EMVA 1288 Data Sheet m0708

This datasheet describes the specification according to the standard 1288 for “Characterization and Presentation of Specification Data for Image Sensors and Cameras of the European Machine Vision Association (EMVA)” (see www.standard1288.org or the Zenodo EMVA 1288 community) release 3.0 with proprietary extensions from AEON. The measurements were performed with the AEON ACC3 Release 6, 26.11.2016, SN 0005(MatrixVision). The performance parameters and estimated accuracy of the measurements are described in the technical report for the instrument, its calibration in the corresponding specification and calibration report.

Measurements performed by T.Renner, Matrix Vision GmbH

<table>
<thead>
<tr>
<th>Vendor</th>
<th>MATRIX VISION</th>
<th>Type of data presented</th>
<th>Single</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>mvBlueCOUGAR-XD107C</td>
<td>Operation point 1, (page 5)</td>
<td></td>
</tr>
<tr>
<td>Serial number</td>
<td>GX205616</td>
<td>Wavelength centroid</td>
<td>468.0 nm</td>
</tr>
<tr>
<td>Sensor diagonal</td>
<td>17.55 mm</td>
<td>Wavelength FWHM</td>
<td>20.0 nm</td>
</tr>
<tr>
<td>Lens category</td>
<td>C-Mount</td>
<td>Gain, black-level</td>
<td>12/0dB, 0.3</td>
</tr>
<tr>
<td>Resolution</td>
<td>3216 × 2208, 16 bit</td>
<td>Operation point 2, (page 11)</td>
<td></td>
</tr>
<tr>
<td>Pixel size</td>
<td>4.50 µm × 4.50 µm</td>
<td>Wavelength centroid</td>
<td>536.0 nm</td>
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<tr>
<td>Sensor</td>
<td>IMX420</td>
<td>Wavelength FWHM</td>
<td>31.0 nm</td>
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<td>Sensor type</td>
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<td>Gain, black-level</td>
<td>12/0dB, 0.3</td>
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<td>Shutter type</td>
<td>Global</td>
<td>Operation point 3, (page 17)</td>
<td></td>
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<tr>
<td>Overlap capabilities</td>
<td>Overlapping</td>
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<td>Maximum frame rate</td>
<td>16.8 Hz</td>
<td>Wavelength FWHM</td>
<td>13.0 nm</td>
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<tr>
<td>Interface type</td>
<td>GigE Vision</td>
<td>Gain, black-level</td>
<td>12/0dB, 0.3</td>
</tr>
</tbody>
</table>

Optional data measured

None
EMVA 1288 Summary Sheet for Operating Point 1

<table>
<thead>
<tr>
<th>Type of data</th>
<th>Single</th>
<th>Gain, black-level</th>
<th>12/0dB, 0.3</th>
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</thead>
<tbody>
<tr>
<td>Exposure control</td>
<td>By irradiance</td>
<td>Environmental temperature</td>
<td>27.1°C</td>
</tr>
<tr>
<td>Exposure time</td>
<td>19.00 ms</td>
<td>Camera body temperature</td>
<td>57.7°C</td>
</tr>
<tr>
<td>Frame rate</td>
<td>13.0 Hz</td>
<td>Internal temperature(s)</td>
<td>—</td>
</tr>
<tr>
<td>Data transfer mode</td>
<td>BayerRG16</td>
<td>Wavelength, centr., FWHM</td>
<td>468 nm, 20.0 nm</td>
</tr>
</tbody>
</table>

Quantum efficiency
\[ \eta = 50.2\% \]

Overall system gain
\[ K = 2.549 \text{ DN/ } e^{-} \]
\[ 1/K = 0.392 \text{ e }^{-/\text{DN}} \]

Temporal dark noise & DSNU
\[ \sigma_y,\text{dark} = 11.95 \text{ DN} \]
\[ \text{DSNU}_{1288} = — \text{ DN} \]
\[ \sigma_d = 4.69 \text{ e}^{-} \]
\[ \text{DSNU}_{1288} = — \text{ e}^{-} \]

