MPPC modules

C11208 series

Photon counting module with built-in TE-cooled MPPC®

The C11208 series is a photon counting module that contains a thermoelectrically cooled MPPC (multi-pixel photon counter) capable of detecting ultra-low light. Along with the thermoelectrically cooled MPPC, it consists of a current-to-voltage converter, a high-speed comparator, a high-voltage power supply circuit, a temperature control circuit, a counter circuit, and a microcontroller. The MPPC is efficiently cooled down to -10 °C to reduce the dark count (approx. 1/20 that of the C10507 series). A USB port is also included to connect to a PC for threshold level setting and data acquisition. No external power supply is required since the circuitry is powered by the USB bus. The C11208 series extracts maximum performance from the MPPC to achieve excellent photon counting characteristics.

Features

- → **Contains TE-cooled MPPC**
- → **Reduced dark count [approx. 1/20 that of C10507 series (room temperature type)]**
- → **Includes all circuits necessary for MPPC operation**
- → **Driven by USB bus power (no external power supply required)**
- → **Compact and lightweight**

Applications

- → **Ultra-low light detection**
- → **Analytical instruments**
- → **Fluorescence lifetime measurement**
- → **Particle counters**
- → **Bioluminescence analysis**

Selection guide

Type no.	Internal MPPC			
	Number of pixels	Pixel size (μm)	Effective active area (mm)	Type no.
CE compliant C11208-01	1600	25 × 25		S11028-025
CE compliant C11208-02	400	50 × 50	1 × 1	S11028-050
CE compliant C11208-03	100	100 × 100		S11028-100

CE

The C11208 series conform to the European EMC directive (applied standard: EN 61326-1 Class B).

Absolute maximum ratings

Parameter	Condition	Value	Unit
Operating temperature	No condensation	0 to +35[*1]	°C
Storage temperature	No condensation	-20 to +60	°C

*1: Includes an internal temperature monitor function that does not allow the MPPC module to operate when the internal temperature at the start of cooling is below 0 °C or above 35 °C.

Specifications (Ta=25 °C, unless otherwise noted)

Parameter		Condition	Min.	Typ.	Max.	Unit
Spectral response range				320 to 900		nm
Peak sensitivity wavelength				440		nm
Element temperature (Setting temperature)[*2] [*3]				-10		°C
Photon detection efficiency[*4]	C11208-01	$\lambda=\lambda p$ 0.5 p.e. (threshold level)	-	20	-	%
	C11208-02		-	40	-	
	C11208-03		-	50	-	
Dark count	C11208-01	0.5 p.e. (threshold level)	-	20	30	kcps
	C11208-02		-	30	40	
	C11208-03		-	40	50	
Analog output voltage[*3] [*5]			80	100	120	mV/p.e.
Temperature stability of analog output voltage		0 to +35 °C	-	-	±4	%
Comparator output				TTL compatible		-
Comparator threshold level				0.5, 1.5, 2.5, 3.5, 4.5, 5.5, 6.5, 7.5, disable (adjustable 9 states)		p. e.
Interface				USB 1.1		-

