Driving the Absolute Best From EMCCD Technology

Andor’s iXon3 897 back-illuminated EMCCD has single photon detection capability combined with > 90% QE. This highly popular 512 x 512 frame transfer format delivers unequalled thermoelectric cooling down to -100°C, industry-lowest clock induced charge noise, and operates at 35 frames/sec (full resolution). Andor’s ‘overclocked’ vertical shift capability offers distinct speed advantages and minimises vertical smear. EMCCD and conventional CCD readout modes provide heightened application flexibility.

The iXon3 897 benefits from an advanced set of user-requested features, including OptAcquire, Count Convert, Spurious Noise Filters, Cropped Sensor Mode, Signal Averaging and enhanced Photon Counting capability. Patented EMCAL™ and RealGain™ provide sustained quantitative EM gain calibration.

Features and Benefits

- **TE cooling to -100°C**
  Critical for elimination of dark current detection limit
- **OptAcquire**
  Optimize the highly flexible iXon3 for different application requirements at the click of a button
- **Count Convert**
  Quantitatively capture and view data in electrons or incident photons. Real-time or post-processing
- **RealGain™**
  Absolute EMCCD gain selectable directly from a linear and quantitative scale
- **EMCAL™**
  Patented user-initiated self-recalibration of EM Gain
- **Spurious Noise Filters**
  Intelligent algorithms to filter clock induced charge events from the background. Real time or post-processing
- **Cropped Sensor Mode**
  Specialised acquisition mode for continuous imaging with fastest possible temporal resolution
- **iCam**
  The market-leading exposure time fast-switching software
- **Minimal Clock-Induced Charge**
  Unique pixel clocking parameters, yielding minimized spurious noise floor
- **UltraVac™**
  Critical for sustained vacuum integrity and to maintain unequalled cooling and QE performance, year after year
- **Selectable amplifier outputs – EMCCD and conventional**
  ‘2 in 1’ flexibility. EMCCD for ultra-sensitivity at speed, conventional CCD for longer acquisitions
- **Superior Baseline Clamp and EM stability**
  Quantitative accuracy of dynamic measurements
- **Enhanced Photon Counting Modes**
  Intuitive single photon counting modes to overcome multiplicative noise, Real time or post-processing
- **Real Time Signal Averaging**
  Recursive and frame averaging functions for improved SNR
- **Built-in C-mount compatible shutter (optional)**
  Easy means to record reference dark images

Specifications Summary

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active pixels</td>
<td>512 x 512</td>
</tr>
<tr>
<td>Pixel size (W x H)</td>
<td>16 x 16 μm</td>
</tr>
<tr>
<td>Active area pixel well depth</td>
<td>160,000 e⁻</td>
</tr>
<tr>
<td>Gain register pixel well depth</td>
<td>800,000 e⁻</td>
</tr>
<tr>
<td>Maximum readout rate</td>
<td>10 MHz</td>
</tr>
<tr>
<td>Frame rate</td>
<td>35 - 7,980 fps</td>
</tr>
<tr>
<td>Read noise</td>
<td>&lt; 1e⁻ with EM gain</td>
</tr>
<tr>
<td>Maximum cooling</td>
<td>-100°C</td>
</tr>
</tbody>
</table>
**System Specifications**

<table>
<thead>
<tr>
<th>Model number</th>
<th>897</th>
</tr>
</thead>
</table>
| Sensor options | BV: Back Illuminated CCD, Vis optimized  
UVB: Back Illuminated CCD with UV coating  
BB: Back illuminated, blue optimised AR coating |
| Active pixels | 512 x 512 |
| Pixel size | 16 x 16 μm |
| Image area | 8.2 x 8.2 mm with 100% fill factor |
| Minimum temperature air cooled | -85°C  
-90°C  
-100°C |
| Digitization | True 14 bit @ 10, 5, 3 & 1 MHz readout rate (16 bit available @ 1 MHz) |
| Triggering | Internal, External, External Start, External Exposure, Software Trigger |
| System window type | Single window with double-sided AR coating (standard for BV model) |
| Blemish specification | Grade 1 sensor (CCD97), as defined by the sensor manufacturer e2V  
For further details see http://www.e2v.com/?go=d&doc=3D04FAC0-24E8-7360-B6420154CCF0FBEC |

