

C-RED One

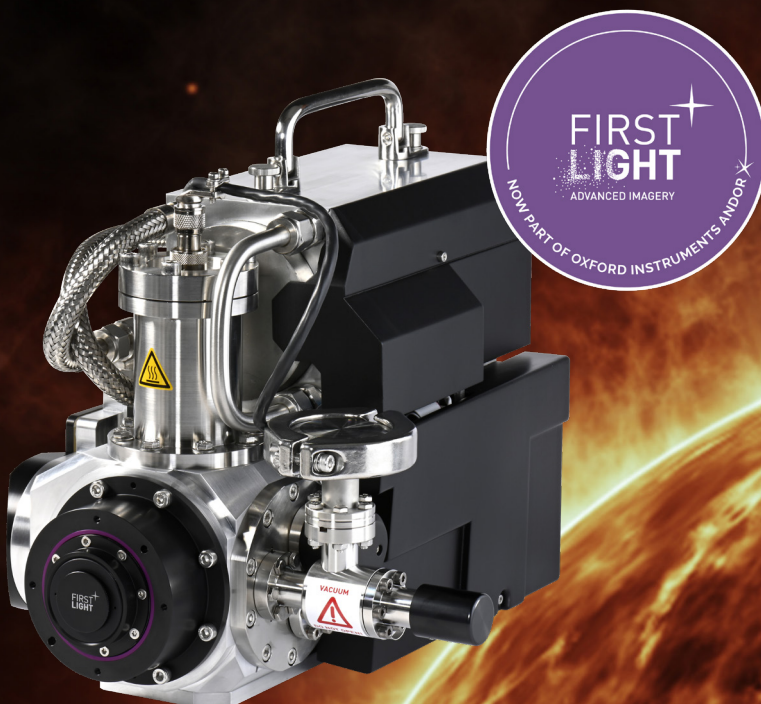
Ultra Low Noise Ultra High-Speed SWIR Camera

Key Specifications

- ✓ 320 x 256 e-APD MCT
- ✓ 24 μm pixel pitch
- ✓ Near and SWIR: 0.80 - 2.43 μm
- ✓ 70% QE, wavelength from 1.20 - 2.43 μm
- ✓ Up to 3500 fps full frame
- ✓ Sub electron readout noise
- ✓ Multiple Readout Modes

Key Applications

- ✓ Adaptive Optics for Astronomy
- ✓ Space Debris Tracking
- ✓ Interferometry
- ✓ Hyperspectral imaging
- ✓ Free Space Optical Communications
- ✓ Low-light fluorescence microscopy



Introducing C-RED One



The discovery of electron initiated avalanche photodiodes (e-APD) using mercury cadmium telluride (MCT) semiconductor materials permitted a significant breakthrough in SWIR imaging. C-RED One uses a unique 320 x 256 pixels HgCdTe e- APD array with **24 µm pixel pitch** with a **wide spectral response** over **J, H and K bands**, and outstanding cosmetics.

The sensor delivers unprecedented **sub-electron readout noise**, taking advantage of the e-APD noise free multiplication gain and non-destructive readout ability.

C-RED One is capable of capturing up to **3500 full frames per second**, without compromising on sub electron readout noise or very low background. The camera can also capture multiple

regions of interest (ROI) readout allowing faster image rate (10's of KHz) while maintaining sub-electron readout noise.

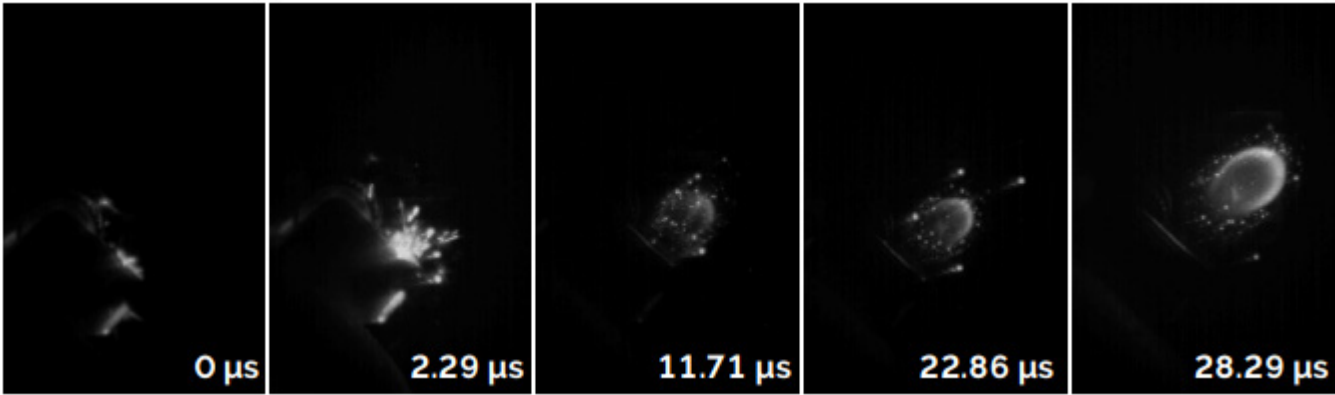
C-RED One offers multiple readout modes:

