

**greateyes**

DISCOVER WHAT  
THE EYE CAN'T SEE

# Full-Frame Deep Cooling Scientific **X-ray CCD** Camera for Spectroscopy and Imaging



**In-Vacuum Type**

## Typical Applications

EUV Lithography  
Soft X-Ray Spectroscopy  
Plasma Emission Spectroscopy  
High Harmonic Generation Spectroscopy  
NEXAFS Spectroscopy  
Resonant Inelastic X-Ray Scattering

## Key Specifications

High Quantum Efficiency  
Ultra Deep Cooling to  $-100\text{ }^{\circ}\text{C}$   
18-bit Dynamic Range  
Multi-MHz Readout  
Compact Design

# Full-Frame Deep Cooling Scientific X-ray CCD Camera for Spectroscopy

# ALEX<sup>S</sup>



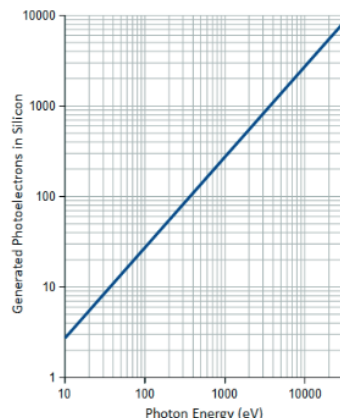
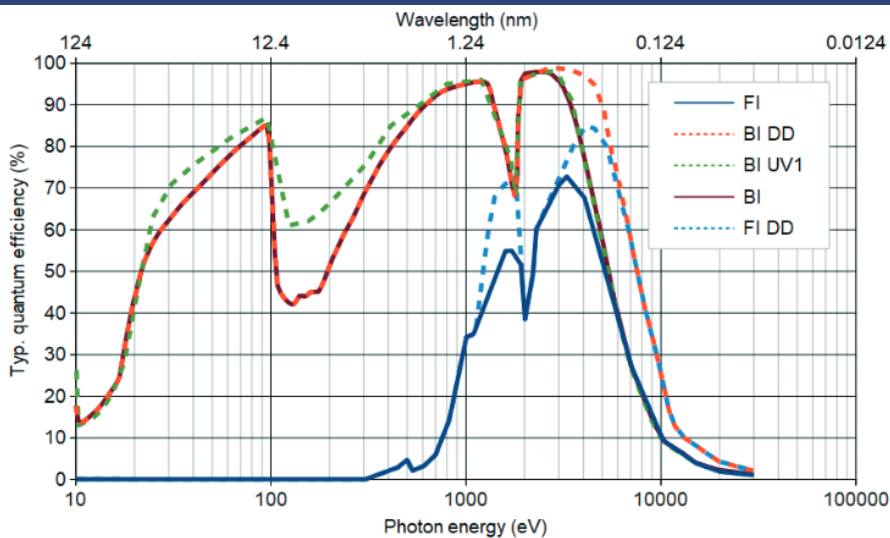
## Features & Benefits

- **Ultra deep TE cooling to -100 °C**  
lowest dark current for better detection limit
- **GigE & USB 3.0 data interface**  
local or remote network operation – your choice!
- **Fast readout speeds up to 5 MHz**  
fast frame rates paired with low-noise electronics
- **High QE up to 98%**  
very sensitive sensors for low light applications
- **User selectable gain**  
balance your detector for best SNR and dynamic range
- **Flexible software options**  
camera software and SDKs available

