OXFORD INSTRUMENTS

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Sona

sCMOS

NEW The Back-illuminated sCMOS Microscopy Camera You've Been Waiting For...

Key Specifications

- -45°C Vacuum Cooled
- 95% QE
- 70 fps
- 4.2 Megapixel (Sona 4.2B-11)
  largest on-sample field of view
- 2.0 Megapixel (Sona 2.0B-11)
  perfect for 22 mm C-mount port

Key Microscopy Benefits

- ✓ Capture large fields of cells and tissues
- ✓ Reduced phototoxicity
- ✓ Accurate physiology (lower fluorophore concentrations)
- ✓ Vacuum protection of sensor - no QE sensitivity decay

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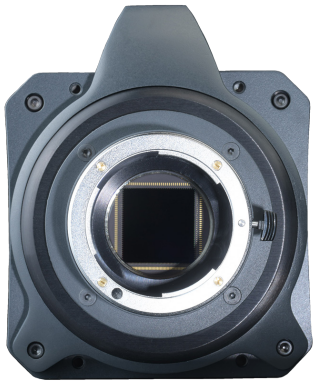
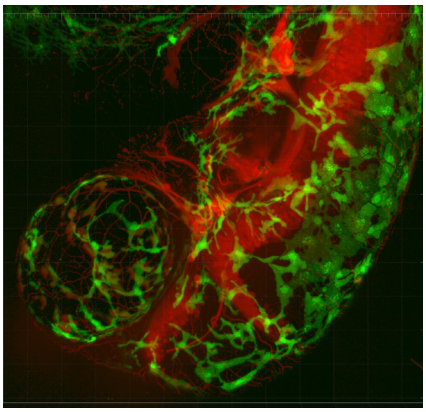
What is Sona?



Sona is Andor's new flagship high performance, vacuum-cooled sCMOS camera platform, specifically for fluorescence microscopy. It has been designed from the ground up to deliver unparalleled performance and versatility. The Sona platform makes its debut with **Sona 4.2B-11** and **Sona 2.0B-11**: the most sensitive back-illuminated sCMOS cameras available on the market.

The Most Sensitive Back-illuminated sCMOS

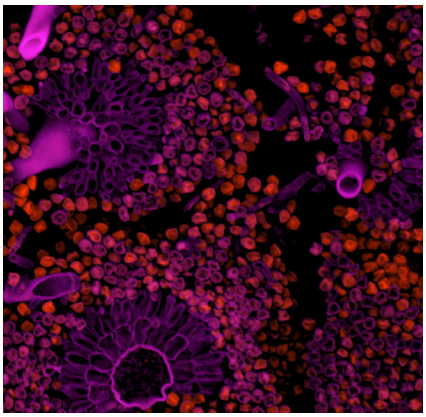
Sona 4.2B-11 and Sona 2.0B-11 back-illuminated sCMOS models each feature **95% Quantum Efficiency** and Andor's unique **vacuum cooling to -45°C**, thus also minimizing noise. Back-illuminated sensors are esteemed specifically for enhanced sensitivity – it makes sense to choose the most sensitive adaption of this high end technology.



- ✓ Reduce excitation power – preserve living specimens during observation
- ✓ Reduce fluorophore concentrations – obtain more accurate physiology
- ✓ Reduce exposure times – follow faster processes

The Largest Field of View

The flagship model, Sona 4.2B-11, is highly adaptable and presents an exclusive solution for capturing extremely large fields of cells or whole embryos with exceptional clarity. Furthermore, Sona 2.0B-11 maximizes the field of view available through C-mount microscope ports up to 22 mm. Pre-configured ROIs readily adapt for use with 19mm and 18mm ports.



