High resolution X-ray imaging system

▲M11427-42 (Camera: ORCA®-Fusion)

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**

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Imaging unit line up

Microscopic type

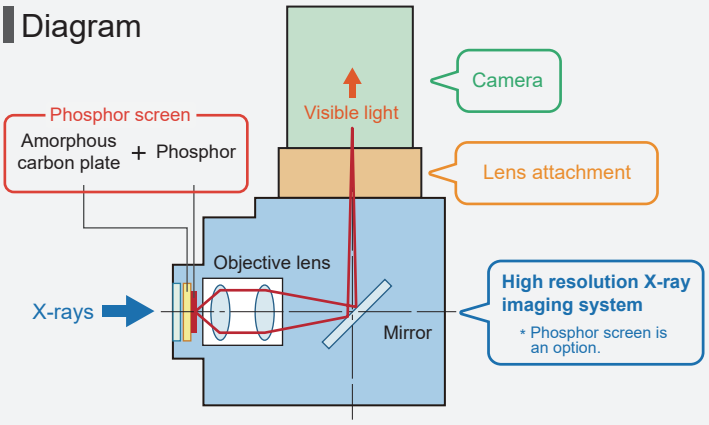
M11427-54, -55, -56 AA50

- Resolution: 4 µm or smaller

* Phosphor screen is not included. Please select from options.

High resolution X-ray imaging system AA50

Diagram



Phosphor screen line up (Options)

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

Bonding method	Type number	Phosphor material	Phosphor thickness (µm)
1) Direct bonding	A15150-LU010DB	LuAG	10
	A15150-LU050DB		50
	A15150-LU100DB		100
	A15150-GA010DB	GAGG	10
	A15150-GA050DB		50
	A15150-GA100DB		100
2) Glue bonding	A15150-LU010GB	LuAG	10
	A15150-LU050GB		50
	A15150-LU100GB		100
	A15150-GA010GB	GAGG	10
	A15150-GA050GB		50
	A15150-GA100GB		100
1) 2) Common items			
Phosphor screen size	Diameter		15 mm
	Effective diameter		10 mm
Phosphor screen matrix	Material		Amorphous carbon
	Diameter × Thickness		20 mm × 1 mm
Space ring	Material		Black plastic
	Outer diameter × Inner diameter × Thickness		20 mm × 16 mm × 2 mm

Please refer to the next page

High-durability single-crystal phosphor screen

Large area type

M11427-41, -42 AA40

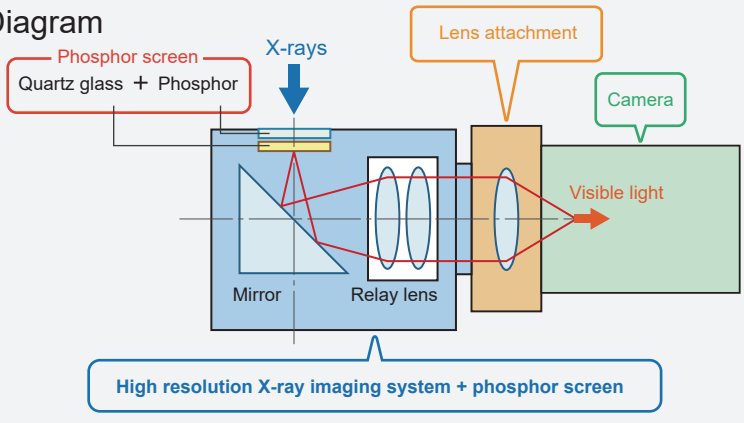
- Resolution: 10 µm
- Scintillator diameter: 16 mm

