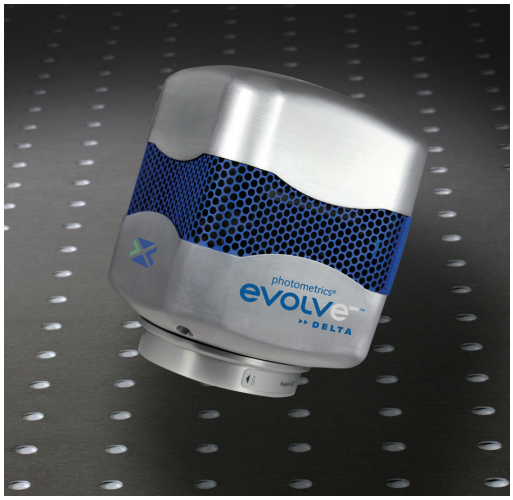


photometrics®
evolve™
DELTA

The new Evolve™ 512 Delta EMCCD Camera

Extremely sensitive, high speed imaging from 67 to >2400 fps

- Fastest acquisition rate for a 512x512 EMCCD Camera
- Lowest read noise available for a high-speed EMCCD camera
- Superb EM Gain and Bias stability enabling truly quantitative measurements
- Most accurate and fastest EM calibration technique in the industry
- Available with exclusive eXcelon™ technology
- Two year complete camera warranty
- LightSpeed™ mode for extremely high speed ROI acquisitions - New!

Primary applications:

Super-Resolution Microscopy
Single Molecule Fluorescence
Ratiometric Ion Imaging
TIRF
Spinning Disc Confocal Microscopy
Quantitative FRET

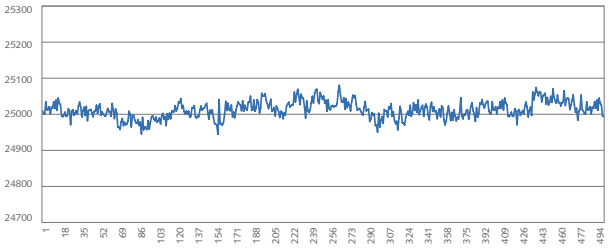
Available with Exclusive eXcelon™ Technology

Features	Benefits
Back-Thinned EMCCD Sensor	Extreme sensitivity to detect single photon signals Electron Multiplication to minimize read noise <1 electron Large pixels to maximize signal collection ability
High Speed Triggering	Precise timing with complex systems, controlling illumination, shutters and filter wheels, and other triggered devices
Multiple Read-Out Speeds	Optimize your acquisition to your experiment High speed imaging at 20MHz providing 67 frames per second, 1099 frames per second @ 16x16 pixel ROI, 4x4 binning Video Rate imaging at 10MHz
Standard CCD Imaging Mode	5MHz and .625MHz speeds available for time-lapse imaging
LightSpeed Mode	Maximize image acquisition rate for highly dynamic events Arbitrary ROIs enabled for flexibility in selecting targeted areas Simultaneous dual channel imaging at extremely high frame rates when used with the DV2™ Image a 128x128 array at 798 frames per second
Rapid-Cal™	Extremely stable EM Gain performance over the life of the camera Most accurate and precise integrated EM Calibration routine using a highly stable integrated light source Calibrates your EM gain in less than three minutes
Highly-Stabilized Cooling Performance	Ensures consistent and accurate EM Gain performance and virtually eliminates dark current generation
16-bit Digitization	Wide dynamic range allows detection of bright and dim signals in the same image
Turbo-1394™ Interface (IEEE-1394a)	Universally accepted interface that provides high-bandwidth, uninterrupted data transfer with no dropped frames Windows® 7 32/64-bit, Windows 8 32/64-bit
PVCam® Driver	Established driver supported by numerous third-party imaging software packages
Exclusive eXcelon Technology (optional)	Enhanced QE in Blue and near IR wavelengths, provides anti-etaloning in the near IR wavelengths
SMART Streaming™	Faster acquisition rates with variable exposures, ideal for multi-probed live cell imaging Select up to 12 unique exposure times
PAR Feedback System	Photometrics Active Regulation, delivers unsurpassed EM gain stability for outstanding signal fidelity
ACE Technology	Advanced Clocking Enhancement, provides lowest noise floor and minimizes generation of spurious charge and background events

