EMVA 1288 Report Summary Cover Page

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

TE2010

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

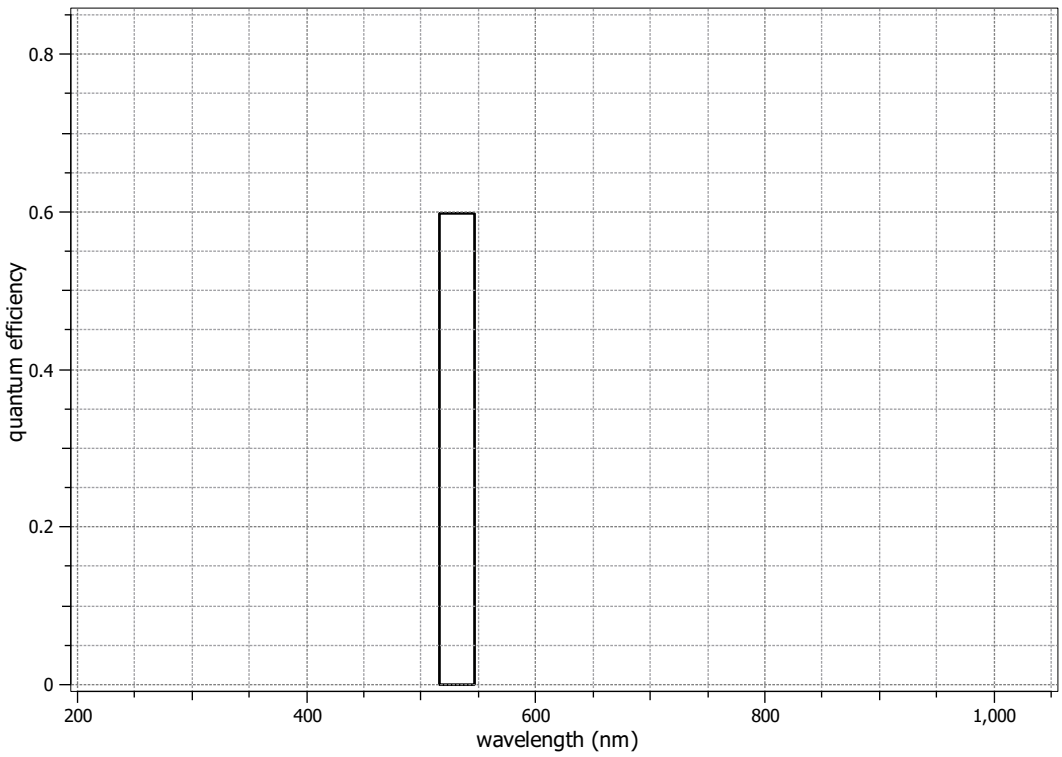
EMVA 1288 Data Sheet m0298

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-E2010
Serial number	535
Sensor diagonal	28.24 mm
Lens category	F-Mount
Resolution	1280 × 832, 10 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	19251.0 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	



