

EMVA 1288 Report Summary

Cover Page

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

C540, C540J, C980, C980J

Refer to the report corresponding with your camera configuration:

- Monochrome models PDF pages 2-5
- Color models PDF pages 6-13

Each report summary was generated by Vision Research in accordance with the EMVA 1288 4.0 standard.

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

EMVA 1288 Data Sheet m0596

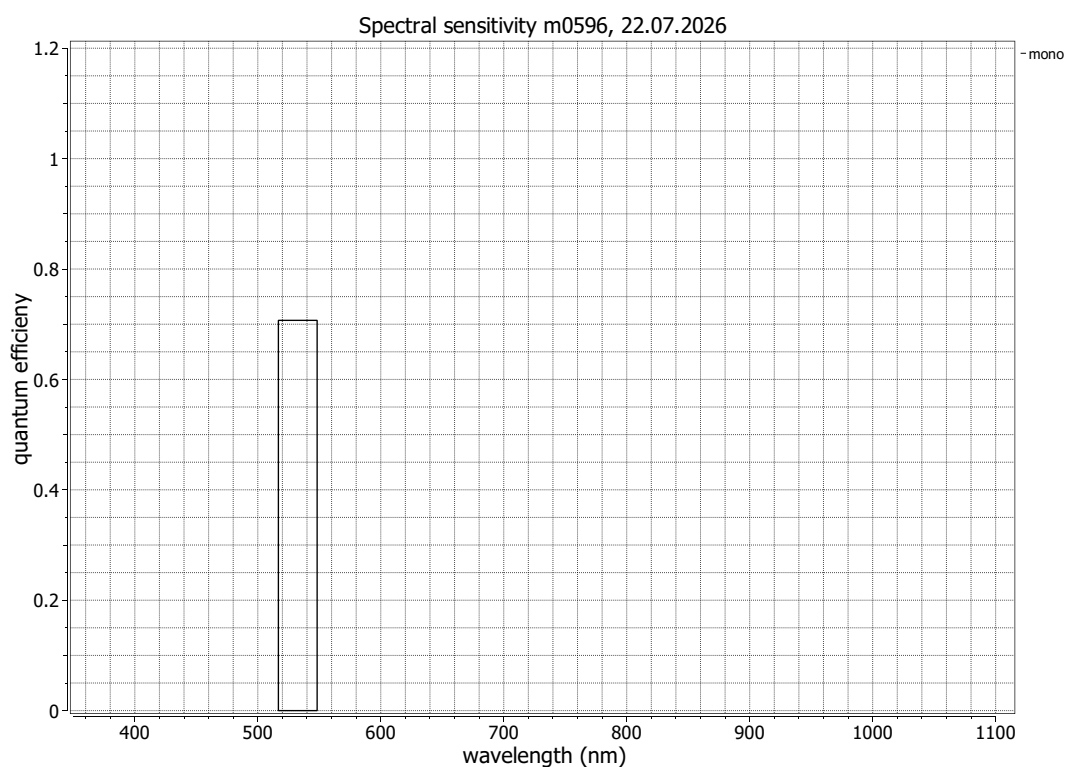
This data sheet describes the specification according to the standard 1288 Release 4.0 Linear issued on 21 June 2021 for "Characterization and Presentation of Specification Data for Image Sensors and Cameras" by the European Machine Vision Association (EMVA), published at <https://www.emva.org/standards-technology/emva-1288/> with proprietary extensions from AEON. The measurements were performed with the AEON ACC2b RGB-IR, Release 9, 31.10.2023, SN 0032(AMETEK), software version 2.0.

Measurements performed by Vision Research.

Type of data presented	Single
Vendor	Vision Research
Model	Phantom C540
Serial number	2122
Sensor diagonal	15.31 mm
Lens category	C-Mount
Resolution	2560 × 1680, 12 bit
Offset/Size used	0 × 0/ 2560 × 1680
Pixel size (h × v)	5.00 μm × 5.00 μm
Sensor	Vision Research Proprietary
Sensor type	CMOS
Shutter type	Global
Overlap cap.	Overlapping
Max. frame rate	1146.0 Hz
Interface type	Ethernet

Nr.	Centroid/FWHM	Gain, blacklevel	t_{exp} (ms)
1	532.5/31.5 nm	1 / 0.4%	0.120

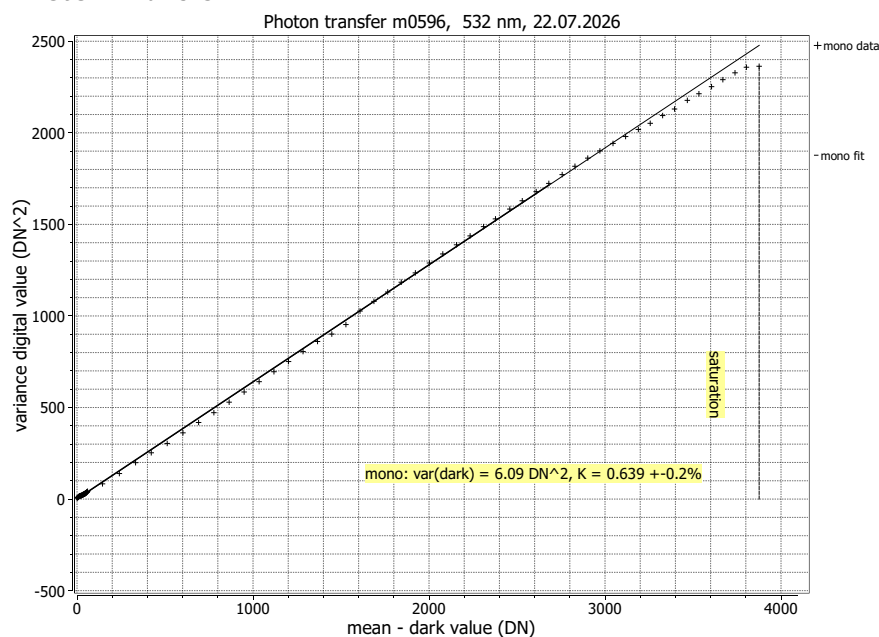
Optional data measured: None



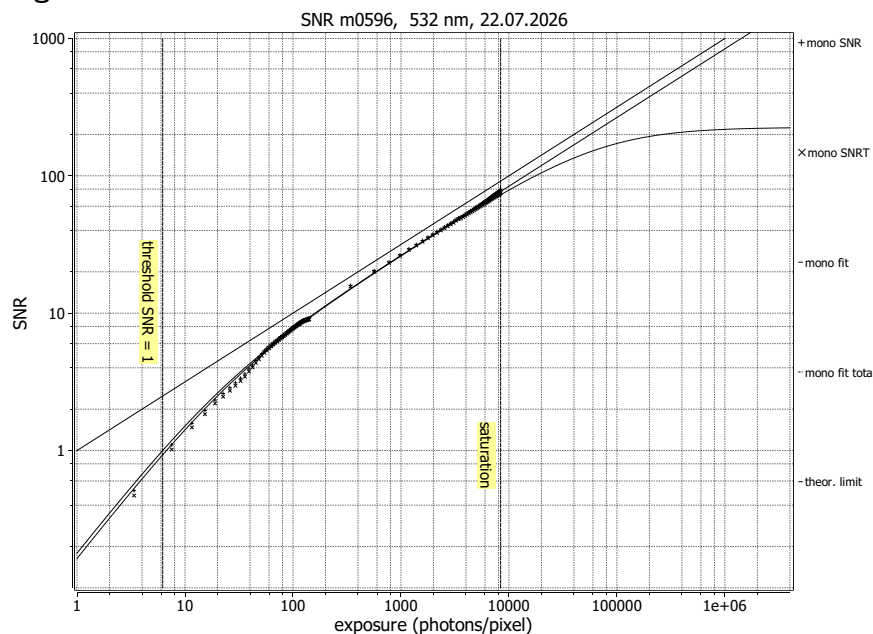
Summary Sheet for Operation Point 1 at a Wavelength of 533 nm

