

datasheet

# pc<sub>o</sub>.panda 4.2 USB

ultra-compact sCMOS camera

line scanning mode

resolution  
**4.2 MPixel**

pixel size  
**6.5  $\mu\text{m}$  x 6.5  $\mu\text{m}$**

interface  
**USB 3.1 Gen 1**



65 mm

ultra-compact  
design

available in  
monochrome and color

resolution  
2048 x 2048 pixels

quantum efficiency  
up to 80 %

single-cable solution  
data & power supply via USB 3.1

## technical data

### image sensor

<b>sensor technology</b>	scientific CMOS (sCMOS)
<b>color type</b>	monochrome color (bayer pattern)
<b>resolution (horizontal x vertical)</b>	2048 px x 2048 px
<b>pixel size (horizontal x vertical)</b>	6.5 $\mu\text{m}$ x 6.5 $\mu\text{m}$
<b>sensor size (horizontal x vertical)</b>	13.3 mm x 13.3 mm
<b>sensor diagonal</b>	18.8 mm
<b>shutter mode</b>	rolling shutter additional feature: <b>line scanning mode</b>
<b>modulation transfer function (theoretical max.)</b>	76.9 lp/mm
<b>peak quantum efficiency</b>	80 % @ 600 nm (monochrome)
<b>spectral range</b>	370 nm - 1100 nm (monochrome)
<b>dark current (typ.)</b>	8.0 e <sup>-</sup> /pixel/s @ +32 °C sensor temperature
<b>fullwell capacity</b>	45 000 e <sup>-</sup>
<b>readout noise (typ.)<sup>1</sup></b>	2.3 e <sup>-</sup> rms 2.1 e <sup>-</sup> med
<b>dynamic range (intra-scene)<sup>2</sup></b>	21 500 : 1 (87 dB)

<sup>1</sup> 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.

<sup>2</sup> The dynamic range value is calculated with the median value of the readout noise and rounded.

### frame rate table

#### vertical resolution reduction

<b>2048 x 2048</b>	40 fps
<b>2048 x 1024</b>	80 fps
<b>2048 x 512</b>	161 fps
<b>2048 x 256</b>	303 fps
<b>2048 x 128</b>	528 fps

#### typical resolutions

<b>1920 x 1080</b>	76 fps
<b>1600 x 1200</b>	69 fps
<b>1280 x 1024</b>	80 fps
<b>640 x 480</b>	171 fps
<b>320 x 240</b>	321 fps

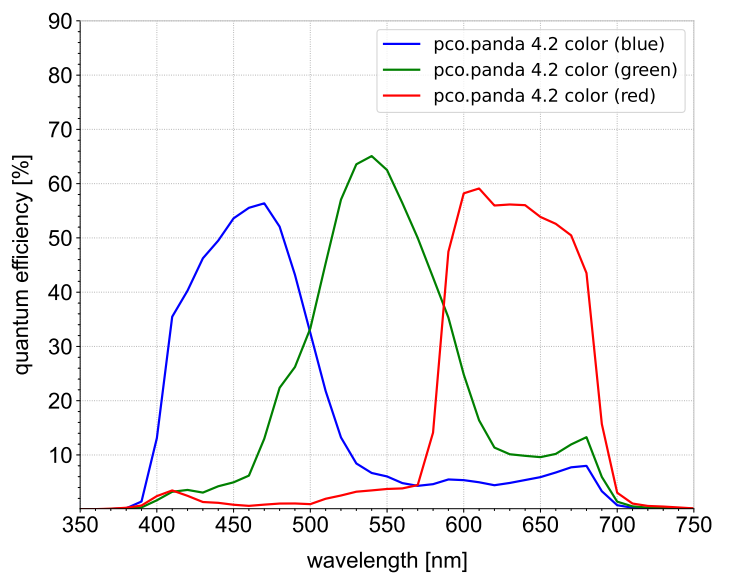
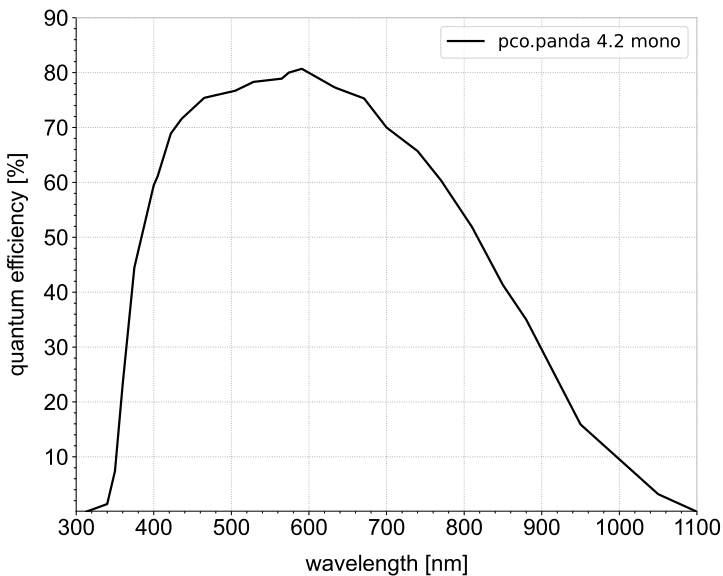
**camera**

