

# iKon-L 936 [DO]

## Features & benefits

## “4 Megapixel Deep-Cooled CCD for X-ray Imaging”

### Open front end\*<sup>1</sup>

Provides a direct interface to your vacuum chamber with optional filter holder. A range of custom interfacing flanges are available for standard vacuum connections, e.g. CF, ISO and KF.

### Deep TE cooling

Operating temperatures of as low as -100°C are achievable depending on the vacuum conditions. Negligible dark current at low operating temperatures, without the aggravation or safety concerns associated with LN<sub>2</sub>.

### Large area 2048 x 2048 sensor

Large field of view and high resolution.

### Quad-speed readout up to 5 MHz

Extensive choice of readout digitization speeds. Slower readout for low noise, faster speeds for dynamic processes and 5 MHz for focusing mode.

### USB 2.0 connection

USB 2.0 connection direct from back of camera - no controller box required! Use with USB 2.0 to fiber-optic converter for long distance control.

### Ultra low-noise readout

Intelligent low-noise electronics offer the most ‘silent’ system noise available.

### High Dynamic Range

High well capacity and 16-bit digitization for simultaneous quantification of dim and bright signal.

### Dual output

Software select between either a High Sensitivity output for low-light applications, or a High Capacity output for maximum dynamic range with extensive binning.

### Cropped sensor mode

Specialized acquisition mode for continuous imaging from sub-area with very fast temporal resolution.

### Enhanced Baseline Clamp

Essential for quantitative accuracy of dynamic measurements.

### Solis (i) software

User-friendly interface offering intuitive acquisition optimization and data processing/analysis.

### Windows and Linux

Andor’s user-friendly SDK supports both Windows and Linux OS.

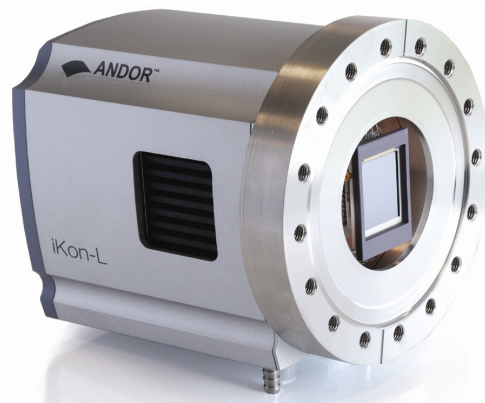
Andor’s iKon-L 936 [DO] is designed with x-ray imaging in mind, an ideal system to interface to vacuum chambers for direct X-ray detection.

The 2048 x 2048 array and 13.5µm<sup>2</sup> pixels combine to deliver a 27.6 x 27.6mm active image area, TE cooled down to -100°C.

The iKon-L 936 [DO] offers outstanding resolution, field of view, sensitivity and dynamic range performance.

Ultimate sensitivity performance is achieved through combination of

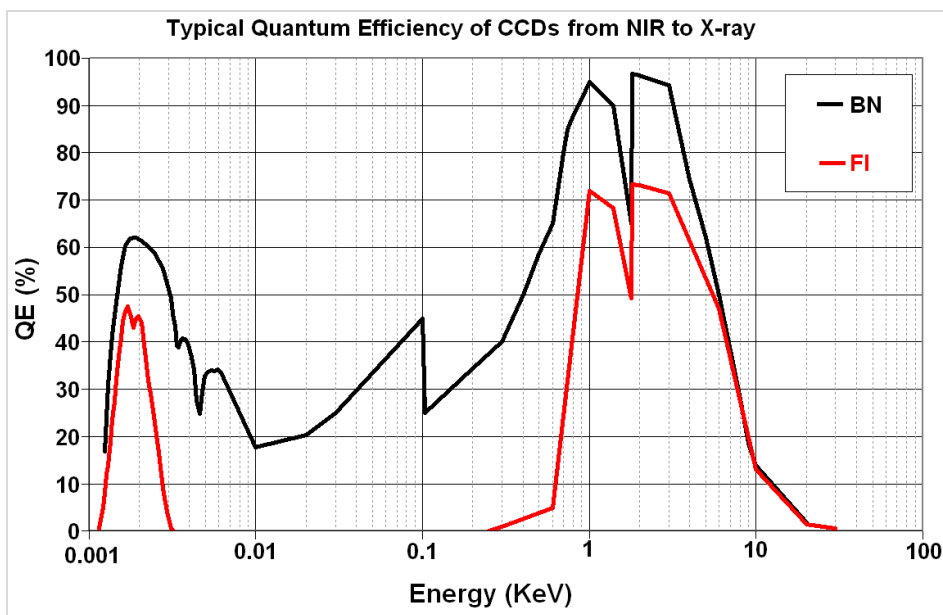
>90% QE (back-illuminated sensor), low noise readout electronics and exceptionally deep TE cooling. iKon-L 936 [DO] boasts a proprietary large area 5-stage TE cooler (4-stage optional), enabling cooling of this large area sensor down to an unprecedented -100°C without the aggravation of liquid nitrogen or compressed gas cooling, perfect for the longest of exposure times.



