

pco.[®]

pco.camware Camera Control Software

FOR WINDOWS




excelitas[®]

Excelitas PCO GmbH asks you to carefully read and follow the instructions in this document.
For any questions or comments, please feel free to contact us at any time.

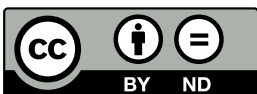


address:	Excelitas PCO GmbH Donaupark 11 93309 Kelheim, Germany
phone:	(+49) 9441-2005-0 (+1) 866-662-6653 (+86) 400-080-2255
mail:	pco@excelitas.com
web:	www.excelitas.com/pco

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1 Introduction

This manual describes the operation and basic functions of the pco.camware software application developed by PCO. Using this software, all current and most older PCO cameras can be operated.

Camera-specific data and values are provided in the corresponding camera documentation.

Additional instructional videos demonstrating the use of pco.camware are available [online](#).

 Not all listed functions are supported by every camera!

1.1 Conventions

The following typographic conventions are used in this manual:

Value	Description
<i>bold italics</i>	Terminology used in the pco.camware user interface.
<u>1.2</u>	A bold, underlined chapter number indicates a hyperlink to that chapter.
1	Indicates step-by-step instructions.
Note	Indicates important information that must be observed.
hyperlink	Blue highlighted text indicates a hyperlink to an external website.
 + NOTICE	Highlights important precautions and limitations.
<i>lightbulb icon</i>	Indicates helpful tips.

1.2 System requirements

Download the latest versions of our software and camera drivers from our [website](#).

System components	Minimum requirements
OS (64-bit)	Windows 7 or later ¹
CPU	Intel®/ Xeon Core™ i7/ i9 > 2.8 GHz
RAM ²	> 8 GB DDR3
GPU	NVIDIA CUDA CC $\geq$ 5.0 (get current runtime version from NVIDIA)
Display	Full-HD resolution display

[Contact us](#) if you have any questions about your system configuration.

¹We recommend to use only currently supported operating systems.

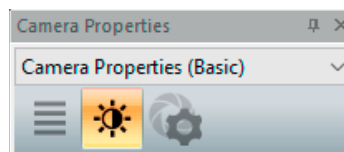
²Depending on the camera model, recording may use either the camera's internal RAM or the PC's RAM. When recording in PC RAM, longer recordings require more free RAM, as recording stops when the available RAM is exhausted.

1.3 NVIDIA CUDA driver

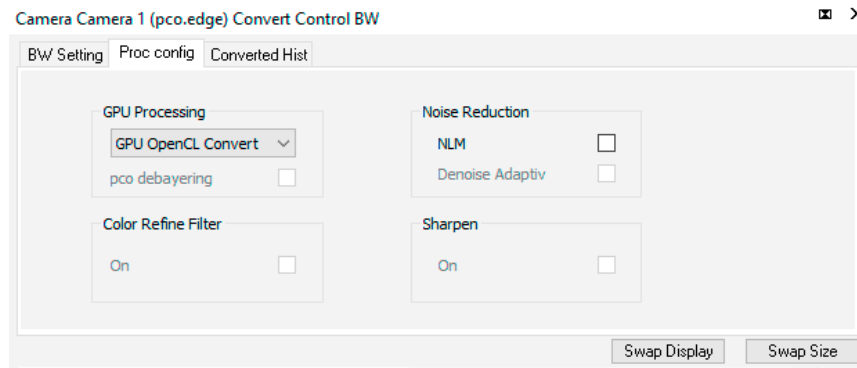
Our software relies on GPU processing, so the video drivers must be up to date. Update your NVIDIA driver before using pco.camware. If you have an older driver version **GPU Processing** will not work properly and therefore slow down image processing.

Use the following steps to check whether **GPU Processing** is enabled in pco.camware:

- 1 Open the **Convert Control** dialog.



- 2 Select the **Proc config** tab.



If **GPU Processing** is disabled and shown in gray, this indicates a driver issue. Update your NVIDIA driver or check the computer manufacturer's website for appropriate graphics driver updates.

1.4 Installation

The pco.camware application enables you to control most camera parameters and settings. Images can be displayed on a monitor and may be downloaded and stored. Installation files for pco.camware are available for the latest 64-bit Windows operating systems.



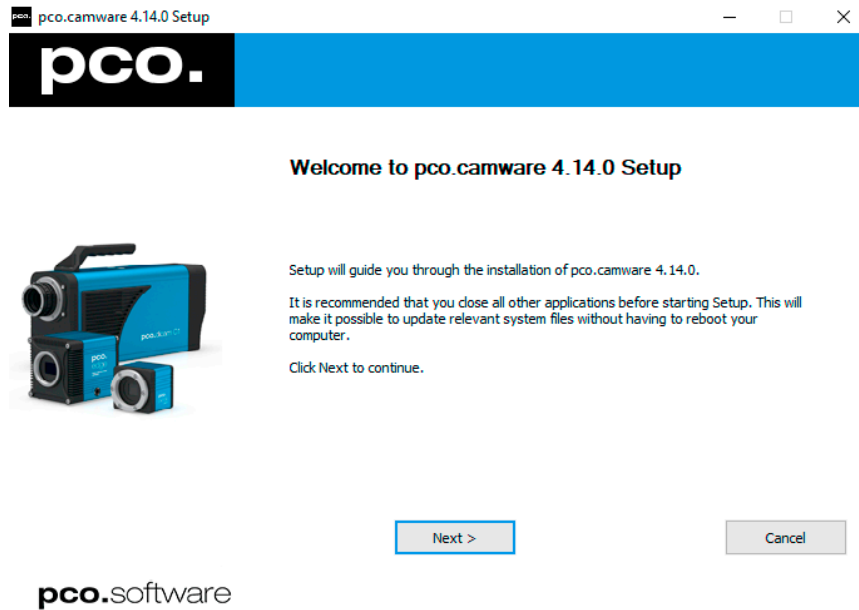
Before installing the software, ensure that your system meets the **minimum requirements** (see [1.2](#)) and verify that you have the required permissions to install software.

Follow these steps:

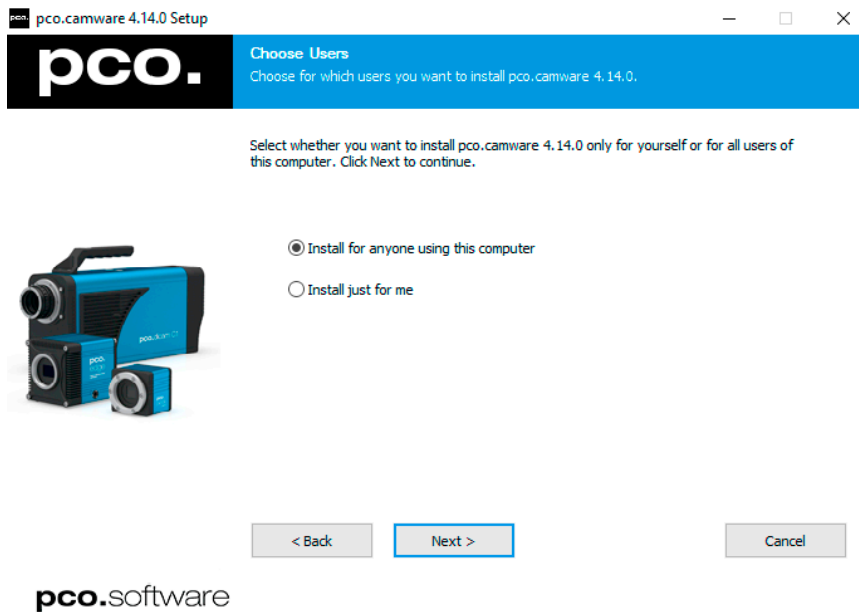
- 1 Download the installation files from our [website](#).
- 2 Start the installer.



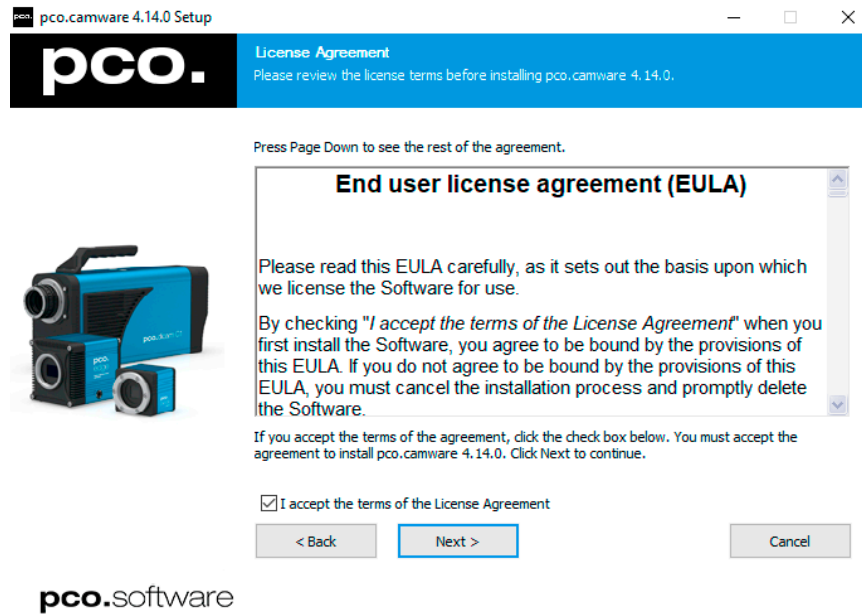
- 3 Follow the on-screen instructions and select the options as described below.



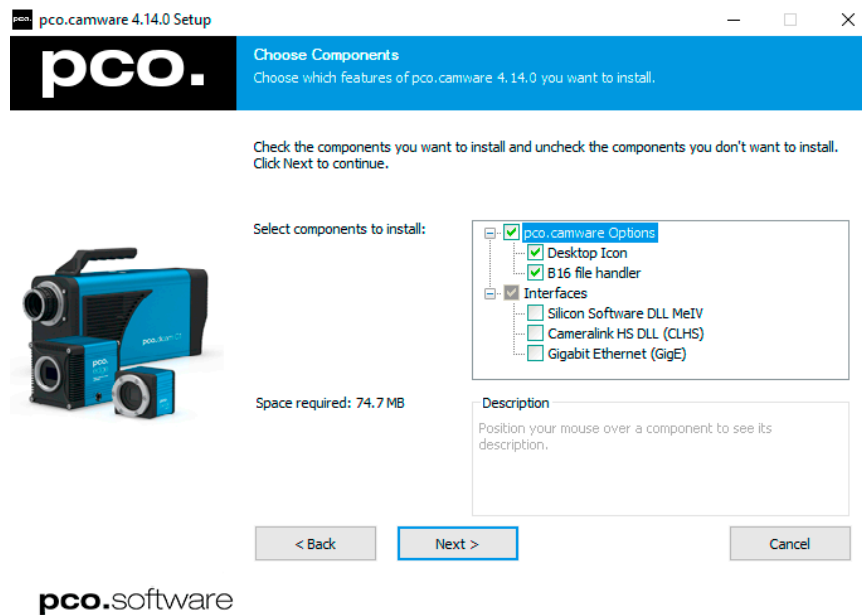
- 4 Choose **Install for anyone using this computer** to install in the program folder; otherwise it is installed in the user folder and available only to the current user.



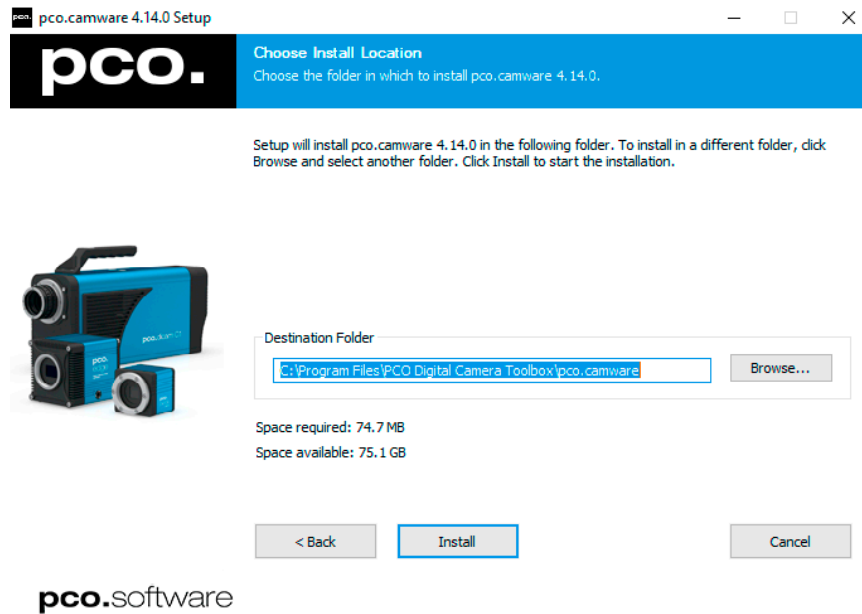
5 Accept the License Agreement.



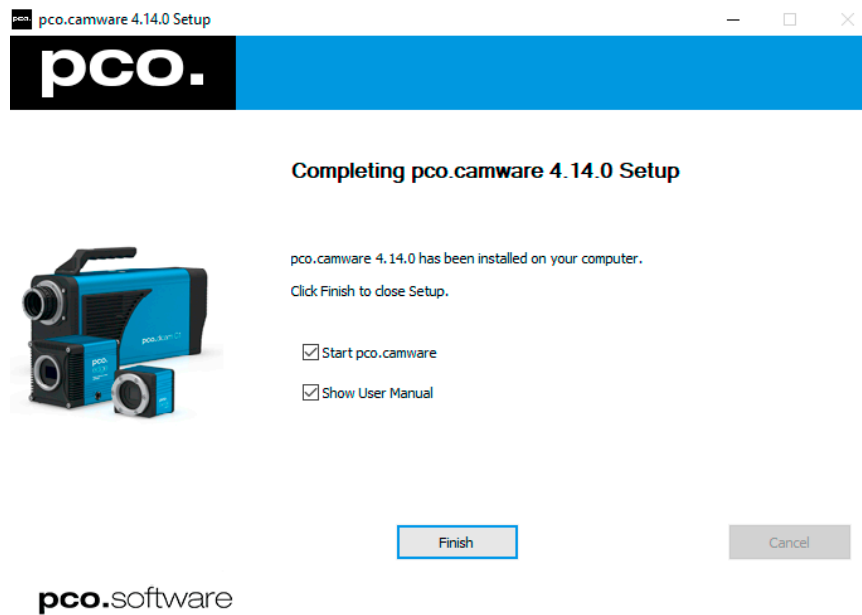
6 Select additional drivers **Silicon Software DLL MeIV** for the Camera Link interface or **Camera Link HS DLL CLHS** for the Camera Link HS interface. For USB and USB3, the driver must be installed separately.



- 7 Accept the default destination folder. Change it only if absolutely necessary.



- 8 Click **Finish** to complete the installation and start pco.camware.



After successful installation, the program folder PCO Digital Camera Toolbox is created in the installation directory and a PCO desktop icon is added.

To uninstall pco.camware, use the standard software uninstallation function provided by the Windows operating system.

2 Quick Start Guide



For your first images, choose a compatible lens and an object that is visible under normal light conditions as well as easy to focus on.

Required setup

Your computer:

- has the latest version of [pco.camware](https://www.pco.com) and
- the latest version of the correct [PCO driver](#) installed,
- (and is, if provided, equipped with an [interface card](#)).

Your camera:

- is connected to the computer and
- is powered by the provided power supply and power cable.

The diagram illustrates the 7 steps for setting up pco.camware and starting a live preview:

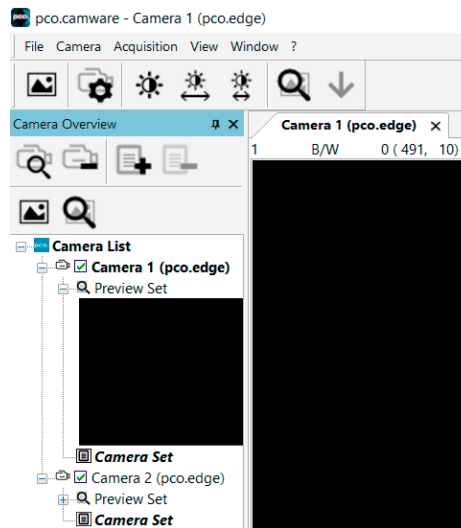
- 1** Switch on your camera. (Arrow points to the power button on the camera unit.)
- 2** Start [pco.camware](https://www.pco.com). (Arrow points to the pco.camware logo.)
- 3** Start **Live Preview**. (Arrow points to the 'Live Preview' button in the Camera List panel.)
- 4** Right-click, check **Continuous Auto Range**. (Arrow points to the 'Continuous Auto Range' checkbox in the context menu.)
- 5** If necessary, adjust the **Exposure** time. (Arrow points to the 'Exposure [ms]' field in the Camera Properties panel.)
- 6** Check the image, use your lens or adapter to set the aperture and focus. (Arrow points to the live preview image.)
- 7** Once the object is in focus, end **Live Preview** and click **Record**. (Arrow points to the 'Record' button in the Recorder panel.)



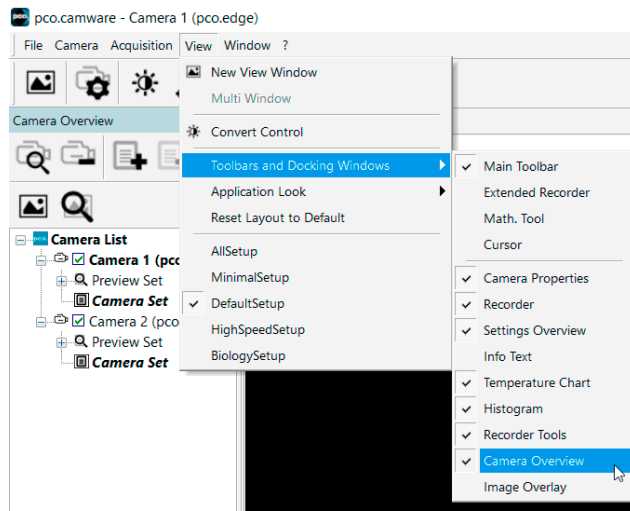
3 pco.camware software

3.1 Camera Overview

The **Camera Overview** window displays the **Camera List** of connected PCO cameras and serves as the central interface for organizing and switching between camera configurations for single- and multi-camera operation.



If the window is closed, open it via **View -> Toolbars and Docking Windows -> Camera Overview**.



Icons

Use **Scan cameras** to detect cameras or **Close camera** to close the active camera.

Add set creates a new **Camera Set**, while **Delete set** removes the selected one.

New View Window opens an additional view window.

Start **Live Preview** to adjust aperture and focus and obtain an initial view of the object.

Camera List

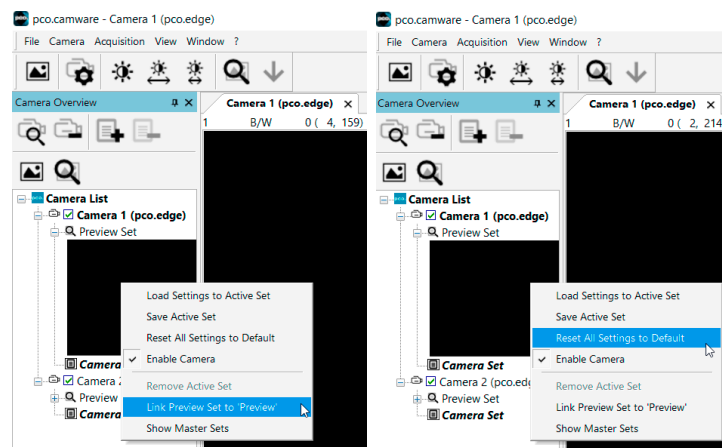
Connected cameras are listed with a number and their camera type. Each camera is automatically assigned a **Preview Set** and a **Camera Set**, which are based on the current configuration in the **Camera Properties** window (see 3.2).

The **Preview Set** defines the camera configuration applied whenever **Live Preview** is started, provided that **Link Preview Set to 'Preview'** is enabled. Its settings can be adjusted in the Camera Properties window.

Clicking the plus icon displays a small monochrome preview image.

A **Camera Set** stores the current Camera Properties configuration. Multiple Camera Sets can be created for each camera (up to 30 sets per camera) using **Add set**, renamed by clicking the set name, and copied to other cameras by drag-and-drop. The active Camera Set can be switched at any time (except during recording).

Right-click context menu



Load Settings to Active Set / Save Active Set

Camera Sets can be loaded from and saved to .ini files.

Reset All Camera Settings to Default

Resets all settings in the registry to their default values.

Enable Camera

Enables or disables the selected camera; disabling requires at least one other enabled camera.

Remove Active Set

Permanently deletes the active Camera Set. This action cannot be undone unless the set has been saved externally.

Link Preview Set to 'Preview'

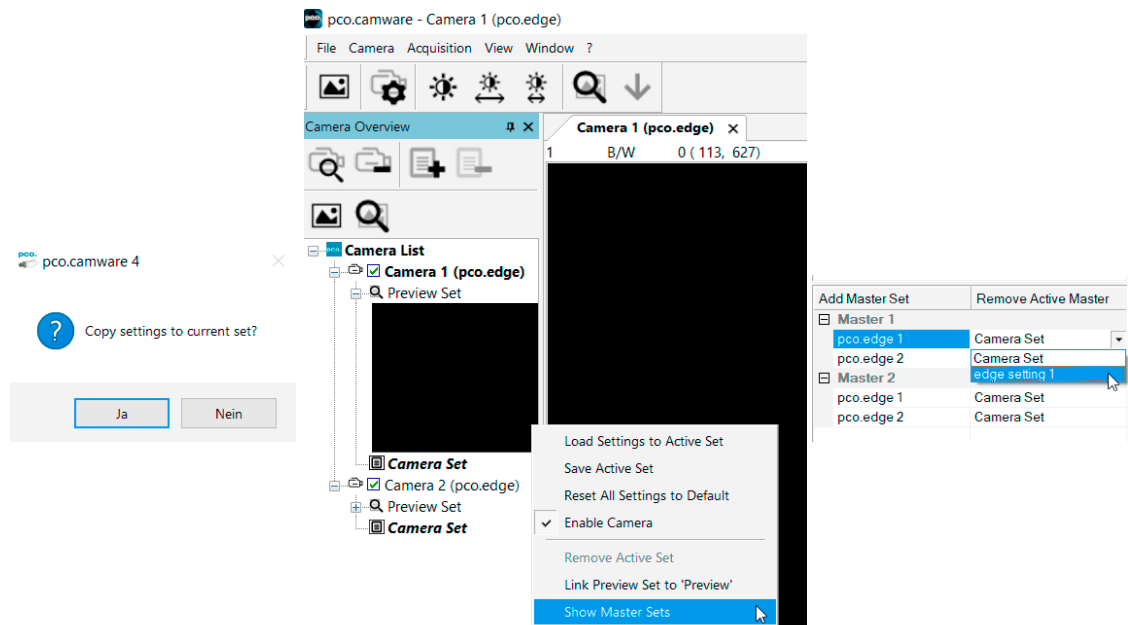
When this option is enabled, **Live Preview** uses the parameters defined in the **Preview Set**. If it is disabled, Live Preview displays live images using the parameters of the active **Camera Set**.

For example, linking the Preview Set is useful when preview and recording lighting conditions differ and require different exposure times.



Show Master Sets

Master Sets are intended for multi-camera setups to control which **Camera Set** is active for each camera. A Master Set groups one Camera Set per connected camera and applies them together. Activating a Master Set switches all cameras simultaneously to the predefined Camera Sets, allowing quick changes between complete multi-camera configurations. Master Sets can be added and removed as required. A Master Set becomes active when it is selected.



