specim IQ camera settings, create models and reference spectrums.

The use of Specim IQ is easy with the intuitive user interface. No previous experience or expertise in hyperspectral imaging is required. The user interface on the camera display guides you through the imaging steps, and helps you to validate the data quality. The camera can be operated in a data recording mode, which provides hyperspectral data (raw and reflectance data) or in an application mode that, in addition, also provides the processed result shown on the display.

Correspondingly, the use of Specim IQ Studio is easy with the graphical user interface necessitating no developer skills. The wizard-type of workflow assists you in each step, and informs you when the necessary steps are successfully done. With Specim IQ Studio, you can define an application with a dedicated data processing algorithm, and load the application to the Specim IQ camera. Now, the application is ready in the camera, and you can take the image in the desired location (for example, in the field) and immediately see the results on the display.

You can load several applications to Specim IQ, and each application can be for a different purpose. You can easily upgrade the camera software by storing the new SW package on the memory card, and by starting the upgrade procedure with a simple key press combination.

A hyperspectral camera, such as Specim IQ, is an imaging device that is used to collect an image with broad spectral information on each image pixel of the target. In comparison to a standard grayscale with

single intensity information averaged over the whole wavelength band, or a colour camera with red, green and blue region averaged intensities, a hyperspectral camera can sample the wavelength region of the camera with hundreds of spectral samples. The spectrum saved from the target with continuous and high wavelength sampling, can be used to detect the imaged material, or determine its physical and chemical properties.

The Specim IQ wavelength range is 400-1000 nm, and it is based on Specim's push-broom technology, that is, line scan cameras. The system consists of a front lens, an imaging spectrograph and an image sensor. The system images one single line from the target with one snapshot captured on the system image sensor. The light from the target line is dispersed into a spectrum with the imaging optics, keeping the spatial information. In this way, one axis of the sensor (horizontal direction) is used for spatial distribution and the other (vertical axis) for spectral information from each imaged position. In other words, each column of the image contains a separate spectrum from a dedicated position along the imaged line. Furthermore, as the single image contains only information along one line, the full area of interest has to be imaged, scanned, line-by-line. The resulting hyperspectral image is a 3D data structure, datacube, where two dimensions are used for spatial information and one for spectral information.

In Specim IQ, the number of imaged lines is standard and thus the camera always captures a 2D image, the resolution of which is 512x512 pixels. In the spectral dimension, the number of recorded spectral bands is 204, which can be binned by x2 or x3.

Specim IQ is suitable for various user groups, from beginners to researchers in hyperspectral imaging. It is an imaging solution that provides information in an instant, for critical decision making and response. The users can make measurements that used to be possible in the laboratory only, in the field or virtually at any desired spot.

The camera can be used indoors, outdoors, with a tripod, handheld or mounted on a vehicle. The recommended light source for Specim IQ is a halogen-based illumination that covers the full 400 to 1000 nm range. In outdoor conditions, direct sunlight can also be used.

The Specim IQ sales package contains the camera and all the necessary accessories that are needed to get started and shoot the first images. Have fun with Specim IQ!

1.2 Spectral Imaging

Introduction to spectral imaging.

When you take a digital color photograph, you are actually taking three pictures. The final picture is a combination of three colors, red, green and blue, each taken from a relatively wide area of the spectrum. The final colors visible to the human eye are formed by overlapping red, green and blue with each other, in various quantities, to reproduce the array of different colors.

The **RGB** model in conventional imaging has a biological basis. The human eye only contains three color receptor types. These receptors are called cone cells. Each receptor type responds to different wavelength ranges of the color spectrum. In this analogy, we can say that humans have three color channels.

On the other hand, when you take a spectral image, you are actually taking dozens of pictures. The final picture is a combination of up to 220 colors, each taken from a narrow area of the spectrum. By increasing the number of pictures and narrowing the spectrum, we gain extremely accurate data on the target.

Light, as we perceive it, is electromagnetic radiation that is visible to the human eye in the wavelength range of approximately 400–700 nanometers (nm). Every color that we can see resides within this wavelength range. For example, the color orange has a wavelength in the range of 590–620 nm.

With spectral imaging, we can take pictures with an expanded wavelength range, also recording the data invisible to the human eye. The vast amount of recorded data can be computed and analyzed. Finally, the results not visible to the human eye can also be converted into the RGB model, if necessary.

To sum up, when we take a conventional photo, we gain wavelength information from each recorded pixel, as follows:

- Through three color channels (RGB)

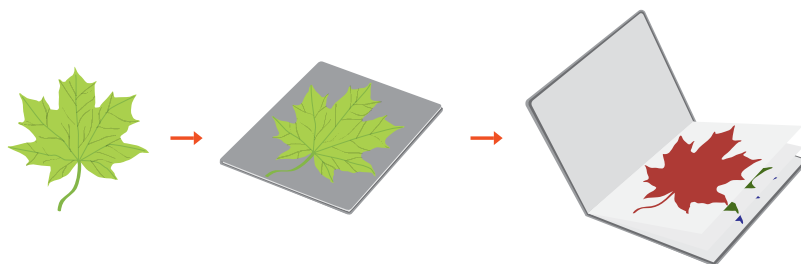


Figure 3: Comparing the amount of RGB data to the pages of a book

- In the wavelength range of 400—700 nm

If we look at the data cube of a conventional photograph, it can be seen as a book that has three translucent pages:

1. The first page contains the red wavelengths. The wavelength range of the page is approximately 75 nm.
2. The second page contains the green wavelengths. The wavelength range of the page is approximately 100 nm.
3. The third page contains the blue wavelengths. The wavelength range of the page is approximately 150 nm.

When we look through the pages of the book, we see the picture in full colour as depicted on the cover of the book in the figure below. In IQ, the book consists of up to 220 pages. The wavelength range of each page is approximately 2.7 nm.

When we take a spectral photograph, we gain wavelength information from each recorded pixel:

- Through up to hundreds of color channels

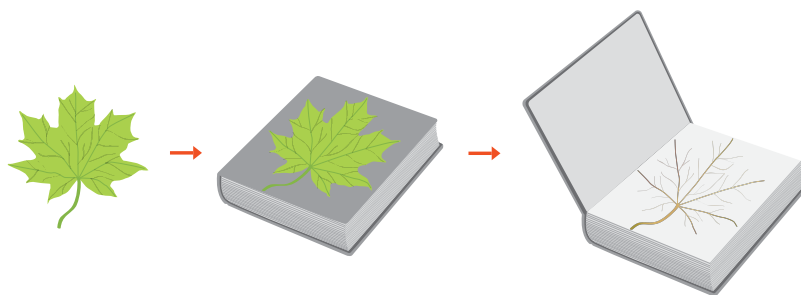


Figure 4: Comparing the amount of Hyperspectral data to the pages of a book

- In the wavelength range of 400—1 000 nm



Tip:

For more information, see video tutorials *What is Hyperspectral Imaging* and *What Hyperspectral Imaging Provides*, on the Specim website.

Using hyperspectral imaging, we can create a much richer image of the reality than just a normal photograph.

What can we, then, do with the richer image of the reality? Since we know that each material reflects light in a different way, we can detect different materials from the spectral images. And not only materials, but also the amount of materials and materials in different conditions.

For example, if we see a conventional photograph of an apple, we recognize that it is an apple, but we cannot exactly tell how ripe that apple actually is. With spectral imaging, we can, because the color of a ripe apple differs slightly from that of a raw apple.

When dealing with extremely small differences in the reflected light wavelengths, we cannot rely on our eyes to tell the differences that cause the wavelength variation in each photographed target. In the apple example, we need information on the exact wavelengths that are reflected from the apple during its different stages toward ripeness. These sets of spectral reflectance information are called spectral libraries.

From a more technical perspective, it is not only the reflected wavelengths in the spectral photograph that indicate the existence or non-existence of a particular material in the photographed target. Often, it is necessary to use various calculation models to dig even deeper into the characteristics of the target. These calculation models, for their part, are called spectral processing models.

To make things even easier for the user, we can combine spectral libraries with spectral processing models to create specific spectral imaging applications for specific purposes. For example, we can create an application for telling the ripeness of an apple, or an application for mapping wheat fields to locate areas that need more fertilizers. The foreseeable use cases for these applications are virtually infinite.

1.2.1 Datacube

The image that is recorded with a hyperspectral camera is called a datacube. In a datacube, the images with different wavelengths are stacked on top of each other. This is shown in figure [Figure 4: Comparing the amount of Hyperspectral data to the pages of a book](#). In short, a datacube is a three-dimensional array of values.

When a target is recorded with a hyperspectral camera, the system records a total of three different datacubes:

- A raw datacube
- A dark frame
- A white reference

These three datacubes and their content are needed to remove the effect of the camera optics and sensor from the measured image. Another important reason for recording all the data is the need to allow for and correct the effect of different illumination on the measurements. In this way, it is possible to compare data measured from different environments with each other.

Raw Datacube

A raw datacube contains the intensity of measured light from the target, with all the wavelengths directly in the way the hyperspectral camera detects it. This is the actual measurement, but it is not comparable with other measurements, unless the signal is corrected with the other measured data.

Dark Frame

In every digital camera, including the hyperspectral camera, the sensor has a baseline signal due to the camera electronics. This baseline signal varies, if the sensor is used in different temperatures, or if the integration time is changed. When making spectral measurements with a hyperspectral camera, we only want to measure the actual light reflected from the target, and the sensor effect must be removed. For this, the dark signal from the sensor is stored as a dark frame. At the same time, applying the dark frame to the measured raw datacube, we can also remove part of the noise, and correct the non-uniformity of the image.

White Reference

When making hyperspectral measurements, it is crucial to know what kind of a signal and spectrum the used illumination, either artificial or natural, has. Without this information, it is not possible to know what

kind of a spectrum is reflected from the target. The material can only be studied reliably by using the spectrum that only contains the signal from the measured target.

One of the most commonly used methods to enable this correction, is to also measure a white reference. In practice, this means measuring the image fully or partially covered with a white reference target. The white reference target contains material that has a reflectance close to 100% without any spectral features. When the white reference is measured in the same illumination and measurement geometry and distance as the actual material, the signal from the white reference target can be assumed to only contain the signal from the illumination. It also includes the information about the spectral response of the used hyperspectral camera, that is, how the camera will affect the measured spectrum.

The signal from the white reference target is saved as a white reference datacube. This information will be used to make the reflectance transformation for the measured data.

Reflectance Transformation

When the full measurement of a selected target is performed with a hyperspectral camera, the three datacubes, that is, the raw datacube, dark frame, and white reference, are collected together and saved. This data is used to convert the raw data to a reflectance, which shows directly what kind of spectra the target is reflecting. Reflectance transformation, which is in some cases called normalization, is performed for the measurements with the following equation:

$$\text{Reflectance} = \frac{\text{Raw_data}^{t1} - \text{Dark}^{t1}}{\text{White}^{t2} - \text{Dark}^{t2}} \times \frac{t2}{t1}$$

The resulting reflectance datacube is comparable with the measurements done in different conditions and illuminations. In the equation, the integration times $t1$ and $t2$ refer to a situation where a different integration time is used with [Custom white reference mode](#). The Custom white reference mode can be used, for example, in a scenario where you have a highly reflective white reference and a target with low reflectance. In this case, both measurements must have their own dark frame, and the result has to be multiplied by the ratio of the used integration times.

The values $t1$ and $t2$ refer to using the Custom white reference mode that allows separate integration times for recording the white reference and the target data. If you use Custom white reference mode:

- $t1$ = Dataset integration time
- $t2$ = White reference integration time
- $\text{Dark_}t1$ = dark reference for dataset
- $\text{Dark_}t2$ = dark reference for white reference

If you use simultaneous white reference mode $t1 = t2$ and $\text{Dark_}t1 = \text{Dark_}t2$.

1.2.2 Illumination

In spectral imaging, good illumination plays a bigger role than in conventional digital imaging. When arranging illumination, pay attention to three main parameters:

- Intensity
- Spectral response
- Uniformity

Intensity

Hyperspectral cameras require considerably more light, that is, intensity, than standard imaging cameras. The main reason for this can also be explained with the book example presented in [Spectral Imaging](#).

Let us assume that the total amount of reflected light from the target is 100 units. In a standard camera, the blue, green, and red pages each cover approximately one third of the full spectrum. This results in a

situation where only 33 units of light will be used for each color. However, in the hyperspectral camera the same light will be split over approximately 200 pages, that is, spectral bands. In this scenario, only 0.5 units of light will be collected for each spectral sample. In other words, the hyperspectral camera requires $33/0.5 = 66$ times more light.

The need for light can be partly compensated by using longer integration (exposure) times, but at the same time the measurement becomes slower. In most cases, the illumination used for hyperspectral imaging is brighter than the illumination used for standard cameras.

Spectral response

Illumination for hyperspectral imaging must always have a continuous spectrum that covers the full wavelength range, over which the hyperspectral camera is operating. If the illumination does not have signal in some of the wavelengths, the measured data on those wavelengths is not valid.

The best option for Specim IQ is a halogen-based illumination (see [Figure 5: Halogen Spectrum](#)) that covers the full 400 to 1000 nm range. In outdoor conditions, direct sunlight (see [Figure 6: Sunlight Spectrum](#)) can also be used.

The most commonly used indoor light sources are LEDs (see [Figure 7: LED Spectrum](#)) and fluorescence tubes (see [Figure 8: Fluorescence Tube Spectrum](#)). However, their spectral response is not suitable for the full spectral measurements with Specim IQ. The LED response does not cover the full wavelength range of Specim IQ, and the fluorescence tube spectrum consists mainly on strong gas emission peaks. There are some special cases, where these illumination systems can be used, but you must be extremely certain about the analysis that you are doing with this type of an illumination.

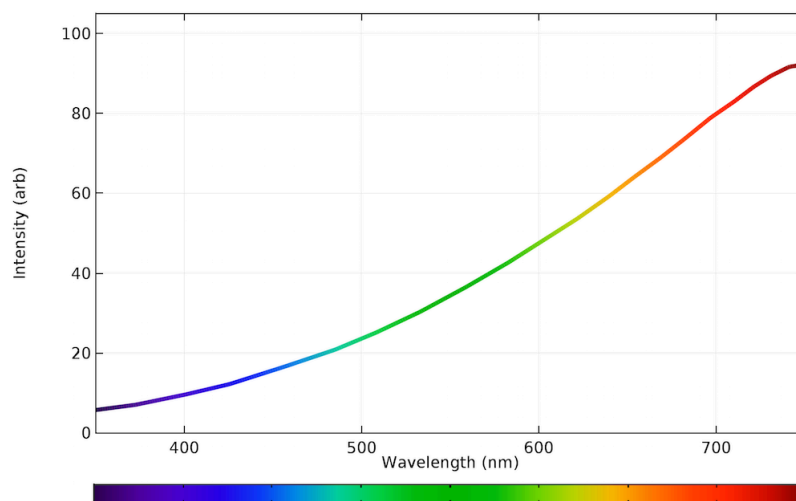


Figure 5: Halogen Spectrum

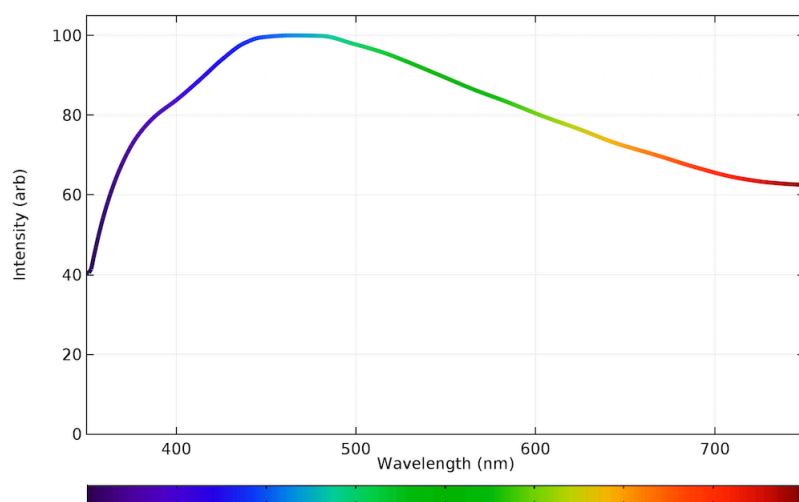


Figure 6: Sunlight Spectrum

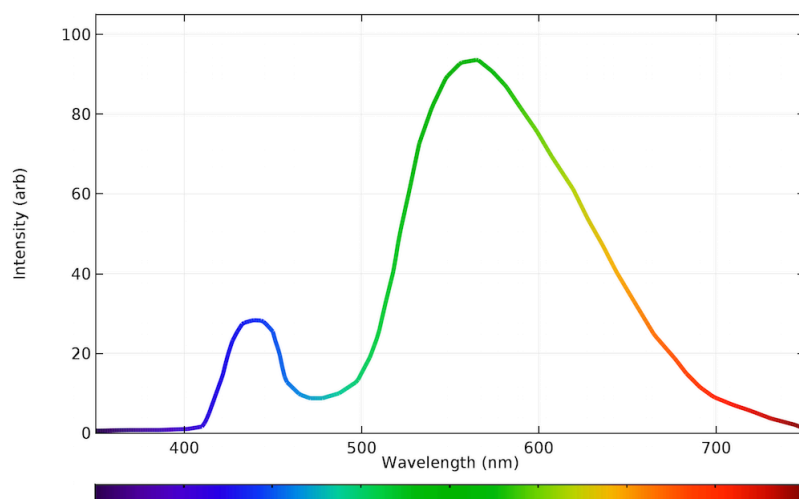


Figure 7: LED Spectrum

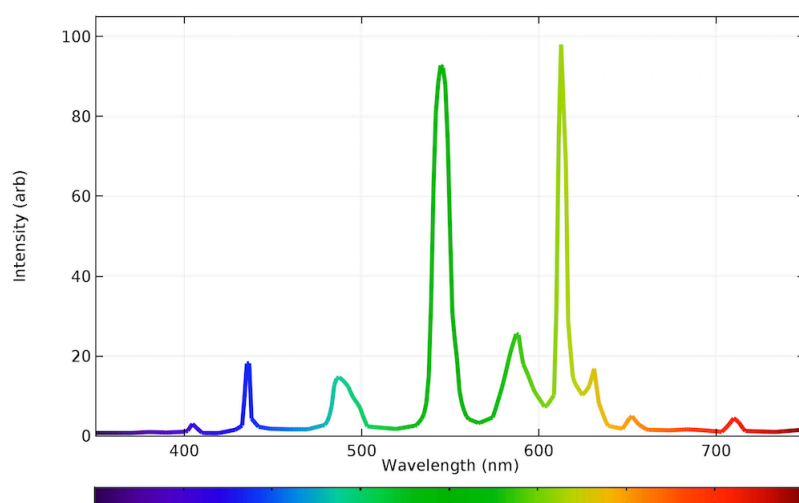


Figure 8: Fluorescence Tube Spectrum

Uniformity

Another important illumination parameter is the uniformity of the illuminated area. This means that the light coming for each position of the imaged area should have the same spectral response and intensity. There should be neither shadows nor specular reflections, in the illuminated area. In practice, this is extremely difficult to achieve, but it is always better to use several, preferably two or four light sources instead of one, to illuminate the area.

As a good starting value for halogen illumination for Specim IQ can be two units of 125 W halogen sources without focusing optics. This can be even two basic construction illumination units.

Another possibility is to use more focused halogen sources. In this case, for example four units of 35 W halogen bulbs, with approximately 30 degrees opening, will give sufficient light intensity for the Specim IQ. Higher illumination power and intensity will give the possibility to use Specim IQ with shorter integration times, but it will increase the heat load to the measured area. A smaller illumination power can be used, especially in the cases where the target is needed to be protected. In these cases, longer integration and measurement times are needed.

Illumination with Specim IQ

When illuminating your data recording target area for Specim IQ, please pay attention to the parameters mentioned above. In the images below you can see the recommended positions for the illumination sources. Whether you are using two or four light sources, place them symmetrically with respect to the Specim IQ. There should be at least 15 centimeter distance between the light sources and the Specim IQ, to avoid overheating of the device with the light sources. The minimum distance to the target with Specim IQ is 15 centimeters.

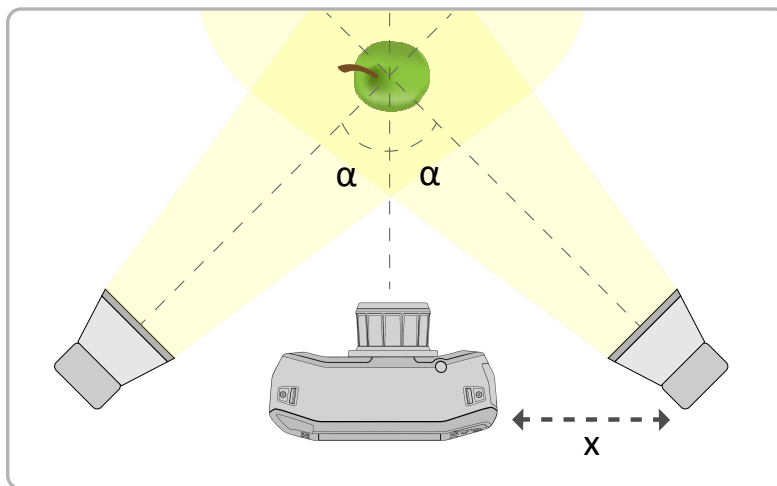


Figure 9: Ideal illumination positioning for Specim IQ, where $\alpha = \sim 45^\circ$ and $x = \text{min. } 15 \text{ cm}$

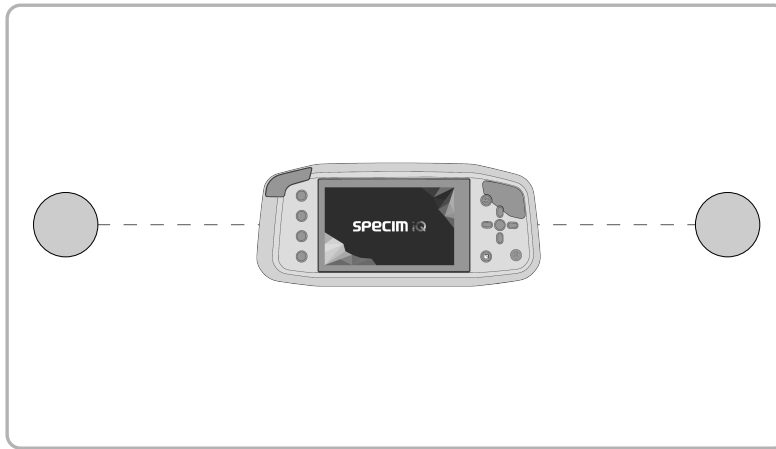


Figure 10: Positioning two light sources with Specim IQ

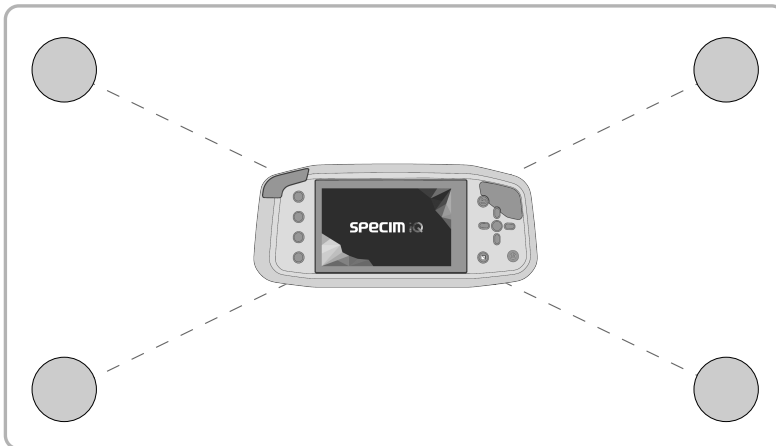


Figure 11: Positioning four light sources with Specim IQ

1.2.3 Dataset

A dataset refers to a single measurement made with a hyperspectral camera, such as Specim IQ. A basic dataset contains the raw datacube, dark frame, white reference, auxiliary metadata, and the reflectance

datacube. The content may vary, as some of these can be left out, and some additional results can be added, depending on the measurement setup. However, the dataset is structured as follows:

At dataset root:

- The `manifest.xml` file. This file lists the files in the dataset.
- An image from the viewfinder camera.
- An image from the spectral camera.

Folders:

- The `Capture` folder containing the raw datacube, the dark frame datacube, and the white reference datacube.
- The `Metadata` folder containing the `metadata.xml` file, which includes all metadata related to the image.
- The `Results` folder containing the results as saved by the application used. For example, the reflectance datacube would reside in this folder.

The dataset contains the following file types:

- `.validated`: Custom dataset validation file
- `.raw`: Unprocessed, raw data
- `.dat`: Reflectance data
- `.hdr`: Header file. Each data file (raw and processed) is coupled with a header file with the same file name.
- `.xml`: Metadata and manifest files
- `.png`: RGB images

1.3 Legal Information

Certification

Specim, Spectral Imaging Ltd has developed Quality Management System for its use covering design, development, manufacturing, sales and support of optical measurement devices. QMS follows ISO9001:2015 and enables more efficient operation and product management in a systematic way utilizing metrics. Specim QMS has been audited by Bureau Veritas Certification Holding SAS – UK Branch and found to be in accordance with the requirements of the management system standards.

Warranty Conditions

Specim warrants the Product, provided the serial number appears on the Product and it is as originally configured by the factory, against defects in materials or due to faulty workmanship, as follows:

For a period of **two years (24 months)** from the date of delivery to the customer there will be no labor and material charges for repairing or replacing (depending on the defect type) the defective Product. When the parts are sent to Specim for repair the customer will cover the delivery costs and after the repair the parts are sent back to the customer at Specim's cost.

Specim's liability to user of the Product shall in no event exceed the actual cash amount received by Specim for the defective Product. If failure of the Product has resulted from accident, abuse, or misapplication, Specim shall have no responsibility under this limited warranty. Specim shall not be liable for any direct or indirect damages arising out of the use of, or inability to use this product.

Limited Liability

1. Specim shall in no event be liable for loss of production, loss of business, loss of profits or loss of use, loss of data or revenue, damage to property, or for any special, indirect, incidental or consequential damages.

2. The aggregate liability of Specim is limited to the sum of money, actually paid by the Customer to Specim for the system delivered.

The Warranty and Limited Liability clauses above in this quote shall supersede other possible contract clauses between Specim and the customer regarding Specim's warranty responsibility and liability.

Disclaimer

All information provided in this guide and provided manuals is believed to be complete, accurate and reliable at the time of delivery. No responsibility is assumed by Specim, Spectral Imaging Oy Ltd. for its use. Specim, Spectral Imaging Oy Ltd reserves the right to make changes to this information without notice. Reproduction of this manual in whole or in part, by any means, is prohibited without prior permission having been obtained from Specim, Spectral Imaging Oy Ltd.

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1.4 Contacting Support

Further information and technical support are available from **Specim, Spectral Imaging Oy Ltd.** in Finland. Contact information:

- Community: www.specim.com/community
- WWW: www.specim.com/iq

1.5 Glossary

Glossary of IQ terms.

1.5.1 A

1.5.1.1 A-GPS

Assisted GPS.

1.5.1.2 AM

Application Mode (AM) is a Specim IQ mode, where data recording, saving, processing, and visualization are based on the selected application.

1.5.1.3 AOI

The user defines areas of interest (AOI) on the **DATA** tab of the **Identification Model Creator**, in Specim IQ Studio.

1.5.1.4 Application

Application is a non-editable executable that is exported from the application project, and can be run in the Specim IQ camera.

1.5.1.5 Application project

Application project is a pre-defined workflow with a graphical user interface in Specim IQ Studio, to create applications for the Specim IQ camera. The application project is used within Specim IQ Studio to define the application, and it can be saved for future changes and needs.

1.5.1.6 ASM

In the Automatic Screening Mode (ASM) you can create a single target identification application directly in the IQ device. To do this, you record the training data, based on which you create a single identification class. You can use this class to detect similar materials or compounds from the recordings that follow.

1.5.2 B

1.5.2.1 Binary mask

A mask visualization method for SAM. Binary mask visualization shows the class in one solid color.

1.5.3 C

1.5.3.1 Calibration check

A workflow that the end user carries out, when required (every 30 days). The workflow validates that the device is correctly calibrated, and provides accurate results.

1.5.3.2 Catalog

Catalog contains the datasets recorded with Specim IQ. Catalogs are used both in IQ and in IQ Studio. IQ Studio can have multiple catalogs, where as in IQ, the datasets are stored in a single catalog.

1.5.3.3 Class

A class is a group of spectra that are used to describe the same material or phenomena. In IQ, the classes are defined by reference(s) spectra and a threshold value.

1.5.3.4 Classification

A tab in Specim IQ Studio, where the algorithm for the classification and the mask visualization method is selected.

1.5.3.5 Custom button

Four custom buttons to the left of the touch screen have a changing function, depending on the screen view. The function is displayed on the screen next to the button. The function can only be used from the button.

1.5.3.6 Custom white reference

A white reference method for Specim IQ, where the white reference is recorded and saved to IQ prior to the actual data recording(s).

1.5.4 D

1.5.4.1 Data recording

A workflow in Specim IQ where the data is being recorded and stored.

1.5.4.2 Data Recording Mode

You can choose between three data recording modes in Specim IQ;

- Default Recording Mode (DRM)
- Automatic Screening Mode (ASM)
- Application Mode (AM)

1.5.4.3 Distance Automatic

The viewfinder camera and the actual spectral camera have a parallax between them. This means that they are not located on a same optical axis and, depending on the distance to the target, these two cameras see the target in a different angle. This parallax error makes it difficult to overlay the images from these two cameras without image registration error.

Due to this a parallax, adjustment is needed to be able to overlay the spectral and viewfinder camera images with the best possible accuracy.

An automatic calibration of the parallax error is done in the recording settings view, by edge detection between the viewfinder and focus cameras. The spectral camera and focus camera are calibrated to be on the same optical axis, so the focus camera can be used to correct the error. Based on the amount of error,

which depends on the target distance, the vertical position of the viewfinder camera image is adjusted accordingly. When the adjustment is made, you can see a small vertical shift of the background image to match it with the focus camera. Due to this, it is important to readjust the camera targeting to the target in the data recording settings view, so that the correct position will be measured.

On the viewfinder view, the error due to the difference on camera position and target distance is not made yet. If the target does not have clear enough edges for the automatic correction to work, there is also a possibility to adjust the parallax manually. You can do this by keeping the **Custom 4** button pressed, and by adjusting the distance to the target, up or down, from the spectral camera area on the touch screen. When the images from these two cameras are matching, releasing the **Custom 4** button will keep the setting. The adjustment can be released by half-pressing the shutter button.

1.5.4.4 DRM

Default Recording Mode (DRM) is a device mode to use Specim IQ with the default settings to record raw and reflectance data.

1.5.4.5 Data recording settings

A view in Specim IQ, where you can set the integration time, and adjust the parallax correction. This view can be reached by half pressing the shutter button.

1.5.4.6 Device UI

A tab in Application creator, where the user can choose the order and colors of the classes available in the Specim IQ.

1.5.5 E

1.5.5.1 Extended data view

A view to examine and research the recorded data in Specim IQ Studio.

1.5.6 G

1.5.6.1 GPS

Global positioning system.

1.5.7 H

1.5.7.1 Heat mask

A mask visualization method for SAM. Heat mask visualization shows the class in a color scale that visualizes the amount of correspondence to the reference spectrum. The color scale is from full correspondence to the threshold value.

1.5.8 I

1.5.8.1 Integration time

Relates to the period of time, that is used to collect light distribution, that is, the spectra along a single imaged line on Specim IQ.

1.5.8.2 Intensity histogram

Visible in the Specim IQ Quick data validation view. You can check the data quality from the histogram. The maximum and minimum values for each spectra of the image are shown in separate histograms, to show the dynamics used, possible saturation and low signal levels.

1.5.8.3 Intensity slider

A slider for adjusting the intensity threshold when selecting the white reference area in Specim IQ. Can be operated from the touch screen or by using the UP/DOWN buttons.

1.5.9 M

1.5.9.1 Model

Model is a non-editable executable that describes the algorithms and methods to extract information from spectra. It is exported from the model project and can be included to an application project(s).

1.5.9.2 Model project

Model project is a predefined workflow with a graphical user interface in Specim IQ Studio to create data processing models. The model project is used within Specim IQ Studio to define the model, and it can be saved for future changes and needs.

1.5.10 N

1.5.10.1 Navigation button

Physical navigation button in Specim IQ. Four directional navigation buttons are located around the SET/MENU button.

1.5.11 P

1.5.11.1 Pre-defined white reference

A white reference method for Specim IQ. This is a preset white reference that can be used to make estimated reflectance conversion for the data in cases when using white reference panel is not possible.

1.5.11.2 Preprocessing

Data preprocessing is a step in data processing that is used to enhance the spatial or spectral features of the data, and thus improve the classification results. In Specim IQ, there is a preprocessing possibility for smoothing the spectra.

1.5.11.3 Profile

A profile contains the device settings and a list of installed applications. When you import a new profile to Specim IQ, the device settings will be overwritten, and the applications listed on the profile will be installed onto the device.

1.5.12 Q

1.5.12.1 Quick data validation

A view in Specim IQ, where the recorded data is visualized alongside intensity histograms. In this view, you can validate and check the data quality.

1.5.13 R

1.5.13.1 RGB

Red, Green and Blue.

1.5.13.2 Reference spectrum

To create classes in the identification model creator, you have to select a reference spectrum from the imaged data or spectral library. You can also save references to a spectral library.

1.5.13.3 Reflectance transformation

A calculation where the white and dark reference are used to convert the raw data measured with Specim IQ to reflectance.

1.5.14 S

1.5.14.1 SAM

The Spectral Angle Mapper Classification (SAM) is an unautomated classification method for directly comparing image spectra (test spectra) to a previously known spectra (reference spectra). Reference

spectra can be first measured in the laboratory, in the field or it can be a library spectra. This method treats both the questioned test spectra and reference spectra as vectors and calculates the angle between them. The result of the SAM classification is an image showing the best match between test spectra and reference spectra at each pixel.

This method is insensitive to illumination because the SAM algorithm uses only the vector direction and not the vector length. One assumption made with SAM is the supposition that all the image pixels represent the pure spectra of a reference material. This is not always the case especially in boundary regions where spectra may be the sum of two different materials.

The threshold value for creating a class mask in Specim IQ Studio is the threshold value for the Spectral Angle Mapper (SAM) method that defines whether the measured spectra belong to the same class as the reference spectrum. In IQ Studio, this value (angle) is not converted to radians.

In SAM calculation, the angular difference between the reference spectrum and measured spectrum is calculated. The angle is multidimensional, as the calculation is performed for all spectral bands. The formula for the angular difference calculation is:

$$\theta(\chi, \gamma) = \cos^{-1} \left(\frac{\sum_{i=1}^n \chi_i \gamma_i}{\left(\sum_{i=1}^n \chi_i^2 \right)^{\frac{1}{2}} * \left(\sum_{i=1}^n \gamma_i^2 \right)^{\frac{1}{2}}} \right)$$

where

- χ is the measured spectrum
- γ is the reference spectrum, and
- n is the number of spectral bands.



Tip:

To view the formula in a larger format, right-click the formula, and select **Math Settings > Zoom Trigger > Hover**, and take your mouse over the formula.

To adjust the formula window size, select **Math Settings > Zoom Factor**, and select the desired zoom factor.

If you use several references, it is usual to establish that the reference spectrum with the smallest angle is the class that the measured spectrum belongs to.

If you want to limit the size of the class, you can give a threshold value to the results. This value indicates how big the angle can be, and still have the measured pixel counted as belonging to the same class as the reference pixel.

The formula above gives the value in radians. If you use SAM in, for example, ENVI or other processing software, the threshold value is usually given in radians, for example Threshold = 0.1.

In IQ Studio, the threshold is calculated without the preceding cos-1-, giving the formula:

$$\theta(\chi, \gamma) = \left(\frac{\sum_{i=1}^n \chi_i \gamma_i}{\left(\sum_{i=1}^n \chi_i^2 \right)^{\frac{1}{2}} * \left(\sum_{i=1}^n \gamma_i^2 \right)^{\frac{1}{2}}} \right)$$

The reason for this is that, besides converting the angles to radians, the cos-1 slows down the calculation. Without the cos-1, the result will be a value between 0 and 1 that has no unit, and where 1 fully matches the reference spectrum and 0 can be basically any spectrum. In practice, we only need to use values between 0.95 and 1, to achieve sufficient precision in SAM calculation.

Now, as we do not perform the conversion to radians, we will give the threshold value directly in the form we get it from the latter equation above. We simply indicate an angle, such as 0.9676, and tell that all spectra between that value and 1 still belong to the same class, denoted by the reference spectrum.

1.5.14.2 SET button

A physical selection button in the Specim IQ. Located in the middle of the navigation buttons.

1.5.14.3 Simultaneous white reference

A white reference method for Specim IQ, where the white reference panel is measured together with the target, and the white reference is defined from the recorded data.

1.5.14.4 Spectral library

Spectral library is a collection of reflectance spectra from different materials. It contains the name of the material and the specific references spectra. The spectrum for a specific material from a spectral library can be used to create an identification model for this material.

1.5.15 T

1.5.15.1 Tag

Tags are short text labels describing the images. There are two types of tags:

- Global tags are specific to the whole image
- Material tags are specific to a certain spatial position

1.5.15.2 Test run

The last tab in the model creator and application creator. In the **Test run** view, you can test the created model or application settings with full testing datasets, and evaluate the effects of the made choices.

1.5.15.3 Thumbnail

A small preview image of the dataset for quick and informative data search.

1.5.15.4 Timelapse

A data recording option in Specim IQ. You can define the number of occurrences and the interval between data recording.

1.5.16 V

1.5.16.1 Viewfinder

The main view of Specim IQ. Opens when the device is switched on.

1.5.17 W

1.5.17.1 White reference

Information about the used illumination and Specim IQ transmission. Needed for reflectance transformation and collected from either recorded data or an internal library.

1.5.17.2 White reference panel

The white reference panel material has 100% reflectivity in the wavelength range of Specim IQ. The panel must be measured when using the Custom or Simultaneous white reference mode. The measured signal from the white reference panel is the white reference that is used in reflectance transformation to correct the measurements between different measurement conditions and make the data recording comparable with each other.

2 Specim IQ User Manual

Specim IQ and instructions for using it.

2.1 Camera Parts

This section lists the camera parts.

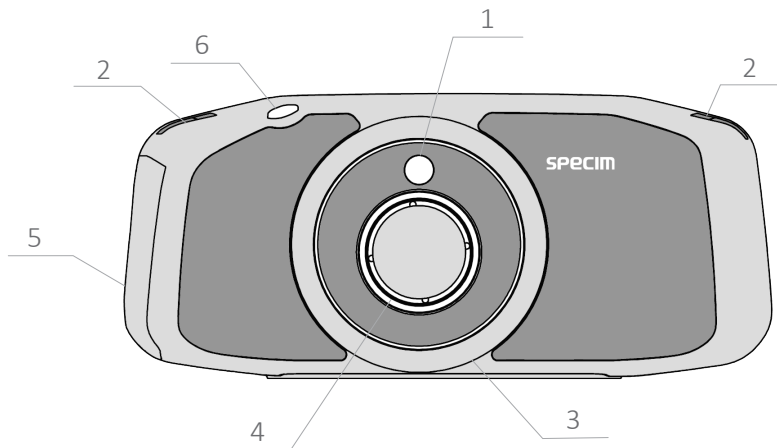


Figure 12: Specim IQ Seen from Front

The parts are:

1. Viewfinder camera
2. Strap mount
3. Focus ring
4. Spectral camera lens
5. Battery chamber
6. Shutter button

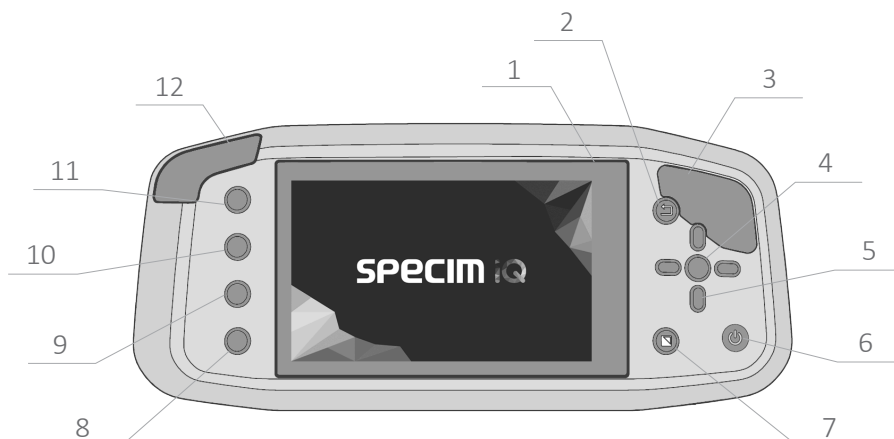


Figure 13: Specim IQ Seen from Back

The parts are:

1. Touch screen

2. Back button
3. Grip
4. SET button
5. Navigation button
6. Power button
7. White reference mode button
8. Custom 4 button
9. Custom 3 button
10. Custom 2 button
11. Custom 1 button
12. USB cover

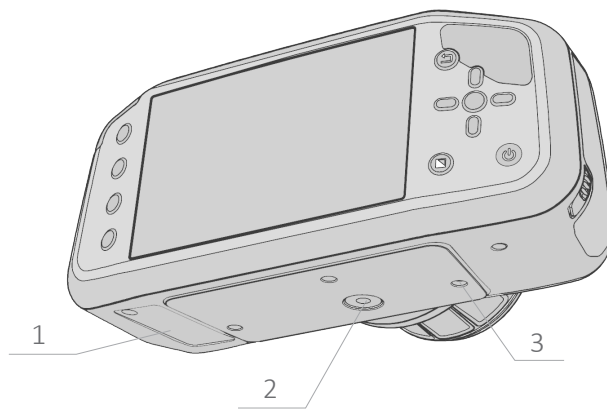


Figure 14: Specim IQ Seen from Below

The parts are:

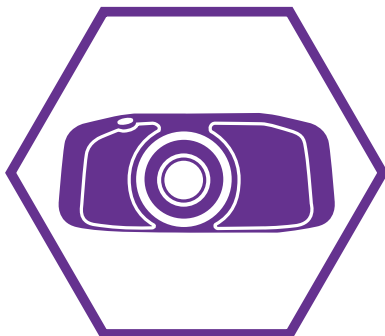
1. Type plate
2. Standard camera thread
3. Position pin holes

2.2 Sales Box Content

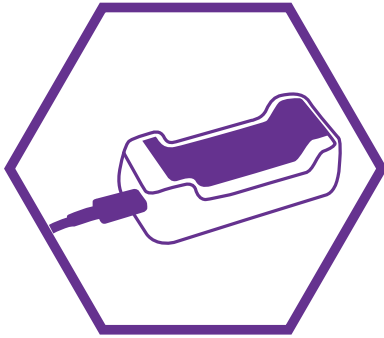
This section lists the Specim IQ sales box content.

The Specim IQ sales box contains items as follows:

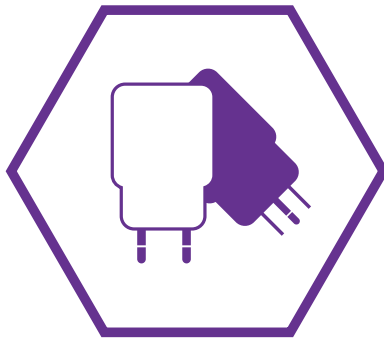
- Device with front lens cap



- Size: 91 mm x 207 mm x 125,5 mm
- Display protective foil
- Battery charger with charger cable KEEPOWER



- Size: 92 mm x 60 mm x 60 mm
- Cable with USB-A, 500 mA
- Charger wall plug 2,0A



- Variants: EU, US, CHINA, AUSTRALIA, UK
- Data cable USB cable type C - USB type A (device – Specim IQ Studio)



- 500 mA cable, length 1 m
- Battery

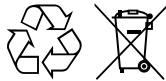


- Size: 70 mm x 27 mm (diameter)
- Type 26650



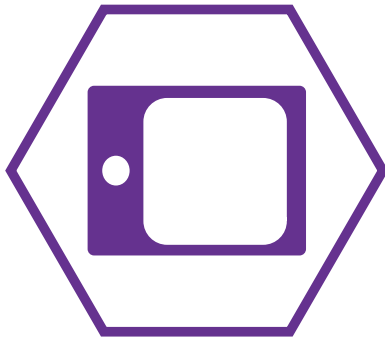
Warning:

**RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE.
DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS:**



Product Description

1. Please charge this battery with a quality li-ion battery charger before first use.
 2. Do not keep or use this battery in high temperature or humid environment. The operating temperatures are:
 - Charge: 0°C—+45°C
 - Discharge: -10°C—+60°C
 - Storage Temperature: -20°C—+60°C
 3. Do not use the battery if there is weeping, bulging or any other problem.
 4. Do not throw the battery into fire or water, as it may burst into fire or explode.
 5. Do not crush, hit or impact the battery.
 6. Do not disassemble the battery.
 7. Keep the battery out of reach of children.
 8. The battery will be hot when it works; remove it carefully after use.
 9. If the battery has not been used for a long time (for example, over three months), charge it before using it again.
 10. If the electrolyte gets into your eyes, immediately flush them out with water, and seek medical treatment.
- White reference panel

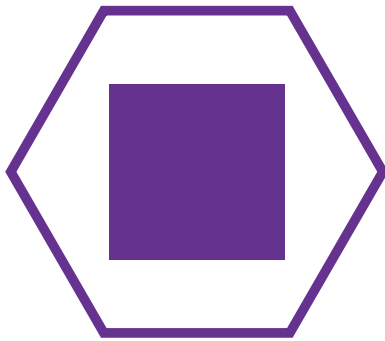


- Square panel, the size of the white reference area is 100 mm x 100 mm
- Thickness 5 mm + 5 mm envelope
- Calibration check tile

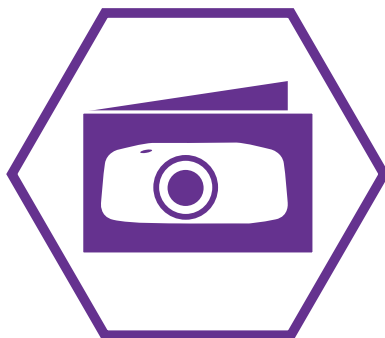


Note:

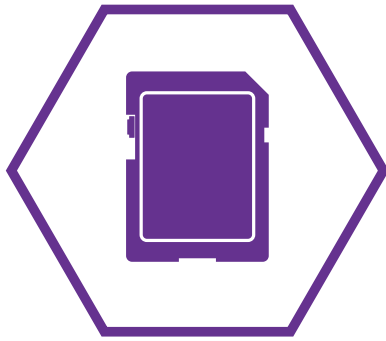
Specim IQ is paired up with the calibration tile provided in the same sales box. Do not lose this tile!



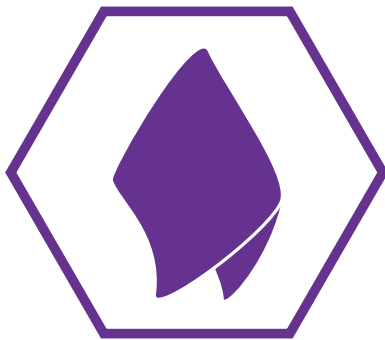
- Size: 10 cm x 10 cm x 0,5 cm
- Two Specim IQ booklets, Quick guide, Warranty conditions



- Memory card



- SanDisk Ultra 8 GB, SDHC Class 10, 40 MB/s
- Display/lens cleaning cloth



- Size (folded): 120 mm x 120 mm x 10 mm

2.3 Getting Started

This chapter describes the preparatory steps before you start recording data with Specim IQ.

2.3.1 Powering ON and Powering OFF

This section describes how to power ON/OFF Specim IQ.

Before powering ON, ensure that you have a write-enabled memory card in the camera.

Proceed as follows:

To power ON:

1. Press the power button for 2—3 seconds to switch the Specim IQ on.

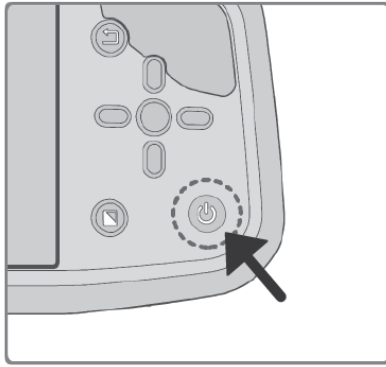


Figure 15: Power Button

2. Release the power button when you hear a beep.

Specim IQ is powered ON.

3. Optional: If you power on for the first time, or after a firmware update, you must read and accept the Terms and conditions of use.

Read the entire agreement. The screen below is opened:

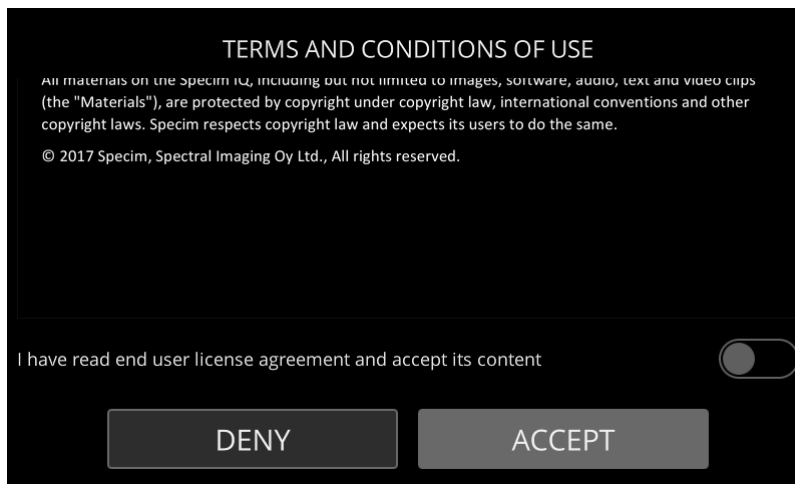


Figure 16: Terms and Conditions of Use

4. Optional: Slide the **I have read end-user license agreement and accept its content** slider to the ON position.

The screen below is opened:

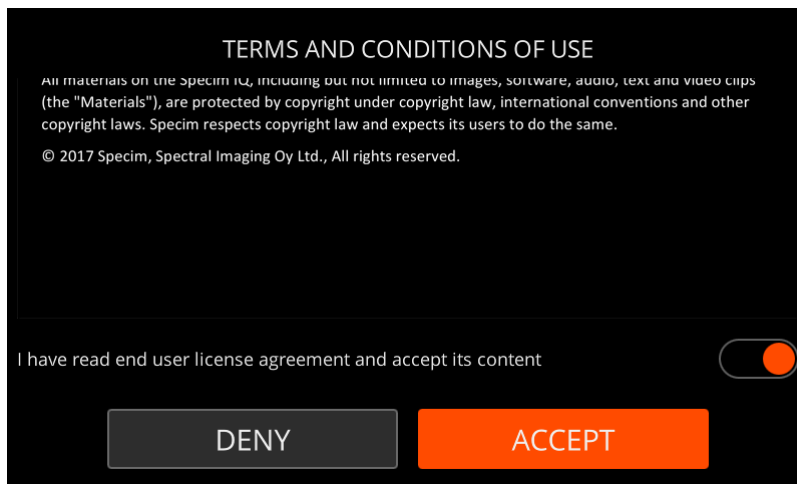


Figure 17: Accepting the Terms and Conditions of Use

5. Optional: Select:

- **ACCEPT** to accept the license terms, and continue.
- **DENY** to shut down the device.

You must accept the terms and conditions of use, to use the camera.

To power OFF:

6. Press the power button for at least five seconds.

The screen below is opened:

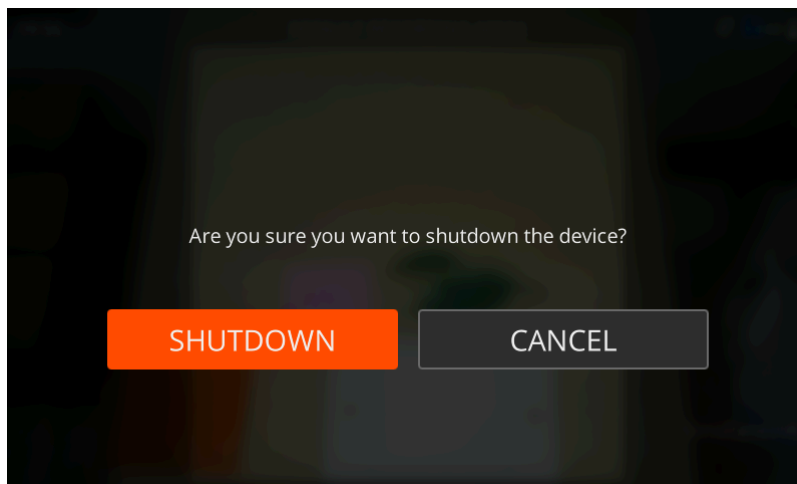


Figure 18: Shutdown

Select either:

- **SHUTDOWN** to switch Specim IQ off.
- **CANCEL** to return to the previous screen.

2.3.2 Charging the Battery

This section describes how to charge the Specim IQ battery.

The battery icon on the viewfinder indicates the remaining battery charge. See [Viewfinder](#).

The camera also warns you on low battery level:



Figure 19: Battery Low



Note:

You cannot recharge the battery directly through the camera.

Proceed as follows:

1. Open the battery compartment door by sliding the lock downward.

The door will spring open.

2. Remove the battery from the battery compartment.
 - a) Use the battery removal tab to pull out the battery.

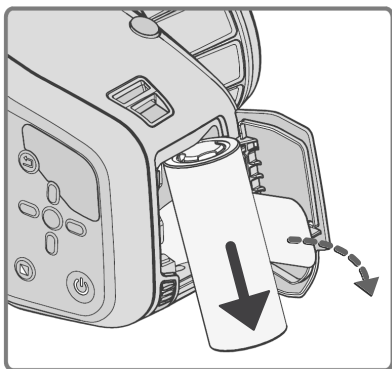


Figure 20: Remove the Battery

- b) Slide the battery downward out of its place.
 3. Insert the charger mains cable into a mains socket.
 4. Place the battery to the battery slot on the charger.
- See the charger manual.
5. Switch the charger to 1000 mA charging current, by pressing the charger button.
 6. Recharging starts automatically.

At room temperature (23°C / 73°F), it takes approximately one day to fully recharge a completely exhausted battery. The time required to recharge the battery depends on the ambient temperature and charge level of the battery.

7. After recharging, detach the cable from the main socket.
8. Insert the battery to the battery compartment.

Slide the battery upward until it locks in place.

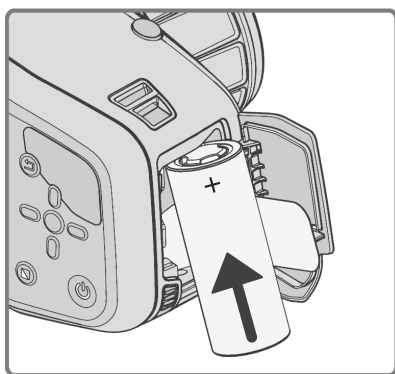


Figure 21: Insert the Battery

9. Close the battery compartment door.

2.3.3 Viewfinder

This section describes the icons on the viewfinder.

The viewfinder icons are:

Table 1: Viewfinder Icons

Icon	Description
	GPS is on, and it has found a satellite.
	GPS is on, but it has not found a satellite yet. The image blinks.
	GPS is off.
	This animation indicates that the device is saving data onto the memory card.
	The number next to the SD card icon indicates the number of images you can take, until the memory card is full.
	This icon indicates the device battery level. In the figure, the battery is full.
	This icon indicates the device battery level. In the figure, the battery level is low.

2.3.4 Using Memory Cards

This section contains tips on using memory cards with Specim IQ.

Use up to 32 GB SDHC memory cards of class 10, 40 MB/s, or better.

Do not remove the memory card from the device if the device is connected to the PC.

Do not remove the memory card from the device while recording data. If you do, the screen below is opened, and you must power OFF and power ON the device, before recording data.

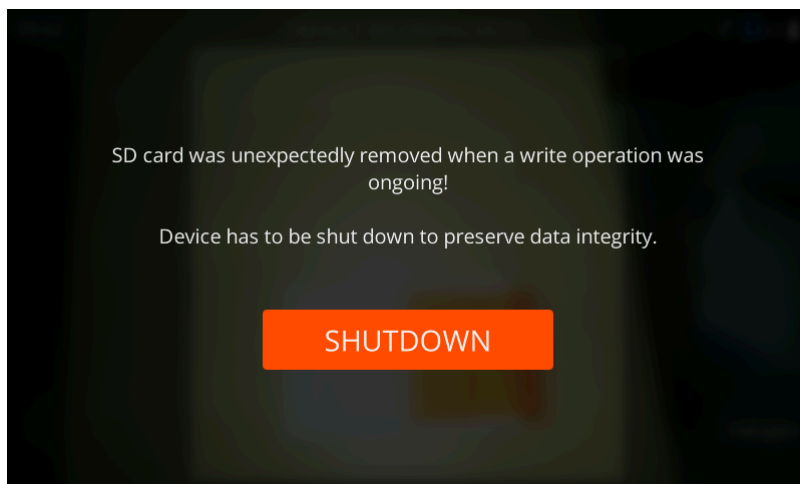


Figure 22: SD Card Removed while Recording Data

When you have copied the recorded data to the Specim IQ Studio software, empty the card by formatting it on the Specim IQ device.

If, for example, data recording is interrupted, Specim IQ writes a `.lock` file on the memory card. You can safely ignore these files.



Important:

If you swap memory cards when the device is in the sleep mode, power OFF and power ON the device, before recording data.

Related Tasks

[Formatting the Memory Card](#)

This section describes how to format the memory card.

2.3.4.1 Inserting and Ejecting the Memory Card

This section describes how to insert and eject the Specim IQ memory card.

Proceed as follows:

To insert the memory card:

1. Open the battery compartment lock by sliding the lock downward.

The lock will spring open.

2. Slide the memory card in as shown until it clicks into place.

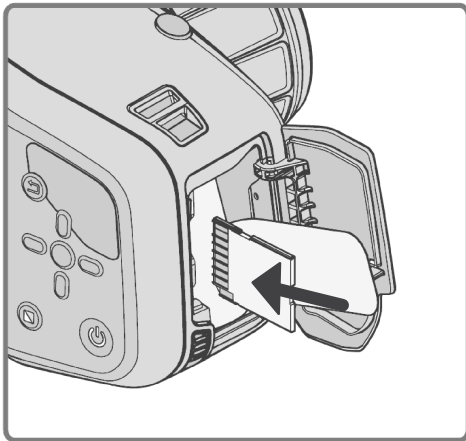


Figure 23: Inserting the Memory Card

To eject the memory card::

3. Open the battery compartment lock by sliding the lock downward.

The lock will spring open.

4. Push the memory card to release its lock.

The memory card will spring out.

5. Slide the memory card out as shown.

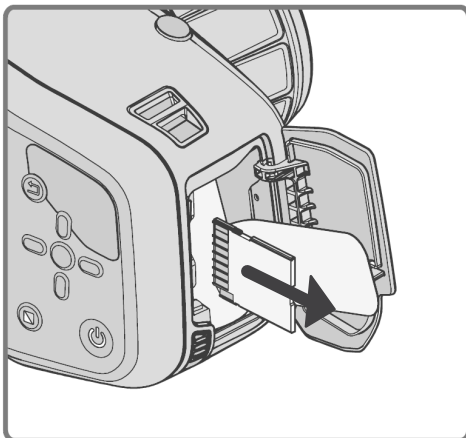


Figure 24: Ejecting the Memory Card

2.3.5 Connecting Specim IQ to Your Computer

This section describes how to connect Specim IQ to your computer.

Proceed as follows:

1. Open the USB cover from its upper left corner.

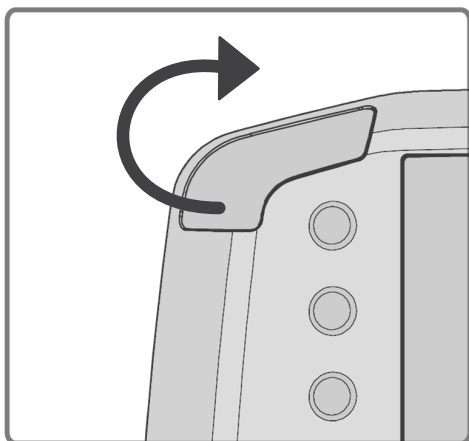


Figure 25: Opening the USB Cover

2. Attach the white USB cable, and connect it to your PC.

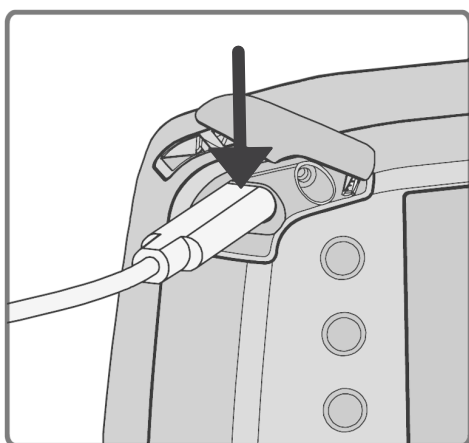


Figure 26: Attaching the USB Cable

3. Make sure Specim IQ is powered on.
4. Open *Specim IQ Studio* and select **DEVICE**.

2.3.6 Selecting the White Reference Method

This section describes how to select the white reference method for scanning on Specim IQ.

There are three white reference methods on Specim IQ.

- **Custom** — A white reference method for Specim IQ, where the white reference is recorded and saved to IQ before the actual data recording(s). This option is best suited in stable lighting conditions. It is recommended, for example, in a situation where the target is dark and gives a poor signal with normal exposure time. You can record the white reference with normal exposure time to avoid over-exposure, store it, and then increase the exposure time to improve the signal level. See [Using the Custom White Reference Mode](#).
- **Simultaneous** — Simultaneous white reference means that you include the white reference panel to every scan you take. This option should be used if lighting environment changes between recordings. For more information on using the simultaneous white reference method as a part of the default recording mode, see [Default Recording Mode](#).
- **Pre-defined** — The camera is also equipped with a pre-defined white reference mode, which can be selected if the measurement situation is such that, for some reason, the white reference panel cannot be positioned to the image area. Pre-defined white reference contains reference spectra of a standard halogen illumination stored in the device. Pre-defined white reference is suitable in use cases where

you want to make an estimated reflectance transformation and instantly get the results of the recorded data at the site. However, remember that due to the estimated white reference, the accuracy of the result is not high. Ensure that the actual light source is halogen when you choose the pre-defined reference mode.

The parameters for **Pre-defined** halogen white reference mode are:

- Integration time = 50 ms
- WL range 400-1000nm
- Illumination by Hedler Digi C Kit / C12
- Working distance 0,5 m

See [Using the Pre-defined White Reference Mode](#).



Note:

The recommended white reference modes to be used in Specim IQ are **Custom** and **Simultaneous** white reference modes. With these modes, the actual and exact illumination conditions can be measured and the reflectance transformation will be the most accurate.

2.3.6.1 Using the Custom White Reference Mode

This section describes how to use the custom white reference mode, on Specim IQ.

Proceed as follows:

1. Press the **SET** button to open the main menu.
2. Press the **Custom 1** button to select the default recording mode ([DRM](#)).
3. Press the **BACK** button  to return to the viewfinder.
4. Press the **WHITE REFERENCE** button  button to select the white reference method.
5. Select **Custom**.

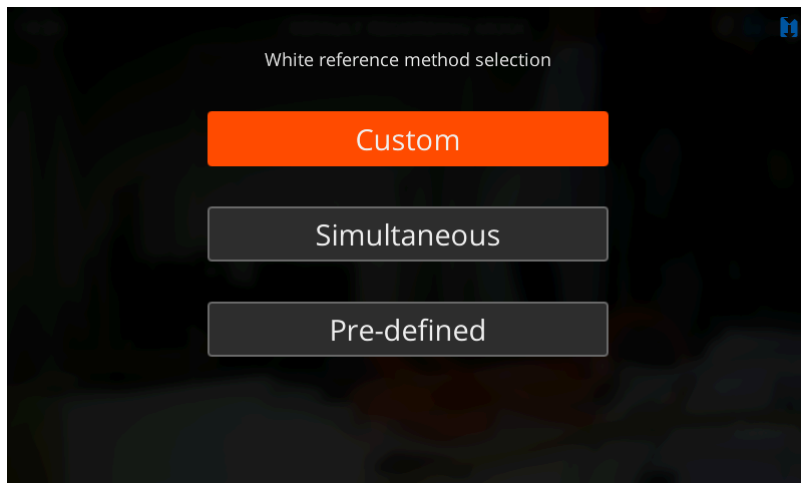


Figure 27: Selecting the White Reference Method

Specim IQ checks if there already is a white reference saved on the device.

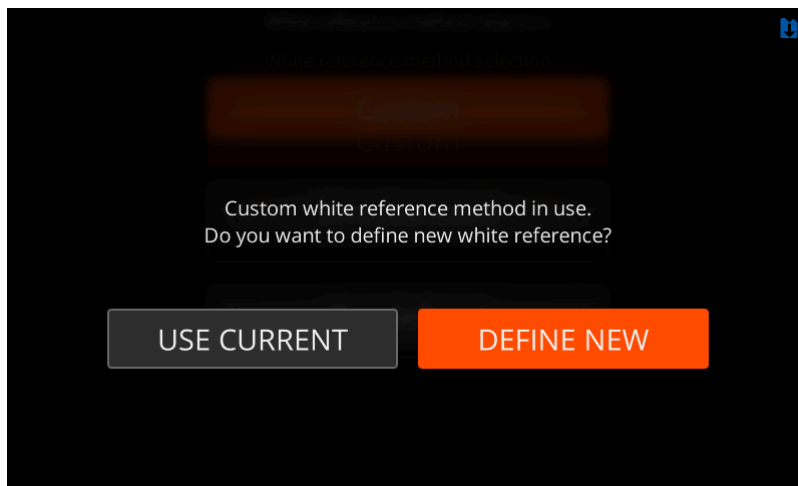


Figure 28: Defining a New White Reference

- If there is, Specim IQ gives you two options:
 - **Use current** — Use the saved white reference.
There can only be one white reference saved on Specim IQ.
 - **Define new** — Define a new white reference by carrying out the data recording flow, and pointing the WR panel area in a similar way as in the Simultaneous WR method. After this recording procedure, the custom WR has been defined, and the WR panel is no longer needed in the same data recording environment.
- If there is not, define a new white reference by using the simultaneous white reference method.

6. Select **Define**.

7. Place the white reference panel next to the target.

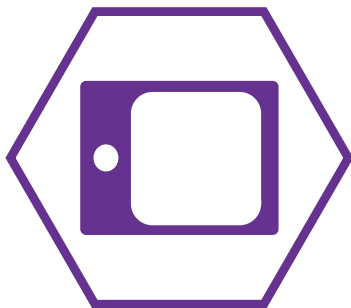


Figure 29: White Reference Panel

8. Press the **SHUTTER** button halfway.

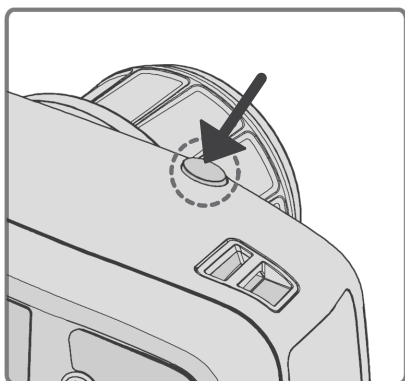


Figure 30: Shutter Button

9. Make the data recording settings.

See [Defining Data Recording Settings](#).

10. When done, press the **SHUTTER** button completely.

The camera starts the spectral camera, measures a dark frame, and begins scanning. A progress bar is shown on the screen.



Figure 31: Recording Data

11. Validate the recorded data.

The screen below is opened:

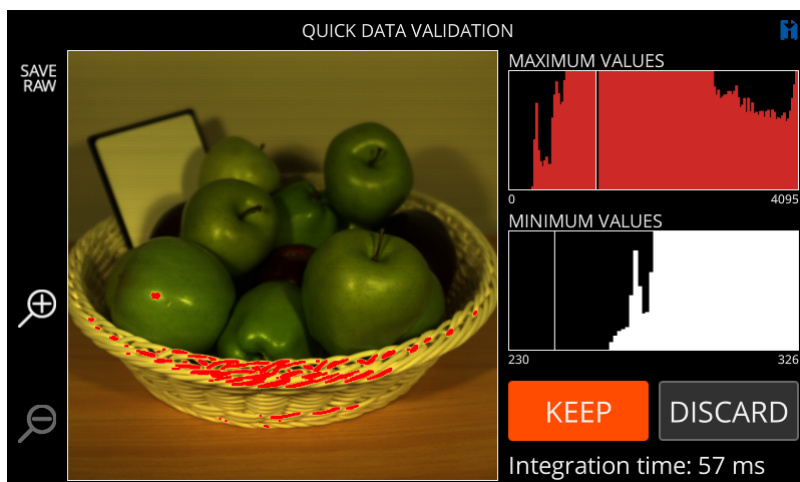


Figure 32: Quick Data Validation

For more information, see [Quick Data Validation](#).

Select either:

- **KEEP** — If you are satisfied with data quality, select **KEEP** to continue.
- **DISCARD** — If you are not satisfied with data quality, select **DISCARD** to return to viewfinder.

The system asks for your confirmation, before discarding the data.

- **Save RAW** — If you have enabled Allow RAW data saving in advanced settings, you can press the **Custom 1** button to save RAW data only, and return to viewfinder.

12. Select the white reference area.

See [Selecting the White Reference Area for DRM](#).

13. Select **SET** to carry out the reflectance transformation.

The screen below is opened:

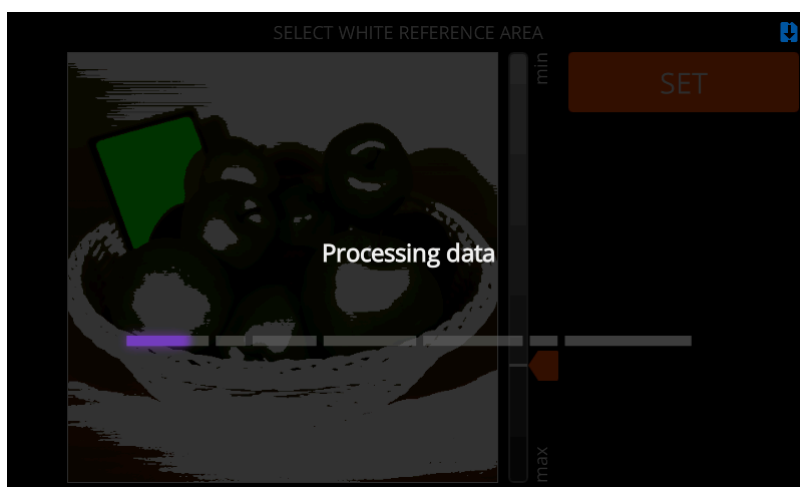


Figure 33: Processing Data

14. The custom white reference has now been successfully created.

The screen below is opened:

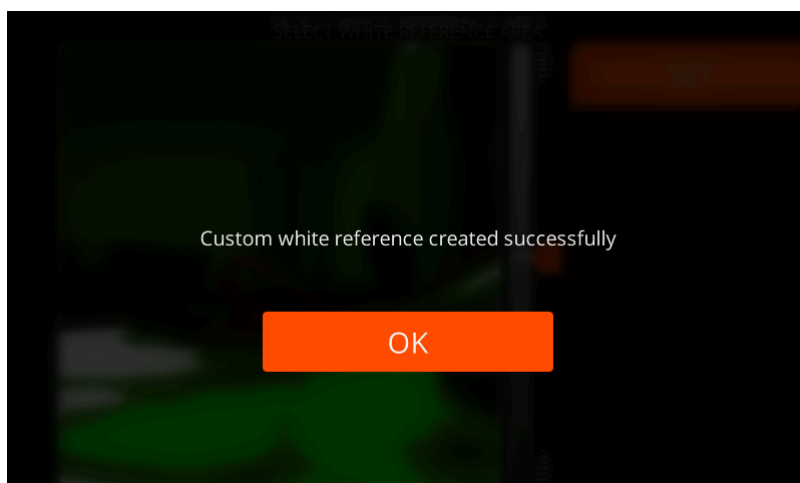


Figure 34: Custom White Reference Defined

Now, you can capture data under the same lighting conditions. The steps for data recording are identical to the simultaneous white reference mode, except that you do not have to:

- Place the white reference panel next to the target.

- Select the white reference area.

2.3.6.2 Using the Pre-defined White Reference Mode

This section describes how to use the custom whiter reference mode, on Specim IQ.

Proceed as follows:

1. Press the **SET** button to open the main menu.
2. Press the **Custom 1** button to select the default recording mode (*DRM*).
3. Press the **BACK** button  to return to the viewfinder.
4. Press the **WHITE REFERENCE** button  button to select the white reference method.
5. Select **Pre-defined**.

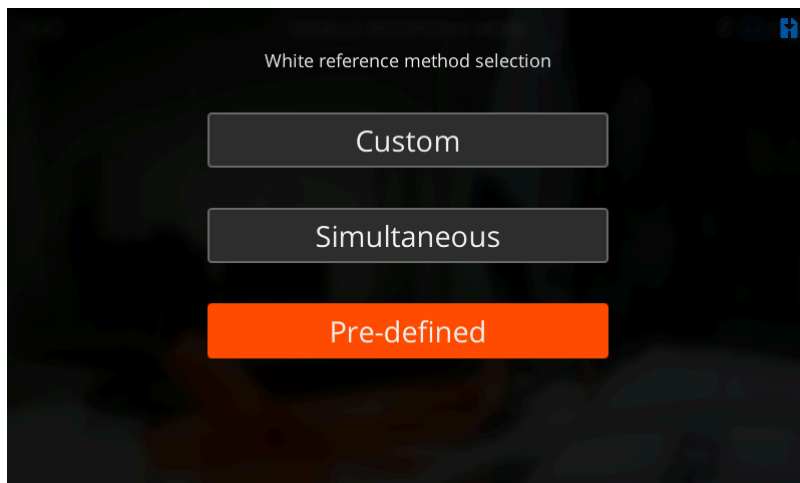


Figure 35: Selecting the White Reference Method

6. Select the pre-defined white reference method that you want to use.

This is a preset white reference that can be used to make estimated reflectance conversion for the data in cases when using white reference panel is not possible.

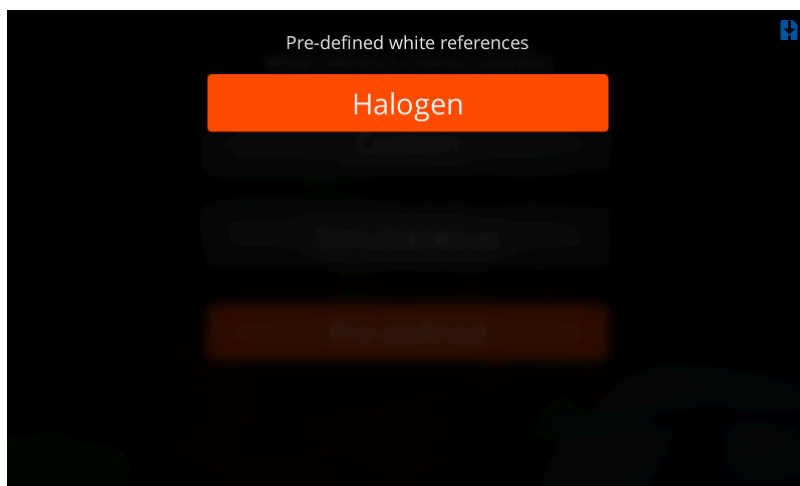


Figure 36: Selecting Halogen

7. Select, for example, **Halogen**.
8. Proceed with the data recording procedure.

The steps for data recording are identical to the simultaneous white reference mode, except that you do not have to:

- Place the white reference panel next to the target.

- Select the white reference area.

2.3.7 Taking Screenshots

This section describes how to take screenshots from the camera screen.

Proceed as follows:

1. Open the view from which you want to take the screenshot.
2. Simultaneously press the **Custom 1** button and the power button.

The screenshot is taken, and the resulting .png file is saved in the **SCREENSHOTS** folder on the SD Card.

2.4 Using the Catalog

This section contains instructions for using the **Catalog**.

The catalog is used to select and view recorded data on Specim IQ.

1. To open the **Catalog**, press the **SET** button, and select **Catalog**.

The latest recorded dataset is shown. For more information on this view, see [Catalog Main View](#).

2. Browse the images by sliding your finger from left to right or right to left, on the touch screen.

You can also use the navigation button left and navigation button right to browse images.

3. To select the image that you want to view, from a list, press the **Custom 4** button (⌂).

The screen below is opened:

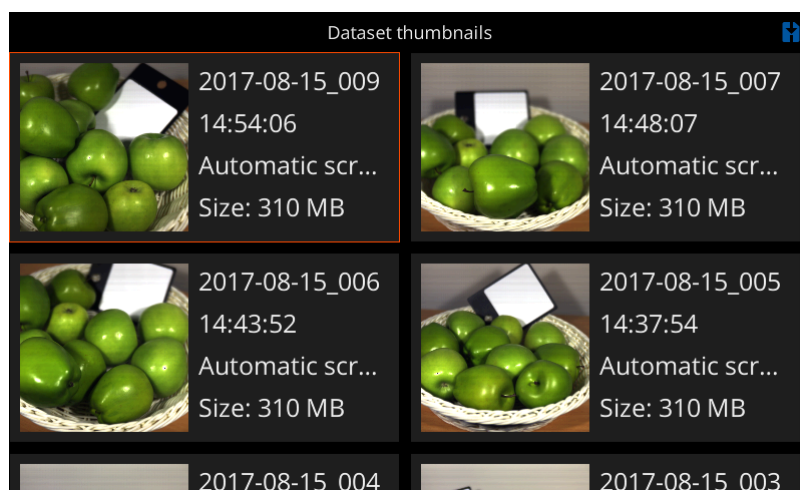


Figure 37: Dataset Thumbnails

4. Select the dataset to view it in the full-screen mode.

2.5 Recording Data

This chapter describes how to record data on Specim IQ.

2.5.1 Default Recording Mode

This section describes how to use the default recording mode with the simultaneous white reference method, on Specim IQ.

In the default recording mode, the raw data from camera is recorded and saved to a dataset with separate reference data. In addition, the reflectance transformation is also applied to the data, and the reflectance datacube is saved separately.

Proceed as follows:

1. Press the **SET** button to open the main menu.
2. Press the **Custom 1** button to select the default recording mode (*DRM*).
3. Press the **BACK** button  to return to the viewfinder.
4. Press the **WHITE REFERENCE** button  button to select the white reference method.
5. Select **Simultaneous**.

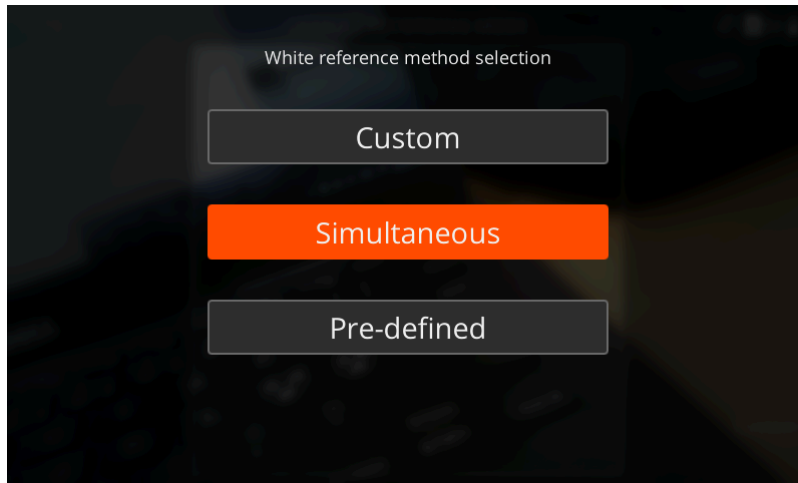


Figure 38: Selecting the White Reference Method

6. Place the white reference panel next to the target.

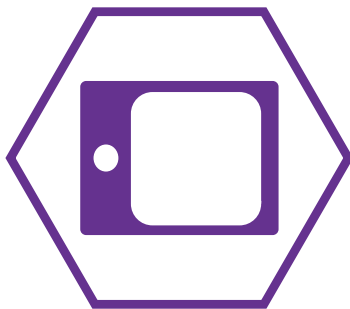


Figure 39: White Reference Panel

7. Press the **SHUTTER** button halfway.

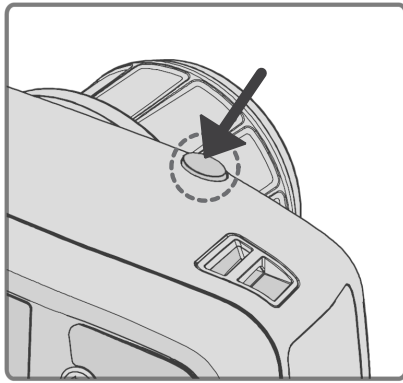


Figure 40: Shutter Button

8. Make the data recording settings.

See [Defining Data Recording Settings](#).