Specifications			
Sensor	e2V CCD97		
Array Size	512x512		
Pixel Size	16 x 16um		
Single Pixel Full-Well	200,000e-		
EM Register Full-Well	800,000e-		
Digitization	16-bit		
Interface	IEEE 1394a (FireWire)		
Read Noise (e- rms) 20 MHz EM Port 10 MHz EM Port 5 MHz Standard Port .625 MHz Standard Port	Without EM Gain 75e- 55e- 18e- 6e-	With EM Gain <1e <1e	
Bias Stability A measurement of the camera stability when no light hits the sensor. A slope of zero would be ideal. *See footnote #1.*		≤0.001 ADU/Frame	
Linearity		>99%	
Field Uniformity The image quality of the EMCCD is assessed for gradients. A complete lack of any gradient (i.e a flat image) would provide a numerical value of 1.00 *See footnote #2.*		20 MHZ EM 10 MHZ EM 5MHz .625MHz	1.065 1.003 1.012 1.008
Stabilized Cooling Temperature		Air cooled (@ ambient air 20˚C) - Standard Liquid cooled (@ ambient air 20˚C) - Optional	-75˚C -75˚C
Dark Current		0.003 e-/pixel/sec (*See footnote #3.*)	
Background Events (20 MHz, 1000X EM gain) Standard operation		0.002 events/pixel (@ 1000X EM gain)	
Parallel Shift Rate The shift rate is optimized for maximum frame rates while providing extremely high charge transfer efficiency and minimal generation of clock-induced charge		0.248 µseconds	
Triggering Modes Hardware triggering enables synchronization between many different system components. All triggering modes are supported in overlap and non-overlap read out modes		Trigger first Strobe Bulb SMART Streaming (*See footnote #5.)*	
Charge Transfer Efficiency		As specified by CCD manufacturer's datasheet (*See footnote #6.*)	
Dark Signal Non-uniformity (DSNU)		As specified by CCD manufacturer's datasheet (*See footnote #6.*)	
Photoresponse Non-uniformity (PRNU)		As specified by CCD manufacturer's datasheet (*See footnote #6.*)	

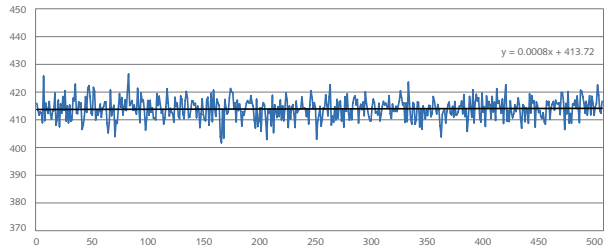
Note: Specifications are subject to change.

EM Gain Stability 20MHz @ 350X



Note: Actual data.

Bias Stability 20MHz



Note: Actual data (*See footnote #7.*)

Frame Rates

Binning	512 x 512	256 x 256	128 x 128	64 x 64	16 x 16
1 x 1	67.4	130.4	243.4	418	823.3
2 x 2	130	242.4	416.4	631	986
4 x 4	240.5	413.4	627.2	818.1	1098.7

(Frames per second)

Note: Frame rates are measured at 20 MHz with 0-second exposure times.

