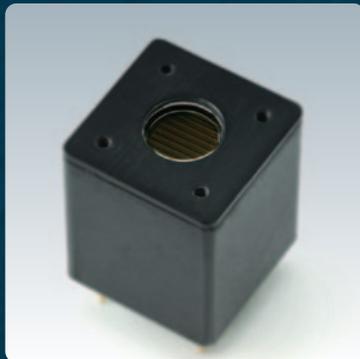
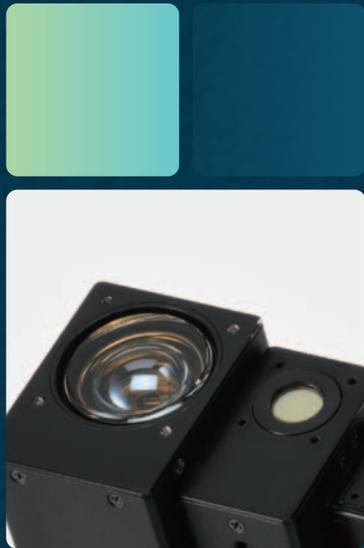
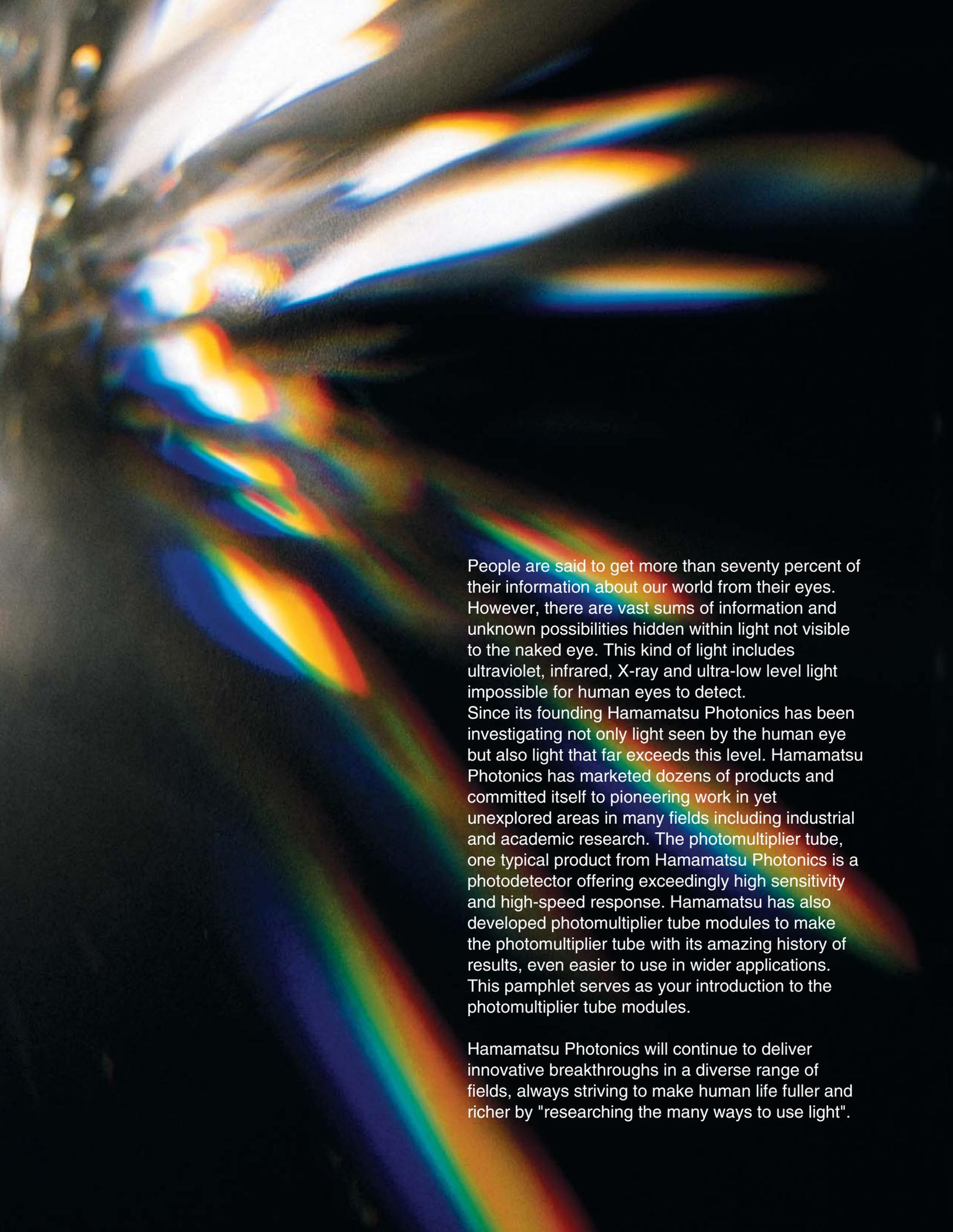




# PHOTOMULTIPLIER TUBE MODULES





People are said to get more than seventy percent of their information about our world from their eyes. However, there are vast sums of information and unknown possibilities hidden within light not visible to the naked eye. This kind of light includes ultraviolet, infrared, X-ray and ultra-low level light impossible for human eyes to detect.

Since its founding Hamamatsu Photonics has been investigating not only light seen by the human eye but also light that far exceeds this level. Hamamatsu Photonics has marketed dozens of products and committed itself to pioneering work in yet unexplored areas in many fields including industrial and academic research. The photomultiplier tube, one typical product from Hamamatsu Photonics is a photodetector offering exceedingly high sensitivity and high-speed response. Hamamatsu has also developed photomultiplier tube modules to make the photomultiplier tube with its amazing history of results, even easier to use in wider applications. This pamphlet serves as your introduction to the photomultiplier tube modules.

Hamamatsu Photonics will continue to deliver innovative breakthroughs in a diverse range of fields, always striving to make human life fuller and richer by "researching the many ways to use light".

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Hamamatsu offers a full lineup of photomultiplier tube (PMT) modules adaptable to various kinds of applications and measurements. Now you can make the best choice from among our PMT modules available with diverse device characteristics and shapes, analog or digital outputs, CPU and interfaces for control and data transfer with computers and even gating function.

Function	Current output		Voltage output	
	Type	With gate function		With cooler
Micro PMT	 H12402/12403 P.8			 H12404/12405 P.9
	 H14066 P.8			
Metal package PMT	 H10720/H10721 H11900/H11901 P.11	 H11526/H12056 H11706 P.14 P.15	 H7422 P.13	 H10722/H11902 H10723/H11903 P.22 P.23
	 H14600 P.12			
Side-on PMT	 H9305/H13320 P.16			 H9306/H9307 P.24
	 H11461 P.17			 H11462 P.24
Head-on PMT	 H7826 P.18	 H10425 H10426 P.18 P.19	 H14447 P.19	 H7827 P.25
	 H11411 H11432 P.21	 H13543 P.21		 H10492 H10493 P.25 P.26

## What is PMT module

The PMT module is basically comprised of a photomultiplier tube to convert light into electrical signals, a high-voltage power supply circuit, and a voltage divider circuit to distribute the optimum voltage to each dynode, all assembled into a single compact case. In addition to these basic PMT modules, Hamamatsu also provides modules having various additional functions such as signal processing, cooling and interface to PC.

Photon counting				Type
	With gate function	CPU + I/F	With cooler	
 <p>H12406 P.10</p>				Micro PMT
 <p>H10682 P.27</p>		 <p>H11890 P.27</p>	 <p>H7421 P.28</p>	Metal package PMT
 <p>H12386 P.27</p>				
 <p>H12525 P.29</p>	 <p>H8259 P.29</p>			Side-on PMT
 <p>H12775 P.30</p>	 <p>H7828 P.30</p>	 <p>H9319 P.32</p>		Head-on PMT
 <p>H13467 P.31</p>	 <p>H11870 P.31 H11123 P.32</p>			

# Constitution examples

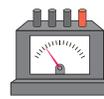
Examples of how to use PMT modules and related products are shown below according to the type of measurement.

The cable ends of the cable output types do not have connectors such as BNC connectors. We can install a connector (extra charge) if needed. Please specify the type of connector along with the cable length when placing your order.

## Connecting to ammeters



Current output type

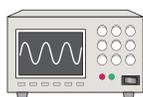


Commercial ammeter

## Connecting to oscilloscopes



Current / Voltage output type



Commercial oscilloscope



Current output type



Amplifier unit (P.33)



Commercial oscilloscope

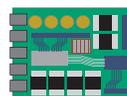
## Using AD converters



Current output type



Amplifier unit (P.33)



Commercial ADC board



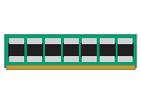
## Time-correlated single photon counting



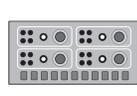
Current output type



Amplifier unit (P.33)



Commercial CFD



Commercial TAC



## Photon counting



Photon counting head



Commercial counter



Photon counting head



Photon counting head



Counting unit (P.34)



Current output type selected for photon counting



Photon counting unit (P.34)



Counting unit (P.34)



# Application examples

## Flowcytometers

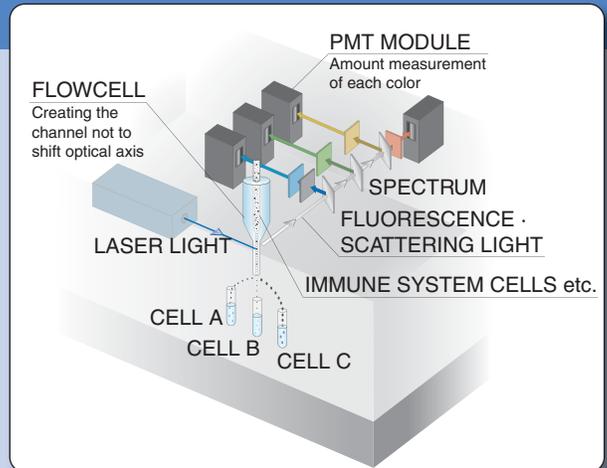
In a flowcytometers, cells labeled with fluorescent material flow in a solution along a flow cell while moving at a certain interval. A laser beam is then irradiated onto the cells and the scattered light from the cells and fluorescence from the fluorescent material are measured by a photomultiplier tube. Various kinds of information are acquired from the scattered and fluorescence such as cell surface antigens, cell periods, number of cells, immunity functions and reticulocytes, and the cells can also be separated from each other. Rapid advances are recently being made in irradiation by multiple lasers, 6-channel color analysis, high-speed operation, and compact flow systems.

**Vital characteristics**

- High-speed response
- High quantum efficiency

**PMT modules**

- H11900/H11901 series (P.11)
- H10720/H10721 series (P.11)
- H9305/H13320 series (P.16)



TPMOC0142EC

## DNA chip reader

A DNA chip reader is used to analyze colossal amounts of genetic information. The DNA chip is a substrate on which a large amount of DNA is arrayed usually by a method using semiconductor lithographic technology, or a method dispensing the DNA onto a slide glass using a high-precision robot. On the DNA chip, hybridization is performed on the DNA labeled by a fluorescent dye. The DNA chip is then scanned by laser beam and by measuring the fluorescent intensity of the hybridized DNA spot, the genetic information is acquired from among the targeted DNA.

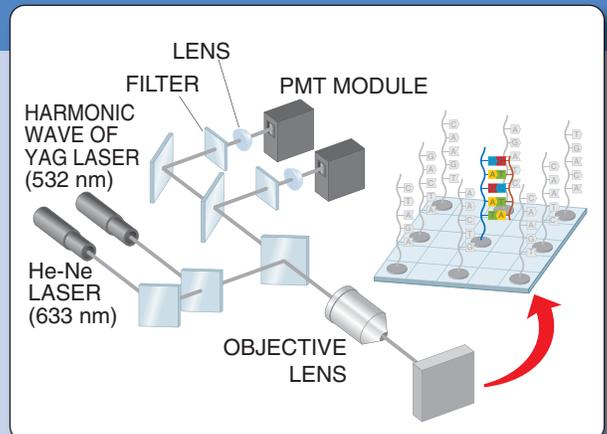
(Hybridization is process to link 2 chains of DNA each having a complementary base.)

**Vital characteristics**

- High-speed response
- High quantum efficiency

**PMT modules**

- H9305/H13320 series (P.16)



TPMOC0140EB

## Blood inspection

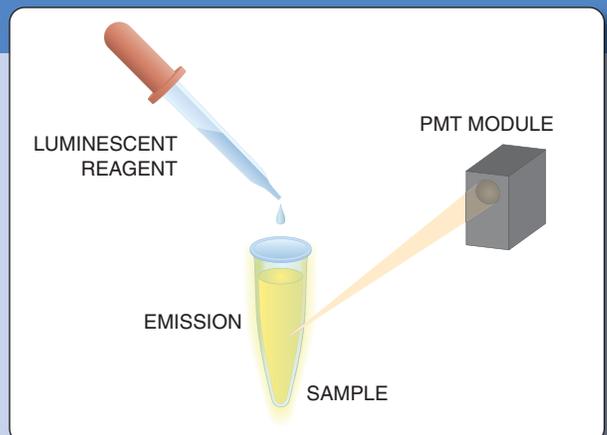
Blood includes the antigen, which is the material causes immune reaction, of individual disease or bacteria which the person has. There is a blood inspection method which can decide that the subject has a disease or bacteria to what extent by reacting small amount of blood with an antibody as a reagent which bonds with specific antigen and measuring its amount of luminescence. While the study in order to improve efficiency of bonding or emission has been advanced, there has been also a demand to decrease the amount of sample used to measure. In order to achieve such demand, photomultiplier tubes are used as the detector which can perform single photon counting.

**Vital characteristics**

- Wide dynamic range
- High sensitivity

**PMT modules**

- H10682-110 (P.27)
- H10721-110 (P.11)



TPMOC0259EA

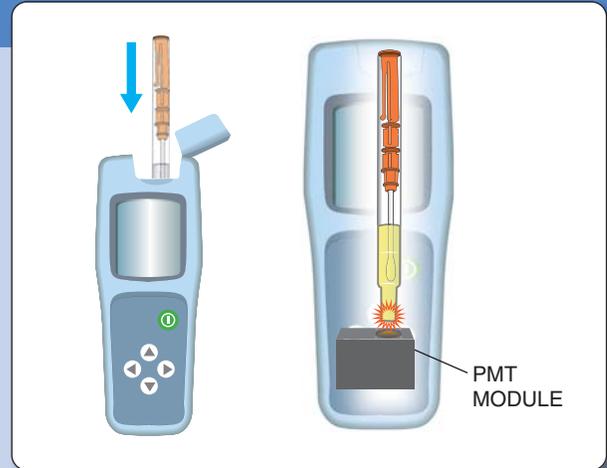
# Application examples

## Hygiene monitor

The hygiene monitor is also called an ATP analyzer. This device extracts the ATP held in bacteria and cells and makes measurements by causing a reaction with the luminous reagent in the ATP using the firefly's light emission principle. This hygiene monitor is used for making purity checks at restaurants and factories producing foods, etc. In the test, the surface of the object for inspection is wiped with a cotton swab and the extent of dirt or contamination immediately found just by inserting the swab in the sanitary monitor. A great feature of the hygiene monitor is that the photon counting method allows highly sensitive measurements using just an extremely small amount of sample material.

**Vital characteristics** ● Compact and light weight  
● Low power consumption

**PMT modules** ● H7828 (P.30)



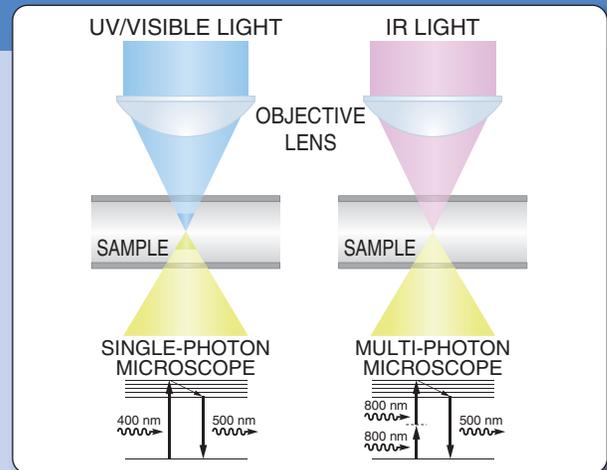
TPMOC0137EB

## Multi-photon microscope

In this method, fluorescent molecules can be excited with near infrared light by letting the molecules absorb two photons almost simultaneously, and the resulting visible to UV fluorescence is observed. The cross sectional area absorbing the two photons is extremely small, so nearly all the fluorescence must be detected as a signal at any position from the focal point. Other advantages are that nearly twice the wavelength is used compared to excitation by one photon. This not only means that unwanted effects from scattering and background noise inside the sample due to excitation light are drastically reduced but also that damage to cells from UV light is minimized.

**Vital characteristics** ● High quantum efficiency

**PMT modules** ● H7422-40 (P.13)  
● H9305-03 (P.16)



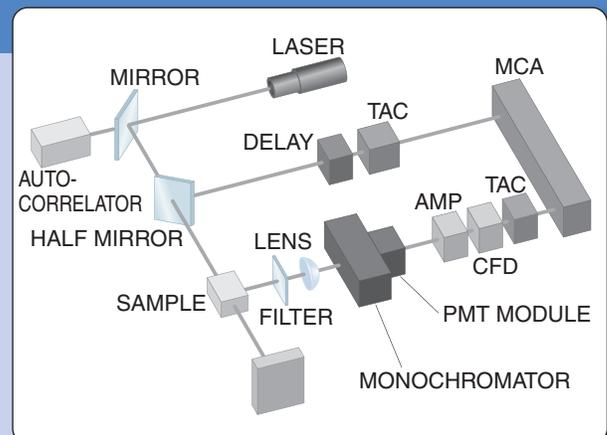
TPMOC0138EB

## Time-correlated single photon counting

Time-correlated single photon counting is used to measure low-level light emitted from a sample when excited with a pulsed laser, based on the theory that a histogram obtained by repeatedly measuring the single photon many times at a slightly delayed timing represents a waveform of the emitted light. Electrical signals produced by a laser driver are slightly delayed and used as trigger signals while the PMT module detects the light emission from a sample. The PMT module output pulse signals are then input to a time-to-amplitude converter (TAC) that produces an electrical pulse in proportion to the time difference between a light detection signal and a trigger signal. A multichannel analyzer (MCA) creates a frequency distribution of the output signals from the TAC, to obtain a waveform of the light emission of the sample.

**Vital characteristics** ● High-speed response  
● High gain

**PMT modules** ● H10721P-110 (P.11) ● H11901P-110 (P.10)  
● H7422P series (P.13)



TPMOC0163EB

## Portable survey meters

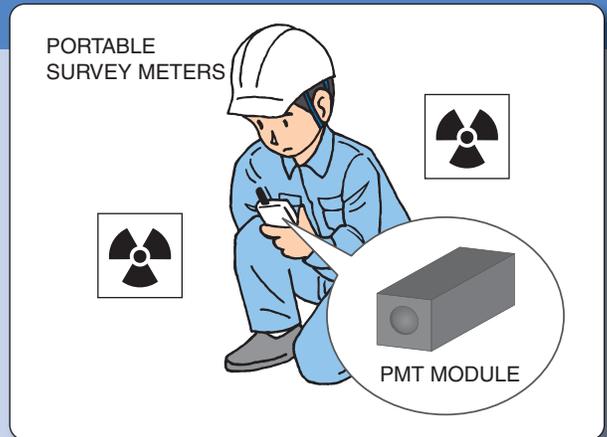
Portable radiation measurement devices or survey meters are essential for detecting radioactive substances for public safety in customs inspections, nuclear power plants, and hospitals, etc. Among various radiation measurement devices, the most sensitive type uses a combination of photomultiplier tube and scintillator and offers sensitivity ranging from several ten to hundreds of times higher than Geiger-Müller counters (GM counters). Photomultiplier tubes used in this application must be compact, rugged, and easily coupled to scintillators, and also have low power consumption.

**Vital characteristics**

- Compact and light weight
- Low power consumption
- Vibration-resistant

**PMT modules**

- H14600-100 (P.12)
- H10720-110/H10721-110 (P.11)
- H7826 (P.18)



## Semiconductor wafer inspection systems

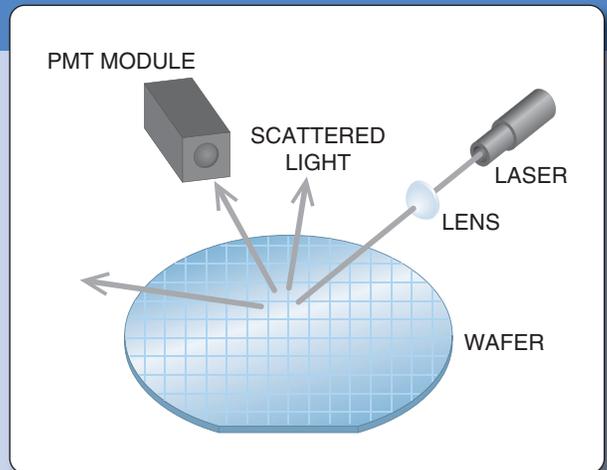
These systems find defects on semiconductor wafers, by scanning a laser beam onto the wafer and then detecting the resulting scattered light to find any debris, dirt or damage on the wafer surface. Advances in semiconductor technology have made lithographic lines on wafers even finer so that even smaller defects must now be detected making these inspection devices an essential tool.

