

user manual

# pco.dimax cs



**pco.**

**PCO asks you to read this manual carefully before using the pco.dimax cs camera system and follow the instructions.**

**Contact us for further questions or comments.**



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The cover picture shows a typical PCO camera system.  
The lens is sold separately.

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# 1. INTRODUCTION



## High-speed meets high resolution.

This high-speed 12 bit CMOS camera series incorporates advanced CMOS and electronics technology. It is perfectly suited for high-speed camera applications such as material testing, offboard crash and sled or impact tests or super slow motion movie clips. The camera systems feature also a variety of trigger options to cover all off-board and on-board applications required by the automotive industry.

### The camera's main features are:

	pco.dimax cs1	pco.dimax cs3	pco.dimax cs4
Maximum resolution (pixel)	1296 x 1024	1920 x 1440	2016 x 2016
Maximum speed @full resolution (fps)	3086	1603	1102

- **12 bit** dynamic range
- **Color** or **monochrome** image sensor versions available
- **Correlated Double Imaging** for superior image quality
- **Exposure time range** 1.5  $\mu$ s - 40 ms
- **Integrated image memory** (RAM 9 GB)
- **Double shutter operation** (optional)
- **Gigabit Ethernet (GigE)** data interface
- **HD-SDI** video output
- **Multiple trigger interface**
- **IRIG-B** (unmodulated) from B000 to B007 and B120 to B127

### Example areas of application

- automotive crash tests
- high-speed particle image velocimetry (PIV)
- short time physics
- spray analysis
- material testing
- tensile tests
- airbag inflation
- fast flow visualization
- hydrodynamics
- fuel injection
- combustion imaging
- semiconductor quality control
- fast events in nature and industry
- super slow motion movie clips
- ballistics

## 1.1 INTENDED USE

This camera system is designed for use by technicians, engineers and scientists. It is a scientific measuring instrument, which provides images. It is suited for applications with acceleration forces of up to 150G. The camera may only be used according to the instructions of this manual. Provisions, limitations and operating conditions stated in this manual must be respected. Unauthorized modifications or alterations of the device are forbidden for safety reasons.

## 1.2 REASONABLE FORESEEABLE MISUSE

**Overstress:** It is not allowed to use the camera for applications with acceleration forces higher than 150G.

**Temperature:** It is not allowed to use the camera beyond the specified temperature range.

**Use of lenses during onboard tests:** only special C-mount lenses (for high-G applications) are permitted. F-mount lenses must not be used.

**Accessories:** It is not allowed to use the **PCO Accessories** for HighG applications. The **Extension box** and the **breakout cable** must not be used for high-G applications.

**Open:** opening the camera voids warranty.

## 2. SAFETY INSTRUCTIONS



**DANGER**

Read the safety instructions completely.

### **DAMAGED POWER CABLE OR POWER PLUG**

Danger to life due to electrical shock!

- Each time the camera is used, check the power cable for damage.



**WARNING**

### **ELECTRIC SHOCK WARNING DUE TO VOLTAGE PARTS INSIDE**

Risk of injury due to electrical shock!

- Never slide any items through slits or holes into the camera.



**CAUTION**

### **MOISTURE**

Risk of injury due to electric shock if moisture enters the camera.

- To avoid the risk of water condensation, protect the camera against extreme changes of ambient temperature.



**CAUTION**

### **TRIPPING HAZARD**

Risk of injury from tripping over loose cables.

- Never position the cable in a way that it could become a tripping hazard.

**NOTICE**

### **HUMIDITY, DUST OR RADIATION**

Humidity, dust or x-rays could damage the camera.

- Never operate the camera in humid or dusty environments or in places with high level of x-ray radiation.

**NOTICE**

### **SHOCK & VIBRATION**

To avoid damaging the camera it must be firmly mounted and protected against strong shocks or vibrations.

- Use the camera's mounting threads to secure it.

**NOTICE**

### **LENS MOUNTING**

Do not force the lens onto the camera.

- To protect the lens connector thread from damage, screw in the lens gently to avoid thread damage.

**NOTICE**

### **LIQUIDS DAMAGE CAMERA**

If liquids have penetrated the device.

- Switch the camera off immediately, detach it from power and contact PCO's customer support.

**NOTICE**

### **DAMAGED CAMERA HOUSING**

If the camera has been dropped or the body is damaged.

- Switch the camera off immediately, detach it from power and contact PCO's customer support.

**NOTICE**

### **IF CAMERA IS NOT WORKING PROPERLY**

In case all actions following this manual to get the camera working properly were unsuccessful.

- Switch the camera off immediately, detach it from power and contact PCO's customer support.

## 3. SYSTEM COMPONENTS

The camera system includes the following parts.



### Camera

F-mount + C-mount (exchangeable) optical connection



### Rear Panel Connections (see A1.2)

- Battery / Lens Controller
- LEDs indicate camera status
- Lemo Connector (Power - GigE - Trigger – Sync In/out – Stat out)



### Breakout cable

RJ45 Cat6, BNC Sync In, BNC Trig In, XLR power  
see chapter **A3.1**



### Extension Box (optional)

see chapter **A3.2**



### Power Supply

**In:** 100-240V AC 50-60Hz, 1.4A max. **Out:** 24V DC 2.71A

### Power Cord

Standard IEC13 connector



### Digital Camera Tools (USB flash drive content)

- Camware: software for camera control & image acquisition
- Manuals
- Driver & tools
- Software development kit (SDK) & demo programs in C and C++



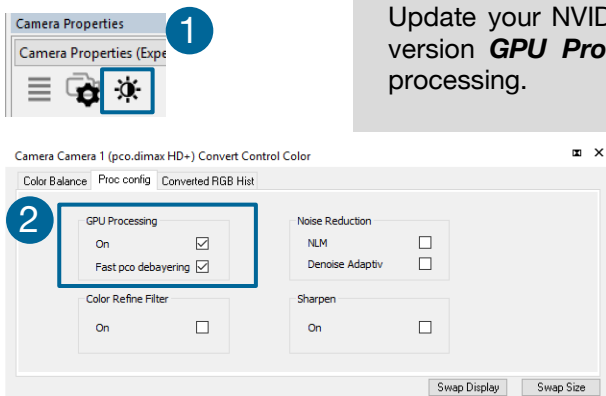
## 4. INSTALLATION

You will find all necessary files on the accompanying USB flash drive. You may also download the latest versions of our software, camera driver and third party software drivers from our website.

### Minimum system requirements:

- Clock speed > 2.4 GHz (Intel Core i7)
- RAM 4 GB
- Windows 7 or higher (no server version)
- Full-HD display
- Gigabit Ethernet GigE (1000 Mbps network interface card)

### 4.1 NVIDIA CUDA DRIVER



Update your NVIDIA driver for Camware 4. In case of an old driver version **GPU Processing** will not work and therefore slow image processing.

Check if **GPU Processing** is activated by having a look into the **Proc config settings** **2** in the **Convert Control window** **1** (see Convert Control chapter **6.3.8**).

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. Your NVIDIA driver version must be at least **333.11** or higher.

## 4.2 GIGE DRIVER

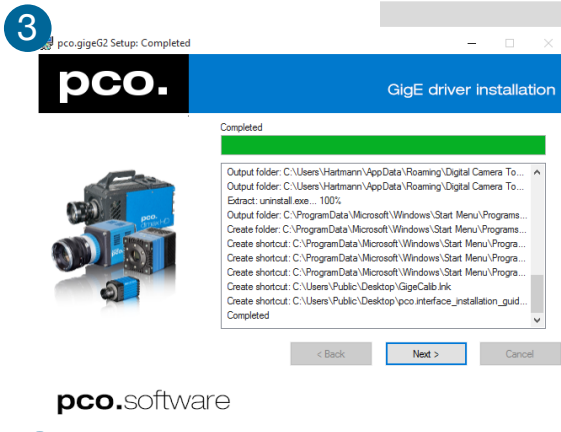
### NOTE

If installer fails, use uninstaller, remove all old files and then try again.

First install the PCO GigE driver to your computer, from the attached usb flash drive or from the PCO website [www.pco.de](http://www.pco.de).

Before installing, you have to **remove previously** installed GigE driver. The installer will do this for you. Or open **control panel** → **programs and functions** → and uninstall PCO GigE driver.

- 1 Start the GigE driver setup and follow the instructions.
- 2 Choose installation directory.
- 3 GigE driver installation is completed.
- 4 Reboot your computer to complete the installation.
- 5 Start **Calib Tool** see **A2**



### NOTE

This installation process installs both drivers: Gen2 and the former Gen1 V3.1 allowing former GigE cameras to run properly.

## 4.3 CAMWARE

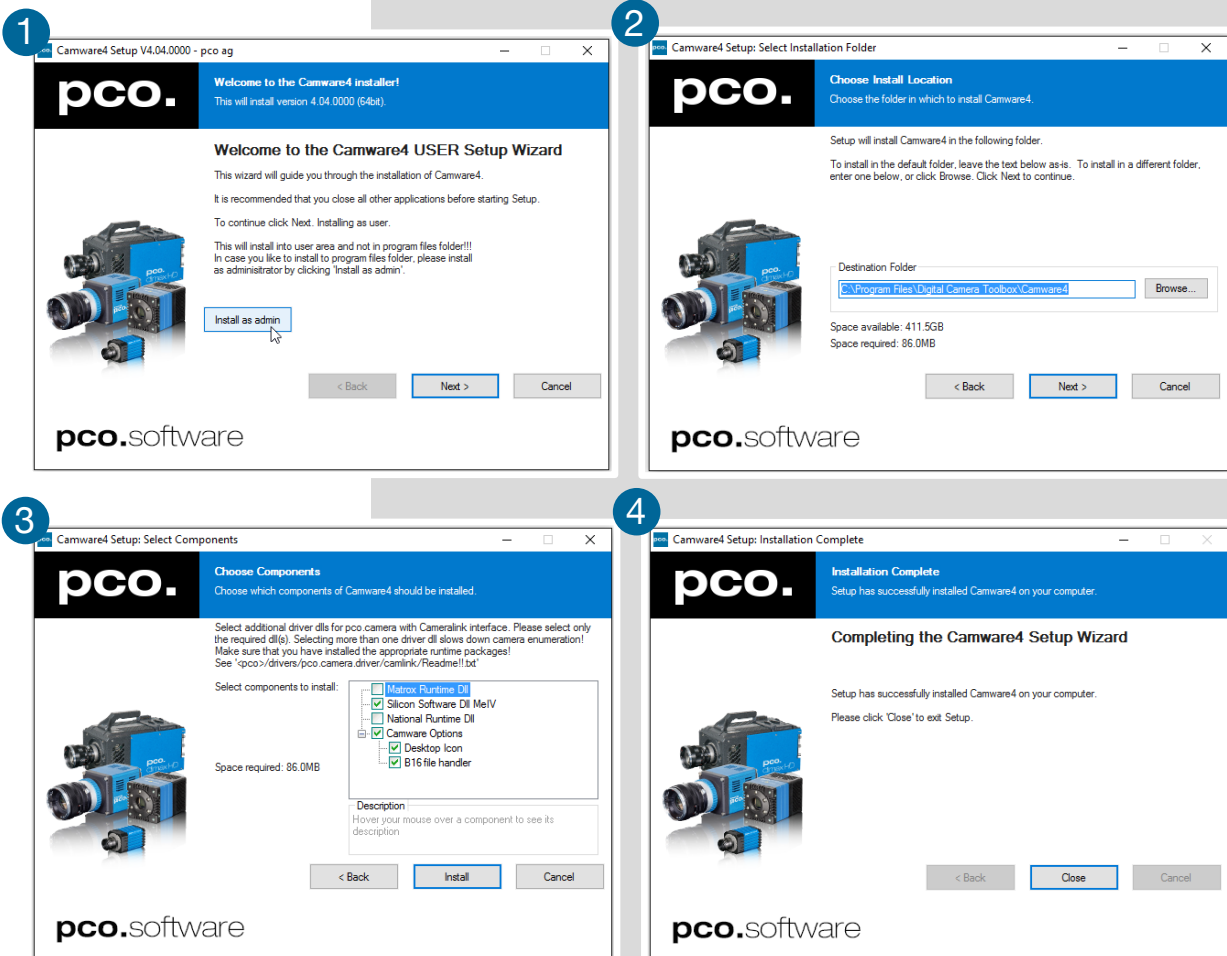
The Camware Windows application software enables to control every camera parameter or setting. Images can be displayed on a monitor and may be downloaded and stored. The enclosed USB flash drive contains installation files for the software for latest Windows operating systems in 32 / 64 bit.

After a successful installation, you will find the program file **Digital Camera Toolbox** in your program directory and a **Camware 32 / 64 button** on your desktop. Other helpful tools are also installed in the same directory.

To uninstall the Camware program, use the Software feature under Windows' **System Control**.

### Follow the installation wizard

- 1 Install Camware **as Admin** to install to program folder, instead it will be installed only to user folder
- 2 Choose install directory
- 3 Choose components: Select additional drivers for Camera Link interface (not recommended for pco.dimax cs)
- 4 After the next two screens installation is complete



## 5. QUICK START

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

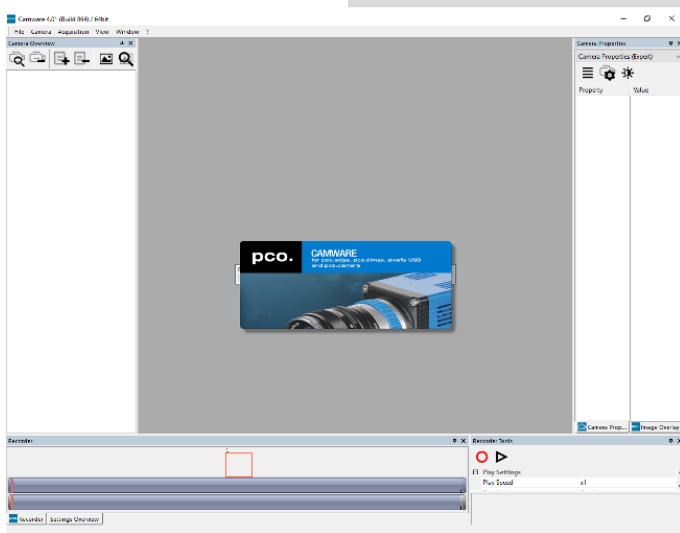
### 5.1 PREPARATION

- **Computer** is turned on
- **Installation** is finished (see chapter 4)
- **An appropriate lens** is attached (remove cap) or the camera is attached properly to the microscope, spectrograph or other scientific device
- **Camera** is connected to the power supply
- **Camera** is connected to the computer and **switched on**
- **Camera** is booted and ready after 5 to 20 s when a **beep** sounds

### 5.2 START



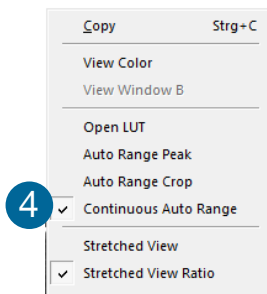
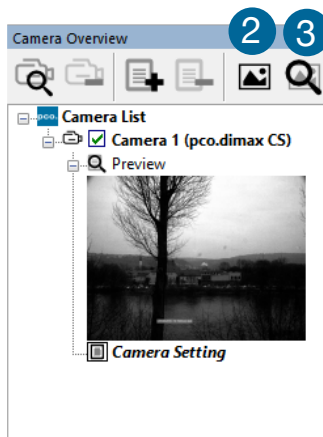
Start **Camware** and the **graphical user interface** will start up:



#### NOTE

Always install latest Camware version to get the full functionality of your pco camera ([www.pco.de/support](http://www.pco.de/support)).

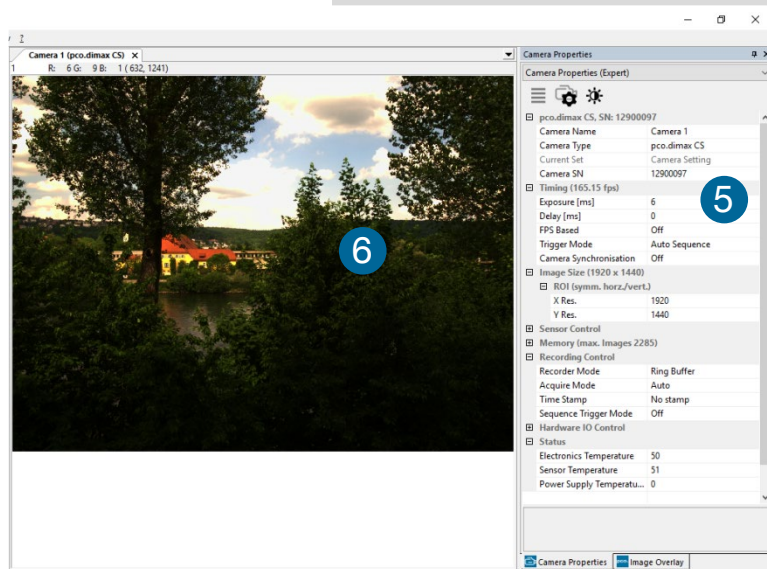
## 5.3 FIRST IMAGE



## Follow the instructions:



- **Camware** must be started 1
- A view window 2 is shown automatically, if not open a new one
- Start **live preview** 3
- Right-click into the view window and apply **Continuous Auto Range** 4
- You may have to adjust **exposure time** 5, **aperture** and **focus**
- Now you should clearly 6 see the **object** in the window



If you need to change **exposure time** (e.g. the image is still either too dark or too bright), go to chapter 6.3.2.

For recording and saving images, see chapter 6.3.8 and chapter 6.6 for detailed information.

**NOTE**

Live preview: Useful for fast and easy camera adjustment and focusing. Does not record and store images.

## 6. CAMWARE 4 SOFTWARE



PCO's Camware is an outperforming software for camera control, image acquisition and archiving of images in various file formats. This chapter provides a detailed description of all Camware functions.

Camware works with any kind of PCO camera. Visit [www.pco.de](http://www.pco.de) the latest version of this software.

### 6.1 INTRODUCTION

**Chapter 6.2** Camera Overview / List: shows all connected cameras and all set recording profiles

**Chapter 6.3** describes the **Camera Properties** window. This is the main interface for all camera settings.

<b>6.3.1 TIMING</b>	Timing /Trigger modes/ synchronization
<b>6.3.2 IMAGE SIZE</b>	ROI / Sensor format / Binning
<b>6.3.3 SENSOR CONTROL</b>	CDI / Double shutter / Temperature
<b>6.3.4 MEMORY</b>	Camera Internal memory (RAM)
<b>6.3.5 RECORDING CONTROL</b>	Recorder Acquire Mode / Timestamp / Sequence trigger
<b>6.3.6 STATUS</b>	Temperature
<b>6.3.7 HARDWARE I/O CONTROL</b>	Input and Output Options
<b>6.3.8 CONVERT CONTROL</b>	Contrast, Saturation, Gamma...

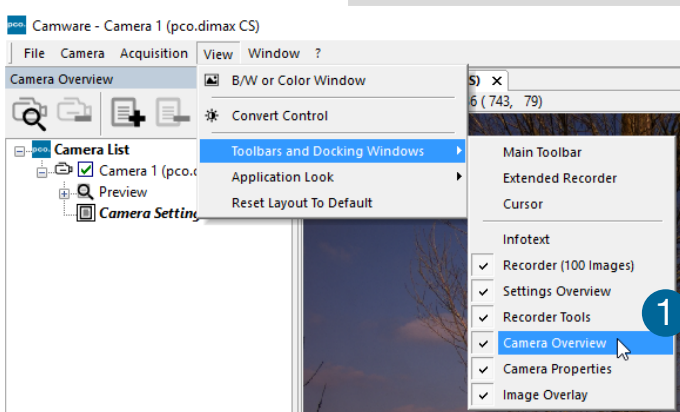
**Chapter 6.5 / 6.6 / 6.7 / 6.8** describe the recording functions

<b>6.4 IMAGE OVERLAY</b>	Overlay for recorded images
<b>6.5 RECORDER TOOLS</b>	Record / Play and Settings
<b>6.6 VIEW WINDOW</b>	View window functions
<b>6.7 RECORDER (IMAGES)</b>	Preview of recorded images
<b>6.8 SETTINGS OVERVIEW</b>	Overview of all parameter settings

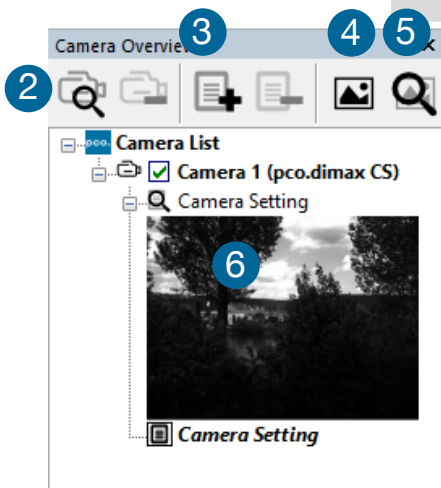
**Chapter 6.9** introduces to further Camware features

<b>6.9.1 DEMO MODE</b>	If no camera is connected
<b>6.9.2 FILE MENU</b>	Open / Save / Print files / Direct record to file / Options / AVI Codec Dialog / Lookup table
<b>6.9.3 CAMERA MENU</b>	Camera control / Close / Rescan
<b>6.9.4 ACQUISITION MENU</b>	Live preview / Acquire sequence / Auto camera RAM segment switching
<b>6.9.5 VIEW MENU</b>	B/W or Color window / Convert Control / Toolbars / Application Look / Reset layout to default
<b>6.9.6 WINDOW MENU</b>	New / Close / Split window
<b>6.9.8 HELP MENU</b>	Create Support file/ Logging / Support mail / About Camware
<b>6.9.8 VIEW WINDOW MENU</b>	Right-click menu: Zoom; Flip; Mirror; Rotate...
<b>6.9.9 ADDITIONAL FEATURES</b>	White Balance, Contrast, ROI by Mouse, Short-cut list

## 6.2 CAMERA OVERVIEW / LIST



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

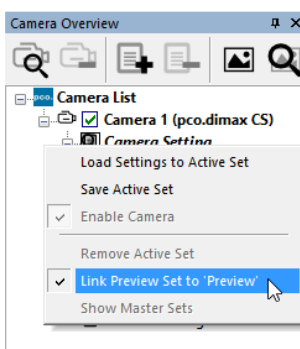


The **Camera Overview** window supports management of more than one PCO cameras and displays a list of the connected ones. Camware is able to **scan** ② for connected cameras or close a connected camera. It allows to define several different **Settings** for each camera (max. 30 sets per camera → **add new set** ③). **New view windows** ④ can be opened and the **Live Preview** ⑤ function started. When opened up, the **Preview** shows a **small preview window** ⑥ (always monochrome) integrated in the camera list.

**Live preview** facilitates the aperture and focus adjustment, allowing a first look at your object.

During **Live preview Trigger** and **Acquire mode** are set to **Auto**.

**Camera Setting:** all presets, such as resolution and frame rate in the **Camera Properties** (see 6.3) are saved to **Camera Settings**. Define different **Settings** with different **Preferences** in **Camera Properties** for each of your experiments. Settings can be switched easily at any time (not during record) and copied to other cameras.

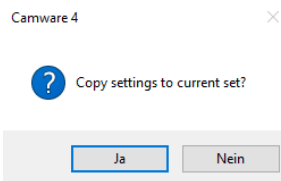


### **Link Preview Set to 'Preview'**

When **Link Preview Set to Preview** is ticked the Preview will always be active with the set parameters when starting a **Live Preview** ⑤.

In case this function is deactivated, the **Live Preview** will always show live images with the parameters of your active setting.

