OXFORD INSTRUMENTS | ANDOR

iXon Ultra

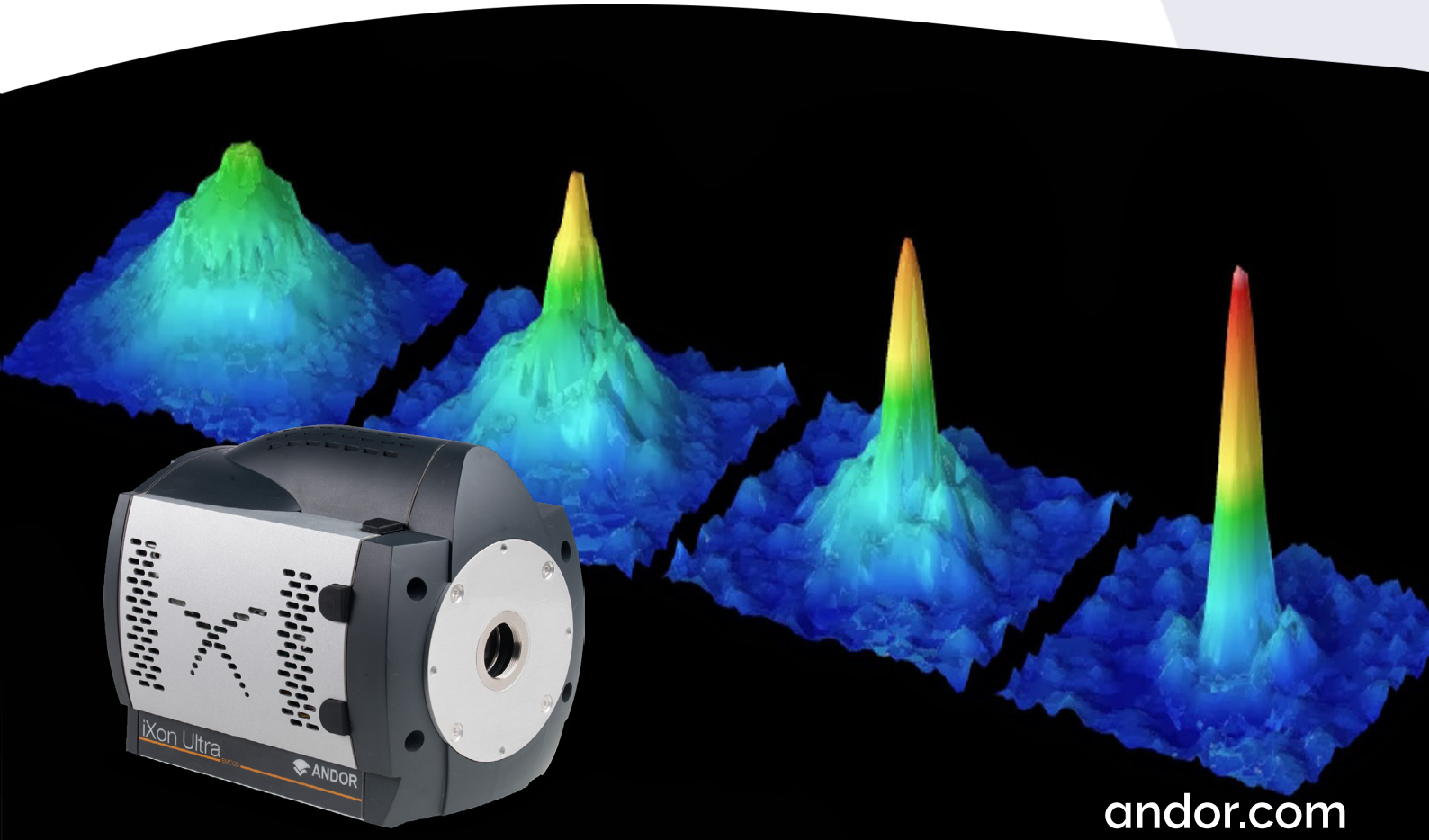
The World's Highest Performance Back-illuminated EMCCDs

Key Specifications

- ✓ Single photon sensitive
- ✓ Exceptional QE > 95%
- ✓ 13 or 16 µm pixel size
- ✓ Active pixels: 1024 x 1024 or 512 x 512
- ✓ TE cooling down to -95 or -100°C
- ✓ 26 or 56 fps full frame
- ✓ SRRF-Stream+ real time super-resolution

Key Applications

- ✓ Quantum imaging
- ✓ Cold atom & ion research
- ✓ Fast astronomy
- ✓ Tomography
- ✓ Fast spectroscopy
- ✓ Single molecule detection
- ✓ Super-resolution



andor.com

iXon Ultra

iXon Ultra 888: Field of View & Sensitivity... Now 3x Faster!

The highly innovative **iXon Ultra 888** megapixel, back-illuminated EMCCD camera offers single photon sensitivity across a large field of view, at 26 fps. Building on a rich history of first to market innovation, the 'supercharged' iXon Ultra 888, represents a massive performance boost for the largest available EMCCD sensor, as well as the first USB 3.0 enabled EMCCD camera.

The iXon Ultra 888 has been fundamentally re-engineered to facilitate a 3x acceleration of the pixel readout speed to an unprecedented 30 MHz, whilst maintaining quantitative stability, propelling the full frame performance to video rate. Furthermore, Andor's unique 'Crop Mode' can be employed to further boost frame rates from a user defined sub-region, for example pushing a 512 x 512 sub-array to 93 fps and a 128 x 128 area to 697 fps.

With a 1024 x 1024 sensor format and 13 µm pixel size, the resolving power, field of view and unparalleled speed of the iXon Ultra 888 render it the most attractive and versatile EMCCD option for demanding applications such as single molecule detection, super-resolution microscopy, live cell imaging and high time resolution astronomy.

The iXon Ultra is designed to be the most flexible yet easy to use EMCCD on the market, optimizable for a wide variety of application requirements in a single click via the OptAcquire™ feature. Furthermore, signal can be quantitatively calibrated in units of electrons or photons, either in real time or post-processing. Patented, pioneering technology offers automated recalibration of EM gain, alongside anti-ageing protection.

Crucially, the iXon brand carries an outstanding reputation within the industry for quality and reliability, brandishing an unparalleled track record of minimal field failures.

NOW WITH SRRF-STREAM+ TECHNOLOGY

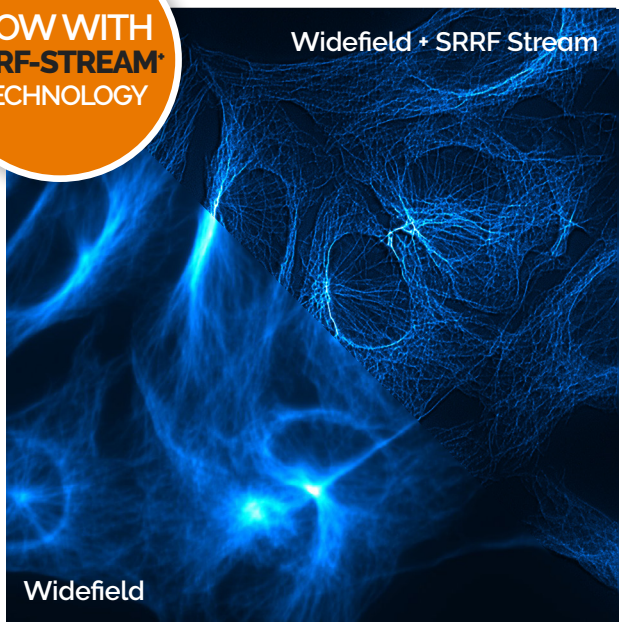
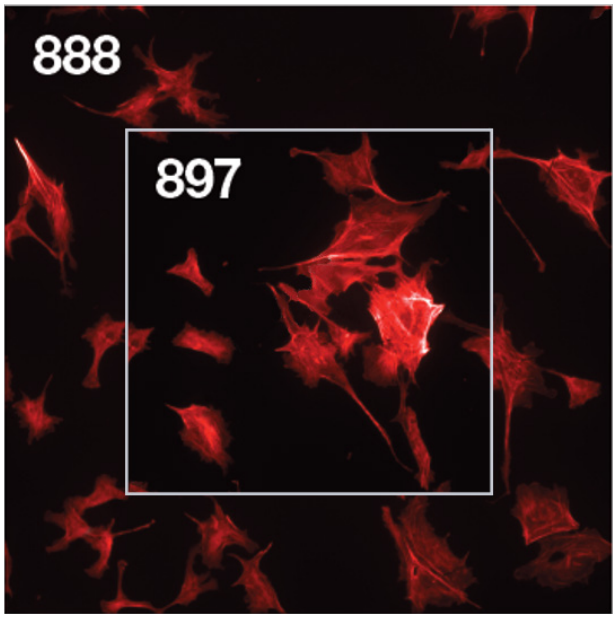


Image comparison of a fluorescently labelled fixed BPAE cell, recorded with a widefield fluorescence microscope and a SRRF-Stream enabled iXon 888 camera.

Key Specifications

Active pixels (H x V)	1024 x 1024
Pixel size (W x H; µm)	13 x 13
Image area (mm)	13.3 x 13.3
Active Area Pixel Well Depth (e-)	80,000
Max Readout Rate (MHz)	30
Frame rates (fps)	26 (full frame) - 9690
Read noise (e-)	<1 with EM gain
QE Max	>95%



Field of View Comparison between iXon Ultra models. The 888 model has a x2.6 greater sensitive area than the 897 model.

iXon Ultra 897: The market leading back-illuminated EMCCD, now accelerated to 56 fps.

The **iXon Ultra 897** platform takes the popular back-illuminated 512 x 512 frame transfer sensor and overclocks readout to 17 MHz, pushing speed performance to an outstanding 56 fps (full frame), whilst maintaining single photon sensitivity and quantitative stability throughout. New Optically Centred Crop Mode unlocks unparalleled frame rate performance from centrally located ROIs, ideal for the particular speed and sensitivity requirements of super-resolution microscopy.

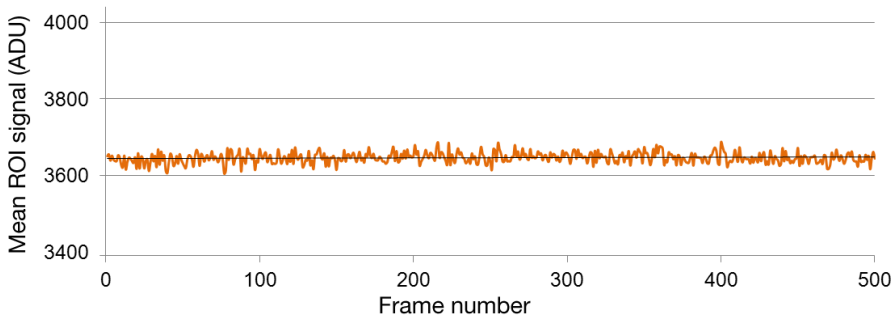
The iXon Ultra maintains all the advanced performance attributes that have defined the industry-leading iXon range, such as deep vacuum cooling to -100˚C, extremely low spurious noise, and Andor's patented EM gain recalibration technology (EMCA™). Count Convert functionality allows real time data acquisition in units of electrons or incident photons and OptAcquire facilitates one-click optimization of this versatile camera to a variety of application conditions.

Additional features of the iXon Ultra include plug and play USB connectivity, a lower noise conventional CCD mode and an additional Camera Link output, offering the unique ability to directly access data for 'on the fly' processing, ideally suited to data intensive applications such as adaptive optics or super-resolution microscopy.

Key Specifications

Active pixels (H x V)	512 x 512
Pixel size (W x H; µm)	16 x 16
Image area (mm)	8.2 x 8.2
Active Area Pixel Well Depth (e-)	180,000
Max Readout Rate (MHz)	17
Frame rates (fps)	56 (full frame) - 11,074
Read noise (e-)	<1 with EM gain
QE Max	>95%

Stability Plot



EM Gain stability in the iXon Ultra 897 @ 55 fps. 500 frame kinetic series; frame transfer (overlapped) acquisition; 17.8 ms exposure time; x300 EM gain.

Features & Benefits

Single Photon Sensitive & > 95% QE	Optimal SNR in light starved applications such as single molecule detection and quantum physics.
NEW 'SRRF-Stream+' (optional)	Real time, cell super-resolution functionality. Living and fixed cells, works on most modern fluorescence microscopes. Super-resolution down to 50 nm.
Blue optimized model	Our new sensor option offers up to 20% higher sensitivity to photons across the blue region of the spectrum, ideal for quantum and ion imaging as well as blue-emitting BEC.
Overclocked readout speeds	Follow dynamic changing processes.
Crop Mode	Continuous imaging with fastest possible frame rate from centrally positioned ROIs. Highly enabling for live cell super-resolution and much more (e.g. 251 fps with 256 x 256 ROI).
TE cooling to -100°C	Elimination of dark current detection limit.
RealGain™	Absolute EMCCD gain selectable directly from a linear and quantitative scale.
Lower Noise CCD Mode	'2 in 1' flexibility. EMCCD for ultra-sensitivity at speed, conventional CCD for longer acquisitions.
Fringe Suppression (optional)	Reduced etaloning in NIR.
OptAcquire	Optimize the highly flexible iXon for different application requirements at the click of a button.
Count Convert	Quantitatively capture and view data in electrons or incident photons. Count Convert does this important conversion for you.
EMCAL™	Patented user-initiated self-recalibration of EM gain.
Qualified down to -20°C ambient temperature	Excellent for use at observatories.
Minimal Clock-Induced Charge	Confident discrimination of single photon events in Quantum Imaging.
UltraVac™	Critical for sustained vacuum integrity and to maintain unequalled cooling and QE performance, year after year. Seven year vacuum warranty.
Spurious Noise Filter	Intelligent algorithms to filter clock induced charge events from the background.
Direct Data Access	Camera Link output port to facilitate direct access to data for 'on the fly' processing.
Enhanced photon counting modes	Intuitive single photon counting modes ideal for Quantum Imaging. Real time or post-processing.
FPGA Timestamp	Hardware generated timestamp with 10 ns accuracy.
ASTRO.control compatibility (Ultra only)	Redlogix ASTRO.control is a dedicated platform for control of astronomical telescopes and instrumentation http://www.andor.com/astrocontrol.aspx

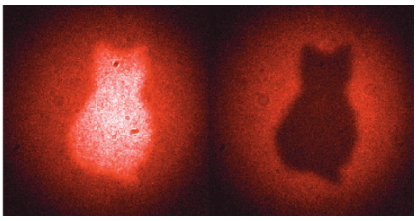
Application Focus

The Physicist's Choice

The unique high-performance specifications of the optimized iXon range have been serving the physical scientist and astronomer in scenarios that demand more than simply an EM sensor in a camera. Andor have worked with numerous scientists to deliver solutions that work for their particular application requirements, such as specific coatings, coupling to fibre optic scintillators and 'minimized latency' direct data access solutions.

Quantum Science

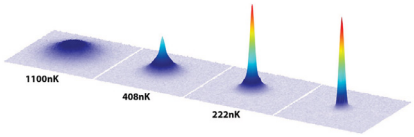
Quantum entanglement is now being studied with the aim of providing insight into the practical applications of this phenomenon. Quantum cryptography, communication and computing may soon rely on high-fidelity readouts of entangled photons. To detect these single particles researchers must rely on the most sensitive detection as is provided by iXon Ultra EMCCD cameras.



Quantum entanglement, see Quantum imaging finally saves Schrödinger's cat. Courtesy of Anton Zeilinger, Institute for Quantum Optics and Quantum Information, University of Vienna.

Cold Atom & Ion Research

Our new blue-enhanced back-illuminated EMCCD sensor option is ideal for cold atom imaging experiments such as blue-emitting Bose-Einstein Condensation (BEC), ion traps and degenerate matter studies. Single photon sensitivity enables users to discern signals from single trapped ions and atoms.



A phase transition and BEC formation in a gas of erbium atoms imaged at 401 nm matched by camera's QE at approx. 75%. Courtesy of K. Aikawa et al., University of Innsbruck, Austria.

Fast Astronomy

Extremely fast and ultra-sensitive performance of binned sub-regions make the iXon Ultra an ideal Shack Hartmann AO detector. The large FOV of the Ultra 888 and fast frame rate are ideal for Lucky / Speckle Imaging. Qualified down to -20°C ambient, perfect for night observation.

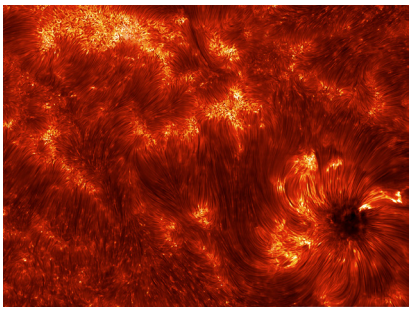
The iXon Ultra 888 serves as the Focal Plane Imager of the SOFIA telescope. Courtesy of Pasquale Temi & E.E. Becklin, NASA.

Tomography

Lens coupled or customer fibre coupled, the iXon Ultra provides the superlative ultrasensitive, large array solution for fast tomography.

Fast Spectroscopy

The iXon Ultra has been a very valuable detector for fast spectroscopy applications, such for rapid spectroscopic mapping or fast monitoring of fast chemical reactions. When operated in full vertical binning the cameras can be pushed to thousands of spectra per second, accessing sub-ms dynamics. The iXon Ultra camera models are fully compatible with Andor's Kymera and Shamrock range of high-end spectrographs.



Magnetic fibrils that weave through the solar chromosphere. Courtesy of Kevin Reardon, National Solar Observatory.

iXon Ultra 888 – Capture everything

- ✓ **Extreme Sensitivity** – capture, resolve and quantify extremely weak structures.
- ✓ **Capture More** – the 13.3 x 13.3 mm sensor of the Ultra 888 is well suited to the optically useful FOV from a microscope.
- ✓ **3x Faster** – more and more studies of cell processes require greater temporal resolution. The Ultra 888 offers the fastest available EMCCD readout capability.
- ✓ **Superb Image Quality** – megapixel resolution and uniform backgrounds for publication quality imaging.
- ✓ **2 in 1** – the Ultra 888 can operate as an EMCCD or a low noise CCD, rendering it optimal for both fast and slow capture.

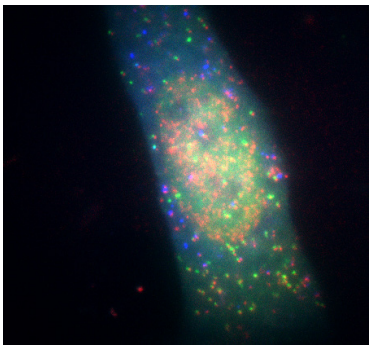
Application Focus

The Biologist's Choice

In applications such as single molecule microscopy, super-resolution, live cell microscopy (including confocal), calcium signalling, transport/motile imaging and intracellular bioluminescence, weak, rapidly changing fluorescent signals from cells must be dynamically imaged. Andor's iXon technology offers an ideal detection solution. Ultra-sensitive detection capability in fluorescence microscopy facilitates use of lower excitation powers (thereby reducing photobleaching and phototoxicity) and lower dye concentrations.

Single Molecule Detection

Andor's iXon EMCCD has long been the gold standard detector of the biophysics laboratory, and remains the dominant detector type, operating in a low light regime that is less suited to sCMOS cameras. The 3x accelerated 30 MHz readout speed of the iXon Ultra 888, especially combined with 'Optically Centred Crop Mode', means that dynamic single molecule processes can be better characterized. The 13 µm pixel provides superb resolving capability at the diffraction limit.

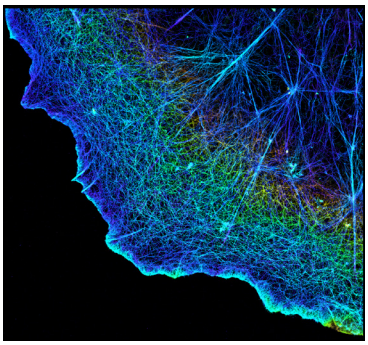


Single molecule imaging mRNA (red), during translation, and proteins, FLAG-KDM5B (green) and HA-KDM5B (blue). Courtesy of Timothy J. Stasevich, IGAF, Colorado State University.

Spinning disk confocal

The iXon Ultra 888 is the ultimate detector to drive stunning performance from confocal spinning disk technology. Whilst affording superb confocality and low rates of phototoxicity, spinning disk experiments are inherently photon starved, by virtue of the photon rejection implicit to optical sectioning.

The superior sensitivity of the iXon Ultra detector brings these low light images to life.



3D STORM image of actin cytoskeleton (AF647-phalloidin) in COS-7 cell. Colour codes for z-depth. Image courtesy of Xiaowei Zhuang, Harvard University.

Luminescence

The iXon Ultra can be used in either single photon counting mode (EM amplifier) or in slow scan, deep cooled CCD mode (CCD amplifier) as a highly sensitive and flexible detector in this typically long exposure, extreme low light application.

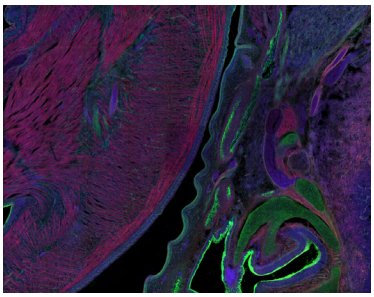
SRRF-Stream+

Exclusive to compatible Andor cameras, SRRF-Stream leverages GPU optimization to greatly increase processing of the SRRF algorithm This makes it possible to perform super-resolution microscopy on conventional modern fluorescence microscopes in real-time!

- ✓ **Real Time** – enhanced workflow, avoids post-processing. View in 'Live Mode'.
- ✓ **Low Excitation Intensities** – prolonged live cell observations & accurate physiology.
- ✓ **Conventional Fluorophores**– simple labelling, no photo-switching required.
- ✓ **Live Cell Dynamics** – full FOV super-res images every 1-2 secs. > 10 fps using ROI.
- ✓ **Cost-Effective** – convert conventional fluorescence microscopes to super-resolution microscopes.

Andor's new "**SRRF-Stream+**" provides even better performance. The original SRRF-Stream, localization was limited to 6-axes, which provided a compromise of image quality and speed for most datasets. However. for SRRF-Stream+ it has been possible to increase the axes of radiality to 24, by maximising GPU processing, enhancing image quality with minimal impact to speed. Find out more in the SRRF-Stream+ technical note.

Users of the original SRRF-Stream can upgrade to the new SRRF-Stream+ using an updater utility from their local Andor product support.



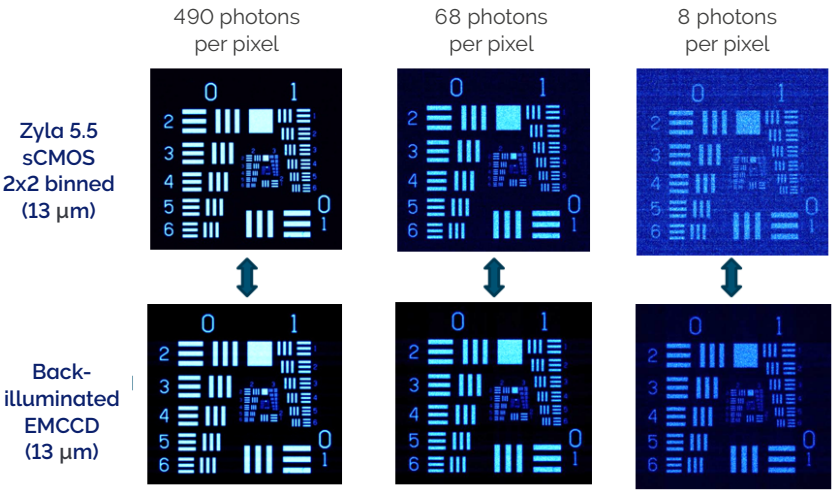
Spinning disk confocal image (right) of a mouse embryo section with F-actin (AF568-phalloidin), membrane glycoproteins (AF488-WGA), and DNA (DAPI) labelling.

