user manual **pco.**camware







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.



An Excelitas Technologies Brand

telephone:	+49 (0) 9441 2005 50
fax:	+49 (0) 9441 2005 20
postal address:	Excelitas PCO GmbH Donaupark 11 93309 Kelheim, Germany
email:	pco@excelitas.com
web:	www.pco.de

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Appendix

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1 Introduction

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

In the pco.camware manual all basic functions of the software are described, but all specific camera data, values and special functions can be found in the corresponding camera manual.

Not all of the listed functions are supported by all cameras!

1.1 Conventions

The following typographic conventions are used in this manual:

Value	Description
bold italics	Terms that can be found in the pco.camware.
Features	Heading with a chapter.
3.9.2	Bold chapter: hyperlink to a chapter.
00	Numbers that help to find functions quickly.
Note	Notes that must be observed.

1.2 System requirements

Download the latest versions of our software and camera drivers from the PCO website. Contact us if you have any questions about your system configuration.

System requirements	
Intel®/ Xeon Core™ i7/ i9 at least 2.8 GHz	Full-HD resolution display
RAM > 8 GB DDR3	Windows 7 or higher
NVIDIA CUDA CC >= 3.5 (get current runtime version from NVIDIA)	

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.

Check if GPU Processing is activated by having a look into the Proc config settings



1 in the Convert Control window

Camera Camera 1 (pco.edge) Convert Control BW		x X
BW Setting Proc config Converted Hist		
GPU Processing GPU OpenCL Convert ~ pco debayering	Noise Reduction NLM Denoise Adaptiv	
Color Refine Filter	Sharpen	
On	On	
		Swap Display Swap Size

(see Convert Control chapter 3.3.8).

Camera Properties	μ×
Camera Properties (Basic)	~
🗏 🔅 🚱	

If *GPU Processing* is disabled and shown grayed, update your NVIDIA driver or check the website of the computer manufacturer for graphic card driver updates.

1.4 Installation

The pco.camware Microsoft Windows application software enables you to control every camera parameter or setting. Images can be displayed on a monitor and may be downloaded and stored. Installation files for latest 64-bit Windows operating systems are available.

After a successful installation, you will find the program folder PCO Digital Camera Toolbox in your program directory and a PCO button on your desktop.

To uninstall the pco.camware program, use 'Apps and Features' under Windows' System Control.

Follow the installation Wizard:

1 *Install as admin* to install to program folder, otherwise it will be installed only to user folder.



3 Choose components; select additional drivers for Camera Link interface *Silicon Software DLL MeIV* or *Camera Link HS DLL CLHS* for Camera Link HS interface (for USB and USB3 the appropriate driver must first be installed).

pco.camware 4.14.0 Setup				X
pco.	License Agreement Please review the license terms bef	ore installing pco.camware 4.14.0.		
	Press Page Down to see the rest of End user lic	the agreement. ense agreement (EUL	.A)	
	Please read this EULA ca we license the Software for By checking " <i>I accept the</i> first install the Software, y this EULA. If you do not ac EULA, you must cancel the the Software. If you accept the terms of the agree agreement to instal pco.camware 4	refully, as it sets out the basis or or use. <i>terms of the License Agreeme</i> ou agree to be bound by the provision ree to be bound by the provision e installation process and prom ement, dick the check box below. You mu .14.0. Click Next to continue.	upon which <i>nt</i> ⁿ when you ovisions of ons of this nptly delete st accept the	e
pco.software	I accept the terms of the Licens < <back< li=""> Next </back<>	e Agreement	Cancel	
•				
pco.camware 4.14.0 Setup			>	X
pco.	Choose Components Choose which features of pco.camv	vare 4.14.0 you want to install.		
	Check the components you want to Click Next to continue.	install and uncheck the components you	don't want to install.	
	Select components to install:	Vec. camware Options Vec. Camware Options Vec. Desktop Icon Vec. B16 file handler Vec. Interfaces Silcon Software DLL MeIV Cameralink HS DLL (CLHS) Gigabit Ethernet (GigE)		
	Space required: 74.7 MB	Description Position your mouse over a component description.	to see its	
	< Back Next	>	Cancel	
nco.software				

4 After the next two screens installation is complete.



2 Quick start

In order to get familiar with your new camera and software it will helpful to first aim the camera at an object easy to focus on and visible under normal light conditions.

2.1 Preparation

1 Computer is turned on.

2 Installation of pco.camware and camera specific driver is finished.

- 3 An appropriate lens is attached (remove cap) or the camera is attached properly to the microscope, spectrograph or other scientific device.
- 4 Camera is connected to the computer.

5 Camera is connected to the power supply and powered up.

2.2 Start







Always install latest pco.camware version from our web site to use the full capabilities of your camera.

2.3 First image

Follow the Instructions:









4 Start *Live Preview*.





5 Right-click in the View Window & apply Continuous Auto Range.



6 You may have to adjust *Exposure* time, and the aperture and focus of the mounted lens.

7 Now you should clearly see the object in the window.

To change Exposure time (e.g. the image is still either too dark or too bright), go to chapter <u>3.3.1</u> For recording and saving, see chapter <u>3.3.5</u>, <u>3.5</u> and <u>3.9.2</u> for detailed information.

Note

Live preview is useful for fast and easy camera adjustment and focusing, but does not record or store images.

3 PCO.Camware for Software

3.1 Chapter overview

Value	Description	Page
<u>3.3.1</u> timing	Exposure, Delay, Trigger Mode, FPS Control Mode, FPS Presets, Master/Slave Mode*	14
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<u>3.3.4</u> memory	Active RAM Segment, RAM Segment 1-3	23
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3.9.4 acquisition menu	Live Preview, Acquire Single Image, Record Sequence, Memory Allocation Dialog, Auto Camera RAM Segment Switching	50
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3.9.8 view window menu	Right-click: Zoom / Flip / Mirror / Rotate	55
3.9.9 additional features	White Balance, Fold-up window, Setting Contrast Area by Mouse, Setting a new ROI by Mouse, Short Cut List	57

3.2 Camera overview/list



1 If closed, open the Camera Overview window by selecting the View tab and Toolbars and Docking Windows -> Camera Overview.



Camera Overview

2 The Camera Overview window supports the management of more than one PCO cameras and displays a Camera List of the connected ones. You are able to Scan Cameras or close an active camera.



The user can define several different Camera Sets for each camera (max. 30 sets per camera -> Add set).



4 New View Windows can be opened.

5 The Live Preview function can be started.



Live Preview

Live Preview facilitates the aperture and focus adjustment, allowing a first look at your object. During *Live Preview*, *Trigger Mode* is set to *Auto Sequence* by default. This can be changed in **Recorder Tools.** Preview can be set to use external trigger if needed.

6 When opened up, the *Live Preview* shows a small *Preview* window (always monochrome) integrated in the Camera List.

7 Camera Sets

All settings, such as resolution and frame rate, in the Camera Properties (see 3.3.3) are saved to Camera Sets. Define different Camera Sets with different preferences in Camera Properties for each of your experiments. Camera Sets can be switched at any time (not during record) and copied to other cameras.

Important Setting (for all cameras without internal memory)

Memory Allocation Dialog

If you want to change the number of recorded images in pco.camware, you must open the Acquisition Tab (see 3.9.4) and select Memory Allocation Dialog. This sets the number of images recorded

pco.camware - Camera 1 (pco.edge) File Camera Acquisition View Window Live Preview Acquire Single I SPACE Camera Overvie Record Sequence CTRL+A × 2) Q C Auto Camera RAM Segment Swi 🛋 Q Memory Allocation Dialog Camera List Allocate # of images OK Q Preview Se 100 # of images Cancel Max. allocatable 787 🗉 Camera Set Camera 2 (pco.edge) Review Se Camera Set

in one sequence. The maximum is defined by the available PC RAM size.

Link Preview Set to 'Preview'

8 When *Link Preview Set to 'Preview'* is ticked the *Preview* will always be active with the set parameters when starting a *Live Preview*.

If this function is deactivated, the *Live Preview* will always show live images with the parameters of your active *Set*. Setting a higher exposure time for *Preview Set* and linking it to the *Preview* function is beneficial if *Preview* light conditions are different from those in recording situations.



Reset All Camera Settings to Default

Using **Reset All Settings to Default** in the Camera List context menu will reset all settings in the registry to default values.

Copy Settings to Current Set

To copy e.g. *Camera Set 1* to *Camera Set 4*, just drag and drop e.g. *Camera Set 1* to *Camera Set 4* and pco.camware asks to confirm it. It is possible to copy each setting to every camera.

Master Sets

This function facilitates image acquisition with multiple cameras. Defining two or more *Master Sets* allows easy switching between different predefined settings for each camera during an experiment. Each image acquisition or experiment can be recorded with its own *Master Set*.

To enable *Master Sets*, right-click in the *Camera Overview* window and click *Show Master Sets*.

Define different Master Sets. Select individual Camera Settings within each Master Set.

Functions:



Remove Active Master.



Activate it by clicking on for example Master 1.



3.3 Camera properties

The *Camera Properties* window is the main interface for all camera settings. The active set selected within *Camera List* is adjusted here.

The former main topic *Camera Control* dialog (known from pco.camware 3.x) and the *Convert Control* (see <u>3.3.8</u>) dialog can also be opened, but these dialogs will be removed in future versions of pco.camware.

Four view options with various functions can be selected: *Basic*, *Custom*, *Expert*, and the adjustable *MyCustomSetup* (see instructions below).

Camera Properties	Д.
Camera Properties (Expert)	ß
Camera Properties (Basic)	
Camera Properties (Custom)	
Camera Properties (Expert)	

Basic mode only shows camera name, type, set, serial number and exposure time. In Basic mode the frame rate is always calculated automatically based on the selected exposure time: if exposure time increases, frame rate decreases, etc. this mode is recommended for beginners.

