

user manual

pco.edge 4.2 bi

pco.edge 4.2 bi UV



pco.

An Excelitas Technologies Brand

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

In case of any questions or comments, contact us at PCO.



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The cover photo shows an exemplary PCO camera system.
The lens is sold separately.

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1. INTRODUCTION



Advantages of the pco.edge 4.2 bi (UV)

Features

Innovations aren't always about having that one big new idea. Unique technology also comes from evolution, combining existing and new technology. When our tried and trusted pco.edge series pools forces with modern back illuminated (bi) sensor technology, the result is our pco.edge 4.2 bi (UV).

The adjustable cooling system allows the use of air or water to cool the sensor down to -25 °C. At this temperature, the dark current is reduced to 0.2 e-/pixel/s.

According to your application you can choose an input window specialized either for the UV or VIS range. High resolution and 6.5 x 6.5 μm^2 pixel size guarantees high-quality images with quantum efficiency up to 95 %. The pco.edge 4.2 bi (UV) incorporates a powerful USB 3.1 interface complementing its performance.

Main Features

- Resolution: 2048 x 2048 pixels
- Superior quantum efficiency up to 95 %
- 26667:1 dynamic range
- lowest dark current (typ.) 0.2 e-/pixel/s
- USB 3.1 interface

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. The camera may only be used according to the instructions of this manual. The disclosures and operating conditions in these operating instructions installation must be respected. Unauthorized modifications and changes of the device are forbidden for safety reasons.

1.2 CONVENTIONS

The following typographic conventions are used in this manual:

<i>bold italics</i>	Terms that can be found in the software pco.camware
Features	Heading within a chapter
A1.3	Bold chapter: hyperlink to a chapter
1 1	Numbers that help to find functions quickly
NOTE	Notes that must be observed

2. SAFETY INSTRUCTIONS



DANGER

Read the safety instructions completely and follow them strictly.

DAMAGED POWER CABLE OR POWER PLUG

Danger to life due to electric 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 electric 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 levels of x-ray radiation.

NOTICE

JOLT & 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

Screw in the lens gently to avoid thread damage.

- To protect the lens connector thread from damage, use minimal force when attaching a lens to the camera.

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 camera 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



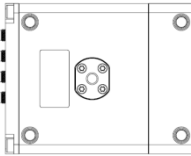
Camera

- F-mount / C-mount optical connection
- For standard C-mount / F-mount lenses and adapters



Rear Panel

- USB 3.1 Type C connector
- LED indicates camera status (see **A1.3**)
- SMA connectors
- Power connector



Serial Number Tag

Mounting Thread

- 1x 1/4" - 20 UNC



USB Cables

- USB Type C screwable to USB Type C regular (3 m)
- USB Type C (2 m)



USB 3.1 Gen2 Interface Card

- 1x USB 3.1 Gen2 Type C socket
- 1x USB 3.1 Gen2 Type A socket
- PCI Express x4 V3.0



Power Supply & Power Cord

- Output: 24 VDC / 36W / 1.5A
- Connector: Lemo FGG.0B
- Voltage input: 115 VAC - 230 VAC; IEC 60320 C14 plug
- Power cord IEC 60320 C13



Digital Camera Tools (USB flash drive content)

- pco.camware: software for camera control & image acquisition
- Camera driver & tools
- Software Development Kit (SDK) & demo programs in C and C++

4. INSTALLATION

You 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 (www.pco.de).

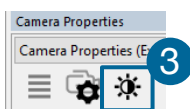
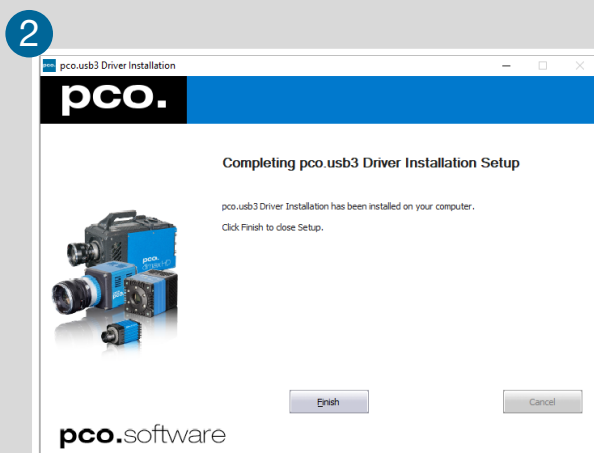
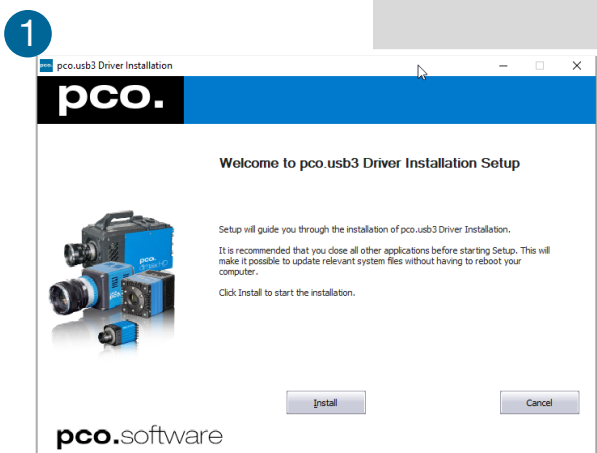
Minimum System Requirements:

- Intel® Core™ i7
- RAM > 8 GB DDR3
- Windows 7 or higher
- Full-HD resolution display
- USB 3.1 Gen1

4.1 DRIVER

Install PCO USB 3.0/3.1 Driver

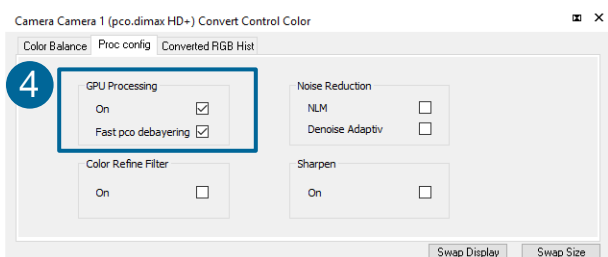
Always install the latest USB driver version. After these two screens the driver is completely installed. ① ②



NVIDIA Cuda Driver

Only relevant if an NVIDIA graphics card is used! **GPU Processing** is only working with NVIDIA graphics cards.

Update your NVIDIA driver for pco.camware. In case of an old driver version **GPU Processing** is not working. Therefore image processing is slow.



Check if **GPU Processing** is activated by having a look into the **Proc config** settings ④ in the **Convert Control** window ③ (see pco.camware manual).

If **GPU Processing** is disabled and greyed out, update your NVIDIA driver.