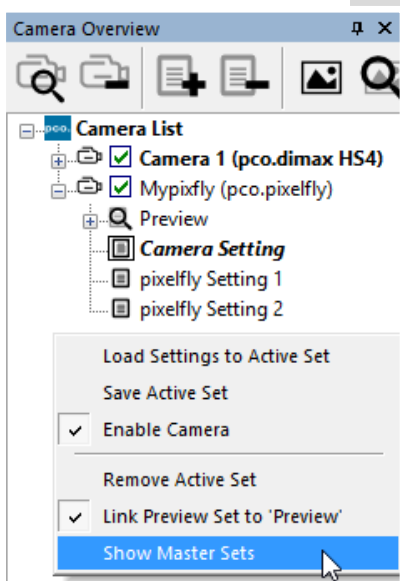
Setting a higher exposure time for **Preview** set and linking it to the preview function is beneficial if preview light conditions are different from those in recording situations.



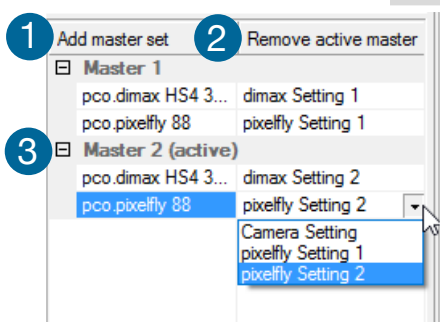
**Click and drag camera setting:** to copy e.g. **Camera Setting 1** to **Camera Setting 4**, just drag & drop **Setting 1** to **Setting 4** and Camware will ask to confirm it. It is possible to copy each setting to every camera.

### 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 display Master Sets, right-click in the **Camera Overview** window and click **Show Master Sets**.



#### Master Set window

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

#### Functions:

Add **Master Set** ① or **Remove active master** ②. **Activate** it by clicking on one of your sets ③.

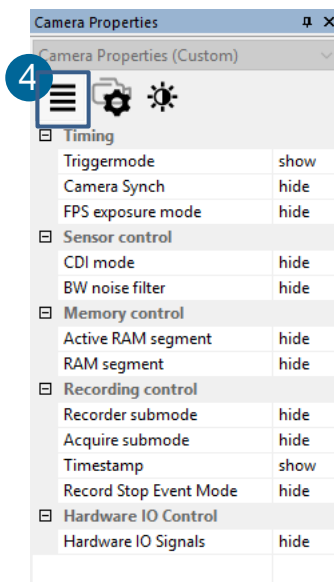
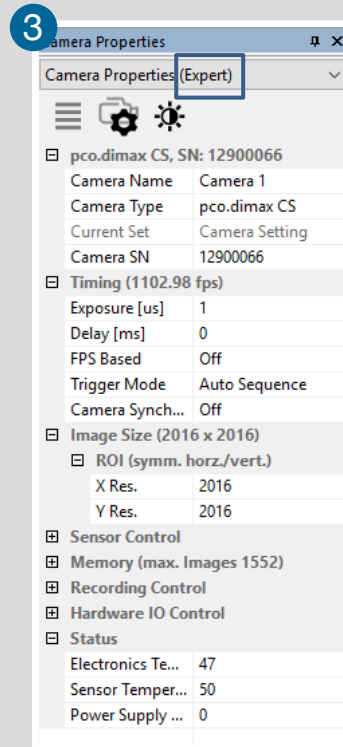
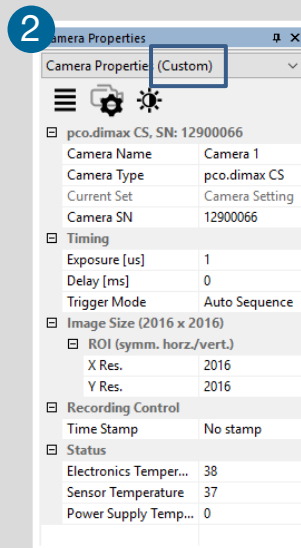
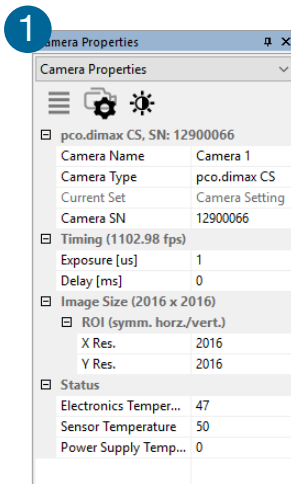


## 6.3 CAMERA PROPERTIES

The **Camera Properties** window in Camware is the main interface for all camera settings. The active set in **Camera list** is adjusted here.

The former topic **Camera Control** (known from Camware 3.x) and the **Convert Control** (see 6.3.8) can be opened additionally.

Three view options with various functions can be selected: **Basic**, **Custom** and **Expert**.



**Exposure [ms]**  
Specifies the exposure time

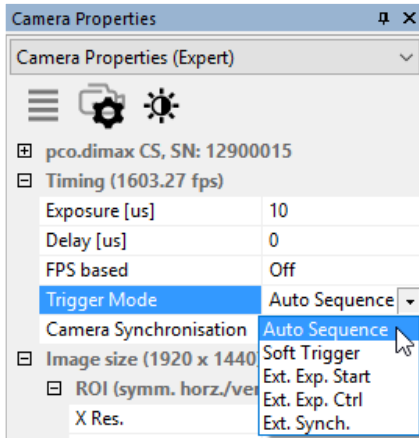
**Basic** mode ① only shows camera name, timing, image size and status. In **Basic Mode** the frame rate is always calculated automatically based on the selected exposure time, i.e. while exposure time is increased, frame rate decreases. It is recommended for Camware beginners.

**Custom** mode ② shows several more setting possibilities and functions are hidden or shown by the **Custom Properties Button**. Beside the **Basic mode** many more options are selectable. ④

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

An **explanation** for every **feature** is displayed below the properties dialog.

## 6.3.1 TIMING



### General Information

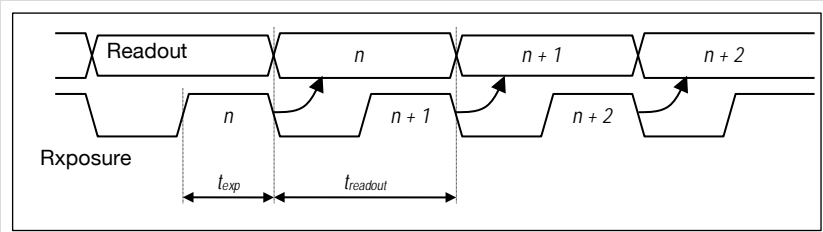
The most important parameter for a high-speed camera is the frame rate. The upper limit of the frame rate is defined by the exposure time and the readout time.

In this context **trigger** means exposure trigger, i.e. the trigger signal controls the exposure of a single image.

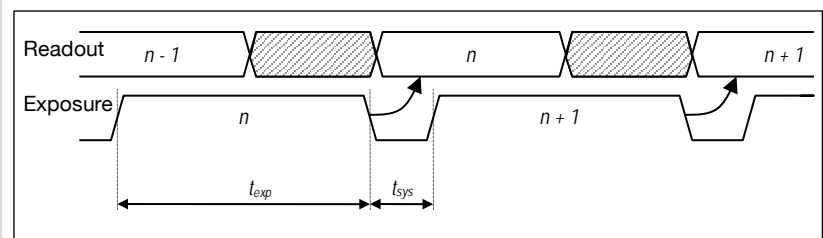
Exposure and readout of one image are done simultaneously, i.e. while image  $n$  is being read out from the sensor, image  $n+1$  is already integrated within the sensor's pixel.

Readout time correlates with the resolution: if you select a smaller resolution (fewer rows and columns) the readout time is also reduced.

In case of short exposure times, the **readout** time is the limiting factor, i.e. a new image can only be recorded, if the previous image has been read out.



For long exposure times, the **exposure** time is the limiting factor:



### NOTE

As the pco.dimax cs is a high-speed camera, triggering single images using the **Soft Trigger button** will result in a significantly degraded image quality (**noisy** images).

### Trigger Modes ①

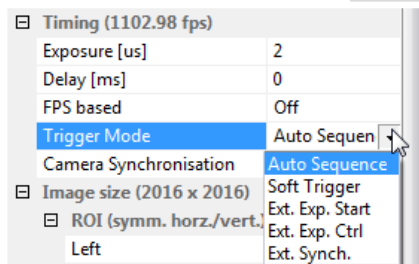
**Auto Sequence:** the camera optimizes the image recording to achieve the best possible frame rate. In the **Auto Sequence Exposure Control** mode, the camera achieves the highest possible frame rate against the set exposure time and the time required for a frame readout. Upon a start command the sequential recording starts and lasts until a stop command..

**Software Trigger:** single images are recorded by this Camware command. A single image is acquired by pressing the Single Trigger button. This button appears after pressing the Start Record button. Other signals have no influence on this operating mode.

**External Synchronization (BNC Sync In):** the pco.dimax also uses an external synchronization signal feeding a **phase-locked loop** (PLL) in the camera.

### Advantages of the PLL (**Ext synch**) solution:

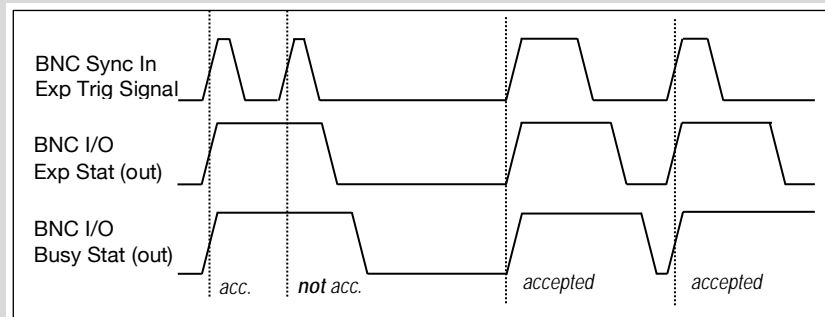
- Availability: only for frequencies of 1, 10, 100 or 1000 Hz
- Reliability: in case of dropouts of the external synchronization signal, the synchronization is kept internally by the PLL signal with only small deviation.
- Noise immunity: interference on the signal is automatically detected and discarded.
- Flexibility: the cameras can even be set to different frame rates, as long as all frame rates are an integer multiple of the synchronization frequency.



### **External Exposure Start (Ext. Exp. Start):**

The image acquisition is triggered by an external signal. The single trigger button acquires a single image for a test.

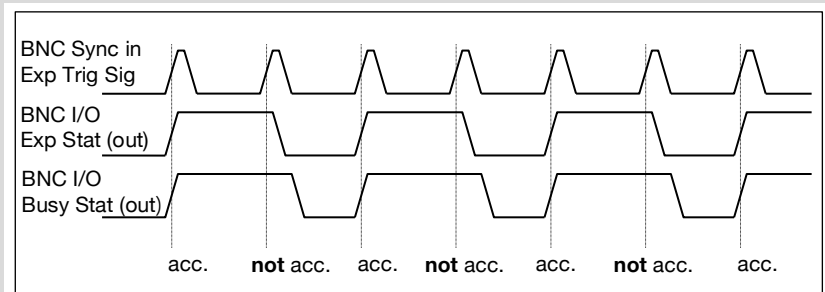
In **Ext. Exp. Start** exposure control mode, image acquisition starts by the falling or rising edge of the signal at the **BNC Sync In** input (see Appendix A1.2). The frame rate cannot be set, as the frame rate is defined by the frequency of the external signal. However the exposure time and ROI (Region of Interest) settings affect the maximum possible frame rate.



### NOTE

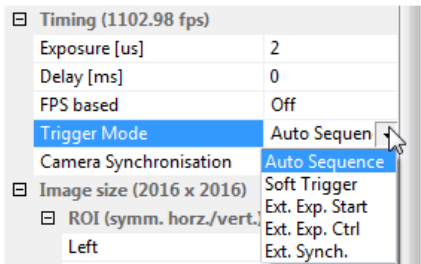
If the trigger rate of the external signal is very near the maximum possible frame rate (difference < 1/1000), then it will be random, whether or not a trigger is accepted!

A new trigger is possible after  $t_{\text{readout}}$  or  $(t_{\text{exp}} + t_{\text{sys}})$  (whichever is longer) after the preceding trigger. The **Busy Status (BNC I/O)** signal (see chapter 6.3.6) indicates whether a **new trigger** is accepted. The maximum achievable frame rate in **External Trigger** mode is negligibly less (about 0.1%) than in Auto Sequence mode. 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 3<sup>rd</sup>, every 4<sup>th</sup> etc. trigger edge will be accepted.



In order to avoid trade-offs at maximum frame rate use either the **Busy Status signal BNC I/O** (see chapter 6.3.7) or make sure the external trigger rate follows this condition:

$$\text{Ext. Trigger Rate} \leq f_{\text{max}} / 1.001.$$



### NOTE

Exposure trigger differs from T0 Trigger and should not be mixed up.

Exp. Trig. (BNC Sync In) triggers single frames based on a falling / rising edge. T0 Trigger (BNC Trig In) terminates the active recording with a single signal edge and allows to record a predefined number of images after T0 (see chapter 6.3.5 Sequence Trigger Mode).

### NOTE

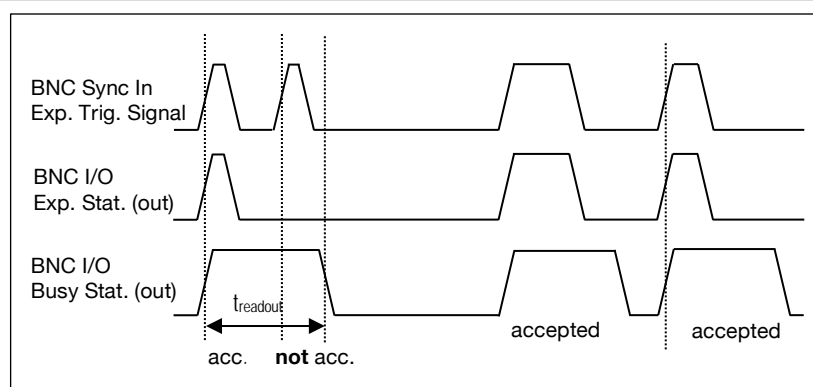
There is no specified timing for the software trigger. The software trigger is not recommended for applications where an exact timing is required!

### External Exposure Control (Ext. Exp. Ctrl):

An external signal applied to the exposure trigger input (**BNC Sync In** see chapter 6.3.7), controls **start and duration** of the exposure.

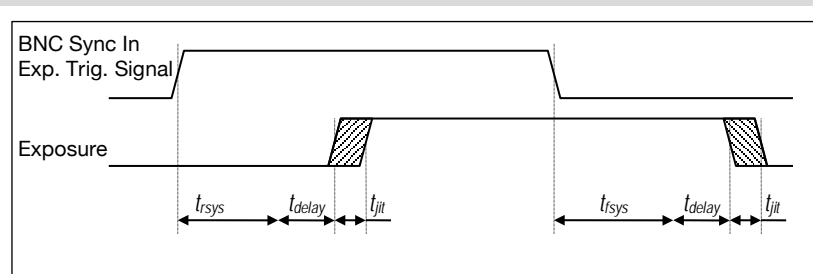
In trigger mode **Ext. Exp. Ctrl** a new exposure starts by the falling or rising edge of the signal at the **BNC Sync In** input. The exposure is finished when the opposite edge is detected. Thus in this mode, the start as well as the length of the exposure time can be externally controlled. No further settings can be made, as the image timing is completely controlled by the exposure trigger signal yet. There is a maximum exposure time. If the trigger pulse is longer than 20ms, the integration will be stopped at 20ms.

A new trigger is possible after  $t_{\text{readout}}$  or  $(t_{\text{exp}} + t_{\text{sys}})$  (whichever is longer) following the preceding trigger. The Busy Status (**BNC I/O**) signal (see chapter 6.3.7) indicates whether a new trigger is accepted.



### Detailed Timing for External Exposure Start /Control

The detailed timing for external trigger includes system delay times, an adjustable additional delay time and the jitter.



### Parameters for the following tables:

- Width of the selected ROI must be a multiple of 24
- Data is not applicable in trigger mode **External Exposure Start**.
- Trigger edges occurring within  $t_{\text{delay}} + 200\text{ns}$  after a previous trigger are ignored.

$t_{\text{jit}}$ : -0 /+25ns                       $t_{\text{delay}}$  configurable 0...1ms  
 $t_{\text{rsys}} + t_{\text{fsys}}$  system delay times depending on ROI (see next page)

Timing (1100.81 fps)	
Exposure [us]	100
Delay [us]	1
FPS based	Off
Trigger Mode	Auto Sequence
Camera Synchronisation	Off

ns
<input checked="" type="checkbox"/> us
ms
Auto.Timebase

Timing	
Exposure [ns]	10363
Frame Rate [mHz]	500
FPS based	On
FPS presets	Select a preset
Trigger Mode	Auto Sequence
Camera Synchronisation	Off

## Timing ②

**The exposure and delay time** can be precisely set in steps of 1  $\mu$ s. The effective stepsize depends on the operation mode. 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.

Easily change time base by clicking on **...** and the respective window opens.

**FPS based:** 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. (Selectable for Auto Sequence trigger mode and **preset** for External synchronization mode.)

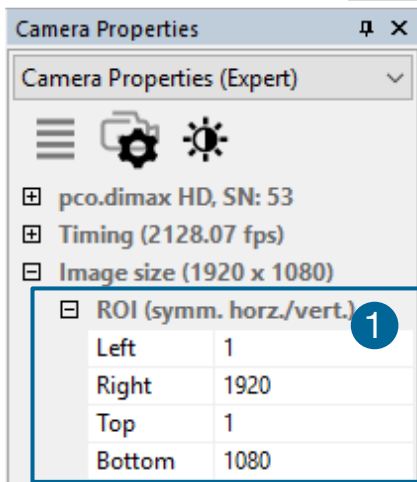
First the frame rate is set. If the time required for readout of the image is longer than 1 / frame rate, then the frame rate will be reduced to 1 / treadout.

camera type	exposure time	delay time
pco.dimax cs	1.5 $\mu$ s ... 40 ms	2 $\mu$ s ... 40 ms

If FPS based is selected and the selected exposure time requires a lower frame rate, the exposure time will be cut to the maximum possible time at that frame rate.

The minimum selectable frame rate is 0.465 Hz, but it only makes sense to use:  **$\geq 20$ Hz**.

## 6.3.2 IMAGE SIZE

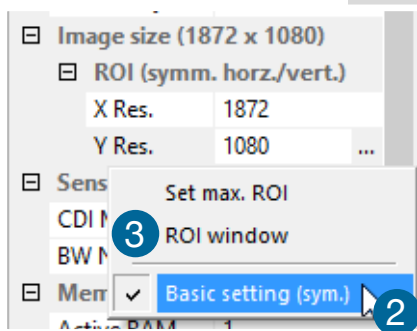


### Region of Interest ①

To speed up frame rate and to save storage space, the ROI (region of interest) selects only a part of the sensor to be read out. Due to the sensor structure and readout electronics the selectable region is always symmetric to the center.

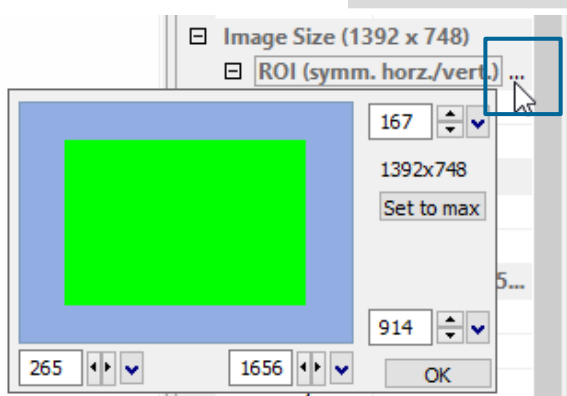
#### *pco.dimax cs*

increments horizontal:	24 pixel steps
increments vertical:	4 pixel steps
minimum ROI:	24 x 8 pixels



### Basic Setting: ②

Activate **Basic Setting** by clicking on  to easily set a **ROI** by just typing in the horizontal and vertical resolution in pixels.

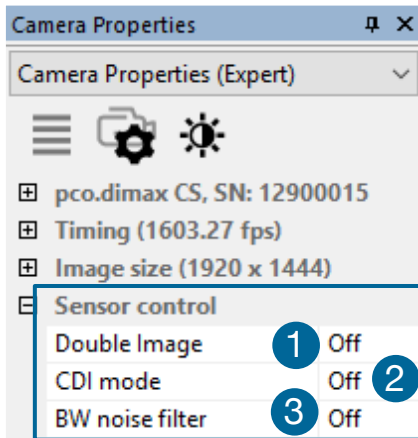


### ROI window

Select the ROI (symm. horz./vert.) menu and activate ROI Window by clicking on  or use the  right to the **X Res / Y Res** and click on **ROI window**. ③

The ROI window will open and it is possible to set a new **Region of Interest** by dragging a window with the mouse or by keying in the values.

### 6.3.3 SENSOR CONTROL



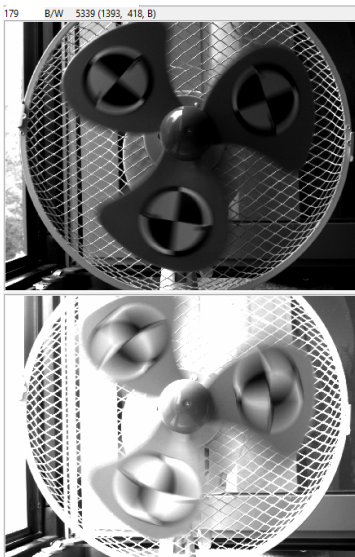
#### Double Image / Double Shutter (only for monochrome sensors) ①

This feature is widely used for particle image velocimetry (PIV) measurements and is an optional feature of the pco.dimax cs series. The **first exposure time**  $t_{e1}$  may be any exposure time of the available range of the pco.dimax camera. The **second exposure time**  $t_{e2}$  cannot be directly adjusted. The length of the second exposure is the readout time of the first image. The interframing time  $t_{if}$  denotes the transition time between end of exposure #1 and start of exposure #2.

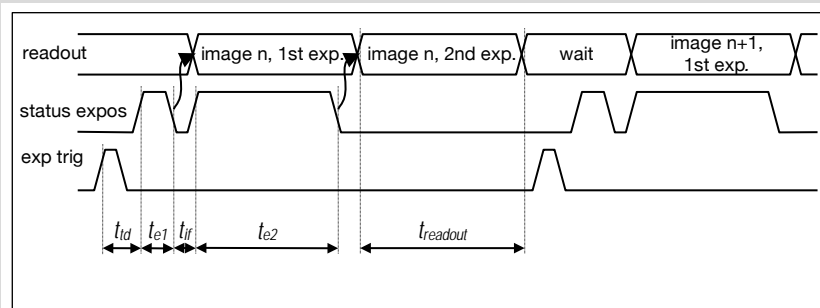
As can be seen the maximum frame rate of the double image mode (where frame rate is defined as the frequency of the double images) will drop to just half the value compared to the standard mode.

The double image mode will work only in the trigger modes **Auto Sequence** and **External Exposure Start**. See 6.3.1.

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



#### Timing Diagram for Auto Sequence



$t_{e1}$ : exposure 1  
 $t_{id}$ : trigger delay time  
 $t_{if}$ : interframing time

$t_{e2}$ : exposure 2  
 $t_{id}$ : intrinsic delay  
 $t_{readout}$ : readout time

#### CDI mode ②

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

The min. exposure time is calculated as follows:

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

$t_{exp}$  = min. exposure time  
 $f_{CDI}$  = max. frame rate

#### Example:

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

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

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

### B/W Noise Filter (only available for pco.dimax cs b/w) ③

Intelligent spatial noise filter.

## 6.3.4 MEMORY

Memory (max. Images 1101)	
Active RAM segment	1
RAM segment 1	800
RAM segment 2	100
RAM segment 3	55

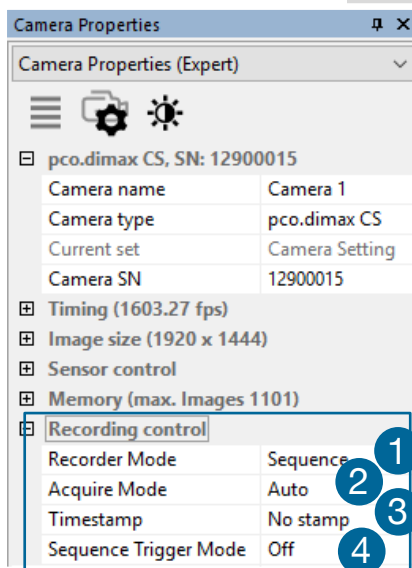
The **Memory area** controls the pco.dimax built-in memory.

