

user manual

pco.pixelfly™ 1.3 SWIR

versatile VIS - SWIR 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.



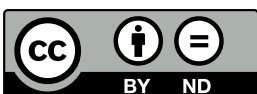
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pco.pixelfly™ 1.3 SWIR user manual 1.0.0

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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.

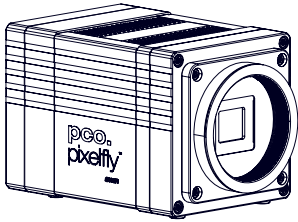
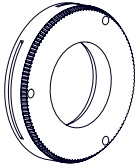



DAMAGED CAMERA HOUSING: If the camera has been dropped or the camera's housing is damaged: Switch the camera off immediately, detach it from power and contact PCO's customer support.

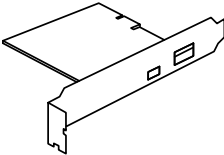
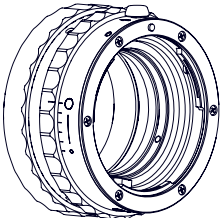

2 System components



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

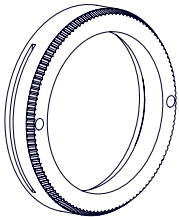
Article	Picture	Details
pco.pixelfly™ 1.3 SWIR		chapter 2.1
C-mount adapter		chapter 2.3.1
Cables (USB C-C)		chapter 2.5

There is a range of optional camera accessories available for the pco.pixelfly™ 1.3 SWIR series:

Article	Picture	Details
USB interface card		chapter 2.2
F-mount adapter		chapter 2.3.2
Interface cables (SMA - BNC)		chapter 2.5

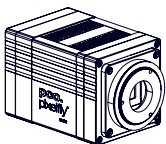
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Article	Picture	Details
TFL-mount adapter		chapter 2.3.3

Please note that all pco.software products can be downloaded for free from the PCO website. For more information see [chapter 7](#).

2.1 Camera pco.pixelfly™ 1.3 SWIR



Thanks for choosing a pco.pixelfly™ 1.3 SWIR camera. The pco.pixelfly™ 1.3 SWIR is a high performance machine vision camera due to its special InGaAs image sensor which is sensitive in the shortwave infrared, near infrared and visible range of the electromagnetic spectrum. It shows a favorably high sensitivity in the whole spectral range with up to 90 % in the shortwave infrared part. The small pixels enable the use of small magnification optics in microscopy and a low dark current for even longer exposure times.

Main Features

- VIS & SWIR sensitivity (350 nm to 1700 nm)
- Small pixel size (5 µm x 5 µm)
- Long exposure times (due to low dark current)
- Excellent peak QE (of 90 %)
- (Easy to use) USB 3.1 Gen 1 data interface
- TEC controlled sensor temperature
- Global Shutter (camera)
- InGaAs sensor technology
- Resolution 1280 x 1024 pixel
- Max. frame rate 72 fps @ 1.3 Mpixel
- Genicam supported



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, please feel free to contact PCO or the local representative.

Areas of application	
Brightfield microscopy	Inspection
Fluorescence microscopy	Material selection

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Areas of application	
Structured illumination microscopy (SIM)	Material sorting
Wafer inspection	Biometrics
High-Speed bright field ratio imaging	Industrial quality inspection
Intravital microscopy	Waste sorting
In-vivo microscopy	Thermography
Industrial packaging	Semiconductor inspection
Food processing quality control	

2.2 USB interface



CAUTION: Please make sure that your PC provides enough power to operate the camera. If not, it can not be guaranteed that the camera works as intended.

2.3 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.

2.3.1 C-mount adapter

The C-mount adapter is screwed in the front of the camera and fixed with two 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).

