ZL41 Wave sCMOS
Highly Flexible Workhorse Camera for Physical Sciences

Key Specifications
- Up to 82% QE
- < 1 e- read noise
- Up to 100 fps
- 32-bit binning mode
- Spectroscopy modes
- Operate down to -20°C ambient

Key Applications
- Large sky surveys
- Bose Einstein Condensation
- Quantum computing
- Beam profiling & Fluid dynamics
- Speckle interferometry
- Wavefront sensing
- Multi-fibre spectroscopy

andor.oxinst.com
Introducing the ZL41 Wave family

Andor’s ZL41 Wave physical sciences workhorse sCMOS camera platform delivers sheer excellence in speed, sensitivity, dynamic range and resolution, with comprehensive imaging and spectroscopy functionalities.

Building upon the strengths of the original Zyla sCMOS series, the cost-effective, multi-functional, compact, thermoelectrically cooled design of ZL41 Wave benefits from a reengineered and enhanced sensor chamber and is supported within a wide range of physical science software environments, integrating perfectly into any optical laboratory or observatory setting.

<table>
<thead>
<tr>
<th>ZL41 Wave Features Specifically for Physical Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NEW</strong> 32-bit binning mode Access huge dynamic range through extensive pixel binning. User-selectable data bit-depth up to 32-bit, transmitted upstream over the camera interface.</td>
</tr>
<tr>
<td>Spectroscopy mode On-head asymmetric pixel binning and multitrack. Spectroscopist-friendly spectra and multi-track data, prior to transfer through 10-tap or USB interface. Upstream data size reduction and easier user data processing.</td>
</tr>
<tr>
<td>Fast Spectroscopy: Up to 27,000 spectra/sec Study of transient spectral phenomena with sub-millisecond time resolution</td>
</tr>
<tr>
<td>PIV capability (ZL41 Wave 5.5) Perfect for fluid dynamics. Global Shutter mode of ZL41 Wave 5.5 facilitating image pair acquisition with an inter-frame gap of down to 100 ns.</td>
</tr>
<tr>
<td><strong>NEW</strong> Operate down to -20°C ambient temp Ideal for use at observatories under cold conditions.</td>
</tr>
<tr>
<td>Liquid/Water cooling (optional) Access -10°C cooling (at any altitude) for reduced darkcurrent. Also recommended for extremely vibration-sensitive set-ups.</td>
</tr>
<tr>
<td>ZERO etaloning in the NIR Front-illuminated sensor architecture. no unwanted signal modulation in the NIR compared to back-illuminated devices.</td>
</tr>
<tr>
<td>GPU Express Simplify and optimize data transfer from the camera - ideal for today’s data intensive imaging experiments. Leverage CUDA-enabled Nvidia GPU processing to accelerate the data acquisition pipeline.</td>
</tr>
<tr>
<td>Linux, Windows, LabView and MATLAB ready Full and flexible SDK options for a wide variety of physical science laboratory and observatory uses.</td>
</tr>
<tr>
<td><strong>NEW</strong> Python ready Python wrapper integration and full supporting documentation in latest camera SDK helps integration and full control of custom-build systems.</td>
</tr>
<tr>
<td><strong>NEW</strong> ASCOM, EPICS and Tango ready Supported in open source software platforms. ASCOM astronomy instrument control standard. EPICS and Tango Lima used for hardware control at a number of particle accelerators and large scientific instruments facilities worldwide.</td>
</tr>
</tbody>
</table>

**ZL41 Wave 4.2: Superior Sensitivity**

ZL41 Wave 4.2 provides exceptional sensitivity from a combination of 82% QE and very low 0.9 e- read noise from a 4.2 Megapixel sensor. Ideal for pushing frame rates in light starved applications within astronomy, quantum imaging, quantum computing, spectroscopy and 3D-tomography fields.

**ZL41 Wave 5.5: Global Shutter and Large Field of View**

ZL41 Wave 5.5 is an ideal workhorse camera, a highly cost-effective and flexible solution that delivers a superior field of view from a 5.5 Megapixel sensor. Furthermore, this camera offers 2-in-1 rolling and true global shutter functionality. Global shutter is key to techniques such as particle imaging velocimetry (PIV), astronomical object tracking and fluid dynamics.
ZL41 Wave for Extended Dynamic Range

Andor’s ZL41 Wave bundles multiple approaches to achieving extended dynamic range imaging and spectroscopy.

