

# MPPC modules

Hamamatsu provides a full lineup of MPPC modules capable of measuring light over a wide range (10 orders of magnitude) from the photon counting region to nW (nano watt) region. MPPC modules contain an amplifier, a high-voltage power supply circuit, and other components needed for MPPC operation. MPPC modules operate just by connecting them to a power supply (e.g.,  $\pm 5$  V).

Hamamatsu offers a wide lineup of MPPC modules including cooled modules that give a low dark count and non-cooled modules with a temperature compensation function for stable measurement. Hamamatsu also provides starter kits developed for making initial MPPC evaluations and high-accuracy temperature-compensated high-voltage power supply modules designed to operate an MPPC.

## 1 Features

- Wide lineup to meet various applications and incident light levels (number of photons)

Our lineup includes analog output types for applications handling relatively high levels of light where analog signals are required, digital output types for photon counting, and a starter kit for initial MPPC evaluation.

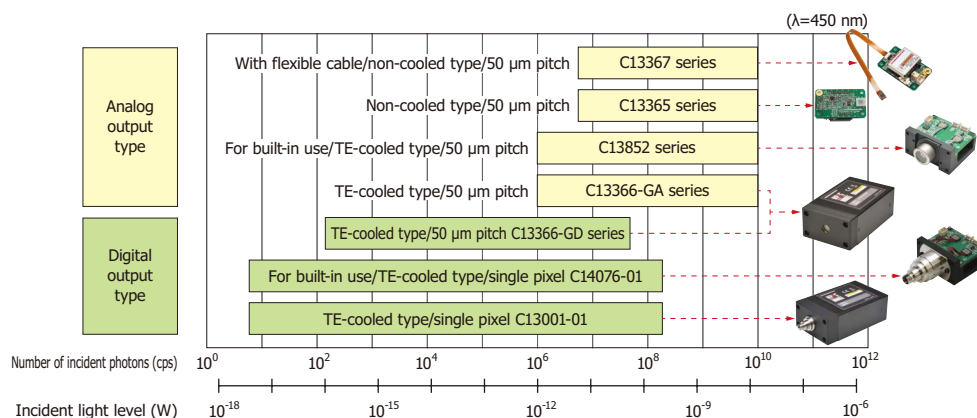
- Contains a high-precision temperature compensation circuit or temperature control circuit

The MPPC is used in Geiger mode where the gain is very high. Ambient temperature fluctuations cause the gain to vary even if the same reverse voltage is applied. To keep the MPPC gain constant, the MPPC modules use temperature compensation circuit that adjusts the MPPC reverse voltage as the ambient temperature changes or temperature control circuit that regulates the MPPC element temperature using a thermoelectric cooler.

In temperature compensation circuit, a high-precision temperature sensor is installed near the MPPC element to accurately sense the MPPC temperature. The reverse voltage applied to the MPPC is then adjusted according to changes in the ambient temperature so that the gain is kept constant with high accuracy and stability. In temperature control circuit, the MPPC chip and a temperature sensor are mounted on a thermoelectric cooler. Based on information from the temperature sensor, the MPPC chip temperature is precisely controlled and maintained at a constant level so that the MPPC gain is kept constant even if the ambient temperature changes.

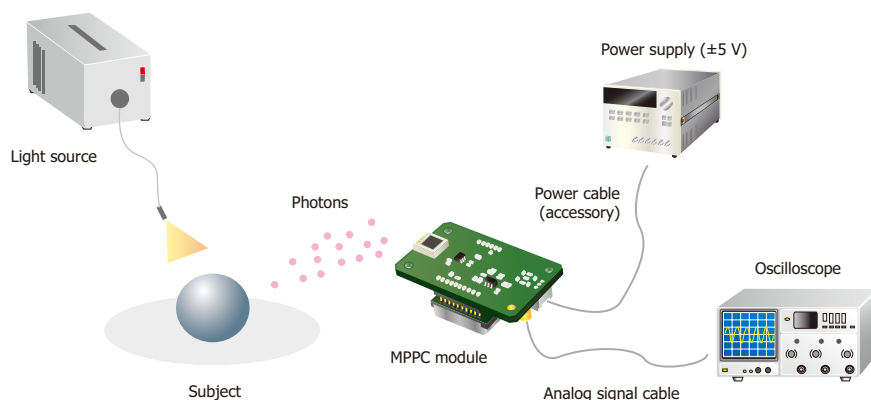
- Includes a signal readout circuit optimized for MPPC
- Includes a low-noise high-voltage power supply
- Compact and lightweight