- ✓ Perfect for capturing large fields of cells, embryos and tissues
- ✓ High content imaging
- ✓ Developmental biology – capture whole embryos
- ✓ Tissue cultures – minimize stitching, maximize throughput
- ✓ Organoids – unravelling cell connectivities
- ✓ Gene editing – screen large cell cultures for successful phenotype expression

Features and Benefits

Feature	Benefit
95% QE & lowest noise	Prolong live cell observations / accurately measure physiology.
4.2 Megapixel & 32 mm F-mount (Sona 4.2B-11)	Capture maximum field of cells, whole embryos and large tissue samples.
2.0 Megapixel and 22 mm C-mount (Sona 2.0B-11)	Ideal for modern microscopes that have C-mount ports up to 22 mm. Readily adapt for use on 19 mm and 18 mm ports.
Easily adaptable to x60 and x40 objectives	Combine with the Magnifying Coupler Unit (MCU) – preserve optical clarity over a range of sample types.
Vacuum cooled to -45^{0}C	Very weak signals require lowest noise floor: Don't be limited by camera thermal noise!
The ONLY vacuum back-illuminated sCMOS*[1]	Andor's proprietary UltraVac™ technology protects the sensor from (a) QE degradation, and (b) moisture condensation. 5 year vacuum warranty.
48 fps (4.2 Megapixel); 70 fps (2.0 Megapixel)	Image highly dynamic samples without signal smear - e.g. cell motility, membrane dynamics, ion flux, blood flow.
Extended Dynamic Range (EDR) mode	'One snap quantification' across a 53 000:1 signal range - measure challenging bright-dim samples such as neurons.
> 99.7% linearity	Market leading quantitative accuracy over the whole signal range – confidence of measurement in any application where signal intensity indicates local concentration.
Anti-Glow Technology	Allows access to full 4.2 Megapixel array with long exposures – maximize field of view and sensitivity.
User configurable ROI	Adapt to a range of microscope port sizes. Push frame rates and save data storage space.
Fan and water cooling as standard	Water cooling for maximum sensitivity and highly vibration sensitive set-ups, e.g. super-resolution and electrophysiology.
USB 3.0 ('*USB 3.1 Gen 1*')*[7]	A convenient, high speed interface.

UltraVac™ - Why is Vacuum Technology Important?

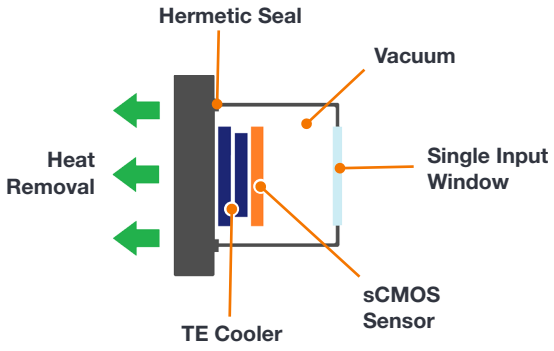
As well as affording superior minimization of the noise floor, the performance longevity benefits of Andor's vacuum sensor enclosure should not be overlooked:

Reason 1: Sensor Protection

Unless protected by vacuum, back-illuminated silicon sensors are susceptible to attack from moisture, hydrocarbons and other gas contaminants, resulting in gradual performance decline, **including QE decline**.

Reason 2: No re-backfilling of sensor enclosure

UltraVac™ uses a **hermetic vacuum seal**, completely preventing any gas and moisture ingress from the outside environment. This avoids moisture condensation on the sensor and the need to return to factory for repair. At Andor, we back this up with a standard **5 year warranty** on the Sona vacuum enclosure.



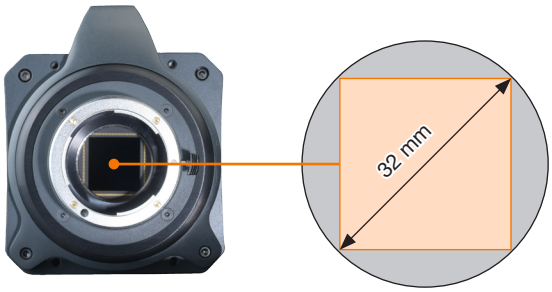
Andor's UltraVac™ provides superior sensor protection and longevity.

Superior Field of View

The flagship Sona **4.2B-11** back-illuminated model utilizes Andor's unique technology approach that 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**. With the right objective matching, this can be used to harness the entire field of view available from the microscope.
This is perfect for applications that require large fields of cells, whole embryos or tissue tissue samples to be captured with absolute clarity, for example in high content screening, organoid imaging and gene editing.

