

user manual

pco.edge 10 bi LT

the next level sCMOS camera



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



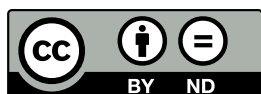
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1 Safety

This camera system is a scientific measuring equipment and is designed for use by technicians, engineers, and scientists. 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 and alterations of the device are forbidden for safety reasons.



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.



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.



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.



TRIPPING HAZARD: Risk of injury from tripping over loose cables. Never position the cable in a way that it could become a tripping hazard.



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.



SHOCK AND 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.



LENS MOUNTING: Do not force the lens onto the camera. Screw in the lens gently to avoid thread damage.



LIQUIDS DAMAGE CAMERA: If liquids have penetrated the device: Switch the camera off immediately, detach it from power and contact PCO's customer support.

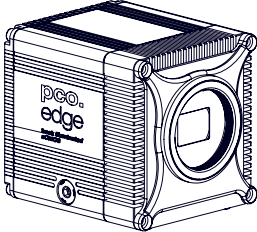
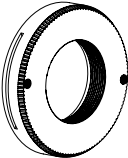
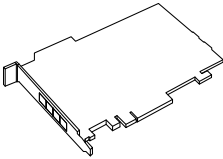
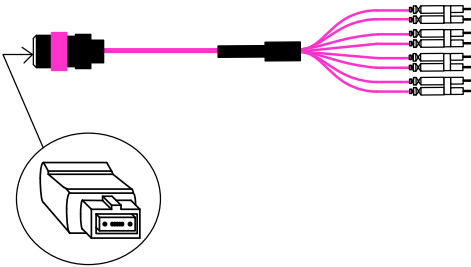
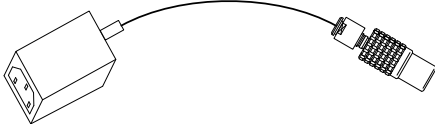


DAMAGED CAMERA HOUSING: If the camera has been dropped or the camera's housing is damaged: Switch the camera off immediately, detach it from power and contact PCO's customer support.

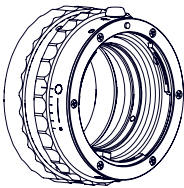
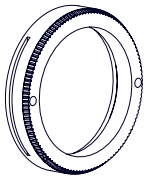
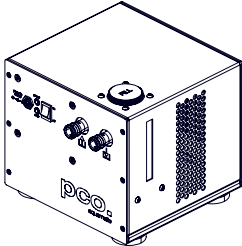
2 System components



The following standard components are included in your scope of delivery:

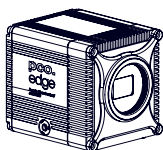
Article	Picture	Details
pco.edge 10 bi LT		chapter 3
C-mount adapter		chapter 2.2.1
Kaya frame grabber		chapter B
Cables (CLHS)		chapter 2.3
Power supply		chapter 2.3

These accessories are available for the pco.edge 10 bi LT series:

Article	Picture	Details
F-mount adapter		chapter 2.2.2
TFL-mount adapter		chapter 2.2.3
Interface cables (SMA - BNC)		chapter 2.3
Aquamatic III		chapter A

All pco.software products can be downloaded for free from the PCO website. For more information see the PCO [homepage](#).

2.1 Camera pco.edge 10 bi LT



Thanks for choosing a pco.edge 10 bi LT camera. The pco.edge 10 bi LT is PCO's next level sCMOS camera with a new imaging performance. Thanks to its back-illuminated image sensor it comes with a quantum efficiency of up to 85 % with broad spectrum out to NIR. The sensor incorporates microlenses and a full pixel height deep trench isolation for crosstalk suppression resulting in an excellent MTF.

Main Features

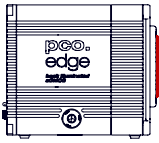
- Back-illuminated sCMOS with high MTF
- High resolution 4416 x 2368 pixel
- Low readout noise $1.3e^-$ @ 120 fps
- High dynamic range 15,385 : 1
- temperature-stabilized image sensor
- Fiber-optic data interface
- Pixel size $4.6 \mu m \times 4.6 \mu m$
- Rolling Shutter (RS)
- Up to 85 % quantum efficiency



This document contains important information about the camera pco.edge 10 bi LT. Please read the instructions given in this document carefully. It contains useful information and advice to operate the camera in intended way. If there are any questions regarding the pco.edge 10 bi LT camera, please feel free to contact PCO or the local representative.

Areas of application	
Brightfield microscopy	Mesoscopy
Fluorescence microscopy	High-Speed bright field ratio imaging
Förster resonance energy transfer (FRET)	Spinning disk confocal microscopy
High throughput screening of fluorescent samples	Digital pathology
Single molecule localization microscopy (SMLM) – PALM, STORM, dSTORM, GSDIM	High content screening of fluorescent samples
High throughput screening of fluorescent samples	Disaster recovery
Lightsheet fluorescence microscopy (LSFM)	Image intensifier imaging
PIV: particle image velocimetry	Tunnel inspection
Selective plane imaging microscopy (SPIM)	Biochip reading
Structured illumination microscopy (SIM)	Calcium imaging
Fluorescence recovery after photobleaching (FRAP)	Ophthalmology
High content screening of fluorescent samples	

2.2 Lens mount adapters



PCO cameras have an interchangeable lens adapter system to use the camera with different standard lenses. The adjustment of the lens mount can be done by the user.

2.2.1 C-mount adapter

The C-mount adapter is screwed in the front of the camera and fixed with three allen screws (marked in red). In order to set the standard back focal distance of the C-mount (17.526 mm), screw in the C-mount ring until it stands out 1.8 mm from the camera front (see *figure 2.1, right*).

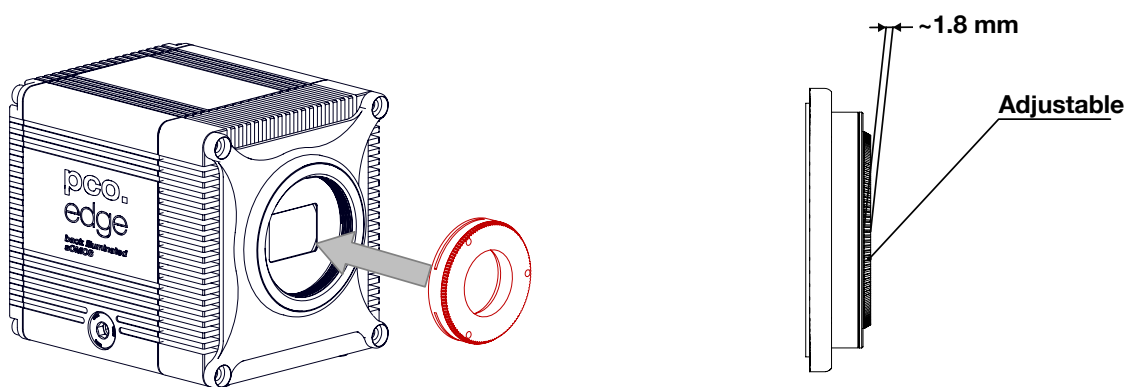


Figure 2.1: C-Mount installation.

Use a suitable lens with a large aperture for fine adjustment.

Follow these steps for the fine adjustment:

- Set the lens focus to infinity and look at an object which is far away.
- Rule of thumb: The distance to the object must be at least 200 times the focal length of the lens. The further away, the better.
- Then turn the lens mount in until the object is sharp.
- Look at an object which is positioned at the minimum working distance of your lens (as described in the corresponding datasheet).
- Set the lens focus to the minimum working distance (the opposite direction of infinity).
- Now adjust the lens mount until this object is sharp.
- Repeat the above steps until the focus is consistently sharp in both positions.



CAUTION: The allen screws are designed for a maximum torque of 1 Nm. All torque values in this manual are recommendations.

Keep in mind that C-mount lenses can cause shadings at the edges of large-sized sensors.

Most C-mount lenses can illuminate a maximum image circle in the range of 9 mm (1/1.8") to 22 mm (4/3") diameter only. The pco.edge 10 bi LT has a sensor diagonal of 23.05 mm.

To achieve less shaded images, the ROI function can be used to limit the resolution of the sensor when using lenses with smaller image circles than the sensor diameter.

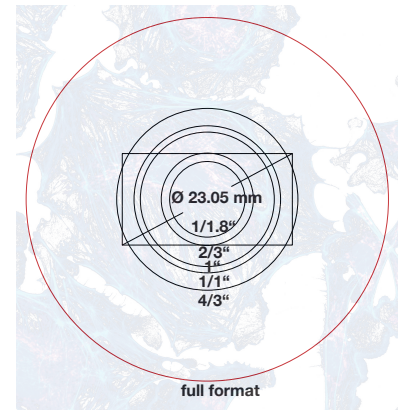
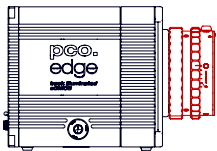


Figure 2.2: sensor size vs. image circles of various C-mount lenses.

2.2.2 F-mount adapter



The optional F-mount adapter is screwed in the front of the camera and fixed with by the lower adjustment ring of the adapter. In order to set the accurate back focal distance of the F-mount (46.50 mm), the position of the adapter can be adjusted. The same procedure as described in **chapter 2.2.1** is applicable.

