

HAMAMATSU

DATA SHEET

Electron Multiplier CCD Digital Camera

C9100-02 (1000 × 1000)

C9100-12 (BT-CCD)



The C9100 cameras 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 10^{-8} Torr. High vacuum, deep cooling and specially designed electronics combine to reduce camera noise before the gain multiplication process begins.

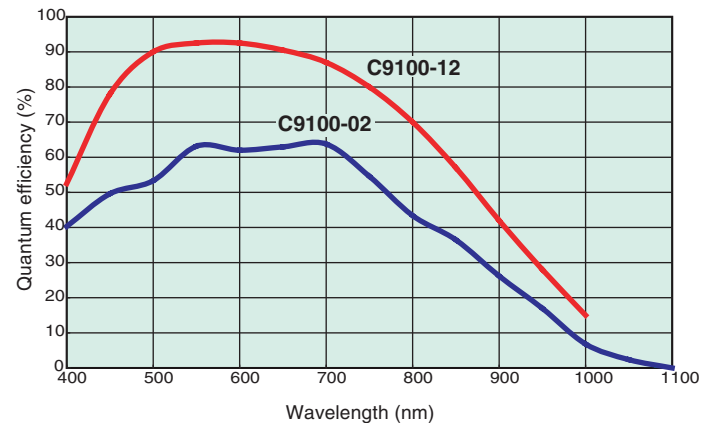
Using on-chip electron gain multiplication and deep cooling, the signal level can be greatly increased relative to the camera noise; providing a relative read noise of less than one electron at high gain levels. Depending on the model, gain factors up to 2000 times are possible while still operating 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 cameras.

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

And rich kinds of external synchronization mode are available, addition to the internal synchronization mode. Especially, the readout trigger synchronization 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 series cameras are recommended for any application requiring, speed, signal to noise, dynamic range and resolution at low light levels.

SPECTRAL RESPONSE CHARACTERISTICS



★ This is typical, not guaranteed

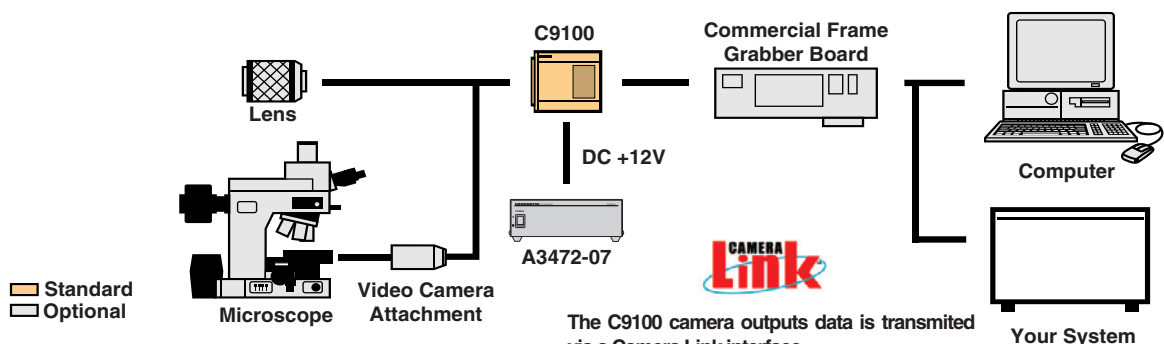
FEATURES

- High EM gain (2000 times)
- $-50\text{ }^{\circ}\text{C}$ cooling with hermetic sealed head
- Real time ($> 30\text{ Hz}$) readout with full resolution
 - 35 MHz clock for C9100-02 (1000 × 1000)
 - 11 MHz clock for C9100-12 (512 × 512)
- Stable cooling at $-50\text{ }^{\circ}\text{C}$ at 0 to $+40\text{ }^{\circ}\text{C}$ ambient temperature
- Rich kinds of external synchronization mode
- Readout trigger synchronization 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

