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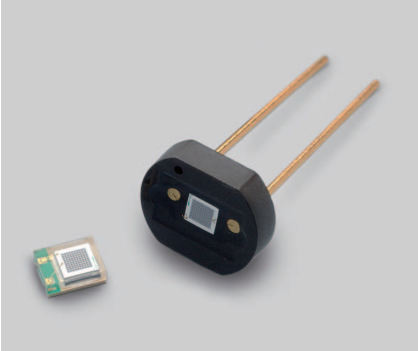
# MPPC® (multi-pixel photon counter)



S12571-010, -015C/P

## Low afterpulses, wide dynamic range, for high-speed measurement Photosensitive area: 1 × 1 mm

These MPPCs utilize very small pixels arrayed at high densities to achieve a high-speed recovery time and wide dynamic range. Hamamatsu currently produces MPPC with a pixel density up to 10000 pixels/mm$^2$ (pixel pitch: 10 µm). Utilizing advanced technology to enhance photon detection efficiency minimizes the drop in photon detection efficiency that usually occurs due to shrinking the pixel pitch.

### Features

- **Low afterpulse**
- **High fill factor**
- **High photon detection efficiency**
- **Wide operating voltage range**
- **Short recovery time**
- **High count rate**

### Applications

- **Scintillation measurement**
- **Low-light-level detection**
- **Scattered light measurement**

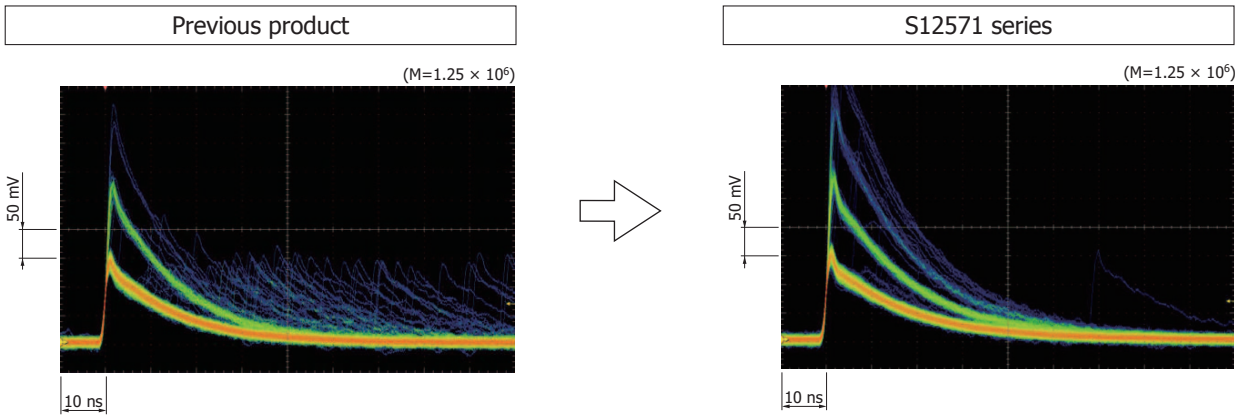
### Related product (sold separately)

- **MPPC module** **C11209-110**

## Low afterpulse

When an MPPC detects photons, the output may contain spurious signals appearing with a time delay from the light input to the MPPC. These signals are called afterpulses. Compared to our previously marketed products, the S12571 series have drastically reduced afterpulses due to use of improved materials and wafer process technologies. Reducing afterpulses brings various benefits such as a better S/N, a wider operating voltage range, and improved time resolution and photon detection efficiency in high voltage regions.

### Pulse waveform comparison



## Structure

| Parameter | Symbol | S12571 | | | | Unit |
|---|---|---|---|---|---|---|
| | | -010C | -010P | -015C | -015P | |
| Effective photosensitive area | - | 1 × 1 | | 1 × 1 | | mm |
| Pixel pitch | - | 10 | | 15 | | μm |
| Number of pixels | - | 10000 | | 4489 | | - |
| Geometrical fill factor | - | 33 | | 53 | | % |
| Package | - | Ceramic | Surface mount type | Ceramic | Surface mount type | - |
| Window | - | Silicone resin | Epoxy resin | Silicone resin | Epoxy resin | - |
| Window refractive index | - | 1.41 | 1.55 | 1.41 | 1.55 | - |