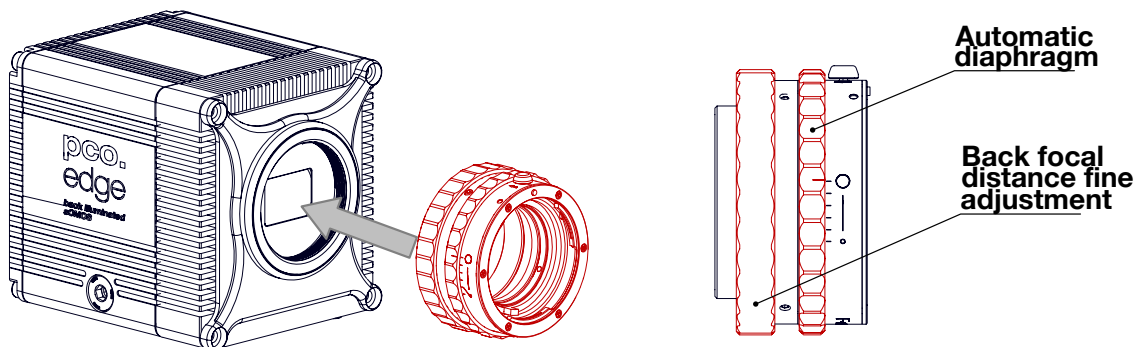


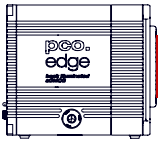
Figure 2.3: F-mount description.

PCO's proprietary F-mount adapter supports lenses with an automatic diaphragm. It manually sets the lens aperture by turning the upper adjustment ring of the adapter. F-mount lenses without an automatic diaphragm can be connected to the mount at the camera, but the aperture cannot be changed.

Matching lenses with automatic diaphragm

Manufacturer	Lens type
Nikon	Nikkor Type D, Nikkor Type G
Zeiss	ZF.2 (Otus, Milvus, Interlock, Distagon, Planar)
Tamron	Type 35 mm: A012, A007, A009, A011, F012, F013
	Type APS-C(H): B001, B005, G005

2.2.3 TFL-mount adapter



The optional TFL-mount adapter is screwed in the front of the camera and fixed with three allen screws (marked in red). In order to set the standard back focal distance of the TFL-mount (17.526 mm), screw in the TFL-mount ring until it stands out around 1.8 mm from the camera front (see figure 2.4, right). The TFL mount supports lenses with a maximum sensor diagonal of 28.3 mm.

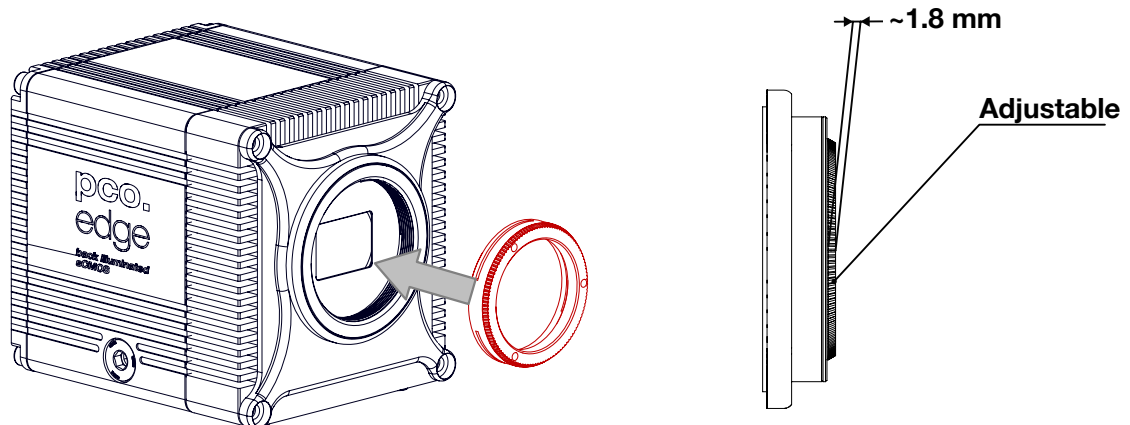


Figure 2.4: TFL-mount installation.

The fine adjustment is done in the same way as described in **chapter 2.2.1**.

2.3 Cables

The pco.edge 10 bi LT is delivered with an USB interface cable for data transfer and a power supply cable.

Article	Length	Description	Scope of delivery
Interface cable	5 m	FOL MTP/LC (Female B/4X) BREAKOUT OM4	included
SMA cable	0.3 m	Coaxial cable type SMA-BNC	available on request
Power supply	1.5 m	Input: 100 - 240 VAC; Output: 24 VDC/ 2.71 A	included

Please note that other cables may not be suitable for your camera. If a cable is equipped with a screwable mount, make sure to attach it to the camera accordingly.



NOTE Only use cables which are approved by PCO. Otherwise full functionality cannot be guaranteed.

2.4 MachVis software



The MachVis Software can be used to select a suitable lens for a camera or optical setup. With its help it's possible to find fitting lenses for variable types of cameras. More information can be found on the [web](#).

3 Camera overview

The following chapter provides an overview of the pco.edge 10 bi LT.

3.1 Camera interfaces

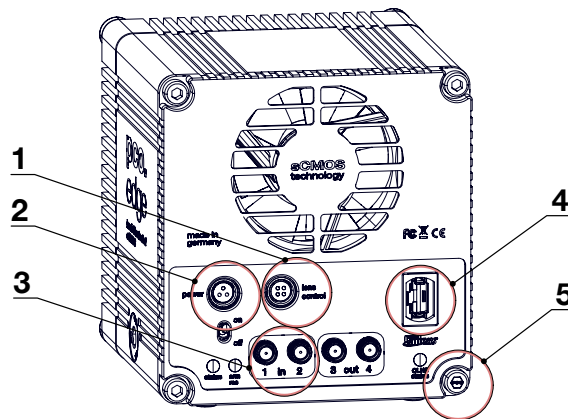


Figure 3.1: pco.edge 10 bi LT rear panel interfaces.

Interfaces	
1	Lens control
2	Power interface
3	Trigger and status via SMA connectors
4	Data interface via Camera link HS
5	Tamper protection

Please refer to the pco.edge 10 bi manual for further information on camera interfaces.

3.2 Hardware setup

- If the camera needs to be cooled by water, connect the camera to the pco.aquamatic III or any other system for water cooling (see chapter **A**).
- Power the camera via the included power supply.
- Connect the camera to the PC via the included CLHS cable.
- Connect the SMA interfaces via coaxial cables for status or trigger functionality to other equipment.

3.3 Data and power interface

The pco.edge 10 bi LT is available with the following interfaces:

Camera	Interface	Interface connector
pco.edge 10 bi LT	CLHS	MPO Connector (F3, 2X2, S10)

3.4 LEDs

The functionality of the LEDs on the rear panel of the camera is listed in the following table.

LED "arm/rec"		LED "status"		Meaning
OFF		Orange		Camera is booting
OFF		Green		Camera is ready for operation
OFF		Red		Error
Orange		Green		Arm camera / rec state off
Orange blinking		Green		Recording
OFF		OFF		Camera without power

3.5 Trigger and status interfaces

The pco.edge 10 bi LT provides different operation modes (see **chapter 4**). These can be controlled and monitored via control signals at the rear panel of the camera. In total, there are four trigger and status interfaces. Of these, there are two signal inputs (frame trigger, acquire enable) and two signal outputs (exposure, busy).

Functional behavior

The assignment of functionality of the signals at the SMA interfaces can be done by software (e.g. pco.camware). The inputs and outputs can be either switched ON (with different functionality) or OFF. Further the signal polarity can be selected (level-sensitive or edge-sensitive respectively).

		Parameter	Option
SMA 1	input	exposure trigger	auto sequence, soft trigger, external exposure start, external exposure control
			off
		signal polarity	rising (default)
			falling
SMA 2	input	acquire enable	external, sequence, auto

Continued on next page

Continued from previous page

		Parameter	Option
			off
		signal polarity	high (default)
			low
SMA 3	output	status busy	on
			off
		signal polarity	high (default)
			low
SMA 4	output	status exposure	on
			off
		signal polarity	high (default)
			low

The active states (high/low, rising/falling edge respectively) can be set by software commands or in pco.camware. The default values are listed in the table above.

A functional description of the trigger modes and corresponding output signals is given in **chapter 4**.

Status signals

Status signals are signals generated by the camera for synchronization purposes.

The **busy** signal (SMA 3) is active if the camera is recording or when it is switched on. When a “false or low busy” signal is read, the camera setup is complete and no trigger has been detected, meaning that the camera is ready to receive trigger signals for exposures.

The **exposure** signal (SMA 4) is active during exposure and inactive at all other times.

Electrical properties

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

Output (3 = Status Busy; 2 = Status Exposure)	
Type	digital
Level	3.3 V LVTTTL
Coupling	DC

4 Operation modes

The camera can be used in different modes. These will be introduced in the following chapter.

4.1 Trigger modes

The pco.edge 10 bi LT incorporates several trigger modes. In this context trigger means exposure trigger, i.e., the trigger signal that controls the exposure time of single image (light integration time). Trigger modes can be set via software (e.g. pco.camware, SDK command), trigger related input and output signals are accessible via the SMA interfaces (see **chapter 3.5**).

trigger
auto

Auto sequence mode

In the Auto Sequence mode, the camera determines the highest possible frame rate for the defined exposure time and the time required for a frame readout. After a start command is given, the sequential recording is started, until a stop command is given. These commands can be set by software. Any signals at the trigger input (hardware I/Os) are irrelevant.