**Vital characteristics**

- High-speed response
- Wide dynamic range

**PMT modules**

- H10721 series (P.11)
- H11901 series (P.11)



## Laser radar

One use of laser radar (often called "LIDAR\*") is making atmospheric measurements. A laser beam is emitted into the atmosphere and the light scattered by the "atmospheric molecules" and "suspended elements" then detected. The scattered light is absorbed by "trace gases" during its return and is therefore extremely faint. These "trace elements", and the distribution and concentration of suspended elements" can be analyzed by measuring this faint light. Lidar is actually used in measurements of aerosol and ozone concentrations, CO<sub>2</sub>, SO<sub>2</sub> and NO<sub>x</sub> concentrations, wind velocity and also the extent of visibility.

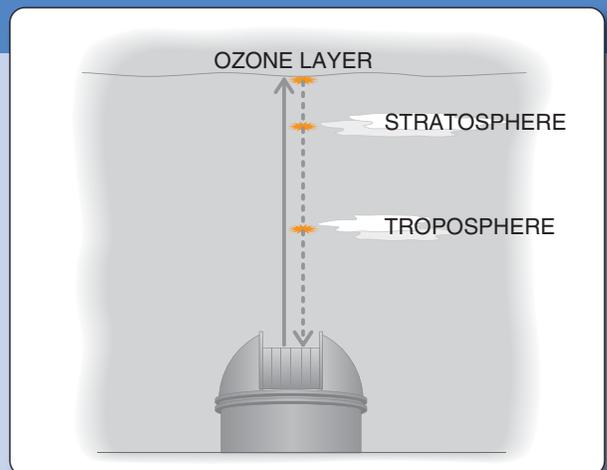
\* LIDAR: Light Detection And Ranging

**Vital characteristics**

- Gated operation
- Less after pulse

**PMT modules**

- H11526 series (P.14)
- H11870-01 (P.31)



## Micro PMT modules H12402 series Micro PMT modules H12403 series

(at +25 °C)



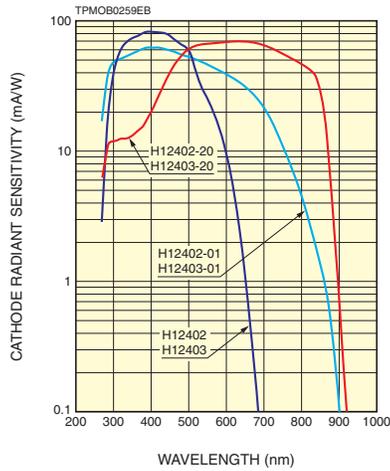
▲(Left) H12403 series,  
(Right) H12402 series

Parameter	H12402 H12403	H12402-01 H12403-01	H12402-20 H12403-20	Unit
Spectral response	300 to 650	300 to 850	300 to 920	nm
Effective area	3 (X) × 1 (Y)			mm
Input voltage	+4.5 to +5.5			V
Recommended control voltage adjustment range	+0.5 to +1.0 (Max. +1.15)			V
Gain ①	Typ. 2.0 × 10 <sup>6</sup>	3.5 × 10 <sup>5</sup>	2.5 × 10 <sup>5</sup>	—
Maximum average output signal current	5			μA
Dark current ①	Typ. 0.3			nA
Settling time ②	Max. 10			s
Operating ambient temperature	+5 to +50			°C

① Control voltage +0.9 V

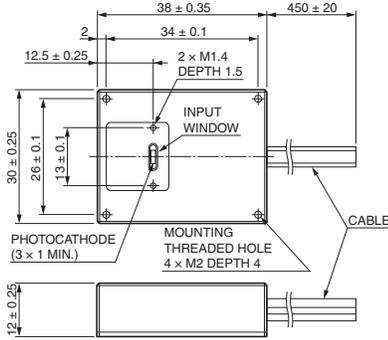
② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



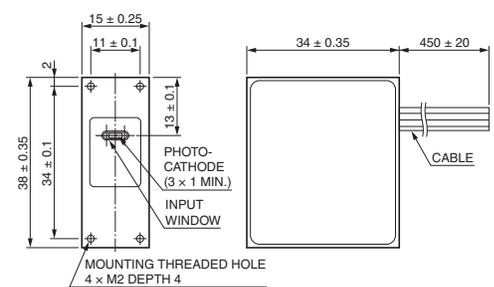
### ● Dimensional outline (Unit: mm)

#### ■ H12402 series



LOW VOLTAGE INPUT (+5 V): UL1430 AWG26 (RED)  
GND : UL1430 AWG26 (BLACK)  
Vref OUTPUT (+1.2 V) : UL1430 AWG26 (BLUE)  
Vcont INPUT : UL1430 AWG26 (WHITE)  
No suffix (+0.5 V to +1.0 V)  
-01, -20 (-0.5 V to +1.1 V)  
SIGNAL OUTPUT : RG-174/U Weight: 42 g  
TPMOA0083ED

#### ■ H12403 series



LOW VOLTAGE INPUT (+5 V): UL1430 AWG26 (RED)  
GND : UL1430 AWG26 (BLACK)  
Vref OUTPUT (+1.2 V) : UL1430 AWG26 (BLUE)  
Vcont INPUT : UL1430 AWG26 (WHITE)  
No suffix (+0.5 V to +1.0 V)  
-01, -20 (-0.5 V to +1.1 V)  
SIGNAL OUTPUT : RG-174/U Weight: 52 g

TPMOA0084ED

## Micro PMT modules H14066 series

(at +25 °C)

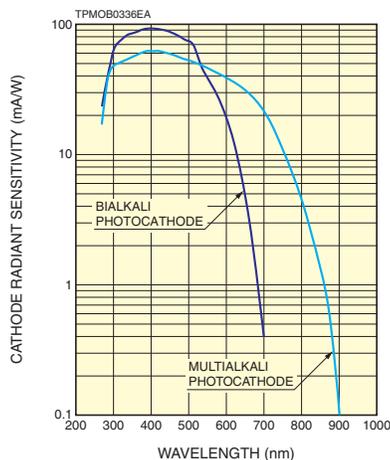


Parameter	H14066	H14066-01	Unit
Spectral response	300 to 650	300 to 850	nm
Effective area	4 (X) × 1 (Y)		
Input voltage	+4.75 to +5.25		
Recommended control voltage adjustment range	+0.5 to +1.0 (Max. +1.15)		
Gain ①	2.0 × 10 <sup>6</sup>	3.5 × 10 <sup>5</sup>	—
Maximum average output signal current	5		
Dark current ①	Typ. 0.3		
Settling time ②	Max. 10		
Operating ambient temperature	+5 to +50		

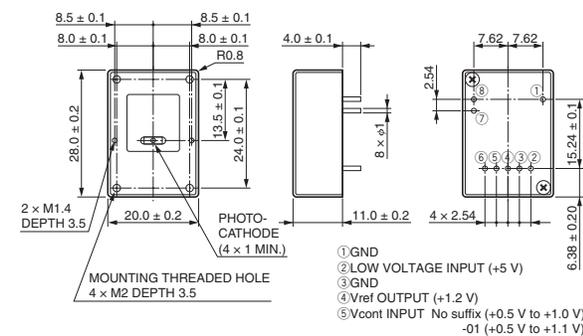
① Control voltage +0.9 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response

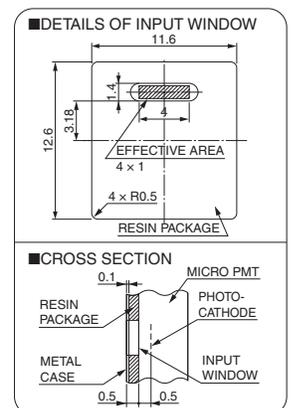


### ● Dimensional outline (Unit: mm)



① GND  
② LOW VOLTAGE INPUT (+5 V)  
③ GND  
④ Vref OUTPUT (+1.2 V)  
⑤ Vcont INPUT No suffix (+0.5 V to +1.0 V)  
-01 (+0.5 V to +1.1 V)  
⑥ NC  
⑦ SIGNAL OUTPUT  
⑧ SIGNAL GND Weight: 10 g  
TPMOA0108EA

#### H14066



## Micro PMT modules H12404 series Micro PMT modules H12405 series

(at +25 °C)



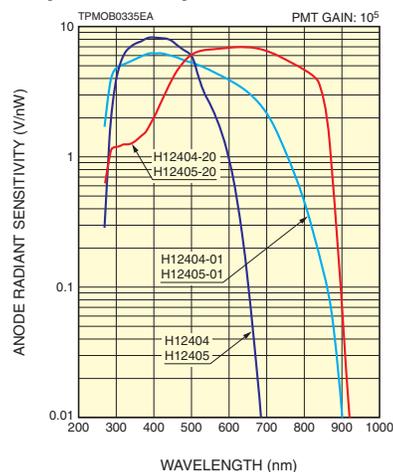
▲(Left) H12405 series,  
(Right) H12404 series

Parameter	H12404 H12405	H12404-01 H12405-01	H12404-20 H12405-20	Unit
Spectral response	300 to 650	300 to 850	300 to 920	nm
Effective area	3 (X) × 1 (Y)			mm
Input voltage	±4.5 to ±5.5			V
Recommended control voltage adjustment range	+0.5 to +1.0 (Max. +1.15)			V
Micro PMT gain <sup>①</sup>	2.0 × 10 <sup>6</sup>	3.5 × 10 <sup>5</sup>	2.5 × 10 <sup>5</sup>	—
Frequency bandwidth	DC to 20 kHz			—
Current-to voltage conversion factor	1			V/μA
Maximum output signal voltage	+4 (Load resistance 10 kΩ)			V
Voltage output depending on PMT dark current <sup>①</sup>	Typ. 0.3	0.6		mV
Settling time <sup>②</sup>	10			s
Operating ambient temperature	+5 to +50			°C

①Control voltage +0.9 V

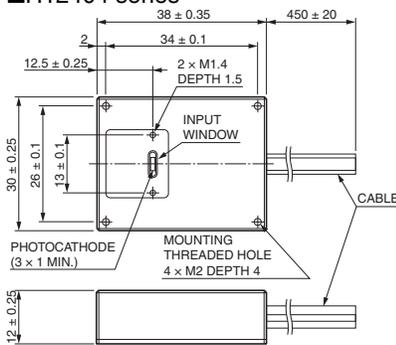
②The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ●Spectral response



### ●Dimensional outline (Unit: mm)

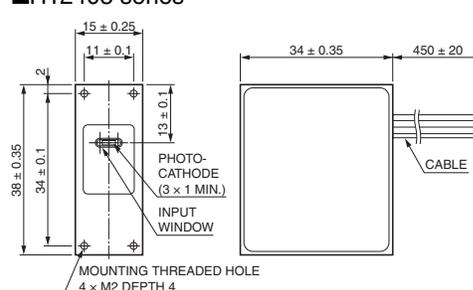
#### ■H12404 series



LOW VOLTAGE INPUT (+5 V) : UL1430 AWG26 (RED)  
 LOW VOLTAGE INPUT (-5 V) : UL1430 AWG26 (GREEN)  
 GND : UL1430 AWG26 (BLACK)  
 Vref OUTPUT (+1.2 V) : UL1430 AWG26 (BLUE)  
 Vcont INPUT : UL1430 AWG26 (WHITE)  
 No suffix (+0.5 V to +1.0 V)  
 -01, -20 (-0.5 V to +1.1 V)  
 SIGNAL OUTPUT : RG-174/U Weight: 44 g

TPMOA0109EA

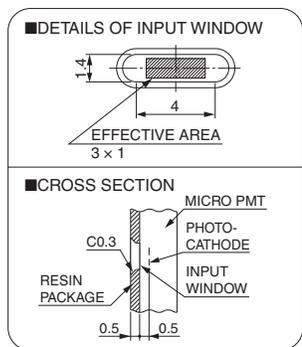
#### ■H12405 series



LOW VOLTAGE INPUT (+5 V) : UL1430 AWG26 (RED)  
 LOW VOLTAGE INPUT (-5 V) : UL1430 AWG26 (GREEN)  
 GND : UL1430 AWG26 (BLACK)  
 Vref OUTPUT (+1.2 V) : UL1430 AWG26 (BLUE)  
 Vcont INPUT : UL1430 AWG26 (WHITE)  
 No suffix (+0.5 V to +1.0 V)  
 -01, -20 (-0.5 V to +1.1 V)  
 SIGNAL OUTPUT : RG-174/U Weight: 54 g

TPMOA0110EA

### H12402/H12403/H12404/H12405



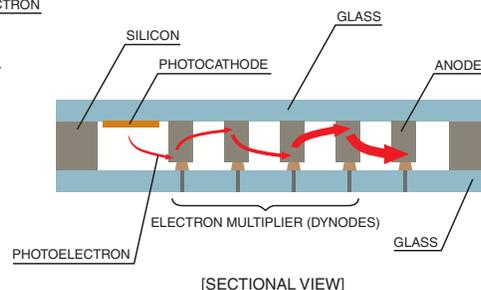
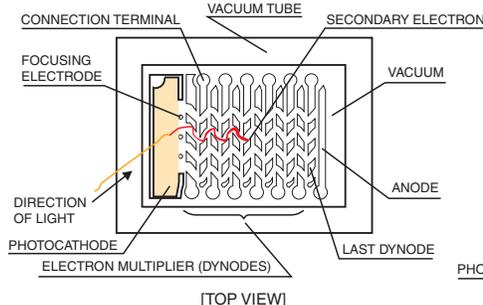
TPMHA00590B

## Full-scale Micro PMT image!



Micro PMT works on the same vacuum tube technology and principle as conventional PMTs and so can deliver the same performance as conventional PMT yet in a compact and light-weight unit.

### ■ Micro PMT internal structure



# Micro PMT photon counting heads H12406 series

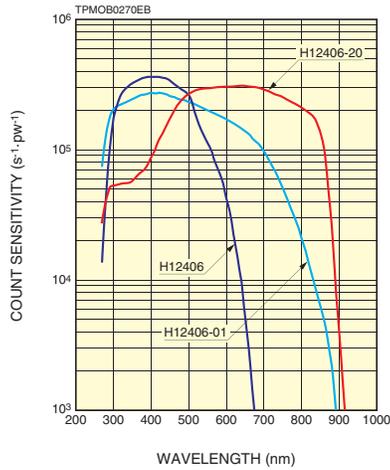
Photon counting

(at +25 °C)

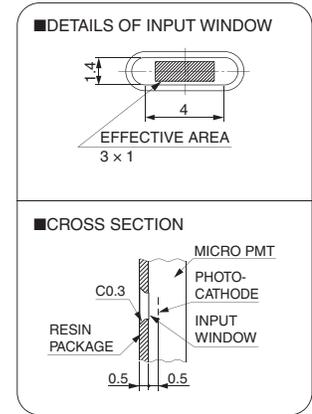
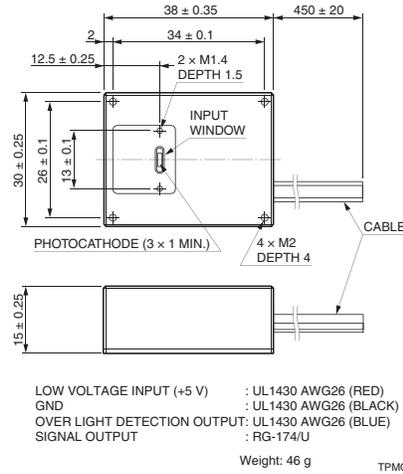


Parameter	H12406	H12406-01	H12406-20	Unit
Spectral response	300 to 650	300 to 850	300 to 920	nm
Effective area	3(X) × 1(Y)			mm
Input voltage	+4.75 to +5.25			V
Count linearity	5.0 × 10 <sup>6</sup>			s <sup>-1</sup>
Dark count	Typ. 10	100	500	s <sup>-1</sup>
Pulse-pair resolution	20			ns
Output pulse width	10			ns
Output pulse height	Min. +2.0 (Load resistance 50 Ω)			V
Recommended load resistance	50			Ω
Operating ambient temperature	+5 to +50			°C

## ● Count sensitivity

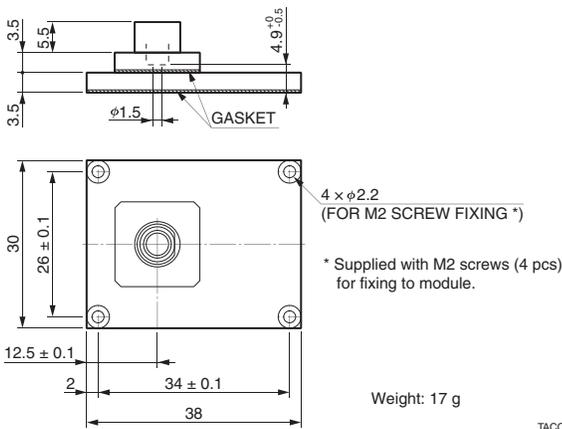


## ● Dimensional outline (Unit: mm)

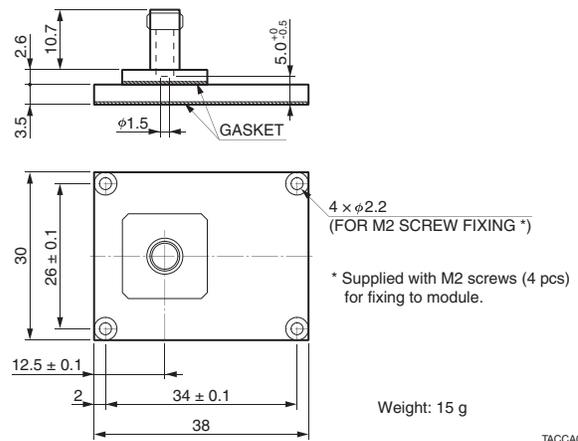


## ■ OPTION

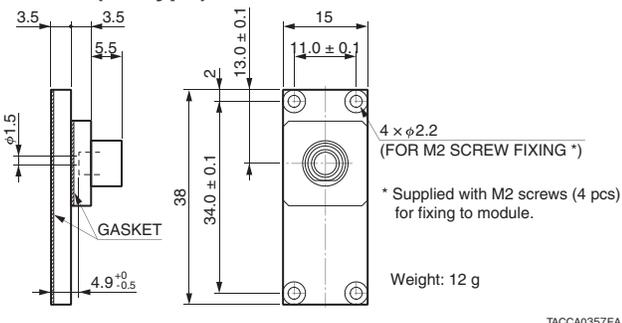
### ● E13561 (FC type)



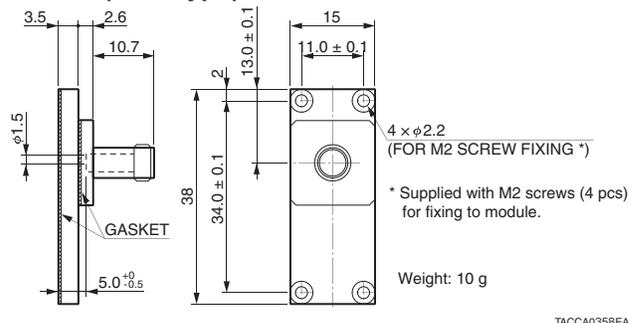
### ● E13562 (SMA type)



### ● E13563 (FC type)



### ● E13564 (SMA type)



\* E13561 and E13562 are the exclusive options for H12402/H12404/H12406 series, E13563 and E13564 are the exclusive options for H12403/H12405 series.

