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).

### 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

### SPECTRAL RESPONSE

- **This is typical, not guaranteed.**
SYSTEM CONFIGURATION

![Diagram of system configuration]

SPECIFICATIONS

<table>
<thead>
<tr>
<th>Type number</th>
<th>C9100-13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camera head type</td>
<td>Hermetic vacuum-sealed air/water-cooled head</td>
</tr>
<tr>
<td>Imaging device</td>
<td>Back-thinned Frame Transfer CCD</td>
</tr>
<tr>
<td>Effective no. of pixels</td>
<td>512 (H) × 512 (V)</td>
</tr>
<tr>
<td>Cell size</td>
<td>16 μm (H) × 16 μm (V)</td>
</tr>
<tr>
<td>Cell size</td>
<td>8.192 mm (H) × 8.192 mm (V)</td>
</tr>
<tr>
<td>Pixel clock rate</td>
<td>11 MHz, 2.75 MHz, 0.69 MHz</td>
</tr>
<tr>
<td>Normal clock rate</td>
<td>2.75 MHz, 0.69 MHz</td>
</tr>
<tr>
<td>Electron multiplication gain (typ.)</td>
<td>1 or 4 to 1200 times</td>
</tr>
<tr>
<td>Ultra low light detection</td>
<td>Photon imaging mode</td>
</tr>
<tr>
<td>Fastest readout speed</td>
<td>31.9 frame/s to 404.4 frame/s</td>
</tr>
<tr>
<td>Readout noise (r.m.s.) (typ.)</td>
<td>25 electrons (at 11 MHz)</td>
</tr>
<tr>
<td>Gain</td>
<td>4 times</td>
</tr>
<tr>
<td>Gain</td>
<td>1200 times</td>
</tr>
<tr>
<td>Normal CCD</td>
<td>17 electrons (at 2.75 MHz)</td>
</tr>
<tr>
<td>Gain</td>
<td>8 electrons (at 0.69 MHz)</td>
</tr>
<tr>
<td>Full well capacity (typ.)</td>
<td>370 000 electrons (Max. 800 000 electrons)</td>
</tr>
<tr>
<td>Analog gain</td>
<td>1/2 times to 5 times</td>
</tr>
<tr>
<td>Cooling method / temperature</td>
<td>Forced-air cooled</td>
</tr>
<tr>
<td>Water cooled</td>
<td>-65 °C stabilized (0 °C to 30 °C)</td>
</tr>
<tr>
<td>Water cooled</td>
<td>-90 °C (Water temperature : lower than +10 °C)</td>
</tr>
<tr>
<td>Dark current (typ.)</td>
<td>0.01 electron/pixel/s</td>
</tr>
<tr>
<td>Exposure time</td>
<td>30.5 ms or more</td>
</tr>
<tr>
<td>A/D converter</td>
<td>16 bit</td>
</tr>
<tr>
<td>Output signal / External control</td>
<td>CameraLink</td>
</tr>
<tr>
<td>Sub-array</td>
<td>Yes</td>
</tr>
<tr>
<td>External synchronization</td>
<td>Edge trigger, Level trigger, Start trigger, Synchronous readout trigger</td>
</tr>
<tr>
<td>Trigger output</td>
<td>Yes</td>
</tr>
<tr>
<td>Image processing features (real-time)</td>
<td>Background subtraction, Shading correction, Recursive filter</td>
</tr>
<tr>
<td>Lens mount</td>
<td>C-mount</td>
</tr>
<tr>
<td>Power requirements</td>
<td>AC 100 V to 240 V</td>
</tr>
<tr>
<td>Power consumption</td>
<td>50 Hz / 60 Hz</td>
</tr>
<tr>
<td>Ambient storage temperature</td>
<td>-10 °C to + 50 °C</td>
</tr>
<tr>
<td>Ambient operating temperature</td>
<td>0 °C to +40 °C</td>
</tr>
<tr>
<td>Performance guaranteed temperature</td>
<td>0 °C to +30 °C</td>
</tr>
<tr>
<td>Ambient operating/storage humidity</td>
<td>70 % max. (with no condensation)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Binning</th>
<th>Effective vertical width (Sub-array)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 × 1</td>
<td>31.9</td>
</tr>
<tr>
<td>2 × 2</td>
<td>60.9</td>
</tr>
<tr>
<td>4 × 4</td>
<td>111.5</td>
</tr>
</tbody>
</table>

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

DIMENSIONAL OUTLINES (Unit : mm)

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

Homepage Address http://www.hamamatsu.com

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