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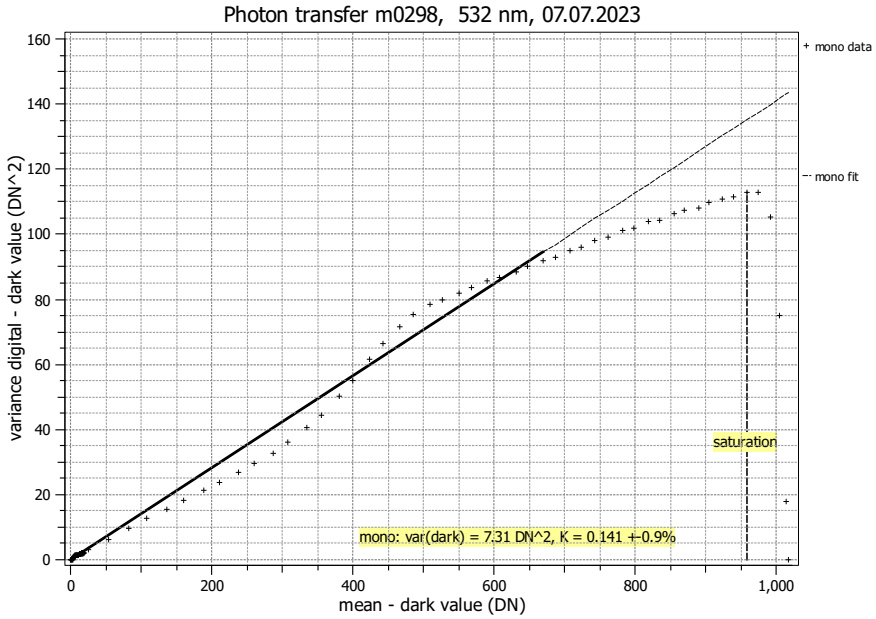
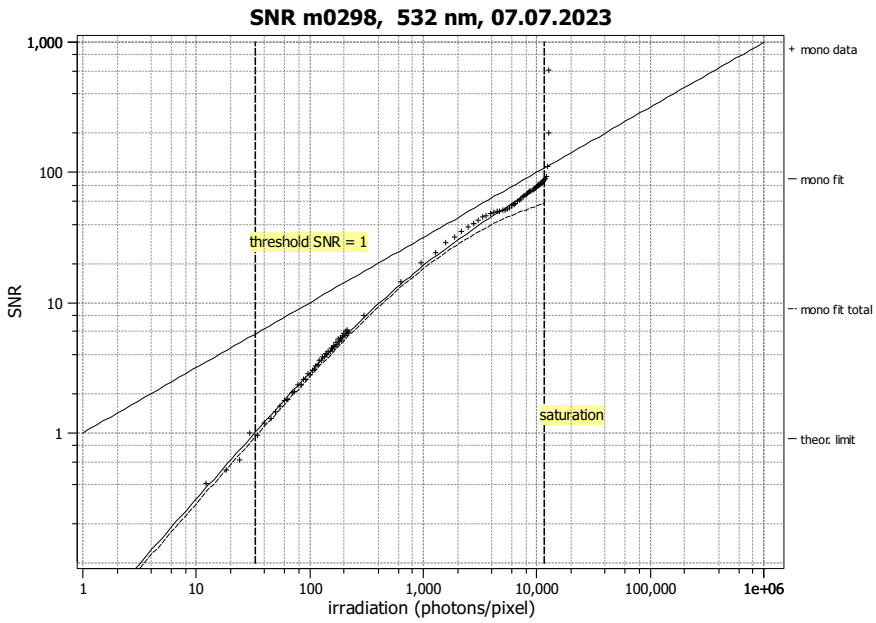
Summary Sheet for Operation Point 1 at a Wavelength of 532 nm

Type of data	Single	Gain, black-level	1 / 0
Exposure control	By irradiance	Environmental temperature	24.4°C
Exposure time	20.00 μs	Camera body temperature	32.7°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Mono 10	Wavelength, centr., FWHM	532 nm, 31.2 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η	59.9%

Overall system gain

K	0.141 DN/e$^-$
$1/K$	7.089 e$^-$/DN

Temporal dark noise

σ_d	19.05 e$^-$
$\sigma_{y.\mathrm{dark}}$	2.70 DN

Signal-to-noise ratio

$\mathrm{SNR}_{\mathrm{max}}$	84
	38.5 dB
	6.4 bit
$1/\mathrm{SNR}_{\mathrm{max}}$	1.19 %

Absolute sensitivity threshold

$\mu_{p.\mathrm{min}}$	32.9 p
$\mu_{p.\mathrm{min.area}}$	0.10 p/μm^2
$\mu_{e.\mathrm{min}}$	19.7 e$^-$
$\mu_{e.\mathrm{min.area}}$	0.06 e$^-$/μm^2

Saturation capacity

$\mu_{p.\mathrm{sat}}$	11717 p
$\mu_{p.\mathrm{sat.area}}$	34 p/μm^2
$\mu_{e.\mathrm{sat}}$	7014 e$^-$
$\mu_{e.\mathrm{sat.area}}$	20 e$^-$/μm^2

Dynamic range

DR	357
	51.0 dB
	8.5 bit

Spatial nonuniformities

DSNU_{1288}	8.23 e$^-$
	1.16 DN
PRNU_{1288}	1.22 %

Linearity error

$\mathrm{LE}_{\mathrm{min}}$	-3.34%
$\mathrm{LE}_{\mathrm{max}}$	2.25%

Dark current

$\mu_{c.\mathrm{mean}}$	25517 ± 1188 e$^-$/s
	3599.6 DN/s
$\mu_{c.\mathrm{var}}$	33702 ± 9114 e$^-$/s
T_{d}	— °C