The RAM has four segments. In Camware only three are usable to save images. The fourth is used by Camware itself for internal processes.

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

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

## 6.3.5 RECORDING CONTROL



### Recorder Mode ①

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.

### Acquire Mode ②

The **Acquire Mode** enables or disables the recording by an external signal.

If set to **Auto** all images are accepted and all images taken are saved. A signal at the **BNC Trig In** input (see 6.3.6) is ignored when set to **Auto**.

If set to **External**, the camera **only** records images, when the **external signal** applies.

### NOTE

Acquire mode still requires initial camera recording activation by software (press record button)!

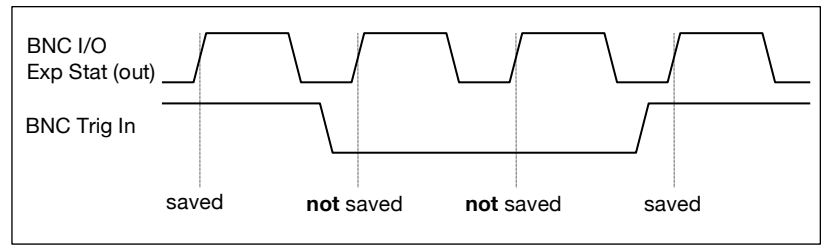
The signal at the BNC Trig In input does not affect the sensor's timing scheme.

The **BNC Trig In** is sampled at the beginning of the exposure, shown by the rising edge of the exposure status (**BNC I/O**) output.

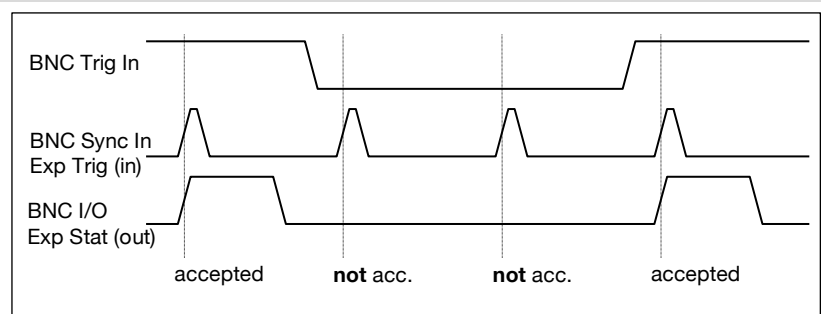
**BNC Trig In input high:** (low, when inverted): image saved to memory

**BNC Trig In input low (high, when inverted):** image lost (not saved to memory)



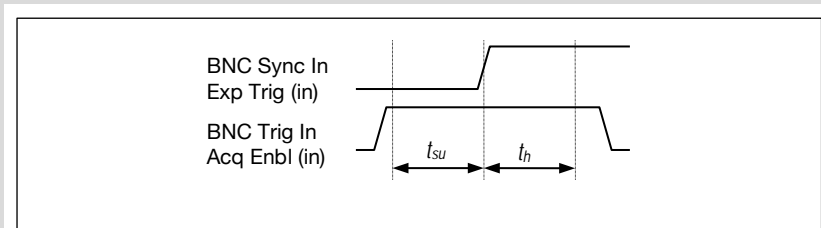


In trigger mode **External Exp. Start**, the **BNC Trig In** input acts as a gate for the trigger signal. A rising trigger edge (rising, falling when **BNC Sync In** is inverted) is accepted only when the **BNC Trig In** signal is high (low, when inverted).



In trigger mode **External Exp. Ctrl**, the **BNC Trig In** input works very similar to the mode **External Exp. Start**. However, the **BNC Trig In** input is ignored for the edge which is closing the exposure time (an already started exposure will be finished).

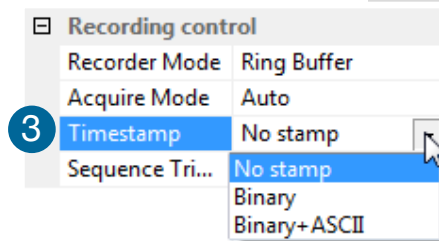
When using **BNC Trig In** in external trigger modes, the following timing specification should be met:



pco.dimax model cs	
$t_{su}$	60 ns
$t_h$	60 ns

If the **BNC Trig In** signal changes within the window of  $t_{su}$  (set up) to  $t_h$  (hold), the behavior is random. The trigger may be accepted or ignored.

### Timestamp 3



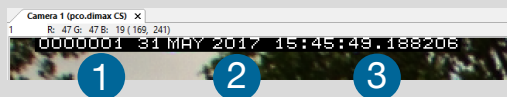
A time stamp can be placed into the upper left corner of the image. It can be either set to **no stamp**, **binary** or **binary with text**. The time resolution is 1  $\mu$ s.

In binary mode the first 16 pixels will be filled with the time stamp information (binary code). The numbers are coded in binary coded decimal (BCD) with one byte per pixel. Every pixel contains two digits. If the pixels have higher resolution than 8 bits, then the BCD digits are right bound adjusted and the upper bits are zero. For further information refer to the SDK manual.

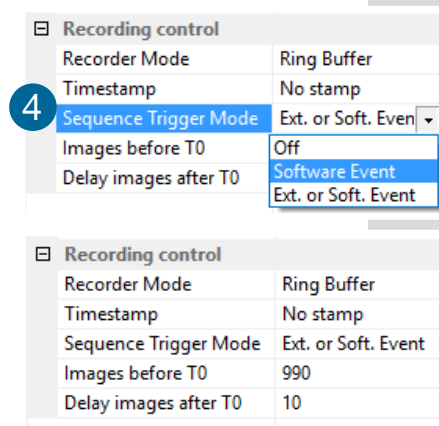
In binary and ASCII mode text will be placed into the image its content (271x 8 pixels).

The timestamp shows the end of the exposure time.

Three different **information** is stamped onto the image: number of the image 1, date 2 and time 3.



### Sequence Trigger Mode 4



The **Sequence Trigger Mode** enables the user to stop capturing a sequence of images via an external signal, so called T0 trigger. The user can set the number of images before and after the trigger event.

Since the Sequence Trigger Mode uses the **BNC Trig In** input (see chapter 6.3.6), the acquire function cannot be used. The acquire mode thus has to be set to Auto.

The camera already records images into the selected RAM and may have filled it completely before the **Sequence Trigger Mode** starts. Therefore the recorder mode should be set to **Ring Buffer**.

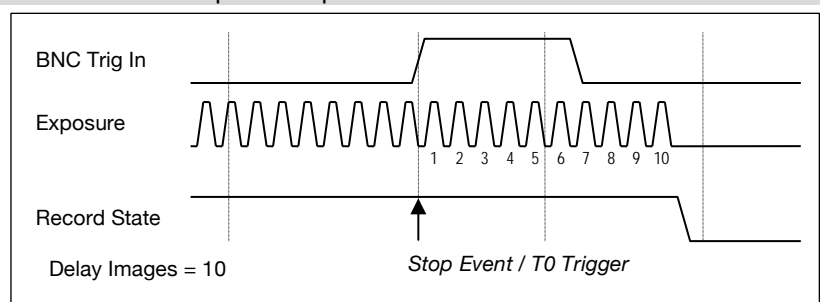
**Off:** function is not active; signal at **BNC Trig In** does not stop the record.

**Software Event:** only a software command can stop the sequence.

**Ext. or Soft. Event:** both, a signal edge at **BNC Trig In** or a software command can stop the sequence.

#### NOTE

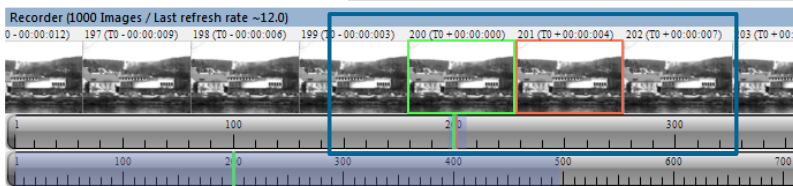
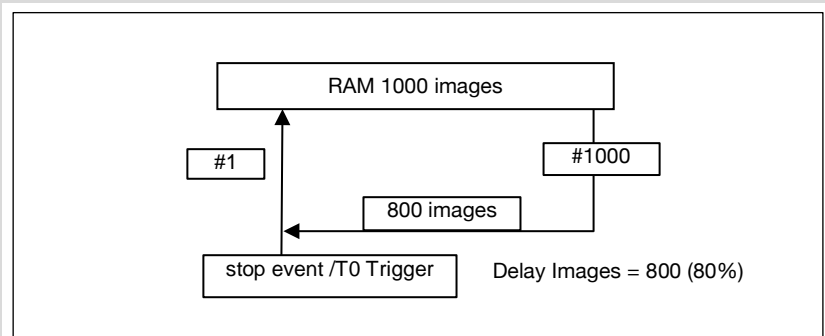
When using the Extension box make sure signal polarity is inverted to a TTL signal type at the acquire enable (BNC Trig In) input. (Trig In BNC input) for TTL signal type.



Recording control	
Recorder Mode	Sequence
Acquire Mode	Auto
Timestamp	No stamp
Sequence Trigger M...	Ext. or Soft. Event
Images before T0	200
Delay images after T0	800

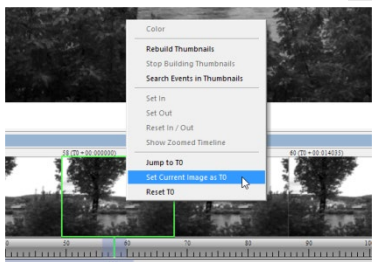
The relative position of the T0 trigger within the recorded time window depends on the size of the **RAM segment** and the **delay images** parameter. The following figure shows an example, where the buffer size is 1000 images: The position of the trigger is always calculated backwards from the end of the buffer. The relation is always in terms of images.

In this context **T0 is the point at which the sequence trigger is set** (at the **BNC Trig In** input).



After recording is finished **Recorder Images** (see chapter 6.7) shows the thumbnail images of the last recording: Image T0 is framed in **green**, the currently selected image in **orange**.

All images before and after T0 are specifically marked, e.g. with 202 (T0 + 00:00:007). 202, in this case, corresponds to the image number and its recording point in time after T0. The time stamp is divided into min : s : ms.



**Additional possibility to define T0:** Right-click into the thumbnails and **Set Current Image as T0**. Reset T0 erases this manually set T0.

All **Recorder Images** features see 6.7.

### 6.3.6 STATUS

Status	
Electronics Temperature	41
Sensor Temperature	41
Power Supply Temperature	0

Shows the current temperature level of the pco.dimax cs camera.

## 6.3.7 HARDWARE I/O CONTROL

Hardware IO Control		
1	Acquire Enable	On
	Signal Filter	Off
	Signal Polarity	High
2	Exposure Trigger	On
	Signal Filter	Off
	Signal Polarity	Rising
3	Select IO Signal	Status Expos
	Status Expos	On
	Signal Polarity	High

Status Expos	
Select IO Signal	Status Expos
Status Expos	Status Expos
Signal Polarity	Status Busy
	Status Armed



Camware	Extension box	Breakout cable	Polarity	Description
	Type	Type		
Acquire enable	1 Trig In	Trig In	high/low	If checked on, a signal for Acquire mode or Sequence Trigger mode (see chapter 6.3.5) is accepted at the BNC Trig In input
	RS-485 TTL	RS-485 TTL		
Exposure Trigger	2 Sync In	Sync In	rising / falling edge	If checked on, a signal for External Exp. Start or External Exp. Ctrl trigger mode (see chapter 6.3.1) is accepted at the BNC Sync In input
	RS-485 TTL	RS-485 TTL		
Status Exposure	3 I/O	n/a	high/low	If checked on, a signal indicating <b>exposure status</b> , <b>busy status</b> or <b>armed status</b> is given at the BNC I/O output. Once an acceptable trigger edge is received, <b>busy</b> will be <b>high</b> . As soon as <b>busy</b> is low again, a new trigger edge is accepted. Status armed is high till a <b>T0 Trigger</b> is received.
	TTL RS-485 TTL/GND			

### Applied hardware signal type: CONTACT

BNC Input	Trigger Mode (Camware)	Breakout cable	Extension box
		Signal Type Software I/O	Signal Type Software I/O
Acq. Enbl. (Trig In)	Seq. Trigger / Acquire External	TTL	RS-485
Exp. Trigger (Sync In)	Ext. Exp. Start / Ctrl.	TTL	n/a

### NOTICE

When working with Extension box make sure signal polarity is inverted to a TTL signal type at the acquire enable (BNC Trig In) input.

**BNC** sockets see chapter **A3.2** Extension Box.

**NOTICE**

**Filter:** electrical interference filters (off, medium, high). An active filter causes an internal signal delay.

**Polarity:** active for high/low signal or rising / falling edge

**Acquire Mode : external (Signal Type Contact)**

Polarity high: if signal is high / contact is open, camera captures images;

Polarity low: if signal is low / contact is closed, camera captures images.

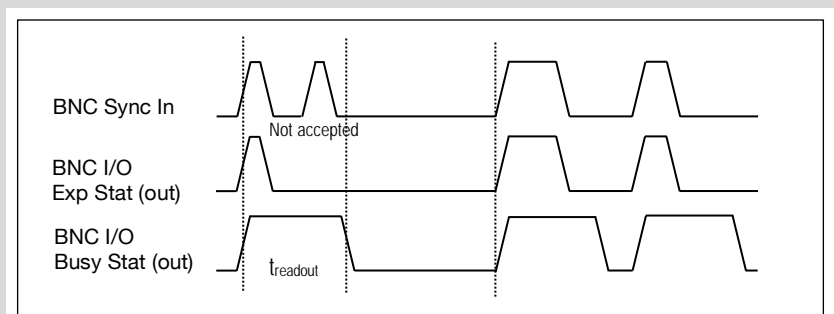
**Sequence Trigger Mode: Ext. or Soft. Event**

Polarity high: if signal is high / contact is open, camera keeps recording images

Polarity low: if signal is low / contact is closed, camera stops recording images immediately or when **Delay Images after T0** trigger event have been recorded

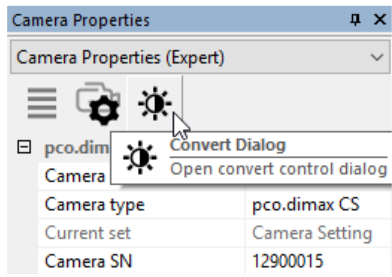
Type	Explanation
RS-485	Receiver sensitivity: $\pm 200$ mV Note: termination of 120 Ohms outside camera required
TTL	Maximum low level: 0.8 V Minimum high level: 2 V
Contact	Maximum switch on resistance: 100 Ohms Minimum switch off resistance: 40 kOhms Minimum switch voltage rating: 5 VDC Minimum switch current rating: 1 mA

This graph shows the **output signals Exp. Stat** and **Busy Stat** of the pco.dimax cs camera in **Ext. Exp. Start / Ext. Exp. Ctrl mode** (see 6.3.5) after an exposure trigger signal is received:



BNC Sync In: the second trigger is not accepted, because the camera is still in readout mode  $\rightarrow$  see Busy Status  $t_{\text{readout}}$ .

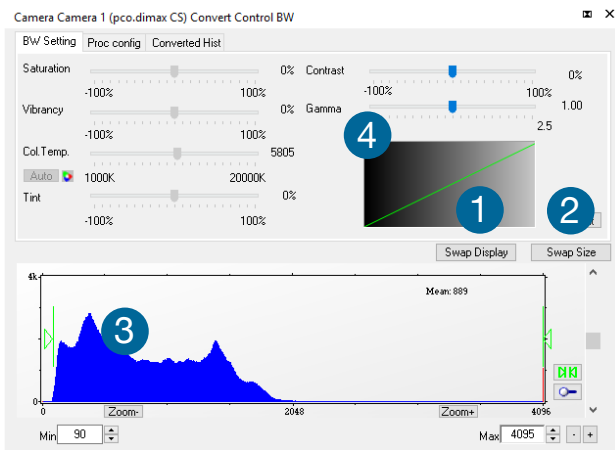
## 6.3.8 CONVERT CONTROL



Start the **Convert Control Dialog** with the **Black/White Button** in Camera Properties.

### Convert Control BW

The display of the original 12 bit image intensity values (x-axis) in the shown 8 bit values (y-axis) can be arranged.



**BW Settings** (includes histogram of original data)

It is possible to **hide** the histogram of original data **1** and to **switch tab/histogram** **2**.

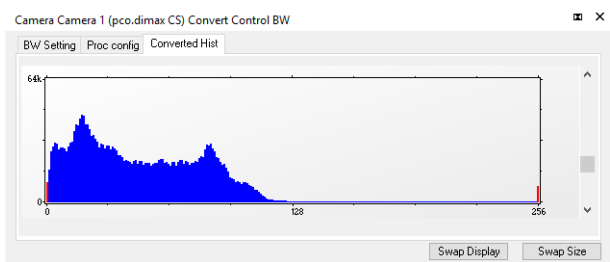
**Green sliders in histogram** **3**

**left slider** = Min 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** = Max controller (corresponds to value 255). Values above that mark are set to 255, i.e. displayed as white.

The values in-between are converted into a value between **0** and **255** according to **Contrast** and **Gamma** settings. See the small **graph** **4** reflects the calculation.

**Proc config tab**: see under Convert Control Color

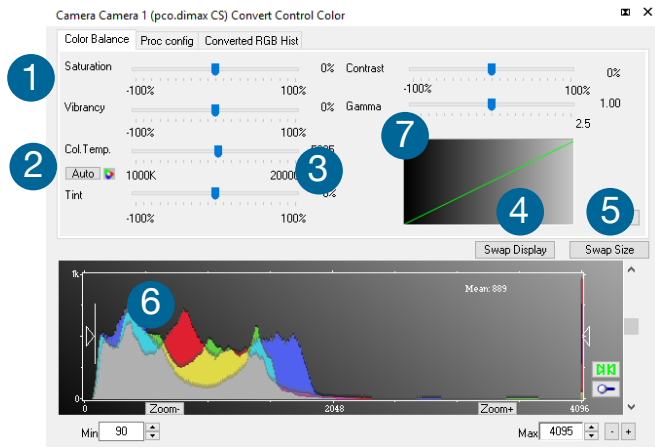


### Converted Hist

Tab shows the **histogram of converted data**.

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

## Convert Control Color (only pco.dimax cs color)



### Color Balance (Histogram of original data)

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

Press the Auto button to set the **white balance** **2**.

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

It is possible to **hide the histogram of original data** **4** and to **switch tab/histogram** **5**.

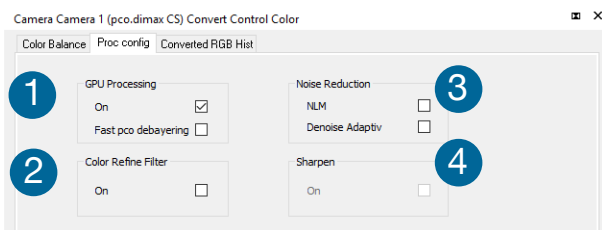
The user can influence how the 12 bit intensity values of the original image are displayed in 8 bit values in different ways.

### White sliders in histogram **6**

**left slider** = Min 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** = Max controller (corresponds to value 255). Values above that mark are set to 255, i.e. displayed as full color.

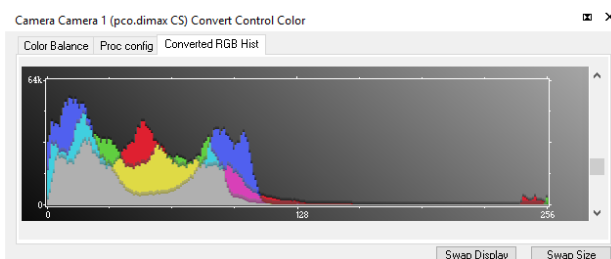
The values in-between are converted into a value between 0 and 255 according to **Contrast** and **Gamma** settings. The small **7 graph** reflects the calculation.



### Proc. Config (Process configuration)

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

- |          |   |
|----------|---|
| <b>1</b> | <b>GPU Processing</b><br><b>On:</b> Switch on in order to significantly reduce processing time (increases refresh rate of the live image)<br><b>Fast pco debayering:</b> only color cameras |
| <b>2</b> | <b>Color Refine Filter</b> only color cameras   |
| <b>3</b> | <b>Noise Reduction</b><br><b>NLM:</b> Non local means algorithm<br><b>Denoise Adaptive:</b> only color cameras  |
| <b>4</b> | <b>Sharpen:</b><br><b>On:</b> only color cameras (first activate <b>Fast pco debayering</b> )   |



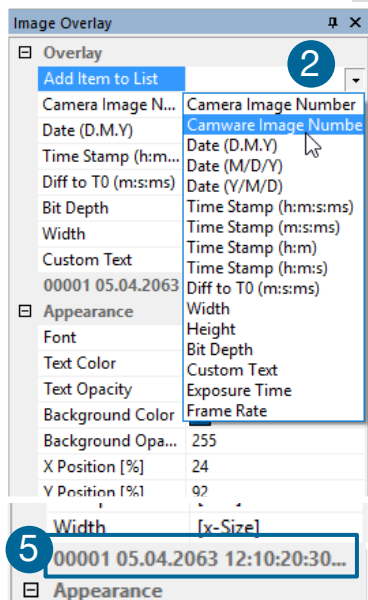
### Converted Hist

This tab shows the **histogram of converted data**.

## 6.4 IMAGE OVERLAY



Open **Image Overlay**: these two buttons allow easy switch between **Camera Properties** and **Image Overlay**.<sup>1</sup>  
If not available, see **6.9.5 View Menu** to activate this menu.



This function enables an **individually configurable image overlay** allowing to display information within the images.  
Many different options are available by clicking **Add item to...**<sup>2</sup>

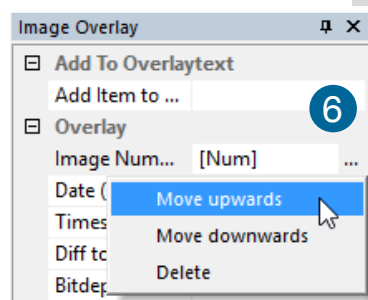
Also the **Appearance** is configurable:  
Font, Text color, Text opacity, Background color, Background opacity and horizontal or vertical orientation.

**Camera image number**<sup>3</sup> and **Camware Image Number**<sup>4</sup> are two different count methods:

**Camera image number**: the image numbers are incremented continuously. When recording in Ring Buffer mode, the image numbers exceed the number of images stored in the RAM memory of the computer since images are overwritten when the memory is full, starting with the first image in loop.

**Camware image number**: the software displays the image numbers according to the number of images being recorded (starting with image 1).

006964 000001 26.06.2017 10:54:48:521 12 1584 pco

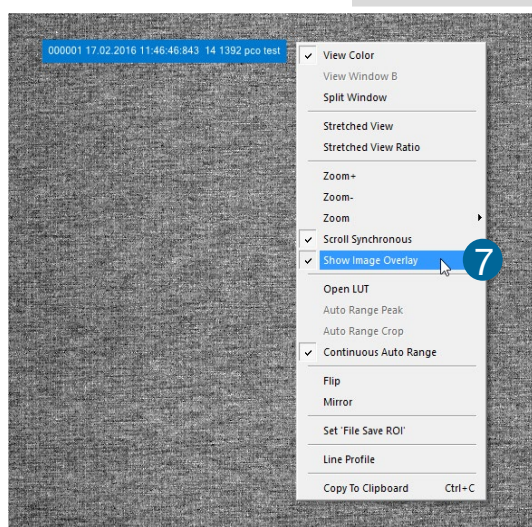


A preview of the image overlay is shown.<sup>5</sup>

Each item can be moved upwards, downwards or deleted by clicking on ...<sup>6</sup>



By **drag & drop** the **Image Overlay** can be moved easily to your favorite position within an image.