9. When done, press the **SHUTTER** button completely.

The camera starts the spectral camera, measures a dark frame, and begins scanning. A progress bar is shown on the screen.



Figure 41: Recording Data

10. Validate the recorded data.

The screen below is opened:

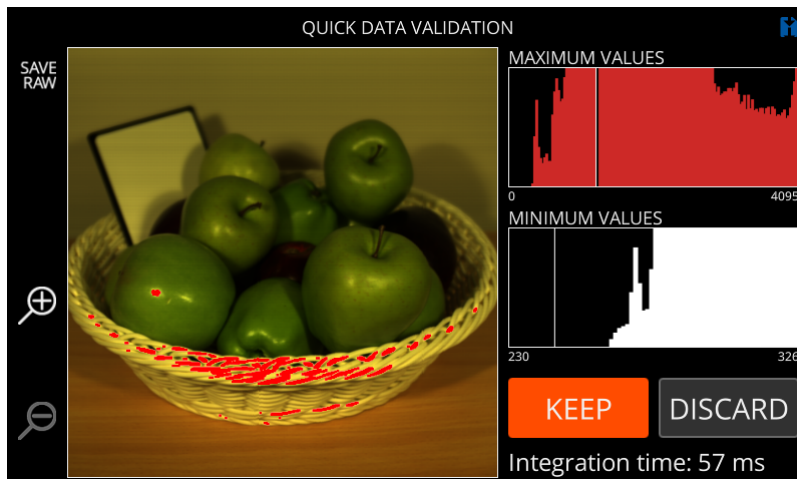


Figure 42: Quick Data Validation

For more information, see [Quick Data Validation](#).

Select either:

- **KEEP** — If you are satisfied with data quality, select **KEEP** to continue.
- **DISCARD** — If you are not satisfied with data quality, select **DISCARD** to return to viewfinder.

The system asks for your confirmation, before discarding the data.

- **Save RAW** — If you have enabled Allow RAW data saving in advanced settings, you can press the **Custom 1** button to save RAW data only, and return to viewfinder.

11. Select the white reference area.

See [Selecting the White Reference Area for DRM](#).

12. Select **SET** to carry out the reflectance transformation.

The screen below is opened:

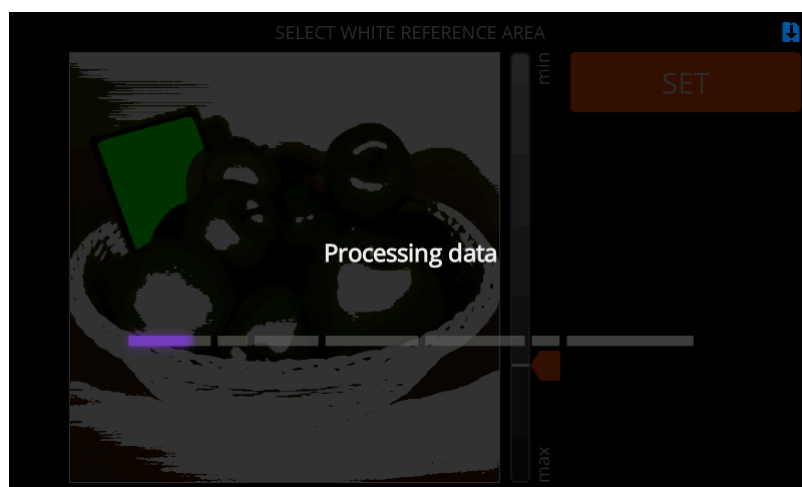


Figure 43: Processing Data

13. Finalize the image in the catalog main view.

The screen below is opened:

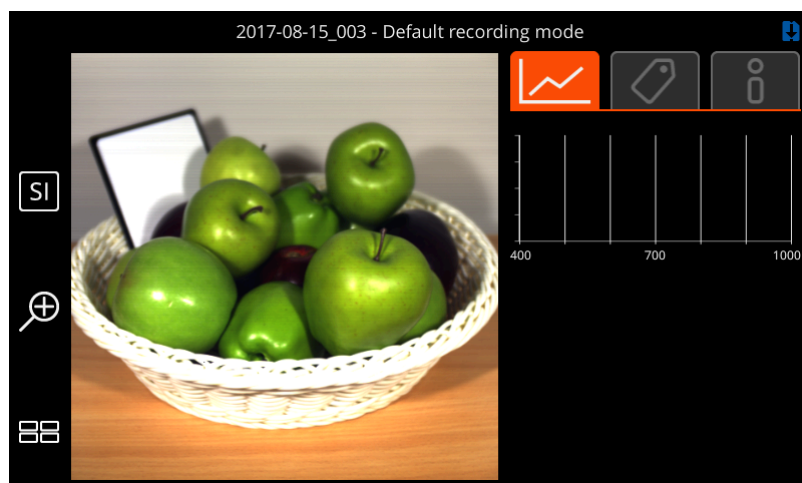


Figure 44: Catalog Main View

For more information, see [Catalog Main View](#).

2.5.2 Automatic Screening Mode

This section describes how to use the automatic screening mode with the simultaneous white reference method, on Specim IQ.

In the Automatic Screening Mode (*ASM*) you can create a single target identification application directly in the IQ device. To do this, you record the training data, based on which you create a single identification class. You can use this class to detect similar materials or compounds from the recordings that follow.

Proceed as follows:

1. Press the **WHITE REFERENCE** button  button to select the white reference method.
2. Select **Simultaneous**.

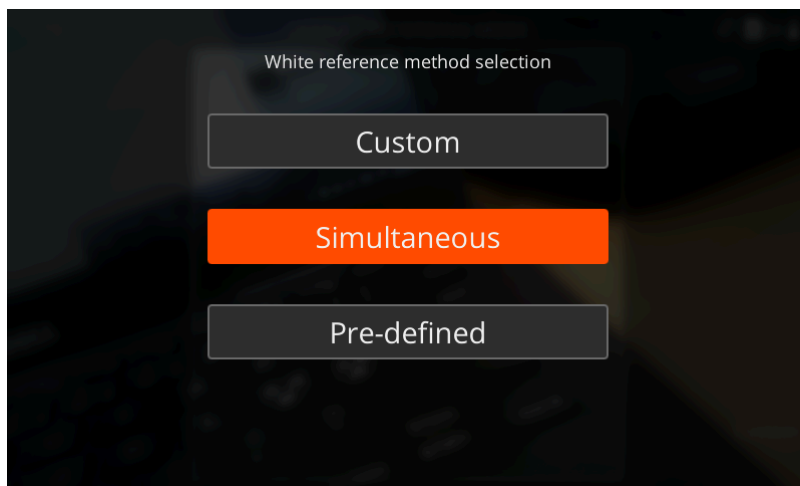


Figure 45: Selecting the White Reference Method

3. Press the **SET** button to open the main menu.
4. Press the **Custom 2** button to select the automatic screening mode (*ASM*).
5. Optional: If you use the device for the first time or, for example, after a factory reset, you do not have a target on the device.

The screen below is opened:

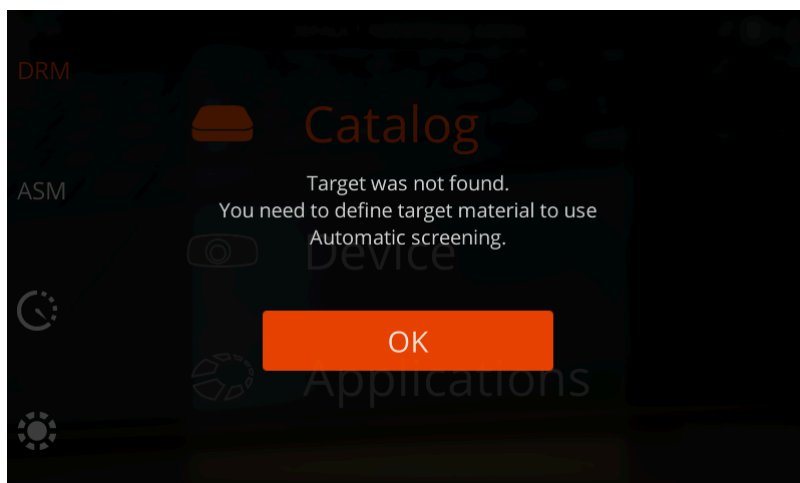


Figure 46: Target not Found



Note:

However, if the target is found, continue this procedure from step 8.

6. Select **OK**.

The screen below is opened:

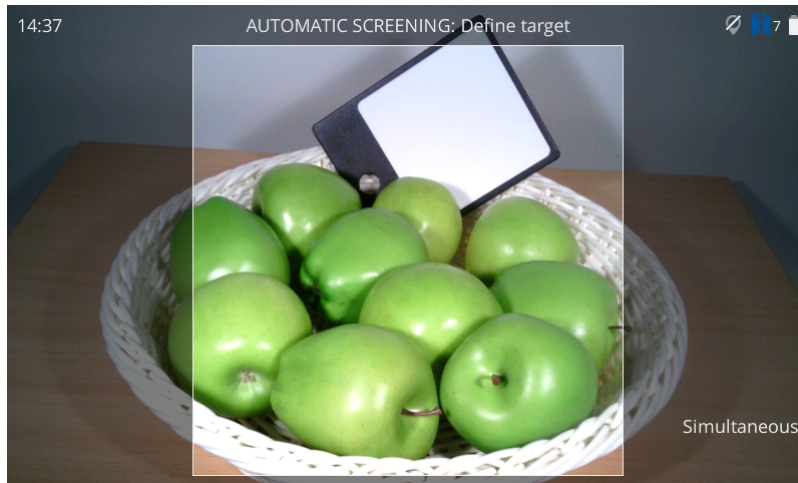


Figure 47: Define Target

7. Make the data recording settings.

See [Defining Data Recording Settings](#).

8. Select the white reference area.

See [Selecting the White Reference Area in ASM](#).

9. Create a target.

The mask refers to a color mask on the image, indicating the identified materials.

The screen below is opened:



Figure 48: Creating a Mask

- a) Use the touch screen to select a target from the image.

The screen below is opened:



Figure 49: Selecting a Target

b) Select **Create mask**.

The mask creation begins.

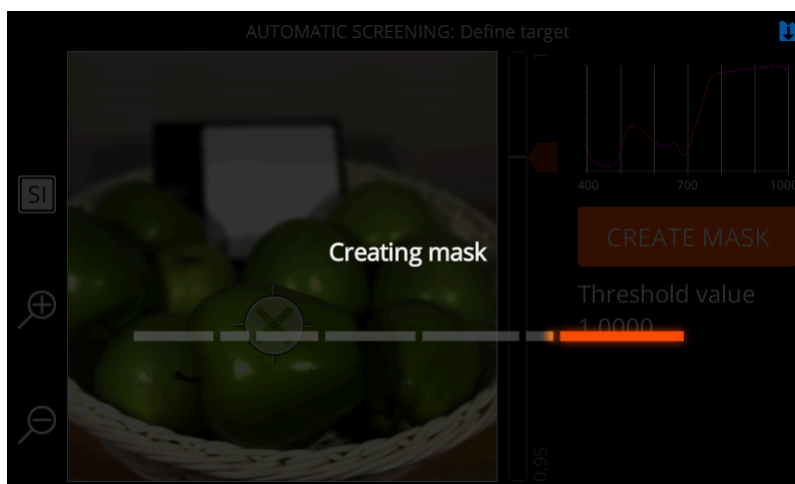


Figure 50: Creating a Mask

c) When the mask is done, it is shown on the screen.

The screen below is opened:

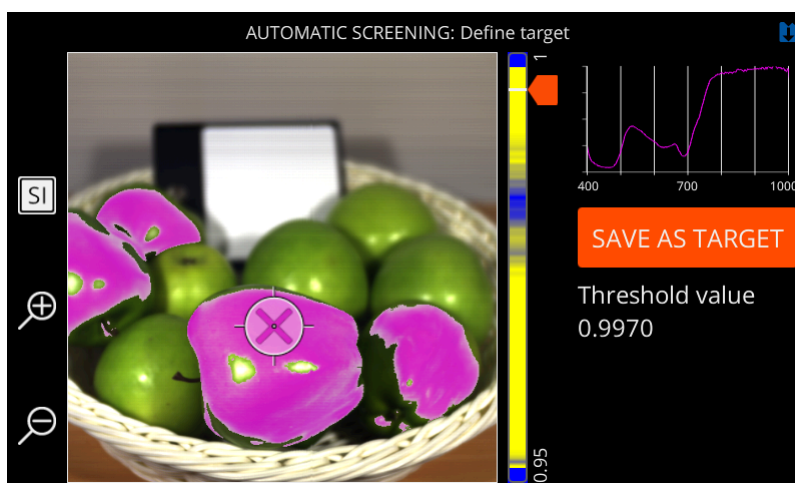


Figure 51: A Mask

d) Use the slider or **UP** and **DOWN** buttons to adjust the mask threshold.



Figure 52: Adjusting Mask Threshold

In short, **Threshold** defines the spectral range that will be visualized as the identified substance. Slide the slider and see the results on the full-size view, until you have overlaid the desired range, depicted with the selected **Class color**. See also the tip below.

From a more technical perspective, the **Threshold** slider range depicts the spectra from the entire image in such a way that, at the top, there are the spectra that most resemble the reference spectrum, and at the bottom there are the spectra that least resemble the reference spectrum. The spectra at the top of the slider are visualized in the full-size view.



Tip:

If you select a strict **Threshold**, that is, a value close to 1.0, you will get a class that indicates the correct areas of interest in the captured images, and hardly any false positive results. However, sometimes you also want to get false positive results. In this way, you can capture images that *possibly* contain the substance to be identified. If this is the case, use a less strict threshold value.

- e) Select **SAVE AS TARGET**.

The screen below is opened:

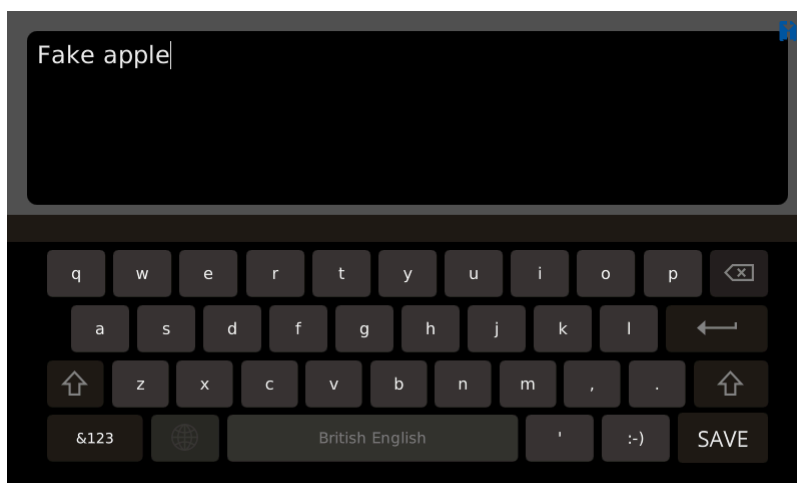


Figure 53: Naming the Target

- f) When done, select **SAVE**.

The screen below is opened:

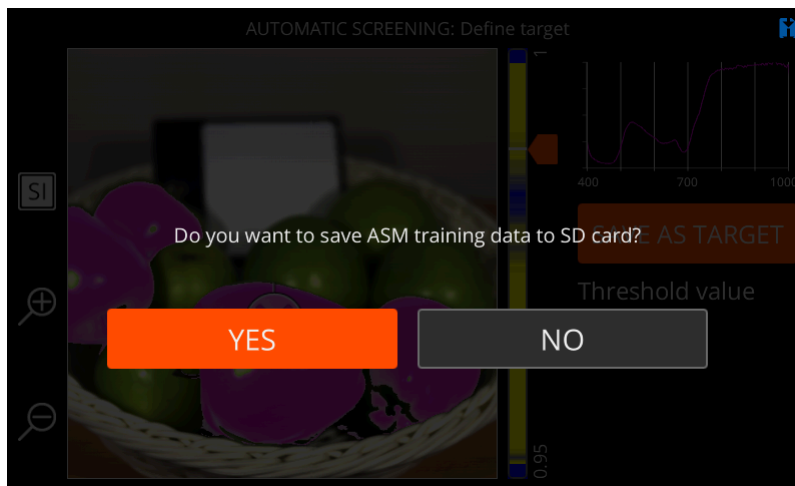


Figure 54: Saving the Target

g) Select **YES** to save the dataset on the SD card.

10. Press the **SHUTTER** button halfway.

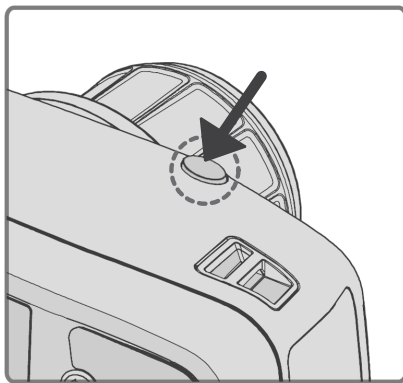


Figure 55: Shutter Button

11. Make the data recording settings.

See [Defining Data Recording Settings](#).

12. When done, press the **SHUTTER** button completely.

The camera starts the spectral camera, measures a dark frame, and begins scanning. A progress bar is shown on the screen.



Figure 56: Recording Data

13. Validate the recorded data.

The screen below is opened:

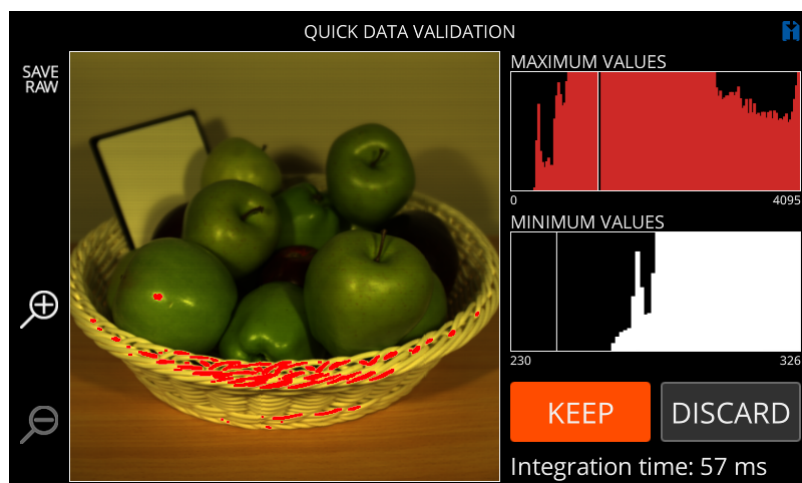


Figure 57: Quick Data Validation

For more information, see [Quick Data Validation](#).

Select either:

- **KEEP** — If you are satisfied with data quality, select **KEEP** to continue.
- **DISCARD** — If you are not satisfied with data quality, select **DISCARD** to return to viewfinder.

The system asks for your confirmation, before discarding the data.

- **Save RAW** — If you have enabled Allow RAW data saving in advanced settings, you can press the **Custom 1** button to save RAW data only, and return to viewfinder.

14. Select the white reference area.

See [Selecting the White Reference Area for DRM](#).

15. Select **SET** to carry out the reflectance transformation.

The screen below is opened:

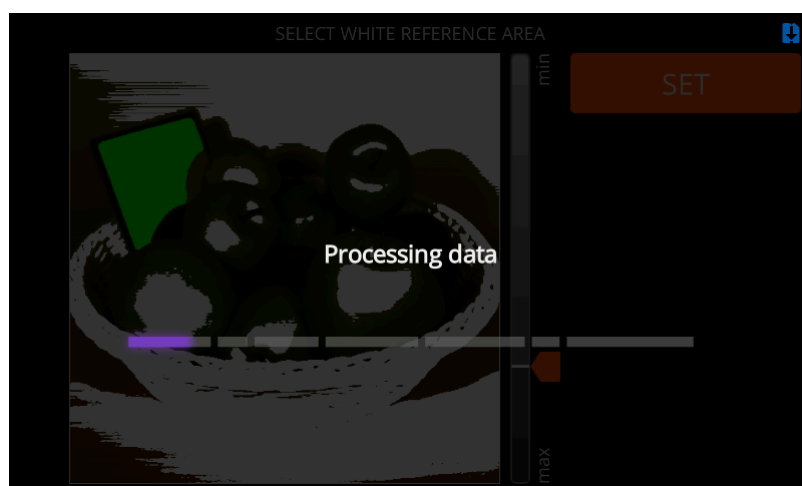


Figure 58: Processing Data

16. View the image in the catalog main view.

The screen below is opened:



Figure 59: Catalog Main View

For more information, see [Catalog Main View](#).

17. Select a spot from the touch screen to view its spectrum.

The screen below is opened:

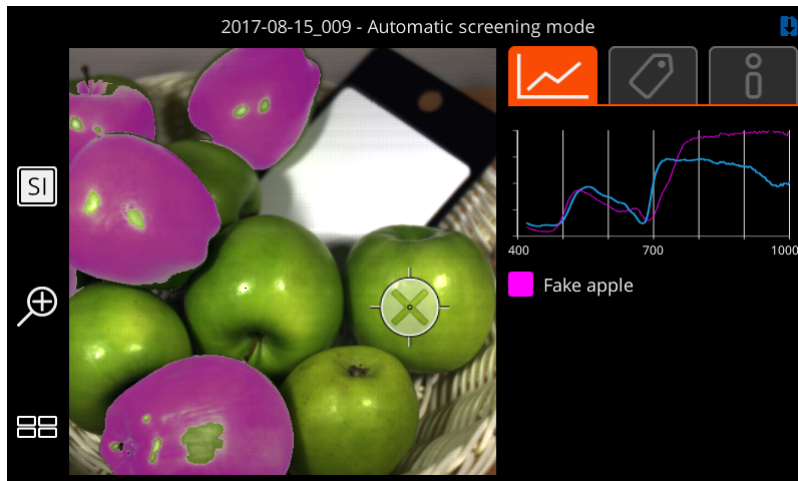


Figure 60: Screening



Tip:

Click the spectrum to see it in the full-screen mode.

18. Compare the spectra.

2.5.3 Application Mode

This section describes how to use the application mode with the simultaneous white reference method, on Specim IQ.

In the application mode, you collect data that is processed in the desired way.

Proceed as follows:

1. Press the **WHITE REFERENCE** button  button to select the white reference method.
2. Select your preferred white reference method.

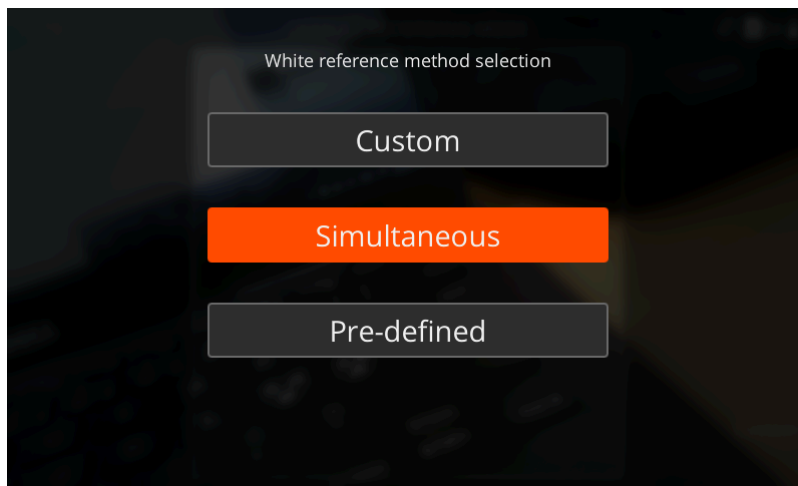


Figure 61: Selecting the White Reference Method

This example uses the Simultaneous white reference mode, but please note that any white reference mode can be used with application mode.

3. Select **Applications**.
4. Use the touch screen or the **UP**, **DOWN** and **SET** buttons to select the application.

The system asks for your confirmation.

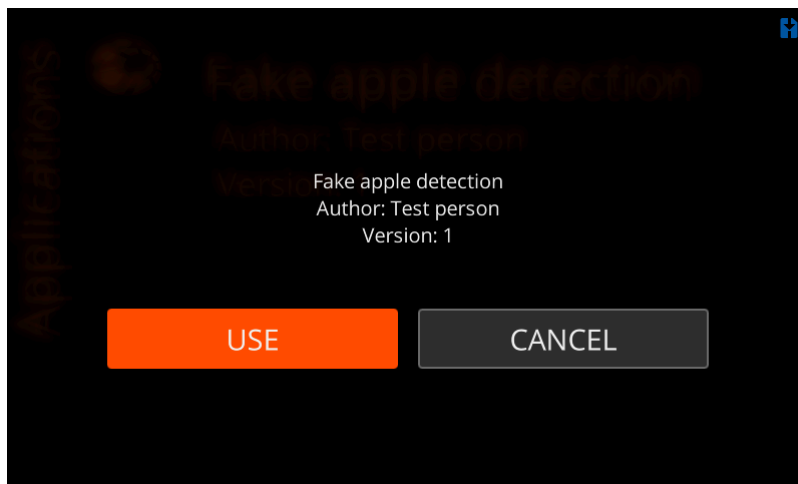


Figure 62: Selecting the Application

Select either:

- **USE** to use the selected application.
 - **CANCEL** to return to the main menu.
5. Press the **SHUTTER** button halfway.

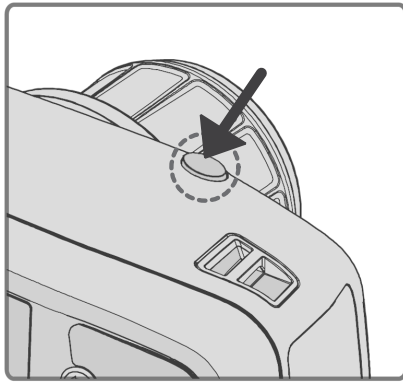


Figure 63: Shutter Button

6. Make the data recording settings.

See [Defining Data Recording Settings](#).

7. When done, press the **SHUTTER** button completely.

The camera starts the spectral camera, measures a dark frame, and begins scanning. A progress bar is shown on the screen.



Figure 64: Recording Data

8. Validate the recorded data.

The screen below is opened:

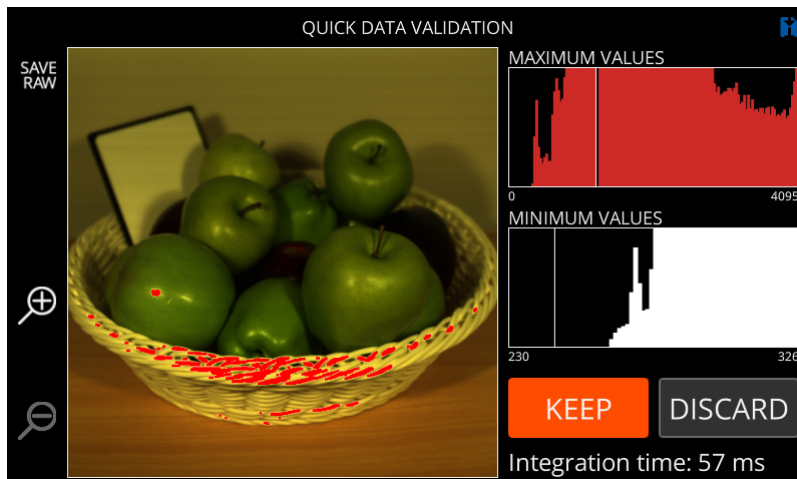


Figure 65: Quick Data Validation

For more information, see [Quick Data Validation](#).

Select either:

- **KEEP** — If you are satisfied with data quality, select **KEEP** to continue.
- **DISCARD** — If you are not satisfied with data quality, select **DISCARD** to return to viewfinder.

The system asks for your confirmation, before discarding the data.

- **Save RAW** — If you have enabled Allow RAW data saving in advanced settings, you can press the **Custom 1** button to save RAW data only, and return to viewfinder.

9. Select the white reference area.

See [Selecting the White Reference Area for AM](#).

10. Select **SET** to carry out the reflectance transformation.

The screen below is opened:

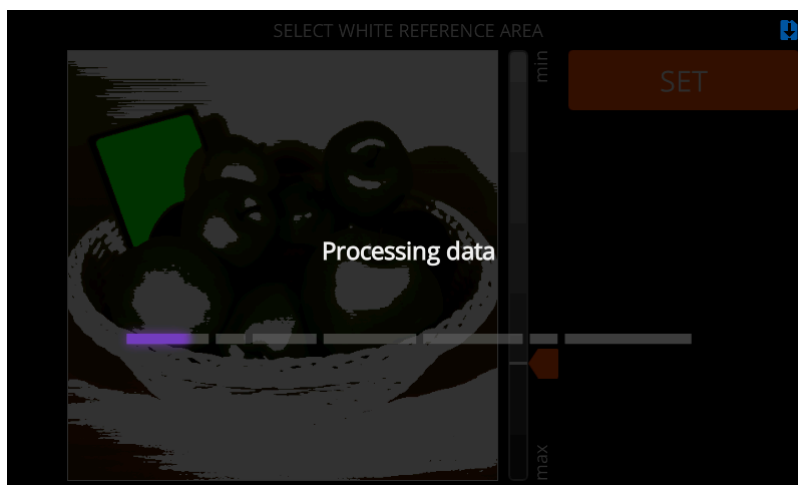


Figure 66: Processing Data

11. View the image in the catalog main view.

The screen below is opened:

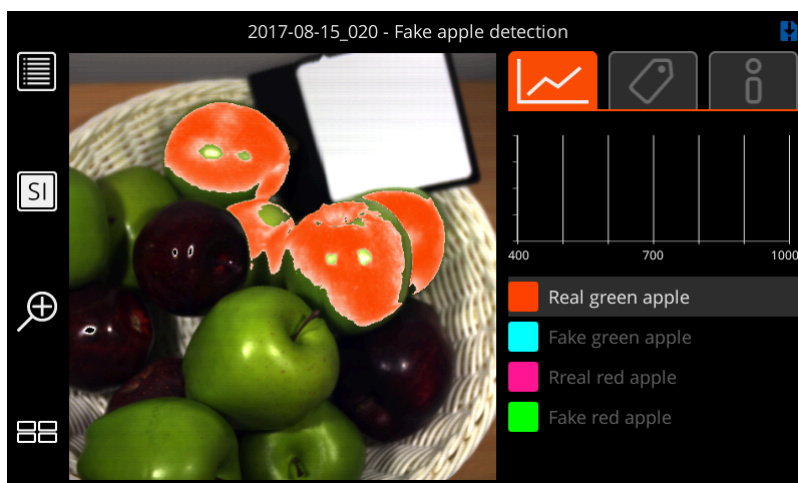


Figure 67: Catalog Main View

For more information, see [Catalog Main View](#).

 **Tip:**

In IQ Studio Application Creator, you can also create a class that displays all classes at the same time, such as in the figure below:



Figure 68: Display All Classes at the Same Time

Related Information

[Creating an Application Project](#)

This section describes how to create a new application project.

2.5.4 Defining Data Recording Settings

This section describes how to define the data recording settings when recording data on Specim IQ.

Defining data recording settings is part of the data recording procedure on every data recording mode.

Proceed as follows:

1. Focus the camera.

In the figure below, the focusing area is the green square in the middle of the view.

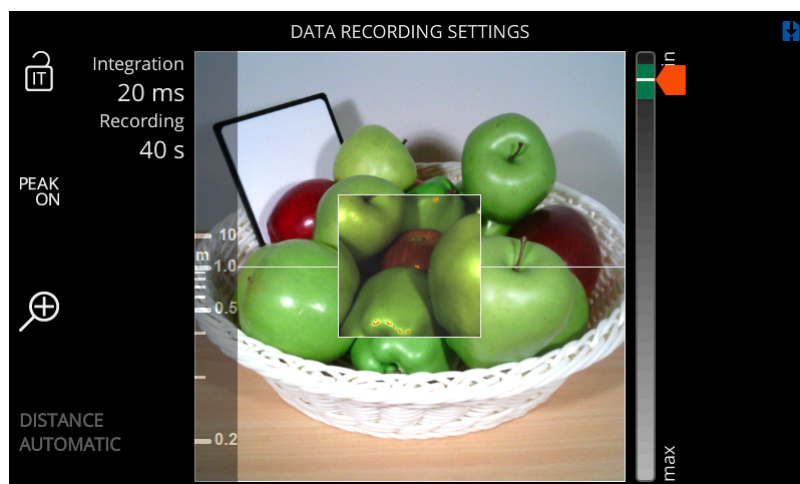


Figure 69: Data Recording Settings View



Tip:

You can click the focusing area to enlarge it.

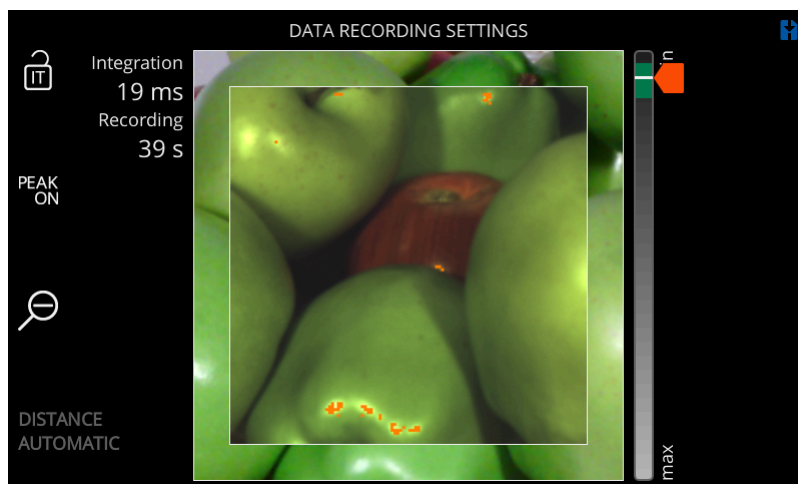


Figure 70: Enlarging the Focusing Area

You can focus the camera by:

- Manually rotating the objective focusing ring.

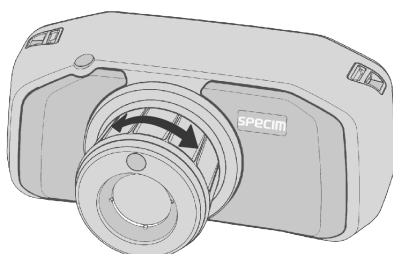


Figure 71: Rotating the Focus Ring

- Selecting **FOCUS PEAKING** by selecting the **Custom 2** button. **FOCUS PEAKING** indicates the focused area by orange color. The more orange you see, the sharper the focus.
 - **PEAK ON** indicates that **FOCUS PEAKING** is ON.
 - **PEAK OFF** indicates that **FOCUS PEAKING** is OFF.
2. Set the integration time by sliding the white indicator line with your finger, or with the navigation buttons.

The camera calculates an estimate of a suitable integration time, and marks it with a green area on the integration time slider range. The current integration time and the estimated recording time are shown in the upper left-hand corner of the viewfinder.

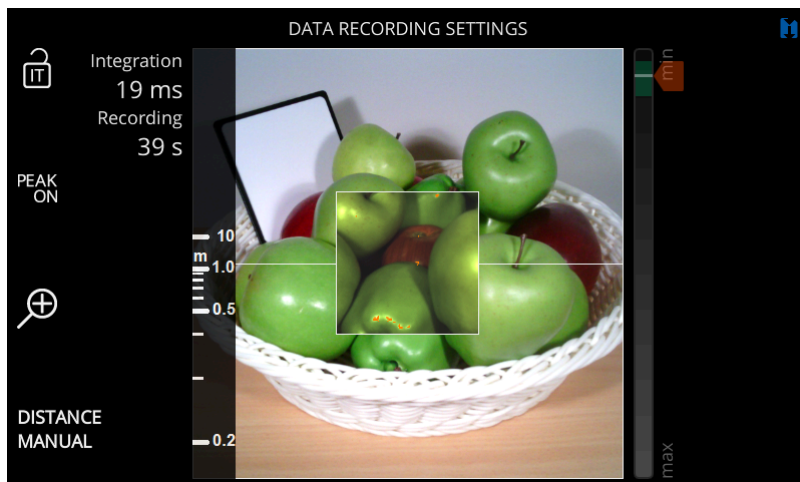
If necessary, you can also lock the integration time by pressing the **Custom 1** button. The **Custom 1** button symbol indicates if the integration time has been locked or not, as follows:

-  — Integration time is locked.
-  — Integration time is not locked.

You can adjust the integration time by:

- Sliding the integration time slider upward or downward, on the touch screen.
 - Using the **UP** and **DOWN** buttons.
3. Optional: Align the focus camera and viewfinder camera views.

The focus camera and the viewfinder camera objectives are on different places on the camera. The **DISTANCE AUTOMATIC** mode attempts to align these views with each other, but occasionally it fails to do so. In these cases, the focus camera and viewfinder camera views may not be perfectly aligned, as depicted in the figure below:



See also [Distance Automatic](#).

To align the views:

Figure 72: Focus Camera and Viewfinder Camera Views

- Enable **DISTANCE MANUAL** by pressing the **Custom 4** button.
- Use the **UP** and **DOWN** buttons or the touch screen to align the viewfinder camera view with the focus camera view.

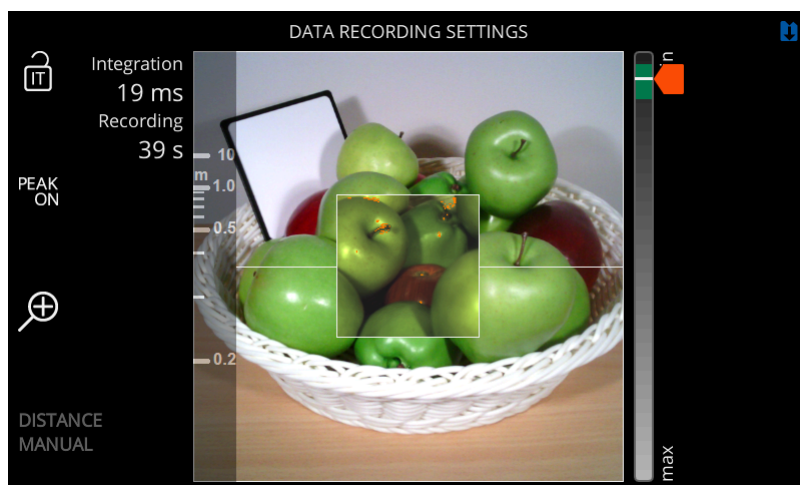


Figure 73: Focus Camera and Viewfinder Camera Views

2.5.5 Selecting the White Reference Area for DRM

This section describes how to select the white reference area when recording data on the default recording mode, on Specim IQ.

Selecting the white reference area is part of the data recording procedure on every data recording mode.

Proceed as follows:

1. Locate the white reference area from the touch screen.

The screen below is opened:

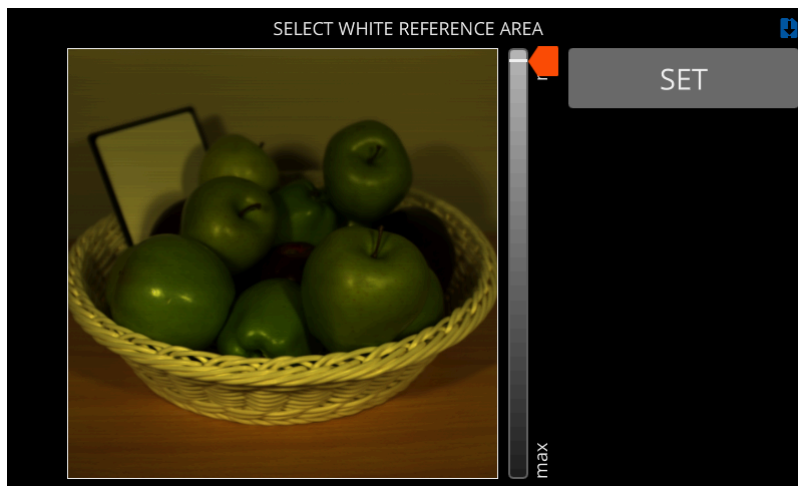


Figure 74: Select White Reference

The maximum intensity area blinks on the image. If this is the correct area, select it, whereupon it turns green.

If you cannot find the white reference, use the slider or **UP** and **DOWN** buttons to change the intensity threshold value used to look for these areas, to be visualized on the screen. Adjust the threshold until you see the white reference on the screen.

2. Touch the white reference area to select it.

When selected, the white reference area is indicated by green color.

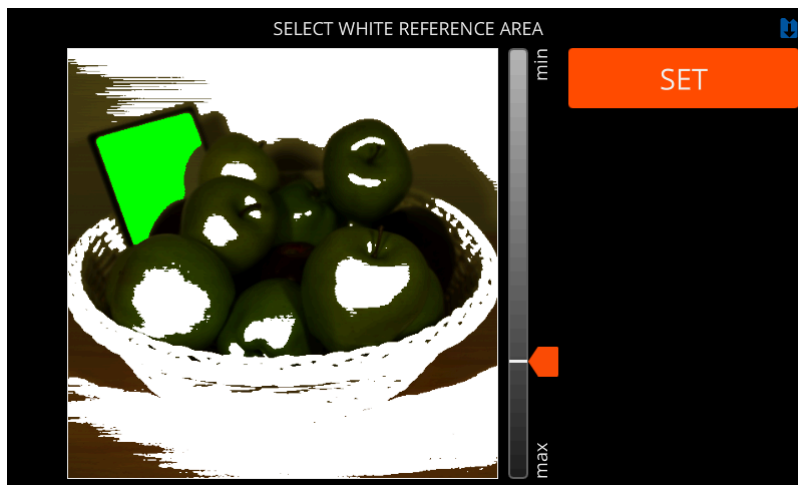


Figure 75: Locating the White Reference Area

2.5.6 Selecting the White Reference Area in ASM

This section describes how to select the white reference area when recording data on the automatic screening mode, on Specim IQ.

Selecting the white reference area is part of the data recording procedure on every data recording mode.

Proceed as follows:

1. Locate the white reference area from the touch screen.

The screen below is opened:

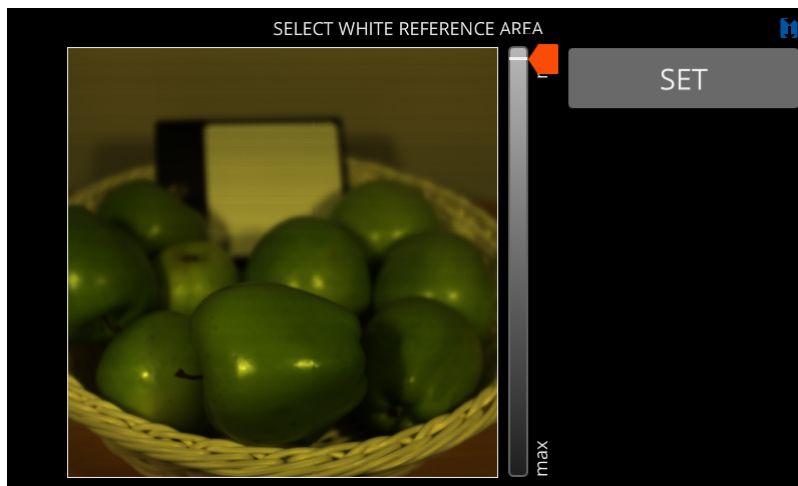


Figure 76: Select White Reference

The maximum intensity area blinks on the image. If this is the correct area, select it, whereupon it turns green.

If you cannot find the white reference, use the slider or **UP** and **DOWN** buttons to change the intensity threshold value used to look for these areas, to be visualized on the screen. Adjust the threshold until you see the white reference on the screen.

2. Touch the white reference area to select it.

When selected, the white reference area is indicated by green color.

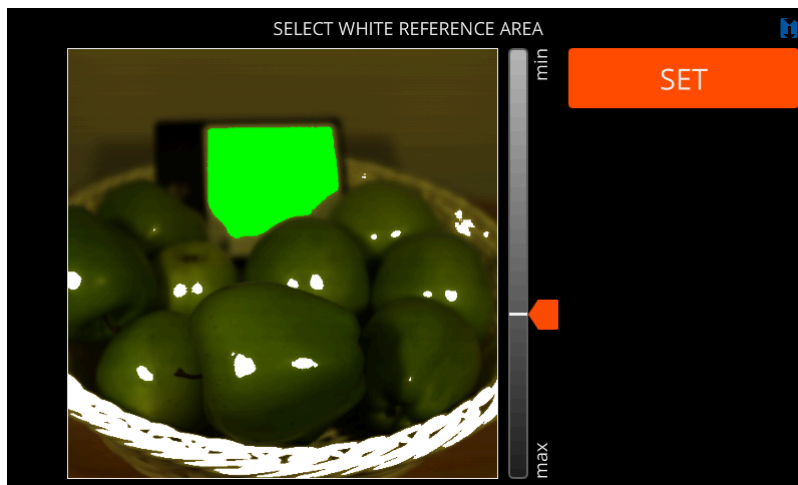


Figure 77: Locating the White Reference Area

2.5.7 Selecting the White Reference Area for AM

This section describes how to select the white reference area when recording data on the application mode, on Specim IQ.

Selecting the white reference area is part of the data recording procedure on every data recording mode.

Proceed as follows:

1. Locate the white reference area from the touch screen.

The screen below is opened:

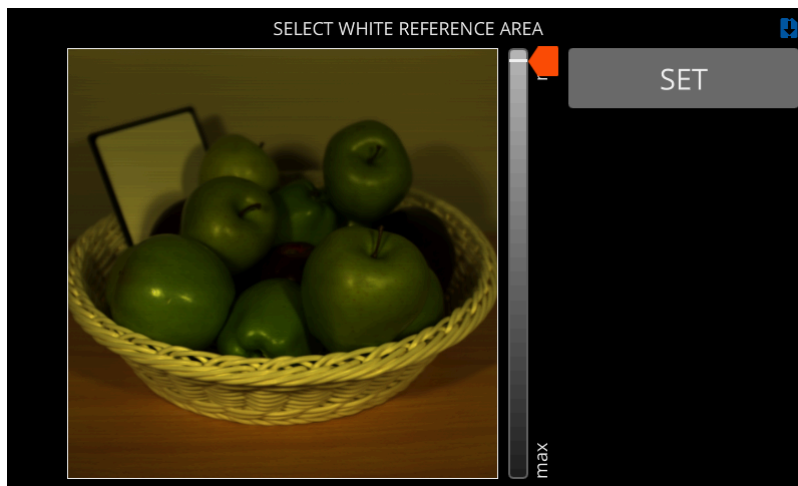


Figure 78: Select White Reference

The maximum intensity area blinks on the image. If this is the correct area, select it, whereupon it turns green.

If you cannot find the white reference, use the slider or **UP** and **DOWN** buttons to change the intensity threshold value used to look for these areas, to be visualized on the screen. Adjust the threshold until you see the white reference on the screen.

2. Touch the white reference area to select it.

When selected, the white reference area is indicated by green color.

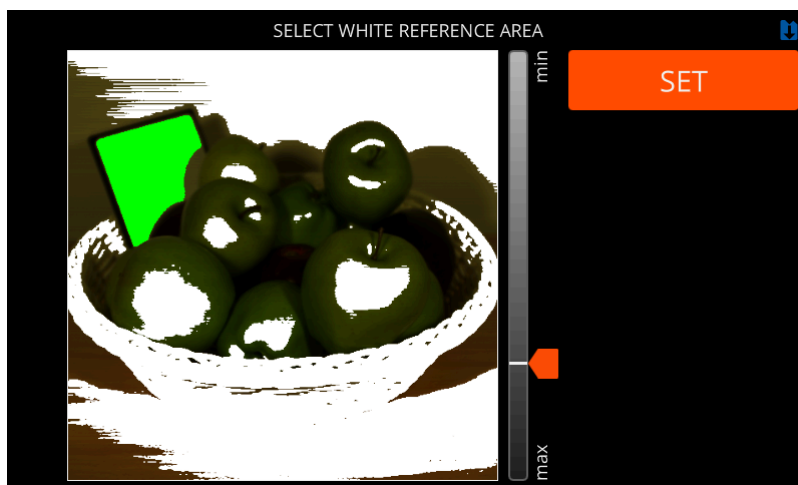


Figure 79: Locating the White Reference Area

2.5.8 Quick Data Validation

This section describes how to use quick data validation on Specim IQ.

By validating data, you ensure that the recorded data is good enough to be saved and analysed.

You validate the data as part of the image capturing procedure, in the **QUICK DATA VALIDATION** screen. An example of the **QUICK DATA VALIDATION** screen is depicted below:

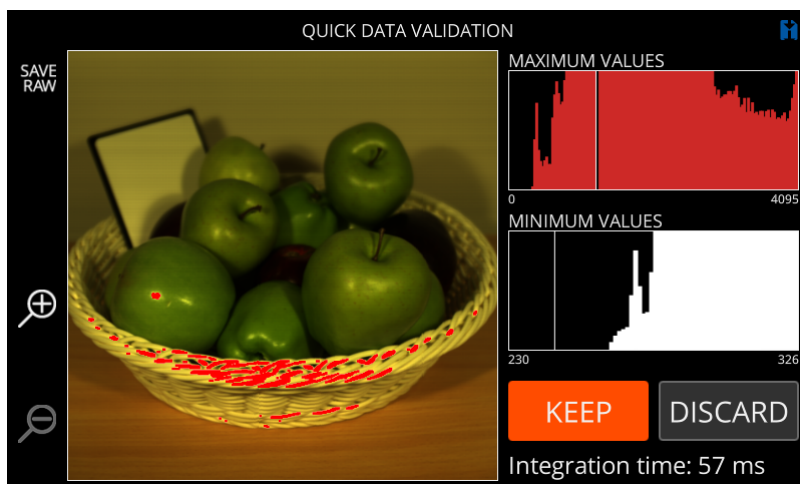


Figure 80: Quick Data Validation

Proceed as follows:

1. Check that the image has been scanned from the correct area.
2. Zoom in to the image to check that the image is sharp.
3. Check that the image has been exposed correctly and that the illumination is appropriate.

There are two intensity histograms for this:

- **MAXIMUM VALUES** — The maximum values histogram shows the amount of the maximum intensities (0-4095) by each pixel (that is, the highest spectrum value of each pixel). The values are added by intensity and shown as histogram. The maximum shown value (y-axis) is 512, and all the values over that are clipped.

The histogram is color coded as follows:

- White — The image quality is at an acceptable level. In this case, the histogram overlaps the threshold line on the histogram. This is the desired result. The larger the covered area, the better.



Figure 81: Acceptable Image Histogram

- Blue — The dataset is undersaturated (that is, all values are below 30%, indicated by the vertical line in the histogram). The image integration time is probably too short, and the signal level is too low. In this case, the histogram is drawn entirely to the left-hand side of the threshold line on the histogram.

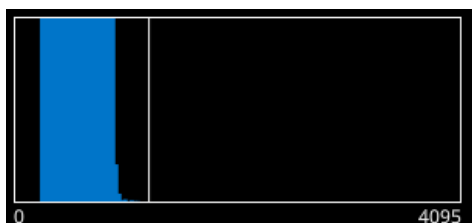


Figure 82: Low Signal Level Image Histogram

- Red — There is oversaturation on the image, as there are pixels with full intensity (4095). The integration time is probably too long.



Figure 83: Saturated Image Histogram

The saturated areas blink red and white on top of the image.

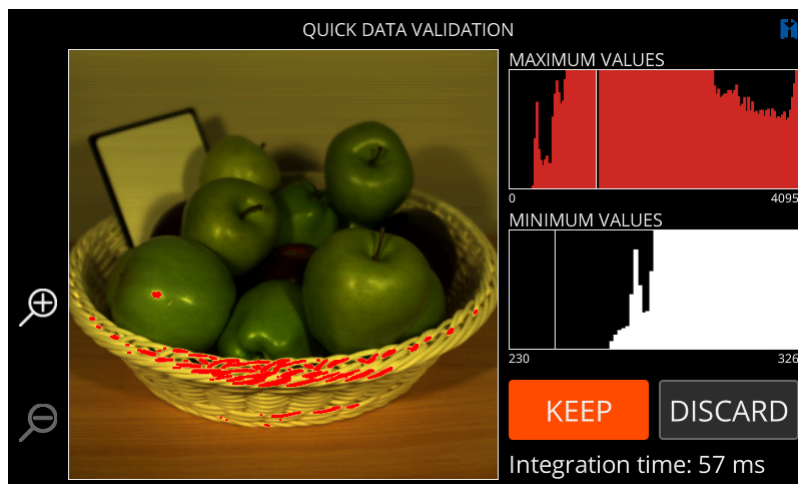


Figure 84: Saturated Areas

If you select **KEEP**, the saturated areas are excluded from the saved data.

- **MINIMUM VALUES** — The camera looks into each recorded spectra on the image, and takes the minimum value from each spectrum. These values are shown on the **MINIMUM VALUES** histogram.

The **MINIMUM VALUES** histogram is similar to the **MAXIMUM VALUES** histogram, but shows the smallest spectrum values and, instead of the full range, shows the range of intensities between 230 and 300, with the warning level of 245. The **MINIMUM VALUES** histogram is always white, but the values shown should always be above the indicated warning level.

This histogram is useful as it detects noise on low intensity values, which might indicate a too short integration time. You can read the histogram as follows:

- If the values fall on the right-hand side of the threshold line on the histogram, the data is of good quality.
- If the values fall on the left-hand side of the threshold line on the histogram, the illumination does not cover the entire wavelength range. Classification or detection may fail.



Note:

The dataset may be fine even if the minimum and maximum values are indicated to be above or below the accepted values, as the values are calculated through the whole dataset and the recorded sample might have values in a valid range in the desired spectrum. The quick validation window itself indicates oversaturation by highlighting the oversaturated areas. Observe that the recorded sample is not oversaturated.

4. Select either:

- **KEEP** — If you are satisfied with data quality, select **KEEP** to continue.
- **DISCARD** — If you are not satisfied with data quality, select **DISCARD** to return to viewfinder.

The system asks for your confirmation, before discarding the data.

2.5.9 Catalog Main View

In the catalog main view, you can view and edit dataset information.

The catalog main view is automatically opened as part of the data recording procedures, and you can open it for any dataset saved in the Specim IQ, by selecting **Device > Catalog**.

The catalog main view is depicted in the figure below:

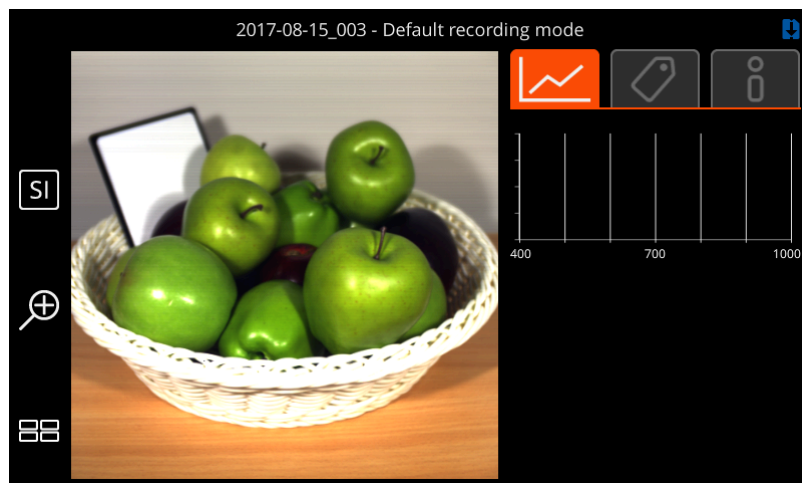


Figure 85: Catalog Main View

In this view, you can use the custom buttons as follows:

- **Custom 1** — Toggle between the classes on the spectral image. This button is only available for data recorded in the application mode.
- **Custom 2** — This button has two alternative functions:
 - In the default recording mode, toggle between the spectral image (SI) and viewfinder image (VF).
 - In the application recording mode and automatic screening mode, toggle between views, as follows:
 - Mask over the spectral image
 - Spectral image without the mask
 - RGB image
 - Mask only
- **Custom 3** — Zoom in to the image. When zoomed-in, the **Custom 4** can be used to zoom out.



Tip:

You can move the zoomed-in image on the touch screen and by using the navigation buttons.

When zoomed-in, touch the list icon  to the right of the image, to view the tool tabs on top of the image, as shown in the figure below:

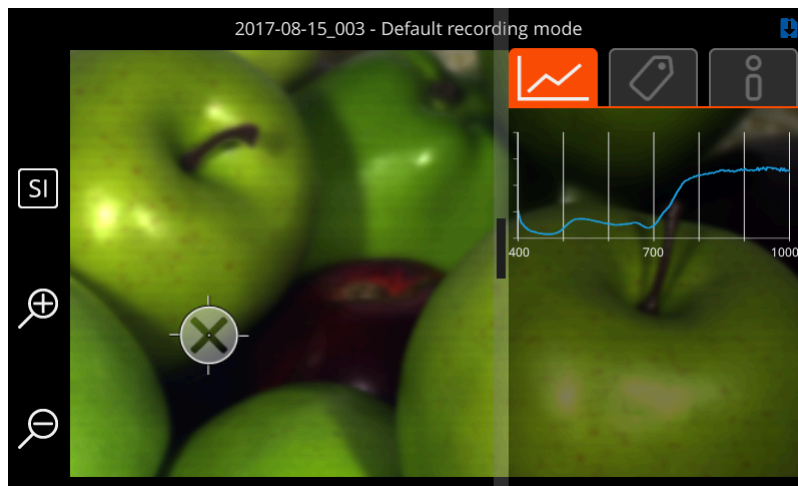


Figure 86: Tools on top of the Zoom View

- **Custom 4** — View thumbnail images.

There are three tabs on the screen:

-  — Select a spot on the image and view its spectrum.
-  — Add tags to the image.

For more information, see [Tags](#).

-  — View image info.

In this view, you have three options:

- **Dataset info** — Select this option to view more information on the dataset. See [Viewing Dataset Info](#).
- **Edit description** — Select this option to edit the image description. See [Editing the Dataset Description](#).
- **Delete** — Select this option to delete the image. See [Deleting a Dataset](#).

2.5.9.1 Zooming Images

This section describes how to zoom in to and out of images on Specim IQ.

Proceed as follows:

1. Open the image in the catalog main view>.

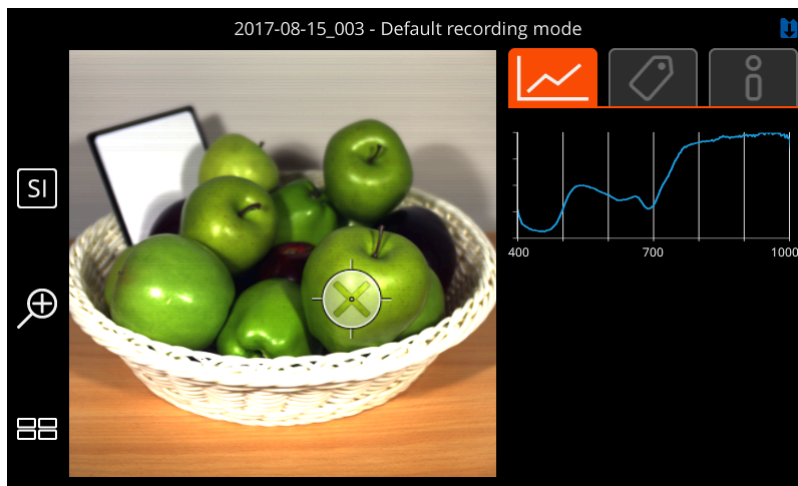


Figure 87: Image in the Catalog Main View

Zooming in

2. Use the **Custom 3** button to zoom in to the image.



Figure 88: Zoomed Image



Tip:

You can move the zoomed-in image by touch.

3. You can view the spectrum area by clicking the class selection icon on the slider



Figure 89: Zoomed Image Spectrum Area

4. Optional: Select an area of interest, and view its spectrum, by touching the touch screen.

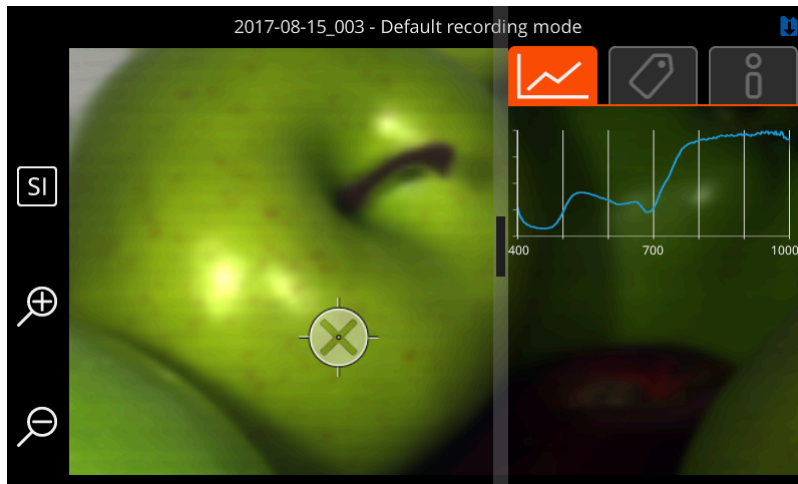


Figure 90: Zoomed Image Spectrum View

5. Optional: Click the spectrum area to enlarge the spectrum area.

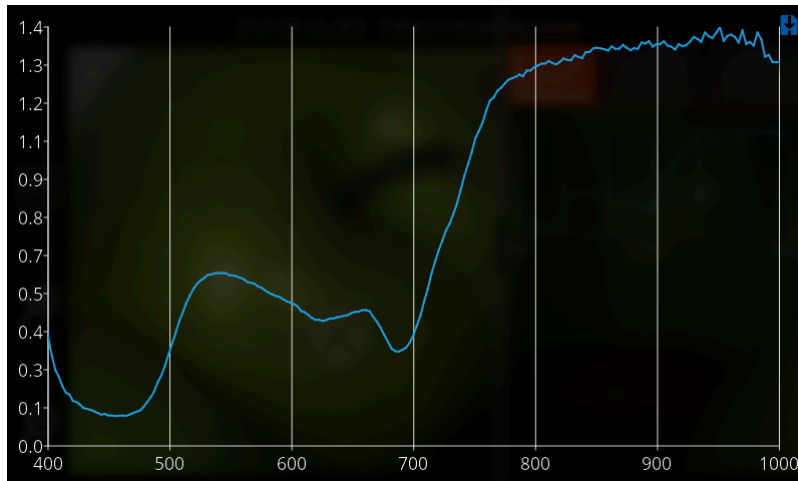


Figure 91: Enlarging the Spectrum Area

Zooming out

6. Use the **Custom 4** button to zoom out of the image.

You can zoom out until you reach the catalog view.

The screen below is opened:

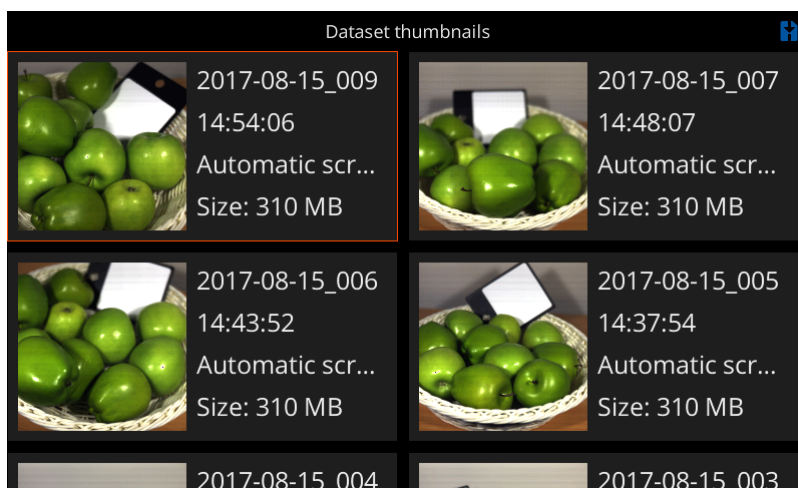


Figure 92: Dataset Thumbnails

2.5.9.2 Tags

This section describes how to work with image tags on Specim IQ.

Tags are short text labels describing the images. There are two types of tags:

- Global tags are related to the entire image. For example, the name of the data recorder can be added as a global tag.
- Material tags are related to a specific pixel. A material tag consists of a tag name and the tag pixel position.

Adding a Material Tag

This section describes how to add a material tag to an image on Specim IQ.

Proceed as follows:

1. Open the image in the catalog main view.
2. Use the touch screen to select the desired pixel of interest on the image.

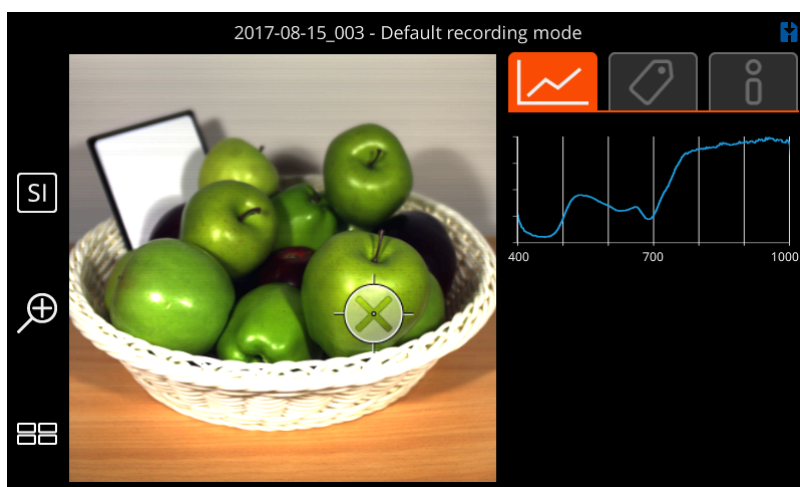


Figure 93: Selecting a Pixel of Interest

3. Open the tags tab.

The screen below is opened:

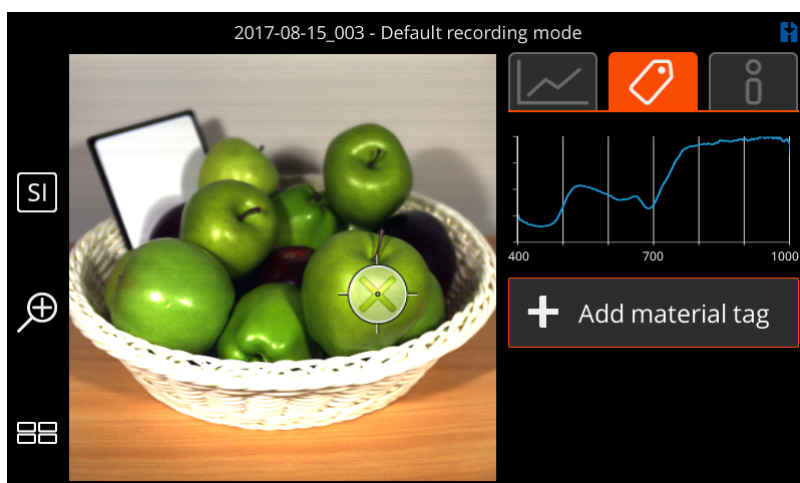


Figure 94: Material Tag View

4. Click the plus sign to enter the tag.

The screen below is opened:

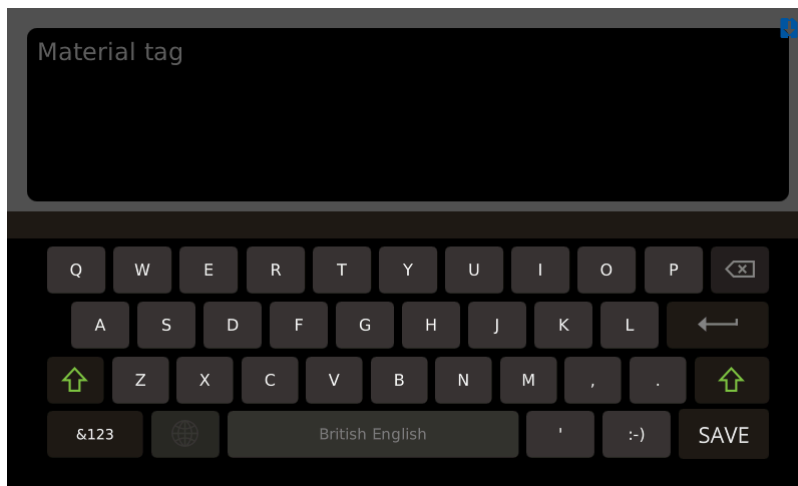


Figure 95: Adding a Material Tag Description

5. When done, select **SAVE**.

Adding a Global Tag

This section describes how to add a global tag to an image on Specim IQ.

Proceed as follows:

1. Open the image in the catalog main view.
2. Open the tags tab.

The screen below is opened:

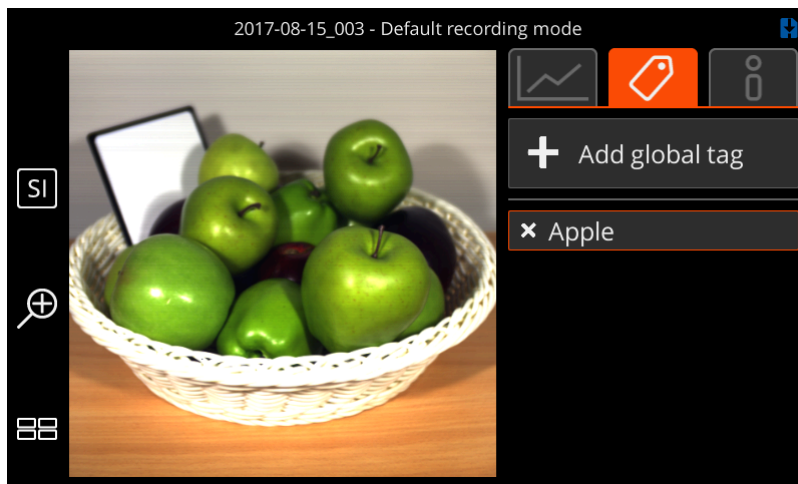


Figure 96: Global Tag View

3. Click the plus sign to enter the tag.

The screen below is opened:

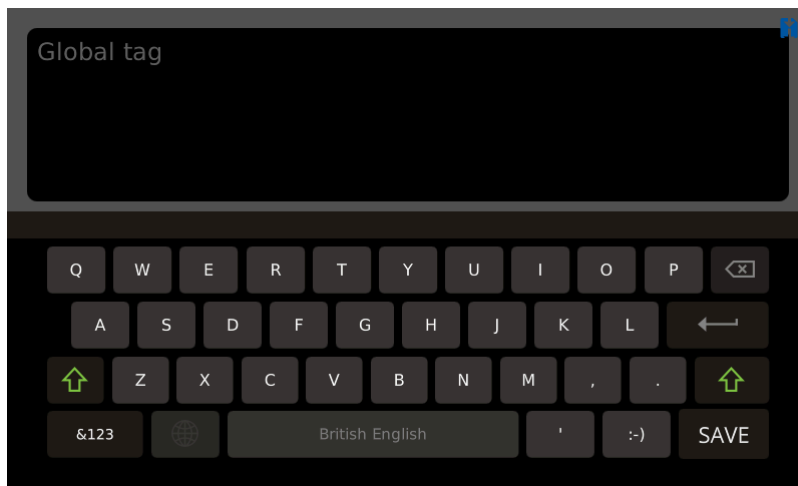


Figure 97: Adding a Global Tag Description

4. When done, select **SAVE**.

Editing Tag Information

This section describes how to edit tag information on Specim IQ.

Proceed as follows:

1. Open the image in the catalog main view.

The current tags are listed next to the image. In the figure below, the tag names are:

- Fake apple
- Fake aple

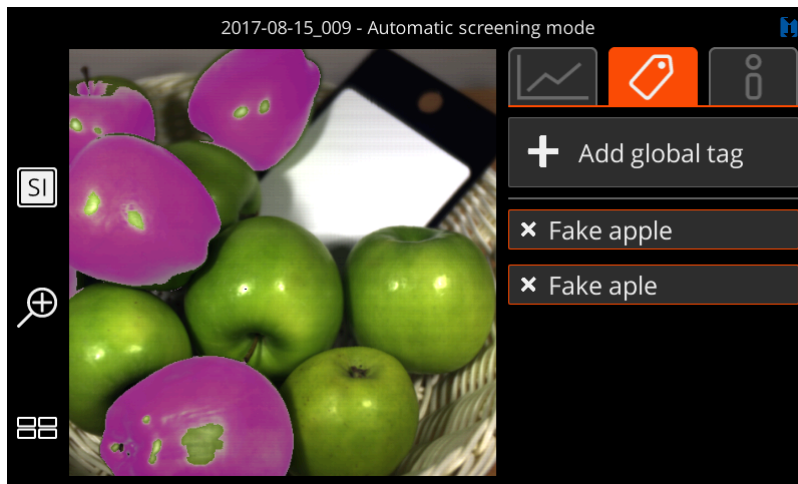


Figure 98: Tags

2. Select the tag that you want to edit, by touching it.

The screen below is opened:

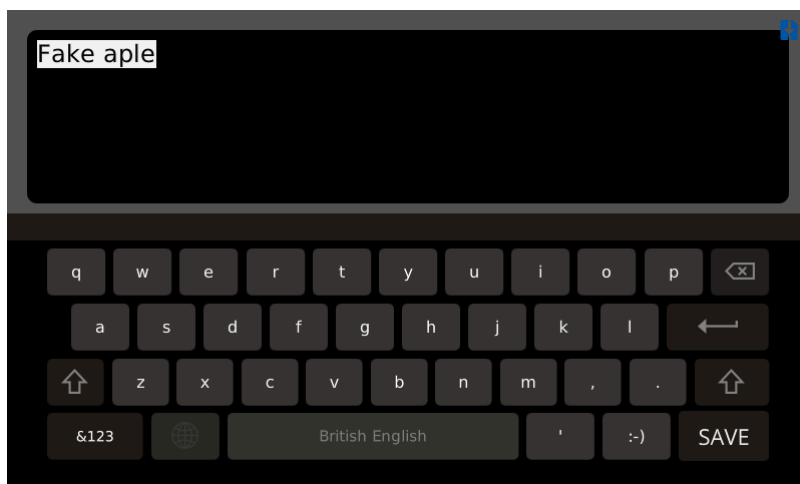


Figure 99: Editing a Tag

3. Enter a new name for the tag.



Note:

Tag names must be unique to the dataset.

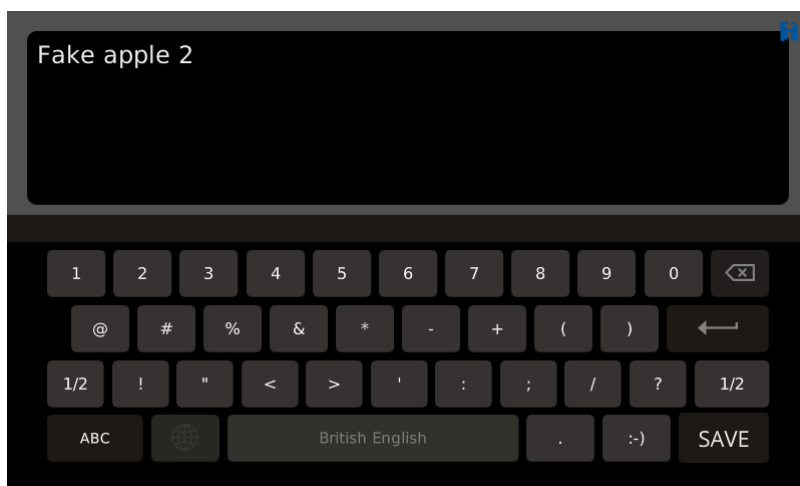


Figure 100: Editing a Tag

4. When done, select **Save**.

The screen below is opened:

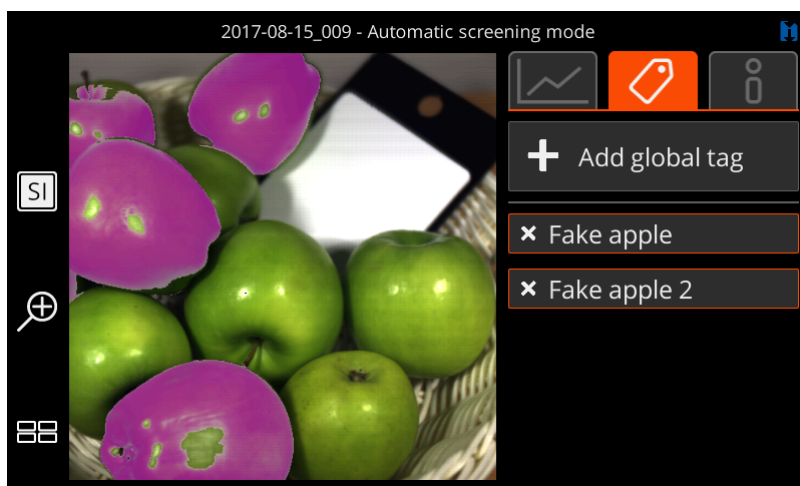


Figure 101: Tags

Deleting a Tag

This section describes how to delete a tag on Specim IQ.

Proceed as follows:

1. Open the image in the catalog main view.

The current tags are listed next to the image. In the figure below, the tag names are:

- Fake apple
- Fake aple

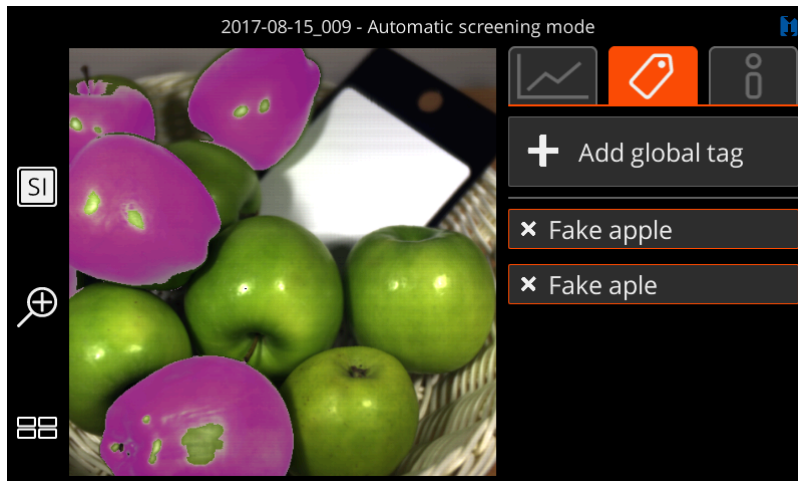


Figure 102: Tags

2. Delete the desired tag by touching the cross section of the tag.

The screen below is opened:

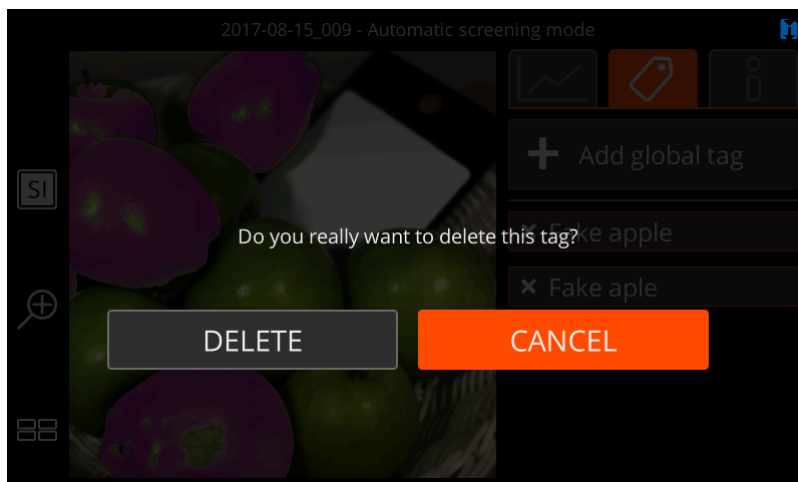


Figure 103: Deleting a Tag

- **DELETE** to delete the tag.
 - **CANCEL** to return to the catalog main view.
3. If you selected **DELETE**, the tag is removed from the tag list.

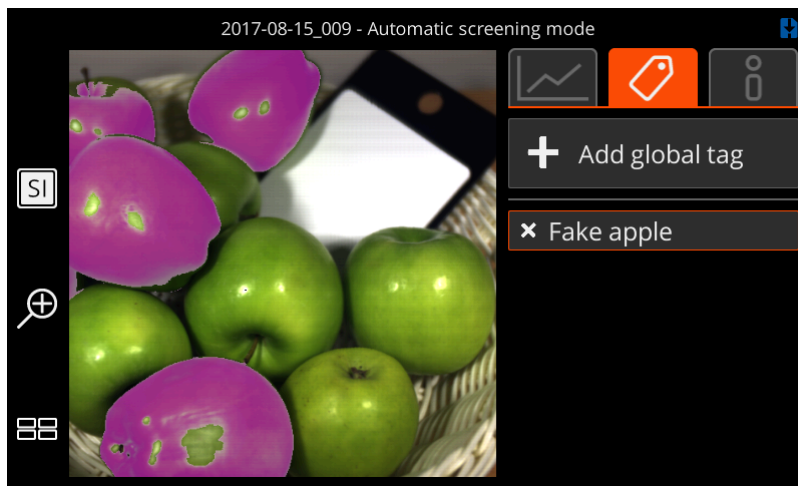


Figure 104: Tags

2.5.9.3 Viewing Dataset Info

This section describes how to view dataset info on Specim IQ.