3.2 Camera Properties

The **Camera Properties** window replaces the former **Camera Control** dialog, which remains accessible under **File -> Options -> View Properties -> Show Camera Control**.

The **Camera Properties** window is the main interface for all camera settings. The active Camera Set selected in the **Camera List** (see 3.1) is configured here. Only properties supported by the selected camera are displayed, while properties that are not available for that camera are hidden. When a Camera Property is clicked, a brief description is displayed at the bottom of the window.

The Camera Properties window offers four modes: **Basic**, **Custom**, **Expert**, and **MyCustomSetup**. All modes display general camera information such as camera type, name, serial number, and status. Basic, Custom, and Expert are selectable in the user interface and differ in the properties shown, while MyCustomSetup is configured separately.



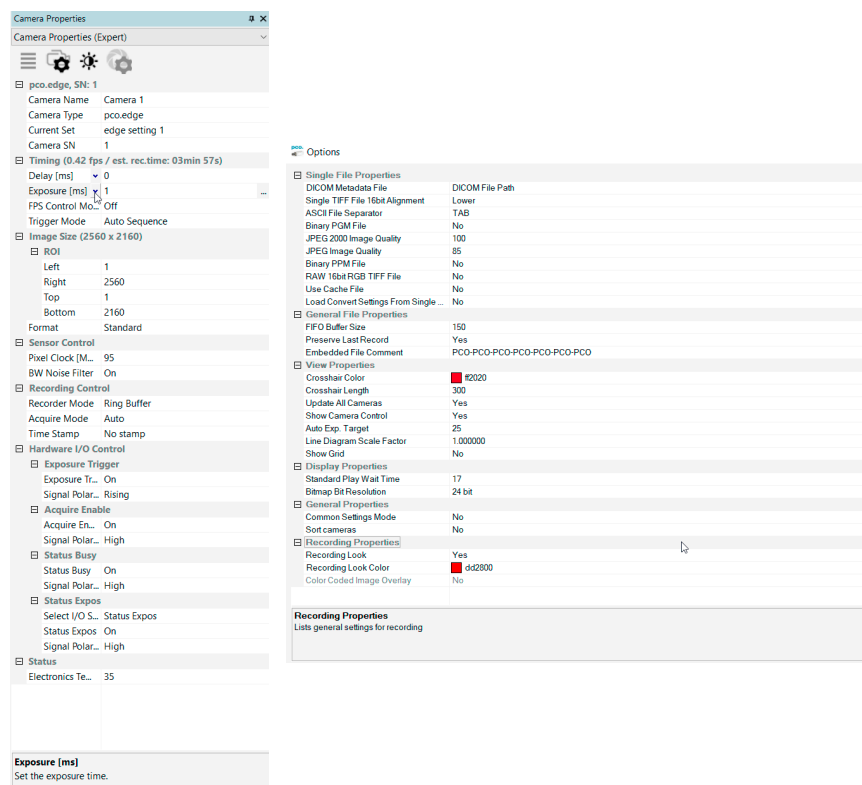
Basic provides access to commonly used camera properties for standard operation and is recommended for beginners.

Custom allows users to select which Camera Properties are shown, providing a configurable view tailored to individual requirements. It is suitable for users who want access to specific properties without showing all available settings. The list of properties can be accessed via the **Custom Properties** icon.

Expert provides access to all available Camera Properties. It is intended for advanced users who require detailed control over camera configuration.

MyCustomSetup allows advanced users to create a custom configuration using a registry file (.reg). The setup must be created before this mode becomes selectable. Instructions for creating and editing the required files are provided in C:\ProgramData\pco:

- CustomSettingMode.txt contains instructions on how to use the .reg file.
- CustomSettingMode.reg can be edited with a regular text editor.



Common Settings Mode



This feature is available only when multiple cameras of the same type are active.

In this mode, camera properties can be handled collectively rather than individually per camera. This simplifies configuration in multi-camera setups by reducing repetitive parameter adjustments across cameras.

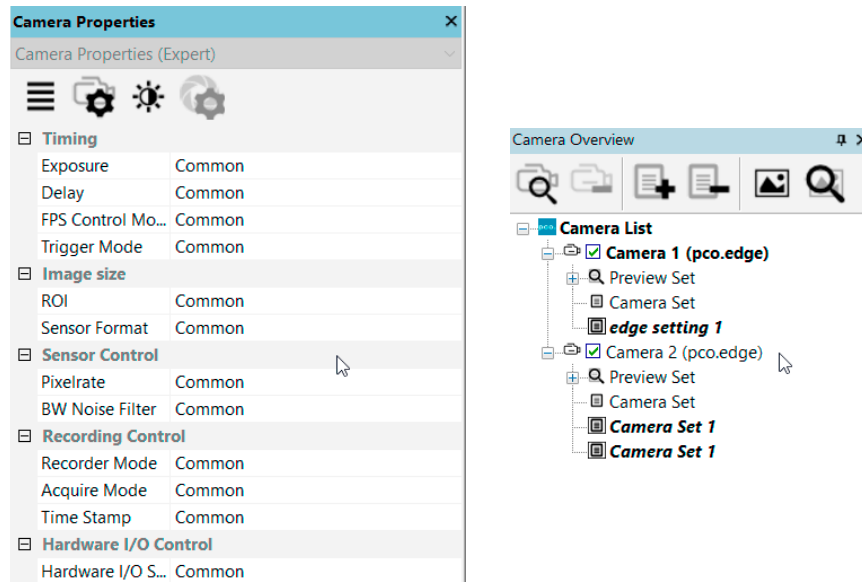
Enable **Common Settings Mode** under **File -> Options -> General Properties** by setting it to **Yes**.

When enabled, selecting the menu icon (with four horizontal lines) in the **Camera Properties** window displays the **Common Properties** view. When **Camera Properties (Custom)** is selected, the view can be switched between **Common** and **Custom**.



Camera Properties are classified as either **Common**, applying to all cameras, or **Individual**, remaining camera-specific. Common properties are defined for Camera 1 and then applied automatically to all active cameras. For all other cameras, only properties marked as **Individual** are displayed; all common properties are hidden.

Common Settings Mode also affects **Camera Sets**: when a Camera Set is created, edited, and activated, the configuration is duplicated across all cameras.



3.2.1 Camera Information

The upper section of the Camera Properties window shows a read-only overview of the selected camera, including the **Camera Name**, **Camera Type**, **Current Set**, **Camera SN**, and **Firmware Version**.

3.2.2 Timing

The **Timing** information displayed in the user interface shows timing values calculated from the current exposure, readout, and delay settings. Depending on the selected **Trigger Mode**, either the frame rate (fps) and estimated recording time or the maximum achievable frame rate is displayed.

The frame rate is an essential parameter of a camera. The maximum achievable frame rate is determined by the exposure time and the sensor readout time. The readout time is determined by the sensor design and line timing, where the line time defines the time required to read out a single sensor line. Depending on the selected settings and the camera architecture, either the readout process or the exposure time limits the achievable frame rate. For short exposure times, the sensor readout is typically the limiting factor, whereas for longer exposure times the exposure duration becomes the limiting factor.

Lower frame rates can be achieved by inserting additional delay times between exposures. This also applies to external triggering.

Some camera sensors allow exposure and readout to overlap in time, which can increase the achievable frame rate. Even in this case, the effective frame rate is determined by the longer of the exposure time and the readout time.

The diagrams below illustrate this behavior for a sensor architecture with exposure while readout.

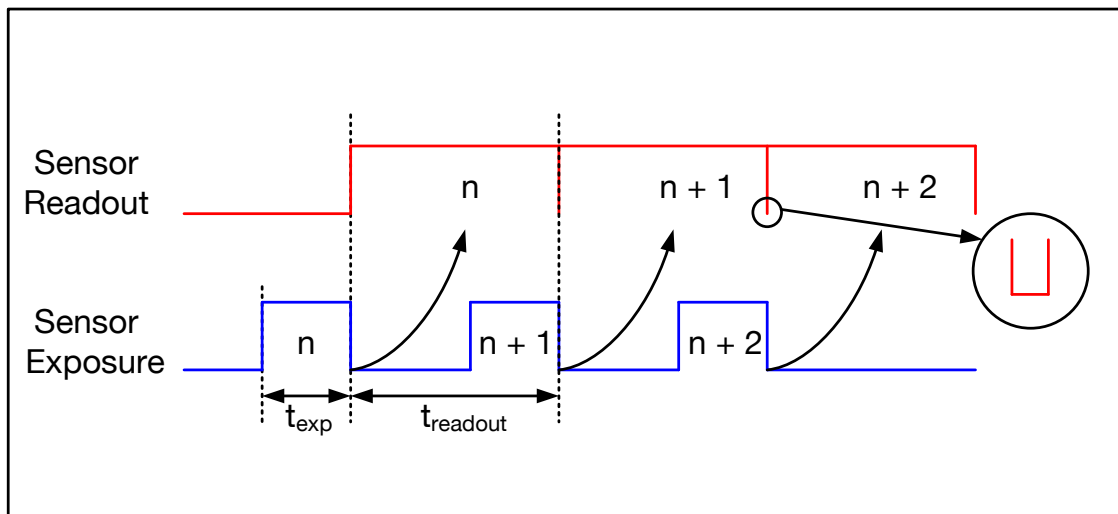


Figure 3.1: Readout-limited frame rate at short exposure times (example with exposure while readout)

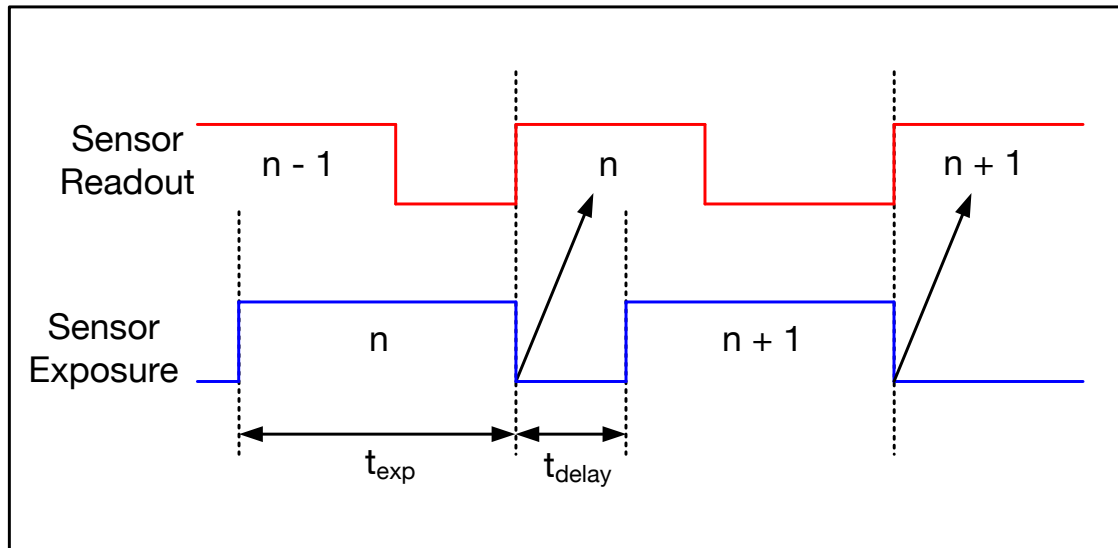


Figure 3.2: Exposure-limited frame rate at long exposure times (example with exposure while readout)

The selected region of interest (ROI) may affect the sensor readout time and thus may influence the maximum achievable frame rate (see [3.2.3](#)).

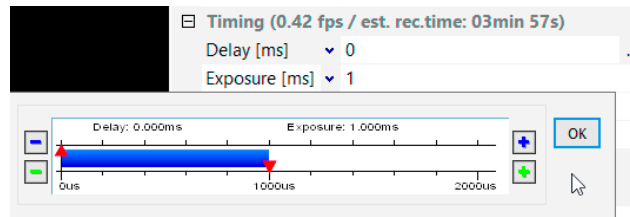
Exposure and Delay

The **Exposure** and **Delay** times can be precisely set in camera-specific steps. The effective step size depends on internal camera constraints (usually in ns) and on the selected time base. If a value outside the supported range of the camera is entered, it is automatically adjusted to the nearest valid setting.

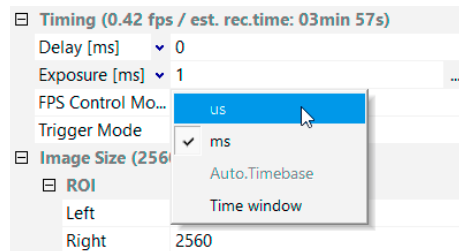
For line scan cameras, these settings apply to a single line.

Values can be entered directly in the fields, adjusted stepwise using the up and down arrow controls, or modified via sliders that appear when clicking the arrow icons.

As an alternative, selecting **Time Window** opens a dialog for configuring the Exposure and Delay times.

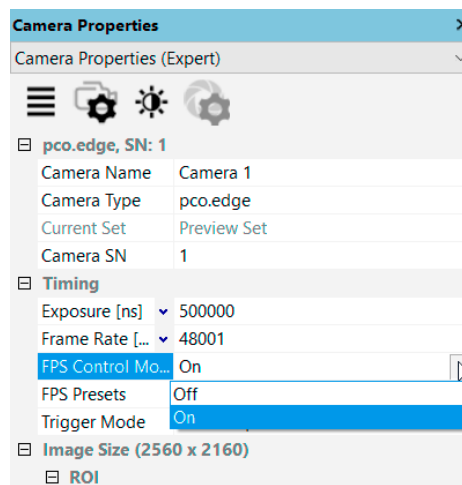


The time base can be changed using the ... control when **Auto. Timebase** is disabled, which can be done in the same menu.



FPS Control Mode

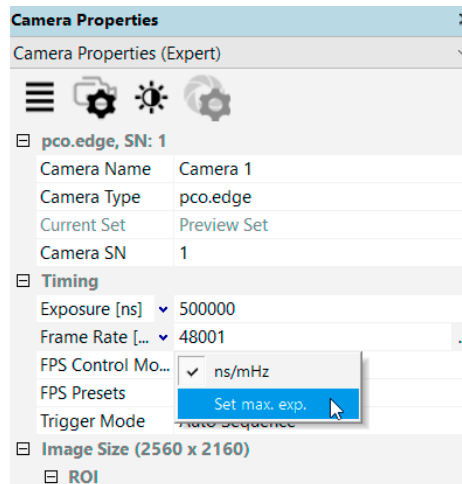
When this mode is enabled, the **Frame Rate [fps]** is set directly and the camera adjusts the image acquisition to achieve the selected frame rate. If the selected frame rate cannot be achieved because image readout takes too long, the frame rate is automatically reduced to the maximum frame rate supported by the camera.



Once the effective frame rate is determined, the exposure time is limited accordingly. At the selected frame rate, the exposure time cannot exceed the frame period ($1 / \text{fps}$). If a longer exposure time is selected, it is automatically reduced to the maximum value that still allows the selected frame rate.

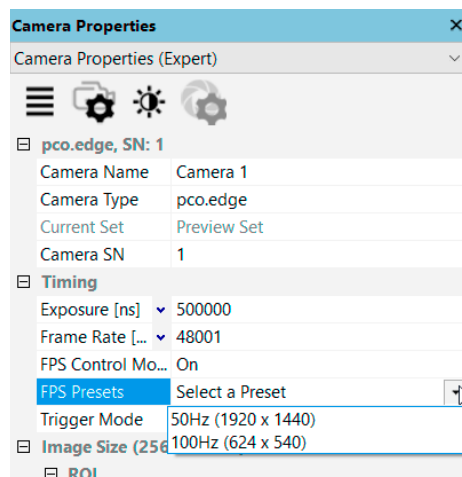
Selecting **Set max. exp.** automatically sets the exposure time to this maximum value for the selected frame rate.





FPS Presets

This setting allows predefined combinations of frame rate and resolution to be selected. The available presets depend on the camera model.



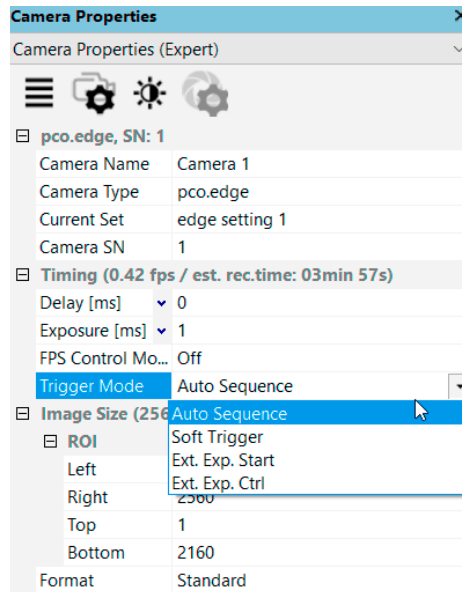
Line Scanning Mode

When enabled, **Line Scanning Mode** replaces the **Exposure** and **Delay** time settings with **Line Time**, **Exposure Lines**, and **Delay Lines**. This allows exposure and delay to be defined more precisely in relation to the sensor readout.

Trigger Mode

This setting refers to an exposure trigger and defines when individual exposures (light integration) occur during image acquisition.

Depending on the selected trigger mode, images can be acquired continuously, by software triggering, or by external trigger signals. Exposures are generated only while the recording state is active, which is controlled via the **Record/Stop** control in the **Recorder Tools** window (see [3.4](#)).



Auto Sequence acquires images continuously. Based on the configured exposure time and the time required for sensor readout, the camera determines the maximum achievable frame rate and optimizes image acquisition accordingly.

Image acquisition starts when the **Record** button is pressed and continues until it is stopped using the same control.

Soft Trigger acquires single images.

A single image is recorded by clicking the **Trigger** button, which becomes available after pressing the **Record** button.

Ext. Exp. Start records single images triggered by a signal edge at the input connector (see [3.2.7](#)). The frequency of the external signal determines the frame rate. The Soft Trigger function can also be used in this mode.

After entering the recording state with the **Record** button, a single image is recorded for each accepted trigger signal. The **Status Busy** signal at the output connector indicates whether a new trigger can be accepted.

Depending on the camera model, the maximum achievable frame rate in Ext. Exp. Start may be lower than in Auto Sequence mode.

If the frequency of the external trigger signal is too close to the maximum achievable frame rate, trigger acceptance is not guaranteed and individual trigger events may be ignored.

If the external trigger frequency exceeds the maximum achievable frame rate, trigger events are accepted at a reduced rate to match the camera's capabilities, and excess trigger events are ignored.

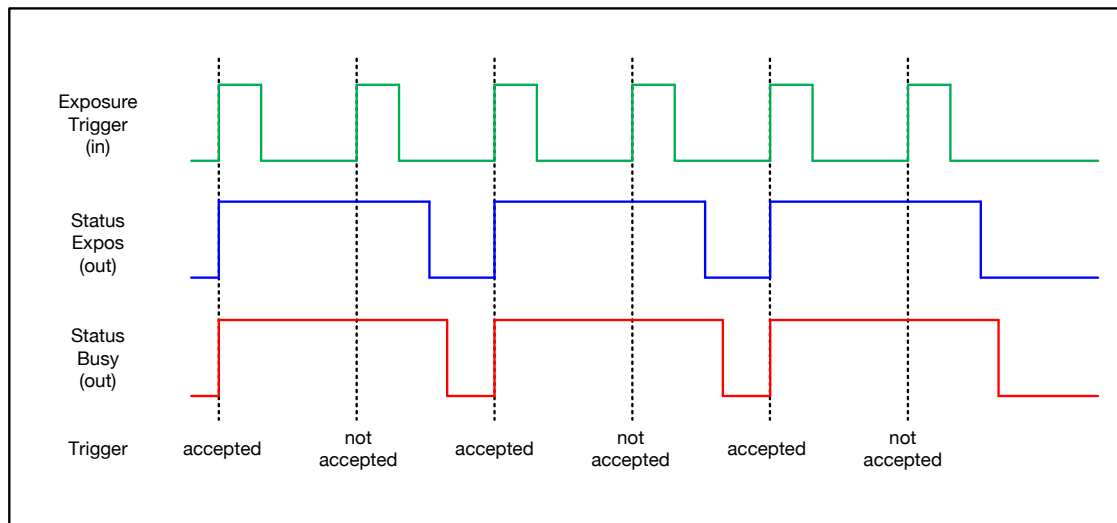


Figure 3.3: Trigger acceptance behavior in Ext. Exp. Start (accepted and ignored trigger edges)

Ext. Exp. Ctrl initiates the exposure of a single image on a signal edge at the input connector and ends the exposure upon detection of the opposite signal edge. In this mode, both the start and the duration of the exposure are controlled by the external signal. Accordingly, no additional timing settings are available, as the image timing is fully determined by the external trigger signal.

After entering the recording state with the **Record** button, a single image is recorded for each accepted trigger signal. The **Status Busy** signal at the output connector indicates whether a new trigger can be accepted.

The camera has a maximum supported exposure time. In Ext. Exp. Ctrl, the exposure is automatically stopped when this limit is reached.

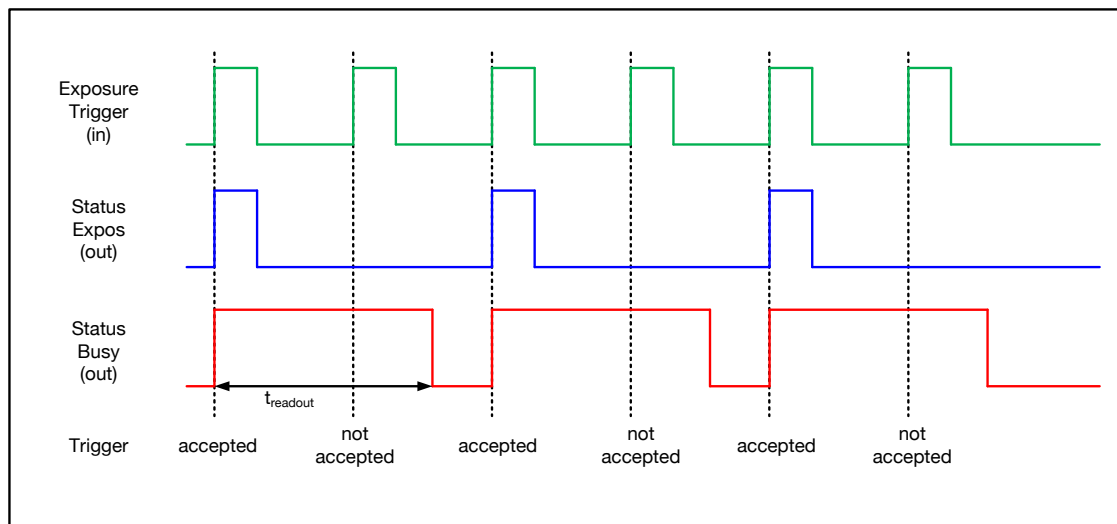
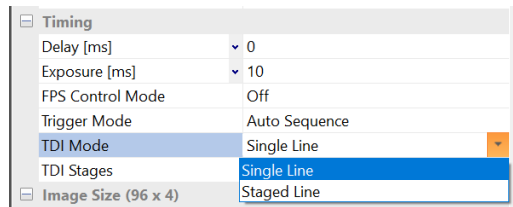


Figure 3.4: Trigger acceptance behavior in Ext. Exp. Ctrl (accepted and ignored trigger edges)

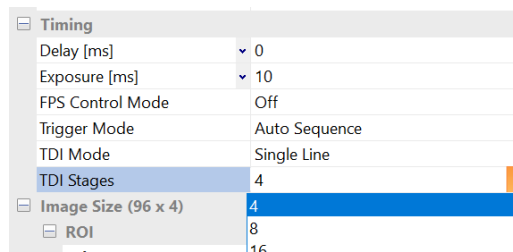
TDI Mode and TDI Stages

These settings are for cameras that support Time Delay Integration (TDI).

