MPPC® (Multi-Pixel Photon Counter)

S13720 series

Near infrared MPPC

MPPC is a type of device called SiPM (Silicon Photomultipliers). It is a new type of photon counting device that consists of multiple Geiger mode APD (avalanche photodiode) pixels. It is an opto-semiconductor with outstanding photon counting capability and low operating voltage and is immune to the effects of magnetic fields.

The S13720 series near infrared MPPC provides high photon detection efficiency in the near infrared region.

Features

- High photon detection efficiency (twice that of Hamamatsu S13360 series): 7% (λ=905 nm)
- Low crosstalk
- Small package (S13720-1325PS)
- High gain: 10⁵ to 10⁶

Applications

- Distance measurement (e.g., LiDAR)

Structure

<table>
<thead>
<tr>
<th>Parameter</th>
<th>S13720-1325CS</th>
<th>S13720-1325PS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective photosensitive area</td>
<td>1.3 × 1.3 mm</td>
<td></td>
</tr>
<tr>
<td>Pixel pitch</td>
<td>25 μm</td>
<td></td>
</tr>
<tr>
<td>Number of pixels/ch</td>
<td>2668</td>
<td>-</td>
</tr>
<tr>
<td>Fill factor</td>
<td>47 %</td>
<td></td>
</tr>
<tr>
<td>Package</td>
<td>Ceramic</td>
<td>Surface mount type</td>
</tr>
<tr>
<td>Window material</td>
<td>Silicone</td>
<td>-</td>
</tr>
<tr>
<td>Refractive index of window material</td>
<td>1.41</td>
<td>1.57</td>
</tr>
</tbody>
</table>

Absolute maximum ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>S13720-1325CS</th>
<th>S13720-1325PS</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature*¹</td>
<td>Topr</td>
<td>-40 to +85 °C</td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature*¹</td>
<td>Tstg</td>
<td>-40 to +105 °C</td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>Soldering conditions</td>
<td>Tsol</td>
<td>350 °C max., once, 3 s max</td>
<td>Peak temperature: 260 °C , 3 times*²</td>
<td>-</td>
</tr>
</tbody>
</table>

*¹: No dew condensation
When there is a temperature difference between a product and the surrounding area in high humidity environment, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.

*²: JEDEC level 2a
Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to use the product within the absolute maximum ratings.
### Electrical and optical characteristics (Typ. Ta=25 °C, overvoltage=7 V, unless otherwise noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectral response range</td>
<td>Min.</td>
<td>Typ.</td>
</tr>
<tr>
<td>Peak sensitivity wavelength</td>
<td>λ</td>
<td>350 to 1000</td>
</tr>
<tr>
<td>Peak sensitivity wavelength</td>
<td>λp</td>
<td>660</td>
</tr>
<tr>
<td>Photon detection efficiency*3</td>
<td>PDE</td>
<td>22</td>
</tr>
<tr>
<td>Peak sensitivity wavelength</td>
<td>λ=λp</td>
<td>7</td>
</tr>
<tr>
<td>Breakdown voltage</td>
<td>VBR</td>
<td>52</td>
</tr>
<tr>
<td>Recommended operating voltage*4</td>
<td>Vop</td>
<td>VBR + 7</td>
</tr>
<tr>
<td>Dark count</td>
<td>-</td>
<td>500</td>
</tr>
<tr>
<td>Crosstalk probability</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>Terminal capacitance</td>
<td>Ct</td>
<td>65</td>
</tr>
<tr>
<td>Gain</td>
<td>M</td>
<td>1.1 × 10^6</td>
</tr>
<tr>
<td>Temperature coefficient of reverse voltage</td>
<td>ΔTVop</td>
<td>54</td>
</tr>
</tbody>
</table>

*3: Photon detection efficiency does not include crosstalk or afterpulses.

*4: Refer to the label affixed to the product package. Recommended operating voltage variation in-reel products: ±0.25 V/reel

### Photon detection efficiency vs. wavelength (typical example)

![Photon detection efficiency vs. wavelength](image)

(Ta=25 °C, Vop=VBR + 7)
Gain, crosstalk probability, photon detection efficiency-overvoltage characteristics (typical example)

* Converted from photon detection efficiency ($\lambda=660 \text{ nm}$)

Pulse waveform

Measurement circuit
MPPC (Multi-Pixel Photon Counter)  |  S13720 series

**Directivity**

(Typ. light: tungsten lamp)

Relative sensitivity (%)

**Linearity**

(Ta=25 °C, λ=850 nm)

Output current (A) vs. Incident light level (W)

**Dark current vs. overvoltage**

(Ta=25 °C)

Dark current (A) vs. Overvoltage (V)
### Dimensional outlines (unit: mm)

#### S13720-1325CS

- **Anode terminal**
- **Indicator hole**
- **Photosensitive area**: 1.3 × 1.3
- **Silicone resin**
- **Photosensitive surface**
- **Lead**: Ø0.45 ± 0.05
- **Tolerance unless otherwise noted**: ±0.2
- **Lead material**: Fe-Ni-Co alloy
- **Lead processing**: Au plating
- **Chip position accuracy**: X, Y ≤ ±0.25 with respect to package center
- **The coating resin may swell a maximum of 0.1 mm above the top of the package.**

#### S13720-1325PS

- **Photosensitive area**: 1.3 × 1.3
- **Silicone resin**
- **Photosensitive surface**
- **Index mark**: 0.6 ± 0.15
- **Recommended land pattern**
- **Tolerance unless otherwise noted**: ±0.1
- **Dimension from the center of the chip to the center of the package**: ±0.05

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**KAPDA0178EA**

**KAPDA0177EB**
This surface mount type package product supports lead-free soldering. After unpacking, store it in an environment at a temperature of 30 °C or less and a humidity of 60% or less, and perform soldering within 4 weeks.

- The effect that the product is subject to during reflow soldering varies depending on the circuit board and reflow oven that are used. When you set reflow soldering conditions, check that problems do not occur in the product by testing out the conditions in advance.
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- **Standard packing specifications (S13720-1325PS)**

  - **Reel (conforms to JEITA ET-7200)**
  
<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Hub diameter</th>
<th>Tape width</th>
<th>Material</th>
<th>Electrostatic characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>180 mm</td>
<td>60 mm</td>
<td>8 mm</td>
<td>PS</td>
<td>Conductive</td>
</tr>
</tbody>
</table>

  - Embossed tape (unit: mm, material: PS, conductive)

  - Packing quantity
    1000 pcs/reel

  - Packing type
    Reel and desiccant in moisture-proof packaging (vacuum-sealed)
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Related information
www.hamamatsu.com/sp/ssd/doc_en.html

- Precautions
  - Disclaimer
  - Metal, ceramic, plastic packages
  - Surface mount type products

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MPPC module C14193-1325SA

The C14193-1325SA is an optical measurement module that can detect low light levels. It consists of an MPPC, a high-speed amplifier circuit, a high-voltage circuit, and a temperature compensation circuit. The built-in small pixel pitch (25 μm) MPPC S13720-1325CS allows high photon detection efficiency in the near infrared region as well as high-speed measurement and wide dynamic range. The C14193-1325SA runs simply by connecting a single power supply (+5 V).

### Features

- Internal MPPC: S13720-1325CS
- High-speed response
- Built-in temperature compensation circuit
- Compact and lightweight

### Applications

- Distance measurement (e.g., LiDAR)
- S13720-1325CS evaluation

### Pulse waveform

![Pulse waveform diagram]

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### Block diagram

![Block diagram diagram]
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MPPC is a registered trademark of Hamamatsu Photonics K.K.

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