pco.1600 - 1288 data

The following data are typical data for the pco.1600 camera system measured in an EMVA 1288 standard[1] compliant way. All symbols presented refer to the linear camera model, which is described in the Standard[2].

Temporal Noise and Sensitivity

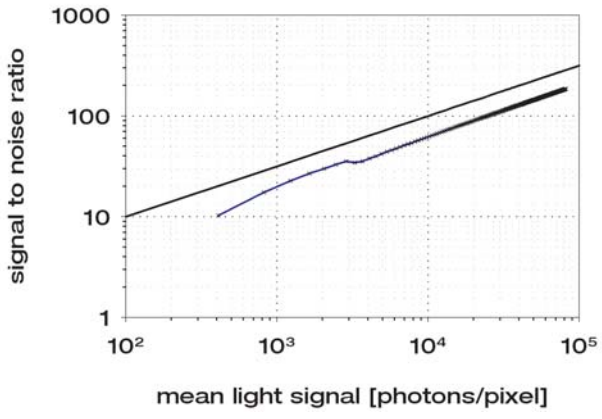
Temporal Noise refers to the noise in the time dimension. Therefore the differences per pixel between consecutive images are addressed. The sensitivity in general shows the characteristic of the camera system to convert light into digital information.

Basic Parameters

	unit	setpoint	pco.1600
total quantum efficiency η_{mean}	%	@ 423nm	43.1
inverse of overall system gain 1/k (conversion factor)	e^-/DN[3]	typical	2.1
saturation capacity $\mu_{e.sat}$	e^-	typical	35 804
standard deviation of temporal dark noise σ_{d0}	e^-	@ 0s exposure time	10
dark current N_{d30}	e^-/s	@ 30°C housing temperature	tbd[4]
doubling temperature k_d	°C		tbd

Derived Parameters

Signal-to-Noise-Ratio (SNR)



Data were measured with monochrome light at 525nm peak wavelength. The solid line gives the theoretical limit defined by the statistical character of light, here the SNR is the number of photons divided by the square root of number of photons, which gives the maximum achievable SNR of light.

[1] The mathematical model and explanation of the EMVA 1288 Standard can be downloaded at: www.emva.org
[2] All measurements were performed at 10MHz pixelclock
[3] The 1288 Standard uses [DN] for digital number instead of [count], which we used in our product sheets before.
[4] To-be-done (tbd) in a later issue of the 1288 data of this camera

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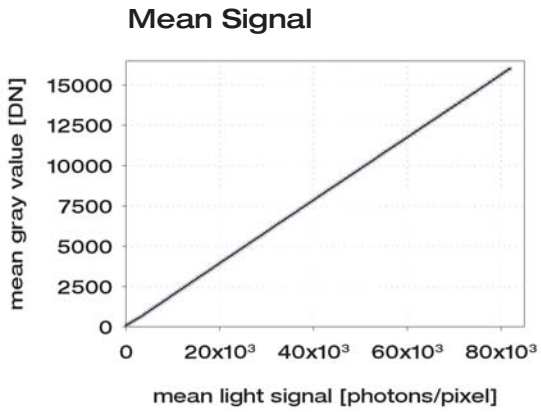
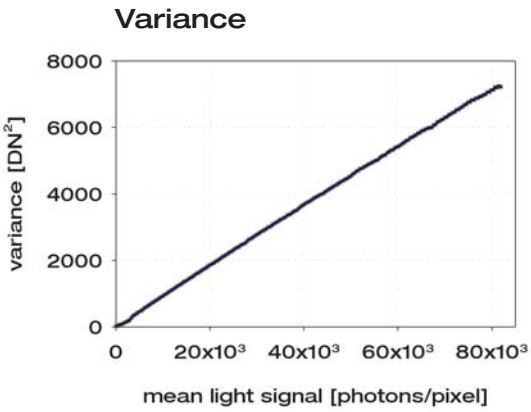
Raw Data



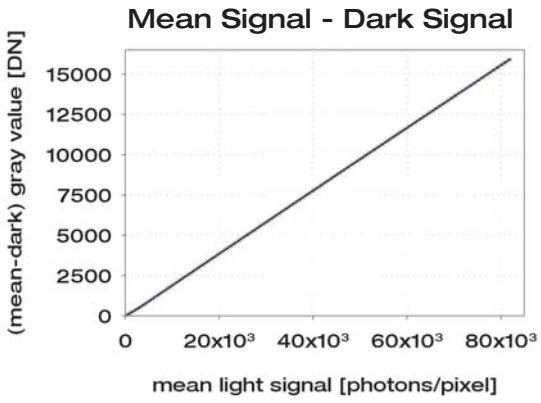


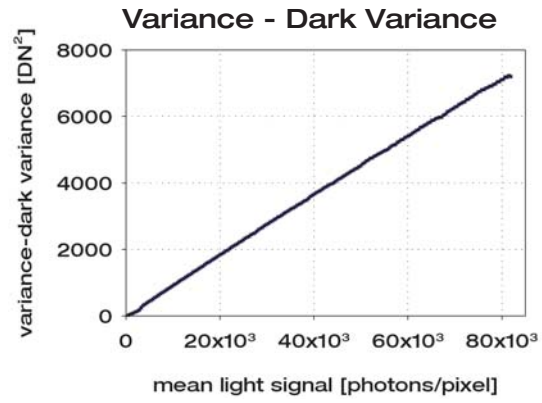
The left graph shows how good (or linear) the digital signal of the camera corresponds to the light input signal. The right graph uses the photon transfer technique to measure the conversion factor or inverse of total system gain of the camera system. If the variance vs. mean gray level is used, the slope of the curve directly yields to the conversion factor.