**Advanced Performance Specifications**

<table>
<thead>
<tr>
<th>Dark current and background events</th>
<th>0.001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark current (e/pixel/sec) @ -85°C</td>
<td>0.005</td>
</tr>
<tr>
<td>Spurious background (events/pix) @ 1000x gain / -85°C</td>
<td>0.001</td>
</tr>
</tbody>
</table>

**Gain register pixel well depth**<sup>+</sup> 800,000 e-

<table>
<thead>
<tr>
<th>Pixel readout rates</th>
<th>Electron Multiplying Amplifier</th>
<th>Conventional Amplifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MHz through EMCCD amplifier</td>
<td>Typical</td>
<td>With Electron Multiplication</td>
</tr>
<tr>
<td>10 MHz through EMCCD amplifier</td>
<td>49</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>5 MHz through EMCCD amplifier</td>
<td>42</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>3 MHz through EMCCD amplifier</td>
<td>32</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>1 MHz through EMCCD amplifier</td>
<td>21</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>1 MHz through conventional amplifier</td>
<td>6</td>
<td>-</td>
</tr>
</tbody>
</table>

**Read noise (e-)**<sup>+</sup> 0.3 to 3.3 μs (variable)

**Linear absolute Electron Multiplier gain**<sup>+</sup> 1 - 1000 times via RealGain™ (calibration stable at all cooling temperatures)

**Linearity**<sup>+</sup> Better than 99%

**Frame Rates (Standard Mode)**

<table>
<thead>
<tr>
<th>Binning</th>
<th>Array size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 1</td>
<td>35, 68, 132, 251, 168, 456, 2128</td>
</tr>
<tr>
<td>2 x 2</td>
<td>68, 132, 248, 452, 313, 757, -</td>
</tr>
<tr>
<td>4 x 4</td>
<td>131, 246, 439, 735, 549, 1111, -</td>
</tr>
<tr>
<td>8 x 8</td>
<td>231, 426, 699, 1031, 833, 1351, -</td>
</tr>
</tbody>
</table>

**Frame Rates (Cropped Sensor Mode)**

<table>
<thead>
<tr>
<th>Binning</th>
<th>Array size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 1</td>
<td>69, 395, 988, 2577, 176, 538, 7980</td>
</tr>
<tr>
<td>2 x 2</td>
<td>136, 743, 1764, 5400, 342, 1025, -</td>
</tr>
<tr>
<td>4 x 4</td>
<td>260, 1327, 2902, 6068, 649, 1677, -</td>
</tr>
<tr>
<td>8 x 8</td>
<td>483, 2184, 4285, 7375, 1268, 3209, -</td>
</tr>
</tbody>
</table>
Quantum Efficiency Curves

QE v Fluorophores Curve

Stability Plot

Application Image

EM Gain stability in the iXon 897. 200 frame kinetic series; frame transfer (overlapped) acquisition; 30 ms exposure time; x300 EM gain.

Composite triple color image of a microtubule protein (EB1-GFP) imaged with objective-type TIRFM (60x 1.45NA), using the 897 model. The different colors reveal the dynamics of the microtubules over time: frame 1 = red; frame 10 = green; frame 20 = blue.

Courtesy of Dr Derek Toomre, CINEMA laboratory, Dept. Cell Biology, Yale University
Creating The Optimum Product for You

How to customise the iXon3 897:

**Step 1.**
Simply select from the 2 digitisation options that best suit your needs from the selection opposite.

**Step 2.**
Verify lens mount suitability.

**Step 3.**
Please indicate if you require a shutter fitted to your iXon3 897.

**Step 4.**
The iXon3 897 (BB sensor only) comes with 2 alternative options for window coatings. Please select the coating which best suits your needs.