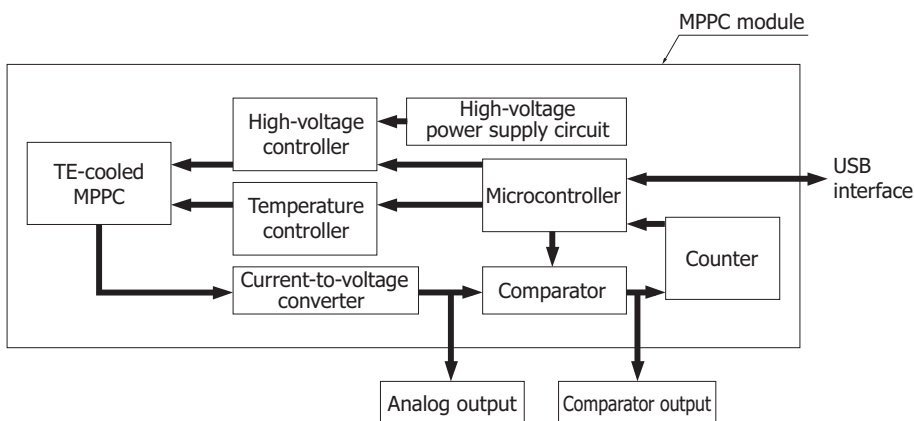*2: If the element temperature becomes 2 °C higher or lower than the setting temperature, cooling stops automatically and no signal is output.
*3: Cannot be changed
*4: Photon detection efficiency includes effects of crosstalk and afterpulses.
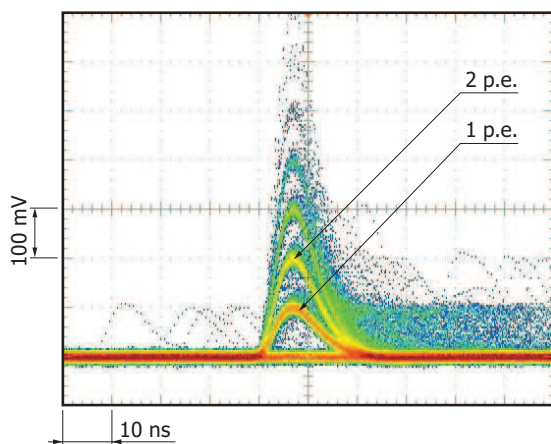*5: Should be used with 50 Ω termination
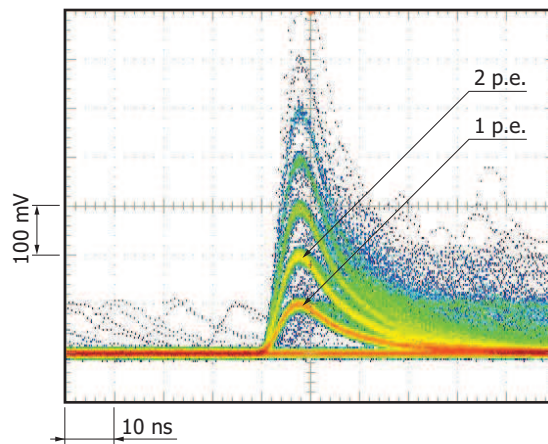
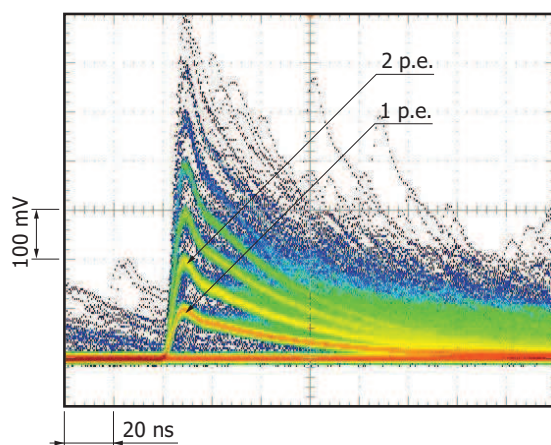## Block diagram

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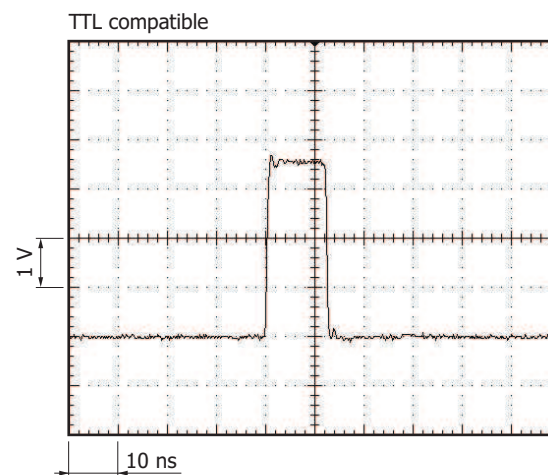## Measurement example

Analog output (C11208-01)

100 mV
2 p.e.
1 p.e.
10 ns

Analog output (C11208-02)