4.2 CAMWARE SOFTWARE

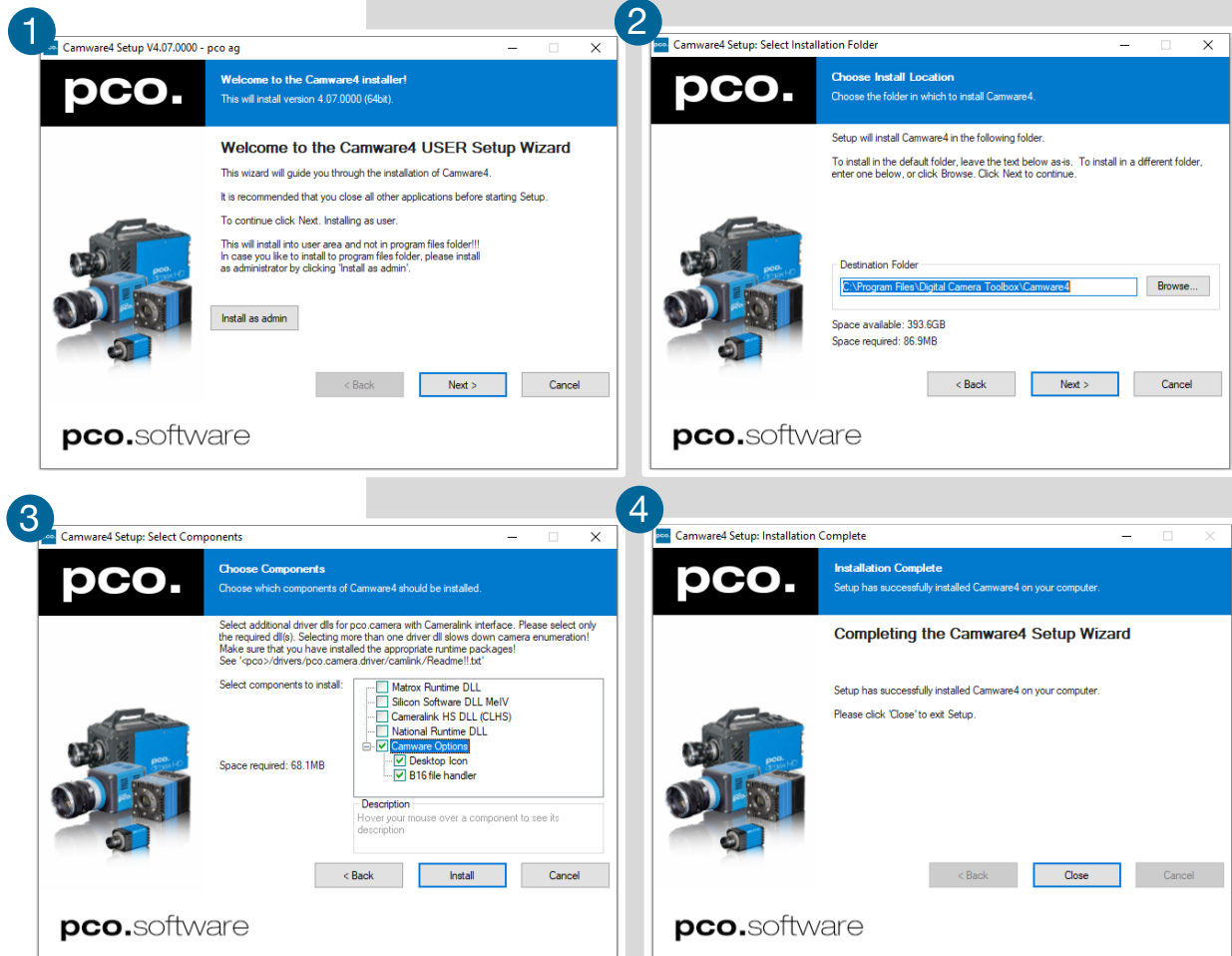
The pco.camware application software enables to control every camera parameter or setting. Images can be displayed on a monitor and may be downloaded and stored. The USB flash drive contains the installation files for the software for latest Windows operating systems in 32 & 64 bit.

After a successful installation, you find the program file Digital Camera Toolbox in your program directory and a pco.camware 32 / 64 button on your desktop.

To uninstall the pco.camware program, use the software feature under Windows' system control.

Follow the Installation Wizard

- 1 **Install as admin** to install to program folder, otherwise it is installed only to user folder
- 2 Choose install directory
- 3 Choose components: select additional drivers (not recommended for pco.edge 4.2 bi (UV))
- 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, if you first aim at an object that is easy to focus and that can be seen at standard light conditions.

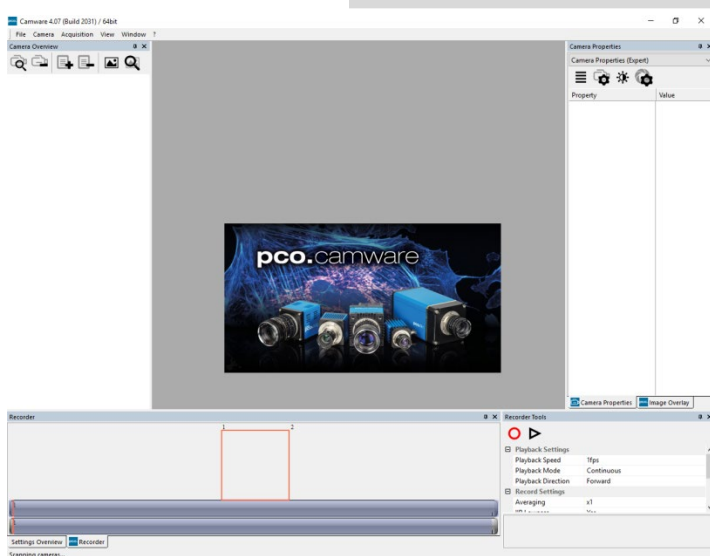
5.1 PREPARATION

- 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 PC

5.2 START



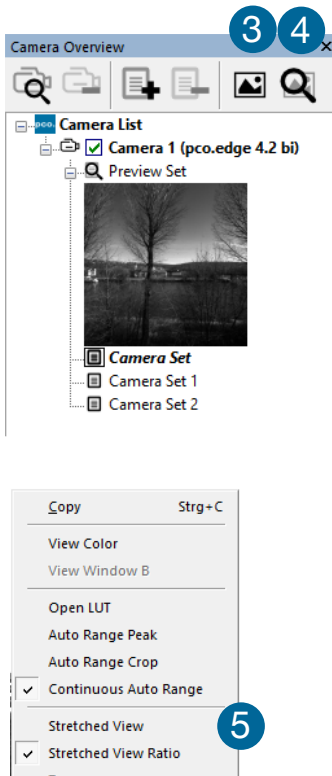
Start pco.camware and the graphical user interface starts up:



NOTE

Always install latest pco.camware version to be able to use full function of your camera (www.pco.de/support).

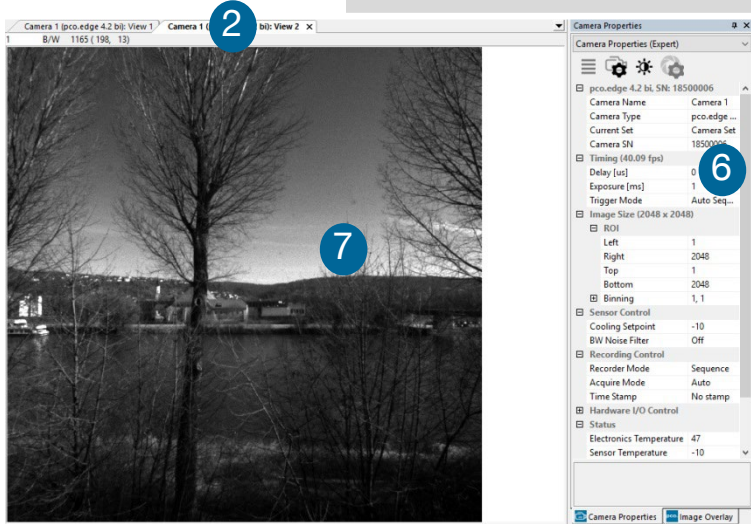
5.3 FIRST IMAGE



Follow the Instructions



- pco.camware must be started 1
- A **View Window** 2 is shown automatically or open a new one 3
- Start **Live Preview** 4
- Right-click in the view window & apply **Continuous Auto Range** 5
- You may adjust **Exposure** time 6, aperture and focus of the mounted lens
- Now you should clearly see the object in the window 7



To change **Exposure** time (e.g. the image is still either too dark or too bright) and to record and save images, see pco.camware manual for detailed information.