Sona 4.2B-11

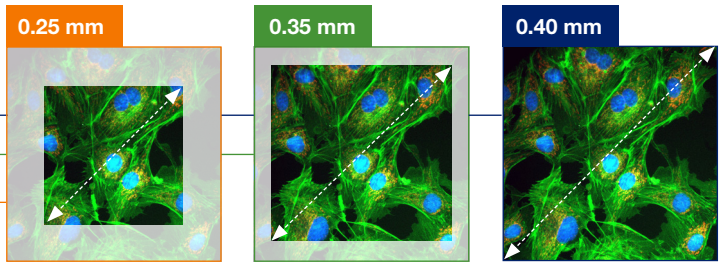
- **Mount Flexibility -** Sona 4.2B-11 comes with F-mount attachment as standard. However for maximum flexibility Andor also offer an optional user exchangeable C-mount adapter, usable with ROI sizes of up to 1400 x 1400 pixels (2 Megapixel).
- **Magnifying Coupler Unit (MCU)** - Andor offer a 2x magnifying coupler, compatible with a range of modern research microscopes and ports. Ideal for utilizing the entire 2048 x 2048 array in conjunction with 60x and 40x objectives, preserving Nyquist resolution. See ordering information on page 10.



- ✓ 32 mm sensor diagonal (2048 x 2048 pixels)
- ✓ F-mount as standard
- ✓ Ideal for microscope output ports up to 32 mm
- ✓ Magnifying Coupler Units or tube lens enable objective matching to suit smaller microscope output port sizes e.g. 25 mm

Objective matching examples

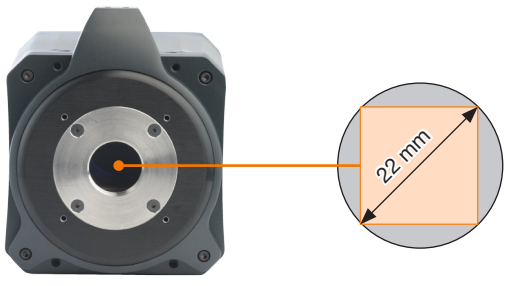
Objective		Tube Lens / Coupler Mag	Sensor Array Size (pixels)	FoV mm (diagonal)
Mag	NA			
x40	0.95	x2.0	2048 x 2048	0.40
x60	1.4	x1.5	2048 x 2048	0.35
x100	1.49	x1.0	1608 x 1608 (ROI)	0.25



By using the appropriate magnifying coupler you can fully exploit the larger sensor area available from the Sona and capture a larger on-sample field of view, while maintaining Nyquist resolution.

Sona 2.0B-11

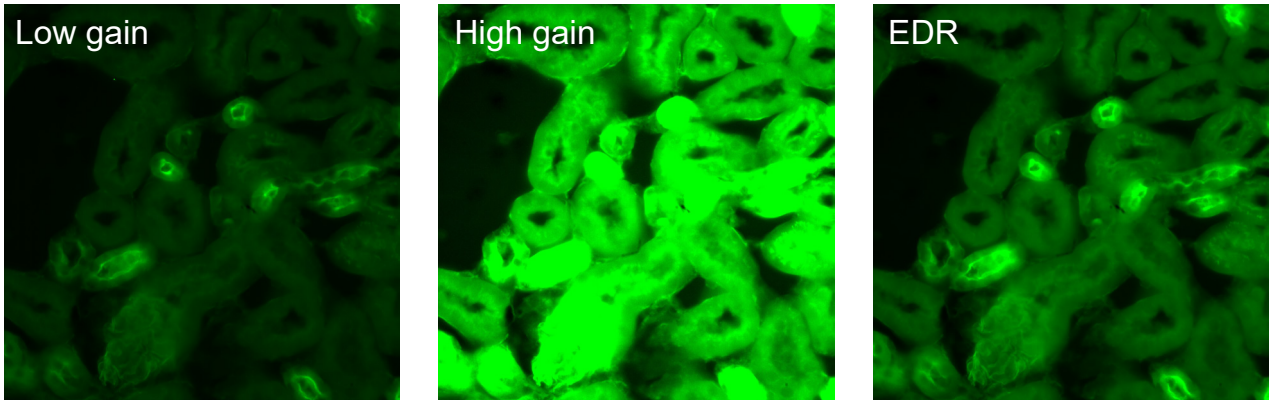
- **Maximize C-mount Field of View -** Sona 2.0B-11 is based on a 2 Megapixel array with 22 mm diagonal, perfectly sized to optimize the field of view available through its C-mount interface.
- **One camera, multiple ports** - Sona 2.0B-11 is adapted for use across a wide range of C-mount port sizes, via a range of pre-configured, centrally positioned ROIs.