Dual Amplifiers (16-bit mode)

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 complemented by enhanced on-head intelligence to deliver linearity > 99.8%, for unparalleled quantitative photometric accuracy across the full signal range.

32-bit binning mode

Many applications require pixel binning in order to (a) boost SNR via an expanded photon collection area (via the binned pixel area), and (b) further extend dynamic range through an increased pixel well depth (which scales linearly with the number of binned pixels). Vertical binning of pixels is also standard in spectroscopy mode.

The ZL41 Wave maintains dynamic range through extensive binning with a user-definable bit depth selection, which offers up to 32-bit upstream data packaging to overcome the limitation of standard 16-bit data transfer through the CameraLink or USB3 interface.

Fast stacking (accumulation) of images or spectra

The ZL41 Wave is exceptionally well suited to massively extending dynamic range through fast stacking of images or spectra. sCMOS technology is ideally suited to this approach as it is capable of very fast frame rates with an ultra-low read noise.

ZL41 Wave for Spectroscopy

ZL41 Wave is for fast spectroscopy applications, such as spectral mapping, fluorescence correlation spectroscopy or fast transient phenomena sampling, including fast chemical reaction monitoring. The multi-track spectral mode of ZL41 Wave is ideally suited to multi-fibre spectroscopy, allowing many points of a sample to be simultaneously and spectrally monitored with high data throughput. Furthermore, the high-QE front illuminated sensor structure means that ZL41 Wave can capture spectra with zero etaloning (also known as fringing) in the red/NIR, a phenomenon that can otherwise adversely affect back-illuminated sensors.

How the sCMOS sensor is used in the different modes

0.15 seconds 0.30 seconds

Dynamic Range and Effective Well Depth as a function of the number of stacked (accumulated) frames, plotted for ZL41 Wave. A Dynamic Range of 164,300:1, and a corresponding Effective Well Depth of 900,000 electrons can be reached with only 30 stacked frames. At maximum frame rate, this number of accumulated frames takes only 0.3 secs to acquire, achieving 3.3 fps. This capability is significant for a range of challenges across imaging and spectroscopic characterisations.
Key Features

Fast Frame Rate
ZL41 models read out a full frame in only 10 milliseconds, enabling 100 fps, and can measure dynamics across timescales ranging from milliseconds to tens of seconds. Ideal for measuring rapid photometric/astrometric variability and fast imaging of quantum phenomena.

High Sensitivity
The parallel readout architecture and innovative pixel design enables ZL41 Wave to drive very low read noise performance of < 1 e-, while still achieving maximum readout speed and full dynamic range. The ZL41 Wave 4.2 delivers a peak QE of 82%, with broad response across the UV-VIS-NIR range, with zero etaloning in the near infra-red.

6.5 µm Pixel
The 6.5 µm pixel sizes of ZL41 models offer a solution to more closely resolution match the camera to the specific optical configuration. Pixel binning with 32-bit digitization offers further usage flexibility.

PIV Capability
The ZL41 Wave 5.5 model is well suited to the Particle Imaging Velocimetry (PIV) technique for flow visualisation. Temporal resolution between image pairs is a key requirement of this approach and the global shutter mode of this camera can be harnessed to deliver an optical inter-frame gap of down to ~ 100 ns.

Enhanced Sensor Enclosure
Building upon the strengths of the original Zyla sCMOS camera series, ZL41 Wave benefits from an updated sensor chamber design and manufacture process, as well as a comprehensive seal test procedure, providing even greater long-term protection from condensation ingress in high humidity environments (3 year chamber warranty).

No Mechanical Shutter
Applications that involve frequent cycling of mechanical shutters, such as X-Ray Tomography or Large Sky Surveys, require routine shutter replacements and associated down time. ZL41 Wave offers on-sensor Rolling and Global electronic shutter, thus overcoming the need for mechanical shutters. This furthermore avoids the exposure gradient effects associated with of iris shutter, thus much better for accurate photometry.

