TELEDYNE
PRINCETON INSTRUMENTS
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Part of the Teledyne Imaging Group

ProEM®+:1600

The ProEM+: 1600 EMCCD cameras from Princeton Instruments are the most advanced spectroscopy EMCCD cameras on the market. ***The 1600 x 200 and 1600 x 400 format sensors, featuring PI's exclusive eXcelon®3 technology, provide the lowest etaloning in the NIR, and enhanced QE in blue and red.*** These cameras feature a high speed Electron Multiplying (EM) mode to capture fast kinetics as well as a normal CCD mode with very low read noise for precision photometry. The ProEM+: 1600^2/1600^4 cameras are deep cooled using either air or liquid, while the all metal, hermetic vacuum seals are warrantied for life – the only such guarantee in the industry. Both models feature the latest Gigabit Ethernet (GigE) interface to allow remote operation over a single cable without the need for custom frame grabbers.

FEATURES	BENEFITS
eXcelon3 technology	Higher QE in the UV and near IR regions; extremely low etaloning
1600 x 200 and 1600 x 400 format	16 µm pixels for high spectral resolution
Electron multiplication (EM) gain	Amplify weak signals above the read noise floor
OptiCAL	Linear, absolute EM gain calibration using built in precision light source
Improved BASE correction routine	Baseline Active Stability Engine: Bias correction ensures a flat and highly stable baseline for quantitative measurements
Deep thermoelectric cooling with air or liquid recirculation	Minimizes dark current, allowing long exposure times. Use convenient forced-air cooling or liquid cooling for vibration-sensitive environments
Single fused silica vacuum window	Minimizes reflection losses from the UV to the NIR; Optional AR coating and wedge windows are available
Dual redout modes	Individually optimized signal chains for a true 2-in-1 camera configuration, for high speed (EM mode) or long integration (normal CCD mode) applications
Readout rates of 1, 4 and 8 MHz in EM mode	Acquire spectral data at over 4000 frames per second
100 kHz readout	Low noise register provides conventional CCD readout when EM gain is not needed
Ultralow binned read noise	Negligibly increases noise, unlike in CMOS detectors
Gigabit Ethernet (GigE)	Reliable data transmission over 50 m for remote operation
Standard spectroscopy flange mount	Easily mounts to IsoPlane, Acton Series, and many other spectrometers
Optional: LightField® (for Windows 8/7, 64-bit) Or WinView/Spec (for Windows 8/7/XP, 32-bit)	Flexible software packages for data acquisition, display and analysis; LightField offers intuitive, cutting edge user interface, IntelliCal® and more.
PICAM (64-bit) / PVCAM (32-bit) software development kits (SDKs)	Compatible with Windows 8/7/XP, and Linux; Universal programming interfaces for easy custom programming.
LabVIEW® and MATLAB®	Easy integration of camera into complex experiments.
Ultra-low correlated noise	Strategic circuit design minimizes non-random noise in spectra and images

Applications:

Scanning Confocal Spectroscopy, Hyperspectral Imaging and Single Molecule Spectroscopy