Signal-to-noise ratio & PRNU
\[ \text{SNR}_{\text{max}} = 159 \]
\[ \text{SNR}_{\text{max}} = 44.0 \text{ dB} \]
\[ 1/\text{SNR}_{\text{max}} = 7.3 \text{ bit} \]
\[ \text{PRNU}_{1288} = 0.63\% \]
\[ \text{PRNU}_{1288} = — \% \]

Nonlinearity
\[ \text{LE} = 0.24\% \]
\[ \text{LE}_{\text{min}} = -0.28\% \]
\[ \text{LE}_{\text{max}} = 0.19\% \]

Sensitivity & saturation
\[ \mu_{p,\text{min}} = 10.39 \text{ p } \]
\[ \mu_{p,\text{sat}} = 0.513 \text{ p }/\mu m^2 \]
\[ \mu_{e,\text{min}} = 50174 \text{ p } \]
\[ \mu_{e,\text{sat}} = 2478 \text{ p }/\mu m^2 \]
\[ \mu_{e,\text{min}} = 5.22 \text{ e }^{-} \]
\[ \mu_{e,\text{sat}} = 0.258 \text{ e }^{-}/\mu m^2 \]
\[ \mu_{e,\text{sat}} = 25179 \text{ e }^{-} \]
\[ \mu_{e,\text{sat}} = 1243 \text{ e }^{-}/\mu m^2 \]

Dynamic range
\[ \text{DR} = 4828 \]
\[ \text{DR} = 73.7 \text{ dB} \]
\[ \text{DR} = 12.2 \text{ bit} \]

Dark current
\[ \mu_{c,\text{mean}} = — \text{ DN/s} \]
\[ \mu_{c,\text{mean}} = — \text{ e }^{-/s} \]
\[ \mu_{c,\text{var}} = — \text{ e }^{-/s} \]
EMVA 1288 Summary Sheet for Operating Point 2

Type of data | Single
---|---
Exposure control | By irradiance
Exposure time | 19.00 ms
Frame rate | 13.0 Hz
Data transfer mode | BayerRG16

Gain, black-level | 12/0dB, 0.3
Environmental temperature | 27.1°C
Camera body temperature | 57.7°C
Internal temperature(s) | —
Wavelength, centr., FWHM | 536 nm, 31.0 nm

Quantum efficiency

\( \eta \) | 61.4%

Overall system gain

\( K \) | 2.540 DN/e\(^{-}\)
\( 1/K \) | 0.394 e\(^{-}\)/DN

Temporal dark noise & DSNU

\( \sigma_{y,\text{dark}} \) | 11.95 DN
DSNU\(_{1288} \) | — DN
\( \sigma_{d} \) | 4.70 e\(^{-}\)
DSNU\(_{1288} \) | — e\(^{-}\)

Signal-to-noise ratio & PRNU

SNR\(_{\text{max}} \) | 159
\( 1/\text{SNR}_{\text{max}} \) | 44.0 dB
7.3 bit
1/SNR\(_{\text{max}} \) | 0.63%
PRNU\(_{1288} \) | — %

Nonlinearity

LE | 0.25%
LE\(_{\text{min}} \) | -0.30%
LE\(_{\text{max}} \) | 0.21%

Sensitivity & saturation

\( \mu_{p,\text{min}} \) | 8.52 p
\( \mu_{p,\text{sat}} \) | 0.421 p/\( \mu \text{m}^2 \)
41111 p
2030 p/\( \mu \text{m}^2 \)
\( \mu_{e,\text{min}} \) | 5.23 e\(^{-}\)
\( \mu_{e,\text{sat}} \) | 0.258 e\(^{-}\)/\( \mu \text{m}^2 \)
25246 e\(^{-}\)
1247 e\(^{-}\)/\( \mu \text{m}^2 \)

Dynamic range

DR | 4825
73.7 dB
12.2 bit

Dark current

\( \mu_{c,\text{mean}} \) | — DN/s
\( \mu_{c,\text{mean}} \) | — e\(^{-}\)/s
\( \mu_{c,\text{var}} \) | — e\(^{-}\)/s
EMVA 1288 Summary Sheet for Operating Point 3