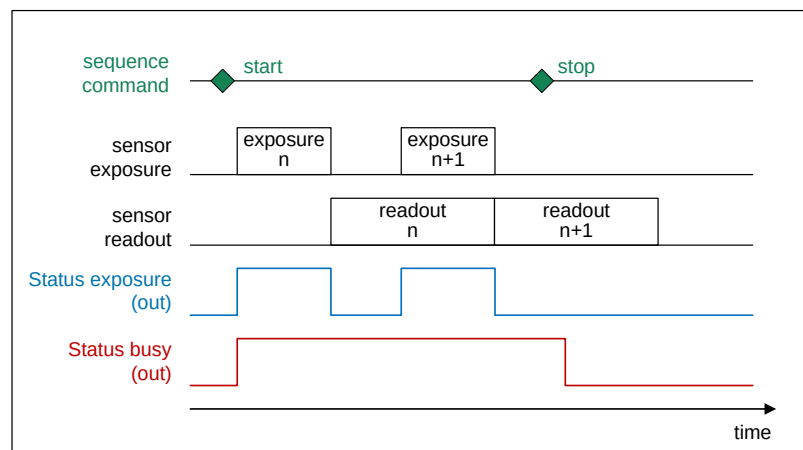


Figure 4.1: auto sequence explanation.

trigger
soft

Soft(ware) trigger mode

Within this trigger mode, recording of single images can be triggered by software with corresponding commands.

trigger
EES

External exposure start

In the external exposure start mode, single images are recorded with each rising or falling edge of the signal at the input trigger interface (SMA 1). The resulting frame rate is defined by the frequency of this trigger signal. However, the predefined exposure time and ROI settings affect the maximum possible frame rate.

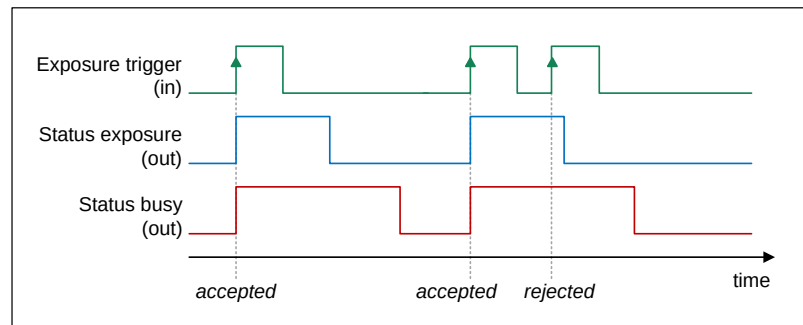


Figure 4.2: external exposure start explanation.

The status exposure output indicates the time of the active exposure phase. The status busy output indicates whether the camera is ready to process and accept a new trigger signal. A trigger signal during active state of the signal *status busy* will be rejected.

The exposure time is started in steps of the line time. That means, the exposure time can start up to approximately 32 μs after the respective trigger signal.

If the rate of the external trigger input signal is close to the maximum possible frame rate (1 ms difference), it will be random whether the trigger is accepted or not.

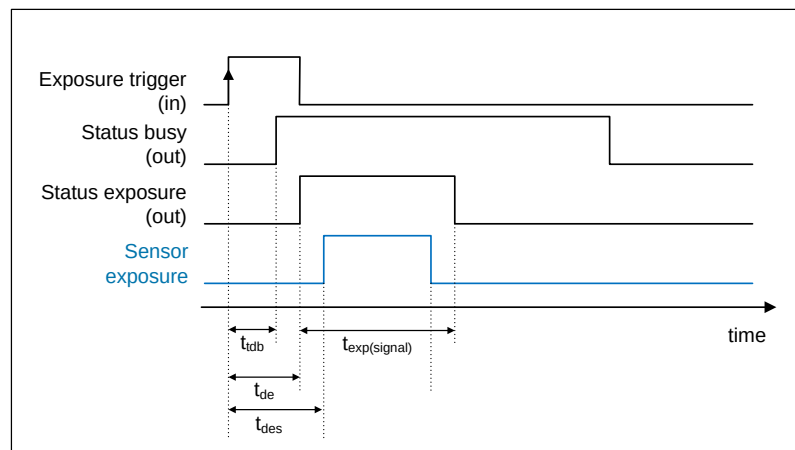


Figure 4.3: exposure trigger.

Delay time		Value
Delay busy	t_{db}	tbd
Delay exposure time	t_{de}	tbd
Delay trigger to sensor exposure	t_{des}	tbd

trigger
EEC

External exposure control

Within this trigger mode, the externally applied signal (SMA 1) defines the start and the duration of the exposure time. A new exposure is started by rising or falling edge of the trigger signal and end when the opposite edge is detected. The image sequence is completely controlled by the external signal. Any defined delay and exposure time values are ineffective.

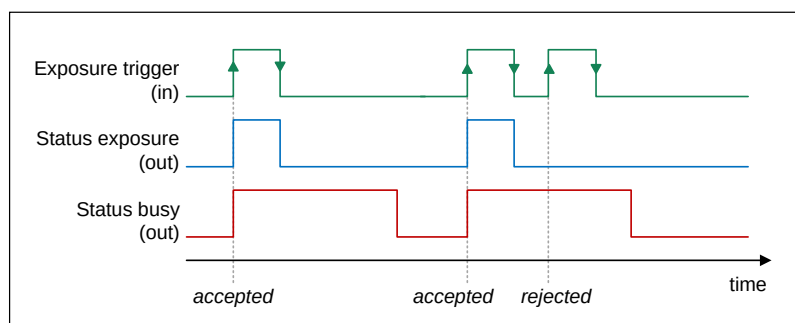


Figure 4.4: external exposure control explanation.

The status exposure output indicates the time of the active exposure phase. The *status busy* output indicates whether the camera is ready to process and accept a new trigger signal. A trigger signal during active state of the signal *status busy* will be rejected.

The exposure time is started in steps of the line time. That means, the exposure time can start up to approximately 32 μ s after the respective trigger signal.

If the rate of the external trigger input signal is close to the maximum possible frame rate (1 ms difference), it will be random whether the trigger is accepted or not.

The maximum exposure time of the camera is limited. The exposure time will be stopped automatically if the maximum exposure time is reached.

4.2 Acquire mode

The **Acquire Mode** is an additional instance to control image acquisition by an external signal. Like a master signal, the *acquire enable* signal enables or disables a time slot in which images are recorded according to the selected trigger mode.

The acquire enable signal is active high by default. That means, a high-level enables image acquisition and a low-level disables it (or vice versa if the signal level is changed to low active).

There are two configurations of the acquire enable mode: **auto** and **external**.

acquire
auto

If acquire enable mode is set to **auto**, any signal at the acquire enable input interface is ignored. There is no logical connection between the input and the trigger modes.

acquire
external

If acquire enable mode is set to **external**, the camera records images only, if enabled by an external acquire enable signal at SMA 2.

Example timing diagram: Trigger mode is set to *external exposure start* and acquire mode is set to *external mode*. The image acquisition is paused once the acquire enable signal turns low, signals at the external trigger input are ignored. Image acquisition is resumed as soon as the acquire enable signal turns high.

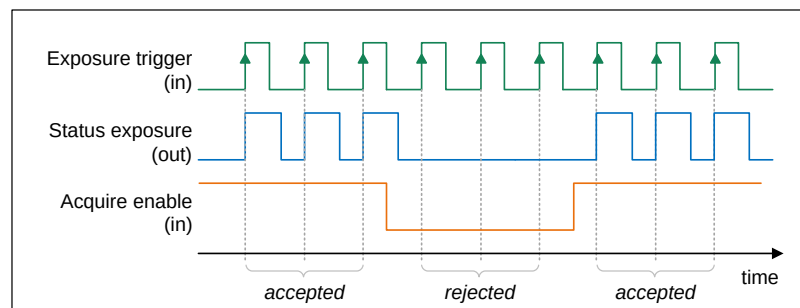


Figure 4.5: acquire mode explanation.

5 Operation



In the following chapter the system requirements in terms of connection and memory needed to use the camera will be explained. The table below shows the required GPU memory for different camera types and modes.

5.1 System requirements

System Requirements	
Interface	Camera link HS FOL

The following values are suggested minimum requirements for the used PC to facilitate smooth operation:

GPU Memory

Operation mode & sensor	Resolution < 10 MPixel	Resolution ≥ 10 MPixel
Single shutter monochrome	≥ 1 GB	≥ 2 GB
Single shutter color	≥ 2 GB	≥ 4 GB
Double shutter monochrome	≥ 2 GB	≥ 4 GB

5.2 Quick start guide

The following instructions will guide the user through the first startup of the camera.

Step 1

Install the latest version of pco.camware (see **chapter 7**) and Kaya frame grabber driver (**chapter B**).

Step 2

Connect the camera to the PC via the Camera link HS cable. Make sure that the status LED turns green. The camera is ready for operation.

Step 3

Start **pco.camware**.



The software should find your camera automatically. If not, the user can do a rescan to connect with your plugged camera. The command **Scan cameras** can be accessed via the **Main toolbar** or the **Camera Overview** window.

Menu -> Camera -> Rescan

A new view window should open automatically. The user can also open a new **View Window** manually via the button **New View Window** located in the **Main toolbar** or the **Camera Overview** window.

Menu -> View -> New View Window**Step 4**

Start the **Live Preview** by clicking the button in the **Main toolbar** or the **Camera Overview** window. The arm/rec LED starts flashing in orange.

**Menu -> Acquisition -> Live Preview**

Right click in the **View Window** and apply **Continuous Auto Range**. The user may now have to adjust exposure time of the camera as well as aperture and focus of the mounted lens. The user should now see the object clearly in the **View Window**.

Note: Live Preview is useful for fast and easy camera adjustment and focusing. It does not record or store images.

For more information, please check the user manual of **pco.camware** available at the PCO website.

6 Camera mechanics

At this point, the mechanics of the camera are presented. The illustrations show contours and size of the pco.edge 10 bi LT.