- ✓ Global reset: Single read, Correlated Double Sampling (CDS), multiple non-destructive readouts (NDR) including ramp up and Fowler modes.
- ✓ Rolling reset: Single, N readout and IOTA including Ramp up and Fowler modes

C-RED One is an **autonomous** system: the sensor is placed in a sealed vacuum environment and cooled down to **cryogenic temperature** (90 K) using an integrated pulse tube with a high reliability. The vacuum regeneration is managed by the camera.

C-RED One's vibration control system (VCS) allows for major dampening of vibrations, especially along the vertical axis of the camera (-47% according to our measurements) and is available for integration in highly sensitive systems. C-RED One is opening new opportunities for high sensitivity and high speed SWIR imaging.

C-RED One can be customized to meet your application requirements, with flexible filters and optical configurations, tailored to your scientific needs.

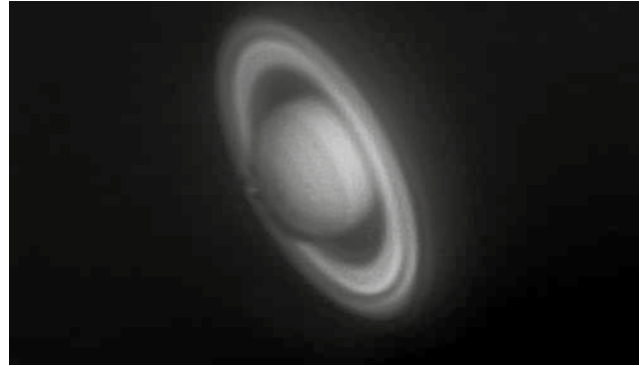


Lighter spark detection at 3500 FPS full frame. Courtesy of First Light Imaging

Astronomy

Visible cameras have been used for a very long time in astronomy, and now, Short Wave Infrared (SWIR) cameras are opening the path to new observations and discoveries. Unlike light at visible wavelengths, infrared light is not blocked by interstellar dust.

Astronomers use SWIR cameras to study the J-band (1.1 – 1.4 µm), H-band (1.5 – 1.8 µm) and K-band (2.0 – 2.4 µm). One of the major applications of Oxford Instruments - First Light Imaging's cameras in astronomy is adaptive optics: the active correction loop used to reduce the atmospheric disturbances that cause spatial and temporal distortions.



Astronomy imaging in the SWIR range. Image of Saturn at 50 ms exposure with C-RED 2. Courtesy of JL Gach, First Light Imaging.

Extreme Adaptive Optics (XAO)

Designed for high-speed wavefront sensors with a proven track record (RISTRETTO, VLT/SPHERE SAXO+,...), C-RED One provides sub-electron read noise and kilohertz frame rates enabling real-time atmospheric turbulence corrections.

Free-space optical communications

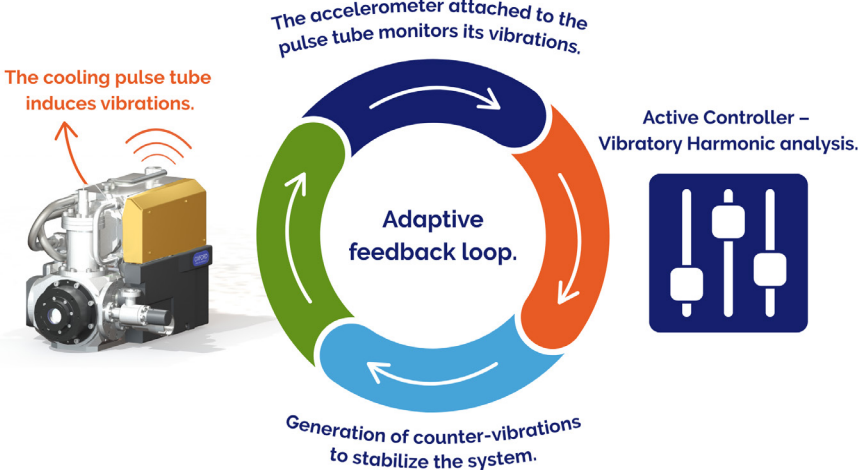
C-RED One offers great QE at the well-known 1550 nm wavelength. Its speed associated with the low latency of its cameralink interface makes it suitable for secure communications between space and ground-stations.