LightSpeed Mode Frame Rates

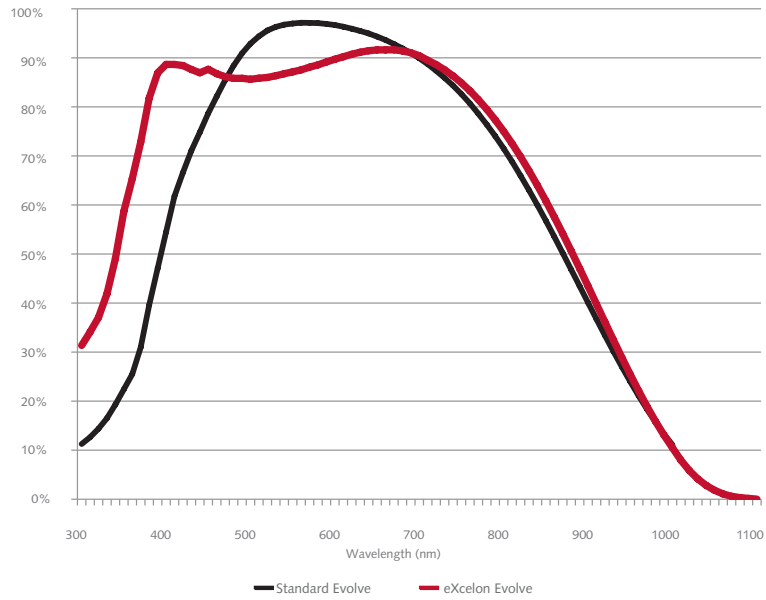
	Single Channel				Dual Channel		
Binning	256 x 256	128 x 128	64 x 64	32 x 32	256 x 128	128 x 64	64 x 32
1 x 1	226	798	1862	2837	428	1328	2500
2 x 2	425	1316	2463	3096	765	1942	2959
4 x 4	759	1927	2821	3333	1268	2545	3257

(Frames per second)

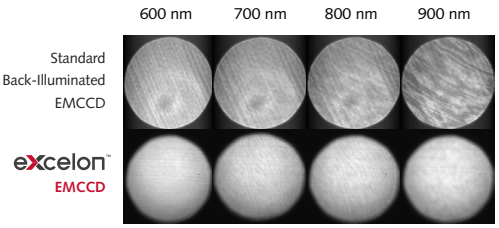
Note: Frame rates are preliminary. For the latest published frame rates visit www.photometrics.com

Exclusive eXcelon Technology (optional)

Quantum Efficiency Curve



eXcelon™

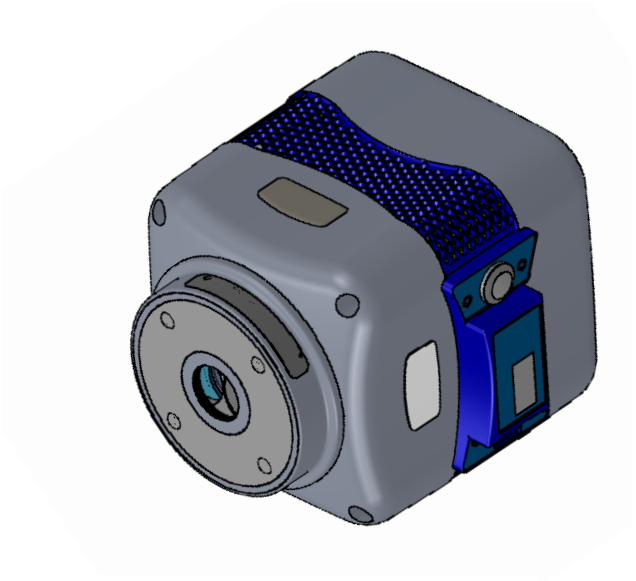


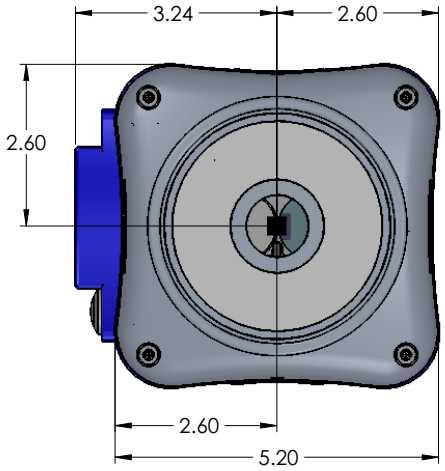
Reduced Etaloning	Up to 10 times lower etaloning in near IR wavelengths compared to standard back-illuminated sensors
Improved Sensitivity	Provides higher QE in the blue (<450nm) and near IR (>700nm)
Exclusive Technology	Available on Evolve EMCCD Cameras

