OEM

PRODUCT DATASHEET

Evolve™ 512

EMCCD CAMERA

The Photometrics Evolve 512 OEM is the ultimate deep-cooled, back-thinned EMCCD camera. Years of engineering expertise have enabled Photometrics to perfect every element of this camera. It offers builders of sophisticated, life-science instrumentation, the world's first revolutionary Advanced Feature Set. These features were specifically designed for EMCCD cameras, in a mechanical package that is more conducive for instrument mounting.

Each of the Evolve camera's advanced features can easily be enabled or disabled by the camera user via software control. This functionality enhances the quantitative nature of the camera while simultaneously allowing researchers to concentrate on acquiring image data relevant to their work.

Since the Evolve 512 camera control is provided through a standard PVCAM API, instrument builders have chosen to offer it as a high performance upgrade to their instruments based on routine PVCAM cameras.

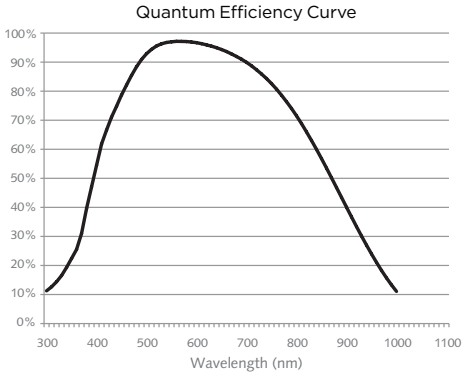
FEATURES	BENEFITS
EM gain	Very high sensitivity Low-noise, impact-ionization process
Back-illuminated EMCCD	CCD97 or CCD97-X (with eXcelon technology), highest available quantum efficiency (>90% peak QE)
Intelligent FPGA design	Precise linearization of EM gain Self-calibrating linearization ensures truly quantitative data consistently, time and again Ensures bias stability to guarantee a stable background
PAR feedback system (Photometrics Active Regulation)	Delivers unsurpassed EM gain stability for outstanding signal fidelity across 16 bits
ACE technology (Advanced Clocking Enhancement)	Pixel-clock timing resolution 12x better than other EMCCD cameras Provides lowest noise floor and minimizes generation of spurious charge and background events
10-MHz readout	Excellent for high-speed image visualization
5- and 1-MHz readout	Perfect for high-precision photometry
Dual amplifiers	Select readout mode via software for optimized (1) high-speed / high-sensitivity performance (EM) or (2) wide-dynamic-range performance (traditional CCD mode)
Exclusive eXcelon Technology (optional)	Anti-Etaloning in near IR wavelengths

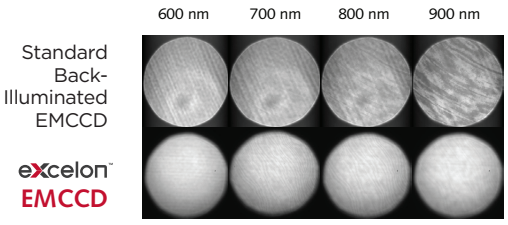
APPLICATIONS

- **Confocal Microscopy**
- **Super Resolution Microscopy**
- **Live-Cell Fluorescence Imaging**
- **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®	Allows camera to read out pixel values in terms of electrons measured, thereby enabling user to calculate actual photon flux
Electrons-per-gray-level selector	Allows user to select how many electrons will cause a single gray-level increase in the image data, thus permitting utilization of Quant-View while maintaining full dynamic range of EMCCD
Rapid-Cal®	3-minute EM calibration process is most accurate in industry; camera does not need to be detached from microscope; no special attachments required; user-initiated
Background Event Reduction Technology®	Identifies pixels that are likely to contain spurious event data and then makes corrections, if desired
Black-Lock® / Top-Lock®	Intensity-filtering tool narrows visualization to the intensity range of the image features in which the user is most interested
Vari-Bit® selectable bit depth (8-16 bits)	Improves image quality by matching digitization bit depth to actual intrascene dynamic range