## Common specifications

Pixel readout frequency	50 kHz, 250kHz, 1 MHz, 3 MHz (5 MHz for visualization mode; up to 6 speeds)
Readout modes	2 output nodes
AD converter resolution	18-bit
Linearity	Better than 99%
CCD epitaxial thickness	15 µm standard, 40 µm for deep depletion (DD) models
Flange types	ISO-F DN63, knife-edge sealed CF DN63, CF DN100, CF DN160
Vacuum compatibility	With CF flange: 10 <sup>-10</sup> mbar (UHV capability)
Bakeout temperature	Max. +80 °C
Distance flange - focal plane	6 mm for CF DN63, 8 mm for CF DN100 (can be customised)
CCD sensor cooling	-100°C to 20°C, forced air or liquid cooling
Temperature monitoring	Two thermistors at CCD sensor and thermoelectric cooler (hot side)
Data link	Gigabit Ethernet, USB 3.0
Software	greateyes Vision software for Windows 7 / 10
SDK and drivers	DLL for Windows; LabVIEW, EPICS, Linux driver (optional)
TTL interface signals	Sync out, shutter out, external trigger in
Operating conditions	Temperature: 0°C to 35°C ambient, relative humidity <80% (non-condensing)
Power supply	80-264 VAC (115/230 typical), 47-63 Hz (50/60 typical), max. 1.1 A (230 VAC), 1.9 A (115 VAC)
Certification	CE
Dimensions	8.3 cm (3.27") × 10.0 cm (3.94") × 10.9 cm (4.29") (W × H × L, camera body)
Weight	2.9 Kg (with CF DN63 flange)

## X線分光CCD 量子効率曲線



The mean energy of a photon to generate an electron-hole pair in silicon is 3.66 eV.

## モデル

	ALEX 1024 256	ALEX 2048 512
Sensor code	FI FI DD BI UV1 BI DD	FI BI BI UV1
Nominal pixel format	1024 × 256	2048 × 512
Image area	26.6 mm × 6.7 mm	27.6 mm × 6.9 mm
Pixel size	26 μm × 26 μm	13.5 μm × 13.5 μm
Full well capacity	500 ke <sup>-</sup> / 700 ke <sup>-</sup> (DD)	100 ke <sup>-</sup>
Register well capacity	1 000 ke <sup>-</sup> / 1 400 ke <sup>-</sup> (DD)	400 ke <sup>-</sup>
Typ. read noise (e <sup>-</sup> )	FI BI DD	FI / BI
@ 50 kHz	4.2 6.0 5.7	3.5
@ 1 MHz	12.0 13.1 12.3	7.2
@ 3 MHz	22.0 23.0 22.5	11.3
Dark current @ -100°C	0.0004 e <sup>-</sup> /pixel/s 0.005 e <sup>-</sup> /pixel/s (DD)	0.00025 e <sup>-</sup> /pixel/s
User selectable gain	0.3 counts/e <sup>-</sup> (low noise mode)	0.4 counts/e <sup>-</sup> (high capacity) 1.2 counts/e <sup>-</sup> (low noise)
CCD sensor type	Front-illuminated (FI), back-illuminated (BI), deep depletion fringe suppression (DD), enhanced back-illuminated (BI UV1)	
Blemish specifications	Grade 0 or grade 1 (standard) as specified by sensor manufacturer. For more information, please see: <a href="https://www.greateyes.de/en/glossar.html">https://www.greateyes.de/en/glossar.html</a>	

