OEM

PRODUCT DATASHEET

Evolve® 512 Delta
EMCCD CAMERA

After years of engineering expertise that perfected every element of the original Evolve 512 camera, Photometrics continues to push technology boundaries. The Evolve 512 Delta OEM is the most advanced EMCCD technology in the Photometrics product portfolio, providing instrumentation builders a significantly advanced, life science imaging offering.

Designed specifically for demanding super resolution applications, the Evolve 512 Delta OEM camera delivers an unprecedented new level of speed and sensitivity. The camera is available with a revolutionary new LightSpeed mode which maximizes image acquisition rates for dynamic live cell, high-speed events by enabling frame rates of up to 3,000 frames per second (fps) The Evolve 512 Delta OEM also provides superior quantitative and detection performance, with accurate and precise triggering capability.

Camera control is provided through the standard Photometrics PVCAM API. Instrument builders have chosen to offer this camera as a high performance upgrade to their instruments based on routine PVCAM cameras.

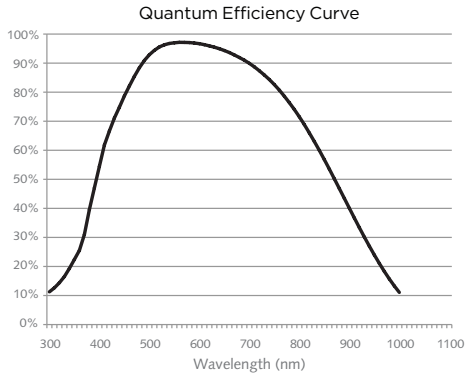
FEATURES	BENEFITS
Back-Thinned EMCCD Sensor	Extreme sensitivity to detect single photon signals Electron Multiplication to minimize read noise <1 electron Large pixels to maximize signal collection ability
High Speed Triggering	Precise timing with complex systems, controlling illumination, shutters and 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 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 DV Lambda and DV2 Image a 128x128 array at 794 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
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

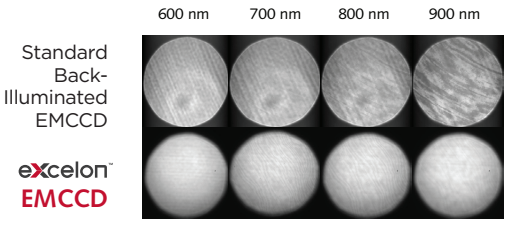
APPLICATIONS

- **Super-Resolution Microscopy**
- **Single Molecule Fluorescence**
- **Ratiometric Ion Imaging**
- **Spinning Disc Confocal Microscopy**
- **Small Animal Imaging**

eXcelon™

Exclusive eXcelon Technology (optional)





Reduced Etaloning	Up to 10 times lower etaloning in near IR wavelengths compared to standard back-illuminated sensors
Exclusive Technology	Available on Evolve EMCCD Cameras

SPECIFICATIONS

512 x 512 imaging array, 16 x 16-µm pixels	• Optimized field of view and highest sensitivity
16 bit digitization	• Wide dynamic range allows detection of bright and dim signals in the same image
Frame-transfer EMCCD	• 100% duty cycle to collect continuous data • No mechanical shutter required
C- mount	• Easily attaches to microscopes, standard lenses, or optical equipment
Turbo-1394™ interface (IEEE-1394a)	• Universally accepted interface that provides high-bandwidth, uninterrupted data transfer with no dropped frames
PVCam® Circular buffers Device sequencing	• Supported by numerous third-party software packages • Real-time focus • Precise integration with shutters, filter wheels, etc.

ADVANCED FEATURES

Quant-View™	• Maximizes quantitiave measurements by converting intensities to the number of photo-electrons measured at the sensor.
Background Event Reduction Technology™	• Improves image quality by removing spurious single-pixel events. The threshold is software controlled.

These features can be enabled/disabled through software control.

SPECIFICATIONS

Sensor	e2V CCD97	
Array Size	512x512	
Pixel Size	16 x 16µm	
Single Pixel Full-Well	185,000e-	
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- 65e- 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%
Stabilized Cooling Temperature		Air cooled (@ ambient air 20˚C) - Standard - 75˚C Liquid cooled (@ ambient air 20˚C) - Optional - 75˚C
Dark Current		0.003 e-/pixel/sec (See footnote #2)
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.		0.200 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 #4)
Charge Transfer Efficiency		As specified by CCD manufacturer's datasheet (See footnote #5)
Dark Signal Non-uniformity (DSNU)		As specified by CCD manufacturer's datasheet (See footnote #5)
Photoresponse Non-uniformity (PRNU)		As specified by CCD manufacturer's datasheet (See footnote #5)

Note: Specifications are subject to change.

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)

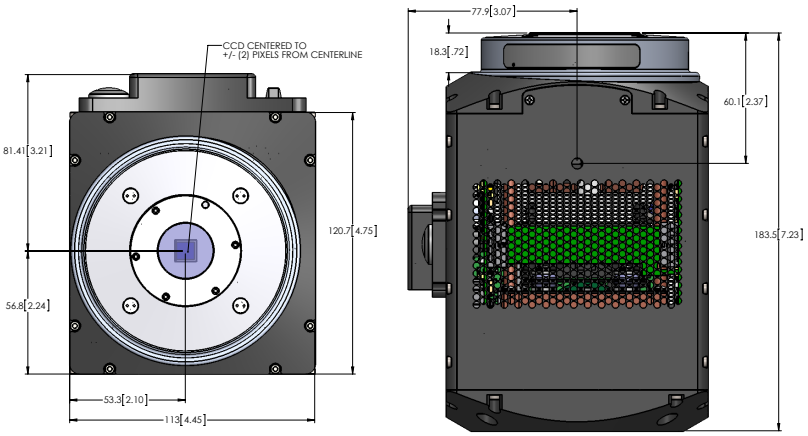
Note: Frame rates are measured at 20 MHz with 0-second exposure times.

LightSpeed Mode Frame Rates

Binning	Single Channel				Dual Channel		
	256 x 256	128 x 128	64 x 64	32 x 32	256 x 128	128 x 64	64 x 32
1 x 1	225	794	1820	2745	424	1300	2428
2 x 2	421	1291	2371	3065	755	1906	2870
4 x 4	748	1862	2787	3217	1237	2552	3118

(Frames per second)

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



#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 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.

#3 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.

#4 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.

#5 http://www.e2v-us.com/products/imaging/technical-papers/

#6 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.

Specifications in this datasheet are subject to change.

OEM

- Cameras optimized for application needs
- Flexible and customizable branding options
- Unique part number/Bill of Materials (BOM)
- Single driver platform supports a wide range of product offerings
- Strategically located global service centers
- Dedicated support from a focused OEM team

PHOTOMETRICS

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Results are typical and may vary from camera to camera.

*For more information, visit the Photometrics website at www.photometrics.com

Note: Specifications are typical and subject to change.

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