Type of data	Single	Gain, black-level	1 / 0.4%
Exposure control	By irradiance	Environmental temperature	24.7°C
Exposure time	120.000 us	Camera body temperature	31.6°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Mono 12	Wavelength, centr., FWHM	533 nm, 31.5 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η 70.7%

Overall system gain

K 0.6393 DN/e⁻

$1/K$ 1.564 e⁻/DN

Temporal dark noise

σ_d 3.83 e⁻

$\sigma_{y,\text{dark}}$ 2.47 DN

Signal-to-noise ratio

SNR_{max} 77.0

37.7 dB

$1/\text{SNR}_{\text{max}}$ 1.299 %

Absolute sensitivity threshold

$\mu_{e,\text{min}}$ 4.39 e⁻

$\mu_{e,\text{min},\text{area}}$ 0.176 e⁻/μm²

Saturation capacity

$\mu_{e,\text{sat}}$ 5922 e⁻

$\mu_{e,\text{sat},\text{area}}$ 237 e⁻/μm²

Dynamic range

DR 1348

62.59 dB

Spatial nonuniformities

DSNU₁₂₈₈ 1.74 e⁻

DSNU_{1288.col} 0.06 e⁻

DSNU_{1288.row} 0.09 e⁻

DSNU_{1288.pix} 1.74 e⁻

PRNU₁₂₈₈ 0.443 %

PRNU_{1288.col} 0.005 %

PRNU_{1288.row} 0.046 %

PRNU_{1288.pix} 0.441 %

Linearity error

LE 1.00%

Dark current

$\mu_{c,\text{mean}}$ 21.0 e⁻/s

$\mu_{c,\text{var}}$ 76.3 e⁻/s

EMVA 1288 Data Sheet m0583

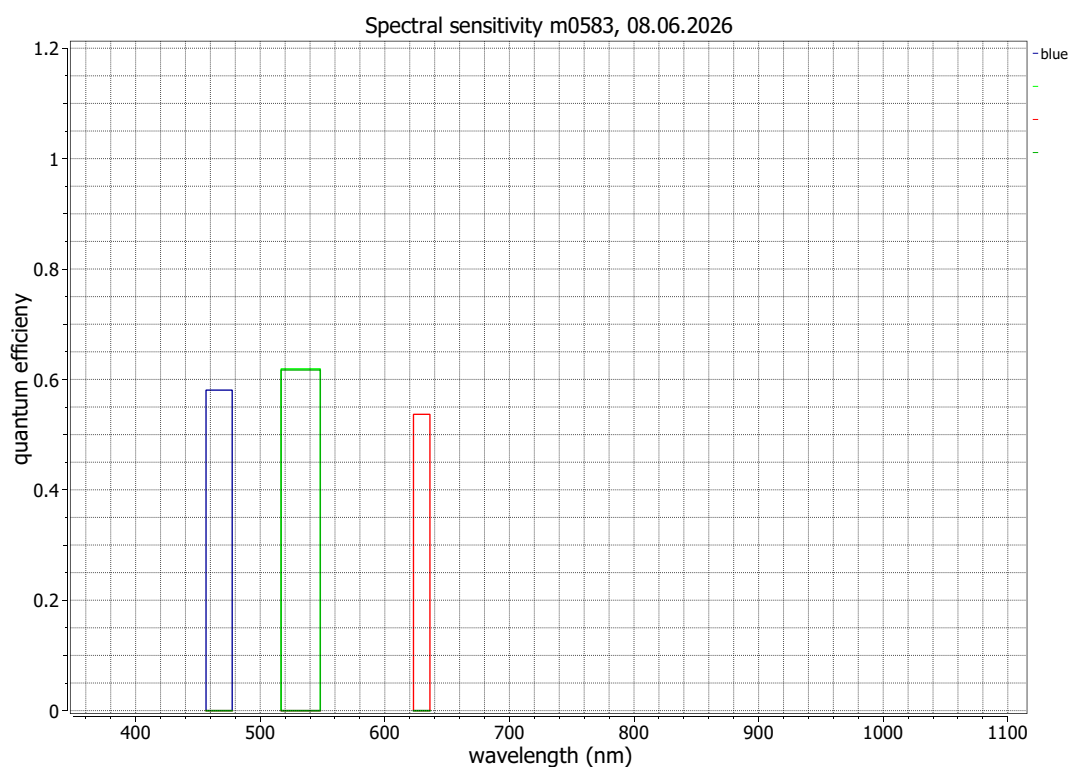
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Measurements performed by Vision Research.

Type of data presented	Single
Vendor	Vision Research
Model	Phantom C540
Serial number	10153
Sensor diagonal	15.31 mm
Lens category	C-Mount
Resolution	2560 × 1680, 12 bit
Offset/Size used	0 × 0/ 2560 × 1680
Pixel size (h×v)	5.00 μm × 5.00 μm
Sensor	Vision Research Proprietary
Sensor type	CMOS
Shutter type	Global
Overlap cap.	Overlapping
Max. frame rate	1146.0 Hz
Interface type	Ethernet

Nr.	Centroid/FWHM	Gain, blacklevel	t_{exp} (ms)
1	467.0/21.0 nm	1 / 0.4%	0.120
2	532.5/31.5 nm	1 / 0.4%	0.120
3	629.6/13.2 nm	1 / 0.4%	0.120