### Camera overview

Active Pixels* <sup>2</sup>	2048 x 2048
Pixel Size (W x H; µm)	13.5 x 13.5
Image Area (mm)	27.6 x 27.6
Active Area pixel well depth (e <sup>-</sup> , typical [min])	100,000 [60,000]
Frame Rate (frames per sec)* <sup>3</sup>	0.92
Read Noise (e <sup>-</sup> , typical [Max])	
@ 50 kHz	2.9 [4]
@ 1 MHz	6.4 [10]
@ 3 MHz	11.8 [14]
@ 5 MHz	27.4 [35]

### Quantum efficiency\*<sup>4</sup>



## Technical specifications

### System characteristics

Pixel Readout Rate (MHz)	5, 3, 1, 0.05
Linearity (% maximum) <sup>5</sup>	1
Vertical Clock Speed (µs, maximum)	38 (software selectable)
Software Selectable Sensitivity (e <sup>-</sup> per A/D count, typical)	
HS output	4.2, 2.3, 1.2
HC output	14.5, 8.0, 4.3
Dummy Pixels	50, 50, 0, 4
Digitization	16 bit (at all readout speeds)

### System Readout Noise (e<sup>-</sup>, typical [max])<sup>6</sup>

Pixel Readout Rate	High Sensitivity output	High Capacity output
0.05 MHz	2.9 [4]	9 [12]
1 MHz	6.4 [10]	23 [30]
3 MHz	11.8 [14]	42 [56]
5 MHz	27.3 [35]	65 [80]

### Minimum sensor temperatures (typical)<sup>7</sup>

	4-stage Cooler (W)	5-stage Cooler (Z)
Air cooled (ambient air at 20°C)	-70°C	-80°C
Re-circulator (XW-RECR) (ambient air @ 20°C)	-75°C	-95°C
Water-cooled (@ 10 °C, 0.75 l / min)	-80°C	-100°C

### Blemish specifications

As defined by the sensor manufacturer e2v and shown in the table below:

GRADE	1
Column defects; black or white	3
Black spots	150
Traps >200 e <sup>-</sup>	20
White spots	150

For complete description of blemish types and thresholds, please download the datasheet for the 42-40 (back illuminated, AIMO) sensor from the E2V web site:

<http://www.e2v.com/products/ccd-and-cmos-imaging-and-semiconductors/imaging-scientific-sensors/datasheets.cfm>

### Dark current (back-illuminated)<sup>8</sup>

@ -100°C for back illuminated device (typical e <sup>-</sup> /pix/sec [max])	0.00008 [0.0003]
@ -90°C for back illuminated device (typical e <sup>-</sup> /pix/sec [max])	0.00013 [0.0008]
@ -70°C for back illuminated device (typical e <sup>-</sup> /pix/sec [max])	0.001 [0.007]

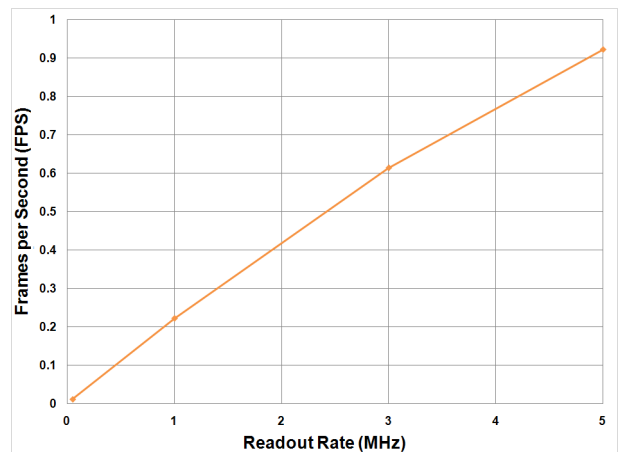
### Operating & storage conditions

Operating Temperature	0°C to 30°C ambient
Max bakeout temperature	55°C
Vacuum Compatibility	Not to exceed 1.33 x 10 <sup>-9</sup> mbar
Relative Humidity	< 70% (non-condensing)
Storage Temperature	-25°C to 55°C