- ✓ 22 mm sensor diagonal (1400 x 1400 pixels)
- ✓ C-mount as standard
- ✓ Ideal for microscope output ports up to 22 mm

Quantitative Accuracy

Sona 4.2B-11 and Sona 2.0B-11 each offer an **Extended Dynamic Range (EDR)** functionality, supported by a 16-bit data range. Harnessing an innovative 'dual amplifier' sensor architecture, we can access the **maximum pixel well depth AND the lowest noise simultaneously**, ensuring that we can quantify extremely weak and relatively bright signal regions in one snap. This functionality is useful for imaging and quantifying many challenging samples, such as neurons.



Above: The same image compared under different modes. Low gain - captures brighter regions and accesses the max. pixel well depth. High gain - captures dim regions with minimum noise floor. Extended Dynamic Range - captures and quantifies both high and low signal regions, combining lowest noise and maximum pixel well depth.

Market-leading linearity

To achieve best-in-class quantification accuracy, Andor have implemented enhanced on-camera intelligence to deliver linearity of > 99.7%.

Why do we need superb quantitative accuracy?

Many applications require accurate quantitative information rather than simply structural detail; any measurement where intensity correlates to quantity or concentration will benefit from superior linearity.

For example:

- Physiological parameters such as calcium, pH, cAMP or PIP3 levels.
- FRET analysis, such as for distance or co-localization measurements at the nanometer scale.
- Gene expression analysis with fusion proteins.
- Localization Super-Resolution Microscopy for better Gaussian fit.

Rapid Frame Rates

Sona 4.2B-11 and Sona 2.0B-11 offer fast frame rate capability, rendering them ideal for following dynamic cell processes such as ion signalling, cell motility and blood flow, while avoiding image smear. Region of Interest (ROI) and 12-bit readout mode can be utilised to considerably boost frame rates further.

12-bit mode for 2x speed boost!

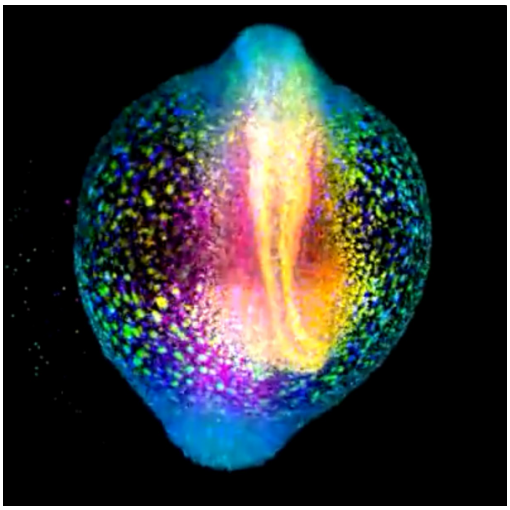
Sona 4.2B-11 and Sona 2.0B-11 each offer both 16-bit and 12-bit modes. 12-bit is selected specifically to accelerate frame rate by 2x, while sacrificing wide dynamic range, useful for imaging fast processes using low light modalities such as spinning disk confocal or TIRF.

Application Focus

Developmental Biology

Imaging has been instrumental for following the entire lifespan of organisms to track fates of developing cells, tissues and organs. Whole-embryo and whole-body imaging of well-established model organisms including the zebrafish and *C. elegans* let us understand various interconnected functional networks that shed light on nerve impulse propagation in neural circuits or ventricular pacemakers in heart models.