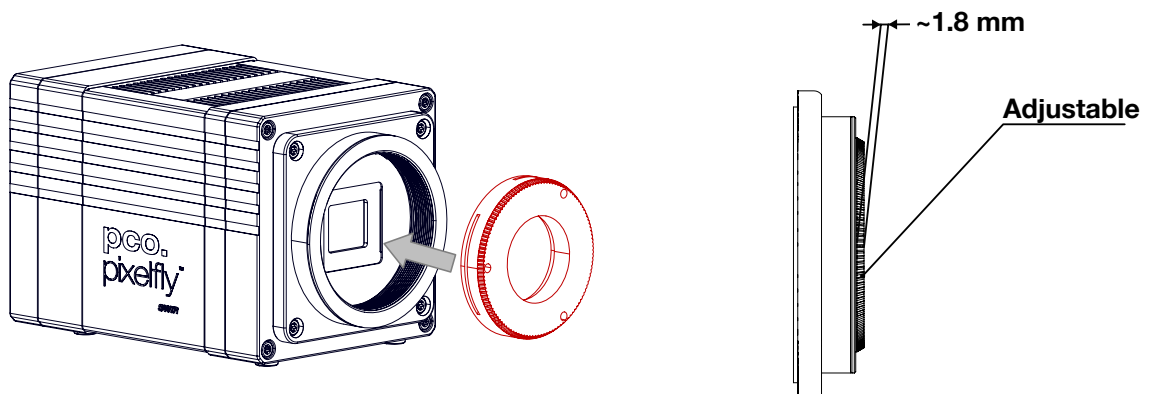


Figure 2.1: C-Mount installation.

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.pixelfly™ 1.3 SWIR has a sensor diagonal of 8.2 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.

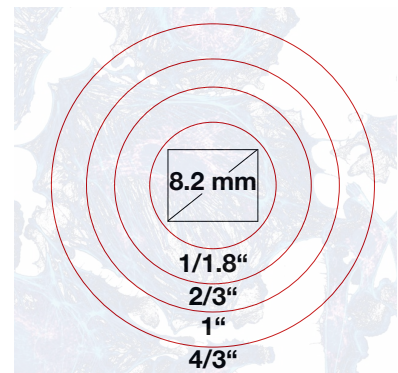


Figure 2.2: sensor size vs. image circles of various C-mount lenses.

2.3.2 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 2.3.1** is applicable.

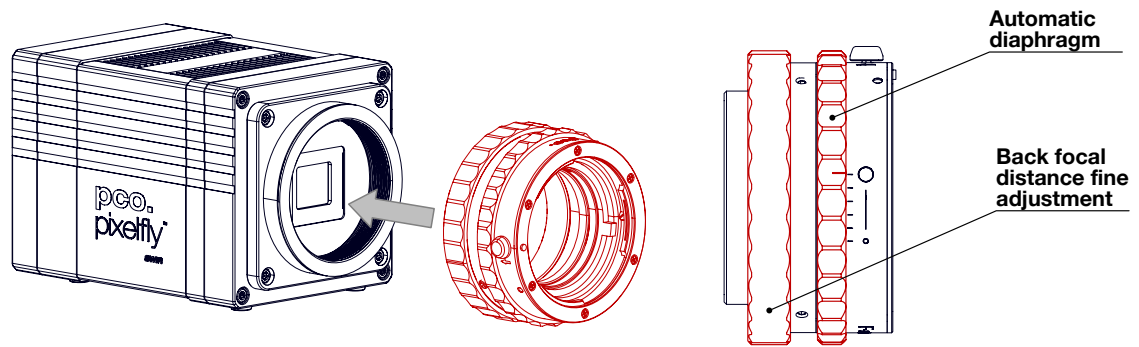


Figure 2.3: F-mount description.

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

2.3.3 TFL-mount adapter



The optional TFL-mount adapter is screwed in the front of the camera and fixed with two 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.