## Photosensor modules H10720 series Photosensor modules H10721 series

Settling time 10 s

+3 V to +5 V operating

(at +25 °C)



▲(Left) H10720 series,  
(Right) H10721 series

Parameter	H10720-110	H10720-113	H10720-210	H10720-01	H10720-04	H10720-09	H10720-20	Unit
	H10721-110	H10721-113	H10721-210	H10721-01	H10721-04	H10721-09	H10721-20	
Spectral response	230 to 700	185 to 700	230 to 700	230 to 870	185 to 870	185 to 320	230 to 920	nm
Effective area	φ8							mm
Input voltage	+2.8 to +5.5							V
Maximum input current ①	2.7 (Dark condition)							mA
Recommended control voltage adjustment range	+0.5 to +1.1 (Max. +1.1)							V
Gain ①	Typ. 2.0 × 10 <sup>6</sup>					— *	2.0 × 10 <sup>6</sup>	—
Maximum average output signal current	100					10	100	μA
Dark current ①	Typ. 1	1	1	1	1	0.01	10	nA
P type dark count ①	Typ. 50	50	50	600	600	15	—	s <sup>-1</sup>
Settling time ②	Max. 10							s
Operating ambient temperature	+5 to +50							°C

① Control voltage +1.0 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

\* -09: 4.0 × 10<sup>5</sup>, P-09: 1.0 × 10<sup>6</sup>

## Photosensor modules H11900 series Photosensor modules H11901 series

Settling time 0.2 s

+15 V operating

(at +25 °C)



▲(Left) H11900 series,  
(Right) H11901 series

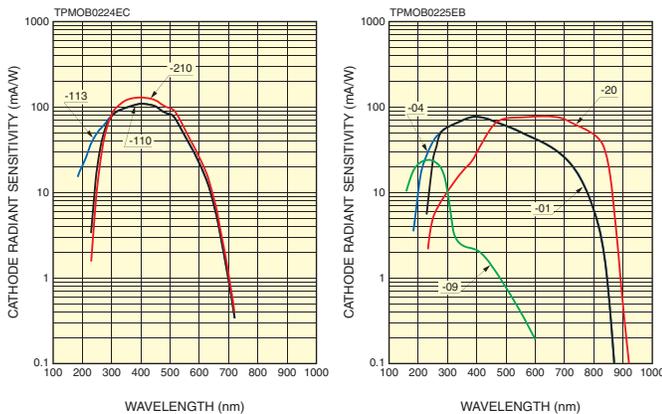
Parameter	H11900-110	H11900-113	H11900-210	H11900-01	H11900-04	H11900-09	H11900-20	Unit
	H11901-110	H11901-113	H11901-210	H11901-01	H11901-04	H11901-09	H11901-20	
Spectral response	230 to 700	185 to 700	230 to 700	230 to 870	185 to 870	185 to 320	230 to 920	nm
Effective area	φ8							mm
Input voltage	+11.5 to +15.5							V
Maximum input current ①	12 (Dark condition)							mA
Recommended control voltage adjustment range	+0.5 to +1.1 (Max. +1.1)							V
Gain ①	Typ. 2.0 × 10 <sup>6</sup>					— *	2.0 × 10 <sup>6</sup>	—
Maximum average output signal current	100					10	100	μA
Dark current ①	Typ. 1	1	1	1	1	0.01	10	nA
P type dark count ①	Typ. 50	50	50	600	600	15	—	s <sup>-1</sup>
Settling time ②	Max. 0.2							s
Operating ambient temperature	+5 to +50							°C

① Control voltage +1.0 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

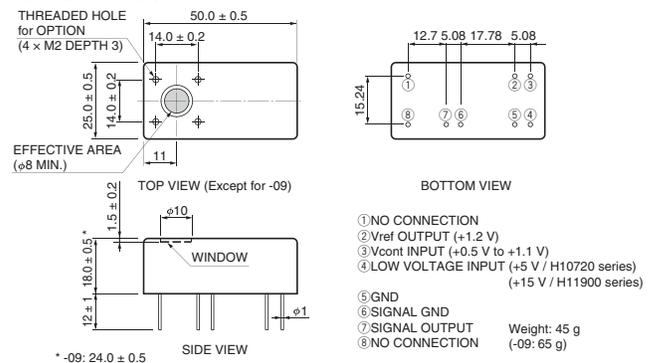
\* -09: 4.0 × 10<sup>5</sup>, P-09: 1.0 × 10<sup>6</sup>

### ● Spectral response

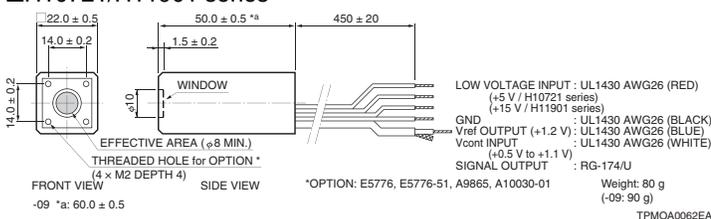


### ● Dimensional outline (Unit: mm)

#### ■ H10720/H11900 series



#### ■ H10721/H11901 series



# Current output

## Photosensor modules H14600 series

(at +25 °C)

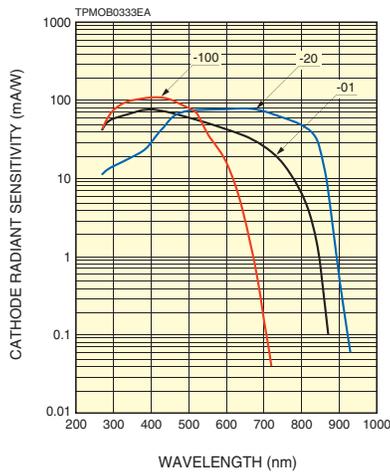


Parameter	H14600-100	H14600-01	H14600-20	Unit
Spectral response	300 to 650	300 to 870	300 to 920	nm
Effective area	φ8			mm
Input voltage	+4.5 to +5.5			V
Recommended control voltage adjustment range	+0.5 to +1.0 (Max. +1.0)			V
Gain <sup>①</sup>	Typ. 1.0 × 10 <sup>6</sup>			—
Maximum average output signal current	100			μA
Dark current <sup>①</sup>	Typ. 0.5	1	10	nA
Settling time <sup>②</sup>	Max. 10			s
Operating ambient temperature	+5 to +50			°C

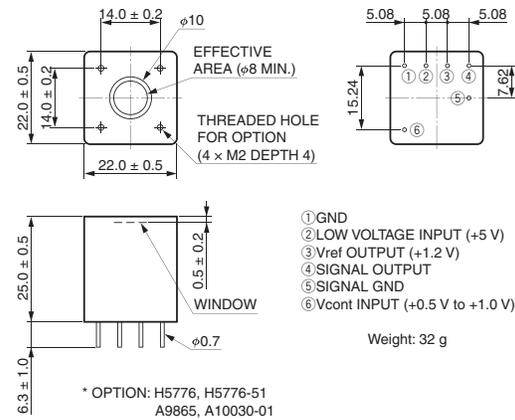
① Control voltage = +0.9 V

② The time required for the output to reach a stable level following a change in the control voltage from +0.9 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



## Photosensor modules H7422 series Cooler

(at +25 °C)



Heatsink with fan (A7423)  
sold separately

Parameter	H7422-40	H7422-50	H7422P-40	H7422P-50	Unit
Spectral response	300 to 720	380 to 890	300 to 720	380 to 890	nm
Effective area	$\phi 5$				mm
Input voltage	+11.5 to +15.5				V
Recommended control voltage adjustment range	+0.5 to +0.8 (Max. +0.9)				V
Gain <sup>①</sup>	Typ. $5.0 \times 10^5$	Typ. $5.0 \times 10^5$	Typ. $1.0 \times 10^6$	Typ. $1.0 \times 10^6$	—
Maximum average output signal current	2				$\mu\text{A}$
Dark current (at 0 °C) <sup>①</sup>	Typ. 0.4	Typ. 0.5	Typ. 0.4	Typ. 0.5	nA
Dark count (at 0 °C) <sup>①</sup>	Typ. —	Typ. —	Typ. 100	Typ. 125	s <sup>-1</sup>
Settling time <sup>②</sup>	0.2				s
Operating ambient temperature	+5 to +35				°C
Over light protection <sup>③</sup>	10				$\mu\text{A}$

① Control voltage +1.0 V

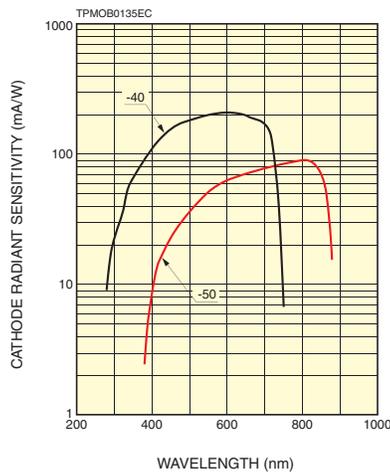
② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

③ We also provide "A type" that over light protective function works at 50  $\mu\text{A}$ .

### Cooling specifications

Cooling method	Thermoelectric cooling	—
Max. cooling temperature ( $\Delta T$ )	35	°C
Cooling time	Approx. 5	min

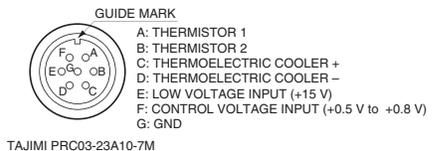
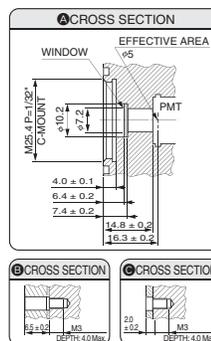
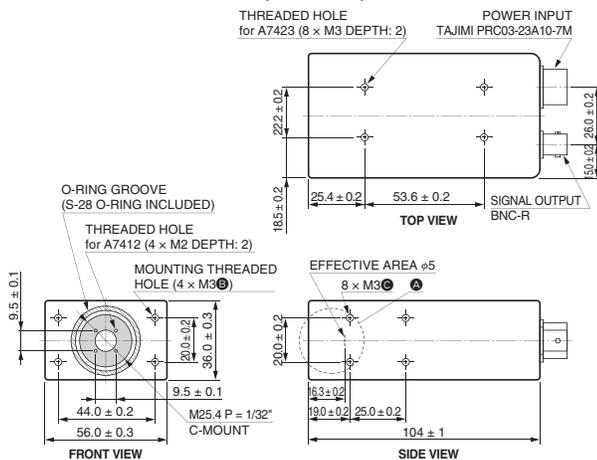
### ● Spectral response



### ● Option

- Heatsink with fan A7423
- Single cable E1168-05
- Optical fiber adapter (FC type) A7412
- C-mount adapter A7413
- Power supply unit with temperature control (AC100 V to 240 V input)  
C8137-02
- Power supply unit with temperature control (+12 V input, on-board type)  
M13414

### ● Dimensional outline (Unit: mm)



TPMOA0024ED

Weight: 400 g

# Current output

## Photosensor modules H11526 series

Gate 100 ns

Settling time 2 s

(at +25 °C)

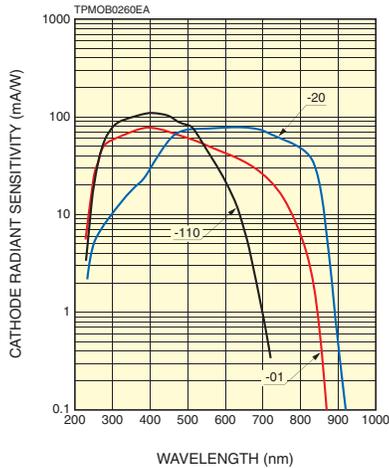


Parameter	H11526-110-NN H11526-110-NF	H11526-01-NN H11526-01-NF	H11526-20-NN H11526-20-NF	Unit
Spectral response	230 to 700	230 to 870	230 to 920	nm
Effective area	φ8			mm
Input voltage	+14.5 to +15.5			V
Recommended control voltage adjustment range	+0.4 to +0.9 (Max. +0.9)			V
Gain <sup>①</sup>	Typ.	2.0 × 10 <sup>6</sup>		—
Maximum average output signal current	100			μA
Dark current <sup>①</sup>	Typ.	1	10	nA
Settling time <sup>②</sup>	2			s
Operating ambient temperature	+5 to +45			°C

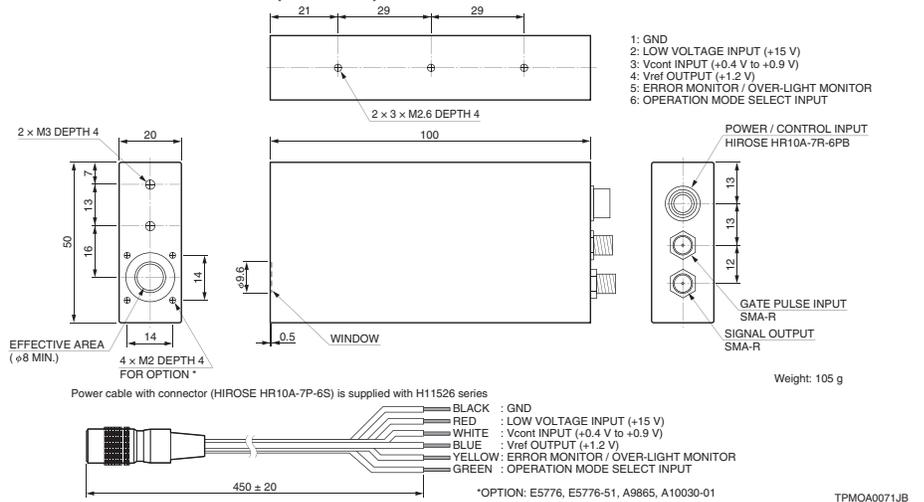
① Control voltage +0.8 V

② The time required for the output to reach a stable level following a change in the control voltage from +0.8 V to +0.4 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



## Photosensor modules H12056 series

Gate 10 ms

Settling time 10 s

(at +25 °C)

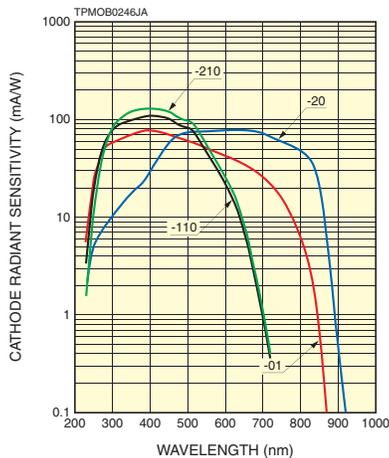


Parameter	H12056-110 H12056P-110	H12056-210 H12056P-210	H12056-01 H12056P-01	H12056-20	Unit
Spectral response	230 to 700		230 to 870	230 to 920	nm
Effective area	φ8				mm
Input voltage	+4.5 to +5.5				V
Recommended control voltage adjustment range	+0.5 to +1.1 (Max. +1.1)				V
Gain <sup>①</sup>	Typ.	2.0 × 10 <sup>6</sup>			—
Maximum average output signal current	100				μA
Dark current <sup>①</sup>	Typ.	1	1	10	nA
P type dark count <sup>①</sup>	Typ.	50	50	600	s <sup>-1</sup>
Settling time <sup>②</sup>	10				s
Operating ambient temperature	+5 to +50				°C

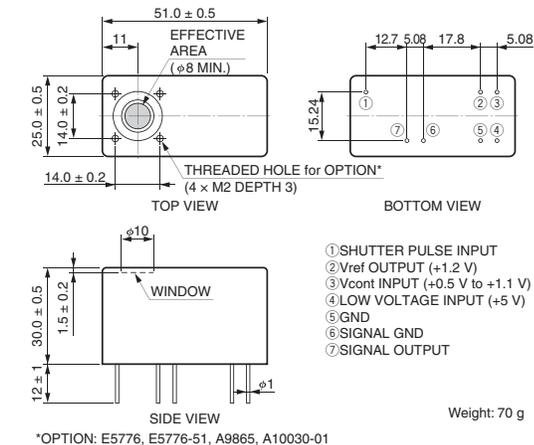
① Control voltage +1.0 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



## Photosensor modules H11706 series

Gate 1  $\mu\text{s}$

Settling time 0.2 s

(at +25 °C)



Parameter	H11706-01 H11706P-01	H11706-20	H11706-40 H11706P-40	Unit
Spectral response	230 to 870	230 to 920	300 to 720	nm
Effective area	$\phi 8$		$\phi 5$	mm
Input voltage	+14.5 to +15.5			V
Recommended control voltage adjustment range	+0.5 to +1.1 (Max. +1.1)		+0.5 to +0.8 (Max. +0.9)	V
Gain <sup>①</sup>	Typ. $2.0 \times 10^6$		$5.0 \times 10^5$	—
Maximum average output signal current	100		2	$\mu\text{A}$
Dark current <sup>①</sup>	Typ. 1		10	nA
P type dark count <sup>①</sup>	Typ. 600		—	$\text{s}^{-1}$
Settling time	0.2 <sup>②</sup>		0.2 <sup>③</sup>	s
Operating ambient temperature	+5 to +50		+5 to +35	°C

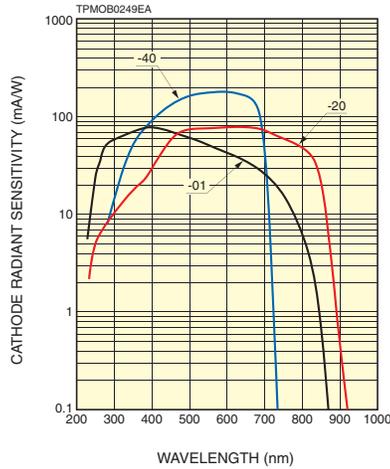
① H11706-01, H11706P-01, H11706-20: control voltage +1.0 V

H11706-40, H11706P-40: control voltage +0.8 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V.

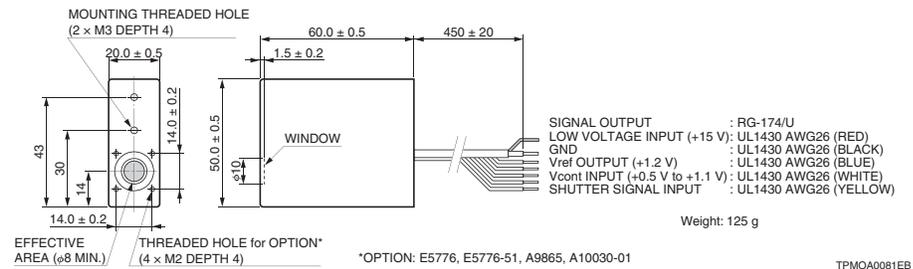
③ The time required for the output to reach a stable level following a change in the control voltage from +0.9 V to +0.5 V.

### ● Spectral response

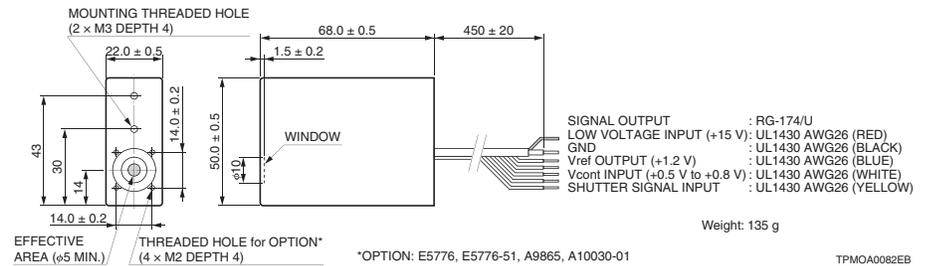


### ● Dimensional outline (Unit: mm)

#### ■ H10706-01/-20



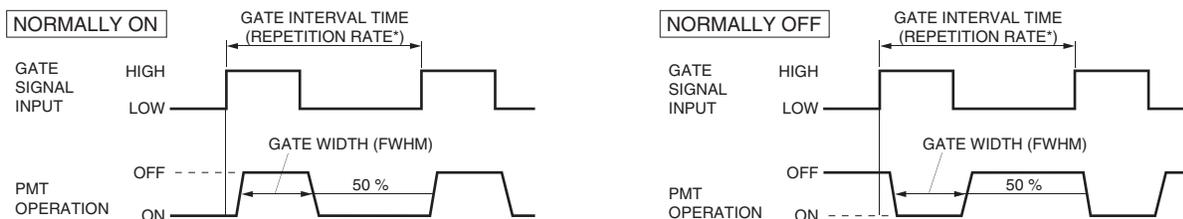
#### ■ H10706-40



### ● Gate characteristics

Parameter	H11526-xx-NN	H11526-xx-NF	H11706	H12056	Unit
Gate mode	Mode	Normally ON	Normally OFF	Normally ON	—
Gate mode	Gate width (FWHM)	100 ns to DC			—
	Repetition rate	Max.	10	10	kHz
	Switching ratio	Typ.	$10^6$	$10^3$	—
Gate signal	Input HIGH level	+3.5 to +5			V
	Input impedance	10			k $\Omega$

### ● Gate operation mode



\* GATE INTERVAL TIME 100  $\mu\text{s}$  → REPETITION RATE 10 kHz  
 GATE INTERVAL TIME 10 ms → REPETITION RATE 100 Hz

TPMOC0260EA

# Current output

## Photosensor modules H9305 series

+15 V operating

(at +25 °C)



Parameter	H9305-01	H9305-02	H9305-03	H9305-13	H9305-04	H9305-05	H9305-09	Unit	
Spectral response	185 to 750	185 to 900	185 to 900	185 to 900	185 to 830	185 to 650	185 to 320	nm	
Effective area (X × Y)	3.7 × 13.0							mm	
Input voltage	+11.5 to +15.5							V	
Recommended control voltage adjustment range	+0.25 to +1.0 (Max. +1.2)							V	
Gain <sup>①</sup>	Typ.	5.8 × 10 <sup>6</sup>	4.0 × 10 <sup>6</sup>	4.0 × 10 <sup>6</sup>	4.0 × 10 <sup>6</sup>	3.5 × 10 <sup>6</sup>	7.5 × 10 <sup>6</sup>	4.0 × 10 <sup>6</sup>	—
Maximum average output signal current	10							μA	
Dark current <sup>①</sup>	Typ.	1	1	2	3	0.1	0.5	0.5	nA
Settling time <sup>②</sup>	Max.	10							s
Operating ambient temperature	+5 to +50							°C	

① Control voltage +1.0 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

## Photosensor modules H13320 series

+3 V to +5 V operating

(at +25 °C)