6.1 Mechanical outlines

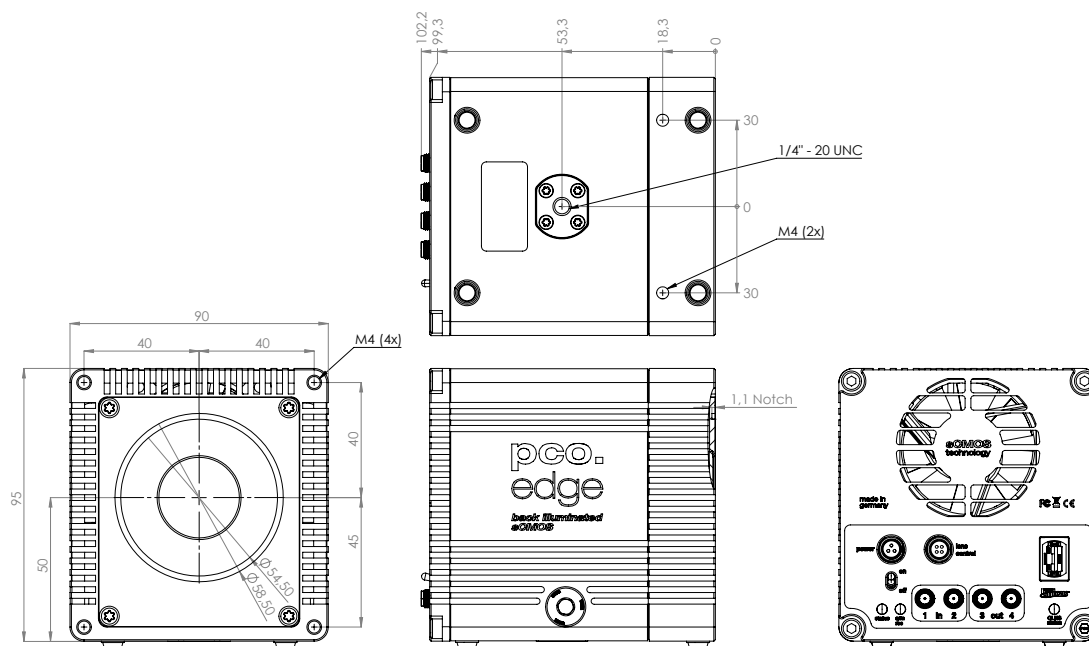


Figure 6.1: outlines pco.edge 10 bi LT (all dimensions given in mm).

For more questions, visit the manufacturer's website or contact your local representative. Detailed drawings, step files and 3D PDFs are available at www.pco.de or on request.

6.2 Mounting

The pco.edge 10 bi LT provides different options for mounting. Please make sure that the camera is mounted in a stable way to avoid vibrations, which might disturb image quality.

Bottom mounting

The camera can be mounted via the thread at the bottom of the housing.

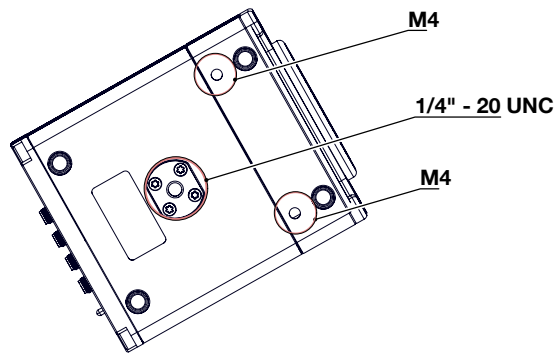


Figure 6.2: bottom view of the camera (threads marked in red).



CAUTION Do not exceed the maximum recommended torque for the mounting screws. Maximum recommended torque for M4: 2.2 Nm; 1/4" - 20 UNC: 7 Nm

7 Software

The main camera control software **pco.camware** is the first choice to get started with the camera. It enables full control of all camera settings and makes image acquisition and storage very easy. Using different layouts, styles and features the user can customize it exactly to his needs.

The use case is in the field of microscopy: PCO cameras are also integrated in **µManager**.

To create an own application for the camera: PCO offers a wide range of Software Development Kits (SDK) for different programming languages, both for Windows and Linux. **pco.sdk** and **pco.recorder** are designed for **C**, **C++** and **C#** apps. With **pco.python**, **pco.matlab**, **pco.labview** and **pco.java** the user can control the camera in **python**, **matlab**, **labview** and **java** applications, respectively.

In case of using a different software: PCO cameras are also integrated in a variety of microscopy and high-speed software applications, like **FalCon eXtra**, **Leica LAS X Life Science**, **NIS-Elements**, **VisiView** and many more. Check the manufacturers homepage to find a list of all applications that support PCO cameras.

The user can access and download the latest versions of all software products for free on the PCO [website](#).

7.1 Software requirements

Software requirements	
Operating system	Windows 10 or higher or Linux (Windows 10 recommended)
CPU	i7 or XEON > 2.5 GHz
RAM	16 GB
Display/Graphics	Full-HD resolution display
	monochrome: Nvidia GPU recommended

8 Specifications

The following technical details describe the camera and its features:

sCMOS image sensor ¹

Parameter	Value
Sensor type	Scientific CMOS (sCMOS)
Color type	Monochrome
Shutter type	Rolling Shutter
Resolution (h x v)	4416 x 2368 active pixel
Pixel size (h x v)	4.6 μm x 4.6 μm
Sensor format/diagonal	20.3 mm x 10.8 mm / 23.0 mm
MTF	108.6 lp/mm (theoretical)
Fullwell capacity	20.000 e^-
Readout noise (typ.) ²	TBD med e^- / 1.3 rms e^-
Dynamic range (typ.)	83.7 dB
Quantum efficiency	85 % @ 500 nm
Spectral range	400 nm to 1100 nm
Dark current (typ.)	0.4 $\text{e}^-/\text{pixel/s}$ @ +10 °C ambient temperature
DSNU	< 0.37 e^- rms
PRNU	< 0.72 %

¹ Based on image sensor data sheet.

² The readout noise values are given as median (med) and root mean square (rms) values, due to the different noise models, which can be used for evaluation. All values are raw data without any filtering.

Camera system

Parameter	Value
Maximum frame rate @ full resolution	122 fps
Exposure/shutter time	6.8 μs - 1 s
Dynamic range A/D	16 bit
A/D conversion factor	0.275 e^-/DN
Pixel data rate	1467 MPixel/s
Binning horizontal	x2, x4
Binning vertical	x2, x4
Region of interest (ROI)	Horizontal: steps of 1 column, Vertical: steps of 8 rows
Non linearity	< 0.33 %
Cooling method	forced air & water
Trigger input signals	Frame trigger, sequence trigger, programmable input
Trigger output signals	Exposure, busy, programmable output (SMA connectors)

Continued on next page

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Parameter	Value
Input / output signal interface	SMA connectors
Time stamp	In image (1 μ s resolution)
Data interface	Camera Link HS FOL

General

Parameter	Value
Power supply	24 VDC ($\pm$ 10 %)
Power consumption	Typ. < 40 W over power connector
Weight	1.35 kg
Operating temperature	+10 °C to +40 °C
Operating humidity range	10 % to 80 % (non-condensing)
Storage temperature range	-10 °C to +60 °C
CE/FCC certified	Yes

Frame rate table

Resolution	pco.edge 10 bi LT
4416 x 2368	122 fps
4416 x 2048	141 fps
4416 x 1024	281 fps
4416 x 512	557 fps
4416 x 256	1098 fps
4416 x 128	2132 fps
4416 x 64	4028 fps
4416 x 32	7252 fps
4416 x 16	12,086 fps
4416 x 8	18,130 fps

Typical resolutions

Resolution	pco.edge 10 bi LT
2304 x 2304	125 fps
2048 x 2048	141 fps
1920 x 1080	266 fps
1280 x 1024	281 fps
640 x 512	557 fps
512 x 256	1098 fps

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A Aquamatic III

The water cooling system pco.aquamatic III is the cooling option for all PCO cameras. This will be introduced to the user in the following chapter.

A.1 Safety

Hazard warnings

H302 – Harmful if swallowed.

H373 – May cause damage to organs through prolonged or repeated exposure.

Safety instructions

P101 – If medical advice is needed, have product container or label at hand.

P102 – Keep out of reach of children.

P103 – Read label before use.

P260 – Do not breathe dust/fume/gas/mist/vapours/spray.

P264 – Wash thoroughly after handling.

P270 – Do not eat, drink or smoke when using this product.

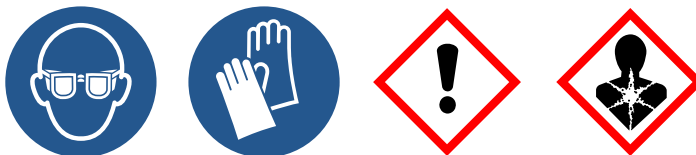
P301 + P312 + P330 – IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell. Rinse mouth.

P501 – Dispose of contents/container to hazardous waste collection point.

Protective gloves: The glove Material must be impermeable and resistant to the product/ the substance/ the preparation/ the chemical mixture. Selection of the glove material can be given for the product/ the preparation/ the chemical mixture. Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation.

Material of gloves: The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material cannot be calculated in advance and has therefore to be checked prior to the application.

Penetration time of glove material: The exact break through time must be found out by the manufacturer of the protective gloves and has to be observed. When handling with chemical substances, protective gloves must be worn with the CE-label including four control digits. The quality of the protective gloves resistant to chemicals must be chosen as a function of the specific working place concentration and quantity of hazardous substances. For special purposes, it is recommended to check the resistance to chemicals of the protective gloves mentioned above together with the supplier of these gloves.



All these notes refer to the coolant Glysantin 50 %. Please also read the information the manufacturer provides in his documents.

This cooling system is a scientific measuring equipment and is designed for use by technicians, engineers, and scientists. The cooler 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 and alterations of the device are forbidden for safety reasons.



DAMAGED POWER CABLE OR POWER PLUG: Danger to life due to electric shock. Each time the cooler is used, check the power cable for damage.



