



STANFORD PHOTONICS, INC.

ELECTRONIC IMAGING TECHNOLOGIES

XR/MEGA-10Z^{zero}™

ZERO EFFECTIVE READ NOISE/DARK COUNTS
COOLED PHOTOCATHODE ICCD CAMERA



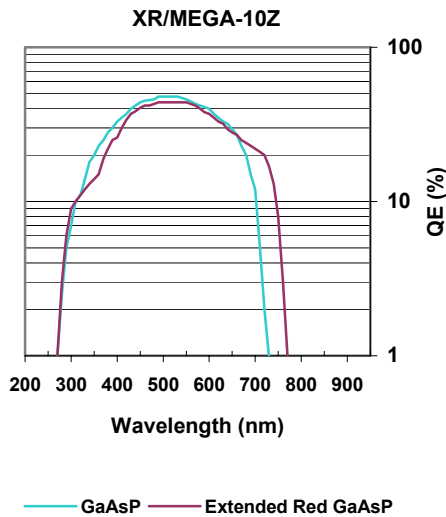
- **True photon limited imaging: Dark counts virtually eliminated by photocathode cooling**
- **CCD cooling for integrations up to 60 sec.**
- **High Quantum Efficiency: 40-50% Typical**
- **Dual MCP: Light gains of up to 2 million**
- **Video rates and faster for dynamic event capture**
- **10 bit, mega-pixel resolution**
- **Exclusive ABF™/Automatic Bright Field technology**

The **XR/MEGA-10Z™** ICCD camera platform is a breakthrough product that pushes low light imaging and detection to new limits of performance. Stanford Photonics has combined the high QE and low intrinsic dark current characteristics of GaAsP intensifier technology with Peltier cooling for what amounts to virtually zero dark current/dark counts for video rate sampling. 1-2 counts per frame at 30 frames per second (FPS) and far less than one count per frame, on average, at 120 FPS is typical. Because of the high gain afforded by a dual MCP amplifying stage, single photon events can be digitized and visualized far above the read out noise level of the CCD that converts the intensified image to an electronic 2-D image. As a result, the read noise is also a non-factor, non-contributor to the experimental result. The XR/MEGA-10Z™ is the first imaging product in the commercial marketplace to demonstrate *effective* read noise and dark count levels of zero. Another benefit of the dual MCP structure is a dramatic reduction of ion feedback noise, or what is sometimes referred to as "scintillation" noise, in a high gain image. Even at gains of 500K to 1000K, ion feedback is almost non-existent and the image is characterized by the photon statistics and not the spurious noise that is common to single MCP intensifiers when used at maximum gain. Added features of the XR/MEGA-10Z™ are Peltier cooling of the CCD (for extended exposures/time lapse applications) and the exclusive ABF™ (Automatic Bright Field) feature that instantaneously adjusts photocathode gate time and intensifier gain to compensate for up to seven decades of light level change, allowing hands-off surveys of samples with a large variance in brightness and bright field imaging without the need for a second camera. The XR/MEGA-10Z™ is patent pending.