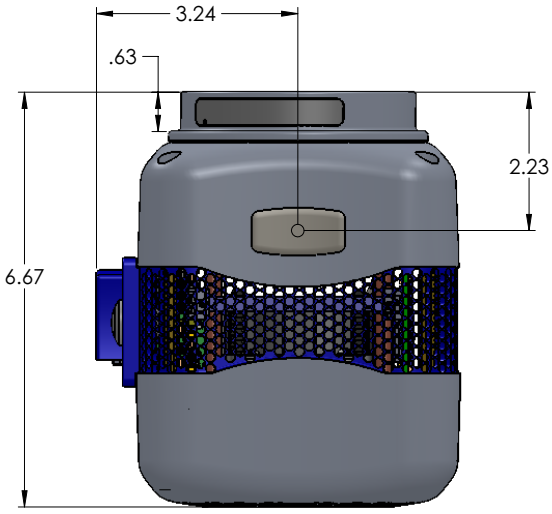
Liquid Cooled Evolve 512 EMCCD Camera (optional)

- Ideal for vibration-sensitive applications (eg. Super Resolution Imaging, Atomic Force Microscopy)
- -75°C with 20°C liquid temperature*

*Note: Use of Equipment not originally provided by Photometrics for use with Liquid Cooled Cameras will void any and all warranty coverage of the product. This is due to the specific requirements of the cooling system and camera based on the type of liquid, liquid viscosity, flow rate, among other key factors to achieve the specified performance levels.







Footnotes

#1 Bias stability – The imaging stability of the EMCCD camera can be assessed by measuring its output with no light falling on the sensor and measuring the slope of the average intensity. The slope of the average intensity value of a 200 frame sequence (where y=mx+b of the least squares fit) is measured.

#2 Field uniformity – Specification was obtained using the following formula: $\sigma(bias)/(\sigma(bias_1\text{-}bias_2)*.707) \leq 1.15$

#3 Dark current – This is measured in a traditional manner (as with all CCD cameras) by taking a long integration to obtain a signal. An average measurement is taken over the CCD area (excluding blemishes). It should be noted that dark current can vary significantly between different CCDs, and the numbers here are typical.

#4 Background events – As EMCCD cameras are actually capable of detecting single photons, the real detection limit of these cameras is set by the number of dark background events. These can arise from two things, dark current (which is thermal generation of an electron and is a temperature dependent phenomenon) and also clock induced charge (CIC) electrons (also called spurious charge). Each can lead to the generation of non-photon derived electrons which are multiplied through the electron-multiplication register, generating random high value pixels which are above the read noise.

These background events are measured by taking 16 ms exposure at 20MHz speed with 1000X EM Gain applied and counting the number of random high value pixels which are at a single event threshold above the modal value of the image histogram. This number is expressed as a probability of an event per pixel. The number can vary from frame to frame and sensor to sensor; however, a typical value is provided.

#5 Sequenced Multiple Acquisition in Real Time Streaming (SMART Streaming) provides the ability to set up to 12 different exposure times in a sequence, and then iterate through them repeatedly, allowing for extremely quick changes in exposure time for added experimental flexibility.

#6 http://www.e2v.com/products-and-services/high-performance-imaging-solutions/technical-papers/

#7 Gain stability – The actual amount of EM Gain applied on each image in a stream of images can vary depending on many electrical engineering factors.

2013 Laboratory Equipment Readers' Choice WINNER

PHOTOMETRICS
www.photometrics.com
info@photometrics.com
tel: +1 520.889.9933