EMCCD or sCMOS?

Since the introduction of sCMOS technology by Andor, the question of the performance comparison against the more established Electron Multiplying CCD (EMCCD) has been a common one.

Being a very fast, low noise technology, sCMOS does hold some potential to offer an alternative technology across some applications and techniques, including to an extent, TIRF microscopy. Whilst the read noise of sCMOS is very low compared to CCDs, EMCCD technology holds the distinct advantage of being able to practically eliminate read noise, rendering them single photon sensitive.

After a few years of sCMOS being tested in the market, we are concluding that the primary light staved applications for which EMCCDs were originally purchased, such as single molecule detection and low light spinning disk confocal microscopy, are continuing to strongly benefit from this ultrasensitive technology. EMCCDs offer a raw sensitivity that cannot be surpassed in the very low light regime.



Images at a range of incident light intensity, acquired using back-illuminated EMCCD iXon 888 and Zyla 5.5 sCMOS cameras (2x2 binned pixels). At low light intensities, the Signal to Noise Ratio advantage of the EMCCD is apparent (in this example the 8 photons per pixel images).

Plot of Signal to Noise Ratio versus Incident Photon Intensity, comparing a back-illuminated EMCCD iXon 888 (13 µm pixel size) to 2x2 binned Zyla sCMOS cameras (13 µm pixel size after binning)

Technical Specifications

System Specifications •2

	Ultra 888		Ultra 897	
Sensor QE options	#BV: Back Illuminated, standard AR coated BVF: Back Illuminated, standard AR coated with fringe suppression UVB: Back Illuminated, standard AR with additional lumogen coating #EX: Back illuminated, dual AR coated EXF: Back illuminated, dual AR coated with fringe suppression NEW #BB: Back-illuminated, blue optimized AR coated			
Fringe Suppression	Available on EXF and BVF sensor options			
Active pixels	1024 x 1024		512 x 512	
Pixel size	13 x 13 µm		16 x 16 µm	
Image area	13.3 x 13.3 mm with 100% fill factor		8.2 x 8.2 mm with 100% fill factor	
Pixel Readout Rate Minimum temperature, air cooled, ambient 20˚C Chiller liquid cooling, coolant @ 10˚C, >0.75l/min	10 MHz -80°C -95°C	30 MHz•3 -60°C -75°C	10 MHz -80°C -100°C	17 MHz -80°C -100°C
Thermostatic Precision	± 0.01˚C			
Triggering	Internal, External, External Start, External Exposure, Software Trigger			
System window type	#BV and BVF: UV-grade fused silica, Broadband Visible-Near Infrared, 0.5 degree wedge UVB, #EX, EXF: UV-grade fused silica, Broadband Vacuum Ultraviolet-Near Infrared, 0.5 degree wedge #BB: UV-grade fused silica, Broadband Vacuum Ultraviolet-Near Infrared, 0.5 degree wedge			
Blemish specification	Grade 1 sensor from supplier. Camera blemishes as defined by Andor Grade A			
Digitization	16-bit (at all speeds)			
PC Interface	USB 3.0•12		USB 2.0	
Lens Mount	C-mount			
Direct Data Access	Camera Link 3-tap output			

Advanced Performance Specifications •2

	Ultra 888						Ultra 897						
Dark current and background events•4,5													
Dark current (e-/pixel/sec) @ -80˚C	0.00025						0.00030						
Dark current (e-/pixel/sec) @ max cooling	0.00011						0.00015						
Spurious background (events/pix) @ 1000x gain / -85˚C	0.005						0.0018						
Active area pixel well depth	80,000 e^-						180,000 e^-						
Gain register pixel well depth•6,7	730,000 e^-						800,000 e^-						
Pixel readout rates	EM Amplifier: 30, 20, 10 & 1 MHz Conventional Amplifier: 1 & 0.1 MHz						EM Amplifier: 17, 10, 5 & 1 MHz Conventional Amplifier: 3, 1 & 0.08 MHz						
Read noise (e-)•7	EMCCD Amplifier				Conventional Amplifier		EMCCD Amplifier				Conventional Amplifier		
MHz	30	20	10	1	1	0.1	17	10	5	1	3	1	0.08
Without Electron Multiplication	130	80	40	12	6	3.5	89	65	37	15	9.6	5.3	2.7
With Electron Multiplication	< 1	< 1	< 1	< 1	-	-	< 1	< 1	< 1	< 1	-	-	-
Linear absolute Electron Multiplier gain	1 - 1000 times via RealGain™ (calibration stable at all cooling temperatures)												
Linearity•8	Better than 99.9%												
Vertical clock speed	0.6 to 4.33 µs (user selectable)						0.3 to 3.33 µs (user selectable)						
Timestamp accuracy	10 ns												
NEW SRRF-Stream+ mode	Optional												

iXon Ultra 888 Frame Rates

Standard Mode•3,9

Binning	1024 x 1024	512 x 512	256 x 256	128 x 128	1024 x 100	1024 x 32	1024 x 1
1 x 1	26	50	95	171	220	498	1163
2 x 2	50	94	170	285	368	699	-
4 x 4	92	167	281	426	552	870	-

Crop Mode - Optically Centred frame rates in brackets•3,9

Binning	512 x 512	256 x 256	128 x 128	64 x 64	1024 x 100	1024 x 32	1024 x 1
1 x 1	93 (78)	190 (251)	670 (697)	2053 (1319)	259	778	9690
2 x 2	170 (143)	350 (426)	1150 (1019)	3123 (1646)	492	1416	-
4 x 4	291 (245)	601 (653)	1772 (1504)	4109 (1857)	887	2370	-

iXon Ultra 897 Frame Rates

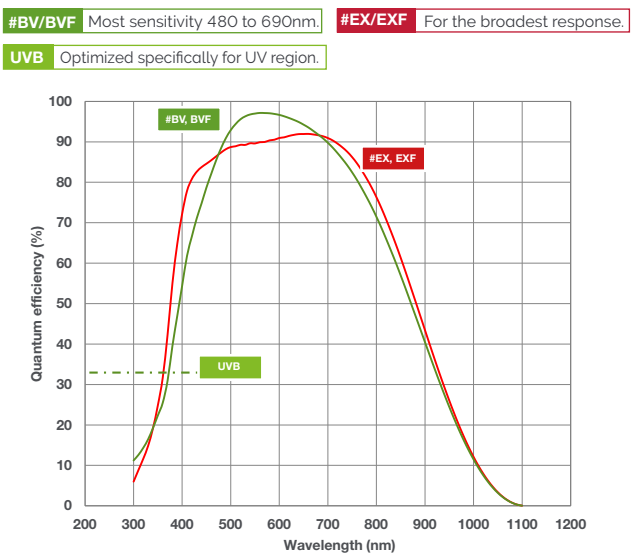
Standard Mode•10

Binning	512 x 512	256 x 256	128 x 128	64 x 64	512 x 100	512 x 32	512 x 1
1 x 1	56	110	212	398	267	708	2,881
2 x 2	109	210	394	699	486	1,141	-
4 x 4	206	385	682	1,109	820	1,615	-

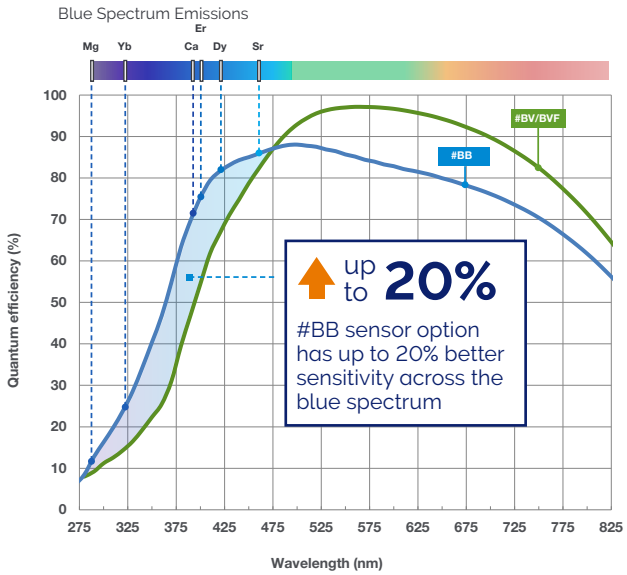
Crop Mode - Optically Centred frame rates in brackets•10

Binning	256 x 256	128 x 128	64 x 64	32 x 32	512 x 100	512 x 32	512 x 1
1 x 1	111 (174)	595 (569)	1,433 (1,490)	3,533 (3,021)	282	857	11,074
2 x 2	215 (329)	1,094 (1,013)	2,481 (2,325)	5,555 (4,048)	541	1,607	-
4 x 4	405 (593)	1 ,883 (1,661)	3,906 (3,236)	7,751 (4,878)	1,005	2,865	-

Quantum Efficiency (QE) Curves•11



Blue-optimized sensor option for quantum and BEC studies



Creating The Optimum Product for You

Step 1. Choose the camera type

Camera Type

Description	Code
iXon Ultra 888: 1024 x 1024 EMCCD, max. 30 MHz, with USB 3.0	**DU-888U3-CS0-**
iXon Ultra 897: 512 x 512 EMCCD, max. 17 MHz, with USB 2.0	**DU-897U-CS0-**

Add sensor type code to camera code (see step 2)
NOTE: If **SRRF-Stream+** real time super-resolution functionality is required with your iXon Ultra, please order as an 'accessory' in step 4 below.

Step 2. Choose the sensor type option

Sensor Type

Description	Code	Description	Code
Back-illuminated, standard AR coated	**#BV**	Back-illuminated, EX2 dual AR coated	**#EX**
Back-illuminated, standard AR coated with fringe suppression	**BVF**	Back-illuminated, EX2 dual AR coated with fringe suppression	**EXF**
Back Illuminated, standard AR with additional lumogen coating	**UVB**	NEW Back-illuminated, blue optimized AR coated	**#BB**

Add sensor type code to camera code (step 1)

Step 3. Select an alternative camera window (optional)

Camera Window

The standard window has been selected to satisfy most applications. However, other options are available. The alternative camera window code must be specified at time of ordering.
To view and select other window options please refer to the 'Camera Windows Supplementary Specification Sheet' which gives the transmission characteristics, product codes and procedure for entering the order. Further detailed information on the windows is in the Technical note – 'Camera Windows: Optimizing for Different Spectral Regions'.

Step 4. Select the required accessories

Accessories

Description	Order Code
SRRF-Stream+ real time super-resolution functionality, compatible with iXon Ultra and iXon Life EMCCD platforms. Camera must be connected to acquisition PC workstation containing an Nvidia GPU card (compute capability v3.0, or above, and 4GB or greater on-board GPU RAM).	**SRRF-STREAM-IXON**
SRRF-Stream Dell Workstation (English), pre-installed with a recommended and tested GPU card, alongside SRRF-Stream enabled MicroManager and Andor SDK2 with SRRF-Stream.	**WKST-SRRF-9ZY**
Monitor (optional) - Dell UltraSharp U3417W - 34.14" Curved LED	**FUS-MNTR-34W**
Dell UltraSharp UP3017 - 30" with PremierColor	**FUS-MNTR-30**
OptoMask accessory, used to mask unwanted sensor area during Crop Mode acquisition (refer to OptoMask Specification Sheet for further information).	**OPTMSK-L/ OPTMSK-OC-L/ OPTMSK-OC-S**

Description	Order Code
Re-circulator for enhanced cooling performance	**XW-RECR**
Oasis 160 Ultra compact chiller unit (tubing to be ordered separately)	**ACC-XW-CHIL-160**
6 mm tubing options for ACC-XW-CHIL-160 (2x2.5 m or 2x5m lengths)	**ACC-6MM-TUBING-2X2.5/ ACC-6MM-TUBING-2X5M**
C-mount to Nikon F-mount adapter	**OA-CNAF**
C-mount to Olympus adapter	**OA-COFM**
C-mount to T-mount adapter	**OA-CTOT**
15 m Active USB 3.0 connector cable (power supply not required) Icron for Ultra 888	**ACC-ASE-06887**
50 m Fibre Optic USB 3.0 extender solution inc. power supply (Adnaco) for Ultra 888	**ACC-ASE-08762**
100 m Fibre Optic USB 3.0 extender solution inc. power supply (Adnaco) for Ultra 888	**ACC-ASE-07860**

Step 5. Select the required software

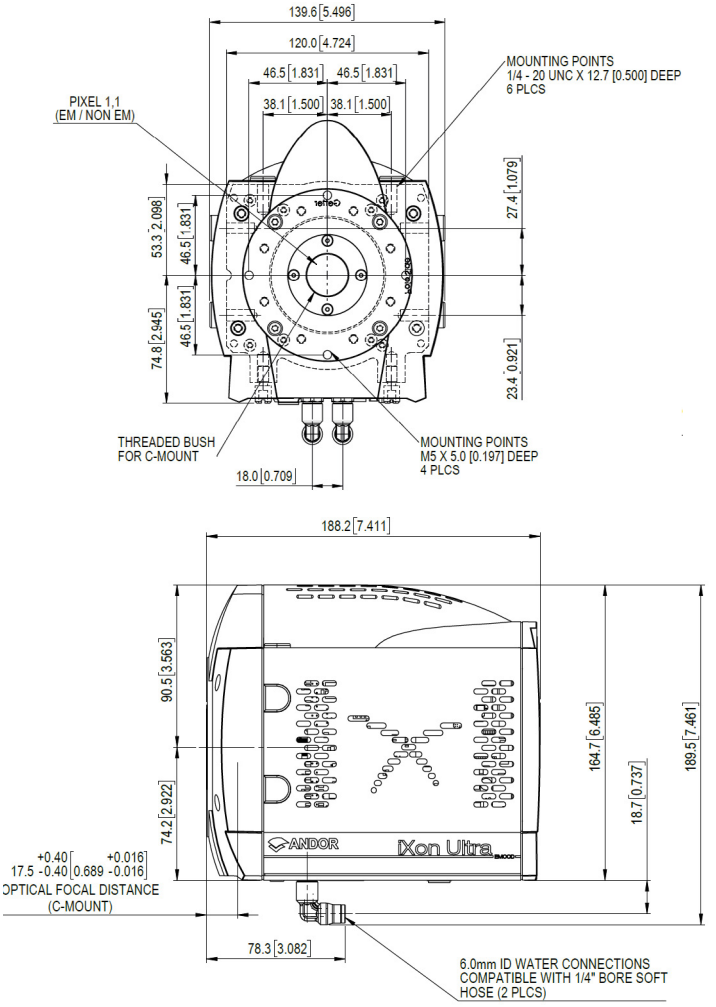
Software

The iXon Ultra series requires one of the following software options:
Solis Imaging: A 32-bit and fully 64-bit enabled application for Windows (8, 8.1 and 10) offering rich functionality for data acquisition and processing. AndorBasic provides macro language control of data acquisition, processing, display and export.
Andor SDK: A software development kit that allows you to control the Andor range of cameras from your own application. Available as 32 and 64-bit libraries for Windows (8, 8.1 and 10), compatible with C/C++, C#, Delphi, VB.NET, LabVIEW and Matlab. Linux SDK compatible with C/C++.
Andor iQ A comprehensive multi-dimensional imaging software package. Offers tight synchronization of EMCCD with a comprehensive range of microscopy hardware, along with comprehensive rendering and analysis functionality. Modular architecture for best price/performance package on the market.
Third party software compatibility, drivers are available for a variety of third party imaging packages.
For SRRF-Stream+ the iXon must be operated either through MicroManager (Open Imaging) open source microscopy software platform, or through the Andor SDK, if SRRF-Stream functionality is to be accessed.

Product Drawings

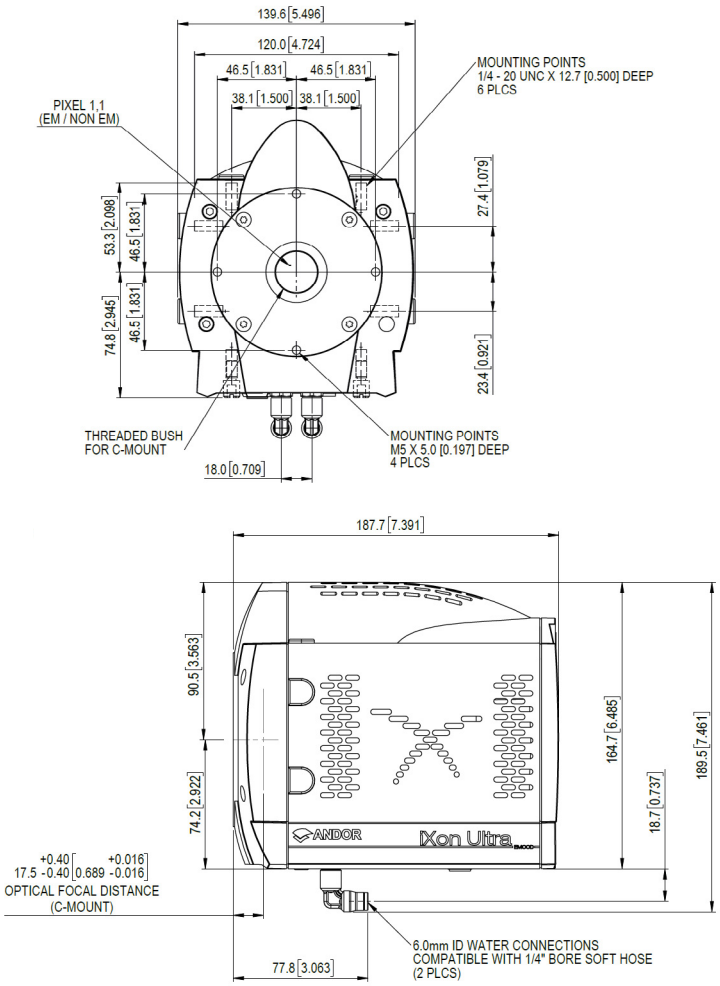
Dimensions in mm [inches]

iXon Ultra 888



Weight 3.7 Kg

iXon Ultra 897



Weight 3.7 Kg

Ultra 888 Power Requirements

- Power Input: +12 VDC ± 5% @ 8 A
- Power Consumption: 96 W max
- Ripple and noise: 120 mV max (peak-peak 0 - 20 MHz)
- External Power Supply: 100 - 240 VAC 50/60 Hz

Ultra 897 Power Requirements

- Power Input: +12 VDC ± 5% @ 6 A
- Power Consumption: 72 W max
- Ripple and noise: 120 mV max (peak-peak 0 - 20 MHz)
- External Power Supply: 100 - 240 VAC 50/60 Hz

Logic: Connector type: 26 way D Type with 8 programmable digital inputs or outputs for control and sensing of up to 8 external devices, Minimum cable clearance required: 90 mm, Weight: 3.7 kg [8 lb 3 oz] approx.

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.com/contact

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Items shipped with your iXon Ultra 888:
1x Andor ACZ-03463: 2m Multi I/O timing cable, offering Fire, External Trigger, Shutter and Arm
1x 3m USB 3.0 cable Type A to Type B
PCIe USB 3.0 Card Adapter (2-Port)[12]
1x Power supply unit with mains cable
1x Quick Start guide
1x Electronic copy of user manuals
1x SRRF-Stream Quick Start guide (if applicable)
1x Individual system performance booklet

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1x Power supply unit with mains cable
1x Quick Start guide
1x Electronic copy of user manuals
1x SRRF-Stream Quick Start guide (if applicable)
1x Individual system performance booklet

Recommended Computer Requirements:
- 3.0 GHz single core or 2.6 GHz multi core processor
- 2 GB RAM
- 100 MB free disc space to install software (at least 1 GB recommended for data spooling)
- USB 3.0 Super Speed Host Controller capable of a sustained rate of 60MB/s for iXon Ultra 888
- USB 2.0 High Speed Host Controller capable of sustained rate of 40MB/s for iXon Ultra 897
- Solid-state drive (SSD) capable of a minimum sustained write speed of 100MB/S for spooling data
- Windows (8, 8.1 and 10) or Linux
- SRRF-Stream+ - If selected, the PC requires a Nvidia GPU card. See page 10 for further details.

Footnotes: Specifications are subject to change without notice

1. Assembled in a state-of-the-art cleanroom facility, Andor's UltraVac™ vacuum process combines a permanent hermetic vacuum seal (no o-rings), with a stringent protocol to minimize outgassing, including use of proprietary materials.
2. Figures are typical unless otherwise stated.
3. At 30 MHz overclocked pixel readout rate, thermal dissipation from the sensor is higher since a greater proportion of time is spent vertical shifting, and it is necessary to set a higher sensor cooling temperature at this rate. Furthermore, stable cooling performance will depend on other variables such as vertical clock speed, Region of Interest size (Standard or Crop Mode) and ambient temp. As such, user testing is advised to determine the stable sensor cooling temperature for selected conditions. Status of temperature stability is apparent through the acquisition software.
4. The dark current measurement is averaged over the sensor area excluding any regions of blemishes.
5. Using Electron Multiplication the iXon is capable of detecting single photons, therefore the true camera detection limit is set by the number of 'dark' background events. These events consist of both residual thermally generated electrons and Clock Induced Charge (CIC) electrons (also referred to as Spurious Noise), each appearing as random single spikes above the read noise floor. A thresholding scheme is employed to count these single electron events and is quoted as a probability of an event per pixel. Acquisition conditions are full resolution and max frame rate (30 MHz readout; frame-transfer mode; 1.1 µs vertical clock speed; x 1000 EM gain; 10 ms exposure; -95°C).
6. The EM register on CCD201 sensors has a linear response up to ~400,000 electrons and a full well depth of ~730,000 electrons.
7. Readout noise is for the entire system. It is a combination of sensor readout noise and A/D noise. Measurement is for Single Pixel readout with the sensor at a temperature of -75°C and minimum exposure time under dark conditions. Under Electron Multiplying conditions, the effective system readout noise is reduced to sub 1 e^- levels.
8. Linearity is measured from a plot of counts vs. exposure time under constant photon flux up to the saturation point of the system, at 10 MHz readout speed.
9. All measurements are made at 30 MHz pixel readout speed with 0.6 µs vertical clock speed. It also assumes internal trigger mode of operation. Standard and Crop Mode frame rates shown are for 'Corner Tethered' ROIs, with 'Optically Centred' ROI frame rates shown within brackets.
10. All measurements are made at 17 MHz pixel readout speed with 0.3 µs vertical clock speed. It also assumes internal trigger mode of operation. Standard and Crop Mode frame rates shown are for 'Corner Tethered' ROIs, with 'Optically Centred' ROI frame rates shown within brackets.
11. Quantum efficiency of the sensor at 25°C, as supplied by the sensor manufacturer.
12. iXon Ultra 888 should work with any modern USB 3.0 enabled PC/laptop, as every USB 3.0 port should have its own host controller. iXon Ultra 888 also ships with a USB 3.0 PCI card as a means to add a USB 3.0 port to an older PC, or as a diagnostic aid to interoperability issues.