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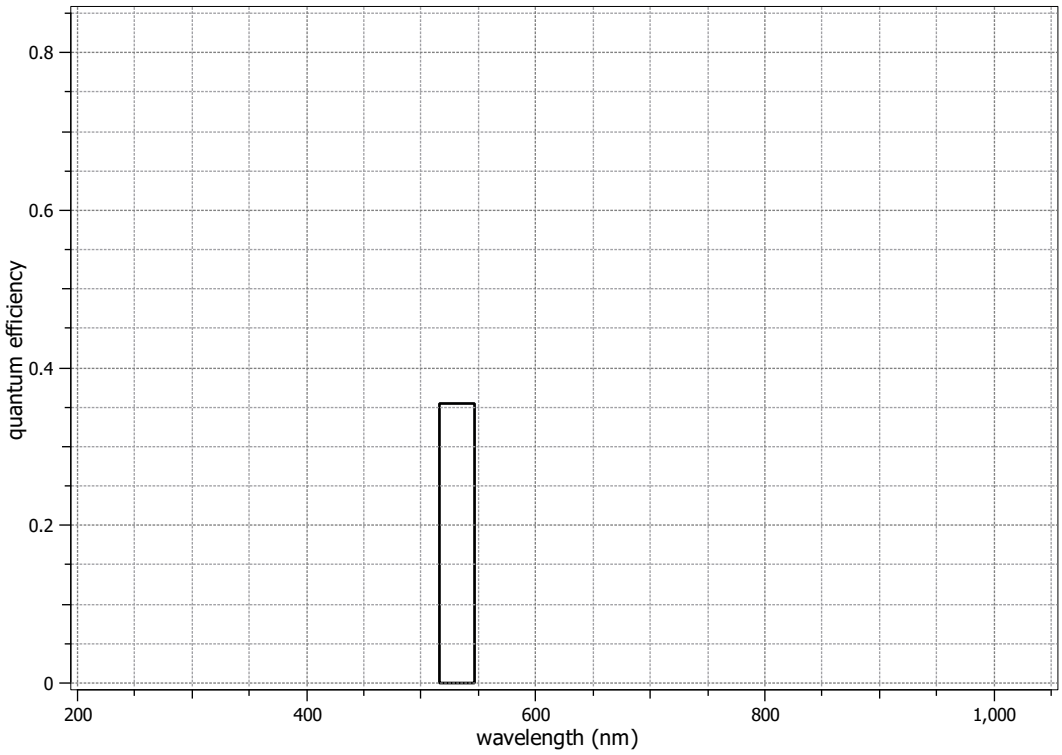
EMVA 1288 Data Sheet m0299

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-E2010
Serial number	535
Sensor diagonal	27.62 mm
Lens category	F-Mount
Resolution	640 × 384, 10 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	82442.0 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	



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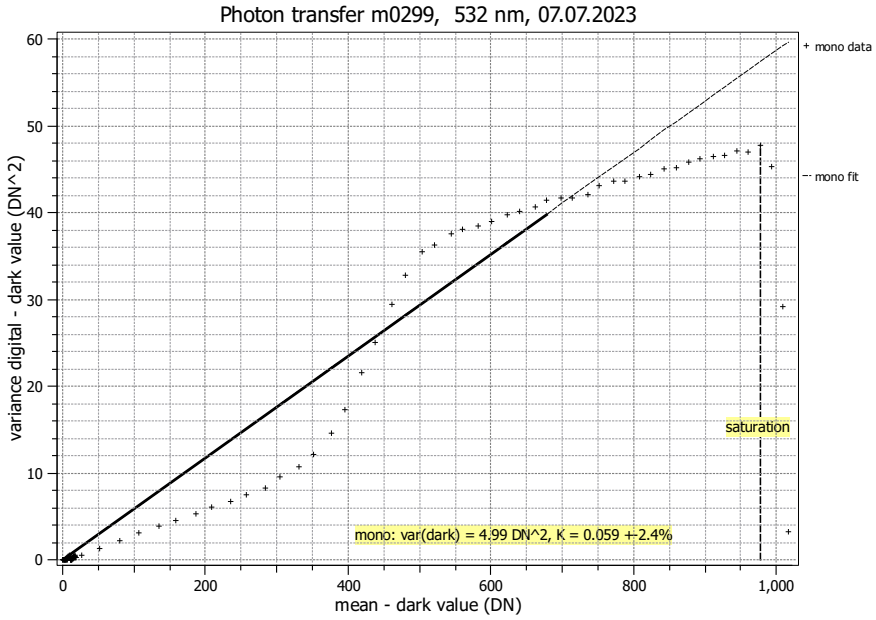
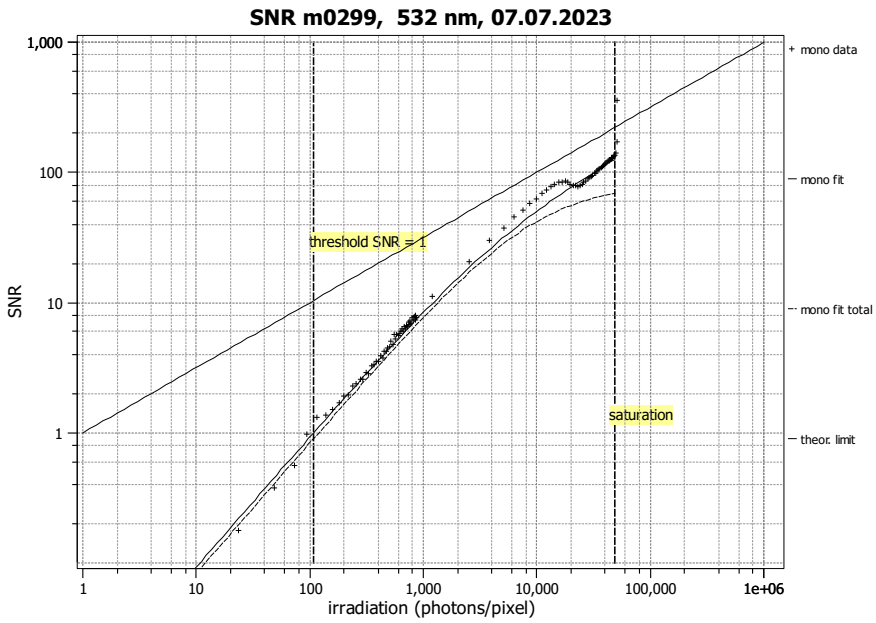
Summary Sheet for Operation Point 1 at a Wavelength of 532 nm