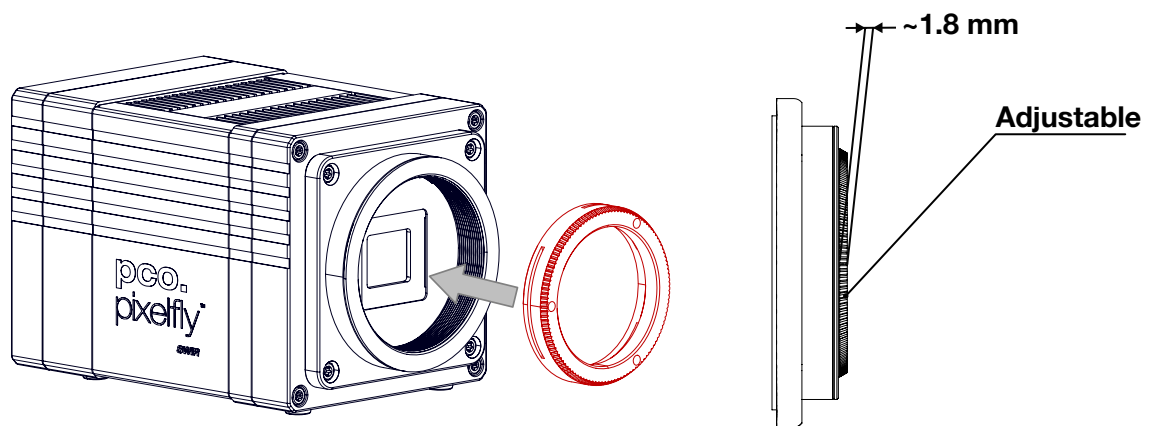


Figure 2.4: TFL-mount installation.

The fine adjustment is done in the same way as described in [chapter 2.3.1](#).

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](#).

2.5 Cables

The pco.pixelfly™ 1.3 SWIR is delivered with a USB interface cable for power supply and data transfer.

Article	Length	Description	Scope of delivery
USB cable	2 m	USB 3.1 type C-C, DELOCK 83668	Included
Interface cable	0.3 m	Coaxial cable type SMA-BNC	Available on request

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.

3 Camera overview

The following chapter provides an overview of the pco.pixelfly™ 1.3 SWIR.

3.1 Camera interfaces

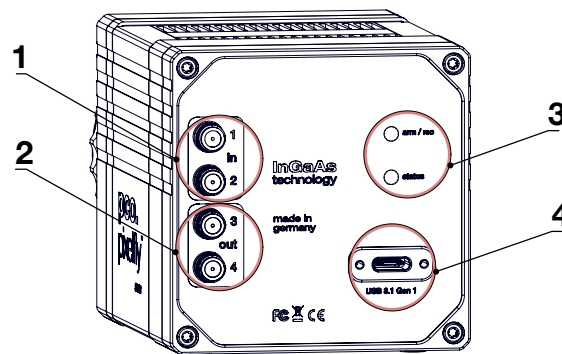


Figure 3.1: pco.pixelfly™ 1.3 SWIR rear panel interfaces.

Interfaces	
1	trigger and status via SMA connectors (input)
2	trigger and status via SMA connectors (output)
3	status LEDs
4	power and data interface via USB 3.1 Gen 1

Hardware setup

Connect the camera to the PC with the included USB-C cable.

- The USB cable manages both: the data transfer from the camera to the PC and the power supply for the camera.
- If the PC does not have a USB-C port: use the included USB interface card/frame grabber (see [chapter 2.2](#)).

Connect the SMA plugs with coaxial cables for status or trigger functionality to the equipment (see [chapter 3.4](#)).













3.2 Data and power interface

The pco.pixelfly™ 1.3 SWIR is available with the following interfaces:

Camera	Interface	Interface connector
pco.pixelfly™ 1.3 SWIR	USB 3.1 Gen 1	USB-C socket

3.3 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

3.4 Trigger and status interfaces

The pco.pixelfly™ 1.3 SWIR 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 one signal output (exposure).

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.

		Parameter	Option
SMA 1	input	exposure trigger	auto sequence, soft trigger, external exposure start, external exposure control, low latency trigger
			off
		signal polarity	rising (default)
SMA 2	input	acquire enable	external, sequence, auto
			off
		signal polarity	low (default)
SMA 3	output	signal trigger	on
		signal polarity	high (default)
SMA 4	output	status exposure	on
		signal polarity	high (default)

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 **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 Echo; 4 = 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 Global shutter

Image acquisition and readout with the pco.pixelfly™ 1.3 SWIR is based on global shutter mode. That means, each pixel in the sensor begins and ends the exposure simultaneously. After the exposure phase and a small defined time slot, the readout phase of the pixels starts directly. During the readout phase, the next exposure phase can be started.