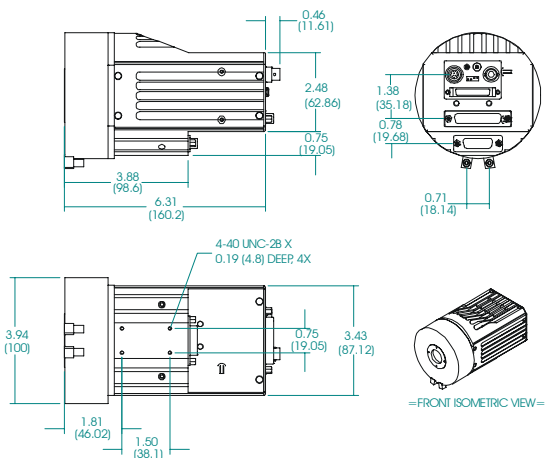
CAMERA MODELS	FEATURES/ BENEFITS
<p>XR/MEGA-10Z™: General purpose/multi-user; Highest resolution</p> <ul style="list-style-type: none"> • 1.4K by 1K full resolution, 15 FPS • 640 by 480 (binned 2X2), 30 FPS • 1.4K by 104 V (binned 4X) for 40% height, 120 FPS and • RS-170 high resolution (1.4K by 488 interlaced) • RS-170 windowed, 2X zoom (640 by 480 interlaced) <p>XR/MEGA-10Z™ S30: Highest Speed</p> <ul style="list-style-type: none"> • 1K by 1K, 30 FPS • 512 by 512 (binned 2X2), 60 FPS • 256 by 256 (binned 4X4), 90 FPS • 1.4K by 180 V (binned 4X) for 70% height, 120 FPS <p>BOTH MODELS:</p> <ul style="list-style-type: none"> • 10 bit, LVDS PCI or Camera Link® interface for maximum transfer speeds • On chip integration via computer or external control • Gating power supply with auto bright field (ABF™) or external control • Remote, hand held controller for gain and mode control: <ul style="list-style-type: none"> • Compact, illuminated read-out of camera and intensifier set up parameters • Remote switching/ selection/setting of gains and modes. 	<p>GaAsP (Gallium Arsenide Phosphide)</p> <ul style="list-style-type: none"> • Highest Quantum Efficiency tube available for the near UV and visible spectrum. • Lowest intrinsic dark current <p>DUAL MICROCHANNEL PLATE (MCP) GAIN STAGE</p> <ul style="list-style-type: none"> • Gains of up to 1M, typical • Reduced ion feedback noise relative to single stage image intensifiers <p>PHOTOCATHODE SOLID STATE COOLING</p> <ul style="list-style-type: none"> • No fans; vibration free • Dark current reduction to 1-2 counts per frame at 30 frames per second (FPS) • Creates ideal detector for single molecule imaging <p>CCD COOLING TO -20°C</p> <ul style="list-style-type: none"> • Extended on-chip integration for exposures of up to 60 sec. • Perfect for time lapse exposures and low flux luminescence <p>SIMULTANEOUS ANALOG AND DIGITAL OUTPUTS</p> <ul style="list-style-type: none"> • RS-170 display and recording (XR/MEGA-10Z™) or multisync display (XR/MEGA-10Z™ S-30) • High Speed Camera Link® or LVDS digital bus and interface for highest image speeds and storage rates, universal connectivity to large selection of image capture boards <p>SINGLE STEP FIBER OPTIC BONDING</p> <ul style="list-style-type: none"> • Optimized design and process derived from extensive experience in military and night vision arena. 10-15% improvement relative to standard methods <p>EXCLUSIVE ABF™ EXPOSURE CONTROL</p> <ul style="list-style-type: none"> • In-camera electronics automatically control intensifier gate speed (shutter) and gain on a frame by frame basis for seven decades of light level compensation • Use for survey mode, bright field/fluorescence interweaving • Protects image intensifier tube from inadvertent high light exposure • Easy override to fixed/manual gain operation for quantitative measurements

XR/MEGA-10Z™ ICCD Camera and System Specifications

SPECTRAL RESPONSE CURVES



CAMERA DIMENSIONS: in.(mm)



CAMERA CONTROLLER



INTENSIFIER OPTIONS:

GaAsP and Extended Red GaAsP

Both versions of the intensifier tubes used in the XR/MEGA-10Z™ are dual MCP devices with typical maximum gains of 1,000,000 and reduced ion feedback generation. The extended red GaAsP may have slightly higher EBI on average, but still provides for low single digit dark count levels at video speeds. The 750 nm long wavelength cutoff of the red tube makes it ideal for applications with emissions near and above 700 nm.