Type of data	Single	Gain, black-level	1 / 0
Exposure control	By irradiance	Environmental temperature	24.8°C
Exposure time	20.00 μs	Camera body temperature	33.0°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Mono 10 (Binning)	Wavelength, centr., FWHM	532 nm, 31.2 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η	35.5%

Overall system gain

K	0.059 DN/e$^-$
$1/K$	17.031 e$^-$/DN

Temporal dark noise

σ_d	37.72 e$^-$
$\sigma_{y.\text{dark}}$	2.23 DN

Signal-to-noise ratio

SNR_{max}	131
	42.4 dB
	7.0 bit
$1/\text{SNR}_{\text{max}}$	0.76 %

Absolute sensitivity threshold

$\mu_{p.\text{min}}$	108.6 p
$\mu_{p.\text{min.area}}$	0.08 p/μm^2
$\mu_{e.\text{min}}$	38.5 e$^-$
$\mu_{e.\text{min.area}}$	0.03 e$^-$/μm^2

Saturation capacity

$\mu_{p.\text{sat}}$	48602 p
$\mu_{p.\text{sat.area}}$	36 p/μm^2
$\mu_{e.\text{sat}}$	17258 e$^-$
$\mu_{e.\text{sat.area}}$	13 e$^-$/μm^2

Dynamic range

DR	448
	53.0 dB
	8.8 bit

Spatial nonuniformities

DSNU_{1288}	18.44 e$^-$
	1.08 DN
PRNU_{1288}	1.21 %

Linearity error

LE_{min}	-3.36%
LE_{max}	2.67%

Dark current

$\mu_{c.\text{mean}}$	62553 ± 1500 e$^-$/s
	3672.8 DN/s
$\mu_{c.\text{var}}$	95936 ± 31860 e$^-$/s
T_{d}	— °C

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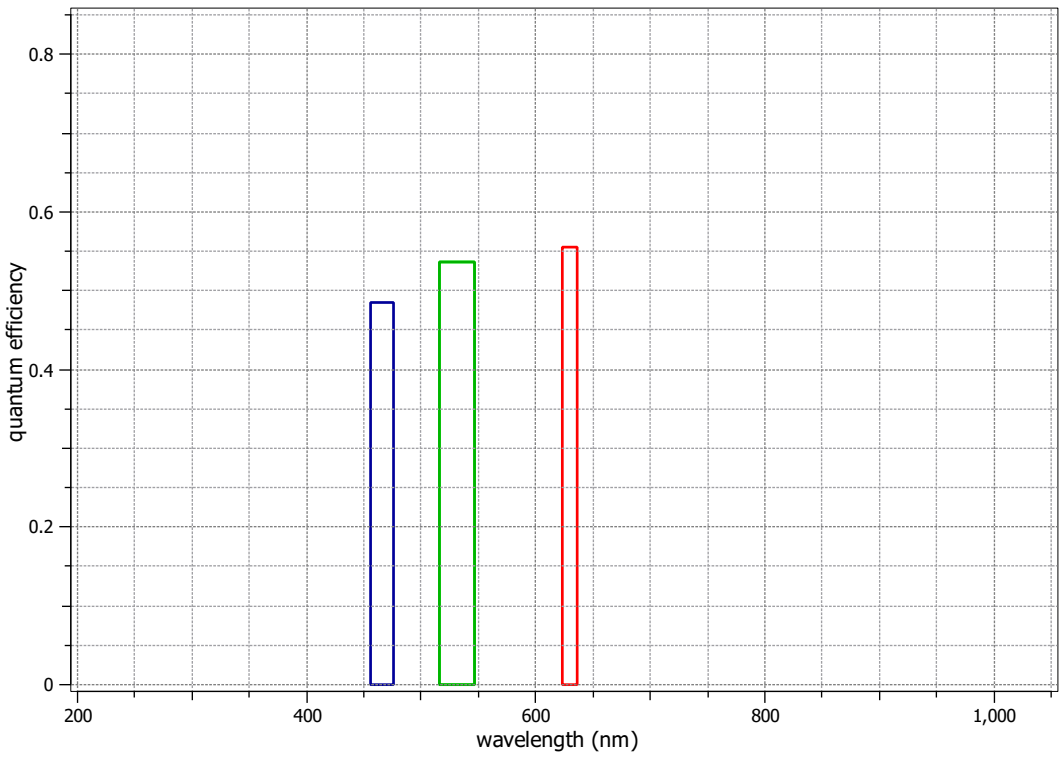
EMVA 1288 Data Sheet m0305