2 *Custom* mode shows several more setting possibilities and functions are hidden or shown by the Custom Properties button. In addition to the Basic mode options, all other options are selectable.

3 *Expert* mode (for advanced users) shows all possible camera feature settings.

4 *MyCustomSetup* mode can be used to create custom settings with a .reg file. This option can only be selected once the setup has been created.

Open C:\ProgramData\pco.

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

An explanation for every setting is displayed below the Camera Properties dialog.

	*	^	
Camera Properties (I	Expert)	~	
=	0		
≡ da v.	14 4		
E pco.edge, SN: 1			
Camera Name	Camera 1		
Camera Type	nco edge		
Current Set	edge setting 1		
Comoro SN	1		
Califera Six	I contract data and a state	Coptions 2	
E Timing (0.42 tp	s / est. rec.time: 03min 575)		
Delay [ms]	0	DICOM Metadata File	DICOM File Both
Exposure [ms]	1		lignment Lower
FPS Control Mo	° Off	ASCII File Separator	TAB
Trigger Mode	Auto Sequence	Binary PGM File	No
E Image Size (256	0 x 2160)	JPEG 2000 Image Qua	lity 100
		JPEG Image Quality	85
Left	1	Binary PPM File	No
Right	2560	RAW 16bit RGB TIFF I	ile No
Top	1	Use Cache File	No
lop Damage	2460	Load Convert Settings	From Single No
Bottom	2100	E General File Prope	ties 150
Format	Standard	FIFU Butter Size	150
Sensor Control		Embedded File Comm	net PCO.PCO.PCO.PCO.PCO.PCO
Pixel Clock [M	95	View Properties	10010040040040040
BW Noise Filter	On	Crosshair Color	#2020
Recording Cont	rol	Crosshair Length	300
Recorder Mode	Ring Buffer	Update All Cameras	Yes
Acquire Mode	Auto	Show Camera Control	Yes
Time Change	No stores	Auto Exp. Target	25
nine stamp	ivo stamp	Line Diagram Scale Fa	actor 1.000000
Hardware I/O C	ontrol	Show Grid	No
Exposure Tri	gger	Display Properties	
Exposure Tr	On	Standard Play Wait Tir	ne 17
Signal Polar	Rising	Bitmap Bit Resolution	24 bit
Acquire Enal	ble	General Properties	
Acquire En	On	Common Settings Mod	No No
Signal Polar	High	E Recording Properti	INO
Statue Ruev		Recording Look	Yes
Ctatus Dusy	01	Recording Look Color	dd2800
Status Busy	UI	Color Coded Image O	verlay No
Signal Polar	High		
Status Expos			
Select I/O S	Status Expos	Recording Properties	
Status Expos	On	Lists general settings for r	ecording
Signal Polar	High		
E Status	-		

Common Settings Mode / Common Properties

If you work with two or more identical PCO cameras, the *Common Properties* help simplify the recording setup by determining which settings are common to all cameras and which are set individually for each camera.

This setting is available only when multiple cameras of the same type are active in pco.camware.

In order to be able to use the *Common Properties*, *the Common Setting Mode* must be activated. To do this, open the *File* menu and click *Options*. Under *General Properties* set the *Common Settings Mode* to *Yes*, (see <u>3.9.2</u>).

Now you can switch the menu in *Camera Properties*. Click on the four horizontal lines. Immediately *Camera Properties* switches to the *Common Properties*. If *Camera Properties Custom mode* is selected you can choose between *Common* and *Custom*.

All settings for which *Common* is selected must be set for *Camera 1* and then automatically apply to all cameras.

The camera properties of camera 2, 3, 4, etc. only show the options set to *Individual*, all others are hidden.

All other setting options can be set to *Common*, so that an easy operation via channel 1 is possible, but *Exposure* and *Delay* can be set independently for each camera.

Significantly, *Common Settings Mode* affects the *Camera Sets*. If you create a new set or edit an existing one and click on it to activate it, it will be duplicated on all other cameras.

Ca	mera Properties			×
Ca	mera Properties (E	xpert)		\sim
-	🗏 😼 🌣	G		
Ξ	Timing			
	Exposure	Common		
	Delay	Common		
	FPS Control Mo	Common		
	Trigger Mode	Common		
Ξ	Image size			
	ROI	Common		
	Sensor Format	Common		
Ξ	Sensor Control		Ν	
	Pixelrate	Common	13	
	BW Noise Filter	Common		
Ξ	Recording Contr	ol		
	Recorder Mode	Common		
	Acquire Mode	Common		
	Time Stamp	Common		
Ξ	Hardware I/O Co	ontrol		
	Hardware I/O S	Common		

Set Fan and LED

Set LEDs on the rear panel to On or Off.

\square	Fan / LED Control			Ξ	Fan / LED Control		
	Automatic Fan Control	On			Automatic Fan Control	Off	
	Fan Speed [%]	50	~		Fan Speed [%]	50	20
	Camera LED	On			Camera LED	On	

Set fan via dropdown menu to *Manual* or *Auto*. If set to *Manual*, you will be able to set the speed of the camera fan from 0 % to 100 %.

Note It is the users' responsibility to monitor the camera condition. PCO is not responsible for

damage to the camera from overheating due to the fan switched off during operation. Take care and do not overheat your camera!

3.3.1 Timing

Introduction to Timing

An important parameter for a camera is the frame rate. The upper limit of the frame rate is defined by exposure and readout time.

The figure below shows the timing scheme. Exposure and readout are done simultaneously. This means while image n is read out from the sensor, image n+1 is already integrated within the

sensor's pixel elements.

Figure 1 shows that for short exposure times, the readout is the limiting factor. The second figure shows that for long exposure times the exposure time plus delay (t_{delay}) is the limiting factor.

Car	Camera Properties ×					
Ca	mer	a Properties	5 (E	xpert)		\sim
Ξ		G)÷	G.		
Ξ	pc	o.edge, SN:	1			
	Car	mera Name		Camera 1		
	Car	mera Type		pco.edge		
	Cu	rrent Set		edge setting 1		
	Car	mera SN		1		
Ξ	Tir	ning (0.42	fps	s / est. rec.time: 03min 57s)		
	De	lay [ms]	*	0		
	Exp	oosure [ms]	*	1		
	FPS	Control Me	o	Off		
	Trig	gger Mode		Auto Sequence		-
Ξ	Im	age Size (2	56	Auto Sequence	2	
	Ξ	ROI		Soft Trigger		
		Left		Ext. Exp. Start		
		Right		2000		
		Тор		1		
		Bottom		2160		
	For	mat		Standard		



Figure 3.1: Image timing for short exposure times - readout time is the limiting factor.



Figure 3.2: Image timing for long exposure times - exposure time is the limiting factor.

Lower frame rates can be achieved by inserting additional delay times before each exposure. This is valid also for external triggering as it defines when a next trigger can be set and is recognized.

Maximum Frame Rate

3 The maximum achievable frame rate based on the timing and ROI settings is calculated and displayed automatically.

Trigger Mode

In this context trigger means exposure trigger, i.e. the trigger signal controls the exposure time of a single image (light integration time). Input and output connectors are camera specific – see the manual for your specific camera.

Auto Sequence: the camera optimizes the image recording to achieve the best possible frame rate.

In *Auto Sequence* mode, the camera determines the highest possible frame rate for the set exposure time and the time required for a frame readout.

After a start command is given, the sequential recording begins and continues until a stop command is given.

Soft Trigger: single images are recorded with this command. A single image is acquired by clicking the **Software Trigger** button, which appears after pressing the **Record** button (see <u>3.5</u>). Other signals have no influence on this operating mode.

Car	Camera Properties ×					
Car	Camera Properties (Expert)					
Ξ		i	(÷	G.		
Ξ	pco	o.edge, SN:	1			
	Car	mera Name		Camera 1		
	Car	mera Type		pco.edge		
	Cur	rent Set		edge setting 1		
	Car	mera SN		1		
	Tin	ning (0.42	fps	s / est. rec.time: 03min 57s)		
	De	lay [ms]	•	0		
	Exp	osure [ms]	*	1		
	FPS	Control Me	o	Off		
	Trig	gger Mode		Auto Sequence	•	
\square	lm	age Size (2	56	Auto Sequence 💦		
	Ξ	ROI		Soft Trigger		
		Left		Ext. Exp. Start		
		Right		2000		
		Тор		1		
		Bottom		2160		
	For	mat		Standard		

Ext. Exp. Start: in External Exposure Start mode, single image recording is started by the falling or rising edge of the voltage signal at the input connector. The frame rate cannot be set, as the frame rate is defined by the frequency of the external signal. However the predefined exposure time and ROI settings affect the maximum possible frame rate.

The Status Busy signal at output connector indicates whether a new trigger can be accepted.

Note If the trigger rate of the external signal is very close to the maximum possible frame rate (difference < 1/1000), it will be random whether a trigger is accepted or not.



The maximum achievable frame rate in external trigger mode might be lower than in Auto Sequence mode depending on your camera model, since some cameras start exposing after the readout of the previous image is completed. Refer to the camera specific manual for details.

If the trigger rate of the external signal is higher than the maximum possible frame rate, every second trigger pulse is ignored. Therefore the actual frame rate drops to half of the external trigger rate. If the trigger rate is increased further, then only every third, every fourth etc. trigger edge is accepted.



Ext. Exp. Ctrl: in 'External Exposure Control' an external signal applied at the input connector controls the start and the duration of the exposure.

A new exposure is started by the falling or rising edge of the voltage signal at the input connector. The exposure is finished when the opposite edge is detected. In this mode, the start as well as the length of the exposure time can be controlled. No further settings can be made, as the image timing is completely controlled by the external trigger signal.



Note that the externally controlled exposure time is limited. The integration will be stopped automatically if the maximum exposure time of your camera is achieved.

The **Status Busy** signal at output connector indicates if a new trigger is accepted.

