EMVA 1288 Report Summary Cover Page

Package includes all associated EMVA Report Summaries valid for the following Phantom camera models

T3610, T2410

Refer to the report corresponding with your camera configuration:

- Monochrome models, Standard mode: PDF pages 2-3
- Monochrome models, Binned mode: PDF pages 4-5
- Color models, Standard mode: PDF pages 6-9

Each report summary was generated by Vision Research in accordance with the EMVA 1288 3.1 standard.

For more information on EMVA 1288 image measurements visit:
www.phantomhighspeed.com/emva

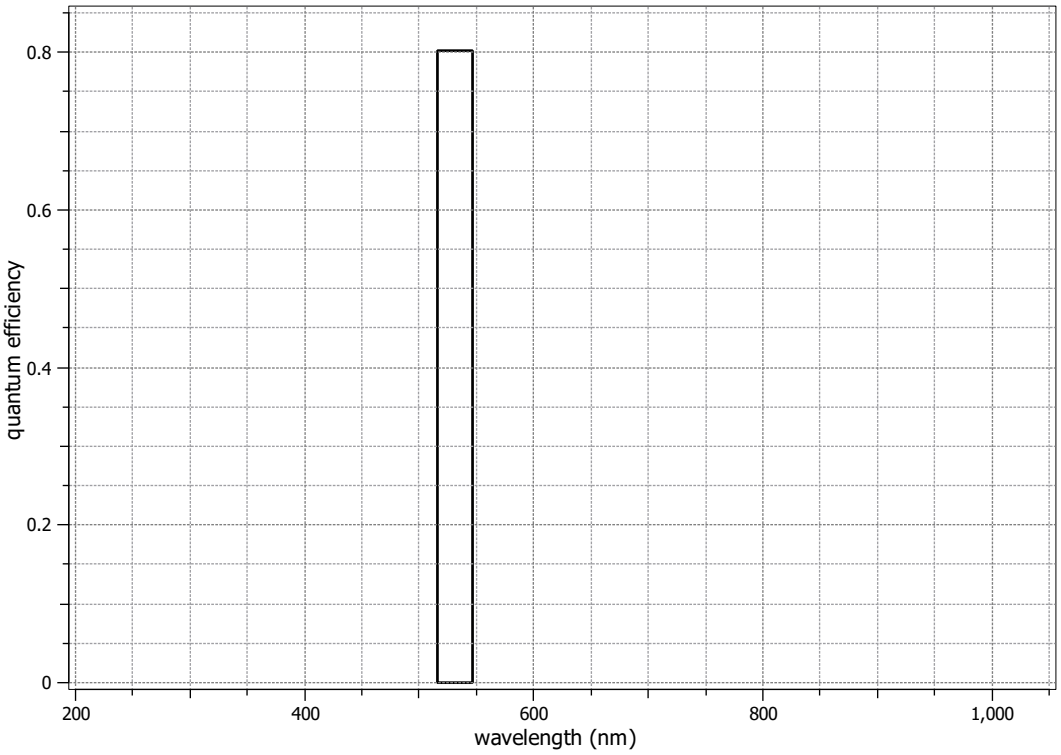
EMVA 1288 Data Sheet m0138

This datasheet describes the specification according to the standard 1288 release 3.1 for "Characterization and Presentation of Specification Data for Image Sensors and Cameras" issued on December 30, 2016 by the European Machine Vision Association (EMVA), published at `www.standard1288.org` and the *zenodo EMVA 1288 community* with proprietary extensions from AEON. The measurements were performed with the AEON ACC2b RGB-IR, Release 9, 30.07.2018, SN 0032(AMETEK.

Measurements were performed by Vision Research. Measurements are on raw sensor data.

Vendor	Vision Research
Model	Phantom T-3610
Serial number	446
Sensor diagonal	27.92 mm
Lens category	F-Mount
Resolution	1280 × 800, 12 bit
Pixel size (h×v)	18.50 μm × 18.50 μm
Sensor	Vision Research Proprietary
Sensor type	CMOS
Shutter type	Global
Overlap cap.	Overlapping
Max. frame rate	38043.0 Hz
Interface type	Ethernet