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-E2010
Serial number	535
Sensor diagonal	28.24 mm
Lens category	F-Mount
Resolution	1280 × 832, 10 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	19251.0 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	



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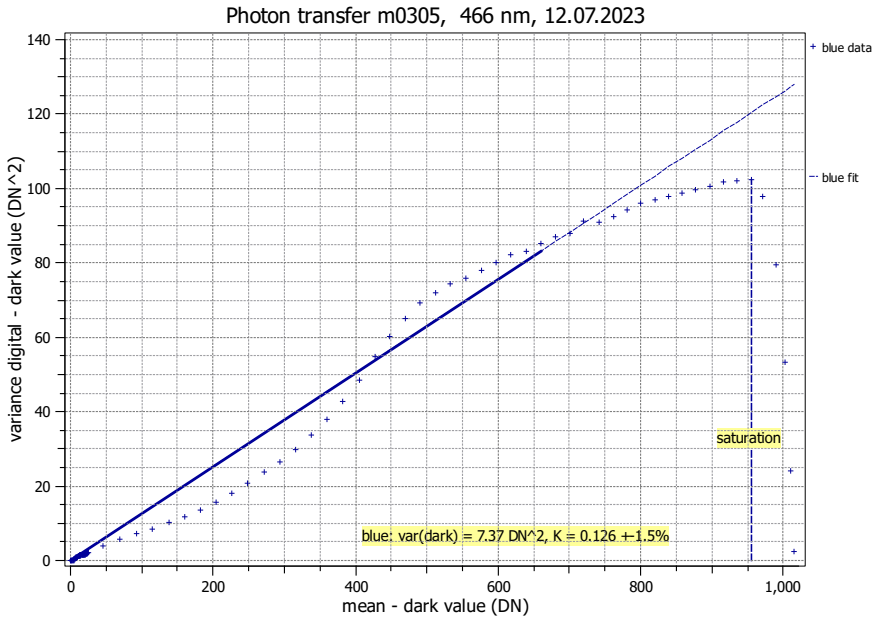
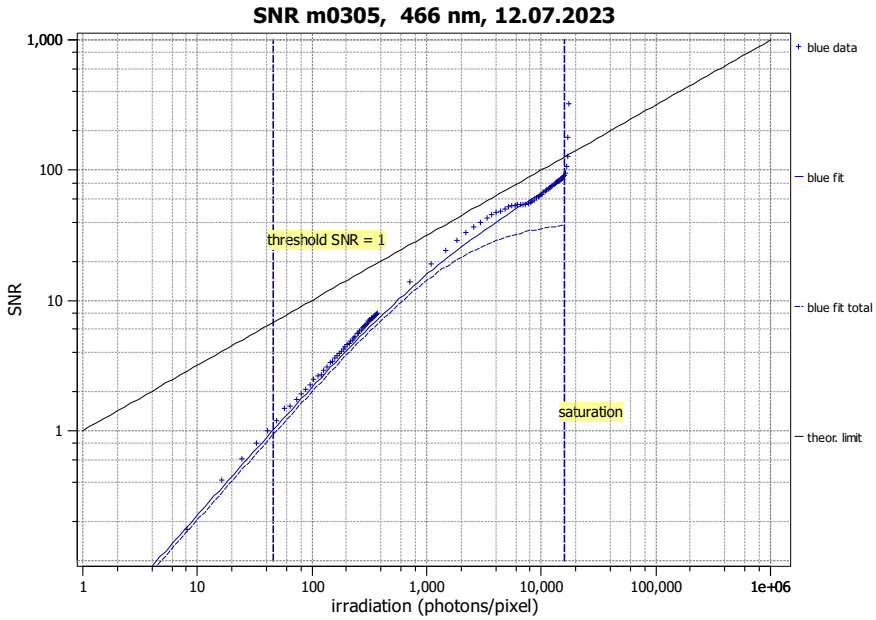
Summary Sheet for Operation Point 1 at a Wavelength of 466 nm

