

# 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
- ✓ 1600 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

# 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  $\mu\text{m}$  pixels, thermoelectric cooling down to  $-100^{\circ}\text{C}$  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 $-100^{\circ}\text{C}$	Negligible dark current without the inconvenience of $\text{LN}_2$
UltraVac™	Critical for sustained vacuum integrity and to maintain unequalled cooling and QE performance, year after year
16 x 16 $\mu\text{m}$ 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) – two cameras in one for best broad photon fluxes coverage
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 <sup>•1</sup>

Model number	DU970P	DU971P
Sensor options	<ul style="list-style-type: none"> <li>● BVF: Back Illuminated CCD, Vis-optimized and anti-fringing</li> <li>● FI: Front Illuminated CCD</li> <li>● UVB: Back Illuminated CCD with UV coating</li> </ul>	<ul style="list-style-type: none"> <li>● BV: Back Illuminated CCD, Vis-optimized</li> <li>● FI: Front Illuminated CCD</li> <li>● UVB: Back Illuminated CCD with UV coating</li> </ul>
Active pixels <sup>•2</sup>	1600 x 200	1600 x 400
Pixel size	16 x 16 $\mu\text{m}$	
Image area	25.6 x 3.2 mm with 100% fill factor	25.6 x 6.4 mm with 100% fill factor
Minimum temperatures <sup>•3</sup>		
Air cooled	-80°C	
Coolant recirculator	-95°C	
Coolant chiller, coolant @ 10°C, 0.75L/min	-100°C	
Max spectra per second <sup>•4</sup>	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, UVB sensors: UV-grade fused silica, 'Broadband VUV-NIR', unwedged (Various AR coatings & MgF <sub>2</sub> options available)	
Blemish specifications	Grade 1 sensor from supplier. Camera blemishes as defined by Andor Grade A <a href="http://andor.oxinst.com/learning/view/article/ccd-blemishes-and-non-uniformities">andor.oxinst.com/learning/view/article/ccd-blemishes-and-non-uniformities</a>	

## Advanced Specifications <sup>•1</sup>

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

## Applications & Techniques Guide

	BV models	BVF models	FI 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?

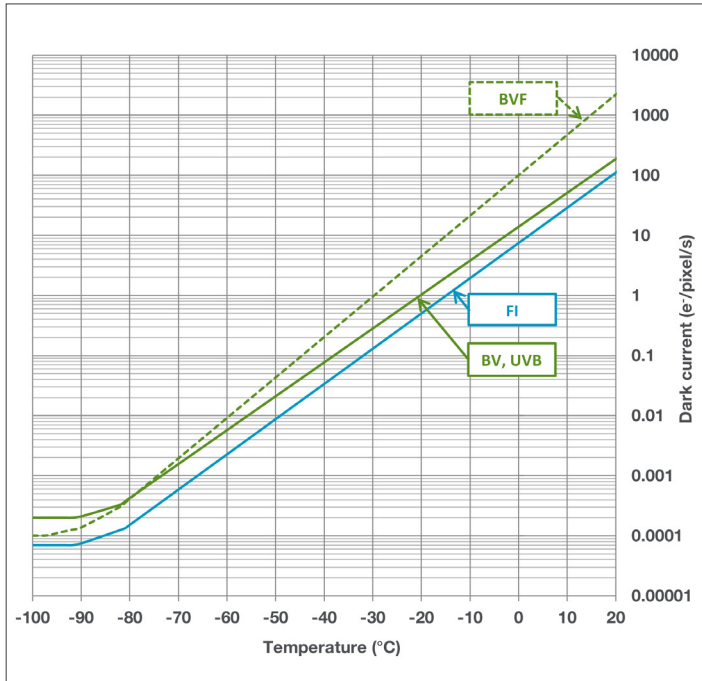
Need to work further into the NIR? The [iDus InGaAs series](#), with up to 1024 pixel linear array with transmission to 2.2  $\mu\text{m}$ .

Need high sensitivity in the NIR and/or higher dynamic range? The [Newton CCD](#) platform provide back-illuminated deep-depletion and 26  $\mu\text{m}$  pixel options