**Step 5.**
The iXon3 897 requires at least one of the following controller card and software options:
- CCI-23 PCI Controller card.
- CCI-24 PCIe Controller card.

**Step 6.**
The following accessories are available:
- OPTOMASK Optomask microscopy accessory, used to mask unwanted sensor area during Cropped Sensor mode acquisition.
- XW-RECR Re-circulator for enhanced cooling performance.
- ACC-XW-CHIL-160 Oasis 160 Ultra compact chiller unit.
- OA-CNAF C-mount to Nikon F-mount adapter.
- OA-COFM C-mount to Olympus adapter.
- OA-CTOT C-mount to T-mount adapter.

**Step 7.**
For compatibility, please indicate which accessories are required.
## Product Drawings

Dimensions in mm [inches]

- **Mounting points, 6 off 1/4-20 UNC Tapped x 15mm deep**
- **Focal Plane 17.5 mm from face plate**

**Weight:** 3.4 kg [7 lb 8 oz]

## Connecting to the iXon3

**Camera Control**
- Connector type: PCI or PCIe

**TTL / Logic**
- Connector type: SMB, provided with SMB - BNC cable
- Fire (Output), Shutter (Output), Arm (Output), External Trigger (Input)

**I²C connector**
- Compatible with Fischer SC102A053-130, pinouts as follow:
  1 = I²C Clock, 2 = I²C Data, 3 = Ground, 4 = +5 Vdc
- Minimum cable clearance required at rear of camera
  90 mm

## Typical Applications

- Single Molecule Detection
- Super Resolution (PALM, STORM)
- TIRF Microscopy
- Spinning Disk Confocal Microscopy
- Selective/Single Plane Illumination Microscopy (SPIM)
- Calcium Flux
- Whole Genome Sequencing
- FRET / FRAP
- Microspectroscopy / Hyperspectral Imaging
- Lucky Astronomy
- Single Photon Counting
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Fax +86 (10) 6445 5401

Items shipped with your camera:
- 1x PCI or PCIe controller card + SATA adapter
- 1x Controller card splitter/ fly-lead (if required)
- 1x 3m iXon3 detector cable
- 2x 2m SMB - BNC connection cables
- 1x Power supply with mains cable
- 1x Quick launch guide
- 1x CD containing Andor user manuals
- 1x Individual system performance booklet
- 1x Disposable ESD wrist strap

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. The dark current measurement is averaged over the sensor area excluding any regions of blemishes.

4. Using Electron Multiplication the iXon3 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 (10 MHz readout; frame-transfer mode; 0.5 µs vertical clock speed; x 1000 EM gain; 10 ms exposure; -85°C).

5. The EM register on CCD97 sensors has a linear response up to 400,000 electrons max. and a full well depth of ~800,000 electrons max.

6. 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 1e- levels.

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. All measurements are made with 0.3 µs vertical clock speed. It also assumes internal trigger mode of operation.

9. Quantum efficiency of the sensor at 20°C, as measured by the sensor Manufacturer.

Recommended Computer Requirements:
- 3.0 GHz single core or 2.6 GHz multi core processor
- 2 GB RAM
- 100 MB free hard disc to install software (at least 1 GB recommended for data spooling)
- PCI 2.2 or PCIe slot
- 10,000 rpm SATA hard drive preferred for extended kinetic series
- Windows (XP, Vista and 7) 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
- 110 - 240 VAC, 50/60 Hz

Front cover image: A large scale 3D STORM image of a cultured hippocampal neuron colored in z. Courtesy of Melike Lakadamyali, Institute of Photonic Sciences, ICFO, Barcelona, Spain and Hazen Babcock from Harvard University, Cambridge, MA