<b>max. frame rate @ full resolution</b>	40 fps
<b>exposure time range</b>	21 $\mu$ s - 5 s
<b>dynamic range A/D<sup>1</sup></b>	16 bit
<b>conversion factor<sup>2</sup></b>	0.65 e-/DN
<b>pixel rate</b>	176 MPixel/s
<b>region of interest (ROI)</b>	horizontal: steps of 8 columns (min. 32) vertical: steps of 1 rows (min. 8)
<b>binning</b>	horizontal: x2, x4 (sum) vertical: x2, x4 (sum)
<b>non-linearity</b>	< 0.6 %
<b>dark signal non-uniformity (DSNU)</b>	< 0.5 e- rms
<b>photo response non-uniformity (PRNU)</b>	< 0.6 %
<b>cooling method</b>	passive cooling
<b>trigger input signals</b>	external exposure start, external exposure control, acquire enable
<b>status output signals</b>	exposure, busy, line
<b>input / output signal connectors</b>	SMA
<b>time stamp</b>	in image (1 $\mu$ s resolution)
<b>data interface</b>	USB 3.1 Gen 1

<sup>1</sup> The high dynamic signal is simultaneously converted at high and low gain by two 12 bit A/D converters and the two 12 bit values are sophisticatedly merged into one 16 bit value.

<sup>2</sup> According to EMVA1288, the conversion factor equals the inverse of the system gain and can be operational mode dependent.