## フランジタイプ

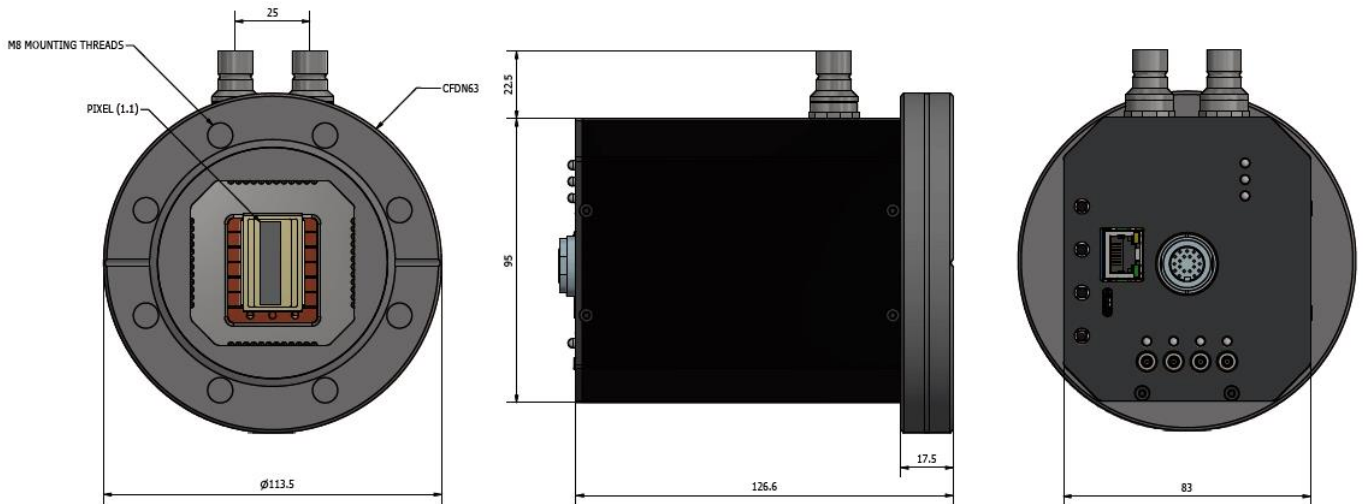
Order code	Description
CF1	Knife-edge sealed CF DN63 flange with threaded holes
CF2	Knife-edge sealed CF DN100 flange with through holes
CF4	Rotatable, knife-edge sealed CF DN100 flange with through holes

We also provide quick release, rotatable and other flanges of various sizes, please let us know your requirement.

## X線分光用アクセサリ、ソフトウェア

Order code	Description
<i>A) Accessories for imaging purposes</i>	
GE-SR35	35mm shutter, including shutter driver module
<i>B) Accessories for enhanced cooling performance</i>	
GE-CR01	Compact recirculator operating at room temperature for deep camera cooling
GE-CR02	Recirculating water chiller, temperature range -5°C to 30°C for ultra-deep camera cooling
<i>C) Software development kit (SDK) and drivers</i>	
GE-LAB01	LabVIEW driver
GE-EP	EPICS driver
GE-LX01	Linux driver
GE-PYT01	Python SDK

## 分光用X線CCD外観寸法



# Full-Frame Deep Cooling Scientific X-ray CCD Camera for Imaging

# ALEX<sup>i</sup>



## Features & Benefits

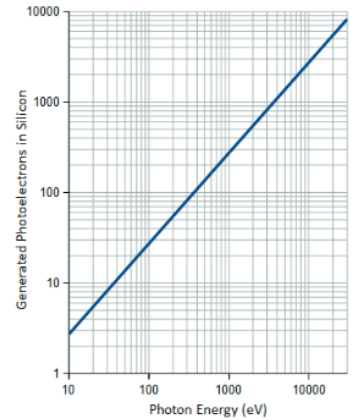
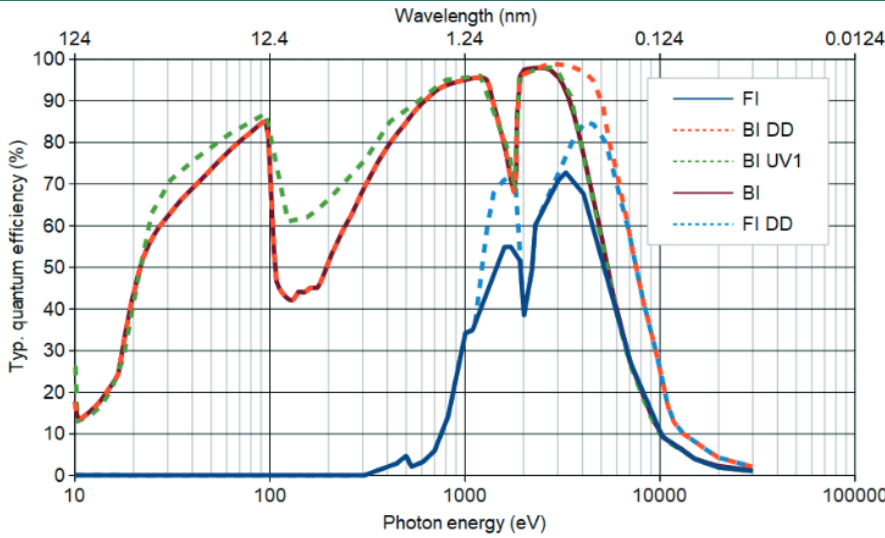
- **Ultra deep TE cooling up to -100 °C**  
lowest dark current for better detection limit
- **GigE & USB 3.0 data interface**  
local or remote network operation – your choice!
- **Fast readout speeds up to 5 MHz**  
fast frame rates paired with low-noise electronics
- **High QE up to 98%**  
very sensitive sensors for low light applications
- **User selectable gain**  
balance your detector for best SNR and dynamic range
- **Flexible software options**  
camera software and SDKs available