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 cooler.



MOISTURE: Risk of injury due to electric shock if moisture enters the cooler. To avoid the risk of water condensation, protect the cooler against extreme changes of ambient temperature.



TRIPPING HAZARD: Risk of injury from tripping over loose cables. Never position the cable in a way that it could become a tripping hazard.



HUMIDITY, DUST OR RADIATION: Humidity, dust or X-rays could damage the cooler. Never operate the cooler in humid or dusty environments or in places with high levels of X-ray radiation.



SHOCK AND VIBRATION: To avoid damaging the cooler, it must be firmly mounted and protected against strong shocks or vibrations. Use the cooler's mounting threads to secure it.



LIQUIDS DAMAGE COOLER: If liquids have penetrated the device: Switch the cooler off immediately, detach it from power and contact PCO's customer support.



DAMAGED COOLER HOUSING: If the cooler has been dropped or the cooler's housing is damaged: Switch the cooler off immediately, detach it from power and contact PCO's customer support.

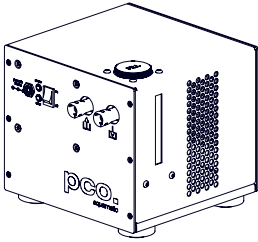
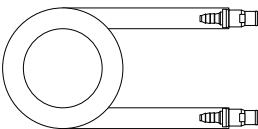
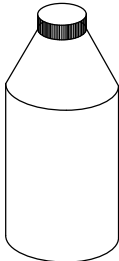


TIGHTLY SEALED GOGGLES: Wear eye/face protection.

A.2 System components



The following standard components are included in your scope of delivery:

Article	Picture	Details
pco.aquamatic III (order number: 30108000245)		chapter A.5
water hose (2x 5 m) with NS212 male connection (order number: 30108000212)		chapter A.8
power supply unit 12 VDC/ 2 A		chapter A.5
1 L Protect Glysantin 50 % (order number: 10305000192)		chapter A.1

Please read the instructions given in this document carefully. It contains useful information and advice to operate the cooling system in the intended way. The pco.aquamatic III must be operated with the cooling fluid Protect Glysantin 50 %.

If there are any questions regarding the pco.aquamatic III, please feel free to contact PCO or the local representative.

A.3 Overview

The following chapter provides an overview of the pco.aquamatic III.

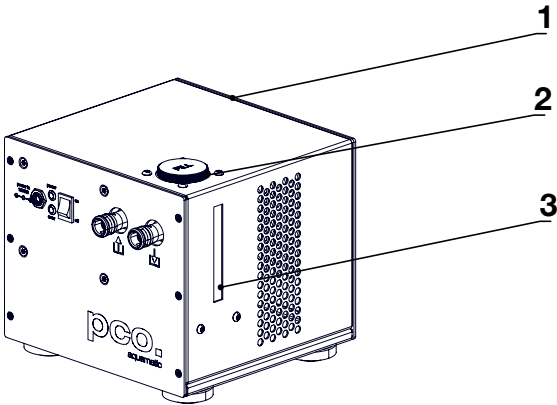


Figure A.1: pco.aquamatic III overview.

Interfaces	
1	pco.aquamatic III
2	fillport
3	water-level window

A.4 Cooler interfaces

The cooling unit is equipped with various connections and signaling interfaces, as shown below.

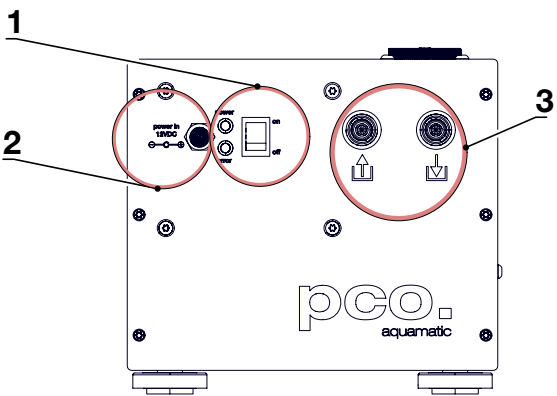


Figure A.2: pco.aquamatic III front panel interfaces.

Interfaces	
1	ON/OFF switch and status LEDs
2	power input

Continued on next page

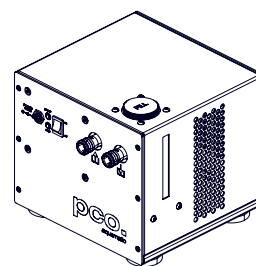
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Interfaces	
3	water in- and outlet (2x G-1/8" thread)

A.5 Specifications

The pco.aquamatic III is described by the following data:

Description	Value
L x W x H	214 mm x 203 mm x 186.6 mm
Material	Steel
Color	Black
Max. delivery height	2.2 m
Max. flow rate	max. 32 l/h
Voltage	12 VDC
Max. power consumption	20 W



A.6 Flow chart

The arrows on the housing of the cooling unit indicate flow direction.

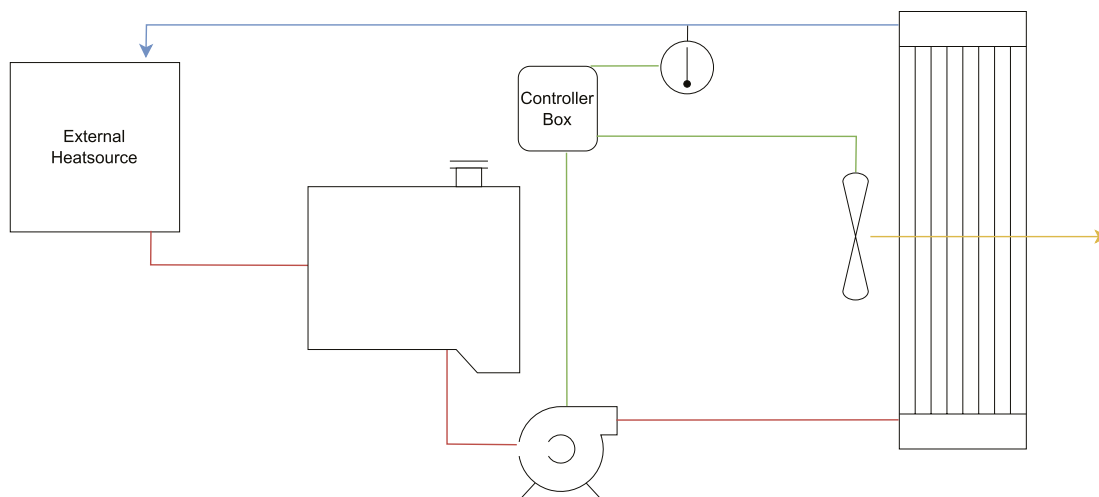


Figure A.3: pco.aquamatic III flow chart.

A.7 Setting up the cooling unit

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 III for maximum cooling performance. All tubes and

power cords need to run kink-free. The cooling container should have a clearance of 5 cm/ 2 inches when in use. Full performance cannot be guaranteed if this is not observed.

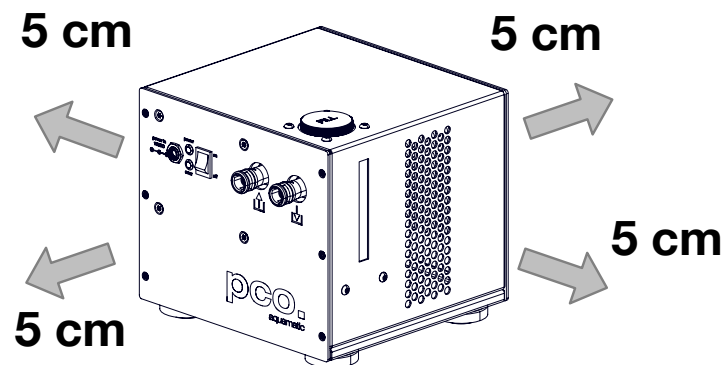


Figure A.4: pco.aquamatic III distances.

In case of problems with the coolant or if there is any need of help in operating or handling the coolant or the unit, contact PCO or local distributor.

A.8 First time installation

In the following chapter the use of the pco.aquamatic III and the procedure will be explained. Normally no maintenance and almost no care is required. The coolant's level of the reservoir (water tank) should be checked before commissioning or every ten operating hours.

Only use Protect Glysantin 50 % for the pco.aquamatic III. Do not use or add any other coolant or normal water.

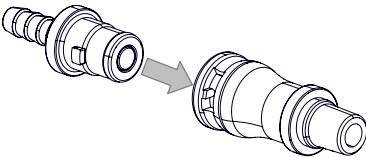
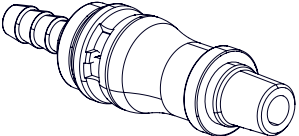
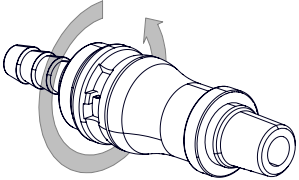
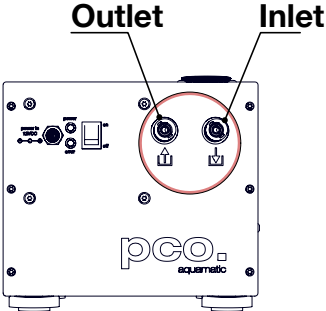
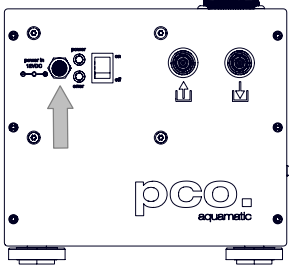


NOTE

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

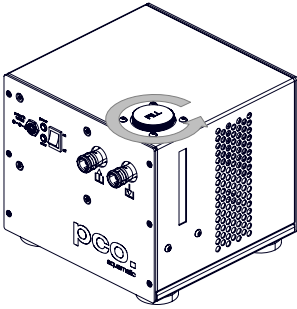
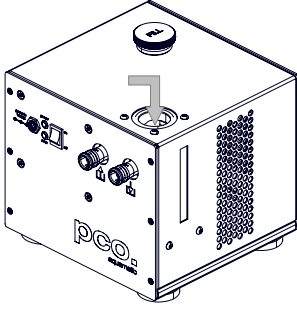
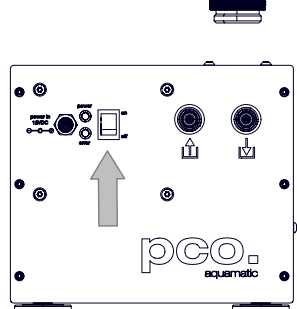
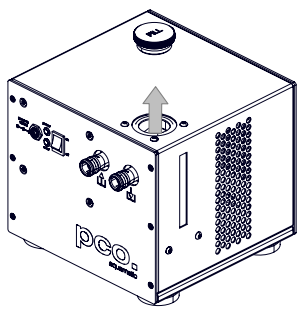
Complete the following steps for a successful first-time installation.