NOTE

Live preview: useful for fast and easy camera adjustment and focusing.

6. ROLLING SHUTTER

The pco.edge 4.2 bi (UV) uses the rolling shutter mode. In this mode the pixel reset and exposure start is carried out line by line. Each line has the same exposure time, but a different start and end of exposure. Within one line, the exposure starts simultaneously for all pixels.

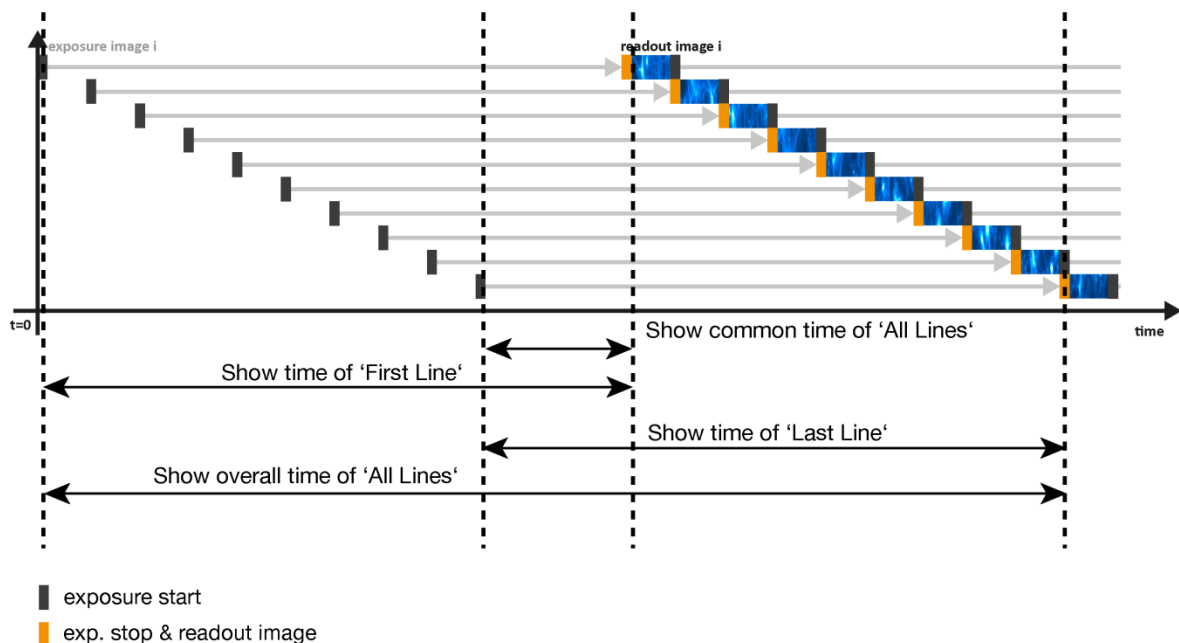
The exposure time of each line starts with the corresponding reset of the line. Then after a predefined time (exposure time), the exposure is stopped. The light induced accumulated charge carriers of the pixels in a line are recorded into memory in a low noise (readout) mode. This way the content of the pixels is assembled in the memory to form the complete image.

The diagram shows different signal timing settings (see chapter 7.1). During **Show common time of 'All Lines'** the image sensor is completely exposed to light. The labels **Show time of 'First Line'** and **'Last Line'** are the setting for the first / last exposed line and **Show overall time of 'All Lines'** for the entire exposure period.

There are two different timing cases for rolling shutter mode, which are explained on the following pages:

- exposure time > sensor readout time
- exposure time < sensor readout time

Rolling Shutter General Timing Diagram



NOTE

The exposure and delay time can be adjusted in steps of one line time.

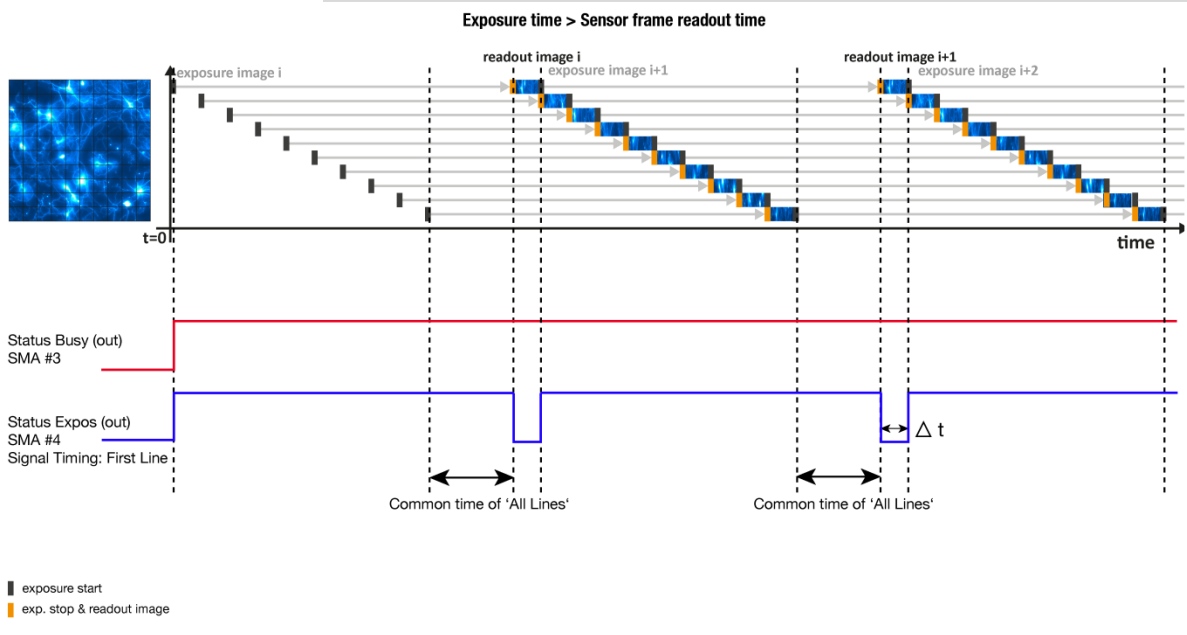
Timing

Camera	Exposure time	Delay time	Line time
pco.edge 4.2 bi (UV) USB 3.1	10 μ s ... 20 s	0 ... 5 s	12.174 μ s

Exposure time > Sensor frame readout time

In case the required exposure time is longer than the frame readout time, the image sensor is completely exposed to light for some time (**Show common time of 'All Lines'** also see General Timing Diagram). In case of a triggered flash illumination, this would be the best moment to illuminate the image sensor. The hardware signal for the time **Show common time of 'All Lines'** is available on connector #4 (see 7.1).

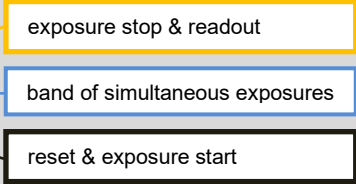
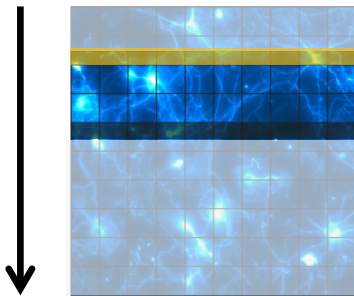
This is an example timing diagram for **Trigger Mode Auto Sequence**, SMA explanation see 7.1



$$\Delta t = 4.4 \mu\text{s}$$

Exposure time < Sensor frame readout time

In case the required exposure time is shorter than the frame readout time, the image is readout through an exposure band moving from the top to the bottom of the sensor.