Right click in the image window to turn on Show **Image Overlay** and activate this function.<sup>7</sup>

### NOTE

This function does not overwrite image data.



## 6.5 RECORDER TOOLS

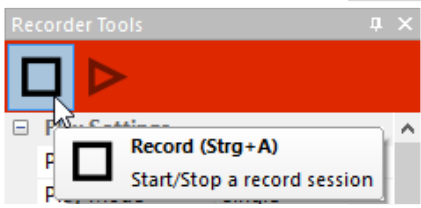
**Recorder Tools** provides **Record** and **Play** function, **Play Settings** and **Record Settings**.

Located on the right lower side of Camware or, if closed, activated by **View Menu** (see chapter 6.9.5)

### Record

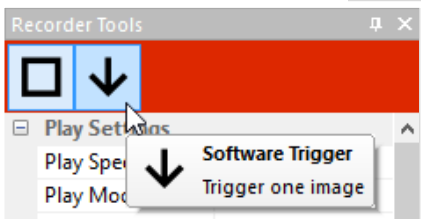


**Start/Stop record** with Record Button.  
or press **enter** in the **View window** to start or stop recording.



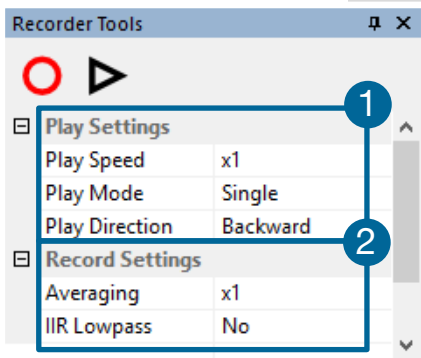
**Record:** in record state Camware software is highlighted in red.

Exposure time may be changed during recording. See 6.3 **Camera Properties**.



**Software Trigger Mode:** after record is started an arrow pointing downwards appears. Clicking on it triggers a single image. (see 6.3.1).

### Play Settings ①



**Play Speed:** selectable play speed from x1 to x256 or from 1fps to 16 fps. E.g. in mode x1 a recording with 1000 fps is played with 25 fps.

1 fps means that only one frame per second is played.

**Play Mode:** selectable play mode of the recorder (continuous or one-time (re)play).

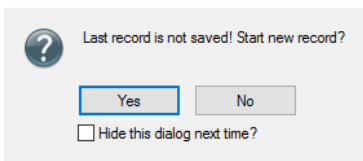
**Play Direction:** selectable direction of record play (forward or backward)

### Record Settings ②

**Averaging:** averaging images in the buffer reduces statistically independent (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 90% of the previous image and 10% of the new image to create images with clearly reduced noise.

Image (actual) = Image (act - 1) \* 0.9 + Image (new) \* 0.1



### Reminder dialog

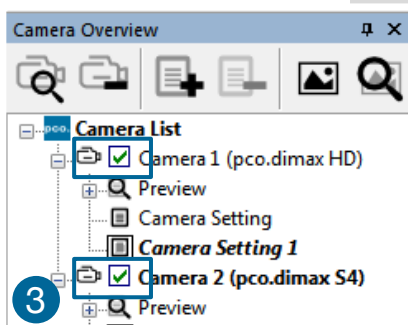
If you made a recording but did not save it yet, Camware will remind you to save the record before starting a new one.

**Extended Recorder** can be activated (see 6.9.5)



### Functions:

- 1 Start & Stop record / Stop record / Replay
- 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

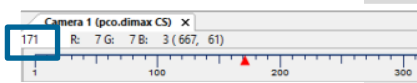
With all cameras activated recording is started simultaneously for all cameras.

Recorder will use Recorder mode settings (Sequence or Ring Buffer) of the selected camera for all cameras (see 6.3.8)

For single camera recording, deactivate cameras by removing the check mark from the box. 3

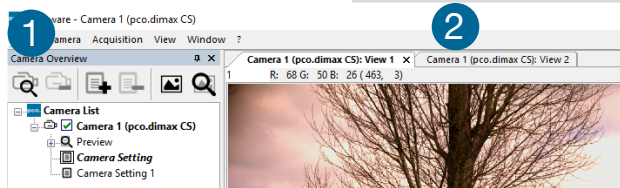
## 6.6 VIEW WINDOW

### Quick-scroll through images

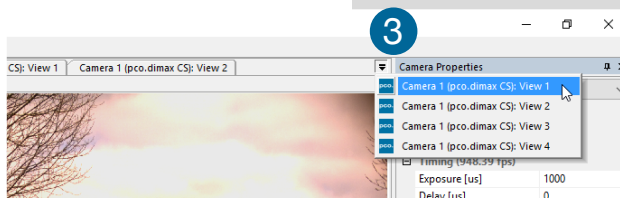


Having recorded at least 50 images, you can scroll through the images quickly. To do this, hold down the left mouse button on the image number. Additionally you can enter the **desired image number** directly into the number field.

### More View Windows

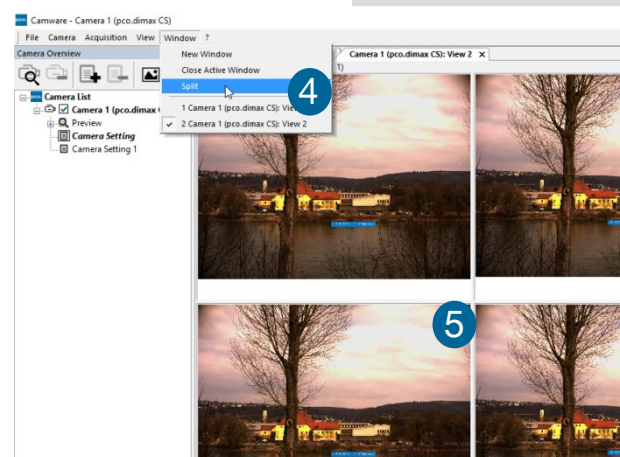


You may open more than one window for one camera: just click on **new view window** 1 and Camware will create a new one 2. Even when multiple view windows (or from multiple cameras) are open, the same image number is always shown in all of the view windows.



A **dropdown menu** 3 helps to select a view window. If there are more view windows than can be displayed on the desktop, you may select individual view windows.

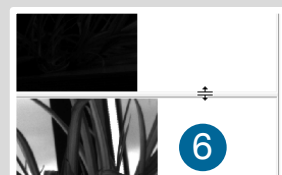
### Split View Window



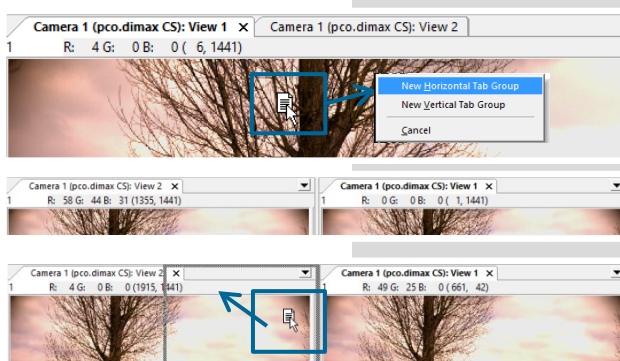
The view window can be split. Choose **Window** → **Split** 4 and a split cross will be shown. The size of splitted window elements is easily adjusted by grabbing and dragging the dividing lines 5.

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 6.9.8)

To undo the split, double click on the dividing line (after symbol 6 is visible).



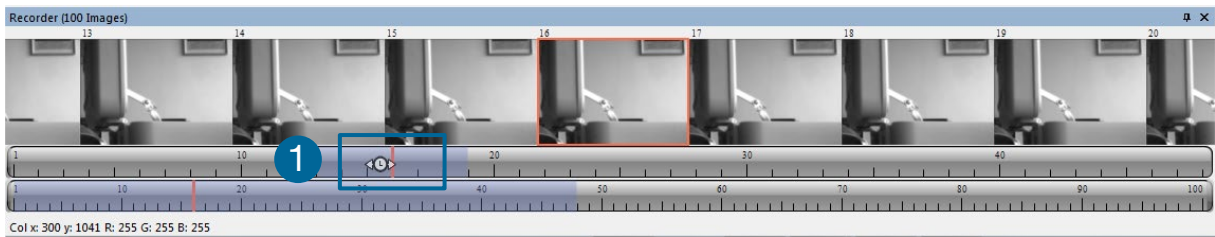
### Two Tabs side by side or on top of each other



To view two tabs side by side or arranged one above the other just drag a tab and Camware will ask you whether you want to create a new horizontal or vertical tab group. Undo this by dragging the tab back to its former position. This also applies for view windows of several cameras.

## 6.7 RECORDER (IMAGES)

When recording is done, small preview images (thumbnails) are built and displayed automatically. This will take some time depending on the performance of your computer system.



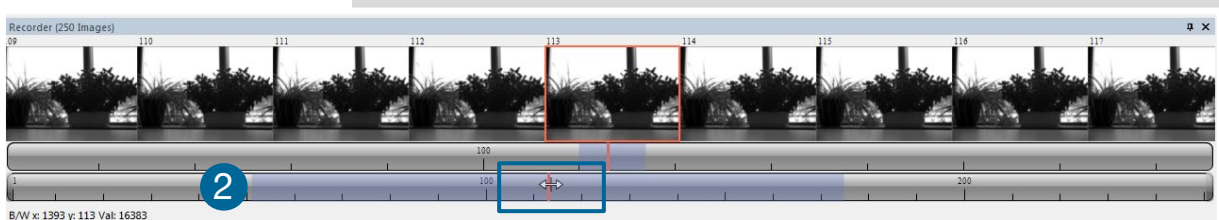
Clicking (left mouse button) within the upper scale bar **1**, you can adjust the number of images which are shown by moving the mouse left or right. Minimum is **20** and maximum is **half of the recorded images** in this scale.



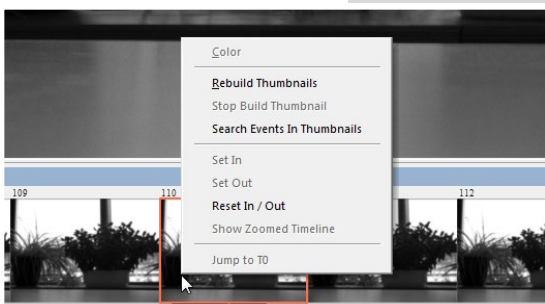
**Quick scrolling:** scroll through the thumbnails by dragging the orange bar with the mouse or by **mouse wheel** while the cursor is over the image number bar.

While **quick scrolling**, **Preview** window displays the active image sequence. This allows to quickly scroll through the image sequence displaying the live 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).

Clicking on a thumbnail image it will be shown on the view window. Scroll **via mouse wheel** through the thumbnails. The upper **blue bar** refers to the number of displayed thumbnails. The lower blue bar shows the range of the upper scale in relation to the whole record.



The second scale shows the total number of recorded images. It allows fast scrolling through the images **2**.

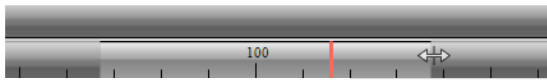


### **Right-click menu (click on thumbnails)**

Allows to rebuild all thumbnails and to search for events.

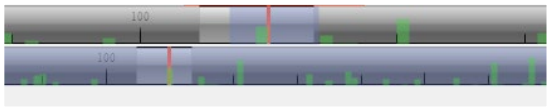
Furthermore the **Set In / Out** enables to set values for a sequence, which can be played via play button. Reset In / Out discards these settings.

**Set In / Out** is active: if you **save/export** your images, only the selected ones are saved/exported (see **6.9.2**).

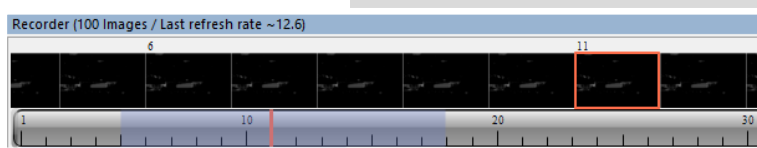


The **light gray area** in the upper scale shows an **In-Out** example area. To define a new area: just **right-click on the start and end frame** in one of the scales. The **In** image must be left to the red bar, the **Out** image to the right of the red bar.

Adjust the In / Out area by holding down the left mouse button and slide the borders to increase / decrease.



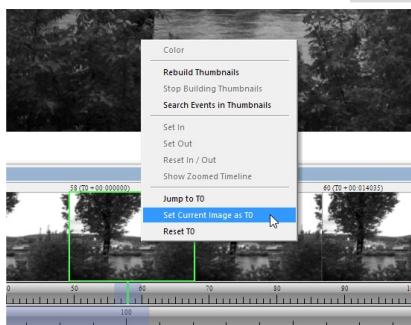
**Search Events in Thumbnails:** detected events are displayed as **green bars**.



#### **Too dark or bright thumbnails**

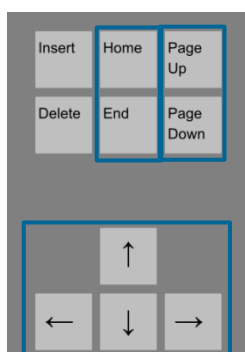
If thumbnails are too dark or too bright, right-click in view window (see 6.9.8) and select **Auto Range Peak** or **Auto Range Crop**. Then

right-click on a thumbnail image and select **Rebuild Thumbnails**. Now the thumbnail images should conform to the view window.



#### **Set current Image as T0**

It is possible to set a T0 Image manually. For information about T0, see **Sequence Trigger Mode** in chapter 6.3.5. This T0 Image can be resetted.



#### **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.

## 6.8 SETTINGS OVERVIEW

Camera	Auto Save	Type	Status	Frame Rate	Resolution	Exposure Time	No. of Images	T0 Pos.	Ext. Sy...
Camera 1	<input type="checkbox"/> Off	pco.dimax HD (53)	Ready	2128	1920 x 1080	100us	1000	inactive	-
Camera 2	<input type="checkbox"/> Off	pco.dimax standard (68)	Ready	928	2016 x 2016	1ms	999	inactive	-

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

The parameters can only be changed under **6.3 Camera Properties**.

Switch easily between the **Recorder (Images)** section and the **Settings Overview**.<sup>11</sup>

No.	Function	Description
1	Camera name	Name
2	Auto Save	Off , Unconfigured (red), OK (green)
3	Type	Camera type and serial number
4	Status	Ready or Recording Green background: Images are in memory
5	Frame Rate	Currently selected frame rate
6	Resolution	Resolution in pixels
7	Exposure Time	Selected exposure time
8	Number of Images	Number of images to be recorded
9	T0 Position	See T0 chapter Fehler! Verweisquelle konnte nicht gefunden werden.
10	Ext. Sync. State	Status: <b>Locked</b> or -

**Ext. Sync State** is only available if the **Trigger Mode** of the camera is set to **External Synchronized** (see **6.3.1**), that means the recording of the cameras is externally synchronized. It takes up to 30s until the synchronization is completed and **Locked** is displayed. This function will **not** display a Master / Slave synchronization.

“-“ means **not synchronized** (Ext. Sync Mode activated / deactivated).

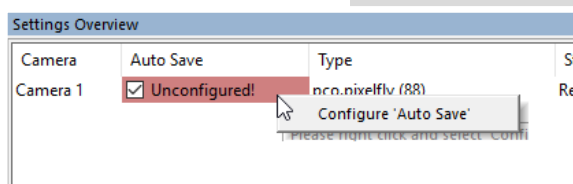
Camera	Auto Save	Type	Status	Frame Rate	Resolution	Exposure Time	No. of Images	T0 Pos.	Ext. Sync. State
Camera 1	<input type="checkbox"/> Off	pco.dimax HD (53)	Recording	100	1920 x 1080	100us	1000	inactive	Locked
Camera 2	<input type="checkbox"/> Off	pco.dimax standard (68)	Recording	100	1920 x 1080	100us	1000	inactive	Locked

## 6.8.1 AUTO SAVE

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

**For standard file save** see File Menu **6.9.2**.

**Explanations** will be displayed 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).

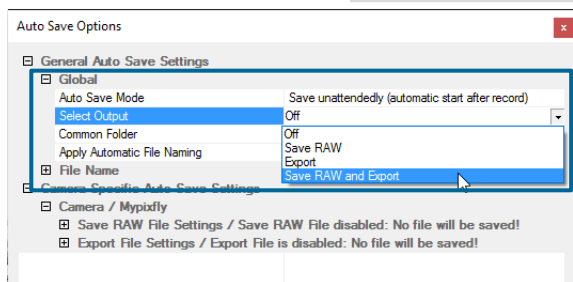
Right-click on the **Unconfigured!** field and click on **Configure 'Auto Save'**. The **Auto Save Options** dialog is displayed.

First, configure the **General Auto Save Settings - Global**

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

The **Save manually** mode allows to store RAW images and export images after recording a session, when hitting the **SHIFT and A** keys. This allows to cut the image sequence 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.



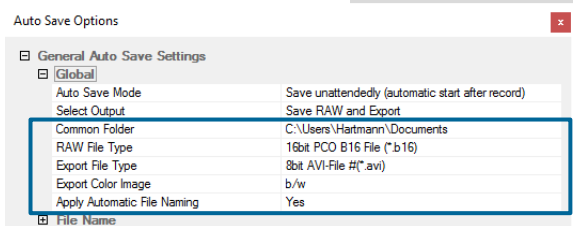
**Select Output:**

**Off** – Auto Save is deactivated

**Save RAW** – Only 16 bit RAW files are stored (b16, pcoraw, MultiTif-File, Tiff)

**Export** – only compressed files are stored (BMP, JPG, Tiff, AVI, MPEG, WMV)

**Save RAW and Export** – RAW and Export files are stored simultaneously



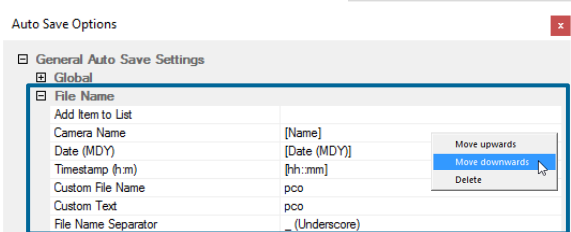
**Common Folder:** main folder for stored files

**RAW and Export file Type:** select the type of RAW and Export file

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

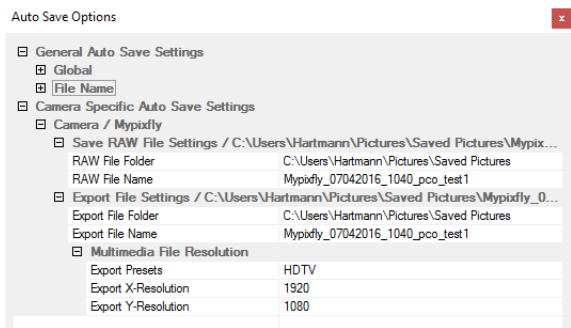
**Apply Automatic File Naming:** if set to **yes**, stored files are automatically named by Camware.

## General Auto Save Settings – File name



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

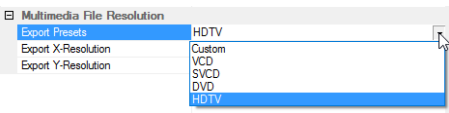
## Camera Specific Auto Save Settings:



Configure camera specific settings for each connected camera.

**Save RAW File Settings:** set **RAW File Folder** and **RAW File Name**.

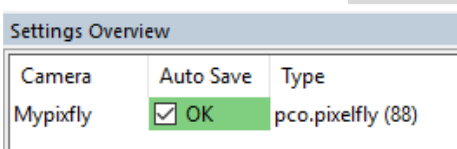
**Export File Settings:** set **Export File Folder** and **Export File Name**.



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



**Finish** the configuration by clicking **OK**.



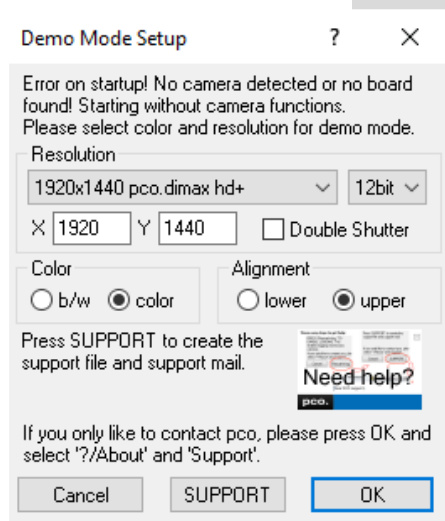
After configuration is finished, **Auto Save** status turns **OK** (highlighted)



## 6.9 CAMWARE FEATURES

This chapter describes in detail the Camware Demo Mode and the File, Camera, Acquisition, View and Window menus.

### 6.9.1 DEMO MODE



Upon start Camware, it automatically recognizes the camera type of the connected and running cameras.

Camware starts in Demo Mode, if your camera is switched off or no camera is connected.

In this mode all **image processing** features are available, but all **camera settings** are deactivated. Just tell Camware the type of image you want to open. For that purpose, the **Demo Mode Setup** window opens and asks for the corresponding input.

**Need Help?** Having troubles to run the camera, this window will pop up. See instruction in appendix **A7**.

#### **Resolution**

The drop down list displays the image sensor spatial resolutions of all PCO camera systems. Select the specific resolution and bit depth of the images to be opened! Double Shutter mode should be ticked 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**

Select between **MSB** (most significant bit) upper alignment and **LSB** (least significant bit) lower alignment to display stored images.

```

Infotext
C:\Users\Hartmann\Desktop\TH\TES\TEST_00001.b16
PCO - CamWare Recorder Comment File
Record Date: 16.02.2016 Time: 15:54:32

Camera Settings
Camera Type      : pco.pixelfly
Picture Size horz./vert. : 1392/1040
ROI horz./vert.  : 1-1392/1-1040
Binning horz./vert. : x1/x1
Exposure / Delay : 5.000000 ms / 0.000000 ms
ADC-Operation    : 1
Offset Regulation : auto
IR-Sensitivity    : off
Pixelrate        : 24 MHz
Conversion factor : 1.00 e/count
Camera serial number : 138
  
```

#### **Infotext**

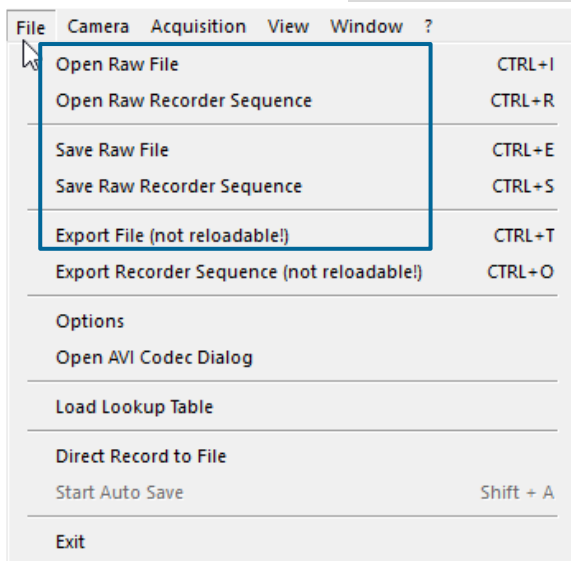
The **Infotext** is automatically shown in Camware if you open a stored raw sequence.

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

This text file is saved with every recorded raw sequence / image. Camware asks you for custom text before your images are saved. You can add information, e.g. lens and aperture of your experiment.

**Infotext** can be activated in the View Menu **6.9.5** at any time.

## 6.9.2 FILE MENU



### NOTE

Be aware of the different storage characteristics of the formats, for example \*.bmp - the bitmap format stores 8 bit values only and therefore the image content of a 16 bit image is reduced, if stored as bitmap.

### Open RAW File (single image only)

This command imports a single image into the active image window. Only files with the extension and format **\*.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 image itself is fitted to the current image size. If the recorder is disabled, the current image size is set to the parameters of the imported image.