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

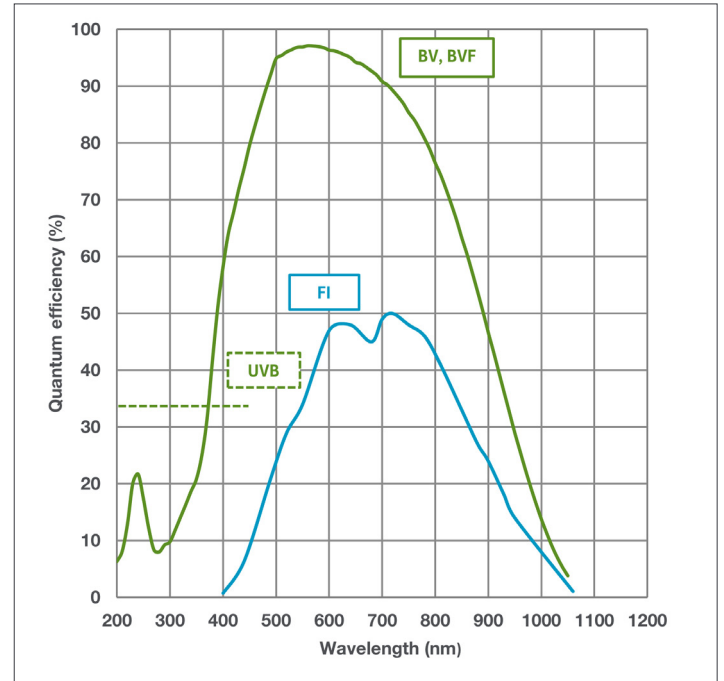
The Newton series combines seamlessly with Andor's research grade Kymera and Shamrock Czerny-Turner spectrographs.

## Dark Current <sup>9</sup>

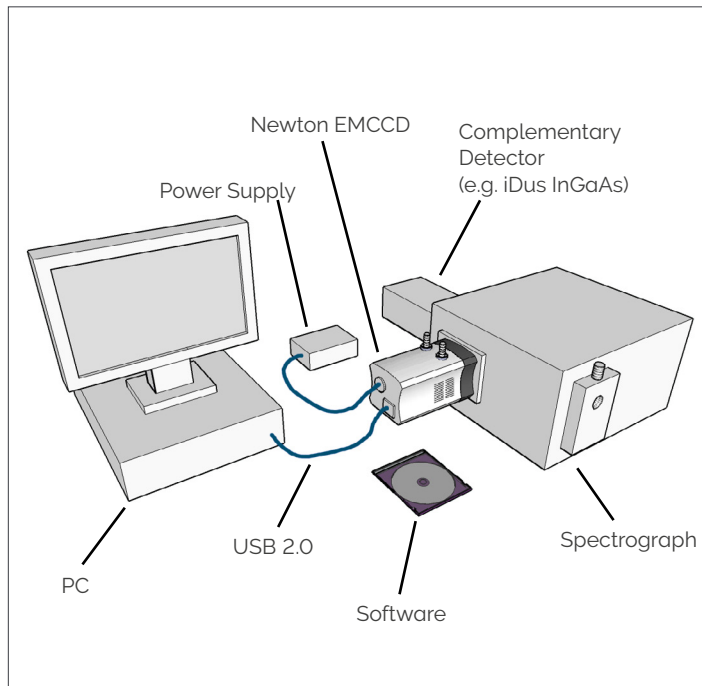


## Quantum Efficiency Curves <sup>10</sup>

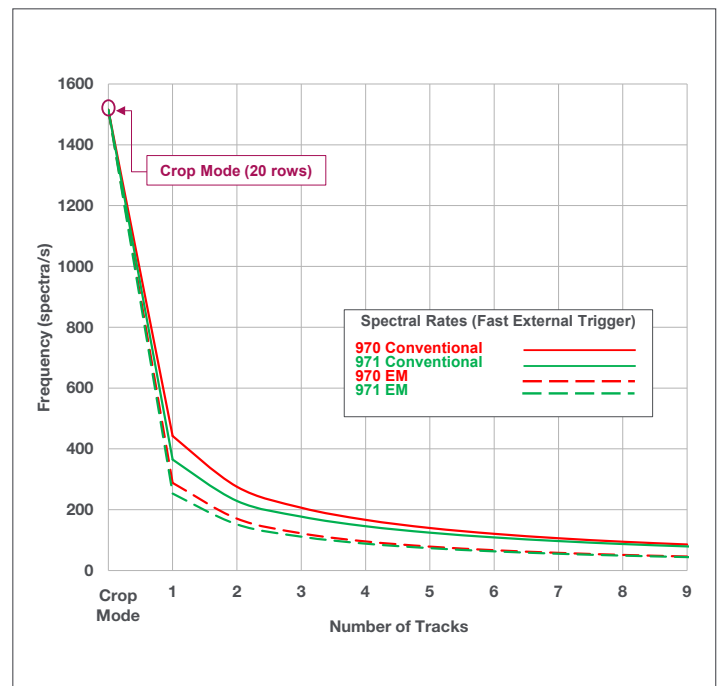
25°C



## Typical Setup



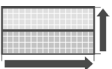
## Readout Rate & Speed <sup>11</sup>



# Creating the Optimum Product for you

DU **970** P- **BVF**  
example shown

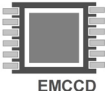
**Step 1. Choose the sensor array size**



Array Size

Description	Code
1600 x 200 array	<b>970</b>
1600 x 400 array	<b>971</b>


**Step 2. Choose the sensor type option**



EMCCD  
Sensor Type

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

**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 Tool](#). Further detailed information on windows can be found in the technical note – [How to Select a Window for your Camera](#).