Type of data	Single	Gain, black-level	1 / 0
Exposure control	By irradiance	Environmental temperature	24.0°C
Exposure time	20.00 μs	Camera body temperature	33.6°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Color 10	Wavelength, centr., FWHM	466 nm, 20.3 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η	48.5%

Overall system gain

K	0.126 DN/e$^-$
$1/K$	7.935 e$^-$/DN

Temporal dark noise

σ_d	21.42 e$^-$
$\sigma_{y.\text{dark}}$	2.71 DN

Signal-to-noise ratio

SNR_{max}	88
	38.9 dB
	6.5 bit
$1/\text{SNR}_{\text{max}}$	1.14 %

Absolute sensitivity threshold

$\mu_{p.\text{min}}$	45.4 p
$\mu_{p.\text{min.area}}$	0.13 p/μm^2
$\mu_{e.\text{min}}$	22.0 e$^-$
$\mu_{e.\text{min.area}}$	0.06 e$^-$/μm^2

Saturation capacity

$\mu_{p.\text{sat}}$	15870 p
$\mu_{p.\text{sat.area}}$	46 p/μm^2
$\mu_{e.\text{sat}}$	7702 e$^-$
$\mu_{e.\text{sat.area}}$	23 e$^-$/μm^2

Dynamic range

DR	349
	50.9 dB
	8.4 bit

Spatial nonuniformities

DSNU_{1288}	9.36 e$^-$
	1.18 DN
PRNU_{1288}	2.37 %

Linearity error

LE_{min}	-0.85%
LE_{max}	0.65%

Dark current

$\mu_{c.\text{mean}}$	25418 ± 906 e$^-$/s
	3203.2 DN/s
$\mu_{c.\text{var}}$	40632 ± 11026 e$^-$/s
T_{d}	— °C

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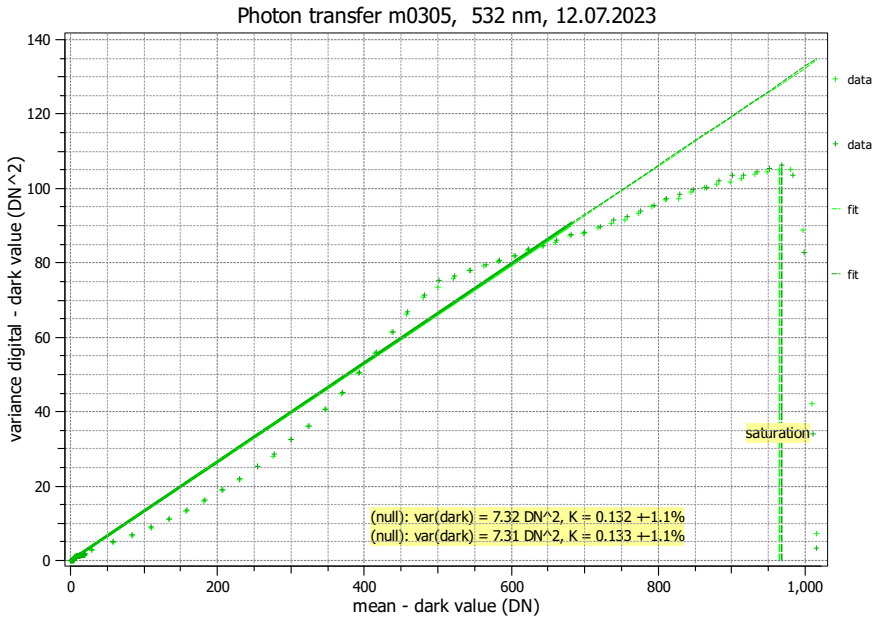
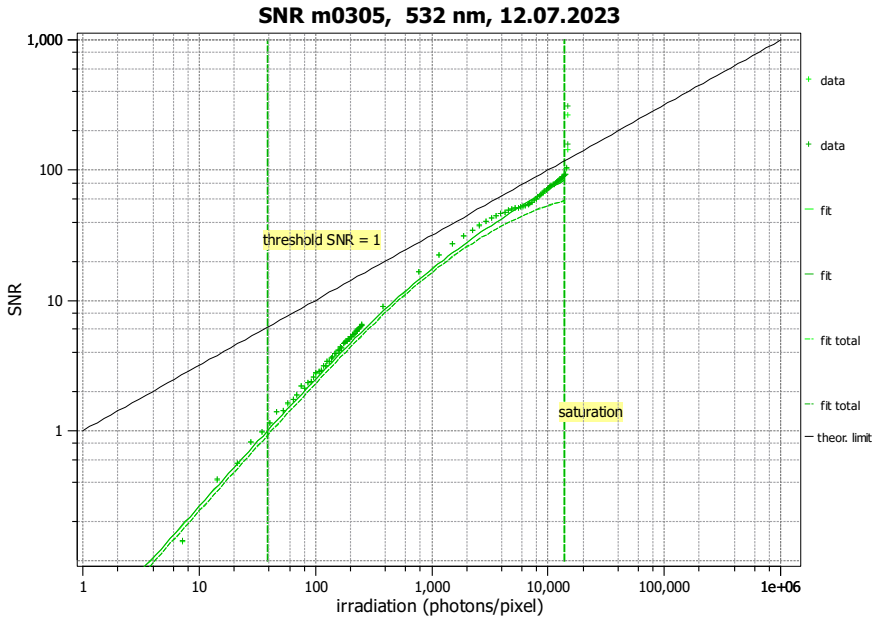
Summary Sheet for Operation Point 2 at a Wavelength of 532 nm