**quantum efficiency**



### general

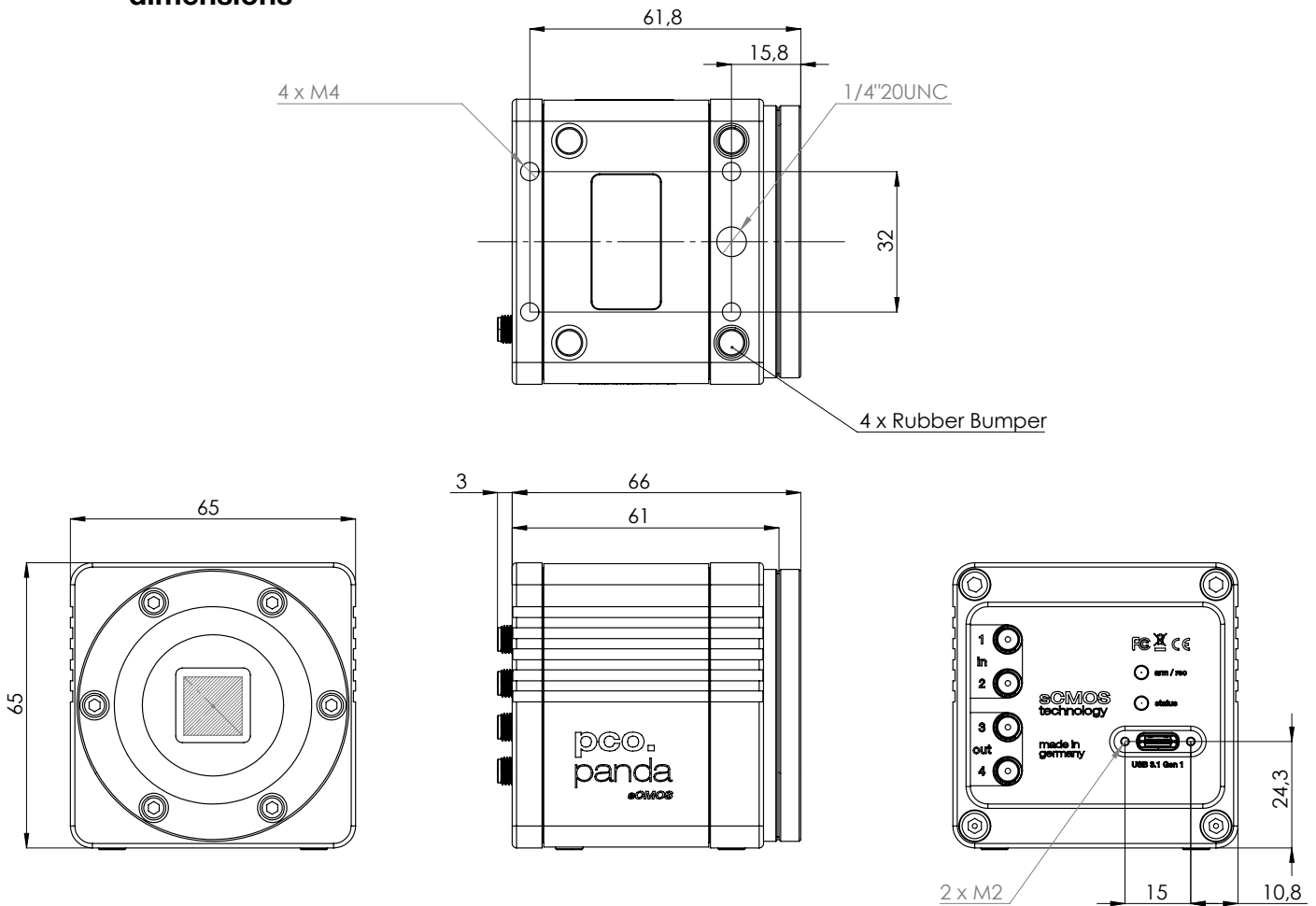
power supply	power over USB 3.1 Gen 1
power consumption	max. 6 W
weight	0.42 kg
dimensions (height x width x length)	65 mm x 65 mm x 66 mm
operating temperature range	+10 °C to +40 °C
storage temperature range	-10 °C to +60 °C
humidity range (non-condensing)	10 % to 80 % (recommended < 65 %)
certifications	CE, FCC, UKCA

### optical interface

direct mounting distance	10.5 mm (±10 %)
lens mounting	C-mount
optional lens mounting	F-mount, TFL-mount

Configure your optical setup with our **MachVis Lens Selector** online tool.

### dimensions



outlines of pco.panda 4.2 USB (all dimensions given in mm)