### Open RAW Recorder Sequence (image sequence from one camera)

Imports a sequence of images. If more than one camera is connected and an image window is currently 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 format **\*.b16**, **\*.pcoraw**, **\*.tif** and **multi tif** can be imported.

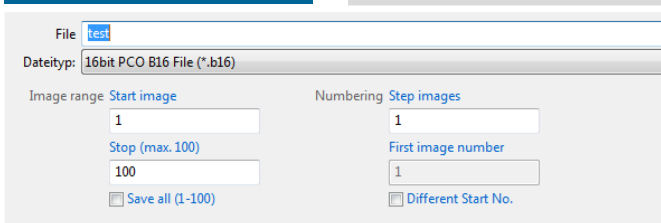
### Save RAW File (single image only)

Saves the image displayed in the active window and opens the Save file dialog. The image file can be saved in **16bit \*.b16** and **\*.tif** format. If more than one camera is connected, save all current images by selecting Export all images in the Save file dialog box. This feature saves one image of each active camera in one step (it is not necessary to repeat the save process for each camera). The Save command is not available if no image window is open. For **Auto File Save** see **6.8.1**

### Save RAW Recorder Sequence (image sequence from one camera)

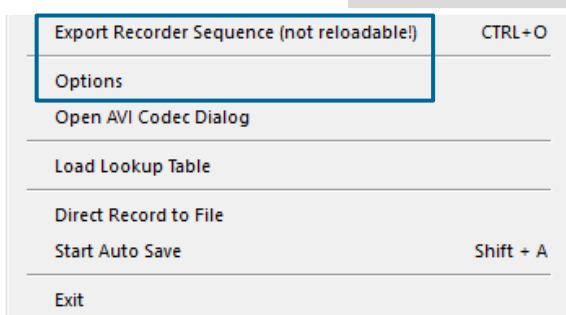
Save Recorder saves or exports image sequences. If more than one camera is connected and an image window is currently open, the record of the active window will be saved. The command opens the Save recorder file dialog box. It is possible to select the number of saved images, to step images and to choose the

first image number. For **Auto File Save** see **6.8.1**



### Export File (not reloadable!)

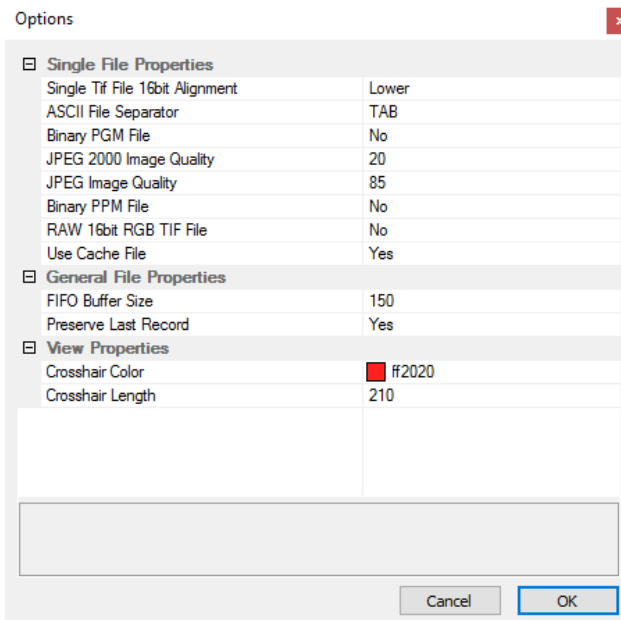
Exports the image of the active image window. This command opens the Export Image dialog box. Files with the extensions fts, tif, bmp, asc, jpg, and jp2 can be exported. This topic is not visible, if no image window is open. For **Auto File Save** see **6.8.1**



### Export Recorder Sequence (not reloadable!)

Exports a sequence of images. If more than one camera is connected the image record of the currently open window will be saved. If no image window is open the Export Recorder Sequence menu does not appear. This command opens the Export recorder box. Files with the extensions fts, tif, bmp, asc, avi, mpg, jpg, jp2, and wmv can be exported (see Appendix A6). For **Auto File Save** see 6.8.1

## Options



### Single File Properties

**Single tif file 16 bit alignment:** upper / lower

**ASCII File Separator:** select a separator for the values in the ASCII file. Select tab, space, semicolon, colon, comma, hyphen, slash or backslash.

**Binary pgm file:** set the format of the pgm (portable gray map) file. Select: yes, no.

**Jpeg2000 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 tif 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. Select: yes, no

### General File Properties

**FIFO buffer size:** set the FIFO buffer size in number of images. This avoids gaps during file write delays. Usually it is set to 150.

**Preserve last record:** preserves current recorded images. When set, the user will be asked whether to really start a new record or to close.

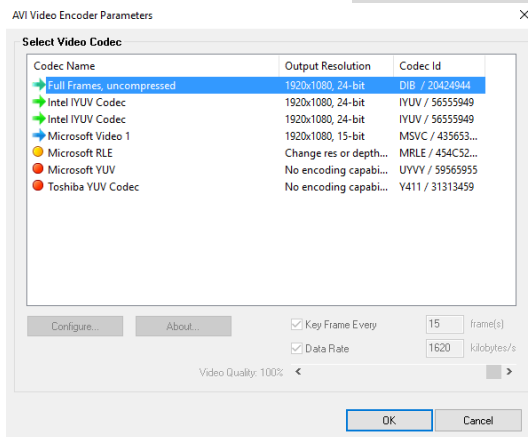
### View Properties:

**Crosshair color:** set crosshair color, save ROI and line tool.

**Crosshair length:** set the crosshair length in pixel.

Activate crosshair: see chapter 6.9.8

### Open AVI Codec Dialog



Using **Auto File Save 6.8.1** and selecting AVI for video output affects stored video sequences.

Only available, if **AVI video format** is selected.

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

### 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.

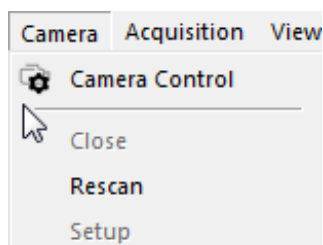
### Start Auto Save

Only available, if **Auto Save** is activated, see **6.8.1**

### Exit

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

## 6.9.3 CAMERA MENU



### Camera Control

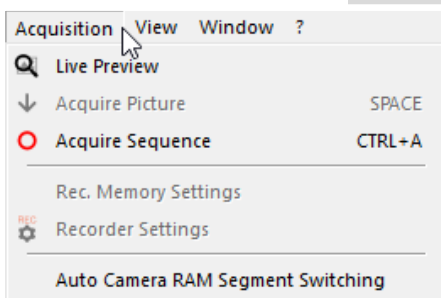
Opens the camera control window (see **6.3**).

### Close

Disconnects camera and switches Camware to Demo Mode. In case of multiple cameras, all cameras must be closed for Camware to switch to Demo Mode.

**Rescan** Disconnects and reconnects all cameras.

## 6.9.4 ACQUISITION MENU



### Live Preview

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

### Acquire Picture

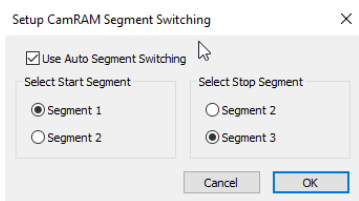
Active if Recorder Mode is set to **Soft Trigger**, see **6.3.1**

### Acquire Sequence

Starts recording images into the system memory according to Trigger Mode selection (see **6.3.1**). During recording, all camera controls are locked.

Rec. Memory Settings (not available)

Recorder Settings (not available)



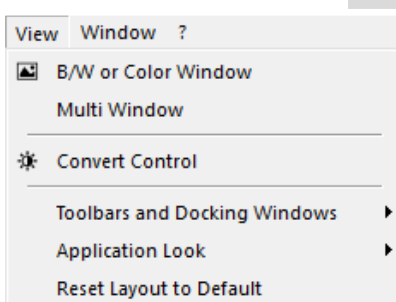
### Auto Camera RAM Segment Switching

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

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

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

## 6.9.5 VIEW MENU

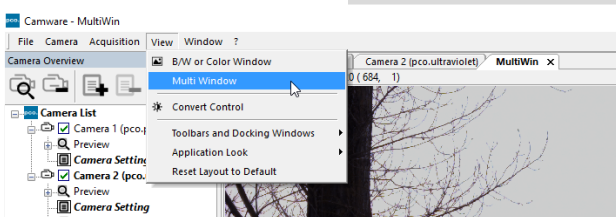


### B/W or Color Window

Opens a new display window.

### Convert Control

See chapter **6.3.8**.

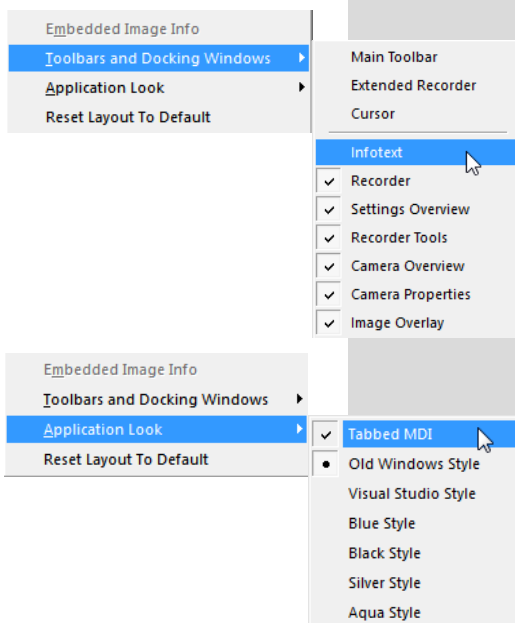


### Multi window

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).

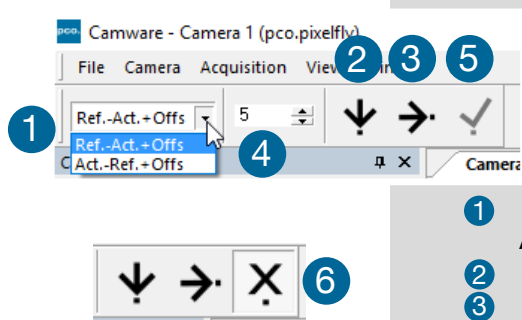


### Toolbars and Docking Windows

Standard toolbars of Camware 4 are Recorder/ Recorder Tools / Camera Overview / Camera Properties and Image Overlay. **Additional Toolbars** known from Camware 3.x are displayable, but not essentially needed: Main Toolbar / Extended Recorder / Cursor. For function **Infotext** see 6.9.1.

### Application Look

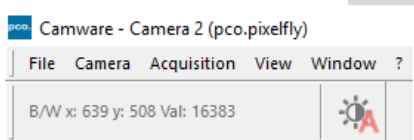
The Style and Look of Camware can be customized; many different style sheets are selectable. The Tabbed MDI function (un)docks the view windows.



### Math Tools

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

- 1 Reference (image) – Actual (image) + Offset or Actual (image) – Reference (image) +Offset
- 2 a reference picture is acquired and copied to reference buffer
- 3 last acquired image is copied to reference buffer
- 4 add offset to avoid negative values, which would not be visible
- 5 enable math function
- 6 disable math function



### Cursor

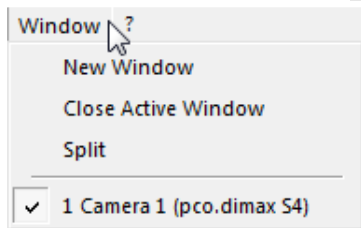
Shows position of mouse cursor.

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

### Reset layout to default

This resets all customized changes and restores the default layout.

## 6.9.6 WINDOW MENU



### New Window

A new view window will open.

### Close Window

Active window closes.

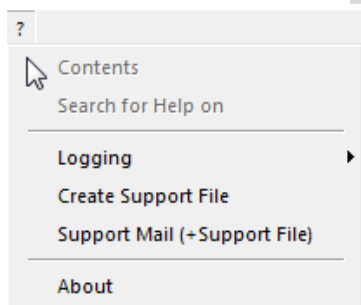
### Split

The view window splits in four quarters.

### Camera overview

Shows all connected cameras, e.g. **1 Camera 1 (pco.dimax S4)**.

## 6.9.7 HELP MENU



### Contents

Opens the main page of the program help.

### Search for Help on

Opens an index list for help.

Camware 4



#### Generate support file?

This will generate a file called CWSupport.zip, which will be attached to the mail, if selected. It will contain some logfiles and additional info about your system:  
PCO\_Reg.txt (Registry entries about driver)  
Conflicts.info (Info file about the computers hardware).

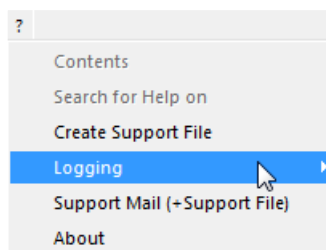
Yes

No

### Create Support File

Press **YES** to activate log files and reboot Camware and your pco.dimax.

After log files are activated it is possible to create a support file. Send this file to the PCO support (see **A7**)



### Logging

#### Enable Logging:

Activates Camware log files (this cuts down performance)

#### Clear Logfiles: (only visible if logging is enabled)

This command erases all actual log files

#### Explore Logfiles:

Opens windows explorer

#### Disable Logging (only visible if logging is enabled)

Disables logging



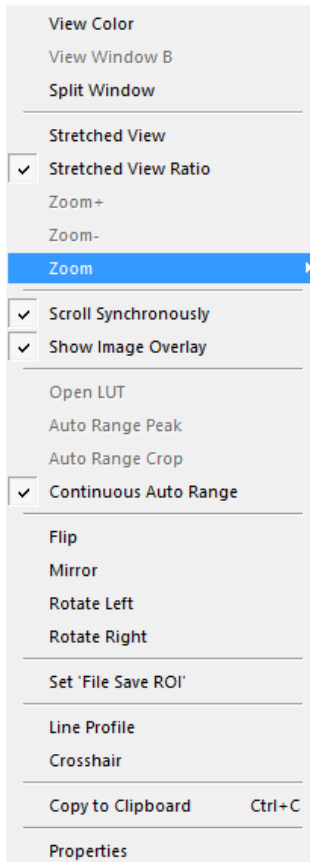
### Support Mail

Opens your email-program and the created support file is added automatically as attachment.

### About Camware

Shows program information.

## 6.9.8 VIEW WINDOW MENU

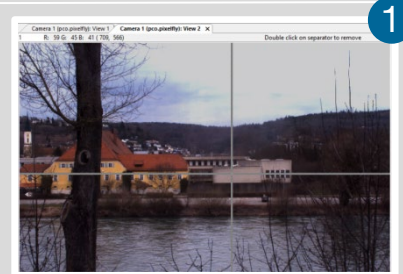


All functions of the **View window menu** are explained briefly. **Right-click** in the View window to open this menu.

**View Color:** color window.

**View Window B:** Double Shutter activation switches to window B (second image).

**Split window:** ① splits the View window in four parts. Double click on separator to undo.



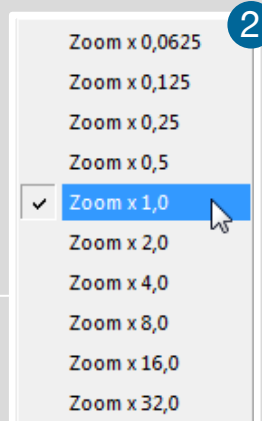
**Stretched View:** image is fitted into the display window.

**Stretched View Ratio:** aspect ratio is maintained.

**Zoom +/-:** ② image zoom (only available if **Stretched View** is deactivated).

**Zoom:** set the Zoom factor (from 0.0625 to 32).

**Scroll Synchronously:** scroll synchronously through all open image windows (only available if **Stretched View** is deactivated).



**Show Image Overlay:** activates the overlay see 6.4

**Open LUT:** opens **look-up table** file for false-color representation.

**Auto Range Peak:** searches for the minimum and maximum 14 bit intensity values of the image. Given these numbers the converter scales the 8 bit display (256) within these two values.

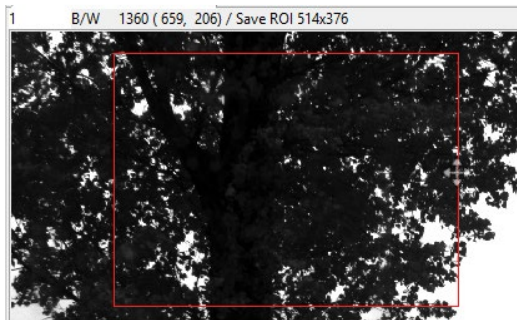
**Auto Range Crop:** sets the converter to ignore the extreme intensity values of the image and scales the display in a smaller range. Thus dark or bright light spots, reflections, etc. are cut off.

**Continuous Auto Range:** (Crop): enables the automatic min/max function (Auto Range Crop) during record and replay.

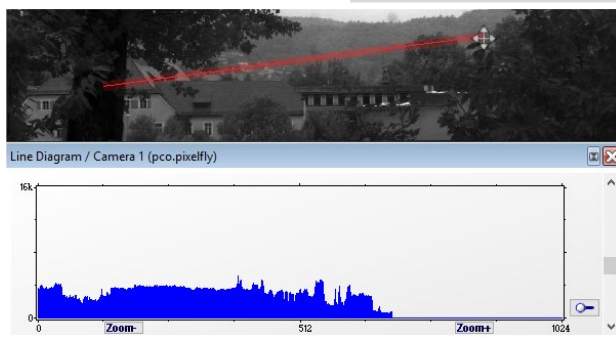


**Flip/Mirror:** image will be flipped or mirrored.

**Rotate Left/Right:** rotates the image in steps of 90°.



**Set 'File Save ROI':** if you want to save just a part of the recorded image (region of interest), it is possible to draw a rectangle with the mouse. This rectangle is valid for all recorded images and can be dragged at its edges.



**Line Tool:** point the mouse where the line should start and left-click. 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.



**Crosshair:** activates a centered crosshair. Size and color are selectable see chapter 6.9.2 → **Options**.

To move the crosshair drag it by mouse. Reset it to center position by double-click into the center of the crosshair.

View Mode	
View Color	no
View Mode	Stretched View ...
Zoom	0.5
Common View Mode	
Flip	no
Mirror	no
Rotation	no
Scroll Synch...	yes
Show Image...	no
Image Conversion	
Convert Min	183
Convert Max	220

**Copy to Clipboard:** will copy the actual image to clipboard.

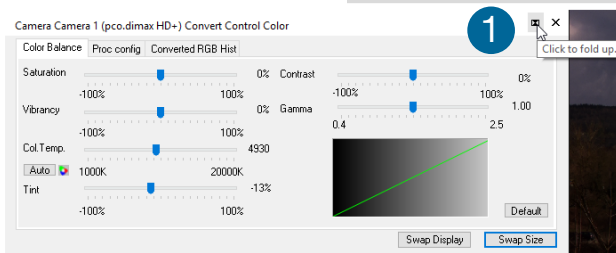
**Properties:** shows the current settings for **View Mode** / **Common View Mode** and **Image Conversion**.

## 6.9.9 ADDITIONAL FEATURES

### White Balance by Mouse

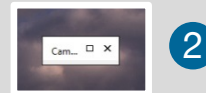
Change **white balance** by mouse: Press the CTRL (STRG) and shift button simultaneously and select a white or gray area within the image by dragging a rectangle while holding the left mouse button. The pixel values within the coordinates of the selection rectangle are used for calculating a new **white balance**.

For best results we recommend to use the white balance button in the Convert Control Color (see 6.3.8).



### Fold Up Window

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



### 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 selection rectangle's size by moving the mouse. After releasing the mouse button the coordinates of selection rectangle act as a border for calculating the minimum and maximum values.

### Setting a new ROI by Mouse

Change **Region of Interest** by mouse (see ROI 6.3.2.). Just press the CTRL (STRG) button 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. Reset the ROI to maximum by pressing the CTRL (STRG) button and the right mouse button.

### Short Cut List

- Start / Stop record: ENTER
- Acquire Picture: SPACE (Soft Trigger mode)
- Acquire Sequence: STRG + A / CTRL + A
- Auto Save: ALT + D
- Export File: STRG + T / CTRL + T
- Export Recorder Sequence: STRG + O / CTRL + O
- Open Raw Image File: STRG + I / CTRL + I
- Open Raw Recorder Sequence: STRG + R / CTRL + R
- Save Raw Image File: STRG + E / CTRL + E
- Save Raw Recorder Sequence: STRG + S / CTRL + S

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# A1 TECHNICAL DATA

## A1.1 DATA SHEET

Sensor			
Image sensor	Proprietary sensor		
Resolution	cs1	1296 x 1024 pixels	
	cs3	1920 x 1440 pixels	
	cs4	2016 x 2016 pixels	
Sensor format / diagonal	cs1	14.26 x 11.26 mm <sup>2</sup>	18.17 mm
	cs3	21.12 x 15.84 mm <sup>2</sup>	26.40 mm
	cs4	22.18 x 22.18 mm <sup>2</sup>	31.36 mm
Pixel size	11 x 11 μm <sup>2</sup>		
Shutter mode	Global Shutter		
Fullwell capacity	36 000 e <sup>-</sup>		
Quantum efficiency	50% @ peak		
Spectral range (b/ w sensor)	290 ... 1100 nm		
Readout noise	22 e <sup>-</sup> (typ.) 18 e <sup>-</sup> (CDI)*		
Dynamic range	1600:1, 64 dB ; 2000:1, 66 dB (CDI)*		
Dark current	530 e <sup>-</sup> /pixel/s @ 20°C		
Non-linearity	< 0.5% (diff.), < 0.2% (integr.)		
DSNU (dark signal non-uniformity)	< 0.6 counts rms @ 90% center zone		
PRNU (photo response non-uniformity)	< 1% @ 80% signal		
Camera			
Max. fps @full resolution	cs1	3086 fps	
	cs3	1603 fps	
	cs4	1102 fps	
Exposure time	1.5 μs ... 40 ms		
Dynamic range A/D	12 bit		
Region of interest	24 x 4 pixel steps (centered)		
Internal memory	9 GB		
Output signals	Status exposure/Status busy		
Multi-camera Synchronization	Sync In/Out (Master/Slave), PLL		
Trigger / Synchronization signals	TTL, RS-485, Contact		
Data interface	Gigabit Ethernet		
Time stamp	in image (1 μs resolution)		
Time code input	IRIG-B unmodulated (optional)		
Interframing time	3.58 μs (optional)		
Operating temperature	0° - 40°C		
Housing	enclosed housing		
Shock resistance	150g for 11ms		
Power supply range	15 - 48 V DC		
Power consumption	27 W		
Camera connector	LEMO (18-pins: 2B-318-CLN)		
Lens mount	C-mount + F-mount / EF-mount (optional)		
Mounting threads	2x ¼", 2x M4, 14x M6		
Weight	0.985 kg (C-mount version)		

\*in correlated double image mode (CDI) the readout noise is reduced and therefore the intra-scene dynamic is improved.