**Step 4. Select the required accessories and adapters**




Accessories & Adapters

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

**Spectrograph Compatibility**  
The Newton series is fully compatible with Andor's Kymera and Shamrock spectrographs (193 - 750 nm focal lengths). Spectrograph mounting flanges and software control are available for a wide variety of 3<sup>rd</sup> 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

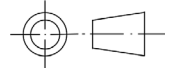
**The Newton EMCCD requires at least one of the following software options:**

**Solis for Spectroscopy A** 32-bit and fully 64-bit enabled application for Windows (8.1 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 3<sup>rd</sup> party spectrographs is also available, see list in step 4 above.

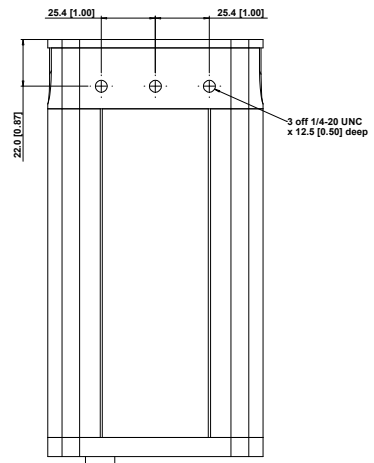
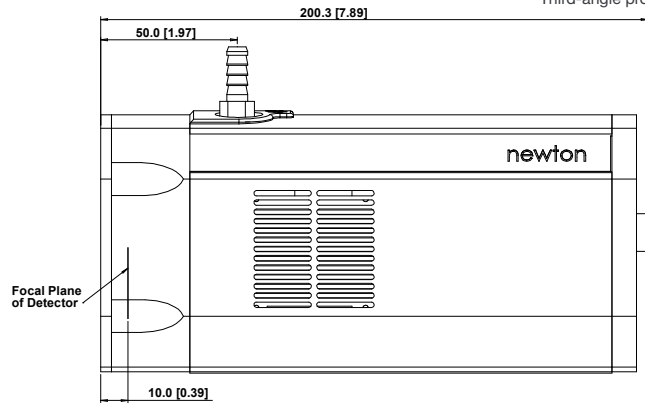
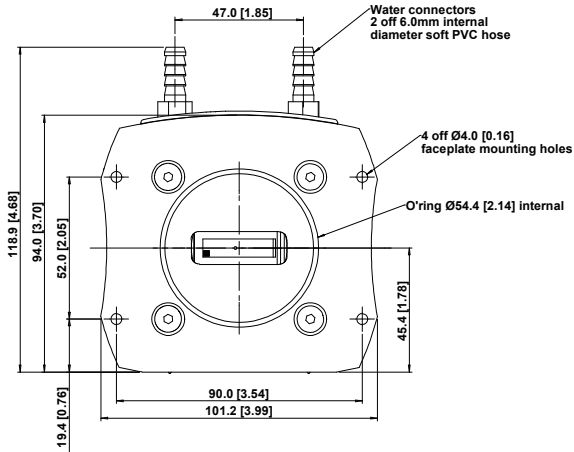
**Andor SDK** A software development kit that allows you to control the Andor range of cameras from your own application. Available as 32/ 64-bit libraries for Windows (8.1 and 10) and Linux. Compatible with C/C++, C#, Delphi, VB.NET, LabVIEW, MATLAB and Python.

# Product Drawings

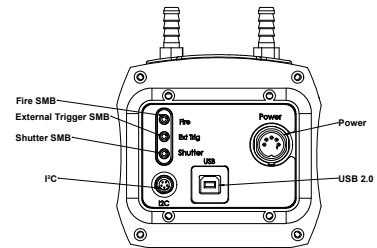
Dimensions in mm [inches]



Third-angle projection



Mounting hole locations



Rear connector panel

■ = 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)

### I<sup>2</sup>C connector

Compatible with Fischer SC102A054-130

1 = Shutter (TTL), 2 = I<sup>2</sup>C Clock, 3 = I<sup>2</sup>C Data, 4 = +5 V<sub>DC</sub>, 5 = Ground

Minimum cable clearance required at rear of camera: 100 mm

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## China

Beijing | Shanghai | Guangzhou  
Phone +86 (400) 678 0609  
Fax +86 (10) 5884 7901



### Items shipped with your camera:

- 1x 2 m BNC - SMB connection cable
- 1x 3 m 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 (8.1 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

### 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 (in conventional mode) of 4.9  $\mu$ s. Achievable spectral rates will vary with selected trigger mode.
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.
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 9.7  $\mu$ s 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.



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