Exposure Time and Timebase

It is possible to change time-base from automatic to µs or ms. If your input is out of the range of the camera, it is automatically changed to the next possible setting. The adjustment steps of exposure time and delay time depend on the specific camera model.



Timing

The *Exposure* and *Delay* time can be precisely set in camera specific steps. The effective step size depends on minimum internal camera restrictions (usually in ns) or the time base set. The slider and the up/down control refer to the blue highlighted unit. The resulting frame rate is derived from this setting. Delay time setting is not recommended for high-speed applications.

Change time base by clicking on ... and the respective window opens.

	Timing (0.42 f	os /	/ est. rec.time: 03min 57s)	
	Delay [ms]	• 0	0	
	Exposure [ms]	•	ns	1
	FPS Control Mo.		115	
	Trigger Mode			
Ξ	Image Size (25	6	✓ ms	
			Auto.Timebase	
	Left		Time window	

In this context menu, you can also choose *Time window*, which will open a high dynamic dialog to control the exposure and delay times (single shutter mode). Click *OK* to validate the changes and hit ESC on your keyboard to close the window.

E	Timing (0.42 f Delay [ms]	ps / est. rec.time: 03min 57s) • 0	
	Exposure [ms]	~ 1	
Delay: 0.000ms	Expos	ure: 1.000ms	
	1000us		

FPS Control Mode

The camera optimizes the image recording to achieve the selected frame rate. The exposure time is limited to 1/fps, lower values can be selected.

Camera Properties	×					
Camera Properties (Expert) ~					
🗏 😼 🔅	G.					
🛛 pco.edge, SN: 1						
Camera Name	Camera 1					
Camera Type	pco.edge					
Current Set	Preview Set					
Camera SN	1					
Timing						
Exposure [ns] 🗸	500000					
Frame Rate [🗸	48001					
FPS Control Mo	On					
FPS Presets	Off					
Trigger Mode	On					
Image Size (256 ROI	□ Image Size (2560 x 2160)					

First the frame rate is set. If the time required for readout of the image is longer than 1 / frame rate, then the frame rate will be reduced to $1 / t_{readout}$.

If **FPS Control Mode** is selected and the selected exposure time requires a lower frame rate, the exposure time will be reduced to the maximum possible time at that frame rate.

FPS Presets

If **FPS Control Mode** is set to on, a predefined combination of frame rate and resolution may be selected.

These presets may vary and depend on your PCO camera model:

For example pco.edge 5.5: 50 Hz @ 1920x1440 (full resolution).



Clicking on **Set max. exp.** pco.camware sets the maximum possible exposure time according to the selected frame rate.



3.3.2 Image size

1 Region of Interest

ROI (Region of Interest) selects a part of the sensor to be read out, thus reducing the amount of image data and potentially increasing the frame rate.

Based on your camera model, the ROI might need to be set symmetrically, especially to affect the frame rate.

	Image Size (2560 x 2160)				
1	I ROI		~		
	Left	1			
	Right	2560			
	Тор	1			
	Bottom	2160			
ROI Presets		Select a Preset			
F	ormat	Standard			

Click ... and tick **Basic setting (sym.)** to establish a ROI by typing in the horizontal and vertical resolution in pixels.

Ξ	lm ⊟	age Size (256 ROI	0 x 2160)	
		Left	1	
		Right	Set max. ROI	
		Тор	ROI window	
		Bottom	Set aver POI	
	RO	I Presets	Set sym. ROI	
	For	mat	Basic setting (sym.)	
	C	Control	K_	

ROI window

Use the ... right of the size edit boxes and click on ROI window.

The *ROI window* opens and a new 'Region of Interest' may be defined using a mouse or by typing in specific numbers.

Ξ	Im	age	Size (256	0 x 216))		
E ROI							
		Left	t	1			
		Rig	ht	2560			
		YR	esolution	2160			
	RO	I Pi				1	2
	For	rma				2560/2160	
Ξ	Se	nsc				2300x2100	
	Pix	el 🕻				Set to max	
	BW	/ N				Set sym.	
Ξ	Re	cor					
	Re	cor				2160 🖕 🗸	
	Ac	qui	1 ••	•	2560 🔸 🗸	ОК	
	Tin	ne 5	tamp	INO STAL	up qu	51	



Binning combines adjacent pixels (in either the horizontal or vertical direction) to form super pixels. This increases the signal to noise ratio (SNR) and but decreases the spatial resolution of the image.

E Im	age Size (204 ROI	8 x 2048)
	Left	1
	Right	2048
	Тор	1
	Bottom	2048
Ξ	Binning	
	Horizontal	1
	Vertical	1
🗆 Se	nsor Control	1 3
Of	fset Control	2
BW	/ Noise Filter	4

Examples for available binning modes:

H1xV1, H1xV2, H1xV4, H2xV1, H2xV2, H2xV4, H4xV1, H4xV2, H4xV4.

3 Format

In some of the cameras, it is possible to change the standard resolution (sensor format).

3.3.3 Sensor control



The pixel clock sets the clock frequency and therefore the image sensor readout speed. A higher Pixel Clock leads to higher achievable frame rates but influences image quality.

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

2 B/W Noise Filter

In addition to the processing of the calibration of the camera, a dynamic noise filter can be activated to remove so-called blinkers and high noise pixels. If you encounter unexpected aliasing effects, turn this filter off.

3 Offset Control

Select *Auto* to automatically compensate dark current and signal drift of the offset. Select *Off* to deactivate *Offset Control*.

Ξ	Sensor Control		
	Offset Control	Auto	

The offset is recalculated if the exposure time is changed during a *Record* session. This applies also if any setting in *Camera Properties* is changed. The offset is not recalculated if recording

only stops and restarts and no other properties are changed.

4 Cooling Setpoint

Set the cooling temperature of your camera. The set temperature has an effect on the noise performance of the camera. Depending on the cooling system, it takes a few minutes after starting the camera to reach the set temperature.

Camera Properties		
Camera Properties (Expert)		\sim
≣ 🔅 🏠		
pco.pixelfly 1.3 SWIR, SN: 2		
Timing (41.90 fps / est. rec.time: 2.387s)		
Sensor Control		
Cooling Setpoint 20		
Recording Control		
Status		

5 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_{itf} 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.



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.

Camera Properties	џ	×
Camera Properties (Expert)		\sim
🗏 🌣 🏠		
E Timing (6.12 fps / est. rec.time: 16.342s)		
Sensor Control		
Double Image Off	F	
BW Noise Filter On	i i i	
Recording Control		
Hardware I/O Control		
Status		



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

6 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: ${\rm t_{exp}}=\frac{1}{2*f_{CDI}}$

t _{exp} : min. exposure time	f _{CDI} : max. frame rate

Example:

resolution = 1920 x 1080 pixel; f_{CDI} = 1067 fps -> t_{exp} = 467 μs

In this case t_{exp} is both, minimum and maximum exposure time.

To increase t_{exp} decrease frame rate or resolution.

7 Conversion Factor

The conversion factor defines how many charges (electrons), generated by light striking a pixel, are necessary to generate one count (one intensity level) in the digital image. Therefore, the conversion factor describes the gain when converting electrons into a digital value.

Example:

The pco.pixelfly usb has two conversion factors: $1.0 e^{-1}$ count and $1.5 e^{-1}$ count, both of which can be used in 1x1 (full resolution) and higher binning modes. Binning is available for the pco.pixelfly usb / pco.ultraviolet. The usable extended fullwell-capacity rises in binning mode from 16000 to 24000e⁻. For 1x1 binning (full resolution) it makes sense to keep $1.0 e^{-1}$ count, as changing the conversion factor to $1.5 e^{-1}$ the full dynamic range of 16384 grey steps is not accessible. In *binning mode* you can use both conversion factors: for low light conditions, the $1.0 e^{-1}$ count mode helps to spread the low image information content over the full 14 bits. For brighter images it makes sense to use $1.5 e^{-1}$ count to access the full dynamic.

3.3.4 Memory

For cameras with internal memory (RAM).

The RAM has four different segments. In pco.camware only three can be used to save images. The fourth is used by pco.camware itself for internal processes.

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

You may record into three different segments and to set the exact number of images in each segment. The software always shows the maximum number of images (depending on RAM size and chosen ROI).

Active RAM Segment: choose the active segment: e.g. 1, 2 or 3.

3.3.5 Recording control



For cameras without internal RAM:

Our software uses free RAM space on your computer. In **Sequence mode** the recording stops when RAM space is full. In **Ring Buffer** mode the camera only stops by a stop command, hence overwriting previous images continuously, starting at the first image. For longer recording periods an appropriate RAID system is necessary, see also the **Direct Record to File** option, see <u>3.9.2</u>.

Recording Control		
Recorder Mode	Ring Buffer	
Acquire Mode	Auto	
Time Stamp	No stamp	00

For cameras with internal memory:

The recorded images are temporarily saved as 16 bit multi TIFF if thumbnails are generated after recording is done. In **Sequence mode** the camera stops after the memory (i.e. the active RAM segment) is completely filled. In **Ring Buffer** mode the camera records until it is stopped – overwriting the previous images continuously. Also see **Memory Allocation Dialog 3.9.4**.

2 Acquire Mode

The *Acquire Mode* is an additional instance to control image acquisition by an external signal. Like a gate signal it opens or closes the time window during which images according to the selected *Trigger Mode* (see <u>3.3.1</u>) are recorded.

If set to Auto any signal at the Acquire Enable input connector is ignored.

If set to *External*, the camera only records images if the external signal enables it.

The *Acquire Mode* is level controlled. This means when the signal level is "high" image acquisition is possible, at the level "low" not (or inverted). A practical example would be an illumination of the experiment which generates a signal and is coupled to the *Acquire Enable* input: light on means level "high" and thus image acquisition, light off level "low" and no image acquisition.

In *Trigger Mode Auto Sequence* the sensor timing scheme (image acquisition of the sensor) is paused by the signal at the *Acquire Enable* input connector. The *Acquire Enable* input is sampled at the beginning of the image generation, shown by at the rising edge of the *Status Expos* output connector.

