Meet BLAZE™
The Next Generation of Spectroscopy Cameras

For close to four decades, Princeton Instruments has produced iconic cameras, spectrometers, and software — advanced scientific tools utilized daily by leading researchers and Nobel laureates around the world. Now we’re pleased to introduce BLAZE spectroscopy CCD cameras.

Thanks to revolutionary new sensors with up to 3x higher NIR sensitivity and low dark current, there are no better cameras than BLAZE for demanding applications. BLAZE gives you blazing spectral rates up to thousands of spectra per second. For low-light applications, BLAZE delivers TRUE -100°C cooling for ultra-low dark current, ideal for long exposures. We believe no other scientific low-light spectroscopy camera can match BLAZE’s performance and ease of use.

With BLAZE, spectroscopy will never be the same!

Applications include: Raman Spectroscopy, Photoluminescence, Nanoparticle Research, Carbon Nanotube Studies, Pump-Probe Experiments, Fluorescence, Micro-spectroscopy

BLAZE is sensitive. Two proprietary new sensors offer BLAZE users unrivaled performance for spectroscopy applications.

HR-Sensors offer higher quantum efficiency in the NIR than any other spectroscopic devices. They are perfect for Raman spectroscopy and photoluminescence applications.

LD-Sensors, meanwhile, are back-illuminated, deep-depletion devices designed to minimize dark current. These CCDs are ideal for the long exposures required by low-light applications.

BLAZE is fast. ADC readout speeds 10-15x higher than previous cameras allow BLAZE to capture spectral data at unparalleled spectral rates. With full vertical binning, these exceptional cameras can operate at spectral rates greater than 1 kHz. Even higher spectral rates are achievable with custom binning or kinetics operations.

Additionally, unique bi-directional clocking enables BLAZE users to utilize the camera’s new SeNsR™ operating mode for low-light applications. This exclusive technology is described in more detail on page 3.

BLAZE is cool. No other camera comes close to the thermolectric cooling capabilities of BLAZE. BLAZE incorporates state-of-the-art ArcTec™ cooling technology, capable of operation down to TRUE -100°C. Other manufacturers claim deep cooling, but BLAZE is the only camera that achieves -95°C cooling in air and TRUE -100°C with 20°C liquid. This deep cooling ability allows BLAZE to operate with extremely low dark current, ideal for long-exposure requirements. Unlike competitive cameras, BLAZE only requires the use of (near room temperature) 20°C liquid to achieve -100°C, so you don’t have to worry about any damaging condensation.

**Princeton Instruments’ new, low-noise BLAZE™ CCD cameras are the most advanced high-sensitivity, ultra-fast, deep-cooled spectroscopic detectors available.**
Key Camera Features:

- Two proprietary new sensors: HR-Sensors and LD-Sensors
- HR-Sensors: unmatched NIR quantum efficiency (up to 75% @ 1000 nm)
- LD-Sensors: inverted-mode, deep-depletion sensors with low dark current for excellent broadband performance and improved NIR response
- Exclusive new SeNsR technology allows rapid control and charge shifting on the sensor to enhance pump-probe experiments and increase signal-to-noise performance of the system.
- High speed: spectral rates greater than 1 kHz full vertical binning
- ADC readout speeds 10-15x higher than conventional spectroscopy CCD cameras
- Exclusive ArcTec technology cools the sensor to -95°C in air (without chillers or cryocoolers). Cools to TRUE -100°C (with 20°C liquid assist). Absolutely no condensation.
- Cooling design features all-metal seals backed by a permanent vacuum guarantee.
- A high-speed USB 3.0 data interface with an optional fiberoptic connection supports remote operation.
- BLAZE is compatible with Princeton Instruments IsoPlane®, SpectraPro®, and SpectraPro HRS spectrographs.
- BLAZE is fully supported by 64-bit Princeton Instruments LightField® software.