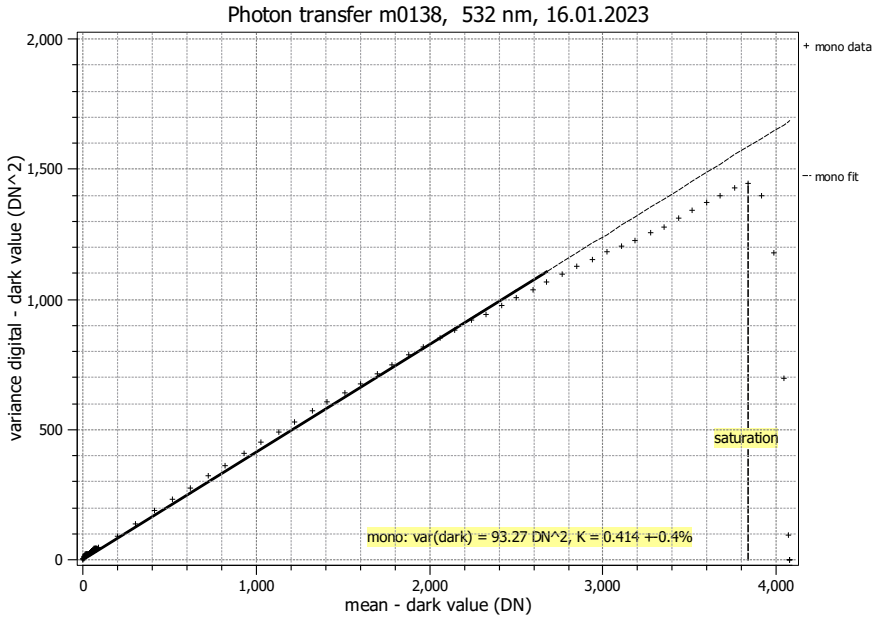
Type of data presented	Single
Operation point 1	
Wavelength centroid	531.5 nm
Wavelength FWHM	31.2 nm
Gain, black-level	1 / 0
Optional data measured	
None	



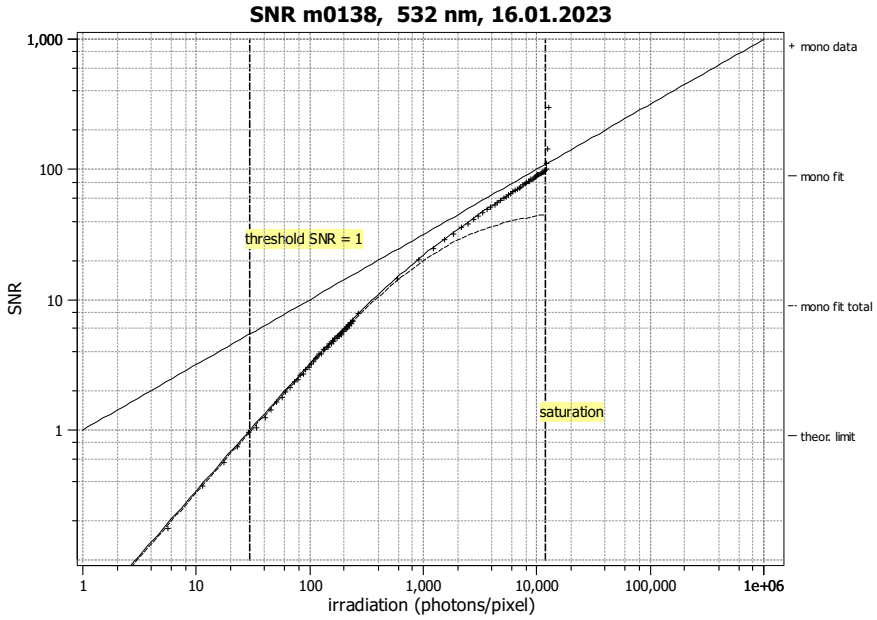
Summary Sheet for Operation Point 1 at a Wavelength of 532 nm

Type of data	Single	Gain, black-level	1 / 0
Exposure control	By irradiance	Environmental temperature	24.5°C
Exposure time	50.00 µs	Camera body temperature	36.6°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Mono 12	Wavelength, centr., FWHM	532 nm, 31.2 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η	80.3%

Overall system gain

K	0.414 DN/e$^-$
$1/K$	2.418 e$^-$/DN

Temporal dark noise

σ_d	23.34 e$^-$
$\sigma_{y.\mathrm{dark}}$	9.66 DN

Signal-to-noise ratio

$\mathrm{SNR}_{\max}$	97
	39.8 dB
	6.6 bit
$1/\mathrm{SNR}_{\max}$	1.03 %

Absolute sensitivity threshold

$\mu_{p.\mathrm{min}}$	29.7 p
$\mu_{p.\mathrm{min.area}}$	0.09 p/µm^2
$\mu_{e.\mathrm{min}}$	23.9 e$^-$
$\mu_{e.\mathrm{min.area}}$	0.07 e$^-$/µm^2

Saturation capacity

$\mu_{p.\mathrm{sat}}$	11797 p
$\mu_{p.\mathrm{sat.area}}$	34 p/µm^2
$\mu_{e.\mathrm{sat}}$	9469 e$^-$
$\mu_{e.\mathrm{sat.area}}$	28 e$^-$/µm^2

Dynamic range

DR	397
	52.0 dB
	8.6 bit

Spatial nonuniformities

DSNU_{1288}	6.26 e$^-$
	2.59 DN
PRNU_{1288}	1.97 %

Linearity error

$\mathrm{LE}_{\min}$	-1.60%
$\mathrm{LE}_{\max}$	1.25%

Dark current

$\mu_{c.\mathrm{mean}}$	19296 ± 175 e$^-$/s
	7979.1 DN/s
$\mu_{c.\mathrm{var}}$	21033 ± 2425 e$^-$/s
T_d	— °C