Operating & Storage Conditions
- Operating Temperature: -20°C to 30°C ambient
- Relative Humidity: < 70% (non-condensing)
- Storage Temperature: -25°C to 50°C

Power Requirements
- Please refer to page 11

LiXonUltraSS 1120 R1

OXFORD INSTRUMENTS | ANDOR

Marana sCMOS

Ultimate Sensitivity Back-illuminated sCMOS for Astronomy & Physical Sciences

Key Specifications

- ✓ High resolution: 4.2 Megapixel
- ✓ High sensitivity: Up to 95% QE
- ✓ Fast speeds: Up to 74 fps
- ✓ Large field of view: Up to 32 mm
- ✓ Deep cooled: -45˚C cooling
- ✓ Protected: UltraVac™ sensor enclosure
- ✓ Flexible: 11 µm & 6.5 µm pixel sensors

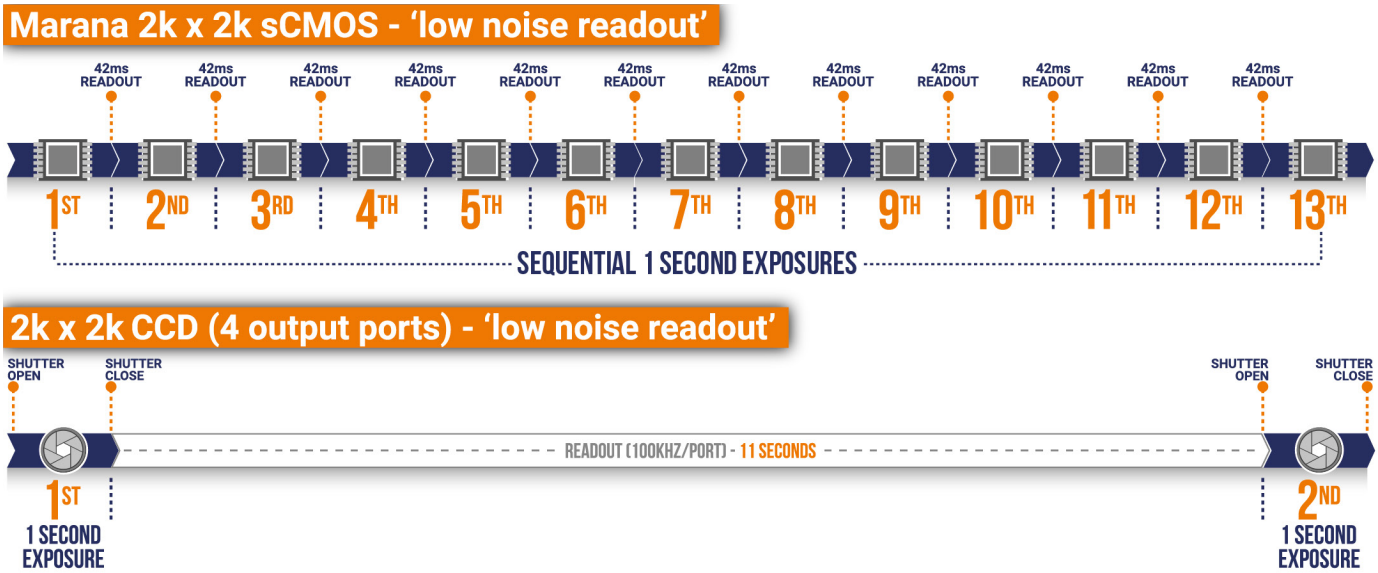
Key Applications

- ✓ Space debris tracking
- ✓ Quantum gases
- ✓ Near Earth object tracking
- ✓ Tomography
- ✓ Wavefront sensing
- ✓ Spectroscopy
- ✓ Wafer inspection

andor.com

Introducing Marana

Marana is Andor's new flagship high performance, vacuum cooled sCMOS camera platform, specifically for applications within physical sciences and astronomy. Designed from the ground up to deliver market leading performance and versatility. Crucially, Marana sCMOS reads out 4.2 Megapixel high resolution arrays in less than 50 milliseconds while maintaining very low read noise; hundreds of times faster than a similar resolution CCD detector. Marana is ideally suited to applications that require exposure times from microseconds through to several seconds.



The Most Sensitive Back-illuminated sCMOS

Marana 4.2B-11 and **new Marana 4.2B-6** back-illuminated sCMOS cameras feature up to **95% Quantum Efficiency** combined with Andor's unique **vacuum cooling to -45°C**, minimizing noise. Since back-illuminated sensors are chosen specifically for enhanced sensitivity, it makes sense to choose the most sensitive adaption of this high end technology.

How do we benefit from enhanced sensitivity?

- ✓ Space debris & NEO – track smaller objects
- ✓ Detect smaller occultations
- ✓ Lower laser powers – preserve photosensitive samples
- ✓ Shorter exposures – follow fast events, e.g. pulsars and fast reactions
- ✓ Lower detection limits / trace concentrations
- ✓ Higher dynamic range photometry
- ✓ AO wavefront sensing on weaker signals
- ✓ Extremely narrowband filters (e.g. Solar)
- ✓ Fluorescence down to single ultra-cold atoms

Features and Benefits

From Quantum Gas Dynamics to Astronomical Occultations, Marana combines the sensitivity, speed, resolution and field of view to take on the most demanding of imaging or spectroscopic challenges.

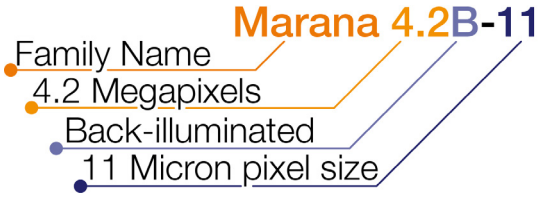
Feature	Benefit
All Marana Models	
Up to 95% QE & lowest noise	Maximum signal to noise for light starved measurements. Detect smaller orbital debris; BEC fluorescence.
Vacuum cooled to -45°C	Very weak signals require lowest noise floor. Also minimizes population of hot pixels.
4.2 Megapixel	High pixel resolution, maintaining image clarity over an extended field of view.
The ONLY vacuum back-illuminated sCMOS•[1]	Andor's proprietary UltraVac™ technology protects the sensor from (a) QE degradation, and (b) moisture condensation.
Extended Dynamic Range (EDR) Mode	'One snap quantification' across the full dynamic range - perfect for Photometry.
Exposure Flexibility	Ideal for experiments that require exposures from microseconds up to several seconds.
> 99.7% linearity	Market leading quantitative accuracy over the whole signal range.
Fan and liquid cooling as standard	Liquid cooling for maximum sensitivity.
Adaptive Optics Ready	Minimize lag after data collection - transfer of row data immediately after exposing.
Marana 4.2B-11 (11 µm pixels)	
Anti-Glow Technology	Suppresses the effects of sensor amplifier glow, allowing access to the full 4.2 Megapixel array.
11 µm pixels and 32 mm sensor diagonal	Largest field of view sCMOS, compatible with wide range of acquisition times. Large sky scanning; Tomography.
UV-optimized QE option	Enhanced UV sensitivity between 260 - 400 nm. Wafer Inspection (266 nm).
NEW Marana 4.2B-6 (6.5 µm pixels)	
6.5 µm pixels	Smaller pixels better suited to some optical systems, e.g. echelle astrospectroscopy and cold atom imaging.
USB 3.0 and CoaXPress connectivity options	USB 3.0 provides flexibility. CoaXPress enables the highest speeds to capture the most dynamic events.
Low Noise Mode	Further reduces read noise floor at expense of pixel well depth, while maintaining a fast frame rate. Ideal when highest possible sensitivity is a priority.
High Speed Mode	Acquire images at high speeds of up to 74 fps in full frame 16-bit mode via CoaXPress! Boost speeds even further using regions of interest.
Superfast Spectroscopy Ready	On-head vertical pixel binning, ideal for dynamic spectroscopy (up to >25,000 spectra/sec).

The Marana sCMOS series

Marana 4.2B-11: Superior Field of View

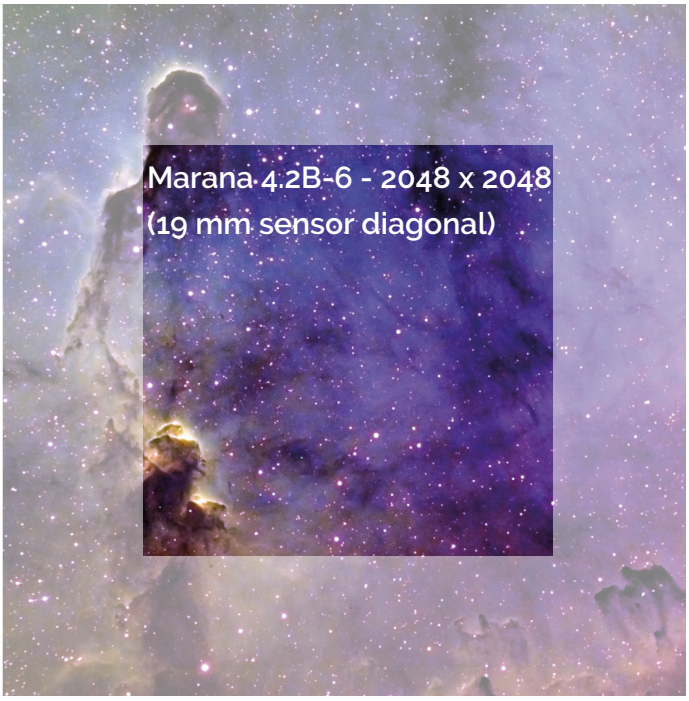
The **Marana 4.2B-11** is the detector of choice when field of view and sensitivity are required. Andor's unique glow suppression approach enables you to usefully and uniquely access the entire 2048 x 2048 pixel array of the GSense 400 BSI sensor, offering an impressive 32 mm sensor diagonal.

Marana 4.2B-11 presents an exclusive solution for capturing a large field of view across a wide range of exposure conditions, **from microseconds up to several seconds**.



How do we benefit from a larger field of view?

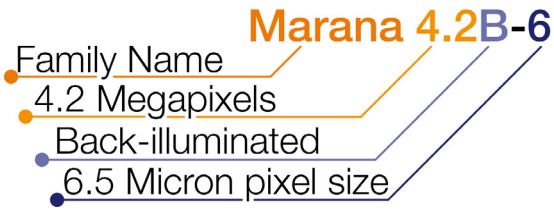
- ✓ Search more sky – Space Debris and NEO tracking
- ✓ Capture Sun Spots & Solar Flares
- ✓ Tomography – reconstruct larger objects without sacrificing resolution
- ✓ Wafer inspection with high throughput (266 nm)



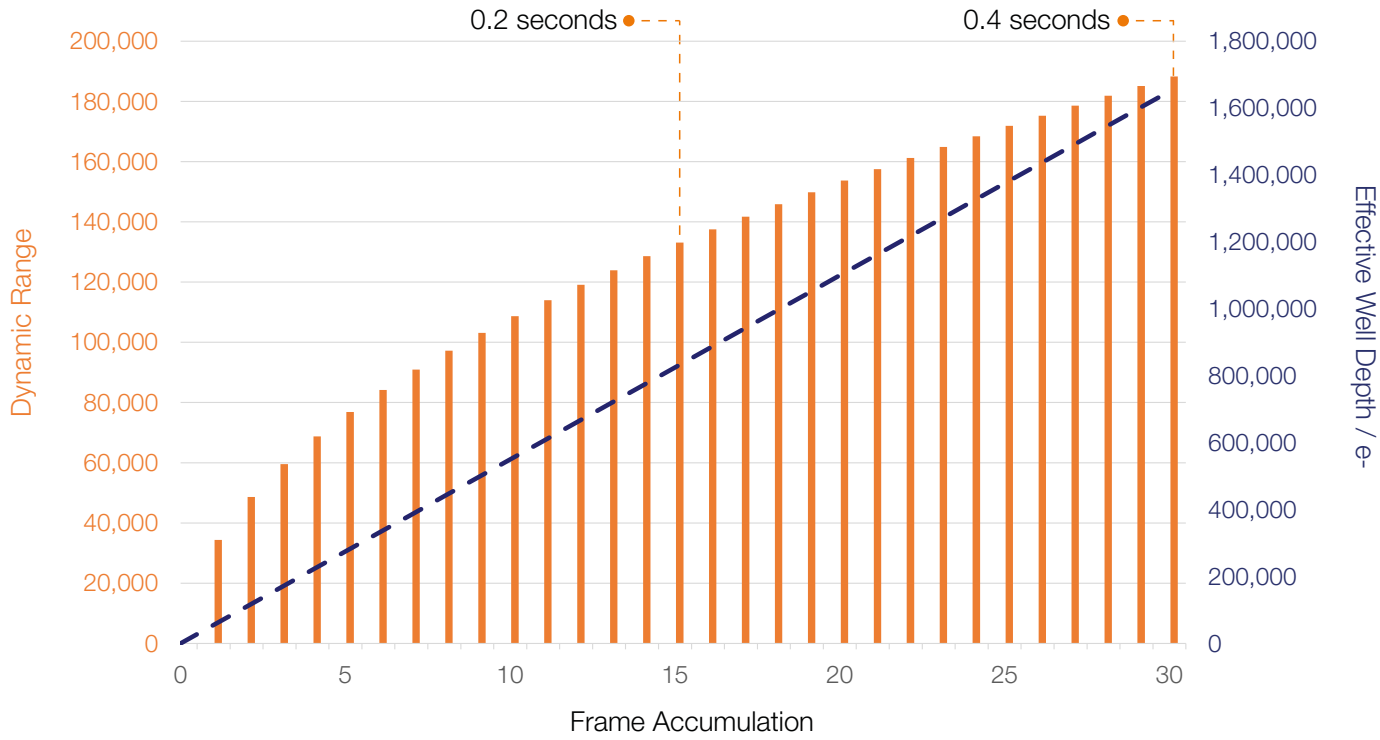
Marana 4.2B-6: Fastest Speed

Marana 4.2B-6 is the most sensitive back-illuminated camera available for imaging or spectroscopic applications requiring higher speed, reaching 74 fps with full 16-bit data range. Applications include quantum gas dynamics, fast high resolution spectroscopy, fast image stacking (for further extending dynamic range), hyperspectral imaging and non-destructive imaging of movement via X-ray or Neutron Radiography.

The smaller 6.5 µm pixel is better suited to resolution matching across many laboratory-based optical imaging configurations, as well as in echelle spectroscopy.



Extend Dynamic Range - Fast Image Stacking

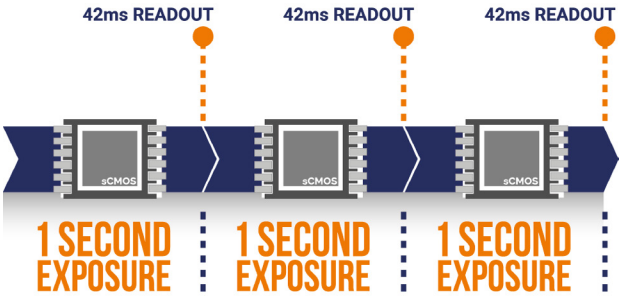


Dynamic Range and Effective Well Depth as a function of the number of stacked (accumulated) frames, plotted for Marana 4.2B-6. A Dynamic Range of 188,280:1, and a corresponding Effective Well Depth of 1,650,000 electrons can be reached with only 30 stacked frames. At maximum frame rate, this number of accumulated frames takes only 0.4 secs to acquire, achieving > 2 fps. This capability is significant for a range of challenges across imaging and spectroscopic characterisations.

Key Features

Large Field of View

The 32 mm sensor diagonal of Marana 4.2B-11 covers more sky at high resolution in astronomical observations, improving statistics of detection and tracking.



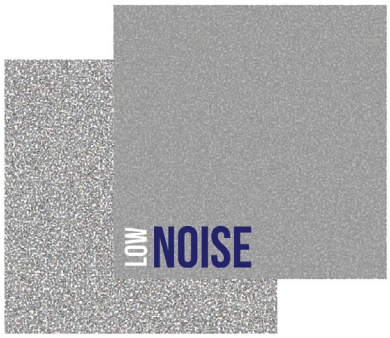
Fast Sensor Readout

Taking only 13.5 milliseconds (4.2B-6) or 42 milliseconds (4.2B-11) per 16-bit full frame readout, Marana can measure photometric variability across a wide range of timescales, ideal for imaging rapid celestial changes and fast measurements of Quantum Gas dynamics.

Extended Dynamic Range

On-chip dual-amplifier design means the whole photometric range, from the noise floor up to the saturation limit, can be captured with one image. The wide dynamic range is complimented by enhanced on-head intelligence to deliver linearity > 99.7%, for unparalleled quantitative photometric accuracy across the full signal range.

Combine with fast image stacking (accumulation) to extend dynamic range even further.



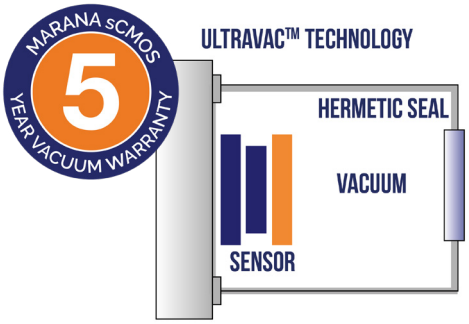
Highly Sensitive

The back-illuminated sensors of Marana ensure a peak QE of 95%, with broad response across the UV-VIS-NIR range. The massively parallel readout architecture and innovative pixel design enables Marana to drive very low read noise performance, < 2 e-, while still achieving maximum readout speed and full dynamic range. Marana 4.2B-6 offers a further low noise mode to achieve 1.2 e- noise at reduced pixel well depth – ideal for fluorescent quantum gas measurements of low atom numbers.

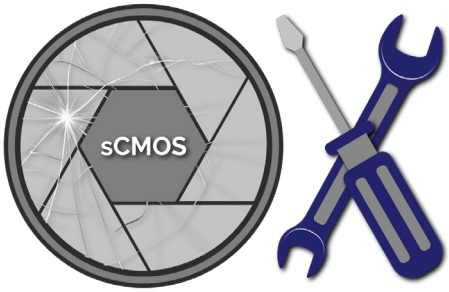
Key Features

Vacuum Sensor Enclosure

sCMOS cameras from other manufacturers use O-ring sealed, back-filled sensor enclosures, susceptible to moisture ingress and routine factory maintenance. Andor is the only manufacturer of vacuum enclosed sCMOS cameras, based on our proven UltraVac™ process, offering superior cooling and ultimate sensor protection. Expect the vacuum to hold firm, year after year.



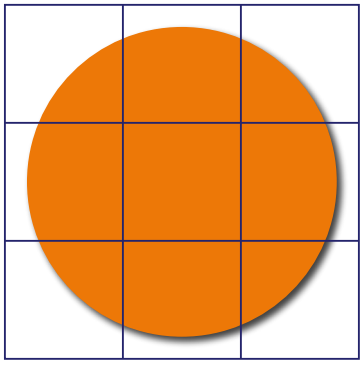
No Mechanical Shutter



Applications that involve frequent cycling of mechanical shutters, such as exoplanet studies or X-ray tomography, require routine shutter replacements and associated down time. Marana offers on-sensor Rolling Shutter, thus overcomes the need for mechanical shutters. Furthermore, this avoids the exposure gradient effects associated with that of an iris shutter, thus much better for accurate photometry.

Low Maintenance Astronomy

The vacuum enclosure and shutter-free longevity benefits of Marana are particularly relevant to the needs of astronomers, where cameras are often in remote unmanned observing locations and need to operate without service intervention, over long durations of time. This ultimately translates not only into greater experimental efficiency, but also into a lower cost of ownership.



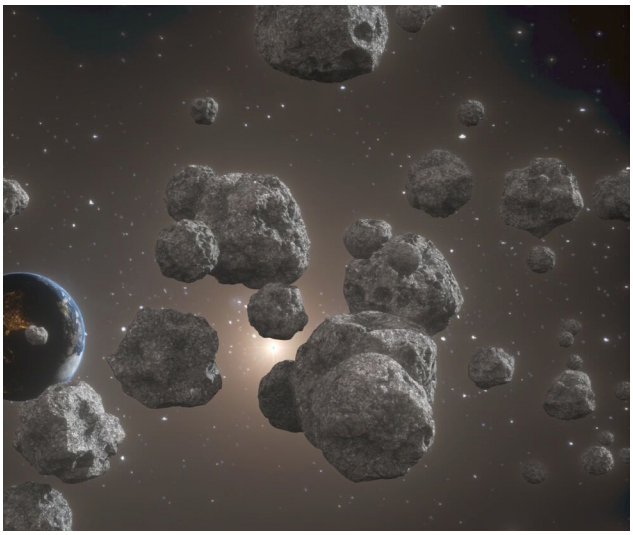
Pixel Size Options

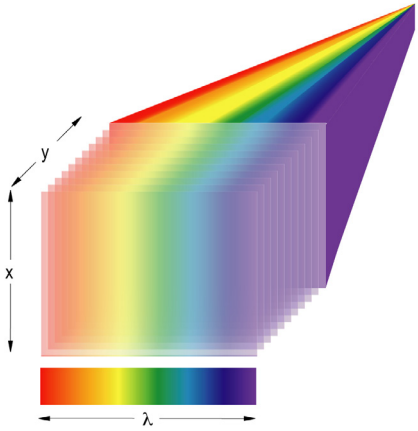
The 11 µm or 6.5 µm pixel sizes of the available Marana models offer a solution to more closely resolution match the camera to the specific optical configuration. Pixel binning offers further usage flexibility.

Application Focus

Solar System Objects

A Near-Earth Object (NEO) is any small Solar System body whose orbit brings it into proximity with Earth. Over 20,000 known Near Earth Asteroids have been discovered, of which almost 1000 are larger than 1 km. The inventory is much less complete for smaller objects, which still have potential for large scale damage. While asteroids are constantly being eliminated from our solar system, unfortunately new ones are pulled into orbit. Thus, NEO surveys are required as an ongoing discipline in astronomy. The large field of view, very high sensitivity and fast readout of Marana 4.2B-11 is ideal for enhancing statistics of object detection, either directly visualised or by occultation.





Hyperspectral

Marana is ideal for fast, high dynamic range spectral imaging, either: (a) hyperspectral configurations (push-broom or otherwise), enabling full data cubes to be rapidly acquired, or (b) high density multi-track spectroscopy at fast spectral rates and/or very high dynamic range through image stacking. For example, Marana 4.2B-6 can acquire 10 spectral tracks at almost 1500 fps, and can acquire a single spectrum at up to 25,000 fps.

X-Ray or Neutron Tomography

For high throughout 3D tomography (or even 4D: 3D + time), the high resolution Marana 4.2B-11 or Marana 4.2-6 back-illuminated sCMOS models, featuring low noise, fast readout and 95% QE, present a superb solution. Lens/scintillator coupled tomography using Marana enables reconstruction of large objects without sacrificing resolution and clarity. Lack of mechanical shutter means shutter lifetime is not an issue, reducing downtime.