100 mV
2 p.e.
1 p.e.
10 ns

Analog output (C11208-03)

100 mV
2 p.e.
1 p.e.
20 ns

Comparator output

TTL compatible

1 V
10 ns

■ Setup

Trigger signal

Oscilloscope

Photons

Optical fiber

Optical attenuator

Light source

MPPC module

PC

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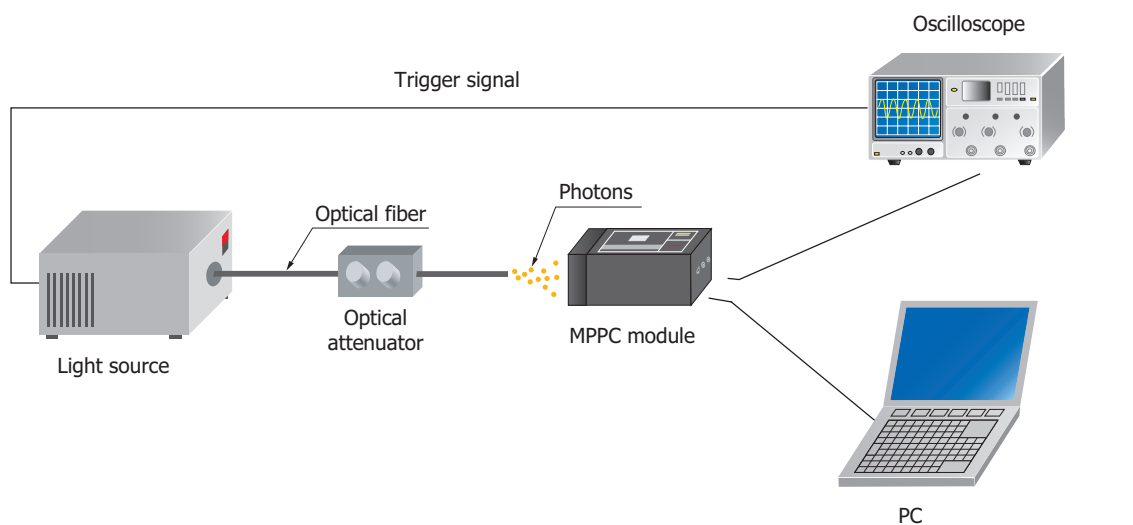
Photon detection efficiency vs. wavelength (typical example)

(0.5 p.e. threshold level)

C11208-03
C11208-02
C11208-01
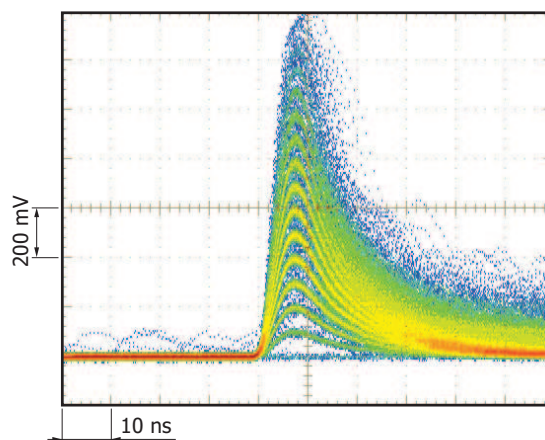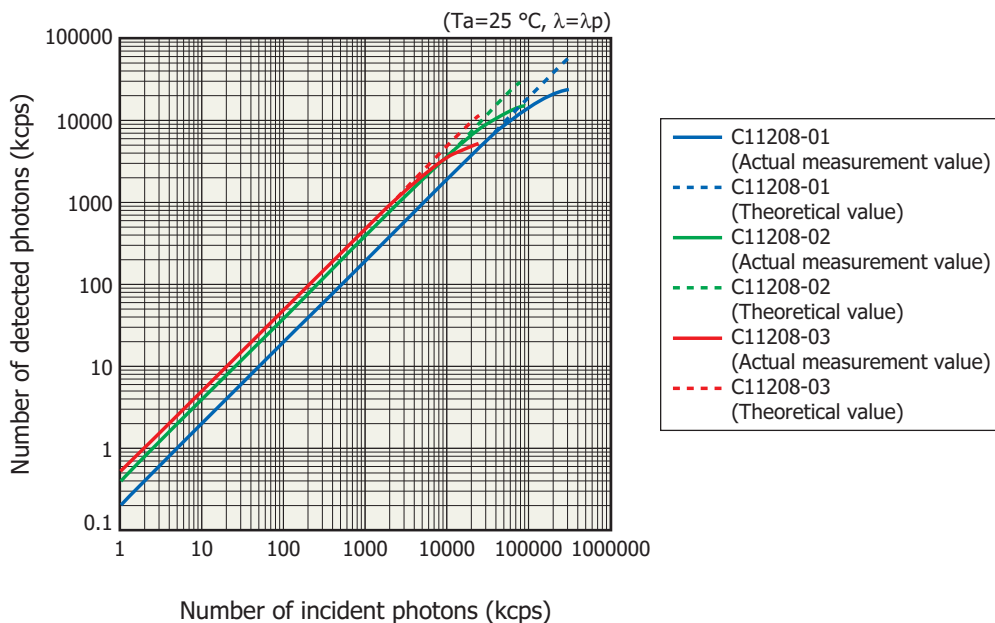
Photon detection efficiency* (%)