High resolution X-ray imaging system AA40

M11427-62 AA60

- Resolution: 10 µm
- Scintillator diameter: 35 mm

Diagram



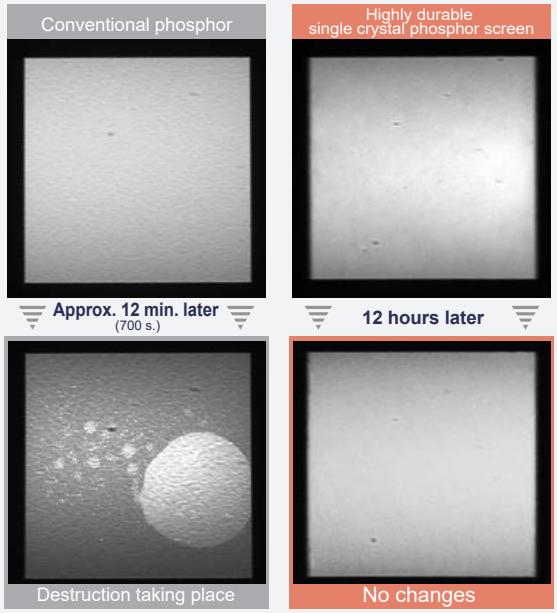
SPECIFICATIONS

Model name	M11427-54	M11427-55	M11427-56	M11427-41	M11427-42	M11427-62
Phosphor diameter	10 mm			16 mm		35 mm
Input window material	Be (0.5 mm)					Amorphous carbon (0.5 mm)
X-ray energy	3 keV or higher					6 keV or higher
Phosphor material	LuAG ($Lu_3Al_5O_{12}$: Ce+), GAGG ($Gd_3Al_2Ga_3O_{12}$: Ce+)			P43 (Gd_2O_2S: Tb)		
Peak emission wavelength	LuAG: 535 nm, GAGG: 520 nm			540 nm		
10 % decay time	LuAG: 70 ns, GAGG: 92 ns			1 ms		
Thickness of phosphor	10 µm / 50 µm / 100 µm			10 µm		
Base material of phosphor	Amorphous carbon			Quartz glass		
Spatial resolution**	4 µm	2 µm	1 µm	10 µm		10 µm or higher
1st lens	10× (NA 0.3)	20× (NA 0.4)	50× (NA 0.55)	24 mm	50 mm (F1.4)	75 mm (F2.8)
2nd lens	-			50 mm, 75 mm		
ND filter	-			ND 10 / ND 1		

* Phosphor screen is an optional item and must be ordered separately. (Please refer to the previous page)
** Measured value with ORCA-Flash4.0 V3. It varies depending on the camera.

High-durability single-crystal scintillator revolutionizes conventional imaging

X-ray durability 1) Synchrotron radiation white X-ray



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 (9 m), Aluminum (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 mm^2
Detector	Adhesive type: AA40 (f = 50 mm) + ORCA-Flash2.8 (f = 35 mm) * Direct bonding type: AA40 (f = 50 mm) + ORCA-Flash4.0 (f = 50 mm) *
Pixel resolution	Adhesive type: 5.1 µm / pixel, direct bonding type: 6.5 µm / pixel
Scintillator	LuAG (Thickness: conventionally about 20 µm, high-durability single crystal phosphor screen about 20 µm)

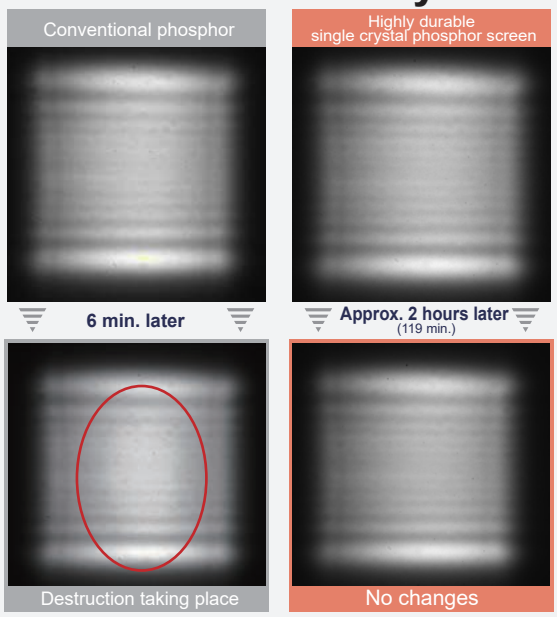
* AA40 is used for durability evaluation. This product is not recommended for use with AA40.

Data courtesy

JAPAN SYNCHROTORON RADIATION RESEARCH INSTITUTE (JASRI)
Industrial application Division
Dr. Kentaro KAJIWARA

* 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) Flux density 4.7×10^{13} photons/s/mm^2



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	4.7×10^{13} photons/s/mm^2
Beam size	350 × 350 μm^2
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)

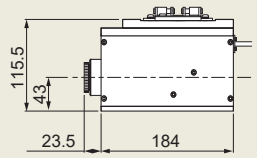
Data courtesy

JAPAN SYNCHROTORON RADIATION RESEARCH INSTITUTE (JASRI)
Dr. Kentaro UESUGI

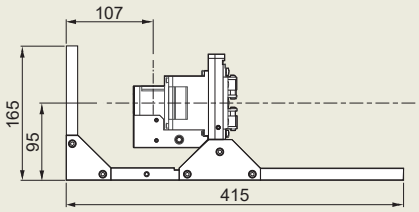
* The data described is based on the conditions at the time of evaluation and may not apply to all cases. Please consider as a reference case.

