

# C-RED One

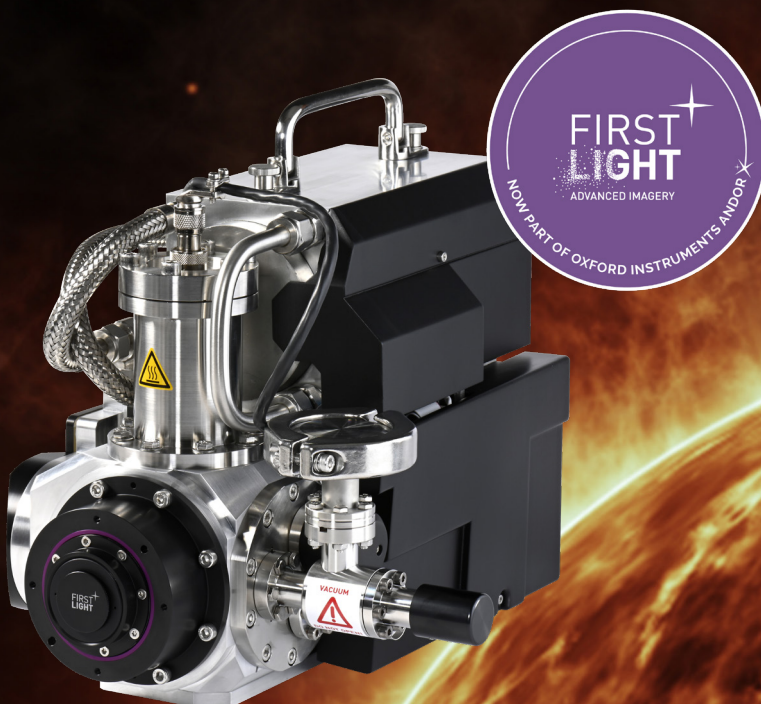
## Ultra Low Noise Ultra High-Speed SWIR Camera

### Key Specifications

- ✓ 320 x 256 e-APD MCT,
- ✓ 24  $\mu\text{m}$  pixel pitch
- ✓ SWIR 0.8 - 2.43  $\mu\text{m}$
- ✓ 70% QE, wavelength from 0.9 to 1.7  $\mu\text{m}$
- ✓ 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
- ✓ Semiconductor inspection
- ✓ Gas monitoring
- ✓ Leak detection



## 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 an unique 320 x 256 pixels HgCdTe e- APD array with 24  $\mu\text{m}$  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
- ✓ Rolling reset
- ✓ Single read, CDS or multiple non destructive reads.

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.

A vibration control system allows for the reduction of vibrations by x10 is available for integration in highly sensitive systems. C-RED One is opening new opportunities for high sensitivity and high speed SWIR imaging.