Sona 4.2B-11 provides a solution to the large fields of view that are inherent to study of developmental specimens, for example using the Light Sheet Microscopy technique.



A developing zebrafish embryo imaged from 4 to 18 hours post fertilization where each cell nucleus is labelled with GFP. Cells are color-coded for depth to visualize how dynamic cell reorganization gives rise to the body axis of zebrafish. Image courtesy of Gopi Shah, Max Planck Institute of Molecular Cell Biology and Genetics, Dresden.

Gene Editing

Recent years have seen a gradual increase in the number of studies related to Crispr-Cas9 system where this novel and versatile tool has been used with great precision for DNA editing and a multitude of applications that can benefit from this.

The best in class sensitivity offered by the back-illuminated deep cooled Sona sCMOS cameras are well suited to imaging of Crispr-Cas9 constructs, ideal for fast and sensitive detection of light emitted by labelled DNA/RNA or related proteins involved in strand cleavage and modification of the existing genetic code. The large field of view also permits screening of large cell cultures for successful gene edits.

Plasma Membrane Dynamics

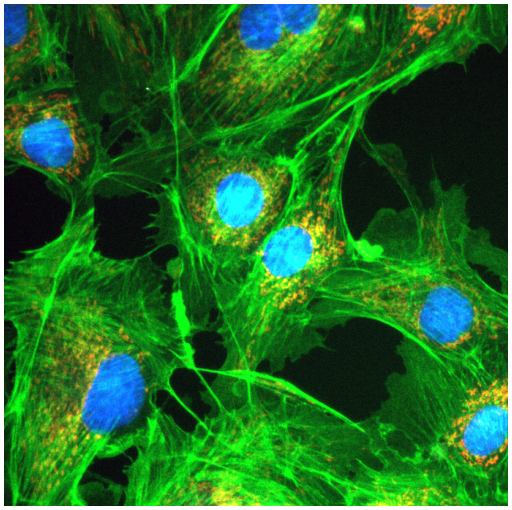
Analysis of phenomena associated with the plasma membrane is crucial for a large number of biological models involving cell adhesion, cell-to-cell communication, signal transduction as well as cell fate differentiation.

The plasma membrane can be imaged in many ways, some of which can involve direct membrane labelling with lipophilic or voltage sensitive dyes. Rapid remodelling of the plasma membrane can be imaged with the rapid frame rate, highly sensitive back-illuminated Sona cameras, perfectly suited to the low light conditions inherent to TIRF Microscopy.

Intracellular Trafficking

Without mechanisms to allow ongoing traffic of molecules, the cell's finely tuned machinery would immediately grind to a halt. Fast and sensitive imaging is crucial for studies of endosome cycling, Golgi vesicles pathways, axonal transport, hormone release or synaptic vesicle pool replenishment.

Andor sCMOS cameras have for many years been the detector of choice for experiments involving imaging of cellular traffic. The new Sona 4.2B-11 and 2.0B-11 models, with their large FOV, resolution and speed, are ideal for tracking intricate events and dependencies occurring within the cell's transport and communications networks.



Bovine pulmonary artery endothelial cells (BPAEC) imaged with Andor Sona 4.2B-11 on a Nikon Ti2 inverted microscope with a x60, 1.4 NA objective lens. MitoTracker Red was used to stain the mitochondria in the live cells, with accumulation dependent upon membrane potential. Following fixation and permeabilization, F-actin was stained with Alexa Fluor 488 phalloidin, and the nuclei were counterstained with the blue-fluorescent DNA stain DAPI.