Wavelength (nm)
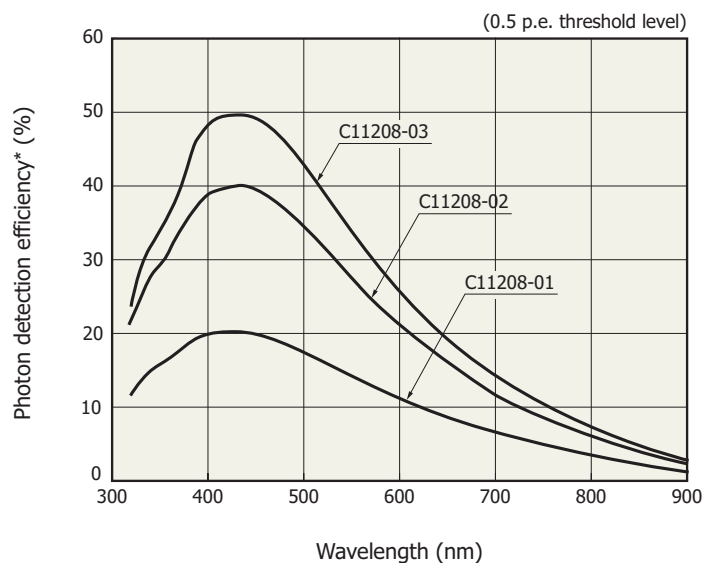
* Photon detection efficiency includes effects of crosstalk and afterpulses.

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Saturation output voltage (typical example)

200 mV

10 ns

Linearity (typical example)

(Ta=25 °C, λ=λp)

Number of detected photons (kcps)

Number of incident photons (kcps)

— C11208-01 (Actual measurement value)
--- C11208-01 (Theoretical value)
— C11208-02 (Actual measurement value)
--- C11208-02 (Theoretical value)
— C11208-03 (Actual measurement value)
--- C11208-03 (Theoretical value)

The MPPC module and a point light source, which face each other at a certain distance, are placed in darkness, and a calibration photodiode is installed in position very close the MPPC. The number of photons incident on the MPPC module is detected by the calibration photodiode and is then compared with the output count of the MPPC module in order to find the linearity.