Proceed as follows:

1. Open the image in the catalog main view.

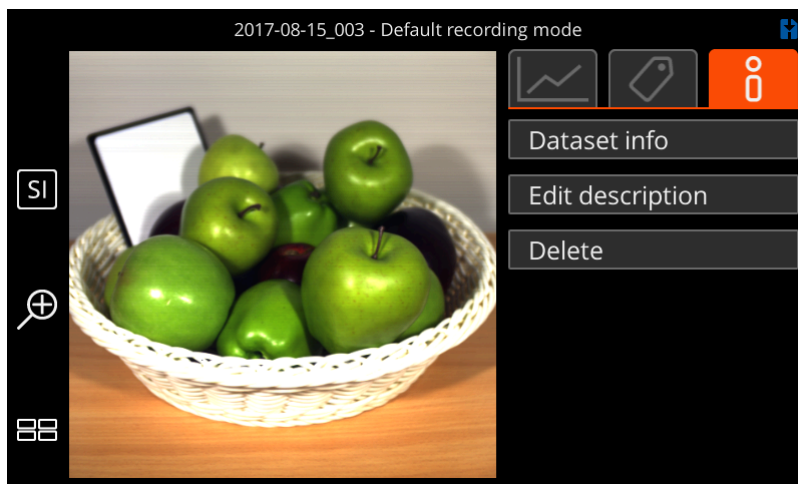


Figure 105: Dataset Info

2. Select **Dataset info**.

The screen below is opened:

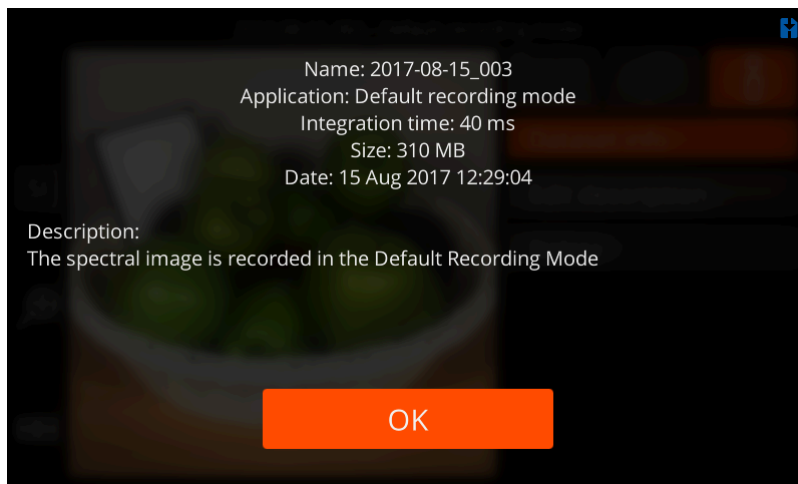


Figure 106: Dataset Info

Information is provided as follows:

- **Name** — The image name.
- **Application** — The application that was used when capturing this image.
- **Integration time** — The integration time that was used when capturing this image.
- **Size** — The image file size.
- **Date** — The date and time when the data was recorded.
- **Description** — A description of the image.

3. When done, select **OK**.

2.5.9.4 Editing the Dataset Description

This section describes how to edit the dataset description on Specim IQ.

Proceed as follows:

1. Open the image in the catalog main view.

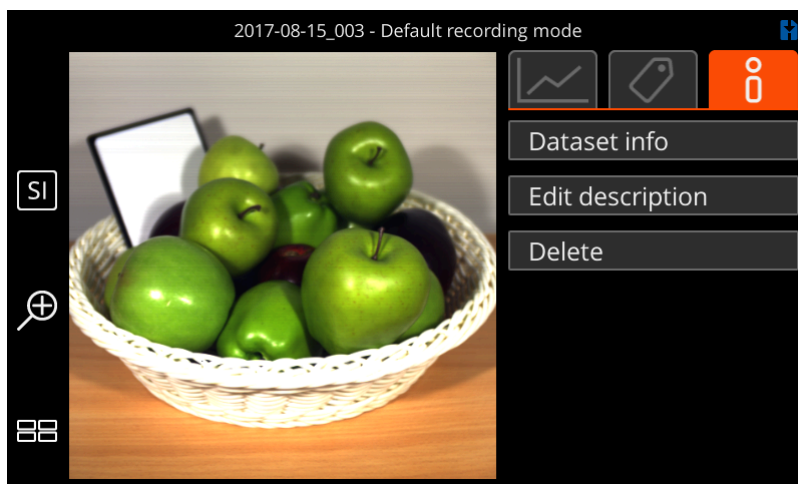


Figure 107: Dataset Info

2. Select **Edit description**.

The screen below is opened:

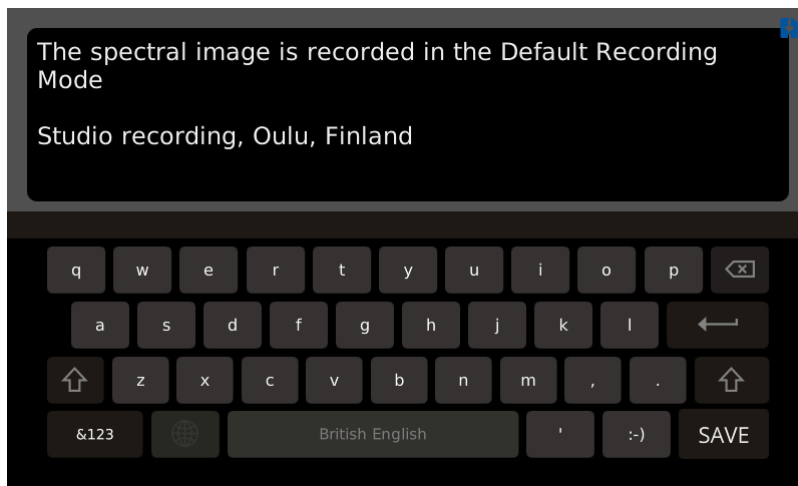


Figure 108: Editing the Dataset Description

3. Enter the dataset description.
4. When done, select **OK**.

2.5.9.5 Deleting a Dataset

This section describes how to delete a dataset from Specim IQ.

Proceed as follows:

1. Open the image in the catalog main view.

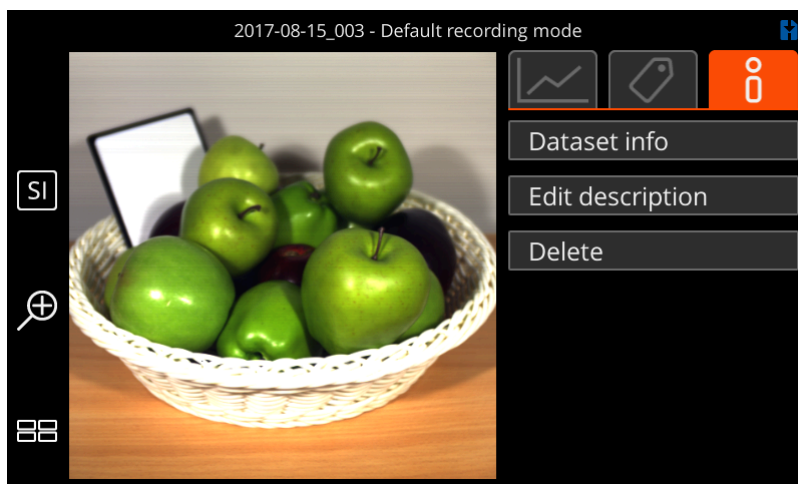


Figure 109: Dataset Info

2. Select **Delete**.

The screen below is opened:

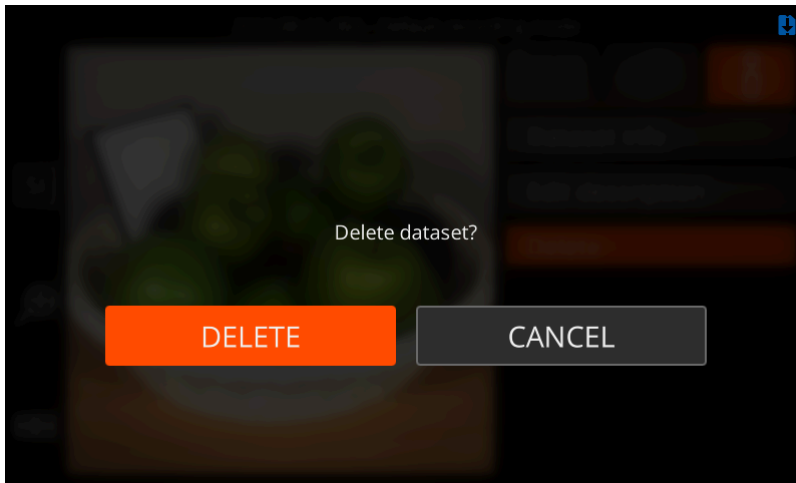


Figure 110: Deleting a Dataset

Select either:

- **DELETE** to delete the dataset.
- **CANCEL** to return to the catalog main view.

2.6 Transferring Data to Your Computer

This section describes how to transfer data from Specim IQ to your computer.

You can transfer data to your computer by two methods:

- By moving the memory card from the camera to your computer memory card reader.
- By connecting the camera to your computer with the USB cable provided in the sales box.

Proceed as follows:

Memory card

1. Open the battery compartment door by sliding the lock downward.

The door will spring open.

2. Push the memory card, whereupon it will spring out.

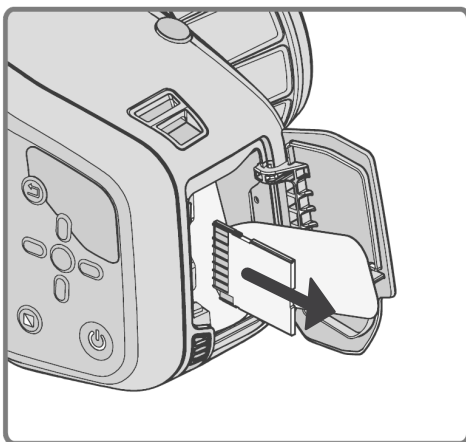


Figure 111: Removing the Memory Card

3. Insert the memory card to your computer memory card reader.

Windows Explorer is opened.

4. Import the files to *Specim IQ Studio*.

See [Importing Data from the File System](#).

USB

5. Open the USB cover from its upper left corner.

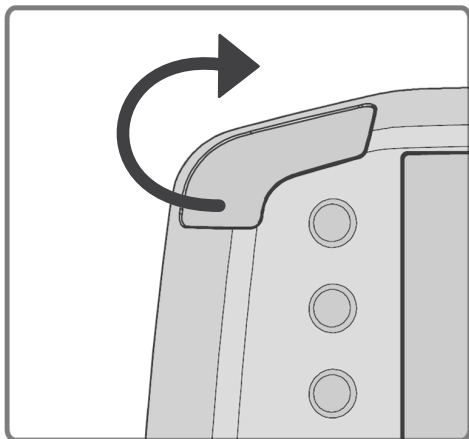


Figure 112: Opening the USB Cover

6. Attach the white USB cable, and connect it to your PC.

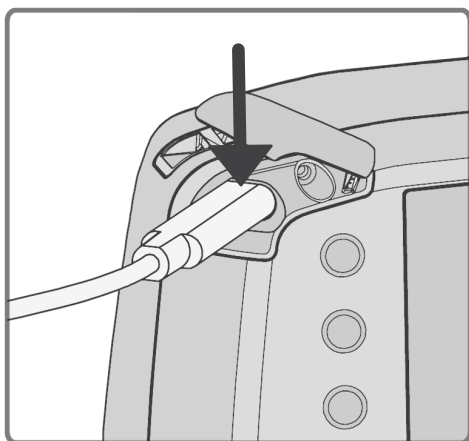


Figure 113: Attaching the USB Cable

7. Import the files to *Specim IQ Studio*.

See [Importing Data from Specim IQ](#).

2.7 Using Timelapse

This section describes how to use the timelapse function on Specim IQ.

- Ensure that you have enough free space on your memory card for the data that will be recorded.
- Ensure that the camera battery has enough power left to record the planned number of datasets.

If your battery runs out during the timelapse period, the last data set may be corrupted.

Adjust and lock the integration time before enabling the timelapse:

1. Open Data recording settings view.
2. Adjust integration time
3. Press Custom 1 button to lock integration time.

4. Enable timelapse mode.

When defining the timelapse period, pay attention to the fact that a timelapse period shorter than 10 minutes may be too short for long integration times. If the set interval is passed, before the current datacube has been recorded, the recording of the next datacube will start immediately after the previous one. For example, if your timelapse period is five minutes, and the data recording lasts for six minutes, you will end up with a timelapse period of six minutes.



Note:

If you have locked integration time, you cannot change it in the timelapse view.



Important:

If you use a long timelapse period, it may be necessary to feed power to the camera. For this, you will need a 3 A charger and a cable capable of transferring 3 A, which are not included in the sales box.

Proceed as follows:

1. Select the measurement mode that you want to use for the timelapse: *DRM*, *ASM*, or *AM*.
2. Arrange the measurement setup with the illumination and camera.
3. Make test measurements, record the custom white reference, or select a pre-defined white reference
4. Adjust the integration time, and lock it, if needed.
5. Select **SET**.
6. Press the **Custom 3** button.

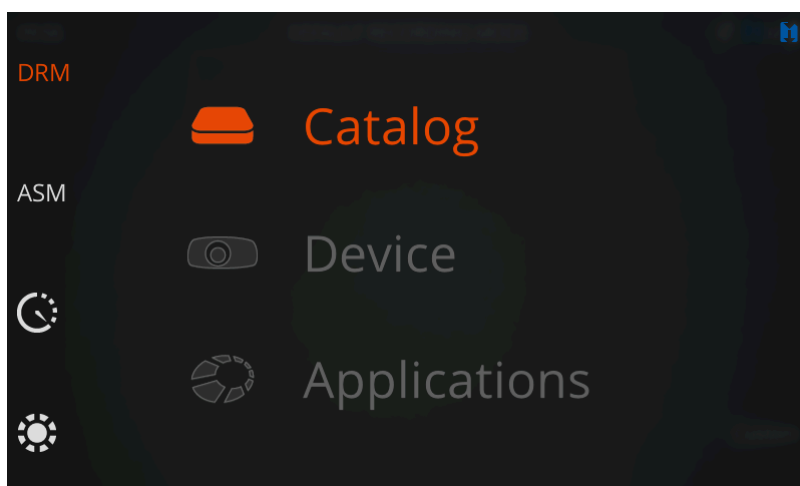


Figure 114: Selecting Time Lapse

7. Select the white reference method for the timelapse scans.

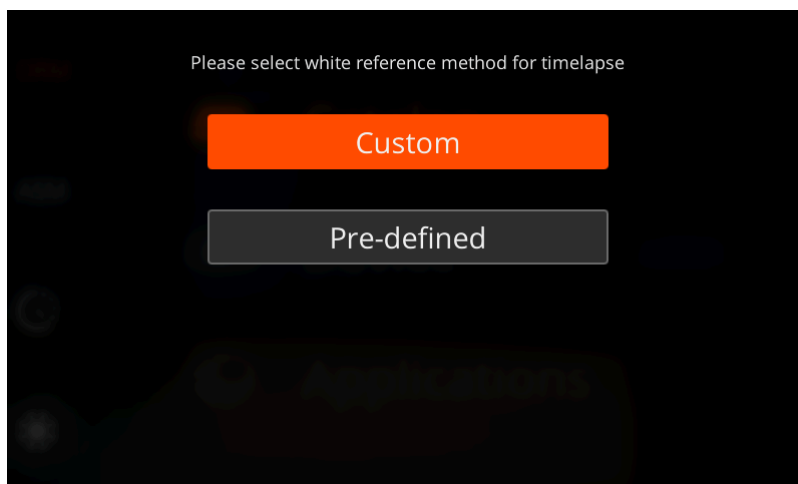


Figure 115: Selecting the White Reference Method for Timelapse Scans

The options are:

- **Custom** — Select a custom white reference.
- **Pre-defined** — Select a pre-defined white reference.

See [Selecting the White Reference Method](#).

8. Define the timelapse settings.

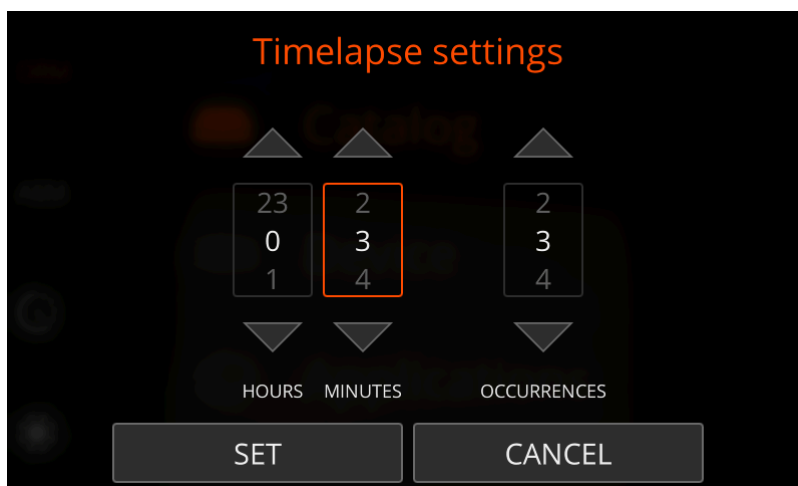


Figure 116: Defining the Timelapse Settings

The settings are:

- **HOURS** — Use the up and down arrow buttons to define on how many hours' interval data will be recorded.

If you define, for example, one hour and zero minutes, data will be recorded every hour.

- **MINUTES** — Use the up and down arrow buttons to define on how many minutes' interval data will be recorded. Two minutes is the minimum time interval.

If you define, for example, fifteen minutes and zero hours, data will be recorded every fifteen minutes.

- **OCCURRENCES** — Use the up and down arrow buttons to define the number of scans that will be taken.

If there is not enough free space on the memory card for the selected number of scans, the screen below is opened:

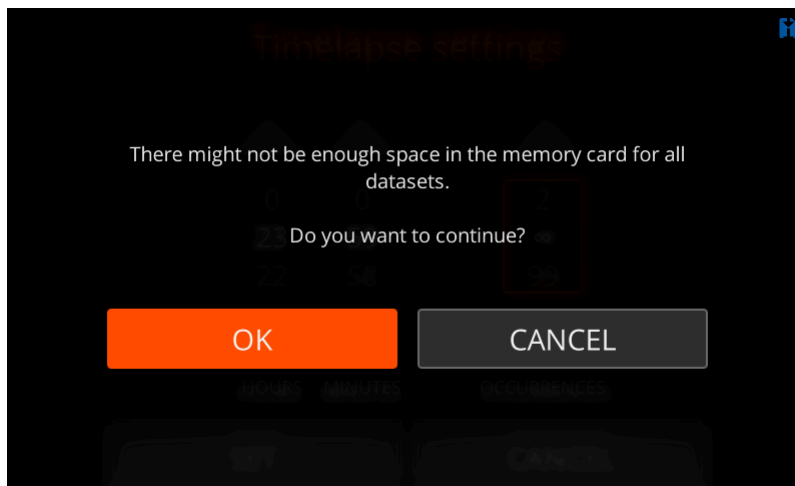


Figure 117: Not Enough Free Space for the Selected Number of Scans

9. Select **SET**.

10. Focus the view.

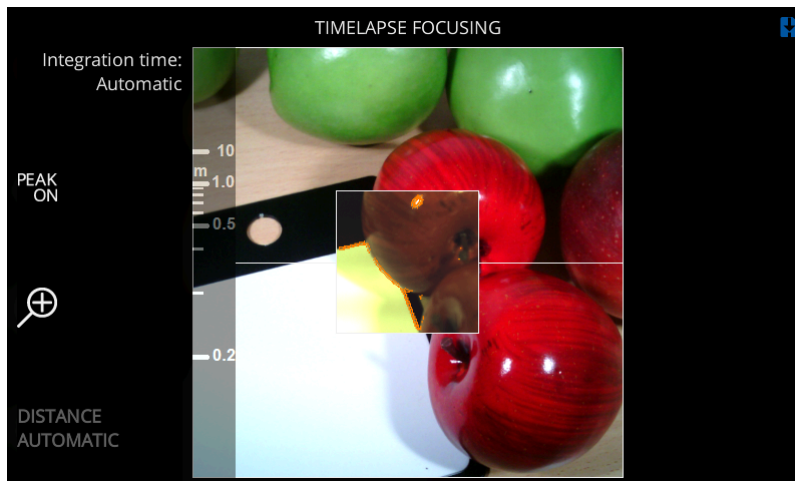


Figure 118: Focusing the View

11. Fully press the **SHUTTER** button.

The timelapse scanning starts.

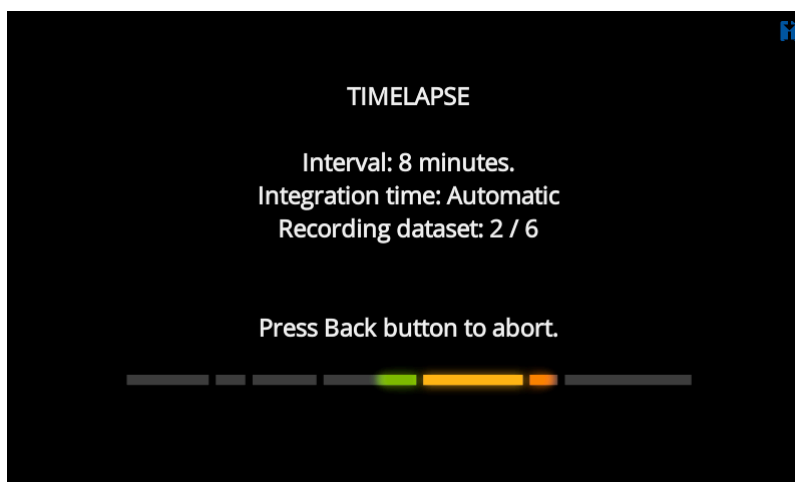


Figure 119: Timelapse in Progress

12. Wait until the timelapse period is over.

If you want to cancel the timelapse function, press the **BACK** button .

2.8 Settings

This section describes how to view and modify the Specim IQ settings.

You can open the settings view by pressing the **SET** button, and selecting **Device**.

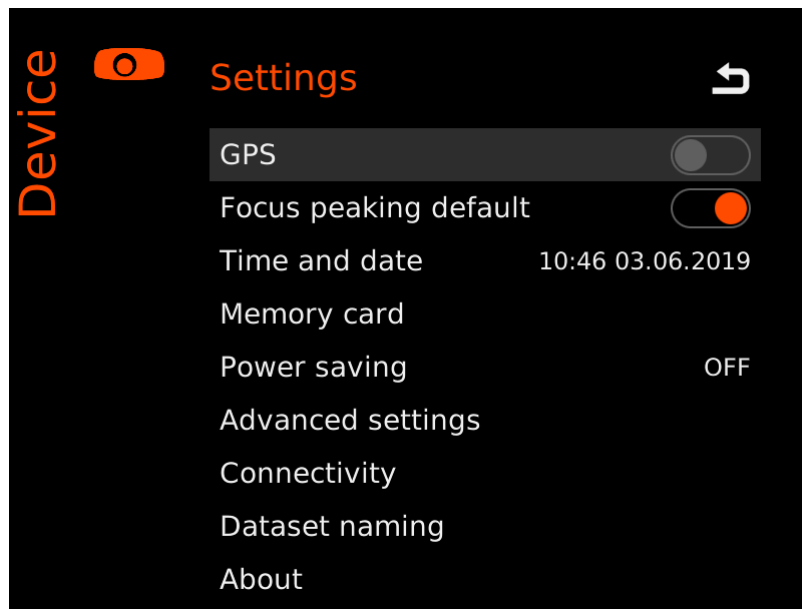


Figure 120: Settings View

2.8.1 GPS

This section describes how to use the GPS function on Specim IQ.

Specim IQ can store and recover the exact location information of the image in the image metadata if needed. GPS set through IQ Studio is A-GPS, and faster than the standard GPS. See [Modifying Device Settings](#).

The GPS settings are reset:

- In two hours, if the camera is without battery.
- In conjunction with a factory reset.

The GPS states on the viewfinder are:

Table 2: GPS States

Icon	Description
	GPS is on, and it has found a satellite.
	GPS is on, but it has not found a satellite yet. The image blinks.

Icon	Description
	GPS is off.

Proceed as follows:

1. Press the **SET** button, and select **Device > GPS**.

The screen below is opened:

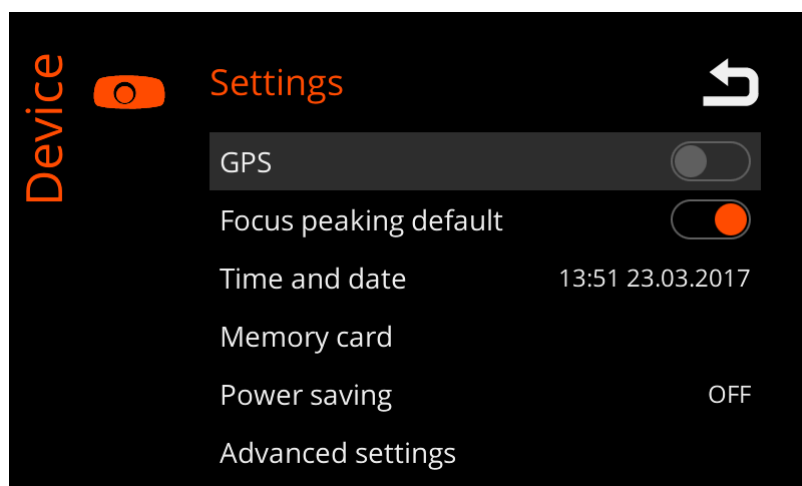


Figure 121: GPS

Enabling GPS

2. To enable GPS:

a) Slide the **GPS** slider to the **ON** position.

Disabling GPS

3. To disable GPS:

a) Slide the **GPS** slider to the **OFF** position.

4. When done, press the **BACK** button  to return to the **Device menu** screen.

When the Specim IQ's GPS function is enabled, the GPS location information is saved into the .xml file within the dataset's metadata folder. The name of the file is <dataset_name.xml> .

The GPS information is stored as:

- <key field="latitude" readonly="0">65.06156371</key>
- <key field="longitude" readonly="0">25.43647618</key>

If the fields above are missing, please make sure that the GPS function is enabled.

If the value of fields above is zero, GPS lock has not been acquired yet. Note that GPS only works outdoors, where Specim IQ is able to connect to the GPS satellites.

2.8.2 Focus Peaking Default

This section describes how to use focus peaking by default, when recording data on Specim IQ.

Focus peaking indicates the focused area by orange color. The more orange you see, the sharper the focus.

Proceed as follows:

1. Press the **SET** button, and select **Device**.

The screen below is opened:

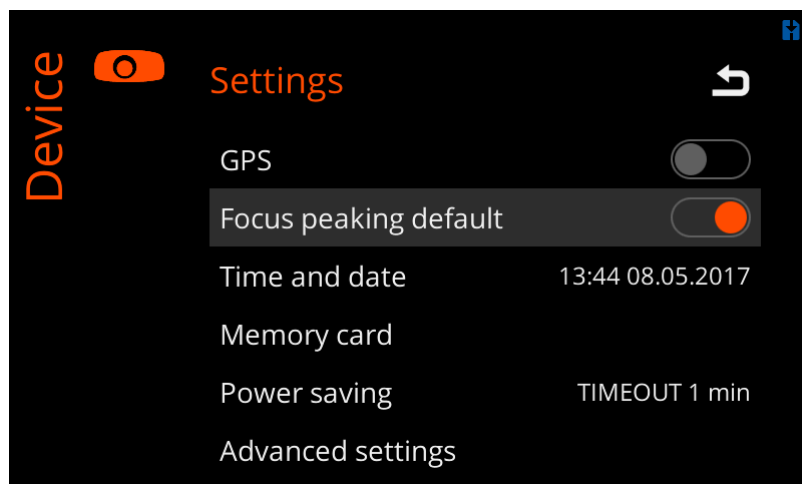


Figure 122: Focus Peaking

2. You can set focus peaking on or off by toggling the **Focus peaking default** slider.

The figure below depicts the **DATA RECORDING SETTINGS** view with focus peaking ON. The orange areas indicate the camera focus.

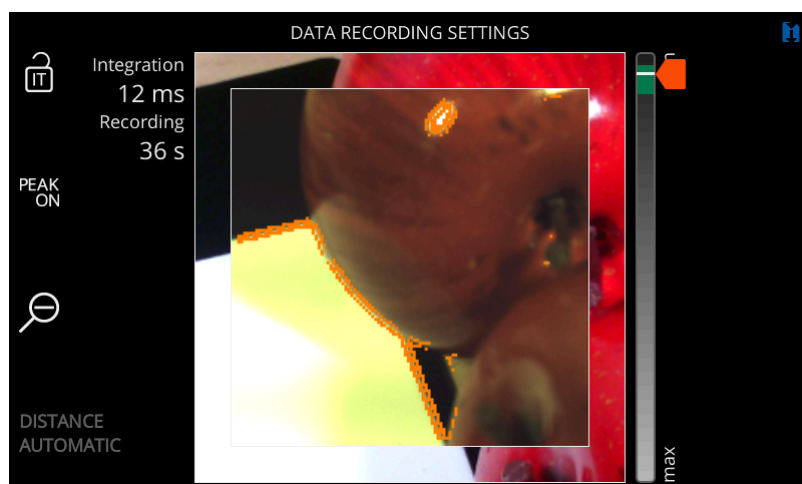


Figure 123: Focus Peaking ON



Tip:

You can toggle focus peaking on and off with the **Custom 2** button. In this way, you can compare the image with focus peaking on or off.

2.8.3 Time and Date

This section describes how to set the time and date for Specim IQ.

The time and date settings are reset in 10 minutes, if the camera is without battery.

Proceed as follows:

1. Press the **SET** button, and select **Device > Time and date**.

The screen below is opened:

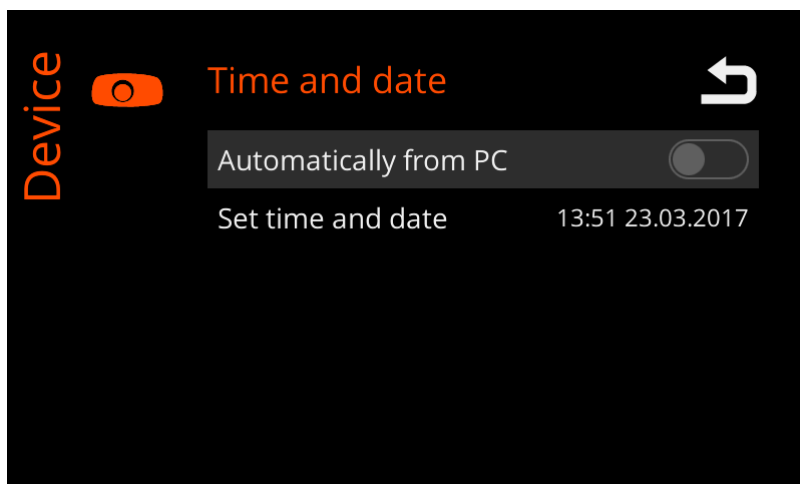


Figure 124: Setting the Time and Date

2. You can set the time and date either by:

- Automatically obtaining the time and date from your computer when the camera is connected to the computer.

If you want to select this option, slide the **Automatically from PC** slider to the **ON** position.

If you select this option, you cannot set time and date manually.

- Manually setting the time and date.

If you want to choose this option, select **Set time and date**.

The screen below is opened:

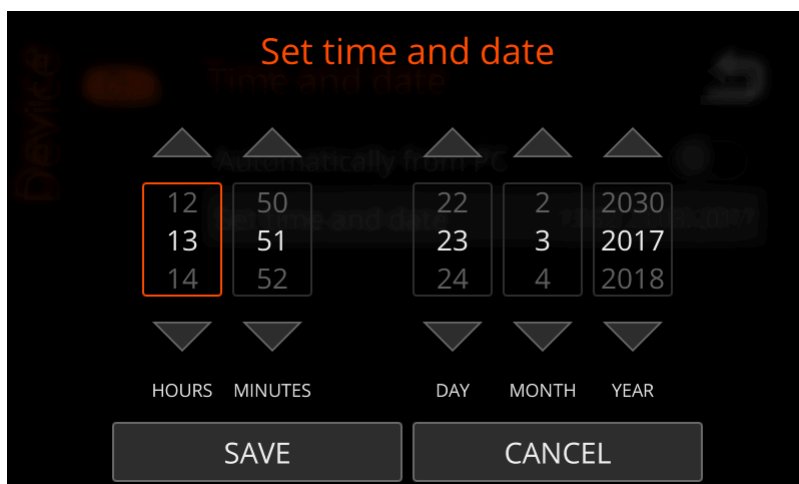


Figure 125: Manually Setting the Time and Date

You can navigate in the time and date fields with the left and right arrow buttons.

The settings are:

- **HOURS** — Use the up and down arrow buttons to set the hours.
- **MINUTES** — Use the up and down arrow buttons to set the minutes.
- **DAY** — Use the up and down arrow buttons to set the day.
- **MONTH** — Use the up and down arrow buttons to set the month.
- **YEAR** — Use the up and down arrow buttons to set the year.

3. When done, press the:

- **SAVE** button to accept the settings and return to the menu.
- **CANCEL** button to cancel the settings and return to the menu.

2.8.4 Memory Card

In **Memory card** settings, you can:

- Check the free space on the memory card
- Format the memory card

2.8.4.1 Checking the Free Space on the Memory Card

This section describes how to check the free space on the memory card.

Proceed as follows:

1. Press the **SET** button, and select **Device > Memory card**.

The screen below is opened:

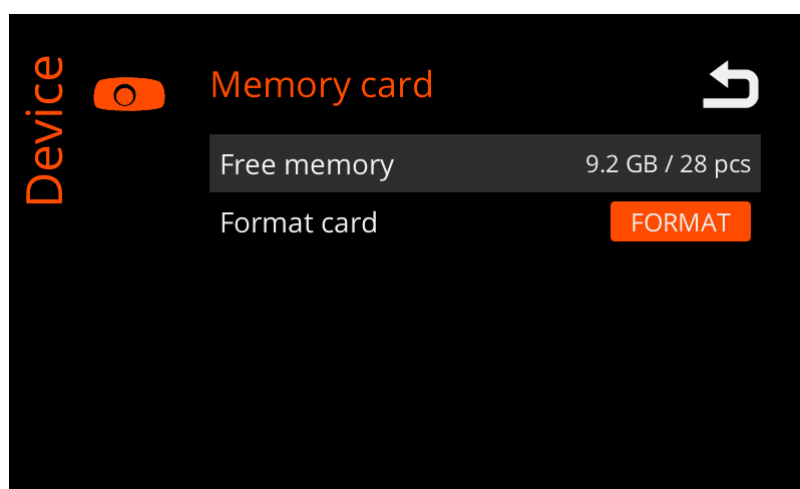


Figure 126: Checking the Free Space on the Memory Card

The free space on the memory card is indicated by two values:

- The amount of free space in gigabytes.
- For how many scans there is room, on the memory card.

2. When done, press the **BACK** button  to return to the **Settings** screen.

2.8.4.2 Formatting the Memory Card

This section describes how to format the memory card.

You may format the SD card in the camera after importing all datasets from the card to IQ Studio. Regular formatting may prevent SD card file system corruption. It is recommended to always format the memory card on the camera, not on the computer.



Note:

Formatting deletes all data from the card.

Proceed as follows:

1. Press the **SET** button, and select **Device > Memory card**.

The screen below is opened:

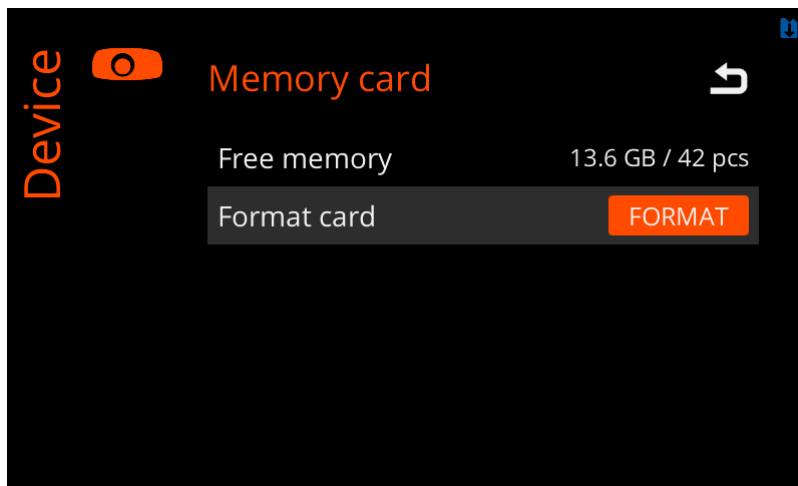


Figure 127: Formatting the Memory Card

2. Select **FORMAT**.

The system asks for your confirmation.

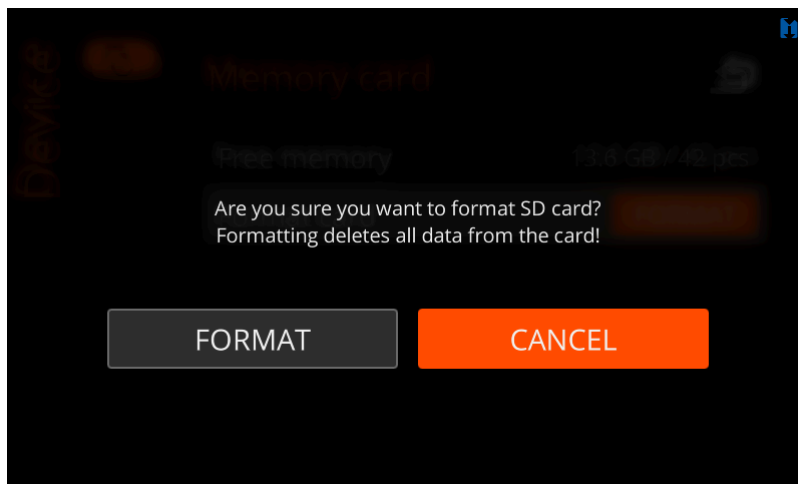


Figure 128: Formatting the Memory Card - Confirmation

Select:

- **FORMAT** to continue this procedure.
- **CANCEL** to return to the **Memory card** screen.

3. When done, press the **BACK** button ↶ to return to the **Settings** screen.

Related Information

[Using Memory Cards](#)

This section contains tips on using memory cards with Specim IQ.

2.8.5 Using Power Saving

This section describes how to use the power saving function on Specim IQ.

When power saving is enabled, an unused device will enter sleep state. This will save the battery. You can wake up a sleeping device by quickly pressing the power button.



Tip:

You can also set the device in sleep state, and return to normal operation, by quickly pressing the power button. Power saving does not have to be enabled for this.

Proceed as follows:

1. Press the **SET** button, and select **Device > Power saving**.

The screen below is opened:

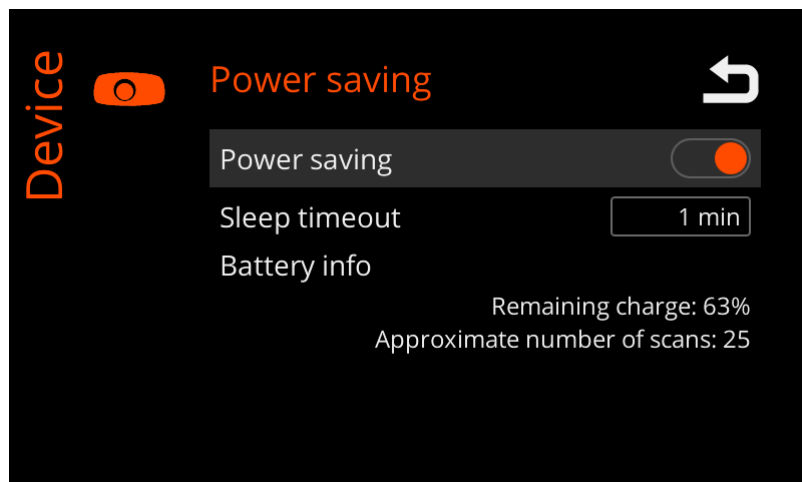


Figure 129: Power Saving

The current battery info is shown in the **Battery info** fields, as follows:

- **Remaining charge** — This field indicates the remaining charge of the battery, in percentage from 0% to 100%.
- **Approximate number of scans** — This field indicates the estimated number of scans you can make without recharging the battery.

Enabling Power Saving

2. To enable power saving:
 - a) Slide the **Power saving** slider to the **ON** position.
 - b) Select a suitable sleep timeout from the **Sleep timeout** menu.

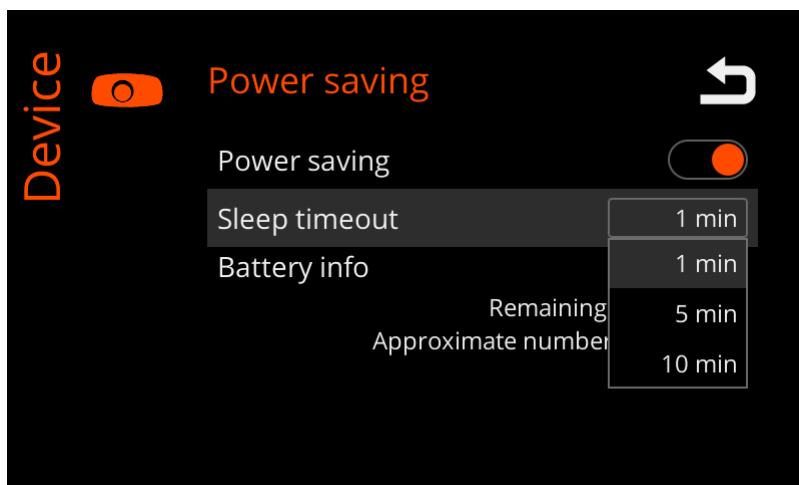


Figure 130: Selecting the Sleep Timeout

Disabling Power Saving

3. To disable power saving:
 - a) Slide the **Power saving** slider to the **OFF** position.
4. When done, press the **BACK** button  to return to the **Settings** screen.

2.8.6 Advanced Settings

This section describes how to view and modify the Specim IQ settings.

You can open the advanced settings view by pressing the **SET** button, and selecting **Device > Advanced settings**.

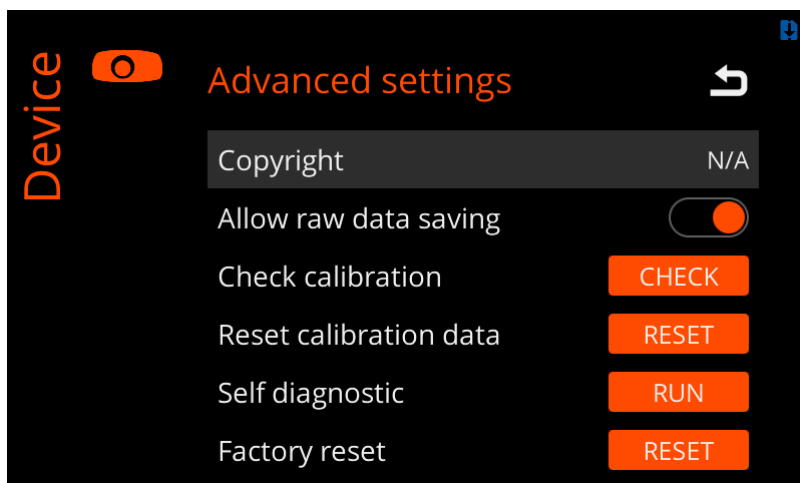


Figure 131: Advanced Settings View

2.8.6.1 Allow Raw Data Saving

This section describes how to only save raw data on Specim IQ.

Raw data refers to the unprocessed data from the image sensor.

If you allow raw data saving, you can press the **Custom 1** button in the quick data validation screen (see [Quick Data Validation](#)), which is opened after you have recorded the data, to save RAW data only. In other words, reflectance data is not saved.

By default, raw data is always saved to the dataset folder, on *DRM*, *ASM* and *AM* workflows. See [Dataset](#).

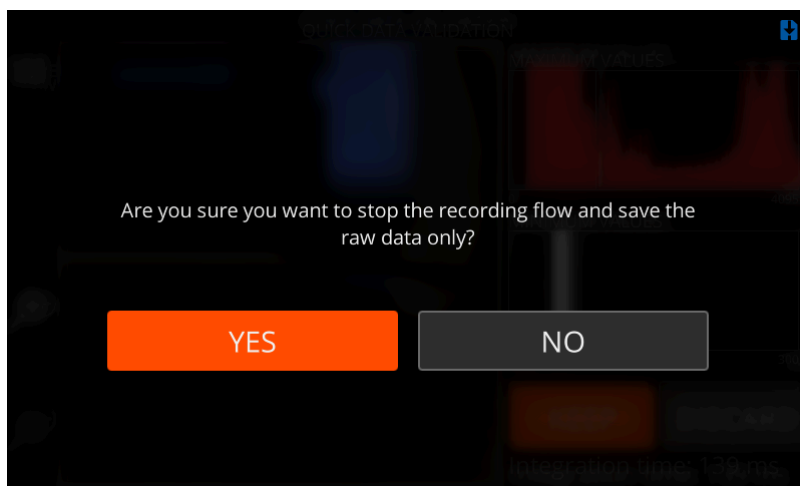


Figure 132: Saving Raw Data Only

Proceed as follows:

1. Press the **SET** button, and select **Device > Advanced settings**.

The screen below is opened:

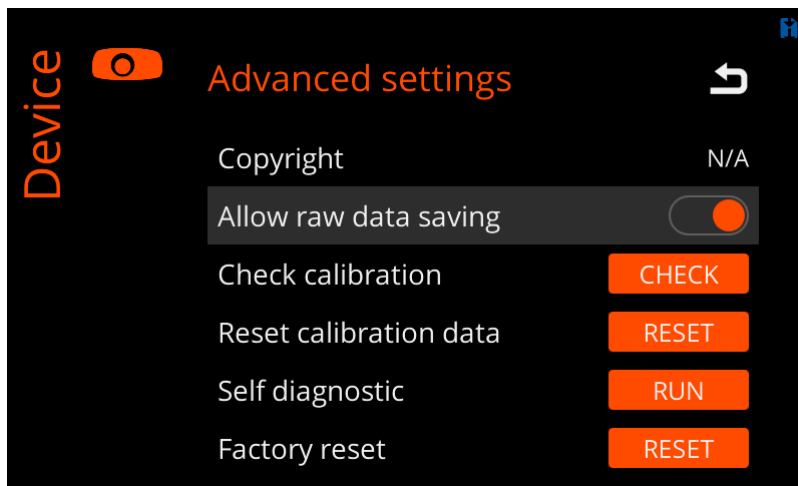


Figure 133: Allow Raw Data Saving

2. You can allow or deny raw data saving by toggling the **Allow raw data saving** slider.

2.8.6.2 Check Calibration

This section describes how to check the Specim IQ calibration.



Note:

Specim IQ is paired up with the calibration tile provided in the same sales box. Do not lose this tile!

Calibration check verifies that the calibration of the camera spectral range is correct. Incorrect spectral range leads to unreliable data.

A calibration check request is shown 30 days after the latest calibration check. If you skip the calibration check, a new request will be shown after three days.

Before you start, make sure that you have:

- Calibration tile
- White reference panel
- Sufficient illumination

Proceed as follows:

1. Switch on the camera.
2. Press the **SET** button, and select **Device > Advanced settings > Check calibration**.

The screen below is opened:

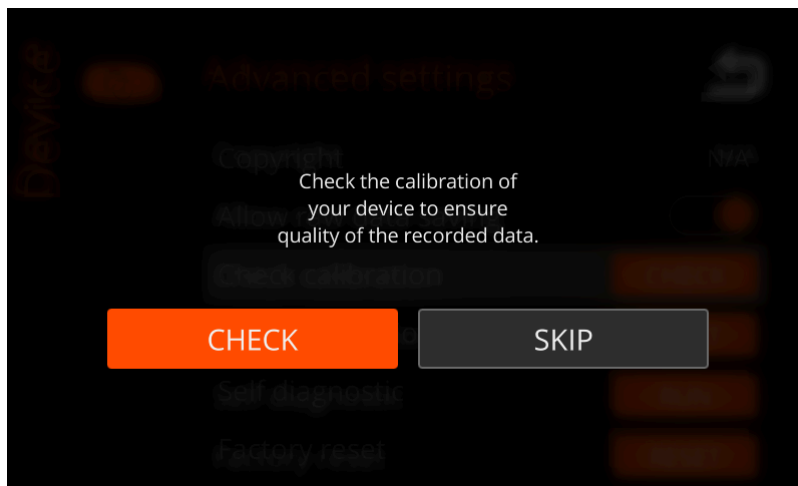


Figure 134: Check Calibration

3. Select **CHECK**
4. Select **OK**.
5. Cover half of the white reference with the calibration tile.

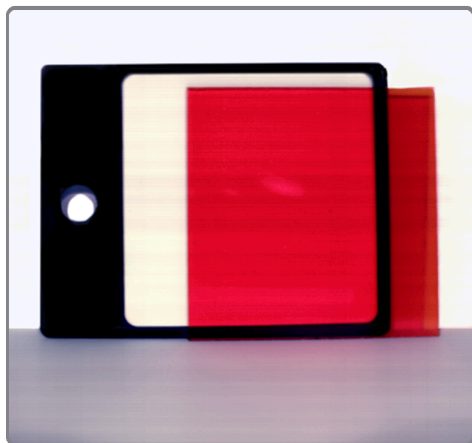


Figure 135: White Reference Covered

6. Half-press the **SHUTTER** button to make the data recording settings.

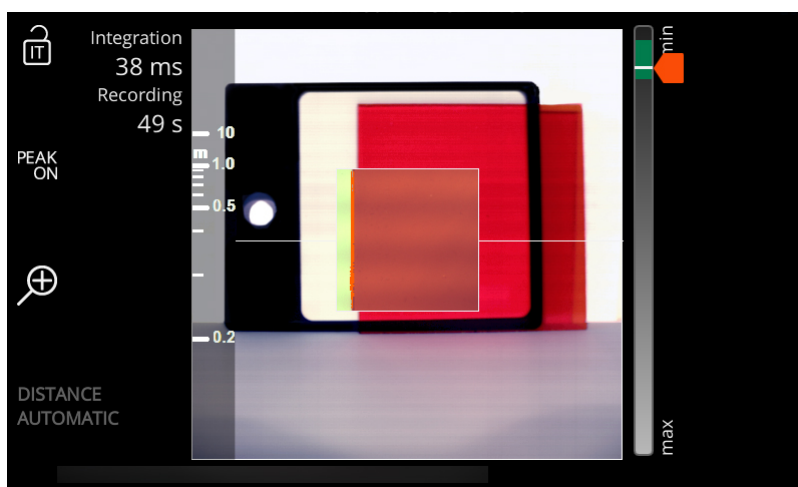


Figure 136: Data recording settings

See also [Defining Data Recording Settings](#).

7. Record the data by fully pressing the **SHUTTER** button.

8. Validate and check data quality from the image preview and the intensity histograms.

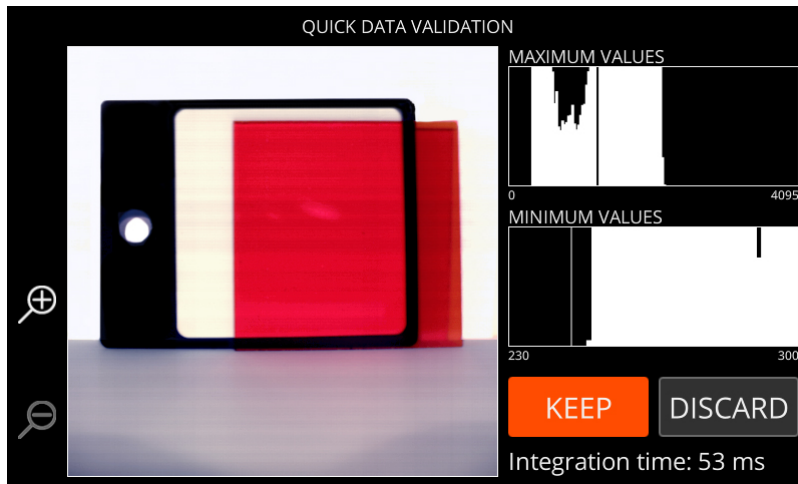


Figure 137: Validating the Data

See also [Quick Data Validation](#).

If:

- The quality is good, select **KEEP** and continue this procedure.
 - If you want to discard the data, select **DISCARD**, and record new data.
9. Use the intensity slider to help select the correct white reference area. Select the area by touching it on the screen and select **SET**.

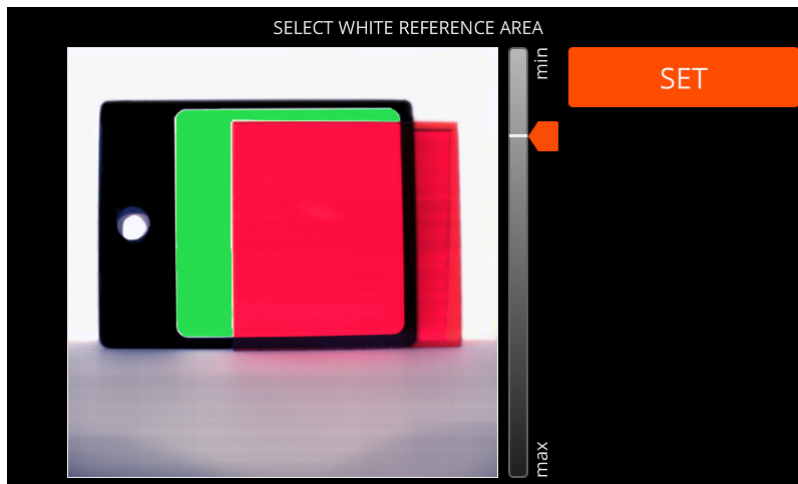


Figure 138: Selecting the White Reference Area

See also [Selecting the White Reference Area for DRM](#).

10. Select the focus area by touching an orange area on the screen and select **OK**.

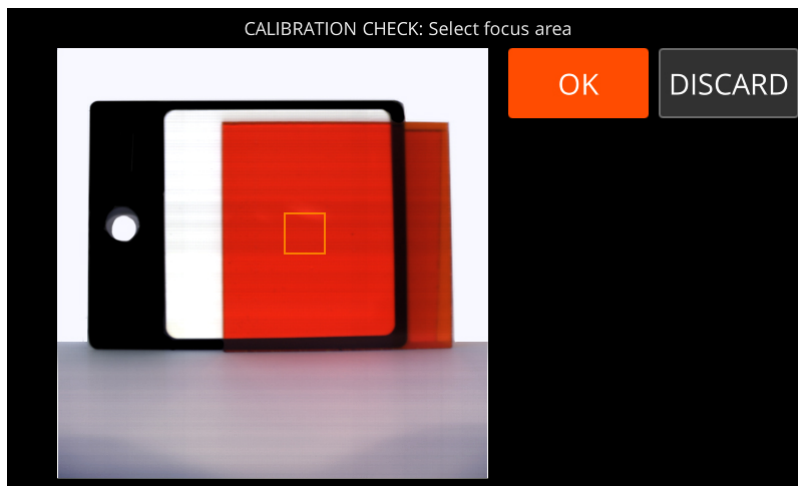


Figure 139: Selecting the Focus Area

An orange square appears to visualize the selection. Make sure that the selection is fully on top of the Calibration Tile that overlays the White Reference panel.

11. Wait until checking the calibration is finished.

12. If checking the calibration:

- Succeeds, the screen below is opened:

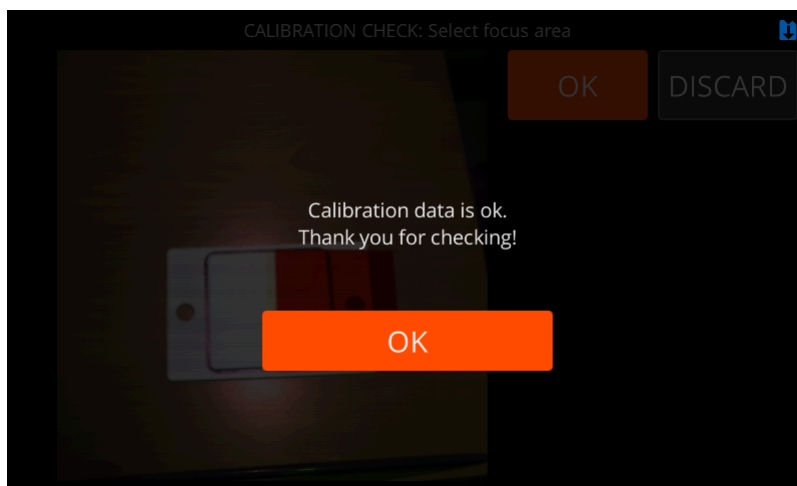


Figure 140: Calibration Checked Successfully

Select **OK**.

- Fails, the screen below is opened:

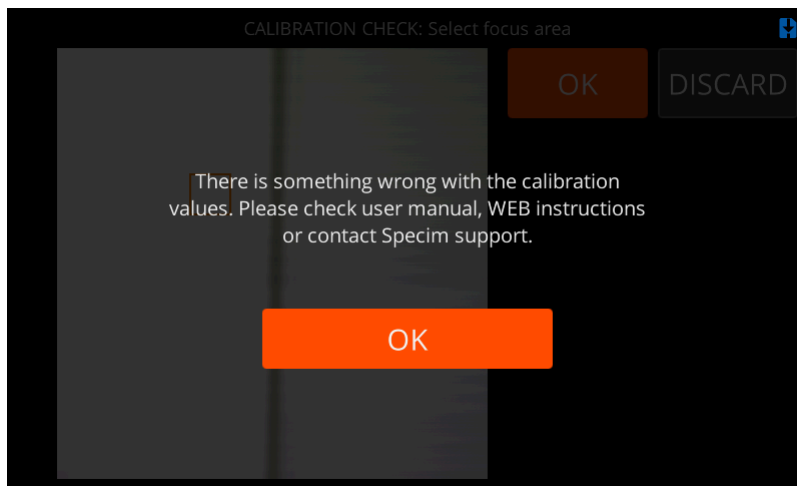


Figure 141: Calibration Failed

Select **OK**.

If calibration fails, reset calibration data. See [Reset Calibration Data](#)

Related Tasks

[Reset Calibration Data](#)

This section describes how to reset the calibration data on Specim IQ.

2.8.6.3 Reset Calibration Data

This section describes how to reset the calibration data on Specim IQ.

If the calibration check result deviates from the factory calibration value, reset the calibration data. Resetting the calibration data sets a new value, which will be used for calibration checks. If the new value deviates too much from the original, the camera will display an error message, and you should send the camera to Specim for re-calibration.

Proceed as follows:

1. Press the **SET** button, and select **Device > Advanced settings > Reset calibration data > RESET**.
2. If there is no need to reset the calibration data, the screen below is opened.

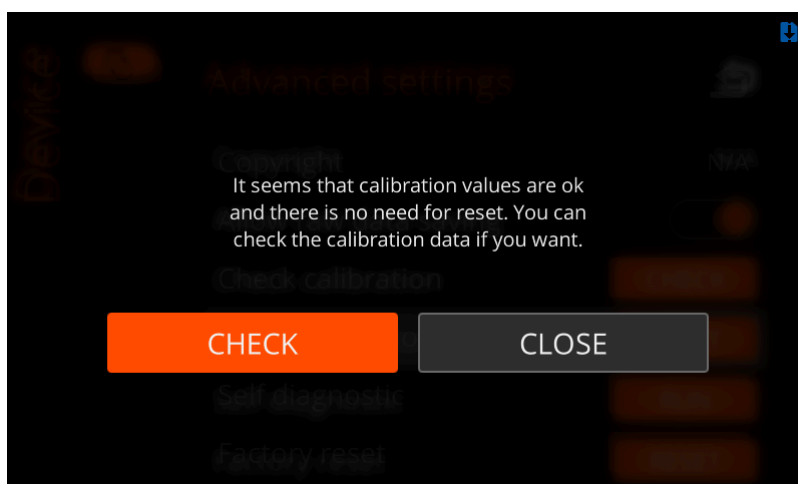


Figure 142: No Need to Reset Calibration Data

Select:

- **CHECK** to check calibration. See [Check Calibration](#).
- **CLOSE** to return to **Advanced settings**.

3. If there is need to reset the calibration data, the resetting procedure begins.

Related Tasks

[Check Calibration](#)

This section describes how to check the Specim IQ calibration.

2.8.6.4 Self Diagnostic

This section describes how to carry out the self-check procedure for Specim IQ.

Self diagnostic is a tool for Specim support personnel. It is used for remote troubleshooting of the camera. Run the self diagnostic procedure only upon request by the Specim support personnel.

Proceed as follows:

1. Press the **SET** button, and select **Device > Advanced settings > Self diagnostic > RUN**.
2. Place the device on a horizontal flat surface.
3. When the system asks for confirmation, select **OK**.

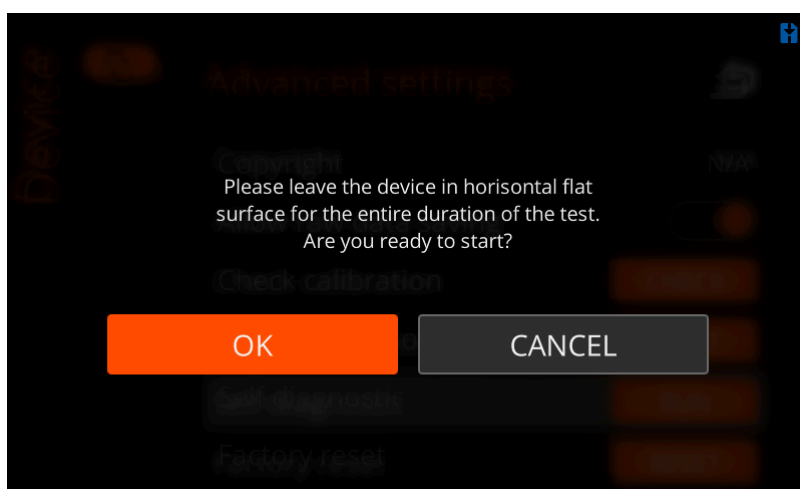


Figure 143: Self Diagnostic

The system runs the self-check procedure and reports on the results on the user interface.

4. If the procedure:
 - Fails, the screen below opened:

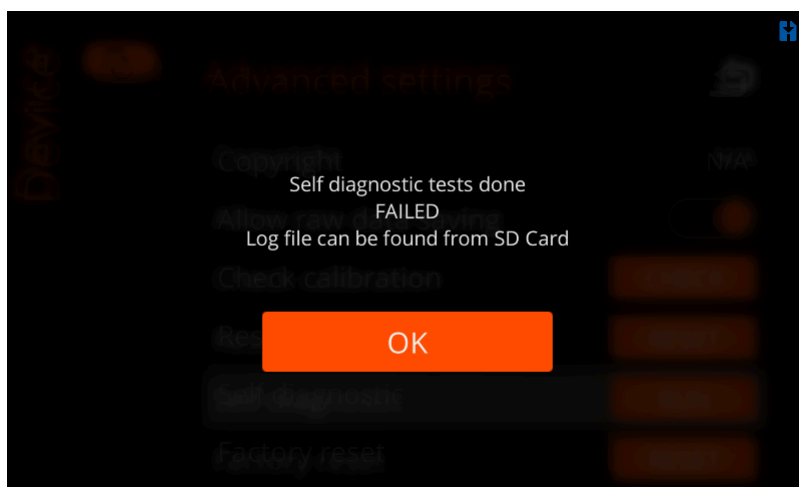


Figure 144: Failed Self Diagnostic

Select **OK** and continue by viewing the log file saved on the memory card. You must view the log on a text editor on your computer.

- Succeeds, the screen below opened:

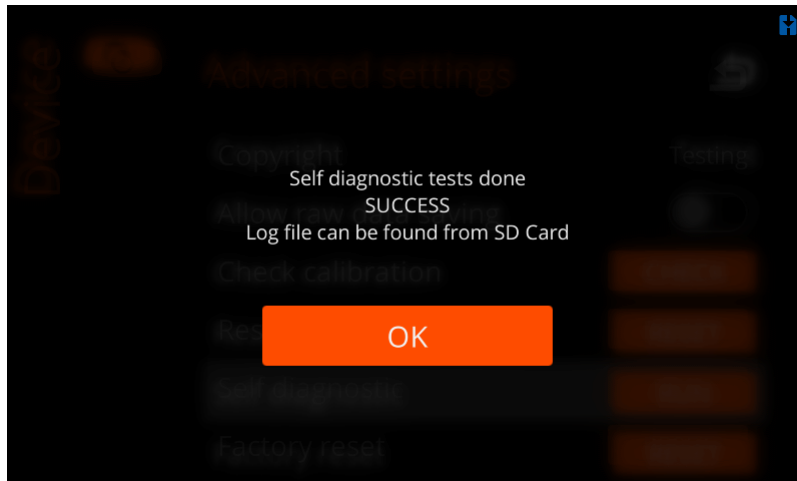


Figure 145: Succeeded Self Diagnostic

Select **OK** to return to **Advanced settings**.

2.8.6.5 Factory Reset

This section describes how to factory reset your Specim IQ.

A factory reset returns all settings and customizations to the original factory settings, and the uploaded applications, custom white references and so on, will be erased.

Proceed as follows:

1. Press the **SET** button, and select **Device > Advanced settings > Factory reset**.

The screen below is opened:

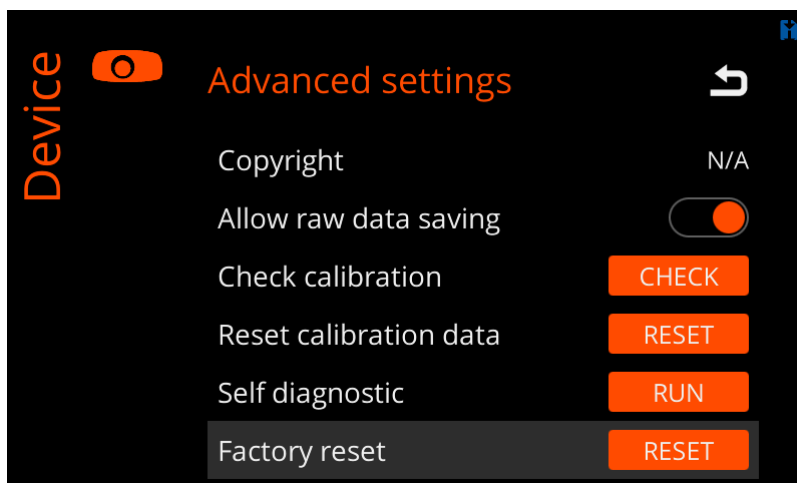


Figure 146: Factory Reset

2. Select **RESET**

The system asks for your confirmation, before deleting any data.

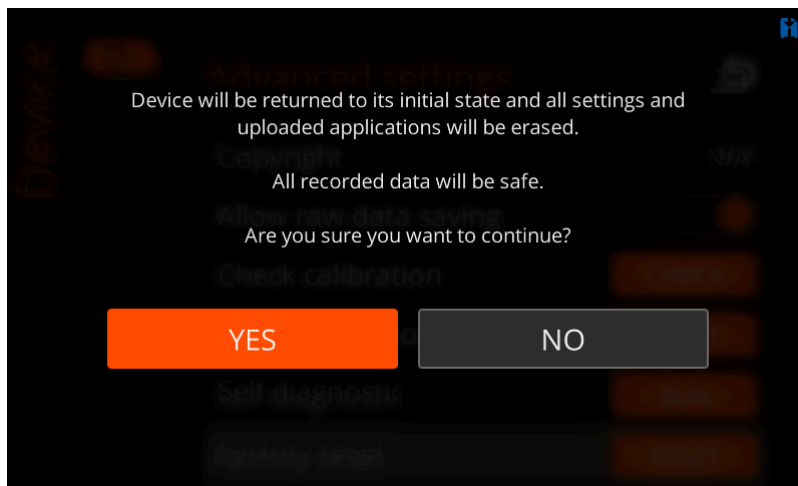


Figure 147: Factory Reset Confirmation

Select:

- **YES** to proceed with the resetting.
- **NO** to return to **Advanced settings**.

3. If you selected **YES**, the resetting procedure begins.

2.8.7 Connectivity

1. Press the **SET** button and select **Connectivity**.

The screen below is opened:

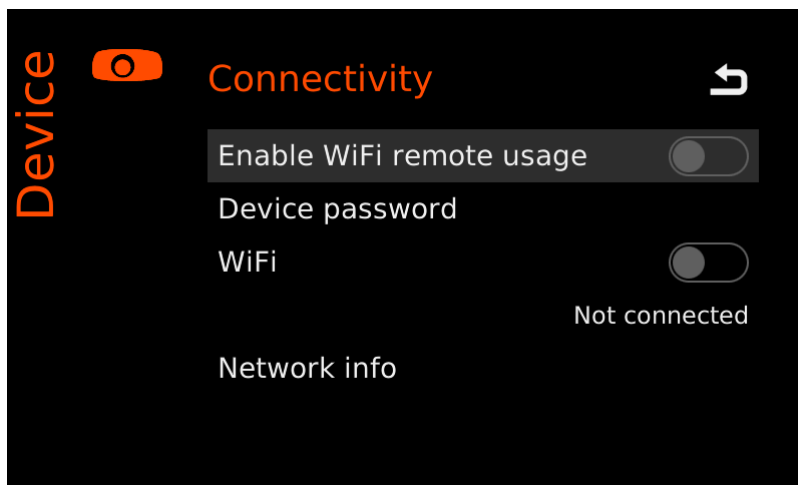


Figure 148: Connectivity main view

2. Slide the **Enable remote usage** slider to enable the remote use.

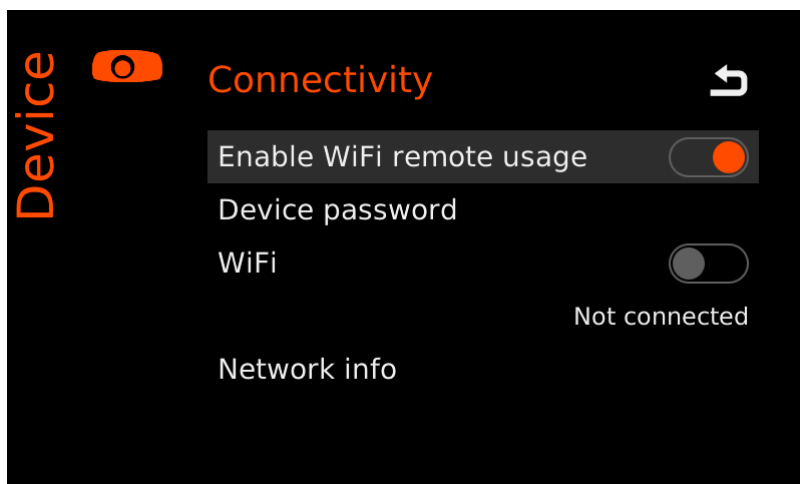


Figure 149: Enable remote use

3. Define a password for the remote session (OPTIONAL).

Select **Remote password**, type the desired password and select **OK**. Use the slider to define if the defined password can be seen in the Connectivity menu.

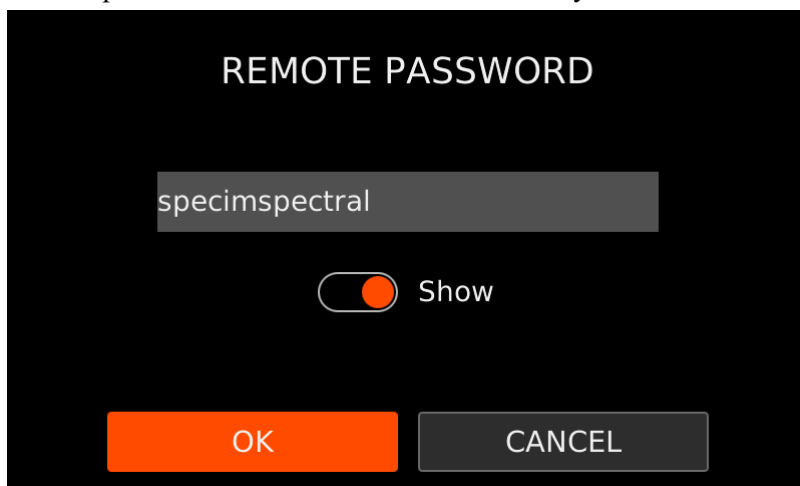


Figure 150: Defining remote password

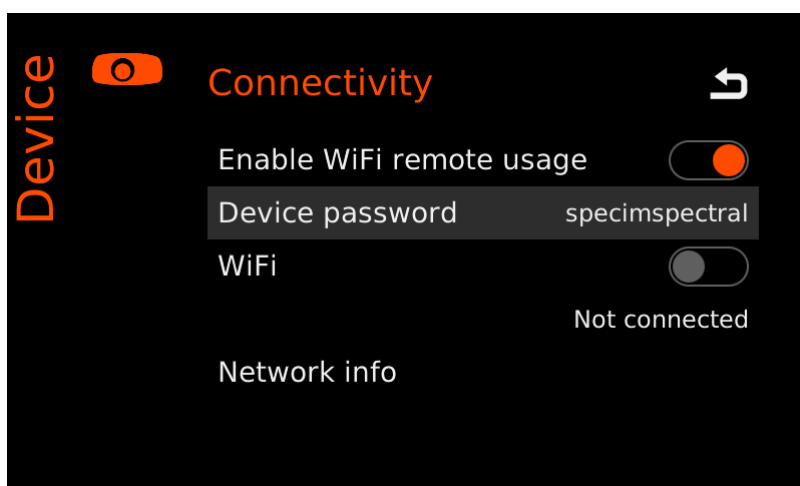


Figure 151: Remote password defined and visible

4. Slide the **WiFi** slider to see the available networks.

Join the same network with the computer, from which you are operating the Specim IQ Studio. Select the desired Network and press Connect. Provide a Network Password if required.

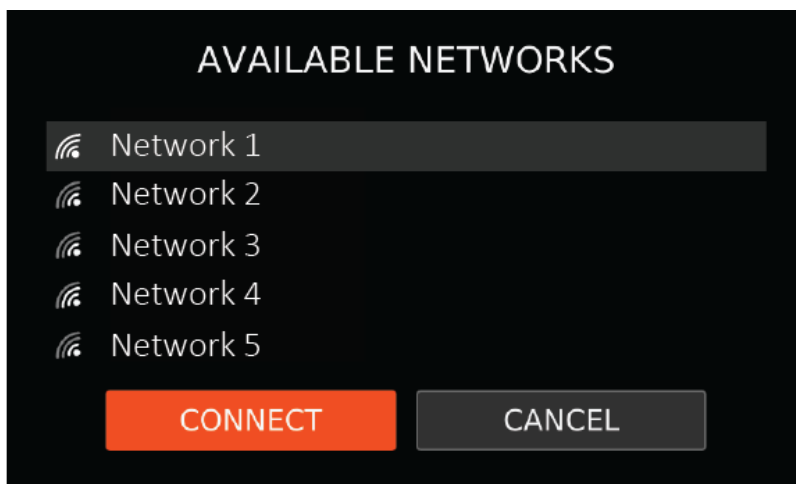


Figure 152: Selecting the desired network

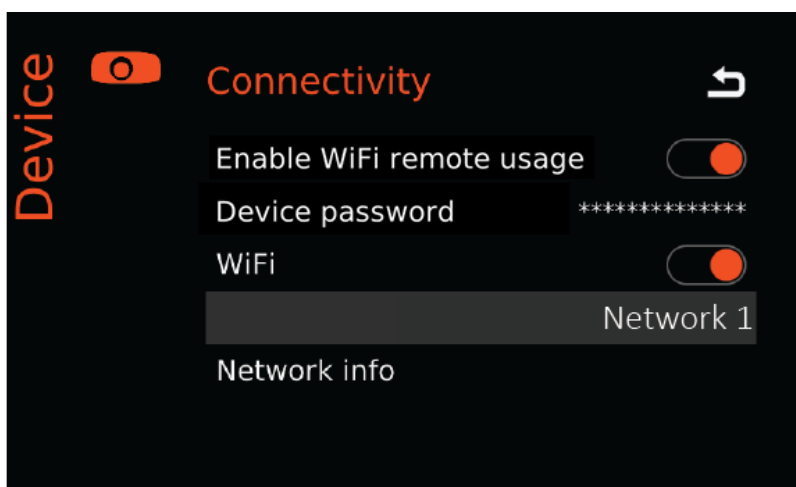


Figure 153: WiFi network connected

2.8.8 Dataset Naming

This section describes how to edit dataset naming settings in Specim IQ.

The dataset naming is set by default to a format YYYY-MM-DD-001, where the last numbers are running.

You can change the dataset naming format with the following options:

- Prefix
- Include date
- Suffix/Define numbering start

Therefore, the possible dataset naming combination are:

- Prefix + Date + Number (e.g. Device1_2018-12-10_012)
- Prefix + Number (e.g. Device1_012)
- Date + Number (e.g. 2018-12-10_012)
- Number only: (e.g. 012)



Caution: Do not use special characters in dataset names, as they will render the dataset unusable. For more information, see [File Name Restrictions in IQ Studio](#)

To change the dataset naming, proceed as follows:

1. Press the **SET** button and select **Device > Dataset naming**.

The screen below is opened:



Figure 154: Dataset naming main view

2. Select **Prefix** to add prefix in dataset numbering

The screen below is opened:

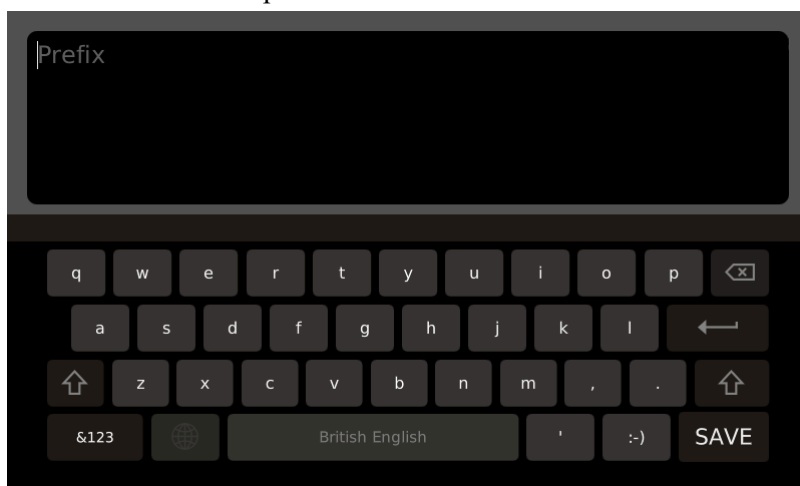


Figure 155: Defining the prefix

- a. Type in the desired prefix that will appear in the beginning of the dataset names.

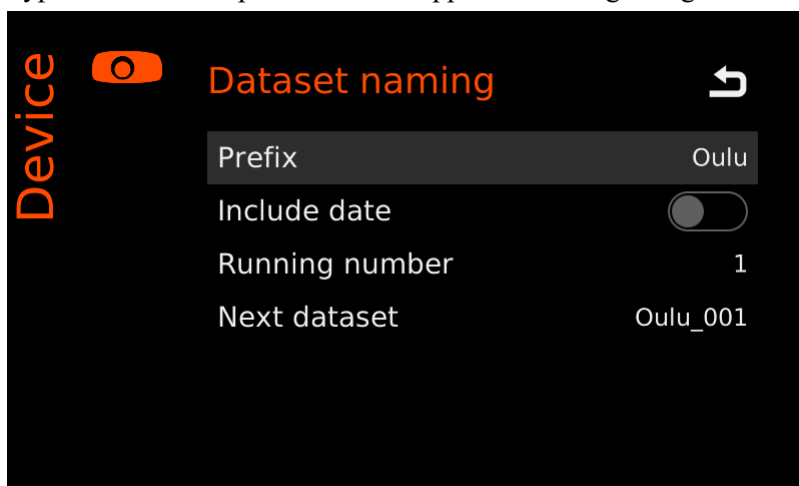


Figure 156: Prefix defined

- b. Select **SAVE** when ready.
3. Use **Include date** slider to include/exclude date.