## Absolute maximum ratings (Ta=25 °C)

| Parameter | Symbol | S12571 | | | | Unit |
|---|---|---|---|---|---|---|
| | | -010C | -010P | -015C | -015P | |
| Operating temperature*1 | Topr | -20 to +60 | | -20 to +60 | | °C |
| Storage temperature*1 | Tstg | -20 to +80 | | -20 to +80 | | °C |
| Reflow soldering conditions*2 | Tsol | | Peak temperature: 240 °C, twice (see P.5) | | Peak temperature: 240 °C, twice (see P.5) | - |
| Soldering conditions | - | 350 °C max. once, 3 s max.*3 | - | 350 °C max. once, 3 s max.*3 | - | - |

*1: No 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 5a
*3: At least 1 mm away from lead root
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.

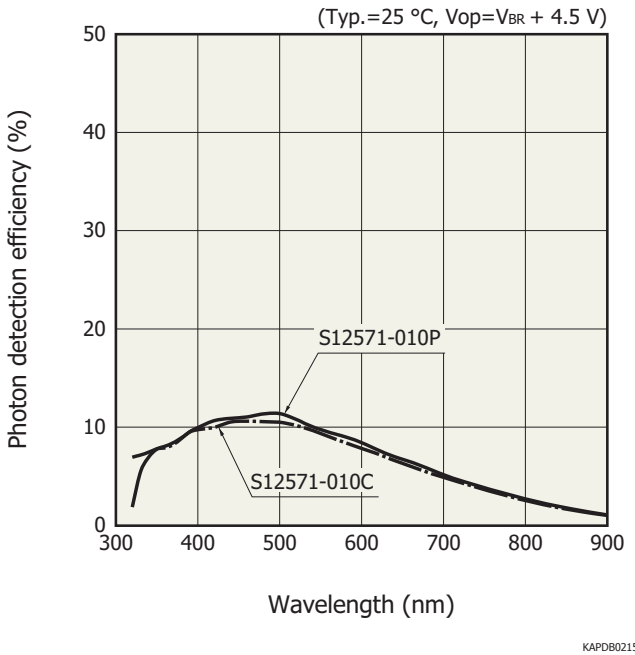
## Electrical and optical characteristics (Ta=25 °C, unless otherwise noted)

| Parameter | | Symbol | S12571 | | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | -010C | -010P | -015C | -015P | |
| Spectral response range | | λ | 320 to 900 | | 320 to 900 | | nm |
| Peak sensitivity wavelength | | λp | 470 | | 460 | | nm |
| Photon detection efficiency (λ=λp)*4 | | PDE | 10 | | 25 | | % |
| Dark count*5 | Typ. | - | 100 | | 100 | | kcps |
| | Max. | | 200 | | 200 | | |
| Time resolution (FWHM)*6 | | - | 300 | | 250 | | ps |
| Terminal capacitance | | Ct | 35 | | 35 | | pF |
| Gain | | M | $1.35 \times 10^5$ | | $2.3 \times 10^5$ | | - |
| Gain temperature coefficient | | ΔTM | $1.6 \times 10^3$ | | $3.5 \times 10^3$ | | /°C |
| Breakdown voltage | | VBR | 65 ± 10 | | 65 ± 10 | | V |
| Recommended operating voltage | | Vop | VBR + 4.5 | | VBR + 4.0 | | V |
| Temperature coefficient of recommended operating voltage | | ΔTVop | 60 | | 60 | | mV/°C |

*4: Photon detection efficiency does not include crosstalk or afterpulses.
*5: Threshold=0.5 p.e.
*6: Single photon level
Note: The above characteristics were measured the operating voltage that yields the gain listed in this catalog.
(Refer to the data attached to each product.)
The last letter of each type number indicates the package type (C: ceramic, P: surface mount type).

