EMVA 1288 Camera Standard Release 3.1

Version 3.1 release candidate 2 of the EMVA 1288 standard was published on September 30, 2016. It will become the official release by the end of the year if no objections are filed. Version 3 of the standard proved to be a robust and stable release. Therefore, the new release contains only a few refinements and additions. Its major new feature is a standardized summary datasheet making camera comparison even more easier. The most important refinement is a better definition of the camera signal nonlinearity. The only two other major additions are: a) the total SNR curve which includes the spatial nonuniformities, and b) diagrams of horizontal and vertical profiles for a meaningful and well-arranged characterization of the different types of the spatial nonuniformities.

If you want to learn more

More information on the standard and licensing documents are available at www.standard1288.org. The complete standard can be downloaded free of charge. The working group is open for all manufacturers, system integrators and distributors of cameras and image sensors. Institutes carrying out research in this field are also welcome to join. A collection of publicly accessible data sheets can be found here: https://zenodo.org/communities/emva1288

Companies providing services and/or equipment

AEON, Hanau, Germany: http://www.aeon.de/en/emva_1288.html
Aphesa, Harzé, Belgium: www.aphesa.com/
Image Engineering, Cologne, Germany: http://www.image-engineering.de/

EMVA 1288 courses offered in 2016 and 2017

AEON, Hanau, Germany
Three-day course with introduction to image sensors, basics and advanced EMVA 1288 standard

February 8-10, 2017
September 27-29, 2017

(in German language, in English on request) / http://www.aeon.de/en/image_processing_training.html

Aphesa, Harzé, Belgium
For a detailed schedule, please refer to http://www.aphesa.com/is_consulting.php#courses

Framos, Munich, Germany
Two-day course

December 6-7, 2016
June 28-29, 2017
December 5-6, 2017

(in English language) / https://www.framos.com/news-events/trainings/emva-1288/

AEON and Framos offer discounts for EMVA members!

FINAL
30.12.2016

1288
EMVA Standard Compliant

The EMVA 1288 Camera Standard

NEW: Release 3.1

with standardized summary page

Objective specification of gray scale/colour area and line cameras and image sensors including

- Spectral sensitivity
- Noise: Signal/noise ratio (SNR), maximal SNR and dark noise
- Absolute sensitivity threshold and saturation capacity
- Nonuniformities (dark signal and photoresponse)
- Quick assessment of nonuniformities with profile plots (new)
- Linearity: Relative measure better adapted to large dynamic ranges (new)
- Defect pixel characterization
- Dark current

Standardized summary page with all essential information for quick and versatile direct camera comparison (new)

Standard open for custom extensions and free access to all documents

Example data sheets and all documents also available at https://zenodo.org/communities/emva1288

www.standard1288.org

A standard by emva
european machine vision association

1288 EMVA Standard Compliant

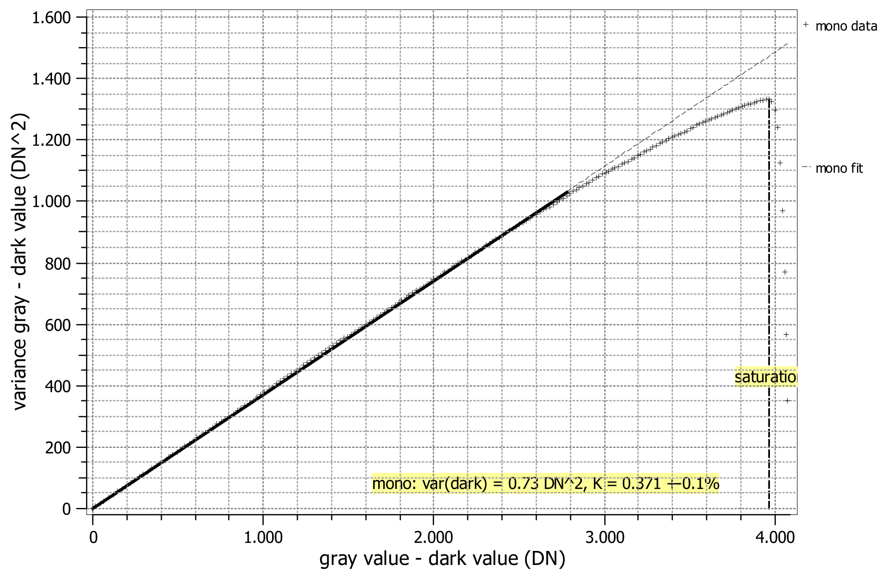
Summary Sheet for Operating Point 1 at a Wavelength of 534 nm

1

Type of data	Single	Gain, black-level	0.0 dB, 0.122
Exposure control	By irradiance	Environmental temperature	20.2° C
Exposure time	1.00 ms	Camera body temperature	30.6° C
Frame rate	38.9 Hz	Internal temperature(s)	—
Data transfer mode	Mono12Packed, Mode 7	Wavelength, centr., FWHM	534 nm, 31.3 nm