In **Single Line** mode, the configured **Exposure** time apply to a single TDI stage. In **Staged Line** mode, the configured times represent the total exposure for one line over all TDI stages.



Selects the number of TDI stages used for image acquisition. Increasing the number of stages increases the total integration time and the accumulated signal.



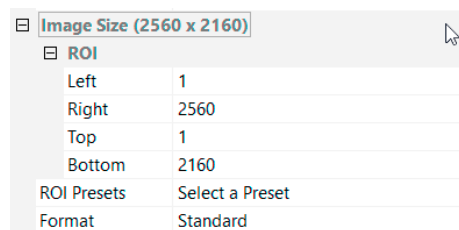
3.2.3 Image Size

The **Image Size** information displays the current image resolution, which is defined by the selected Region of Interest (ROI) and binning settings.

Region of Interest

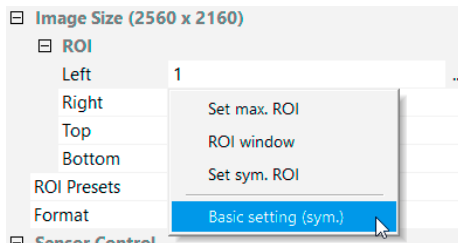
The Region of Interest (**ROI**) specifies the area of the image sensor that is read out. Reducing the ROI decreases the amount of image data and can increase the achievable frame rate.

It is defined by horizontal (**Left, Right**) and vertical (**Top, Bottom**) limits, specified in pixels. ROI values are limited to camera-specific step sizes and are automatically adjusted to a valid setting.

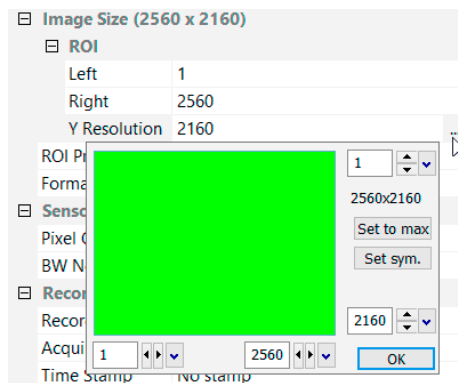


Depending on the camera model, the ROI may need to be set symmetrically. The software provides options to force a symmetrical ROI or to automatically set the maximum supported ROI.





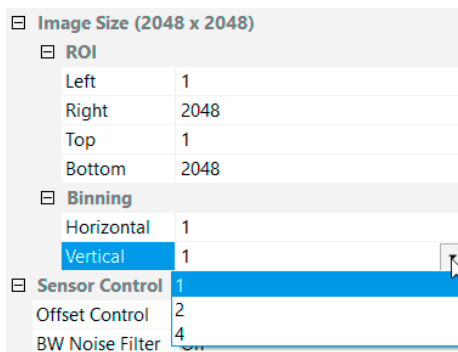
As an alternative, the ROI can be adjusted graphically using the **ROI window**, where the desired region can be defined directly within the image display.



Binning

In this process, adjacent pixels are combined to form super pixels. Increasing the binning factor combines the signal of multiple pixels and can improve the signal-to-noise ratio (SNR), while reducing the spatial resolution of the image.

Binning can be applied independently in the horizontal and vertical directions. Depending on the camera model, options for **Sum** and **Average** binning may be available. If no option is provided, sum binning is used.



Format

This setting changes the sensor format (resolution), allowing selection between **Standard**, **Ext.** (extended), and **Alternative** formats.

In the standard format, only effective image pixels are read out. The extended format may include additional sensor pixels beyond the standard image area, such as dark or reference pixels. The alternative format provides an alternative predefined resolution, typically smaller than the standard format.



3.2.4 Sensor Control

The **Sensor Control** section includes sensor-specific parameters that influence sensor operation, such as readout speed and signal processing.

Pixel Clock [MHz]

This setting sets the sensor readout speed. A higher pixel clock enables higher achievable frame rates, while a lower pixel clock may reduce image noise.

Sensor Control	
Pixel Clock [M...	95
BW Noise Filter	On

Offset Control

To ensure a stable image baseline, **Offset Control** compensates the sensor's dark signal (offset) and its drift over time.

In **Auto** mode (default), the offset is adjusted automatically to account for changes in exposure time and sensor conditions. **Offset Control** can be deactivated if a fixed offset is required.

Sensor Control	
Offset Control	Auto

Note The offset is recalculated when the exposure time or other **Camera Properties** settings are changed during the recording state. Restarting recording without changing any settings does not trigger recalculation.

BW Noise Filter

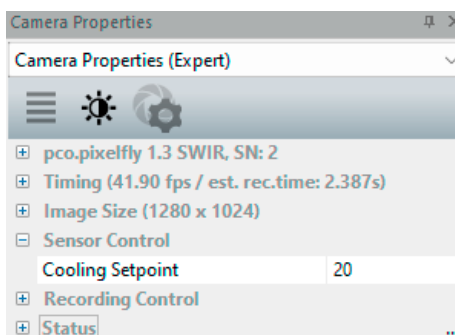
In addition to camera calibration processing, a dynamic noise filter is enabled to remove blinkers and high-noise pixels. If unexpected aliasing effects occur, turn off this filter.

Sensor Control	
Pixel Clock [M...	95
BW Noise Filter	On

Cooling Setpoint

This setting defines the target temperature of the image sensor. The selected temperature may influence the noise performance of the camera, as it is calibrated at a specific sensor temperature.

Depending on the cooling system, it may take several minutes after startup to reach the set temperature.



Double Image

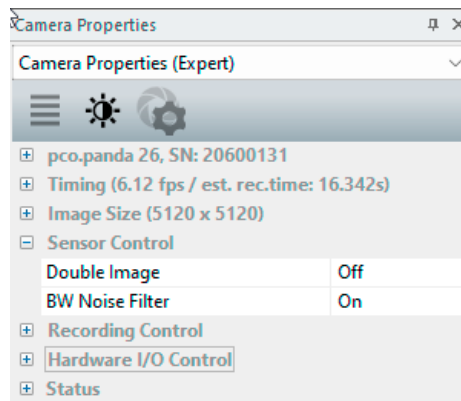
This feature is used to turn on alternative modes, such as particle image velocimetry (PIV) measurements or double shutter.

The first exposure time t_{e1} may be any exposure time of the available range of the PCO camera. The second exposure time t_{e2} cannot be directly adjusted. The length of the second exposure is the readout time of the first image. The interframing time t_{if} denotes the transition time between end of exposure #1 and start of exposure #2.

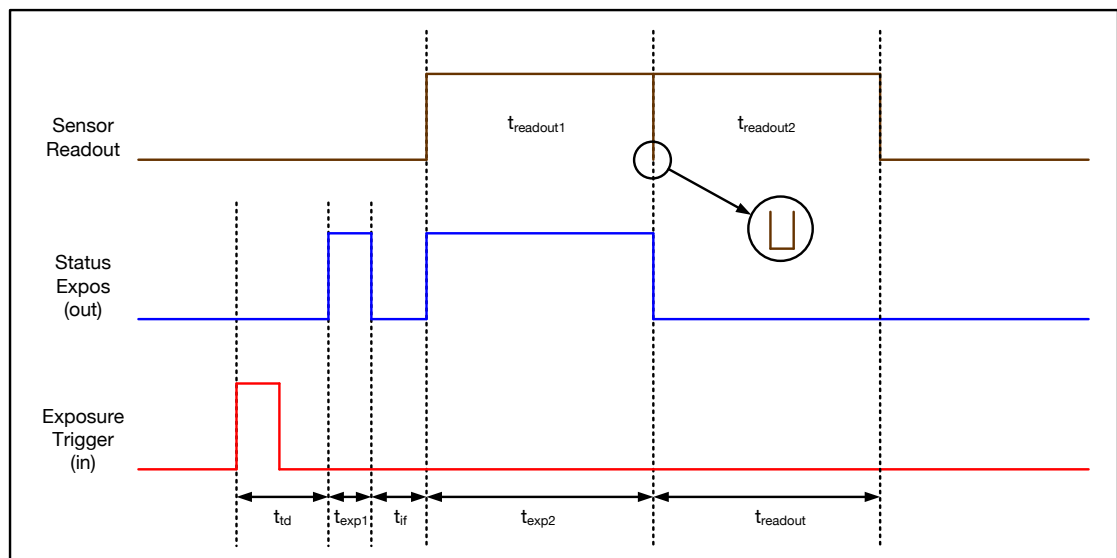
As can be seen the maximum frame rate of the double image mode (where frame rate is defined as the frequency of the double images) will drop to just half the value compared to the standard mode.

The double image mode will work only in the trigger modes **Auto Sequence** and **Ext. Exp. Start**.

Note To achieve a blur free second image the environment should be kept dark and the exposure duration of the second image determined by a flash light.



Example timing diagram for **Trigger Mode Auto Sequence**:



t_{exp1} : exposure 1	t_{exp2} : exposure 2
t_{td} : delay time	t_{id} : intrinsic delay
t_{if} : interframing time	$t_{readout}$: readout time

CDI mode

The correlated double image (CDI) mode records images with increased dynamic range and a 30% better performance on low signal side images (at the expense of half of the usual frame rate, because double images are acquired).

The min. exposure time is calculated as follows: $t_{exp} = \frac{1}{2 * f_{CDI}}$

t_{exp} : min. exposure time	f_{CDI} : max. frame rate
--------------------------------	-----------------------------

Example:

resolution = 1920 x 1080 pixel; $f_{CDI} = 1067$ fps -> $t_{exp} = 467 \mu s$

In this case t_{exp} is both, minimum and maximum exposure time. To increase t_{exp} decrease frame rate or resolution.

Conversion Factor

The conversion factor describes the relationship between collected charge and the resulting digital signal value. It indicates how many electrons correspond to one digital intensity level. This setting is used to switch between available gain modes, such as high-gain, low-gain, or low-light mode.

3.2.5 Memory



This section is only available for cameras with internal memory (RAM).

The RAM is divided into four segments. Three segments can be used to store images, while the fourth segment is reserved for internal operations.

Memory (max. Images 690)	
Active RAM Se...	1
RAM Segment 1	690
RAM Segment 2	0
RAM Segment 3	0

Images can be distributed across the three available recording segments. The number of images assigned to each segment can be configured individually. The software displays the maximum number of images that can be stored based on the available RAM and the selected ROI.

Images are recorded to the segment selected in **Active RAM Segment**.



3.2.6 Recording Control

This section contains settings related to image acquisition and recording.

Recording Control	
Recorder Mode	Ring Buffer
Acquire Mode	Auto
Time Stamp	No stamp

Recorder Mode

The **Recorder Mode** determines the recording behavior.

Sequence records images until the configured image count is reached or storage is full. For cameras with internal memory, the active RAM segment is used for image storage. Cameras without internal memory use available system RAM for recording. For longer recording periods, use a suitable RAID system or the **Direct Record to File** option (see [3.8.2](#)).

Ring Buffer records continuously until stopped by overwriting the oldest images once the configured image count is reached.

The image count is configured in the **Memory Allocation Dialog** (see [3.8.4](#)). The maximum allocatable image count depends on the available memory.

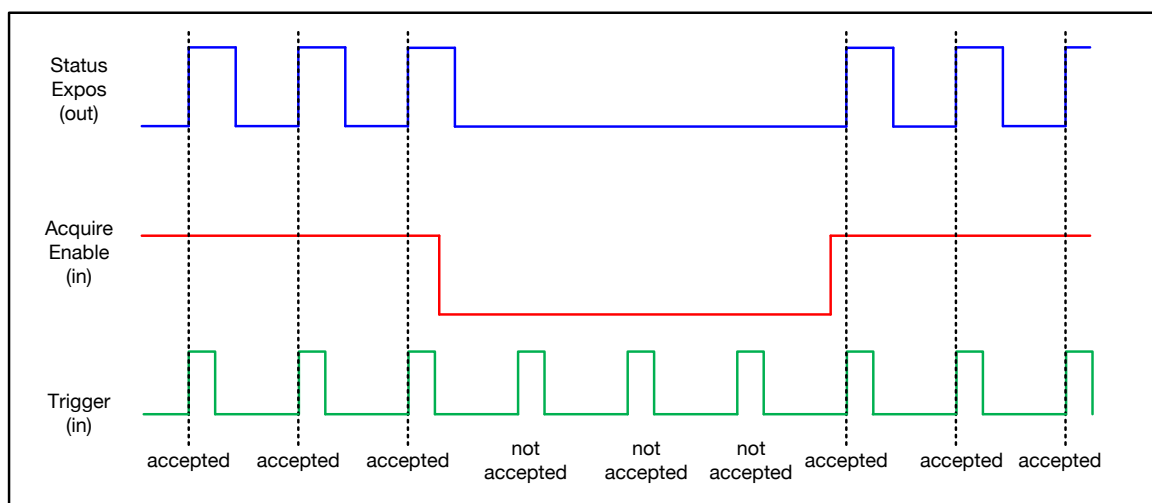
Acquire Mode

The **Acquire Mode** provides additional control of image acquisition using an external signal. For signal configuration, refer to the Hardware IO Control section (see [3.2.7](#)).

In **Auto** mode, this external signal is ignored.

In **External** mode, the external signal acts as a gate that defines the time window during which image acquisition is possible. It is level-controlled and image acquisition is enabled at one signal level and disabled at the other (depending on the signal polarity), following the selected **Trigger Mode**.

Example An illumination source generates a signal connected to the acquire enable input. While the illumination is on (signal level high), image acquisition is enabled. When the illumination is off (signal level low), image acquisition is disabled.



In **Sequence Trigger** mode, each valid signal edge starts an acquisition sequence according to the selected **Trigger Mode**. The sequence length is defined by **Number of Images**, which is available only

in this mode. Once a sequence is completed, the system waits for the next valid signal edge to start a new sequence until recording is stopped.

Recording Control	
Recorder Mode	Ring Buffer
Acquire Mode	Sequence Trigger
Number of Images	0
Time Stamp	Binary+ASCII

Time Stamp

This setting determines how time stamp information is stored with recorded images.

A time stamp can be embedded in the upper-left corner of the image. The time resolution of the time stamp is 1 μ s. The time stamp represents the end of the exposure. Each time stamp contains an image number, the date, and the time.



No Stamp stores no time stamp information.

In **Binary**, the first 16 pixels of the image contain the time stamp information encoded as binary data. The time stamp values are encoded in BCD (Binary-Coded Decimal). Each pixel stores 1 byte: 2 BCD digits $\times$ 4 bits = 8 bits. If the pixel depth exceeds 8 bits, the BCD-encoded byte is right-aligned within the pixel value, and the unused upper bits are set to zero.

For further details, refer to the [pco.sdk manual](#).

ASCII writes the time stamp as text directly into the image, replacing the image content in a region of 271×8 pixels.

Binary+ASCII combines both the binary and ASCII time stamp representations.

Sequence Trigger Mode

The **Sequence Trigger Mode** uses a T0 trigger event to stop recording and is typically used with **Ring Buffer** mode. When enabled, **Acquire Mode** is hidden. The additional settings **Images before T0** and **Delay Images after T0** specify the number of images recorded before and after the trigger event.

3.2.7 Hardware IO Control

The available **Hardware I/O Control** options depend on the camera model. This section is used to configure the external signals used for triggering, acquisition control, and status outputs.



Hardware I/O Control	
Exposure Trigger	
Exposure Trigger	On
Signal Polarity	Rising
Acquire Enable	
Acquire Enable	On
Signal Polarity	High
Status Busy	
Select I/O Signal	Low
Status Busy	On
Signal Polarity	High
Status Expos	
Select I/O Signal	Status Expos
Signal Timing	Show time of 'First Line'
Status Expos	On
Signal Polarity	High

Settings are changed using the corresponding drop-down menus. Signals can be enabled or disabled, and their polarity can be configured. Additional configuration options may be available depending on the selected signal.

3.2.8 Fan / LED Control

This section is used to configure the camera fan and LEDs.

Fan / LED Control	
Automatic Fan Control	On
Fan Speed [%]	50
Camera LED	On

Fan / LED Control	
Automatic Fan Control	Off
Fan Speed [%]	50
Camera LED	On

Automatic Fan Control

This is enabled by default. When set to **On**, the fan speed is controlled automatically. When set to **Off**, the fan speed can be adjusted manually using **Fan Speed**.



NOTICE: When **Automatic Fan Control** is disabled, the selected fan speed must provide sufficient cooling. Setting the fan speed too low or switching it off may cause the camera to overheat and result in damage.

Camera LED

Switch LEDs **On** or **Off**.

3.2.9 Status

Displays the temperatures of various camera components.

Status	
Electronics Temperature	29
Sensor Temperature	20.5
Power Supply Temperature	29

Electronics Temperature

Shows the current FPGA temperature.

Sensor Temperature

Shows the current sensor temperature.

Power Supply Temperature

Shows the current temperature of the internal power supply.



NOTICE: If a temperature exceeds the permitted operating range, a warning is displayed. Ensure adequate cooling and avoid exposing the camera to direct sunlight or other heat sources.



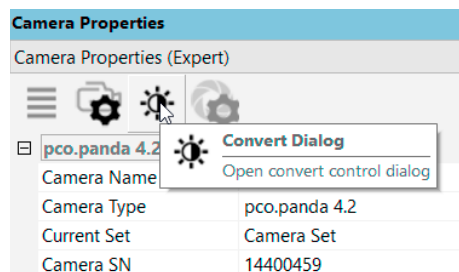
There is also a **Temperature Chart** window that displays these temperatures graphically over time that can be shown or hidden via **View** → **Toolbars and Docking Windows** → **Temperature Chart**.

3.2.10 Convert Control dialog

The **Convert Control Dialog** is used to adjust the display of image data. The original image intensity values are converted to 8-bit display values according to the settings selected here.

Depending on the connected camera, the dialog is displayed as **Convert Control BW** (monochrome cameras) or **Convert Control Color** (color cameras).

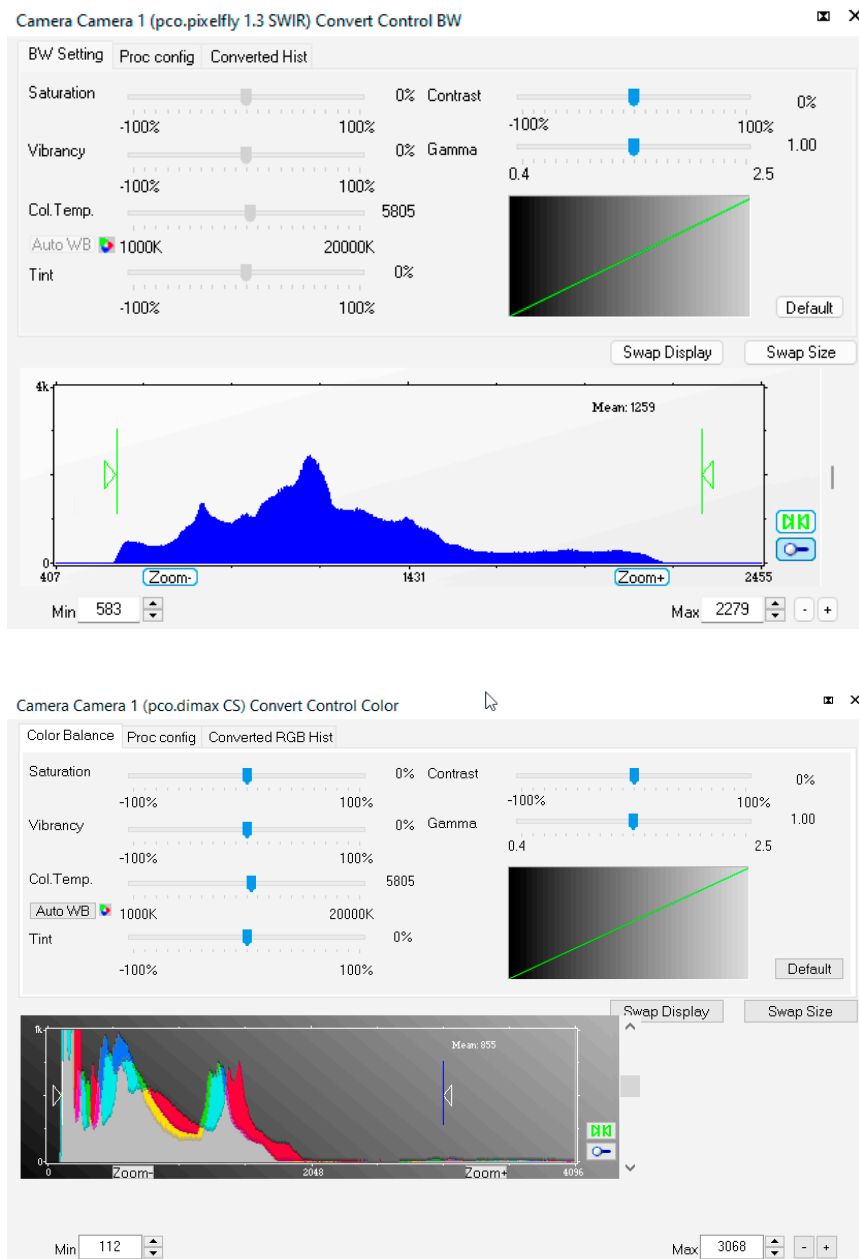
Open the **Convert Control Dialog** with the **Convert Control** icon in **Camera Properties** (or via **View** → **Convert Control**).

**BW Setting** tab or **Color Balance** tab

This tab is labeled according to the connected camera variant (monochrome or color). It contains controls for image display and conversion, including **Saturation**, **Vibrancy**, **Col. Temp.** (Color Temperature), **Tint**, **Contrast**, and **Gamma**. Color-specific settings are enabled for color cameras only.

Saturation and **Vibrancy** control color intensity. **Col. Temp.** and **Tint** control the color balance. **Auto WB** automatically adjusts the white balance.

The small graph visualizes how the current **Contrast** and **Gamma** settings affect the conversion of image intensity values for display.



Histogram (monochrome camera)

The histogram displays the distribution of the original image intensity values. The left and right sliders define the intensity range used for display. Image intensity values below the minimum are displayed as black, while values above the maximum are displayed as white.

In large view, the histogram is available in all three tabs.

Swap Display toggles between the selected tab view and the histogram of the original image data.

Swap Size toggles between a combined view showing both the selected tab and the histogram, and a single-view display.

Zoom- and **Zoom+** adjust the horizontal zoom level of the histogram. When zoomed in, the histogram can be panned horizontally to view different intensity ranges.

The vertical control on the right changes the vertical scale.



Histogram (color camera)

The histogram displays the distribution of the red, green, and blue image intensity values. The left and right sliders define the intensity range used for display. Color values below the minimum are displayed as 0, while values above the maximum are displayed as 255.

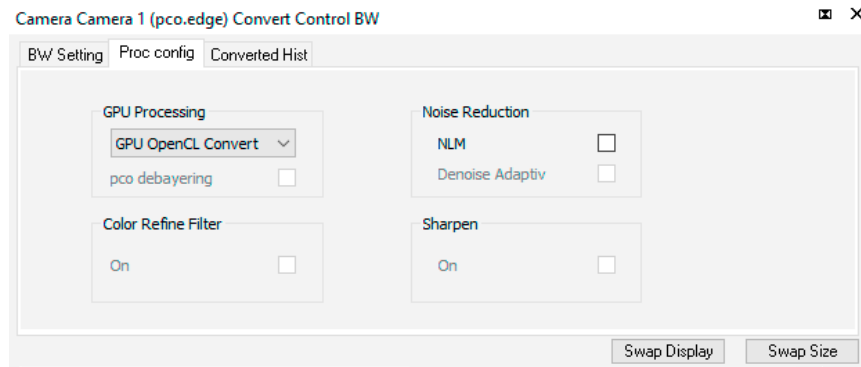
In large view, the histogram is available in all three tabs.