Interferometry

Showcased in Visble/IR interferometers (CHARA, MIRC-X, MYSTIC) for fringe tracking, C-RED One's low noise combined with highspeed enables high resolution stellar observations.

Vibration Control System (VCS)

Thanks to its active pulse tube controller, C-RED One achieves significant advancement in minimizing the vibrational noise at the sensor level. By actively monitoring and damping harmonic vibrations, C-RED One's VCS enables a significant reduction in vibrations. VCS refines sub-micron stability crucial for high speed, low noise infrared imaging.



Technical Specifications

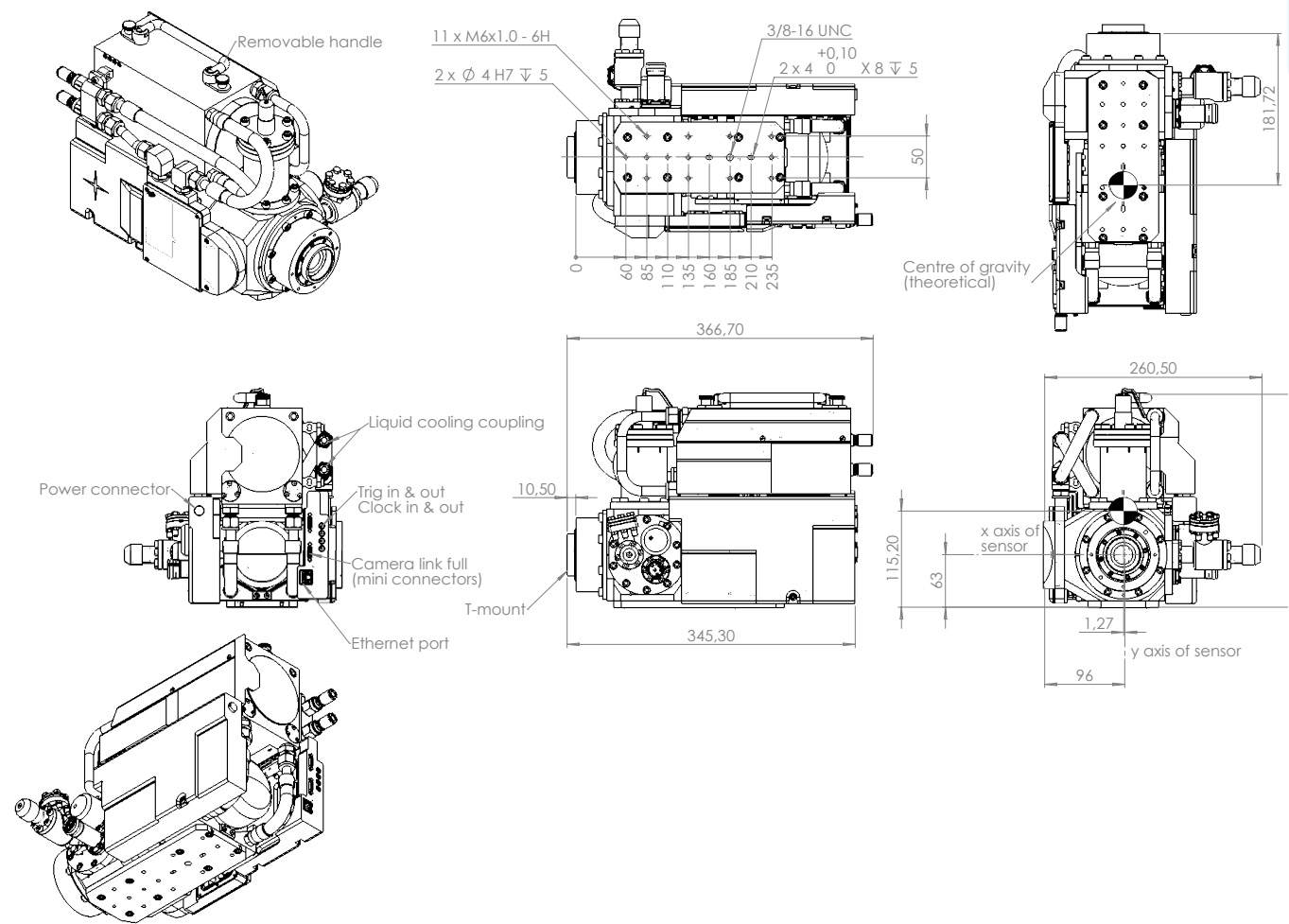
Specifications^{•1}

Sensor Specifications	C-RED One
Maximum speed Full Frame single readout	3500 fps
Readout Noise at 1720 fps CDS readout and gain x50, looking at a black body at a temperature of 90 K	<1e-
Dark current looking at a black body at a temperature of 90 K and e-APD gain x10	<80 e-/p/s
Quantization	16 bit
Detector Operating Temperature (No LN ₂)	80 K
Flat Quantum Efficiency from 1.1 μm to 2.4 μm (J, H, K) at 100 K	>60%
Operability due to signal response / pixels with signal <0.8*median at bias of 9 V and integration time of 10 ms	>99.9%
Operability due to CDS noise / pixels with noise <2*median at bias of 9 V and integration time of 10 ms	>99.9%
Excess noise Factor F	<1.25
Pulse tube cooling, vibration imparted to the detector with respect to the front flange of the camera (RMS along each detector axis)	<1 μm

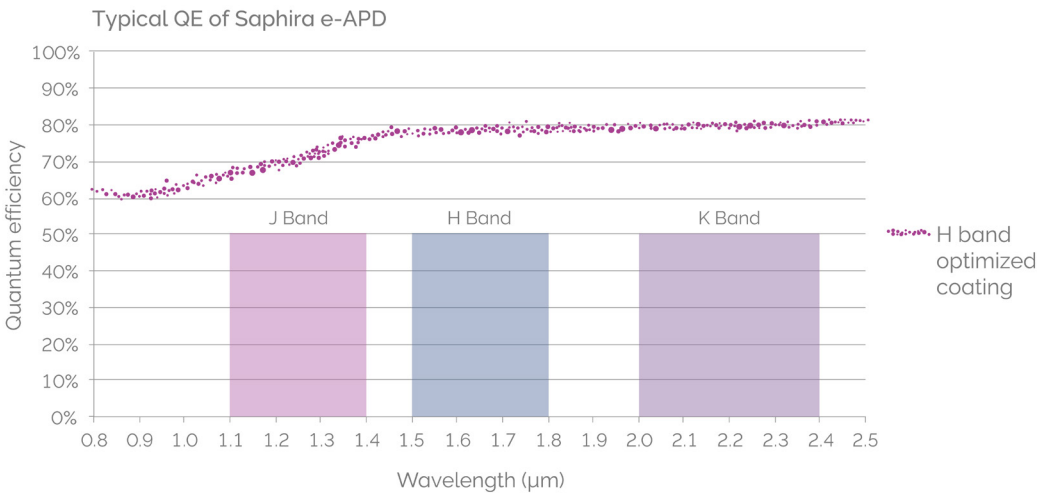
Features	All models
Optical interface	T-Mount