Follow steps 1-7

Article	Picture	Details
Step 1		Connect tubes to cooling unit and camera by inserting the connector into the intended counterpart.
Step 2		NOTE: Subsequently turn both connections into each other.
Step 3		NOTE: Turn both connectors until they are interlocked together. Make sure that none of the hoses are kinked.
Step 4		The pco.aquamatic III has two different connections: One of them is the input for the water connection, the other one is the output . As shown, both are clearly marked and must be used as such. Regarding the camera, there is no prescribed flow direction concerning the water.
Step 5		Connect to power.

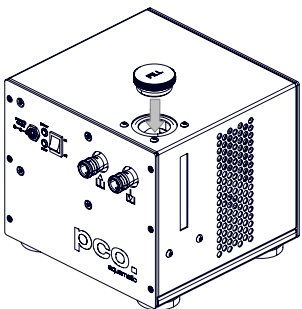
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Article	Picture	Details
Step 6		Open tank cover.
Step 7		Slowly fill in the coolant.
Step 8		Turn power switch on (I). Refill the cooling reservoir as needed to keep the level.
Step 9		While the cooling liquid flows back to the tank make sure there remains no air in the system - this may take a few minutes (move hoses if necessary).

Continued on next page

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Article	Picture	Details
Step 10		Close the tank cover. The pco.aquamatic III is now ready to use.

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 bump chamber is completely filled. To ensure this, move hoses or remove air by evacuating. The usable tank volume amounts 200 ml.

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.

A.9 Mechanical dimensions

Following illustrations show the mechanical outlines of the pco.aquamatic III.

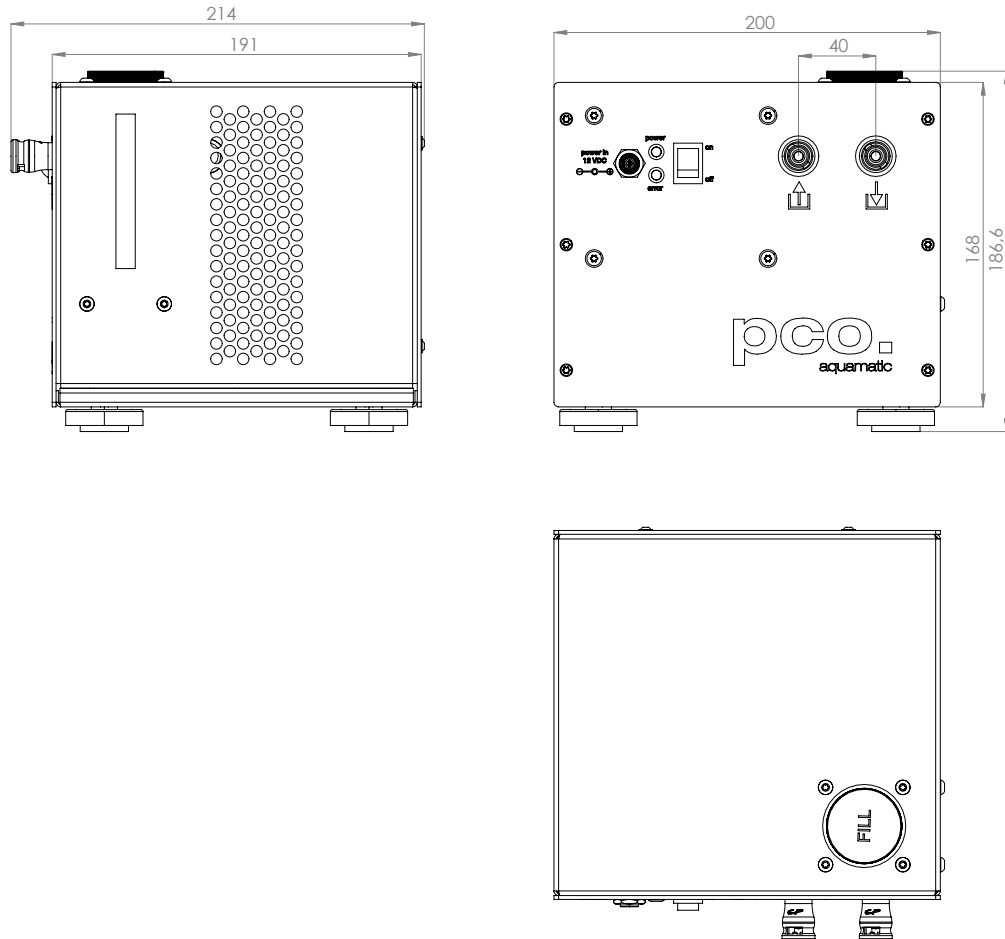


Figure A.5: outlines of pco.aquamatic III (all dimensions given in mm).

A.10 Operational and storage data

The following table shows the usage data to prevent any errors:

Description	Value
Max. system temperature	60 °C
Input	12 VDC/ 2.0 A
Operating temperature	+5 °C to +40 °C
Storage temperature	-10 °C to +60 °C
Storage conditions	Dust-free and clean (Empty the cooler for storage)

A.11 Errors

The pco.aquamatic III can display various errors. These are listed in the following table:

Error	Sound	LED
Fan does not rotate	Fast beeping (two times per second)	Error LED flashes every second
Error LED flashes every second	Alternate beeping: high/low (once per second a high and a low tone)	Error LED flashes every second
Temperature too high (48 °C)	Slow beeping (one time per second)	Error LED lights up continuously
Temperature sensor has an error or is not plugged in	Slow beeping (one time per second)	Error LED and power LED flash alternately (once per second)

If several errors occur in parallel, the signal priorities are as follows:

Pump error: Priority 1

Fan error: Priority 2

Temperature error: Priority 3

B Kaya frame grabber

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

B.1 Introduction

KAYA KOMODO (II) FRAME GRABBER INSTALLATION

This manual describes the installation of the **Kaya Komodo CLHS Frame Grabber** and **Kaya Komodo II CLHS Frame Grabber** for PCO cameras with CLHS FOL interface. For further description of the Kaya Frame Grabbers and Software see also the Kaya manuals. During PCO Software installation, CLHS FOL must be selected to access PCO cameras via Kaya Frame Grabbers.

Availability

- pco.edge 4.2/5.5 with CLHS FOL interface
- pco.edge 10 bi LT with CLHS FOL interface
- pco.dicam C1
- dicam C4 (4x Camera Link HS interface)

Support

- In case of errors please contact us at PCO:
- support@pco.de
- tel +49 9441 2005 0

System requirements

- Please consider the following system requirements:
- PCIe slot x8 or x16
- Recommended: Gen 3 and 8 lanes (see chapter 4)
- Windows 10 (64 bit)

B.2 Safety instructions

CLASS 1 LASER PRODUCT

Risk of injury due to laser beam.

- Do not look into the laser beam or at direct reflexes.
- Do not point the laser beam at persons.
- Manipulations of the laser device are not allowed.



ELECTRIC SHOCK WARNING DUE TO VOLTAGE PARTS INSIDE

Risk of injury due to electric shock.



- Always pull the main plug before opening the computer.

B.3 Frame grabber installation

Instructions for installing and testing the **Kaya Komodo (II) CLHS Frame Grabber** card. This card is required to be able to use a PCO camera with CLHS FOL interface. 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 electric shock.



- Always pull the main plug before opening the computer.

Install the latest Kaya Komodo package (Download approved version from our website). Only 64-bit computer systems are supported.

Follow these steps:

Step 1: Shutdown your computer, open the computer case and install the frame grabber card.

Step 2: Start the Installation Executable: KAYA_Vision_Point_Setup_(version)_Windows_64.exe
You can start a silent installation by calling the installation exe with command line parameters:

KAYA_Vision_Point_Setup_2021.1_SP_1_Windows_64.exe /SILENT /NORESTART /COMPONENTS="*,lvirtual_com_port"

Step 3: Select the proper folder on your computer.

Step 4: Deselect **Virtual COM port for serial communication**.

Step 5: The frame grabber card should be displayed within the device manager. If the device is not shown this way, reinstall the driver.

Step 6: Check the system requirements (chapter [B.4](#)).