<table>
<thead>
<tr>
<th>Type of data</th>
<th>Single</th>
<th>Gain, black-level</th>
<th>12/0dB, 0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure control</td>
<td>By irradiance</td>
<td>Environmental temperature</td>
<td>27.1°C</td>
</tr>
<tr>
<td>Exposure time</td>
<td>19.00 ms</td>
<td>Camera body temperature</td>
<td>57.7°C</td>
</tr>
<tr>
<td>Frame rate</td>
<td>13.0 Hz</td>
<td>Internal temperature(s)</td>
<td>—</td>
</tr>
<tr>
<td>Data transfer mode</td>
<td>BayerRG16</td>
<td>Wavelength, centr., FWHM</td>
<td>630 nm, 13.0 nm</td>
</tr>
</tbody>
</table>

**Quantum efficiency**

\[ \eta = 57.5\% \]

**Overall system gain**

\[ K = 2.519 \text{DN/e}^- \]

\[ 1/K = 0.397 \text{e}^-/\text{DN} \]

**Temporal dark noise & DSNU**

\[ \sigma_{y,dark} = 13.25 \text{DN} \]

\[ \text{DSNU}_{1288} = — \text{DN} \]

\[ \sigma_d = 5.26 \text{e}^- \]

\[ \text{DSNU}_{1288} = — \text{e}^- \]

**Signal-to-noise ratio & PRNU**

\[ \text{SNR}_{\text{max}} = 160 \]

44.1 dB

7.3 bit

\[ 1/\text{SNR}_{\text{max}} = 0.62\% \]

\[ \text{PRNU}_{1288} = — \% \]

**Nonlinearity**

\[ \text{LE} = 0.37\% \]

\[ \text{LE}_{\text{min}} = -0.48\% \]

\[ \text{LE}_{\text{max}} = 0.25\% \]

**Sensitivity & saturation**

\[ \mu_{p,\text{min}} = 10.05 \text{p} \]

0.496 p/\(\text{m}^2\)

\[ \mu_{p,\text{sat}} = 44593 \text{p} \]

2202 p/\(\text{m}^2\)

\[ \mu_{e,\text{min}} = 5.78 \text{e}^- \]

0.286 e^-/\(\text{m}^2\)

\[ \mu_{e,\text{sat}} = 25657 \text{e}^- \]

1267 e^-/\(\text{m}^2\)

**Dynamic range**

\[ \text{DR} = 4436 \]

72.9 dB

12.1 bit

**Dark current**

\[ \mu_{c,\text{mean}} = — \text{DN/s} \]

\[ \mu_{c,\text{mean}} = — \text{e}^-/\text{s} \]

\[ \mu_{c,\text{var}} = — \text{e}^-/\text{s} \]
EMVA 1288 Data Sheet m0661

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](http://www.standard1288.org) and the Zenodo EMVA 1288 community with proprietary extensions from AEON. The measurements were performed with the AEON ACC3 Release 6, 26.11.2016, SN 0005(MatrixVision).

Measurements performed by T.Renner, Matrix Vision GmbH

<table>
<thead>
<tr>
<th>Vendor</th>
<th>MATRIX VISION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>mvBlueCOUGAR-XD107C</td>
</tr>
<tr>
<td>Serial number</td>
<td>GX205616</td>
</tr>
<tr>
<td>Sensor diagonal</td>
<td>17.55 mm</td>
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<tr>
<td>Lens category</td>
<td>C-Mount</td>
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<tr>
<td>Resolution</td>
<td>3216 × 2208, 12 bit</td>
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<tr>
<td>Pixel size (h×v)</td>
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<tr>
<td>Sensor</td>
<td>IMX420</td>
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<tr>
<td>Sensor type</td>
<td>CMOS</td>
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<td>Shutter type</td>
<td>Global</td>
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<td>Overlap cap.</td>
<td>Overlapping</td>
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<td>Max. frame rate</td>
<td>16.8 Hz</td>
</tr>
<tr>
<td>Interface type</td>
<td>GigE Vision</td>
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</tbody>
</table>