Type of data	Single	Gain, black-level	1 / 0
Exposure control	By irradiance	Environmental temperature	24.0°C
Exposure time	20.00 μs	Camera body temperature	33.7°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Color 10	Wavelength, centr., FWHM	532 nm, 31.2 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η	53.6%

Overall system gain

K	0.132 DN/e$^-$
$1/K$	7.552 e$^-$/DN

Temporal dark noise

σ_d	20.31 e$^-$
$\sigma_{y.\mathrm{dark}}$	2.71 DN

Signal-to-noise ratio

$\mathrm{SNR}_{\mathrm{max}}$	86
	38.7 dB
	6.4 bit
$1/\mathrm{SNR}_{\mathrm{max}}$	1.16 %

Absolute sensitivity threshold

$\mu_{p.\mathrm{min}}$	39.1 p
$\mu_{p.\mathrm{min.area}}$	0.11 p/μm^2
$\mu_{e.\mathrm{min}}$	20.9 e$^-$
$\mu_{e.\mathrm{min.area}}$	0.06 e$^-$/μm^2

Saturation capacity

$\mu_{p.\mathrm{sat}}$	13896 p
$\mu_{p.\mathrm{sat.area}}$	41 p/μm^2
$\mu_{e.\mathrm{sat}}$	7445 e$^-$
$\mu_{e.\mathrm{sat.area}}$	22 e$^-$/μm^2

Dynamic range

DR	356
	51.0 dB
	8.5 bit

Spatial nonuniformities

DSNU_{1288}	8.83 e$^-$
	1.17 DN
PRNU_{1288}	1.23 %

Linearity error

$\mathrm{LE}_{\mathrm{min}}$	-1.01%
$\mathrm{LE}_{\mathrm{max}}$	1.10%

Dark current

$\mu_{c.\mathrm{mean}}$	24252 ± 876 e$^-$/s
	3211.4 DN/s
$\mu_{c.\mathrm{var}}$	36497 ± 10021 e$^-$/s
T_{d}	— °C