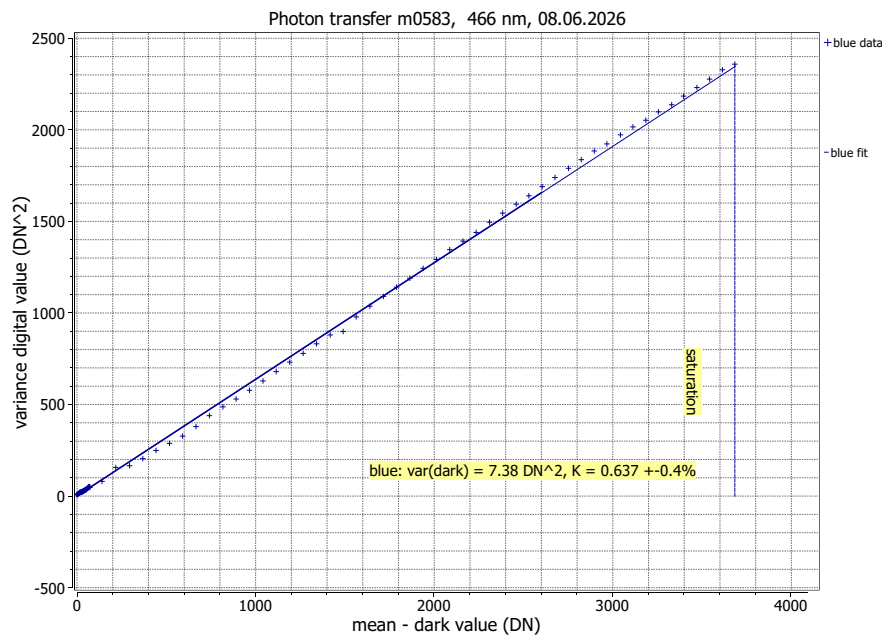
Optional data measured: None



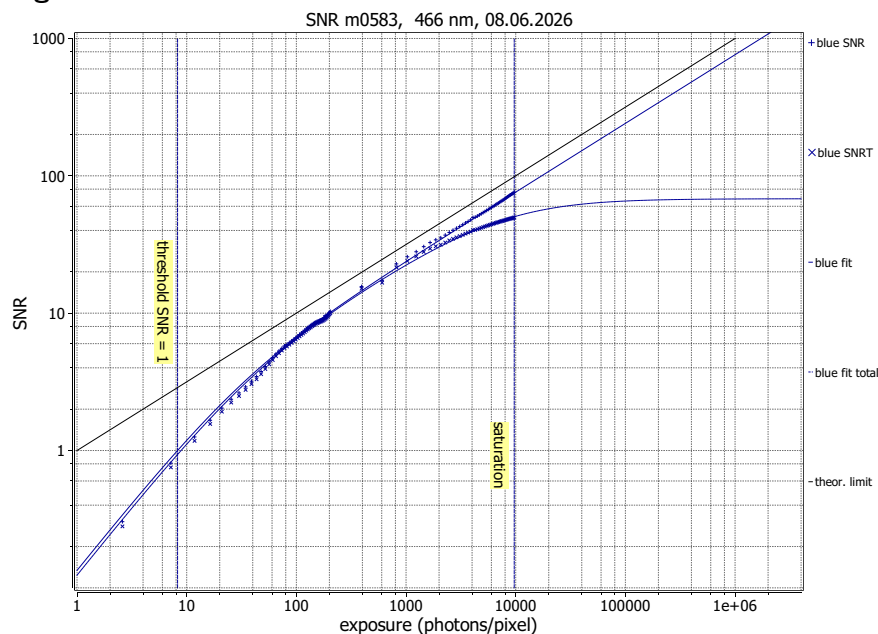
Summary Sheet for Operation Point 1 at a Wavelength of 467 nm

Type of data	Single	Gain, black-level	1 / 0.4%
Exposure control	By irradiance	Environmental temperature	23.5°C
Exposure time	120.000 us	Camera body temperature	30.0°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Color 12	Wavelength, centr., FWHM	467 nm, 21.0 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η 58.1%

Overall system gain

K 0.6369 DN/e⁻

$1/K$ 1.570 e⁻/DN

Temporal dark noise

σ_d 4.24 e⁻

$\sigma_{y, \text{dark}}$ 2.72 DN

Signal-to-noise ratio

SNR_{max} 75.0

37.5 dB

$1/\text{SNR}_{\text{max}}$ 1.333 %

Absolute sensitivity threshold

$\mu_{e, \text{min}}$ 4.79 e⁻

$\mu_{e, \text{min, area}}$ 0.192 e⁻/μm²

Saturation capacity

$\mu_{e, \text{sat}}$ 5626 e⁻

$\mu_{e, \text{sat, area}}$ 225 e⁻/μm²

Dynamic range

DR 1174

61.39 dB

Spatial nonuniformities

DSNU₁₂₈₈ 1.81 e⁻

DSNU_{1288.col} 0.05 e⁻

DSNU_{1288.row} 0.06 e⁻

DSNU_{1288.pix} 1.81 e⁻

PRNU₁₂₈₈ 1.47 %

PRNU_{1288.col} 0.04 %

PRNU_{1288.row} 0.77 %

PRNU_{1288.pix} 1.25 %

Linearity error

LE 1.29%

Dark current

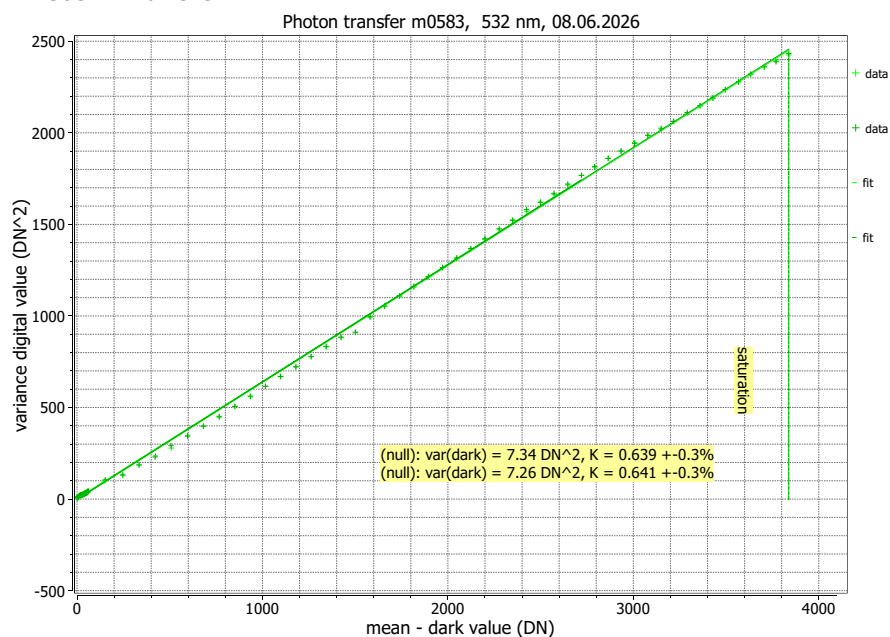
$\mu_{c, \text{mean}}$ -22.6 e⁻/s

$\mu_{c, \text{var}}$ 62.8 e⁻/s

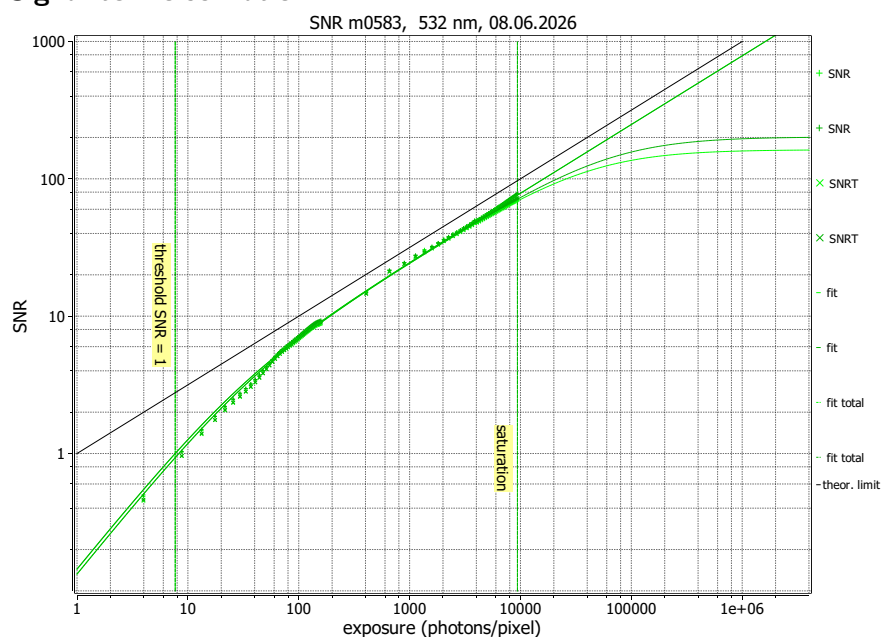
Summary Sheet for Operation Point 2 at a Wavelength of 533 nm