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Technical Data

Performance Specifications[•2]

Model	Sona 4.2B-11	Sona 2.0B-11
Sensor Type	Back-Illuminated Scientific CMOS	
Array Size	2048 (W) x 2048 (H) 4.2 Megapixel	1400 (W) x 1400 (H) 2.0 Megapixel
Pixel Size	11 x 11 µm	
Image Area	22.5 mm x 22.5 mm (31.9 mm diagonal)	15.5 mm x 15.5 mm (21.8 mm diagonal)
Readout Modes	Rolling Shutter and simulated Global Shutter	
Pixel Readout Rates	100 MHz (16-bit mode) 200 MHz (12-bit mode)	
Quantum Efficiency[•3]	95% (max)	
Read Noise (e^-), median	1.6 e^- (at any readout rate)	
Sensor operating temperature[•4] Air cooled Water/liquid cooled	 -25°C (@30°C ambient) -45°C (@10°C water)	
Dark Current Air cooled (@-25°C) Water/liquid cooled (@ -45°C)	 0.4 e^-/pixel/s 0.2 e^-/pixel/s	
Active area pixel well depth	85 000 e^-	
Dynamic Range	53 000:1	
Data Range	16-bit (extended dynamic range) 12-bit (maximum frame rate)	
Linearity[•6]	> 99.7%	
PRNU	< 0.5% (@ half-light range)	
Region of Interest (ROI)	User-definable (1 pixel granularity, min. size 8 x 8)	
Pre-defined ROI	1608 x 1608, 1200 x 1200, 1024 x 1024, 512 x 512, 128 x 128	1024 x 1024, 512 x 512, 128 x 128
Pixel Binning (on FPGA)	Pre-set options: 2x2, 3x3, 4x4, 8x8. User definable binning (including asymmetric) to 1-pixel granularity.	

General Specifications [•2]

Model	Sona 4.2B-11	Sona 2.0B-11
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[•5]	Start exposure - End exposure (row 1), Start exposure - End exposure (row n)	
Image Timestamp Accuracy	25 ns	
PC Interface	USB 3.0[•7]	
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.

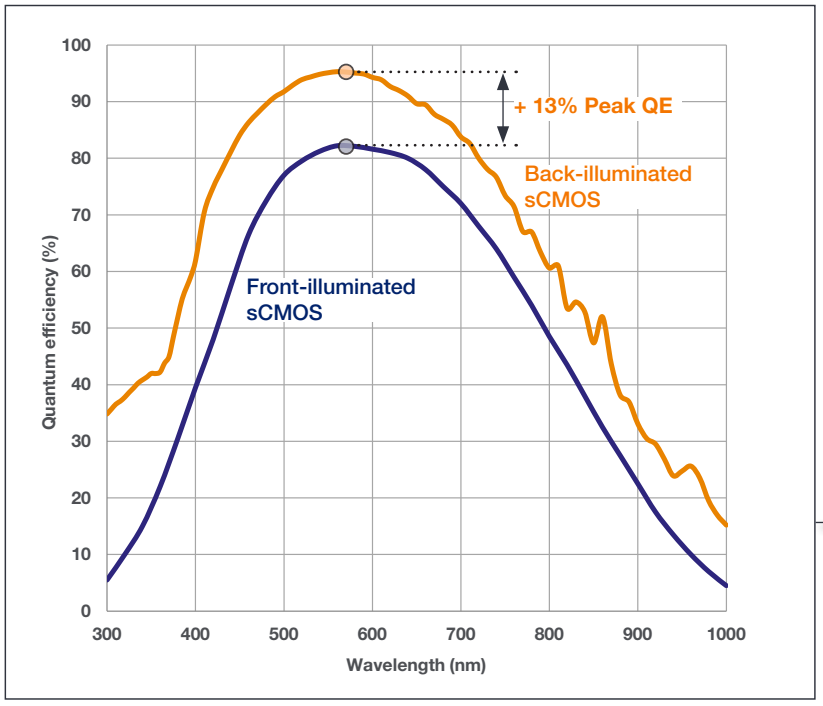
Frame Rates

Max Frame Rate (fps)	Sona 4.2B-11		Sona 2.0B-11	
ROI Size (W x H)	16-bit	12-bit	16-bit	12-bit
2048 x 2048	24	48	-	-
1608 x 1608	30	61	-	-
1400 x 1400	35	70	35	70
1200 x 1200	41	81	41	81
1024 x 1024	48	95	48	95
512 x 512	95	190	95	190
256 x 256	190	378	190	378
128 x 128	378	750	378	750
2048 x 8	5415	9747	-	-
1200 x 8	5415	9747	5415	9747

Note: frame rates do not differ if partial or full rows are selected.