For example:

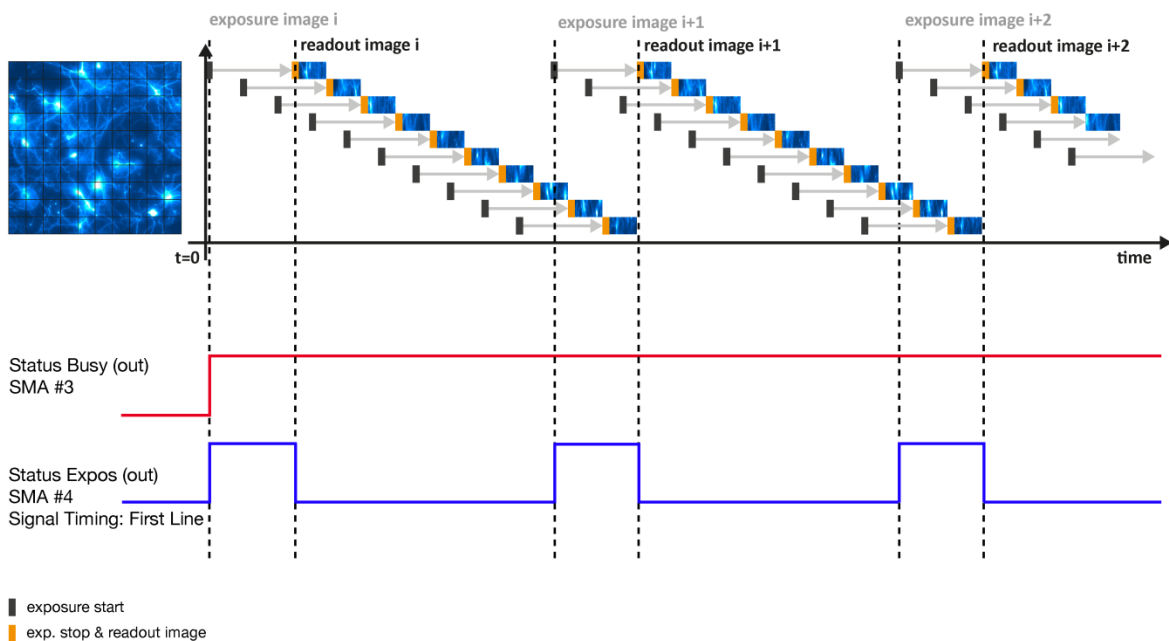
How can you calculate the band of simultaneous exposure lines at an exposure time of 100µs (@ full resolution)?

$$\frac{\text{Exposure time}}{\text{Line time}} = \text{Number of simultaneous exposure lines}$$

$$\frac{100 \mu\text{s}}{12.174 \mu\text{s}} = 8,2 \rightarrow 8 \text{ lines}$$

This is an example timing diagram for **Trigger Mode Auto Sequence**, SMA explanation see 7.1

Exposure time < Sensor frame readout time

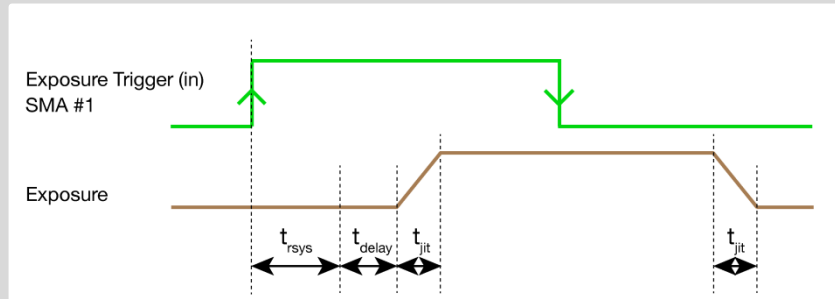


NOTE

The jitter t_{jit} can be a maximum of one line time.

Details for External Exposure Start and External Exposure Control

The detailed timing for external trigger includes system delay times, an adjustable additional delay time, and the jitter. Explanation for all **Trigger Modes** see pco.camware manual.



Name	Explanation	Value
t_{jit}	Jitter	≤ 1 line time ¹
t_{sys}	Fixed system delay of rising edge	$2x$ line time ¹
t_{delay}	Programmable delay time	$0 \mu s \dots 5 s$

¹line time = 12.174 μs

For optimized synchronization (minimized jitter time) use the falling edge of the line signal at the **Status Expos** output SMA #4 (see 7.1).

System time t_{sys} is depending on your camera settings and can be read out from your camera, for further information see SDK manual function PCO_GetImageTiming.

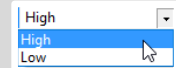
7. CAMWARE SOFTWARE

This chapter contains only camera-specific additions to the pco.camware manual. All main functions and explanations can be found in the pco.camware manual.

7.1 HARDWARE IO CONTROL

Hardware IO Control	
Exposure Trigger	
1	Exposure Trigger On
	Signal Polarity Rising
Acquire Enable	
2	Acquire Enable On
	Signal Polarity High
Status Busy	
3	Status Busy On
	Signal Polarity High
Status Expos	
4	Select IO Signal Status Expos
	Signal Timing Show time of 'Last Line'
	Status Expos On
	Signal Polarity High

Change settings are done via drop-down menu.



Exposure Trigger 1

If checked, a signal for **External Exposure Start Trigger Mode** is accepted at the **Exposure Trigger** SMA input #1.

Exposure Trigger: On; Off
Signal Polarity: Rising; Falling



Acquire Enable 2

If checked, a signal for **Acquire Mode** is accepted at the **Acquire Enable** SMA input #2.

Acquire Enable: On; Off
Signal Polarity: High; Low

Status Busy 3

If checked on, a signal indicating busy status is provided at the **Status Busy** output. Once an acceptable trigger edge is received, 'busy' goes to status high. As soon as 'busy' goes low again, a new trigger edge is accepted.

Status Busy: On; Off
Signal Polarity: High; Low

Status Expos / Status Line 4

If checked, a signal indicating exposure or line status is given at the status output. **Status Expos** indicates the actual exposure window for one frame. Use the falling edge of the **Status Line** signal for optimized synchronization.

Detailed explanation for **Signal timing** see next page!

Select IO Signal: Status Expos; Status Line
Signal timing: Show time of 'First Line'; Show common time of 'All lines'; Show time of 'Last line'; Show overall time of 'All lines'
Status Expos: On; Off
Signal Polarity: High; Low

Enabling and Polarity of IO Signals

The polarity of the input and output signals indicating their active states is selectable (positive or negative logic).