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SPECIFICATIONS

	ProEM+: 1600² eXcelon3	ProEM+: 1600⁴ eXcelon3
Sensor Format	Back-illuminated EMCCD with eXcelon3 technology. 3.2 mm sensor height for high-speed data acquisition.	Back-illuminated EMCCD with eXcelon3 technology. 6.4 mm sensor height for multiple-ROI spectroscopy with fiber bundles.
CCD format	1600 X 200, 16 µm pixels 25.6 X 3.2 mm (optically centered)	1600 X 400, 16 µm pixels 25.6 X 6.4 mm (optically centered)
	EM mode	Low noise mode
Read noise*	15 e- rms @ 1 MHz 27 e- rms @ 4 MHz 75 e- rms @ 8 MHz Read noise effectively reduced to <1 e- rms with on-chip multiplication gain enabled	4 e- rms @ 100 kHz 7 e- rms @ 1 MHz
Spectrometric well capacity*	350 ke-	200 ke-
Nonlinearity	<1% (≤ 1 MHz) <2% (4 & 8 MHz)	<1% (≤ 1 MHz)
Operating temperature (@ +20° C ambient)	-60° C guaranteed (air); -75° C typical (liquid cooling with CoolCube recirculator)	
Dark current*	< 0.01 e/p/s at -60° C	
Clock-induced charge (CIC) (typical)	< 0.02 e/p/frame (2 or 3 µs vertical shift @ 8 MHz ADC)	
Electron multiplication (EM) gain	1 to 1000x, controlled in linear, absolute steps	
Digitization	16 bits	
Vertical shift rate	**1600²**: 2 or 3 µs/row (optimized for EM); 4 or 6 µs/row (optimized for LN) **1600⁴**: 3 or 4 µs/row (optimized for EM); 5 or 6 µs/row (optimized for LN)	
Spectral rate @ 8 MHz	**1600²** Full Vertical Bin: 1150 fps | Custom chip 20 rows binned: 2150 fps **1600⁴** Full Vertical Bin : 600 fps | Custom chip 20 rows binned: 2050 fps Single row: 4500 fp	
Binning	Flexible binning in vertical, and 2x to 32x in horizontal	
Operating systems supported	Windows 8/7 (64-bit) and Linux (64-bit), Windows 8/7/XP (32-bit)	
I/O signals	Exposure, Readout, Trigger In, Trigger Out, Waiting for Trigger	
Operating environment	+5 to +30° C ambient, non-condensing atmosphere	
Data interface	Gigabet Ethernet (GigE)	
Dimensions Weight	7.93 inches (20.15 cm) x 6.70 inches (17.02 cm) x 5.8 inches (14.73 cm) L x W x H Approximately 9.2 lbs (4.2 kg)	

Software-selectable gains	High	Medium	Low
- Low noise amplifier	1 e-/ct	2 e-/ct	4 e-/ct
- Electron multiplication amplifier	2.5 e-/ct	5 e-/ct	10 e-/ct