## A1.2 REAR PANEL

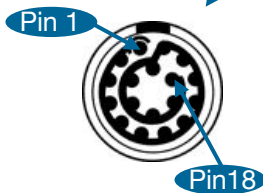


1 **HD-SDI** BNC plug for 75 Ω coaxial BNC cable, see **A5**

2 **LEMO II** power connector for **Battery**, electronic **Lens** controller or **HD-SDI monitor**

3 Status **LEDs**

LED	Color	Description
PWR	Green	Voltage applied
	Red	Error state
LAN	Orange	Network connection is active (flashing)
		If connection is lost: permanent light
REC	Blue	rec state = on: permanent light:
		Flashes while rec after T0



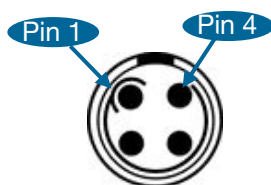
4 **LEMO I** Connector for Synchronization, Power Supply, Trigger Signals and GigE network connection

5 **Fan**

### Lemo I Pin assignment (EEG.2B.318.CLN)

(Fitting male connector: FGG.2B.318.CYCD92ZN)

Pin	Signal name	Color
1	Ethernet A-	Orange
2	Ethernet D-	Brown
3	Ethernet B-	Green
4	Ethernet B+	White (Green)
5	Ethernet C+	Black
6	Status +	Red
7	+SUPPLY	Orange (BI 1)
8	+SUPPLY	Red (BI 2)
9	SYNC+	Yellow
10	SYNC-	Green
11	-SUPPLY	Gray (BI 3)
12	-SUPPLY	Black (BI 4)
13	Ethernet A+	White (or)
14	Ethernet D+	White (br)
15	Ethernet C-	White (bl)
16	Status- /CamPresent	Blue
17	TRG+	White
18	TRG-	Brown (for TTL: not connected with GND)
Case		Ethernet Screen TRG shield SYNC shield



### Lemo II Pin assignment (EEG.0B.304.CLN)

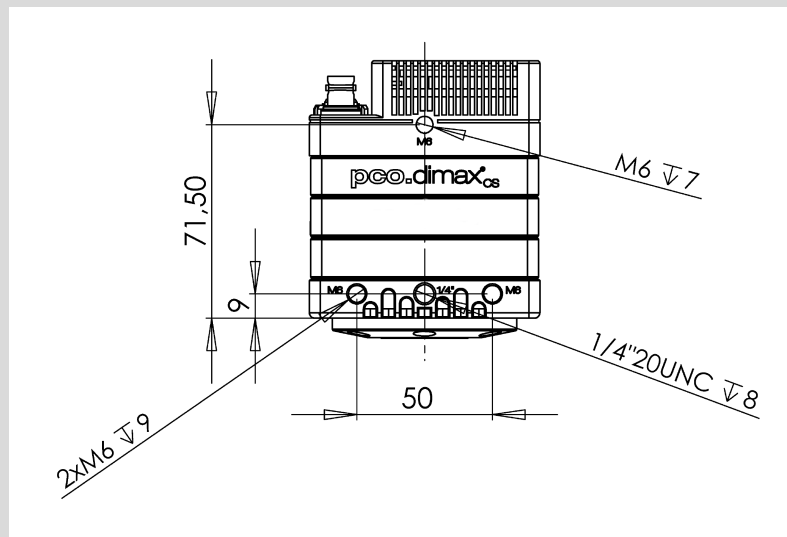
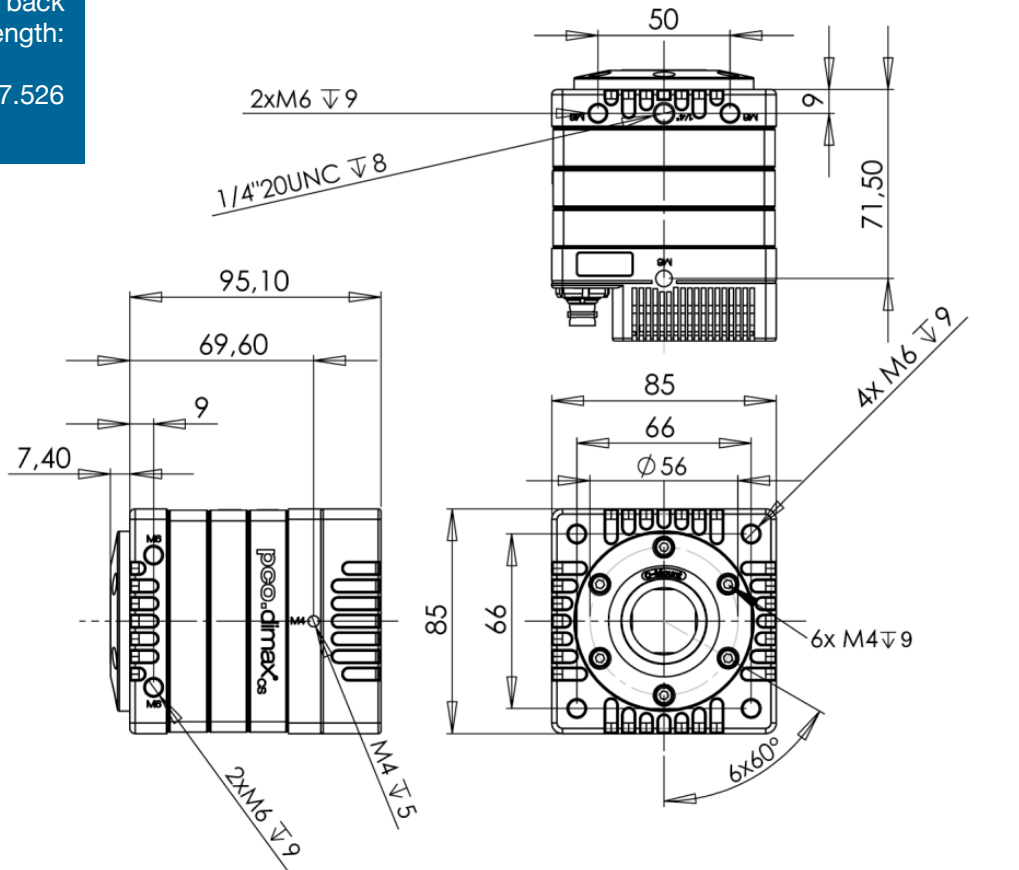
(Fitting male connector: FGG.0B.304.CYCD52Z)

1	SUPPLY OUT	12V Out Standard (15 W)
2	SUPPLY IN & RXD	(RXD bidirectional modulated) Communication battery and lens controller
3	TXD	Communication battery and lens controller
4	GROUND	

## A1.3 DIMENSIONS

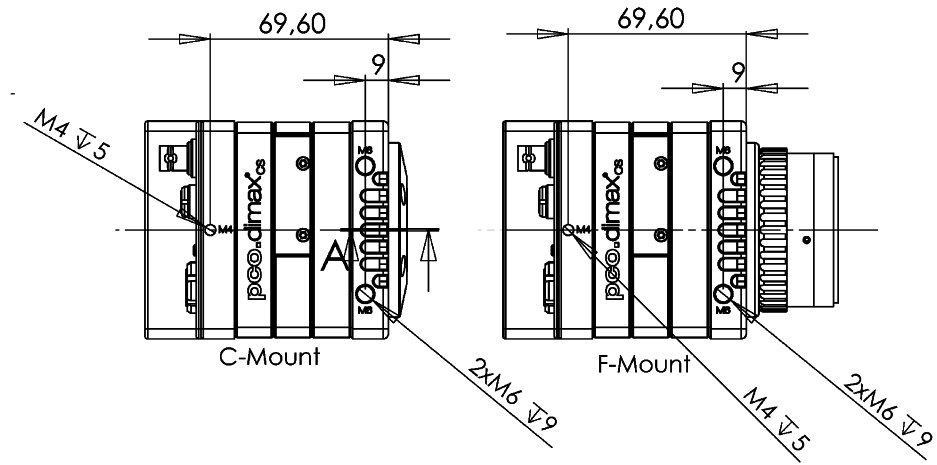
### NOTE

F-Mount back focal length: 46.50 mm.  
C-Mount: 17.526 mm

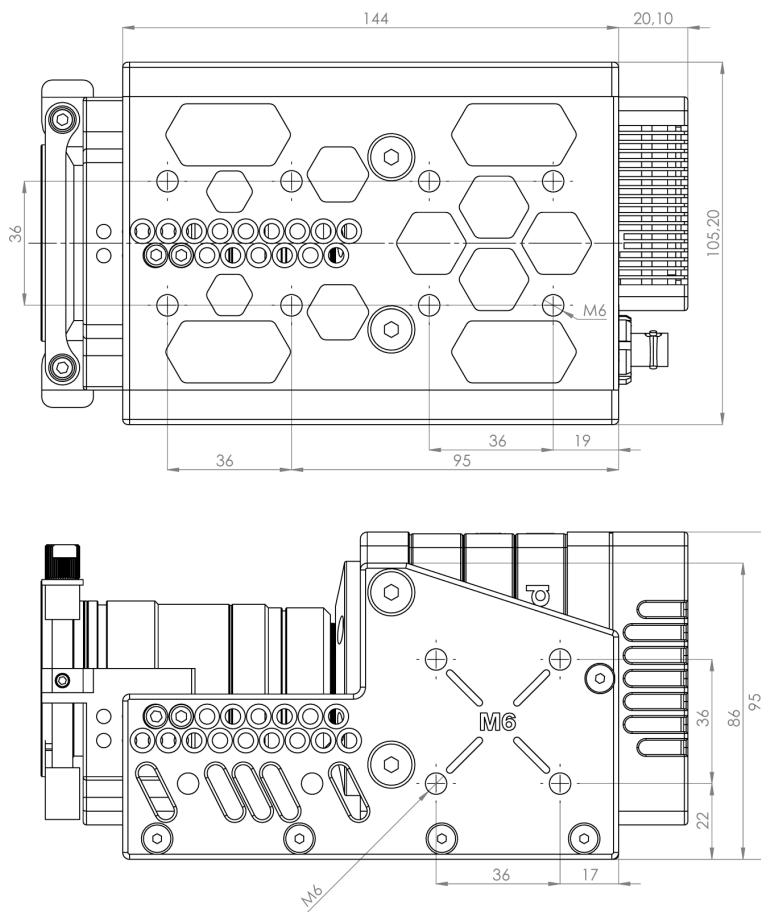


All dimensions given in millimeter.

**C-Mount vs F-Mount**



**Lens cage**



## A1.4 INPUT WINDOW FILTER

The safety glass as input window in front of the color sensor acts as anti-reflective coated filter (98% light transmission). Monochrome cameras have a Suprasil input window.

The spectral range of the **pco.dimax color** is: 400 nm – 700 nm.

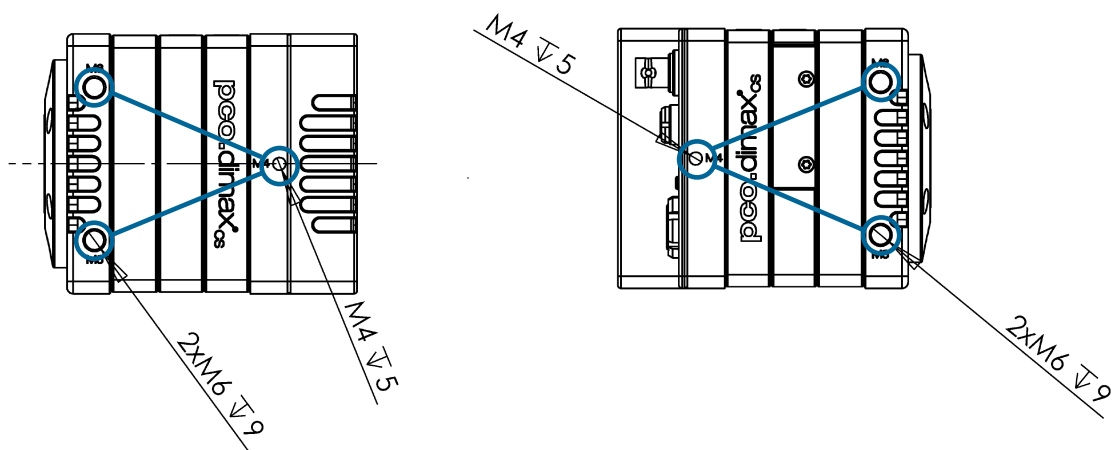
## A1.5 MOUNTING

A stable mounting of the camera system is required for applications with acceleration forces of up to 150G.

- PCO recommends to use the **mounting threads** of the pco.dimax cs camera.
- It is **recommended** to primarily use the threads on the black front part of the camera
- It is **not allowed** to only use the M4 threads near the rear side of the camera
- Always mount the camera by a **three-point screw connection**.
- Always use **two sides** of the camera for the screwing
- **Carefully** tighten the screws

The body of the camera is made of aluminium and the threads are reinforced with HeliCoil® inserts.

Drawings show the M6 and M4 threads on the left and right side of pco.dimax cs.





## A2 GIGABIT ETHERNET INTERFACE

GigE is an interface standard for high-performance industrial cameras developed by a group of about 50 companies. GigE is based on the Gigabit Ethernet standard which uses standard Ethernet category cabling. The standard is trying to unify protocols currently used in machine vision industrial cameras and let 3rd party organizations develop compatible software and hardware ([www.machinevisiononline.org](http://www.machinevisiononline.org)).

**System requirements** (check PCO website for latest versions)

- GigE PCO firmware > V2.00
- Camware software package
- GigE driver generation 2 > V4.0.0.00
- Complete network environment must be GigE compliant Cat5e or higher patch cable

### A2.1 QUICK INSTALLATION GUIDE

Follow the steps in this sequence. Additional information can be found in the respective subchapters.

First Step <b>NIC</b>	<b>Install network interface card (NIC)</b> See chapter <b>A2.2</b>
Second Step <b>IP Address</b>	<b>Configure the IP address of your NIC</b> See chapter <b>A2.2.1</b>
Third Step <b>Driver</b>	<b>Install GigE driver</b> Follow instructions. See chapter <b>A2.4</b> Driver <b>4.2</b>
Fourth Step <b>Uncheck</b>	<b>Deactivate (uncheck) the GigE driver</b> <i>pco.camera with GigE</i> at each NIC that will <b>not</b> physically be connected to your camera (Win 7/8) See chapter <b>A2.4.2</b>
Fifth Step <b>Calib Tool</b>	<b>Apply PCO GigE Calibration Tool</b> for camera calibration See chapter <b>A2.5</b>
Sixth Step <b>Test</b>	<b>Test your calibration</b> see chapter <b>A2.5.6</b>
Final Step	<b>After successful calibration</b> Start Camware

## A2.2 NETWORK INTERFACE CARD

Your computer must have a network interface card (NIC) to connect the camera via GigE, either an onboard NIC (mainboard) or a plug-in card.

### **PCIe**

Ideally it is a PCI Express NIC to achieve the highest data transfer rates.

The PCI Express interface allows a faster and more stable data transfer rates than ordinary PCI interfaces. Finally, NIC's performance depends on the used chipset. Recommended are chipsets from Intel.

### **Driver**

Make sure the **specific driver** of the NIC is installed to your Operating System (OS) – Otherwise the OS may use a standard plug & play driver not top-performing with the hardware.

### **Configuration**

For checking your network connection or changing parameters open the **properties dialog** of your LAN connection. See chapter **A2.2.1**.

### **Mainboard Slot for NIC**

Installing a NIC in a **PCIe** slot of your computer, check the data transfer rates of the preferred slot. Some mainboards do not provide the required data transfer rates on all **PCIe** slots. See **A2.6**.

## A2.2.1 IP ADDRESS CONFIGURATION

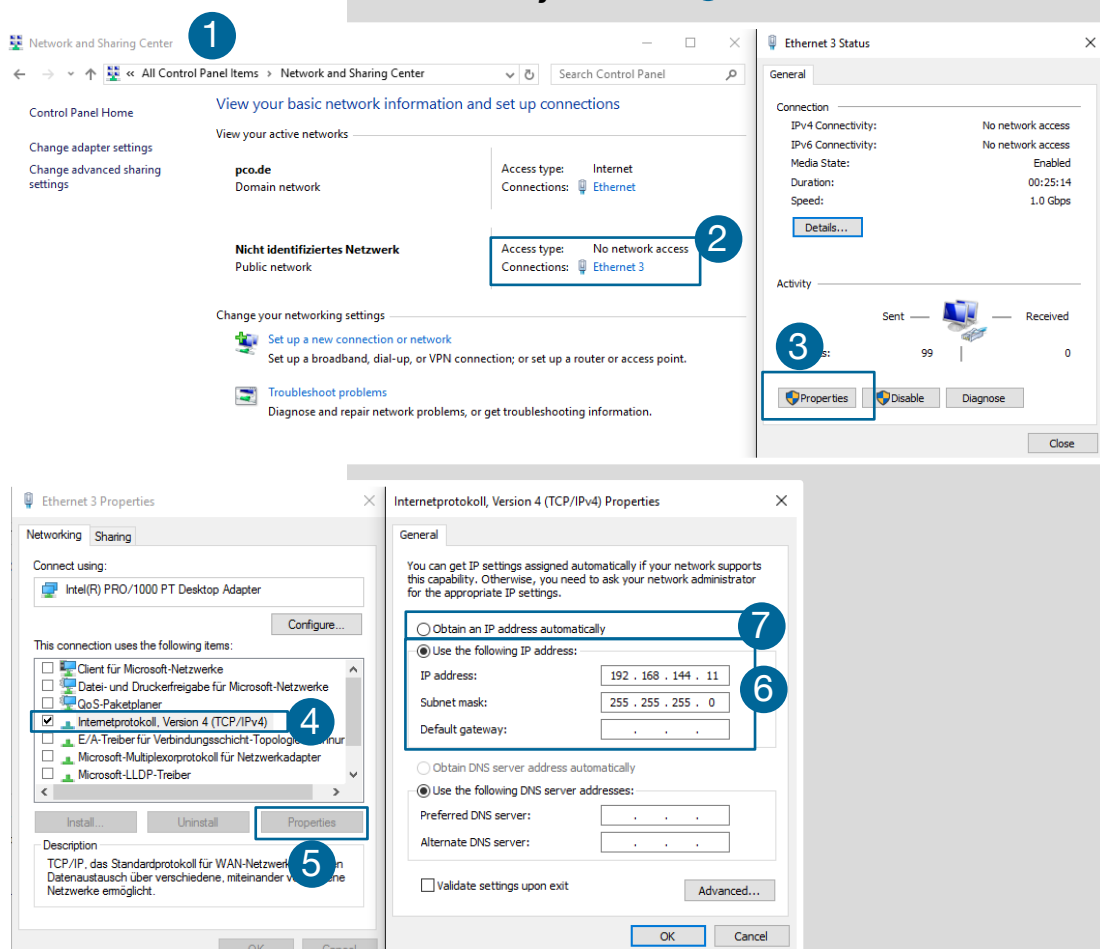
**How to configure an IP address manually: exemplary for Windows 10** (configuration for Win 7/8 is identical)

- 1 Start → Control Panel → Network and Sharing Center
- 2 Select your GigE network connection
- 3 Properties
- 4 Internet protocol version 4 (TCP/IPv4)
- 5 Properties
- 6 Use the following IP address

Use internet protocol **version 4** (TCP/IPv4) only, TCP/IPv6 is not supported by PCO cameras.

**Recommended:** configure your IP address **manually**.

The use of **Dynamic Host Configuration Protocol (DHCP)** is not recommended. DHCP is active if **obtain an IP address automatically** is selected **7**.



## A2.2.2 JUMBO PACKETS / BUFFER SETTINGS

### NOTICE

**These settings are for experts' use only!**

#### To change these settings:

Win7/8/10: Start → control panel → network and sharing center → change adapter settings → select network connection e.g. Ethernet 2 connected to your camera → right-click → properties → configure → advanced

**Jumbo Packets** and **Transmit / Receive Buffer** are settings of your network card and can be changed with the windows control panel.

These **buffer settings** help to reduce the loss of data packets (images) while transferring data from camera to network interface card.

#### **Transmit / receive buffer (recommended for GbE network only)**

For some NIC's you may set parameters manually which affect the stability of the data transfer. The most important ones are **Transmit and Receive Buffer**.

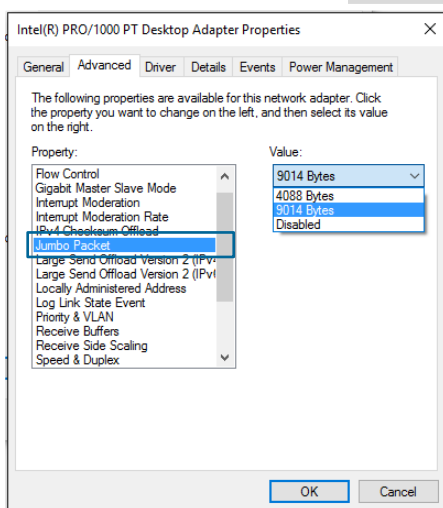
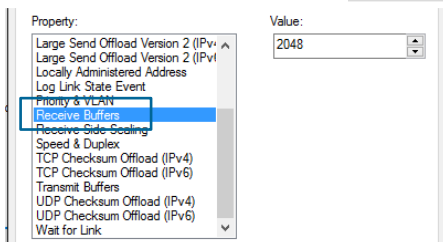
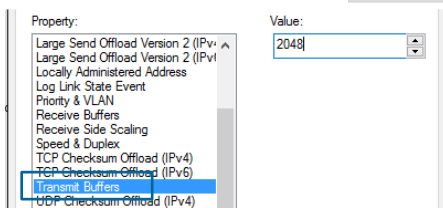
Always set the value of these parameters to their **maximum**.

#### **Jumbo packet (expert use only –use with one camera only)**

Activate **Jumbo Packet(s)** to reduce overheads and CPU cycles, in case your network adapter supports it.

All network components must be Jumbo Packet compatible.

You must use **Calib Tool** to set Packet Size of your camera, see **A2.5**.



### A2.2.3 RECOMMENDED HARDWARE

The following hardware components have been tested by PCO. Their use guarantees stable data transfer rates.

Hardware	GbE	10GbE
NIC	Intel Ethernet Server Adapter I210 T1	Intel Ethernet Converged Network Adapter X550-T2
NIC	Intel Ethernet Server Adapter I350 T2 (2 port)	
NIC	Intel Ethernet Server Adapter I350 T4 (4 port)	
Switch	Standard 1 Gbit switch	Netgear ProSAFE XS716T

### A2.2.4 NETWORK ENVIRONMENT/PATCH CABLE

A correct network configuration is crucial to achieve the best image data transfer rates. It is mandatory that **any component** used for the network connection between camera and computer is compatible with a data transfer rate of 1000 MBit/s for Gigabit Ethernet or 10 Gigabit/s for 10 Gigabit Ethernet.

Some of these components are the NIC, router, hub, switch, etc., but also the patch cable.

The quality of patch cables is specified in categories. It is necessary to use **category 5e-, 6-, or 7- patch cables** for a network connection with a data transfer rate of **GbE**, for **10GbE** network only **Twisted Pair Cat 7e**.

	GbE	10GbE
Network cable	Cat 5e, 6, 7	TP Cat 7e
Max. cable length	100m	100m

### A2.2.5 CABLE LENGTH

#### **Available cable lengths:**

	length
standard	10 m Cat 6 (for Extension Box)
optional	0.5 m; 2 m; 5 m; 12.5 m; 30 m; 50 m
maximum	100 m
included	breakout cable (3m Cat 6 RJ-45)

## A2.3 SINGLE/MULTIPLE CAMERA OPERATION

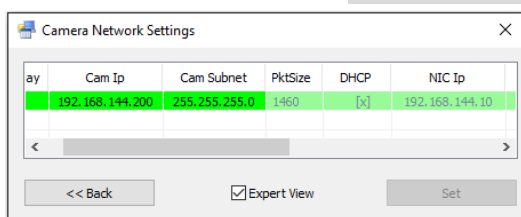
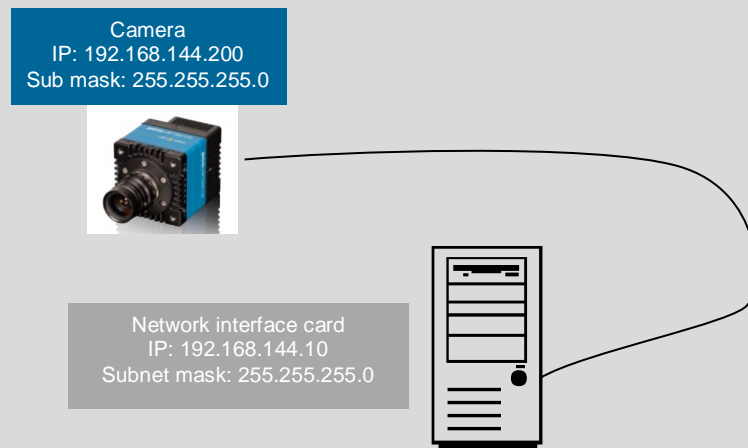
The subchapters explain single and multi-camera use.

