

# ImageEM<sup>TM</sup>



## EM-CCD Camera C9100-13

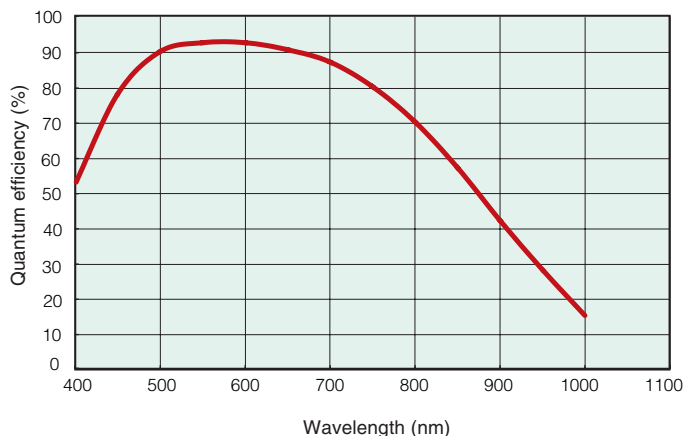
### Electron Multiplier CCD Camera



The ImageEM camera evolved from the popular C9100-12 electron multiplier CCD camera. This new generation camera incorporates the latest Hamamatsu engineering and technology to provide a high speed readout rate of 32 frames per second at full spatial resolution and 16 bit digitization. With QE over 90 % and cooling down to -90 °C, both low noise and high gain are realized in one camera. ImageEM includes dual readout modes to take advantage of these features. In the EM-CCD readout mode, the on-chip gain provides high speed imaging at very low light levels. In the normal CCD readout mode, the low noise readout and deep cooling provide exceptional images even in long integration situations. High dynamic range, high resolution, high signal to noise ratios and high speed are all hallmarks of this new generation EM-CCD camera. In addition, Photon Imaging mode enables ultra low light detection.

Other new features included in the ImageEM are real-time image processing (Background subtraction, Shading correction, and a Recursive filter) plus special internal and external synchronization features. It is now possible to optimize frame synchronization for spinning disk confocal microscopes at up to 32 frames per second with the synchronous readout trigger (Patent Pending).

#### SPECTRAL RESPONSE



★ This is typical, not guaranteed.

#### FEATURES

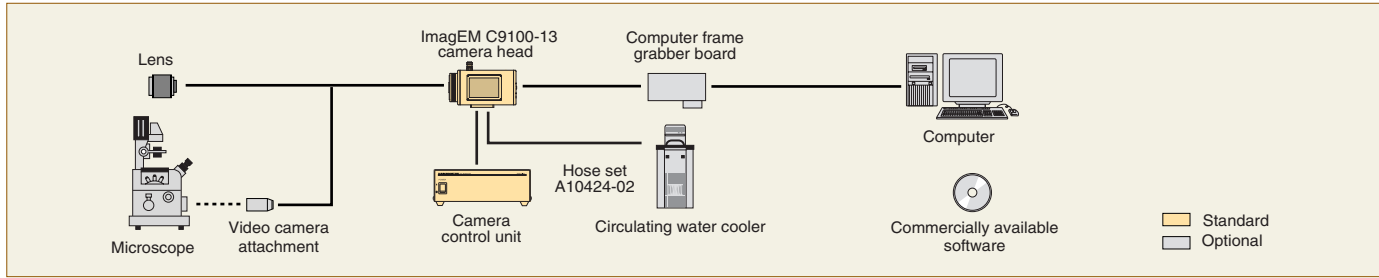
- High quantum efficiency of 90 % at the peak wavelength
- -90 °C cooling with hermetic sealed head (requires water cooling at +10 °C)
- Dual readout mode (EM-CCD readout / NORMAL CCD readout)
- High EM gain (1200 times)
- Real time (32 frame/s) readout at full resolution (512 × 512)
- Ultra low light detection in Photon Imaging mode
- Flexible external synchronization modes
- Synchronous readout trigger mode (Patent pending)
- Both fan and water cooling are included (selectable)
- Image reversal function in the EM-CCD readout
- Anti-reflection coating on both sides of input window

#### APPLICATIONS

- Real time imaging of low light fluorescence
- Intracellular ion measurement
- Single molecule fluorescence imaging with TIRF microscopy
- Real time confocal microscopy
- Luciferase reporter gene assay
- Luminescence imaging