Multiple Readout Modes	Global reset
	Rolling reset
	Single read, CDS or multiple non destructive reads
Region of Interest (ROI)	User definable
PC Interface	Ultra low latency Camera Link® full interface
Triggering	Clock & Trigger input/output for synchronous operation
Specialised fittings	Embedded cold blocking filters
Wavelength sensitivity range & baffle design	H band configuration (0.8 - 1.75 μm) with f/4 baffle
	K band configuration (0.8 - 2.43 μm) with f/20 baffle
Operating temperature	80 K
Software	Graphical User Interface: First Light Vision Software Development Kit: (C, C++, C#, Python, MatLab) / LabVIEW / μManager
Customer special request	Custom design available upon request, please contact your local sales representative fli-sales@oxinst.com

Product Drawings

Dimensions in mm [inches]
Weight: 19.4 kg



Quantum Efficiency (QE) Curve



Creating The Optimum Product for You

Step 1.

Select the camera type



Camera Type

Description	Code
C-RED One HKHK f/4: 320 x 256 e-MCT APD camera, 3500 FPS, <1 e- RON, HKHK band configuration, f/4 aperture	PAC-CR1-S320-H4
C-RED One KK f/20: 320 x 256 e-MCT APD camera, 3500 FPS, <1 e- RON, KK band configuration, f/20 aperture	PAC-CR1-S320-K20
C-RED One HKHK f/4 with Vibration Controller System: 320 x 256 e-MCT APD camera, 3500 FPS, <1 e- RON, HKHK band configuration, f/4 aperture, with VCS.	PAC-CR1-S320-H4-A
C-RED One KK f/20 with Vibration Controller System: 320 x 256 e-MCT APD camera, 3500 FPS, <1 e- RON, KK band configuration, f/20 aperture, with VCS.	PAC-CR1-S320-K20-A

Step 2.