[Figure 1] Measurable incident light level range



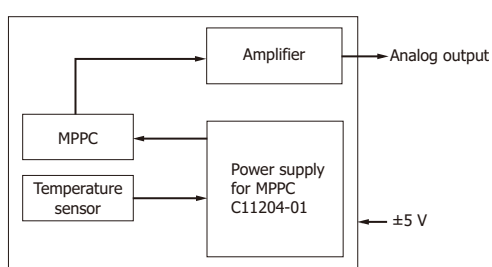
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[Figure 2] Connection example (analog output type)



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[Figure 3] Block diagram (C13365 series)



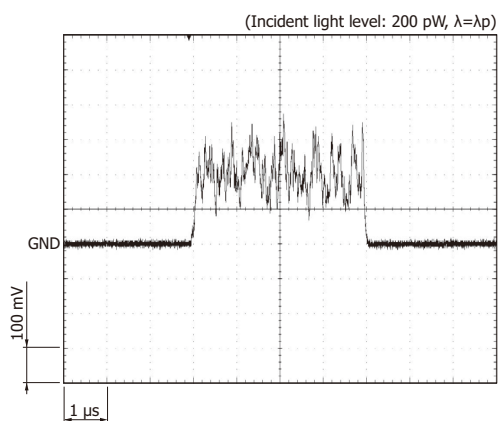
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## 2 How to use

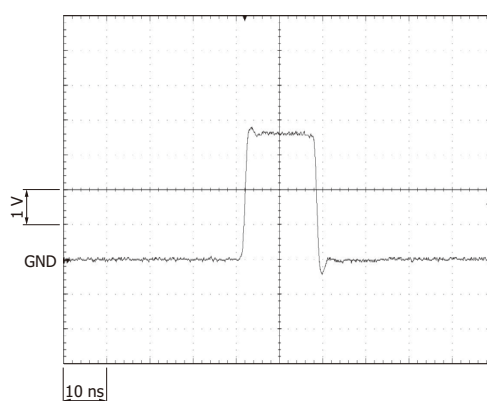
To use the MPPC module, connect it to an external power supply by using the power cable that came supplied with the MPPC module. The signal is output from the coaxial connector on the MPPC module. If using an analog output type MPPC module, the output waveforms can be monitored by connecting to an oscilloscope and the like. If using a digital output type, the number of output pulses can be counted by connecting to a frequency counter and the like.

[Figure 4] Output waveforms

### (a) Analog output type



### (b) Digital output type (TTL compatible)



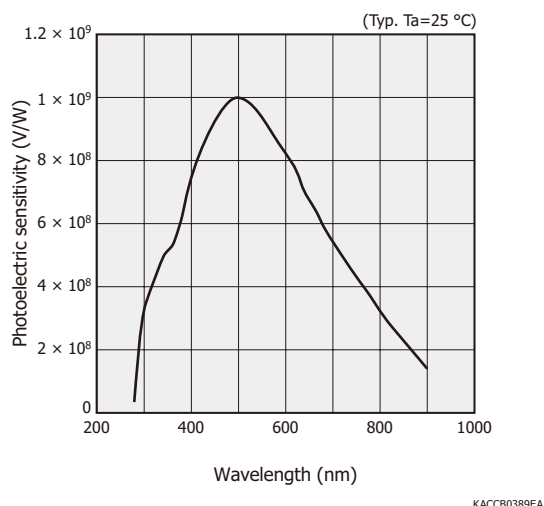
## 3 Characteristics

### » Sensitivity

#### (1) Photoelectric sensitivity (analog output type)

On analog output types, photoelectric sensitivity is defined as the output voltage from the MPPC module divided by the incident light level (unit: W) at a given wavelength, and is expressed in volts per watt (V/W).