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Connection example

To use the MPPC module, it must be connected to a PC through a USB 1.1 interface. The MPPC is powered by the USB bus power from the PC. Various MPPC module operations are performed on the PC, and the measurement data can be monitored on the PC. Connecting the analog output to an oscilloscope allows monitoring the output waveforms. Connecting the comparator output to a frequency counter allows obtaining the count value.
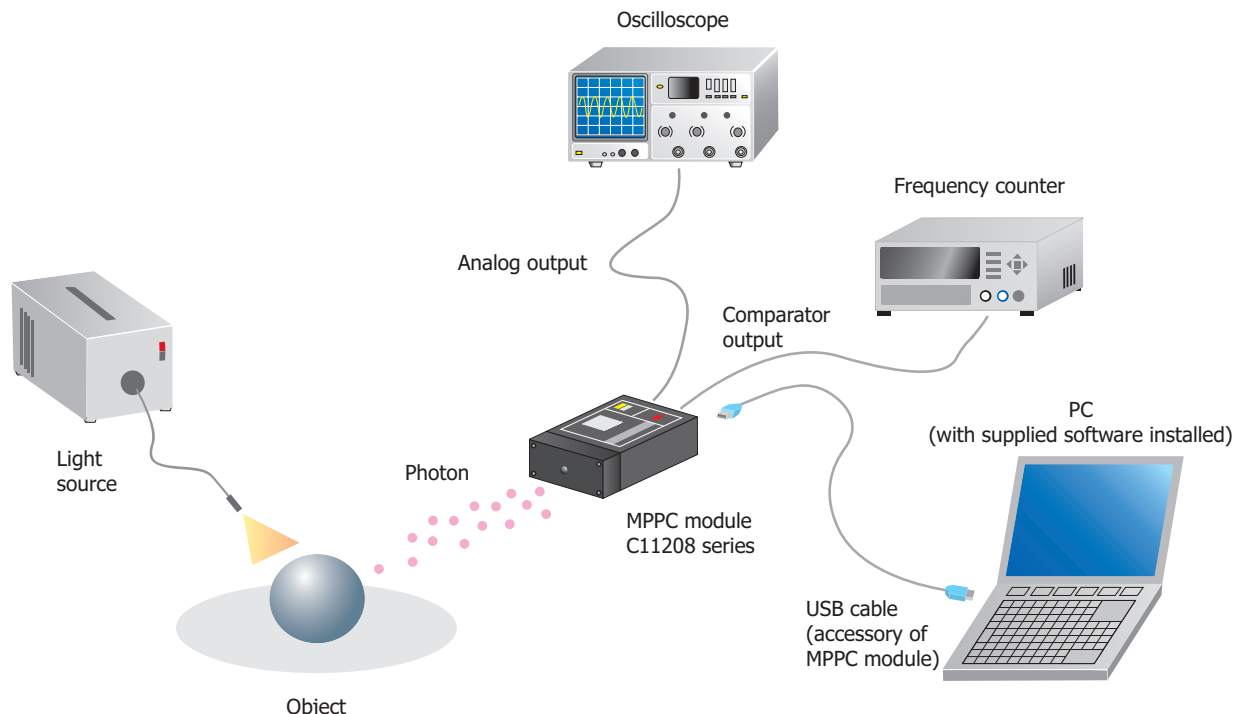
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Sample software

The sample software is designed to easily perform basic MPPC module operations. Using the sample software makes it easy to perform measurements. Basic functions of the sample software are acquiring data, displaying measurement data graphs, and saving data.

■ System requirements for sample software
The sample software operation is verified by the following systems. Operation with other systems is not guaranteed.

Microsoft® Windows® XP Professional SP3 (32-bit)[6]
Microsoft® Windows® Vista Business SP1, SP2 (32-bit)[6]
Microsoft® Windows® 7 Professional no SP, SP1 (32-bit/64-bit)[6]

We recommend using a PC with a high-performance CPU and a large capacity memory. A high-performance CPU and large memory are especially important when operating two or more MPPC modules simultaneously.