## Common specifications

Pixel readout frequency	50 kHz, 250kHz, 1 MHz, 3 MHz (5 MHz for visualization mode; up to 6 speeds)
Readout modes	2 output nodes for 1 Mpx and 4 Mpx camera, 4 output nodes for 16 Mpx camera
AD converter resolution	18-bit
Linearity	Better than 99%
CCD epitaxial thickness	15 µm standard, 40 µm for deep depletion (DD) models
Flange types	ISO-F DN63, knife-edge sealed CF DN63, CF DN100, CF DN160
Vacuum compatibility	With CF flange: 10 <sup>-10</sup> mbar (UHV capability)
Bakeout temperature	Max. +80 °C
Flange - focal plane	1 Mpx with CF DN63: 6 mm; 4 Mpx with CF DN63: 5 mm; 16 Mpx with CF DN160: -27 mm (all distance can be customised)
Temperature monitoring	Two thermistors at CCD sensor and thermoelectric cooler (hot side)
Data link	Gigabit Ethernet, USB 3.0
Software	greateyes Vision software for Windows 7 / 10
SDK and drivers	DLL for Windows; LabVIEW, EPICS, Linux driver (optional)
TTL interface signals	Sync out, shutter out, external trigger in
Operating conditions	Temperature: 0°C to 35°C ambient, relative humidity <80% (non-condensing)
Power supply	1 Mpx & 4 Mpx: 80-264 VAC (typ. 115/230), 47-63 Hz (typ. 50/60), max. 1.1 A (230 V) / 1.9 A (115 V) 16 Mpx: 85-264 VAC (typ. 115/230), 47-63 Hz (typ. 50/60), max. 1.9 A (230 V) / 3.8 A (115 V)
Certification	CE
Dimensions	8.3 cm (3.27") × 10.0 cm (3.94") × 10.9 cm (4.29") (W × H × L, 1 Mpx & 4 Mpx camera body) 13.7 cm (5.39") × 13.7 cm (5.39") × 13.3 cm (5.24") (W × H × L, 16 Mpx camera body)
Weight	2.9 kg (1 Mpx & 4 Mpx, CF DN63) / 4.3 kg (1 Mpx & 4 Mpx, CF DN 100) / 12.5kg (16 Mpx, CF DN160)

## X線イメージングCCD 量子効率曲線



The mean energy of a photon to generate an electron-hole pair in silicon is 3.66 eV.