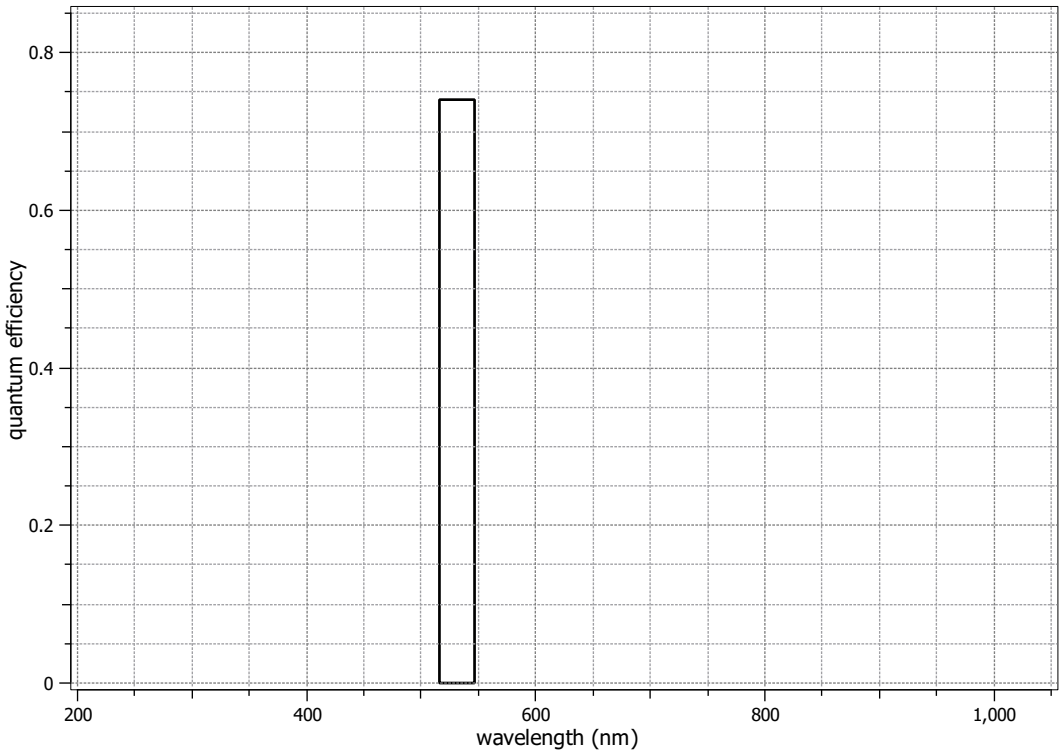
EMVA 1288 Data Sheet m0139

This datasheet describes the specification according to the standard 1288 release 3.1 for "Characterization and Presentation of Specification Data for Image Sensors and Cameras" issued on December 30, 2016 by the European Machine Vision Association (EMVA), published at `www.standard1288.org` and the *zenodo EMVA 1288 community* with proprietary extensions from AEON. The measurements were performed with the AEON ACC2b RGB-IR, Release 9, 30.07.2018, SN 0032(AMETEK.

Measurements were performed by Vision Research. Measurements are on raw sensor data.

Vendor	Vision Research
Model	Phantom T-3610
Serial number	446
Sensor diagonal	27.62 mm
Lens category	F-Mount
Resolution	640 × 384, 12 bit
Pixel size (h×v)	37.00 μm × 37.00 μm
Sensor	Vision Research Proprietary
Sensor type	CMOS
Shutter type	Global
Overlap cap.	Overlapping
Max. frame rate	156716.0 Hz
Interface type	Ethernet

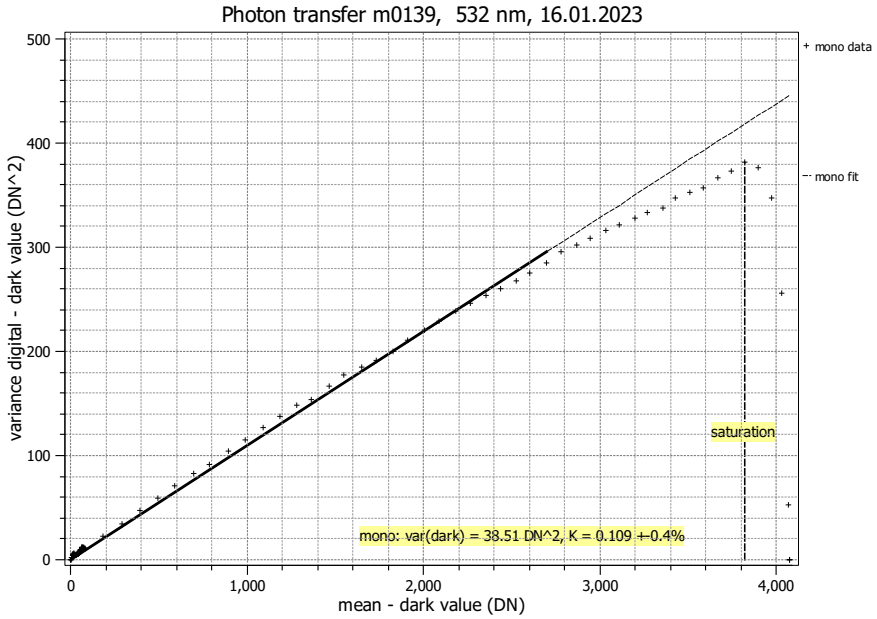
Type of data presented	Single
Operation point 1	
Wavelength centroid	531.5 nm
Wavelength FWHM	31.2 nm
Gain, black-level	1 / 0
Optional data measured	
None	