The available controls are the same as for the grayscale histogram.

Proc config tab

This tab contains image processing options such as GPU-based processing, noise reduction, color refinement, and image sharpening.

Depending on the camera model and configuration, not all options may be available.



GPU Processing

Selects the processing method used for image conversion. Depending on the system configuration, image conversion can be performed on the CPU, a compatible NVIDIA GPU, or a compatible OpenCL-capable GPU. GPU-based processing typically reduces image processing time compared to CPU-based processing.



If the NVIDIA-based GPU processing option is not available, ensure that a compatible NVIDIA graphics device is installed and that the NVIDIA driver is up to date.

pco debayering enables the pco debayering algorithm for Bayer-pattern color images. This option is available for color cameras only.

Color Refine Filter

Enables color refinement. This option is available for color cameras only.

Noise Reduction

Provides image noise reduction. **NLM** enables the Non-Local Means noise reduction algorithm, which reduces image noise while preserving image details. **Denoise Adaptive** enables adaptive image noise reduction. This option is available for color cameras only.

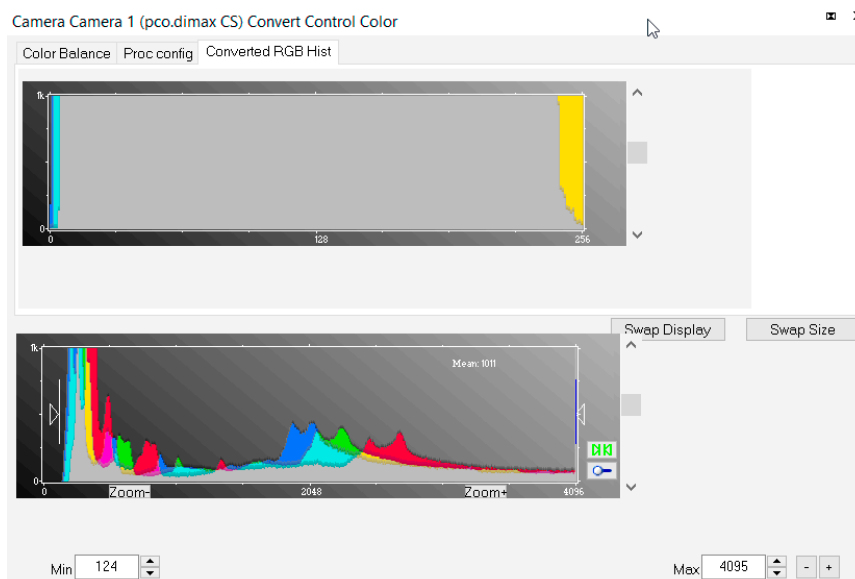
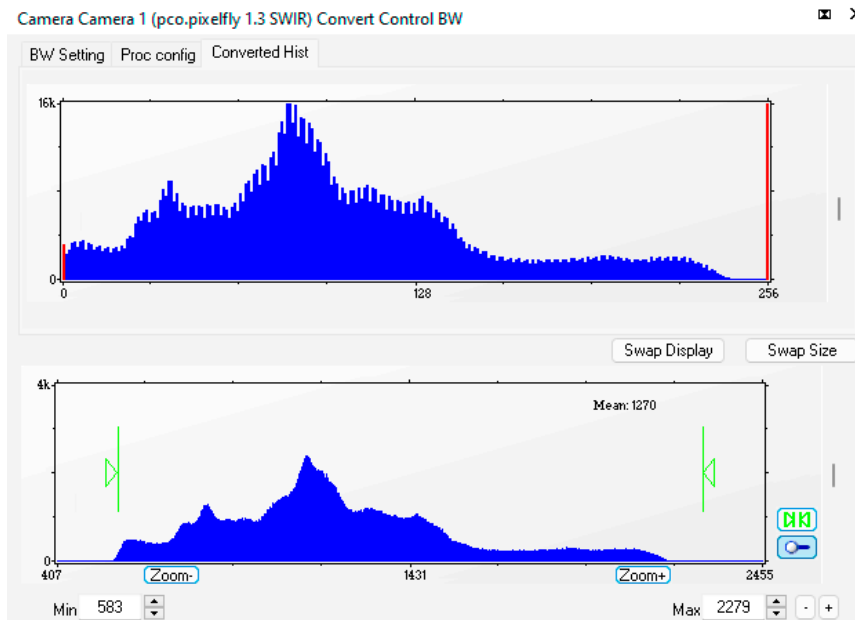
Sharpen

Enables image sharpening. This option is available for color cameras only and requires **pco debayering** to be enabled.



Converted Hist tab or **Convert RGB Hist** tab

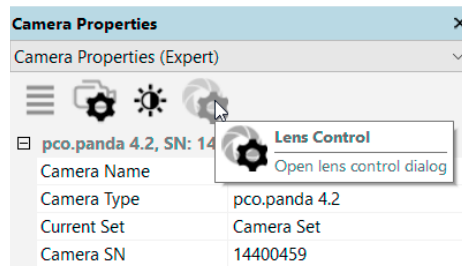
This tab is labeled according to the connected camera variant (monochrome or color). It displays the histogram of the resulting 8-bit display values, reflecting the current conversion settings. The control on the right side adjusts the vertical histogram scale.



3.2.11 Lens Control dialog

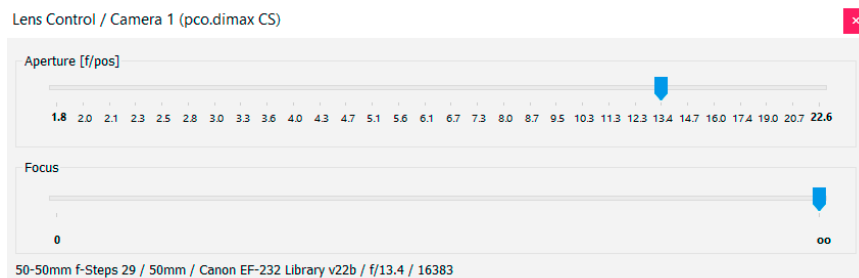
The **Lens Control** dialog shows information about the mounted EF lens and the current position of aperture and focus.





Aperture (f/pos) controls the aperture of the connected lens. All available aperture settings are listed.

Focus controls the focus position of the connected lens from 0 to infinity.



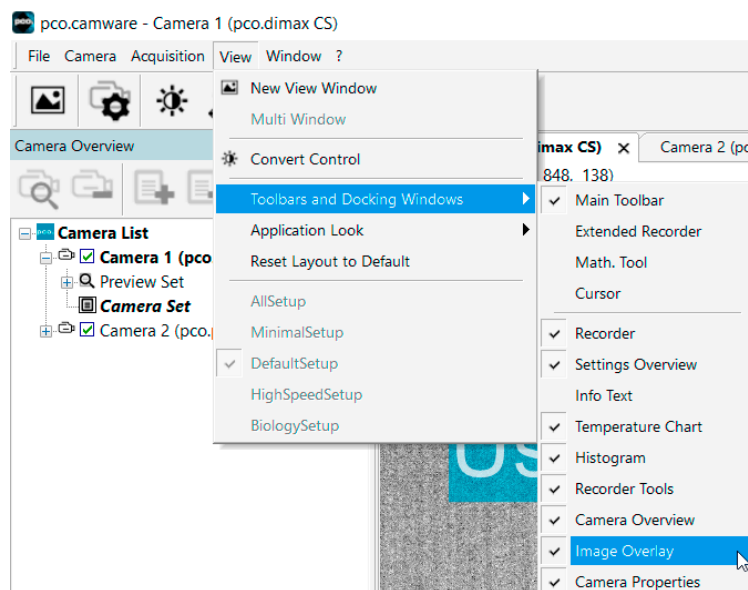
3.3 Image Overlay

The **Image Overlay** window is used to configure information displayed directly on the image.

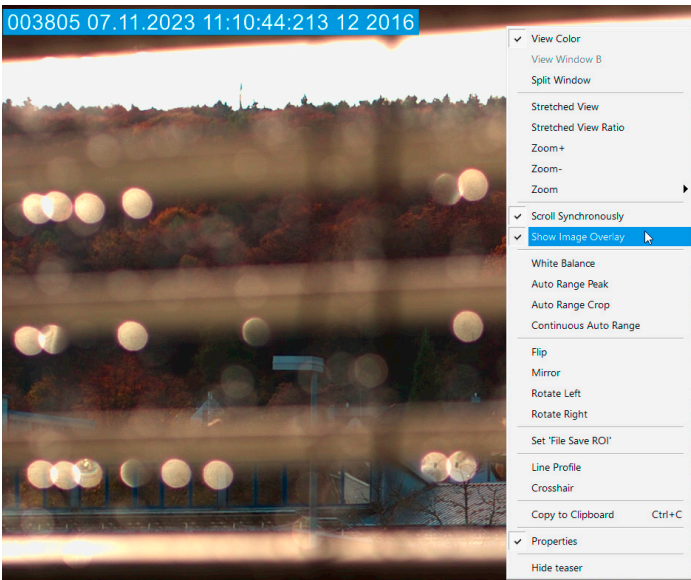


Image overlays do not modify recorded raw image data. They are applied only to the converted 8-bit display image.

It is available as a tab at the bottom of the **Camera Properties** window. If it is not, enable it via **View → Toolbars and Docking Windows → Image Overlay**.



To display the configured overlay, enable **Show Image Overlay** in the **View** window context menu. Drag & drop the **Image Overlay** to the desired position within an image.

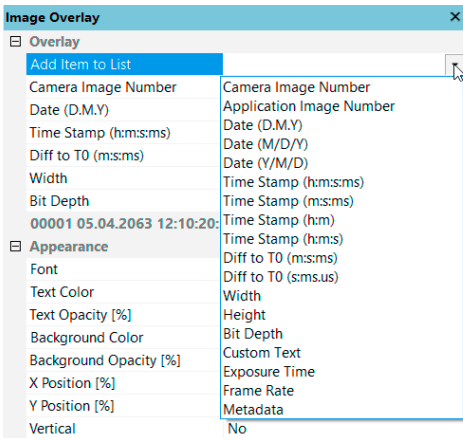


Overlay

This section is used to select information displayed on the image.

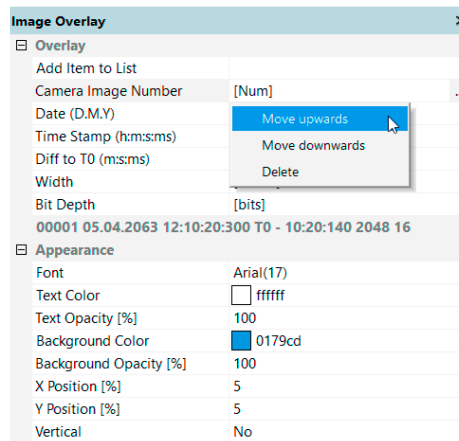
Add Item to List

Adds an overlay item. Available items include image numbers, date and time information, image dimensions, exposure information, frame rate, metadata, and custom text.



Camera Image Number and **Application Image Number** refer to different image numbering schemes. **Camera Image Number** is assigned by the camera and continues to increment even after older images are overwritten in **Ring Buffer** mode. **Application Image Number** is assigned by the application and starts at 1, resetting to 1 when the buffer is full.

Items can be reordered using **Move Upwards** and **Move Downwards** or by dragging and dropping, and removed using **Delete**.



Appearance

In this section, the appearance of the overlay can be configured, including font, colors, transparency, and position.

3.4 Recorder Tools

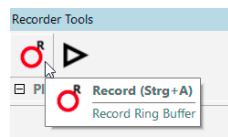
The **Recorder Tools** window provides controls for image recording and playback, as well as related settings and display options.

If it is not displayed, enable it via **View** → **Toolbars and Docking Windows** → **Recorder Tools**.

Record

Clicking the **Record** button puts the camera into the recording state. Image acquisition behavior depends on the settings selected in Camera Properties (see 3.2). During the recording state, the button changes to **Stop** and the user interface is highlighted in red.

The recording state can also be entered by pressing **Enter**.

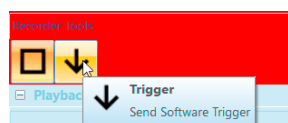


Stop

Available only during the recording state. Clicking **Stop** ends the recording state.

Trigger

Available only during the recording state. During the recording state, the **Playback** button changes to **Trigger**. Clicking **Trigger** issues a software trigger event.

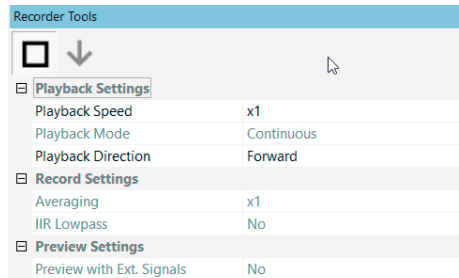


Playback

This button is available only when the camera is not in the recording state. Replays the last recorded image sequence using the selected playback settings.

Playback Settings

This section contains settings controlling image playback.

**Playback Speed**

Controls the playback speed. Available settings range from **1 fps** to **16 fps** and from **x1** to **x256**. At **x1**, all images are displayed as fast as possible. Higher x values accelerate playback by displaying only every x-th image. For fps settings, the selected number of images is displayed per second.

Playback Mode

Selects either **Single** or **Continuous** playback.

Playback Direction

Selects the playback direction (**Forward** or **Backward**).

Record Settings

This section contains settings that affect image acquisition and recording.

Averaging

Specifies the number of acquired images that are averaged to generate a single image. Available averaging factors range from **x1** to **x1024**.

IIR Lowpass

Enables image averaging using an Infinite impulse response (IIR) filter. For each image, 50% of the previously calculated image and 50% of the newly acquired image are combined, reducing image noise.

$$\text{Image (calculated)} = \{ \text{Image (calculated previously)} + \text{Image (new)} \} / 2$$

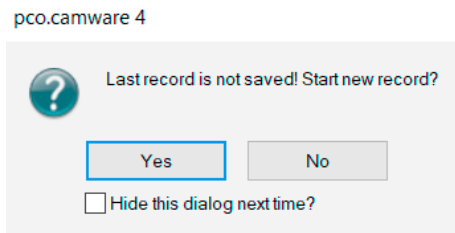
Preview Settings

If **Preview with Ext. Signals** is set to **Yes**: Trigger Mode **Ext. Exp. Start / Ext. Exp. Ctrl.** or **Acquire Mode External** are active during Live Preview, if the **Trigger Mode** or **Acquire Mode** is enabled in the **Preview** set.

Use this during **Live Preview** e.g. for external synchronization of a camera and an external light source.



Reminder Dialog



If you made a recording but did not save it yet, pco.camware will remind you to do it before starting a new one. If the dialog is deactivated, it can be reactivated via the file options menu [3.8.2](#).

Extended Recorder

Extended Recorder can be activated (see [3.8.5](#)).



Record / Stop record / **Play**.

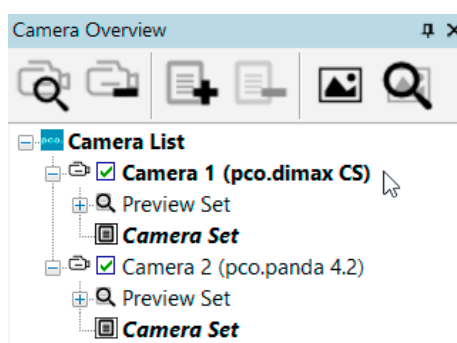
First Image (jump to first image) / **Fast Backward** (jump backward) / **Back** (jump one image backward).

Forward (jump one image forward) / **Fast Forward** (jump forward) / **Last Image** (jump to last image in record).

Recording with multiple cameras

With all cameras activated recording starts simultaneously on all of them.

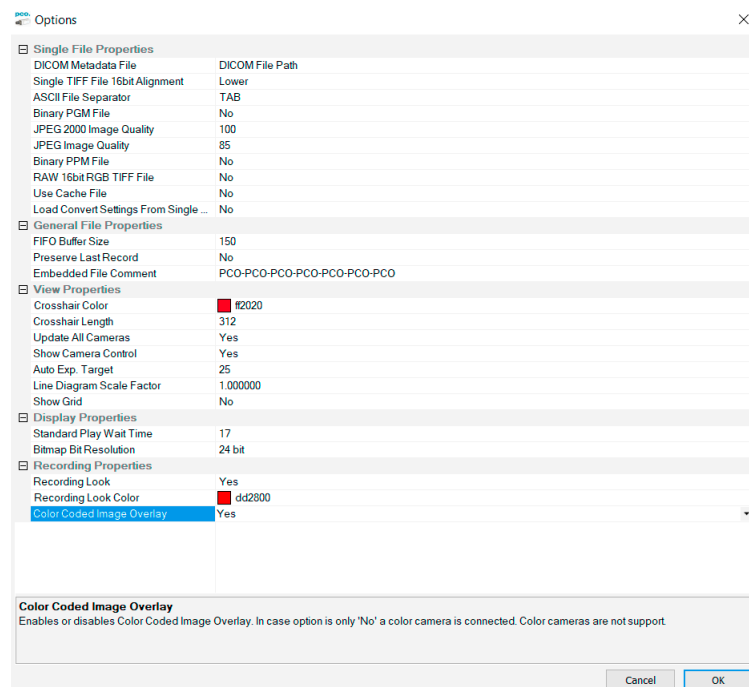
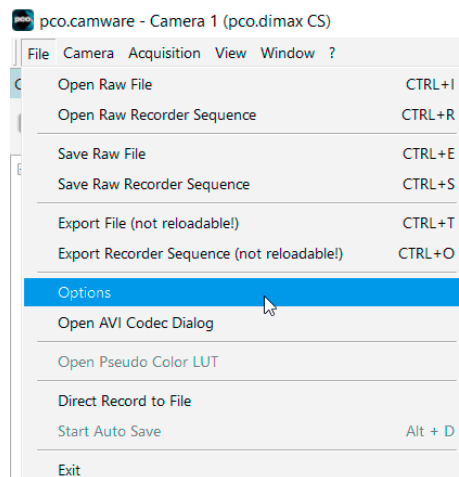
Recorder will use **Recorder Mode** settings (**Sequence** or **Ring Buffer**) of the selected camera for all cameras (see [3.2.6](#)).



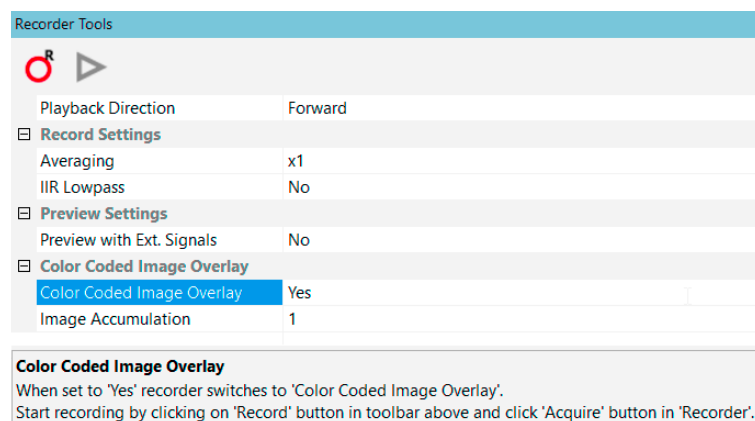
For single camera recording, deactivate cameras by removing the check mark from the box.

Color Coded Image Overlay

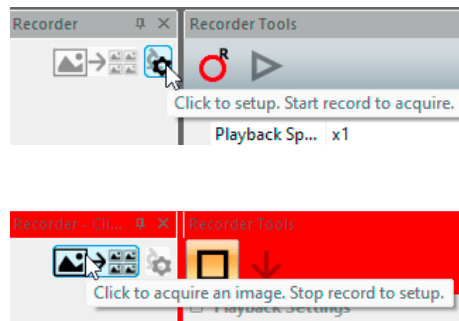
Set up and acquire a sequence of images that are overlayed to form a color composite. Enable Color Coded Image Overlay under **File -> Options -> Recording Properties**.



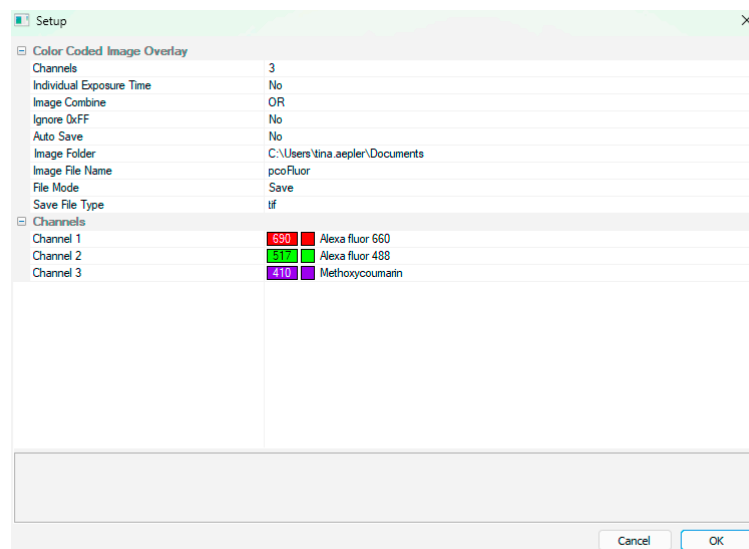
Now it can be activated in the **Recorder Tools** window.



The Recorder window will now have 2 additional buttons.



Click on the setup button to open the **Setup**.



Channels sets the number of images per sequence.

The + adds a fluorophore to the end of the list, the - deletes it.

Individual Exposure Time sets an individual exposure time for each image of the sequence (LUT min/max are always individual).

Image Combine sets the calculation method for the combining images.

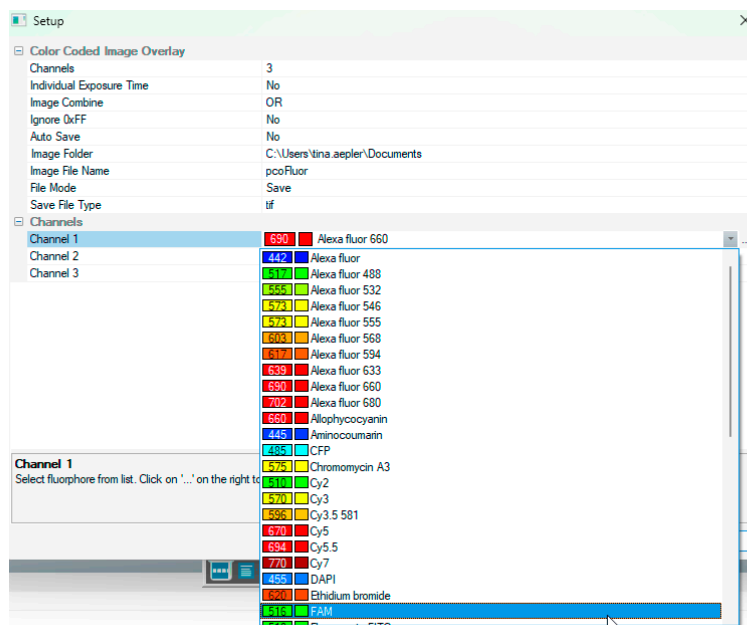
Auto Save enables the saving of images during the recording of the sequence.

Image Folder sets the file location, **Image File Name** sets the file name.

File Mode sets whether Save and/or Export should be used.