"Both the Sona 4.2B-11 and Sona 2.0B-11 offer fast frame rate capabilities, rendering them ideal for following dynamic cell processes... Region of Interest (ROI) and 12-bit readout mode can boost frame rates even further."

Quantum Efficiency •3

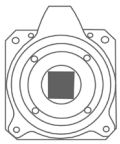


"Andor's new back-illuminated Sona sCMOS delivers significant improvements in QE when compared against the most recent generation of front-illuminated sCMOS based cameras."

sCMOS type	QE (%) peak
Sona Back-illuminated sCMOS	95%
Front-illuminated sCMOS models	82%

Creating The Optimum Product for You

Step 1. Choose the camera type



Camera Type

Description	Code
Sona 4.2B-11: 4.2 Megapixel Back-illuminated sCMOS, 11 µm pixel, 95% QE, 48 fps, USB 3.0, F-mount*	**SONA-4BV11**
Sona 2.0B-11: 2.0 Megapixel Back Illuminated sCMOS, 11 µm pixel, 95% QE, 70 fps, USB 3.0, C-mount	**SONA-2BV11**

Step 2. Select the required accessories

Accessories

Description	Order Code
MCU with 2x magnification for matching Sona to Leica microscopes	**MCU-SONA-LEI**
MCU with x2 magnification for matching Sona to Nikon Ti Series (TiE and Ti2) microscopes	**MCU-SONA-NIK-TI**
MCU with x2 magnification for matching Sona to Olympus microscopes	**MCU-SONA-OLY**
C-mount - convert Sona 4.2B-11 to C-mount (for use with ROIs)	**ACC-MEC-11936**
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**

Step 3. Select the required software

Software

Sona requires one of the following software options:

Solis Imaging A 32-bit and fully 64-bit enabled application for Windows (7, 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 the Andor range of cameras from your own application. Available as 32 and 64-bit libraries for Windows (7, 8, 8.1 and 10), compatible with C/C++, C#, Delphi, VB.NET, LabVIEW and Matlab. Linux SDK compatible with C/C++.

Third party software compatibility
Drivers are available for a variety of third party imaging packages. See Andor web site for detail: andor.com/software

Have you found what you are looking for?

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.

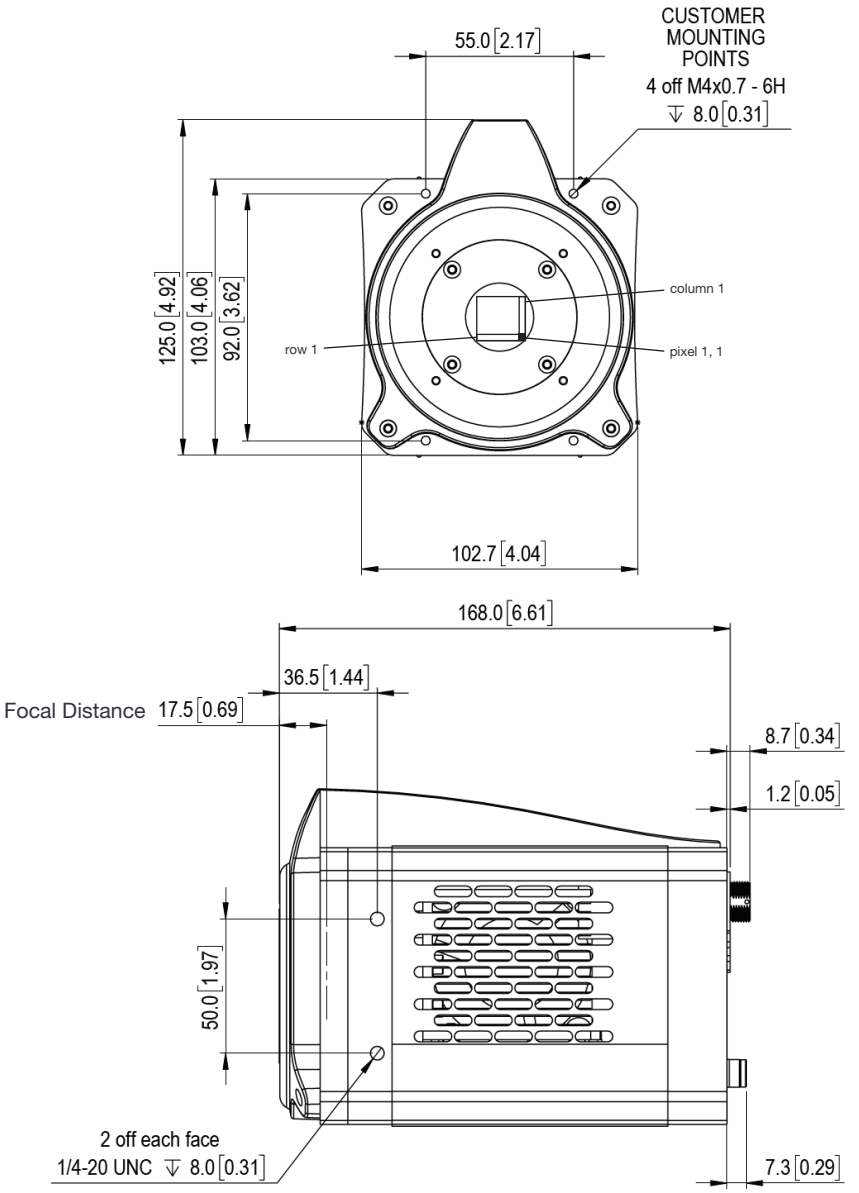
Need more sensitivity? The iXon Life EMCCD platform offers single photon sensitivity and 95% back-illuminated QE, further boosted by cooling to -80 ^{0}C. Ideal for demanding light starved applications such as single molecule biophysics.