Type of data	Single	Gain, black-level	1 / 0.4%
Exposure control	By irradiance	Environmental temperature	23.4°C
Exposure time	120.000 us	Camera body temperature	29.9°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Color 12	Wavelength, centr., FWHM	533 nm, 31.5 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

 η 61.9%

Overall system gain

 K 0.6388 DN/e⁻
 $1/K$ 1.565 e⁻/DN

Temporal dark noise

 σ_d 4.22 e⁻
 $\sigma_{y,\text{dark}}$ 2.71 DN

Signal-to-noise ratio

 SNR_{max} 76.2

37.6 dB

 $1/\text{SNR}_{\text{max}}$ 1.312 %

Absolute sensitivity threshold

 $\mu_{e,\text{min}}$ 4.77 e⁻
 $\mu_{e,\text{min},\text{area}}$ 0.191 e⁻/μm²

Saturation capacity

 $\mu_{e,\text{sat}}$ 5814 e⁻
 $\mu_{e,\text{sat},\text{area}}$ 233 e⁻/μm²

Dynamic range

DR 1219

61.72 dB

Spatial nonuniformities

 DSNU_{1288} 1.80 e⁻
 $\text{DSNU}_{1288,\text{col}}$ 0.04 e⁻
 $\text{DSNU}_{1288,\text{row}}$ 0.06 e⁻
 $\text{DSNU}_{1288,\text{pix}}$ 1.80 e⁻
 PRNU_{1288} 0.614 %

 $\text{PRNU}_{1288,\text{col}}$ 0.008 %

 $\text{PRNU}_{1288,\text{row}}$ 0.359 %

 $\text{PRNU}_{1288,\text{pix}}$ 0.497 %

Linearity error

LE 1.78%

Dark current

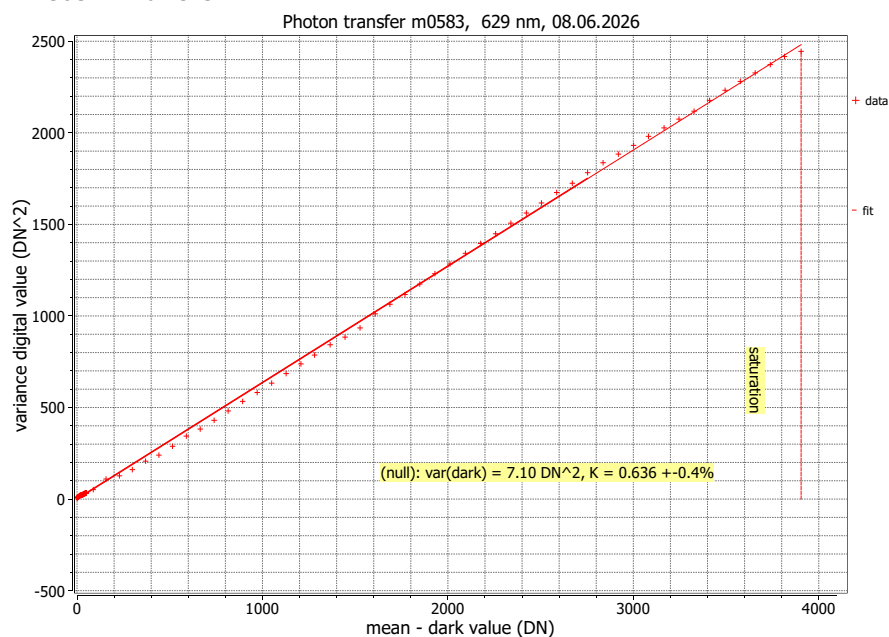
 $\mu_{c,\text{mean}}$ -22.9 e⁻/s

 $\mu_{c,\text{var}}$ 62.1 e⁻/s

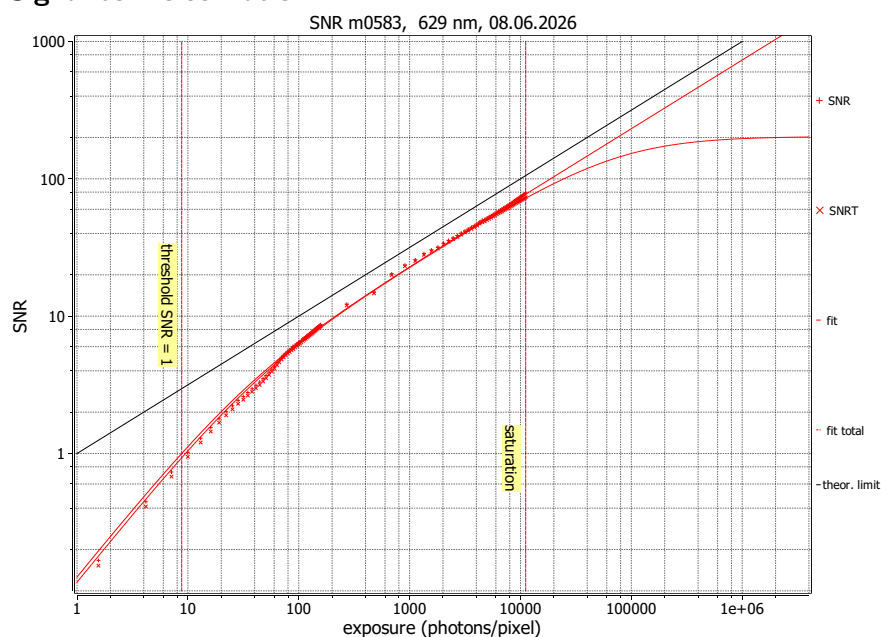
Summary Sheet for Operation Point 3 at a Wavelength of 630 nm

Type of data	Single	Gain, black-level	1 / 0.4%
Exposure control	By irradiance	Environmental temperature	23.2°C
Exposure time	120.000 us	Camera body temperature	29.9°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Color 12	Wavelength, centr., FWHM	630 nm, 13.2 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η 53.7%