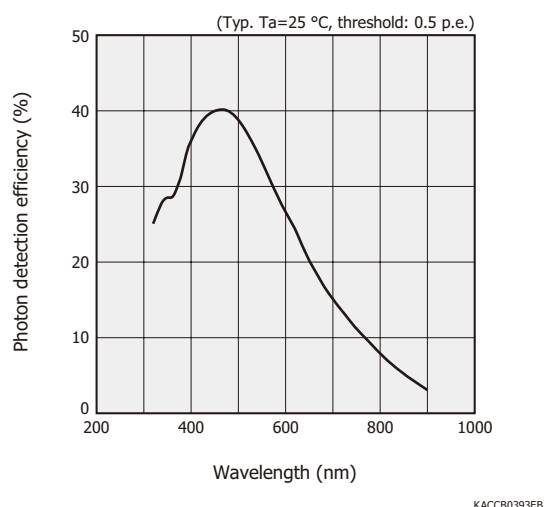
[Figure 5] Photoelectric sensitivity vs. wavelength (C13365 series)



## (2) Photon detection efficiency (digital output type)

On digital output types, photon detection efficiency is defined as the number of photons detected by the MPPC module divided by the number of incident photons and is expressed as a percentage.

[Figure 6] Photon detection efficiency vs. wavelength (C13366 series)



## » Dynamic range

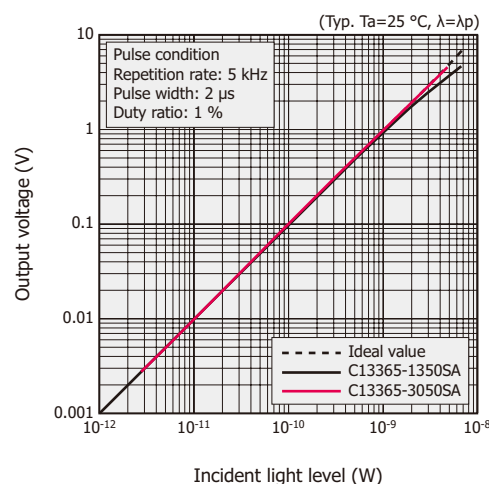
### (1) Analog output type

Figure 7 shows typical dynamic ranges for analog output types (non-cooled type). Comparing the C13365-1350SA (photosensitive area: 1.3 mm sq.) with the C13365-3050SA (photosensitive area: 3 mm sq.) proves that the C13365-3050SA exhibits better linearity since it contains a larger number of pixels.

When the incident light level is high, the heat generated in the chip becomes too large to ignore. In this case, decreasing the duty ratio of the incident light is recommended. If using a thermoelectrically cooled

type, the element temperature will be maintained at a constant level, so the heat generated in the chip can be ignored in most cases.

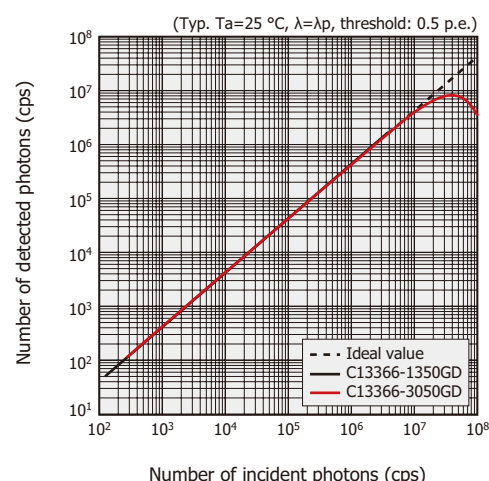
[Figure 7] Output voltage vs. incident light level (C13365 series)



### (2) Digital output type

Figure 8 shows dynamic ranges for digital output types. Since the lower detection limit is determined by the dark count, the C13366-1350GD (photosensitive area: 1.3 mm sq.) is better at the lower limit than the C13366-3050GD (photosensitive area: 3 mm sq.). When the number of incident photons becomes larger, the output begins to deviate from the ideal linearity due to overlapping of pulses, and eventually no pulses will appear in the output.