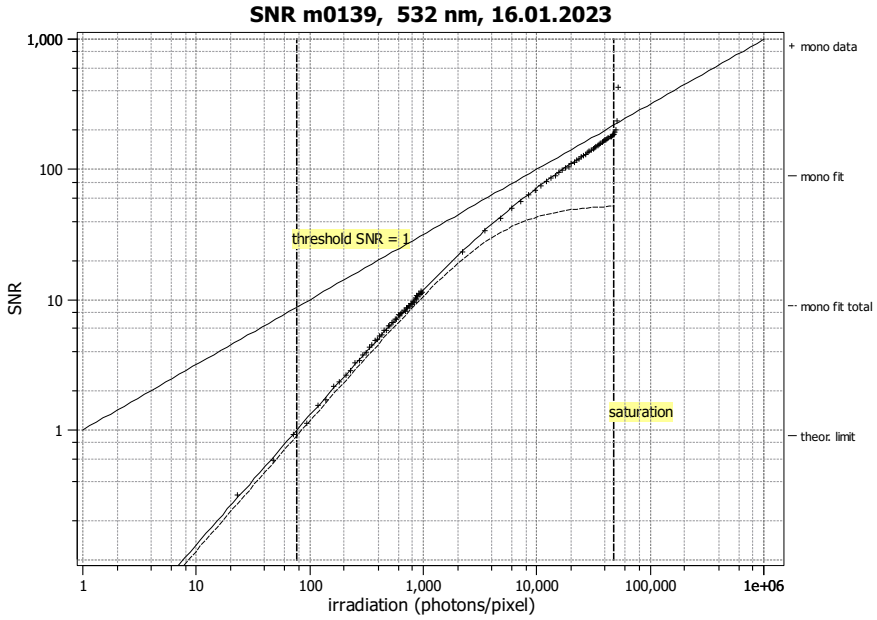
Summary Sheet for Operation Point 1 at a Wavelength of 532 nm

Type of data	Single	Gain, black-level	1 / 0
Exposure control	By irradiance	Environmental temperature	24.6°C
Exposure time	50.00 µs	Camera body temperature	36.6°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Mono 12 (Binning)	Wavelength, centr., FWHM	532 nm, 31.2 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η	74.1%

Overall system gain

K	0.109 DN/e$^-$
$1/K$	9.135 e$^-$/DN

Temporal dark noise

σ_d	56.63 e$^-$
$\sigma_{y.\mathrm{dark}}$	6.21 DN

Signal-to-noise ratio

$\mathrm{SNR}_{\max}$	189
	45.5 dB
	7.6 bit
$1/\mathrm{SNR}_{\max}$	0.53 %

Absolute sensitivity threshold

$\mu_{p.\mathrm{min}}$	77.2 p
$\mu_{p.\mathrm{min.area}}$	0.06 p/µm^2
$\mu_{e.\mathrm{min}}$	57.2 e$^-$
$\mu_{e.\mathrm{min.area}}$	0.04 e$^-$/µm^2

Saturation capacity

$\mu_{p.\mathrm{sat}}$	48049 p
$\mu_{p.\mathrm{sat.area}}$	35 p/µm^2
$\mu_{e.\mathrm{sat}}$	35581 e$^-$
$\mu_{e.\mathrm{sat.area}}$	26 e$^-$/µm^2

Dynamic range

DR	622
	55.9 dB
	9.3 bit

Spatial nonuniformities

DSNU_{1288}	27.16 e$^-$
	2.97 DN
PRNU_{1288}	1.83 %

Linearity error

$\mathrm{LE}_{\min}$	-2.05%
$\mathrm{LE}_{\max}$	1.37%

Dark current

$\mu_{c.\mathrm{mean}}$	77023 ± 776 e$^-$/s
	8431.8 DN/s
$\mu_{c.\mathrm{var}}$	98251 ± 13607 e$^-$/s
T_d	— °C