Overall system gain

K 0.6358 DN/e⁻

$1/K$ 1.573 e⁻/DN

Temporal dark noise

σ_d 4.17 e⁻

$\sigma_{y,\text{dark}}$ 2.66 DN

Signal-to-noise ratio

SNR_{max} 77.3

37.8 dB

$1/\text{SNR}_{\text{max}}$ 1.293 %

Absolute sensitivity threshold

$\mu_{e,\text{min}}$ 4.72 e⁻

$\mu_{e,\text{min},\text{area}}$ 0.189 e⁻/μm²

Saturation capacity

$\mu_{e,\text{sat}}$ 5982 e⁻

$\mu_{e,\text{sat},\text{area}}$ 239 e⁻/μm²

Dynamic range

DR 1268

62.06 dB

Spatial nonuniformities

DSNU₁₂₈₈ 1.86 e⁻

DSNU_{1288.col} 0.04 e⁻

DSNU_{1288.row} 0.06 e⁻

DSNU_{1288.pix} 1.85 e⁻

PRNU₁₂₈₈ 0.491 %

PRNU_{1288.col} 0.007 %

PRNU_{1288.row} 0.193 %

PRNU_{1288.pix} 0.451 %

Linearity error

LE 1.30%

Dark current

$\mu_{c,\text{mean}}$ -18.3 e⁻/s

$\mu_{c,\text{var}}$ -1.55 e⁻/s

EMVA 1288 Data Sheet m0605

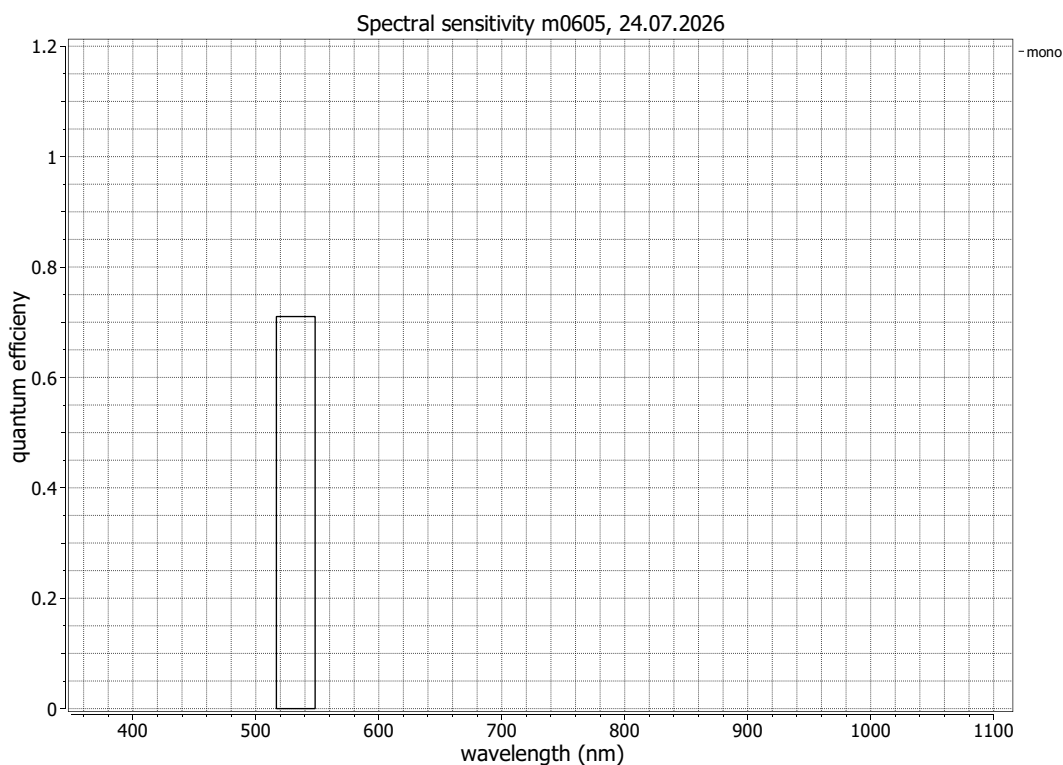
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Measurements performed by Vision Research.

Type of data presented	Single
Vendor	Vision Research
Model	Phantom C980
Serial number	2122
Sensor diagonal	22.03 mm
Lens category	C-Mount
Resolution	3840 × 2160, 12 bit
Offset/Size used	0 × 0/ 3840 × 2160
Pixel size (h × v)	5.00 μm × 5.00 μm
Sensor	Vision Research Proprietary
Sensor type	CMOS
Shutter type	Global
Overlap cap.	Overlapping
Max. frame rate	1180.0 Hz
Interface type	Ethernet

Nr.	Centroid/FWHM	Gain, blacklevel	t_{exp} (ms)
1	532.5/31.5 nm	1 / 0.4%	0.120

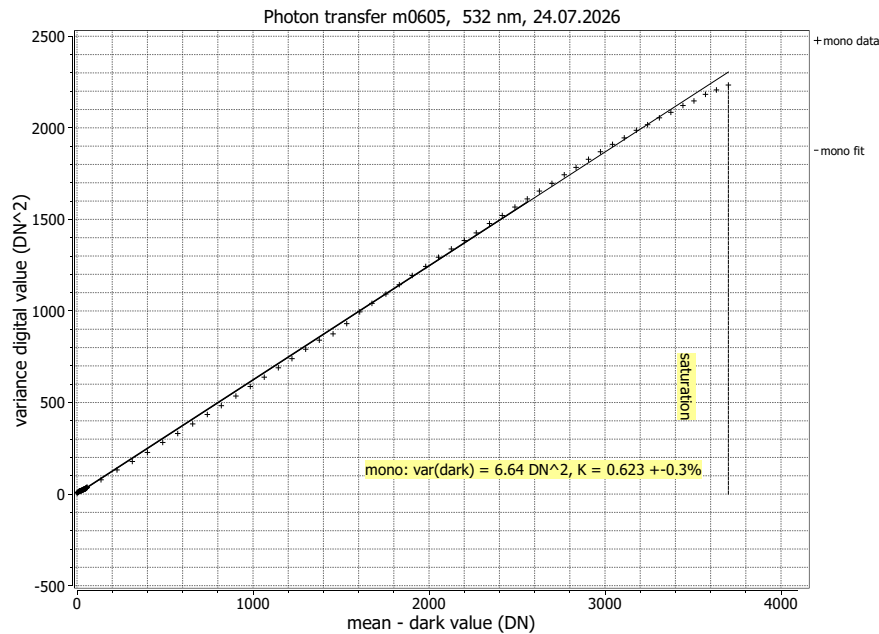
Optional data measured: None



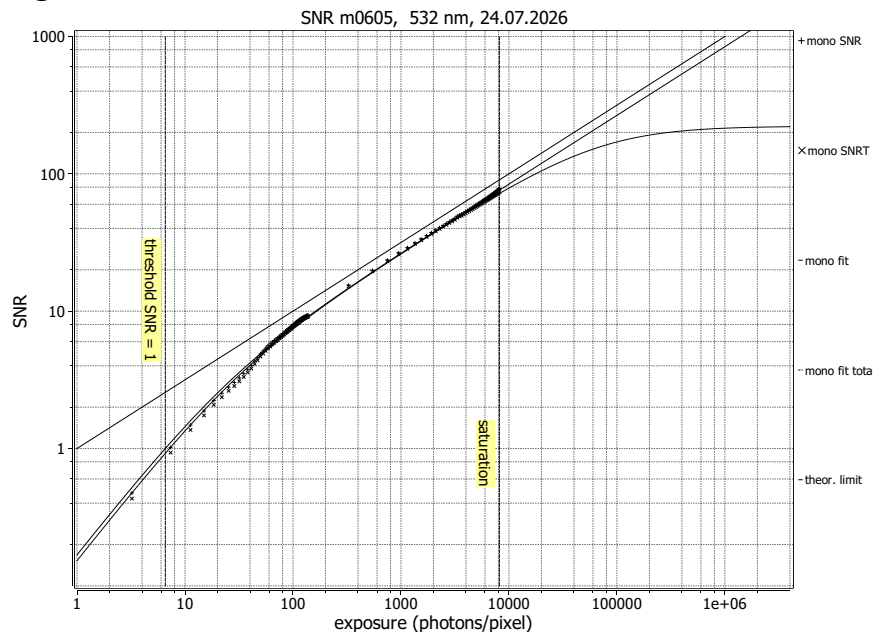
Summary Sheet for Operation Point 1 at a Wavelength of 533 nm