Advanced new SeNsR technology

Thanks to its unique bi-directional clocking ability, BLAZE offers a new SeNsR operating mode for low-light applications. With SeNsR, it is now possible to rapidly shift the charge (i.e., signal) on the CCD without reading out the data.

1. Using a fiber or mask, the center rows of pixels are exposed, leaving the rest of the CCD dark. Spectral data is collected for **Sample (S1)**, which is then shifted up on the CCD and held in position without reading out the data.

2. A second exposure is then taken as **Reference (R1)** and then the Sample and Reference “signals” are shifted down on the CCD.

3. **Sample (S1)** is re-exposed and shifted up.

4. **Reference (R1)** is re-exposed and the process is repeated, alternating sample-reference exposures – S1, R1, S2, R2, S3, R3, Sn, Rn, etc. – until the desired accumulations are achieved.

5. Sample spectral data is accumulated as S1+S2+S3+Sn while reference data is accumulated as R1+R2+R3+Rn. Accumulated sample and reference data is then read out for processing.
Exclusive New Sensor Technologies

Two revolutionary new sensors were developed for BLAZE, making it the ideal spectroscopy camera. HR-Sensors are super-deep-depletion devices that offer the highest NIR quantum efficiency of any spectroscopic CCD. LD-Sensors are deep-depletion devices designed for extremely low dark current, allowing long exposures in demanding spectroscopic applications.

Proprietary new HR-Sensors

This new generation of sensors provides the highest NIR performance of any spectroscopic CCDs available.

HR-Sensors feature a thick depletion region of high-resistivity bulk silicon to deliver up to 75% quantum efficiency at 1000 nm, making them especially desirable for light detection in the wavelength region between traditional CCDs’ and InGaAs detectors’ sensitivity ranges (i.e., typically 800 to 1100 nm).

Spatial resolution is optimized by applying a bias voltage, resulting in a “fully depleted” silicon region with no diffusion of charge. The bias voltage generates an electric field that pushes the charge toward the correct pixels and does not allow charge to migrate to adjacent pixels.

Proprietary new LD-Sensors

Deep-depletion CCDs were developed to enhance quantum efficiency at NIR wavelengths by increasing the silicon depletion region to about 4 times the thickness of standard back-illuminated CCDs.

LD-Sensors are a new generation of advanced deep-depletion devices that run in inverted mode, resulting in very low dark current with excellent broadband performance and improved NIR quantum efficiency.
Exceptional Sensor Quantum Efficiency

Graph shows typical QE data measured at +25°C. QE decreases at normal operating temperatures. For the best results for your application, please discuss the specific parameters of your experiment with your sales representative.
BLAZE cameras utilize proprietary ArcTec technology, the most advanced cooling design available for spectroscopic CCDs. **TRUE -100°C cooling** of a CCD without liquid nitrogen requires extensive knowledge of thermodynamics, computational fluid dynamics, and ultra-high vacuum (UHV) environments. ArcTec includes custom-designed Peltier devices, advanced multi-stage thermoelectric cooling, and permanent all-metal UHV seals to achieve unprecedented CCD cooling.

Never sweat it.

BLAZE cameras cool CCDs down to -95°C in air without chillers or liquid assist and can achieve TRUE -100°C cooling using near room temperature (i.e., 20°C) liquid assist. By contrast, competitive cameras claim -100°C operation; however, this requires 10°C chilled liquid and creates the very real possibility of harmful condensation forming inside the cameras that can ultimately compromise the ability to cool their sensors. The colder CCD temperatures achieved by BLAZE cameras result in lower dark current, allowing longer exposure times and superior low-light detection capabilities.