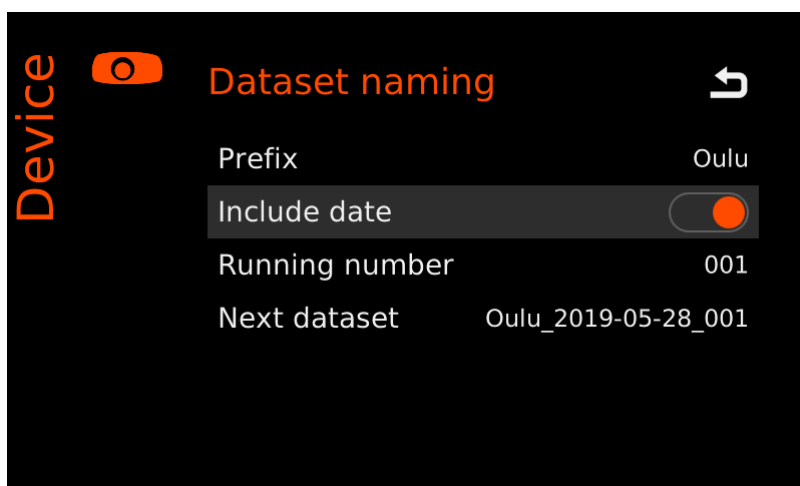


Figure 157: Date included in the dataset name

4. Select **Suffix** to use numbering in the dataset names.

The screen below is opened:

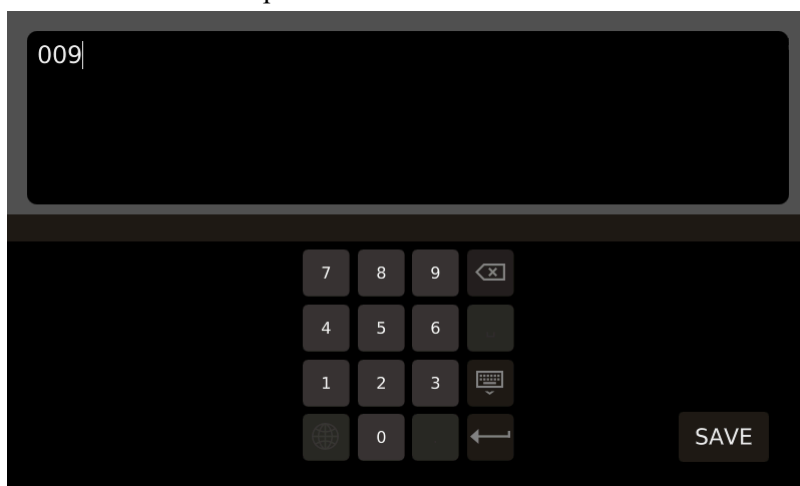


Figure 158: Dataset numbering

- a. Type the number from which the numbering will start.
- b. Select **SAVE** when ready.

Check the current dataset naming settings in the Naming format/Next dataset field.

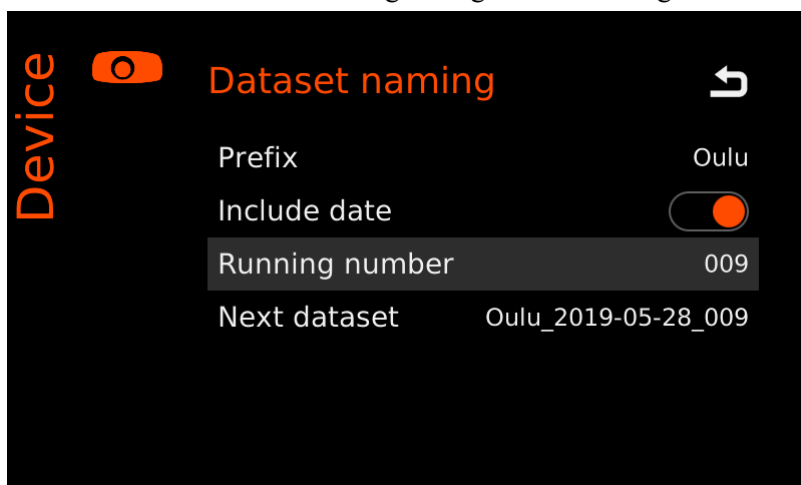


Figure 159: Dataset current naming settings

2.8.9 Viewing Camera Information

This section describes how to view device information on Specim IQ.

Proceed as follows:

1. Switch on the camera.
2. Press the **SET** button, and select **Device > About**.

The screen below is opened:

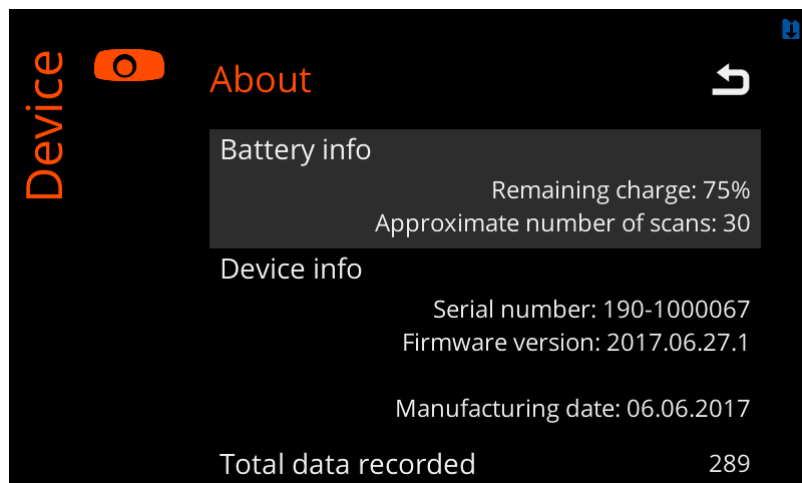


Figure 160: About Specim IQ - Screen 1

Information is provided as follows:

- **Battery info**
 - **Remaining charge** — This field indicates the remaining charge of the battery, in percentage from 0% to 100%.
 - **Approximate number of scans** — This field indicates the estimated number of scans you can make without recharging the battery.
- **Device info**
 - **Firmware version** — This field indicates the firmware version installed on the camera.
 - **Serial number** — This field indicates the serial number of the camera.
 - **Manufacturing date** — This field indicates the manufacturing date of the camera.
- **Total data recorded** — This field indicates the number of scans that have been made with this camera.

3. Press the **DOWN** button to see more information.

The screen below is opened:

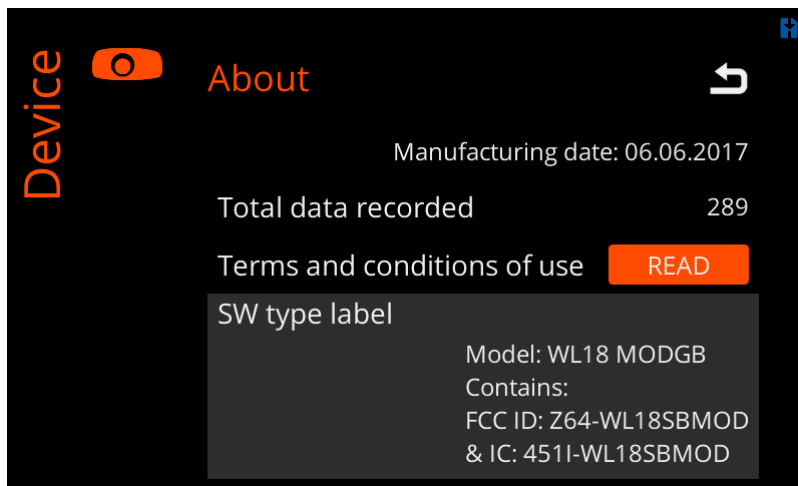


Figure 161: About Specim IQ - Screen 2

Information is provided as follows:

- **Terms and conditions of use**
Select **READ** to read the terms and conditions of use. You must accept the terms to use the camera.
- **SW type label**— The camera type label. The physical type label is at the bottom of the camera.

2.8.10 Adjusting the Display Brightness

This section describes how to adjust the Specim IQ display brightness.

The default value of display brightness is 80%.



Note:

Increasing the brightness will affect the battery life time.

Proceed as follows:

1. In the viewfinder, press the **SET** button.

The screen below is opened:

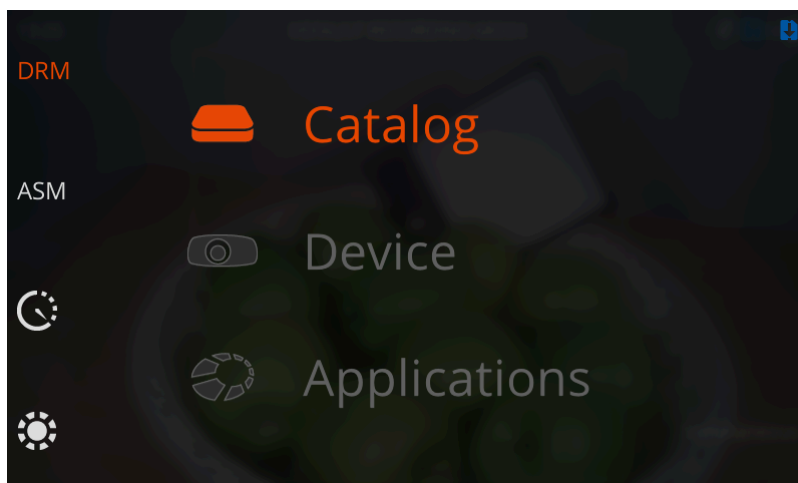


Figure 162: Menu view

2. Press the **Custom 4** button.

The screen below is opened:

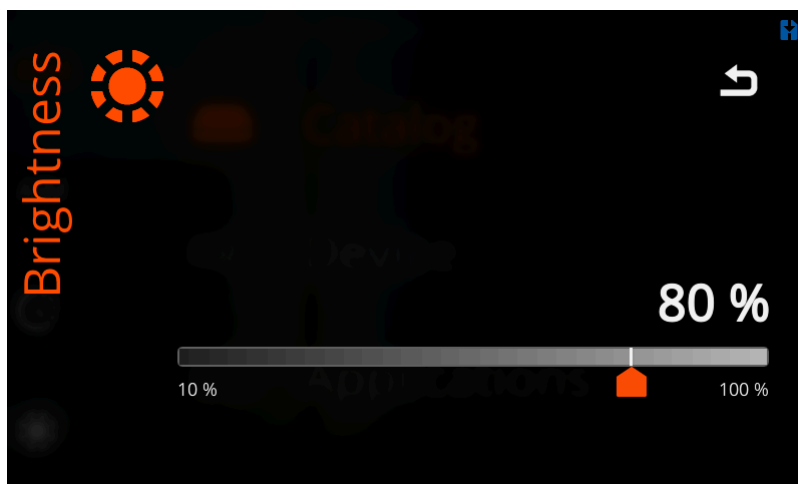


Figure 163: Adjusting the Display Brightness

The current brightness setting is indicated in percentage from 10% to 100%.

3. You can adjust the display brightness either by:
 - Sliding the slider on the touch screen.
 - Using the **LEFT** and **RIGHT** buttons.
4. When done, press the:
 - **BACK** button to return to the menu.
 - **SHUTTER** button to return to the viewfinder.

2.9 Maintenance Guide

This chapter describes how to maintain Specim IQ.

2.9.1 Cleaning the Camera Body and Lens

This section describes how to keep Specim IQ clean.

Proceed as follows:

1. Clean the camera body with a non-linting cleaning cloth.
2. If cleaning with a non-linting cleaning cloth is not sufficient enough, clean your camera body with:
 - Wipes pre-moistened with isopropanol.
 - A non-linting cleaning cloth. Dampen the cloth with distilled water or isopropanol, before cleaning the body.
3. Clean the lens with wipes pre-moistened with isopropanol.

2.9.2 Cleaning the White Reference

This section describes how to keep white reference clean.

Proceed as follows:

1. Blow the white reference with clean air / nitrogen.



Note: DO NOT use Freon.

2. If clean air / nitrogen blowing is not sufficient enough, clean the white reference with:
 - Wiping with pure alcohol moistened wipes.

- Wet sanding under running, lukewarm tap water with Grit 180-240 waterproof sand paper.
3. Leave the white reference to dry or blow-dry with clean air/nitrogen.

2.9.3 Troubleshooting

This section provides troubleshooting instructions for Specim IQ.

Table 3: Troubleshooting

Symptom	Solution
Data has not been saved on the memory card.	The memory card has been removed too soon from Specim IQ. Check that the memory card is unlocked.
Specim IQ does not start.	Check that: • The battery has been inserted in the correct way. • There is power in the battery, by placing the battery on the charger. • The battery poles and cover are undamaged.
Connection to the PC cannot be established.	Check that: • The cables are connected and undamaged. • The USB drivers are installed on your PC. • Specim IQ is ON.
Picture is not sharp.	• Camera has moved during exposure. • Re-focus the objective. • Clean the lens.
Picture is too dark or completely dark.	• Improve the illumination. • Check data recording settings and data validation.
Picture has stripes.	Stripes have no effect on Specim IQ performance.
Specim IQ freezes.	Proceed as follows: 1. Remove the battery. 2. Keep the device OFF for, at least, 30 seconds. 3. Insert the battery. 4. Start the device.
Touch screen does not work.	The four custom keys have symbols on the screen, but these symbols are not on the touchable screen area. Use custom keys as physical buttons only.
On the data recording settings screen, there is a black box in the middle of the spectral image area.	The box in the middle of the spectral image area is the focus camera area. If this area is black, you have the lens cover on.

Symptom	Solution
Specim IQ does not record data.	The SHUTTER button is a two-function button. When you press the button halfway, the Data recording settings screen is opened. Set the integration time, after which you can record data by fully pressing the SHUTTER button.
Specim IQ Studio does not find my dataset.	Check the dataset file name for special characters. If you have used special characters (see File Name Restrictions in IQ Studio), contact Specim.

2.9.4 Updating Firmware

This section describes how to update the Specim IQ firmware.



Note: Always use the latest available software versions.

Proceed as follows:

1. Switch the device off.

See [Powering ON and Powering OFF](#).

2. Remove the memory card from the device.

See [Inserting and Ejecting the Memory Card](#).

3. Download the new firmware.

The firmware consists of two files:

- An image file (`system.img`)
- An algorithm file (`flash-algo.fit`)

4. Unzip and copy the new firmware files onto the root of the memory card.

5. Insert the memory card into the device.

See [Inserting and Ejecting the Memory Card](#).

6. Simultaneously press and hold the **Custom 1** and **Power** buttons until you hear a beep and the device powers on.

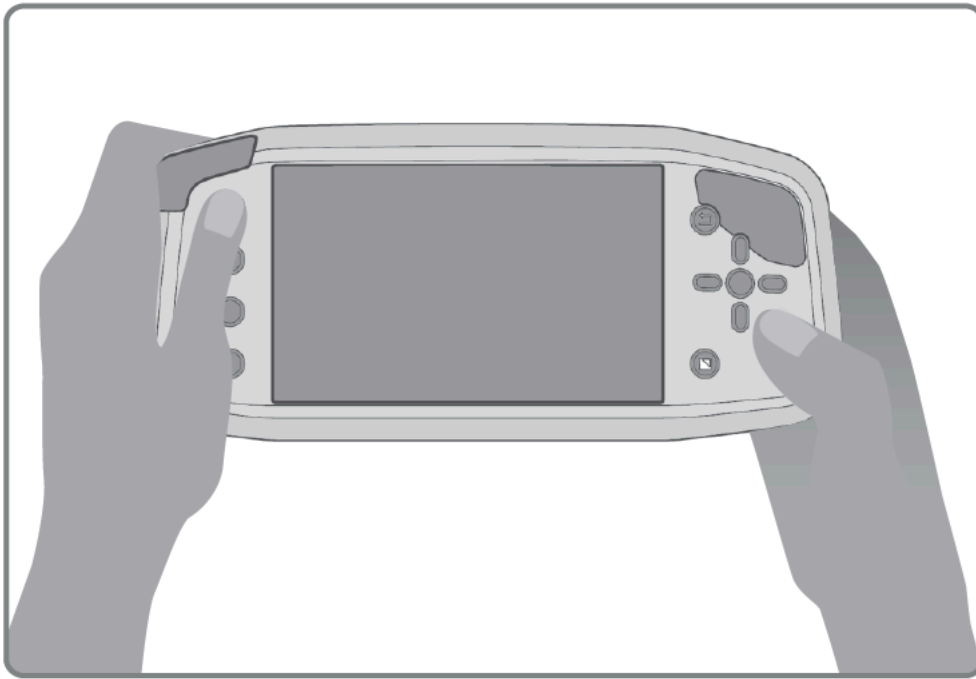


Figure 164: Device update

The firmware update begins.

7. Wait until you see the **TERMS AND CONDITIONS OF USE** screen.

The screen below is opened:

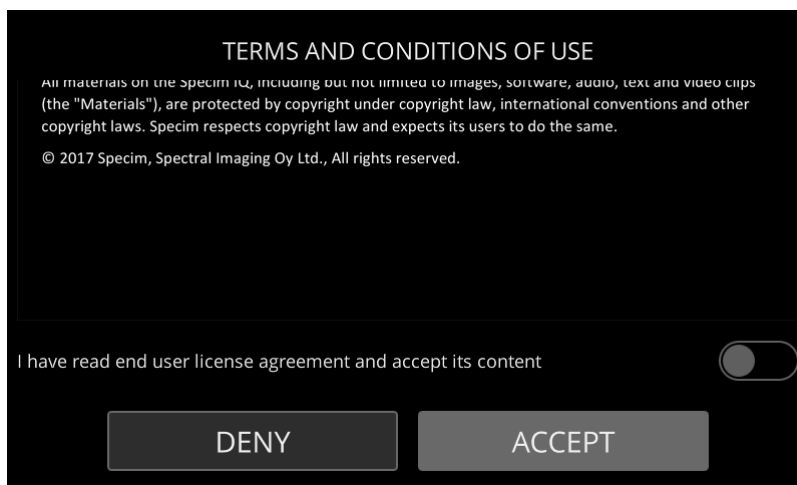


Figure 165: Terms and Conditions of Use

8. Slide the **I have read end-user license agreement and accept its content** slider to the ON position.

The screen below is opened:

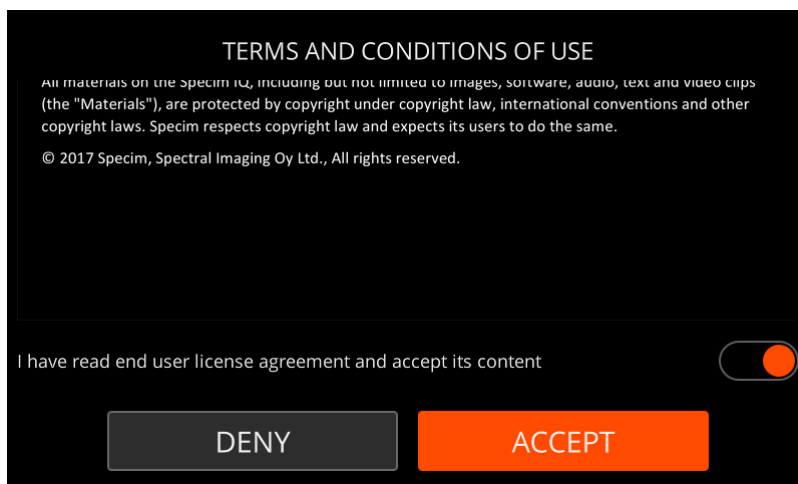


Figure 166: Accepting Terms and Conditions of Use

9. Select .

- **ACCEPT** to accept the license terms, and continue.
- **DENY** to shut down the device.

You must accept the terms of the end user license agreement to use the camera.

Specim IQ Studio it will automatically let you know about the available updates for Specim IQ and Specim IQ Studio, and offer a link to the installation files.

2.10 Specifications

This chapter contains the Specim IQ specifications.

Main Specifications

SPECIM IQ MAIN FEATURES
Spectral camera
Viewfinder camera
Focus camera
Scanner & motor
Embedded data processing unit
Operating software for data acquisition and processing
Replaceable data storage
Touch screen display and physical buttons
Rechargeable battery power supply
SPECIM IQ MAIN FUNCTIONALITIES

IQ operational modes	Default recording mode Automatic Screening mode Application mode (user definable) Time lapse mode
User adjustments	Integration time adjustment Focus adjustment (manual) Metadata and tag addition
Data format	Specim Dataset with ENVI compatible data files
Data export	With SD card or through USB connection
Operational time	Appx. 100 measurement with one SD card and battery.

Hardware Specifications

DEVICE OPERATION	
User interface SW	Specim
DEVICE HARDWARE	
Viewfinder camera	5 Mpix (rescaled to 1280*960 pixels)
Focus camera	1.3 Mpix
Spectral camera	Specim
Sd-card reader	UHS-1 SD (Max. 32 GB SD memory card)
Processor	NVIDIA Tegra K1
Cpu	Kepler Mobile
Memory	2GBytes DDR3L RAM and 8GB EMMC
Gps module	U-BLOX GPS/GNSS MAX-M8Q-0
Operating voltage	3.7 V
Battery	5200mAh Li-Ion battery (Type 26650)
USER INTERFACE	
Buttons	12+1 physical buttons
Display & keyboard	4.3" touch screen
Buzzer	Indication sounds for the user
Usb connector	USB Type-C
DIMENSIONS	
Size	207 x 91 x 74 mm (depth with lens 125,5 mm)
Weight	1.3 kg

Camera Specifications

OPTICAL	
Wavelength band	400 – 1000 nm
F/number at Sensor	F/1.7
F/number at Slit	F/2.2
Magnification (Sensor / Slit)	1/1.3
Keystone	Corrected
Smile	Corrected
Spectral resolution	7 nm
Slit Length	11.70 mm
Slit Height	42 µm
SENSOR	
Sensor type	CMOS
Spatial Sampling	512 pix
Spectral Bands	204 (with Bin 2x: 102, Bin 3x: 68)
Image resolution	512 x 512 pix
Pixel size	17.58 x 17.58 µm
Data output	12 bit
QE peak	>45 %
Full-well capacity	>32000 e-
Peak SNR	> 400 : 1
OBJECTIVE / FRONT LENS	
Working distance	150 - ∞ mm
Focal length	21 mm
F/number at Slit	F/2.2
Full field of view (FOV)	31 x 31 deg
Full field of view (FOV) at 1 m	0.55 x 0.55 m
Filter thread	M40.5 x 0,5

Environmental Specifications

DEVICE OPERATION	
Temperature, operational	+5°C - +40°C
Temperature, storage	-20°C - +50°C
Humidity operational	95% non-condensing

3 Specim IQ Studio User Manual

Specim IQ Studio and instructions for using it.

Specim IQ Studio is software for the Specim IQ, and other hyperspectral imaging devices. IQ Studio allows you to import, export and manage hyperspectral data, manage Specim IQ settings, create new applications, models and reference spectrums. With the IQ Studio, it is also possible to save, load, import and export device profiles.

3.1 System Requirements

This chapter contains the system requirements for using Specim IQ Studio.

Operating system:

- 64-bit Windows 7 / Windows 10
- Processor: Quad-core
- RAM: 8Gb
- Hard disk: 600Mb*

*Software installation size, additional space requirement depends on the number of stored datasets

3.2 Installing and Updating Specim IQ Studio

This section describes how to install Specim IQ Studio. Make sure your system meets the requirements listed in [System Requirements](#).

Proceed as follows:

1. Download the software from the User Community at <http://www.specim.com/iq/downloads>.
2. Double-click the software installation executive.

The software installation wizard is opened, and the **Licence Agreement** screen is shown.

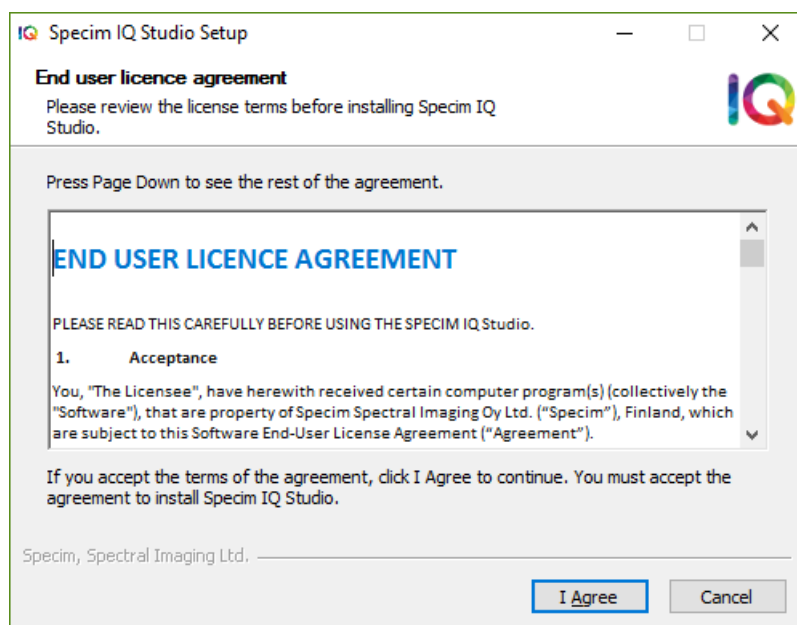


Figure 167: End User Licence Agreement

3. Select **I Agree**.

The **Choose Components** screen is shown.

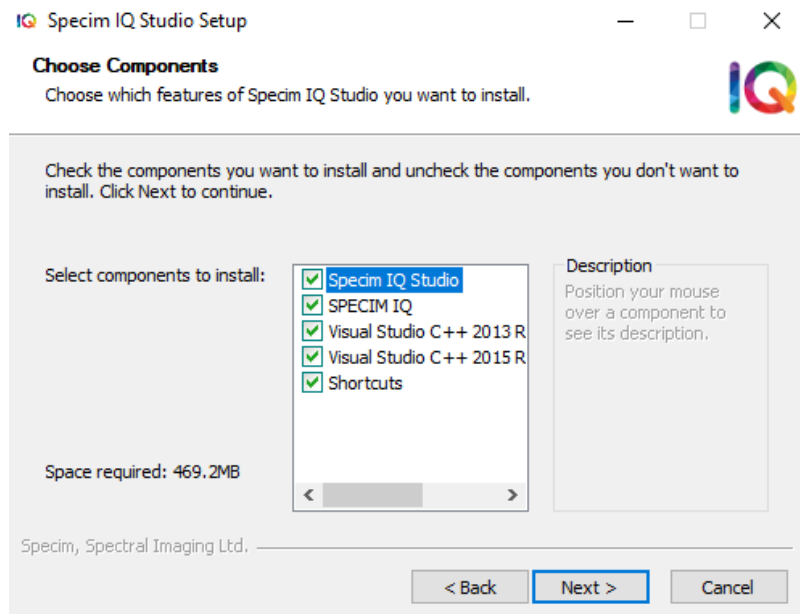


Figure 168: Choose Components

The components are:

- SPECIM IQ refers to the drivers used to identify the IQ camera, when it is connected to the computer.
- Visual Studio C++ components are software plugins required for using the IQ Studio on the computer.
- Shortcuts refers to a desktop shortcut to IQ Studio.

4. Accept the default values by selecting **Next**.

The **Choose Install Location** screen is shown.

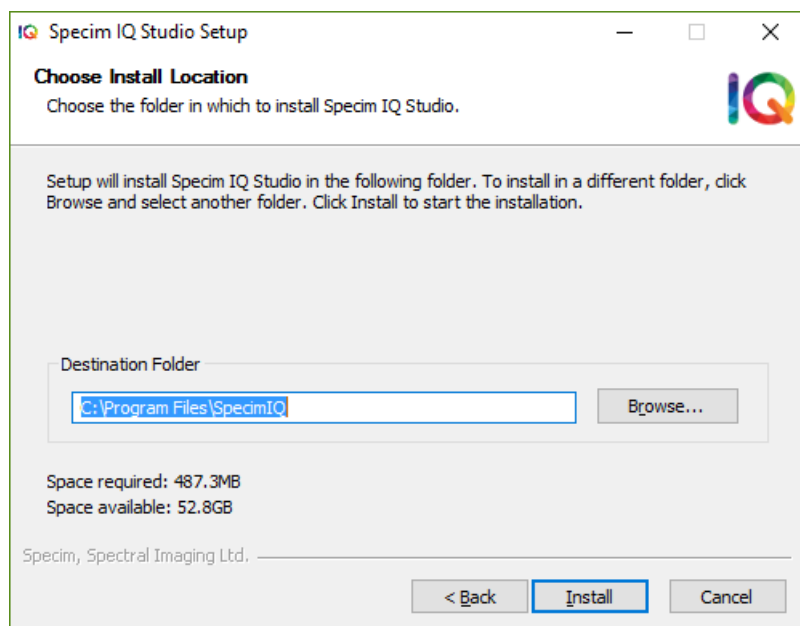


Figure 169: Choose Install Location

5. Accept the default values by selecting **Install**.

The **Installing** screen is shown.

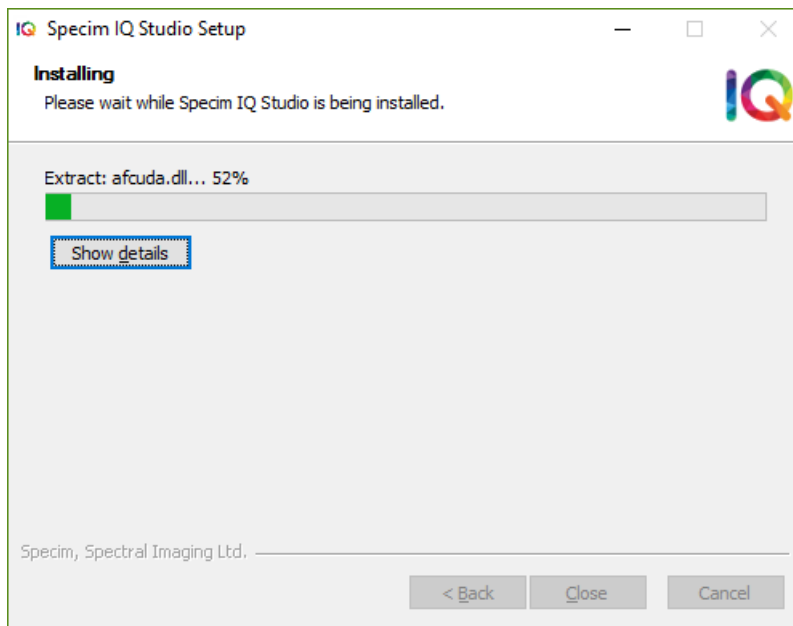


Figure 170: Installing

6. Install SPECIM IQ DRIVER.

The SPECIM IQ DRIVER installation screen is shown.

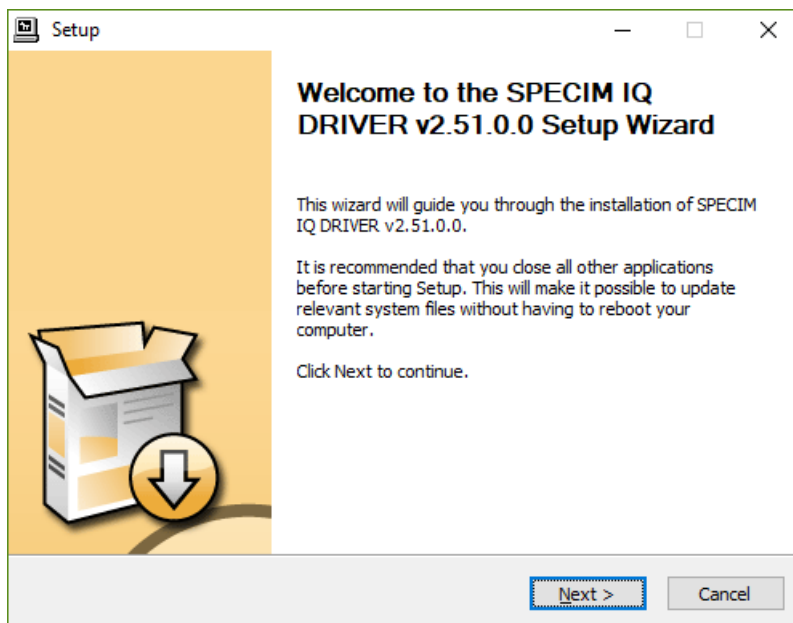


Figure 171: SPECIM IQ DRIVER Installation Screen

7. Accept the installation by selecting Next.

The **Choose Install Location** screen is shown.

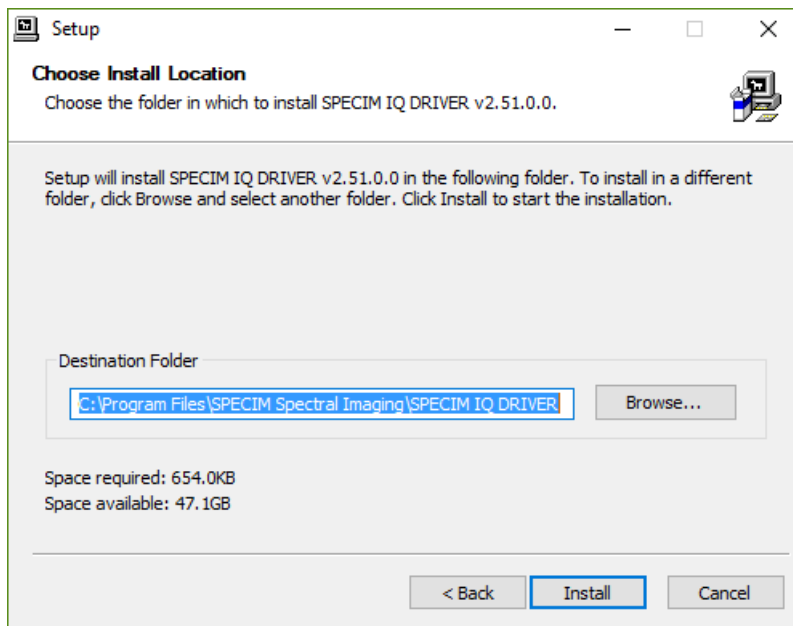


Figure 172: Choose Install Location

8. Accept the default values by selecting **Install**.

The **Installing** screen is shown.

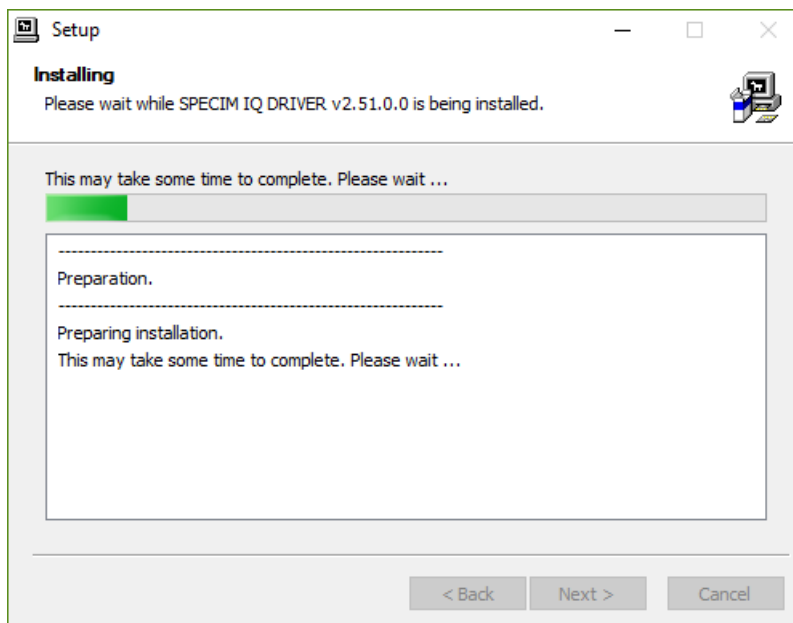


Figure 173: Installing SPECIM IQ DRIVER

9. Select **Next**.

The installation is complete.

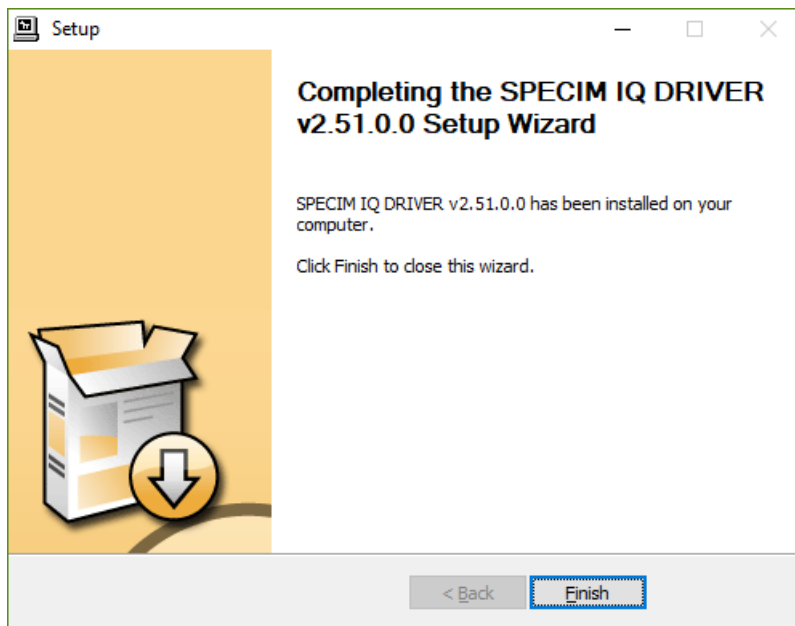


Figure 174: Completing the SPECIM IQ DRIVER Installation

10. Select Finish.

To complete the installation, you must disconnect and reconnect your Specim IQ device. You can do this now or later. Make your selection in the screen below. If Specim IQ was not connected to computer during software installation, you can choose Yes to exit the wizard and connect the device later.

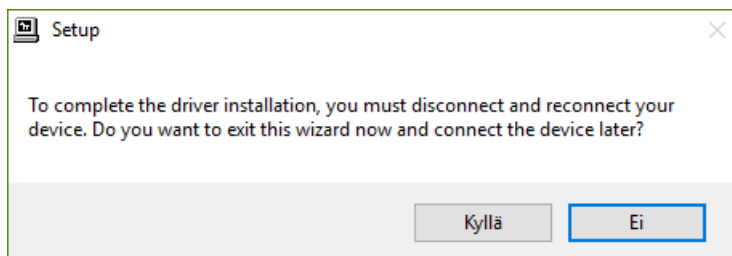


Figure 175: Disconnecting Specim IQ

11. When done, wait until the installation is complete.

The **Installation Complete** screen is shown.

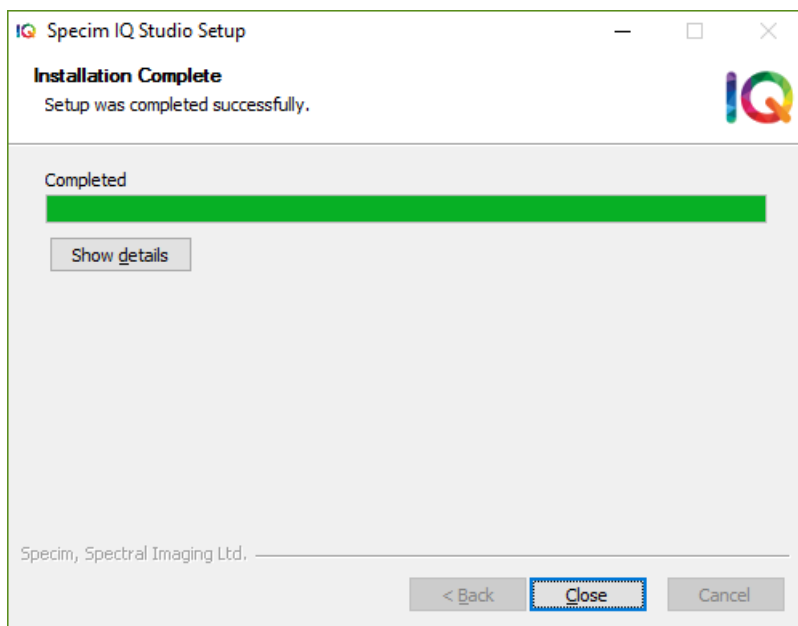


Figure 176: Installation Complete

12. Select **Close**.

13. The software is now ready for use.

Specim IQ Studio will automatically let you know about the available updates for Specim IQ and Specim IQ Studio, and offer a link to the installation files.

3.3 Software Concept

When you use the Specim IQ Studio software and Specim IQ, you will come across with a number of interrelated concepts as depicted in the figure below:

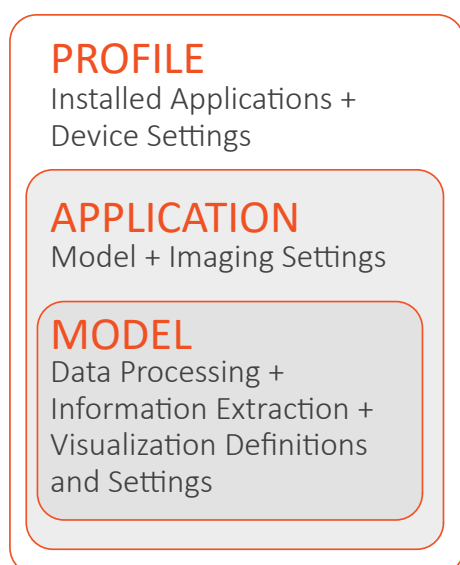


Figure 177: Software Concept

The concepts are:

- **Model** — Model is a non-editable executable that is exported from the model project, and can be imported to the application project.

Model project — Model project is a predefined workflow with a Graphical User Interface (GUI) in Specim IQ Studio to create data processing models. The model project is used within Specim IQ Studio to define the model, and it can be saved for future changes and needs.

- **Application** — Application is a non-editable executable that is exported from the application project, and can be run in the Specim IQ camera.

Application project — Application project is a pre-defined workflow with a GUI in Specim IQ Studio to create applications for the Specim IQ camera. The application project is used within Specim IQ Studio to define the application, and it can be saved for future changes and needs.

- **Profile** — A profile contains the device settings and a list of installed applications.

When you import a new profile to Specim IQ, the device settings will be overwritten, and the applications listed on the profile will be installed onto the device.

- **Spectral library** — Together with functions, spectral libraries are used as building blocks for models. In spectral imaging, we need information on the exact wavelengths that are reflected from various materials in various conditions. These sets of spectral reflectance information are called spectral libraries.

In Specim IQ Studio, you can create your own spectral libraries or import existing ones.

3.4 Specim IQ Studio User Interface

The figure below depicts the main page of the Specim IQ Studio user interface with the **CATALOG** view open.

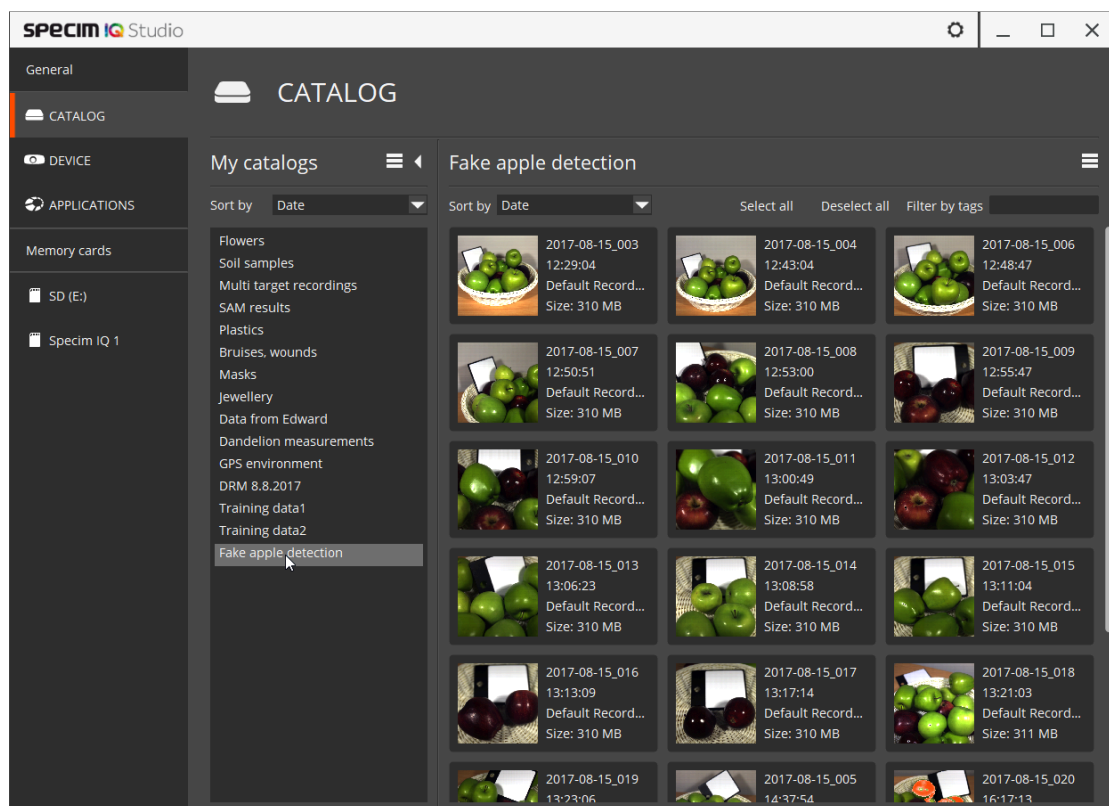


Figure 178: Main Page

The menu on the left contains links to the views where you can manage objects as follows:

- **CATALOG** — On this page, you can manage catalogs of pictures.
- **DEVICE** — On this page, you can manage the device connected to the PC on which the Specim IQ Studio software runs.
- **APPLICATIONS** — On this page, you can manage applications and models, and projects related to them.

The connected Specim IQs and SD cards in the memory card reader are shown below the main menu, under the **Memory cards** heading.



Tip:

Double-clicking an image opens it in the extended data view. See [Extended Data View](#).

3.4.1 Keyboard Shortcuts

You can use the keyboard shortcuts below on Specim IQ Studio

Shortcut	Action
CTRL + A	Select all
CTRL + click	Select individual items from a list
F2	Rename an item
Esc	Close a dialog

3.4.2 File Name Restrictions in IQ Studio

The characters below cannot be used on file names in IQ Studio:

- < — Less than
- > — Greater than
- = — Equal
- . — Full stop
- , — Comma
- : — Colon
- ; — Semicolon
- ' — Apostrophe
- " — Double quote
- / — Forward slash
- \ — Backslash
- | — Vertical bar or pipe
- ? — Question mark
- ! — Exclamation mark
- * — Asterisk
- # — Hash symbol
- & — Ampersand
- @ — Asperand
- § — Section sign
- ½ — Half symbol
- % — Percentage
- μ — Micro
- ~ — Tilde
- " — Overdots
- ` — Grave accent

- ' — Acute accent
- ^ — Circumflex
- £ — Pound symbol
- \$ — Dollar sign
- € — Euro
- ¢ — Currency sign
- (and) — Open and closed parenthesis
- { and } — Open and closed brace
- [and] — Open and closed bracket

For more information, see [https://msdn.microsoft.com/en-us/library/windows/desktop/aa365247\(v=vs.85\).aspx](https://msdn.microsoft.com/en-us/library/windows/desktop/aa365247(v=vs.85).aspx).

3.4.3 CATALOG

A catalog is a folder containing the datasets you have recorded by using Specim IQ.

The figure below depicts the **CATALOG** view.

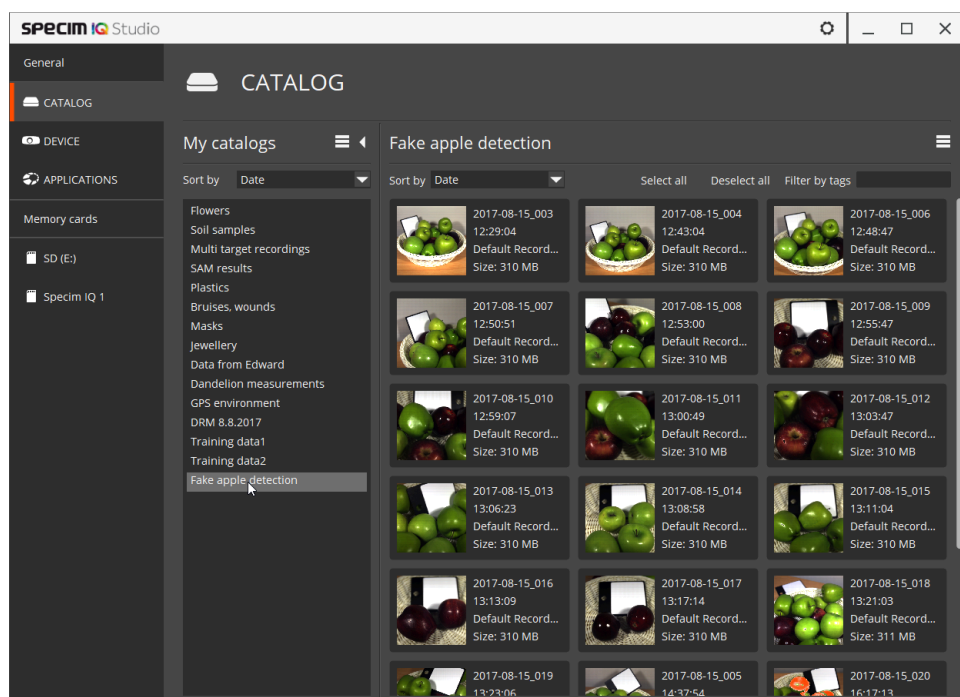


Figure 179: CATALOG View

The **CATALOG** view is divided into two areas:

- **My catalogs** — This area contains a list of your catalogs.

You can sort the list by selecting the **Sort by** drop-down menu. You can sort by:

- Date — Sort by the date when the catalog was created.
- Name — Sort by the catalog name.
- Number of datasets — Sort by the number of datasets within the catalog.



Tip:

You can hide/show the **My catalogs** area by clicking the arrow on the area frame.

- **Catalog content** — This area shows the contents of the selected catalog. For each dataset, you can see:
 - A thumbnail image of the dataset

- The dataset name in format YYYY-MM-DD_consecutive_number
- The time when the dataset was recorded
- The application used
- The dataset size

For sorting and selecting datasets, see [Sorting and Selecting Datasets](#).

Double-click a dataset to open the [Extended Data View](#).

3.4.3.1 Extended Data View

When you double click a dataset in the **Catalog content** view, the dataset is opened in the extended data view. The extended data view consists of four tabs described below:

- In the **Results** tab, you can consider the results of the dataset.

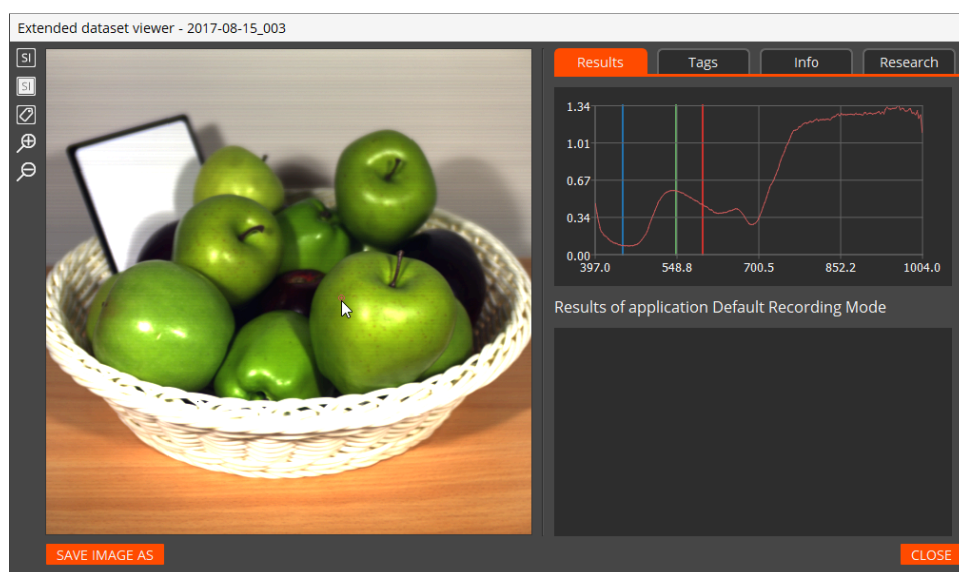


Figure 180: Extended Data View - Results

For more information, see [Results](#).

- In the **Tags** tab, you can edit the tags of the dataset.

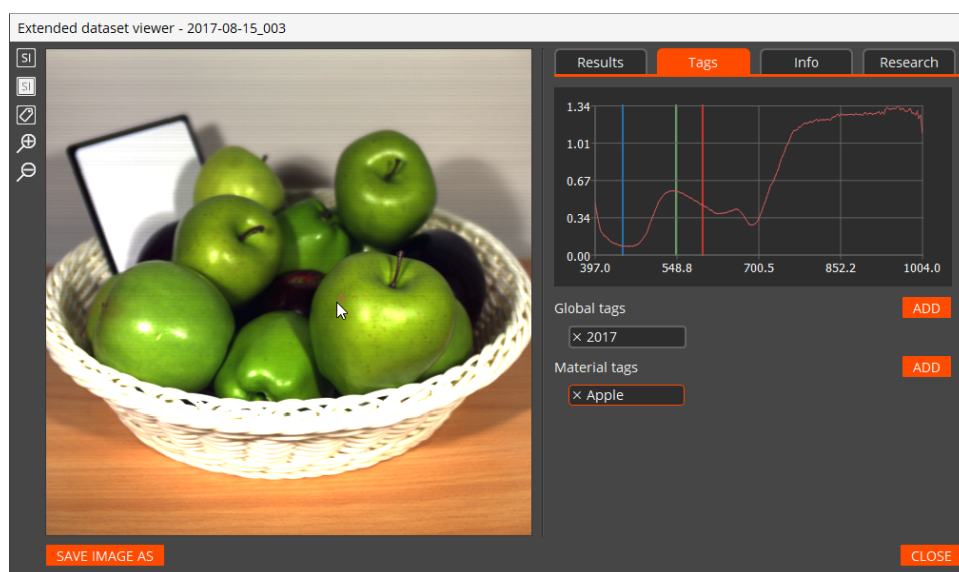


Figure 181: Extended Data View - Tags

For more information, see [Tags](#).

- In the **Info** tab, you can edit the dataset information.

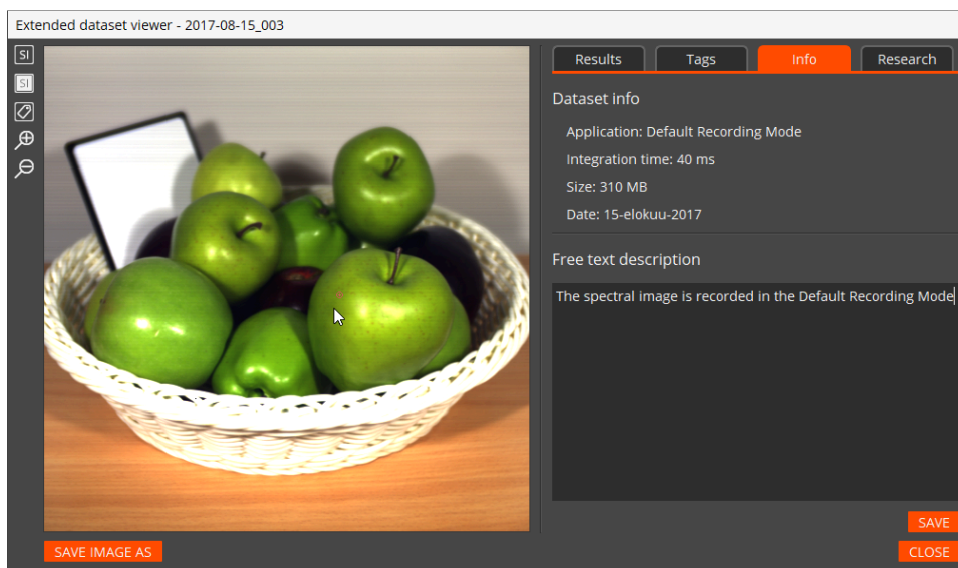


Figure 182: Extended Data View - Info

For more information, see [Info](#).

- In the **Research** tab, you:
 - Test the mask visualization with data.
 - Save references to the spectral library.
 - Edit the false *RGB* visualization of the dataset.

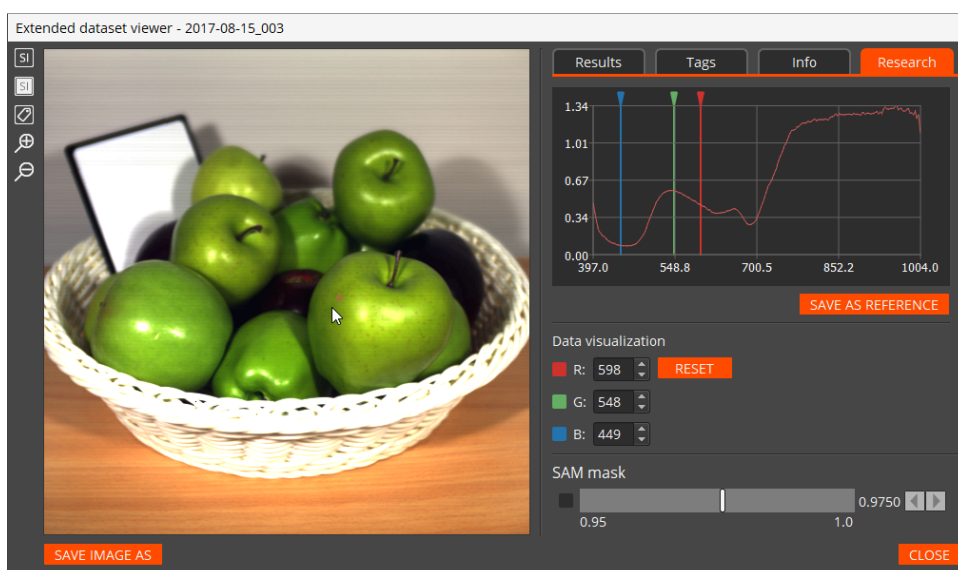


Figure 183: Extended Data View - Research

For more information, see [Research](#).

The buttons in this view are:

-  — Press this button to toggle the spectral image visibility on or off.
-  — Press this button to toggle the spectral image mask on or off.

This icon is only visible, if the data was captured with an application or in the Automatic Screening Mode.

-  — Press this button to view the material tags on the visualized dataset.
-  — Press this button to zoom in to the image.
-  — Press this button to zoom out of the image.
-

You can save the opened image by selecting **Save image as**.

- You can close the image by selecting **Close**.

3.4.4 DEVICE

A device refers to Specim IQ. In this view, you can manage Specim IQs and camera profiles.

The figure below depicts the **DEVICE** view.



Tip:

Your device is visible in the **DEVICE** view only if it is switched ON and connected to the PC with the USB cable.

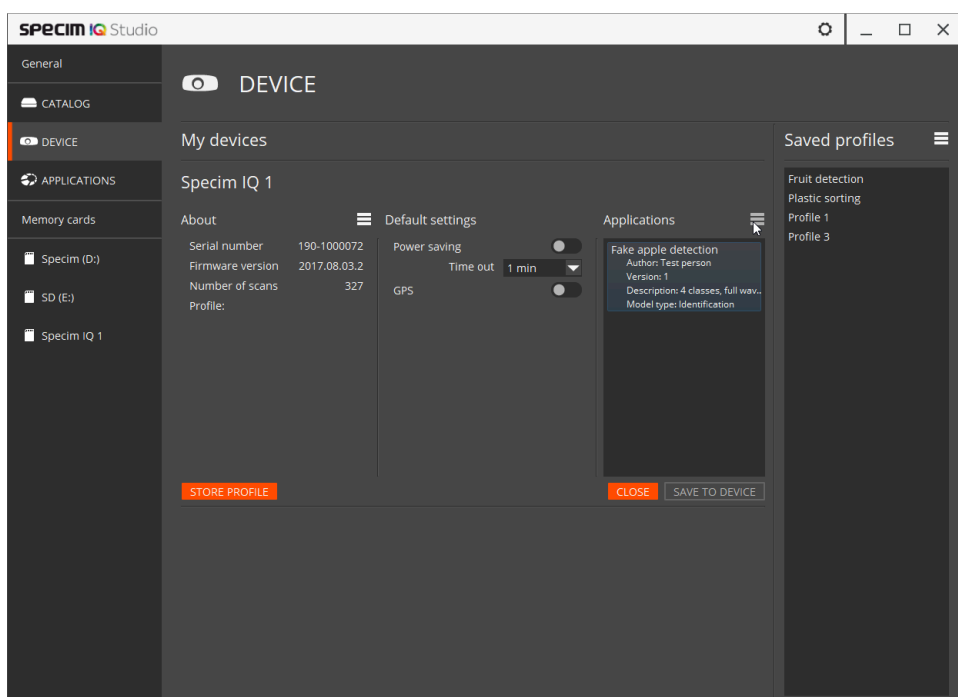


Figure 184: Device Information

The **DEVICE** view is divided into two areas:

- The **My devices** area contains a list of all managed devices. The memory cards in the managed devices are listed in the frame to the left.
To view more information on the device, select **OPEN**.
- **Saved profiles** — This area contains a list your saved profiles. A profile contains the device settings and a list of installed applications.

3.4.5 APPLICATIONS

An application contains the model and the Specim IQ settings packaged in executable form for Specim IQ.

The **APPLICATIONS** view consists of three tabs, described in more detail in the following sections.

3.4.5.1 APPLICATIONS

In this view, you can manage applications.

The figure below depicts the **APPLICATIONS** view.

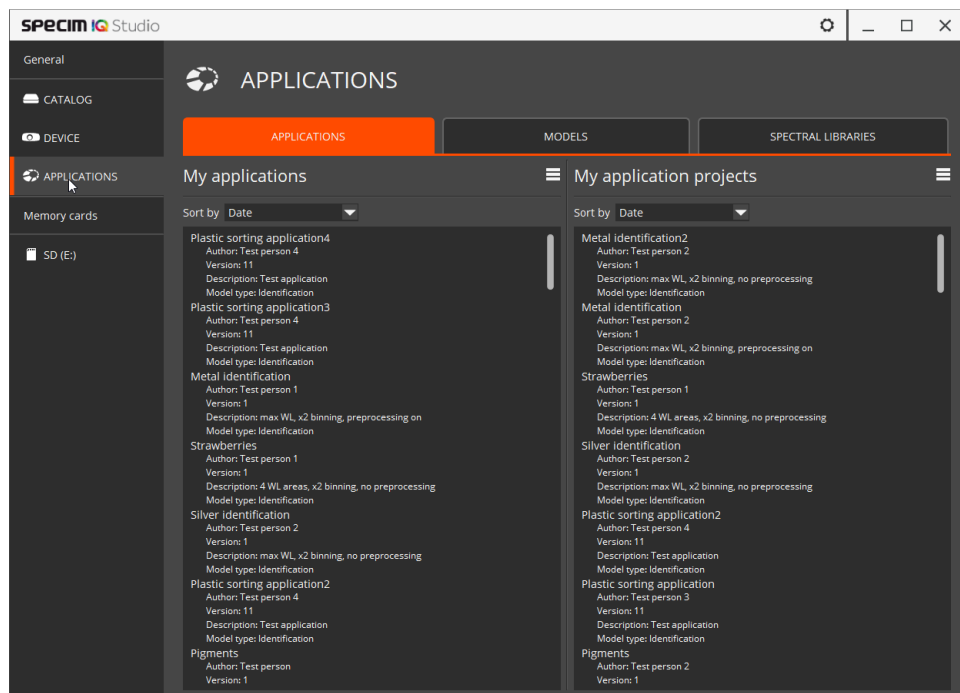


Figure 185: APPLICATIONS View

The **Applications** view is divided into two areas:

- **My applications** — This area contains a list of your applications.

These applications have been created with the application creator and converted into software packages that Specim IQ can read. The application packages cannot be edited. If you need to make changes, you must edit the application project and save it as a new application.

The application list provides basic information on all applications, such as:

- Application name
- Application description
- **My application projects** — This area contains a list your application projects.

The application projects are used to gather the application components together, and to create software packages that Specim IQ can read.

The application project list provides basic information on all application projects, such as:

- Application project name
- Application project description

3.4.5.2 MODELS

A model defines the data processing flow for an application. In this view, you can manage models.

The figure below depicts the **MODELS** view.

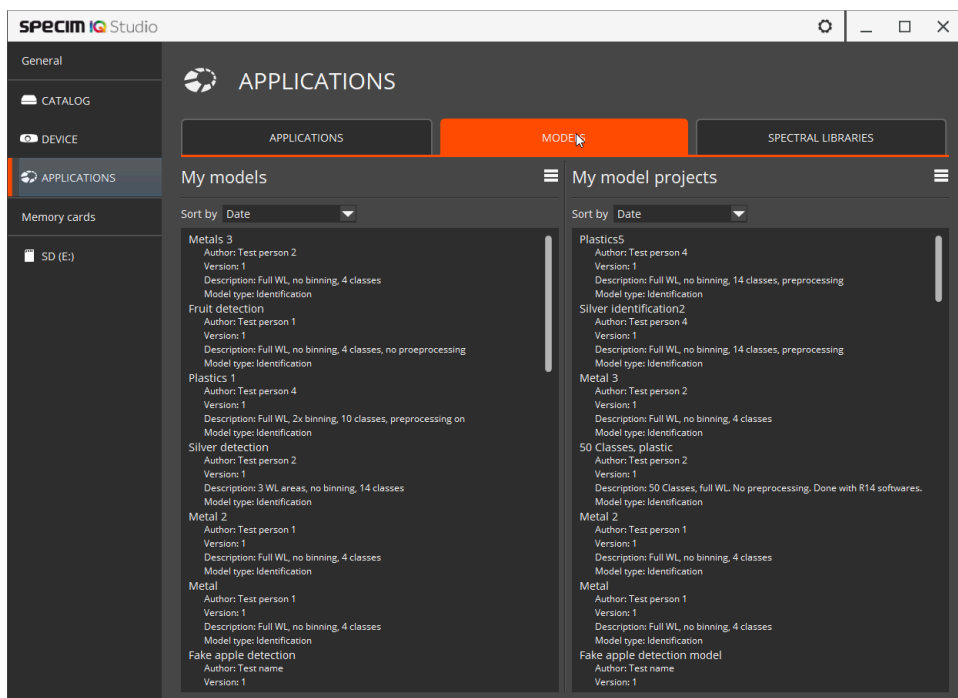


Figure 186: MODELS View

The **MODELS** view is divided into two areas:

- **My models** — This area contains a list of your models.

These models have been created with the model creator and converted into software packages that Specim IQ can read. The model packages cannot be edited. If you need to make changes, you must edit the model project and save it as a new model.

The model list provides basic information on all applications, such as:

- Model name
- Model description
- **My model projects** — This area contains a list your model projects.

The model projects are used to gather the model components together, and to create software packages that Specim IQ can read.

The model project list provides basic information on all model projects, such as:

- Model project name
- Model project description

3.4.5.3 SPECTRAL LIBRARIES

In spectral imaging, we need information on the exact wavelengths that are reflected from various materials in various conditions. These sets of spectral reflectance information are called spectral libraries. In this view, you can manage spectral libraries.

The figure below depicts the **SPECTRAL LIBRARIES** view.

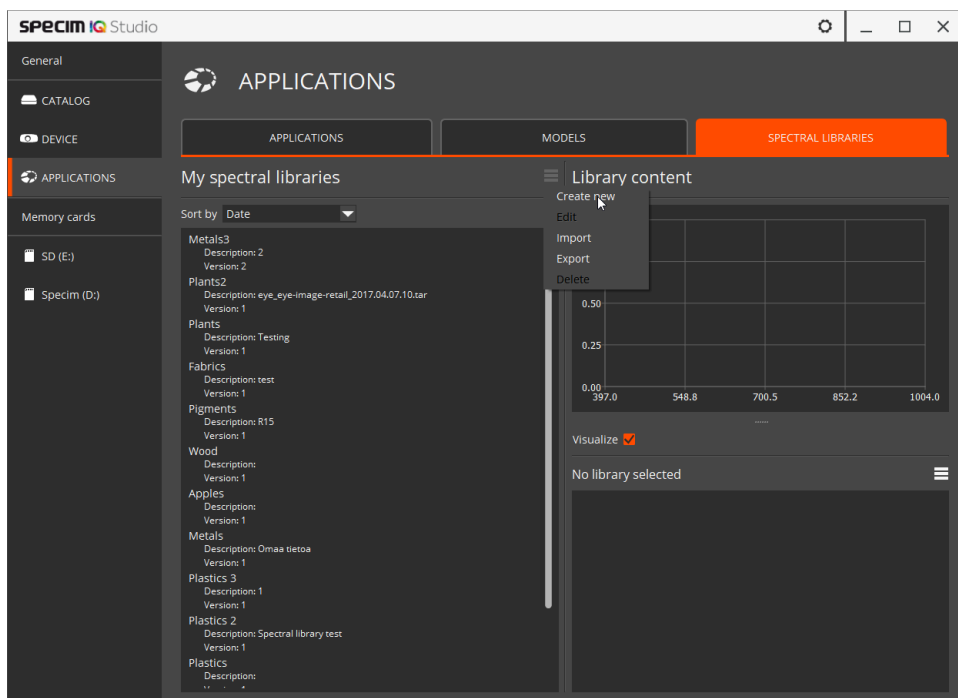


Figure 187: SPECTRAL LIBRARIES View

The **SPECTRAL LIBRARIES** view is divided into two areas:

- **My spectral libraries** — This area contains a list of the spectral libraries you have created or purchased.

The spectral library list provides basic information on all spectral libraries, such as:

- Spectral library name
- Spectral library description
- **Library content** — This area contains spectra from the selected spectral library. Select an item to view its spectrum in the graph.

3.5 Using Specim IQ Studio

This section describes how to use Specim IQ Studio.

3.5.1 Opening and Closing Specim IQ Studio

This section describes how to open and close Specim IQ Studio.

Proceed as follows:

1. To open Specim IQ Studio, select **Start > Specim IQ Studio > Specim IQ Studio**, or double-click the software icon on your desktop.

Specim IQ Studio software icon on Windows desktop:



Figure 188: Specim IQ Studio Software Icon

2. To close Specim IQ Studio, click the X close button at the top right-hand corner of the user interface.

3.5.2 Managing Catalogs

This section describes how to manage catalogs.

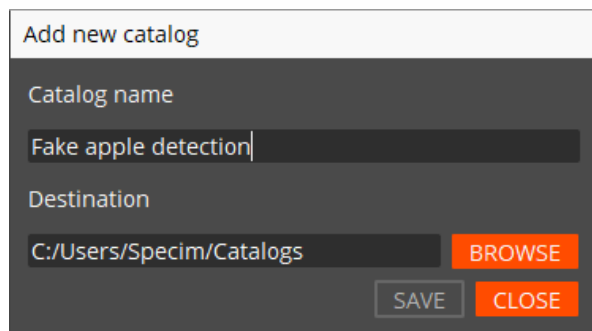
3.5.2.1 Creating a New Catalog

This section describes how to create a new catalog.

Proceed as follows:

1. Select **My catalogs** >  > **New**.

The screen below is opened:



The dialog box titled "Add new catalog" contains the following fields and buttons:

- Catalog name:** A text input field containing "Fake apple detection".
- Destination:** A text input field containing "C:/Users/Specim/Catalogs".
- BROWSE:** An orange button next to the destination field.
- SAVE:** A gray button at the bottom left.
- CLOSE:** An orange button at the bottom right.

Figure 189: Add New Catalog

2. Select the destination folder for the new catalog, or accept the default destination folder.



Tip:

The datasets recorded with IQ, and stored in catalogs, are large in size. Save the catalogs onto a large hard drive. Avoid storing them onto the same drive with the computer operating system.

3. Enter a name for the catalog.

Use a unique name for the catalog.

4. Select **SAVE**.

5. The new catalog is added to **My catalogs** list.

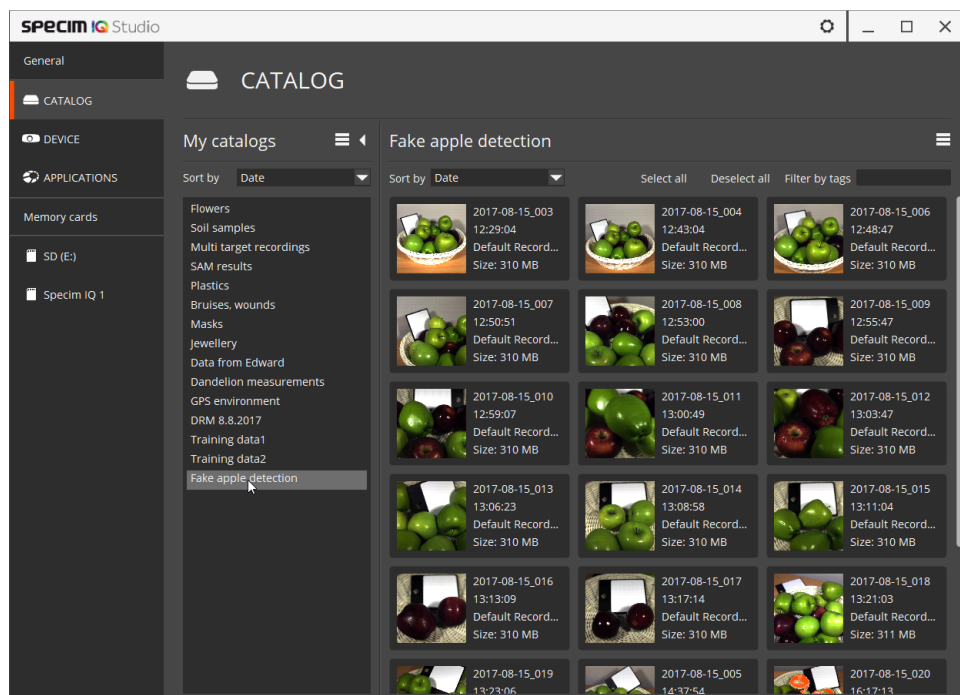


Figure 190: My Catalogs

3.5.2.2 Importing Data from Specim IQ

This section describes how to import data from Specim IQ to a catalog.

Proceed as follows:

1. Connect the Specim IQ to the USB port, or insert the SD card to the computer card reader.

The connected SD card is shown in the **Memory cards** list.

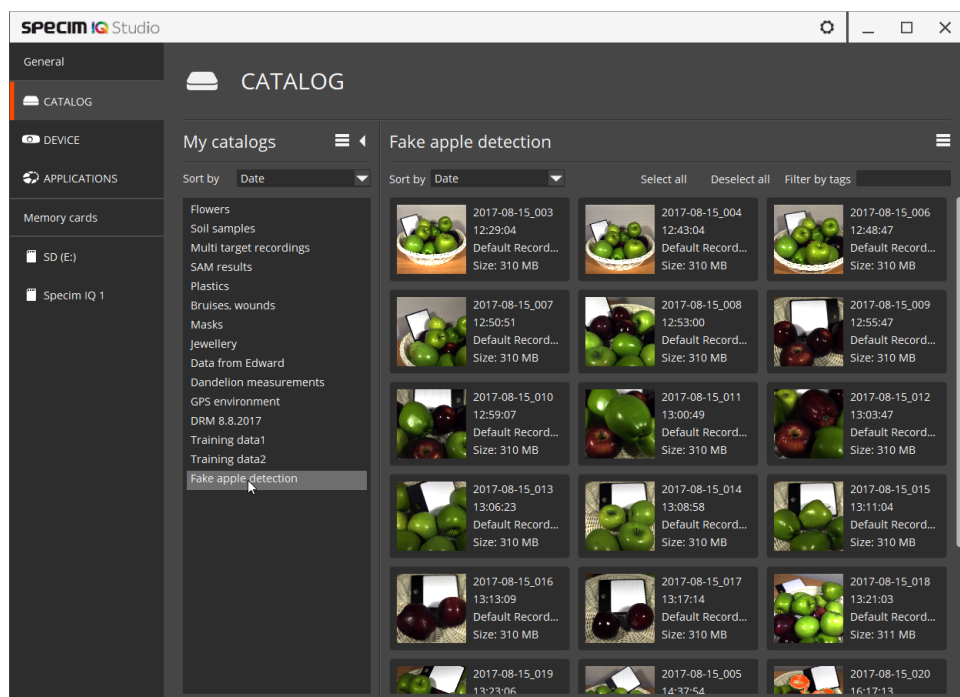


Figure 191: SD Cards

2. Select the desired source device or memory card.

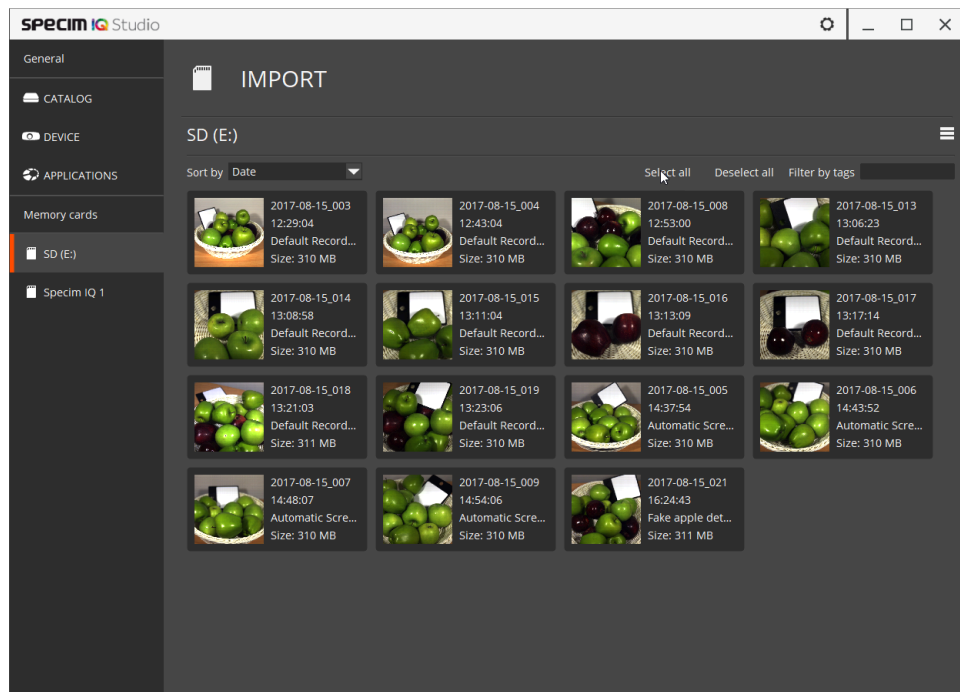


Figure 192: Selecting the Source

3. Select the dataset(s) to be imported.



Tip:

You can select all datasets by clicking **Select all**.

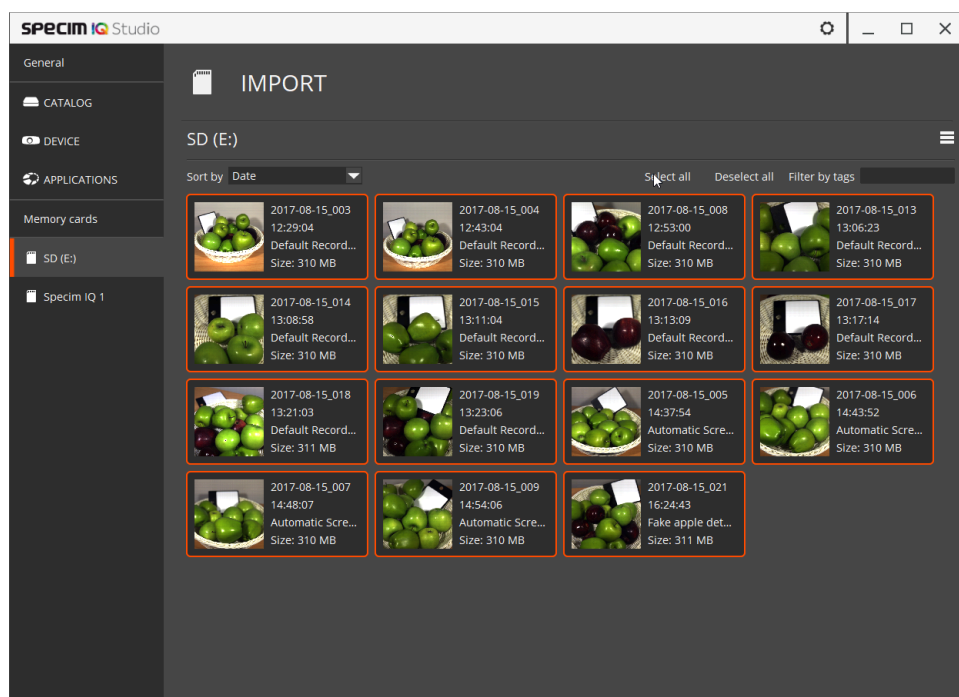


Figure 193: Selecting the Dataset(s)

See also [Keyboard Shortcuts](#).

4. Select  > **Import**.

The screen below is opened:

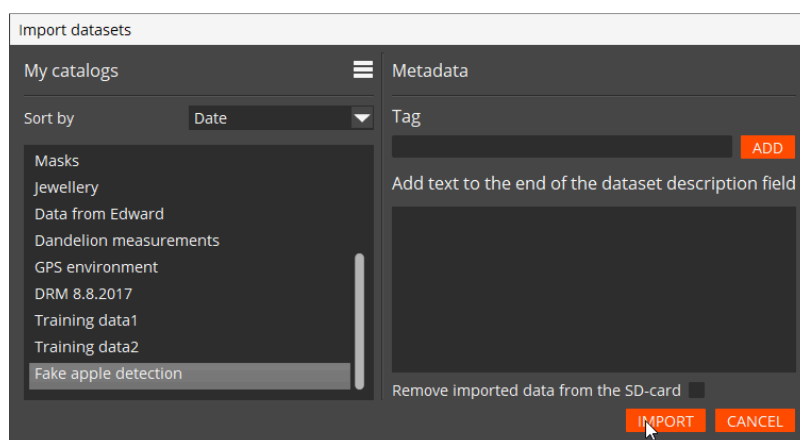


Figure 194: Import Datasets

5. Select the destination catalog from **My catalogs**.

You can also create a new catalog by selecting **My catalogs** >  > **New**.