Image acquisition is in an idle state if the *Acquire Enable* input is on low level (high, when inverted); it pauses image acquisition until the *Acquire Enable* input is on high level again (low, when inverted).



In *Trigger Mode External Exposure Start*, the *Acquire Enable* input connector works like a gate for the trigger signal.

The rising edge of the trigger (falling when *Exposure Trigger* is inverted) is accepted only when the *Acquire Enable* signal is high level (low, when inverted).

Example:



Status Expos signal for Signal Timing First Line (for Rolling Shutter pco.panda and pco.edge).

In *Trigger Mode External Exposure Control* the *Acquire Enable* input works very similar to the mode *External Exposure Start*. However, the *Acquire Enable* input is ignored for the rising/falling edge which is closing the exposure time (an already started exposure will be finished).

Using Acquire Enable in External Trigger Modes, following timing specification should be met:



If the *Acquire Enable* signal changes during the time window of t_{su} (set up) to t_h (hold), the behavior is random. The trigger may be accepted or ignored. Specific values for your camera can be found in the camera manual.

Sequence Trigger

Once a falling or rising edge at the *Acquire Enable* trigger input (see chapter <u>3.3.7</u>) is recognized, an internal image counter starts. It counts all acquired images and stops the recording when the predefined number of images is reached.

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

Example Timing Diagram:

Trigger Mode is set to *Ext. Exposure Start* and *Acquire Mode* is set to *Sequence Trigger* mode; Image counter: 3.



Note Do not confuse the function with the Sequence Trigger Mode (see camera specific manual).

3 Time Stamp

A time stamp can be placed into the upper left corner of the image. It can be either **No Stamp**, **Binary**, **Binary** + **ASCII** (text) or **ASCII**.

The time resolution is 1 μ s. In binary mode the first 16 pixels will be filled with the time stamp information (binary code). The numbers are coded in BCD with one byte per pixel, which means that every pixel contains 2 digits. If the pixels have more resolution than 8 bits, then the BCD digits are right bound placed and the upper bits are zero.

(1 BCD digit 4 bits; 2 numbers 2 BCD 8 bits = 1 byte; every pixel contains 2 digits)

For further information refer to our SDK manual. In binary and ASCII mode text will be placed into the image replacing the content of the image (271x 8 pixels). Time stamp shows the end of exposure time.

Three values are stamped onto the image:



0000017 06 NOV 2023 10:17:14.816000

3.3.6 Status

Shows the temperature of various camera elements.

1 Electronics Temperature

Shows the actual temperature of the FPGA.

2 Power Supply Temperature

Shows the actual temperature of the voltage supply inside the camera.

3 Sensor Temperature

Shows the actual sensor temperature.

	Status	
	Electronics Temperature	29
	Sensor Temperature	20.5
	Power Supply Temperature	29

For cooled cameras:

A Peltier cooling unit keeps the sensor's dark current to an acceptable minimum to achieve a continuous image acquisition free of any drift phenomena. Either an internal fan or an external water cooling system assures proper heat transfer from the Peltier element to stabilize the temperature of the camera.



If the temperature rises above a certain level, pco.camware will give you a warning. Please

always ensure adequate cooling of the cameras. Do not expose it to direct sunlight or other sources of heat.

3.3.7 Hardware IO control

Hardware IO control options differ depending on the camera model. Refer to the camera specific manual to see which options are available for your camera.
Ha	rdware I/O Control	
Ξ	Exposure Trigger	
	Exposure Trigger	On
	Signal Polarity	Rising
Ξ	Acquire Enable	
	Acquire Enable	On
	Signal Polarity	High
Ξ	Status Busy	
	Select I/O Signal	Status Busy
	Status Busy	On
	Signal Polarity	High
Ξ	Status Expos	
	Select I/O Signal	Status Expos
	Signal Timing	Show time of 'First Line'
	Status Expos	On
	Signal Polarity	High
		Hardware I/O Control Exposure Trigger Exposure Trigger Signal Polarity Acquire Enable Acquire Enable Signal Polarity Select I/O Signal Signal Polarity Select I/O Signal Signal Timing Signal Timing Status Expos Signal Polarity Signal

Change settings using the drop-down menu.

🗄 Ha	ardware I/O Control		
Ξ	Exposure Trigger		
	Exposure Trigger	On	
	Signal Polarity	Rising	
Ξ	Acquire Enable		
	Acquire Enable	On	
	Signal Polarity	High	•
Ξ	Status Busy	High	45
	Select I/O Signal	Low	
	Status Busy	On	
	Signal Polarity	High	
Ξ	Status Expos		
	Select I/O Signal	Status Expos	
	Signal Timing	Show time of 'First Line'	
	Status Expos	On	
	Signal Polarity	High	

Enabling and Polarity of IO Signals

Signals can be enable or disabled from this menu. The polarity of the input and output signals indicating their active states is selectable (positive or negative logic).

The polarity of level-sensitive signals can be set to *High* (positive logic) or *Low* (negative logic).

The polarity of edge-sensitive signals can be set to *Rising* (positive logic) or *Falling* (negative logic).

3.3.8 Convert control

Start the Convert Dialog with the black/white button in Camera Properties.



Convert Control BW

The conversion of the original 12/14/16 bit image intensity values (x-axis) to the corresponding 8 bit values of your computer can be arranged.

BW Setting (includes histogram of original data)

1 Swap Display shows either gamma setting graph or histogram of the converted image (8 bit).



Swap Size shows both in the same window.



Left slider: minimum controller (corresponds to value 0 of the 8 bit display). Values below that mark are set to 0, i.e. displayed as black.

Right slider: maximum controller (corresponds to value 255). Values above that mark are set to 255, i.e. displayed as white.



The values in-between are converted to a value between 0 and 255 depending on *Contrast* and *Gamma* settings.

4 See the small graph, which reflects the calculation.

Proc config tab: see Convert Control Color on next page.

Converted Hist

This tab shows you the histogram of converted data.



Other functions (Saturation, Vibrancy, Col.Temp, Tint) are inactive for monochrome cameras.

Convert Control Color (only color cameras)

The displayed color images are RGB images, calculated with the help of the three different color channels (red, green, blue). As a result, there are three different histograms for an RGB image: one for each color channel. The available user controls are the same as those for grayscale histogram.

Color Balance (Histogram of original data)

1 Intensity of a single color is controlled by **Saturation** and **Vibrancy**.



3 The balancing of RGB is controlled by **Col.Temp.** and **Tint**.

4 Swap Display shows either gamma setting graph or histogram.

5 Swap Size shows both in the same window.

6

White sliders in histogram

R × Camera Camera 1 (pco.dimax CS) Convert Control Color Color Balance Proc config Converted RGB Hist Saturation 0% Contrast 0% -100% -100% 100% 100% 1.00 Vibrancy 0% Gamma 04 25 -100% 100% Col.Temp. 5805 Auto WB 👂 1000K 20000K ۵% Tint Default -100% 100% Swap Display Swap Size 0 Zoom Min 112 Max 3068 🔶 - +

Left slider:

Minimum controller (corresponds to value 0 of the 8 bit display). Values below that mark are set to 0, i.e. displayed as no color.

Right slider:

Maximum controller (corresponds to value 255). Values above that mark are set to 255, i.e. displayed as full color. The values in-between are converted to a value between 0 and 255 depending on *Contrast* and *Gamma* settings.

7 The small graph reflects the lookup table calculation, includin gamma, contrast, brightness, etc.

Proc. Config (Process configuration)

Due to proprietary high-end algorithms used for these image processing features, no detailed description is given here.

8 GPU Processing

Choose between **Opencl** and **Nvidia GPU** in order to significantly reduce processing time (increases refresh rate of the live image). If this option is not available use an Nvidia graphics device or update to the most recent driver for Nvidia GPU.

Fast pco debayering: only for color cameras. An alternative method for removing the Bayer pattern.

9 Color define Filter: only for color cameras



11

NLM: non-local means algorithm

Denoise Adaptive: only for color cameras

Color Balance Proc config Converted RGB	Hist		
GPU Processing GPU OpenCL Convert v pco debayering v	Noise Reduction NLM [Denoise Adaptiv [
Color Refine Filter	Sharpen On [
	Mean: 855	Swap Display	Swap S
	٩	DINI	

On: only for color cameras (first activate Fast pco debayering)

Converted RGB Hist

This tab shows you the histogram of converted data.



3.3.9 Lens control dialog

Open *Lens Control Dialog* with this button. Button is only active if a camera with EF lens is detected.

Lens Control is only available for pco.edge with Camera Link HS interface, pco.dimax cs and pco.dicam C1.



Settings

Aperture (f/pos): select the aperture. All possible apertures of your lens are listed.

Focus: select focus from 0 to infinity.

Lens	Co	ontr	ol	/ Ca	ame	ra 1	l (pc	o.di	max	CS)																						
Ар	Aperture [f/pos]																															
	1.4	8 2	.0	2.1	2.3	2.5	2.8	3.0	3.3	3.6	4.0	43	4.7	5.1	5.6	6.1	6.7	7.3	8.0	8.7	9.5	10.3	11.3	12.3	13,4	14.7	16.0	17,4	19.0	20.7	22.6	
Fo	cus																															
	0																														00	
50-5	0m	m f·	Ste	eps	29 /	50m	nm /	Cano	on EF	-232	Libr	ary v	22b	/ f/1	3.4 /	163	83															



1 Lens Control Dialog shows detailed information about the mounted lens and the current position of aperture and focus.

3.4 Image overlay



1 Open Image Overlay: toggle between Camera Properties and Image Overlay with these tab controls.

If not available, see 3.9.5 to activate it.



This function enables a configurable image overlay allowing to display information within the images.

2 Many options are available by clicking Add item to List.

The *Appearance* is of the overlay is configurable:

Font, Text Color, Text Opacity, Background Color, Background Opacity and X Position or Y Position.