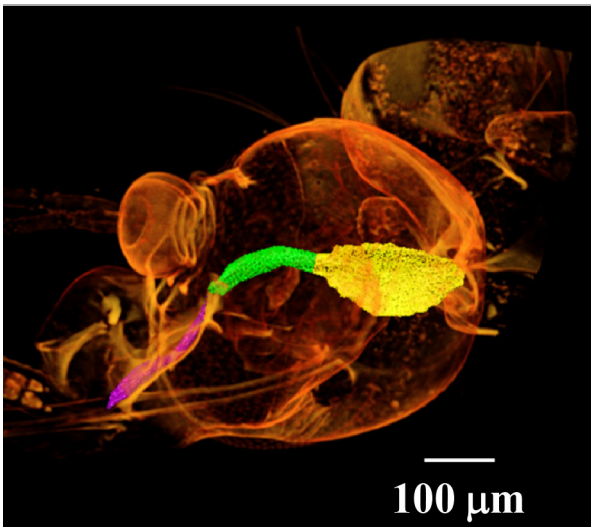


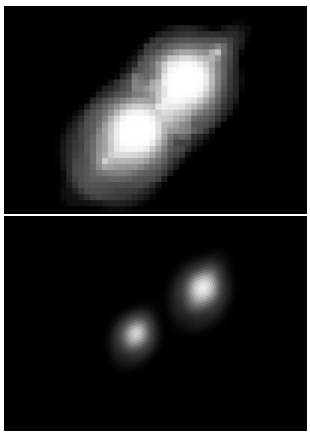
Image courtesy of Prof. S.J. Lee & Dr. Ha, Pohang University of Science and Technology (POSTECH), Republic of Korea.

Application Focus

Quantum Gases

Marana 4.2B-11 or Marana 4.2B-6 can be readily integrated into optical systems for imaging ultracold quantum gases, such as Bose Einstein Condensates. The rapid frame rates of Marana 4.2B-6 is ideal for fast, continuous (not burst) dynamic studies, market-leading sensitivity enabling high SNR capture of even small numbers of trapped atoms.

Resolution Enhancement



Lucky/Speckle Imaging - Marana models can be used for the 'Atmospheric Freezing' techniques of Lucky and Speckle Imaging, enabling resolution enhancement of ground-based astronomy over a large field of view. The 74 fps (full array) with 100% duty cycle of Marana 4.2B-6 means that enhanced resolution images can be generated within a few seconds of acquisition.

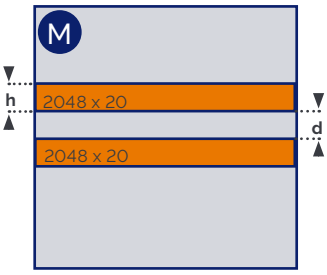
Wavefront Sensing – Marana 4.2B-6 is an ideal fast wavefront sensor for Adaptive Optics. A 128x128 ROI yields 1165 fps, and individual pixel rows can be transmitted immediately after recording for on-the-fly image processing with minimal time lag.

Orbital Debris

Orbital Debris, or Space Debris, are terms for the mass of defunct human-made objects in Earth orbit, such as old satellites and spent rocket stages. There are about 500,000 pieces of 'space junk' down to items about 0.5 inches (1.27 cm) wide in orbit. Of those, about 21,000 objects are larger than 4 inches (10.1 cm) in diameter. Marana 4.2B-11 offers a very large area and is a superb detector solution for ground based Orbital Debris tracking, capable of searching more sky while maintaining high resolving capability. Low noise enables high-quality data capture of even relatively small (and dim) objects, and rapid frame rates enable temporal oversampling of fast moving/rotating objects.

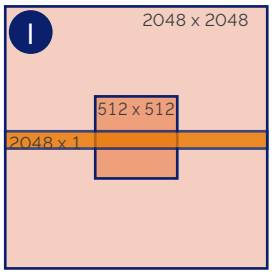
Different Modes for Marana

Multi-track Mode



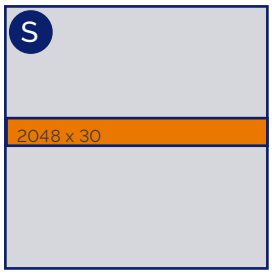
Up to 256 vertically binned tracks can be used for multi-track analysis without sacrificing speed.

Imaging Mode



The array size may be defined for either resolution or maximum speed.

Spectroscopy Mode



A vertically binned track is centred on the sensor enabling the maximum spectral rate to capture dynamic events.

I Imaging Mode 4.2B-11

Frame rate table

ROI Size (W x H)	Max Frame Rate (fps)		ROI area (of sensor)	Example scenarios of use
	16-bit	12-bit (Fast Speed)		
2048x2048	24	48	22.5 mm x 22.5 mm	Full FOV imaging, Space debris, NEOs, Hyperspectral
2048 x 1200	41	81	22.5 mm x 13.2 mm	High density multitrack on Kymera/Shamrock
1608x1608	30	61	17.7 mm x 17.7 mm	Reduced ROI, faster frame rates
1400x1400	35	70	15.4 mm x 15.4 mm	
1200x1200	41	81	13.2 mm x 13.2 mm	
1024x1024	48	95	11.3 mm x 11.3 mm	
512x512	95	190	5.6 mm x 5.6 mm	
256x256	190	378	2.8 mm x 2.8 mm	
128x128	378	750	1.4 mm x 1.4 mm	
2048x8	5415	9747	22.5 mm x 88 mm	Single or dual track spectroscopy
2048x2	16244	24367	22.5 mm x 22 mm	Single track spectroscopy
2048x1	24367	24367	22.5 mm x 11 mm	Single track spectroscopy with ultrafast rates

M Multi-track Mode 4.2B-11

Vertically binned tracks (overlap ON)

Number of Tracks	Track height (h)		Track separation (d)		Max Acquisition Rate	
	Pixels	µm	Pixels	µm	16-bit	12-bit (Fast Speed)
2	10	110	10	110	2,321	4,430
2	10	110	0	0	2,321	4,430
2	20	220	10	110	1,189	2,321
6	50	550	40	440	162	323
10	10	110	0	0	483	956
10	20	220	0	0	242	483
10	30	330	30	330	162	323
50	20	220	0	0	49	97
60	20	220	0	0	41	81
100	20	220	0	0	24	49

Spectroscopy Mode 4.2B-11

Vertically binned tracks (overlap ON)

Array Size (W x H)	Max Spectra Rate	
	16-bit	12-bit (Fast Speed)
any x 1	24367	24367
any x 2	16244	24367
any x 8	5415	9747
any x 1200	41	81
any x 2048	24	48

Spectroscopy Mode 4.2B-6

Vertically binned tracks (overlap ON)

Array Size (W x H)	Max Spectra Rate	
	16-bit	12-bit (Low Noise)
any x 1	25253	14881
any x 2	25253	14881
any x 8	15152	8929
any x 1200	126	74
any x 2048	74	44

Imaging Mode 4.2B-6

Frame rate table

ROI Size (W x H)	Max Frame Rate (fps)				ROI area (of sensor)
	USB 3.0		CoaXPress		
	16-bit	12-bit (Low Noise)	16-bit	12-bit (Low Noise)	
2048x2048	40	43	74	44	13.3 mm x 13.3 mm
1400x1400	85	63	108	64	9.1 mm x 9.1 mm
1200x1200	116	74	126	74	7.8 mm x 7.8 mm
1024x1024	148	87	148	87	6.7 mm x 6.7 mm
512x512	295	174	295	174	3.3 mm x 3.3 mm
256x256	587	346	587	346	1.7 mm x 1.7 mm
128x128	1165	686	1166	687	0.8 mm x 0.8 mm

Multi-track Mode 4.2B-6

Vertically binned tracks (overlap ON)

Number of Tracks	Track height (h)		Track separation (d)		Max Acquisition Rate	
	Pixels	µm	Pixels	µm	16-bit	12-bit (Low Noise)
2	10	65	10	65	6887	4058
2	10	65	0	0	6887	4058
2	20	130	10	65	3608	2126
6	50	325	40	260	502	296
10	10	65	0	0	1485	875
10	20	130	0	0	750	442
10	30	195	30	195	502	296
50	20	130	0	0	151	89
60	20	130	0	0	126	74
100	20	130	0	0	76	45

Note: Frame/spectral rates do not differ if partial or full rows are selected. For Marana 4.2B-6 for frame rates using USB 3.0 for Multi-track and Spectroscopy modes please see our technical note: Marana Frame Rates, which is avaliable in our Learning Center.

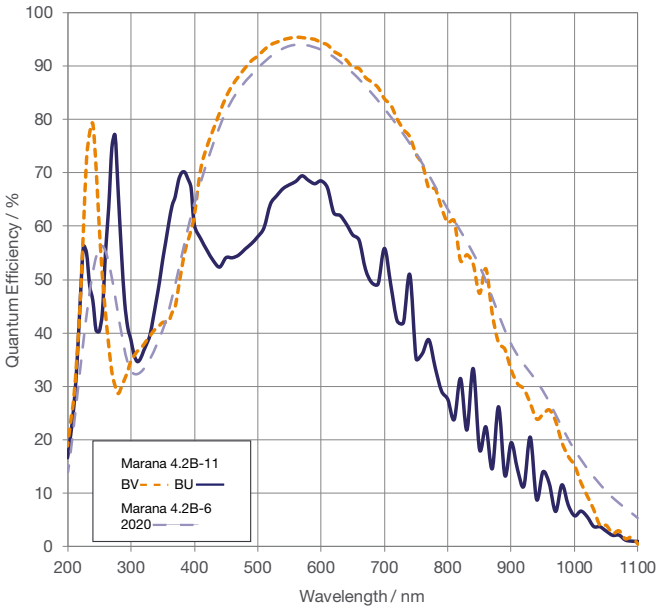
Technical Data•2

Model	Marana 4.2B-11	Marana 4.2B-6
Sensor Type	Back-Illuminated Scientific CMOS	
Array Size	2048 (W) x 2048 (H) 4.2 Megapixel	
Pixel Size	11 x 11 µm	6.5 x 6.5 µm
Image Area	22.5 mm x 22.5 mm (31.9 mm diagonal)	13.3 mm x 13.3 mm (18.8 mm diagonal)
Readout Modes	Rolling Shutter	
Pixel Readout Rates	100 MHz (High Dynamic Range mode, 16-bit) 200 MHz (Fast Speed mode, 12-bit)	310 MHz (Fast High Dynamic Range mode, 16-bit) 180 MHz (Low Noise mode, 12-bit)
Quantum Efficiency•3	up to 95%	
Read Noise (e-) median	1.6 e^- (at any readout rate)	1.6 e^- (Fast High Dynamic Range mode, 16-bit) 1.2 e^- (Low Noise mode, 12-bit)
Sensor operating temperature•4 Air cooled Water/liquid cooled	-25°C (up to 30°C ambient) -45°C (@16°C water)	
Dark Current•5 Air cooled (@-25°C) Water/liquid cooled (@ -45°C)	0.7 e^-/pixel/s 0.3 e^-/pixel/s	0.15 e^-/pixel/s 0.10 e^-/pixel/s
Active area pixel well depth	85 000 e^- (High Dynamic Range mode, 16-bit) 2600 e^- (Fast Speed mode, 12-bit, bit depth limited)	55 000 e^- (Fast High Dynamic Range mode, 16-bit) 1800 e^- (Low Noise mode, 12-bit, bit depth limited)
Dynamic Range	53 000:1 (High Dynamic Range mode, 16-bit)	34 000:1 (Fast High Dynamic Range mode, 16-bit)
Data Range	16-bit (High Dynamic Range mode) 12-bit (Fast Speed mode)	16-bit (Fast High Dynamic Range mode) 12-bit (Low Noise mode)
Linearity•6	> 99.7%	
PRNU	< 0.5% (@ half-light range)	
Region of Interest (ROI)	User-definable, 1 pixel granularity, min. size 25 (w) x 1 (h)	User-definable, 1 pixel granularity, min. size 9 (w) x 1 (h)
Pre-defined ROI	1608 x 1608, 1200 x 1200, 1024 x 1024, 512 x 512, 128 x 128	
Pixel Binning (on FPGA)	2 x 2, 3 x 3, 4 x 4, 8 x 8 (user-definable binning also available)	
I/O	O: Fire Row 1, Fire Row n, Fire All, Fire Any, Arm, I: External	
Trigger Modes	Internal, External, External Start, External Exposure, Software	
Software Exposure Events•7	Start exposure - End exposure (row 1), Start exposure - End exposure (row n)	
Image Timestamp Accuracy	25 ns	
PC Interface	USB 3.0•8	USB 3.0•8 and CoaXPress
Camera Window	AR coated UV grade fused silica window	
Lens Mount	F-mount*	C-Mount

* Optional user-switchable C-Mount accessory available for use with smaller ROI sizes.

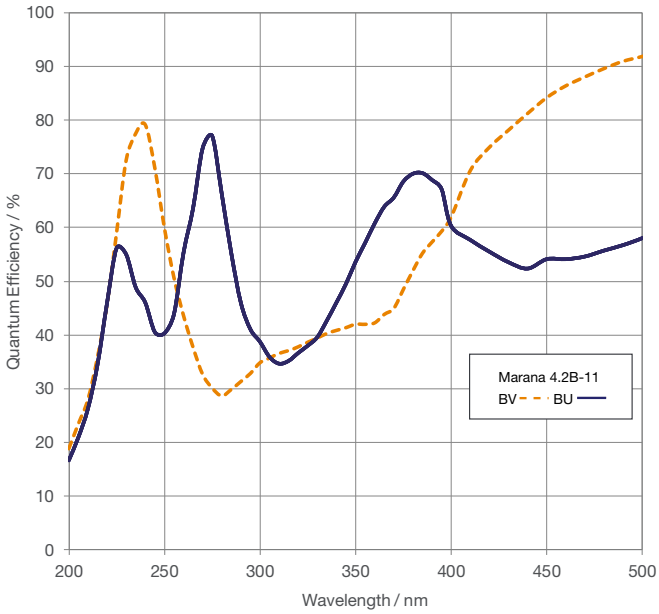
Quantum Efficiency •3

All cameras in the Marana platform feature back-illuminated sensor architecture which allows collection of light from the sample without circuitry blocking the photosensitive area of the detector.



UV Flexibility with Marana 4.2B-11

Marana 4.2B-11 comes with two sensor options, 'BV' and 'BU'. Each offer a particular performance profile across the Blue/UV region, with the 'BU' sensor in particular showing greater optimization across this range, offering high QE solutions for both 266 nm and 355 nm laser lines.



Flexible Connectivity

1 **USB 3.0•8**
A convenient, universally available high speed interface.

2 **TTL / Logic**
Connector type: 15-way D-type to BNC cable with
Fire (Output), External Trigger (Input), Shutter (Output).

3 **CoaXPress (Marana 4.2B-6 only)**
CoaXPress (2 lane) offers the highest speed data interface

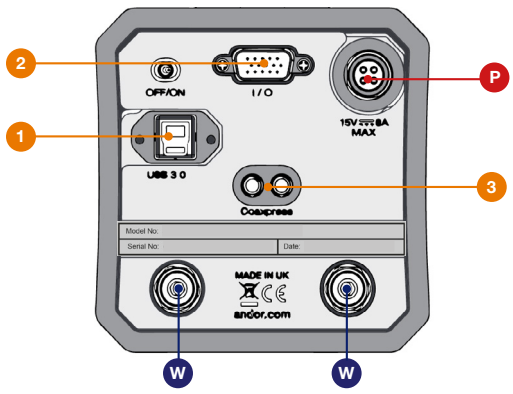
W **Water Cooling**
Connection to recirculator or other water/ liquid cooling system is possible for maximum sensitivity.

P **Power**
Connection to PSU refer to power requirements on page 16.

Notes: Minimum cable clearance required at rear of camera: 100 mm.

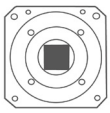
Marana 4.2B-6 Purchase Flexibility

Don't want to commit to CoaXPress connectivity from the outset? If preferred, order the less expensive USB 3.0-only version and later avail of a simple in-field upgrade to CoaXPress capability, using the **CHAM-UPG-CXP** code, if and when additional speed is needed. The upgrade includes CoaXPress card, cable and remote session to upgrade camera firmware and unlock CoaXPress capability. Please contact your sales representative for more information.



Creating the Optimum Product for you

Step 1. Choose the camera type



Camera Type

Description	Code
Marana 4.2B-11: 4.2 Megapixel Back-illuminated sCMOS, VIS/NIR optimized, 11 µm pixel, 95% QE, 48 fps, USB 3.0, F-mount*	MARANA-4BV11
Marana 4.2B-11: 4.2 Megapixel Back-illuminated sCMOS, UV-optimized, 11 µm pixel, 95% QE, 48 fps, USB 3.0, F-mount*	MARANA-4BU11
Marana 4.2B-6: 4.2 Megapixel Back Illuminated sCMOS, 6.5 µm pixel, 95% QE, 43 fps, USB 3.0, C-mount	MARANA-4BV6U
Marana 4.2B-6: 4.2 Megapixel Back Illuminated sCMOS, 6.5 µm pixel, 95% QE, 74 fps, USB 3.0 and CoaXPress, C-mount	MARANA-4BV6X

* Optional user-switchable C-Mount accessory available for use with smaller ROI sizes.

Step 2. Select an alternative camera window (optional)

Camera Window

The standard window has been selected to satisfy most applications. However, other options are available. The alternative camera window code must be specified at time of ordering.

To view and select other window options please refer to the table in the Technical Note – 'Camera Windows Supplementary Specification Sheet'which gives the transmission characteristics, product codes and procedure for entering the order. Further detailed information on the windows can be found in the Technical note – 'Camera Windows: Optimizing for Different Spectral Regions'.

Step 3. Select the required accessories

Accessories

Description	Order Code
C-mount - convert Marana 4.2B-11 to C-mount (for use with smaller Regions of Interest)	ACC-MEC-11936
F-mount - F-mount kit used to convert Marana 4.2B-6 for use with F-mount lenses (e.g. accessing smaller f#)	F-MOUNT-ADP-KIT
Mounting flange for Kymera 328i and 193i spectrographs	MFL-KY-MARANA
Mounting flange for the Shamrock 500i	MFL-SR500-MARANA
Re-circulator for enhanced cooling performance (supplied with 2x2.5 m tubing as standard)	XW-RECR
Oasis 160 Ultra compact chiller unit (tubing to be ordered separately)	ACC-XW-CHIL-160
6 mm tubing options for Oasis 160 Ultra compact chiller (2x2.5 m or 2x5 m lengths)	ACC-6MM-TUBING-2X2.5 ACC-6MM-TUBING-2X5M
Pair of barbed hose inserts for 6 mm tubing	6MM-HOSE-BARBS
CoaXPress cables: 30 m cables (set of 2x individual cables supplied)	ACC-COAXP-CABLE-2020

CSR Please contact your local sales representative regarding other options such as different cable lengths, mounting types, camera window options or other customizations you may require for system integration or your specific application.

Step 4. Select the required software

Software

Marana requires one of the following software options:

Solis Imaging A 32-bit and fully 64-bit enabled application for Windows (8, 8.1 and 10) offering rich functionality for data acquisition and processing. AndorBasic provides macro language control of data acquisition, processing, display and export.

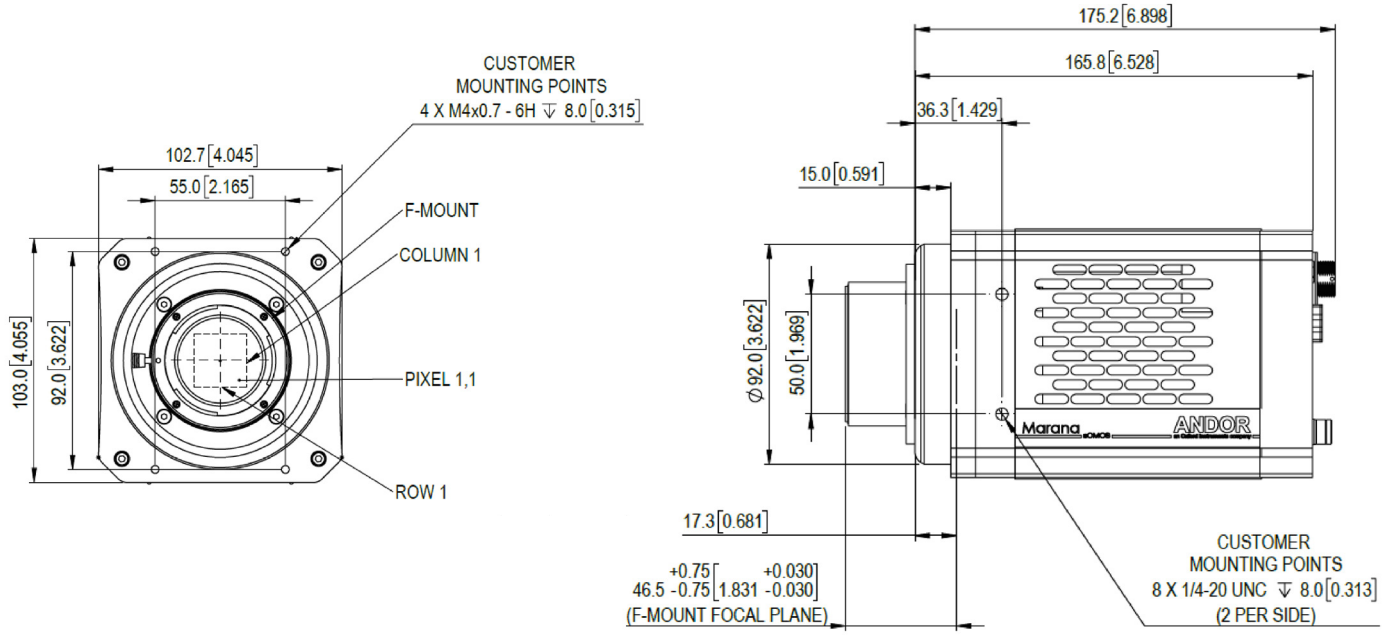
Andor SDK3 A software development kit that allows you to control Andor sCMOS cameras from your own application. Available as a 32-bit or 64-bit library for Windows (8, 8.1 and 10) and Linux. Compatible with C/C++, LabView and Matlab.

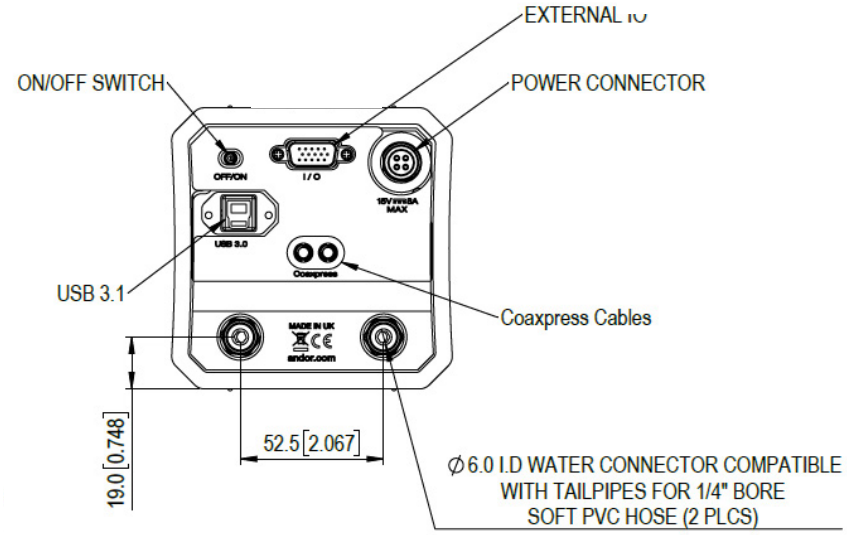
GPU Express Andor GPU Express library has been created to simplify and optimize data transfers from camera to a CUDA-enabled NVidia Graphical Processing Unit (GPU) card to facilitate accelerated GPU processing as part of the acquisition pipeline. Integrates easily with Andor SDK3 for Windows.