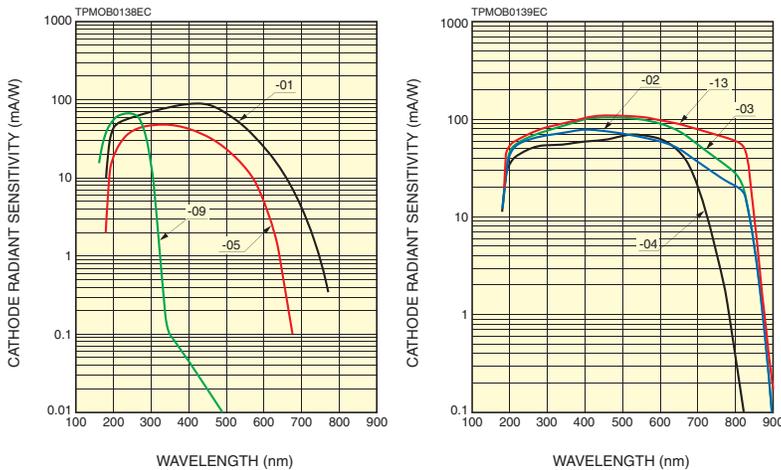


Parameter	H13320-01	H13320-02	H13320-03	H13320-13	H13320-04	H13320-05	H13320-09	Unit	
Spectral response	185 to 750	185 to 900	185 to 900	185 to 900	185 to 830	185 to 650	185 to 320	nm	
Effective area (X × Y)	3.7 × 13.0							mm	
Input voltage	+2.8 to +5.5							V	
Recommended control voltage adjustment range	+0.25 to +1.0 (Max. +1.2)							V	
Gain <sup>①</sup>	Typ.	5.8 × 10 <sup>6</sup>	4.0 × 10 <sup>6</sup>	4.0 × 10 <sup>6</sup>	4.0 × 10 <sup>6</sup>	3.5 × 10 <sup>6</sup>	7.5 × 10 <sup>6</sup>	4.0 × 10 <sup>6</sup>	—
Maximum average output signal current	10							μA	
Dark current <sup>①</sup>	Typ.	1	1	2	3	0.1	0.5	0.5	nA
Settling time <sup>②</sup>	Max.	14							s
Operating ambient temperature	+5 to +50							°C	

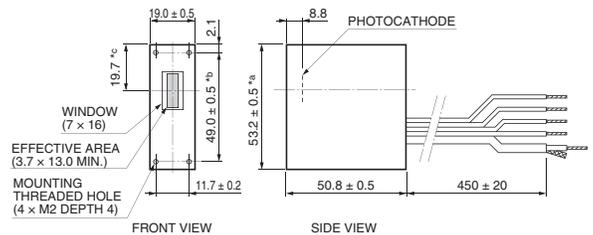
① Control voltage +1.0 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



-09 \*a: 57.7 ± 0.5  
 \*b: 53.5 ± 0.5  
 \*c: 24.0 ± 0.5

LOW VOLTAGE INPUT (+5 V / H13320 SERIES): UL1430 AWG26 (RED)  
 (+15 V / H9305 SERIES)

GND : UL1430 AWG26 (BLACK)  
 Vref OUTPUT (+1.2 V) : UL1430 AWG26 (BLUE)  
 Vcont INPUT (+0.25 V to +1.0 V) : UL1430 AWG26 (WHITE)  
 SIGNAL OUTPUT : RG-174/U

Weight: 110 g (-09: 115 g)

TPMOA0013JH

## Photosensor modules H11461 series

(at +25 °C)

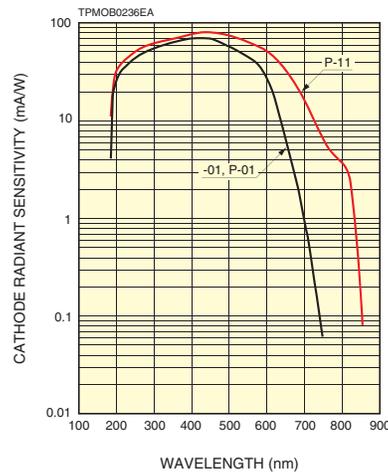
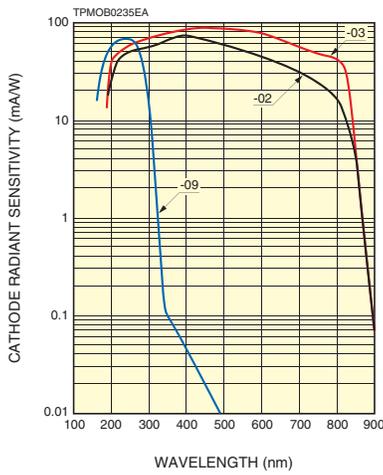


Parameter	H11461-01	H11461-02	H11461-03	H11461-09	H11461P-01	H11461P-11	Unit	
Spectral response	185 to 710	185 to 900	185 to 900	185 to 320	185 to 710	185 to 850	nm	
Effective area (X × Y)	4 × 20						mm	
Input voltage	+4.5 to +5.5						V	
Recommended control voltage adjustment range	+0.5 to +1.1 (Max. +1.2)						V	
Gain <sup>①</sup>	Typ.	1.2 × 10 <sup>7</sup>	1.0 × 10 <sup>7</sup>	9.5 × 10 <sup>6</sup>	1.0 × 10 <sup>7</sup>	1.2 × 10 <sup>7</sup>	3.5 × 10 <sup>6</sup>	—
Maximum average output signal current	100						μA	
Dark current <sup>①</sup>	Typ.	0.2	3	10	1	0.1	0.2	nA
Dark count <sup>①</sup>	Typ.	—	—	—	—	30	80	s <sup>-1</sup>
Settling time <sup>②</sup>	Max.	14						s
Operating ambient temperature	+5 to +50						°C	

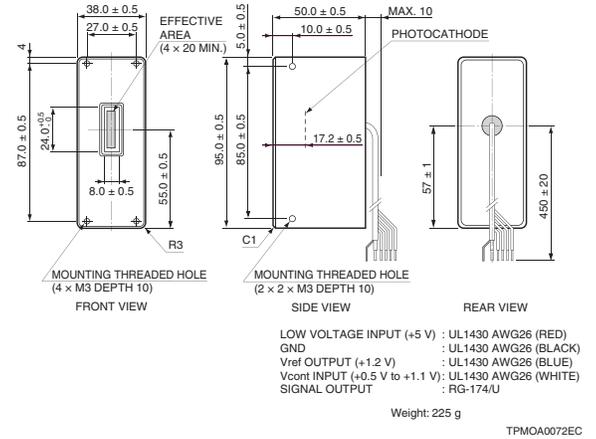
① Control voltage +1.0 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



# Current output

## Photosensor modules H7826 series

(at +25 °C)

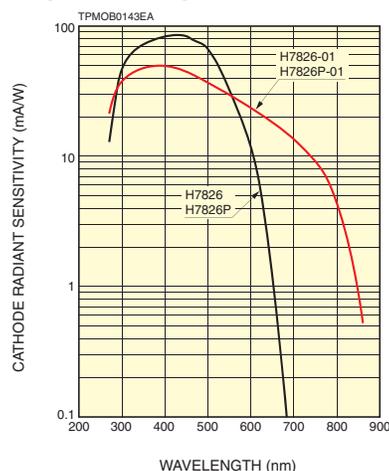


Parameter	H7826	H7826-01	H7826P	H7826P-01	Unit
Spectral response	300 to 650	300 to 850	300 to 650	300 to 850	nm
Effective area	$\phi 15$				mm
Input voltage	+11.5 to +15.5				V
Recommended control voltage adjustment range	+0.5 to +1.1 (Max. +1.2)				V
Gain <sup>①</sup>	Typ. $5.5 \times 10^5$	$2.5 \times 10^5$	$1.8 \times 10^6$	$1.0 \times 10^6$	—
Maximum average output signal current	100				$\mu$ A
Dark current <sup>①</sup>	Typ. 3			3	nA
Dark count	Typ. —	200		2000	s <sup>-1</sup>
Settling time <sup>②</sup>	Max. 0.2				s
Operating ambient temperature	+5 to +45				°C

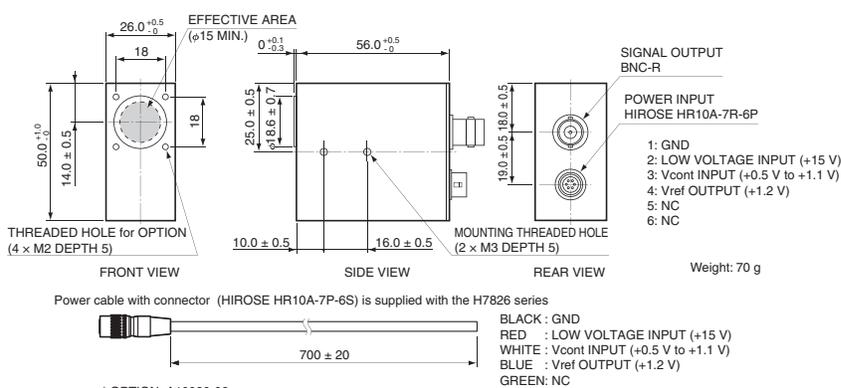
① Control voltage +1.0 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



TPMOA0005EF

## Photosensor modules H10425 series

(at +25 °C)

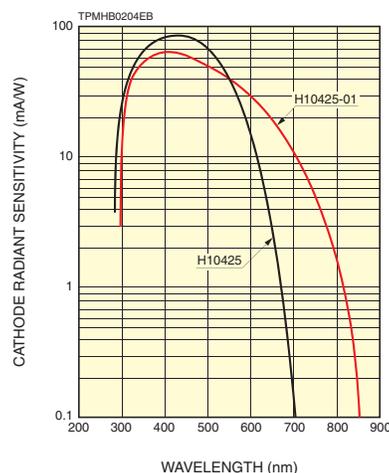


Parameter	H10425	H10425-01	Unit	
Spectral response	300 to 650	300 to 850	nm	
Effective area	$\phi 22$		mm	
Input voltage	+11.5 to +15.5		V	
Recommended control voltage adjustment range	+0.5 to +1.1 (Max. +1.2)		V	
Gain <sup>①</sup>	Typ. $2.0 \times 10^6$	$5.0 \times 10^5$	—	
Maximum average output signal current	100		$\mu$ A	
Dark current <sup>①</sup>	Typ. 3			nA
Settling time <sup>②</sup>	Max. 10			s
Operating ambient temperature	+5 to +50		°C	

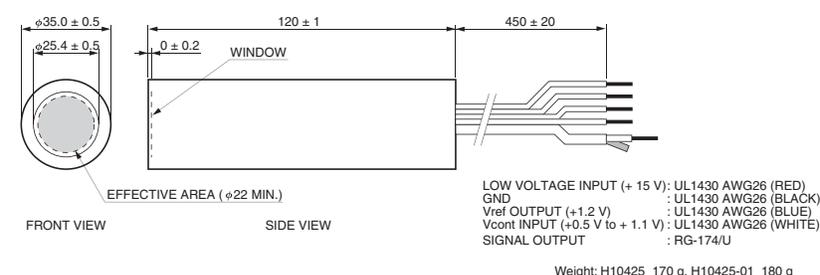
① Control voltage +1.0 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



TPMOA0046EB

## Photosensor modules H10426 series

(at +25 °C)

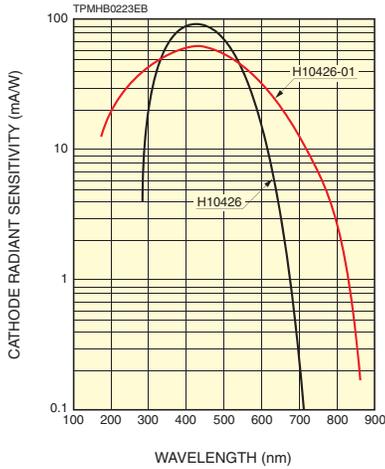


Parameter	H10426	H10426-01	Unit
Spectral response	300 to 650	185 to 850	nm
Effective area	$\phi 25$		mm
Input voltage	+11.5 to +15.5		V
Recommended control voltage adjustment range	+0.5 to +1.4 (Max. +1.5)		V
Gain <sup>①</sup>	Typ.	2.1 × 10 <sup>6</sup>	—
Maximum average output signal current	100		μA
Dark current <sup>①</sup>	Typ.	2	nA
Settling time <sup>②</sup>	Max.	10	s
Operating ambient temperature	+5 to +50		°C

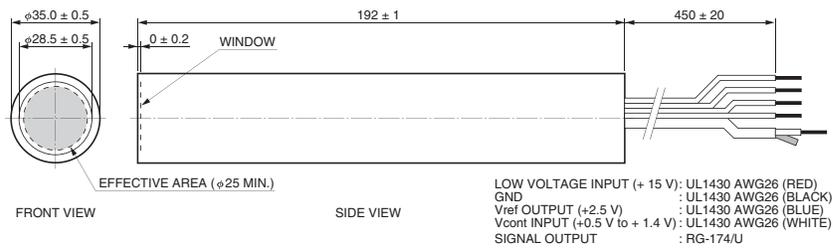
① Control voltage +1.0 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



LOW VOLTAGE INPUT (+15 V): UL1430 AWG26 (RED)  
 GND : UL1430 AWG26 (BLACK)  
 Vref OUTPUT (+2.5 V) : UL1430 AWG26 (BLUE)  
 Vcont INPUT (+0.5 V to +1.4 V): UL1430 AWG26 (WHITE)  
 SIGNAL OUTPUT : RG-174/U

Weight: 270 g

TPMOA0047EB

## High speed photosensor module H14447

Rise time **350 ps**

(at +25 °C)

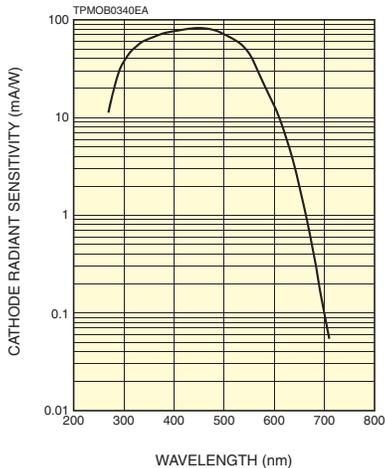


Parameter	H14447	Unit
Spectral response	300 to 650	nm
Effective area	$\phi 25$	mm
Input voltage	+4.8 to +5.5	V
Recommended control voltage adjustment range	+1.6 to +2.0 (Max. +2.1)	V
Gain <sup>①</sup>	Typ.	8.4 × 10 <sup>3</sup>
Maximum average output signal current	100	μA
Dark current <sup>①</sup>	Typ.	0.1
Settling time <sup>②</sup>	Max.	10
Operating ambient temperature	+5 to +50	°C

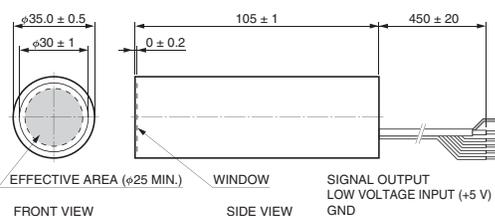
① Control voltage +2.0 V

② The time required for the output to reach a stable level following a change in the control voltage from +2.0 V to +1.6 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



SIGNAL OUTPUT : RG-174/U  
 LOW VOLTAGE INPUT (+5 V) : UL1430 AWG26 (RED)  
 GND : UL1430 AWG26 (BLACK)  
 Vref OUTPUT (+2.5 V) : UL1430 AWG26 (BLUE)  
 Vcont INPUT (+1.6 V to +2.0 V): UL1430 AWG26 (WHITE)

Weight: 105 g

TPMOA0100EA

# Current output

## Photomultiplier tube module H11411

(at +25 °C)

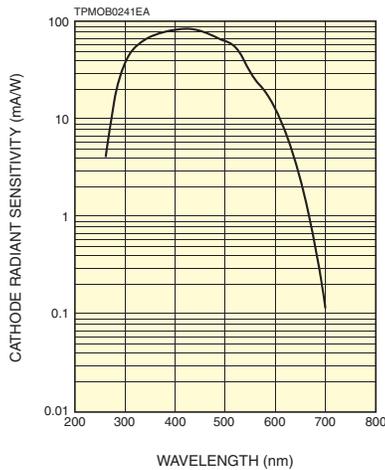


Parameter	H11411	Unit
Spectral response	300 to 650	nm
Effective area	φ46	mm
Input voltage	+11.5 to +15.5	V
Recommended control voltage adjustment range	+0.5 to +1.8 (Max. +1.9)	V
Gain <sup>①</sup>	Typ. 3.3 × 10 <sup>6</sup>	—
Maximum average output signal current	200	μA
Dark current <sup>①</sup>	Typ. 6	nA
Settling time <sup>②</sup>	Max. 10	s
Operating ambient temperature	+5 to +50	°C

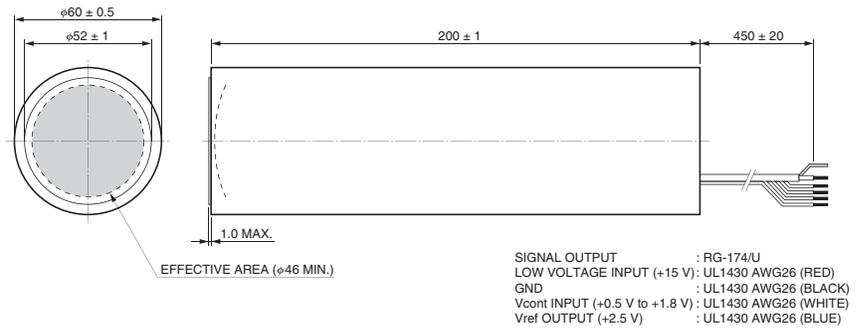
① Control voltage +1.75 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



Weight: 560 g

TPMOA0074EB

## Photomultiplier tube modules H11432 series

(at +25 °C)

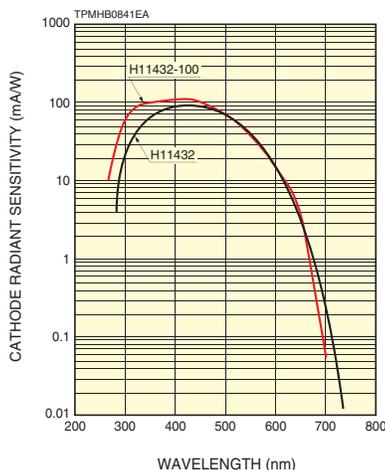


Parameter	H11432	H11432-100	Unit
Spectral response	300 to 650	300 to 650	nm
Effective area	φ34	φ34	mm
Input voltage	+4.5 to +5.5	+4.5 to +5.5	V
Recommended control voltage adjustment range	+0.5 to +1.45 (Max. +1.5)	+0.5 to +1.45 (Max. +1.5)	V
Gain <sup>①</sup>	Typ. 5.0 × 10 <sup>5</sup>	5.0 × 10 <sup>5</sup>	—
Maximum average output signal current	100	100	μA
Dark current <sup>①</sup>	Typ. 10	10	nA
Settling time <sup>②</sup>	Max. 10	10	s
Operating ambient temperature	+5 to +50	+5 to +50	°C

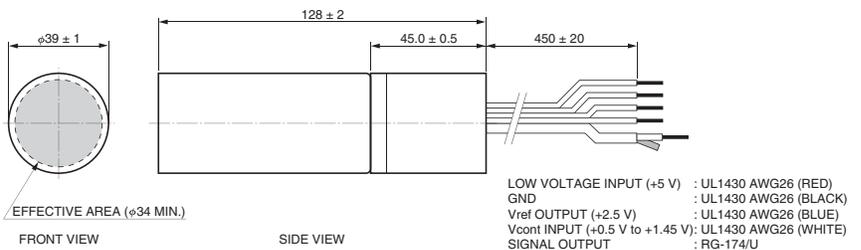
① Control voltage +1.3 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



Weight: 135 g

TPMHA0566EB

## Photosensor modules H13543 series

Square photocathode

(at +25 °C)

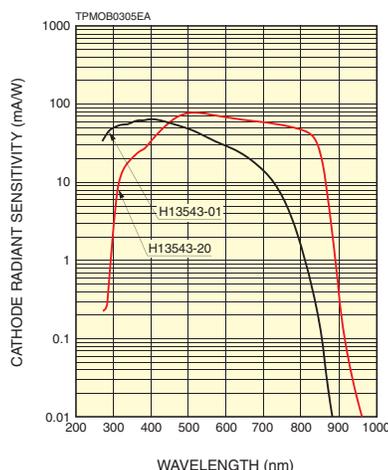
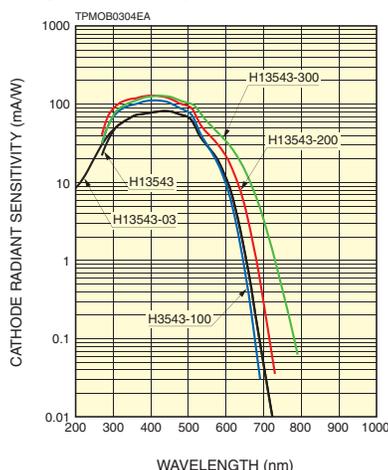


Parameter	H13543	H13543-01	H13543-03	H13543-20	H13543-100	H13543-200	H13543-300	Unit
Spectral response	300 to 650	300 to 850	185 to 650	300 to 920	300 to 650	300 to 650	300 to 700	nm
Effective area (X × Y)	18 × 18							mm
Input voltage	+4.5 to +5.5							V
Recommended control voltage adjustment range	+0.4 to +0.8 (Max. +0.9)							V
Gain <sup>①</sup>	Typ. 2.0 × 10 <sup>6</sup>	1.0 × 10 <sup>6</sup>	1.0 × 10 <sup>6</sup>	2.0 × 10 <sup>6</sup>	—			
Maximum average output signal current	100							μA
Dark current <sup>①</sup>	Typ. 2	10	2	20	2	2	2	nA
Settling time <sup>②</sup>	Max. 10							s
Operating ambient temperature	+5 to +50							°C

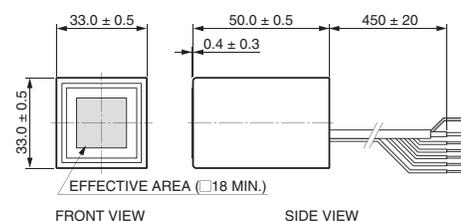
① Control voltage +0.8 V

② The time required for the output to reach a stable level following a change in the control voltage from +0.8 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



SIGNAL OUTPUT : RG-174/U  
 LOW VOLTAGE INPUT (+5 V): UL1430 AWG26 (RED)  
 GND : UL1430 AWG26 (BLACK)  
 Vref OUTPUT (+1.2 V) : UL1430 AWG26 (BLUE)  
 Vcont INPUT : UL1430 AWG26 (WHITE)

Weight: 110 g

TPMOA0099EA

## Related products

### Photomultiplier tube modules operable in a vacuum H13229, H14211

The H14211 / H13229 are current output type photomultiplier tube modules that include an R9880 series photomultiplier tube.