3 **Camera Image Number** The image numbers are incremented continuously. Recording in **Ring Buffer** mode, once the camera's RAM is full, results in overwriting the images, starting with the first image in the loop. However the camera continues to increment the image number.

Application Image Number The software displays the image numbers according to the quantity of images being recorded (starting with image 1). After *Ring Buffer* is full the number is always reset to 1.

lma	age Overlay	×					
Ξ	Overlay						
	Add Item to List	T					
	Camera Image Number	Camera Image Number					
	Date (D.M.Y)	Application Image Number					
	Time Stamp (h:m:s:ms)	Date (D.M.Y)					
	Diff to T0 (m:s:ms)	Date (W/D/Y) Date (V/M/D)					
	Width	Time Stamp (h:m:s:ms)					
	Bit Depth	Time Stamp (m:s:ms) Time Stamp (h:m)					
	00001 05.04.2063 12:10:20:						
Ξ	Appearance	Time Stamp (h:m:s)					
	Font	Diff to T0 (m:s:ms)					
	Text Color	Width					
	Text Opacity [%]	Height					
	Background Color	Bit Depth					
	Background Opacity [%]	Custom Text					
	X Position [%]	Exposure Time					
	Y Position [%]	Metadata					
	Vertical	No					

5 A preview of the *Image Overlay* is shown.

6 Each item can be moved or deleted: Move Upwards, Move Downwards or Delete by clicking on ... or move freely by clicking on ... and dragging an item.

lma	age Overlay		×
Ξ	Overlay		
	Add Item to List		
	Camera Image Number	[Num]	
	Date (D.M.Y)	Move upwards	
	Time Stamp (h:m:s:ms)	Move downwards	
	Diff to T0 (m:s:ms)	Delete	
	Width	Delete	
	Bit Depth	[bits]	
	00001 05.04.2063 12:10:20:3	300 T0 - 10:20:140 2048 16	
Ξ	Appearance		
	Font	Arial(17)	
	Text Color		
	Text Opacity [%]	100	
	Background Color	0179cd	
	Background Opacity [%]	100	
	X Position [%]	5	
	Y Position [%]	5	
	Vertical	No	

Drag & drop the *Image Overlay* to the desired position within an image.





7 Right click in the image to start **Show Image Overlay**.





This function does not overwrite raw recorded image data. Only the converted 8 bit image will be covered depending on the opacity.

3.5 Recorder tools

Recorder Tools provides Record and Play function, Play Settings and Record Settings.

Located on the right lower side of pco.camware or, if closed, activated by View Menu (see chapter **3.9.5**).

Record

Start/Stop record: with *Record* Button or press *enter* in the *View window* to Start / Stop a record session.



Record: in record state pco.camware software is highlighted in red.

Exposure time can be changed during recording. See <u>3.3</u> *Camera Properties*.

Recorde	er Tools	
	\mathbf{V}	•
🗆 Pla	yback Settings	

Software Trigger: after record is started an arrow pointing downward appears. Clicking on it triggers a single image. (see **3.3.1**).

Recorder Tools								
	1	<u>.</u>						
🗆 Pla	ybac	<u></u>	Trigger					
		¥	Send Software Trigger					

1 Play Settings

Play Speed: selectable Play Speed from x1 to x256 or from 1 fps to 16 fps.

E.g. in mode x1 a recording with 1000 fps is played as fast as possible.

1 fps means that only one frame per second is played. X2 displays only each second image.

Play Mode: selectable play mode of the recorder (Single or Continuous (re)play).

Play Direction: selects direction of record play (Forward or Backward).

Recorder Tools	
$\Box \downarrow$	\searrow
Playback Settings	
Playback Speed	x1
Playback Mode	Continuous
Playback Direction	Forward
Record Settings	
Averaging	x1
IIR Lowpass	No
Preview Settings	
Preview with Ext. Signals	No

2 Record Settings

Averaging: averaging images in the buffer reduces random image noise. Set a value higher than x1 in the drop-down list and this number of images will be averaged.

IIR Lowpass: another option to reduce the noise is the activation of the Infinite impulse response *IIR Lowpass* filter. This filter takes 50% of the previous image and 50% of the new image to create images with reduced noise.

Image (actual) = {Image (act - 1) + Image (new) } / 2

Preview Settings

If **Preview with ext. signals** is set to **Yes**: **Trigger Mode Ext. Exp.** / **Ext. Exp. Ctrl. Start** 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.

pco.cam	ware 4							
Last record is not saved! Start new record								
	Yes	No						
[Hide this dialog	g next time?						

Reminder Dialog

If you made a recording but did 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 <u>3.9.2</u>.



Extended Recorder

Extended Recorder can be activated (see 3.9.5).

- 1 Record / Stop record / Play.
- 2 First image (jump to first image) / Back fast (jump backward) / Back (jump one image backward).

3 Forward (jump one image forward) / Forward fast (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 <u>3.3.5</u>).

•

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

80	po	co.camware - Camera 1 (pco.dimax CS)	
][File	Camera Acquisition View Window ?	
C		Open Raw File	CTRL+I
1		Open Raw Recorder Sequence	CTRL+R
6		Save Raw File	CTRL+E
Ľ		Save Raw Recorder Sequence	CTRL+S
		Export File (not reloadable!)	CTRL+T
		Export Recorder Sequence (not reloadable!)	CTRL+O
		Options	
		Open AVI Codec Dialog	
		Open Pseudo Color LUT	
		Start Auto Save	Alt + D
		Exit	

Coolor Coded Image Overlay

Set up and acquire a sequence of images that are overlayed to form a color composite. To open Color Coded Image Overlay, open:



2 Options



4 If enabled, it can be activated in the **Recorder Tools** window.

Coptions 200			\times
Single File Properties			
DICOM Metadata File	DICOM File Path		
Single TIFF File 16bit Alignment	Lower		
ASCII File Separator	TAB		
Binary PGM File	No		
JPEG 2000 Image Quality	100		
JPEG Image Quality	85		
Binary PPM File	No		
RAW 16bit RGB TIFF File	No		
Use Cache File	No		
Load Convert Settings From Single	No		
General File Properties			
FIFO Buffer Size	150		
Preserve Last Record	No		
Embedded File Comment	PCO-PCO-PCO-PCO-PCO-PCO		
View Properties			
Crosshair Color	ff2020		
Crosshair Length	312		
Update All Cameras	Yes		
Show Camera Control	Yes		
Auto Exp. Target	25		
Line Diagram Scale Factor	1.000000		
Show Grid	No		
Display Properties			
Standard Play Wait Time	17		
Bitmap Bit Resolution	24 bit		
Recording Properties			
Recording Look	Yes		
Recording Look Color	dd2800		
Color Coded Image Overlay	Yes		*
			63
Color Coded Image Overlay Enables or disables Color Coded Image	Overlay. In case option is only 'No' a color camera is connected. Color cameras are	not support.	
		Cancel	ОК

Rec	Recorder Tools								
C	ゔ ⊳								
	Playback Direction	Forward							
Ξ	Record Settings								
	Averaging	x1							
	IIR Lowpass	No							
Ξ	Preview Settings								
	Preview with Ext. Signals	No							
Ξ	Color Coded Image Overlay								
	Color Coded Image Overlay	Yes							
	Image Accumulation	1							

Color Coded Image Overlay

When set to 'Yes' recorder switches to 'Color Coded Image Overlay'.

Start recording by clicking on 'Record' button in toolbar above and click 'Acquire' button in 'Recorder'.



5 The Recorder window will now have 2 additional buttons. Click on the setup button.

Recorder 🛛 🕂 🗙	Recorder Tools
	o ⊳
(Click to setup. Start record to acquire.
	Playback Sp x1

This opens the Setup dialog.

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.

Setup	>
Color Coded Image Overlay	
Channels	3
Individual Exposure Time	No
Image Combine	OR
Ignore 0xFF	No
Auto Save	No
Image Folder	C:\Users\tina.aepler\Documents
Image File Name	pcoFluor
File Mode	Save
Save File Type	tif
Channels	
Channel 1	690 Alexa fluor 660
Channel 2	517 Alexa fluor 488
Channel 3	410 Methoxycoumarin
	Cancel OK

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.

-	-	
•	Setup	
-	Color Coded Image Overlay	
	Channels	3
	Individual Exposure Time	No
	Image Combine	OR
	Ignore 0xFF	No
	Auto Save	No
	Image Folder	C:\Users\tina.aepler\Documents
	Image File Name	pcoFluor
	File Mode	Save
	Save File Type	ff
-	Channels	
	Channel 1	690 Alexa fluor 660
	Channel 2	442 Alexa fluor
	Channel 3	517 Alexa fluor 488
Cł	vannel 1	1223 Alexa fluor 555 2031 Alexa fluor 558 1211 Alexa fluor 594 1352 Alexa fluor 594 1352 Alexa fluor 503 1352 Alexa fluor 600 1352 Alexa fluor 600 1353 Alexa fluor 600 1353 Alexa fluor 600 1353 CPP 1354 CP
Se	lect fluorphore from list. Click on '' on the right to	510 G/C 520 G/C 520 G/C 525 G/C Gy3 5581
		570 Cy5 594 Cy5 5 570 Cy7 455 DAPI
		Ethidum bromide Elicit FAM

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*.

Color Coded Image Overlay Channels 3 Individual Exposure Time No Image Combine OR Ignore &CF No Auto Save No Image Folder C.Vuenrvina aepler\Documents Image File Mode Save Save File Type If Channel 1 500 Channel 2 Sort list by wavelength Channel 3 If Sort list by mane Edit list Move downwards Remove	\times
Image Folder C-\Users \Una sepler\Documents Image File Name pooFluor File Mode Save Save File Type tf Channel 1 Channel 1 Channel 2 Channel 3 Sort list by wavelength Channel 3 Sort list by name Edit list More upwards Remove Remove	
Channel 1 590 Aexa fluor 660 Channel 2 Channel 3 V Sort list by wavelength Sort list by mane Edit list Move upwards Remove	
Add	
Channel 1 Select fluorphore from list. Click on '' on the right to change sort order or to edit fluorophores.	