Comprehensive Software Solutions
ZL41 Wave offers an extensive portfolio of software compatibility solutions, assembled with physical science users in mind. Our accessible sCMOS SDK (SDK3), with full documentation, is available with Python, LabView and MATLAB wrappers. We also offer support for open source platforms such as ASCOM, EPICS and Tango Lima.

Low Maintenance Astronomy
ZL41 Wave has been tested down to -20°C, suited for use at observatories where night observations routinely occur in sub-zero ambient conditions.
Application Focus

Large Sky Surveys

Large arrays of cost-effective, high performance ZL41 Wave cameras can be very effectively deployed to continuously and quantitatively monitor huge sections of the night sky, looking for photometric or astrometric changes or occultations across a range of time-resolutions. Whether used for Near-Earth Object (NEO) detection, Orbital Debris tracking or Exoplanet hunting, ZL41 Wave 4.2 offers highest sensitivity, facilitating detection of smaller objects or minor occultations. Alternatively, the ZL41 Wave 5.5 model offers true global shutter, which can be important in the context of tracking moving objects relative to a reference background of stars.

X-Ray or Neutron Tomography

For high throughput 3D tomography (or even 4D: 3D + time), the high-resolution ZL41 Wave models, featuring low noise, fast readout and high QE, present a superb solution. Lens/scintillator coupled tomography using ZL41 enables reconstruction of large objects without sacrificing resolution and clarity. Lack of mechanical shutter means shutter lifetime is not an issue, reducing downtime.

Quantum Imaging

ZL41 Wave can be readily integrated into optical systems for imaging ultracold quantum gases, such as Bose Einstein Condensates or even single trapped ion/atom fluorescence studies with continuous (i.e. non-burst) frame rates of more than 26,000 fps.

Hyperspectral

ZL41 Wave 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. For example, ZL41 Wave 4.2 can acquire 20 spectral tracks (each 12 pixels high) at 445 fps and can acquire a single spectrum at up to 28,041 fps.

Resolution Enhancement

Lucky/Speckle Imaging – ZL41 Wave can be used for the ‘Atmospheric Freezing’ techniques of Lucky and Speckle Imaging, enabling resolution enhancement of ground-based astronomy. The 100 fps (full array) with 100% duty cycle means that enhanced resolution images can be generated within a few seconds of acquisition.

Wavefront Sensing – ZL41 Wave is a fast wavefront sensor for Adaptive Optics, for example a 128x128 Region of Interest of ZL41 Wave 4.2 yielding 1627 fps.
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

**ZL41 Wave**
- For physical imaging, astronomy and spectroscopy
  - 3D flow field study by PIV using 4x cameras, courtesy of Gioacchino Cafiero, Università 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

**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)

**Balor sCMOS**
  - Orbital debris & asteroid tracking
  - Large sky surveys
  - Solar studies
  - Exoplanet discovery
  - Supernovae detection

**Balor-X or Marana-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

---

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 Marana 4.2B-6 platform, configured with CoaXPress interface, can deliver 135 fps from a full 4.2 Megapixel array, faster still with sub-array selection.

**Need more sensitivity?** The Marana back-illuminated sCMOS family offers up to 95% QE for maximum photon capture. 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 ‘BEX2-DD’ NIR-Enhanced options, extending sensitivity deep into the near-IR range. Ideal for exoplanet detection on dwarf stars as well as 785nm laser usages (e.g. BEC and near-IR Raman).