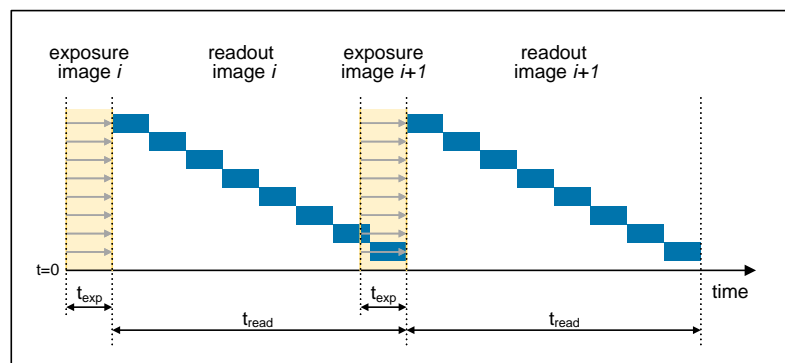


Figure 4.1: global shutter explanation.

The overall readout time of the sensor is determined by the line time, i.e. the time needed to readout one line. Depending on the number of lines to be readout (ROI settings), the total time of the readout phase can be calculated:

$$t_{readout} = N_{lines} \cdot t_{line}$$

With a line time of 13.5 μ s and 1024 lines, the total readout time results to 14 ms.

Timing

The exposure and delay time (programmable time between acknowledge of a trigger input and start of exposure) can be set in steps of one line time.

Camera	Exposure time	Delay time	Step size
pco.pixelfly™ 1.3 SWIR	20 μ s to 720 s	0 μ s to 1 s	13.5 μ s

4.2 Trigger modes

The pco.pixelfly™ 1.3 SWIR 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 3.4](#)).



NOTE: Input and output signals polarity can not be changed.

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.

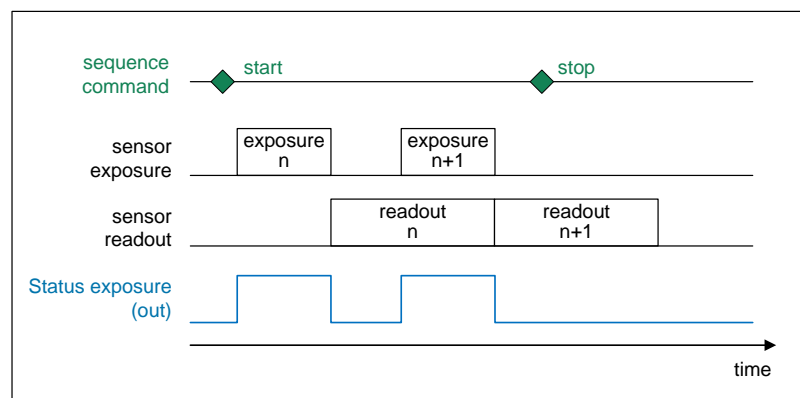


Figure 4.2: auto sequence explanation.

trigger
soft

Soft(ware) trigger mode

Within this trigger mode, recording of single images can be triggered by software with corresponding commands. In all other modes the soft(ware) trigger will be ignored.

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.

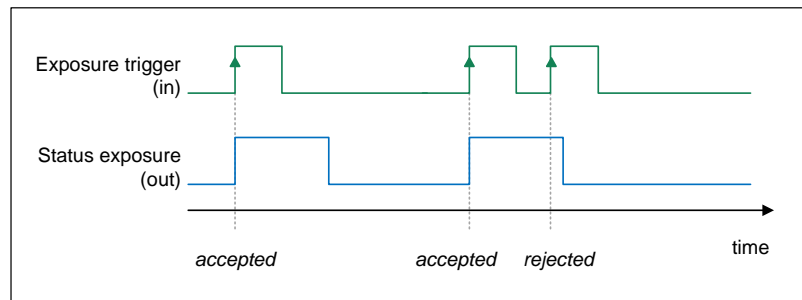


Figure 4.3: external exposure start explanation.

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.

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.