### Power requirements

- 24Vdc @ 150 Watts

### Full Frame Rate<sup>9</sup>



### Maximum Frames per second<sup>10</sup>

3 MHz readout			
Binning	Full Resolution	1024 x 1024	512 x 512
1 x 1	0.614	1.17	2.137
2 x 2	1.333	2.214	3.631
4 x 4	2.386	3.608	5.379
8 x 8	3.564	5.085	7.001
16 x 16	4.585	6.326	8.215

5 MHz readout (Focusing Mode)			
Binning	Full Resolution	1024 x 1024	512 x 512
1 x 1	0.922	1.718	3.019
2 x 2	1.643	2.876	4.654
4 x 4	2.627	4.292	6.359
8 x 8	3.715	5.676	7.774
16 x 16	4.672	6.759	8.745

### Computer requirements

To handle data transfer rates of 5 MHz readout, over extended kinetic series, a powerful computer is recommended, e.g.:

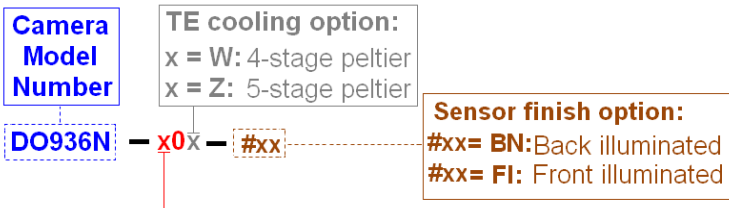
- 3 GHz Pentium (or better) + 1Gbyte RAM
- 32 MB free hard disc to install software
- USB 2.0

Need more information? Please contact us at:

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## Ordering information &amp; notes

To order the camera you require, please use the following ordering system:



x = I: Imperial 5/16 UNC threaded holes in the vacuum interface flange

x = M: Metric M8 threaded holes in the vacuum interface flange

E.g. a DO-936N-M0Z-#FI is a front illuminated iKon-L DO936 camera with Metric threaded holes, and 5-stage peltier vacuum cooling.

The 936 [DO] is supplied with the following as standard:

<b>PS-29</b>	150W Power Supply* <sup>11</sup>
<b>PS-40</b>	24V DC-driven supply for powering the complete camera

The 936 [DO] also requires one of the following software options:

<b>Andor Solis (i)</b>	A ready-to-run Windows 2000, XP and Vista-based package with rich functionality for data acquisition and processing. (64 and 32 bit OS supported)
<b>Andor SDK</b>	A DLL driver and software development kit that let you create your own applications for the Andor Camera. Available for Windows 2000, XP, Vista and Linux. (64 and 32 bit OS supported)

The following accessories are available for use with the 936 [DO]:

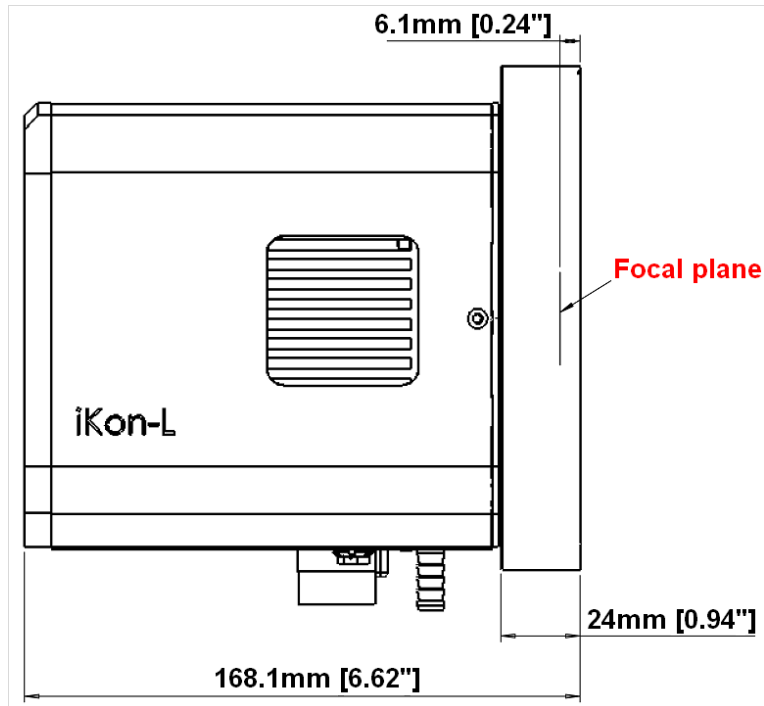
<b>XW-RECR</b>	Re-circulator for enhanced cooling performance
<b>XW-CHIL-150</b>	Chiller/re-circulator for enhanced cooling performance
<b>XU-RECR/TRANS</b>	USB 2.0 Extender kit comprising Transmitter, Receiver & Power Supplies