Type of data presented: Single

**Operation point 1 (page 5)**
- Wavelength centroid: 468.0 nm
- Wavelength FWHM: 20.0 nm
- Gain, black-level: 0dB, 0.1

**Operation point 2 (page 20)**
- Wavelength centroid: 536.0 nm
- Wavelength FWHM: 31.0 nm
- Gain, black-level: 0dB, 0.1

**Operation point 3 (page 35)**
- Wavelength centroid: 630.0 nm
- Wavelength FWHM: 13.0 nm
- Gain, black-level: 0dB, 0.1

Optional data measured:
- None

![Quantum efficiency chart](chart.png)

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Summary Sheet for Operation Point 1 at a Wavelength of 468 nm

Type of data | Single
---|---
Exposure control | By irradiance
Exposure time | 18.00 ms
Frame rate | 16.8 Hz
Data transfer mode | BayerRG12

Gain, black-level | 0dB, 0.1
Environmental temperature | 24.8°C
Camera body temperature | 54.9°C
Internal temperature(s) | —

Wavelength, centr., FWHM | 468 nm, 20.0 nm

Photon Transfer

- Photon transfer m0661, 468 nm, 30.01.2018
- Blue data
- Blue fit
- Blue fit total

Signal-to-Noise Ratio

- SNR m0661, 468 nm, 30.01.2018
- Blue data
- Blue fit
- Blue fit total
- Theoretical limit

Quantum efficiency

\( \eta = 50.3\% \)

Overall system gain

\( K = 0.158 \text{ DN/e}^- \)
\( 1/K = 6.318 \text{ e}^-/\text{DN} \)

Temporal dark noise

\( \sigma_d = 6.03 \text{e}^- \)
\( \sigma_y,dark = 1.00 \text{ DN} \)

Signal-to-noise ratio

- \( \text{SNR}_{\text{max}} = 159 \)
- 44.0 dB
- 7.3 bit
- \( 1/\text{SNR}_{\text{max}} = 0.63\% \)

Absolute sensitivity threshold

- \( \mu_{\text{p}.\min} = 13.57 \text{ p} \)
- \( \mu_{\text{p}.\min}.\text{area} = 0.670 \text{ p/}\mu \text{m}^2 \)
- \( \mu_{\text{e}.\min} = 6.82 \text{ e}^- \)
- \( \mu_{\text{e}.\min}.\text{area} = 0.337 \text{ e}^-/\mu \text{m}^2 \)

Saturation capacity

- \( \mu_{\text{p}.\text{sat}} = 50200 \text{ p} \)
- \( \mu_{\text{p}.\text{sat}.\text{area}} = 2479 \text{ p/}\mu \text{m}^2 \)
- \( \mu_{\text{e}.\text{sat}} = 25233 \text{ e}^- \)
- \( \mu_{\text{e}.\text{sat}.\text{area}} = 1246 \text{ e}^-/\mu \text{m}^2 \)

Dynamic range

- \( \text{DR} = 3700 \)
- 71.4 dB
- 11.9 bit

Spatial nonuniformities

- \( \text{DSNU}_{\text{1288}} = 3.29 \text{ e}^- \)
- \( \text{PRNU}_{\text{1288}} = 0.52 \text{ DN} \)

Linearity error

- \( \text{LE}_{\text{min}} = -0.34\% \)
- \( \text{LE}_{\text{max}} = 0.21\% \)

Dark current

- \( \mu_{\text{c}.\text{mean}} = -50 \pm 8 \text{ e}^-/\text{s} \)
- \( -8.0 \text{ DN/s} \)
- \( \mu_{\text{c}.\text{var}} = -44 \pm 12 \text{ e}^-/\text{s} \)
- \( T_d = - ^\circ \text{C} \)
### Summary Sheet for Operation Point 2 at a Wavelength of 536 nm

#### Type of data
- Single

#### Exposure control
- By irradiance

#### Exposure time
- 18.00 ms

#### Frame rate
- 16.8 Hz

#### Data transfer mode
- BayerRG12

#### Gain, black-level
- 0dB, 0.1

#### Environmental temperature
- 25.0°C

#### Camera body temperature
- 55.4°C

#### Internal temperature(s)
- —

### Photon Transfer

#### Signal-to-Noise Ratio

- **SNR**
  - **max** 158 dB
  - 7.3 bit
  - **1/SNR** max 0.63%

- **Saturation capacity**
  - **μc.s.at** 41171 p
  - **μc.s.at.area** 2033 p/μm²
  - **μc.s.at** 25115 e⁻¹
  - **μc.s.at.area** 1240 e⁻¹/μm²