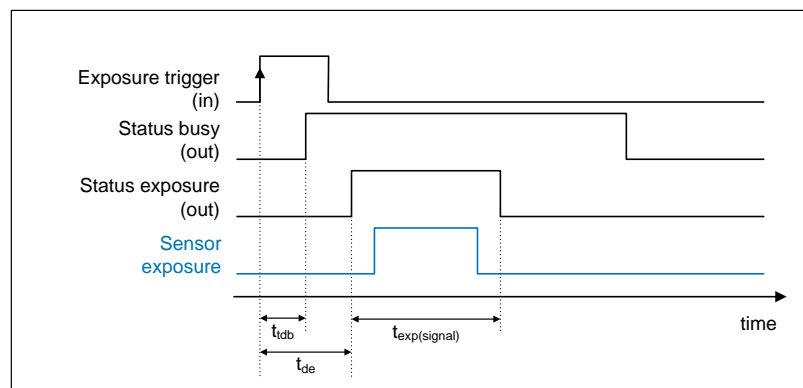


Figure 4.4: exposure trigger.

Delay time		Value
Delay exposure time	t_{de}	692 ns ± 24 ns
Delay trigger to sensor exposure	t_{des}	1100 ns ± 100 ns

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.

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

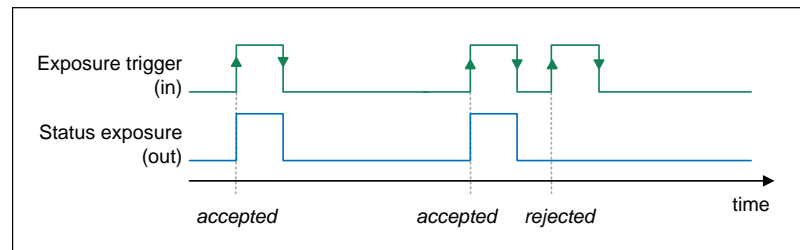


Figure 4.5: external exposure control explanation.

The status exposure output indicates the time of the active exposure phase. A trigger signal during active state of the signal *status busy* will be rejected.

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.

4.3 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.

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 signals turns high.

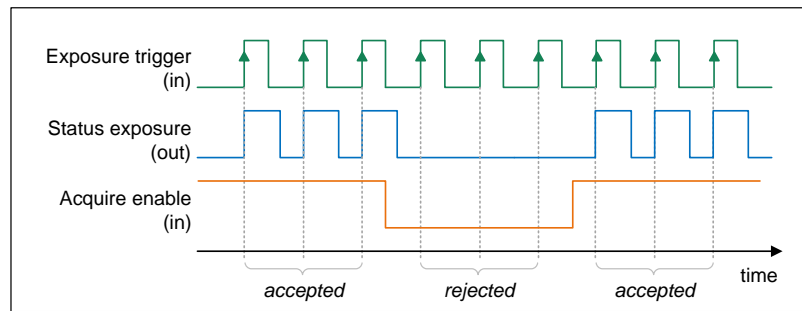


Figure 4.6: acquire mode explanation.

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	USB 3.1 Gen 1

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 PCO USB driver (**chapter 2.2**).

STEP 2

Connect the camera to the PC via the USB 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.pixelfly™ 1.3 SWIR.