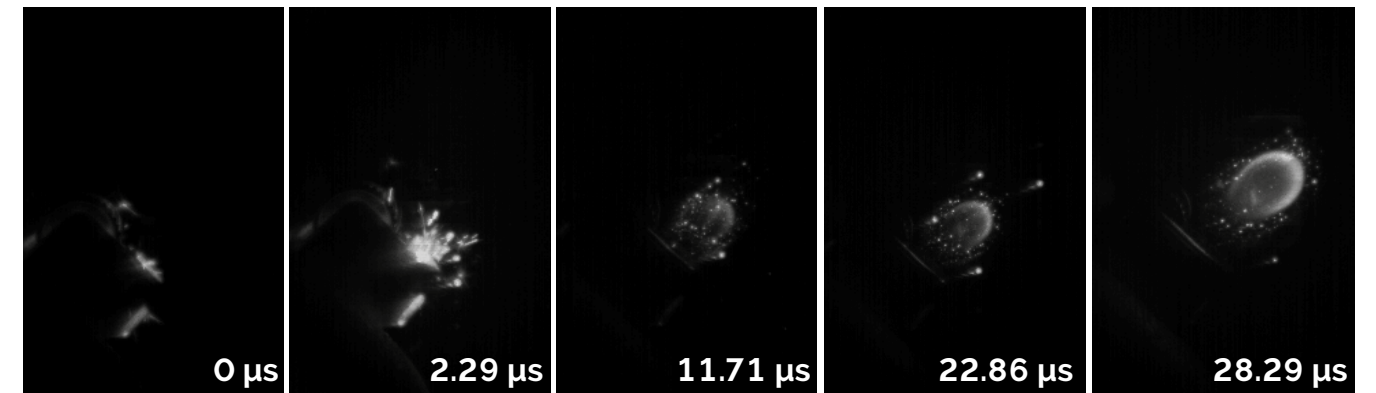
## Astronomy

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  $\mu\text{m}$ ), H-band (1.5 – 1.8  $\mu\text{m}$ ) and K-band (2.0 – 2.4  $\mu\text{m}$ ). One of the major applications of 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.*