**HAMAMATSU**

## SYSTEM CONFIGURATION



## SPECIFICATIONS

Type number	C9100-13		
Camera head type	Hermetic vacuum-sealed air/water-cooled head <sup>①</sup>		
Imaging device	Back-thinned Frame Transfer CCD		
Effective no. of pixels	512 (H) × 512 (V)		
Cell size	16 μm (H) × 16 μm (V)		
Effective area	8.192 mm (H) × 8.192 mm (V)		
Pixel clock rate	EM-CCD	11 MHz, 2.75 MHz, 0.69 MHz	
	NORMAL CCD	2.75 MHz, 0.69 MHz	
Electron multiplication gain (typ.)	1 or 4 to 1200 times <sup>②</sup>		
Ultra low light detection	Photon Imaging mode		
Fastest readout speed	31.9 frame/s to 404.4 frame/s		
Readout noise (r.m.s.) (typ.)	EM-CCD	gain 4 times	25 electrons (at 11 MHz) 20 electrons (at 2.75 MHz) 8 electrons (at 0.69 MHz)
		gain 1200 times	1 electron max. (at 11 MHz) 1 electron max. (at 2.75 MHz) 1 electron max. (at 0.69 MHz)
			NORMAL CCD
	Full well capacity (typ.) <sup>③</sup>	370 000 electrons (Max. 800 000 electrons)	
	Analog gain	1/2 times to 5 times	
	Cooling method / temperature	Forced-air cooled	-65 °C stabilized (0 °C to +30 °C)
Water cooled <sup>④</sup>		-80 °C stabilized (Water temperature : +20 °C) -90 °C (Water temperature : lower than +10 °C) <sup>⑤</sup>	
Dark current (typ.)	Forced-air cooled (-65 °C)	0.01 electron/pixel/s	
	Water cooled (-80 °C)	0.001 electron/pixel/s	
Exposure time <sup>⑥</sup>	Internal sync mode	30.5 ms or more	
	External trigger mode	10 μs or more	
A/D converter	16 bit		
Output signal / External control	CameraLink		
Sub-array	Yes		
Binning	2×2, 4×4 (8×8, 16×16) <sup>⑦</sup>		
External synchronization <sup>⑧</sup>	Edge trigger, Level trigger, Start trigger, Synchronous readout trigger		
Trigger output <sup>⑧</sup>	Yes		
Image processing features (real-time)	Background subtraction, Shading correction, Recursive filter		
Lens mount	C-mount		
Power requirements	AC 100 V to 240 V 50 Hz / 60 Hz		
Power consumption	Approx. 140 V·A		
Ambient storage temperature	-10 °C to +50 °C		
Ambient operating temperature	0 °C to +40 °C		
Performance guaranteed temperature	0 °C to +30 °C		
Ambient operating/storage humidity	70 % max. (with no condensation)		

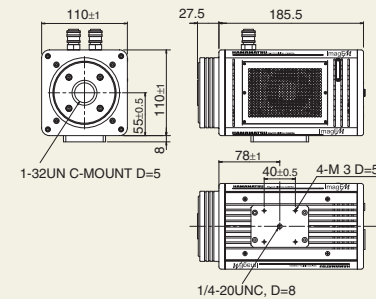
### ● Fastest Readout Speed (Internal synchronization mode, Unit : frame/s typ.)

Binning	Effective vertical width (Sub-array)					
	512	256	128	64	32	16
1 × 1	31.9	59.6	105.0	169.7	245.2	315.4
2 × 2	60.9	107.1	172.4	248.0	317.7	369.6
4 × 4	111.5	178.1	253.9	322.5	372.8	404.4

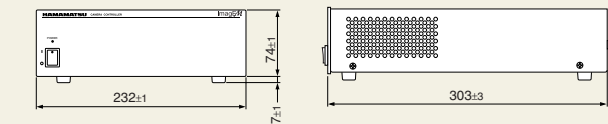
- ① The hermetic sealed head maintains a high degree of vacuum 10<sup>-8</sup> Torr, without re-evacuation.
- ② Even with electron multiplier gain maximum, dark signal is kept low level for low light imaging.
- ③ Linearity is not assured when full well capacity is more than 370 000 electrons.
- ④ Water volume 1.2 liter/min.
- ⑤ Image smearing may appear when the exposure time is short.
- ⑥ C-MOS 3.3 V with reversible polarity.
- ⑦ 8 × 8 and 16 × 16 binning are available on special order. Please consult with our sales office.
- ⑧ The maximum cooling temperature may vary subject to set-up environment.

## DIMENSIONAL OUTLINES (Unit : mm)

### ■ Camera head (Approx. 3.7 kg)



### ■ Camera control unit (Approx. 3.0 kg)



## OPTIONS

- Commercially available software
- Circulating water cooler
- Hose set A10424-02



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