6.1 Mechanical outlines

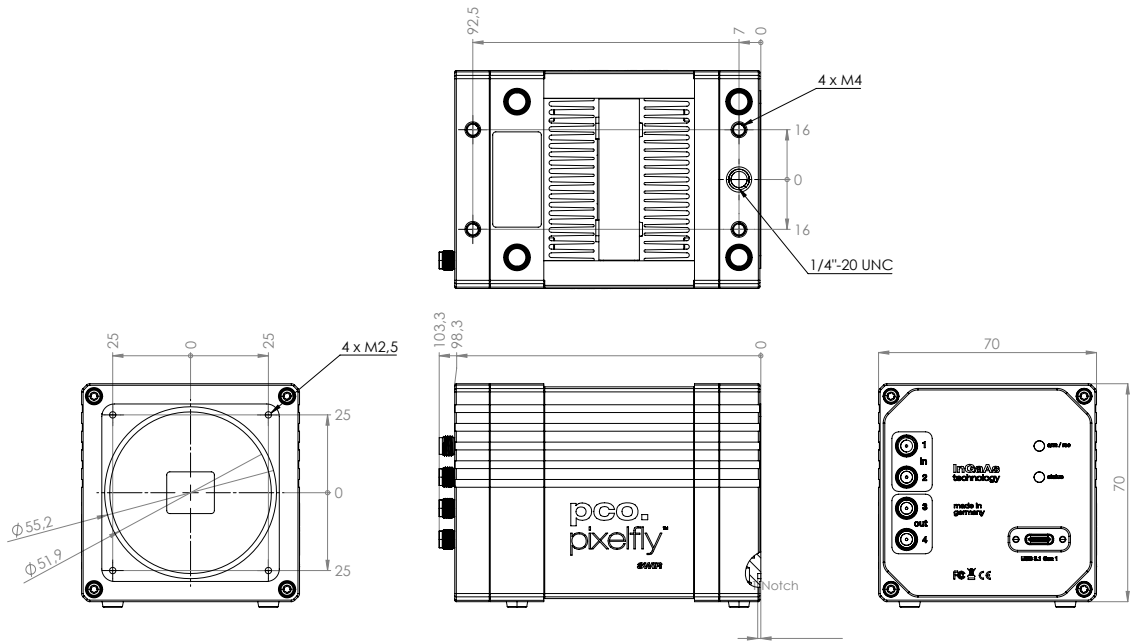


Figure 6.1: outlines pco.pixelfly™ 1.3 SWIR (all dimensions given in mm).

Detailed drawings, step files and 3D PDFs are available on the PCO Homepage or on request.

6.2 Mounting

The pco.pixelfly™ 1.3 SWIR 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 threads at the bottom of the housing.

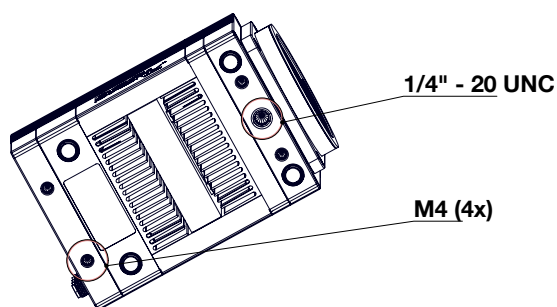


Figure 6.2: bottom view of the camera (threads marked in red).

Front mounting

The camera can be directly mounted via its front for shortest distance between the cameras' focal plane and object. Therefore, the lens adapter needs to be removed. A circular groove within the front serves as light trap. For direct mounting, it is essential to use a rubber ring between camera and mounting surface to block any parasitic light.

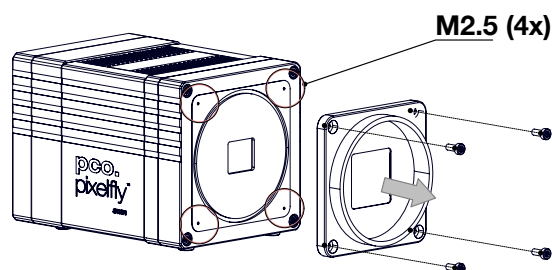


Figure 6.3: front view of the camera without lens adapter (threads marked in red).



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; for M2.5: 0.5 Nm



NOTE For direct mounting via the front of the camera, it is essential to use a rubber ring to block any parasitic light.

7 Software

The main camera control software **pco.camware** is the first choice get started with the camera. It enables full control of all camera settings and makes image acquisition and storage very easy. Using different layouts, stiles 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
	color: Nvidia GPU essential

7.2 USB 3.0/3.1 driver installation

PCO USB 3 driver Installation

Follow these steps to install the **PCO USB 3 driver** under Windows 10.

- Download the latest USB driver for Windows 10 from the PCO Homepage (Software section).
- Follow the instructions of the Installer.
- PCO GeniCam driver V1.4.0.
- pco.pixelfly SWIR.exe tool: Download correction data.