See [Adding a Catalog to the My Catalogs List](#).

6. Optional: You can add tags to the imported images as follows:
 - a) Write the desired tag in the **Tag** field.
 - b) Select **ADD**.
7. Optional: Enter a description for the imported images, in the **Free text description** field.
8. Optional: If you want to remove the imported images from the SD card, check the **Remove imported data from the SD card** check box.

The system will also ask for your confirmation for data deletion, after the import is complete.

9. Select **IMPORT**.

The data import begins.

The screen below is opened:

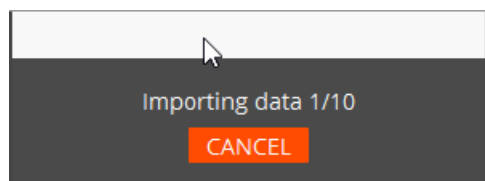


Figure 195: Importing Data

10. Wait until all data has been imported.

11. Disconnect the Specim IQ from the USB port, or eject the SD card from the computer card reader.

3.5.2.3 Importing Data from the File System

This section describes how to import data to a catalog from your file system.

Proceed as follows:

1. Select **<catalog name> > ≡ > Import**.
2. Windows file manager is opened.
3. Select the dataset(s) to be imported.



Tip:

Each dataset forms a folder in your file system. However, Windows file manager allows you to select one folder only. If you need to import several datasets, place them in the same folder, and import this folder.

4. Select **Select folder**.

Datasets must have unique names. In the case of a name conflict, the screen below is opened:

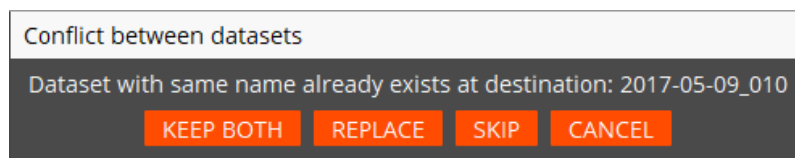


Figure 196: Name Conflict

Select:

- **KEEP BOTH** — The dataset is imported and renamed with a (n) at the end of the dataset name. N is a consecutive number.
- **REPLACE** — The dataset is imported and the existing dataset is replaced with the new one.
- **SKIP** — Do not import this dataset, but continue importing from the next selected dataset.
- **CANCEL** — Cancel the importing procedure.

5. The dataset(s) are imported to the system.

3.5.2.4 Adding a Catalog to the My Catalogs List

This section describes how to add a previously removed catalog, to the My catalogs list.

Proceed as follows:

1. Select **My catalogs > ≡ > Add to list**.

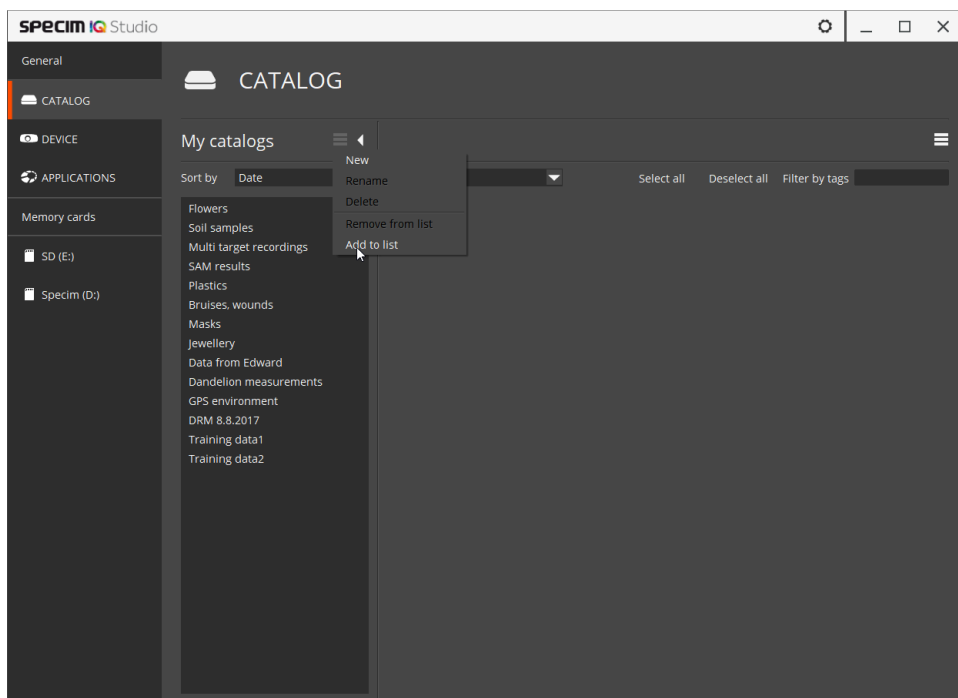


Figure 197: Adding a Catalog

2. Windows file manager is opened.



Tip:

By default, the catalogs are in C : /Users/<user>/Specim/Catalogs folder.

3. Select the catalog to be added.
4. Select **Add**.
5. The previously removed catalog is added to **My catalogs**.

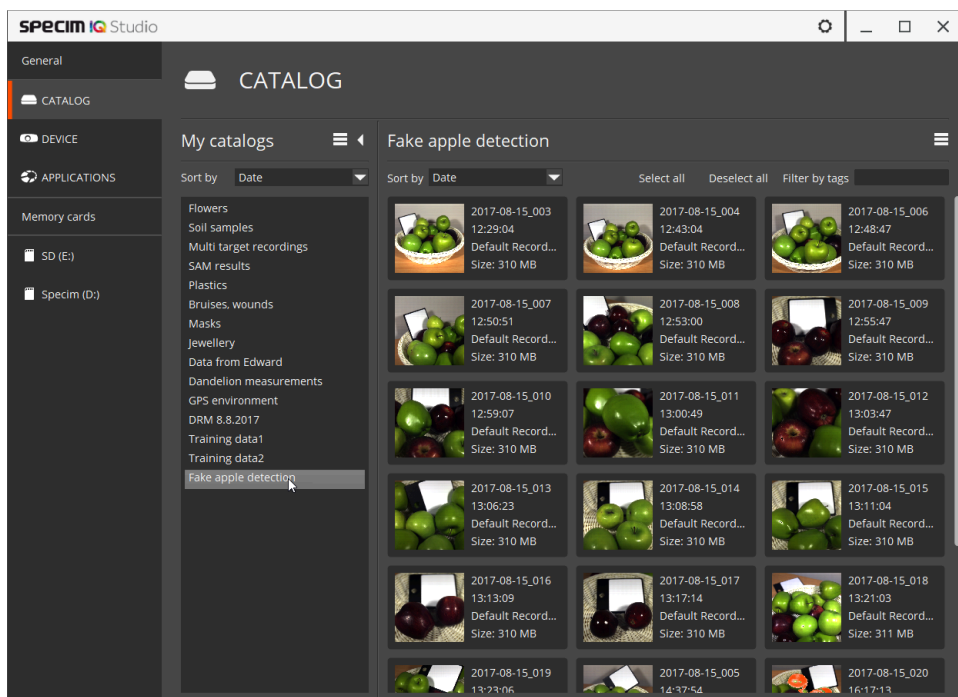


Figure 198: Catalog Added

Related Tasks

[Removing a Catalog from the My Catalogs List](#)

This section describes how to remove a catalog from the My catalogs list.

3.5.2.5 Removing a Catalog from the My Catalogs List

This section describes how to remove a catalog from the My catalogs list.

Removing a catalog will remove the catalog from **My catalogs**, but the catalog will remain on the computer hard drive.

Proceed as follows:

1. Select the catalog to be removed from **My catalogs**.
2. Select **My catalogs** >  > **Remove from list**.

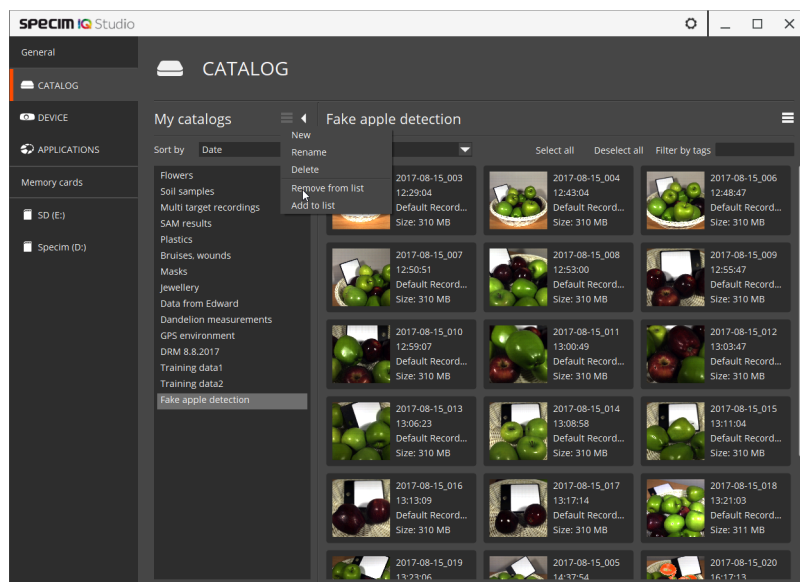


Figure 199: Removing a Catalog

3. The system asks for your confirmation. Select:
 - **OK** to proceed.
 - **CANCEL** to cancel.
4. If you select **OK**, the catalog is removed from **My catalogs**.

Related Tasks

[Adding a Catalog to the My Catalogs List](#)

This section describes how to add a previously removed catalog, to the My catalogs list.

3.5.2.6 Deleting a Catalog

This section describes how to delete a catalog.

Deleting a catalog will remove the catalog both from **My catalogs** and from the computer hard drive.

Proceed as follows:

1. Select the catalog to be removed from **My catalogs**.



Tip:

If catalogs are shown as grayed out in the list, the actual physical folder on the hard drive containing the catalog, has been removed or deleted. You can return the catalog by returning the folder to the same location, or by first selecting **Remove from list**, and then returning the catalog in the new physical location by selecting **Add to the list**.

2. Select **My catalogs** >  > **Delete**.

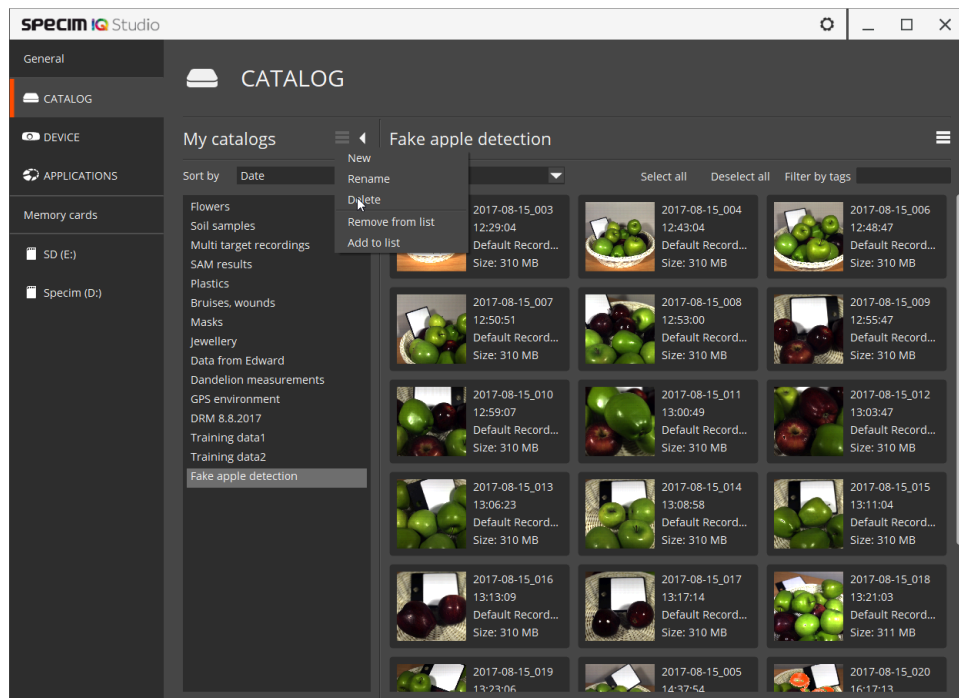


Figure 200: Deleting a Catalog

3. The system asks for your confirmation. Select:
 - **OK** to proceed.
 - **CANCEL** to cancel.
4. The catalog is removed from **My catalogs** and from the computer hard drive.

3.5.2.7 Managing Datasets

This section describes how to manage datasets in different catalogs.

Sorting and Selecting Datasets

You can sort and select datasets as follows:

- You can sort the list by selecting the **Sort by** drop-down menu. You can sort by:
 - Date — Sort by the date when the data was recorded.
 - Size — Sort by the dataset size.
 - Name — Sort by the dataset name.
 - Application — Sort by the application used to record the data.
- You can select/deselect a single dataset by clicking it with your mouse.

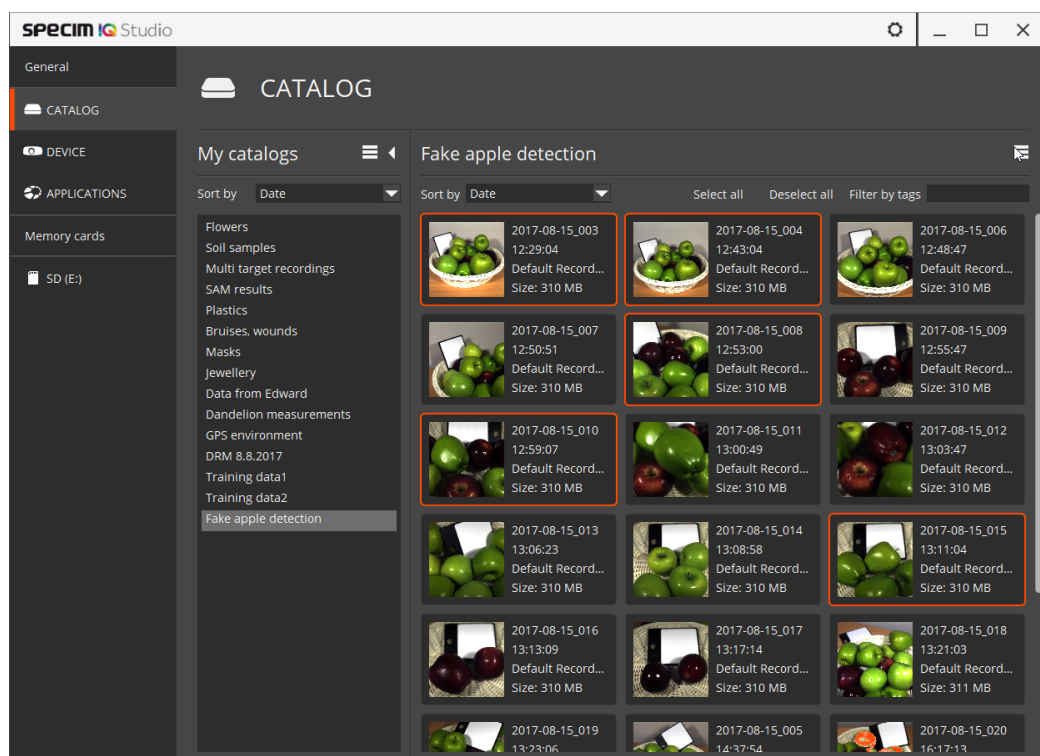


Figure 201: Selecting Datasets

The selected datasets are surrounded by an orange line.

- You can select/deselect all datasets by pressing the **Select all/Deselect all** button. These functions only affect datasets currently visible in the **Catalog content** view.
- You can filter out a dataset by entering the filtering criteria to the **Filter by tags** field, select the filtered dataset, and filter again. Your selections will remain valid even if the next filtering would hide them.

Exporting Datasets

This section describes how to export datasets.

Proceed as follows:

1. Select the dataset(s) to be exported from the **Catalog content** view.
2. Select **<catalog name> >  > Export**.

The screen below is opened:

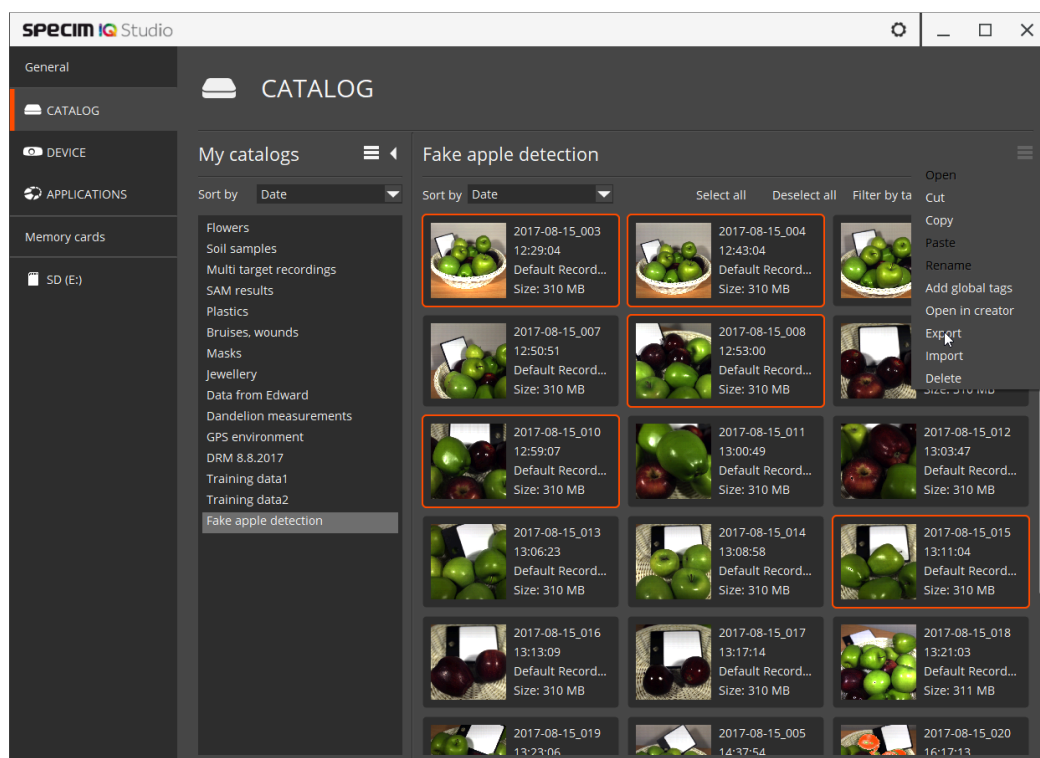


Figure 202: Exporting Datasets

3. Windows file manager is opened.
4. Select the destination folder for the exported datasets.
5. Select **Select folder**.
6. The export dialog is shown.

If you select **Cancel** while exporting, the already exported datasets will be kept in the destination folder. However, the dataset being currently exported will not be saved to the destination folder.

Cutting, Copying and Pasting Datasets

This section describes how to cut, copy and paste datasets.

Proceed as follows:

1. Select the dataset(s) to be cut or copied from the **Catalog content** view.
2. Select <catalog name> >  > **Cut** or <catalog name> >  > **Copy**.

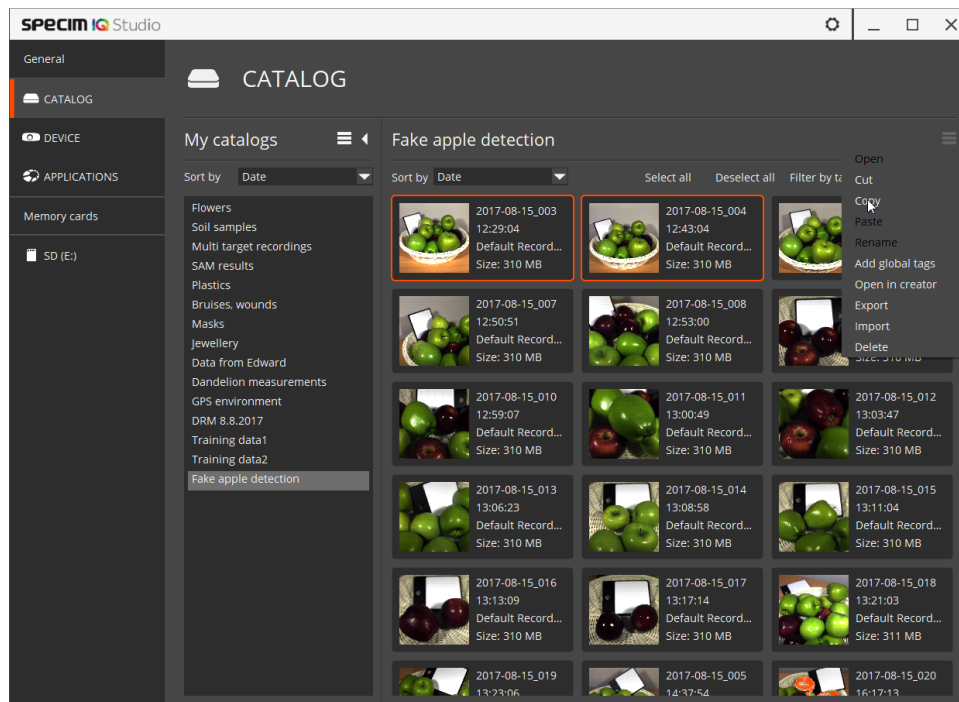


Figure 203: Copying a Dataset

3. Select the destination catalog for the cut or copied datasets.
4. Select <catalog name> >  > Paste.

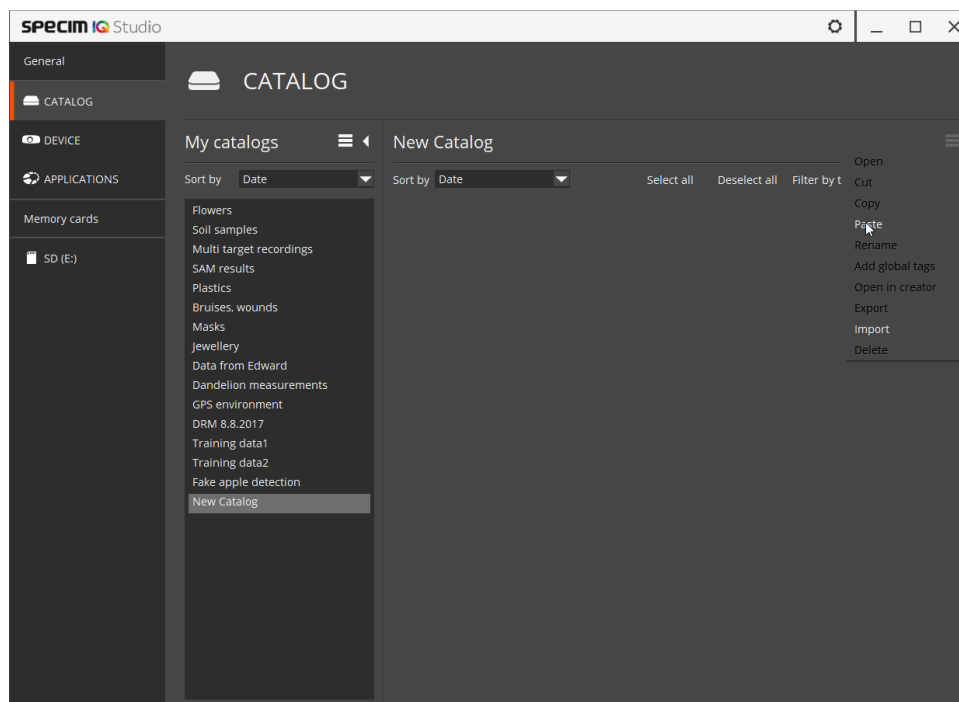


Figure 204: Pasting a Dataset

5. The cut or copied datasets appear in the destination catalog.

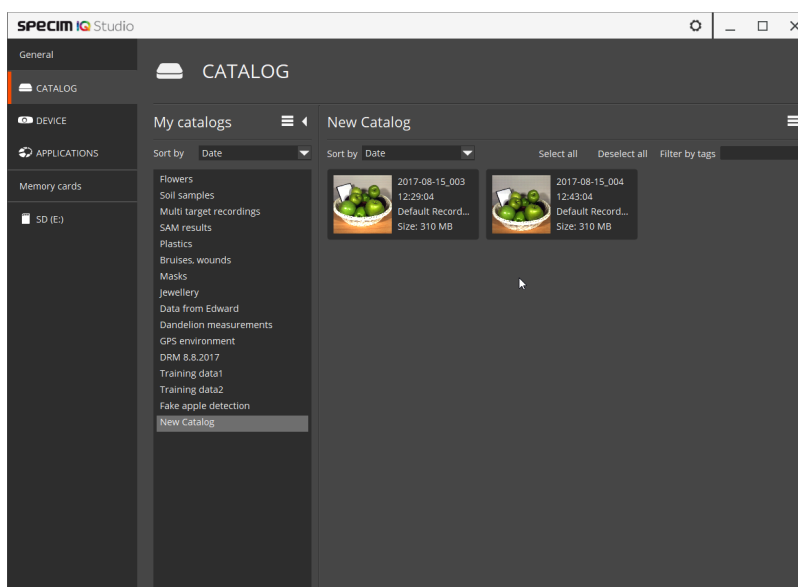


Figure 205: Pasting a Dataset

The cut datasets are removed from the original catalog.

Datasets must have unique names. In the case of a name conflict, the screen below is opened:

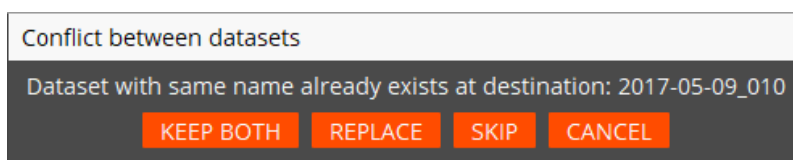


Figure 206: Conflict between Datasets

Select:

- **KEEP BOTH** — The dataset is pasted and renamed with a (n) at the end of the dataset name. N is a consecutive number.
- **REPLACE** — The dataset is pasted and the existing dataset is replaced with the new one.
- **SKIP** — Do not paste this dataset, but continue pasting from the next selected dataset.
- **CANCEL** — Cancel the pasting procedure.

Renaming a Dataset

This section describes how to rename a dataset.



Important:

Do not rename datasets in Windows File Manager. If you do, Specim IQ Studio will no longer recognize them, and you must rename them back to their original names, to use them.



Caution: Do not use special characters in dataset names, as they will render the dataset unusable. For more information, see [File Name Restrictions in IQ Studio](#)

Proceed as follows:

1. Select the dataset to be renamed from the **Catalog content** view.
2. Select <catalog name> >  > **Rename**.

The screen below is opened:

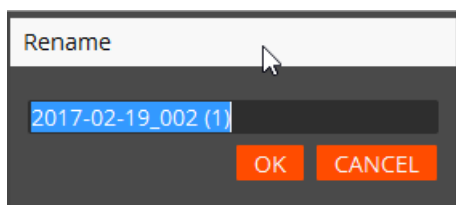


Figure 207: Renaming a Dataset

3. The dataset name field is activated for editing.
4. Enter the new dataset name.
5. Select *OK*.

Opening a Dataset in Model Creator

This section describes how to open a dataset in the model creator.

Proceed as follows:

1. Select the desired dataset(s) from the **Catalog content** view.
2. Select **<catalog name>** > **>** > **Open in creator**.
3. The model creator project view opens, and the selected dataset(s) are included in the project, and selected in the **DATA** tab.

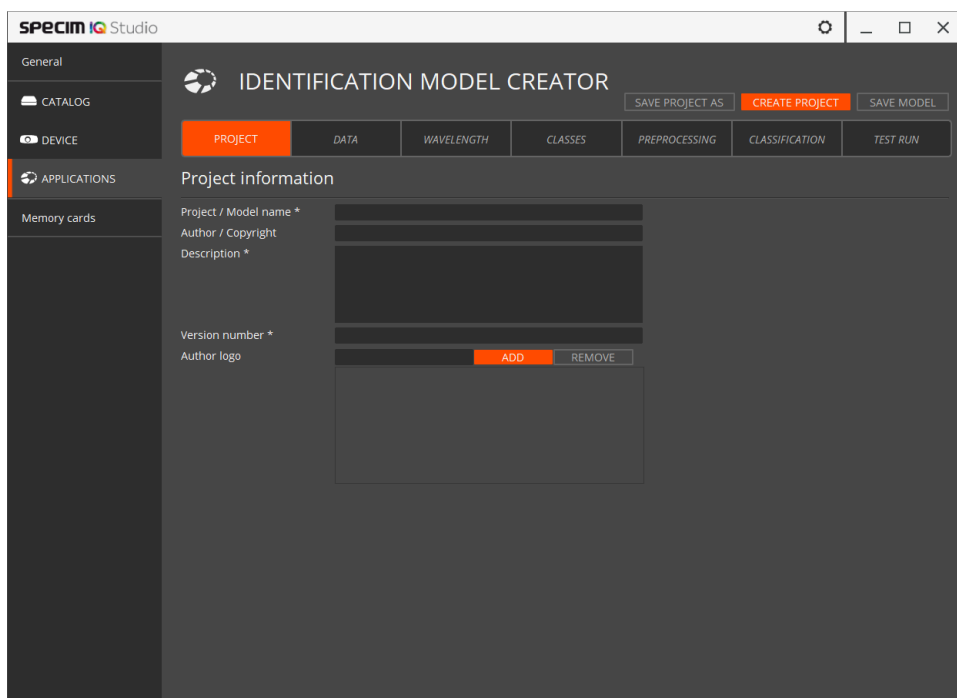


Figure 208: PROJECT View

Related Information

[PROJECT](#)

This section describes how to create a new model project.

Deleting Datasets from an SD Card

This section describes how to delete datasets from an SD card.



Tip:

You can also delete data from an SD card when importing data from it. See [Importing Data from Specim IQ](#).

Proceed as follows:

1. Insert the SD card to the computer card reader, or connect the Specim IQ to the USB port.

The inserted card or Specim IQ is shown in the **Memory cards** list.

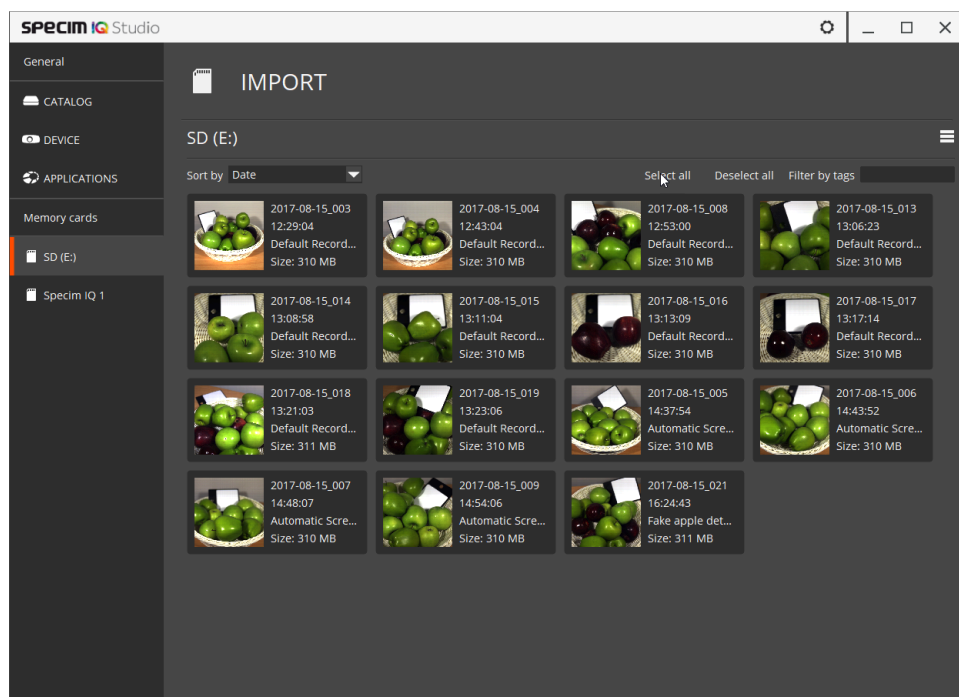


Figure 209: SD Cards

2. Select the dataset(s) to be deleted.
3. Select  > **Delete**.
4. The system asks for your confirmation. Select:
 - **OK** to proceed.
 - **CANCEL** to cancel.

3.5.2.8 Using Extended Data View

When you double click a dataset in the **Catalog content** view, the dataset is opened in the extended data view. The extended data view consists of four tabs described in the following sections.

Results

This section describes how to use the **Results** tab in Extended Data View.

Proceed as follows:

1. Open the **Results** tab in Extended Data View.

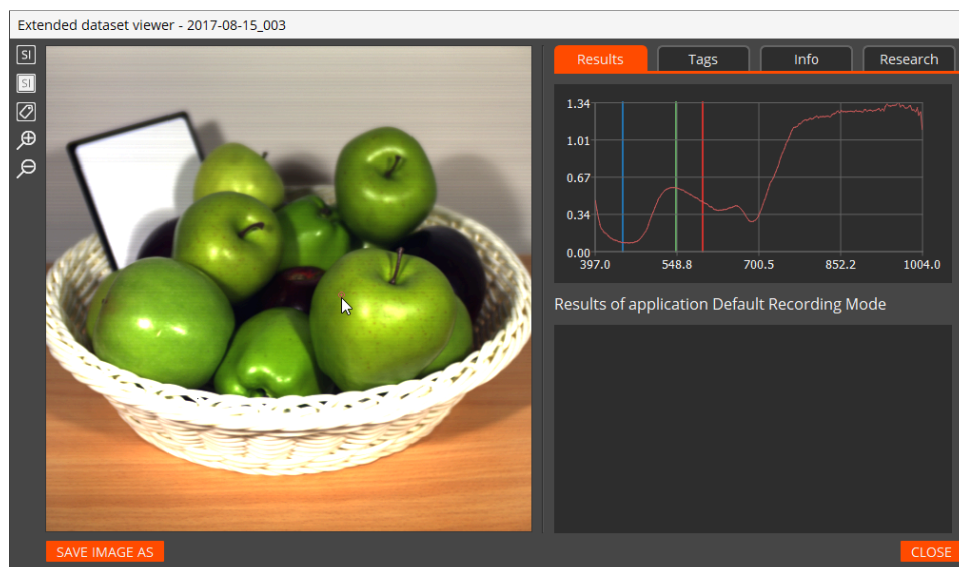


Figure 210: Extended Data View - Results

2. Click the image to see the spectrum from the selected point.
3. You can adjust the view as follows:

The buttons in this view are:

-  — Press this button to toggle the spectral image visibility on or off.
-  — Press this button to toggle the spectral image mask on or off.

This icon is only visible, if the data was captured with an application or in the Automatic Screening Mode.

-  — Press this button to view the material tags on the visualized dataset.
-  — Press this button to zoom in to the image.
-  — Press this button to zoom out of the image.
-

You can save the opened image by selecting **Save image as**.

- You can close the image by selecting **Close**.

Tags

This section describes how to use the **Tags** tab in Extended Data View.

Tags are short text labels describing the images. There are two types of tags:

- Global tags are related to the entire image. For example, the name of the data recorder can be added as a global tag.
- Material tags are related to a specific pixel. A material tag consists of a tag name and the tag pixel position.

Proceed as follows:

1. Open the **Tags** tab in Extended Data View.

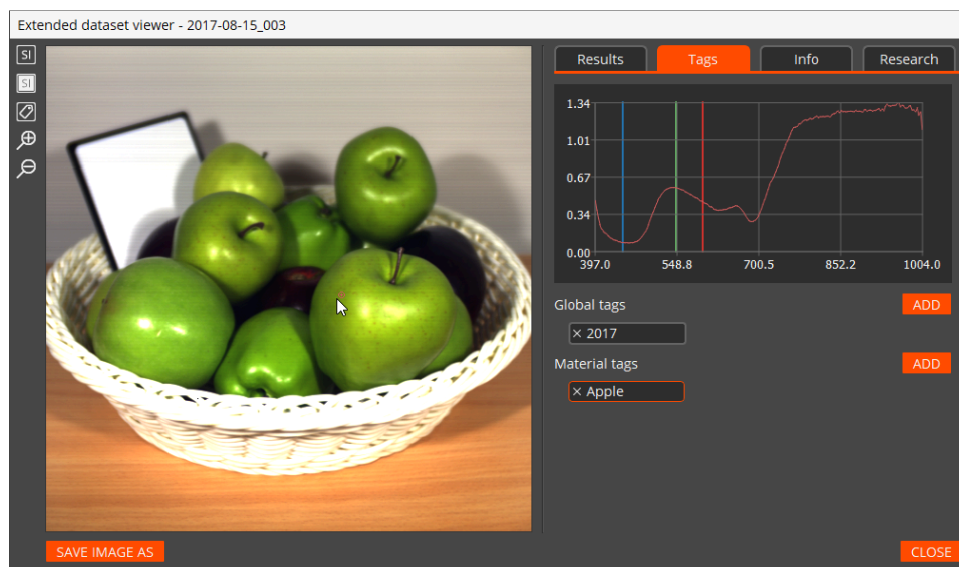


Figure 211: Extended Data View - Tags

2. To add a global tag:
 - a) Select **ADD** for global tags.
 - b) Enter a name for the tag.
 - c) Select **OK**.
3. To add a material tag:
 - a) Select the pixel.
 - b) Select **ADD** for material tags.
 - c) Enter a name for the tag.
 - d) Select **OK**.
4. To remove tags, click the cross icon on the tag. The tag is removed from the selected image.

You cannot edit tag names. If you want to change a tag name, delete the tag and create a new one.

5. You can adjust the view as follows:

The buttons in this view are:

-  — Press this button to toggle the spectral image visibility on or off.
-  — Press this button to toggle the spectral image mask on or off.
-  — Press this button to view the material tags on the visualized dataset.
-  — Press this button to zoom in to the image.
-  — Press this button to zoom out of the image.
- 

You can save the opened image by selecting **Save image as**.

- You can close the image by selecting **Close**.

Info

This section describes how to use the **Info** tab in Extended Data View.

Proceed as follows:

1. Open the **Info** tab in Extended Data View.

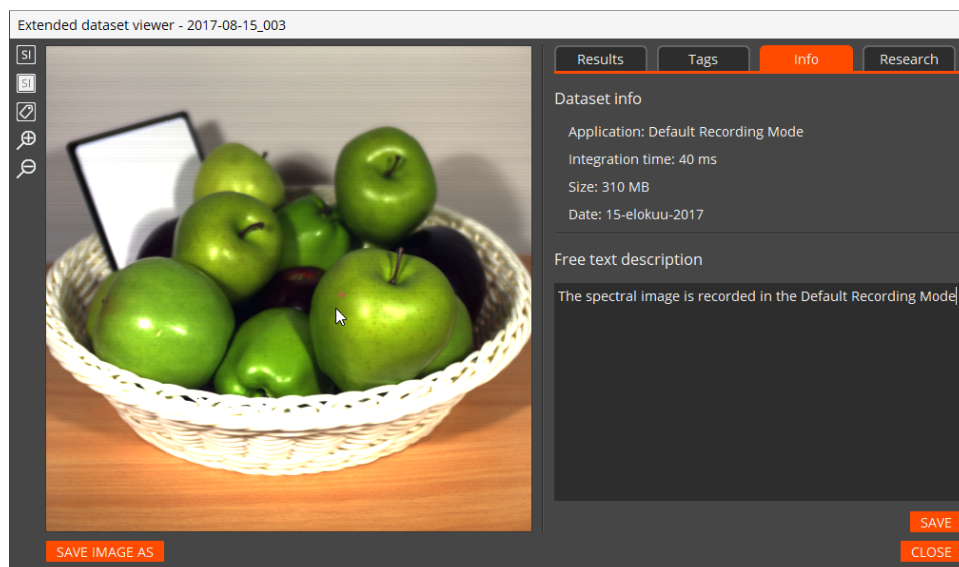


Figure 212: Extended Data View - Info

Information is provided as follows:

- **Application** — Name of the application that was used when capturing this dataset.
 - **Integration time** — The integration time that was used when capturing this dataset.
 - **Size** — The dataset size in megabytes.
 - **Date** — The date when this dataset was captured.
2. To edit the **Free text description**, click the area and then enter the text.
 3. Select **SAVE**.
 4. You can adjust the view as follows:

The buttons in this view are:

-  — Press this button to toggle the spectral image visibility on or off.
-  — Press this button to toggle the spectral image mask on or off.

This icon is only visible, if the data was captured with an application or in the Automatic Screening Mode.

-  — Press this button to view the material tags on the visualized dataset.
-  — Press this button to zoom in to the image.
-  — Press this button to zoom out of the image.
-

You can save the opened image by selecting **Save image as**.

- You can close the image by selecting **Close**.

Research

This section describes how to use the **Research** tab in Extended Data View.

Proceed as follows:

1. Open the **Research** tab in Extended Data View.

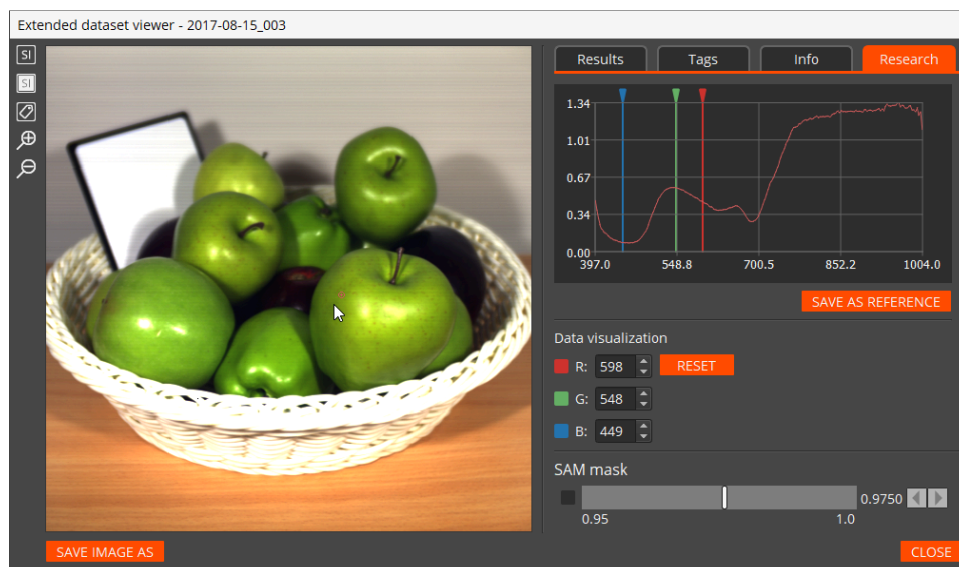


Figure 213: Extended Data View - Research

2. To find data areas of interest, in the image:

- a) Click the dataset view.

The spectrum from the selected pixel is shown in the spectrum graph.

- b) Examine the spectrum.



Tip:

You can view the graph more closely by double-clicking it.

- c) In the **Data visualization** area, you can use the numerical red, green and blue wavelength settings to modify the wavelengths used to build the false RGB to, for example, see a visualization from the infrared wavelengths.

The **Reset** button resets modified values to default values.



Tip:

You can also use the mouse to slide the red, green and blue wavelength lines to suitable locations.

- d) Select the **SAM mask** check box to see if there are areas in the image that have the same spectrum shape as the reference spectrum.

The slider range depicts the spectra from the entire image in such a way that, on the right, there are the spectra that most resemble the reference spectrum, and on the left, there are the spectra that least resemble the reference spectrum. The spectra on the right-hand side of the slider are visualized in the full-size view.

Use the slider to select the threshold defining the maximum difference from the reference spectrum that will be displayed.

- e) Select **Save as reference**, if you want to save the spectrum as a reference to a spectral library.

3. You can adjust the view as follows:

The buttons in this view are:

- — Press this button to toggle the spectral image visibility on or off.
- — Press this button to toggle the spectral image mask on or off.

This icon is only visible, if the data was captured with an application or in the Automatic Screening Mode.

-  — Press this button to view the material tags on the visualized dataset.
-  — Press this button to zoom in to the image.
-  — Press this button to zoom out of the image.
-

You can save the opened image by selecting **Save image as**.

- You can close the image by selecting **Close**.

3.5.3 Managing Devices

This section describes how to manage devices in the **DEVICE** view.

3.5.3.1 Viewing Device Information

This section describes how to view device information on Specim IQ Studio.

Proceed as follows:

1. Connect Specim IQ to your computer.

See [Connecting Specim IQ to Your Computer](#).

2. Select **DEVICE > OPEN**.

The screen below is opened:

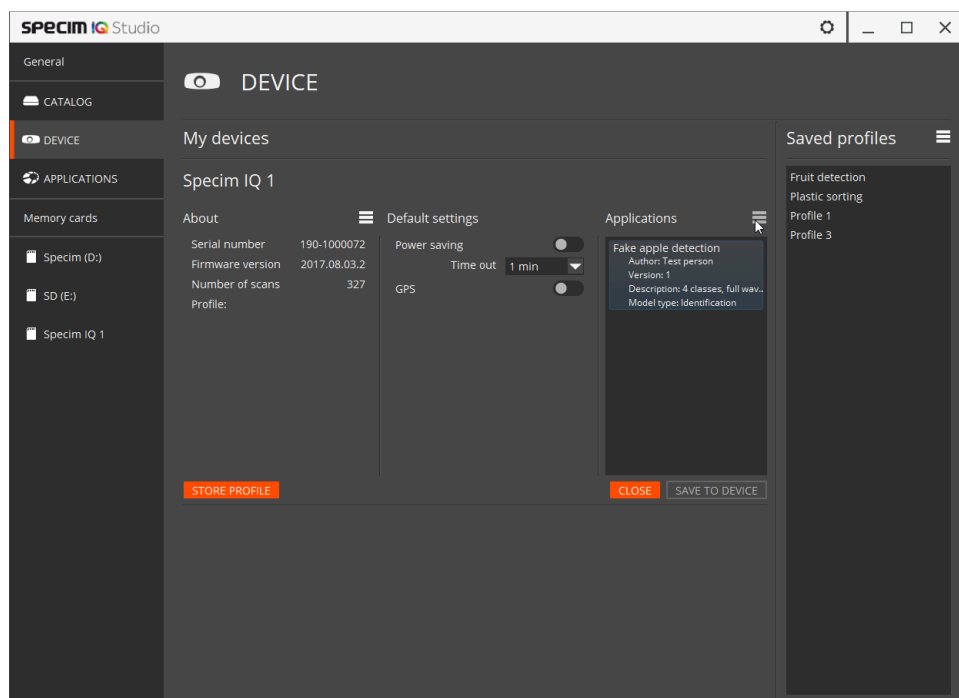


Figure 214: Device Information

In the **About** area, information is provided as follows:

- **Firmware version** — This field indicates the firmware version installed on the camera.
 - **Number of scans** — The total number of scans taken with this camera.
 - **Profile** — This field indicates the profile installed on the camera.
3. When done, select either:
 - **STORE PROFILE** — Press this button to save the settings as a new profile.
 - **CLOSE** — Press this button to discard the changes and return to the **DEVICE** view.

- **SAVE TO DEVICE** — Press this button to save the changes to the connected camera.

3.5.3.2 Modifying Device Settings

This section describes how to modify device settings on Specim IQ Studio.



Tip:

GPS set through IQ Studio uses the *A-GPS* system, and is faster than the standard GPS.

Proceed as follows:

1. Connect Specim IQ to your computer.

See [Connecting Specim IQ to Your Computer](#).

2. Select **DEVICE > OPEN**.

The screen below is opened:

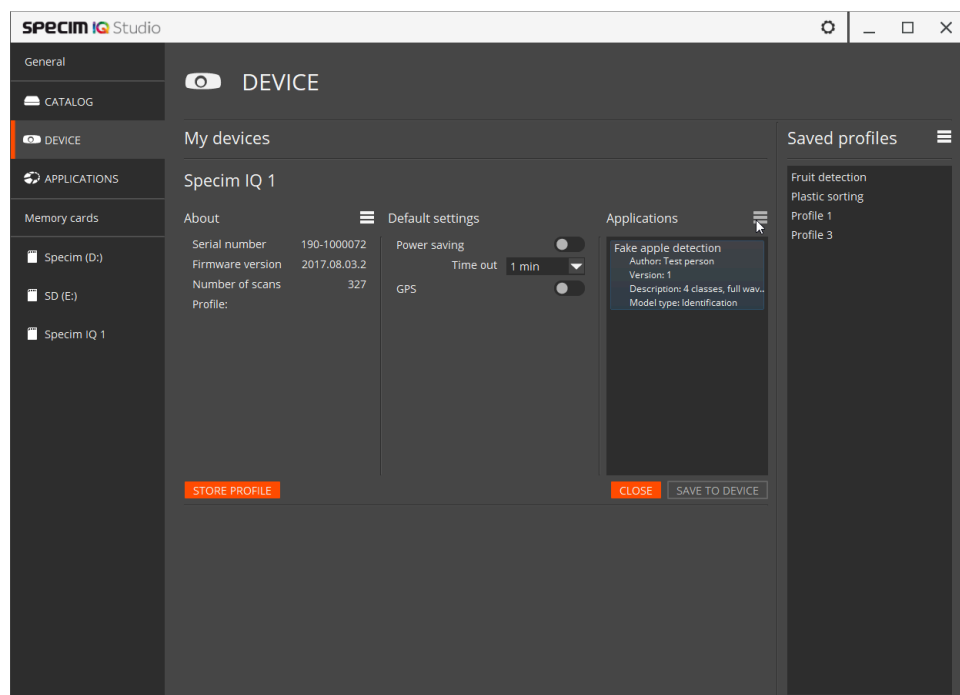


Figure 215: Device Information

You can modify the device settings in the **Default settings** area as follows:

- **Power saving** — You can:
 - Enable power saving by sliding the **Power saving** slider to the **ON** position.
 - Disable power saving by sliding the **Power saving** slider to the **OFF** position.
 - Select a suitable sleep timeout from the **Time out** menu.
 - **GPS** — You can:
 - Enable *GPS* features by sliding the **GPS** slider to the **ON** position.
 - Disable GPS features by sliding the **GPS** slider to the **OFF** position.
3. When done, select either:
 - **STORE PROFILE** — Press this button to save the settings as a new profile.
 - **CLOSE** — Press this button to discard the changes and return to the **DEVICE** view.
 - **SAVE TO DEVICE** — Press this button to save the changes to the connected camera.

Related Information

[Managing Applications](#)

This section describes how to manage applications in the **DEVICE** view.

3.5.3.3 Renaming the Device

This section describes how to modify device settings on Specim IQ Studio.

Proceed as follows:

1. Connect Specim IQ to your computer.

See [Connecting Specim IQ to Your Computer](#).

2. Select **DEVICE** > **OPEN** to open the desired device information area.

The screen below is opened:

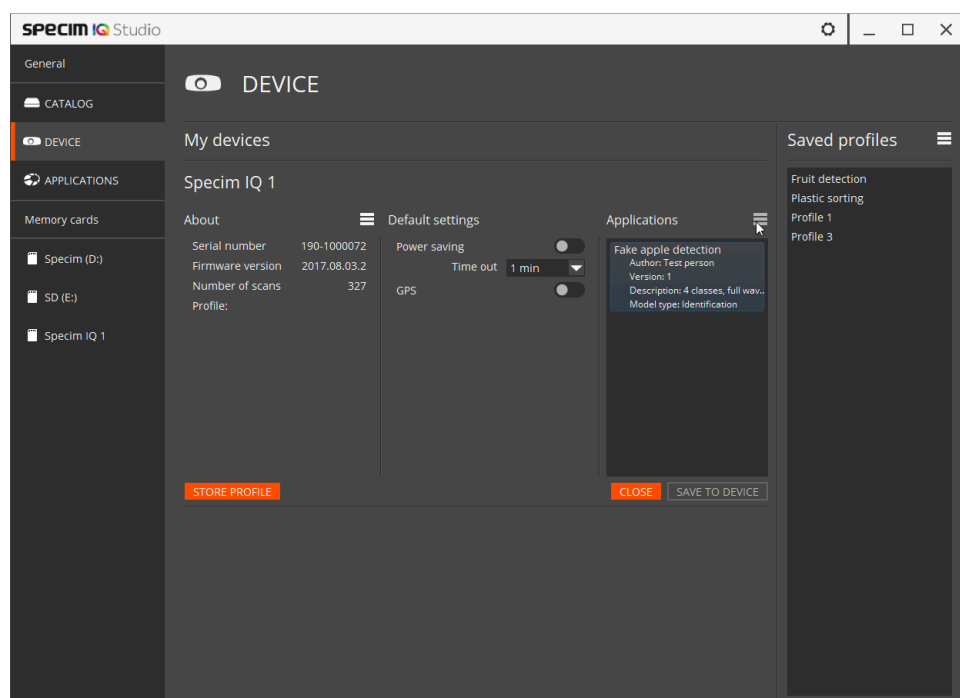


Figure 216: Device Information

3. Select **About** >  > **Rename device**.

The screen below is opened:

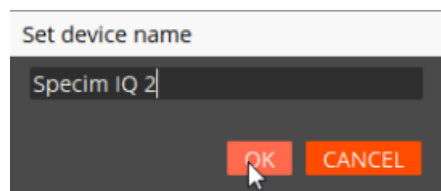


Figure 217: Renaming the Device

4. Enter the new name to the **Set device name** field.
5. Select **OK**.

The device name is changed:

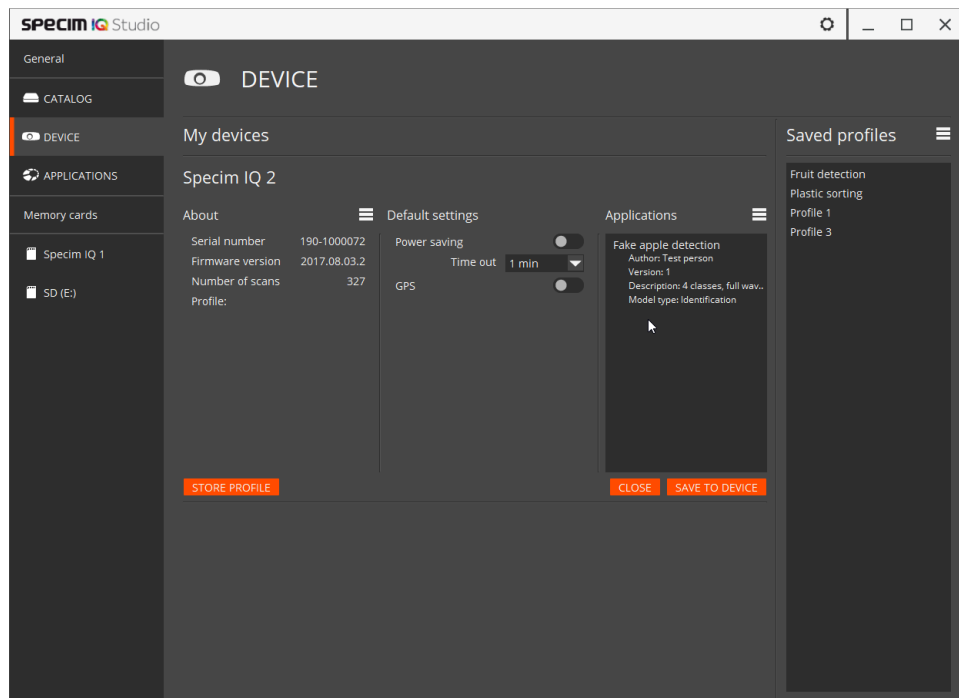


Figure 218: Renamed Device

6. When done, select either:

- **STORE PROFILE** — Press this button to save the settings as a new profile.
- **CLOSE** — Press this button to discard the changes and return to the **DEVICE** view.
- **SAVE TO DEVICE** — Press this button to save the changes to the connected camera.

3.5.3.4 Editing the Copyright Statement

This section describes how to edit the copyright statement saved as metadata on each measurement data recorded with Specim IQ.

Proceed as follows:

1. Connect Specim IQ to your computer.
See [Connecting Specim IQ to Your Computer](#).
2. Select **DEVICE** > **OPEN** to open the desired device information area.

The screen below is opened:

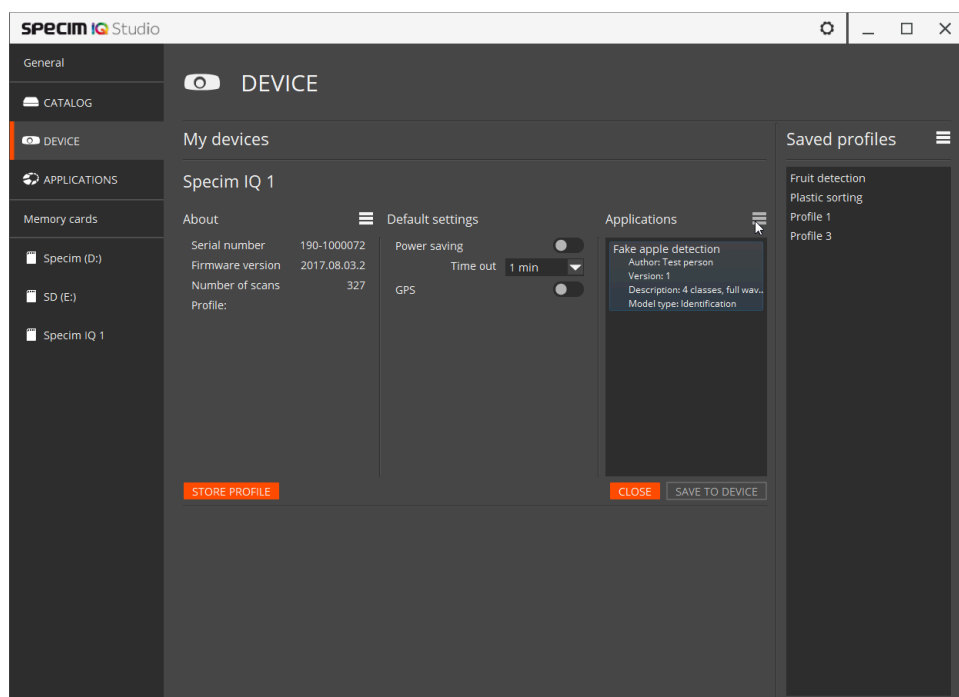


Figure 219: Device Information

3. Select **About** >  > **Edit copyright**.

The screen below is opened:

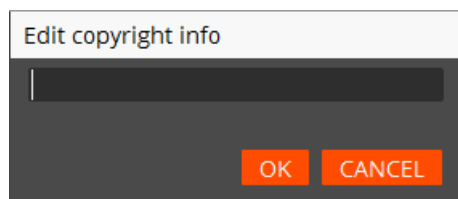


Figure 220: Editing the Copyright Statement

4. Enter the new copyright statement to the **Edit copyright info** field.
5. Select **OK**.
6. When done, select either:
 - **STORE PROFILE** — Press this button to save the settings as a new profile.
 - **CLOSE** — Press this button to discard the changes and return to the **DEVICE** view.
 - **SAVE TO DEVICE** — Press this button to save the changes to the connected camera.

3.5.4 Managing Applications

This section describes how to manage applications in the **DEVICE** view.

Related Tasks

[Modifying Device Settings](#)

This section describes how to modify device settings on Specim IQ Studio.

[Editing a Profile](#)

This section describes how to edit a device profile on Specim IQ Studio.

3.5.4.1 Adding an Application

This section describes how to add an application to Specim IQ.

Proceed as follows:

1. Connect Specim IQ to your computer.

See [Connecting Specim IQ to Your Computer](#).

2. Select **DEVICE** > **OPEN** to open the desired device information area.

The screen below is opened:

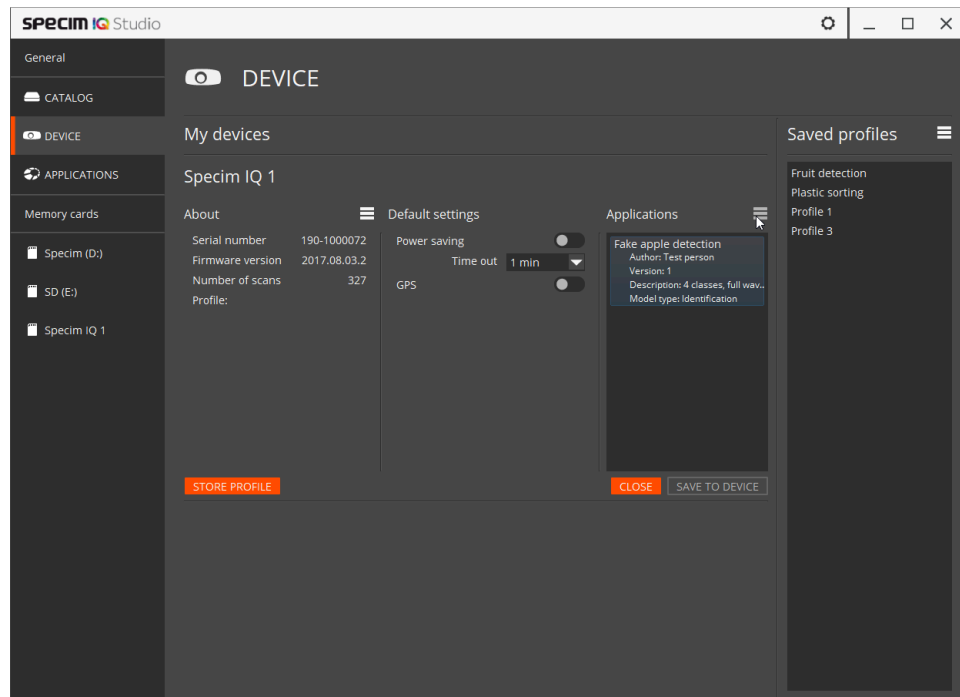


Figure 221: Device Information

3. Select **Applications** >  > **Add**.

The screen below is opened:

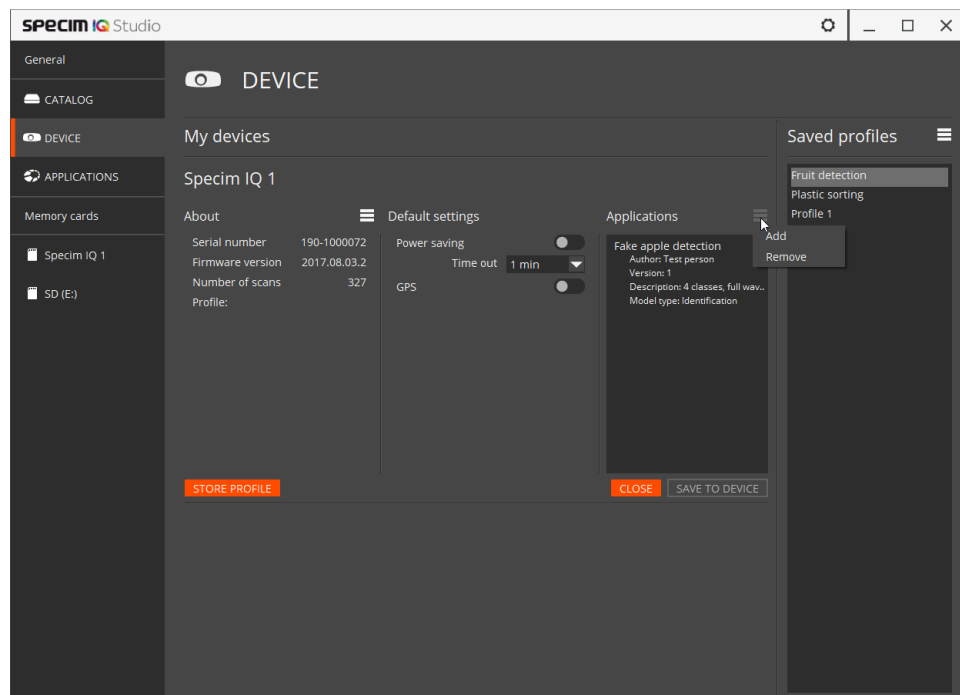


Figure 222: Adding an Application

4. Select the application(s) from the list.

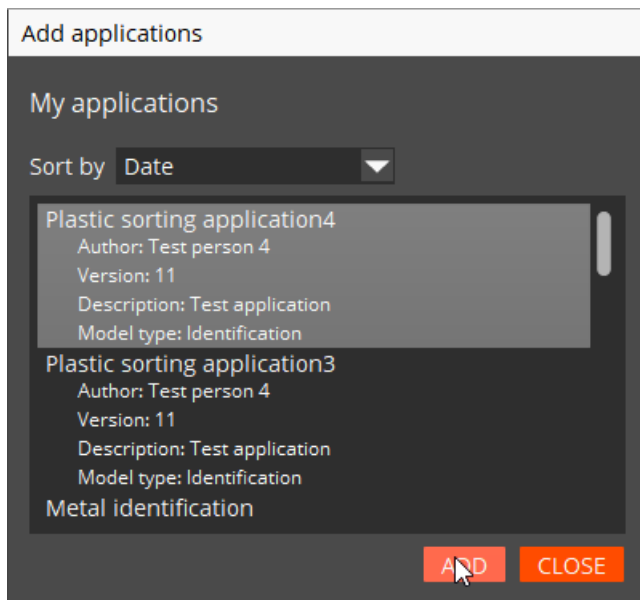


Figure 223: Selecting Applications

5. Select **ADD**.
6. When done, select either:
 - **STORE PROFILE** — Press this button to save the settings as a new profile.
 - **CLOSE** — Press this button to discard the changes and return to the **DEVICE** view.
 - **SAVE TO DEVICE** — Press this button to save the changes to the connected camera.

3.5.4.2 Removing an Application

This section describes how to remove an application from Specim IQ.

Proceed as follows:

1. Connect Specim IQ to your computer.
See [Connecting Specim IQ to Your Computer](#).
2. Select **DEVICE > OPEN** to open the desired device information area.

The screen below is opened:

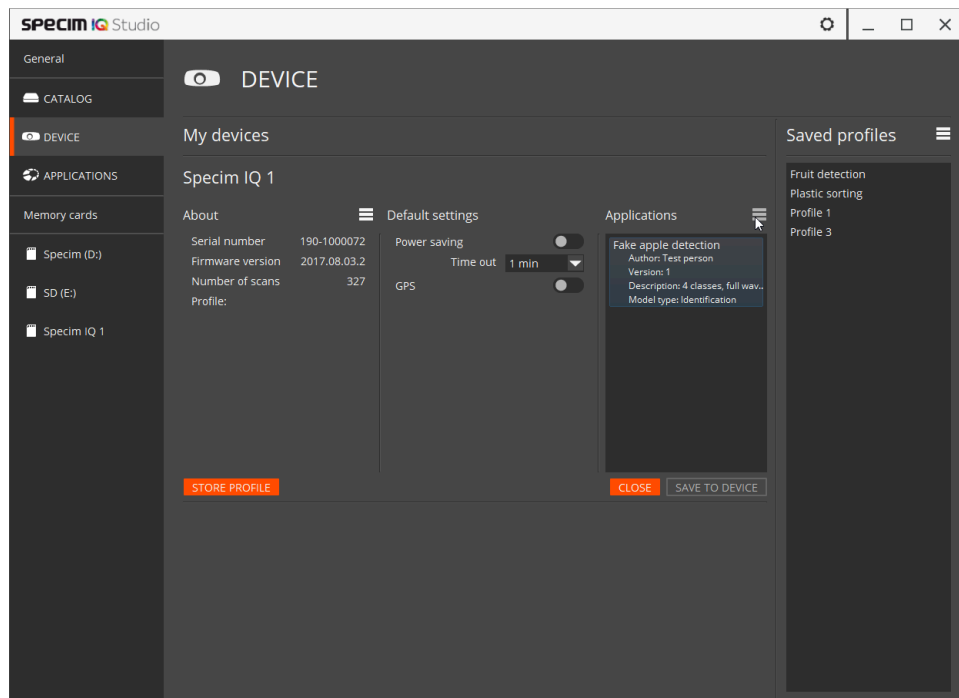


Figure 224: Device Information

3. Select the application to be removed, from the **Applications** list.
4. Select **Applications** >  > **Remove**.

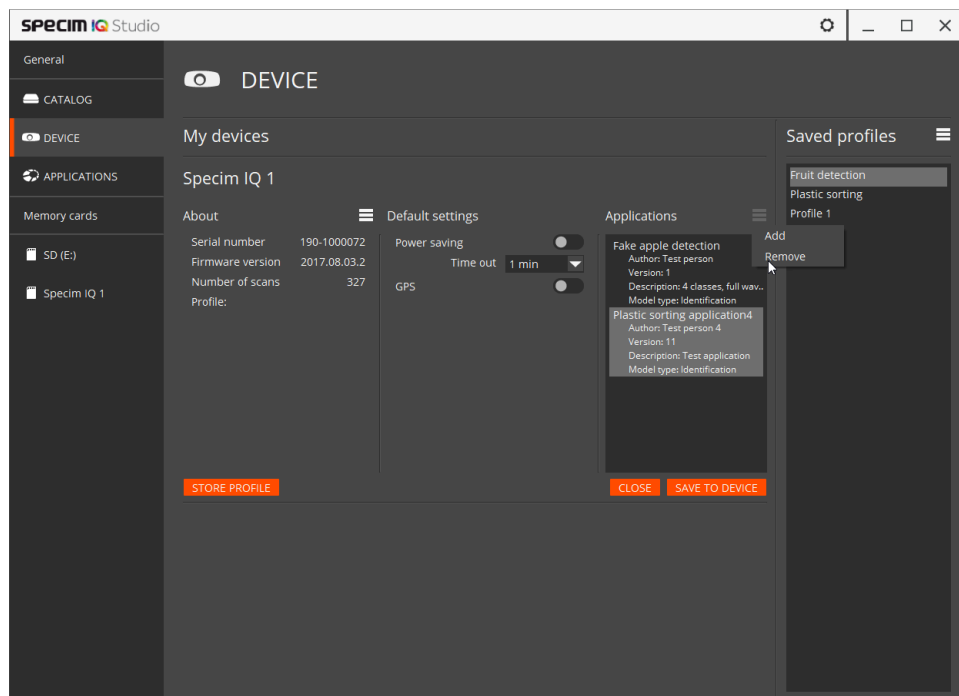


Figure 225: Removing an Application

5. The system asks for your confirmation:

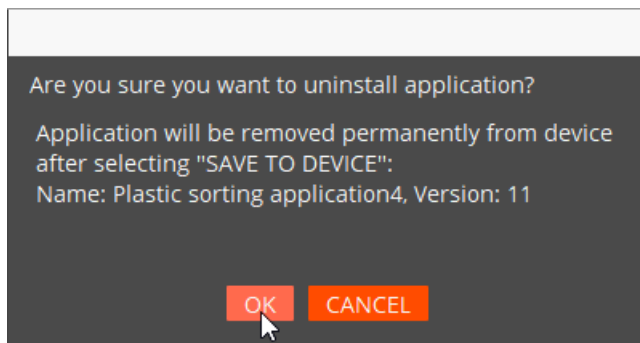


Figure 226: Removing an Application - Confirmation

6. Select either:

- **OK** to continue.
- **CANCEL** to cancel and return to the **DEVICE** screen.

7. When done, select either:

- **STORE PROFILE** — Press this button to save the settings as a new profile.
- **CLOSE** — Press this button to discard the changes and return to the **DEVICE** view.
- **SAVE TO DEVICE** — Press this button to save the changes to the connected camera.

3.5.5 Managing Profiles

This section describes how to manage profiles in the **DEVICE** view.

3.5.5.1 Loading a Profile to Specim IQ

This section describes how to load a device profile to Specim IQ.

If a saved profile on the list is grayed out, some of the applications included in the profile are not present in the software. Remove the missing applications by editing the profile, or import the applications back to the applications list on the **Applications** page.



Tip:

You can also drag and drop profiles from the **Saved profiles** list to the main view of Specim IQ Studio.

Proceed as follows:

1. Connect Specim IQ to your computer.

See [Connecting Specim IQ to Your Computer](#).

2. Select **DEVICE > OPEN** to open the desired device information area.

The screen below is opened:

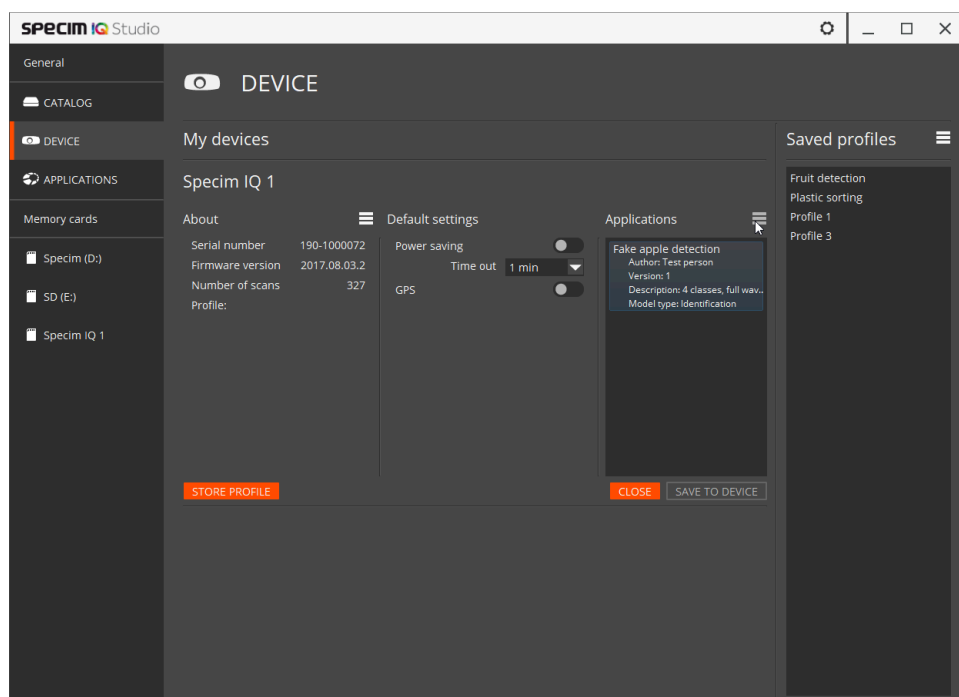


Figure 227: Device Information

3. Select **DEVICE** > **Saved profiles** >  > **Load to device**.



Tip:

You can also drag and drop profiles to the device.

The system asks for your confirmation, before actually loading a profile.

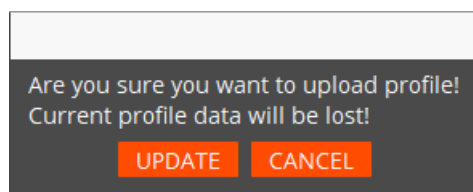


Figure 228: Loading a Profile

4. Select either:
 - **Update** — Press this button to upload the profile to the device.
 - **Cancel** — Press this button to cancel.

3.5.5.2 Editing a Profile

This section describes how to edit a device profile on Specim IQ Studio.

Proceed as follows:

1. Connect Specim IQ to your computer.
See [Connecting Specim IQ to Your Computer](#).
2. Select **DEVICE** > **OPEN** to open the desired device information area.

The screen below is opened:

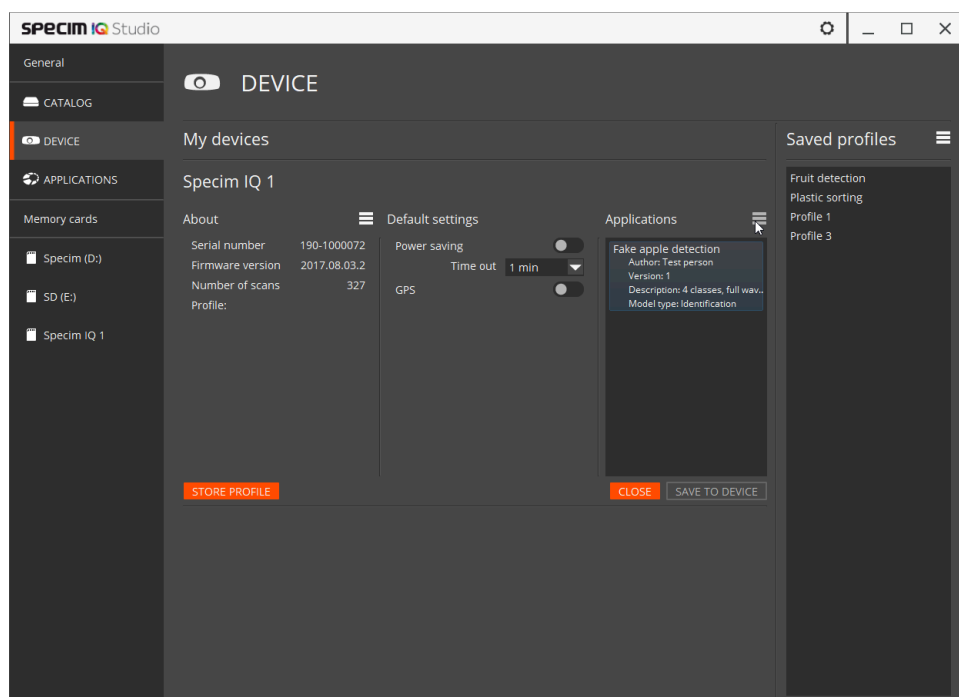


Figure 229: Device Information

3. Select **DEVICE** > **Saved profiles** > > **Open**.
4. Make the desired changes in the **Edit profile** view.

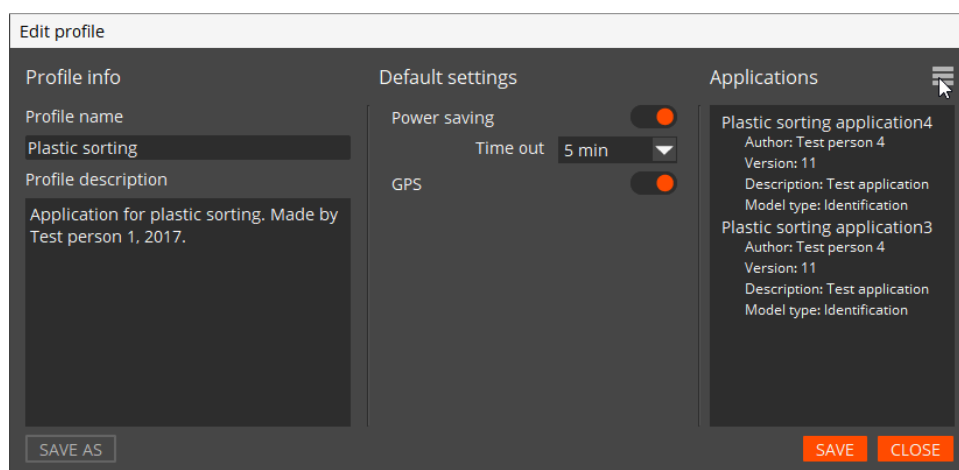


Figure 230: Edit profile

The profiles settings are:

- **Profile name** — You can edit the profile name in this field.
- **Profile description** — You can edit the profile description in this field.
- **Power saving** — You can:
 - Enable power saving by sliding the **Power saving** slider to the **ON** position.
 - Disable power saving by sliding the **Power saving** slider to the **OFF** position.
 - Select a suitable sleep timeout from the **Time out** menu.
- **GPS** — You can:
 - Enable **GPS** features by sliding the **GPS** slider to the **ON** position.
 - Disable GPS features by sliding the **GPS** slider to the **OFF** position.

5. Select either:

- **SAVE AS** — Press this button to save the profile as a new profile.
- **SAVE** — Press this button to save the changes to the profile.
- **CLOSE** — Press this button to discard changes and close the screen.

Related Information

[Managing Applications](#)

This section describes how to manage applications in the **DEVICE** view.

3.5.5.3 Exporting a Profile

This section describes how to export a profile.

Proceed as follows:

1. Connect Specim IQ to your computer.

See [Connecting Specim IQ to Your Computer](#).