Third party software compatibility Drivers are available for a variety of third party imaging packages. See Andor website for detail: https://andor.oxinst.com/learning/view/article/third-party-imaging-software-support

Mechanical Drawings

Dimensions in mm [inches]
(shown for F-mount)





Note: Operational CoaXPress connection only avaliable with **MARANA-4BV6X model.**

Weight: ~3 kg [6.61 lbs] approx.

Have you found what you are looking for?

Need Larger Field of View? Balor sCMOS offers a 16.9 Megapixel sensor with 12 µm pixel pitch, reading the entire array in only 18.5 milliseconds.

Need faster frame rates? The Zyla sCMOS platform, configured with CameraLink interface, can deliver 100 fps from a full 5.5 or 4.2 Megapixel array, faster still with sub-array selection.

Need more sensitivity? The iXon Ultra EMCCD platform offers single photon sensitivity and 95% back-illuminated QE, further boosted by cooling down to -100°C. Ideal for demanding light starved or single photon counting applications such as quantum entanglement studies.

Need better NIR performance? The iKon-M and iKon-L range of CCDs offer NIR-Enhanced QE options ('BR-DD' and 'BEX2-DD'), extending sensitivity deep into the NIR range. Ideal for exoplanet detection on dwarf stars as well as 785 nm laser usages (e.g. BEC and NIR Raman).

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.com/contact

Our regional headquarters are:

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

Japan
Tokyo
Phone +81 (3) 6732 8968
Fax +81 (3) 6732 8939

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

China
Beijing
Phone +86 (10) 5884 7900
Fax +86 (10) 5884 7901

Items shipped with your camera

1x USB 3.0 PCIe card•7
1x USB 3.0 Cable (3 m)•7
1x Multi I/O Timing Cable (BNC to D-type: 1.5 m)
1x 15 V PSU
1x Country specific power cord
1x User manuals in electronic format
1x Quickstart Guide
1x Individual system performance booklet
Marana 4.2B-6 with CoaXPress also includes:
1x CoaXPress 3.0 PCIe card with external trigger
1x CoaXPress Cable (3 m)
1x Multi I/O Timing Cable (BNC to SMB: 1.5 m)

Footnotes

1. Assembled in a state-of-the-art facility, Andor's UltraVac™ vacuum process combines a permanent hermetic vacuum seal (no O-rings), with a stringent protocol and proprietary materials to minimize outgassing. Outgassing is the release of trapped gases that would otherwise degrade cooling performance and potentially cause sensor failure.
2. Figures are typical and target specifications and therefore subject to change.
3. Quantum efficiency as supplied by the sensor manufacturer.
4. Coolant temperature must be above dew point.
5. Read noise measured at 0oC (Marana 4.2B-6) and 15oC (Marana 4.2B-11).
6. Linearity is measured from a plot of Signal vs. Exposure Time over the full dynamic range.
7. Software Exposure Events provide rapid software notification (SDK only) of the start and end of acquisition.
8. Marana connects to your control PC using a USB 3.0 connection. This may also be referred to as USB 3.1 (Gen 1). Andor provide a USB 3.0 card and cable, and recommend that these are used to ensure optimum performance.

Minimum Computer Requirements:

- 3.0 GHz single core or 2.4 GHz dual or quad core processor
- 8 GB RAM
- Hard drive: 850 MB/sec write speed recommended for the data rate associated with the max. frame rates. 250 MB free hard disc to install software
- USB 3.0 slot (or x4 PCIe slot for USB 3.0 card)
- x8 PCIe slot for CXP PCIe card
- Windows (8, 8.1 and 10) or Linux

Operating & Storage Conditions:

- Operating Temperature: 0°C to +30°C ambient
- Operating Altitude: up to 6000 m
- Relative Humidity: <70% (non-condensing)
- Storage Temperature: -10°C to 50°C

Power Requirements:

- 100 - 240 VAC, 50 - 60 Hz
- Power consumption: 40 - 46 W typical / 114W max (model dependent)

MARANAFAMILY SS 1020 R1

OXFORD INSTRUMENTS | ANDOR

Newton CCD

Spectroscopy at Pace

Key Specifications

- ✓ Peak QE up to 95%
- ✓ TE cooling down to -100°C
- ✓ Ultravac™ technology
- ✓ 26 or 13.5 µm pixel size
- ✓ 1024x256 or 2048x512 pixel matrix
- ✓ Up to 1,612 spectra per second
- ✓ Read noise as low as 2.5 e-

Key Applications

- ✓ Raman
- ✓ Fluorescence
- ✓ Luminescence
- ✓ Photoluminescence
- ✓ Absorption/Transmission/Reflection
- ✓ Micro-spectroscopy
- ✓ Non-linear spectroscopy (SFG/SHG)

Available with **Anti-fringing Deep Depletion & Dual AR Extended Dynamic Range** Technology

andor.oxinst.com

Introducing Newton CCD

Spectroscopy at Pace

The high-end USB 2.0 Newton CCD series brings together Andor's ultra fast, low-noise electronics platform and market-leading deep thermo-electric cooling to -100°C, complemented by Andor's Ultravac™ technology with its un-matched reliability track record in the scientific and industrial communities.

Broadband detection rates of up to 1,600 spectra per second are enabled with intelligent Crop Mode operation. The Newton CCD is an ideal tool for ultrafast UV, VIS or NIR spectroscopy (or all the above with the Dual AR-coating BEX2-DD technology), such as 2D chemical mapping, online process monitoring or non-invasive medical diagnosis.

The Newton 940 series offers 13.5 x 13.5 µm pixels for the highest UV to VIS resolution spectroscopy, while the 920 series and its 26 x 26 µm offers the highest dynamic range for UV to NIR applications. Both > 6.6 mm high sensors are ideally suited for multi-track spectroscopy or hyper-spectral imaging.

Features & Benefits

Feature	Benefit
Peak QE up to 95%	Visible-optimized 'BV', infrared-optimized 'BR-DD' and broadband UV-NIR 'BEX2-DD' model
Fringe suppression technology (BR-DD models)	Fringing greatly reduced (Deep-Depletion)
Extended range dual-AR option	Superior UV-NIR broadband QE
TE cooling down to -100°C	Critical for elimination of dark current detection limit - no inconvenience associated with LN_2
Multi-Megahertz Readout	High repetition rates achievable with low noise electronics
Crop Mode Operation	Up to 1,600 spectra per second rates
Single UV-grade fused silica window	Best UV-NIR throughput performance, specific AR coating and wedge options available
Down to 13.5 x 13.5 µm pixels	Optimized format for high resolution spectroscopy
Software-selectable pre-amplifier gain	Choice of best SNR performance or dynamic range at the touch of a button
USB 2.0 connection	Ideal for laptop operation, Seamless operation alongside USB-based Shamrock spectrograph family
Solis software for Spectroscopy	Comprehensive, user-friendly interface for simultaneous detector & spectrograph control
Software Development Kit (SDK)	Ease of control integration into complex setups: Matlab, Labview, Visual Basic or C/C++

Key Specifications •[1]

Model number	DU920P	DU920P Bx-DD	DU940P
Sensor options	• BU: Back Illuminated CCD, UV-Enhanced, 350 nm optimized • BU2: Back Illuminated CCD, UV-Enhanced, 250 nm optimized • BVF: Back Illuminated CCD, Vis-optimized and anti-fringing • OE: Open Electrode CCD	• BR-DD: Back Illuminated, Deep Depletion CCD with anti-fringing • BEX2-DD: Back Illuminated, Deep Depletion CCD with anti-fringing, extended range dual AR coating	• BU: Back Illuminated CCD, UV-Enhanced, 350 nm optimized • BU2: Back Illuminated CCD, UV-Enhanced, 250 nm optimized • BV: Back Illuminated CCD, Vis-optimized • FI: Front Illuminated CCD • UV: Front Illuminated CCD with UV coating
Active pixels •[2]	1024 x 255	1024 x 256	2048 x 512
Pixel size	26 x 26 µm	26 x 26 µm	13.5 x 13.5 µm
Image area	26.7 x 6.7 mm with 100% fill factor	26.7 x 6.7 mm with 100% fill factor	27.6 x 6.9 mm with 100% fill factor
Minimum temperatures •[3] Air cooled Coolant recirculator Coolant chiller, coolant @ 10°C, 0.75 l/min	-80°C -95°C -100°C		
Max spectra per second •[4]	144 (OE - Full Vertical Bin) 273 (Full Vertical Bin) 1,149 (OE - Crop Mode - 20 rows) 1,612 (Crop Mode - 20 rows)	272 (Full Vertical Bin), 1,587 (Crop Mode - 20 rows)	122 (Full Vertical Bin), 943 (Crop Mode - 20 rows)
System window type	BV, BVF, FI, UV, UVB, OE sensors: UV-grade fused silica, 'Broadband VUV-NIR', unwedged BR-DD sensor: UV-grade fused silica, 'VIS-NIR enhanced', wedged BEX2-DD sensor: UV-grade fused silica, 'Broadband VUV-NIR', wedged (Various AR coatings & MgF_2 options available)		
Blemish specifications	Grade 1 sensor from supplier. Camera blemishes as defined by Andor Grade A andor.oxinst.com/learning/view/article/ccd-blemishes-and-non-uniformities		

Advanced Specifications •[1]

Dark current, e^-/pixel/sec @ max cooling FI, UV OE BU, BU2, BV/BVF, UVB Bx-DD	- 0.0002 0.0003 -			- - - 0.003			0.0003 - 0.0002 -		
Register well depth Standard mode High Sensitivity mode High Capacity mode	1,000,000 e^- - -			1,000,000 e^- - -			- 150,000 e^- 600,000 e^-		
Active area pixel well depth •[5]	BU, BU2, BVF: 400,000 e^- OE: 300,000 e^-			650,000 e^-			BU, BU2, BV: 100,000 e^- FI,UV: 140,000 e^-		
Read noise (e^-) •[6] Standard mode: Typ (Max) High Sensitivity mode: Typ (Max High Capacity mode: Typ (Max)	50 kHz 4 (8) - -	1 MHz 12 (18) - -	3 MHz 20 (30) - -	50 kHz 4 (8) - -	1 MHz 12 (15) - -	3 MHz 15 (30) - -	50 kHz - 2.5 (4) 9 (12)	1 MHz - 7 (12) 27 (32)	3 MHz - 11 (15) 40 (56)
Sensitivity (e^-/count) Standard mode High Sensitivity mode High Capacity mode	Adjustable from 2.5 - 10 - -			Adjustable from 2.5 - 10 - -			- Adjustable from 1 - 4 Adjustable from 4 - 16		
Linearity •[7]	Better than 99%								
Digitization	16 bit								
Vertical clock speed •[8]	Software selectable between 2 - 179 µs								

Applications Guide	BU/ BU2 models	BV/BVF models	BR-DD models	BEX2-DD models	FI models	OE models	UV models
Absorption/Transmittance/Reflection	○	●	○	○	○	○	○
Fluorescence & Luminescence	○	●	○	○	○	○	○
NIR Spectroscopy			●	○	○	○	○
Raman Spectroscopy (244 – 488 nm)	●	○				○	○
Raman Spectroscopy (514, 531 nm)	○	●	○	○	○	○	○
Raman Spectroscopy (633, 785, 830 nm)			●	○	○	○	○
UV-VIS-NIR broadband spectroscopy				●		○	○

○ = Suitable ● = Optimum

Have you found what you are looking for?

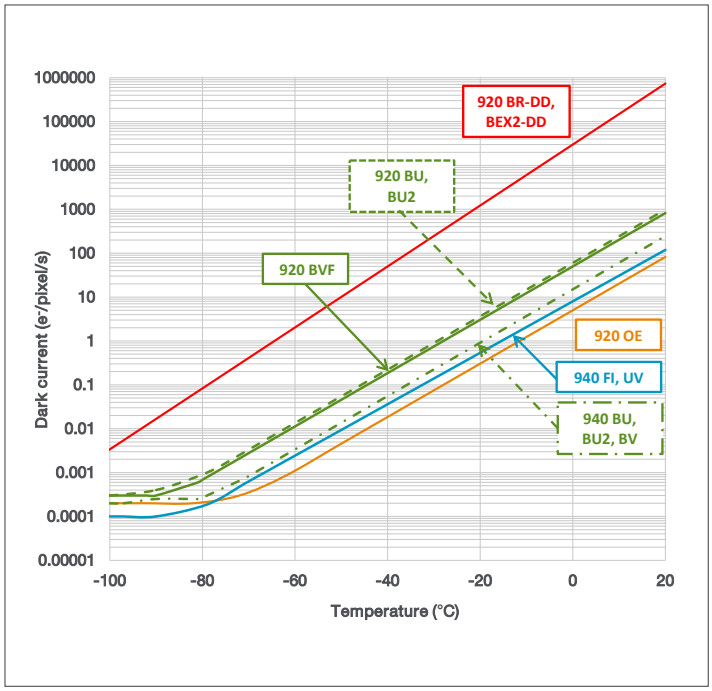
Need to work further into the NIR? The iDus InGaAs series, with up to 1024 pixel linear array with transmission to 2.2 µm.

Need higher sensitivity in the Visible? The Newton EMCCD provide detection capabilities down to single photon.

Need a customized version? Please contact us to discuss our Customer Special Request options.

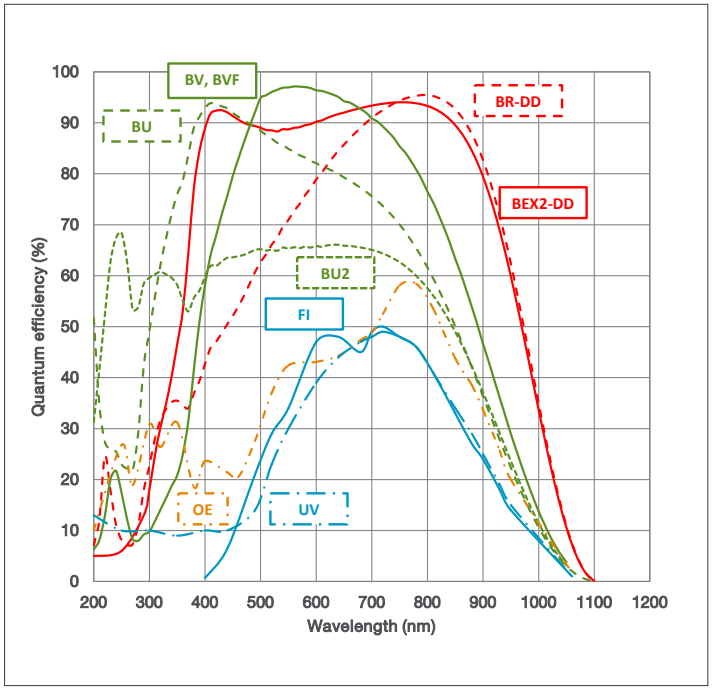
The Newton series combines seamlessly with Andor's research grade Kymera and Shamrock Czerny-Turner spectrographs.

Dark Current •9

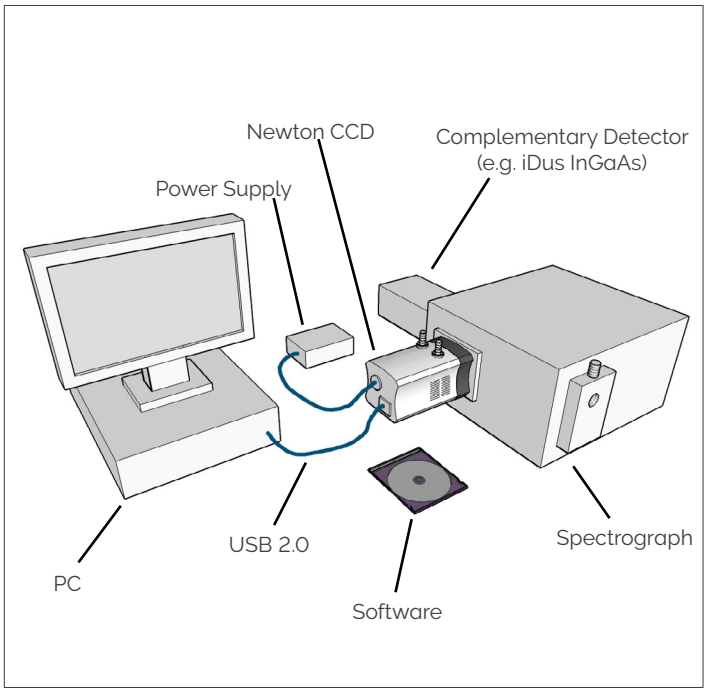


Quantum Efficiency Curves •10

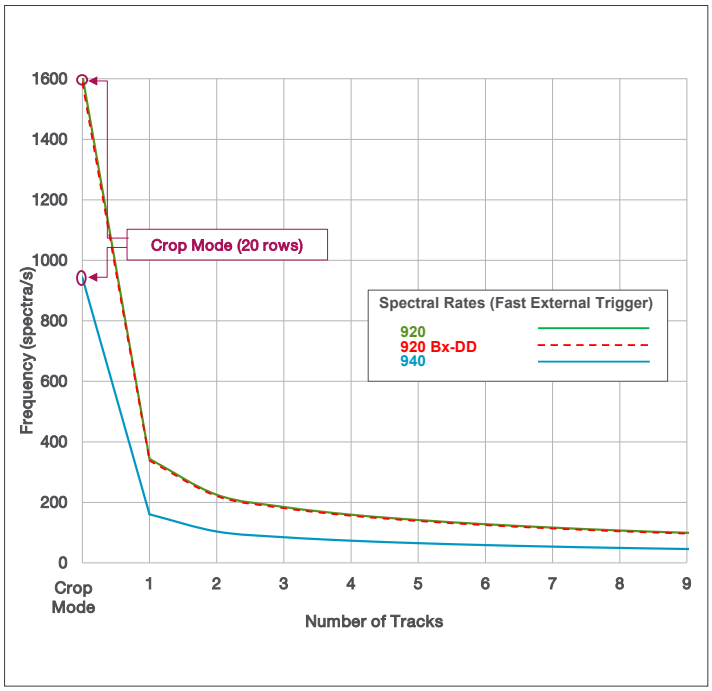
25°C



Typical Setup



Readout Rate & Speed •11



Creating the Optimum Product for you

DU 940 P- BV

example shown

Step 1. Choose the sensor array size

Array Size

Description	Code
1024 x 255 array 1024 x 255 array (BxDD)	920
2048 x 512 array	940

Step 2. Choose the sensor type option

CCD

Sensor Type

Description	Code
Back Illuminated CCD, Vis-optimized	BV
Back Illuminated, Deep Depletion CCD with fringe suppression and extended range dual AR coating (920 only)	BEX2-DD
Back Illuminated, Deep Depletion CCD with fringe suppression (920 only)	BR-DD
Front Illuminated CCD	FI
Back Illuminated CCD, Blue optimized AR coating	BU
Back Illuminated CCD, Vis-optimized and anti-fringing (920 only)	BVF
Back Illuminated CCD, AR coated for optimized performance in the 250 nm region	BU2
Front Illuminated CCD with UV coating	UV
Open Electrode CCD (920 only)	OE

Step 3. Select an alternative camera window (optional)

Camera Window

The standard window has been selected to satisfy most applications. However, other options are available. The alternative camera window code must be specified at time of ordering.
To view and select other window options please refer to the Camera Windows Selector which gives the transmission characteristics, product codes and procedure for entering the order. Further detailed information on the windows can be found in the Technical note – 'Camera Windows: Optimizing for Different Spectral Regions'.

Step 4. Select the required accessories and adapters

Accessories & Adapters

Description	Order Code
Coolant re-circulator for enhanced cooling performance	XW-RECR
Oasis 160 Ultra Compact Chiller Unit (tubing to be ordered separately)	ACC-XW-CHIL-160
6 mm tubing options for ACC-XW-CHIL-160 (2x2.5 m or 2x5 m lengths)	ACC-6MM-TUBING-2X2.5/ ACC-6MM-TUBING-2X5M
C-mount lens adaptor	ACC-LM-C
F-mount lens adaptor	ACC-LM-NIKON-F
Nikon F-mount lens adaptor with shutter	LMS-NIKON-F-NS25B
Shutter Driver for NS25B Bistable Shutter (not needed for Kymera/Shamrock spectrographs)	ACC-SD-VED24
Bistable Shutter, Standalone (not needed for Kymera/Shamrock spectrographs)	ACC-SHT-NS25B

Spectrograph Compatibility
The Newton series is fully compatible with Andor's Kymera and Shamrock spectrographs (163 - 750 nm focal lengths). Spectrograph mounting flanges and software control are available for a wide variety of 3rd party spectrographs including, McPherson, JY/Horiba, PI/Acton, Chromex/Bruker, Oriel/Newport, Photon Design, Dongwoo, Bentham, Solar TII and others.

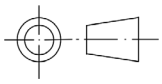
Step 5. Select the required software

Software

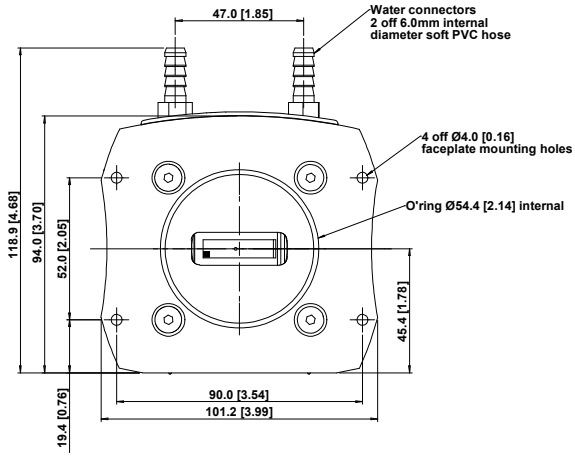
The Newton CCD requires at least one of the following software options:
Solis for Spectroscopy A 32-bit and fully 64-bit enabled application for Windows (8, 8.1 and 10) offering rich functionality for data acquisition and processing. AndorBasic provides macro language control of data acquisition, processing, display and export. Control of Andor Kymera and Shamrock spectrographs and a very wide range of 3rd party spectrographs is also available, see list in step 4 above.
Andor SDK A software development kit that allows you to control the Andor range of cameras from your own application. Available as 32/64-bit libraries for Windows (8, 8.1 and 10) and Linux. Compatible with C/C++, C#, Delphi, VB.NET, LabVIEW and Matlab.