7.3 Download correction data

The pco.pixelfly™ 1.3 SWIR provides correction data, which can be downloaded and transferred to an offline PC. This will be explained in the following chapter.

This message will be shown, if there is no correction-reference data found. The message can be suppressed by choosing 'cancel'.

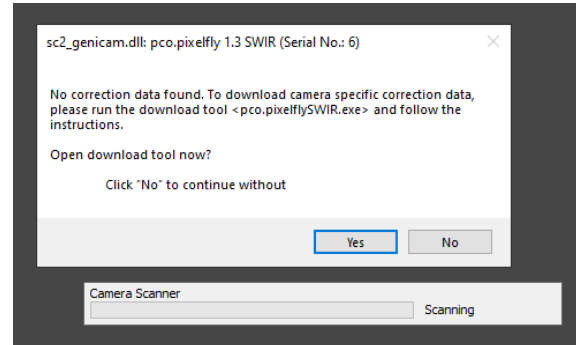


Figure 7.1: start correction data.

The 'scan' button will lead to the next illustration. After clicking the button, the calib is searching for a pco.pixelfly™ 1.3 SWIR camera.

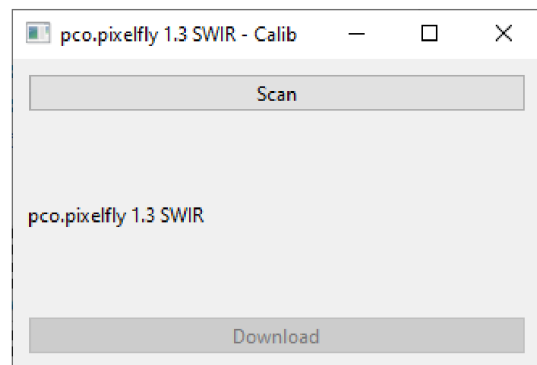


Figure 7.2: start scan.

The pco.pixelfly™ 1.3 SWIR - Calib shows this window during the scan, while searching for a pco.pixelfly™ 1.3 SWIR camera.

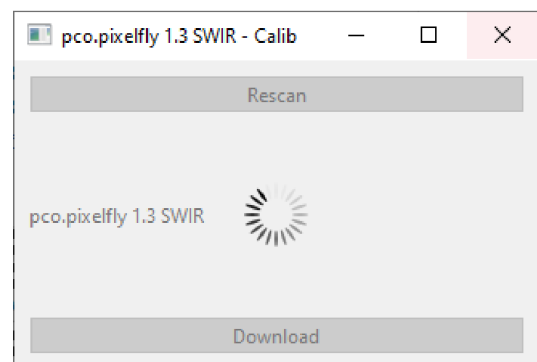


Figure 7.3: searching for pco.pixelfly™ 1.3 SWIR.

To find connected cameras, push the button 'Rescan'. After finding the camera(s), click the button 'Download for connected camera'.

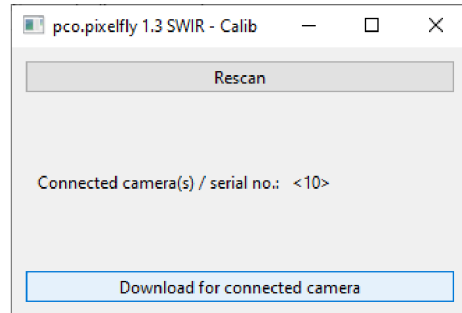


Figure 7.4: download for connected camera.

The message on the right side is shown, when no pco.pixelfly™ 1.3 SWIR can be found. There are two options: Fill in a 'serial number' or do a 'rescan'.

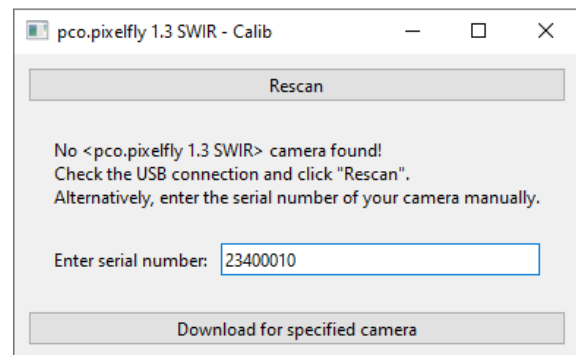


Figure 7.5: no camera found.

