The high resolution X-ray imaging system is designed for the application of X-ray imaging in synchrotron radiation facility, which consists of a combination of the imaging unit M11427 series and digital CMOS cameras. Adopting unique indirect type X-ray imaging mechanism, it enables to combine various type of cameras for real time X-ray imaging.

The imaging unit of this system uses an optical design that reduces damage to the detector due to X-rays, so it also supports imaging with high-power X-ray beams such as radiation facilities.

Digital CMOS cameras can be selected from four types, including sensitivity, resolution, and readout speed, depending on the application. In addition, it can be easily replaced by the dedicated camera mounting mechanism.

**FEATURES**
- X-ray proof design
- High resolution
- Easy to exchange phosphors
- Remote controllable focus adjustment
- One touch design for camera attachment
- Highly durable single crystal phosphor screen
  (For the AA50 optional use)

**APPLICATIONS**
- Synchrotron imaging
- X-ray beam alignment
- X-ray CT
- X-ray microscope
Imaging unit line up

Microscopic type

**M11427-54, -55, -56 AA50**

- Resolution: 4 μm or smaller
- *Phosphor screen is not included. Please select from options.

- Resolution: 10 μm
- Scintillator diameter: 16 mm

**Phosphor screen line up (Options)**

Various types of high-durability single-crystal phosphor screen (Direct bonding type) have been added that enables imaging at much higher X-ray flux density than before.

<table>
<thead>
<tr>
<th>Bonding method</th>
<th>Type number</th>
<th>Phosphor material</th>
<th>Phosphor thickness (μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Direct bonding</td>
<td>A15150-LU010DB</td>
<td>LuAG</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>A15150-LU050DB</td>
<td>LuAG</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>A15150-LU100DB</td>
<td>LuAG</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>A15150-GA010DB</td>
<td>GAGG</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>A15150-GA050DB</td>
<td>GAGG</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>A15150-GA100DB</td>
<td>GAGG</td>
<td>100</td>
</tr>
<tr>
<td>2) Glue bonding</td>
<td>A15150-LU010GB</td>
<td>LuAG</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>A15150-LU050GB</td>
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<td>A15150-GA010GB</td>
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<td>A15150-GA100GB</td>
<td>GAGG</td>
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</table>

<table>
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<tr>
<th>Bonding method</th>
<th>Type number</th>
<th>Phosphor material</th>
<th>Phosphor thickness (μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) 2) Common items</td>
<td>Phosphor screen size</td>
<td>Diameter</td>
<td>15 mm</td>
</tr>
<tr>
<td></td>
<td>Effective diameter</td>
<td>16 mm</td>
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</tr>
<tr>
<td></td>
<td>Phosphor screen matrix</td>
<td>Material</td>
<td>Amorphous carbon</td>
</tr>
<tr>
<td></td>
<td>Diameter × Thickness</td>
<td>20 mm × 1 mm</td>
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</tr>
<tr>
<td></td>
<td>Space ring</td>
<td>Material</td>
<td>Black plastic</td>
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<tr>
<td></td>
<td>Outer diameter × Inner diameter × Thickness</td>
<td>20 mm × 16 mm × 2 mm</td>
<td></td>
</tr>
</tbody>
</table>

Please refer to the next page

High-durability single-crystal phosphor screen

Large area type

**M11427-41, -42 AA40**

- Resolution: 10 μm
- Scintillator diameter: 16 mm

**M11427-62 AA60**

- Resolution: 10 μm
- Scintillator diameter: 35 mm
**High-durability single-crystal scintillator revolutionizes conventional imaging**

### Synchrotron radiation white X-ray

**X-ray durability 1)**

**Conventional phosphor**

- Approx. 12 min. later (700 s.)
- Destruction taking place

**Highly durable single crystal phosphor screen**

- 12 hours later
- No changes

Even when white X-ray is incident, stable imaging and measurement are realized for a long time.