---

**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.

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

## Model Specific Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>ZL41 Wave 5.5</th>
<th>ZL41 Wave 4.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor type</td>
<td>Front Illuminated Scientific CMOS</td>
<td>Front Illuminated Scientific CMOS</td>
</tr>
<tr>
<td>Active pixels (W x H)</td>
<td>2560 x 2160 (5.5 Megapixel)</td>
<td>2048 x 2048 (4.2 Megapixel)</td>
</tr>
<tr>
<td>Sensor size</td>
<td>16.0 x 14.0 mm</td>
<td>13.3 x 13.3 mm</td>
</tr>
<tr>
<td></td>
<td>21.8 mm diagonal</td>
<td>18.8 mm diagonal</td>
</tr>
<tr>
<td>Pixel readout rate (MHz)</td>
<td>200 (100 MHz x 2 sensor halves)</td>
<td>216 (108 MHz x 2 sensor halves)</td>
</tr>
<tr>
<td></td>
<td>560 (280 MHz x 2 sensor halves)</td>
<td>540 (270 MHz x 2 sensor halves)</td>
</tr>
<tr>
<td>Read noise (e-) Median [rms]</td>
<td>@ 200 MHz</td>
<td>@ 216 MHz</td>
</tr>
<tr>
<td></td>
<td>Rolling Shutter</td>
<td>Global Shutter</td>
</tr>
<tr>
<td></td>
<td>0.9[1.2]</td>
<td>2.3[2.5]</td>
</tr>
<tr>
<td></td>
<td>1.1[1.6]</td>
<td>2.4[2.6]</td>
</tr>
<tr>
<td>Maximum Quantum Efficiency</td>
<td>64%</td>
<td>82%</td>
</tr>
<tr>
<td>Sensor Operating Temperature</td>
<td>0ºC to 30ºC ambient</td>
<td>0ºC to 27ºC ambient</td>
</tr>
<tr>
<td>Air cooled</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Liquid/water cooled</td>
<td>0.019</td>
<td>0.019</td>
</tr>
<tr>
<td>Readout modes</td>
<td>Rolling Shutter and True Global Shutter (Snapshot)</td>
<td>Rolling Shutter and Global Clear</td>
</tr>
<tr>
<td>Maximum dynamic range</td>
<td>33.000:1</td>
<td>33.000:1</td>
</tr>
<tr>
<td>Photons Response Non-Uniformity (PRNU)</td>
<td>Half-light range</td>
<td>&lt; 0.01%</td>
</tr>
<tr>
<td></td>
<td>Low light range</td>
<td>&lt; 0.1%</td>
</tr>
<tr>
<td>User defined ROI (granularity)</td>
<td>Yes (1 pixel) **</td>
<td>Yes (1 pixel) **</td>
</tr>
<tr>
<td>Data range</td>
<td>12-bit (fastest USB 3.0 speeds) and 16-bit (maximum dynamic range)</td>
<td></td>
</tr>
<tr>
<td>Interface options</td>
<td>USB 3.0* or Camera Link</td>
<td></td>
</tr>
</tbody>
</table>

* 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 and USB 3.0 models

## General Specifications

- Pixel size (W x H): 6.5 µm
- Pixel well depth (e-): 30,000
- Linearity (% maximum)*
  - Full light range: Better than 99.8%
  - Low light range (< 1000 electrons signal): 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**: Start exposure - End exposure (row 1), Start exposure - End exposure (row n)
- Hardware timestamp accuracy: 25 ms
- Internal memory: 1 GB

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### Quantum Efficiency (QE) Curve

The Quantum Efficiency (QE) curve is shown for ZL41 Wave 4.2.

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**Notes:**
- * 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 and USB 3.0 models
Creating The Optimum Product for You

Step 1. Select the camera type

<table>
<thead>
<tr>
<th>Camera Type</th>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZL41 Wave 4.2, 4.2 Megapixel, Rolling shutter, 53 fps, USB 3.0</td>
<td>ACM-4.2P-USB3-S</td>
<td></td>
</tr>
<tr>
<td>ZL41 Wave 4.4, 4.4 Megapixel, Rolling shutter, 100 fps, Camera Link</td>
<td>ZYLA-4.4P-CL10-S</td>
<td></td>
</tr>
<tr>
<td>ZL41 Wave 5.5, 5.5 Megapixel, Rolling and Global shutter, 40 fps, USB 3.0</td>
<td>ZL41-5.5-USB3-S</td>
<td></td>
</tr>
<tr>
<td>ZL41 Wave 5.5, 5.5 Megapixel, Rolling and Global shutter, 100 fps, Camera Link</td>
<td>ZL41-5.5-CL10-S</td>
<td></td>
</tr>
</tbody>
</table>

For liquid cooled variant, insert ‘-W’ in front of the ‘-S’. For example ZYLA-4.2P-USB-W-S
Please note this option provides liquid/water cooling instead of fan cooling, not both.