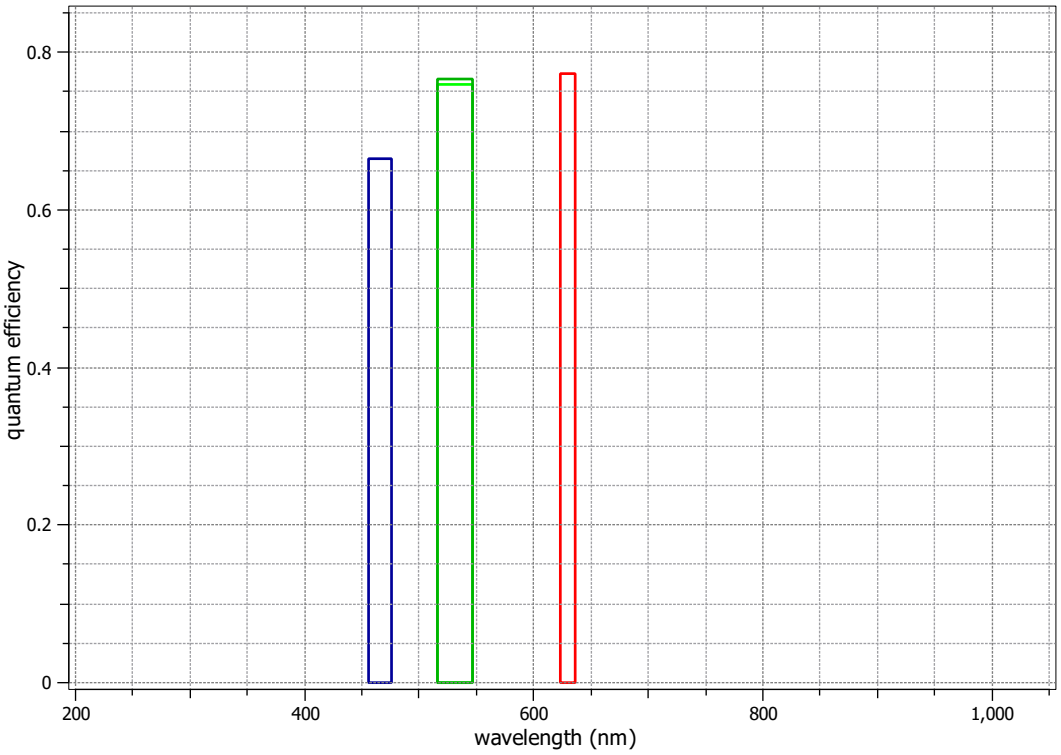
EMVA 1288 Data Sheet m0191

This datasheet describes the specification according to the standard 1288 release 3.1 for "Characterization and Presentation of Specification Data for Image Sensors and Cameras" issued on December 30, 2016 by the European Machine Vision Association (EMVA), published at `www.standard1288.org` and the *zenodo EMVA 1288 community* with proprietary extensions from AEON. The measurements were performed with the AEON ACC2b RGB-IR, Release 9, 30.07.2018, SN 0032(AMETEK.

Measurements were performed by Vision Research. Measurements are on raw sensor data.

Vendor	Vision Research
Model	Phantom T-3610
Serial number	29120
Sensor diagonal	27.92 mm
Lens category	F-Mount
Resolution	1280 × 800, 12 bit
Pixel size (h×v)	18.50 μm × 18.50 μm
Sensor	Vision Research Proprietary
Sensor type	CMOS
Shutter type	Global
Overlap cap.	Overlapping
Max. frame rate	38043.0 Hz
Interface type	Ethernet

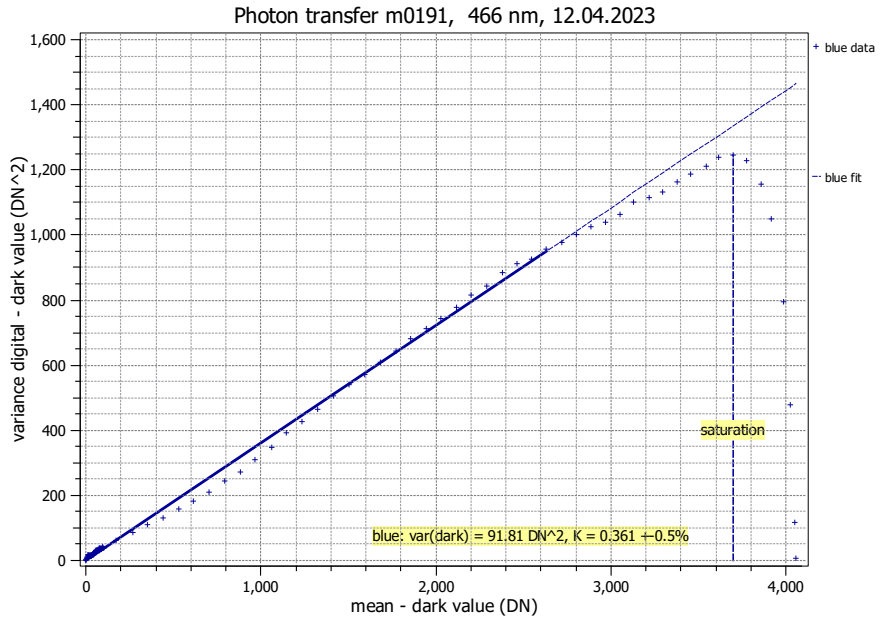
Type of data presented	Single
Operation point 1	
Wavelength centroid	466.2 nm
Wavelength FWHM	20.3 nm
Gain, black-level	1 / 0
Operation point 2	
Wavelength centroid	531.5 nm
Wavelength FWHM	31.2 nm
Gain, black-level	1 / 0
Operation point 3	
Wavelength centroid	629.4 nm
Wavelength FWHM	13.3 nm
Gain, black-level	1 / 0
Optional data measured	
None	