Type of data	Single	Gain, black-level	1 / 0.4%
Exposure control	By irradiance	Environmental temperature	23.7°C
Exposure time	120.000 us	Camera body temperature	30.4°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Mono 12	Wavelength, centr., FWHM	533 nm, 31.5 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η 71.0%

Overall system gain

K 0.6230 DN/e⁻

$1/K$ 1.605 e⁻/DN

Temporal dark noise

σ_d 4.11 e⁻

$\sigma_{y,\text{dark}}$ 2.58 DN

Signal-to-noise ratio

SNR_{max} 76.1

37.6 dB

$1/\text{SNR}_{\text{max}}$ 1.314 %

Absolute sensitivity threshold

$\mu_{e,\text{min}}$ 4.67 e⁻

$\mu_{e,\text{min},\text{area}}$ 0.187 e⁻/μm²

Saturation capacity

$\mu_{e,\text{sat}}$ 5793 e⁻

$\mu_{e,\text{sat},\text{area}}$ 232 e⁻/μm²

Dynamic range

DR 1241

61.88 dB

Spatial nonuniformities

DSNU₁₂₈₈ 1.96 e⁻

DSNU_{1288.col} 0.10 e⁻

DSNU_{1288.row} 0.08 e⁻

DSNU_{1288.pix} 1.95 e⁻

PRNU₁₂₈₈ 0.450 %

PRNU_{1288.col} 0.008 %

PRNU_{1288.row} 0.065 %

PRNU_{1288.pix} 0.445 %

Linearity error

LE 1.05%

Dark current

$\mu_{c,\text{mean}}$ -11.5 e⁻/s

$\mu_{c,\text{var}}$ 68.3 e⁻/s

EMVA 1288 Data Sheet m0585

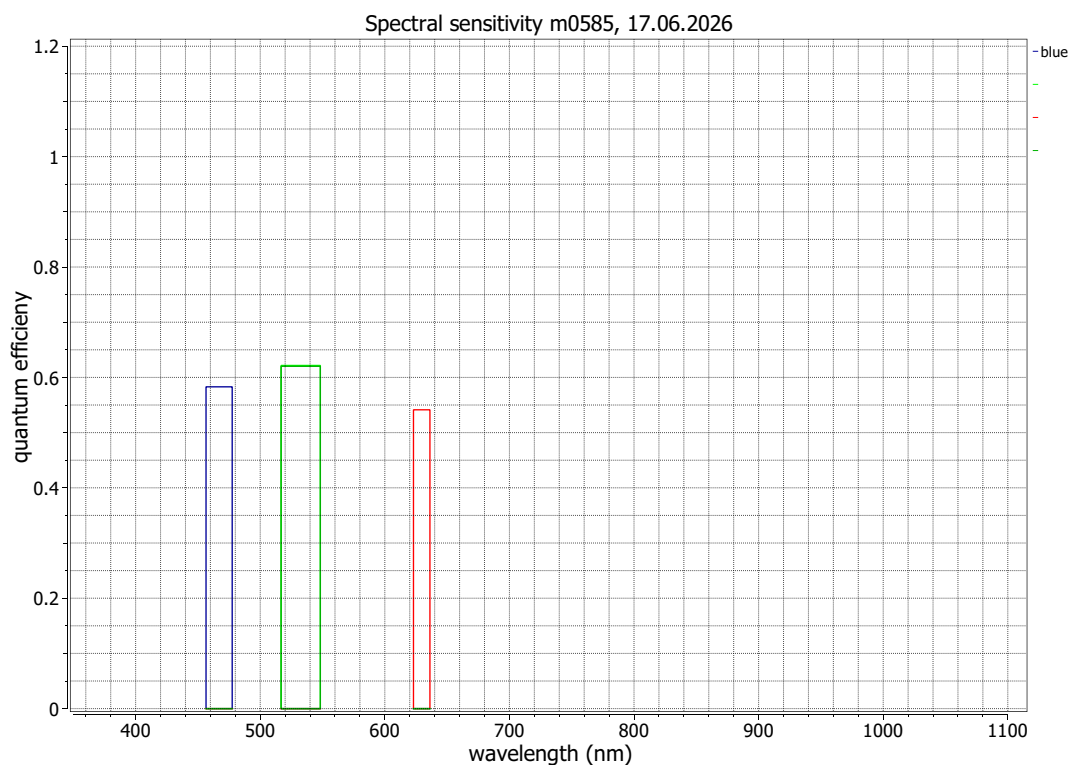
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Measurements performed by Vision Research.

Type of data presented	Single
Vendor	Vision Research
Model	Phantom C980
Serial number	1144
Sensor diagonal	22.03 mm
Lens category	C-Mount
Resolution	3840 × 2160, 12 bit
Offset/Size used	0 × 0/ 3840 × 2160
Pixel size (h×v)	5.00 μm × 5.00 μm
Sensor	Vision Research Proprietary
Sensor type	CMOS
Shutter type	Global
Overlap cap.	Overlapping
Max. frame rate	1180.0 Hz
Interface type	Ethernet

Nr.	Centroid/FWHM	Gain, blacklevel	t_{exp} (ms)
1	467.0/21.0 nm	1 / 0.4%	0.120
2	532.5/31.5 nm	1 / 0.4%	0.120
3	629.6/13.2 nm	1 / 0.4%	0.120