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.

Fluorophore Edito	ır ?	×	Setup		×
Add new fluorophore wit	th 'Add'. Remove with 'D	elete'.	Color Coded Image Overlay		
Double click name to ex	£	_	Channels	3	
Click on Color to change	e lookup table color.	_	Individual Exposure Time	No	
	Distate	OK I	Image Combine	OR	
Muu	Delete		Ignore 0xFF	No	
Ekussenhose /	EM Color		Auto Save	No	
	- Color		Image Folder	C:\Users\tina.aepler\Documents	
 Alexa fluor 	442		Image File Name	pcoFluor	
Alexa fluor 488	517		File Mode	Save	
Alexa fluor 532	555		Save File Type	të .	
Alexa fluor 546	573		Channels		
Alexa fluor 555	573		Channel 1	690 Alexa fluor 660	*
Alexa fluor 568	603		Channel 2	517 Alexa fluor 488	_
Alexa fluor 594	617		Channel 3	410 Methoxycoumarin	
Alexa fluor 633	639				
Alexa fluor 660	690				
Alexa fluor 680	702				
 Allophycocyanin 	660				
 Aminocoumarin 	445				
✓ CFP	485				
 Chromomycin A3 	575				
✓ Cy2	510				
🖌 Cy3	570				
✓ Cy3.5 581	596				
✓ Cy5	670	r i i i i i i i i i i i i i i i i i i i	Channel 1		
✓ Cy5.5	694		Select fluorphore from list. Click on '' o	n the right to change sort order or to edit fluorophores.	
🖌 Cy7	770				
✓ DAPI	455				
 Ethidium bromide 	620				
✓ FAM	516				Cancel OK

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.



3.6 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.

/ C	amera 1	(pco.din	nax CS) 🗙	Came	Camera 2 (pco.panda 4.2)							
778	B/W	611 (1	135, 27)									
1		1 1	500	· •	1000	i	i	1	'	1500		

More View Windows



1 You may open more than one window for one camera: click View Window button



2 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.



3 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.

Camera 1 (pco.dimax CS): View 5	Camera 1 (pco.dimax CS): View 6	Camera 1 (pco.dimax CS): View 7
		Camera 1 (pco.dimax CS): View 1
		🔤 Camera 1 (pco.dimax CS): View 10
		🔤 Camera 1 (pco.dimax CS): View 11
		🔤 Camera 1 (pco.dimax CS): View 12
		🔤 Camera 1 (pco.dimax CS): View 13
		🔤 Camera 1 (pco.dimax CS): View 14
		🔤 Camera 1 (pco.dimax CS): View 15

Split View Window

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

5 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 3.9.8).





6 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.

1214	Camera B/W	1 (pco.dimax C 1368 (518,	S): View 2	Camera 1	(Feedback	Horizontal Vertical Tab	Tab Group	2 (pco.	panda 4.2)		
		4. X 4							Merch .	a me	, and states

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.

pca.camuase - Camera 1 (pco.dimax CS)					- 0	3
ie Camera Acquisition View Window 7						
3 3 4 * * Q J	,		Passes 1 loss discu 78	N	n v l	
			1154 BANK 4785 (1988 1998			
<u>приячи</u>	D DE DI 88			C 22 View Mode		
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ra 1 (positimer CD				Image Hel. 2018		
9/W 1575 (2916, 2007)			a state of the sta	Starting and and a start of the		
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	and a state of the second se		SALAR REAL PROPERTY AND A DESCRIPTION OF A	Sharina. No		
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Calego Cat	the state of the s		ALL AND A	Gamma a 188	076	
O Design (get and the			ALC: NO. OF THE OWNER	Contrast + 1	-	
Comment lat	A REAL PROPERTY AND A REAL			🖰 Image Conversion Device	Resided Very	NAK.
Camera 2 (pop panda 4.2)				MME IN	in Mode	
B R Proving Let				Device Quadra M4000	0	
E Carnero Set				Partime v. SY640	-	
				Device RA. 115 MB		
0	mera 1 (pos.dimar CS) Camera 1 (pos.dimar CS)					
	Comera I (posufieros CS) x Comera 2 (pospenda 42)					
2	N 8/W 1211 (566, 585)				O MANAGED T	
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	and all the second s				2276	
Commission International		and the second s			22.0	
Index 5	THE R. P. LEWIS CO., LANSING MICH.	Annual second			Promot	
x.dinac051200. Camera Set		and the second s			10	
cepanda4214400. Comera-Set	CONTRACTOR OF TAXABLE PARTY OF TAXABLE PARTY.	The second	29		re blode	
luster 2					100	
in candard 2 14420. Camera Tet			No		-	
	CONTRACTOR OF THE OWNER		STREET, STREET	State 1 1 1 1 1 1 1 1	oli Syn. Yee	
		and the second data was not been been been been been been been bee	29S.mbs (A CONTRACTOR OF A CONTRACTOR O	wina, No	
		Cherry Constanting			oge Conversion	
		Contraction of the local division of the loc	The second statement of the second se	A Design of the party of the second data in the second data and th	and - + 100	
					ana + 100	
				Contraction of the second s	eut = 0	
					anage Conversion Der	NO
				-		

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.



