



# BOOST™

emccd BT 2001



The SPOT™ BOOST™ BT 2001 back illuminated EMCCD has single photon detection capability without an image intensifier, combined with greater than 90% QE of a back-illuminated sensor. Containing a 512 x 512 L3Vision™ Frame Transfer CCD sensor from E2V Technologies, it enables charge to be multiplied on the sensor before it is read out, while utilizing the full QE performance of the CCD sensor. The EMCCD gain of the camera can be varied from unity up to a thousand times directly through the software. The system offers a range of readouts from 10 MHz to 1 MHz at **up to 16-bit digitization**. This camera has both EMCCD and conventional amplifier outputs and benefits from minimized dark current with unequaled thermoelectric cooling down to  $-100^{\circ}$  C.

### CAMERA SPECS

- **EMCCD Technology**
- **16-bit digitization**
- **True Linear gain**
- **> 90% QE back-illuminated sensor**
- **Variable readout rates up to 10 MHz**
- **Vacuum sealed cooling**
- **Thermoelectric cooling to  $-100^{\circ}$  C possible**
- **512 x 512 Frame Transfer sensor**
- **High dynamic range**
- **Built-in C-mount compatible shutter**
- **EM protect**

Ultimate in sensitivity from EMCCD gain – even single photon signals are amplified above the noise floor

Allows for meaningful capture of real data at 1 MHz operation

Control EMCCD gain with a linear, quantified scale – ask for a gain value and get it corrected to the CCD temperature

Maximum possible photon collection efficiency

Quantitative accuracy at all speeds

Critical for sustained vacuum integrity to maintain unequaled cooling and QE performance

Critical for elimination of dark current detection limit – an EMCCD must!

High resolution, large field of view and fast, shutterless imaging

Extended sensor dynamic range (readout speed dependent) and matched digitization for quantization of dim and bright signals

Easy means to record control dark images – excellent for optimization of experimental set-up

EM gain register is protected from accidental damage using built-in algorithms. Also limits long-term gain aging.

### CAMERA OVERVIEW

<b>Active Pixels</b>	512 x 512
<b>Pixel Size (WxH; <math>\mu</math>m)</b>	16 x 16
<b>Image Area (mm)</b>	8.2 x 8.2
<b>Active Area pixel well depth (e-, typical)</b>	200,000
<b>Gain Register pixel well depth (e-, typical)</b>	800,000 <sup>3</sup>
<b>Max Readout Rate (MHz)</b>	10
<b>Frame Rate (frames per sec)</b>	35 to >500
<b>Read Noise (e-)</b>	<1 EM gain < 50 conventional @ 10 MHz

### SYSTEM CHARACTERISTICS

<b>Peak QE</b>	>92%
<b>Pixel Readout Rate (MHz)</b>	
<b>Electron Multiplying Amplifier</b>	10, 5, 3, 1
<b>Conventional Amplifier</b>	3 and 1
<b>Digitization @ 10, 5, 3 &amp; 1 MHz readout rate</b>	True 14-bit <b>16-bit @ 1MHz</b>
<b>Vertical Clock Speed (<math>\mu</math>s)</b>	0.3 to 3.3 (variable)
<b>Linear Electron Multiplier Gain (software controlled)</b>	1 – 1000 times
<b>Non-Linearity</b>	<1%
<b>Triggering</b>	Internal, external, external start
<b>Camera window type</b>	Single window with double-sided AR coating—standard for BV model

**DARK CURRENT & DARK CURRENT BACKGROUND EVENTS<sup>5</sup>**

@ -85° C (e-/pix/sec) 0.001  
 EMCCD-Amplified Background Events<sup>6</sup> (events/pix) @ 1000 x gain and -85° C 0.005

**NOISE**

System Readout Noise (typical; e-) <sup>7</sup>	Typical	with Electron Multiplication
10MHz through EMCCD amplifier	49	<1
5MHz through EMCCD amplifier	40	<1

**OPERATING & STORAGE CONDITIONS**

**Operating Temperature** 0° C to 30° C ambient  
**Relative Humidity** < 70% (non-condensing)  
**Storage Temperature** -25° C to 55° C