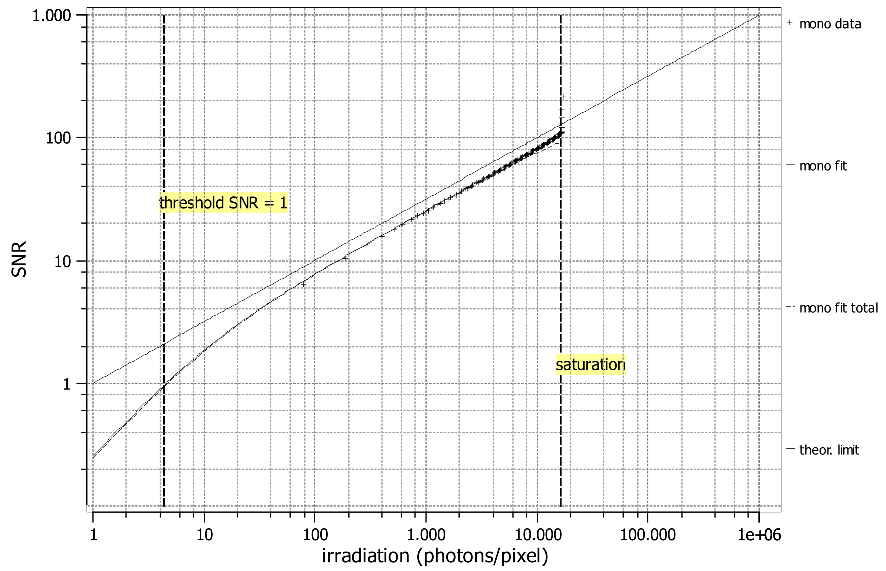
2a Photon Transfer

Photon transfer m0904, 534 nm, 10.01.2016



2b Signal-to-Noise Ratio

SNR m0904, 534 nm, 10.01.2016



3

Quantum efficiency		
η	65.2%	a
Overall system gain		
K	0.371 DN/e$^-$	
$1/K$	2.692 e$^-$ /DN	
Temporal dark noise		
σ_d	2.17 e$^-$	
$\sigma_{y.dark}$	0.86 DN	
Signal-to-noise ratio		
SNR_{max}	103	
	40.3 dB	
	6.7 bit	
$1/SNR_{max}$	0.97 %	
Absolute sensitivity threshold		
$\mu_{p.min}$	4.38 p	b
$\mu_{p.min.area}$	0.368 p/μm^2	
$\mu_{e.min}$	2.86 e$^-$	
$\mu_{e.min.area}$	0.240 e$^-$ / μm^2	
Saturation capacity		
$\mu_{p.sat}$	16421 p	c
$\mu_{p.sat.area}$	1380 p/μm^2	
$\mu_{e.sat}$	10704 e$^-$	
$\mu_{e.sat.area}$	899 e$^-$ / μm^2	
Dynamic range		
DR	3746	
	71.5 dB	
	11.9 bit	
Spatial nonuniformities		
$DSNU_{1288}$	0.76 e$^-$	
	0.28 DN	
$PRNU_{1288}$	0.48 %	
Linearity error		
LE_{min}	-0.30%	
LE_{max}	0.13%	
Dark current		
$\mu_{c.mean}$	5.8 e$^-$ /s	
	2.2 DN/s	
$\mu_{c.var}$	6.0 e$^-$ /s	
T_d	— °C	

How to use the summary datasheet

The summary data sheet as shown on the left contains three mayor elements.

1 **Operating point:** Contains a complete description of the settings of the operating point at which the EMVA 1288 measurements have been acquired. Settings not specified are assumed to be in the factory default mode. If, for instance, the binning factor is not given, the camera was measured without binning. This ensures that the measurements can be repeated anytime under the same conditions.

2 **Photon transfer and SNR curves:** The upper graph contains the photon transfer curve [2a], i. e., the variance of the image sensor noise versus the mean value. For an ideal linear camera this curve should be linear. Only if the lower 70% of the curve are linear, can the EMVA 1288 performance parameters be estimated accurately. If a camera has any type of deficiencies, these can often first seen in the photon transfer curve. The double-logarithmic SNR curve [2b] is a nice overall graphical representation of all camera performance parameters except for the dark current. The absolute sensitivity threshold is marked as well as the saturation capacity. In addition, the maximum signal-to-noise ratio and the dynamic range can be read from the graph. The total SNR is plotted as a dashed line. It includes both the variances from the temporal noise and the nonuniformities. If this line lies recognizably below the solid line of the SNR curve, nonuniformities significantly reduce the performance of the camera.

3 **EMVA 1288 performance parameters:** This colum lists all EMVA 1288 performance parameters. Here only some aspects of the three most important are discussed:

a **Quantum efficiency:** Denotes how efficiently a camera converts light into electric charges. Thus, if you have enough light in your application, this parameter is not critical. Be aware that this parameter requires an absolute calibration of the measuring equipment which is typically not more accurate than 3%. So differences in the quantum efficiencies between different data sheets in the range of a few percent are not significant and no decision criterion.

b **Absolute sensitivity threshold:** Tells you the lowest light level the camera can detect. It is given in photons and in photons per area unit (μm^2). The latter is important if you compare cameras with different pixel sizes because in most applications the irradiance (photons per time and area) at the image plane is given.

c **Saturation capacity:** Gives the largest irradiation the camera can measure. It also determines the best possible signal quality you can get from an image sensor, the maximum signal-to-noise ratio.

These examplary considerations clearly indicate how you can find the best camera for your application. Find out the most critical parameter by asking questions like: Do I have enough light? Do I have to see both dark and bright parts in the image with enough resolution? Do I have to detect slight intensity variations? Then take the corresponding EMVA 1288 parameters and compare.