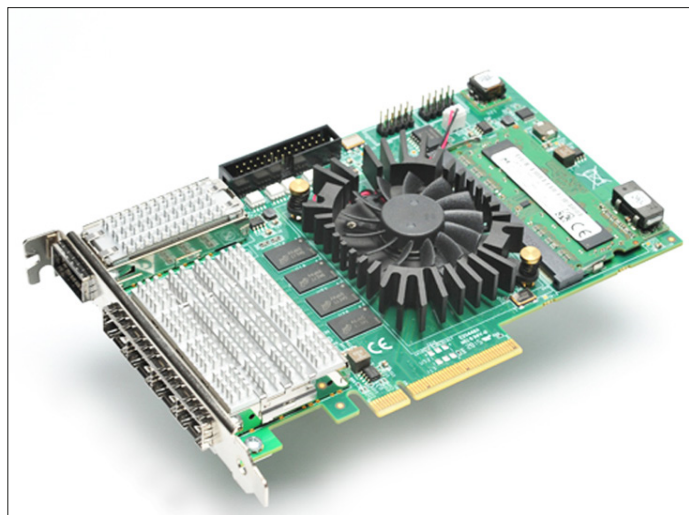


Figure B.1: Illustration of the Kaya frame grabber.

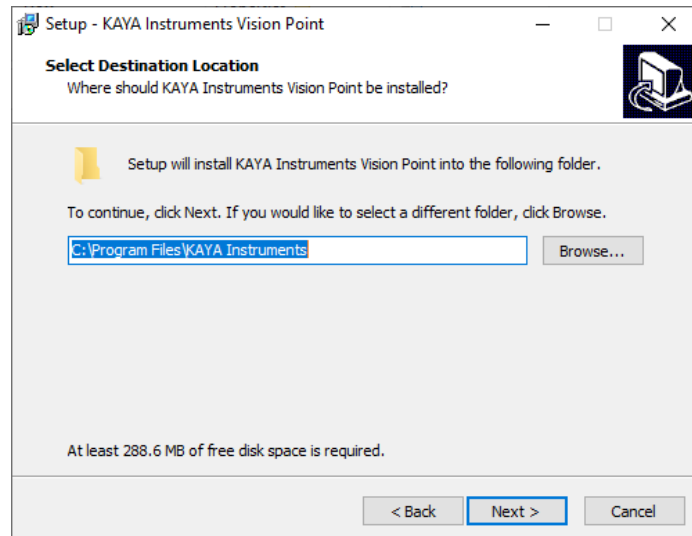


Figure B.2: Step 1 of the installation.

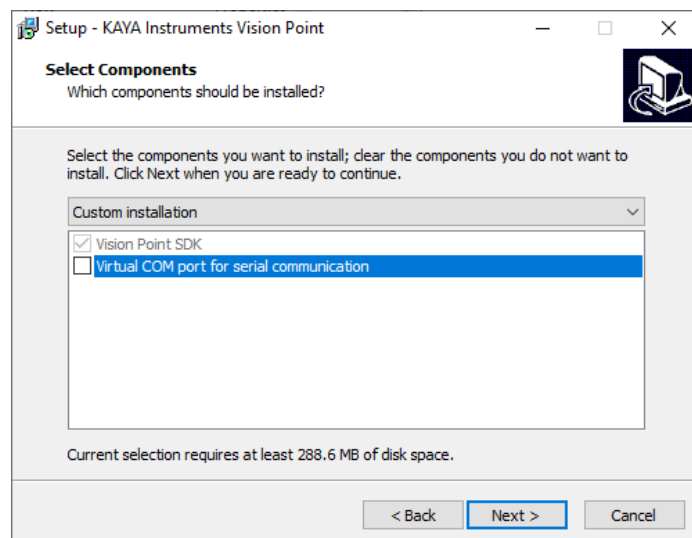


Figure B.3: Step 2 of the installation.

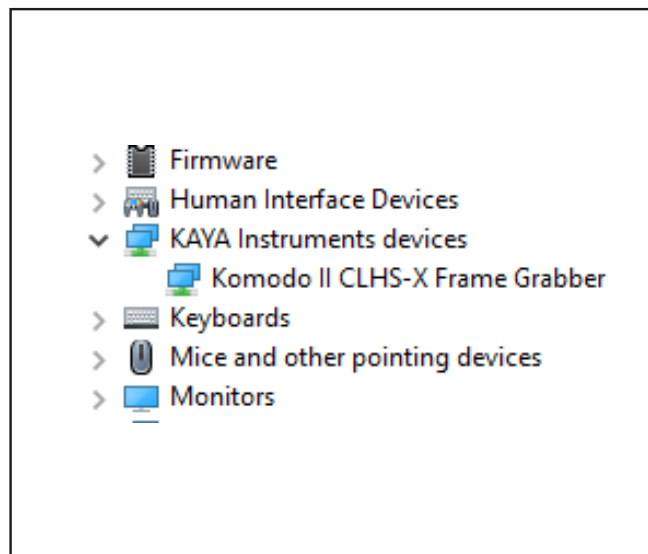
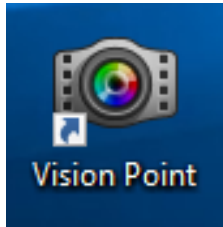


Figure B.4: Step 3 of the installation.

B.4 Vision point software

Start the **Vision Point** application.



After the installation is finished, open the Vision Point software and check the hardware information. First click **Create new project**.

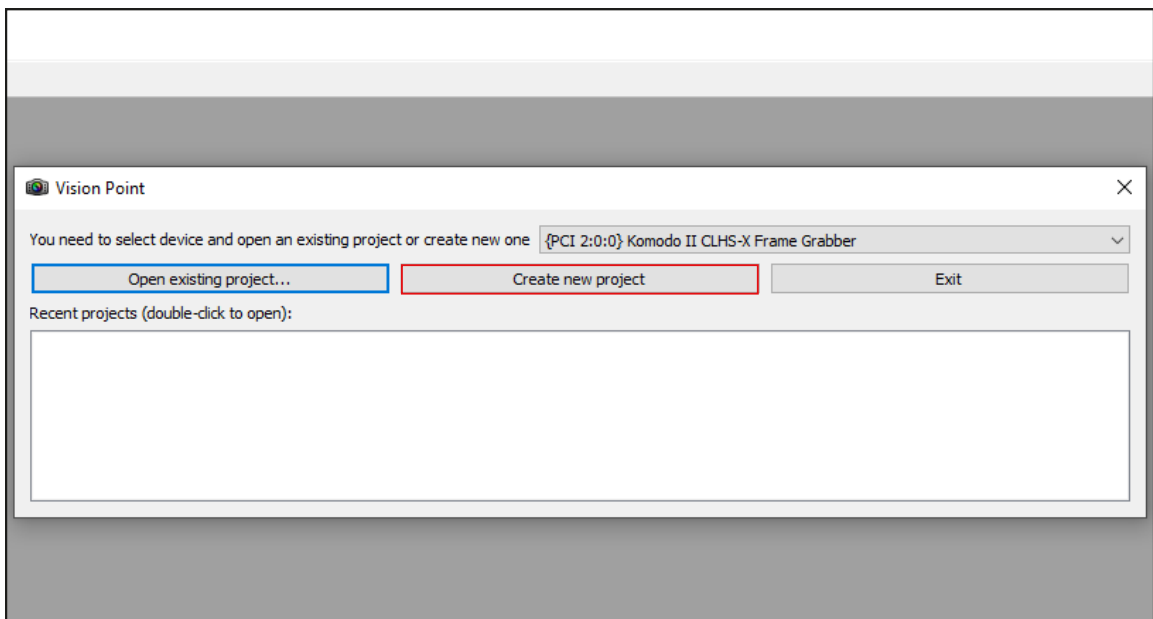


Figure B.5: Create a new project.

Take a look at the **Project** tab.

Click **Frame Grabber - Hardware Information**.

Check the following values:

- Firmware version:
- Komodo II : 4.3.1 or higher
- Kommodo: 4.21.0 or higher
- PCIe generation: 3 (see **PCI Express Generation 2/3**)
- PCIe lanes: 8

