

# EM-CCD Camera C9100-02

## Electron Multiplier CCD Digital Camera



The C9100-02 camera bring together all the advantages of the latest Electron Multiplication CCDs with Hamamatsu engineering. High gain, good signal to noise, resolution and speed are combined with a proprietary hermetic vacuum chamber evacuated to  $1.33 \times 10^{-6}$  Pa ( $10^{-8}$  torr). High vacuum, deep cooling and specially designed electronics combine to reduce camera noise before the gain multiplication process begins.

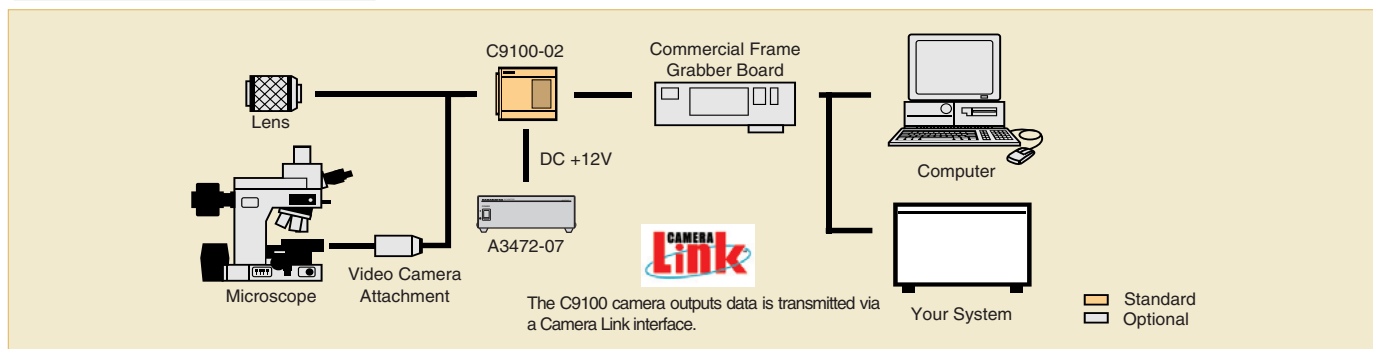
Using on-chip electron gain multiplication and deep cooling, the signal level can be greatly increased relative to the camera noise providing a relative read noise of less than one electron at high gain levels. gain factors up to 2000 times are possible while still operating at 30 frames per second at full spatial resolution and 14 bit digitization. Frame rates of 250 frames per second or greater are possible by using the binning and sub-array features of the C9100.

Furthermore, the camera controls the stable cooling temperature at  $-50$  °C even when the ambient temperature is fluctuated from  $0$  °C to  $+40$  °C. The constant cooling temperature can work out the uniformed electron multiplication factor and low noise characteristic.

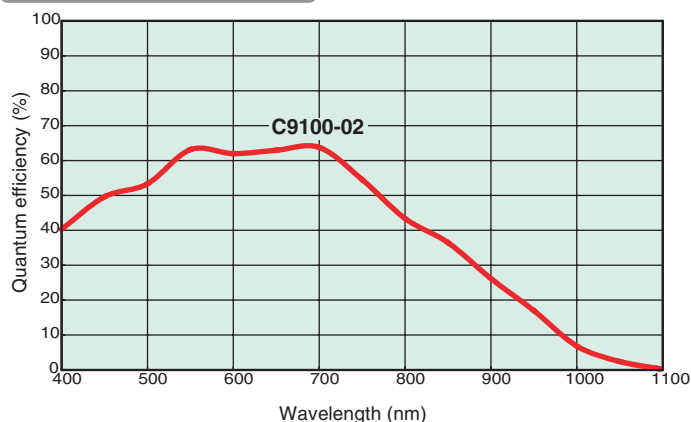
And kinds of external synchronization mode are available, addition to the internal synchronization mode. Especially, the synchronous readout trigger mode can achieve the optimized frame rate and exposure time such as 30 frames per second with 32 millisecond exposure at C9100-02 (Patent pending).

The C9100-02 series is recommended for any application requiring, speed, signal to noise ratio, dynamic range and resolution at low light levels.

### SYSTEM CONFIGURATION



### SPECTRAL RESPONSE



★ This is typical, not guaranteed.

### FEATURES

- High EM gain (2000 times)
- $-50$  °C cooling with hermetic sealed head
- Real time ( $> 30$  Hz) readout with full resolution
  - 35 MHz clock ( $1000 \times 1000$ )
- Stable cooling at  $-50$  °C (at  $0$  °C to  $+40$  °C ambient temperature)
- Various kinds of external synchronization mode
- Synchronous readout trigger mode (Patent pending)

### APPLICATIONS

- Real time imaging for low light imaging
- Real time confocal microscopy
- I.I. readout for single molecule fluorescence imaging
- TIRF microscope imaging

