



XR/TURBO-EXTM

ICCD CAMERAS FOR IMAGING AT THE **EXtreme**



- Photon limited fluorescence and luminescence
- High Quantum Efficiency: 40-50% typical
- Single and dual MCP's: gains of 20K-2Million
- Very fast: 90 or 120 FPS base ; 640 by 480 pixels
- Full-function imaging via Piper ControlTM software
- "Z" option: zero effective read noise/darks counts

The XR/TURBO-EXTM ICCD camera platform provides the highest resolution and sensitivity options available to scientists looking to image at the limits of detection **AND** at capture speeds well beyond 30 frames per second. The use of advanced design GaAsP intensifier tube technology yields high quantum efficiency imaging extending from 300 nm into the near IR. The XR/TURBO-EX uses a 640 by 480 pixel fast clocking CCD fiber-optic coupled to the intensifier with selectable magnification ratios; unbinned pixel sizes ranging in size from 10 to 20 microns at the image plane. Proprietary single step fiber optic bonding assures maximum system resolution and contrast. The Stanford Photonics XRTM cameras are the only products on the market with the exclusive ABFTM (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 for hands-off surveys of samples with large variances in brightness and bright field imaging without the need for a second camera. The XR/TURBO-EX products are Mac[®] and PC compatible and are supported by a number of high-end image capture and analysis systems. Optimized speed and flexibility in viewing, acquisition, control, storage and retrieval of data can be realized via Stanford Photonics' proprietary Piper ControlTM RAID -based image streaming software. For the ultimate in single photon detection for fluorescence or luminescence, the TURBO may be configured with our cooled cathode dual MCP: 25 darks counts per second per frame at -20 C.

CAMERA MODELS

XR/TURBO-EXTM: LVDS output for Mac and PC platforms

- 640 by 480 pixels, 90 FPS
- 320 by 240 full frame (pixels binned 2X2), 400 FPS
- 96 by 76 full frame (binned 6X), 1000 FPS
- 640 by 480 pixels, 60 FPS for direct analog display via multi-sync monitor

XR/TURBO-120EX: Highest Speed, unbinned pixels

- 640 by 480 pixels, 120 FPS
- 640 by 200 pixels (approx. 1/2 ht.), 260 FPS
- 640 by 105 pixels (approx. 1/4 ht.), 400 FPS
- SLIT scan, 640 by 30 pixels vertical, 1000 FPS
- Pixel size in all modes: 10, 15, or 20 microns (nominal, based on fiber optic taper ratio)

BOTH MODELS:

- 10 bit digital output (12 bit custom request)
- On chip integration via computer or external control
- Gating power supply with auto (ABFTM) or external control
- Remote, hand held controller for gain and mode control:
 - Compact, illuminated read-out of camera and intensifier set up parameters
 - Remote switching/ selection/ setting of gains and modes.

FEATURES/ BENEFITS

GaAsP (Gallium Arsenide Phosphide)

- Highest Quantum Efficiency tube available for the near UV and visible spectrum
- Extremely low dark count level (10-20X lower than GIII, typical): ideal for TIRF, FRET and other low background preps.
- Peak spectral response spanning 425 to 625 nm with extended red response option to 750 nm.

THIN-FILMED EXTENDED BLUE GEN III (Gallium Arsenide)

- Highest resolution and cosmetic quality
- Moderate dark level count; good QE
- Peak spectral response spanning 525 (FURA/GFP) to 850 nm (Rhodamine, CY5 and CY7, near IR).

THE -Z GaAsP: DUAL MCP, COOLED CATHODE, "ZERO" DARK COUNTS

- High speed single molecule imaging; FRET; BRET
- Fast luminescence kinetics and photon counting applications

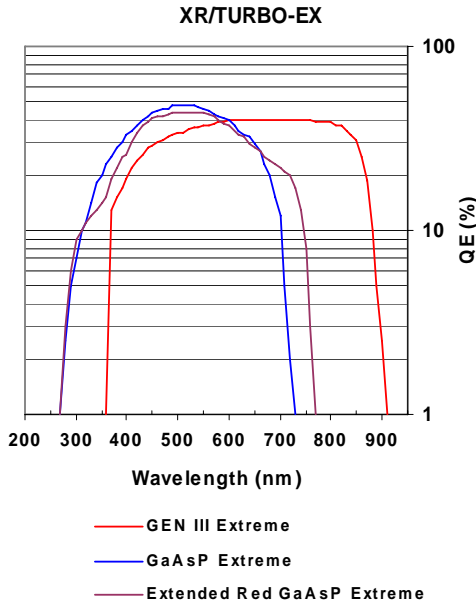
SINGLE STEP FIBER OPTIC BONDING

- Optimized design and process derived from extensive experience in military and night vision arena
- 10-15% contrast improvement relative to standard bonding methods

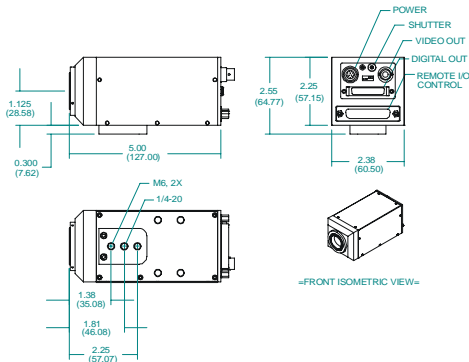
EXCLUSIVE ABFTM EXPOSURE CONTROL

- 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

SPECTRAL RESPONSE CURVES



CAMERA DIMENSIONS: in (mm)