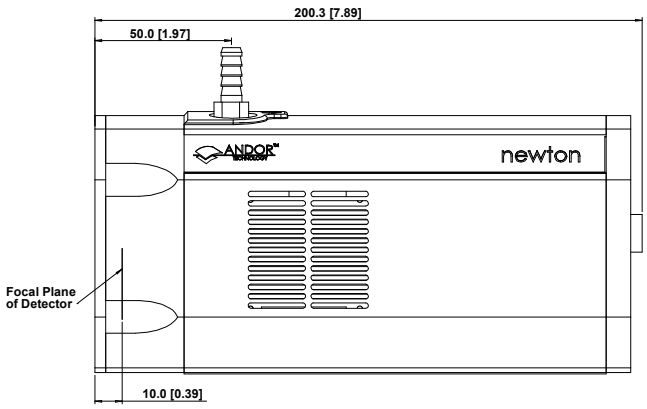
Product Drawings

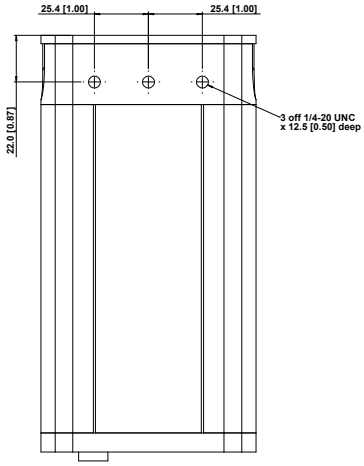
Dimensions in mm [inches]



Third-angle projection







Mounting hole locations

■ = position of pixel 1,1

Weight: 2.7 kg [5 lb 15 oz]

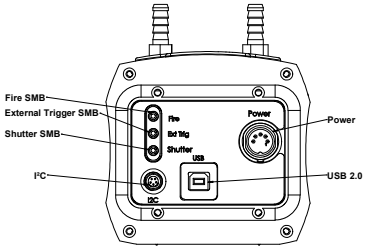
Connecting to the Newton

Camera Control
Connector type: USB 2.0

TTL / Logic
Connector type: SMB, provided with SMB - BNC cable
1 = Fire (Output), 2 = External Trigger (Input), 3 = Shutter (Output)

I²C connector
Compatible with Fischer SC102A054-130
1 = Shutter (TTL), 2 = I²C Clock, 3 = I²C Data, 4 = +5 V_{DC}, 5 = Ground

Minimum cable clearance required at rear of camera
100 mm



Rear connector panel

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.com/contact

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Fax +44 (28) 9031 0792

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Tokyo
Phone +81 (3) 6732 8968
Fax +81 (3) 6732 8939

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

China
Beijing
Phone +86 (10) 5884 7900
Fax +86 (10) 5884 7901

Items shipped with your camera:
1x 2m BNC - SMB connection cable
1x 3m USB 2.0 cable Type A to Type B
1x Set of hex keys (7/64", 3/32" & 3 mm)
1x Power supply with mains cable
1x User manuals in electronic format
1x Individual system performance booklet
1x Copy of Solis software or SDK (if ordered)

Minimum Computer Requirements:
- 3.0 GHz single core or 2.4 GHz multi core processor
- 2 GB RAM
- 100 MB free hard disc to install software (at least 1 GB recommended for data spooling)
- USB 2.0 High Speed Host Controller capable of sustained rate of 40 MB/s
- Windows (8, 8.1 and 10) or Linux

Operating & Storage Conditions
- Operating Temperature: 0°C to 30°C ambient
- Relative Humidity: < 70% (non-condensing)
- Storage Temperature: -25°C to 50°C

Power Requirements
- 100 - 240 VAC, 50 - 60 Hz
- Power consumption: 48 W max

Footnotes: Specifications are subject to change without notice

1. Figures are typical unless otherwise stated.
2. Edge pixels may exhibit a partial response.
3. Cooling is provided by the use of an external mains driven power supply. Minimum temperatures listed are typical values with ambient temperature of 20°C. Systems are specified in terms of minimum dark current achievable rather than absolute temperature.
4. Based on horizontal pixel readout rate of 3 MHz and a vertical shift speed of 12.9 µs (920 models), 14.5 µs (940 models) and 25.7 µs (OE model).
   Achievable spectral rates will vary with selected trigger mode. Due to the nature of the Open Electrode sensor, the minimum Vertical Shift Speed (VSS) available is 25.7 µs, which will produce a lower maximum spectral rate compared to other models in the series.
5. Shown for High Capacity mode. For high sensitivity mode the measurable well depth value will be lower, as a result of the combination of higher sensitivity values and A/D 16 bits digitization.
6. Readout noise is for the entire system. It is a combination of CCD readout noise and A/D noise. Measurement is for Single Pixel readout with the CCD at a temperature of -80°C and minimum exposure time under dark conditions. Noise values will change with readout mode.
7. Linearity is measured from a plot of counts vs exposure time under constant photon flux up to the saturation point of the system.
8. Vertical speeds are software selectable. All sensors are designed to give optimum Charge Transfer Efficiency (CTE) at 12.9 µs (920 models), 14.5 µs (940 models) and 25.7 µs (OE model) vertical pixel shift, some decrease in CTE may be observed at faster shift speeds.
9. The graph shows typical dark current level as a function of temperature. The dark current measurement is averaged over the CCD area excluding any regions of blemishes.
10. Quantum efficiency of the sensor as supplied by the sensor manufacturer
11. The chart shows the maximum possible readout rates available when using Multi-track mode, each track being defined as 20 rows. Crop mode is a specific single-track readout method optimized for rapid kinetic-type acquisition.

SNewtonCCDSS 0721 R1

OXFORD INSTRUMENTS | ANDOR

Newton EMCCD

Market Leading Platform for Ultra-Sensitive & Ultrafast Spectroscopy

Key Specifications

- ✓ < 1 e- readout noise
- ✓ Peak QE up to 95%
- ✓ TE cooling down to -100°C
- ✓ Ultravac™ technology
- ✓ 16 µm pixel size
- ✓ 600 x 200 or 400 pixel matrix
- ✓ Up to 1,515 spectra per second

Key Applications

- ✓ Raman
- ✓ Fluorescence/Luminescence/ Photoluminescence
- ✓ Absorption/Transmission/Reflection
- ✓ Non-linear spectroscopy (SFG/SHG)
- ✓ Single Molecule Spectroscopy
- ✓ Chemical mapping

Available with **Anti-fringing** Back-Illuminated Technology

andor.oxinst.com

Introducing Newton EMCCD

Market Leading Platform for Ultra-Sensitive and Ultrafast Spectroscopy

EM technology enables charge from each pixel to be multiplied on the sensor before readout, providing single photon sensitivity. The Newton EM platform combines a 1600 x 200 (or 1600 x 400) array of 16 µm pixels, thermoelectric cooling down to -100˚C for negligible dark current, 3 MHz readout and USB 2.0 plug-and-play connectivity to provide unrivalled performance for spectroscopic applications. The dual output amplifiers allow software selection between either a conventional CCD or Electron Multiplying outputs to suit a broad range of photon regime conditions. This makes the Newton EMCCD the ideal choice for ultrafast chemical mapping applications e.g. SERS, TERS or luminescence mapping.

Features & Benefits

Feature	Benefit
EM sensor technology	< 1 e- read noise
Fringe suppression technology as standard (970-BVF only)	Fringing minimized for NIR applications
Multi-Megahertz Readout	High repetition rates achievable with low noise electronics
Crop Mode	Up to 1,515 spectra per second rates
TE cooling to -100˚C	Negligible dark current without the inconvenience of LN_2
UltraVac™	Critical for sustained vacuum integrity and to maintain unequalled cooling and QE performance, year after year
16 x 16 µm pixel size	Optimized pixel size for high resolution spectroscopy
Dual output amplifiers	Software-selectable between conventional CCD output (low light) or an Electron Multiplying output (ultra low light)
USB 2.0 connection	Ideal for laptop operation Seamless operation alongside USB-based Shamrock spectrograph family
Solis software for Spectroscopy	Comprehensive, user-friendly interface for simultaneous detector & spectrograph control
Software Development Kit (SDK)	Ease of control integration into complex setups: Matlab, Labview, Visual Basic or C/C++

Key Specifications •1

Model number	DU970P	DU971P
Sensor options	• BVF: Back Illuminated CCD, Vis-optimized and anti-fringing • FI: Front Illuminated CCD • UV: Front Illuminated CCD with UV coating • UVB: Back Illuminated CCD with UV coating	• BV: Back Illuminated CCD, Vis-optimized • FI: Front Illuminated CCD • UVB: Back Illuminated CCD with UV coating
Active pixels •2	1600 x 200	1600 x 400
Pixel size	16 x 16 µm	
Image area	25.6 x 3.2 mm with 100% fill factor	25.6 x 6.4 mm with 100% fill factor
Minimum temperatures •3 Air cooled Coolant recirculator Coolant chiller, coolant @ 10°C, 0.75l/min	-80°C -95°C -100°C	
Max spectra per second •4	649 (Full Vertical Bin), 1,515 (Crop Mode - 20 rows)	396 (Full Vertical Bin), 1,515 (Crop Mode - 20 rows)
System window type	BV, BVF, FI, UV, UVB sensors: UV-grade fused silica, 'Broadband VUV-NIR', unwedged (Various AR coatings & MgF_2 options available)	
Blemish specifications	Grade 1 sensor from supplier. Camera blemishes as defined by Andor Grade A andor.oxinst.com/learning/view/article/ccd-blemishes-and-non-uniformities	

Advanced Specifications •1

Dark current, e^-/pixel/sec @ max cooling FI, UV BV, UVB BVF	0.00007 0.00020 0.00010		
Output node well depth Conventional mode Electron Multiplying mode	300,000 e^- 1,300,000 e^-		
Register well depth Conventional mode Electron Multiplying mode	400,000 e^- 800,000 e^-		
Active area pixel well depth	200,000 e^- •5		
Read noise (e^-) •6 Conventional mode: Typ (Max) - EM off Electron Multiplying mode: Typ (Max) - EM off Electron Multiplying mode: Typ (Max) - EM on	50 kHz 2.8 (5) 8 (15) < 1	1 MHz 6.7 (9) 25 (35) < 1	3 MHz 8.5 (12) 38 (50) < 1
Sensitivity (e^-/count) Conventional mode Electron Multiplying mode	Adjustable from 0.8 - 3 Adjustable from 5 - 20		
Electron Multiplier gain	1 - 1,000 times (software controlled)		
Linearity •6	Better than 99%		
Digitization	16 bit		
Vertical clock speed •8	4.9, 9.8, 19, 38, 57 (software selectable)		

Applications & Techniques Guide	BV models	BVF models	FI models	UV models	UVB models
Absorption/Transmittance/Reflection	●	●		○	○
Fluorescence & Luminescence	●	●	○	○	●
Raman Spectroscopy (244 – 488 nm)	○	○		○	●
Raman Spectroscopy (514, 532 nm)	●	●		○	
Raman Spectroscopy (633 nm)	○	●	○		
Photon Counting	●	●			○
Single Molecule Spectroscopy	●	●		○	○

○ = Suitable ● = Optimum

Have you found what you are looking for?

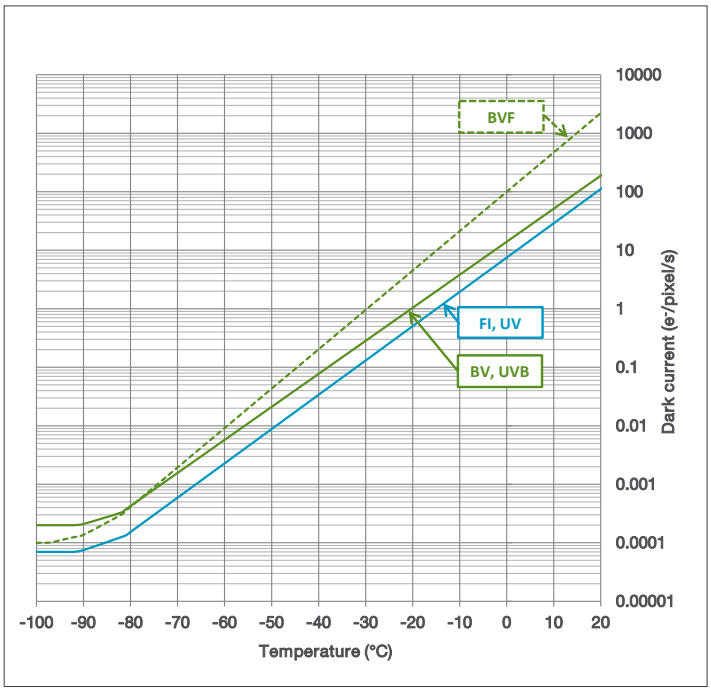
Need to work further into the NIR? The iDus InGaAs series, with up to 1024 pixel linear array with transmission to 2.2 µm.

Need high sensitivity in the NIR and/or higher dynamic range? The Newton CCD platform provide back-illuminated deep-depletion and 26 µm pixel options

Need a customized version? Please contact us to discuss our Customer Special Request options.

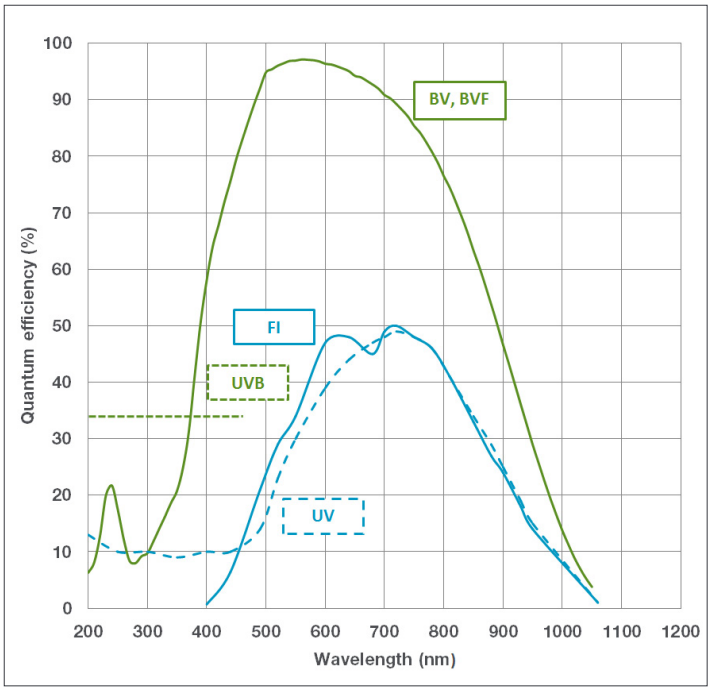
The Newton series combines seamlessly with Andor's research grade Kymera and Shamrock Czerny-Turner spectrographs.

Dark Current [9]

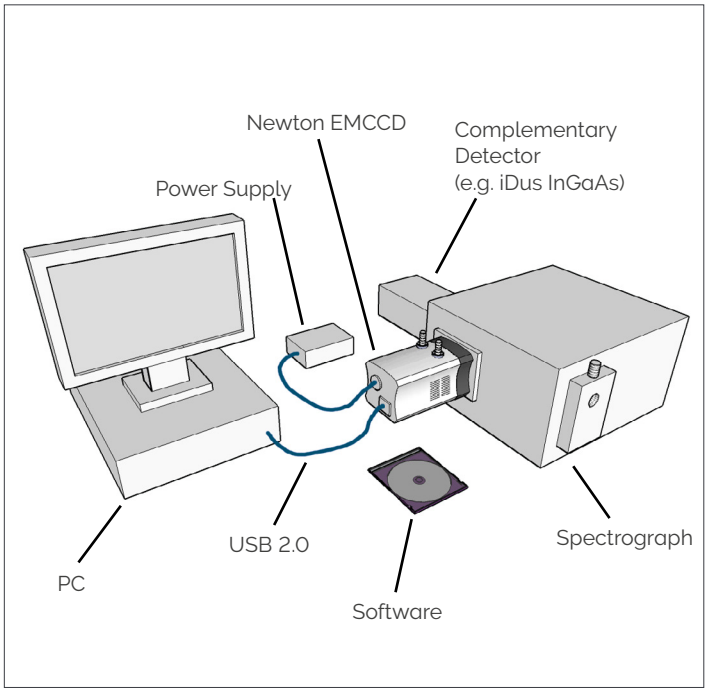


Quantum Efficiency Curves [10]

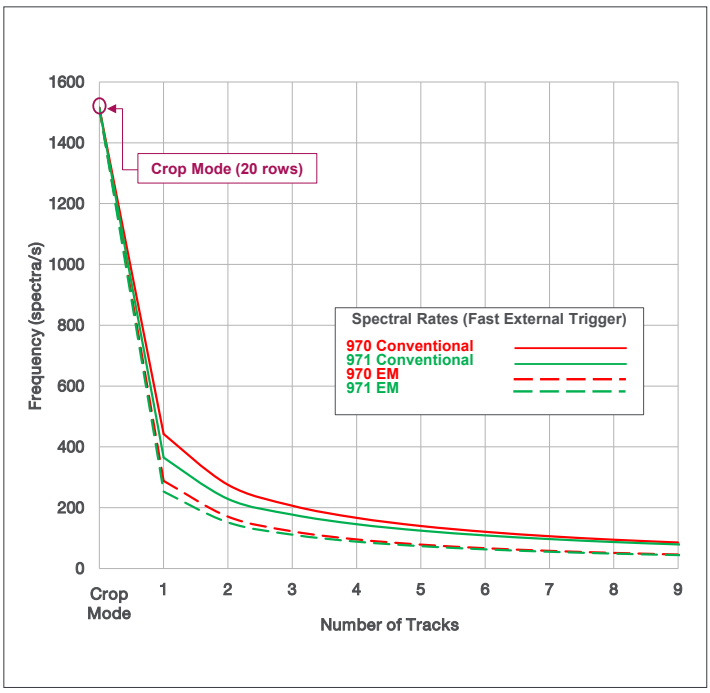
25˚C



Typical Setup



Readout Rate & Speed [11]

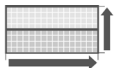


Creating the Optimum Product for you

DU 970 P- BVF

example shown

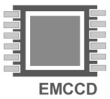
Step 1. Choose the sensor array size



Array Size

Description	Code
1600 x 200 array	970
1600 x 400 array	971

Step 2. Choose the sensor type option



Sensor Type

Description	Code
Back Illuminated CCD, Vis-optimized	BV
Back Illuminated CCD, Vis-optimized and anti-fringing (970 model only)	BVF
Front Illuminated CCD	FI
Front Illuminated CCD with UV coating (970 model only)	UV
Back Illuminated CCD with UV coating	UVB

Step 3. Select an alternative camera window (optional)

Camera Window

The standard window has been selected to satisfy most applications. However, other options are available. The alternative camera window code must be specified at time of ordering.
To view and select other window options please refer to the 'Camera Windows Selector' which gives the transmission characteristics, product codes and procedure for entering the order. Further detailed information on the windows can be found in the Technical note – 'Camera Windows: Optimizing for Different Spectral Regions'.

Step 4. Select the required accessories and adapters

Accessories & Adapters

Description	Order Code
Coolant re-circulator for enhanced cooling performance	XW-RECR
Oasis 160 Ultra Compact Chiller Unit (tubing to be ordered separately)	ACC-XW-CHIL-160
6 mm tubing options for ACC-XW-CHIL-160 (2x2.5 m or 2x5 m lengths)	ACC-6MM-TUBING-2X2.5/ ACC-6MM-TUBING-2X5M
C-mount lens adaptor	ACC-LM-C
F-mount lens adaptor	ACC-LM-NIKON-F
Nikon F-mount lens adaptor with shutter	LMS-NIKON-F-NS25B
Shutter Driver for NS25B Bistable Shutter (not needed for Kymera/Shamrock spectrographs)	ACC-SD-VED24
Bistable Shutter, Standalone (not needed for Kymera/Shamrock spectrographs)	ACC-SHT-NS25B

Spectrograph Compatibility
The Newton series is fully compatible with Andor's Kymera and Shamrock spectrographs (163 - 750 nm focal lengths). Spectrograph mounting flanges and software control are available for a wide variety of 3rd party spectrographs including, McPherson, JY/Horiba, PI/Acton, Chromex/Bruker, Oriel/Newport, Photon Design, Dongwoo, Bentham, Solar TII and others.

Step 5. Select the required software

Software

The Newton EMCCD requires at least one of the following software options:
Solis for Spectroscopy A 32-bit and fully 64-bit enabled application for Windows (8, 8.1 and 10) offering rich functionality for data acquisition and processing. AndorBasic provides macro language control of data acquisition, processing, display and export. Control of Andor Kymera and Shamrock spectrographs and a very wide range of 3rd party spectrographs is also available, see list in step 4 above.
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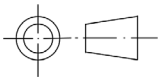
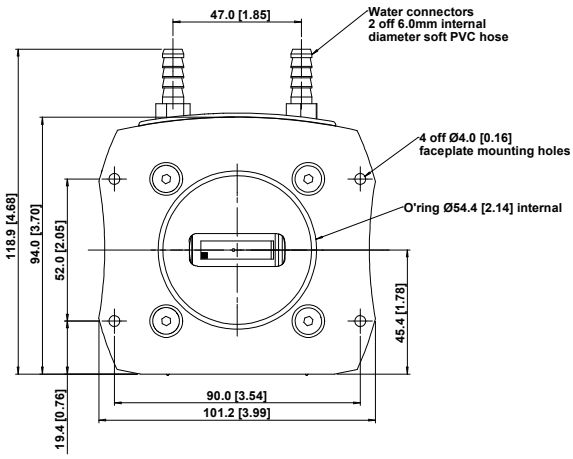
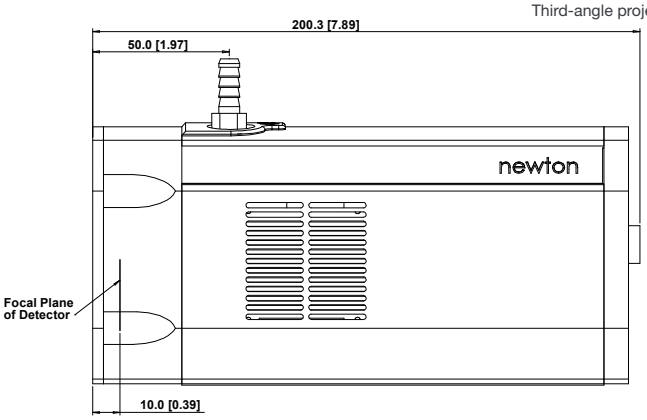
Product Drawings

Dimensions in mm [inches]



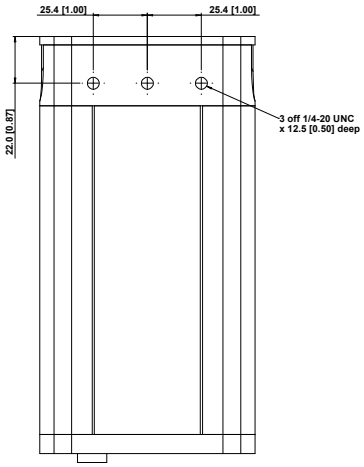
Third-angle projection





■ = position of pixel 1,1

Weight: 2.7 kg [5 lb 15 oz]



Mounting hole locations

Connecting to the Newton

Camera Control
Connector type: USB 2.0

TTL / Logic
Connector type: SMB, provided with SMB - BNC cable
1 = Fire (Output), 2 = External Trigger (Input), 3 = Shutter (Output)

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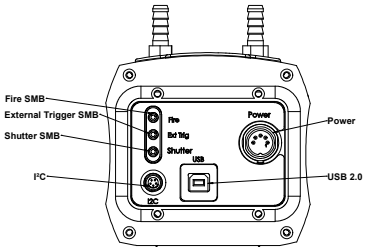

Rear connector panel

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5. Shown for EM mode. For Conventional mode the measurable well depth value will be lower, as a result of the combination of higher sensitivity values and A/D 16 bits digitization.
6. Readout noise is for the entire system. It is a combination of CCD readout noise and A/D noise. Measurement is for Single Pixel readout with the CCD at a temperature of -80°C and minimum exposure time under dark conditions. Noise values will change with readout mode.
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8. Vertical speeds are software selectable. All sensors are designed to give optimum Charge Transfer Efficiency (CTE) at 9.7 µs vertical pixel shift, some decrease in CTE may be observed at faster shift speeds.
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10. Quantum efficiency of the sensor as supplied by the sensor manufacturer.
11. The chart shows the maximum possible readout rates available when using Multi-track mode, each track being defined as 20 rows. Crop mode is a specific single-track readout method optimized for rapid kinetic-type acquisition.