## モデル

ALEXi Series	ALEX 1024 1024		ALEX 2048 2048		ALEX 4096 4096	
Sensor code	FI BI BI UV1	BI DD	FI BI	BI DD BI UV1	BI	BI UV1
Nominal pixel format	1024 × 1024		2048 × 2048		4096 × 4096	
Image area	13.3 mm × 13.3 mm		27.6 mm × 27.6 mm		61.4 mm × 61.4 mm	
Pixel size	13 μm × 13 μm		13.5 μm × 13.5 μm		15 μm × 15 μm	
CCD sensor cooling	-100 °C to 20 °C		-90 °C to 20 °C		-90 °C to 20 °C	
Full well capacity	100 ke <sup>-</sup>	120 ke <sup>-</sup>	100 ke <sup>-</sup>	150 ke <sup>-</sup>	150 ke <sup>-</sup>	350 ke <sup>-</sup>
Register well / Output node	400 ke <sup>-</sup> / -		400 ke <sup>-</sup> / 1 000 ke <sup>-</sup>	600 ke <sup>-</sup> / 1 000 ke <sup>-</sup>	850 ke <sup>-</sup> / 900 ke <sup>-</sup>	350 ke <sup>-</sup> / 600 ke <sup>-</sup>
Typ. read noise (e <sup>-</sup> )						
@ 50 kHz	2.5		3.0		4.7	2.5
@ 1 MHz	6.5		7.0		9.5	6.3
@ 3 MHz	9.0		12.6		17.0	10.5
Dark current (e <sup>-</sup> /pixel/s)	@ -100 °C		@ -90 °C		@ -90 °C	
	0.00015	0.0005	0.0001	0.01	0.00008	0.004
User selectable gain	0.65 counts/e <sup>-</sup>		0.5 counts/e <sup>-</sup> (low noise) 1.5 counts/e <sup>-</sup> (high capacity)		0.4 counts/e <sup>-</sup> (low noise) 1.2 counts/e <sup>-</sup> (high capacity)	
CCD sensor type	Front-illuminated (FI), back-illuminated (BI), deep depletion fringe suppression (DD), enhanced back-illuminated (BI UV1)					
Blemish specifications	Grade 0 or grade 1 (standard) as specified by sensor manufacturer. For more information, please see: <a href="https://www.greateyes.de/en/glossar.html">https://www.greateyes.de/en/glossar.html</a>					

## フランジタイプ

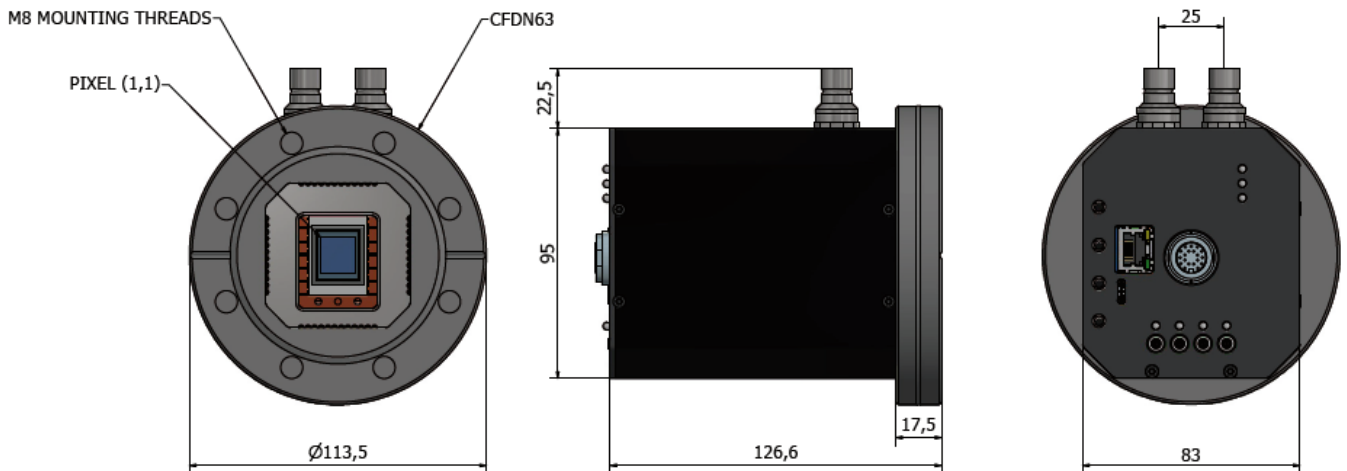
Order code	Description
CF1	Knife-edge sealed CF DN63 flange with threaded holes
CF2	Knife-edge sealed CF DN100 flange with through holes
CF3	Knife-edge sealed CF DN160 flange with through holes
CF4	Rotatable, knife-edge sealed CF DN100 flange with through holes