(refer to MEGA-10Z data sheet for TURBO-Z dimensions and mechanicals)

CAMERA CONTROLLER



INTENSIFIER OPTIONS:

Unfilmed GaAsP and Thin Filmed Extended Blue Gen III

Eliminating or thinning the ion barrier film in the -EX™ designs results in 30-40% more electrons generated by the photocathode (conversion of in-coming photons to electrons) traveling into and through the amplifying stage of the intensifier to the final output image. At low light, this creates measurably higher sensitivity and signal-to-noise relative to standard Gen III and filmed technology.

| Parameter | GaAsP EXTreme | GEN III EXTreme |
|--|---------------------------|-----------------------|
| Spectral Response (min. and max. wavelengths for 10% QE and higher) | 300nm to 700nm | 370nm to 875nm |
| Equivalent Background Input (EBI) X10 ⁻¹¹ lum/cm ² | 0.2 Max., 0.05 typical | 2.5 Max., 1.0 typical |
| Dark Counts (-20 C Cathode cooling) | 25 per frame, 1 sec. exp. | TBD |
| Resolution (limiting) ¹ | 55 lp/mm (45 lp/mm dual) | 64 lp/mm |
| Phosphor and decay time to 10% ² | P43, 2 ms | P43, 2 ms |
| Max. Gain | 40,000 typical (1M dual) | 80,000 typical |
| Min. Gate Width (internal via ABF™) | 100 ns | 100 ns |
| Min. Gate Width (External/ Optional) ³ | 5 ns | 5 ns |

Notes:

- (1) The ICX414 image sensor(1:1 fiber optic), has a resolution limit of approximately 50 line pairs per millimeter. This is less than either of the tubes and defines the finest structure that can be resolved at the image plane.
- (2) 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.
- (3) 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 ICX414 scientific grade image sensor, which has a full frame pixel count of 640 by 480. Pixels are 10 microns square (nominal). The addition of a fiber optic taper between the CCD and image intensifier output creates a step up in pixel size from 10 so that a larger input aperture can be achieved at the input image plane. Stock taper sizes/step-ups provide 15 or 20 micron pixels, unbinned. For the 10 micron pixel size, the resolution limit is close to 50 line pairs per millimeter, so the CCD and not the image intensifier is the limiting resolution element. At 100X, the pixels (1:1 fiber optic) are roughly 100nm square when referenced back to the object plane.

| Type | XR/TURBO-EX™ | XR/TURBO-120EX™ |
|---|-----------------------|-----------------------|
| Active Pixels (readout) | 640 x 480 | 640 x 480 |
| Baseline frame rate | 90 FPS, Full Frame | 120 FPS, Full frame |
| Effective Pixel Size (including taper mag.) | 10/15/20 microns | 10/15/20 microns |
| Single Pixel Well Capacity | 40,000 electrons | 40,000 electrons |
| Pixel Clock | 40 MHz | 45 MHz |
| Read out noise (CCD) | 18 electrons rms | 20 electrons rms |
| Active Image Area, base | 6.4 mm by 4.8mm min | 6.4 mm by 4.8mm min |
| Min/max taper dependent | 12.8 mm by 9.6 mm max | 12.8 mm by 9.6 mm max |

MODES AND SPEEDS

| | | |
|-----------------------|---------------------------------|-------------------------------|
| Mode 1 (Full Frame) | 640 by 480, 90 FPS | 640 by 480, 120 FPS |
| Mode 2 | 320 by 240 (2 X 2 bin), 400 FPS | 640 by 200 (1/2 ht.), 260 FPS |
| Mode 3 | 96 by 76 (6 X 6 bin), 1000 FPS | 640 by 105 (1/4 ht.), 400 FPS |
| Mode 4 | 640 by 480, 60 FPS (disp. mode) | 640 by 30 (slit), 1000 FPS |
| Other modes/mix match | Consult factory | Consult factory |

CAMERA

| | |
|-------------------|---|
| Digital outputs | 10 bit LVDS or Camera Link® |
| Video Gain | Unity to 10X. Manual for VLDS. Serial/Soft for CL/120 versions. |
| External Controls | Free run or Async.; Mode select; Integrate on chip |
| Thread Mount | C-mount, 18mm image format |
| Weight | 26 oz./728 gms. |
| Power | 12VDC @ 400 mA |

SYSTEM

Both versions of the XR/Turbo-EX are fully supported by Stanford Photonics' Piper Control™ Software Platform. Piper has been designed from the ground up to provide lossless digital streaming of uncompressed images to RAM or RAID while generating frame synchronous event triggers/controls and real time display of raw or processed data. Process functions include on-chip and RAM-based frame integration, averaging, auto-scaling, image blending and fusion, ROI ratioing and others that simplify the experimental process while providing real time validation of experimental data. Please consult the factory for more information on Piper™ and other commercial software packages for these products. Cameras are shipped with the following accessories:

- 12 VDC power supply; wall mount
- Computer interface cable (capture card and software specific)
- Hand held controller and 2 meter interconnect cable

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