**COMPUTER REQUIREMENTS**

To handle data transfer rates of 10MHz readout over extended sequential (kinetic) series, a powerful computer is recommended, e.g:

- 3 GHz Pentium (or better)
- 1GB RAM
- 10,000 rpm SATA hard drive, preferred for extended kinetic series

**Power Requirements<sup>8</sup>:**  
 0.6A @ +12V | 0.3A @ -12V | 3.0A @ +5V

- Also:**
- PCI-compatible computer
  - PCI slot must have bus master capability
  - Available auxiliary internal power connector
  - 32 Mbytes free hard disc space

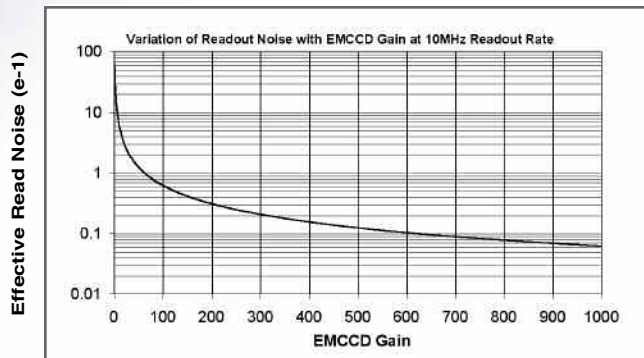
**Operating System:**  
 Windows 2000 or XP operating system

**Need more information?**

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 For footnote review: [www.diaginc.com/boostnotes](http://www.diaginc.com/boostnotes)

BOOST™ Model:BT 2001 512 x 512 7.10.06

**NOISE & EMCCD GAIN**



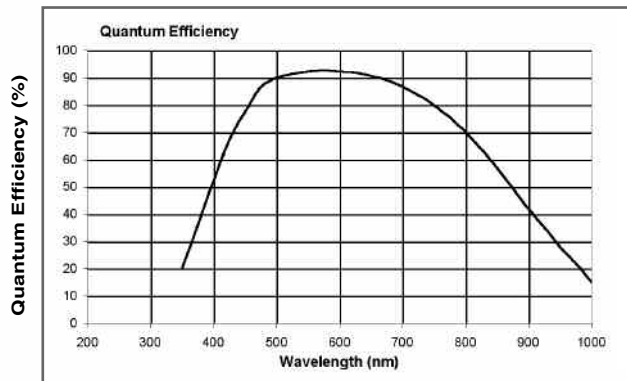
**Cooling Temperature**

Air-cooled (ambient air @ 20° C) -85

Water cooled using Re-circulator (RC180) (ambient air @ 20° C) -90

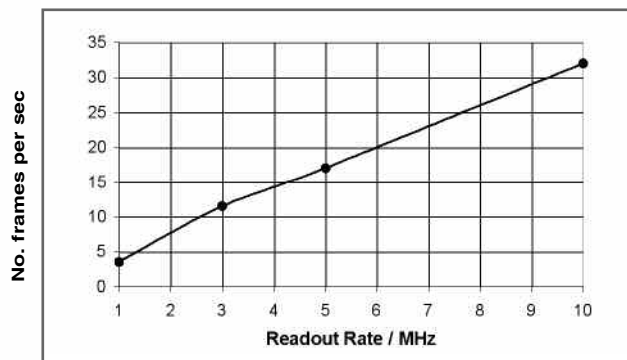
Water-cooled using Chiller (water @ 12° C, 0.75 l / min) -100

**QUANTUM EFFICIENCY**



**Quantum Efficiency at 575nm and -20° C<sup>9</sup>**

**FULL FRAME RATE<sup>10</sup>**



**MAX FRAMES PER SEC<sup>11</sup>**

Array size	512 x 512	256 x 256	128 x 128	512 H x 100 V
<b>Binning (full frame)</b>				
1x1	35	68	132	168
2x1	68	132	248	313
2x2	68	132	248	313
4x1	131	246	439	549
4x4	131	246	439	549



# BOOST™

dimensions