2. Select **DEVICE** > **OPEN** to open the desired device information area.

The screen below is opened:

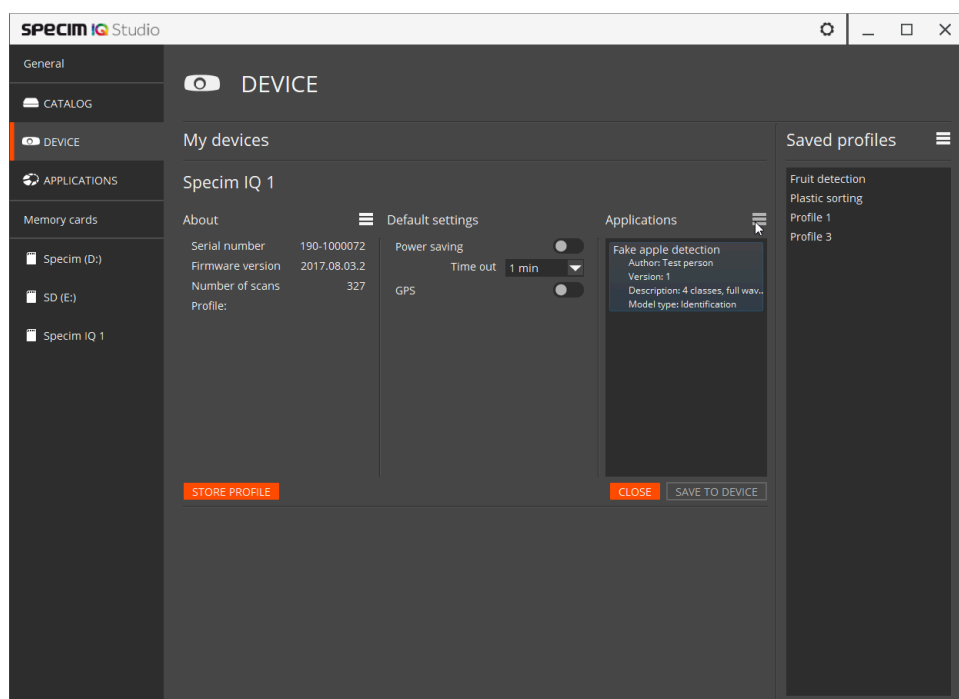


Figure 231: Device Information

3. Select the profile that you want export, from the **Saved profiles** list.

4. Select **DEVICE** > **Saved profiles** > > **Export**.

5. Windows file manager is opened.

6. Select the destination folder for the exported profile.

7. Select **Select folder**.

The profile names must be unique. If there is a file name conflict, the screen below is shown:

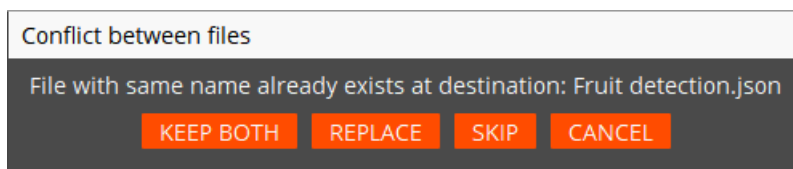


Figure 232: Conflict between Files

The options are:

- **KEEP BOTH** — Press this button to keep both profiles. If you choose this option, a consecutive number in parenthesis is appended to the profile file name.
- **REPLACE** — Press this button to replace the existing profile file with the new profile file.
- **SKIP** — Press this button to skip the profile file.
- **CANCEL** — Press this button to cancel the exporting procedure.

3.5.5.4 Importing a Profile

This section describes how to import a profile.

Proceed as follows:

1. Connect Specim IQ to your computer.

See [Connecting Specim IQ to Your Computer](#).

2. Select **DEVICE > OPEN** to open the desired device information area.

The screen below is opened:

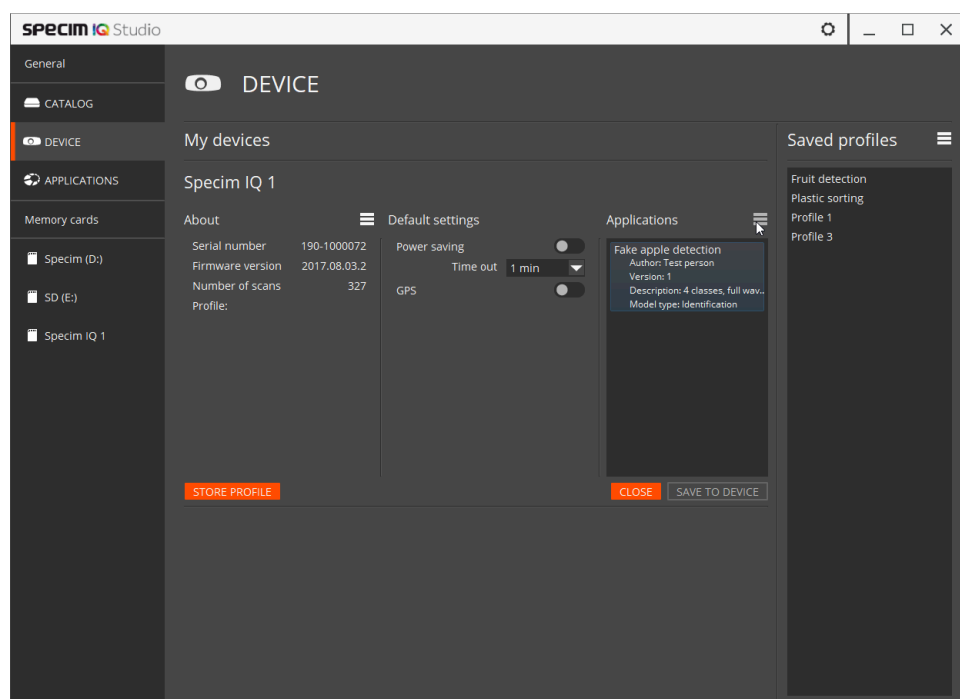


Figure 233: Device Information

3. Select **DEVICE > Saved profiles >  > IMPORT**.
4. Windows file manager is opened.
5. Select the profile to be imported.
6. Select **IMPORT**.

The profile names must be unique. If there is a file name conflict, the screen below is shown:

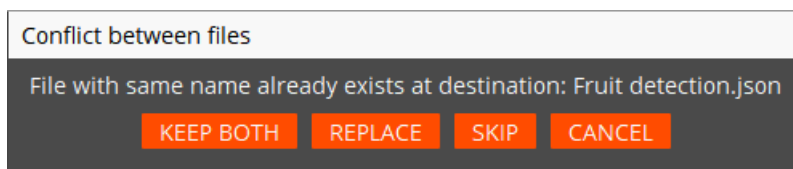


Figure 234: Conflict between Files

The options are:

- **KEEP BOTH** — Press this button to keep both profiles. If you choose this option, a consecutive number in parenthesis is appended to the profile file name.
- **REPLACE** — Press this button to replace the existing profile file with the new profile file.
- **SKIP** — Press this button to skip the profile file.
- **CANCEL** — Press this button to cancel the exporting procedure.

3.5.5.5 Deleting a Profile

This section describes how to delete a device profile.

Proceed as follows:

1. Connect Specim IQ to your computer.

See [Connecting Specim IQ to Your Computer](#).

2. Select **DEVICE** > **OPEN** to open the desired device information area.

The screen below is opened:

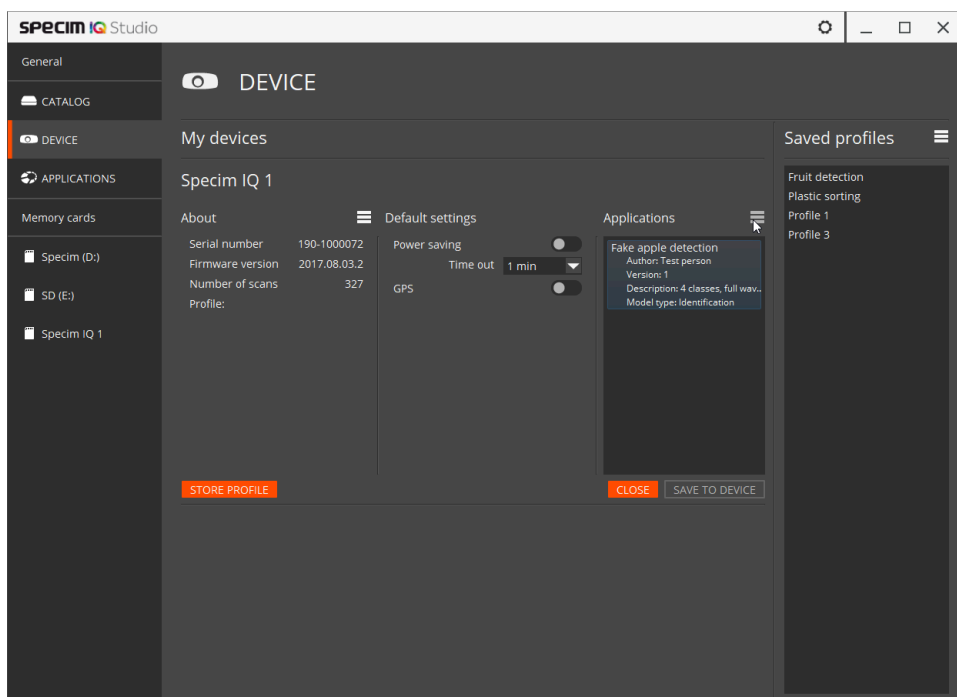


Figure 235: Device Information

3. Select **DEVICE** > **Saved profiles** > > **Delete**.
4. The system asks for your confirmation. Select:
 - **OK** to proceed.
 - **CANCEL** to cancel.
5. If you select **OK**, the profile is removed from the device.

3.5.6 Remote Use

This section describes example workflow for using the remote functionality between the Specim IQ Studio and the Specim IQ camera.



Note: Sleep functionality is disabled when the Remote session has been established



Note: Battery drains faster when using WiFi for the Remote connection.

3.5.6.1 Defining the Remote Connection Using USB

Remote connection can be established either with USB or WiFi. To establish the connection using USB, proceed as follows:

1. Connect Specim IQ to your computer with USB.
2. Define a password for the remote session (OPTIONAL).
 - a) Press the **SET** button.
 - b) Select **Device**.
 - c) Select **Connectivity**.
 - d) Select **Remote password**, type the desired password and select **OK**.
 - e) Use the slider to define if the defined password can be seen in the Connectivity menu.

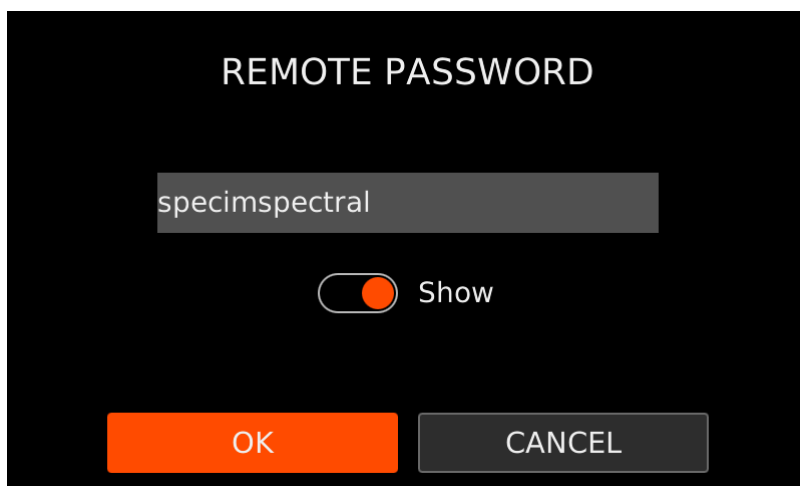


Figure 236: Defining device password

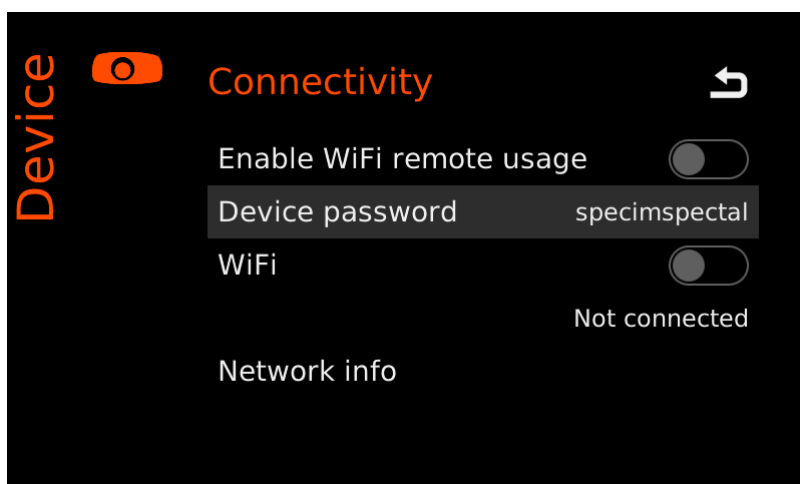


Figure 237: Device password defined and visible

3.5.6.2 Defining the Remote Connection Using WiFi

Remote connection can be established either with USB or WiFi. To establish the connection using WiFi, proceed as follows:

1. Connect the computer, from which you are operating the Specim IQ Studio, to a network.
2. Power on the Specim IQ device, press the **SET** button and select **Device**.
3. Select **Connectivity**, enable remote use and connect to a Wi-Fi network.

Read [Connectivity](#) section for more information about the **Connectivity** tab use.

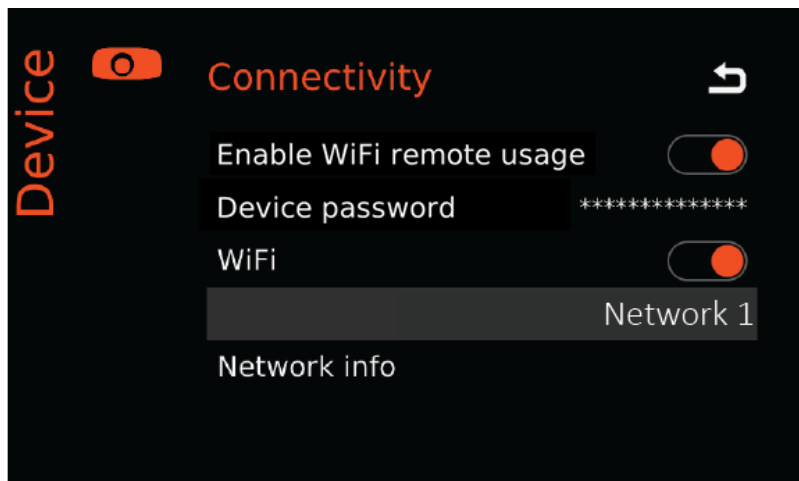


Figure 238: WiFi network connected

3.5.6.3 Opening Remote Connection

When operating Specim IQ remotely through Specim IQ Studio, the data is automatically saved to the memory card. You can choose to remotely import the data to a desired Specim IQ Studio's Catalog and delete the data from the memory card after the import.

To open the Remote session dialog and to define the data saving settings, proceed as follows:

1. In IQ Studio, go to the **DEVICE** tab and select **REMOTE**.

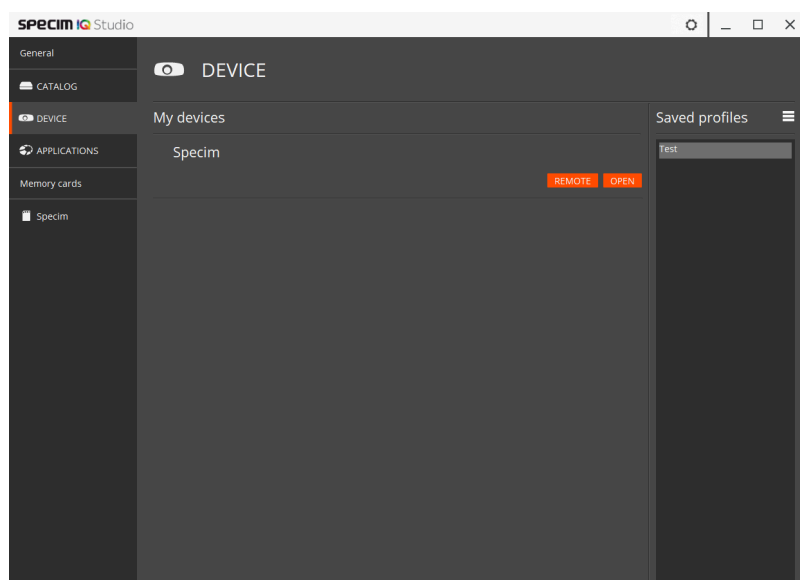


Figure 239: Selecting remote use in IQ Studio

Enter the remote password if it has been defined in the Specim IQ device. Specim IQ Studio remembers the password for each device.



Note: If the remote use has not been enabled from the device, the Remote connection cannot be established over WiFi.

2. Define data saving settings in the **Remote Session Options** dialog.

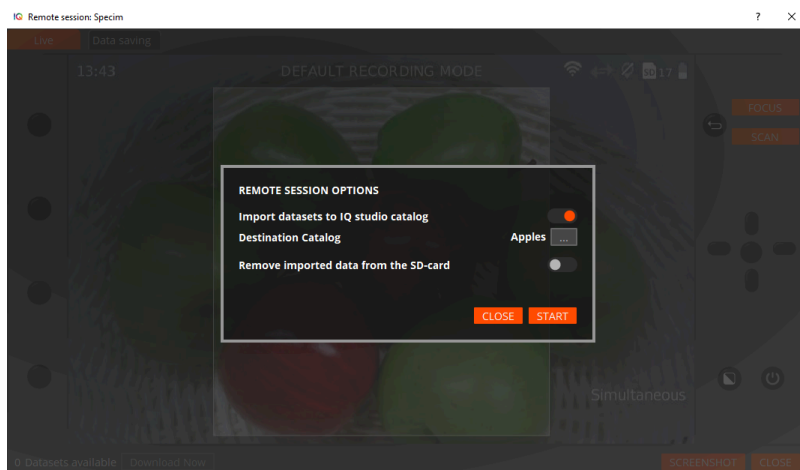


Figure 240: Remote Session Options

The memory card is automatically selected for data saving location. To import your data to a Specim IQ Studio's Catalog:

- Slide the **Copy datasets to IQ Studio Catalog** button.
- Select the Catalog where you wish the data to be copied.
- Choose if you want to delete the data from the memory card after the copy/import.

3. Select **START** once ready.



Note: Once the data saving settings have been made in this view, they cannot be edited during the remote session.

3.5.6.4 Managing Remote Use

You can now operate the Specim IQ device through the Remote Session dialog in Specim IQ Studio. The Remote session has the following tabs:

Live tab

Live tab allows you to operate the camera remotely.

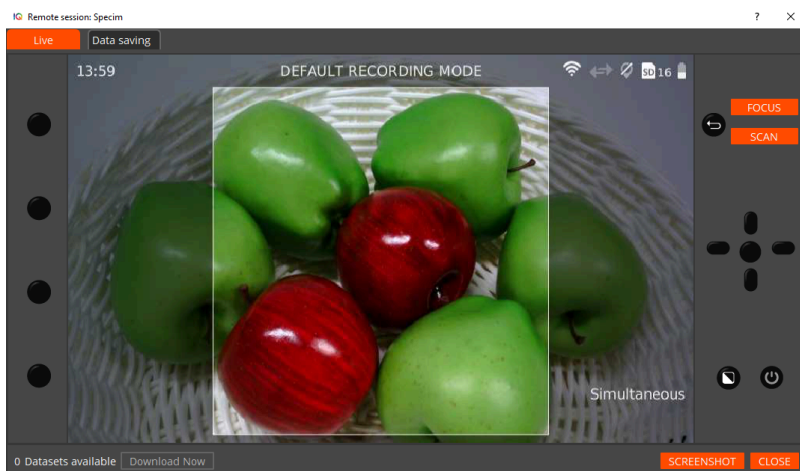


Figure 241: Live tab

Camera's view is livestreamed to the remote dialog with the graphical buttons imitating the camera's physical buttons. The camera is operated remotely with these buttons and with the touchscreen, much in the same way as on the camera itself.

In the bottom left corner, you can see the number of recorded datasets available for importing to Specim IQ Studio's Catalog. If the data saving settings define that the data will be copied to the Specim IQ Studio's Catalog, click the **Download now** button to import the available datasets.



Note: Focusing the Specim IQ camera remotely is not possible. Focusing the camera happens manually by rotating the objective.

Data saving

Data saving tab allows you to see and study the recorded data. There are two Catalog visualization options: **Session datasets** and **All datasets**. Data Saving tab has content only when IQ Studio Catalog is chosen in data saving settings.

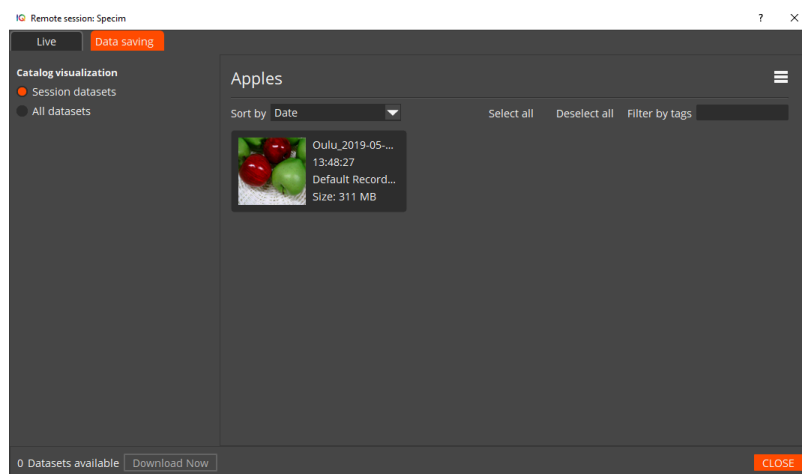


Figure 242: Data saving tab

Closing the remote session

Close button closing the Remote session.



Note: If you are importing data to Catalog, make sure that the data has been fully imported before closing the session.

3.5.7 About Specim IQ Studio

This section describes how to view more information on Specim IQ Studio.

Proceed as follows:

1. Select the settings wheel in the main menu:



Figure 243: Settings Wheel

2. Information, such as the software version, on Specim IQ Studio is shown.

The screen below is opened:



Figure 244: About Specim IQ Studio

On this screen, you can:

- Open the end-user license agreement
- Open the Specim support website
- Read the spectral library reader license.

4 Specim IQ Studio Advanced User Manual

Specim IQ Studio for advanced users.

4.1 Application Creation Workflow

This section describes an example workflow for using the IQ system.

In this example, we create an application that identifies plastic apples from real ones.

The main steps of the process are depicted in the figure below:

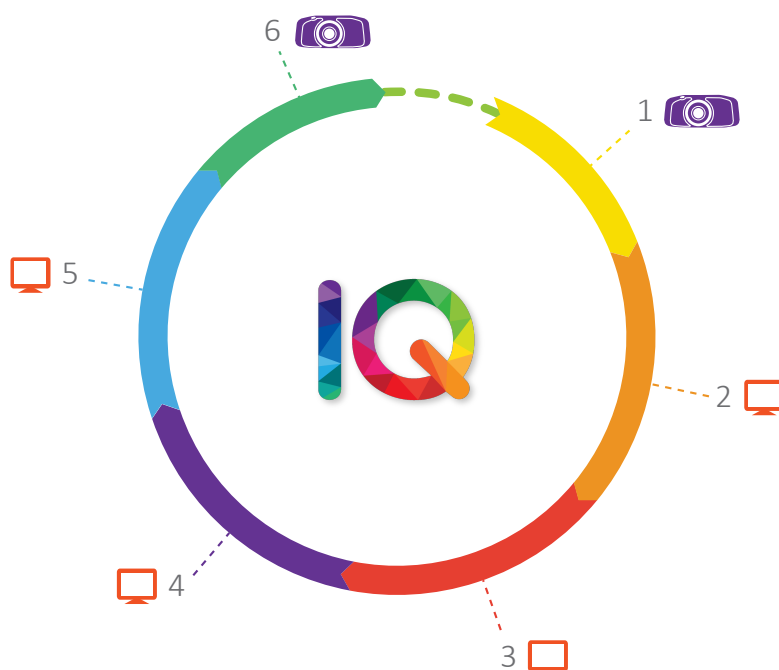


Figure 245: Application Creation Workflow

The steps are:

1. Collect training data
2. Import data
3. Create identification model
4. Create application
5. Create and upload device profile
6. Application results

Proceed as follows:

1. Record data with Specim IQ with *DRM*.

Follow the Quick Guide instructions or IQ manual, to record data from real apples and plastic apples. You can also download the example data set *Apples (Recorded in Application Mode)* from the Downloads section in the IQ User Community.

2. Create a catalog.

- a) Select **CATALOG > My catalogs > [Menu Icon] > New**.

The screen below is opened:

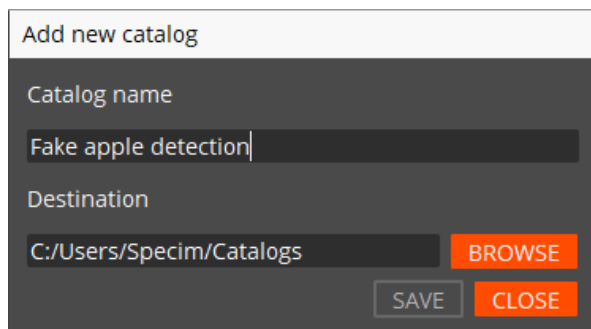


Figure 246: Add New Catalog

- b) Name the catalog as **Fake apple detection**.
c) Select **SAVE**.

3. Transfer the recorded data to Specim IQ Studio.

- a) Attach the device to the PC by using the USB cable, or insert the SD card to the card reader.
b) The SD card appears as an external storage device on the list.
c) Select the SD card from the side bar.

The SD card contents are populated to the catalog content view.

- d) Select the dataset(s).
e) Select **[Menu Icon] > Import**.
f) Define the destination catalog.
g) Enter a **Free description** and add optional tags.
h) Select **Import**.

4. Create the model.

- a) Select **APPLICATIONS > MODELS**.
b) Select **My model projects > [Menu Icon] > Create model**.

The screen below is opened:

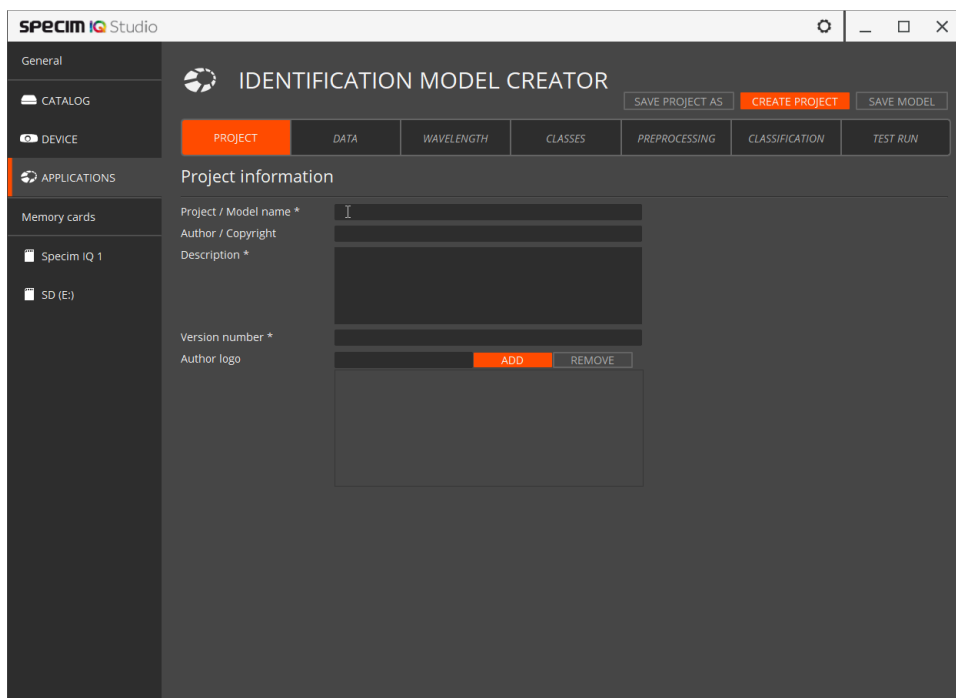


Figure 247: Create Model Project

c) Enter project information as follows:

- **Project name** — Fake apple detection
- **Description** — A model for detecting fake apples.
- **Version number** — 1.0.

d) Select **Create project**.

e) The project is saved in the C:\Users\Username\Specim\Projects folder.

5. Select the **DATA** tab.

In this step, we select the amount of training data that the model uses to identify the target.

- Select **Dataset** >  > **Open**.
- Select the **Fake apple detection** dataset from the **My catalogs** list.

The screen below is opened:

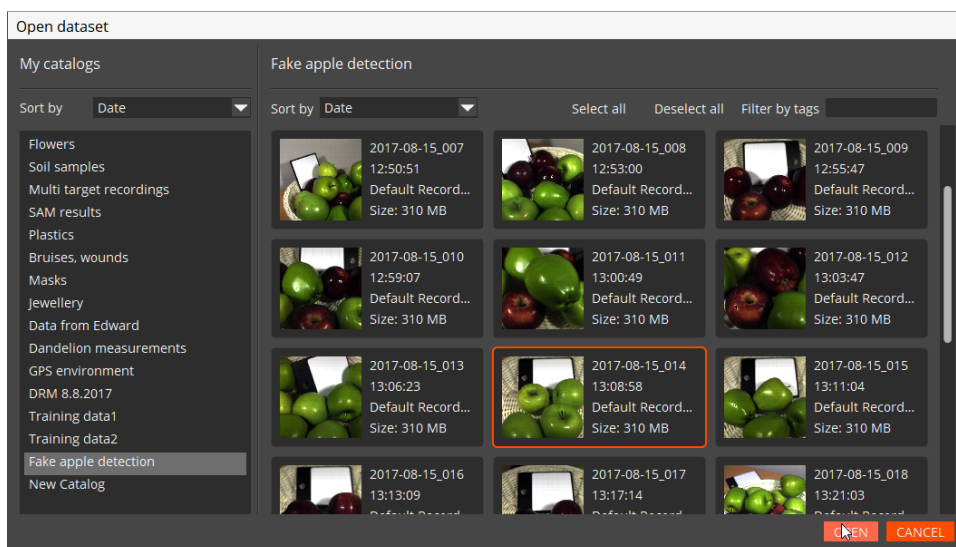


Figure 248: Select Datasets

- c) Select datasets that contain plastic apples.
- d) Select **Open**.
- e) Select **AOIs** > **Create new**, or double click the visualization area to open the **Create AOIs** dialog.

The screen below is opened:

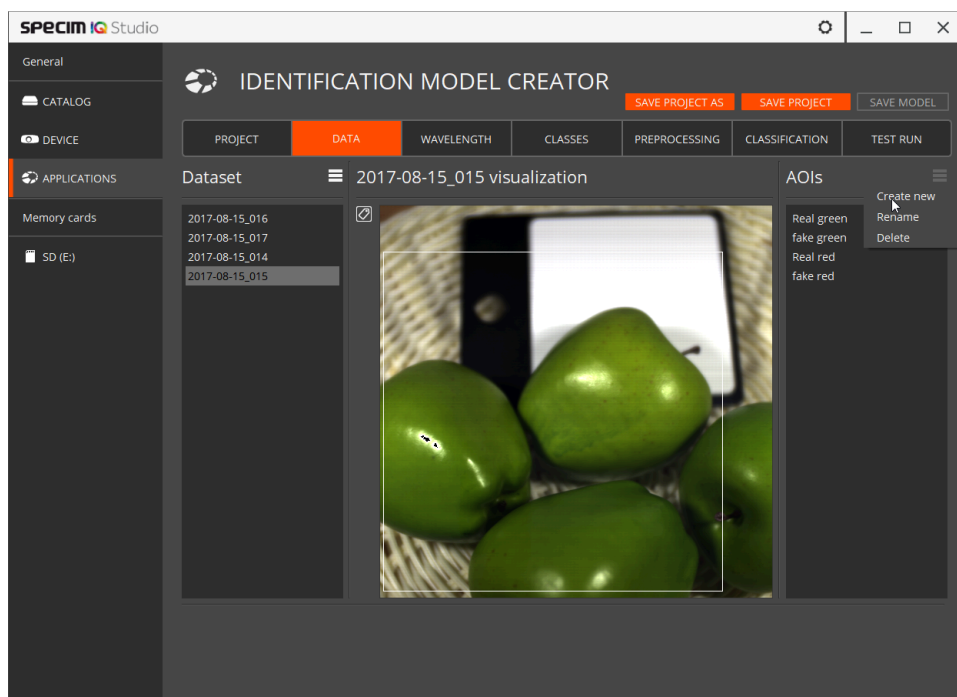


Figure 249: Create Area of Interest (AOI)

- f) Use your mouse to draw a rectangular area of interest onto the dataset image.
- Select the area of interest in such a way that it contains both real apples and plastic apples.

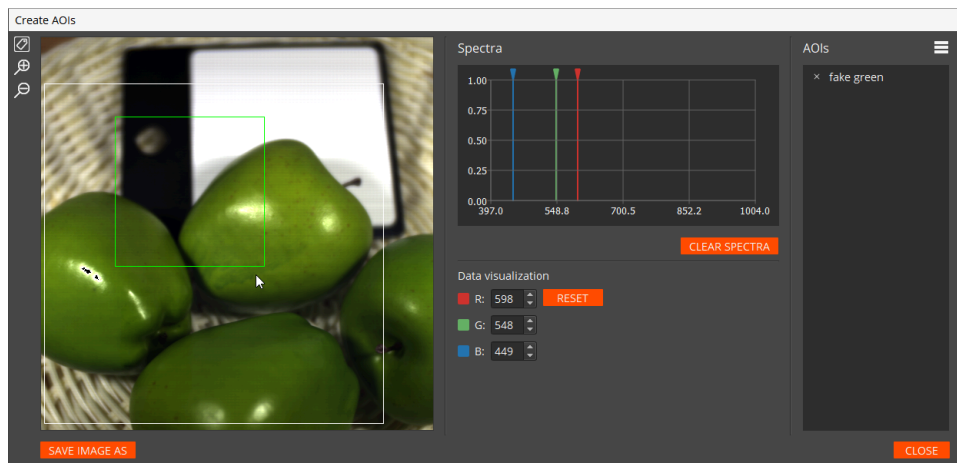


Figure 250: AOI Example

- g) Double-click the AOI name to rename the AOI.
 - h) Press Enter.
 - i) Press **CLOSE** to close the dialog.
6. Select the **WAVELENGTH** tab.

In this step, we limit the wavelength bandwidth that the model uses to identify the target.

When limiting the wavelength, try to look for the area where you can see differences in the spectra. These are the most important wavelengths.

- a) Select the AOI that you just created.

The AOI wavelengths are depicted on four graphs. You can use any graph to limit the wavelength.

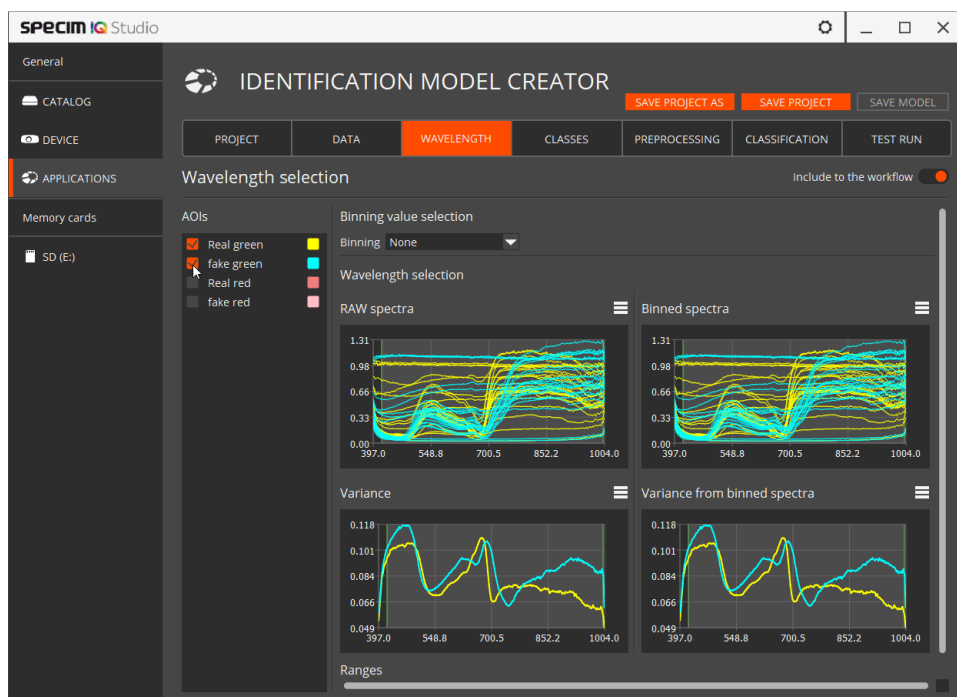


Figure 251: AOI Wavelengths

- b) Double-click the wavelength screen that you want to use to limit the wavelength.
- c) Use the sliding pointers or use numerical values to limit the wavelength.
- d) Select **Save**.

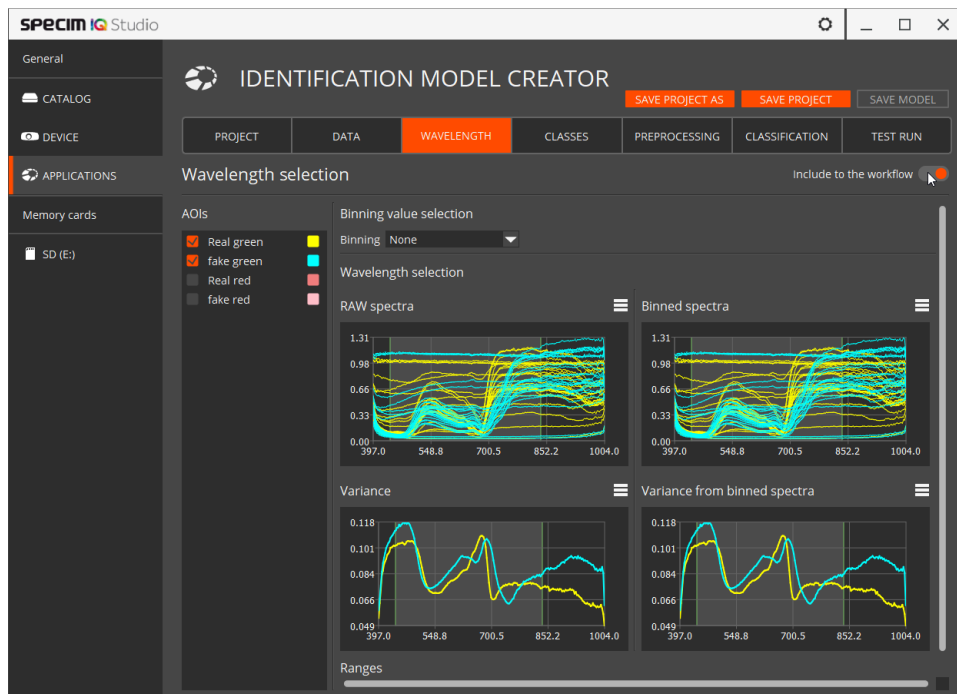


Figure 252: Limited AOI Wavelengths

- e) Make sure that **Include to the workflow** is on.
7. Select the **CLASSES** tab.

In this step, you select the material that you want to identify.

The AOI is visualized on the data visualization area.

- a) Select the AOI.
- b) Double-click the AOI visualization area.

The screen below is opened:

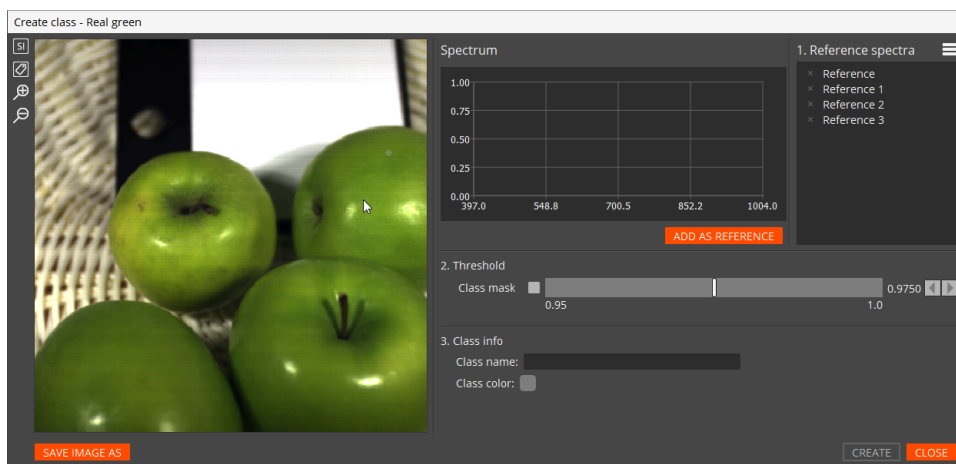


Figure 253: Locate Reference Spectrum

In this dialog, you locate the reference spectrum that describes the substance that you want identify, as well as possible.

- c) Use your mouse to select and view potential positions for the reference spectra.

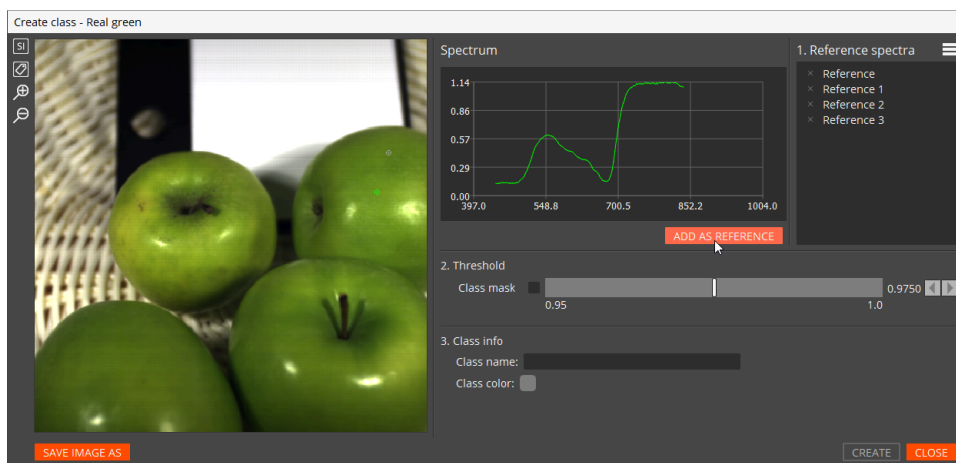


Figure 254: Selecting the Reference Spectrum

Pick one that defines the substance that you want identify, that is, from the fake apple.

- d) Select **ADD AS REFERENCE**.
- e) Name the reference as **Fake apple**, and press Enter.
- f) Select the **Class mask** check box.

The screen below is opened:

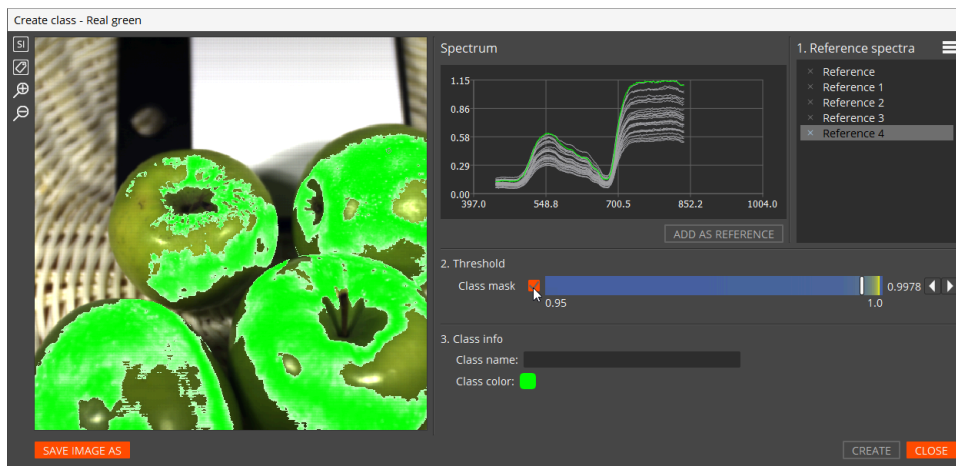


Figure 255: SAM Mask

The class mask depicts the areas on the AOI that match the selected reference spectra, as a colored mask.

The software picks random positions from the masked area and shows their spectra on the **Spectrum** area.

- g) Slide the **Class mask** slider so that the selected reference spectrum can be clearly separated from other reference spectra.

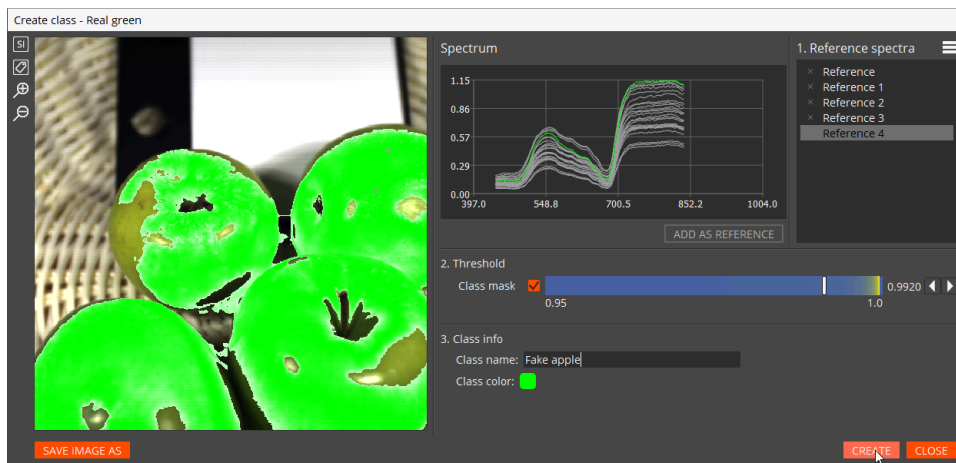


Figure 256: SAM Mask

- h) Choose a color for the class visualization.
i) Name the class as **Fake apple**.
j) Select **CREATE**.
k) Select the **Fake apple** class and select **Compute**.

The screen below is opened:

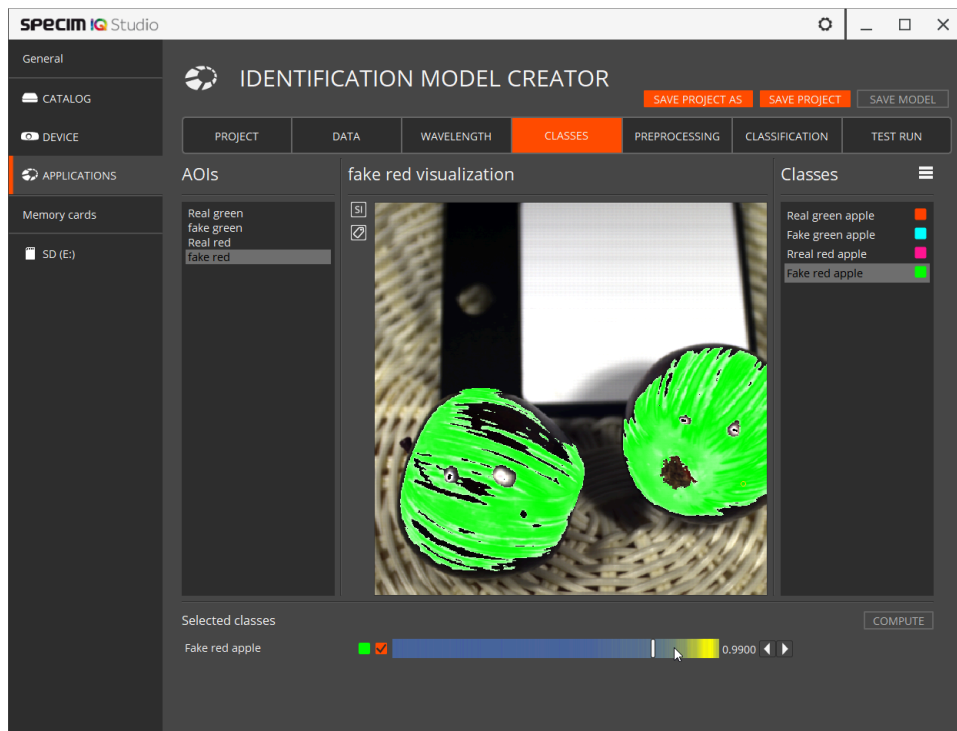


Figure 257: Checking the Class

Check that you can see the class you created from the reference spectrum.

8. Select the PREPROCESSING tab.

In this step, you remove noise from the spectrum.

- a) Activate **Include to the workflow**.
- b) In this example, just use the default values.
- c) Select the classes.
- d) Select **Compute**.

9. Select the CLASSIFICATION tab.

In this step, you select a method to compare the reference spectrum to the data.

- a) Select the **SAM** classification method.
- b) Select the classes and the AOI.
- c) Select **Compute**.
- d) Examine the results.

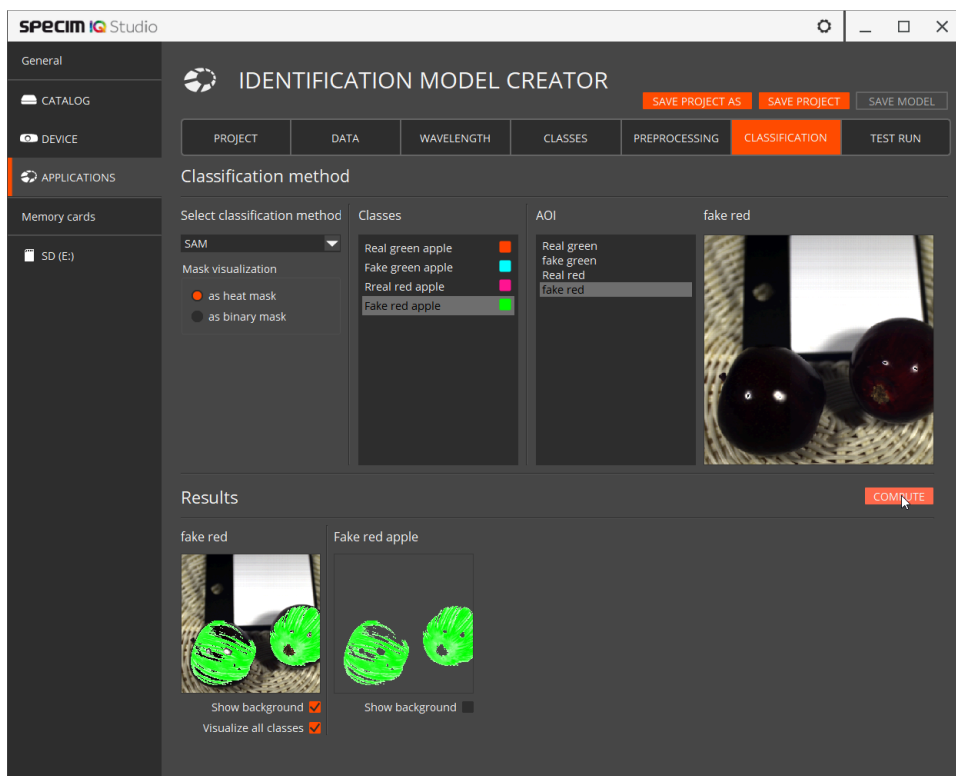


Figure 258: Checking the Classification



Tip:

You can select the mask visualization method between heat and binary mask:

- The heat mask visualizes the amount of identification in a color scale. The colors indicate the correspondence to the reference spectrum. An intensive color has a lot of similarities to the reference spectrum, whereas the lighter parts have less similarities.
- The binary mask, for its part, visualizes the class results in one solid color.

If something is wrong, you can repeat and modify steps 5-9 until you are satisfied with the results.

10. Select the TEST RUN tab.

- Open other datasets recorded under various lighting conditions.
- Select datasets.
- Select **Compute**.
- Examine the results.

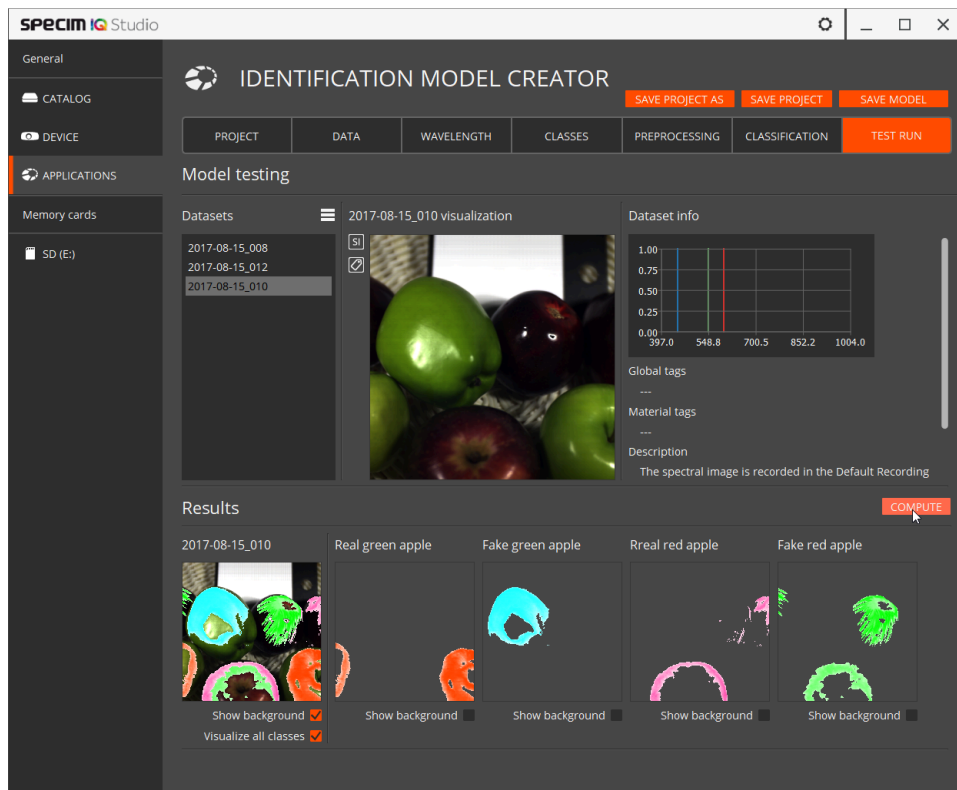


Figure 259: Test Run for a Model

- e) Save the model by selecting **Save model**.
- f) Save the project by selecting **Save project**.

The model appears on the models list.

11. Select APPLICATIONS > APPLICATIONS.

- a) Select **Create project**.

The **Application creator** is opened.

- b) Enter project information as follows:
 - **Project / Application name** — Fake apple detection
 - **Description** — An application for detecting fake apples
 - **Version number** — 1
- c) Select **Add**.
- d) Select the desired model from the list.
- e) Select **Add**.
- f) Select **Create project**.

12. Select the MODEL tab.

- a) Review the selected model.

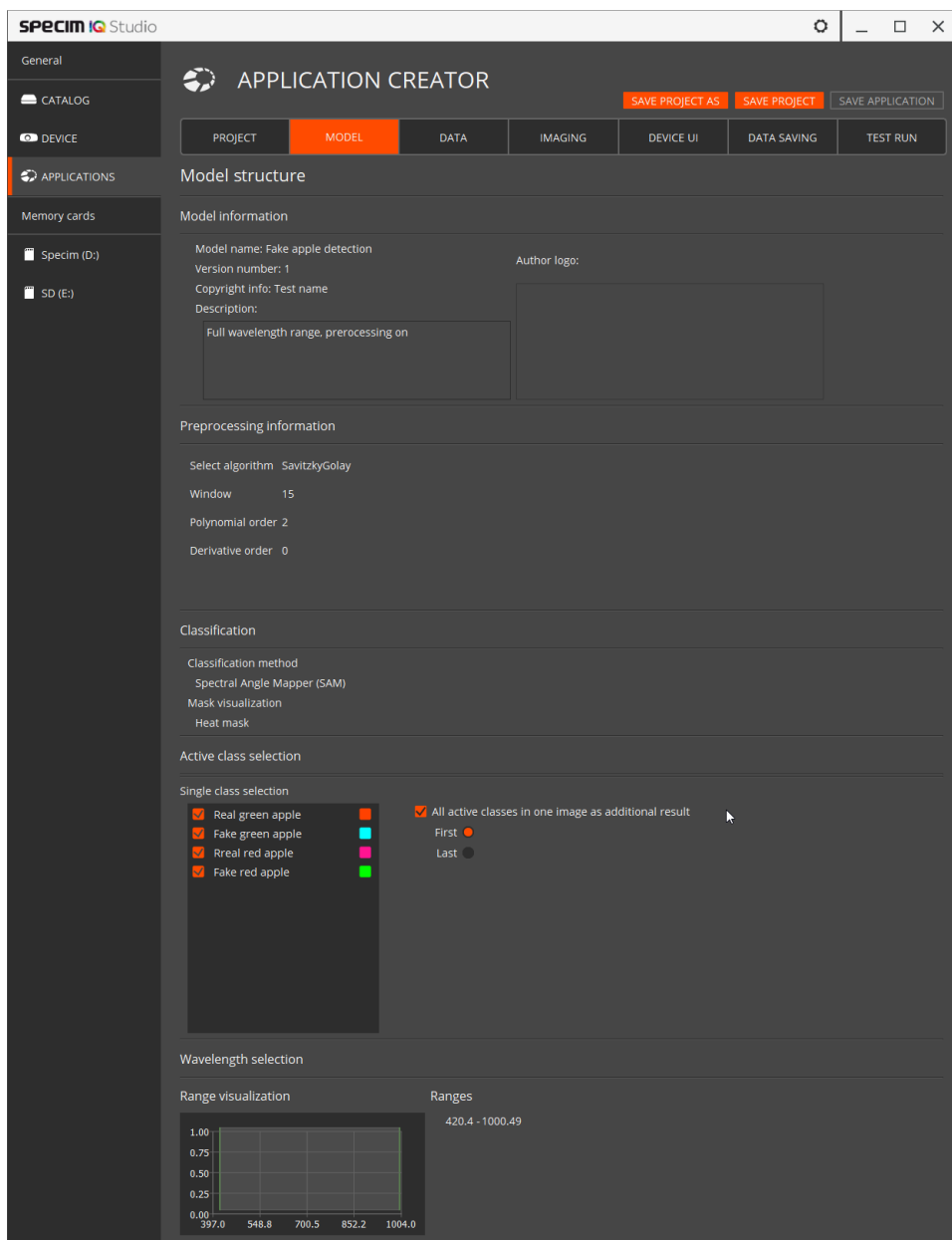


Figure 260: Reviewing the Model

b) Select the classes that will be used on the application.

13. Select the DATA tab.

a) Open the datasets.

b) Select the dataset.

c) Select **Compute**.

d) Examine the results to check that the visualization is ok.

If necessary, you can modify the visualization settings as follows:

- By dragging the RGB lines in the **Application dataset visualization** area.
- By editing the RGB values in the **Data visualization** area.

These settings are saved to the application.

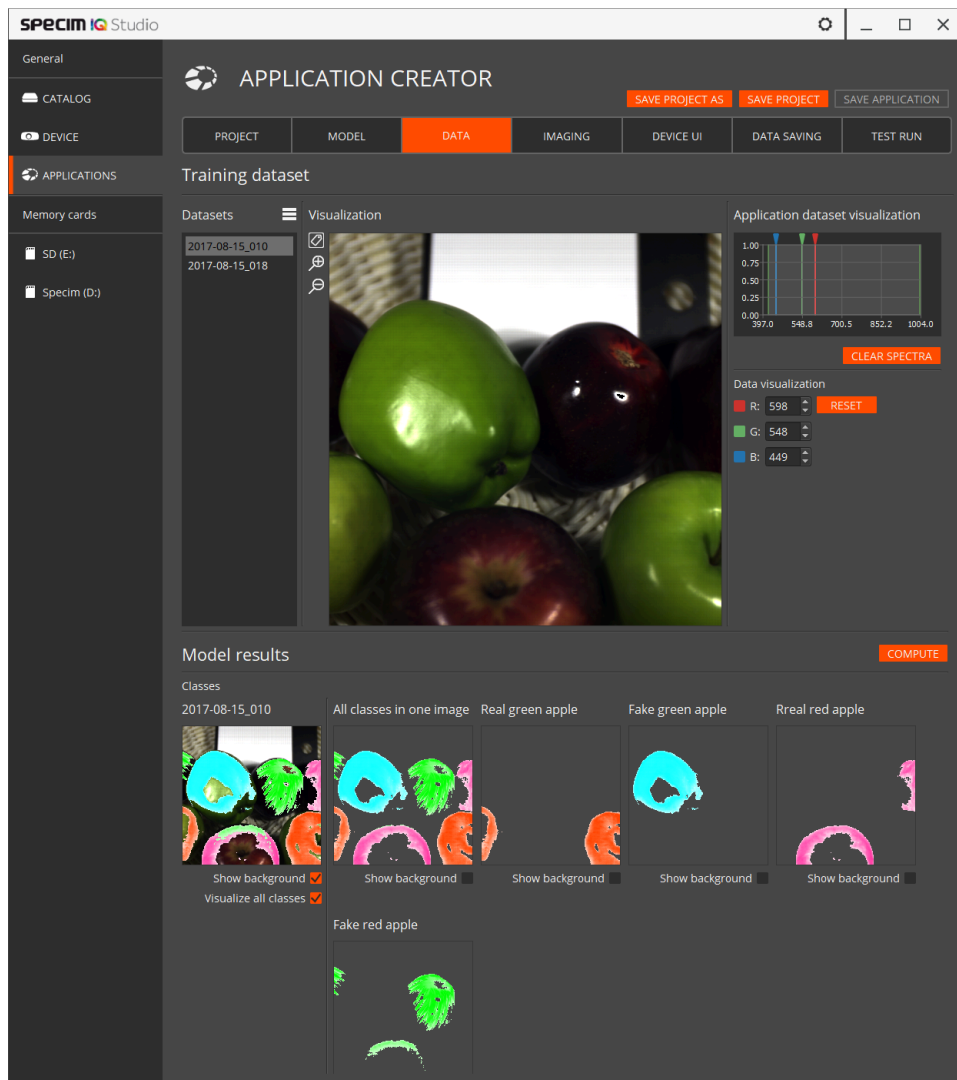


Figure 261: Checking the Visualization

14. Select the **IMAGING** tab.

a) Select the settings for RAW data saving. Raw data refers to the unprocessed data from the image sensor. The options are:

- **With model binning settings** — Save RAW data with model binning settings.
- **With no binning** — Save RAW data without binning.

15. Select the **DEVICE UI** tab.

a) Define the Specim IQ user interface settings, that is, the order in which the model results will be displayed on the device user interface.

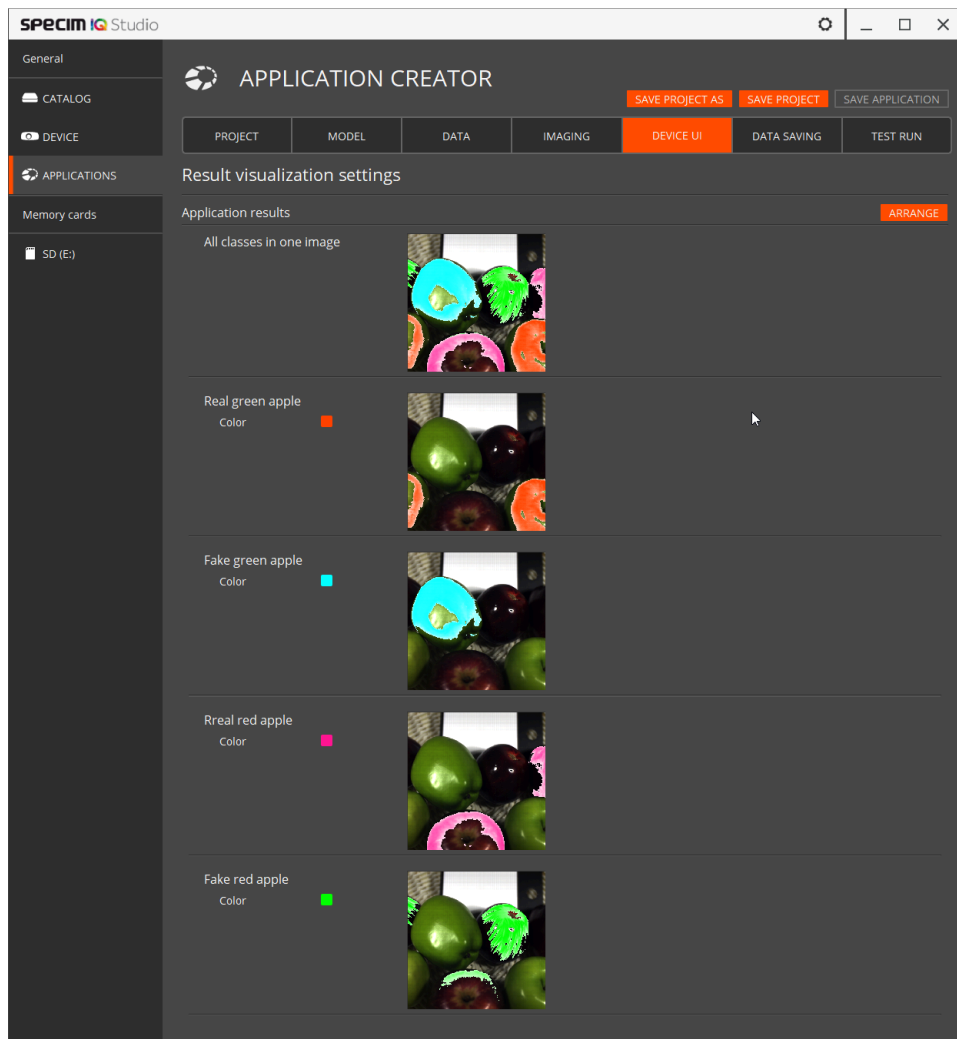


Figure 262: Visualization Settings

16. Select the **DATA SAVING tab.**

- a) Define the data saving settings, that is, what data from the device and results from the model will be saved.

On this tab, you can also add tags and a description that will be appended to the saved data.

17. Select the **TEST RUN tab.**

- a) Open the datasets.
- b) Select datasets from the **Catalog** view.
- c) Select a dataset.
- d) Select **Compute**.
- e) Examine the functionality and results in the simulator.

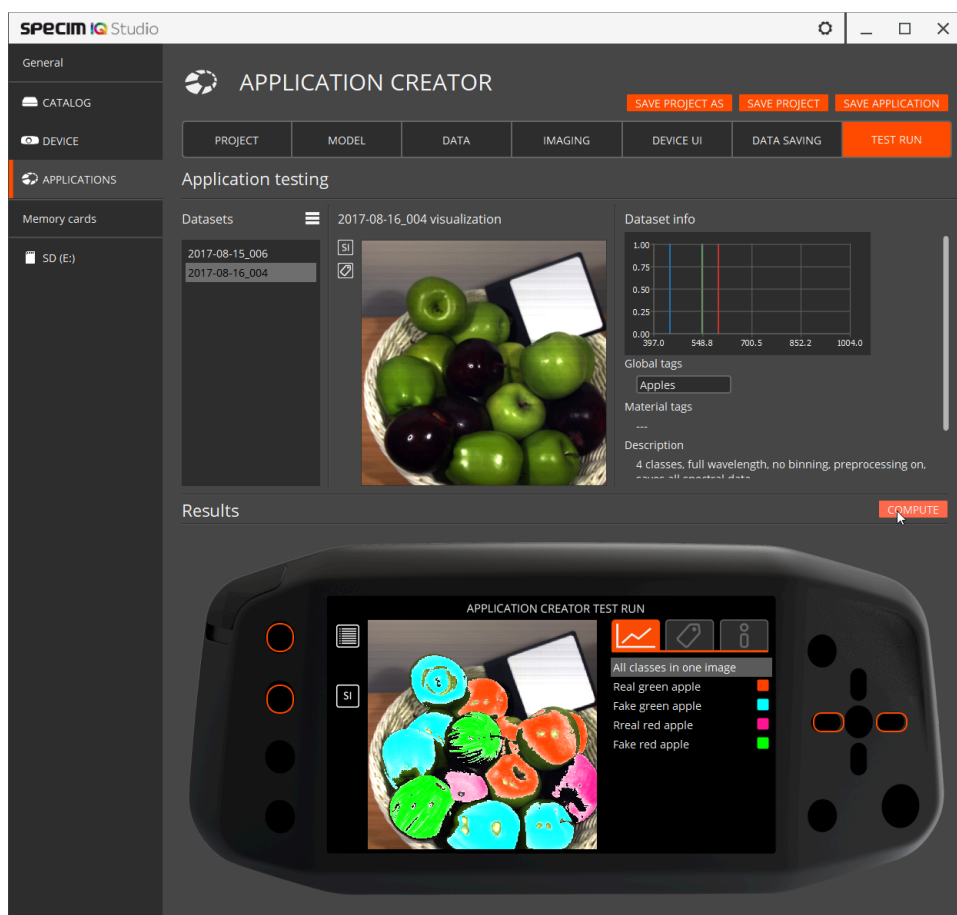


Figure 263: Simulator View

- f) Select **Save application**.
- g) Select **Save project**.

The application appears on the applications list.

18. Install the application to the device.

- a) Select **DEVICE**.
- b) Select the desired device.
- c) Select **Open**.
- d) Select **Applications** >  > **Add**.
- e) Select the application or applications.
- f) Select **ADD**.
- g) Select **SAVE TO DEVICE**.
- h) Select **CLOSE**.
- i) Disconnect the device.

19. To record data with the created application:

- a) Open the Specim IQ device, and press the **SET** button.
- b) Select **Applications**.
- c) Select the desired application from the list.
- d) From the dialog, select **USE**.
- e) Record data. See [Recording Data](#).

4.2 Managing Applications

This section describes how to manage applications.

The figure below depicts the **APPLICATIONS** view.

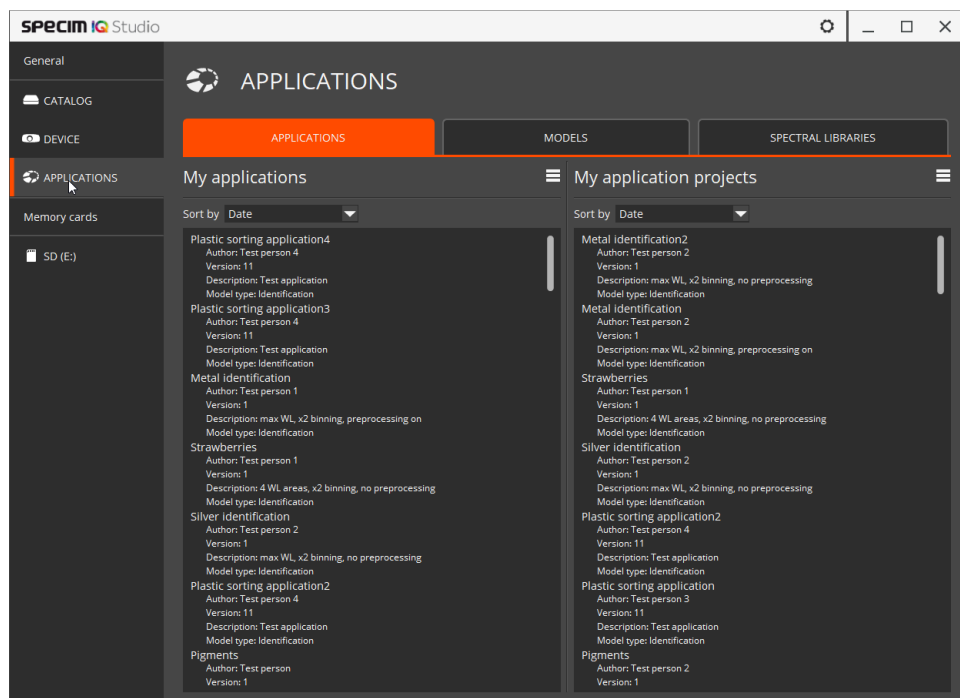


Figure 264: APPLICATIONS View

The **APPLICATIONS** view is divided into two areas:

- **My applications** — Applications that have been finalised for being used on Specim IQ. You cannot edit these applications.
- **My application projects** — Application projects that are used to create applications for being used on Specim IQ. You can open these applications in the application creator and edit them.

4.2.1 Working with Applications

This section describes how to work with applications.

4.2.1.1 Importing an Application

This section describes how to import an application.

Proceed as follows:

1. Select **APPLICATIONS** > **My applications** >  > **Import**.

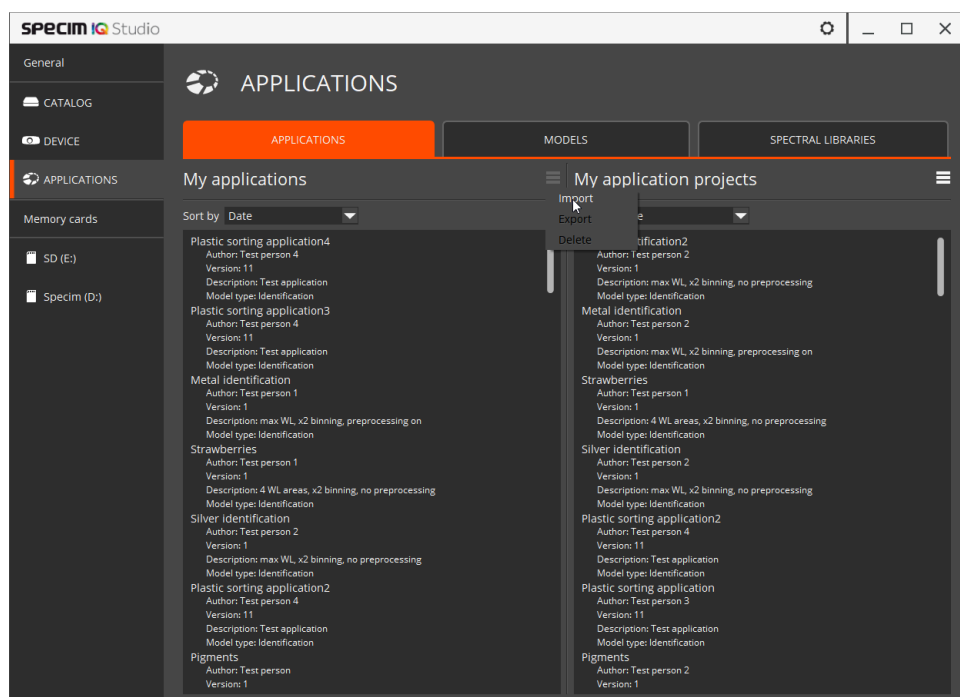


Figure 265: Importing an Application

2. Windows file manager is opened.
3. Select the application .zip file to be imported.
4. Select **Open**.

If you unintentionally attempt to import, for example, a model, the error message below is shown:

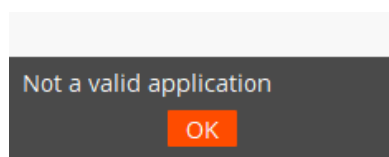


Figure 266: Not a Valid Application

Select an application file and try again.

4.2.1.2 Exporting an Application

This section describes how to export an application.

Proceed as follows:

1. Select **APPLICATIONS > Applications**.
2. Select the application to be exported.
3. Select **My applications > [Menu Icon] > Export**.

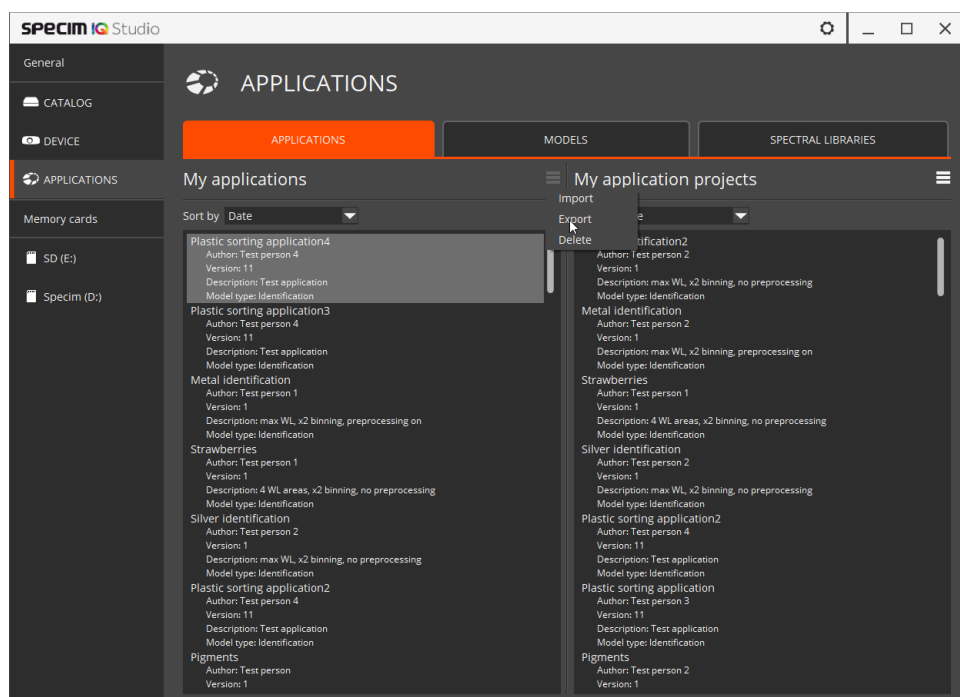


Figure 267: Exporting an Application

4. Windows file manager is opened.
5. Select the destination folder for the exported application.
6. Select **Select folder**.

4.2.1.3 Deleting an Application

This section describes how to delete an application.

Deleting an application will remove the application both from **My applications** and from the computer hard drive.

Proceed as follows:

1. Select **APPLICATIONS > Applications**.
2. Select the application to be removed from **My applications**.
3. Select **My applications >  > Delete**.

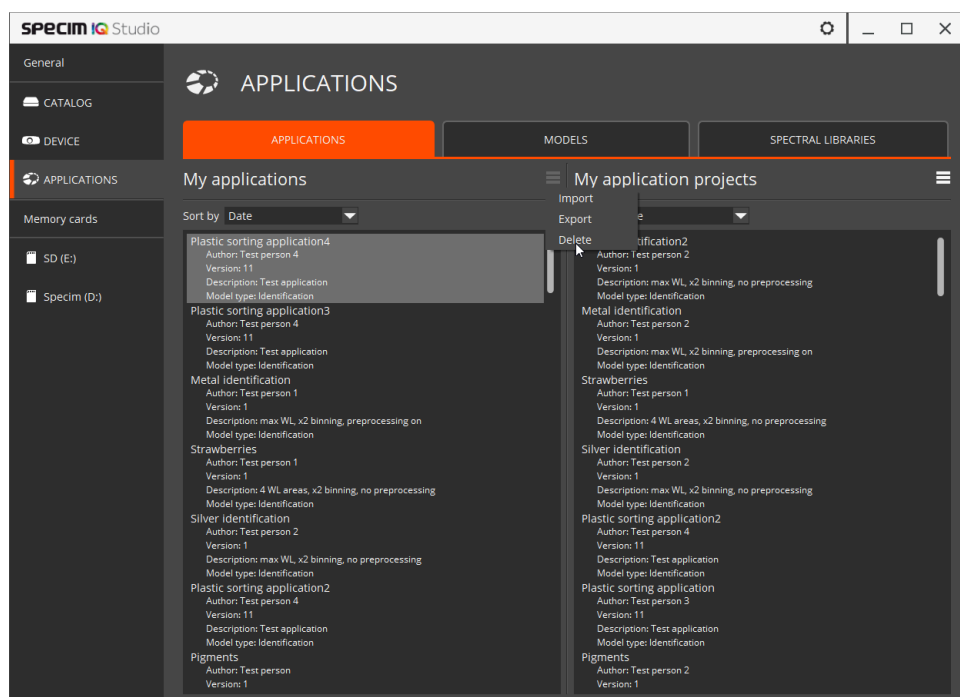


Figure 268: Deleting an Application

4. The system asks for your confirmation. Select:
 - **OK** to proceed.
 - **CANCEL** to cancel.
5. If you select **OK**, the application is removed from **My applications** and from the computer hard drive.

4.2.2 Working with Application Projects

This section describes how to work with application projects.

4.2.2.1 Creating an Application Project

This section describes how to create a new application project.

Application creator is a wizard used to create new applications. **Application creator** is opened when you select **APPLICATIONS** > **My application projects** >  > **Create new**.

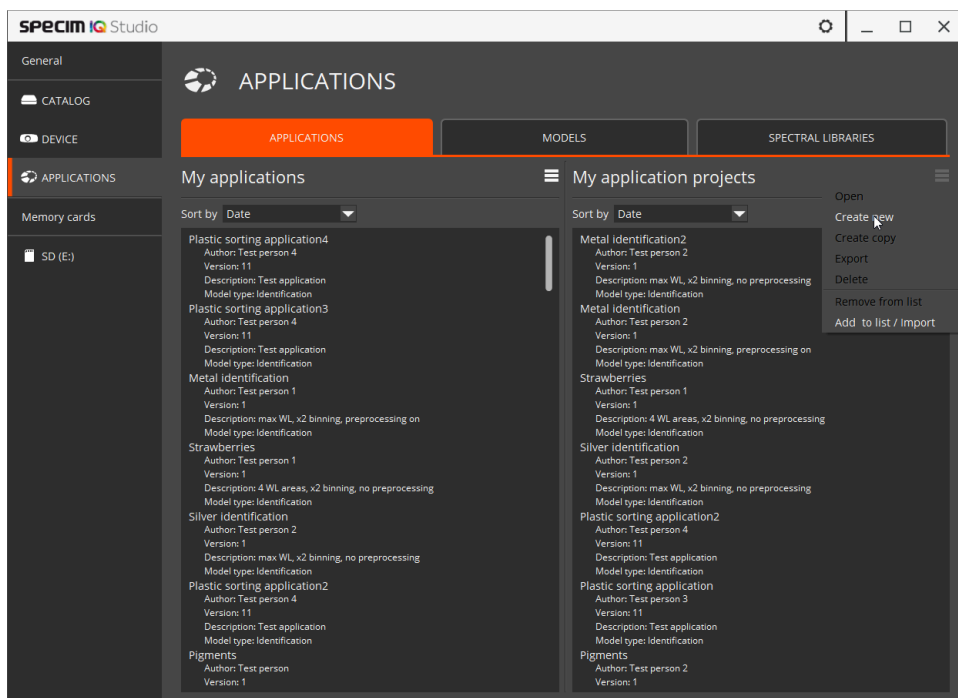


Figure 269: Creating an Application Project



Note:

Before you can create an application, you must have a model. See [Creating a Model Project](#).