## Photon detection efficiency vs. wavelength

S12571-010C/P

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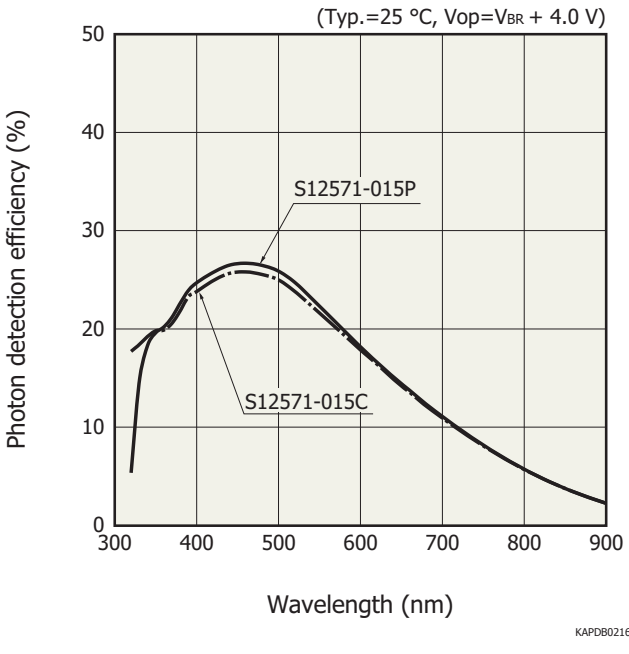
S12571-015C/P

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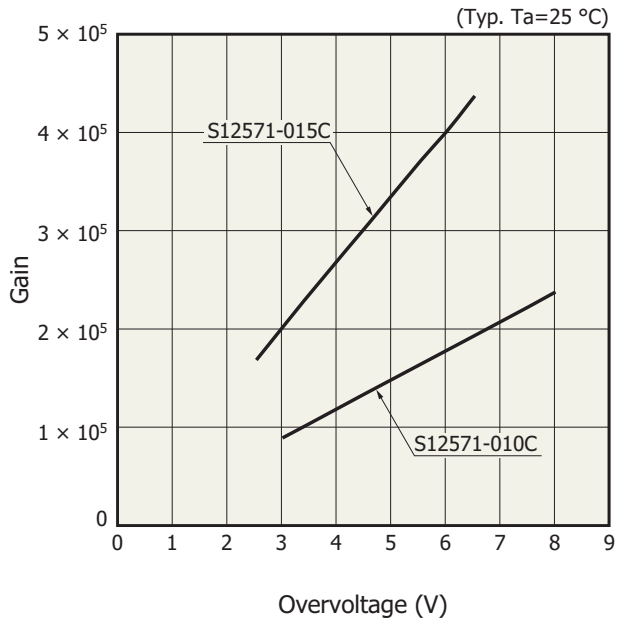
Photon detection efficiency does not include crosstalk or afterpulses.

## Gain vs. overvoltage

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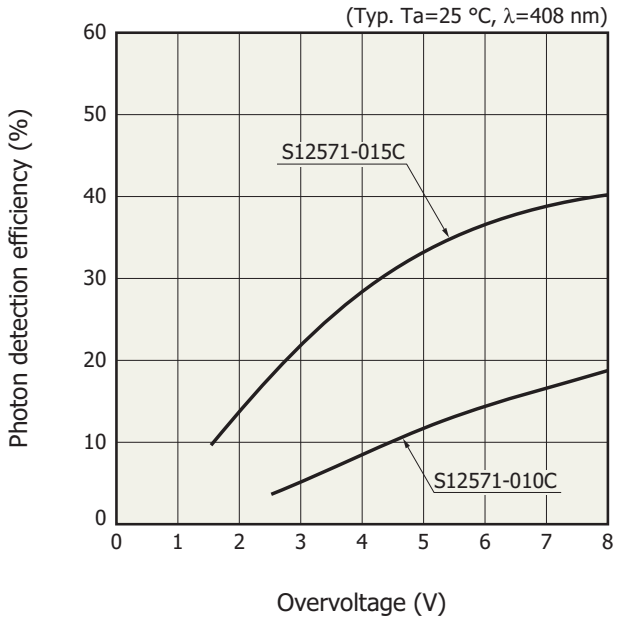
## Photon detection efficiency vs. overvoltage