### A2.3.1 SINGLE CAMERA

**Single camera** operation means camera and computer are connected via **Point to Point** connection, i.e. direct connection via LAN cable between the GigE connector of the camera and the network interface card of your computer.

- Connect **NIC** and **camera** via **patch cable** directly.
- Configure the IP address and Subnet mask of your NIC, see **A2.2.1**

**Configuration example:**



**Calibration Tool:**

Use the **Calibration Tool** to configure these settings, see chapter **A2.5** (e.g. configuration of a pco.dimax camera connected to a NIC).

## A2.3.2 MULTIPLE CAMERAS

There are two basic ways to connect **multiple cameras** to a computer: with a **switch** or with one network interface **port per camera**.

### A2.3.2.1 SWITCH

#### NOTICE

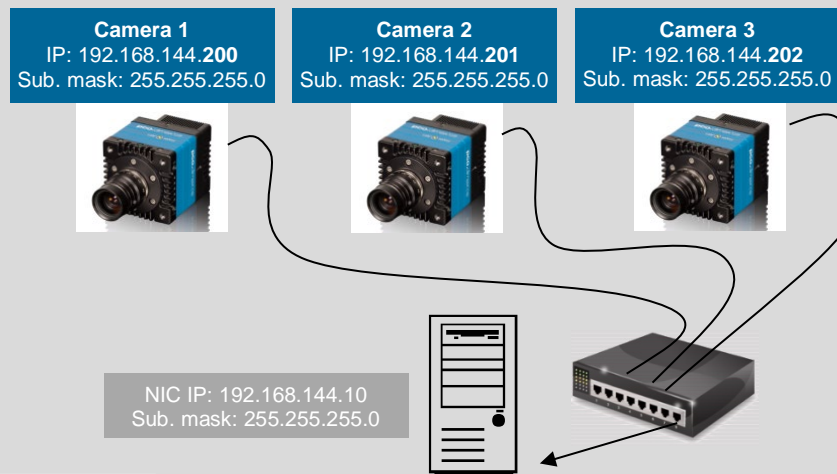
The network settings using a switch can be configured manually or with a DHCP server.

Using a switch may cause network **performance problem**: if the connected cameras require a higher bandwidth than provided by the switch and the associated network card. See also Network and Packet Delay **A2.5.3**

#### Via switch without a DHCP server:

- Camera and NIC IP addresses have to be set manually.
- The **subnet** of camera and NIC, i.e. the first three sections of camera and NIC IP address must be identical (see configuration example).
- The next section of each camera and NIC IP can be any value **between 1 and 254**, but may not be the same for both devices.
- For example: NIC IP **192.168.144.10**; a proper camera IP would be **192.168.144.100**. The Subnet mask must be exactly the same, e.g. **255.255.255.0**.

#### Configuration example:



	Cam Ip	Cam Subnet	PktSize	DHCP	NIC Ip
✓	192.168.145.200	255.255.255.0	1460	[x]	192.168.145.10
✓	192.168.144.200	255.255.255.0	1460	[x]	192.168.144.10

<< Back     Expert View    Set

#### Calibration Tool:

Use the **Calibration Tool** to configure these settings, see chapter **A2.5** (e.g. configuration of a switch with two pco.dimax cameras).

**Via switch with DHCP server:**

- NIC and cameras obtain the IP addresses automatically by a DHCP server.

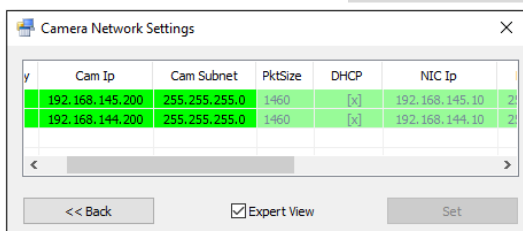
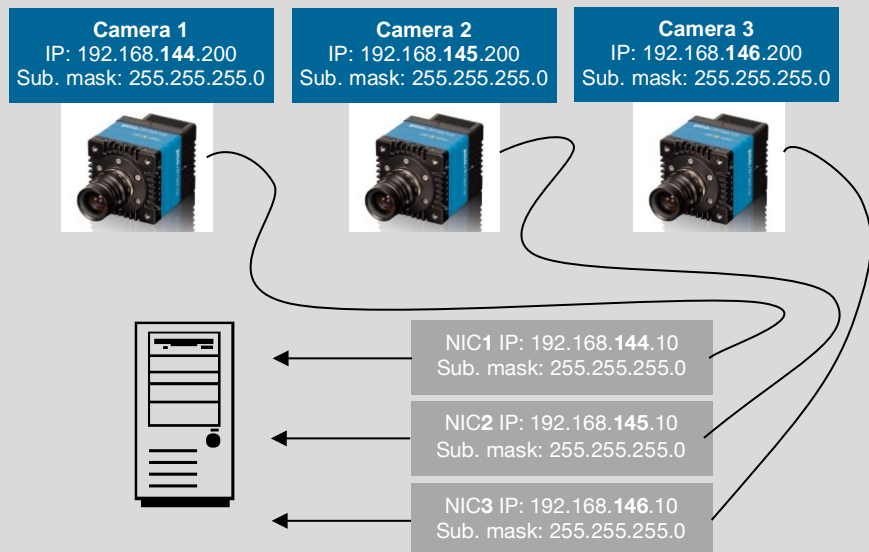
## A2.3.2.2 SEVERAL NICS

**Via several NIC's (or NIC ports) at one computer:**

- Camera and NIC IP addresses have to be set **manually**.
- Each **camera and NIC** pair needs its own subnet (see configuration example).
- Using NICs with multiple ports: check the bandwidth of the PCIe slot.

The following example shows how to calibrate IP addresses when connecting cameras to individual NIC's. Most **important** is that **each camera & NIC combination needs its own subnet** and the camera IP address and subnet and NIC IP address and subnet have to match.

**Configuration example:**



**Calibration Tool:**

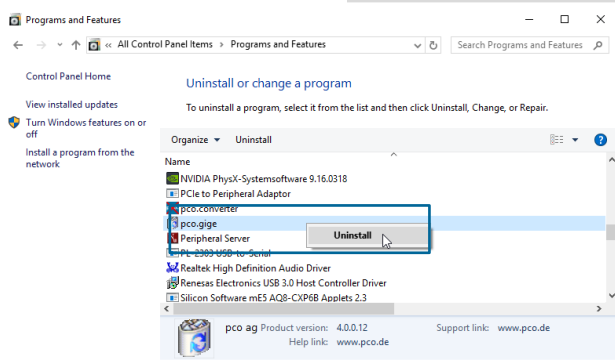
Use the **Calibration Tool** to configure these settings, see **A2.5** (e.g. configuration of two NIC's with two pco.dimax cameras).



## A2.4 DRIVER INSTALLATION

GigE driver installation see chapter 4.2

### A2.4.1 UNINSTALL DRIVER



Open the file **GigE\_Uninstall.exe** (Win7/8: Right-click and select **Run as Administrator**)

#### Win 7/8/10

Click Start → Control Panel → Programs and Features → Select: **pco.gige** and double-click to uninstall

**Or on Win7/8:** Start → Programs → Digital Camera Toolbox → pco.gige/pco.gige2 → Uninstall

### A2.4.2 DE/ACTIVATING FILTER DRIVER (WIN7/8)

#### NOTICE

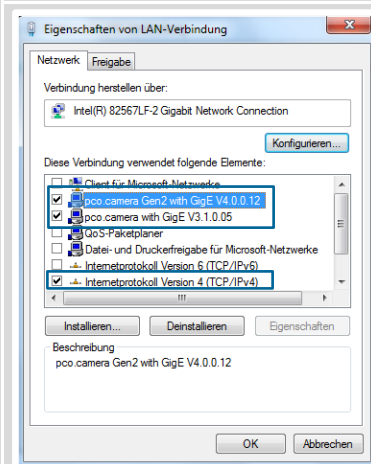
It is mandatory that the PCO GigE driver is only activated at the specific NIC physically connected to your camera. In addition, just the service **pco.camera with GigE** and the **Internet protocol Version 4 (TCP/IPv4)** should be activated for each NIC used for PCO cameras.

With active virus scan/firewall an connected camera may not be recognized.

Tick the **pco.camera with GigE** check box for activating or deactivating GigE drivers.

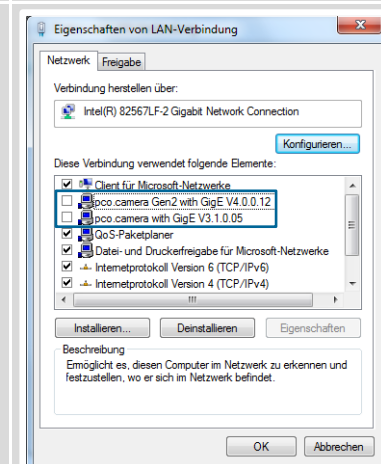
Camera is operated with this network card.

Activate **both GigE drivers** and **internet protocol version 4 TCP/IP**. Deactivate all other elements.



Camera is **NOT** operated with this network card.

Deactivate **both GigE drivers**. Activate all other elements.



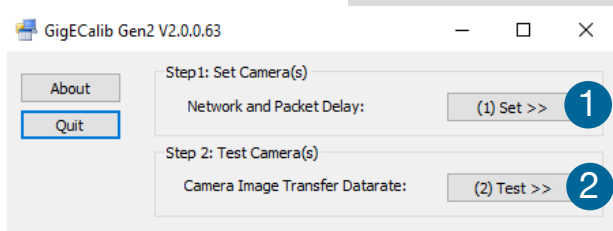
## A2.5 CALIBRATION TOOL

The PCO GigE Calibration Tool is part of the PCO software package, starts automatically after the PCO GigE Driver installation and is automatically linked to your desktop.

- **Win 7:** Start → All programs → Digital Camera Toolbox → pco.gigeG2 → GigECalib
- **Win10:** Start → All Apps → Digital Camera Toolbox → GigECalib

### **The purpose of this software:**

- Set camera network parameter (Packet Delay **A2.5.3**).
- Change the network settings (IP address & subnet mask **A2.5.4**) of the camera.
- Display connected PCO GigE cameras.
- Check the correct network configuration.
- Test the data transfer rate (Test **A2.5.5**).

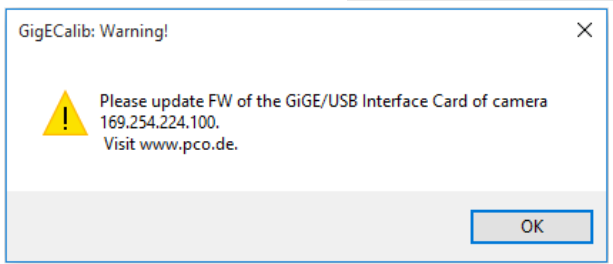


### **How does it work?**

The **Start Dialog** offers two possibilities:

- 1 Choose **Set Network and Packet Delay (SET>>)** to calibrate network parameters like IP address, Subnet mask and **Packet Delay** of all connected cameras. See chapter **A2.5.3** and **A2.5.4**.
- 2 Or choose **Test Camera Image Transfer Datarate (TEST>>)** to test the image data transfer rate of all PCO GigE cameras correctly connected to your PC. See chapter **A2.5.6**.

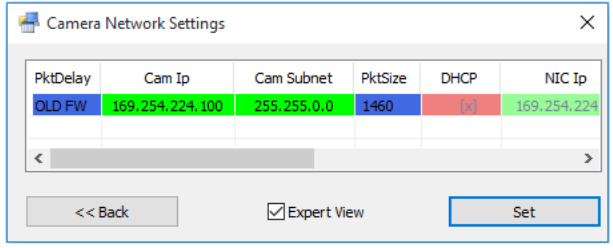
### A2.5.1 FIRMWARE WARNING



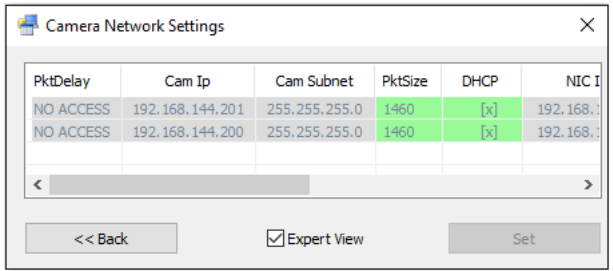
If this message pops up after clicking **SET>>** a calibration will not be performed.

The driver needs a new firmware version to work properly.

Download it from [www.pco.de](http://www.pco.de). Select Support and your camera type.



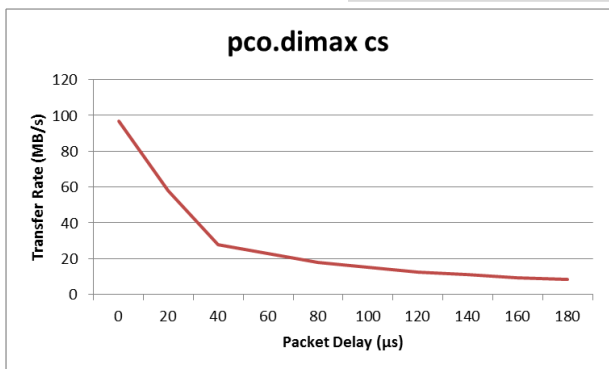
### A2.5.2 BLOCKED ACCESS



If you can't change the configuration (all fields are grayed out) other software accesses the camera (e.g. Camware).

Close all applications that directly access the camera.

## A2.5.3 NETWORK AND PACKET DELAY



The dialog **Camera Network Settings** sets the **Packet Delay** and changes the PCO GigE Camera network settings.

The **Packet Delay** value indicates the **delay (in µs)** inserted between each ethernet packet of the image payload data.

It is an approximate flow-control mechanism, if the application or the network infrastructure cannot keep up with the ethernet packets sent by the device. A packet delay **always slows down** data transfer rate.

**Example:** if two PCO GigE cameras are connected to a single Gigabit Ethernet Port (for example via a network switch) the sum of the bandwidths has to be smaller than the maximum possible data transfer rate transmitted by GigE (100 MB/s).

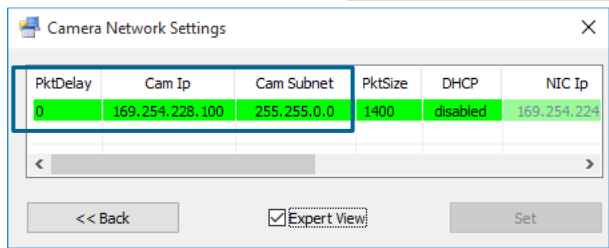
### NOTICE

If **Packet Delay** is increased, the data transfer rate is decreased.

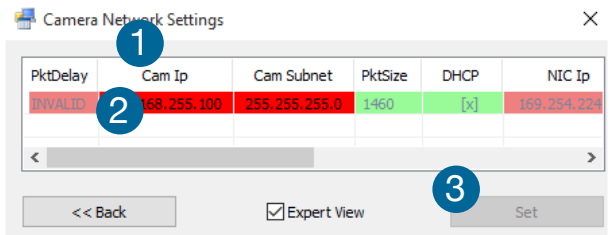
**Table Delay Time and transfer rate pco.dimax cs**

Delay/µs	0	20	40	60	80	100	120	140	160	180
MB/s	97	58	28	23	18	15	12.5	11	9.5	8.8

## A2.5.4 SET CAMERA IP ADDRESS & PACKET DELAY



Make sure the camera IP address (Cam IP) and the camera network mask (Cam Subnet) fit to the network interface card (NIC IP & NIC Subnet) connected to. Everything is correct if all values are highlighted in **green**.

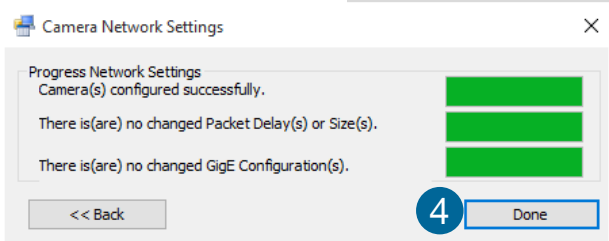


If camera IP or subnet is **not correct**, it will be highlighted in **red** ①. The first three sections of camera and NIC IP must be identical. The fourth section between 1 and 254.

For example: NIC IP **192.168.144.49**; a proper camera IP would be **192.168.144.100**.

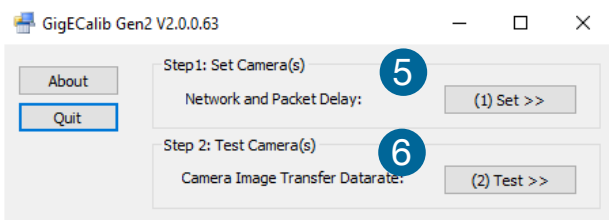
The subnet mask must be exactly the same, e.g **255.255.255.0**.

Set **Packet Delay**, standard is **40**. Read **A2.5.3** before setting the **Packet Delay**.



You can only change **camera** IP & subnet with this tool, but **not** NIC IP & subnet (for NIC configuration see **A2.2.1**).

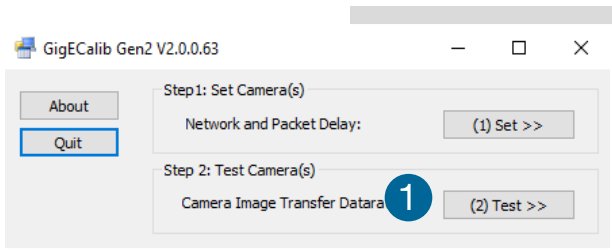
Double-click onto the table ② to change the value. Press the **Set** ③ button to validate the changings. After configuration is finished click **Done** ④.



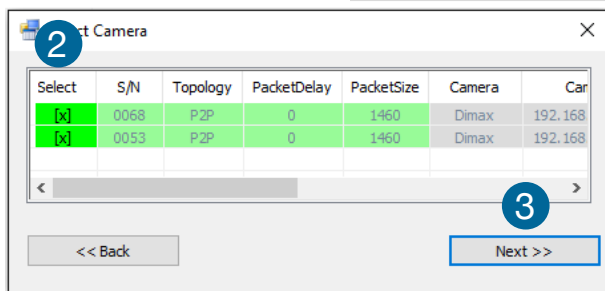
The next step is to check if IP and Subnet configuration is correct: click **Set>>** ⑤ again to check if all values are highlighted in **green**.

Finally always **Test>>** ⑥ your settings. See chapters **A2.5.5** and **A2.5.6**.

## A2.5.5 IMAGE DATA TRANSFER RATE

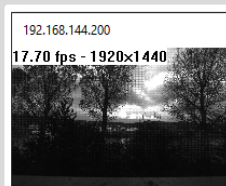
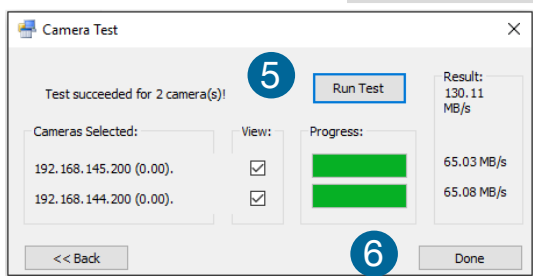


First click **Test >>** ① then double-click into the **Select** ② column of the table to select the camera. If a camera is not highlighted in **green** it cannot be selected for testing. If more than one camera is selected, they are going to be tested in parallel.



Press **Next >>** ③ button to open the **Camera Test** dialog.

## A2.5.6 CAMERA TEST



All cameras selected in the **Select Camera** dialog are listed here. If the **View box** is checked the transferred images are displayed. Click the ⑤ **Run Test** to start the **Camera Transfer Test**. The test grabs images from **each** camera listed – the images from all camera **are transferred in parallel!**

The whole **Camera Transfer Test** succeeds only, if each **Single Camera Transfer Test** succeeds. With a **Single Camera Transfer Test** 100 Images are transferred, and it fails, if more than 0.1% of all transferred ethernet packets got lost.

If a **Single Camera Transfer Test** and so the **Camera Transfer Test for all connected cameras** fails, first check the **Packet Delay** value. It indicates the delay (in  $\mu$ s) inserted between each ethernet packet of the image payload data.

The application or the network infrastructure cannot keep up with the ethernet packets coming from the device. So, if a **Single Camera Transfer Test** fails, increase the **Packet Delay** value (see A2.5.3). Once finished click **Done** ⑥ .

### NOTICE

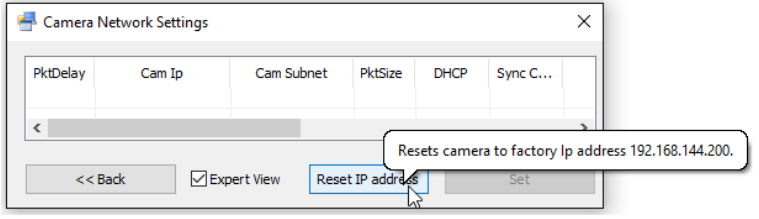
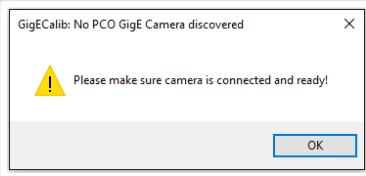
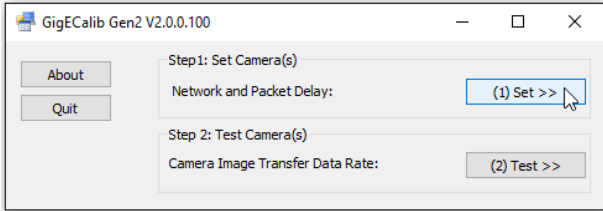
The Gen2 GigE maximum data transfer rate is about 100 MB/s. For a pco.dimax camera with the Gen1 GigE interface card, the maximum data rate is up to 68 MB/s.

### A2.5.7 RESET IP ADDRESS

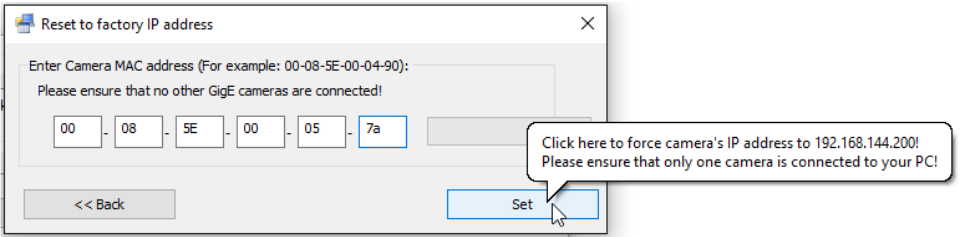
**NOTICE**

This is a **special function**, which is not necessary for normal configuration, but required if the camera is properly connected and not found by the **Calib Tool** because of an incorrect IP address. Only connect one camera to your computer, if you want to use this function.

Click **Set**. If **Calib Tool** can not find a correctly connected camera an error will be displayed.

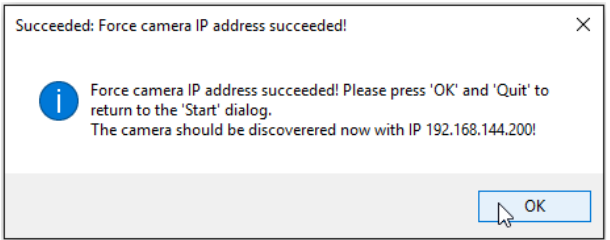


**Reset IP address** of your camera.

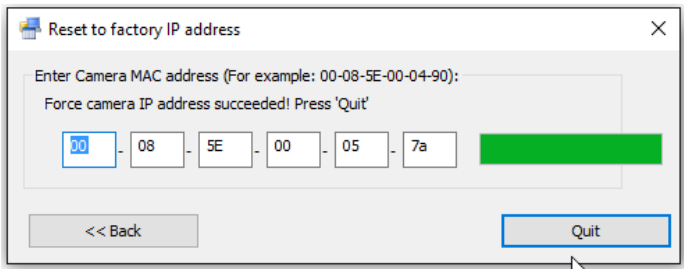


Enter **MAC address** of your camera (see sticker on the camera).