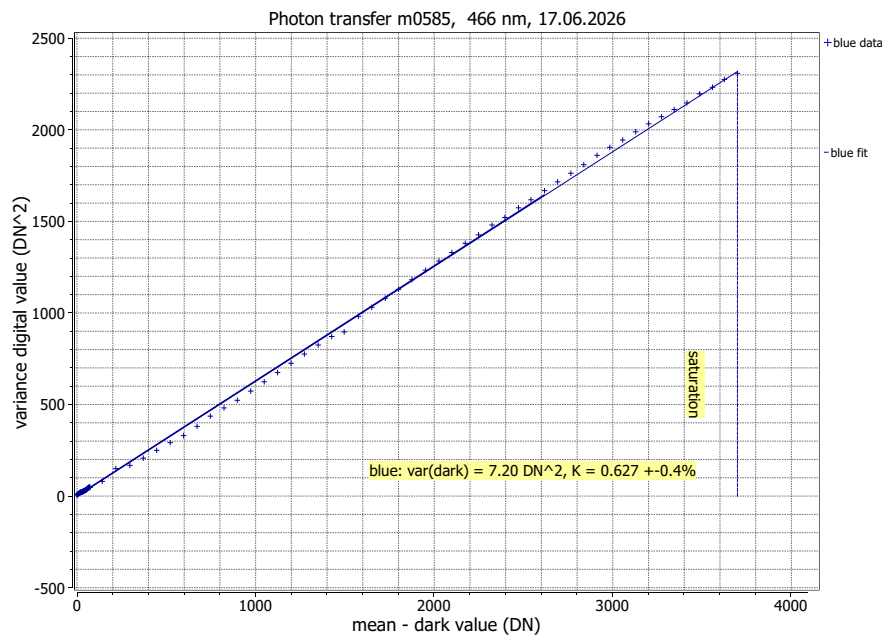
Optional data measured: None



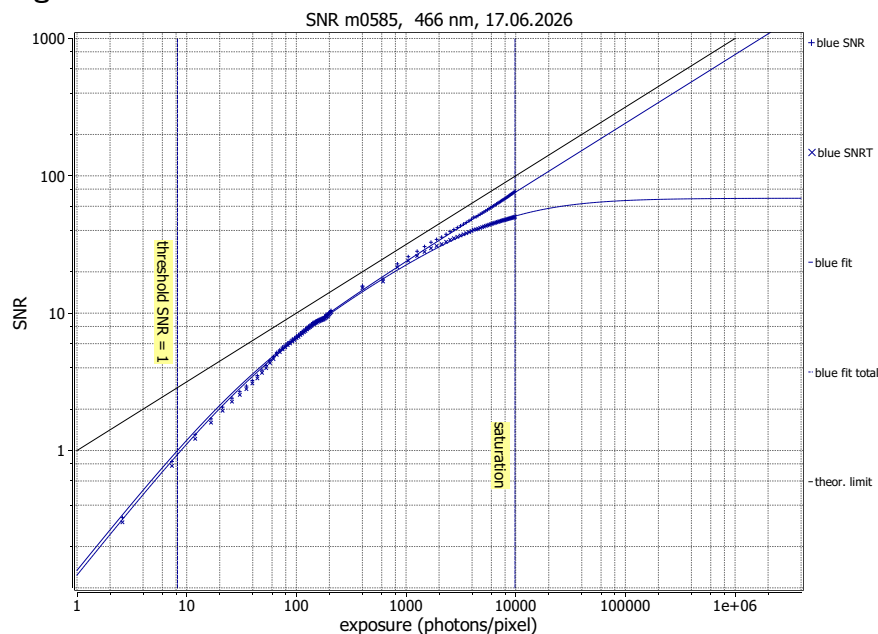
Summary Sheet for Operation Point 1 at a Wavelength of 467 nm

Type of data	Single	Gain, black-level	1 / 0.4%
Exposure control	By irradiance	Environmental temperature	22.6°C
Exposure time	120.000 us	Camera body temperature	28.9°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Color 12	Wavelength, centr., FWHM	467 nm, 21.0 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η 58.3%

Overall system gain

K 0.6272 DN/e⁻

$1/K$ 1.594 e⁻/DN

Temporal dark noise

σ_d 4.25 e⁻

$\sigma_{y,\text{dark}}$ 2.68 DN

Signal-to-noise ratio

SNR_{max} 75.8

37.6 dB

$1/\text{SNR}_{\text{max}}$ 1.320 %

Absolute sensitivity threshold

$\mu_{e,\text{min}}$ 4.81 e⁻

$\mu_{e,\text{min},\text{area}}$ 0.192 e⁻/μm²

Saturation capacity

$\mu_{e,\text{sat}}$ 5743 e⁻

$\mu_{e,\text{sat},\text{area}}$ 230 e⁻/μm²

Dynamic range

DR 1195

61.55 dB

Spatial nonuniformities

DSNU₁₂₈₈ 1.81 e⁻

DSNU_{1288.col} 0.05 e⁻

DSNU_{1288.row} 0.06 e⁻

DSNU_{1288.pix} 1.81 e⁻

PRNU₁₂₈₈ 1.46 %

PRNU_{1288.col} 0.04 %

PRNU_{1288.row} 0.74 %

PRNU_{1288.pix} 1.25 %

Linearity error

LE 1.21%

Dark current

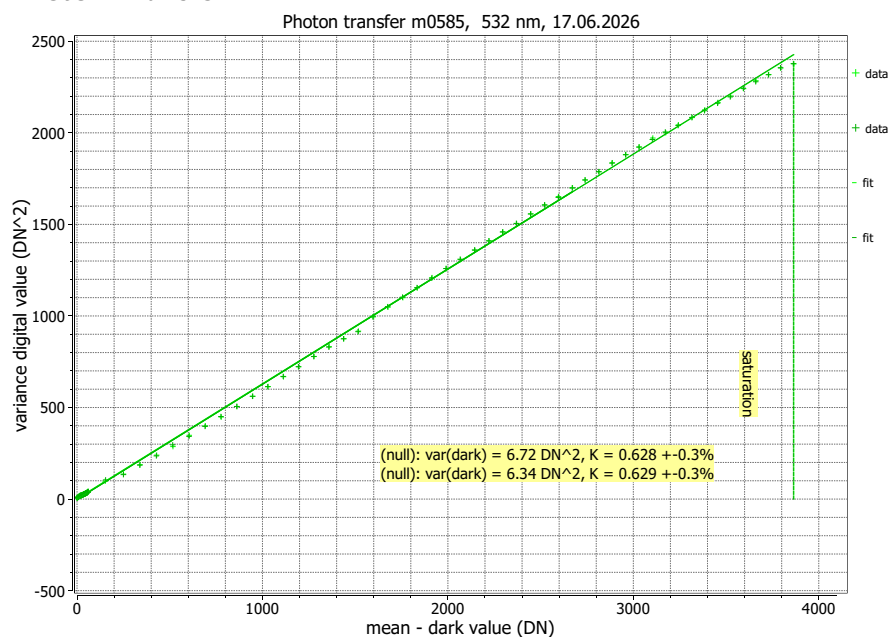
$\mu_{c,\text{mean}}$ -25.3 e⁻/s

$\mu_{c,\text{var}}$ 47.1 e⁻/s

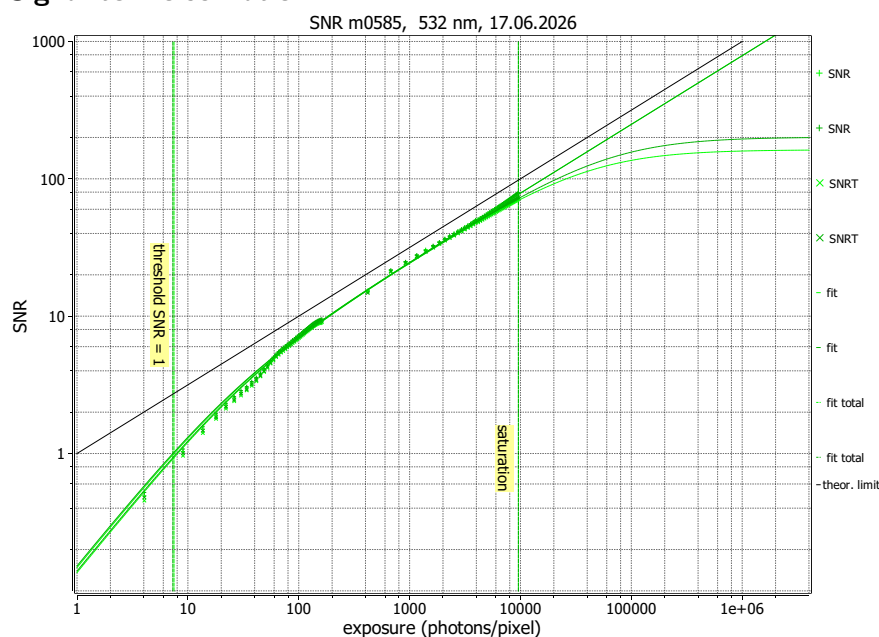
Summary Sheet for Operation Point 2 at a Wavelength of 533 nm