**Measurement conditions**

- **Beam line**: SPring-8 BL28B2
- **X-ray energy**: White
- **Attenuator**: Air (0.034 mm) Be window (1 mm thick on the beam line side + 0.5 mm thick on the detector side)
- **Beam size**: 3×3 mm²
- **Detector**: AA40 (f = 50 mm) + ORCA-Flash2.8 (f = 35 mm) *
- **Pixel resolution**: 0.21 μm/ pixel
- **Scintillator**: LuAG (Thickness: conventionally about 20 μm, high-durability single crystal phosphor screen about 20 μm)

* AA40 is used for durability evaluation. This product is not recommended for use with AA40.

**Data courtesy**

JAPAN SYNCHROTRON RADIATION RESEARCH INSTITUTE (JASRI)

Industrial application Division

Dr. Kentaro KAJWARA

* The data described is based on the conditions at the time of evaluation and may not apply to all cases. Please consider as a reference case.

**X-ray durability 2)**

**Conventional phosphor**

- 6 min. later
- Destruction taking place

**Highly durable single crystal phosphor screen**

- Approx. 2 hours later (119 min.)
- No changes

Even when X-rays of flux density more than 20 times used conventionally are incident, stable imaging and measurement are realized for a long time.

**Measurement conditions**

- **Beam line**: SPring-8 BL47XU
- **X-ray energy**: 8 keV
- **Attenuator**: None
- **Flux density**: 4.7×10¹³ photons/s/mm²
- **Beam size**: 350 × 350 μm²
- **Detector**: AA50 (objective lens10×/NA 0.3) + C13949-50U
- **Pixel resolution**: 0.21 μm/pixel
- **Scintillator**: LuAG (Thickness: Conventional 22.3 μm, High-durability single crystal phosphor screen 21.4 μm)

**Data courtesy**

JAPAN SYNCHROTRON RADIATION RESEARCH INSTITUTE (JASRI)

Dr. Kentaro UESUGI

* The data described is based on the conditions at the time of evaluation and may not apply to all cases. Please consider as a reference case.
**High resolution X-ray imaging system**

- **ORCA-Flash4.0 V3 (C13440-20CU)**
- **ORCA-Lightning (C14120-20P)**
- **ORCA-spark (C11440-20P)**

**Specifications**

- **Effective number of pixels**
  - 2304 (H) × 2048 (V) for ORCA-Flash4.0 V3
  - 4608 (H) × 2592 (V) for ORCA-Lightning
  - 1920 (H) × 1200 (V) for ORCA-spark

- **Cell size**
  - 6.5 μm (H) × 6.5 μm (V) for ORCA-Flash4.0 V3
  - 6.5 μm (H) × 5.86 μm (V) for ORCA-Lightning

- **Effective area**
  - 14.976 mm (H) × 14.976 mm (V) for ORCA-Flash4.0 V3
  - 13.3 mm (H) × 13.3 mm (V) for ORCA-Lightning
  - 11.25 mm (H) × 7.03 mm (V) for ORCA-spark

- **Full well capacity**
  - 15 000 electrons for ORCA-Flash4.0 V3
  - 20 000 electrons for ORCA-Lightning
  - 30 000 electrons for ORCA-spark

- **Readout speed**
  - Fast scan: 415 frames/s for ORCA-Flash4.0 V3
  - Standard scan: 100 frames/s for ORCA-Lightning
  - Ultra quiet scan: 30 frames/s for ORCA-spark

- **Readout noise (rms)**
  - 0.7 electrons for ORCA-Flash4.0 V3
  - 1.0 electrons for ORCA-Lightning
  - 2.7 electrons for ORCA-spark