Press **Set** to reset the current IP address of your camera to the **factory default IP address**.

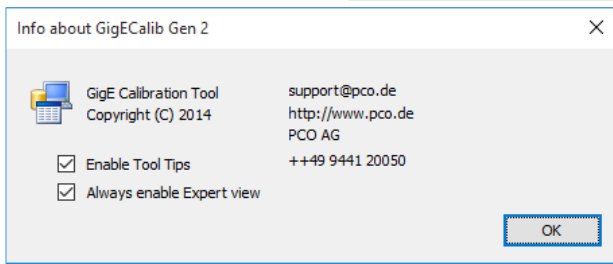


This window pops up after successful IP address reset. Press **OK** to return to the **Reset to factory IP address window**.

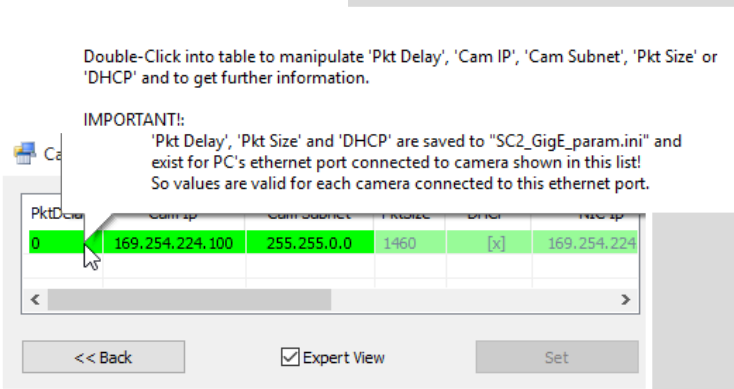


Final step: press quit to return to the **Start Dialog**. Your camera should now be correctly displayed and it is possible to continue GigE configuration.

## A2.5.8 TOOL TIPS



Enable / disable **Tool Tips** run the PCO GigE Calibration Tool. Click the **About** button of the **Start Dialog** and activate/deactivate the **Enable Tool Tips** check box.  
**Enable Expert view:** all setting options are enabled.



**Tool Tips** helps to understand the functionality of the calibration tool. Packet Delay and other settings are explained in detail.

## A2.6 HELP GUIDE

Firewall	If your camera is not recognized, <b>deactivate</b> Firewall and Antivirus programs.
Driver (NIC)	Install <b>original driver</b> of your network interface card (e.g. intel driver) assuring full performance.
Latest Driver	Always install the <b>latest</b> PCO GigE driver (see <a href="https://www.pco.de/support">https://www.pco.de/support</a> ).
Buffer	Pay attention to the network interface card <b>buffer settings</b> (see <b>A2.2</b> ).
Firmware	If the <b>Calib Tool</b> tells to update the <b>firmware</b> , download and install the latest version for your camera.
Slow data transfer rate (NIC)	If your computer has a network card installed (PCI / PCI express slot) and the data transfer rate is <b>slow</b> or data transfer is only working with a <b>high packet delay</b> (see <b>A2.5.3</b> ): remove the NIC and select a different slot of your mainboard. Some slots may not reach the specified data transfer rate. Also check the wiring diagram of your mainboard to select the fastest slot. If you have a <b>mainboard</b> with e.g. <b>two network ports</b> , the same problem can occur.
Windows Update	Install the latest windows updates. It <b>prevents</b> from problems with the GigE driver installation



## A2.7 PERFORMANCE

The following table shows example configurations: minimum and recommended ones. The specified values are only valid for these configurations and should be an orientation.

### Setup

	Minimum	Recommended	
Network interface card (NIC)	100 Mbps NIC with standard PCI interface (only working with GigE Gen2 driver)	GbE NIC with <b>PCI Express</b> interface Recommended NIC see <b>A2.2.3</b>	10GbE NIC Recommended NIC see <b>A2.2.3</b>
NIC configuration	Receive / transmit buffer is set to maximum		
Network connection	P2P or via switch	P2P	
Patch cable	Cat5e	Cat5e or higher	TP Cat7e
Additional network components	switch, hub, router are compatible to 100 Mbps	no additional components	no additional components
Network environment	-	virus protection/ firewall inactive	
Driver	PCO GigE driver installed		
Packet delay /max speed mode	20 µs / off	0 µs / off	0 µs / off
Computer	INTEL® Core™ i5 CPU; 2.4GHz; 4GB RAM	INTEL® Core™ i7 CPU; >2.8GHz; 8GB RAM	
Operating system	Win 7 – x64/x86	Win 7/8/10 – x64	

### NOTICE

Data transfer rate performance depends on sensor resolution.

## A3 ACCESSORIES

Available accessories for pco.dimax cs camera systems.

### A3.1 BREAKOUT CABLE



Standard equipment for every pco.dimax cs camera.

**Connectors:**

- RJ-45 Cat.6 cable for GigE interface (3m)
- BNC **Trig in** (2m): T0, Record stop, Acquire trigger, TTL or Contact closure possible (5 kOhm after +5V)
- BNC **Sync in** (2m): TTL signal for sync. or single frame trigger (5kOhm after ground)
- XLR cable for power supply (0.5m)

### A3.2 EXTENSION BOX



The pco.extension box is optional for the pco.dimax cs. It manages all connection options of the camera system.

**BNC: (50Ω cable required)**

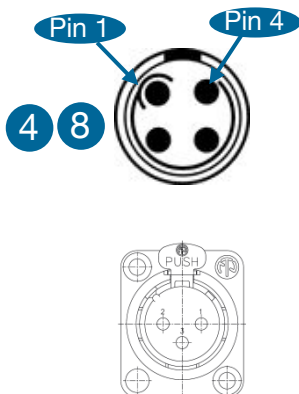
- 1 I/O:** Input/Output: TTL status out/ busy or exposure time (0 and 5V)
- 2 Sync In:** TTL signal for synchronization or single frame trigger (5kOhm after ground)
- 3 Trig In:** T0, Record stop, Acquire trigger, TTL or Contact closure possible (5 kOhm after +5V)
- 4 12V out:** two 12V output connectors (1.5A each) for external devices e.g. HD-SDI monitor; (input voltage  $\geq$  15V)

Pin1	12V out ( $\pm$ 5%)	Pin3	n/a
Pin2	n/a	Pin4	GND

Socket: Lemo EEG.0B.304.CLN (Fitting male connector: FGG.0B.304.CLAD52Z)

**NOTE**

Using the Extension box make sure signal polarity is inverted to a TTL signal type at the acquire enable (BNC Trig In) input.



**5 Cam:** connection to camera; Lemo EEG.2B.318.CLN see **A1.2**

Pin	Function	Pin	Function
1	Ethernet A-	10	<b>SYNC- (to BNC)</b>
2	Ethernet D-	11	-SUP (GND)
3	Ethernet B-	12	-SUP (GND)
4	Ethernet B+	13	Ethernet A+
5	Ethernet C+	14	Ethernet D+
6	<b>Status (to BNC)</b>	15	Ethernet C-
7	+SUPPLY	16	<b>Status (to BNC)</b>
8	+SUPPLY	17	<b>TRG+ (to BNC)</b>
9	<b>SYNC+ (to BNC)</b>	18	<b>TRG- (to BNC)</b>

These **BNC** signals are transmitted differentially. Extension box includes TTL to RS485 converters.

**6 GigE:** standard RJ45 Ethernet plug

**7 LED:**

**Orange LED:** voltage is applied

**Green LED:** power switch is set to **on**

**Blue LED:** green LED will change to blue for 2s if a trigger signal is received

**8 Batt In:**

Pin1	External battery	Pin3	n/a
Pin2	pco.battery pack	Pin4	GND

Socket: Lemo EEG.0B.304.CLN (Fitting male connector: FGG.0B.304.CLAD52Z)

**9 On/Off:** pull this switch and then turn it up or down (Safety switch)

**10 Trigger button:** pushing generates an internal pulse (700µs) to the **Trig In BNC socket** as **OR gate**.

**11 Power:** 12-48V XLR /Neutrik socket (fitting connector e.g. NC3MX-BAG)

Pin1	GND	Pin3	n/a
Pin2	+Voltage		

**Power supply (provided):** 24V 2.71A (65W) for 90/250 VAC

**12 Mounting Threads:** 2x M4, 3x ¼ inch, 2x M6 holes.

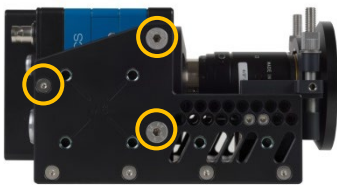
## A3.3 LENS CAGE



This cage is available for all pco.dimax cs models and guarantees a stable mounting of camera and **C-Mount** lens. PCO recommends the **Lens cage** when strong acceleration forces can occur on the lens. Contact PCO for further information and matching lenses. An individual adaption to your lens is possible.

**Mounting threads to mount the lens cage to your equipment:**

Right side: 6x M6; Left side: 6x M6; Bottom: 8x M6



**Mount the camera:** use the two hexagon socket (Allen) screws on the bottom of the camera and the three screws on each side to fix the camera to the lens cage.



### The height-adjustable lens holder

**Mount the lens:** use the two hexagon socket (Allen) screws on each side and two screws on the bottom to fix the lens holder to the cage.

The **height adjustment** can be adjusted by **vertical movement** to the lens.

Then attach the clamping bracket and tighten it with the two knurled screws. The knurled screws must **not** be tightened **with tools**, as this could **damage the lens**.

The lens holder must be installed so that the lens is fixed without the moving parts being blocked.



The clamping bracket **can be turned by 180 degrees** to clamp certain lenses properly.



**Hexagon socket (Allen) set screw:** finally fix the screw on both sides of the lens cage with a tightening torque of 2.5 Nm.

## A4 MOUNT ADAPTER

### A4.1 PCO F-MOUNT ADAPTER



This is the **F-mount adapter** from PCO. If you have got a lens with **automatic diaphragm**, this adapter allows you to easily adjust the aperture by turning the aperture ring on the adapter.

F-mount lenses without an **automatic diaphragm** can be adapted to the camera's lens mount but the aperture cannot be set.



#### Adjust back focal length

Set the focus of your lens to infinity. After that, look for an object in infinity and generate a sharp image by turning the adapter. Use the rearmost ring to fix the setting.

#### Matching lenses with automatic diaphragm:

**Nikon:** all Nikkor lenses of type D and type G (not for type E, this one is only electronic).

**Zeiss:** all ZEISS ZF.2 lenses (Otus, Milvus, Interlock, Distagon, Planar).

**Sigma:** only lenses, which already have a manual diaphragm ring; all other lenses have an aperture control lever, which does not spring back, if you turn the aperture ring at the adapter.

**Tamron:** only some lenses provide automatic diaphragm (no specific lens family):

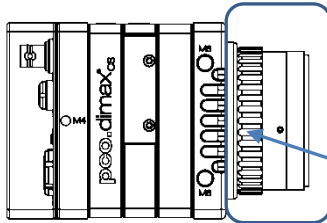
#### Type 35mm F-Mount

- [A012](#) -> SP 15-30mm F/2.8 Di VC USD
- [A007](#) -> SP 24-70mm F/2.8 Di VC USD
- [A009](#) -> SP 70-200mm F/2.8 Di VC USD
- [A011](#) -> SP 150-600mm F/5-6.3 Di VC USD
- [F012](#) -> SP 35mm F/1.8 Di VC USD
- [F013](#) -> SP 45mm F/1.8 Di VC USD
- [F017](#) -> SP 90mm F/2.8 Di MACRO 1:1 VC USD

#### Type APS-C(H) F-Mount

- [B001](#) -> SP AF 10-24mm F/3.5-4.5 Di II LD Aspherical [IF]
- [B005](#) -> SP AF 17-50mm F/2.8 XR Di II VC LD Aspherical [IF]
- [G005](#) -> SP AF 60mm F/2.0 Di II LD [IF] Macro 1:1

## A4.2 CHANGE F-MOUNT TO C-MOUNT / FOCAL DISTANCE

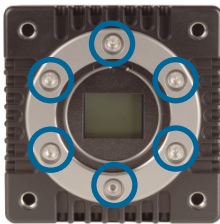


How to change the optical input from **F-mount to C-mount**:

### Step 1: Remove F-mount Adapter

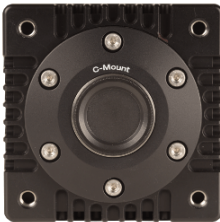
Grasp the F-mount adapter at the black ring (counter ring) and turn it counterclockwise.

Counter ring



### Step 2: Remove F-mount Ring

Unscrew these six Allen screws and carefully remove the F-mount ring.



### Step 3: C-Mount Adapter

Mount the C-Mount adapter with the six Allen screws.



### Limitations of C-mount lenses

Keep in mind that C-mount lenses could produce shadings at the edges of large sensors. Most C-mount lenses are able to illuminate a maximum image circle of 11 mm (2/3"), 16 mm (1") or 22 mm (4/3") diameter only. The pco.dimax cs cameras have a sensor diagonal from 18.17 to 31.36 mm, thus you may have to use the ROI function for a shadeless image while using C-mount lenses with smaller image circles.

### Adjust Back Focal Length

Adjust the back focal length (e.g. if you cannot focus to infinity or to the minimum object distance of your lens), proceed as follows: Install a lens and set it to infinity. Turn the rearmost black ring counterclockwise until it is loose. Hold the black ring in position and turn the front part of the F-mount adapter in any direction until the image is sharp. Then turn the black ring clockwise to fix the position.

## A5 HD-SDI



**HD-SDI** is the **High Definition Serial Interface** and a special standard of the film industry.

### Features:

- 1x HD-SDI BNC connector (see **A1.2**)
- Required cable: 75  $\Omega$  coaxial BNC cable (RG59, Belden 1694A)
- It is only an output interface – control of the camera is not possible!
- HD-SDI can only transfer certain resolutions and frame rates, see table below
- The output is scaled so that the entire image appears on the HD-SDI screen – no ROI restriction
- It can be used for e.g. an output monitor or a recorder
- No parallel image output in Camware and HD-SDI possible
- Bit rate: PAL: 1.485 Gbit/s; NTSC: 1.4835 Gbit/s;  $f_{\text{NTSC}} = f_{\text{PAL}}/1.001$

### Overview of available formats:

No.	Standard	Resolution	FPS	Mode	Format
1	SMPTE274M	1920 x 1080	25 fps	Single YCC10	PAL
7	SMPTE296M	1280 x 720	50 fps	Single YCC10	PAL
11	SMPTE274M	1920 x 1080	30 fps	Single YCC10	PAL
12	SMPTE274M	1920 x 1080	29.97 fps	Single YCC10	NTSC
13	SMPTE274M	1920 x 1080	24 fps	Single YCC10	PAL
14	SMPTE274M	1920 x 1080	23.98 fps	Single YCC10	NTSC
23	SMPTE296M	1280 x 720	24 fps	Single YCC10	PAL
24	SMPTE296M	1280 x 720	23.98 fps	Single YCC10	NTSC

## A6 IMAGE FILE FORMATS

There are different file formats available for saving camera images with 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 of an Extended Header (32 Long-parameter), the latter of which 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 six parameters must always exist. The rest of the parameters, as well as the comment field, are optional.

	Parameter	Function
1	PCO-	the first 4 byte are the characters PCO-
2	file size	file size in byte
3	header length	header size + comment field in byte
4	image width	image width in pixel
5	image height	image height in pixel
6	extended header	-1 (true), extended header follows
7	color mode	0 = black/white camera, 1 = color camera
8	b/w min	black/white LUT-setting, minimum value
9	b/w max	black/white LUT-setting, maximum value
10	b/w linlog	black/white LUT-setting, 0 = linear, 1 = logarithmic
11	red min	red LUT-setting, minimum value
12	red max	red LUT-setting, maximum value
13	green min	green LUT-setting, minimum value
14	green max	green LUT-setting, maximum value
15	blue min	blue LUT-setting, minimum value
16	blue max	blue LUT-setting, maximum value
17	color linlog	color LUT-setting, 0 = linear, 1 = logarithmic
18 ... 266	internal use	

Comment file in ASCII characters with variable length of 0...XX.  
The length of the comment field must be documented in the header length field.

	16 bit pixel data
line 1, pixel 1	value of the first pixel
line 1, pixel 2	value of the second pixel
...	...

**PCO recommends that all images should be saved first in the b16 or TIFF format.** 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 BigTIFF format, thus allowing for file size > 4GB. A new PCO proprietary compression scheme is added if necessary.

**Standard File Formats****TIFF**

Tag Image File Format, version 6.0 and lower. There is a 16bit monochrome and color image format.

**BMP**

Windows Bitmap Format, b/w or color 8 bit format images, which have been saved in BMP format can't be reloaded in Camware - only as 8 bit images, i.e. part of the original information (16 bit) is lost.

**FTS**

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

**ASCII**

16 bit format, some mathematical programs prefer 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.

## A7 CUSTOMER SERVICE

### A7.1 SERVICE

The camera is designed to operate with no need of special adjustments or periodic inspections.

### A7.2 MAINTENANCE



**CAUTION**

#### **UNPLUG CAMERA BEFORE CLEANING**

Risk of injury due to electrical shock!

- Unplug the camera from any power supply before cleaning it.

**NOTICE**

#### **CLEANING**

- Use a soft, dry cloth for cleaning the camera.
- Do not clean the input window unless it is absolutely necessary.
- Be careful and avoid scratches and damage to the input window surface.
- Do not use liquid cleaners or sprays.

**NOTICE**

#### **LENS CLEANING**

- The lens is best cleaned with pressurized air or with liquid cleaners such as pure alcohol or with special optical cleaners that are available at premium photo stores.
- Use a cotton swab dipped in pure alcohol or optical cleaning liquid and wipe only on the glass surface.
- Do not get any cleaning liquid on the metallic parts such as the lens thread, because tiny detached particles may scratch the surface.

**NOTICE**

#### **CLEANING LIQUIDS**

Aggressive cleaning liquids can damage your camera.

- Never use aggressive cleaning liquids such as gasoline, acetone, spirits or nitro cleanser.
- Every time the input window is cleaned, there is the possibility of surface damage.

**NOTICE**

#### **PROTECTIVE CAP**

Always store the camera with the protective cap or with a lens mounted to avoid dust and dirt on the input window.

### A7.3 RECYCLING



To dispose your camera, **send it to PCO** or take it to a local **recycling center**.

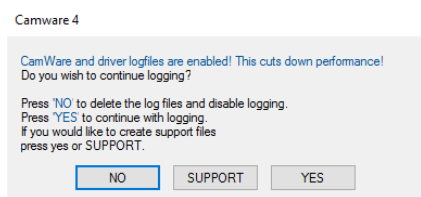
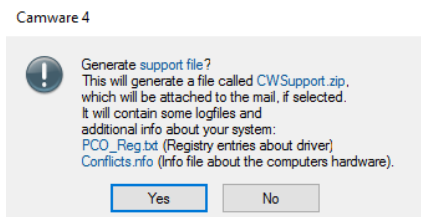
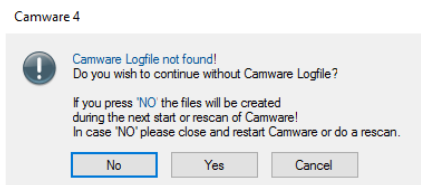
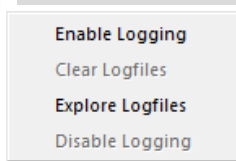
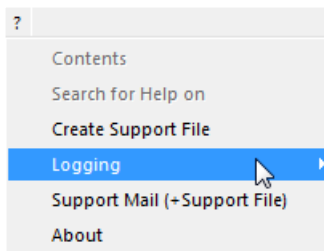
The camera includes electronic devices, which can contain materials harmful to the environment. These electronic devices must be recycled.

## A7.4 LOGFILE / SUPPORT FILE

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

**To speed your request up, we need following information:**

Short description of the problem	Operating system (PC)
Description of your application	Processor type (PC)
Camera settings	Memory
Type and version of camera	Graphic card
Software being used	Graphic card setup
Camera serial number	



### How to create a logfile:

<b>Enable log files:</b>	? Help <b>Menu</b> → Logging → Enable Logfile → Camware will ask you to press <b>NO</b> to activate <b>Logfiles</b> after <b>restart</b> of Camware
<b>Repeat</b>	the workflow which produces the faults
<b>Open the Help Menu</b>	Click Support Mail (+ Support File) → Camware will ask you: <b>Generate support file?</b>
<b>Save this file</b>	( <b>CWSupport.zip – don't rename it</b> ) and send it to <b>PCO Support</b> (support@pco.de)
<b>Or visit our website:</b>	<a href="http://www.pco.de/support/">http://www.pco.de/support/</a> and upload the support file with our support form

### Repair

Before sending the camera for **repair**, **first contact** your local dealer or **PCO** respectively.

When shipping the camera for repair, be certain to carefully pack the camera with proper shipping materials. If possible use the original packaging. Use the protection cap to protect the camera on the lens thread.

## A7.5 TROUBLE SHOOTING

### **Communication problems (camera is not detected)**

- Take a look at the LEDs and note their state
- Disconnect and reconnect your interface , then wait (about 1 min) for **Beep** and start Camware camera search again
- If this does not work –test another interface
  - Restart your camera by plugging off /on power supply: look at LED sequence and note their state
  - all LEDs are off for several seconds (if the break time was too short, it might be that last LED status is shown again)
  - all LEDs light up (red, green and blue)
  - green LED is blinking for several seconds, then green continuous, all other LEDs off
  - red LED means initializing failed
- Show us your log-files including extra information (any other abnormalities / camera equipped with a battery?)

### **Image Error (e.g. quadrant error)**

Describe your error (send us a Raw B16 or TIFF screenshot)

### **Fan control**

The pco.dimax has a fan control. After starting or restarting camera fan runs with highest rotation (noisy) and should slow down after about 30s.

### **GigE-Connection**

After start-up or (re)connection of GigE cable or by pushing the reset-knob at the rear of the pco.dimax, the connection of the GigE interface will be reestablished.

A short **beep** just confirms the physical network connection, not a pco driver linkage; although an operating network connection is indispensable for the driver.

Repeating beeps signalize a defective cable, communication is interrupted.

### **Firmware, Software and Driver Update**

You will find all necessary software and drivers on the accompanying USB flash drive.

For the latest versions check our website:

<http://www.pco.de/support/supportProducts/high-speed-cameras/>

## A8 INDEX

**NOTE:**

The mentioned page is always the starting page of a chapter!

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## ABOUT PCO



pco.

**In 1987**, PCO was founded with the objective to develop and to produce specialized fast and sensitive video camera systems, mainly for scientific applications. Meanwhile the product range of PCO cameras covers digital camera systems with high dynamic range, high resolution, high speed and low noise, which are sold in the scientific and industrial market all over the world.

**Currently** PCO is one of the leading manufacturers of scientific cameras. Worldwide representatives, together with our own sales department and technical support assure that PCO keeps in touch with our customers and their needs. The actual wide range of specialized camera systems is the result of technical challenge and product specific know-how. A design according to advanced techniques, a high standard of production and strict quality controls guaranty a reliable operation of the cameras. Our own developments in conjunction with an excellent contact to leading manufacturers of image sensors ensure our access to state-of-the-art CCD- and CMOS-technology for our cameras.

**Since 2001**, PCO is located in its own facility building in Kelheim at the shore of the beautiful and international river Danube. Here in the county Bavaria, which is well known for its excellent support and conditions for high technology companies, we share the benefits of the simple access to high performance products and services in the surrounding area.

**Kelheim** itself is a historical town, first documented in 866. The small city is founded at the confluence of the Danube and the Altmühl, which has been converted into the Rhine-Main-Danube bypass channel for water transport. Located in Danube-valley, it is the heart of a beautiful river and forest covered lime plateau landscape. It's landmark, the Hall of Liberation, was built by Ludwig I. in 1863 on the Mount Michael and is visible from all over the city and valley. The beautiful Danube-Gorge, which is protected as natural monument since 1840, is located between Kelheim and the famous abbey Weltenburg.

**pco.**