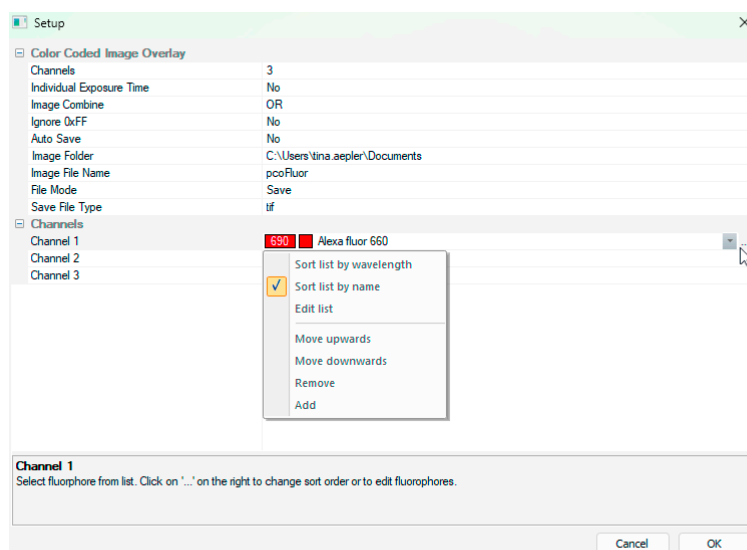
Save File Type and **Export File Type** set the respective file types.

You can select individual fluorophores for each channel from a predefined list by clicking on them in the **Channels** section.



You can change the order of channels: Click on the three dots at the end of the channel line and select **Move upwards** or **Move downwards**. You can also rearrange the channels via drag and drop.

Remove or add fluorophores in the sequence with **Remove** and **Add**.



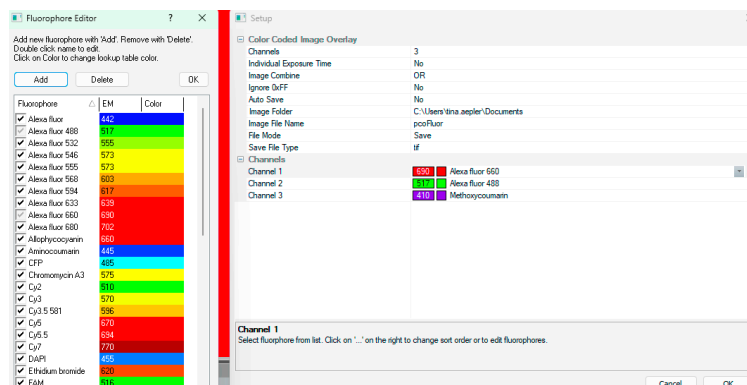
You can also edit the Fluorophore List with **Edit list**. This will open the **Fluorophore Editor**.

Use the header bar in the **Fluorophore Editor** to arrange the fluorophores either by name (**Fluorophore**) or wavelength (**EM**). You can edit the names of both the fluorophores and the wavelength EMs by double-clicking on the entry.

The arrow next to the column shows the sorting order.

Clicking on **Color** opens a color selection dialog.



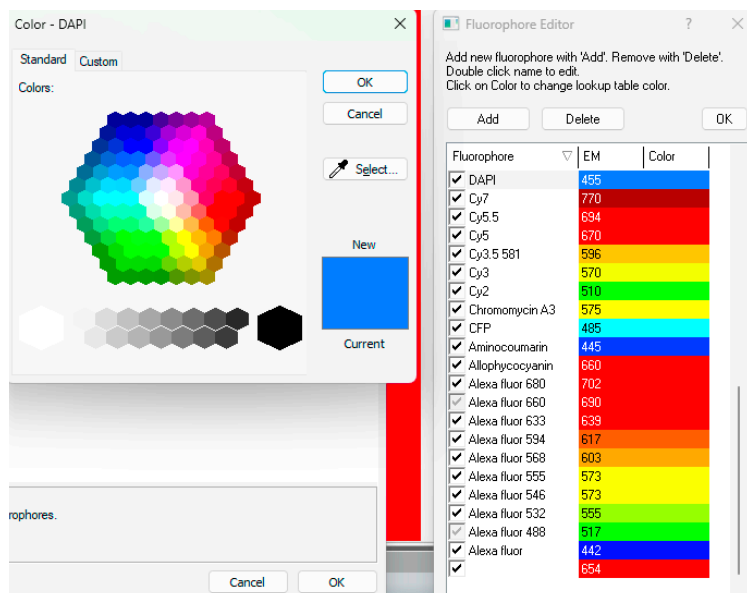


Click on **Add** to add fluorophores to the list and click on **Delete** to remove them.

The checkmark column at the far-left of the **Fluorophore Editor** sets whether the individual fluorophores can be selected in the drop-down list for the channel.

If a fluorophore has already been selected, it cannot be unchecked and will be grayed out.

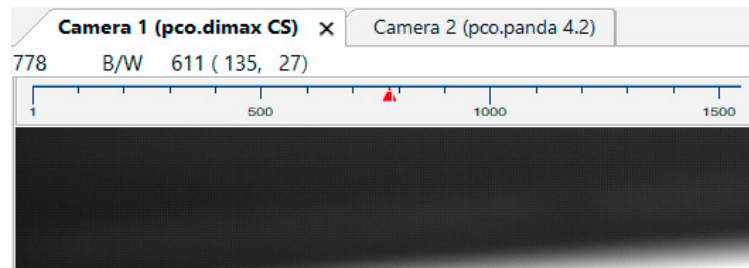
Multiple fluorophores can be selected at once by holding Shift while checking in the column.



3.5 View window

Quick Scrolling

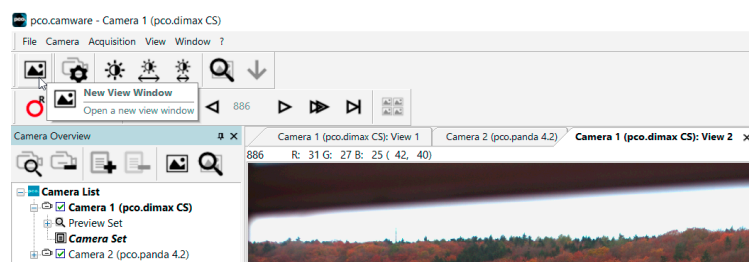
If at least 50 images have been recorded, you can scroll through them quickly by holding down the left mouse button on the image number. Alternatively, you can enter the desired image number directly into the number field or use the mouse wheel to scroll up or down.



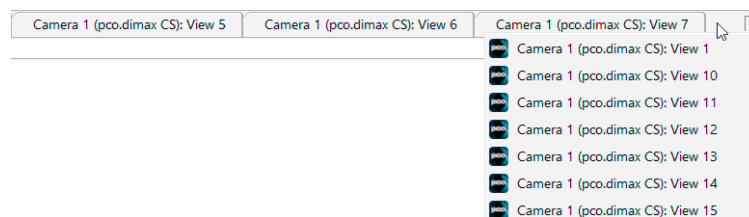
More View Windows

You may open more than one window for one camera: click View Window button and pco.camware will create a new one.

Even when multiple **View Windows** (or from multiple cameras) are open, the same image number is always shown in all of the **View Windows**.



A dropdown menu helps to select a **View Window**. If there are more **View Windows** than can be displayed on the desktop, you may select individual **View Windows**.



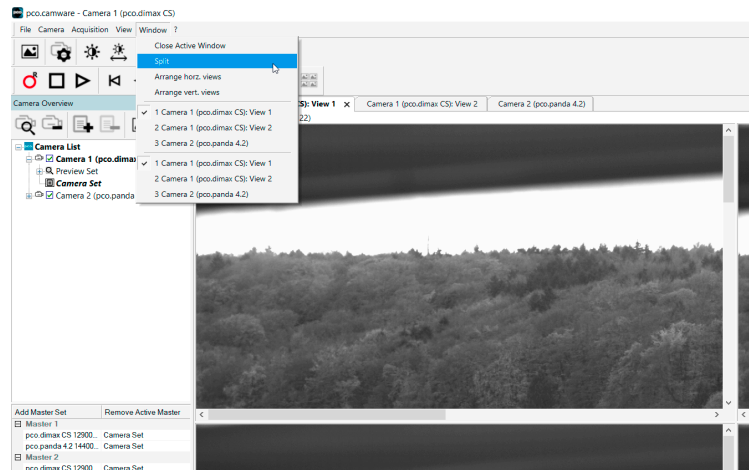
Split View Window

The View Window can be split. Click Window -> Split and a split cross is shown.

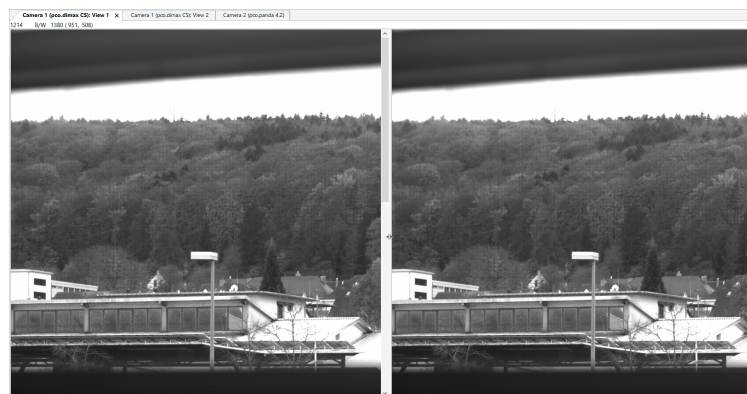
The size of split window elements is easily adjusted by grabbing and dragging the dividing lines.

The main reason for this function is to view four sections of the image in one view. Choose the **Zoom±** function to zoom in the image (first turn off **Stretched View** see [3.8.8](#)).



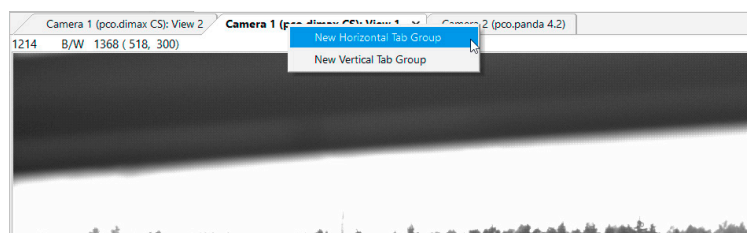


To undo the split, double click on the dividing line (after symbol is visible).



New Horizontal / Vertical Tab Group

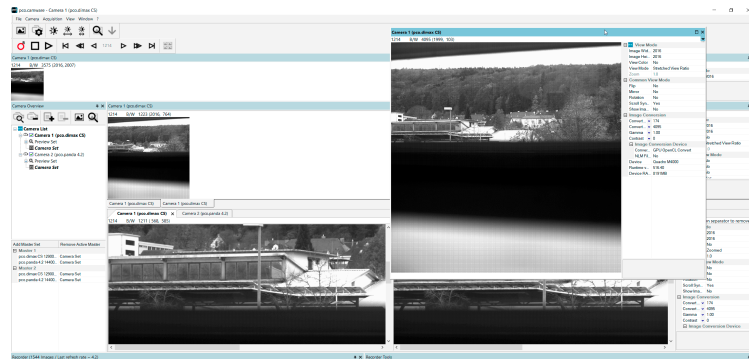
To view two tabs side by side or arranged one above the other just drag a tab and pco.camware will prompt to create a **New Horizontal / Vertical Tab Group**. Undo this by dragging the tab back to its former position. This also applies for **View Windows** of several cameras.



Place View Window

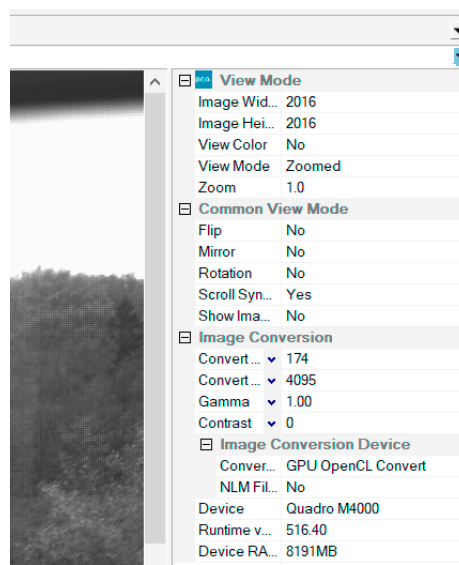
This function provides free positioning of one or more **View Windows**. Just drag the **View Window** by mouse and move it upwards to undock from the **View Window** tab bar. Now place it to a second monitor or dock it to the desired toolbar. Some example screen shots show the variety of options.





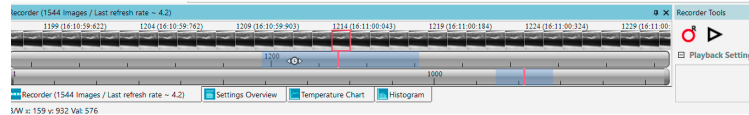
View Mode Properties

Click on the triangle button on the right-hand side of the view window to open or close the view mode properties.



3.6 Recorder (Images)

When recording is done, small preview images (thumbnails) are built and displayed automatically in the **Recorder (Images)** docking window.



This may take some time depending on the performance of your computer system and the interface used.

A green bar indicates the thumbnail download is in progress, and pco.camware is frozen during this download. The build process can be stopped by selecting **Stop Build Thumbnail** in the **Right-click Menu** (next page).

Clicking (left mouse button) within the upper scale bar, you can adjust the number of images shown by moving the mouse left or right. Minimum is 20 and maximum is half of the total recorded images.

Quick Scrolling

Scroll through the thumbnails by dragging the orange bar with the mouse or by mouse wheel while the cursor is over the image number bar.

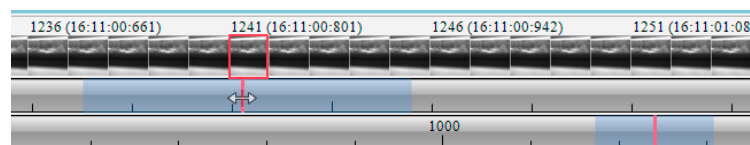
While quick scrolling, the **Preview Window** displays the active image sequence. This allows you to quickly scroll through the image sequence displaying the images in the **Preview Window** forwards or backwards. The **View Window** will not actively show live images during quick scrolling (only in normal scrolling speed by mouse-wheel).

Thumbnail Image

Clicking on a thumbnail image it will make it appear in the **View Window**. Scroll via mouse wheel through the thumbnails.

The upper blue bar refers to the number of displayed thumbnails. The lower blue bar shows the range of the upper scale in relation to the whole record.

The second scale shows the total number of recorded images. It allows fast scrolling through the images.



Right-Click Menu

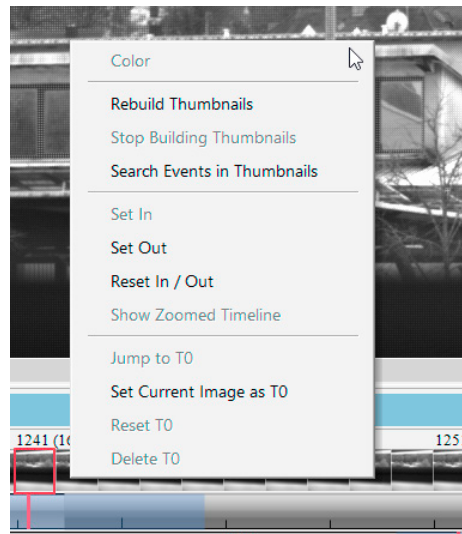
Right-click on thumbnails to open the menu. From this menu, you can rebuild all thumbnails and search for events.

Use **Set In / Out** to set values for a sequence that can be played via play button.

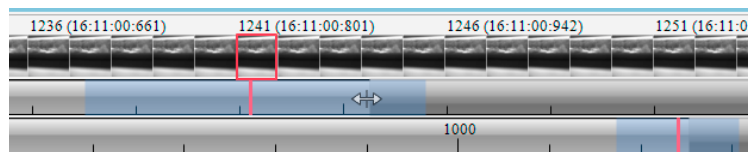
Reset In / Out discards these settings.

Set In / Out is active: if you save/export your images, only the selected ones are saved/exported (see [3.8.2](#)).

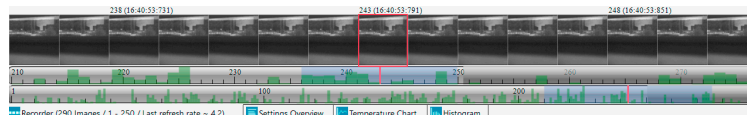




The light gray area in the upper scale shows an **In-Out** example area. To define a new area, right-click on the start and end frame in one of the scales. The **In** image must be left of the red bar, the **Out** image to the right of the red bar. Adjust the **In / Out** area by holding down the left mouse button and slide the borders to increase / decrease the range.



Search Events in Thumbnails: detected events are shown as green bars.



Too Dark or Bright Thumbnails

If thumbnails are too dark or too bright, right-click in **View Window** (see 3.8.8) and select **Auto Range Peak** or **Auto Range Crop**. Then right-click on a thumbnail image and select **Rebuild Thumbnails**. Now the thumbnail images should conform to the **View Window**.



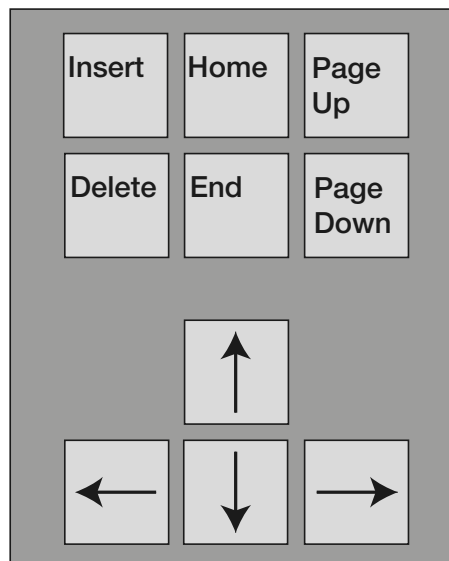
Keyboard Scrolling

Use your keyboard to scroll through the Images. Page up / down keys: 10 Images up or down. Arrow keys: quick scrolling through the images.

Advantage: fluent video playback in the View Window (forwards or backwards).

Home/Pos1 key: first image. End key: last image.





Additional Short-Cuts

While mouse is in the thumbnail area in **Recorder (Images)**:

Press CTRL + click jumps in that direction to the end. Left of the current image to jump to the first image. Right of the current image to jump to the last image.



3.7 Settings Overview

Open **Settings Overview** in the lower toolbar right next to the recorder. If it is not visible see chapter [3.5 Toolbars and Docking Windows](#) to open it.

Settings Overview shows the most important parameters of your camera(s) at a glance. If more than one camera is connected, each camera and its parameters are listed.

Settings Overview									
Camera	Auto S.	Type	Status	Frame Rate	Resolution	Exposure Time	No. of Images	TO Pos.	Ext. Sync. State
Camera 1	Off	pco.dimax CS (12900036)	Ready	83	2016 x 2016	12ms	1544	inactive	-
Camera 2	Off	pco.panda 4.2 (14400459)	Ready	40	2048 x 2048	191us	100	-	-

The parameters can only be changed under [3.2](#).

Switch easily between the **Recorder (Images)** section and the **Settings Overview**.

Number	Function	Description
1	Camera name	Name
2	Auto Save	Off, Unconfigured (red), OK (green)
3	Type	Camera type and serial number
4	Status	Ready or Recording; Green background: Images are in memory.
5	Frame rate	Currently selected frame rate
6	Resolution	Resolution in pixels
7	Exposure time	Selected exposure time
8	Number of images	Number of images to be recorded
9	T0 Position	See camera specific manual
10	Ext. Sync. State	See camera specific manual

3.7.1 Auto Save

Auto Save helps to save recorded images or sequences in an easy way. There is no need to save each image/sequence separately from each connected camera. This function is very useful if you use more than one camera. Once configured **Auto Save** can acquire and save as many images / sequences as needed during your experiment. This function stores **RAW** (e.g. b16, TIFF) and **Export** (compressed e.g. AVI, JPG) files.

For standard file save and export see **File menu 3.8.2**. Explanations are shown in the info text window at the bottom of the menu.

Enable **Auto Save** by clicking on the check box. The text changes to **Unconfigured!** (red background).

Right-click on the **Unconfigured!** field and click on **Configure 'Auto Save'**. The **Auto Save Options** dialog is displayed.

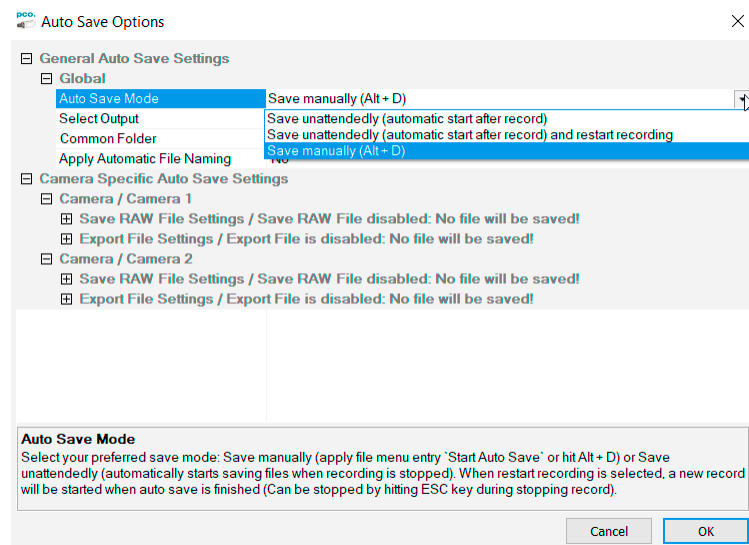
Settings Overview									
Camera	Auto Save	Type	Status	Frame Rate	Resolution	Exposure Time	No. of Imag..	T0 Pos.	Ext. S..
Camera 1	☒ Unconfigured!	Configure 'Auto Save'	Ready	36	2016 x 2016	28ms	1544	inactive	-
Camera 2	☐ Off		Ready	40	2048 x 2048	10ms	10	-	-

General Auto Save Settings

Global



Auto Save Mode: three different modes are available, **Save manually** and two variants of **Save unattendedly**.



The **Save manually** mode stores RAW images and export images after a recording session, when **ALT** and **D** keys are pressed. This can be useful for selecting a subset of the image sequence in the **Recorder Toolbar** before saving.

The **Save unattendedly** mode downloads all RAW images and exports the complete image sequences of all cameras immediately after an active recording is stopped.

Save unattendedly (automatic start after record): saves all image data after recording, without any further user interaction.

Save unattendedly (automatic start after record) and restart recording: after a recording has been saved, **Auto Save** restarts the recording, and then saves again – endlessly (stopped by stopping the recording).

Select Output:

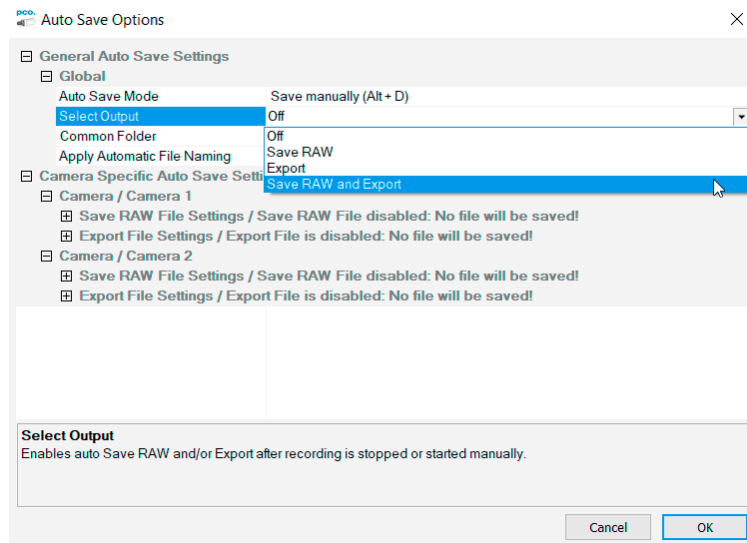
Off: **Auto Save** is deactivated

Save RAW: only 16 bit RAW files are stored (b16, PCO Raw-File, MultiTif-File, tiff)

Export: only converted files (8 bit) are stored (bmp, jpg, tiff, avi, mpeg, wmv)

Save RAW and Export: RAW and converted files are stored simultaneously.