The output terminal is selectable from a pin or a cable output.



H14211

H13229

# Voltage output

## Photosensor modules H10722 series

Settling time 10 s

±5 V operating

(at +25 °C)



Parameter	H10722-110	H10722-113	H10722-210	H10722-01	H10722-04	H10722-20	Unit
Spectral response	230 to 700	185 to 700	230 to 700	230 to 870	185 to 870	230 to 920	nm
Effective area	φ8						mm
Input voltage	±4.5 to ±5.5						V
Maximum input current	+6.2 / -3.5 (Dark condition)						mA
Recommended control voltage adjustment range	+0.5 to +1.1 (Max. +1.1)						V
Photomultiplier tube gain <sup>①</sup> Typ.	2.0 × 10 <sup>6</sup>						—
Frequency bandwidth	DC to 20 kHz						—
Current-to-voltage conversion factor	1						V/μA
Maximum output signal voltage	+4 (Load resistance 10 kΩ)						V
Voltage output depending on PMT dark current <sup>①</sup> Typ.	1	1	1	1	1	10	mV
Settling time <sup>②</sup> Max.	10						s
Operating ambient temperature	+5 to +50						°C

① Control voltage +1.0 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

## Photosensor modules H11902 series

Settling time 0.2 s

±15 V operating

(at +25 °C)

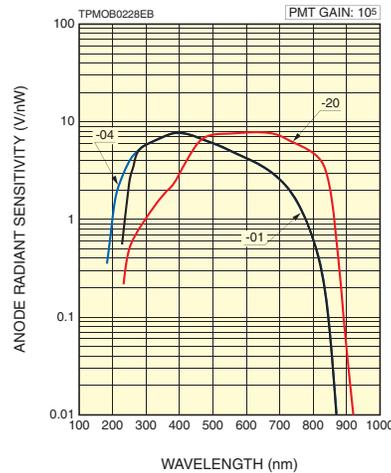
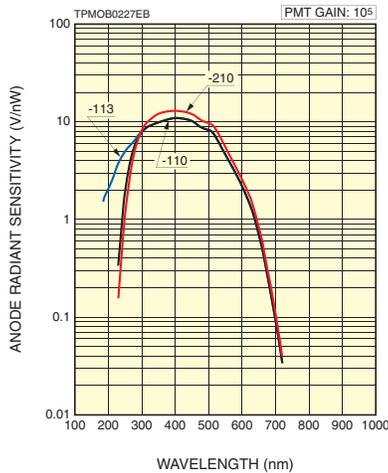


Parameter	H11902-110	H11902-113	H11902-210	H11902-01	H11902-04	H11902-20	Unit
Spectral response	230 to 700	185 to 700	230 to 700	230 to 870	185 to 870	230 to 920	nm
Effective area	φ8						mm
Input voltage	±11.5 to ±15.5						V
Maximum input current	+13 / -1 (Dark condition)						mA
Recommended control voltage adjustment range	+0.5 to +1.1 (Max. +1.1)						V
Photomultiplier tube gain <sup>①</sup> Typ.	2.0 × 10 <sup>6</sup>						—
Frequency bandwidth	DC to 20 kHz						—
Current-to-voltage conversion factor	1						V/μA
Maximum output signal voltage	+10 (Load resistance 10 kΩ)						V
Voltage output depending on PMT dark current <sup>①</sup> Typ.	1	1	1	1	1	10	mV
Settling time <sup>②</sup> Max.	0.2						s
Operating ambient temperature	+5 to +50						°C

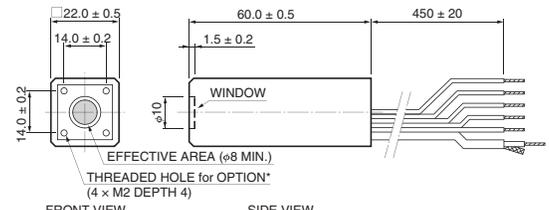
① Control voltage +1.0 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



- LOW VOLTAGE INPUT (+5 V / H10722 SERIES) : UL1430 AWG26 (RED)
- LOW VOLTAGE INPUT (+15 V / H11902 SERIES) : UL1430 AWG26 (GREEN)
- LOW VOLTAGE INPUT (-5 V / H10722 SERIES) : UL1430 AWG26 (GREEN)
- LOW VOLTAGE INPUT (-15 V / H11902 SERIES) : UL1430 AWG26 (GREEN)
- GND : UL1430 AWG26 (BLACK)
- Vref OUTPUT (+1.2 V) : UL1430 AWG26 (BLUE)
- Vcont INPUT (+0.5 V to +1.1 V) : UL1430 AWG26 (WHITE)
- SIGNAL OUTPUT : RG-174/U

Weight: 90 g

\*OPTION: E5776, E5776-51, A9865, A10030-01

TPMOA0063EB

## Photosensor modules H10723 series

Settling time 10 s

±5 V operating

(at +25 °C)



Parameter	H10723-110	H10723-113	H10723-210	H10723-01	H10723-04	H10723-20	Unit
Spectral response	230 to 700	185 to 700	230 to 700	230 to 870	185 to 870	230 to 920	nm
Effective area	φ8						mm
Input voltage	±4.5 to ±5.5						V
Maximum input current	+6.2 / -3.5 (Dark condition)						mA
Recommended control voltage adjustment range	+0.5 to +1.1 (Max. +1.1)						V
Photomultiplier tube gain <sup>①</sup> Typ.	2.0 × 10 <sup>6</sup>						—
Frequency bandwidth	DC to 200 kHz						—
Current-to-voltage conversion factor	0.1						V/μA
Maximum output signal voltage	+4 (Load resistance 10 kΩ)						V
Voltage output depending on PMT dark current <sup>①</sup> Typ.	0.1	0.1	0.1	0.1	0.1	1	mV
Settling time <sup>②</sup> Max.	10						s
Operating ambient temperature	+5 to +50						°C

① Control voltage +1.0 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

## Photosensor modules H11903 series

Settling time 0.2 s

±15 V operating

(at +25 °C)

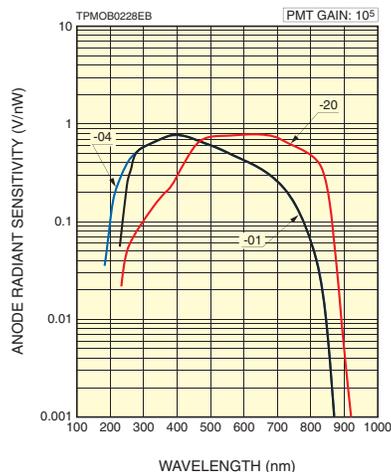
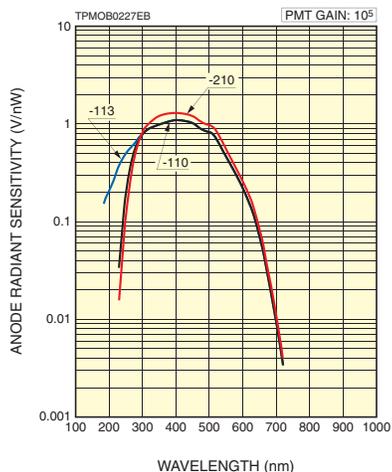


Parameter	H11903-110	H11903-113	H11903-210	H11903-01	H11903-04	H11903-20	Unit
Spectral response	230 to 700	185 to 700	230 to 700	230 to 870	185 to 870	230 to 920	nm
Effective area	φ8						mm
Input voltage	±11.5 to ±15.5						V
Maximum input current	+20 / -8 (Dark condition)						mA
Recommended control voltage adjustment range	+0.5 to +1.1 (Max. +1.1)						V
Photomultiplier tube gain <sup>①</sup> Typ.	2.0 × 10 <sup>6</sup>						—
Frequency bandwidth	DC to 200 kHz						—
Current-to-voltage conversion factor	0.1						V/μA
Maximum output signal voltage	+10 (Load resistance 10 kΩ)						V
Voltage output depending on PMT dark current <sup>①</sup> Typ.	0.1	0.1	0.1	0.1	0.1	1	mV
Settling time <sup>②</sup> Max.	0.2						s
Operating ambient temperature	+5 to +50						°C

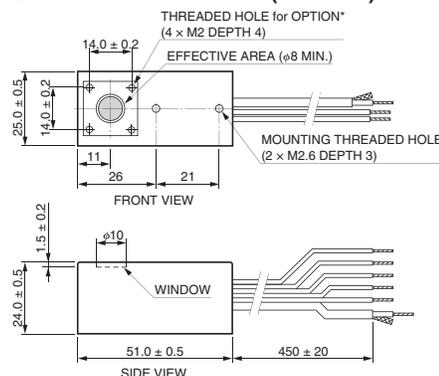
① Control voltage +1.0 V

② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



LOW VOLTAGE INPUT (+5 V / H10723 SERIES) : UL1430 AWG26 (RED)  
 (+15 V / H11903 SERIES)  
 LOW VOLTAGE INPUT (-5 V / H10723 SERIES) : UL1430 AWG26 (GREEN)  
 (-15 V / H11903 SERIES)  
 GND : UL1430 AWG26 (BLACK)  
 Vref OUTPUT (+1.2 V) : UL1430 AWG26 (BLUE)  
 Vcont INPUT (+0.5 V to +1.1 V) : UL1430 AWG26 (WHITE)  
 SIGNAL OUTPUT : RG-174/U

Weight: 90 g

\*OPTION: E5776, E5776-51, A9865, A10030-01

TPMOA0064EB

# Voltage output

## Photosensor modules H9306 series Photosensor modules H9307 series

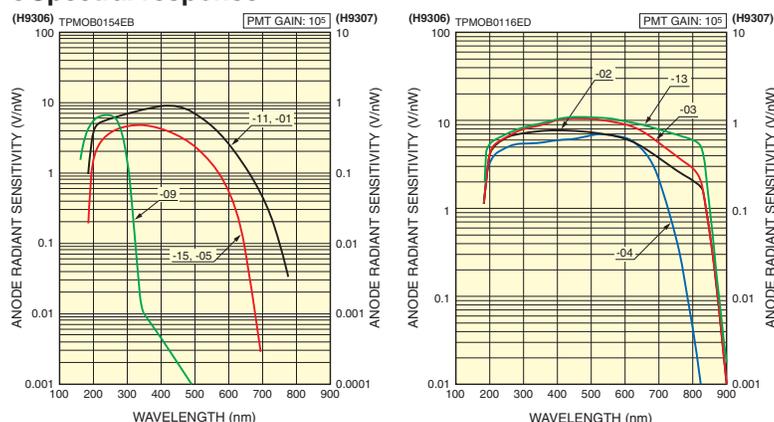
(at +25 °C)



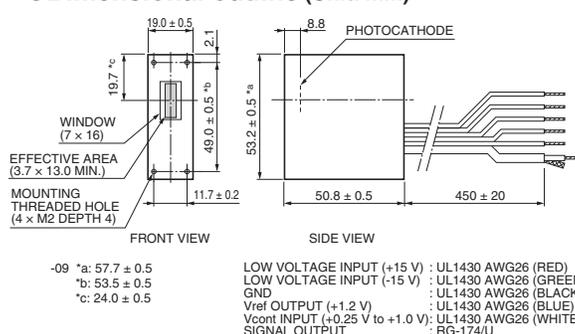
Parameter	H9306-01 H9307-01	H9306-02 H9307-02	H9306-03 H9307-03	H9306-13 H9307-13	H9306-04 H9307-04	H9306-05 H9307-05	H9306-09 H9307-09	Unit
Spectral response	185 to 750	185 to 900	185 to 900	185 to 900	185 to 830	185 to 650	185 to 320	nm
Effective area (X × Y)	3.7 × 13.0							mm
Input voltage	±11.5 to ±15.5							V
Recommended control voltage adjustment range	+0.25 to +1.0 (Max. +1.2)							V
Photomultiplier tube gain <sup>①</sup> Typ.	5.8 × 10 <sup>6</sup>	4.0 × 10 <sup>6</sup>	4.0 × 10 <sup>6</sup>	4.0 × 10 <sup>6</sup>	3.5 × 10 <sup>6</sup>	7.5 × 10 <sup>6</sup>	4.0 × 10 <sup>6</sup>	—
Frequency bandwidth	H9306 series: DC to 20, H9307 series: DC to 200							kHz
Current-to-voltage conversion factor	H9306 series: 1, H9307 series: 0.1							V/μA
Maximum output signal voltage	H9306 series: +10, H9307 series: +1 (Load resistance 10 kΩ)							V
Voltage output depending on PMT dark current <sup>①</sup>	H9306 Typ.	1	1	2	3	0.1	0.5	mV
	H9307 Typ.	0.1	0.1	0.2	0.3	0.01	0.05	
Settling time <sup>②</sup>	Max. 10							s
Operating ambient temperature	+5 to +50							°C

① Control voltage +1.0 V ② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



## Photosensor modules H11462 series

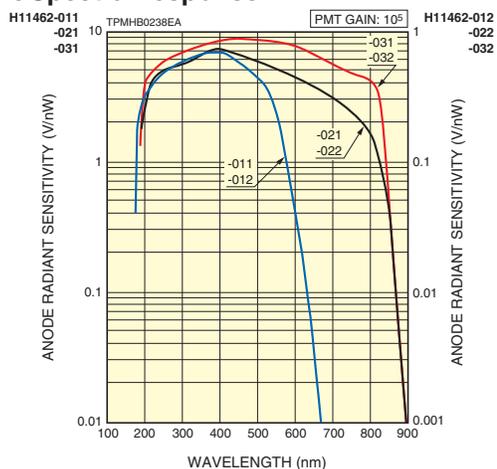
(at +25 °C)



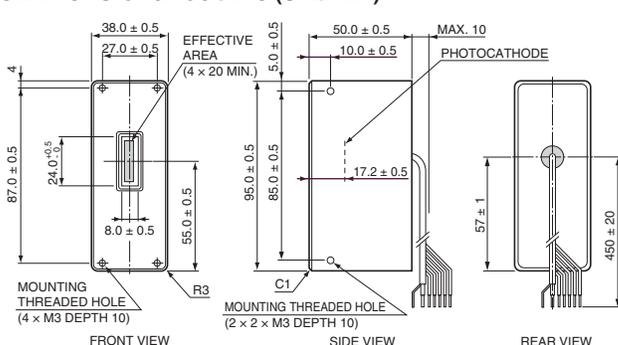
Parameter	H11462-011	H11462-012	H11462-021	H11462-022	H11462-031	H11462-032	Unit
Spectral response	185 to 710		185 to 900		185 to 900		nm
Effective area (X × Y)	4 × 20						mm
Input voltage	±4.5 to ±5.5						V
Recommended control voltage adjustment range	+0.5 to +1.1 (Max. +1.2)						V
Photomultiplier tube gain <sup>①</sup> Typ.	1.2 × 10 <sup>7</sup>		1.0 × 10 <sup>7</sup>		9.5 × 10 <sup>6</sup>		—
Frequency bandwidth (DC to)	20	200	20	200	20	200	kHz
Current-to-voltage conversion factor	1	0.1	1	0.1	1	0.1	V/μA
Maximum output signal voltage	+4 (Load resistance 10 kΩ)						V
Voltage output depending on PMT dark current <sup>①</sup> Typ.	0.2	0.02	3	0.3	10	1	mV
Settling time <sup>②</sup>	Max. 14						s
Operating ambient temperature	+5 to +50						°C

① Control voltage +1.0 V ② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



LOW VOLTAGE INPUT (+5 V) : UL1430 AWG26 (RED)  
 LOW VOLTAGE INPUT (-5 V) : UL1430 AWG26 (GREEN)  
 GND : UL1430 AWG26 (BLACK)  
 Vref OUTPUT (+1.2 V) : UL1430 AWG26 (BLUE)  
 Vcont INPUT (+0.5 V to +1.1 V) : UL1430 AWG26 (WHITE)  
 SIGNAL OUTPUT : RG-174/U

Weight: 225 g

TPMOA0073EC

## Photosensor modules H7827 series

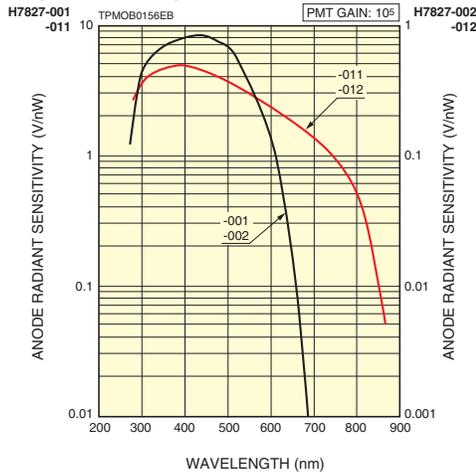
(at +25 °C)



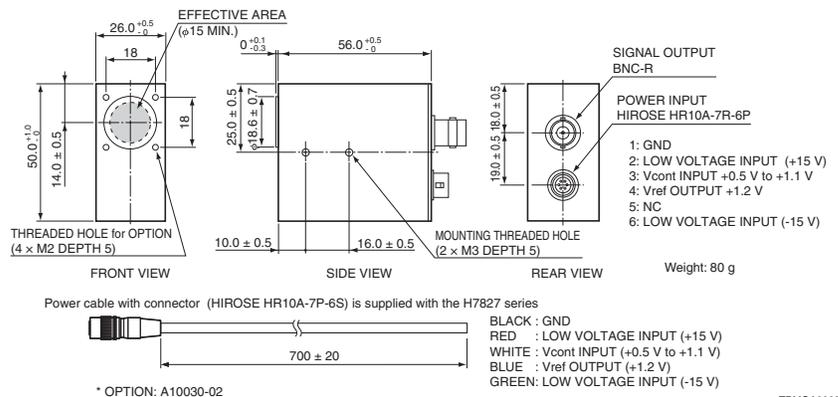
Parameter	H7827-001	H7827-002	H7827-011	H7827-012	Unit
Spectral response	300 to 650		300 to 850		nm
Effective area	$\phi 15$				
Input voltage	$\pm 11.5$ to $\pm 15.5$				
Recommended control voltage adjustment range	+0.5 to +1.1 (Max. +1.2)				
Photomultiplier tube gain ① Typ.	$5.5 \times 10^5$		$2.5 \times 10^5$		—
Frequency bandwidth (DC to)	20	200	20	200	kHz
Current-to-voltage conversion factor	1	0.1	1	0.1	V/ $\mu$ A
Maximum output signal voltage	+10 (Load resistance 10 k $\Omega$ )				
Voltage output depending on PMT dark current ① Typ.	3	0.3	3	0.3	mV
Settling time ② Max.	0.2				
Operating ambient temperature	+5 to +45				

① Control voltage +1.0 V ② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



TPMOA0023ED

## Photosensor modules H10492 series

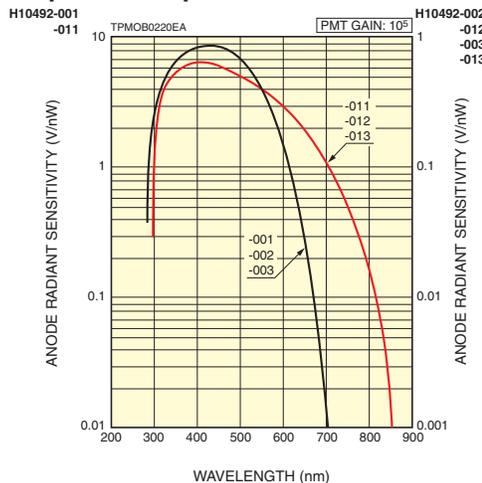
(at +25 °C)