Select the required accessories



Accessories

The part codes in Step 1 DO NOT include accessories such as grabber cards or cables. Please order either grabber kits or individual grabber cards and cables from the below accessory list.*3

Acquisition Accessories Description	Order Code
Camera Link® cables 5 m	ACC-CAB-CLF-000
Camera Link® cables 10 m	ACC-CAB-CLF-001
Matrox Grabber CL RAD EV 1G CLSF	ACC-GRA-CLF-000
Cooling Accessories Description	Order Code
Cooling pack	PAC-COO-400-R00
Synchronise Accessories Description	Order Code
Synchro cables 1 m	ACC-CAB-SYN-000
Synchro cables 3 m	ACC-CAB-SYN-001

Step 3.

Software



Software

Your product is provided with the following software options:

Graphical User Interface: First Light Vision

Software Development Kit: (C, C++, C#, Python, MatLab) / LabVIEW / µManager

Meet the Extended Cameras Family

C-RED 2



Ultra high speed, low noise, short wave infrared camera, able to run at 600 fps with a readout noise under 30 electrons and a very low dark current <600 e-/p/s.

- ✓ Astronomy
- ✓ Adaptive Optics
- ✓ Fluorescence microscopy research
- ✓ Hyperspectral imaging
- ✓ Low visibility imaging
- ✓ Semicon inspection
- ✓ Quality / production control

Read More

C-RED 2 ER



C-RED 2 ER 1.9 µm and 2.2 µm are high speed extended InGaAs cameras for eSWIR imaging.

- ✓ Astronomy
- ✓ Adaptive Optics
- ✓ Life Sciences / Research
- ✓ Surveillance and Safety
- ✓ Long range imaging
- ✓ Hyper/Multispectral imaging
- ✓ Quality/Production control

Read More

C-RED 3



Specially designed for short exposure times applications, C-RED 3 is a very compact high speed VGA uncooled camera for short wave infrared (SWIR) imaging.

- ✓ Free space optical communications
- ✓ Semiconductor inspection
- ✓ Quality/production control
- ✓ Adaptive optics
- ✓ Laser beam profiling
- ✓ Welding
- ✓ Hyperspectral imaging
- ✓ Thermography

Read More

C-RED 2 Lite



C-RED 2 Lite is the stabilized version of C-RED 2, able to run at 600 fps with 30 e- readout noise.

- ✓ Free space optics
- ✓ Laser communications
- ✓ Quantitative spectral imaging
- ✓ Hyper/multispectral imaging
- ✓ Thermography
- ✓ Additive manufacturing
- ✓ Non destructive inspection
- ✓ Laser beam profiling

Read More

Order Today

Need more information? At Andor we are committed to finding the correct solution for you. With a dedicated team of technical advisors, we are able to offer you one-to-one guidance and technical support on all Andor products.

For a full listing of our local sales offices, please see: andor.oxinst.com/contact

Our regional headquarters are:

Europe

Belfast, Northern Ireland
Phone +44 (28) 9023 7126
Fax +44 (28) 9031 0792

North America

Concord, MA, USA
Phone +1 (860) 290 9211
Fax +1 (860) 290 9566

Japan

Tokyo
Phone +81 (3) 6744 4703
Fax +81 (3) 3446 8320

China

Beijing | Shanghai | Guangzhou
Phone +86 (400) 678 0609
Fax +86 (10) 5884 7901



Items shipped with your camera:

Camera (model as ordered)
Power supply
1x Quick coupling set (cooling connectors)
2x Synchro cables

Minimum Computer Requirements:

RAM: 8 GB minimum
Processor: Intel® Core™ i5 or higher
Screen resolution: at least 1920 x 1080
See [system requirements](#) for more information.

Operating and Storage Conditions

- Detector operating Temperature: 80K
- Operating temperature (environment): 0 to +25°C
- Relative Humidity: 5 to 80%
- Storage Temperature: -10 to +35°C
- Storage humidity: 3 to 100% without condensation

Power Requirements

- Camera 24 V DC
- Power supply 100-240 VAC, 50 Hz/60 Hz
- Max. power consumption: 700 W ^{*2}

Footnotes: Specifications are subject to change without notice

1. Average values observed.
2. A 700 W power supply is required to manage peak consumption, the average consumption is ~ 300 W during cooling and ~ 70 W to keep the sensor cold.
3. Please note that our software and SDK support grabber cards from Euresys and Zebra. We recommend caution when using other grabber cards