**Lens attachment**

**For ORCA-Fusion**

<table>
<thead>
<tr>
<th>Imaging unit</th>
<th>Lens Attachment</th>
<th>Second lens focal distance (mm)</th>
<th>Imaging magnification (Calculated amount)</th>
<th>Effective field of view (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M11427-54, -55, -56</td>
<td>A11444-700</td>
<td>None</td>
<td>20.0</td>
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<tr>
<td>A11444-750</td>
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<td>1.00</td>
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<tr>
<td>A11444-775</td>
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<td>9.984</td>
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<tr>
<td>M11427-62</td>
<td>A11444-750</td>
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<td>0.67</td>
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<tr>
<td>A11444-775</td>
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<td>1.00</td>
<td>14.976</td>
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**For ORCA-Flash4.0 V3**

<table>
<thead>
<tr>
<th>Imaging unit</th>
<th>Lens Attachment</th>
<th>Second lens focal distance (mm)</th>
<th>Imaging magnification (Calculated amount)</th>
<th>Effective field of view (mm)</th>
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<tbody>
<tr>
<td>M11427-54, -55, -56</td>
<td>A11444-400</td>
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<td>A11444-4105</td>
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<td>1.67</td>
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<td>A11444-4105</td>
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**For ORCA-Lightning**

<table>
<thead>
<tr>
<th>Imaging unit</th>
<th>Lens Attachment</th>
<th>Second lens focal distance (mm)</th>
<th>Imaging magnification (Calculated amount)</th>
<th>Effective field of view (mm)</th>
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</thead>
<tbody>
<tr>
<td>M11427-54, -55, -56</td>
<td>A11444-500</td>
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<td>1.267</td>
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<td>A11444-550</td>
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<td>A11444-575</td>
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<td>A11444-550</td>
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<td>38.016</td>
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<tr>
<td>A11444-575</td>
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<td>1.00</td>
<td>25.344</td>
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</table>

**For ORCA-spark**

<table>
<thead>
<tr>
<th>Imaging unit</th>
<th>Lens Attachment</th>
<th>Second lens focal distance (mm)</th>
<th>Imaging magnification (Calculated amount)</th>
<th>Effective field of view (mm)</th>
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</thead>
<tbody>
<tr>
<td>M11427-54, -55, -56</td>
<td>A11444-600</td>
<td>None</td>
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<td>0.563</td>
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<td>A11444-650</td>
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<td>1.00</td>
<td>11.25</td>
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</tr>
<tr>
<td>A11444-675</td>
<td>75</td>
<td>1.50</td>
<td>7.03</td>
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<tr>
<td>M11427-62</td>
<td>A11444-650</td>
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<td>0.67</td>
<td>16.875</td>
</tr>
<tr>
<td>A11444-675</td>
<td>75</td>
<td>1.00</td>
<td>11.25</td>
<td></td>
</tr>
</tbody>
</table>

**CAMERA SELECTION**

- **High resolution X-ray imaging system**
  - ORCA-Flash4.0 V3 (C13440-20CU)
  - ORCA-Lightning (C14120-20P)
  - ORCA-spark (C11440-20P)

**DIMENSIONAL OUTLINES**

- Please refer to the camera catalog for detail information.

**Lens attachment**

- **For ORCA-Fusion**
  - Imaging unit: A11444-700
  - Second lens focal distance (mm): 50
  - Imaging magnification (Calculated amount): 1.00
  - Effective field of view (mm): 14.976 (H) × 14.976 (V)

- **For ORCA-Flash4.0 V3**
  - Imaging unit: A11444-400
  - Second lens focal distance (mm): 35
  - Imaging magnification (Calculated amount): 0.70
  - Effective field of view (mm): 19.017 (H) × 19.017 (V)

- **For ORCA-Lightning**
  - Imaging unit: A11444-500
  - Second lens focal distance (mm): 50
  - Imaging magnification (Calculated amount): 1.00
  - Effective field of view (mm): 25.344 (H) × 25.344 (V)

- **For ORCA-spark**
  - Imaging unit: A11444-600
  - Second lens focal distance (mm): 50
  - Imaging magnification (Calculated amount): 1.00
  - Effective field of view (mm): 11.25 (H) × 7.03 (V)