3.7 Recorder (Images)

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

ecorde	(1544 Ima	ges / Last i	refresh rat	te ~ 4.2)										a x	Recorder Tools
-	1199 (16:1	0:59:622)	1	204 (16:10:59:76)	2) 12	09 (16:10:59:5	903)	1214 (16:11	00:043)	1219 (16:11:0	0:184)	1224 (16:11:00	324)	1229 (16:11:00:	d N
~~~															0 -
						1200	(II)								Playback Settings
-	_					_				1000	_				
Reco	rder (1544	Images / L	ast refresi	h rate ~ 4.2)	Settings	Overview	Tempera	ture Chart	Histogram						
Wat 1	59 v: 932 V	at 576													

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

1 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 guick 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.

3 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.



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

1236 (16:11:00:661)	1241	(16:11:00:801)	1246 (10	6:11:00:942)	1251 (16:11:01:082		
	and and the second				Carlot Contactor		
	-						
		1	1	1		1	
			1000				
			1				

### **Right-Click Menu**

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

6 Reset In / Out discards these settings.

pco.camware

to search for events.

Set In / Out is active: if you save / export your images, only the selected ones are saved/exported (see <u>3.9.2</u>).



The light gray area in the upper scale shows an *In-Out* example area. To define a new area, rightclick 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.

	1236	(16:11	:00:66	51)		1241	(16:11	:00:80	1)		1246	(16:11	:00:94	2)		1251	(16:11	:01
23	-	-	-	-	and and a second	Carden and	-	-	-	-	-	-	Contract of the	Contract of	and services.	-	Contract of	
	-			-		F				-								
	1		1			1		<	₩>		1	_		_	_		_	
	_	_	_	_	_	_	_	_	_	_	1000	_	_	_				
		1		- I.			1		1				1		1			



238 (16:40:53:731)	243 (16:40:53:791)	248 (16:40:53:851)
		WELL OF WELL OF WELL OF WELL OF WELL OF
	and Printerson Printerson Printerson Printerson	and the same division of the s
210 220 230	240 250	260 270
أتريق والمراجع الأرب أوالاستار الملاح ماريا		
Recorder (290 Images / 1 - 250 / Last refresh rate ~ 4.2)	Settings Overview 🔄 Temperature Chart 📊 Histogram	

### **Too Dark or Bright Thumbnails**

If thumbnails are too dark or too bright, right-click in *View Window* (see <u>3.9.8</u>) 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*.

Recorder (761 Ima	ges / Last refresh rate ~ /	4.2)								¢ ×
	41 (16:51:31:21	9)			46 (16:51:31:279)				1 (16:51:31:340)	
THE T	Les The	HILL THE	Le TIME			1.0	The The		THE THE	
			_	_		_				
1	1	1		1		1			100	
1	100	200		300	400		500	600	70	

### **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.

Insert	Home	Page Up
Delete	End	Page Down
-		$\rightarrow$

### **Additional Short-Cuts**

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

Press CTRL + left mouse button to jump to the first image. Press CTRL + right mouse button to jump to the last image.

R. BRITH	and the second s
and solution	and and a
	1000

## 3.8 Settings overview

Open **Settings Overview** in the lower toolbar right next to the recorder. If it is not visible see chapter **<u>3.6</u>** *Toolbars and Docking Windows* to open it.

Settings Overvie	ttings Overview									
Camera	Auto S	Туре	Status	Frame Rate	Resolution	Exposure Time	No. of Images	T0 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	-	-	

**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.

Recorder (1544 Images / 953 - 1385 / Last refresh rate ~ 4.2)						a ×
		1 (16:10:36:265)	2 (16:10:36:268)	3 (16:10:36:271)	4 (16:10:36:274)	5 (16:10:36:277)
100 200	300	400	500	60	0	700
		1	1000			
Recorder (1544 Images / 953 - 1385 / Last refresh rate ~ 4.2)	Settings Ov	erview 💦 🚾 Tempera	ture Chart 🛛 📶 Hist	ogram		

The parameters can only be changed under **3.3**.



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

Number	Function	Description
0	Camera name	Name
0	Auto Save	Off, Unconfigured (red), OK (green)
3	Туре	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
	Exposure time	Selected exposure time
8	Number of images	Number of images to be recorded

Continued on next page

### Continued from previous page

Number	Function	Description
9	T0 Position	See camera specific manual
10	Ext. Sync. State	See camera specific manual

### 3.8.1 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 acquireand 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* <u>3.9.2</u>. 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	Туре	Status	Frame Rate	Resolution	Exposure Time	No. of Imag	T0 Pos.	Ext. S
Camera 1	🗹 Unconfiguredl 🛛 📐	Configure (Auto Saus)	Ready	36	2016 x 2016	28ms	1544	inactive	-
Camera 2	Off	compute Auto save	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.

Contemporary Contemporary Auto Save Options			×
General Auto Save Settings     Global			
Auto Save Mode	Save manually (Alt + D)		1
Select Output	Save unattendedly (automatic start after record)		in the second
Common Folder	Save unattendedly (automatic start after record) and	d restart recordir	ıg
Apply Automatic File Naming	Save manually (Ait+D)		
Camera Specific Auto Save Sett	ings		
Camera / Camera 1			
Save RAW File Settings /	Save RAW File disabled: No file will be save	d!	
Export File Settings / Expo	rt File is disabled: No file will be saved!		
Camera / Camera 2			
Save RAW File Settings /	Save RAW File disabled: No file will be save	d!	
Export File Settings / Expo	rt File is disabled: No file will be saved!		
Auto Cours Manda			
Selectivour preferred save mode: Save	manually (apply file menu entry "Start Auto Save" or h	uit Alt + D) or Sav	
unattendedly (automatically starts saving	files when recording is stopped). When restart record	ding is selected	e , a new record
will be started when auto save is finished	(Can be stopped by hitting ESC key during stopping	record).	
		Cancel	ОК

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 selcting 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 unattendely (automatic start after record):* saves all image data after recording, without any further user interaction.

**Save unattendely (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.

🎬 Auto Save Options			×			
☐ General Auto Save Settings ☐ Global						
Auto Save Mode	Save manually (Alt + D)					
Select Output	Off		-			
Common Folder	Off					
Apply Automatic File Naming Save RAW						
Camera Specific Auto Save Sett	Export		N			
Camera / Camera 1	Save RAW and Export		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			
Save RAW File Settings /	Save RAW File disabled: No file will be save	d!				
Export File Settings / Expo	ort File is disabled: No file will be saved!					
Camera / Camera 2						
F Save RAW File Settings /	Save RAW File disabled: No file will be save	d!				
Export File Settings / Expo	art File is disabled. No file will be saved!					
Select Output						
Enables auto Save RAW and/or Export	atter recording is stopped or started manually.					
		Cancel	ОК			

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.

at Aut	to Save Options				×	
⊟ Ger	neral Auto Save Settings Global				^	
A	Auto Save Mode	Save manually (Alt + D)				
S	Select Output	Save RAW and Export				
C	Common Folder	C:\Users\Tobias.Bischof\Documents			10	
F	RAW File Type	16bit PCO B16 File (*.B16)				
E	Export File Type	8bit AVI File #(*.avi)				
E	Export Color Image	b/w				
A	Apply Automatic File Naming	Yes				
	File Name					
A	Add Item to List					
C	Camera Name	[Name]				
0	Date (MDY)	[Date (MDY)]				
Т	Time Stamp (hm)	[hhmm]				
C	Custom Text	pco				
F	File Name Separator	_(Underscore)				
🖃 Can	nera Specific Auto Save Setti	ngs				
Ξ (	Camera / Camera 1					
	Save RAW File Settings / CAUsers\Tobias Rischof\Documents\Camera 1, 11062023, 1650, n					
			Cancel	ОК		

### File Name

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

auto Save Options		×
General Auto Save Settings		^
Global		
Auto Save Mode	Save manually (Alt + D)	
Select Output	Save RAW and Export	
Common Folder	C:\Users\Tobias.Bischof\Documents	
RAW File Type	16bit PCO B16 File (*.B16)	
Export File Type	8bit AVI File #(*.avi)	
Export Color Image	b/w	
Apply Automatic File Naming	Yes	
File Name		
Add Item to List		
Camera Name	[Name]	
Date (MDY)	Move upwards	
Time Stamp (hm)	more opwards	
Custom Text	Move downwards	
File Name Separator	Delete	
E Camera Specific Auto Save Set	ttinga	
Camera / Camera 1		
Save RAW File Settings /	C:\Llsers\Tohias Bischof\Documents\Camera 1 11062023 1650 n	~
Camera Name Adds the camera name that is assigned Click menu button on the right to change	I to the camera in the properties dialog. Click and drag an item to change order. order or to delete item.	
	Cancel OK	

### **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).

Auto Save Options		×
General Auto Save Settings Global File Name Camera Specific Auto Save S Camera / Camera 1 Save RAW File Settings	ettings :/CNUsers\Tobias BischofDocuments\Camera 1, 11062023, 16	50 p
RAW File Folder	C:\Users\Tobias.Bischof\Documents	
RAW File Name	Camera 1 11062023 1650 pco	N
Export File Settings / C:	Users\Tobias.Bischof\Documents\Camera 1_11062023_1650_p	co.avi
Export File Folder	C:\Users\Tobias.Bischof\Documents	
Export File Name	Camera 1_11062023_1650_pco	
Multimedia File Reso	olution	
Export Presets	DVD	
Export X-Resolution	720	
Export Y-Resolution	576	
🖃 Camera / Camera 2		
Save RAW File Settings	; / C:\Users\Tobias.Bischof\Documents\Camera 2_11062023_16	50_p
RAW File Folder	C:\Users\Tobias.Bischof\Documents	
RAW File Name	Camera 2, 11062023, 1650, non	$\sim$
File Name Shows the list of currently seleted item notice. To reduce this risk, please add	is that will be used for automatic file naming. Files might be overwritten with d Time Stamp (hms) or a counter, which usually generates a unique file nar	out prior ne.
	Cancel	ОК

*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.

Auto Save Options				$\times$
Export File Name	Camera 1_11062023_1653_pco			~
Multimedia File Resoluti	on			
Export Presets	DVD			
Export X-Resolution	720			
Export Y-Resolution	576			
🖃 Camera / Camera 2				
Save RAW File Settings / C	:\Users\Tobias.Bischof\Documents\Camera	2_11062023_1	1653_p	
RAW File Folder	C:\Users\Tobias.Bischof\Documents			
RAW File Name	Camera 2_11062023_1653_pco			
Export File Settings / C:\Us	ers\Tobias.Bischof\Documents\Camera 2_1	1062023_1653_	pco.avi	
Export File Folder	C:\Users\Tobias.Bischof\Documents			
Export File Name	Camera 2_11062023_1653_pco			
Multimedia File Resoluti	on			
Export Presets	SVCD		•	
Export X-Resolution	Custom			
Export Y-Resolution	VCD			
	HDTV		N	
			3	~
Export Presets Select a resolution preset or choose 'Cus	tom' for entering an individual resolution.			
		Cancel	ОК	

Finish the configuration by clicking **OK**.

Settings Over	view								
Camera	Auto Save	Туре	Status	Frame Rate	Resolution	Exposure Time	No. of Imag	T0 Pos.	Ext. S
Camera 1	🗹 ОК	pco.dimax CS (12900036)	Ready	36	2016 x 2016	28ms	1544	inactive	-
Camera 2	🗹 ок	pco.panda 4.2 (14400459)	Ready	40	2048 x 2048	10ms	10	-	-

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

## 3.9 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.

### 3.9.1 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 laoded and processed when the camera is not connected. The **Demo Mode Setup** window opens, requesting the corresponding input.

🚏 Demo Mode S	etup	? ×			
Error on startup! No found! Starting with Please select color Besolution	camera detected out camera function and resolution for	l or no board ons. demo mode.			
custom		~ 10bit ~			
X 100 Y 10	)0 🗌 🗌 Dor	uble Image			
Color	Alianment				
● b/w ○ color	<ul> <li>Iower</li> </ul>	) upper			
PRESS 'Rescan'n log.' TO ENABLE LOGGING. This enables logging and rescans cameras.					
select '?/About' and 'Support'.					
Cancel	Rescan+log	OK			