All specifications subject to change.
* Typical

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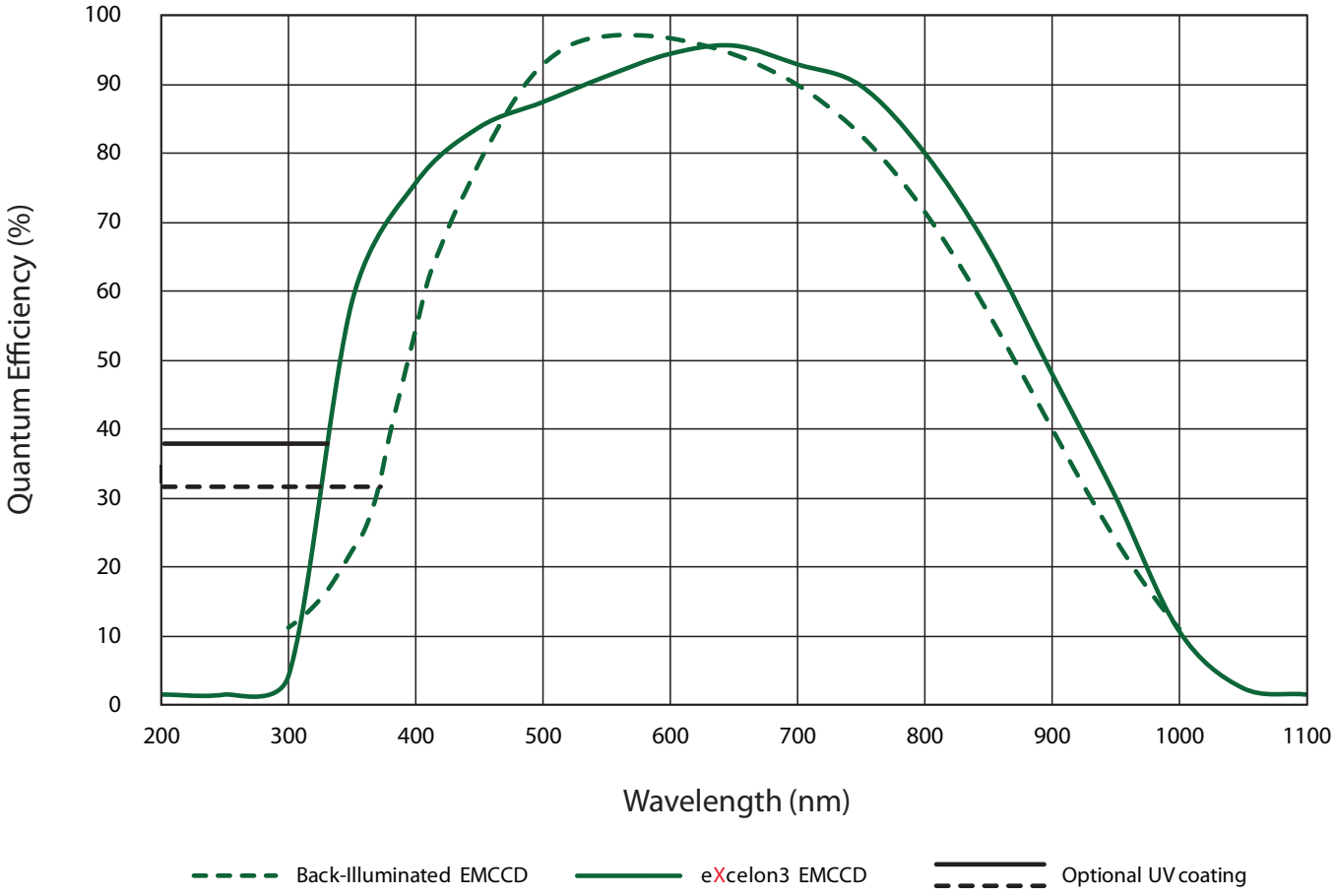
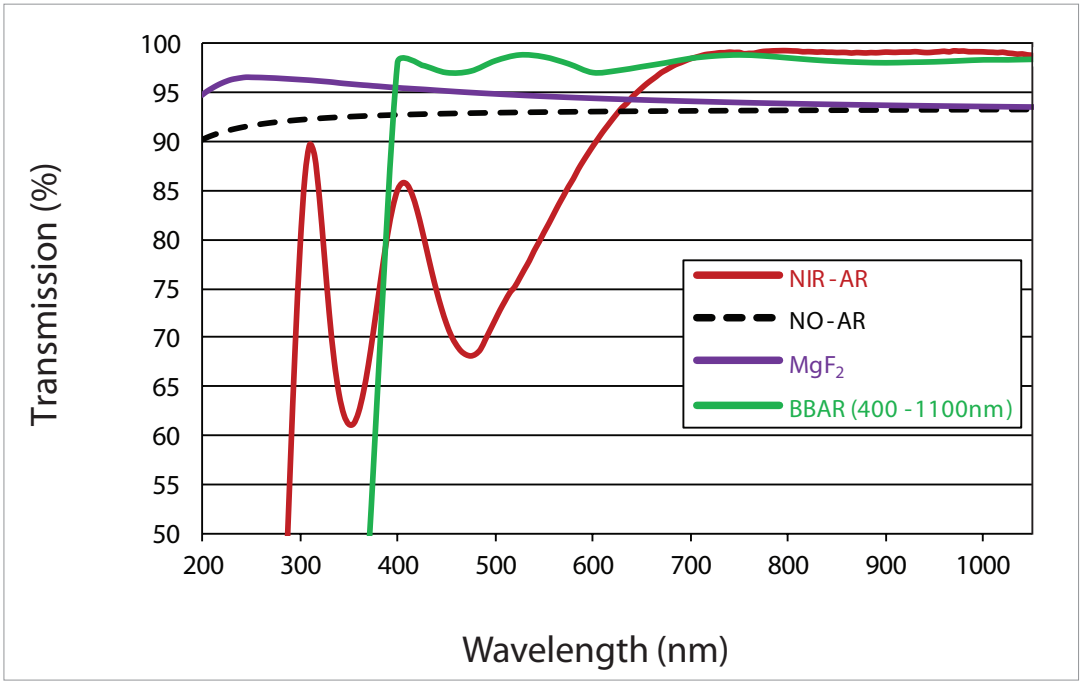
QUANTUM EFFICIENCY CURVE