We also provide quick release, rotatable and other flanges of various sizes, please let us know your requirement.

## X線イメージング用アクセサリ、ソフトウェア

Order code	Description
<i>A) Accessories for imaging purposes</i>	
GE-SR25	25mm shutter for 1 Mpx camera, including shutter driver module
GE-SR45	45mm shutter for 4 Mpx camera, including shutter driver module
<i>B) Accessories for enhanced cooling performance</i>	
GE-CR01	Compact recirculator operating at room temperature for deep camera cooling
GE-CR02	Recirculating water chiller, temperature range -5°C to 30°C for ultra-deep camera cooling
<i>C) Software development kit (SDK) and drivers</i>	
GE-LAB01	LabVIEW driver
GE-EP	EPICS driver
GE-LX01	Linux driver
GE-PYT01	Python SDK

## X線イメージング用CCD外観寸法



\*Only valid for ALEX 1024 1024 and ALEX 2048 2048. For the drawing of ALEX 4096 4096, please send us an enquiry.

# Scientific In-Vacuum CCD Camera for VUV EUV X-ray spectroscopy and imaging



## Model specifications

	GE-VAC 1024 1024 series	GE-VAC 1024 256 series			GE-VAC 2048 512 series	
Nominal pixel format	1024 × 1024	1024 × 256			2048 × 512	
Image area	13.3 mm × 13.3 mm	26.6 mm × 6.7 mm			27.6 mm × 6.9 mm	
Pixel size	13 μm × 13 μm	26 μm × 26 μm			13.5 μm × 13.5 μm	
Full well capacity	100 ke <sup>-</sup> / 120 ke <sup>-</sup> (DD)	500 ke <sup>-</sup> / 700 ke <sup>-</sup> (DD)			100 ke <sup>-</sup>	
Register well capacity	400 ke <sup>-</sup>	1 000 ke <sup>-</sup> / 1 400 ke <sup>-</sup> (DD)			400 ke <sup>-</sup>	
Typ. read noise (e <sup>-</sup> )	FI / BI / DD	FI	BI	DD	FI / BI	
	@ 500 kHz	5.2	7.5	9.7	9.0	5.7
	@ 1 MHz	6.6	10.7	12.1	11.6	6.9
	@ 3 MHz	9.7	17.3	19.2	18.0	10.3
Dark current @ -80°C	0.0003 e <sup>-</sup> /pixel/s 0.017 e <sup>-</sup> /pixel/s (DD)	0.0005 e <sup>-</sup> /pixel/s 0.08 e <sup>-</sup> /pixel/s (DD)			0.0003 e <sup>-</sup> /pixel/s	
Gain	1 counts/e <sup>-</sup> (high) 0.4 counts/e <sup>-</sup> (low)	1 counts/e <sup>-</sup> (high) 0.2 counts/e <sup>-</sup> (low)			1 counts/e <sup>-</sup> (high) 0.4 counts/e <sup>-</sup> (low)	
CCD sensor type	Front-illuminated (FI), back-illuminated (BI), deep depletion fringe suppression (DD), enhanced back-illuminated (UV1)					
Blemish specifications	Grade 0 or grade 1 (standard) as specified by sensor manufacturer					



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