Step 2. Select the required accessories

<table>
<thead>
<tr>
<th>Description</th>
<th>Order Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-mount adapter</td>
<td>ACM-05574</td>
</tr>
<tr>
<td>Re-circulator for enhanced cooling performance</td>
<td>XW-RECR</td>
</tr>
<tr>
<td>Oasis 160 Ultra compact chiller unit</td>
<td>ACC-XW-CHL-160</td>
</tr>
<tr>
<td>3 meter 7-way Multi I/O timing cable, offering Fire, External Trigger, Shutter and Arm.</td>
<td>ACC-ACZ-05612</td>
</tr>
<tr>
<td>5 meter cable for use with Avion frame grabber for Camera Link 10-tap models. (2 cables required)</td>
<td>ACC-ASE-13532</td>
</tr>
<tr>
<td>30 meter fibre-optic extender solution for Camera Link 10-tap models.</td>
<td>ACC-ZYLFOX-10TAP-30M</td>
</tr>
<tr>
<td>100 meter fibre-optic extender solution for Camera Link 10-tap models.</td>
<td>ACC-ZYLFOX-10TAP-100</td>
</tr>
<tr>
<td>15 meter active USB 3.0 connector cable (power supply not required). For use with ZL41 USB 3.0 models.</td>
<td>ACC-ASE-06887</td>
</tr>
<tr>
<td>50 meter fibre optic USB 3.0 extender solution including power supply. For use with ZL41 USB 3.0 models.</td>
<td>ACC-ASE-08762</td>
</tr>
<tr>
<td>100 meter fibre optic USB 3.0 extender solution including power supply. For use with ZL41 USB 3.0 models.</td>
<td>ACC-ASE-07860</td>
</tr>
</tbody>
</table>

Step 3. Select the required software

<table>
<thead>
<tr>
<th>Software</th>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solis Imaging</td>
<td>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.</td>
<td>ZL41-4.2P-USB3-S</td>
</tr>
<tr>
<td>Andor SDK3</td>
<td>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.</td>
<td>ZL41-5.5-CL10-S</td>
</tr>
<tr>
<td>Third Party Software</td>
<td>Drivers are available so that the ZL41 Wave can be operated through a wide range of third party imaging packages. ZL41 Wave maintains compatibility with the previous Zyla family. See our third party software matrix for more information.</td>
<td>ZL41-5.5-CL10-S</td>
</tr>
</tbody>
</table>

Product Drawings

Dimensions in mm [inches]

Weight: 1 kg [2 lbs 3 oz]

Product drawings of the water cooled ZL41 Wave can be found here.

Connecting to the ZL41 Wave

Camera Control
Connector type: 3 meter Camera Link 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)
Order Today

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Fax +44 (28) 9031 0792

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

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

Items shipped with your camera
For Camera Link 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 User guide in electronic format
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
- PCI Express x4 or greater for USB 3.0 models
- PCI Express x8 or greater for Camera Link

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 as supplied by the manufacturer.
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, in accord with EMVA 1288 standard.
6. Software Exposure Events provide rapid software notification (SDK only) of the start and end of acquisition, useful for light synchronization to moving peripheral devices e.g. Z-stage.
7. ‘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 ZL41 Wave 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.
8. ZL41 Wave 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. ZL41 Wave USB 3.0 models also ship 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 or to ensure maximum speed.
9. The maximum frames/s table for ZL41 Wave 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. 12-bit single amplifier Sustained frame rates are dependent on write speed of the hard disc and other overheads of the acquisition software and hardware devices.

Operating and Storage Conditions
- Operating Temperature:
  - ZL41 Wave 5.5: -20ºC to 30ºC ambient
  - ZL41 Wave 4.2: -20ºC to 27ºC ambient
- Relative Humidity: < 70% (non-condensing)
- Storage Temperature: -20ºC to 50ºC

Power 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: 12 V @ 5 A Max, 12 V @ 2.5 A Nominal

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