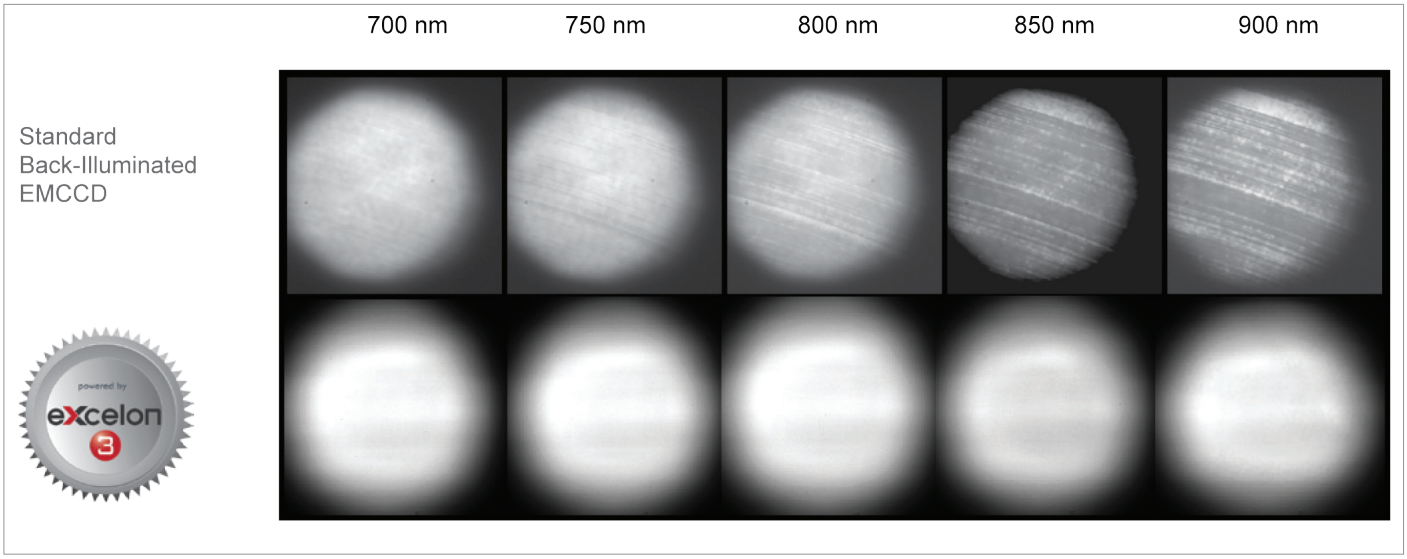
NOTE: Graph shows typical Quantum Efficiency (QE) data measured at + 25°C, representing expected performance at this temperature. QE will be lower at operating temperature. For the best results for your application, please discuss the specific parameters of your experiment with your sales representative.

VACUUM WINDOW AR COATINGS

NOTE:
Standard anti-reflection (AR) coatings shown. Custom AR coatings and wedge window options are also available. Contact your local sales representative for more information.