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

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

Detailed Explanation for Status Expos SMA #4 Signal Timing

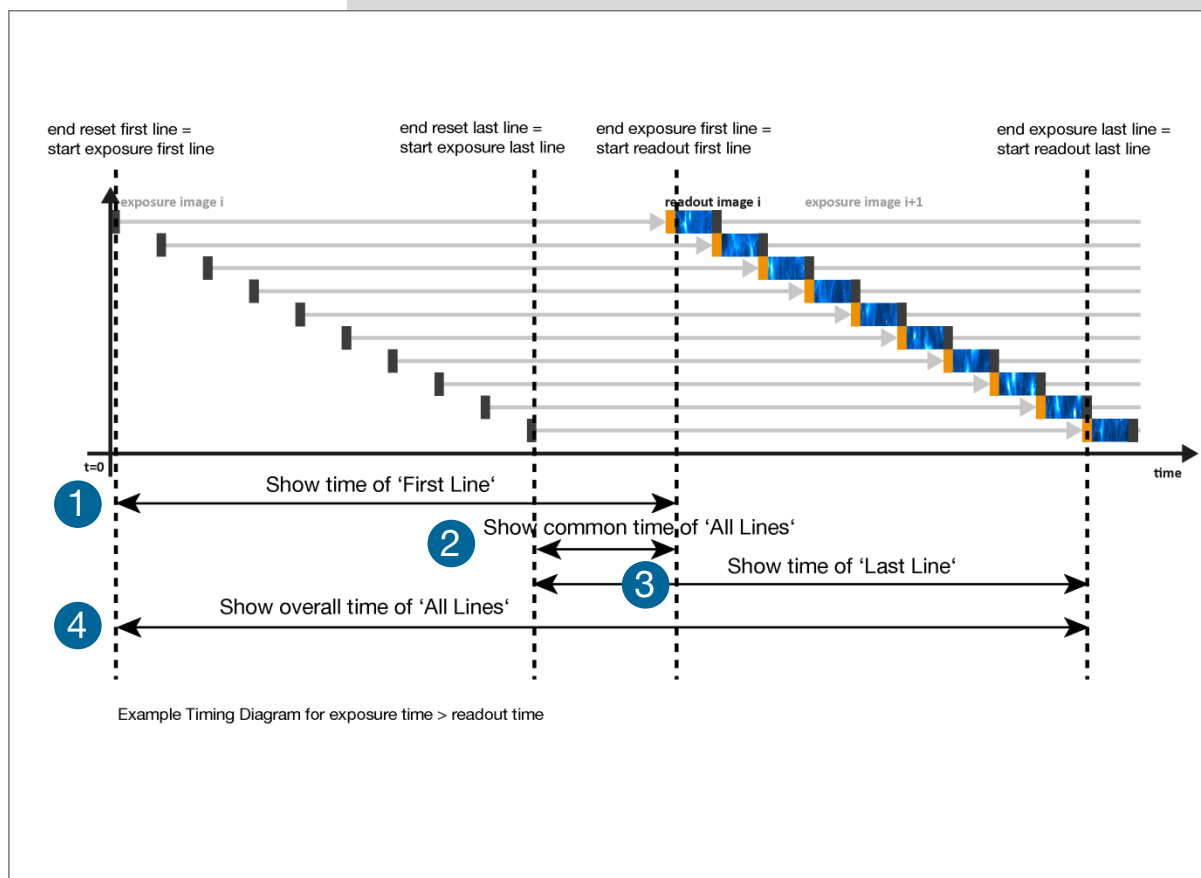
Setting in pco.camware:

Status Expos	
Select IO Signal	Status Expos
Signal Timing	Show time of 'Last Line'
Status Expos	On
Signal Polarity	High

- 1 Show time of 'Last Line'
- 2 Show time of 'First Line'
- 3 Show common time of 'All Lines'
- 4 Show time of 'Last Line'
- 5 Show overall time of 'All Lines'

There are four different signal types selectable. The example timing diagram shows all four different possibilities:

- 1 Shows the exposure time of the first line
- 2 Shows when all sensor lines are exposed
- 3 Shows the exposure time of the last line
- 4 Shows if any sensor line is integrating



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A1 TECHNICAL DATA

A1.1 DATA SHEET

Image sensor	pco.edge 4.2 bi (UV)
Type of sensor	Customized sCMOS
Resolution (h x v)	2048 x 2048 pixel
Pixel size (h x v)	6.5 μm x 6.5 μm
Sensor format / diagonal	13.3 x 13.3 mm / 18.8 mm
Shutter mode	Rolling Shutter (RS)
MTF	76.9 lp/mm (theoretical)

Camera	
Frame rate	40 fps @ full resolution
Exposure / shutter time	10 μs ... 20 s
Dynamic range A/D	16 bit
Binning (h x v)	1x1 ... 4x4
Cooling method	Adjustable: from -25°C to +20°C Peltier with forced air (fan) and water cooling. Calibration setpoint: -10°C
Trigger input signals	Frame Trigger, Acquire (SMA connectors)
Trigger output signals	Exposure, Busy (SMA connectors)
Data interface	USB 3.1 Gen1
Timestamp	In image (1 μs resolution)

General	
Power supply	Power over USB 3.1 Gen1 Type C and power connector (24 VDC +/- 10%)
Power consumption	Typ. 4.5 W over USB 3.1 Gen 1 and typ. 10.0 W (max. 22.0 W) over power connector
Weight	920 g
Operating temperature	+10°C ... +40°C
Operating humidity range	10% ... 80% (non-condensing)
Storing temperature range	-10°C ... +60°C
Optical interface	F-mount, C-mount
CE / FCC certified	Yes

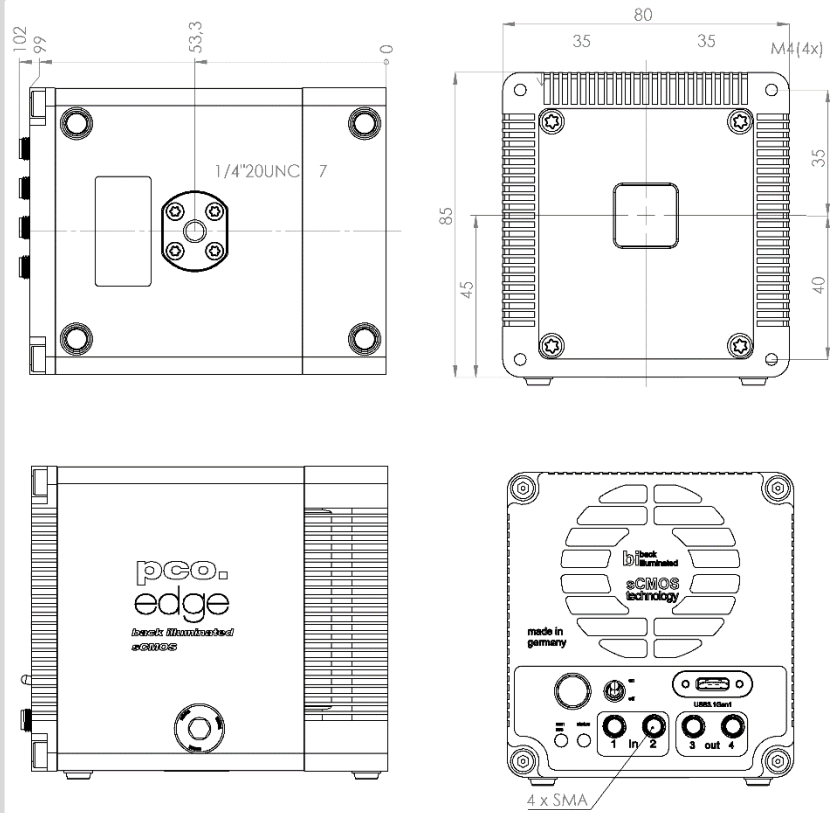
ROI step sizes	
Horizontal steps	32 pixel steps
Vertical steps	8 pixel steps
Minimum ROI	64 x 16 pixels

Subject to change, refer to current data sheet available on our website.