Specifications are subject to change without notice

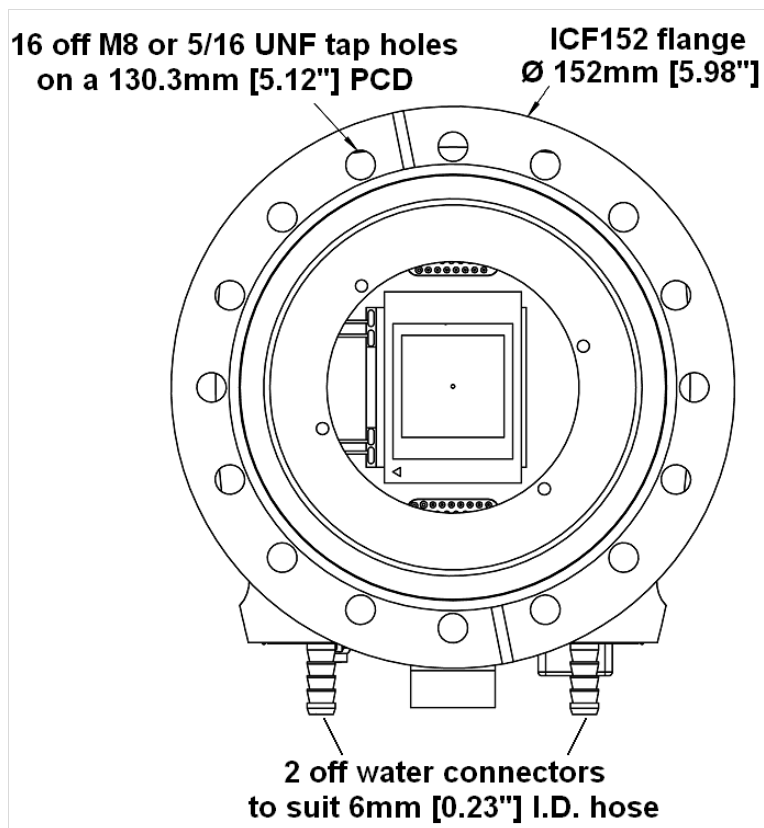
- ◆ 1 **IMPORTANT** - There are a number of points to note for the use of open front end systems:
  - Due to the fact that there is direct access to the CCD sensor when the front plate is removed, there is no warranty for the sensor
  - When the front plate is removed, appropriate precautions must be taken to prevent accidental damage to the sensor surface
  - Appropriate precautions (baffles, filters) must be taken to prevent accidental exposure of the sensor to high photon fluxes as this can permanently damage the CCD
  - Adequate precautions must be taken to prevent either condensation or contamination occurring on the sensor
- ◆ 2 Edge pixels may exhibit a partial response.
- ◆ 3 Based on a horizontal pixel readout rate of 5 MHz (focusing mode) and a vertical shift speed of 38µs.
- ◆ 4 Quantum efficiency of the CCD sensor as measured by the CCD Manufacturer (shown at room temperature)
- ◆ 5 Linearity is measured from a plot of counts vs. signal up to the saturation point of the system. Linearity is expressed as a percentage deviation from a straight line fit.
- ◆ 6 System 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 -90°C and minimum exposure time under dark conditions. Noise values will change with pre-amplifier gain (PAG) selection. Values quoted are measured with highest available PAG setting.
- ◆ 7 Cooling is provided by the use of an external, mains driven, power supply. Minimum temperatures listed are typical values. Systems are specified in terms of minimum dark current achievable rather than absolute temperature.
- ◆ 8 This value is obtained using the traditional method of measuring dark current, i.e. taking a long integration time to get a darksignal that is well above the read noise. The dark current measurement is averaged over the CCD area excluding any regions of blemishes. The values given here are for the back-illuminated sensor type. Front-illuminated sensor darkcurrent values are typically a factor of 2 lower still.
- ◆ 9 The graph shows the full frame rates possible when reading out the sensor at 5, 3, 1 and 0.05 MHz pixel readout rates, using 38µs vertical clock speed.
- ◆ 10 Shown are the frame rates at 5 MHz and 3 MHz digitization rates for a range of binning or array size combinations. All measurements are made with 38µs vertical clock speed. It also assumes internal trigger mode of operation and 'zero' exposure time.
- ◆ 11 The PS-29 power supply may be omitted from the order if the customer can provide their own nominal 24V DC power supply to feed the PS-40 Power Supply. Please contact Andor directly if you require further clarification on this.

## Dimensions

Weight: 5.3 Kg [11.68 lb]



Side view



Front face