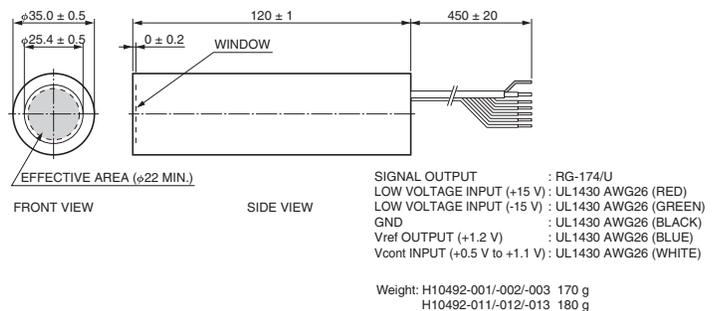
Parameter	H10492-001	H10492-002	H10492-003	H10492-011	H10492-012	H10492-013	Unit
Spectral response	300 to 650			300 to 850			nm
Effective area	$\phi 22$						
Input voltage	$\pm 11.5$ to $\pm 15.5$						
Recommended control voltage adjustment range	+0.5 to +1.1 (Max. +1.2)						
Photomultiplier tube gain ① Typ.	$2.0 \times 10^6$			$5.0 \times 10^5$			—
Frequency bandwidth (DC to)	20	200	8000	20	200	8000	kHz
Current-to-voltage conversion factor	1	0.1	0.1	1	0.1	0.1	V/ $\mu$ A
Maximum output signal voltage	-001/-002/-011/-012: +10 (Load resistance 10 k $\Omega$ ), -003/-013: +10 (Load resistance 500 $\Omega$ )			+5 (Load resistance 50 $\Omega$ )			V
Voltage output depending on PMT dark current ① Typ.	3	0.3	0.3	3	0.3	0.3	mV
Settling time ② Max.	10						
Operating ambient temperature	+5 to +50						

① Control voltage +1.0 V ② The time required for the output to reach a stable level following a change in the control voltage from +1.0 V to +0.5 V

### ● Spectral response



### ● Dimensional outline (Unit: mm)



TPMOA0059EB



## Photon counting heads H10682 series Photon counting heads H12386 series Photon counting heads H11890 series

CPU+I/F

(at +25 °C)



▲H10682 series



▲H12386 series



▲H11890 series

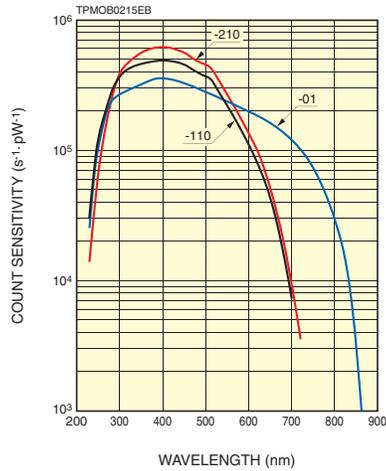
Parameter	H10682-110 H12386-110	H10682-210 H12386-210	H10682-01 H12386-01	Unit
Spectral response	230 to 700	230 to 700	230 to 870	nm
Effective area	φ8			mm
Input voltage	+4.75 to +5.25			V
Count linearity	5.0 × 10 <sup>6</sup>			s <sup>-1</sup>
Dark count	Typ. 50	50	600	s <sup>-1</sup>
Pulse-pair resolution	20			ns
Output pulse width	10			ns
Output pulse Height	Min. +2.0 (Load resistance 50 Ω), +4.0 (Un-terminated)			V
Recommended load resistance	50			Ω
Operating ambient temperature	+5 to +40			°C

(at +25 °C)

Parameter	H11890-110	H11890-210	H11890-01	Unit
Spectral response	230 to 700	230 to 700	230 to 870	nm
Effective area	φ8			mm
Input voltage	USB Bus power			—
Count linearity	5.0 × 10 <sup>6</sup> (with function of linearity correction: 2.0 × 10 <sup>7</sup> )			s <sup>-1</sup>
Dark count	Typ. 50	50	600	s <sup>-1</sup>
Pulse-pair resolution	20			ns
Counter gate time	1 to 10000			ms
Interface ①	USB2.0			—
Compatible OS ②	Windows® 7 Pro, 8 Pro, 10 Pro			—
Operating ambient temperature	+5 to +40			°C

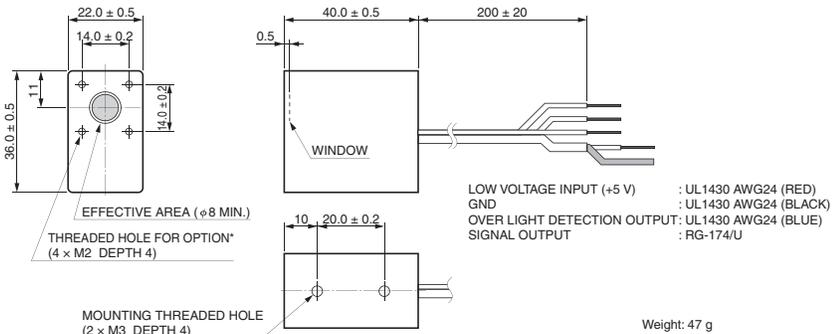
① Conform to in RS-232C    ② Sample program supplied

### ● Count sensitivity



### ● Dimensional outline (Unit: mm)

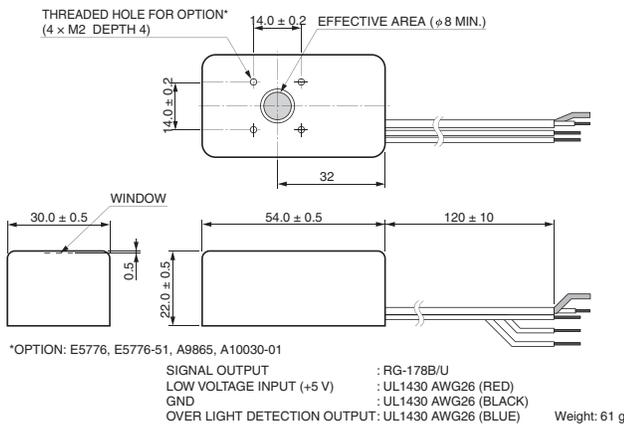
#### ■ H10682 series



\*OPTION: E5776, E5776-51, A9865, A10030-01

TPMOA0058EB

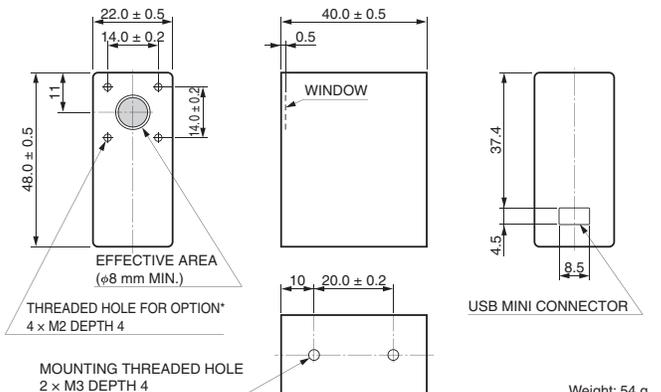
#### ■ H12386 series



\*OPTION: E5776, E5776-51, A9865, A10030-01

TPMOA0090EA

#### ■ H11890 series



\*OPTION: E5776, E5776-51, A9865, A10030-01

TPMOA0075EC

# Photon counting

## Photon counting heads H7421 series

Cooler

(at +25 °C)



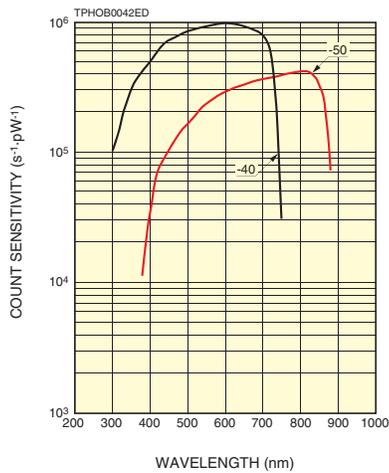
Heatsink with fan (A7423) sold separately

Parameter	H7421-40	H7421-50	Unit
Spectral response	300 to 720	380 to 890	nm
Effective area	φ5		mm
Input voltage	+4.5 to +5.5		V
Count linearity	1.5 × 10 <sup>6</sup>		s <sup>-1</sup>
Dark count (at 0 °C)   Typ.	100	125	s <sup>-1</sup>
Pulse-pair resolution	70		ns
Output pulse width	30		ns
Output pulse Height   Min.	+3.0		V
Recommended load resistance	50		Ω
Operating ambient temperature	+5 to +35		°C

### Cooling specifications

Cooling method	Thermoelectric cooling	—
Max. cooling temperature (ΔT)	35	°C
Cooling time	Approx. 5	min

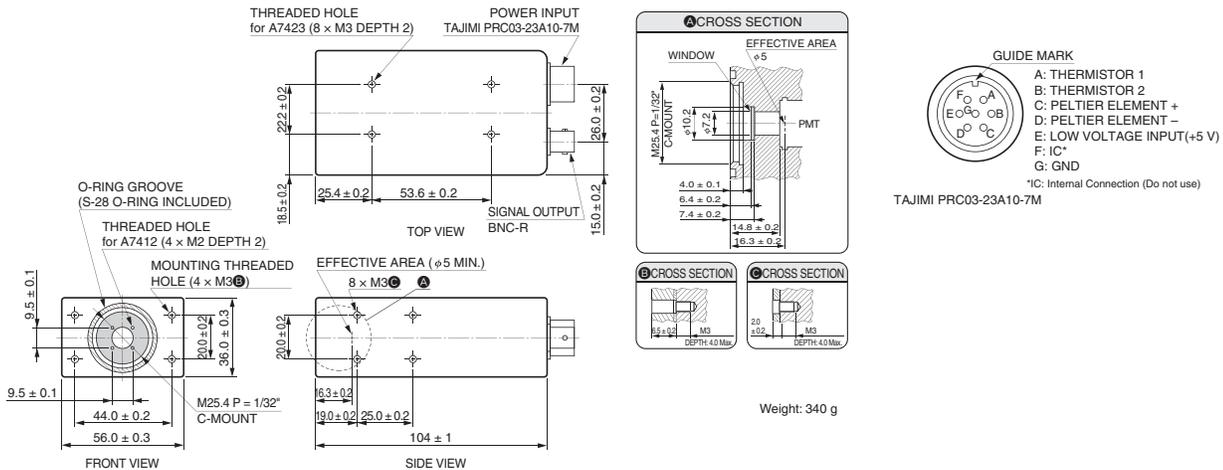
### ●Count sensitivity



### ●Option

- Heatsink with fan A7423
- Single cable E1168-05
- Optical fiber adapter (FC type) A7412
- C-mount adapter A7413
- Power supply unit with temperature control (AC100 V to 240 V input) C8137
- Power supply unit with temperature control (+12 V input, on-board type) M13413

### ●Dimensional outline (Unit: mm)



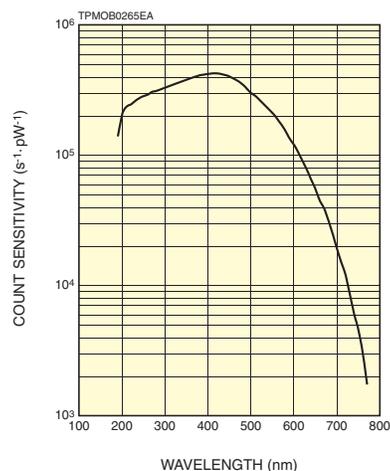
## Photon counting head H12525-01

(at +25 °C)

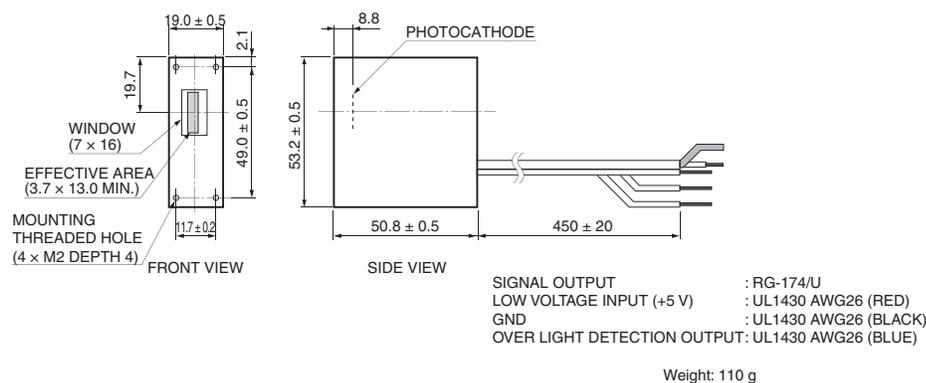


Parameter	H12525-01	Unit
Spectral response	185 to 750	nm
Effective area (X × Y)	3.7 × 13.0	mm
Input voltage	+4.75 to +5.25	V
Count linearity	$2.0 \times 10^6$	$s^{-1}$
Dark count	Typ. 50	$s^{-1}$
Pulse-pair resolution	20	ns
Output pulse width	10	ns
Output pulse Height	Min. +2.0 (Load resistance 50 Ω), +4.0 (Un-terminated)	V
Recommended load resistance	50	Ω
Operating ambient temperature	+5 to +40	°C

### ●Count sensitivity



### ●Dimensional outline (Unit: mm)



TPMOA0089EC

## Photon counting heads H8259 series

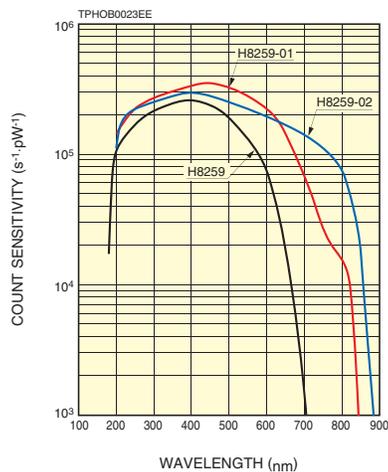
Gate 50 μs

(at +25 °C)

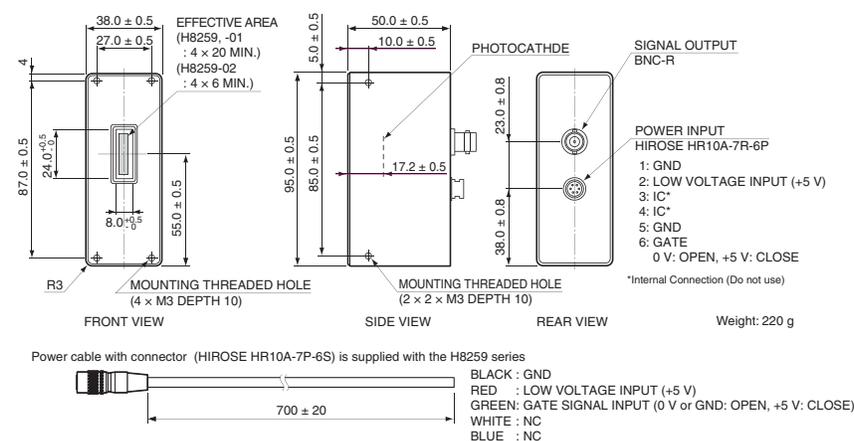


Parameter	H8259	H8259-01	H8259-02	Unit
Spectral response	185 to 680	185 to 850	185 to 900	nm
Effective area (X × Y)	4 × 20		4 × 6	mm
Input voltage	+4.5 to +5.5			V
Count linearity	$2.5 \times 10^6$			$s^{-1}$
Dark count	Typ. 30	80	400	$s^{-1}$
Gate width (FWHM)	50 μs to DC (Normally ON)			—
Repetition rate	Max. 10			kHz
Pulse-pair resolution	35			ns
Output pulse width	30			ns
Output pulse Height	Min. +2.0 (Load resistance 50 Ω)			V
Recommended load resistance	50			Ω
Operating ambient temperature	+5 to +40			°C

### ●Count sensitivity



### ●Dimensional outline (Unit: mm)

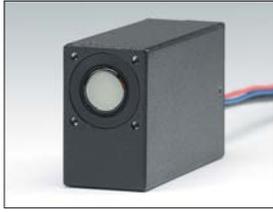


TPHOA0027EF

# Photon counting

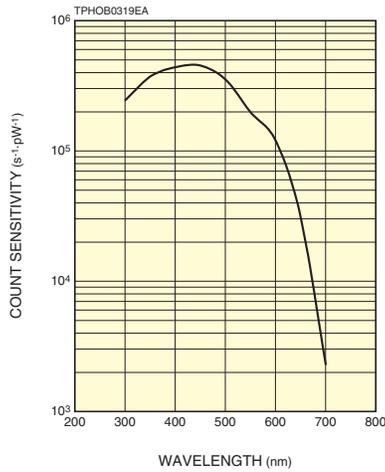
## Photon counting head H12775

(at +25 °C)

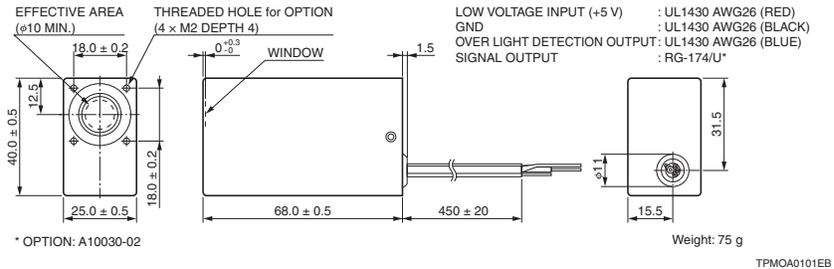


Parameter	H12775	Unit
Spectral response	300 to 650	nm
Effective area	φ 10	mm
Input voltage	+4.75 to +5.25	V
Count linearity	$5.0 \times 10^6$	s <sup>-1</sup>
Dark count	Typ. 30	s <sup>-1</sup>
Pulse-pair resolution	20	ns
Output pulse width	10	ns
Output pulse Height	Min. +2.0 (Load resistance 50 Ω), +4.0 (Un-terminated)	V
Recommended load resistance	50	Ω
Operating ambient temperature	+5 to +40	°C

### ●Count sensitivity



### ●Dimensional outline (Unit: mm)



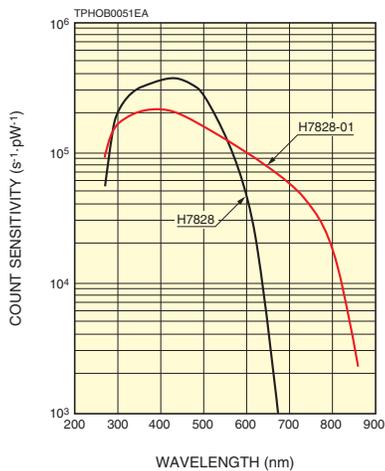
## Photon counting heads H7828 series

(at +25 °C)

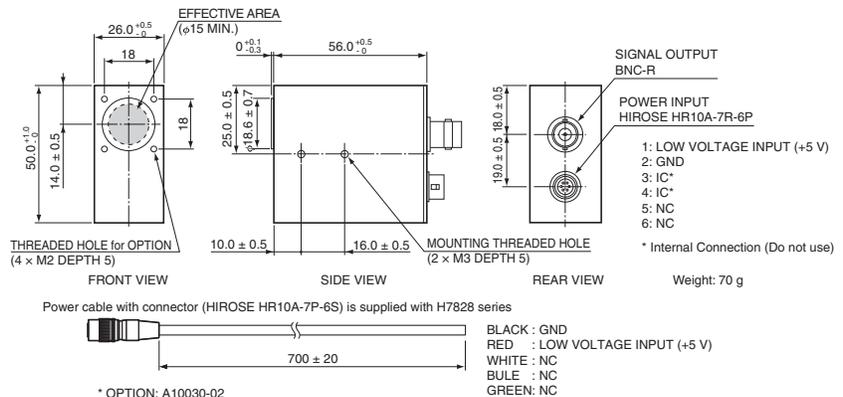


Parameter	H7828	H7828-01	Unit
Spectral response	300 to 650	300 to 850	nm
Effective area	φ 15		mm
Input voltage	+4.5 to +5.5		V
Count linearity	$1.5 \times 10^6$		s <sup>-1</sup>
Dark count	Typ. 200	2000	s <sup>-1</sup>
Pulse-pair resolution	70		ns
Output pulse width	30		ns
Output pulse Height	Min. +3.0 (Load resistance 50 Ω)		V
Recommended load resistance	50		Ω
Operating ambient temperature	+5 to +40		°C

### ●Count sensitivity



### ●Dimensional outline (Unit: mm)



## Photon counting heads H11870 series Photon counting heads H13467 series

(at +25 °C)



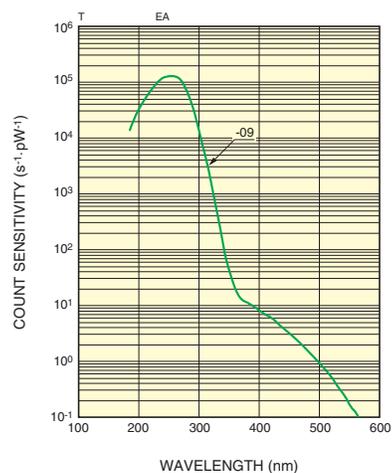
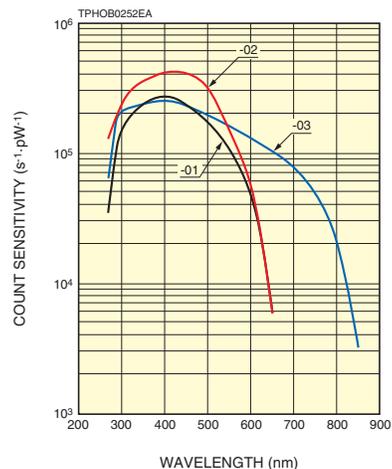
▲H11870 series



▲H13467 series

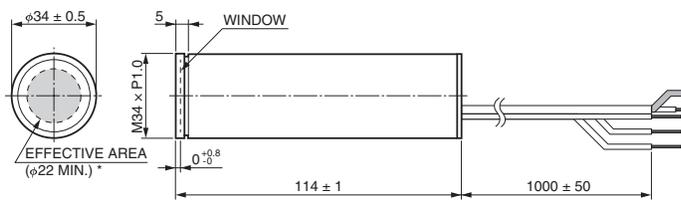
Parameter	H11870-01 H13467-01	H11870-02 H13467-02	H11870-03 H13467-03	H11870-09	Unit
Spectral response	300 to 650	300 to 650	300 to 850	185 to 320	nm
Effective area	$\phi 22$			$\phi 21$	mm
Input voltage	+4.75 to +5.25				V
Count linearity	$6.0 \times 10^6$				$s^{-1}$
Dark count	Typ. 15	60	5000	15	$s^{-1}$
Pulse-pair resolution	18				ns
Output pulse width	9				ns
Output pulse Height	Min. +2.0 (Load resistance 50 $\Omega$ ), +4.0 (Un-terminated)				V
Recommended load resistance	50				$\Omega$
Operating ambient temperature	+5 to +40				$^{\circ}C$

### ●Count sensitivity



### ●Dimensional outline (Unit: mm)

#### ■H11870 series



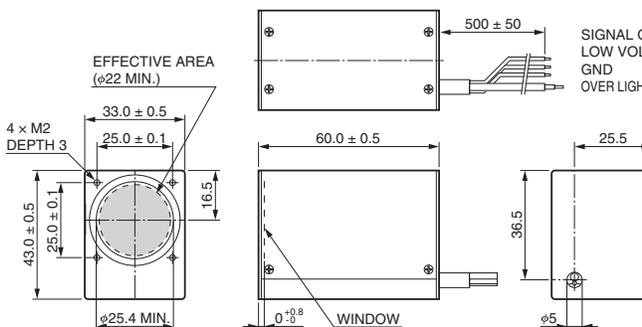
FRONT VIEW  
\* -09:  $\phi 21$  MIN.