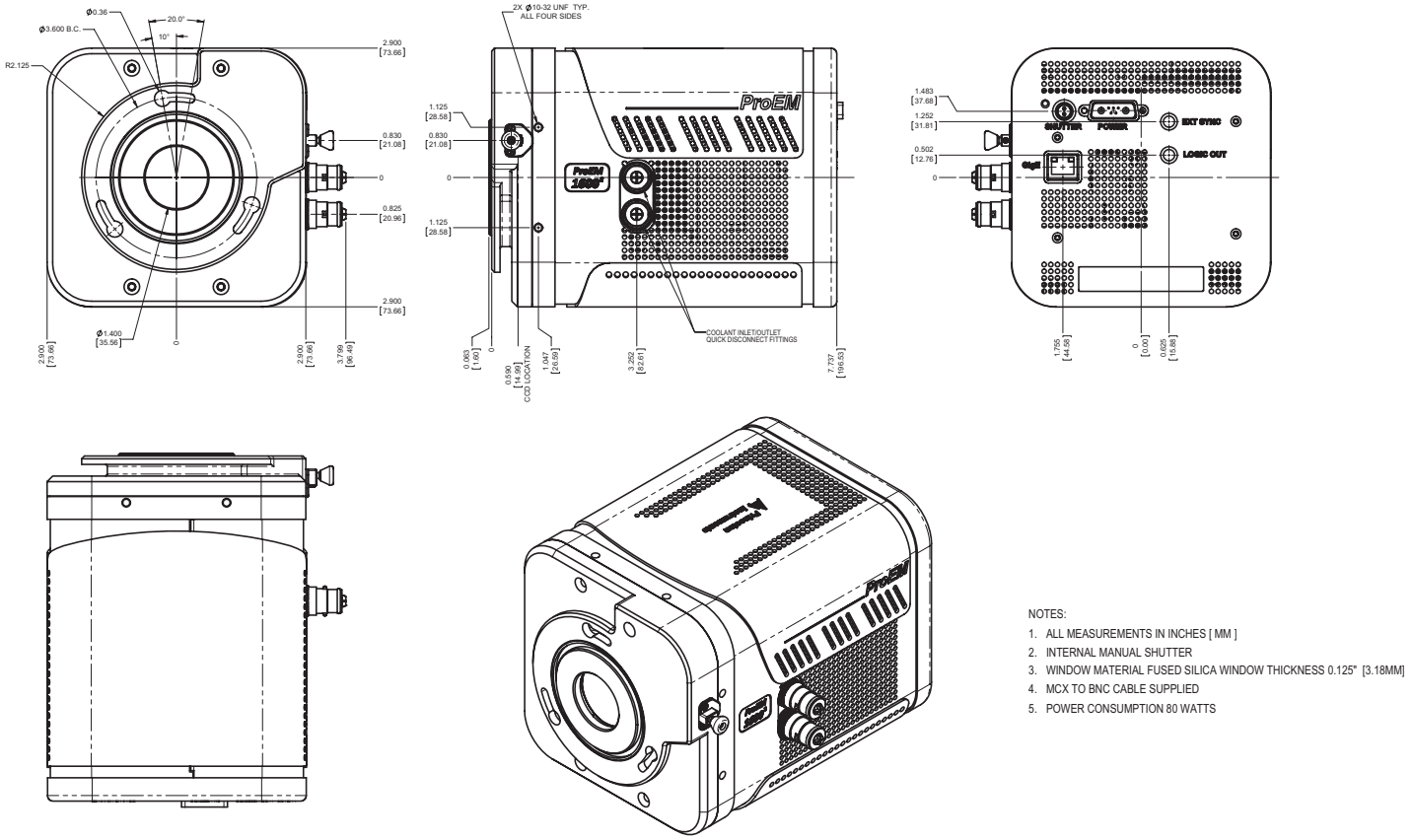


eXcelon PERFORMANCE



Data taken with white light source through a monochromator comparing etaloning performance of eXcelon vs conventional back-illuminated EMCCDs.

OUTLINE DRAWING WITH SPECTROSCOPY MOUNT



NOTES:

1. ALL MEASUREMENTS IN INCHES [MM]
2. INTERNAL MANUAL SHUTTER
3. WINDOW MATERIAL FUSED SILICA WINDOW THICKNESS 0.125" [3.18MM]
4. MCX TO BNC CABLE SUPPLIED
5. POWER CONSUMPTION 80 WATTS