Type of data	Single	Gain, black-level	1 / 0.4%
Exposure control	By irradiance	Environmental temperature	22.4°C
Exposure time	120.000 us	Camera body temperature	28.8°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Color 12	Wavelength, centr., FWHM	533 nm, 31.5 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

 η 62.2%

Overall system gain

 K 0.6279 DN/e⁻
 $1/K$ 1.593 e⁻/DN

Temporal dark noise

 σ_d 4.10 e⁻
 $\sigma_{y,\text{dark}}$ 2.59 DN

Signal-to-noise ratio

 SNR_{max} 77.2

37.7 dB

 $1/\text{SNR}_{\text{max}}$ 1.296 %

Absolute sensitivity threshold

 $\mu_{e,\text{min}}$ 4.66 e⁻
 $\mu_{e,\text{min},\text{area}}$ 0.186 e⁻/μm²

Saturation capacity

 $\mu_{e,\text{sat}}$ 5955 e⁻
 $\mu_{e,\text{sat},\text{area}}$ 238 e⁻/μm²

Dynamic range

DR 1278

62.13 dB

Spatial nonuniformities

 DSNU_{1288} 1.80 e⁻
 $\text{DSNU}_{1288,\text{col}}$ 0.05 e⁻
 $\text{DSNU}_{1288,\text{row}}$ 0.06 e⁻
 $\text{DSNU}_{1288,\text{pix}}$ 1.80 e⁻
 PRNU_{1288} 0.615 %

 $\text{PRNU}_{1288,\text{col}}$ 0.017 %

 $\text{PRNU}_{1288,\text{row}}$ 0.365 %

 $\text{PRNU}_{1288,\text{pix}}$ 0.494 %

Linearity error

LE 1.68%

Dark current

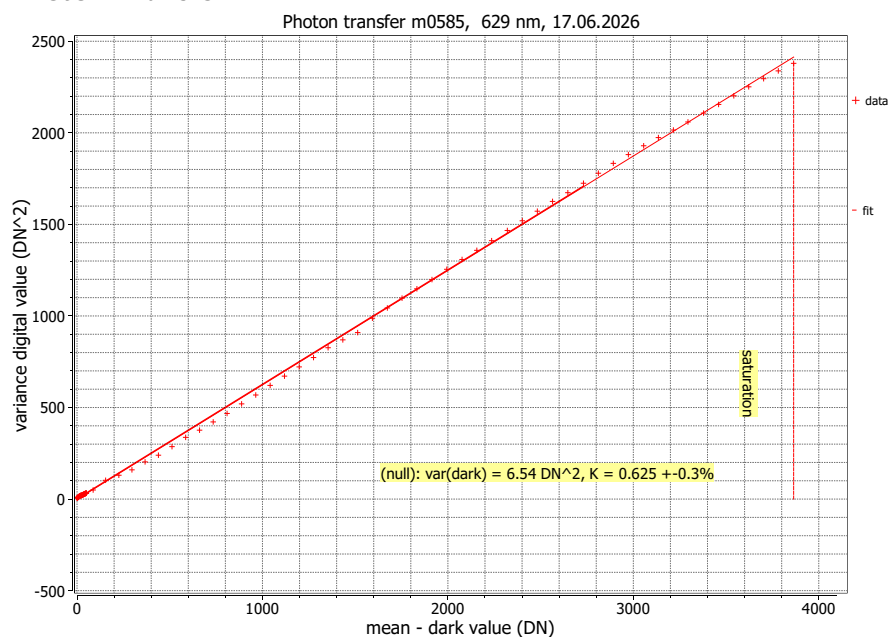
 $\mu_{c,\text{mean}}$ -13.1 e⁻/s

 $\mu_{c,\text{var}}$ 53.8 e⁻/s

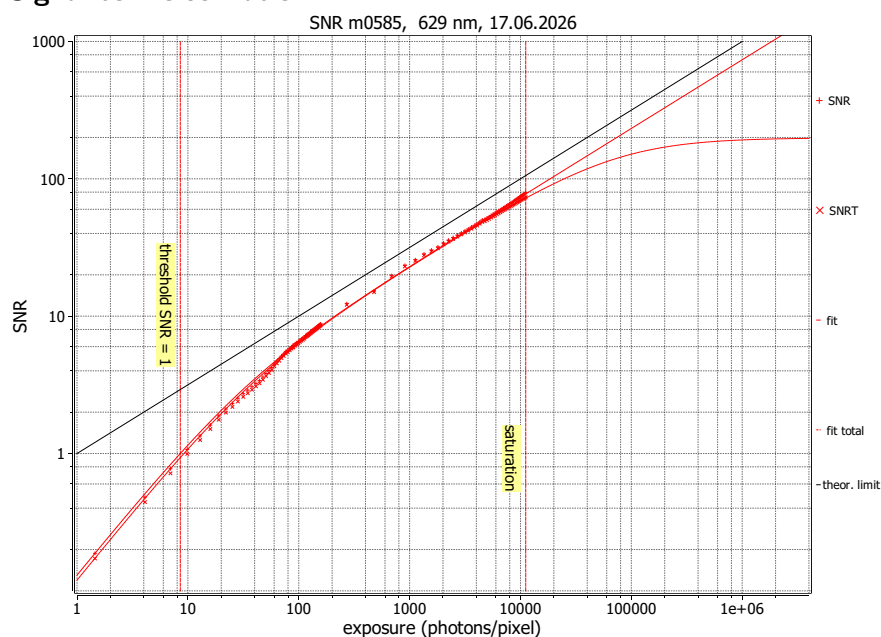
Summary Sheet for Operation Point 3 at a Wavelength of 630 nm

Type of data	Single	Gain, black-level	1 / 0.4%
Exposure control	By irradiance	Environmental temperature	22.3°C
Exposure time	120.000 us	Camera body temperature	28.7°C
Frame rate	1000.0 Hz	Internal temperature(s)	—
Data transfer mode	Color 12	Wavelength, centr., FWHM	630 nm, 13.2 nm

Photon Transfer



Signal-to-Noise Ratio



Quantum efficiency

η 54.1%

Overall system gain

K 0.6249 DN/e⁻

$1/K$ 1.600 e⁻/DN

Temporal dark noise

σ_d 4.07 e⁻

$\sigma_{y,\text{dark}}$ 2.56 DN

Signal-to-noise ratio

SNR_{max} 77.7

37.8 dB

$1/\text{SNR}_{\text{max}}$ 1.287 %

Absolute sensitivity threshold

$\mu_{e,\text{min}}$ 4.62 e⁻

$\mu_{e,\text{min},\text{area}}$ 0.185 e⁻/μm²

Saturation capacity

$\mu_{e,\text{sat}}$ 6037 e⁻

$\mu_{e,\text{sat},\text{area}}$ 241 e⁻/μm²

Dynamic range

DR 1306

62.32 dB

Spatial nonuniformities

DSNU₁₂₈₈ 1.77 e⁻

DSNU_{1288.col} 0.05 e⁻

DSNU_{1288.row} 0.06 e⁻

DSNU_{1288.pix} 1.77 e⁻

PRNU₁₂₈₈ 0.503 %

PRNU_{1288.col} 0.016 %

PRNU_{1288.row} 0.197 %

PRNU_{1288.pix} 0.462 %

Linearity error

LE 1.22%

Dark current

$\mu_{c,\text{mean}}$ -9.87 e⁻/s

$\mu_{c,\text{var}}$ 63.1 e⁻/s