...SEE the Future

Princeton Instruments ACTON

PhotonMAX: 512B

The PhotonMAX: 512B from Princeton Instruments/Acton is the most advanced, no-compromise electron-multiplying CCD (EMCCD) camera on the market today. Not only is it capable of single-photon sensitivity at high frame rates, it minimizes dark current by thermoelectrically cooling a back-illuminated detector up to -80ºC without any water assistance. Furthermore, its all-metal, hermetic vacuum seals are guaranteed for the lifetime of the camera- only such guarantee in the industry. Its ultra-precise electronics are designed to deliver the most stable results for the most demanding quantitative applications. A 512 x 512-pixel, frame-transfer EMCCD and 10-MHz, 16-bit digitizer provide the performance needed to measure fast kinetics. In fact, the PhotonMAX is a true "2-in-1" imaging solution, boasting dual amplifiers that make the camera ideal for applications requiring either high speed or long exposures. The state-of-the-art camera interface offers circular buffers for real-time frame access and focus. It also offers optional fiber optic data interface for remote operation.

Applications: Single-molecule detection, spectroscopy, chemi-luminescence, astronomy, adaptive optics, hyperspectral imaging, phosphor imaging and tomography

Features	Benefits
On-chip multiplication gain	Low-noise, impact-ionization process for single-photon sensitivity
Back-illuminated CCD	>90% peak quantum efficiency offers the highest available sensitivity
Frame-transfer architecture	No need for mechanical shutter Allows 100% duty cycle imaging for particle-tracking applications
Deep cooling	Thermoelectric air cooling to -80°C minimizes dark current and allows long exposure times No need for bulky chilled-water circulators that cause condensation around the experiment optics For vibration sensitive environments, a compact room temperature liquid circulator is available as an option
Lifetime vacuum	Permanent, all-metal vacuum seals guaranteed for lifetime of the camera Maintenance-free operation
Single optical window	Vacuum window is the only optical surface between incident light and the CCD surface No losses due to multiple optical surfaces
Dual amplifiers	Individually optimized signal chains for a true 2-in-1 camera configuration Use the camera for applications that require high speed ("on-chip multiplication gain" amplifier) or long integration ("traditional" amplifier)
16-bit digitization	Wide dynamic range to capture dim and bright signals in a single image Offered at all speeds. Adjustable Analog gains to access full well capacity of the CCD.
10- and 5-MHz readout	Video rates at full-frame resolution (use ROI for hundreds of frames per second)
1-MHz readout	Slower speed of the "traditional" amplifier yields the performance of a traditional slow-scan CCD camera
Kinetics readout mode	Powerful readout mode offers microsecond time resolution between sub-frames
PCI interface **Fiber optic interface (optional)**	The best data-interface design in the industry Optional fiberoptic data interface for distances up to 300 meters, ideal for hazardous environments Compatible with Windows® 2000/XP, Linux®, and Mac OS X
Software interface	Universal interface for easy custom programming Real-time focus and image access via circular buffers Full-feature LabVIEW™ VIs available
Triggering	Built-in, multiple-trigger modes No external trigger boxes necessary Acquire images using single trigger, multiple triggers, or bulb trigger (allows control of exposure time via external TTL level)
I/O signals	Expose, readout, and shutter signals for synchronization with external devices Programmable input/output ports for complete control
C-mount	Easily attaches to microscopes, standard lenses, or optical equipment