SIGNAL OUTPUT : RG-174/U  
LOW VOLTAGE INPUT (+5 V) : UL1430 AWG24 (RED)  
GND : UL1430 AWG24 (BLACK)  
OVER LIGHT DETECTION OUTPUT : UL1430 AWG24 (BLUE)

Weight: 140 g

TPMOA0088EC

#### ■H13467 series



SIGNAL OUTPUT : RG-174/U  
LOW VOLTAGE INPUT (+5 V) : UL1430 AWG24 (RED)  
GND : UL1430 AWG24 (BLACK)  
OVER LIGHT DETECTION OUTPUT : UL1430 AWG24 (BLUE)

Weight: 111 g

TPMOA0092EB

# Photon counting

## Photon counting heads H9319 series

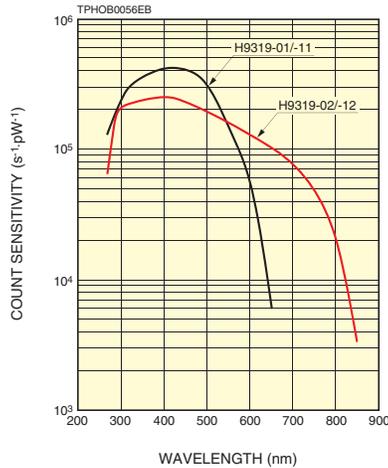
CPU+I/F

(at +25 °C)

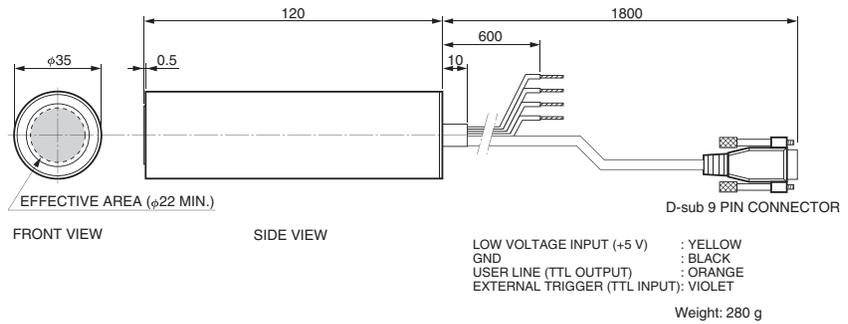


Parameter	H9319-01	H9319-11	H9319-02	H9319-12	Unit
Spectral response	300 to 650		300 to 850		nm
Effective area	$\phi 22$				mm
Input voltage	+4.75 to +5.25				V
Count linearity	$20 \times 10^6$				$s^{-1}$
Dark count	Typ. 150		10000		$s^{-1}$
Counter gate time	10 to 1000				ms
Input signal (External trigger input)	TTL level signal				—
Output signal (User line output)	TTL level signal				—
Interface	RS-232C				—
Sample program	yes	no	yes	no	—
Operating ambient temperature	+5 to +50				°C

### ●Count sensitivity



### ●Dimensional outline (Unit: mm)



TPMOA0032EB

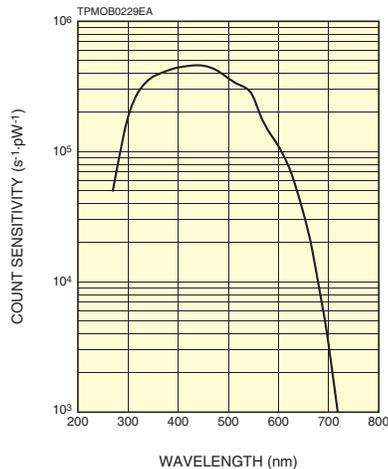
## Photon counting head H11123

(at +25 °C)

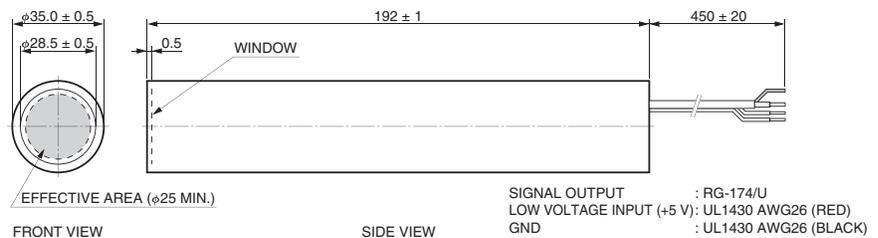


Parameter	H11123	Unit
Spectral response	300 to 650	nm
Effective area	$\phi 25$	mm
Input voltage	+4.75 to +5.25	V
Count linearity	$5.0 \times 10^6$	$s^{-1}$
Dark count	Typ. 100	$s^{-1}$
Pulse-pair resolution	20	ns
Output pulse width	10	ns
Output pulse Height	Min. +2.0 (Load resistance 50 $\Omega$ ), +4.0 (Un-terminated)	V
Recommended load resistance	50	$\Omega$
Operating ambient temperature	+5 to +40	°C

### ●Count sensitivity



### ●Dimensional outline (Unit: mm)



TPMOA0065EB

## Power supplies for PMT modules C7169, C10709

The C7169 and C10709 are power supply units for photomultiplier tube modules. Input voltage and control voltage for photomultiplier tube modules can be supplied by this power supply unit alone.



Parameter	C7169	C10709	Unit
Output voltage	±15	±5	V
Output current	0.3 (+15 V), 0.2 (-15 V)	2.0 (+5 V), 0.2 (-5 V)	A
Control voltage <sup>Ⓐ</sup> (variable voltage range)	+0.25 to +1.8		V
Applicable products	H7826, H7827, H9305, H9306 H9307, H10425, H10426, H10492 H10493, H11411, H11526, H11706 H11900, H11901, H11902, H11903	H10720, H10721, H10722, H10723 H11432, H11461, H11462, H12056 H12402, H12403, H12404, H12405 H13320, H13543, H14066, H14600	—
Output connector	Binding post		—
Input voltage	AC 100 to AC 240		V

<sup>Ⓐ</sup>Adjust within the recommended control voltage range for the photosensor module being used.

## Amplifier units, Amplifier modules

These are amplifier units and amplifier modules for photomultiplier tubes and current output type PMT modules.

Output signal from photomultiplier tubes can be directly input into these amplifiers.



Type No.	Frequency bandwidth (-3 dB)	Current-to-voltage conversion factor	Signal input polarity (Output)	Signal connector		Supply voltage (V)
				Input	Output	
<b>C7319</b>	DC to 20 kHz DC to 200 kHz (Switchable)	0.1 V/μA, 1 V/μA 10 V/μA (Switchable)	Positive / Negative (Inverting)	BNC-R		±5 to ±15
<b>C12419</b>	DC to 1 MHz	1 V/μA	Positive / Negative (Inverting)	BNC-R		±15
<b>C9999</b>	DC to 10 MHz	50 mV/μA	Positive / Negative (Non-inverting)	BNC-R		±5
<b>C9999-01</b>		10 mV/μA	Positive / Negative (Inverting / Non-inverting)	BNC-R		
<b>C6438</b>	DC to 50 MHz	0.5 mV/μA	Positive / Negative (Non-inverting)	BNC-R		±5
<b>C6438-01</b>		25 mV/μA	Positive / Negative (Non-inverting)	BNC-R		
<b>C6438-02</b>		5 mV/μA	Positive / Negative (Inverting / Non-inverting)	BNC-R		
<b>C9663</b>	DC to 150 MHz	4 mV/μA	Positive / Negative (Non-inverting)	BNC-R		±5
<b>C11184</b>	DC to 300 MHz	1.25 mV/μA	Positive / Negative (Non-inverting)	MCX-R (MCX-BNC adapter is supplied)		±5
<b>C5594-12</b>	50 kHz to 1.5 GHz	3.15 mV/μA	Positive / Negative (Non-inverting)	SMA-P	SMA-R	+12 to +16
<b>C5594-22</b>				SMA-R	SMA-R	
<b>C5594-44</b>				BNC-R	BNC-R	
<b>M7279</b>	DC to 10 MHz	10 mV/μA	Positive / Negative (Non-inverting)	On-board mounting		±5 to ±6.5
<b>M8879</b>	DC to 150 MHz	4 mV/μA	Positive / Negative (Non-inverting)	On-board mounting		±5 to ±6

# Related products

## Photon counting unit C9744

The photon counting unit C9744 converts single photoelectron pulses from a photomultiplier tube into digital signals of logic pulse by use of the built-in amplifier and discriminator circuits. Photon counting can be easily performed by simply connecting a counter to the output of the photon counting unit. The C9744, which incorporates a prescaler (division by 10), can perform measurement with an excellent output linearity up to  $10^7 \text{ s}^{-1}$ .



Parameter	Description / Value		Unit
Input impedance	50		$\Omega$
Discrimination level (input conversion)	-0.4 to -16		mV
Required PMT gain	$3 \times 10^6$		—
Prescaler	$\div 1$	$\div 10$	—
Count linearity	$4 \times 10^6$	$1 \times 10^7$	$\text{s}^{-1}$
Pulse-pair resolution	25	10	ns
Output pulse width	10	Depends on count rate	ns
Output pulse	CMOS, positive logic		—
Connector	Input / output: BNC-R, Power: DIN-R (6 pin) <sup>Ⓐ</sup>		—
Supply voltage	+5.0 V, 130 mA / -5.0 V, 50 mA		—

<sup>Ⓐ</sup>Supplied with a cable (1.5 m) attached to the mating plug.

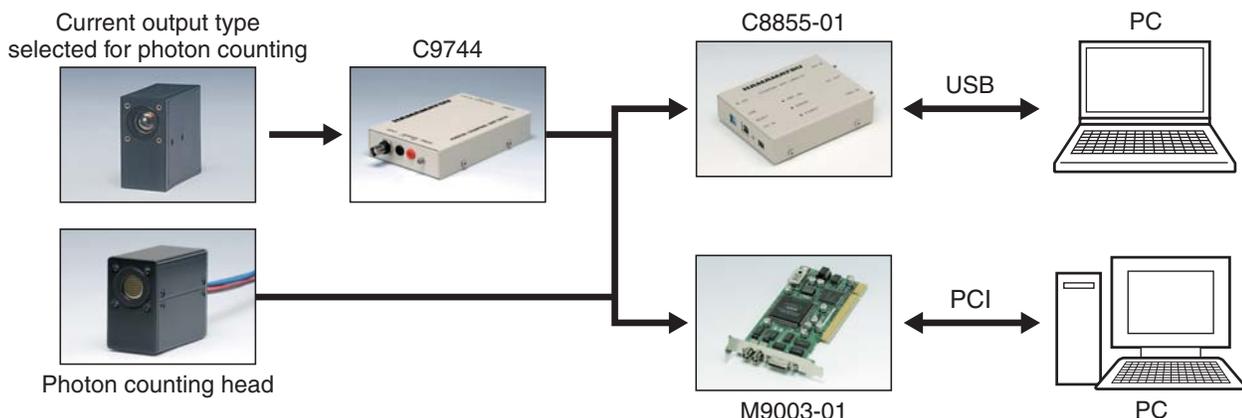
## Counting unit C8855-01, Counting board M9003-01

The C8855-01 is a counting unit with a USB interface and M9003-01 is a counting board that is PCI bus add-in type. Both products have two counter circuits (double counter method) capable of counting input signals with no dead time. The C8855-01 is supplied with sample software and therefore you can start measurement as soon as the C8855-01 is delivered.



Parameter	C8855-01	M9003-01	Unit
Number of input signals	1	2	ch
Signal input level	CMOS positive logic	TTL positive logic	—
Signal pulse width	8 or longer		ns
Input impedance	50 $\Omega$	50 $\Omega$ (at SW ON), 100 k $\Omega$ (at SW OFF)	—
Max. count rate	50		MHz
Internal counter gate time	50 $\mu\text{s}$ to 10 s	50 ns to 12.75 $\mu\text{s}$	—
Trigger method	Software / External trigger		—
External trigger signal	TTL negative logic		—
OS	Windows <sup>®</sup> 7/8/8.1/10 Professional		—
Data transfer method / transfer quantity	—	DMA transfer / 64 M bytes MAX.	—
Supply voltage	+7 V / 500 mA Max. (AC adapter included)	PCI standard	—

### Example of connections for photon counting measurement



## Optical blocks for PMT module

Optical blocks are precision units that contain or can contain optical components such as bandpass filters and dichroic mirrors. These blocks are specially designed for low-light-level measurements using PMT modules. Their optical components are precisely arranged to ensure complete light shielding. They can be easily attached/detached by thumbscrews allowing optical blocks to be freely combined as needed. Optical blocks can be assembled in combination with light sources such as lasers or microscope objective lenses to create confocal optical systems or fluorescence microscopes.

### Lineup

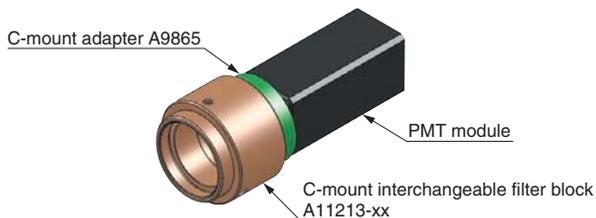
<p><b>C-mount adapter</b> <span style="float: right;">A9865</span></p>  <p>This adapter connects a PMT module to C-mount threaded optical blocks. This adapter can also be connected to a device with C-mount.</p>	<p><b>Adapter block</b> <span style="float: right;">A10030-01/-02</span></p>  <p>The A10030-01 is an adapter block for connecting a PMT module to a V-groove type optical block.</p>	 <p>▲Optical block combinations</p>
<p><b>Fiber adapter block</b> <span style="float: right;">A10037 series</span></p>  <p>This block connects to optical fibers with a FC/SMA connector. The lens assembled in the block collimates the light spreading from the optical fiber.</p>	<p><b>Filter block</b> <span style="float: right;">A10033-90</span></p>  <p>The A10033-90 is a holder block for assembling a commercially available 15 mm diameter filter.</p>	
<p><b>Pinhole block</b> <span style="float: right;">A11027</span></p>  <p>This is a holder block that can hold a commercially available, mount type pinhole. Light passing through the pinhole is collimated by the lens in the block and is output.</p>	<p><b>C-mount interchangeable filter block</b> <span style="float: right;">A11213 series</span></p>  <p>The A11213 series is a C-mount connection block for installing a commercially available 25 mm diameter filter or lens. This block allows angle adjustment and so is useful as a spacer or adapter that connects between C-mounts.</p>	<p><b>C-mount interchangeable dichroic block</b> <span style="float: right;">A11214</span></p>  <p>The A11214 is a C-mount connection block for installing a commercially available dichroic mirror having a 45 degree incident angle, 1 mm thickness, and dimensions of 26 x 38 mm.</p>

\* Other types of optical blocks are also available besides the products listed here. For more details please refer to the individual catalogs or access our web site.

### Connection example

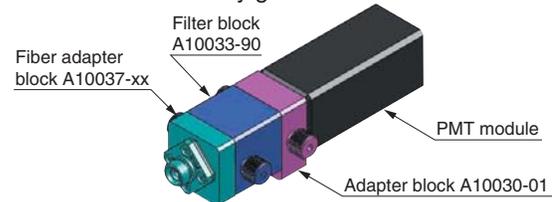
#### ●Single wavelength detection with C mount

Optical filter within the block passes only light at a specific wavelength which is then detected by the PMT module.



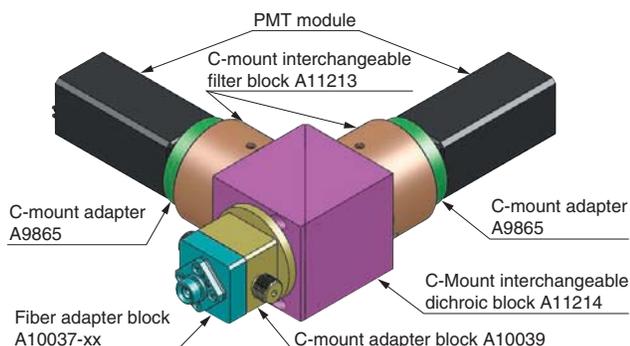
#### ●Fiber-optic single wavelength detection

Light emitted and spreading from an optical fiber cable is collimated by the lens within the A10037 series fiber adapter block and so is effectively guided to the PMT module.



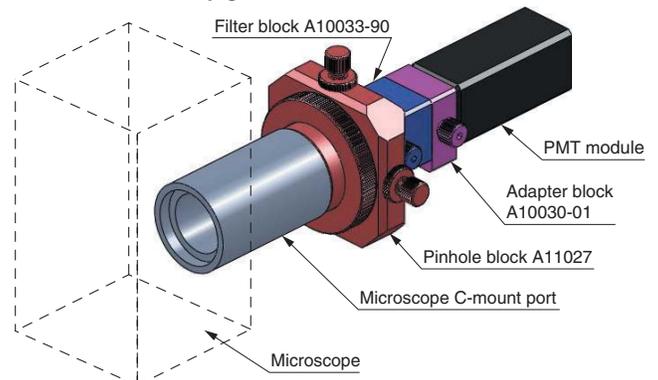
#### ●Fiber-optic dual wavelength detection

The dichroic mirror within the block reflects light shorter than a certain wavelength and passes light longer than that wavelength. The optical filters further pass only light at a specific wavelength which is then detected by PMT modules.



#### ●Extended example of microscope

Connecting the A11027 pinhole block to the C-mount port of a microscope configures a confocal optical system. Light passing through the pinhole is collimated by the lens in the block and is efficiently guided to the PMT module.



# Related products

## Stabilized light sources L11416, L11494 series

The L11416 and L11494 series are LED light sources mainly designed for adjusting the sensitivity of PMT (photomultiplier tubes) and PMT modules. The L11416 series is a test tube type easily mounted in lab devices such as for blood sampling, while the L11494 series is a plate type designed to be placed on a sample stage.

Stable continuous light of approximately 1 pW is always output because the LED emission power is controlled by monitoring with a photodiode.

