ImagEM™

New from Hamamatsu

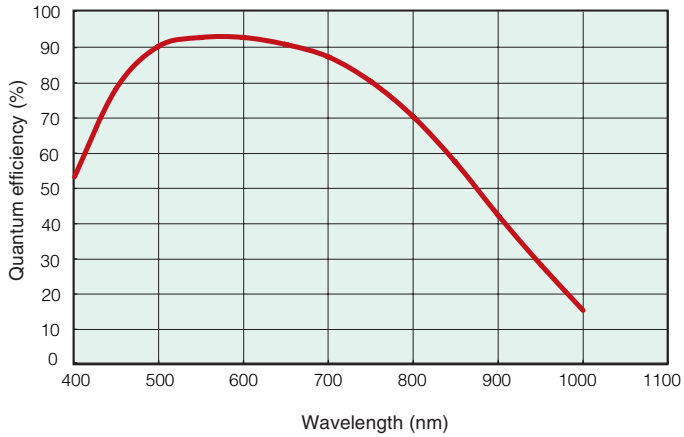
EM-CCD Camera C9100-13

Electron Multiplier CCD Camera

The ImagEM 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. ImagEM 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 ImagEM 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**

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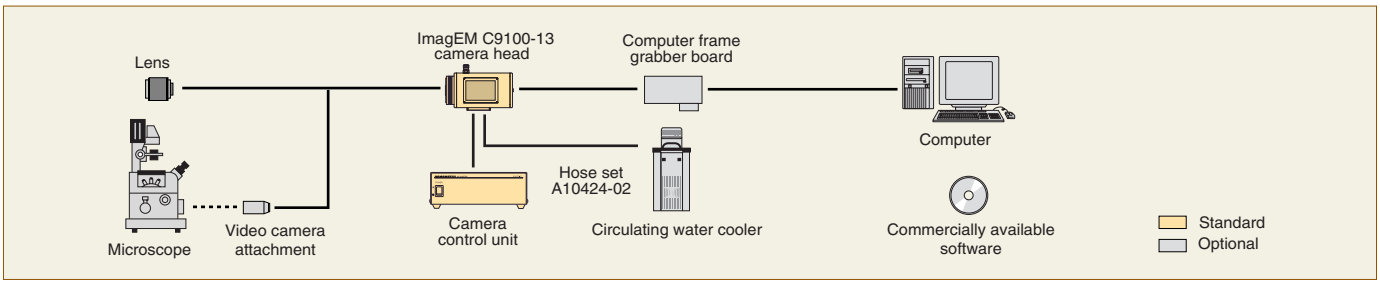
SYSTEM CONFIGURATION



SPECIFICATIONS

Type number			C9100-13
Camera head type			Hermetic vacuum-sealed air/water-cooled head ①
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 ②
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		17 electrons (at 2.75 MHz)
			8 electrons (at 0.69 MHz)
Full well capacity (typ.) ③			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 ④		-80 ˚C stabilized (Water temperature : +20 ˚C)
			-90 ˚C (Water temperature : lower than +10 ˚C) ⑧
Dark current (typ.)	Forced-air cooled (-65 ˚C)		0.01 electron/pixel/s
	Water cooled (-80˚C)		0.001 electron/pixel/s
Exposure time ⑤	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) ⑦
External synchronization ⑥			Edge trigger, Level trigger, Start trigger, Synchronous readout trigger
Trigger output ⑥			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)

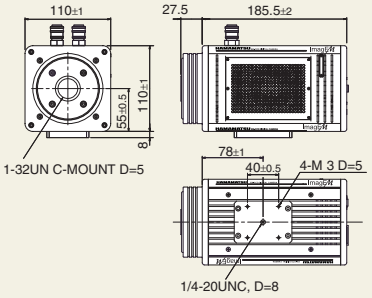
● Fastest Readout Speed (Internal synchronization mode, Unit : frame/s typ.)

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

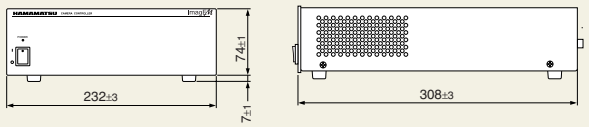
① The hermetic sealed head maintains a high degree of vacuum 10^{-8} Torr, without re-evacuation.
② Even with electron multiplier gain maximum, dark signal is kept low level for low light imaging.
③ Linearity is not assured when full well capacity is more than 370 000 electrons.
④ Water volume 1.2 liter/min.
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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