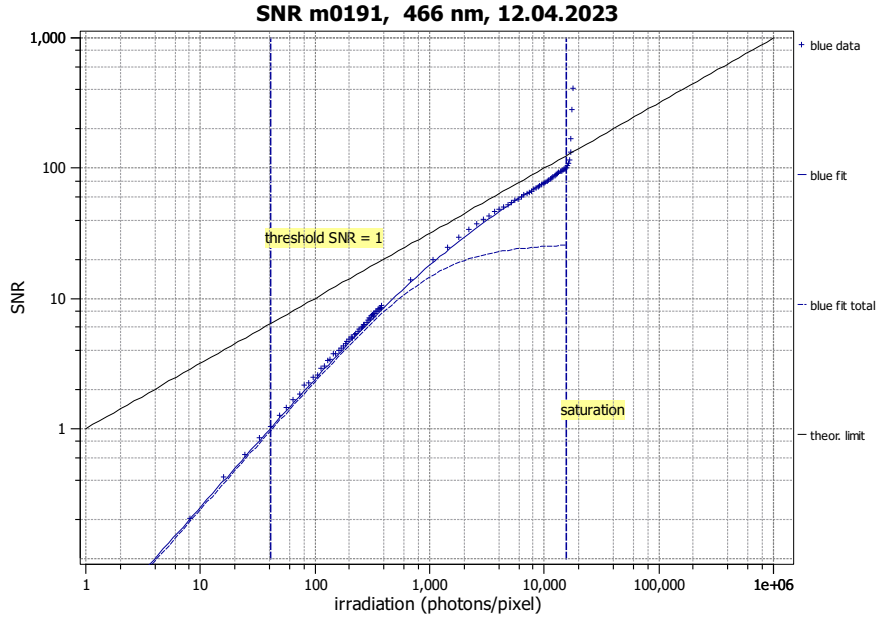
Summary Sheet for Operation Point 1 at a Wavelength of 466 nm

Type of data	Single	Gain, black-level	1 / 0
Exposure control	By irradiance	Environmental temperature	23.6°C
Exposure time	30.00 µs	Camera body temperature	33.6°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Color 12	Wavelength, centr., FWHM	466 nm, 20.3 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η	66.5%

Overall system gain

K	0.361 DN/e$^-$
$1/K$	2.769 e$^-$/DN

Temporal dark noise

σ_d	26.52 e$^-$
$\sigma_{y.\mathrm{dark}}$	9.58 DN

Signal-to-noise ratio

$\mathrm{SNR}_{\max}$	101
	40.1 dB
	6.7 bit
$1/\mathrm{SNR}_{\max}$	0.99 %

Absolute sensitivity threshold

$\mu_{p.\min}$	40.7 p
$\mu_{p.\min.\mathrm{area}}$	0.12 p/µm^2
$\mu_{e.\min}$	27.0 e$^-$
$\mu_{e.\min.\mathrm{area}}$	0.08 e$^-$/µm^2

Saturation capacity

$\mu_{p.\mathrm{sat}}$	15496 p
$\mu_{p.\mathrm{sat.area}}$	45 p/µm^2
$\mu_{e.\mathrm{sat}}$	10300 e$^-$
$\mu_{e.\mathrm{sat.area}}$	30 e$^-$/µm^2

Dynamic range

DR	381
	51.6 dB
	8.6 bit

Spatial nonuniformities

DSNU_{1288}	8.19 e$^-$
	2.96 DN
PRNU_{1288}	3.79 %

Linearity error

$\mathrm{LE}_{\min}$	-1.26%
$\mathrm{LE}_{\max}$	0.87%

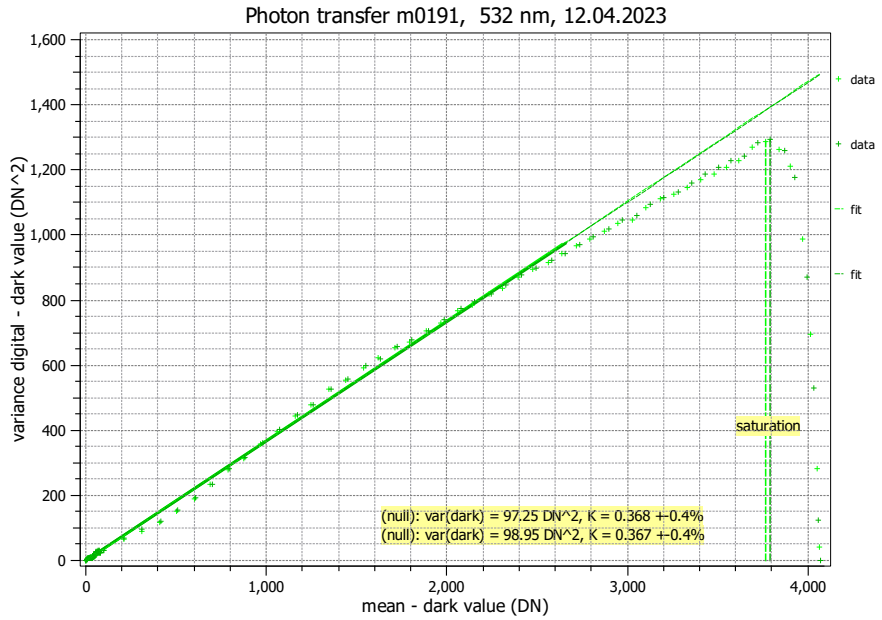
Dark current

$\mu_{c.\mathrm{mean}}$	27804 ± 247 e$^-$/s
	10042.5 DN/s
$\mu_{c.\mathrm{var}}$	30392 ± 3238 e$^-$/s
T_d	— °C