[Figure 8] Number of detected photons vs. number of incident photons (C13366 series)



## 4 Power supply modules

Running the MPPC requires a voltage around 40 to 60 V and since the gain changes when the ambient temperature

changes, a temperature compensation function is necessary to deal with temperature changes. Hamamatsu have high-voltage power supply modules with such features.

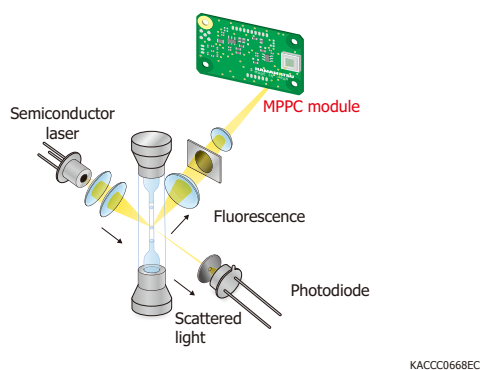
[Figure 9] Power supply module



## 5 Applications

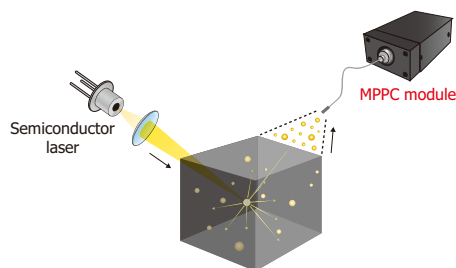
### » Flow cytometry

To detect the type, quantity, and nucleic acid (DNA, RNA), etc. of cells, laser light is incident on a fast running solution containing the cells. This enables the MPPC module to capture the minute fluorescence that is emitted.



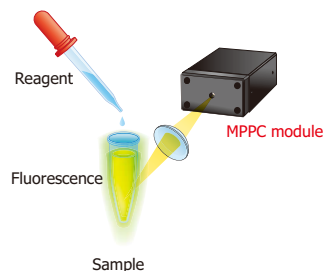
### » Particle measurement

Laser is transmitted through a chamber containing gas or liquid with particles. By detecting the scattered light from the particles, the quantity and diameter distributions of the particles can be attained.



### » Fluorescence measurement

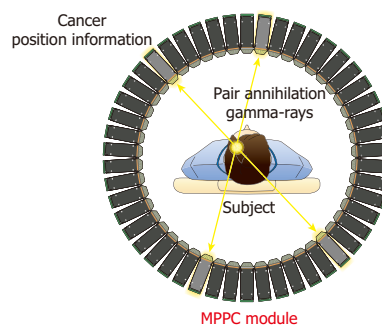
The MPPC module can detect minute fluorescence emission of reagents.



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### » Scintillation measurement

MPPC modules arranged around 360° detect pair annihilation gamma-rays to capture the target position such as cancer tissue.



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## 6 Q&A

### ⚙ What is the recommended power supply?

We introduce a commercially available stabilized power supply suitable for the MPPC module used. Please contact your local Hamamatsu sales office.

### ⚙ Is it possible to change the gain of the MPPC module?

For some products, a gain adjustment tool (sold separately) is available. Please contact us.

### ⚙ What kind of power cable comes with the module?

The MPPC modules come with a power cable of about 1 meter long with a single cut end.

Information described in this material is current as of May 2025.

Product specifications are subject to change without prior notice due to improvements or other reasons. This document has been carefully prepared and the information contained is believed to be accurate. In rare cases, however, there may be inaccuracies such as text errors. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.

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