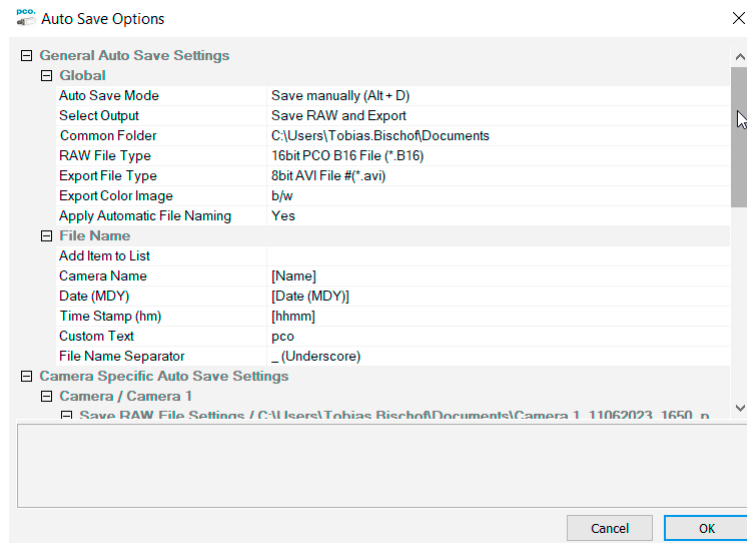


Common Folder: select main folder for stored files

Raw and Export File Type: select the type of RAW and converted file

Export Color Image: select to export color images (only for color cameras)

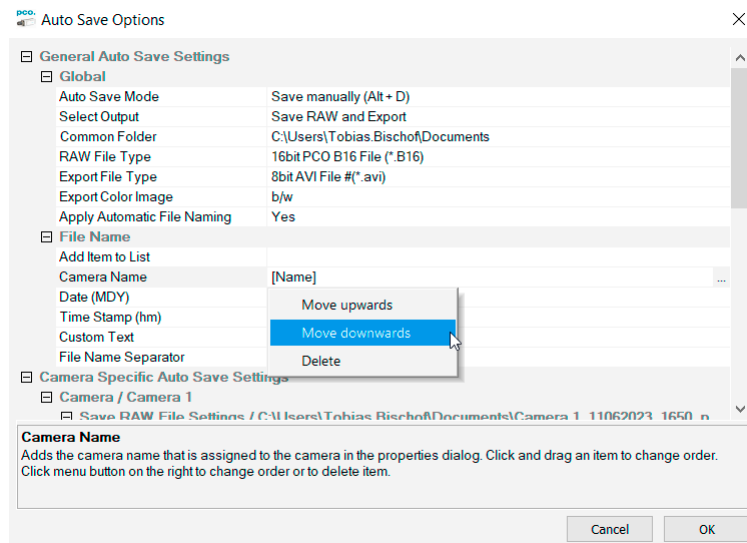
Apply Automatic File Naming: if set to **Yes**, stored files are automatically named by pco.camware according to your automatic file name settings.



File Name

Set file name individually by adding or deleting items. Position these elements as needed.



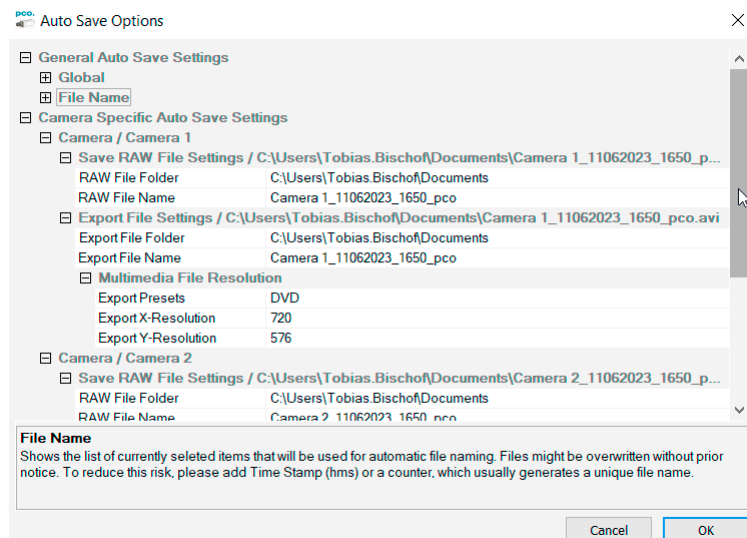


Camera Specific Auto Save Settings

Configure camera specific settings for each connected camera.

Save RAW File Settings: set **RAW File Folder** and **RAW File Name** (if not set to automatic file naming).

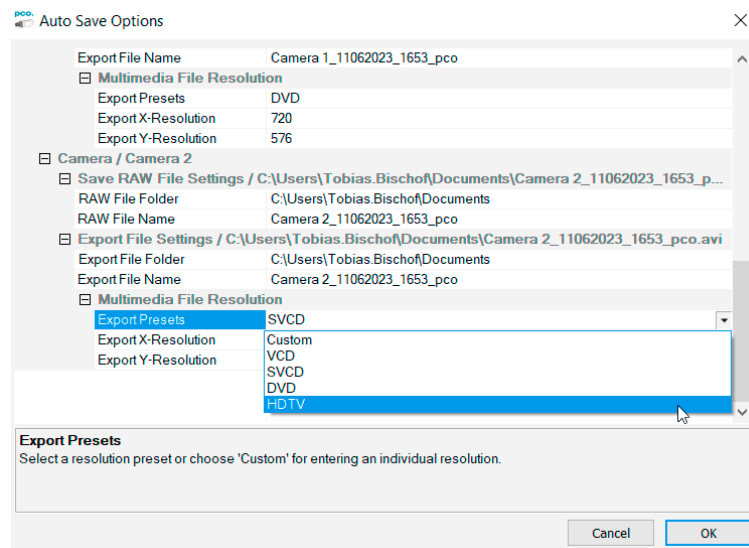
Export File Settings: set **Export File Folder** and **Export File Name** (if not set to automatic file naming).



Multimedia File Resolution: set predefined video export resolution or enter a **Custom** x- and y-resolution.

You may have to set the resolution to match the configured resolution of your camera here.





Finish the configuration by clicking **OK**.

Camera	Auto Save	Type	Status	Frame Rate	Resolution	Exposure Time	No. of Imag...	TO Pos.	Ext. S...
Camera 1	☒ OK	pco.dimax CS (12900036)	Ready	36	2016 x 2016	28ms	1544	inactive	-
Camera 2	☒ OK	pco.panda 4.2 (14400459)	Ready	40	2048 x 2048	10ms	10	-	-

After configuration is finished, **Auto Save** status turns **OK** (green background).

3.8 Tabs and features

This chapter describes in detail the pco.camware **Demo Mode** and the pco.camware tabs: **File**, **Camera**, **Acquisition**, **View** and **Window**. The right-click menu and some additional features are also described.

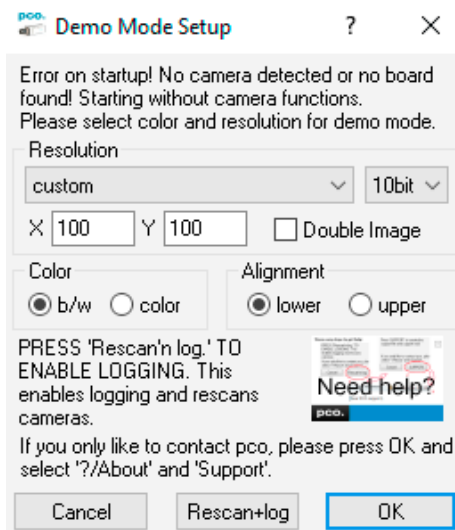
3.8.1 Demo mode

Upon startup pco.camware automatically recognizes the camera type of all connected and running cameras.

It starts in **Demo Mode** if your camera is off or no camera is connected.

If you want to force pco.camware into **Demo Mode**, hold down the D key and press **Scan Cameras** button.

In this mode all image processing features are available, but all camera settings and options are deactivated. An image type can be selected to simulate the output of a particular camera model so images can be loaded and processed when the camera is not connected. The ***Demo Mode Setup*** window opens, requesting the corresponding input.



Need Help? Having troubles to run the camera this window will pop up. Follow instructions of chapter [C](#).

Resolution

The drop down list displays the existing image sensor spatial resolutions of all PCO camera systems. Select the specific resolution and bit depth of the images to be opened. To open Double Image (shutter) images tick **Double Shutter** if such images have been recorded.

Color

With the radio buttons, the user can specify whether the image type is monochrome (b/w) or color.

Alignment

These two radio buttons adjust whether MSB (most significant bit) aligned (upper) or LSB (least significant bit) aligned (lower) images have been stored.

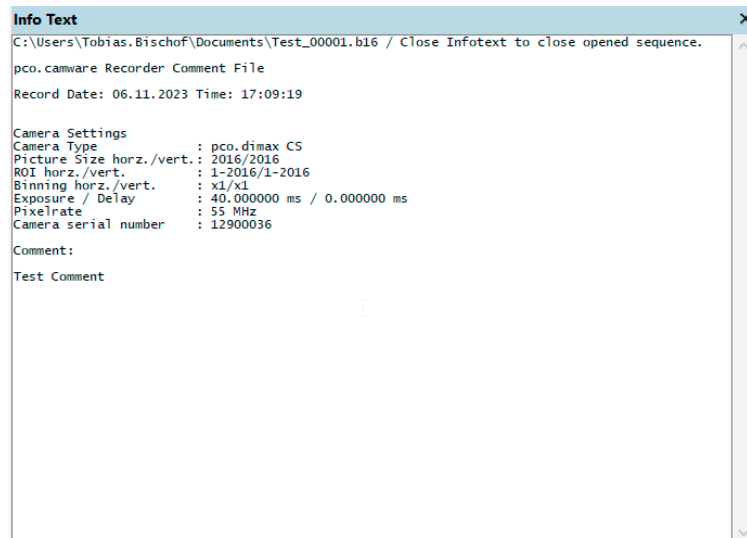
Infotext

The **Infotext** is automatically shown in pco.camware if you open a stored image sequence.

The **Camera Properties** settings, storing location and Record date are listed in this file.

Infotext can be activated in the View Menu [3.8.5](#) at any time.

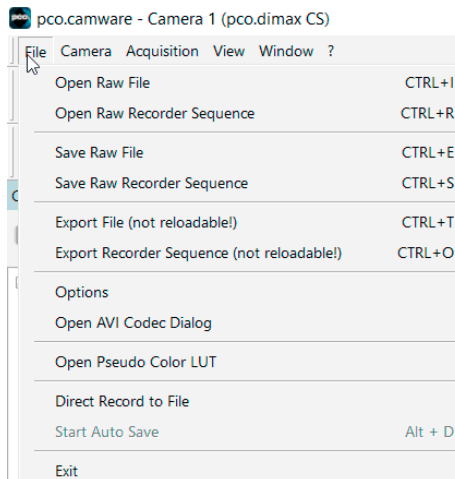




3.8.2 File menu

Open Raw File

Imports a single image into the active image window. Only files with the extension and format of *.b16 (PCO proprietary binary image format) and *.tif (16 bit TIFF image format) can be imported. If the recorder is enabled, each imported image is transferred to the buffer shown in the picture number. The imported image is adjusted to the current image size.



Open Raw Recorder Sequence

Imports a sequence of images. If more than one camera is connected and an image window is open, the sequence is loaded to the active window. If no image window is open, the images are loaded to camera #1. This command opens the Open file dialog box. Only files with the extension and the format of ***.b16**, ***.pcoraw**, ***.tif** and **multi tif** can be imported.

Save Raw File

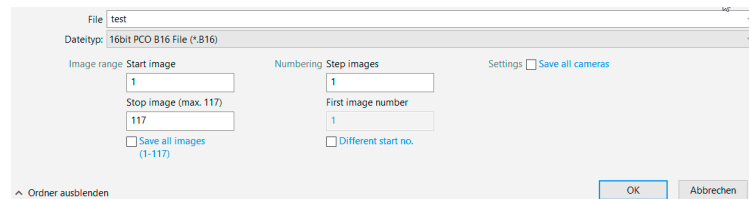
Saves the image displayed in the active window and opens the Save file dialog. The image file can be saved in **16bit *.b16**, **dcm** or ***.tif** format. If more than one camera is connected, it is possible to save all



current images by selecting Export all images in the Save file dialog box. This feature saves one image of each active camera within one process step (it is not necessary to repeat the procedure for each camera). The save command is not available if no image window is open. For **Auto File Save** see [3.7.1](#).

Save Raw Recorder Sequence

Saves or exports image sequences. If more than one camera is connected and an image window is currently open, the record of the active window is saved. The command opens the Save recorder file dialog box. It is possible to select the number of saved images, to step images and to choose the first image number. For **Auto File Save** see [3.7.1](#).

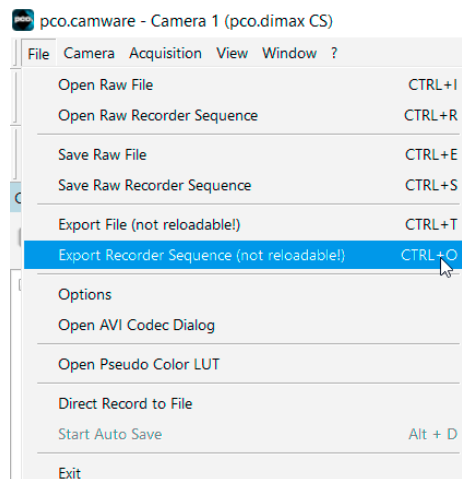


Export File (not reloadable!)

Exports the image of the active image window. This command opens the **Export File** dialog box. Files with the extensions asc, bmp, fts, jp2, jpg, pgm, png, tif can be exported. This item will not be available if no image window is open. For **Auto File Save** see [3.7.1](#).

Export Recorder Sequence (not reloadable!)

Exports a sequence of images. If more than one camera is connected the image record of the currently open window will be saved. If no image window is open the Export Recorder Sequence menu does not appear. This command opens the Export recorder box. Files with the extensions asc, avi, bmp, fts, jp2, jpg, mpg, pgm, png, tif and wmv can be exported (see Appendix [A](#)). **Auto File Save** see [3.7.1](#).



Options

Single File Properties

Single TIFF File 16bit Alignment: upper/lower

ASCII File Separator: select a separator for the values in the ASCII file. Select: TAB, SPACE, SEMI-COLON, COLON, COMMA, HYPHEN, SLASH, BACKSLASH.

Binary PGM File: set the format of the pgm (portable gray map) file. Select: Yes, No.

JPEG 2000 Image Quality: set compression from 20 to 100 %.

JPEG Image Quality: set compression from 20 to 100 %.

Binary PPM File: set format of the ppm (portable pixmap) file. Select: Yes, No.

RAW 16bit RGB TIFF File: save raw tif without color balance. Select: Yes, No.

Use Cache File: caches image data on disc for a camera with camera internal memory and thumbnail readout. Select: Yes, No.

General File Properties

FIFO Buffer Size: set the FIFO buffer size in number of images for **Direct Record To File**. This avoids gaps during file write delays. Usually it is set to 150.

Preserve Last Record: preserves current recorded images. The user is prompted whether to really start a new record or to close.

Embedded File Comment: add a comment.

View Properties:

Crosshair Color: set crosshair color (color for save ROI & line tool).

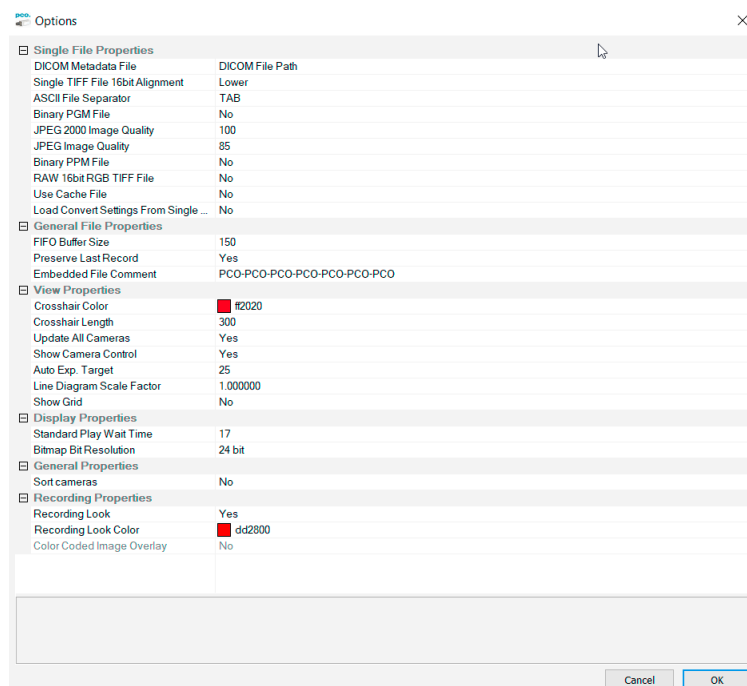
Crosshair Length: set crosshair length in pixels (see chapter [3.8.8](#)).

Update All Cameras: update all non-streaming cameras during recording or preview. Set to **No** to update only the active camera.

Display Properties

Standard Play Wait Time: set wait time in ms to get reduce tearing and stuttering display during **Multi Window**.

Bitmap Bit Resolution: 24 bit: sets the bit resolution of the bitmaps created for display and export.

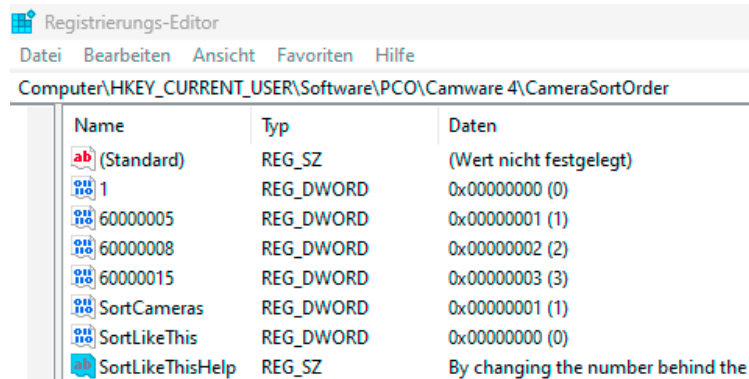


General Properties

Common Settings Mode: activate this mode to use the common settings during multi camera operation. Select: Yes, No.

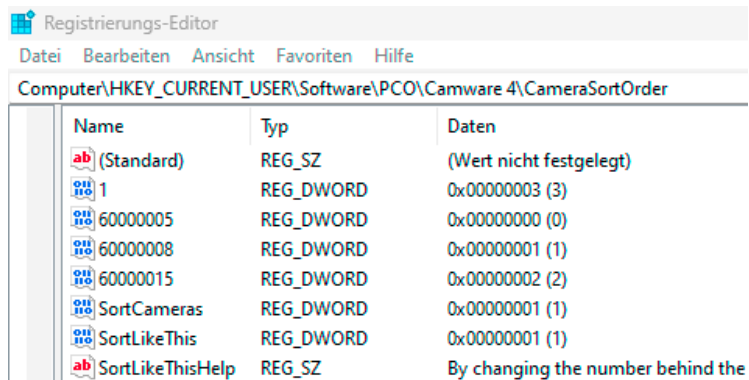
Sort cameras: activate this option in order to sort the cameras ascending related to their camera serial number.

Once sorted the order will be visible in the registry under 'CameraSortOrder'. If it is necessary to change the order by SN, this can be done by setting 'SortLikeThis' and adapting the number associated with the serial number of the camera. 'SortCameras' must be kept on.



Name	Typ	Daten
(Standard)	REG_SZ	(Wert nicht festgelegt)
1	REG_DWORD	0x00000000 (0)
60000005	REG_DWORD	0x00000001 (1)
60000008	REG_DWORD	0x00000002 (2)
60000015	REG_DWORD	0x00000003 (3)
SortCameras	REG_DWORD	0x00000001 (1)
SortLikeThis	REG_DWORD	0x00000000 (0)
SortLikeThisHelp	REG_SZ	By changing the number behind the

In this sample camera SN 1 is at position 0. If you want to place this camera as last camera, change SN1 'Value Data' from 0 to 3 and the other cameras to 0,1,2. SortLikeThis must be set to 1. Then the cameras will be sorted 'like this' enumeration here in registry under Value Data.



Name	Typ	Daten
(Standard)	REG_SZ	(Wert nicht festgelegt)
1	REG_DWORD	0x00000003 (3)
60000005	REG_DWORD	0x00000000 (0)
60000008	REG_DWORD	0x00000001 (1)
60000015	REG_DWORD	0x00000002 (2)
SortCameras	REG_DWORD	0x00000001 (1)
SortLikeThis	REG_DWORD	0x00000001 (1)
SortLikeThisHelp	REG_SZ	By changing the number behind the

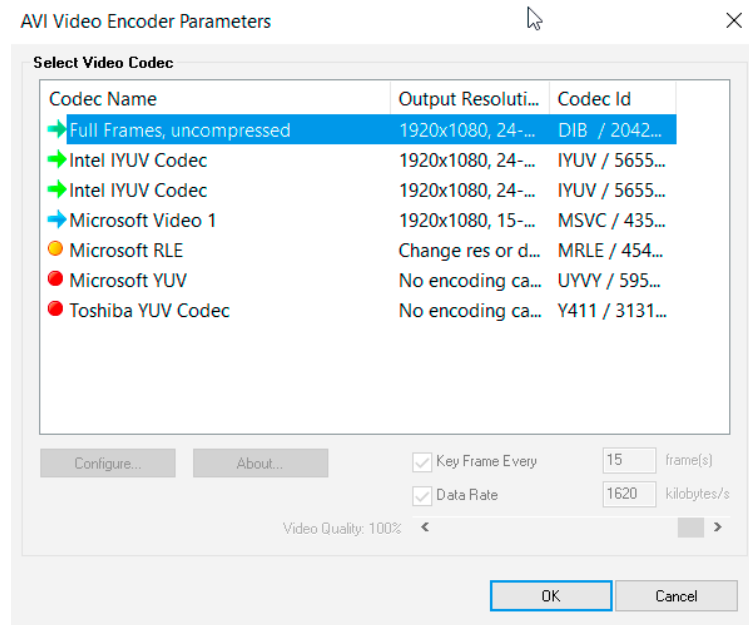
Open AVI Codec Dialog

Set these options only if you use **Auto File Save** see [3.7.1](#).

Select the (compression) codec that you want to use for your stored sequences. All installed codecs are listed here.

If you use **Auto File Save**, this setting takes an effect on your stored video sequences.





Load Lookup Table (for monochrome cameras)

This feature assigns pseudo colors (Lookup-Table LUT) to a monochrome image. Either select one of the four predefined or create your own. The result is shown in the color **View Window**.

Direct Record to File

Preset a certain number of images to be stored. If the camera captures images faster than the computer can save to disk, you will lose images. Images display doesn't interfere with the record process.

Start Auto Save

Only available if **Auto Save** is activated (see [3.7.1](#)).