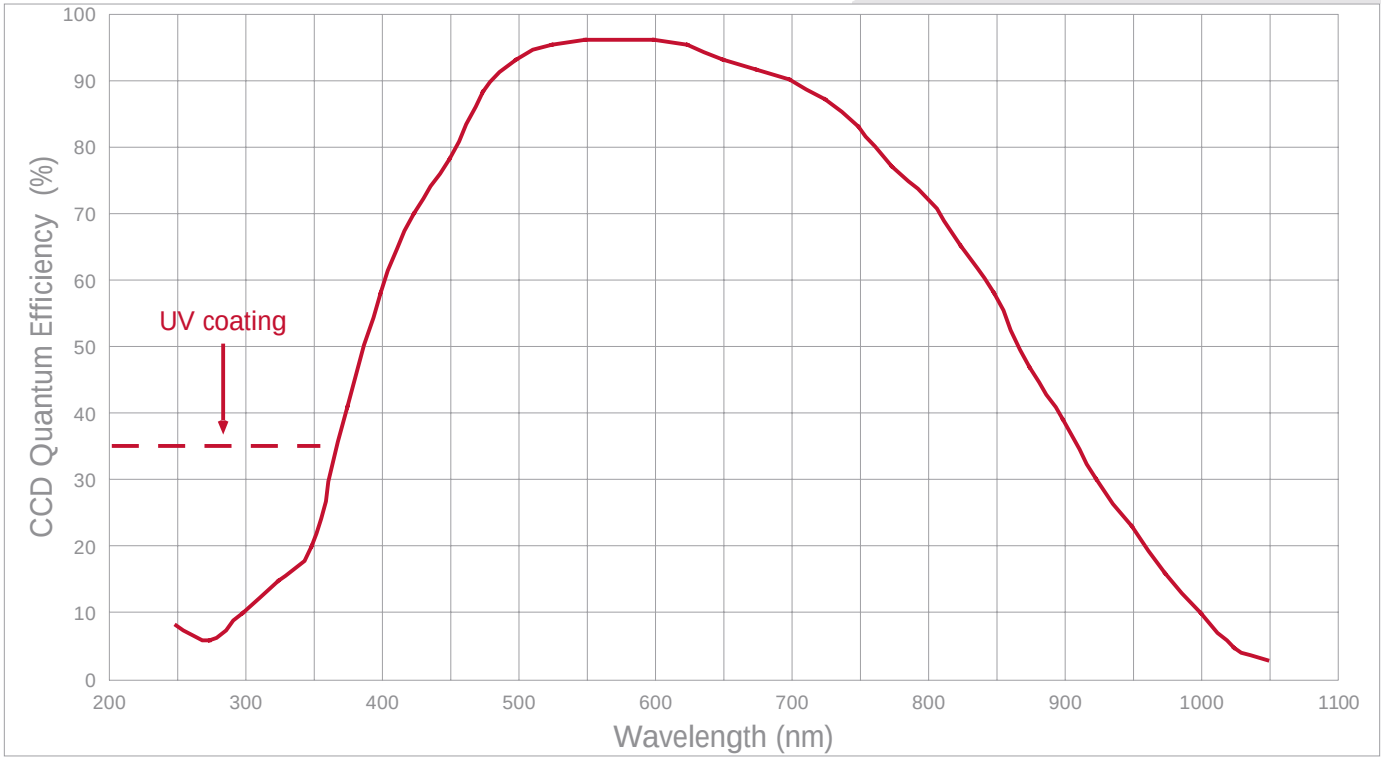
PhotonMAX: 512B Specifications

CCD image sensor	e2v CCD97; back-illuminated, frame-transfer CCD with on-chip multiplication gain	
CCD format	512 x 512 imaging pixels 16 x 16-µm pixels 8.2 x 8.2-mm imaging area (optically centered)	
	"On-chip multiplication gain" amplifier	"Traditional" amplifier
Read noise (typical)	~40 e- rms @ 5 MHz ~55 e- rms @ 10 MHz Read noise effectively reduced to <1 e- rms with on-chip multiplication gain enabled	8 e- rms @ 1 MHz 15 e- rms @ 5 MHz
Full well (typical)	800 ke-	200 ke-
Non-Linearity	<2%	<1%
Analog gain (typical)	12, 6, 3 e-/p/s	4, 2, 1 e-/p/s
Deepest cooling temperature	-70°C ±0.05°C	-80°C ± 0.05°C
Dark current@ -70°C	0.005 e-/p/sec (typical) 0.01 e-/p/sec (maximum)	
Spurious events (typical)	0.005 e-/pixel/frame clock induced events measured with 33msec exposure time and ~1000x multiplication gain	
On-chip multiplication gain	1 to 1000x Software controlled in 4,096 steps	
Digitization	16 bits @ 10 MHz, 5 MHz, and 1 MHz	
Vertical shift rate	2 µsec/row*	
Binning	Flexible binning capabilities in parallel direction; 1 through 6 binning in serial direction	
Operating environment	0 to 30°C ambient, 0 to 80% relative humidity noncondensing	