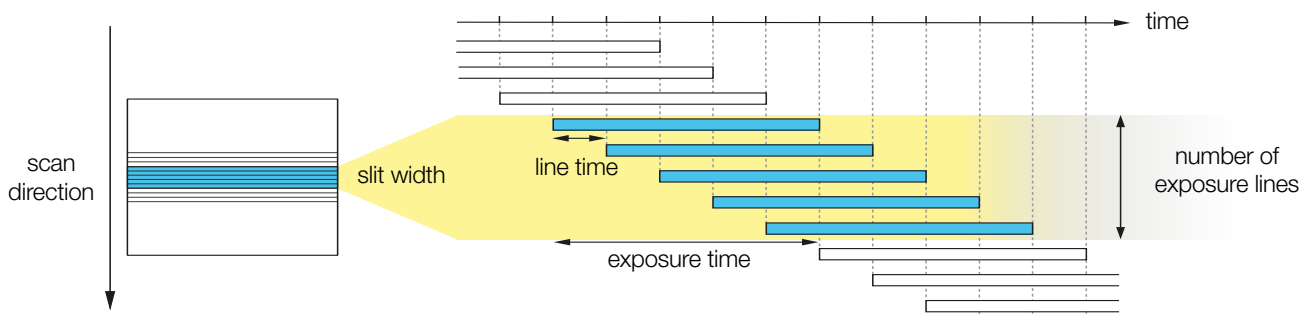
## line scanning mode

The line scanning mode is a special readout mode dedicated to lightsheet fluorescence microscopy (LSFM). Built on the rolling shutter mode, this feature enables optimized synchronization of the camera and the microscope system.

Unlike the standard rolling shutter mode, in which the only adjustable parameter is the exposure time, line scanning mode allows adjustment of two key parameters: the number of exposure lines and the line time, setting the exposure time according to the relation:

$$\text{exposure time} = \text{number of exposure lines} \times \text{line time.}$$

Together, the number of exposure lines and line time control the slit characteristics—with the slit referring to the area of the sensor exposed at any given time. While the number of exposure lines defines the slit width, which corresponds to the height of the moving exposure window, the line time determines the slit speed.



exemplary readout in line scanning mode with a slit width of five exposure lines

By synchronizing the slit with the focused excitation of the lightsheet, the impact of scattered light is minimized. Additionally, the fast scan rates, high sensitivity, low readout noise, and high dynamic range of the line scanning mode enhance the benefits of LSFM.

As LSFM reduces the risk of sample damage and photobleaching while enabling 3D imaging with minimal phototoxicity, it is ideal for live-cell imaging, in vivo studies, and dynamic biological processes.

## software

### Your first choice is pco.camware:

Our main camera control software enables control of most camera settings and facilitates image acquisition and storage.

You can customize it exactly to your needs using different layouts, styles and features.

### You prefer to use a different software:

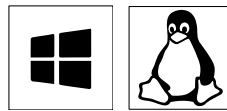
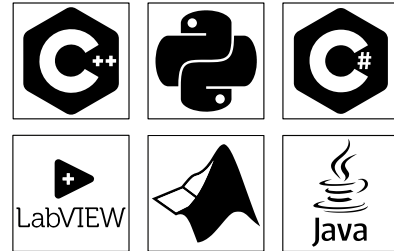
Our cameras integrate with a range of third-party software applications.

In microscopy we offer dedicated support for  $\mu$ Manager, while ensuring compatibility with other software maintained by their providers.

### You want to create your own application:

We feature a wide range of software development kits (SDK) for various programming languages, such as C++, Python, C#, LabVIEW, Matlab, and Java.

If you are looking for more general SDKs, we present pco.sdk and pco.recorder, our low-level SDKs with C interface.



Our software is available for Windows and Linux platforms.

Visit our **website** for detailed information, installation guidance, and Github projects.

## areas of application

biochip reading | brightfield microscopy | calcium imaging | digital pathology | fluorescence microscopy | fluorescence recovery after photobleaching (FRAP) | Förster resonance energy transfer (FRET) | high-content screening | high-speed brightfield ratio imaging | high-throughput screening | industrial quality inspection | lightsheet fluorescence microscopy (LSFM) | ophthalmology | single molecule localization microscopy (SMLM) – PALM, STORM, dSTORM, GSDIM | spinning disk confocal microscopy | structured illumination microscopy (SIM) | total internal reflection fluorescence microscopy (TIRF)

### ordering information

<b>pco.panda 4.2 USB</b>	85108074001	camera system, 2048 x 2048 pixel, monochrome, rolling shutter, USB 3.1 interface
<b>pco.panda 4.2 C USB</b>	85108074005	camera system, 2048 x 2048 pixel, color, rolling shutter, USB 3.1 interface

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