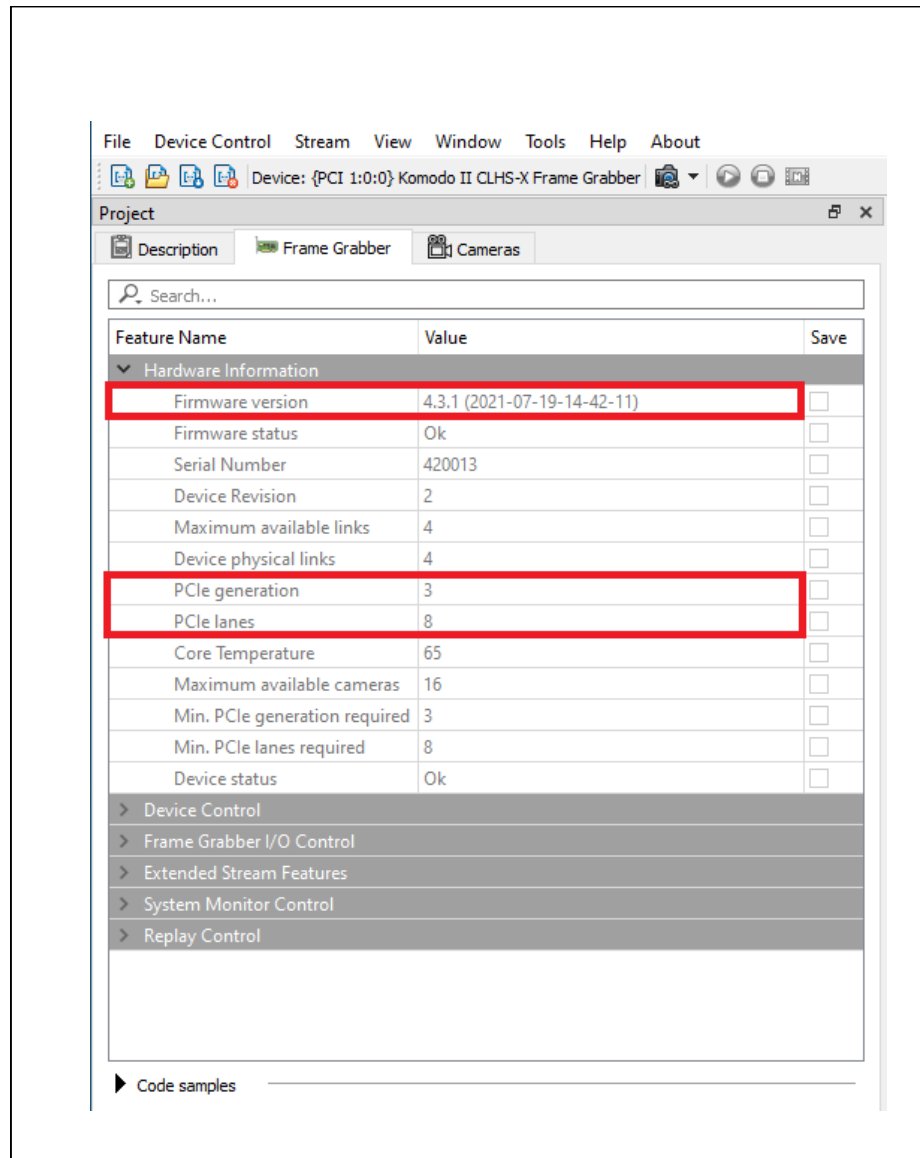


Figure B.6: Edit a project.

For proper operation, the Frame Grabber firmware must be updated to the versions listed above, see chapter **B.5**.

PCI Express Generation 2/3:

If the Frame Grabber is installed in a PCIe slot with only Gen2 capability and/or with only 4 PCIe lanes, memory bandwidth for image transfers is limited and images might be lost. Vision Point software will inform you if your system has limitations:

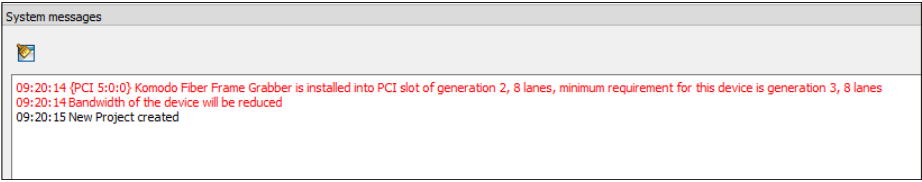


Figure B.7: Vision Point - Error.

B.5 Update firmware of the grabber

How to update the firmware of a the Kaya Komodo (II) CLHS Frame Grabber card.

Step 1: Select **Device Control - Firmware update...**

Step 2: Select proper firmware update file.

Step 3: Click **Next** and wait until the update process is finished. **Do not unplug and/or switch off your computer during the update.**

Step 4: Power down your computer. A restart is not sufficient.

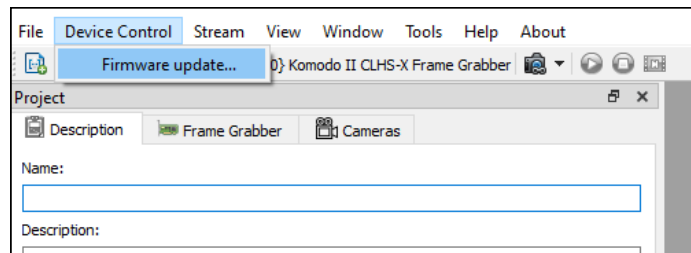


Figure B.8: Step 1 Firmware update.

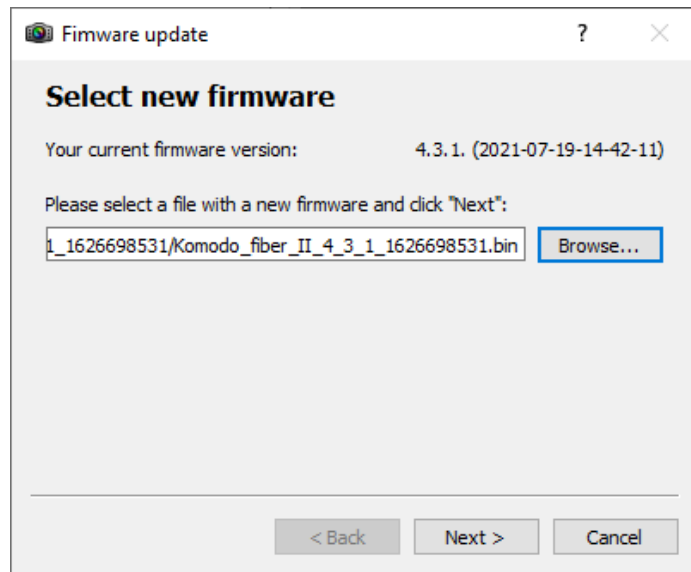


Figure B.9: Step 2 Firmware update.

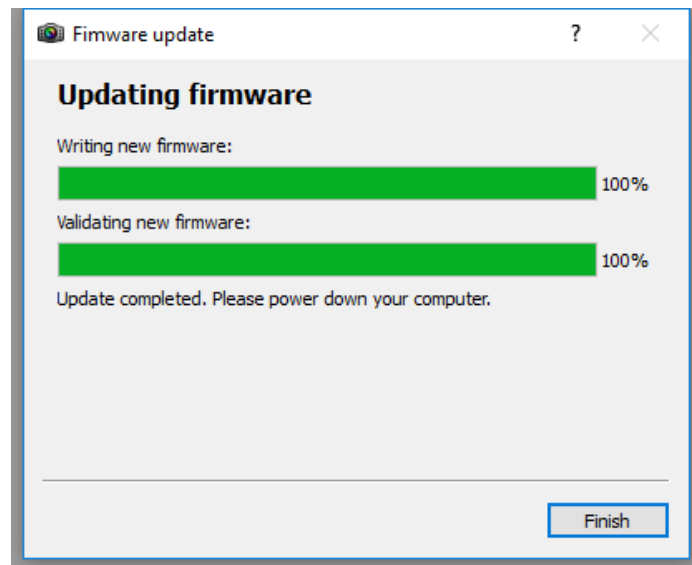


Figure B.10: Step 3 Firmware update.

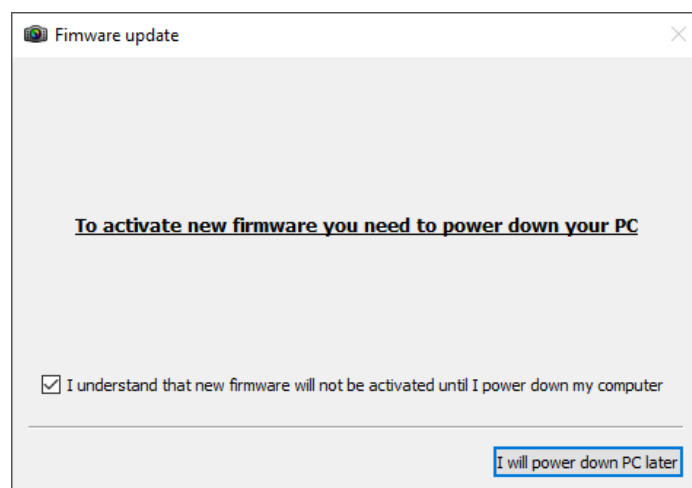


Figure B.11: Step 4 Firmware update.

C Troubleshooting

If any questions or problems should arise, feel free to use the following options:

- Contact us via email: support@pco.de
- Fill out the [support ticket](#) on our website (Click [here](#) for the chinese version)
- Read the pco.troubleshooting manual for help with PCO software product

D Warranty

Excelitas PCO GmbH warrants the original purchaser for a period of two (2) full years, calculated from the date of purchase, that the equipment sold is free from defects in material and workmanship. In the event of a claim under this guarantee, the equipment is to be sent, including a description of the fault, to Excelitas PCO GmbH. Returned equipment will not be accepted without a ticket number, issued by the support team, support@pco.de.

Follow shipping instructions provided by the service technician. The unit should be returned in its original packaging if possible. In the case of damage caused by wear and tear, careless handling, neglect, by the use of force or in the case of interventions and repairs not carried out by Excelitas PCO GmbH, the guarantee ceases to be valid. This guarantee may not form the basis for any claims for damages, in particular not for compensation of consequential damages. The warranty is not transferable.

E Recycling



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

The camera and all its accessories include electronic devices, which contain materials harmful to the environment. These electronic devices must be recycled.

F About Excelitas PCO

PCO, an Excelitas Technologies® Corp. brand, is a leading specialist and Pioneer in Cameras and Optoelectronics with more than 30 years of expert knowledge and experience of developing and manufacturing high-end imaging systems. The company's cutting edge sCMOS and high-speed cameras are used in scientific and industrial research, automotive testing, quality control, metrology and a large variety of other applications all over the world.

The PCO® advanced imaging concept was conceived in the early 1980s by imaging pioneer, Dr. Emil Ott, who was conducting research at the Technical University of Munich for the Chair of Technical Electrophysics. His work there led to the establishment of PCO AG in 1987 with the introduction of the first image-intensified camera followed by the development of its proprietary Advanced Core technologies which greatly surpassed the imaging performance standards of the day.

Today, PCO continues to innovate, offering a wide range of high-performance camera technologies covering scientific, high-speed, intensified and FLIM imaging applications across the scientific research, industrial and automotive sectors.

Acquired by Excelitas Technologies in 2021, PCO represents a world renowned brand of high-performance scientific CMOS, sCMOS, CCD and high-speed cameras that complement Excelitas' expansive range of illumination, optical and sensor technologies and extend the bounds of our end-to-end photonic solutions capabilities.



An Excelitas Technologies Brand

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