The two graphs with mean dark signal vs. exposure time and variance dark signal vs. exposure time, which are required by the 1288 standard, have been omitted, because the exposure time has not been changed for the presented measurements, but the light signal itself. Therefore everything was measured with the same exposure time.
The corresponding mean and variance values are:

$\mu_{y.dark}$ = 98.34 [DN]

$s^2_{y.temp.dark}$ = 20.69 [DN²]





Both graphs show the same curves like above, but corrected for the dark signals, which include the dark signal noise and dark current contributions to the total signal.

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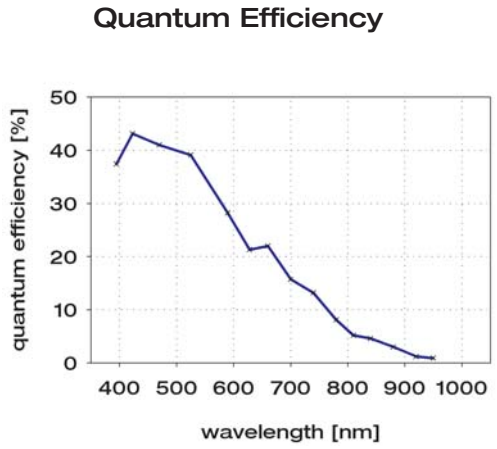

quantum efficiency [%]	wavelength [nm]
37.4	395
43.1	423
41.0	470
39.1	525
28.2	590
21.3	628
22.0	660
15.7	700
13.2	740
8.1	780
5.2	810
4.6	840
3.0	880
1.2	920
0.9	950

The quantum efficiency curve shows the efficiency, with which impinging light is converted into charge carriers in the image sensor. I includes all effects of the camera and the chip (cover glasses, micro lenses, fill factor etc.). As corresponding curves of image sensor manufacturers are measured sensor only, the quantities will be different.

Spatial Noise

The Spatial Noise refers to the noise in the spatial dimension. Therefore the differences at homogeneous or no illumination within one image but without the temporal noise are addressed.

Basic Parameters

	unit	setpoint	pco.1600
standard deviation of spatial offset noise σ_0	e^-		tbd
standard deviation of spatial gain noise S_g	%		tbd

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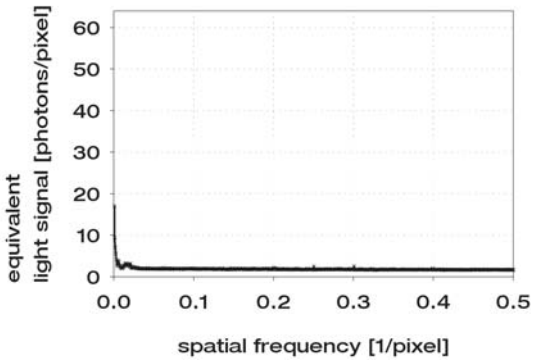
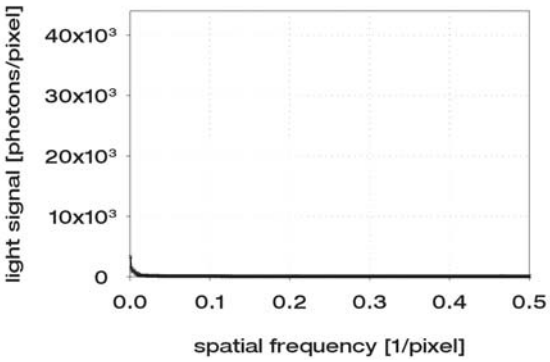
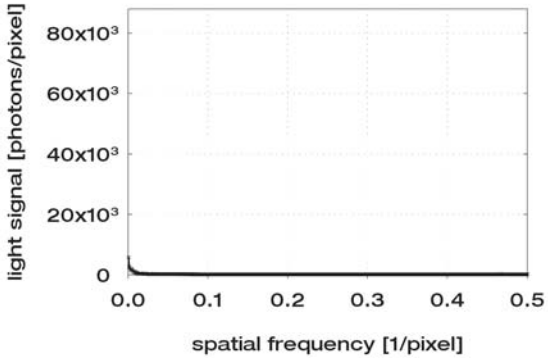
Spectrogram - no light



Spectrogram - 50% light signal



Spectrogram - 90% light signal



The spectrogram curves show the averaged Fast Fourier Transformations of each line in an image at various homogeneous illuminations of the camera. In case of no light, the corresponding noise values were converted in equivalent light signals for better comparison.

pco.1600 1288 data sheet 10/2005
subject to changes without prior notice
All measurements were performed by:
AEON GmbH, www.aeon.de

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