- **Dynamic range**
  - **DR** 3690
  - 71.3 dB
  - 11.8 bit

- **Spatial nonuniformities**
  - **DSNU** 1288
  - **PRNU** 0.70%

- **Linearity error**
  - **LE** min -0.38%
  - **LE** max 0.33%

- **Dark current**
  - **μc.mean** -50 ± 8 e⁻¹/s
  - **μc.var** -44 ± 12 e⁻¹/s
  - **T_d** — °C
## Summary Sheet for Operation Point 3 at a Wavelength of 630 nm

<table>
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<th>Parameter</th>
<th>Value</th>
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<tbody>
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<td>Type of data</td>
<td>Single</td>
</tr>
<tr>
<td>Exposure control</td>
<td>By irradiance</td>
</tr>
<tr>
<td>Exposure time</td>
<td>18.00 ms</td>
</tr>
<tr>
<td>Frame rate</td>
<td>16.8 Hz</td>
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<tr>
<td>Data transfer mode</td>
<td>BayerRG12</td>
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<tr>
<td>Gain, black-level</td>
<td>0dB, 0.1</td>
</tr>
<tr>
<td>Environmental temperature</td>
<td>25.2 °C</td>
</tr>
<tr>
<td>Camera body temperature</td>
<td>56.0 °C</td>
</tr>
<tr>
<td>Internal temperature(s)</td>
<td>—</td>
</tr>
<tr>
<td>Wavelength, centr., FWHM</td>
<td>630 nm, 13.0 nm</td>
</tr>
</tbody>
</table>

### Photon Transfer

![Photon Transfer Graph](image)

### Signal-to-Noise Ratio

![Signal-to-Noise Ratio Graph](image)

### Quantum efficiency

\[ \eta = 56.7\% \]

### Overall system gain

\[ K = 0.158 \text{ DN/e}^{-} \]
\[ 1/K = 6.323 \text{ e}^{-}/\text{DN} \]

### Temporal dark noise

\[ \sigma_d = 6.08 \text{ e}^{-} \]
\[ \sigma_y.dark = 1.00 \text{ DN} \]

### Signal-to-noise ratio

\[ \text{SNR}_{\text{max}} = 159 \]
\[ 44.1 \text{ dB} \]
\[ 7.3 \text{ bit} \]
\[ 1/\text{SNR}_{\text{max}} = 0.63\% \]

### Absolute sensitivity threshold

\[ \mu.p.\text{min} = 12.11 \text{ p} \]
\[ \mu.p.\text{min.area} = 0.598 \text{ p}/\mu\text{m}^2 \]
\[ \mu.e.\text{min} = 6.87 \text{ e}^{-} \]
\[ \mu.e.\text{min.area} = 0.339 \text{ e}^{-}/\mu\text{m}^2 \]

### Saturation capacity

\[ \mu.p.\text{sat} = 44835 \text{ p} \]
\[ \mu.p.\text{sat.area} = 2214 \text{ p}/\mu\text{m}^2 \]
\[ \mu.e.\text{sat} = 25438 \text{ e}^{-} \]
\[ \mu.e.\text{sat.area} = 1256 \text{ e}^{-}/\mu\text{m}^2 \]

### Dynamic range

\[ \text{DR} = 3704 \]
\[ 71.4 \text{ dB} \]
\[ 11.9 \text{ bit} \]

### Spatial nonuniformities

\[ \text{DSNU}_{1288} = 3.26 \text{ e}^{-} \]
\[ 0.52 \text{ DN} \]
\[ \text{PRNU}_{1288} = 0.71\% \]

### Linearity error

\[ \text{LE}_{\text{min}} = -1.09\% \]
\[ \text{LE}_{\text{max}} = 0.48\% \]

### Dark current

\[ \mu.c.\text{mean} = -49 \pm 8 \text{ e}^{-}/\text{s} \]
\[ -7.8 \text{ DN/s} \]
\[ \mu.c.\text{var} = -38 \pm 12 \text{ e}^{-}/\text{s} \]
\[ T_d = -{^\circ}{\text{C}} \]