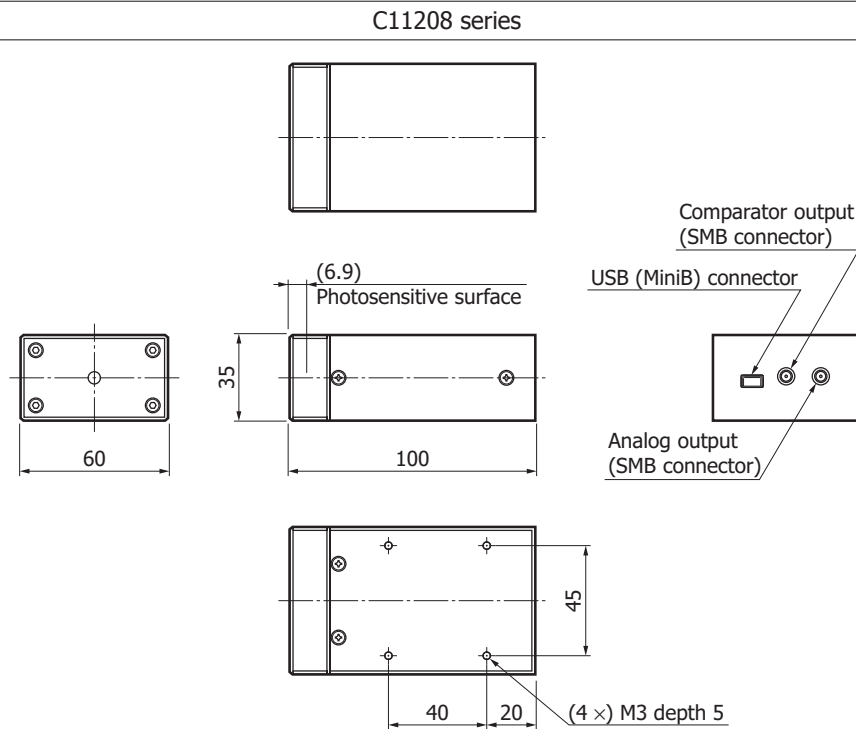■ Example of measuring ultra-low level light
This graph shows an output change when very low level light is input in dark conditions.
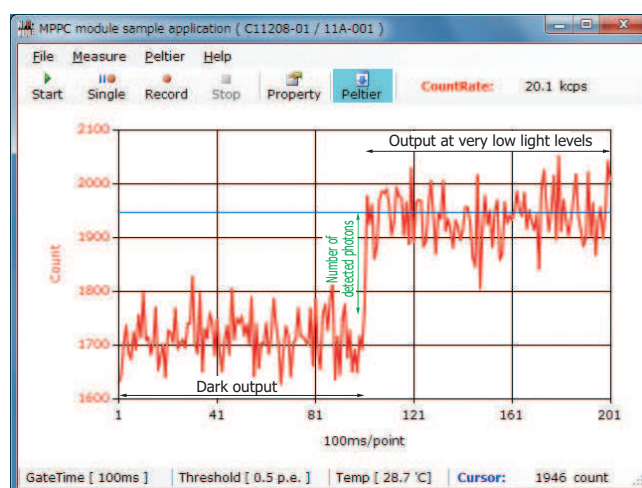
Vertical axis: Number of input counts per gate time setting
Horizontal axis: Time [1 second per scale division (10)]

*6: Microsoft Windows is either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries

Dimensional outline (unit: mm, tolerance unless otherwise noted: ±0.5)

C11208 series

(6.9)
Photosensitive surface

35

60

100

Comparator output
(SMB connector)

USB (MiniB) connector

Analog output
(SMB connector)

45

40   20   (4 ×) M3 depth 5

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Accessories

· USB cable
· Quick start guide
· CD-ROM (Instruction manual, sample software)

Precautions

· Do not use organic solvent such as thinner and acetone for cleaning. Use a soft dry cloth to wipe clean the surface of the MPPC module.
· For instructions on how to install the sample software to your PC, refer to the "Quick start guide" that comes with the MPPC module. When installing the sample software, make sure that the MPPC module is not connected to the PC. Otherwise, the software installation might fail.
· Power to this product is supplied from the USB port on the PC. Due to the USB specifications, the maximum power that can be supplied from one USB port is limited to 5 V, 500 mA. Avoid connecting two or more units to one USB port through a hub. Typical power consumption of the MPPC module is 500 mA.
· Depending on the PC model, the power supplied from the USB port might be interrupted when the power saving function or screensaver is activated. In this case, the MPPC module also stops operation and might create problems when the PC returns from power saving or screensaver mode.
  If USB power from your PC is interrupted in this same way, disable the power saving function and screensaver. For information on PC functions and settings, refer to the PC operation manual.
· The entire case of this module also serves as a heatsink, so do not cover it with a light-shielding cloth, etc. Doing so may increase the internal temperature, leading to malfunction of the module.