If the correction data should be copied to an offline PC, click the button 'transfer information'.

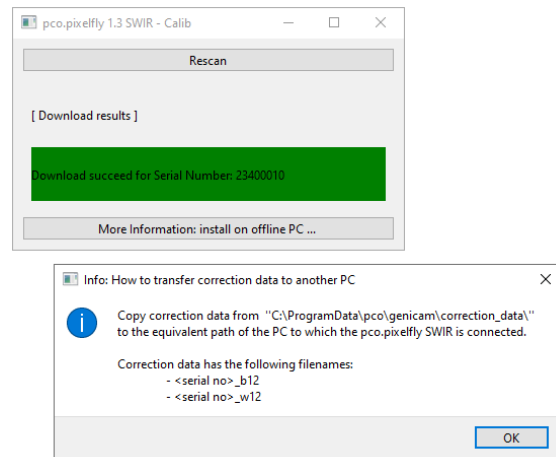


Figure 7.6: transfer of the correction data.

8 Specifications

The following technical details describe the camera and its features:

Image sensor

Parameter	Value
Sensor type	InGaAs technology, monochrome
Shutter type	Global shutter
Resolution (h x v)	1280 x 1024 active pixel
Pixel size (h x v)	5 μm x 5 μm
Sensor format/diagonal	6.4 mm x 5.1 mm / 8.2 mm
MTF	100 lp/mm (theoretical)
Fullwell capacity	155.700 e ⁻
Readout noise (typ.) ¹	220 med e ⁻ / 210 rms e ⁻
Dynamic range (typ.)	57 dB
Quantum efficiency	90 % @ 1200 nm
Spectral range	350 nm to 1700 nm
Dark current (typ.)	2000 e ⁻ /pixel/s @ 20 °C ambient temperature
DSNU	< 147 e ⁻ rms
PRNU	< 0.9 %
Anti blooming factor ²	> 10,000
Parasitic light sensitivity	1/10,000

¹ 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.

² Based on image sensor data sheet.

Camera system

Parameter	Value
Maximum frame rate @ full resolution	72.2 fps
Exposure/shutter time	20 μs - 720 s
Dynamic range A/D	12 bit
A/D conversion factor	41 e ⁻ /DN
Pixel data rate	93 MPixel/s
Binning horizontal	x1
Binning vertical	x1
Region of interest (ROI)	Horizontal: steps of 8 columns (min. 64), Vertical: steps of 4 rows (min. 16)
Non linearity	< 0.5 %
Cooling method	Peltier with forced air, dewpoint regulated
Trigger input signals	Frame trigger, sequence trigger, programmable input

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Parameter	Value
Trigger output signals	Exposure, busy, programmable output
Input/output signal interface	SMA connectors
Time stamp	In image (1 ms resolution)
Data interface	USB 3.1 Gen 1

General

Parameter	Value
Power delivery	Power over USB 3.1 Gen 1
Power consumption	Typ. 7.0 W (max. 15.0 W)
Weight	680 g
Operating temperature	+10 °C to +40 °C
Operating humidity range	10 % to 80 % (non-condensing)
Storage temperature range	-10 °C to +60 °C
Optical interface	C-mount (optional: F-mount, TFL-mount)
CE/FCC certified	Yes

Frame rate table

Resolution	pco.pixelfly™ 1.3 SWIR
1280 x 1024	72 fps
1280 x 512	TBD
1280 x 256	TBD
1280 x 128	TBD
1280 x 16	TBD
1280 x 1024	TBD
1024 x 768	TBD
800 x 600	TBD
640 x 480	TBD
320 x 240	TBD

9 Troubleshooting

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

- Contact us via email: pco@excelitas.com
- 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

10 Warranty

PCO Excelitas 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 PCO Excelitas GmbH. Returned equipment will not be accepted without a ticket number, issued by the support team, pco@excelitas.com.

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.

11 Recycling



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

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

12 About Excelitas PCO

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

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

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

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

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