A1.2 MECHANICAL DIMENSIONS

NOTE

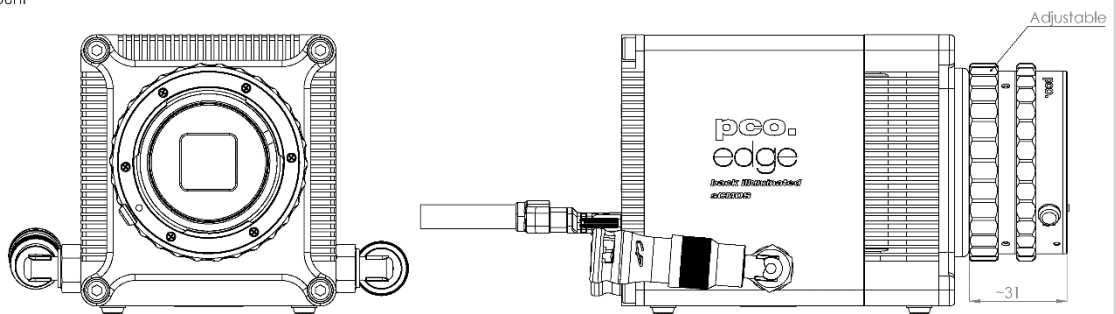
C-Mount flange
focal distance:
17.52 mm



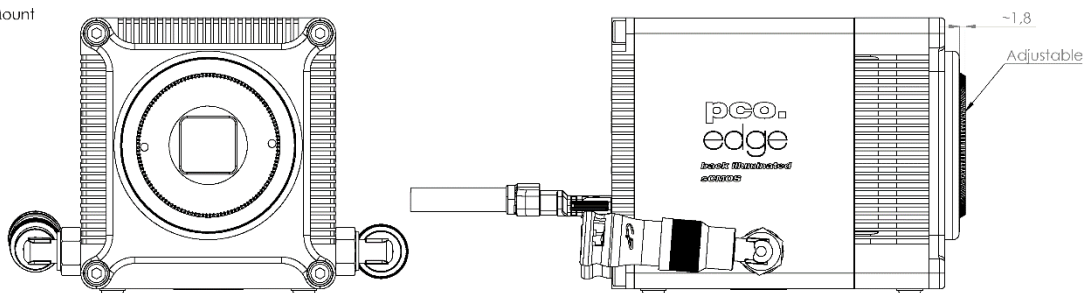
All dimensions given in millimeter.

2D and 3D technical drawings are available on our website
3D step files and further technical drawings are available on request.

F-Mount



C-Mount



A1.3 REAR PANEL



Status LEDs 1

(LED1: green / red; LED 2: orange)

Color		Description
Red / green continuous		Camera is booting
Green		Camera is ready for operation
Orange continuous		Arm camera / rec state off
Orange blinking		Recording on
Red continuous		Error

Interface Connector 2

USB 3.1 plug Type C

Power supply for the camera via USB cable

SMA Inputs 3

(see chapter 7)

Input (1=Exposure Trigger; 2=Acquire Enable)	
Type	Digital
Level	3.3 V LVTTTL (5 V tolerant)
Coupling	DC
Impedance	1 k Ω
Slew rate	> 1 V/ms

SMA Outputs 4

(see chapter 7)

Output (3=Status Busy; 4=Status Expos)	
Type	Digital
Level	3.3 V LVTTTL
Coupling	DC

Power Input 5

LEMO socket ECG.0B.302.CLV	
Pin1	VCC 24 V DC (+/- 10 %)
Pin2	Ground

Appropriate Lemo plug: FGG.0B.302.CLAD52Z



Power Switch 6

A2 HARDWARE MOUNTING

Instructions how to mount the pco.edge 4.2 bi (UV) camera system.

A2.1 USB CARD INSTALLATION



WARNING

NOTE

In multi-camera operation, each pco.edge 4.2 bi camera needs its own USB host controller card.

An external Delock USB 3.1 Gen2 host controller card comes along with each pco.edge 4.2 bi (UV) camera.

Hardware Installation

First shut down your computer and install the USB 3.1 Gen2 host controller card. Hardware installation must be performed by a technician, because high voltages can occur on the device.

ELECTRIC SHOCK WARNING DUE TO VOLTAGE PARTS INSIDE

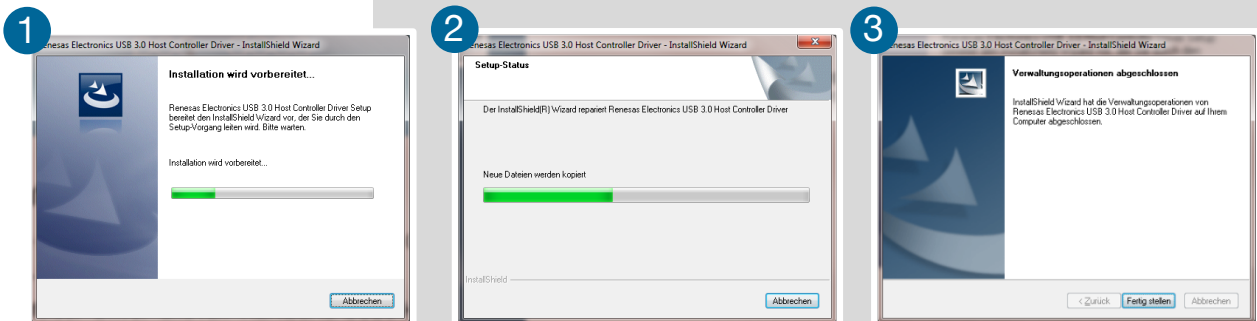
Risk of injury due to electrical shock.

→ Always pull the main plug before opening the computer.

Driver Installation Instructions

- Within the provided installation files USB_HBA, open the folder U3X4-PCIE4XE101, U3X4-PCIE1XE101, U3-PCIE1XG202.
- Open the subfolder Driver and run RENESAS-USB3-Host-Driver-30230-setup.exe.
- If your current OS is Win 7 / 8 and the User Account Control is enabled, a dialog prompts whether you wish to start the setup: accept with Yes.

- 1 At first the installation is prepared.
- 2 Secondly the software components are copied automatically.
- 3 Finally the installation is completed and the USB 3.1 Gen2 extension card can be used.



A2.2 CABLE MOUNTING



NOTICE



In order to ensure a proper function of the pco.edge 4.2 bi (UV), it is recommended to secure the USB cable with the fixing screws.

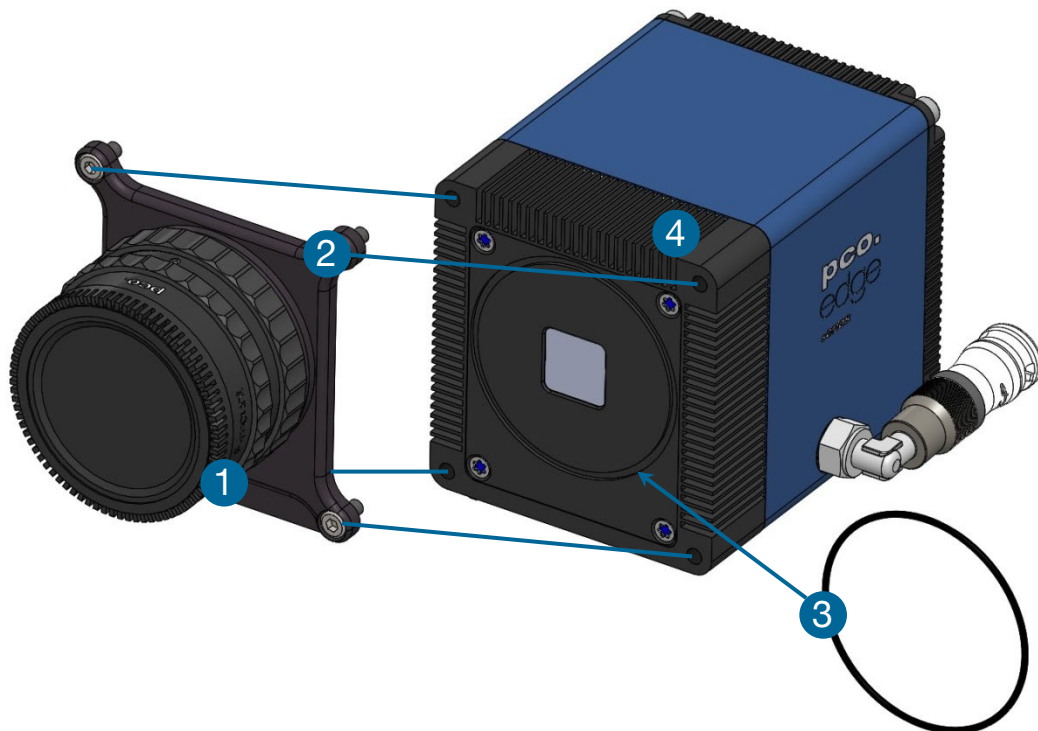
The accompanying USB cable is equipped with one screwable plug.