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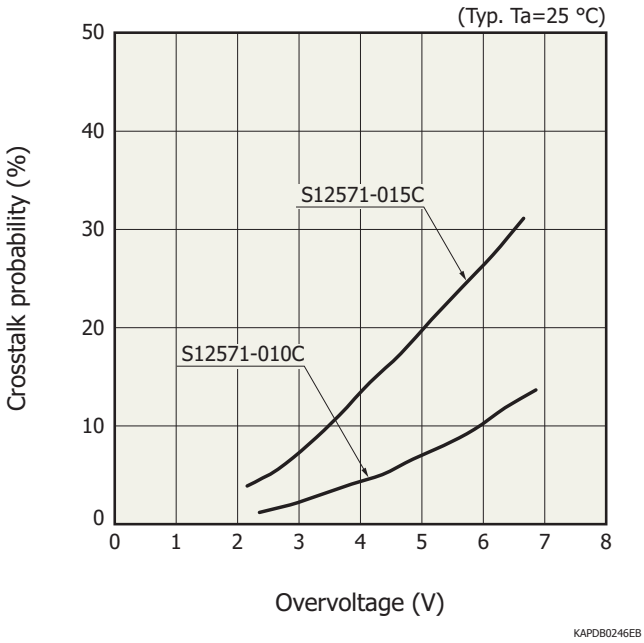
## Crosstalk probability vs. overvoltage

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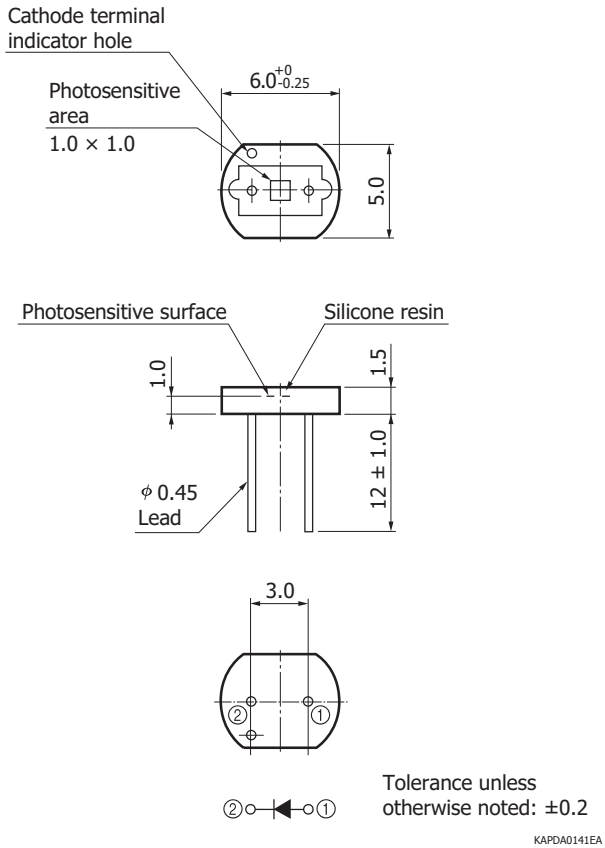
Because the high-speed, wide dynamic range MPPC has a small pixel capacitance, the gain is smaller than the MPPC for general measurement. The gain and photon detection efficiency are increased by applying the higher operating voltage. Please use it with the appropriate operating voltage because the crosstalk increases at the same time.

## Dimensional outlines (unit: mm)

S12571-010/-015C

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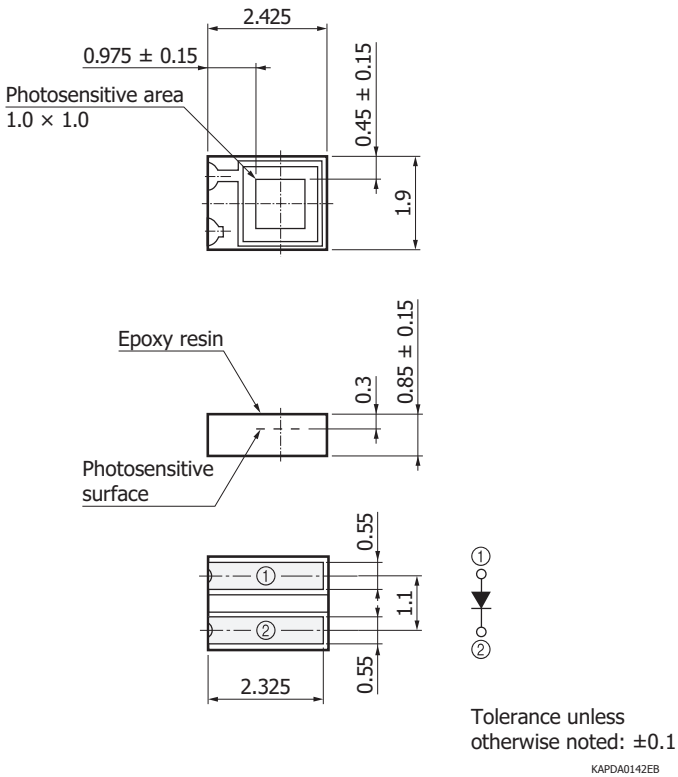
S12571-010/-015P