DIMENSIONAL OUTLINES (Unit: mm)

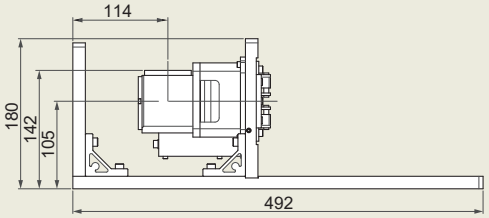
●High resolution X-ray imaging system
M11427-54, -55, -56 (Approx. 3.7 kg)



●High resolution X-ray imaging system
M11427-41, -42 (Approx. 5.2 kg)



●High resolution X-ray imaging system
M11427-62 (Approx. 6.5 kg)



Camera selection

Camera type number	ORCA-Fusion (C14440-20UP)		ORCA-Flash4.0 V3 (C13440-20CU)		ORCA-Lightning (C14120-20P)		ORCA-spark (C11440-36U)
Effective number of pixels	2304 (H) × 2304 (V)		2048 (H) × 2048 (V)		4608 (H) × 2592 (V)		1920 (H) × 1200 (V)
Cell size	6.5 µm (H) × 6.5 µm (V)		6.5 µm (H) × 6.5 µm (V)		5.5 µm (H) × 5.5 µm (V)		5.86 µm (H) × 5.86 µm (V)
Effective area	14.976 mm (H) × 14.976 mm (V)		13.3 mm (H) × 13.3 mm (V)		25.344 mm (H) × 14.256 mm (V)		11.25 mm (H) × 7.03 mm (V)
Full well capacity	15 000 electrons		30 000 electrons		Standard Full Well Capacity Mode	1000 electrons	33 000 electrons
					High Full Well Capacity Mode	38 000 electrons	
Readout speed	Fast scan	89.1 frames/s	Standard scan	100 frames/s	Standard Full Well Capacity Mode	121 frames/s	64.9 frames/s
	Standard scan	23.2 frames/s	Slow scan	30 frames/s	High Full Well Capacity Mode	30 frames/s	
	Ultra quiet scan	5.42 frames/s	-	-	-	-	
Readout noise (rms)	Fast scan	1.4 electrons	Standard scan	1.6 electrons	Standard Full Well Capacity Mode	2.0 electrons	6.6 electrons
	Standard scan	1.0 electrons	Slow scan	1.4 electrons	High Full Well Capacity Mode	2.7 electrons	
	Ultra quiet scan	0.7 electrons	-	-	-	-	

● Please refer to the camera catalog for detail information.

Lens attachment

■ For ORCA-Fusion

Imaging unit	Lens Attachment	Second lens focal distance (mm)	Imaging magnification (Calculated amount)	Effective field of view (mm)	
				H	V
M11427 -54, -55, -56	A11444-700	None	20.0	0.749	0.749
M11427 -41, -42	A11444-750	50	1.00	14.976	14.976
	A11444-775	75	1.50	9.984	9.984
M11427-62	A11444-750	50	0.67	22.464	22.464
	A11444-775	75	1.00	14.976	14.976

■ For ORCA-Flash4.0 V3

Imaging unit	Lens Attachment	Second lens focal distance (mm)	Imaging magnification (Calculated amount)	Effective field of view (mm)	
				H	V
M11427 -54, -55, -56	A11444-400	None	20.0	0.666	0.666
M11427 -41, -42	A11444-435	35	0.70	19.017	19.017
	A11444-450	50	1.00	13.312	13.312
	A11444-4105	105	2.10	6.339	6.339
M11427-62	A11444-435	35	0.47	28.526	28.526
	A11444-450	50	0.67	19.968	19.968
	A11444-4105	105	1.40	9.509	9.509

■ For ORCA-Lightning

Imaging unit	Lens Attachment	Second lens focal distance (mm)	Imaging magnification (Calculated amount)	Effective field of view (mm)	
				H	V
M11427 -54, -55, -56	A11444-500	None	20.0	1.267	0.713
M11427 -41, -42	A11444-550	50	1.00	25.344	14.256
	A11444-575	75	1.50	16.896	9.504
M11427-62	A11444-550	50	0.67	38.016	21.384
	A11444-575	75	1.00	25.344	14.256

■ For ORCA-spark

Imaging unit	Lens Attachment	Second lens focal distance (mm)	Imaging magnification (Calculated amount)	Effective field of view (mm)	
				H	V
M11427 -54, -55, -56	A11444-600	None	20.0	0.563	0.352
M11427 -41, -42	A11444-650	50	1.00	11.25	7.03
	A11444-675	75	1.50	7.5	4.687
M11427-62	A11444-650	50	0.67	16.875	10.545
	A11444-675	75	1.00	11.25	7.03

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