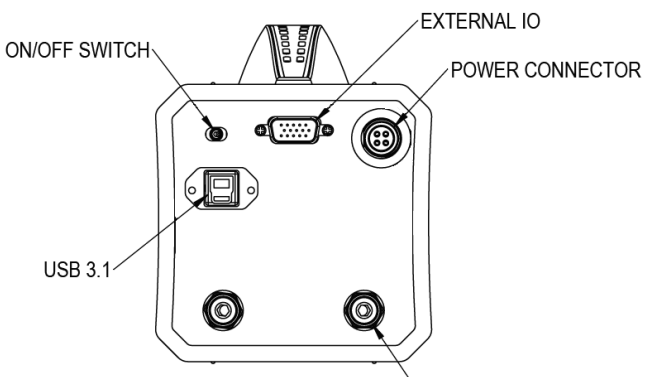
Need smaller pixels? The Neo and Zyla sCMOS cameras offer sensors with 6.5 µm pixel pitch, ideal for 40x and 60x objectives without need for further magnification.

Need better NIR performance? The iXon EMCCD range offers sensor options that extend QE further into the NIR region of the spectrum. Ideal for the increasingly popular range of red/NIR enhanced fluorophores, offering enhanced signal to background contrast and deeper penetration into tissues.

Mechanical Drawings

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





Weight: ~2.7 kg [5.95 lbs] approx.

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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:

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Fax +86 (10) 8271 9055

Items shipped with your camera

1x USB 3.0 PCIe card•7
1x USB 3.0 Cable (3m)•7
1x Multi I/O Timing Cable (BNC to D-type: 1.5m)
1x 15V PSU
1x Country speciifc power cord (5m)
1x User manuals in electronic format
1x Quickstart Guide

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. Software Exposure Events provide rapid software notification (SDK only) of the start and end of acquisition.
6. Linearity is measured from a plot of Signal vs. Exposure Time over the full dynamic range.
7. The Sona 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.

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Minimum Computer Requirements:

- 3.0 GHz single core or 2.4 GHz dual or quad core processor
- 8 GB RAM
- Hard drive: 2.3 GB/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 x8 PCIe slot for USB 3.0 card)
- Windows (7, 8, 8.1 and 10) or Linux

Operating & Storage Conditions:

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

Power Requirements:

- 100 - 240 VAC, 50 - 60 Hz
- Power consumption: 40W typical / 114W max

µManager
Fusion