Application creator guides you through a number of steps, described in more detail in the following sections.

Related Tasks

[Application Mode](#)

This section describes how to use the application mode with the simultaneous white reference method, on Specim IQ.

PROJECT

This section describes how to create a new application project.

The minimum project requirements on this screen are:

- Fill in the obligatory project information.
- You must select a model for the project.

The figure below depicts the **Application creator PROJECT** view.

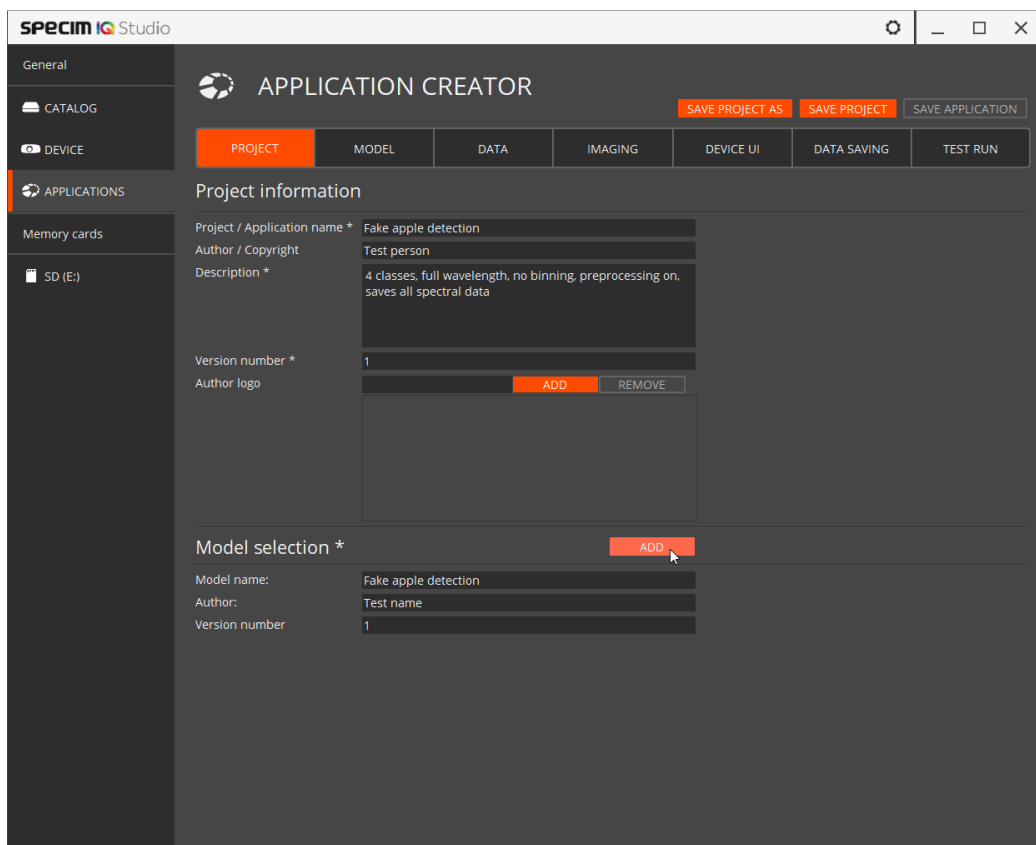


Figure 270: PROJECT View

Proceed as follows:

1. Define project information as follows:



Note:

The mandatory fields are marked with an asterisk (*).

- **Project / Application name** — Enter a descriptive name for the project. The project name will also become the application name.
- **Author / Copyright** — Enter the name of the project author and/or copyright information.
- **Description** — Enter a detailed description of the application, providing all information necessary for the application user. The description will be visible on the application list in the Specim IQ. Furthermore, the description will also be included in the measurement data.



Important:

Enter a detailed description of the application, as you will not necessarily be able to see the application name or version number in IQ Studio later.

- **Version number** — Add a version number for the project. The version number will be included in the application. If you make changes to the application, increment the version number. In this way, you can use different application versions on Specim IQ.
- **Author logo** — Add a logo file for the project. The logo will be automatically scaled for the Specim IQ screen, and will be shown when the application is being loaded.



Note:

If you add an author logo to the model and to the application, both logos will be visible on Specim IQ, when you start the application.

2. In the **Model selection** area, select **Add** to add a model to the project.

3. Select the model.

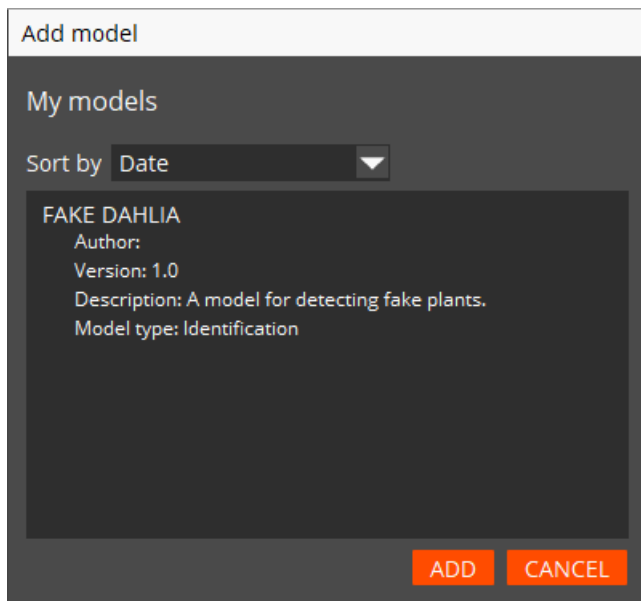


Figure 271: Adding a Model

4. When done, select **Add**.

5. When done, select **Create project** from the top menu bar.

The screen below is opened:

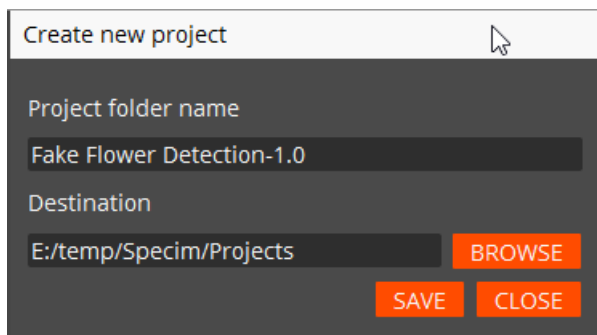


Figure 272: Create New Project

Fill in:

- **Project folder name** — Name of the folder where this project will be saved at.



Note:

When you create a project file, you cannot tell if it is an application project or a model project, by looking at the project files. Always create separate folders for model and application projects.

- **Destination** — Location of the folder where this project will be saved at.

6. When done, select **Save**.

7. Proceed to the **MODEL** tab.

MODEL

In this view, you can check what the selected model will accomplish in this application.

The minimum project requirements on this screen are:

- There are no minimum requirements for this screen, but you can restrict the classes that the model calculates. In other words, you can check that the model carries out the desired functionalities.

The figure below depicts the **Application creator MODEL** view.

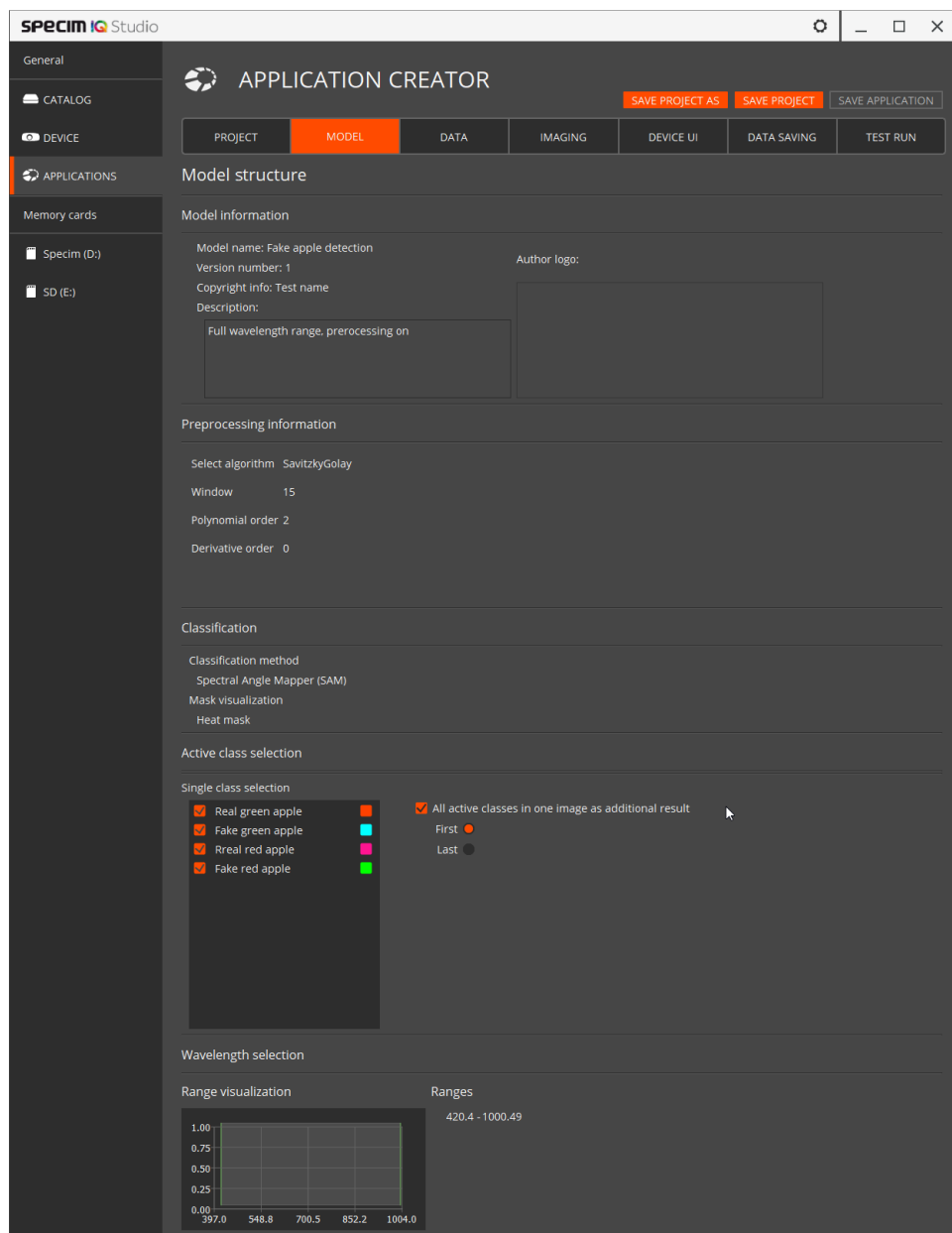


Figure 273: MODEL View

Proceed as follows:

1. Review project information as follows:

- **Model structure**
 - **Model information** — Model information is provided as follows:
 - **Model name** — The model name.
 - **Version number** — The version number of the model.
 - **Copyright info** — The model copyright information.
 - **Description** — The model description.
 - **Author logo** — The logo added for the model.
 - **Preprocessing information** — A list of pre-processing algorithms used within this model.

Depending on the model, preprocessing can also be disabled.

- **Classification** — A list of classification settings used on this model.
- **Device imaging settings** — This area indicates the wavelength range that will be used in this application.

You cannot edit the wavelength range on this screen.

2. When done, select **Save project**.

3. Proceed to the **DATA** tab.

DATA

In this view, you use the selected model against the selected dataset to view how the settings affect real data.

The minimum project requirements on this screen are:

- Select one dataset, and calculate the results by the selected model, to see the visualization that the application will produce.

The figure below depicts the **Application creator DATA** view.

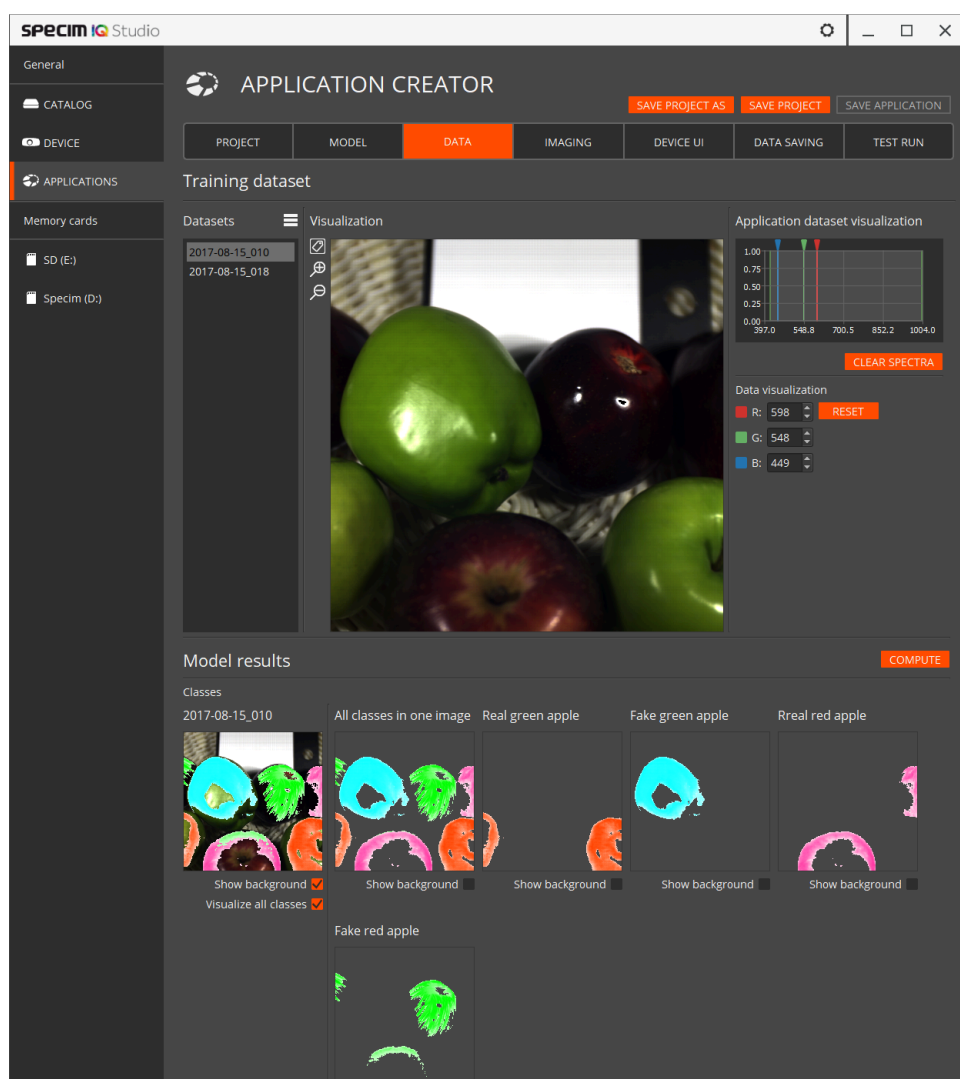


Figure 274: DATA View

Proceed as follows:

1. Select **Datasets** >  > **Open**, and select the desired catalog.
2. Select the desired datasets and select **OPEN**.

3. The dataset is opened in the **Visualization** area.

The buttons in this view are:

-  — Press this button to view the material tags on the visualized dataset.
-  — Press this button to zoom in to the image.
-  — Press this button to zoom out of the image.

4. Select a pixel of interest from the **Visualization** area.

5. The spectrum from the selected pixel is shown in the **Application dataset visualization** area.



Tip:

You can double click the **Application dataset visualization** area to open it enlarged.

If necessary, you can modify the visualization settings as follows:

- By dragging the RGB lines in the **Application dataset visualization** area.
- By editing the RGB values in the **Data visualization** area.

These settings are saved to the application.

6. Test the dataset against the model selected for the application by selecting **Compute**.

7. The **Model results** area is opened.

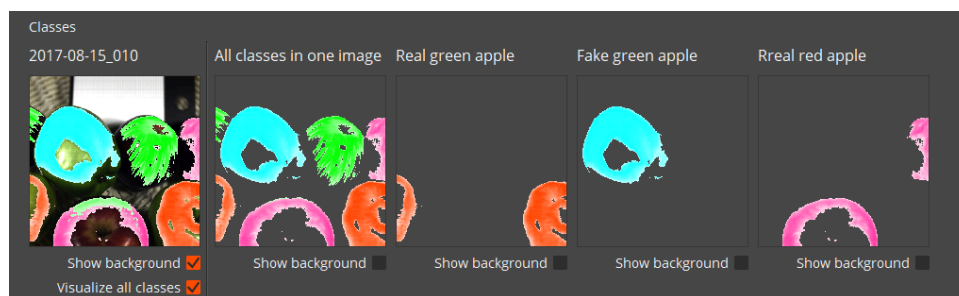


Figure 275: Model results View

In this view, you can see the identification results, that is, how the model handles the dataset.



Tip:

You can double click the result windows to open them enlarged.

The check boxes are:

- **Show background** — Show the *RGB* image as the background image.
- **Visualize all classes** — Show all classes visualized on top of the false RGB image.

8. When done, select **Save project**.

9. Proceed to the **IMAGING** tab.

IMAGING

In this view, you define if the application will save the spectral data binned or without binning.

The minimum project requirements on this screen are:

- Select if the application will use the wavelength ranges set by the model, or the full wavelength range.

The figure below depicts the **Application creator IMAGING** view.

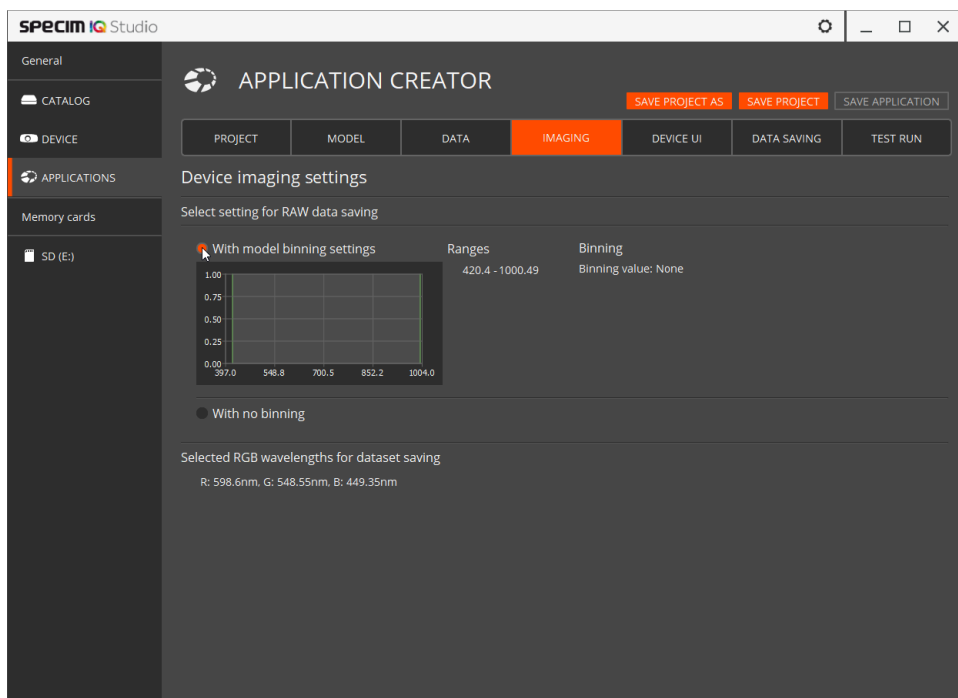


Figure 276: IMAGING View

Proceed as follows:

1. Define project information as follows:

- **Device imaging settings**

Select the settings for RAW data saving. Raw data refers to the unprocessed data from the image sensor. The options are:

- **With model binning settings** — Save RAW data with model binning settings.
- **With no binning** — Save RAW data without binning.

2. When done, select **Save project**.

3. Proceed to the **DEVICE UI** tab.

DEVICE UI

In this view, you define the Specim IQ user interface settings, that is, the order in which the model results will be displayed on the device user interface.

The minimum project requirements on this screen are:

- Check that the class visualization colours and result presentation order are suitable for the application.

The figure below depicts the **Application creator DEVICE UI** view.

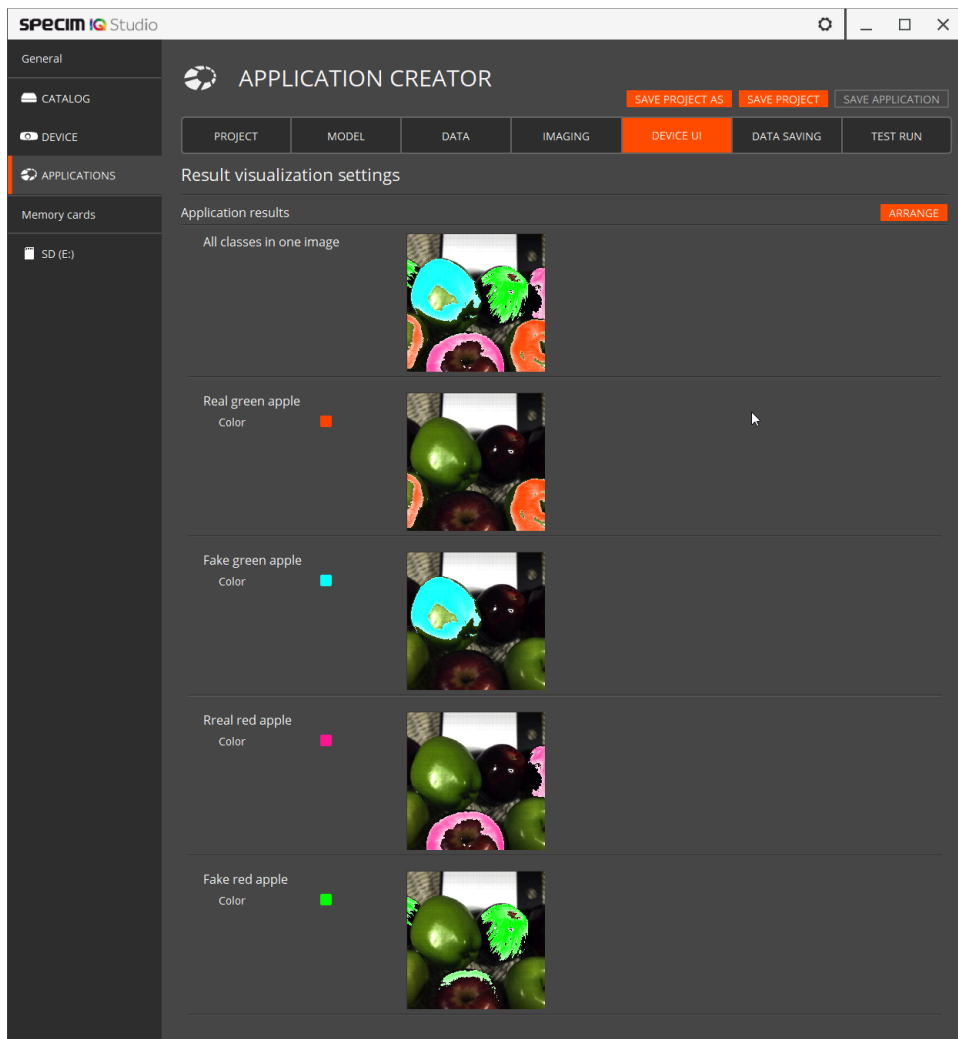


Figure 277: DEVICE UI View

Proceed as follows:

1. Optional: To re-arrange the result presentation order:
 - a) Select **ARRANGE**.

The screen below is opened:

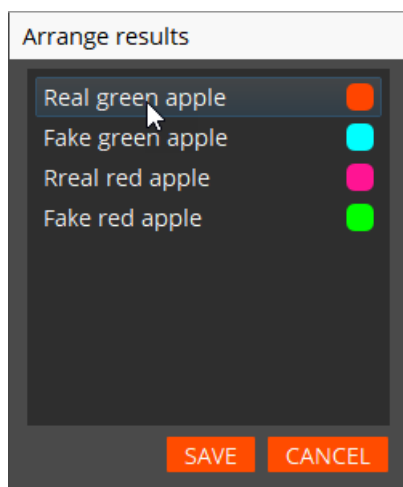


Figure 278: Arranging the Result Presentation Order

- b) Re-arrange the result presentation order by dragging the class with the cursor.

The screen below is opened:

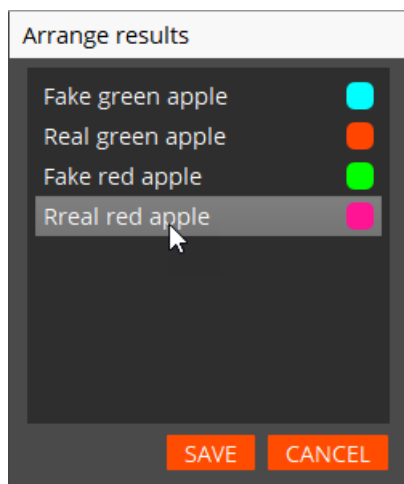


Figure 279: New Result Presentation Order

- c) When done, select **Save**.
2. Optional: Select the **Color** box to pick a screen color that will be used for the class on the device screen.

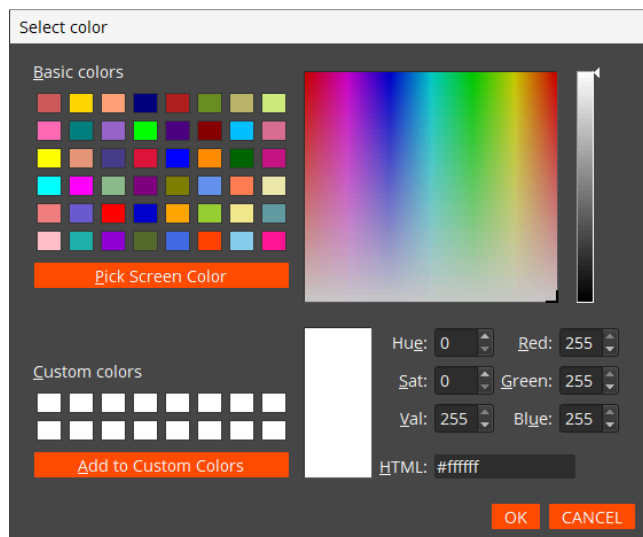


Figure 280: Select color

- a) Select the color.

There are four ways to pick the color:

- Pick the color from the **Basic colors** list.
 - Pick the color from the color gradient area. You can use the color slider to further refine your color selection.
 - Pick the color by entering the desired values to the **Hue**, **Sat**, **Val**, **Red**, **Green** and **Blue** fields.
 - Pick the color by entering an HTML colod code in the **HTML** field.
- b) When you have picked a screen color, you can also add it to your custom colors by selecting **Add to Custom Colors**.

Your custom colors will be available to you later, when you, for example, add more classes to your model.

- c) Select **OK**.
3. When done, select **Save project**.

4. Proceed to the **DATA SAVING** tab.

DATA SAVING

In this view, you define what and how data will be saved to the dataset after the recording and processing.

The minimum project requirements on this screen are:

- Define the data that you want to save.

The figure below depicts the **Application creator DATA SAVING** view.

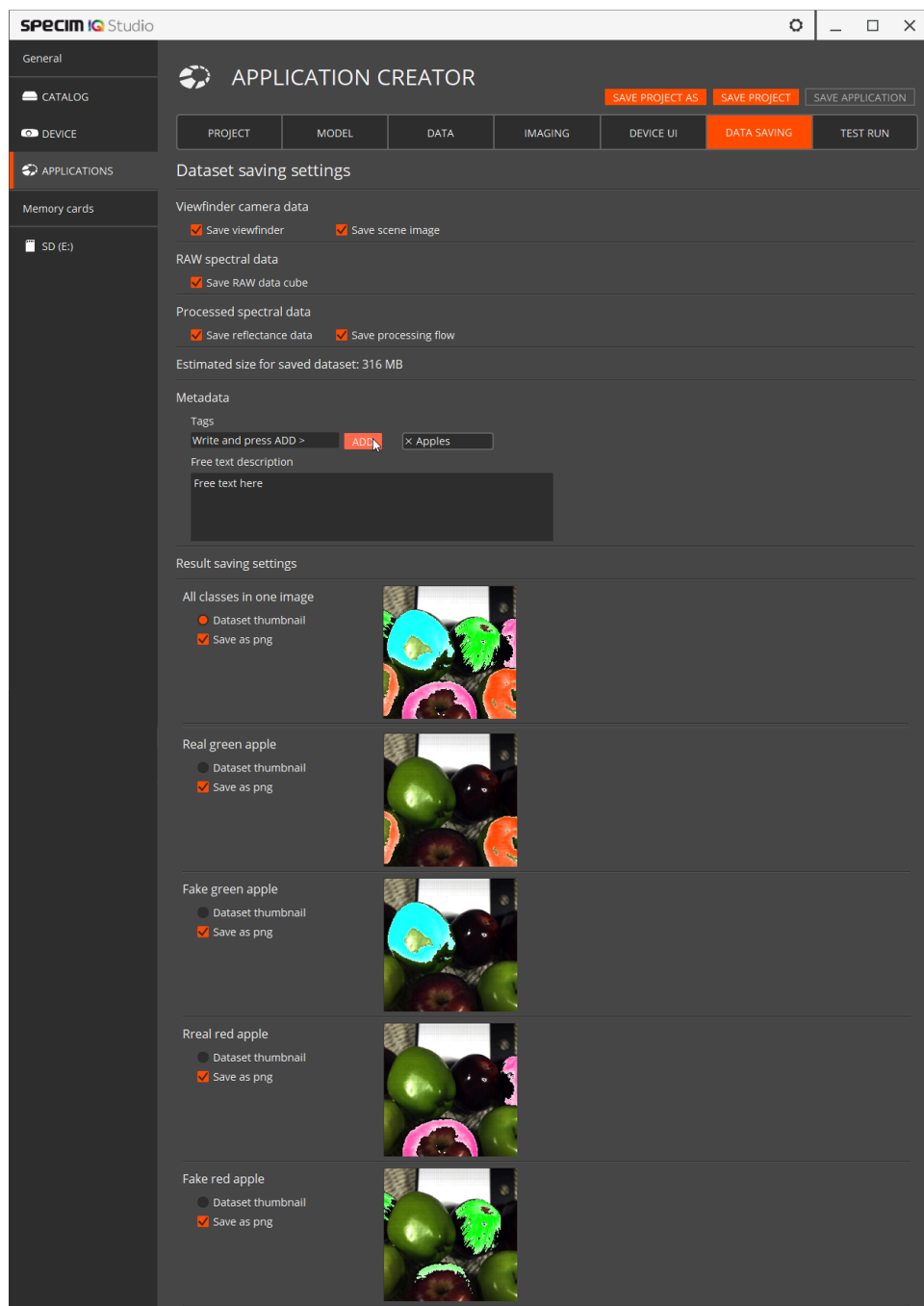


Figure 281: DATA SAVING View

Proceed as follows:

1. Use the check boxes to define project information, as follows:

- **Viewfinder camera data**

- Select the **RGB** image to be saved. The options are:
 - **Save viewfinder** — Save only the spectral imaging area of the viewfinder image.
 - **Save scene image** — Save the entire scene image. The scene RGB includes an overlay frame to indicate the place for the spectral imaging area.
 - Save both.
- **RAW spectral data**

Select **Save RAW data cube** to save RAW data. If you do not select this option, only the defined data of interest will be saved.

- **Processed spectral data**
 - Select the processed spectral data to be saved. The options are:
 - **Save reflectance data** — Save the data that was used to form the reflectance data.
 - **Save processing flow** — Save the processing flow for the datasets.
 - Save both.
- **Metadata**
 - Select the metadata to be saved. The options are:
 - **Tags** — You can create and save various data tags for the image as follows.
 - To add a tag, enter the tag in the **Tags** field and press Enter.
 - To remove a tag, click the tag cross icon.
 - **Free text description** — You can write a description of the image in this field.
- **Results saving settings**

In this area, all selected result visualizations are listed. You can choose a combination of saving options.



Tip:

You can double click the result visualizations to open them enlarged.

The options are:

- **Dataset thumbnail** — Select one dataset image to be used as a thumbnail image on Specim IQ Studio SD card and **CATALOG** views.
- **Save as png** — Save an RGB image with the reference overlay, in the PNG format.

2. When done, select **Save project**.

3. Proceed to the **TEST RUN** tab.

TEST RUN

In this view, you test that the application will work as desired on Specim IQ.

The figure below depicts the **Application creator TEST RUN** view.

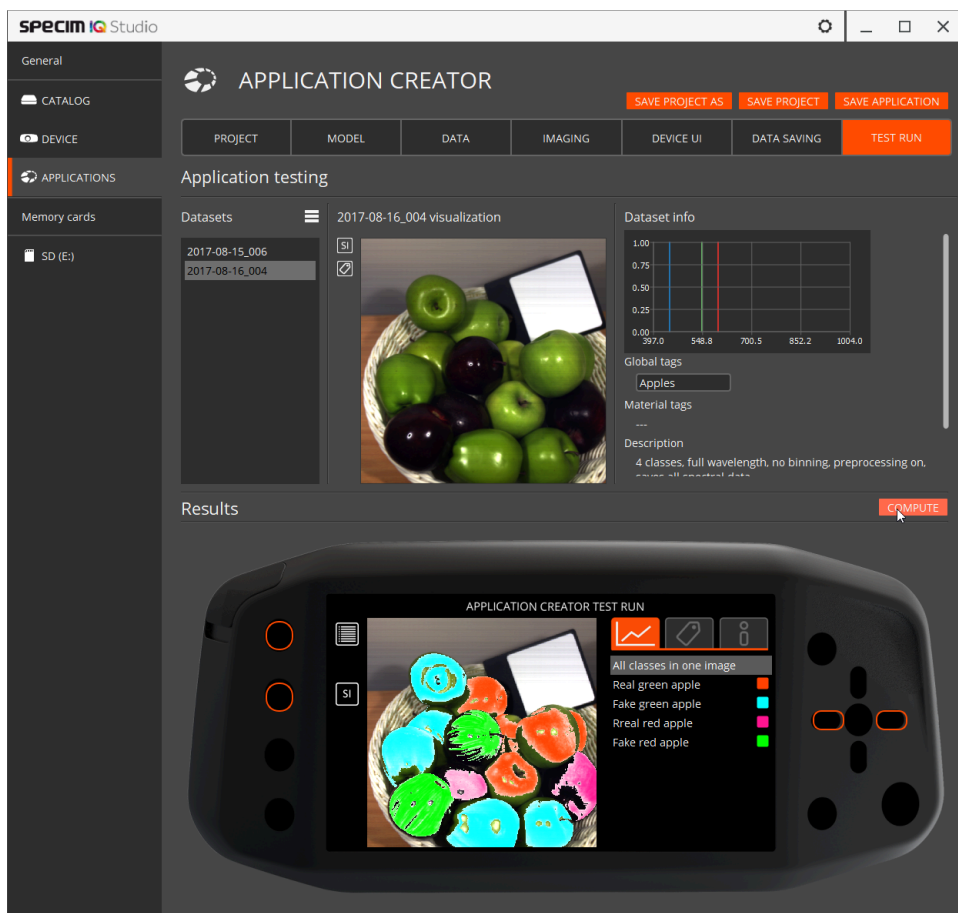


Figure 282: TEST RUN View

In this view, you can select datasets to test your application in the simulator.

Proceed as follows:

1. Select **Dataset** >  > **Open**, and select the desired catalog.
2. Select the desired datasets and select **OPEN**.
3. The dataset is opened in the **Visualization** area.

The buttons in this view are:

-  — Press this button to toggle the spectral image visibility on or off.
-  — Press this button to view the tags on the visualized dataset.

 Tip:

You can open the dataset in the full-size view by double clicking the visualization area. In the full-size view, you can select one pixel from the false RGB and scrutinize the spectrum of the selected pixel in the spectrum area.

4. When you are satisfied with the selected dataset, select **Compute**.

On the **Results** view, you can test the project and verify that it would also work on the device itself, without deploying it as an application.



Figure 283: Simulation View

On the **Results** view, you can:

- Use the  button to switch between classes.
- Use the  button to toggle the false RGB image on or off.
- Browse datasets by using the navigation buttons to the right.



5. If you are satisfied with the results, select **Save application**.

The screen below is opened:

Save application

Application name *

FAKE APPLE DETECTION

Author / Copyright

Description *

An application that detects fake apples from real ones.

Version number *

1.0

SAVE

CLOSE

Figure 284: Save Application

6. Select **Save**

The application appears in the **My applications** list.

7. Select **Save project**.

4.2.2.2 Opening an Application Project in Creator

This section describes how to open an existing application project for editing.

Proceed as follows:

1. Select the application project to be opened from **APPLICATIONS**.
2. Select **My application projects** >  > **Open**.



Tip:

You can also double click the project in the **My application projects** list to open it.

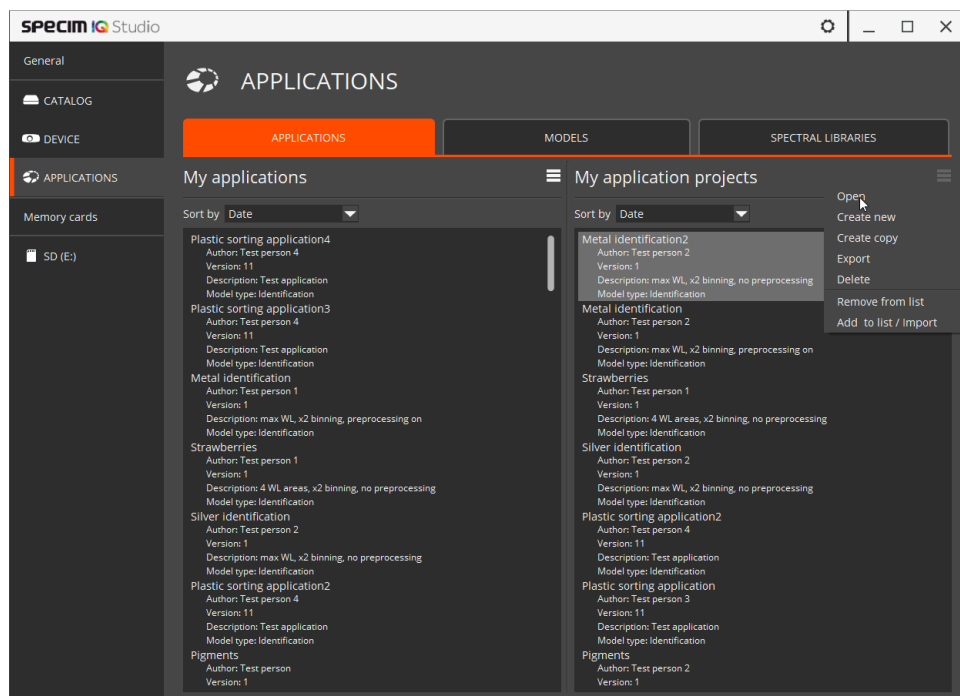


Figure 285: Opening an Application Project

The project is opened in the creator.

3. Proceed as described in [Creating an Application Project](#).

4.2.2.3 Adding an Application Project to the Project List

This section describes how to add a previously removed application project to the project list.

Proceed as follows:

1. Select **APPLICATIONS**.
2. Select **My application projects** >  > **Add to list**.

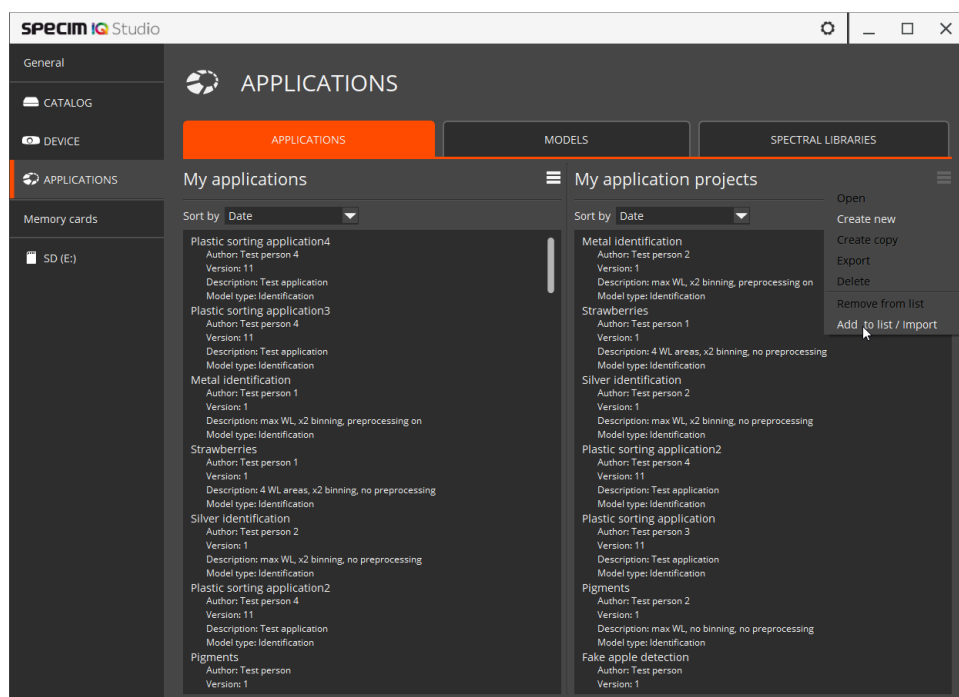


Figure 286: Adding an Application Project to the Project List

3. Windows file manager is opened.
4. Select the root file of the project to be added to the list.
5. Select **Select folder**.
6. The project is added to the list.

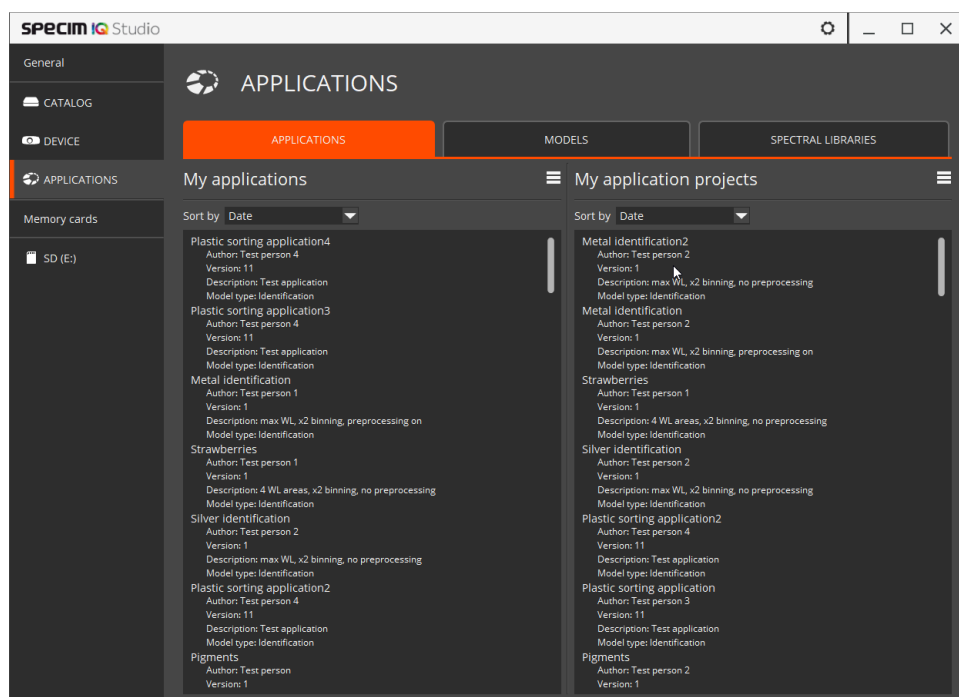


Figure 287: Application Project Added



Note:

The **Add to list/Import** command creates a path to the existing location of the project folder.

4.2.2.4 Removing an Application Project from the Project List

This section describes how to remove an application project from the project list.

When you remove an application project from the project list, it is only removed from the list, not from your hard disk. If necessary, you can later bring it back to the project list. See [Adding a Model Project to the Project List](#).

Proceed as follows:

1. Select **APPLICATIONS**.
2. Select the application that you want to remove from the **My application projects** list.
3. Select **My application projects** >  > **Remove from list**.

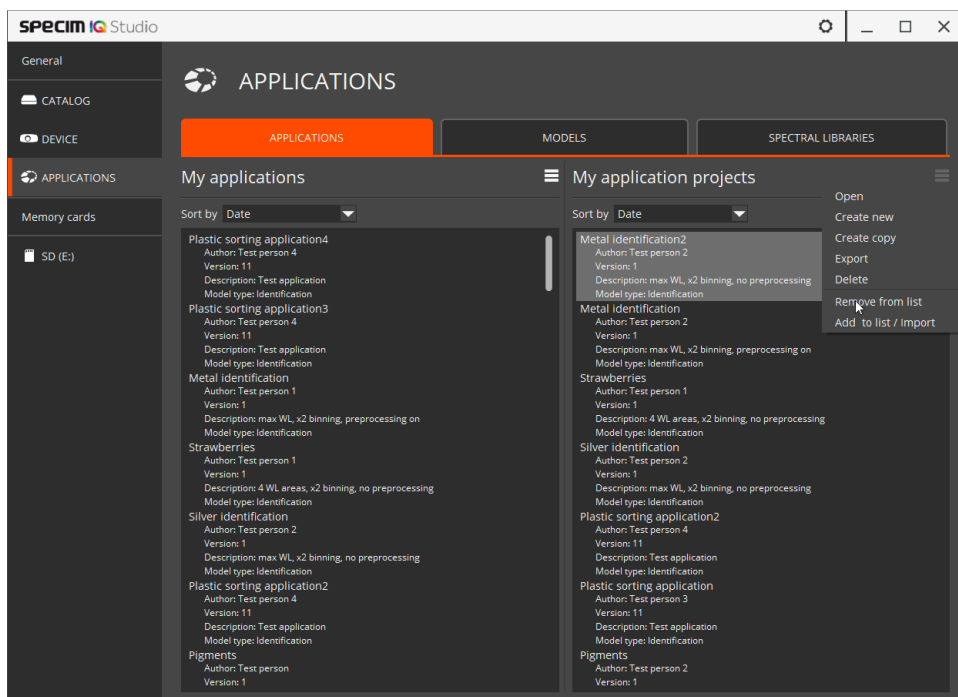


Figure 288: Removing an Application Project from the Project List

4. The project is removed from the list.

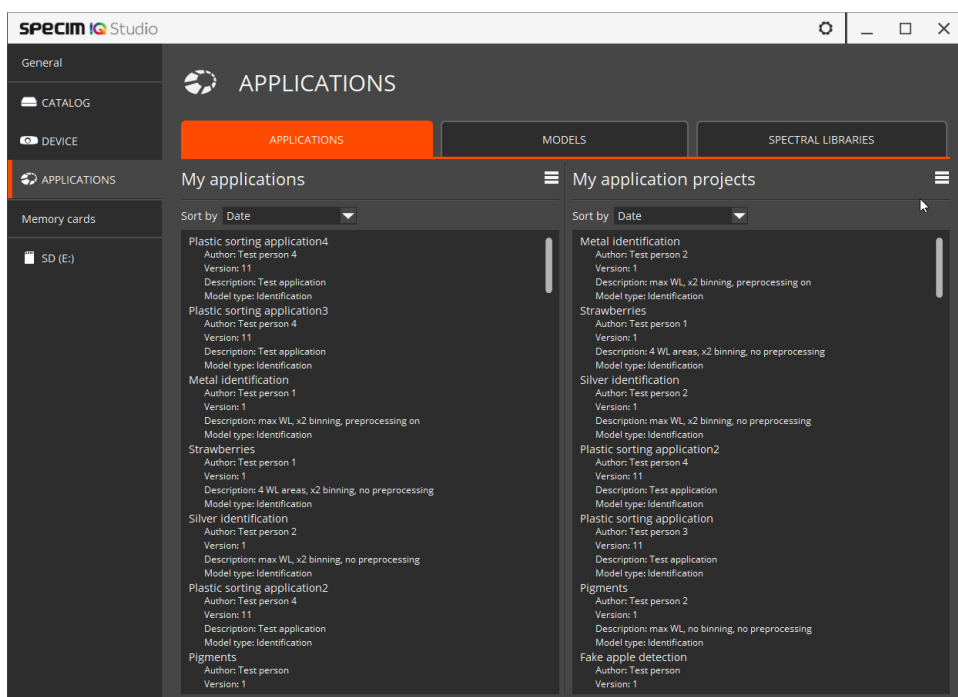


Figure 289: Application Project Removed

4.2.2.5 Creating a Copy of an Application Project

This section describes how to duplicate an application project.

You cannot make an exact copy of a project. You must change, at least, the project version number.

Proceed as follows:

1. Select **APPLICATIONS**.
2. Select the project that you want to duplicate.
3. Select **My application projects** >  > **Create copy**.

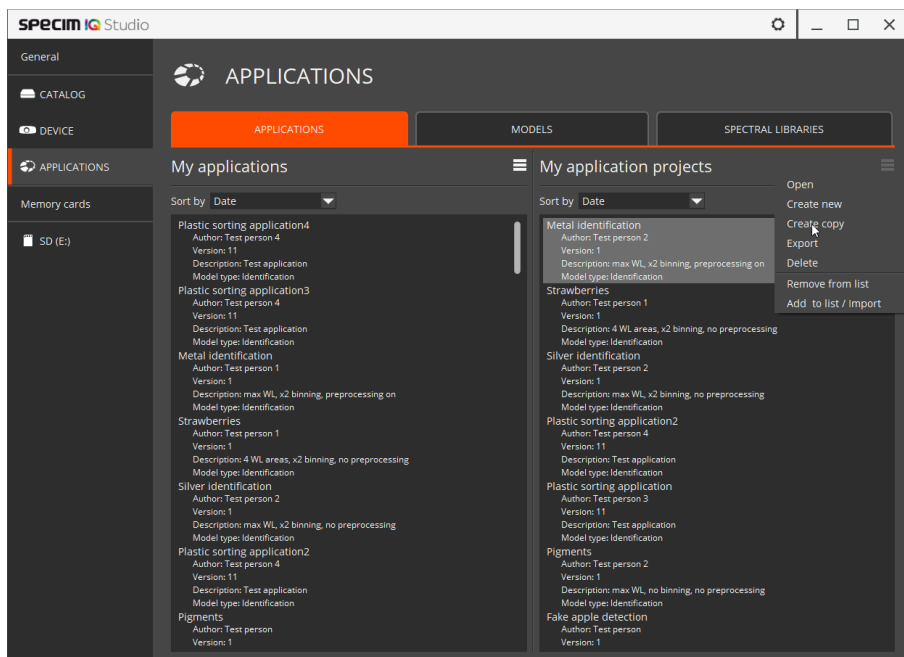


Figure 290: Duplicating an Application Project

4. Define project information as follows:

The screen below is opened:

Create copy

Application project name *

Metal identification

Author / Copyright

Test person 2

Description *

max WL, x2 binning, preprocessing on

Version number *

1

Include source data

☒

Project folder name *

Metal identification-1

Destination *

C:/Users/USERNAME/Specim/Projects

BROWSE

SAVE AS NEW

CLOSE

Figure 291: Duplicating an Application Project



Note:

The mandatory fields are marked with an asterisk (*).

- **Application project name** — Enter a descriptive name for the application.
- **Author / Copyright** — Enter the name of the application author and/or copyright information.
- **Description** — Enter a detailed description of the application, providing all information necessary for the application user. Furthermore, the description will also be included in the measurement data.
- **Version number** — Add a version number for the project. The version number will be included in the application. If you make changes to the application, upgrade the version number. In this way, you can use different application versions on Specim IQ.
- **Include source data** — Check this check box if you want to include the source data on the project duplicate.
- **Project folder name** — Name of the folder where this project will be saved at.
- **Destination** — Location of the folder where this project will be saved at.

5. Select **Save as new**.

6. The project is added to the list.

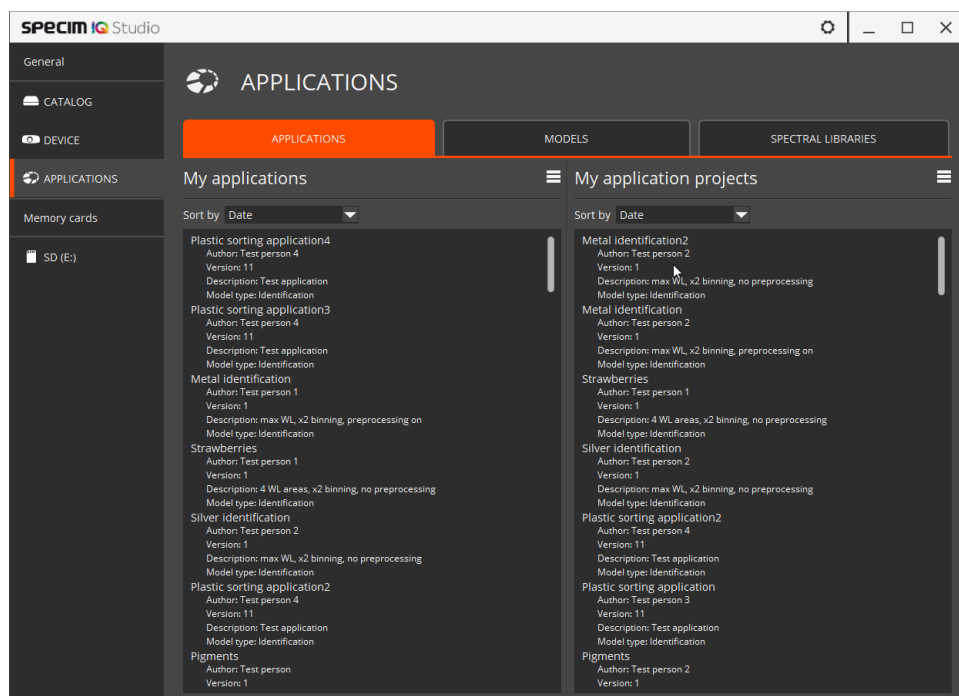


Figure 292: Application Project Added

4.2.2.6 Deleting an Application Project

This section describes how to delete an application project.

Deleting an application project will remove the application both from **My application projects** and from the computer hard drive.

Proceed as follows:

1. Select **APPLICATIONS**.
2. Select the application project to be removed from **My application projects**.
3. Select **My application projects** >  > **Delete**.

The screen below is opened:

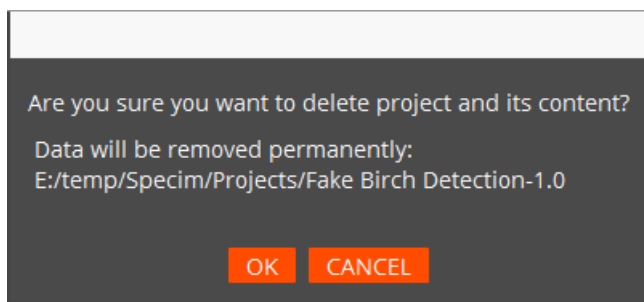


Figure 293: Deleting a Project

4. The system asks for your confirmation. Select:
 - **OK** to proceed.
 - **CANCEL** to cancel.
5. If you select **OK**, the project is removed from **My application projects** and from the computer hard drive.

4.3 Managing Models

This section describes how to manage models.

The figure below depicts the **MODELS** view.

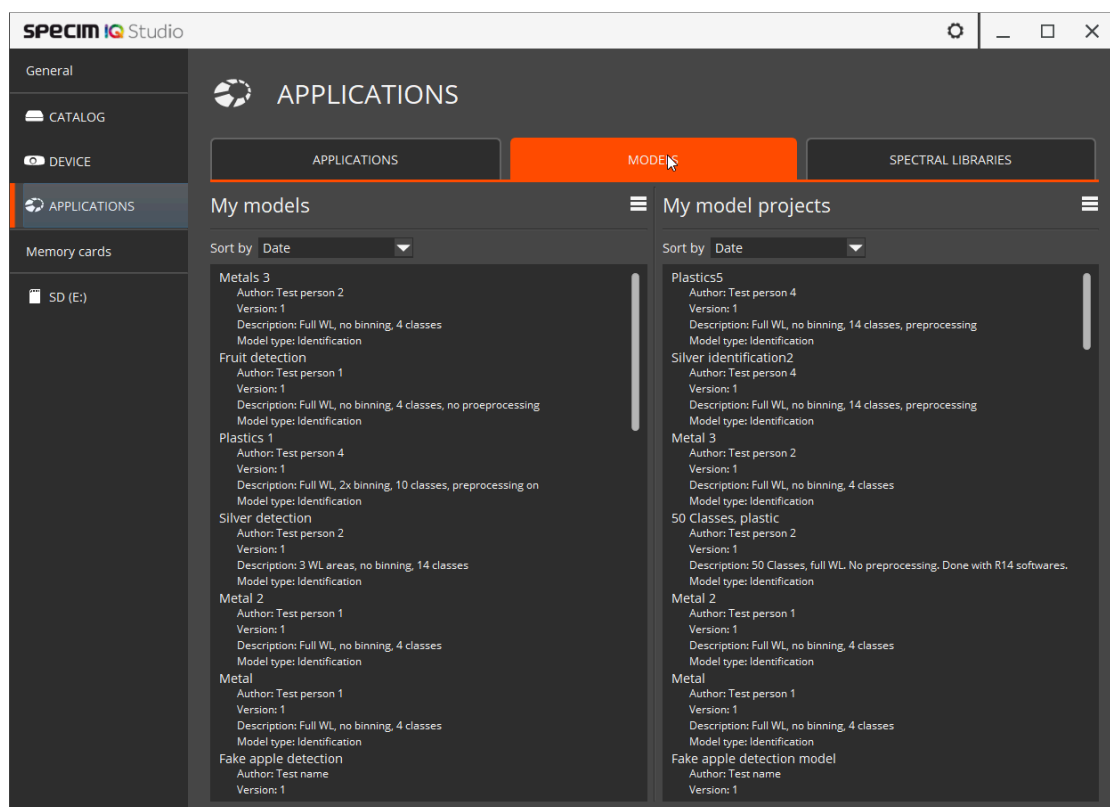


Figure 294: MODELS View

The **MODELS** view is divided into two areas:

- **My models** — Models that have been finalised for being used within an application. You cannot edit these models.

- **My model projects** — Model projects that are used to create models for being used within an application. You can open these projects in the model creator and edit them.

4.3.1 Working with Models

This section describes how to work with models.

4.3.1.1 Importing a Model

This section describes how to import a model.

Proceed as follows:

1. Select **APPLICATIONS > MODELS > My models > ≡ > Import**.

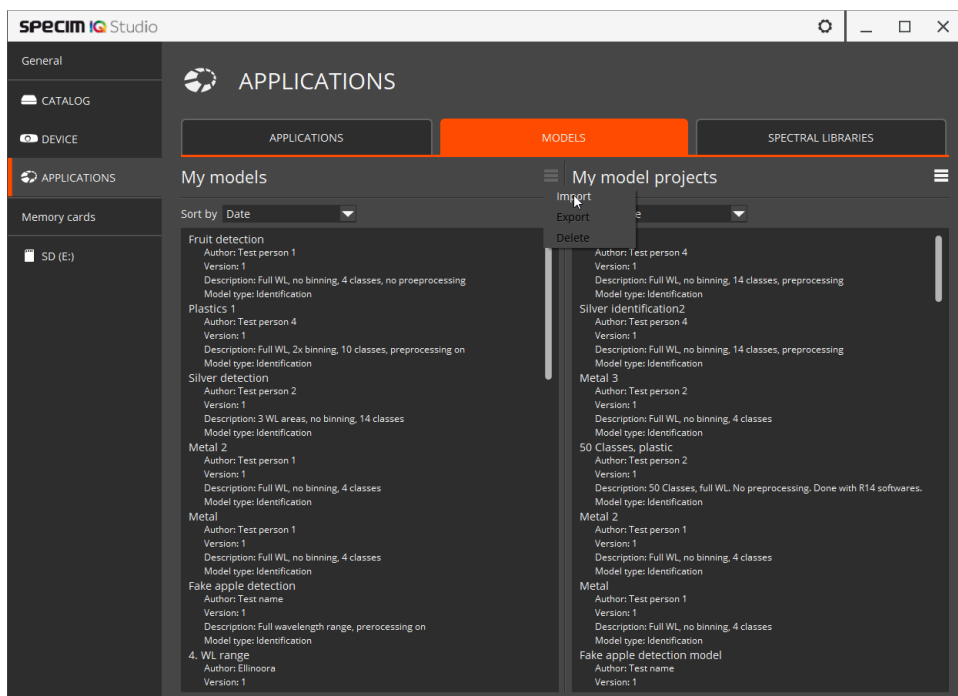


Figure 295: Importing a Model

2. Windows file manager is opened.
3. Select the model .zip file to be imported.
4. Select **Open**.

If you unintentionally attempt to import, for example, an application, the error message below is shown:

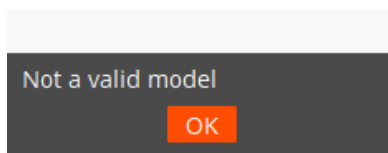


Figure 296: Not a Valid Model

Select a model file and try again.

4.3.1.2 Exporting a Model

This section describes how to export a model.

Proceed as follows:

1. Select **APPLICATIONS > MODELS > My models > Export**.

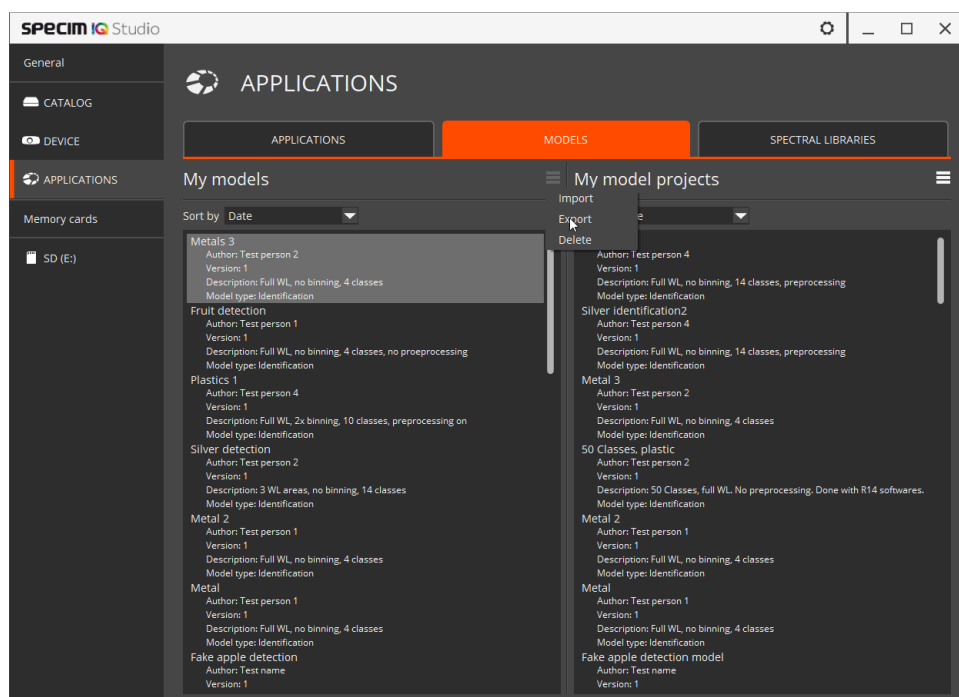


Figure 297: Exporting a Model

2. Select the model to be exported.
3. Select **My models** >  > **Export**.
4. Windows file manager is opened.
5. Select the destination folder for the exported model.
6. Select **Export**.

4.3.1.3 Deleting a Model

This section describes how to delete a model.

Deleting a model will remove the model both from **My models** and from the computer hard drive.

Proceed as follows:

1. Select the model to be removed from **APPLICATIONS** > **MODELS**.
2. Select **My models** >  > **Delete**.

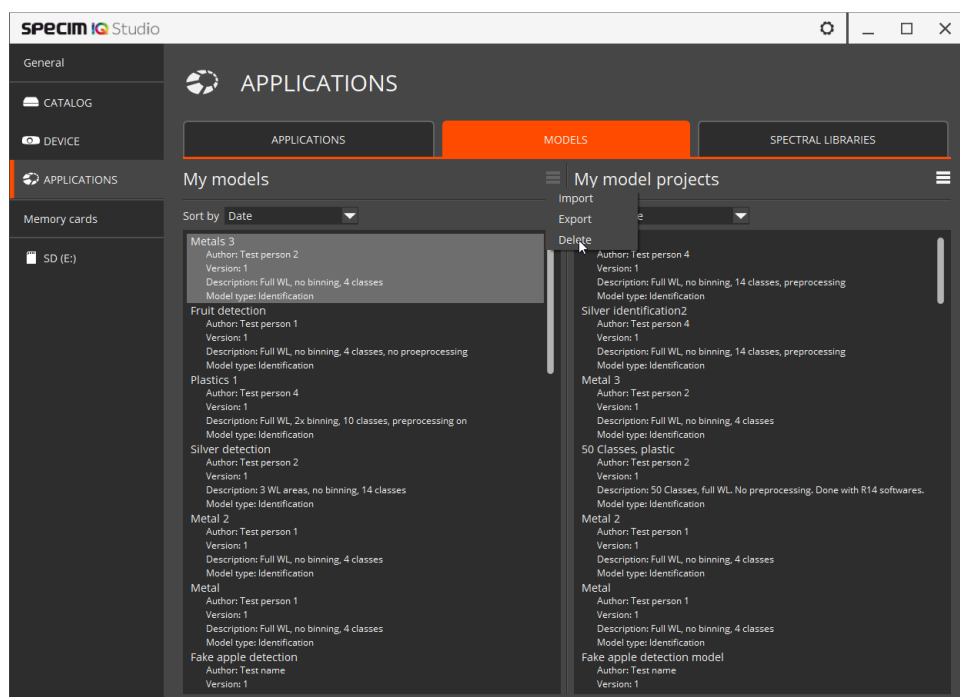


Figure 298: Deleting a Model

3. The system asks for your confirmation. Select:

- **OK** to proceed.
- **CANCEL** to cancel.

4. If you select **OK**, the model is removed from **My models** and from the computer hard drive.

4.3.2 Working with Model Projects

This section describes how to work with model projects.

4.3.2.1 Creating a Model Project

This section describes how to create a new model project.

Identification Model creator is a wizard used to create new models. **Identification Model creator** is opened when you select **APPLICATIONS > MODELS > Create model**.

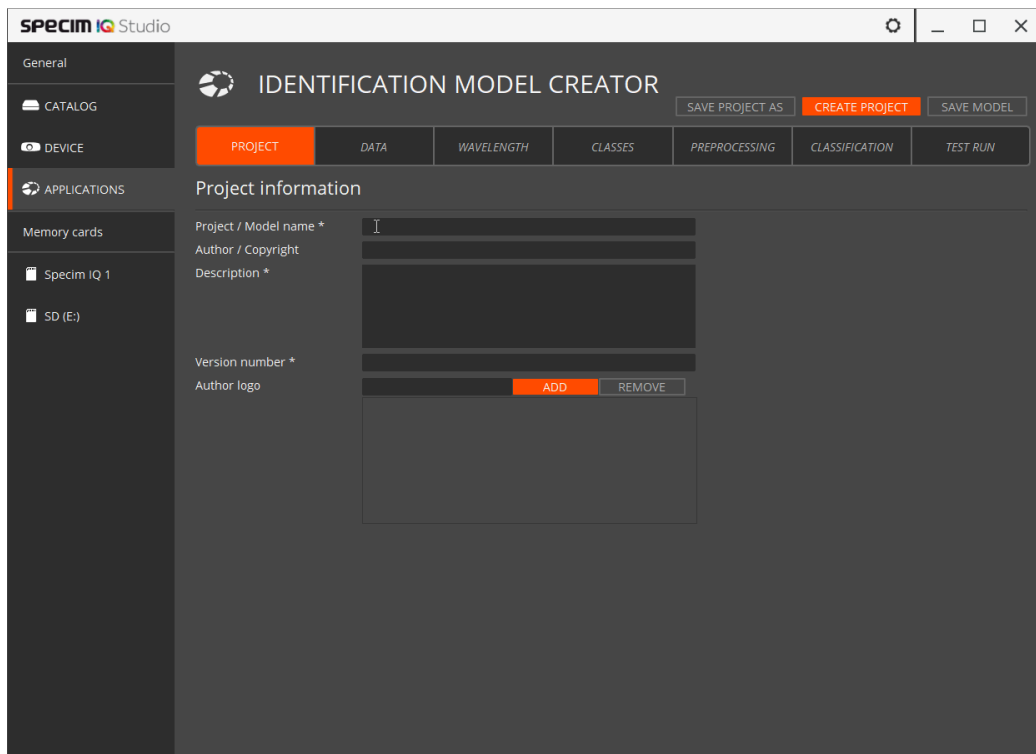


Figure 299: Creating a Model Project

Identification Model creator guides you through a number of steps, described in more detail in the following sections.

PROJECT

This section describes how to create a new model project.

The minimum project requirements on this screen are:

- Fill in the obligatory project information.

The figure below depicts the **Identification Model creator PROJECT** view.

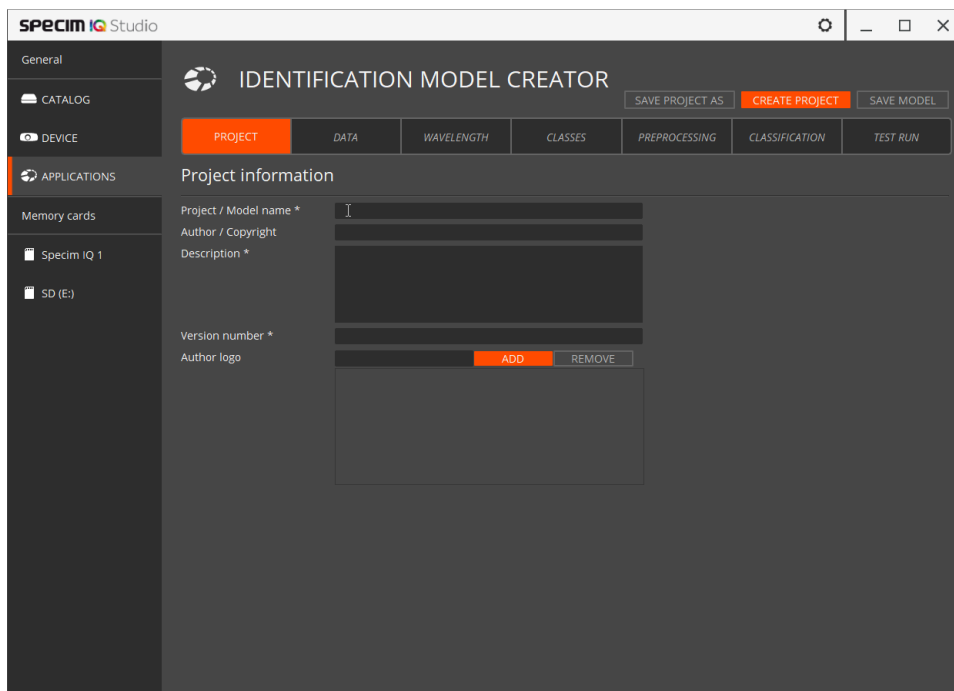


Figure 300: PROJECT View

Proceed as follows:

1. Define project information as follows:



Note:

The mandatory fields are marked with an asterisk (*).

- **Project information**

- **Project / model name** — Enter a descriptive name for the model. The project name will also become the model name.
- **Author / Copyright** — Enter the name of the model author and/or copyright information.
- **Description** — Enter a detailed description of the model, providing all information necessary for the model user. Furthermore, the description will also be included in the measurement data.
- **Version number** — Add a version number for the project. The version number will be included in the model. If you make changes to the model, upgrade the version number. In this way, you can use different model versions on applications.
- **Author logo** — Add a logo file for the model. The logo will be shown in Specim IQ when loading the application.



Note:

If you add an author logo to the model and to the application, both logos will be visible on Specim IQ, when you start the application.

2. When done, select **Create project** from the top menu bar.

The screen below is opened:

Figure 301: Create New Project

Fill in:

- **Project folder name** — Name of the folder where this project will be saved at.



Note:

When you create a project file, you cannot tell if it is an application project or a model project, by looking at the project files. Always create separate folders for model and application projects.

- **Destination** — Location of the folder where this project will be saved at.

3. When done, select **Save**.

4. Proceed to the **DATA** tab.

Related Tasks

[Opening a Dataset in Model Creator](#)

This section describes how to open a dataset in the model creator.

DATA

This section describes how to add datasets and areas of interest to the model.

The minimum project requirements on this screen are:

- You must create at least one area of interest.
- If you have captured binned data, you cannot use it on the model creator.

The figure below depicts the **Identification Model creator DATA** view.

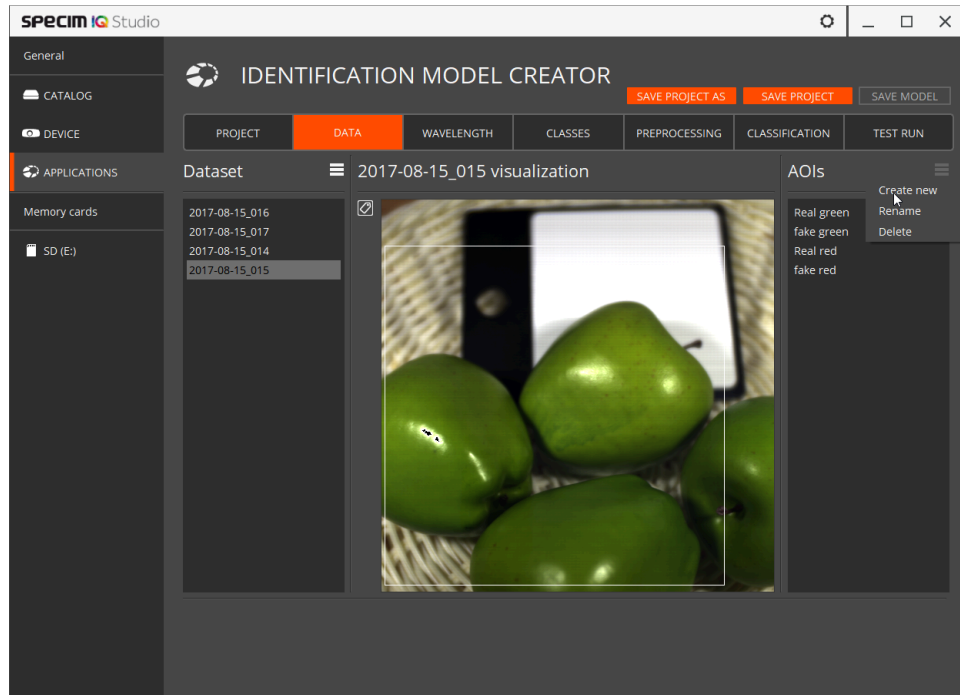


Figure 302: DATA View

In this view, you can select the areas of interest from the selected datasets, and save them for further research.

The button in this view is:

-  — Press this button to view the tags on the visualized dataset.

Proceed as follows:

1. Select **Dataset** >  > **Open** to open and view the desired dataset(s) as false *RGB*.
 - a) Select the desired catalog from **My catalogs**.

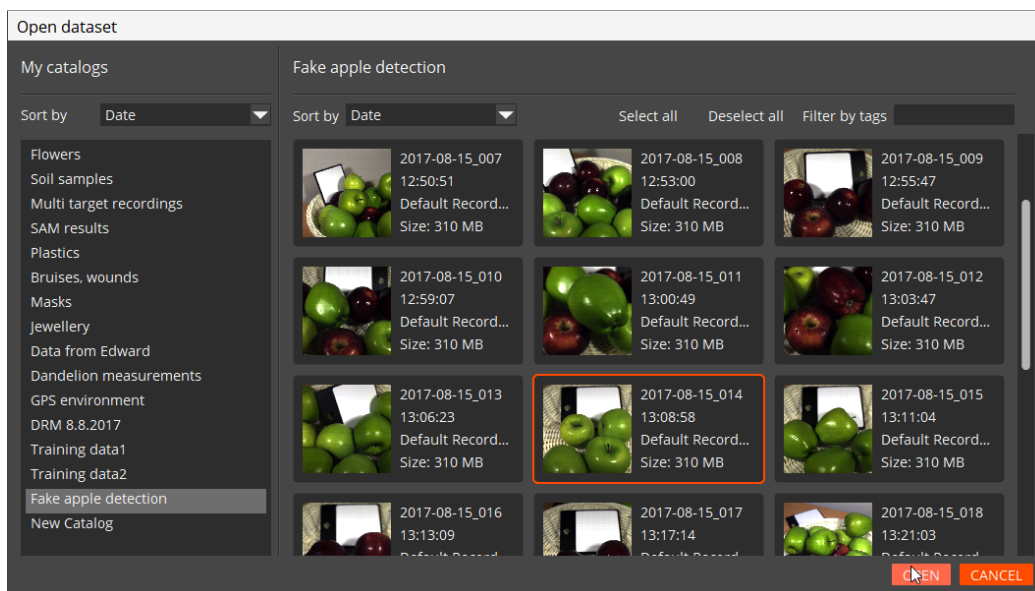


Figure 303: Selecting the Datasets

- b) Select the datasets.

See also [Keyboard Shortcuts](#).

- c) Select **Open**.

The selected datasets appear on the **Dataset** list.

2. To add an area of interest:

- a) Select the desired dataset from the **Dataset** list.
- b) Double-click the dataset image.

The screen below is opened:

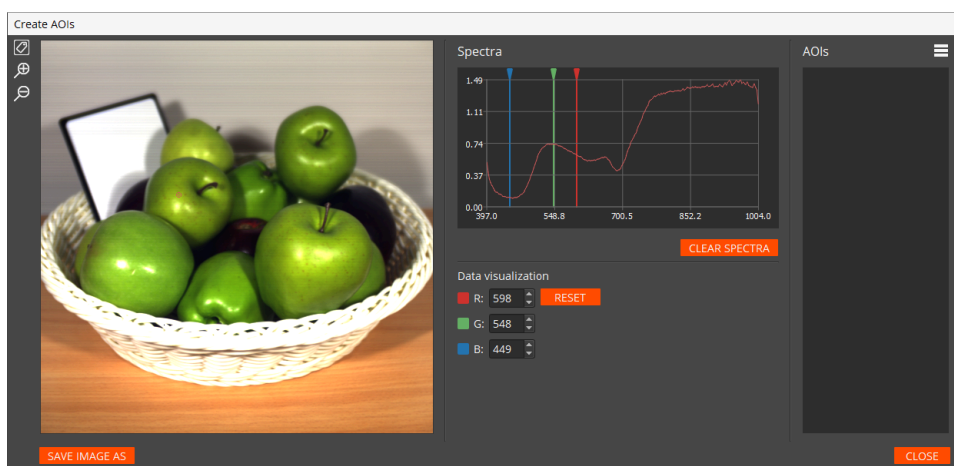


Figure 304: Create AOIs

- c) Select a square area of interest by pressing the left mouse button, dragging the cursor, and releasing the left mouse button, on the false RGB.



Tip:

When you select an area of interest, include some background area, as we are looking for the changes in the spectra.

On the selected areas of interest, select spectra from several different areas on the area of interest, so that it will be easy for you to later select the most suitable wavelengths for the workflow.

You can see the selected areas of interest on the false RGB, surrounded by rectangles of different colour. You can only select rectangular areas of interest.

If there are pixels selected on the area of interest to show the spectrum, those selections will also be added to the area of interest.

If there is a tag on the area of interest, the area of interest will be named with the tag name. If an area of interest with the same name already exists, an index will be added to the name of the area of interest.

If necessary, you can modify the visualization settings as follows:

- By dragging the RGB lines in the **Application dataset visualization** area.
- By editing the RGB values in the **Data visualization** area.

d) The area of interest is added to the **AOIs** list.

3. Rename the area of interest by double-clicking its name in the areas of interest list, or select **AOIs** >  > **Rename**.

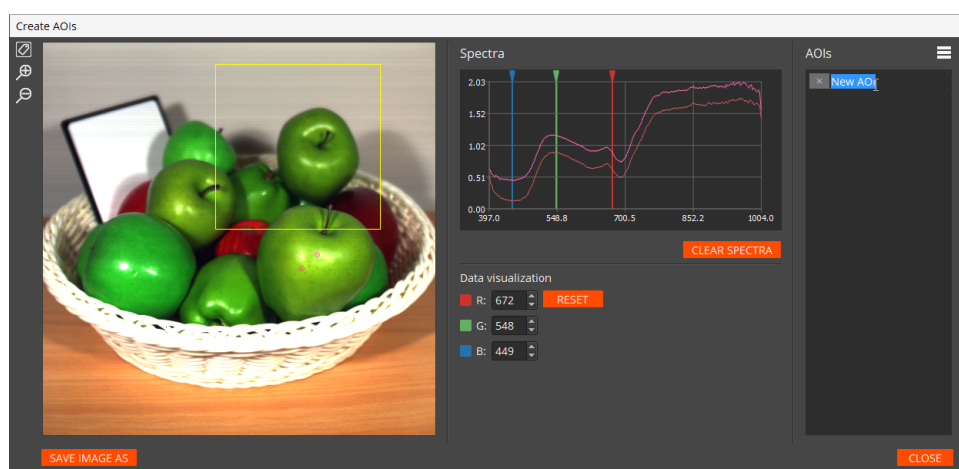


Figure 305: Renaming an Area of Interest

- a) Enter a new name over the old name on blue background color.
 - b) Press Enter.
4. Optional: To remove an area of interest:
 - a) Select the area of interest you want to delete from the **AOIs** list.
 - b) Select **AOIs** >  > **Delete**, or click the cross icon in front of the AOI name.
 5. When done, select **Save project**.
 6. Proceed to the **WAVELENGTH** tab.