### ■Features

- High stability even at photon counting level

### ■Specifications

#### ●L11416 series

Parameter	L11416-470	L11416-525	L11416-555	L11416-590	Unit
Peak emission wavelength	465	522	555	592	nm
Spectral half width	26	35	30	18	nm
Light emission power	1 ± 0.5 <sup>Ⓐ</sup>				pW
Emission stability (0 °C to +50 °C)	±2 Max.				%
Battery	Button battery SR41 or equivalent				—
Battery service Life	Min.	24			h
Operating ambient temperature / humidity <sup>Ⓑ</sup>	0 °C to +50 °C / below 85 %				—
Storage temperature / humidity <sup>Ⓑ</sup>	-20 °C to +60 °C / below 85 %				—
Weight	13				g

<sup>Ⓐ</sup>Adjusted by using a 22 mm effective diameter photon counting head placed at a position 5 mm away from the L11416. <sup>Ⓑ</sup>No condensation

#### ●L11494 series

Parameter	L11494-430	L11494-470	L11494-525	L11494-660	Unit
Peak emission wavelength	428	465	522	660	nm
Spectral half width	65	26	35	30	nm
Light emission power	High: 1 ± 0.5, Low: 0.01 ± 0.005 <sup>Ⓒ</sup>				pW
Emission area	φ7.0				mm
Emission stability (0 °C to +50 °C)	±2 Max.				%
Battery	Button battery SR41 or equivalent				—
Battery service life	Min.	10	24		h
Operating ambient temperature / humidity <sup>Ⓓ</sup>	0 °C to +50 °C / below 85 %				—
Storage temperature / humidity <sup>Ⓓ</sup>	-20 °C to +60 °C / below 85 %				—
Weight	23				g

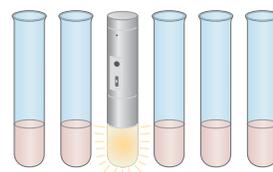
<sup>Ⓒ</sup>Adjusted by using an 8 mm effective diameter photon counting head placed in direct contact with the L11494. <sup>Ⓓ</sup>No condensation



▲Left: L11494, Right: L11416

### ■Image during use

#### ●L11416



TACCC0172EA

#### ●L11494



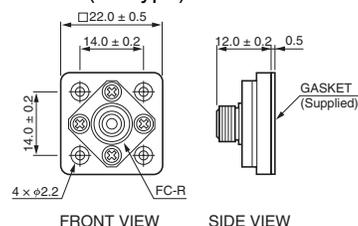
TACCC0150EB

## Optical fiber adapters for PMT modules E5776, E5776-51

This optical fiber adapter allows connection to an optical fiber cable which has FC or SMA connector. Guiding the light with an optical fiber can be easily performed by fixing this adapter to incident surface of photomultiplier tube module.



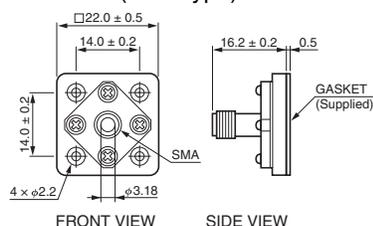
#### E5776 (FC type)



\* Supplied with M2 screws (4 pcs) for fixing to module

TACCA0055EC

#### E5776-51 (SMA type)



\* Supplied with M2 screws (4 pcs) for fixing to module

TACCA0239EC

Connectable PMT modules: H10682, H10720, H10721, H10722, H10723, H11526, H11706  
H11890, H11900, H11901, H11902, H11903, H12056, H12386, H14600

\* When bandpass filter or the like are required between optical fiber and module, it is recommended to use the fiber adapter block A10037 series (P.35), which includes the lens that can collimate diffused light from an optical fiber.

## General Characteristics

### Photocathode radiant sensitivity and quantum efficiency

Radiant sensitivity is the photoelectric current generated from the photocathode when struck by light at a given wavelength, divided by the incident radiant power, and expressed in A/W (amperes per watt). Quantum efficiency (QE) is the number of photoelectrons emitted from the photocathode divided by the number of incident photons and is usually expressed as a percent. Cathode radiant sensitivity is one factor in determining signal-to-noise (S/N) characteristics and detection limit of measurement systems, and is used to calculate signal-to-noise ratio (S/N ratio) and noise equivalent power (NEP) representing a lower detection limit.

Measurement of radiant sensitivity requires a sophisticated system using a spectrophotometer and also takes a lot of time. Because of this, we only attach spectral response data showing radiant sensitivity to the photomultiplier tube when specially requested by the customer and we charge for this service. Cathode radiant sensitivity cannot be measured once the photomultiplier tube is assembled as a module. If radiant sensitivity data is necessary, please request it when placing an order.

### Luminous sensitivity

Cathode luminous sensitivity is the photoelectric current generated from the photocathode when a photomultiplier tube receives light flux from a tungsten filament lamp operated at a distribution temperature of 2856 K. Anode luminous sensitivity is the anode output current per incident light flux on the photocathode of a photomultiplier tube when a specific high voltage is applied. The light flux is lowered to an appropriate level by using a neutral density filter.

Luminous sensitivity data is measured and listed in the test sheet prior to shipment except for some types of PMT modules. Luminous sensitivity is particularly useful when comparing PMT modules having a similar spectral response range.

### Blue sensitivity index and red/white ratio

Although different from absolute spectral response characteristics, the blue sensitivity index and the red/white ratio are often used for simple comparison of photomultiplier tube spectral response.

Blue sensitivity index is the photoelectric current generated from the photocathode when a blue filter is interposed in the same measurement system as used to measure cathode luminous sensitivity. Blue sensitivity index is an essential parameter in scintillation counting because the NaI(Tl) scintillators frequently used in scintillation counting, produce light emissions close to the blue spectrum when transmitted through a blue filter. Blue sensitivity index is not represented in lumens because the light flux once transmitted through a blue filter cannot be expressed in lumens.

Red/white ratio is used for comparing the sensitivity of photomultiplier tubes having a spectral response extending to the near infrared region. Like blue sensitivity index, the red/white ratio is also measured with the measurement system used for cathode luminous sensitivity, but a red to infrared filter is interposed. Red/white ratio is defined as the ratio of the cathode sensitivity measured with a red to infrared filter, to the cathode luminous sensitivity when measured without a filter.

### Gain

Gain of PMT modules listed in this catalog is the ratio of anode output current to cathode output current, measured at specified values of control voltage. Gain depends directly on the high voltage applied to the photomultiplier tube, which is adjusted by a control voltage.

### Dark current

A small amount of output current appears from a PMT module even when operated in a completely darkness. This output current is called "dark current". Dark current varies with the control voltage in proportion to the change in gain. However, the slope of the dark current versus the voltage curve becomes less and less steep as the control voltage is decreased. This dark current at a low control voltage is mainly comprised of leakage current generated on the glass stem and lead pins or the surface of the circuit boards. When a PMT module is operated at a normal high voltage, most of dark current originates from thermionic emissions, especially those from the photocathode. Cooling the module is therefore very effective in reducing the dark current. Hamamatsu PMT modules are designed to exhibit low dark current when used within the specified operating temperature range. However, in applications where dark current is a critical factor, using a PMT module with a built-in cooler is recommended.

### Spatial uniformity

When a spot light strikes the photocathode of a photomultiplier tube, the photoelectric sensitivity may vary depending on the photocathode position. This variation in sensitivity is called "spatial uniformity". Spatial uniformity is caused by the irregular sensitivity of the photocathode itself and also by a non-uniform loss of electrons while focused and multiplied by the dynodes after being emitted from different positions on photocathode. Spatial uniformity also depends on the light wavelength. In general, head-on photomultiplier tubes provide better spatial uniformity than side-on tubes. To reduce the adverse effects of spatial uniformity on measurement, the input light must be made to illuminate a wider area on the photocathode or a diffuser plate must be placed in front of the photocathode.

### Temperature characteristics

The sensitivity and dark current (dark count) of photomultiplier tubes change with the ambient temperature. The rate of this change (temperature coefficient) depends on the light wavelength. As the ambient temperature decreases, the sensitivity increases in the ultraviolet to visible region while it tends to decrease in the longer wavelength region. As temperature decreases, dark current also decreases because the thermionic emission of electrons is reduced.

### Drift and life characteristics

While operating a photomultiplier tube continuously over a long period, the anode output current may vary slightly over time, even though the operating conditions have been kept constant. In this kind of anode current behavior, the stability over a short operating time is called the drift characteristic, while the stability over an extended period of time is called the life characteristic. Both drift and life characteristics differ according to the type of photomultiplier tubes and the magnitude of anode current drawn from the photomultiplier tube. When stability is of prime importance, operating the tube at an average anode current of 1  $\mu$ A or less is recommended.

### Time response characteristics

The time response characteristics of photomultiplier tubes are very important when measuring high-speed signals. Time response characteristics are usually evaluated in terms of electron transit time, rise time and electron transit time spread (T.T.S.). These characteristics differ depending on the type of photomultiplier tube contained in the PMT module and must be carefully selected to meet the application. In addition to the time response characteristics

# Technical guide

of photomultiplier tubes, the signal load conditions have effects on PMT module response speeds, particularly on the current-output PMT modules. As the load resistance is made larger, the response speeds of the current-output PMT modules reduce.

## Signal-to-noise characteristics

When observing the output waveform of a photomultiplier tube, fluctuations (AC components) can be seen in the signal components. This is so-called "shot noise" resulting from fluctuations in the photoemission and electron multiplication processes.

Since the effects of DC dark current can be largely eliminated, shot noise is the dominant factor in determining the signal-to-noise ratio (S/N ratio) in low-light-level measurement.

To minimize the shot noise and obtain a better S/N ratio, note the following points.

1. Use a photomultiplier tube that has as high a quantum efficiency as possible on the wavelength range to be measured.
2. Design the optical system for better light collection efficiency so that the incident light is guided to the photomultiplier tube with minimum loss.
3. Narrow the measuring system bandwidth as much as possible, as long as no problem occurs in the measurement.

## Power Supply Circuit Characteristics

### Power supply circuit

There are mainly two types of power supply circuits used in Hamamatsu PMT modules. One type is the Cockcroft-Walton circuit. The other is an active type divider circuit combined with the Cockcroft-Walton circuit.

### Cockcroft-Walton circuit

The Cockcroft-Walton circuit is a voltage booster circuit with an array of series-connected diodes, and with capacitors connected at each of the alternate connection points. When a reference voltage is applied to this circuit, voltage potentials boosted 1 time, 2 times, 3 times ... (multiplied by integers) are applied to the dynodes of the photomultiplier tube. This circuit delivers good linearity in both DC and pulsed currents while maintaining low power consumption, and allows designing a compact circuit, but the settling time becomes temporarily long.

### Active type divider circuit combined with Cockcroft-Walton circuit

This circuit consists of a Cockcroft-Walton circuit that generates a voltage applied to the entire photomultiplier tube and an active type divider circuit that applies a voltage to each dynode. In the active type divider circuit, transistors are used in place of voltage-dividing resistors for the last few dynodes. This method prevents the dynode-to-dynode voltage from being affected by the photomultiplier tube signal current, allowing good linearity to be obtained up to 60 to 70% of the voltage divider circuit current. This circuit also features short settling time compared to when only a Cockcroft-Walton circuit is used.

### Ripple noise

Switching noise may get into the output signal of PMT modules by induction since high-voltage power supplies in PMT modules use a switching power supply. This induced noise is called "ripple noise". Although Hamamatsu PMT modules are designed to minimize this ripple noise, taking the following measures will

reduce it even further.

- 1) Place a low-pass filter after the signal output from the PMT module.
- 2) Increase the control voltage to raise the photomultiplier tube gain and lower the amplifier gain.

At Hamamatsu Photonics, ripple noise is measured with a signal load resistance 1 M $\Omega$  and a load capacitance of 22 pF.

### Settling time

When the control voltage for a PMT module is changed, the high voltage applied to the photomultiplier tube also changes, but has a slight delay due to the timing of the control voltage input. The settling time is the time required to reach the specified level of high voltage after changing the control voltage. At Hamamatsu Photonics, this settling time is measured when changing the control voltage from +1.0 V to +0.5 V.

## Voltage output type PMT modules

### Using as a charge amplifier

Voltage output type PMT modules incorporate an operational amplifier that converts a current output from the photomultiplier tube into a voltage output. The operational amplifier has feedback resistance and capacitance, and also serves as a simple charge amplifier allowing pulse measurements such as in scintillation counting applications.

## Photosensor Module with Gate Function

### Gate operation

When the primary excitation light from a strong light sources enters a photomultiplier tube, the signal processing system may saturate, causing adverse effects on the measurement. A mechanical shutter could be used to shut off such primary light. However, mechanical shutters are limited in terms of high-speed operation and service life. In contrast, gate operation is effective in serving as an electronic shutter to gate off excessive light, by changing the dynode voltage in the photomultiplier tube. The electronic shutter operates at high speeds with a high extinction ratio. There are two methods of gate operation. In one method the photomultiplier tube is normally off and turns on when a gate signal is input. In the other method, the photomultiplier tube is normally on and turns off when a gate signal is input.

### Gate noise

High-speed gate pulses must be input to perform high-speed gate operation. When a gate pulse is input to a photomultiplier tube, induced noise is generated and appears in the anode signal due to interelectrode capacitance. This is called gate noise. Reducing the gate pulse voltage or noise canceling techniques are effective to some extent in decreasing this gate noise, but cannot completely eliminate it. So it is necessary to increase the photomultiplier tube gain or use the photomultiplier tube with high gain.

### Switching ratio

This is the ratio of the photomultiplier tube outputs when the gate is tuned on and off at a constant light level incident on the photocathode. For example, while normally off operation, if the gate-off output is 1 nA and the gate-on output is 10  $\mu$ A, the switching ratio is 1 nA to 10  $\mu$ A or expressed as 1 : 10<sup>4</sup>.

# Photon Counting Head

## Principle of photon counting

When light intensity becomes extremely low, light can be counted as individual photons. Photomultiplier tubes are ideal for photon counting because they exhibit excellent time resolution, high gain and yet low noise. In low-light-level measurement, photon counting has advantages over the analog detection method. For example, noise pulses can be easily separated, and high stability and a high S/N ratio obtained.

## Quantum efficiency

The most important characteristic in photon counting is the photocathode quantum efficiency. The probability of photoelectron emission when a single photon strikes the photocathode is called the photocathode quantum efficiency. Since the number of photoelectrons emitted per photon is one or zero, the quantum efficiency is defined as the ratio of the number of photoelectrons emitted from the photocathode to the number of photons incident on the photocathode over a unit of time. There are various types of photocathodes. It is essential to choose the photocathode that provides the highest quantum efficiency at the wavelength to be measured.

## Detection efficiency

Detection efficiency is the ratio of the number of counted pulses (photomultiplier tube output pulses) to the number of incident photons. The "count sensitivity" listed in this catalog is related to this detection efficiency.

## Correction of count loss

Theoretically, the maximum count rate is a reciprocal of pulse-pair resolution (ability to discriminate between successive pulses). However, since chemiluminescence and bioluminescence occur randomly, the detected signal pulses may overlap each other, causing a counting loss or error. Considering the probability of pulse overlap, the maximum effective count rate would be 1/10 th of the theoretical rate. This count loss of overlapped pulses can be corrected by the following equation.

$$N = \frac{n}{1-n \cdot t}$$

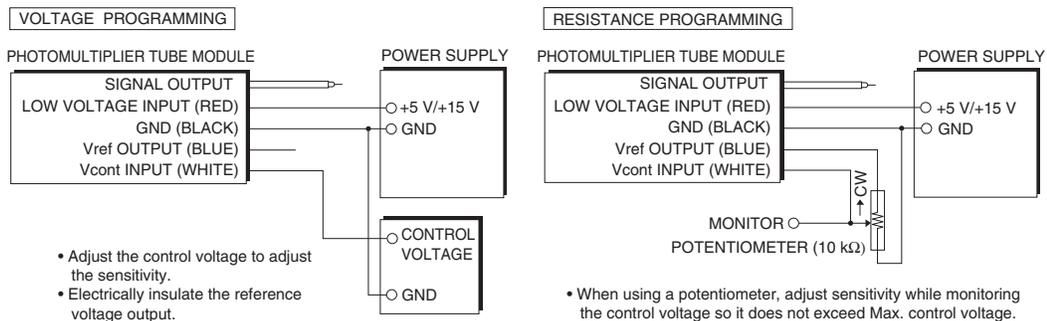
N : True count rate

n : Measured count rate

t : Pulse resolution

## Sensitivity adjustment method

### ● Current output type

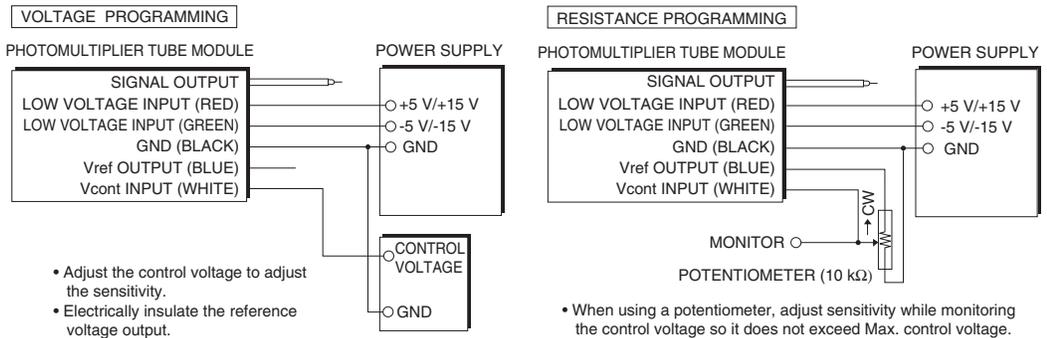


Low voltage input	Conforming product Type No.
+5 V	H10720, H10721, H11432, H11461, H12056, H12402, H12403, H13320, H13543, H14066, H14600, H14447
+15 V	H7826, H9305, H10425, H10426, H11411, H11526, H11706, H11900, H11901

\* The power supply for photomultiplier tube modules(P.33) is available.

TPMOC0240EB

### ● Voltage output type



Low voltage input	Conforming product Type No.
±5 V	H10722, H10723, H11462, H12404, H12405
±15 V	H7827, H9306, H9307, H10492, H10493, H11902, H11903

\* The power supply for photomultiplier tube modules(P.33) is available.

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# Precaution

## Safety precautions



### WARNING

Subject to local technical requirements and regulations, availability of products included in this promotional material may vary. Please consult with our sales office.



HIGH  
VOLTAGE

Some products listed in this catalog generate a high voltage internally. Be sure to observe the following safety measures and take sufficient precautions to prevent possible electrical shocks.

- Always turn off the power before moving, installing and inspecting the products or connecting/disconnecting the cables and connectors.
- Do not modify any part of the product and do not open the housing case. Malfunctions or electrical shocks might result and the products might overheat, smoke or catch fire.

## Handling precautions

Take the following precautions when handling PMT modules.

- Do not expose the photocathode of PMT modules to excessive light such as sunlight. If exposed, noise will increase and photocathode sensitivity will deteriorate.
- Do not touch the light input window with bare hands. Dirt and grime on the window causes loss of optical transmittance. If the window becomes soiled with dirt or grime, wipe it clean using alcohol.
- Helium will penetrate through silica (quartz) glass windows and increase noise. Avoid using or storing those PMT modules in an atmosphere where helium is present.
- Carefully check that the power supply output voltage and polarity are correct.
- Do not apply strong vibrations or impacts to PMT modules.
- Do not apply a strong tightening force to localized sections.
- Do not let moisture or dust penetrate inside.
- Consult with us if you must take special countermeasures against tough conditions such as high temperatures, high humidity or strong magnetic fields.
- When designing equipment using or incorporating products listed in this catalog, install safety interlocks (breakers, etc.) to prevent accidents from electrical shocks or excessive light input, etc.

## Warranty

Hamamatsu PMT modules and related products are warranted to the original purchaser for a period of one year after delivery. The warranty is limited to repair or replacement of defective products due to defects in workmanship or materials used in their manufacture.

Even if within the warranty period, the warranty shall not apply to failures due to misuse, mishandling, modification by the customer, or accidents such as natural or manmade disasters.

The customer should inspect and test all products as soon as they are delivered.

## Ordering Information

This catalog lists PMT modules and related products currently available from Hamamatsu Photonics. Please select those products that best match your design specifications. Delivery time depends on the type of product. Some are already in stock but some require extra delivery time. If you do not find the exact product you want in this catalog, feel free to contact our sales office nearest you. We will modify our current products or design new types to meet your specific needs.



# HAMAMATSU

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## Main Products

### Electron Tubes

Photomultiplier Tubes  
Photomultiplier Tube Modules  
Microchannel Plates  
Image Intensifiers  
Xenon Lamps / Mercury Xenon Lamps  
Deuterium Lamps  
Light Source Applied Products  
Laser Applied Products  
Microfocus X-ray Sources  
X-ray Imaging Devices

### Opto-semiconductors

Si photodiodes  
APD  
Photo IC  
Image sensors  
PSD  
Infrared detectors  
LED  
Optical communication devices  
Automotive devices  
X-ray flat panel sensors  
Mini-spectrometers  
Opto-semiconductor modules

### Imaging and Processing Systems

Cameras / Image Processing Measuring Systems  
X-ray Products  
Life Science Systems  
Medical Systems  
Semiconductor Failure Analysis Systems  
FPD / LED Characteristic Evaluation Systems  
Spectroscopic and Optical Measurement Systems

### Laser Products

Semiconductor lasers  
Applied products of semiconductor lasers  
Solid state lasers

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