**BLAZE cooling summary:**

- Multi-stage thermoelectric cooling with custom-designed Peltier devices for unprecedented cooling capabilities
- Permanent all-metal UHV seals for reliable long-term operation
- Ability to operate at -95°C without chillers or liquid assist
- Ability to reach -100°C with 20°C liquid assist

**Liquid assist**
(required for maximum cooling)

<table>
<thead>
<tr>
<th>Dark current (e-/pixel/second)</th>
<th>0.0005</th>
<th>0.0006</th>
<th>0.008</th>
<th>0.003</th>
<th>0.00056</th>
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<tbody>
<tr>
<td>20°C</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>5</td>
<td>NA</td>
</tr>
<tr>
<td>10°C</td>
<td>10</td>
<td>5</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

*Competitive cameras require an extremely dry environment (≤43% relative humidity) to achieve their coldest operating temperatures! Otherwise their cooling capability is limited.*
### Specifications

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Active area (L x W, pixels)</td>
<td>1340 x 100</td>
<td>1340 x 400</td>
</tr>
<tr>
<td>Pixel size</td>
<td>20 x 20 µm</td>
<td>20 x 20 µm</td>
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<tr>
<td>Image area</td>
<td>26.8 mm x 2.0 mm</td>
<td>26.8 mm x 8.0 mm</td>
</tr>
<tr>
<td>Minimum operating temperatures</td>
<td>Air cooled, no liquid assist</td>
<td>-95ºC</td>
</tr>
<tr>
<td>Thermostatic precision</td>
<td>±/− 0.05ºC</td>
<td>4, 8, 10, 20 μs/row (software selectable)</td>
</tr>
<tr>
<td>Vertical clock speeds</td>
<td>4, 8, 10, 20 μs/row (software selectable)</td>
<td>4, 8, 10, 20 μs/row (software selectable)</td>
</tr>
<tr>
<td>Maximum spectra per second*</td>
<td>Full Vertical Binning: 1,650 Cropped Mode, 10 rows: 3,500 Kinetics Mode, 1 row: up to 215 kHz</td>
<td>Full Vertical Binning: 412 Cropped Mode, 10 rows: 3,500 Kinetics Mode, 1 row: up to 215 kHz</td>
</tr>
<tr>
<td>Full frame rate*</td>
<td>218</td>
<td>54</td>
</tr>
<tr>
<td>Dark current (typical @ max. cooling)</td>
<td>0.0015 e-/pix/sec</td>
<td>0.0005 e-/pix/sec</td>
</tr>
<tr>
<td>ADC speeds</td>
<td>Low Noise: 2 x 100 kHz, 2 x 1 MHz, 2 x 4 MHz High Speed: 2 x 5 MHz, 2 x 10 MHz, 2 x 16 MHz</td>
<td>Low Noise: 2 x 100 kHz, 2 x 1 MHz, 2 x 5 MHz High Speed: 2 x 6.25 MHz, 2 x 8.33 MHz, 2 x 10 MHz</td>
</tr>
<tr>
<td>System read noise</td>
<td>≤3 e- @ 100 kHz ≤10 e- @ 1 MHz</td>
<td>≤2.5 e- @ 100 kHz ≤8 e- @ 1 MHz</td>
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<tr>
<td>Readout modes</td>
<td>Full Frame, Cropped, Bi-Directional, Kinetics</td>
<td></td>
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<tr>
<td>Full well capacity</td>
<td>128 ke-</td>
<td>180 ke-</td>
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<tr>
<td>Linearity</td>
<td>≥99%</td>
<td></td>
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<tr>
<td>Digitization</td>
<td>16 bits</td>
<td></td>
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<tr>
<td>Data interface</td>
<td>USB 3.0</td>
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<tr>
<td>Certification</td>
<td>CE, UL/CSA, FCC Part 15, VCCI (Japan), BSMI (Taiwan), KN32 &amp; KN35 (Korea), AS/NZS (Australia, New Zealand)</td>
<td></td>
</tr>
<tr>
<td>I/O signals</td>
<td>Trigger In, TTL Out, Readout Monitor, Expose Monitor, Shutter Monitor, External Shutter Control</td>
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</table>