Parameter	GaAsP	Extended Red GaAsP
Spectral Response (min. and max. wavelengths for 10% QE and higher)	300nm to 700nm	300nm to 750nm
Equivalent Background Input (EBI) X10 ⁻¹¹ lum/cm ²	0.001 Max./0.00025 typical at -20°C	
Dark Counts	1-2 detected per frame at -20°C, 30 FPS	
Resolution (limiting)	45 lp/mm minimum, 50 lp/mm typical	
Phosphor and decay time to 10% ¹	P43, 2 ms	
Max. Gain	1,000,000 typical	
Single photon signal level at Max. Gain	10-20: 1 ratio above CCD black level/zero	
Min. Gate Width (internal via ABF™)	100 ns	
Min. Gate Width (External/Optional) ²	5 ns	

Notes:

- (1) The decay time of P43 decreases with shorter (pulsed) exposure. For example, a 250 microsecond pulsed excitation and/or a photocathode gate time of 250 microseconds reduces the decay time to 1 ms. Higher temporal resolution within each frame can be derived by using a pulsed or gated exposure.
- (2) Both intensifier tube types can be externally gated to 5 ns. Contact the main office for information regarding gating and gate control options.

CCD SENSOR AND READOUT ELECTRONICS

Both cameras use the Sony XX285 scientific grade image sensor, which has a full frame pixel count of 1380 by 1024K. Pixels are 6.47 microns square. The addition of a 1.6:1 fiber optic taper between the CCD and image intensifier output creates an effective pixel sized of 10.35 microns at the input image plane. For this pixel size the resolution limit is close to 50 line pairs per millimeter. Because the intensifier tube will have a typical resolution of 45-50 lp/mm, it will define the limiting system resolution. For example, at 40 lp/mm (close to the limit), the effective pixel size at the image plane is 12.5 microns. At 100X, this reduces to a 125 nm square pixel when referenced back to the object/sample plane.

Type	XR/MEGA-10Z™	XR/MEGA-10Z™ S30
Active Pixels (readout)	1380 x 1024	1024 X 1024
Baseline frame rate	15 FPS, Full frame	30 FPS, Full frame
Effective Pixel Size (including taper mag.)	10.35 microns	10.35 microns
Single Pixel Well Capacity	18,000 electrons	18,000 electrons
Pixel Clock (unbinned, native)	27 Mhz	45 Mhz
Read out noise (CCD)	10 electrons rms	15 electrons rms
Active Image Area	14.23 mm H by 10.6 mm V	10.6 mm H by 10.6 mm V

MODES AND SPEEDS

Unbinned full frame	1.4 by 1K, 15 FPS	1K by 1K, 30 FPS
2 by 2 binning, full	640 by 480, 30 FPS	512 by 512, 60 FPS
4 by 4 binning, full		256 by 256, 90 FPS
1 by 4 binning, centered	1.4 by 108 (40% V height), 120 FPS	1K by 180 (70% V height), 120FPS
Analog video	1.4K by 488 RS-170 and 640 by 480 RS-170, 2X Zoom	Analog progressive scan output; all modes

CAMERA

Digital outputs	10 bit LVDS or Camera Link®
Video Gain (Manual Remote)	Unity to 10X
External Controls	Free run or Async.; Mode select; Integrate on chip
Thread Mount	C-mount, 18mm image format
Weight	4 lbs. /1.8 kg
Power	12VDC @ 400 mA

SYSTEM

Because of the RS-170 outputs available with the XR/MEGA-10Z™, this model can be operated in a stand-alone mode with direct video display and video recording devices. Images may also be captured into a computer using analog (typically 640 by 480 by 8 bits) frame grabbers. Both the XR/MEGA-10Z™ and XR/MEGA-10Z-S30™ can be input as 10 bit digital images into a PC or Mac® using a number of Camera Link® or PCI LVDS capture cards and software systems. Contact main office for more information regarding high performance software and acquisition via Camera Link®. Each camera is shipped with:

- 12 VDC power supply; wall mount
- Computer interface cable (capture card and software specific)
- Hand held controller and 2 meter interconnect cable
- Power supply (15W) and interconnect cable for Peltier cooling elements
- Closed system recirculating chiller (18°C water/IPA) for Peltier heat dump

Note: Specifications are typical and subject to change without notice. All sales are subject to export control under the International Traffic in Arms Treaty.