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OXFORD INSTRUMENTS | ANDOR

Zyla sCMOS

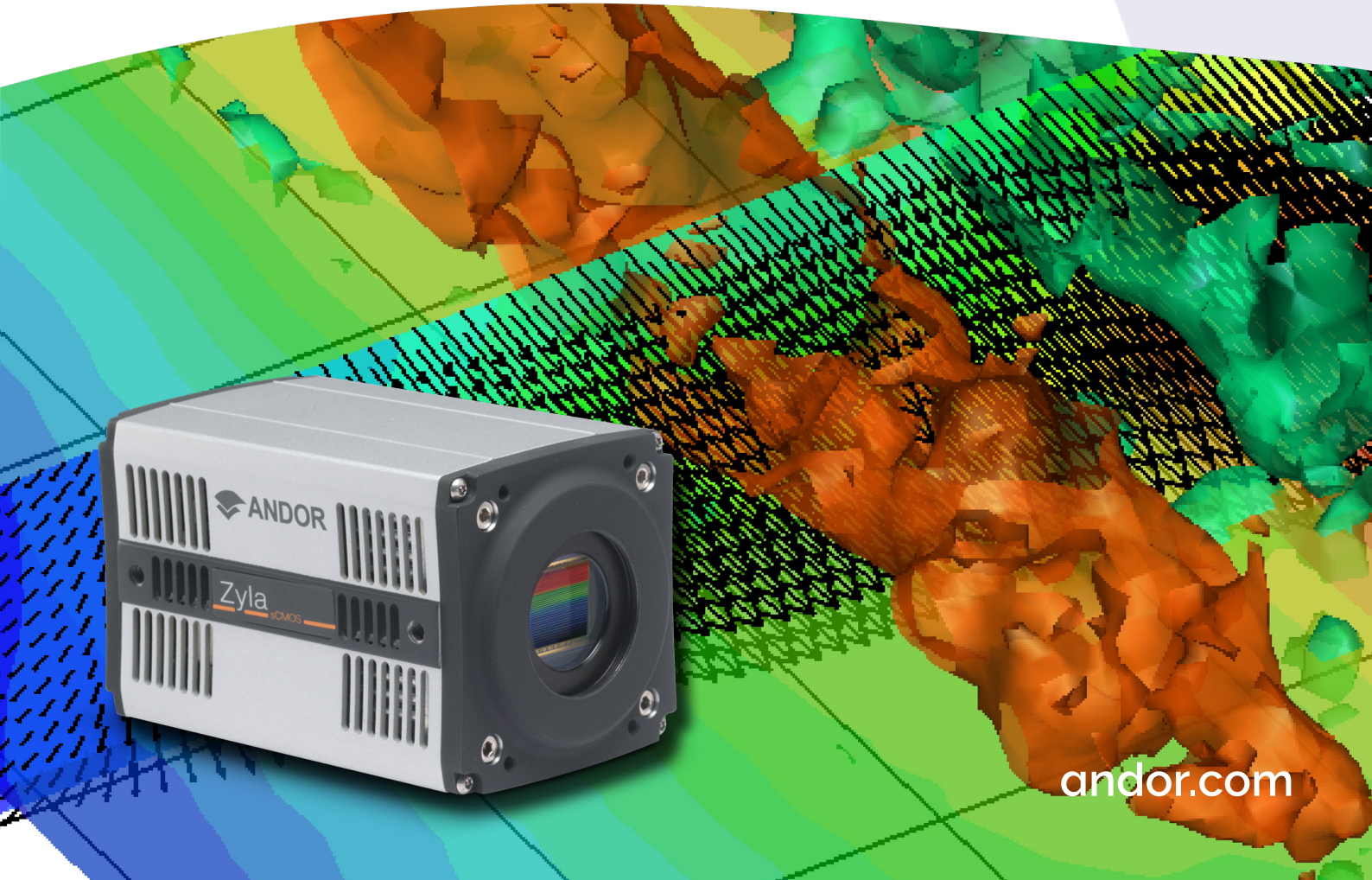
Speed and Sensitivity for Physical Science Imaging and Spectroscopy

Key Specifications

- ✓ 4.2 or 5.5 megapixel sCMOS
- ✓ 12-bit and 16-bit modes
- ✓ 0.9 e^- read noise
- ✓ Up to 100 fps via Camera Link
- ✓ 33,000:1 dynamic range
- ✓ Rolling & True Global Shutter (Zyla 5.5)
- ✓ 82% peak QE (Zyla 4.2)

Key Applications

- ✓ Solar Astronomy
- ✓ Particle Imaging Velocimetry
- ✓ Lucky / Speckle Imaging
- ✓ Hyperspectral Imaging
- ✓ Adaptive Optics
- ✓ Bose Einstein Condensation
- ✓ Extensive Spectroscopy Modes



andor.com

Features & Benefits

Andor's Zyla sCMOS camera platform offers high speed, high sensitivity and high resolution imaging and spectroscopy performance. The remarkably light and compact, thermoelectrically cooled design, integrates perfectly into both laboratory and OEM applications alike. Zyla is ideally suited to many cutting edge experiments that push the boundaries of speed and sensitivity.

Feature	Benefit
5.5 & 4.2 megapixel sensor formats and 6.5 µm pixels	Extremely sharp resolution over a 22 mm (Zyla 5.5) and 19 mm (Zyla 4.2 PLUS) diagonal field of view. Ideal for astronomy, area scanning applications or multi-track spectroscopy.
~ 1 e^- Read Noise	Noise floor down to 0.9e-. Lower detection limit than any CCD.
100 fps (Camera Link)	Zyla offers '10-tap' Camera Link for maximum sustained frame rates.
Up to 27,000 fps ('FCS' mode) or sps	Excellent time resolution capabilities for study of transient phenomena through user-definable Region of Interest control.
Rolling and Global shutter (Zyla 5.5)	Maximum exposure and readout flexibility across all applications. Global Shutter for freeze frame capture of fast moving/changing events.
12-bit and 16-bit modes	12-bit mode for fastest frame rates through USB 3.0; 16-bit mode for full dynamic range.
Market leading USB 3.0 speed	Superb USB 3.0 data transfer efficiency and Zyla's unique 12-bit high speed mode deliver up to 53 fps full resolution. Follow dynamic processes with improved temporal resolution.
Extended Dynamic Range	Unique 'dual gain amplifier' sensor architecture offering dynamic range of 33,000:1.
QE_{max} up to 82%	Highest available photon capture efficiency across visible/NIR.
ZERO etaloning in the NIR	Front-illuminated sensor architecture, no unwanted signal modulation in the NIR compared to back-illuminated devices.
Better than 99.8% linearity	Unparalleled quantitative measurement accuracy across the full dynamic range.
PIV mode inter-frame down to 100 ns	sCMOS sensor architecture allows rapid image pair acquisition with optical transition time between images down to 100 ns, well suited to a wide range of Particle Image Velocimetry (PIV) applications.
TE cooling to 0°C in up to 30°C ambient	Ideal for OEM integration into enclosed systems.
GPU Express	Simplify and optimize data transfers from camera to Graphical Processing Unit (GPU) card to facilitate accelerated GPU processing as part of the acquisition pipeline.
Hardware Timestamp	FPGA generated timestamp with 25 ns accuracy.
Compact and Light	Ideal for integration into space restrictive set-ups. Ideal for OEM.

NEW Spectroscopy Modes (option)

On-head asymmetric binning and multi-track	On-board intelligence delivering spectroscopists-friendly spectra and multi-track data prior to transfer through 10-tap or USB interface. Upfront data size reduction and easier user data processing.
Selectable bit-depth up to 32-bit	Preserve dynamic range in extensive on-head binning scenarios. User-selectable data bit depth to be transmitted over the camera interface, up to 32-bit.

Zyla - The Physicist's Choice

Zyla sCMOS has become a well established detector amongst physicists, biophysicists and astronomers, the advanced combination of speed, sensitivity and dynamic range enabling new ground to be broken.

- ✓ **Dual Amplifier** – novel pixel architecture means you don't need to pre-select gain. Access lowest read noise and full well depth simultaneously.
- ✓ **1000 fps** – Access extremely fast frame rates through user definable Region of Interest control, suited to many applications within the physical sciences.
- ✓ **GPU Express** – for real time processing.
- ✓ **Global Shutter** – Zyla 5.5 offers this important mode that completely avoids spatial distortion, and ensures temporal correlation across all regions of the sensor. Achieve sub-microsecond inter-frame gaps in PIV applications.
- ✓ **Low darkcurrent** – low read noise is complimented by extremely competitive darkcurrent, also ensuring minimized hot pixel blemishes.
- ✓ **Cooling options** – standard Zyla 5.5 camera air cools to 0°C at up to +30°C ambient. Water cooled option available on request.
- ✓ **Blemish correction maps and advanced control** Andor provide the capability to turn off/on blemish correction for those who prefer to perform this themselves. Bespoke blemish maps can also be provided.
- ✓ **Compact and Light** – the extremely small volume footprint of Zyla renders it adaptable to intricate optical set-ups.

Application Areas

Particle Imaging Velocimetry

The true Global Shutter mode of Zyla 5.5 facilitates an inter-frame gap of down to 100 ns.

Lucky / Speckle Imaging

Zyla's fast frame rate and large field of view are ideal for this resolution enhancing technique. GPU Express for real time data processing.

Solar Astronomy

Fast frame rates, wide dynamic range and great linearity present a very formidable solution to the specific detector needs of next generation large solar telescopes.

Bose Einstein Condensation

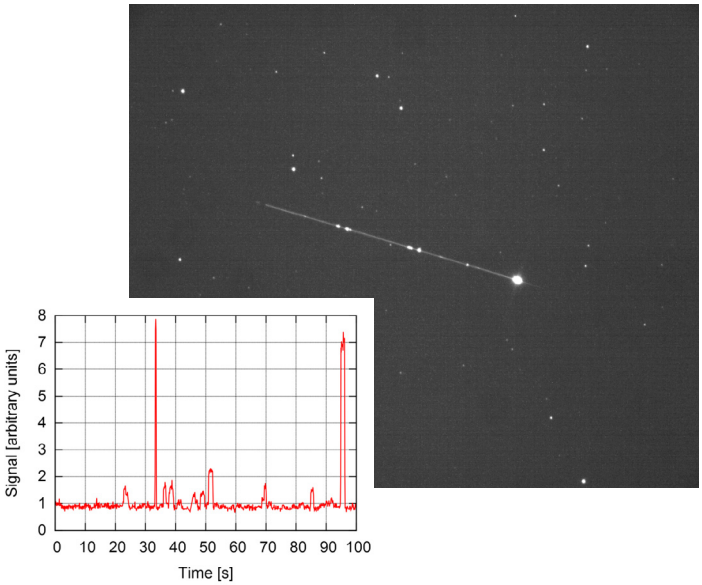
The QE profile of Zyla is very good in the red/NIR region, ideal for BEC of Rb.

Adaptive Optics

Accessing > 1000 fps using ROIs renders the Zyla an ideal Wavefront detector. Use with data splitter to enable direct data access.

Fluorescence Correlation Spectroscopy

Superb temporal resolution from small ROIs are excellent for accurately measuring diffusion coefficients.



Zyla 5.5 operating at 10 Hz, detecting a Russian rocket upper stage - image and corresponding light curve shown. *Institute of Technical Physics Deutsches Zentrum für Luft- und Raumfahrt (DLR) - German Aerospace Center, Stuttgart, Germany.*

Spectroscopy Modes (option)

✓ **On-head asymmetric binning** & multi-track
Intelligent data processing from the sensor into Spectroscopy-friendly spectra or multi-channel data format, ahead of transfer through the 10-tap or USB interface; greatly reduces data post-processing and data set size at the user side.

✓ **User-definable bit depth**
Up to 32-bit data packaging option to overcome the limitation of the standard 16-bits data transfer through 10-tap or USB3 in extensive binning scenarios.

Hyperspectral Imaging & multi-track spectroscopy

On-head FPGA functions can discriminate up to 256 individual channels (e.g. multi-leg fibre optic) with no acquisition rate sacrifice compared to CCDs. Takes great advantage of Andor's spectrograph portfolio imaging portfolio.

Transient spectroscopy

Samples highly dynamic chemical reactions or phenomena with spectral rates up to 27,000 sps with 10-tap Zyla 5.5 and 26,000 sps with 10-tap Zyla 4.2.

Rolling & Global Shutter

The **Zyla 5.5** uniquely offers both Rolling and *true* Global Shutter exposure modes. This provides superior application and synchronization flexibility and the ability, through global exposure, to closely emulate the familiar 'Snapshot' exposure mechanism of interline CCDs.

Rolling & Global Shutter Mechanisms

Rolling and *true* Global Shutter modes describe two distinct types of exposure and readout sequence.

In rolling shutter, available in Zyla 4.2 PLUS and Zyla 5.5, different lines of the array are exposed at different times as the read out 'wave' sweeps through the sensor. 10 ms is required at the start to 'activate' the sensor to expose, and then 10 ms is required at the end to readout the sensor. Use when there is a minimal risk of spatial distortion from moving samples.

In true global shutter, available in Zyla 5.5, each pixel in the sensor begins the exposure simultaneously and ends the exposure simultaneously. This provides a true 'Snapshot' exposure capability for moving samples that is both 'photon-efficient' and easy to synchronize to. Zyla 4.2 PLUS, while utilizing a rolling shutter sensor, offers a *Simulated* Global Exposure mechanism to overcome risk of spatial distortion. This mechanism is more elaborate and less photon/time efficient than true Global Shutter. Click here to read more about Rolling and Global shutter modes on our Zyla camera.

Key Benefits of *True* Global Exposure

- ✓ **NO spatial distortion** – avoiding the spatial distortion risk of rolling exposure
- ✓ Tight syncing to p**eripheral switching devices**
- ✓ **Higher signal to noise** due to reduced dead time – the entire exposure cycle can be used
- ✓ **Simplicity** – all the benefits of a 'snapshot exposure mode'
- ✓ **Continuous or pulsed** light sources
- ✓ 100 ns inter-frame gaps in PIV applications

Global Shutter exposure and readout (single scan)

Exposure Start | Exposure | Exposure End

Rolling Shutter exposure and readout (single scan)

Exposure Start | Exposure | Readout

'Simulated' Global Exposure in Zyla 4.2 PLUS

Click here to read more about this mode and other Frequently Asked Questions on Rolling and Global Exposure modes.

For further information of Rolling and Global Shutter, please access the following technical notes through the Andor Learning Centre: 1) Rolling and Global Shutter 2) Synchronizing to Rolling and Global Shutter sCMOS cameras

GPU Express

The Andor GPU Express library has been created to simplify and optimize data transfers from camera to a CUDA-enabled Nvidia Graphical Processing Unit (GPU) card to facilitate accelerated GPU processing as part of the acquisition pipeline. GPU Express integrates easily with SDK3 for Windows, providing a user-friendly but powerful solution for management of high bandwidth data flow challenges; ideal for data intensive applications such as tomography, 3D PIV or Adaptive Optics.

- ✓ Enhanced convenience, afforded by simple, optimized GPU data management
- ✓ Optimal data throughput
- ✓ Superb, easily accessible documentation and examples

Meet the Extended sCMOS Family for Physical Sciences

Marana sCMOS

Back-illuminated, deep cooled sCMOS
Ultimate sensitivity and large FoV

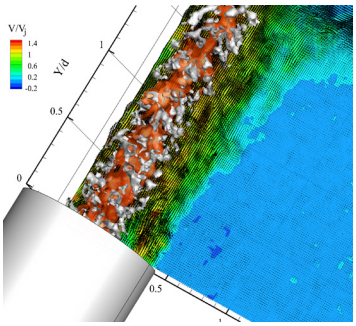
- ✓ Near earth object (NEO) detection
- ✓ Space debris tracking
- ✓ Solar astronomy
- ✓ Fast time resolution astrophysics
- ✓ Wafer inspection

Read more

Zyla sCMOS

For physical imaging, astronomy and spectroscopy

3D flow field study by PIV (using 4x Zyla), courtesy of Gioacchino Cafiero, Universit´a di Napoli Federico II.

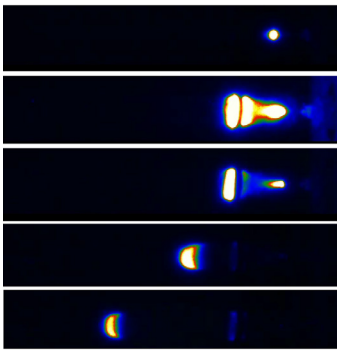


iStar sCMOS

For nanosecond gated imaging and spectroscopy

- ✓ Quantum physics
- ✓ Plasma diagnostics
- ✓ Flow/spray/combustion processes study
- ✓ Planar Laser-Induced Fluorescence (PLIF)
- ✓ Time-resolved luminescence

Plasma bullet time-dynamics studies, courtesy of Jérôme Bredin at York Plasma Institute.



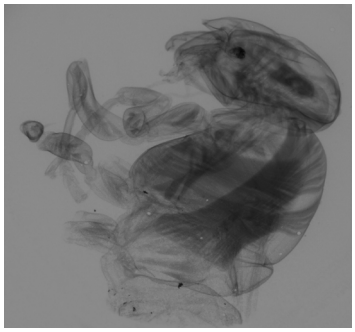
Read more

Zyla-HF

For indirect x-ray imaging

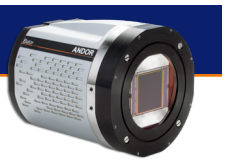
- ✓ Hard x-ray imaging and spectroscopy
- ✓ High Harmonic Generation (HHG)
- ✓ X-ray plasma spectroscopy
- ✓ X-ray tomography
- ✓ Transmission Electron Microscopy (TEM)

X-ray absorption image of a wasp taken with a 40 kV X-ray source, courtesy of Crytur.



Read more

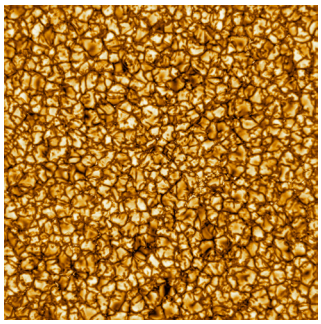
Balor sCMOS



Capture More. Further. Faster.

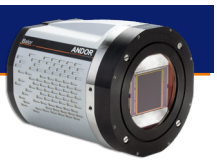
- ✓ Orbital debris & asteroid tracking
- ✓ Large sky surveys
- ✓ Solar studies
- ✓ Exoplanet discovery
- ✓ Supernovae detection

The highest resolution image of the Sun's surface ever taken using Balor sCMOS. Credit: NSO/AURA/NSF



Read more

Balor-X sCMOS



Solution for High Energy Physics

- ✓ Hard x-ray & neutron tomography
- ✓ Hard x-ray microscopy
- ✓ X-ray diffraction & crystallography
- ✓ X-ray scattering - SAXS & WAXS
- ✓ Engineered material science

Read more

Technical Data

Model Specific Specifications[*1]

Model	Zyla 5.5			Zyla 4.2 PLUS	
Sensor type	Front Illuminated Scientific CMOS			Front Illuminated Scientific CMOS	
Active pixels (W x H)	2560 x 2160 (5.5 Megapixel)			2048 x 2048 (4.2 Megapixel)	
Sensor size	16.6 x 14.0 mm 21.8 mm diagonal			13.3 x 13.3 mm 18.8 mm diagonal	
Pixel readout rate (MHz)	200 (100 MHz x 2 sensor halves) 560 (280 MHz x 2 sensor halves)			Slow Read 216 (108 MHz x 2 sensor halves) Fast Read 540 (270 MHz x 2 sensor halves)	
Read noise (e^-) Median [rms] •[2]		Rolling Shutter	Global Shutter		Rolling Shutter
	@ 200 MHz	0.9 [1.2]	2.3 [2.5]	@ 216 MHz	0.90 [1.1]
	@ 560 MHz	1.2 [1.6]	2.4 [2.6]	@ 540 MHz	1.10 [1.3]
Maximum Quantum Efficiency •[3]	64%			82%	
Sensor Operating Temperature Air cooled Water cooled	0°C (up to 30°C ambient) -10°C*			0°C (up to 27°C ambient) -10°C*	
Dark current, e^-/pixel/sec @ min temp •[4] Air cooled Water cooled	0.10 0.019			0.10 0.019	
Readout modes	Rolling Shutter and True Global Shutter (Snapshot)			Rolling Shutter and Global Clear •[8]	
Maximum dynamic range	33,000:1			33,000:1	
Photon Response Non-Uniformity (PRNU) Half-light range Low light range	< 0.01% < 0.1%				
Pre-defined Region of Interest (ROI)	2048 x 2048, 1920 x 1080, 1392 x 1040, 512 x 512, 128 x 128			1920 x 1080, 1392 x 1040, 512 x 512, 128 x 128	
User defined ROI (granularity)	Yes (1 pixel) **				
Data range	12-bit (fastest USB 3.0 speeds) and 16-bit (maximum dynamic range)				
Interface options	USB 3.0•[9] Camera Link 10-tap				

* Cooling temperature must be above the dew point
** Minimum ROI size: 4 x 8 (W x H) possible for 12- or 16-bit modes and for both Camera Link 10-tap and USB 3.0 models

General Specifications[*1]

Pixel size (W x H)	6.5 µm
Pixel well depth (e-)	30,000
Linearity (%, maximum)•[5] Full light range Low light range (< 1000 electrons signal)	Better than 99.8% Better than 99.9%
MTF (Nyquist @ 555 nm)	45%
Pixel binning	Hardware binning: 2 x 2, 3 x 3, 4 x 4, 8 x 8
Anti-blooming factor	x 10,000
I/O	External Trigger, Fire, Fire n, Fire All, Fire Any, Arm
Trigger Modes	Internal, External, External Start, External Exposure, Software Trigger
Software Exposure Events•[6]	Start exposure - End exposure (row 1), Start exposure - End exposure (row n)
Hardware timestamp accuracy	25 ns
Internal memory	1 GB

I Imaging Mode

Frame Rate Table - 12-bit (16-bit)[7]