The maximum torque for the screws is 0.1 Nm.

Screw Connection to the Camera (recommended)

- The screw threads of the camera are very sensitive due to the small size.
- Plug the USB cable into the camera.
- Then attach the fittings to the threads by hand.

A2.3 DIRECT CAMERA MOUNTING



The hardware design allows to mount the camera very close to an optical setup (e.g. a microscope) without F- or C-mount adapter but with the help of a rubber ring.

This allows to reduce the distance from the focal plane of the sensor to the adaption plate to only 6.18 mm.

Contact us, if you need the rubber ring. The ring is not included in the standard package of the camera:
O-ring D 55 x 1.5 material number: 10305100011

NOTICE

The rubber ring is essential for this direct adaption, as it is necessary to block parasitic light.

Mounting Steps

First, the adapter **1** containing the lens mount must be removed. Completely unscrew the four cylinder head screws M4 x 8 **2** and remove the adapter.

As second step, place the rubber ring **3** in the intended recess of the camera.

Finally screw the camera to your optical setup by using the four M4 screw sockets **4**.

Always make sure that the O-ring does not slip out of the recess!

A3 F-MOUNT ADAPTER

A3.1 PCO F-MOUNT ADAPTER



PCO's proprietary F-mount adapter for lenses with automatic diaphragm. Sets manually the lens aperture by turning the ring on the adapter.

F-mount lenses without automatic diaphragm can be fastened to the camera's mount but the aperture not changed.



Adjust Back Focal Length

To adjust the back focal length (e.g. you cannot focus to infinity or to the minimum object distance of your lens), proceed as follows:

Set the focus of your lens to infinity. Look at 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 particular 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

A3.2 CHANGE FROM F-MOUNT TO C-MOUNT

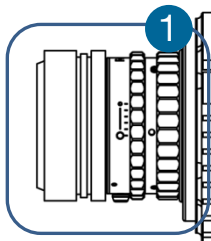
NOTICE

How to change the optical input from F-mount to C-mount.

MECHANICAL DAMAGE OF THE C-MOUNT RING

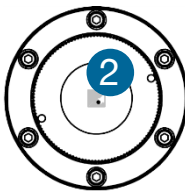
Tightening the hexagon socket setscrews too tight will permanently damage the C-mount ring.

- Use a torque wrench and select a maximum torque of 1 Nm to tighten the hexagon socket setscrews.



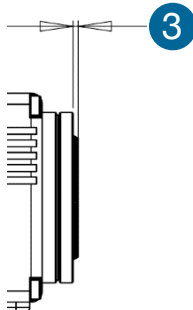
Step 1: Remove F-mount adapter

Turn the black lock ring **1** counterclockwise to loosen the F-mount adapter and then unscrew it.



Step 2: Insert C-mount ring

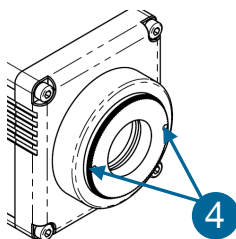
Carefully screw the C-mount ring **2** clockwise. The two hexagon setscrews must be visible on the outside.



Step 3: Adjust flange focal distance

In order to reach the standard support dimension of C-mount (17.526 mm), screw in the C-mount ring so far that it protrudes outwards a distance of 1.8 mm **3**.

For fine adjustment use a suitable lens with large aperture.



Step 4: Fix the C-mount ring

To fix the C-mount ring, tighten both hexagon setscrews **4** (1.5 mm hex key) to a maximum torque of 1 Nm.

Limitations of C-mount Lenses

Keep in mind that C-mount lenses could cause shadings at the edges of big sized 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.edge bi has a sensor diagonal of 18.8 mm, it follows that you have to use the ROI function for a shade less image while using the C-mount adapter with the two smaller C-mount diameters.

A4 WATER COOLING OPTION PCO.AQUAMATIC II

This is the re-cooling system for pco.edge cameras with water-cooling.

A4.1 SYSTEM COMPONENTS



	Description
1	pco.aquamatic
2	connection tube 5m PVC 3541-01 PCO (Colder NS212 fittings)
3	power supply (1.2m cable length)
4	power cable
5	camera cable 5m (FGG-RG58-NC3MX)
6	Innovatec Protect IP 11

Normally no maintenance and almost no care is required. Only the coolant's level of the reservoir (water tank) should be checked from time to time.

Only use Innovatec Protect IP for the pco.aquamatic! Do not use or add any other coolant or normal water! If you need to add cooling liquid in order to maintain the tank level, contact PCO for additional supply.

The coolant will turn yellow after some hours of operation. This is normal and no sign of wear or malfunction. The optimum pH-value is between 8 and 9 (check this value if you are concerned about the coolant's quality).

NOTE

The recommended service interval for the change of the coolant is four years.

A4.2 FIRST TIME INSTALLATION



Take care to place the unit on a flat and firm surface. Do not cover the cooling vents of the unit. Ensure free airflow around the pco.aquamatic for maximum cooling performance. All tubes and power cords need to run kink-free.

Before installation of the unit carefully read the Innovatek Protect IP safety datasheet (see [Innovatek Website](#)).



outlet flow



inlet flow

Follow Steps 1 – 6

- 1 Connect tubes to cooling unit and camera. The two arrows on the housing of the cooling unit only indicate flow direction. Either connection of the camera can be used for *in* or *out*.
- 2 Connect to power.
- 3 Open tank cover.
- 4 Turn power switch on (I).
- 5 Slowly fill in the coolant while the unit is running. Refill as needed to keep the level.
- 6 While the cooling liquid flows back to the tank make sure all air gets out of the system – this takes a few minutes (move hoses if necessary).

The cooling liquid tank is full when liquid level is approximately 1-2 cm from the top of the tank. The integrated pump only works when the pump chamber is completely filled. To ensure this Move hoses or remove air by evacuating. Tank capacity is approximately 500 ml.

After steps 1 – 6 are completed successfully the system is ready for operation.

NOTE

The hose connectors are waterproof in not connected state. Maybe they lose one drop of cooling liquid from time to time. There is no need to empty the hoses while storing the camera system.

A4.3 OPERATION



First connect the power out of the cooling unit with the power in of the pco.edge camera by using the *PCO WAT camera cable*.

The cooling unit provides two operation modes.
Operation Mode on: the cooling unit turns on and provides permanently power to the camera. The camera can be switched on and off as needed.



Operation mode follow: the cooling unit turns on when the camera is switched on and vice versa.

Error Codes

The coolant temperature sensor is located in the coolant tank.