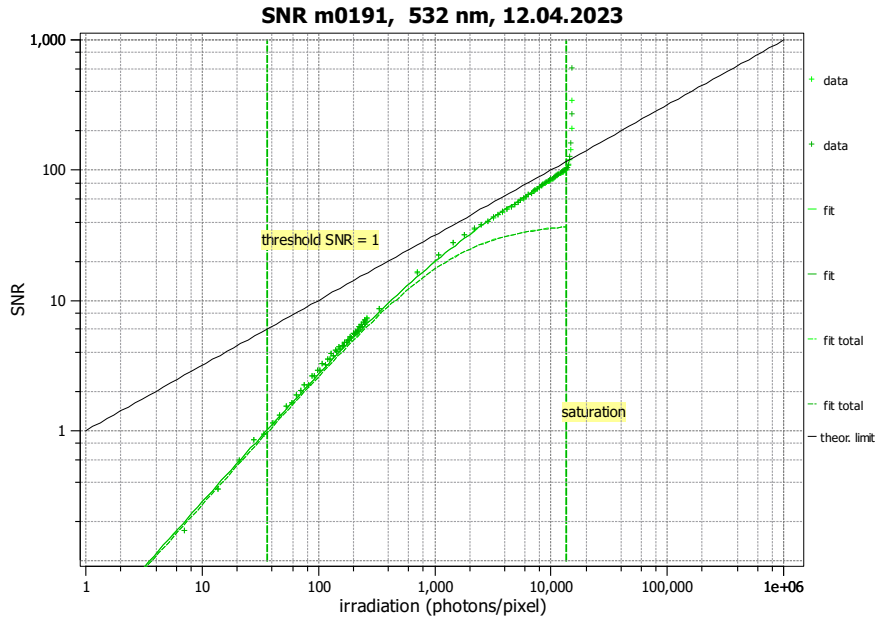
Summary Sheet for Operation Point 2 at a Wavelength of 532 nm

Type of data	Single	Gain, black-level	1 / 0
Exposure control	By irradiance	Environmental temperature	23.7°C
Exposure time	30.00 µs	Camera body temperature	34.2°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Color 12	Wavelength, centr., FWHM	532 nm, 31.2 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η	76.0%

Overall system gain

K	0.368 DN/e$^-$
$1/K$	2.720 e$^-$/DN

Temporal dark noise

σ_d	26.81 e$^-$
$\sigma_{y.\mathrm{dark}}$	9.86 DN

Signal-to-noise ratio

$\mathrm{SNR}_{\max}$	102
	40.1 dB
	6.7 bit
$1/\mathrm{SNR}_{\max}$	0.98 %

Absolute sensitivity threshold

$\mu_{p.\mathrm{min}}$	36.0 p
$\mu_{p.\mathrm{min.area}}$	0.11 p/µm^2
$\mu_{e.\mathrm{min}}$	27.3 e$^-$
$\mu_{e.\mathrm{min.area}}$	0.08 e$^-$/µm^2

Saturation capacity

$\mu_{p.\mathrm{sat}}$	13620 p
$\mu_{p.\mathrm{sat.area}}$	40 p/µm^2
$\mu_{e.\mathrm{sat}}$	10344 e$^-$
$\mu_{e.\mathrm{sat.area}}$	30 e$^-$/µm^2