Array Size (W x H)	Zyla 5.5 USB 3.0 Rolling Shutter	Zyla 5.5 USB 3.0 Global Shutter	Zyla 5.5 10-tap Rolling Shutter	Zyla 5.5 10-tap Global Shutter	Zyla 4.2 PLUS 10-tap Rolling Shutter	Zyla 4.2 PLUS USB 3.0 Rolling Shutter
2560 x 2160	40 (30)	40 (30)	100 (75)	49 (49)	-	-
2048 x 2048	53 (40)	52 (39)	105 (98)	52 (52)	101 (101)	53 (40)
1920 x 1080	107 (80)	98 (80)	200 (200)	97 (97)	192 (192)	107 (80)
512 x 512	422 (422)	201 (201)	422 (422)	201 (201)	406 (406)	406 (406)
128 x 128	1691 (1691)	716 (716)	1691 (1691)	716 (716)	1627 (1627)	1627 (1627)
2048 x 8 (FCS mode)	13020 (10250)	4008 (4008)	27057 (27057)	4008 (4008)	26041 (26041)	13020 (10250)
1024 x 8 (FCS mode)	27057 (27057)	4008 (4008)	27057 (27057)	4008 (4008)	26041 (26041)	26041 (26041)

S Spectroscopy Mode

Vertically binned tracks 12 & 16-bit[7]

Array Size (W x H)	Zyla 5.5 10 tap / USB 3.0 Rolling Shutter*	Zyla 5.5 10 tap / USB 3.0 Global Shutter**	Zyla 4.2 PLUS 10 tap/USB 3.0 Rolling Shutter*
any x 8	27,057	4,008	26,041
any x 12	18,038	3,491	17,361
any x 16	13,528	3,092	13,020
any x 31	6,764	2,122	6,510
any x 77	2,705	1,093	2,604
any x 100	2,164	909	2,083
any x 128	1,691	736	1,627
any x 154	1,387	618	1,335
any x 462	466	224	448
any x 512	422	203	406
any x 1040	208	102	200
any x 1080	200	98	192
any x 2048	105	52	101

M Multi-track Mode

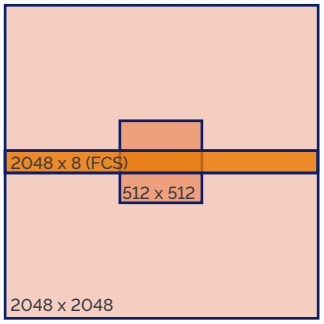
Vertically binned tracks 12 & 16-bit[7]

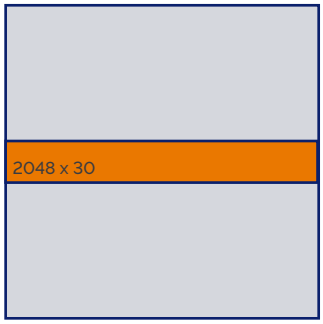
Number of tracks (centred vertically)	Track height (h, pixels)	Tracks separation (d, pixels)	Zyla 5.5 10-tap / USB 3.0 Rolling Shutter*	Zyla 5.5 10-tap / USB 3.0 Global Shutter**	Zyla 4.2 PLUS 10-tap/USB 3.0 Rolling Shutter*
2	12	12	6,012	1,967	5,787
2	20	20	3,607	1,370	3,472
2	154	77	557	265	536
20	12	12	462	222	445
20	20	20	277	135	267
50	12	12	182	89	175
50	20	20	109	54	105
256	8	0	105	52	101

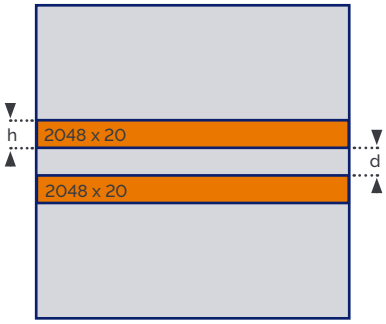
* Overlap ON
** Overlap OFF

How the sCMOS sensor is used in the different modes

The diagrams below illustrate how the sCMOS sensor array is used for the different modes (in this example for the Zyla 4.2 PLUS).





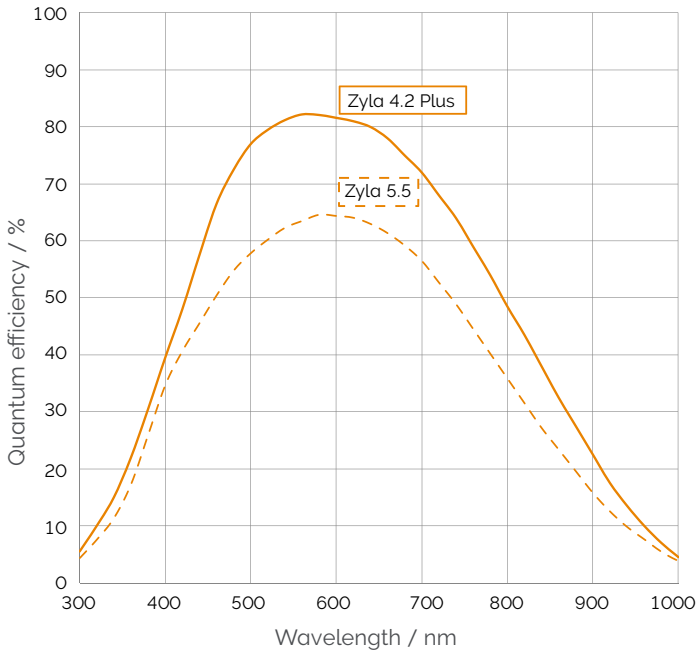


I Imaging Mode
The array size may be defined (includes FCS modes) for either resolution or maximum speed.

S Spectroscopy Mode
A vertically binned track is centred on the sensor enabling the maximum spectral rate to capture dynamic events.

M Multi-track Mode
Up to 256 vertically binned tracks can be used for multi-track analysis without sacrificing speed.

Quantum Efficiency (QE) Curve •3



sCMOS for Spectroscopy and Andor Research-grade Spectrographs

Highly modular motorized platforms with dual output ports, dual/triple/quadruple grating turrets and a wide range of motorized and field-upgradable accessories.

Shamrock 750

Delivers the highest spectral resolution of the spectrograph range, down to 0.02 nm.

Shamrock 500i

Ideal combination of high spectral resolution, imaging capabilities for multi-track acquisitions. Convenient USB interface alongside fully motorized platform and light coupling accessories.

Shamrock 163

Rugged, compact 163 mm focal length manual spectrograph, highly configurable for general, everyday lab spectroscopy.

Kymera 193i

Intelligent, modular and compact imaging spectrograph with Adaptive Focus technology, fully motorized, RFID-tagged dual grating turret, dual detector output ports and seamless interfacing to microscopes for micro-spectroscopy applications.

Kymera 328i

Intelligent, modular and compact imaging spectrograph with Adaptive Focus technology and intelligent TruRes™ spectral resolution enhancement option. Quad grating turret and dual input and output ports allow ease of integration into demanding optical setups or multi-modal laboratories.

Resolution Calculator
andor.com/calculators

sCMOS or EMCCD?

Since the introduction of sCMOS technology by Andor, the question of the performance comparison against the more established Electron Multiplying CCD (EMCCD) has been common.

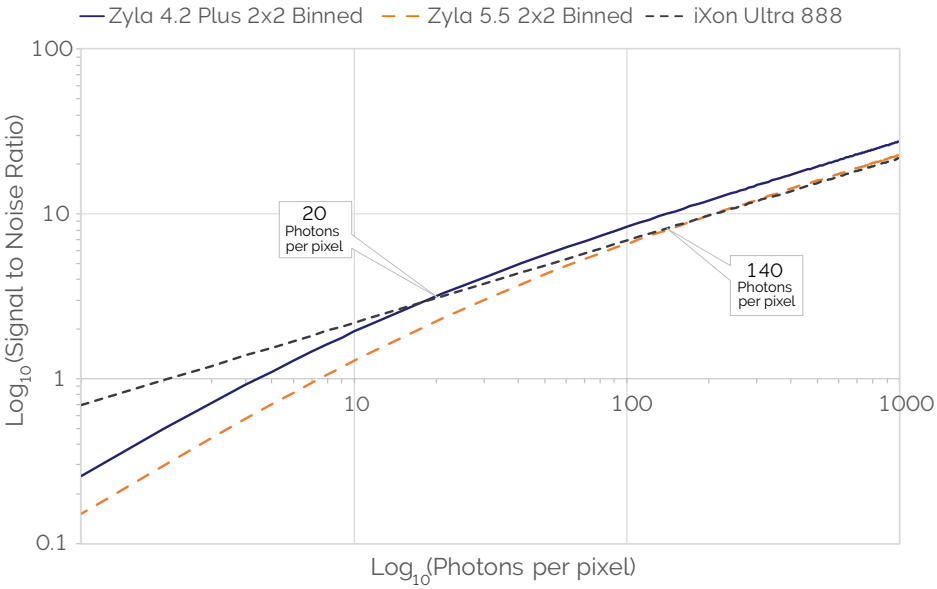
sCMOS offer a very fast, low noise technology, which holds potential as an alternative to single photon sensitive detectors across some applications and techniques, including cold atom imaging or fast spectral chemical mapping.

Whilst the read noise of sCMOS is very low compared to CCDs, EMCCD technology holds the distinct advantage of being able to practically eliminate read noise, rendering them single photon sensitive.

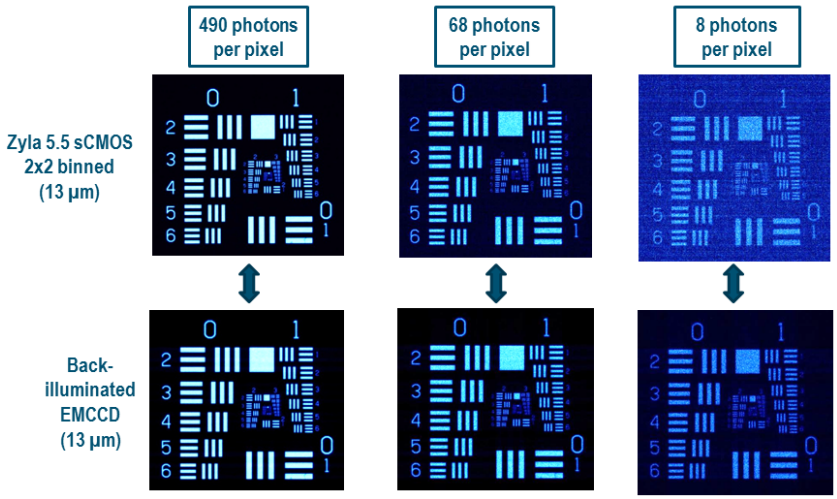
A decade on from the release of the first sCMOS detectors, there are still applications that benefit from the ultra-sensitive EMCCD technology.

For example quantum optics, photon counting and some astronomy applications such as Lucky Astronomy and wave front detection.

EMCCDs offer a raw sensitivity that cannot be surpassed in the very low light regime. However, EMCCDs remain relatively expensive, so they will always be considered a more selective, 'high-end' solution.

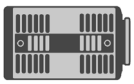


Plot of Signal to Noise Ratio versus Incident Photon Intensity, comparing back-illuminated EMCCD iXon 888 (13 µm pixel size) to 2x2 binned Zyla sCMOS cameras (13 µm pixel size after binning). Calculations were performed using our online signal to noise calculator tool available here.



Images at a range of incident light intensity, acquired using back-illuminated EMCCD iXon 888 and Zyla 5.5 sCMOS cameras (2x2 binned pixels). At low light intensities, the Signal to Noise Ratio advantage of the EMCCD is apparent.

Step 1. Select the camera type



Camera Type

Description	Code
ZYLA 4.2 PLUS, 4.2 Megapixel, Rolling shutter, Camera Link 10-tap	**ZYLA-4.2P-CL10**
ZYLA 4.2 PLUS, 4.2 Megapixel, Rolling shutter, USB 3.0	**ZYLA-4.2P-USB3**
ZYLA 5.5, 5.5 Megapixel, Rolling and Global shutter, Camera Link 10-tap	**ZYLA-5.5-CL10**
ZYLA 5.5, 5.5 Megapixel, Rolling and Global shutter, USB 3.0	**ZYLA-5.5-USB3**

For Spectroscopy mode option, add -S to your selected camera codes
For water cooled option, add -W to your selected camera code

Step 2. Select the required accessories

Accessories

Description	Order Code
F-mount adapter	**ACM-05574**
Auto extension tubes (set of 3) for C-mount	**OA-ECMT**
Auto extension tubes (set of 3) for Nikon F	**OA-ENAF**
Re-circulator for enhanced cooling performance	**XW-RECR**
Oasis 160 Ultra compact chiller unit	**ACC-XW-CHIL-160**
3 meter 7-way Multi I/O timing cable, offering Fire, External Trigger, Shutter and Arm.	**ACC-ACZ-05612**
5 meter cable for use with Axion frame grabber for Camera Link 10-tap models. (2 cables required)	**ACC-ASE-13532**
30 meter fibre-optic extender solution for Camera Link 10-tap models.	**ACC-ZYLFOX-10TAP-30M**
100 meter fibre-optic extender solution for Camera Link 10-tap models.	**ACC-ZYLFOX-10TAP-100**
15 meter active USB 3.0 connector cable (power supply not required). For use with Zyla USB 3.0 models.	**ACC-ASE-06887**
50 meter fibre optic USB 3.0 extender solution including power supply. For use with Zyla USB 3.0 models.	**ACC-ASE-08762**
100 meter fibre optic USB 3.0 extender solution including power supply. For use with Zyla USB 3.0 models.	**ACC-ASE-07860**
PC Workstation for up to 100 fps continuous spooling to hard drives, acquiring up to 120,000 12-bit full resolution images: Dell T7910XL, 2.6 GHz Eight Core, 8 GB RAM, 4 x 250GB SSD hard drive configured in RAID 0.	**WKST-1 WIN**
PC Workstation for up to 100 fps continuous spooling to RAM, acquiring up to 6,000 12-bit full resolution images: Dell T5810, 3.5 GHz Quad Core, 64 GB RAM.	**WKST-3 WIN**

For further information on PC workstations for Zyla, please refer to the technical note PC Specifications for sCMOS

Step 3. Select the required software

Software

The Zyla also requires at least one of the following software options:

Solis Spectroscopy A 32-bit and fully 64-bit enabled application for Windows (8, 8.1 and 10) offering rich functionality for data acquisition and processing. AndorBasic provides macro language control of data acquisition, processing, display and export.

Andor SDK3 A software development kit that allows you to control Andor sCMOS cameras from your own application. Available as a 32 or 64-bit library for Windows (8, 8.1 and 10) and Linux. Compatible with C/C++, LabView and Matlab.

GPU Express Andor GPU Express library has been created to simplify and optimize data transfers from camera to a CUDA-enabled Nvidia Graphical Processing Unit (GPU) card to facilitate accelerated GPU processing as part of the acquisition pipeline. Integrates easily with Andor SDK3 for Windows.

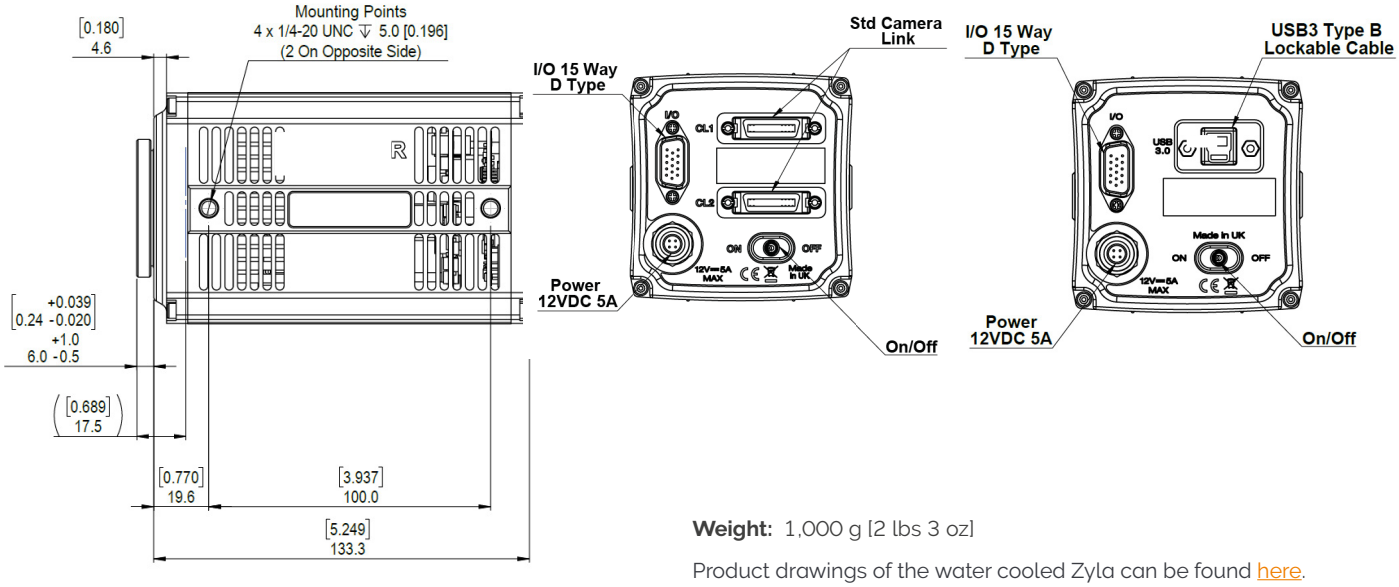
Third party software compatibility

Drivers are available so that the Zyla can be operated through a large variety of third party software packages. See Andor website for detail.

Product Drawings

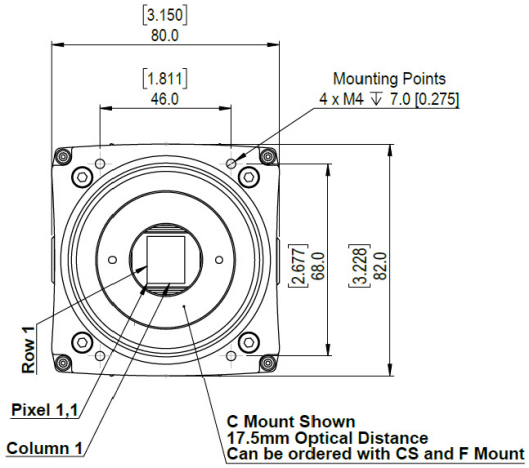
Dimensions in mm [inches]

Third-angle projection



Weight: 1,000 g [2 lbs 3 oz]

Product drawings of the water cooled Zyla can be found here.



Connecting to the Zyla

Camera Control

Connector type: 3 meter Camera Link 10-tap connectors or USB 3.0. (Longer lengths available as accessories).

TTL / Logic

1 x 3-way Multi I/O timing cable, offering Fire, External Trigger and Arm (1.5 meter)

Regulatory Compliance

- RoHS compliant
- EU EMC Directive
- EU LV Directive
- IEC 61010-1 CB Scheme

External Power Supply Compliance

- UL-certified for Canada and US
- Japanese PSE Mark

POWER SUPPLY REQUIREMENTS

- Power: +12 VDC ± 5% @ 5A
- Ripple: 200 mV peak-peak 0 - 20 MHz
- 100 - 240 VAC 50/60 Hz external power supply
- Power Consumption: 12V @ 5A Max, 12V @ 2.5A Nominal

15-way D-type pinouts

1	ARM	Output
2	Aux_Out_1*	Output
3	FIRE row n	Output
4	FIRE row 1	Output
5	Aux_Out_2	Output
6	Ground	GND
7	External Trigger	Input
8	Spare Input	Input
9	Reserved	N/A
10	Reserved	N/A
11	Reserved	N/A
12	Reserved	N/A
13	Reserved	N/A
14	Reserved	N/A
15	Reserved	N/A

* Aux_Out_1 is configurable as Fire, Fire n, Fire All or Fire Any. Refer to the Zyla hardware manual.

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.com/contact

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Items shipped with your camera

For Camera Link 10-Tap Models:1 x Camera Link Card and 2 x 3 meter connector cables.
For USB 3.0 models: 1 x USB 3.0 PCIe Card and 1 x 3 meter USB 3.0 cable (Type A to B)
1 x Power supply with mains cable
1 x 3-way Multi I/O timing cable, offering Fire, External Trigger and Arm (1.5 meter)
1 x Quick Start Guide
1 x Electronic copy of user guide
1 x Individual system performance sheet

Minimum Computer Requirements:

- 2.68 GHz Quad Core
- 4GB RAM (increase RAM if to be used for continuous data spooling)

Hard Drive:

- Minimum 450 MB/s continuous write for USB 3.0 models
- Minimum 850 MB/s continuous write for Camera Link 10-tap models
- PCI Express x4 or greater for USB 3.0 models
- PCI Express x8 or greater for Camera Link 10-tap models
- Windows (8, 8.1 or 10) or Linux

*See technical note entitled: 'PC Specifications for sCMOS'
** Note, Andor supply PC workstations for Zyla, see page 10.

Operating and Storage Conditions

Operating Temperature:

- Zyla 5.5: 0°C to 30°C ambient
- Zyla 4.2: 0°C to 27°C ambient
- Relative Humidity: < 70% (non-condensing)
- Storage Temperature: -10°C to 50°C

Power Requirements

- Please refer to page 11

Footnotes:

Specifications are subject to change without notice

1. Figures are typical unless otherwise stated.
2. Readout noise is for the entire system and is taken as a median over the sensor area excluding any regions of blemishes. It is a combination of sensor readout noise and A/D noise.
3. Quantum efficiency of the sensor at 20°C.
4. Dark current measurement is taken as a median over the sensor area excluding any regions of blemishes.
5. Linearity is measured from a plot of Signal vs. Exposure Time over the full dynamic range.
6. Software Exposure Events provide rapid software notification (SDK only) of the start and end of acquisition, useful for tight synchronization to moving peripheral devices e.g. Z-stage.
7. The maximum frames/s table for Zyla indicate the maximum speed at which the device can acquire images in a standard system at full frame and also a range of sub-array size, for both rolling and global shutter read modes (Zyla 5.5), 12-bit single amplifier (rates also apply to dual amplifier 16-bit for Zyla 4.2). Note that the write speed of the PC hard drive can impose a further restriction to achieving sustained kinetic series acquisition.
8. 'Global Clear' is an optional keep clean mechanism that can be implemented in rolling shutter mode, which purges charge from all rows of the sensor simultaneously, at the exposure start. The exposure end is still rolling shutter. It can be used alongside the Fire All output of the camera and a pulsed light source to simulate Global Exposure mechanism, albeit less efficiently than the true Global Shutter exposure mode of Zyla 5.5. Furthermore Global Clear differs from true Global Shutter in that it can only be used in 'non-overlap' readout mode, i.e. sequential exposure and readout phases rather than simultaneous.
9. Zyla USB 3.0 models should work with any modern USB 3.0 enabled PC/laptop (provided hard drives or RAM is sufficient to support data rates) as every USB 3.0 port should have its own host controller. Zyla USB 3.0 models also ship with a USB 3.0 PCIe card as a means to add a USB 3.0 port to an older PC, or as a diagnostic aid to interoperability issues or to ensure maximum speed.

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