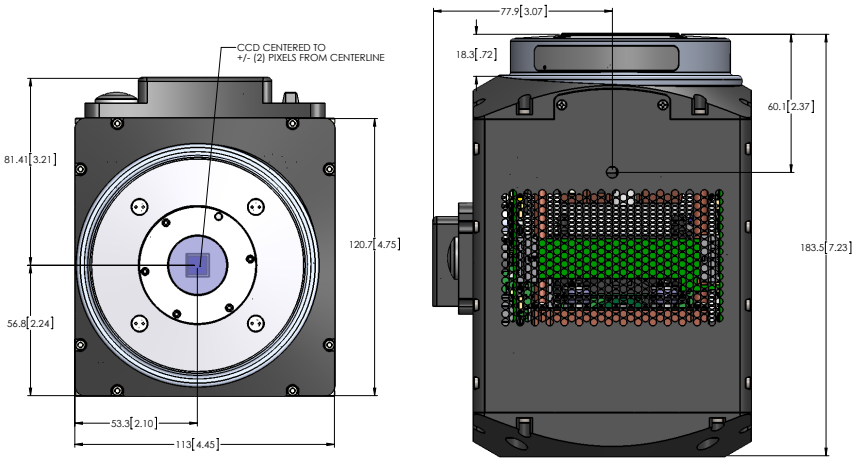
SPECIFICATIONS

Read noise (e- rms @ Gain State 3)	
10 MHz EM Port	45e-
5 MHz EM Port	32e-
5 MHz non-EM Port	12e-
1.25 MHz non-EM Port	6e-
Pixel Well Depth	
Active area	200,000e-
Gain register	800,000e-
Bias stability A measurement of the camera stability when no light hits the sensor. A slope of zero would be ideal. (See footnote #1)	≤0.0006 ADU/Frame
Gain stability A measurement of the stability of the electron multiplication applied to images. Ideal value would be 0. The stability of the EM gain applied can be quantified by measuring the slope of a sequence of images with known amount of light and EM Gain applied. (See footnote #2)	≤0.0012 ADU/Frame (@ 10MHz, 350X, Gain State 3, 20K ADU)
Baseline bias value	500ADU but can be varied
Cooling temperature	Air cooled (@ ambient air 20˚C) - Standard - 85˚C Liquid cooled (@ ambient 20˚C) - Optional - 85˚C
Dark current	0.001 e-/pixel/sec (See footnote #3)
Background events (10 MHz, 1000X EM gain) Standard operation (10 MHz, 1000X EM gain) BERT operation	 0.0045 events/pixel (@ 1000X EM gain) not detectable (See footnote #4)
Relative charge transfer efficiency Photometrics is able to measure this on each camera and optimize this parameter.	Optimized on each camera (See footnote #5)
Charge transfer efficiency	As specified by CCD manufacturer's data sheet (See footnote #6)
Dark signal non-uniformity (DSNU)	As specified by CCD manufacturer's data sheet (See footnote #6)
Photoresponse non-uniformity (PRNU)	As specified by CCD manufacturer's data sheet (See footnote #6)
Parallel shift rate	0.7 µsec. This is optimized with Charge Transfer Efficiency (CTE) and CIC. Test results demonstrate that increasing parallel shift rate further can decrease CTE and increase CIC, adversely affecting image quality and sensitivity.

Note: Specifications are subject to change.

Binning	Region			
	512 x 512	256 x 256	128 x 128	64 x 64
1 x 1	33.7	65.5	124	224
2 x 2	65.8	124.4	224	376
4 x 4	124	224	376	563
8 x 8	224	374.5	562	748

(Frames per second)



#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 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. The slope of the average intensity value of a 200 frame sequence (where y=mx+b of the least squares fit) (@ 10MHz, 350X, GS 3, 20K ADU) is measured. An ideal value would be zero.

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 30 ms exposure at 10MHz 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 Relative CTE – Photometrics employs an unpublished trade secret way of optimizing charge transfer efficiency. We have been doing this for years and are able to measure relative charge transfer efficiency and actually tune each camera in order to optimize this parameter. This ensures better optimal image performance.

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

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®

info@photometrics.com
www.photometrics.com
Telephone: +1 520.889.9933
Toll Free: +1 800.874.9789

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.

Rev A1