Temperature	Action
27°C	fan turns off
36°C	fan turns on
55°C	warning message
60°C	error message

If a warning level is passed, the Power LED blinks slowly and the Error LED displays the error code. If a failure level is passed, the Power LED blinks fast and the Error LED shows the error code.

power	error	Error / Failure
on	off	none
1Hz flash	one short flash	warning when temperature at 55 °C (also if sensor is defect or missing)
2Hz flash	one short flash	failure when temperature at 60 °C
1Hz flash	two short flashes	fan speed (also if a high deviation of the standard value is reached)

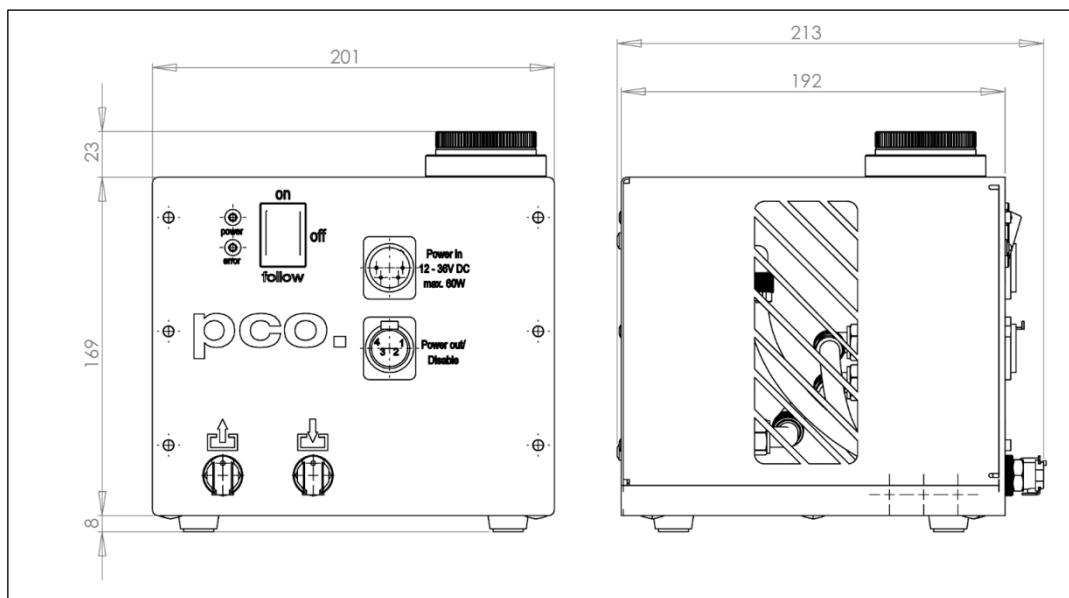
NOTE

The camera has its own protection circuit and will shut down Peltier cooling automatically when the electronics temperature exceeds safety level. The camera itself will keep on running, but sensor temperature will increase. (valid for air and water cooling!)
 If the camera and the water cooler have a different power supply, always first shut down camera and then the cooling system to avoid damages.

A4.4 DIMENSIONS

All dimensions are given in millimeter.

Weight: 4kg (completely filled coolant tank)



A4.5 YOUR OWN COOLING SYSTEM

You are not obliged to purchase the pco.aquamatic system - you may use your own water cooling device. A separate power supply will be provided to every pco.edge camera with water connection. The hardware of the pco.edge cameras with USB 3.1 interface is designed to work with or without a water cooling system. A fan inside the camera provides adequate cooling anyway.

In case you use an own water cooling system, make sure the liquid you use to cool your camera is always ABOVE the dew point of the ambient temperature. In order to avoid any occurrence of condensation, use a cooling liquid at room temperature.

- A liquid flow rate of 1–2 litres per minute is sufficient
- Always use Innovatec Protect IP cooling fluid or an equivalent cooling fluid

A5 CUSTOMER SERVICE

A5.1 SERVICE

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

A5.2 MAINTENANCE



CAUTION

UNPLUG CAMERA BEFORE CLEANING

Risk of injury due to electric 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 (clean it with pressurized air).
- 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 high quality 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.

A5.3 RECYCLING



If you want 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.

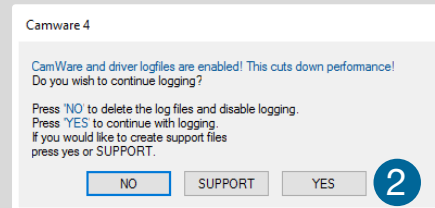
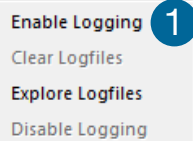
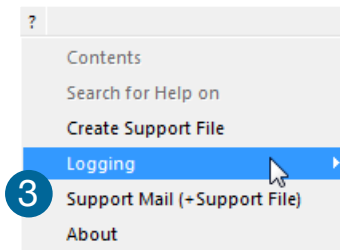
A5.4 TROUBLE SHOOTING

Use pco.camware to create logfiles for the PCO support.

How to Create Logfiles

Enable Logging ①

Open **? Help** menu, select **Logging** and then **Enable Logging**. The pco.camware will ask you to press **YES ②** to activate **Logfiles** after a restart of the software.



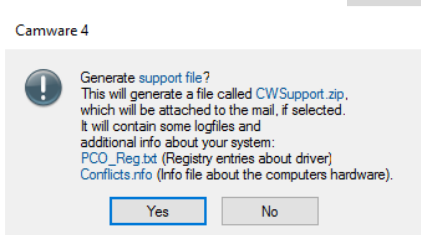
Repeat Workflow

The workflow which produces the error must be repeated while logging is enabled.

Support Mail (+Support File) ③

Open **? Help** menu, select **Support Mail (+Support File)** and a support file with all necessary files is created

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



Alternatively use the support form on our website: <http://www.pco.de/support/> and upload the support file.

To Speed up Your Request

Give us the following information:

- Describe your problem!
- Your application?
- Your camera:
 - Type and version
 - Serial number
- Your setup:
 - Software version
 - Operating system
 - Processor and memory
 - Graphics card

Firmware, Software and Driver Update

You will find all necessary software and drivers on the accompanying USB storage device. For the latest versions check PCO [website](#).

A6 INDEX

NOTE:

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

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ABOUT PCO



pco.

pco.history

“PCO” stands for what we are: a Pioneer in Cameras and Optoelectronics. With 30 years of expert knowledge and experience PCO has forged ahead to becoming a leading specialist and innovator in digital imaging used in scientific and industrial applications such as life and physical science, high-speed imaging and machine vision. However, the beginning of PCO’s story of success dates back to the 1980s and a research project of the founder, Dr. Emil Ott, who was working at the Technical University Munich for the Chair of Technical Electrophysics. While performing measurements with intensified slow scan cameras, Dr. Ott realized that the existing standard did not meet the sophisticated requirements of scientific applications – and so PCO came to life in 1987. With a small team of engineers Dr. Ott began to develop his first image intensified camera followed by several variations on the original model, geared to overcoming all the existing flaws and surpassing standards of the day. During these early years PCO developed a now well established core of advance technologies used as the foundation to develop cutting edge products.

In the early 1990s PCO expanded its business activities to the global market by successfully establishing an international network of highly trained sales partners and customers. We entered additional fields beyond traditional scientific research expanding the potential for our cameras’ applications in life science, automotive testing and even broadcasting. This step paved the way for a wide range of innovative highlights:

As of 2017, PCO has three decades of technical know-how and expert knowledge in the development and manufacturing of high-performing camera systems. In-house competence of all significant technical disciplines and partnering with leading image sensors manufactures ensures cutting edge sCMOS, CMOS and CCD technology for all PCO cameras.

pco.prospect

“If you want to do something special, particularly in the high end fields, you have to develop your own image sensors. So we work with partner companies who develop tailored sensors made especially for us. This is something we are doing continuously, so we’re already working on the next generation of cameras that we will introduce in the coming years” – Dr. Emil Ott.

In PCO’s first 30 years, Dr. Emil Ott took a company that he started right after finishing university and has built it into a major player in scientific and industrial cameras – and there’s plenty more to come.

pco.

An Excelitas Technologies Brand