* 4 μs vertical clock speed; HR-Sensor cameras: 2 x 16 MHz; LD-Sensor cameras: 2 x 10 MHz

#### Readout rates

<table>
<thead>
<tr>
<th>Spectral rates</th>
<th>2 ports</th>
<th>Frame rates</th>
<th>2 ports</th>
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<tbody>
<tr>
<td>16 MHz</td>
<td>1,650</td>
<td>16 MHz</td>
<td>218</td>
</tr>
<tr>
<td>10 MHz</td>
<td>1,260</td>
<td>10 MHz</td>
<td>140</td>
</tr>
<tr>
<td>5 MHz</td>
<td>1,095</td>
<td>5 MHz</td>
<td>70</td>
</tr>
<tr>
<td>4 MHz</td>
<td>990</td>
<td>4 MHz</td>
<td>57</td>
</tr>
<tr>
<td>1 MHz</td>
<td>680</td>
<td>1 MHz</td>
<td>14.8</td>
</tr>
<tr>
<td>100 kHz</td>
<td>133</td>
<td>100 kHz</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Specifications are typical and subject to change without notice.
LightField Software

The combination of LightField, BLAZE, and Princeton Instruments spectrographs provides researchers with the most advanced and reliable toolset for experimental setup, data acquisition, and post processing of spectroscopic data.

► Powerful 64-bit software package with Microsoft® Windows® 10 support
► Complete control of Princeton Instruments cameras and spectrometers
► Dependable data integrity via automatic saving to disk, time stamping, and retention of both raw and corrected data
► Seamless integration of new SeNsR technology for lock-in and pump-probe experiments
► Seamless integration with ResXtreme™ spectral deconvolution add-ins for SpectraPro HRS spectrographs
► For multi-user facilities, LightField can remember each user’s experimental configuration
► LightField Math allows simple to complex math functions to be applied to live or stored data, along with an easy-to-use editor to create your own formulas
► Integrated LabVIEW® (National Instruments) and MATLAB® (MathWorks) support
► Exports to your favorite file formats, including TIFF, FITS, ASCII, AVI, IGOR, and Origin
► Live data processing operations provide real-time evaluation of incoming data to optimize experimental parameters
Vacuum Window AR Coatings (optional)

Notes:

- Standard anti-reflection (AR) coating options are shown on graph.
- Designed by Acton Optics, our BBAR coating offers unmatched performance for range from 400 nm to 1100 nm.
- Custom wedge window options and other AR coatings are also available.

Contact your local sales representative for more information.
How To Order

Cameras

How To Order

Cameras

Model Numbers:
BLAZE 100HR
BLAZE 400HR

BLAZE 100BR LD
BLAZE 400BR LD

Options

Unichrome: enhanced UV response for BLAZE cameras
Vacuum Window Coatings: anti-reflection coatings for BLAZE cameras (see page 9)
CoolCUBE II: for liquid-cooled operation of BLAZE cameras
LightField: powerful 64-bit software for imaging and spectroscopy (see page 8)

Other Spectroscopy Products
Princeton Instruments offers a broad range of state-of-the-art spectrographs and cameras for spectroscopy.

Spectrographs:
IsoPlane: award-winning imaging spectrographs
SpectraPro HRS Series: new multi-port spectrographs
LS-785: f/2 lens spectrograph
FERGIE™: complete, compact, and easy-to-use spectroscopy system

Cameras:
PIXIS: best-selling CCD cameras
PyLoN®: LN-cooled, low-dark-current cameras
PyLoN-IR: linear InGaAs arrays
ProEM®: EMCCD cameras
PI-MAX®4: fastest ICCD cameras
NIRvana®: 2D InGaAs cameras
KURO™: back-illuminated sCMOS cameras

Need help?
Send a message to info@princetoninstruments.com and a friendly Princeton Instruments representative will be in touch with you shortly.
Contact your local Princeton Instruments representative for additional information.

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