## SPECIFICATIONS

Type number		C9100-02	
Camera head type		Hermetic vacuum-sealed air-cooled head	
Imaging device		Frame transfer CCD	
Effective number of pixels		1000 (H) × 1000 (V)	
Cell size		8 μm (H) × 8 μm (V)	
Effective area		8.0 mm (H) × 8.0 mm (V)	
Pixel clock rate		35 MHz/pixel	
Frame rate***	binning	1 × 1	30.1 frame/s
		2 × 2	57.0 frame/s
		4 × 4	103.0 frame/s
		8 × 8	172.7 frame/s
		16 × 16	262.0 frame/s
Readout noise(r.m.s.) (typ.)	at EM-gain min.	10 electrons	
	at EM-gain max.	< 1 electrons	
Full well capacity (typ.)		70 000 electrons	
Electron multiplier gain max.		2000 times*	
Cooling method		Forced-air peltier cooling with hermetic sealing**	
Cooling temperature		Absolute and stabilized to - 50 °C (at ambient room temperature 0 °C to + 40 °C)	
Exposure time	Internal sync mode	100 μs to 10 s	
	External trigger mode	100 μs to 10 s	
A/D converter		14 bit	
Output signal / External control		CameraLink	
Electronic shutter		Yes	
Sub-array***		Yes	
External trigger		Yes	
Offset enhancement		Yes	
Lens mount		C-mount	
Power requirements		DC +12 V	
Power consumption		Approx. 60 V-A	
Ambient storage temperature		- 10 °C to + 50 °C	
Ambient operating temperature		0 °C to + 40 °C	
Ambient operating/storage humidity		70 % max. (with no condensation)	

### ● Readout Speed

*** Frame rate of each binning and sub-array condition		Effective vertical width (Sub-array)							
Frame rate (frame/s)	Binning	1000	512	256	128	64	32	16	
		1 × 1	30.1	55.8	101.0	169.8	257.7	347.2	420.2
2 × 2	2 × 2	57.0	101.0	169.8	257.7	347.2	420.2	469.5	500.0
	4 × 4	103.0	169.8	257.3	347.2	420.2	469.5	500.0	515.5
	8 × 8	172.7	257.7	347.2	420.2	469.5	500.0	515.5	
	16 × 16	262.0	346.0	418.4	467.3	497.5	512.8	520.8	

\* Even with electron multiplier gain maximum, dark signal is kept low level for low light imaging.

\*\* The hermetic sealed head maintains a high degree of vacuum  $1.33 \times 10^{-8}$  Pa ( $10^{-8}$  torr), without re-evacuation.

## OPTION

### ● Power supply unit: A3472-07

Line voltage: 100 V to 240 V AC input

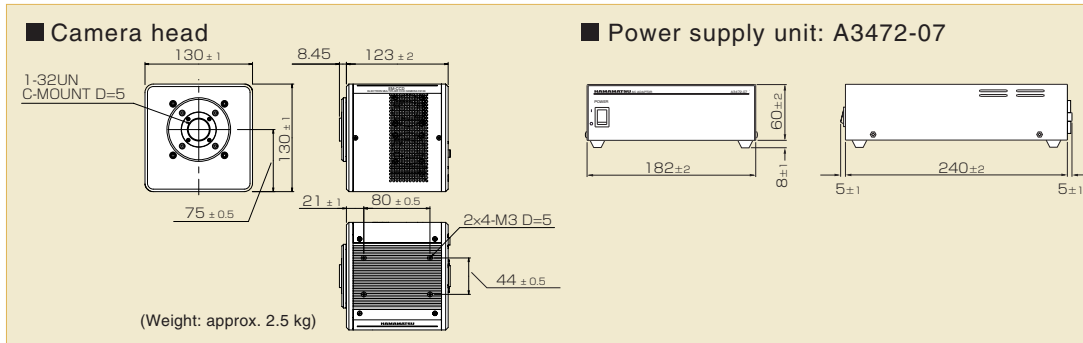
Output voltage: DC +12 V

Dimension: 182 mm (W) × 240 mm (D) × 60 mm (H)

### ● Power cable: A9189-05

## DIMENSIONAL OUTLINES

(Unit : mm)



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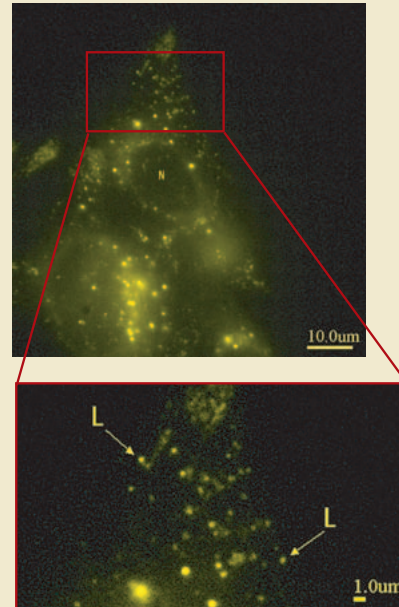
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## MEASUREMENT EXAMPLE

### ● High resolution observation of Lysosome trafficking



Observation of the intracellular behavior of Lysosomes in a CHO cultured cell using Lyso Tracker™. Sampling rate : 33 ms (30 frame/sec, 1000 × 1000 pixel) (Excitation light is attenuated by ND 10 % to reduce fading) N : Nucleus L : Lysosome