Exit

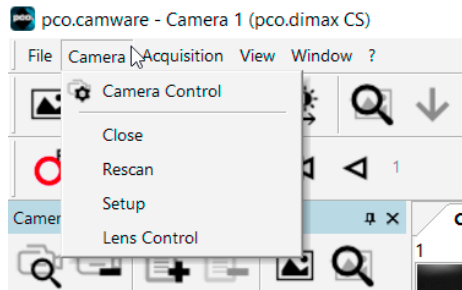
Exits the program and closes all channel dialog windows. Window positions, settings and sizes are stored in the windows registry and will be loaded again at next start-up.



3.8.3 Camera menu

Camera Control

Opens the camera control window.



Close

Disconnects camera when more than one camera is connected.

Rescan

Disconnects and reconnects all cameras.

Setup

This function lists former options e.g. switch shutter mode depending on your camera model, see camera specific manual.

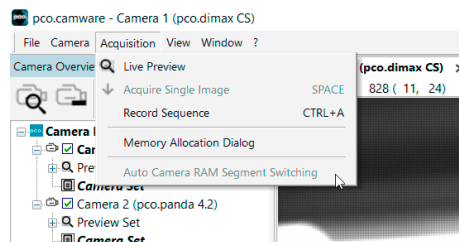
Lens Control

See chapter [3.2.11](#).

3.8.4 Acquisition menu

Live Preview

Live Preview is useful for fast and easy adjusting and focusing of the camera. The active window will be updated. To see another window, simply click on the window. This option is not available in Double Shutter mode.



Acquire Single Image

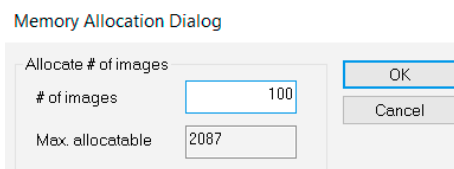
Active if **Trigger Mode** is set to **Soft Trigger**, see [3.2.2](#).

Record Sequence

Starts recording images into the computer system memory according to **Trigger Mode** selection (see [3.2.2](#)). During recording, all camera controls except for **Exposure** and **Delay** time are locked.

Memory Allocation Dialog

Only available for cameras without internal memory. This sets the number of images recorded in one sequence. The maximum is defined by available computer RAM size.



Auto Camera RAM Segment Switching

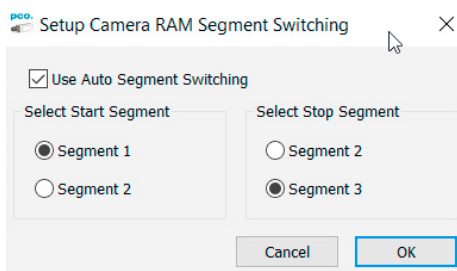
Only for cameras with internal memory (Cam RAM).

Records automatically in two or three different camera RAM segments one after another resulting in two or three separate image sequences.

If **Recorder Mode** is set to **Sequence** and the set number of images is achieved the RAM segment switches automatically to the next segment and stops after the last segment is full.

If **Recorder Mode** is set to **Ring Buffer** a stop trigger must stop the active record into the dedicated segment. A new record starts automatically into the next segment.

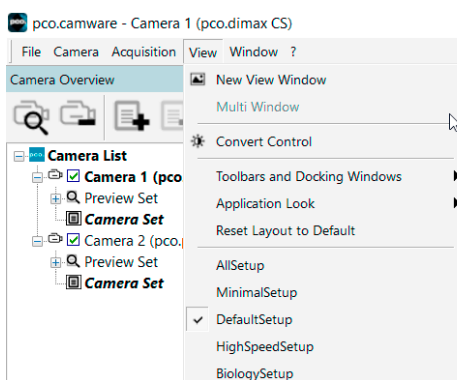




3.8.5 View menu

New View Window

Use this command to open a **New View Window**.

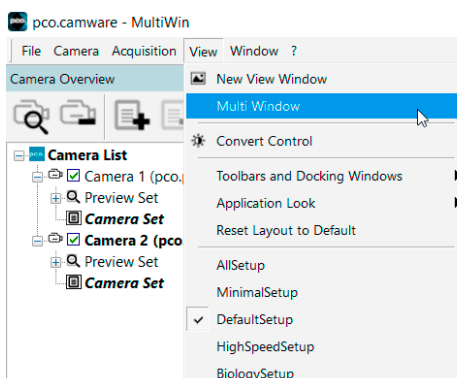


Multi Window

View the images of all active cameras in consecutive order in one window. It provides an easy comparison of the views of different cameras.

Use the same ROI and timing settings for all cameras.

Only available when using more than one camera and only after a complete sequence is recorded (sequence mode) or after buffer is full for the first time (Ring Buffer).



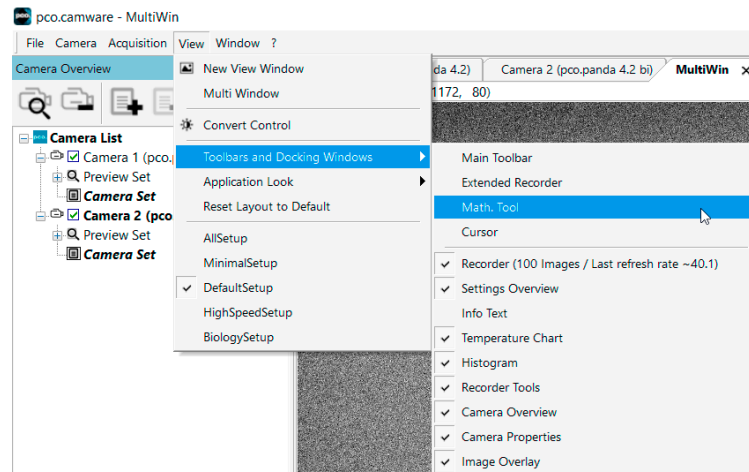
Convert Control

See chapter [3.2.10](#).

Toolbars and Docking Windows

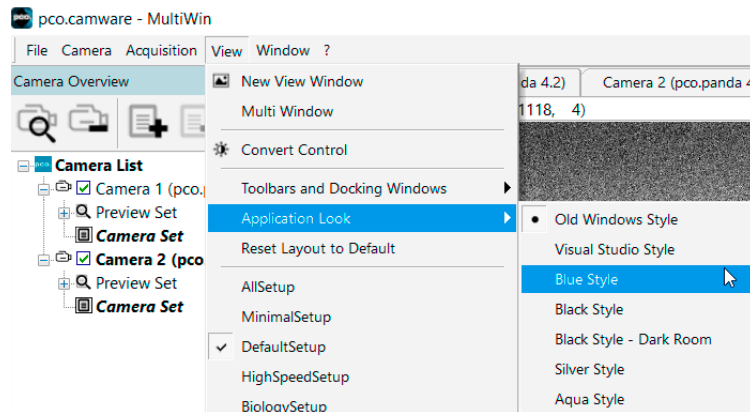
Standard toolbars of pco.camware are Recorder/ Recorder Tools / Camera Overview / Camera Properties and Image Overlay.

Additional Toolbars are available, but not essential: **Main Toolbar / Extended Recorder / Math. Tool / Cursor**. See below. For function **Infotext** see [3.8.1](#).



Application Look

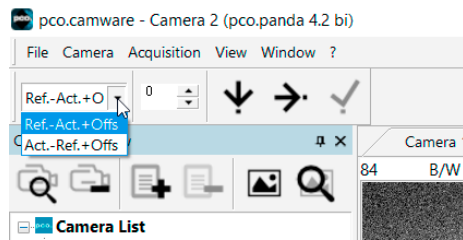
Style and look of pco.camware can be customized; many different style sheets are selectable. The **Tabbed MDI** function docks or undocks the view windows.



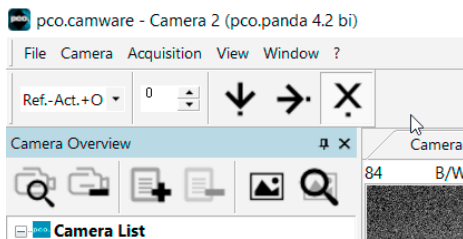
Math. Tool

Calculate the difference between a reference image and the actual image. Activating **Math. Tool** every new acquired image is subtracted from the reference image or vice versa:





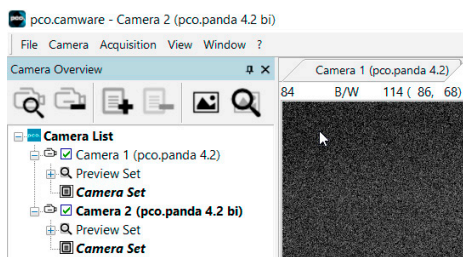
- 1 Reference (image) – Actual (image) + Offset or Actual (image) – Reference (image) + Offset
- 2 A reference picture is acquired and copied to reference buffer
- 3 Last acquired image is copied to reference buffer
- 4 Add offset to avoid negative values, which would not be visible
- 5 Enable math function
- 6 Disable math function



Cursor

Shows position of mouse cursor and the corresponding pixel value.

Example: B/W (black/white camera) x-axis: 639; y-axis: 508; Value: 16383 counts.



Reset Layout to Default

Resets all customized changes and restores the default layout.

Selectable Layouts

If a **camware_setup.ini** file is available either via a local path or C:\ProgramData\pco, new configurable layouts will be available in the view menu.

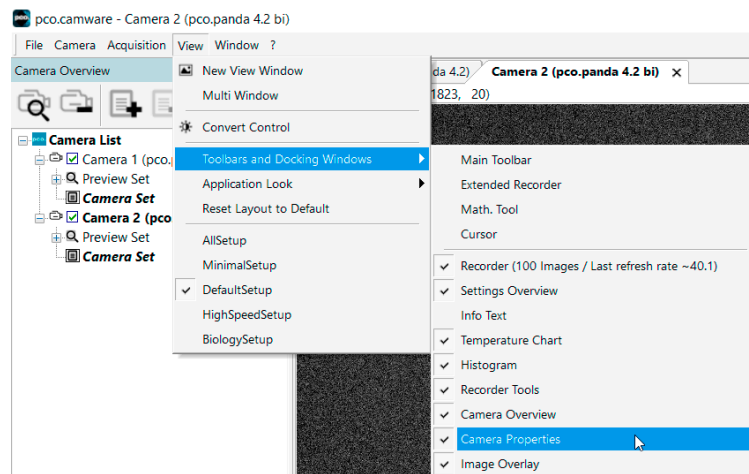
The ini file can be set with a main chapter and several setup chapter.

Main chapter (example):



```
[Camware Setup]
Setup=DefaultSetup
SetupLoaded=DefaultSetup
Setup1=AllSetup
Setup2=MinimalSetup
Setup3=DefaultSetup
Setup4=HighSpeedSetup
Setup5=BiologySetup
```

The setup chapter stores which setup is selected for loading and which one is active currently. Available setups are listed according to their own name, which appears in the view menu if the setup is valid.



53 A setup may contain a selection from the following entries:

```
[DefaultSetup]
MainToolbar=0
ExtendedRecorder=0
MathTool=0
Cursor=0
Recorder=1
SettingsOverview=0
TemperatureChart=0
Histogram=0
RecorderTools=1
CameraOverview=1
CameraProperties=1
ImageOverlay=0
CommonTimeProperties=0
CameraSetMode=2
```

A "1" beside the entry name marks the entry as active and "0" as inactive. **CameraSetMode** controls how Camera Properties are displayed: 0=Basic, 1=Custom, 2=Expert

The ini-file can be configured and extended. There is no limit in number of setups. Currently 5 Setups are pre-configured.



3.8.6 Window menu

Close Active Window

Active window closes.

Split

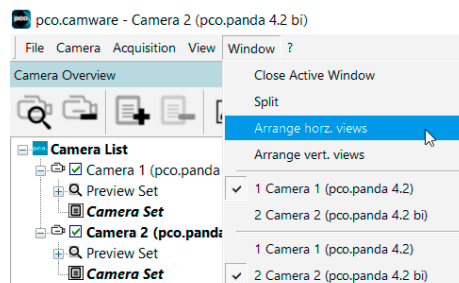
The view window splits in four quarters.

Arrange horz. views

Arranges the windows in horizontal direction.

Arrange vert. views

Arranges the windows in vertical direction.

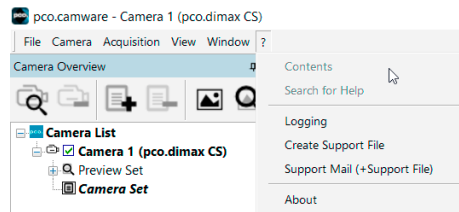


Open Windows

Shows all connected cameras, e.g. **1 camera (pco.ultraviolet)**.



3.8.7 Help menu



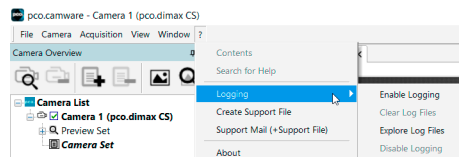
Logging

Enable Logging: Activates pco.camware log files (this cuts down performance).

Clear Logfiles: (only visible if logging is enabled) this command erases all actual log files.

Explore Logfiles: opens windows explorer.

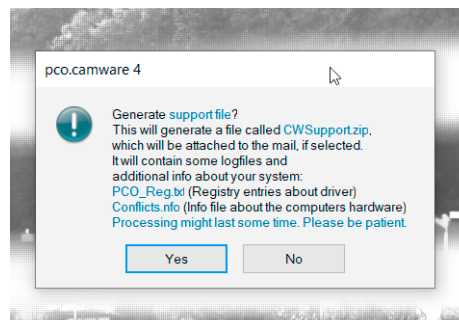
Disable Logging: (only visible if logging is enabled) disables logging.



Create Support File

Press **YES** to activate log files. Reboot pco.camware and your PCO camera.

After log files are activated it is possible to create a support file. Send this file to PCO support (see [C](#)).



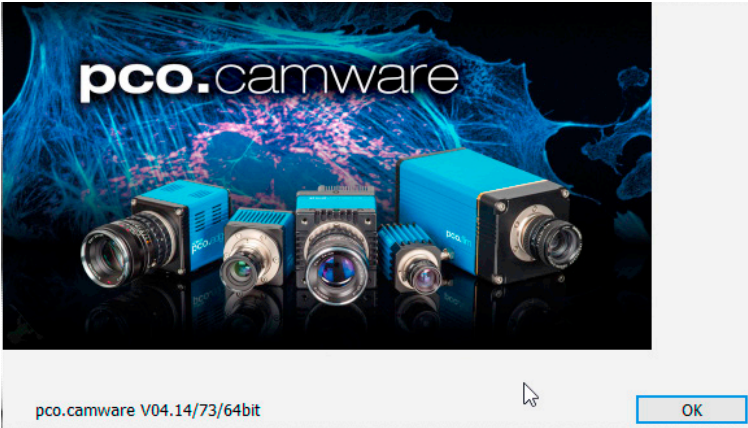
Support Mail

This command opens your email-program and the created support file is added automatically as attachment.

About

This window shows program information.





3.8.8 View window menu

Right-click in the **View Window** to open this menu.

View Color

Switch to color window. Required for LUT if monochrome camera is attached.

View Window B

Available when **Double Image** is active see [3.2.4](#).

Split Window

Splits the **View Window** in four quadrants. Double-click on separator to undo.

Stretched View

Image is resized to fit the **View Window**.

Stretched View Ratio

Aspect ratio is maintained in "stretched" view.

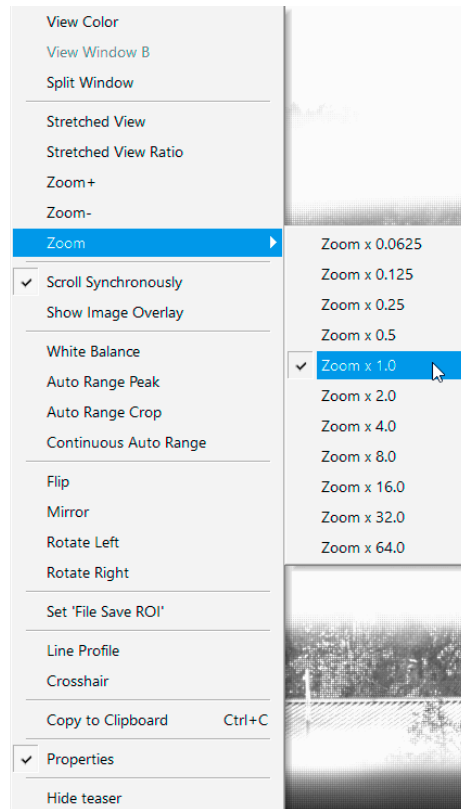
Zoom +/-

Image zoom (only available if Stretched View is deactivated).

Zoom

Sets the factor of the zoom (from 0.0625 to 32).





Scroll Synchronously

If more than one **View Window** is open, you may scroll through all images synchronously (available if **Stretched View** is deactivated).

Show Image Overlay

Activates the **Image Overlay** see [3.3](#).

Open LUT

Opens look-up table file for false-color representation.

Auto Range Peak

Searches for the minimum and maximum 12/14/16 bit intensity values of the image. Based on these limits, the converter scales the 8 bit display (256) within these two values.

Auto Range Crop

Sets the converter to ignore the extreme intensity values of the image and scales the display in a smaller range. Thus dark or bright light spots, reflections, etc. are cut off.

Continuous Auto Range

(Crop) Enables the automatic min / max function (Auto Range Crop) during record and replay.

Flip / Mirror

Image will be flipped or mirrored.

Rotate Left / Right

Rotates the image in steps of 90°.

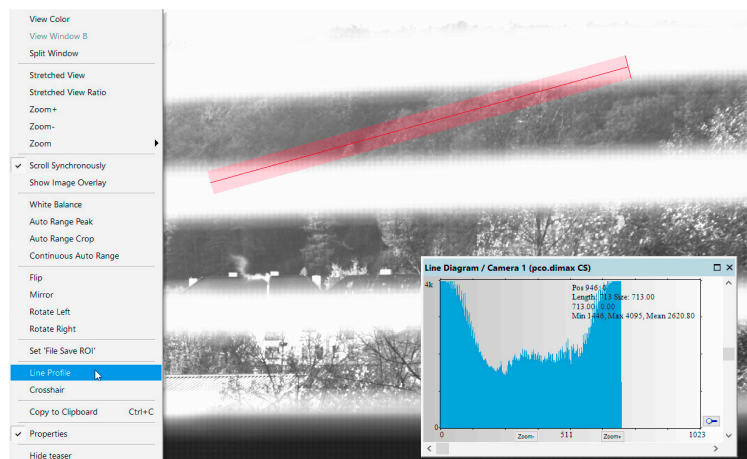
Set 'File Save ROI'

To save just a part of the recorded image (region of interest), draw a rectangle with the mouse. This rectangle is valid for all recorded images and can be dragged at its edges.



Line Profile

Left-click on **Line Profile** and the line starts automatically at the point where the View Window menu is opened. Move the mouse to the desired line end and left-click again. The line may be stretched, shrunk or moved by grasping its end point. A **Line Diagram** opens. The graph in the length of the line (units: pixel) is displayed showing the intensity values of the pixels along the red line.

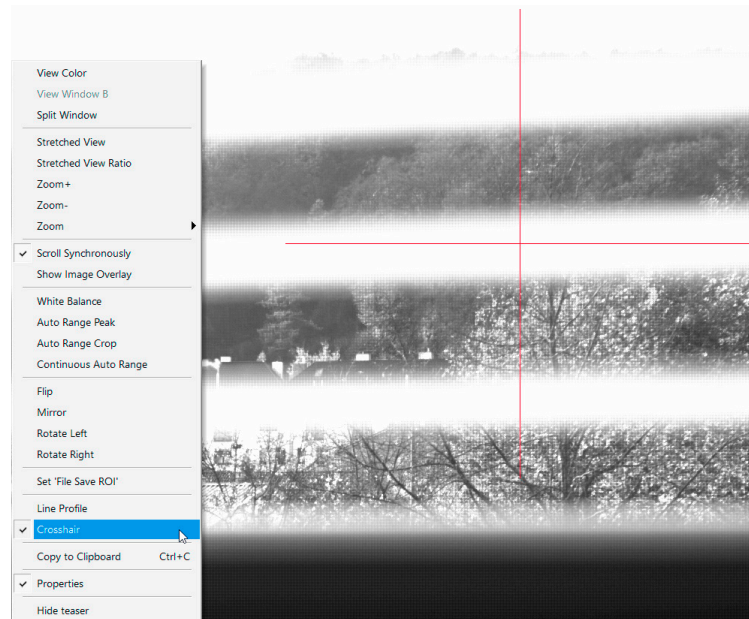


Crosshairs

Activates centered crosshairs. Size and color are selectable see chapter [3.8.2](#) -> **Options**.



To move the crosshairs drag it with the mouse. Reset it to center position by double-clicking into center of the crosshairs.

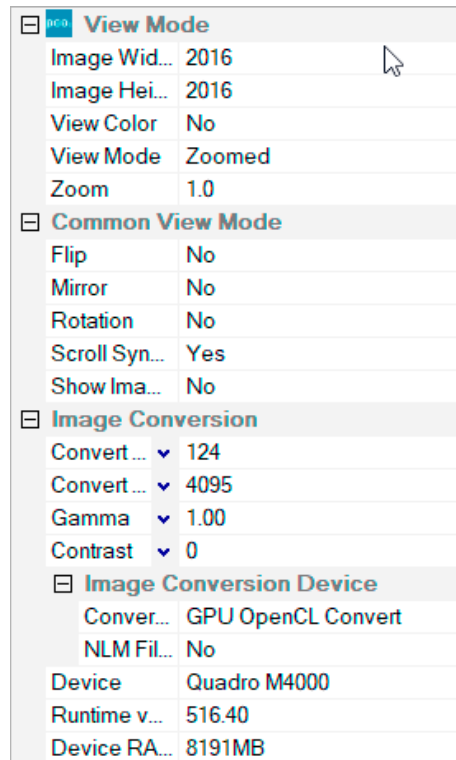


Copy to Clipboard

Copies the actual image to clipboard.

Properties

Displays the current settings for **View Mode / Common View Mode** and **Image Conversion**. They can be opened and closed via the triangle button in the View window (see chapter [3.5](#)).



3.8.9 Additional features

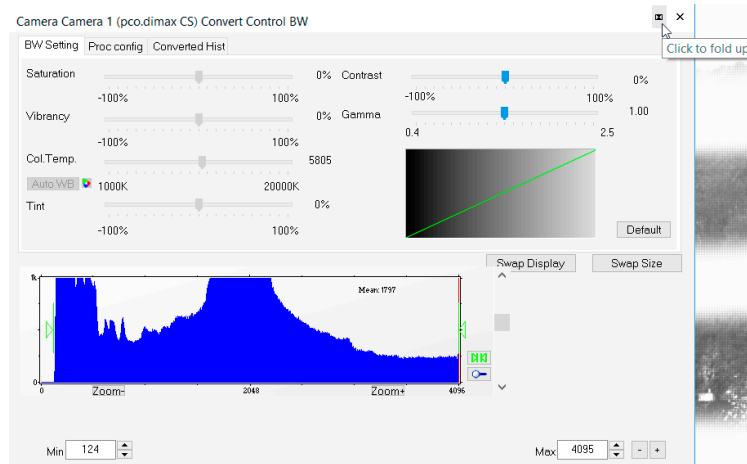
White Balance by Mouse

Change white balance with a mouse by pressing the CTRL and Shift keys at the same time, then selecting a white or gray area within the image by dragging a rectangle while holding the left mouse button. The pixel values within the coordinates of the selection rectangle are used for calculating a new white balance. For best results we recommend to use the white balance button in the **Convert Control Color** (see [3.2.10](#)).