SYSTEM CONFIGURATION



SPECIFICATIONS

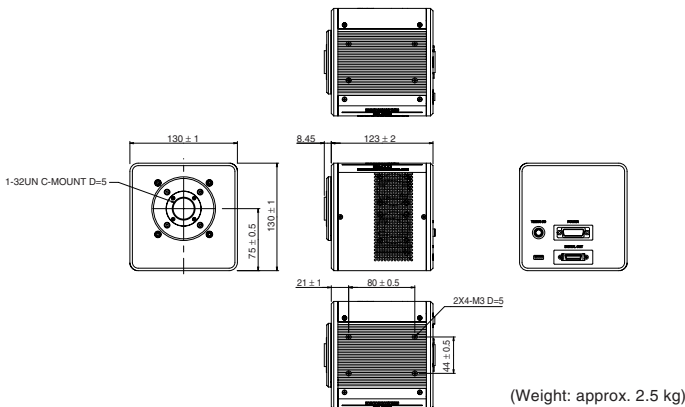
Type number	C9100-02		C9100-12	
Camera head type	Hermetic vacuum-sealed air-cooled head			
Imaging device	Frame transfer CCD		Backthinned Frame transfer CCD	
Effective no. of pixels	1000 (H) × 1000 (V)		512 (H) × 512 (V)	
Cell size	8 μm (H) × 8 μm (V)		16 μm (H) × 16 μm (V)	
Effective area	8.0 mm (H) × 8.0 mm (V)		8.192 mm (H) × 8.192 mm (V)	
Pixel clock rate	35 MHz/pixel		11 MHz/pixel	
Frame rate***	1 × 1	30.1 frame/s	35.8 frame/s	
		57.0 frame/s	66.9 frame/s	
		103.0 frame/s	118.2 frame/s	
		172.7 frame/s	191.6 frame/s	
		262.0 frame/s	277.0 frame/s	
Readout noise(r.m.s.) typ.	at EM-gain min. at EM-gain max.	10 electrons	40 electrons	
		< 1 electrons	< 1 electrons	
		70 000 electrons	370 000 electrons	
		× 2000*	× 2000*	
Full well capacity typ.	70 000 electrons			
Electron multiplier gain max.	× 2000*			
Cooling method	Forced-air peltier cooling with hermetic sealing**			
Cooling temperature	absolute and stabilized to - 50 °C @ ambient room temperature 0 °C to + 40 °C			
A/D converter	14 bit			
Output signal / External control	Camera Link			
Exposure time	Internal sync mode	100 μs to 10 s		27.1 ms to 10 s
	External trigger mode	100 μs to 10 s		1 ms to 10 s
Electronic shutter	Yes		No	
Sub-array***	Yes			
External trigger	Yes			
Offset enhancement	Yes			
Contrast enhancement	No			
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)			

* 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 10⁻⁸ Torr, without re-evacuation.

*** Frame rate of each binning and sub-array condition	Effective vertical width (Sub-array)	C9100-02														C9100-12					
		C9100-02														C9100-12					
		1000	512	256	128	64	32	16	512	256	128	64	32	16							
Frame rate (frame/s)	1 × 1	30.1	55.8	101.0	169.8	257.7	347.2	420.2	420.2	35.8	66.9	118.3	191.9	279.3	361.0						
	Binning	2 × 2	57.0	101.0	169.8	257.7	347.2	420.2	469.5	66.9	118.3	191.9	279.3	361.0	421.9						
		4 × 4	103.0	169.8	257.3	347.2	420.2	469.5	500.0	118.2	191.9	278.6	359.7	421.9	460.8						
		8 × 8	172.7	257.7	347.2	420.2	469.5	500.0	515.5	191.6	278.6	359.7	420.2	460.8	483.1						
	16 × 16	262.0	346.0	418.4	467.3	497.5	512.8	520.8	277.0	357.1	418.4	456.6	478.5	490.2							

DIMENSIONAL OUTLINES (Unit: mm)



OPTIONAL

- **Power supply unit: A3472-07**
Line voltage: 100 to 240V AC input
Output voltage: DC +12V
Dimension: 182 mm (W) × 240 mm (D) × 60 mm(H)
- **Power cable: A9189-05**

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