WAVELENGTH

This section describes how to define the interesting wavelength range for the model.

The minimum project requirements on this screen are:

- Select the wavelength range. You have two alternative options:
 - If you want to use the entire wavelength range, deactivate the **Include to the workflow** slider.
 - Select the interesting wavelength range, and activate the **Include to the workflow** slider.

The figure below depicts the **Identification Model creator WAVELENGTH** view.

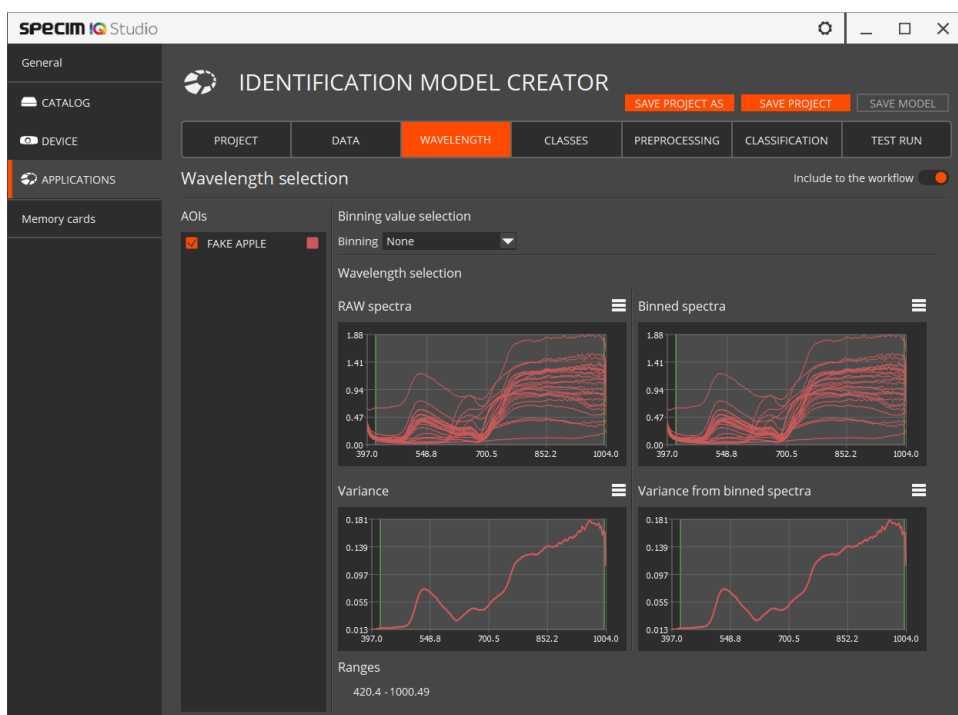


Figure 306: WAVELENGTH View

In this view, you can select the wavelength ranges to be recorded from the datasets that you will later take with this model. Limiting the wavelength range decreases the size of the recorded dataset, and saves memory.

The default wavelength range is 420-1000 nm.



Note:

If you use the maximum wavelength range instead of the default range, the stray light effect may affect the spectra at the very extremes of the wavelength range selection, thus reducing data quality.

Proceed as follows:

1. Select the binning value from the **Binning** drop down list.

Binning combines a number of adjacent pixels into a single pixel. If you use, for example, the x2 binning value, an array of 2 pixels will become a single larger pixel, reducing the overall number of pixels. With Specim IQ, binning is used in spectral direction only.

The options are:

- None — Use no binning
 - x2 — With the x2 binning value, an array of 2 pixels will become a single larger pixel.
 - x3 — With the x3 binning value, an array of 3 pixels will become a single larger pixel.
2. The areas of interest defined in the **DATA** tab are shown in the **List of AOIs**. You can select the areas of interest you want to view.



Tip:

It is a good idea to choose all the areas of interest and use the **Variance** visualization to find out how much you can limit the wavelength range to be analyzed.

The selected AOIs are visualized in four graphs as follows:

- **RAW spectra** — This graph visualizes the RAW spectrum from the selected wavelength range and areas of interest.

30 spectra from random positions will be displayed for each area of interest. However, if there are pixels selected on the area of interest, these pixels will be used in addition to the 30 spectra.

- **Binned spectra** — This graph visualizes the binned spectrum. You can select the binning value from the **Binning** drop-down menu.

If binning is selected, the workflow will include both the RAW spectrum and the binned spectrum.

- **Variance** — This graph visualizes the variance spectra, that is, how much variance there is between the selected spectra on each wavelength range.

If the variance is large, there are lots of differences in the AOI graph, and the AOI is probably suitable for detecting substances from each other.

You can analyze the information on different wavelength ranges based on variance. High variance at the beginning and end of the wavelength range usually indicates high noise. High variance at the center area indicates spectral changes that are related to the measured material or material properties.

Limit or select the wavelength ranges containing valid information, or that have low noise. See [Managing Wavelengths](#).

- **Variance from binned spectra** — This graph visualizes the variance spectra from the binned results.
3. If you want to change or split the wavelength ranges, see [Managing Wavelengths](#).
 4. Use the **Include to the workflow** slider to find out how the wavelength range selection affects the overall workflow.

When **Include to the workflow** is:

- On, the wavelength range settings will affect the workflow. This is the default value.
- Off, the entire wavelength range is used for the workflow.

5. When done, select **Save project**.

6. Proceed to the **CLASSES** tab.

Managing Wavelengths

This section describes how to manage wavelength range settings.

By defining the recorded wavelengths, you can limit the amount of recorded data.

Proceed as follows:

1. In the **Wavelength selection** screen, double click the spectrum area.
2. A pop-up screen is opened.

Default Wavelength Range



The anchors on top of the diagram indicate the wavelength ranges.

3. To split a wavelength range, select the plus sign on top of the graph.



Note:

If you split the wavelengths, you cannot use preprocessing.

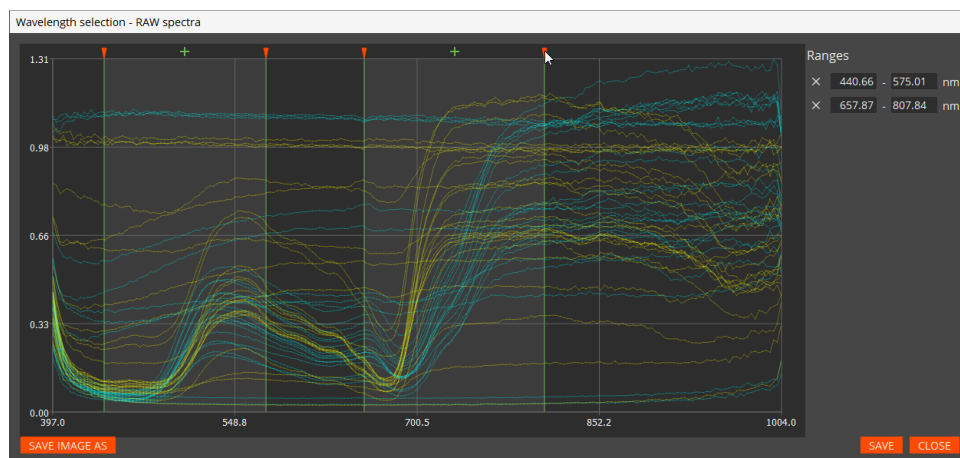


Figure 307: Splitting a Wavelength Range

The default split between anchors is 20 nm.

The maximum number of wavelength ranges is four.

4. Adjust wavelength ranges as necessary.

To adjust wavelength ranges, you can:

- Drag the range limit lines.
- Enter new values in the range definition fields or use the up and down arrows.

Wavelength ranges cannot be overlapped.

5. Remove splits as necessary.

To remove a split, click the cross icon next to the range definition field that you want to delete.



Figure 308: Delete Wavelength Split

CLASSES

This section describes how to define the classes for the model. Before creating classes, learn more about the SAM algorithm that is used for identification.

For more information, see [SAM](#).

A class is used to identify targets from the recorded data.

The minimum project requirements on this screen are:

- Create at least one class.

The figure below depicts the **Identification Model creator CLASSES** view.

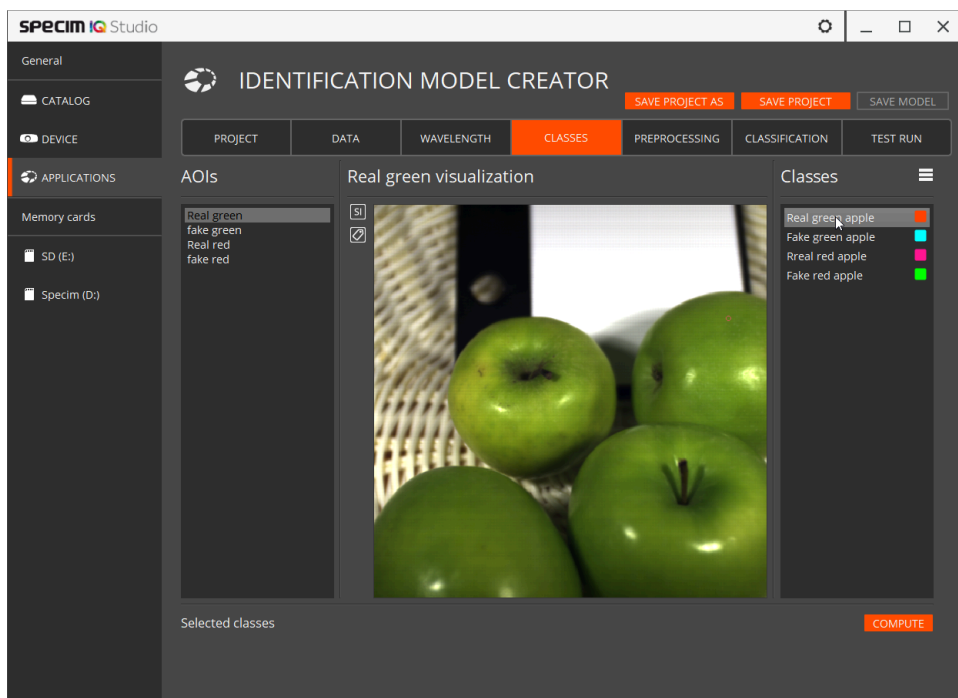


Figure 309: CLASSES View

In this view, you can define classes from the selected areas of interest.

Proceed as follows:

1. Select the area of interest for visualization from the **AOIs** list.
2. Double-click the visualization area, or select **Classes** >  > **Create new**, to open the area of interest in the full-size view.

The screen below is opened:

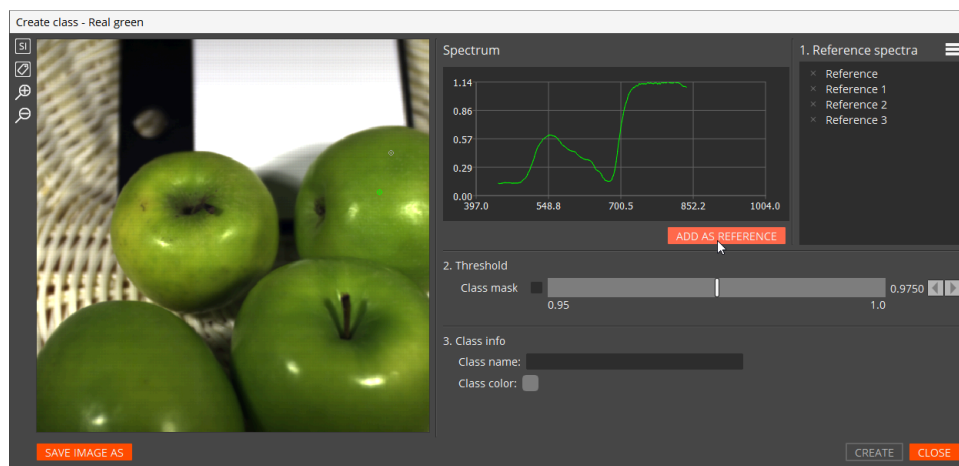


Figure 310: Create Class

3. Select one pixel from the false RGB to scrutinize this reference spectrum in the **Spectrum** area. Make sure to select a spectrum that represents well the target.



Tip:

You can also:

- Add the selected spectrum to an existing reference library by selecting **Reference spectra** >  > **Add to library**.



Note:

The maximum number of references in one class is 50.

The screen below is opened:

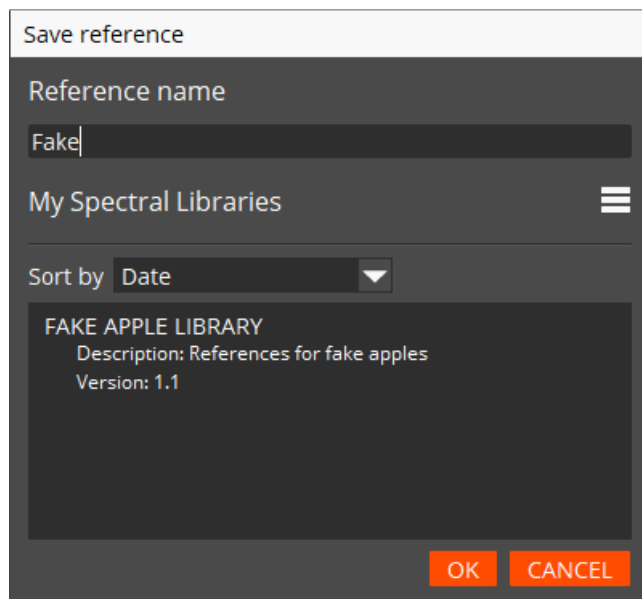


Figure 311: Add to Spectral Library

Select the desired library and select **OK**.

- Add the selected spectrum to a new reference library by selecting **Reference spectra** >  > **Add to library**.

The screen below is opened:

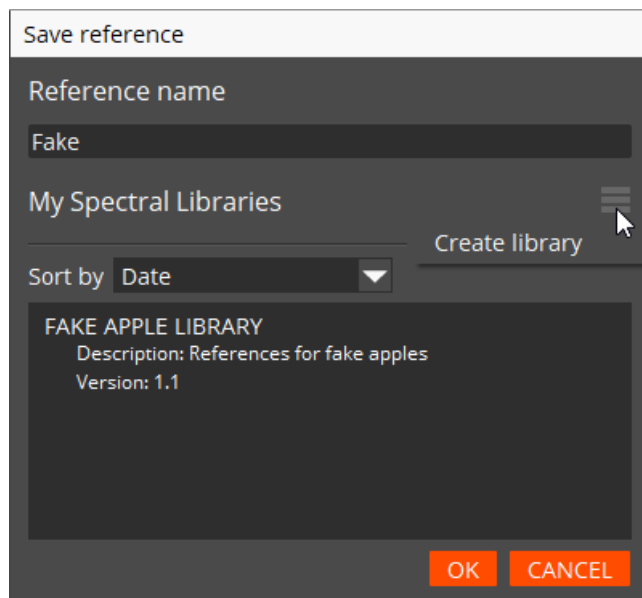


Figure 312: Add to Spectral Library

Select  > **Create library**.

For more instructions on creating a new library, see [Creating a New Spectral Library](#).

- Import reference spectra from spectral libraries by selecting **Reference spectra** >  > **Add from library**.

4. Select the **Threshold** check box to use SAM mask visualization.

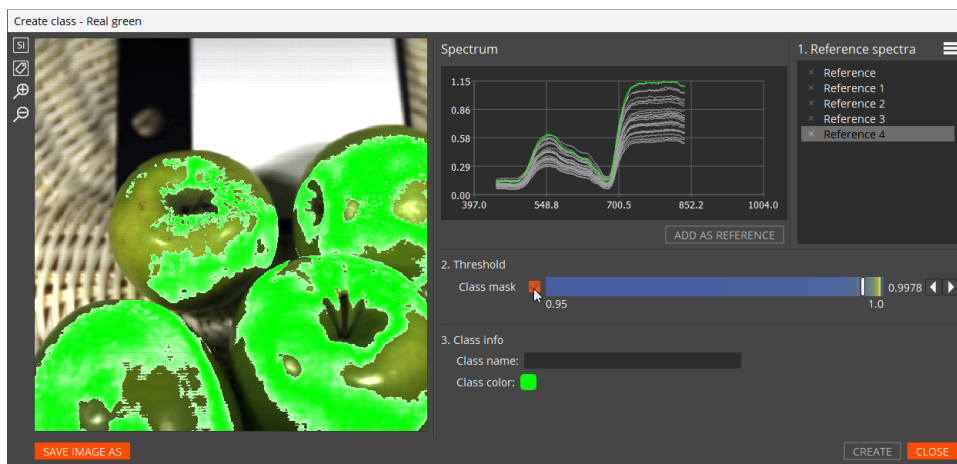


Figure 313: SAM Mask Visualization

In short, **Threshold** defines the spectral range that will be visualized as the identified substance. Slide the slider and see the results on the full-size view, until you have overlaid the desired range, depicted with the selected **Class color**. See also the tip below.

From a more technical perspective, the **Threshold** slider range depicts the spectra from the entire image in such a way that, on the right, there are the spectra that most resemble the reference spectrum, and on the left there are the spectra that least resemble the reference spectrum. The spectra on the right-hand side of the slider are visualized in the full-size view.



Tip:

If you select a strict **Threshold**, that is, a value close to 1.0, you will get a class that indicates the correct areas of interest in the captured images, and hardly any false positive results. However, sometimes you also want to get false positive results. In this way, you can capture images that *possibly* contain the substance to be identified. If this is the case, use a less strict threshold value.

5. When done with the area of interest, enter a name for the class in the **Class name** field.
6. Optional: Select the **Class color** box to pick a screen color that will be used for the class on the IQ Studio software, and on the device screen.

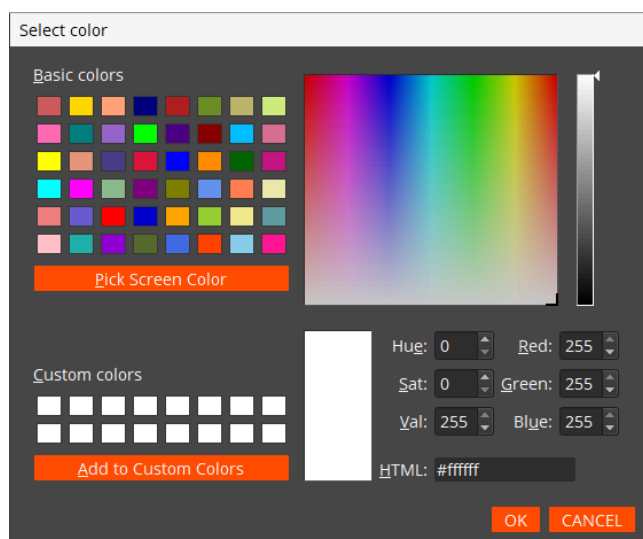


Figure 314: Select color

a) Select the color.

There are four ways to pick the color:

- Pick the color from the **Basic colors** list.
- Pick the color from the color gradient area. You can use the color slider to further refine your color selection.
- Pick the color by entering the desired values to the **Hue**, **Sat**, **Val**, **Red**, **Green** and **Blue** fields.
- Pick the color by entering an HTML color code in the **HTML** field.

b) When you have picked a screen color, you can also add it to your custom colors by selecting **Add to Custom Colors**.

Your custom colors will be available to you later, when you, for example, add more classes to your model.

c) Select **OK**.

7. Select **CREATE**.

8. The saved class is shown in the **Classes** list.

When you select a class from the **Classes**, the **Threshold** mask is overlaid on top of the selected area of interest. In this way, you can check if the class is also present on other areas of interest. If necessary, adjust the mask, and save the class.

9. Optional: To merge classes:

a) Select the classes that you want to merge, from the **Classes** list.

b) Select **Classes** >  > **Merge**.

The screen below is opened:

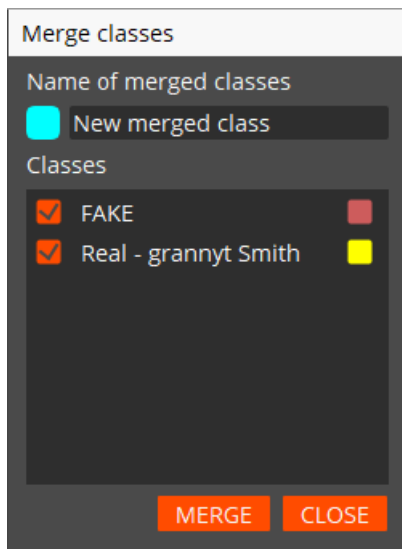


Figure 315: Merge Classes

- c) Select the classes that you want to merge, by using the check boxes in front of the class names.



Note:

The maximum number of classes that you can merge, is five.

- d) Enter a name for the merged class in the **Name of merged classes** field.

- e) Select:

- **MERGE** — Select **MERGE** to merge the classes.
- **CANCEL** — Select **CANCEL** to to return to the **CLASSES** view without merging the classes.

10.Optional: To check the class with other areas of interest:

- a) Select an area of interest.
- b) Select the class from the **Classes** list.
- c) Select **Compute**.

The screen below is opened:

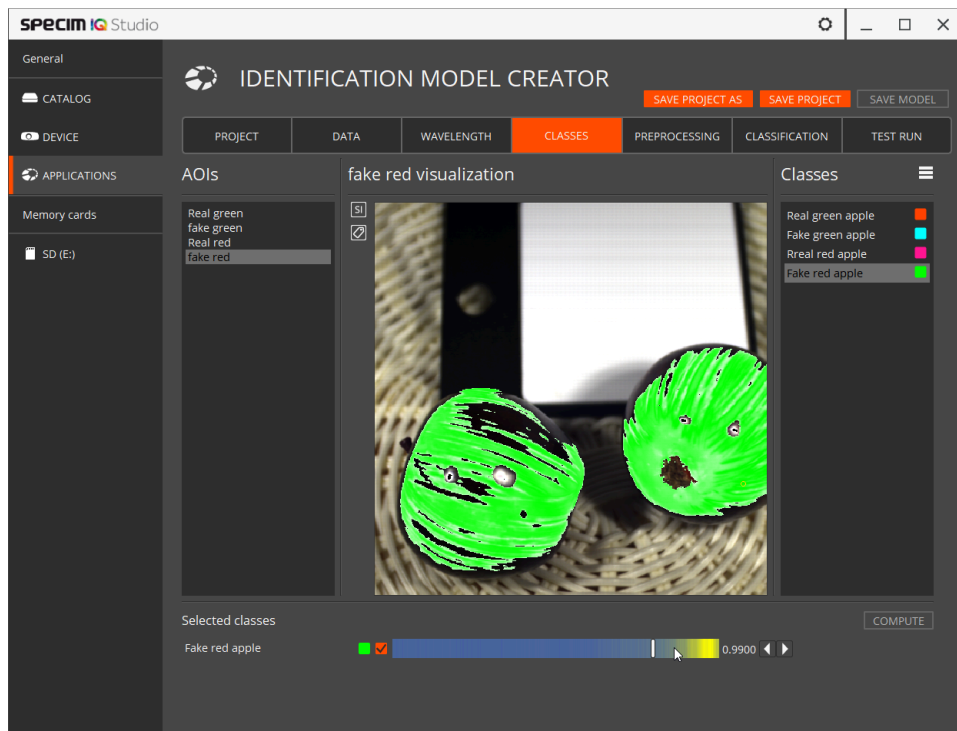


Figure 316: Validating the Class

The **Threshold** mask is overlaid on top of the selected area of interest. If necessary, adjust the threshold, and save the class.

11. Repeat the class creation process for all areas of interest required for the desired application.
12. When done, select **Save project**.
13. Proceed to the **PREPROCESSING** tab.

Related Tasks

[Building a Spectral Library](#)

This section describes how to build your spectral library.

PREPROCESSING

This section describes how to define the preprocessing algorithm for the model.

The minimum project requirements on this screen are:

- Select the preprocessing algorithm.
- Define whether or not the preprocessing algorithm will be used on the workflow.

The figure below depicts the **Identification Model creator PREPROCESSING** view.

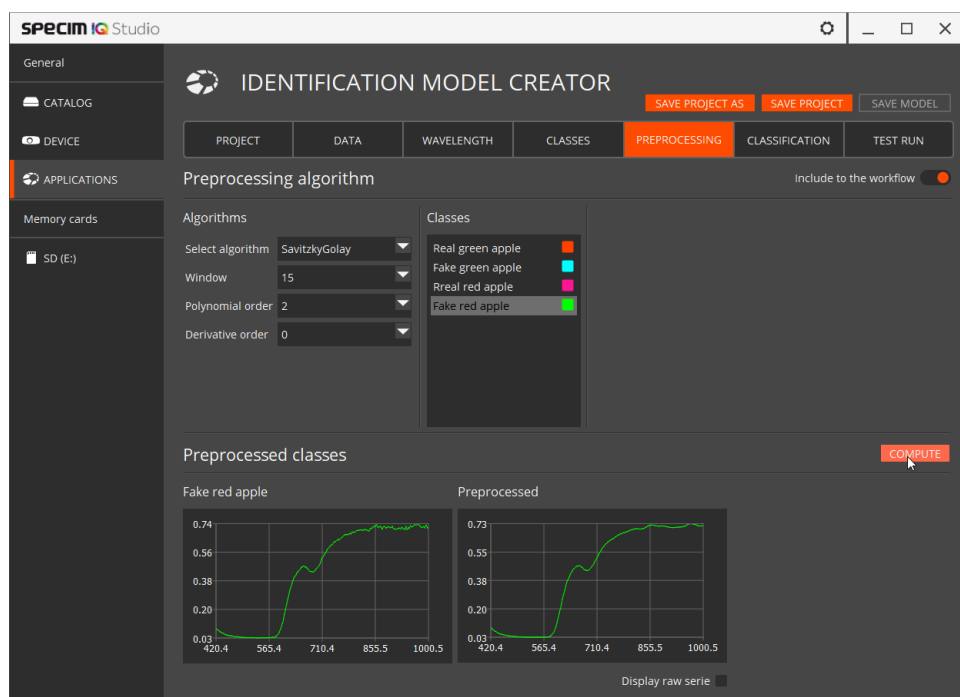


Figure 317: PREPROCESSING View

In this view, you can select the pre-processing algorithm, and compute results for the AOIs to visualize preprocessing results.

Proceed as follows:

1. Select the classes that you want to preprocess in the **Classes** area.
2. The **Preprocessing algorithm** > **Select algorithm** drop-down menu has the **SavitzkyGolay** preprocessing algorithm selected. You cannot change this selection.

A Savitzky–Golay filter is a digital filter that can be applied to a set of digital data points for the purpose of smoothing the data, that is, to increase the signal-to-noise ratio without greatly distorting the signal. This is achieved, in a process known as convolution, by fitting successive sub-sets of adjacent data points with a low-degree polynomial by the method of linear least squares.

3. Select the **Polynomial order** for the Savitzky–Golay filter.

Polynomial order defines the number of coefficients for the function that will be applied for the data. You can only select this value by comparing the results with the original data. Possible values are 2 or 3.

4. Test the selected algorithm against the selected AOIs by selecting **Compute**.



Tip:

You can double click the class graphs to open them enlarged.

In the **Preprocessed class visualization** area, you will see:

- The selected classes in the **Classes** column.
- The pre-processed classes in the **Preprocessed classes** column.

The options are:

- Select **Display raw serie** to view the original graph in the background of the preprocessed graph.
5. Use the **Include to the workflow** slider to see how the preprocessing algorithm affects the overall workflow.

When **Include to the workflow** is:

- On, the preprocessing algorithm will affect the workflow.

- Off, the preprocessing algorithm will not affect the workflow. This is the default value.

6. When done, select **Save project**.

7. Proceed to the **CLASSIFICATION** tab.

CLASSIFICATION

This section describes how to define the classification method for the model.

The minimum project requirements on this screen are:

- Select the classification method.
- Select the class mask visualization method.

The figure below depicts the **Identification Model creator > CLASSIFICATION** view.

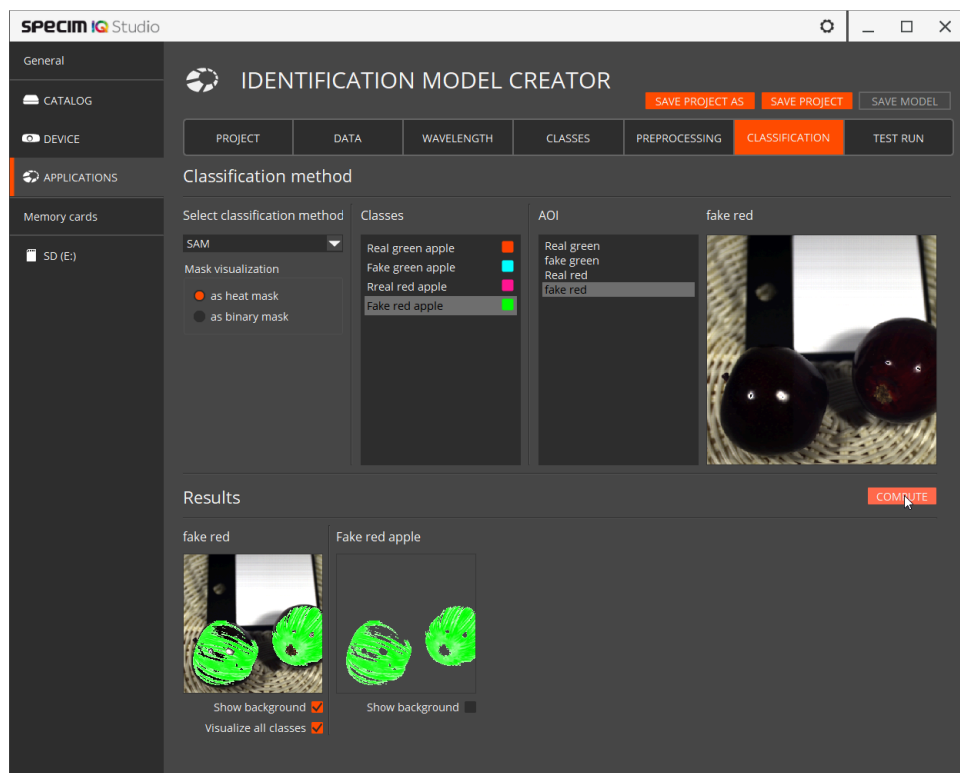


Figure 318: CLASSIFICATION View

In this view, you can select the classification method for the model, and visualize the results after classification.

Proceed as follows:

1. You can only select the Spectral Angle Mapper (**SAM**) classification method from the **Select classification method** drop-down menu.
2. Select the classes for visualization from the **Classes** list.
3. Select the area of interest for visualization from the **AOI** list.

The false **RGB** area shows the selected area of interest.

4. Select **Mask visualization**. The options are:

- **As heat mask** — Heat mask visualization uses a color scale to indicate how closely the pixel matches the reference spectrum. The closer the color is to the chosen class color, the stronger the match is. Lighter colors indicate pixels that are further from the reference spectrum.

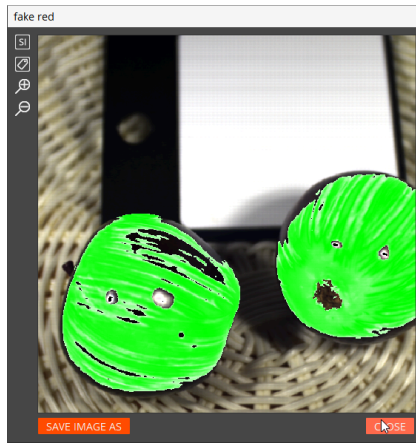


Figure 319: Area of Interest - Heat Masked

- **As binary mask** — Use the class mask for each pixel that belongs to the class.

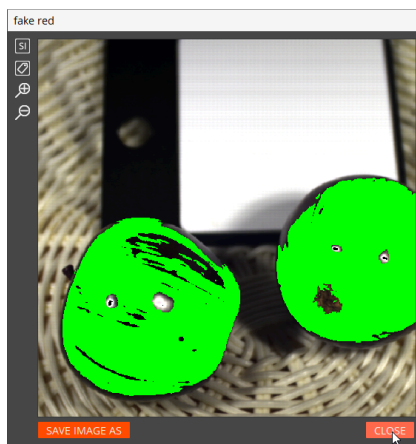


Figure 320: Area of Interest - Binary Masked

5. Test the classes against the selected areas of interest by selecting **Compute**.

The results are shown on the false RGB image in the **Results** area.

In this view, you can see the results, that is, how the model handles the dataset. Also, the individual classes are shown.

The check boxes are:

- **Visualize all classes** — Show all classes visualized on top of the false RGB image.
- **Show background** — Show the *RGB* image as the background image.

6. Examine the results.



Tip:

You can double click the result windows to open them enlarged.

If something is wrong, you can repeat and modify the previous steps until you are satisfied with the results. For example, if you have defined a too strict threshold value, return to the **CLASSES** tab to make the necessary changes.

7. When done, select **Save project**.
8. Proceed to the **TEST RUN** tab.

TEST RUN

This section describes how to test run the model with full datasets.

The figure below depicts the **Identification Model creator TEST RUN** view.

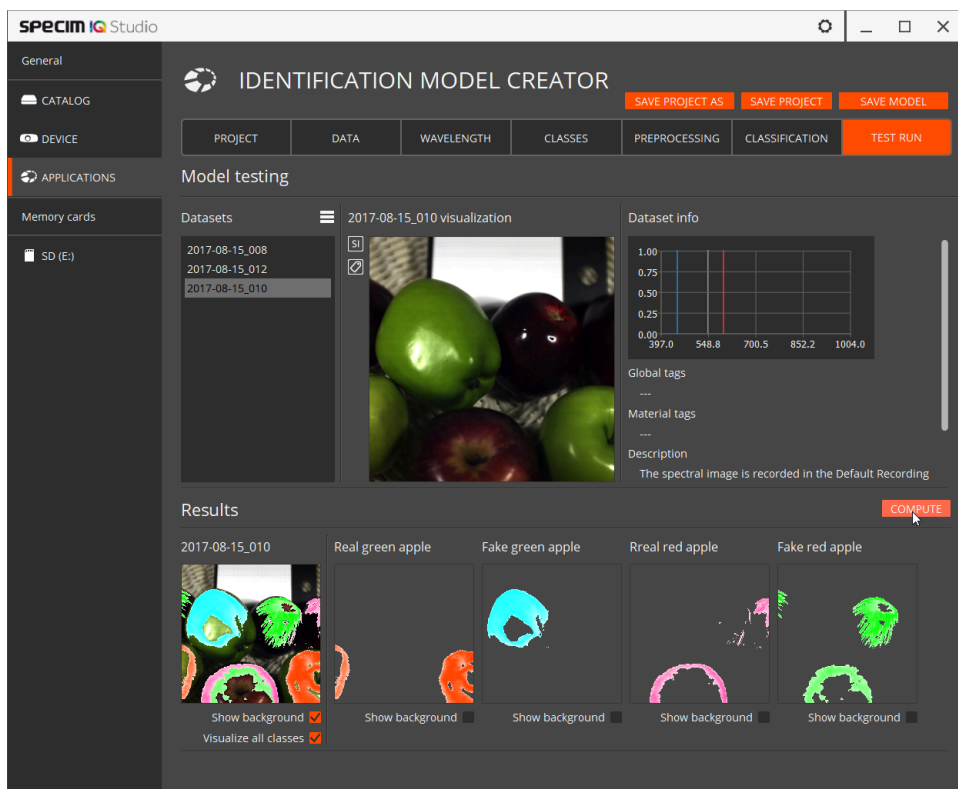


Figure 321: TEST RUN View

In this view, you can select datasets to test your model against test data. We recommend using datasets recorded under various lighting conditions.

Proceed as follows:

1. Select **Datasets** >  > **Open** to open test data.
2. The datasets are opened in the **Model testing** view.

The buttons in this view are:

-  — Press this button to toggle the spectral image visibility on or off.
-  — Press this button to view the tags on the visualized dataset.



Tip:

You can open the dataset in the full-size view by double clicking the visualization area. In the full-size view, you can select one pixel from the false RGB and scrutinize the spectrum of the selected pixel in the spectrum area.

3. To adjust visualization, double-click the visualization area to open the dataset in the full-size view.

The screen below is opened:

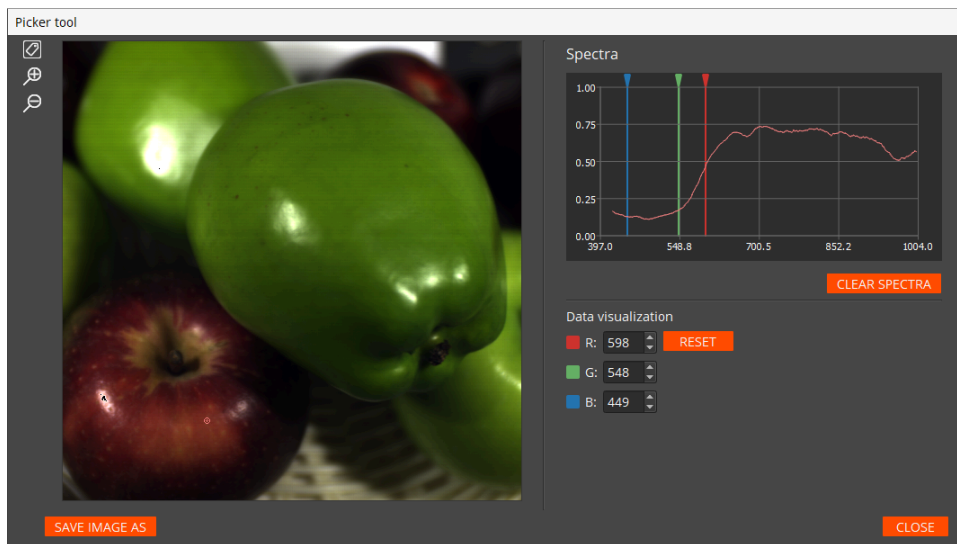


Figure 322: Selecting Spectra

4. When you are satisfied with the selected dataset, select **Compute**.

The results for each created class are visualized in the **Classes** area.



Tip:

You can double click the result windows to open them enlarged.

The check boxes are:

- **Visualize all classes** — Show all classes visualized on top of the false RGB image.
 - **Show background** — Show the *RGB* image as the background image.
5. If you are satisfied with the results, select **Save model**.

The screen below is opened:

Figure 323: Save Model

If something is wrong, you can repeat and modify the previous steps until you are satisfied with the results.

6. Select **Save**

The model appears in the **My models** list.

7. When done, select **Save project**.

4.3.2.2 Opening a Model Project in Creator

This section describes how to open an existing model project for editing.

Proceed as follows:

1. Select the model project to be opened from **APPLICATIONS > MODELS**.
2. Select **My model projects > [Menu Icon] > Open**.



Tip:

You can also double click the project in the **My model projects** list to open it.

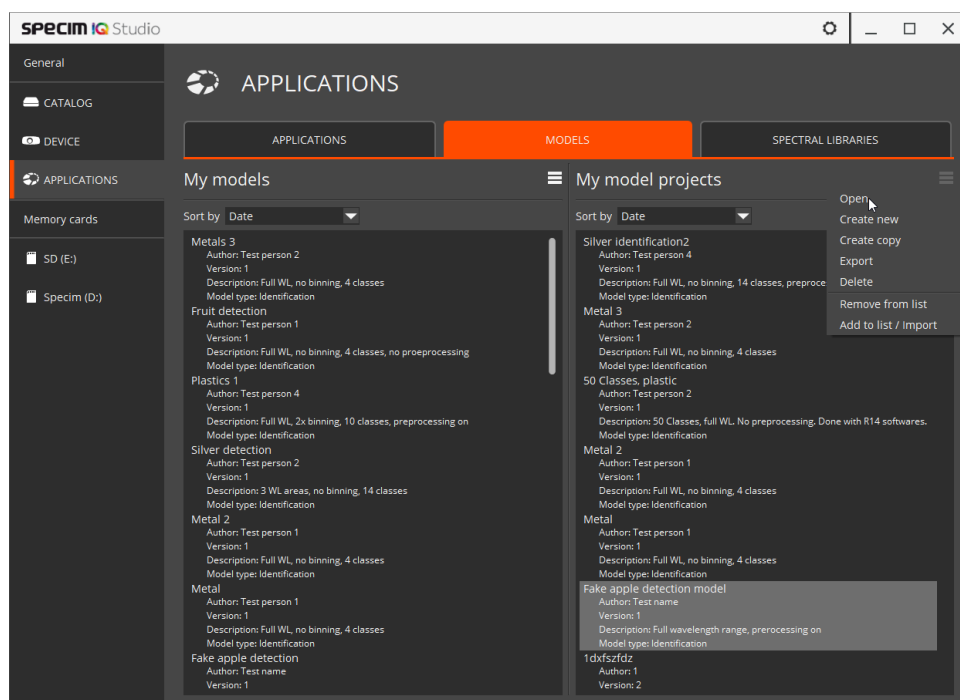


Figure 324: Opening a Model Project

The project is opened in the creator.

3. Proceed as described in [Creating a Model Project](#).

4.3.2.3 Adding a Model Project to the Project List

This section describes how to add a previously removed model project to the project list.

Proceed as follows:

1. Select **APPLICATIONS > MODELS**.
2. Select **My model projects > [Menu Icon] > Add to list**.

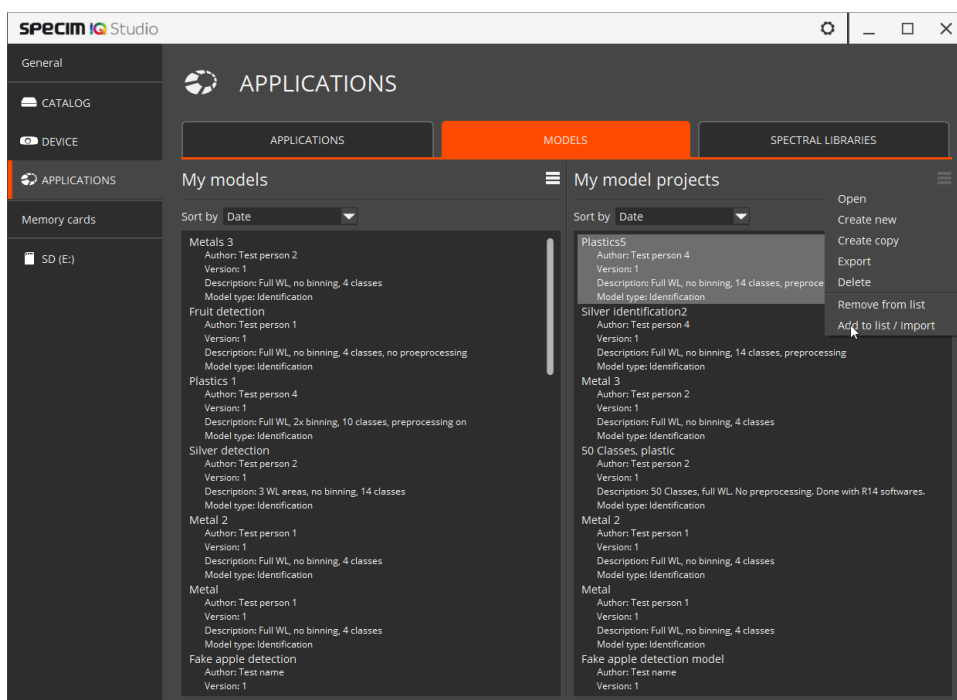


Figure 325: Adding a Model Project to the Project List

3. Windows file manager is opened.
4. Select the root folder of the project to be added to the list.
5. Select **Select folder**.
6. The project is added to the list.

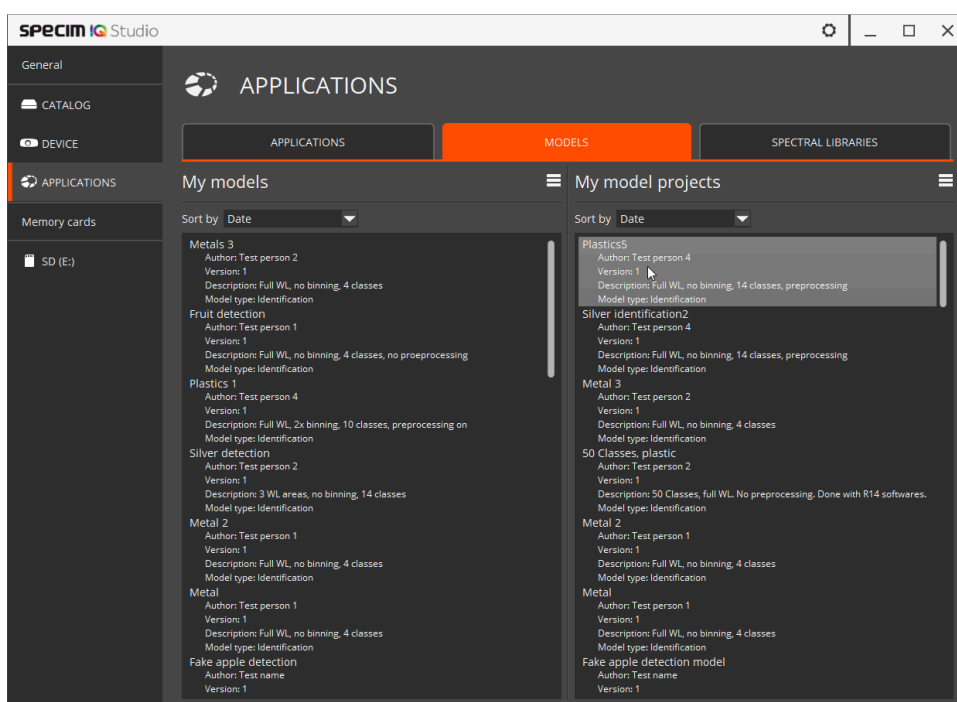


Figure 326: Model Project Added



Note:

The **Add to list/Import** command creates a path to the existing location of the project folder.

4.3.2.4 Removing a Model Project from the Project List

This section describes how to remove a model project from the project list.

When you remove a model project from the project list, it is only removed from the list, not from your hard disk. If necessary, you can later bring it back to the project list. See [Adding a Model Project to the Project List](#).

Proceed as follows:

1. Select **APPLICATIONS > MODELS**.
2. Select the model project that you want to remove from the **My model projects** list.
3. Select **My model projects >  > Remove from list**.

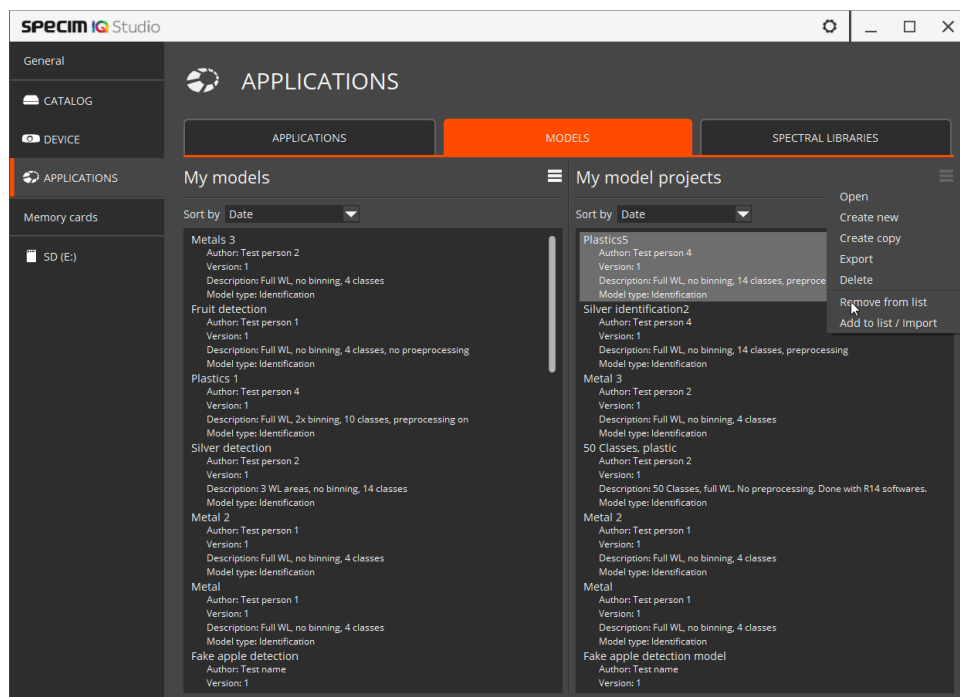


Figure 327: Removing a Model Project from the Project List

4. The project is removed from the list.

4.3.2.5 Creating a Copy of a Model Project

This section describes how to duplicate a model project.

You cannot make an exact copy of a project. You must change, at least, the project version number.

Proceed as follows:

1. Select **APPLICATIONS > MODELS**.
2. Select the project that you want to duplicate.
3. Select **My model projects >  > Create copy**.

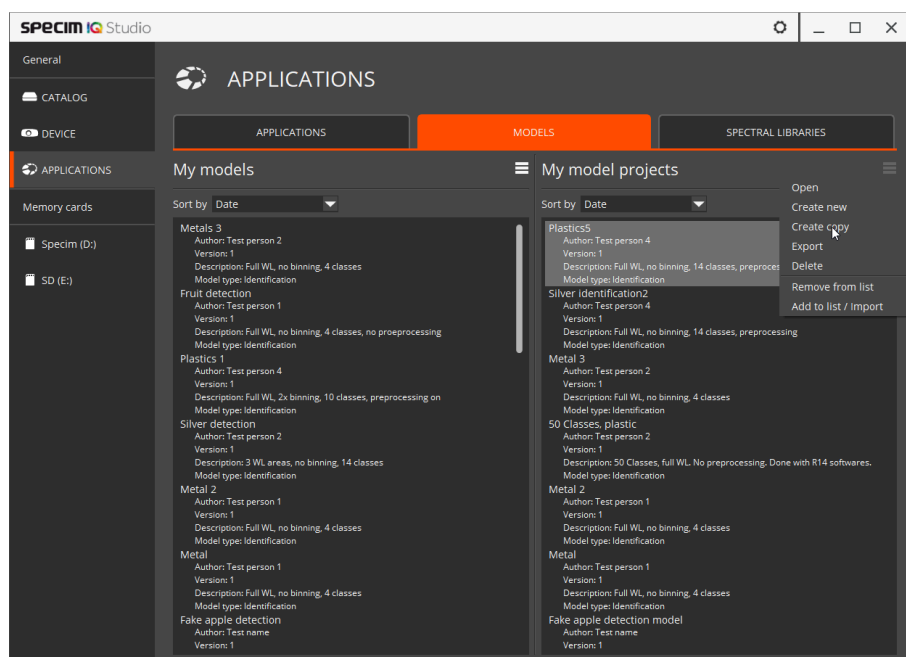


Figure 328: Creating a Copy of a Model Project

4. Define project information as follows:

The screen below is opened:

Create copy

Model project name *

Plastics5

Author / Copyright

Test person 4

Description *

Full WL, no binning, 14 classes, preprocessing

Version number *

1

Include source data

☒

Project folder name *

Plastics5-1

Destination *

C:/Users/Username/Desktop

BROWSE

SAVE AS NEW

CLOSE

Figure 329: Creating a Copy of a Model Project



Note:

The mandatory fields are marked with an asterisk (*).

- **Model project name** — Enter a descriptive name for the model. The project name will also become the model name.
- **Author / Copyright** — Enter the name of the model author and/or copyright information.
- **Description** — Enter a detailed description of the model, providing all information necessary for the model user. Furthermore, the description will also be included in the measurement data.
- **Version number** — Add a version number for the project. The version number will be included in the model. If you make changes to the model, upgrade the version number. In this way, you can use different model versions on applications.

- **Include source data** — Check this check box if you want to include the source data on the project duplicate.
 - **Project folder name** — Name of the folder where this project will be saved at.
 - **Destination** — Location of the folder where this project will be saved at.
5. Select **Save as new**.
 6. The project is added to the list.

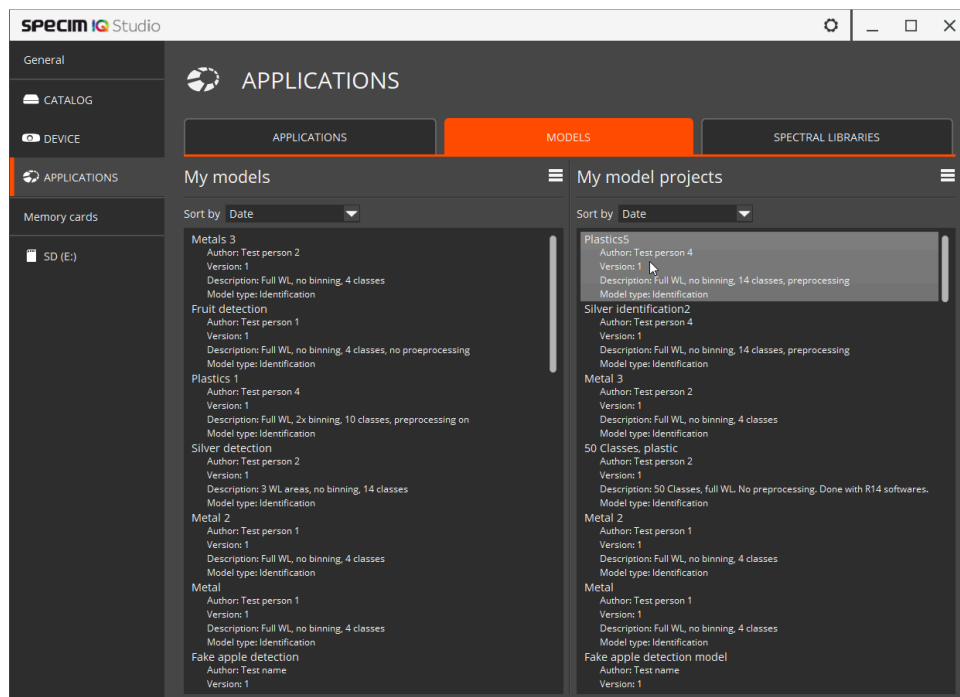


Figure 330: Model Project Added

4.3.2.6 Deleting a Model Project

This section describes how to delete a model project.

Deleting a model project will remove the model project both from **My model projects** and from the computer hard drive.

Proceed as follows:

1. Select the model project to be removed from **APPLICATIONS > MODELS**.
2. Select **My model projects > [Menu Icon] > Delete**.

The screen below is opened:

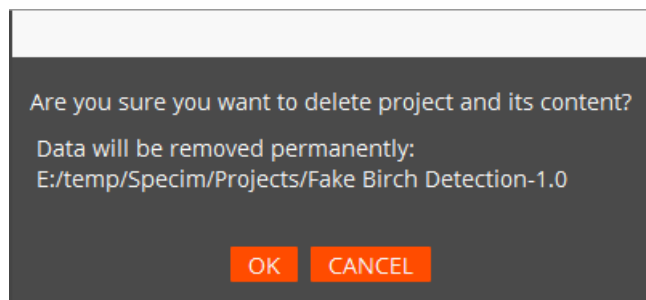


Figure 331: Deleting a Project

3. The system asks for your confirmation. Select:
 - **OK** to proceed.

- **CANCEL** to cancel.
- If you select **OK**, the project is removed from **My model projects** and from the computer hard drive.

4.4 Managing Spectral Libraries

This section describes how to manage spectral libraries. The figure below depicts the **SPECTRAL LIBRARIES** view.

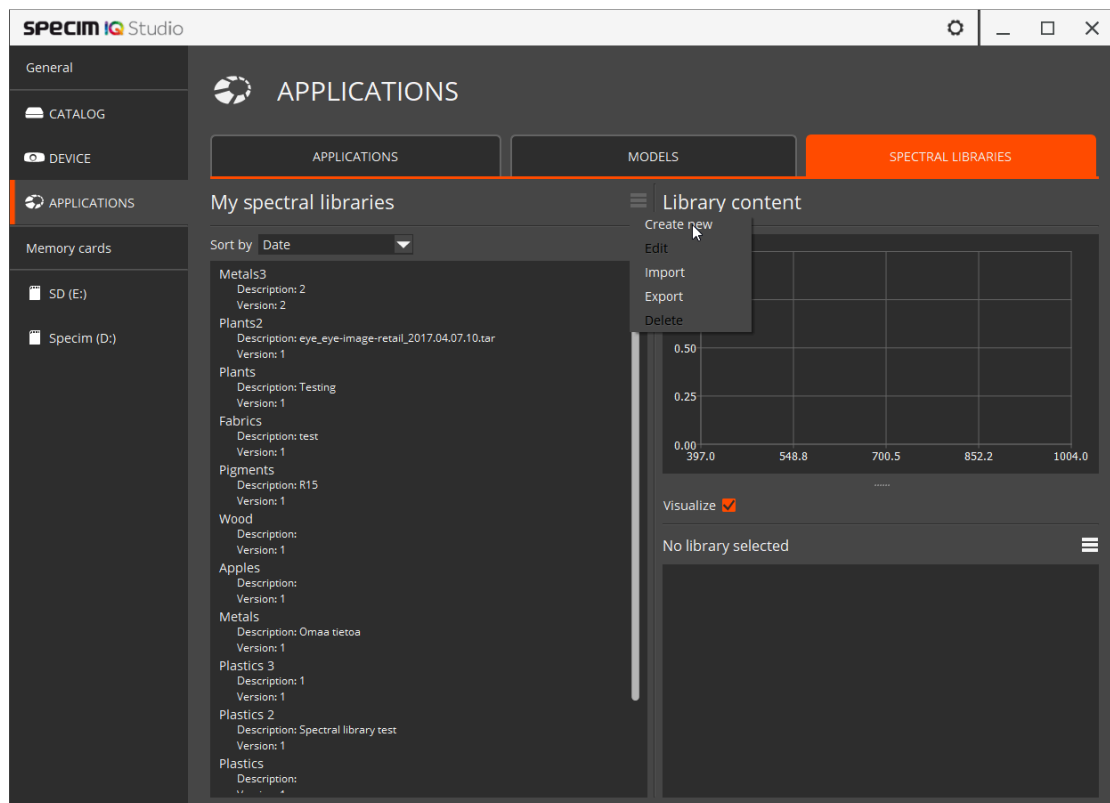


Figure 332: SPECTRAL LIBRARIES View

The current spectral libraries are listed in the **My spectral libraries** list.

You can sort the order of spectral libraries by:

- **Date** - Sort by the library creation date.
- **Name** - Sort by the library name.

The spectra in the selected library are listed in the **Library content** list on the right.

4.4.1 Building a Spectral Library

This section describes how to build your spectral library.

Proceed as follows:

- Optional: Create a new spectral library.

For more information, see [Creating a New Spectral Library](#).

- Record data with Specim IQ.
- Import the images to Specim IQ Studio.

For more information, see [Importing Data from Specim IQ](#).

- Select **CATALOG**.

5. Double click the dataset thumbnail, whereupon it will be opened in the extended dataset viewer.



Tip:

You can also add references to libraries and create new libraries when creating a new class.

For more information, see [CLASSES](#).

6. Select the **Research** tab.

The screen below is opened:

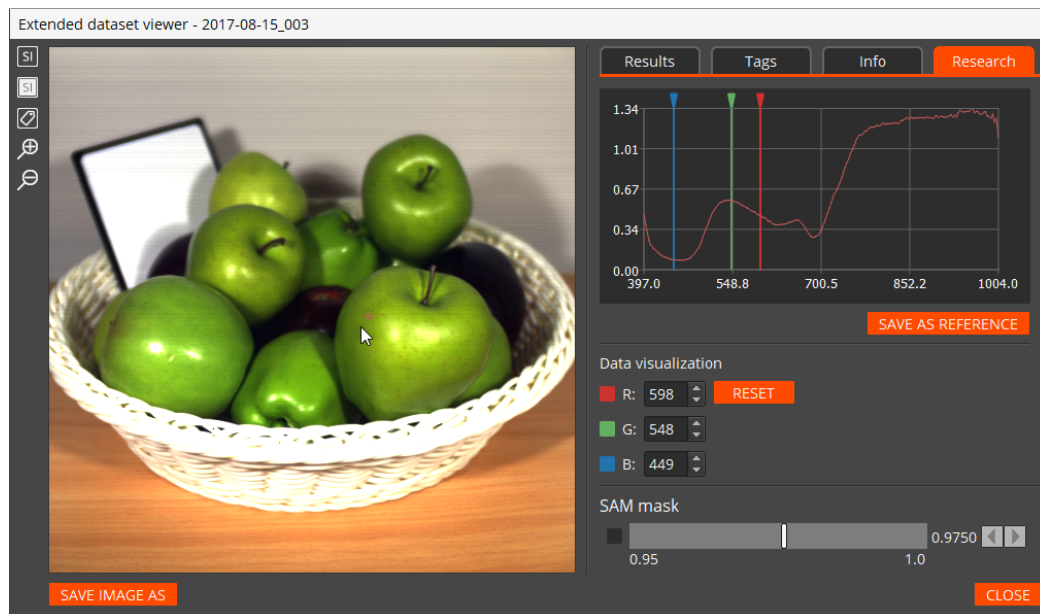


Figure 333: Extended Dataset Viewer - Research

7. On the false RGB view, select a pixel that contains the spectrum that you want to add to your spectral library.
8. Select **SAVE AS REFERENCE**.

The screen below is opened:

Figure 334: Naming a Spectrum

9. Name the spectrum.
10. Select the spectral library where you want to save the spectrum.



Tip:

To create a new library, select > **Create new library**.

For more instructions on creating a new library, see [Creating a New Spectral Library](#).

11. Select OK.

The spectrum is added to the spectral library.

12. Select CLOSE.

Related Tasks

CLASSES

This section describes how to define the classes for the model. Before creating classes, learn more about the SAM algorithm that is used for identification.

4.4.2 Creating a New Spectral Library

This section describes how to create a new spectral library.

Proceed as follows:

1. Select APPLICATIONS > SPECTRAL LIBRARIES.

The screen below is opened:

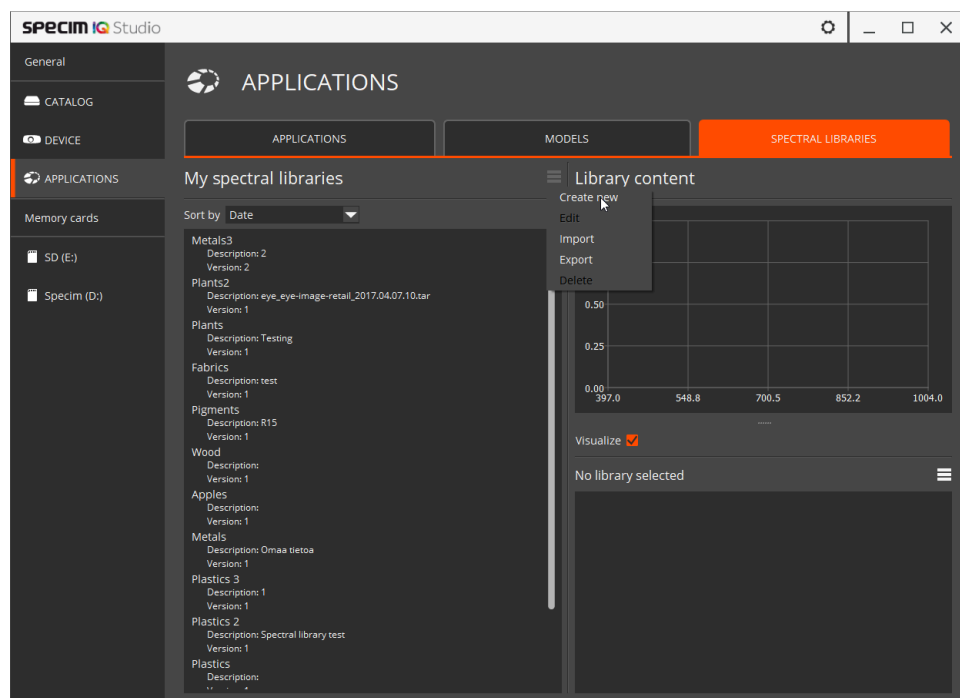


Figure 335: SPECTRAL LIBRARIES View

2. Select My spectral libraries > > Create new.

The screen below is opened:

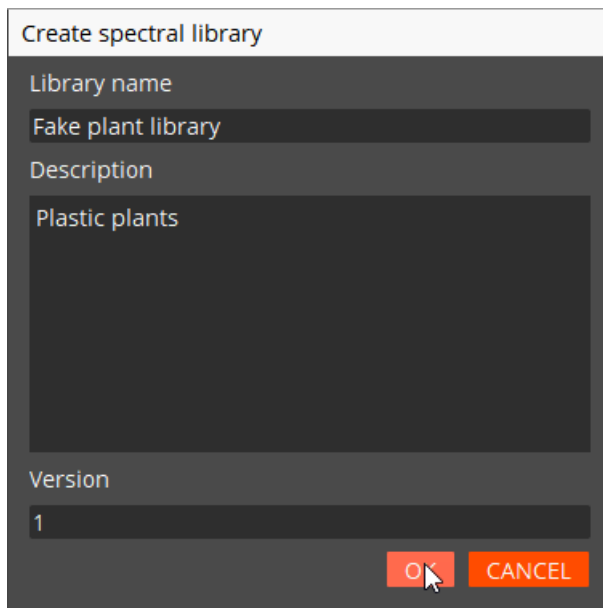


Figure 336: Creating a New Spectral Library

3. Enter spectral library information as follows:
 - **Name** - The library name.
 - **Description** - A description of the library.
 - **Version** - The library version.
4. Select **OK**.
5. The new library is added to the **SPECTRAL LIBRARIES** view.

4.4.3 Importing a Spectral Library

This section describes how to import a spectral library to IQ Studio.

You can import spectral references from two types of spectral libraries:

- USGS libraries. For more information, see <https://speclab.cr.usgs.gov/spectral-lib.html>.
- ENVI libraries.

The spectral library sampling can differ from that of Specim IQ, as the library will be re-sampled in conjunction with the import procedure. The spectrum does not have to cover the entire 400—1000 nm range, but it has to be continuous. Furthermore, the spectrum must not have overlapping values, that is, the imported spectrum must be based on the spectrum from one measurement only.

Proceed as follows:

1. Select **APPLICATIONS > SPECTRAL LIBRARIES**.

The screen below is opened:

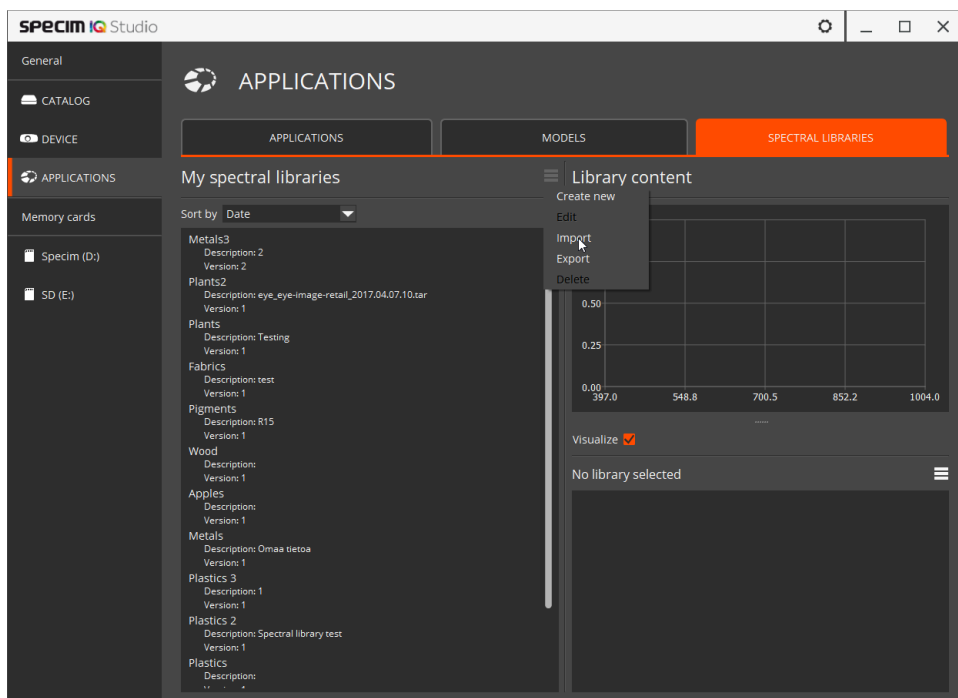


Figure 337: SPECTRAL LIBRARIES View

2. Select **My spectral libraries** >  > **Import**.
3. Windows file manager is opened.
4. Select the spectral library to be imported.

If you import:

- An ENVI `.sli` library file, select a HDR file.
- A USGS library file, select a binary file without file extension.

5. Select **Open**.

The spectral references are read from the library.

The screen below is opened:



Figure 338: Reference Import Screen

Check the **Visualize** check box to see the selected reference graph(s).

6. Import the references as follows:

- a) Select the desired references from the **Source library** list.

See also [Keyboard Shortcuts](#).

- b) Select **ADD**.

The selected references are moved to the **Import content** list.

- c) Select the desired references from the **Import content** list.

See also [Keyboard Shortcuts](#).

To remove references from the **Import content** list, select the reference and select **REMOVE**

- d) Select the target library from **My spectral libraries**.



Tip:

To create a new library, select **My spectral libraries** > > **Create new library**.

For more instructions on creating a new library, see [Creating a New Spectral Library](#).

- e) Select **IMPORT**.

The screen below is opened:

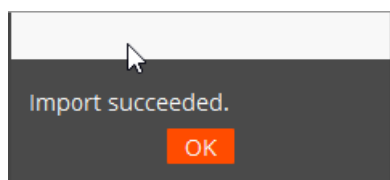


Figure 339: Import Succeeded

7. Select **Close**.

4.4.4 Exporting a Spectral Library

This section describes how to export a spectral library.

Proceed as follows:

1. Select **APPLICATIONS > SPECTRAL LIBRARIES**.

The screen below is opened:

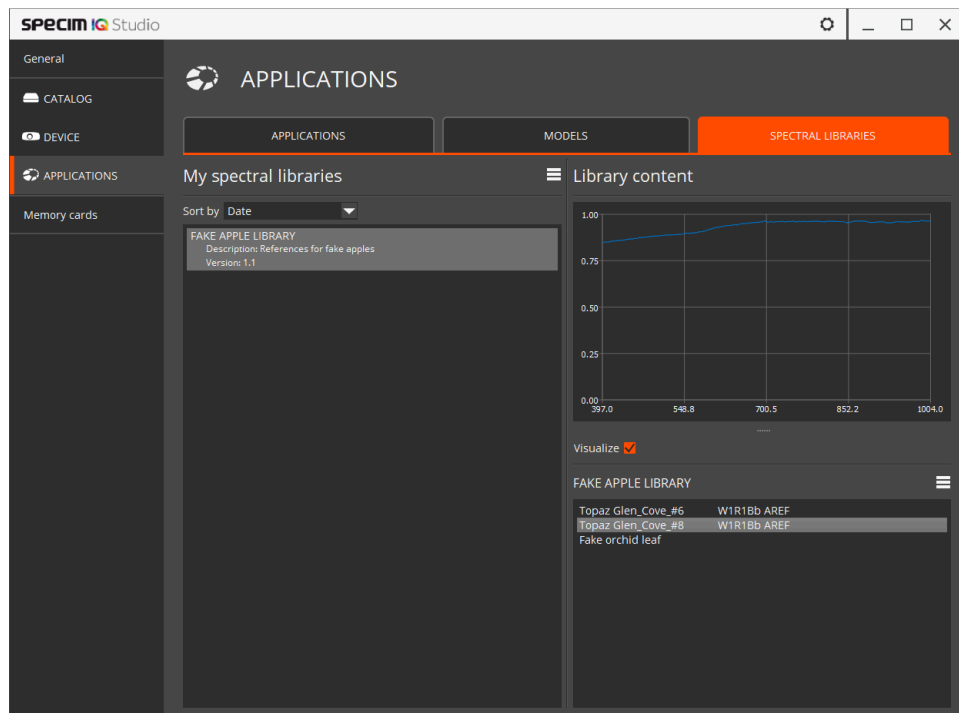


Figure 340: SPECTRAL LIBRARIES View

2. Select the spectral library to be exported.
3. Select **My spectral libraries** >  > **Export**.
4. Windows file manager is opened.
5. Select the destination folder for the exported spectral library.
6. Select **Open**.

The selected library is exported as a .json file.

4.4.5 Deleting a Spectral Library

This section describes how to delete a spectral library.

Deleting a spectral library will remove the spectral library both from **My spectral libraries** and from the computer hard drive.

Proceed as follows:

1. Select **APPLICATIONS > SPECTRAL LIBRARIES**.

The screen below is opened:

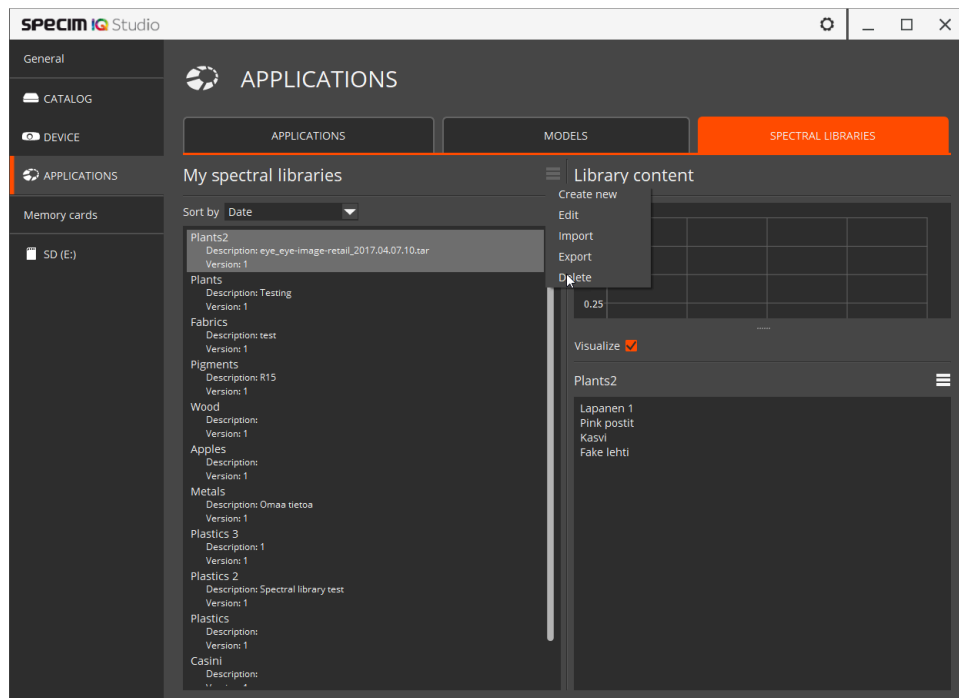


Figure 341: SPECTRAL LIBRARIES View

2. Select the spectral library to be removed from the **My spectral libraries** list.
3. Select **My spectral libraries** >  > **Delete**.
4. The system asks for your confirmation. Select:
 - **OK** to proceed.
 - **CANCEL** to cancel.
5. The spectral library is removed from **My spectral libraries** and from the computer hard drive.

4.4.6 Editing Spectral Library Information

This section describes how to edit spectral library information.

Proceed as follows:

1. Select **APPLICATIONS** > **SPECTRAL LIBRARIES**.

The screen below is opened:

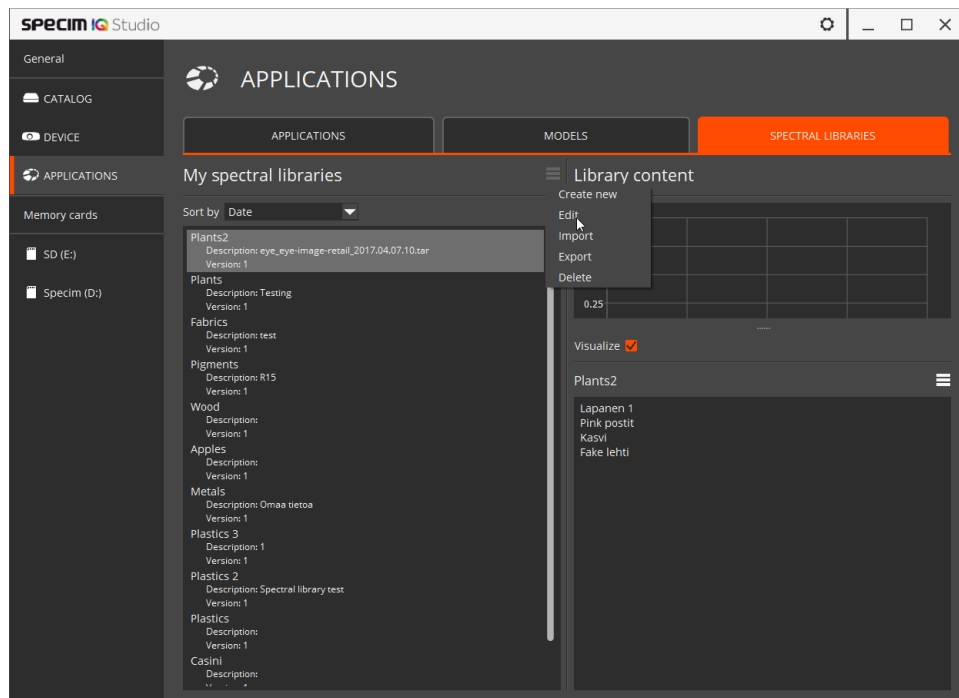


Figure 342: SPECTRAL LIBRARIES View

2. Select the spectral library the information on which you want to edit.
3. Select **My spectral libraries** >  > **Edit**.

The screen below is opened:

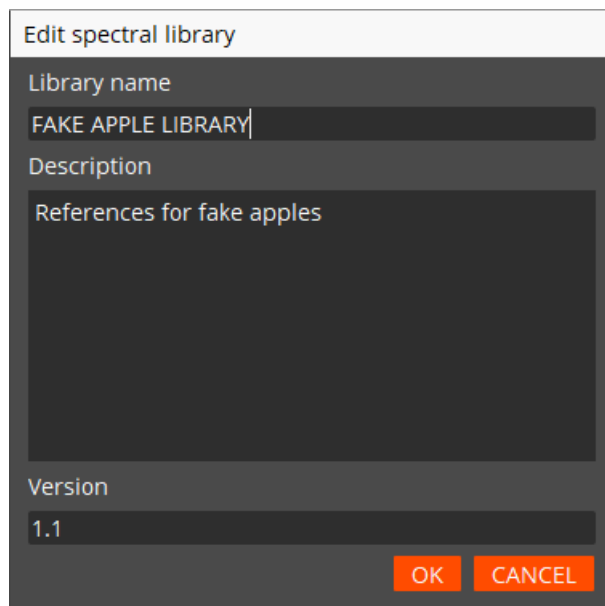


Figure 343: Edit Spectral Library

4. Edit spectral library information as follows:
 - **Name** - The library name.
 - **Description** - A description of the library.
 - **Version** - The library version.
5. Select **OK**.

4.5 Troubleshooting

This section provides troubleshooting instructions for Specim IQ.

Table 4: Troubleshooting

Symptom	Solution
Data has not been saved on the memory card.	The memory card has been removed too soon from Specim IQ. Check that the memory card is unlocked.
Specim IQ does not start.	Check that: - The battery has been inserted in the correct way. - There is power in the battery, by placing the battery on the charger. - The battery poles and cover are undamaged.
Connection to the PC cannot be established.	Check that: - The cables are connected and undamaged. - The USB drivers are installed on your PC. - Specim IQ is ON.
Picture is not sharp.	- Camera has moved during exposure. - Re-focus the objective. - Clean the lens.
Picture is too dark or completely dark.	- Improve the illumination. - Check data recording settings and data validation.
Picture has stripes.	Stripes have no effect on Specim IQ performance.
Specim IQ freezes.	Proceed as follows: 1. Remove the battery. 2. Keep the device OFF for, at least, 30 seconds. 3. Insert the battery. 4. Start the device.
Touch screen does not work.	The four custom keys have symbols on the screen, but these symbols are not on the touchable screen area. Use custom keys as physical buttons only.
On the data recording settings screen, there is a black box in the middle of the spectral image area.	The box in the middle of the spectral image area is the focus camera area. If this area is black, you have the lens cover on.

Symptom	Solution
Specim IQ does not record data.	The SHUTTER button is a two-function button. When you press the button halfway, the Data recording settings screen is opened. Set the integration time, after which you can record data by fully pressing the SHUTTER button.
Specim IQ Studio does not find my dataset.	Check the dataset file name for special characters. If you have used special characters (see File Name Restrictions in IQ Studio), contact Specim.

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