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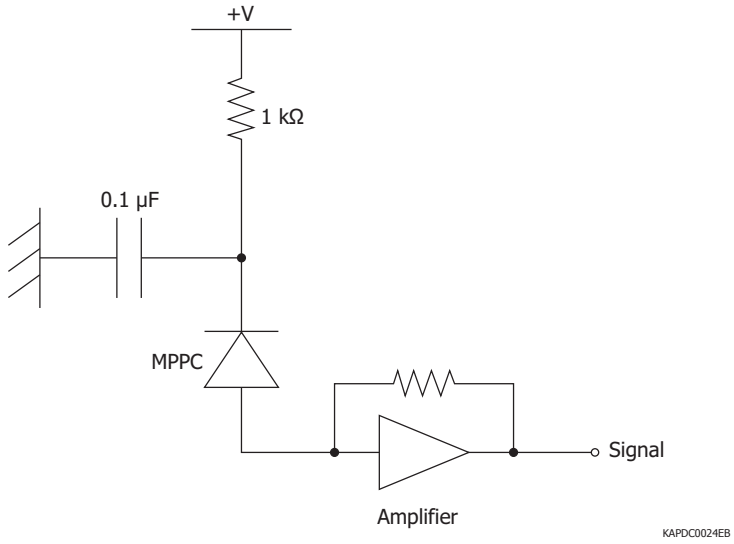
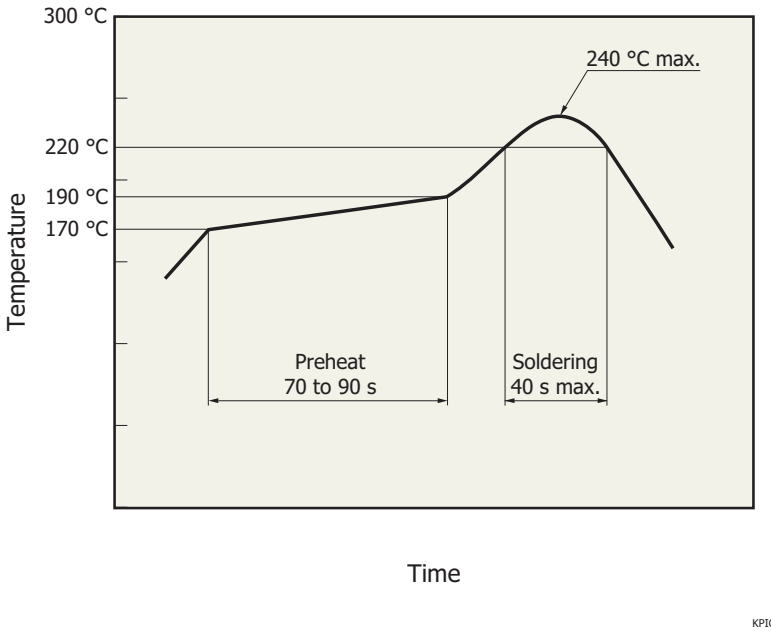
## Connection example




## Measured example of temperature profile with our hot-air reflow oven for product testing




· This surface mount type product supports lead-free soldering. After unpacking, store it in an environment at a temperature of 25 °C or less and a humidity of 60% or less, and perform soldering within 24 hours.
· This effect that the product receives during reflow soldering varies depending on the circuit board and reflow oven that are used. Before actual reflow soldering, check for any problems by testing out the reflow soldering methods in advance.

## Precautions

· If necessary, incorporate appropriate protective circuits in power supplies, devices, and measuring instruments to prevent overvoltage and overcurrent.

## Related information

www.hamamatsu.com/sp/ssd/doc_en.html

■ Precautions
· Disclaimer
· Metal, ceramic, plastic package products
· Surface mount type products



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