**Need Help?** Having troubles to run the camera this window will pop up. Follow instructions of chapter **B**.

### 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 <u>3.9.5</u> at any time.

Info Text	;
C:\Users\Tobias.Bischof\Documents\Test_00001.b16 / Close Infotext to close opened sequence	
pco.camware Recorder Comment File	
Record Date: 06.11.2023 Time: 17:09:19	
Camera Settings         Camera Type       : pco.dimax CS         Picture Size horz./vert.:       2016/2016         ROI horz./vert.       : 1-2016/1-2016         Binning horz./vert.       : 1/x1         Exposure / Delay       : 40.000000 ms / 0.000000 ms         Pixelrate       : 55 MHz         Camera serial number       : 1200036	
Comment:	
Test Comment	
Ι	

## 3.9.2 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.

📄 po	co.camware - Camera 1 (pco.dimax CS)	
File	Camera Acquisition View Window ?	
45	Open Raw File	CTRL+I
1	Open Raw Recorder Sequence	CTRL+R
	Save Raw File	CTRL+E
c	Save Raw Recorder Sequence	CTRL+S
	Export File (not reloadable!)	CTRL+T
<u> </u>	Export Recorder Sequence (not reloadable!)	CTRL+O
(	Options	
	Open AVI Codec Dialog	
	Open Pseudo Color LUT	
	Direct Record to File	
	Start Auto Save	Alt + D
	Exit	

### **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 **3.8.1**.

#### 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 <u>3.8.1</u>.

				lus"
File	test			~
Dateityp:	16bit PCO B16 File (*.B16)			~
Image ra	nge Start image	Numbering Step images	Settings Save all cameras	
	Stop image (max. 117) 117	First image number 1		
	Save all images (1-117)	Different start no.		
<ul> <li>Ordner ausblender</li> </ul>				OK Abbrechen

#### 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 <u>3.8.1</u>.

#### 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 <u>A</u>). *Auto File Save* see <u>3.8.1</u>.



#### Options

**Single File Properties** 

Single TIFF File 16bit Alignment: upper/lower

**ASCII File Seperator:** select a separator for the values in the ASCII file. Select: TAB, SPACE, SEMICOLON, 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 3.9.8).

**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.

Single File Properties		N	
DICOM Metadata File	DICOM File Both	L3	
Single TIEE File 16hit Alignment	Lower		
ACON File Consenter	TAD		
ASCIT File Separator	TAD No.		
Binary PGM File	NO		
JPEG 2000 Image Quality	100		
JPEG Image Quality	85		
Binary PPM File	No		
RAW 16bit RGB TIFF File	No		
Use Cache File	No		
Load Convert Settings From Single	No		
General File Properties			
FIFO Buffer Size	150		
Preserve Last Record	Yes		
Embedded File Comment	PCO-PCO-PCO-PCO-PCO-PCO		
View Properties			
Crosshair Color	ff2020		
Crosshair Length	300		
Update All Cameras	Yes		
Show Camera Control	Yes		
Auto Exp. Target	25		
Line Diagram Scale Factor	1.000000		
Show Grid	No		
Display Properties			
Standard Play Wait Time	17		
Bitmap Bit Resolution	24 bit		
General Properties			
Sort cameras	No		
E Recording Properties			
Recording Look	Yes		
Recording Look Color	dd2800		
Color Coded Image Overlay	No		
oolor ooded image overlay			

### **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.

📫 Re	Registrierungs-Editor						
Datei	Bearbeiten A	nsicht	Favoriten	Hilfe			
Comp	outer\HKEY_CURF	RENT_US	SER\Software	e\PCO\C	amware 4\CameraSortOrder		
	Name	1	бур		Daten		
	ab (Standard)	F	REG_SZ		(Wert nicht festgelegt)		
	86 1	F	REG_DWORD	1	0x0000000 (0)		
	88 6000005	F	REG_DWORD	)	0x00000001 (1)		
	80000008 🔣	F	REG_DWORD	)	0x0000002 (2)		
	88 60000015	F	REG_DWORD	1	0x0000003 (3)		
	3 SortCameras	F	REG_DWORD	1	0x00000001 (1)		
	🕮 SortLikeThis	F	REG_DWORD	)	0x00000000 (0)		
	all SortLikeThisH	lelp F	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.

Re	gistrierungs-Editor		
Datei	Bearbeiten Ansich	t Favoriten Hilfe	
Com	outer\HKEY_CURRENT_	USER\Software\PCO\C	amware 4\CameraSortOrder
	Name	Тур	Daten
	ab (Standard)	REG_SZ	(Wert nicht festgelegt)
	<u>88</u> 1	REG_DWORD	0x0000003 (3)
	88 6000005	REG_DWORD	0x00000000 (0)
	88 6000008	REG_DWORD	0x00000001 (1)
	88 60000015	REG_DWORD	0x0000002 (2)
	88 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 3.8.1.

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.

ect Video Codec		
Codec Name	Output Resoluti	Codec Id
Full Frames, uncompressed	1920x1080, 24	DIB / 2042
➡ Intel IYUV Codec	1920x1080, 24	IYUV / 5655
➡Intel IYUV Codec	1920x1080, 24	IYUV / 5655
Microsoft Video 1	1920x1080, 15	MSVC / 435
Microsoft RLE	Change res or d	MRLE / 454
Microsoft YUV	No encoding ca	UYVY / 595
Toshiba YUV Codec	No encoding ca	Y411 / 3131
Configure About	🧹 Key Frame Every	15 frame(s)
	🗸 Data Rate	1620 kilobytes/
Video Qi	uality: 100% 🔍	>

### 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 <u>3.8.1</u>).

### 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.

### 3.9.3 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 3.3.9.
# 3.9.4 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.

pco.camware - (	Camera 1 (pco.dimax CS)		
File Camera Acq	uisition View Window ?		
Camera Overvie 🔍	Live Preview		(pco.dimax CS) ×
	Acquire Single Image	SPACE	828 ( 11, 24)
Q -	Record Sequence	CTRL+A	
🖃 🚾 Camera I	Memory Allocation Dialog		
	Auto Camera RAM Segment	t Switching	
📄 🖾 Camera	2 (pco.panda 4.2)		
🕀 🔍 Preview	Set		
Camero	a Set	-	

### Acquire Single Image

Active if *Trigger Mode* is set to *Soft Trigger*, see <u>3.3.1</u>.

#### **Record Sequence**

Starts recording images into the computer system memory according to *Trigger Mode* selection (see <u>3.3.1</u>). 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.

Memory Allocation Dialog		
Allocate # of images	ОК	
# of images 100	Cancel	
Max. allocatable 2087		

## 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.

pco.camware

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.

Setup Camera RAM Se	gment Switching	×
Use Auto Segment Switc	hing	- 0
Select Start Segment	Select Stop Se	gment
Segment 1	O Segment 2	2
🔾 Segment 2	Segment :	3
	Cancel	ОК

## 3.9.5 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 3.3.8.

#### **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 <u>3.9.1</u>.



## **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:

pco.camwar	e - Camera 2 (	pco.panda 4.	2 bi)		
File Camera	Acquisition Vi	iew Window	?		
RefAct.+O		∳ ≯	$\checkmark$		
CActRef.+Offs	(	ť	ι×		Camera
Q C		<b>~</b>	i.	84	B/W
🖃 🔤 Camera L	ist				

- 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.

# 3.9.6 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).

# 3.9.7 Help menu

## Contents

Not available.

### Search for Help on

Not available.



## 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.

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

pco.camware - Camera 1 (pco.dimax CS)			
File Camera Acquisition View Window ?			
Camera Overview 0	Contents	<	
Ġ 🕒 📭 🗖 🗖 .	Search for Help		
	Logging 🔥 🕨	Enable Logging	
Camera 1 (pco.dimax CS)	Create Support File	Clear Log Files	
Q. Preview Set	Support Mail (+Support File)	Explore Log Files	
Camera Set	About	Disable 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  $\underline{B}$ ).



## Support Mail

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

# About Camware

This window shows program information.



# 3.9.8 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 **3.3.3**.



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.

2 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 3.4.

# **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 <u>3.9.2</u> -> **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 3.6).

Ξ	🚥 View Mo	de
	Image Wid	2016
	Image Hei	2016
	View Color	No
	View Mode	Zoomed
	Zoom	1.0
$\square$	Common Vi	ew Mode
	Flip	No
	Mirror	No
	Rotation	No
	Scroll Syn	Yes
	Show Ima	No
$\square$	Image Conv	version
	Convert 🗸	124
	Convert 🗸	4095
	Gamma 🗸 🗸	1.00
	Contrast 👻	0
	🗆 Image C	onversion Device
	Conver	GPU OpenCL Convert
	NLM Fil	No
	Device	Quadro M4000
	Runtime v	516.40
	Device RA	8191MB

# 3.9.9 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 3.3.8).

#### **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 **3.3.2** *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

# Appendix

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В	Trouble Shooting	92
С	Index	94
D	About Excelitas PCO	96

# A Image File Formats

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

#### b16

The b16 16 bit 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	рсо-	B16 file identificator "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. 41280)
0x10	image height	image height in pixel (e.g. 12048)
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 (0b/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 (0red 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)
0x480x7F	gap	filled with 0
0x80Headersize -1	Embedded structure	see structure ${\tt Bild}$ definition below. Gap will be filled with 0.
		16 Bit Pixel Values

Continued on next page

Continued from previous page

Address	Parameter	Denotation
Headersize	Line 1, pixel 1	value of first pixel
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** Trouble Shooting

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.

pco.camware - Camera 1 (pco.dimax CS)		
File Camera Acquisition View Window ?		
Camera Overview 🎝	Contents	<
Q 🗅 📭 🗖 🗖 Q	Search for Help	
🖃 🚾 Camera List	Logging 🕨 🕨	Enable Logging
□ □ □ Camera 1 (pco.dimax CS)	Create Support File	Clear Log Files
R Preview Set	Support Mail (+Support File)	Explore Log Files
Camera Set	About	Disable Logging
pco.camware 4	N	
pco.camware and driver log Do you wish to continue logg Press 'NO' to delete the log f Press 'YCS' to continue with If you would like to reate sup	্থি files are enabled! This cuts down performance! ing? Tiles and disable logging. logging.	

#### **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.

pco.cam	ware 4	1 and	
0	Generate support file? This will generate a fil which will be attached It will contain some log additional info about y PCO_Reg.bd (Registry Conflicts.nfo (Info file a Processing might last	e called CWSuppo to the mail, if selec fifles and our system: y entries about driv bout the computer some time. Please	rt.zip, ted. er) s hardware) è be patient
	Yes	No	

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

# **C** Index

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# **D** About Excelitas PCO

PCO, an Excelitas Technologies brand, is a leading specialist and Pioneer in Cameras and Optoelectronics. With more than 35 years of expert knowledge and experience of developing and manufacturing high-end camera systems, PCO has grown into a leading specialist and innovator in digital imaging for scientific and industrial applications.

In-house competence of all significant technical disciplines and partnering with leading image sensor manufacturers ensures cutting edge sCMOS and high-speed imaging technology. The company's customers' input has a direct path back to its product development and support teams, enabling the constant advancement of hardware and software.

PCO is supporting the constant advancement of science and industry by relentlessly pursuing technological perfection. The company's cameras are used in scientific and industrial research, automotive testing, quality control, metrology and a large variety of other applications all over the world.

PCO represents a world renowned brand of high-performance scientific CMOS, sCMOS, CCD and high-speed cameras that complement Excelitas' expansive range of illumination, optical and sensor technologies and extends the bounds of our end-to-end photonic solutions capabilities.



An Excelitas Technologies Brand



An Excelitas Technologies Brand

telephone: fax: postal address:

email:

web:

+ 49 (0) 9441 2005 50
 + 49 (0) 9441 2005 20
 Excelitas PCO GmbH
 Donaupark 11
 93309 Kelheim, Germany
 pco@excelitas.com
 www.pco.de
 www.excelitas.com