Fold Up Window

- 1 The **Convert Control** window can be minimized / folded.
- 2 Move the pointer over the bar and the window will unfold again.





Setting Contrast Area by Mouse

Control the minimum and maximum values used for the conversion from 16 bit to 8 bit with the mouse. Move the mouse cursor into a region which should be shown with maximum contrast. Press the SHIFT and the left mouse button. Hold down the mouse button while changing the selected rectangle's size by moving the mouse. After releasing the mouse button the coordinates of the selected rectangle act as a border for calculating the minimum and maximum values.

Setting a new ROI by Mouse

In the same manner you can setup a new region of interest (see [3.2.3 ROI](#)) for the camera. Press the CTRL key and drag an area with the left mouse button. The coordinates of the selection rectangle are used for calculating a new region of interest, which will be adapted to the camera capabilities automatically. You can reset the ROI to maximum by pressing the CTRL key and the right mouse button.

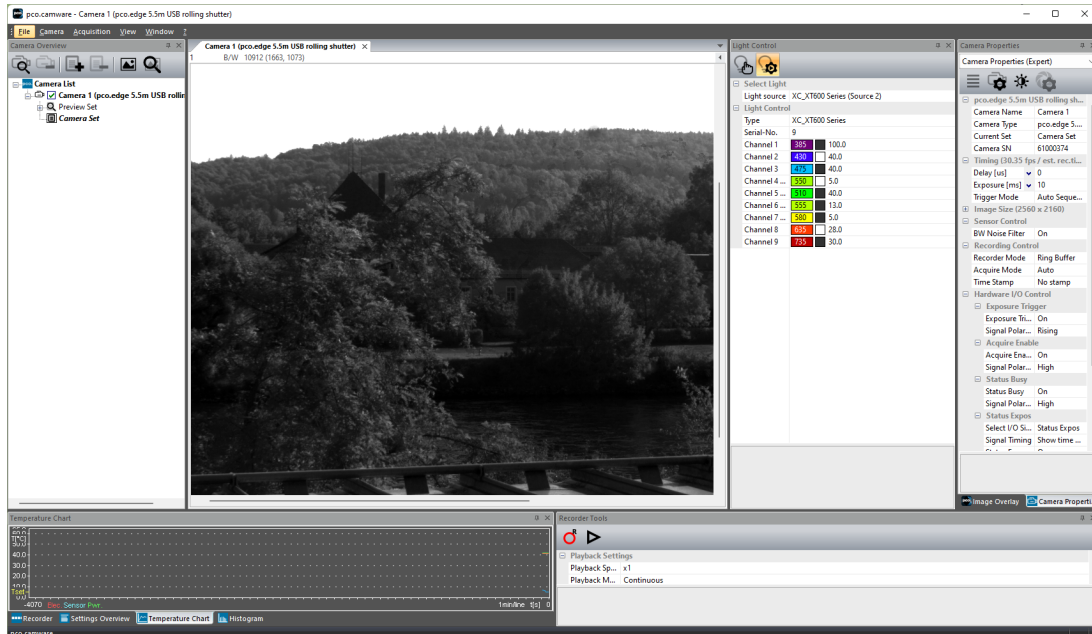
Short Cut List

- Start / Stop record: ENTER
- Acquire Picture: SPACE (Soft Trigger mode)
- Acquire Sequence: CTRL + A
- Auto Save: ALT + D
- Export File: CTRL + T
- Export Recorder Sequence: CTRL + O
- INSERT: saves an image during recording, an easy way to save an image e.g. when working on a microscope.
- Open Raw Image File: CTRL + I
- Open Raw Recorder Sequence: CTRL + R
- Save Raw Image File: CTRL + E
- Save Raw Recorder Sequence: CTRL + S



3.9 Camware X-Cite integration

You are able to also control Excelitas X-Cite® light sources within pco.camware. This makes it very intuitive to use X-Cite light sources together with PCO cameras without the need of using and maintaining multiple applications.



This chapter is a quick start guide on how to enable and use the X-Cite control feature inside pco.camware. Therefore you do not need to install **any** additional driver or software for X-Cite, just installing pco.camware as usual is enough.



Always be sure to follow the X-Cite safety instructions. Never look into the beam or hold the light guide in your hands when the light source is on.

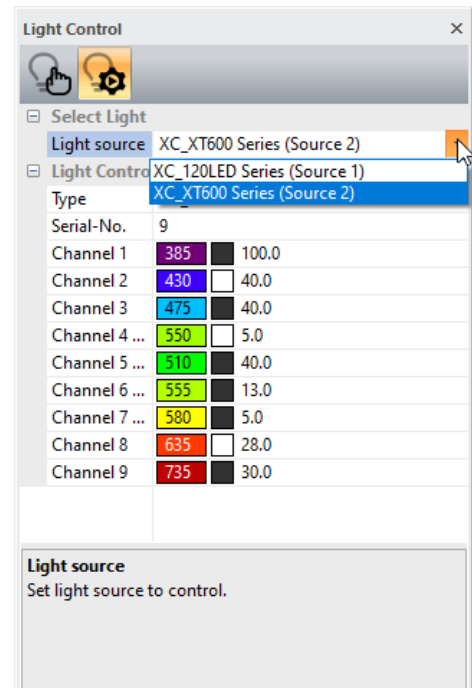
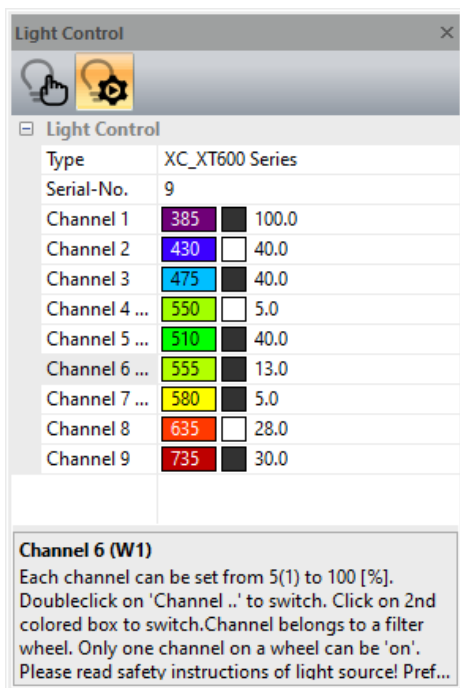
If you encounter any problems with your X-Cite light source, please visit the X-Cite homepage (<https://www.excelitas.com/de/product-category/x-cite-illuminators>) for further information.

3.9.1 Usage

In order to use the X-Cite light control in pco.camware, you have to make sure that your light source is switched on and is connected to your PC **before you start pco.camware**

On startup, pco.camware automatically searches for all connected cameras and also for all connected X-Cite light sources. If at least one light source is found, the associated light control dialog will appear. This dialog is shown below. See left for one connected light source, or right for multiple connected light sources.





Tip Make sure to activate the histogram in the GUI and deactivate auto range to easily track the brightness changes in the images when changing the light intensity.

Per default, the light is only switched on when recording is active! This behavior can be changed in the settings, see chapter 3.9.3.

3.9.2 Light control dialog

The usage of the light control dialog is very intuitive.

- **Light source** controls which light source is currently active (This is only visible if multiple light sources are connected)
- **Type** displays the windows driver name of the X-Cite light source
- **Serial-No** displays the serial number of the X-Cite light source
- **Channel X** controls the channel with number X of the light source. Depending on the light source you can either have multiple channels or only one (e.g. for a white light source)
- The gray box below the list will always display additional information for the currently selected element

Note In the screenshots you will see a **(W1)** on some of the channels. This indicates that for activating this channel, a movement of the filter wheel might be necessary, which will take approximately 2 seconds. Additionally, only one of the channels on the filter wheel can be activated at a time (this is automatically handled by pco.camware), while all other channels can be controlled independently.



Channel Settings

The control of each channel consists of 3 elements which are (from left to right):

Channel 2	385	☐	9.0
Channel 3	435	☐	7.0

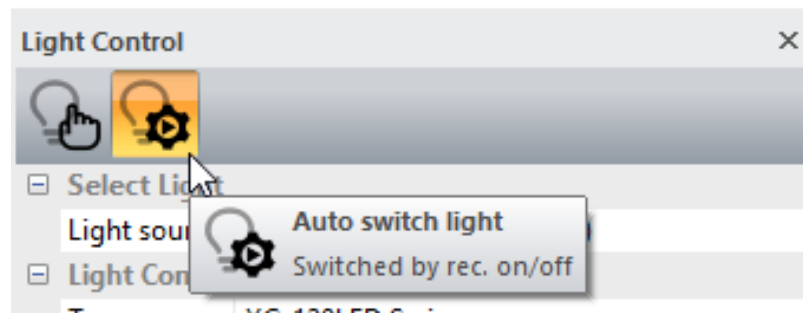
- a display of the wavelength of the channel, colored in approximately the color that corresponds to the wavelength
- a checkable box for activating and deactivating the channel. In default each channel is off (= black, like *Channel 2* in the screenshot above), when clicking on this box the channel will be activated (= white, like *Channel 3* in the screenshot above)
- a numerical input to control the intensity of the channel. You can change the intensity value with either the mouse wheel or the keyboard. The intensity can be set in a range from 5.0 to 100.0 with a stepping of 1.0

3.9.3 Sync Light with Acquisition

The software is able to control the sync of the light source with the recording state of the camera. This means that the light is only **ON** when the camera is actually recording (i.e when pco.camware GUI is red). In this mode, activating the channels (setting associated boxes to white) will not directly activate the light. Only during active recording the light is activated according to the current selections in the light control dialog.

This feature prevents your sample from over-exposition. Thus, permanent damage of the imaged cells and/or bleaching of your fluorophore can be minimized.

Per default, this feature is **enabled** as it is the typical use case. You can switch between *auto* and permanent illumination by using the two buttons on the top of the light control dialog, like shown in the following screenshot.



Note The synchronization that is described here refers to the recording state of the camera, i.e will be switched on when recording starts and switched off when the recording ends. For some applications you may want to have the light source only active during the actual exposure time of an image and it should be switched off during delay and readout. For this you need to synchronize the exposure output signal with the TTL of your light source. Please read the manuals of your PCO camera and your X-Cite light source for further information on this.

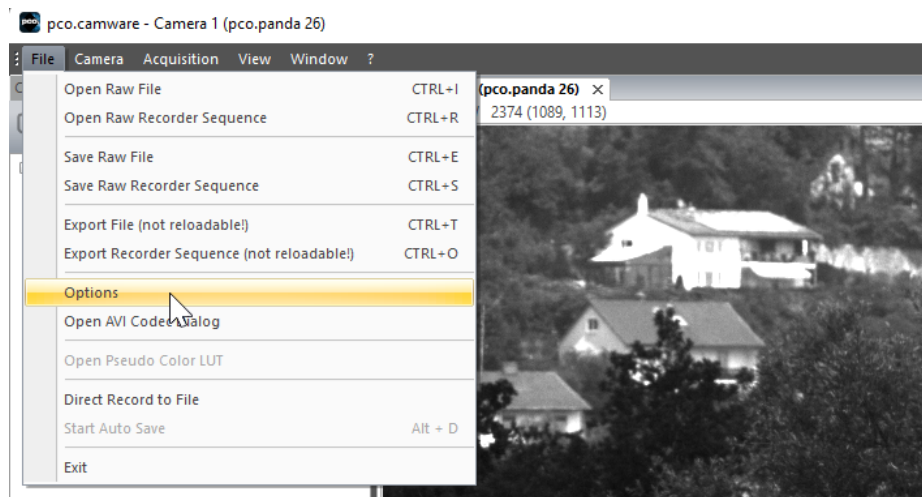
3.9.4 Auto-Link Light Source

When you are working with at least 2 cameras and at least 2 light sources, pco.camware has an additional feature to automatically link a light source to a camera. **This is done automatically on startup of pco.camware.** For successful auto-link, please ensure an open beam path, so that light from the source can be detected by the camera. When an assigned camera is selected in the *Camera List*, the linked light source automatically becomes also selected in the light control dialog. Thus, you always configure the correct light source for the camera.

To enable this feature:

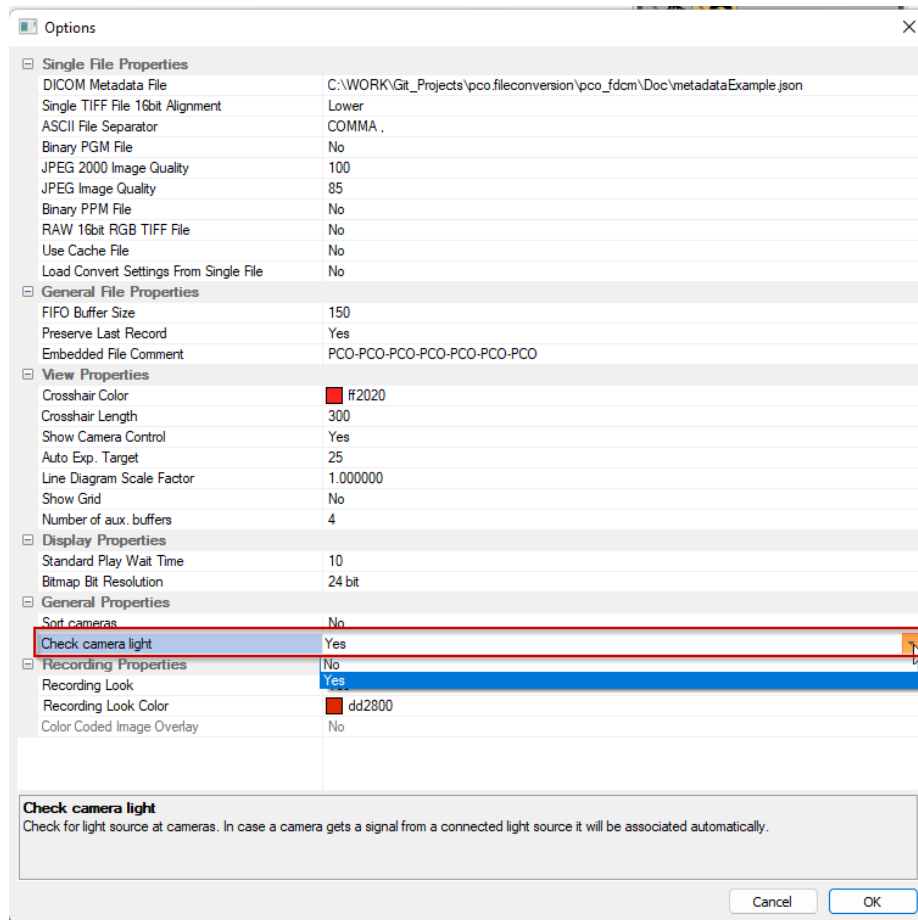
- at least 2 cameras must be connected
- at least 2 light sources must be connected
- *Auto switch light* must be switched off (see chapter 3.9.3).

Then open the pco.camware options menu, which can be found under *File -> Options*.



To enable the feature, the *Check camera light* option must be set to **Yes** (default is **Yes**, see figure below)³.

³This option is only visible when at least 2 cameras are detected.



Always be sure to follow the X-Cite safety instructions. Never look into the beam or hold the light guide in your hands when the light source is on.
Be especially careful when this feature is activated.

Appendix

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A Image File Formats

There are several file formats available for saving camera images with pco.camware:

PCO Formats

b16

The b16 format is similar to the bmp format. However, 16 bit pixel values are used instead of 8 bit pixel values.

The file format consists either of a Basic Header (6 Long-parameter) or an Extended Header (32 Long-parameter), the latter is optional for additional information. It might follow a variable comment field (ASCII code). Finally, there is the actual data set that is saved linearly (as in the case of BMP files).

With the exception of the first value, all parameters are Long Integers (4 Byte). The first 6 parameters must always exist. The rest of the parameters, as well as the comment field, are optional.

Address	Parameter	Denotation
0x00	pco-	B16 file identifier "PCO-"
0x04	file size	file size in byte
0x08	header length	headersize in byte (older versions: 128, 256, 512; act.: 1024)
0x0C	image width	image width in pixel (e.g. 4 ...1280)
0x10	image height	image height in pixel (e.g. 1 ...2048)
0x14	extended header	-1 (true), extended header
0x18	color mode	0 = b/w camera, 1 = color camera
0x1C	b/w min	black / white LUT-setup, minimum value (0 ...b/w max)
0x20	b/w max	black / white LUT-setup, max. value (b/w min ...bit-resolution ² -1; 12 bit -> 4095)
0x24	b/w linlog	black / white LUT-linear or log; 0 = linear, 1 = logarithmic
0x28	red min	red LUT-setup, minimum value (0 ...red max)
0x2C	red max	red LUT-setup, maximum value (red min. ...bit-resolution ² -1; 12 bit -> 4095)
0x30	green min	green LUT-setup
0x34	green max	green LUT-setup
0x38	blue min	blue LUT-setup
0x3C	blue max	blue LUT-setup
0x40	color linlog	color LUT-linear or log., 0 = lin, 1 = log
0x44	doubleshutter	0 = single image, 'DS' = doubleshutter (0x5344)
0x48 ...0x7F	gap	filled with 0
0x80 ...Headersize -1	Embedded structure	see structure <code>Bild</code> definition below. Gap will be filled with 0.
		16 Bit Pixel Values
Headersize	Line 1, pixel 1	value of first pixel

Continued on next page

Continued from previous page

Address	Parameter	Denotation
Headersize + 2	Line 1, pixel 2	value of second pixel
...	...	

A pixel value is a hexadecimal value, e.g. 0x1234 (4660), which is listed in the file as 0x34 0x12. Typical scan line: 0x34 0x12 0x29 0x12 ... (4660 4649 ...). The order of pixels starts with top left and scans down to bottom right of the image.

Most of the table values are still valid, but it is recommended to use the structure data for reading parameters. This is by design and due to the historical evolution of the b16 parameters.

PCO recommends that all images should be saved first in one of the following formats. The advantage is to have the b16 or tiff images available all the time, having the maximum 16 bit information. Note that not all image analysis programs can accommodate 16 bit data. The 8 bit format saves only the information displayed on the monitor screen. The 16 bit information will be lost and cannot be recovered.

pcoraw

This 16 bit pco file format is based on the new BigTIFF format, thus allowing for file size > 4GB. A new pco proprietary compression scheme is added if it is necessary.

Standard File Formats

TIFF

Tag Image File Format, version 6.0 and lower. Both 16bit monochrome and color image formats are available. For the 48bit RGB export format, the resulting image has only demosaicking and optional white-balancing. The dynamic of the camera will not be changed.

BMP

Windows Bitmap Format, b/w or color 8 bit format-images, which have been saved in BMP format can be loaded later only as 8 bit images, i.e. part of the original information (16 bit) is lost.

FTS

Flexible Image Transport System, Version 3.1, is a 16 bit image format defined by the NASA/Science Office of Standards and Technology (NOST) has defined this format. Some programs use the FIT extension for this format.

ASCII

16 bit format for mathematical programs that process ASCII data.

JPG



JPEG (named after the Joint Photographic Experts Group who created the standard) is a commonly used method of lossy compression for photographic images. The degree of compression can be adjusted, allowing a selectable tradeoff between storage size and image quality.

JP2

JPEG 2000 is a wavelet-based image compression standard and coding system. It was created by the Joint Photographic Experts Group committee in the year 2000 with the intention of superseding their original discrete cosine transform-based JPEG standard (created 1992).

AVI

Audio Video Interleave is a multimedia container format introduced by Microsoft in November 1992 as part of its Video for Windows technology.

MPG

MPEG-1, similar to JPEG, is a standard for lossy compression of video and audio developed by the Moving Picture Experts Group (MPEG).

WMV

Windows Media Video (WMV) is a compressed video format for several proprietary codecs developed by Microsoft. The original video format, known as WMV, was originally designed for Internet streaming applications, as a competitor to RealVideo.

B Active Support

This section lists the currently supported operating systems, runtimes, and tools as well as planned support changes.

Operating systems

OS	Minimum supported	Latest supported	Planned
Debian LTS	11 (until 2026)	12	13 (2026)
Ubuntu LTS	20 (until 2026)	22	24 (2026)
Redhat	8 (until 2026)	9	10 (2026)
Windows	10 (until 2027)	11	Not planned

Runtimes/Tools

Name	Minimum supported	Latest supported	Planned
Python	3.8 (until 2026)	3.12	3.13 (2027)
.Net Framework	4.6 (until 2026)	4.8.1	Not planned
cMake	3.20	—	Not planned
GPU CC	5.0 (until 2026)	—	7.0 (2026)



C Troubleshooting

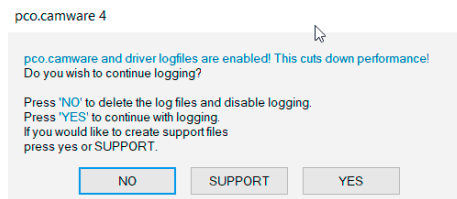
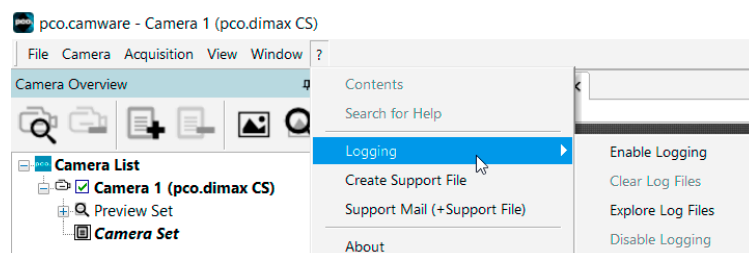
If you have a question that is not adequately addressed in this manual, contact PCO or your local dealer.

How to create Logfiles

1 Enable Logging

Open **? Help** menu, select **Logging** and then **Enable Logging**.

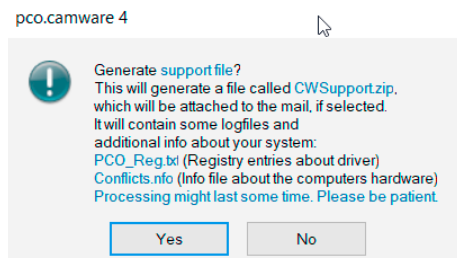
2 The pco.camware will ask you to press **YES** to activate **Logfiles** after a restart of the software.



Repeat Workflow

The workflow that produces the errors must be repeated while logging is enabled.

The pco.camware opens a new email addressed to pco@excelitas.com, attach the **Support File** manually to this email and send the mail to PCO support.



Alternatively use the support form on our website and upload the support file.

To speed up your Request

Give us the following information:

- Describe the problem!
- Your application?
- Your camera: Type and Version, Serial number
- Your setup: Software version, operating system, processor and memory, graphics card

Firmware, Software and Driver Updates

All necessary software and drivers can be downloaded from our website:

<https://www.excelitas.com/product-category/pco-camera-software>



About Excelitas®

Excelitas is a leading provider of advanced, life-enriching technologies that make a difference, serving global market leaders in the life sciences, advanced industrial, next-generation semiconductor and avionics end markets. Headquartered in Pittsburgh, PA, USA, Excelitas is an essential partner in the design, development and manufacture of advanced technologies, offering leading-edge innovation in sensing, detection, imaging, optics and specialty illumination for customers worldwide.

Excelitas is at the forefront of addressing many of the relevant megatrends impacting the world today, including precision medicine, industrial automation, artificial intelligence and connected devices (IoT).



+49 9441 2005 0
Europe

+1 866 662 6653
North America

+86 400 080 2255
Asia-Pacific

Donaupark 11
93309 Kelheim
Germany

excelitas.com
pco@excelitas.com

For a complete listing of our global offices, visit www.excelitas.com/locations

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