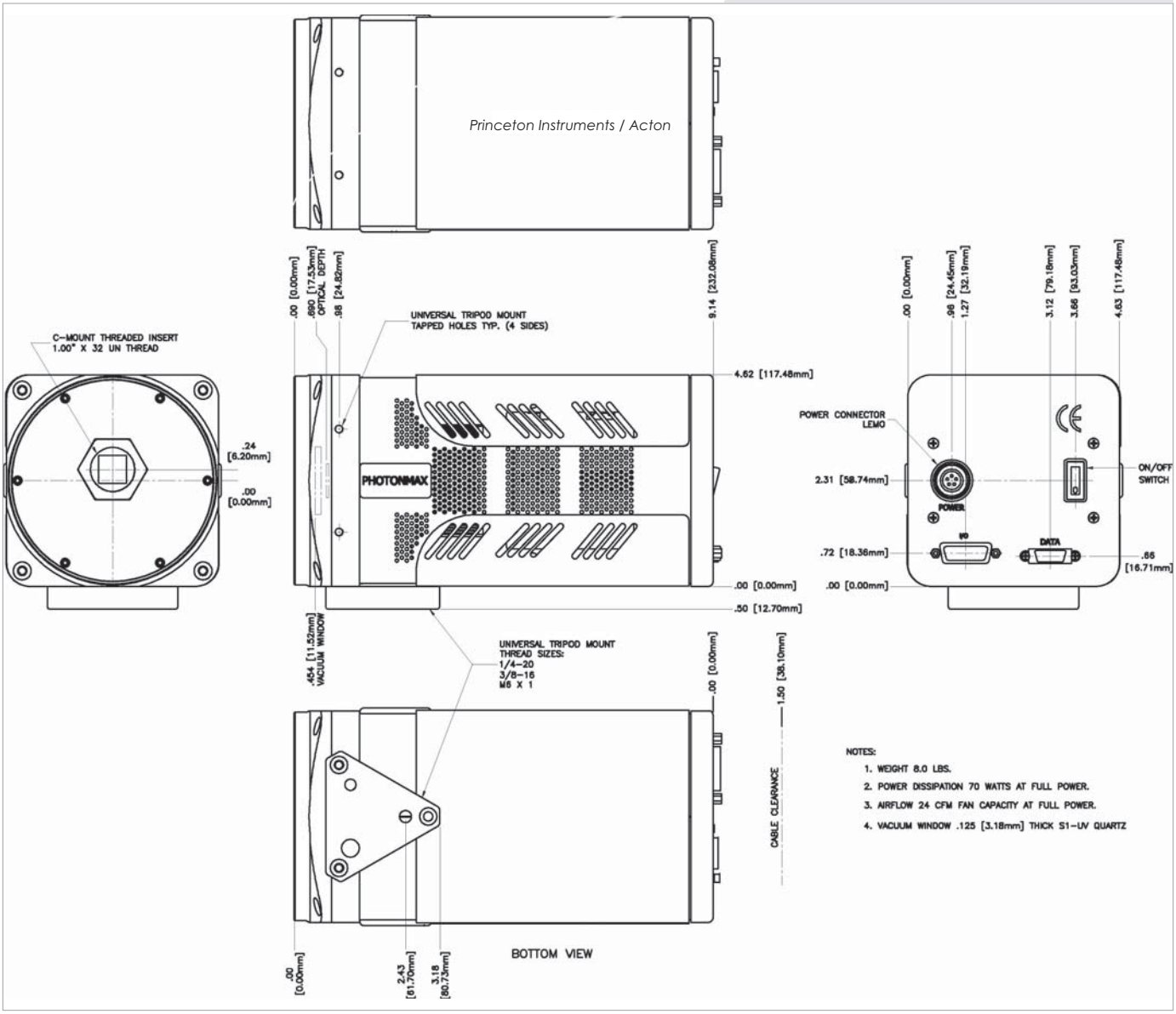
Notes: All specifications subject to change.

*All performance parameters such as full well, charge transfer efficiency, read noise and image quality are optimized at 2 usec/row. Contact factory for faster vertical speed operation. It must be noted that faster vertical shift speeds adversely affect the quantitative performance.

QE Curve



PhotonMAX Drawing



Frame Rate

Binning	Region			
	512 x 512	256 x 256	128 x 128	64 x 64
1 x 1	29	54	95	155
2 x 2	56	95	155	227
4 x 4	98	155	227	295
6 x 6	130	195	262	329

(Frames per second)

Note: Frame rates are measured at 10 MHz digitization and 2usec/row vertical shift speed

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