Dynamic range

DR	379
	51.6 dB
	8.6 bit

Spatial nonuniformities

DSNU_{1288}	8.50 e$^-$
	3.12 DN
PRNU_{1288}	2.52 %

Linearity error

$\mathrm{LE}_{\min}$	-2.05%
$\mathrm{LE}_{\max}$	2.29%

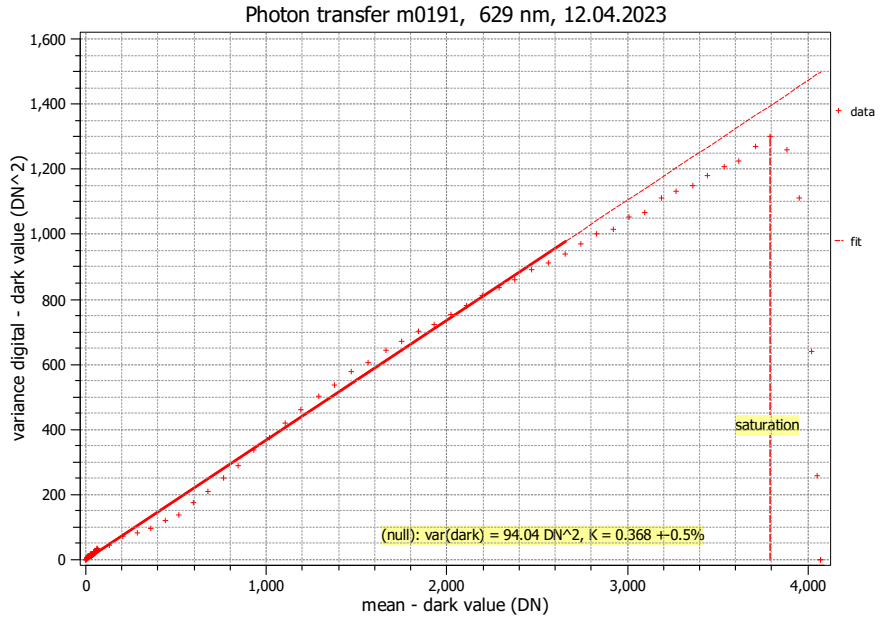
Dark current

$\mu_{c.\mathrm{mean}}$	27246 ± 245 e$^-$/s
	10018.7 DN/s
$\mu_{c.\mathrm{var}}$	27266 ± 2534 e$^-$/s
T_d	— °C

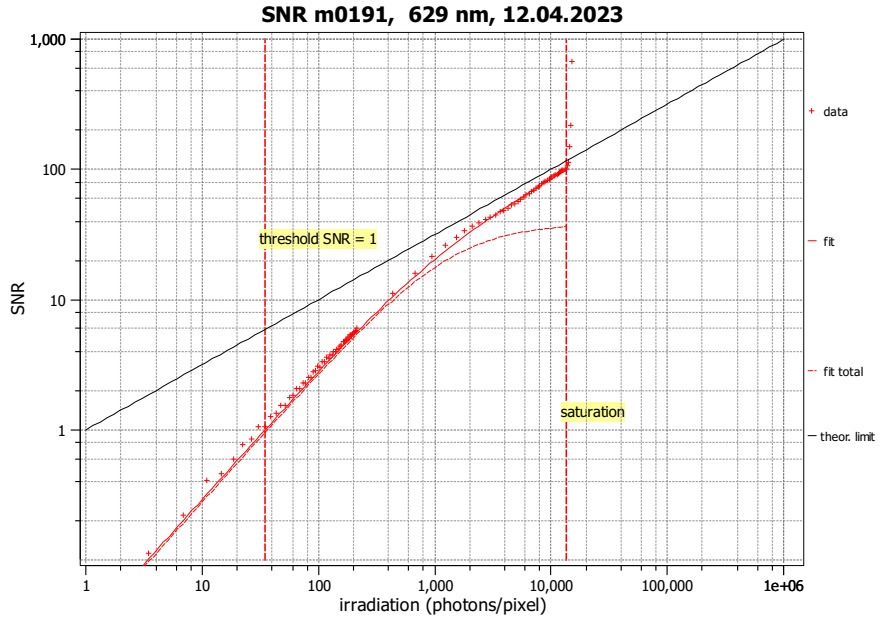
Summary Sheet for Operation Point 3 at a Wavelength of 629 nm

Type of data	Single	Gain, black-level	1 / 0
Exposure control	By irradiance	Environmental temperature	23.9°C
Exposure time	30.00 µs	Camera body temperature	34.5°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Color 12	Wavelength, centr., FWHM	629 nm, 13.3 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η	77.3%

Overall system gain

K	0.368 DN/e$^-$
$1/K$	2.717 e$^-$/DN

Temporal dark noise

σ_d	26.33 e$^-$
$\sigma_{y.\mathrm{dark}}$	9.70 DN

Signal-to-noise ratio

$\mathrm{SNR}_{\max}$	102
	40.2 dB
	6.7 bit
$1/\mathrm{SNR}_{\max}$	0.98 %

Absolute sensitivity threshold

$\mu_{p.\mathrm{min}}$	34.7 p
$\mu_{p.\mathrm{min.area}}$	0.10 p/µm^2
$\mu_{e.\mathrm{min}}$	26.8 e$^-$
$\mu_{e.\mathrm{min.area}}$	0.08 e$^-$/µm^2

Saturation capacity

$\mu_{p.\mathrm{sat}}$	13434 p
$\mu_{p.\mathrm{sat.area}}$	39 p/µm^2
$\mu_{e.\mathrm{sat}}$	10385 e$^-$
$\mu_{e.\mathrm{sat.area}}$	30 e$^-$/µm^2

Dynamic range

DR	387
	51.7 dB
	8.6 bit

Spatial nonuniformities

DSNU_{1288}	8.35 e$^-$
	3.07 DN
PRNU_{1288}	2.56 %

Linearity error

$\mathrm{LE}_{\min}$	-2.52%
$\mathrm{LE}_{\max}$	2.11%

Dark current

$\mu_{c.\mathrm{mean}}$	27329 ± 246 e$^-$/s
	10032.4 DN/s
$\mu_{c.\mathrm{var}}$	26709 ± 2429 e$^-$/s
T_d	— °C