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Options (sold separately)

Coaxial converter adapter A10613 series

The A10613 series is a coaxial adapter that converts the SMB coaxial connector for signal-output on the MPPC module to a BNC or SMA coaxial connector. This adapter allows connecting a BNC or SMA cable to the MPPC module.

A10613-01 (SMB-BNC)

A10613-02 (SMB-SMA)

Description of terms

▷ Analog output voltage

The MPPC module analog output is set so as to obtain a peak voltage of 100 mV at 1 p.e.

▷ Dark count

Output pulses are produced not only by photon-generated carriers but also by thermally-generated dark current carriers. The dark current pulses are measured as dark count which then causes detection errors. The dark count can be reduced by lowering the temperature. In the MPPC module, the count value measured at 0.5 p.e. is defined as the dark count.

▷ Photon detection efficiency: PDE

This is a measure of what percent of the incident photons were detected. Not all carriers generated by the incidence of photons will create pulses at an amplitude large enough to be detected, so photon detection efficiency is lower than quantum efficiency. In the MPPC module, the count value measured using a threshold of 0.5 p.e. is defined as the dark count.

▷ p.e. (photon equivalent)

This indicates that one photon was detected. For example, a 1 p.e. pulse is equivalent to the pulse (including noise components) obtained when one photon is detected.

Lineup of MPPC module

Type no.		Internal MPPC					Spectral response range (nm)
		Number of pixels	Pixel size (μm)	Package	Effective photosensitive area (mm)	Type no.	
Room temperature type	C10507-11-025U	1600	25 × 25	Metal	1 × 1	S10362-11-025U	320 to 900
	C10507-11-050U	400	50 × 50			S10362-11-050U	
	C10507-11-100U	100	100 × 100			S10362-11-100U	
	C10507-11-025C	1600	25 × 25	Ceramic		S10362-11-025C	
	C10507-11-050C	400	50 × 50			S10362-11-050C	
	C10507-11-100C	100	100 × 100			S10362-11-100C	
	CE compliant C10751-01	1600	25 × 25	Metal		S10362-11-025U	
	CE compliant C10751-02	400	50 × 50			S10362-11-050U	
	CE compliant C10751-03	100	100 × 100			S10362-11-100U	
TE-cooled type	CE compliant C11208-01	1600	25 × 25			S11028-025	
	CE compliant C11208-02	400	50 × 50			S11028-050	
	CE compliant C11208-03	100	100 × 100			S11028-100	

Note: The last letter of each type number indicates package materials (U: metal, C: ceramic).
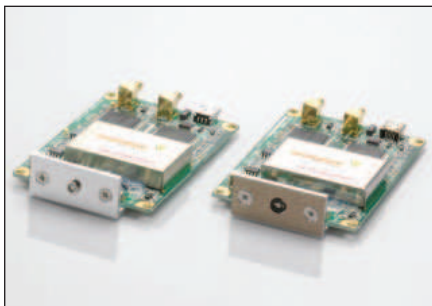
C10507-11 series	C10751 series	C11208 series

Information described in this material is current as of September, 2011.
Product specifications are subject to change without prior notice due to improvements or other reasons. Before assembly into final products, please contact us for the delivery specification sheet to check the latest information.
Type numbers of products listed in the delivery specification sheets or supplied as samples may have a suffix "(X)" which means preliminary specifications or a suffix "(Z)" which means developmental specifications.
The product warranty is valid for one year after delivery and is limited to product repair or replacement for defects discovered and reported to us within that one year period. However, even if within the warranty period we accept absolutely no liability for any loss caused by natural disasters or improper product use.
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