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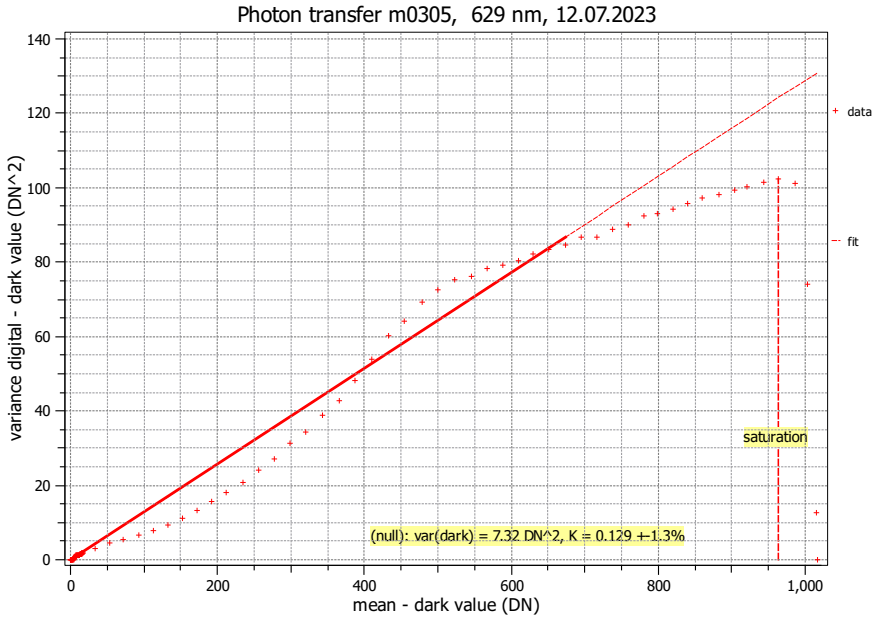
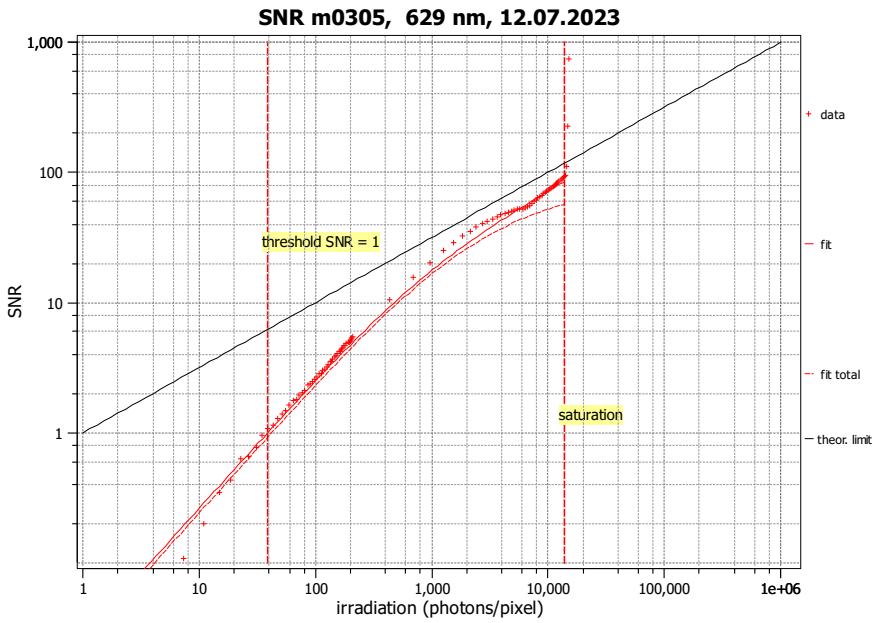
Summary Sheet for Operation Point 3 at a Wavelength of 629 nm

Type of data	Single	Gain, black-level	1 / 0
Exposure control	By irradiance	Environmental temperature	23.9°C
Exposure time	20.00 μs	Camera body temperature	33.7°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Color 10	Wavelength, centr., FWHM	629 nm, 13.3 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η	55.5%

Overall system gain

K	0.129 DN/e$^-$
$1/K$	7.762 e$^-$/DN

Temporal dark noise

σ_d	20.88 e$^-$
$\sigma_{y.\mathrm{dark}}$	2.71 DN

Signal-to-noise ratio

$\mathrm{SNR}_{\mathrm{max}}$	87
	38.8 dB
	6.4 bit
$1/\mathrm{SNR}_{\mathrm{max}}$	1.15 %

Absolute sensitivity threshold

$\mu_{p.\mathrm{min}}$	38.8 p
$\mu_{p.\mathrm{min.area}}$	0.11 p/μm^2
$\mu_{e.\mathrm{min}}$	21.5 e$^-$
$\mu_{e.\mathrm{min.area}}$	0.06 e$^-$/μm^2

Saturation capacity

$\mu_{p.\mathrm{sat}}$	13739 p
$\mu_{p.\mathrm{sat.area}}$	40 p/μm^2
$\mu_{e.\mathrm{sat}}$	7624 e$^-$
$\mu_{e.\mathrm{sat.area}}$	22 e$^-$/μm^2

Dynamic range

DR	354
	51.0 dB
	8.5 bit

Spatial nonuniformities

DSNU_{1288}	9.13 e$^-$
	1.18 DN
PRNU_{1288}	1.30 %

Linearity error

$\mathrm{LE}_{\mathrm{min}}$	-1.97%
$\mathrm{LE}_{\mathrm{max}}$	1.46%

Dark current

$\mu_{c.\mathrm{mean}}$	24237 ± 941 e$^-$/s
	3216.9 DN/s
$\mu_{c.\mathrm{var}}$	36540 ± 10001 e$^-$/s
T_{d}	— °C

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