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

# Technical Specifications

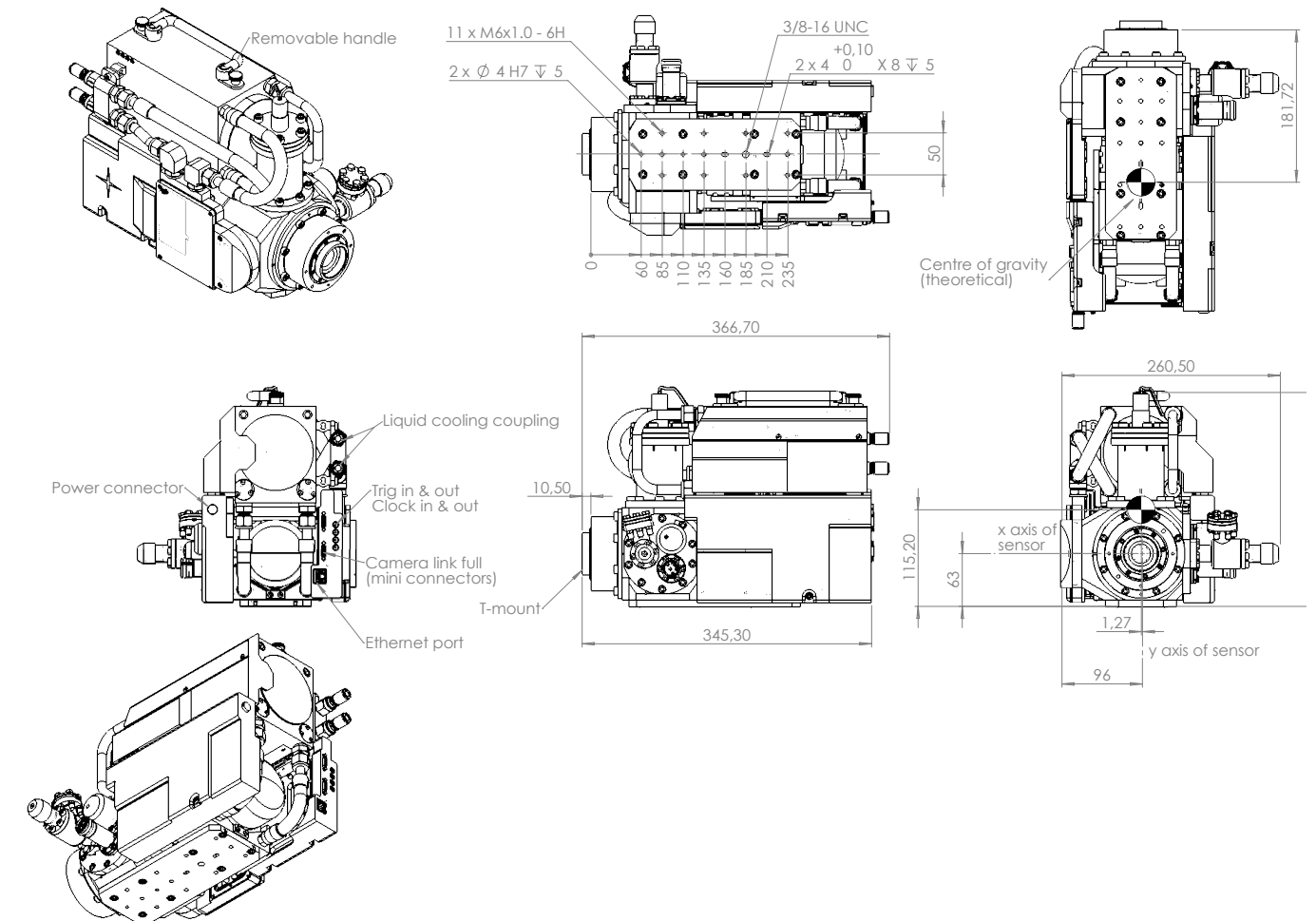
## Specifications<sup>•1</sup>

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 <sub>2</sub> )	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	<0.1%
Operability due to CDS noise / pixels with noise <2*median at bias of 9 V and integration time of 10 ms	<0.1%
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

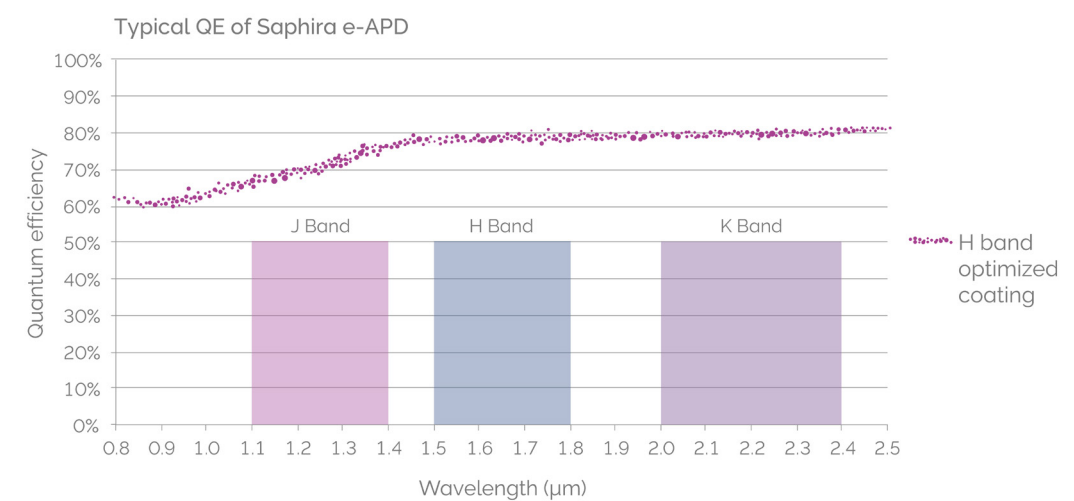
Features	All models
Optical interface	T-Mount
Multiple Readout Modes	Global reset
	Rolling reset
	Single read, CDS or multiple non destructive reads
Region of Interest (ROI)	User definable
PC Interface	Ultra low latency Camera Link® full interface
Triggering	Clock & Trigger input/output for synchronous 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

# Product Drawings

Dimensions in mm [inches]  
Weight: 19.4 kg



## Quantum Efficiency (QE) Curve





# Creating The Optimum Product for You

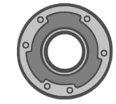
## Step 1. Select the camera type



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	<b>PAC-CR1-S320-H4</b>
C-RED One KK f/20: 320 x 256 e-MCT APD camera, 3500 FPS, <1 e- RON, KK band configuration, f/20 aperture	<b>PAC-CR1-S320-K20</b>
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 active damping	<b>PAC-CR1-S320-H4-A</b>
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 active damping	<b>PAC-CR1-S320-K20-A</b>

## Step 2. Select the required accessories



Accessories

Description	Order Code
Cooling pack	<b>PAC-COO-400-R00</b>
Synchro cables 1 m	<b>ACC-CAB-SYN-000</b>
Synchro cables 3 m	<b>ACC-CAB-SYN-001</b>
Camera Link® cables 5 m	<b>ACC-CAB-CLF-000</b>
Camera Link® cables 10 m	<b>ACC-CAB-CLF-001</b>
Matrix Grabber CL RAD EV 1G CLSF	<b>ACC-GRA-CLF-000</b>

## 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](#)

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### 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.